

CHAPTER 14 – TRAFFIC CONTROL DEVICES

TABLE OF CONTENTS

Section	Title	Page
14.1	General	<u>14-114-4</u>
14.2	Design Requirements	<u>14-114-4</u>
14.2.1	Traffic Signal Design Requirements	<u>14-114-1</u>
A.	Special Requirements for Loveland (GMA and City Limits).....	<u>14-114-1</u>
B.	Special Requirements for Fort Collins (GMA and City Limits).....	<u>14-314-2</u>
14.3	Traffic Signing	<u>14-514-3</u>
14.3.1	General	<u>14-514-3</u>
A.	Type and Location of Signs.....	<u>14-514-3</u>
B.	Design, Installation, and Maintenance.....	<u>14-514-3</u>
C.	New Roadway	<u>14-514-4</u>
D.	Other Standards	<u>14-514-4</u>
E.	Sign Posts, Supports, and Mountings	<u>14-514-4</u>
F.	Sign Reflectivity	<u>14-614-5</u>
G.	Backing Plates	<u>14-614-5</u>
14.3.2	Intersections	<u>14-614-5</u>
A.	Street Name Sign.....	<u>14-614-5</u>
B.	Stop Signs.....	<u>14-814-6</u>
C.	Warning Signs	<u>14-814-6</u>
14.3.3	Traffic Control Signs	<u>14-814-6</u>
A.	Design and Size	<u>14-814-6</u>
B.	Mounting	<u>14-814-7</u>
C.	Regulatory	<u>14-814-7</u>
D.	Warning	<u>14-914-7</u>
E.	Guide	<u>14-1014-8</u>
14.3.4	Roundabouts	<u>14-1014-8</u>
A.	Modern Roundabouts	<u>14-1014-8</u>
B.	Mini Roundabouts	<u>14-1014-9</u>
14.4	Pavement Marking and Striping	<u>14-1014-9</u>
14.4.1	General	<u>14-1014-9</u>
A.	Type and Location of Striping and Markings.....	<u>14-1014-9</u>
B.	Design, Installation, and Maintenance.....	<u>14-1014-9</u>
C.	New Roadway	<u>14-1014-9</u>
14.4.2	Pavement Markings (Symbols, Arrows, “ONLY”s)	<u>14-1114-10</u>
A.	General	<u>14-1114-10</u>
B.	Preformed Thermoplastic Pavement Marking Specifications.....	<u>14-1114-10</u>
C.	Crosswalks.....	<u>14-1114-10</u>
D.	Stop Bars	<u>14-1114-10</u>
E.	Symbols	<u>14-1214-10</u>
F.	For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, “ONLY”s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint. Bikeways.....	<u>14-1214-11</u>
G.	Roundabouts.....	<u>14-1214-11</u>
14.4.3	Striping	<u>14-1214-11</u>
A.	General	<u>14-1214-11</u>
B.	Broken Line	<u>14-1314-11</u>
C.	Turn Bay Line.....	<u>14-1314-12</u>

D. Centerline	14-1314-12
E. Parking Stalls and Angle Parking.....	14-1314-12
F. Bikeway	14-1314-12
14.4.4 Temporary Striping	14-1314-12
A. Specifications	14-1314-12
B. Time Duration Limit	14-1314-12
C. Extensions	14-1314-12

LIST OF TABLES

This Chapter Does Not Contain Tables

LIST OF FIGURES

This Chapter^[NB1] Does Not Contain Figures^[BS3]

CHAPTER 14 – TRAFFIC CONTROL DEVICES

14.1 GENERAL

This chapter describes general signal, signing, and striping design requirements for use in the Local Entity. All design and construction of signals, signing, and striping shall be in conformance with this chapter and the latest revision of the MUTCD. For Fort Collins^{[SK4][SK5]} ^[NB6](city limits only) also refer to Appendix “F”, *City of Fort Collins Traffic Operations Manual*.^[BS7]

14.2 DESIGN REQUIREMENTS

14.2.1 Traffic Signal Design Requirements

The design of traffic signals shall be performed by the Local Entity or a qualified Traffic Engineer approved by the Local Entity. The Local Entity may charge the cost of design and construction to the Developer when the work is completed by the Local Entity.

