## 8.10 ACCEPTANCE AND TESTING

## 8.11 FIELD TESTS AND CERTIFICATION OF MATERIALS

Sampling and testing are required to determine whether quality of materials and construction are in reasonably close conformance with plans and specifications.

Project inspectors shall identify and inspect all materials received on a project before they are incorporated into work. Inspectors shall determine that proper inspection reports or certifications are on hand, and that no unusual alterations in characteristics of materials due to handling or other causes occurred.

Guide schedules attached to *Materials I.M. 204* contain various field tests and sampling frequencies on asphalt materials and mixtures.

The Quality Management - Asphalt (QM-A) program was started in 1992 with the goal of improving the overall quality of HMA produced and giving the contractor the responsibility for mix design, sampling, testing, and making mix adjustments. In other words, contractors assumed start-to-finish responsibility for the product they produce and place. QM-A is the implementation of contractor process control for HMA mix production and placement. Field tests and certifications are the same for conventionally administered projects and QM-A projects. The major differences are the increased frequency of HMA sampling and testing, who performs the work, and contractor responsibility for conceiving and implementing mix changes to achieve specification compliance. Most administrative questions involving QM-A projects can be answered by referring to *Materials I.M. 511* and the current specifications for Hot Mix Asphalt Mixtures.

Nearly all ~~p~~Primary and ~~i~~Interstate HMA tonnage is ~~typically~~ constructed under QM-A specifications. It is intended that QM-A be applied to HMA on all ~~i~~Interstate contracts, and all other contracts with more than 5000 Mg (tons) of HMA. State park, institution, maintenance and other projects utilizing small HMA quantities will not typically be QM-A.

**Asphalt Materials**
Acceptance of asphalt materials will be on the basis of certification from an approved refinery or distribution terminal source. Formal approval of a source is to be issued by the Office of Materials. *Refer to Materials I.M. 437* for additional information.

Each shipment invoice covering certified materials delivered to a project shall have a signed certification statement as to type and grade, specific gravity or mass per liter, load quantity, batch number or other identification, project number, and compliance with appropriate Iowa DOT specifications. Copy of this invoice shall be furnished to project engineer or project inspector for review and filing.

**Aggregates**
Aggregate production and inspection are covered in detail by *Materials I.M.'s 204 and 209*. Acceptance for quality will be based on source monitoring and test results on assurance or project samples. Acceptance of mixture gradation is outlined in *Construction Manual 2.53and 3.22*.

## 8.12 RESPONSIBILITY AND DOCUMENTING HMA MIXTURE PROPORTIONING CHANGES

*Specification 2303* and *Materials I.M.s 510 and 511* give explicit guidelines that shall be followed for controlling HMA mixtures. They establish job mix criteria and corrective procedures to be followed when mixture characteristics are changed from the job mix formula during mix production.

District Materials Engineers have primary responsibility for authorizing changes made by the contractor to keep the mixture characteristics within all *Specification and I.M.* guidelines. They will inform project engineer of changes and follow up with written documentation. Each of these parties may designate a representative to approve desired change.

On QM-A projects, contractor has sole responsibility for making mix changes; however, District Materials Engineer or project engineer must be kept informed and involved in these changes. Mix change decisions must be an interactive process between contractor and agency.

The project engineer must also insure that required changes are implemented as soon as possible when mixture characteristics fall outside *Specification 2303* and *Materials I.M. 510 Appendix A* limits. On each working day, project engineer shall determine if work for previous working day was within *Specification* and *I.M.* guidelines. If not, immediately consult with District Materials and the contractor to assure corrective action is taken.

**Adjusting Asphalt Binder Contents**

For determining whether asphalt binder content is within required guidelines, refer to *Specification 2303*. Limits are given for the air voids that are determined daily on a specimen in the District Materials Laboratory. This will be calculated by District Materials according to *Materials I.M.s 321* and *501*, based on the Rice Procedure as per *Materials I.M. 350*. Project engineer or designated representative (probably plant inspector) must get these air voids daily from District Materials. Footnotes at the bottom of each applicable table in *I.M. 511* shall be reviewed carefully, because they give precautions to follow for heavily traveled pavements as well as other requirements.

