

FIELD SAMPLING AND TESTING MANUAL

SECTION 400

BITUMINOUS PAVEMENT

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All test procedures used within and referred to in the section can be found under “Testing Procedures” of this manual. The test procedures are listed in the following order: AASHTO, ASTM, and NDDOT. Any modifications will be listed at the beginning of each test procedure.

Blank copies of the forms referred to in the section will be found numerically at the end of the section. The most current edition of these forms should be used. These forms are found on the NDDOT internet website, or you may duplicate the ones behind each section.

SECTION 401

PRIME, TACK, OR FOG COAT

401 DESCRIPTION

This work consists of preparing and treating a surface with bitumen and/or blotter material.

401.1 ACCEPTANCE SAMPLES AND TESTS

Field Laboratory Testing: The Engineer or Representative must obtain and split aggregate samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. Samples are obtained from material placed in a stockpile or delivered directly to the project. One sample is obtained for sieve analysis and tested according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," for every five miles, or fraction thereof. Compute the sieve analysis results on SFN 9987, "Aggregate Sample Worksheet." Record the results on SFN 10072, "Aggregate Quality Test Summary."

The Contractor, under the observation of the Engineer or Representative, must obtain and split two samples of bitumen from each load delivered to the project according to NDDOT 1, "Sampling of Bituminous Materials." If emulsified asphalt, submit both samples to the district laboratory. If cutback asphalt, submit one sample to the Materials and Research Laboratory and retain the other as a check sample.

District Laboratory Testing: For emulsion samples perform the sieve test and the Saybolt viscosity test according to AASHTO T 59, "Standard Method of Test for Emulsified Asphalts."

A minimum of one test per project is required for acceptance of aggregate.

Materials and Research Laboratory Testing: Perform tests on all cutback asphalt samples.

401.2 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS

District Laboratory Testing: The District Materials Coordinator or Representative must obtain one aggregate sample for sieve analysis for every ten miles, or fraction thereof. The samples are obtained according to AASHTO T 2, "Sampling of Aggregates," and tested according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer

than No. 200 Sieve in Mineral Aggregates by Washing.” Compute the results on SFN 9987, “Aggregate Sample Worksheet.”

Materials and Research Laboratory Testing: If emulsified asphalt, the Engineer or Representative must obtain one sample for the project and submit it to the Materials and Research Laboratory for the sieve and Saybolt viscosity tests. Tests are run according to AASHTO T 59, “Standard Method of Test for Emulsified Asphalts.”

SECTION 402

COLD BITUMINOUS PAVEMENT

402 DESCRIPTION

This work consists of constructing one or more courses of cold bituminous mixture on a prepared foundation.

402.1 ACCEPTANCE SAMPLES AND TESTS

Field Laboratory Testing: The Contractor obtains for the Engineer or Representative one aggregate sample for each 1,000 tons produced with a maximum of three samples per day. Samples are obtained from the windrow after all aggregates have been blended for each lift, or from the stationary plant, if plant issued. Samples are obtained prior to the addition of bitumen. Samples are obtained and split according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. Conduct sieve analysis according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Record results on SFN 10072, "Aggregate Quality Test Summary."

On the first day and for a minimum of one per day thereafter, perform two moisture tests on aggregate according to AASHTO T 255, "Total Evaporable Moisture Content of Aggregate by Drying." After a rain more sampling may be required as determined by the Engineer.

The Engineer determines the bitumen content in the mixture from the daily cutoff and records results on SFN 9988, "Mix Bitumen Cut-Off Report."

The Contractor, under the observation of the Engineer or Representative, must obtain two samples of bitumen from each load delivered to the project according to NDDOT 1, "Sampling of Bituminous Materials," and are given to the Engineer.

If emulsified asphalt, submit both samples to the district laboratory. If cutback asphalt, submit one sample to the Materials and Research Laboratory and retain the other as a check sample.

District Laboratory Testing: For emulsion samples perform the sieve and Saybolt viscosity tests according to AASHTO T 59, "Standard Method of Test for Emulsified Asphalts."

Materials and Research Laboratory Testing: Perform tests on all cutback asphalt samples.

402.2 ASSURANCE SAMPLES AND TESTS

District Laboratory Testing: The District Materials Coordinator or Representative must obtain and split one aggregate sample according to AASHTO T 2, "Sampling of Aggregate," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. Conduct the sieve analysis according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Determine the physical properties on one sample for each 10,000 tons produced according to NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

The Engineer or Representative performs depth and width measurements at two random locations per mile. Record the measurements on SFN 13889, "Project Records Samples/Tests Report." If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

Materials and Research Laboratory Testing: If emulsified asphalt, the Engineer or a Representative obtains one sample and submits it to the Materials and Research Laboratory for the sieve and Saybolt viscosity tests. Tests are conducted according to AASHTO T 59, "Standard Method of Test for Emulsified Asphalts."

The District Materials Coordinator or Representative must submit to the Materials and Research Laboratory one aggregate sample for sieve analysis for each ten miles in length, or fraction thereof. The sieve analysis is conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

SECTION 403

STOCKPILED HOT BITUMINOUS MIX

403 DESCRIPTION

The work consists of aggregate and bituminous material mixed in a central mixing plant and stockpiled as specified in the contract.

403.1 ACCEPTANCE SAMPLES AND TESTS DURING AGGREGATE PRODUCTION

Field Laboratory Testing: During aggregate production and before mix production can begin the Contractor, under the observation of the Engineer or Representative, obtains one aggregate sample for sieve analysis and physical properties. The sieve analysis is conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Physical properties are determined according to NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Record the results on SFN 10072, "Aggregate Quality Test Summary."

403.2 ACCEPTANCE SAMPLES AND TESTS DURING MIX PRODUCTION

Field Laboratory Testing: District personnel obtain aggregate samples for sieve analysis for each 1,000 tons of mix produced. Samples are obtained according to AASHTO T 2, "Sampling of Aggregates." The sieve analysis is conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Record the results on SFN 10072, "Aggregate Quality Test Summary."

The Contractor, under the observation of the Engineer or Representative, must obtain two samples of bitumen from each load delivered to the project. Sample is obtained according to NDDOT 1, "Sampling of Bituminous Materials," and given to the Engineer.

If emulsified asphalt, the Engineer submits both samples to the district laboratory. If cutback asphalt, submit one sample to the Materials and Research Laboratory and retain the other as a check sample.

The district laboratory will perform sieve and Saybolt viscosity tests on emulsion samples according to AASHTO T 59, "Standard Method of Test for Emulsified Asphalts."

Materials and Research Laboratory Testing: Perform tests on all cutback asphalt samples.

SECTION 407

HOT RECYCLED BITUMINOUS PAVEMENT

407 DESCRIPTION

This work consists of processing and placing salvaged bituminous material on the roadway. Processing may include crushing, screening, blending, adding bitumen, virgin aggregate, or other specified additives.

407.1 ACCEPTANCE SAMPLES AND TESTS

Field Laboratory Testing: The Engineer or Representative shall perform two moisture tests on aggregate the first day and a minimum of one per day thereafter. Moisture tests are performed according to AASHTO T 255, "Total Evaporable Moisture Content of Aggregate by Drying." More tests are required after a rain as determined by the Engineer. Obtain one sample for every 500 tons of virgin aggregate for sieve analysis with a maximum of three samples per day. Samples are obtained according to AASHTO T 2, "Sampling of Aggregates." Conduct sieve analysis according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Record the results on SFN 10072, "Aggregate Quality Tests Summary."

Contractor Testing: The Contractor obtains mix samples from behind the paver at random times according to NDDOT 5 "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples." One sample is obtained for each 1500 tons of mix. The Contractor compacts three Marshall specimens with each sample obtained and determines the densities according to AASHTO T 166, "Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens," and AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." Enter the results on SFN 50289, "Maximum Density Worksheet."

The Contractor, under the observation of the Engineer or Representative, provides pavement cores for density determination. The number of cores required, and the lot and subplot definitions are outlined in Section 408.05 C of the NDDOT Standard Specifications. Enter the data on SFN 59132, "Density Pay Factor."

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, obtains one core from two random locations per mile for density testing and depth determination. Cores are obtained and tested according to NDDOT 2, "Contractor Coring." Random locations to obtain cores shall be determined by the Engineer.

The Engineer or Representative must obtain and test one aggregate sample for sieve analysis and physical properties for every 5,000 tons of virgin aggregate. The samples are obtained and split according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. Sieve analysis is conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Physical properties are determined according to NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Record the results on SFN 10072, "Aggregate Quality Test Summary."

If a NHS system project, a copy of SFN 13889, "Project Records Samples/Test Report," shall be submitted to the FHWA at completion of the project for compliance purposes.

407.2 VERIFICATION SAMPLES AND TESTS (NHS PROJECTS ONLY)

District Field Laboratory Testing: One sample is required for each 10,000 tons of mix with a minimum of one sample per project. The Engineer or Representative obtains one mix sample from behind the paver according to NDDOT 5 "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples."

The district field laboratory personnel shall compact three Marshall specimens from the sample according to AASHTO T 245, "Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus." The densities of the field Marshall plugs are determined according to AASHTO T 166, "Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens," and AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." Enter the results on SFN 50289, "Maximum Density Worksheet."

See Appendix 400-A for acceptable tolerances between QC and verification test results.

The results of the acceptance and verification tests for air voids and maximum specific gravity must correlate within acceptable tolerances. The tolerances are given in the following table.

5/8" and No. 4 Sieve	± 7%
No. 30 Sieve	± 5%
No. 200 Sieve	± 2.5%
Air Voids	± 2.0%
Maximum Specific Gravity	± 0.035

407.3 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS (NHS PROJECTS ONLY)

District Laboratory Testing: The District Materials Coordinator shall compact three Marshall specimens from the sample according to AASHTO T 245, "Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus." The densities of the field Marshall plugs are determined according to AASHTO T 166, "Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens," and AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." Enter the results on SFN 50289, "Maximum Density Worksheet."

See Appendix 400-A, "Quality Control Program," for acceptable tolerances between QC and verification test results.

SECTION 408

HOT BITUMINOUS PAVEMENT

408 DESCRIPTION

This work consists of constructing one or more courses of bituminous pavement on a prepared foundation. The bituminous pavement will be a mixture of aggregate, filler if required, and bitumen. The Contractor shall be responsible for providing an aggregate that meets the specified mix design properties.

There are two 408 sections in the "Field Sampling and Testing Manual." Section 408 Hot Bituminous Pavement and Section 408 Superpave. Use the section requirements for the class of material specified in the plans.

408.1 ACCEPTANCE SAMPLES AND TESTS DURING AGGREGATE PRODUCTION

Contractor Testing: The Contractor obtains and splits aggregate samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. A minimum of one aggregate gradation test is required for each 1,000 tons of aggregate produced for the first 10,000 tons. After 10,000 tons is produced, the testing frequency is a minimum of one test per 2,000 tons of aggregate produced. The aggregate gradation test is run according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing."

The Contractor will provide the Engineer with an aggregate sample representing each stockpile for a mix design. The total weight of the combined sample will be about 150 lbs. The Contractor will also provide eight one-liter cans of PG asphalt to be used on the project. This sample is to be submitted to the District Materials Coordinator for either a NDDOT developed mix design or a Contractor developed mix design. The mix design sample is to be submitted at least seven days prior to mix production. See Appendix 400-B, "Verification of Contractor Mix Designs."

District Laboratory Testing: As soon as the Contractor determines the aggregate is representative and prior to the initial mix design, it is recommended the District Materials Coordinator obtain and test aggregate samples from each aggregate stockpile during the first week of aggregate production. The aggregate samples should be tested to determine the bulk (dry) and apparent specific gravity and the percent water absorption by dry weight of aggregate according to AASHTO T 84, "Specific Gravity and Absorption of Fine Aggregate;" and AASHTO T 85, "Specific Gravity and Absorption of Coarse Aggregate." One test is performed for each 10,000 ton of each aggregate component produced. The individual specific gravity values determined by the Contractor and the district laboratory should correlate within 0.040.

