

1A.05 SIGN SPECIFICATIONS

1. All Signs shall conform to current Manual on Uniform Traffic Control Devices (MUTCD) Specifications.
2. All signs shall be installed on Telespar post with Telespar anchors at proper heights per current MUTCD Standards.
3. Sign material shall be as follows:
 - a. 36” x 36” or less shall be .080 gauge aluminum – pre-punched holes.
 - b. 48” x 48” or larger shall be .100 gauge aluminum – pre-punched holes.
 - c. 36” x 9” shall be .080 gauge aluminum – pre-punched holes.
 - d. 42” x 9” shall be .080 gauge aluminum – pre-punched holes.
4. All signs shall be High Intensity Prismatic (HIP) or Diamond Grade Reflective (DG) Type 11 Sheeting with at least ten year guarantee, or approved equal. Legends and symbols shall be made with Electro Cut (EC) Film may also use traffic grade inks with approved laminate. The County reserves the right to request material changes to signs.
5. Sign sheeting standard, use reflective white background with green EC Film may also use traffic grade inks with approved laminate on top layer with reverse weed which shows the reflective white blocked uppercase and lowercase letters, numbers and arrows.
6. Street and Avenue signs for post mounting shall be aluminum, 9” x 36” (minimum)
9” x 42” (maximum) in length.
7. Please contact Signs and Markings Supervisor for sign lay out and font sizes.
(720) 874-6777



URBAN



RURAL

8. At signalized intersections these signs shall be sized in accordance with Specifications for Oversize Street Signs or approved equal in the Highway Standards. Use Word Font D – Initial uppercase letters at least 12 inches and lowercase letters at least 9 inches in height.
9. All signs shall be mounted with County approved bolts, nut and washers.
10. Telespar type post and anchors shall meet or exceed the following:

(All Telespar post shall be attached to anchors with 3/8" corner bolt with nut. Rivets will not be allowed)

- a. Post – 1 3/4" x 1 3/4" x 10' – 11' – 12' = 14 gauge, ASTM Specification No. A446, Grade A, Drilled on 1" centers.
- b. Anchors – 2" x 2" x 3', 12 gauge, ASTM Specification No. A446, drilled on 1" centers.
- c. Post – 2" x 2" x 10' – 11' – 12' = 14 gauge, ASTM Specification No. A446, Grade A, Drilled on 1" centers.
- d. Anchors – 2 1/4" x 2 1/4" x 3', 12 gauge, ASTM Specification No. A446, drilled on 1" centers.
- e. All post and anchors shall be galvanized to ASTM Specification A525 coating designation G90

11. Wood/Metal/Fiberglass/post mounting: Band-It Type #201 3/4" stainless steel band, Band-It Type #201 3/4" Ear-Lokt-Buckle, Band-It Type #D022 3/4" Bracket, 5/16" x 3/4" Bolt w/six- sided head, 5/16" washer.
12. Sign shall have a seven foot (7') clearance (minimum) from the bottom of sign to the ground at installation, or as approved by MUTCD Standards.
13. All multiple mounted signs on single post, the lowest sign shall be no lower than six (6') feet on urban roadways, with a one (1") gap between signs. The lowest sign shall be seven (7') feet if near pedestrian or parking traffic. All signs placed in rural setting shall be installed to current MUTCD Specifications.
14. All signs placed with the exception of STOP and YIELD signs, Shall be near property lines; they are not to intrude on driveways, doorways or any type of entrance.
15. For all street name signs, the signs shall be bolted at the ends with County approved bolts, nuts and washers.
16. Signs shall be placed behind curb to minimum specifications according to MUTCD. (Part II Signs) Standards.
17. Signs shall be placed a minimum of five (5') feet from fire hydrants.
18. Placement of "STOP" signs shall be in accordance with County Standards. Behind curb, ramp or crosswalk with the minimum of 36" inches behind sidewalk at the radius point or as approved by County Transportation Division.
19. Signs placed in concrete shall be either core drilled with a 4" inch hole, or a piece of 4" inch PVC pipe may be poured into the full depth of the concrete and flush with the top of concrete.
20. All sign placement shall call for current utility locates (**811**) Call before you Dig. Current locates shall be established before final inspection of sign installation.