When test results for air voids (field and/or lab) are outside the limits given in *Specification 2303*, project engineer needs to contact District Materials to initiate changes in HMA mixture. When asphalt binder content changes are considered to adjust air voids, caution must be used to assure that adequate film thickness required in *Materials I.M. 501 Appendix A, Table 1* is maintained. When the resulting film thickness is outside the specified range, procedures given in *Construction Manual Appendix 2-34 (Table M)* should be used to determine the appropriate price adjustment. Reductions in asphalt binder content must not reduce the target below calculated the minimum allowable asphalt binder content. Documentation of changes should be on "Daily HMA Plant Report" ( Form 800241).

On QM-A projects, job mix control is done essentially the same way except the contractor is responsible for sampling, testing, reporting results, and making appropriate mix changes. Also, HMA mix sampling and testing is performed up to four times per day at the HMA plant site so immediate results are available. For QM-A, the contractor is responsible for making meaningful mix changes before the lab void running average goes out of compliance. When a lab void running average goes out of compliance, the contractor must shut down and implement changes intended to correct the noncomplying voids. If the contractor fails to shut down voluntarily, the project engineer may shut down the contractor until corrective action is taken. A price adjustment for failure to shut down or make timely and meaningful mix proportion changes may be appropriate. The project engineer should coordinate closely with the District Materials Engineer for a resolution when lab voids are noncomplying on a QM-A project. Lab voids will be monitored daily by District Materials, but the project engineer must also remain informed of the test results.

Work using HMA mixtures with air voids outside the limits shall be avoided. If District Materials cannot be reached in a timely manner, project engineer shall change asphalt binder content as necessary to stay within *Specification 2303*guidelines and report this change to District Materials as soon as possible. Such changes will be reviewed later by District Materials and shall be documented by plant inspector on "Daily HMA Plant Report."

**Documenting Corrective Action for Noncomplying Air Voids Test on Specimens Taken from Constructed Pavement**
*Materials I.M. 204* also requires project engineers to report tests for field air voids on mix samples from compacted roadway on "Daily HMA Plant Report." *Specification 2303* stipulates the required range for these tests.

Range given for these voids is the average of all tests for each day's construction calculated by plant inspector.

When tests for these air voids are outside required range, density results shall first be reviewed. Example: If density results ~~should be~~ are on lower end of range but still passing, perhaps air voids will fall within range specified by increasing density. After review of density and testing procedures, Materials forces shall be notified to consider changes in mix proportions. If conflicts develop between lab and field voids, concentrate on achieving proper lab voids. Generally there won't be a problem keeping field voids within specification if lab voids are on target.

When noncomplying tests for air voids in specimens taken from constructed pavement occur, project engineer will notify District Materials. Plant inspector will document noncompliance on "Daily HMA Plant Report" containing the noncomplying test results.

In response, District Materials Engineer will inform project engineer what changes in mix proportions, if any, should be made. District Materials Engineers will furnish project personnel written documentation for the decision or action taken.

**Adjusting Aggregate Proportions**
Contractor must occasionally adjust aggregate proportions to consistently comply with job mix target gradation tolerance and to correct calibration errors.

Contractors shall initiate and make changes necessary to insure compliance under guidelines set forth by *Specification 2303* and. Contractor shall not be allowed to make such changes without prior approval of project engineer.

For QM-A projects, the contractor shall also initiate and make appropriate changes. Although this must be done as an interactive procedure with project engineer, approval of the project engineer for these changes is not necessary as long as results are within the constraints of specifications and Materials I.M.'s.

Proportion changes of up to 5 percent for each material may be approved without delaying operations for qualifying tests. District Materials should be contacted when desired change is between 5 and 10 percent for each material. Single changes greater than 10 percent require a new mix design unless waived by project engineer.

*Specification 2303* and *I.M.s and 510 and 511* provide many of the guidelines needed for making mix change decisions. Project engineers are expected to reference these documents and communicate closely with District Materials prior to, during, and after the need for decisions concerning mix proportion changes so problems can be avoided.

Proportion changes shall be documented by plant inspector on "Daily HMA Plant Report."

