Provided By:

MECHANICALLY INSTALLED INTERLOCKING CONCRETE PAVEMENT

SECTION 32 14 13

Note: This is a guide specification for installation of interlocking concrete pavers in the U.S. using mechanical equipment. This document is intended for large road, industrial and port pavements involving engineers, project inspectors, general contractors, paver installation contractors, and paver manufacturers. Like every large paving project, mechanical installation of interlocking concrete pavements requires forethought and planning among all these parties from its inception. This specification should be used as a tool to facilitate that planning process, as well as for quality control and quality assurance processes during the project. ***The text must be edited by a qualified, licensed design professional to suit specific project requirements. ICPI makes no representations or warranties of any kind, expressed or implied, and disclaims any liability for damages resulting in the use of this guide construction specification.***

Notes are provided for consideration in the editing process. Selected paragraphs and phrases are [bracketed] for editing during project planning and drafting this specification. The following should be read as preparation for editing this guide specification: ICPI Tech Spec 11 Mechanical Installation of Interlocking Concrete Pavements and ICPI Tech Spec 15 A Guide for the Specification of Mechanically Installed Interlocking Concrete Pavements. Structural design for street pavements is covered in ICPI Tech Spec 4 Structural Design of Interlocking Concrete Pavements and in ASCE 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways. Industrial and port pavement design is covered in the ICPI manual, Port and Industrial Pavement Design with Concrete Pavers – Second Edition.

The term Contractor designates the general contractor, Subcontractor designates the concrete paver installation subcontractor, and Manufacturer designates the concrete paver producer or supplier. The contractual relationships among the Owner, Engineer, General Contractor, Subcontractors, and Manufacturers will vary with each project. This document assumes that the Engineer works for the Owner who hires a General Contractor to build the project. The General Contractor subcontracts to a company specializing in interlocking concrete paving. The Subcontractor purchases pavers from a paver Manufacturer. The Engineer or employees working for the owner inspect and accept the paving. This guide specification provides a Quality Control Plan and mock-up as the bases of acceptance before paving begins.

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Interlocking concrete pavers (mechanically installed).
2. Bedding sand and joint filling sands.
3. Joint sand [sealer] [stabilization] materials

Revised September 27, 2021

B. Related Sections

1. Section [ ] - Earthwork and Aggregate Base.
2. Section [ ] - Cement-treated Base.
3. Section [ ] - Asphalt-treated Base.
4. Section [ ] – Asphalt Concrete Paving
5. Section [ ] - Portland Cement Concrete Paving.
6. Section [ ] - Drainage Appurtenances.
7. Section [ ] – Concrete Curbs.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE)

1. 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways.

B. American Society for Testing Materials (ASTM)

1. C33 Specification for Concrete Aggregates.
2. C136 Method for Sieve Analysis for Fine and Coarse Aggregate.
3. C140 Sampling and Testing Concrete Masonry Units.
4. C144 Standard Specification for Aggregate for Masonry Mortar.
5. C418 Test Method for Abrasion Resistance of Concrete by Sandblasting.
6. C936 Specification for Solid Interlocking Concrete Paving Units.
7. C1645 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.

C. Interlocking Concrete Pavement Institute (ICPI)

1. Port and Industrial Pavement Design with Concrete Pavers – Second Edition.
2. Tech Spec 4 Structural Design of Interlocking Concrete Pavements.
3. Tech Spec 5 Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement.
4. Tech Spec 11 Mechanical Installation of Interlocking Concrete Pavements.
5. Tech Spec 15 A Guide for the Specification of Mechanically Installed Interlocking Concrete Pavements.

1.03 DEFINITIONS

A. Wearing surface: Top surface of the paver surrounded by a chamfer.

B. Wearing course: Surfacing consisting of interlocking concrete pavers and joint sand on a sand bedding layer.

C. Interlock: Frictional forces between pavers which prevent them from rotating or moving horizontally or vertically in relation to each other.

