



*MONTANA DEPARTMENT
OF TRANSPORTATION*

*Construction Engineering Services Bureau
Construction Review Section*

*QUALITY ASSURANCE (QA)
INSPECTION GUIDE*

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CHAPTER 1 – GENERAL

A. GUIDE PURPOSE

This Quality Assurance (QA) inspection guide assumes an understanding of specifications and test procedures. MDT inspectors are contractually required to follow specified procedures. Contractors must produce work and material conforming to specification.

B. QA PURPOSE

Test results determine whether work and materials conform to specification.

QC is a contractor responsibility to control manufactured product quality, and may be statistically based. Contractors produce test data and monitor product quality. Statistical parameters may help control QC, but they are not required or covered by this QA manual. Acceptance sampling and testing constitute “Quality Assurance (QA)”.

Acceptance is determined by evaluating test results using statistical formulas. QA formulas determine product acceptability, incentives and price reductions.

Quality incentives reward Contractors for material and workmanship quality higher than required by the contract. Incentive pay encourages contractors to produce higher quality products. Subsection 105.03.2 outlines QA item procedures, tolerances and formulas used to evaluate conformance. The following items are accepted via QA testing:

1. Plant Mix Bituminous Surfacing
 - Aggregate Gradation Subsections 401.04.3, 701.03.2 & Special Provisions
 - Compaction Subsection 401.03.12 & Special Provisions
 - Volumetric Acceptance Special Provisions
 - Ride Specification Special Provisions
2. Open Graded Friction Course
 - Vacant
3. Aggregate Surfacing
 - Includes Base, Surfacing & Cover Material Subsections 301.03.1, 701.02 & Special Provisions

4. Concrete Pavement Aggregate
 - Gradation Subsections 701.01.1 & 701.01.2
 - Fineness Modulus Subsection 701.01.1.F
5. Performance Graded Asphalt Binder (PGAB)
 - High and low temperature Components Subsection 402.03.8
 - Ductility Subsection 402.03.8
6. Concrete
 - SD concrete Special Provisions
 - Other Subsection 551.03.7

C. QA SPECIFICATION ORGANIZATION

QA specifications assign sampling and testing responsibility, and stipulate required test methods, target test results and tolerances. QA specifications may be integral to special, supplemental, or standard specifications. Standard Specification Subsection 105.03.2 outlines acceptance evaluation by lot. Specification changes may be made using a supplemental specification or special provision. Special provisions update, correct, and clarify standard specification information, or add extra requirements. A consistently used special provision becomes a supplemental specification until standard specifications are updated.

CHAPTER 2 – QA ITEM REQUIREMENTS

A. RANDOM SAMPLING

Random sampling is mandatory for QA items. Sampling “lots” are divided into between three and seven “sublots”. A sample is randomly selected from within each subplot so each lot portion has an equal chance of selection. Calculators and computer programs generate random numbers determining sample location(s). Seed numbers are typically required but must be changed to avoid generating similar random number sequences. Random number tables may be used for sample selection, as described in MT-416. Lot sampling sequence must be selected before measurement or sampling and be unknown to the contractor. Place the original copy showing random sample selection numbers and item notes in the EPM project file. Samples must be taken at a specific time and place and according to designated sequences. Do not wait for contractors to make changes or amend field work if changes jeopardize sampling sequence. Do not sample in advance or wait to sample as a convenience to the Contractor. Samples must represent actual field production sequence(s).

B. TEST METHODS

Specifications stipulate Materials Manual required QA item test method(s), equipment and procedure(s). Alternate test procedures may cause poor material to be accepted or encourage contractor claims. Adhere to test procedures and use properly functioning testing equipment. Review test specifications, which may vary between projects. Review MDT Materials Manual test methods for equipment and procedural changes. Materials Manual section MT-601 covers sampling and testing frequency.

C. LOTS

Item QA samples are divided into lots, or sample groups representing material quantities produced by an identical process. QA item specifications define lot quantities, which are divided into sublots for sample selection. Each subplot is represented by a sample. Minimum and maximum subplot sample numbers are specified for individual material items.

