# PAVERS FOR AIRFIELDS (FAA AND TRANSPORT CANADA)

## ITEM P-502

*Note: This guide specification for the U.S. is for concrete pavers for airfields. Concrete pavers are approved for FAA- funded projects on a case-by-case basis. This guide specification is not published by FAA in their Advisory Circulars. However, it follows FAA specification format and structure as well as for quality control and quality assurance. The specification accompanies the ICPI manual, Airfield Pavement Design with Concrete Pavers.* ***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.***

## 1.0 DESCRIPTION

**502-1.1 This item shall consist of a surface course composed of interlocking concrete pavers set in bedding sand on an approved base course constructed in accordance with the Plans and Specifications. All paver pavers shall be manufactured for the construction of paved surfaces to be trafficked by jet or propeller driven aircraft. This item shall include paver pavers, bedding sand, joint sand, edge restraints, and sealer manufactured and installed in accordance with these specifications. This item shall be required for construction of concrete paver pavements in the manner and at the locations shown on the Plans, or as directed by the Engineer.**

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**For aircraft with gross weights in excess of 100,000 lbs. (440 KN) a stabilized base is required in accordance with FAA AC 150/5320-6C. A woven geotextile is required when a cement treated base (e.g. FAA Item P-304) is used to prevent loss of bedding sand through shrinkage cracks in the cement treated base. A woven geotextile fabric is also recommended when pavers are used as an overlay or inlay over cracked hot mix asphalt surfaces. When pavers are constructed on an aggregate base to serve aircraft with gross weights under 100,000 lbs. (440 KN), a geotextile fabric is not generally required. The use of concrete pavers is not recommended for areas subjected to full power or reverse thrust (e.g. runways or apron areas where aircraft "power-back" operations are conducted). Further guidance on design requirements and construction details for concrete pavers can be found in Interlocking Concrete Pavement Institute (ICPI) Publication, Airfield Pavement Design with Concrete Pavers.**

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## 2.0 MATERIALS

**502-2.1 CONCRETE PAVERS.**

a. General. Concrete pavers shall be manufactured in accordance with ASTM C936, except as modified by Sections 502-4.1 and 502-4.2 of this Specification. Hard face or coated pavers with special finishes

Revised September 27, 2021

shall not be used. Pavers shall be chamfered with a beveled edge around the top of the paver unit and shall be constructed with spacer bars, i.e., small protrusions on each side of the paver to keep the pavers uniformly spaced so that sand can fill the joints. Chamfers shall have a nominal width of 1/8-inch to 1/4-inch (3 mm to 6 mm) and the spacers shall have a nominal size of 1/16-inch (2 mm) in thickness. Concrete pavers shall be manufactured by a member of the ICPI.

b. Dimensions. Concrete pavers shall consist of rectangular chamfered units, 4 inches (100 mm) by 8 inches (200 mm) by 3.125 inches (80 mm) thick nominal dimensions, or other shapes and sizes as shown on the Plans. All pavers shall have round spacer bars, not exceeding 2 mm in thickness.

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**Dentated pavers are acceptable provided the plan aspect ratio is nominally 2:1. The minimum thickness of concrete pavers for airport application is 3.125 inches (80 mm).**

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c. Color. Color shall be natural grey, except where indicated on the Plans. Colored pavers shall use synthetic or natural iron oxide pigments conforming to ASTM C979, or other approved pigments with proven colorfastness.

d. Freeze-Thaw Durability. The Contractor shall submit test results and certification that the concrete pavers meet the durability requirements of ASTM C936 using the test procedure, ASTM C1645, in Appendix X1. Optional Test Method for Freeze-Thaw Durability.

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**Where freeze-thaw conditions are not anticipated, paragraph 502-2.1.d can be deleted.**

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e. Efflorescence. Concrete pavers shall be manufactured with additives to reduce efflorescence.

f. Abrasion Resistance. Abrasion resistance of concrete pavers shall conform to the weight loss requirements of ASTM C936 when tested in accordance with ASTM C418.

g. Acceptance. Concrete pavers shall be accepted by the Engineer at the source of manufacture in accordance with the acceptance requirements contained in Sections 502-4.1 and 502-4.2. 502-2.2 BEDDING SAND. Bedding sand shall be coarse, naturally occurring or manufactured hard sand. Grading shall not vary from the high limit on one sieve to the low limit on the next larger sieve. Bedding sand shall conform to the requirements of ASTM C33, except for gradation requirements which are contained in Table 1 of this Specification. Locally available manufactured sand is acceptable, provided the sand is manufactured from rock having a Los Angeles (LA) Abrasion of 20 or less, when tested in accordance with ASTM C131, and the sand is washed to meet the grading requirements of Table 1. The sand shall contain no more than 10 percent of acid soluble material per ASTM C88. The bedding sand shall conform to the bedding sand degradation test requirements contained in paragraph 502-4.2.b.