D. Bedding course: A screeded sand layer on which the pavers are bedded.

E. Laying face: Working edge of the pavement where the laying of pavers occurs.

F. Base: Layer(s) of material under the wearing course.

G. Cluster: A group of pavers forming a single layer that is grabbed, held, and placed by a paver-laying machine on a screeded sand bedding course.

H. Bundle: Paver clusters stacked vertically, bound with plastic wrap and/or strapping, and tagged for shipment to and installation at the site. A bundle may or may not be secured to a wooden pallet. Bundles of pavers are also called cubes of pavers.

Note: Concrete paver bundles supplied without pallets can reduce material handling costs. In such cases, bundles are strapped together for shipment then delivered and transported around the site with clamps attached to various wheeled equipment. The Subcontractor may provide some wooden pallets at the site to facilitate movement of bundles.

I. Joint filling sand: Sand used to fill spaces between concrete pavers.

J. [Joint sand sealer: A liquid capable of penetrating joint sand and holding it in place upon curing.] [Joint sand stabilizer: water-activated polymers mixed with sand that help render it immobile.]

Note: Edit the following four articles per the General Conditions of the Contract.

K. Owner: The project owner, manager, or a representative of the Owner such as a project Engineer.

L. Contractor: General Contractor responsible for selected work and coordination of work by subcontractors including the paving installation subcontractor.

M. Subcontractor: A paving installation company who enters into a contract with the General Contractor to install bedding sand, interlocking concrete pavers, joint sand and accessory materials or work as indicated in the project contract.

N. Manufacturer: Producer of interlocking concrete pavers for mechanical installation on the project. The manufacturer typically enters into an agreement with Subcontractor to supply pavers. In some cases, the supply agreement can be with the General Contractor or project Owner.

1.04 SUBMITTALS

A. 4 pavers with the date of manufacture marked on each

B. Manufacturer's catalog cut sheets and production mold drawings.

C. The stitching pattern for joint clusters when the pavers are placed on the bedding sand.

D. 6 lbs (3 kg) bedding sand.

E. 3 lbs (1.5 kg) joint filling sand.

F. [Manufacturer's catalog cut sheets of joint stabilization material].

Note: Joint sand sealer and stabilization materials are optional and are selected if early stabilization of joint sand is desired.

G. [1-quart (1-liter) joint sand stabilizer].

H. Quality Control Plan.

1.05 QUALITY CONTROL PLAN

A. General

The Contractor shall provide the Engineer, Subcontractor, and Manufacturer with a Quality Control Plan describing methods and procedures that assure all materials and completed construction submitted for acceptance conform to contract requirements, The Plan applies to specified materials manufactured or processed by the Contractor or procured from subcontractors or manufacturers. The Contractor shall meet the requirements in the Plan with personnel, equipment, supplies and facilities necessary to obtain samples, perform and document tests, and to construct the pavement.

The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work, or delegate same, at a rate sufficient to ensure that the work conforms to the Contract requirements. The Plan shall be implemented wholly or in part by the Contractor, Subcontractor, Manufacturer, or by an independent organization approved by the Engineer. Regardless of implementation of parts of Plan by others, its administration, including compliance and modification, shall remain the responsibility of the Contractor.

B. Pre-construction Conference

The Plan shall be submitted to the Engineer at least [30] days prior to the start of paving. The Contractor, paving Subcontractor, and Manufacturer shall meet with the Engineer prior to start of paving to decide quality control responsibilities for items in this Section. The Engineer shall determine meeting time and location.

C. The Plan shall include as a minimum:

1. Quality Control organization chart.
2. Names, qualifications, addresses, email and telephone contact information of responsible personnel.
3. Area of responsibility and authority of each individual.
4. A listing of outside testing laboratories employed by the Contractor and a description of the services provided.
5. Indicate tests performed by Contractor personnel.
6. Preparation and maintenance of a Testing Plan containing a listing of all tests to be performed by the Contractor and the frequency of testing.
7. Procedures for ensuring tests are conducted according with the Plan including documentation and that corrective actions when necessary.

D. Quality Control Plan Elements

Note: Testing laboratories should have on-site facilities for testing bedding and joint sands.

