

MONTANA DEPARTMENT OF TRANSPORTATION

Construction Engineering Services Bureau

Construction Review Section

QUALITY ASSURANCE INSPECTION GUIDE

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CHAPTER 1 – GENERAL

101.01 PURPOSE OF GUIDE

This guide will assist inspectors working with Quality Assurance (QA) specifications.

This guide does not take the place of reading and understanding the specifications and test procedures.

Inspectors should understand that we are required by the contract to follow specified procedures. The Contractor is required to produce work and material that conforms to specifications.

101.02 WHY AND WHERE WE USE QA

Test results are assessed to verify compliance of work and materials with specification requirements. Subsection 105.03 of the Standard Specification provides methods for making these determinations.

Inspectors must clearly understand quality control (QC), quality assurance (QA and their distinctions. QC is a method used by the contractor to control the quality of a manufactured product. QC may or may not be statistically based. Quality control is the responsibility of the contractor. The contractor selects the methods used to express test data and monitors the quality of the product being produced. It is suggested that a statistical quality control method be used to control QC, but it is not required. For this reason, statistical quality control is not referenced, and the expression used is quality control (QC). Common QC tests are sieve analysis, concrete properties, and plant mix density testing, temperature monitoring or depth checks behind the paver.

Quality Assurance (QA) is the method used to describe proper sampling by the contractor and testing by the Department. QA relies heavily on statistical-based formulas for sampling and test result evaluations. QA formulas are used to determine if the product is acceptable, and if an incentive or a price reduction should be applied (see Subsection 105.03).

101.03 INSPECTOR'S ROLE IN INCENTIVES AND STANDARDS

Inspectors should avoid imposing personal expectations on contractors. Incentives reward contractors for exceeding the required standards, encouraging high-quality work and materials.

101.04 CONFORMITY WITH PLANS AND SPECIFICATIONS (Subsection 105.03)

Subsection 105.03.1 states the general procedures for evaluating contract item materials and workmanship. The Engineer decides whether the work or material is within contract requirements. If not, a decision whether it will serve the design purpose is needed. If it does not, then it must be removed and replaced. The work or material can be accepted with a price adjustment if it is adequate to serve the design purpose.

Sound engineering judgment is required.

Subsection 105.03.2 designates items subject to QA. QA uses specified tolerances and formulas to evaluate conformance to the contract. As a result, multiple people will come up with the same outcome determination for the same test results.

The following contract items are evaluated for acceptance under QA provisions as of March 2026:

1. **Plant Mix Bituminous Surfacing**
    - Compaction..... Subsection 401.03.21
    - Volumetric Acceptance..... 401.03.5 or 401.03.6
    - Ride Specification 401.03.23
2. **Open Graded Friction Course**
    - Vacant
3. **Aggregate Surfacing (Gradation and Fracture)**
    - Crushed Aggregate Course (CAC) Subsections 301.03.1, 701
    - Cover Material..... 409.03.1
4. **Concrete Pavement (Class Pave)**
    - Concrete Properties (Air and Strength)
    - Optimized Gradation ..... Subsections 551.03.8 & 701.01.3
    - Ride Specification ..... Special Provisions
5. **Performance Graded Asphalt Binder (PGAB)**
    - High and low temperature
    - Components..... Subsection 402.03.8
    - Ductility ..... Subsection 402.03.8
6. **MSCR Graded Asphalt Binder**
    - Percent Recovery..... 702.01
7. **Concrete**
    - Class General, Structure, Structure Low Slump, Drilled Shaft, Deck and Overlay Concrete Properties (Air and Strength) 551.03.8
    - Gradation (Optimized/Combined or Conventional .....551.03.8)
    - Class Deck and Overlay also has Permeability 551.03.C.1.c

101.05 HOW SPECIFICATIONS ARE ORGANIZED

Specifications define sampling and testing responsibilities, required tests, methods, targets, and tolerances. References include the project specific special provisions, standard specifications, and the materials manual.

Subsection 105.03.2 explains what to do with the test results.

Changes to specifications will be made from time to time. Some requirements will be outlined as special provisions.

Often special provisions are created when specifications are changed to update, correct, clarify information or add a new construction practice. This allows evaluation through actual field use in a project. If the special provision is successful, these changes will be adopted as a standard specification. Some special provisions are unique to a specific project and will not become a standard specification.

