STATE OF CALIFORNIA• DEPARTMENT OF TRANSPORTATION

POLICY DIRECTIVE

TR-0011 (REV 9/2006)

TRAFFIC OPERATIONS POLICY DIRECTIVE	NUMBER: 11-04	PAGE: 1 of 5
ROBERT COPP, DIVISION CHIEF (Signature)	DATE ISSUED: October 5, 2011	EFFECTIVE DATE: October 5, 2011

SUBJECT:

Guidelines for Installation of Rumble Strips

DISTRIBUTION

- ☒ All District Directors
- ☒ All Deputy District Directors - Traffic Operations
- ☒ All Deputy District Directors - Maintenance
- ☒ All Deputy District Directors - Construction
- ☒ All Deputy District Directors - Design
- ☐ All Deputy District Directors - Transportation Planning
- ☒ Chief, Division of Engineering Services
- ☒ Chief Counsel, Legal Division
- ☐ Publications (California MUTCD Website) www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/ca_mutcd.htm
- ☒ Headquarters Division Chiefs for:

Construction, Maintenance, Design

DOES THIS DIRECTIVE AFFECT OR SUPERSEDE ANOTHER DOCUMENT? ☒YES ☐NO	IF YES, DESCRIBE **California Department of Transportation Standard Plans and Specifications: See Implementation Section B**
WILL THIS DIRECTIVE BE INCORPORATED IN THE CALIFORNIA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES ☐YES ☒NO	IF YES, DESCRIBE

DIRECTIVE

The content of this directive should be applied when rumble strips are considered for inclusion within highway projects on the state highway system. The directive introduces:

- Rumble Strip Guidelines for the California Department of Transportation (Department) as outlined under the Implementation section of this document.
  See Implementation Section A
- Proposed new and revisions to existing standard plans and specifications related to rumble strips.
  See Implementation Section B

DELEGATION

No new delegations of authority are created under this policy.

BACKGROUND

The Department has used rumble strips in an attempt to alert inattentive or drowsy drivers that their vehicles are drifting out of their travel lane. Rumble strips are installed both in the shoulders as well as in the center of the roadway. As vehicle tires pass over the rumble strips, the driver receives an auditory and mild tactile warning to correct their steering path. Due to their safety benefits, the Department and departments of transportation across the nation have applied rumble strips on a widespread basis. In Section 5103 of the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) enacted in August 2005, Congress recognized that federally-sponsored transportation research indicated that rumble strips improve safety. As such, Section 1401 of SAFETEA-LU lists the installation of rumble strips as a safety measure that may be carried out under the provisions of a Highway Safety Improvement Program.

A significant amount of research has been conducted nationwide on the application of rumble strips. The Department has participated in research that has validated the effectiveness of rumble strips. The Department has taken steps to make rumble strips more accommodating for bicyclists and to make them traversable without discomfort or control issues. Research has indicated that shoulder and centerline rumble strips when installed separately or together improve safety. Shoulder rumble strips can reduce severe run off road collisions in excess of 25%. Centerline rumble strips can reduce cross centerline collisions in excess of 25 percent. A combination of both shoulder and centerline rumble strips can reduce collisions even further.

ADA Notice For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 653-3657 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS89, Sacramento, CA 95814.

IMPLEMENTATION Section A

The Department installs shoulder and centerline rumble strips as follows:

Shoulder Rumble Strips

Where:

Rumble strips should be considered for installation on roads as a measure to reduce run off road collisions.

Installation Method:

Rumble strips are ground into the pavement surface; engineering judgment should be used to evaluate the condition of the pavement prior to rumble strip installation.

Alignment:

Rumble strips should be installed at the edge of traveled way. If installed at narrow shoulder locations, it is recommended to put the rumble strip beneath the applied edge stripe. Consideration should be given for bicyclists when installing this treatment in narrow shoulder areas or in conjunction with centerline rumble strip treatments. Inclusion of pull out locations, widening of shoulders, installation of signing, and other treatments should be considered to accommodate bicycles.

Dimensions:

Lateral width is 6"- 12". At the direction and approval of the district traffic engineer, larger widths may be used to accommodate special circumstances where rumble strips are needed within or across the traveled lane to alert motorists or to facilitate traffic calming.

