CHAPTER 8
TRANSPORTATION STANDARDS

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8.01 Adoption of the Colorado Department of Transportation (CDOT) Specifications with Modifications

The current edition of the "Colorado Department of Transportation Standard Specifications for Road and Bridge Construction" is hereby adopted by reference in these Standards as the City of Boulder transportation construction standards, except as specifically amended by the provisions of this chapter.

(A) Section 401, Plant Mix Pavements - General

(1) **Subsection 401.02, "Composition of Mixtures,"** is amended to incorporate the following additions:

(a) A job-mix formula shall be submitted to the Director of Public Works for approval prior to placing any hot bituminous pavement. The formula shall indicate the aggregate gradation, asphalt cement content, hydrated lime content, and optimum density. If requested by the Director, a sample of the aggregate and asphalt cement shall be submitted for approval (for test purposes) prior to placing any hot bituminous pavement.

(b) The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature for the mixture at the discharge point of the plant.

(c) When submitting the job-mix formula, the contractor shall supply certified test results on all asphalt cements, aggregates, and mixes used for hot bituminous pavement, and certify that all materials meet or exceed all required specifications and tests.

(d) The Director reserves the right to sample materials and mixtures throughout project construction to determine whether specifications and requirements have been met and to confirm the certified test results. The contractor is responsible for providing a bituminous mixture that meets the job formula and specifications.

(e) The contractor shall be responsible for providing adequate field testing of materials used on the project and providing copies of the test results to the City to assure compliance with these specifications.

(f) The top layer of hot bituminous pavement shall not contain any reclaimed asphalt material, unless approved by the Director.

(2) **Subsection 401.11, "Tack Coat,"** is amended to incorporate the following additions:

(a) A tack coat shall be evenly applied to all existing asphalt or concrete surfaces that will be in contact with asphalt prior to hot bituminous pavement placement. A slow-setting, diluted emulsion shall be used, diluted with one part water to one part asphalt emulsion. The rate of application shall be 0.1 gallons per square yard of diluted asphalt emulsion. Before dilution, the emulsified asphalt shall comply

with AASHTO M140 or M208.

(b) Only the amount of tack coat necessary for the day's operation is to be placed on the surface. All traffic not essential to the work shall be kept off the tack coat.

(3) **Subsection 401.12, "Surface Conditioning,"** is amended to incorporate the following addition: All vegetation shall be removed from any existing surface to be overlaid.

(4) **Subsection 401.16, "Spreading and Finishing,"** is amended to incorporate the following additions:

(a) The bituminous mixture shall be placed with an asphalt paver if possible. The contractor shall receive permission from the Director to use placement methods other than a paver. The lift thickness shall be at least twice the maximum particle size for the hot bituminous pavement mix. The maximum lift thickness for the final lift shall be 2 inches, unless otherwise approved by the Director.

(b) Areas to be patched shall be excavated and squared to a neat line, leaving the sides of the excavation vertical. Prior to placement of the patch, the exposed sides of the existing pavement shall be thoroughly coated with slow-setting Emulsified Asphalt. Hot bituminous pavement shall then be placed and compacted in succeeding layers; no layer shall be more than 3 inches deep.

(B) Section 403, Hot Bituminous Pavement

(1) **Subsection 403.02, "Materials,"** is amended to incorporate the following additions:

(a) Design mixes shall be established using the Marshall Method of compaction. The method will be applied based on street classification according to Table 8-1, "Marshall Method by Street Classification."

Table 8-1: Marshall Method by Street Classification

Design Method	Laboratory Compaction	Street Classification
Marshall Method, ASTM D 1559 Asphalt Institute MS-2	50 blows per side	Local, Collector, and Minor Arterial (ESAL < 1 million)
Marshall Method, ASTM D 1559 Asphalt Institute MS-2	75 blows per side	Major Arterial (ESAL < 1 million)

(b) The design mix for hot bituminous pavement shall conform to Table 8-2, "Hot Bituminous Pavement Design Mix," and Table 8-3, "Minimum Voids in the Mineral Aggregate (VMA)."

