

**FIELD SAMPLING AND TESTING MANUAL**

**SECTION 400**

**BITUMINOUS PAVEMENTS**

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**Reference Forms:**

SFN 9987 Aggregate Sample Worksheet  
SFN 9988 Mix Bitumen Cut-Off Report  
SFN 10072 Aggregate Quality Tests Summary  
SFN 13889 Project Records Samples/Tests Report  
SFN 18552 Daily Report - Hot Bituminous Pavement - Quality Control  
SFN 18674 Asphalt Content & Virgin Aggregate Determination  
SFN 50289 Maximum Density Worksheet  
SFN 59132 Density Pay Factor

**All test procedures used within and referred to in this section can be found under “Testing Procedures” of this manual.**

**Only use the current forms off of the NDDOT website under “Forms” instead of the blank copies found at the end of each section. The copies placed in this manual are for reference only and are not updated regularly.**

**Section 401  
Prime, Tack, or Fog Coat**

**401.01 Description.**

This work consists of treating a surface with cut-back or emulsified asphalt material.

**401.02 Acceptance Samples and Tests.****A. Engineer Responsibility.**

Bitumen:

Under the observation of the Engineer, the Contractor will obtain a sample, which is two containers, of bitumen from each load delivered to the project following NDDOT 1, "Sampling of Bituminous Materials."

For emulsion samples received from the Contractor, the Engineer will submit all samples to the District Materials Coordinator.

For cutback asphalt samples received from the Contractor, the Engineer will submit one container sample to Materials and Research and retain one container as a check.

Aggregate:

The Engineer will obtain and split aggregate samples according to ND T 2, "Sampling of Aggregate," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

The Engineer will obtain these samples from material placed in a stockpile or material delivered directly to the project. Table 401-1 shows test method and frequency for aggregate testing.

Table 401-1	
Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per 5 miles or fraction thereof.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per 5 miles or fraction thereof.

Compute the sieve analysis results on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary."

Water:

Obtain one sample per water source according to Section 812 of the NDDOT *Standard Specifications for Road and Bridge Construction* and submit to Materials and Research.

### **B. District Materials Coordinator Responsibility.**

For emulsified asphalt samples, the District Materials Coordinator will test for sieve and viscosity only, according to tests listed in AASHTO T 59, "Emulsified Asphalts." The sieve and viscosity tests may be waived if the Engineer determines there is not a consistency problem with the emulsion.

Testing frequency for emulsion testing is the first truck load delivered to the project and then one random sample from the next four trucks delivered. The testing frequency then goes to two random samples from each additional five truck lot, or fraction of a five truck lot.

### **C. Materials and Research Responsibility.**

For emulsified asphalts, Materials and Research tests the random 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 Materials and Research for testing.

Materials and Research will inform the District when sample submittal is required due to failing tests.

Materials and Research will then test samples around the one that does not pass to determine a failing lot size. For example, using Table 401-2 below there are four loads of emulsion delivered during the first half of a project and five loads for the second half of the project:

Table 401-2				
First Half of Project				
Sample 1	Sample 2	Sample 3	Sample 4	
Second Half of Project				
Sample 5	Sample 6	Sample 7	Sample 8	Sample 9

- The District submits Sample 3 and Sample 7. Sample 3 from the first half passes and all material from the first half is accepted with no further testing.

- Sample 7 from the second half fails so Materials and Research will test Samples 6 and 8. If Sample 6 passes, Sample 5 is accepted with no further testing.
- If Sample 8 fails, Sample 9 is tested. If Sample 9 passes, the failing lot size is made up of loads 7 and 8.

Perform testing on all cutback asphalt samples, submitted by the Engineer, according to Section 818 of the NDDOT *Standard Specifications for Road and Bridge Construction*.

Test submitted water samples according to the requirements of Section 812 of the NDDOT *Standard Specifications for Road and Bridge Construction*.

### **401.03 Independent Assurance (IA) Samples and Tests.**

#### **A. Engineer Responsibility.**

*Reserved.*

#### **B. District Materials Coordinator Responsibility.**

Bitumen:

For all emulsions, one sample is randomly selected from each of the first and second halves of the project and sent to Materials and Research.

Samples should be submitted in a timely manner because there is a time frame in which testing can be done.

Aggregate:

The District Materials Coordinator will obtain and split samples according to ND T 2, "Sampling of Aggregate," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

The District Materials Coordinator will obtain these samples from material placed in a stockpile or material delivered directly to the project. Table 401-3 shows the test method and frequency for aggregate produced.

Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per 10 miles or fraction thereof.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per 10 miles or fraction thereof.

Table 401-4 shows the allowable tolerances between the IA and acceptance samples.

Table 401-4	
Test	Tolerance
ND T 11, Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing, ND T 27, "Sieve Analysis of Fine and Coarse Aggregates":	
5/8 inch sieve	±7%
No. 4 sieve	±7%
No. 200 sieve	±2.5%

### C. Materials and Research Responsibility.

Bitumen:

Tests and frequency for IA for viscosity and sieve are shown in Table 401-5.

Table 401-5	
Test	Frequency
AASHTO T 59, "Emulsified Asphalts"	2 test results per project.

Tolerance between IA and acceptance tests are in Table 401-6.

Table 401-6	
Test	Tolerance
AASHTO T 59, "Emulsified Asphalts":	
Sieve	±0.08%
Viscosity	25° C ±15%
	50° C ± 21%

If the IA testing is not within specified tolerances, the District Materials Coordinator obtains an additional sample for testing.

The District Materials Coordinator and Materials and Research personnel will examine equipment used and review testing procedures. This will continue until the differences are resolved.

**Section 411  
Milling Pavement Surface**

**411.01 Description**

This work consists of milling pavement surface.

**411.02 Acceptance Samples and Tests**

Sampling and testing not required.

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## Section 420 Bituminous Seal Coat

### 420.01 Description.

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

### 420.02 Acceptance Samples and Tests with a Field Laboratory.

#### A. Engineer Responsibility.

Bitumen:

Under the observation of the Engineer, the Contractor will obtain a sample, which is two containers, of bitumen from each load delivered to the project following NDDOT 1, "Sampling of Bituminous Materials."

For emulsion samples received from the Contractor, the Engineer will submit all samples to the District Materials Coordinator.

Aggregate:

The Engineer shall obtain three random samples from each lot of cover coat material for testing. Obtain and split aggregate samples according to ND T 2, "Sampling of Aggregate" and ND T 248, "Reducing Samples of Aggregate to Testing Size." Table 420-1 shows test method and frequency.

Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	*1 test result per lot.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	*1 test result per lot.

\*Definition of a lot:

- 1,200 tons of material.
- Plan quantity, if plan quantity is less than 1,200 tons.
- If final lot is less than 600 tons include it in the previous lot.
- If final lot is greater than 600 tons it is a separate lot.
- Lots continue from day to day. Each day does not start a new lot.