For CDOT highways, the design will follow the current version of **Colorado Department of Transportation Standards** for a standard mast arm type traffic signal installation. For city streets not on the state highway system the design will follow the ~~1994~~current version of **Colorado Department of Transportation Standards** for a standard mast arm type traffic signal installation, with the changes below in Loveland or Fort Collins (GMA and city limits^[SK8]):^[NB9]

A. Special Requirements for **Loveland (GMA and City Limits)**^{[NB10][SK11]}

- Galvanized and painted mast arm/signal poles, luminaire arms, and extensions shall be painted with Standard Valmont Color Medium **Bronze (Brown)**.^[BS12]
- Street light luminaire extensions (galvanized and powder coated) shall be ~~ordered~~ **delivered for** all poles. A 35-foot luminaire mounting height and a 15-foot luminaire arm (galvanized and painted) shall be used to mount a 250 or 400 Watt **LED EquivalentHPS** streetlight fixture (or approved equal). Streetlight fixtures are to be obtained from the City of Loveland’s warehouse at no cost to the project or the traffic division. The luminaire arm shall be rotated 10 degrees in front of the mast arm (-10 degrees). **If free rights turn lanes are provided or anticipated, a second luminaire arm shall be provided 145 degrees clockwise from the first luminaire arm.**
- ~~Current requirements for signal cabinets, battery backup, controllers, conflict monitors, CCTV cameras, fiber optic switches, data radios, vehicular detection equipment, and other ancillary devices shall be obtained from the local agency engineer during the design process as they change frequently. In general, all new and reconstructed traffic signals shall be compatible with and connected to the City’s existing central traffic signal management system. Some corridors are running special hardware or software and signals added to those corridors shall be compatible.~~^[BS13]~~The signal cabinet shall be a SafeTran Model #333SD (or approved equal) wired for a full 8 phase with overlaps operation with Signal Sense SSDC 1500 UPS (or approved equal) with three (3) 79 Amp backup batteries.~~
- ~~Signal Controller shall be a Naztec 970 traffic signal controller (or approved equal) with the latest version of software.~~

Chapter 14 – TRAFFIC CONTROL DEVICES
Section 14.2 Design Requirements

- ~~4. A Fiber optics switch is provided in each signal cabinet and at other locations as needed. A Rugged Com RS 900GP 12 port multilink patch panel part number FWM 1X SP BK (or approved equal) is also required.~~
- 5.4. Opticom fire preemption system complete with Global 721 detectors (or approved equal), wiring, and Global 752 card (or approved equal) in the cabinet (3M system) is required^[SK14].
- ~~6.5. Attachment height for mast arms to signal pole shall meet CDOT specifications on CDOT corridors (20' attachment height) and at 19 feet on other corridors, unless located on CDOT highways where the latest CDOT specifications (20' attachment height) shall be required.~~
- 7.6. A ^[SK15] Panasonic pan-tilt-zoom (PTZ) camera ~~model WV SW396 (or approved equal)~~ shall be required at each signalized intersection. The camera shall include all wiring including an unspliced ~~latest~~ CAT 5e cable from camera to controller cabinet, properly terminated in accordance with manufacturer's recommendations.
- 8.7. Black, 12"-12"-12" polycarbonate signal head cap visors with 5" black louvered aluminum back plates shall be mounted using ~~s~~Sky ~~b~~B brackets (or approved equal) over the center of each lane. Side of pole mounted 12"-12"-12" are for the far side right, which will cover any dedicated right turn lanes. Use of far side left 12"-12"-12" or 12"-12"-12"-12" heads with cut away visors are determined on an intersection by intersection basis but will be used in most cases on State Highways and/or arterials with significant large truck traffic. Intersections with left turn phasing shall have far left side heads. Four section Flashing Yellow Arrow indications shall be standard for all new left turn phasing installed at intersections where permissive left turn phasing is a possibility. Section heads shall not be doghouse style unless otherwise approved Local Entity.
- 9.8. Black 16-inch poly LED countdown pedestrian heads and a clamshell/banding mounting system are required ~~with black Polara Bulldog ADA pedestrian buttons (or approved equal)~~ for all standard pedestrian movements.
- ~~10.9.~~ Two 3-inch conduits and one 2" conduit (Schedule 80 PVC minimum) will be used for wiring between the signal bases and the cabinet. For vehicle loops, use a 2-inch conduit from the water valve pull boxes to the nearest pull box. Trenched conduit shall be UL Listed Schedule 80 PVC with glued joints. Bored conduit shall be continuous UL Listed HDPE Schedule 80 smooth wall conduit designed for directional boring.
- ~~11.10.~~ Traffic signal pull boxes shall be polymer concrete Tier 22 with traffic logo on the lid. There are 4 standard sizes depending on the application: 13" x 24" x 12", 17" x 30" x 12", 24" x 36" x 18", and 36" x 48" x 18". Split lid for fiber optics. See Figure 14-4 for pull box specifications.
- ~~12.11.~~ Pedestrian buttons shall be the black Polara bulldog type (or approved equal) with audio alert, LED light, and sign housing/back plate that shall be a 5" x 7" man/arrow white on black. If accessible pedestrian signals are required, they shall be Polara.
12. See Figure 14-3A for example traffic signal layout and Figure 14-3B for Traffic Signal General Notes.