TESTING FREQUENCY

CONTRACT ITEM	QA TEST	SUB-LOT / SAMPLE SIZE	LOT SIZE	SPECIFICATION
Plant Mix Bituminous Surfacing Gr. B	Aggregate Gradation	600 tons PMBS (600 mt)	3,000 tons PMBS (3,000 mt)	Subsections 401.03.3 & 701.03.2
	Compaction	600 tons PMBS (600 mt)	3,000 tons PMBS (3,000 mt)	Subsection 401.03.12 Special Provision
Plant Mix Bituminous Surfacing Gr. S Volumetric Acceptance	Volumetrics	1000 tons PMBS (1000 mt)	5000 tons PMBS (5000 mt)	Special Provisions
Plant Mix Bituminous Surfacing Gr. S Gradation Acceptance	Aggregate Gradation	1000 tons PMBS (1000 mt)	5000 tons PMBS (5000 mt)	Special Provisions
Plant Mix Surfacing Gr. D Commercial	Aggregate Gradation	600 tons PMBS (600 mt)	3000 tons PMS (3000 mt)	Special Provisions
PGAB Evaluation		500 tons PMBS (500 mt)	3,000 tons PMBS (3,000 mt)	Subsections 402.03.2 & 702.02
Open Graded Friction Course	Vacant			
Aggregate Surfacing	Base - Surfacing	2,500 tons (2,500 mt) 1,250 yd ³ (1,250 m ³)	12,500 tons (12,500 mt) 6,250 yd ³ (6,250 m ³)	Subsections 301.03.1 701.02 Special Provisions
	Cover Material	38,500 yd ² (35,700 M ²)	192,500 yd ² (178,500 mi ²)	Subsections 409.03.1 & 701.02
	Cement Treated Base	1,500 tons	7,500 tons	Subsections

CONTRACT ITEM	QA TEST	SUB-LOT / SAMPLE SIZE	LOT SIZE	SPECIFICATION
		(1,500 mt)	(7,500 mt)	304.03.2 & 701.02
Concrete Aggregate Pavement	Gradation Fineness Modulus	750 yd ³ PCCP (750 m ³) Minimum of 3 tests / day	Days Production	Subsection 701.01.1 & 701.01.2 & 701.01.1.F
Concrete	Strength, Air, Slump	Not Applicable	200 yds ³ (153 M ³) Minimum of 1 per day	551.03.7 and Special Provisions

D. QUALITY CONTROL

Contractors use their own QA sampling and testing to control production quality and make adjustments, but may use Departmental acceptance tests for quality control. Contractors are responsible for the final product. Inspector involvement with quality control sampling, testing, or decision making risks unwanted Department responsibility. Although the Department is required to share test results with contractors, avoid discussing mitigation measures.

E. ACCEPTANCE TESTS

QA acceptance samples are taken according to a random sampling sequence. Sampling devices are often integral to contractor equipment, and collected from laid down material or at the point of production. Contractors must provide a properly sized sample. Inspectors must witness sample collection and splitting. Acceptance tests are run upon lot completion. If the lot itself meets contract requirements, the lot is tested. Federal regulations require Independent Assurance (IA) sampling and testing by agency personnel. The Materials Bureau conducts IA sampling and testing to spot check

acceptance sampling, testing and effectiveness. IA sampling also supplements contractor test results (Materials Manual MT- 602).

F. ACCEPTABLE LOTS

A lot is acceptable if all test results are within specified tolerance. Note on the QA evaluation form whether tests are within tolerance. Check for quality incentive if applicable.

G. FORMULAS AND EVALUATION FORMS

A lot element is evaluated for conformance if one or multiple test results are outside tolerance limits for that element, in accordance with Standard Specification Subsection 105.03. Proper formulas must be used for material evaluation. One formula is typically used if a single maximum limit is specified, or when an average test value is above a range midpoint, or job mix target value. Another formula is used when a minimum limit is specified, or if an average test value falls below a specified range midpoint, or below a target value. "F" factors are given within standard, supplemental or special specification, but may be superseded by special provision. For each item, a QA form should be completed, and a copy given to the contractor at lot completion. Project Managers use the QA program to enter, evaluate and administer QA data. Use the program to enter job mix tolerances and targets.