Test all samples from the lot and determine acceptance of the lot based on the average of the tests.

Obtain one sample of blotter material for every five miles or fraction thereof. Obtain these samples from material placed in a stockpile or material delivered directly to the project. Table 420-1 lists the tests to be conducted.

Compute the sieve analysis on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary."

Submit an aggregate sample to Materials and Research for L.A. Abrasion according to AASHTO T 96.

## **B. District Materials Coordinator Responsibility.**

Bitumen:

The District Materials Coordinator will test the emulsified asphalt samples for sieve and viscosity only according to tests listed in AASHTO T 59, "Emulsified Asphalts."

The sieve and viscosity tests may be waived if the Engineer determines there is not a consistency problem with the emulsion.

For all emulsions, one sample is randomly selected from the first and second halves of the project and sent to Materials and Research for testing.

Aggregate:

Table 420-2 shows test method and frequency.

Table 420-2	
Test	Frequency
ND T 113, "Lightweight Pieces of Aggregate"	*1 test result per lot.

\*Definition of a lot:

- Lot is every 10 miles or fraction thereof.

## **C. Materials and Research Responsibility.**

Bitumen:

Materials and Research tests the random 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 Materials and Research for testing.

Materials and Research will inform the District when sample submittal is required due to failing tests.

Materials and Research will then test samples around the one that does not pass to determine a failing lot size. For example, using Table 420-3 there are four loads of

emulsion delivered during the first half of a project and five loads for the second half of the project.

Table 420-3				
First Half of Project				
Sample 1	Sample 2	Sample 3	Sample 4	
Second Half of Project				
Sample 5	Sample 6	Sample 7	Sample 8	Sample 9

- The District submits Sample 3 and Sample 7. Sample 3 from the first half passes and all material from the first half is accepted with no further testing.
- Sample 7 from the second half fails so Materials and Research will test Samples 6 and 8. If Sample 6 passes, Sample 5 is accepted with no further testing.
- If Sample 8 fails, Sample 9 is tested. If Sample 9 passes, the failing lot size is made up of loads 7 and 8.

Aggregate:

Perform L.A. Abrasion, AASHTO T 96, on a sample obtained during aggregate production.

Table 420-4 shows test method and frequency.

Table 420-4	
Test	Frequency
AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"	*1 test result per project.

\*If the aggregate source has been tested previously by the Department and the material is within allowable limits, the test for L.A. Abrasion will not be required.

### 420.03 Independent Assurance (IA) Samples and Tests with a Field Laboratory.

#### A. Engineer Responsibility.

Conduct IA tests on split samples taken by the District Materials Coordinator. Testing performed will be as directed by the District Materials Coordinator.

#### B. District Materials Coordinator Responsibility.

Bitumen:

If the District Materials Coordinator conducts a test for sieve and viscosity according to tests listed in AASHTO T 59, "Emulsified Asphalts," then for IA another sample is

tested and the remaining sample is submitted to Materials and Research.

Aggregate:

The District Materials Coordinator will obtain aggregate samples. These samples will be an equal split sample with the Engineer.

The District Materials Coordinator shall obtain and split aggregate samples according to ND T 2, "Sampling of Aggregate," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

Table 420-5 shows test method and frequency.

Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per 10 miles or fraction thereof.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per 10 miles or fraction thereof.

Compute the sieve analysis on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary."

Table 420-6 shows the tolerance between IA and acceptance tests.

Test	Tolerance
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing, and ND T 27, "Sieve Analysis of Fine and Coarse Aggregates":	
3/8 inch sieve	±7%
No. 4 sieve	±7%
No. 8 sieve	±7%
No. 200 sieve	±2.5%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The Engineer and District Materials Coordinator will examine equipment used and review testing procedures. This will continue until the differences are resolved.

A sample of blotter material is not required.

### C. Materials and Research Responsibility.

If the District Materials Coordinator has conducted a test for sieve and viscosity according to tests listed in AASHTO T 59, "Emulsified Asphalts," then an IA must be completed.

Table 420-7 shows test method and frequency for IA.

Test	Frequency
AASHTO T 59, "Emulsified Asphalts"	1 test result per project.
ND T 113, "Lightweight Pieces of Aggregate"	1 test result per project.

Table 420-8 shows the tolerance between IA and acceptance tests.

Test	Tolerance
AASHTO T 59, "Emulsified Asphalts": Sieve	±0.08%
Viscosity	25° C ±15% 50° C ± 21%
ND T 113, Lightweight Pieces in Aggregate	±3%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

#### **420.04 Acceptance Samples and Tests without a Field Laboratory.**

##### **A. Engineer Responsibility.**

Under the observation of the Engineer, the Contractor will obtain a sample, which is two containers, of bitumen from each load delivered to the project following NDDOT 1, "Sampling of Bituminous Materials."

For emulsion samples received from the Contractor, the Engineer will submit all samples to the District Materials Coordinator.

##### **B. District Materials Coordinator Responsibility.**

Bitumen:

The District Materials Coordinator will test the emulsified asphalt samples for sieve

and viscosity only according to tests listed in AASHTO T 59, "Emulsified Asphalts."

The sieve and viscosity tests may be waived if the Engineer determines there is not a consistency problem with the emulsion.

For all emulsions, one sample is randomly selected from the first and second halves of the project and sent to Materials and Research for testing.

Aggregate:

Obtain three random samples from each lot of cover coat material. Obtain and split aggregate samples according to ND T 2, "Sampling of Aggregate," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

Test all samples from the lot and determine acceptance of the lot based on the average of the tests. Table 420-9 shows test method and frequency.

Table 420-9	
Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	*1 test result per lot.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	*1 test result per lot.
ND T 113, "Lightweight Pieces of Aggregate"	*1 test result per lot.

\*Definition of a lot:

- 1,200 tons;
- 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.
- For ND T 113 a lot is every 10 miles or fraction thereof.
- Lots continue from day to day. Each day does not start a new lot.

Compute the sieve analysis on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary."

Obtain one sample of blotter material for every five miles or fraction thereof. Obtain these samples from material placed in a stockpile or material delivered directly to the project. Table 420-9 above lists the tests to be conducted excluding ND T 113.

### C. Materials and Research Responsibility.

Bitumen:

Test samples according to Section 818 of the NDDOT *Standard Specifications for Road and Bridge Construction* for the appropriate material.

Aggregate:

Perform L.A. Abrasion, AASHTO T 96, on a sample obtained during aggregate production. Table 420-10 shows test method and frequency.

Table 420-10	
Test	Frequency
AASHTO T 96, "Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"	*1 test result per project.

