SECTION 32 12 43
POROUS FLEXIBLE PAVEMENT (PFP)
FLEXI-PAVE POROUS FLEXIBLE PAVEMENT SYSTEM
(Rev. 7.71 – Performance-Based Master Specification)
SECTION 32 12 43 – FLEXI-PAVE POROUS FLEXIBLE PAVEMENT (PFP)

PART 1 – GENERAL

1.01 SUMMARY

A. Scope of Work

Provide all labor, materials, equipment, and supervision necessary to furnish and install a porous flexible pavement system as indicated on the Contract Documents and specified herein. Work includes, but is not limited to, surface course materials, base materials, geotextiles, geogrids, mixing, placement, finishing, curing, and protection.

B. Description of System

Flexi-Pave Porous Flexible Pavement is a monolithic, flexible, porous paving system composed of angular aggregate and/or recycled rubber bound with a high-performance polyurethane binder. The system is engineered to provide structural load distribution, high permeability, durability under freeze–thaw exposure, resistance to chemical attack, and long-term service life with minimal maintenance. Flexi-Pave is not a decorative resin-bound aggregate surfacing. It is a functional pavement system intended to perform as a complete assembly, including surface course and engineered base components, and is designed to accommodate movement from subgrade variability, tree root growth, and thermal cycling.

C. Performance Objectives

The porous flexible pavement system shall meet the following performance objectives:

1. Tree Preservation
    - Allow air, water, and nutrient exchange to underlying soils
    - Minimize root damage and soil compaction
    - Accommodate future root growth without cracking or displacement
2. Stormwater Management
    - Provide rapid vertical infiltration of surface water
    - Reduce surface runoff and ponding
    - Support Low Impact Development (LID) and green infrastructure goals
3. Heat Island Mitigation
    - Reduce surface temperatures relative to conventional impervious pavements
    - Allow evaporative cooling through porous structure

D. Typical Applications

Applications include, but are not limited to:

- Sidewalks and pedestrian walkways
- Trails and shared-use paths
- Plazas and courtyards
- Tree surrounds and root-zone paving
- Bike lanes, bike share pads, and light vehicular areas
- Parking area diffusion strips

1.02 RELATED SECTIONS

Coordinate work of this Section with the following, as applicable:

- Section 31 20 00 – Earth Moving
- Section 32 05 00 – Common Work Results for Exterior Improvements
- Section 33 40 00 – Storm Drainage Utilities
- Landscape and Tree Protection Sections
- Concrete and Asphalt Paving Sections at interface locations

1.03 DEFINITIONS

For purposes of this Section, the following definitions apply:

A. Porous / Pervious / Permeable

Terms used interchangeably to describe paving systems that allow water to pass vertically through the surface into the soil.

B. Porous Flexible Pavement

A paving system consisting of aggregate and/or recycled rubber bound with a polyurethane binder, forming a flexible, interconnected void structure that allows water infiltration while distributing structural loads.

C. Subgrade

The native or prepared soil beneath the pavement structure.

D. Subbase

A layer between subgrade and base course used to improve load distribution or drainage.

E. Base Course

An open-graded aggregate layer under pavement that provides stormwater storage capacity.

F. Geotextile Fabric

A needle punched non-woven permeable fabric used to separate soil from stone.

G. Geogrid

A structural reinforcement grid that improves load distribution and reduces rutting.

H. Panel
A defined section of porous flexible pavement bounded by formwork.
I. Diameter at Breast Height (DBH)
Tree trunk diameter measured at 4.5 feet above finished grade.
J. Critical Root Zone (CRZ)
The area beneath a tree extending radially 1.5 feet per inch of trunk DBH.
K. ISA Certified Arborist (CA)
An individual certified by the International Society of Arboriculture.
L. Supersonic Air Tool (SSAT / Air Spade)
A pneumatic excavation tool used by arborists to excavate soil without damaging roots.
M. Directional Root Pinning (DRP)
A non-invasive alternative to root pruning, performed using SSAT to redirect roots.
N. Root Protection Matting (RPM)
Matting used to protect CRZs, which prevents soil compaction, rutting, & contamination.
O. Root Aeration Matting (RAM, vRAM, TreeRAM)
A structural vented system used to mitigate impervious cover over CRZs.
P. Tree Growth Regulator (TGR)
A plant growth regulator (e.g., Cambistat) used to regrow roots after root pruning or damage.
Q. Mycorrhizae (Mycor)
Symbiotic fungi applied to trees that have undergone stress, root loss or root damage.

1.04 PERFORMANCE-BASED TEST STANDARDS
The porous flexible pavement system shall meet or exceed the following minimum quantitative performance criteria, as demonstrated by independent laboratory testing, manufacturer test data, or documented field performance of comparable installations. All test data submitted for compliance shall be generated by an independent testing laboratory accredited to ISO/IEC 17025 or equivalent. The porous flexible pavement system shall meet or exceed the following minimum criteria:
A. Freeze–Thaw Resistance
- Test Method: ASTM C666, Procedure A
- Test Duration: Minimum 300 freeze–thaw cycles
- Acceptance Criteria:
    - No visible cracking, spalling, raveling, or loss of cohesion
    - No loss of structural integrity or serviceability
    - Maximum mass loss: ≤ 1.0 percent, *if mass loss is measured*
    - No measurable reduction in permeability or flexibility affecting performance

B. Infiltration / Permeability
- Minimum Infiltration Rate:
  ≥ 2,500 gallons per square foot per hour**,**
  equivalent to approximately 4,000 inches per hour (rounded)
- Post-Conditioning Performance:
  Pavement shall retain not less than 80 percent of initial measured infiltration capacity after simulated clogging and cleaning cycles, where tested.
- Test Methods:
    - ASTM D3385 – Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer
    - Or approved equivalent field or laboratory permeability test method acceptable to the Engineer

C. Abrasion, Scuff, and Surface Wear Resistance
- Wet Track Abrasion Resistance
    - Test Method**:** ISSA TB-100
    - Acceptance Criteria**:**
        - Maximum material loss: ≤ 1.0 gram after 1,000 cycles
- Cohesion / Torque Resistance
    - Test Method: ISSA TB-139
    - Acceptance Criteria:
        - Minimum torque resistance: ≥ 2.0 N·m
        - No visible surface tearing, aggregate pull-out, or binder failure
- Localized Wear Resistance (Qualitative Verification)
    - Pavement shall demonstrate resistance to surface damage under simulated localized pivoting, dragging, or rolling loads representative of pedestrian-area use and routine maintenance activities.

D. Accelerated Weathering / Ultraviolet (UV) Resistance
- Accelerated Weathering Test Method:
    - ASTM G154 (UV Fluorescent Apparatus) or
    - ASTM G155 (Xenon Arc Apparatus)
- Exposure Duration:
    - Minimum 2,000 hours accelerated exposure
- Acceptance Criteria:

- No visible surface cracking, embrittlement, or binder breakdown
- No loss of aggregate bond or surface cohesion
- No measurable reduction in flexibility affecting serviceability
- Maximum color change (ΔE): ≤ 5.0, where color stability is evaluated

E. Flexibility / Deflection Capacity

- Test Method**:** PRI TM-025 beam deflection test or approved equivalent
- Acceptance Criteria**:**
  - Minimum mid-span deflection capacity: ≥ 3.0 mm without cracking or surface rupture
  - Elastic recovery: ≥ 90 percent recovery after load removal
  - No visible cracking, delamination, or permanent deformation after testing

F. Rutting / Permanent Deformation Resistance

- Test Method: Hamburg Loaded Wheel Tester (TXDOT 242-F or equivalent)
- Test Conditions:
  - Water bath temperature: 50°C (122°F)
  - Minimum load cycles: 8,000
- Acceptance Criteria:
  - Maximum rut depth: ≤ 2.5 mm at completion of test
  - No stripping, raveling, binder breakdown, or structural instability
  - No evidence of progressive deformation beyond initial conditioning

G. Static Creep Resistance

- Test Method: ASTM D2990 (Static Creep and Creep Rupture of Plastics) or approved equivalent method adapted for composite pavement materials
- Acceptance Criteria:
  - Maximum permanent strain: ≤ 2.0 percent under sustained design load
  - Elastic recovery: ≥ 90 percent upon removal of load
  - No cracking, delamination, or binder separation following test completion

H. Resilient Modulus

- Test Method: ASTM D7369 (Resilient Modulus of Asphalt Mixtures by Indirect Tension Test) or approved equivalent method adapted for composite porous pavement materials
- Acceptance Criteria:
  - Minimum resilient modulus sufficient to distribute anticipated pedestrian and maintenance-vehicle loads without distress
  - Indicative minimum resilient modulus: ≥ 250 MPa, unless otherwise approved by the Engineer based on documented performance data
  - Pavement shall demonstrate stable modulus values over repeated loading cycles without progressive degradation

Clarifying Statement

The Basis-of-Design porous flexible pavement system is Flexi-Pave, manufactured by Capitol Flexi-Pave, LLC. The system consists of twelve (12) standardized mix design families and a structured binder classification matrix as well as 21,658 standard color combinations derived from controlled rubber, aggregate, and modifier configurations within the parametric mix design framework established in this specification, and as defined in Tables 2.02.B-1, 2.02.B-2, and 2.05-1.