13. All design work of the cable installation and selection of the communications electronic equipment shall be approved by the Traffic Engineer prior to acquisition and installation. Upon completion of the cable installation, final as-builts shall be submitted for review and approval.
14. All new signals shall be interconnected into the existing City signal system using either fiber optics (preferred) or data radio.
- ~~13.~~15. Three inch conduit shall be installed along all arterials for future signal interconnect. Pull boxes shall be provided at 500 foot spacing in accordance with standard drawing 14XX. Separate pull boxes shall be provided adjacent to signal cabinets for signal wiring and fiber optics. When installed, fiber optic cables shall be 48 strand single mode fiber with 100 feet of slack provided at each pull box. Laterals between the signal cabinet and the fiber optic pull box may be 12 strand single mode fiber^[SK16].

B. Special Requirements for Fort Collins (GMA and City Limits)^[SK17]

1. Galvanized and painted mast arm/signal poles, luminaire arms, and extensions painted with Standard Retardo Brown or Forest Green shall be used.^[BS18]
2. Street light luminaire extensions (galvanized and painted) shall be ordered on all poles. A 30-foot luminaire mounting height and a *15-foot* luminaire arm (galvanized and painted) shall be used to mount a 250 Watt HPS^[DB19]^[BS20] streetlight^[SK21] fixture. Streetlight fixtures are to be purchased from the City of Fort Collins warehouse.
- ~~3. Current requirements for signal cabinets, battery backup, controllers, conflict monitors, CCTV cameras, fiber optic switches, data radios, vehicular detection equipment, and other ancillary devices shall be obtained from the local agency engineer during the design process as they change frequently. In general, all new and reconstructed traffic signals shall be compatible with and connected to the City's existing central traffic signal management system. Some corridors are running special hardware or software and signals added to those corridors shall be compatible.~~^[BS22]
- ~~3. 2070 L Controller and Cabinet Model #332 wired for a full 8 phase with overlaps operation with the latest version of city approved firmware is required.~~
- ~~4. City standard spread spectrum radio with antenna and complete wiring, including modem card in the controller, is required.~~^[BS23]
- ~~5.4.~~Opticom fire preemption system complete with detectors, wiring, and card in the cabinet(3M system) is required.
- ~~6. Attachment height for mast arm to pole shall be at 19 feet instead of CDOT standard 20 feet.~~^[BS24]
- ~~7. Micro loops complete with wiring and detector cards for counting traffic on all approach lanes shall be used.~~
- ~~8.5.~~Yellow, 12"-12"-12" aluminum signal heads with 4" black back plates shall be mounted using astrobrackets-skybrackets over the center of each lane. Side of pole mounted 12"-12"-12" are for the far side right, which will cover any dedicated right turn lanes. Use of far side left 12"-12"-12" heads are determined on an intersection

Chapter 14 – TRAFFIC CONTROL DEVICES
Section 14.2 Design Requirements

~~by intersection basis but will be used in most cases on State Highways or Arterials with significant large truck traffic. Intersections with left turn phasing shall have far left side heads. Four section Flashing Yellow Arrow indications shall be standard for all new left turn phasing installed at intersections where protected/permissive left turn phasing is indicated.~~

~~9.6. Black Yellow~~ 16-inch LED pedestrian heads (hand/man) with visors and a clamshell/banding mounting system. ~~are required with ADA pedestrian buttons for all standard pedestrian movements.~~

~~7. One Two~~ 3-inch and one 2-inch conduits (Schedule 40 PVC minimum) ~~will be used for wiring shall be installed between the signal bases and each the corner secondary pull box. Two 3-inch and two 2-inch conduits (Schedule 40 PVC minimum) shall be installed connecting the secondary pull boxes. Three 3-inch and three 2-inch conduits shall be installed between the main pull box and the cabinet. For vehicle loops, use a 2-inch conduit from the water valve pull boxes to the nearest pull box~~ [DB25][SK26][BS27]

~~8. Traffic signal pull boxes shall be polymer concrete Tier 22. The lid shall be marked "TRAFFIC" or "TRAFFIC SIGNAL". There are 4 standard sizes depending on the application: 13" x 24" x 18", 17" x 30" x 18", 24" x 36" x 18", and 36" x 48" x 18".~~