**Filler/Bitumen Ratio**
Specification 2303 and *Materials I.M. 510 Appendix A* give explicit guidelines that shall be followed in relation to filler/bitumen ratio. For Marshall mixes, the filler/bitumen ratio is determined by dividing the percentage of cold feed material passing the 75 µm (#200) sieve by the total percentage of asphalt binder used, as determined by tank stick or by actual mass (weight). For Gyratory mixes, the filler/bitumen ratio is determined by dividing the cold feed material passing the 75 µm (#200) sieve by the "effective" percentage of asphalt binder used, taking into account asphalt binder absorbed by the aggregate. See *Materials I.M. 501* for additional information, including applicable equations and example calculations.

Plant inspector should determine how a proportion change will affect the filler/bitumen ratio before allowing contractor to make such a change.

If filler/bitumen ratio is outside the limits established in *Specification 2303* and *I.M. 510 Appendix A*, a "Noncompliance Notice" (Form 820245) shall be issued immediately. If additional verification samples are taken, they must be run and an average calculated.

Plant inspector will then refer to *Construction Manual 2.53*. The average of all verification tests for the lot shall be used to determine filler/bitumen ratio.

When filler/bitumen ratio for an HMA mixture falls outside the limits established by specification for that material, the affected material will be considered noncomplying and subject to price adjustment. See *Construction Manual Appendix 2-34 (Table J)* for additional guidance.

## 8.13 DENSITY CONTROLS FOR HMA CONSTRUCTION

**Uncompacted HMA Samples**
Specifications for HMA require each layer to be compacted to a density not less than a given percentage of laboratory density representing that particular lot.

On non QM-A projects, a comparative laboratory density shall be determined for each lot from mixture samples obtained as prescribed by *Materials I.M. 322*. The contract documents will normally require that the contractor transport samples to the District Materials Lab. Such deliveries shall be done promptly. Prompt delivery requires that the contractor obtain hot box samples within several hours after daily production begins for immediate delivery to the District Materials Lab. Normally, the first hot box sample must be delivered by noon to report results the same day. District Materials personnel will perform the laboratory density tests. The contractor should deliver the first split aggregate sample with the hot box each day if gradation acceptance testing is performed in the District Materials Lab.

District Materials will promptly communicate test results back to inspection forces so they may be used to calculate comparative percentages. If more than one sample is used to determine laboratory densities for any lot with the same mixture, an average of that lot's laboratory densities shall be used.

If a laboratory density is not available from District Materials for a particular day's sample, the daily control shall be based on laboratory density for previous day's construction using the same mixture.

On QM-A projects, up to four paired hot box samples per day will be obtained by the contractor, as directed and witnessed by certified agency personnel (HMA Level 1 or HMA Sampler). One of each paired sample is then transported to the field lab for quality control testing. The hot box samples must be taken from behind the paver as prescribed by *I.M. 322*, by a technician with either HMA Level I or HMA Sampler certification. The grade inspector or plant monitor directs and witnesses contractor sampling to ensure it is properly done by appropriately certified personnel. The contractor will also transport the verification portion of the paired hot box samples, the split cold feed verification samples, and asphalt binder verification samples to the District Materials Lab on a daily basis. The inspector or plant monitor must properly identify and secure all verification samples with tamper-proof devices prior to transport by contractor personnel. No security measures are required if custody of samples is maintained by agency personnel.

An average of all laboratory compacted ~~gyratory or Marshall~~ specimens from the daily hot box samples will be used to determine the degree of field density. The specification for Hot Mix Asphalt Mixtures describes how to calculate laboratory density for a given~~the~~ lot when less than four hot box samples are obtained for ~~a~~the lot.

**Compacted HMA Samples**

Density of pavement is determined from core samples cut by contractor, normally on the next working day following construction.

Seven samples shall be cut from each lot of construction. For surface courses designed 25 mm (1 inch) or less in thickness, each one-half day's construction is designated as a lot. Each full day's production may be separated into two lots for determinations of quality index (density). This must be agreed to at preconstruction conference.

Specifications also describe a statistical procedure for field density evaluation together with a formula and schedule for payment adjustments when noncompliance occurs. Project inspection personnel shall observe the following when using the statistical procedure. These procedures are valid for all HMA projects.