Compliance with the performance criteria of this specification is achieved through a complete, system-based design incorporating:

- Defined mix family selection and thickness codes
- Season-specific polyurethane binder classifications
- Blended rubber and angular, triple-washed, kiln-dried aggregate components
- Engineered base depths and reinforcement per Table 2.02.B-2
- Non-woven geotextile separation and geogrid reinforcement
- Dowel connections at rigid interfaces
- Chamfered or restrained edges as required
- Flexible load-distribution behavior consistent with porous pavement design

Systems that rely on decorative resin-bound or epoxy-based aggregate matrices, rounded or uniform aggregates lacking angular interlock, single-lift construction without structural reinforcement, binder systems limited to a single chemistry or seasonal formulation, or crumb rubber outside the specified 1–5 mm range shall not be considered equivalent where long-term structural performance, color stability, arboricultural compatibility, and year-round installation capability are required.

Proposed approved equals must demonstrate equivalency to the complete system architecture defined in this specification and shall not be evaluated solely on appearance or isolated laboratory test data. Equivalency shall require documented compliance with mix family structure, binder classification breadth, structural matrix alignment, reinforcement requirements, and color availability consistent with the Basis-of-Design system.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

Porous flexible pavement (PFP) materials shall be manufactured by a firm that is primarily and continuously engaged in the dedicated manufacture of porous flexible paving materials, and that directly produces and controls the specialty rubber and

aggregate components incorporated into the system. Manufacturers whose business model relies on purchasing, re-wholesaling, rebranding, relabeling, brokering, or assembling rubber or aggregate materials produced or processed by third-party commodity suppliers shall not be considered qualified. The manufacturer shall demonstrate that it is the actual producer, exercising direct control over raw material selection, processing, washing, drying, coloring, inventory management, and quality assurance of all critical porous flexible pavement components supplied for the Work. All material production and handling practices referenced in this section shall be consistent with, and further governed by, the applicable requirements of Part 2 – Products, without restatement herein. Manufacturer shall demonstrate that all mix families, modifiers, thickness codes, and color options shown in Section 2.02 are routinely produced and supported by active inventory and production capacity.

1. Rubber Manufacturing, Coloring Capability, and Production Reliability
The manufacturer shall possess and operate in-house facilities, equipment, and process control necessary to produce architectural-grade colored crumb rubber specifically for porous flexible pavement applications. Manufacturer qualifications shall include:

- Ownership and operation of batch or continuous color-mixing equipment specifically designed to uniformly coat 1–5 mm crumb rubber particles with integral pigments.
- Use of controlled mechanical mixing systems capable of achieving complete and consistent pigment encapsulation of individual rubber particles, not surface dusting or post-coating.
- Ownership and operation of a drying trommel, rotary dryer, or equivalent thermal processing system as part of the rubber coloring process to stabilize pigments and produce a free-flowing finished product suitable for polyurethane binder adhesion.
- Maintenance of an in-house inventory of standard bulk colorants and pigments, sufficient to produce standard rubber color offerings on demand and year-round, without reliance on third-party pigment manufacturing lead times after receipt of an order.
- Ability to maintain batch-to-batch color consistency, repeatability, and inventory control across multiple production runs.
- Manufacturer shall demonstrate that colored crumb rubber production is a routine, continuous operation, not an intermittent or special-order process.

Manufacturers that purchase pre-colored rubber, outsource rubber coloring operations, or rely on commodity rubber or pigment suppliers to intermittently retool production lines shall not be considered qualified.

2. Rubber Color Availability and Range

- Manufacturer shall maintain a minimum inventory of fifty (50) standard rubber colors suitable for architectural, landscape, and municipal applications.
- Manufacturers offering fewer than fifty (50) standard rubber colors shall not be considered admissible as approved equals.
- A complete manufacturer rubber color chart shall be submitted in accordance with Section 1.06 – Submittals.

3. Aggregate Manufacturing Capability, Equipment Ownership, and Color Availability
In addition to meeting the technical aggregate requirements of Section 2.04, the manufacturer shall demonstrate direct manufacturing control, equipment ownership, and inventory depth sufficient to support architectural porous flexible pavement applications. Manufacturer qualifications shall include:

- Ownership and operation of in-house aggregate processing equipment, including the dedicated washing trommels, drying trommels, rotary kiln dryers, or equivalent systems required to meet the washing and drying requirements of Sections 2.04(D) and 2.04(E).
- Direct control over aggregate sourcing, processing, washing, drying, and storage; subcontracted or outsourced aggregate washing or drying operations shall not be acceptable.
- Operation of dedicated facilities capable of producing clean, angular, kiln-dried aggregates suitable for porous flexible pavement.
- Maintenance of a minimum inventory of fifty (50) standard aggregate colors, textures, or mineral blends suitable for architectural paving applications.
- Ability to supply aggregates in consistent color, gradation, cleanliness, and quality across multiple production runs and project phases.
- Aggregate color availability shall be routine and stock-based, not limited to special-order or project-specific sourcing.

Manufacturers unable to demonstrate both ownership and operation of aggregate processing equipment and meaningful aggregate color breadth shall not be considered approved equals.

4. Aggregate Storage, Handling, and Production Control

- Washed and dried aggregates shall be stored indoors in controlled environments immediately following processing.
- Outdoor stockpiling of washed or dried aggregates shall not be permitted.
- Manufacturer shall maintain documented procedures to prevent moisture reabsorption, humidity exposure, contamination, and color cross-contamination prior to shipment and use.
- Aggregate production, storage, and handling practices shall be consistent with Section 2.04 and subject to verification during submittal review.

B. Domestic Manufacturing & Material Origin Compliance
Where applicable, porous flexible pavement materials shall comply with:

- Buy American Act (BAA)
- Build America, Buy America Act (BABA)
- Applicable federal, state, or municipal domestic preference requirements

For projects subject to domestic sourcing requirements:

1. All rubber, aggregate, binder, geotextile, and geogrid components shall be:
    - Manufactured in the United States, and
    - Produced from raw materials sourced and processed in the United States in compliance with governing statutes.
2. Final mixing, blending, coloring, washing, drying, and binder formulation shall occur within the United States.
3. Reliance on foreign-manufactured raw materials, foreign binder resins, or foreign aggregate and pre-colored rubber shall not be permitted where domestic preference laws apply.
4. Manufacturers operating solely as U.S. distributors of foreign-manufactured systems shall not satisfy domestic manufacturing requirements.

Manufacturer shall provide written certification of domestic manufacturing compliance, including identification of:

- Manufacturing facility locations
- Raw material sourcing locations
- Processing and assembly locations

Failure to provide documentation demonstrating compliance shall constitute grounds for rejection.

C. Installer Qualifications

Installation of porous flexible pavement (PFP) shall be performed only by firms that can demonstrate manufacturer-certified training, documented recent production volume, and a primary business focus on porous flexible pavement installation, consistent with the scope of the Work. Self-asserted experience, incidental installation history, general construction background, or familiarity with superficially similar materials shall not be considered sufficient.

1. Manufacturer-Certified Training

- Installation crews shall be led by personnel who have been trained directly by the manufacturer of the porous flexible pavement materials supplied for the Work.
- Manufacturer-issued training certificates shall:
    - Identify the individual(s) trained, not merely the company
    - Be current and applicable to the materials, systems, and procedures specified
- Personnel lacking manufacturer-certified training shall not be permitted to direct, supervise, or lead installation activities.

2. On-Site Manufacturer-Trained Personnel Requirement

- A minimum of one (1) manufacturer-trained individual, holding a valid manufacturer-issued training certificate, shall be present on site at all times during:
    - Mixing
    - Placement
    - Finishing
    - Curing
- Absence of a manufacturer-trained individual during any phase of placement or curing shall constitute cause for rejection of the Work.

3. Documented Recent Installation Experience

Installer shall demonstrate recent, verifiable production experience, not historical or intermittent activity.

- Installer shall document installation of porous flexible pavement within the twelve (12) months immediately preceding the bid or proposal date.
- Installer shall demonstrate a minimum of twenty-five thousand (25,000) square feet of porous flexible pavement installed during that twelve-month period.
- Documentation shall include, at a minimum:
    - Project names and locations
    - Installation dates
    - Square footage installed per project
    - Identification of manufacturer-trained personnel who led the work
    - Client or Owner organization name
    - Client or Owner contact person
    - Telephone number and email address for each referenced project
- Installers unable to demonstrate this minimum recent production volume, or unwilling to provide verifiable client contact information, shall not be considered qualified, regardless of prior historical experience.

4. Primary Trade and Business Focus Requirement

- Installation of porous flexible pavement shall be the primary line of work performed by the installer.
- Firms whose principal business is landscaping, concrete, asphalt paving, general contracting, or other construction trades—and that perform porous flexible pavement installation only occasionally or as an ancillary service—shall not be considered qualified.
- Installer shall demonstrate that porous flexible pavement installation constitutes the core, recurring business activity, supported by staffing, equipment, and documented production volume.
- This requirement is intended to ensure that installation is performed by firms with the depth of experience necessary to satisfy the performance, durability, arboricultural, and warranty requirements of porous flexible pavement systems.

