Volume 2

Section 1.1

CONSTRUCTION AGGREGATES

1.1.1 PURPOSE

To assign sampling and testing requirements to Aggregate Producers, and to establish compliance with the requirements of ***Chapter 14-103, Florida Administrative Code (F.A.C.)***.

1.1.2 AUTHORITY

Section 334.044(2), (10)(a) and (d), Florida Statutes (F.S.)
Section 334.24(2) and (4), Florida Statutes (F.S.)
Chapter 14-103, Florida Administrative Code (F.A.C.)

1.1.3 SCOPE

Principal users are the Aggregate Producers, State, State Materials Office, and the District Materials Offices.

1.1.4 SAMPLING, TESTING AND REPORTING

1.1.4.1 REQUIREMENTS FOR INITIAL SOURCE APPROVAL AND NEW-PRODUCT APPROVAL

The producer must supply test data to the Department that indicates that each product from each process meets the quality and uniformity requirements of ***Section 1.1.5***. The number of tests submitted for Department evaluation with a request for initial source approval is given in ***Tables 1, 2, 3, and 4***. No test data shall be older than 90 days. This data must represent production spread periodically over at a rate of 30 days, with a maximum of two samples per day for coarse and fine aggregate at least 21 days and a maximum of 60 days for base aggregate. In order to add another coarse or fine product to an approved source's coarse or fine products list, the producer must supply test data that represent a production period spread over a week, with a maximum of four samples per day. Redistribution Terminals must supply test data to the Department that represent at least one shipment. If the quantity of material shipped is such that testing at Department-assigned frequencies does not yield sufficient data for approval, the material may be certified through a Conditional Quality Control Certification System.

The following sections set forth the testing requirements for coarse and fine aggregate, base materials, and riprap. Approved test methods are listed in ***Appendix 20***.

1.1.4.1.1 COARSE AGGREGATE

1.1.4.1.1.1 General Requirements

The minimum number of producer test results per aggregate code, grade, or stone size from a single process required to establish quality and control of aggregates are given in ***Table 1*** below.

Table 1. Required Tests for Coarse Aggregate Approval

Test Type	No. of Tests For:		Test Method
	Initial Source Approval	Additional Product	
Gradation	30	15	AASHTO T 27
Passing #200 Sieve	30	15	FM 1-T 011
Los Angeles (LA) Abrasion	15	5	FM 1-T 096
Bulk Specific Gravity (Dry)* And Absorption*	15	15	FM 1-T 085
Acid Insoluble for Friction Course	5	5	FM 5-510

* = For aggregates to be used in bituminous asphalt mixes

1.1.4.1.1.2 Additional Requirements

In addition, depending upon type of aggregate, specific properties and characteristics, usage, and contract specifications, the Department shall determine the requirements for the following tests: dry-rodded weight (AASHTO T-19), soundness (AASHTO T-104), sulphur, phosphate, extraneous substances (AASHTO T-112) (i.e. sticks, friable particles, pyrite, limonite, goethite and other iron compounds, and other deleterious substances).

Single production runs of aggregate intended for Asphalt Rubber Membrane Interlayer on a single project may be approved by the Department based on representative test data submitted by the producer. The Department will determine the appropriate number and type of samples to be submitted per stockpile or shipment.

1.1.4.1.2 FINE AGGREGATE

1.1.4.1.2.1 General Requirements

The minimum number of tests per aggregate code, grade, or stone size from a single process required to establish quality and control of aggregates are given in ***Table 2*** (for Silica Sand) and ***Table 3*** (for screenings) below.

Table 2. Required Tests for Fine Aggregate Approval – Silica Sand

Test Type	No. of Tests For		Test Method
	Initial Source Approval	Additional Product	
Gradation	30	15	AASHTO T 27
Passing #200 Sieve	30	15	FM 1-T 011
Bulk Specific Gravity (Dry)* And Absorption*	15	15	FM 1-T 084
Fineness Modulus	30	15	AASHTO T 27
Color	30	15	AASHTO T 21

* = For aggregates to be used in bituminous asphalt mixes

Table 3. Required Tests for Fine Aggregate Approval – Screenings

Test Type	No. of Tests For		Test Method
	Initial Source Approval	Additional Product	
Gradation	30	15	AASHTO T 27
Passing #200 Sieve	30	15	FM 1-T 011
Modified LA Abrasion	15	5	FM 1-T 096
Bulk Specific Gravity (Dry)* And Absorption*	15	15	FM 1-T 084

* = For aggregates to be used in bituminous asphalt mixes

1.1.4.1.2.2 Additional Requirements

In addition, depending upon type of aggregate, specific properties and characteristics, usage, and contract specifications, the Department **shall** determine the requirements for the following tests: fineness modulus (AASHTO T 27), specific gravity (FM 1-T 084), absorption (FM 1-T 084), soundness (AASHTO T 104), sulphur, phosphate, extraneous substances (i.e. marcasite, pyrite, limonite, goethite and other iron compounds, deleterious substances not specifically named).

FDOT-approved masonry sand may be certified to an approved FDOT Concrete plant and transported to a project site.

1.1.4.1.3 BASE AGGREGATE

1.1.4.1.3.1 General Requirements

The minimum number of tests per aggregate code, grade, or stone size from a single process required to establish quality and control of materials are given in ***Table 4*** below.

Table 4. Required Tests for Base Aggregate Approval

	No. of Tests for Material Category			
Test Type	**Limerock, Bank Run Shell, Cemented Coquina, Shell Rock**	**Recycled Concrete Aggregate**	**Graded Aggregate Base**	**Test Method**
Limerock Bearing Ratio Values	3	3	3	FM 5-515
Carbonate Content*	6	N.A.	N.A.	FM 5-514
Gradation	6	6	15	AASHTO T 27
Passing #200 Sieve	N.A.	6	15	FM 1-T 011
Liquid Limits, Plasticity	3	N.A.	3	AASHTO T 89, AASHTO T 90
Soundness*	N.A.	N.A.	2	AASHTO T 104
L.A. Abrasion	N.A.	N.A.	3	FM 1-T 096
Asbestos	N.A.	3	N.A.	Polarized Electron Microscope**

Testing requirements shall be based on a minimum 3,000-ton stockpile that must be available at the time of Department Verification

* = for Approval Only

** = Asbestos testing shall be waived for material obtained from Department projects

1.1.4.1.3.2 Additional Requirements

In addition, depending upon type of aggregate, specific properties and characteristics, usage, and contract specifications, the Department shall determine the requirements for the following tests: sand, clay content and identification, organic content, and other deleterious substances (e.g. by Petrographic analysis).

1.1.4.1.4 RIPRAP MATERIALS (BANK AND SHORE, DITCH LINING, BEDDING STONE, OR OTHER)

1.1.4.1.4.1 General Requirements

Department approval of producer quality and control of these materials are on a pretested stockpile basis. The minimum number of tests required per aggregate code, grade, or stone size to establish quality and control during processing of a single stockpile **up to 5,000 tons** are given in ***Table 5*** below.

Table 5. Required Tests for Riprap Approval

Tests Required By Applicable Project Specifications	No. of Tests for Stockpile Maximum Size		Test Method
	2,500 tons	5,000 tons	
Gradation	1	1	FM 5-538
Specific Gravity	2	3	FM 1-T 085
L.A. Abrasion	2	3	FM 3-C 535
Soundness	2	3	AASHTO T 104
Absorption	2	3	FM 1-T 085

An approved mine will be allowed to certify riprap in accordance with the method depicted in **Appendix 21**. The source must have a history of at least six previously approved stockpiles with L.A. Abrasion meeting compliance standards, in Section 2.2, of less than or equal to 35, Bulk

Specific Gravity Dry greater than or equal to 2.5 and Absorption less than or equal to 1.0 percent.

1.1.4.2 MINIMUM REQUIREMENTS FOR CERTIFICATION

Once a source is approved, the producer is to maintain an ongoing sampling and testing program to verify the quality and uniformity of the day-to-day production for each aggregate code, grade or stone size. The source may continue to certify products provided it meets the requirements in ***Rule Chapter 14-103.0071, F.A.C***.

1.1.4.2.1 MINES

1.1.4.2.1.1 Coarse Aggregate

1.1.4.2.1.1.1 Gradation

####### 1.1.4.2.1.1.1.1 Sieve Limits Set by Specification

Minimum sampling and testing frequencies for gradation will be set in accordance with ***Appendices 1 through 11***, as applicable, with the maximum frequency of any one required sieve determining the minimum required for entire gradation. For all appendices, the convention for frequencies such as 1 per day is denoted as 1/ day and 1 per 2 weeks is denoted as 1/ 2 weeks. For sieve ranges not specified in the appendices, the Department will determine the minimum frequency by criteria on which appendices were derived.

####### 1.1.4.2.1.1.1.2 Sieve Limits For Asphalt Aggregate Gradations with Producer-Set Targets

Test and report the following listed sieves starting with the sieve at which 100 percent by mass passes and ending with the first sieve at which less than 5 percent by mass passes:
1 inch (in), 3/4 in, 1/2 in, 3/8 in, Number (No.) 4, No. 8, No. 16, No. 30,

Based on the producer's initial data submittal, the average result for each sieve will be set as the target. The upper and lower specification will be defined by assigning a control band of plus or minus 15.0 percent passing by mass to the target of the critical sieve. Sieves with targets less than or equal to 10 and greater or equal to 90 will not be assigned a control band. However, no oversized material will be permitted for the starting sieve. For all other sieves, the upper and lower specifications will be defined by assigning a control band of plus or minus 10.0 percent passing by mass to the target.
When the 3/8-inch sieve is the critical sieve, the 1/2-inch sieve will not be assigned a control band.

1.1.4.2.1.1.2 L.A. Abrasion

Minimum sampling and testing frequencies for L.A. Abrasion will be set in accordance with ***Appendix 12***.

1.1.4.2.1.1.3 Acid Insoluble Test for Friction Course

Minimum sampling and testing frequencies for Acid Insolubles will be set in accordance with ***Appendices 17 and 18***. Testing shall be waived for granitic aggregates.

1.1.4.2.1.1.4 Bulk Specific Gravity (Dry)

Minimum sampling and testing frequencies for Bulk Specific Gravity (Dry) will be set in accordance with ***Appendix 12A***.

1.1.4.2.1.1.5 Other Properties

Sampling and testing frequencies for other aggregate properties will be established by the Department at the time of approval, based on the characteristics of the aggregate and contract specifications.

1.1.4.2.1.2 Fine Aggregate

1.1.4.2.1.2.1 Silica Sand

1.1.4.2.1.2.1.1 Standard Gradation & Percent Passing #200 Sieve

Minimum sampling and testing frequencies for gradation will be set in accordance with ***Appendices 1, 1A, 3, 6, 6A, 8, and 13***, as applicable, with the maximum frequency of any one required sieve determining the minimum required for entire gradation. For sieve ranges not specified in the appendices, the Department will determine the minimum frequency by criteria on which appendices were derived.

Fineness Modulus is required on all gradation samples.

1.1.4.2.1.2.1.2 Organic Impurities (Color)

Minimum sampling and testing frequency for color is one per week and increases to the minimum will be set by the Department on a mine by mine basis.

1.1.4.2.1.2.2 Screenings

1.1.4.2.1.2.2.1 Sieve Limits for Asphalt Aggregate with Producer Set Targets

Gradation controls for screenings shall be the same as for coarse aggregate except that the 3/8 inch and No. 4 sieves shall be

controlled by the specifications. Additional sieves required for testing and reporting include No. 8, No. 16, No. 30, No. 50 and No. 100. Sieves with targets less than or equal to 10 will not be assigned a control band.

1.1.4.2.1.2.3 Bulk Specific Gravity (Dry)

Minimum sampling and testing frequencies for Bulk Specific Gravity (Dry) for all fine aggregates will be set in accordance with ***Appendix 12A***.

1.1.4.2.1.2.4 Other Properties

Sampling and testing frequencies for other material properties will be established by the Department at the time of approval, based on the characteristics of the aggregate and contract specifications.

1.1.4.2.1.3 Base Aggregate

1.1.4.2.1.3.1 Limerock Bearing Ratio

Minimum sampling and testing frequencies will be set by the Department in accordance with ***Appendix 16***. If carbonate content falls outside a range of ±10% of the target set at approval and the LBR average falls below 140, LBR testing frequencies will be set at twice the normal frequency given in ***Appendix 16***. Testing frequency will return to normal after three consecutive passing LBR results.

1.1.4.2.1.3.2 Carbonate Content

The Department will sample and test for carbonate content. The producer is not required to test for carbonate content.

1.1.4.2.1.3.3 Gradation, Minus #200, Liquid Limits and Plasticity

Minimum sampling and testing frequencies will be set at the same frequency of the LBR test and samples may be obtained from the LBR sample.

1.1.4.2.1.3.4 Other Properties

Sampling and testing frequencies for other material properties will be established by the Department at the time of approval, based on the characteristics of the aggregate and contract specifications.

1.1.4.2.2 REDISTRIBUTION TERMINALS

The Department shall set the sampling and testing frequency for all aggregates received at Redistribution Terminals in accordance with ***Table 6*** below.

Table 6. Minimum Sampling and Testing Frequencies for Incoming Aggregate Products at Redistribution Terminals:

Rail Redistribution Terminals:	**Compliance Level, %**	
	> 95	**90 - 95**
Gradation	1 per 20 cumulative rail cars	2 per 20 cumulative rail cars
Minus 200	1 per 20 cumulative rail cars	2 per 20 cumulative rail cars
Ship Redistribution Terminals:		
Gradation	1 per 3,000 tons offloaded	2 per 3,000 tons offloaded
Minus 200	1 per 3,000 tons offloaded	2 per 3,000 tons offloaded
LBR, Liquid Limits, Plasticity, and Grade for Aggregate Base	3 each per shipment	6 each per shipment
Acid Insoluble	1 per product per shipment	2 per product per shipment
Barge Redistribution Terminals:		
Gradation	1 per barge	3 per barge
Minus 200	1 per barge	3 per barge
LBR, Liquid Limits, Plasticity, and Grade for Aggregate Base	2 each per shipment	4 each per shipment
Acid Insoluble	1 per product per shipment	2 per product per shipment

For Liquid Limits and Plastic Limits, the following requirements apply for ***Table 6***:

1) No failure in last 30 results is considered >95%
2) One or more failures in last 30 is considered 90-95%

For aggregate shipments received at Redistribution Terminals from Type 1 and 2 mines, aggregate certification from the mine will be used in lieu of retesting at the Terminal for L.A. Abrasion, Limerock Bearing Ratio, Acid

Insoluble, Liquid Limits and Plasticity, Bulk Specific Gravity, Absorption, and Color. However, QC tests for Gradation and Passing #200 sieve shall be required at the terminal.
For Riprap materials received at Redistribution Terminals from Type 3 mines, the minimum number tests will be one for each type established in Section (I) (A) 4 of this manual, per shipment received from Type 3 mines.

In addition, depending upon type of aggregate, size, usage and specific properties and characteristics, additional tests and frequencies will be set by the Department according to contract specification requirements.

1.1.4.3 REPORTING AND RECORDING

Data shall be submitted electronically to the Department's database. All producer data including worksheets will be available to the Department mine inspector at the mine and received in the Department's database within the limits set for each type of test given in ***Table 7*** below. Availability at the source shall be considered the Department's ability to view test results from the producer's QC laboratory.

Table 7. Availability of Test Results and Department Receipt

Type of Test	Testing Frequency	Availability (work days)	Received by the Department (work days)
Gradation (including -200)	all	1 (one)	5 (five)
LBR	1 per week >1 per week	10 (ten) 7 (seven)	10 (ten) 10 (ten)
LA Abrasion	all	4 (four)	7 (seven)
Color	all	3 (three)	7 (seven)
Soundness	all	10 (ten)	14 (fourteen)
Fineness Modulus	all	1 (one)	5 (five)
Specific Gravity	all	3 (three)	6(six)

Type of Test	Testing Frequency	Availability (work days)	Received by the Department (work days)
Liquid Limits and Plasticity	If no failing result in last 30	7 (seven)	10 (ten)
	If failing result in last 30	3 (three)	10 (ten)
Free Shell	all	1 (one)	5 (five)
Other tests	------set by the Department-----		

1.1.5 AGGREGATE COMPLIANCE LIMITS AND STANDARDS

Statistical analysis shall be performed on the most recent thirty (30) QC test results of each aggregate code, grade, or type of aggregate from each operation when available. All test results must pass specifications, and the statistical analysis will determine compliance with all pertinent specifications, control bands and Department standards. Examples of how to calculate compliance levels are given in ***Appendix 23***.

When the quality or uniformity of the aggregate is such that there is low testing frequency or a producer's QC program is inactive resulting in a smaller number of test results, all QC results less than one (1) year old from date sampled will be analyzed for compliance and to verify an existing frequency or establish a new frequency even if the total number of test values used in the analysis is less than thirty (30). The Department will perform Verification tests to evaluate the effectiveness of the producer's Quality Control Program.

1.1.5.1 INITIAL DATA SUBMITTAL

Initial data submitted for approval must have all tests passing specifications, with at least 95.0% compliance with all pertinent specifications, control bands and Department standards.

For Base aggregates, all Limerock Bearing Ratio test values shall be at least 100, except all Limerock Bearing Ratio test values shall be at least 150 for Recycled Concrete Aggregate base.

