

417 ASPHALTIC CONCRETE (END PRODUCT) SHRP VOLUMETRIC MIX

SHRP is the abbreviation for the Strategic Highway Research Program. The 417 specification is similar to the 416 specification in some ways but it takes advantage of new technology in the testing of the asphaltic concrete mix.

Materials, testing procedures, and construction requirements are basically the same for the various types of asphaltic concrete pavement. For the sake of brevity, most inspection procedures can be found in the "Asphalt Concrete" section of this manual. This subsection of the manual contains additional inspection procedures and contract administration requirements for specification 417.

417-2 Mix Design Criteria

Specification bands are given to identify acceptable starting points for mix design, they are NOT for production control. Once the mix design is complete and accepted there is no need for the inspector to refer to this subsection. The upper and lower limits of production control bands are found in 417-7.04 and are based on the target values given in the particular mix design for each individual project.

417-3 Materials

417-3.01 Mineral Aggregate

The biggest factors that affect the variations in asphalt mix properties are the aggregate crushing, screening, and stockpile operations. Often problems in compaction and gradation can be traced back to poor controls during crushing. It is very important for ADOT Inspectors to carefully monitor this operation and ensure the Contractor is doing all the sampling and testing properly. The Contractor has complete control of the crushing operation and ADOT does not usually interfere with this unless there is a regulatory violation referred to in Subsection 1001.

417-3.02 Mineral Admixture

Fine aggregate must be obtained from crushed gravel or crushed rock in accordance with subsection 417-3.01 of the Standard Specifications. All uncrushed material finer than the #4 sieve must be removed before crushing the aggregate. This will ensure that the fines are manufactured and less rounded. This helps achieve higher stability in the mix. The contractor may blend back as much as 15% natural fines but the blend of all the fine aggregate must meet the uncompacted voids requirement and the natural fines cannot have more than 4% finer than the #200 sieve.

Mineral admixture may be called for in the mix design. If it is required, the mineral admixture will be 1.0% by weight of the mineral aggregate. It can be as much as 2.0% if testing shows that amount is necessary to meet the Index of Retained Strength (Immersion Compression) requirements. The specifications allow three types of mineral admixture. The two types of cement must be added as a dry powder to the mineral aggregate for mixing in the pugmill. The lime must be hydrated and can be added as a dry powder or as a slurry (with water). Large chunks of mineral admixture are not allowed into the mix and the inspector should look for signs that these dry materials have been wetted during storage. There is another lime product called quicklime (CaO) that cannot be added to the mix. When CaO is mixed with water it is slaked (hydrated) which means the water is chemically combined with it. The hydrated lime called for in the specification is slaked, but it can still look like a dry powder even though there is some water combined in it. The inspector is made aware of these differences because CaO is dangerous to handle and if blended into the asphaltic concrete it will damage it.

417-3.03 Bituminous Materials

Bituminous material will be a PG grade and the type will be found in the Special Provisions for the project.

When there is a source of asphalt cement that has not previously been used, it is a good practice to sample the asphalt cement as soon as it arrives at the plant. The acceptability of this "new" material should be determined as quickly as possible before too much pavement is placed. Acceptable certificates of compliance will be required for each load of asphalt cement, as well as for any mineral admixture before these materials are incorporated into the project.

417-4 Mix Design Procedure

Specification bands are given to identify acceptable starting points for mix design, they are not for production control. Once the mix design is complete and accepted there is no need for the inspector to refer to this subsection. The upper and lower limits of production control bands are found in 406-7.04 and are based on the target values given in the particular mix design for each individual project. The SHRP mix design must be formulated using the coarse or fine grading bands shown in the specifications. These bands pass below or above (respectively) the restricted zone on the gradation chart.

Overall the voids in the mineral aggregate (VMA) is lower in this type of mix. Specifications require that the lab compacted test specimens, except for Arizona Test Method 802, shall be prepared using the Gyrotory Compactor in accordance with AASHTO Provisional Standard TP-4.

Fractured faces in the coarse aggregate (+ No.4 sieve) are 85% minimum with two faces instead of 70% minimum with one fractured face as under the 416 Standard Specifications. There is also a requirement for flat and elongated particles (5:1 ratio) not to exceed 10%.