5. Integrated Arboricultural Expertise

Porous flexible pavement is primarily intended for use in and around trees, including installations within root zones where preservation of existing trees and their root systems is a fundamental design objective. Accordingly, all porous flexible pavement installations shall be performed with integrated arboricultural oversight provided by an ISA Certified Arborist who is a full-time employee of the installer performing the Work. Use of independent consultants, subcontracted arborists, temporary personnel, or 1099 arrangements shall not be permitted to satisfy this requirement. The installer-employed ISA Certified Arborist shall:

- Be a full-time, W-2 employee of the installing firm
- Be integrally involved in porous flexible pavement operations, not retained solely for inspection or advisory purposes
- Possess demonstrated expertise in:
    - Tree protection during construction
    - Root system physiology and response to disturbance
    - Non-invasive excavation techniques, including air excavation
    - Root protection and preservation methods

The ISA Certified Arborist shall have direct authority and responsibility for tree-related aspects of the Work, including:

- Review and approval of installation methods prior to construction
- Direction of non-invasive excavation and root-zone preparation activities
- Continuous on-site involvement during work affecting soils and roots
- Authority to modify or halt installation activities that pose a risk to tree health or survivability
- Verification that construction practices align with the intent of porous flexible pavement: to preserve tree roots and support long-term tree life

Indiscriminate root pruning, mechanical excavation within root zones, or construction practices that compromise tree health shall not be permitted. Work performed without continuous involvement of a full-time, installer-employed ISA Certified Arborist shall be considered non-compliant and subject to rejection.

D. Mock-Ups / Field Samples

- Mock-up shall include the project's proposed mix design and the representative color finish. Where multiple colors are proposed, mock-up shall demonstrate the full intended appearance range and transitions.

E. Workmanship Criteria and Acceptance Standards

Completed porous flexible pavement Work shall meet all of the following workmanship criteria to be accepted:

1. Thickness: Installed thickness shall conform to Contract Documents and approved mix design. No area shall be deficient beyond manufacturer tolerances.
2. Monolithic Construction: Pavement shall be continuous and monolithic, free of cold joints, segregation, delamination, or loose zones.
3. Surface Uniformity: Surface shall be uniform in texture and appearance with no tearing, pull marks, screed ridges, or excessive open voids.
4. Edge and Transition Quality: Edges and transitions shall be neat, properly supported, and free of raveling or crumbling.
5. No Raveling or Sloughing: Surface shall exhibit no aggregate loss, sloughing, or binder separation under normal pedestrian and maintenance-vehicle use.
6. Drainage Performance: Pavement shall freely infiltrate water without persistent surface ponding attributable to the surface course.
7. Curing and Protection: Pavement shall show no damage resulting from premature traffic, contamination, or improper protection during cure.
8. Color Conformance: Installed color shall match approved submittals. Blotching, banding, or inconsistent coloration shall be cause for rejection.
9. Tree Protection Compliance: All work within CRZs shall comply with approved arborist-directed methods. Indiscriminate root pruning, mechanical excavation, or soil compaction within CRZs is prohibited and constitutes non-compliant work.
10. ADA Compliance: All work shall comply with maximum 2% side slopes & 5% running slopes.
11. Edge Treatment: All work shall maintain consistently formed 45-degree beveled edges unless bound by another edge treatment such as concrete, brick, steel, etc.

Rejected Work shall be removed and replaced at no additional cost to Owner.

F. Warranty

Provide a minimum five (5) year warranty covering materials and workmanship.

Optional Extended Warranty

Provide an optional extended warranty of thirty-five (35) years to be provided when the Owner elects to participate in a manufacturer-administered extended warranty program that includes:

- Annual inspections by manufacturer-approved personnel
- Periodic surface overspray applications, where recommended
- Payment of associated inspection and maintenance fees

Extended warranty eligibility is contingent upon compliance with manufacturer requirements and payment of associated fees. Warranty shall remain valid only when Work is performed by a qualified installer meeting Section 1.05(B) requirements and when installation, protection, and use limitations are followed.

1.06 Submittals

Domestic Manufacturer & Material Origin Certification

Submit a manufacturer certification letter on manufacturer letterhead certifying that materials supplied for the project comply with this specification and include:

- Buy American / domestic origin certification identifying manufacturing and raw material sourcing locations
- Bill of lading documentation confirming domestic production and that all materials were shipped directly from an approved manufacturer, as proof of origin and supply-chain compliance

Installer and Arborist Credentials
- Manufacturer training certificates identifying named individuals leading the installation crew
- ISA Certification documentation for the full-time, installer-employed arborist

Mix Design Submittal
In accordance with Section 2.02.B, submit project-specific mix design(s) and schematic construction detail including:
- Mix family
- Thickness code
- Modifier stacking (if applicable)
- Color selection(s)
- Rubber and aggregate proportions
- Wear course and base course depths
- Binder type(s) for each course
- Geotextile fabrics
- Geogrids
- Edge treatments
- Base aggregate depth(s) & material

Color Submittals
- PDF color chart demonstrating at least fifty (50) standard pavement colors available
- Physical sample board demonstrating at least fifty (50) standard pavement colors

Pour Stop, Joint, and Doweling Plan
Submit a plan indicating:
- Placement sequencing and pour limits
- Pour stops and cold joint locations
- Planned joints and terminations
- Curing and protection sequencing
- Dowels between porous flexible pavement and adjacent pavements, to maintain alignment and edge integrity

PART 2 – PRODUCTS
2.01 BASIS OF DESIGN / MANUFACTURER
A. Basis of Design
Porous flexible pavement system shall be Flexi-Pave Porous Flexible Pavement, as manufactured by Capitol Flexi-Pave, LLC., or an approved equal meeting all requirements of this specification.

APPROVED MANUFACTURER:
Capitol Flexi-Pave, LLC
202.760.1099 DC Office
571.383.7000 Virginia Plant
512.500.8780 Texas Office
409.515.4463 Texas Plant
www.capitolflexipave.com
sales@capitolflexipave.com

The Basis of Design establishes minimum performance, material quality, manufacturing control, color availability, arboricultural compatibility, and long-term durability requirements.

B. Manufacturer
- Manufacturer shall comply with Section 1.05(A) – Manufacturer Qualifications.
- Manufacturer shall be the actual producer of the porous flexible pavement materials supplied, including:
    - Specialty colored crumb rubber
    - Triple washed and kiln dried aggregate
- Re-wholesalers, re-branders, distributors, or brokers of third-party materials shall not be considered manufacturers for purposes of this specification.

C. Approved Equal Requirements
Proposed approved equals shall demonstrate compliance with all applicable domestic manufacturing requirements. Systems manufactured outside the United States or distributed domestically but manufactured abroad shall not be considered equivalent where domestic preference statutes apply. Proposed approved equals shall demonstrate full compliance with all requirements of this specification as well as to demonstrate an equivalent documented parametric system including defined mix families, modifier controls, thickness coding, structural loading matrix, and color breadth comparable to Section 2.02.B, including but not limited to:

1. Manufacturing Control
    - Direct manufacture of rubber and aggregate components
    - Triple washing and kiln drying of aggregate

- Defined moisture control limits
- Supply-chain transparency with bills of lading

2. Material Composition
   - Blended rubber and aggregate porous flexible pavement system
   - Typical mix designs incorporating rubber and aggregate in proportions consistent with pedestrian and tree-adjacent applications
3. Color Capability
   - Minimum fifty (50) standard rubber colors
   - Minimum fifty (50) standard aggregate colors
   - Availability of additional custom colors derived from internationally recognized color systems (e.g., RAL)
   - Submission of PDF color chart and physical sample board as specified in Section 1.06
4. Performance Compliance
   - Compliance with all performance criteria specified in Section 1.04
   - Demonstrated long-term permeability without mechanical vacuuming
   - Flexibility suitable for tree-root interaction
5. Installer and Arboricultural Integration
   - Availability of manufacturer-certified installers meeting Section 1.05(B)
   - Integration with full-time, installer-employed ISA Certified Arborists
   - Demonstrated use of non-invasive root preservation techniques

Failure to meet any requirement of this specification shall constitute grounds for rejection as an approved equal.

D. Substitution Timing

Requests for substitution shall be submitted in accordance with Division 01 requirements and shall include all documentation required under Sections 1.05 and 1.06. Substitution requests submitted after the bid period or lacking complete documentation shall not be considered

2.02 POROUS FLEXIBLE PAVEMENT SYSTEM DESCRIPTION

A. General Description

Porous flexible pavement (PFP) shall consist of a monolithic, porous, flexible paving system composed of blended rubber and mineral aggregate bound together with a flexible polyurethane binder.

The system shall be designed to:

- Support pedestrian and trail use
- Preserve and protect tree root systems
- Accommodate soil movement and root growth
- Allow rapid vertical infiltration of surface water
- Maintain long-term permeability without mechanical vacuuming

PFP is not a decorative topping, resin-bound aggregate overlay, or rigid pavement substitute.

B. Flexi-Pave Mix Design Nomenclature & Parametric System Matrix

Flexi-Pave porous flexible pavement systems are provided as standardized, pre-engineered mix families. Each mix designation identifies material composition, allowable modifiers, thickness, binder classification, hardness level, and intended functional application category. The governing mix families and allowable modifiers are defined in **Table 2.02.B-1**.