The recommended longitudinal milling pattern is 5" groove + or – 1", 5/16" depth + or – 1/16", and 1 foot center to center spacing + or – 2".

Layout Considerations:

Break rumble strips for intersections, driveways, and freeway exit gore areas. Recommended break distances are 50 feet for intersections and driveways and 150 feet for freeway ramps. Break distances may be adjusted and the need for breaks in the shoulder rumble strip pattern may be assessed at low volume driveways or other locations based upon the engineering judgment of the district traffic engineer.

Operational Considerations:

Field testing has confirmed that the rumble strip depths mentioned above are traversable by bicycles. Consideration should be given when installing in narrow shoulder areas or when in conjunction with centerline rumble strip treatments. Inclusion of pull out locations, widening shoulders, installing sign(s) and other treatments should be considered to accommodate bicycles.

Special considerations:

Engineering judgment should be used when considering installation as follows:

a) On roads with speed limits of 35 mph or less where noise is a concern.
b) When pavement condition is deteriorated or exhibits cracking; pavement improvement may be needed to complete the treatment, consult the District Maintenance engineer if there are questions regarding pavement quality.

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Do not install milled shoulder rumble strips:

a) Between through or turning lanes at intersections.
b) On bridge decks, approach slabs, or concrete weigh in motion slabs; alternative proprietary raised profile rumble strips materials are available to apply for use in these areas.

Centerline Rumble Strips

Where:

Centerline rumble strips should be considered for installation on undivided highways as a measure to reduce cross centerline collisions.

Installation method:

Centerline rumble strips are ground into the pavement surface; engineering judgment should be used to evaluate the condition of the pavement prior to centerline rumble strip installation.

Alignment:

Where installed, centerline rumble strips should be installed continuously through passing and no passing zones as a pavement treatment below various pavement markings.

Centerline rumble strips may be installed in or below painted medians between lanes. Decisions regarding the width of the median should be made based upon the judgment of the traffic engineer recommending their installation. For medians 24 inches or greater in width, roadways are noted as divided per CVC section 21651; evaluation of the speed zone when considering a median installation is recommended.

Dimensions:

Lateral width is 6" - 12". Larger widths may be used to accommodate special circumstances at the direction and approval of the district traffic engineer (for example, to highlight areas within medians or buffers zones between lanes where traffic is not desired).

The recommended longitudinal milling pattern is 5" groove + or – 1", 5/16" depth + or – 1/16", and 1 foot center to center spacing + or – 2".

Layout Considerations:

Centerline rumble strips should be broken for all public street intersections and commercial driveways with approximately 500 or more vehicles per day.

Operational Considerations:

Bicyclists may have the need to cross over the centerline therefore the rumble strip depths mentioned above are recommended. Centerline rumble strip depths greater than recommended may be installed based upon engineering judgment and with the approval of the district traffic engineer.

Special Considerations:

Engineering judgment should be used when considering installation as follows:

a. Within suburban or urban areas or on roads with speed limits of 35 mph or less where noise may be a concern.
b. When pavement condition is deteriorated or exhibits cracking; pavement improvement may be needed to complete the treatment, consult the District Maintenance engineer if there are questions regarding pavement quality.

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Do not install milled centerline rumble strips:

a) Bordering two-way left turn lanes, within intersections, driveways or other high volume turning areas.

b) On bridge decks, approach slabs, or concrete weigh in motion slabs; alternative proprietary raised profile rumble strips materials are available to apply for use in these areas.

IMPLEMENTATION Section B

Proposed new and revisions to existing Department standard plans and specifications related to rumble strips, see attached.

