STATE OF TEXAS DEPARTMENT OF TRANSPORTATION

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PLANS OF PROPOSED

HIGHWAY ROUTINE MAINTENANCE CONTRACT

TYPE OF WORK:

TRAFFIC SIGNAL MAINTENANCE (WILL - CALL)

PROJECT NO. : RMC - 642757001

HIGHWAY: US 67 LIMITS OF WORK: VARIOUS

GRAPHICS FILE MAINTENANCE PROJECT NO. RMC - 642757001 CHECKED STATE DIST. STATE COUNTY TEXAS 23 BROWN CONT. SECT. HIGHWAY NO. CHECKED 6427 57 001 US 67

FINAL PLANS:

Contractor:
Letting date:
Date Contractor began work:
Date work was completed:
Date work was accepted:
Final CONTRACT COST:

CHANGE ORDER SUMMARY:

REQUIRED SIGNS SHALL BE IN ACCORDANCE WITH BC(1)-21 THRU BC(12)-21 AND THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES"



THE STANDARD SHEETS SPECIFICALLY IDENTIFIED ABOVE HAVE BEEN SELECTED BY ME OR UNDER MY RESPONSIBLE SUPERVISION AS BEING APPLICABLE TO THIS PROJECT.



12/12/2022

SPECIFICATIONS ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION NOVEMBER 1, 2014, AND SPECIAL SPECIFICATION ITEMS INCLUDED IN THE CONTRACT SHALL GOVERN ON THIS PROJECT.

EXCEPTIONS: NONE
EQUATIONS: NONE
RAILROAD: NONE



TEXAS DEPARTMENT OF TRANSPORTATION

SUBMITTED FOR LETTING:

DocuSigned by:

Blake Stembridge 12/12/2022

A2E1607EC542461...

MAINTENANCE ENGINEER

APPROVED FOR LETTING:

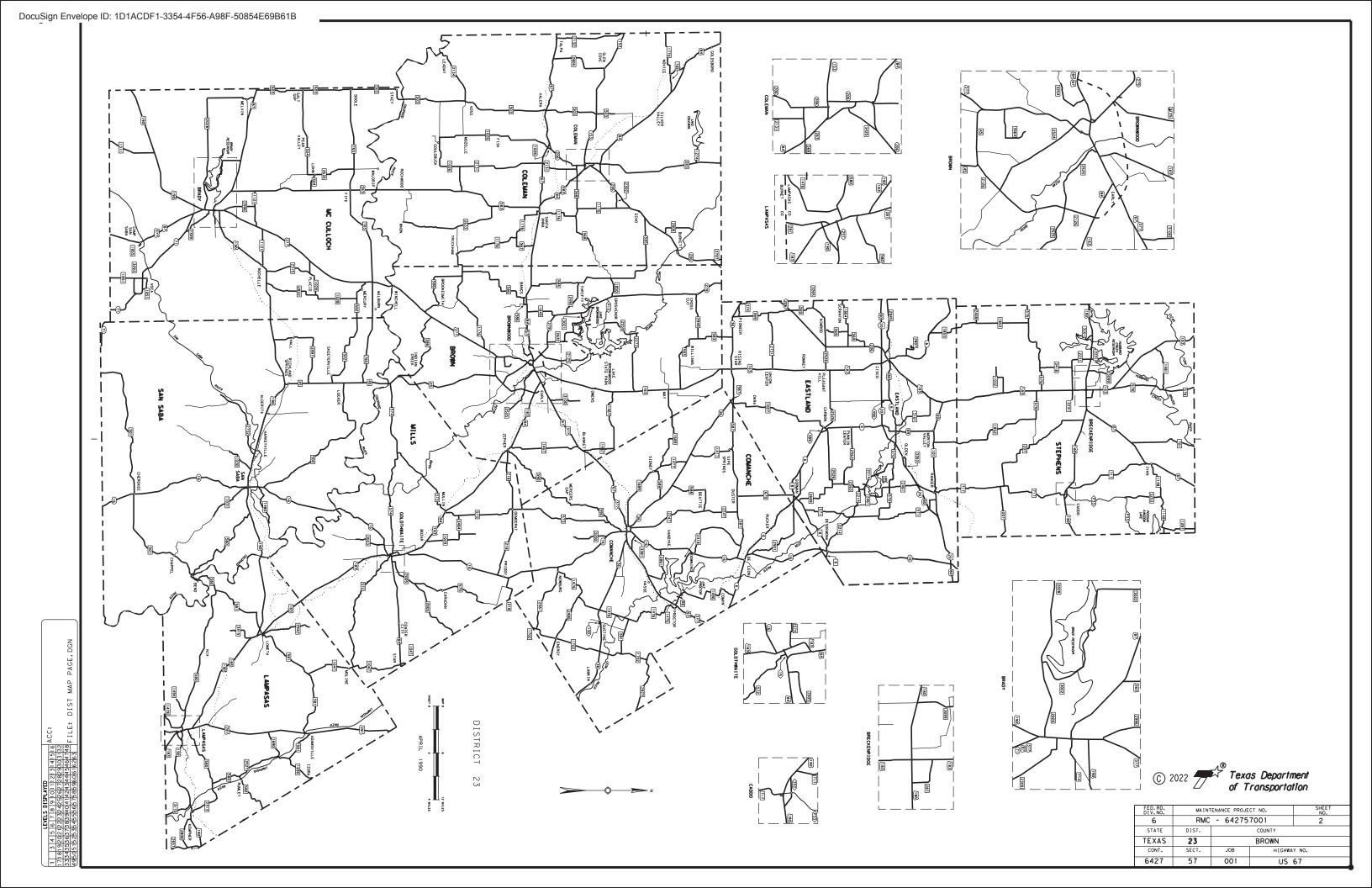
DocuSigned by:
Elias H. Ruchi

BB9FD402431A4A3...

DISTRICT ENGINEER

12/12/2022

DATE



Project Number: RMC-642757001

County: BROWN Control: 6427-57-001

Highway: US0067

GENERAL NOTES:

This Contract is a **CALLOUT AS NEEDED**, **NON-SITE-SPECIFIC** Contract. The Department makes no guarantee for continuous work at any given time at any given location(s). <u>This Contract will be used to install, upgrade, or repair signal and illumination components.</u>

All materials shall be new.

The Department will supply the following materials:

- Signal Cabinets-this includes the controller, conflict monitor, flash transfer relays, and load switches.
- LED's- this includes pedestrian and vehicle signal indications.
- Signal Heads- this includes pedestrian and vehicle signal heads.
- · Back plates.
- Tunnel Visors.
- Accessible Pedestrian Signal Units.
- <u>Luminaire poles</u>-this includes 50 ft. and 40 ft. poles. Bases will be provided by the Department
- <u>Luminaire fixtures and lamps</u>-this includes regular and high mast fixtures and lamps.
- Aviation fixtures and lamps will not be provided by the Department.
- Screw-In foundations.
- Ground boxes-the Contractor will be responsible for all other materials needed to install the ground box.
- Battery boxes.
- <u>Electrical services</u>-the Contractor will be responsible for all components <u>except</u> the service enclosure.
- <u>Flashing Beacon Assembly</u>-this includes all parts of the assembly, including solar components, <u>except</u>: conduit, wiring, fuses, slugs, and fuse holders.
- <u>Ped Pole Assembly</u>-this includes the pedestrian signal section and indication. The Contractor will be responsible for all required wiring and fuse holders if needed.
- Flasher cabinets.
- VIVDS cameras.
- Signal poles.

Counties included are: Brown, Coleman, Comanche, Eastland, Lampasas, McCulloch, Mills, San Saba and Stephens.

The Engineer will send the Contractor a **WORK ORDER** for requested work. Be available to make repairs Monday through Friday and weekends if directed. **Begin work within 72 hours** (for **ALL** items on this Contract) after phone, fax, or email notification, or by date designated by the Engineer on the **WORK ORDER**.

The Engineer will specify the number of **WORKING DAYS** granted for each **WORK ORDER** based on a percentage of the dollar amount of the **WORK ORDER** verses the total dollar amount of the Contract.

The minimum dollar amount for each WORK ORDER will be \$1,000.

After the Work Order is issued, the Contractor shall be responsible for notifying the Signal Shop at (325)643-0476 before beginning any work.

The Contractor shall repair any damages caused by any process of construction or any damages resulting from any act or omissions on behalf of the Contractor. This work is subsidiary to the Contract items.

Project Number: RMC-642757001

County: BROWN Control: 6427-57-001

Highway: US0067

ITEM 2 INSTRUCTIONS TO BIDDERS

Contractor questions on this project are to be emailed to the following individual(s):

Name Email Address
Christopher J. Graf, P.E.
Blake G. Stembridge, P.E.
Blake G. Stembridge, P.E.

Contractor questions will be accepted through email by the above individuals.

All contractor questions will be reviewed by the Engineer. Once a response is developed, it will be posted to TxDOT's Public FTP at the following Address:

https://ftp.dot.state.tx.us/pub/txdot-info/Pre-Letting Responses/

All questions submitted that generate a response will be posted through this site. The site is organized by District, Project Type (Construction or Maintenance), Letting Date, CCSJ/Project Name.

ITEM 7 LEGAL RELATIONS AND RESPONSIBILITIES

No significant traffic generator events identified.

ITEM 8 PROSECUTION AND PROGRESS

Liquidated damages will be assessed in accordance with Item 8, at the rate shown in Special Provision 000-1243, "Schedule of Liquidated Damages."

ITEM 502 BARRICADES, SIGNS AND TRAFFIC HANDLING

Project Limit Barricades will not be required for this project.

The Contractor shall not block traffic lanes from 7:00 a.m. to 8:30 a.m. and 4:30 p.m. to 6:00 p.m. unless otherwise approved by the Engineer.

The Contractor shall have all necessary equipment needed to perform the work and the necessary traffic control.

All Contractor's flagging personnel shall wear clean safety vests and hard hats while flagging and shall have appropriate flagging certification.

Flags on roll-up signs are not required.

General Notes Sheet A General Notes Sheet B

Project Number: RMC-642757001

County: BROWN Control: 6427-57-001

Highway: US0067

ITEM 610 ROADWAY ILLUMINATION ASSEMBLIES

If a new foundation is required, it will be paid for with Item 6000-6059 Install Foundation.

If a lamp is the only component to be replaced it will be paid for with Item 6000-6138 Replace Lamp (Pole Mount Fixture). For any other repairs, the lamp will be subsidiary to the pertinent bid items.

ITEM 618 CONDUIT

All conduit shall be SCH 80 PVC

See Plans & Specifications regarding type of conduit. All couplings and connections shall be tight and waterproof. Each end of every PVC pipe connection and/or coupling shall be cleaned with PVC cleaner and glued thoroughly with PVC sealer. Proposed and existing conduit shall be brought into a pull box and elbowed unless otherwise shown. Where a rigid metal conduit run terminates, a bushing shall be provided to protect the wire from abrasion.

The conduit shall be placed at a minimum depth of two 4 ft. unless otherwise shown on the plans or directed by the Engineer. If utility lines or other obstacles are at the 4 ft. minimum depth then the conduit shall be routed under the utility or obstacle unless otherwise approved by the Engineer.

The conduit shall be placed on a 2 in. sand cushion and then backfilled with a minimum of 6 inches of sand fill. The remainder of the trench shall be backfilled with flexible base or soil as required by location of conduit on the project.

Flexible metal shall not be used on this project.

High density polyethylene (HDPE) may be threaded and used with threaded PVC connectors or couplings.

Use materials from prequalified material producers list as shown on the Texas Department of Transportation (TxDOT) - Construction Division's (CST) material producer list. Category is "Roadway Illumination and Electrical Supplies."

ITEM 620 ELECTRICAL CONDUCTORS

Labeling conductors with label maker is acceptable.

A continuous bare or green insulated copper wire No. 8 or larger shall be installed in every conduit throughout the electrical system in accordance with Item 680 "Installation of Highway Traffic Signals", the electric detail sheets, and the latest edition of the National Electric Code.

Grounding conductors that share the same conduit, junction box, ground box or structure shall be bonded together at every accessible point in accordance with the National Electrical Code.

Use ONLY certified persons to perform electrical work. See Item 7.18 "Electrical Requirements" for additional details.

For both transformer and shoe-base type illumination poles, provide double-pole breakaway fuse holder as shown on the Texas Department of Transportation (TxDOT)-Construction Division's (CST) material producers list. Category is "Roadway Illumination and Electrical Supplies". Fuse holder is shown on list under Items 610 & 620. Provide 10 amp time delay fuses. For Flashing Beacons (Item 685) and Ped poles (Item 687) within the project, provide single-pole breakaway disconnects.

Use Bussman HEBW, Littlefuse LEB, Ferraz-Shawmut FEB, or equal on ungrounded conductors.

Project Number: RMC-642757001

County: BROWN Control: 6427-57-001

Highway: US0067

For all grounded conductors use Bussman HET, Littlefuse LET, Ferraz-Shawmut FEBN, or equal. These breakaway connectors have a white colored marking and a permanently installed solid neutral.

ITEM 628 ELECTRICAL SERVICES

Any service installed by others shall comply with all TxDOT Standards from weather head to fixtures.

Coordinate setting up the electrical service with District Operations to insure the meter is installed under the proper account name.

Photocell enclosed in pedestal services shall be orientated in a northerly direction unless otherwise directed.

ITEM 647 LARGE ROADSIDE SIGN SUPPORTS AND ASSEMBLIES

647-6002 RELOCATE LRSA:

This Item will be used to repair, reinstall, or relocate existing large roadside sign supports and assemblies. If directed by the Engineer, the Contractor may have to furnish new sign supports.

ITEM 656 FOUNDATIONS FOR TRAFFIC CONTROL DEVICES

Drilled shaft foundations for electrical use shall be grounded using a ground rod. Roadside Flashing Beacon foundations shall be of the Screw-in Anchor type.

ITEM 690 MAINTENANCE OF TRAFFIC SIGNALS

690-6006-003 REMOVAL OF GROUND BOXES:

Removal of existing ground boxes requires the removal of ground box and concrete apron if present, cut off or fold over conduit sweep ells then fill the vacancy with like material.

690-6007-003 REPLACE OF GROUND BOXES and 690-6008 INSTALL OF GROUND BOXES:

All new ground boxes shall be TY A unless otherwise noted on the WORK ORDER. All ground boxes shall be installed with aprons.

690-6010-003 REPLACE OF CABLES:

This Item will consist of TRF SIG CBL (TY A) (12 AWG) (4 CONDR) and TRF SIG CBL (TY A) (12 AWG) (12 CONDR). For bidding purposes, assume most locations will use 12 conductor.

690-6025-003 REPLACE SIGNAL HEAD ASSM and 690-6026-003 INSTALL OF SIGNAL HEAD ASSM:

Mount all vehicle signal heads between 18 ft. and 19 ft. above the pavement surface, measured from the bottom of the head. Mount all pedestrian heads, measured from the bottom of the head, 7 ft. above sidewalk or grade. Signal head assembly shall consist of no less than 1 and no more than 12 sections. Fully assemble heads, LEDs, backplates, and mounting hardware and install the assembly as required. Signal head assembly is measured and paid for by each assembly installed complete in place.

690-6036-003 INSTALL OF FND FOR GROUND MNT CABINETS: Refer to Standard TS-CF-04 for dimensions.

690-6039-003 REPLACE OF CONTROL CABINET (GRND MNT):

The Contractor shall remove the existing cabinet and install the cabinet provided by the Department. If cabinet wiring is not labeled in a legible manner, the Contractor shall re-label all cabinet wiring. The Contractor shall place stop signs with all-way

General Notes Sheet C General Notes General Notes Sheet D

Project Number: RMC-642757001

DocuSign Envelope ID: 1D1ACDF1-3354-4F56-A98F-50854E69B61B

County: BROWN Control: 6427-57-001

Highway: US0067

placards on all approaches of intersection or have local law enforcement control the intersection when the signal power is turned off

690-6042-003 REPLACE OF CONTROL CABINET (POLE MNT):

The Contractor shall remove the existing cabinet and install the cabinet provided by the Department. If cabinet wiring is not labeled in a legible manner, the Contractor shall re-label all cabinet wiring. The Contractor shall place stop signs with all-wayplacards on all approaches of intersection or have local law enforcement control the intersection when the signal power is turned off.

690-6063-003 REMOVAL OF CONCRETE FOUNDATIONS:

Remove concrete to 1 ft. below grade and fill vacancy with like material.

690-6072-003 INS OF TRF SIG PL FND (36" DRIL SHFT) (For Strain Poles):

The Contractor shall provide anchor bolts, which will be subsidiary to this Item.

690-6140-003 WRAP SIGNAL CABLE:

Shall consist of wrapping the signal cable to the strain wire in each direction as needed. The Contractor shall use #6 aluminum wire for wrapping. Existing cable clamps may be left in place.

ITEM 6000 MAINTENANCE OF ILLUMINATION

The Contractor is responsible for lowering and raising illumination ring as part of any high mast item.

6000-6059 INSTALL FOUNDATION:

This Item will be used to pay for foundations for illumination poles only. The largest requested foundation will be 8' deep and have a 30" diameter. The Contractor shall provide anchor bolts, which will be subsidiary to this Item.

ITEM 6002 VIDEO IMAGING VEHICLE DETECTION SYSTEM

The primary communications link between the VIVDS camera and the VIVDS Processor System shall be coaxial cable accompanied by a three conductor 16 AWG, 24 DC or 115 VAC camera power cable.

ITEM 6185 TRUCK MOUNTED ATTENUATOR (TMA) AND TRAILER ATTENUATOR (TA)

TMA's needed will be calculated by the day per Call-Out.