CHAPTER 2 – REQUIREMENTS COMMON TO ALL QA ITEMS

201.01 RANDOM SAMPLING

Random sampling is mandatory for all QA items. The Department most commonly uses stratified random sampling.

A lot is divided into sublots. The number of sublots can range from three to seven. A sample is randomly selected from within each sublot. This ensures that each portion of the sublot/lot has the same chance of being selected.

MT-606 in the Materials Manual describes a method for selecting random samples by using a random number table. The Department commonly uses Engineering Apps as a tool to generate random sampling event reports. Some calculators and computer programs will generate random numbers. If a seed number is required, it must be changed for each lot to avoid generating the same sequence of random numbers.

The sampling sequence for each lot must be selected beforehand. Do not give this information to the contractor. Retain the original hard copy of the random sample selection numbers with the notes for that item in the project file at the Project Manager's office.

Samples must be taken according to the sequence. Do not wait for the contractor to adjust or to fix something. Do not take a sample ahead of time or wait because it may be more convenient for you or the contractor. Do not try to get "good" or "bad" material. We want a sample that represents what is being produced. If a Project Manager suspects an issue with any material, additional samples can be requested.

201.02 TEST METHODS

The specifications state which test methods are used for each QA item. The sampling equipment needed and procedures to be followed are found in the Materials Manual.

The sampling and test procedures must be followed to make the results valid. Not following procedures may cause the Department to accept poor quality material, cause disputes or claims from the contractor.

Do not take shortcuts or use faulty equipment.

Read the specifications for the item you are testing on each project. The test specification may be different for each project.

Read the Test Method in the Materials Manual. Equipment and procedures are changed from time to time. AASHTO/ASTM procedures are accessed through an electronic database via Intranet.

Sampling and testing frequencies are identified in section MT-601.

201.03 LOTS

The total quantity of a QA item is broken down into lots. A lot is an isolated quantity of material produced by the same processes.

The specification for each QA item gives the quantity of material in a lot. The lot is broken down into sublots for sample selection purposes. Each sublot is represented by a sample. This avoids taking two or more samples very close together.

The lot is represented by all the samples. Each sample represents a portion of the lot. The minimum and maximum numbers of sublots are listed in the individual specifications.

SUBLOT/LOT TEST FREQUENCY

CONTRACT ITEM	QA TEST	SUBLOT/SAMPLE SIZE	LOT SIZE	SPECIFICATION
Plant Mix Bituminous Surfacing Acceptance	Compaction	600 tons PMBS	3,000 tons PMBS	Subsection 401.03.21
		4000 ft. of longitudinal joint	20000 ft. of longitudinal joint	
	Volumetrics	1000 tons PMBS	5000 tons PMBS	401.03.5 or 401.03.6
	Ride	N/A	Project lane length	401.03.23
PGAB or MSCR Evaluation		25 tons Binder	150 tons Binder	Subsections 402.03.8
		Commercial Mix 1/450 tons of mix	2700 tons	
Cement Treated Base (CTB)	Strength	1 per 750 yd^3	1 lot = 5 samples	304.03.14
	Gradation	1 per 1500 tons (750 yd^3)	7,500 tons (3,750 yd^3)	
Aggregate Surfacing	Base - Surfacing	1,250 yd^3	6,250 yd^3	Subsections 301.03.1 701.02
	Cover Material	38,500 yd^2	192,500 yd^2	Subsections 409.03.1 & 701.02.8
	Cement Treated Base	1,500 tons	7,500 tons	Subsections 304.03.1 & 701.02.9
Concrete Class Pave	Gradation	1 Combined Gradation See MT 601 701.01 concrete during production	Days Production or 1000 yd^3, whichever is less.	Subsection 701.01.3
	Air	1/30 yd^3	Days Production or 1000 yd^3, whichever is less.	See Table 551-2 of Standard Specifications
	Strength cylinders	see MT 601 for Class Pave	Min of 2 sets per lot (1000 yd^3 or each day)	
Concrete All classes except class Pave Pours of 30 yd^3 or less see 551.03.8 (C) (1)	Gradation	1	200 yd^3	551.03.8
	Air	1/30 yd^3 See Standard specifications or MT 601 for testing frequencies		
	Strength Cylinders	2 sets per lot (1 set is 4 cylinders) from different loads placed	Single days placement or every 200 yd^3	
Class Deck and Overlay exceptions	Air	1/30 yd^3, Class Overlay is First Load and then every 16 yd^3 for Air		
	Permeability Tests ran on 28-day strength specimens (Deck and Overlay)			
Class Drilled Shaft	Air is not a QA item	Same as Strength	Same as Strength	

201.04 QUALITY CONTROL

The Contractor is responsible for controlling quality under QC. They are to do their own sampling and testing to control production. They make their decisions as to whether the material is good or bad and what adjustments may be required. They are responsible for the final product.