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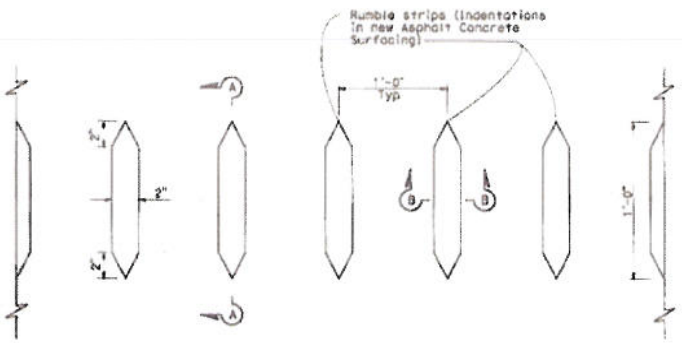
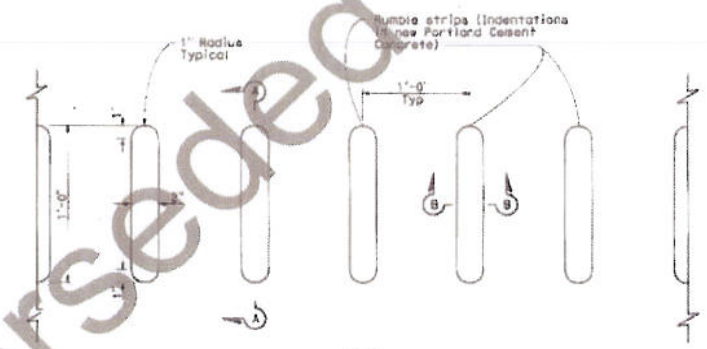
SECTION A-A

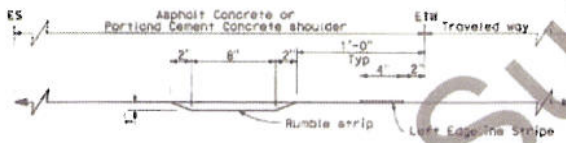
SECTION B-B



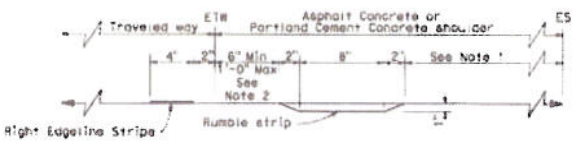
PLAN
ASPHALT CONCRETE SURFACING
ROLLED-IN INDENTATIONS
DETAIL A



PLAN
PORTLAND CEMENT CONCRETE
ROLLED-IN INDENTATIONS
DETAIL B



RUMBLE STRIP PLACEMENT
LEFT OF DIRECTION OF TRAVEL



RUMBLE STRIP PLACEMENT
RIGHT OF DIRECTION OF TRAVEL

TYPICAL ROLLED-IN RUMBLE STRIP
SHOULDER PLACEMENT

NOTES:

1. Where bicycles are permitted, shoulder rumble strips should not be used right of direction of travel unless a minimum of 5'-0" of clear shoulder width for bicycle use is available between the rumble strip and the outer edge of the shoulder. Where bicycles are not permitted, a minimum of 4'-0" of distance is required between the rumble strip and the outer edge of the shoulder.
2. Unless otherwise shown on the plans or specified in the special provisions, the 6" offset from the edge of traveled way to the edge of the rumble strip shall be used for rumble strip placement right of the direction of travel.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

SHOULDER RUMBLE STRIP DETAILS
ROLLED-IN INDENTATIONS

NO SCALE

A40A

Craig A. Copelan
REGISTERED CIVIL ENGINEER
May 1, 2006
PLANS APPROVAL DATE
Craig A. Copelan No. C36701 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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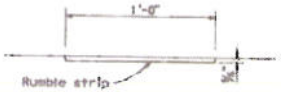
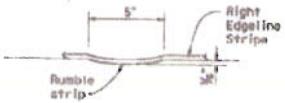
To get to the Caltrans web site go to: http://www.dot.ca.gov

Superseded

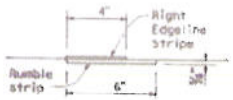
SECTION A-A



SECTION B-B

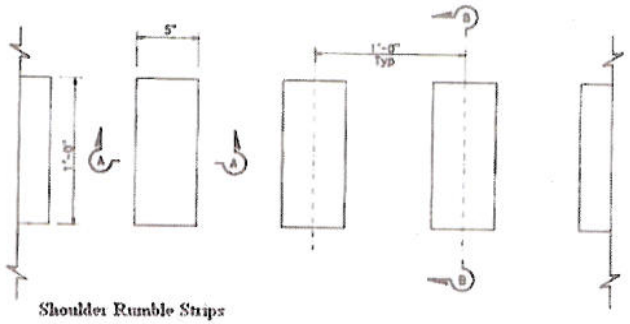


SECTION C-C

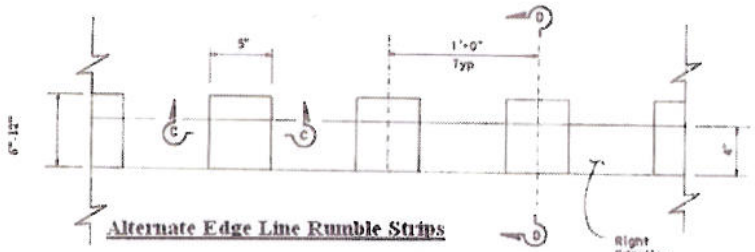


SECTION D-D

To accompany plans dated .....

