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## TII Publications



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# Stone Mastic Asphalt – Checks and Key Points

**CC-PAV-04014**  
March 2020

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## TII Publications



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# 1. Introduction

The aim of this Technical Document is to provide Employer's Representatives and other interested parties with background information on key attributes for the installation of Stone Mastic Asphalt. This document is provided to enhance the understanding of the written requirements of the specifications with photographs and notes are used to emphasise the points being made. The photographs aim to show examples of good practice and poor practice.

The Document is not a specification but should be read in conjunction with contract specific documentation and other TII Publications including the Specification for Road Works. It is not the intention for this Technical Document to replace the requirements of the Specification for Road Works but to help in the interpretation of the requirements. In many instances the specification reference is provided in order for the user to easily locate the actual specification requirement.

It is important to note that this Technical Document does not purport to cover every aspect of Stone Mastic Asphalt nor any legal interpretation of the Specification for Road Works. It is the Contractors responsibility to ensure the end product installed is fit for the intended purpose and durable for its expected life.

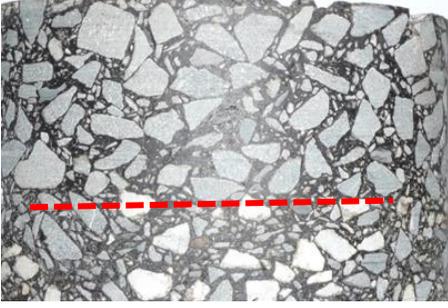
## 2. Checklist of items required prior to commencing works:

| Item            | Specification Reference    | Task   | Done<br>✓ |
|-----------------|----------------------------|--|-----------|
| CE Marking      | CC-SPW-00900 Clause 5      | Review documentation for compliance with specified SMA mixture:  |           |
|                 | CC-SPW-00900 Table 7       | Constituents - Type testing, Declaration of Performance, CE Marking - CC-GSW-00900 Table NG1.2a          |           |
|                 | CC-SPW-00900 Table 8       | Product Composition - Type testing, Declaration of Performance, CE Marking - CC-GSW-00900 Table NG1.2a   |           |
| Works Proposals | CC-SPW-00900 Clause 10.1.2 | Contractor to submit works proposals to include:   |           |
|                 |                            | Laying and compaction plant – CC-SPW-00900 Clause 10.1.7 & 10.1.9 & 10.1.9.3                             |           |
|                 |                            | Working in different climatic conditions - CC-SPW-00900 Clause 10.1.5, 10.1.5.1 & CC-GSW-00900 NG 10.1.5 |           |
|                 |                            | Formation of joints - CC-SPW-00900 Clause 10.1.8 & CC-GSW-00900 NG 10.1.8                                |           |
|                 |                            | Further reading CC-GSW-00900 Clause NGA 10   |           |

### 3. Checklist of items required during and after completion of the works:

| Item               | Specification Reference   | Task   | Done<br>✓ |
|--------------------|---------------------------|--|-----------|
| Works Requirements | CC-SPW-00900 Table 9      | Undertake checks and review for compliance with specified requirements including:  |           |
|                    | CC-GSW-00900 Table NG10.1 | Traceability of material in the works – laying records – CC-SPW-00900 Clause 10.1.2  |           |
|                    | CC-GSW-00900 Table NG10.2 | Operating Compliance Level of the manufacturing plant – obtain reports - CC-GSW-00900 Clause NG1.5   |           |
|                    |                           | Temperatures - CC-SPW-00900 Clause 10.1.6 & CC-GSW-00900 Clause NG 10.1.6  |           |
|                    |                           | Mixture Properties - CC-SPW-00900 Clause 10.1.10.3   |           |
|                    |                           | Macrotexture - CC-SPW-00900 Clause 10.1.11   |           |
| Monitoring         | AM-PAV-06049 Clause 7.2   | The Implementation Authority is required to confirm that the data is compliant with the Specification and that the test records are available for review. Macrotexture testing should be carried out by an independent entity. This would ensure that there is an independent record of works performance by both parties in the event of any legal or contractual issues arising. |           |