Table 1

GRADING REQUIREMENTS FOR BEDDING SAND

| Sieve Size | Percent Passing |
|---|---|
| 3/8 in. (9.5 mm) | 100 |
| No. 4 (4.75 mm) | 95 to 100 |
| No. 8 (2.36 mm) | 80 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 2 |

**502-2.3 JOINT SAND. All sand for joints shall conform to the grading requirements of ASTM C144, except that 100 percent by weight shall pass the No. 16 sieve (1.18 mm). The percent maximum passing the No. 200 sieve shall be 5%. Sand blasting sand may be used. Masonry and beach sands shall not be used.**

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**Where locally available, bagged silica sand should be specified for joint sand.**

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**502-2.4 EDGE RESTRAINTS. Edge restraints shall be fabricated and installed as shown on the Plans.**

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**Typical details for edge restraints can be found in ICPI Publication Tech Spec 3, Edge Restraints for Interlocking Concrete Pavements, as well as Airfield Design with Concrete Pavers. The Engineer shall reference the applicable requirements and specification items for the type of edge restraint specified (e.g. galvanized steel angle or concrete) in accordance with the Guidelines contained in the ICPI publication.**

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**502-2.5 SEALER. Sealer for stabilizing joint sand shall be a urethane, or approved equal, capable of 100 percent elongation in accordance with ASTM D2370. The sealer shall have demonstrated acceptable performance in similar application for a minimum of one (1) year. The sealer shall be applied in strict accordance with manufacturer's recommendations and shall carry a five (5) year minimum manufacturer's warranty. The sealer shall stabilize the joint sand to resist repeated blasts from jet engines and propeller wash and shall prevent the ingress of water through the joint sand. The sealer shall also be resistant to jet fuels, aviation gasoline, hydraulic fluids, and de-icing chemicals.**

**502-2.6 JOINT SEALING FILLER. When shown on the Plans, joint sealing filler used for sealing joints at edge restraint interfaces shall conform to Item P-605. No separate payment shall be made for this item, which is considered incidental to installation of edge restraints.**

## 3.0 INITIAL ACCEPTANCE REQUIREMENTS

**502-3.1 SUBMITTALS. The Contractor shall submit the following for the approval of the Engineer at least 30 days prior to the start of concrete paver installation.**

a. Certifications. The Contractor shall provide certifications that all materials to be incorporated into the work can meet the requirements of Sections 502-2.1 and 502-4.2. Certifications shall be substantiated by data from tests performed within 90 days of the planned start date for installation.

b. Samples. The Contractor shall submit the following samples for preliminary testing and evaluation by the Engineer.

(1) Pavers. Ten (10) concrete pavers, cured for a minimum of 28 days, shall be submitted to the Engineer for testing and evaluation in accordance with Sections 502-4.1 and 502-4.2 of this Specification.

(2) Bedding and Joint Sand. Sieve analyses and samples of bedding and joint sand shall be submitted to the Engineer for evaluation and testing in accordance with Sections 502-4.1 and 502-4.2 of this Specification.

(3) Sealer. Manufacturer's catalogue cuts shall be submitted for sealer.

(4) Edge Restraints. Mill reports and steel detailing showing hole sizes and layout shall be submitted to the Engineer for approval, when steel angle edge restraints are shown on the Plans. When concrete edge restraints are shown on the Plans, the concrete shall conform to Item P-610.

c. Statement of Contractor Qualifications. The paver Contractor shall have installed at least 300,000 square feet (30,000 square metres) in commercial, municipal, port, or airport projects over the past twenty-four (24) months. If mechanical installation is to be used, at least 100,000 sq. ft. (10,000 sq. metres) of which shall have been mechanically installed. Submit list to the Engineer of projects completed by Installer. Include list of completed projects with project names, addresses, telephone numbers, email addresses, names of Engineers/Architects and Owners, and dates of construction.

d. ICPI Certification. The paver contractor shall provide current certificates from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program for job foremen on the project.

