Compaction Equipment & Operations

Module 8

Compaction Equipment & Operations

- Types of rollers
  - Static steel
  - Vibratory
  - Pneumatic

- Proper roller procedures
- Tender mix considerations
- Number of rollers necessary?
- Opening to traffic
Types of Rollers

- Static steel wheel
- Pneumatic – rubber tired
- Vibratory

Static Steel-Wheeled Rollers
**Static Steel-Wheeled Rollers**

00745.24(a) Steel-Wheeled Rollers – Steel-wheeled rollers shall have:

- A gross static weight of at least 8 tons
- If steel-wheeled rollers are used for finish rolling, they shall have: A gross static weight of at least 6 tons

**Special Provisions 00745.24(a)**

Static Steel Wheeled rollers shall have a minimum gross static mass of:

<table>
<thead>
<tr>
<th></th>
<th>Level 1 &amp; 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>BD &amp; Intermediate</td>
<td>8 ton</td>
<td>10 ton</td>
<td>12 ton</td>
</tr>
<tr>
<td>Finish</td>
<td>6 ton</td>
<td>8 ton</td>
<td>10 ton</td>
</tr>
</tbody>
</table>

**Vibratory Rollers**

- Amplitude
- Frequency
- Impact Spacing
- Operation
Vibratory Rollers

00745.24(b) Vibratory Rollers – Vibratory rollers shall be:

- Equipped with amplitude and frequency controls
- Specifically designed to compact ACP
- Capable of at least 2000 vibrations per minute
- Have a gross static weight the same as static steel wheeled

Do not operate in vibratory mode for lifts thinner than two times the maximum aggregate size for the type of ACP being compacted.
Typical Data for Vibratory Tandem Rollers

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>5.5-8.0</td>
<td>14,700</td>
<td>43</td>
<td>54</td>
<td>136</td>
<td>258</td>
<td>2,900</td>
</tr>
<tr>
<td>9.5-11.0</td>
<td>20,500</td>
<td>48</td>
<td>66</td>
<td>155</td>
<td>381</td>
<td>2,600</td>
</tr>
<tr>
<td>&gt; 13.0</td>
<td>30,000</td>
<td>60</td>
<td>84</td>
<td>179</td>
<td>420</td>
<td>2,400</td>
</tr>
</tbody>
</table>
Vibratory Rollers

- Operate at speeds to get 10 blows per foot minimum
- Typically operate at High Frequency and Low Amplitude
- Can operate at High Amplitude for thicker mats
# Pneumatic Tired Rollers

- Wheel load
- Tire design
- Inflation pressure
- Contact area

## Pneumatic Tired Rollers

00745.24(c) **Pneumatic-tired Rollers** – Pneumatic-tired rollers shall:

- Be tandem, or multiple axle, multiple wheel type
- Have smooth tread, pneumatic tires of equal size
- Have tires staggered on the axles, spaced and overlapped to provide uniform compacting pressure for the full compacting width
- Have a minimum total load of 2,800 pounds per tire with tire inflation pressures of 45 to 90 psi
- Be fully skirted to reduce tire heat loss and mixture pick up

*Make sure they are ballasted. Most have a water tank that can be filled to maximize weight.*

**Pneumatic-tired rollers should NEVER stop!!!!**
DON’T PARK ON THE MAT!

Tire Inflation Pressure
Vs. Ground Contact Pressure

To prevent pick up on tires - get them hot!
### Inflation Pressure & Ground Contact Pressure at Various Wheel Loads and Ply Ratings

<table>
<thead>
<tr>
<th>Example</th>
<th>Ply Rating</th>
<th>Wheel Load (lb)</th>
<th>Tire Pressure (PSI)</th>
<th>Contact Area (in²)</th>
<th>Ground Contact Pressure (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14</td>
<td>1250</td>
<td>130</td>
<td>16</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>2800</td>
<td>130</td>
<td>30</td>
<td>92</td>
</tr>
<tr>
<td>B</td>
<td>14</td>
<td>2300</td>
<td>35</td>
<td>41</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>2300</td>
<td>130</td>
<td>26</td>
<td>88</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>2800</td>
<td>90</td>
<td>38</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>2800</td>
<td>130</td>
<td>30</td>
<td>92</td>
</tr>
</tbody>
</table>
Compaction Procedures

Temperature

00745.49(a-1) **Temperature** – Complete breakdown and intermediate compaction before the ACP temperature drops below 180° F, unless otherwise directed or required based on the control strip. For WMAC complete breakdown and intermediate compaction before the ACP temperature drops below 160° F. When the rolling causes tearing, displacement, cracking or shoving, make necessary changes in compaction temperature, type of compaction equipment, and rolling procedures.

