



Preventive Maintenance for Flexible Pavements

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Overview

- Typical preventive maintenance treatments
 - Crack Seal
 - Chip Seal
 - Patching
 - Mill and fill patch ★
 - Overlay
 - Grader
- Costs
- Life extension

Crack Sealing



Benefits of Crack Sealing

- Minimize water intrusion into pavement structure and incompressibles into cracks
 - This reduces the crack growth and raveling
- Extend pavement life by limiting future deterioration
 - Slows spalling at cracks
 - Prevents potholes too!
- Maintains pavement structure
- Protects agency's investments

Typically extends pavement life 1-4 years

Terminology

- Crack Sealing – placement of specialized sealant material into or above cracks to prevent the intrusion of water and incompressibles
 - Performed on working cracks (generally greater than 1/8" wide in summer (wider in winter).
 - Typically lasts 2+ years
- Crack Filling – placement of ordinary materials into low-moving cracks to reduce infiltration
 - Performed on non-working cracks (e.g. do not open and close)
 - In general, not meant as a permanent fix
- Crack sealing can be used for any crack treatment

Crack Seal



Crack Fill



Amount of Cracks

Acceptable

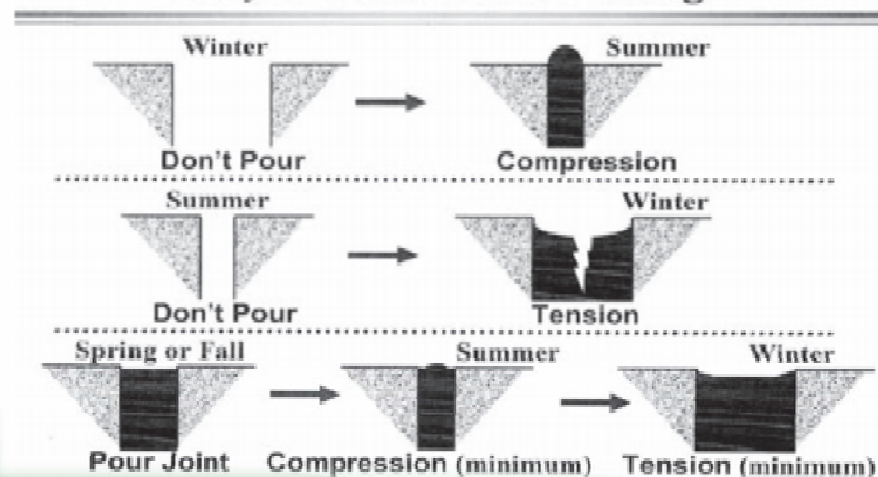
Too Many!



Best Time of Year for Sealing

- Crack sealing is most effective when the cracks first appear
 - Keeps water intrusion to a minimum
- Crack sealing is most effective in early spring (dry) or fall when the cracks are at their optimum width

Winter & Summer NOT the Right Time for Joint and Crack Sealing



Transverse Cracks

- Form perpendicular to lane
 - Thermal
 - Reflective
- Typically caused by environmental factors or by reflection of underlying pavement condition
- Often experience extreme movement (worse on the east side of the state)