\*If the aggregate source has been tested previously by the Department and the material is within allowable limits, the test for L.A. Abrasion will not be required.

### 420.05 Independent Assurance (IA) Samples and Tests without a Field Laboratory.

#### A. Engineer Responsibility.

*Reserved.*

#### B. District Materials Coordinator Responsibility.

Conduct IA tests on split samples. Obtain and split the sample. Submit a split sample to Materials and Research.

#### C. Materials and Research Responsibility.

Bitumen:

If the District Materials Coordinator has conducted a test for sieve and viscosity according to tests listed in AASHTO T 59, "Emulsified Asphalts," then the following must be completed.

Tests and frequency for IA for viscosity and sieve are shown in Table 420-11.

Table 420-11	
Test	Frequency
AASHTO T 59, "Emulsified Asphalts"	1 test result per project.

Tolerances between IA and acceptance tests are in Table 420-12.

Table 420-12	
Test	Tolerance
AASHTO T 59, "Emulsified Asphalts":	
Sieve	±0.08%
Viscosity	25° C ±15%
	50° C ± 21%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

Aggregate:

Obtain and split aggregate samples according to ND T 2, Sampling of Aggregate and ND T 248, Reducing Samples of Aggregate to Testing Size. Table 420-13 shows test method and frequency.

Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test per 10 miles or fraction thereof.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	1 test per 10 miles or fraction thereof.
ND T 113, "Lightweight Pieces of Aggregate"	1 test per 10 miles or fraction thereof.

Compute the sieve analysis on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary." Table 420-14 shows tolerance between IA and acceptance tests.

Test	Tolerance
ND T 11, Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing, and ND T 27, "Sieve Analysis of Fine and Coarse Aggregates":	
3/8 inch sieve	±7%
No. 4 sieve	±7%
No. 8 sieve	±7%
No. 200 sieve	±2.5%
ND T 113, Lightweight Pieces in Aggregate	±3%

If the IA testing is not within specified tolerances, the District Materials Coordinator obtains an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

A sample of blotter material is not required.

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## Section 421 Micro Surfacing

### 421.01 Description.

This work consists of applying a thin overlay material of modified emulsified asphalt, aggregate, water and additives over a prepared surface.

### 421.02 Acceptance Samples and Tests.

#### A. Engineer Responsibility.

Bitumen:

Under the observation of the Engineer, the Contractor will obtain a sample, which is two containers, of bitumen from each load delivered to the project following NDDOT 1, "Sampling of Bituminous Materials."

For emulsion samples received from the Contractor, the Engineer will submit all samples to the District Materials Coordinator.

Aggregate:

Obtain a minimum of three moisture samples per day. Submit samples to the District Materials Coordinator.

#### B. District Materials Coordinator Responsibility.

Bitumen:

The District Materials Coordinator will test the emulsified asphalt samples for sieve and viscosity, only, according to AASHTO T 59, "Emulsified Asphalts." The sieve and viscosity tests may be waived if the Engineer determines there is not a consistency problem with the emulsion.

Aggregate:

Obtain five random samples from each stockpile. Test each aggregate sample and determine acceptance based on the average of the five tests.

Obtain and split aggregate samples according to ND T 2, "Sampling of Aggregate," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

Table 421-1 shows test method and frequency.

Table 421-1	
Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per stockpile.
ND T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per stockpile.

Compute the sieve analysis results on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary."

Obtain material for determining moisture content.

Table 421-2 shows test method and frequency.

Table 421-2	
Test	Frequency
ND T 255, "Total Evaporable Moisture Content of Aggregate by Drying"	3 test result per day.

### C. Materials and Research Responsibility.

Bitumen:

Materials and Research tests the random 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 Materials and Research for testing.

Materials and Research will inform the District when sample submittal is required due to failing tests.

Materials and Research will then test samples around the one that does not pass to determine a failing lot size. For example, using Table 421-3 there are four loads of emulsion delivered during the first half of a project and five loads for the second half of the project.

Table 421-3				
First Half of Project				
Sample 1	Sample 2	Sample 3	Sample 4	
Second Half of Project				
Sample 5	Sample 6	Sample 7	Sample 8	Sample 9

- The District submits Sample 3 and Sample 7. Sample 3 from the first half passes and all material from the first half is accepted with no further testing.
- Sample 7 from the second half fails so Materials and Research will test Samples 6 and 8. If Sample 6 passes, Sample 5 is accepted with no further testing.
- If Sample 8 fails, Sample 9 is tested. If Sample 9 passes, the failing lot size is made up of loads 7 and 8.

### 421.03 Independent Assurance (IA) Samples and Tests.

#### A. Engineer Responsibility.

*Reserved.*

#### B. District Materials Coordinator Responsibility.

The District Materials Coordinator will obtain and split an aggregate sample. One half to the sample will be submitted to the Materials and Research Laboratory.

Sample used to determine moisture shall be an equal split. The District Material Coordinator will identify different equipment and personnel to conduct the IA sample.

Table 421-4 shows test method and frequency.

Table 421-4	
Test	Frequency
ND T 255, "Total Evaporable Moisture Content of Aggregate by Drying"	1 test result per project.

Tolerance between IA and acceptance tests is in Table 421-5.

Table 421-5	
Test	Tolerance
ND T 255, "Total Evaporable Moisture Content of Aggregate by Drying"	±1.0%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and designated personnel will examine equipment used and review testing procedures. This will continue until the differences are resolved.

### C. Materials and Research Responsibility.

Bitumen:

Test and frequency for IA for viscosity and sieve are shown in Table 421-6.

Table 421-6	
Test	Frequency
AASHTO T 59, "Emulsified Asphalts"	1 test result per project.

Tolerance between IA and acceptance tests is in Table 421-7.

Table 421-7	
Test	Tolerance
AASHTO T 59, "Emulsified Asphalts": Sieve	$\pm 0.08\%$
Viscosity	25° C $\pm 15\%$ 50° C $\pm 21\%$

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

Aggregate:

Tests and frequency for IA are shown in Table 421-8.

Table 421-8	
Test	Worksheet
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per project.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per project.
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of Sand Equivalent Test"	1 test result per project.

Tolerance between IA and acceptance tests is in Table 421-9.

Table 421-9	
Test	Tolerance
ND T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing," ND T 27, "Sieve Analysis of Fine and Coarse Aggregates":	
3/8" sieve	±7%
#4 sieve	±7%
#8 sieve	±7%
#200 sieve	±2.5%
ND T 176, "Fines in Graded Aggregates and Soils by Use of Sand Equivalent Test"	±5%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

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## Section 422 Slurry Seal

### 422.01 Description.

This work consists of applying a material composed of emulsified asphalt, aggregate, water, and additives over a prepared surface.

