

Flexible Paving



FLEXIBLE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Full depth asphaltic concrete paving over prepared subgrade

1.2 REFERENCES

- A. ASTM C29: Unit Weight and Voids in Aggregate
- B. ASTM C88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C. ASTM C117: Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
- D. ASTM C128: Specific Gravity Test and Absorption of Fine Aggregate
- E. ASTM C131: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- F. ASTM C136: Sieve or Screen Analysis of Fine and Coarse Aggregates
- G. ASTM D4: Bitumen Content
- H. ASTM D5: Penetration of Bituminous Materials
- I. ASTM D70: Specific Gravity of Semi-Solid Bituminous Materials
- J. ASTM D93: Flash Point by Pensky-Martens Closed Tester
- K. ASTM D113: Ductility of Bituminous Materials
- L. ASTM D1188: Bulk Specific Gravity of Compacted Bituminous Mixtures
- M. ASTM D1559: Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
- N. ASTM D2041: Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
- O. ASTM D2170: Kinematic Viscosity of Asphalts (Bitumens)
- P. ASTM D2172: Quantities Extraction of Bitumens from Bituminous Paving Mixtures
- Q. ASTM D2419: Sand Equivalent Value of Soils and Fine Aggregate
- R. ASTM D290: Bituminous Mixing Plant Inspection
- S. ASTM D946: Asphalt Cement for Use in Pavement Construction

- T. ASTM D692: Course Aggregate for Bituminous Paving
- U. ASTM D1073: Fine Aggregate for Bituminous Paving Mixtures
- V. ASTM 1241: Materials for Soil-Aggregate Subbase, Base and Surface Courses
- W. ASTM D2026: Cutback Asphalt (Slow-Curing Type)
- X. ASTM D2027: Cutback Asphalt (Medium-Curing Type)
- Y. ASTM D2028: Cutback Asphalt (Rapid-Curing Type)
- Z. MS-2: Mix Design Method for Asphalt Concrete and Other Hot Mix Types -The Asphaltic Institute (AI)
- AA. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- BB. Colorado Department of Transportation
- CC. Colorado Asphalt Pavement Association

1.3 SUBMITTALS

- A. Samples: Provide samples of materials for laboratory testing and job-mix design for asphaltic concrete paving section.
- B. Record of Work: Maintain record of time and date of placement, temperature, and weather conditions, retain until completion and furnish copy to Town.
- C. Test Reports: Submit laboratory reports for following materials tests
 - 1. Coarse and fine aggregate from each material source and each required grading
 - a. Sieve analysis: ASTM C136 (AASHTO T19)
 - b. Unit weight of slag: ASTM C29 (AASHTO T19)
 - c. Soundness: ASTM C88 (AASHTO T104) for surface course aggregates only
 - d. Sand equivalent: ASTM D2419 (AASHTO T176)
 - e. Abrasion of coarse aggregate: ASTM C131 (AASHTO T96), for surface course aggregates only
 - 2. Asphalt cement for each penetration grade
 - a. Penetration: ASTM D5 (AASHTO T49)
 - b. Viscosity (Kinematic): ASTM D2170 (AASHTO T201)
 - c. Flash Point: ASTM D93 (AASHTO T48)
 - d. Ductility: ASTM D113 (AASHTO T51)
 - e. Solubility: ASTM D4 (AASHTO T44)
 - f. Specific gravity: ASTM D70 (AASHTO T43)
 - 3. Job-mix design mixtures for each material or grade
 - a. Bulk specific gravity for fine aggregate: ASTM C128 (AASHTO T84)

4. Uncompacted asphalt concrete mix: Maximum specific gravity ASTM D2041 (AASHTO T209)
5. Compacted asphalt concrete mix
 - a. Bulk density: ASTM D1188 (AASHTO T166)
 - b. Marshall stability and flow: ASTM D1559
6. Density and void analysis
 - a. Provide each series of asphalt concrete mixture test specimens, in accordance with MS-2
 - b. Use Marshall method of mix design unless otherwise directed or acceptable to Town
7. Sampling and testing of asphalt concrete mixtures for quality control during paving operations
 - a. Uncompacted asphalt concrete mix
 - i) Asphalt cement content: ASTM D2172 (AASHTO T164)
 - ii) Penetration of recovered asphalt cement: ASTM D5 (AASHTO T49)
 - iii) Ductibility of recovered asphalt cement: ASTM D113 (AASHTO T51)
 - b. Compacted asphalt concrete mix
 - i) Bulk density: ASTM D1188 (AASHTO T166)
 - ii) Marshall stability and flow: ASTM D1559
 - c. Perform at least one test for each day's paving but not less than one test per each 4000 sf of each lift.