PROCEDURES: Street name signs are placed to serve as guidance and safety devices at various locations.

- **Stop Controlled Intersections (4-way intersections)**

Street name signs shall be placed above the stop signs at a two-way stop controlled intersections. When the main street is a north/south street the street name signs will be placed on the northeast and southwest corners. When the main street is an east/west street the street name signs will be placed on the northwest and southeast corners. When the intersection is controlled by an all-way stop the signs will only be placed on the northeast and southwest corners.

- **T-intersections, Right Angle Intersections and Curved Alignment**

Only one location will require a street name sign in these locations. The street name signs shall be located above the stop sign at T-intersections. Right angle intersections will have the sign located on the inside corner of the curve, and likewise for the curved alignment.

- **Signalized Intersections**

Street Name signs shall be placed overhead on the traffic signal mast arm at signalized intersections.

1A.06 CROSSWALKS

BACKGROUND

The primary purpose of marked crosswalks is to guide pedestrians in a proper path when crossing the street. Crosswalks can be designated at controlled intersections, uncontrolled intersections, or mid-block locations. When no control is provided, the crosswalks also serve as a warning to motorists that a pedestrian crossing point exists. With uncontrolled crossings, advance warning signs are required.

Crosswalks should be considered whenever there is a clear need for increased visibility and designation of a crossing area. Marked crosswalks are found at:

- Signalized intersections equipped with pedestrian signals
- Designated school crossings
- Crossings at a two-way and four-way stop intersections
- Intersection crossings with unusual geometric design where the pedestrian path is confusing and could lead to potential conflict

1A.06 POLICY CROSSWALKS

Arapahoe County will use the following guidelines for crosswalks:

<u>Functional Classification</u>	<u>General Requirement</u>	<u>Specific Locations</u>
Arterial Streets	Controlled Intersections	<p>Signalized intersections which are equipped with pedestrian signals.</p> <p>Multi-way stop intersections which are designated as approved school crossings.</p>
Collector Streets	Controlled and Uncontrolled Intersections	<p>Signalized intersections which are equipped with pedestrian signals.</p> <p>Any intersection which is designated as an approved school crossing.</p> <p>Any intersection which meets the County's warrants.</p>
Local Streets	Controlled and Uncontrolled Intersection as well As mid-block locations	<p>Any location which is designated as an approved school crossing.</p> <p>Any location which meets the County's warrants.</p>

REQUIREMENTS

In order for Arapahoe County to designate a location as an approved school crossing, the school district MUST submit to the County a probable school-age pedestrian route map(s). The designated route(s) should be designed to assure that the children:

- Form into a group as soon as possible to be more readily visible to motorists.
- Cross the fewest number of streets to reduce vehicle/pedestrian exposures. When determining which streets to cross, factors such as vehicle approach speeds, traffic volumes, and road geometry should be considered.
- Walk on sidewalks or paths where available.
- Walk the shortest possible distance on streets without sidewalks or shoulders.
- Avoid high speed, high volume roadways.
- Make maximum use of protective techniques, (crossing guards, traffic control devices).
- Use easements with walkways through parks or other available areas where student safety is maximized.

County staff will then review the plans and work with School District personnel in determining which crossings should be marked and signed. Engineering judgment which considers factors such as the number of children crossing, the location of crossing with respect to the school, and the physical characteristics of the area will be used in making the final decision.

The Arapahoe County warrants for non-school related crosswalks are listed below:

Functional Classification	Street Volume (1)	Pedestrian Crossing Volume (2)	Speed Limit
Arterial	600	50	35+ MPH
Collector	300	25	25-35 MPH
Local (3)	100	15	20-30 MPH

1. Minimum traffic volume for a 1-hour period.
2. Minimum pedestrian volume for the same 1 hour period

3. The warrants for a local street only apply to a crossing which serves a recreational area or provides continuity in a trail system.