1.1.5.2 FULL QC CERTIFICATION SYSTEM

A source with all tests passing specifications, and with at least 95.0% compliance of all pertinent specifications, control bands and Department standards (30 most recent data) will use the Full QC Certification System for that product. For Base aggregates, all Limerock Bearing Ratio Test results shall have lot averages at least 100 and all individual test values at least 90, except all Limerock Bearing Ratio test values shall be at least 150 for Recycled Concrete Aggregate base.

The average asphalt aggregate bulk specific gravity analysis for the most recent data for a specific material code cannot differ from the initial (as determined by the Department or from that data submitted for approval) data analysis average by more than 0.05.

1.1.5.3 CONDITIONAL QC CERTIFICATION SYSTEM

A source with any test not passing specifications, and with a compliance of less than 95.0% but at least 90.0% with all pertinent specifications, control bands and Department standards (30 most recent data) will use the Conditional QC Certification System for that product.

For Base aggregates, this compliance level occurs when all Limerock Bearing Ratio tests have a lot average below 100, or an individual test value is below 90.

For Recycled Concrete Aggregate base, this compliance level occurs when any test result is below 150.

Average asphalt aggregate bulk specific gravity for the most recent data for a specific material code differs from the initial data analysis by more than 0.05. (Producer may elect to apply for approval of material under a different material code number for average data less than initial data).

1.1.5.4 SUSPENDED APPROVAL

A product with any test not passing specifications, and with a compliance of less than 90.0% with all pertinent specifications, control bands and Department standards (30 most recent data), shall be suspended. (Exception - Limerock Bearing Ratio test – two (2) consecutive lot averages less than 100 or two (2) individual test values below 90 in the same lot or individual test values below 90 in consecutive lots.)

1.1.5.5 RESOLUTION PROCESS

If a Verification test result fails specifications and the QC test result passes, then acceptance will be determined by test results from the verification hold sample or a verification re-sample run by a laboratory that is AASTHO

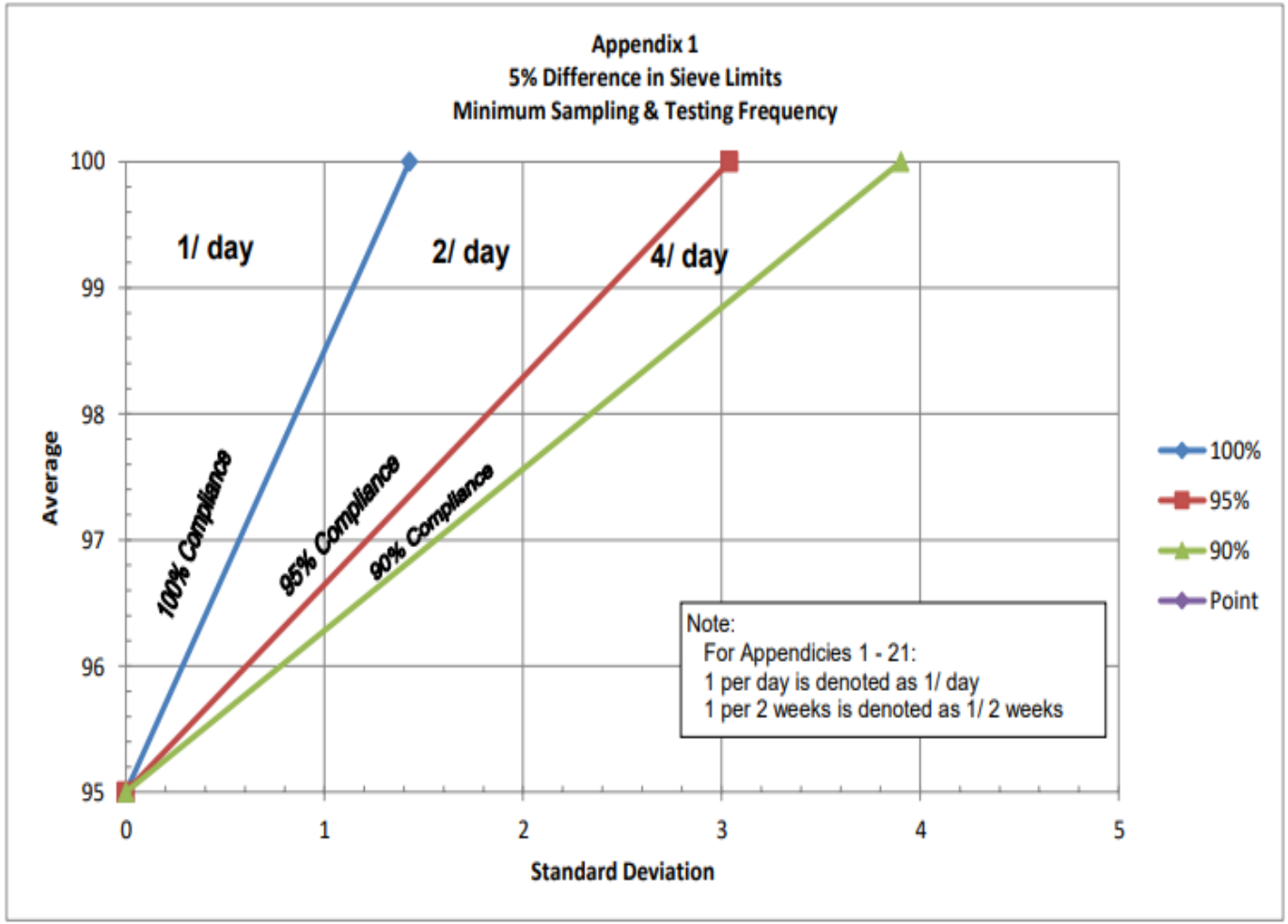
accredited.

1.1.6 GENERALIZED AGGREGATE FLOW

The relationship between mines and terminals, acceptance of aggregate at point-of-use, and points of sampling and testing responsibilities are given in ***Appendix 19*** for coarse aggregate as a general pattern.

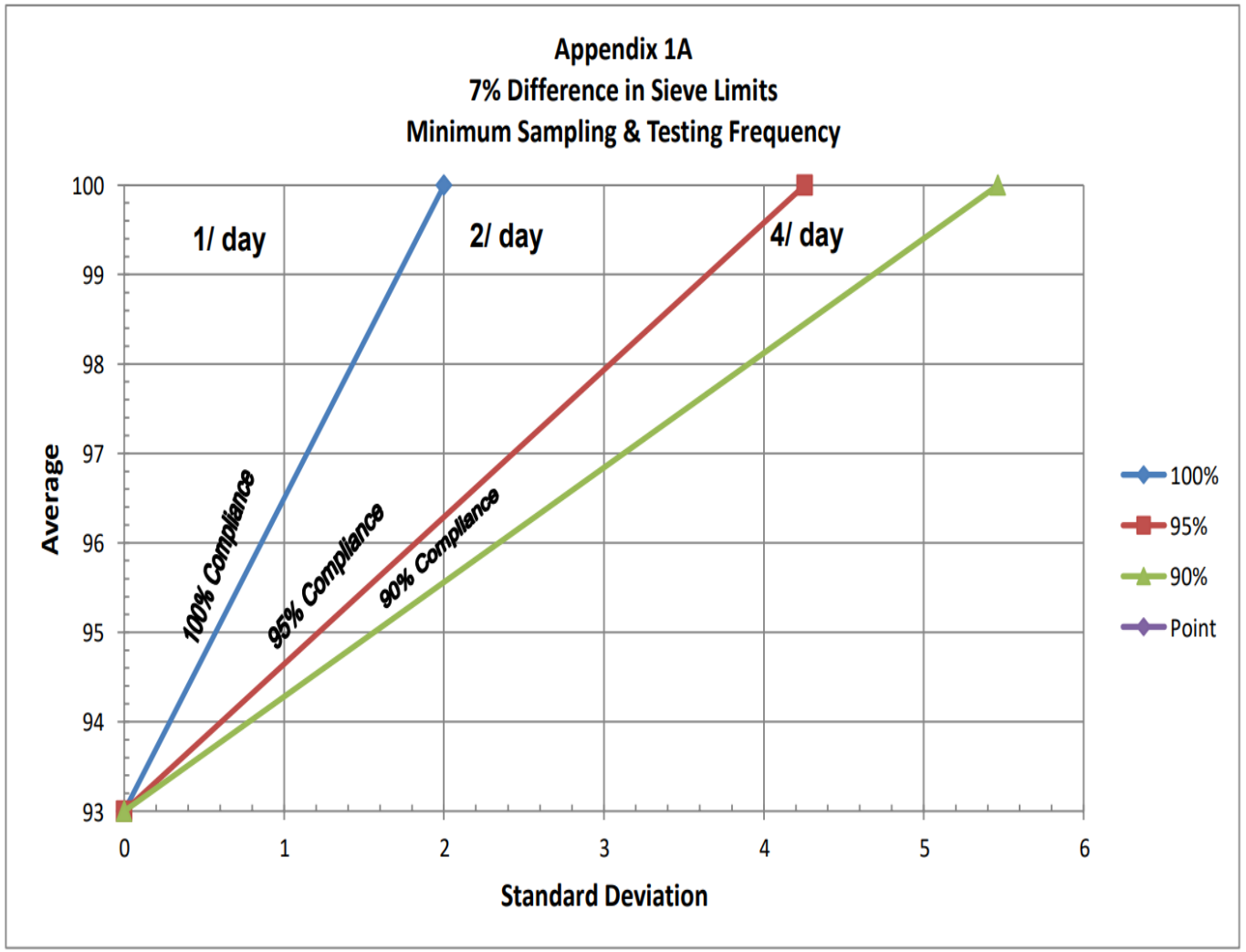
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	95
Upper Limit	100

In 5% Range



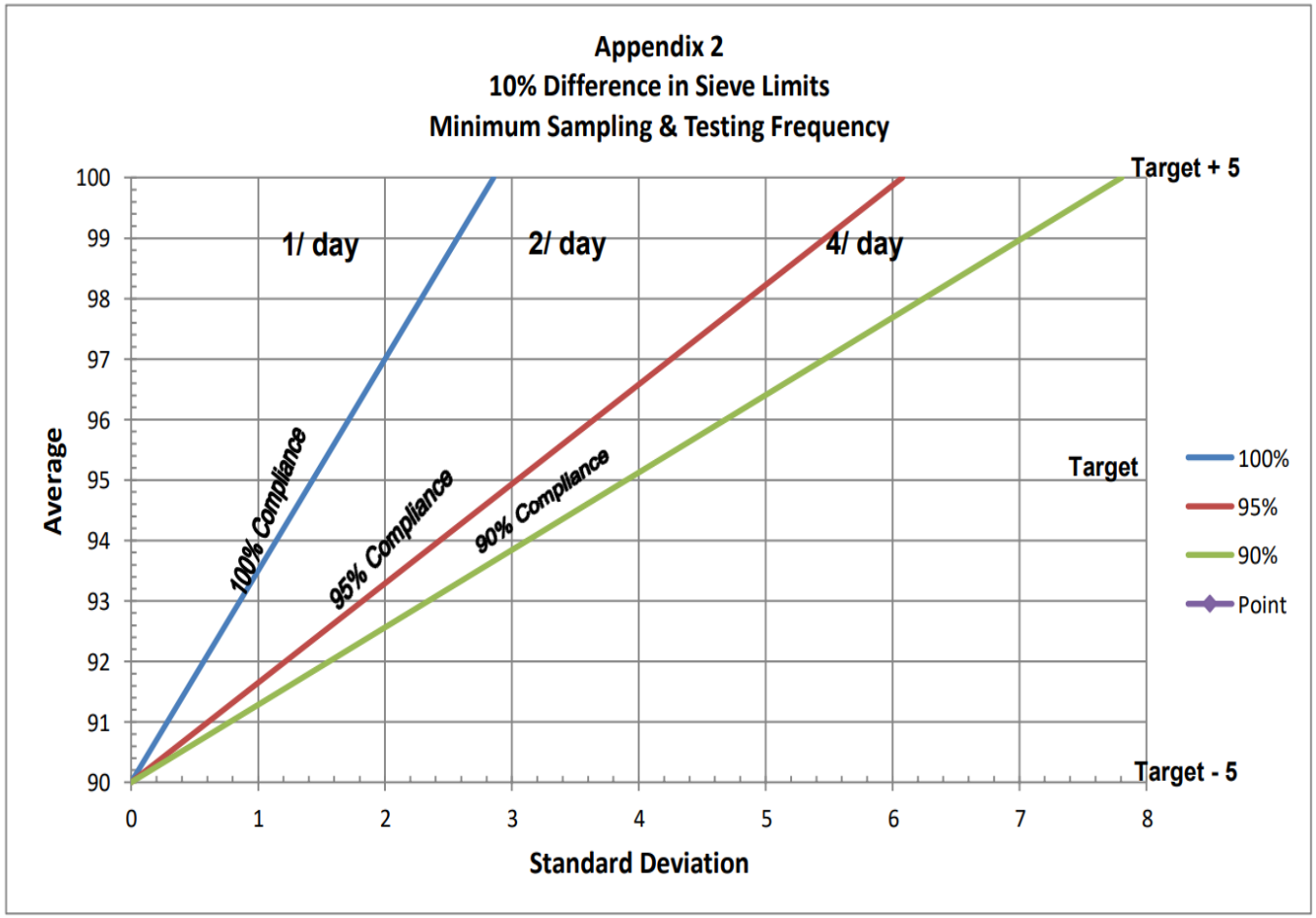
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	93
Upper Limit	100

In 7% Range



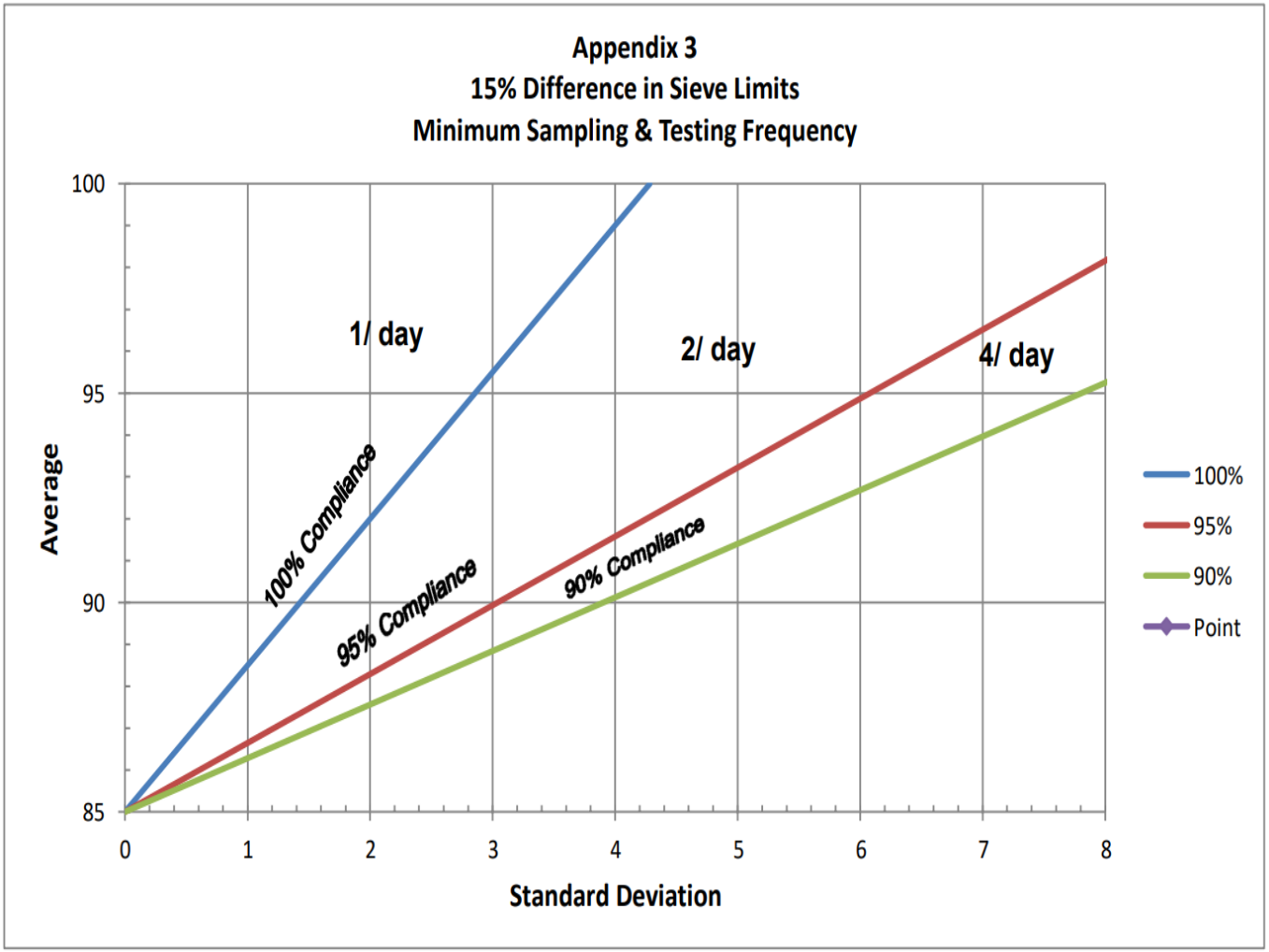
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	90
Upper Limit	100