There is one more allowable self-directed target change ($\frac{3}{4}$ inch sieve; +/- 2%) and the +/-1% allowed on the No.40 sieve under the 416 Standard Specifications is now changed to the No.30 sieve instead.

417-6 Construction Requirements

Although the 417 Standard Specifications allow the Contractor significant latitude on how asphalt is produced and placed, some inspections at the plant and at the project site will still be required. It is also a good idea to document the contractor's materials handling procedures for future reference even if we do not control the individual steps of this process.

Since the Contractor has the responsibility for quality control (QC), the Contractor's staff should do most of the routine inspection work. ADOT Inspectors still have some involvement during paving, but most of their effort should be focused on ensuring that both the Contractor's production and QC work are done properly and consistently. Subsection 417-6 of the Standard Specifications:

1. Describes the requirements for admixture mixing and control.
2. Requires the use of the automatic screed control device on laydown machines.
3. Requires the contractor to submit a copy of the pyrometer record at the end of each shift.
4. Specifies the use of a system to stop the mixing if mineral admixture flow is stopped.

5. Requires all core holes to be patched within 48 hours
6. Requires all vertical edges to be tacked as directed.
7. Specifies the authority to stop the work to prevent weather conditions from damaging the asphaltic concrete pavement.

417-7 Acceptance

Although acceptance testing is done by random sampling, the Inspector still has the authority under 417-7.01 to take plate samples and cores at any time and from any place if the material appears to be defective. If the Inspector observes what appears to be defective material coming from behind the paver or out of the delivery trucks, then take additional samples. This direct sampling is allowed under any of ADOT's paving specifications even though some are end product. Directed samples by the Department are not allowed for any part of the statistical analysis for the lot. The inspector is reminded to review the information on stratified random sampling and to be familiar with the proper use of random number tables (see 1331-1) or a calculator as a random number generator.

Significant deviations in asphalt content from the percentage called for in the design (more than $\pm 0.2\%$) should be discussed and resolved with the Contractor. If the plant is dedicated to exclusive production for one project, the Engineer can evaluate the asphalt content reported from the acceptance lab and compare it with the contractor's hot plant report. If the discrepancy is greater than 0.1%, a correction value should be applied.

For acceptance, rejection, and payment purposes, asphaltic concrete paving production is broken down into "lots." The Inspector must always read the specifications to determine the lot size. Under the quality lot, ADOT compares mix properties such as aggregate gradation, asphalt cement content, effective voids, and stability, with the values specified in the mix design and contract documents. If any one of these properties is in reject, the entire lot is rejected and not just the area of pavement where the particular sample was taken. Compaction lots are handled in the same way.

Sand equivalent, fractured (faces) coarse aggregate particles, uncompacted void content, and smoothness are part of the acceptance testing, but when failures occur only the sections of pavement represented by that particular test are rejected. The contractor has the option of submitting a revised mix design or reworking the stockpiles to correct the deficiencies. Continual retesting until a passing result occurs is not a valid solution.

Once a section of paving has been completed, the Inspectors are now in a position to accept or reject that portion of the work. They should:

1. Check for straight edge tolerances particularly, at the joints.
2. Layout the compaction core locations.
3. Mark lots which are in reject due to any failures in mix properties (such as asphalt cement content, gradation, or stability).

For each mixture-properties lot, the acceptance lab will test for gradation, AC content, effective voids, and stability (from the four plate samples). For each compaction-lot the acceptance lab will test density from the cores. They will issue the results on a form similar to the one shown in Exhibit AC-4. This form will have the pay factors computed for the lot.

If the test results show failure of any of the mix properties or compaction requirements, the area represented by the samples should be rejected. However, keep in mind that these samples are not to be included in the random samples for lot acceptance and pay factor adjustments. They pertain only to isolated areas. Only the test results of the random samples apply to the entire shift's production.

