


Construction of Quality Hot Mix Asphalt Pavements - 1 Day Course 



Testing and Acceptance of Hot Mix Asphalt


Greg Harder, P.E.
Asphalt Institute Regional Engineer
Tully, NY

Quality Control and Quality Assurance 


On almost every roadway project, the component materials are tested.

Quality Control - testing that helps the *producer* ensure that they are *providing* a quality product


Quality Assurance - testing that helps the *owner* ensure that they are *receiving* a quality product

Types of Acceptance Specifications 

- Method
 - Extreme agency control
 - Materials
 - Equipment
 - Construction methods
- End-Result
 - Less agency control
 - What does “good quality” look like?


Types of Specifications 

- Quality-Assurance
 - Statistically based
 - QC by contractor
 - QA by agency or their representative
- Performance-Type
 - Evaluation of in-place performance
 - Predetermined parameters and timeframes
 - Warranty
- Combinations

Visual Inspection of the Mix 


An important part of QC/QA is to watch and evaluate the mix as it is delivered to the project. Look for:

Blue Smoke
Stiff Appearance
Mix Slumped in Truck
Lean, Dull Appearance
Segregation
Contamination

Representative Samples 


A **critical** concept in any sampling and testing plan is that the samples must be **representative** of the materials used.


If the samples do not represent the materials used, there is no point in testing them.

Random Sampling 


A key component of obtaining a representative sample of any construction material is the concept of *random* sampling.

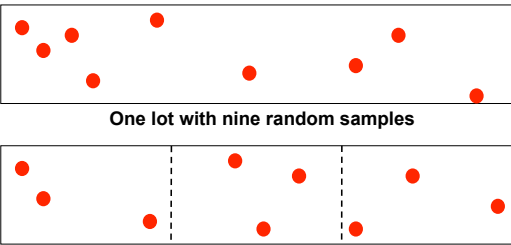
Random means that all parts of the lot of material have an equal chance of being included in the sample.



Stratified-Random Sampling 


ASTM D 3665 provides the standard practice for random sampling of construction materials. It suggests that the *best and most practical method* of ensuring that samples include the full range of a construction process is a process called *stratified-random sampling*.


Stratified-Random Sampling 



One lot with nine random samples


One lot with nine random samples stratified into three sublots



Stratified-Random Sampling 


Question: Does prescribing random or stratified-random sampling mean that I ignore areas which are obviously deficient if they don't fall within my random sampling area?

Answer: Of course not! The contract should be written to allow for the removal and replacement of any obviously deficient material.

Sampling and Testing Plan for Quality Control 

A written plan specifying:


- What will be sampled
- Where the samples will be obtained
- How the samples will be obtained
- Who will obtain the samples
- How many samples will be obtained
- What will be done with the samples
- How the results will be documented and shared

What to sample 

On larger scale projects, the following is usually sampled:



- Asphalt binder
- Aggregate
- Loose asphalt mix
- Compacted asphalt mix


On smaller-scale projects, at least sample loose and compacted mix

Where to obtain samples 

Sampling Asphalt Binder (at the plant)


- The delivery truck
- The delivery lines from the truck to the storage tank
- The storage tank at the plant





Where to obtain samples 

Sampling Aggregates


- The delivery truck or stockpile (single aggregate)
- The flowing aggregate stream or conveyor belt (combined aggregate)




Where to obtain samples 

Sampling the Asphalt Mixture

- The delivery truck (loose mix)
- The roadway prior to compaction (loose mix)
- The roadway after compaction (compacted mix)



What will be done with the samples 


Specify exactly what tests are to be performed as regular QC/QA testing. Typically, these include:

Aggregates:

- Gradation

Asphalt Mixture:


- Asphalt Binder Content
- Bulk Specific Gravity (lab-molded specimens and roadway cores)
- Maximum Theoretical Specific Gravity (Rice's Test)
- Air Voids/Density (calculated)
- VMA (calculated)

Who will obtain the sample 

The Quality Control Plan should specify who will obtain the sample:

- A representative of the contractor
- A representative of the agency
 - Field inspector
 - Materials Lab personnel
 - Private laboratory

It should also specify whether an agency representative must be present at the time of sampling.

How many samples will be obtained 

- One per lot or per subplot?
- Two per lot or per subplot?
- Three? Four?

TOO FEW -

Testing may not accurately characterize mix

TOO MANY -

Testing program unnecessarily expensive

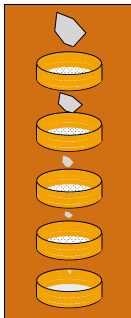
How many samples will be obtained asphalt institute

- One per lot or per subplot?
- Two per lot or per subplot?
- Three? Four?

SMALL PROJECT -
Testing costs harder to justify


LARGE PROJECT -
Consequences of failure higher

Aggregate Test: Gradation asphalt institute




Purpose of the Test:
To determine whether the field sample contains the same percentages of particle sizes as the mix design job mix formula (JMF).
This test gives some indication regarding whether the asphalt plant used the aggregate types, sources, and percentages planned.


HMA Test: Ignition Oven asphalt institute




Purpose of the Test:
To determine whether the plant used the amount of binder as designed in the mix JMF.




HMA Test: Bulk Specific Gravity (G_{mb}) asphalt institute



Purpose of the Test:
The test determines the bulk specific gravity of the lab-molded specimen or roadway core. The specimens include asphalt binder, aggregates, and air.
The G_{mb} is not the final goal, but is used in calculations to determine whether the volumetrics of the field mix matches specifications.