In 10% Range



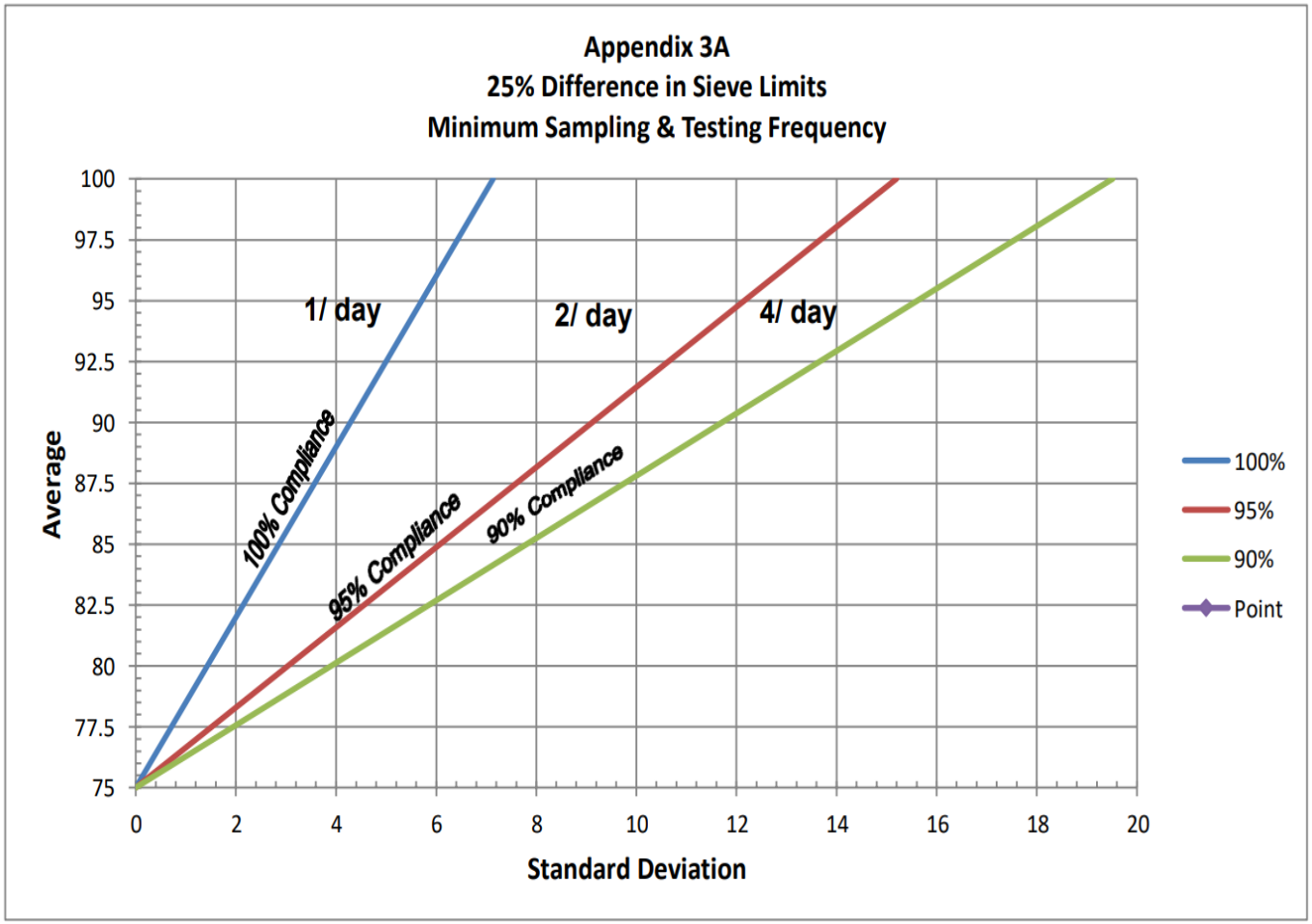
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	85
Upper Limit	100

In 15% Range



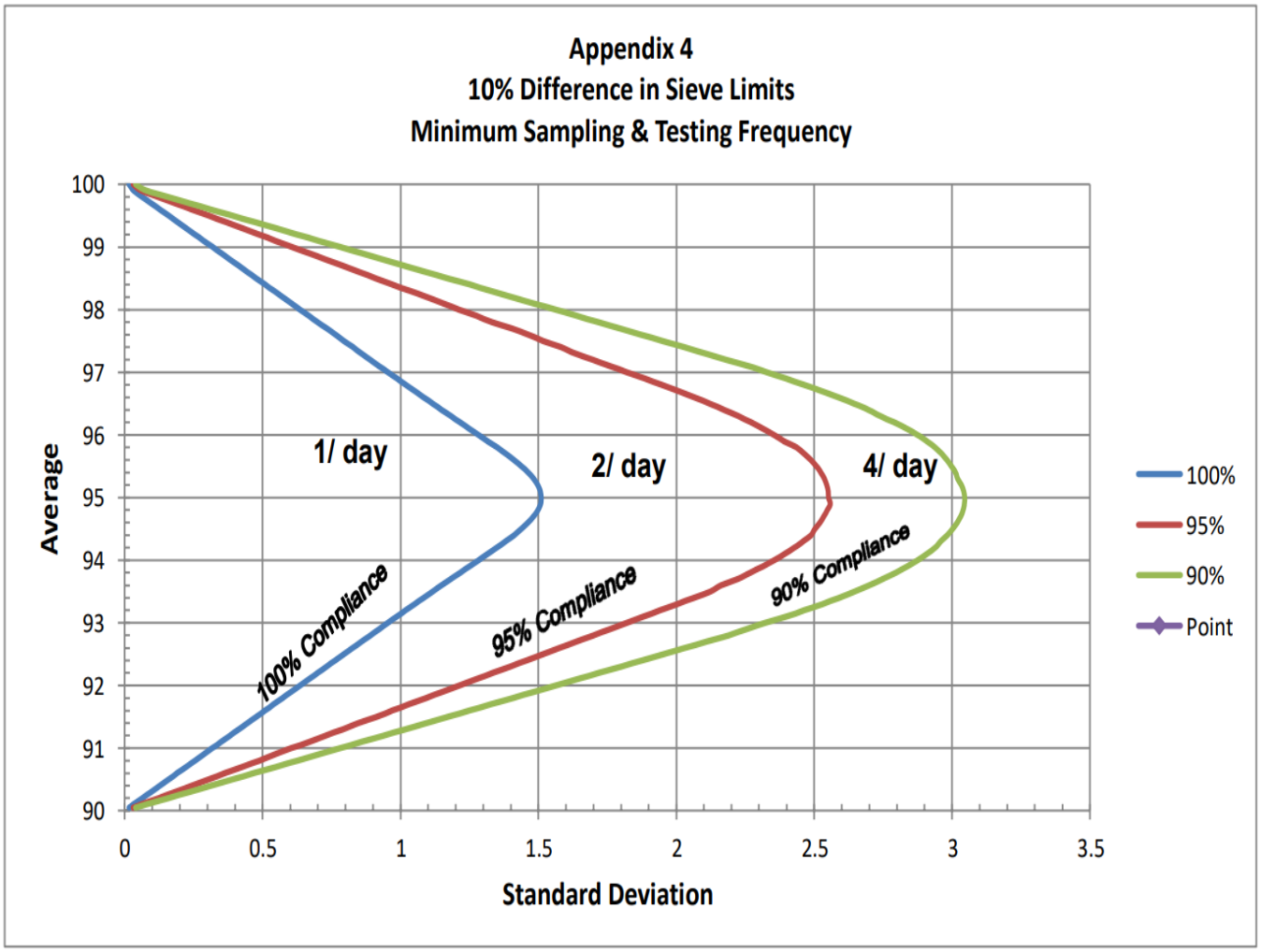
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	75
Upper Limit	100

In 25% Range



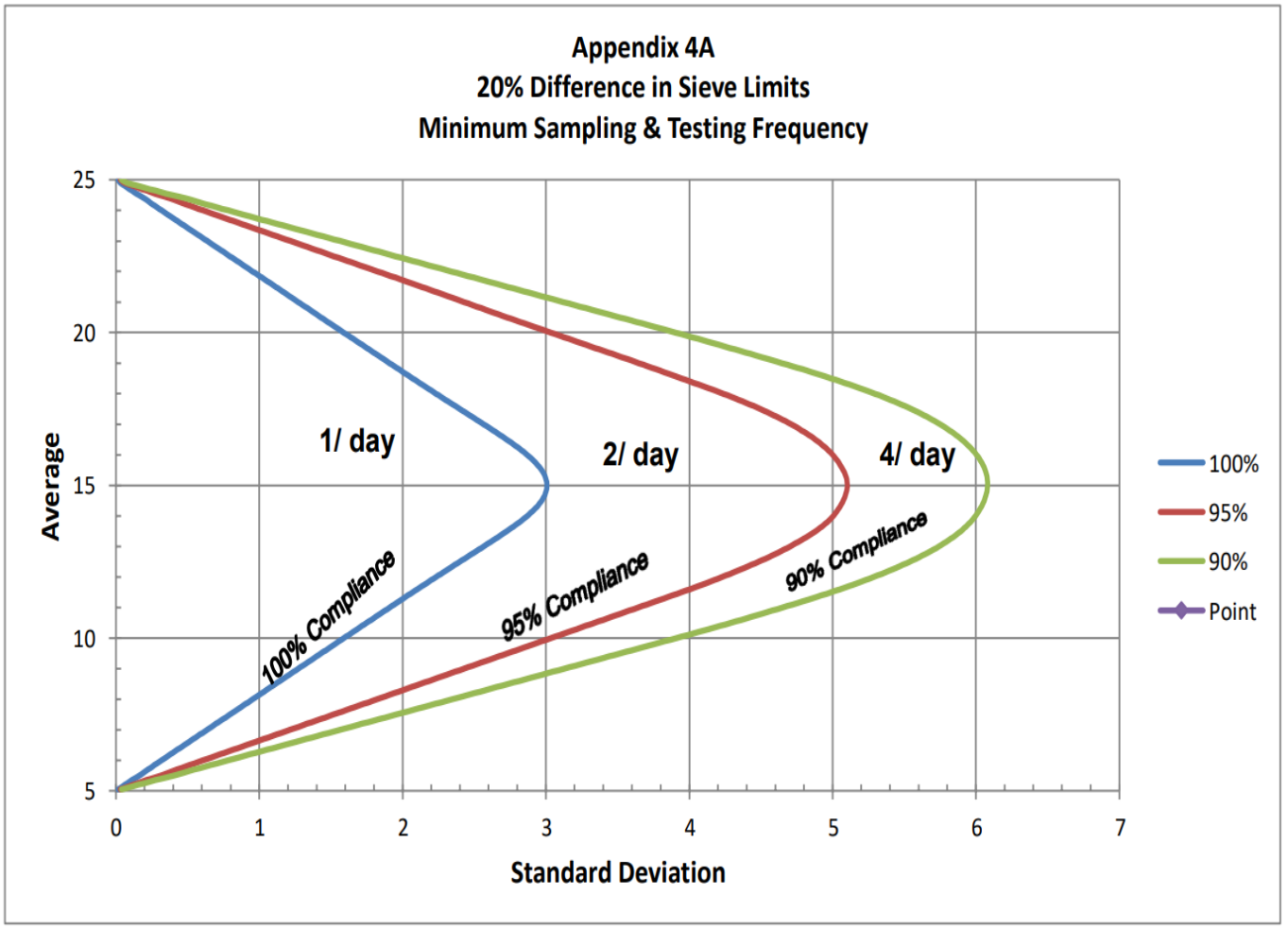
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	90
Upper Limit	100

In 10% Range



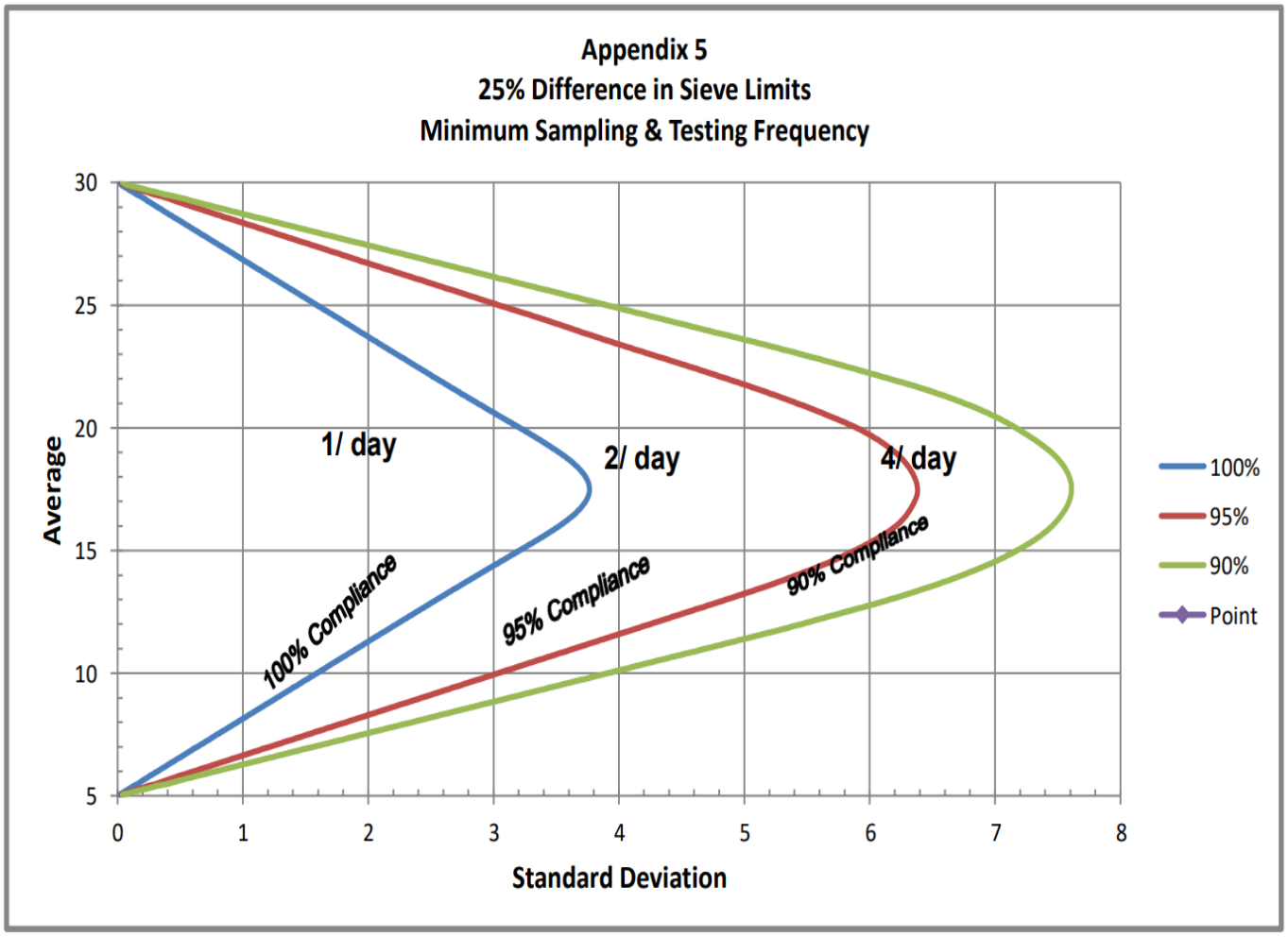
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	5
Upper Limit	25

In 20% Range



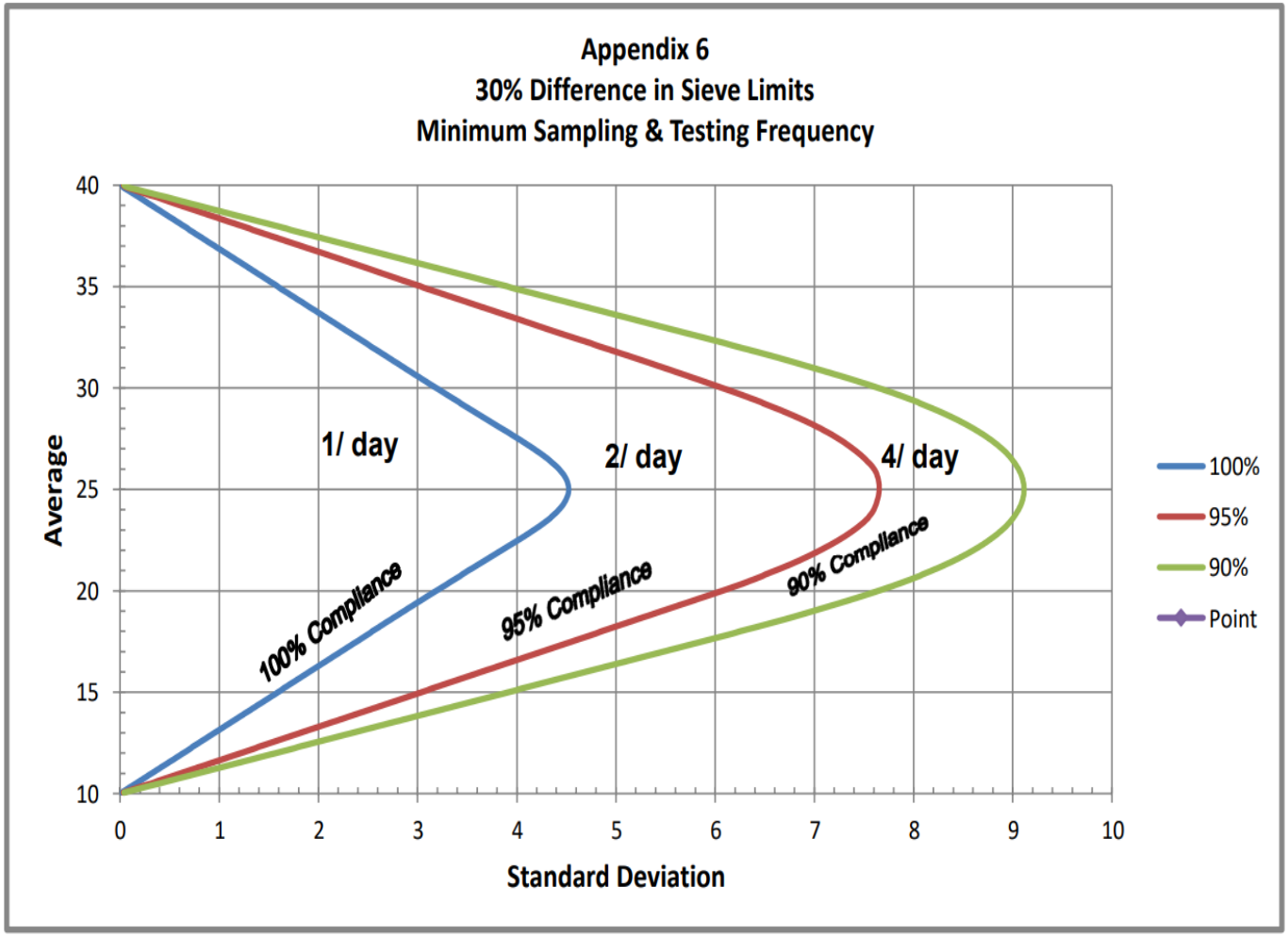
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	5
Upper Limit	30

