

MANUAL CHANGE TRANSMITTAL		NO. 26-4
TITLE: Department of Transportation <i>Construction Manual</i>	APPROVED BY:  Ramon Hopkins, Chief Division of Construction	DATE ISSUED: 9-17-2026
SUBJECT AREA Sections 4-12, 4-65, 4-82, 4-84, 4-95	ISSUING UNIT Division of Construction	
SUPERSEDES Sections 4-12 of February 2021, 4-65 of July 2019, 4-82 of May 2021, 4-84 of July 2019, and 4-95 of July 2019	DISTRIBUTION All Requested Manual Holders	

The purpose of this manual change transmittal is to announce updates and corrections to the Caltrans *Construction Manual*. Please note the updates and print new sections for your manual as needed. Updated sections are published on <https://dot.ca.gov/programs/construction/construction-manual> and are indicated by the date listed in the right-hand column on that page. Content changes, not including edits for clarity, are enumerated.

Section 4-12, "Temporary Traffic Control"

Updated guidance for temporary traffic control devices, temporary barrier systems, temporary traffic screens, temporary crash cushions, and impact attenuator vehicles to align with the current *Standard Specifications*, *Standard Plans*, and *California Manual on Uniform Traffic Control Devices*.

Section 4-65, "Concrete Pipe"

Revised Section 4-6506, "Payment," to clarify the payment examples for pipe placement.

Section 4-82, "Signs and Markers"

Revised Section 4-8205, "Quality Control," to update the quality control requirements for sign fabrication.

Section 4-84, "Marking"

Revised Section 4-8406, "Payment," to update the payment requirements for the removal of traffic stripes, aligning them with the *Standard Specifications*.

Section 4-95, "Epoxy"

Revised Section 4-9503, "During Course of Work," to update the temperature requirements for storing epoxy components.

Section 12 Temporary Traffic Control

4-1201 General

4-1202 Before Work Begins

4-1202A Flagging

4-1202B Temporary Traffic Control Devices

4-1202B (1) Traffic Cones

4-1202B (2) Plastic Traffic Drums

4-1202B (3) Portable Delineators

4-1202B (4) Channelizers

4-1202B (5) Barricades

4-1202B (6) Construction Area Signs

4-1202B (7) Telescoping Flag Trees

4-1202B (8) Temporary Barrier Systems

4-1202B (9) Temporary Traffic Screens

4-1202B (10) Temporary Crash Cushions

4-1202B (11) Impact Attenuator Vehicles

4-1202B (12) Flashing Arrow Signs

4-1202B (13) Portable Flashing Beacons

4-1202B (14) Portable Changeable Message Signs

4-1202B (15) Portable Signal Systems

4-1202B (16) Temporary Flashing Beacon Systems

4-1202B (17) Automated Work Zone Information Systems

4-1202B (18) Portable Transverse Rumble Strips

4-1202B (19) Portable Radar Speed Feedback Sign Systems

4-1202B (20) Automated Flagger Assistance Devices

4-1202B (21) Temporary Automated End of Queue Warning System

4-1202C Maintaining Traffic

4-1202C (1) Traffic Control Systems

4-1202C (1a) Lane Closure System

4-1202C (2) Temporary Pedestrian Access Routes

4-1202C (3) Bridge Cleaning and Painting Activities

4-1202D Temporary Pavement Delineation

4-1202D (1) Temporary Pavement Markers

4-1203 During the Course of Work

4-1203A Flagging

4-1203B Temporary Traffic Control Devices

4-1203B (1) Traffic Cones

4-1203B (2) Plastic Traffic Drums

4-1203B (3) Portable Delineators

4-1203B (4) Channelizers

- 4-1203B (5) Barricades
- 4-1203B (6) Construction Area Signs
- 4-1203B (7) Telescoping Flag Trees
- 4-1203B (8) Temporary Barrier Systems
- 4-1203B (9) Temporary Traffic Screens
- 4-1203B (10) Temporary Crash Cushions
- 4-1203B (11) Impact Attenuator Vehicles
- 4-1203B (12) Flashing Arrow Signs
- 4-1203B (13) Portable Flashing Beacons
- 4-1203B (14) Portable Changeable Message Signs
- 4-1203B (15) Portable Signal Systems
- 4-1203B (16) Temporary Flashing Beacon Systems
- 4-1203B (17) Automated Work Zone Information Systems
- 4-1203B (18) Portable Transverse Rumble Strips
- 4-1203B (19) Portable Radar Speed Feedback Sign Systems
- 4-1203B (20) Automated Flagger Assistance Devices
- 4-1203B (21) Temporary Automated End of Queue Warning System
- 4-1203C Maintaining Traffic
 - 4-1203C (1) Traffic Control Systems
 - 4-1203C (1a) Closure Schedules
 - 4-1203C (1b) Contingency Plans for Closures
 - 4-1203C (1c) Lane Closure System
 - 4-1203C (1d) Status Updates for Authorized Closures
 - 4-1203C (1e) Field Adjustments
 - 4-1203C (1f) Placement Sequence and the Start of Work
 - 4-1203C (1g) Drive-Through Inspection
 - 4-1203C (1h) Maintenance
 - 4-1203C (1i) Reverse Operations Inside Closures
 - 4-1203C (2) Temporary Pedestrian Access Routes
 - 4-1203C (3) Bridge Cleaning and Painting Activities
- 4-1203D Temporary Pavement Delineation
 - 4-1203D (1) Temporary Pavement Markers
 - 4-1203D (2) Channelizers
 - 4-1203D (3) Temporary Lane Line and Center Delineation
 - 4-1203D (4) Temporary Edge Line Delineation
 - 4-1203D (5) Temporary Traffic Stripe Tape
 - 4-1203D (6) Temporary Traffic Stripe Paint
 - 4-1203D (7) Temporary Pavement Marking Tape
 - 4-1203D (8) Temporary Pavement Marking Paint
- 4-1203E Temporary Pavement Delineation for Seal Coats
- 4-1204 Level of Inspection**
- 4-1205 Quality Control**

4-1206 Payment

4-1206A Flagging

4-1206B Temporary Traffic Control Devices

4-1206B (1) Traffic Cones

4-1206B (2) Plastic Traffic Drums

4-1206B (3) Portable Delineators

4-1206B (4) Channelizers

4-1206B (5) Barricades

4-1206B (6) Construction Area Signs

4-1206B (7) Temporary Barrier Systems

4-1206B (8) Temporary Traffic Screens

4-1206B (9) Temporary Crash Cushion Modules

4-1206B (10) Impact Attenuator Vehicles

4-1206B (11) Flashing Arrow Signs

4-1206B (12) Portable Flashing Beacons

4-1206B (13) Portable Changeable Message Signs

4-1206B (14) Portable Signal Systems

4-1206B (15) Temporary Flashing Beacon Systems

4-1206B (16) Automated Work Zone Information Systems

4-1206B (17) Portable Transverse Rumble Strips

4-1206B (18) Portable Radar Speed Feedback Sign Systems

4-1206B (19) Automated Flagger Assistance Devices

4-1206B (20) Temporary Automated End of Queue Warning System

4-1206C Traffic Control Systems

Section 12 Temporary Traffic Control

4-1201 General

This section provides guidelines for inspecting temporary traffic control devices in construction areas. For traffic control requirements, refer to Section 12, “Temporary Traffic Control,” of the *Standard Specifications* and to the *California Manual on Uniform Traffic Control Devices (California MUTCD)*. If a discrepancy occurs between the contract plans and specifications and the *California MUTCD*, the plans and specifications govern. Also refer to Section 2-2, “Traffic,” of this manual, which provides guidance and a general overview of providing a safe and convenient passage of public traffic through the construction area and is complementary to this section.

Temporary traffic control devices are divided into categories:

- Category 1 devices include traffic cones, plastic traffic drums, portable delineators, and channelizers.
- Category 2 devices include barricades and portable sign supports.
- Category 3 devices include crash cushions, impact attenuator vehicles, temporary railings, temporary barriers, and end treatments for temporary railings and barriers.

The condition of temporary traffic control devices should comply with the most current edition of the American Traffic Safety Services Association (ATSSA) publication *Quality Guidelines for Temporary Traffic Control Devices and Features*. Contact Construction at headquarters for a current hard copy.

4-1202 Before Work Begins

Take the following steps before work begins:

- Determine what construction area signs should be placed before work begins for the entire project and before each stage of the project.
- Determine the methods and equipment the contractor will use for closing lanes, ramps, and roadways, and for flagging and controlling one-way traffic.

4-1202A Flagging

Discuss any flagging operation with the contractor before the operation begins. Confirm flaggers are wearing American National Standards Institute (ANSI)-compliant garments in accordance with the Construction Safety Orders of the California Department of Industrial Relations, or the prime contractor’s or subcontractor’s Injury and Illness Prevention Program or *Code of Safe Practices*, whichever is more stringent. Review with the contractor how flaggers will communicate with each other, with pilot cars, and with workers inside the controlled

area. The contractor should develop a plan for handling emergencies and emergency vehicles in the control zone.

4-1202B Temporary Traffic Control Devices

Verify that temporary traffic control devices comply with the contract requirements.

The resident engineer may accept use of contractor-proposed devices on the Authorized Materials List for Highway Safety Features.

Determine if the temporary traffic control devices to be used are on the Authorized Materials List for Signing and Delineation Materials and if they require a certificate of compliance.

Obtain self-certification using Form DOT CEM-0612, "Work Zone Category 1 Temporary Traffic Control Device Certificate of Crashworthiness," from the contractor.

Request a list of Category 2 temporary traffic control devices to be used on the project and copies of their Federal Highway Administration acceptance letters.

Verify that Category 3 temporary traffic control devices are on the Authorized Materials List for Highway Safety Features.

4-1202B (1) Traffic Cones

If the contractor plans to use cones for night work, determine the type of cone proposed. All cones should use the same type and brand of retroreflective sheeting.

4-1202B (2) Plastic Traffic Drums

All drums should use the same type and brand of retroreflective sheeting. Verify the base is shaped to prevent rolling if struck by vehicles.

4-1202B (3) Portable Delineators

Obtain a sample of the type of portable delineator to be used on the project. Verify the base is shaped to prevent delineators from rolling if struck by vehicles.

4-1202B (4) Channelizers

Verify the channelizer's post is predominantly orange.

4-1202B (5) Barricades

Verify barricade construction complies with Section 12-3.10, "Barricades," of the *Standard Specifications* and Standard Plan A73C, "Delineators, Channelizers, and Barricades."