Transverse Cracks



Longitudinal Cracks

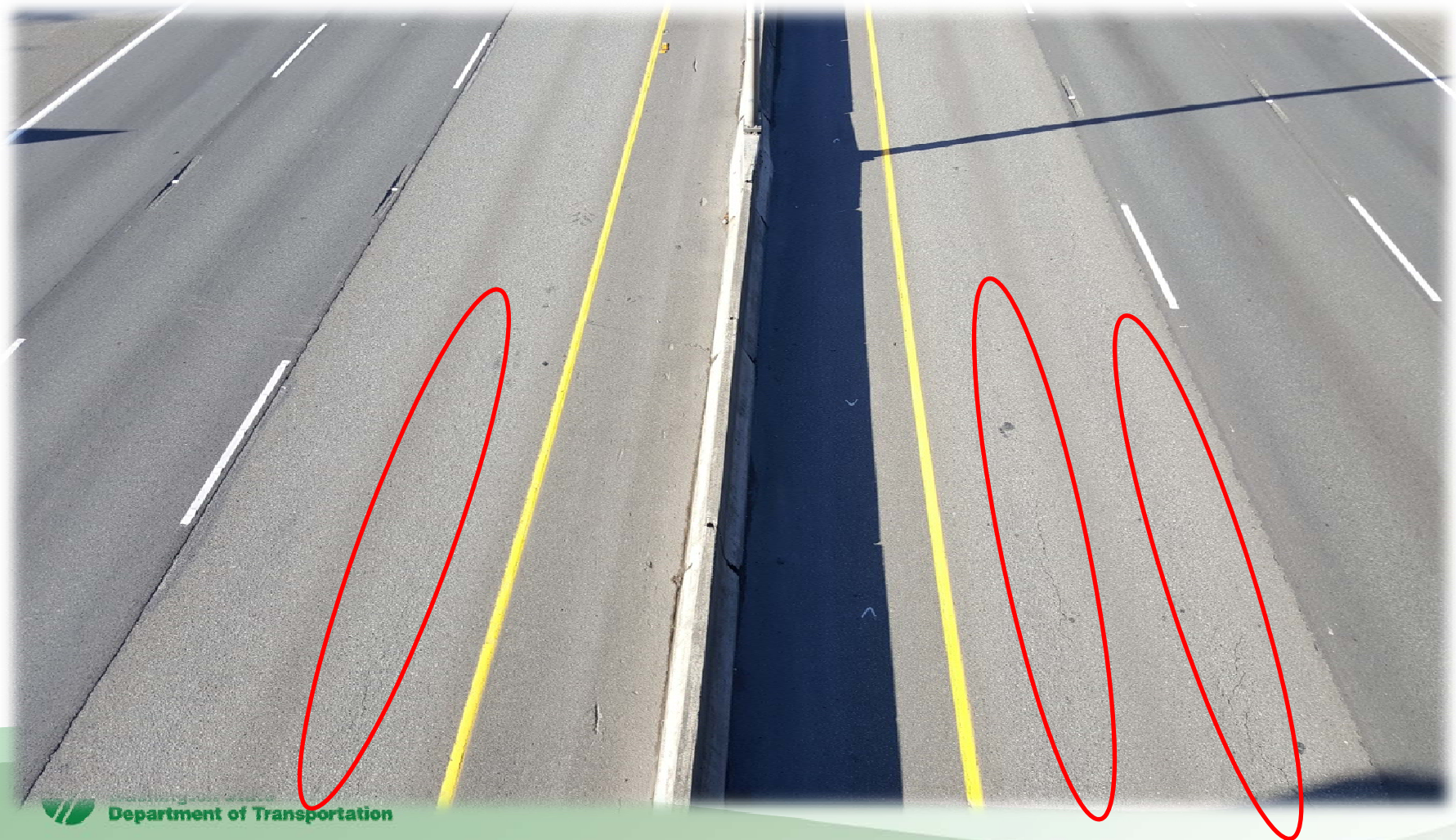
- Form parallel to lane
 - Construction Joint
 - Reflective
 - Wheel path
- Typically caused by construction of pavement joint, other construction practices or traffic loading
- Can also be exacerbated by environmental conditions



Longitudinal Cracks/Joints



Longitudinal Cracks



Block Cracking

- Typically form in older pavements
 - Hardening of asphalt
 - Thermal/shrinkage of asphalt in cold weather
 - Form in traffic and non-traffic areas



Top Down Cracking

- The majority of our pavements have top-down cracking
- Typically occurs with thicker pavements (6" +)



Material Specifications

<u>Type</u>	<u>High Temp (C)</u>	<u>Low Temp (C)</u>
Type IV	52, 58	-28, -34, -40, -46
Type II, III	52, 58, 64	-10, -16, -22, -28
Type I	52, 58, 64	-10, -16, -22

- Type I: Moderate climates, tested at low temperature of -18C using 50% extension
- Type II and III: Most climates, tested at low temperature of -29C using 50% extension
- Type IV: Very cold climates, tested at low temperature of -29C using 200% extension

High/Low Temperatures



Sealant Configuration

- Flush with pavement or *slight* overband
 - Flush works best where snow plows are expected...



Installation Instructions

SAFETY FIRST:

- Always follow the equipment and product manufacturer's recommendations
 - Sealant must be applied at the proper temperature
 - Typically between 375°F and 400°F
- Wear recommended personal protective equipment
- Set up proper traffic control for roadway and situation



Melter Equipment

- Oil-jacketed
- Thermostatic heat controls
- Continuous agitation
- Over-heating safety controls
- Right size for operation
- Keep vat at least 1/3 full to maintain temperatures

Always follow the equipment manufacturer's recommendations



Feeding the Melter



Applicator Tips

Flush Fill Tip



For flush fill applications, you will need enough room to get the material in the crack.

Overband Tip



Tips come in all shapes and sizes. It depends on the amount of flow you need or the width of the top band (to cover raveling or small cracks).

Crack Preparation

Preparation is the most important part of crack sealing!