Table 2.02.B-1 – Flexi-Pave Mix Design Families & Modifiers

Mix Family	Allowed Modifiers	Valid Thickness Codes	Mix Name	Binder Class	Pavement Hardnes Level	Mix Rates	Typical Applications	Expansion Joints Required	Available Colors
HD####	X, T	1000–10000	Flexi-Pave Heavy Duty SBR/Aggregate	Firm	●●●●	50% SBR Rubber / 50% Aggregate	Sidewalks, trails, tree pits/surrounds, CRZ's	N	92
HDA####	X, T, A	1000–10000	Flexi-Pave Heavy Duty SBR/Architectural Aggregate	Firm	●●●●	50% SBR Rubber / 50% Architectural Aggregate	Sidewalks, trails, tree pits/surrounds, CRZ's	N	4600
HDG####	X, T, G	1000–10000	Flexi-Pave Heavy Duty SBR/Glass	Firm	●●●	50% SBR Rubber / 50% Recycled Glass	Sidewalks, trails, tree pits/surrounds, CRZ's	N	4600
HDE####	X, T, E	1000–10000	Flexi-Pave Heavy Duty SBR/EPDM/Aggregate	Firm	●●●●	50% SBR & EPDM Blend / 50% Aggregate	Sidewalks, trails, tree pits/surrounds, CRZ's	N	2116
AS####	X, T, G	1000–8000	Flexi-Pave All-Stone	Firm	●●●●●	100% Architectural Aggregate	Plazas, courtyards, vehicular surfaces	Y	1275
AG####	X, T	1000–8000	Flexi-Pave All-Glass	Firm	●●●●●	100% Recycled Glass	Plazas, courtyards, vehicular surfaces	Y	465
PH####	X, T	1000–6000	Flexi-Pave All-Rubber Firm	Firm	●●●	100% SBR Rubber	Tree pits/surrounds, sport courts, fitness trails & pads	N	92
PHE####	X, T, E	1000–6000	Flexi-Pave All-Rubber SBR/EPDM Firm	Firm	●●●	50% SBR & 50% EPDM Blend	Tree pits/surrounds, sport courts, fitness trails & pads	N	2116
EPH####	X	1000–6000	Flexi-Pave All-Rubber EPDM Firm	Firm	●●●	100% EPDM Wear Course & 100% SBR Base Course	Tree pits/surrounds, sport courts, fitness trails & pads	N	2047
PS####	X	1000–6000	Flexi-Pave All-Rubber SBR Soft	Soft	●●	100% SBR Rubber	Safety surfaces	N	92
PSE####	X, E	1000–6000	Flexi-Pave All-Rubber SBR/EPDM Soft	Soft	●●	50% SBR & 50% EPDM Blend	Safety surfaces	N	2116
EPS####	X	1000–6000	Flexi-Pave All-Rubber EPDM Soft	Soft	●●	100% EPDM Wear Course & 100% SBR Base Course	Safety surfaces	N	2047

No mix outside those shown in Table 2.02.B-1 shall be permitted unless formally submitted and evaluated under the Approved Equal provisions of this specification. Modifiers shall only be used where permitted by the mix family shown. Modifier stacking shall comply strictly with Table 2.02.B-1.

1. Modifier Definitions

Modifiers shall have the following technical meaning:

- **X** – Post-cure overspray to enhance surface integrity/scuff resistance and support extended warranty programs
- **T** – Traction grit integrated into X overspray
- **A** – Architectural aggregate substitution for standard Aggregate (50 additional aggregate colors)
- **E** – EPDM substitution for standard SBR Rubber (23 additional rubber colors)
- **G** – Recycled glass substitution for standard Aggregate (30 additional glass colors)

Modifiers alter material composition and/or surface characteristics but do not alter structural base requirements.

2. Thickness Code Definition
The four or five-digit thickness code (####) incorporated into mix design nomenclature corresponds directly to total installed pavement thickness, as follows:

- 1000 = 1 inch total thickness
- 2000 = 2 inches total thickness
- 3000 = 3 inches total thickness
- 4000 = 4 inches total thickness
- And so forth, in one-inch increments.

Thickness selection shall comply with the structural and loading matrix defined in Table 2.02.B-2 and shall not be reduced for aesthetic or cost considerations.

3. Structural Thickness & Load Application Matrix
Structural thickness, stone base depth, reinforcement configuration, binder classification, and allowable loading categories shall comply with **Table 2.02.B-2**.

Table 2.02.B-2 – Thickness, Base, Loading & Reinforcement Matrix

Pavement Thickness (inches)	Stone Base Thickness (inches)	Pedestrian Use	Bicycles	Golf Carts, Gators, Light-Duty Maint. Vehicles	Passenger Cars & Light Duty Trucks	Medium Duty Trucks	Heavy Duty Trucks	Construction Equipment with Surface Protection per Section 2.09D	Pavement Number of Lift Courses	Base Course Binder Classification per Section 2.05	Wear Course Binder Classification per Section 2.05	Geotextile on existing grade	Geogrid on top of Geogextile	Geogrid interlayers every 4" of stone base	Geogrid on top of stone base	Total layers of geogrid required
2	4	●	◑	○	○	○	○	○	1	-	Aliphatic	●	●	-	○	1
3	6	●	●	◑	○	○	○	○	2	Aromatic	Aliphatic	●	●	1	●	3
4	8	●	●	●	◑	○	○	◑	2	Aromatic	Aliphatic	●	●	1	●	3
6	10	●	●	●	●	◑	○	●	2	Aromatic	Aliphatic	●	●	2	●	4
8	12	●	●	●	●	●	◑	●	2	Aromatic	Aliphatic	●	●	2	●	4
10	16	●	●	●	●	●	●	●	2	Aromatic	Aliphatic	●	●	3	●	5

● Regularly ◑ Intermittent ○ Never

Structural requirements shall not be reduced based on aesthetic selections. Where loading exceeds pedestrian use, thickness and base shall be selected strictly in accordance with Table 2.02.B-2.

4. Vehicular Application Clarification
Flexi-Pave systems are primarily intended for sidewalks, trails, plazas, tree surrounds, and other pedestrian-oriented applications. Vehicular load classifications shown in Table 2.02.B-2 represent engineered system capabilities and are intended for project-specific structural design scenarios where loading requirements are formally defined by the design professional. Vehicular applications are not typical and shall be evaluated on a case-by-case basis in coordination with the manufacturer and the structural requirements of this specification.

5. System Integrity Statement
Selection of mix family, modifiers, thickness code, or color combination does not constitute a custom system.
All configurations remain subject to:

- Performance requirements in Part 1
- Material requirements in Part 2
- Subbase and reinforcement requirements defined herein
- Installation controls in Part 3

Approved equals shall demonstrate equivalency in:

- Mix family structure
- Modifier framework
- Parametric thickness and reinforcement matrix
- Documented color breadth and inventory capability

2.03 RUBBER COMPONENT
A. General
Rubber used in porous flexible pavement shall be a specialty-produced, clean, colored crumb rubber engineered specifically for porous flexible pavement applications. Rubber shall not be derived from commodity rubber mulch, playground surfacing, athletic infill, or other bulk rubber products unless fully reprocessed and certified to meet the requirements of this specification.

B. Material Requirements

1. Particle Size and Gradation
    - Rubber particle size shall be uniformly controlled within the range of 1 mm to 5 mm.
    - Rubber shall be free of oversized particles, fines, fibers, and dust.
    - Particle shape shall promote interlock with aggregate and binder without creating excessive void collapse.
2. Cleanliness and Contaminant Control
    - Rubber shall be free of:
        - Residual steel or wire
        - Textile fibers

        - Oils, greases, or release agents
        - Dust or fines that inhibit binder adhesion
    - Rubber shall be processed using equipment capable of producing consistent, contaminant-free material suitable for architectural paving applications.
3. Coloring
    - Rubber shall be completely encapsulated by permanent non-toxic colored pigments using a batch mixer or continuous mixer dedicated to coloring 1-5 mm SBR crumb rubber.
    - Rubber coloring methods using insufficient quantities of pigments which allow parts of the black underlaying rubber to shine through shall not be permitted.
    - Colored rubber pigments shall demonstrate long-term exterior color stability consistent with binder UV performance requirements defined in Section 2.05.

C. Color Availability

- Manufacturer shall offer a minimum of fifty (50) standard SBR colored crumb rubber colors**.**
- Manufacturer shall demonstrate the capability to produce any additional custom color derived from internationally recognized color systems, including the RAL color chart.
- Rubber limited to a small selection of commodity colors (typically four to eight colors) shall not be considered acceptable.
- Rubber color availability shall be supported by:
    - A PDF color chart
    - A physical sample board as required under Section 1.06

D. Manufacturing Control

- Rubber shall be manufactured directly by the porous flexible pavement manufacturer or under its direct control.
- Rubber shall not be purchased from third-party commodity producers and resold without production disclosure and quality control.
- Manufacturer shall maintain consistent production capability to support:
    - Year-round availability
    - Predictable lead times
    - Project-specific color requirements

E. Storage and Handling

- Rubber shall be stored indoors in a dry, clean environment prior to shipment and use.
- Rubber shall be protected from:
    - Moisture
    - UV exposure prior to installation
    - Contamination during handling and transport

2.04 AGGREGATE COMPONENT

A. General

Aggregate used in porous flexible pavement shall be carefully sourced, processed, washed, dried, and stored specifically for use in porous flexible pavement systems. Aggregate intended for bulk construction uses, outdoor stockpiling, or general-purpose applications shall not be considered acceptable unless fully processed in accordance with this specification.

B. Aggregate Type and Source

1. Material Types
    - Aggregate may consist of one or more of the following, as approved by the manufacturer:
        - Crushed granite
        - Crushed marble
        - Crushed limestone
        - Crushed basalt
        - Crushed travertine
        - Crushed gneiss
        - Crushed glass
        - Other manufacturer approved minerals & aggregates suitable for architectural paving
    - Recycled or industrial by-product aggregates may be permitted only where demonstrated to meet all performance, cleanliness, and durability requirements of this specification.
2. Particle Shape
    - Aggregate shall be angular, crushed, and multi-faceted to promote mechanical interlock and structural stability.
    - Rounded or naturally smooth aggregates (e.g., pea gravel) shall not be permitted.