Both Advance and Crossing signs should be used in conjunction with designated crosswalks. The Advance sign should be placed 150 to 200 feet before the crosswalk while the Crossing sign should be located at the actual crosswalk. Crossing signs will not be used at crosswalks that have stop sign control. The design of both signs is governed by the Manual on Uniform Traffic Control. (MUTCD)

Note: Not all conditions/areas may relate to the above criteria for non-school related crosswalks. Engineering judgement should be used where the above conditions cannot be met but may justify marked crosswalks (i.e., parks, seasonal recreation areas, etc.). The MUTCD, however, should be used as a guideline to any crosswalk considerations. MUTCD design sign standards and specifications shall always apply.

1A.07 PAVEMENT MARKINGS

The work in this contract shall consist of the Contractor furnishing all labor, equipment, and materials for removal and installation of permanent pavement markings in arterial, collector, local streets, and selected facilities within the ARAPAHOE COUNTY GOVERNMENT.

The Arapahoe County Road & Bridge maintains the pavement markings on all public right-of-ways after completion of the two (2) year warranty period. All installed pavement markings shall be installed in accordance to the standards and latest revisions of the (MUTCD) Manual on Uniformed Traffic Control Devices, Federal Highway Administration Standard Specifications for Road and Bridge Construction, Colorado DOT, and ARAPAHOE COUNTY GOVERNMENT.

At intersections all markings shall be of a permanent type marking, to include but not limited to: Crosswalks, Stop Bars, Arrows, and Onlys.

All new roadways shall be painted using epoxy paint unless otherwise approved by the County Traffic engineer, and shall be painted with a full striping width of 15 mils when applied. Drop on glass beads shall be applied at the rate of no less than seventeen (17), and no more than twenty-five (25) pounds per gallon of paint using Potters P-20+ 80% round.

PART I – GENERAL

All pavement markings shall be placed in accordance with the following requirements:

When the term “full compliance” is used, it means pavement markings shall meet the requirements of these specifications.

- A. *Pavement Marking Plan.* When pavement marking location details are not provided in the Contract, the Contractor shall submit a layout of existing conditions to the County for approval or modification. This layout is to be used as the final pavement marking plan. The layout of pavement marking shall be the responsibility of the contractor. The County Project Representative will review each project site for final marking placement.
- B. *Roadways Closed to Traffic During Construction.* Full compliance pavement markings shall be in place on all roadways prior to opening traffic. The County Project Representative will determine the location and need for full compliance prior to roadways being open to traffic.
- C. *Roadways Constructed Under Traffic.* Full compliance final pavement markings shall be placed within two (2) weeks after final surfacing is completed. Full compliance pavement markings shall also be placed on any roadways open to traffic when the project pavement work is discontinued for more than two (2) weeks. The County Project Representative will be responsible for coordinating the schedule for the installation of the markings within this two (2) week period.
- D. Temporary pavement markings and control points for the installation of those pavement markings for roadways that are being constructed under traffic are as follows:

- 1. When one roadway of a normally physically divided highway is closed, and a crossover is constructed, full compliance pavement marking shall be placed along the tapers and through the median crossovers to the two-way traffic section. Pavement marking through the two-way traffic section shall be as shown on the plans.

When a two-lane highway is closed, and a bypass detour is provided, full compliance pavement markings shall be placed the full length of the detour prior to operation of the detour.

In either case, the type of marking materials applied to a final surface, when removed, shall not leave a scar that will conflict with permanent markings.

- 2. The following criteria apply to all construction and maintenance on roadways open to traffic other than (D) 1 above.

Control points, four-inch by two-foot marks at 40-foot intervals, are guide

markers for the installation of temporary and/or full compliance markings.

All temporary broken-line pavement markings shall be installed daily and shall be at least 18 inches long with a maximum gap of 38 feet. An 18-inch stripe with a maximum gap of 18 feet shall be used on curves for roadways with severe curvature. A severe curve is defined as a curve whose safe speed is 10 mph or more below the approach posted speed limit.

Temporary pavement markings for “no passing zones” shall be full compliance.

For a short-term situation (3 calendar days or less) where temporary broken center lines are installed, “no passing” restrictions may be identified by appropriate signs including R4-1 and R4-2 until final markings are installed.

For roadways with a volume of 750 ADT or less, “no passing” restrictions can be identified for up to two (2) weeks with appropriate signs.