- Clean
 - Use stiff-bristled broom to remove vegetation
 - Blow debris out of crack with compressed air (can use vacuum system)
- Dry
 - Can use heat lance if needed to burn weeds and dry a moist pavement (up to 40°F)
 - DO NOT crack seal if the pavement is wet!
- Pavement temperature is 40°F and rising
- Bondable – check for excessive raveling
- Routing the crack is an option



Crack Preparation

- Using a stiff wire brush is a great first step to cleaning the crack
- Follow with compressed air



Air Lance



Burning Weeds



Crack Seal



When NOT To Crack Seal

- Crack seal is good for:
 - Low to medium severity longitudinal or transverse cracks
 - Can seal cracks about $\frac{1}{4}$ " or greater but nothing spalled or depressed
 - Some transverse cracks wider than $\frac{3}{4}$ " get crack filled or a mastic is used



Doesn't Treat All Distress



Washington State
Department of Transportation

Distress Needs More Than Just Crack Seal



What We Don't Want To See...



Chip Seal

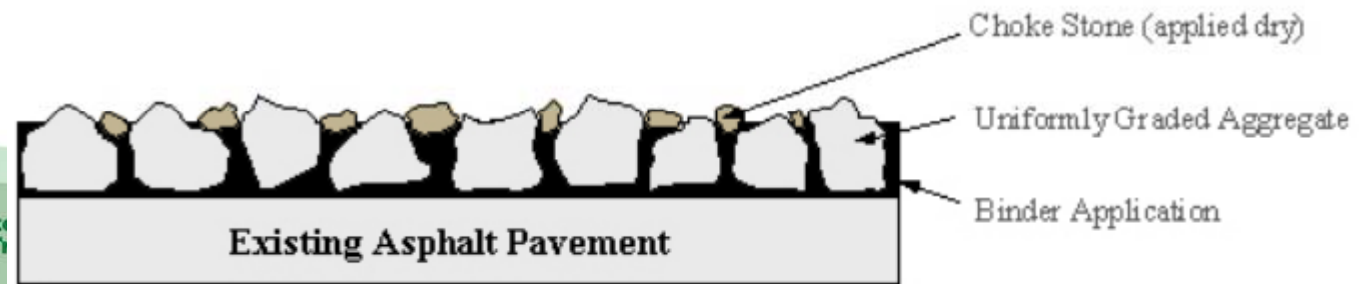


Benefits of Chip Seals

- Preventive maintenance restores the function of the existing pavement and extends the service life
 - Does not increase the structural capacity or strength
- Seals the minor cracks to prevent water intrusion
- Can be used as rut filling
- Not for major cracking, but can be used in conjunction with patching and crack sealing
 - Best to wait for a season after crack sealing if using rubberized materials

Best Time to Seal?

- In general, it's best to put chip seals down between May 1 – August 15
- Need good weather
 - No rain
- Minimum surface temperature is 60°F and rising
- Maximum surface temperature is 130°F
 - May need choke stone...
- Beware of wind
 - Can cause issues with binder placement



Pavement Preparation

- Pavement needs to be clean and dry
- If crack sealing or pavement repair done, ideal if completed well before the chip seal
 - Pavement repair at least 3 months prior
 - Crack seal at least 6 months prior
- Can chip seal over rumble strips
- Remove thermoplastics
- Cover manholes, monuments, etc.
- Protect driveways, sidewalks, curb and gutters
- Choose locations wisely
 - Intersections (stop and go, turning movements)
 - Acceleration/deceleration lanes
 - Steep grades
 - High traffic volume
- Understand factors that affect rate adjustments



Materials

- Aggregates
 - 3/8" -#4
 - 90% minimum fracture
- Binder
 - CRS-2P
- Depends on:
 - Existing surface condition
 - Traffic volumes
 - Weather
 - Temperature
 - Time of day/year

%pass by sieve size	1/2" -#4	3/8" -#4	#4-0 (choke only)
5/8"	99-100		
1/2"	90-100	99-100	
3/8"	60-85	70-90	99-100
#4	0-3	0-5	76-100
#10			30-60
#200	0-1.5	0-1.5	0-10.0
Binder (approx. min application rate (gal/sy))	0.50	0.45	-

Aggregates

- Aggregate surface should be wet without a sheen
- Too much water will not allow the chip seal to set up
 - LONGER traffic control!
 - MORE chip loss
- Add 10% to what you need



Loader Operator

- Loader should penetrate from near bottom of stockpile, but not scraping the ground
- Do not contaminate stockpile
- Keep wheels off the stockpile
- If excessive dust, lightly water stockpile