C. Particle Size and Gradation

- Aggregate particle size shall be nominally between 3 mm to 9.5 mm**.**
- Aggregate shall be well graded within this range to complement the rubber component and binder system.
- Aggregate shall be free of fines, dust, and oversized particles.
- Gradation shall be controlled to support:
    - Porosity and permeability
    - Structural interlock

- Long-term resistance to raveling and deformation

D. Washing Requirements

- Aggregate shall be mechanically washed with water a minimum of three (3) times prior to use.
- Washing shall be performed using a dedicated washing trommel or equivalent continuous mechanical washing system that actively tumbles and agitates the aggregate.
- Washing methods limited to spray-downs, incidental wetting, or single-pass washing shall be considered non-compliant**.**
- Washing shall remove:
  - Fines and dust
  - Surface coatings
  - Clays and silts
  - Organic contaminants

E. Drying Requirements

- Following washing, aggregate shall be kiln dried using a rotary kiln dryer or kiln-integrated trommel system**.**
- Drying equipment shall be capable of achieving consistent, uniform moisture reduction throughout the aggregate mass.
- Aggregate moisture content at the time of mixing shall not exceed 0.25 percent by weight**,** unless otherwise approved by the manufacturer based on documented performance data.
- Aggregate shall be free-flowing and coal-dry at the time of mixing.

F. Storage and Handling

- Washed and dried aggregate shall be stored indoors in a controlled, dry environment immediately following processing.
- Outdoor stockpiling of washed or dried aggregate shall not be permitted.
- Aggregate shall be protected from:
  - Moisture reabsorption
  - Humidity exposure
  - Contamination during storage and transport

G. Manufacturing Control

- Aggregate shall be processed and prepared under direct control of the porous flexible pavement manufacturer**.**
- Reliance on bulk aggregate suppliers without dedicated washing, drying, and indoor storage capability shall not be acceptable.
- Manufacturer shall maintain documentation demonstrating compliance with washing, drying, and storage requirements.

2.05 POLYURETHANE BINDER SYSTEM

A. General

The porous flexible pavement binder shall consist of a moisture-cure polyurethane system specifically formulated for use with washed, kiln-dried architectural aggregates and 1–5 mm colored crumb rubber. Binder selection shall comply with the classification framework defined herein and shall correspond to:

- Mix family selection (Section 2.02.B)
- Pavement lift (base vs. wear course)
- Environmental conditions at time of installation
- Long-term color stability requirements

All binder systems shall meet the performance requirements of this specification, including UV stability, flexibility, adhesion, and cure characteristics.

B. Binder Classification Framework

Polyurethane binders shall be classified according to three parameters:

1. **Firmness**
   - Hard (H)
   - Soft (S)
2. **Binder Type**
   - Amber (A)
   - Clear (C)
3. **Environmental Cure Class**
   - Standard Ambient
   - Hot / Humid
   - Winter Safe

The governing binder classifications shall be as shown in:

Table 2.05-1 – Flexi-Pave Binder Classification Matrix

Binder Name	Firmness	Compound	Color	Intended Use
CFP-HAS001	Hard	Aromatic	Amber	Standard Ambient
CFP-HAH002	Hard	Aromatic	Amber	Hot/Humid Environments
CFP-HAW003	Hard	Aromatic	Amber	Winter Safe
CFP-HCS001	Hard	Aliphatic	Clear	Standard Ambient
CFP-HCH002	Hard	Aliphatic	Clear	Hot/Humid Environments
CFP-HCW003	Hard	Aliphatic	Clear	Winter Safe
CFP-SAS001	Soft	Aromatic	Amber	Standard Ambient
CFP-SAH002	Soft	Aromatic	Amber	Hot/Humid Environments
CFP-SAW003	Soft	Aromatic	Amber	Winter Safe
CFP-SCS001	Soft	Aliphatic	Clear	Standard Ambient
CFP-SCH002	Soft	Aliphatic	Clear	Hot/Humid Environments
CFP-SCW003	Soft	Aliphatic	Clear	Winter Safe

Binders shall be designated using the manufacturer's classification system shown in Table 2.05-1. Equivalent systems shall demonstrate compliance with the same three-axis classification structure.

C. Polymer Type Selection and Color Stability

Amber binders (A) are aromatic polyurethane systems that exhibit natural amber coloration and are subject to ultraviolet-induced color shift commonly referred to as infrared (IR) yellowing.

Due to this characteristic:

- Amber binders are suitable for base course applications where long-term color exposure is not critical.
- Amber binders shall not be used as the exposed wear surface in applications requiring long-term color stability.

Clear binders (C) are aliphatic polyurethane systems formulated for enhanced UV resistance and long-term color retention.

Clear binders shall be used:

- For top wear courses where long-term color integrity is required.
- For light-colored pavement systems.
- For architectural applications where color accuracy is critical.

Light-colored crumb rubber and aggregate systems require significantly higher pigment loading to fully encapsulate black SBR substrate materials. Clear aliphatic binders are necessary to preserve these lighter color formulations and prevent long-term UV discoloration. Binder selection shall ensure that final installed pavement color remains consistent with the approved submittal samples.

D. Environmental Cure Classification

Binder environmental class shall be selected based on installation conditions.

Environmental classifications shall include:

- Standard Ambient Conditions
- Hot / High Humidity Conditions
- Winter Safe / Low Temperature Conditions

Winter Safe binder systems shall be formulated to cure effectively in low-temperature conditions (30s–50s °F), provided subgrade is not frozen and ambient temperatures are above freezing and rising. Binder systems shall not be limited to a single seasonal formulation. Manufacturers proposing approved equals shall demonstrate availability of season-specific binder systems sufficient to support year-round installation consistent with Section 3.01.

E. Firmness Selection

Firmness classification (Hard vs. Soft) shall align with:

- Mix family hardness level (Table 2.02.B-1)
- Intended application
- Structural and wear requirements

F. Approved Equal Requirements – Binder System

Proposed equivalent binder systems shall demonstrate:

- Equivalent firmness classification
- Equivalent binder type classification (Amber and Clear availability)
- Equivalent environmental cure classifications supporting year-round installation
- UV stability minimum five (5) years
- Compatibility with mix families defined in Section 2.02
- Cure behavior consistent with Sections 3.01, 3.04, and 3.05

Systems limited to a single binder chemistry, single seasonal formulation, or lacking clear UV-stable wear course capability shall not be considered equivalent.

2.06 MIX DESIGN SELECTION AND CONFIGURATION

A. General

Porous flexible pavement shall be supplied using manufacturer-developed mix designs selected from the approved mix families defined in Section 2.02.B, Table 2.02.B-1. Mixes shall not be custom-formulated outside the defined family and modifier structure

unless formally submitted and approved under the substitution provisions of this specification. Mix designation submitted shall identify:

- Mix family
- Thickness code (####)
- Modifier stacking (if applicable)
- Binder classification per Section 2.05
- Color selections

B. Component Proportions

Mix proportions shall conform to the parameters of the selected mix family.

- Rubber particle size: 1 mm to 5 mm (Section 2.03)
- Aggregate particle size: 3 mm to 9.5 mm (Section 2.04)
- Binder ratio: Maintain dry ingredient to binder ratio between 9.6:1 and 12:1 by weight
- Binder shall fully coat particles without excessive pore fill

Component adjustments outside the defined family structure shall not be permitted without formal approval.

C. Structural Application Alignment

Mix family and thickness code selection shall comply with:

- Structural loading classifications in Table 2.02.B-2
- Base depth requirements in Table 2.02.B-2
- Reinforcement requirements in Table 2.02.B-2
- Tree-adjacent requirements in Part 3

Application descriptions (sidewalk, trail, plaza, tree pit, etc.) are descriptive only. Structural design shall govern.

D. Thickness

Installed thickness shall correspond to the selected four-digit thickness code defined in Section 2.02.B. Thickness shall not be reduced for aesthetic or cost considerations.

E. Surface Treatments and Oversprays

Oversprays and surface modifiers shall be limited to those permitted in Table 2.02.B-1. Overspray application shall:

- Not reduce permeability
- Align with binder classification per Section 2.05
- Be compatible with selected mix family
- Utilize aliphatic binders to prevent IR Yellowing and pavement color change after application

F. Submittals

For each mix design proposed, submit:

- Mix family designation
- Thickness code
- Modifier stacking
- Binder classification per Section 2.05
- Rubber and aggregate colors
- Reinforcement configuration
- Edge treatment including dowel connection details

Submittals not aligned with Section 2.02.B shall be rejected.

2.07 VENTED ROOT AERATION MATTING (vRAM / TreeRAM)

This section purposefully left blank.

2.08 GEOTEXTILES AND GEOGRIDS

A. General

Geotextile and geogrid reinforcement requirements shall comply with Table 2.02.B-2 and shall not be omitted except as specifically permitted by the manufacturer based on documented site conditions. These materials are required to:

- Separate base materials from underlying soils
- Prevent migration of fines
- Reduce rutting and differential settlement
- Distribute loads over sensitive or variable subgrades
- Protect pavement from damage due to misuse and abuse

Geotextiles and geogrids are integral system components and shall not be omitted without manufacturer approval in writing.

B. Geotextile Fabric

1. Type and Material
    - Geotextile fabric shall be non-woven, needle-punched geotextile suitable for separation, filtration, and stabilization beneath porous pavement systems.
    - Basis of Design: Mirafi® 140N or approved equivalent.
    - Fabric shall be permeable and compatible with porous flexible pavement and tree-adjacent applications.

