12 Quality Control Procedures

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CHAPTER TWELVE: QUALITY CONTROL PROCEDURES

The foundation for a successful Quality Assurance program is the control maintained by the Contractor to assure that all materials submitted for acceptance conform to the contract requirements. To accomplish this, the Contractor is required to have a functional Quality Control Plan (QCP) to keep the process in control, quickly determine when the process goes out of control, and respond adequately to bring the process back into control.

This chapter includes the minimum requirements for maintaining quality control during production of QC/QA Hot Mix Asphalt. Acceptance test results by INDOT are shared with the Contractor; however, results of these tests should not be used for quality control purposes.

CONTRACTOR PERSONNEL

The Contractor personnel required to provide quality control on a QC/QA Hot Mix Asphalt contract includes a QCP Manager, QCP Site Manager, and a Quality Control Technician. One quality control person may perform the duties of more than one position.

QCP MANAGER

The QCP Manager is responsible for the overall administration of the QCP on the contract.

QCP SITE MANAGER

The QCP Site Manager is responsible for the execution of the QCP and is the liaison with the PE/PS. This person is often also the QCP Manager.

QUALITY CONTROL TECHNICIAN

The quality control technician is responsible for the following duties:

1) Paving operations and joint construction
2) Quality control tests for temperature, density, and smoothness
3) Pavement samples for quality control and INDOT acceptance

MILLING

The Contractor is required to designate the procedures for milling the existing material to include as a minimum the general procedures, equipment, and testing that is conducted.

MILLING PLAN

The general procedures for asphalt milling, asphalt removal, PCCP milling, scarification and profile milling, and transition milling are required to be designated in the QCP.

EQUIPMENT

A description of the equipment required to mill, cut, and remove the existing material is required to be designated. Figure 12-1 is an example of a milling machine that is commonly used.

Figure 12-1. Milling Machine

TESTING

The procedure for measuring the macrotexture of the milled surface in accordance with **ITM 812** is required (Figure 12-2). The purpose of this test is to measure the condition of the surface after milling in preparation for resurfacing with HMA.

Figure 12-2. Macrotexture Test

A minimum frequency of one macrotexture test is required. The requirements in accordance with Section **306** are as follows:

	Macrotexture
Asphalt Scarification & Profile Preparation	≥ 2.2 for single course overlays ≥ 1.8 for multiple course overlays
Asphalt Milling	≥ 2.2 for single course overlays ≥ 1.8 for multiple course overlays
PCCP milling	≥ 1.8

The procedure, frequency, and equipment for measuring the cross-slope and longitudinal surface finish of the milled material is also required.

PROCESS BALANCE

The procedures for balancing the HMA operation, include the production, transportation, placement, and compaction of the mixture. The purpose of this balancing is to assure that there is the proper amount of HMA to provide continual operation of the paver and that there is a sufficient number of rollers to provide an effective compaction production rate approximately equal to the paver speed. One procedure to determine whether the HMA operation is balanced uses an average paver speed and plant production chart, roller coverage tables, and roller drum widths (Figures 12-3 to 12-6). The following examples explain the procedures required to use this procedure.

Example 1

Calculate the approximate plant production that will result in a process balance for the following mixture and breakdown roller:

Given:	19.0 mm Intermediate	
	Lay rate: 150 lb/yd^2	
	Pavement width:	12 feet
	Breakdown roller:	Dynapac CC-42A
	Maximum roller speed:	2 ½ mph
	Number of breakdown passes:	2

1) Drum width = 66 inches (Figure 12-3)

2) Drum roller laps = 3 (Figure 12-4)

3) Coverage speed = 28.3 ft/min (Figure 12-4)

The breakdown roller coverage is required to equal the average paver speed in Figure 12-6 if the operation is in balance.

4) Plant production ≈ 165 t/hr (Figure 12-6)

Therefore, if the HMA plant is producing 165 t/hr and the breakdown rolling is done by a Dynapac CC-42A roller with 2 passes, the HMA paving operation will be in balance.

Example 2

Calculate the approximate plant production that will result in a process balance for the following mixture and breakdown roller:

Given:	25.0 mm Base	
	Lay rate:	250 lb/yd^2
	Pavement width:	12 feet
	Breakdown roller:	three wheel roller
	Maximum roller speed:	3 mph
	Number of breakdown passes:	2

1) Drum Roller Laps = 4 (Figure 12-5)

2) Coverage Speed = 26.4 ft/min (Figure 12-5)

The breakdown roller coverage is required to equal the average paver speed in Figure 12-6 if the operation is in balance.