Binder

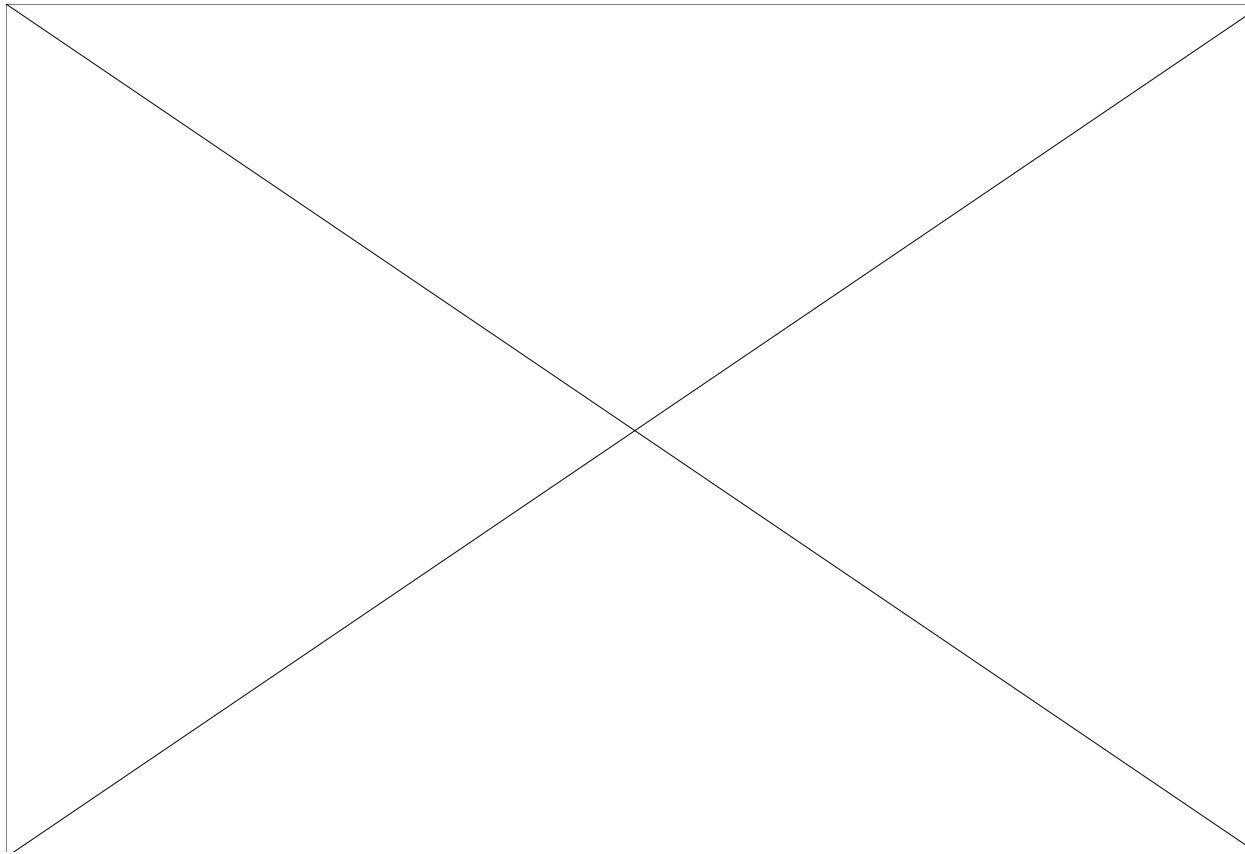
- Make sure you calibrate the distributor!
- CRS-2P
 - Do NOT dilute
 - Application rate is approximately 0.45 gal/sy for a 3/8" -#4 aggregate
 - Application temperature between 165-180°F
- Ensure distributor truck is clean