(c) The addition of any recycled material is subject to approval by the Director prior to use in any asphalt mix. All mixes including recycled material shall meet all standard specifications and contain no more than 10% recycled material.

(d) Hot bituminous pavement for patching shall be Grading C with AC-10 asphalt cement.

(e) A minimum of one percent hydrated lime by weight of the combined aggregate shall be added to all aggregate for hot bituminous pavement.

Table 8-2: Hot Bituminous Pavement Design Mix

Property	Test Method	Value
Voids, Percent	MS-2; AASHTO T269	3-5
Stability, Minimum	MS-2; AASHTO T245	1800
Flow (0.01")	MS-2: AASHTO T245	8-16
Aggregate retained on the No. 4 Sieve with at least two Fractured Faces % Min.	CP-45	70
Accelerated Moisture Susceptibility Tensile Strength Ratio (Lottman) Min.	AASHTO T283	80
Minimum Dry Split Tensile Strength, PSI	AASHTO T283	30
Voids in Mineral Aggregate, VMA, % Min.	MS-2	See Table 8.01-3
Grade of Asphalt Cement		AC-10

Table 8-3: Minimum Voids in the Mineral Aggregate (VMA)

Nominal Maximum Size*, Inches (mm)**	Design Air Voids **		
	3.0%	4.0%	5.0%
1 ½ (37.5)	11	12	13
1 (25.0)	12	13	14
¾ (19.0)	13	14	15
½ (12.5)	14	15	16
3/8 (9.5)	15	16	17

* The Nominal Maximum Size is defined as one sieve larger than the first sieve to retain more than 10%.
** Interpolate specified VMA values for design air voids between those listed.

(C) Section 608, Sidewalks and Multi-Use Paths

(1) Subsection 608.03(e), "Joints," is amended to incorporate the following additions:

All jointing of bikepath, bikeway, and bike trail concrete pavement shall be saw cut at the nearest contraction joint and shall be removed and replaced full width. No partial removal and replacement will be allowed. No longitudinal joints will be allowed in either sidewalk

or bikepath concrete pavements.

(D) Section 610, Median Cover Material

(1) **Subsection 610.02, "Materials,"** is amended to incorporate the following additions:

Patterned concrete shall be colored concrete and meet the requirements of Section 601 with the following exceptions:

Field Compressive Strength (28 days), psi (Not a specification requirement)	4500
Cement Content, lbs./cu. Yd., minimum	610
Max. Water/cement ratio lbs. Water/lbs. Cement	0.44
Entrained and Entrapped Air, percent	4 - 8
Slump, AASHTO T 119, inches	2 – 5
Coarse Aggregate, AASHTO M43	Size No. 8
Fine Aggregate, AASHTO M6, percent of total aggregate	50 - 78

(a) An approved water reducing admixture shall be used in the mix.

(b) The coloring agent shall be integral to the concrete mixture.

(c) The color and pattern shall be as defined in the plans as approved by the City.

(d) Colored wax curing membrane shall be as recommended by the supplier of the coloring agent.

(2) **Subsection 610.03, "Construction Requirements,"** is amended to incorporate the following additions: Patterned concrete may be used for median cover material. Construction shall conform to the requirements of CDOT Subsection 608.03 with the following exceptions:

(a) While the concrete is still plastic, a special pattern forming tool shall be applied to the concrete surface to form the specified pattern. All tears and voids resulting from the pattern forming shall be repaired.

(b) Curing shall include application of two coats of colored wax curing membrane. The first coat shall be applied within 2 hours of finishing. The second coat shall be applied between 10 and 20 days following the first application.

(E) Section 703, Aggregates

Subsection 703.04, "Aggregate for Hot Plant Mix Bituminous Pavement," paragraph 3 is deleted and replaced with the following revision:

(1) The aggregate from individual sources shall have a percentage of wear of not more than 40 when tested in accordance with AASHTO T96 after 500 revolutions. The aggregate from individual sources shall contain no more than a 1 percent deleterious material including clay lumps, vegetable matter, friable particles, and other deleterious substances tested in accordance with AASHTO T112.