Review the submittal for any Type 3 barricade to be used as a sign support for crashworthiness to the Transportation Research Board's National Cooperative Highway Research Program (NCHRP) Report 350 criteria or the American Association of State Highway and Transportation Officials (AASHTO's) *Manual for*

Assessing Safety Hardware (MASH) as a single unit with a sign panel of the size and type used.

4-1202B (6) Construction Area Signs

At the preconstruction conference, remind the contractor to maintain an inventory of commonly required items at the job site and arrange for sign panels, posts, and mounting hardware or portable sign mounts to be furnished on short notice.

Verify construction area signs are from a commercial sign manufacturer and have a Type 3 or higher grade retroreflective sheeting.

Review Section 12-3.11, "Construction Area Signs," of the *Standard Specifications* for additional requirements.

4-1202B (7) Telescoping Flag Trees

Verify telescoping flag trees are from a commercial-quality material manufacturer.

4-1202B (8) Temporary Barrier Systems

Obtain the required submittals for temporary barrier systems.

Verify the temporary barrier system is:

- Fabricated at a plant on the Authorized Facility Audit List, which can be found at: <https://dot.ca.gov/programs/engineering-services/authorized-facility-audit-list>
- Listed on the Authorized Materials List for Highway Safety Features, except for non-proprietary barriers. The list can be found at: <https://dot.ca.gov/programs/engineering-services/authorized-materials-lists>

Review the *Standard Specifications* and *Standard Plans* for clear area width, staking, taper, system length, reflectors, curve radius, and minimum setback requirements.

4-1202B (9) Temporary Traffic Screens

Review the *Standard Plans* for the temporary traffic screen requirements.

Verify that the temporary traffic screen is on the Authorized Materials List.

4-1202B (10) Temporary Crash Cushions

Obtain the required submittals for temporary crash cushions.

Verify the proposed temporary crash cushions are on the Authorized Materials List for Highway Safety Features.

Inspect temporary crash cushions to confirm they comply with the specifications and manufacturer requirements.

Review the project plans and Standard Plans T1A, "Temporary Crash Cushion, Sand Filled (Unidirectional)"; T1A1, "Temporary Crash Cushion, Sand Filled (Unidirectional)"; T1B, "Temporary Crash Cushion, Sand Filled (Bidirectional)"; and T2, "Temporary Crash Cushion, Sand Filled (Shoulder Installations)." Frequently, the

plans for stage construction, detour, or traffic handling will require arrays of temporary crash cushion modules. Changes to any of these plans may alter the need for temporary crash cushion modules.

Temporary crash cushion modules may be installed on wooden pallets as an option. Verify that pallet height is 4½ inches or less. Pallets that exceed this height raise the sand in the crash cushions above the acceptable level. Do not allow the use of commercial pallets that exceed the maximum height.

4-1202B (11) Impact Attenuator Vehicles

- Verify that the impact attenuator vehicle complies with all specification requirements.
- Check that the attenuator meets the test level requirement for the posted speed limit.
- Verify that the weight of the attenuator and the weight of the support truck are within the specified limits as shown on the Authorized Material Lists for Highway Safety Features.

4-1202B (12) Flashing Arrow Signs

Verify that Type 1 and Type 2 flashing arrow signs comply with the specification requirements, including number of panel lights, display modes, power source, and devices to plumb and level the trailer.

4-1202B (13) Portable Flashing Beacons

Verify that portable flashing beacons comply with the requirements in Section 12-3.31, “Portable Flashing Beacons,” of the *Standard Specifications*.

4-1202B (14) Portable Changeable Message Signs

- Request a certificate of compliance for each portable changeable message sign.
- Obtain a contact cell phone number for the contractor before starting activities that require a portable changeable message sign and arrange for an inspection with the contractor before the first deployment.
- Verify that the sign complies with the requirements of Section 12-3.32, “Portable Changeable Message Signs,” of the *Standard Specifications*, including number of lines and characters in a line, display modes, power source, and devices to plumb and level the trailer.

4-1202B (15) Portable Signal Systems

Confirm portable signal systems comply with the requirements in Section 12-3.33, “Portable Signal Systems,” of the *Standard Specifications*.

Verify that the line-of-sight visibility in the field meets sight distance standards. If sight distance is not adequate, contact the district traffic engineer for suggestions or recommendations.

When portable signal systems are used in forests or grasslands, confirm adherence to all fire safety requirements. Checking fire safety requirements may require coordination with personnel from the U.S. Forest Service, Bureau of Land Management, or California Department of Forestry and Fire Protection.

4-1202B (16) Temporary Flashing Beacon Systems

Confirm temporary flashing beacon systems comply with the requirements in Section 12-3.34, “Temporary Flashing Beacon Systems,” of the *Standard Specifications*.

4-1202B (17) Automated Work Zone Information Systems

- Verify that automated work zone information systems comply with the general system functionality, motorist information messages, system communications, traffic data acquisition, and user interface specification requirements.
- Obtain the name and contact information for the assigned onsite system coordinator.
- Request the user interface software and provide it to the transportation management center for installation.

4-1202B (18) Portable Transverse Rumble Strips

Obtain a copy of the manufacturer’s instructions for the portable transverse rumble strips.

Verify portable transverse rumble strips comply with the requirements in Section 12-3.36 “Portable Transverse Rumble Strips,” of the *Standard Specifications*.

4-1202B (19) Portable Radar Speed Feedback Sign Systems

Verify portable radar speed feedback sign systems comply with the requirements in Section 12-3.37 “Portable Radar Speed Feedback Sign Systems,” of the *Standard Specifications*.

Obtain required submittals for the systems in accordance with Section 87-14, “Radar Speed Feedback Sign Systems,” of the *Standard Specifications*.

4-1202B (20) Automated Flagger Assistance Devices

Verify that automated flagger assistance devices (AFAD) comply with the requirements in Section 12-3.38 “Automated Flagger Assistance Devices,” of the *Standard Specifications*.

Obtain a copy of the manufacturer’s operating instructions.

4-1202B (21) Temporary Automated End of Queue Warning System

Verify that temporary automated end of queue warning systems comply with the requirements in Section 12-3.41, “Temporary Automated End of Queue Warning Systems,” of the *Standard Specifications*.

4-1202C Maintaining Traffic

Before work begins, carefully review the plans, specifications, closure charts, and Standard Plans T9, “Traffic Control System Tables for Lane and Ramp Closures,” through T17, “Traffic Control System for Moving Lane Closure on Two Lane Highways.” It is important to plan which personnel, signage, and equipment will be required to implement the traffic control system.

Verify that the contractor has all components on hand before setting up any traffic control system and that all components meet the specifications requirements.

Verify that the contractor notifies and cooperates with local authorities wherever the local authorities regulate traffic.

When multiple projects in one area occur at the same time, do the following:

- Require contractors to coordinate their efforts by resolving schedule conflicts before submitting their schedules for closures.
- Verify there are no closure conflicts before implementation.
- Review these requirements with the contractors before work starts.

4-1202C (1) Traffic Control Systems

Verify the contractor removes or covers any construction area signs that duplicate or contradict the signs for a project within 250 feet of another project. Refer to Section 5-1.20, “Coordination with Other Entities,” of the *Standard Specifications*, if applicable, and the special provisions.

- Inspect the signs and equipment the contractor proposes to use, at the contractor’s or subcontractor’s yard, if possible, before their first use.
- Verify that all necessary signs, cones, drums, and other equipment are on hand before a system is set up for the first time. If the proposed materials have been previously used, check them for acceptability listed in the ATSSA publication *Quality Guidelines for Temporary Traffic Control Devices and Features*, which may be obtained from Construction headquarters. Require the contractor to replace any unacceptable equipment. It is easier to correct deficiencies before the system is installed.
- If the contractor is to place traffic control systems repeatedly in the same area, the contractor can request to mark locations of advance warning signs, cones, and drums on the shoulder. This makes the placement of closures more efficient and allows for more consistent taper alignments.

4-1202C (1a) Lane Closure System

Contractors are required to request closures using the Caltrans Lane Closure System (LCS) and status closures using the Lane Closure System Mobile webpage.

To confirm that contractors can access LCS and LCS Mobile, do the following before work begins:

- Remind the contractor of the requirement to complete the LCS web-based training.
- Provide the contractor with the internet link to access the LCS web-based training.

<https://dot.ca.gov/programs/construction/training>

- Obtain the information of trained contractor representatives, including whether they will be requesting closures or providing closure status, or both.
- Set up LCS accounts for the trained contractor's employees to request closures or provide closure status accordingly and provide them with their login information within 5 days after they have completed the training. The LCS will send the contractor's employees a unique password by email after the accounts are created. For contractor's employees that will perform both functions, create an account to request closures and set the option in the account to status closures.
- Contact the district traffic manager for assistance with either of these tasks.

4-1202C (2) *Temporary Pedestrian Access Routes*

Review Sections 12-4.04, "Temporary Pedestrian Access Routes," and 16-2.02, "Temporary Pedestrian Facilities," of the *Standard Specifications* for the temporary pedestrian facilities requirements.

If an existing pedestrian route will be affected by the work activities, verify the project includes Bid Item Code 124000 and that a designed temporary pedestrian access route (TPAR) is part of the contract plans or that the TPAR *Standard Plans* are appropriate for the pedestrian route affected by the work activities. If the bid item is not included in the project, process a change order to provide a TPAR.

During the preconstruction conference, discuss:

- TPAR requirements described in the specifications.
- The contractor's responsibility to provide written notice 5 days before closing an existing pedestrian route.
- The design and construction at the contractor's expense, when the contractor's means and methods require the closure of an existing pedestrian route. Caltrans does not pay for providing the TPAR when the pedestrian route closure is the result of contractor's means and methods. The contractor must submit a work plan and obtain authorization to proceed before starting work.
- The contractor's responsibility to submit a Form DOT CEM-2311, "Temporary Pedestrian Access Route Contractor Compliance Report," within 2 business days after construction of a TPAR, and a Form DOT CEM-2312, "Temporary Pedestrian Access Route Contractor Weekly Report," within 2 business days of completing a weekly inspection. The contractor compliance report forms are available at:

<https://dot.ca.gov/programs/construction/forms>

Review the contractor's work plan for compliance with the requirements in Section 12-4.04, "Temporary Pedestrian Access Routes," of the *Standard Specifications*. Depending on the project conditions, the contractor may use Standard Plans T30, "Temporary Pedestrian Access Routes Typical Sidewalk Closure and Pedestrian Detour," through T34, "Temporary Pedestrian Access Routes Curb Ramp Options," as a baseline for designing and constructing a TPAR.

4-1202C (3) Bridge Cleaning and Painting Activities

Review Section 12-4.05, "Bridge Cleaning and Painting Activities," of the *Standard Specifications*.