In 25% Range



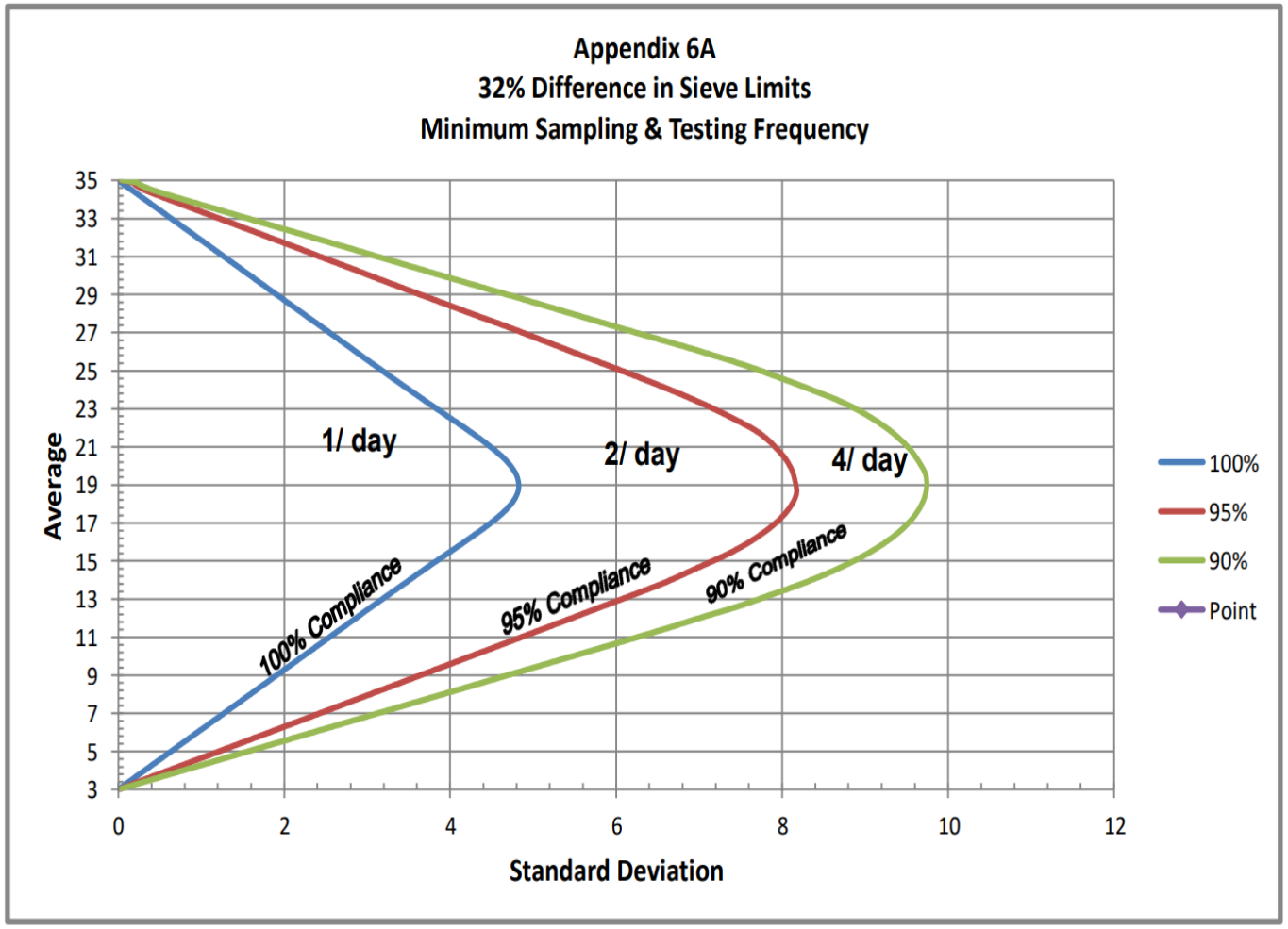
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	10
Upper Limit	40

In 30% Range



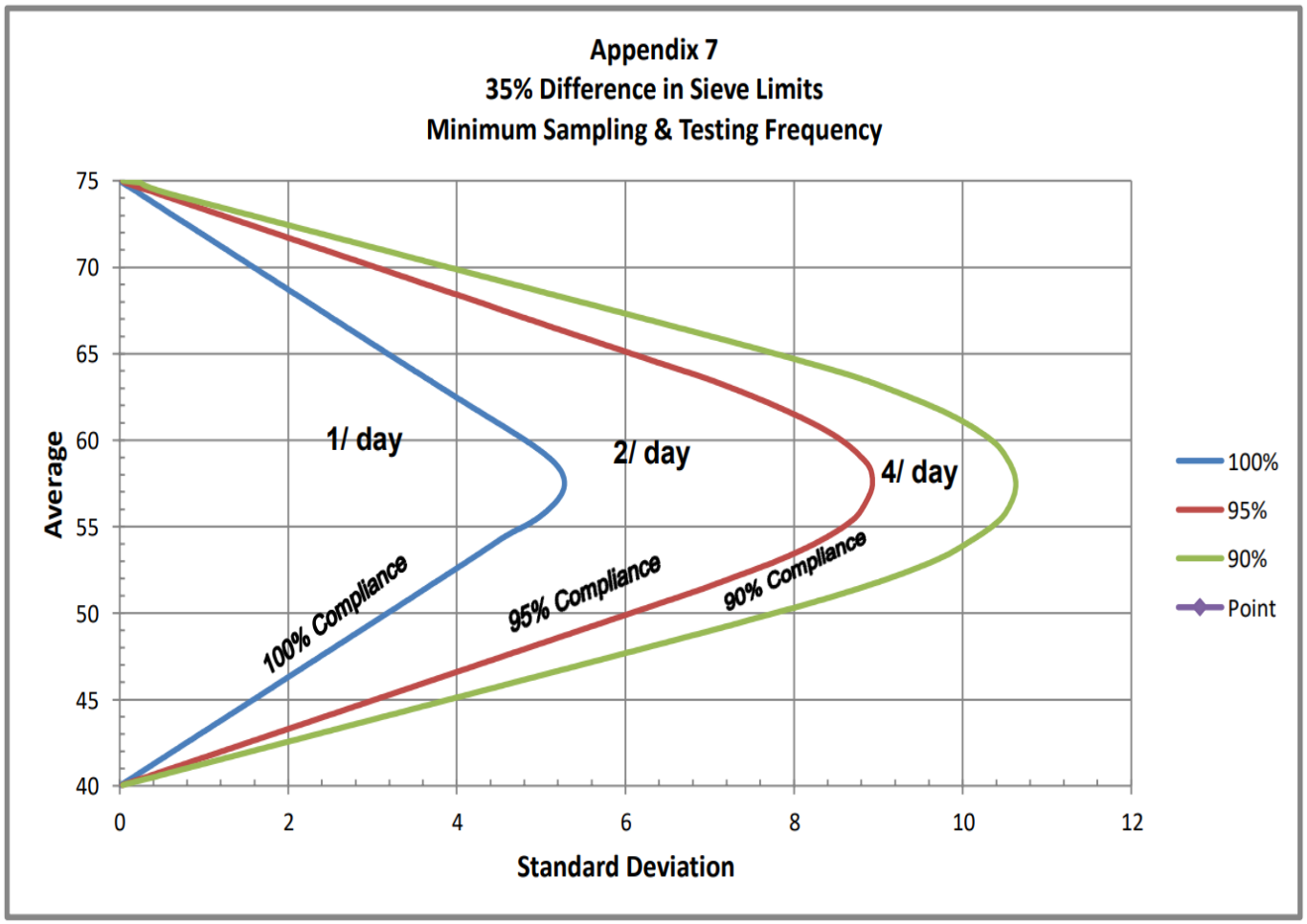
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	3
Upper Limit	35

In 32% Range



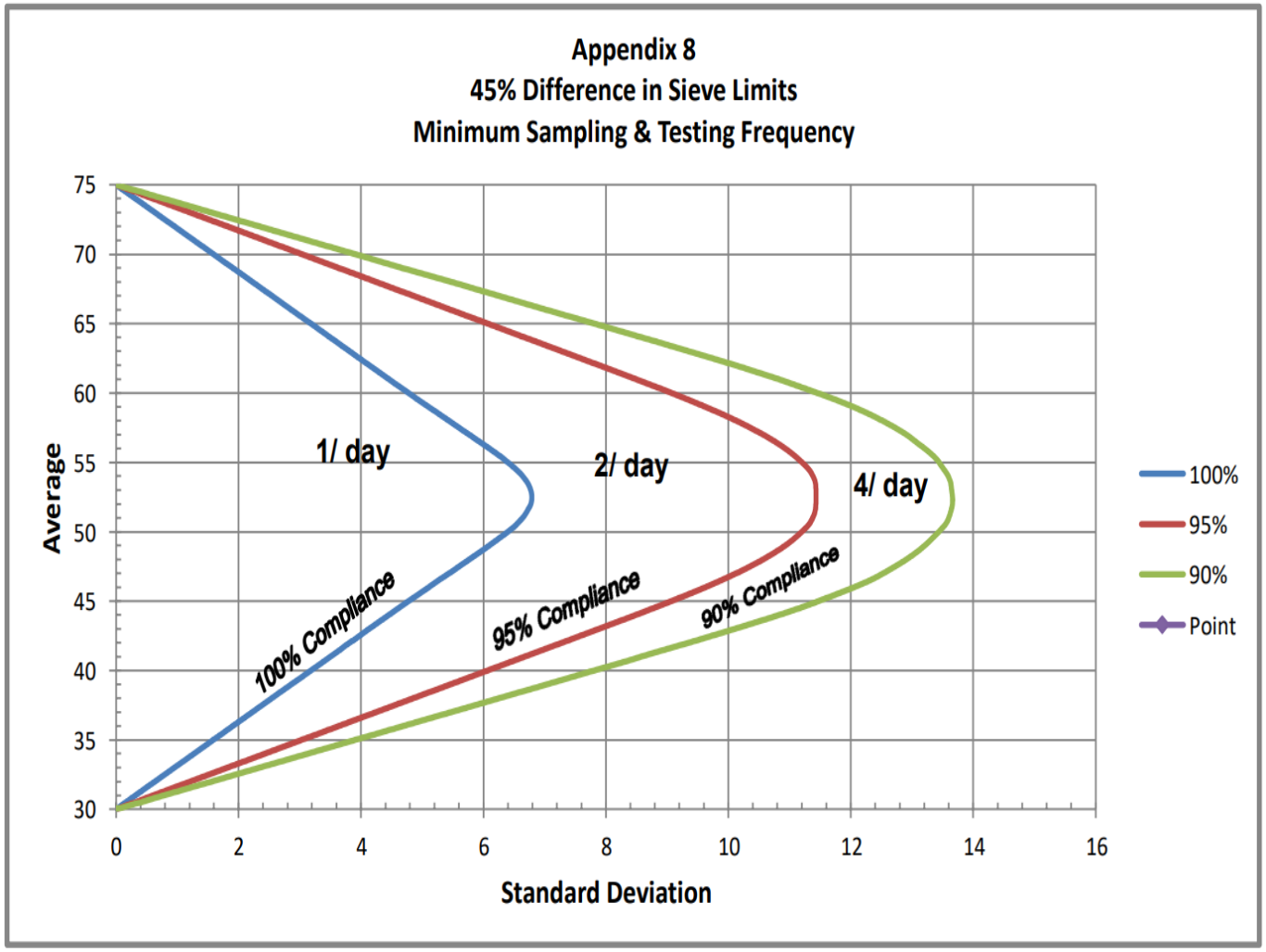
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	40
Upper Limit	75