## 4. Key points during and after completion of the works:

| Key point   | Level   | Example Photographs  |   | Specification References and notes  |
|-------------|---|--|---|---|
| SMA Mixture | Good  |  <p>Surface course above red line</p>  |  <p>Surface course above red line</p>  | <p>The composition of SMA requires sufficient binder film thickness to provide a dense mixture with low air voids.</p> <p>Mixtures with paving grade binder always require a fibre additive to ensure the binder is retained on the aggregate.</p> <p>The use of mixtures with paving grade binder is limited to roads carrying up to 100 commercial vehicles per lane per day.</p>   |
|             | Mixture is dense<br><br>Few air voids<br><br>Durable                |  |   |   |
| SMA Mixture | Poor  |  <p>Surface course above red line</p> |  <p>Surface course above red line</p> | <p>Many mixtures with Polymer Modified Binder also require a fibre additive to ensure the binder is retained on the aggregate.</p> <p>If the binder film thickness is too low the voids are not sufficiently filled. This can lead to water ingress and reduced durability.</p> <p>If the binder film thickness is too high it can cause a loss of interparticle friction. This can lead to insufficient stability and deformation.</p> |
|             | Mixture is partially dense<br><br>Many air voids<br><br>Not durable |  |   |   |

| Key point      | Level                           | Example Photographs   |  | Specification References and notes   |
|----------------|---------------------------------|---|--|--|
| Surface finish | Variable<br><br>Binder Flushing |   |   | <p>The manufacturing process can also play a significant role in the ability of the SMA mixture to provide a consistent surface finish.</p> <p>The temperature of the SMA mixture should be within the limits contained in Tables 8 and 9 of CC-SPW-00900.</p> <p>Overheating can lead to binder drainage.</p>   |
|                | Good<br><br>Consistent          |   |   | <p>If the mixture temperature is too low, reduced cohesion occurs at the interface between the binder film and aggregate leading to excessive voids in the finished surface and subsequent loss of material.</p> <p>The surface finish is highly influenced by the mixture design.</p> <p>A well designed mixture produces a homogenous blend of components without segregation.</p> |
|                | Poor<br><br>Variable            |  |  | <p>A poorly designed mixture can produce an imbalance of components leading to segregation during placement.</p>   |

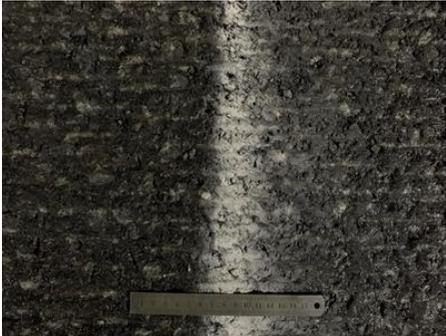
| Key point | Level                                     | Example Photographs   |  | Specification References and notes  |
|-----------|---|---|--|---|
| Transport | Use of release agent<br><br>Good Practice |  <p data-bbox="692 576 1003 608">Release agent application</p>  |  <p data-bbox="1184 580 1509 612">Automatic sprinkler system</p>  | <p data-bbox="1615 276 1966 304">CC-SPW-00900 Claus 10.1.3</p> <p data-bbox="1615 323 2119 443">To facilitate the discharge of asphalt, the floor of the vehicle shall be coated with water, a liquid soap solution or proprietary release agent.</p> <p data-bbox="1615 462 2119 582">Manual treatment with an atomised sprayer or automatic sprinklers fitted at the manufacturing plant ensure appropriate application.</p>  |
|           | Poor practice                             |  <p data-bbox="680 930 1012 962">Sand used as release agent</p>  <p data-bbox="730 1318 963 1350">Clean vehicle body</p> |  <p data-bbox="1180 930 1512 962">Sand used as release agent</p>  <p data-bbox="1171 1318 1520 1350">Material stuck to vehicle body</p> | <p data-bbox="1615 651 2119 738">Use of sand or crushed rock fines should not be permitted as a release agent as it becomes part of the mixture being laid.</p> <p data-bbox="1615 758 2119 877">This can result in delamination of the mixture from the underlying layer or pockets of uncoated material in the laid mat.</p> <p data-bbox="1615 978 2119 1098">Insulated transport is essential to minimise heat loss prior to use. CC-SPW-00900 Clause 10.1.3 stipulates the requirements for transport.</p> <p data-bbox="1615 1117 2119 1236">Vehicle inspections on site should only take place if hopper material or screed indicates contamination, binder drainage or cold material.</p> |