**502-3.2 TEST STRIP. Prior to installation of unit pavers, construct a test strip at least 10-feet by 10-feet for each form and pattern of concrete paver required. Build mock-up(s) using materials, base construction, joints and special features for contiguous work, as indicated for final unit of work. The test strip shall also be used to establish "roll down" and sand surcharge requirements for grade control.**

a. Locate mock-ups on project site in the location as directed by Engineer.

b. Notify Engineer in advance of dates when mock-up(s) will be erected.

c. Demonstrate quality of workmanship that will be produced in final unit of work.

d. Obtain Engineer's acceptance of mock-up(s) before start of final unit of work.

e. Retain and maintain mock-up(s) during construction in undisturbed condition as a standard for judging work.

f. Accepted mock-up(s) in undisturbed condition at time of substantial completion may become part of completed unit of work.

**502-3.3 CONCRETE MIX DESIGN. Proportioning requirements for concrete for paver manufacturer shall be designed for a compressive strength consistent with the acceptance criteria contained in Sections 502-4.1 and 502-4.2. Prior to the start of paver production and after approval of all material to be used in the concrete, the Contractor shall submit a mix design verification showing the proportions and actual compressive strengths at 28 days of the unit pavers, tested in accordance with Section 502-4.1 of this Specification. The mix design shall include a complete list of materials including type, brand, source and amount of cement, fly ash or other pozzolans, ground slag, and admixtures, and copies of test reports and certifications. Production shall not begin until the mix design and accompanying test data are reviewed and approved by the Engineer. The mix design shall be submitted at least 15 days prior to the start of paver production.**

## 4.0 MATERIAL ACCEPTANCE

**502-4.1 ACCEPTANCE SAMPLING AND TESTING. All testing for acceptance of concrete pavers, and bedding and joint sand, will be performed by the Engineer without cost to the Contractor. Concrete pavers will be sampled at the location of manufacture and tested by the Engineer for acceptance before shipment to the job site. Bedding and joint sand will be sampled from stockpiles maintained by the Contractor at the job site for testing by the Engineer.**

a. Concrete Pavers. Concrete pavers shall be sampled, tested, and accepted by the Engineer on a lot basis. A lot shall consist of [ ] paver units, except for the last lot, which shall consist of the number of units required for completion of paving. Each lot shall be divided into five (5) equal sublots. Three (3) full size units shall be randomly located by the Engineer within each sublot in accordance with ASTM D3665. Each specimen selected shall be suitably marked so that it can be identified according to lot, sublot, and sample number at any time. The Engineer shall perform the following tests for acceptance on the number of samples indicated below.

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**The lot size shall consist of one-tenth (1/10) of the total area to be paved, or 50,000 concrete pavers, whichever is smaller. The minimum lot size shall be 25,000 concrete pavers.**

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(1) Compressive Strength. Compressive strength testing in accordance with ASTM C140 shall be performed on samples at 28 days. One (1) full paver sample from each sublot (5 total) shall be tested. This result shall represent the compressive strength for each of the five (5) individual sublots.

(2) Absorption. Five (5) full units, randomly selected from the ten (10) remaining units from each sublot, will be tested by the Engineer for absorption in accordance with Section 8 and Annex A4 of ASTM C140.

(3) Dimensions. The dimensions of the remaining five (5) units will be measured by the Engineer in accordance with Section 6 and Annex A4 of ASTM C140.

(4) Abrasion Resistance. Three (3) units shall be sampled out of every 500,000 units produced and abrasion resistance shall be measured in accordance with ASTM C418.

(5) Freeze-Thaw Durability. Three (3) units shall be sampled out of every 250,000 units produced and freeze-thaw durability shall be measured in accordance with ASTM C1645 at forty-nine (49) freeze thaw cycles. Weight loss per square metre of surface area shall be reported at twenty-five (25) and if applicable, at forty-nine (49) cycles.

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**The requirements for freeze-thaw durability can be deleted where freezing conditions are not anticipated.**

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b. Bedding Sand. Bedding sand shall be sampled, tested, and accepted by the Engineer on a lot basis. A lot shall consist of [ ] square feet (square metres) of sand placed for paving, except for the last lot, which shall consist of the number of square feet (metres) required for completion of paving. Each lot shall be subjected to the following tests for acceptance.