In 35% Range



Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	30
Upper Limit	75

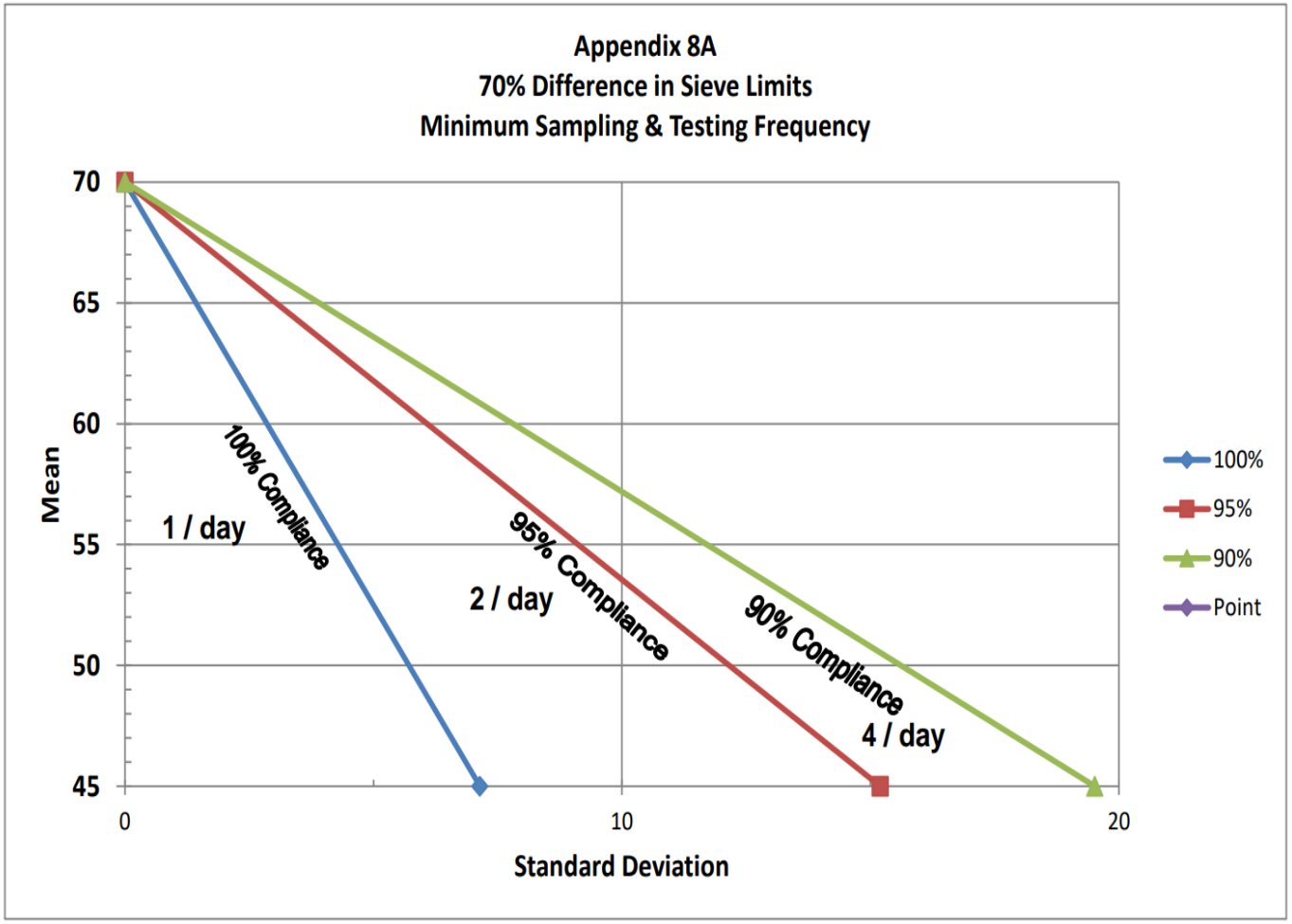
In 45% Range



Please enter your specific information below	
Mean	
Standard Deviation	

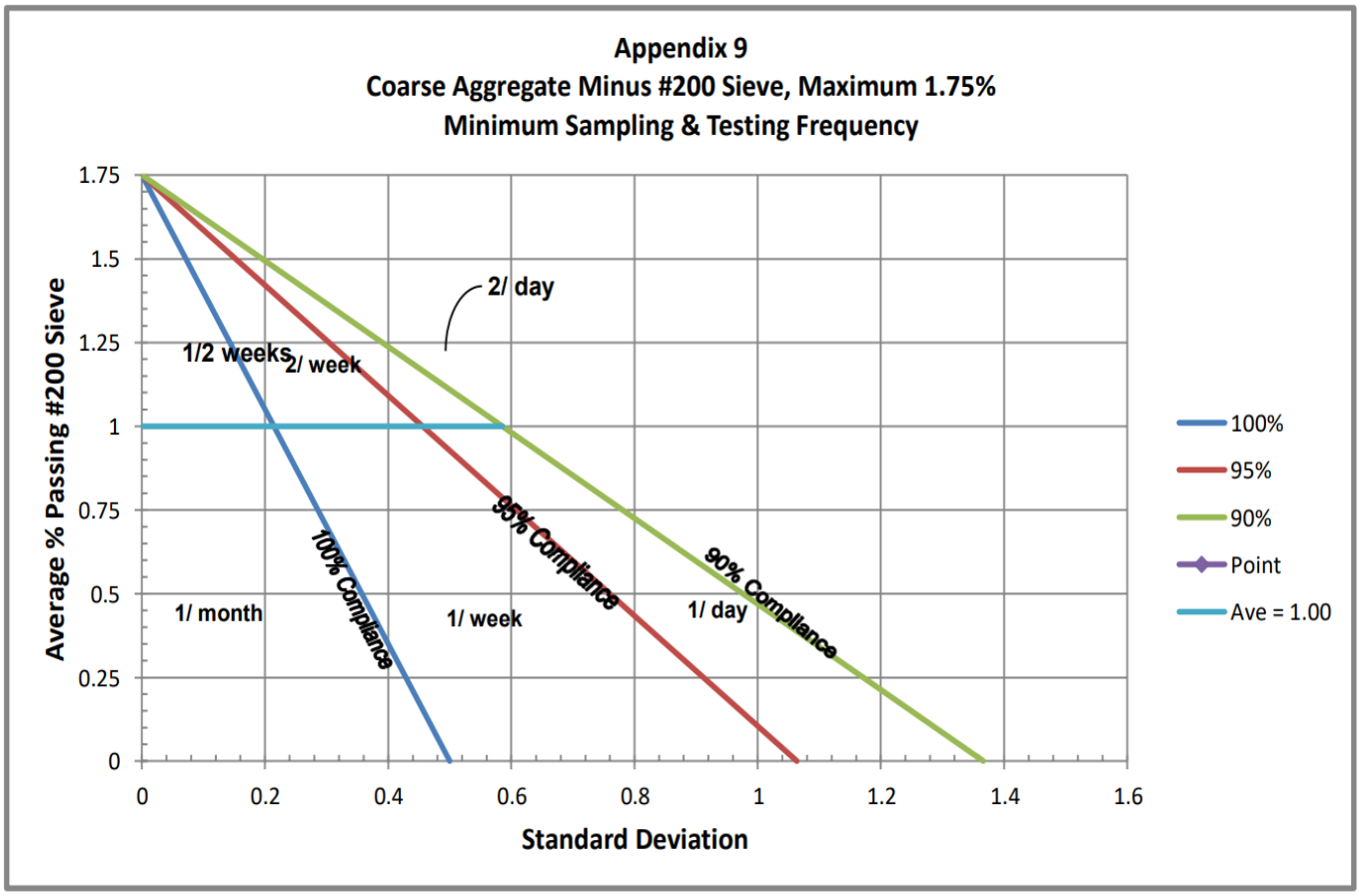
Upper Limit	70

In 70% Range



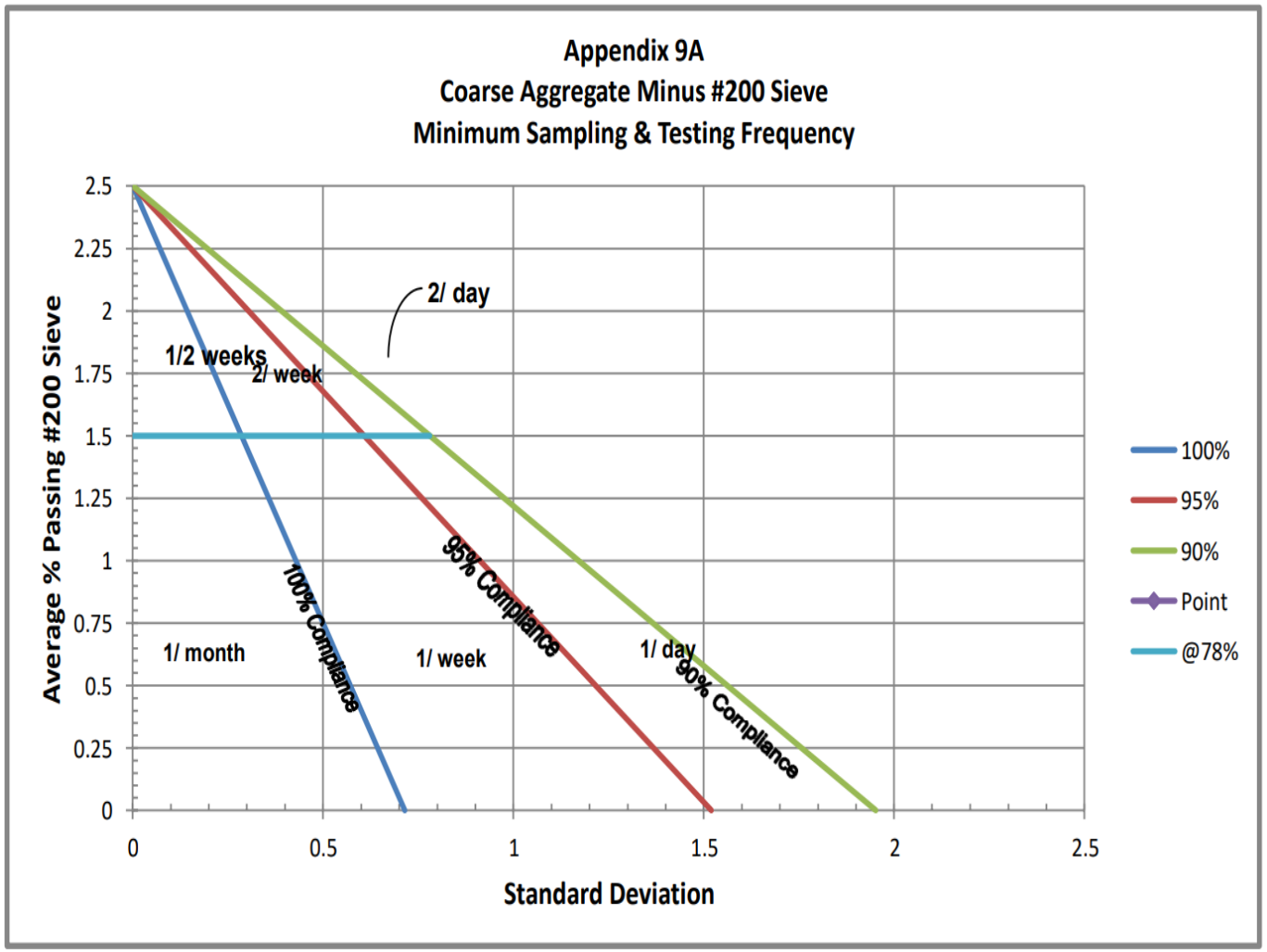
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	0
Upper Limit	1.75

In 1.75% Range



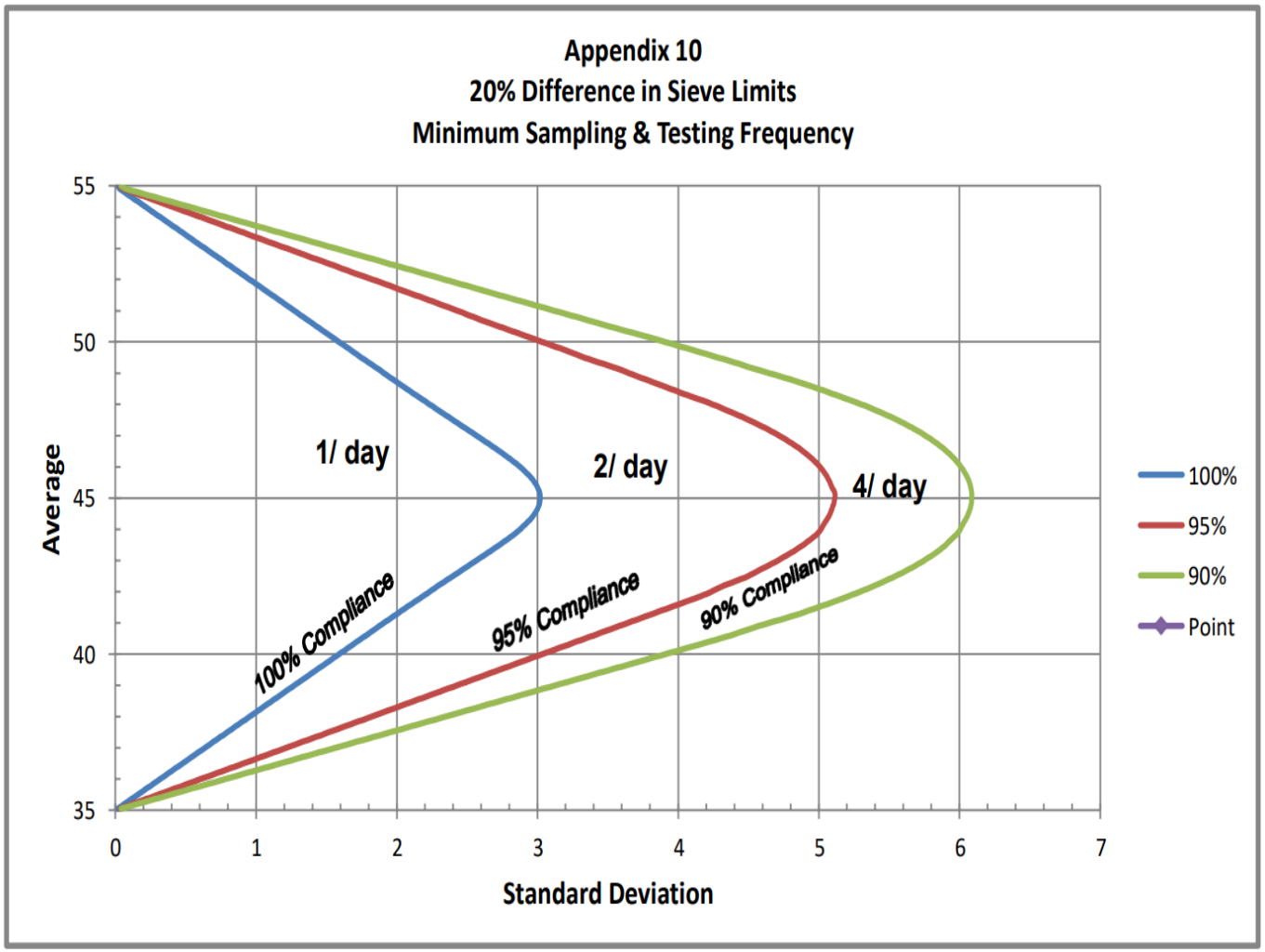
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	0
Upper Limit	2.5

In 2.5% Range



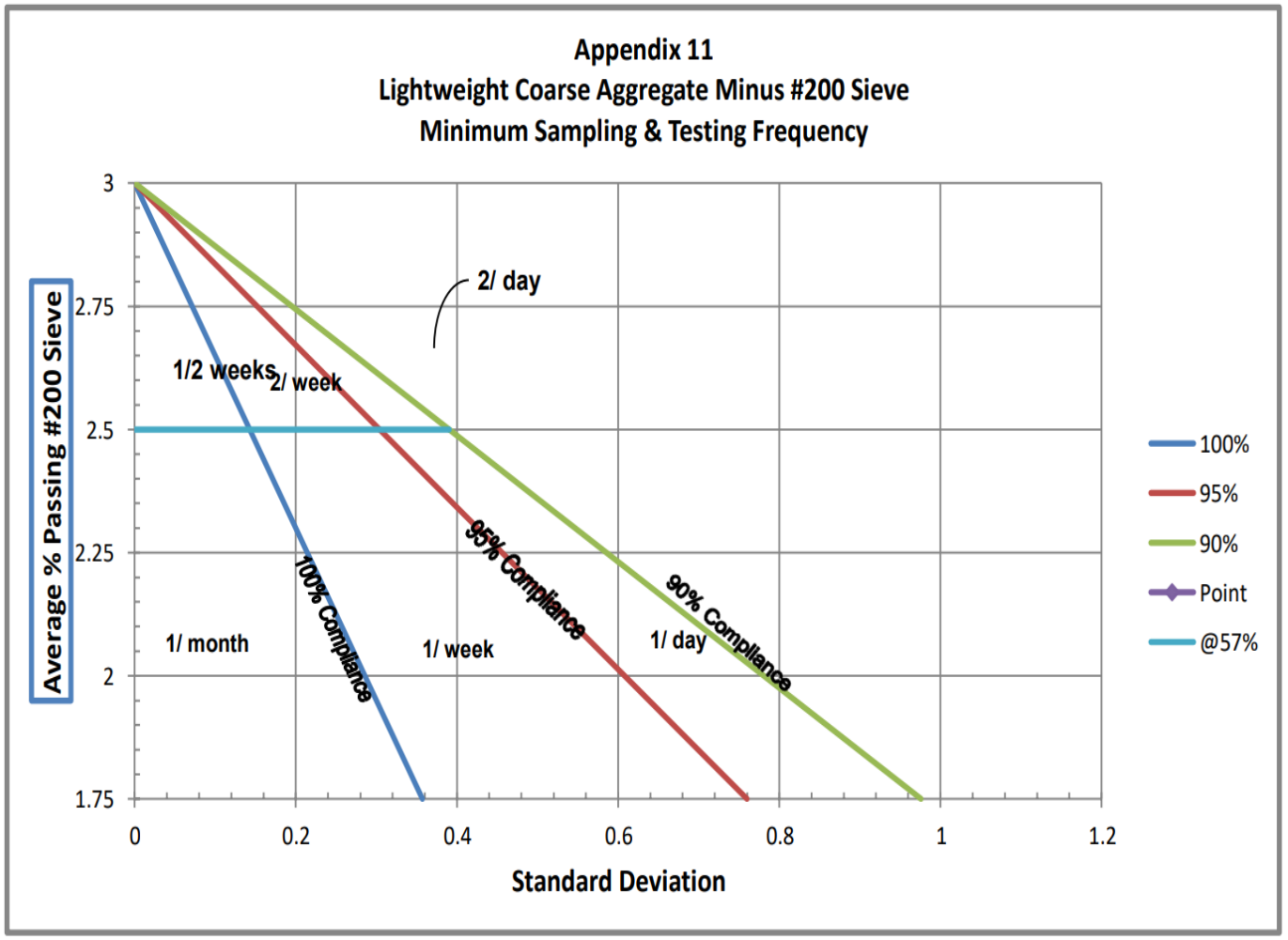
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	35
Upper Limit	55

In 20% Range



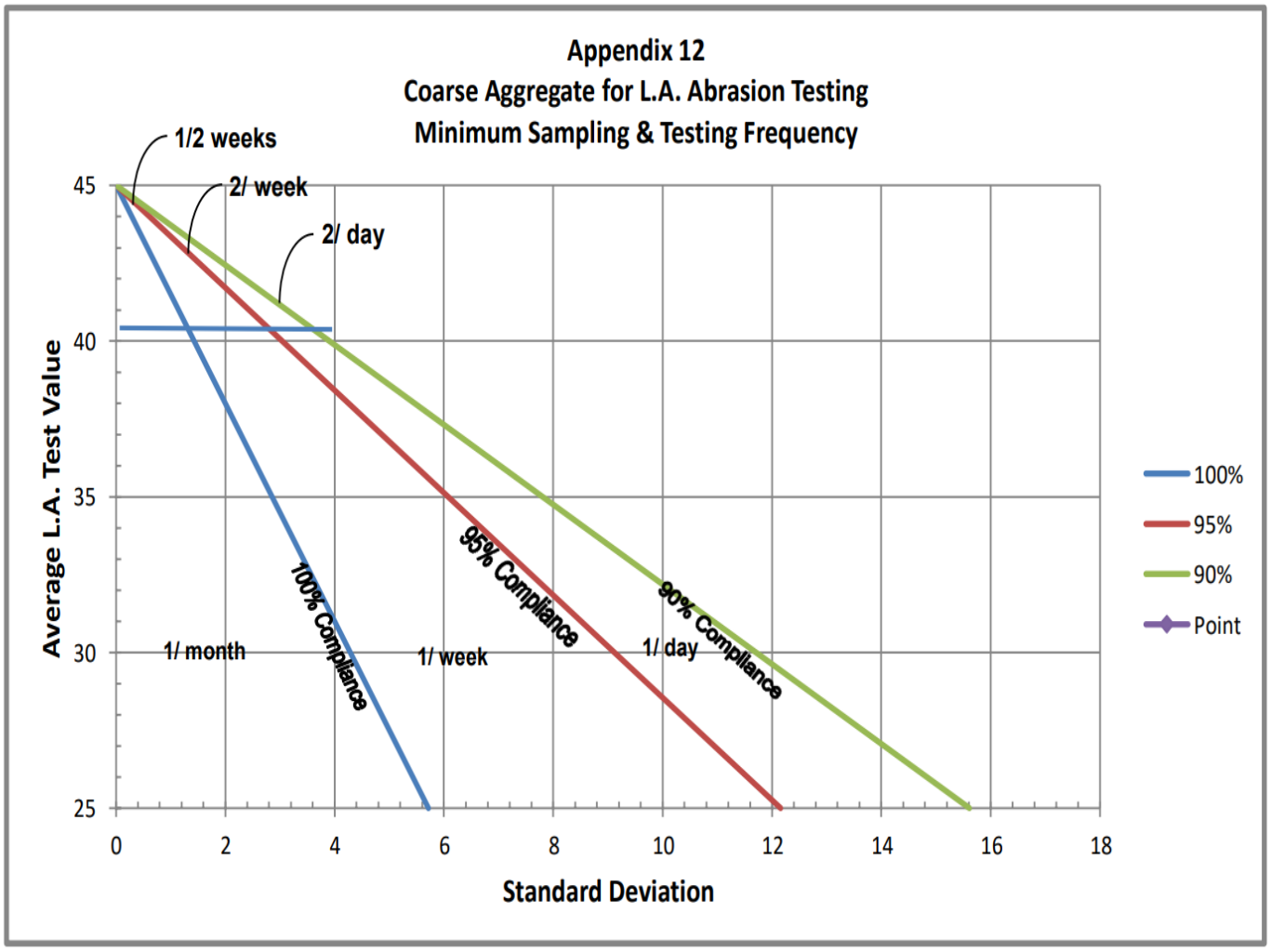
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	1.75
Upper Limit	3