Verify that signs to be used comply with the specification requirements.

4-1202D Temporary Pavement Delineation

Review Sections 12-6, "Temporary Pavement Delineation" and 84-2, "Traffic Stripes and Pavement Markings," of the *Standard Specifications* for temporary pavement delineation requirements.

4-1202D (1) Temporary Pavement Markers

Verify temporary pavement markers comply with Section 81-3, "Pavement Markers," of the *Standard Specifications*, except for the waiting period before placing pavement markers on new asphalt concrete.

Verify that signs to be used comply with the specification requirements.

Refer to Sections 12-6, "Temporary Pavement Delineation" and 12-7 "Temporary Pavement Delineation for Seal Coats," of the *Standard Specifications* for temporary signing requirements for no-passing zones.

4-1203 During the Course of Work

- Use the most current edition of the American Traffic Safety Services Association (ATSSA) publication *Quality Guidelines for Temporary Traffic Control Devices and Features* to confirm acceptability of traffic control devices. Request the guidelines from Construction headquarters.
- Inspect Category 2 temporary traffic control devices to confirm they are labeled with the Federal Highway Administration (FHWA) acceptance letter code and the name of the manufacturer.
- Verify Category 3 temporary traffic control devices are the type shown on the Authorized Materials List for Highway Safety Features.
- Verify that traffic handling devices meet the visibility and legibility requirements.
- Verify that the contractor maintains all traffic control devices in good working order throughout the project's life. Verify that all traffic control devices are correctly placed and functioning properly. If temporary traffic control devices are damaged, displaced, or stop operating or functioning as described from any

cause during the progress of the work, have the contractor repair, repaint, or replace the components and restore them to their original positions.

- Do not allow the contractor to mix different types of temporary traffic control devices on the same alignment. Types include plastic traffic drums, portable delineators, channelizers, tubular markers, traffic cones, and Type 1 and Type 2 barricades.
- Verify that the contractor removes traffic-handling equipment and devices from the job site when they are no longer needed for controlling traffic.

4-1203A Flagging

Observe the flagging operation to verify that flaggers are using the correct procedures for directing motorists in accordance with California Code of Regulations, Title 8, Section 1599, (8 CCR 1599) “Flaggers,” and Chapter 6E, “Flagger Control,” of the *California MUTCD*. Also, verify that flagging stations are laid out correctly, are visible to approaching traffic, are illuminated during nighttime, and have correct advance warning signs.

4-1203B Temporary Traffic Control Devices

Inspect all traffic control devices to verify conformity with the *Standard Specifications*. If you authorize the devices for use, record the authorization in the daily reports.

4-1203B (1) Traffic Cones

Require the contractor to anchor bases of traffic cones that do not have enough size and weight to keep the cones in an upright position.

Prohibit the use of traffic cones that have been damaged or coated with asphalt or other substances that prevent the cones from functioning as intended.

4-1203B (2) Plastic Traffic Drums

Check the contractor’s layout work. Allow only one type of plastic traffic drum on the project.

Require ballast for drums according to manufacturer specifications. Do not allow the use of sandbags.

Require proper maintenance of plastic traffic drums.

4-1203B (3) Portable Delineators

- Allow only one type of portable delineator on the project.
- Verify that portable delineators meet the dimension requirements.
- Confirm that portable delineators remain upright when unattended, otherwise require the contractor to place a ballast on the delineator’s base.

4-1203B (4) *Channelizers*

Check the contractor's layout work.

Verify that the pavement is clean and dry and the contractor places the channelizers during conditions that meet the required temperatures. Review Section 81-3, "Pavement Markers," of the *Standard Specifications*. Do not allow the contractor to use the double-stick butyl pads provided by the channelizer manufacturer; these pads do not meet Caltrans requirements.

Ask the contractor to replace channelizers that are displaced or fail to remain in an upright position. The contractor is responsible for the replacement expenses.

4-1203B (5) *Barricades*

Check Type 3 barricades, used as sign supports, for FHWA acceptance letter number label showing they have been crash tested as a single unit with a sign panel of the size and type used.

Allow the contractor to use only bags of dry sand when weighting is necessary. Verify weights are placed on the feet or lower parts of the frame or stays. Do not allow the contractor to place objects any higher or use hard objects such as concrete or rocks for weights.

Confirm the contractor maintains barricades in good condition and keeps the reflective surfaces clean.

4-1203B (6) *Construction Area Signs*

Remind the contractor to notify the regional notification centers before digging for the installation of signposts. Hand digging is required unless the location is free of underground utilities.

Allow only the use of sandbags when it is necessary to weigh down sign standards to prevent the wind from overturning them. Do not permit rocks, concrete, or other hard objects to be used for this purpose.

Check construction area signs often during the course of the work. Verify visibility and legibility requirements. Require the contractor to keep signs clean and clearly visible; repair them if damaged.

Verify that construction area signs are placed outside the traveled way, do not block or protrude more than 4 inches into bicycle and pedestrian routes, and comply with Americans with Disabilities Act requirements.

Do not allow the use of nonretroreflective portable signs during hours of darkness.

Check signposts to confirm compliance with breakaway features.

Verify that the contractor installs, relocates, covers, and removes signs as required. Construction signs should be covered or removed whenever they no longer serve a purpose. Verify that covers placed on sign panels completely block out any messages so that the messages cannot be seen day or night. The covers should also present an acceptable appearance.

4-1203B (7) Telescoping Flag Trees

Verify telescoping flag trees maintain an upright position when being used.

4-1203B (8) Temporary Barrier Systems

Verify the exposed surfaces of temporary barrier systems have received a fresh coat of white paint before initial placement on the job. Order repainting when needed.

Verify that all new and used temporary barrier system elements comply with requirements for end connection and surface finish. Verify temporary barrier system is placed on a firm, stable foundation uniformly graded throughout the entire length of the railing.

Check the alignment of temporary barrier system elements for any substantial offset to each other. Order realignment of displaced segments before work begins.

Verify that temporary barrier system placement meets the offset, clear area width, staking, taper, system length, reflectors, curve radius, and minimum setback requirements.

Verify that the contractor protects temporary barrier system blunt ends within 15 feet of the edge of the traveled way with temporary crash cushions.

Check that the contractor installs and maintains Type P marker panels on temporary barrier systems.

Confirm the contractor installs and maintains a reflector on each barrier segment placed within 10 feet of an open traffic lane.

Verify all stakes and anchor bolts are removed, and the area is restored to its previous condition or constructed to its planned condition after removal of temporary barrier systems.

4-1203B (9) Temporary Traffic Screens

After installation, review the screen placement, especially near entrance and exit ramps. If the screen blocks motorist visibility, order its removal and consult with the district traffic engineer concerning alternatives.

Confirm supporting steel pipes are placed on the traffic side of the screen so that if a panel becomes dislodged, the plywood will fall away from traffic.

The specifications require temporary traffic screens to have 3-foot-long openings spaced at 200-foot intervals. The purpose of the gaps is to allow drivers and passengers of vehicles to get behind the barrier in case of a disabled vehicle. If the opening has a drop off behind it that might present a hazard to the public, document in the resident engineer's daily report an exception to the *Standard Specifications* requirements and have the contractor close the gap for public safety purposes.

4-1203B (10) Temporary Crash Cushions

- Verify the temporary crash cushion array is:
 - In place before opening traffic lanes adjacent to the protected obstacle.

- Installed according to manufacturer instructions.
- Verify the temporary crash cushion is offset from a barrier, dike, or curb as required.
- Check that all crash cushion modules are filled with the proper weight of sand. Check pallet heights when used.
- Verify a minimum clearance of 8 feet between the array and the nearest traffic lane. If the clearance to the traffic lane cannot be obtained, an in-line temporary crash cushion must be installed.
- Verify the contractor installs Type 3 markers.

4-1203B (11) Impact Attenuator Vehicles

Do not allow the use of a damaged impact attenuator vehicle.

Verify the contractor uses an impact attenuator vehicle as a shadow vehicle in moving closures and during placement and removal of components in stationary closures.

Verify there is enough shoulder width before allowing the use of an impact attenuator vehicle for placement and removal of components on two-lane, two-way highways.

Impact attenuator vehicles used for setting up and removing temporary traffic control devices are not stationary.

Stationary impact attenuator vehicles are used in advance of the work area to protect workers and the traveling public. Stationary impact attenuator vehicles are required and paid for when a bid item for stationary impact attenuator vehicles is included in the bid item list.

Projects with multiple work areas within the project or within a traffic control system may require the use of stationary impact attenuator vehicles to protect each work area that is within a 500 feet separation distance downstream from the adjacent work area.

4-1203B (12) Flashing Arrow Signs

Verify the proper types of flashing arrow signs are used.

- Verify the flashing arrow sign trailer can be leveled and plumbed.
- Verify the lights are dimmed at night and set on bright during daylight hours.
- Verify the lights are not glaring into approaching traffic, especially truck traffic.
- Confirm compliance with the minimum legibility distances.
- Verify the signs are properly aimed at approaching traffic.
 - Pay special attention to the aiming of the sign whenever solar-powered signs are used. The special bulbs used with solar signs have much narrower beams than conventional bulbs and, therefore, require greater care while being aimed.

4-1203B (13) Portable Flashing Beacons

Confirm the contractor places portable flashing beacons according to the plans and removes them from the traveled way at the end of each night's work.

Verify portable flashing beacons operate according to the specifications.

4-1203B (14) Portable Changeable Message Signs

Portable Changeable Message Signs (PCMS) are required only during times, places, or activities stated in the plans and specifications and are not required when the traffic control system is nonoperational or for discretionary use. PCMS can be used in place of an advance flagger to remove workers from the roadway to improve worker safety from traffic.

Verify that the trailer bearing the sign can be leveled and that the sign operates within the required minimum and maximum heights. Verify the contractor delineates a PCMS with a taper of traffic cones according to the *Standard Plans*.

Confirm the sign is placed where it is most visible to approaching motorists. Check that the sign complies with the visibility and legibility requirements. Pay special attention to locations where vertical or horizontal curvature restricts the sight distance. Drivers should be able to read the entire message at least two times before passing the sign.

Confirm the signs display only pre-approved messages and that the messages conform to the *Changeable Message Sign Guidelines*, and district and Caltrans policy. The *Changeable Message Sign Guidelines* developed by the Division of Traffic Operations provide a listing of approved abbreviations for PCMS. Prohibit messages that do not convey real-time information to the motorist. Examples of unacceptable messages include "Drive carefully," "Have a Nice Day," and "Thank you."