1. Independent testing laboratory(ies) Plan includes, but is not limited to the following:
   a. A letter certifying calibration of the testing equipment to be used for the specified tests.
   b. Upon approval of the Engineer, perform testing of samples prior to commencement of paving to demonstrate their ability to meet the specified requirements.
2. Paver manufacturer, facilities, and paver transport to the site
   a. Provide evidence of experience in the manufacture of interlocking concrete pavers including history of supplying projects of similar application and size.
   b. Include project references in writing with contact information for verification.
   c. The project history and references shall demonstrate ability to perform the paver installation and related work indicated in the plans and specifications to the satisfaction of the Engineer.
   d. List the personnel and experience producing pavers for this project.
   e. Describe ability to manufacture, cure, package, store, and deliver the concrete pavers in sufficient quantities and rates without delay to the project.
   f. Provide diagrams and photos showing the number and stacked height of pavers on pallets, or in bundles without pallets, banding of the pavers, use and placement of plastic wrap, pallet dimensions and construction, and overall loaded pallet or bundle dimensions.
   g. Provide a storage and retrieval plan at the factory and designate transportation routes to the site.

Note: Paver purchasing typically includes the price of shipment and delivery to the site, i.e., F.O.B. at the site. On occasion, the purchase price may be F.O.B. at the plant. The Contractor and Subcontractor should verify the terms of the purchase and delivery with the manufacturer.

   h. Description of the transportation method(s) of pavers to the site that incurs no shifting or damage in transit that may result interference with and delay of their installation.
   i. Typical daily production and delivery rate to the site for determining on-site testing frequencies.
   j. Test results from test conducted within [one (1) year] of the project contract demonstrating the capability of the manufacturer to meet the requirements of ASTM C936.
3. Manufacturer quality control of paver dimensional tolerances - General

   Provide a plan for managing dimensional tolerances of the pavers and clusters so as to not interfere with their placement by paving machine(s) during mechanical installation. The contents of this plan include, but are not limited to the following:
   a. Drawings of the manufacturer's mold assembly including overall dimensions, pattern, dimensions of all cavities including radii, spacer bars, and the top portion of the mold known as a head or shoe.

b. The actual, measured dimensions of all mold cavities prior to manufacture of concrete pavers for this project.

Note: Production mold wear is a function of the concrete mix, mold steel, and production machine settings. A manufacturer manages growth in paver size typically through use of several production molds. These should be rotated through the production machine(s) on an appropriate schedule so that all experience approximately the same amount of wear on the inside of the mold cavities. The number of production molds utilized for a project will increase with the size of the project.

c. Anticipated production cycles per mold and a mold rotation plan.

d. A statement of how often mold cavities in each production mold will be measured during production and recording thereof.

e. Production records for each bundle showing at a minimum the date of manufacture, a mix design designation, mold number, mold cycles, and sequential bundle numbers.

Note: Variation in cluster size can make them difficult to install thereby reducing the quality of the pavement while increasing mechanized paving productivity and increasing costs. Following certain procedures during manufacture will reduce the risk of concentrated areas of cluster sizes that will not fit next to previously placed clusters. They are (1) consistent monitoring of mold cavity dimensions and mold rotation; during manufacture, (2) consistent filling of the mold cavities, (3) providing pavers with a water/cement ratio that does not cause the units to slump or produce "bellies" on their sides after the pavers are released from the mold, and (4) moderating the speed of production equipment such that pavers are not contorted or damaged when released from the mold. All of these factors are monitored by regular measurement of the cluster sizes by the Manufacturer and the Subcontractor.

Note: Any device or jig used in the paver production plant to check cluster dimensions should be duplicated in the field for measurements at the site. The sampling frequency should provide at least a 95% confidence level. The ICPI does not recognize the stack test as a means for determining dimensional consistency, i.e., stacking 8 to 10 pavers on their sides to indicate square sides from a stable column of pavers, or leaning and instability due to bulging sides (i.e., "bellies").

f. Provide the method and sampling frequency for measuring the overall length and width of clusters at the factory and in the field. Provide written agreement among Owner, Contractor, Subcontractor, and Manufacturer.