1.4 QUALITY ASSURANCE

- A. Conform materials and installation to applicable portions of Colorado Department of Transportation and the Town of Winter Park construction specifications, standards and details.

1.5 REGULATORY REQUIREMENTS

- A. For work on public streets or rights-of-way conform to the requirements of Town of Winter Park construction specifications, standards and details.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Transport mixture from mix plant in trucks with tight, clean, non-sticking compartments. Coat hauling compartments with lime-water mixture to prevent sticking. Elevate and drain compartment of excess solution before loading mix.
- B. Cover to protect from weather and prevent loss of heat when temperature is below 50 degrees F
- C. Provide insulated truck beds during temperature below 50 degrees F on long distance deliveries

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply when underlying surface is muddy, frozen or wet
- B. Do not place by spreading and finishing machine tack coat or asphaltic cement when temperature is below 45 degrees F and falling. Place when above 40 degrees F and rising

PART 2 PRODUCTS

2.1 MATERIALS

- A. Tack Coat: Emulsified asphalt: SS-1 or CSS-1h, ASTM D977
- B. Asphaltic Cement: ASTM D946, AASHTO M226, AC10 or AC20 grade determined by design mix, homogeneous, free from water, no tendency to foam when heated to 347 degrees F, and per CDOT Standard Section 702.
- C. Aggregate for Asphaltic Concrete, General
 - 1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D692
 - 2. Sand, stone, or slag screening: ASTM D1073
 - 3. Percent wear: ASTM C131, less than 45 for aggregates retained in #10 sieve
- D. Base Course Aggregates for Asphaltic Concrete
 - 1. Uncrushed gravel may be used in mixture if it meets design criteria specified
 - 2. Provide uniform quality combined aggregates with a minimum sand equivalent value of 40
 - 3. Provide aggregate in gradations for courses to comply with Class S and SG, Colorado Department of Transportation, ASTM C136
 - 4. A maximum of 20% Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.
- E. Surface Course Aggregates for Asphaltic Concrete
 - 1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions
 - 2. Provide uniform quality combined aggregate with a minimum sand equivalent value of 50
 - 3. Provide aggregate in gradations for courses to comply with Class SX, Colorado Department of Transportation, ASTM C136.
- F. Weed Control: First application, "Roundup." Second application, Casoron "W-50" or "G-10" with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

- A. Traffic Control Devices

1. Signs. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by Town. Private property or nonstandard signs will not be maintained by Town. Contact Town for additional details and submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements. All signs shall be 3M-engineer grade reflective sheeting or accepted substitute.
 - a. Traffic/Parking Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick. Facing shall be specified reflective sheeting with standard sign colors based on standard graphics and as directed by Town.
 2. Sign Posts.
 - a. All sign posts will be provided by the Town.
 3. Sign Post Anchor Bases (Stubs). All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4" by 2-1/4" anchor for large posts and 1-3/4" by 1-3/4" anchor for regular posts. Bases shall be embedded a minimum of 36" below finished grade and shall extend 3" above finished grade.
 4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are present which will not properly compact at sign base, install a 6" diameter by 36" deep concrete footing around signs post anchor base for all signs in landscaped areas.
 5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.
- B. Pavement Marking. Specified pavement marking materials shall be used at locations as identified below.
1. FS TT-P-115, Type I Alkyd, white, blue, yellow and red color paint meeting requirements of CDOT Standard Specification 708. Verify colors and extent of painting prior to painting. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on internal pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on internal drive, road or street pavements.
 2. Furnish paint with a no-pick-up maximum drying time of 20 minutes, when tested according to ASTM D711 using a wet film thickness of 0.015-inch when tested and applied at 77 degrees F.
 3. 3M Stamark 5730 preformed plastic marking material or an accepted substitute shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes in right-of-way. Use of thermoplastic pavement marking is not permitted.

2.3 MIXES/SOURCE QUALITY CONTROL

- A. Determine full depth design mix based upon aggregates furnished
 1. Test mix by independent laboratory at Contractor's expense

2. Grade dependent on temperature during placement
 3. Submit mix designs for review and acceptance by Town
- B. Submit mix design giving unit weight and to meet following requirements prior to placement of asphalt:

Property – 50 Blow	S Mix	SX Mix
Marshall Stability lbs	1600 (min.)	500 (min.)
Flow, 0.01'	8-18	8-20
Air Voids in Mix, %	3-5	3-5
VMA, % min.	14	15
Initial Gyration	7-8	7-8
Design Gyration	75-100	75-100
Hveem Stability	30 min	30 min
Voids Filled w/ Asphalt	65-75	65-75