PCMS are considered working equipment when actively displaying a message, otherwise they are nonoperating. Ask the contractor to remove nonoperating portable message signs from the job site away from traffic or protect it in accordance with Section 7-1.04 "Public Safety," of the *Standard Specifications*. Consult with the district traffic engineer for other acceptable means to protect the sign instead of the temporary barrier system required by the specifications. In many cases, placing a PCMS behind existing guard railing will protect it.

4-1203B (15) Portable Signal Systems

Verify the planned signal system includes a backup power source and automatic transfer switches.

Do not allow the use of power from private parties to power the temporary signal system.

If a system shutdown occurs, planned or unplanned, the contractor should provide flaggers to control traffic until the traffic signals are functioning correctly.

Periodically review the portable signal system to document its maintenance. Record inspection dates and conditions observed in the project records.

4-1203B (16) Temporary Flashing Beacon Systems

Verify that the temporary flashing beacon system includes a backup power source and automatic transfer switches.

Do not allow the use of power from private parties to power the temporary flashing beacon system.

Verify that temporary flashing beacon systems are relocated as work progresses according to the specifications.

4-1203B (17) Automated Work Zone Information Systems

Provide the contractor with the message content and the thresholds used for triggering when the messages will be displayed. Consult with the district traffic manager for assistance with these items.

When necessary, ask the contractor to adjust placement or message content of signs based on changing project or traffic conditions.

4-1203B (18) Portable Transverse Rumble Strips

Make sure that portable transverse rumble strips are placed before closing the lane to traffic.

Verify that the color of the portable transverse rumble strips is black or orange and arranged in accordance with Standard Plan T13, "Traffic Control System with Reversible Control on Two Lane Conventional Highways."

Check that portable transverse rumble strips are not placed on sharp horizontal or vertical curves or through pedestrian routes.

If the portable transverse rumble strips become out of alignment or skewed by more than 6 inches, have the contractor readjust them to the original location.

4-1203B (19) Portable Radar Speed Feedback Sign Systems

Make sure that the contractor places the portable radar speed feedback sign systems as far from the traveled way as practical, where they are visible and legible to approaching traffic, taking into account any vertical or horizontal roadway curvatures, as shown on the following Standard Plans:

- Standard Plan T18, "Traffic Control System Construction Work Zone Speed Limit Reduction on Freeways and Expressways"
- Standard Plan T19, "Traffic Control System Construction Work Zone Speed Limit Reduction on Conventional Highways"

- Standard Plan T20, “Traffic Control System Construction Work Zone Speed Limit Reduction Details”
- Standard Plan T21, “Traffic Control System Construction Work Zone Speed Limit Reduction Twenty-four Hours a Day 7 Days a Week (24/7)”
- Standard Plan T22, “Traffic Control System for Construction Work Zone Speed Limit Reduction on Two Lane Conventional Highways”

Verify that additional speed limit signs indicating the reduced speed limit are placed within the construction work zone as specified.

For continuous construction work zone speed limit reduction, verify that advisory warning signs are posted to alert motorists of the roadway condition as specified and as shown on the *Standard Plans*.

4-1203B (20) Automated Flagger Assistance Devices

Automated flagger assistance devices (AFAD) can be used in place of flaggers to remove workers from the roadway to improve worker safety from traffic

Confirm that AFAD are placed in accordance with the plans and where clearly visible to the AFAD operator and to approaching traffic.

When AFAD are in use, allow the contractor to use portable vehicle transverse rumble strips, but do not allow the use of a 48-inch-by-48-inch W20-7 sign or gate cones.

When an AFAD becomes inoperable, notify the contractor to immediately replace it with an identical device, use a flagger with the appropriate-size advance warning sign and gate cones as shown in Standard Plan T13 -or stop all construction activities that require the device to be in operation.

4-1203B (21) Temporary Automated End of Queue Warning System

Verify that the contractor provides a Type 1 or Type 2 temporary automated end of queue warning system for each closure as shown on Standard Plans T26, “Temporary Automated End of Queue Warning System Type 1,” and T27, “Temporary Automated End of Queue Warning System Type 2,” respectively, of the *Standard Plans*.

Make sure the temporary automated end of queue warning system is in operation only during work, unless special provisions require one for 24 hours a day, 7 days a week for certain construction activities.

Obtain a weekly temporary automated end of queue warning system operations report.

4-1203C Maintaining Traffic

4-1203C (1) Traffic Control Systems

Do not allow the contractor to close 2 adjacent ramps in the same direction of travel unless necessary because of the operation, project conditions, or approved lane

closure charts. Require the contractor to set up an off-the-highway detour before closing all ramps in both directions of travel at the same interchange.

Verify that the contractor follows the notification and signing requirements before setting up any traffic control systems.

Remind the contractor of Americans with Disabilities Act requirements if the traffic control system will affect pedestrian traffic and a temporary pedestrian access route is needed.

4-1203C (1a) Closure Schedules

Confirm the contractor submits a schedule of planned closures in advance as required by Section 12-4.02A(3), "Submittals," of the *Standard Specifications*. Closures that will reduce horizontal or vertical clearances require even more notification. Inform the Transportation Permits Unit 15 days in advance of the closure. This notification allows Caltrans to coordinate work within the highway corridor.

Confirm that the contractor's closure requests comply with the closure charts. Review the requests to avoid oversights and overbooking.

4-1203C (1b) Contingency Plans for Closures

If the contractor fails to reopen the highway according to the closure charts, suspend work and request a detailed written construction contingency plan demonstrating that the highway will be opened as soon as possible. Refer to Section 2-214D, "Construction Contingency Plan," of this manual.

Do not permit any closures until the contractor submits this plan and it is authorized in accordance with the specifications.

When an operation is terminated before the time the specifications allow because of circumstances beyond the contractor's control, consider granting time, compensation, or both, within the terms of the contract. If the operation is terminated before completion of the planned work because of circumstances within the contractor's control or because of equipment breakdown, do not allow compensation and charge a working day as appropriate.

4-1203C (1c) Lane Closure System

- Confirm the contractor's employee uses the assigned user identification to submit the closure requests in the Lane Closure System (LCS). The closure requests are stored with a "SAVED" status.
- Review the closure requests for compliance with the closure requirements charts and other contract requirements. If the engineer accepts a closure request, the status will change to "PENDING." If the engineer rejects a closure request, LCS will send the contractor an email asking for a correction and resubmission.

- Verify the district traffic manager reviews a closure request for conflicts before approving it. The status in LCS will change to “APPROVED.” The LCS will notify the contractor by email of the approval or rejection.
- Confirm that the contractor cancels scheduled closures that are not needed at least 2 days in advance, using the LCS. The LCS will generate email notifications to the resident engineer and the district traffic manager when the contractor cancels a closure.

4-1203C (1d) Status Updates for Authorized Closures

During the course of work, monitor the contractor’s activities and verify the contractor provides closure status in LCS for:

- Stationary closures on a traffic lane using code:
 - 10-97 before placing the first cone on the traffic lane.
 - 10-98 after removing all the cones from the traffic lane.
- Stationary closures on the shoulder using code:
 - 10-97 before placing the first cone after the last advance warning sign.
 - 10-98 after removing the last cone before the advance warning signs.
- Moving closures using code:
 - 10-97 before the actual start time of the closure.
 - 10-98 after the actual end time of the closure.
- Closures not needed on the authorized date using code 10-22 within 2 hours after the authorized start time.

The LCS will notify the resident engineers and designated inspectors by email when the contractor changes the status of a closure.

If a contractor is unable to access the LCS Mobile webpage, obtain the closure status from the contractor and notify the Transportation Management Center.

Keep the project’s completion dates current in the LCS. The contractor will not be able to access projects in LCS after the completion date.

4-1203C (1e) Field Adjustments

Field adjustments to the traffic handling plans are frequent occurrences.

Adjustments should be made to create adequate sight distance, to avoid locations that require drivers to make multiple decisions, to accommodate expected queues, and to coordinate activities at multiple locations. The following are typical situations in which field adjustments are necessary:

- *T Series Standard Plans*—Show minimum acceptable standards for traffic control. Increasing taper lengths, adding signs, and increasing sign spacing to allow for traffic queuing are all acceptable measures if the *Standard Plans*’ minimum requirements are met.

- Signs—Review sign line of sight and verify it complies with Section 12-3.11, “Construction Area Signs,” of the *Standard Specifications*. Signs should not be placed at the apex of horizontal curves, crests of vertical curves, or where trees or bushes hinder visibility of the sign.
- Vertical and horizontal curves—Verify tapers are visible for their entire length to approaching traffic. Do not hide the taper of a traffic control system behind a vertical or horizontal curve. Extend the straight section, known as the tangent portion of the closure, to better position the taper. Under ideal conditions, all advance warning signs and the taper would be in a tangent with the taper placed on a slight upgrade for improved visibility.
- Ramps and connectors—Managing ramps and connectors within a closure requires additional consideration. Extend exit ramp tapers back through the closure as an extension of the ramp’s shoulder line. Avoid sharply angled tapers. Extend entrance ramps through the closed lane by projecting the left shoulder line.
- Traffic queues—Contain traffic queues completely within the advance warning signs of any closure. Containment may require modestly increasing the spacing between signs or require the placing of additional signs. Some districts have adopted a practice of providing motorists with additional warning by displaying information a mile or more in advance of the closure using portable or fixed changeable message signs. In metropolitan areas, this type of warning may be feasible with cooperation of the Transportation Management Center. Refer to Section 12-4.02C(10), “End of Queue Monitoring and Warning with Pickup Truck Mounted Changeable Message Sign,” of the *Standard Specifications* for monitoring traffic end of queue and warning approaching traffic.
- Multiple closures and inter-project coordination—Avoid multiple closures with overlapping sign patterns. Connect closures by extending the tangents. Confirm that the contractors are coordinating placement and pickup of the closure so that the traffic control system is maintained in accordance with the *Standard Plans* at all times.
- Length of closure—Avoid long closures with no evidence of activity. Consider placing supplemental tapers within an existing closure. When the work has safely progressed beyond the supplemental taper, remove the upstream taper and tangent. Confirm that advance warning signs for the new taper are located correctly.

If long closures are unavoidable, protect the active work area by placing barricades or drums across the closed lanes, upstream of the work area. Also, when possible, use barrier vehicles or an impact attenuator vehicle between the approaching motorist and workers on foot.