408.2 ACCEPTANCE SAMPLES AND TESTS DURING MIX PRODUCTION

Field Laboratory Testing – Aggregate: The Contractor performs two moisture tests on the aggregate blend the first day and a minimum of one per day thereafter. Moisture tests are performed according to AASHTO T 255, “Total Evaporable Moisture Content of Aggregate by Drying.” More samples and tests are required after a rain as determined by the Engineer.

The Engineer or Representative submits one composite aggregate sample, obtained by the Contractor during the beginning of aggregate stockpiling, to the District Materials Coordinator. The District Materials Coordinator sends the sample to the Materials and Research Laboratory to determine the L.A. abrasion loss percentage according to AASHTO T 96, “Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.”

On each hot bituminous pavement project the Contractor, under the observation of the Engineer or Representative, shall obtain one aggregate sample from the cold feed belt at random times, as determined by the Engineer, for each 1,500 ton of mix produced with a minimum of one sample per day. The aggregate sample is obtained and split according to AASHTO T 2, “Sampling of Aggregates,” and AASHTO T 248, “Reducing Samples of Aggregate to Testing Size,” respectively. A sieve analysis is conducted according to AASHTO T 27, “Sieve Analysis of Fine and Coarse Aggregates,” and AASHTO T 11, “Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.” Compute the results on SFN 9987, “Aggregate Sample Worksheet.” Enter the results on SFN 18552, “Daily Report-Hot Bituminous Pavement – Quality Control.” Record the summary of results on SFN 10072, “Aggregate Quality Test Summary.”

The Contractor shall obtain aggregate samples before the addition of bitumen into the mix. The aggregate samples are obtained from the cold feed belt according to AASHTO T 2, “Sampling of Aggregates,” and split according to AASHTO T 248, “Reducing Samples of Aggregate to Testing Size.” The aggregate sample is tested to determine shale content according to AASHTO T 113, “Lightweight Pieces in Aggregate”; plasticity index according to AASHTO T 90, “Determining the Plastic Limit and Plasticity Index of Soils”; and fractured faces according to NDDOT 4, “Percentage of Fractured Particles in Coarse Aggregate.”

The shale content and plasticity index are determined by the average of test results from three random samples obtained from the cold feed belt from each lot of 10,000 tons, or fraction thereof. The samples are tested and the material accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits, test only one of the three samples from each subsequent lot.

If at any time the sample tested does not meet the specified requirements, the remaining two samples are tested. The average of the three samples is used to determine acceptance of the material. If an average of three test results is used to determine the acceptance for a lot, then each subsequent lot shall have all three samples tested. However, the testing can be reduced once again to only one test per subsequent lot after a lot has all three samples within the specified limits.

The percent of fractured particles is determined by the average of test results from three random samples that are obtained from the cold feed belt from each lot of 10,000 tons of bituminous mixture produced. The material is accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits, test only one of the three samples from each subsequent lot.

If at any time the sample tested does not meet the specified requirements, the remaining two samples are tested. The average of the three samples is used to determine acceptance of the material. If an average of three test results is used to determine the acceptance for a lot, then each subsequent lot shall have all three samples tested. However, the testing can be reduced once again to only one test per subsequent lot after a lot has all three samples within the specified limits.

Field Laboratory Testing – HMA: The Contractor obtains mix samples from behind the paver according to NDDOT 5 “Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples.” The samples are obtained at random times, as specified by the Engineer. A mix sample is obtained each time an aggregate sample is obtained for sieve analysis.

Field Laboratory Testing - Bitumen: The Contractor, under the observation of the Engineer or Representative, will obtain bitumen samples according to NDDOT 1, “Sampling of Bituminous Materials.”

Contractor Testing: The Contractor compacts three Marshall specimens with each sample that is obtained. Compact the samples according to AASHTO T 245, “Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.”

The Contractor determines the densities of the field Marshall plugs according to AASHTO T 166, “Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens,” and AASHTO T 209, “Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.” Enter the results on SFN 50289, “Maximum Density Worksheet.”

The Contractor, under the observation of the Engineer or Representative, provides two pavement cores in each subplot for density determination. Cores are

obtained adjacent to each other and at random locations. Random locations are determined by the Engineer. Cores are given immediately to the Engineer or Representative after being obtained. Cores are obtained and prepared according to NDDOT 2, "Contractor Coring." The Engineer determines the density of the sublots by averaging the two cores. Enter the data on SFN 59132, "Density Pay Factor."

Each subplot will be one paver-lift wide (excluding the shoulders) by 2,000 feet long, and of the depth specified for the pavement. If the partial subplot remaining at the end of the production day is 1,000 feet in length or greater, it will be considered a separate subplot. If it is less than 1,000 feet long it will be included in the last complete subplot. If the total day's production is less than 2,000 feet long and one paver-width wide, that production is considered a lot. The average density of the mainline pavement placed each production day will be the average of the densities of all that day's sublots.

Materials and Research Laboratory Testing: Determine L.A. abrasion loss percentage according to AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine," on a composite aggregate sample obtained during the beginning of aggregate stockpiling.

408.3 ASSURANCE SAMPLES AND TESTS

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, obtains and splits one aggregate sample for sieve analysis and determining physical properties for each 10,000 tons of mix produced. Sample is obtained and split according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The sieve analysis is conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Physical properties are conducted according to NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Record the results on SFN 10072, "Aggregate Quality Test Summary."

Materials and Research Laboratory Testing: The Contractor obtains, and the District Materials Coordinator submits to the Materials and Research Laboratory, one aggregate sample for each ten miles in length, or fraction thereof, of roadway. Materials and Research conducts the sieve analysis on the samples according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

408.4 VERIFICATION SAMPLES AND TESTS (NHS PROJECTS ONLY)

A second field laboratory is required for NHS projects only.

Field Laboratory Testing: The Engineer or Representative will conduct verification tests on independent samples.

The Contractor, under the observation of the Engineer or Representative, shall obtain samples from the cold feed belt, bitumen tank, and obtain cores. Cores are obtained according to NDDOT 2, "Contractor Coring."

The Engineer obtains HMA samples from behind the paver according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples." The Engineer will test at an increased rate during the first lot of production to determine the accuracy of the quality control testing. The Engineer will test a minimum of four tests for the Contractor's first ten tests, and then 10% or greater of the frequency required for the Contractor's QC testing.

The Contractor obtains for the Engineer one aggregate sample for each 10,000 tons of mix produced. The sample is obtained and split according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The District Materials Coordinator will conduct the sieve analysis according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." The physical properties are determined according to NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

The Engineer compacts three Marshall specimens from the sample according to AASHTO T 245, "Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus." The Engineer determines the densities of the field Marshall plugs according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens," and AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." Record the results on SFN 50289, "Maximum Density Worksheet."

The results of the acceptance and verification tests will correlate within acceptable tolerances given in the following table.

5/8" and No. 4 sieve	± 7%
No. 30 sieve	± 5%
No. 200 sieve	± 2.5%
Air Voids	± 2.0%
Maximum Specific Gravity	± 0.035

District Laboratory Testing: For width and depth checks and compliance on NHS projects only, the Contractor is to provide one full depth core, under the observation of the Engineer or Representative, for depth determination. The core is obtained from one random location per mile as determined by the District Materials Coordinator or Representative. The core will be obtained after the final lift is placed. Width measurements are to be taken at the same location that the core is obtained. The core is obtained according to NDDOT 2, "Contractor Coring."

If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

408.5 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS

District Laboratory Testing: The District Materials Coordinator conducts IA tests on split samples obtained by the Contractor.

Samples are obtained by the Contractor, under the observation of the District Materials Coordinator, according to AASHTO T 2, "Sampling of Aggregate" and split according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size."

The IA tests run by the Contractor can be used for acceptance.

IA testing on split samples will be done once during the first ten tests required of the Contractor. The IA sample will be further split for testing by the QA tester. If the initial IA test is acceptable, then one more IA test is required on a split sample at the approximate mid-point of the project, and again near the end of the project.

If the initial IA testing is not within specified tolerances, additional samples will be immediately obtained for testing, equipment will be checked, and testing procedures will be reviewed. This will continue until the differences are resolved. The additional IA testing will be performed by the IA tester and the other lab (QC or verification) that is not within the specified tolerance. See Appendix 400-A, "Quality Control Program."

The Contractor obtains for the District Materials Coordinator one mix sample from behind the paver according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples," for each 10,000 tons of mix produced, with a minimum of one sample per project. See Appendix 400-B, "Verification of Contractor Mix Designs."

Results from the QC, QA, and IA testing will correlate within acceptable tolerances given in the following table.

5/8" - No. 4 sieve	± 5%
No. 30 sieve	± 3%
No. 200 sieve	± 1.5%
Plastic Index	± 2%
Fractured Faces	± 5%
Air Voids	± 1.0%
Maximum Specific Gravity	± 0.020
Lightweight Pieces of Aggregate	± 1%
Aggregate Bulk Sp Gr (dry), each fraction	± 0.040
Aggregate Apparent Sp Gr, each fraction	± 0.040

Dispute Resolution: If the cause of disagreement between the verification and quality control results cannot be determined, the dispute resolution process will be implemented. See Appendix 400-A, "Dispute Resolution."

Width and Depth Checks: The Contractor, under the observation of the Engineer or Representative, is to provide one full depth core for depth determination. The core will be obtained from one random location per mile as determined by the Engineer or Representative and after the final lift is placed according to NDDOT 2, "Contractor Coring." The Engineer or Representative takes the width measurements at the same location where the core is obtained.

If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

SECTION 408**SUPERPAVE (SPV)****408 DESCRIPTION
SPV**

This work consists of constructing one or more courses of bituminous pavement on a prepared foundation. The bituminous pavement will be a mixture of aggregate, filler if required, and bitumen. The Contractor shall be responsible for providing an aggregate that meets the mix design properties that are specified.

There are two 408 sections in the “Field Sampling and Testing Manual.” Section 408 Hot Bituminous Pavement and Section 408 Superpave. Use the section requirements for the class of material specified in the plans.

**408.1 ACCEPTANCE SAMPLES AND TESTS DURING AGGREGATE PRODUCTION
SPV**

Contractor Testing: The Contractor obtains and splits aggregate samples according to AASHTO T 2, “Sampling of Aggregates,” and AASHTO T 248, “Reducing Samples of Aggregate to Testing Size,” respectively. A minimum of one sieve analysis test is required for each 1,000 tons of aggregate produced for the first 10,000 tons. Sieve analysis is conducted according to AASHTO T 27, “Sieve Analysis of Fine and Coarse Aggregate,” and AASHTO T 11, “Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.” After 10,000 tons is produced the testing frequency for aggregate gradation is a minimum of one test per 2,000 tons of aggregate produced. Compute the results on SFN 9987, “Aggregate Sample Worksheet.”

During aggregate production fine aggregate angularity testing is required and is conducted according to AASHTO T 304, “Uncompacted Void Content of Fine Aggregate.” The testing frequency for the fine aggregate angularity will be the average of three random samples from the first 5,000 tons of material produced from each stockpile. The fine aggregate angularity from each stockpile will be combined to determine the final blend results.

The Contractor will provide the Engineer with a 165-lb sample from each stockpile for the mix design. Aggregate samples are submitted 30 days prior to production. Samples are submitted to the District Materials Laboratory for a NDDOT developed mix design or a verification of a Contractor developed mix design. See Appendix 400-B, “Verification of Contractor Mix Design.”

The Superpave volumetric mix design is done according to NDDOT Standard Specifications, Section 410 under “Construction Requirements.”