~~10.9.~~

~~11.10.~~ Pedestrian buttons shall be the yellow bulldog type with audio alert, LED light, and 9" X 12" sign housing/back plate [DB28][SK29]. ~~Where required, Accessible Pedestrian Signal Detectors shall be Polara.~~

~~11. All new signals shall be interconnected into the existing City signal system using either fiber optics (preferred) or data radio.~~

~~12. The City of Fort Collins operates its own communications network for the traffic management system, and as such, any new traffic signal installation shall include the design and expansion of that communications network from an approved existing access point to the new signal. The design and expansion of the communications network shall be per the traffic operations specifications current at that time.~~

~~13. The traffic signal system communication network utilizes 48 strand single mode fiber optic cable, per traffic operations specifications. The fiber shall be undergrounded in 2" HDPE schedule 40, SDR 11, or heavier conduit, with 24" x 36" or larger pull boxes placed every 1000 feet. A 100 foot coil of fiber cable shall be stored in all pull boxes, with exceptions approved by the traffic operations department.~~

~~12. All design work of the cable installation and selection of the communications electronic equipment shall be approved by the Traffic Engineer prior to acquisition and installation. Upon completion of the cable installation, final as-builts shall be submitted for review and approval.~~

~~13. Where interconnection does not exist, a 2-inch conduit shall be installed along all arterials for future signal interconnect. Pull boxes shall be provided at 1000 foot~~

spacing. Separate pull boxes shall be provided adjacent to signal cabinets for signal wiring and fiber optics. When installed, fiber optic cables shall be 48 strand single mode fiber with 150 feet of slack provided at each pull box. Laterals between the signal cabinet and the fiber optic pull box may be 12 strand single mode fiber^[SK30].

14.

14.3 TRAFFIC SIGNING

14.3.1 General

A. Type and Location of Signs

The Local Entity Engineer shall make the final determination regarding the type and location of signage controls within the right-of-way. These controls shall include traffic control signs, street name signs, delineators, and permanent barricades.

B. Design, Installation, and Maintenance

Because the Local Entity will maintain the permanent traffic control devices on public rights-of-way, all traffic control devices shall be fabricated and installed in accordance with **Chapter 22, Construction Specifications**. All design shall be in accordance with this chapter and the latest revisions of the MUTCD and Standard Highway Signs and Markings, and in Fort Collins (GMA and city limits) refer to Appendix F, City of Fort Collins Traffic Operations Manual.

C. New Roadway

Permanent signage, unless otherwise approved by the Local Entity Engineer, shall be completely in place before any new Roadway is opened to the public.

D. Other Standards

These Standards are to be used in conjunction with other applicable Local Entity Regulations.

E. Sign Posts, Supports, and Mountings

For Fort Collins (GMA and city limits) also refer to Appendix F, City of Fort Collins Traffic Operations Manual. Sign posts and their foundations and sign mountings shall be constructed to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

1. Sign Post. The post shall be constructed in two sections:
 - a. Anchor (Stub). A 2-1/4-inch 12-gauge galvanized steel square stub section with holes, three (3) feet long, is driven into the ground 30 to 33 inches with 3 to 6 inches remaining above the final grade. The sign post system's material specification is Telspar 22F12A 03PG, 2-1/4-inch x 3 feet anchor post with holes, or perforated.
 - b. Sign Post. A 2-inch square galvanized steel post section with holes is inserted into the stub and bolted. The material specification is Telspar 20F12P-10PG, 2-inch square 12-gauge 10-foot post with holes. Posts shall be installed 6 to 8 inches into the anchor (stub), which has 3 to 6 inches sticking out above the final grade.

2. Post Bolts. Two 2-1/2-inch long, 3/8-inch hex head bolts are used to attach sign posts to sign anchor (stubs). These bolts shall be installed in adjacent holes at the top of the anchor (stub), at 90 degrees to one another.
3. Sign Bolts. Signs shall be mounted to the post with a minimum of one drive rivet (TL3806 EG) and nylon washer (against sign face) at the top of sign. The bottom of the sign shall be attached with one 5/16" hex bolt, one metal washer and one nylon washer against sign face. The bolt or rivet system is used to fasten signs to the Telspar post.
4. Other Sign Mounts. Streetlights and approved utility poles, when located appropriately, may be used for signs such as warning, parking, and speed limit signs. Streetlight locations should be checked for potential sign installation during the design process and shown on the sign plan sheets. Refer to **Section 14.4.3 B**.
5. Breakaway Post System. Posts must be of appropriate length to comply with MUTCD specifications for the location, must conform to **the Local Entity's Specifications**, and must meet the Federal breakaway standards. See **Construction Drawing 1414** for Cantilever arm brackets for street name signs mounted on light or signal posts. [NB31][SK32]