### 422.02 Acceptance Samples and Tests.

#### A. Engineer Responsibility.

Bitumen:

Under the observation of the Engineer, the Contractor will obtain a sample, which is two containers, of bitumen from each load delivered to the project following NDDOT 1, "Sampling of Bituminous Materials."

For emulsion samples received from the Contractor, the Engineer will submit all samples to the District Materials Coordinator.

#### B. District Materials Coordinator Responsibility.

Bitumen:

The District Materials Coordinator will test the emulsified asphalt samples for sieve and viscosity, only, according to AASHTO T 59, "Emulsified Asphalts." The sieve and viscosity tests may be waived if the Engineer determines there is not a consistency problem with the emulsion.

Aggregate:

Obtain five random samples from each stockpile. Test each aggregate sample and determine acceptance based on the average of the five tests.

Obtain and split aggregate samples according to ND T 2, "Sampling of Aggregate," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

Table 422-1 shows test method and frequency.

Table 422-1	
Test	Frequency
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per stockpile.
ND T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per stockpile.

Compute the sieve analysis results on SFN 9987, "Aggregate Sample Worksheet." Results are recorded on SFN 10072, "Aggregate Quality Test Summary."

### C. Materials and Research Responsibility.

Bitumen:

Materials and Research tests the random 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 Materials and Research for testing.

Materials and Research will inform the District when sample submittal is required due to failing tests.

Materials and Research will then test samples around the one that does not pass to determine a failing lot size. For example, using Table 422-3 there are four loads of emulsion delivered during the first half of a project and five loads for the second half of the project.

Table 422-3				
First Half of Project				
Sample 1	Sample 2	Sample 3	Sample 4	
Second Half of Project				
Sample 5	Sample 6	Sample 7	Sample 8	Sample 9

- The District submits Sample 3 and Sample 7. Sample 3 from the first half passes and all material from the first half is accepted with no further testing.
- Sample 7 from the second half fails so Materials and Research will test Samples 6 and 8. If Sample 6 passes, Sample 5 is accepted with no further testing.
- If Sample 8 fails, Sample 9 is tested. If Sample 9 passes, the failing lot size is made up of loads 7 and 8.

### 422.03 Independent Assurance (IA) Samples and Tests.

#### A. Engineer Responsibility.

*Reserved*

**B. District Materials Coordinator Responsibility.**

The District Materials Coordinator will obtain and split an aggregate sample. One half to the sample will be submitted to the Materials and Research Laboratory.

Samples will be obtained and split according to ND T 2, "Sampling of Aggregates," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

**C. Materials and Research Responsibility.**

Bitumen:

Tests and frequency for IA for viscosity and sieve are shown in Table 422-4.

Table 422-4	
Test	Frequency
AASHTO T 59, "Emulsified Asphalts"	1 test result per project.

Tolerance between IA and acceptance tests is in Table 422-5.

Table 422-5	
Test	Tolerance
AASHTO T 59, "Emulsified Asphalts":	
Sieve	±0.08%
Viscosity	25° C ±15% 50° C ± 21%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

Aggregate:

Tests and frequency for IA are shown in Table 422-6.

Table 422-6	
Test	Worksheet
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	1 test result per project.
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	1 test result per project.
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of Sand Equivalent Test"	1 test result per project.

Tolerance between IA and acceptance tests are in Table 422-7.

Table 422-7	
Test	Tolerance
ND T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing," ND T 27, "Sieve Analysis of Fine and Coarse Aggregates":	
3/8" sieve	±7%
#4 sieve	±7%
#8 sieve	±7%
#200 sieve	±2.5%
ND T 176, "Fines in Graded Aggregates and Soils by Use of Sand Equivalent Test"	±5%

If the IA testing is not within specified tolerances, the District Materials Coordinator will obtain an additional sample for testing.

The District Materials Coordinator and Materials and Research will examine equipment used and review testing procedures. This will continue until the differences are resolved.

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## Section 430 Hot Mix Asphalt (HMA) Sampling and Testing Requirements

### 430.01 Description

This work consists of constructing one or more courses of bituminous pavement on a prepared surface.

This section includes:

- Contractor Quality Control (QC) testing for pavements.
- The Department's responsibilities for Quality Assurance (QA) testing.
- Independent Assurance (IA) testing.
- Dispute resolution requirements.

QC tests that have been verified by QA tests will be used for the acceptance of materials.

### 430.02 Quality Control Testing

The Contractor's QC program will be conducted by certified personnel as outlined in the NDDOT Technical Certification Program. QC samples will be split under the observation of the Engineer.

#### A. Testing During Aggregate Production.

##### 1. Engineer Testing.

*Reserved.*

##### 2. Contractor Testing.

The Contractor will obtain and reduce aggregate samples according to ND T 2, "Sampling of Aggregates," and ND T 248, "Reducing Samples of Aggregate to Testing Size."

- a. The Contractor will perform one test per 1,000 tons of material produced for each aggregate stockpile.

Table 430-1 lists the tests to be conducted.

<b>Table 430-1</b>	
<b>Test</b>	<b>Worksheet</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	SFN 9987, Aggregate Sample Worksheet
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	SFN 9987, Aggregate Sample Worksheet

- b. The Contractor will test one sample from the first 5,000 tons of material produced from each stockpile. After the initial testing, the testing frequency will change to one sample tested for each 10,000 tons of material produced per stockpile.

Table 430-2 lists the tests to be conducted.

<b>Table 430-2</b>	
<b>Test</b>	<b>Worksheet</b>
NDDOT 4, "Percentage of Fracture Particles in Coarse Aggregate"	SFN 9987, Aggregate Sample Worksheet
ND T 113, "Lightweight Pieces in Aggregate"	SFN 9987, Aggregate Sample Worksheet
ND T 304, "Fine Aggregate Angularity"	SFN 51701, Uncompacted Void Content of Fine Aggregate
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"	SFN 51730, Sand Equivalent of Fine Aggregate
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	SFN 51700, Flat or Elongated Particles in Coarse Aggregate

- c. For each stockpile the Contractor will obtain a 90-pound sample for every 10,000 tons of material produced. The Contractor will split the sample and give one half of the sample to the Engineer. The sample will be obtained and split under the observation of the Engineer.

When a stockpile is less than 10,000 tons for the project, a minimum of two samples per stockpile will be obtained and tests performed.

Table 430-3 lists the tests to be conducted.

<b>Table 430-3</b>	
<b>Test</b>	<b>Worksheet</b>
ND T 84, "Specific Gravity and Absorption of Fine Aggregate"	SFN 2199, Fine Aggregate Specific Gravity Worksheet
ND T 85, "Specific Gravity and Absorption of Coarse Aggregate"	SFN 10081, Coarse Aggregate Specific Gravity Worksheet

### 3. District Materials Coordinator Testing.

This section is to determine the specific gravity of the material according to Section 430.04 C.2, "Determination of Specific Gravity" in the *NDDOT Standard Specifications for Road and Bridge Construction*.