District Laboratory Testing: As soon as the Contractor determines the aggregate is representative and prior to the initial mix design, it is recommended

the district laboratory test each aggregate stockpile during the first week of aggregate production to determine the bulk (dry) and apparent specific gravity and the percent water absorption by dry weight of aggregate. Testing should be conducted according to AASHTO T 84, "Specific Gravity and Absorption of Fine Aggregate," and AASHTO T 85, "Specific Gravity and Absorption of Coarse Aggregate." One test is performed for each 10,000 ton of each aggregate component produced. The individual specific gravity values determined by the Contractor and the district laboratory should correlate within 0.040.

408.2 ACCEPTANCE SAMPLES AND TESTS DURING MIX PRODUCTION SPV

Field Laboratory Testing – Aggregate: The Contractor performs two moisture tests on the aggregate blend the first day and a minimum of one per day thereafter. Testing is conducted according to AASHTO T 255, "Total Evaporable Moisture Content of Aggregate by Drying." More tests are required after a rain as determined by the Engineer.

The Engineer or Representative submits one composite aggregate sample, obtained by the Contractor during the beginning of aggregate stockpiling, to the District Materials Coordinator. The District Materials Coordinator sends the sample to the Materials and Research Laboratory to determine the L.A. abrasion loss percentage according to AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine."

On each hot bituminous pavement project the Contractor, under the observation of the Engineer or Representative and at random times as determined by the Engineer, shall obtain one aggregate sample from the cold feed belt for each 1,500 ton of mix produced with a minimum of one sample per day. The sample is obtained and split according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. A sieve analysis is conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet," and enter the results on SFN 18552, "Daily Report – Hot Bituminous Pavement – Quality Control (Penalty Assessed)." The summary of results is to be reported on SFN 10072, "Aggregate Quality Test Summary."

The Contractor, under the observation of the Engineer or Representative, shall obtain from the cold feed belt from each lot of 10,000 tons of aggregate produced, aggregate samples before the addition of bitumen into the mix. The aggregate samples are tested according to AASHTO T 304, "Uncompacted Void Content of Fine Aggregate"; AASHTO T 113, "Lightweight Pieces in Aggregate"; ASTM D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregates"; NDDOT 4, "Percentage of Fractured

Particles in Coarse Aggregate”; and AASHTO T 176, “Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.”

The lightweight pieces of aggregate, coarse aggregate, angularity, and flat and elongated pieces of the aggregate are determined by the average of test results from three random samples obtained from the cold feed belt from each lot of 10,000 tons produced, or fraction thereof.

The testing frequency for the fine aggregate angularity and clay content will be the average of three random samples from the first 10,000 tons of material produced from each stockpile. The fine aggregate angularity and clay content from each stockpile will be combined to determine the final blend results. The samples are tested and the material accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits, test only one of the three samples from each subsequent lot.

If at any time the sample tested does not meet the specified requirements, the remaining two samples are tested. The average of the three samples is used to determine acceptance of the material. If an average of three test results is used to determine the acceptance for a lot, then each subsequent lot shall have all three samples tested. However, the testing can be reduced once again to only one test per subsequent lot after a lot has all three samples within the specified limits.

Field Laboratory Testing – HMA: The Contractor obtains mix samples from behind the paver according to NDDOT 5, “Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples.” Mix samples are obtained at random times as determined by the Engineer and at the same time an aggregate sample is obtained for sieve analysis. See Appendix 400-B, “Verification of Contractor Mix Designs.”

The Contractor compacts two gyratory specimens from each sample obtained according to AASHTO T 312, “Preparing and Determining the Density of the HMA Specimens by Means of the Superpave Gyratory Compactor.”

The Contractor determines the densities of the field gyratory plugs according to AASHTO T 166, “Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens,” and AASHTO T 209, “Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.” The results are recorded onto SFN 50289, “Maximum Density Worksheet.”

The Contractor, under the observation of the Engineer or Representative, obtains two pavement cores in each subplot adjacent to each other and at random locations as determined by the Engineer. Cores are obtained according to NDDOT 2, “Contractor Coring,” and given to the Engineer immediately after they are obtained for density determination. Density testing is conducted according to AASHTO T 166, “Bulk Specific Gravity of Compacted Bituminous Mixtures Using

Saturated Surface Dry Specimens.” The average of the two cores is used to determine the density of the subplot. The results are recorded onto SFN 59132, “Density Pay Factor.”

Each subplot will be one paver lift wide (excluding the shoulders) by 2,000 feet long and of the depth specified for the pavement. If the partial subplot remaining at the end of the production day is 1,000 feet in length or greater, it will be considered a separate subplot. If it is less than 1,000 feet long it will be included in the last complete subplot. If the total day’s production is less than 2,000 feet long and one paver width wide that production is considered a lot. The average density of the mainline pavement placed each production day will be the average of the densities of all that day’s sublots.

Field Laboratory Testing – Bitumen: The Contractor obtains bitumen samples according to NDDOT 1, “Sampling of Bituminous Materials.”

Materials and Research Laboratory Testing: Determine L.A. abrasion loss percentage according to AASHTO T 96, “Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the L.A. Machine,” on a composite aggregate sample obtained during the beginning of aggregate stockpiling.

408.3 ASSURANCE SAMPLES AND TESTS

SPV

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, obtains and splits one aggregate sample according to AASHTO T 2, “Sampling of Aggregates” and AASHTO T 248, “Reducing Samples of Aggregate to Testing Size,” respectively. The District Materials Coordinator runs a sieve analysis according to AASHTO T 27, “Sieve Analysis of Fine and Coarse Aggregate,” and AASHTO T 11, “Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.” Physical properties of the sample are determined for each 10,000 tons of mix produced according to NDDOT 4, “Percentage of Fractured Particles in Coarse Aggregate”; AASHTO T 90, “Determining the Plastic Limit and Plasticity Index of Soils”; and AASHTO T 113, “Lightweight Pieces in Aggregate.” Compute the results on SFN 9987, “Aggregate Sample Worksheet.”

Materials and Research Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, obtains for sieve analysis, one aggregate sample for each 10 miles in length, or fraction thereof. Samples are submitted to the Materials and Research Laboratory by the District Materials Coordinator. The sieve analysis is conducted according to AASHTO T 27, “Sieve Analysis of Fine and Coarse Aggregate,” and AASHTO T 11, “Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.” Compute the results on SFN 9987, “Aggregate Sample Worksheet.”

408.4 VERIFICATION SAMPLES AND TESTS (NHS PROJECTS ONLY) SPV

A second field laboratory is required on all NHS projects.

Field Laboratory Testing: The Engineer will conduct verification tests on independent samples.

The Contractor, under the observation of the Engineer or Representative, shall obtain samples from the cold feed belt, bitumen tank, and obtain cores.

The Engineer obtains HMA samples from behind the paver according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples," and NDDOT 2, "Contractor Coring."

A sieve analysis is conducted on the sample according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Physical properties are determined for each 10,000 tons of mix produced according to NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

Compact two gyratory specimens from the sample according to AASHTO T 312, "Preparing and Determining the Density of the HMA Specimens by Means of the Superpave Gyratory Compactor." Determine the densities of the field Marshall plugs according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface Dry Specimens," and AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." Record the results on SFN 50289, "Maximum Density Worksheet."

The results of the acceptance and verification tests will correlate within acceptable tolerances given in the following table.

5/8" and No. 4 sieve	± 7%
No. 30 sieve	± 5%
No. 200 sieve	± 2.5%
Air Voids	± 2.0%
Maximum Specific Gravity	± 0.035

Included with Superpave projects:

Fine Aggregate Angularity	± 3%
Flat and Elongated Pieces	± 3%
Clay Content	± 7%

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, obtains one full depth core for depth determination according to NDDOT 2, "Contractor Coring." Cores are obtained after the final lift is placed and at one random location per mile as determined by the Engineer. Width measurements are to be taken at the same location where the core is obtained.

If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

408.5 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS (NHS PROJECTS SPV ONLY)

The Contractor obtains and splits for the Engineer one aggregate sample according to AASHTO T 2, "Sampling of Aggregate," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The Engineer submits the sample to the District Materials Coordinator to conduct IA tests.

IA testing on split samples will be done once during the first ten tests required of the Contractor. The IA sample will be further split for testing by the verification tester. If the initial IA test is acceptable, then one more IA test is required on a split sample at the approximate midpoint of the project and again near the end of the project.

The IA tests run by the Contractor can be used for acceptance.

If the initial IA testing is not within specified tolerances, additional samples will be immediately obtained for testing, equipment will be checked, and testing procedures will be reviewed. This will continue until the differences are resolved. The additional IA tests will be performed by the IA tester and the other lab (QC or QA) that is not within the specified tolerance.

Results from the QC and IA testing will correlate within acceptable tolerances given in the following table.

5/8" - No. 4 sieve	± 5%
No. 30 sieve	± 3%
No. 200 sieve	± 1.5%
Fractured Faces	± 5%
Air Voids	± 1.0%
Maximum Specific Gravity	± 0.020
Lightweight pieces of aggregate	± 1%
Aggregate Bulk Sp Gr (dry), each fraction	± 0.040
Aggregate Apparent Sp Gr, each fraction	± 0.040
Fine Aggregate Angularity	± 2.5%
Flat and Elongated Pieces	± 2.5%
Clay Content	± 5.0%

Dispute Resolution: If the cause of disagreement between the quality assurance and quality control results cannot be determined, the dispute resolution process will be implemented. See Appendix 400-A, "Quality Control Program," for dispute resolution.

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, is to provide one full depth core according to NDDOT 2, "Contractor Coring," for depth determination. A core is obtained at one random location per mile as determined by the Engineer. The core will be obtained after the final lift is placed. Width measurements are to be taken at the same location that the core is obtained. The Engineer tests the cores according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface Dry Specimens."

If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

SECTION 409

HOT BITUMINOUS PAVEMENT FOR QUALITY CONTROL/QUALITY ASSURANCE (QC/QA) PROJECTS

409 DESCRIPTION

This work consists of constructing one or more courses of bituminous pavement on a prepared surface for Quality Control/Quality Assurance (QC/QA) projects. The Contractor is responsible for process control and performs the necessary testing to control the quality of the work.

409.1 SAMPLES AND TESTS DURING AGGREGATE PRODUCTION

Contractor Testing: The Contractor obtains and splits aggregate samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The aggregate will be tested for gradation according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." The physical properties will be determined according to AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

The testing frequency for gradation will be one test per 1,000 tons of material produced for each aggregate stockpile. The testing frequency for the plastic index, fractured faces, and lightweight pieces of aggregate will be the average of three random composite samples from the first 5,000 tons of material produced.

If all three samples pass, the testing frequency will change to one of three samples tested for each 10,000 tons of material produced.

If a sample fails, the remaining two samples will be tested and averaged for acceptance of that lot. The testing frequency will then revert to the average of three tests per 5,000 tons until all three samples pass, then one of three samples will be tested for each 10,000 tons.

During the first week of aggregate production for each class of aggregate and as soon as the Contractor determines the aggregate is representative, prior to the initial mix design, the Contractor will obtain a 90-lb sample of each aggregate component according to AASHTO T 2, "Sampling of Aggregates." The Contractor splits the samples according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size." One-half of each aggregate sample will be submitted to the Engineer for testing. The Contractor and the Engineer will test the samples to determine the bulk (dry) and apparent specific gravity and the

percent water absorption by dry weight of aggregate. The testing will be completed according to AASHTO T 84, "Specific Gravity and Absorption of Fine Aggregate," and AASHTO T 85, "Specific Gravity and Absorption of Coarse Aggregate." One test will be performed for each 10,000 ton of each aggregate component produced. A minimum of two tests will be required for each aggregate component. Testing will begin within two working days of sampling.