4-1203C (1f) Placement Sequence and the Start of Work

Verify the contractor completely installs the traffic control system before commencing work. An impact attenuator vehicle must be used for the placement and

removal of temporary traffic control devices when required by the contract. The following are some possible installation procedures that may be used by the contractor, depending on the situation in which the system will be used:

- Systems affecting traffic only in one direction—Start with the first device that the drivers will see as they enter the work zone, usually a “Road Work Ahead” sign. Additional devices are placed in sequence, moving in the direction of the traffic flow. Move the workers and equipment onto the closed lanes only after all system components are in place.
- Systems affecting traffic in both directions—Install the first sign drivers will see traveling in the opposing direction. Then install in sequence all remaining signs and devices in the opposing direction of travel. Next install the first sign drivers will see in approaching the work area from the affected direction. Place all remaining signs and devices in sequence through the work area. If flaggers are to be used, have flaggers take their stations; then move workers and equipment onto the road.
- Removal of the traffic control system—Remove all workers and equipment from the roadway. Then remove the devices and signs in the reverse order of placement. Restore all signs and signals to normal operation.

4-1203C (1g) Drive-Through Inspection

After installation and when the inspector is available, make a drive-through inspection of the system. During the inspection, drive through the system as though you have no knowledge of the work zone. Confirm the intended vehicle path is clearly visible. Remember that the motorist has no knowledge of the traffic control plan and is entirely dependent on the system for warning and guidance. Document this inspection in the daily report; indicate weather, traffic conditions, and time of inspection.

4-1203C (1h) Maintenance

Verify contractors are assigning personnel and maintaining closures in accordance with the T Series *Standard Plans*. Maintaining such closures is a full-time assignment, and the assigned worker should have no other duty. Ideally, the assistant resident engineer should be able to communicate directly with the contractor’s maintenance person by radio or cell phone. The maintenance person should have spare cones, signs, and barricades available to replace or restore system elements displaced or damaged by traffic.

4-1203C (1i) Reverse Operations Inside Closures

Workers may operate vehicles opposite the flow of traffic inside a closed lane only with the previous authorization of the resident engineer. Certain equipment, such as dike placement machines, can only operate off one side of the equipment and may need to be operated against live traffic. Similarly, certain striping operations require the operator to operate against live traffic because of clearances.

The following practices are recommended if opposing operations are undertaken:

- During daylight operations, the vehicles facing oncoming traffic should have their headlights and their flashing amber lights turned on at all times.
- During night operations, the vehicles should have their headlights turned off and their hazard lights and flashing amber lights turned on.
- At no time should a U-turn be permitted in traffic.

4-1203C (2) Temporary Pedestrian Access Routes

- Confirm the contractor provides a temporary pedestrian access route (TPAR) nearby, off the traveled way, when the construction activities require the closure of an existing pedestrian route.
- If closure of an existing pedestrian route is required because of the contractor's means and methods, remind the contractor of their responsibility to design and construct a TPAR at their expense, and obtain authorization to proceed with the work activities. Do not pay the contractor for providing the TPAR.
- Verify TPARs are constructed in compliance with the requirements in Section 12-4.04, "Temporary Pedestrian Access Routes," of the *Standard Specifications* before allowing use by pedestrians. Use Form DOT CEM-2301, "Temporary Pedestrian Access Route Compliance Inspection Report," to document initial construction compliance of TPARs.
- Obtain from the contractor the completed Form DOT CEM-2311, "Temporary Pedestrian Access Route Contractor Compliance Report," within 2 business days after construction of a TPAR.
- Verify that the contractor provides overhead covering, overhead lighting, or both when required.
- Inspect TPARs weekly to verify that they are clean and unobstructed and comply with the Americans with Disabilities Act and the work plan required by the specifications. Use Form DOT CEM-2302, "Temporary Pedestrian Access Route Weekly Inspection Report," to document that TPARs are maintained in compliance during the course of work.
- Obtain from the contractor, the completed Form DOT CEM-2312, "Temporary Pedestrian Access Route Contractor Weekly Report," within 2 business days of completing a weekly inspection.
- Form DOT CEM-2303, "Temporary Pedestrian Access Route Sidewalk Detour Inspection Report," may be used by the engineer and the contractor to report weekly inspections if the TPAR is provided using an existing pedestrian route.
- File completed ADA compliance reports in Category 23, "Temporary Pedestrian Access Routes," of the project files.

4-1203C (3) Bridge Cleaning and Painting Activities

- Verify the required signs are placed during the cleaning and painting activities and removed at the end of each work shift.

- Verify the traveled way is free of obstructions and residue before opening the area to traffic.

4-1203D Temporary Pavement Delineation

- Verify temporary or permanent pavement delineation is in place before opening the traveled way to traffic.
- Verify temporary pavement markers are the same color as the lane line or centerline markers being replaced. Confirm the contractor uses the long-term temporary pavement marker for 180 days or less and the short-term temporary pavement marker for 14 days or less.
- Do not allow the application of temporary pavement delineation over existing pavement delineation.
- Verify removal of any temporary delineation that conflicts with any subsequent or new traffic pattern for the area.

4-1203D (1) Temporary Pavement Markers

- Do not allow the use of epoxy adhesive to place pavement markers in areas where the removal of the pavement markers is required.
- Temporary pavement markers will not adhere to a cold in-place recycling surface. Use alternate methods to delineate this type of surface.
- Use of 180-day temporary pavement markers on an open-graded surface is not advised; when removed, the marker glue can peel up the open grade.

4-1203D (2) Channelizers

Verify channelizers used for temporary edge line delineation are predominantly orange and the surface-mounted type.

4-1203D (3) Temporary Lane Line and Center Delineation

- Verify pavement marker spacing.
- Verify the contractor installs the temporary no-passing zone signs if no-passing centerline pavement delineation is obliterated. Determine the exact location of the temporary signs and when they are no longer needed for the direction of traffic.
- Verify no-passing zone signs are removed when no longer required.

4-1203D (4) Temporary Edge Line Delineation

- Verify the contractor cements the bases of channelizers used for temporary edge line delineation as specified.
- Allow the use of paint only if the temporary traffic stripe is not required to be removed.

4-1203D (5) Temporary Traffic Stripe Tape

Verify that temporary traffic stripe tape for use more than 14 days is applied according to the specifications, and temporary traffic stripe tape to remain in use 14 days or less is applied according to the manufacturer instructions.

4-1203D (6) Temporary Traffic Stripe Paint

Review Section 84-2.03, "Construction," of the *Standard Specifications* for the application requirements for temporary traffic stripe paint.

4-1203D (7) Temporary Pavement Marking Tape

Verify that temporary pavement marking tape to remain in place more than 14 days is applied according to the specifications, and that temporary pavement marking tape to remain in place 14 days or less is applied according to the manufacturer instructions.

4-1203D (8) Temporary Pavement Marking Paint

Review Section 84-2.03, "Construction," of the *Standard Specifications* for the application requirements for temporary pavement marking paint.

4-1203E Temporary Pavement Delineation for Seal Coats

- Verify the contractor installs the temporary no-passing zone signs if no-passing centerline pavement delineation is obliterated. Determine the exact location of the temporary signs and when they are no longer needed for the direction of traffic.
- Verify temporary pavement delineation is maintained until it is replaced with the permanent pavement delineation. Direct the contractor to remove any temporary pavement delineation that conflicts with the permanent pavement delineation.

4-1204 Level of Inspection

Conduct intermittent day and night inspections to verify compliance with visibility and legibility requirements for:

- Retroreflective bands on portable delineators.
- Retroreflective sheeting on channelizers.
- Retroreflective sleeves on traffic cones.
- Construction area signs.
- Portable changeable message signs.
- Flashing arrow signs.

4-1205 Quality Control

While specific levels of quality control for temporary traffic control are not included in Section 12, “Temporary Traffic Control,” of the *Standard Specifications*, the contractor is responsible for providing quality control under Sections 5-1.01, “General,” and 6-2.02, “Quality Control,” of the *Standard Specifications*.

Verify that the contractor schedules and conducts a meeting to discuss the operation of impact attenuator vehicles as required under Section 12-3.23A(4), “Quality Assurance,” of the *Standard Specifications*. Verify attendance of subcontractor’s and other contractor’s personnel involved with traffic control. Make sure your designated staff and other state staff involved with traffic control attend the meeting when possible.

4-1206 Payment

The following guidelines are for measuring and paying for various traffic control devices for construction areas.

4-1206A Flagging

Compensation for flaggers shown on the contract plans, including advance flaggers and additional flaggers will be included in the bid item for traffic control system. If advanced flaggers or additional flaggers are not shown or specified, then Caltrans pays 100 percent by change order. For public safety, when flaggers are not shown on the plans or specified and when ordered by the engineer, providing flaggers is change order work for which Caltrans pays 100 percent.

Compensation for flaggers used for all movements of workers, construction vehicles, and equipment on or across lanes open to traffic will be included in the bid item of work involved.

For public convenience, such as routing traffic through detours when not shown on the plans and when ordered by the engineer, providing flaggers is change order work for which Caltrans pays 100 percent.

4-1206B Temporary Traffic Control Devices

4-1206B (1) Traffic Cones

Traffic cones are paid for as part of the contract item for the traffic control system.

4-1206B (2) Plastic Traffic Drums

Count the plastic traffic drums for payment as they are placed in the locations shown on the plans. Drums used instead of cones, barricades, or delineators as part of a traffic control system or used as specified under the “Public Safety” section in the contract are not to be paid for at contract item price.

4-1206B (3) Portable Delineators

Portable delineators are paid for as part of the contract item for the traffic control system.

4-1206B (4) Channelizers

Channelizers are paid for by the unit. The contract item price includes the costs of maintaining, replacing, and repairing channelizers. The contract item price also includes the costs of work necessary to restore channelizers damaged by public traffic.

4-1206B (5) Barricades

Initial placement of each barricade is paid for as a contract item at the time of placement. Subsequent relocations of each barricade are paid for as extra work using the force account method. Damaged barricades should be repaired at the contractor's expense, regardless of the cause, including damage by public traffic.

4-1206B (6) Construction Area Signs

Construction area signs, except those used in traffic control systems for closures, are paid for as a lump sum item. The cost of the contractor's inventory of replacement sign materials is included in the contract price for construction area signs. Additional signs ordered by the resident engineer are paid for as extra work.

The cost of covering, uncovering, and removing signs no longer needed is included in the contract price for construction area signs.

When determining how much to include on a progress pay estimate, withhold some payment sufficient to cover the cost of maintaining and removing the signs.

4-1206B (7) Temporary Barrier Systems

Review the "Public Safety" section in the contract. Do not use the contract item for temporary barrier systems to pay for a temporary barrier that is placed to fulfill the requirements of the "Public Safety" section.

Withhold some payment from progress pay estimates to cover the cost of removing temporary barrier systems.

4-1206B (8) Temporary Traffic Screens

Measure and pay for temporary traffic screen according to the specifications.