In 1.25% Range



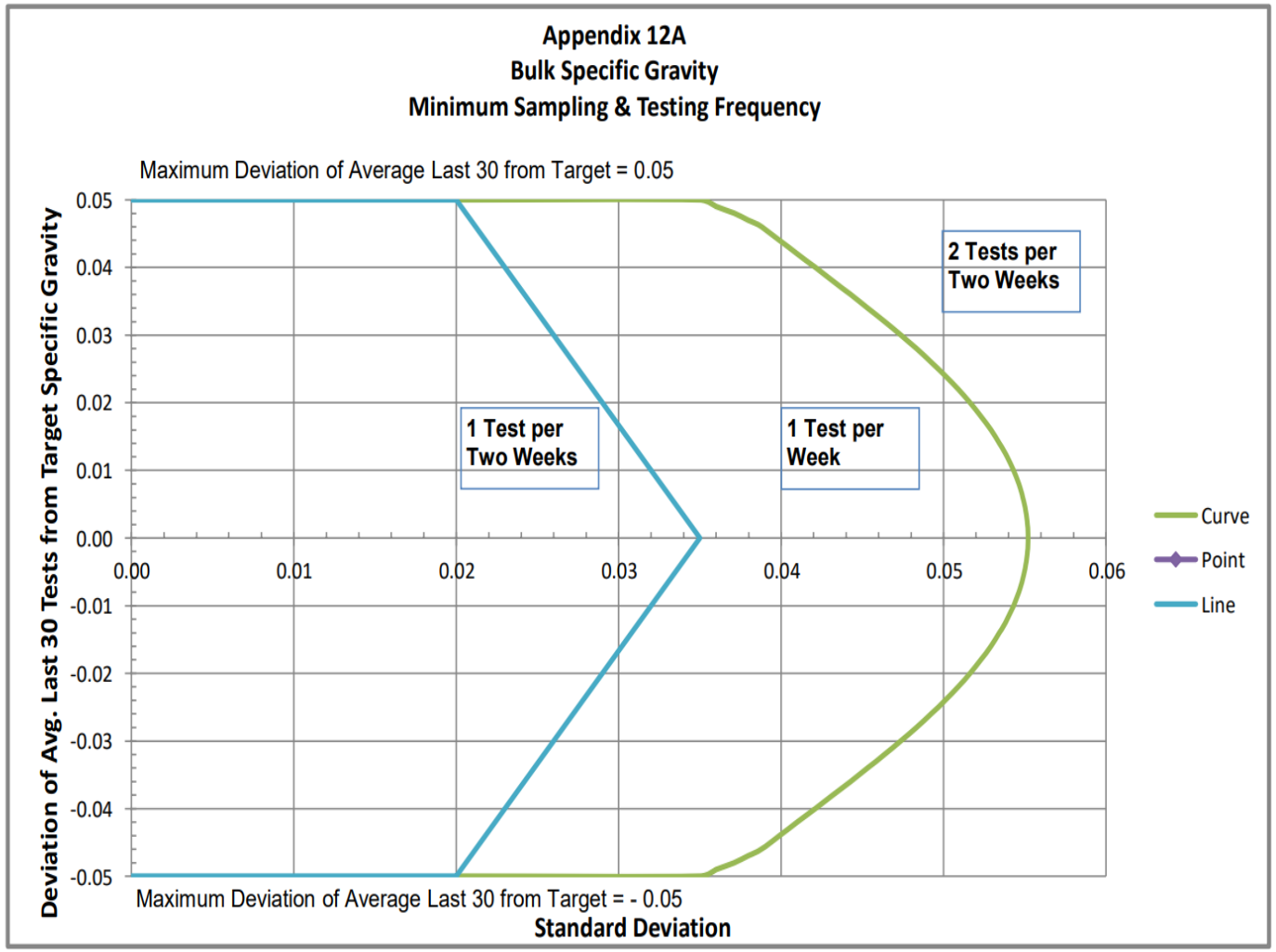
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	25
Upper Limit	45

In 20% Range



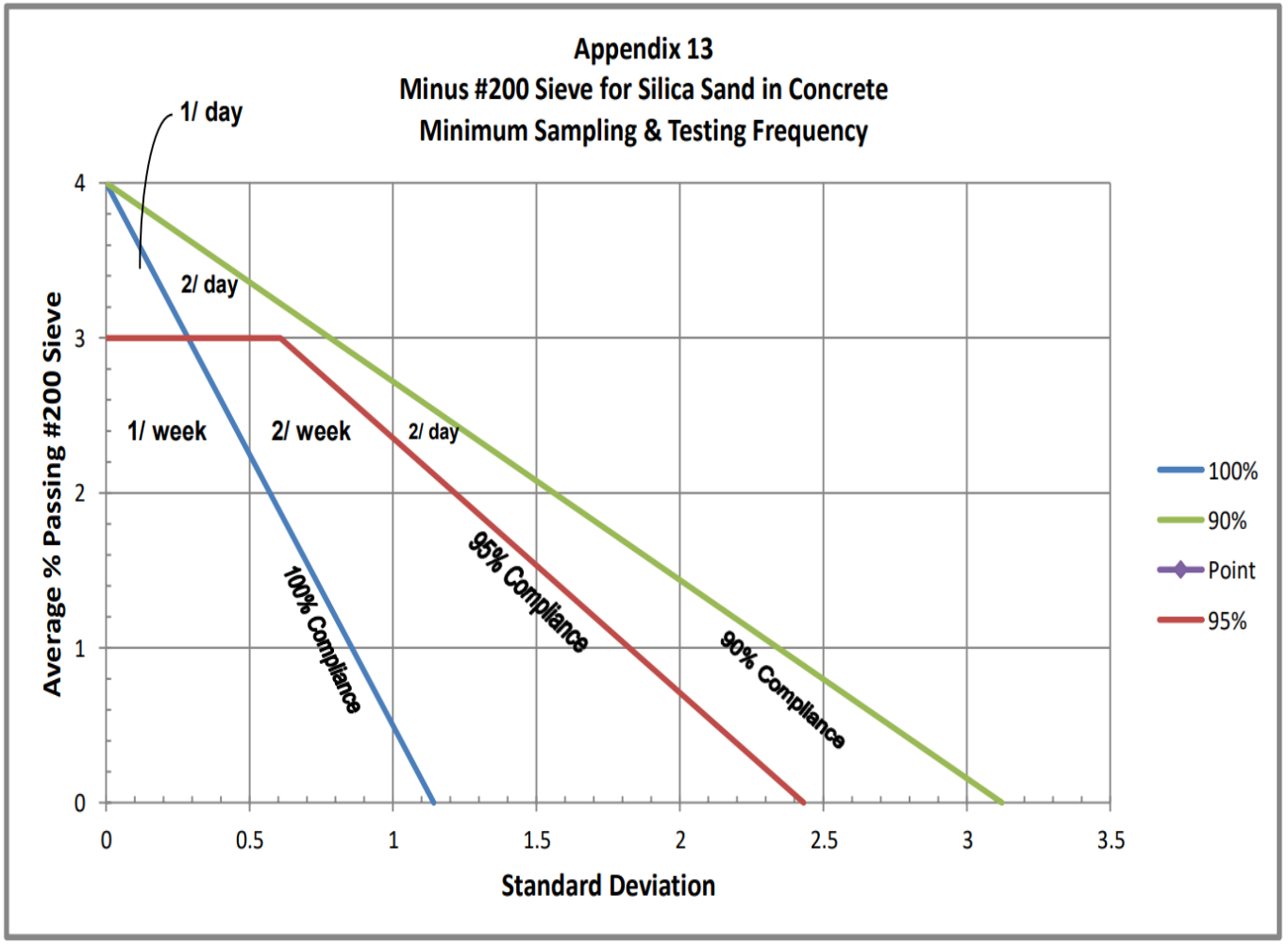
Please enter your specific information below	
Mean - Target	
Standard Deviation	
Mean	
Target	

Y Axis Min	-0.05
Y Axis Max	0.05



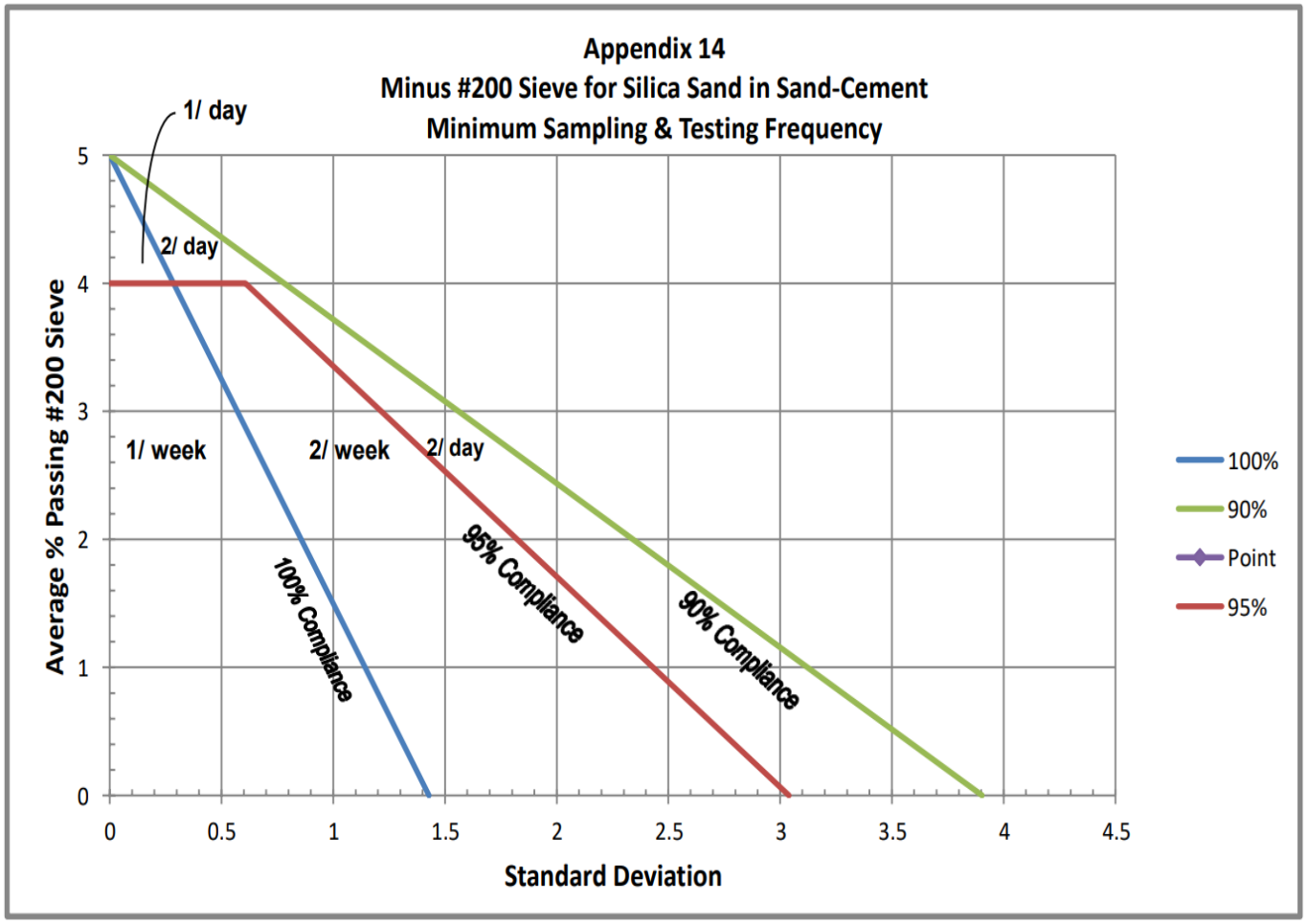
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	0
Upper Limit	4

In 4% Range



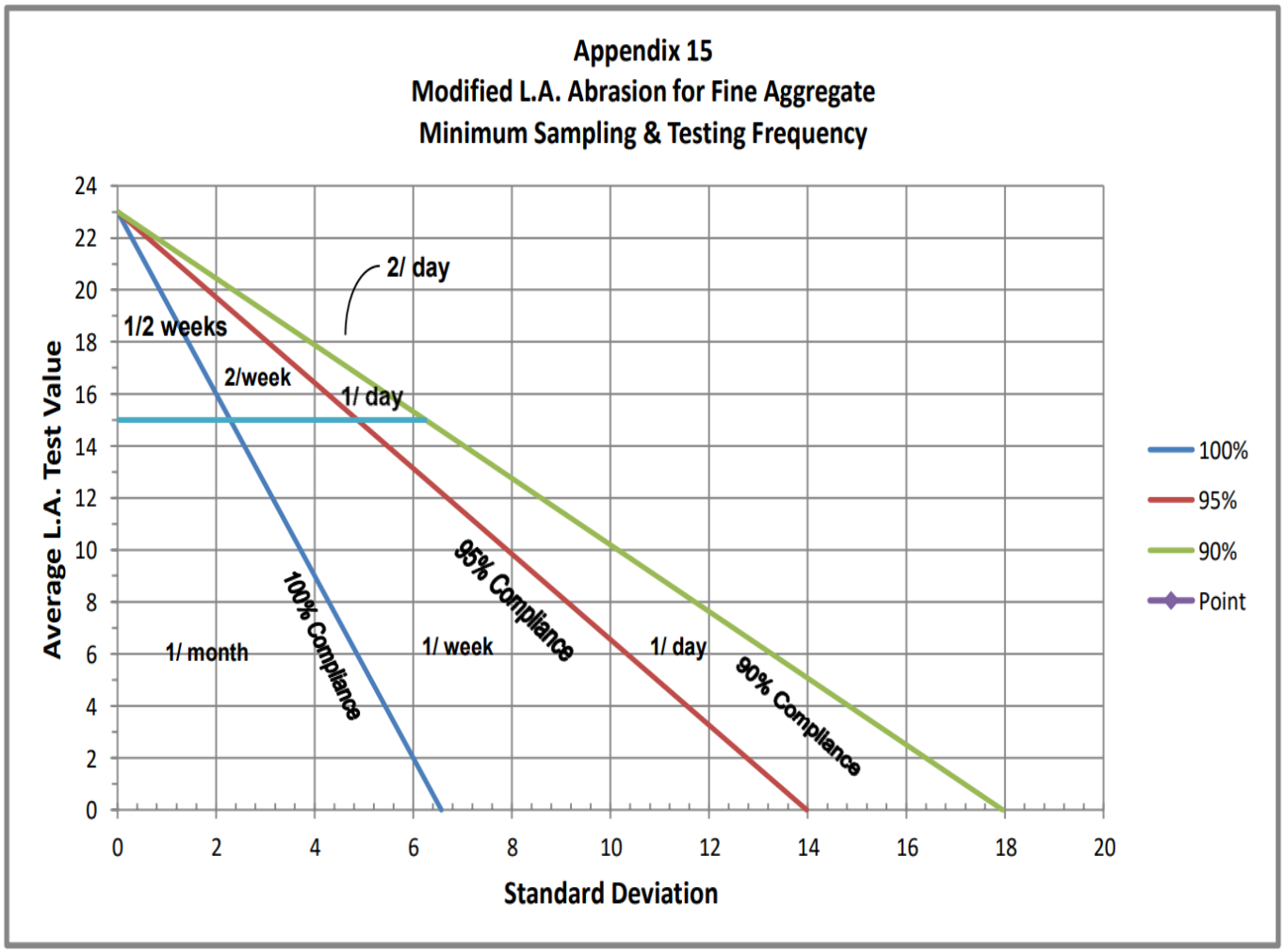
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	0
Upper Limit	5