| Key point           | Level           | Example Photographs   |  | Specification References and notes  |
|---------------------|-----------------|---|--|---|
| Transport Continued | Time in transit |  <p data-bbox="622 635 1070 662">Loose material with shiny appearance</p>  <p data-bbox="734 1002 958 1029">Well insulated load</p> |  <p data-bbox="1133 635 1559 662">Loose material with dull appearance</p>  <p data-bbox="1223 991 1469 1018">Poorly insulated load</p> | <p data-bbox="1615 277 2101 368">Material at the correct temperature has a shiny appearance, is free flowing and retains good workability for compaction.</p> <p data-bbox="1615 384 2101 507">Material that is losing temperature has a dull appearance, is lumpy and does not retain sufficient workability for adequate compaction.</p> <p data-bbox="1615 699 2101 758">Material stored for extended periods can lose temperature.</p> <p data-bbox="1615 774 2101 833">Effective vehicle insulation and tight covers assist in minimising heat loss.</p> |

| Key point     | Level   | Example Photographs  |  | Specification References and notes   |
|---------------|---|--|--|--|
| Material flow | Discharge into hopper   |  <p data-bbox="786 619 909 647">Good flow</p>        |  <p data-bbox="1290 608 1406 636">Poor flow</p> | <p data-bbox="1615 276 2114 331">Loss of temperature leads to clumps of material. These accumulations can cause:</p> <ul data-bbox="1615 355 1995 662" style="list-style-type: none"> <li data-bbox="1615 355 1872 384">• Poor material flow</li> <li data-bbox="1615 400 1783 429">• Blockages</li> <li data-bbox="1615 445 1977 474">• Dragging under the screed</li> <li data-bbox="1615 489 1995 518">• Blemishes in the paved mat</li> <li data-bbox="1615 534 1787 563">• Poor finish</li> <li data-bbox="1615 579 1787 608">• Poor joints</li> <li data-bbox="1615 624 1995 662">• Fretting of the finished layer</li> </ul> <p data-bbox="1615 683 2051 770">Removing clumps of material prior to reaching the screed will remove their negative impact on the finished mat.</p> |
|               | On Conveyors  |  <p data-bbox="786 967 909 995">Good flow</p>        |  <p data-bbox="1290 967 1406 995">Poor flow</p> |  |
| At Augers     |  <p data-bbox="786 1366 909 1394">Good flow</p> |  <p data-bbox="1290 1382 1406 1410">Poor flow</p> |  |  |

| Key point   | Level                    | Example Photographs  |   | Specification References and notes  |
|-------------|--------------------------|--|---|---|
| Preparation | Substrate<br>Cleanliness |  <p style="text-align: center;">Surface deposits</p>  <p style="text-align: center;">Pressure washing surface</p>  <p style="text-align: center;">Good surface cleaning (new construction)</p> |  <p style="text-align: center;">Cleaned surface</p>  <p style="text-align: center;">Sweeper</p>  <p style="text-align: center;">Poor surface cleaning (reconstruction)</p> | <p>CC-SPW-00900 Clause 10.1.1.1</p> <p>Any packed mud or other deposits on the road surface shall be thoroughly removed and the road surface shall be swept free of all loose and deleterious materials.</p> <p>A good bond is required to mitigate against stresses imparted by trafficking and breaking.</p> <p>Bond to the underlying substrate is particularly important for surfacing that is laid at a nominal thickness of 40mm and less.</p> <p>Effective removal of detritus can be achieved by pressure washing, repeated sweeping and cleaning with spray bars fitted to water tankers.</p> <p>Reconstruction works that take place during overnight closures bring added time constraints.</p> <p>If the existing surface is milled immediately prior to installing the new surfacing, extra care is needed to remove all milling residue.</p> <p>The substrate should be checked thoroughly.</p> |

| Key point             | Level                           | Example Photographs  |   | Specification References and notes   |
|-----------------------|---------------------------------|--|---|--|
| Preparation continued | Substrate Cleanliness continued |  <p>Traffic loops</p>  <p>Loose material</p>  <p>Thermoplastic road marking</p> |  <p>Traffic loops</p>  <p>Joint off cut</p>  <p>Substantial thickness of road marking</p> | <p>Redundant traffic loops should be removed.</p> <p>Loose material and joint off cuts should be removed.</p> <p>Consideration should be given to using temporary painted road markings if the markings are being left in place.</p> <p>Thermoplastic road markings should be removed before overlaying with a single Surface course layer as the markings can constitute a substantial element of the overall layer thickness if left in place.</p> |