(2) For quarries or sources which contain minerals which are not of similar composition, the abrasion and friable particle requirements shall be applied to each mineral composition.

(3) All aggregate shall meet the sodium or magnesium sulfate test in accordance with

AASHTO M29.

(F) Section 612, Delineators and Reflectors

Subsection 612.02, "Materials," is amended to incorporate the following additions: All delineators shall be "safe hit" reflective delineators, and shall be anchored according to manufacturer's recommendations.

(G) Section 614, Traffic Control Devices

(1) **Subsection 614.02, "Sign Posts and Sign Structures,"** is amended to incorporate the following additions:

(a) All signs must be mounted on "TELESPAR" posts or approved equal. These installations shall be per manufacturer's recommendations and be constructed in two sections including the base and the post.

(b) The post size shall conform to manufacturers recommendations according to the total sign area square footage and wind loading, but in no instance shall post size be less than 2" square, 12 gauge material, affixed to base by means of two (each) drive rivets with washers on the back side of post and right or left side of post, at a length to accommodate the proper mounting height of sign to be affixed per the MUTCD.

(c) The "TELESPAR" sign base shall be 2 ¼ x 36 inches in length and shall be driven into the ground 33 to 34 inches with 2 to 3 inches exposed above final grade.

(d) Sign Bolts: Sign shall be affixed to post with a minimum of two (each) 5/16 x 2-¾ inch bolts with locking nut and vandal proof (Gator Lock or approved equal) hardware on each side (front/back) with nylon washer or equivalent behind the Gator lock on the sheeting side.

(e) Banded Sign Mount: All banding material shall be ¾ inch wide stainless Steel banding. Hardware for installation of signs less than 30" attached to a signal/light pole shall consist of a buckle bracket. For 30"or greater signs, Sign Fix is required to be mounted on the sign and a slider bracket to affix sign to the banding.

(f) Other Sign Mounts: Utility wood poles can be used when the location is appropriate for signs with prior approval from the Director. The mounting hardware shall be lag bolts with washers, with nylon washer or equivalent against the sheeting side.

(g) Cantilever Mount: Cantilever mounts shall be approved by the Director prior to being used.

(h) CDOT Breakaway Post System: Signs placed in rights-of-way under the

jurisdiction of CDOT shall provide a breakaway system in accordance with CDOT standards (M & S Standards section S-614-5).

(2) **Subsection 614.04, "Sign Panels,"** is amended to incorporate the following additions:

(a) All reflective sheeting shall be ASTM D 4956-04 Type XI Diamond Grade Cubed (DG3) or equivalent approved by the Director.

(b) All sign blanks shall be constructed using 0.100 gauge aluminum material.

(c) All public street name signs shall be constructed using extruded aluminum alloy 6063-T6, or approved equal, with 0.091 inch thick web, 0.250 inch thick edges, and square corners. All non-extruded signs shall be mounted on 0.100 gage aluminum with rounded radius corners. All public street name signs shall be constructed using reflective sheeting stated above and have a blue background with white lettering.

(H) Section 627, Pavement Marking

Subsection 627.03, "General," is amended to incorporate the following additions:

(1) White and yellow skip markings shall be 4 inches wide and 10 feet long with a 30 foot gap between.

(2) All crosswalk lines shall be applied longitudinally, and shall be 24 inches wide by 10 feet long.

(3) On concrete surfaces all curing compound shall be removed prior to the installation of any pavement marking.

(4) Maintenance Striping

(a) All lane, center, and channelizing lines shall be striped with epoxy pavement markings at 15 mm thickness with glass beads.

(b) All crosswalk lines installed on asphalt surfaces shall be provided using pre-formed plastic pavement markings 3M A270 E/S series tape. On concrete surfaces, an equivalent pre-form thermoplastic marking can be used if approved by the Director.

(b) All lane use arrows on concrete surfaces shall be Premark Brand Elongated Series Contrast Arrows.

(c) All lane use arrows on Asphalt Surfaces shall be pre-formed plastic pavement markings, 3M Elongated L270 ES Series.

