

SECTION _____ INTERLOCKING COMPOSITE PERMEABLE PAVER SYSTEM

Note: This guide specification for U.S. applications describes construction of Aspire Interlocking Composite Permeable Paver System over an open-graded crushed stone bedding layer (typically ASTM No. 8 stone). The pavers and bedding layer are placed over an open-graded crushed stone base with exfiltration to the soil subgrade. In low infiltration soils or installations with impermeable liners, some or all drainage is directed to an outlet via perforated drainpipes in the subbase. While this guide specification does not cover excavation, liners and drainpipes, notes are provided on these aspects.

The text must be edited to suit specific project requirements. It should be reviewed by a qualified civil or geotechnical engineer, or landscape architect familiar with the site conditions. Edit this specification term as necessary to identify the design professional in the General Conditions of the Contract.

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Interlocking Composite Permeable Paver System
2. Crushed stone bedding material
3. Open-graded subbase aggregate
4. Open-graded base aggregate
5. Bedding and joint/opening filler materials
6. Edge restraints
7. [Geotextiles]

B. Related Sections

1. Section []: Curbs.
2. Section []: [Stabilized] aggregate base.
3. Section []: [PVC] Drainage pipes
4. Section []: Impermeable liner.
5. Section []: Edge restraints.
6. Section []: Drainage pipes and appurtenances.
7. Section []: Earthworks/excavation/soil compaction.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
5. C 936, Standard Specification for Solid Interlocking Concrete Pavers.
6. C 979, Specification for Pigments for Integrally Colored Concrete.
7. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
8. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
9. D 1883, Test Method for California Bearing Ratio of Laboratory-Compacted Soils.
10. ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).
11. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils

and Calculation of Relative Density.

- B. Aspire Pavers
 - 1. Aspire Interlocking Composite Permeable Paver Installation Instructions.
- C. Interlocking Concrete Pavement Institute (ICPI)
 - 1. Permeable Interlocking Concrete Pavement manual.
 - 2. Permeable Design Pro software for hydrologic and structural design

1.03 SUBMITTALS

- A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Paver contractor's drawings and details: Indicate perimeter conditions, junction with other materials, expansion and control joints, paver [layout,] [patterns,] [color arrangement,] installation [and setting] details. Indicate layout, pattern, and relationship of paving joints to fixtures, and project formed details.
- C. Minimum 3 lb (2 kg) samples of subbase, base, and bedding aggregate materials.
- D. Sieve analysis of aggregates for subbase, base, and bedding materials per ASTM C 136.
- E. Project specific or producer/manufacturer source test results for void ratio and bulk density of the base and subbase aggregates.
- F. Soils report indicating density test reports, classification, and infiltration rate measured on-site under compacted conditions, and suitability for the intended project.
- G. Erosion and sediment control plan.
- H. [Stormwater management (quality and quantity) calculations; structural analysis for vehicular applications] using ICPI Permeable Interlocking Concrete Pavements manual, Permeable Design Pro or [specify] design methods and models.
- I. Aspire Interlocking Composite Permeable Paver System:
 - 1. Paver manufacturer's Product Data Sheet with product specifications.
 - 2. Sample 16" x 16" Grid with Permeable Pavers in the color(s) chosen. Submit samples indicating the range of color expected in the finished installation.
 - 3. Accepted samples become the standard of acceptance for the work of this Section.
 - 4. Manufacturers' material safety data sheets for the safe handling of the specified paving materials and other products specified herein.

1.04 QUALITY ASSURANCE

- A. Paver Installation Contractor Qualifications:
 - 1. Demonstrate that job foremen on the project have current training and instruction in Aspire Interlocking Composite Paver System installation techniques.
 - 2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.
 - 3. Written Method Statement and Quality Control Plan that describes material staging and flow, paving direction, and installation procedures, including representative reporting forms that ensure conformance to the project specifications.
- B. Regulatory Requirements and Approvals: [Specify applicable licensing, bonding, or other requirements of regulatory agencies.].
- C. Review the paver installation contractor's Method Statement and Quality Control Plan with a pre-construction meeting of representatives from the manufacturer, paver installation subcontractor, general contractor, engineer and/or owner's representative.
- D. Mock-Ups:
 - 1. Install a 8 ft x 8 ft (2.44 m x 2.44 m) paver area.