General Notes Sheet E



Estimate Sheet

							ESTIMATE SI	UMI	MARY						
						CONTROL 6427-5 US0377	57-001	A L	ITEM CODE			DESCRIPTION	UNIT	тотл	AL
EST	FINAL	EST	FINAL	EST	FINAL	EST	FINAL	<u> </u>	ITEM CODE	DESC	SP NO			EST	FINAL
						10.000			416 6018			DRILL SHAFT (SIGN MTS) (24 IN)	LF	10.000	
						5.000			420 6074 001		001	CL C CONC (MISC)	CY	5.000	
						8.000			500	6033		MOBILIZATION (CALLOUT)	EA	8.000	
						250.000			618	6046		CONDT (PVC) (SCH 80) (2")	LF	250.000	
						250.000			618	6047		CONDT (PVC) (SCH 80) (2") (BORE)	LF	250.000	
						250.000			618	6054		CONDT (PVC) (SCH 80) (3") (BORE)	LF	250.000	
						250.000			620	6006		ELEC CONDR (NO.10) INSULATED	LF	250.000	
						250.000			620	6009		ELEC CONDR (NO.6) BARE	LF	250.000	
						250.000			620	6010	1	ELEC CONDR (NO.6) INSULATED	LF	250.000	
						5.000			647	6002		RELOCATE LRSA	EA	5.000	
						2.000			682	6016		VEH SIG SEC (12")LED(HOUSING ONLY)	EA	2.000	
						2.000		\vdash	686	6293	1	INS TRF SIG PL AM (STRAN)(INSTLL ONLY)	EA	2.000	
						2.000			690	6006	1	REMOVAL OF GROUND BOXES	EA	2.000	
						2.000		+	690	6007	1	REPLACE OF GROUND BOXES	EA	2.000	
						5.000		+	690	6008	1	INSTALL OF GROUND BOXES	EA	5.000	
						300.000		+	690	6010			LF	300.000	
						+		+	†	1		REPLACE OF CABLES	LF		
						100.000			690	6016	1	REMOVAL OF SPAN CABLE ASSM	LF	100.000	
						100.000			690	6018		INSTALL OF SPAN CABLE ASSM		100.000	
						2.000			690	6019		REPLACE OF ELECTRICAL SERVICE	EA	2.000	
						2.000			690	6020	1	INSTALL OF ELECTRICAL SERVICE	EA	2.000	
						2.000			690	6025	1	REPLACE OF SIGNAL HEAD ASSM	EA	2.000	
						2.000			690	6026		INSTALL OF SIGNAL HEAD ASSM	EA	2.000	
						15.000			690	6028		REPLACE OF SIGNAL RELATED SIGNS	EA	15.000	
						2.000			690	6036	1	INSTALL OF FND FOR GROUND MNT CABINETS	EA	2.000	
						2.000			690	6039		REPLACE OF CONTROL CABINET(GRND MNT)	EA	2.000	
						2.000			690	6042		REPLACE OF CONTROL CABINET(POLE MNT)	EA	2.000	
						2.000			690	6052		REPLACE OF SIGNAL POLE ASSM	EA	2.000	
						2.000			690	6063		REMOVAL OF CONCRETE FOUNDATIONS	EA	2.000	
						175.000			690	6065		REPLACE OF LUMINAIRE HEAD	EA	175.000	
						10.000			690	6072		INS OF TRF SIG PL FND (36" DRIL SHFT)	LF	10.000	
						2.000			690	6090		REPLACE LED TRAF SIG LAMP UNIT	EA	2.000	
						5.000			690	6128		INSTALL SCREW-IN FND	EA	5.000	
						250.000			690	6137		VIVDS CABLE (INSTALL)	LF	250.000	
						5.000		oxdot	690	6138		VIVDS CAMERA (INSTALL)	EA	5.000	
						10.000			690	6140		WRAP SIGNAL CABLE	LF	10.000	
						5.000			6000	6016		INSTALL ELECTRICAL SPLICE	EA	5.000	
						10.000			6000	6024		INSTALL ROADWAY ILLUM ASSEMBLY (LED)	EA	10.000	
						10.000			6000	6042		REPLACE HIGH MAST LUMINAIRES	EA	10.000	
						3.000			6000	6059		INSTALL FOUNDATION	EA	3.000	
						3.000			-	6060		REMOVE FOUNDATION	EA	3.000	
						20.000			-	6082		REPLACE FUSE	EA	20.000	
						5.000			6000	6083		REPLACE FUSE HOLDER	EA	5.000	
						5.000			6000	6103		RAISE AND LOWER RING (HIGH MAST LIGHT)	EA	5.000	
						5.000			 	6138	1	REPLACE LAMP FOR POLE MNT FIXTURE	EA	5.000	
						30.000				6002	002	TMA (STATIONARY)	DAY	30.000	
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ESTIMATE &	QUANTITY SHEET
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DIST	COUNTY	CCSJ	SHEET
23	BROWN	6427-57-001	5A

BARRICADE AND CONSTRUCTION (BC) STANDARD SHEETS GENERAL NOTES:

- 1. The Barricade and Construction Standard Sheets (BC sheets) are intended to show typical examples for placement of temporary traffic control devices, construction pavement markings, and typical work zone signs. The information contained in these sheets meet or exceed the requirements shown in the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
- 2. The development and design of the Traffic Control Plan (TCP) is the responsibility of the Engineer.
- 3. The Contractor may propose changes to the TCP that are signed and sealed by a licensed professional engineer for approval. The Engineer may develop, sign and seal Contractor proposed changes.
- 4. The Contractor is responsible for installing and maintaining the traffic control devices as shown in the plans. The Contractor may not move or change the approximate location of any device without the approval of the Engineer.
- 5. Geometric design of lane shifts and detours should, when possible, meet the applicable design criteria contained in manuals such as the American Association of State Highway and Transportation Officials (AASHTO), "A Policy on Geometric Design of Highways and Streets," the TxDOT "Roadway Design Manual" or engineering judgment.
- 6. When projects abut, the Engineer(s) may omit the END ROAD WORK, TRAFFIC FINES DOUBLE, and other advance warning signs if the signing would be redundant and the work areas appear continuous to the motorists. If the adjacent project is completed first, the Contractor shall erect the necessary warning signs as shown on these sheets, the TCP sheets or as directed by the Engineer. The BEGIN ROAD WORK NEXT X MILES sign shall be revised to show appropriate work zone distance.
- 7. The Engineer may require duplicate warning signs on the median side of divided highways where median width will permit and traffic volumes justify the signing.
- 8. All signs shall be constructed in accordance with the details found in the "Standard Highway Sign Designs for Texas," latest edition. Sign details not shown in this manual shall be shown in the plans or the Engineer shall provide a detail to the Contractor before the sign is manufactured.
- 9. The temporary traffic control devices shown in the illustrations of the BC sheets are examples. As necessary, the Engineer will determine the most appropriate traffic control devices to be used.
- 10. Where highway construction or maintenance work is being undertaken, other than mobile operations as defined by the Texas Manual on Uniform Traffic Control Devices, CSJ limit signs are required. CSJ limit signs are shown on BC(2). The OBEY WARNING SIGNS STATE LAW sign, STAY ALERT TALK OR TEXT LATER and the WORK ZONE TRAFFIC FINES DOUBLE sign with plaque shall be erected in advance of the CSJ limits. The BEGIN ROAD WORK NEXT X MILES, CONTRACTOR and END ROAD WORK signs shall be erected at or near the CSJ limits. For mobile operations, CSJ limit signs are not required.
- 11. Traffic control devices should be in place only while work is actually in progress or a definite need exists.
- 12. The Engineer has the final decision on the location of all traffic control devices.
- 13. Inactive equipment and work vehicles, including workers' private vehicles must be parked away from travel lanes. They should be as close to the right-of-way line as possible, or located behind a barrier or guardrail, or as approved by the Engineer.

WORKER SAFETY NOTES:

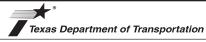
- 1. Workers on foot who are exposed to traffic or to construction equipment within the right-of-way shall wear high-visibility safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel," or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Class 3 garments should be considered for high traffic volume work areas or night time work.
- 2. Except in emergency situations, flagger stations shall be illuminated when flagging is used at night.

COMPLIANT WORKZONE TRAFFIC CONTROL DEVICES

- Only pre-qualified products shall be used. The "Compliant Work Zone Traffic Control Devices List" (CWZTCD) describes pre-qualified products and their sources.
- 2. Work zone traffic control devices shall be compliant with the Manual for Assessing safety Hardware (MASH).

THE DOCUMENTS BELOW CAN BE FOUND ON-LINE AT http://www.txdot.gov COMPLIANT WORK ZONE TRAFFIC CONTROL DEVICES LIST (CWZTCD) DEPARTMENTAL MATERIAL SPECIFICATIONS (DMS) MATERIAL PRODUCER LIST (MPL) ROADWAY DESIGN MANUAL - SEE "MANUALS (ONLINE MANUALS)" STANDARD HIGHWAY SIGN DESIGNS FOR TEXAS (SHSD) TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD) TRAFFIC ENGINEERING STANDARD SHEETS

SHEET 1 OF 12

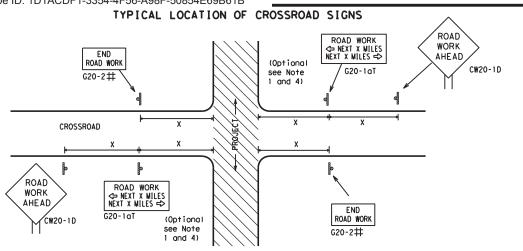


Safety Division Standard

BARRICADE AND CONSTRUCTION
GENERAL NOTES
AND REQUIREMENTS

BC(1)-21

			•					
ILE:	bc-21.dgn	DN: T	kDOT	ck: TxDOT	DW:	TxDOT	ck: TxDOT	
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REVISIONS 4-03 7-13		6427	57	001		US	US 67	
9-07	8-14	DIST		COUNTY			SHEET NO.	
5-10	5-21	23		BROWN	ı		6	



 \sharp May be mounted on back of "ROAD WORK AHEAD" (CW20-1D) sign with approval of Engineer. (See note 2 below)

- The typical minimum signing on a crossroad approach should be a "ROAD WORK AHEAD" (CW20-1D) sign and a (G20-2) "END ROAD WORK" sign, unless noted otherwise in plans.
- 2. The Engineer may use the reduced size 36" x 36" ROAD WORK AHEAD (CW20-1D) sign mounted back to back with the reduced size 36" x 18" "END ROAD WORK" (G20-2) sign on low volume crossroads (see Note 4 under "Typical Construction Warning Sign Size and Spacing"). See the "Standard Highway Sign Designs for Texas" manual for sign details. The Engineer may omit the advance warning signs on low volume crossroads. The Engineer will determine whether a road is low volume as per TMUTCD Part 5. This information shall be shown in the plans.
- Based on existing field conditions, the Engineer/Inspector may require additional signs such as FLAGGER AHEAD, LOOSE GRAVEL, or other appropriate signs. When additional signs are required, these signs will be considered part of the minimum requirements. The Engineer/Inspector will determine the proper location and spacing of any sign not shown on the BC sheets, Traffic Control Plan sheets or the Work Zone Standard Sheets.
- 4. The "ROAD WORK NEXT X MILES" (G20-1aT) sign shall be required at high volume crossroads to advise motorists of the length of construction in either direction from the intersection. The Engineer will determine whether a roadway is considered high volume.
- 5. Additional traffic control devices may be shown elsewhere in the plans for higher volume crossroads.
- 6. When work occurs in the intersection area, appropriate traffic control devices, as shown elsewhere in the plans or as determined by the Engineer/Inspector, shall be in place.

BEGIN T-INTERSECTION WORK ZONE ★ ★ G20-9TP ★ ★ R20-5T FINES DOUBL X R20-50TP MORKERS ARE PRESENT ROAD WORK ⟨⇒ NEXT X MILES X X G20-2bT WORK ZONE G20-1bTI \Diamond INTERSECTED 1000' -1500' - Hwy 1 Block - City 1000'-1500' - Hwy 1 Block - City ROADWAY \Rightarrow ROAD WORK G20-1bTR NEXT X MILES => 801 WORK ZONE G20-2bT * * Limit BEGIN G20-5T WORK * * G20-9TP ZONE TRAFFI G20-6T * * R20-5T FINES DOUBLE ★ ★ R20-5aTP

 ##EN
 ##EN
 ##ER
 ##ER ROAD WORK G20-2

CSJ LIMITS AT T-INTERSECTION

- 1. The Engineer will determine the types and location of any additional traffic control devices, such as a flagger and accompanying signs, or other signs, that should be used when work is being performed at or near an intersection.
- 2. If construction closes the road at a T-intersection, the Contractor shall place the "CONTRACTOR NAME"(G20-6T) sign behind the Type 3 Barricades for the road closure (see BC(10) also). The "ROAD WORK NEXT X MILES" left arrow(G20-1bTL) and "ROAD WORK NEXT X MILES" right arrow (G20-1bTR)" signs shall be replaced by the detour signing called for in the plans.

SAMPLE LAYOUT OF SIGNING FOR WORK BEGINNING AT THE CSJ LIMITS

TYPICAL CONSTRUCTION WARNING SIGN SIZE AND SPACING 1,5,6

SIZE

onventional Expressway/ Freeway or Series 48" x 48' 48" x 48" 48" x 48' 36" x 36" 48" x 48" 48" × 48" CW10, CW12

SPACING

Posted Speed	Sign∆ Spacing "X"
MPH	Feet (Apprx.)
30	120
35	160
40	240
45	320
50	400
55	500 ²
60	600²
65	700 ²
70	800 ²
75	900 ²
80	1000²
*	* 3

- * For typical sign spacings on divided highways, expressways and freeways, see Part 6 of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) typical application diagrams or TCP Standard Sheets.
- \triangle Minimum distance from work area to first Advance Warning sign nearest the work area and/or distance between each additional sign.

GENERAL NOTES

Sign

Number

CW20' CW21

CW22

CW23

CW25

CW14

CW1, CW2,

CW7. CW8.

CW9, CW11

CW3, CW4,

CW5, CW6,

CW8-3,

- 1. Special or larger size signs may be used as necessary.
- 2. Distance between signs should be increased as required to have 1500 feet advance warning.
- 3. Distance between signs should be increased as required to have 1/2 mile or more advance warning.
- 4. 36" x 36" "ROAD WORK AHEAD" (CW20-1D) signs may be used on low volume crossroads at the discretion of the Engineer as per TMUTCD Part 5. See Note 2 under "Typical Location of Crossroad Signs".
- 5. Only diamond shaped warning sign sizes are indicated.
- 6. See sign size listing in "TMUTCD", Sign Appendix or the "Standard Highway Sign Designs for Texas" manual for complete list of available sign design

WORK AREAS IN MULTIPLE LOCATIONS WITHIN CSJ LIMITS X X G20-9TP SPEED STAY ALERT R4-1 PASS appropriate ROAD LIMIT OBEY TRAFFIC **X X** R20-5T WORK FINES WARNING * * G20-5 ROAD WORK CW1-4L AHEAD DOUBLE SIGNS CW20-1D € X R20-5aTP ME PRESENT ROAD STATE LAW TALK OR TEXT LATER CW13-1P R2-1* > ROAD ★ ★ G20-6T WORK CW1 - 4R CW20-1D WORK G20-10T * * R20-3T X X AHEAD CONTRACTOR ХX AHEAD Type 3 Barricade or MPH CW13-1P CW20-1D channelizing devices \Diamond \Diamond \Diamond \Diamond \Rightarrow \Leftrightarrow Beginning of NO-PASSING \Rightarrow \Rightarrow SPEED END G20-2bT X X R2-1 LIMIT line should 3X $\otimes \times \times$ FND coordinate ROAD WORK When extended distances occur between minimal work spaces, the Engineer/Inspector should ensure additional with sign "ROAD WORK AHEAD"(CW20-1D)signs are placed in advance of these work areas to remind drivers they are still G20-2 X X location **NOTES** within the project limits. See the applicable TCP sheets for exact location and spacing of signs and channelizina devices.

The Contractor shall determine the appropriate distance to be placed on the G20-1 series signs and "BEGIN ROAD WORK NEXT X MILES" (G20-5T) sign for each specific project. This distance shall replace the "X" and shall be rounded to the nearest whole mile with the approval of the Engineer.

- The "BEGIN WORK ZONE" (G20-9TP) and "END WORK ZONE" (G20-2b1 shall be used as shown on the sample layout when advance signs are required outside the CSJ Limits. They inform the motorist of entering or leaving a part of the work zone lying outside the CSJ Limits where traffic fines may double if workers are present.
- ** CSJ limit signing is required for highway construction and maintenance work, with the exception of mobile operations.
- Area for placement of "ROAD WORK AHEAD" (CW20-1D) sign and other signs or devices as called for on the Traffic
- Contractor will install a regulatory speed limit sign at the end of the work zone.

	LEGEND
I	Type 3 Barricade
000	Channelizing Devices
+	Sign
Х	See Typical Construction Warning Sign Size and Spacing chart or the TMUTCD for sign spacing requirements.

SHEET 2 OF 12



Traffic Safety

BARRICADE AND CONSTRUCTION PROJECT LIMIT

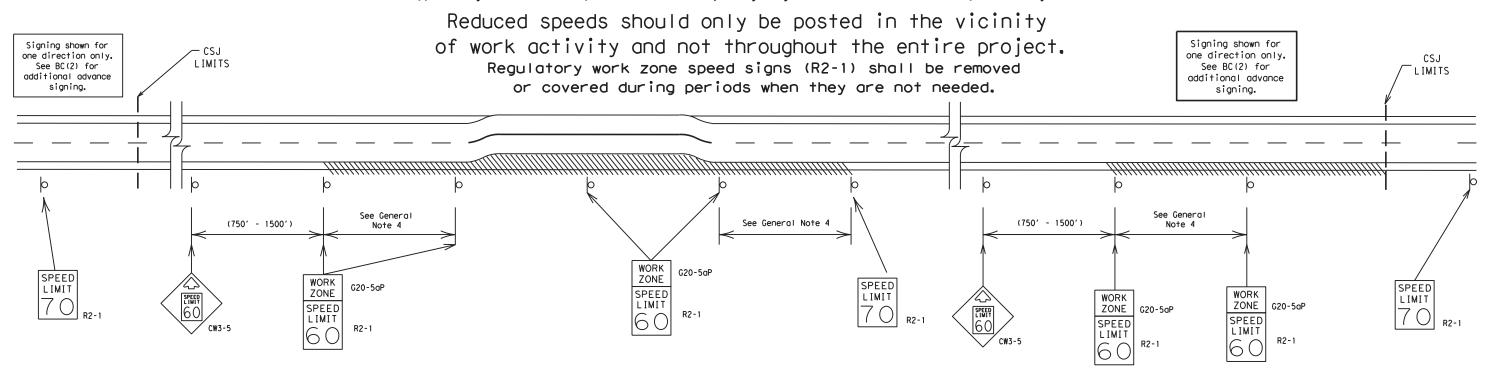
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SAMPLE LAYOUT OF SIGNING	G FOR WORK BEGINNING DOWNST	REAM OF THE CSJ LIMITS	BEGIN		
ROAD CLOSED R11-2	CW1-4L ROAD WORK AHEAD	ROAD ** ** G20-5T ROAD WORK WEXT x MILES NAME ADDRESS CITY STATE STATE CITY STATE CITY STATE CITY STATE CITY CIT	SPEED X ** C20-9TP ZONE LIMIT X ** R20-5T FINES DOUBLE WAR PRESENT	STAY ALERT TALK OR TEXT LATER	OBEY WARNING SIGNS STATE LAW
CW1-6 Barricade or channelizing devices	CW13-1P X CW20-1D X 4 4	CW20-1E ** **G20-61 STATE CONTRACTOR	R2-1 X X ARE PRESENT	G20-10T **	X X 4
3	Channelizing Devices				小小小
WORK SPACE		END ROAD WORK G20-2 * *	X SPEED R2-1	END G20-	-2bT 米 米

TYPICAL APPLICATION OF WORK ZONE SPEED LIMIT SIGNS

Work zone speed limits shall be regulatory, established in accordance with the "Procedures for Establishing Speed Zones," and approved by the Texas Transportation Commission, or by City Ordinance when within Incorporated City Limits.