H. PRICE REDUCTIONS

The price paid for lot material(s) is reduced when "P" value is 3 or more.

"P" values less than three indicate lots meeting specification. Concrete price within a lot is reduced by pay factors representing air entrainment and strength, according to the SD concrete special provision. If contracts do not have this provision, refer to 551.03.7. Unit price may be further reduced by deductions associated with silane sealer, fogging, water cure during bridge deck concrete placement, and water cure special provisions. Price reductions are compensation to the Department for diminished product quality, lifetime and performance. Contractors may not accept a price reduction instead of

producing specified material. Pay estimate deduction procedures are discussed under "PROGRESS ESTIMATES".

I. AUTOMATIC SHUTDOWNS

QA specifications require contractors to stop work and make adjustments when:

1. Three consecutive lots have a "P" value of five or more.
2. Excluding the first lot, three tests within a lot have at least one result outside specification, and lot "P" value is five or more.

Evaluation forms include a written order to the contractor to stop work.

Contractors are required to bring production within specification, but are not directed how to do so. Project Managers must evaluate if necessary adjustments have been made to continue production. A single passing test does not signify proper adjustments have been made. A consecutive test series showing a "P" value less than 3 signifies aggregate gradation, compaction, and volumetric properties are in conformance.

Shutdown procedure does not apply to asphalt penetration results due to test result delays. Shutdown orders are given to contractors as soon as a lot is evaluated and computations checked.

J. MULTIPLE "P" VALUES

Several sample elements are tested for some QA items, such as aggregate gradation, which requires individual sieve evaluation. Multiple sieves may be outside specification. "P" value is calculated for each failing sieve. Positive "P" values are added to determine lot "P" value. Disregard negative "P" values.

K. "P" VALUES EXCEEDING 25

Lots having a "P" value exceeding 25 may require removal and replacement, require corrective action or allow Contractors to leave material in place with a price deduction if material will initially perform as intended, but with reduced service life. Contact the District Construction Supervisor or Engineer if a lot has a "P" value of 25 or more. Lot tests must be evaluated to determine whether material should be removed.

L. QUALITY INCENTIVES

Quality incentives apply to hot mix, concrete surfacing aggregate, or as part of density and ride specifications, and share savings generated by enhanced service life and high quality work. Incentives also encourage contractors to use new methods to produce a uniform product close to mix target properties.

M. PROGRESS ESTIMATES & ELECTRONIC SUBMITTALS

Project Managers enter price reductions and incentives into progress estimates. Incentives and price reductions for all QA items are assigned to the split with which they were associated. Transfer electronic QA computer data directly to the Helena headquarters quality assurance system daily to minimize data entry mistakes.

CHAPTER 3 – INDIVIDUAL SPECIFICATIONS

A. GENERAL

These items are covered by QA specification:

1. Plant mix aggregate gradation
2. Surfacing and cover aggregate gradation
3. PCCP aggregate gradation and fineness modulus
4. Plant mix compaction
5. Volumetric acceptance
6. Performance Grade Asphalt Binder (PGAB)
7. Performance grade tolerance testing
8. Flexible pavement ride specification
9. Concrete

B. PLANT MIX AGGREGATE GRADATION

Special Provisions for Grade "S" plant mix surfacing aggregate gradation allow price reductions and incentive payments. Normal lots consist of 3,000 tons divided into five 600 ton sublots. Acceptance samples are obtained from the combined cold feed at drum dryer plants. Sample individual batch plant bins with screen decks and separate hot feed bins according to MT-201 and MT-202. Examine test results to determine material qualifies for an incentive. If test results do not meet specification, "P" value must be computed. Large negative "P" values may indicate incorrect formula usage. Multiple sieve sizes may be outside tolerance. Add positive "P" values to calculate total "P" value, and disregard negative "P" values. Results are evaluated using contractor submitted job mix targets and tolerances for specified sieves.

Job mix targets may be changed only to improve mix quality, and may require a new mix design. Tests must show new designs to be equal to or better than initially designed mix. A new Engineer approved mix design is required if Contractors use a new aggregate. Contractors may change blend percentages to control gradation.

