

APPENDIX 3. Sample Aggregates Specifications

Following are sample specifications for gravel road aggregate surface courses from several different states. Road personnel should check with their State Department of Transportation or their Local Technical Assistance Program / Technology Transfer (T2) Center for specifications being used in their own state. Many state DOTs have their specifications readily available via their Web sites.

A3.1 Pennsylvania’s Driving Surface Aggregate

Material Specifications: All Driving Surface Aggregate (DSA) is to be derived from natural stone formations. Stone is defined as rock that has been crushed; rock is defined as consolidated mineral matter. For use in this program, both are restricted to that which has been mined or quarried from existing geologic bedrock formations.

All components of the aggregate mix are to be derived from crushed parent rock material that meets program specifications for abrasion resistance, pH and freedom from contaminants. Ninety-eight percent (98%) of fines passing the #200 sieve must be parent rock material. No clay or silt soil may be added. The amount of particles passing the #200 sieve shall be determined using the washing procedures specified in PTM No. 100.

Size: The required amounts and allowed ranges, determined by percent weight, for various size particles are shown in Table 1.

LA Abrasion: The acceptable limit as measured by weight loss is “less than 40% loss.” Los Angeles Abrasion test, AASHTO T-96 [ASTM C 131] shall be used to determine this property. Existing data obtained from tests made for and approved by PENNDOT will be accepted.

<i>Passing sieve</i>	<i>Lower %</i>	<i>High%</i>
1 ½ inches	100	
¾ inches	65	90
#4	30	65
#16	15	30
#200	10	20

Table 1. DSA Gradation

Sulfate Test: Soundness or resistance to freeze/thaw [*i.e., sulfate test*] is not specified for this application because a gravel road driving surface aggregate is not bound within a concrete or asphalt mix.

pH: Aggregate must be in the range of pH 6 to pH 12.45 as measured by EPA 9045C.

Optimum Moisture: Material is to be delivered and placed at optimum moisture content as determined for that particular source. The optimum percentage moisture is to be identified by the supplier in the bid/purchasing documents.

Transport: Tarps are to be used to cover 100% of the load’s exposed surface from the time of loading until immediately before dumping. This requirement includes standing time waiting to dump.

Aggregate producers are required by the program to certify that the aggregate they deliver conforms to the program specifications.

Road Surface Preparation: Driving Surface Aggregate will reflect the shape of the surface to which it is applied; therefore, all road surface preparation work is to be completed before delivery and placement of the aggregate.

1. Prepare underdrainage, including drain tile, French drains (porous fill) and crosspipes.
2. Address surface drainage features such as broad-based dips, [grade breaks](#), crown, and side-slope.
3. Establish proper cross-slope in existing base (Fig. 1). Recommended crown or slope is ½ to ¾ inch rise per horizontal foot. Proper shape may be a flat “A” crown profile, an in-slope or out-slope. If exposed bedrock or insufficient material prevents proper shaping of the road base, additional base material may be needed.
4. To bind aggregate with the road base, scarify impermeable smooth surfaces such as oil and chip, exposed bedrock or smooth tight aggregate. Do not loosen coarse aggregate or chinked stone roadbeds rough enough to permit binding with Driving Surface Aggregate.
5. If required, separation fabric should be placed according to manufacturer’s recommendations.

Placement: An un-compacted uniform depth of 8 inches of DSA is to be used to establish the driving surface. Placement is to be in a single 8-inch lift. The preferred method of application is through a paver. Set the paver adjustments on application thickness and width so it is unnecessary to use a grader. The required crown or side slope is to range from ½ to ¾ inch rise per horizontal foot. This slope is to be achieved by properly preparing base and placing aggregate in a uniform lift. When the paver is applying aggregate, care should be taken to keep the paver at or near capacity at all times.

To fill driving surface areas outside the specified width (e.g., driveway entrances, pull-offs, and passing lanes), additional DSA is to be added and tapered to grade or butted against a precut channel of the same depth. If berm or bank edges don’t exist to hold the new DSA surface, then sufficient material is to be placed, tapered and compacted to form protective edge berms. Material shall be compacted to a final thickness of approximately 6 inches.