4-1206B (9) Temporary Crash Cushion Modules

Review the "Public Safety" section in the contract. Do not use the contract item for temporary crash cushion modules to pay for temporary crash cushion modules that are placed to fulfill the requirements of the "Public Safety" section.

Withhold some payment from progress pay estimates to cover the cost of removing temporary crash cushion modules.

4-1206B (10) Impact Attenuator Vehicles

Impact attenuator vehicles are paid for as part of the contract item for the traffic control system.

Payment for stationary impact attenuator vehicles is included in the corresponding bid item. Each stationary impact attenuator vehicle placed upstream of the work area is paid by the day.

4-1206B (11) Flashing Arrow Signs

Flashing arrow signs are paid for as part of the contract item for the traffic control system.

4-1206B (12) Portable Flashing Beacons

Portable flashing beacons are measured and paid for at contract item price by the unit, except when they are part of a traffic control system. In that case, portable flashing beacons are paid for as part of the contract item for the traffic control system.

Directing the contractor to move the portable flashing beacon after initial placement is change order work.

4-1206B (13) Portable Changeable Message Signs

The contract item for PCMS, commonly bid as “furnish-each” or “furnish-lump sum,” includes all costs for placement, operation, maintenance, relocation, and removal of the signs.

Direct the contractor to provide PCMS for use not otherwise provided for in the contract, with a minimum notice of 1 full working day. Payment is computed as extra work.

4-1206B (14) Portable Signal Systems

If the portable signal system is out of operation, the contractor must provide flaggers to control the traffic until the traffic signals are in operation. The cost of providing flaggers is included in the bid item cost for portable signal systems.

4-1206B (15) Temporary Flashing Beacon Systems

The contract item for a temporary flashing beacon system, commonly bid as “furnish-each” or “furnish-lump sum,” includes all costs for placement, operation, maintenance, relocation, and removal of the system.

4-1206B (16) Automated Work Zone Information Systems

The lump sum payment for this item includes all costs for placement, operation, maintenance, relocation, and removal of the Automated Work Zone Information System.

4-1206B (17) Portable Transverse Rumble Strips

Portable transverse rumble strips will be paid under a contract bid item.

4-1206B (18) Portable Radar Speed Feedback Sign Systems

Portable radar speed feedback sign systems will be paid under a contract bid item.

4-1206B (19) Automated Flagger Assistance Devices

Automated flagger assistance devices (AFAD) will be paid under a contract bid item.

If an AFAD bid item is not shown on the bid item list, providing AFAD is change order work.

4-1206B (20) Temporary Automated End of Queue Warning System

If the temporary automated end of queue warning system malfunctions for a cumulative period of 4 hours or more, no payment will be made for the day.

4-1206C Traffic Control Systems

For all project work, the lump sum payment for the traffic control system includes payment for all labor, equipment, and materials to install, maintain, and remove the traffic control system as shown on the plans or *Standard Plans*. The contract item for the traffic control system includes payment for portable signs, cones, delineators, and flashing arrow signs as shown on the plans for the traffic control system and impact attenuator vehicle.

Include compensation or credit in the change order when an ordered change in the work affects the contract item for the traffic control system.

Traffic control costs in support of extra work are to be paid as part of the extra work. Compute the payment as a force account or as an adjustment of compensation based on a force account analysis. The change order that authorizes the extra work should reflect these costs.

In addition to adjustments for ordered changes, process change orders that adjust compensation when increased or decreased closures are required because of underruns or overruns in the engineer's estimated quantities. Process change orders for bid items that require traffic control that are not caused by an ordered change for a contract item or items. Calculate the adjustment on a force account basis. The change order must clearly state there will be adjustment on the traffic control system item by reason of this change.

Section 65 Concrete Pipe

- 4-6501 General**
- 4-6502 Before Work Begins**
- 4-6503 During the Course of Work**
- 4-6504 Level of Inspection**
- 4-6505 Quality Control**
- 4-6506 Payment**

Section 65 Concrete Pipe

4-6501 General

This section provides guidelines for inspecting concrete pipe for work specified under Section 65, “Concrete Pipe,” of the *Standard Specifications*. Concrete pipe includes circular reinforced concrete pipe, oval-shaped reinforced concrete pipe, reinforced concrete pipe arch, and nonreinforced concrete pipe. The contractor selects the class of pipe and method of backfill shown in Sheet A62D, “Excavation and Backfill—Concrete Pipe Culverts,” of the *Standard Plans*, unless the bid item list specifies the class or method. Materials Engineering and Testing Services (METS) personnel will test and inspect the pipe during manufacturing, but the resident engineer and assistant resident engineers must verify that the correct combination of class of pipe and earthwork methods are used in each location.

4-6502 Before Work Begins

Before work begins, review the plans and specifications and inspect the sites of all planned installations. Reviewing these items sufficiently in advance helps prevent scheduling conflicts and errors in ordering materials. During the preliminary review and inspections, the resident engineers and assistant resident engineers should also do the following:

- Review the “Materials Information” from METS and make sure that the special provisions cover any special requirements.
- Note any unsolved drainage problems and make any necessary changes by change order.
- As soon as final locations and lengths are determined, give the contractor a revised pipe list, including those pipes added or altered by change order.
- Obtain from the contractor the selected class of reinforced concrete pipe and method of backfill to be used for each length of culvert. Also obtain from the contractor culverts that are to be manufactured using the direct design method or nonreinforced pipe where allowed by the specifications and *Standard Plans*.
- Verify that Form DOT CEM-3101, “Notice of Materials to Be Used,” includes concrete pipe of the type and class specified. Refer to Section 6-202, “Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.

4-6503 During the Course of Work

During the course of work, do the following:

- Once the pipe arrives at the job site, check the identification tags or marks to verify that a METS inspector has inspected the pipe at the source of origin.

- Determine the final acceptability of the pipe using the guidelines in Section 6-2, "Acceptance of Manufactured or Fabricated Materials and Products," of this manual. Sections of pipe that have met the requirements of the three-edge bearing test may be used in the work. Cracks resulting from the three-edge bearing test are not a reason for rejecting the pipe. Small numbers of hairline cracks and minor chips are not so serious as to require rejecting pipe, either. However, the following problems are not acceptable: pipe with cracks through the wall; exposed reinforcing steel; or damaged bells, spigots, or joint grooves.
- For culverts that have been installed and backfilled, cracks should not exceed 1/100 inch in width in severely corrosive environments; such as environments consisting of a potential of hydrogen (pH) of 5.5 or less, seawater, or water containing vegetal or animal wastes or chloride concentration greater than 500 parts per million (ppm). Conversely, culverts installed in a noncorrosive environment, such as environments consisting of a pH greater than 5.5, water containing animal or vegetal wastes or chloride concentrations less than 500 ppm, or cracks of up to 1/8 inch in width in the installed pipe, are acceptable if they are not excessive in number. Note the requirements in the specifications for marking pipe. Make sure that pipe of the specified size, type, and class is installed at the proper locations.
- Before structure excavation, require that embankments be constructed as specified. Before installing pipe, determine the acceptability of excavations and any required bedding, as described in the specifications and as shown in the *Standard Plans*. Excavation must occur for each bell to avoid shear cracking.
- Require methods of handling that will not damage the pipe.
- At the contractor's option and expense, the contractor may use extra strong pipe to withstand the pressures of jacking. Make sure any voids resulting from jacking are filled.
- Elliptically reinforced pipe must be placed so the minor axis is vertical. Note the locations of indicators, painted stripes, or lift holes to verify proper placement. Before the contractor places the backfill, check that lift holes are plugged.
- Verify that pipes are placed with belled ends upstream. Where possible, pipes should be laid on the upgrade. Progress on the upgrade facilitates tight joints, particularly for pipes on steep grades. However, extending existing pipes downstream will require laying pipe on the downgrade or will require a special connecting structure.
- Joints must have smooth, uniform interior surfaces. Unless otherwise required, joints must be sealed completely with cement mortar, rubber gaskets, or resilient materials. Reject gaskets that have cracks or splits.
- Check the aggregate and the proportioning of cement mortar. The mortar must be used within 30 minutes after the addition of water. Permit the use of admixtures to improve workability and determine the amounts to be added.

- Make sure rubber gaskets are stored in a cool place away from sunlight. If lubrication is required before installation, require the contractor to follow the manufacturer's instructions.
- Make sure resilient materials are tested before use. While sealing with liquid materials, verify that molds or runners retain the liquid materials. Liquid sealers must be placed continuously and agitated until the joint is completely filled.
- Review backfill details on the contract plans, *Standard Plans*, or both. Determine that the class of reinforced concrete pipe and method of backfill selected by the contractor meet these details. Refer to Section 4-19, "Earthwork," of this manual for additional instructions on excavation and backfill.
- Backfill may be done while the mortar in joints is plastic. However, after the mortar sets, do not permit backfill until 16 hours after sealing. Further, because free water may not contact the pipeline until seals containing portland cement have aged 24 hours, no backfill may be placed during this period if it must be watered in place. Require backfilling in a manner that will not damage seals, whether by direct contact or through displacement of joints. Imported structure backfill should be checked for pH and resistivity levels to verify that the service life of the pipe will not decrease. The limits of concrete backfill, when required, will be shown on the plans. Concrete backfill is paid for as a separate item. The contractor may use slurry cement backfill for backfilling culverts. When either concrete backfill or slurry cement backfill is used, observe carefully and verify that the pipe is not displaced or floated by uneven or too rapid placement. For rapid strength concrete or rapid strength slurry cement backfill, allow only nonchloride admixtures to accelerate the setting time.
- Require that minimum cover for construction loads, as shown in the *Standard Plans*, be placed over reinforced concrete pipe culverts.
- Insist that pipes be protected from damage during continuing operations. Periodically inspect pipes as work progresses. A particularly critical time to inspect comes after the completion of the grading plane and before the start of base and surfacing. During the final phases of the project, make another inspection, primarily to find any pipes that need cleaning.

4-6504 Level of Inspection

Suggested levels of inspection for typical work activities are:

- Intermittent inspection of trench excavation.
- Benchmark inspection of bedding and pipe installation.
- Intermittent inspection of backfill.
- Intermittent inspection of sampling and testing of materials, compaction, and applying curing seal.

4-6505 Quality Control

Witness the specified hydrostatic tests for siphons and low-head conduits. Verify hydrostatic test results and leakage calculations. Refer to Section 65-2.01D(2), "Field Testing of Siphon and Pressure Pipe," of the *Standard Specifications*.