Fly ash or other mineral filler may be blended to obtain gradation. Unless added to the cold feed, mineral filler is included within gradation calculations. The Department does not pay for separate material blending. Mineral filler such as hydrated lime is not included as part of mix design gradations. Mineral filler is a bid item paid for at contract price, for which contractors add a specified bid percentage.

C. SURFACING AND COVER AGGREGATE GRADATION

Surfacing aggregate and cover material are covered by QA specification.

Both incentive and price reductions may be applied to Crushed Aggregate Course (CAC), but only price reductions are applied to cover material. Roadway material samples are taken by the contractor and witnessed by inspectors.

"P" value is computed for test results outside specification. Make sure the appropriate formula is used to calculate "P" value. Large negative "P" values indicate an incorrect formula may have been used. Tests may be outside tolerance for specified sieve sizes. Positive "P" values are added to calculate total lot "P" value. Disregard negative "P" values. Surfacing aggregate gradation specifications list a range of values to select formulas. Ranges must be mathematically adjusted if binder is added. Example data below shows information describing Crushed Top Surfacing (CTS) Type A, Grade 2:

<u>Sieve</u>	Upper Limit	Binder			New Upper
	<u>Spec.</u>	<u>90% Used</u>	<u>Gradation</u>	<u>10% Used</u>	<u>Limit</u>
4	70	63	100	10	73
10	55	50	90	9.0	59
200	5	4.5	30	3.0	7.5

The lower limit is also computed to define the new specification band. Targets set by Contractors must be within upper and lower target limits.

When “tons” are used, normal lot size for base and surfacing aggregate is 12,500 tons (12,500 mt), or five 2,500 ton (2,500 mt) sublots. When “yd³” are used, normal base and surfacing aggregate lot size is 6,250 yd³ (6,250 m³), or five 1,250 yd³ (1,250 m³) sublots. For aggregate analysis and acceptance, cover material quantities placed over 192,500 yd³ (178,500 m³) are equivalent to 2500 ton (2500 metric ton) lots. Material quantity placed over 38,500 yd³ (35,700 m³) is equivalent to a 500 ton (500 metric ton) subplot. Small project quantities must have three tests to constitute a lot.

D. PCCP AGGREGATE GRADATION AND FINENESS MODULUS

Concrete pavement aggregates are subject to QA specifications and price reduction. Incentives are not applied. PCCP aggregates are furnished in multiple sizes, such as fine, medium and coarse, and evaluated using aggregate size specifications. Positive "P" values for each aggregate size are added to compute total lot "P" value. Concrete samples are collected in yd³ (m³). Specifications require Contractors to furnish and operate aggregate sampling devices. A PCCP lot is daily PCCP production quantity. 750 yd³ (750 m³) constitute a subplot. At least three tests must be run each production day.

E. OPEN GRADED FRICTION COURSE AGGREGATE GRADATION (Vacant)

F. VOLUMETRIC ACCEPTANCE

Plant Mix Bituminous Surfacing Grade "S" Volumetric Acceptance is based on four QA evaluated volumetric properties:

VMA – Voids in Mineral Aggregate

VFA – Voids Filled with Asphalt

VTM – Voids in Total Mix

D/A – Dust/Asphalt

Contractors set initial job mix targets before producing a second PMS lot so plant calibration and adjustments can be carried out to match mix design criteria and account for field test results. Contractors may change volumetric mix targets once during production. When plant mix production is finished, contractors have two days to submit revised job mix targets within the target range. Contractors are allowed to change targets to allow for mix plant changes. If a poorly chosen target is selected, and not allowed opportunity for correction, the target continually forces contractors to make plant adjustments to approach the poorly chosen target. In most cases, continual or sudden plant adjustment produces poor quality mix. Allowing contractors to adjust plant mix target values ensures a higher quality and more uniform mix.

Outliers

Data points are expected to fall within a statistical distribution. “Outliers” fall outside this distribution, and should be evaluated for legitimacy. The Grade “S” volumetric special provision outlines how to identify outliers as part of volumetric QA data analysis.