The District Materials Coordinator will obtain a split of the sample from the Contractor and determine the bulk (dry), apparent specific gravity, and the percent water absorption of each stockpile according to Table 430-3.

The District Materials Coordinator will conduct the tests on the initial sample received. The District Materials Coordinator has the option to run tests of any additional samples that are received.

### B. Mix Design.

#### 1. Engineer Testing.

*Reserved.*

#### 2. Contractor Testing.

After the specific gravity of the material has been determined as specified in Section 430.04 C.2, "Determination of Specific Gravity," *NDDOT Standard Specifications for Road and Bridge Construction*, the Contractor will develop a mix design. The mix design will meet all of the requirements as specified in Section 430.03 C, "Superpave Mix Properties," *NDDOT Standard Specifications for Road and Bridge Construction*. The Contractor will use the Department's mix design program available at [www.dot.nd.gov](http://www.dot.nd.gov).

The Contractor will submit the completed mix design, including all test data, to the Engineer as specified in Section 430.04 D, "Mix Design," of the *NDDOT Standard Specifications for Road and Bridge Construction*.

### 3. District Materials Coordinator Testing.

The District Materials Coordinator will verify the Contractor mix design by using one or more of the following procedures:

- a. A full mix design using the materials and mix proportions supplied by the Contractor.
- b. A one-point mix design using the Contractor's optimum asphalt content, the materials, and mix proportions supplied by the Contractor.
- c. NDDOT produced specimen developed from loose asphaltic concrete mix prepared at the optimum asphalt content recommended by the Contractor mix design.
- d. Historic data from past projects utilizing the same aggregate source.

The mix design will be approved if the testing is within the tolerances shown in Table 430-4.

<b>Test</b>	<b>Tolerance</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates," and ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing:"	
No. 4 sieve and larger	±5
No. 30 sieve	±3
No. 200 sieve	±1.5
NDDOT 4, "Percentage of Fracture Particles in Coarse Aggregate"	±5
ND T 113, "Lightweight Pieces in Aggregate"	±1.0
ND T 304, "Fine Aggregate Angularity"	±1
ND T 176, "Plastic Fines in Graded Aggregates and Soils By Use of the Sand Equivalent Test"	±5
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	±1
Aggregate Bulk Specific Gravity (dry), each fraction.	±0.040
Aggregate Apparent Specific Gravity, each fraction	±0.040
Air Voids:	±1.0
ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt," and ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface Dry Specimens"	
ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"	±0.030

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

#### **4. Materials and Research Division Testing.**

*Reserved.*

### **C. Testing During Mix Production.**

#### **1. Engineer Testing.**

During mix production, one half of the split aggregate and hot mix asphalt QC samples will be retained by the QA. These samples will be retained until QA testing confirms the validity of the QC testing.

#### **2. Contractor Testing.**

- a.** The Contractor will perform ND T 255, "Total Evaporable Moisture Content of Aggregate by Drying," twice on the first day of mix production and once per day before plant startup of mix production thereafter.

The Contractor will perform additional testing after a rain event until the test results are consistent.

- b.** The Contractor will obtain an aggregate sample from the cold feed belt according to ND T 2, "Sampling of Aggregates," at times directed by the Engineer. The Contractor will obtain one sample for each 1,500 tons of material produced, with a minimum of one sample obtained per day, as directed by the Engineer.

The Contractor will split the sample, under the observation of the Engineer, according to ND T 248, "Reducing Samples of Aggregate to Testing Size," and will bag and number the samples.

The Contractor will perform testing on one half of the sample and will submit the remaining half to the Engineer.

Table 430-5 lists the tests to be conducted.

<b>Test</b>	<b>Worksheet</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	SFN 9987, Aggregate Sample Worksheet
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	SFN 9987, Aggregate Sample Worksheet
*ND T 304, "Fine Aggregate Angularity"	SFN 51701, Uncompacted Void Content of Fine Aggregate

\*One sample for each 3000 tons of material produced with a minimum of one sample per day.

- c. The Contractor will obtain three random aggregate samples from the cold feed belt for each lot of 10,000 tons of mix produced. The Contractor will test each sample and the Engineer will determine acceptance of the lot based on the average of the three samples.

If the results of each sample from a lot are within the designated range, the Contractor will collect three samples from the next lot and test one of the samples. If the results of the test are within the designated range, the Engineer will accept the lot.

If the results of the test are outside of the designated range, the Contractor will test the remaining two samples and the Engineer will determine acceptance of the lot based on the average of the three test results.

When the average of three results is needed to determine acceptance of a lot, the Contractor will continue to test three samples for each lot of 10,000 tons of material. The Contractor may return to testing a single sample only after all three samples are within the designated range.

Table 430-6 lists the tests to be conducted.

<b>Test</b>	<b>Worksheet</b>
NDDOT 4, "Percentage of Fracture Particles in Coarse Aggregate"	SFN 9987, Aggregate Sample Worksheet
ND T 113, "Lightweight Pieces in Aggregate"	SFN 9987, Aggregate Sample Worksheet
*ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"	SFN 51730, Sand Equivalent of Fine Aggregate
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	SFN 51700, Flat or Elongated Particles in Coarse Aggregate

\*The test results are not averaged.

- d. The Contractor will obtain a mix sample from behind the paver each time an aggregate sample is taken for sieve analysis. The sample is obtained according to NDDOT 5, "Sampling and Splitting Field Verification Hot Mix Asphalt (HMA) Samples."

Table 430-7 lists the tests to be conducted.

<b>Test</b>	<b>Worksheet</b>
ND T 312, "Preparing and Determining the Density of Hot Mix Asphalt Specimens by Means of Superpave Gyrotory Compactor"	SFN 50289, Maximum Density Worksheet
ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens"	SFN 50289, Maximum Density Worksheet
ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"	SFN 50289, Maximum Density Worksheet

Contractor will collect bituminous samples, under the observation of the Engineer, according to NDDOT 1, "Sampling of Bituminous Materials."

- e. Contractor will collect bituminous samples, under the observation of the Engineer, according to NDDOT 1, "Sampling of Bituminous Materials."

Obtain one sample for every 250 tons of material for each supplier and grade of asphalt cement, or fraction thereof, randomly selected and observed by the Engineer.

### **3. District Materials Coordinator Testing.**

If the project is on the NHS system the District Materials Coordinator will complete SFN 13889, Project Records Samples/Tests Report, and send a copy to the engineer at project completion.

The Contractor will be required to obtain one core per mile of roadway paved at random locations selected by the District Materials Coordinator after the final HMA lift is placed. The Engineer will take width measurements at the same location that the cores are obtained.