GUIDANCE FOR USE:

LONG/INTERMEDIATE TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit should be included on the design of the traffic control plans when restricted geometrics with a lower design speed are present in the work zone and modification of the geometrics to a higher design speed is not feasible.

Long/Intermediate Term Work Zone Speed Limit signs, when approved as described above, should be posted and visible to the motorist when work activity is present. Work activity may also be defined as a change in the roadway that requires a reduced speed for motorists to safely negotiate the work area, including:

- a) rough road or damaged pavement surface
- b) substantial alteration of roadway geometrics (diversions)
- c) construction detours
- d) grade
- e) width
- f) other conditions readily apparent to the driver

As long as any of these conditions exist, the work zone speed limit signs should remain in place.

SHORT TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit may be included on the design of the traffic control plans when workers or equipment are not behind concrete barrier, when work activity is within 10 feet of the traveled way or actually in the traveled way.

Short Term Work Zone Speed Limit signs should be posted and visible to the motorists only when work activity is present. When work activity is not present, signs shall be removed or covered. (See Removing or Covering on BC(4)).

GENERAL NOTES

- Regulatory work zone speed limits should be used only for sections of construction projects where speed control is of major importance.
- Regulatory work zone speed limit signs shall be placed on supports at a 7 foot minimum mounting height.
- 3. Speed zone signs are illustrated for one direction of travel and are normally posted for each direction of travel.
- 4. Frequency of work zone speed limit signs should be:

40 mph and greater 0.2 to 2 miles

35 mph and less

0.2 to 2 miles 0.2 to 1 mile

- Regulatory speed limit signs shall have black legend and border on a white reflective background (See "Reflective Sheeting" on BC(4)).
- Fabrication, erection and maintenance of the "ADVANCE SPEED LIMIT" (CW3-5) sign, "WORK ZONE" (G20-5aP) plaque and the "SPEED LIMIT" (R2-1) signs shall not be paid for directly, but shall be considered subsidiary to Item 502.
- 7. Turning signs from view, laying signs over or down will not be allowed, unless as otherwise noted under "REMOVING OR COVERING" on BC(4).
- 8. Techniques that may help reduce traffic speeds include but are not limited to:
 A. Law enforcement.
 - B. Flagger stationed next to sign.
 - C. Portable changeable message sign (PCMS).
 - D. Low-power (drone) radar transmitter.
- E. Speed monitor trailers or signs.
- Speeds shown on details above are for illustration only.
 Work Zone Speed Limits should only be posted as approved for each project.
- 10. For more specific guidance concerning the type of work, work zone conditions and factors impacting allowable regulatory construction speed zone reduction see TxDOT form #1204 in the TxDOT e-form system.

SHEET 3 OF 12



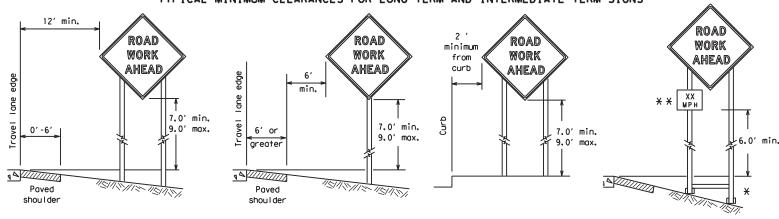
Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION WORK ZONE SPEED LIMIT

BC(3)-21

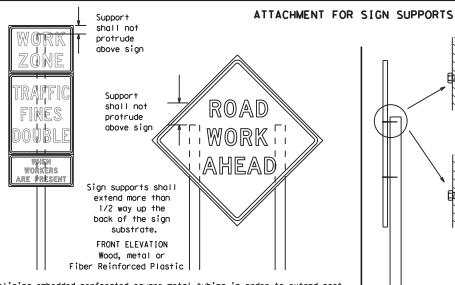
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TYPICAL MINIMUM CLEARANCES FOR LONG TERM AND INTERMEDIATE TERM SIGNS



* When placing skid supports on unlevel ground, the leg post lengths must be adjusted so the sign appears straight and plumb. Objects shall NOT be placed under skids as a means of leveling.

* X When plaques are placed on dual-leg supports, they should be attached to the upright nearest the travel lane. Supplemental plaques (advisory or distance) should not cover the surface of the parent sign.



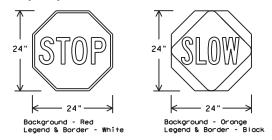
Splicing embedded perforated square metal tubing in order to extend post height will only be allowed when the splice is made using four bolts, two above and two below the spice point. Splice must be located entirely behind the sign substrate, not near the base of the support. Splice insert lengths should be at least 5 times nominal post size, centered on the splice and of at least the same gauge material.

Attachment to wooden supports will be by bolts and nuts or screws. Use TxDOT's or manufacturer's recommended procedures for attaching sign substrates to other types of sign supports

> Nails shall NOT be allowed. Each sign shall be attached directly to the sign support. Multiple signs shall not be joined or spliced by any means. Wood supports shall not be extended or repaired by splicing or other means.

STOP/SLOW PADDLES

- 1. STOP/SLOW paddles are the primary method to control traffic by flaggers. The STOP/SLOW paddle size should be 24" x 24".
- STOP/SLOW paddles shall be retroreflectorized when used at night. 3. STOP/SLOW paddles may be attached to a staff with a minimum length of 6' to the bottom of the sign.
- 4. Any lights incorporated into the STOP or SLOW paddle faces shall only be as specifically described in Section 6E.03 Hand Signaling Devices in the TMUTCD.



SHEETING RE	QUIREMENT	(WHEN USED AT NIGHT)			
USAGE	COLOR	SIGN FACE MATERIAL			
BACKGROUND	RED	TYPE B OR C SHEETING			
BACKGROUND	ORANGE	TYPE B _{FL} OR C _{FL} SHEETING			
LEGEND & BORDER	WHITE	TYPE B OR C SHEETING			
LEGEND & BORDER	BLACK	ACRYLIC NON-REFLECTIVE FILM			

CONTRACTOR REQUIREMENTS FOR MAINTAINING PERMANENT SIGNS WITHIN THE PROJECT LIMITS

SIDE ELEVATION

Wood

- Permanent signs are used to give notice of traffic laws or regulations, call attention to conditions that are potentially hazardous to traffic operations, show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, specific service (LOGO), or cultural information. Drivers proceeding through a work zone need the same, if not better route guidance as normally installed on a roadway without construction.
- When permanent regulatory or warning signs conflict with work zone conditions, remove or cover the permanent signs until the permanent sign message matches the roadway condition. For details for covering large guide signs see the TS-CD standard.
- When existing permanent signs are moved and relocated due to construction purposes, they shall be visible to motorists at all times.
- If existing signs are to be relocated on their original supports, they shall be installed on crashworthy bases as shown on the SMD Standard sheets. The signs shall meet the required mounting heights shown on the BC Sheets or the SMD Standards. This work should be paid for under the appropriate pay item for relocating existing signs.
- If permanent signs are to be removed and relocated using temporary supports, the Contractor shall use crashworthy supports as shown on the BC standard sheets, TLRS standard sheets or the CWZICD list. The signs shall meet the required mounting heights shown on the BC, or the SMD standard sheets during construction. This work should be paid for under the appropriate pay item for relocating existing signs.
- Any sign or traffic control device that is struck or damaged by the Contractor or his/her construction equipment shall be replaced as soon as possible by the Contractor to ensure proper guidance for the motorists. This will be subsidiary to Item 502.

GENERAL NOTES FOR WORK ZONE SIGNS

- Contractor shall install and maintain signs in a straight and plumb condition and/or as directed by the Engineer.
- Wooden sign posts shall be painted white.
- Barricades shall NOT be used as sign supports
- All signs shall be installed in accordance with the plans or as directed by the Engineer. Signs shall be used to regulate, warn, and guide the traveling public safely through the work zone.
- The Contractor may furnish either the sign design shown in the plans or in the "Standard Highway Sign Designs for Texas" (SHSD). The Engineer/Inspector may require the Contractor to furnish other work zone signs that are shown in the TMUTCD but may have been omitted from the plans. Any variation in the plans shall be documented by written agreement between the Engineer and the Contractor's Responsible Person. All changes must be documented in writing before being implemented. This can include documenting the changes in the Inspector's TxDOT diary and having both the Inspector and Contractor initial and date the agreed upon changes.
- The Contractor shall furnish sign supports listed in the "Compliant Work Zone Traffic Control Device List" (CWZTCD) for small roadside signs. Supports for temporary large roadside signs shall meet the requirements detailed on the Temporary Large Roadside Signs (TLRS) standard sheets. The Contractor shall install the sign support in accordance with the manufacturer's recommendations. If there is a question reaardina installation procedures, the Contractor shall furnish the Engineer a copy of the manufacturer's installation recommendations so the Engineer can verify the correct procedures are being followed.
- The Contractor is responsible for installing signs on approved supports and replacing signs with damaged or cracked substrates and/or damaged or marred reflective sheeting as directed by the Engineer/Inspector.
- Identification markings may be shown only on the back of the sign substrate. The maximum height of letters and/or company logos used for identification shall be 1 inch.
- The Contractor shall replace damaged wood posts. New or damaged wood sign posts shall not be spliced.

<u>DURATION OF WORK (as defined by the "Texas Manual on Uniform Traffic Control Devices" Part 6)</u>

- The types of sign supports, sign mounting height, the size of signs, and the type of sign substrates can vary based on the type of work being performed. The Engineer is responsible for selecting the appropriate size sign for the type of work being performed. The Contractor is responsible for ensuring the sign support, sign mounting height and substrate meets manufacturer's recommendations in regard to crashworthiness and duration of work requirements.
 - a. Long-term stationary work that occupies a location more than 3 days.
 - Intermediate-term stationary work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than one hour.
 - Short-term stationary daytime work that occupies a location for more than 1 hour in a single daylight period.
 - Short, duration work that occupies a location up to 1 hour.
 - Mobile work that moves continuously or intermittently (stopping for up to approximately 15 minutes.)

SIGN MOUNTING HEIGHT

- The bottom of Long-term/Intermediate-term signs shall be at least 7 feet, but not more than 9 feet, above the paved surface, except as shown for supplemental plagues mounted below other signs.
- The bottom of Short-term/Short Duration signs shall be a minimum of 1 foot above the pavement surface but no more than 2 feet above
- the ground. Long-term/Intermediate-term Signs may be used in lieu of Short-term/Short Duration signing.
- Short-term/Short Duration signs shall be used only during daylight and shall be removed at the end of the workday or raised to appropriate Long-term/Intermediate sign height.
- Regulatory signs shall be mounted at least 7 feet, but not more than 9 feet, above the paved surface regardless of work duration.

SIZE OF SIGNS

The Contractor shall furnish the sign sizes shown on BC (2) unless otherwise shown in the plans or as directed by the Engineer.

SIGN SUBSTRATES

- The Contractor shall ensure the sign substrate is installed in accordance with the manufacturer's recommendations for the type of sign support that is being used. The CWZTCD lists each substrate that can be used on the different types and models of sign supports.
- "Mesh" type materials are NOT an approved sign substrate, regardless of the tightness of the weave.
- All wooden individual sign panels fabricated from 2 or more pieces shall have one or more plywood cleat, 1/2" thick by 6" wide, fastened to the back of the sign and extending fully across the sign. The cleat shall be attached to the back of the sign using wood screws that do not penetrate the face of the sign panel. The screws shall be placed on both sides of the splice and spaced at 6" centers. The Engineer may approve other methods of splicing the sign face.

REFLECTIVE SHEETING

- 1. All signs shall be retroreflective and constructed of sheeting meeting the color and retro-reflectivity requirements of DMS-8300
- for rigid signs or DMS-8310 for roll-up signs. The web address for DMS specifications is shown on BC(1).
- White sheeting, meeting the requirements of DMS-8300 Type A, shall be used for signs with a white background.
- 3. Orange sheeting, meeting the requirements of DMS-8300 Type B_{FL} or Type C_{FL} , shall be used for rigid signs with orange backgrounds.

SIGN LETTERS

1. All sign letters and numbers shall be clear, and open rounded type uppercase alphabet letters as approved by the Federal Highway Administration (FHWA) and as published in the "Standard Highway Sign Design for Texas" manual. Signs, letters and numbers shall be of first class workmanship in accordance with Department Standards and Specifications.

REMOVING OR COVERING

- When sign messages may be confusing or do not apply, the signs shall be removed or completely covered.
- Long-term stationary or intermediate stationary signs installed on square metal tubing may be turned away from traffic 90 degrees when the sign message is not applicable. This technique may not be used for signs installed in the median of divided highways or near any intersections where the sign may be seen from approaching traffic.
- Signs installed on wooden skids shall not be turned at 90 degree angles to the roadway. These signs should be removed or completely covered when not required.
- When signs are covered, the material used shall be opaque, such as heavy mil black plastic, or other materials which will cover the entire sign face and maintain their opaque properties under automobile headlights at night, without damaging the sign sheeting.
- Burlap shall NOT be used to cover signs. Duct tape or other adhesive material shall NOT be affixed to a sign face.
- Signs and anchor stubs shall be removed and holes backfilled upon completion of work.

SIGN SUPPORT WEIGHTS

- 1. Where sign supports require the use of weights to keep from turning over, the use of sandbags with dry, cohesionless sand should be used. The sandbags will be tied shut to keep the sand from spilling and to maintain a
- constant weight.
- Rock, concrete, iron, steel or other solid objects shall not be permitted for use as sign support weights. Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs.
- Sandbags shall be made of a durable material that tears upon vehicular
- impact. Rubber (such as tire inner tubes) shall NOT be used. Rubber ballasts designed for channelizing devices should not be used for ballast on portable sign supports. Sign supports designed and manufactured
- with rubber bases may be used when shown on the CWZTCD list. Sandbags shall only be placed along or laid over the base supports of the traffic control device and shall not be suspended above ground level or hung with rope, wire, chains or other fasteners. Sandbags shall be placed along the length of the skids to weigh down the sign support.
- Sandbags shall NOT be placed under the skid and shall not be used to level sign supports placed on slopes.

FLAGS ON SIGNS

1. Flags may be used to draw attention to warning signs. When used, the flag shall be 16 inches square or larger and shall be orange or fluorescent red-orange in color. Flags shall not be allowed to cover any portion of the sign face. SHEET 4 OF 12



BARRICADE AND CONSTRUCTION TEMPORARY SIGN NOTES

Traffic Safety

BC(4)-21

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* LONG/INTERMEDIATE TERM STATIONARY - PORTABLE SKID MOUNTED SIGN SUPPORTS

pin at angle needed to match sideslope

2"

SINGLE LEG BASE

Welds to start on

opposite sides going in opposite directions. Minimum

weld, do not

back fill puddle.

weld starts here

2.5'

-2" x 2"

12 ga. upright

Post Post Post max. desirable 34" min. in Optional strong soils, reinforcing 48" 55" min. in minimum sleeve -34" min, in weak soils. (1/2" larger strong soils than sian 55" min, in post) x 18' weak soils. Anchor Stub Anchor Stub (1/4" larger (1/4" larger than sign than sign post) post) -OPTION 2 OPTION 1 OPTION 3 (Anchor Stub) (Direct Embedment) (Anchor Stub and Reinforcing Sleeve)) PERFORATED SQUARE METAL TUBING

GROUND MOUNTED SIGN SUPPORTS

Refer to the CWZTCD and the manufacturer's installation procedure for each type sign support.

The maximum sign square footage shall adhere to the manufacturer's recommendation.

Two post installations can be used for larger signs.

-9 sq. ft. or lessthe CWZTCD, except 5/8" plywood. 10mm extruded 1/2" plywood is allowed. thinwall plastic sign only Ø 3/8" x 3" gr. 5 bolt (2 per support) joining sign panel and supports 1 3/4" x 1 3/4" x 11 foot 12 ga post (DO NOT SPLICE) -Ø3/8 " X 3" gr. 1 3/4 " x 1 3/4 " x 129" 5 bolt (hole to hole) 12 ga. support telescopes into sleeve 1 3/4 " x 1 3/4 " x 129" 1 3/4" galv. round with 5/16" holes (hole to hole) or 1 3/4" x 1 3/4" 12 ga. square square tubing — 1 3/4 " x 1 3/4 " x 52" (hole perforated to hole) 12 ga. square perforated tubing upright Upright must tubing diagonal brace telescope to provide 7' height -Completely welded 2" x 2" x 59" above pavement 48" around tubina 1 3/4 " x 1 3/4 " x 32" (hole (hole to hole) to hole) 12 ga. square perforated 12 ga. perforated 2" x 2" x 8" tubing skid-(hole to hole) 12 ga. square -3/8" X 4-1/2 gr. perforated 5 BOLT (TYP.) 1/2" tubing sleeve welded to skid

16 sq. ft. or less of any rigid sign

substrate listed in section J. 2.d of

WEDGE ANCHORS

Post

See the CWZTCD

WING CHANNEL

for embedment.

Both steel and plastic Wedge Anchor Systems as shown on the SMD Standard Sheets may be used as temporary sign supports for signs up to 10 square feet of sign face. They may be set in concrete or in sturdy soils if approved by the Engineer. (See web address for "Traffic Engineering Standard Sheets" on BC(1)).

OTHER DESIGNS

MORE DETAILS OF APPROVED LONG/INTERMEDIATE
AND SHORT TERM SUPPORTS CAN BE FOUND ON THE
CWZTCD LIST. SEE BC(1) FOR WEBSITE LOCATION.