| Key point             | Level                         | Example Photographs  |  | Specification References and notes   |
|-----------------------|-------------------------------|--|--|--|
| Preparation continued | Surface drying and heating    |  <p data-bbox="667 627 1032 651">removing water from substrate</p>   |  <p data-bbox="1122 627 1576 651">wet surface on left/dry surface on right</p>  | <p data-bbox="1615 276 2114 363">Large scale surface driers are available to remove moisture, dry and heat a full lane width in one pass.</p> <p data-bbox="1615 384 2024 408">These units are particularly useful:</p> <ul data-bbox="1615 432 2114 584" style="list-style-type: none"> <li>• where extensive washing and cleaning is required</li> <li>• on overnight closures</li> <li>• to raise substrate temperature</li> </ul>  |
| Bond to substrate     | Good application of bond coat |  <p data-bbox="763 1011 931 1035">New substrate</p>  <p data-bbox="752 1382 943 1406">Milled substrate</p> |  <p data-bbox="1261 1011 1429 1035">New substrate</p>  <p data-bbox="1249 1382 1440 1406">Milled substrate</p> | <p data-bbox="1615 679 2114 799">Bond to the underlying substrate is essential for all materials. As SMA may be laid as thin as 25mm, achieving this bond is very important.</p> <p data-bbox="1615 818 1980 842">CC-SPW-00900 Clause 10.1.4</p> <p data-bbox="1615 866 2085 922">Application shall be carried out with a calibrated mechanical binder distributor.</p> <p data-bbox="1615 1062 2101 1206">Before spraying is commenced, the surface shall be free of all loose material, the surface as a whole shall be dry and any damp areas shall be completely free of standing water.</p> |

| Key point                   | Level                         | Example Photographs   |  | Specification References and notes  |
|-----------------------------|-------------------------------|---|--|---|
| Bond to substrate continued | Poor application of bond coat |  <p data-bbox="629 595 1064 624">Bond coat picked up on vehicle tyres</p>  <p data-bbox="734 962 958 991">Vehicle tyre marks</p>  <p data-bbox="734 1342 958 1370">Vehicle tyre marks</p> |  <p data-bbox="1167 600 1512 628">Close up of Bond coat pick up</p>  <p data-bbox="1211 967 1473 995">No vehicle tyre marks</p>  <p data-bbox="1211 1342 1473 1370">No vehicle tyre marks</p> | <p data-bbox="1615 276 2107 368">Removal of Bond coat from the substrate is detrimental to the long term performance of the pavement.</p> <p data-bbox="1615 384 2040 445">The 'pick up' generally occurs in the wheelpaths of the delivery vehicles.</p> <p data-bbox="1615 461 2096 611">These wheelpaths are typically in the same locations as the wheelpaths of the regular traffic. Hence, the location with most impact has the least amount of bond.</p> <p data-bbox="1615 643 2074 735">After application, an emulsion must be allowed to break (turn from brown to black) before the asphalt is laid.</p> <p data-bbox="1615 751 2067 812">These photographs show the effect of product type and timing of application.</p> <p data-bbox="1615 828 2058 888">Different products may have different characteristics and break times.</p> <p data-bbox="1615 1015 2112 1107">Bond coat 'pick up' occurred in the wheelpaths of one laying rip but not in the other laying rip.</p> |

| Key point    | Level   | Example Photographs   |   | Specification References and notes   |
|--------------|---------|---|---|--|
| Macrotexture | Typical |  <p data-bbox="674 596 1019 627">SMA 14 typical macrotexture</p>  |  <p data-bbox="1173 596 1518 627">SMA 10 typical macrotexture</p>  | <p data-bbox="1615 277 2040 363">CC-SPW-00900 Table 9 provides maximum and minimum levels to be achieved.</p> <p data-bbox="1615 384 1995 411">Macrotexture should be uniform.</p> <p data-bbox="1615 432 2092 518">Surfaces with high macrotexture are prone to water ingress and reduced long term durability.</p> |
|              | Reduced |  <p data-bbox="665 965 1028 994">SMA 14 reduced macrotexture</p>  |  <p data-bbox="1167 959 1529 987">SMA 10 reduced macrotexture</p>  |  |
|              | High    |  <p data-bbox="687 1345 1005 1374">SMA 14 high macrotexture</p> |  <p data-bbox="1184 1345 1503 1374">SMA 10 high macrotexture</p> |  |