3) Plant production ≈ 260 t/hr (Figure 12-6)

Therefore, if the HMA plant is producing 260 t/hr and the breakdown rolling is done by a three-wheel roller with 2 passes, the HMA paving operation will be in balance.

VIBRATORY ROLLERS

MANUFACTURER	MODEL	DRUM WIDTH
Bomag	BW-120AD	48 in.
Bomag	BW-140AD	56 in.
Bomag	BW-160AD	65 in.
Bomag	BW-201AD	84 in.
Bomag	BW-220AD	80 in.
Bros	VM-268H	68 in.
Case	752	63 in.
Dynapac	CC-21A	55 in.
Dynapac	CC-42A	66 in.
Dynapac	CC-50A	84 in.
Gallion (Dresser)	VOS2-66A	66 in.
Gallion (Dresser)	VOS2-66B	66 in.
Hyster	C727A	72 in.
Hyster	C766A	72 in.
Ing-Rand	DA-50	75 in.
Ing-Rand	DD-90	66 in.
Ing-Rand	DD-145	84 in.
Raygo	6604-A	66 in.
Raygo	7204-A	72 in.
Rex	SP-1100	80 in.
Rex	SP-1000	66 in.
Rex	SP-910S	84 in.
Tampo	RS-166A	66 in.
Tampo	RS-188A	84 in.
Tampo	RS-288A	84 in.

Figure 12-3. Vibratory Roller Drum Widths

2.5 MPH ROLLER SPEED

PAVER LAY DOWN WIDTH IN FEET	DRUM ROLLER LAPS								
	DRUM WIDTH - INCHES								
	55	56	65	66	68	72	75	80	84
10	3	3	2	2	2	2	2	2	2
12	3	3	3	3	3	3	2	2	2
14	4	4	3	3	3	3	3	3	3
16	4	4	4	4	3	3	3	3	3
17	5	4	4	4	4	3	3	3	3
18	5	5	4	4	4	4	4	3	3
19	5	5	4	4	4	4	4	3	3
20	5	5	4	4	4	4	4	4	3
21	5	5	5	5	4	4	4	4	4
22	6	6	5	5	5	4	4	4	4

ROLLER LAPS	COVERAGE SPEED IN FT./MIN.					
	2 PASSES	3 PASSES	4 PASSES	5 PASSES	6 PASSES	8 PASSES
2	39.6	28.3	22.0	18.0	15.2	11.7
3	28.3	22.0	15.2	13.2	10.4	7.9
4	22.0	15.2	11.7	9.4	7.9	6.0
5	18.0	13.2	9.4	7.9	6.4	
6	15.2	10.4	7.9	6.4	5.4	

Figure 12-4. Vibratory Roller Coverage Speed Chart

3.0 MPH ROLLER SPEED

PAVER LAY DOWN WIDTH IN FEET	DRUM ROLLER LAPS		
	ROLLER WIDTH - INCHES *		
	3-WHEEL 40	PNEUMATIC 68	TANDEM 54
10	4	2	3
12	4	3	3
14	5	3	4
16	5	3	4
17	6	4	5
18	6	4	5
19	7	4	5
20	7	4	5
21	8	4	6
22	8	5	6

ROLLER LAPS	COVERAGE SPEED IN FT./MIN.					
	2 PASSES	3 PASSES	4 PASSES	5 PASSES	6 PASSES	8 PASSES
2	47.5	33.9	26.4	21.6	18.3	14.0
3	33.9	26.4	18.3	15.8	12.5	9.5
4	26.4	18.3	14.0	10.9	9.5	7.2
5	21.6	15.9	11.3	9.5	7.6	5.9
6	18.3	12.5	9.5	7.6	6.5	4.9

* Roller widths for the 3-wheel, Pneumatic and Tandem Rollers may vary.