<u>DSA CALCULATION FORMULA</u>			
DSA Needed (tons)	Road Width (ft)	Road Length (ft)	X X 0.042
=			
Applies to standard 8" lift, compacted to 6"			

Compaction Sequence: Verify that moisture is optimum for compaction. If the material has dried out, re-wet the DSA surface with a water truck. If clumps of aggregate adhere to the roller drum, the aggregate may be too moist. Allow drying time before rolling. Do not use the vibratory rolling mode if that action brings water to the surface of the aggregate.

Only self-powered machines designed specifically for compaction shall be used. Compaction with truck tires is not acceptable.

- 1A. Supported Edge: *If edge of placed aggregate is supported by an existing bank*

or berm: First pass: Roll slowly in static mode on the outside edge of placed aggregate.

1B. Unsupported Edge: *If the edge of the placed aggregate is not supported*:

First Pass: Roll slowly in static mode near but not over unsupported outside edges. Once that path is firm, move progressively closer to the outside edge with static passes until unsupported edge is firm.

2. Sequence: As in all rolling operations, compaction is achieved making overlapping lengthwise passes beginning at the ditch or berm-side and working toward the crown or the top edge (if it is a side-sloped or super-elevated section of road). In no case should the roller be run lengthwise on the top of the [road crown](#).

3A. Static Roller: The minimum acceptable weight of a static roller is 10 tons. Repeat the sequence of overlapping passes until desired compaction is achieved.

3B. Vibratory Roller: The minimum striking force of vibratory rollers is 20,000 lbs. When using a vibratory roller, the initial pass over un-compacted aggregate should be completed in static mode. All successive passes should be made using the vibratory mode until the desired level of compaction is achieved. The final pass over each area should be made in static mode to remove all roller edge marks. The vibratory roller should be set to deliver between 6 and 17 impacts per linear foot with the roller moving at the speed at which a person walks on each pass upgrade. **Vibration must be turned off during downgrade passes.** Vibrating the drum when rolling downgrade will cause aggregate to flow in “waves” in front of the roller, resulting in an uneven surface.

4. Desired Compaction: Unless more refined testing equipment is available, adequate compaction is indicated when no further depressions are created with a roller or loaded dump truck. Cracking of larger stones or rocks in the road surface is another reliable indication of adequate compaction.

A3.2 Illinois DOT Specifications. (excerpts)(www.dot.il.gov)

Section 402. Aggregate Surface Course

402.01 Description. This work shall consist of furnishing and placing one or more course of aggregate upon a prepared [subgrade](#).

402.02 Materials. Materials shall meet the requirements of Section 1000, Article 1004.04

1004.04 Coarse Aggregate for Aggregate Surface Course.

a. Description. The coarse aggregate shall be pit run gravel, gravel, crushed gravel, novaculite, crushed stone, crushed concrete, crushed slag or crushed sandstone.

a. Quality. The coarse aggregate shall be Class D Quality or better.

Quality Test	Class D
Sodium Sulfate Soundness ² 5 cycle, AASHTO T104 ^{1,2} , Max % loss	25 ³
Los Angeles Abrasion AASHTO T96, Max % loss	45

¹As modified by the Department

²Does not apply to crushed concrete.

³For aggregate surface course, the maximum percent loss shall be 30.

- b. Gradation.
1. For aggregate surface course Type B, Gradation CA6, CA9, or CA10 may be used. If approved by the Engineer, Gradation CA4 or CA12 may be used.
 2. For aggregate subbase Type B, Gradation CA6, CA10, CA12, , or CA19 shall be used. If approved by the Engineer, Gradation CA2 or CA4 may be used.
 3. For aggregate Subbase Type C, Gradation CA7 or combined size CA5 and CA7 shall be used.
 4. For granular aggregate courses (base, subbase, and shoulder except subbase Types B and C), Gradation CA6, or CA10 shall be used. If specified, Gradation CA2 or CA4 For aggregate surface course Type B, Gradation CA6, CA9, or CA10 may be used. If approved by the Engineer, Gradation CA4 or CA12 may be used.
 5. Stabilized aggregate courses (base, subbase, and shoulder), Gradation CA6 or CA10 shall be used. If approved by the Engineer, Gradation CA2, CA4, or CA12 may be used.
 6. For aggregate surface course Type A, Gradation CA6, or CA10 shall be used. If approved by the Engineer, Gradation CA2, CA4, CA9, or CA12 may be used.
- c. Plasticity. All material shall comply with the plasticity index requirements listed below.