(d) Adherence to manufacturer's installation recommendations (method) is required.

(5) New Striping

(a) Approval of final lay-out is required prior to placement of pavement markings

(b) On concrete surfaces all curing compound shall be removed prior to the installation of any pavement markings.

(c) Adherence to manufacturer's installation recommendations is required.

(d) All lane use arrows on concrete surfaces shall be Premark Brand Elongated Series Contrast Arrows.

(e) All lane use arrows on Asphalt Surfaces shall be pre-formed plastic pavement markings, 3M Elongated L270 ES Series.

(I) Section 713, Traffic Control Materials

(1) **Subsection 713.04, "Sign Panel Backgrounds,"** is amended to incorporate the following addition: Aluminum sign panels may also have a Class II (A-1) anodic coating clear finish as defined in the "Aluminum Association Standards for Anodically Coated Aluminum Alloys for Architectural Applications."

(2) **Subsection 713.06, "Messages,"** is amended to incorporate the following additions:

(a) All street name signs on non-signalized intersections shall be 9 inches wide with 6 inch, upper-case, series D capital letters, together with 4 ¾ inch, lower-case, series D letters for the name of the street, and a 3 inch, upper-case, series D capital letter together with 2 ¼ inch, lower- case, series D letters for "Avenue," "Street," 3 inch block numbers below the abbreviation of "Ave.," "St.," etc. The "Ave" etc. and block numbers shall be centered on the sign with a 1 inch separation between them. When block numbers are not used, "Ave", "St", "Rd", etc. shall be 6 inch upper case with 4 /4 inch lower case letters series D. On numbered streets, a 6 inch, series D number shall be used with 4 ¾ inch, lower-case, series D letters for "th", "st" and "nd" to be held in line with the number that it follows.

(b) All reflective sheeting for street name sign faces shall be Type XI 3M - Diamond Grade Cubed sheeting or approved equal.

(3) **Subsection 713.08, "Glass Beads for Traffic Markings,"** is amended to incorporate the following addition: Glass beads shall be applied on Epoxy Pavement Markings Lane Lines at a rate of 15 to 18 pounds per gallon.

(4) **Subsection 713.13**, "Preformed Plastic Materials," is amended to incorporate the following additions:

(a) Preformed Plastic: material shall be 3M Stamark Series A270 ES for all transverse & longitudinal lines. All lane use symbols shall be 3M Stamark Series L270 ES.

(b) Preformed Plastic: (New Concrete Application) "white only" material shall be 3M Stamark Series A380I-5 ES (contrast) for all longitudinal skip lines or channelizing lines.

(5) **Subsection 713.14**, "Preformed Thermoplastic Material," is amended to incorporate the following additions:

(a) Preformed Thermoplastic; Materials shall be alkyd based materials for transverse & longitudinal lines, or approved equivalent.

(b) All materials shall be 90 mm thick with beads. Only preformed thermoplastic marking material listed on CDOT's approved products list may be used.

(6) **Subsection 713.19,** Methyl Methacrylate Pavement Marking,"
Methyl Methacrylate material shall be approved by the Director prior to being used on transportation facilities in the public right-of-way.

8.02 Traffic Signals

All traffic signal design and construction shall be performed in accordance with the Section 2-2-11, "Traffic Engineering," B.R.C. 1981 and these Standards.

8.03 Traffic Signs and Markings

(A) Required

The applicant shall be responsible for the installation of all traffic control devices, street name signs, and pavement markings prior to opening or reopening any public transportation facility.

(B) Signing and Striping Plan

A complete signing and striping plan shall be submitted as part of project or development construction plans, to be approved by the Director prior to installation. The plan shall specify the locations, types, and combinations of approved signs, pavement markings, and barricades required for each project or development.

(C) Conformance with MUTCD

All signs, sign materials, and barricade warning lights shall conform to the standards set forth in the current edition of the "Manual on Uniform Traffic Control Devices (MUTCD)", and these Standards.

(D) Materials

The quality of material used in traffic signs, type and quality of all vandal-proof sign hardware, and quality of all metal square sign posts shall be in conformance with these Standards, subject to approval by the Director.