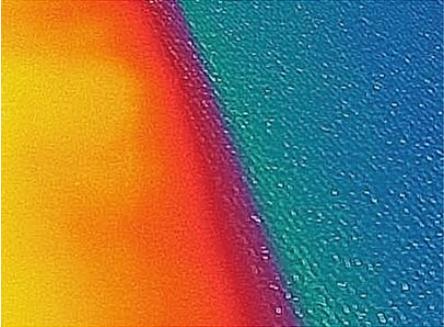
| Key point         | Level       | Example Photographs  |  | Specification References and notes  |
|-------------------|-------------|--|--|---|
| Transverse joints | Preparation |  <p data-bbox="745 579 947 611">Poor preparation</p>                             |  <p data-bbox="1238 579 1440 611">Good preparation</p>                            | <p data-bbox="1612 276 1982 308">CC-SPW-00900 Clause 10.1.8</p> <p data-bbox="1612 323 2112 451">The unsupported edge of longitudinal and transverse joints shall be cut back to a vertical face, by a width equal to or greater than the layer thickness.</p> <p data-bbox="1612 467 2112 523">The cut should extend to the full depth of the layer.</p> |
|                   | Formation   |  <p data-bbox="633 946 1059 978">Poor joint formation and compaction</p>         |  <p data-bbox="1126 946 1552 978">Good joint formation and compaction</p>         |   |
|                   |             |  <p data-bbox="633 1345 1059 1401">Good practice matching transverse joint</p> |  <p data-bbox="1104 1345 1574 1377">Good practice matching transverse joint</p> |   |

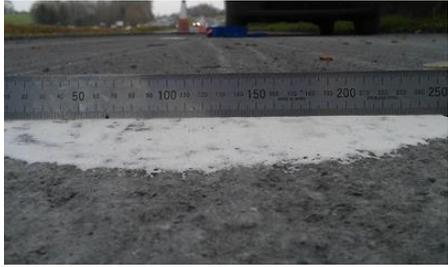
| Key point                   | Level       | Example Photographs  |  | Specification References and notes  |
|-----------------------------|-------------|--|--|---|
| Transverse joints continued | Sealing     |  <p data-bbox="790 596 902 624">Unsealed</p>                                 |  <p data-bbox="1305 596 1395 624">Sealed</p>                                  | <p data-bbox="1615 272 2056 300">Unsealed joints permit water ingress.</p> <p data-bbox="1615 320 2056 347">Sealed joints prevent water ingress.</p> <p data-bbox="1615 368 2085 427">Sealing should not protrude beyond the texture of the surface.</p>  |
| Longitudinal joints         | Preparation |  <p data-bbox="678 970 1014 997">Sufficient thickness cut back</p>           |  <p data-bbox="1171 970 1507 997">Insufficient thickness cut back</p>         | <p data-bbox="1615 651 1989 678">CC-SPW-00900 Clause 10.1.8</p> <p data-bbox="1615 699 2107 815">The unsupported edge of longitudinal and transverse joints shall be cut back to a vertical face, by a width equal to or greater than the layer thickness.</p> <p data-bbox="1615 836 2101 895">The cut should extend to the full depth of the layer.</p>   |
|                             | Formation   |  <p data-bbox="633 1358 1059 1385">Good joint formation and compaction</p> |  <p data-bbox="1126 1358 1552 1385">Poor joint formation and compaction</p> | <p data-bbox="1615 1023 2011 1050">Poor joints may be as a result of:</p> <ul data-bbox="1615 1070 2056 1289" style="list-style-type: none"> <li data-bbox="1615 1070 1944 1098">• Insufficient depth of cut</li> <li data-bbox="1615 1114 2056 1141">• Insufficient treatment with binder</li> <li data-bbox="1615 1161 1921 1189">• Incorrect level control</li> <li data-bbox="1615 1209 2011 1236">• Low compaction temperature</li> <li data-bbox="1615 1257 1944 1284">• Insufficient compaction</li> </ul> |