2. Performance Requirements
    - Geotextile shall:
        - Allow vertical and lateral movement of water and air
        - Prevent migration of fines into base layers
        - Maintain integrity under installation and service conditions
    - Impermeable, woven or film-backed fabrics shall not be permitted.
3. Placement and Installation
    - Geotextile shall be placed between subgrade soils and base materials.
    - Adjacent sections shall overlap a minimum of twelve (12) inches**.**
    - Fabric shall be secured to the subgrade using minimum 8-inch landscape nails or approved equivalent fasteners.
    - Fabric shall be installed smooth and free of wrinkles, tears, or damage.

C. Geogrid Reinforcement

1. Type and Material
    - Geogrid shall be a triaxial or biaxial polymer grid designed for load distribution and soil reinforcement.
    - Basis of Design: Tensar® TriAx® Geogrid or approved equivalent.
    - Geogrid shall be compatible with porous flexible pavement base assemblies and tree-adjacent installations.
2. Performance Requirements
    - Geogrid shall:
        - Distribute loads and reduce stress on underlying soils
        - Minimize rutting and deformation
        - Support pedestrian and maintenance-vehicle loading conditions
    - Geogrid shall not restrict drainage or soil aeration.
3. Placement and Installation
    - Geogrid placement and number of layers shall comply with Table 2.02.B-2 based on selected thickness code, base depth, and loading classification.
    - Adjacent sections shall overlap a minimum of twelve (12) inches**.**
    - Geogrid shall be secured using sod staples or approved equivalent anchoring methods to prevent movement during base placement.
    - Installation shall be coordinated with subgrade preparation, base thickness, and tree-adjacent requirements.

D. Approved Products

- Geotextiles and geogrids shall be selected and approved by the porous flexible pavement manufacturer.
- Substitutions shall demonstrate equivalent:
    - Permeability
    - Strength
    - Durability
    - Compatibility with tree-adjacent porous pavement installations

2.09 ACCESSORIES AND APPURTENANCES

A. General

Accessories and appurtenances shall be provided as required to:

- Ensure proper interface with adjacent pavements and structures
- Maintain alignment, continuity, and edge integrity
- Protect porous flexible pavement during construction and curing
- Support long-term performance and maintainability

All accessories shall be compatible with porous flexible pavement materials, arboricultural requirements, and manufacturer installation methods.

B. Dowel Bars and Pavement Interfaces

1. Dowel Bars
    - Dowel bars shall be used where porous flexible pavement interfaces with adjacent pavements, including concrete, asphalt, unit pavers, or similar rigid or semi-rigid materials.
    - Dowel bar spacing and embedment shall be coordinated with the selected thickness code and structural configuration in Table 2.02.B-2.
    - Dowel bars shall consist of one of the following:
        - Stainless steel rods
        - Fiberglass rods
        - Epoxy-coated reinforcing steel
    - Dowel bars shall:
        - Maintain alignment between pavement systems
        - Reduce differential settlement and edge movement
        - Be resistant to corrosion and suitable for exterior use
        - Not be affixed in place with epoxy or other adhesives
    - Dowel spacing shall be a minimum of twelve (12) inches and a maximum of eighteen (18) inches on center**,** unless otherwise approved by the manufacturer.

    - Dowel diameter, embedment depth, and installation method shall be coordinated with adjacent pavement design and approved by the manufacturer.
2. Interface Preparation
    - Adjacent pavements shall be clean, sound, and properly prepared prior to placement of porous flexible pavement.

C. Edge Conditions and Terminations

- Edge restraints are not required for porous flexible pavement when installed in accordance with the selected mix family and thickness code defined in Section 2.02.B.
- Where non-standard edge detailing is required, details shall be approved by the manufacturer.
- Edges shall not be formed at 90˚ unless abutted by an adjacent material such as metal, concrete, stone, etc.
- Edges without adjacent hardscape shall be constructed with a 45˚ chamfer to prevent raveling, separation, undermining, or loss of surface integrity.

D. Protection Materials for Traversing

- Temporary protection materials shall be provided as required to prevent damage to porous flexible pavement during crossings by construction equipment.
- Acceptable protection methods include:
    - Plywood Protection:
        - Two (2) layers of 3/4-inch plywood, stacked with panels oriented in alternating directions to distribute loads
    - Resin-Based Ground Protection Mats:
        - AlturnaMats®, DuraMats®, or approved equivalent resin-based weight-distribution mats
- Protection materials shall:
    - Distribute loads to prevent surface damage or deformation
    - Be carefully installed and removed by hand, in accordance with manufacturer requirements
    - Not trap debris, or contaminants against the pavement surface
- Construction equipment shall not operate directly on porous flexible pavement without approved protection in place.
- Protection measures shall be consistent with the loading classifications and surface protection requirements identified in Table 2.02.B-2.

E. Sealers and Coatings

- Sealers or coatings shall not be applied unless expressly approved by the manufacturer.
- Approved surface oversprays shall be limited to those permitted by the selected mix family and modifier configuration defined in Table 2.02.B-1 and shall comply with Section 2.05 binder classification requirements.

F. Miscellaneous Materials

- Miscellaneous materials required for proper installation, including forms, fasteners, and joint materials, shall be compatible with porous flexible pavement and approved by the manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION & SITE CONDITIONS

A. Verification of Site Conditions

Prior to commencement of porous flexible pavement installation, the Installer shall examine the site and verify that conditions are suitable for execution of the Work in accordance with the Contract Documents.
Installation shall not proceed until all the following conditions are confirmed:

- Site grades, elevations, and limits of Work are as shown on the Drawings
- Subgrade conditions are suitable to receive base materials
- Tree locations and Critical Root Zones (CRZs) are identified and protected
- Approved submittals identifying selected mix family, thickness code, modifier configuration, and binder classification per Sections 2.02.B and 2.05 are available on site.
- Required arboricultural oversight is present

B. Tree Identification and Root Zone Protection

Porous flexible pavement is primarily intended for use in and around trees. Accordingly:

- All trees within or adjacent to the Work area shall be identified prior to construction.
- The limits of the Critical Root Zone (CRZ) for each tree shall be clearly delineated in the field.
- Indiscriminate root pruning is prohibited.
- Excavation within CRZs shall be performed only using non-invasive methods, including SSAT (Supersonic Air Tool) and/or directional root pinning (DRP), under the direction of the installer-employed ISA Certified Arborist.
- Any condition that would require mechanical excavation or root cutting within CRZs shall be reported immediately and Work halted until direction is provided.

C. Existing Conditions and Conflicts

Installer shall identify and report any conditions that may adversely affect installation or long-term performance, including but not limited to:

- Unsuitable soils or excessive moisture

- Unexpected utilities, structures, or obstructions
- Conflicts between Drawings and existing site conditions
- Conditions that may compromise tree health or survivability

Work shall not proceed until such conditions are reviewed and resolved.

D. Subgrade Acceptance

- Subgrade shall be firm, stable, unfrozen, and free of standing water, mud, ice, frost, snow, or loose material.
- Subgrade shall be prepared to receive base depths corresponding to the selected thickness code and loading classification defined in Table 2.02.B-2.
- Porous flexible pavement shall not be installed over frozen subgrade or base materials.
- Subgrade conditions shall be reviewed and accepted by:
    - Installer
    - Manufacturer's representative (as required)
    - Installer-employed ISA Certified Arborist
- Acceptance of subgrade conditions shall be documented prior to base installation.

E. Weather Conditions

- No porous flexible pavement shall be installed when ambient or surface temperatures are at or below freezing (32°F / 0°C).
- Installation shall occur only when temperatures are above freezing and rising, with no forecasted freezing conditions during the curing period.
- High temperature and high humidity conditions shall require use of a manufacturer-approved binder formulation specifically designed for hot and/or humid conditions to ensure proper working time, placement, and cure.
- Low-temperature installations, including work performed in the 33°F to 50°F range, shall require use of a manufacturer-approved winter-safe binder system incorporating accelerators to ensure adequate curing occurs prior to the return of freezing temperatures.
- Binder selection shall be project- and condition-specific and shall be approved by the manufacturer prior to installation.
- Binder classification shall comply with Section 2.05 and correspond to environmental cure class appropriate for prevailing and forecasted conditions.
- Installation shall not proceed if weather conditions are expected to prevent proper placement, curing, or performance of the pavement system.

F. Commencement of Work

Commencement of porous flexible pavement installation shall constitute acknowledgment that:

- Site conditions are acceptable
- Tree protection measures are in place
- Subgrade and base conditions meet specification requirements
- Appropriate binder classification per Section 2.05 has been selected for prevailing and forecasted weather conditions.
- Installer is prepared to execute the Work in full compliance with the Contract Documents

Claims related to conditions that could have been identified during examination shall not be accepted after installation begins.

3.02 PROTECTION OF EXISTING TREES & SITE FEATURES

A. General

Porous flexible pavement is installed primarily to preserve existing trees and their root systems. Protection of trees and associated soils shall take precedence over construction convenience or sequencing. Failure to comply with this section shall constitute cause for immediate suspension of Work.

B. Tree Protection Fencing (TPF)

- Tree Protection Fencing shall be installed around trees where fencing is feasible and where site access allows.
- TPF shall:
    - Enclose the Critical Root Zone (CRZ) to the maximum extent practicable
    - Be installed prior to commencement of any site work
    - Remain in place until completion of porous flexible pavement installation
- Fencing shall be highly visible and sturdy enough to prevent encroachment by personnel, equipment, or materials.
- No storage of materials, spoil, equipment, or debris shall be permitted within fenced areas.