Figure 12-5. Static Roller Coverage Speed Chart

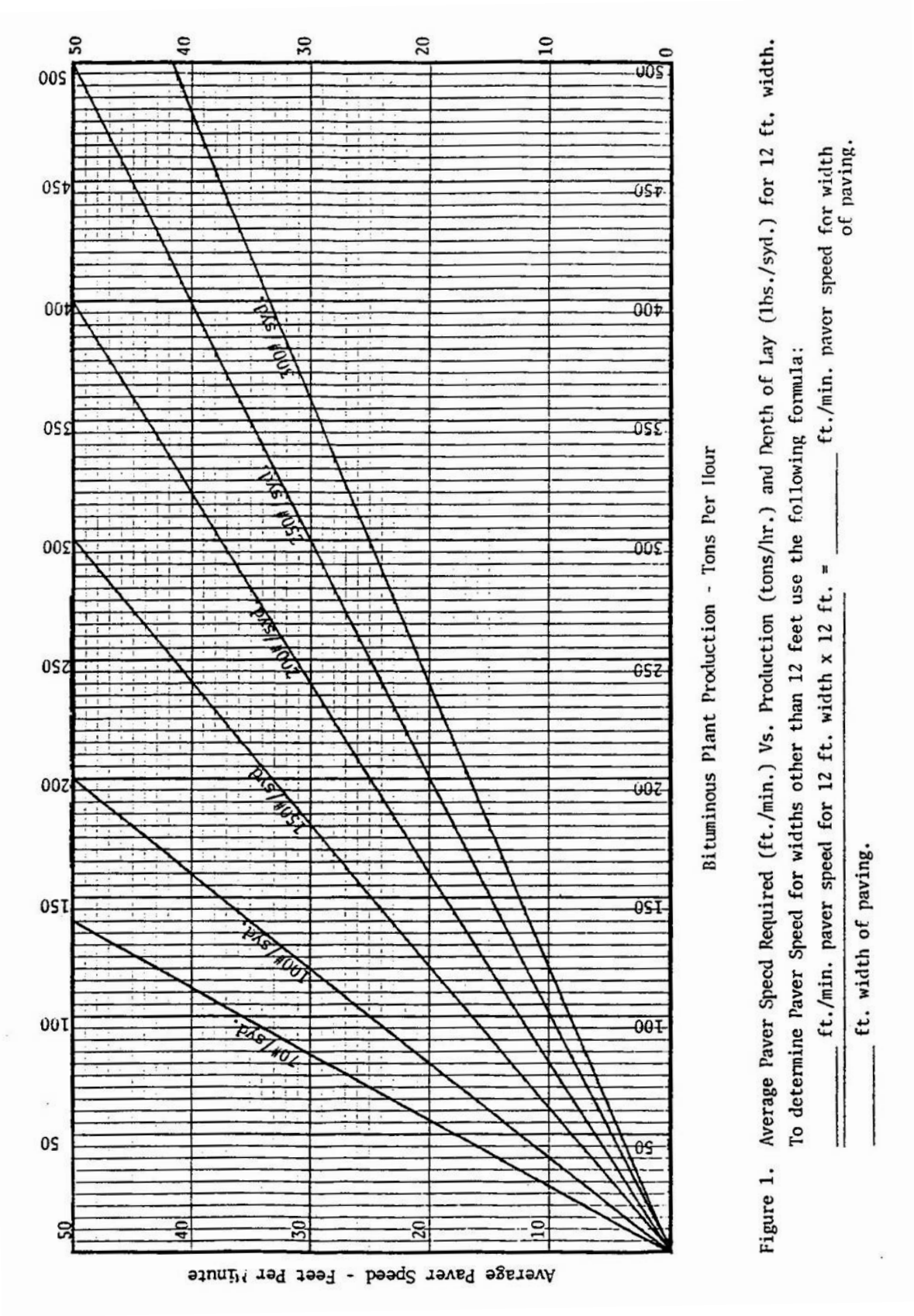

Figure 1. Average Paver Speed Required (ft./min.) Vs. Production (tons/hr.) and Depth of Lay (lbs./syd.) for 12 ft. width.
To determine Paver Speed for widths other than 12 feet use the following formula:

_____ ft./min. paver speed for 12 ft. width x 12 ft. = _____ ft./min. paver speed for width of paving.
_____ ft. width of paving.

Figure 12-6. Paver Speed vs. Plant Production Graph

TRANSPORTATION OF MIXTURE

The Contractor is required to designate the procedures for transportation of the HMA from the plant to the paver.

TRUCK BED COVER

The procedure for when waterproof covers are used and the person that directs their use is required.

UNLOADING

The procedures for unloading trucks and removing the remaining mixture from the truck bed and bed apron is required.

TRANSFER VEHICLES

The procedures for the use of Material Transfer Devices or Windrow Elevators, and the pans for crossing bridges with these devices is required.

PAVING

The Contractor is required to designate the procedures for placement of the HMA.

PAVING PLAN

The general sequence, the widths and depths of paving for each of the major courses, and the planned date for paving to begin and to be completed on the contract are required.

MATERIAL FEED SYSTEM

The procedure for processing the mixture through the paver is required.