Distributor



Spray Bar



Chip Seal Start



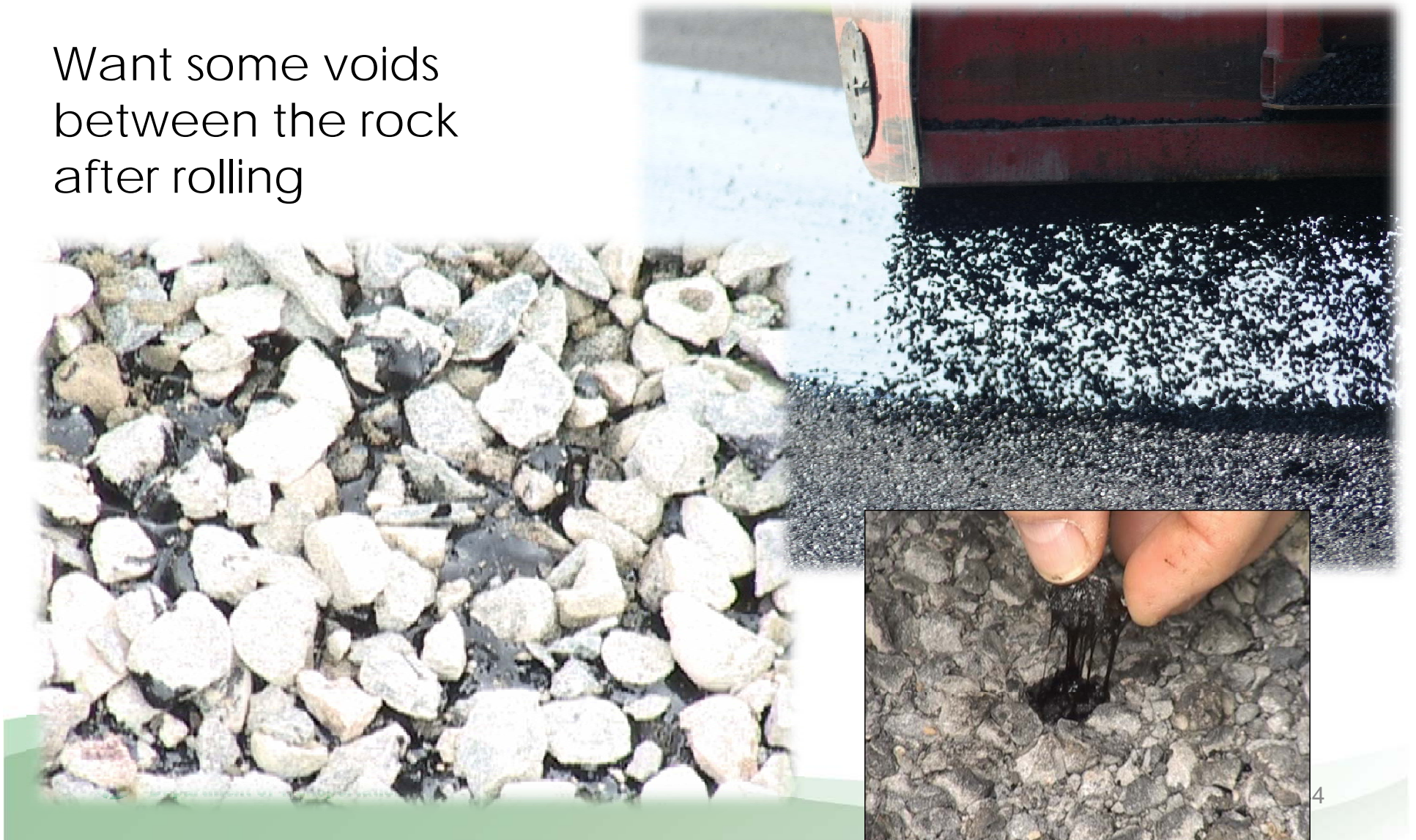
Chip Spreader

- Calibrate your chip spreader!
- Aggregate application rate should be between 20-30 lbs/sy for 3/8" -#4 gradation
 - Typical application rate is 25-28 lbs/sy
 - 20-35 lbs/sy for 1/2" -#4
 - 4-6 lbs/sy for choke (#4-0)
- Will depend on existing pavement, weather, etc.



Aggregate Application Rate

Want some voids
between the rock
after rolling



Rollers

- Pneumatic rollers
 - Ensure tire pressures are all the same
- Keep them moving at 4-8 mph
- One to two rollers needed
 - Two is best
 - 2-4 passes minimum
- Need to seat the aggregate as quickly as possible
- Looking for an embedment depth of 50-70%
- You cannot over roll



Brooming

Brooming operations take place after the binder cures

Can happen as late as the following day for an emulsion-based chip seal



Side Cast



Pick up broom

Traffic Control

- Traffic control is critical!
- Speed should be limited to 25 mph or less
- The longer you can keep the speed down, the better
- Having the vehicles on the fresh chip seal is fine
 - Actually helps set the aggregate
 - Just need to keep the speed down as well as start/stops and turning movements
- No conflicts in signage!



Traffic Control and Pilot Car

- Traffic control needs to be set up prior to start
- Flagger operations need to be in place
- Pilot car ready
 - Travel less than 25 mph at all times
 - Stagger wheelpaths if possible



Reflective Tabs

- Place reflective tabs the day before the project
 - Common spacing is 100 feet
 - Less on curves
- If not using tabs, have temporary tape available on site



Rut Fill

- Chip seal used as a filler for ruts
 - Best when ruts do not exceed 3/8" but has been used for ruts up to 2"
 - Not for pavements with shoving issues



Rut Fill



Considering Choke and Fog Seal?