Temporary pavement stencils (school, railroad, etc.) are not required unless detailed on the plans.

Temporary pavement markings shall be installed per manufacturer’s recommendations in such a way that the markings adequately delineate the desired alignment.

- E. Control points, temporary pavement markings, and Contractor pavement marking plans will not be paid separately, but shall be included in the work.

PART II – MATERIALS AND EXECUTION

- A. Pavement Markings with Paint (Waterborne)

Description. Low VOC, ready mixed, one component, 100% acrylic waterborne traffic paints.

All paints shall be suitable for application to Asphaltic or Portland cement concrete pavements when applied with or without glass beads.

Striping shall be done when the air and pavement temperatures are at least 50° F and rising. The pavement surface and weather conditions shall be conducive to satisfactory results.

Equipment shall be capable of painting a reasonably clean-edged stripe of the designated width ($\pm \frac{1}{4}$ in.) and shall have a bead dispenser directly behind synchronized with the paint applicator. For centerlines and lane lines, an automatic skip control shall be used

that will paint a stripe with a gap, as shown on the plans. Machines having multiple applicators shall be used for centerlines with “no passing zones.” In areas where machines are not practical, suitable hand-operated equipment shall be used. All stripes shall be protected until dry. Paint and beads shall be applied within the following limits using Potters P20+, 20% DM 80% round.

Application Rate or Coverage per Gallon of Paint

	MINIMUM	MAXIMUM
Paint:	100 sq. ft.	110 sq. ft. (Approximately 15 miles when wet)
Beads:	5 lbs. 13 oz.	6 lbs. 3 oz.

Pavement marking paint shall conform to the requirement listed in the table below. All proportions are by weight.

Pigment composition and vehicle composition shall not vary by more than 1.0 percent of each amount specified.

Characteristics:	YELLOW	
WHITE		
Viscosity at 77 degrees F, KU	80-90	80-90
Dry to no pick up time, ASTM D-711 without beads, minutes max.	3 max.	3
No-Track time, Actual @ 77 degrees F/50% RH, seconds max.	90 max.	90
Directional Reflectance % min.	87 min.	50
Contrast Ratio @ 15 mils wet min.	0.98 min.	0.95
Scrub test, Cycles min.	1000 min.	1000
Volatile Organic Compound, grams/liter 150	Below 150	Below
Total Pigment, % By Weight min.	62 min.	62
Total Solids, % By Weight min.	76 min.	76
Total Solids, % By Volume min.	58 min.	58
PH min.	9.6 min.	9.6

Reportable Components:

YELLOW	Vapor Pressure mm Hg @ Temp °F		Weight Percent
METHYL ALCOHOL	97.68	68	5
QUARTZ SILICA	N/A	N/A	0.32
OSHA PEL = 200 PPM (skin) (260 MG/M3), STEL 250 PPM			
ACGIH TLV = 200 PPM (skin) (260 MG/M3) STEL 250 PPM			
NIOSH = TWA 200 PPM, 800 PPM (CEILING)			
2,2,4 TRIMETHYL - 1,3 - PENTANEDIOL MONOISOBUTYRATE			1
NIOSH REL = TWA 0.05 MG/M3, 3,000,000 FIBERS/M3			
OSHA PEL = TWA RESPIRABLE: 0.1 MG/M3 TOTAL DUST: 30 MG/M3			
ACGIH TLV = TWA RESPIRABLE: 0.1 MG/M3			

WHITE	Vapor Pressure mm Hg @ Temp °F		Weight Percent
METHYL ALCOHOL	98.68	68	5
QUARTZ SILICA	N/A	N/A	1.24
OSHA PEL= 200 PPM (SKIN), STEL 250 PPM			
ACGIH = 200 PPM (SKIN), STEL 250 PPM			
NIOSH = TWA 200 PPM, 800 PPM (CEILING)			
2,2,4 TRIMETHYL - 1,3 - PENTANEDIOL MONOISOBUTYRATE			1
NIOSH REL = TWA 0.05 MG/M3, 3,000,000 FIBERS M/3			
OSHA PEL = TWA RESPIRABLE: 0.1 MG/M3, TOTAL DUST: 30 MG/M3			
ACGIH = TWA RESPIRABLE: 0.1 MG/M3			

B. Epoxy Pavement Markings

The epoxy pavement-marking compound shall be applied with equipment that will precisely meter the two components.