GENERAL NOTES

- Nails may be used in the assembly of wooden sign supports, but 3/8" bolts with nuts or 3/8" x 3 1/2" lag screws must be used on every joint for final connection.
- . No more than 2 sign posts shall be placed within a 7 ft. circle, except for specific materials noted on the CWZTCD List.
- When project is completed, all sign supports and foundations shall be removed from the project site. This will be considered subsidiary to Item 502.
 - imes See BC(4) for definition of "Work Duration."
 - * Wood sign posts MUST be one piece. Splicing will NOT be allowed. Posts shall be painted white.
 - ☐ See the CWZTCD for the type of sign substrate that can be used for each approved sign support.

SHEET 5 OF 12



Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION TYPICAL SIGN SUPPORT

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SKID MOUNTED PERFORATED SQUARE STEEL TUBING SIGN SUPPORTS

* LONG/INTERMEDIATE TERM STATIONARY - PORTABLE SKID MOUNTED SIGN SUPPORTS

32'

of results of damages resulting from its use.

WHEN NOT IN USE, REMOVE THE PCMS FROM THE RIGHT-OF-WAY OR PLACE THE PCMS BEHIND BARRIER OR GUARDRAIL WITH SIGN PANEL TURNED PARALLEL TO TRAFFIC

PORTABLE CHANGEABLE MESSAGE SIGNS

- The Engineer/Inspector shall approve all messages used on portable changeable message signs (PCMS).
- Messages on PCMS should contain no more than 8 words (about four to eight characters per word), not including simple words such as "TO," "FOR." "AT." etc.
- Messages should consist of a single phase, or two phases that alternate. Three-phase messages are not allowed. Each phase of the message should convey a single thought, and must be understood by itself.
- Use the word "EXIT" to refer to an exit romp on a freeway; i.e., "EXIT CLOSED." Do not use the term "RAMP."
- Always use the route or interstate designation (IH, US, SH, FM) along with the number when referring to a roadway.
- When in use, the bottom of a stationary PCMS message panel should be a minimum 7 feet above the roadway, where possible.
- 7. The message term "WEEKEND" should be used only if the work is to start on Saturday morning and end by Sunday evening at midnight. Actual days and hours of work should be displayed on the PCMS if work is to begin on Friday evening and/or continue into Monday morning.
- 8. The Engineer/Inspector may select one of two options which are available for displaying a two-phase message on a PCMS. Each phase may be displayed for either four seconds each or for three seconds each.
- Do not "flash" messages or words included in a message. The message should be steady burn or continuous while displayed.
- 10. Do not present redundant information on a two-phase message; i.e., keeping two lines of the message the same and changing the third line.
- 11. Do not use the word "Danger" in message.
- Do not display the message "LANES SHIFT LEFT" or "LANES SHIFT RIGHT" on a PCMS. Drivers do not understand the message.
- 13. Do not display messages that scroll horizontally or vertically across the face of the sign.
- 14. The following table lists abbreviated words and two-word phrases that are acceptable for use on a PCMS. Both words in a phrase must be displayed together. Words or phrases not on this list should not be abbreviated, unless shown in the TMUTCD.
- 15. PCMS character height should be at least 18 inches for trailer mounted units. They should be visible from at least 1/2 (.5) mile and the text should be legible from at least 600 feet at night and 800 feet in daylight. Truck mounted units must have a character height of 10 inches and must be legible from at least 400 feet.
- Each line of text should be centered on the message board rather than left or right justified.
- 17. If disabled, the PCMS should default to an illegible display that will not alarm motorists and will only be used to alert workers that the PCMS has malfunctioned. A pattern such as a series of horizontal solid bars is appropriate.

WORD OR PHRASE	ABBREVIATION	WORD OR PHRASE	ABBREVIATION
Access Road	ACCS RD	Major	MAJ
Alternate	ALT	Miles	MI
Avenue	AVE	Miles Per Hour	MPH
Best Route	BEST RTE	Minor	MNR
Boulevard	BLVD	Monday	MON
Bridge	BRDG	Normal	NORM
Cannot	CANT	North	N
Center	CTR	Nor thbound	(route) N
Construction Ahead	CONST AHD	Parking	PKING
CROSSING	XING	Road	RD
Detour Route	DETOUR RTE	Right Lane	RT LN
Do Not	DONT	Saturday	SAT SERV RD
East	F	Service Road	
Eastbound	(route) E	Shoulder	SHLDR
Emergency	EMER	Slippery	SLIP
Emergency Vehicle	EMER VEH	South	S
Entrance, Enter	ENT	Southbound	(route) S
Express Lane	EXP LN	Speed Street	ST
Expressway	EXPWY		SUN
XXXX Feet	XXXX FT	Sunday	PHONE
Fog Ahead	FOG AHD	Telephone	TEMP
Freeway	FRWY, FWY	Temporary	THURS
Freeway Blocked	FWY BLKD	Thursday	TO DWNTN
Friday	FRI	To Downtown Traffic	TRAF
Hazardous Driving			
Hazardous Material		Travelers	TRVLRS
High-Occupancy	HOV	Tuesday	TUES
Vehicle		Time Minutes	TIME MIN
Highway	HWY	Upper Level	UPR LEVEL
Hour (s)	HR. HRS	Vehicles (s)	VEH, VEHS
Information	INFO	Warning	WARN
It Is	ITS	Wednesday	WED
Junction	JCT	Weight Limit	WT LIMIT
Left	LFT	West	W
Left Lane	LFT LN	Westbound	(route) W
Lane Closed	LN CLOSED	Wet Pavement	WET PVMT
Lower Level	LWR LEVEL	Will Not	WONT
Maintenance	MAINT		

Roadway

designation # IH-number, US-number, SH-number, FM-number

RECOMMENDED PHASES AND FORMATS FOR PCMS MESSAGES DURING ROADWORK ACTIVITIES

(The Engineer may approve other messages not specifically covered here.)

Phase 1: Condition Lists

Road/Lane/Ramp Closure List Other Condition List FREEWAY FRONTAGE ROADWORK ROAD CLOSED ROAD XXX FT REPAIRS X MILE CLOSED XXXX FT ROAD SHOULDER FLAGGER IANF CLOSED CLOSED XXXX FT **NARROWS** AT SH XXX XXX FT XXXX FT ROAD RIGHT LN RIGHT LN TWO-WAY CLSD AT CLOSED NARROWS TRAFFIC FM XXXX XXX FT XXXX FT XX MILE RIGHT X RIGHT X MERGING CONST LANES TRAFFIC TRAFFIC IANES CLOSED OPEN XXXX FT XXX FT

LOOSE

GRAVEL

XXXX FT

DETOUR

X MILE

ROADWORK

PAST

SH XXXX

BUMP

XXXX FT

CENTER
LANE
CLOSED

NIGHT
LANE

DAYTIME
LANE
CLOSURES

I - XX SOUTH
EXIT

CLOSURES

VARIOUS
LANES
CLOSED

X MILE

EXIT CLOSED RIGHT LN TO BE CLOSED

MALL X LANES

DRIVEWAY

CLOSED

XXXXXXXX BLVD

CLOSED

X LANES CLOSED TUE - FRI

ANES TRAFFIC SIGNAL XXXX FT

* LANES SHIFT in Phase 1 must be used with STAY IN LANE in Phase 2.

UNEVEN

LANES

XXXX FT

ROUGH

ROAD

XXXX FT

ROADWORK

NEXT

FRI-SUN

US XXX

EXIT

X MILES

LANES

SHIFT

Phase 2: Possible Component Lists

RIGHT X LINES RIGHT XX MPH XY MPH DETOUR NEXT XXXXXX X EXITS RD EXIT USE EXIT XXX USE EXIT XXX I SECOND USE USE XXX SOUTH TRUCKS USE USE USE USE USE I SECOND USE US XXX EXIT TO I SECOND US XXX EXIT TO I SECOND US XXX TO I SECOND TRUCKS US XXX TO I SECOND TO I SEC	A		e/E Lis	ffect on Trav st	'e I	Location List		Warning List		* * Advance Notice List
NEXT X EXITS RD EXIT CROSSING XX MPH X PM-X A M X PM-X A X PM-X A M X PM-X A X PM-X A M A X X PM-X A M A X X PM-X A M A X X PM-X A M A X M A X				X LINES				LIMIT		
EXIT XXX I-XX NORTH MILES XX MPH		NEXT		xxxxx		RAILROAD		SPEED		APR XX- XX X PM-X AM
US XXX SOUTH TRUCKS USE US XXX N WATCH FOR TRUCKS US XXX N WATCH FOR TRUCKS US XXX N WATCH FOR TRUCKS US XXX N WATCH FOR TRUCKS WATCH FOR TRUCKS WATCH FOR TRUCKS DELAYS EXPECT DELAYS DELAYS DRIVE SAFELY TO XX AM TO XXX AM DRIVE SAFELY TO XX PM XX AM STAY IN ** See Application Guidelines Note 6.				I-XX		x		SPEED		
USE US XXX N TRUCKS TO XXXXXXX EXIT XX AM WATCH FOR TRUCKS TO STOP TO STOP REDUCE SPEED XXX FT USE US XXX D USE CAUTION FM XXXXX DRIVE SAFELY TO XX AM TO XXX AM DRIVE SAFELY TO XX AM TO		US XXX		I-XX E		US XXX		SPEED		
FOR TRUCKS EXPECT DELAYS PREPARE TO STOP REDUCE SPEED XXX FT USE OTHER ROUTES WATCH FOR WORKERS TO FM XXXX DRIVE SAFELY TO XX AM TO XX AM TO XX AM ** See Application Guidelines Note 6.		USE		FOR		то		LANE		MAY X-X XX PM - XX AM
DELAYS TO STOP REDUCE SPEED XXX FT USE USE WATCH FOR ROUTES WATCH FOR WORKERS STAY IN SAFELY TO XX PM NEXT TUE AUG XX TONIGHT XX PM- XX AM ** See Application Guidelines Note 6.		FOR				то				NEXT FRI-SUN
SPEED XXX FT USE WITH TUE AUG XX USE OTHER ROUTES WATCH FOR WORKERS STAY IN ** See Application Guidelines Note 6.				ТО						ТО
OTHER ROUTES FOR WORKERS STAY IN ** See Application Guidelines Note 6.		SPEED		SHOULDER				WITH		TUE
2. IN ** See Application Guidelines Note 6.		OTHER		FOR						
	? .	IN) *			*	¥ See Ap	oplication Guidel	ines N	Note 6.

APPLICATION GUIDELINES

- 1. Only 1 or 2 phases are to be used on a PCMS.
- The 1st phase (or both) should be selected from the "Road/Lane/Ramp Closure List" and the "Other Condition List".
- A 2nd phase can be selected from the "Action to Take/Effect on Travel, Location, General Warning, or Advance Notice Phase Lists".
- A Location Phase is necessary only if a distance or location is not included in the first phase selected.
- If two PCMS are used in sequence, they must be separated by a minimum of 1000 ft. Each PCMS shall be limited to two phases, and should be understandable by themselves.
- 6. For advance notice, when the current date is within seven days of the actual work date, calendar days should be replaced with days of the week. Advance notification should typically be for no more than one week prior to the work.

WORDING ALTERNATIVES

- 1. The words RIGHT, LEFT and ALL can be interchanged as appropriate.
- Roadway designations IH, US, SH, FM and LP can be interchanged as appropriate.
- EAST, WEST, NORTH and SOUTH (or abbreviations E, W, N and S) can be interchanged as appropriate.
- 4. Highway names and numbers replaced as appropriate.
- 5. ROAD, HIGHWAY and FREEWAY can be interchanged as needed.
- AHEAD may be used instead of distances if necessary.
- 7. FT and MI, MILE and MILES interchanged as appropriate.
- 8. AT, BEFORE and PAST interchanged as needed.
- Distances or AHEAD can be eliminated from the message if a location phase is used.

PCMS SIGNS WITHIN THE R.O.W. SHALL BE BEHIND GUARDRAIL OR CONCRETE BARRIER OR SHALL HAVE A MINIMUM OF FOUR (4)

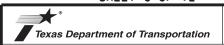
PLASTIC DRUMS PLACED PERPENDICULAR TO TRAFFIC ON THE UPSTREAM SIDE OF THE PCMS, WHEN EXPOSED TO ONE DIRECTION OF TRAFFIC. WHEN EXPOSED TO TWO WAY TRAFFIC, THE FOUR DRUMS SHOULD BE PLACED WITH ONE DRUM AT EACH OF THE FOUR CORNERS OF THE UNIT.

FULL MATRIX PCMS SIGNS

- 1. When Full Matrix PCMS signs are used, the character height and legibility/visibility requirements shall be maintained as listed in Note 15 under "PORTABLE CHANGEABLE MESSAGE SIGNS" above.
- 2. When symbol signs, such as the "Flagger Symbol"(CW20-7) are represented graphically on the Full Matrix PCMS sign and, with the approval of the Engineer, it shall maintain the legibility/visibility requirement listed above.
- 3. When symbol signs are represented graphically on the Full Matrix PCMS, they shall only supplement the use of the static sign represented, and shall not substitute for, or replace that sign.

4. A full matrix PCMS may be used to simulate a flashing arrow board provided it meets the visibility, flash rate and dimming requirements on BC(7), for the same size arrow.

SHEET 6 OF 12



Traffic Safety Division Standard

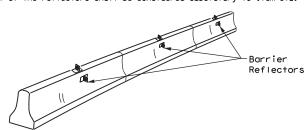
BARRICADE AND CONSTRUCTION PORTABLE CHANGEABLE MESSAGE SIGN (PCMS)

BC(6)-21

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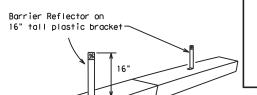
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- Barrier Reflectors shall be pre-qualified, and conform to the color and reflectivity requirements of DMS-8600. A list of prequalified Barrier Reflectors can be found at the Material Producer List web address shown on BC(1).
- 2. Color of Barrier Reflectors shall be as specified in the TMUTCD. The cost of the reflectors shall be considered subsidiary to Item 512.



CONCRETE TRAFFIC BARRIER (CTB)

- 3. Where traffic is on one side of the CTB, two (2) Barrier Reflectors shall be mounted in approximately the midsection of each section of CTB. An alternate mounting location is uniformly spaced at one end of each CTB. This will allow for attachment of a barrier grapple without damaging the reflector. The Barrier Reflector mounted on the side of the CTB shall be located directly below the reflector mounted on top of the barrier, as shown in the detail above.
- 4. Where CTB separates two-way traffic, three barrier reflectors shall be mounted on each section of CTB. The reflector unit on top shall have two yellow reflective faces (Bi-Directional) while the reflectors on each side of the barrier shall have one yellow reflective face, as shown in the detail above.
- 5. When CTB separates traffic traveling in the same direction, no barrier reflectors will be required on top of the CTB.
- 6. Barrier Reflector units shall be yellow or white in color to match the edgeline being supplemented.
- 7. Maximum spacing of Barrier Reflectors is forty (40) feet.
- 8. Pavement markers or temporary flexible-reflective roadway marker tabs shall NOT be used as CTB delineation.
- 9. Attachment of Barrier Reflectors to CTB shall be per manufacturer's
- 10. Missing or damaged Barrier Reflectors shall be replaced as directed by the Engineer.
- 11. Single slope barriers shall be delineated as shown on the above detail.

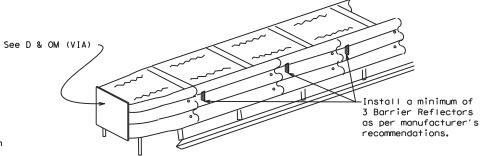


LOW PROFILE CONCRETE BARRIER (LPCB) USED IN WORK ZONES

LPCB is approved for use in work zone locations, where the posted speed is 45mph, or less. See Roadway Standard Sheet LPCB.

Max. spacing of barrier reflectors is 20 feet. Attach the delineators as per manufacturer's recommendations.

LOW PROFILE CONCRETE BARRIER (LPCB)



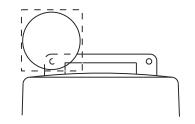
DELINEATION OF END TREATMENTS

END TREATMENTS FOR CTB'S USED IN WORK ZONES

End treatments used on CTB's in work zones shall meet the apppropriate crashworthy standards as defined in the Manual for Assessing Safety Hardware (MASH), Refer to the CWZTCD List for approved end treatments and manufacturers.

BARRIER REFLECTORS FOR CONCRETE TRAFFIC BARRIER AND ATTENUATORS

Type C Warning Light or approved substitute mounted on a drum adjacent to the travel way.



Warning reflector may be round or square. Must have a yellow reflective surface area of at least 30 square inches

WARNING LIGHTS

- 1. Warning lights shall meet the requirements of the TMUTCD.
- 2. Warning lights shall NOT be installed on barricades.
- 3. Type A-Low Intensity Flashing Warning Lights are commonly used with drums. They are intended to warn of or mark a potentially hazardous area. Their use shall be as indicated on this sheet and/or other sheets of the plans by the designation "FL". The Type A Warning Lights shall not be used with signs manufactured with Type B_{FL} or C_{FL} Sheeting meeting the requirements of Departmental Material Specification DMS-8300.
- 4. Type-C and Type D 360 degree Steady Burn Lights are intended to be used in a series for delineation to supplement other traffic control
- devices. Their use shall be as indicated on this sheet and/or other sheets of the plans by the designation "SB". 5. The Engineer/Inspector or the plans shall specify the location and type of warning lights to be installed on the traffic control devices.
- 6. When required by the Engineer, the Contractor shall furnish a copy of the worning lights certification. The warning light manufacturer will certify the warning lights meet the requirements of the latest ITE Purchase Specifications for Flashing and Steady-Burn Warning Lights.
- 7. When used to delineate curves, Type-C and Type D Steady Burn Lights should only be placed on the outside of the curve, not the inside.
- 8. The location of warning lights and warning reflectors on drums shall be as shown elsewhere in the plans.