- Choke fills the voids and prevents larger aggregate from dislodging
 - Prevents tracking and pick up
 - Provides a finer wearing course
 - Helps prevent fly rock
 - Helps prevent plow damage
- Fog seal is a light application of emulsion
 - Typically CSS-1, undiluted rate of 0.05-0.09 gal/sy
 - Helps prevent shedding, fly rock
 - Applied 3-14 days after new chip seal
 - Brooming done prior to fog seal

5 Keys to Success

- Repair old surface ahead of time
- Calibrate equipment prior to use
- Inspect surface to determine appropriate rates (preferably the day of application)
- Choose the right materials
- Timely application of binder and aggregate to optimize the aggregate embedment



Cornrowing



Snow Plow Damage



Hot Weather



Pavement Patching



Benefits of Patching

- Preventive maintenance restores the function of the existing pavement and extends the service life
 - Does not increase the structural capacity or strength
- Focus on two types of preventive preservation:
 - Strategic preservation
 - Emerging needs preservation
- Other preservation component: Reactive
- Two repair methods:
 - Remove and replace the pavement deficiency (**preferred**)
 - Cover the deficiency

Mill and Fill

- Full or partial depth
- Removes the deficiency
- Full depth:
 - Re-compact base
 - Tack edges
 - Multiple lifts if needed
 - No lift should exceed 3"
 - Compaction is key
- Partial depth:
 - Tack everywhere
 - Multiple lifts if needed
 - Compaction is still key!



Partial Depth Repairs



Full Depth Repairs



Mill and Fill

- Remove all pavement deficiencies
- Don't leave a small area in between



Mill and Fill



Overlay

- Lift typically 2 inches or less
- Paver, box, or Montana topper
- Overlay could be used for:
 - Slight depressions, sags or settlements
 - Low or medium severity cracking that covers most of the lane (e.g. block cracking)
 - Slight rutting issues
 - New turn lane, etc.



Asphalt Paver

- Make sure to ask the manufacturer/vendor for paver training. There are a lot of particulars on usage.
- Make sure the screed is heated and that it is on
- Ensure to use blocks at takeoff
- Do not overload the screed
- Keep a consistent paver speed
- Ensure a consistent head of material
- Watch for cool mix/segregation
- Make sure the trucks don't bump the paver
- Don't empty the hopper during paving
- Use the automatic controls
- Ensure there's enough "fluff"



Grader Patch

- Thickest portion around 1.5" -2" but depends on need, tapering down to usually one rock thickness at edge
- Best to use smaller top size aggregate (e.g. Class 3/8")
- Grader patches for:
 - Settlements
 - Slight rutting (shoving)
 - Best to remove the issue