Plate Sampling

Four random plate samples are taken behind the laydown machine during each lot (shift) to determine the mix property pay factors. Samples must be 130 pounds minimum. This is because the samples compacted in the gyratory compactor are much larger and require more material. It is important that samples are indeed taken "randomly" and that the Contractor is unaware ahead of time when the samples will be taken. Advance notice to the Contractor may defeat the purpose of random sampling. During an 8-hour shift, a mix sample should be taken in each 2-hour period on a random basis within that period. This is called "Stratified Random Sampling" and it is generally the best method for ensuring the most representative distribution of random samples. Stratified Random Sampling is not discussed in the 2000 ADOT Standard Specifications and therefore it is neither required nor prohibited. The choice to utilize this method must be made at the pre-paving meeting because any method used must be applied consistently and not switched to and from throughout the project.

The Contractor shall have the necessary personnel on the site at all times during paving so samples can be taken on a moment's notice (20 minutes maximum notice is permissible). The Project Lab should have the samples promptly delivered to the acceptance lab (whether that is the regional lab, the central lab, or a consultant's lab).

Unless specified otherwise, the method of administering low tonnage lots, or lots where a sufficient number samples were not obtained should be mutually agreed upon with the Contractor. Options available include obtaining additional samples through coring or jack hammering, evaluating with $n = 3$, or combining lots with the next day's production. Combining with the following day's production is the most preferable choice.

The referee mixture-properties lot sample must be a split of the acceptance sample. The referee sample should not be taken from a separate plate. Extreme care should be taken in the handling, transporting and storage of referee samples.

ADOT must furnish acceptance test results to the contractor within four working days of receipt of the samples. The test results are reported to the Contractor as soon as they are available. This allows the Contractor to quickly correlate test results in order to produce the best pavement for the project. Occasionally, the acceptance lab (with the Resident Engineer's permission) may fax results directly to the Contractor and the Engineer at the same time.

417-7.04 Gradation, Asphalt Cement Content, and Effective Voids

The requirement for Stability testing is eliminated. Arizona Test Methods 416 and 424 are modified to replace all references to Marshall testing with Gyratory testing in accordance with the AASHTO Provisional Standard TP-4.

The UL and LL for acceptable production limits are given in four different tables depending on the maximum aggregate size and the type of mix (coarse or fine band). The inspector must be sure of which mix is being produced for the project before utilizing these tables.

Generally speaking, these mixes are allowed to be designed with larger particles and some bands are allowed a little more variation from the target value. The idea being that strong support and rock-to-rock contact along

with better control of the other parameters (especially voids and compaction) will ensure a more durable pavement.

The inspector must also be aware of the increased sample size require for this type of mix. The Standard Specifications call for a 130-pound (60 kilograms) minimum sample weight due to the larger size of the laboratory specimens. On lifts of less than 3 inches (75 millimeters) this will usually require two plates to get an adequate sample weight and it will fill more than one bucket as well.

417-7.05 Compaction

For lifts of 1 ½" or less the compaction of the AC follows a method specification and the inspector will have to monitor the temperatures and the rolling to ensure compliance with the specifications. Although there is no compaction lot in this case there will still be a quality lot that is to be evaluated by the 4 random plate samples.

For lifts greater than 1 ½" there will be a compaction lot that is identical to the tonnage of the quality lot. The contractor is responsible for the compaction technique and the lot is evaluated statistically by end product methods. 20 cores will be taken from each lot at random locations. The 10 that are not used will be held for 15 days in case of a request for referee. After that time they must be discarded. Results will be furnished to the contractor within 5 working days of receipt of the samples.

Carefully review subsection 417-7.05(B) of the Standard Specifications before laying out the core locations. Inspectors must mark the exact core locations as calculated from the random numbers since bonuses and penalties are associated with the compaction core results. Furthermore, Inspectors should be watchful over the Contractor's coring operation so that the exact location specified is cored.

In addition to his or her responsibility for compaction methods, the Contractor is responsible for the compaction characteristics of the mix design. Field personnel should not advise the Contractor on compaction procedures, so it remains the Contractor's responsibility. The Inspector should not give implied (tacit) approval of any method.

Instead of a compaction target of 98% of laboratory density as called for under 416; the 417 target is 7% in-place air voids. The UL and LL are +2% and -3% voids respectively, instead of +/- 4 pounds per cubic foot as in 416.