Asphalt Binder in Grade “S” Volumetric Special

Asphalt or aggregate supplier changes to do not necessarily require contractors to submit a new mix design. A new mix design is not needed if:

- aggregate properties are met
- no volumetric job mix target changes are requested
- Hamburg Wheel Track requirements are met
- apparent and bulk dry specific gravities are provided

Because binder content effects volumetric properties, Contractors must set plant mix AC binder content.

G. PLANT MIX SURFACING COMPACTION

Bituminous surfacing compaction is subject to QA price reduction and incentive. Contractors must compact plant mix to 95% target density. At least four Marshall density tests are used to determine target density. See special provisions for Plant Mix Bituminous Surfacing Gr. S, and Core Density Acceptance requirements. Target density is changed each time the running average of the most recent four Marshall test densities changes by 0.5 lb/ft³ more. Target Marshall field densities should not be determined retroactively. Plant mix densities are measured using nuclear density gauges or by core extraction to assess core density. Nuclear gauge density readings must be correlated with core density testing procedures outlined by MT 212 and MT 313. Density acceptance is determined by core sampling and testing. When collecting and handling cores, chain of custody procedure must be in place. Inspectors must witness core extraction, and take sample possession without compromising sample integrity. Nuclear gauge density is compared with core density from each lift as soon as paving begins. When mix design or aggregate source changes, compare nuclear density measurements with core density measurements. Separate cores into lifts, and

use the density of the lift being tested. Take random acceptance tests after rolling is complete. Areas < 0.10 ft (30 mm) thick or within 1 ft (305 mm) of an unconfined edge are excluded from QA density testing. These areas are compacted to a maximum density determined by field testing. As demonstrated below, project managers designate areas excluded from QA density before paving begins, based on existing road conditions and intended lift thickness.

Example: A road section is rough and out of section. The lift may be as thick as 0.12 ft, but more than 50% of the section requires less than 0.10 ft leveling course. The first lift should be excluded from QA, as required density in these areas is specified by the project manager.

Compaction rolling must be completed before mat temperature decreases to 175°F. Project managers may raise this temperature if checking or cracking is observed. Vibratory rolling is considered compaction rolling. Compaction lot size is 3,000 tons (3,000 mt) of Hot Mix Asphalt (HMA) surfacing divided into five 600 ton sublots.

H. PERFORMANCE GRADE ALPHALT BINDER (PGAB) EVALUATION

Ductility readings and high and low temperature asphalt components are subject to QA, and possible price reduction. Asphalt samples are taken from the feed line between asphalt storage tanks and mixing units. Contractors operate sampling devices and place samples in an engineer provided metal container. In compliance with federal regulation, inspectors determine when to carry out and witness sample collection, and immediately possess samples. PGAB evaluation lot size is 3,000 tons of plant mix surfacing (PMS) divided into six 500 ton sublots (Subsection 402.03.2.B).

Promptly submit samples to the Helena materials lab to minimize testing delay. The lab sends test results to districts for project manager review and deduction evaluation. Review supplemental specification 402.03.8 for PGAB requirements. The ductility requirement for PG 64-34 has no tolerance. Immediately stop paving if binder fails the ductility requirement. Resume paving only when binder specifications are met.

I. Flexible Pavement Ride Specification

- A simple and accurate method to measure and enforce MDT surface tolerances.
- Contractor incentive to provide a smooth surface.
- Incentive for increasing road life.
- Cost share savings with contractors if a superior riding surface is attained.
- Cost recovery for rough surfaces and reduced service life.

Ride measuring equipment simulates ride experienced by an average vehicle.

The International Roughness Index (IRI) characterizes ride smoothness in relation to a standard smoothness scale to reflect smoothness experienced by a passenger in an average vehicle. Lower IRI numbers indicate smoother road surfaces. Profile Index (PI) develops a road surface profile to locate surface irregularities and isolate areas requiring correction or grinding. Profile Index (PI) models are generated by a California Profilo-graph 25 ft long, so the PI model may not detect irregularities exceeding 25 ft. Low or high areas should be measured and corrected per MDT Standard Specification 401.03.14. A computer program calculates ride specification QA incentive and disincentive. The ride specification special provision designates ride classification and payment basis.