Inspectors must not get involved in quality control sampling, testing, or decisions. It could cause the Department to assume some of the contractor's responsibilities.

The Contractor may use our QA acceptance tests for quality control. This is not intended practice, but it is allowed.

We are required to make our test results available to the contractor in a timely manner. We do not have to make a special effort to do this, like making a special trip to the foreman or plant operator with every test. The project quality may benefit if the contractor is able to make timely adjustments based on QA results.

Do not tell the Contractor they have a bad test and must adjust. Provide the contractor with the test results only. They decide how to address the situation.

201.05 ACCEPTANCE TESTS

The QA sample is representative of a sublot. The sample will be tested for acceptance.

Acceptance samples must be taken according to the random sampling sequence.

Sampling and testing are performed according to specified procedures. The Contractor operates the sampling devices on equipment and takes the samples from the processed material on the roadway after lay-down or obtains a composite sample at the point of production. The Contractor is required to provide the proper sample size. The inspector must be present and witness the sampling or splitting by the Contractor.

Test results in the lot are evaluated when a lot is complete. The quality of the lot is determined if it meets the contract requirements.

Federal regulations require that Independent Assurance (IA) sampling and testing be done by agency personnel. The Materials Bureau and District labs conduct IA sampling and testing in accordance with MT 602. IA samples are taken and tested to provide an independent spot check of the adequacy and effectiveness of the results obtained in Acceptance sampling and testing and to supplement these test results. District lab personnel are also required to occasionally observe sampling and testing procedures.

201.06 ALL TESTS WITHIN TOLERANCE

The lot is acceptable if all test results are within the specified tolerance. Note on the appropriate QA evaluation report "All tests within tolerance." Check for quality incentive if it applies.

201.07 FORMULAS AND EVALUATION PROCESS

An element of a lot will be evaluated for conformance when the results of one or more tests are outside specified tolerance limits for that element. This is done in accordance with Subsection 105.03.2.

The procedure requires selection of the proper formula. One will be used if a maximum limit only is specified; or when the average of the test value is above the mid-point of a specification band or above a job mix target value, and the other will be used if a minimum limit only is specified; or when the average of the test value is below the mid- point of a specification band or below a job mix target value.

Using the wrong formula has been a common mistake.

The "F" factors are listed in the Standard Specifications. These can be changed by a special provision.

An evaluation report is available for each lot of a QA item. This should be completed, checked and given to the contractor as soon as a lot is complete.

The Project Manager uses the QA program for entering, evaluating and administrating QA data.

Make sure you are using the newest version of the QA Computer Program. Also, be sure the correct job mix tolerances and targets have been entered into the QA program.

201.08 PRICE REDUCTIONS

The price paid for the quantity of material in a lot is reduced when the "P" value is 3 or more.

The lot is in conformance to specifications when the "P" value is less than three or is a negative value.

For concrete, the price paid for the material in a lot is reduced by applying pay factors for gradation, air entrainment, strength and if applicable, permeability

The price reduction is not a penalty to punish the contractor. It is to compensate the Department for an expected decrease in life or performance because the quality is less than specified. The contractor does not have the option of accepting a price reduction in lieu of producing specified material.

Price reductions are deducted from progress estimates. The procedures for doing this are discussed under PROGRESS ESTIMATES (Bid item complete and all testing finished).

201.09 AUTOMATIC SHUTDOWNS

See Subsection 105.03.2.

The QA specifications require the contractor to shut down and adjust get within specifications when either one of the following happens.

1. Three lots in a row have a "P" value of five or more.
2. Beginning with the 2nd lot, when 3 tests within one lot have one or more elements outside the specification bands and the total "P' value for the Lot is 5 or more.

The evaluation forms include a written order for the Contractor to shut down.

The specification requires the Contractor to adjust bring production within specifications. It does not tell them how to do this.