F. Sign Sheeting and Fabrication Reflectivity

All traffic control signs must be fabricated with reflective materials. All reflective ~~materials~~ sheeting to be a minimum of diamond grade material, ~~except parking and street name signs shall be a minimum of high intensity material or greater~~. per Section 14.3.3. All signs or traffic control devices must have a 7-year materials warranty. No silk screened signs will be permitted [DB33][SK34].

For Fort Collins (GMA and city limits) also refer to Appendix F, City of Fort Collins Traffic Operations Manual.

G. Backing Plates Aluminum Sign Blanks

Aluminum blanks of 0.080 inch thickness gauge are standard, except for signs larger than 36 x 36 inches, which shall be ~~.100 or 0.125~~ inch thickness gauge aluminum [SK35]. [NB36]

14.3.2 Intersections

A. Street Name Sign

1. General. All street name signs must conform to these standards, See **Construction Drawing 1411**. If the intersection has a traffic signal, street name signs will be ~~designated~~ designed as part of the signal. Internally illuminated signs are not permitted in Loveland or Fort Collins (GMA and city limits).
- ~~1.~~
2. Minor Intersection. Eight-inch plates with 6" lettering shall be used at all minor intersections; lengths will vary to fit street names. Also see street name sign drawing #1411 [DB37].
3. Multi-Lane ~~major~~ Intersection. ~~10"~~ Ten-inch plates with 8" lettering shall be used at all ~~major~~ intersections on roadways with two or more lanes of traffic moving in the

~~same direction, which include the intersections with Collector and Arterial Roadways~~^[SK38]. ^[DB39]

~~3.4.~~ Signalized Intersections. In Loveland (GMA and city limits), street name signs placed on mast arms at signalized intersections shall use 18” plates with 14” letters.

~~4.5.~~ Sign Assembly. There shall be two plates for each road, with a minimum of four plates per street sign assembly. In Loveland (city limits only), street name signs shall be mounted directly to the sign post with two drive rivets per sign and nylon washers against sign face. Typical installation shall include four street name signs, two for each direction. For signs with lengths of 18” – 30” use 0.080 gageinch blank thickness; for signs 36” – 48” use 0.100 gageinch blank thickness.

~~5.6.~~ Sign Face.

a. Letter Size. Refer to the following table and **Construction Drawing 1411** for letter size specifications.

Type of Mounting	Letter Size	Height of Sign Blank ^[DB40]
Local/Local <u>Minor Intersection</u>	6”	8”, Lengths may vary
<u>Major Intersection</u>	8”	<u>10”, Lengths may vary</u>
Metro Overhead	14”	18”, Lengths may vary

b. Color. Letters and numbers are to be white on a green background face. Private streets shall use green letters on a white background face. The colors shall not fade when exposed to an accelerated test of ultraviolet light equivalent to 5 years of outdoor ~~exposure~~^[DB41]^[SK42]^[SK43].

~~b. No silk screened signs are permitted. Minimum of high intensity materials shall be used for local signs and diamond grade for metro overhead all street name signs.~~

c. Block Numbers and Arrows. All signs shall include block numbers plus arrow pointing toward the higher block number, except on one way streets. Arrow on one way streets shall point in the direction of traffic. Arrows shall meet MUTCD standards as illustrated in the Standard Highway Sign Handbook. Where intersection is in the middle of a numbered block, provide only block numbers without arrows.

d. Border. There shall be no borders on street name ~~signs~~^[NB44] (except for Metro District ~~signs~~^[SK45]).

~~6.~~ Street Name. Street names and 100-block (where applicable) designations should be obtained from the approved plat. ~~Internally illuminated signs are not permitted in Loveland (GMA and city limits).~~^[NB46]

7. Change of Name or Numbers. At the point where a street changes names/numbers from one section to the next, the change shall be designated with a street name assembly by using standard names, numbers, and directional arrows -to indicate change. This will be accomplished using an -18” double height street name plate. ~~This change and shall look like a standard street name sign, separated horizontally with a vertical white line in the middle of the sign.~~^[SK47]

8. **No Outlet Signs.** On any cul-de-sac, temporary dead-end street, or any other streets with only one access point a “No Outlet” sign is required. The “No Outlet” signs may be placed under the street name signs. In Loveland (GMA and city limits), signs shall be W14-2a adapted to fit a 30” x 8” blank.