Note: Mechanized installations may require a larger mock-up area. Consult with the paver installation contractor on the size of the mock-up.

- 2. Use this area to determine surcharge of the bedding layer, lines, laying pattern, color, and texture of the job.
- 3. This area will be used as the standard by which the work will be judged.
- 4. Subject to acceptance by the owner, mock-up may be retained as part of finished work.

5. If mock-up is not retained, remove, and properly dispose of mock-up.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged container packaging with identification tags intact on each paver bundle.
 - 1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
 - 2. Deliver composite pavers to the site in plastic wrapped cubes capable of transfer by forklift or clamp lift.
 - 3. Unload pavers at job site in such a manner that no damage occurs to the product or existing construction
- D Storage and Protection: Store materials in protected area such that they are kept free from mud, dirt, and other foreign materials.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not install in rain or snow.
- B. Do not install frozen bedding materials.

1.07 MAINTENANCE

- A. Extra materials: Provide [Specify area] [Specify percentage] additional material for use by owner for maintenance and repair.
- B. Pavers shall be from the same production run as installed materials.

PART 2 PRODUCTS

Note: Some projects may include permeable paver areas and non-permeable paver areas. Specify each product as required.

2.01 PRODUCT

- A. Manufacturer: Aspire by Brava, 915 E Tyler St, Washington IA 52353, Phone 844-290-4196, aspirepavers.com.
- B. Product: Aspire Interlocking Composite Permeable Paver System
 - 1. Paver Types: Permeable Pavers.
 - a. Material Standard: Comply with material standards set forth by Aspire Pavers
 - b. Colors: Redwood, Boardwalk, Olive, and Waterwheel.
 - c. Paver Size: 4" x 8" x 2" height (102 mm x 203 mm x 52 mm). Total height with Grid is 2.5" (64 mm).
 - d. Grid Size: 16.0 inches (406 mm) x 16.0 inches (406 mm).
 - e. Assembly Size: 16.0 inches (406 mm) x 16.0 inches (406 mm) x 2.5 inches (64 mm) height.
 - f. Infiltration Rate (ASTM C1781): > 470 inches per hour (when newly installed)
 - g. Compressive Strength (ASTM C140-09 Section 7): > 2000 psi.
 - h. Flexural Modulus (ASTM C140-09): >3800 psi
 - i. Water Absorption (ASTM C67 Section 8): < 4.2%
 - j. Freeze/Thaw (ASTM C67 Section 9): Pass
 - k. Coefficient of Friction (ASTM C1028-07): 0.83 Dry, 0.47 Wet
 - l. Fire Classification (ASTM E108-007): Class A
 - m. Chemical Resistance (ASTM F925): Pass
 - n. Specific Gravity (FSBP Test Method): 0.9
 - o. 2" Hail Impact (ASTM ANSI FM 4470-22): Pass

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: Permitted for gradations for crushed stone jointing material, base, and subbase materials. Base and subbase materials shall have a minimum 0.32 void ratio. All substitutions shall be approved in writing by the project engineer.

2.03 CRUSHED STONE FILLER, BEDDING, BASE AND SUBBASE

- A. Crushed stone with 90% fractured faces, LA Abrasion < 40 per ASTM C 131, minimum CBR of 80% per ASTM D 1883.
- B. Do not use rounded river gravel for vehicular applications.
- C. All stone materials shall be washed with less than 1% passing the No. 200 sieve.
- D. Joint/opening filler, bedding, base, and subbase: conforming to ASTM D 448 gradation as shown in Tables 1, 2 and 3 below:

Note: No. 89 stone or that having similar gradation and infiltration rates may be used to fill pavers with narrow joints.