| Key point                     | Level               | Example Photographs   |   | Specification References and notes  |
|-------------------------------|---------------------|---|---|---|
| Longitudinal joints continued | Formation continued |  <p data-bbox="698 566 996 598">Corrective joint matching</p>   |  <p data-bbox="1137 566 1556 598">Timely rolling after corrective action</p>   | <p data-bbox="1615 272 2072 336">Adjacent rips should match the correct depth of the previously laid mat.</p> <p data-bbox="1615 352 2101 475">If undertaking corrective action, the roller must compact as soon as possible to maximise cohesion between the loose material and screed compacted material.</p>   |
|                               | Sealing             |  <p data-bbox="766 928 929 960">Good sealing</p>  <p data-bbox="721 1307 974 1339">Mechanical spraying</p> |  <p data-bbox="1272 928 1422 960">Poor sealing</p>  <p data-bbox="1191 1307 1512 1339">Mechanically sprayed seal</p> | <p data-bbox="1615 614 2101 678">The faces of all cold upstanding edges of material shall be treated with binder.</p> <p data-bbox="1615 694 2101 817">The binder should adhere evenly to the full area of both the cold and the warm upstanding edges when the asphalt is placed.</p> <p data-bbox="1615 976 2101 1040">Mechanical application provides a more uniform spread than manual application.</p> <p data-bbox="1615 1056 2116 1120">Modern bond coat sprayers are fitted with purpose-built units for applying hot binder.</p> |

| Key point   | Level               | Example Photographs  |   | Specification References and notes   |
|-------------|---------------------|--|---|--|
| Roundabouts | Longitudinal joints |  <p data-bbox="685 587 1010 643">Heavily trafficked section of roundabout</p>  <p data-bbox="674 978 1021 1007">Well formed longitudinal joints</p>  <p data-bbox="730 1348 965 1377">Poorly formed joints</p> |  <p data-bbox="1122 587 1576 616">Lightly trafficked section of roundabout</p>  <p data-bbox="1167 978 1514 1007">Well formed longitudinal joints</p>  <p data-bbox="1223 1348 1458 1377">Poorly formed joints</p> | <p data-bbox="1615 276 2092 363">Traffic on a roundabout can impart extra stresses on the surface due to the trajectory that vehicles take.</p> <p data-bbox="1615 384 2092 440">A lower macrotexture is permitted due to lower traffic speeds.</p> <p data-bbox="1615 461 2092 580">Lower macrotexture assists the durability of the surface as aggregate particles are closer together leading to less likelihood of the surface fretting.</p> <p data-bbox="1615 663 2063 751">The joints on this roundabout can withstand heavy traffic and will remain durable.</p> <p data-bbox="1615 772 2092 924">Roundabouts are often installed in short lengths, where 'hot matching' of adjacent rips is attempted without cutting joints. The conditions required for this to succeed are rare.</p> <p data-bbox="1615 1027 2092 1147">Material is always cooling and any delay to compaction will result in less internal friction and cohesive strength in the laid mat.</p> <p data-bbox="1615 1168 2092 1224">This roundabout was not constructed in accordance with best practice.</p> |

| Key point | Level                    | Example Photographs  |  | Specification References and notes   |
|-----------|--------------------------|--|--|--|
| Ironwork  | Formation and compaction |  <p data-bbox="656 619 1037 644">Good formation and compaction</p>  <p data-bbox="763 1007 931 1032">Hand levelling</p>  <p data-bbox="685 1356 1008 1382">Good level and compaction</p> |  <p data-bbox="1160 619 1532 644">Poor formation and compaction</p>  <p data-bbox="1249 1007 1447 1032">Plate compactor</p>  <p data-bbox="1189 1356 1507 1382">Poor level and compaction</p> | <p data-bbox="1615 277 2040 363">As Ironwork is cold, the hot material abutting the ironwork rapidly loses temperature.</p> <p data-bbox="1615 384 2107 534">Where Ironwork is adjusted to the required level prior to surfacing, hand raking / levelling is often necessary, particularly to ensure passage of water to gullies.</p> <p data-bbox="1615 665 2092 815">It is imperative that a plate compactor or 'elephants foot' tool is used to quickly tamp the material at the interface to achieve initial compaction prior to the roller completing compaction.</p> <p data-bbox="1615 1054 2096 1141">Attention to detail is necessary to ensure good level control facilitates passage of water to the gullies.</p> <p data-bbox="1615 1161 2092 1281">The image on the right highlights the negative effect on long term durability of poor attention to level control at the time of placement.</p> |