After 10,000 tons of material is produced, the Contractor will develop a preliminary mix design and submit the results to the department. This mix design is for informational purposes to assure the Contractor has produced material that meets specifications. See Appendix 400-B, "Verification of Contractor Mix Designs."

After 10,000 tons of material is produced, the Contractor will provide the Engineer with an aggregate sample representing each stockpile for a mix design. The total weight of the combined sample will be about 150 lbs. The Contractor will also provide eight one-liter cans of performance-graded (PG) asphalt to be used on the project. This sample is to be submitted to the District Materials Laboratory for either a NDDOT developed mix design or a Contractor developed mix design. The mix design sample is to be submitted at least seven days prior to mix production.

District Laboratory Testing: During the first week of aggregate production the Contractor, under the observation of the Engineer or Representative, will obtain and split aggregate samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The District Lab will test each aggregate stockpile to determine the bulk (dry) and apparent specific gravity and the percent water absorption by dry weight of aggregate. The testing will be completed according to AASHTO T 84, "Specific Gravity and Absorption of Fine Aggregate," and AASHTO T 85, "Specific Gravity and Absorption of Coarse Aggregate." One test will be performed for each 10,000 ton of each aggregate component produced. A minimum of two tests will be required for each aggregate component.

Materials and Research Laboratory Testing: For projects not on the NHS system, a composite aggregate sample is obtained by the Engineer during the beginning of aggregate stockpiling for the District Materials Coordinator. The District Materials Coordinator sends the sample to the Materials and Research Laboratory to determine L.A. abrasion loss percentage according to AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the L.A. Machine." Materials and Research personnel or a Representative designated by the Materials and Research Division will obtain L.A. samples on NHS projects.

409.2 QUALITY CONTROL (QC) SAMPLES AND TESTS DURING MIX PRODUCTION

QC will be the responsibility of the Contractor.

The Contractor will be required to perform random sampling and testing on the aggregate and bituminous mix as the mix is produced and placed on the roadway. Samples will be obtained according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples," and AASHTO T 2, "Sampling of Aggregates." The aggregate sample will be split according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size." Sieve analysis will be conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." The physical properties are determined according to AASHTO T 90, "Determining the Plastic Limit and Plasticity Index of Soils"; NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; and AASHTO T 113, "Lightweight Pieces in Aggregate."

QC Aggregate: The Contractor shall perform two moisture tests according to AASHTO T 255, "Total Evaporable Moisture Content of Aggregate by Drying," on aggregate the first day and a minimum of one per day thereafter. More tests are required after a rain as determined by the Engineer.

Aggregate will be sampled and tested in lot sizes equal to the number of tons placed each production day. The aggregate gradation specified will be the basis of acceptance.

The Contractor shall obtain all aggregate samples at random times as determined by the Contractor. The Contractor will obtain one aggregate sample for each 1,500 ton of mix produced. The samples are obtained from the cold feed belt according to AASHTO T 2, "Sampling of Aggregate" and split according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size." The two representative samples are numbered and bagged. The untested half of the sample will be retained by the Engineer for 24 hours after the test results are made known to the Contractor. Either party may request that the second half of the sample be tested within this 24-hour timeframe. The test results from this retest shall replace the test values of the initial test.

The Contractor shall obtain aggregate samples before the addition of bitumen into the mix. Samples are obtained and split according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The samples are tested according to AASHTO T 113, "Lightweight Pieces in Aggregate"; AASHTO T 90, "Determining Plastic Limit and Plastic Index of Soils"; NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; and AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the L.A. Machine."

The shale content and plasticity index of the aggregate are determined by the average of test results from three random samples obtained from the cold feed belt from each lot of 10,000 tons produced, or fraction thereof. The samples are tested and the material accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits test only one of the three samples from each subsequent lot. If at any time the sample tested does not meet the specified requirements the remaining two samples are tested. The average of the three samples is used to determine acceptance of the material. If an average of three test results is used to determine the acceptance for a lot, then each subsequent lot shall have all three samples tested. However, the testing can be reduced once again to only one test per subsequent lot after a lot has all three samples within the specified limits.

The percentage of fractured faces for coarse aggregate is determined by the average of test results from three random samples obtained from the cold feed belt from each lot of 10,000 tons of bituminous mixture produced. The samples are tested and the material accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits, test only one of the three samples from each subsequent lot. If at any time the sample tested does not meet the specified requirements the remaining two samples are tested.

QC HMA: The Contractor obtains mix samples from behind the paver at random times as specified by the Engineer. A mix sample is obtained each time an aggregate sample is obtained for sieve analysis. The sample is obtained according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples." See Appendix 400-B, "Verification of Contractor Mix Designs."

The Contractor compacts three Marshall specimens according to AASHTO T 245, "Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus." With each sample obtained the Contractor determines the field Marshall density according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens," and the maximum theoretical density according to AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." The results are recorded on SFN 50289, "Maximum Density Worksheet."

QC Bitumen: The Contractor will make random checks of the asphalt content each time a gradation test is obtained. The random checks will be based on readings from the totalizers for the aggregate and the bitumen. Record on SFN 18552, "Daily Report-Hot Bituminous Pavement-Quality Control."

409.3 QUALITY ASSURANCE (QA) SAMPLES AND TESTS

District Field Laboratory Testing: The Engineer or Representative will conduct QA tests on independent samples in the field laboratory.

The Contractor, under the observation of the Engineer or Representative, shall obtain samples from the cold feed belt, bitumen tank, and obtain cores. Samples are obtained according to AASHTO T 2, "Sampling of Aggregates," and NDDOT 2, "Contractor Coring."

The Engineer or Representative shall obtain samples from behind the paver according to NDDOT 5 "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples."

The samples will be tested according to AASHTO T 113, "Lightweight Pieces in Aggregate"; AASHTO T 90, "Determining Plastic Limit and Plastic Index of Soils"; NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens"; and AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures."

The Engineer will test at an increased rate during the first lot of production to determine the accuracy of the quality control testing. The Engineer will test a minimum of four tests for the Contractor's first ten tests and then 10% or greater of the frequency required for the Contractor's QC testing.

Results from the QC and QA testing will correlate within acceptable tolerances given in the following table.

5/8" and No. 4 sieve	± 7%
No. 30 sieve	± 5%
No. 200 sieve	± 2.5%
Plastic Index	± 4%
Lightweight Pieces	± 3%
Fractured Faces	± 5%
Bulk Specific Gravity (Mix)	± 0.040
Maximum Specific Gravity	± 0.035

The Engineer or Representative will read random checks for asphalt content on a daily basis and record on SFN 18674, "Asphalt Content & Virgin Aggregate Determination."

The Contractor obtains two pavement cores in each subplot. Cores are obtained at random locations as determined by the Engineer and according to NDDOT 2, "Contractor Coring." The cores are given to the Engineer for density determination. The cores are obtained adjacent to each other and the average of the two cores is used to determine the density of the subplot. The results are recorded on SFN 59132, "Density Pay Factor."

Each subplot will be one paver-lift wide (excluding the shoulders) by 2,000 feet long and by the depth specified for the pavement. If the partial subplot remaining

at the end of the production day is 1,000 feet in length or greater it will be considered a separate subplot. If it is less than 1,000 feet long it will be included in the last complete subplot. If the total day's production is less than 2,000 feet long and one paver width wide that production is considered a lot. The average density of the mainline pavement placed each production day will be the average of the densities of all that day's sublots.

409.4 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS

District Laboratory Testing: The District Materials Coordinator conducts IA tests on split samples obtained by the Contractor.

Samples are obtained by the Contractor, under the observation of the District Materials Coordinator, according to AASHTO T 2, "Sampling of Aggregate," and split according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size."

The IA tests run by the Contractor can be used for acceptance.

IA testing on split samples will be done once during the first ten tests required of the Contractor. The IA sample will be further split for testing by the QA tester.

If the initial IA testing is acceptable, then one more IA test is required on a split sample at the approximate mid-point of the project and again near the end of the project.

If the initial IA testing is not within specified tolerances, additional samples will be immediately obtained for testing, equipment will be checked, and testing procedures will be reviewed. This will continue until the differences are resolved. The additional IA testing will be performed by the IA tester and the other lab (QC or verification) that is not within the specified tolerance.

Results from the QC, QA, and IA testing will correlate within acceptable tolerances given in the following table.

5/8" - No. 4 sieve	± 5%
No. 30 sieve	± 3%
No. 200 sieve	± 1.5%
Plastic Index	± 2%
Fractured Faces	± 5%
Air Voids	± 1.0%
Maximum Specific Gravity	± 0.020
Lightweight Pieces of Aggregate	± 1%
Aggregate Bulk Sp Gr (dry), each fraction	± 0.040
Aggregate Apparent Sp Gr, each fraction	± 0.040

Dispute Resolution: If the cause of disagreement between the verification and quality control results cannot be determined, the dispute resolution process will be implemented. See Appendix 400-A, "Quality Control Program," for dispute resolution.

Width and Depth Checks: The Contractor, under the observation of the Engineer or Representative, is to provide one full depth core for depth determination. The core will be obtained from one random location per mile as determined by the Engineer or Representative and after the final lift is placed. The core is obtained according to NDDOT 2, "Contractor Coring." The Engineer or Representative takes the width measurements at the same location where the core is obtained.

If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

SECTION 410**HOT BITUMINOUS PAVEMENT
SUPERPAVE VOLUMETRIC MIX DESIGN
FOR QUALITY CONTROL/QUALITY ASSURANCE (QC/QA)****410 DESCRIPTION**

This work consists of constructing one or more courses of bituminous pavement on a prepared surface for QC/QA projects. The Contractor is responsible for process control and performs the necessary testing to control the quality of the work.

410.1 QUALITY CONTROL (QC) SAMPLES AND TESTS DURING AGGREGATE PRODUCTION

Contractor Field Laboratory Testing: During aggregate production the Contractor obtains and splits aggregate samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. The aggregate will be tested for gradation according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate;" and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." The physical properties will be determined according to AASHTO T 304, "Uncompacted Void Content of Fine Aggregate"; AASHTO T 113, "Lightweight Pieces in Aggregate"; ASTM D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"; NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; and AASHTO T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

The testing frequency for gradation will be one test per 1,000 tons of material produced for each aggregate stockpile. The testing frequency for lightweight pieces of aggregate, flat and elongated pieces, and coarse aggregate angularity will be the average of three random composite samples from the first 5,000 tons of material produced.

The testing frequency for the fine aggregate angularity and clay content will be the average of three random samples from the first 5,000 tons of material produced from each stockpile. The fine aggregate angularity and clay content from each stockpile will be combined to determine the final blend results. If all three samples pass, the testing frequency will change to one of three samples tested for each 10,000 tons of material produced.

If a sample fails the remaining two samples will be tested and averaged for acceptance of that lot. The testing frequency will then revert to the average of

three tests per 5,000 tons until all three samples pass, then one of three samples will be tested for each 10,000 tons.

During the first week of aggregate production for each class of aggregate and as soon as the Contractor determines the aggregate is representative, prior to the initial mix design, the Contractor, under the observation of the Engineer or Representative, will obtain a 90-lb sample of each aggregate component. The Contractor obtains and splits the samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. One-half of each aggregate sample will be submitted to the Engineer for testing. The Contractor and the Engineer will test the samples to determine the bulk (dry) and apparent specific gravity and the percent water absorption by dry weight of aggregate. The testing will be completed according to AASHTO T 84, "Specific Gravity and Absorption of Fine Aggregate," and AASHTO T 85, "Specific Gravity and Absorption of Coarse Aggregate." One test will be performed for each 10,000 ton of each aggregate component produced. A minimum of two tests will be required for each aggregate component. Testing will begin within two working days of sampling.

After 10,000 tons of material is produced, the Contractor will develop a preliminary superpave gyratory mix design and submit the results to the District Materials Coordinator or Representative. This mix design is for informational purposes to assure the Contractor has produced specified material. See Appendix 400-B, "Verification of Contractor Mix Designs."