(E) Private Street Signs

Private streets shall be signed as such and shall include the message "NO CITY MAINTENANCE", and be installed on the same support as the street name sign. Any private street name signs should be fabricated and installed according to the specifications for a public right-of-way street name sign except that the sign shall have white lettering on a green background.

8.04 Temporary Traffic Control Plan

(A) Required

The Director of Public Works may require a Temporary Traffic Control (TTC) Plan for any work that impacts a public right-of-way or easement.

(B) Intent

The purpose of this section is to establish standards and methods for handling traffic to be applied when work or work activity in the public right-of-way or public easements impedes or obstructs any mode of transportation, including but not limited to pedestrian, bicycle, transit, or vehicular traffic. These standards are intended to ensure safe and effective work areas, and warn, control, protect, and accommodate all modes of transportation.

(C) Transportation Master Plan

All temporary traffic control plans shall comply with the goals, policies, and standards adopted in the Transportation Master Plan (TMP).

(D) Objectives

Primary objectives of a TTC plan are as follows:

(1) Prevent accidents and injury for both the public and for workers, by providing a safe work area;
(2) Prevent damage to public and private property, including damage to vehicles and construction equipment;
(3) Ensure well defined and safe traffic movements through work areas and temporary traffic control zones;
(4) Efficiently and equitably accommodate pedestrian, bicycle, transit, and vehicular traffic;
(5) Support mode prioritization goals established in the TMP;
(6) Provide effective communication with the public; and
(7) Ensure conformity with these standards for work zone temporary traffic control.

(E) Certification Requirements

(1) Traffic Control Plans shall be prepared by or under the direct supervision of a person certified as a Traffic Control Supervisor (TCS) by the American Traffic Safety Services Association (ATSSA) or with equivalent certification as approved by the Director.
(2) Traffic Control Plans shall be implemented under the direct supervision of a TCS, certified Traffic Control Technician (TCT), or person with equivalent certification as approved by the Director.

(F) Conformance with MUTCD

All traffic control plans, signs, sign materials, barricade warning lights, and other temporary traffic control measures shall conform to the "Manual on Uniform Traffic Control Devices" (current edition), except as specifically amended or supplemented by the provisions of these Standards.

(G) General Requirements

All proposed Traffic Control Plans shall include the following:

(1) The location of work
(2) A description of work to be performed
(3) A construction schedule identifying duration and extent of impacts
(4) A delineation of the proposed work area including any staging, storage, and delivery areas.
(5) Proposed measures to address impacts to vehicles, bicycles, pedestrians, multi-use path facilities, transit facilities, and persons with disabilities.

(H) Non Standard Closures

Traffic control plans which due to their location, duration, extent, hours of operation, or impact will result in more significant impacts to the traveling public require additional information to demonstrate that impacts have been avoided, minimized, and mitigated. The Director may approve the following Non Standard closures upon finding that the applicable criteria have been met:

(1) **Work Hours:** Plans which propose to close a vehicular travel lane on any weekday prior to 9 a.m. or later than 4 p.m., or on any weekend shall demonstrate that such impacts cannot be reasonably avoided or that the proposed schedule reduces impacts to the public compared to closure during normal work hours.

(2) **Multiple Vehicle Lanes:** Plans which propose to close all or multiple vehicle lanes in a single direction of travel shall demonstrate that such impacts cannot be reasonably avoided through alternative scheduling or phasing of work.

(3) **Vehicular Detours:** Plans which propose to detour traffic to another roadway shall demonstrate that such impacts cannot be reasonably avoided and that impacts to the detour route have been mitigated to the extent practicable. Impacts to the detour route shall be evaluated including, without limitation, intersection level of service, traffic speed and volume in residential neighborhoods and school zones, and impacts to all modes of transportation.

(4) **Flagging:** Plans which propose use of flaggers shall demonstrate that the duration or scope of work is such that more permanent control measures are not practical.

(5) **Transit Facilities:** Plans which propose impacts to a transit facility or transit stop must demonstrate that such impacts cannot be avoided and provide for appropriate detours and alternative stop locations.