J. Concrete

Payment for concrete classes AP, DP, AD is adjusted using strength pay factors in accordance with section 551.03.7. SD concrete payment may be reduced in accordance with strength, air, fogging, water cure and silane sealer special provisions.

CHAPTER 4 – SPECIAL SITUATIONS

A. OUT OF SPECIFICATION TESTS AND SAMPLES

When tests fail, contractors may suggest a sample is invalid, isn't representative, or was administered incorrectly. QA samples are randomly selected, so material portions and locations have an equal selection chance. Aggregate and asphalt sampling equipment must be contractor provided. Samples are tested by MDT. Because poorly functioning sampling devices yield poor test results, Contractors and the MDT benefit when contractors provide well maintained and quality sampling devices. Samples can also be compromised if handled or tested improperly. If an aggregate sample is scheduled but a cold feed bin gate is plugged, take the sample according to schedule even though the bin is not functioning properly. Contractors must control production and provide specified material.

Test result differences may be due to construction variables, such as sampling, testing, production, and material variability. Tolerances account for expected variability, and compensate for testing imperfections. Retain aggregate samples until a shift ends, or until results are checked for errors. QA test results are used to determine material acceptance. Do not discard MDT test readings, as cores and nuclear gauges may yield different densities. Formulas allow about 20% of tests to be out of specification before price reductions apply. If core density is used to evaluate a lot, cores must be used for all tests. Core and nuclear gauge test results cannot be combined for evaluation.

When anomalous test results are noticed, use one gauge to verify results.

This situation is the only situation for which "check tests" are acceptable, because verification testing uses an identical material sample.

C. VISUALLY DEFECTIVE MATERIAL

Visibly defective material is sometimes produced or delivered to a location not selected for QA sampling, such as a segregated area exposed by traffic. The engineer or project manager may reject obviously defective material without regard to location in a lot or

sampling sequence in accordance with Subsections 105.03.1 and 105.03.2. If you observe or strongly suspect defective material, isolate and reject the material. Sample and test rejected material, and document results.

D. REPAIRS AND CORRECTION

Contractors may suggest repairing the area around a failing test, as most often happens with compaction testing. Repairs should not be allowed. Unless a price reduction is imposed, the entire lot around a test must meet specification or be replaced.

To ensure the entire lot meets specification after repair, select new random sample locations. All subplot tests are used to evaluate lot quality. If a test is rejected, sufficient test results may no longer be available to represent the lot, invalidating the evaluation.

E. MATERIAL REMOVAL AND REPLACEMENT

The Engineer may require material under QA assessment to be removed and replaced when "P" value reaches 25, and may require concrete removal and replacement when the strength pay factor is less than 0.85. The Engineer may require SD concrete removal and replacement when air pay factor is less than 0.95. Leaving defective material in place risks early failure, but replacement is costly to Contractors. District Administrators and staff should be involved in removal and replacement decisions. Subplot tests and other information should be used to determine lot quality. Additional pavement core testing should be done, and design parameters examined. If evidence indicates premature failure, material should be replaced.

F. PLANT MIX SURFACING COMPACTION PROBLEMS

When compacting the first lift over weak base or subgrade, and where existing pavement is badly cracked and deteriorated, compaction may be unattainable. Review rolling equipment and procedures to decide whether problems are due to particular equipment usage or operation. Set up a section approximately 500 ft long, similar to a test strip described within MT 219 & Subsection 401.03.12. Select five locations for nuclear density testing after every roller pass, and document results. Continue rolling

until density fails to increase or starts to decrease after each pass. Do not continue compaction if the mat has cooled to 175 F.

- Only run vibratory rollers uphill.
- Operate vibratory rollers at high frequency and low amplitude for pavements thinner than 3 in. (75 mm). Higher amplitudes are recommended for lifts exceeding 4 in. (100 mm).
- Vibratory roller drums should impact PMBS at least 12 times / ft.