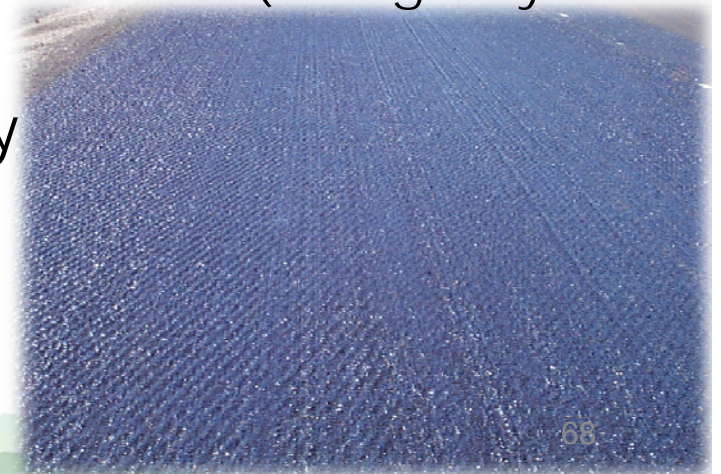


Grader Patch



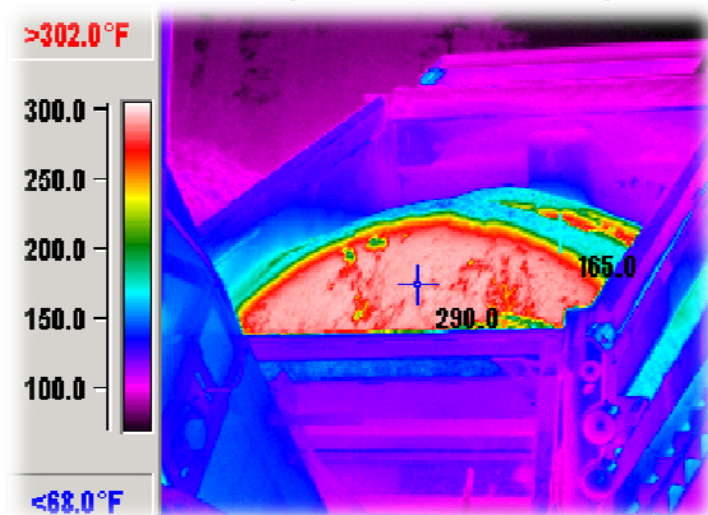
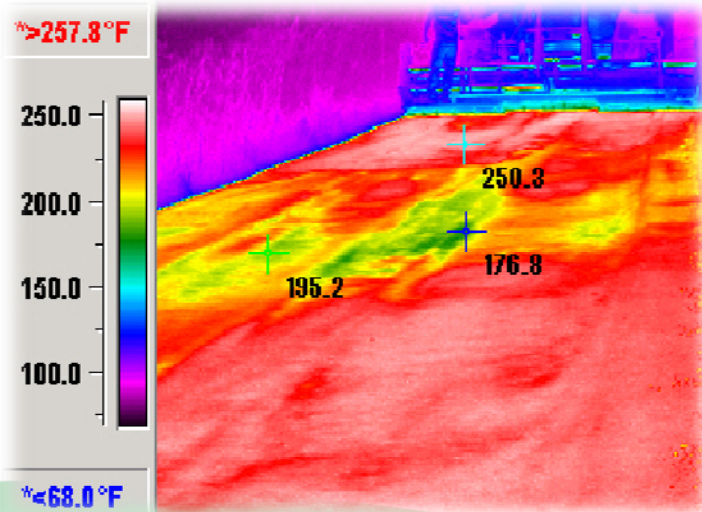
Paving: Important Points

- HMA
 - Class mix should be 3/8" or 1/2" (commercial mix)
 - Binder should be typical for area of use (i.e. PG 64-22, 64-28)
 - Needs to be hot to ensure good compaction
 - Minimum paving depth is 1.5" (preferably thicker for 1/2" mix)
- Tack Coat
 - Use CSS-1 or 1H
 - Can dilute up to 50% (one time dilution only)
 - Typically applied at 0.16 gal/sy if diluted 50:50 (0.08 gal/sy if undiluted)
- Pavement must be clean and dry
- **Compaction!**



HMA

- Mix temperatures:
 - Plant – 300-340°F
 - At Laydown – 250-285°F
- Pavement temperature: 40°F and rising
- Air temperature: 40°F and rising
- Use approved release agent in trucks (not diesel)



Plant Check

- When receiving mix at the plant, here are some items to check:
 - Blue smoke (mix is too hot)
 - Stiff appearance (mix has been burned or held in the silo too long)
 - Dull appearance (mix doesn't have enough binder)
 - Rising steam (too much moisture)
 - Segregation (separation of coarse and fine aggregate)
 - Contamination
 - Mix slumps in truck (too much binder)

Tack Coat



How to Dilute Tack

- ALWAYS add water to the emulsion
- Best if it is warm water
- Maximum amount of water is one part water to one part emulsion
- Only dilute emulsion once
- Know your product – only dilute emulsions such as CSS-1 or CSS-1H
- Do not exceed the shelf life