(6) **Sidewalks:** The following special considerations shall be given to proposed closures of sidewalks:

a) Adjacent to streets not classified as “Local” in the Transportation Master Plan;
b) Located in the CAGID or UHGID boundary areas;
c) Impacted for more than seven days;
d) Where no other sidewalk exists adjacent to the roadway;
e) Serving a school zone or transit stop, or
f) Requiring pedestrians to detour to a facility on a separate parallel roadway. Such proposed closures must demonstrate that impacts cannot be avoided through

alternative construction methods, that the duration and extent of impacts has been minimized, and that an adequate detour has been provided.

(7) **Bicycle Lanes:** Special consideration shall be given to proposed closures of on street bike lanes along roadways with a posted speed limit of 40 mph or greater; or bike lanes that involve contra-flow lanes. Such proposed closures shall demonstrate that impacts cannot be avoided through alternative construction methods, that the facility cannot be reasonably relocated through reassignment of vehicle lanes or other existing facilities, that the duration and extent of impacts has been minimized, and that an adequate detour has been provided.

(8) **Multi-Use Paths:** Special consideration shall be given to proposed closures of sidewalk facilities which have been designated as multi-use paths. Such proposals shall demonstrate that impacts cannot be avoided through alternative construction methods, that the facility cannot be reasonably relocated through reassignment of vehicle lanes or other existing facilities, that the duration and extent of impacts has been minimized, and that an adequate detour has been provided. Detours routes must be of similar width and surface type to the permanent facility.

(9) **Signage:** Where detours or closures impact pedestrian, bicycle, or multi-use path facilities, additional signage as required by Director shall be utilized to supplement the requirements of the MUTCD.

8.05 Fire Lane Sign Specifications

(A) Size

Fire lane signs shall be 12 inches by 18 inches.

(B) Material

Fire lane sign material shall be 0.100-inch thick aluminum alloy 6061-T6 with 3M Diamond Grade Cubed (DG3) sheeting Type XI.

(C) Colors

Fire lane sign colors shall be red letters on a white background. The letter on the symbol shall be black.

(D) Wording

Fire lane signs shall including the wording “FIRE LANE” with an appropriate arrow and a no parking symbol (“P” with a slash).

8.06 Signing for Accessible Parking

Accessible parking signs required for accessible parking spaces shall meet the following standards:

(A) Materials

Sign materials shall conform to the standards set forth in the MUTCD and these Standards.

(B) Required Signs

Three signs shall be required for accessible parking spaces as follows:

(1) **Sign #1:** Sign #1 (R7-8) shall be 12 inches by 18 inches with green lettering on a white background. This sign shall read, "RESERVED PARKING", followed by a blue accessible symbol and a green arrow indicating the stalls restricted to accessible parking.

(2) **Sign #2:** Sign #2 shall be 24 inches by 18 inches with white lettering on a blue background. This sign shall read, "VEHICLES NOT DISPLAYING THE STATE AUTHORIZATION MAY BE TOWED AT OWNER'S EXPENSE. FOR PERMIT INFORMATION CONTACT THE LOCAL MOTOR VEHICLE OFFICE," and shall display a symbol of accessibility.

(3) **Sign #3:** Sign #3 shall be 12 inches by 6 inches with white numerical numbering on a blue background. This sign shall read in numerical value, "$112.00," centered with a white border.

(C) Sign Placement

The accessible parking signs shall be placed as shown on Technical Drawing 2.86, "Accessible Parking Sign Details," in Chapter 11 of these Standards, and are to be set directly facing or no more than 45 degrees from the line of travel of a vehicle entering the stall. These signs may be mounted on a post or may be mounted permanently on an adjacent wall using anchor bolts. Such signs shall be placed at the center of the end stalls of each accessible parking area and at every second stall in-between.

8.07 Signing for Parking Restrictions

(A) Size

Parking restriction signs shall be 12" x 18".

(B) Material

Sign material shall be 0.100-inch thick aluminum alloy 6061-T6 with 3M DG3 (Diamond Grade Cubed) sheeting Type XI.