Establish a single percentage passing each sieve size, a single percent of asphalt and a mix temperature. Maintain job mixes within following percentages of design mix:
Aggregates:

#8 and larger	± 8%
#16 to #100	± 6%
#200	± 2%
Asphalt Content Tolerance	± 0.5%
Discharge Mix temp	± 20° F

PART 3 EXECUTION

3.1 EXAMINATION

- A. Establish and maintain required lines and elevations. Provide grade and location stakes under this section as required for asphaltic concrete paving work.
- B. Operate heavy, rubber-tired front loader over subgrade of paved areas. Where soft spots occur, remove loose materials and replace with Class 6 road base aggregate complying with CDOT standards compacted to level of subgrade.

3.2 PREPARATION

- A. Prepare subgrade under provisions of Earthwork Sections
- B. Loose and Foreign Material
 1. Remove loose and foreign material from compacted subgrade surface immediately before application of paving. Clean surface with mechanical sweeper, blowers, or hand brooms, until surfaces are free from dust

C. Weed Control

1. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow "Round-up" to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.

D. Tack Coat

1. Apply in similar manner as prime coat, except as modified
2. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphaltic concrete or portland cement concrete and surfaces
3. Apply at rate of 0.05 to 0.15 gallons per square yard of surface
4. Apply tack coat by brush to contact surfaces of curbs, gutters, catch basins, and other structures projecting into or abutting asphaltic concrete pavement
5. Allow surfaces to dry until material is at condition of tackiness to receive pavement

3.3 RING/FRAME ADJUSTMENTS

A. Set ring/frames of subsurface structures to final grade as a part of this work.

B. Placing Ring/Frames

1. Surround ring/frames set to elevation with a ring of compacted asphalt concrete base prior to paving
2. Place asphalt concrete mixture up to 1-inch below top of ring/frame, slope to grade, and compact by hand tamping

C. Adjust frames to proper position to meet paving

- D. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations
- E. Set ring/frames to grade, flush with surface of adjacent pavement

3.4 PREPARING THE MIXTURE

- A. Comply with ASTM D995 for material storage, control, and mixing and for plant equipment and operation
- B. Stockpile
 1. Keep each component of the various sized combined aggregates in separate stockpiles
 2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation
- C. Heating
 1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
 2. Use lowest possible temperature to suite temperature viscosity characteristics of asphalt
 3. Do not exceed 350 degrees F
- D. Aggregate
 1. Heat-dry aggregates to acceptable moisture content
 2. Deliver to mixer at recommended temperature to suite penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture
 3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements
- E. Mix aggregate and asphalt cement to achieve 90-95 percent coated particles for base mixtures and 85-90 percent coated particles for surface mixture, per ASTM D2489

3.5 EQUIPMENT

- A. Bituminous Pavers: Self-propelled, spreads without tearing surfaces, and controls pavement edges to true lines without use of stationary forms
- B. Rolling Equipment
 1. Steel-wheel roller: Self-propelled, contact pressure of 250 to 350 psi per inch of width of roller wheel, equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking
 2. Pneumatic-tired rollers: Self-propelled, contact pressure under each tire of 85 to 110 psi, wheels spaced so that one pass will accomplish one complete coverage equal to rolling width of machine, oscillating wheels. Remove and replace immediately tires picking up fines
- C. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools

3.6 PLACING THE MIX

- A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine
- B. Complete placement over full width of section on each day's run
- C. Spread mixture at minimum temperature of 280 degrees F and maximum 350 degrees. With ambient temperatures below 50 degrees F, maintain minimum temperature of 300 degrees in the truck prior to lay down
- D. Inaccessible and small areas may be placed by hand
- E. Conform to the grade, cross section, finish thickness, and density indicated.
- F. Lift Thickness
 - 1. Place in multiple lifts. Place asphalt in lifts such that each compacted lift thickness is no less than 2.0" thick and no greater than 3.0" thick. Top lift to be 2" thick.
 - 2. Typical Lift Thickness Sequencing:

Final Asphalt Section Required (inches)	No. of Lifts	Thickness of each Lift (inches)
2"	1	2
3"	1	3
4"	2	2-2
5"	2	3-2
6"	3	2-2-2
7"	3	3-2-2
8"	3	3-3-2
9"	4	3-2-2-2
10"	4	3-3-2-2
>10	Review with Engineer	

- G. Paver Placing
 - 1. Unless otherwise directed, being placing along centerline of areas in crowned section and at high side on one-way slope and in direction of traffic flow
 - 2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips
 - 3. Complete base courses before placing surface courses
 - 4. Place mixture in continuous operation as practicable
- H. Hand Placing
 - 1. Spread, tamp, and finish mixing using hand tools in areas where machine spreading is not possible as acceptable to Town
 - 2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature

- I. Joints
 1. Construct transverse joint at right angles to centerline when operations are suspended long enough for mixture to chill
 2. Construct joints to have same texture, density, and smoothness as adjacent sections of asphalt concrete course
 3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat
 4. Offset transverse joints in succeeding courses not less than 24 inches
 5. Cut back edge of existing pavement or previously placed course to expose an even, vertical surface for full course thickness
 6. Offset longitudinal joints in succeeding courses not less than 6 inches
 7. When the edges of longitudinal joints are irregular, honeycombed or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness
 8. Wearing course constructed in even number of strips; place 1 longitudinal joint on centerline of road
 9. Wearing course constructed in odd number of strips; place the centerline of 1 strip on centerline of road

- J. Gutter: Finish surface high adjacent to concrete gutter so when compacted surface is slightly higher than edge of curb and flashing

3.7 COMPACTING THE MIX

- A. Provide pneumatic and steel-wheel type rollers to obtain the required pavement density, surface texture and rideability
- B. Begin rolling operations when the mixture will bear weight of roller without excessive displacement
- C. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set
- D. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers
- E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs
- F. Do not roll centers of sections first under any circumstances
- G. Breakdown Rolling
 1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge
 2. Operate rollers as close as possible to paver without causing pavement displacement
 3. Check crown, grade, and smoothness after breakdown rolling
 4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling

- H. Second Rolling
 - 1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction
 - 2. Continue second rolling until mixture has been thoroughly compacted
- I. Finish Rolling
 - 1. Perform finish rolling while mixture is still warm enough for removal of roller marks by combination of steel and pneumatic rollers
 - 2. Continue rolling until roller marks are eliminated and course has attained specified density, and required surface texture and surface tolerances
 - 3. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness
- J. Patching
 - 1. Remove and replace defective areas
 - 2. Cut-out and fill with fresh, hot asphaltic concrete
 - 3. Remove deficient areas for full depth of course
 - 4. Cut sides perpendicular and parallel to direction of traffic with edges vertical
 - 5. Apply tack coat to exposed surfaces before placing new asphaltic concrete mixture
 - 6. Compact by rolling to specified surface density and smoothness

3.8 JOINING TO EXISTING WORK

- A. Cut sides vertically and apply tack coat to exposed asphalt surfaces before placing new pavement. Meet existing thickness of surface and base courses, but not less than specified for new work.

3.9 FIELD QUALITY CONTROL

- A. The Contractor will engage a testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction. Testing Agency will test in-place pavement for density and thickness.
- B. Asphalt density test shall be taken every one-hundred fifty (150) lineal feet per driving lane. Densities shall be between ninety two percent (92%) and ninety six percent (96%) of the Rice unit weight or between ninety five percent (95%) and one-hundred percent (100%) of the Marshall unit weight.
- C. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections
- D. Testing agency will take not less than 4-inch diameter pavement specimens for each completed course from locations as directed by Town
- E. Repair holes from test specimens as specified for patching defective work

- F. Minimum acceptable density of in-place course materials is 95 percent of the recorded laboratory specimen density. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements
- G. Thickness: Variations from drawings
 - 1. Base course: 1/4-inch +
 - 2. Remove and replace paving less than minimum thickness
- H. Surface Smoothness
 - 1. Test using a 10 foot straight edge applied parallel to direction of drainage
 - 2. Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact
 - 3. Do not permit pockets or depressions where water may pool
 - 4. Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to Town
- I. Inspection: The work of this section is subject to the inspection and approval of the Town. The following inspections are required:
 - 1. Protection of adjacent property
 - 2. Staking and establishment of elevations
 - 3. Establishment and compaction of subgrade
 - 4. Placement and compaction of bituminous base course and wearing surface
 - 5. Final inspection
 - 6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

3.10 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of Town

3.11 PROTECTION OF FINISHED WORK

- A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and in no case sooner than 6 hours
- B. Provide barricades and warning devices as required to protect pavement and the general public

3.12 WARRANTY

- A. Provide installer's 2-year written warranty endorsed by the contractor warranting the pavement from creeping, shoring, cracking, softening, settling, ponding and other defects due to improper placing or defective materials. Replace defective materials upon notification by the Town in accordance with the requirements of the original work.

3.13 SCHEDULE OF MIX PLACEMENT:

- A. Refer to Drawings for asphalt thickness and subgrade preparation depth requirements.

END OF SECTION