The Project Manager is allowed considerable discretion in deciding if the necessary adjustments have been made to continue production.

It is neither necessary nor appropriate to accept a single passing test as evidence that an adjustment has been made.

A consecutive series of tests evaluated according to the specifications and showing a "P" value of less than 3 is accepted as being in conformance to aggregate gradations, compaction, and volumetric properties.

The shutdown feature does not apply to binder testing or concrete strength tests because of the delay in getting test results.

The shutdown order is given to the contractor as soon as the lot is evaluated and computation checked.

201.10 MULTIPLE "P" VALUES

Several elements are tested in one sample for some QA items. An example is aggregate gradation. The specifications require each specified sieve be evaluated separately.

There may be more than one specified sieve out of specification in a sample. The "P" value is calculated for each failing specified sieve. The positive "P" values are then added to get the "P" value for the lot. The negative "P" values are disregarded.

201.11 MATERIAL WHERE "P" VALUE IS MORE THAN 25

Lot evaluations having a "P" value of 25 or more may: (1) require complete removal and replacement; (2) require corrective action to bring the material into conformance; or (3) where the finished product is found to be capable of initially performing the intended purpose but with reduced service life expectancy, permit the Contractor to leave the material in place with an appropriate price adjustment.

Contact the District Construction Supervisor/Engineer and District Materials Supervisor anytime a lot has a "P" value of 25 or more. It will be necessary to evaluate all the tests in the lot to determine whether it should be left in place or taken out.

201.12 QUALITY INCENTIVES

Quality incentives are applied to the lots of hot mix asphalt, concrete surfacing aggregate, density and the ride specification.

One purpose of a quality incentive is to share the savings from increased pavement life resulting from high quality work. Another purpose is to encourage contractors to try new methods and equipment to improve quality and to produce a uniform product closer to the job mix target and density.

Quality incentive allowances will be used to offset any price reductions.

201.13 PROGRESS ESTIMATES & COMPUTER SUBMITTALS

The Project Manager is responsible for entering net price reductions and incentives on the progress estimates for the period the work was accomplished except for plant mix paving due to tied incentives and/or a change in final volumetric targets. Incentives and price reductions are to be placed in the appropriate split in which they occurred. This applies to all QA items.

Transfer the electronic QA computer data to the Helena Headquarters Quality Assurance System on a regular basis. Weekly transactions are preferred; this helps catch mistakes and key punch errors.

CHAPTER 3 – INDIVIDUAL SPECIFICATIONS

301.01 GENERAL

The following is a list of items covered by QA specifications as of October 2025:

1. Surfacing and Cover material aggregate gradation
2. PCCP aggregate gradation
3. OGFC aggregate gradation - Vacant
4. Plant mix compaction
5. Plant Mix Bituminous Surfacing Volumetric Acceptance
6. PGAB (Performance Grade Asphalt Binder)or MSCR Binder Properties
7. Ride Specification for Flexible Pavements and PCCP
8. Concrete Properties

301.02 PLANT MIX BITUMINOUS SURFACING –

The contractor may wish to add a different aggregate or one from a different source. This may require the engineer's approval and a new mix design.

The Contractor may change aggregate blend percentages or binder quantities to control volumetrics, Hamburg rut performance, aid in achieving density or improve surface smoothness.

Fly ash or other mineral filler may be used to obtain the required gradation. This is considered blending material. It is included in the gradation by mathematics unless it is added to the cold feed. The Department does not pay for blending material separately.

When mineral filler, such as hydrated lime, is required in the mix design, it is included in the gradation. The Department also pays for it at the contract unit price when it is a bid item. The Contractor is required to add a minimum specified percentage (Subsection 401.03.11). Over specification limits are not eligible for payment (Subsection 401.04.5).

301.03 SURFACING AGGREGATE & COVER MATERIAL – GRADATION

Surfacing aggregate and cover material are under QA specifications. Crushed Aggregate Course (CAC), Cement Treated Base (CTB), and Cover Material are only subject to price reductions, but incentives don’t apply.

Samples are to be taken from processed material on the roadway by the Contractor and witnessed by an inspector. CTB samples are taken before cement and water are added to the mixture prior to entering the pugmill.

If any test results are out of specification, a "P" value is computed. Make sure to use the right formula! A large negative "P" value indicates a wrong formula was used.