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, will obtain these samples, split them, and submit them to the District Materials Coordinator.

During the first week of aggregate production the district laboratory will test each aggregate stockpile to determine the bulk (dry) and apparent specific gravity and the percent water absorption by dry weight of aggregate. The testing will be completed according to AASHTO T 84, "Specific Gravity and Absorption of Fine Aggregate;" and AASHTO T 85, "Specific Gravity and Absorption of Coarse Aggregate." One test will be performed for each 10,000 ton of each aggregate component produced. A minimum of two tests will be required for each aggregate component.

Materials and Research Laboratory Testing: Determine L.A. abrasion loss percentage according to AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine," on a composite aggregate sample obtained during the beginning of aggregate stockpiling. Materials and Research personnel or a Representative designated by the Materials and Research Division will obtain L.A. samples on NHS projects.

410.2 QUALITY CONTROL (QC) SAMPLES AND TESTS DURING MIX PRODUCTION

QC will be the responsibility of the Contractor.

During production of the bituminous mix, the Contractor will be required to perform random sampling and testing on the aggregate and bituminous mix as the mix is being produced and placed on the roadway.

QC Aggregate: Perform two moisture tests according to AASHTO T 255, "Total Evaporable Moisture Content of Aggregate by Drying," on aggregate the first day and a minimum of one per day thereafter. More tests are required after a rain as determined by the Engineer.

Aggregate will be sampled and tested in lot sizes equal to the number of tons placed each production day. The aggregate gradation specified will be the basis of acceptance.

The Contractor will obtain one aggregate sample from the cold feed belt for each 1,500 ton of mix produced. Aggregate samples are obtained at random times according to AASHTO T 2, "Sampling of Aggregates." The sample is split into two representative samples according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size." The samples will be numbered and bagged by the Contractor, under the observation of the Engineer or Representative. The untested half of the sample will be retained by the Contractor for 24 hours after the test results are made known to the Engineer. Either party may request that the second half of the sample be tested within this 24-hour time frame. The test results from this retest shall replace the test values of the initial test.

The Contractor shall obtain aggregate samples before the addition of the bitumen into the mix. The aggregate samples will be tested according to AASHTO T 113, "Lightweight Pieces in Aggregate"; AASHTO T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"; NDDOT 4, "Percentage of Fractured Particles in Coarse Aggregate"; and AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine."

The shale content and clay content of the aggregate are determined by the average of test results from three random samples obtained from the cold feed belt from each lot of 10,000 tons produced, or fraction thereof. The samples are tested and the material accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits test only one of the three samples from each subsequent lot. If at any time the sample tested does not meet the specified requirements the remaining two samples are tested. The average of the three samples is used to determine acceptance of the material. If an average of three test results is used to

determine the acceptance for a lot, then each subsequent lot shall have all three samples tested. However, the testing can be reduced once again to only one test per subsequent lot after a lot has all three samples within the specified limits.

The percentage of fractured faces for coarse aggregate is determined by the average of test results from three random samples obtained from the cold feed belt from each lot of 10,000 tons of bituminous mixture produced. The samples are tested and the material accepted if the average of three samples meets the specified requirements. If each of the samples is within the specified limits test only one of the three samples from each subsequent lot. If at any time the sample tested does not meet the specified requirements the remaining two samples are tested. The average of the three samples is used to determine acceptance of the material. If an average of three test results is used to determine the acceptance for a lot then each subsequent lot shall have all three samples tested. However, the testing can be reduced once again to only one test per subsequent lot after a lot has all three samples within the specified limits.

QC HMA: The Contractor obtains mix samples from behind the paver according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples." Samples are obtained at random times and random locations as specified by the Engineer. A mix sample is obtained each time an aggregate sample is obtained for sieve analysis.

The Contractor shall compact two gyratory specimens from each sample obtained according to AASHTO T 312, "Preparing and Determining the Density of the HMA Specimens by Means of the Superpave Gyratory Compactor."

The Contractor shall determine the field density from the specimens according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens," and maximum theoretical density according to AASHTO T 209, "Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures." The results are recorded on SFN 50289, "Maximum Density Worksheet."

Each subplot will be one paver-lift wide (excluding the shoulders) by 2,000 feet long and of the depth specified for the pavement. If the partial subplot remaining at the end of the production day is 1,000 feet in length or greater it will be considered a separate subplot. If it is less than 1,000 feet long it will be included in the last complete subplot. If the total day's production is less than 2,000 feet long and one paver-width wide that production is considered a lot. The average density of the mainline pavement placed each production day will be the average of the densities of all that day's sublots.

QC Bitumen: The Contractor, under the observation of the Engineer or Representative, will make random checks of the asphalt content each time a gradation test is performed. The random checks will be based on readings from

the totalizers for the aggregate and the bitumen. Record on SFN 18552, "Daily Report-Hot Bituminous Pavement-Quality Control (No Penalty)."

410.3 QUALITY ASSURANCE SAMPLES AND TESTS

District Field Laboratory Testing: The Engineer will conduct QA tests on independent samples in the field lab.

The Contractor, under the observation of the Engineer or Representative, shall obtain samples from the cold feed belt, bitumen tank, and obtain cores. Samples are obtained according to AASHTO T 2, "Sampling of Aggregates," and NDDOT 2, "Contractor Coring."

The Engineer or Representative shall obtain samples from behind the paver according to NDDOT 5 "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples."

The Engineer will test at an increased rate during the first lot of production to determine the accuracy of the quality control testing. The Engineer will test at a minimum of four tests for the Contractor's first ten tests and then 10% or greater of the frequency required for the Contractor's QC testing.

The Contractor, under the observation of the Engineer or Representative, obtains two pavement cores in each subplot adjacent to each other and at random locations as determined by the Engineer. Cores are obtained according to NDDOT 2, "Contractor Coring." Cores are given to the Engineer for density determination. Density tests are conducted according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface Dry Specimens." The average of the two cores is used to determine the density of the subplot. The results are recorded onto SFN 59132, "Density Pay Factor."

Results from the QC and QA testing will correlate within acceptable tolerances given in the following table.

5/8" and No. 4 sieve	± 7%
No. 30 sieve	± 5%
No. 200 sieve	± 2.5%
Lightweight Pieces	± 3%
Fractured Faces	± 5%
Bulk Specific Gravity (Mix)	± 0.040
Maximum Specific Gravity	± 0.035
Fine Aggregate Angularity	± 3%
Flat and Elongated Pieces	± 3%
Clay Content	± 7%

The Contractor, under the observation of the Engineer or Representative, will make checks for asphalt content each time a gradation test is performed.

District Laboratory Testing: The Contractor, under the observation of the Engineer or Representative, is to provide to the Engineer one full depth core for depth determination. The cores are obtained according to NDDOT 2, "Contractor Coring," at one random location per mile as determined by the Engineer and after the final lift is placed. Width measurements are to be taken at the same location that the cores are obtained. The Engineer tests the cores according to AASHTO T 166, "Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface Dry Specimens."

If a NHS system project, submit a copy of SFN 13889, "Project Records Samples/Tests Report," to the FHWA at the completion of the project for compliance purposes.

410.4 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS

District Laboratory Testing: The District Materials Coordinator conducts IA tests on split samples obtained by the Contractor.

Samples are obtained by the Contractor, under the observation of the District Materials Coordinator, according to AASHTO T 2, "Sampling of Aggregate," and split according to AASHTO T 248, "Reducing Samples of Aggregate to Testing Size."

The IA tests run by the Contractor can be used for acceptance.

IA testing on split samples will be done once during the first ten tests required of the Contractor. The IA sample will be further split for testing by the verification tester. If the initial IA test is acceptable, then one more IA test is required on a split sample at the approximate midpoint of the project and again near the end of the project.

If the initial IA testing is not within specified tolerances, additional samples will be immediately obtained for testing, equipment will be checked, and test procedures will be reviewed. This will continue until the differences are resolved. The additional IA testing will be performed by the IA tester and the other lab (QC or QA) that is not within the specified tolerance.

Results from the QC and IA testing will correlate within acceptable tolerances given in the following table.

5/8" - No. 4 sieve	± 5%
No. 30 sieve	± 3%
No. 200 sieve	± 1.5%
Fractured Faces	± 5%
Air Voids	± 1.0%
Maximum Specific Gravity	± 0.020
Lightweight pieces of aggregate	± 1%
Aggregate Bulk Sp Gr (dry), each fraction	± 0.040
Aggregate Apparent Sp Gr, each fraction	± 0.040
Fine Aggregate Angularity	± 2.5%
Flat and Elongated Pieces	± 2.5%
Clay Content	± 5.0%

Dispute Resolution: If the cause of disagreement between the QA and QC results cannot be determined the dispute resolution process will be implemented. See Appendix 400-A, "Quality Control Program," for dispute resolution.

SECTION 420

BITUMINOUS SEAL COAT

420 DESCRIPTION

This work consists of an application of bitumen followed by an application of cover coat material on a prepared surface.

420.1 ACCEPTANCE SAMPLES AND TESTS WITH A FIELD LABORATORY

Field Laboratory Testing: The Engineer or Representative obtains and splits aggregate samples according to AASHTO T 2, "Sampling of Aggregates," and AASHTO T 248, "Reducing Samples of Aggregate to Testing Size," respectively. Obtain three random samples from each lot of cover coat material for sieve analysis and test according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates," and AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing." Compute the results on SFN 9987, "Aggregate Sample Worksheet." Report gradation results to the District Materials Coordinator on SFN 10072, "Aggregate Quality Tests Summary."

A lot is defined as 1,200 tons of material. If plan quantity is less than 1,200 tons a lot is equal to plan quantity. If the final lot is less than 600 tons include it in the previous lot. If the final lot is greater than 600 tons it is a separate lot.

Obtain one sample of blotter material for sieve analysis for every five miles, or fraction thereof. Obtain the samples from material stockpiled on the project or material that is delivered directly to the project.

Submit an aggregate sample to the Materials and Research Laboratory for L.A. abrasion loss percentage testing.

The Contractor, under the observation of the Engineer or Representative, obtains two samples of bitumen from each load delivered to the project. Samples are obtained according to NDDOT 1, "Sampling of Bituminous Materials." If emulsified asphalt, submit both samples to the District Laboratory. If cutback asphalts, the Engineer submits one sample to the Materials and Research Laboratory and retains one in the field for a check sample.

District Laboratory Testing: Perform the sieve test and the Saybolt viscosity test on emulsion samples according to AASHTO T 59, "Standard Method of Test for Emulsified Asphalts."

The District Materials Coordinator or Representative shall submit two one-gallon samples to the Materials and Research Laboratory from the first half of each project. Retain all samples from the first half of the project until results of tests performed by the Materials and Research Laboratory are reported. Submit an additional set of two one-gallon samples to the Materials and Research Laboratory from the second half of the project. Retain all samples from the second half of the project until test results are reported by the Materials and Research Laboratory.

Materials and Research Laboratory Testing: Perform L.A. Abrasion loss percentage according to AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine," on aggregate samples obtained during aggregate production. Materials and Research personnel or a Representative designated by the Materials and Research Division will obtain L.A. samples on NHS projects.

Test a random asphalt sample from both halves of the project. If the samples pass the entire project is accepted with no further testing. If one sample passes from either half of the project then that half is accepted with no further testing. If one sample fails then all samples from that half of the project are submitted to the Materials and Research Laboratory for testing. The Materials and Research Laboratory will then test samples around the one that does not pass to determine a failing lot size.

The Materials and Research Division reserves the right to test any sample submitted from a project.