The equipment shall produce the required amount of heat at the mixing head and gun tip to provide and maintain the temperatures specified.

Before mixing, the individual components A and B shall each be heated to a temperature of 80° F to 140° F. After mixing the application temperature for the combined material at the gun tip shall be 80° F to 140° F. The 140° F upper limit is the maximum temperature under any circumstances.

Both pavement and air temperatures shall be at least 50° F at the time of epoxy

pavement application.

The surface areas of new Portland cement concrete pavement and decks that are to receive markings shall be sandblasted prior to placement of the epoxy pavement marking. The amount of sandblasting shall be sufficient to remove all dirt and curing compound residue.

The surface areas of new asphalt pavement, existing asphalt pavement, and existing concrete pavement that are to receive markings shall be cleaned with a high-pressure air blast to remove loose material prior to placement of the epoxy pavement marking. Any pavement which has become dirty from tracked mud, etc., as determined by the Project Representative and shall be cleaned prior to the placement of the epoxy pavement marking.

When recommended by the epoxy manufacturer, a high-pressure water blast integrated into the gun carriage shall be used to clean the pavement surface prior to epoxy pavement marking application. The water blast shall be followed by a high-pressure air blast to remove all residual water leaving only a damp surface.

Epoxy pavement marking shall be applied to the road surface according to the epoxy manufactures recommended methods at **15 mils minimum thickness**. Glass beads shall be applied into the epoxy pavement marking by means of a pressurized bead applicator at a rate of no less than (17), and no more than (25) pounds per gallon.

Epoxy pavement marking and beads shall be applied within the following limits:

	MINIMUM	MAXIMUM
15 mil Marking:	100 sq. ft.	110 sq. ft.
Beads:	17 lbs.	25 lbs.

Epoxy Pavement Marking Material:

1. *Formulation.* Epoxy pavement marking material shall be a two component, 100% solids, material formulated to provide simple volumetric mixing ratio of two volumes of component A and one volume of component B, unless otherwise recommended by the material manufacturer.
2. *Composition.* The component A of both white and yellow shall be within the following limits:

Pigments:	White:	Yellow:
Min% by weight	18% Titanium	Min% by weight 23%
Chrome	Dioxide, (ASTM D 476 Type II)	Yellow,(ASTM D 211,Type III)
Epoxy Resin	75-82%	70-77%

3. *Epoxy Number.* The epoxy number of the epoxy resin shall be 0.38 ± 0.05 as determined by ASTM D1652 for white and yellow Component A on pigment free basis.
4. *Amine Number.* The Amine number on the curing agent (Component B) shall be 410 ± 50 per ASTM D2071.
5. *Toxicity.* Upon heating to application temperature, the material shall not produce fumes, which are toxic or injurious to persons or property.
6. *Color and Weather Resistance.* The mixed epoxy compound, both white and yellow, when applied to 3-inch by 6-inch aluminum panels at $15 \pm \frac{1}{2}$ mils of thickness with no glass beads and exposed in the Q.U.V.

Environmental Testing Chamber as described in ASTM G 53 shall conform to the following minimum requirements: (The test shall be conducted for 75 hours at 50° C, 4 hours humidity, and 4 hours U.V., in alternating cycles. The prepared panels shall be cured at 77° F for 72 hours prior to exposure.) The color of the white epoxy system shall not be darker than Federal Standard No. 595A17778. The color of the yellow epoxy system shall conform to Federal Standard No. 595A13538. The gloss values of both samples shall not be less than 70° after the test.