WARNING LIGHTS MOUNTED ON PLASTIC DRUMS

- 1. Type A flashing warning lights are intended to warn drivers that they are approaching or are in a potentially hazardous area.
- 2. Type A random flashing warning lights are not intended for delineation and shall not be used in a series.
- 3. A series of sequential flashing warning lights placed on channelizing devices to form a merging taper may be used for delineation. If used, the successive flashing of the sequential warning lights should occur from the beginning of the taper to the end of the merging taper in order to identify the desired vehicle path. The rate of flashing for each light shall be 65 flashes per minute, plus or minus 10 flashes.
- 4. Type C and D steady-burn warning lights are intended to be used in a series to delineate the edge of the travel lane on detours, on lane changes, on lane closures, and on other similar conditions.
- 5. Type A, Type C and Type D warning lights shall be installed at locations as detailed on other sheets in the plans.
- 6. Warning lights shall not be installed on a drum that has a sign, chevron or vertical panel.
- 7. The maximum spacing for warning lights on drums should be identical to the channelizing device spacing.

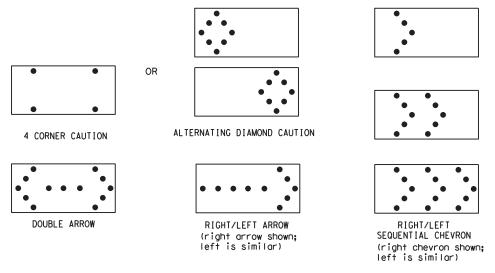
WARNING REFLECTORS MOUNTED ON PLASTIC DRUMS AS A SUBSTITUTE FOR TYPE C (STEADY BURN) WARNING LIGHTS

- 1. A warning reflector or approved substitute may be mounted on a plastic drum as a substitute for a Type C, steady burn warning light at the discretion of the Contractor unless otherwise noted in the plans.
- 2. The warning reflector shall be yellow in color and shall be manufactured using a sign substrate approved for use with plastic drums listed
- 3. The warning reflector shall have a minimum retroreflective surface area (one-side) of 30 square inches.
- 4. Round reflectors shall be fully reflectorized, including the area where attached to the drum.
- 5. Square substrates must have a minimum of 30 square inches of reflectorized sheeting. They do not have to be reflectorized where it attaches to the drum.
- 6. The side of the warning reflector facing approaching traffic shall have sheeting meeting the color and retroreflectivity requirements for DMS 8300-Type B or Type C.
- 7. When used near two-way traffic, both sides of the warning reflector shall be reflectorized.
- 8. The warning reflector should be mounted on the side of the handle nearest approaching traffic.
- 9. The maximum spacing for warning reflectors should be identical to the channelizing device spacing requirements.

Arrow Boards may be located behind channelizing devices in place for a shoulder taper or merging taper, otherwise they shall be delineated with four (4) channelizing devices placed perpendicular to traffic on the upstream side of traffic.

- 1. The Flashing Arrow Board should be used for all lane closures on multi-lane roadways, or slow moving maintenance or construction activities on the travel lanes.

 2. Flashing Arrow Boards should not be used on two-lane, two-way roadways, detours, diversions
- or work on shoulders unless the "CAUTION" display (see detail below) is used.
- The Engineer/Inspector shall choose all appropriate signs, barricades and/or other traffic control devices that should be used in conjunction with the Flashing Arrow Board.
- 4. The Flashing Arrow Board should be able to display the following symbols:



- 5. The "CAUTION" display consists of four corner lamps flashing simultaneously, or the Alternating Diamond Caution mode as shown.
- The straight line caution display is NOT ALLOWED.
- The Flashing Arrow Board shall be capable of minimum 50 percent dimming from rated lamp voltage. The flashing rate of the lamps shall not be less than 25 nor more than 40 flashes per minute.
- Minimum lamp "on time" shall be approximately 50 percent for the flashing arrow and equal intervals of 25 percent for each sequential phase of the flashing chevron.
- 9. The sequential arrow display is NOT ALLOWED.
 10. The flashing arrow display is the TxDOT standard; however, the sequential chevron
- display may be used during daylight operations.
- 11. The Flashing Arrow Board shall be mounted on a vehicle, trailer or other suitable support.
 12. A Flashing Arrow Board SHALL NOT BE USED to laterally shift traffic.
 13. A full matrix PCMS may be used to simulate a Flashing Arrow Board provided it meets visibility,
- flash rate and dimming requirements on this sheet for the same size arrow.
- 14. Minimum mounting height of trailer mounted Arrow Boards should be 7 feet from roadway to bottom of panel.

REQUIREMENTS							
TYPE	MINIMUM SIZE	MINIMUM NUMBER OF PANEL LAMPS	MINIMUM VISIBILITY DISTANCE				
В	30 × 60	13	3/4 mile				
С	48 × 96	15	1 mile				

ATTENTION Flashing Arrow Boards shall be equipped with automatic dimmina devices.

WHEN NOT IN USE, REMOVE THE ARROW BOARD FROM THE RIGHT-OF-WAY OR PLACE THE ARROW BOARD BEHIND CONCRETE TRAFFIC BARRIER OR GUARDRAIL.

FLASHING ARROW BOARDS

SHEET 7 OF 12

TRUCK-MOUNTED ATTENUATORS

- 1. Truck-mounted attenuators (TMA) used on TxDOT facilities must meet the requirements outlined in the Manual for Assessing Safety Hardware (MASH).
- Refer to the CWZTCD for the requirements of Level 2 or Level 3 TMAs.
- 3. Refer to the CWZTCD for a list of approved TMAs.
- 4. TMAs are required on freeways unless otherwise noted in the plans.
- 5. A TMA should be used anytime that it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the work performance.
- 6. The only reason a TMA should not be required is when a work area is spread down the roadway and the work crew is an extended distance from the TMA.



Traffic Safety Division Standard BARRICADE AND CONSTRUCTION

ARROW PANEL. REFLECTORS. WARNING LIGHTS & ATTENUATOR

BC(7)-21

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7-13	5-21	23		BROWN	_		12

GENERAL NOTES

- 1. For long term stationary work zones on freeways, drums shall be used as the primary channelizing device.
- 2. For intermediate term stationary work zones on freeways, drums should be used as the primary channelizing device but may be replaced in tangent sections by vertical panels, or 42" two-piece cones. In tangent sections, one-piece cones may be used with the approval of the Engineer but only if personnel are present on the project at all times to maintain the cones in proper position and location.
- 3. For short term stationary work zones on freeways, drums are the preferred channelizing device but may be replaced in tapers, transitions and tangent sections by vertical panels, two-piece cones or one-piece cones as approved by the Engineer.
- 4. Drums and all related items shall comply with the requirements of the current version of the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD) and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
- 5. Drums, bases, and related materials shall exhibit good workmanship and shall be free from objectionable marks or defects that would adversely affect their appearance or serviceability.
- 6. The Contractor shall have a maximum of 24 hours to replace any plastic drums identified for replacement by the Engineer/Inspector. The replacement device must be an approved device.

GENERAL DESIGN REQUIREMENTS

Pre-qualified plastic drums shall meet the following requirements:

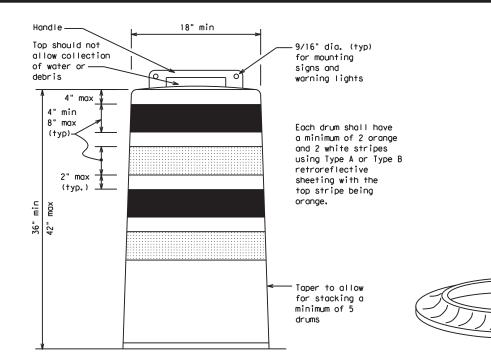
- 1. Plastic drums shall be a two-piece design; the "body" of the drum shall be the top portion and the "base" shall be the bottom.
- 2. The body and base shall lock together in such a manner that the body separates from the base when impacted by a vehicle traveling at a speed of 20 MPH or greater but prevents accidental separation due to normal handling and/or air turbulence created by passing vehicles.
- 3. Plastic drums shall be constructed of lightweight flexible, and deformable materials. The Contractor shall NOT use metal drums or single piece plastic drums as channelization devices or sign supports,
- 4. Drums shall present a profile that is a minimum of 18 inches in width at the 36 inch height when viewed from any direction. The height of drum unit (body installed on base) shall be a minimum of 36 inches and a maximum of 42 inches.
- 5. The top of the drum shall have a built-in handle for easy pickup and shall be designed to drain water and not collect debris. The handle shall have a minimum of two widely spaced 9/16 inch diameter holes to allow attachment of a warning light, warning reflector unit or approved
- 6. The exterior of the drum body shall have a minimum of four alternating orange and white retroreflective circumferential stripes not less than 4 inches nor greater than 8 inches in width. Any non-reflectorized space between any two adjacent stripes shall not exceed 2 inches in
- 7. Bases shall have a maximum width of 36 inches, a maximum height of 4 inches, and a minimum of two footholds of sufficient size to allow base to be held down while separating the drum body from the base.
- 8. Plastic drums shall be constructed of ultra-violet stabilized, orange, high-density polyethylene (HDPE) or other approved material.
- 9. Drum body shall have a maximum unballasted weight of 11 lbs.
- 10.Drum and base shall be marked with manufacturer's name and model number.

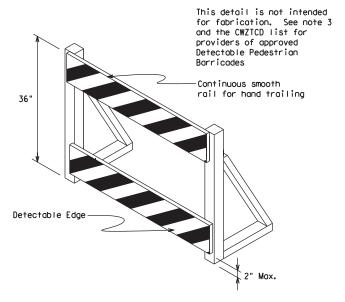
RETROREFLECTIVE SHEETING

- 1. The stripes used on drums shall be constructed of sheeting meeting the color and retroreflectivity requirements of Departmental Materials Specification DMS-8300, "Sign Face Materials." Type A or Type B reflective sheeting shall be supplied unless otherwise specified
- 2. The sheeting shall be suitable for use on and shall adhere to the drum surface such that, upon vehicular impact, the sheeting shall remain adhered in-place and exhibit no delaminating, cracking, or loss of retroreflectivity other than that loss due to abrasion of the sheeting

BALLAST

- 1. Unballasted bases shall be large enough to hold up to 50 lbs. of sand. This base, when filled with the ballast material, should weigh between 35 lbs (minimum) and 50 lbs (maximum). The ballast may be sand in one to three sandbags separate from the base, sand in a sand-filled plastic base, or other ballasting devices as approved by the Engineer. Stacking of sandbags will be allowed, however height of sandbags above pavement surface may not exceed 12 inches.
- 2. Bases with built-in ballast shall weigh between 40 lbs. and 50 lbs. Built-in ballast can be constructed of an integral crumb rubber base or a solid rubber base.
- 3. Recycled truck tire sidewalls may be used for ballast on drums approved for this type of ballast on the CWZTCD list.
- 4. The ballast shall not be heavy objects, water, or any material that would become hazardous to motorists, pedestrians, or workers when the drum is struck by a vehicle.
- 5. When used in regions susceptible to freezing, drums shall have drainage holes in the bottoms so that water will not collect and freeze becoming a hazard when struck by a vehicle.
- 6. Ballast shall not be placed on top of drums.
- 7. Adhesives may be used to secure base of drums to pavement.





DETECTABLE PEDESTRIAN BARRICADES

- 1. When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. Refer to WZ(BTS-2) for Pedestrian Control requirements for Sidewalk Diversions, Sidewalk Detours and Crosswalk Closures.
- 2. Where pedestrians with visual disabilities normally use the closed sidewalk, a Detectable Pedestrian Barricade shall be placed across the full width of the closed sidewalk instead of a Type 3 Barricade.
- 3. Detectable pedestrian barricades similar to the one pictured above, longitudinal channelizing devices, some concrete barriers, and wood or chain link fencing with a continuous detectable edging can satisfactorily delineate a pedestrian
- 4. Tape, rope, or plastic chain strung between devices are not detectable, do not comply with the design standards in the "Americans with Disabilities Act Accessibility Guidelines (ADAAG)" and should not be used as a control for pedestrian
- 5. Warning lights shall not be attached to detectable pedestrian barricades.
- 6. Detectable pedestrian barricades should use 8" nominal barricade rails as shown on BC(10) provided that the top rail provides a smooth continuous rail suitable for hand trailing with no splinters, burrs, or sharp edges.



18" x 24" Sign (Maximum Sign Dimension) Chevron CW1-8, Opposing Traffic Lane Divider, Driveway sign D70a, Keep Right R4 series or other signs as approved by Engineer

See Ballast



12" x 24" Vertical Panel mount with diagonals sloping down towards travel way

Plywood, Aluminum or Metal sign substrates shall NOT be used on plastic drums

SIGNS, CHEVRONS, AND VERTICAL PANELS MOUNTED ON PLASTIC DRUMS

- 1. Signs used on plastic drums shall be manufactured using substrates listed on the CWZTCD.
- 2. Chevrons and other work zone signs with an orange background shall be manufactured with Type B_{FL} or Type C_{FL} Orange sheeting meeting the color and retroreflectivity requirements of DMS-8300, "Sign Face Material," unless otherwise specified in the plans.
- 3. Vertical Panels shall be manufactured with orange and white sheeting meeting the requirements of DMS-8300 Type A or Type B. Diagonal stripes on Vertical Panels shall slope down toward the intended traveled lane.
- 4. Other sign messages (text or symbolic) may be used as approved by the Engineer. Sign dimensions shall not exceed 18 inches in width or 24 inches in height, except for the R9 series signs discussed in note 8 below.
- 5. Signs shall be installed using a 1/2 inch bolt (nominal) and nut, two washers, and one locking washer for each
- 6. Mounting bolts and nuts shall be fully engaged and adequately torqued. Bolts should not extend more than 1/2
- 7. Chevrons may be placed on drums on the outside of curves, on merging tapers or on shifting tapers. When used in these locations, they may be placed on every drum or spaced not more than on every third drum, A minimum of three (3) should be used at each location called for in the plans.
- 8. R9-9, R9-10, R9-11 and R9-11a Sidewalk Closed signs which are 24 inches wide may be mounted on plastic drums, with approval of the Engineer.

SHEET 8 OF 12

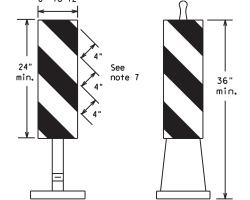
Texas Department of Transportation

Traffic Safety

BARRICADE AND CONSTRUCTION CHANNEL IZING DEVICES

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PORTABLE

(Rigid or self-righting)

1. Vertical Panels (VP's) are normally used to channelize traffic or divide opposing lanes of traffic.

Rigid

Support:

DRIVEABLE

8" to 12"

1841

36

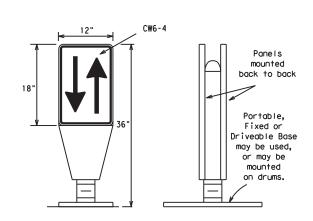
Fixed Base w/ Approved Adhesive

(Driveable Base, or Flexible

Support can be used)

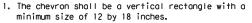
- 2. VP's may be used in daytime or nighttime situations. They may be used at the edge of shoulder drop-offs and other areas such as lane transitions where positive daytime and nighttime delineation is required. The Engineer/Inspector shall refer to the Roadway Design Manual for additional requirements on the use VP's
- 3. VP's should be mounted back to back if used at the edge of cuts adjacent to two-way two lane roadways. Stripes are to be reflective orange and reflective white and should always slope downward toward the travel lane.
- 4. VP's used on expressways and freeways or other high speed roadways, may have more than 270 square inches of retroreflective area facing traffic.
- 5. Self-righting supports are available with portable base. See "Compliant Work Zone Traffic Control Devices List"
- 6. Sheeting for the VP's shall be retroreflective Type A or Type B conforming to Departmental Material Specification DMS-8300, unless noted otherwise,
- 7. Where the height of reflective material on the vertical panel is 36 inches or greater, a panel stripe of 6 inches shall be used.

VERTICAL PANELS (VPs)



- 1. Opposing Traffic Lane Dividers (OTLD) are delineation devices designed to convert a normal one-way roadway section to two-way operation. OTLD's are used on temporary centerlines. The upward and downward arrows on the sign's face indicate the direction of traffic on either side of the divider. The base is secured to the pavement with an adhesive or rubber weight to minimize movement caused by a vehicle impact or wind gust.
- 2. The OTLD may be used in combination with 42"
- 3. Spacing between the OTLD shall not exceed 500 feet. 42" cones or VPs placed between the OTLD's should not exceed 100 foot spacing.
- 4. The OTLD shall be orange with a black nonreflective legend. Sheeting for the OTLD shall be retroreflective Type B_{FL} or Type C_{FL} conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.

OPPOSING TRAFFIC LANE DIVIDERS (OTLD)

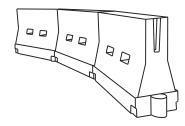


- 2. Chevrons are intended to give notice of a sharp change of alignment with the direction of travel and provide additional emphasis and guidance for vehicle operators with regard to changes in horizontal alignment of the roadway.
- 3. Chevrons, when used, shall be erected on the out side of a sharp curve or turn, or on the far side of an intersection. They shall be in line with and at right angles to approaching traffic. Spacing should be such that the motorist always has three in view, until the change in alignment eliminates its need.
- 4. To be effective, the chevron should be visible for at least 500 feet.
- 5. Chevrons shall be orange with a black nonreflective legend. Sheeting for the chevron shall be retroreflective Type B_{FL} or Type C_{FL} conforming to Departmental Material Specification DMS-8300, unless noted otherwise. The legend shall meet the requirements of DMS-8300.
- 6. For Long Term Stationary use on tapers or transitions on freeways and divided highways, self-righting chevrons may be used to supplement plastic drums but not to replace plastic drums.

CHEVRONS

GENERAL NOTES

- 1. Work Zone channelizing devices illustrated on this sheet may be installed in close proximity to traffic and are suitable for use on high or low speed roadways. The Engineer/Inspector shall ensure that spacing and placement is uniform and in accordance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
- 2. Channelizing devices shown on this sheet may have a driveable, fixed or portable base. The requirement for self-righting channelizing devices must be specified in the General Notes or other plan sheets.
- 3. Channelizing devices on self-righting supports should be used in work zone areas where channelizing devices are frequently impacted by errant vehicles or vehicle related wind gusts making alignment of the channelizing devices difficult to maintain. Locations of these devices shall be detailed elsewhere in the plans. These devices shall conform to the TMUTCD and the "Compliant Work Zone Traffic Control Devices List" (CWZTCD).
- 4. The Contractor shall maintain devices in a clean condition and replace damaged, nonreflective, faded, or broken devices and bases as required by the Engineer/Inspector. The Contractor shall be required to maintain proper device spacing and alignment.
- 5. Portable bases shall be fabricated from virgin and/or recycled rubber. The portable bases shall weigh a minimum of 30 lbs.
- Pavement surfaces shall be prepared in a manner that ensures proper bonding between the adhesives, the fixed mount bases and the pavement surface. Adhesives shall be prepared and applied according to the manufacturer's recommendations.
- 7. The installation and removal of channelizing devices shall not cause detrimental effects to the final pavement surfaces, including pavement surface discoloration or surface integrity. Driveable bases shall not be permitted on final pavement surfaces. The Engineer/Inspector shall approve all application and removal procedures of fixed bases.