C. Root Protection Matting (RPM)

Where Tree Protection Fencing cannot be installed due to access requirements, Root Protection Matting (RPM) shall be provided.

- RPM shall be installed over CRZs anticipated to receive construction traffic or access during the course of work to:
    - Prevent soil compaction
    - Prevent rutting
    - Prevent contamination from construction activities
- RPM shall be installed in accordance with manufacturer recommendations and arborist direction.
- RPM shall remain in place for the duration of construction activities affecting the protected area.

D. Access and Traffic Restrictions

- Construction traffic within CRZs shall be strictly limited.

- Only pedestrian access or maintenance vehicles approved by the installer-employed ISA Certified Arborist shall be permitted.
- Construction equipment is prohibited from operating within CRZs unless approved protection measures are in place and approved by the arborist.

E. Prohibited Activities
The following activities are strictly prohibited within CRZs and tree protection areas:
- Mechanical excavation
- Indiscriminate root pruning
- Soil compaction by equipment or stockpiling
- Storage of materials, fuels, or chemicals
- Washing out concrete or tools
- Disposal of waste or debris

F. Enforcement Authority
- The installer-employed ISA Certified Arborist shall have authority to:
    - Monitor compliance with tree protection requirements
    - Direct modifications to construction practices
    - Order immediate cessation of Work when tree protection measures are violated
- Work shall not resume until violations are corrected and approved.

G. Protection of Other Site Features
- Adjacent pavements, utilities, structures, and landscape features shall be protected from damage.
- Damage resulting from inadequate protection shall be repaired or replaced at no cost to the Owner.

3.03 SUBGRADE & BASE PREPARATION
A. General
Subgrade and base preparation shall be performed in a manner that:
- Preserves soil structure and permeability
- Prevents compaction within Critical Root Zones (CRZs)
- Provides a stable, well-drained foundation for porous flexible pavement
- Supports long-term tree health and pavement performance

Deviation from these requirements shall be grounds for rejection of the Work.

B. Excavation Methods
- Excavation within or adjacent to CRZs shall be performed using non-invasive methods, including SSAT, under the direction of the installer-employed ISA Certified Arborist.
- Mechanical excavation within CRZs is prohibited.
- Excavation outside CRZs shall be performed in a controlled manner to avoid undermining protected areas.
- Exposed roots shall be protected from desiccation, mechanical damage, and contamination.

C. Subgrade Preparation
- Subgrade shall be shaped to required lines and grades without excessive disturbance.
- Subgrade shall remain uncompacted within CRZs except as expressly approved by the arborist.
- Soft, yielding, or unsuitable soils shall be reported and corrected prior to base installation.
- Subgrade shall be free of standing water, mud, ice, frost, snow, or loose material.

D. Geotextile Installation
- Install non-woven, needle-punched geotextile fabric in accordance with Section 2.08.
- Geotextile fabric shall be placed directly on prepared subgrade.
- Adjacent sections shall overlap a minimum of twelve (12) inches.
- Fabric shall be secured to the subgrade using minimum 8-inch landscape nails to prevent movement during subsequent operations.
- Fabric shall be installed smooth and free of wrinkles, tears, or damage.

E. Geogrid Installation
Geogrid installation shall comply with Section 2.08 and Table 2.02.B-2. Number of layers, placement elevations, and reinforcement configuration shall be based on:
- Selected mix family
- Thickness code
- Base depth
- Loading classification

Geogrid shall be:
- Installed directly over geotextile unless otherwise indicated in the approved structural configuration
- Overlapped a minimum of twelve (12) inches
- Secured with sod staples or approved equivalent anchoring methods

- Installed taut, properly aligned, and free of folds or distortion

Additional reinforcement layers, where required by Table 2.02.B-2, shall be installed at elevations consistent with the approved structural configuration.

F. Base Course Materials

- Base shall consist of clean, open-graded crushed stone, such as AASHTO No. 57 stone, Recycled concrete aggregate (RC-57) or approved equivalent.
- Base materials shall be free of fines, clay, or deleterious material.
- Total base depth shall comply with Table 2.02.B-2 unless otherwise directed by the design professional based on project-specific structural analysis.

G. Base Placement and Compaction

- Place No. 57 / RC-57 stone base materials in maximum 6-inch lifts.
- Each lift shall be compacted using a vibratory plate tamper with a minimum of three (3) passes per lift.
- Compaction within CRZs shall be limited to that necessary to seat base materials and shall be performed only as directed by the installer-employed ISA Certified Arborist.
- Compaction equipment shall be selected to avoid root damage and excessive soil disturbance.
- Finished base shall be level, stable, and uniformly graded prior to placement of porous flexible pavement.

H. Inspection and Acceptance

- Subgrade, geotextile, geogrid, and base installation shall be inspected and accepted by:
    - Installer
    - Manufacturer's representative (as required)
    - Installer-employed ISA Certified Arborist
- Work shall not proceed to pavement placement until base conditions are approved.
- Acceptance shall confirm compliance with Table 2.02.B-2 structural configuration and reinforcement requirements.

3.04 MIXING & PLACEMENT OF POROUS FLEXIBLE PAVEMENT

A. General

Porous flexible pavement shall be mixed, placed, and finished strictly in accordance with:

- Approved mix designation identifying mix family, thickness code, modifier configuration, and binder classification per Sections 2.02.B and 2.05
- Manufacturer requirements
- The specific time, quantity, and handling limitations contained herein

Failure to comply with these requirements shall result in visible defects, loss of performance, and rejection of the Work.

B. Mixing Requirements

- Mixing shall be performed using mechanical mixers capable of producing a uniform blend without segregation.
- Hand mixing is not permitted unless specifically approved by manufacturer.
- Rubber and aggregate shall be dry and free-flowing at the time of mixing.
- Binder classification shall comply with Section 2.05 and correspond to environmental conditions at time of placement.
- Binder Quantity:
    - Binder shall be added at a rate of 1 gallon per 100 pounds of combined rubber and aggregate, unless otherwise approved in writing by the manufacturer.
- Mixing Time:
    - Mixing time shall not exceed one (1) minute per 200-pound batch.
    - Under-mixing and over-mixing are prohibited.
- Mixing shall achieve:
    - Complete coating of rubber and aggregate particles
    - Uniform binder distribution without pooling, premature curing or dry pockets

Material exceeding the maximum mixing time or showing signs of clumping or premature curing shall be discarded.

C. Placement Procedures

- Placement thickness shall correspond to the selected thickness code defined in Section 2.02.B.
- Place porous flexible pavement immediately after mixing**.**
- Working Time:
    - Maximum allowable working time shall be fifteen (15) minutes from completion of mixing.
    - After this period, material shall not be touched, manipulated, tooled, or reworked.
- Material shall be placed to required thickness and grade and shall be:
    - Screeded
    - Bull-floated
    - Troweled to achieve approximately twenty-five percent (25%) relative compaction without closing surface void structure.
- Placement shall proceed continuously to maintain a consistent wet, uncured edge at all times so that subsequent pours fully bond to preceding pours.
- Allowing material edges to cure prior to placement of adjacent material is prohibited.

D. Pour Sequencing and Cold Joints

- Pour sequencing shall follow the approved Pour Stop and Joint Plan submitted in accordance with Section 1.06.
- Where placement must stop, a cold joint shall be prepared using the cold-pour finger-joint method.
- Failure to properly prepare cold joints will result in visible joint lines that remain visible in perpetuity and shall be cause for rejection.
- Unplanned cold joints are prohibited unless approved corrective procedures are implemented.

E. Compaction and Finishing

- Compaction and finishing shall be performed using manufacturer-approved methods only.
- Over-compaction, mechanized troweling, or finishing methods that close surface pores are prohibited.
- Finished surface shall be:
    - Uniform in appearance
    - Free of tearing, drag marks, or displacement
    - Open and porous

F. Repairs and Defects

- No repairs shall be performed during the curing period.
- Footprints, tool marks, surface damage, or abnormalities that occur during curing shall not be patched, rubbed, or reworked.
- Corrective Action:
    - Damaged areas shall be addressed no earlier than the following day.
    - Repairs shall consist of cutting out and removing the entire affected section and replacing it with new porous flexible pavement.
    - Partial patching or surface dressing is not permitted.

G. Interfaces with Adjacent Pavements

- Coordinate placement with adjacent pavement systems.
- Install dowel bars in accordance with Section 2.09.
- Ensure flush, aligned transitions between surfaces.

H. Protection During Placement

- Protection requirements shall comply with Section 2.09.D and Table 2.02.B-2 where applicable.
- Protect base, geotextiles, and geogrids from contamination during placement.
- Prevent tracking of soil, debris, or moisture onto uncured pavement.
- Suspend work during precipitation or adverse conditions.

I. Inspection

- Mixing, placement, and finishing operations shall be observed by:
    - Installer
    - Manufacturer's representative (as required)
    - Installer-employed ISA Certified Arborist where work occurs in or adjacent to CRZs
- Deficient work shall be rejected and removed.

3.05 CURING, PROTECTION & ACCESS RESTRICTIONS

A. General

Porous flexible pavement is a chemically curing system. Once placed, it is highly vulnerable to disturbance until curing is complete. Failure to comply with curing and protection requirements shall result in irreversible surface defects and shall be grounds for rejection and replacement of the Work.