Table 1
ASTM No. 8 Grading Requirements
Bedding and Joint/Opening Filler

Sieve Size	Percent Passing
12.5 mm (1/2 in.)	100
9.5 mm (3/8 in.)	85 to 100
4.75 mm (No. 4)	10 to 30
2.36 mm (No. 8)	0 to 10
1.16 mm (No. 16)	0 to 5

Table 2
ASTM No. 57 Base
Grading Requirements

Sieve Size	Percent Passing
37.5 mm (1 1/2 in.)	100
25 mm (1 in.)	95 to 100
12.5 mm (1/2 in.)	25 to 60
4.75 mm (No. 4)	0 to 10
2.36 mm (No. 8)	0 to 5

Table 3
Grading Requirement for ASTM No. 2 Subbase

Sieve Size	Percent Passing
75 mm (3 in.)	100
63 mm (2 1/2 in.)	90 to 100
50 mm (2 in.)	35 to 70
37.5 mm (1 1/2 in.)	0 to 15
19 mm (3/4 in.)	0 to 5

E. Gradation criteria for the bedding and base:

Note: D_x is the particle size at which x percent of the particles are finer. For example, D_{15} is the particle size of the aggregate for which 15% of the particles are smaller and 85% are larger.

- 1. D_{15} base stone / D_{15} bedding stone < 5.
- 2. D_{50} base stone / D_{50} bedding stone > 2.

2.04 ACCESSORIES

A. Provide accessory materials as follows:

Note: Curbs will typically be cast-in-place concrete or precast set-in concrete haunches. Concrete curbs may be specified in another Section. Do not use plastic edging with steel spikes to restrain the paving units for vehicular applications.

1. Edge Restraints
 - a. Manufacturer: [Specify manufacturer.].
 - b. Material: [Pre-cast concrete] [Cut stone] [Concrete].
 - c. Material Standard: [Specify material standard.].

Note: See ICPI publication, Permeable Interlocking Concrete Pavements for guidance on geotextile selection. Geotextile use is optional.

2. Geotextile Fabric:
 - a. Material Type and Description: [Specify material type and description.].
 - b. Material Standard: [Specify material standard.].
 - c. Manufacturer: [Acceptable to interlocking concrete paver manufacturer]]

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. [Specify acceptable paver installation subcontractors.].

3.02 EXAMINATION

Note: The elevations and surface tolerance of the soil subgrade determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies excavation and grading of the soil subgrade with additional bedding materials. Therefore, the surface elevations of the soil subgrade should be checked and accepted by the General Contractor or designated party, with written certification presented to the paver installation subcontractor prior to starting work.

- A. Acceptance of Site Verification of Conditions:
 1. General Contractor shall inspect, accept, and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.

Note: Compaction of the soil subgrade is optional and should be determined by the project engineer. If the soil subgrade requires compaction, compact to a minimum of 95% standard Proctor density per ASTM C 698. Compacted soil density and moisture should be checked in the field with a nuclear density gauge or other test methods for compliance to specifications. Stabilization of the soil and/or base material may be necessary with weak or continually saturated soils, or when subject to high wheel loads. Compaction will reduce the permeability of soils. If soil compaction is necessary, reduced infiltration may require drainpipes within the open-graded subbase to conform to local storm drainage requirements.

- a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
 - b. Provide written density test results for soil subgrade to the Owner, General Contractor, and paver installation subcontractor.
 - c. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage pipes and inlets.
2. Do not proceed with installation of bedding and permeable composite pavers until subgrade soil conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

- A. Verify that the soil subgrade is free from standing water.
- B. Stockpile joint/opening filler, base, and subbase materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.
- C. Edge Restraint Preparation:
 - 1. Install edge restraints per the drawings [at the indicated elevations].

3.04 INSTALLATION

Note: The minimum slope of the soil subgrade is typically 0.5%. Actual slope of soil subgrade will depend on the drainage design and exfiltration type. All drainpipes, observation wells, overflow pipes, and (if applicable) geotextiles, berms, baffles, and impermeable liner should be in place per the drawings prior to or during placement of the subbase and base, depending on their location. Care must be taken not to damage drainpipes during compaction and paving. No mud or sediment can be left on the base or bedding aggregates. If they are contaminated, they must be removed and replaced with clean materials. Base/sub-base thicknesses and drainage should be determined using ICPI's Permeable Interlocking Concrete Pavements manual and Permeable Design Pro software.