#### **4. Materials and Research Division Testing.**

Tests will be run for acceptance or IA according to AASHTO M 320, "Performance-Graded Asphalt Binder."

##### **430.03 Quality Assurance Testing**

###### **1. General.**

Quality assurance testing will be performed during mix production.

###### **2. Contractor Testing.**

The Contractor will collect samples under the observation of the Engineer for bitumen and coring as required. Core samples are to be obtained according to NDDOT 2, "Contractor Coring."

###### **3. Engineer Testing.**

###### **1. Aggregate and Mix Testing.**

The Engineer will conduct QA tests on samples collected separately from the Contractor's sample. Aggregate samples collected at the plant, and asphalt mix samples collected behind the paver will be obtained by the Contractor under the observation of the Engineer.

Aggregate samples from the cold feed belt are obtained according to ND T 2, "Sampling of Aggregates." Asphalt mix samples are obtained according to NDDOT 5, "Procedure for Sampling and Splitting Field Verification HBP Samples."

- a. The Engineer will conduct tests a minimum of four times during the Contractor's first 15,000 tons of mix production, and will conduct a minimum of one set of tests per production day. After the first 15,000 tons of mix has been produced, the Engineer will perform these tests at least once per day of mix production.

Table 430-8 lists the tests to be conducted.

<b>Test</b>	<b>Worksheet</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	SFN 9987, Aggregate Sample Worksheet
ND T 11, "Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing"	SFN 9987, Aggregate Sample Worksheet
ND T 304, "Fine Aggregate Angularity"	SFN 51701, Uncompacted Void Content of Fine Aggregate
ND T 312, "Preparing and Determining the Density of Hot Mix Asphalt Specimens by Means of Superpave Gyratory Compactor"	SFN 50289, Maximum Density Worksheet
ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"	SFN 50289, Maximum Density Worksheet
ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens"	SFN 50289, Maximum Density Worksheet

- b. The Contractor and Engineer will compare the results from one QC test to the QA test.

Table 430-9 shows the allowable tolerance range for each test.

<b>Tests</b>	<b>Tolerance</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates, and ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing": No. 4 sieve and larger No. 30 sieve No. 200 sieve	$\pm 7$ $\pm 5$ $\pm 2.5$
ND T 304, "Fine Aggregate Angularity"	$\pm 1$
Air Voids - ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"; and ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface Dry Specimens"	$\pm 1.0$
ND T 166 "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens"	$\pm 0.040$
ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (Max Specific Gravity)"	$\pm 0.035$

If the comparison for a test listed in Table 430-9 leads to a result outside the ranges specified, the Engineer will request an IA test. A sample will be collected for the IA test and will be a three-way split between the QC, QA, and IA. Evaluation of the procedures and equipment will be conducted to determine the cause of the discrepancy. If the discrepancy cannot be rectified, the dispute resolution procedure in Section 430.04 of this document will be followed.

- c. The Engineer will conduct one test for the first 10,000 tons of mix production and one test every 30,000 tons thereafter.

Table 430-10 lists the tests to be conducted.

<b>Tests</b>	<b>Worksheet</b>
NDDOT 4, "Percentage of Fracture Particles in Coarse Aggregate"	SFN 9987, Aggregate Sample Worksheet
ND T 113, "Lightweight Pieces in Aggregate"	SFN 9987, Aggregate Sample Worksheet
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"	SFN 51730, Sand Equivalent of Fine Aggregate
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	SFN 51700, Flat or Elongated Particles in Coarse Aggregate

- d. The Contractor and Engineer will compare the results of the QC and QA tests. Table 430-11 shows the allowable tolerance range for each test.

<b>Tests</b>	<b>Tolerance</b>
NDDOT 4, "Percentage of Fracture Particles in Coarse Aggregate"	±5
ND T 113, "Lightweight Pieces in Aggregate"	±3.0
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"	±7
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	±3

If the test result comparisons are within the tolerances of Table 430-11 and the QC results are within specifications, than the samples in the Engineer's possession for that lot are to be discarded.

If the comparison for a test listed in Table 430-11 leads to a result outside the ranges specified, the Engineer will request an IA test. A sample will be collected for the IA test and will be a three-way split between the QC, QA, and IA. Evaluation of the procedures and equipment will be conducted to determine the cause of the discrepancy. If the discrepancy cannot be rectified, the dispute resolution procedure in Section 430.04 of this document will be followed.

If the retest also leads to a result outside the specified range, the Contractor will cease production and take corrective action. If the discrepancy cannot be rectified, the dispute resolution procedure in Section 430.04 of this document will be followed.

Tests performed by the IA lab will not be used for material acceptance.

## **2. In-Place Density Testing.**

The Engineer will divide the pavement into lots. A lot is equal to the amount of material, in tons, placed each production day. If a shoulder, or part of a shoulder, is placed monolithically with the mainline, the shoulder quantity will be excluded from the quantity of material represented by the lot.

A subplot is defined as a single lift, one paver width wide and 2,000 feet long. If a partial subplot is less than 1,000 feet, it will be included in the previous subplot. A partial subplot, greater than 1,000 feet in length will be considered a separate subplot.

The Engineer will direct the Contractor to obtain two cores from each subplot. Coring will be conducted according to NDDOT 2, "Contractor Coring." The station and offset location of the cores will be determined using random numbers. If the location of the core falls within one foot of the edge of the pavement, the Engineer will adjust the location or generate new random numbers to select a different area. The Engineer will place marks between 6 and 12 inches apart on a longitudinal plane showing the location for the cores to be obtained.

The Engineer will record the information on SFN 10071, "Compaction Control" and will observe the coring procedure. The Engineer will take immediate possession of the cores.

The Engineer will determine the density of the cores in accordance with ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens," and ND T 209, "Maximum Theoretical Density." The Engineer will determine the acceptance of the subplot based on the average of the two cores. The average of the two cores is recorded on SFN 59132, Density Pay Factor.

The density of a lot will be determined using the recorded average densities of the sublots contained within the lot. The recorded average densities of the sublots will be totaled and divided by the number of sublots within the lot to obtain the average density of the pavement.

### 3. Bitumen Testing.

Bituminous samples are obtained for testing according to NDDOT 1.

### D. District Materials Coordinator Testing.

*Reserved.*

### E. Materials and Research Division Testing.

The Materials and Research Division will perform one test on a composite aggregate sample obtained during the beginning of aggregate stockpiling, according to Table 430-12.

<b>Table 430-12</b>	
<b>Test</b>	<b>Worksheet</b>
AASHTO T 96, "Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"	SFN 9987, Aggregate Sample Worksheet

If the aggregate source has been tested previously by the Department and the material is within allowable limits, the L.A. Abrasion test may be waived at the discretion of the District Materials Coordinator.