GRADE AND SLOPE

The procedure for controlling the grade and slope, including a description of placing wedge and level courses, if applicable, is required.

JOINTS

The procedure for the construction of the longitudinal and transverse joints is required. The starting and stopping procedures of the paver for transverse joints is also required to be included.

ASPHALT MATERIALS

The source, source numbers, type, and grade of materials that are planned for use for the tack coat, prime coat, or seal coat are required.

JOINT COMPACTION

The Contractor is required to designate the procedures for compaction of the longitudinal and transverse joints.

MATERIALS SAMPLING and TESTING

The Contractor is required to designate the procedures for sampling and testing HMA and the frequency of tests.

MIXTURE PROPERTIES

The HMA plant is required to be a HMA Certified Plant in accordance with **ITM 583**. The location of the plant, owner, Producer name and plant number are required.

The laboratory, procedures done for quality control testing of the mixture, and the minimum frequency of samples is required.

MIXTURE TEMPERATURE at PAVER

The procedure for measuring the temperature of the mixture at the paver is required. The temperature is required to be taken immediately behind the paver prior to compaction at a minimum frequency of one test for each 1 hour of paving.

DENSITY

The procedure for measuring the density of the mixture utilizing a non-destructive technique is required. Density tests are required to be taken on the mainline and shoulders. The minimum frequency of tests is one test each 1000 yd^2. A nuclear test device, if used, is required to be calibrated in accordance with **ASTM D 2950** at a minimum frequency of once each 12 months.

The procedure for monitoring the temperature of the mix during compaction to optimize the rolling pattern is also required.

CORING

The plan for when cores are taken and the procedure for refilling the core holes is required.

SMOOTHNESS

The procedure for measuring the smoothness of the pavement is required. The annual certification of the profilograph in accordance with **ITM 901** is also required to be included.

RESPONSE TO TEST RESULTS

The Contractor is required to take corrective action when quality control test results exceed the established limits. The corrective actions are required to be designated in the QCP. As a minimum, corrective actions are required for the mixture tests from the pavement, the temperature measurements, and the density.

PAVEMENT SMOOTHNESS

The Contractor is required to designate the procedures for correcting the profile of non-complying pavement. Areas outside of the allowable tolerance of Section **401.18** are required to be corrected.

DOCUMENTATION

The test results for quality control and documentation of equipment are required to be maintained by the Contractor for a period of three years upon completion of the contract. The records, either electronic and/or hard copies, are required to be maintained at a readily accessible location for review by INDOT at any time. As a minimum, the documentation is required to include test results for the mixture, temperature, density, and smoothness tests of the HMA pavement. Also, documentation of the manufacture, model, and type of paver and rollers used each day of paving is required. Any modifications to this equipment is required to be noted.

QUALITY CONTROL PLAN

The Contractor is required to submit a QCP that is contract specific and states how the process control of materials, equipment, and operations are maintained. As a minimum, the QCP is required to include the following information for each contract.

1) The name, telephone number, duties, and employer of all quality control personnel necessary to implement the QCP. The minimum number of quality control personnel is required to include a QCP Manager, QCP Site Manager, and Quality Control Technician.

2) The procedure for milling to include the general procedures, equipment, testing for macrotexture, and testing for smoothness.

3) The procedure for balancing the HMA process to include plant production, number of trucks, paver speed, and compaction production rate procedure.

4) The procedure for transportation of the HMA to include the use of truck bed covers, truck unloading procedures, procedure for removal of mixture from the truck, and the use of material transfer vehicles.

5) The procedure for paving to include a paving plan, the material feed system, grade and slope control, joint construction, and use of asphalt materials.

6) The procedure for compacting longitudinal and transverse joints.

7) The procedures and frequency for sampling and testing the HMA, to include the mixture behind the paver, the temperature of the mixture at the paver, the density of the mixture, the coring procedure, and the procedure for measuring the smoothness.

8) The response to process control tests not within the established requirements for mixture, density, and smoothness tests.

9) The procedure for documentation of quality control tests and the equipment used on the contract.

QCP APPROVAL

The QCP is required to be submitted to the PE/PS for review at least 15 calendar days prior to commencing HMA operations. The Contractor is required to sign and date the QCP at the time of submittal to the PE/PS. The PE/PS signs and dates the QCP if the contents of the QCP are in compliance with the above-noted requirements. HMA operations are not allowed to begin before the QCP has been accepted.

QCP ADDENDA

The QCP is required to be maintained to reflect the current status of the operations, and revisions are required to be provided in writing prior to initiating the change. The change may not be implemented until the revision has been accepted.