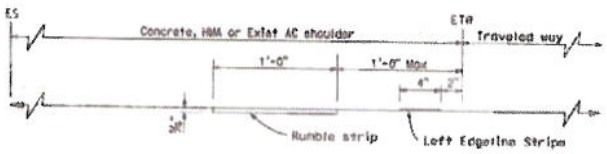


Shoulder Rumble Strips

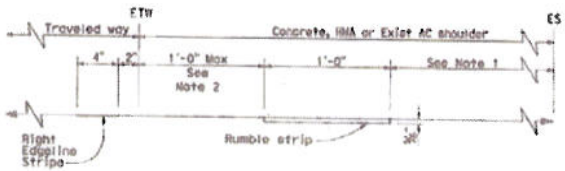


Alternate Edge Line Rumble Strips

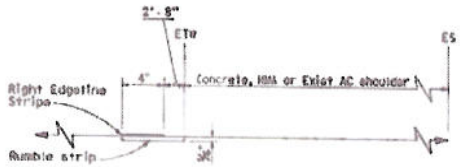
PLAN
GROUND-IN INDENTATIONS



RUMBLE STRIP PLACEMENT
LEFT OF DIRECTION OF TRAVEL



RUMBLE STRIP PLACEMENT
RIGHT OF DIRECTION OF TRAVEL
See Sections A-A and B-B



ALTERNATE RUMBLE STRIP PLACEMENT
RIGHT OF DIRECTION OF TRAVEL
See Sections C-C and D-D

Typical Shoulder Rumble Strip Placement

NOTES:

The Alternate Shoulder Rumble Strip Detail may be considered by the Engineer as a means of accomodating bicycles.

Ground in shoulder rumble strip may be placed up to the edge of travelled way and beneath the edge stripe as determined by the engineer.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

SHOULDER RUMBLE STRIP DETAILS

NO SCALE

RSP A40B DATED MAY 1, 2006 - PAGE 15 OF THE STANDARD PLANS BOOK DATED MAY 2006.

SUPERSEDES STANDARD PLAN A40B

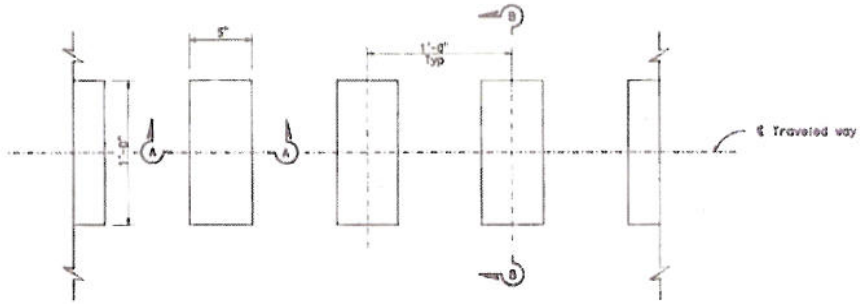
REVISED STANDARD PLAN RSP A40B

2006 REVISED STANDARD PLAN RSP A40B

15

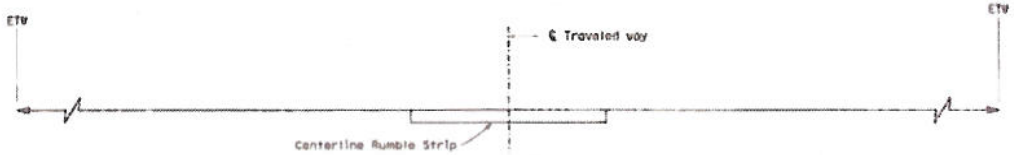
SECTION A-A

SECTION B-B



PLAN

GROUND-IN INDENTATIONS



Typical Centerline Rumble Strip Placement

Note: Centerline Rumble Strips should be installed according to Caltrans Policy and based upon judgement of the engineer.