Tests may be out of tolerance on several specified sizes. The positive "P" values will be added to get the total "P" value for the lot. Negative "P" values are disregarded.

Specifications for surfacing aggregate gradation are given as a band. There is no job mix targets. The midpoints of the band are used to decide which formulas to use.

When TONS are used, the normal lot size for base and top surfacing aggregates is 12,500 tons consisting of five sublots of 2,500 tons. When CUBIC YARDS are used, the normal lot size for base and top-surfacing aggregates is 6,250 yd^3 consisting of five sublots of 1,250 yd^3.

Cover Material – The quantity of material placed in 192,500 yd^2 is considered equivalent to a 2500-ton lot, and the quantity of material placed in 38,500 yd^2) is considered equivalent to a 500-ton sublot for the purposes of aggregate analysis and acceptance.

On projects with small quantities, a minimum of three tests are required to make a lot. Normal lots can have a maximum of seven in the last lot.

301.04 PCCP – AGGREGATE GRADATION

Aggregates for concrete pavements are under QA. They are subject to price reduction or incentive.

PCCP aggregates are furnished in two or more sizes, such as fine, medium and coarse. Each size must be tested, mathematically combined, and evaluated.

Samples are based on cubic or square yards of concrete rather than cubic yards of aggregate.

Specifications require the Contractor to furnish and operate aggregate sampling devices. This requirement should be brought to the Contractor's attention as soon as possible so it can be installed.

A lot is a day's production or every 1000 yd^3, whichever is less. A minimum of 1 test is run for each lot or day’s production.

301.05 VOLUMETRIC ACCEPTANCE

A. Plant Mix Bituminous Surfacing Volumetric Acceptance

Volumetric Acceptance is based on four volumetric properties for QA evaluation.

1. VMA – Voids in Mineral Aggregate
2. VFA – Voids Filled with Asphalt
3. VTM – Voids in Total Mix
4. D/A – Dust/Asphalt

The Contractor sets the initial job mix targets before producing 2000 tons of PMS. This allows the Contractor enough time to calibrate and adjust the plant to match the plant settings to the mix design and the field test results. Once targets are established, each sublot is 1000 tons consisting of a 5000-ton lot.

For Commercial mix bid items see MT 601. Targets are not applicable to Commercial mix.

The Contractor may change the volumetric job mix targets one time during production. At completion of plant mix production, the Contractor has 2 days to submit revised job mix targets. Established targets must be within the target limit range. A project summary spreadsheet from QA suite will assist the Contractor in selecting final targets.

The reason the Contractor is allowed to change targets is to help prevent the Contractor from chasing a bad target. If a Contractor or producer selects a bad target and is not allowed an opportunity to correct the poorly chosen target, the Contractor is forced to continually adjust with the plant settings to try to get closer to the poorly chosen target. In most cases, making radical adjustments with production settings causes a poor-quality mix to be produced. If the contractors are not forced to chase a bad target, the mix should be more uniform and of better quality.

B. Outlier

The term outlier is defined in the Subsection 105.03.3 A Plant Mix Volumetric Properties. An outlier is a statistical term meaning a data point that when plotted is far from the rest of the data points or population. Given a mean and standard deviation, a statistical distribution of data points is expected to fall within a specific range. The points that do not fall within the specific range are called outliers and should be investigated.

Strict rules for determining an outlier are in the Subsection 105.03.3 A. A test sample that is determined to be an outlier is not automatically removed from QA.

Outlier determination is included in the Volumetric Properties specification as a method and a tool to more accurately analyze the volumetric test data in the Grade “S” QA system.

C. Asphalt Binder in Plant Mix Surfacing

A change in the asphalt and/or aggregate supplier does not necessarily require the Contractor to get a new mix design. A new mix design is not needed provided the following aggregate properties are met, no change is requested for the volumetric job mix targets, the Hamburg Wheel Track requirements are met, and the Contractor must supply the apparent and bulk dry specific gravities.

The Contractor is responsible for setting the AC binder content in the PMS, because binder content has a direct effect on the volumetric properties and Hamburg performance.

301.06 PLANT MIX BITUMINOUS SURFACING – MAINLINE COMPACTION

Compaction of plant mix bituminous surfacing is under QA. This includes main line cores and longitudinal joint cores. Both are subject to price reductions and incentives.