(1) Gradation. Each lot will be divided into two (2) equal sublots. One (1) sample shall be randomly located by the Engineer within the sublot in accordance with ASTM D3665. The Engineer shall test each sample for grading in accordance with ASTM C136 (Dry Sieve).

(2) Bedding Sand Degradation. One (1) 3 lbs. (1.4 kg) sample shall be randomly located within each lot in accordance with ASTM D3665. The sample shall be dried for 24 hours at 240 to 250 degrees F (115 to 121 degrees C). Obtain three (3) sub-samples each weighing 0.5 lbs. (0.2 Kg) by passing the main sample several times through a riffle box. Carry out a sieve analysis test on each sub-sample according to ASTM C136. Remix each sub-sample and place in a nominal quart/liter capacity porcelain jar with two (2) 1-inch (25 mm) diameter steel ball bearings weighing 75 +/- 5 grams each. Rotate each jar at 50 rpm for six (6) hours. Repeat the sieve analysis. Record the individual and average sieve analysis.

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**The lot size for bedding sand shall consist of the lesser of 20,000 square feet (2,000 square meters) or one-tenth (1/10) of the total paved area. The minimum lot size shall be 10,000 square feet (1,000 square meters).**

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c. Joint Sand. Joint sand shall be accepted on the lot size specified in paragraph 502-4.1.b., except that only one (1) sample will be randomly selected for each lot. The Engineer shall test the sample for grading in accordance with ASTM C136 (Dry Sieve).

**502-4.2 ACCEPTANCE CRITERIA.**

a. Concrete Pavers. Concrete pavers shall be evaluated on a lot basis by the Engineer for compliance with the acceptance characteristics specified in paragraphs 502-4.2.a(1) through (6), below. All acceptance requirements must be fully met as described below for a lot of concrete pavers to be considered acceptable for incorporation into the work. Failure to meet any one or more of the acceptance requirements detailed below will result in rejection of the entire lot of concrete pavers.

(1) Compressive Strength. For acceptance, the average compressive strength of the five (5) pavers tested in accordance with Paragraph 502-4.1.a(1) shall be 8,000 psi (55 MPa) with no individual test less than 7,200 psi (50 MPa).

(2) Absorption. A lot shall be accepted based on absorption when the average absorption for the five (5) samples tested for each lot in accordance with paragraph 502-4.1.a(3) is less than or equal to 5 percent, with no individual unit having an absorption greater than 7 percent.

(3) Dimensional Tolerances. The dimensional tolerances of each of the five (5) pavers sampled for each lot in accordance with paragraph 502-4.1.a.(3) shall not vary by more than the following amounts:

(a) Length: + 1/16 inch (1.6 mm)

(b) Width: + 1/16 inch (1.6 mm)

(c) Thickness: + 1/8 inch (3.2 mm)

Each side of each paver within the sample shall be normal to the wearing surface and the opposite face. The sides shall be considered normal if the sides do not deviate by more than 1/16 inches (1.6 mm).

(4) Abrasion Resistance. Samples tested in accordance with paragraph 502-4.1.a(4) shall not have a greater volume loss than 0.915 $in.^3$ per 7.75 $in.^2$, (15 $cm^3$ per 50 $cm^3$). The average thickness loss shall not exceed 0.118 in. (3 mm).

(5) Visual Requirements. All pavers shall be sound and free from defects that would interfere with the proper placing of the pavers or impair the strength or performance of the construction.

Defects which impair the structural or functional performance of the wearing surface of the paver shall be sufficient reason for rejection. The Engineer, at his sole discretion, may allow pavers with minor chipping to remain as part of the completed pavement.

(6) Freeze-Thaw Durability. The average weight loss of samples tested in accordance with paragraph 502-4.1.a(6) shall not exceed 200 $g/m^2$ of surface area after twenty-five (25) cycles or 500 $g/m^2$ after forty-nine (49) cycles.

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**Freeze-thaw durability requirements may be deleted where freezing conditions are mild or not applicable.**

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b. Bedding Sand. Bedding sand shall be evaluated by the Engineer on a lot basis for compliance with the following characteristics:

(1) Gradation. The two (2) samples of bedding sand tested in accordance with paragraph 502-4.1.b shall be averaged for comparison to the grading requirements of Table 1. The Contractor shall take appropriate corrective action when the acceptance tests indicate that the grading requirements are not being met.