7. *Drying Time.* The epoxy pavement marking material shall have a setting time to a no-tracking condition of not more than 25 minutes at a temperature of 73° F and above.
8. *Curing.* The epoxy material shall be capable of fully curing under the constant surface temperature condition of 25° F and above.
9. *Adhesion to concrete.* The catalyzed epoxy pavement marking material, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified (4,000 psi minimum) concrete surface that there shall be a 100% concrete failure in the performance of this test.
10. *Hardness.* The epoxy pavement marking materials, when tested according to ASTM D 2240, shall have a Shore D Hardness between 75 and 100. Samples shall be allowed to cure at room temperature ($75^{\circ} \text{F} \pm 2^{\circ}\text{F}$) for a minimum of 12 hours and a maximum of 48 hours prior to performing the indicated test.
11. *Abrasion Resistance.* The abrasion resistance shall be evaluated on Taber Abrader with a 1000-gram load and CS-17 wheels. The wear index shall be calculated based on ASTM test Method C-501 and the wear index for the catalyzed material shall not be more than 70. The test shall be run on

cured samples of material, which have been applied at film thickness of 15 ± ½ mils to code S-16 stainless steel plates. The samples shall be allowed to cure at 75° ± 2° F for a minimum of 48 hours prior to performing the indicated tests.

12. *Tensile Strength.* When tested according to ASTM D 638, the epoxy pavement marking materials shall have a tensile strength of not less than 6,000 pounds per square inch. The Type IV Specimens shall be cast in a suitable dynamic testing machine. The samples shall be allowed to cure at room temperature (75° F ± 2° F) for a minimum of 12 hours and a maximum of 48 hours prior to performing the indicated tests.
13. *Compressive Strength.* When tested according to ASTM D 695, the catalyzed epoxy pavement marking materials shall have a compressive strength of not less than 12,000 pounds per square inch. The cast sample shall be conditioned at room temperature (75° F ± 2° F) for a minimum of 12 hours and a maximum of 48 hours prior to performing the tests. The rate of compression of these samples shall be no more than 1/4-inch per minute.

C. Types of equipment:

1. *Portable applicator.* The portable applicator shall be a device typically used for painting crosswalk lines, stop bars, short lane lines, and short lane center lines. The applicator shall be easily maneuverable and capable of being propelled by the operator.
2. *Mobile applicator.* The mobile applicator shall contain equipment to provide for automatic installation of skip lines in any combination of line and skip up to 40 feet. The mobile applicator shall be moved in conjunction with the melting and heating kettles in such a manner as to provide continuous highway operation of the kettles and the mobile applicator as an integral unit.
3. *Epoxy Primer Equipment.* The epoxy primer application shall be accomplished using equipment having the following features:
 - a. The main storage tank shall be equipped with a visible gauge which will allow the Engineer to readily ascertain the rate of application.
 - b. The main storage tank shall be equipped with a heating device which will maintain the epoxy at a constant efficient temperature.
 - c. The spray nozzle and epoxy spray shall be protected from the action of wind to insure placement where needed.

4. *Cleaning Equipment.* Equipment must be provided to ensure removal of dust, debris, paint, and other foreign matter from the road surface immediately prior to the installation of the composition, or immediately prior to the application of primer.

D. Pavement Primers

The type and application rate of epoxy resin primer shall be as recommended by the thermoplastic or preformed plastic pavement marking manufacturer.

A primer application rate of zero will not be accepted, except for thermoplastic marking and inlaid preformed plastic pavement marking placed on new asphalt surfaces as recommended by the manufacturer and approved in writing by the Engineer. However, if the Engineer determines that a new asphalt surface has become soiled, prior to placement of the pavement markings, pavement primer will be required and shall be applied as approved.

The epoxy resin primer material may be accepted at the job site on the basis of a manufacturer's certification, or a sample may be sent to the Laboratory for testing, in which case three weeks shall be allowed between sampling and intended use.

E. Preform Thermoplastic / Existing Overlay or Older Top Surface Application:

1. All symbols and legends shall comply with the Manual on Uniformed Traffic Control Devices including metric requirements.
2. After the marking has cooled down, a chisel test shall be performed to ensure that a proper bond has been achieved.
3. Road and ambient temperature should have no effect on the performance of the marking material.
4. Dry asphalt of existing moisture. Do not install marking if it is raining or snowing. Wait to install marking 24 hours after it has stopped raining.
5. Do not apply marking on top of salt or other deicers. Wait for 2 or 3 heavy rainfalls prior to installing the marking material, or use a pressure washer.
6. The road must be free of dirt, dust, chemicals, and significant oily

substances.