4. Subcontractor quality control procedures include, but are not limited to the following:

a. Demonstrate installation using mechanical installation by key staff in single projects having a similar application and loads.

b. Provide mechanical installation project history including references in writing with contact information for verification. The history and references shall demonstrate ability to perform the paver installation and related work indicated in the plans and specifications to the satisfaction of the Engineer.

c. List the experience and certification of field personnel and management who will execute the work shown on Contract Drawings and specified herein.

d. Provide personnel operating mechanical installation and screeding equipment on job site with prior experience on a job of similar size.

e. Provide supervisory personnel on site at all times that hold a current certificate in the ICPI Concrete Paver Installer Certification program.

f. Report methods for checking slope and surface tolerances for smoothness and elevations.

g. Record actual daily paving production, including identifying the location and recording the number of bundles installed each day.

h. Show diagrams of proposed areas for storing bundles on the site, on-site staging of storage and use, and the starting point(s) of paving the proposed direction of installation progress for each week of paving.

i. Provide the number of paver installation machines to be present on the site and anticipated average daily installation rate in square feet (m^2).

Note: The Subcontractor and Manufacturer should hold memberships in the Interlocking Concrete Pavement Institute.

1.06 MOCK-UP

Note: Mock-up size should be at least 1000 sf (100 m). Adjust area below to an area appropriate for the job.

A. **Initially construct a mock-up at least [1,000 sf (100 m^2)] with sand, pavers, [and sealer(s)] as specified.**

B. **Locate mock-up on project site as directed by the Engineer.**

C. **Demonstrate use of all mechanical installation and screeding equipment.**

D. **Demonstrate quality of workmanship that will be produced for the remainder of the project including cut pavers at edges, paver border courses, paver pattern(s) in the field of pavement, laying face configuration, cluster placement and offsets, [stitching of half or full pavers among clusters,] pattern direction, typical surcharge and compaction depth of bedding sand and pavers, typical joint widths, joint lines, joints filled with sand, [typical depth of sealer penetration in joints].**

E. **Notify Engineer in advance of dates when mock-up will be erected.**

F. **Obtain Engineer's acceptance of mock-up(s) in writing before start of paving.**

G. **Retain and maintain mock-up during construction in undisturbed condition as a standard for judging work.**

H. **Accepted mock-up in undisturbed condition at time of substantial completion may become part of completed work.**

1.07 DELIVERY, STORAGE AND HANDLING

A. **All required testing for products or materials shall be completed and approved in writing by the Engineer and received prior to delivery of that product or material to the site.**

B. **Deliver concrete pavers, sand, or any other material to the site in such a way that no damage occurs to the product during hauling or unloading.**

C. **Deliver all pavers to the site in a manner that maintains reasonable variation in cluster size. Stage them on the site as per the Plan.**

D. **Identify each bundle of pavers with a weatherproof tag. Mark each tag with the manufacturer, the date of manufacture, the mold number, the project [project phase,] for which the pavers were manufactured, and the sequential bundle number. Any breaks in numbering shall be reported immediately by the Manufacturer to the Subcontractor, Contractor, and Engineer in writing.**

E. **Deliver joint sand to the site. Protect from wind and rain.**

F. **Subcontractor equipment and processes shall not interfere with other site operations.**

1.08 ENVIRONMENTAL CONDITIONS

A. **Do not install sand and pavers during heavy rain or snowfall.**

B. **Do not install sand and pavers on frozen granular base material**

C. **Do not install frozen sand.**

D. **Do not install pavers on saturated or frozen sand.**

E. **Do not install joint sand during conditions where it might become damp.**

PART 2 - PRODUCTS

2.01 CONCRETE PAVERS

A. **Size**

Length: [ ] Width: [ ] Thickness: [ ]

Note: Spacer bars are required mechanical installation and are not included in the overall dimensions.