A. General

- 1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed before application of the [geotextile] and subbase materials.
- 2. Keep area where pavement is to be constructed free from sediment during entire job. [Geotextiles] Base and bedding materials contaminated with sediment shall be removed and replaced with clean materials.
- 3. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation. Report any damage immediately to the project engineer.

B. Geotextiles

- 1. Place on [bottom and] sides of soil subgrade. Secure in place to prevent wrinkling from vehicle tires and tracks.
- 2. Overlap a minimum of [0.3 m (12 in.)] [0.6 m (24 in.)] in the direction of drainage.

C. Open-graded subbase and base

- 1. Moisten, spread, and compact the No. 2 subbase in 4 to 6 in. (100 to 150 mm) lifts [without wrinkling or folding the geotextile. Place subbase to protect geotextile from wrinkling under equipment tires and tracks.]
- 2. For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (10 T) vibratory roller until there is no visible movement of the No. 2 stone. Do not crush aggregate with the roller.
- 3. The surface tolerance of the compacted No. 2 subbase shall be $\pm 2 \frac{1}{2}$ in. (± 65 mm) over a 10 ft (3 m) straightedge.
- 4. Moisten, spread, and compact the No. 57 base layer in one 4 in. (100 mm) thick lift. On this layer, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 t (10 T) vibratory roller until there is no visible movement of the No. 2 stone. Do not crush aggregate with the roller.

Note: At the option of the designer, this supplemental test method noted below can be used to establish a consistent methodology for in-situ density data collection of open-graded aggregate base layer (typically ASTM No. 57 stone). This test method can assist contractors in reaching adequate job site compaction and offer an additional level of confidence for the project owner and designer. This test method is appropriate for pavement subject to consistent vehicular traffic such as parking lots and roads. It is not needed for pedestrian areas and residential driveways.

- 5. Use part of the compacted base area as a control strip for density testing by the [Testing Company].
 - a. The [Testing Company] shall supply nuclear moisture/density gauges and ancillary

equipment required to conduct density and moisture content measurements for compaction of the No. 57 aggregate drainage layer. Qualified testing laboratory operators/gauges may conduct compaction testing. Each gauge operator shall be trained in safe operation, transportation, and handling of the gauge. The registered owner of the gauge shall have and maintain a valid Radioisotope License for each gauge.

- b. Each gauge shall have been calibrated within the last 12 months, either by the manufacturer or other qualified agent, against certified density and moisture reference blocks. The density standard count and the moisture standard count shall be within 2 percent and 4 percent respectively, of the most recent calibration values. A certificate of calibration for each gauge shall accompany each gauge.

6. Target Density

- a. Determine a target density on the control strip during under the following conditions: (1) after initial placement and compaction of the base aggregate layer (2) when there is a perceptible change in the appearance or gradation of the aggregate, (3) when there is a change in the source of aggregate.
- b. Test field density according to ASTM D 2922 *Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (shallow Depth)*. Field density tests shall be performed on compacted base materials to determine within acceptable limits of a target density.

7. Control Strip

- a. The Testing Company shall construct a control strip for the determination of a target density consisting of a single uniform lift as specified in the contract documents, but not more than 4 in. (100 mm) thick and covering approximately 600 yd² (500 m²) in area. No testing shall be performed within 10 ft (3 m) from any unrestrained outside edge of the work area. The control strip may be incorporated into the project upon acceptance of density measurements by the Testing Company.
- b. During construction of the control strip, the surface of the aggregate shall be visibly moist and maintained as such throughout construction and compaction.
- c. After initial placement of the aggregate base material, the compaction equipment shall make two passes over the entire surface of the control strip. Field densities and field moisture contents, using the backscatter/indirect method, shall be determined at five randomly selected locations at least 15 ft (5 m) apart. The dry density and moisture content shall be calculated for each of these locations and the averages shall be used as initial values. The maximum compacted thickness of the aggregate base layer measured for density shall be 4 in. (100 mm).
- d. The compaction equipment shall then make two additional passes over the entire surface of the control strip. After compaction, three separate, random field density and moisture content determinations shall be made, using the backscatter/indirect method, and a new average dry density and moisture content shall be calculated.
- e. If the new average dry density exceeds the previous value by more than 1.2 pcf (20 kg/m³) then two additional passes of the equipment shall be carried out as described above. If the new average dry density does not exceed the previous value by more than 1.2 pcf (20 kg/m³), then compaction of the control strip will be considered satisfactory and complete.