7. The material can be placed over existing preformed thermoplastic, if existing material has been heated with a torch, and the majority has been lifted with a shovel.
8. On Portland cement concrete roads, a sealant may be needed to ensure a proper bond. **(Check manufacturer's recommended instructions for installations.)**
9. Curing compounds must be sandblasted or grinded on new Portland cement concrete to ensure adequate bonding.
10. All leading edges of the pavement markings shall be feathered due to snowplow damage.
11. Glass beads shall be sprinkled onto the pavement marking material surface. This will enhance initial retro-reflectivity and aide in cooling the markings. It is important to keep all traffic off the pavement marking material to prevent damage.
12. Crosswalks, stop bars, sidewalks, and access ramps that have any loose glass beads shall be cleaned thoroughly with a leaf blower immediately after pavement marking is installed.

Pavement marking tape (removable) shall be installed in accordance with the manufacturer's recommendations and maintained throughout the required construction phase at no additional cost to the County.

Pavement marking tape designated in the pay item as removable shall conform to ASTM D 4592, Type I, and shall be 4 ± 0.1 inches wide.

1. *Description.* The marking tape shall consist of weather and traffic resistant yellow or white colored reflective material. The material shall consist of conformable (metal foil) backing with a pressure-sensitive adhesive design for adhesion to asphalt or concrete surfaces.
2. *Requirements:*
 - a. *Color.* The color of the visible or outer surface shall closely match the white or yellow traffic marking paint specified for highway delineation. Glass beads shall be strongly adhered to the tape.
 - b. *Reflectance.* The white and yellow tapes shall have the following initial minimum reflectance values at 0.2° and 0.5° observation angles and 86.0° entrance angles as measured in accordance with

the testing procedures of Federal Test Method Standard 370. The photometric quantity measured is specific luminance (SL) and is expressed as millicandelas per square foot per foot-candle.

Color	White		Yellow	
	0.2°	0.5°	0.2°	0.5°
Specific Luminance	1360	760	820	510

- a. *Adhesive.* The striping tape shall be supplied in rolls ready for application and have a protected pressure sensitive adhesive, which shall not have a protective liner nor require a solvent activator.
- b. *Adhesion.* The material shall adhere to asphalt and concrete surfaces when applied at surface temperatures of 35° F and above. Once applied, the tape shall adhere to the pavement at sub-freezing temperatures.
- c. *Conformability.* The material shall be thin, flexible, conformable, and show no cracking, flaking, or bead loss. Following application, the tape shall remain conformed to the texture of the pavement surface. The thickness shall not be less than 17 mils.
- d. *Removeability.* The tape shall be removable by following manufacturer's recommendations, so long as the material is substantially intact. Removal shall not require sandblast, solvents, or grinding methods.
- e. *Durability.* The striping material applied in accordance with manufacturer's recommended procedures shall be weather resistant and show no appreciable fading, lifting, or shrinkage during the useful life of the line.
- f. *Packaging and Delivery.* The striping material as supplied shall be of good appearance and free of cracks. The edges shall be true, straight, and unbroken.
- g. The Contractor shall specify the material used for temporary pavement markings. Materials shall be durable enough to maintain a minimum reflectivity of 100 millicandelas throughout the life of the detour or their intended use. This may require many applications of temporary pavement markings as determined by the County.
- h. Where temporary pavement marking materials are used on new or existing pavement surfaces, temporary pavement markings, or other material shall be used so it can be removed from surface without scarring.
- i. The striping material shall be packaged in accordance with accepted commercial standards to prevent damage during shipment and storage. The tape as supplied shall be suitable for use for a period of at least one year following delivery when stored at

temperatures of 100° F or below.

F. Temporary Marking Tabs

Raised pavement markers (temporary) shall be installed on centerlines, edge lines, and lane lines where specified in the contract. Single markers shall be installed at 20' intervals for solid lines. A group of three markers at three-foot spacing and at 40-foot intervals shall be installed for skip lines.

When chip seals, slurry seals, or tack coats are used, temporary marking tabs with covers shall be used, or protect the markers with an approved protective cover, which is removed after the asphalt material is sprayed.