B. Manufactured by ICPI member: [name, address, phone, fax, email]

C. Meet the following requirements in ASTM C936:

1. Absorption: 5% average with no individual unit greater than 7% per ASTM C140.
2. Abrasion resistance: No greater volume loss than 0.915 in.3 per 7.75 in.2 (15 cm^3 per 50 cm^2) and average thickness loss shall not exceed 3 mm (0.118 in.) when tested in accordance with Test Method ASTM C418.

Note: Sometimes the project schedule requires that pavers be installed at job site prior to 28 days. If that is the case, the manufacturer can develop strength-age curves to demonstrate the relationship of compressive strength at 3, 7 or 14 days with respect to what the strength will be at 28 days.

Note: Delete article D3 on freeze-thaw testing below and edit D5, D6 and D7 for projects in non-freezing climates.

3. [Freeze-thaw deicing salt durability: average weight loss not exceeding 225 g/m^2 of surface area after twenty-eight (28) cycles or 500 g/m^2 after forty-nine (49) cycles.]
4. Dimensional tolerances: Length and width shall not exceed □0.5 mm from specified dimensions, excluding spacer bars. Height shall not exceed ±1/8 (3 mm) from specified dimensions. Check dimensions with calipers.
5. Color(s): [Natural gray without the use of pigments].

D. Quality Assurance Testing

1. Employ an independent testing laboratory qualified to undertake tests in accordance with the applicable standards specified herein.

Note: The General Conditions may specify who pays for testing. It is recommended that the General Contractor be responsible for all tests. Coordinate the article below with the General Conditions of Contract.

2. Provide all test results to the Engineer, Contractor, Subcontractor, and Manufacturer. Cost of tests shall be paid by the [ ].
3. Provide all test results, pass or fail, in writing within one working day of completion of tests. Immediately notify the Engineer, Contractor, Subcontractor, and Manufacturer if any test results do not meet those specified.
4. Test for absorption, density, compressive strength and dimensional variations per ASTM C140. Use the sampling frequencies below.

Note: The ASTM C1645 freeze-thaw durability test requires several months to conduct. Often the time between manufacture and time of delivery to the site is a matter of weeks or days. In such cases, the Engineer may consider reviewing freeze-thaw deicing salt test results from pavers made for other projects with the same mix design. These test results can be used to demonstrate that the manufacturer can meet the freeze-thaw durability requirements in ASTM C936. Once this requirement is met, the Engineer should consider obtaining freeze-thaw durability test results on a less frequent basis than stated here.

5. [Test according to ASTM C1645 for freeze-thaw deicing salt resistance using a 3% saline solution with the lowest temperature in each freezing cycle reaching –15° C.]

Note: The number of pavers sampled for testing will depend on whether freeze-thaw deicing salts tests are conducted. Adjust sampling frequency below as needed.

6. For the initial testing frequency, randomly select [fourteen (14)] full-size pavers from initial lots of [25,000 sf (2,500 m^2)] manufactured for the project, or when any change occurs in the manufacturing process, mix design, cement, aggregate or other materials.

Note: 25,000 sf (2,500 m^2) approximates an 8-hour day's production by one paver manufacturing machine. This can vary with the machine and production facilities. This quantity and the sample size should be adjusted according to the daily production or delivery from the paver supplier. Consult the paver supplier for a more precise estimate of daily production output. Initial sampling and testing of pavers should be from each day's production at the outset of the project to demonstrate consistency among aggregates and concrete mixes.

7. Test five (5) pavers for dimensional variations, three (3) pavers for density and absorption; and three (3) pavers for compressive strength [and (3) pavers for freeze-thaw durability].

8. If all tested pavers pass all requirements for a sequence of [125,000 sf (12,500 m^2)] of pavers, then reduce the testing frequency for each test to 1 (one) full-sized paver from each [25,000 sf (2,500 m^2)] manufactured. If any pavers fail any of these tests, then revert to the initial testing frequency in paragraphs 3 and 4 above.

Note: 125,000 sf (12,500 m^2) approximates 5 days of production by one paver manufacturing machine. This can vary with the machine and production facilities. This quantity and the sample size should be adjusted according to the daily production or delivery from the paver supplier. Consult the Manufacturer for a more accurate estimate of 5-day or one week's production output.