(2) Bedding Sand Degradation. For each sample tested in accordance with paragraph 502-4.1.b(2), the maximum increase in the percentages passing each sieve and the maximum individual percent passing shall be:

| 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% |

c. Joint Sand. Joint sand sampled and tested in accordance with paragraph 502-4.1.c shall be evaluated for compliance to the requirements of Section 502-2.3.

d. Sealer. The sealer shall meet the requirements of Section 502-2.5.

e. Compliance. Where any of the individual acceptance tests for concrete pavers and/or sand fail to meet the requirements specified above, the lot shall be rejected because of non-compliance subject to the following:

(1) Removal of Defective Materials. The Contractor may elect to inspect the lot, remove any items he/she considers to be defective and submit the remainder for re-sampling and re-testing by the Engineer in accordance with Sections 502-4.1 and 502-4.2 of this Specification. The costs for resampling and retesting shall be borne by the Contractor. Should these further test results fail to meet the requirements, the entire lot shall be rejected. Where defective materials have been discarded from the lot, the lot shall be considered a new lot and the initial test results shall not be used in the Engineer's evaluation for compliance.

## 5.0 DELIVERY, STORAGE, AND HANDLING

**502-5.1 Deliver concrete pavers to project site in steel-banded, plastic-banded, or plastic wrapped cubes capable of transfer by forklift or clamp lift. Unload pavers at project site without damage to pavers or existing construction.**

**502-5.2 Protect unit pavers from damage during delivery, storage and construction.**

**502-5.3 Sand shall be covered with waterproof coverage to prevent exposure to rainfall or removal by wind. Covering shall be secured in place.**

## 6.0 INSTALLATION

**502-6.1 PREPARATION.**

a. Edge Restraints. Edge restraints shall be installed in the manner and in the locations shown on the Plans and in accordance with Section 502-2.4. The location of the edge restraints can be adjusted within +/- 2 inches (5 cm) of the Plan locations to minimize cutting of concrete pavers.

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**For inlays or new construction where pavers will abut hot mix asphalt surfaces, the following additional requirements are recommended.**

**Edge restraints shall be constructed in the following sequence:**

**(1) Construct P-401 courses to the bottom of the bedding sand layer, maintaining close control of grades and surface smoothness;**

**(2) Construct final lifts of P-401 outside the areas designated for concrete pavers, and approximately 1 foot to 2 feet (30 cm to 60 cm) inside the concrete paver areas, maintaining close control of grades and surface smoothness. Sheets of "waxed" paper or other suitable bond breaking material may be used at the edge of the hot mix asphalt to facilitate cutting back the asphalt to its final location.**

**(3) Saw-cut the P-401 material to neat, straight lines at the locations shown on the Plans, adjusting the saw-cut +/- 2 inches (5 cm) to facilitate concrete paver installation.**

**(4) Remove the asphalt in a manner approved by the Engineer to the saw-cut lines.**

**(5) Install the steel angle edge restraint by spiking and install geotextile fabric strips along the length of the angle as shown on the Plans.**

**(6) After concrete paver installation, as described below, apply P-605 joint sealing filler at the hot mix asphalt/concrete paver interface as shown on the Plans.**

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b. Base. The base course for the pavers shall be accepted by the Engineer before the start of paver installation. The base shall be cleared of all loose or foreign material. When indicated on the Plans, a geotextile fabric shall be installed prior to the installation of bedding sand.

c. Lines and Grades. Lines and grades shown on the Plans shall be established and maintained by the Contractor during the installation of the pavers. Allowance for sand surcharge levels should be made at this time.

d. Drainage. Adequate drainage shall be provided during construction by means of temporary drains, ditches, etc. to prevent the build-up of standing water.

**502-6.2 BEDDING SAND INSTALLATION.**

a. Bedding sand shall comply with Section 502-2.2 and paragraph 502-4.2.b. of this Specification.

b. The finished surface of the base to receive the bedding sand shall be uniform and even, meet all smoothness and grade requirements of the base course.

c. Bedding sand shall be spread to a uniform, even thickness, such that, after compaction, it forms a uniform layer, nominally 1-1/4 inches to a maximum of 1-1/2 inches (3 cm to 4 cm), or as shown on the Plans. The Contractor shall allow for surcharge and compaction when establishing the loose thickness of bedding sand.

d. The test strip required by Section 502-3.2 shall be used to determine the true amount of surcharge required to obtain the correct levels.

e. The moisture content of the bedding sand shall remain relatively constant and within 2 percent of optimum moisture. The course shall not be subjected to any trafficking, either by mechanical equipment or pedestrian use.

f. The Contractor shall take all reasonable precautions to prevent the bedding sand from blowing to areas of the Terminal Apron or Taxiways that are open to aircraft operation. If in the opinion of the Engineer, the Contractor's controls are not adequate, the Engineer shall limit the amount of sand that can be spread at any time.

g. Spreading of the laying course sand shall stop when the Engineer considers the weather conditions to be unsuitable. If inclement weather causes deterioration of the laying course sand it shall be lifted and stored to one side to drain prior to reuse.