The Contractor is required to compact the bituminous surfacing to a minimum of 92 % when placed on gravel or 93% otherwise of the established target density with some exceptions (See Subsection 401.03.21 A). MT 328 is used to establish the target Rice gravity (Maximum specific gravity). The average of the first 2 Rice gravity tests establishes the target and are applied retroactively to the beginning of production. Then the averages of the last four Rice Tests densities are used to evaluate the changing of the Rice density target. If the average of the last 4 Rice densities changes .008 or more from the previous established target, a new target is established and is in effect at the time the sample was obtained.

See Subsection 401.03.21A for mainline cores and 401.03.21 B, Longitudinal cores joint core requirements.

Do not make a new target Rice density retroactive except for the beginning of the project.

On paving projects, the density acceptance is by core method. It is very important that the chain of custody is not broken. It is the inspector’s responsibility to witness the core sampling and take possession of the sample without compromising the integrity of the sample.

The Contractor must separate the different lifts and may be done by using a saw on the core. Determine the density only on the lift being placed/tested.

Take the random acceptance tests after all rolling is complete and before opening to traffic.

Areas less than 0.10 foot thick or within 1 foot of a free edge are excluded from QA density testing. These areas must be compacted to the maximum practical density.

The Project Manager determines areas to be excluded from QA density. This needs to be done before paving operations begin. Leveling course, isolation lifts or when the planned nominal thickness is less than 0.10 ft. plant mix is excluded.

For example, the road section is very rough and out of section. The lift is to be 0.12 ft. More than 50% of it will require less than 0.10 ft. thick lift to level it. The first lift on this section should be excluded from QA. The required density in these areas will be specified by the project manager.

Compactive rolling is to be completed before the mat temperature reaches 175°F. The Project Manager may raise this temperature if checking and cracking are observed. Rollers operated in vibratory mode are considered Compactive rolling.

The lot size for compaction is 3,000 tons of plant mix surfacing, consisting of five sublots of 600 ton each. The last lot may have up to 7 if exceeding 3000 tons in this last lot.

301.07 ASPHALT BINDER EVALUATION

Asphalt samples are taken from a sampling device in the feed line between the storage tanks and the mixing unit.

The Contractor operates the sampling device and places the sample in a metal container provided by the engineer.

The sample must be taken when directed by the inspector. The inspector must witness the sampling and immediately take possession of the sample. This is required to comply with federal regulations.

The lot size for Binder Evaluation is 150 tons of Binder, consisting of six sublots of 25 tons each (Subsection 402.03.2.B). For Commercial mix bid items, see MT 601.

Samples are tested in the Helena lab so there is a delay in testing. Submit the samples as soon as possible.

Samples are submitted to the Helena Materials Lab for testing and evaluations. The Materials Lab will send the test results to the District. The Project Manager will check the results and apply any deductions to the estimate.

301.08 RIDE SPECIFICATION FOR FLEXIBLE PAVEMENTS

The ride specification ties the Department's Surface Tolerance Specifications to our Quality Assurance system.

Research has proven that smooth roads have longer service lives and improve customer satisfaction.

The ride specification fulfills the following needs:

- A simple and accurate method to measure and enforce MDT's surface tolerance specifications.
- Provides an incentive for the Contractor who delivers a smooth ride to the traveling public.
- Provide an incentive for increasing the life cycle of the road.
- Share the cost savings with the Contractor when a riding surface of superior quality is attained.
- Recover costs associated with inferior riding surfaces and reduced service life of the road.

The equipment and the specifications are designed to simulate the ride of an average vehicle. This helps to explain some concerns about whether the ride specification is restrictive or lenient. Different vehicles have different rides. Occupants of a luxury car will perceive the ride on a particular section of road differently than the occupants of a ¾ ton pickup due to the different suspension systems.

The International Roughness Index (IRI) is a numerical measurement established to model the ride of a road section and the surface smoothness in an average vehicle. The lower the IRI number, the smoother the ride it is modeling.

The Profile Index (PI) develops an actual profile of the road surface. It is used to accurately measure dips, bumps and their locations on the roadway. The PI portion of the specification indicates the "must grind" areas or areas requiring corrective action.

The PI models the results generated by the California Profilograph, which is generally 25 feet in length. The profilograph is limited in the length of defects it will detect because it is only 25 feet long. This limitation means the PI Index may not detect some of the longer swales or bumps that are obvious.