9. The entire cluster [bundle] of pavers from which the tested paver(s) were sampled shall be rejected when any of the individual test results fails to meet the specified requirements. Additional testing from clusters [bundles] manufactured before and after the rejected test sample to determine, to the satisfaction of the Engineer, the sequence of the paver production run that should be rejected. Any additional testing shall be performed at no cost to the owner.

Note: The extent of nonconformance of test results may necessitate rejection of entire bundles of pavers or larger quantities. The Engineer may need to exercise additional sampling and testing to determine the extent of non-conforming clusters and/or bundles of pavers, and base rejection of clusters of entire bundles on those findings.

2.02 BEDDING SAND

A. Conform to gradation of ASTM C33 with modifications as noted in Table 1. Supply washed, natural or manufactured, angular sand that conforms to the grading below.

Table 1

Grading Requirements for Bedding Sand
ASTM C33

Sieve Size	Percent Passing
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (0.600 mm)	25 to 60
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 1

1. Conduct gradation test per ASTM C136 for every [10,000 sf (1,000 m^2)] of wearing course or part thereof.
2. Testing intervals may be increased upon written approval by the Engineer when sand supplier demonstrates delivery of consistently graded materials.

B. Pass the following degradation test:

1. Obtain a representative sample weighing 3 lbs (1.5 kg). The samples shall be dried for 24 hours or to a constant weight in a thermostatically controlled oven at a temperature of 240-250□ F.
2. Obtain three sub-samples each weighing one-half pound by passing the main sample several times through a riffle box. Conduct a sieve analysis test in accordance with ASTM C136 on each sample.
3. Remix each sub-sample and place in a 4 3/4 in. (120 mm) diameter quart nominal capacity porcelain jar together with two 1 in. (25 mm) diameter steel ball bearings each with a mass of 75 ± 5 grams.
4. Place each jar on a bottle roller to rotate at 50 rpm for a period of six hours.
5. Repeat the sieve analysis on each sub-sample.
6. Report the individual and mean sieve analysis. The samples shall comply if the maximum average increase in the percentages passing each sieve and the maximum individual percent passing are as follows:

Sieve Size	Max. Increase	Max. % Passing
No. 200 (0.075 mm)	2%	2%
No. 100 (0.150 mm)	5%	15%
No. 50 (0.300 mm)	5%	35%

7. Repeat the test for every [250,000 sf (25,000 m^2)] of bedding sand or when there is a change in sand source.

2.03 JOINT FILLING SAND

A. Conform to gradation of ASTM C 144 with modifications as noted in Table 2.

Table 2

Grading Requirements for Joint Filling Sand
ASTM C 144

Sieve Size	Percent Passing
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	95 to 100
No. 16 (1.18 mm)	70 to 100
No. 30 (0.600 mm)	40 to 75
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 5

B. Conduct gradation test per ASTM C136 for every [10,000 sf (1,000 m^2)] of concrete paver wearing course.

C. Testing intervals may be increased upon written approval by the Engineer when sand supplier demonstrates delivery of consistently graded materials.

Note: Sealer or stabilization materials for joint filling sand are optional. They help achieve early stabilization of joint sand. Delete the article below if no joint sealer or stabilization materials are specified.

2.04 [JOINT SAND SEALER] [STABILIZER]

A. [Liquid sealer: 24-hour cure time, capable of penetrating joint sand to a minimum depth of 0.5 in (13 mm) prior to curing as manufactured by [Specify]].

B. [Polymeric joint sand stabilizer as manufactured by [Specify]].

PART 3 EXECUTION

3.01 EXAMINATION

Note: The elevations and surface tolerance of the base determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies in the base surface with additional bedding sand or by other means. Therefore, the surface elevations of the base should be checked and accepted by the General Contractor or designated party with written certification of compliance to project specifications provided to the paving Subcontractor prior to placing bedding sand and concrete pavers.