Striping details which are installed over the centerline rumble strip pavement treatment may vary based upon need at the location of installation and engineering judgement.

To accompany plans dated .....

2006 NEW STANDARD PLAN NSP A40C

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

CENTER LINE RUMBLE STRIP DETAILS

NO SCALE

NSP A40C DATED ..... SUPPLEMENTS
THE STANDARD PLANS BOOK DATED MAY 2006.

NEW STANDARD PLAN NSP A40C

LEGEND

⇨ DIRECTION OF TRAVEL

TYPE D TWO-WAY YELLOW RETROREFLECTIVE, PAVEMENT MARKER

DIST	COUNTY	LOCATION ABBR.	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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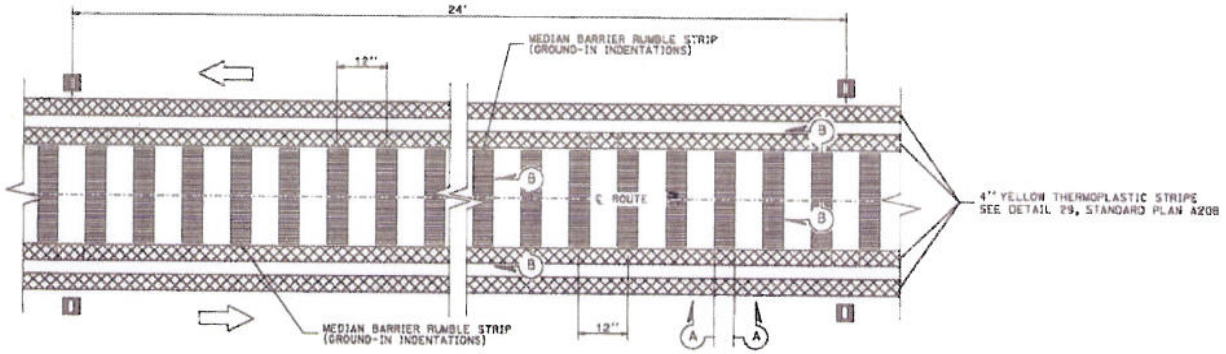
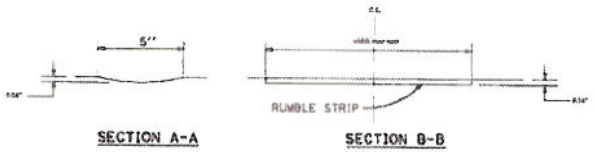
REGISTERED PROFESSIONAL ENGINEER — CIVIL — STATE OF CALIFORNIA



DETAIL 20 WITH MEDIAN BARRIER RUMBLE STRIPS



SECTION A-A SECTION B-B

MEDIAN BARRIER RUMBLE STRIP DETAILS GROUND-IN INDENTATIONS

Note:

Median barrier rumble strips may be installed as a pavement treatement and the striping for detail 29 installed over them. widths of the median barrier rumble strips and the striping paths over or around them may vary based upon the recommendations of the engineer.

Median Barrier Centerline Rumble Strip Detail

DRAFT A40D

June 2010

NO SCALE

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

10-1.__ RUMBLE STRIP

GENERAL

Summary

This work includes constructing rumble strips in the top layer of hot mix asphalt surfacing by *the* ground-in ~~or rolled-in~~ methods.

CONSTRUCTION

~~Choose between ground-in or rolled-in rumble strips.~~

Select the method and equipment for constructing ground-in indentations.

Do not construct rumble strips on structures or approach slabs.

Construct rumble strips within 2 inches of the specified alignment. The grinding equipment must be equipped with a sighting device enabling the operator to maintain the rumble strip alignment.

Indentations must comply with the specified dimensions within 0.06 inch in depth and 10 percent in length and width.

The Engineer orders grinding or removal and replacement of noncompliant rumble strips to bring them within specified tolerances. Ground surface areas must be neat and uniform in appearance.

The grinding equipment must be equipped with a vacuum attachment to remove residue from the roadbed.

Dispose of removed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

On ground areas, apply fog seal coat under Section 37-1, "Seal Coats," of the Standard Specifications.

MEASUREMENT AND PAYMENT

The contract item for rumble strip is measured by the station along the length of the rumble strips without deductions for gaps between indentations.