420.2 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS WITH A FIELD LABORATORY

District Laboratory Testing: The District Materials Coordinator or Representative obtains one aggregate sample for sieve analysis and shale content determination for every ten miles, or fraction thereof. Tests are conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate"; AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

Materials and Research Laboratory Testing: The two one-gallon samples of emulsified asphalt obtained from each half of the project serve as IA samples.

Perform sieve analysis and shale content determination on one aggregate sample per project. Tests are conducted according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate"; AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing"; and AASHTO T 113,

“Lightweight Pieces in Aggregate.” Compute the results on SFN 9987, “Aggregate Sample Worksheet.”

A sample of blotter sand is not required.

420.3 ACCEPTANCE SAMPLES AND TESTS WITHOUT A FIELD LABORATORY

District Laboratory Testing: In the absence of a field laboratory the district laboratory may perform the acceptance testing. The tests and frequency will be the same as required by Section 420.1, “Acceptance Samples and Tests with a Field Laboratory” at the beginning of this section.

The District Materials Coordinator or Representative obtains and splits aggregate samples according to AASHTO T 2, “Sampling of Aggregates,” and AASHTO T 248, “Reducing Samples of Aggregate to Testing Size,” respectively. Obtain three random samples from each lot of cover coat material for sieve analysis and test according to AASHTO T 27, “Sieve Analysis of Fine and Coarse Aggregates,” and AASHTO T 11, “Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing.” Compute the results on SFN 9987, “Aggregate Sample Worksheet.” Report gradation results on SFN 10072, “Aggregate Quality Tests Summary.”

A lot is defined as 1,200 tons of material. If plan quantity is less than 1,200 tons a lot is equal to plan quantity. If the final lot is less than 600 tons include it in the previous lot. If the final lot is greater than 600 tons it is a separate lot.

Obtain one sample of blotter material for sieve analysis for every five miles, or fraction thereof. Obtain the samples from material stockpiled on the project or material that is delivered directly to the project.

Submit an aggregate sample to the Materials and Research Laboratory for L.A. abrasion loss percentage testing.

420.4 INDEPENDENT ASSURANCE (IA) SAMPLES AND TESTS WITHOUT A FIELD LABORATORY

Materials and Research Laboratory Testing: In the absence of a field laboratory the Materials and Research Laboratory may perform the IA testing. Materials and Research personnel, or a Representative designated by the Materials and Research Division, will obtain L.A. samples on NHS projects. The tests and frequency will be the same as required under the “District Laboratory Testing” portion of the “Independent Assurance Samples and Tests with a Field Laboratory,” in Section 420.2 above.

Perform sieve analysis and shale content determination on the aggregate samples received for every ten miles, or fraction thereof. Tests are conducted

according to AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregate"; AASHTO T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing"; and AASHTO T 113, "Lightweight Pieces in Aggregate." Compute the results on SFN 9987, "Aggregate Sample Worksheet."

A sample of blotter sand is not required.

No additional samples other than those submitted for IA testing are required.

APPENDIX 400-A
QUALITY CONTROL PROGRAM

400-A-1 MATERIAL ACCEPTANCE

Materials will be accepted in one of three ways.

A. Certification

By certification as defined in the NDDOT's "Standard Specifications for Road and Bridge Construction."

B. Testing

1. Acceptance based on testing performed by the NDDOT.
2. The frequency for this testing is defined in the NDDOT's "Field Sampling and Testing Manual."

C. Quality Control/Quality Assurance (QC/QA)

1. Acceptance by Quality Control/Quality Assurance (QC/QA).
2. A QC/QA program is made up of the following sections:
 - a. Acceptance based on Contractor quality control testing as specified in the project contract documents.
 - b. Validation based on verification testing performed by the NDDOT, or its Representative.
 - c. Independent assurance.
 - d. Dispute resolution, if required.

400-A-2 QUALITY ASSURANCE PROGRAM**A. QC Sampling and Testing**

QC testing is performed by the Contractor for material acceptance. The frequency and specific location in the construction process at which QC sampling and testing is to be accomplished will be outlined in the contract documents.

The Contractor's QC program will be conducted by certified personnel as outlined in the applicable NDDOT's Certification Program.

QC samples will be split under the observation of the NDDOT, or its Representative. One quarter of the split QC sample will be retained by the verification testing lab.

Results from the QC and verification testing will correlate within acceptable tolerances given in the following table.

Tolerances between QC and Verification Test Results:

5/8" and No. 4 sieve	± 7%
No. 30 sieve	± 5%
No. 200 sieve	± 2.5%
Plastic Index	± 4%
Lightweight Pieces	± 3%
Fractured Faces	± 5%
Bulk Specific Gravity (Mix)	± 0.040
Maximum Specific Gravity	± 0.035

Included with Superpave projects:

Fine Aggregate Angularity	± 3%
Flat and Elongated Pieces	± 3%
Clay Content	± 7%

In addition, data from the QC and verification testing will be compared using statistical analysis. The F test will be used to compare the standard deviations. The t test will be used to compare the mean values. The data sets must pass both of these tests to be acceptable. Until more data is collected and the NDDOT feels comfortable with the F and t acceptance criteria, the F and t statistical analysis will be used for informational purposes only.

If the results of the NDDOT's verification sampling and testing program do not agree with the QC sampling and testing as performed by the Contractor, the NDDOT, or its Representative, will conduct a review of the quality control and verification procedures, calculations, and equipment to determine the cause of disagreement. If the QC and Verification test results do not agree then the QC samples retained by the verification lab will also be tested. The test results from the QC samples will then be used in determining the acceptance of the material.

B. Verification Sampling and Testing

Verification tests on independent samples are required to confirm the quality of the product and will be accomplished in the following manner:

1. The specific test properties required are outlined in the contract documents provided for the project.

2. The NDDOT, or its Representative, will conduct verification tests on samples taken independent of the Contractor's quality control testing.
3. Samples are obtained by the NDDOT, or its Representative, from a location selected at any point in the process, independent of the Contractor's QC program. These samples may be split by the NDDOT, or its Representative, for testing by the Contractor. The Contractor may not use this test for acceptance. The frequency of verification testing will be four tests for the Contractor's first ten tests and then 10% or greater of the frequency required for the Contractor's QC testing. The results of verification testing will be made available to the Contractor.
4. The NDDOT's verification program will be conducted by certified personnel as outlined in the applicable NDDOT's Certification Program.
5. The NDDOT, or its Representative, will observe the Contractor split QC samples and will take possession of one quarter of the split QC sample. This sample will be retained until verification testing confirms the validity of the QC testing.

C. Independent Assurance (IA) Program

Independent Assurance (IA) testing is required to assure that personnel and equipment are capable of performing tests properly. IA will be accomplished by the following means:

1. The NDDOT, or its Representative, may conduct IA tests on split samples taken by the Contractor, the NDDOT, or its Representative. IA testing on split samples will be done once during the first ten tests required of the Contractor to ensure accuracy of the QC testing. The IA sample will be further split for testing by the Verification Tester. This will be used to ensure the accuracy of the verification testing. The specific test parameters and tolerance limits for comparison of test results will be outlined in the QC/QA specifications found in Section 409 and 410 of NDDOT's "Standard Specifications for Road and Bridge Construction."

- a. Acceptable Initial IA Test.

If the initial IA test is acceptable, then one more IA test is required on a split sample at the approximate mid-point of the project and again near the end of the project.

- b. Unacceptable Initial IA Test.

If the initial IA test is not within specified tolerances, additional samples will be immediately obtained for testing, equipment checks will be conducted, and testing procedures will be reviewed. This will continue until the differences are resolved. The additional IA tests will be performed by the Independent

- Assurance Tester and the other lab (QC or Verification) that is not within the specified tolerance.
2. The NDDOT, or its Representative, will periodically observe tests performed by the Contractor and the Verification Tester.
 3. The NDDOT, or its Representative, will ensure that testing personnel are qualified as outlined in the applicable NDDOT Certification Program.
 4. Periodically, the NDDOT, or its Representative, will evaluate testing equipment by one or more of the following means:
 - a. Calibration checks. Equipment calibration checks will be done at the start of the project and again at the approximate mid-point of the project.
 - b. Split samples.
 - c. Proficiency samples.
 5. Should the difference between the QC, Verification, or IA Tester's split or proficiency sample results be greater than specified, the Engineer will investigate the reason for the difference.
 - a. The investigation may include testing by the NDDOT, or its Representative, of any remaining split samples.
 - b. The investigation may also include review and observation of the Contractor or Verification Tester's sampling and testing procedures and equipment.
 6. Progress samples must be sent to the Materials and Research Laboratory according to the Section 408 frequency guide.
 7. The IA tests run by the Contractor can be used for acceptance.

D. Dispute Resolution Program

If the cause of disagreement between the verification and QC results cannot be determined, a dispute resolution process will be implemented. The material remaining from retained samples will be sent to the NDDOT Materials and Research Laboratory. The Materials and Research Laboratory will investigate testing and sampling procedures, plus review equipment used. The results from the NDDOT Materials and Research Laboratory will be considered final.

E. Project Basis

The Independent Assurance (IA) program will be in effect for each project. With this approach, the NDDOT is not required to supply the FHWA with an annual report summarizing the IA program but IA testing will be required on each project.

F. Materials Certification Letter

The materials certification letter shall be submitted for each construction project that is subject to the FHWA construction oversight activities. This can be combined with the "District's Project Acceptance Letter" sent to FHWA at the end of a project.

The following letter is a guide for materials certification by the NDDOT District Materials Coordinators.

<p>Date _____</p> <p>Project Number _____</p> <p>This is to certify that:</p> <p>The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications.</p> <p>Exceptions to the plans and specifications are explained on the back (or on attached sheet).</p> <p>_____ NDDOT District Materials Coordinator</p>
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400-A-3 SAMPLING AND TESTING FREQUENCY GUIDE

Specification Item Number 409

Independent Assurance (IA) Testing	Verification Testing
<p>IA testing is done by the District Materials Coordinator or as directed by the Materials and Research Division.</p> <p>IA testing on split samples will be done once during the first ten tests required of the Contractor to ensure accuracy of the QC and verification testing.</p> <p>If the initial IA testing is acceptable, then one more IA test is required on a split sample at the approximate mid-point of the project and again near the end of the project.</p> <p>If the initial IA test is not within specified tolerances, then testing will be performed on additional samples immediately obtained after the initial IA test, equipment checks will be conducted, and testing procedures reviewed.</p> <p>Equipment calibration checks will be done at the start of the project and again at the approximate mid-point of the project.</p> <p>The IA tests run by the Contractor can be used for acceptance.</p>	<p>Verification testing is done by the NDDOT or its Representative's field laboratory. The verification tester cannot be the same laboratory used for IA testing.</p> <p>Verification testing will take place at a rate of four tests for the Contractor's first ten and then 10% of the testing required for the Contractor's QC program.</p> <p>Independent samples (IA) are obtained by the NDDOT, or its Representative. A Contractor split sample is not allowed for verification test samples.</p> <p>Where safety is a concern, the Contractor will collect verification samples, under the observation of the Engineer, but the samples will still be independent of the Contractor's QC program. These include belt samples, cores, and bituminous samples.</p> <p>The NDDOT, or its Representative, will observe the Contractor split QC samples and will take possession of one quarter of the split QC sample. This sample will be retained until verification testing confirms the validity of the QC testing.</p>

APPENDIX 400-B

VERIFICATION OF CONTRACTOR MIX DESIGNS

A Contractor mix design will be specified in the plans for a 408, 409 or 410 HMA project. The following Plan Note will be used:

"The mix design will be a laboratory mix design determined by the Contractor and approved by the NDDOT. The mix design will be developed according to NDDOT mix design procedures and will meet the requirements of Section 408, 409, or 410 of the NDDOT Standard Specifications. The mix design will be developed using the aggregate source and asphalt cement that is to be used on the project."