Bituminous samples are obtained and tested according to NDDOT 1.

### 430.04 Dispute Resolution

If the cause of disagreement between the QC and QA 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 test the material.

The results from the NDDOT Materials and Research Laboratory will be considered final.

## 430.05 Independent Assurance (IA) Testing

### A. General

IA testing will occur during mix production of aggregate and mix.

IA samples are a split sample tested by the Contractor, the Engineer, and the District Materials Coordinator.

Table 430-13 lists the tests to be conducted.

<b>Table 430-13</b>	
<b>Test</b>	<b>Worksheet</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates"	SFN 9987, Aggregate Sample Worksheet
ND T 11, "Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing"	SFN 9987, Aggregate Sample Worksheet
NDDOT 4, "Percentage of Fracture Particles In Coarse Aggregate"	
ND T 113, "Lightweight Pieces in Aggregate"	SFN 9987, Aggregate Sample Worksheet
ND T 304, "Fine Aggregate Angularity"	SFN 51701, Uncompacted Void Content of Fine Aggregate
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"	SFN 51730, Sand Equivalent of Fine Aggregate
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	SFN 51700, Flat or Elongated Particles in Coarse Aggregate
ND T 312, "Preparing and Determining The Density of Hot Mix Asphalt Specimens by Means of Superpave Gyrotory Compactor"	SFN 50289, Maximum Density Worksheet
ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"	SFN 50289, Maximum Density Worksheet
ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface-Dry Specimens"	SFN 50289, Maximum Density Worksheet

#### 1. Engineer Testing.

IA tests run by the Engineer are additional to required QA samples.

## 2. Contractor Testing.

The Contractor will collect IA samples of aggregate and HMA under the observation of the District Materials Coordinator.

IA tests run by the Contractor can be used for acceptance in lieu of additional QC samples.

## 3. District Materials Coordinator Testing.

The District Materials Coordinator will periodically observe tests performed by the Contractor and the QA tester and ensure that testing personnel are qualified as outlined in the NDDOT Technical Certification Program.

B. Frequency for IA testing is listed in Table 430-14.

<b>Project Tonnage</b>	<b>Number of Tests/Project</b>	<b>Frequency</b>
<10,000 tons	One IA test	IA sample will be obtained during the first four tests run by the Contractor.
10,000 - 20,000 tons	One IA test	IA sample will be obtained at the approximate mid-point of the project.
20,000 - 30,000 tons	Two IA tests	One IA sample will be obtained during the first half of the project and again during the second half of the project.
>30,000 tons	Three IA tests	IA samples will be obtained during the first half, approximate midpoint and second half of the project.

C. The results of the Contractor, Engineer, and District Materials Coordinator tests will be compared.

The results of any test must be within the ranges specified in Table 430-15 when compared to any other test.

<b>Table 430-15</b>	
<b>Tests</b>	<b>Tolerance</b>
ND T 27, "Sieve Analysis of Fine and Coarse Aggregates, and ND T 11, Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing": No. 4 sieve and larger No. 30 sieve No. 200 sieve	 ±5 ±3 ±1.5
NDDOT T 4, "Percentage of Fracture Particles in Coarse Aggregate"	±5
ND T 113, "Lightweight Pieces in Aggregate"	±1.0
ND T 304, "Fine Aggregate Angularity"	±1
ND T 176, "Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test"	±5
ND D 4791, "Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate"	±2
Air Voids - ND T 209, "Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt"; and ND T 166, "Bulk Specific Gravity of Compacted Hot Mix Asphalt Using Saturated Surface Dry Specimens."	±1.0

If the IA testing is not within specified tolerances, the Contractor will obtain an additional sample for testing under the observations of the District Materials Coordinator.

The Contractor, Engineer, and District Materials Coordinator will conduct equipment checks and review testing procedures. This will continue until the differences are resolved.

The IA tester and either the QC or QA lab, whichever is not within the specified tolerances, will perform the additional IA tests.

#### **4. Gyrotory Compliance Tests**

For gyrotory compliance, the IA will be required to obtain one sample during the first four tests run by the Contractor (QC). This sample will be used to ensure the accuracy of the shared gyrotory compactor used by the QC and QA testers.

The Contractor will obtain a sample of hot mix for testing. This sample will be taken from any available location except behind the paver. The Contractor will split the sample and give half to the District Materials Coordinator.

The IA and QC labs will make gyratory plugs and compare the bulk specific gravity ( $G_{mb}$ ) of their specimens. The acceptable tolerance between tests will be:

$$\text{Bulk Specific Gravity of the Mix } (G_{mb}): \pm 0.040$$

The number and frequency of Gyratory Compliance samples will be based on project tonnage as shown in Table 430-16.

<b>Table 430-16</b>	
<b>Project Tonnage</b>	<b>Frequency</b>
<10,000	No Gyratory Compliance
≥10,000	One Gyratory Compliance

If the initial testing is not within specified tolerances, the Contractor will obtain an additional sample for testing, under the observations of the District Materials Coordinator.

The Contractor and District Materials Coordinator will conduct equipment checks, and review testing procedures.

If the second sample is not within specified tolerances, a dispute resolution procedure will be implemented in which a third gyratory will be selected and a three-way split of a sample will be tested. The third gyratory can be from another district or the Materials and Research Laboratory.

**SECTION 400**

**FORMS**

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# AGGREGATE SAMPLE WORKSHEET

North Dakota Department of Transportation, Materials & Research

SFN 9987 (Rev. 08-2015)

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

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

ND T-27 Tested By: \_\_\_\_\_

FRACTURED FACES	
FF = % of particles w/ frac. faces	
WF = Wt. of frac. particles	
WQ = Wt. of questionable frac. particles	
WA = Wt. of total sample	
FF = $[WF + (WQ/2)]/WA \times 100$	
FF =	
ND Spec.	

Sieve Size		Wt. Ret.		% Ret.	% Pass	% Pass Tot. Smpl.	ND Spec.
		Non-Cum.	Cum.				
2.36 mm	No. 8						
2.00 mm	No. 10						
1.18 mm	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							

NDDOT 4 Tested By: \_\_\_\_\_

ND T-27 Tested By: \_\_\_\_\_

ND 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 $(I/J) \times 100$ = %
(D) Total Sample A+B+C = 100.0 %	(L) Lt Wt Pieces, - No. 4, + No. 30 Material % of Total Sample $(K \times C)/100$ = %
(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 $(E/F) \times 100$ = %	
(H) Lt Wt Pieces, + No. 4 Mtrl., % of Total Sample $(G \times A)/100$ = %	
	(M) Lightweight Pieces in Total Sample $(H+L)$ = %

ND T-113 Tested By: \_\_\_\_\_

ND Spec. \_\_\_\_\_

Distribution:

<input type="checkbox"/>	_____ District
<input type="checkbox"/>	Central Lab.