G. Grooved Concrete for Inlay Applications

Prior to installation operation, the Contractor shall submit to the Traffic Engineer instructions from the preformed plastic pavement manufacturer detailing surface preparation, grooving requirements, and material application. The instructions shall include the following:

1. Equipment Requirements
2. Approved Work Methods and Procedures
3. Material Application Temperature Requirements
4. Weather Limitations
5. Special Limitations
6. Special Precautions
7. Any other requirements necessary for successful installation and satisfactory performance of the material.

All materials for use by the County shall have manufacture's installation specifications for installation and shall be supplied to the project representative.

The bottom of the groove shall have a smooth, flat finished surface. This shall be accomplished by utilizing gang-stacking cutting heads having diamond tipped cutting blades. The spacers between each blade shall be such that there will be less than a 10-mil rise in the finished groove between the blades.

The edges of the preformed plastic pavement marking shall be straight and uniform, and uniformly adhere to the pavement.

Grooves shall be clean, dry and free of oil, dirt, grease, paint or other foreign contaminants. Contractor shall protect the grooves from traffic and re-clean grooves as necessary prior to application of the preformed plastic pavement markings.

Grooved width shall be the tape width plus $\nabla \frac{1}{4}$ ". Grooved depth shall be 100% of the tape and adhesive thickness plus 15%. For Series A380-I of A381-I tape,

the grooved depth shall be 80 mils ∇ 10 mils.

Groove position shall be a minimum of 2" from the edge of the tape to the longitudinal pavement joint.

H. Pavement Marking and Striping Installation

ARAPAHOE COUNTY GOVERNMENT shall make the final determination in regards to the type and location of pavement markings and striping within the right-of-way during the review of the project signing and striping plans.

1. Pavement Markings (Symbols and Legends)

All symbols and legends shall comply with the Manual on Uniformed Traffic Control Devices including metric requirements.

The use of preformed pavement markings shall be used with the installation of all symbols and legends; such as, all arrows, "onlys," school x-ings, bike lane symbols, railroad, etc. on new and overlay streets.

2. Crosswalks

General – Crosswalks shall be used at all signalized intersections where pedestrian signal indications are located and approved pedestrian and school crossing locations.

- a. *Standard Crosswalk.* White 8' long x 12" wide "Continental" or standard style bars. The placement of these bars shall be 6' centers
- b. *Transverse Crosswalk.* Where applicable, shall be a white 12" Crosswalk bar on both sides of the designated walkway area, and shall be installed the full asphalt or concrete width of the roadway minus the gutter pans.

3. Stop Bars

- a. Stop bars are required at all signalized intersections and locations specified by the County.
- b. All stop bars shall be white 24" wide, the full width of the appropriate travel lane including the designated bike lane, not closer than 4' from the closest edge of the crosswalk.

4. Bicycle Markings

- a. Bike lane markings shall be used on all streets where designated bike lanes are established. These lanes require a bike rider symbol and an arrow symbol (only).

5. Stencil Painting

All stencils used shall conform to MUTCD standards for shapes and sizes.

I. Striping Requirements

Striping over existing markings shall not vary ¼" along the edge of existing marking. The Contractor may be required to apply markings by means of hand-operated equipment in order to accurately match existing striping at tight radius curves.

The Contractor shall provide flaggers, signs, barricades, cones, or other devices needed to ensure sufficient safety for the motoring public and pedestrian traffic. **When parked vehicles interfere with the installation of any pavement markings, the Contractor shall provide a (3) three day notification to the homeowner, tenant, or any business for vehicle removal.**

Any tire tracking of paint shall be the Contractor's responsibility for the removal.

J. Removal

Pavement markings removal will be paid by the square foot.

The Contractor shall remove all pavement markings listed in Tabulation of Adjustments.

The following are the required procedures / practices for removal:

- a. Pavement markings shall be removed by using a rotary type grinder (a drum type grinder manufactured for this purpose), sandblasting, or by hydro-blasting.
- b. Preform plastic material may require using a weed-burning torch.
- c. The roadway shall have no more than ¼" damage after removal of pavement markings.
- d. Disposal of materials, as a result of removal, are the responsibility of the Contractor.

The Contractor at his expense shall legally dispose of the material.