- Contractor is required to take prescribed number of samples at locations selected and marked out by project inspector. Project inspector or monitor (HMA Level I or HMA Sampler ~~Plus~~ certified) will direct and witness the core sampling. A circle approximately 400 mm (16") in diameter is adequate for identification of sampling location. The core should be taken from within the area identified. It is not appropriate for contractor to use a nuclear device to "hunt" for a particular spot to sample; coring locations are no longer random when a nuclear device is used in this fashion.

- Sample locations should be selected randomly within areas designated by specifications. This may be accomplished by casting a die, using a random number generator, table of random numbers, or drawing lots. If lots are used, the lot drawn shall be replaced each time before drawing again to insure that the same relative location has a chance to be selected for each individual drawing. A core will not be taken less than 300 mm (1 foot) from the edge of a given pass of the finishing machine. Procedure for identifying random locations should provide for the potential to obtain a core sample at any distance 300 mm (1 foot) or greater from the edge. Similarly, random cores are not to be taken within 300 mm (1 foot) of runouts, day's work joints or structures. For pavement sections with a paved (or partially paved) shoulder placed concurrently with mainline lane, the random location should be based on a distance 300 mm (1 foot) or greater form the lane line (painted edgeline location). In other words, the paved shoulder area is excluded from the random core smpling area (lot) for the mainline lane. A spreadsheet for determining random core sample locations is available from the Office of Construction.

- If layer being sampled adheres to a lower layer, it may be necessary to sample through two or more layers or full depth. Contractor will need to remove the extra depth by sawing the sample with a masonry saw. It may be necessary to cool sample by refrigeration or ice to prevent damage during sawing. It is important that core bits be kept sharp.

- Each sample shall be inspected carefully by the contractor and inspector prior to testing (preferably at the time of core drilling). Be sure core sample is representative of density of mixture placed. If damage is noticeable or if sample is thinner or thicker than specifications allow, discard without testing and take another to replace it.

- The project inspector or plant monitor is responsible for performing tests required to determine density of core samples. This typically involves measuring, placing in water bath, drying, and weighing of cores. For most efficient use of time, other plant monitor duties may be performed while the core samples are drying. To be qualified to perform core density testing, the inspector or plant monitor must have obtained either HMA Level I or HMA Sampler ~~Plus~~ certification.

- If test indicates that density is less than specified percentage, sample shall be retested to insure accuracy. However, after a sample is tested, resampling of individual locations shall not be done.

- Tests on density samples give lower results if samples are damaged during handling. Contractors and project inspectors are advised to use extreme care when taking, transporting, and preparing cores for testing.

- Samples should be transported on hard flat surfaces to avoid loss of density by distortion. Core samples must be identified and secured by the inspector in a tamper-proof container prior to transport by contractor personnel. If necessary to store samples, storage should be in a cool place and on a hard flat surface.

- Specifications also require contractor to take density samples as promptly as practical. Samples should be taken no later than the next working day following construction. If contractors are unable to comply with this timing, project inspectors shall stop construction until contractors are able to do so.

- Refer to *Materials I.M.s 501* and *508* and Specifications for determination of "outlier" field density values.

- Project inspector shall report lot failures to project engineer and contractor on the day tests are performed.

**Procedures for Construction of Test Strips**

The specification entitled "Test Strip Construction for Class 1A and IB Compaction" requires the contractor to construct a test strip for both intermediate and surface course mixtures subject to Class 1A compaction. Specifications further require test strips for surface course mixes requiring Class 1B (primary road) compaction. Test strips are used to evaluate properties of HMA mixture and identify an effective rolling pattern. For Class 1B compaction, field density compliance is not typically a problem, therefore documentation of a test strip rolling pattern and nuclear gauge evaluation is optional for the contractor. Test strips for Class 1B compaction on surface courses are required primarily to allow evaluation and adjustment of mix properties, particularly lab voids, before the mix is placed as a surface course.

Proper construction and documentation of test strip is the responsibility of the contractor. Documentation of test strip development and final rolling pattern should be provided by contractor to inspector.

The specifications outline several steps that must be followed to construct a test strip. Documentation of this procedure is required. If properly performed, compacting a control test strip using a nuclear gauge will establish a rolling pattern that achieves required density. Personnel participating in tests must include roller operators, nuclear gauge operator, paving supervisor, project inspector, and District Materials personnel. The following procedure describes steps to be taken by the contractor to effectively construct a test strip.