B. Stop Signs

1. Location of all stop signs shall be determined and discussed in the TIS.
2. Stop signs will be placed in accordance with the TIS, approved construction plans, and the MUTCD. In general, stop signs should be placed at point of curvature- (PC) and behind attached sidewalk^[DB48]^[SK49].

C. Warning Signs

Intersection warning signs may be required on 4- or 6-lane Arterial Roadways in advance of major intersections. An advisory plaque identifying the name of the intersecting side street shall be placed beneath the advance intersection warning sign. Placement of these signs shall be per MUTCD standards.

14.3.3 Traffic Control Signs

A. Design and Size

Sign specifications and diagrams are detailed in the latest revision of the Federal “Standard Highways Signs and Markings,” latest version. This publication is available from the U.S. Department of Transportation, Federal Highway Administration. Acceptable sign sizes are listed in the standard column of the table printed with each diagram. Expressway and construction warning signs shall be a minimum 36” x 36”.

B. Mounting

Signs should be mounted on existing streetlight and power poles, with new posts being used only if necessary. **Streetlight locations should be checked for potential sign installation during the design process and shown on the signing and striping plan sheets.** 3/4" stainless steel banding shall be used to mount signs to fiberglass and steel poles. Installation of signs on wood poles can be achieved by using 3/8” x 2-1/2 inch lag bolts.

C. Regulatory Signs^[NB50]

- ~~1. **Reflectivity.** All regulatory signs, except parking, shall be Diamond grade reflectivity or greater. This includes the red series and black on white signs. For Fort Collins (GMA and city limits), Micro prismatic sheeting or greater is required, except for parking signs.~~
- ~~2. **Sheeting Material.** All signs shall be fabricated with sheeting material, including letters. **No silk-screened signs will be permitted.** For Fort Collins (GMA and city limits), silk-screening is acceptable but must be guaranteed for at least seven years.~~
- ~~3-1. **Stop Sign.** Stop sign sizing shall conform to the MUTCD. However, stop signs shall also not be less than 30” x 30” in size and consist of diamond grade sheeting or greater.~~

- 4.2. Yield Sign. For roundabouts or minor intersections only, a 36”x36”x36” yield sign may be used in lieu of a stop sign, at the discretion of the Local Entity according to MUTCD.
- 5.3. Speed Limit Sign. All Collectors and Arterials should have speed limit signs at a minimum ½- mile intervals. All subdivisions shall have a speed limit sign at each entrance^[DB51].
- 6.4. Parking/No Parking Sign. Designated parking and “no parking” zones shall be signed in accordance with MUTCD. ~~No silk-screened signs are permitted. For Fort Collins (GMA and city limits), silk screening is acceptable but must be guaranteed for at least seven years.~~

D. Warning

1. Sheeting/Reflectivity Requirements. All school crossing signs^[NB52] and associated~~those with, and~~ W16-7P^[DB53] arrow signs shall be made with ~~diamond grade~~ fluorescent yellow/green sheeting. All other warning signs shall be made with fluorescent yellow sheeting.
2. “No Outlet” Sign. On dead end streets, cul-de-sacs, and temporary dead end streets, a “No Outlet” sign will be required and mounted with standard mounting system under the street name sign. The sign shall be an MUTCD #W14-2a^[DB54]~~1p~~, 30 x 6-inch minimum size (30” x 8” minimum in Loveland [city limits only]) black on yellow warning sign. A separate 30” x 30” No Outlet sign may also be required in specific locations.
3. “Road Closed” Sign and Barricades.
 - a. Temporary Dead End. All temporary dead-end streets shall have a Type III barricade with appropriate advance warning sign(s) and as shown in **Construction Drawing 1413**. A temporary dead-end street is anticipated to be a dead end for less than a year. Type III Barricades shall have a “Road Closed” (R11-2, 48 x 30 inches) sign mounted on both sides of the barricade.
 - b. Long-Term Dead End. All dead-end streets anticipated to be a dead end for more than a year must use long-term barricades. The barricade shall consist of a split rail fence with round vertical and horizontal members, pressure treated, with two horizontal rails and a centerline of 10 to 12 feet for vertical members. Delineators shall be installed on the vertical members with a minimum of 2 per member. The “Road Closed” sign shall be mounted directly on the fence. For Fort Collins (GMA and city limits), Type III barricades or OM4-2 object markers may be mounted on telspar posts and anchors shall meet MUTCD standards.
4. Crosswalk Sign. Crosswalks shall be signed where adjacent to a school and on an established school pedestrian route. There are usually a minimum of 4 signs per crosswalk.^[NB55] The color and installation shall be completed according to MUTCD. The color shall be fluorescent yellow ~~green~~^[DB56]^[SK57].