**502-6.3 INSTALLATION OF UNIT PAVERS.**

a. Do not use concrete pavers with chips, cracks, voids, or other defects which may impair functional or structural performance.

b. Use full units without cutting where possible.

c. Ensure that pavers are free of foreign materials before installation.

d. Concrete pavers shall be installed using the herringbone laying pattern shown on the Plans, matching the joint pattern of the field-constructed mock-up(s).

e. Set concrete pavers with a consistent minimum joint width of 1/16-inch (1.5 mm) and a maximum of 1/8-inch (3 mm), being careful not to disturb the bedding sand. Ninety-five (95%) percent of the joints shall be 3/32-inch (2 mm) or less in width. Place pavers hand tight against spacer bars. Using string lines to keep straight joint lines.

f. The pavers shall be laid away from the existing laying face or edge restraint in such a manner as to ensure squareness of pattern.

g. Cut unit pavers with motor-driven masonry saw to provide clean, sharp, unchipped edges. Cut vertical faces and cut grind chamfers on top of cut surface to provide pattern indicated and to fit adjoining work neatly. Hammer cutting or mechanically split pavers are not acceptable. No cut segments shall be smaller than one-third (1/3) of a unit.

h. Lay full pavers first. Lay string courses along all edge restraints and around all concrete collars and similar construction in accordance with the details shown on the Plans.

i. If in the opinion of the Engineer weather conditions are such that the performance of the pavement may be affected, laying operations shall be discontinued and all laid pavers shall be lined and compacted prior to suspension of the works. On recommencement of laying pavers, at least two (2) edge courses of existing pavers shall be lifted and the sand re-screeded before pavers are laid.

**502-6.4 COMPACTION.**

a. Initial Compaction. After the pavers have been laid on the bedding sand, and after all cut pavers have been inserted to provide a full and complete surface, and pattern lines have been straightened, vibrate concrete pavers into bedding with a low amplitude plate vibrator capable of at least 5,000 lbs. (22 KN) compaction force and at least 75 hertz. The effective compactive force from the plate should not be less than 11 pounds per square inch (75 KN per square metre).

Vibrate after edge pavers are installed, and there is a completed, restrained surface; or before surface is exposed to rain.

Before ending each day's work, vibrate installed concrete pavers more than 3 feet (1 m) of the laying face, fill joints and vibrate again. Cover remaining 3 ft with plastic sheets if rain is forecasted. Secure plastic sheets from removal by wind.

b. Joint Sand Installation and Compaction. Immediately after vibration of the pavers to finished level, dry jointing sand shall be brushed over the surface course and the pavement shall be re-compacted until all joints are completely filled with sand. A minimum of two (2) passes shall be made, in addition to initial compaction, parallel and perpendicular to the joint pattern during joint sand installation. Additional sand shall be added until joints are filled. Care shall be taken to ensure that the joints are filled and sand shall be constantly brushed over the surface and the pavement re-compacted as necessary.

c. Final Compaction of Units. On completion of the initial vibration and joint filling with sand, the entire area shall be compacted with an 8 to 10 ton pneumatic rubber-tired roller having a tire pressure of 90 pounds/square inch (620 KPa/sq. m.). Replace any cracked pavers with whole units and roll pavers again.

**502-6.5 SURFACE TESTS.**

a. Smoothness. After completion of final compaction, the finished surface shall not vary more than 1/4-inch (6.35 mm) when tested with a 12-foot (3.6 m) straightedge in any direction.

b. Grade. After completion of final compaction, the finished surface shall deviate no more than 1/2-inch (12.7 mm) from the gradeline, elevations, and cross-sections shown on the Contract Drawings. The top of the pavers shall extend approximately 1/8-inch (3 mm) higher than surrounding appurtenances and asphalt pavement.