*It is not unusual to be obtaining additional density below 180° F. Use the control strip as a guide for proper temperature ranges.*
Compaction Procedures

00745.49(a-2) Rolling – Provide sufficient rollers of the types appropriate to compact the mixture while it is still within the specified temperature. Do not use equipment which crushes the aggregate. Do not displace the line and grade of edges. Moisten steel roller wheels with a minimum amount of water, or other approved material, necessary to prevent the ACP from sticking to them and spotting or defacing the ACP.
Re-Watering During Paving

- Park off the mat if possible
- If on mat, park at an angle
Compaction Operations

00745.49(a-2) Operate rollers at a slow, uniform speed recommended by the manufacturer. Drive rolls or wheels shall be nearest the paver unless otherwise approved. Operate pneumatic rollers no faster than 3 mph. Operate vibratory rollers at frequencies of at least 2000 vibrations per minute.

Begin rolling at the sides and proceed longitudinally, parallel to the road centerline, gradually progressing to the center, unless otherwise directed. On super-elevated curves, begin rolling at the low side and progress to the high side. When paving in echelon, or when abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling pattern. Do not make sharp turns or park rollers on hot ACP. Stop each pass at least 5 feet longitudinally from preceding stops.
One Roller Coverage

1. \[\text{CROWN}\]
2. 2-lanes @ 12 feet
3. Drum Width = 5.5 feet
Compaction Operations

00745.49(a-2) Perform finish rolling with rollers meeting the requirements of 00745.24(a) or 00745.24(b), and continue until all roller marks are eliminated.

It is sometimes necessary to make one or more vibratory passes with the finish roller to achieve compaction. This is contrary to 00745.24(b). It is ok as long as the mat is not damaged.
Compaction Variables

- Roller speed
- Number of coverages
- Rolling zone
- Rolling pattern
### Typical Range of Roller Speeds (mi/hour)

<table>
<thead>
<tr>
<th>Type of Roller</th>
<th>Breakdown</th>
<th>Intermediate</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Steel Wheel</td>
<td>2 to 3.5</td>
<td>2.5 to 4</td>
<td>3 to 5</td>
</tr>
<tr>
<td>*Pneumatic</td>
<td>2 to 3.5*</td>
<td>2.5 to 4*</td>
<td>4 to 7*</td>
</tr>
<tr>
<td>Vibratory</td>
<td>2 to 3</td>
<td>2.5 to 3.5</td>
<td>------</td>
</tr>
</tbody>
</table>

*Default to 00745.49(a-2) for Specification Limits on Pneumatic Roller Speed*

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### One Coverage

How many passes of the roller are needed to cover the width of the mat one time?
Drum Width vs. Lane Width

Number of Passes for One Coverage

Drum Width

Rolling Patterns

Established by:

- Control strips
- Local experience
- Width of paving
- Width of rollers
- Production rate
How many repeat coverages to assure density?

Established by the Control Strip and local experience with the mix
Density

Roller Passes

Passing Density

Balancing Production

HMA Facility

Paving

Trucking

Compaction
Calculating Your Rolling Zone

- Effective Compaction (C-Rate) Production Rate equals 28 ft per minute.
- TAC from Environmental Variables chart equals 10 minutes for 2 in thick mat with mix temperature of 250°F and base temperature of 50°F.
- C-Rate times TAC = 28 fpm x 10 minutes = 280 ft
**Thin Lifts**

**00745.49(c) Thin Pavement** — Compaction to a specified density will not be required for leveling, patches, or where the nominal compacted thickness of a course of dense graded mixtures will be less than 2 inch. Perform breakdown and intermediate rolling until the entire surface has been compacted by at least four coverages of the roller(s). Perform additional coverages, as directed, to obtain finish rolling of the ACP.

A pneumatic-tired roller is recommended for leveling as long as the mat is not too thin or too short which would cause excessive pick-up by the tires. (The tires won't get hot enough!)
Other Areas

00745.49(d) Other Areas – Compaction to a specified density will not be required on temporary surfacing (see 00745.50), guardrail flares, mailbox turnouts, road approaches and areas less than 8 feet wide or limited length, regardless of thickness. Compact these surfaces according to 00749.45
Opening to Traffic
Opening to Traffic

- After finish rolling and density testing is completed
- Generally ok at 140° F for ACP unless they are still getting compaction
- Test for picking with a vehicle for open graded
- Flush with water only if absolutely necessary to open to traffic, but ensure density measurements have been taken first!
Mat Problems

- Surface checking
  - Mix issues
  - Crusted mix

- Tenderness
Surface Checking

- Check that mix is ok
- Use Pneumatic in intermediate to put back together (could be used in finish if necessary)
- Check frequency and amplitude settings
- Stay off in intermediate zone
Tender Mixes

- Check that mix is ok
- Use Pneumatic in intermediate to put back together (could be used in finish if necessary) Could also try in breakdown
- Check frequency and amplitude settings
- Stay off in intermediate zone
- Minimize water from steel wheels
- Make sure roller operators know what temperatures they can hit the mat