LONGITUDINAL CHANNELIZING DEVICES (LCD)

- 1. LCDs are crashworthy, lightweight, deformable devices that are highly visible, have good target value and can be connected together. They are not designed to contain or redirect a vehicle on impact.
- 2. LCDs may be used instead of a line of cones or drums.
- 3. LCDs shall be placed in accordance to application and installation requirements specific to the device, and used only when shown on the CWZTCD list.
- 4. LCDs should not be used to provide positive protection for obstacles, pedestrians or workers.
- 5. LCDs shall be supplemented with retroreflective delineation as required for temporary barriers on BC(7) when placed roughly parallel to the travel lanes.
- 6. LCDs used as barricades placed perpendicular to traffic should have at least one row of reflective sheeting meeting the requirements for barricade rails as shown on BC(10). Place reflective sheeting near the top of the LCD along the full length of the device.

WATER BALLASTED SYSTEMS USED AS BARRIERS

- Water ballasted systems used as barriers shall not be used solely to channelize road users, but also to protect the work space per the appropriate Manual for Assessing Safety Hardware (MASH) crashworthiness requirements based on roadway speed and barrier application.
- 2. Water ballasted systems used to channelize vehicular traffic shall be supplemented with retroreflective delineation or channelizing devices to improve daytime/nighttime visibility. They may also be supplemented with pavement markings.
- 3. Water ballasted systems used as barriers shall be placed in accordance to application and installation requirements specific to the device, and used only when shown on the CWZTCD list.
- 4. Water ballasted systems used as barriers should not be used for a merging taper except in low speed (less than 45 MPH urban areas. When used on a taper in a low speed urban area, the taper shall be delineated and the taper length should be designed to optimize road user operations considering the available geometric conditions.
- When water ballasted systems used as barriers have blunt ends exposed to traffic, they should be attenuated as per manufacturer recommendations or flared to a point outside the clear zone.

If used to channelize pedestrians, longitudinal channelizing devices or water ballasted systems must have a continuous detectable bottom for users of long canes and the top of the unit shall not be less than 32 inches in height.

HOLLOW OR WATER BALLASTED SYSTEMS USED AS LONGITUDINAL CHANNELIZING DEVICES OR BARRIERS

Posted Speed	Formula	D	Minimur esirab er Len **	le	Suggested Maximum Spacing of Channelizing Devices		
		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	
30	2	150′	1651	180′	30'	60′	
35	$L = \frac{WS^2}{60}$	2051	225′	245'	35′	70′	
40	80	2651	2951	320′	40'	80′	
45		450′	495′	540'	45′	90′	
50		500′	550′	600'	50′	100′	
55	L=WS	550′	605′	660′	55′	110′	
60	- " 3	600'	660′	720′	60′	120′	
65		650′	715′	780′	65′	130′	
70		700′	770′	840'	70′	140′	
75		750′	8251	900′	75′	150′	
80		800′	880′	960′	80′	160′	
					·		

XX Taper lengths have been rounded off. L=Length of Taper (FT.) W=Width of Offset (FT.) S=Posted Speed (MPH)

SUGGESTED MAXIMUM SPACING OF CHANNELIZING DEVICES AND MINIMUM DESIRABLE TAPER LENGTHS

SHEET 9 OF 12



Traffic Safety Division Standard

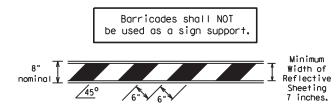
BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(9)-21

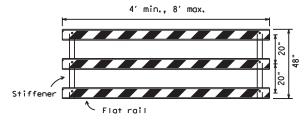
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TYPE 3 BARRICADES

- Refer to the Compliant Work Zone Traffic Control Devices List (CWZTCD) for details of the Type 3 Barricades and a list of all materials used in the construction of Type 3 Barricades.
- Type 3 Barricades shall be used at each end of construction projects closed to all traffic.
- 3. Barricades extending across a roadway should have stripes that slope downward in the direction toward which traffic must turn in detouring. When both right and left turns are provided, the chevron striping may slope downward in both directions from the center of the barricade. Where no turns are provided at a closed road, striping should slope downward in both directions toward the center of roadway.
- Striping of rails, for the right side of the roadway, should slope downward to the left. For the left side of the roadway, striping should slope downward to the right.
- Identification markings may be shown only on the back of the barricade rails. The maximum height of letters and/or company logos used for identification shall be 1".
- Barricades shall not be placed parallel to traffic unless an adequate clear zone is provided.
- 7. Warning lights shall NOT be installed on barricades.
- 8. Where barricades require the use of weights to keep from turning over, the use of sandbags with dry, cohesionless sand is recommended. The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight. Sand bags shall not be stacked in a manner that covers any portion of a barricade rails reflective sheeting. Rock, concrete, iron, steel or other solid objects will NOT be permitted. Sandbags shall be made of a durable material that tears upon vehicular impact. Rubber (such as tire inner tubes) shall not be used for sandbags. Sandbags shall only be placed along or upon the base supports of the device and shall not be suspended above ground level or hung with rope, wire, chains or other fasteners.
- Sheeting for barricades shall be retroreflective Type A or Type B conforming to Departmental Material Specification DMS-8300 unless otherwise noted.

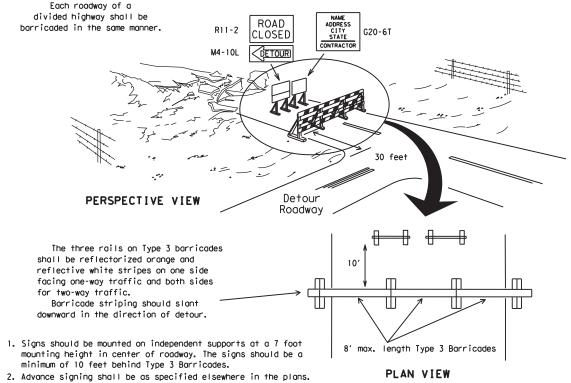


TYPICAL STRIPING DETAIL FOR BARRICADE RAIL



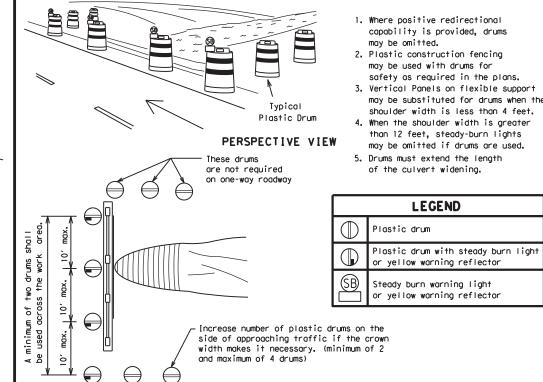
Stiffener may be inside or outside of support, but no more than 2 stiffeners shall be allowed on one barricade.

TYPICAL PANEL DETAIL FOR SKID OR POST TYPE BARRICADES



TYPE 3 BARRICADE (POST AND SKID) TYPICAL APPLICATION

Two-Piece cones



3"-4"

4" min. orange
2" min.
4" min. white
2" min.
2" min.
4" min. orange
4" min. white
4" min. orange
4" min. white

6" min. 2" min. 4" min.

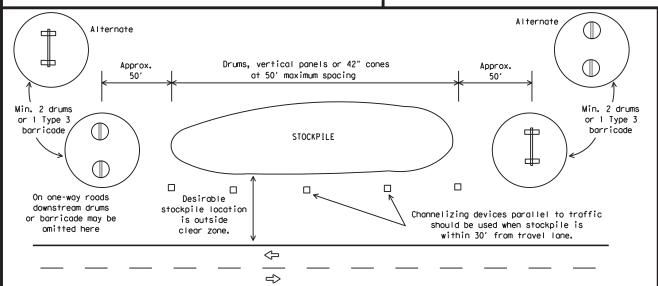
PLAN VIEW

2" mox. 3" min. 2" to 6" 3" min. 28" min.

CULVERT WIDENING OR OTHER ISOLATED WORK WITHIN THE PROJECT LIMITS

One-Piece cones

Tubular Marker

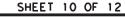


TRAFFIC CONTROL FOR MATERIAL STOCKPILES

28" Cones shall have a minimum weight of 9 1/2 lbs.

42" 2-piece cones shall have a minimum weight of 30 lbs. including base.

- Traffic cones and tubular markers shall be predominantly orange, and meet the height and weight requirements shown above.
- One-piece cones have the body and base of the cone molded in one consolidated unit. Two-piece cones have a cone shaped body and a separate rubber base, or ballast, that is added to keep the device upright and in place.
- 3. Two-piece cones may have a handle or loop extending up to 8" above the minimum height shown, in order to aid in retrieving the device.
- 4. Cones or tubular markers shall have white or white and orange reflective bands as shown above. The reflective bands shall have a smooth, sealed outer surface and meet the requirements of Departmental Material Specification DMS-8300 Type A or Type B.
- 5. 28" cones and tubular markers are generally suitable for short duration and short-term stationary work as defined on BC(4). These should not be used for intermediate-term or long-term stationary work unless personnel is on-site to maintain them in their proper upright position.
- 42" two-piece cones, vertical panels or drums are suitable for all work zone durations.
- Cones or tubular markers used on each project should be of the same size and shape.





Traffic Safety Division Standard

BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

BC(10)-21

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WORK ZONE PAVEMENT MARKINGS

GENERAL

- 1. The Contractor shall be responsible for maintaining work zone and existing pavement markings, in accordance with the standard specifications and special provisions, on all roadways open to traffic within the CSJ limits unless otherwise stated in the plans.
- 2. Color, patterns and dimensions shall be in conformance with the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).
- 3. Additional supplemental pavement marking details may be found in the plans or specifications.
- 4. Pavement markings shall be installed in accordance with the TMUTCD and as shown on the plans.
- 5. When short term markings are required on the plans, short term markings shall conform with the TMUTCD, the plans and details as shown on the Standard Plan Sheet WZ(STPM).
- 6. When standard pavement markings are not in place and the roadway is opened to traffic, DO NOT PASS signs shall be erected to mark the beginning of the sections where passing is prohibited and PASS WITH CARE signs at the beginning of sections where passing
- 7. All work zone pavement markings shall be installed in accordance with Item 662, "Work Zone Pavement Markings."

RAISED PAVEMENT MARKERS

- 1. Raised pavement markers are to be placed according to the patterns
- 2. All raised pavement markers used for work zone markings shall meet the requirements of Item 672, "RAISED PAVEMENT MARKERS" and Departmental Material Specification DMS-4200 or DMS-4300.

PREFABRICATED PAVEMENT MARKINGS

- 1. Removable prefabricated pavement markings shall meet the requirements
- 2. Non-removable prefabricated pavement markings (foil back) shall meet the requirements of DMS-8240.

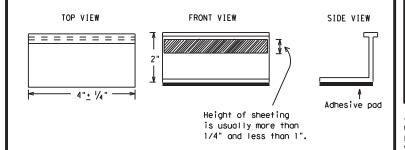
MAINTAINING WORK ZONE PAVEMENT MARKINGS

- 1. The Contractor will be responsible for maintaining work zone pavement markings within the work limits.
- 2. Work zone pavement markings shall be inspected in accordance with the frequency and reporting requirements of work zone traffic control device inspections as required by Form 599.
- 3. The markings should provide a visible reference for a minimum distance of 300 feet during normal daylight hours and 160 feet when illuminated by automobile low-beam headlights at night, unless sight distance is restricted by roadway geometrics.
- 4. Markings failing to meet this criteria within the first 30 days after placement shall be replaced at the expense of the Contractor as per Specification Item 662.

REMOVAL OF PAVEMENT MARKINGS

- 1. Pavement markings that are no longer applicable, could create confusion or direct a motorist toward or into the closed portion of the roadway shall be removed or obliterated before the roadway is opened to traffic.
- 2. The above shall not apply to detours in place for less than three days, where flaggers and/or sufficient channelizing devices are used in lieu of markings to outline the detour route.
- 3. Pavement markings shall be removed to the fullest extent possible, so as not to leave a discernable marking. This shall be by any method approved by TxDOT Specification Item 677 for "Eliminating Existing Pavement Markings and Markers".
- 4. The removal of pavement markings may require resurfacing or seal coating portions of the roadway as described in Item 677.
- 5. Subject to the approval of the Engineer, any method that proves to be successful on a particular type pavement may be used.
- 6. Blast cleaning may be used but will not be required unless specifically shown in the plans.
- 7. Over-painting of the markings SHALL NOT BE permitted.
- 8. Removal of raised pavement markers shall be as directed by the
- 9. Removal of existing pavement markings and markers will be paid for directly in accordance with Item 677, "ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS," unless otherwise stated in the plans.
- 10. Black-out marking tape may be used to cover conflicting existing markings for periods less than two weeks when approved by the Engineer.

Temporary Flexible-Reflective Roadway Marker Tabs



STAPLES OR NAILS SHALL NOT BE USED TO SECURE TEMPORARY FLEXIBLE-REFLECTIVE ROADWAY MARKER TABS TO THE PAVEMENT SURFACE

- 1. Temporary flexible-reflective roadway marker tabs used as guidemarks shall meet the requirements of DMS-8242.
- 2. Tabs detailed on this sheet are to be inspected and accepted by the Engineer or designated representative. Sampling and testing is not normally required, however at the option of the Engineer, either "A" or "B" below may be imposed to assure quality before placement on the
 - A. Select five (5) or more tabs at random from each lot or shipment and submit to the Construction Division, Materials and Pavement Section to determine specification compliance.
 - B. Select five (5) tabs and perform the following test. Affix five (5) tabs at 24 inch intervals on an asphaltic pavement in a straight line. Using a medium size passenger vehicle or pickup, run over the markers with the front and rear tires at a speed of 35 to 40 miles per hour, four (4) times in each direction. No more than one (1) out of the five (5) reflective surfaces shall be lost or displaced as a result of this test.
- 3. Small design variances may be noted between tab manufacturers.
- 4. See Standard Sheet WZ(STPM) for tab placement on new pavements. See Standard Sheet TCP(7-1) for tab placement on seal coat work.

RAISED PAVEMENT MARKERS USED AS GUIDEMARKS

- 1. Raised pavement markers used as guidemarks shall be from the approved product list, and meet the requirements of DMS-4200,
- 2. All temporary construction raised pavement markers provided on a project shall be of the same manufacturer.
- 3. Adhesive for guidemarks shall be bituminous material hot applied or butyl rubber pad for all surfaces, or thermoplastic for concrete surfaces.

Guidemarks shall be designated as: YELLOW - (two amber reflective surfaces with yellow body). WHITE - (one silver reflective surface with white body).

DEPARTMENTAL MATERIAL SPECIFICATIO	NS
PAVEMENT MARKERS (REFLECTORIZED)	DMS-4200
TRAFFIC BUTTONS	DMS-4300
EPOXY AND ADHESIVES	DMS-6100
BITUMINOUS ADHESIVE FOR PAVEMENT MARKERS	DMS-6130
PERMANENT PREFABRICATED PAVEMENT MARKINGS	DMS-8240
TEMPORARY REMOVABLE, PREFABRICATED PAVEMENT MARKINGS	DMS-8241
TEMPORARY FLEXIBLE, REFLECTIVE ROADWAY MARKER TABS	DMS-8242

A list of pregualified reflective raised payement markers. non-reflective traffic buttons, roadway marker tabs and other pavement markings can be found at the Material Producer List web address shown on BC(1).