- Pre-size roller train

  It is extremely important to properly balance roller capacity with paver speed. The paver speed is generally controlled by asphalt plant production rate in megagrams (tons) per hour. This assumes adequate trucks are available for continuous production. Determine paver speed by considering megagrams (tons) delivered to paver and mat thickness and width. Assume paver operates 50 minutes each hour.

  Vibratory rollers are typically used for breakdown rolling. Determine frequency (vibrations per minute) of roller which establishes maximum permissible rolling speed in meters (feet) per minute to assure 35 impacts/m (10 impacts per foot). Contractor should provide this roller information. It can be checked with a tachometer available from the Central Materials Office.

  Estimate number of coverages of each roller to achieve required density. Determine number of passes necessary to accomplish estimated coverages considering width of roller. A coverage requires sufficient side-by-side passes to cover entire mat width once. Include the catch-up pass.

  Knowing maximum roller speed and number of coverages estimated to achieve density, determine total meters per minute (m/min) of full width mat that roller can effectively compact. Assume 80% roller efficiency.

$$\text{m/min (completed)} = \frac{\text{roller speed m/min}}{\text{number of passes for estimated coverages required}}$$

  Compare m/min completed of roller to paver speed. If m/min completed is greater than paver speed in m/min, roller is adequate. If m/min completed is less than paver speed, additional rollers must be provided or paver speed must be reduced to equal or less than roller capacity.

  Example:
  Mat width = 3.5 m (11.5 feet)
  Compacted thickness = .05 m (2 inches)
  Production rate = 135 Mg/h (150 tons/hour)

Roller width = 1.83 m (6 feet)
Frequency = 2400 VPM

Assumptions:
Paver will operate 50 minutes per hour.
Roller efficiency is 80%.
Compacted density equals 2 350 kg/cu m (146.7 pcf).
Density will be achieved with 3 coverages.

A. Determine paver speed to match production

$$\frac{\text{135 Mg/h (150 tons/hour)}}{\text{60 mins./hour}} = \text{2.25 Mg/min (2.5 tons/min.)}$$

$$\frac{\text{2.25 Mg/min (2.5 tons/min.)}}{\text{2.350 Mg/cu m}} = \text{.96 cu m/min (34.08 cubic ft./min.)}$$

$$\frac{\text{.96 cu m/min}}{\text{3.5 m (mat width) x .05 m (thickness)}} = \text{5.5 m/min}$$

Minimum paver speed = (60/50) (5.5 m/min) = 6.6 m/min (21.65 ft./min.)

B. Determine maximum permissible speed of roller

$$\frac{\text{2400 VPM}}{\text{35 impacts/m}} = \text{68 m/min (207 ft./min.)}$$

C. Determine total m/min of full width mat that can be compacted with three coverages.

Roller width = 1.83 m (6 feet)
A .15 m overlap per pass requires three passes per coverage. Nine passes required for three coverages.

Note: A catch-up pass is not needed in this case because third pass on third coverage will end at paver end of compacted area.

$$\text{Completed m/min} = \frac{\text{68 m/min}}{\text{9 passes}} \times \text{0.80 (efficiency)} = \text{6 m/min (18 ft./min.)}$$

Paver speed 6.6 m/min. Roller capacity is inadequate for the indicated paver speed, and appropriate changes to increase roller capacity will be necessary.

Above example considers a vibratory breakdown roller. From experience, we know a rubber-tired intermediate roller is typically needed to achieve interstate density requirements. Same procedure can be used to calculate capacity of rubber roller and compare to paver speed. The only difference is that roller speed is not based on impacts per meter, but rather effectiveness as determined by nuclear gauge testing.

Uniform operation of paver is a critical factor in obtaining consistent density results and smooth pavement. If paver is operated at erratic or excessive speed in short intervals, satisfactory results are difficult to achieve. When an excessive number of trucks arrive at paver simultaneously, paver operators are tempted to increase paver speed and quickly unload all waiting trucks, then stop paver, and await their return or next group. It is better to maintain appropriate paver speed and thereby assist in respacing the trucks. This does not sacrifice production, but maintains uniform rate of production which allows roller operator to maintain rolling speed and still keep up with paver.