Density should increase with each pass, and begin leveling off after the 3rd to 5th pass. If density increases after every one or two passes and reaches the target density, the problem is probably equipment and procedure. If test strip density is initially high and decreases after one or two passes, start a new control strip using low amplitude, low frequency and slower roller speed. High amplitude and/or high frequency could be causing the base to lose density. If density increases within 2 - 4 passes, then levels out but still does not meet density, the problem could be due to a weak subgrade or existing pavement. Test several sites ahead of the paving operation, and determine base density. If the base is weak, contact the Construction Bureau. If density is not attainable within the first lift due to weak base, contact the Construction Bureau to discuss waiving QA for the first lift. Enough resistance should be present in subsequent upper lifts to allow target density compaction. Inform the District Construction Engineer (DCE) or Supervisor and FHWA before proceeding during federal oversight projects.

G. COOPERATION WITH CONTRACTORS

Cooperating with Contractors is the best way to attain quality work, but this does not mean performing testing or making quality control decisions on their behalf. Do not offer opinions regarding testing, or implicating fault, particularly when subcontractors and suppliers may be involved. Make acceptance test results available to the contractor. Make sure suggestions are clearly understood to be only suggestions, as opposed to instruction. Encourage contractors to institute an effective quality control program by emphasizing contractor responsibility when quality is an issue.

CHAPTER 5 – QA RELATED WORK

A. UNSPECIFIED QA PROPERTIES

Volume swell and plasticity index elements are not covered by QA. Ductility, high and low temperature components are the only QA evaluated asphalt properties. Other properties such as viscosity are not QA evaluated, but sampled and tested in accordance with the Materials Manual, and evaluated according to specification and special provision.

B. AGGREGATE SOURCE APPROVAL

Aggregate sources are approved according to source testing, most of which has been completed for prospected sources shown on the plans. Contractor furnished sources must be sampled and tested before approval. Contractors may begin aggregate production before approval, but risk source rejection for project usage.

C. PLANT MIX SURFACING VOLUMETRIC SWELL

Swell is not monitored for QA, but is assessed in the stockpile. Results are acceptable if all test averages are within specification, and not more than one test of any five consecutive tests is outside specified limits. Do not begin plant mix operations until stockpiled aggregate conforms to specification. Samples taken from production belts or stockpiles must be taken by contractors and witnessed by state personnel. Contractors must furnish intended blending percentages for each stockpile, or aggregate approval testing will not be performed.

D. ASPHALT CONTENT

Specifications require asphalt content be maintained within $\pm 0.3\%$ of the target set by the engineer. Insufficient or excessive asphalt significantly affects plant mix behavior. Asphalt content measures asphalt quantity per mix volume. Marshall and Gyratory test results should be evaluated for void changes, or stability and volumetric properties requiring further testing. Low or high Marshall or gyratory voids may indicate cores should be collected for testing subject to Subsection 105.03.1 requirements.

Material not conforming to specifications but serving the design purpose is assessed an appropriate price adjustment. Material not serving the design purpose must be replaced. Additional testing helps with this decision. If nonconforming properties have no effect on or improve the mix, consider adjusting the asphalt content to that of the used material.

CHAPTER 6 – NUMERICAL ROUNDING

A. "P" VALUES

Individual "P" Value: 0.01

"P" Value: 0.1

B. AGGREGATE GRADATION

Aggregate weight on each sieve: to the smallest scale graduation

Sieves larger than 200 mesh:

Percent passing each sieve: 0.1%

Lot average: 1%

200 mesh sieve:

Percent passing each sieve: 0.01%

Lot average: 0.1%

C. PLANT MIX

Density

Inputs to calculate % density of Target Density

Density (lbs/ft³ or kg/m³): 0.1

Rice density: 0.001

% of Target

English

Sublot: 0.1

Lot: 0.1

Metric

Sublot: 1

Lot: 1

Volumetric Rounding

Voids – Brick: 0.01
 Sublot: 0.1
 Lot: 0.1

D/A – Sublot: 0.1
 Lot: 0.1

VFA – Bricks: 0.1
 Sublot: 1
 Lot: 1

VMA – Bricks: 0.01
 Sublot: 0.1
 Lot: 0.1

Ride Specification

“P” Factor: 0.01

Round the second term of the equation using IRI to: 0.001

D. CONCRETE CYLINDERS

Round individual tests and lot averages to the nearest 10 psi or 1 MPa.