4-6506 Payment

The length of pipe to be paid for is the slope length designated by the resident engineer. This slope length is the length shown on the plans, plus or minus any changes the resident engineer makes, or the length as determined from the surveyors' staking notes. If pipe is cut to fit a structure or a slope, the pay length is the length necessary to be placed before cutting, rounded up to the nearest 2-foot increment. If the contractor forms the pipe out from a structure, the formed distance is also part of the length of the pipe necessary before cutting. If the pipe joins a structure at a skew, the length of pipe necessary to be placed before cutting is the longer side of the pipe. Pipe bends, wyes, tees, and other branches must be field measured in accordance with the specifications.

If approved by the engineer, using field measurements instead of calculations or using supplement calculations is acceptable under the following circumstances:

1. A pipe runs between 2 structures. After verifying that the structures are constructed as shown on the plans, determine designated length from a field measurement along the centerline of the pipe between the 2 inside faces. If the pipe is cut, make appropriate adjustments to the field measurement.
2. After verifying that a pipe is properly staked, field measurements may be used between stakes referenced to the ends of the pipe to determine the length designated by the engineer. If using a field measurement to determine pay lengths, include on the quantity sheet an explanation of how the field measurement relates to the length designated by the engineer.

Section 82 Signs and Markers

4-8201 General

4-8202 Before Work Begins

- 4-8202A Sign Panels
- 4-8202B Roadside Signs
- 4-8202C Markers
- 4-8202D Existing Roadside Signs and Markers

4-8203 During the Course of Work

- 4-8203A Sign Panels
- 4-8203B Roadside Signs
- 4-8203C Markers
- 4-8203D Existing Roadside Signs and Markers

4-8204 Level of Inspection

4-8205 Quality Control

4-8206 Payment

Section 82 Signs and Markers

4-8201 General

This section describes the work for providing and installing sign panels, roadside signs, sign overlays, and markers; and it describes work on existing roadside signs and markers at the locations shown on the plans or as directed by the resident engineer. Markers, except highway postmile markers, are used to mark obstructions within or adjacent to the roadbed, including paved shoulders.

4-8202 Before Work Begins

Before work begins, take the following steps:

- Verify that Form DOT CEM-3101, “Notice of Materials to Be Used,” includes markers, sign panels, roadside signposts, and sign overlays. Retroreflective sheeting, including reflectors for markers, and fiberglass-reinforced plastic panel and markers listed on Form DOT CEM-3101 must be on the Authorized Materials List for signing and delineation materials found on the Division of Engineering Services website. Refer to Section 6-202, “Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.
- Review the contract for any requirements for materials furnished by Caltrans. Make sure furnished markers and sign materials have been ordered and will be ready for timely delivery. Inspect and inventory all Caltrans-furnished materials to confirm they are delivered in good condition. Compile a list of deficiencies, if any, and report it to the resident engineer. After delivery, the contractor is responsible for any damage to Caltrans-furnished materials.

4-8202A Sign Panels

Request a certificate of compliance for the following:

- Aluminum sheeting
- Retroreflective sheeting
- Color imaging methods and film
- Protective-overlay film

Obtain and review as-built drawings for the structures requiring modified sign panels.

Inspect signs at the fabrication plant or as they are delivered to the job site. Reject formed panel signs with holes that are slanted or incorrectly spaced. Reject damaged signs, defective signs, and signs with spelling errors before or after installation. Verify that the reflective sheeting is not damaged or compromised during the delivery and installation.

4-8202B Roadside Signs

Review the plans and specifications to determine the types, quantity, and location of signs to be installed and any special requirements included in the contract.

4-8202C Markers

Review the marker list shown on the plans, and inform the contractor of any changes, preferably before material is ordered or information is stenciled on the markers. Part 3, "Markings," of the *California Manual on Uniform Traffic Control Devices*, provides design details for markers.

Request a certificate of compliance for the following:

- Metal target plates
- Enamel coating
- Retroreflective sheeting

Examine markers and retroreflective sheeting to make sure they meet specification. Verify that they match the materials shown on Form DOT CEM-3101, "Notice of Materials to Be Used."

If postmile values are not shown on the plans, provide the contractor with a list of postmile values to be stenciled on highway post markers.

4-8202D Existing Roadside Signs and Markers

Review Section 15, "Existing Facilities," of the *Standard Specifications*.

Inspect existing roadside signs that are to be reset or relocated. If their condition has deteriorated sufficiently to prevent planned use, write a change order to provide for new materials. Inspect existing frames where new sign panels will be installed.

Document existing conditions with photographs or video and file them in the project records.

4-8203 During the Course of Work

4-8203A Sign Panels

Perform the following actions:

- Verify through observation that sign panels and fastening hardware comply with specifications. Verify that exposed portions of fastening hardware on the panel faces have been finished as specified.
- Inspect sign panels for compliance with specified work quality. Make sure sign panels are not chipped or bent.
- Inspect signs after placement and notify the contractor to immediately replace sign panels exhibiting damage or flaws, including sheeting splices or a significant color difference between daytime and nighttime.

- Check that sign panels over lanes and lane arrows are correctly centered over the appropriate lanes.

4-8203B Roadside Signs

Perform the following actions:

- Review the location of postholes to verify that the signs have the correct horizontal clearance and will not be obstructed by other objects or protrude into pedestrian facilities. Verify holes are excavated to the full depth and backfilled as described.
- Check that the minimum vertical clearances to the bottom of the sign panels are as required by the *Standard Plans*.
- Verify that wood posts have breakaway saw cuts and holes.
- If posts are cut or drilled in the field, make sure the contractor treats the exposed areas with a preservative.
- Verify the contractor treats wood block spacers and any cuts to the wood posts with a preservative.
- Check that signs are attached to the posts according to the specifications.
- Contact the district traffic unit for assistance with field review of sign staking and day and night observation of completed signage. Document any assistance received and changes made in the daily report. Inspect the signs during the hours of darkness to verify proper reflectivity.

4-8203C Markers

Perform the following actions:

- Inspect posts for damage during placement.
- Check that target plates and markers are installed after posts are set in place.
- Verify letters and numerals on highway post markers are according to the specifications.
- Inspect finished metal target plates for dents or defects. The maximum edge-to-edge surface deviation from a horizontal plane must not exceed 1/8 inch. Verify that all exposed areas are clean, and areas where the paint is damaged are spot painted.

4-8203D Existing Roadside Signs and Markers

Make sure the contractor protects all existing facilities that will remain in place, temporarily or permanently, whether described in the contract or not. When existing facilities are damaged because of the contractor's operations, the contractor is responsible for repair or replacement. Caltrans is responsible for repair or replacement of existing facilities that are damaged by public traffic.

Make sure existing signs are not removed until the replacement signs are installed or when the existing signs are no longer needed. If an existing sign needs to be covered, check that the signs are completely covered without damaging the sign.

4-8204 Level of Inspection

Suggested levels of inspection for signs and markers are:

- Benchmark inspection of damaged or defective sign panels and markers when delivered to the job site and after installation.
- Intermittent inspection of installation of sign panels, roadside signs, and markers.
- Intermittent inspection of sign and marker posts.

Caltrans staff may refer to the resources available under “Manuals and Guides” on the Division of Safety Programs intranet page for additional sign inspection guidance.

4-8205 Quality Control

Verify sign panels are fabricated at a facility in the Caltrans’ Authorized Facility Audit List for sign panel facilities. The authorized list is available at:

<https://mets.dot.ca.gov/afl/AuditedFacilitiesList.php?amlid=103>

4-8206 Payment

For details of measurement and payment, review contract specifications. Make any necessary measurements and counts.

Refer to Section 6-2.01E, “Material Source Inspection and Testing,” of the *Standard Specifications*, for information about standard deductions taken for Caltrans doing inspection or testing at material sources.

Section 84 Markings

4-8401 General

4-8402 Before Work Begins

4-8402A Traffic Stripes and Pavement Markings

4-8403 During the Course of Work

4-8403A Traffic Stripes and Pavement Markings

4-8403B Rumble Strips

4-8403C Existing Markings

4-8403C (1) Removal of Traffic Stripes and Pavement Markings

4-8403C (2) Removal of Latent Traffic Stripes and Pavement Markings

4-8404 Level of Inspection

4-8405 Quality Control

4-8406 Payment

Section 84 Markings

4-8401 General

This section provides guidelines for inspecting markings for work specified under Section 84, “Markings,” of the *Standard Specifications*. The work consists of applying painted and thermoplastic traffic stripes and pavement markings, constructing rumble strips, and removing existing markings. The special provisions may also allow the contractor to substitute traffic striping and pavement marking tape. Review the bid item list, special provisions, and the contract plans to determine where paint or thermoplastic is required.

4-8402 Before Work Begins

Before work begins, discuss the operation with the Maintenance striping superintendent or supervisor. Ask if there are any particular striping or marking concerns or requests that should be addressed.

Discuss materials to be used with the contractor. If the contractor plans to use solvent-borne or acetone-based paint, verify that its use conforms to the regulations of the local agency for air pollution control.

Review striping and marking plans, standard details, and any special requirements.

Review existing field conditions. Consult with district traffic operations personnel if any changes appear to be necessary.

Verify that Form DOT CEM-3101, “Notice of Materials to Be Used,” includes striping tape, paint, thermoplastic material, and glass beads. All materials listed on Form DOT CEM-3101 must be on the Authorized Materials List for signing and delineation materials. Refer to Section 6-202, “Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.

4-8402A Traffic Stripes and Pavement Markings

Discuss the thermoplastic testing requirements at the preconstruction meeting.

Obtain a copy of the manufacturer’s thermoplastic certificate of compliance and quality control test data from an independent testing laboratory.

Verify that the manufacturer submitted to Caltrans’ Chemical Testing Branch a copy of the certificate of compliance and a single split 6,000-gram representative sample of the thermoplastic lot.

Obtain the safety data sheet for thermoplastic primer.

Obtain the certificate of compliance, Materials Engineering and Testing Services notification letter, and safety data sheet for each lot or batch of paint, and glass beads. Make sure that test results for beads used in drop-on applications include the Environmental Protection Agency test method and that it can be traced to the specific test sample. Verify that the test for arsenic and lead content was performed by an independent laboratory.

Verify large-gradation glass beads are on the Authorized Materials List for two-component traffic striping paints and large-gradation retroreflective glass beads.

Read the manufacturer's instructions for striping tape and thermoplastic materials. When primer is required, determine which type the manufacturer recommends. Also determine the application temperature range for the thermoplastic material.

Discuss with the contractor the methods that will be used to remove existing markings to make sure there will be no "ghost line" left behind.

Inspect the contractor's equipment for specification compliance either in the contractor's or subcontractor's yard or on another project.

Examine the contractor's methods for:

- Checking spread rates of paint and glass beads.
- Measuring application temperatures of thermoplastic material.
- Measuring maximum temperatures of paint.
- Making sure that their stencils will produce correctly dimensioned pavement markings.