**502-6.6 SEALER APPLICATION.**

a. After final compaction, remove all excess sand and debris. Ensure that there is no sand in the chamfers. Apply the sealer as soon as practical after final compaction, strictly following the sealer manufacturer's requirements regarding application methods, equipment, and rate.

b. Traffic shall not be permitted on the pavement until the sealer has cured.

**502-6.7 JOINT SEALING FILLER. The joints at the interface between pavers and adjacent pavement and edge restraint shall be sealed with material conforming to Item P-605 of the Technical Specifications, as shown on the Plans, or as directed by the Engineer. No separate payment will be made for this item which shall be considered incidental to the cost of providing and installing edge restraints.**

**502-6.8 WEATHER LIMITATIONS. Bedding sand, pavers, and joint sand shall not be installed during periods of heavy rain or when temperatures are below 32 degrees F (0 C).**

## 7.0 CONTRACTOR QUALITY CONTROL

**502-7.1 GENERAL. The Contractor shall provide and maintain a quality control system that will provide methods and procedures to assure that all materials and completed construction submitted for acceptance conform to contract requirements whether manufactured or processed by the Contractor or procured from Subcontractors or vendors. Although guidelines are established and certain requirements are specified herein, the Contractor shall assume full responsibility for accomplishing the stated purpose.**

**The Contractor shall provide and maintain a Quality Control Plan, hereinafter referred to as Plan, along with all the personnel, equipment, supplies and facilities necessary to obtain samples, perform and document tests, and otherwise ensure the quality of the product.**

**The Plan shall be submitted to the Engineer at least 15 days prior to the start of paving. The Contractor shall be prepared to discuss and present, before the start of paving, his or her understanding of the quality control responsibilities for specific items as included in these Specifications.**

**The Contractor shall perform process control sampling, testing, and inspection during all phases of the work at a rate sufficient to ensure that the work conforms to the Contract requirements.**

**502-7.2 QUALITY CONTROL PLAN. The Plan may be operated wholly or in part by the Contractor or supplier, or by an independent organization; however, the Plan's administration, including compliance with the Plan and its modification, shall remain the responsibility of the Contractor.**

a. Plan Contents. The Plan shall include as a minimum:

(1) Quality Control organization chart.

(2) Names and qualifications of personnel.

(3) Area of responsibility and authority of each individual.

(4) A listing of any outside organizations such as testing laboratories that will be employed by the Contractor and a description of the services they will provide; or indicate if tests will be performed by Contractor personnel.

(5) Preparation and maintenance of a Testing Plan which shall contain a listing of all tests to be performed by the Contractor and the frequency of testing.

(6) Procedures for ensuring that tests are taken in accordance with the Testing Plan, that they are documented, and that proper corrective actions are taken when necessary. The testing procedures shall be prescribed by clear and complete instructions and shall assure quality control testing of materials as required by the Specifications, or as necessary to maintain the specified quality.

b. Plan Elements. The Plan shall address all elements which affect the quality of the concrete pavers, including but not necessarily limited to the following:

(1) Mix Design for Paver Production

(2) Quality of Cementitious Materials and Admixtures

(3) Proportioning

(4) Control of Water-Cement Ratio

(5) Required Strength

(6) Placement of Bedding Sand

(7) Moisture Content and Absorption of Bedding Sand

(8) Thickness, Smoothness, and Grade Control

c. Plan Administration. The Plan shall address management and coordination of activities of the personnel assigned to this function and shall incorporate the use of the following types of personnel.

(1) Plan Administrator. The individual administering the Plan must be a full-time employee of the Contractor or Paver Installer or a consultant employed by the Contractor or Paver Installer. In either case, the individual employed shall have full authority to institute any and all actions necessary for the successful operation of the Plan.

(2) Plant Control Technician (PCT). This person shall utilize laboratory test results and other quality control practices to ensure the quality of aggregates, cementitious materials, admixtures, and other mix components and adjust and control mix proportioning to meet the mix design(s) for paver production. The Plan shall detail the frequency of each type of test, when and how corrective actions are to be taken, and the means of documentation.

The PCT shall be responsible for periodically inspecting all equipment utilized in proportioning and mixing to ensure its proper operating condition and to ensure that proportioning and mixing is in conformance with the mix design and other Specification requirements. The Plan shall set forth how these duties and responsibilities will be accomplished and documented. The PCT may be an employee of the paver manufacturer.

