What Are Chip Seals?
Steps Involved

• Preconstruction
  – Select Appropriate Pavement
  – Select Materials
  – Design Quantities
  – Equipment Calibration

• Construction
  – Weather
  – Preparing
    – Surface
    – Binder Application
    – Chip Application
    – Rolling
    – Sweeping
    – Traffic Control

• QC
  – Sieve Analysis
  – Moisture Content
  – Embedment Depth
  – Emulsion Viscosity
Aggregate

- Properties
  - Crushed
  - 2 Mechanically Fractured Faces
  - Hard

Like THIS Right?

No... at least < 2%
Design

- Chip Quantity
- Emulsion Quantity
- Substrate Condition
Chip and Emulsion Quantity

- Spread Rate
  - One Stone Thick

- Or.....

About 40%
Getting it One Stone Thick

• Do ‘Board Test’
  – Spread Chips One Stone Thick on 1 sy Board
  – Weigh it
Emulsion

- Properties
  - Thick Enough, but Not Too Thick
  - Fast Setting, but Not Too Fast
  - Sticky

- Spray Rate
  - Embed Chips about 30-50% Initially
  - Traffic Embeds to 75-90%
Substrate Too Soft?
Spray Rate in gsy

= %embedment x avg mat depth
  \times \left(1 - \frac{W}{62.4 \times G}\right) \times T + V

Where

- W = Loose Unit Weight of Aggregate, pcf
- G = Bulk Specific Gravity of Aggregate
- T = Traffic Correction
- V = Surface Condition Correction
Conditions

• Dry
  – No rain threatening
  – Pavement Dry

• Low Wind
  – <10 mph

• Temperate
  – 60 - 90°F
Equipment Calibration
Because This is What We Want

......Almost
First:
Take It’s Temp
This is Too Cold!
Second:
Measure Viscosity
20 to 70 seconds at 85 to 150F for a 6 mm orifice
or
10 to 60 seconds at 85 to 140F for a 7.5 mm orifice
Third:
What’s the Nozzle Size?
The Right Nozzle for the Job

### ETNYRE SPRAYBAR NOZZLES

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part No.</th>
<th>Description</th>
<th>Application Per Square Yard</th>
<th>Application (Métric) Liters Per Square Meter</th>
<th>Flow Gallons Per Minute Per Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3351013**</td>
<td>1/16” Coin Slot</td>
<td>0.05 – 0.20</td>
<td>0.23 – 0.39</td>
<td>3.0 to 4.5</td>
</tr>
<tr>
<td>2</td>
<td>3351008</td>
<td>336-4 V Slot</td>
<td>0.10 – 0.35</td>
<td>0.48 – 1.60</td>
<td>4.6 to 7.5</td>
</tr>
<tr>
<td>3</td>
<td>3351009</td>
<td>335-5 V Slot</td>
<td>0.16 – 0.45</td>
<td>0.92 – 2.66</td>
<td>7.0 to 10.0</td>
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<tr>
<td>4</td>
<td>3352368</td>
<td>Multi-Material V Slot</td>
<td>0.40 – 0.60</td>
<td>1.68 – 1.80</td>
<td>6.0 to 9.0</td>
</tr>
<tr>
<td>5</td>
<td>3351315</td>
<td>3/32” Coin Slot</td>
<td>0.15 – 0.40</td>
<td>0.76 – 1.80</td>
<td>6.0 to 12.0</td>
</tr>
<tr>
<td>6</td>
<td>3352304**</td>
<td>Multi-Material V Slot</td>
<td>0.35 – 0.95</td>
<td>1.50 – 4.30</td>
<td>12.0 to 21.0</td>
</tr>
<tr>
<td>7</td>
<td>3352785**</td>
<td>Multi-Material V Slot</td>
<td>0.20 – 0.55</td>
<td>0.90 – 2.50</td>
<td>7.5 to 12.0</td>
</tr>
<tr>
<td>8</td>
<td>3352210</td>
<td>End Nozzle (3352205)</td>
<td>0.20 – 0.55</td>
<td>0.90 – 2.50</td>
<td>7.5 to 12.0</td>
</tr>
<tr>
<td>9</td>
<td>3351414</td>
<td>3/16” Coin Slot</td>
<td>0.35 – 0.95</td>
<td>1.66 – 4.30</td>
<td>12.0 to 21.0</td>
</tr>
<tr>
<td>10</td>
<td>3351810</td>
<td>1/4” Coin Slot</td>
<td>0.40 – 1.10</td>
<td>1.66 – 5.00</td>
<td>15.0 to 24.0</td>
</tr>
</tbody>
</table>

*Recommended nozzles for seal and chip with emulsified asphalts.
**For application prior to laying a hot mat.
### ROSCO SPRAY NOZZLE GUIDE

<table>
<thead>
<tr>
<th>NOZZLE SIZE</th>
<th>PART NO.</th>
<th>FLOW RATE GPM MAX</th>
<th>APPLICATION RATE GAL PER SQ YD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 00</td>
<td>35565</td>
<td>1.2</td>
<td>.03 - .08</td>
</tr>
<tr>
<td>No. 0</td>
<td>32917</td>
<td>3.0</td>
<td>.05 - .20</td>
</tr>
<tr>
<td>No. 1</td>
<td>32918</td>
<td>4.0</td>
<td>.10 - .30</td>
</tr>
<tr>
<td>No. 2</td>
<td>32919</td>
<td>8.5</td>
<td>.25 - .55</td>
</tr>
<tr>
<td>No. 3</td>
<td>32920</td>
<td>13.5</td>
<td>.35 - 1.0</td>
</tr>
</tbody>
</table>

Correct nozzle depends on application rate, truck speed and type of material being sprayed.

- Exceeding nozzle max flow rate may cause fogging.
- Exceeding 400 FPM truck speed at max application rate for nozzle will exceed max flow rate.
- Using nozzle too large will cause poor spray pattern.
Fourth: Where Do They Go?
Right
Here

But, not Lined Up Like This
Use The Wrench
15 to 30 degrees
All Nozzle Angles Should be Equal

Or...
Fifth: How High The Bar?
This is Too High

Overlap Creates Streaks
This is the Result
Sixth:
Are We Spraying the Correct Rate?
Use the Gauge?

NO!
Use the Dip Stick
For Etnyre, 0 gal is at the Top!
Match Transverse Joints

– Start and Stop on Paper

Nice Angles !
Seventh
Is the Spreader Calibrated?
How Even is the Veil?
Measure the Distance and Width to Get Rid of Two or Three Truckloads

This is Your Chip Spread Rate
8
How Many Rollers?
• Rubber-Tire
  • 3 mph, Max (fast walk)
  • Equal Tires
  • Equal Tire Pressure
• Enough for 1 Coverage Before Gelling
9

When Do We Sweep?
NCHRP Report 680
“Broom Simulator”
- Brooms
  - Push or Pickup
    - EASY Pressure
    - Nylon
  - Timing
    - Before Traffic
    - When Moisture is < 85%
Traffic Control

• Pilot Cars
  – 15-25 mph depending on traffic volume
10

Some Tips
‘Light’ Showing Through Should be Uniform
Edge Nozzle Needed
Thank You!