Why Tack is Important



Delamination

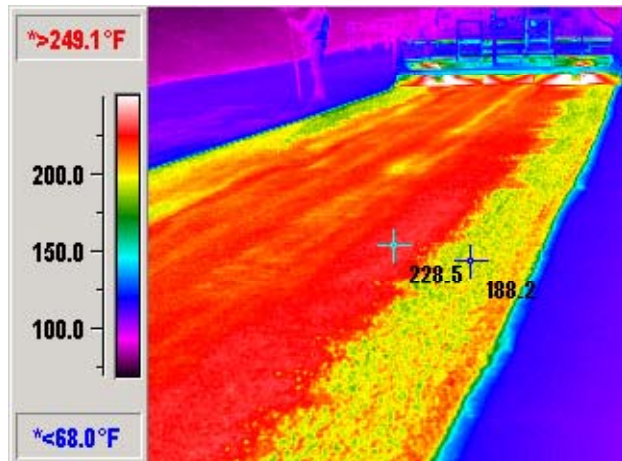


Types of Rollers

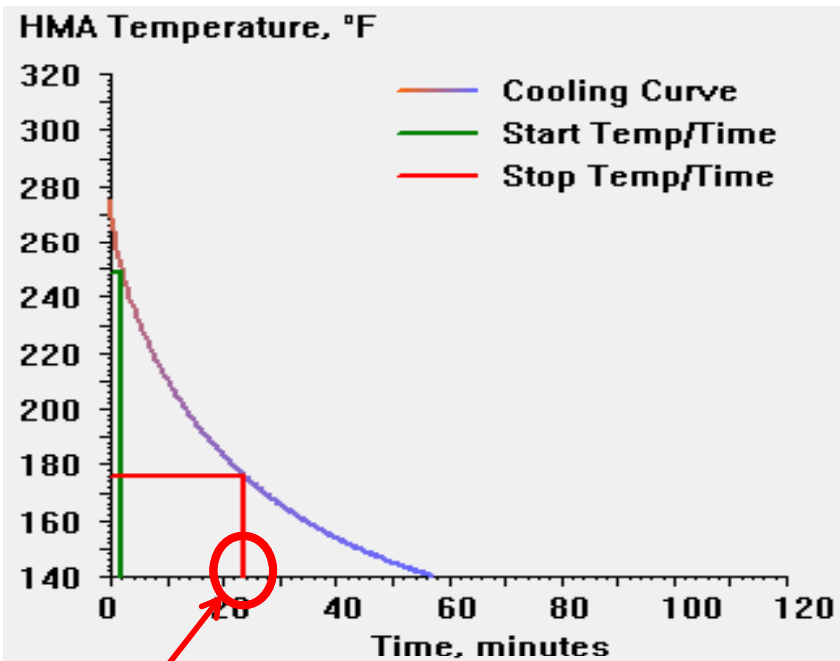
- Steel wheel roller – two modes: static or vibratory
 - Some rollers don't have vibratory mode
 - Vibratory is good to use to re-orient the aggregate and get a tighter mat (higher density)
 - Also good with thicker lifts
 - Vibratory usually run at high frequency and low amplitude for the typical lifts we place (around 2-2.5 inches)
 - If placing thicker lifts, high frequency and high amplitude works best
 - Do not use vibes under 175°F
- Pneumatic roller
 - If used for HMA, need to have the skirts around the wheels
 - Compactive effort is controlled by tire pressure
 - Typically set between 60-120 psi
 - Warm tires up prior to getting on hot mat

Raking/Compacting Joint

- “Bumping” the joint
- Compaction
 - Minimum three passes
 - One pass is up and back

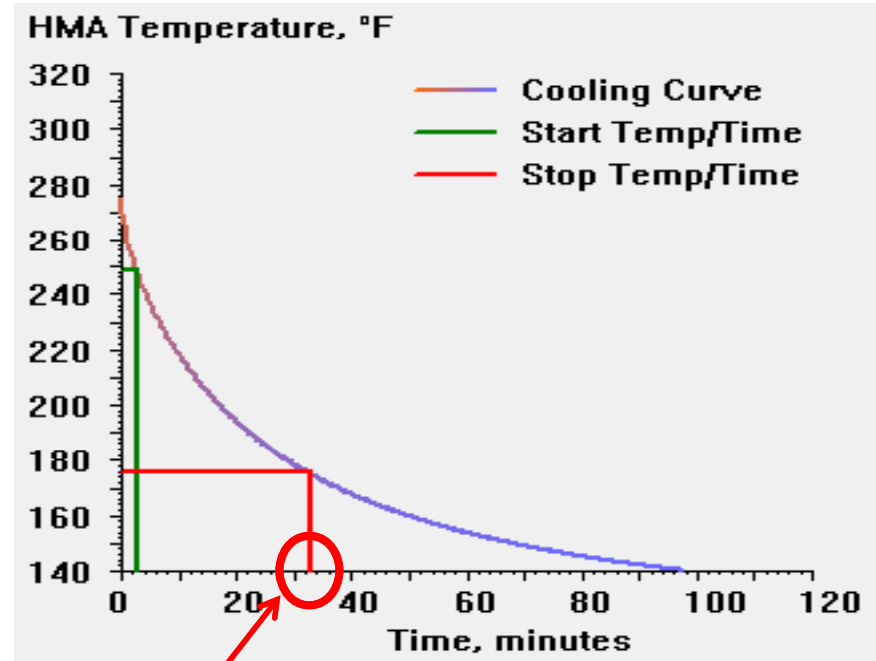


Compaction



Surface 50°F, 5 MPH Wind, Clear

24 minutes



Surface 80°F, 5 MPH Wind, Clear

33 minutes

Compaction

- One of the most important aspects of working with HMA is getting adequate compaction!!
- Ensure the mix is hot
- Compact quickly
- Minimum of 3 passes
- Do not vibratory compact under 175°F
- If a lot of handwork, more compaction will likely be needed



Compaction: What We Don't Want to See



Typical Costs

Treatment	Cost	Typical Amount of Work	Project Cost
Crack Seal	\$0.88/LF	1.3 linear miles/lane mile	\$6,040
Dig Out	\$238/ton	36 tons/lane mile	\$8,568
Chip Seal	0.58/SF	1 lane mile	\$36,749
Wheelpaths only		1 lane mile	\$20,396

Minimum Life Extension: 2-3 years

Questions?