Date	Testing Lab Supervisor
------	------------------------

Laboratory Number

**Liquid Limit, Plastic Limit, and Plasticity Index**

Liquid Limit	#Blows
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	
ND T 89 tested by: _____	
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)	
ND T 90 tested by: _____	

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

**LA Abrasion**

Grading Used: <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D		
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. 07-2011)

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

**BITUMEN IN STORAGE (Begin this Report):**

Tank Number	Hot Gallons	Temp. °F	Vol. Corr. Factor	Gallons @ 60°F	<u>UNIT WEIGHT DATA @ 60° F</u> (from Refinery or Testing Lab.)
				0.0000	Specific Gravity
				0.0000	Lbs./Gal. _____ 0.0000 (SG x 8.33)*

(Total Gals. @ 60°F = 0.0000) x (\* 0.0000 Lbs./Gal.) = 0.0000 Tons <sup>A</sup>  
2,000

**ADD: BITUMEN DELIVERED THIS REPORT:**

Ticket Number	Lbs.						

(Total Bitumen Delivered = 0.0000 Lbs.) ÷ 2,000 = 0.0000 Tons <sup>B</sup>

**LESS: BITUMEN IN STORAGE (End this Report):**

Tank Number	Hot Gallons	Temp. °F	Vol. Corr. Factor	Gallons @ 60°F
				0.0000
				0.0000

(Total Gals. @ 60° F = 0.0000) x (\* 0.0000 Lbs./Gal.) = 0.0000 Tons <sup>C</sup>  
2,000

**LESS: BITUMEN USED FOR ITEMS OTHER THAN MIX:**

(Tack Fog Non-pay/Priv Use Waste etc) \_\_\_\_\_ x (\* 0.0000 Lbs./Gal.) = 0.0000 Tons <sup>D</sup>  
Gals. @ 60° F \_\_\_\_\_ 2,000

**TOTAL: BITUMEN USED FOR ALL MIX PRODUCED THIS REPORT:** A + B - C - D = 0.0000 Tons <sup>E</sup>

**WET MIX PRODUCED THIS REPORT: Per Haul Sheet Nos.** \_\_\_\_\_

(Pay Qty. _____ Tons <sup>F</sup> )	+ (Waste, Non-pay/Priv. Use _____ Tons <sup>G</sup> )	= _____ 0.0000 Tons <sup>H</sup>
Average Percent Bitumen in Wet Mix = (E + H) X 100 =		0.0000 % <sup>I</sup>
Waste, Non-pay/Private Use Bitumen for Mix = (G XI) =		0.0000 Ton <sup>J</sup>
Estimated Net Pay Quantity Bitumen for Mix = (E - J) =		0.0000 Tons <sup>K</sup>

Remarks: \_\_\_\_\_

**DISTRIBUTION:**

Original - Engineer  
Copies - Contractor

\_\_\_\_\_  
Plant Inspector

\_\_\_\_\_  
Engineer





**DAILY REPORT - HOT BITUMINOUS PAVEMENT -  
QUALITY CONTROL**  
North Dakota Department of Transportation, Construction  
SFN 18552 (Rev. 02-2013)

Project	Date
Contractor	District
Aggr. Class	Plant Model
Spec.	Bid Price (HBP)
Stations Paved	

**A. AGGREGATE**

Sieve Size	Gradation Range Limits									
	5/8"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200*
Gradation Range										
Target Values										
Target Range										

**Percent Passing**

Test No.										
Test No.										
Test No.										
Test No.										
Uniformity (U) Dev fr Target Range										

**AGGREGATE PAY FACTOR** =  $\frac{100 - U^{**}}{100}$       A = \_\_\_\_\_

\* Round Percent Passing to the nearest tenth.  
\*\*Largest Uniformity Deviation

**Distribution:**  
Project Engineer (original)  
Contractor

**B. BITUMEN CONTENT**

AC Brand and Type

**Average**

Target Bitumen Content	Average Bitumen Content	
Deviation from Target	<b>AVERAGE PAY FACTOR</b>	

**Uniformity**

Check No. 1	Check No. 2	Check No. 3	Check No. 4
Average	Deviation*		

**UNIFORMITY PAY FACTOR** =  $\frac{100 - [20 (\text{Deviation} - .24)]}{100}$  = \_\_\_\_\_

**BITUMEN PAY FACTOR\*\***      B = \_\_\_\_\_

\*Largest deviation from the average Uniformity Bitumen Content  
\*\*Lowest Pay Factor (Average or Uniformity)

**C. COMPACTION** (From Form No. SFN 59132)

Average Maximum Theoretical Density	(lbs./c.f.)
Pay Factor C =	

**D. DEDUCTION**

**Combined Pay Factor**

Mainline	X _____ (A)	X _____ (B)	X _____ (C)	X _____ (D)
Other	X _____ (A)	X _____ (B)	X _____ (C)	X _____ (D)

**Deduction Factor**

M = 1.0 - _____ (D)	= _____
O = 1.0 - _____ (D)	= _____

Mainline	(Pay Tons This Day) X _____ (Bid Price)	X _____ (Deduction Factor)	X _____ (Payment Adjustment)
Other	(Pay Tons This Day) X _____ (Bid Price)	X _____ (Deduction Factor)	X _____ (Payment Adjustment)

**TOTAL PAYMENT ADJUSTMENT**      \$ \_\_\_\_\_

**REMARKS:**  
Engineer - Inspector

# 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. (Dry Tons)	(2) Salv. Bit. Tons Rdg. (Dry Tons)	% VIR. AGGR. = (1) / (1) + (2) (Dry Tons)	(3) BITUMEN Flow Meter Reading (Gal)	(4) Wt. Per Gal.	(5) AC TONS Tons Used = (3)X(4) /2000	(6) AC Percent Added = (5) / (1)+(2)+(5)
	Random Number	Test Time							
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 = _____
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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. $\frac{A}{D} = \frac{E}{D}$

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

AGGREGATE BLEND PROPORTIONS _____ _____ _____ _____	AC CONTENT: _____ NOTES _____ _____ _____
---	---

\_\_\_\_\_  
 Inspectors Signature

**DENSITY PAY FACTOR**

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

Date Paved	Lot Number	Project Number
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**SPECIFIED DENSITY**

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

**CORE DENSITY (AVERAGE OF 2)**


**AVERAGE PAVEMENT DENSITY** \_\_\_\_\_ **LBS / CU. FT.**

**AVERAGE PAVEMENT DENSITY (% MTD)**

$\frac{\text{AVG. PAVEMENT DENSITY}}{\text{MTD TEST AVG}} \times 100 =$
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PAY FACTOR
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**TARGET DENSITY (% MTD)** \_\_\_\_\_

Inspectors Signature
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