In 5% Range



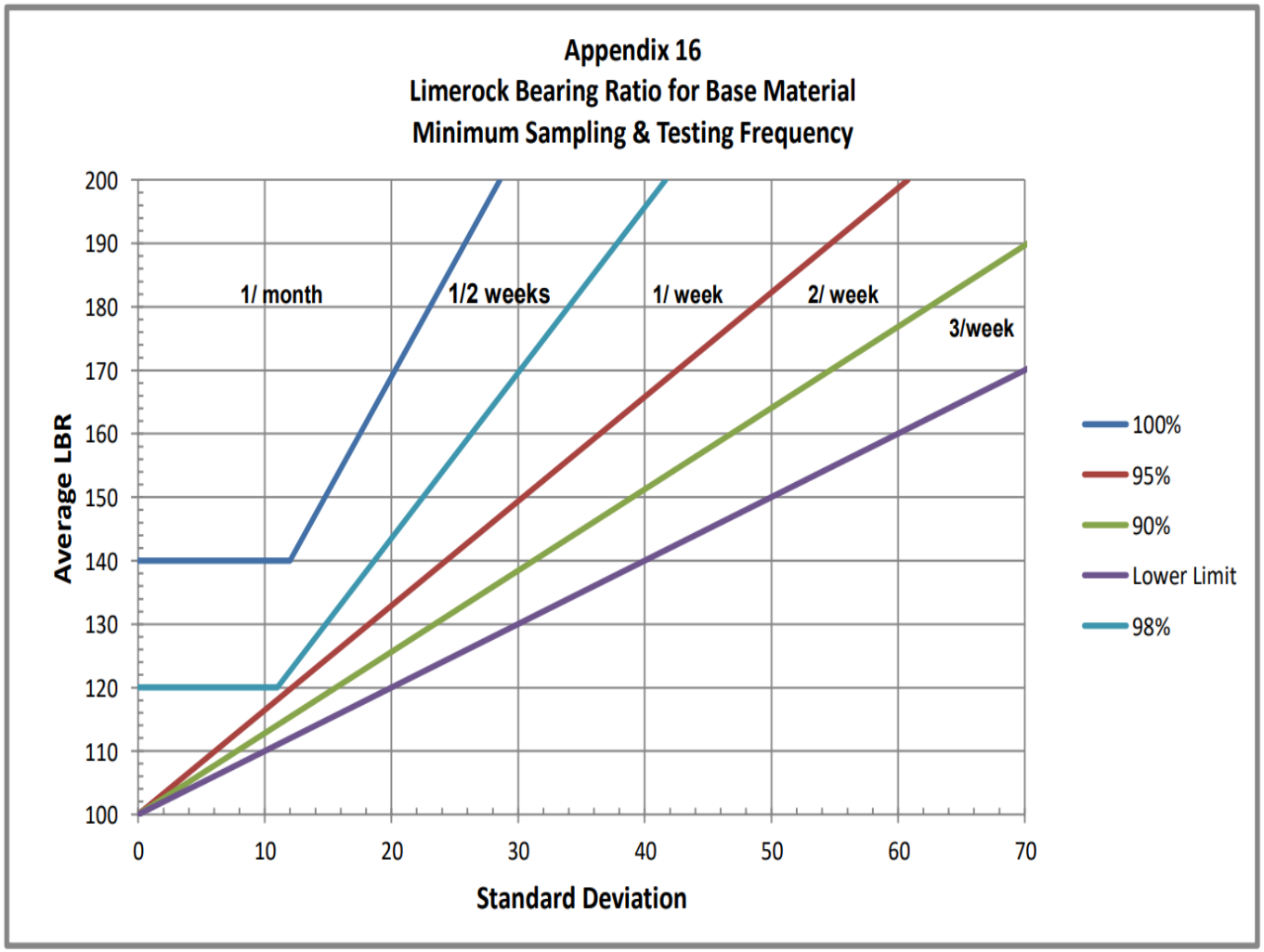
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	0
Upper Limit	23

In 23% Range



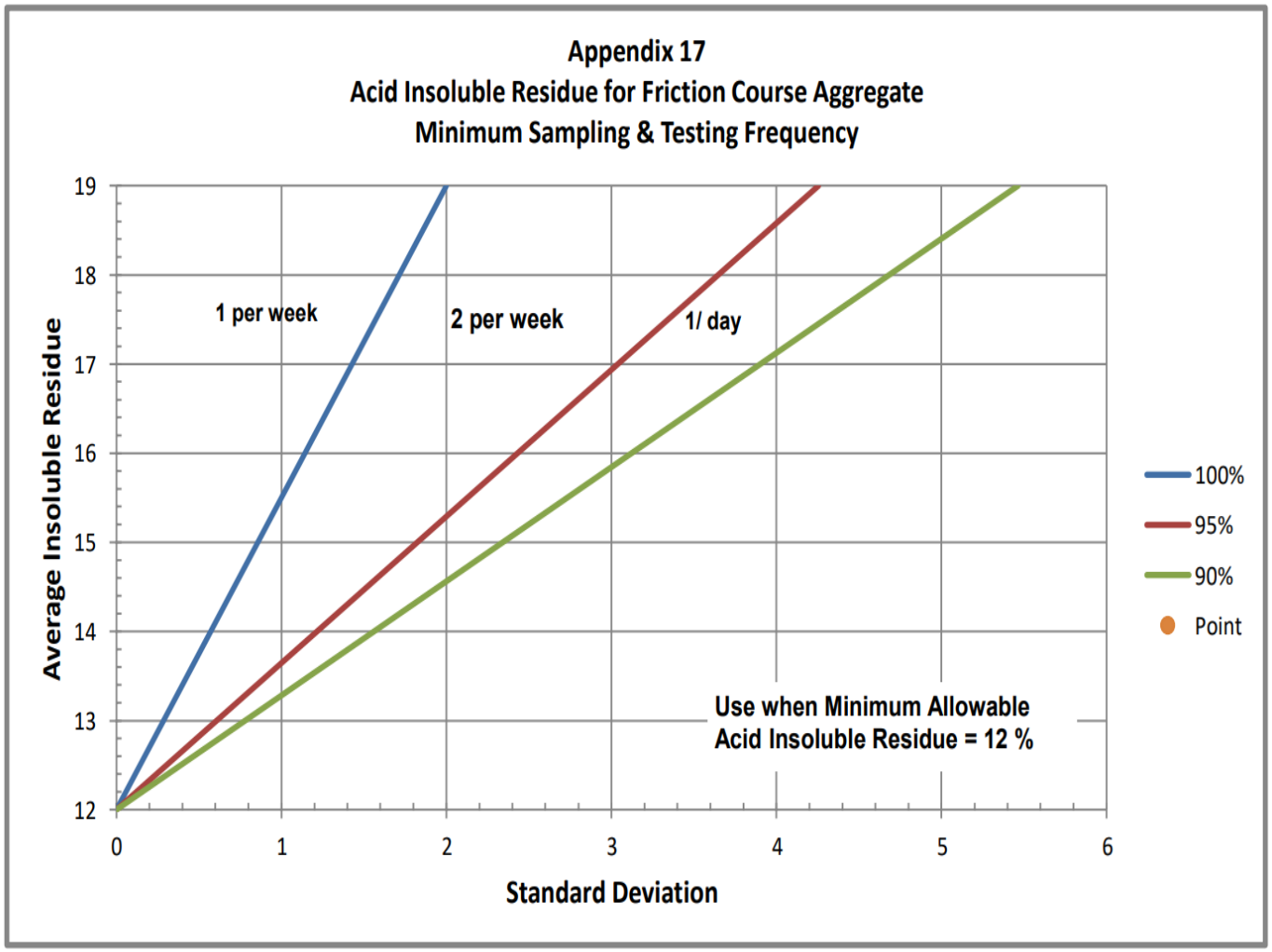
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	100
Upper Limit	200

In 100% Range



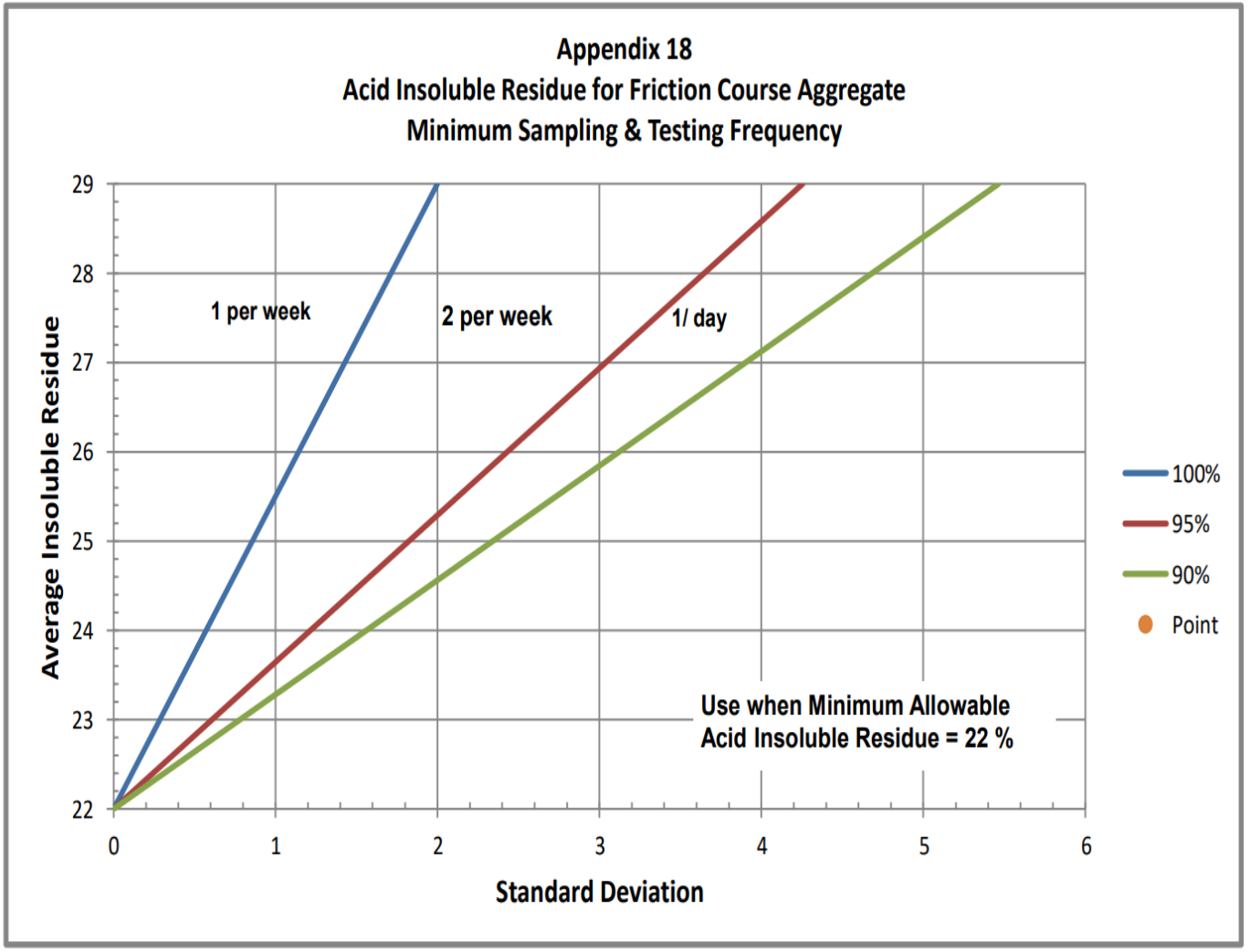
Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	12
Upper Limit	19

In 7% Range

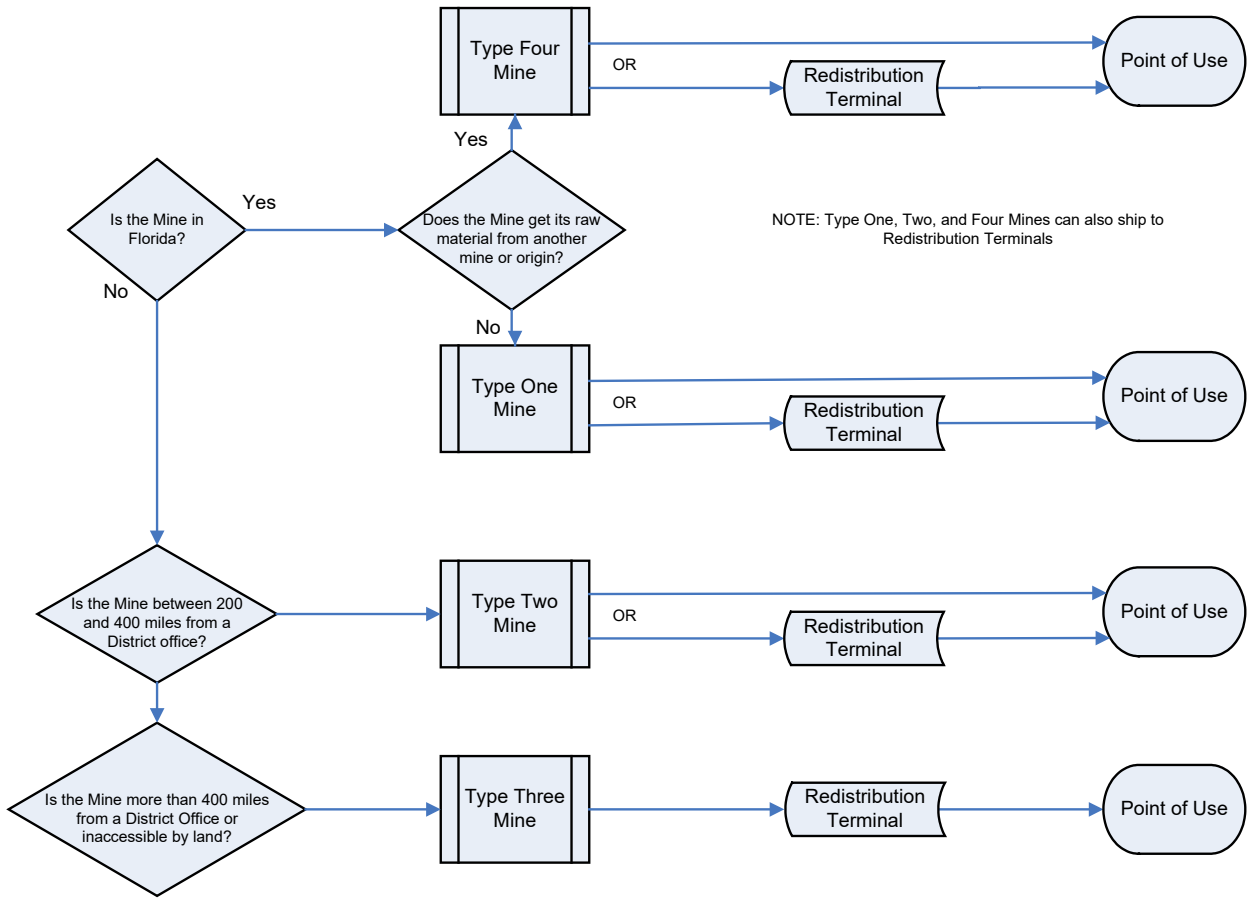


Please enter your specific information below	
Mean	
Standard Deviation	
Lower Limit	22
Upper Limit	29