- Estimate lab density of plant produced mix
  May be slightly higher than job mix lab density depending on aggregate gradation control, aggregate degradation in dryer, and asphalt binder control.

- Check equipment

  Determine and record sizes of all rollers to be used for project. Vibration frequency (discussed earlier), amplitude setting, roller scale weights, tire inflation pressures, tire sizes and contact pressure must be known and documented. Minimum of 550 kPa (80 psi) contact pressure is required. The specifications require an information plate attached to each roller which shows tire size and ply; and correlation of wheel load and tire pressure with contact pressure.

- Select test site

  Wait until approximately 90 Mg (100 tons) of mix have been produced so plant has stabilized. Test area should be about 100 m (328 feet) long where roller may be tested without being interrupted by ramps, bridges, interchanges, etc. Mark off section and record stationing.

  Establish at least three points where nuclear testing will occur. Record location of these points.

- Establish preliminary rolling pattern

  Remember, goal is to establish a roller pattern which will consistently obtain required density. To meet this requirement, it will be necessary to adjust operating techniques until desired results are obtained. Variables may include vibration frequency, amplitude, roller speed, contact pressure, number of coverages, and roller operating zone.

  Change only one variable at a time. Always select a combination that will allow rollers to complete at least the same m/min of completed mat as the paver is producing.

All operating techniques are governed by mix behavior during the rolling process. It will vary from job-to-job and from lift-to-lift.

- Running test

  Using predetermined rolling pattern and placing roller in preselected roller zone, begin compacting mat. Locate nuclear gauge on mat at established locations and take reading. Short nuclear counts are normally used initially, so testing does not interfere with rolling.

  Continue rolling and checking density until effective pattern is established. Develop density growth curves for each roller pattern used. Plot density vs. number of passes on graph paper. Contractor should provide copies of this documentation, including description and location of pattern used, to project inspector.

  After a successful pattern is identified, complete rolling pattern again in another area and take longer nuclear counts to verify results. Document the successful pattern to be used in field book.

  Test strip needs to be established under the same production conditions that will prevail during normal paving operations, such as mix temperature and production rate.

- Cut cores
  After mat has cooled or been iced, cut cores for acceptance. Specifications allow one extra core (8 total) to be cut in test strip area. Lowest core density is discarded. This recognizes the potential for inconsistent results when performing a test strip.

- Correlate nuclear readings with core results

  Allows for more accurate monitoring of density with nuclear device during production.

- Monitor Use of Selected Pattern

  Each day project inspector shall check rolling pattern, including paver speed and roller coverages, and record in field book.

**Resolving Density - Void Conflicts**
Project inspector should be aware that field laboratory and compacted voids will be tightly controlled. This may require more compactive effort and even higher average density for compliance. Field control will allow no more than 8% voids in compacted layer. Become familiar with other controls by reading *Materials I.M. 511* and asking questions of District Materials personnel.

For the case where specified density is met, but field laboratory voids or pavement voids are outside designated limits for more than one day, inspector should request a test strip. Test area should be a straight run of about 100 m (110 yards). Contractor will select combination of rollers to be used and preliminary rolling pattern. Nuclear gauge readings would normally be taken after each pass or series of passes.

Inspector would only observe this process. Documentation of type and amount of compactive effort shall be recorded. Inspector will then select and mark out 5 random core sites within test site. Density cores taken by contractor would be tested and results reported as soon as possible.

Cooperation between project inspector, District Materials, and contractor is essential to reach a timely solution. If all anticipated results are not met, further experimenting with a different combination of rollers and operation should be performed. Changes in gradation may be one of the first items looked at by District Materials. Changes in asphalt binder content would be one of the last items. Relief from minimum laboratory voids specified may only be approved by Office of Materials.

## 8.14 TESTING FOR SMOOTHNESS

Appropriate references for acceptable smoothness of HMA surfaces are *Specifications 2316 & 2317* and *Materials I.M. 341*. Specification 2316 (Pavement Smoothness) applies to HMA paving projects whenever Specification 2317 (Primary and Interstate Pavement Smoothness) does not.