Type of construction	Plasticity Index – Percent ¹	
	Gravel	Crushed Gravel, Stone, Slag
Aggregate Subbase Type A or B	0 to 9	-
Aggregate Base Course Type A or B	0 to 6	0 to 4
Aggregate Surface Course Type A or B ²	2 to 9	-
Stabilized Aggregate Material	0 to 9	0 to 9

¹Plasticity index shall be determined by the method given in AASHTO T90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus #40 material. When clay material is added to adjust plasticity index, the clay material shall be a minus #4 sieve size.

²When Gradation CA9 is used, the plasticity index requirement will not apply.

402.03 Equipment shall meet the requirements of the following Articles of Section 1100:

- a. Tamping Roller.....1101.01
- d. Pneumatic-Tired Roller.....1101.01
- e. Three-Wheel Roller (Note 1)....1101.01
- f. Tandem Roller (Note 1).....1101.01
- g. Spreader.....1101.01
- h. Vibratory Machine (Note 2).....1101.04

Note 1. Three-wheel or tandem rollers shall weigh 6 to 10 tons and shall weigh not less than 200lb/in nor more than 325 lb/in of width of the roller.

Note 2. The vibratory machine shall meet the approval of the Engineer.

Construction Requirements

402.04 Subgrade. The [subgrade](#) shall be prepared according to Section 301 except that Article 301.06 will not apply.

402.05 Type A Requirements. Aggregate surface course, Type A shall be constructed according to Article 351.05(a) and (b) except the bearing ratio requirements shall not apply.

402.07 Type B Requirements. Any one or two gradations of the material specified in Article 1004.04 shall be used except where two gradations of material are used, the change shall not be made at more than one location on the section.

The surfacing material shall be deposited on the [subgrade](#) by means of a spreader.

The equipment used shall be such that the required amount of material will be deposited uniformly along the central portion of the roadbed.

The material which has been deposited shall be spread immediately to the plan cross section. Hauling shall be routed over the spread material so it will cover the entire width of surface. If the equipment used in hauling operations causes ruts extending through the spread material and into the [subgrade](#), and the [subgrade](#) material is being mixed with the surface material, the equipment shall be removed from the work or the rutting otherwise prevented as directed by the Engineer.

The Contractor shall keep the surface smooth by dragging or blading as many times each day as the engineer may direct.

Holes, waves, and undulations which develop and which are not filled by blading shall be filled by adding more material.

A3.3 Michigan DOT Specifications (excerpts) (www.mdot.state.mi.us)

Section 306. Aggregate Surface Course

306.01 Description. Construct an aggregate surface course on a prepared [subgrade](#) or an existing aggregate surface.

306.02 Materials. Use materials meeting the following:

Dense-graded Aggregate 21AA, 21A, 23A.....902

Use aggregate 21AA or 21A if the aggregate surface course will later receive a hot mix asphalt (HMA) surface. Use aggregate 23A if the aggregate surface course is to be constructed without an HMA surface. Use dense-graded aggregate 22A, 23A for temporary maintenance gravel.

902.06 Dense-Graded Aggregates for Base Course, Surface Course, Shoulders, Approaches and Patching. Michigan Class 21AA, 21A, 22A and 23A dense-graded aggregates will consist of natural aggregate, iron blast furnace slag, reverberatory furnace slag, or crushed concrete, in combination with fine aggregate as necessary to meet the gradation requirements in Table 902-1, the physical requirements in Table 902-2, and the following:

- A. Dense-graded aggregates produced by crushing Portland cement concrete will not contain building rubble as evidenced by the presence of more than 5.0%, by particle count, building brick, wood, plaster, or similar materials. Sporadic pieces of steel reinforcement may be present provided they pass the maximum grading sieve size without hand manipulation.

- B. Class 21AA, 21A, and 22A dense-graded aggregates produced from Portland cement concrete will not be used to construct either an aggregate base or aggregate separation layer when either of the following conditions apply:
1. When there is a [geotextile](#) liner or membrane present with permeability requirements.
 2. In a pavement structure with an underdrain, unless there is a filter material between crushed concrete and the underdrain. The filter material will be either a minimum of 12 inches of granular material or a [geotextile](#) liner or blocking membrane that will be a barrier to leachate.
- C. Class 23A dense-graded aggregate may be produced from steel furnace slag, but only for use as an unbound aggregate surface course or as an unbound aggregate shoulder.