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

1. Subgrade preparation, compacted density and elevations conform to specified requirements.
2. Geotextiles [geogrids], if applicable, placed according to drawings and specifications.
3. [Aggregate] [Cement-treated] [Asphalt-treated] [Concrete] [Asphalt] base materials, thickness, [compacted density], surface tolerances and elevations conform to specified requirements.

Note: Edge restraints (typically concrete curbs) should be in place before pavers are installed. Some projects can have completed curb edge restraints with paving starting from them while the construction of curb(s) opposite from them may be under construction. In such cases, the General Contractor may propose an edge restraint installation schedule for approval by the Engineer at the pre-construction conference.

Note: All bollards, lamp posts, utility covers, fire hydrants and like obstructions in the paved area should have a square or rectangular concrete collar.

4. Location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage inlets.

C. Verify that the surface of the base surface is free of debris, standing water or obstructions prior to placing the bedding sand and concrete pavers.

D. Provide drainage during installation of the wearing course and joint fill sand by means of weep holes per the drawings, temporary drains into slot drains, dikes, ditches, etc. to prevent standing water on the base and in the bedding sand.

E. Inspect all locations of paver contact with other elements of the work, including but not limited to, weep holes, slot drains, edge restraints, concrete collars, utility boxes, manholes, and foundations. Verify that all contact surfaces with concrete pavers are vertical.

F. Areas where clearance is not in compliance or the design or contact faces at adjacent pavements, edges, or structures are not vertical shall be brought to the attention of the General Contractor and Engineer in writing including location information.

G. Remediation method(s) shall be proposed by the General Contractor for approval by the Engineer. All such areas shall be repaired prior to commencing paver installation.

3.02 INSTALLATION

A. Bedding Sand Course:

1. Screed a uniform layer to a maximum 1 in. (25 mm) thickness. Maintain a uniform thickness within a tolerance of ±1/4 in. (±6 mm). Allow for surcharge and settlement from compaction of the pavers.
2. Do not expose the screeded bedding course to foot or vehicular traffic.
3. Fill voids with sand from removal of screed rails as the bedding proceeds.
4. Do not allow screeded bedding sand to become saturated, displaced, segregated, or consolidated.

B. Concrete Pavers

1. Locate and secure string lines or snap chalk lines on the bedding sand in the direction of paving at approximately 50 ft (15 m) intervals to establish and maintain joint lines at maximum allowable width of clusters.
2. Lay paver clusters in pattern(s) as shown on the Plans.

Note: Interlocking patterns such as herringbone patterns are recommended for street, industrial and port pavements. The orientation of the pattern is typically governed by the site layout should be included in the drawings.

3. Lay pavers from the existing laying face or edge restraint in such a manner as to ensure squareness of pattern. This may require hand installation to initiate the pattern for laying clusters.
4. Place machine-laid pavers against the existing laying face.
5. Adjust cluster and pavers with rubber hammers and pry bars to maintain straight joint lines.
6. If the cluster pattern is shipped to the site with half-sized paver units, [adjust locations] [remove and fill openings with full-sized pavers] so that each cluster is stitched and interlocked with adjacent clusters into the designated laying pattern. The resulting final pattern shall be part of the method statement.
7. Hand install a string course of pavers as paving proceeds around all obstructions such as concrete collars, catch basins/drains, utility boxes, foundations, and slabs.

Note: Cutting pavers with mechanical (non-powered) splitters for industrial pavement is an acceptable method as long as joint tolerances can be maintained.

8. Do not allow concrete materials emitted from cutting operations to collect or drain on the bedding sand, joint sand, or in unfinished joints. If such contact occurs, remove and replace the affected materials.
9. Cut pavers subject to tires shall be no smaller than one-third of a full paver.
10. Insert cut pavers into laying pattern to provide a full and complete surface.
11. Straighten joint lines and bring joint widths into conformance with this specification.

Note: Paver compaction equipment typically exerts a minimum centrifugal force of 5,000 lbs or 22 kN. Higher force equipment may be required on pavers over 3 1/8 in. (80 mm) thick.