E. Guide

~~1. **Reflectivity Requirements.** The guide signs shall have high intensity sheeting. In Fort Collins (GMA and city limits), the guide signs shall have Micro prismatic sheeting or greater.~~

~~2.1. **Bikeway Signs in Loveland (GMA and city limits).** Bicycle signs for bike lanes shall be provided. If the approved design allows no parking along bike lanes located adjacent to the curb, standard symbol signs for “No Parking” shall be used (MUTCD #R7-9a, 12 x 18 inches). Appropriate right, left, or double arrows shall appear on the bottom portion of the standard sign. Refer to **Construction Drawing 1402a**. Other signs for the beginning and ending points of bike lanes shall be used according to the MUTCD and **AASHTO_Guide for Development of Bicycle Facilities** and as shown on the signing and striping plans or required by the Local Entity ~~Engineer~~^{[DB58][SK59]}.~~

~~In Fort Collins (GMA and city limits), bikeway signs will be furnished by the City of Fort Collins Traffic Operations, and shall be billed to the contractor installing the signs.~~^[NB60]

14.3.4 Roundabouts

A. Modern Roundabouts

See Roundabout Design Guidelines Appendix I

B. Mini Roundabouts

See Roundabout Design Guidelines Appendix I

14.4 PAVEMENT MARKING AND STRIPING

14.4.1 General

A. Type and Location of Striping and Markings

The Local Entity Traffic Engineer shall make the final determination in regards to the type and location of pavement striping and marking within the right-of-way during the review of the project signing and striping plans.

B. Design, Installation, and Maintenance

The Local Entity maintains the permanent pavement striping and marking on public rights-of-way after completion of the warranty period. All such devices shall be specified and installed in accordance with these Standards; all designs shall be in accordance with these Standards and the latest revision of the MUTCD and Colorado supplement. Refer to **Chapter 22, Construction Specifications**, for materials and installation.

C. New Roadway

Permanent striping and marking, unless otherwise approved by the Local Entity Engineer, shall be completely in place before any new Roadway is opened to the public. New striping on new roadways, overlays, and chip seals, etc. will require **two full**

applications of paint^[NB61]^[SK62] in Loveland (GMA and city limits) and Fort Collins (GMA and city limits).

14.4.2 Pavement Markings (Symbols, Arrows, “ONLY”s)

A. General

~~For Loveland (GMA and city limits), The Local Entity (except Fort Collins City Limits) must use all crosswalks, arrows, and legends shall use preformed thermoplastic on all pavement markings such as arrows, “onlys,” crosswalks, railroad crossings, school crossings, stop bars, and bike symbols.~~

For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, “ONLY”s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

B. Preformed Thermoplastic Pavement Marking Specifications

~~1. Preformed thermoplastic pavementThe prefabricated markings described shall be 125 mils (90 mils for bike symbols) in thickness and consist of white or yellow pigmented plastic film with imbedded reflective glass spheres, uniformly distributed throughout their entire cross-sectional area. It shall be possible required to affix the markings to bituminous or Portland cement concrete pavements by use of a two part epoxy adhesive sealer/primer when recommended by the manufacturer. Preformed thermoplastic pavement markings installed on concrete surfaces and shall have a black contrasting border as shown in Appendix L (Loveland Thermoplastic Standards). Prefabricated legends and symbols shall conform to the applicable shapes and sizes as outlined in the MUTCD. All concrete curing compound shall be removed before installing thermoplastic in specific marking locations as approved by the Local Entity Engineer. All linear lines (yield, center, edge, crosswalks, & lane lines) in concrete shall be inlayed thermoplastic. The inlay process shall be per CDOT Specification Section 627.08.~~

C. Crosswalks

1. General. Crosswalks shall be used at all signalized intersections, approved crossings, school routes, adjacent to schools, and as otherwise directed. Refer to **Appendix C** for maps of Local Entity designated school routes.
2. Standard Crosswalk. White 9-foot long, except 12-foot long in Fort Collins (GMA and city limits) x 18-inch wide “Continental” or “Denver” style bars shall be used for all crosswalks.

For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, “ONLY”s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

D. Stop Bars

All stop bars shall be white and a minimum of 18 inches wide. Stop bars are required at signalized locations where the speed limit is 35 mph or higher and other locations specified by the Local Entity Engineer.