f. Upon satisfactory completion of the control strip, an additional seven (7) field density and moisture tests, using the backscatter/indirect method, shall be taken at random locations and the dry density and moisture content values shall be determined. The final dry density and moisture content of the control strip shall be the average of these seven values plus the three most recent values obtained upon completion.

8. Compaction Equipment

a. Use a smooth dual or single smooth drum, minimum 10 ton (10 T) vibratory roller or a minimum 13,500 lbf (60 kN) centrifugal force, reversible vibratory plate compactor that provides maximum compaction force without crushing the aggregate base.

9. Test Report

a. The test report shall include the following:

1. Project description.
2. Sketch of test area and test locations.
3. Aggregate type and layer thicknesses.
4. Aggregate characteristic properties: gradation, void ratio, bulk density.
5. Compaction equipment type and weight.
6. Static or vibratory compaction.
7. Number of passes of the compaction equipment.
8. Test number and location.
9. Individual and average field wet density, moisture content, and dry density values determined after each compaction operation in accordance with ASTM D 2922 *Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)*.
10. Calculation of target density.

D. The surface tolerance of the compacted No. 57 base should not deviate more than ± 1 in. (25 mm) over a 10 ft (3 m) straightedge.

Note: As an alternative test method, in-place density of the base aggregate may be checked per ASTM D 4254. Compacted density should be 95% of the laboratory index density established for the base layer.

E. Bedding layer

1. Moisten, spread, and screed the No. 8 stone bedding material.
2. Fill voids left by removed screed rails with No. 8 stone.
3. The surface tolerance of the screeded No. 8 bedding layer shall be $\pm 3/8$ in (10 mm) over a 10 ft (3 m) straightedge.
4. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.

F. Permeable Interlocking Composite Paver System and joint/opening fill material

1. Lay the installation grids and pavers in the pattern(s) and shown on the drawings. Maintain straight pattern lines.
2. Fill gaps at the edges of the paved area with cut units. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit.
3. Cut pavers and place along the edges with a 10" power miter saw and 10" 24-tooth carbide tipped wood ripping blade (Teflon or other coating recommended).
4. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 5,000 lbf (22 kN) centrifugal compaction force. This will require at least two passes with the plate compactor.
5. Fill the openings and joints with [No. 8] stone.

Note: Some paver joint widths may be narrow and not accept most of the No. 8 stone. Use joint material that will fill joints such as washed ASTM No. 9 or No. 10 stone.

6. Remove excess aggregate on the surface by sweeping pavers clean.
7. Do not compact within 6 ft (2 m) of the unrestrained edges of the paving units.
8. Apply additional aggregate to the openings and joints if needed, filling them completely. Remove excess aggregate by sweeping then compact the pavers. Several applications of joint sand may be required to completely fill joints.
9. All pavers within 6 ft (2 m) of the laying face must be left fully compacted at the completion of each day.
10. The final surface tolerance of compacted pavers shall not deviate more than $\pm 3/8$ (10 mm) under a 10 ft (3 m) long straightedge.
11. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars, or channels.

3.05 FIELD QUALITY CONTROL

- A. After sweeping the surface clean, check final elevations for conformance to the drawings.
- B. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

Note: The surface of the pavers may be 1/8 to 1/4 in. (3 to 6 mm) above the final elevations after compaction. This helps compensate for possible minor settling normal to pavements.

- C. The surface elevation of pavers shall be 1/8 to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars, or channels.
- D. Bond lines for paver courses: $\pm 1/2$ in. (± 15 mm) over a 50 ft (15 m) string line.

3.06 PROTECTION

- A. After work in this section is complete, the General Contractor shall be responsible for protecting work from sediment deposition and damage due to subsequent construction activity on the site.

END OF SECTION