B. Initial Cure Period

- Upon completion of placement and finishing, porous flexible pavement shall be allowed to cure undisturbed for a minimum of twenty-four (24) hours**.**
- During the initial cure period:
    - No foot traffic is permitted
    - No equipment, carts, or maintenance vehicles are permitted
    - No tools or materials shall contact the surface

Disturbance of the surface during the initial 24-hour cure period is prohibited.

C. Protection During Curing

- Binder classification used for the installation shall comply with Section 2.05 and correspond to environmental cure conditions.
- Freshly placed porous flexible pavement shall be protected at all times during curing.
- Protection measures shall include, at a minimum:
    - Temporary barricades
    - Warning signage

    - Physical barriers sufficient to prevent access
- Pavement shall be protected from:
    - Foot traffic
    - Construction traffic
    - Precipitation prior to sufficient cure development
    - Debris, dust, and contamination
- Winter and low-humidity conditions:
    - Protective coverings that trap moisture are required during winter or low-humidity curing conditions, as they aid in proper curing.
    - Coverings shall be installed in a manner that does not mar the surface or suggest texture into the pavement.
- Protection methods shall be approved by the manufacturer.

D. Access Restrictions

- Access restrictions shall align with loading classifications and protection requirements identified in Table 2.02.B-2.
- No access of any kind shall be permitted on porous flexible pavement during the curing period unless expressly approved in writing by the manufacturer.
- Construction equipment is prohibited from operating on uncured pavement.
- Maintenance vehicles shall not access the pavement until curing is complete and acceptance is granted.

E. Post-Cure Access

- Post-cure access shall not exceed the loading classification associated with the selected thickness code per Table 2.02.B-2.
- After the initial curing period and upon approval, limited pedestrian access may be permitted.
- Access by maintenance vehicles shall be permitted only:
    - After manufacturer approval
    - When the surface is protected in accordance with Section 2.09 using:
        - Two (2) layers of 3/4-inch plywood installed in alternating directions, or
        - Approved resin-based weight-distribution mats (e.g., AlturnaMats®, DuraMats®, or equivalent)
- Unprotected access shall void the warranty.

F. Damage During Curing and Repairs

- Footprints, tool marks, surface deformation, contamination, or other damage occurring during curing shall not be repaired during the curing period.
- No rubbing, patching, tooling, or surface manipulation is permitted during cure.
- Corrective Action:
    - Damaged areas shall be addressed no earlier than the following day after initial cure.
    - Repairs shall consist of:
        - Cutting out and removing the entire affected section, and
        - Replacing with new porous flexible pavement
    - All repairs shall be executed using the finger-jointing technique to blend repairs seamlessly with the original paving.
    - Partial patches, cosmetic repairs, or surface dressings are prohibited.

G. Environmental Conditions During Cure

- Curing shall occur only when ambient and surface temperatures remain above freezing.
- Pavement shall be protected from precipitation until curing has progressed sufficiently to prevent surface damage.
- Binder classification shall comply with Section 2.05 and correspond to actual curing conditions, including:
    - Standard binders
    - Hot-weather binders
    - Winter-safe binders

H. Inspection and Acceptance

- Curing and protection measures shall be monitored by:
    - Installer
    - Manufacturer's representative (as required)
    - Installer-employed ISA Certified Arborist where work occurs within CRZs
- Pavement shall not be opened to traffic until accepted.

3.06 FIELD QUALITY CONTROL & ACCEPTANCE

A. General

Field quality control is required to verify that porous flexible pavement has been installed in accordance with:

- Approved submittals identifying mix family, thickness code, modifier configuration, and binder classification per Sections 2.02.B and 2.05
- Manufacturer requirements
- Part 1 Quality Assurance provisions
- Part 2 Product requirements
- Part 3 Execution procedures

Work failing to meet these requirements shall be rejected and corrected at no cost to the Owner.

B. Inspection Authority
The following parties shall have authority to observe, inspect, and evaluate the Work:
- Owner or Owner's Representative
- Designer of Record
- Manufacturer's representative (as required)
- Installer-employed ISA Certified Arborist

Inspection may occur at any stage of the Work, including subgrade preparation, base installation, placement, curing, and post-cure conditions.

C. Field Observations
Field observations shall include, at a minimum, verification of the following:
- Compliance with selected mix family, thickness code, and structural configuration per Table 2.02.B-2
- Verification of base depth in accordance with Table 2.02.B-2
- Compliance with approved mix designs and batch proportions
- Adherence to mixing time and working time limitations
- Proper placement, screeding, floating, and compaction methods
- Continuous wet-edge placement and proper joint execution
- Proper curing, protection, and access control
- Compliance with tree protection requirements

Observed deviations shall be corrected immediately.

D. Acceptance Criteria
Porous flexible pavement shall be accepted only when it meets all of the following:
- Conformance with selected thickness code and structural requirements of Table 2.02.B-2
- Conformance with the approved mock-up (if provided)
- Compliance with workmanship criteria specified in Section 1.05(E)
- Uniform appearance, texture, and color
- No raveling, sloughing, delamination, or surface defects
- Proper bonding at joints and interfaces
- Maintained permeability and open pore structure

E. Rejection of Work
The following conditions shall constitute cause for rejection:
- Use of binder classification inconsistent with Section 2.05 or prevailing environmental conditions
- Failure to comply with required base depth, geotextile, or geogrid configuration per Table 2.02.B-2
- Visible cold joints not executed using approved finger-joint method
- Surface defects caused by premature access or improper curing
- Improper mixing, batching, or working-time violations
- Evidence of over-compaction or closed pore structure
- Damage to tree roots or soil resulting from non-compliant methods

Rejected Work shall be removed and replaced in its entirety.

F. Corrective Actions
- Repairs shall be performed only in accordance with Section 3.04 and 3.05.
- Cosmetic repairs, surface coatings, or patching methods are prohibited.
- All corrective work shall restore the pavement to full compliance with this specification.

G. Final Acceptance
- Final acceptance shall occur only after:
    - Completion of curing
    - Correction of all deficiencies
    - Approval by authorized parties
- Acceptance shall not relieve the installer of warranty obligations.

3.07 MAINTENANCE & WARRANTY CONDITIONS
A. General
Porous flexible pavement is designed to be a low-maintenance, self-cleaning system when installed and used in accordance with this specification. Improper use, unapproved maintenance practices, or unauthorized access shall void the manufacturer warranty. Warranty applicability is contingent upon use within the loading classifications associated with the selected thickness code per Table 2.02.B-2.

B. Routine Maintenance
- Porous flexible pavement does not require routine vacuuming, pressure washing, or mechanical cleaning to maintain permeability.

- Normal maintenance consists of:
    - Periodic removal of surface debris such as leaves or litter, as desired by the Owner
    - Visual inspection for damage caused by external activities
- Use of mechanical sweepers, vacuum trucks, pressure washers, or chemical cleaners is not required and not recommended unless specifically approved by the manufacturer.
- Where overspray modifiers (X or T) are incorporated per Table 2.02.B-1, maintenance shall comply with manufacturer recommendations specific to the selected modifier configuration.

C. Prohibited Maintenance Activities

The following activities are prohibited and shall void the warranty:

- Use of equipment exceeding the loading classification associated with the selected thickness code per Table 2.02.B-2
- Use of construction equipment on the pavement without approved protection
- Use of solid-tire equipment, tracked equipment, or wheeled equipment exceeding approved loads
- Grinding, sanding, or surface abrasion
- Application of sealers, coatings, or surface treatments not approved by the manufacturer
- Cutting, trenching, or excavation through the pavement without manufacturer approval

D. Damage and Repairs

- Damage resulting from misuse, unauthorized access, or prohibited activities shall be repaired at the Owner's expense.
- Repairs shall be performed only by a manufacturer-approved installer.
- Repair procedures shall comply with Sections 3.04 and 3.05, including:
    - Full removal and replacement of damaged sections
    - Use of finger-jointing technique to blend repairs
- Partial patches or cosmetic repairs are prohibited.

E. Standard Warranty

- Manufacturer shall provide a standard five (5) year warranty covering:
    - Materials
    - Installation workmanship
- Warranty shall commence at the date of Substantial Completion.
- Warranty coverage is contingent upon:
    - Installation by a qualified installer meeting Section 1.05(B)
    - Installation consistent with selected mix family and thickness code per Section 2.02.B
    - Compliance with this specification
    - Proper curing, protection, and use
    - Use of binder classification in accordance with Section 2.05

F. Optional Extended Warranty *(Up to 35 Years)*

- An optional extended warranty of up to thirty-five (35) years may be made available by the manufacturer.
- Eligibility for the extended warranty requires:
    - Participation in a manufacturer-administered annual inspection program
    - Performance of manufacturer-approved overspray modifiers (X) in accordance with Table 2.02.B-1 and Section 2.05
    - Payment of applicable inspection and maintenance fees
- Extended warranty terms shall be defined in a separate written agreement between the Owner and the manufacturer.

G. Owner Responsibilities

- Where porous flexible pavement is not designed or rated for vehicular loading per the selected thickness code in Table 2.02.B-2, a best practice is to install removable bollards and appropriate "No Vehicle Access" signage at pavement entry points to prevent unintended vehicular intrusion, prevent misuse, and preserve warranty coverage.
- Owner shall:
    - Prevent unauthorized vehicle or equipment access
    - Maintain protection measures during adjacent construction
    - Notify the manufacturer promptly of any damage or concerns
- Failure to comply with Owner responsibilities may void the warranty.

END OF SECTION 32 12 43