(3) Field Control Technician (FCT). This person shall be responsible for periodically inspecting all equipment and processes utilized in placing to ensure that placing of pavers and bedding and joint sand is in conformance with the Specifications. The Plan shall set forth how these duties and responsibilities will be accomplished and documented.

The Field Control Technician, who can be the Installer's on-site superintendent, shall also be responsible for the following:

(a) Examine surfaces indicated to receive unit pavers for compliance with required installation tolerances. Verify that all surfaces to receive pavers are in proper condition, and that no conditions exist which may adversely affect progress or quality of work.

(b) Verify that base is dry and ready to support bedding material, pavers, and imposed loads.

(c) Verify base gradients and elevations.

(d) Verify location, type, installation, and elevations of adjacent edge restraints, drainage inlets, grounding lugs, and other appurtenances in the pavement.

(e) Provide adequate drainage during the entire construction phase by means of temporary drains, ditches, or other means to prevent the build-up of standing water.

**502-7.3 QUALITY CONTROL TESTING. The Contractor shall perform any quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the approved Quality Control Plan.**

a. Paver Production. The testing program for paver manufacture shall include, but not necessarily be limited to tests for control of:

(1) Batch proportioning

(2) Aggregate gradation (evidence from quarry tickets will be acceptable).

(3) Aggregate moisture content

(4) Water-cement ratio

(5) Density measurements

A minimum of two (2) tests for each shall be made for each production day. For automated plants with recordation, the Contractor can submit printed tickets, in lieu of daily testing, provided evidence of recent plant calibration is submitted to the Engineer for approval prior to the start of production.

b. Bedding and Joint Sand. The Contractor shall control the gradation and moisture content of the bedding and joint sand used for installation. In addition, the Contractor shall determine the optimum moisture content for the bedding sand in accordance with ASTM D1557 and control the moisture content during construction to -2 percent and +3 percent of the optimum moisture content. A minimum of one (1) moisture content test shall be performed for each lot, as defined in accordance with paragraph 502-4.1.b. Moisture content testing shall be in accordance with ASTM C566.

## 8.0 METHOD OF MEASUREMENT

**502-8.1 The quantity of each element of work, installed and accepted, comprising this item, shall be in accordance with the following measurements:**

a. Concrete Pavers and Joint Sand. Per square foot (sf) [square metre (sm)], measured in-place, completed and accepted.

b. Bedding Sand. Per ton, measured on approved truck scales, completed and accepted.

c. Edge Restraint. Per linear foot (lf) [linear metre (lm)], measured in-place, completed and accepted.

d. Sealer. Per square foot (sf) [square metre (sm)], completed and accepted.

## 9.0 BASIS OF PAYMENT

**502-9.1 Payment for accepted quantities of concrete pavers shall be made at the full Contract unit price per square yard. The price shall be full compensation for manufacturing, furnishing, and placing all materials, including pavers, bedding sand, joint sand, edge restraints, and sealer and for all labor, equipment, tools, and incidentals necessary to complete this item.**

| | |
|---|---|
| Item P-502-9.1 | Concrete Pavers and Joint Sand--per square foot (square metre) |
| Item P-502-9.2 | Bedding Sand--per ton (metric ton) |
| Item P-502-9.3 | Edge Restraints--per linear foot (linear metre) |
| Item P-502-9.4 | Sealer--per square foot (square metre) |

## 10.0 MATERIALS AND TESTING REQUIREMENTS

| | |
|---|---|
| ASTM C33 | Specification for Concrete Aggregates |
| ASTM C131 | Method for Resistance to Degradation of Small Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C136 | Method for Sieve Analysis for Fine and Coarse Aggregate |
| ASTM C140 | Method of Sampling and Testing Concrete Masonry Units |
| ASTM C144 | Standard Specification for Aggregate for Masonry Mortar |
| ASTM C566 | Total Moisture Content of Aggregate by Drying |
| ASTM C936 | Specification for Solid Interlocking Concrete Paving Units |
| ASTM C979 | Pigments for Integrally Colored Concrete |
| ASTM C1645 | Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units |

| | |
|---|---|
| ASTM D1557 | Laboratory Compaction Characteristics of Soil Using Modified Effort. |
| ASTM D2370 | Test for Elongation and Tensile Strength of Free Films of Paint, Varnish, Lacquer, and Related Products with a Tensile Testing Apparatus |
| ASTM D3665 | Random Sampling of Paving Materials |

END OF ITEM P-502

## 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.