In 7% Range



Appendix 19 General Aggregate Flow Chart



Appendix 20
Sampling and Testing Methods for Aggregate Sources

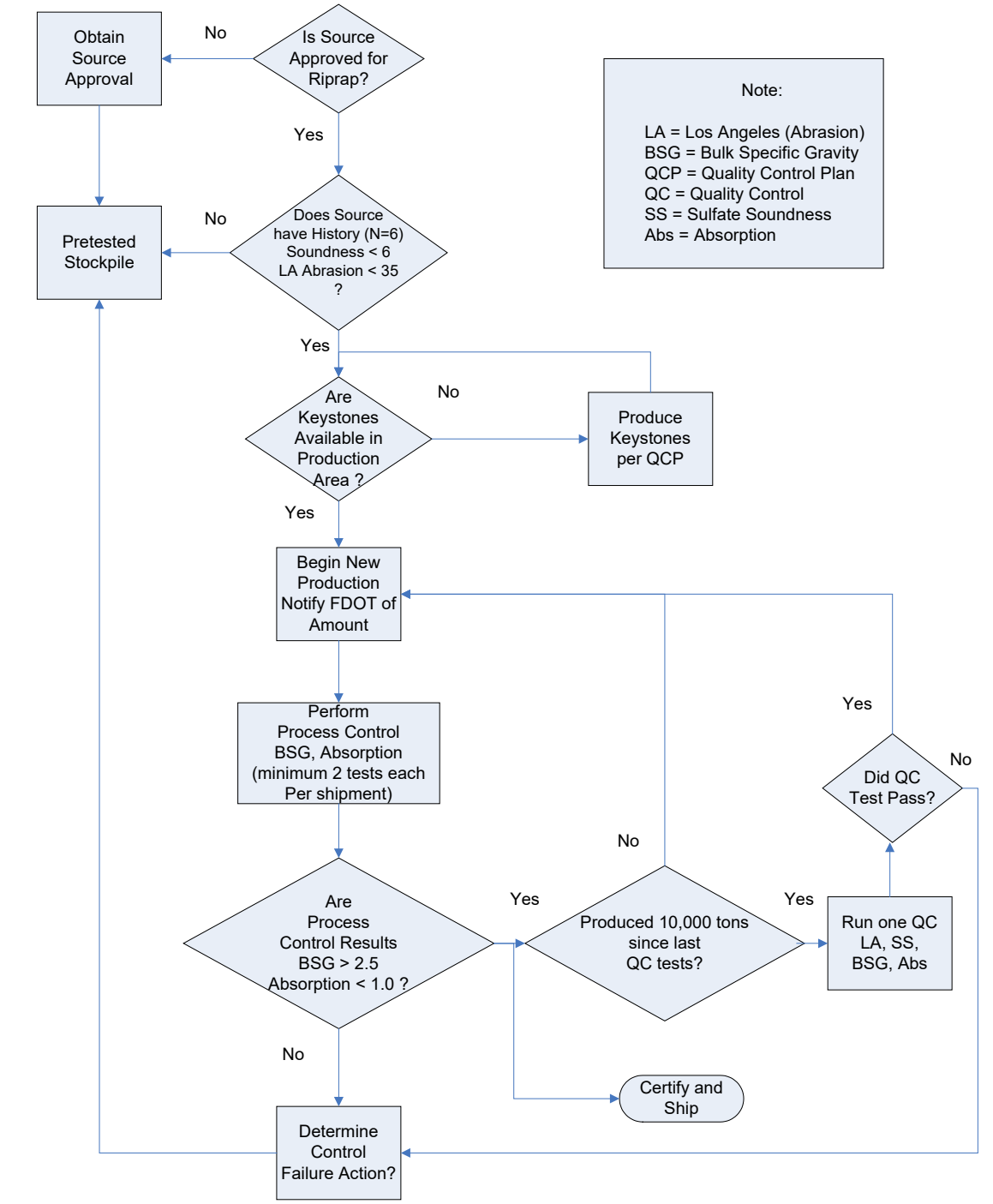
TEST METHOD	TITLE
AASHTO T 19M/T 19-14	Standard Method of Test for Bulk Density ("Unit Weight") and Voids in Aggregate
AASHTO T 21/M 21-20	Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete
AASHTO T 27-20	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHTO R 58-11 (2019)	Standard Practice for Dry Preparation of Disturbed Soil-Aggregate Samples for Test
AASHTO T 89-13- (2017)	Standard Method of Test for Determining the Liquid Limit of Soils
AASHTO T 90-20	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 104-99 (2020)	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 112-21	Standard Method of Test for Clay Lumps and Friable Particles in Aggregate
AASHTO T 113-18	Standard Method of Test for Lightweight Pieces in Aggregate
AASHTO T 255-00 (2017)	Standard Method of Test for Total Moisture Content of Aggregate by Drying
ASTM D 4643-17	Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating
ASTM D 4791-19	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5821-13 (Reapproved 2017)	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM E 274/E274M –15	Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire
ASTM E11-20	Standard Specifications for Woven Wire Test Sieve Cloth and Test Sieves
AASHTO M-231-95 (2019)	Weighing Devices Used in the Testing of

TEST METHOD	TITLE
	Materials
FM 1- R 76 (2020)	Florida Method of Test for Reducing Samples of Aggregate to Testing Size
FM 1-R 90 (2020)	Florida Method of Test for Sampling Aggregate Products
FM 1-T 011 (2020)	Florida Method of Test for Materials Finer Than 75-µm (No. 200)Sieve in Aggregates by Washing
FM 1-T 084 (2020)	Florida Method of Test for Specific Gravity and Absorption of Fine Aggregate
FM 1-T 085 (2020)	Florida Method of Test for Specific Gravity and Absorption of Coarse Aggregate
FM 1-T 096 (2020)	Florida Method of Test for Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 535 (2020)	Florida Method of Test for Resistance to Degradation of Large-Size Coarse Aggregates by Abrasion and Impact in the Los Angles Machine
FM 5-510 (2020)	Florida Method of Test for Determination of Acid Insoluble Material Retained on the 0.075 mm (No. 200) Mesh Sieve
FM 5-514 (2020)	Florida Method of Test for Carbonates and Organic Matter in Base Materials
FM 5-515 (2017)	Florida Method of Test for Limerock Bearing Ratio
FM 5-538 (2020)	Florida Method of Test for Sampling and Testing Rip-Rap Material
FM 5-555 (2020)	Florida Method of Test for Shell Content of Coarse Aggregate

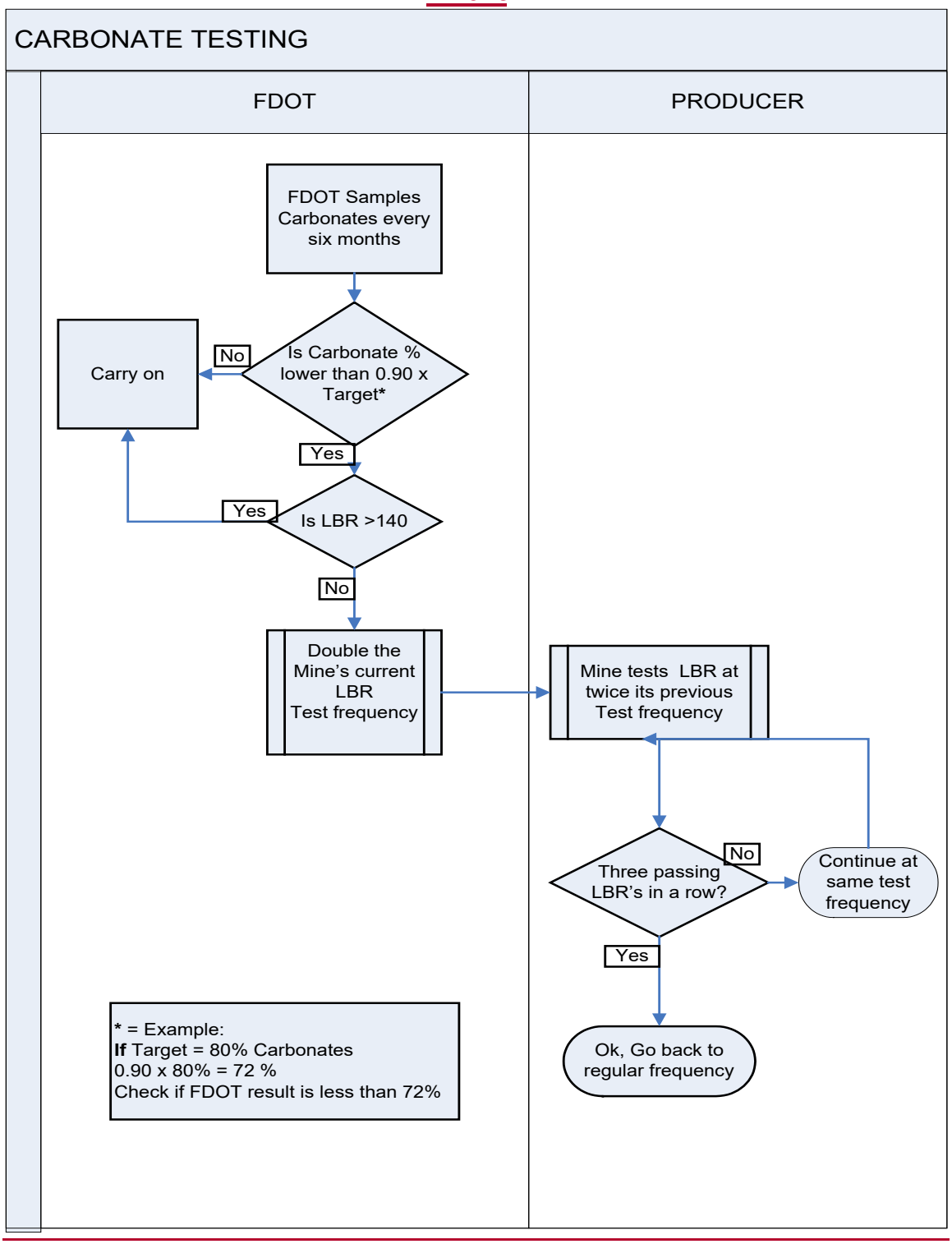
AASHTO T 19M/T 19-14	Standard Method of Test for Bulk Density (“Unit Weight”) and Voids in Aggregate
AASHTO T 21/M 21-15	Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete
AASHTO T 27-14 (2018)	Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHTO R 58-11 (2015)	Standard Method of Test for Dry Preparation of Disturbed Soil and Aggregate Samples for Test
AASHTO T 89- (2017)	Standard Method of Test for Determining the Liquid Limit of Soils
AASHTO T 90-16 (2016)	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 104-99 (2016)	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 112-00 (2017)	Standard Method of Test for Clay Lumps and Friable Particles in Aggregate
AASHTO T 113-15	Standard Method of Test for Lightweight Pieces in Aggregate
AASHTO T 255-00 (2017)	Standard Method of Test for Total Moisture Content of Aggregate by Drying
ASTM D 4643-17	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating
ASTM D 4791-10	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5821-13 (Reapproved 2017)	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM E 274/E274M –15	Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire
ASTM E11-17	Standard Specifications for Woven Wire Test Sieve Cloth and Test Sieves
AASHTO M-231-95 (2019)	Weighing Devices Used in the Testing of Materials
FM 1- R 76 (2015)	Florida Method of Test for Reducing Samples of Aggregate to Testing Size
FM 1-R 90 (2019)	Florida Method of Test for Sampling Aggregate Products
FM 1-T 011 (2015)	Florida Method of Test for Materials Finer Than 75-µm (No. 200)Sieve in Aggregates by Washing
FM 1-T 084 (2015)	Florida Method of Test for Specific Gravity and Absorption of Fine Aggregate
FM 1-T 085 (2015)	Florida Method of Test for Specific Gravity and Absorption of Coarse Aggregate
FM 1-T 096 (2015)	Florida Method of Test for Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine

FM 3-C 535 (2018)	Florida Method of Test for Resistance to Degradation of Large-Size Coarse Aggregates by Abrasion and Impact in the Los Angles Machine
FM 5-510 (2018)	Florida Method of Test for Determination of Acid Insoluble Material Retained on the 0.075 mm (No. 200) Mesh Sieve
FM 5-514 (2015)	Florida Method of Test for Carbonates and Organic Matter in Base Materials
FM 5-515 (2017)	Florida Method of Test for Limerock Bearing Ratio
FM 5-538 (2019)	Florida Method of Test for Sampling and Testing Rip-Rap Material
FM 5-555 (2019)	Florida Method of Test for Shell Content of Coarse Aggregate

Appendix 21
Alternative Riprap Approval Process Flow Chart



Appendix 22
Required LBR Testing Related to Carbonate Testing Process Flow Chart



Appendix 23

Statistical Compliance Limits Determination

In ***Section1.1.5 AGGREGATE COMPLIANCE LIMITS AND STANDARDS*** states "Standard statistical analysis shall be performed on the most recent thirty (30) QC test results of each aggregate code, grade, or type of aggregate from each operation when available.

This standard statistical analysis is used to determine whether a producer's most recent running 30 test results, no older than 365 days, have a greater than or equal to 95 percent probability of complying with Department specifications. This determination requires the calculation of the Z value, that results in a value greater than or equal to 1.645.

A Z value of less than 1.282 indicates that the probability of complying with Department specifications is less than 90 percent.

Note - It is not necessary to calculate Z for the Upper Specification Limit (USL), Z USL, when the USL = 100: or Z for the Lower Specification Limit (LSL), Z LSL, when the LSL = 0. There is no probability of a result greater than 100, or less than zero.

Examples of determining the Z value and compliance follow.

Determining Compliance Limits Using Z Values

Example 1: Code 10, No. 57, Half-inch Sieve

Upper Specification Limit, USL = 60
Lower Specification Limit, LSL = 25

Determine producer's test results for the most recent running 30 results, no older than 365 days, and calculate:
Average of running 30 = 52
Standard Deviation = 3.57

Calculate
1. Z for the Upper Specification Limit, Z USL, and
2. Z for the Lower Specification Limit, Z LSL.

Use the following two equations. The Z value that determines compliance is the lower Z.

$$\text{Z USL} = \frac{(USL - Average)}{Standard\ Deviation}$$

$$Z\ LSL = \frac{(Average - LSL)}{Standard\ Deviation}$$

Calculations:

$$Z\ USL = \frac{(60 - 52)}{3.57} = 2.241$$

$$Z\ LSL = \frac{(52 - 25)}{3.57} = 7.563$$

Lower Value, Z, = 2.241

Perform Comparison: 2.241 is greater than or equal to 1.645,

Conclusion: Probability of compliance with Specification is greater than 95 percent

Example 2: Percent Passing the #200 Sieve

Upper Specification Limit, USL = 1.75
Lower Specification Limit, LSL = 0

Determine producer's test results for the most recent running 30 results, no older than 365 days:
Average of running 30 = 1.22
Standard Deviation = 0.30

In this case, there is no probability of a result less than zero. Calculate Z for the Upper Specification Limit), Z USL, only. The Z USL value determines compliance.

$$\text{Z USL} = \frac{(USL - Average)}{Standard\ Deviation}$$

Calculations:

$$Z\ USL = \frac{(1.75 - 1.22)}{0.30} = 1.767$$

Z USL = 1.767

Perform Comparison: 1.767 is greater than or equal to 1.645,

Conclusion: Probability of compliance with Specification is greater than 95 percent.

Example 3: L.A. Abrasion

Upper Specification Limit, USL = 45
Lower Specification Limit, LSL = 0

Determine producer's test results for the most recent running 30 results, no older than 365 days:
Average of running 30 = 41.2
Standard Deviation = 2.74

In this case, there is no probability of a result less than zero. Calculate Z for the Upper Specification Limit), Z USL, only. The Z USL value determines compliance.

$$\text{Z USL} = \frac{(USL - Average)}{Standard\ Deviation}$$

Calculations:

$$Z\ USL = \frac{(45 - 41.2)}{2.74} = 1.387$$

Z USL = 1.387

Perform Comparison: 1.387 is less than 1.645,

Conclusion: Probability of compliance with Specification is less than 95 percent

Example 4: Code 51, SIB Asphalt, Number 4 Sieve

Target = 40
Upper Target Limit, UTL = 55
Lower Target Limit, LTL = 25

Determine producer's test results for the most recent running 30 results, no older than 365 days, and calculate:
Average of running 30 = 31.3
Standard Deviation = 5.67

Calculate
1. Z for the Upper Target Limit, Z UTL, and
2. Z for the Lower Target Limit, Z LTL.

Use the following two equations. The Z value that determines compliance is the lower Z.

$$\text{Z UTL} = \frac{(UTL - Average)}{Standard\ Deviation}$$

$$Z\ LTL = \frac{(Average - LTL)}{Standard\ Deviation}$$

Calculations:

$$Z\ UTL = \frac{(55 - 31.3)}{5.67} = 4.180$$

$$Z\ LTL = \frac{(31.3 - 25)}{5.67} = 1.111$$

Lower Value, Z LTL, = 1.111

Perform Comparison: 1.111 is less than or equal to 1.282,

Conclusion: Probability of compliance with Specification is less than 90 percent.

Appendix 24

1. Aggregate Independent Assurance Program Checklists*
Aggregate Testing Technician

Organic Impurities in Fine Aggregate for Concrete
AASHTO T 21 (P)
AASHTO T 21 (E)

Sieve Analysis of Fine and Coarse Aggregate
AASHTO T 27 (P)
AASHTO T 27 (E)

Total Moisture Content of Aggregate by Drying
AASHTO T 255 (P)
AASHTO T 255 (E)

Sampling Aggregates
FM 1-R 090 (P)

Total Materials Finer than 75-µm (No. 200) Sieve
FM 1-T 011 (P)
FM 1-T 011 (E)

Specific Gravity and Absorption of Fine Aggregate
FM 1-T 084 (P)
FM 1-T 084 (E)

Specific Gravity and Absorption of Coarse Aggregate
FM 1-T 085 (P)
FM 1-T 085 (E)

Reducing Aggregate Samples to Testing Size
FM 1-R 76 (P)
FM 1-R 76 (E)

* Note: P means Procedure and E means Equipment.

2. Aggregate Independent Assurance Program Checklists
Aggregate Base Testing Technician

Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test
AASHTO R 58 (P)
AASHTO R 58 (E)

Hydrometer
AASHTO T 88 (P)
AASHTO T 88 (E)

Liquid Limit of Soils
AASHTO T 89 (P)
AASHTO T 89 (E)

Plastic Limit and Plasticity Index of Soils
AASHTO T 90 (P)
AASHTO T 90 (E)

The Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in) Drop
FM 1-T 99 (P)
FM 1-T 99 (E)

Laboratory Determination of Moisture Content of Soils
AASHTO T 265 (P)
AASHTO T 265 (E)

Determination of Water (Moisture) Content of Soil by Microwave Oven Heating
ASTM D4643 (P)
ASTM D4643 (E)

Sampling Aggregates
FM 1-T 002 (P)

Moisture-Density Relations of Soils Using a 4.54 Kg (10 lb) Rammer and a 457 mm (18 in.) Drop
FM 1-T 180 (P)
FM 1-T 180 (E)

Reducing Aggregate Samples to Testing Size
FM 1-T 248 (P)
FM 1-T 248 (E)

3. Aggregate Independent Assurance Program Checklists Limerock Bearing Ratio Technician

Limerock Bearing Ratio
FM 5-515 (P)
FM 5-515 (E)

4. Qualified Sampler Technician

Sampling Aggregates
FM 1-T 002 **(P)**

Reducing Aggregate Samples to Testing Size
FM 1-T 248 **(P)**
FM 1-T 248 **(E)**

5. Other

Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

FM 1-T 096 (P)
FM 1-T 096 (E)

Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM 3-C 535 (P)
ASTM 3-C 535 (E)