12. Remove debris from surface prior to initial compaction.
13. Compact the pavers using a vibrating plate compactor with a plate area not less than 2.5 sf (0.2 m^2) that transmits a force of not less than 14 psi (0.1 MPa) at 75 to 100 Hz.
14. After initial compaction, remove cracked or broken pavers, and replace with whole units.

Note: Initial compaction should occur within 6 ft (2 m) of all unrestrained edges at the end of each day. However, large areas of paving are placed each day and often require inspection by the Engineer or other owner's representative prior to initial and final compaction. In these cases, the total allowable uncompacted area should be decided by the Engineer based on the daily production of the Subcontractor, inspection schedules, and weather. Edit article below to reflect maximum distance to laying face for uncompacted pavers.

15. Initial compaction of all placed pavers shall be within [6 feet (2 m)] of all unrestrained edges.

C. Joint Filling Sand

1. After initial compaction of the pavers, sweep and vibrate joint sand into the joints until all are filled to the top and sand is consolidated in the joints.
2. Complete vibration and filling joints with sand to within [6 ft. (2 m)] of any unconfined edge at the end of the day.

Note: Joint sand should be spread on the surface of the pavers in a dry state. If is damp, it can be allowed to dry before sweeping and vibration so it can enter the joints readily.

Note: If joint sealer or stabilizer is not specified, excess joint sand may remain on the paver surface until proof rolling occurs for commercial projects. However, the extent of sand on the surface should not obscure observation of joints such that those with unconsolidated sand in them cannot be identified by visual inspection. For large paving projects, removal of excess sand after filling the joints may be necessary to prevent displacement by wind.

D. Proof Rolling

1. After compaction, remove loose sand and debris from the surface.
2. Engineer shall accept consolidation of joint filling sand in the joints prior to proof rolling.
3. Proof roll the pavement with a minimum 30-ton (27 T) rubber-tired roller with offset wheels.
4. Make a minimum of four passes with a static roller.
5. If sand levels in joints fall after proof rolling, add joint filling sand.
6. Sweep area clean and proof roll again until no change occurs in joint sand levels.
7. Clean the surface on completion of proof rolling so it is free from excess sand and any loose debris.

Note: Delete article below if joint sand stabilization materials are not specified for the project.

E. [Joint Sand Stabilization]

1. [Install joint sand stabilizer within [one week] after completion of a proof rolled area. Clean or re-clean the surface prior to the installation of the stabilizer. Install the stabilizer in accordance with the manufacturer's recommendations.]

F. Tolerances on Completion

Note: The minimum joint width is determined by the size of the spacer bar used for the project. This is typically 2 mm. The maximum joint width depends on the paver shape and thickness. Generally, thicker pavers with more than four sides will require slightly larger joints, often 5 to 6 mm. Consult the Manufacturer for the recommended maximum joint width.

1. Joint widths: 2 mm to [5] mm. No more than 10% of the joints shall exceed [5] mm for the purposes of maintaining straight joint lines.

Note: Surface tolerances on flat slopes should be measured with a rigid straightedge. Tolerances on complex contoured slopes should be measured with a flexible straightedge capable of conforming to the complex curves in the pavement.

Note: Surface tolerances may need to be smaller if the longitudinal and cross slopes of the pavement are 1%.

2. Smoothness: [±3/8 in. (10 mm)] over a [10 ft (3 m)] straightedge.
3. Bond or joint lines: ±½ in. (15 mm) within a 50 ft. (15 m) string line.
4. Check final surface elevations for conformance to drawings.

Note: The top 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 flexible pavements.

5. The surface elevation of pavers shall be 1/8 in. to ¼ in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

3.03 PROTECTION AND CLEAN UP

A. The Contractor shall insure that no vehicles other than those from Subcontractor's work are permitted on any pavers until completion of this unit of Work.

B. Maintain close coordination of vehicular traffic with other contractors working in the area.

C. Protect completed work from damage, fuel or chemical spills, or theft until Final Acceptance. Repair or replace damaged work to original condition, or as directed by the Engineer.

D. Remove all debris and other materials from the pavement.

END OF SECTION

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.