400-B-1 CONTRACTOR REQUIREMENTS FOR VERIFICATION

After 10,000 tons of material is produced and uniform production of each aggregate component is assured, the Contractor shall produce a mix design or series of mix designs until one is developed meeting all requirements specified.

The Contractor shall submit the completed mix design, including all test data, to the appropriate District Materials Laboratory. The mix design report shall be submitted in a NDDOT approved computer format, or using the appropriate State forms for mix designs.

The Contractor shall submit the following materials for mix design verification testing:

1. During aggregate production, the Contractor will supply the district with a 90-lb sample from each aggregate component to determine the physical properties, bulk (dry) and apparent specific gravity, and the percent water absorption by dry weight of the aggregate.
2. An aggregate sample representing each stockpile used for the Contractor mix design. The combined sample will be approximately 150 lbs for either a Marshall or Superpave project. The target value on each sieve for the mix design shall be the average of production samples multiplied by the percentage of material used in the blend proportion. The blended sample will be used for the verification mix design if the gradations obtained from the blended sample are within the tolerances listed in the following table when compared to the target values.

Marshall or Superpave Projects:

5/8" - No. 4 sieve	± 5%
#30 sieve	± 3%
#200 sieve	± 1.5%

3. Eight one-quart cans of PG asphalt. The PG asphalt will be the same type and grade as specified on the plans and from the supplier that will be used on the project. When two types of PG asphalt are specified, the Contractor can supply either type but it must be the same type used for the original mix design.
4. Approximately 30 lbs of loose asphaltic concrete mix prepared at the optimum asphalt content recommended by the mix design.
5. The mix design Job Mix Formula (JMF) submitted by the Contractor will contain the following elements:
 - a. The percentage of aggregate passing each of the specified sieves.
 - b. The percent asphalt cement to be added to the mixture.
 - c. The target air voids will be 4%.
 - d. The maximum specific gravity of the mixture obtained in the laboratory.
 - e. The bulk specific gravity of the mixture obtained in the laboratory.
 - f. The percent VMA of the mixture obtained in the laboratory.
 - g. The stability and flow of the mix (Marshall only).
 - h. Calculated film thickness (microns).
 - i. Calculated dust/asphalt ratio.
 - j. %G_{mm} @ N_{ini} (Superpave only).
 - k. %G_{mm} @ N_{max} (Superpave only).

400-B-2 DISTRICT MATERIALS LABORATORY REQUIREMENTS FOR VERIFICATION

The district will verify the physical properties, the bulk (dry) and apparent specific gravity, and the percent water absorption by dry weight of the aggregate from samples supplied by the Contractor during aggregate production.

The district will verify the Contractor mix design by any or all of the following procedures:

1. A full mix design utilizing the virgin aggregate and blend supplied by the Contractor.
2. HMA specimens developed at the Contractor mix design optimum asphalt content, and made up of the virgin aggregate and blend supplied by the Contractor.
3. HMA specimens developed from loose asphaltic concrete mix prepared at the optimum asphalt content recommended by the Contractor mix design.
4. Historic data from past projects utilizing the same aggregate source.

The Contractor's mix design will be approved if the district's verification testing confirms that the Contractor's mix design results are within the tolerances shown in the following table:

Acceptable Tolerance for Contractor Mix Design Verification

Marshall Projects:

Plastic Index	± 2%
Fractured Faces	± 5%
Lightweight Pieces of Aggregate	± 1%
Aggregate Bulk SpGr (dry), each fraction	± 0.040
Aggregate Apparent SpGr, each fraction	± 0.040
Air Voids	± 1.0%
Maximum SpGr	± 0.030

Superpave Projects:

Fractured Faces	± 5%
Lightweight Pieces of Aggregate	± 1%
Aggregate Bulk SpGr (dry), each fraction	± 0.040
Aggregate Apparent SpGr, each fraction	± 0.040
Fine Aggregate Angularity	± 1%
Flat and Elongated Pieces	± 1%
Clay Content	± 5%
Air Voids	± 1.0%
Maximum SpGr	± 0.030

If the Contractor's mix design is not approved, the Contractor shall submit another mix design. An approved mix design will be required prior to beginning production of hot bituminous pavement.

APPENDIX 400-C

NDDOT TESTING TOLERANCE, RESOLUTION PROCEDURE AND MODIFICATIONS FOR TEST PROCEDURES

400-C-1 ALLOWABLE TOLERANCE

Allowable tolerance from split companion sample, between Contractor (or representative) and NDDOT test results:

$$G_{sb} \text{ (aggregate bulk specific gravity individual component)} = 0.040$$

If the contractor's test results meet tolerance as verified by the NDDOT testing, the contractor's specific gravity numbers will be used to calculate the mix design properties.

400-C-2 RESOLUTION PROCEDURE

Resolution procedure when tolerance is not met:

1. Obtain a second split companion sample. Prior to testing this new sample, review with contractor and agency lab the procedures and testing practices to insure consistent methods are used. If the contractor's specific gravity numbers are within tolerance as verified by the NDDOT testing, use the contractor's numbers to calculate the mix design properties.
2. When a second sample fails to meet allowable tolerance procedures, obtain another sample large enough to be a split companion with a third party. The third party will be the NDDOT Materials and Research Lab. The final three tests of the third sample will be analyzed according to the precision statement set forth in AASHTO T 84 and T 85. The average of the acceptable tests from the final set will be used to determine the mix design properties.

400-C-3 FINE AND/OR COARSE SPECIFIC GRAVITY TEST DECISION

1. If 85% or more of the individual aggregate passes the 4.75 mm (No. 4) sieve, test for fine aggregate specific gravity only. Do not wash out the material passing the 0.075 mm (No. 200) sieve.
2. If less than 15% of the aggregate passes the 4.75 mm (No. 4) sieve, test for coarse aggregate specific gravity only.
3. If an individual aggregate has a value between 15 - 85% passing the 4.75 mm (No. 4) sieve, test for both coarse and fine aggregate specific gravity. Do not wash the material passing the 0.075 mm (No. 200) sieve.

4. When the fine aggregate slumps slightly (25 - 75% of the cone's upper surface area) it indicates that it has reached a surface-dry condition.

400-C-4 FINE AGGREGATE TEST MODIFICATIONS

Experience has indicated for some 9.5 mm (3/8") minus pea rock, 100% crushed fine, and other similar materials it is difficult to obtain a minus 4.75 mm (No. 4) fine aggregate specific gravity that is accurate and reproducible. Do the following when these types of material are encountered:

1. Split the materials on the 2.36 mm (No. 8) sieve instead of the 4.75 mm (No. 4) sieve.
2. Use the 15% rule described above for determining whether both the fine aggregate and coarse aggregate specific gravity need to be tested.
3. Use the pan method option described in the AASHTO T 84 test method to determine the SSD weight.

APPENDIX 400-D

PROCEDURE FOR SAMPLING AND TESTING EMULSIFIED ASPHALT

400-D-1 DESCRIPTION

The following is a description of the NDDOT's procedure for sampling and testing emulsified asphalt materials.

400-D-2 SAMPLE DEFINITION

A sample is defined as two 1/2-gallon plastic, screw top containers filled with the material to be tested. The first 1/2-gallon is tested as the original sample and the second 1/2-gallon is used as a check, if the original sample fails.

400-D-3 PROJECT ENGINEER REQUIREMENTS

- The project Engineer will monitor any emulsion to determine whether there are any problems with pumping it from the transport.
- The Project Engineer will observe the construction sequence to determine if the distributor spray bar is plugging, or if there is any streaking of the spray pattern.
- Any other construction problems attributed to the emulsion will be reported.
- When construction problems are found, the District Materials Coordinator will immediately be informed so that sieve and Saybolt viscosity testing can begin at the frequency specified in the NDDOT Sampling and Testing Manual.

400-D-4 PROJECT SAMPLING AND TESTING

- Project personnel will continue to sample each truck load delivered to the project.
- Each sample will be retained until all testing is completed.
- The sieve and Saybolt viscosity will not be tested unless the Project Engineer along with the District Materials Coordinator determines that there is a consistency problem with the emulsion.
- When emulsion problems are encountered, the District lab will test the Saybolt viscosity and sieve from the truck load delivered at the time problems were encountered. Testing will continue on subsequent trucks around the one that does not pass to determine a failing lot size.
- One emulsion sample is randomly selected from the first and second halves of the project and sent to the Materials and Research Division Laboratory for assurance testing. Do not do this for tack samples.

400-D-5 MATERIALS AND RESEARCH DIVISION TESTING

- The Materials and Research Division Laboratory test the random samples from both halves of the project. If the samples pass, the entire project is accepted with no further testing.
- The Materials and Research Division Lab will inform the District when sample submittal is required due to failing tests.
- The Materials and Research Division Lab will then test samples around the one that does not pass to determine a failing lot size.

APPENDIX 400-E

BITUMINOUS MATERIAL SAMPLING AND TESTING FREQUENCY

400-E-1 DESCRIPTION

The following is a description of the NDDOT's procedures for sampling and testing Performance Graded (PG) asphalt cement, asphalt cutbacks, and crack and joint sealants at the District level and at the Materials and Research Division Laboratory.

400-E-2 PERFORMANCE GRADED ASPHALT CEMENT

Sample Definition:

- A sample is defined as two 1-liter metal, screw-top containers filled with the material to be tested. One liter is tested as the original sample and the second liter is used as a check if the original fails.

District Sampling and Testing:

- NDDOT project personnel will observe the contractor obtain samples from material delivered to the job site.
- The sampling rate will be a minimum of one sample for every 250 tons for each supplier and grade of asphalt cement, or fraction thereof.
- The sample shall be taken randomly within each 250 tons of material.
- A sample will consist of taking two 1-liter samples from the designated transport.
- Both samples will be sent to the NDDOT Materials and Research Laboratory.
- Label each sample can with the following information:
 - Project number
 - PCN number
 - Date sampled
 - Field sample number
 - Manifest number
 - Manufacturer
 - Grade of asphalt
 - Original or check
- Project personnel will also obtain samples as directed by the project engineer at any time extra samples are determined to be necessary.

Materials and Research Laboratory Testing:

- The Materials and Research Lab will randomly test one sample from each lot of four delivered.
- The testing will be the full battery of tests required by AASHTO M 320.

400-E-3 ASPHALT CUTBACKS

Sample Definition:

- A sample is defined as two 1-liter metal, screw-top containers filled with the material to be tested. One liter is tested as the original sample and the second liter is used as a check if the original fails.

District Sampling and Testing:

- NDDOT project personnel will observe the contractor obtain samples from material delivered to the job site
- Obtain two 1-liter samples of cutback from each load delivered to the project.
- Submit one sample to the Materials and Research Division Laboratory and keep one in the field for a check sample.
- Label each sample can with the following information:
 - Project number
 - PCN number
 - Date sampled
 - Field sample number
 - Manifest number
 - Manufacturer
 - Type of cutback asphalt
 - Original or check
- Project personnel will also obtain samples as directed by the project engineer at any time extra samples are determined to be necessary.

Materials and Research Laboratory Testing:

- The Materials and Research Lab will test each sample delivered from the project.
- The testing will be the full battery of tests required by AASHTO for the type of cutback delivered.

400-E-4 CRACK AND JOINT SEALANTS:

District Sampling and Testing:

- The District will sample each lot of crack and joint sealer delivered to the project.
- The sample will consist of two boxes if the material is delivered in 30 pound single sample boxes.
- The sample will consist of one box if the material is delivered in 55 pound double sample boxes.
- All crack and joint sealers shall be submitted in the manufacturer's original unopened container.
- Completely fill out crack and joint sealer sample card and submit it with the sample.

Materials and Research Laboratory Testing:

- The Materials and Research Lab will test one sample brick from material delivered from the project.
- The testing will be the full battery of tests required by AASHTO and ASTM standards for the type of material delivered.