The Departments QA program is used to calculate the QA incentives and disincentives associated with the ride specification.

Subsection 401.03.23A for the Ride Specification indicates the project category and basis of payment (Subsection105.03.3 C).

A tied incentive for compaction, volumetrics, and surface smoothness is used for Volumetric acceptance projects. Poor QA results in one area may affect the incentives of another parameter. Commercial mix is exempt for the tied incentives.

301.09 CONCRETE

Payment for many concrete classes is adjusted by pay factors for Strength, Air, Gradation or Permeability, in accordance with Subsection 551.03.8. Air is not a QA item in Class Drilled Shaft. Permeability is only applicable to class Deck and Overlay. Slump is not a QA test but must still be indicated as Pass or Fail. Slump Targets should be confirmed in the field with the Contractor for the target used in evaluation of the pass/fail.

CHAPTER 4 – SPECIAL SITUATIONS

401.01 GENERAL

This section covers special situations. These include such things as "check samples", "bad tests" and obviously defective material.

401.02 "BAD SAMPLES" AND "BAD TESTS"

The first thing that is often said when tests fail is that the sample was bad, the test was bad, the sample was not "representative", or the tester didn't do the test right.

First, there is no such thing as a "representative sample" under QA. All samples are selected at random. Any part of the material being produced has the same chance of being picked for a sample as any other part.

Sampling equipment for aggregates and asphalt must be provided by the Contractor. Samples are tested by the Department. A poor sampling device will not make a poor material test good but will make good material test poorly. It is to the Contractor's benefit to provide the best sampling device available.

Samples can become "bad" if they are not handled or tested properly.

If you are scheduled to get a plant mix sample and find one cold feed bin gate is plugged. Do you wait until the Contractor gets time to fix it? The answer is no -- have the sample taken when required. The Contractor is responsible for controlling production and providing specification material all the time.

Some contractors do their QC testing at the same time as we are doing the QA testing. They often get different results. Do we have a bad test because of this difference? The answer is no, if we followed the procedures in the Materials Manual.

Differences in test results can be due to construction variabilities. These are sampling, testing, production, and actual material variability. This variability is expected and is accounted for in the tolerances. If tests were perfect, tolerances would be much smaller. Retain aggregate samples until the end of shift or until results have been checked for errors. Retain all failing tests in case of dispute or retesting. The QA test results are what we use for acceptance of the material. "Check" samples are not taken under QA. A check sample is a sample requested when uncertainty of the quality of material is suspected.

401.03 OBVIOUSLY DEFECTIVE MATERIAL

Sometimes material will be produced or delivered that is visibly defective. It may fall in a location that has not been selected for sampling under QA. It may be a segregated area that becomes exposed by traffic.

What do you do about it?

The Engineer or Project Manager has the right to reject obviously defective material without regard to location in a lot or sampling sequence (Subsections 105.03.1 and 105.03.2).

If you see or strongly suspect the material is defective, it can be isolated and rejected. Back up your action by sampling and testing the rejected material.

For example, you see badly segregated mix on the pavement. A randomly selected test site for compaction is not at this location.

You test this area and find it has only 90% compaction. Additional tests indicate the segregation extends for about 30 feet. The area is marked out, and the Contractor is directed to remove and replace it. You check the repair to make sure it meets compaction requirements.

401.04 REPAIRS AND CORRECTION

Sometimes the contractors say they will repair the area around a bad test. This most often happens with compaction.

Should you agree to this?

The answer is **no**.

The lot is represented by all the tests.

Therefore, to eliminate a price reduction, the entire lot, not just the area around a bad test, must meet specifications.

To ensure that the entire lot meets specification, after repairs, we must select all the new random sample locations.

By doing this, the Contractor and we are in the same position as we were to start with. All the sublot tests are used to evaluate the quality of a lot. If we throw out a test, we no longer have enough test results to represent the entire lot. This evaluation is no longer valid.

401.05 REMOVAL AND REPLACEMENT

The Engineer has the option of requiring material under QA to be removed and replaced when the "P" value reaches 25 or more.

For concrete, the Engineer has the option to require removal and replacement when the pay factor for strength equals 0 or the Air is considered remove and replace in accordance with Table 551-6.

The decision whether to remove and replace it has serious consequences.

The decision to leave the material in place takes on a high risk of early failure. The removal and replacement could cost the Contractor and subcontractors and suppliers much more than the bid price.