4-8403 During the Course of Work

4-8403A Traffic Stripes and Pavement Markings

Check the contractor's layout work. Determine that traffic stripes and pavement markings will be correctly located. Where necessary, assist the contractor in matching existing striping cycles.

Make sure employees working around thermoplastic material wear suitable personal safety equipment, long-sleeved shirts, and eye protection.

Verify the pavement is dry, clean, and the surface temperature is as specified before the contractor applies striping or markings.

Before the contractor applies thermoplastic, check:

- Thermoplastic material is heated to the specified temperature range. Thermoplastic material heated to excessive temperatures can flash and splatter when exposed to air. Check the temperature gauges mounted on heating equipment for accuracy.
- The contractor applies primer to all surface substrates except for asphalt pavement less than 6 months old and follows the manufacturer's recommendation for application rate and how long it needs to dry.
- The pavement temperature and document the readings.

Check that recesses for double traffic stripes are constructed in a single pass, are primed, and are kept dry and free of debris. Verify that the thermoplastic traffic stripes and pavement markings are applied before the end of the same work shift.

Before the contractor applies paint, check and document the atmospheric temperature and expected weather conditions. Never allow the contractor to apply paint when rain, fog, or condensation could damage the freshly painted surface.

Verify that the paint temperatures do not exceed the specified maximums for solvent-borne or water-borne paints.

Verify that each coat of paint is applied in one pass of the striping machine.

When two coats of paint are required, verify that the first coat of paint is dry before the second coat of paint is applied. The second coat of paint for centerline striping on 2-lane highways must be applied in the opposite direction of the first coat of paint.

Make sure the contractor uses two layers of glass beads for thermoplastic traffic stripes and pavement markings with enhanced wet-night visibility. The first layer must be high-performance glass beads and the second layer must be Type 2 glass beads.

Check traffic stripes for the correct width and edge definitions, lengths of gaps and individual stripes, alignment, direction of application, and correct superimposition of second coats.

Require the contractor to remove drips, overspray, improper markings, and material tracked by traffic.

Check that the applied thermoplastic material complies with thickness requirements.

Check application rates for glass beads and paint. Inspect the stripes to verify that glass beads are spread uniformly and properly embedded. Verify that paint and glass beads are applied in the order specified for two-component painted traffic stripes and pavement markings. Make sure the striping machine does not travel faster than 10 miles per hour during the application.

Check thermoplastic markings for acceptability as the markings are applied. Do not permit bumps resulting from overlaps in extruded materials. Check complete thermoplastic traffic stripes or thermoplastic pavement marking to make sure it is free of runs, bubbles, craters, drag marks, stretch marks, and debris.

After application, look for any damage to striping or marking and document any rejections. Ask the contractor to remove and replace existing retroreflective pavement markers coated or damaged by work activities.

Conduct and document a nighttime drive-through visual inspection to verify the retroreflectivity of the installed material. Notify the contractor immediately of any areas with deficient retroreflectivity. Require the contractor to measure the retroreflectivity of those areas using a retroreflectometer and correct any deficiencies. Obtain a copy of the measured retroreflectivity readings from the contractor.

4-8403B Rumble Strips

Verify that rumble strips are not constructed:

- On structures, approach slabs, or concrete weigh-in-motion slabs.

- At intersections.
- Bordering two-way left turn lanes, driveways, or other high-volume turning areas.
- Within 6 inches of any concrete pavement joint.

Verify rumble strips comply with the dimension requirements and are within 2 inches of the alignment shown on the plans. If not compliant, have the contractor replace them.

Make sure rumble strips in concrete pavement are constructed after the specified requirements for the concrete pavement are met.

Verify rumble strips in asphalt concrete pavement are constructed on the top layer and a fog seal coat is applied to ground areas.

Check that residue is removed from the roadbed.

4-8403C Existing Markings

Make sure existing markings are removed:

- Without removing pavement to depth of more than 1/8 inch.
- So that the old message cannot be identified.
- In rectangular areas if the grinding method is used.

Verify all residue is swept or vacuumed. Yellow marking residue must be handled, removed, and disposed of according to the lead compliance plan.

Make sure the contractor repairs, at no cost, any damage to the pavement and surfacing that results from removing traffic stripes and pavement markings, in accordance with Section 5-1.36, "Property and Facility Preservation," of the *Standard Specifications*.

4-8403C (1) Removal of Traffic Stripes and Pavement Markings

Yellow striping generally contains lead, so verify special handling for removal and disposal. Usually, if this striping was identified in the contract, the special provisions would cover removal and disposal. However, if the special provisions do not identify special handling for removal of yellow striping, contact the district hazardous waste coordinator to determine if the striping needs to be tested.

Observe areas where traffic stripes or pavement markings have been removed. If conditions after contractual requirements for removal have been met, but the resulting areas present a traffic hazard, order additional work to eliminate the hazard. Make your observations in the same conditions that public traffic will experience, such as driving at night, on wet pavement, or in low sun angles.

4-8403C (2) Removal of Latent Traffic Stripes and Pavement Markings

In the past, removal of existing traffic stripes and pavement markings was not always required on projects before placement of new pavement surfacing. Thus, on some stretches of highway, old traffic stripes and pavement markings exist under layers of pavement. On pavement rehabilitation projects, underlying latent stripes and

markings may become exposed as the contractor removes layers of pavement by grinding or during cold planing of the existing surface.

If latent traffic stripes or pavement markings are exposed during removal of the existing pavement, consider those latent traffic stripes or pavement markings a differing site condition. Review Section 4-1.06, "Differing Site Conditions (23 CFR 635.109)," of the *Standard Specifications*.

Verify that the contractor repairs any pavement damage and depressions in the existing pavement caused by the removal of latent traffic stripes and pavement markings.

Removal of the latent stripes and markings and the repair of the pavement damaged by their removal will be paid as extra work in accordance with Section 4-1.05, "Changes and Extra Work," of the *Standard Specifications*. When the depressions are smaller than 0.05 foot and are filled with overlay material during its placement, pay for the additional overlay material at contract unit price.

4-8404 Level of Inspection

Suggested levels of inspection for pavement markings are:

- Benchmark inspection of layouts, temperatures, and equipment during placement of pavement markings.
- Immediate nighttime visual inspection of pavement marking retroreflectivity.

4-8405 Quality Control

Guidance for quality control activities included in this section is summarized as follows:

- Verify the contractor's testing of glass beads for arsenic and lead.
- Require that the contractor measure traffic stripe retroreflectivity for deficient areas identified during nighttime drive-through.
- Make sure the contractor calibrates the equipment for compliance with application rates for glass beads and paint.
- Witness the contractor's test section of two-component paint, 50-foot test stripe, and verify for homogeneous mixing of the two components, uniform bead distribution, wet film thickness, and curing time.
- Witness the contractor's 1-foot test section of thermoplastic stripe. Collect the test sample and submit it, with Form TL-0101, "Sample Identification Card," to the Chemical Testing Branch, Translab, 5900 Folsom Blvd., Sacramento, California 95819.

4-8406 Payment

Measure the striping and markings according to the units and method specified in the *Standard Specifications* and the special provisions. Record the measurements in the daily reports and calculation sheets to support partial and final payments.

Use a measuring wheel or a vehicle-mounted electronic measuring device to measure the traffic stripes without deductions for gaps.

Areas of the standard pavement markings shown in the *Standard Plans* may be used in the calculations to determine pay quantities. Make field measurements where the areas are variable, such as for limit lines of different lengths.

Rumble strips are paid by the length measured by the station along the length of the rumble strip without deductions for gaps between indentations.

Removal of traffic stripes is paid by the length without deductions for the gaps in broken traffic stripes and includes removal of markers, paint, or marking material evident in a gap in accordance with Section 84-9.04, "Payment," of the *Standard Specifications*.

Section 95 Epoxy

- 4-9501 General
- 4-9502 Before Work Begins
- 4-9503 During the Course of Work
- 4-9504 Payment

Section 95 Epoxy

4-9501 General

Epoxies specified under Section 95, “Epoxy,” of the *Standard Specifications* are 2-component adhesives used for several applications, including the following:

- As a binder to produce high strength epoxy concrete and epoxy mortar
- Pressure grouting cracks in concrete
- Bonding freshly mixed concrete to hardened concrete
- Bonding pavement markers to pavement
- Sealing inductive loops and leads in hot mix asphalt and concrete
- Pressure injection grouting of concrete pavement

Bridge Construction Memo 95-1, “Epoxy—General,” of *Bridge Construction Records and Procedures Manual, Vol. 2*, contains additional information on epoxy selection, mixing, and placement.

4-9502 Before Work Begins

Verify that Form DOT CEM-3101, “Notice of Materials to Be Used,” includes epoxy. Refer to Section 6-202, “Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.

4-9503 During the Course of Work

During the work, take the following steps:

- Determine that the epoxy used for application type is the material specified and obtain necessary certificates of compliance.
- Make sure the epoxy is packaged and labeled as the specifications require for its intended use.
- Verify that epoxy components are stored at temperatures above 35 degrees Fahrenheit, or at the manufacturer's recommended minimum storage temperature, whichever is higher.
- Check that surfaces to receive epoxy are sound and have been properly prepared and cleaned of harmful materials, including rust, paint, grease, and laitance. Inadequate surface preparation or cleaning is often later identified as the reason for poor bonding performance of epoxy when problems occur.
- Verify that the epoxy is mixed and applied under the manufacturer's instructions and specification requirements. If epoxy components show evidence of crystallization, permanent increase in viscosity, uncorrectable settlement of pigments, or are older than the manufacturer's recommended expiration date, the material cannot be used. Check that each individual component is being

thoroughly mixed before mixing with other components. During mixing, pay particular attention to the proportions being mixed and the thoroughness of the blending. Partial kits are not allowed, because it is difficult to verify that proper proportioning will occur. Addition of solvents is not allowed as their inclusion will affect epoxy performance. Monitor the time from mixing to placement and epoxy consistency, making sure the epoxy does not exceed its working life for the temperature at which it is placed.

- Where placing epoxy concrete or mortar, the receiving surface is to be primed with epoxy immediately before placement operations.
- Where bonding freshly mixed concrete to hardened concrete, epoxy is to be applied to the blast-cleaned surface using a brush or roller. Make sure the epoxy is applied without skips or holidays and the freshly mixed concrete is placed while the epoxy is tacky. In the event the epoxy has set in advance of concrete placement, verify that a new coat of epoxy is applied.

4-9504 Payment

Payment for epoxy is included in the contract unit price for items of work in which epoxy is specified.