SECTION 400 FORMS

AGGREGATE SAMPLE WORKSHEET

North Dakota Department of Transportation, Materials & Research
SFN 9987 (Rev. 07-2007)

PCN
Laboratory No.
Field Sample No.
Pit Location
Owner
Project
County
Material/Specification
Date Received
Date Sampled
Sampled From
Submitted By

(mm)	Ret.	Wt. Ret.		% Ret.	% Pass	ND Spec.
		Non-Cum.	Cum.			
100	4"					
90	3 1/2"					
75	3"					
63	2 1/2"					
50	2"					
37.5	1 1/2"					
25.0	1"					
19.0	3/4"					
16.0	5/8"					
12.5	1/2"					
9.5	3/8"					
4.75	No. 4					
Minus No. 4						
Wt. Check						
Original Wt.						

AASHTO T-27 Tested By: _____

FRACTURED FACES

FF = Percentage of particles with fractured faces
 WF = Weight of fractured particles
 WQ = Wt. of questionable fract. particles
 WA = Weight of total sample
 $FF = [WF + (WQ/2)]/WA \times 100$
 FF =
 ND Spec

(mm)	Ret.	Wt. Ret.		% Ret.	% Pass	% Pass Tot. Smpl.	ND Spec.
		Non-Cum.	Cum.				
2.36	No. 8						
2.00	No. 10						
1.18	No. 16						
600µm	No. 30						
425µm	No. 40						
300µm	No. 50						
150µm	No. 100						
75µm	No. 200						
Minus No. 200							
Original Wt.							
Wt. After Wash							
Wash Loss							
Wt. Check							

Tested By: _____

AASHTO T-27 Tested By: _____

AASHTO T-11 Tested By: _____

LIGHTWEIGHT PIECES

+ No. 4 Material

- No. 4, + No. 30 Material

(A) % Retained on No.4 Sieve = %	(I) Weight of Lt Wt Pieces, -No. 4, + No. 30 Mtrl. = g
(B) % Passing No. 30, Total Sample = %	(J) Weight of - No. 4, + No. 30 Material = g
(C) % Pass No. 4 - % Pass No. 30, [100-(A+B)] = %	(K) Lt Wt Pieces, - No. 4, + No. 30 (I/J)x100 = %
(D) Total Sample A+B+C = 100.0 %	(L) Lt Wt Pieces, - No. 4, + No. 30 Material % of Total Sample (KxC)/100 = %
(E) Weight of Lt Wt Pieces in + No. 4 Mtrl. = g	
(F) Weight of + No. 4 Material = g	
(G) Lt Wt Pieces, + No. 4 Mtrl (E/F)x100 = %	
(H) Lt Wt Pieces, + No. 4 Mtrl., % of Total Sample (GxA)/100 = %	
	(M) Lightweight Pieces in Total Sample (H+L) = %

AASHTO T-113 Tested By: _____

* Attention Advised

Distribution:

_____ District
 _____ Central Lab.

Date

Testing Lab Supervisor

Laboratory Number

Liquid Limit, Plastic Limit, and Plasticity Index

Liquid Limit

A. Can no.	tare weight	
B. Can and wet soil		
C. Can and dry soil		
D. Moisture loss (B - C)		
E. Dry soil weight (C - A)		
F. Moisture at blows (D/E) x 100		
	Moisture corrected (F x K)	
G. Liquid Limit		

AASHTO T 89 tested by: _____

#Blows

--

Number of blows N	Factor for Liquid Limit K
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014

Plastic Limit

H. Can No.	tare weight	
I. Can and wet soil		
J. Can and dry soil		
L. Moisture loss (I - J)		
M. Dry soil weight (J - H)		
	Moisture content (L/M) x 100	
O. Plastic Limit		
	Plastic Index (G - O)	

AASHTO T 89 tested by: _____

LA Abrasion

Grading Used:	<input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D	(indicate by circling)
Weight of original sample	(A) =	grams
Weight of sample retained on No. 12	(B) =	grams
Loss	(C) =	grams
LA Abrasion = C/A x 100	=	% Loss

AASHTO T-96 Tested By: _____

Unit Weight

Wt. Loose, lbs	lbs/cf
Wt. Rodded, lbs	lbs/cf

AASHTO T-19 Tested By: _____

MIX BITUMEN CUT-OFF REPORT

North Dakota Department of Transportation, Construction Services
SFN 9988 (Rev. 12-2001)

		Type of Bitumen
Contractor		Project
Report Number	Covering Period (Date and Time) From _____ to _____	

BITUMEN IN STORAGE (Begin this Report):

Tank No.	Hot Gallons	Temp. °F	Vol. Corr. Factor	Gallons @ 60°F	
					UNIT WEIGHT DATA @ 60° F (from Refinery or Testing Lab.) Specific Gravity Lbs./Gal. _____ * (SG x 8.33)

(Total Gals. @ 60°F = _____) x (* _____ Lbs./Gal.) = _____ Tons ^A

ADD: BITUMEN DELIVERED THIS REPORT:

Ticket No.	Lbs.	Ticket No.	Lbs.	Ticket No.	Lbs.	Ticket No.	Lbs.

(Total Bitumen Delivered = _____ Lbs.) ÷ 2,000 = _____ Tons ^B

LESS: BITUMEN IN STORAGE (End this Report):

Tank No.	Hot Gallons	Temp. °F	Vol. Corr. Factor	Gallons @ 60°F

(Total Gals. @ 60° F = _____) x (* _____ Lbs./Gal.) = _____ Tons ^C

LESS: BITUMEN USED FOR ITEMS OTHER THAN MIX:

(Tack, Fog, Non-pay/Priv. Use, Waste, etc.)

(_____) x (* _____ Lbs./Gal.) = _____ Tons ^D
 Gals. @ 60° F 2,000

TOTAL: BITUMEN USED FOR ALL MIX PRODUCED THIS REPORT: A + B - C - D = _____ Tons ^E

WET MIX PRODUCED THIS REPORT: Per Haul Sheet Nos. _____

(Pay Qty. _____ Tons ^F) + (Waste, Non-pay/Priv. Use _____ Tons ^G) = _____ Tons ^H
Average Percent Bitumen in Wet Mix = (E ÷ H) X 100 = _____ % ^I
Waste, Non-pay/Private Use Bitumen for Mix = (G X 1) = _____ Tons ^J
Estimated Net Pay Quantity Bitumen for Mix = (E - J) = _____ Tons ^K

Remarks:

DISTRIBUTION:

Original - Engineer
Copies - Contractor

Plant Inspector

Engineer

ASPHALT CONTENT & VIRGIN AGGREGATE DETERMINATION

North Dakota Department of Transportation, Construction

SFN 18674 (Rev. 04-2000)

Date

Project	Contractor	
Scheduled Hours	Target Ac Content	Target Virgin Aggr. %

Test No.	TIME		(1) Aggr. Tons Rdg.	(2) Salv. Bit. Tons Rdg.	% VIR. AGGR. = (1) / (1) + (2)	(3) BITUMEN	(4) Wt. Per Gal.	(5) AC TONS	(6) AC Percent Added
	Random Number	Test Time	(Dry Tons)	(Dry Tons)	(Dry Tons)	Flow Meter Reading (Gal)		Tons Used = (3)x(4) /2000	= (5) / (1)+(2)+(5)
1									
2									
3									
4									

CUTOFF REPORT COMPARISON	Totalizer Cutoff								
	Totals from the Cutoff Report	Total Mix Produced = _____			Total Bitumen Used = _____				

AVERAGE VIRGIN AGGR. %
 SUM %
 NUMBER = _____

REMARKS
_____ Inspector's Signature

ASPHALT CONTENT & VIRGIN AGGREGATE DETERMINATION

This form is used to determine the asphalt content and the percent of virgin aggregate of the mix during the production day.

Bitumen content uniformity specifications call for the bitumen content to be determined 4 times during a full production day. The pay quantity for virgin aggregate added to recycled mix is determined by the percentage of virgin aggregate used based on plant settings. This form is set up to allow the determination of the asphalt content and the percentage of virgin aggregate at the same time. If the plant is down at the time called for by the random numbers, but the plant starts up again and continues running, take another cutoff as soon as production has stabilized and note the new test time on the form.

EXPLANATION OF COLUMNS:

Column (1) This information is taken from the totalizer. If the total is continuous, the reading when the plant starts will have to be recorded. The totalizer reading should be Zeroed out or read and recorded after dry batching and before production starts.

Column (2) This information is also taken from the totalizer.

% virgin aggregate is determined by dividing the virgin aggregate tons used during the period by the sum of virgin aggregate and salvage bituminous material used during the period. The percentages are added and the average percentage computed.

Column (3) This information is taken from the totalizer. Some plants will read in tons. This information will not have to be converted. Tons reading can be recorded in Column (5)

Column (4) Asphalt weight-per-Gallon is listed on the manifests. This should be the same as the plant setting.

Column (5) Compute the tons Used $(5) = \frac{(3) \times (4)}{2000}$

Column (6) Compute the asphalt percentage. The aggregate tons do not include the asphalt and must be added to the aggregate.

Average Virgin Aggregate %

Compute the average percent of virgin aggregate by adding test results and dividing by the number of test taken. Do not use the final totalizer cut off values to compute the average.

Check with the plant operator to determine if the totalizer reads in wet tons or dry tons. It may be necessary to compute dry tons before entering the tonnage onto the form.

MAXIMUM DENSITY WORKSHEET

North Dakota Department of Transportation, Construction
SFN 50289 (Rev. 03-2003)

Project Number		Contractor		Date	Time
Test Number	Lot Number		Daily Tons	Total Tons	
Station		Lane		Lift	

FIELD PLUGS

PLUG NO.	WEIGHT IN AIR (A)	WEIGHT IN WATER (B)	WEIGHT SAT. SURF (C)	VOLUME C-B = D (D)	BULK SP. GR. $\frac{A}{D} = E$

AVERAGE BULK SP. GR. (F) = _____
DENSITY (F x 62.4) PCF _____

MAXIMUM MIX DENSITY

FLASK NUMBER			
G. SAMPLE CONTAINER & SOLUTION:			
H. CONTAINER & SOLUTION:			
I. SAMPLE IN SOLUTION (G-H)			
J. SAMPLE IN AIR			
K. VOLUME OF VOIDLESS MIX (J-I)			
L. MEAS. MAX. SPEC GRAVITY (J/K)			
M. MAX. THEOR. DENSITY (62.4 X L)			

PERCENT AIR VOIDS
 $\% \text{ AIR VOIDS} = \frac{L-F}{L} \times 100 = (\text{_____} - \text{_____}) 100 = \text{_____} \% \text{ AIR VOIDS}$

AGGREGATE BLEND PROPORTIONS	AC CONTENT: _____																
<table border="0"> <tr><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> </table>	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	NOTES
_____	_____	_____	_____														
_____	_____	_____	_____														
_____	_____	_____	_____														
_____	_____	_____	_____														

Inspectors Signature

DENSITY PAY FACTOR

North Dakota Department of Transportation, Construction
 SFN 59132 (06-2009)

Date Paved	Lot Number	Project Number
------------	------------	----------------

SPECIFIED DENSITY

MAXIMUM THEORETICAL DENSITY			SAMPLE TONS	MTD TESTS	FIELD MARSHALL PLUGS	
SUBLOT NO.	BEG TONS	RANDOM NO.			DENSITY	AIR VOIDS
AVERAGE						

CORE DENSITY (AVERAGE OF 2)

AVERAGE PAVEMENT DENSITY _____ LBS / CU. FT.

AVERAGE PAVEMENT DENSITY (% MTD)

$\frac{\text{AVG. PAVEMENT DENSITY}}{\text{MTD TEST AVG}} \times 100 =$

PAYFACTOR

TARGET DENSITY (% MTD) _____

Inspectors Signature