The contract price paid per station for rumble strip includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing rumble strip complete in place including furnishing and applying fog seal coat to the actual ground areas, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.__ SHOULDER RUMBLE STRIP (CONCRETE PAVEMENT, ROLLED-IN INDENTATIONS)

This work shall consist of constructing shoulder rumble strips by forming indentations in concrete pavement as shown on the plans and as specified in these special provisions.

Shoulder rumble strips shall be constructed in the concrete pavement just prior to initial set. Indentations shall be formed without displacement of adjacent concrete.

Shoulder rumble strips shall not be constructed on structures or approach slabs.

Indentations shall not vary from the specified dimensions shown on the plans by more than 10 percent. Rumble strips shall be constructed within 2 inches of the required alignment. Equipment used to construct the rumble strips shall be equipped with a sighting device that will enable the operator to maintain the alignment of the rumble strip.

Finished rumble strips not meeting specified tolerances, shall be brought within tolerance by either abrasive grinding, or removal and replacement. The corrective method will be selected by the Engineer. Ground surface areas shall be neat and uniform in appearance. The corrective work shall be at the Contractor's expense.

Shoulder rumble strip (concrete pavement, rolled in indentations) will be measured by the station along each shoulder, on which the rumble strip is constructed, parallel with the adjacent traffic lane, without deductions for gaps between the indentations.

The contract price paid per station for shoulder rumble strip (concrete pavement, rolled-in indentations) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the shoulder rumble strip (concrete pavement, rolled-in indentations), complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Superseded

10-1.__ SHOULDER RUMBLE STRIP (CONCRETE PAVEMENT, GROUND-IN INDENTATIONS)

This work shall consist of constructing ground-in shoulder rumble strips in concrete pavement as shown on the plans and as specified in these special provisions.

Shoulder rumble strips shall be constructed in the portland cement concrete pavement by grinding after the concrete has hardened. The indentations shall not be constructed before a period of 10 days has elapsed after the concrete has been placed, nor before the concrete has developed a modulus of rupture of 551 psi.

Shoulder rumble strips shall not be constructed on structures or approach slabs.

Rumble strip indentations shall not vary from the specified dimensions by more than 0.06-inch or 1/16 inch in depth or 10 percent in length and width. Rumble strips shall be constructed within 2 inches of the required alignment. The grinding equipment shall be equipped with a sighting device that will enable the operator to maintain the alignment of the rumble strip.

Residue from grinding operations shall be picked up by means of a vacuum attachment to the grinding machine and shall not be allowed to flow across the pavement nor be left on the surface of the pavement. Residue from grinding concrete pavement shall be disposed of at the location as specified in "Supplemental Project Information" of these special provisions.

At the option of the Contractor, the residue from grinding concrete pavement may be disposed of at a site chosen by the Contractor if the Contractor obtains approval from the California Regional Water Quality Control Board having jurisdiction over the site. A copy of the approval shall be delivered to the Engineer before disposing residue at the site.

The noise level created by the combined grinding operation shall not exceed 86 dBA when measured at a distance of 50 feet at right angles to the direction of travel.

Finished rumble strips not meeting the specified tolerances, shall be brought within tolerance by either abrasive grinding or removal and replacement. The corrective method will be selected by the Engineer. Ground surface areas shall be neat and uniform in appearance. The corrective work shall be at the Contractor's expense.

Shoulder rumble strip (concrete pavement, ground-in indentations) will be measured by the station along each shoulder on which the shoulder rumble strip is constructed, parallel with the adjacent traffic lane, without deductions for gaps between the ground-in indentations.

The contract price paid per station for shoulder rumble strip (concrete pavement, ground-in indentations) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the shoulder rumble strip (concrete pavement, ground-in indentations), complete in place, including removing and disposing of residue from grinding, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.__ SHOULDER RUMBLE STRIP (CONCRETE PAVEMENT, ROLLED-IN INDENTATIONS)

This work shall consist of constructing shoulder rumble strips by forming indentations in concrete pavement as shown on the plans and as specified in these special provisions.

Shoulder rumble strips shall be constructed in the concrete pavement just prior to initial set. Indentations shall be formed without displacement of adjacent concrete.

Shoulder rumble strips shall not be constructed on structures or approach slabs.