The District Administrator and staff should be involved in this decision.

Sublot tests and all other information available should be used to determine the quality of the lot. Additional testing like coring the pavement should be done. Design parameters also should be examined.

If there is evidence to indicate premature failure, the material should be removed and replaced.

401.06 COOPERATION WITH THE CONTRACTOR

Communicate with the Contractor to ensure the Department is receiving a quality product. This does not mean you do their testing or make quality control decisions for them.

- Do not offer opinions on whether tests are good or bad.
- Do not offer opinions on what is wrong or who is at fault, particularly where subcontractors and suppliers may be involved.

Make your acceptance test results available to the Contractor. A Project Manager must discuss and agree with the Contractor to a method of test result distribution at the pre-construction conference. When possible, QA test results should be made available to the Contractor **as soon as possible** while that work item is being constructed.

Make sure that any suggestions are clearly understood to be just that. Too often, when things go wrong, suggestions are twisted into directions.

Encourage the Contractor to pursue an effective quality control program. One of the best ways to do this is to make it clear that they are solely responsible for quality.

CHAPTER 5 – WORK RELATED TO QA

501.01 NON-QA-SPECIFIED PROPERTIES

Liquid limit and plasticity index elements are not covered by QA.

Ductility, high and low temperature components are the only asphalt properties covered under QA. The other properties such as viscosity are non-QA.

The non-QA items are sampled and tested according to the Materials Manual. They are evaluated according to the applicable individual specifications and/or special provisions.

501.02 AGGREGATE SOURCE APPROVAL

There are specified requirements for approving aggregate sources. These consist of different tests to determine the quality of the source.

Most of these tests should have been completed if we prospected the source and it is shown on the plans.

Contractor-furnished sources must be sampled and tested before they can be approved.

The Contractor may begin producing aggregates before approval is made. They should clearly understand that this is at their risk. If the test results indicate the material does not meet specifications, we will not approve the source, and the aggregate cannot be used on our project.

501.03 ASPHALT CONTENT

Having too little asphalt or too much has significant effects on the plant mix surfacing.

Asphalt content is determined over a set period by measuring the amount of asphalt used in a measured amount of mix.

The results of the Gyratory tests should be evaluated. Drastic changes in volumetric properties are good cause for further testing. Low or high Gyratory voids are reason to take additional samples or cores from the pavement.

The material in question is subject to the requirements of Subsection 105.03.1.

If the material does not conform to specifications, we must first decide if it will serve the design purpose. If it will, then we must arrive at an appropriate price adjustment. If it will not serve the design purpose, it must be removed and replaced. This is the purpose of the additional testing and evaluation.

If we find that the out of specification properties had no effect or that the mix improved, we should consider adjusting the target for asphalt content to fit what is being used.

CHAPTER 6 – RULES FOR ROUNDING NUMBERS

601.01 "P" VALUES

Individual “P” Value: 0.01

Total “P” Value: 0.1

601.02 AGGREGATE GRADATION

1. Weight of aggregate on each sieve: to the smallest scale graduation
2. For sieves larger than the 200 mesh.
   a. Percent passing each sieve: 0.1%
   b. Lot average: 0.1%
3. For the 200-mesh sieve.
   a. Percent passing 0.1%
   b. Lot average: 0.1%

601.03 PLANT MIX

A. DENSITY (COMPACTION)

1. Inputs to calculate % of Target Density
   a. Rice Density (or kg/m3): 0.001
   b. Bulk Density: 0.001
2. % of Target

   English

   Sublot: 0.1

   Lot: 0.1

B. Volumetric Rounding

1. %Voids – Brick: 0.01
   Sublot: 0.1
   Lot: 0.1
2. D/A – Sublot: 0.1
   Lot: 0.1
3. VFA – Bricks: 0.1
   Sublot: 1
   Lot: 1
4. VMA – Bricks: 0.01
   Sublot: 0.1
   Lot: 0.1

C. Ride Specification

1. “P” Factor: 0.01

   Term using IRI: 1.0 for individual run and final lane average rounded to 0.1.

   Half mile segments for corrective action evaluation: 0.5 Miles or 2640 ft.

   Shorter segments may occur for short projects or approach area into bridges or at End of Project (EOP).

601.04 Concrete Cylinders (Strength)

Individual tests and the lot average to the nearest 10 psi.