1. Fort Collins (GMA and city limits). Locations where stop bars are required shall be specified by the Local Entity Engineer.

~~E. Symbols~~

~~Preformed thermoplastic pavement marking standard material is available from Flint Trading Co. and shall be a minimum of 125 mils thick or approved equal. This material shall be used for all arrows, "onlys," bike symbols (90 mils), railroad crossing symbols, etc.~~

F.E. For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, "ONLY"s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint. Bikeways

The purpose of the placement of bicycle markings on the roadway is to reinforce the specified use of this designated area (Bike Lane/Bike Routes) and to supplement any regulatory signs. Bicycle markings are to be used on Collector and Arterial Roadways with designated Bike Lanes. Bicycle markings are to be re-installed in the same location on Roadways that have been under construction for routine street maintenance or rehabilitation.

For Fort Collins (GMA and city limits), pavement markings (symbols, arrows, "ONLY"s, crosswalks, stop bars, yield lines, word messages, bike symbols, etc.) shall be painted with epoxy paint.

~~G. Roundabouts~~

- ~~1. Yield Line. The roundabout shall require an 18" material yield line (18" material 36" long with 36" gaps)^[NB63] at the point of entry into the circulatory roadway unless otherwise approved by the Local entity Engineer.~~
- ~~2. Crosswalk. Generally, crosswalks do not need special markings on each approach leg at a roundabout. Refer to Figures 8-13 and 8-14^[NB64] or Section 14.4.2 C.2.~~
- ~~3. All linear lines (yield, center, edge, crosswalks, & lane lines) in concrete shall be inlaid thermoplastic. The inlay process shall be per CDOT Specification Section 627.08^[SK65]^[NB66]~~

14.4.3 Striping

A. General

1. Typical. Typical striping widths for lane lines are 4 inches, unless otherwise noted. Double yellow centerline ~~shall~~**must** have a 4-inch gap between stripes ~~according to MUTCD~~.
2. Pavement. Two coats latex paint (highway type high-solids fast-dry) shall be used for asphalt and concrete pavement striping.
3. Layout. All striping on sealcoats shall require a layout line. Prior to striping, tabs are required for sealcoats (prior to the sealcoat process). All other conditions require spot taping at an interval of 25 ft or closer.
4. Retro-reflectivity. The 2 coats of paint shall be applied with beads for each coat. The application rate for beads shall be 6.5 pounds per gallon. The beads shall be AASHTO M247 †Type 2II, non-floating, water resistant.

B. Broken Line

All broken lines shall be 4-inches wide using a 40 foot cycle (10' paint or thermoplastic, 30' gap).

B.C. DottedBroken Line

All ~~dotted~~broken lines shall be 4-inches wide or 8-inches wide using a 6 foot cycle (2' paint or thermoplastic 4' gap^[NB67]). Dotted lines (8-inches wide) are required at signalized intersections with dual or triple left turns. Dotted lines within intersections shall be inlaid thermoplastic.

C.D. Turn Bay Line

All turn bay lines shall be created with a minimum 8-inch wide line. However, if a turn bay occurs on a horizontal curve, the bay taper from the start of the turn bay to the double wide 8" solid line shall be marked with short 8-inch wide dotted lines (2' long with 4' gap).

D.E. Centerline

All centerline striping shall be double yellow, each a minimum of 4 inches wide, with a 4-inch minimum gap between the two.

E.F. Parking Stalls and Angle Parking

All striping for parking shall be white and 4 inches wide. All edge lines of parking areas shall also be white and a minimum of 4 inches wide.

F.G. Bikeway

A 4-inch minimum wide white stripe shall be used for Bike Lanes.

14.4.4 Temporary Striping

All temporary striping shall conform to “Standard Specifications for Road and Bridge Construction,” published by CDOT, the latest revision except as herein amended. When approved, temporary striping shall be required prior to the opening of a Roadway for travel where pavement and/or permanent striping cannot be completed due to weather and/or time constraints. Refer to **Section 14.4.1 C** if not approved.

A. Specifications

Temporary striping shall be the same color and width as for permanent striping. Temporary striping shall consist of tabs or 4 x 4-inch (min.) tape, depending on the pavement surface, spaced at 25-foot intervals. Refer to **Chapter 22, Construction Specifications**, for additional detail regarding temporary striping.

B. Time Duration Limit

Temporary striping is permitted on Collectors for no more than 7 days.

C. Extensions

Extensions must be requested in writing if weather does not allow installation of permanent striping. For Fort Collins (GMA and city limits), also refer to Appendix F, City of Fort Collins Traffic Operations Manual.