SHEET 11 OF 12

Traffic Safety

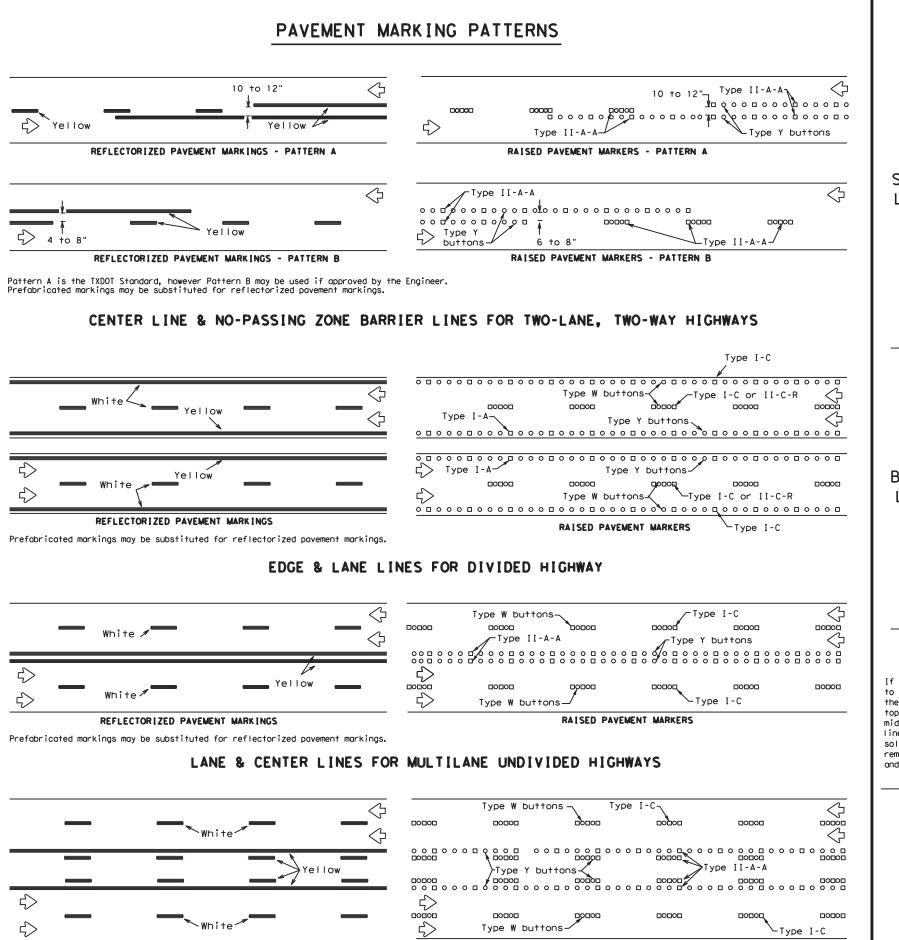


Texas Department of Transportation

BARRICADE AND CONSTRUCTION PAVEMENT MARKINGS

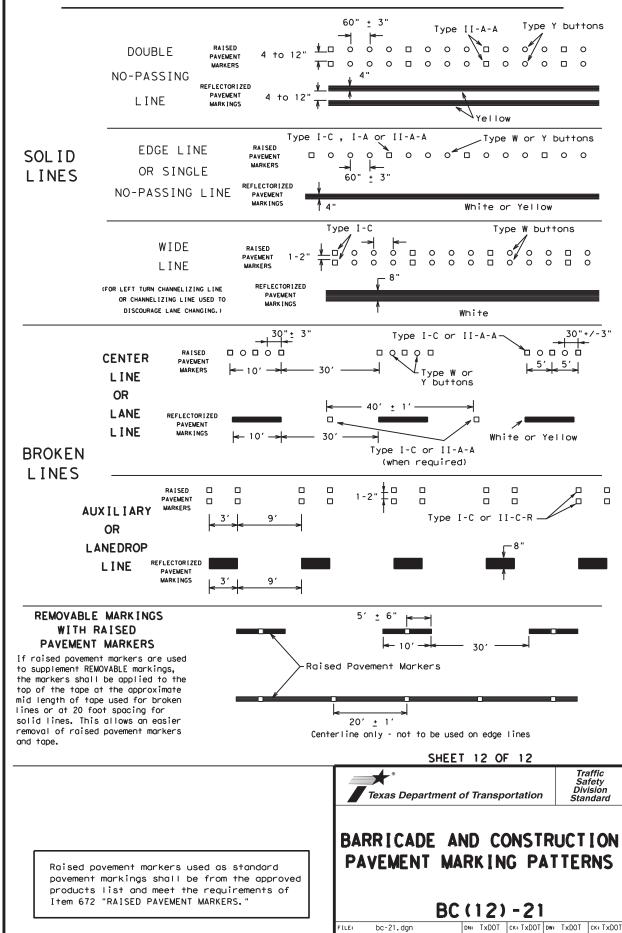
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TWO-WAY LEFT TURN LANE

RAISED PAVEMENT MARKERS



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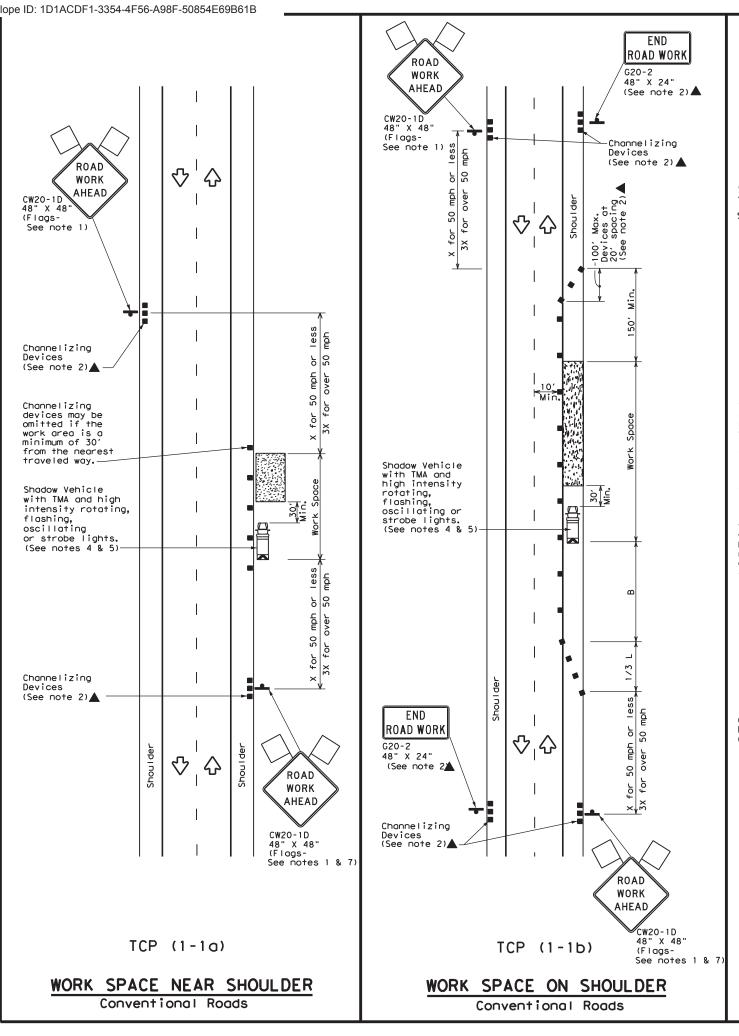
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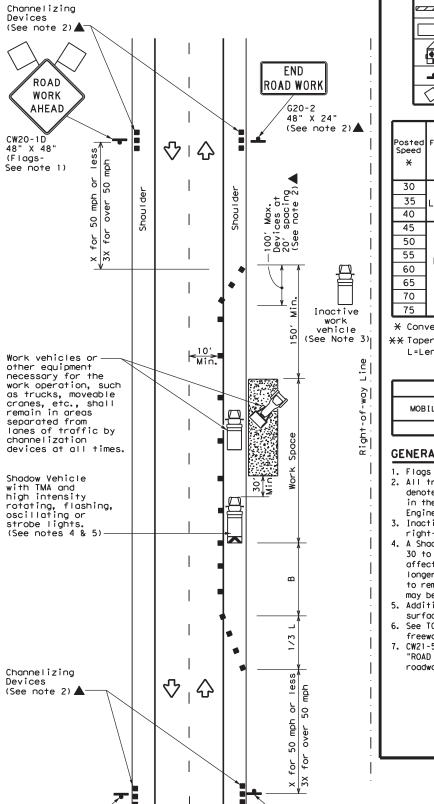
STANDARD WORK ZONE PAVEMENT MARKINGS DETAILS

DATE

REFLECTORIZED PAVEMENT MARKINGS

Prefabricated markings may be substituted for reflectorized pavement markings.





TCP (1-1c)

WORK VEHICLES ON SHOULDER

Conventional Roads

END

ROAD WORK

(See note 2) 📥

G20-2

48" X 24"

	LEGEND							
~~~	Type 3 Barricade		Channelizing Devices					
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)					
<b>E</b>	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)					
-	Sign	♡	Traffic Flow					
$\Diamond$	Flag	4	Flagger					

Posted Speed	××		Spacir Channe		Minimum Sign Spacing "x"	Suggested Longitudinal Buffer Space		
*		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	Distance	"B"
30	2	150′	1651	1801	30'	60′	120′	90'
35	L = WS ²	2051	225'	245'	35′	70′	160′	120′
40	80	265′	295′	3201	40′	80′	240'	155′
45		4501	4951	540′	45′	90′	320′	195′
50		500′	550′	6001	50′	100′	400′	240′
55	L=WS	550′	6051	660′	55′	110′	500′	295′
60	L - W 5	600'	660′	720′	60′	120'	600′	350′
65		650′	715′	7801	65′	130′	700′	410′
70		700′	770′	840′	701	140′	800′	475′
75		750′	825′	900′	75′	150′	900′	540′

- * Conventional Roads Only
- ** Taper lengths have been rounded off.
- L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE										
MOBILE SHORT SHORT TERM INTERMEDIATE LONG TERM TERM STATIONARY STATIONARY										
	1	1								

#### GENERAL NOTES

ROAD

WORK

AHEAD

CW20-1D

48" X 48" (Flags-See notes 1 & 7)

- 1. Flags attached to signs where shown are REQUIRED.
- 2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
- 3. Inactive work vehicles or other equipment should be parked near the right-of-way line and not parked on the paved shoulder.
- 4. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
- 5. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
- 6. See TCP(5-1) for shoulder work on divided highways, expressways and
- 7. CW21-5 "SHOULDER WORK" signs may be used in place of CW20-1D "ROAD WORK AHEAD" signs for shoulder work on conventional

Texas Department of Transportation

Traffic Operations Division Standard

TRAFFIC CONTROL PLAN CONVENTIONAL ROAD SHOULDER WORK

TCP(1-1)-18

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-97 2-18	23		BROW	N	18

42" X 42 " X 42"

R1-2aP ONCOMING 48" X 36"

CW20-4D

CW20-1D

(Flags-See note 1)

48" X 48"

TRAFFIC (See note 8)

ONE LANE

ROAD AHEAD

ROAD

WORK **AHEAD** 

♡ | む

TCP (1-2a)

ONE LANE TWO-WAY

CONTROL WITH YIELD SIGNS (Less than 2000 ADT - See note 7)

	LEGEND									
~~~	Type 3 Barricade		Channelizing Devices							
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)							
E	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)							
-	Sign	♡	Traffic Flow							
\Diamond	Flag	ПО	Flagger							

Posted Speed	peed		Minimum Desirable Taper Lengths **		Suggested Maximum Spacing of Channelizing Devices		Minimum Sign Spacing "x"	Suggested Longitudinal Buffer Space	Stopping Sight Distance
*		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	Distance	"B"	
30	2	150′	1651	1801	30'	60′	1201	90′	200'
35	$L = \frac{WS^2}{60}$	2051	225'	245′	35′	70′	160′	120′	250'
40	80	2651	2951	3201	40'	80′	240'	155′	3051
45		450′	4951	540′	45′	90'	320'	195′	360′
50		5001	550′	600,	50′	100′	4001	240′	425′
55	L=WS	550′	6051	660′	55′	110′	500′	295′	495′
60	L-#3	600'	660′	720′	60′	120′	600'	350′	570′
65		650′	715′	780′	65′	130'	700′	410′	645′
70		700′	7701	840′	701	140′	800′	475′	730′
75		750′	8251	900′	75′	150′	900′	540′	820′

* Conventional Roads Only

** Taper lengths have been rounded off.

L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE									
MOBILE	MOBILE SHORT SHORT TERM INTERMEDIATE LONG TERM DURATION STATIONARY TERM STATIONARY STATIONARY								
	1	1							

GENERAL NOTES

- 1. Flags attached to signs where shown are REQUIRED.
- 2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
- 3. The CW3-4 "BE PREPARED TO STOP" sign may be installed after the CW20-4D "ONE LANE ROAD AHEAD" sign, but proper sign spacing shall be maintained.
- 4. Sign spacing may be increased or an additional CW20-1D "ROAD WORK AHEAD" sign may be used if advance warning ahead of the flagger or R1-2 "YIELD" sign is less than 1500 feet. 5. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet
- in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
- 6. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.

TCP (1-2a)

- 7. R1-2 "YIELD" sign traffic control may be used on projects with approaches that have adequate sight distance. For projects in urban areas, work spaces should be no longer than one half city block. In rural areas on roadways with less than 2000 ADT, work spaces should be no longer than 400 feet.
- 8. R1-2 "YIELD" sign with R1-2aP "TO ONCOMING TRAFFIC" plaque shall be placed on a support at a 7 foot minimum mounting height.

- 9. Flaggers should use two-way radios or other methods of communication to control traffic.
- 10. Length of work space should be based on the ability of flaggers to communicate.
- 11. If the work space is located near a horizontal or vertical curve, the buffer distances should be increased in order to maintain adequate stopping sight distance to the flagger and a queue of stopped vehicles (see table above).
- 12. Channelizing devices on the center-line may be omitted when a pilot car is leading traffic and approved by the Engineer.
- Flaggers should use 24" STOP/SLOW paddles to control traffic. Flags should be limited to emergency situations.



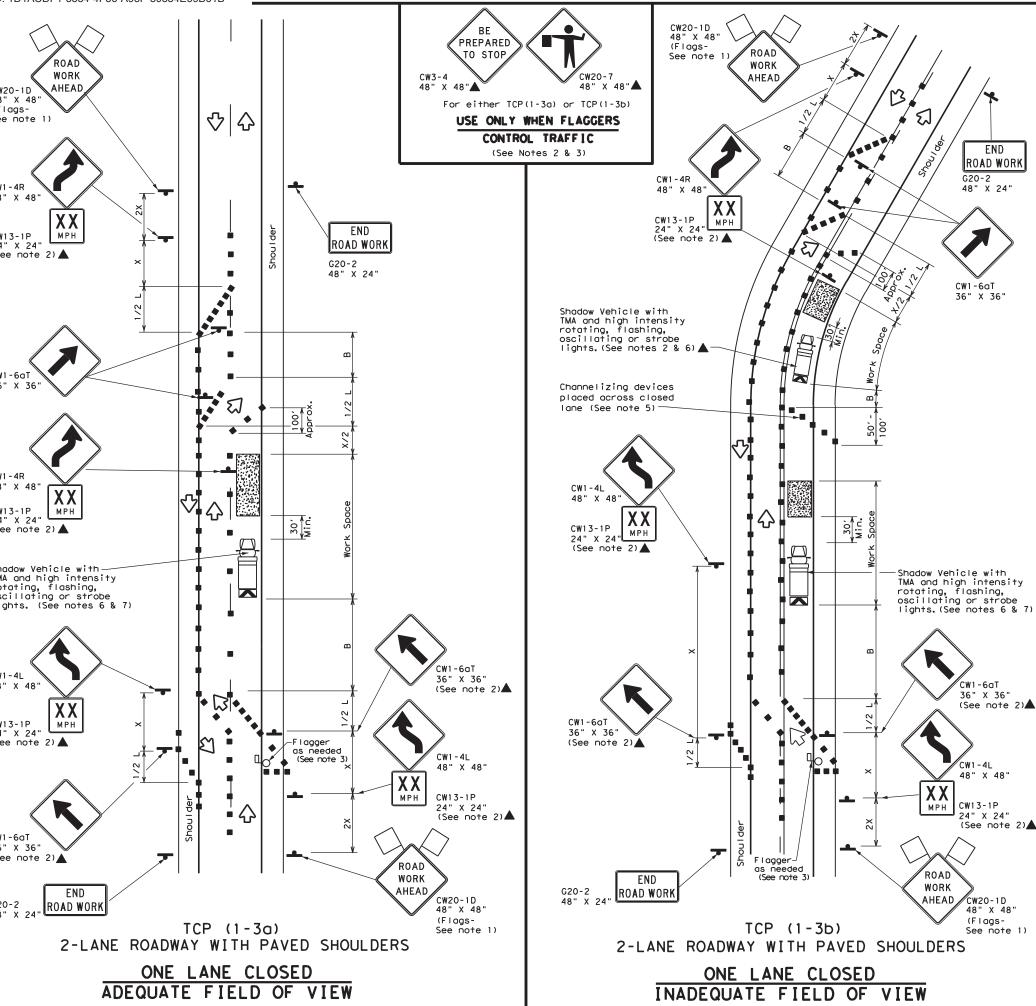
Traffic Operations Division Standard

TRAFFIC CONTROL PLAN ONE-LANE TWO-WAY TRAFFIC CONTROL

TCP(1-2)-18

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© TxDOT December 1985	CONT	SECT	JOB		HIGHWAY
4-90 4-98 REVISIONS	6427	57	001		US 67
2-94 2-12	DIST		COUNTY		SHEET NO.
1-97 2-18	23		BROW	N	19

CW3-4 48" X 48" (See note 2	CW20-4D 48" X 48" ONE LANE ROAD AHEAD TO STOP		ROAD WORK AHEAD CW20-1D 48" X 48" (Flogs-
CW20-7 48" X 48" CW16-2P 24" X 18" (See note 2)		D D	END ROAD WORK G20-2 48" X 24"
emergencies, flagger stations shall be illuminated at night	150.	por otion	
Shadow Vehicle with TMA and high intensity rotating, flashing, oscillating or strobe lights. (See notes 5 & 6) —	B Work Space	CW20-7 48" X 48"	
Except in emergencies, flagger stations shall be illuminated at night	x 50' Min.	XXX CW16-2P 24" X 18" (See note BE PREPARED TO STOP CW3-4 48" X 48" (See note	
END ROAD WORK G20-2 48" X 24"		ONE LANE ROAD AHEAD CW20-4D 48" X 48" ROAD WORK AHEAD CW20-1D 48" X 48' (Flags- See note	
	ONE LANE TO CONTROL WITH	WO-WAY	



	LEGEND									
	Type 3 Barricade		Channelizing Devices							
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)							
E	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)							
-	Sign	♡	Traffic Flow							
\Diamond	Flag	LO	Flagger							

Posted Speed	Formula	D	Minimum esirab er Lend **	le	Spaci: Channe		Sign Spacing	Suggested Longitudinal Buffer Space
*	10.		11'	12' Offset	On a	On a On a Distance		"B"
30	2	150′	165′	180′	30′	60′	1201	90′
35	L = \frac{WS^2}{60}	2051	225′	2451	35′	70′	160′	120'
40	80	2651	295′	3201	40'	80′	240′	155′
45		450'	4951	540′	45′	90′	320′	195′
50		500′	550′	6001	50′	1001	400'	240′
55	L=WS	550′	605′	660′	55′	110′	500′	295′
60	L-W3	600′	660′	720′	60′	120′	600′	350′
65		650′	715′	780′	65′	130′	7001	410′
70		700′	770′	840′	701	140′	8001	475′
75		750′	825′	9001	75′	150′	900′	540′

* Conventional Roads Only

** Taper lengths have been rounded off.

L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE									
MOBILE SHORT SHORT TERM INTERMEDIATE LONG TERM DURATION STATIONARY TERM STATIONARY STATIONARY									
	1	1							

GENERAL NOTES

- 1. Flags attached to signs where shown are REQUIRED
- 2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer.
- 3. Flagger control should NOT be used unless roadway conditions or heavy traffic volume require additional emphasis to safely control traffic. Additional flaggers may be positioned in advance of traffic queues to alert traffic to reduce speed.
- 4. DO NOT PASS, PASS WITH CARE and construction regulatory speed zone signs may be installed downstream of the ROAD WORK AHEAD signs.
- 5. When the work zone is made up of several work spaces, channelizing devices should be placed laterally across the closed lane to re-emphasize closure. Laterally placed channelizing devices should be repeated every 500 to 1000 feet in urban areas and every 1/4 to 1/2 mile in rural areas.
- 6. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of $% \left(1\right) =\left(1\right) \left(1\right)$ the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
- 7. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.
- 8. Where traffic is directed over a yellow centerline, channelizing devices which separate two-way traffic should be spaced on tapers at 20', or 15' if posted speed are 35 mph or slower, and for tangent sections, at 1/2S where S is the speed in mph. This tighter device spacing is intended for the area of conflicting markings not the entire work zone.