Indentations shall not vary from the specified dimensions shown on the plans by more than 10 percent. Rumble strips shall be constructed within 2 inches of the required alignment. Equipment used to construct the rumble strips shall be equipped with a sighting device that will enable the operator to maintain the alignment of the rumble strip.

Finished rumble strips not meeting specified tolerances, shall be brought within tolerance by either abrasive grinding, or removal and replacement. The corrective method will be selected by the Engineer. Ground surface areas shall be neat and uniform in appearance. The corrective work shall be at the Contractor's expense.

Shoulder rumble strip (concrete pavement, rolled in indentations) will be measured by the station along each shoulder, on which the rumble strip is constructed, parallel with the adjacent traffic lane, without deductions for gaps between the indentations.

The contract price paid per station for shoulder rumble strip (concrete pavement, rolled-in indentations) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the shoulder rumble strip (concrete pavement, rolled-in indentations), complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.__ SHOULDER OR CENTERLINE RUMBLE STRIP (CONCRETE PAVEMENT, GROUND-IN INDENTATIONS)

This work shall consist of constructing ground-in shoulder rumble strips in concrete pavement as shown on the plans and as specified in these special provisions.

Shoulder rumble strips shall be constructed in the portland cement concrete pavement by grinding after the concrete has hardened. The indentations shall not be constructed before a period of 10 days has elapsed after the concrete has been placed, nor before the concrete has developed a modulus of rupture of 551 psi.

Shoulder rumble strips shall not be constructed on structures or approach slabs.

Rumble strip indentations shall not vary from the specified dimensions by more than 0.06-inch or 1/16 inch in depth or 10 percent in length and width. Rumble strips shall be constructed within 2 inches of the required alignment. The grinding equipment shall be equipped with a sighting device that will enable the operator to maintain the alignment of the rumble strip.

Residue from grinding operations shall be picked up by means of a vacuum attachment to the grinding machine and shall not be allowed to flow across the pavement nor be left on the surface of the pavement. Residue from grinding concrete pavement shall be disposed of at the location as specified in "Supplemental Project Information" of these special provisions.

At the option of the Contractor, the residue from grinding concrete pavement may be disposed of at a site chosen by the Contractor if the Contractor obtains approval from the California Regional Water Quality Control Board having jurisdiction over the site. A copy of the approval shall be delivered to the Engineer before disposing residue at the site.

The noise level created by the combined grinding operation shall not exceed 86 dBA when measured at a distance of 50 feet at right angles to the direction of travel.

Finished rumble strips not meeting the specified tolerances, shall be brought within tolerance by either abrasive grinding or removal and replacement. The corrective method will be selected by the Engineer. Ground surface areas shall be neat and uniform in appearance. The corrective work shall be at the Contractor's expense.

Shoulder or centerline rumble strip (concrete pavement, ground-in indentations) will be measured by the station along each shoulder on which the shoulder rumble strip is constructed, parallel with the adjacent traffic lane, without deductions for gaps between the ground-in indentations.

The contract price paid per station for shoulder rumble strip (concrete pavement, ground-in indentations) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the shoulder rumble strip (concrete pavement, ground-in indentations), complete in place, including removing and disposing of residue from grinding, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

10-1.__ RUMBLE STRIP

GENERAL

Summary

This work includes constructing rumble strips in the top layer of hot mix asphalt surfacing by ground-in methods.

CONSTRUCTION

Select the method and equipment for constructing ground-in indentations.

Do not construct rumble strips on structures or approach slabs.

Construct rumble strips within 2 inches of the specified alignment. The grinding equipment must be equipped with a sighting device enabling the operator to maintain the rumble strip alignment.

Indentations must comply with the specified dimensions within 0.06 inch in depth and 10 percent in length and width.

The Engineer orders grinding or removal and replacement of noncompliant rumble strips to bring them within specified tolerances. Ground surface areas must be neat and uniform in appearance.

The grinding equipment must be equipped with a vacuum attachment to remove residue from the roadbed.

Dispose of removed material under Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications.

On ground areas, apply fog seal coat under Section 37-1, "Seal Coats," of the Standard Specifications.

MEASUREMENT AND PAYMENT

The contract item for rumble strip is measured by the station along the length of the rumble strips without deductions for gaps between indentations.

The contract price paid per station for rumble strip includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing rumble strip complete in place including furnishing and applying fog seal coat to the actual ground areas, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.