Equipment for smoothness testing includes the 7.6 m (25-foot) California profilograph, rolling surface checker (bump cart), and 3 m (10-foot) straightedge. Pavement surfaces to be tested for smoothness with the 7.6 m (25-foot) profilograph are identified in *Specifications 2316.01 and 2317.01*. The contractor may choose to use a profilograph, in lieu of bump cart or straight edge, to check additional pavement areas for bumps. Unless the contract documents specifically indicate otherwise, paved shoulders are not considered part of the pavement surface and therefore are excluded from profilograph or bump cart testing, although reasonable smoothness from a workmanship standpoint would still apply. The contractor is responsible for providing the profilograph and for performing the testing.

Contractor should be encouraged to test directly behind the finish roller to allow correction of an identified 13 mm (0.5 inch) bump by re-rolling while mixture is still hot enough to be affected.

**Use of Straightedge and Rolling Surface Checker**
Pavement smoothness specification does not relieve contractor of responsibility for proper rolling and workmanship. Each pavement layer is to be inspected visually to insure that surface is free of roller marks and distortion. Transverse joints are to be checked with a 3 m (10-foot) straightedge. Surface courses inspected with a rolling surface checker shall meet 3 mm (1/8 inch) tolerance. For lower courses, 6 mm (1/4 inch) smoothness tolerance may be used.

Contracting authority will continue to provide rolling surface checker and conduct testing on all surfaces not tested by profilograph. However, corrections for surface irregularities shall be made, if possible, before mixture has cooled to 66 degrees C (150 degrees F). A large percentage of irregularities can be corrected by finish rollers above this temperature.

When rolling surface checker is used, it should be operated immediately behind finish rollers. Mixture buildup on the wheels of surface checking straightedge should be regularly removed.

The inspector operating the surface checking straightedge should also observe surface to insure that all roller marks or roller wheel depressions are smoothed out during the finish rolling. The inspector should observe the longitudinal joints carefully to insure that they have been smoothly rolled as specifications require. If surface is not being finished as specifications require, inspector shall stop construction until contractor takes corrective action.

**8.15 CHECKING TRANSVERSE JOINTS FOR SMOOTHNESS**

The specifications require use of a 3 m (10-foot) straightedge for checking surface, intermediate, and base course transverse joints for smoothness. Inspectors shall use straightedge according to the following procedure:

1. The first check with the straightedge is made before saw cut. Straightedge is used to determine where full thickness of layer ends and tapered portion begins. Inspector shall require that saw cut be located in full thickness of layer. All of the layer extending beyond the saw cut, including tapered portion, is then removed.

While the joint is being constructed and checked, inspector shall require the finishing machine to be stopped approximately 10 to 15 m (30 to 50 feet) from the joint. Construction shall not be permitted to continue until the checking has been completed. This permits repaving of the joint, with finishing machine, if straightedge should indicate a poor riding surface has been constructed.

2. The second check with the straightedge is made after finishing machine has constructed the new layer, but before rolling. Straightedge is used to locate irregularities in newly constructed layer and any irregularities found that must be corrected by hand tools. When straightedge indicates no high or low spots, compaction should be permitted with initial roller.

3. The third check with the straightedge is across the joint between cold pavement and hot mixture after compacted with initial roller. This third check indicates whether the correct amount of material has been placed. For instance, if freshly rolled layer is too high, it indicates too much material has been placed. If freshly rolled layer is too low, it indicates not enough hot mixture has been placed.

For that reason, high or low transverse joints are not usually corrected by additional rolling. Instead, corrections should be made by cutting or filling rolled surface while mixture is still warm and can be manipulated. If there are unusually high or low areas after rolling, paths must be shoveled through the pavement for finishing machine tracks. Finishing machine is then backed up to the joint and paving operation is started again.

Above procedure shall be repeated as necessary until straightedge indicates that a good riding joint has been constructed. If repeated repaving operations cause mixture to cool to the extent that reuse becomes impractical, it should be removed and wasted.

4. The final procedure for insuring proper construction at transverse joints is checking for true edge alignment. Edge of the freshly rolled layer should be carefully trimmed by hand tools until it matches the alignment of adjoining cold pavement.