| Key point | Level           | Example Photographs   |   | Specification References and notes   |
|-----------|-----------------|---|---|--|
| Weather   | Wind            | <p>Materials must be adequately compacted above the minimum rolling temperature. As SMA is laid to relatively thin depths, the mixture is prone to rapid cooling, hence the time for compaction can be relatively short.</p> <p>Wind chill at the surface has a significant negative effect on the resultant compaction.</p> <p>A 30mm layer can cool four times as quickly as a 100mm layer under optimum conditions.</p> <p>Cooling is strongly dependent upon initial laying and compaction temperatures and windspeed.</p>  | <p>The current methods of control are based on assessing adverse environmental factors using thermometers for temperature and Anemometers for wind speed.</p> <p>A digital Anemometer can account for wind speed when displaying the temperature.</p> <p>Low ambient temperatures only require a gentle breeze to have a negative effect on compaction. Whereas higher ambient temperatures can tolerate a higher breeze.</p> | <p>The ambient conditions at the time of installation should be recorded.</p> <p>Research has established that:</p> <ul style="list-style-type: none"> <li>• Substrate temperature is important as more heat is lost through the bottom than through the surface of asphalt immediately after laying.</li> <li>• Surface heat loss becomes the dominant loss with increasing time after laying.</li> <li>• The rate of heat loss is proportional to the layer thickness.</li> <li>• Controllable factors of laid thickness and laying temperature play a greater role in cooling than uncontrollable factors of wind speed and air temperature.</li> </ul> |
|           | Thermal imaging | <p>New technologies are being introduced such as thermal imaging and infra-red recordings that can be used to manage and demonstrate mat temperatures to enable assessment of the works with the specification.</p> <p>Such devices provide a complete picture of the temperature distribution of the asphalt and the area to be laid on.</p> <p>The image here shows a freshly laid mat on the left and a cold, milled substrate on the right in blue. The yellow represents the hottest part of the mat, with the red highlighting the cooling effect that the free edge and substrate is having on the material temperature.</p> | <p>This illustrates why material must be compacted before it reaches the critical temperature.</p>  <p>Laid material on left, substrate on right</p>  |  |

| Key point    | Level        | Example Photographs   |   | Specification References and notes  |
|--------------|--------------|---|---|---|
| Ride quality | Good Milling |   |  <p style="text-align: center;">Smooth profile<br/>                     (sand used to emphasise depth of groove)</p>   | <p>When cold milling of the existing pavement is required, the profile and regularity of the milled substrate is important.</p> <p>The profile is particularly important when only replacing the Surface Course.</p> <p>The profile can be affected by the milling machine speed and drum speed.</p>  |
|              | Poor Milling |   |  <p style="text-align: center;">Textured profile<br/>                     (sand used to emphasise depth of groove)</p> |   |
| Regularity   |              |  <p style="text-align: center;">Use of averaging beam</p> |  <p style="text-align: center;">Screed leaves small depression in mat</p>  | <p>CC-SPW-00700 Clause 702</p> <p>The longitudinal regularity of the surface is measured with a rolling straightedge. Limits are given in Table 7/2 of CC-SPW-00700.</p> <p>Transversely, a 3 metre straightedge can be used to check for irregularities.</p> <p>The paver screed can leave small depressions or 'shadows' in the mat if the paver stops.</p> |

| Key point              | Level                | Example Photographs   |   | Specification References and notes  |
|------------------------|----------------------|---|---|---|
| Ride quality continued | Regularity continued |  <p data-bbox="712 616 981 647">Regular rolling pattern</p> |  <p data-bbox="1205 616 1485 647">Irregular rolling pattern</p>  | A uniform rolling pattern provides a uniform finish.  |
|                        | Echelon paving       |  <p data-bbox="757 983 936 1015">Echelon paving</p>         |  <p data-bbox="1205 983 1485 1015">Material transfer vehicle</p> | <p>Echelon paving is a combination of 2 or more pavers laying alongside each other at the same time. The purpose is to omit longitudinal joints.</p> <p>The pavers should be in close proximity to each other to ensure the leading edge does not cool down before the matching rip is laid.</p> <p>Use of a material transfer vehicle omits paver stops and reduces the variability of material temperature.</p> |
| Site Illumination      |                      |   |    | <p>Undertaking works on overnight closures increases the likelihood of missing blemishes in the finished surface.</p> <p>Balloon illumination is vastly superior to traditional lighting towers.</p>  |





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