Table 902-1 Grading Requirements for Dense-Graded Aggregates

Class	Sieve Analysis (MTM 109) Total Percent Passing (b)						Loss by Washing (MTM 108) % Passing #200
	1.5 in.	1 in.	¾ in	½ in	3/8 in	# 8	
21AA, 21A	100	85-100		50-75		20-45	4-8 (e)(f)
22A		100	90-100		65-85	30-50	4-8(e)(f)
23A		100			60-85	25-60	9-16(f)

(b) Based on dry weights

(e) When used for aggregate base courses, surface courses, shoulders and approaches and the material is produced entirely by crushing rock, boulders, cobbles, slag, or concrete, the maximum limit for Loss by Washing will not exceed 10%.

(f) The limits for Loss by Washing of dense-graded aggregates are significant to the nearest whole percent.

Table 902-2 Physical Requirements for Dense-Graded Aggregates

Class (j)	Crushed Material, % min. (MTM 110,117)	Loss, % max, Los Angeles Abrasion (MTM 102)
21AA	95	50
21A	25	50
22A	25	50
23A	25	50

(j) Quarried carbonate (limestone or dolomite) aggregate will not contain over 10% insoluble residue finer than Number 200 sieve when tested in accordance with MTM 103.

306.03 Construction.

- A. Preparation of Base. When required, blade, or scarify and blade, the existing aggregate surface to remove irregularities in the grade.
- B. Placing and Compacting. Provide a uniform aggregate mixture compacted in place with uniform density full depth. Provide a completed surface course conforming to the line, grade or plan cross section.
Place maintenance gravel to provide a flush transition between shoulders, driveways and other areas where traffic is maintained. Maintenance gravel may remain permanently as part of the work, if approved by the Engineer.
Do not place aggregate when the base is unstable. Maintain the aggregate in a smooth, stable condition and provide [dust](#) control until removed or surfaced.
- C. Use of additives. Use of additives to facilitate compaction and for [dust](#) control of the aggregate is acceptable.

A3.4 New York DOT Specifications (excerpts) (www.dot.state.ny.us)

Section 667 – Local Road Gravel Surface, Base, and Subbase Courses

667-1.02 Material Types. Provide materials as specified by the following options.

Type A. Surface quality material with a maximum particle size of 25mm.

Type B. Base quality material with a maximum particle size of 50 mm.

Type C. Subbase quality material with a maximum particle size of 75mm.

667-2.02 Material Requirements. Provide materials for road gravel surface, base and subbase courses that consist of Sand and Gravel, approved Blast Furnace Slag or Stone that meet the requirements contained herein. Provide materials well graded from coarse to fine, and free from organic or other deleterious materials. Any gravel material will be rejected if it is determined to contain any unsound or deleterious materials.

- B. Gradation, Perform sieve analysis in accordance with AASHTO procedures T27, T88 or T311. Provide materials meeting the gradation limits from Table 667-1.
- C. Soundness. Material will be accepted on the basis of Magnesium sulfate. Soundness Loss after four cycles performed according to NYSDOT procedures and Table 667-2.
- D. Plasticity. Determine plasticity using either of the following methods:
 - 1. Plasticity Index. The Plasticity Index of the material passing the #40 mesh sieve shall meet the values in Table 667-2. Determine plasticity using AASHTO tests T89 and T90.
 - 2. Sand Equivalent. The sand equivalence of the granular material shall meet the values in Table 667-2. Determine sand equivalence using AASHTO test T176.

Table 667-1: Percent passing by Weight of Gravel Materials

Sieve (US Sieve)	A (Surface)	B (Base)	C (subbase)
3"			100
2"		100	-
1.5"		85-100	70-100
1"	100	-	-
¾"	85-100	-	-
¼"	50-75	30-50	30-55
#40	15-35	5-20	5-25
#200	8-15	0-5	0-8

Table 667-2: Test and control Limits of Gravel Materials

Material Properties	A (Surface)	B (Base)	C (subbase)
Maximum Soundness loss (%)	20	20	25
Plasticity Index	2-9	0-5	0-8
Sand Equivalent	>25	>40	>35

- E. Elongated Particles Not more than 30%, by weight, of the particles retained on a ½" sieve shall consist of flat or elongated particles. A flat or elongated particle is defined herein as one which has its greatest dimension more than 3 times its least dimension. Acceptance for this requirement will normally be