HMA Test: Rice's Specific Gravity (G_{mm}) asphalt institute



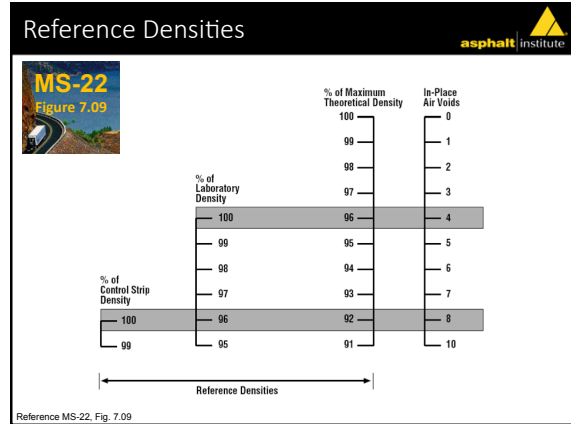
Purpose of the Test:
The test determines the theoretical maximum specific gravity of the asphalt mixture. The samples include asphalt binder and aggregates, but the air is vacuumed out.
The G_{mm} is again not the final goal, but is also used in calculations to determine whether the volumetrics of the field mix matches specifications.


HMA Calculation: Lab-Molded Air Voids asphalt institute

- **What do the test results tell you?**
The test shows the percent air voids in lab-molded specimens. This test indicates a mix property, not in-place air voids.
- **What are the potential ramifications of a failing test result?**
With a low air void content, the mix is either has high binder content or the aggregate structure has changed to produce lower inherent voids, which could result in bleeding or rutting. For high air void contents, the mix likely has a low binder content, which could result in low durability, stripping, or raveling.

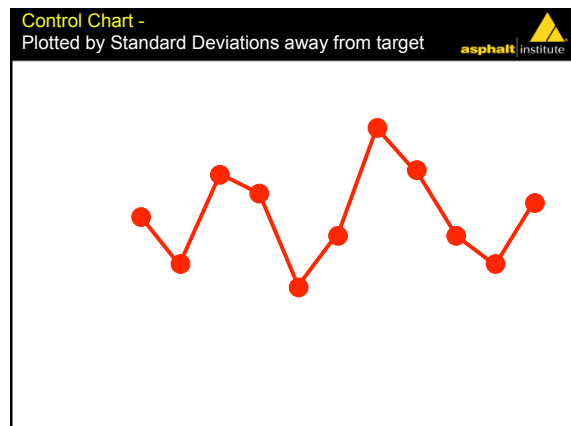
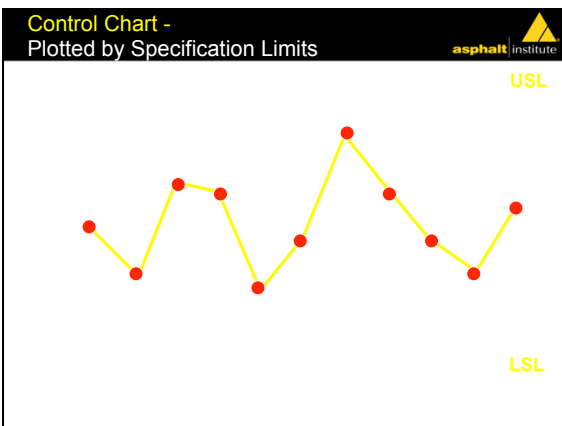
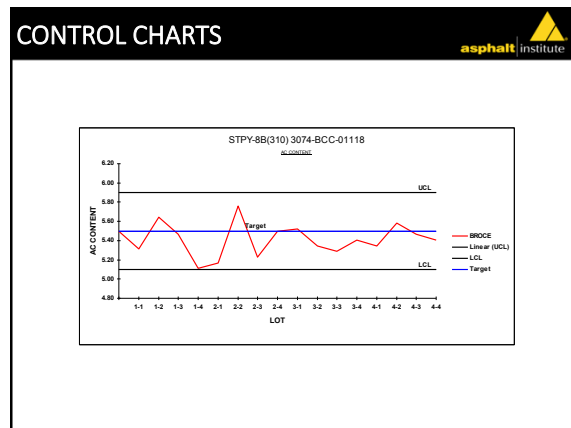
HMA Test: Roadway Density 

- **What do the test results tell you?**
The test indicates the in-place density achieved by the compactive effort of the rolling operation.
- **What are the potential ramifications of a failing test result?**
Low density may result in permeability, stripping, raveling, cracking, premature aging, and premature failure. High density may result in rutting, flushing, or bleeding.




HMA Test Result: VMA 

- **What do the test results tell you?**
VMA is calculated from the binder content test and lab-molded specimens. It tells about the total volume of the voids created by aggregates. Most mix specifications require a minimum VMA.
- **What are the potential ramifications of a failing test result?**
Samples with low VMA do not have enough void space to provide the proper amount of binder and the proper amount of air. Low VMA, depending on the reason, could result in many distress types.



Another commonly-measured characteristic:
Smoothness

Smoothness is usually measured on a project-level basis by the profilograph.



- Reference plane provided by front and back wheels spaced 10 to 30 feet apart
- Deviations from plane measured by center wheel
- Vertical deviations are accumulated and converted into inches per mile

How will you deal with out-of-spec HMA?

- Spell it out in the contract
- Discuss it in the pre-work meeting
- Who samples?
- Does owner personnel need to be present if the contractor samples?
- Who tests?
- Whose tests are acceptable?
- How soon are test results made available?
- Will out-of-spec tests result in work stoppage, deductions from pay, or remove-and-replace?


What is the secret to quality paving?

Consistency and Control

QUESTIONS?

Good Reference Materials on the Topic:

- MS-2:** Mix Design Methods
- SP-2:** Superpave Mix Design
- MS-4:** The Asphalt Handbook
- MS-22:** HMA Construction



<http://www.asphaltinstitute.org>