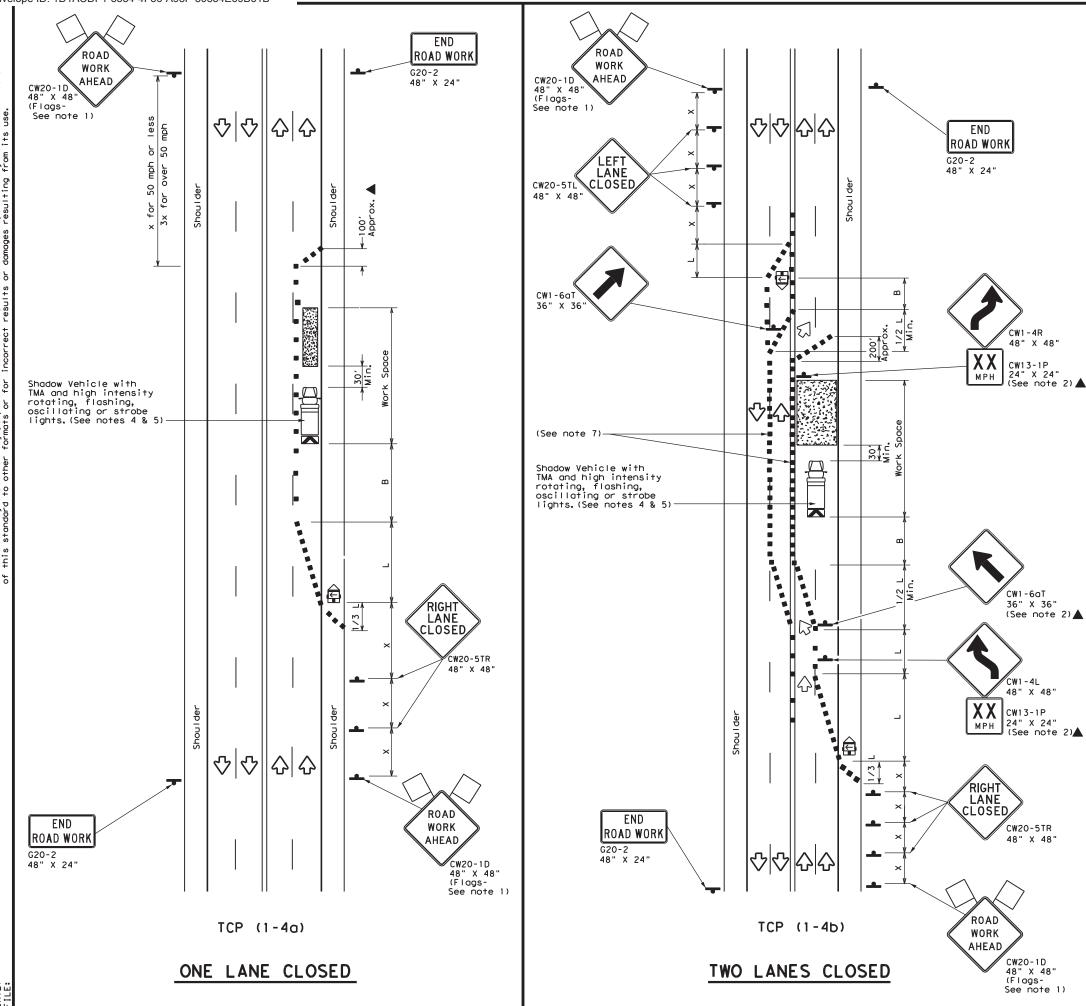


Traffic Operations Division Standard

TRAFFIC CONTROL PLAN TRAFFIC SHIFTS ON TWO LANE ROADS

TCP(1-3)-18

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ℂTxDOT December 1985	CONT	SECT	JOB		HIGHWAY
REVISIONS 2-94 4-98	6427	57	001		US 67
8-95 2-12	DIST	COUNTY			SHEET NO.
1-97 2-18	23		BROW	N	20



	LEGEND						
~~~	Type 3 Barricade	<b>8 8</b>	Channelizing Devices				
	Heavy Work Vehicle	y Work Vehicle					
<b>E</b>	Trailer Mounted Flashing Arrow Board	M	Portable Changeable Message Sign (PCMS)				
-	<b>♣</b> Sign		Traffic Flow				
$\Diamond$	Flag	LO	Flagger				

Posted Speed	Speed		Desirable Taper Lengths **		Suggested Maximum Spacing of Channelizing Devices		Minimum Sign Spacing "x"	Suggested Longitudinal Buffer Space
*		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	Distance	"B"
30	2	150′	1651	1801	30′	60′	120'	90′
35	L = WS ²	2051	225′	245'	35′	70′	160′	120′
40	60	265′	2951	3201	40′	80′	240'	155′
45		450′	495′	540'	45′	90′	320′	195′
50		500′	550′	600′	50'	100′	400′	240′
55	L=WS	550′	605′	660′	55′	110'	500′	295′
60	L - W 3	600′	660′	720′	60′	120'	600′	350′
65	1	650′	715′	780′	65′	130′	700′	410′
70		700′	770′	840'	70′	140'	800′	475′
75		750′	8251	9001	75′	150′	900′	540′

- * Conventional Roads Only
- ₩ Taper lengths have been rounded off.

L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

TYPICAL USAGE					
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY	
	1	1			

#### GENERAL NOTES

- 1. Flags attached to signs where shown are REQUIRED.
- 2. All traffic control devices illustrated are REQUIRED, except those denoted with the triangle symbol may be omitted when stated elsewhere in the plans, or for routine maintenance work, when approved by the Engineer. 3. The CW20-1D "ROAD WORK AHEAD" sign may be repeated if the
- visibility of the work zone is less than 1500 feet.

  4. A Shadow Vehicle with a TMA should be used anytime it can be positioned 30 to 100 feet in advance of the area of crew exposure without adversely affecting the performance or quality of the work. If workers are no longer present but road or work conditions require the traffic control to remain in place, Type 3 Barricades or other channelizing devices may be substituted for the Shadow Vehicle and TMA.
- 5. Additional Shadow Vehicles with TMAs may be positioned off the paved surface, next to those shown in order to protect wider work spaces.

6. If this TCP is used for a left lane closure , CW20-5TL "LEFT LANE CLOSED" signs shall be used and channelizing devices shall be placed on the centerline where needed to protect the work space from opposing traffic with the arrow panel placed in the closed lane near the end of the merging taper.

7. Where traffic is directed over a yellow centerline, channelizing devices which separate two-way traffic should be spaced on tapers at 20' or 15' if posted speeds are 35 mph or slower, and for tangent sections, at 1/2S where S is the speed in mph. This tighter device spacing is intended for the areas of conflicting markings, not the entire work zone.



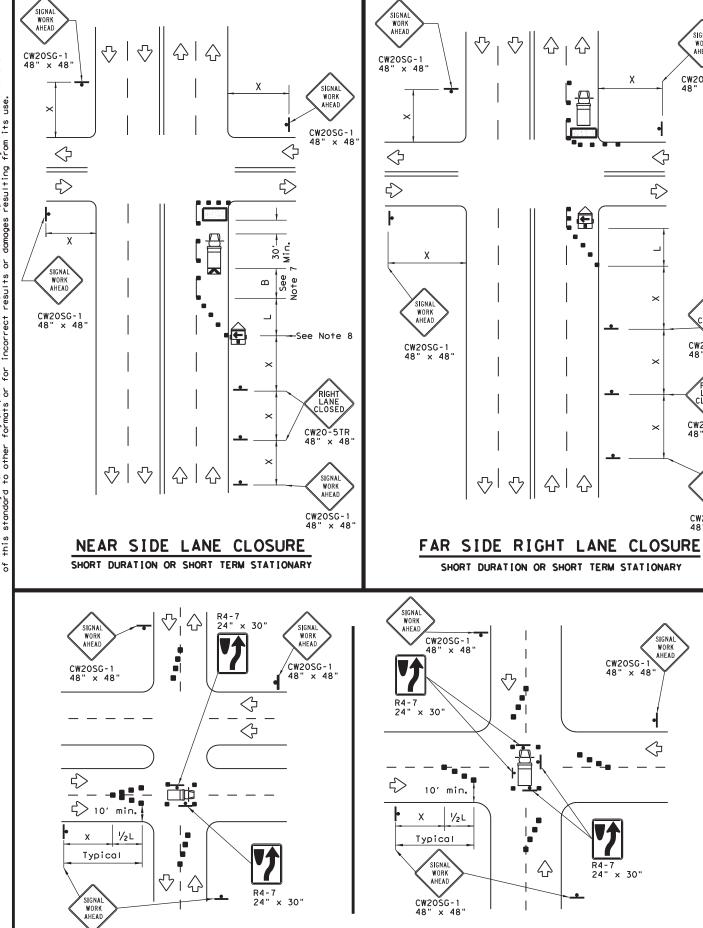
Traffic Operations Division Standard

TRAFFIC CONTROL PLAN LANE CLOSURES ON MULTILANE CONVENTIONAL ROADS

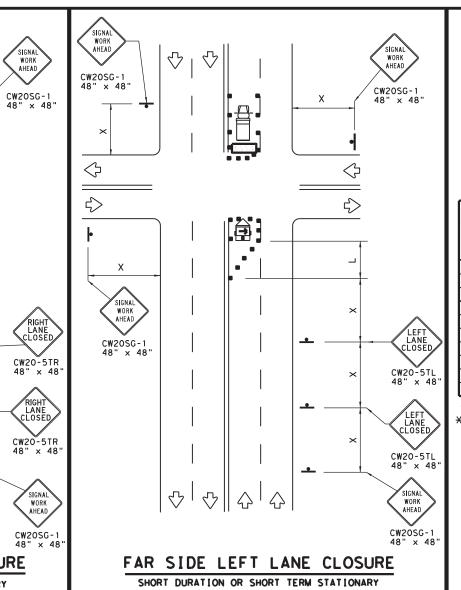
TCP(1-4)-18

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ı	8-95 2-		DIST		COUNTY			SHEET NO.
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CW20SG-1 48" x 48"



OPERATIONS IN THE INTERSECTION



	LEGEND						
~~~	Type 3 Barricade		Channelizing Devices				
	Heavy Work Vehicle		Truck Mounted Attenuator (TMA)				
£	Trailer Mounted Flashing Arrow Board	(X	Portable Changeable Message Sign (PCMS)				
•	Sign	♡	Traffic Flow				
\Diamond	Flag	ПO	Flagger				

Speed	Formula		Minimur esirab er Len **	le	Spacin Channe		Minimum Sign Spacing "X"	Suggested Longitudinal Buffer Space
*		10' Offset	11' Offset	12' Offset	On a Taper	On a Tangent	Distance	"B"
30	2	150′	1651	180′	30'	60′	120'	90'
35	L = WS ²	2051	225'	245'	35′	70′	160′	120′
40	80	265′	295′	3201	40'	80′	240'	155′
45		450′	4951	540′	45′	90′	320′	195′
50		5001	550′	600'	50′	100′	400′	240′
55	L=WS	550′	6051	660′	55′	110′	500′	295′
60	L - III 3	600'	660′	720′	60′	120'	600′	350′
65		650′	715′	780′	65′	130′	700′	410′
70		700′	770′	840′	70′	140′	8001	475′
75		750′	8251	9001	75′	150′	900′	540′

* Conventional Roads Only

** Taper lengths have been rounded off.

L=Length of Taper(FT) W=Width of Offset(FT) S=Posted Speed(MPH)

WORKERS IN BUCKET TRUCKS SHALL NOT WORK ABOVE OPEN LANES OF TRAFFIC.

GENERAL NOTES

SIGNAL WORK AHEAD

 \triangleleft

SIGNAL WORK AHEAD

- 1. The minimum size channelizing device is the 28" cone. 42" Two-piece cones, drums, vertical panels or barricades will be required when the device must be left unattended at night.
- 2. Obstructions or hazards at the work area shall be clearly marked and delineated at all times.
- 3. Flaggers and Flagger Symbol (CW20-7) signs may be required according to field conditions.
- 4. Vehicles parked in roadway shall be equipped with at least two high intensity rotating, flashing, oscillating or strobe type lights.
- 5. High level warning devices (flag trees) may be used at corners of the vehicle.
- 6. When work operations are performed on existing signals, the signals may be placed in flashing red mode when approved by the engineer. If existing signals do not have power, All-Way Stop (R1-1 and R1-3P) signs may be implemented when approved by the engineer.
- 7. For Short-Term Stationary work the buffer space "B" from the above table should be used if field conditions permit. For Short Duration (less than 1 hour) any buffer space provided will enhance the safety of the setup.
- 8. The arrow board at this location may be omitted for Short Duration work if the work vehicle has an arrow board in operation. As an option, the arrow board may be placed at the end of the taper in the closed lane if space is not available at the beginning of the taper.
- 9. Signs and devices for the NEAR SIDE LANE CLOSURE may be altered for a left lane closure by using a LEFT LANE CLOSED (CW20-5TL) and adding channelizing devices on the centerline to protect the work space from opposing traffic.

SHEET 1 OF 2



Traffic Operations Division Standard

TRAFFIC SIGNAL WORK TYPICAL DETAILS

WZ(BTS-1)-13

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98 3-03	23		BROW	٧		22

GENERAL NOTES FOR WORK ZONE SIGNS

Wooden sign posts shall be painted white.

directed by the Engineer.

directed by the Engineer.

DURATION OF WORK

SIGN MOUNTING HEIGHT

REMOVING OR COVERING

shown on Figure 6F-2 of the TMUTCD.

Barricades shall NOT be used as sign supports.

Nails shall NOT be used to attach signs to any support.

Signs shall be installed and maintained in a straight and plumb condition. $\ensuremath{\,^{\circ}}$

All signs shall be installed in accordance with the plans or as

Temporary signs that have damaged or cracked substrates and/or damaged or marred reflective sheeting shall be replaced as

Damaged wood posts shall be replaced. Splicing wood posts will not be allowed.

The Contractor shall furnish the sign design shown in the plans or in the "Standard Highway Sign Designs for Texas" (SHSD).

The Contractor shall furnish sign supports and substrates listed in the "Compliant Work Zone Traffic Control Device List" (CWZTCD), installed as per the manufacturer's recommendations.

Identification markings may be shown only on the back of the sign substrate. The maximum height of letters and/or company logos used for identification shall be 1".

Work zone durations are defined in Part 6, Section 66.02 of the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

Sign height of Long-term/Intermediate-term warning signs shall be as shown on Figure 6F-1 of the TMUTCD.

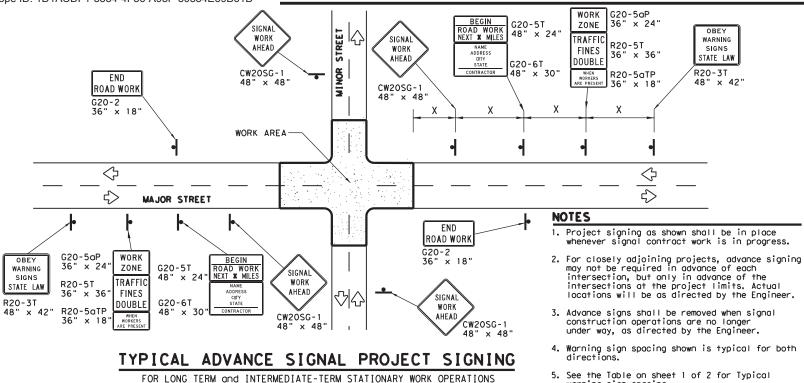
Regulatory signs shall be mounted at least 7 feet, but not more than 9 feet, above the paved surface regardless of work duration.

When signs are covered, the material used shall be opaque, such as heavy mil black plastic, or other materials which will cover the entire sign face and maintain their opaque properties under automobile headlights at night without damaging the sign sheeting. Burlap, or heavy materials such as plywood or aluminum shall not be used to cover signs.

Signs and anchor stubs shall be removed and holes back filled upon completion of the work.

Duct tape or other adhesive material shall NOT be affixed to a sign face. $\,$

Sign height of Short-term/Short_Duration warning signs shall be as



SIGN SUPPORT WEIGHTS

- The sandbags will be tied shut to keep the sand from spilling and to maintain a constant weight.
- permitted for use as sign support weights.
- Sandbags should weigh a minimum of 35 lbs and a maximum of 50 lbs.
- Rubber ballasts designed for channelizing devices should not be used for ballast on portable sign supports. Sign supports designed and manufactured with rubber bases may be used when shown on the CWZTCD
- Sandbags shall only be placed along or laid over the base supports shall be placed along the length of the skids to weigh down the
- Sandbags shall NOT be placed under the skid and shall not be used to level sign supports placed on slopes.

γ						
ı	LEGEND					
ı	-	Sign				
ı		Channelizing Devices				
ı		Type 3 Barricade				

DEPARTMENTAL MATERIAL	SPECIFICATIONS
SIGN FACE MATERIALS	DMS-8300
FLEXIBLE ROLL-UP REFLECTIVE SIGNS	DMS-8310

COLOR	USAGE	SHEETING MATERIAL
ORANGE	BACKGROUND	TYPE B _{FL} OR TYPE C _{FL} SHEETING
WHITE	BACKGROUND	TYPE A SHEETING
BLACK	LEGEND & BORDERS	ACRYLIC NON-REFLECTIVE SHEETING

Only pre-qualified products shall be used. A copy of the "Compliant Work Zone Traffic Control Devices List" (CWZTCD) describes pre-qualified products and their sources and may be found at the following web address:

http://www.txdot.gov/txdot_library/publications/construction.htm

REFLECTIVE SHEETING

All signs shall be retroreflective and constructed of sheeting meeting the requirements of the DMS and color usage table shown on this sheet.

warning sign spacing.

36" × 24"

R20-5T

36" × 36"

R20-5aTP

 \Diamond ⇆ OBEY WARNING

SIGNS

STATE LAW

R20-3T 48" x 42"

- Weights used to keep signs from turning over should be sandbags filled with dry, cohesionless material.
- Rock, concrete, iron, steel or other solid objects will not be
- Sandbaas shall be made of a durable material that tears upon vehicular impact. Rubber, such as tire inner tubes, shall not be used.
- of the traffic control device and shall not be suspended above ground level or hung with rope, wire, chains or other fastners. Sandbags

DEPAR	TMENTA	L MATERIAL	SPEC	IFICA?	ΓI
		Type 3 Barricade	e		
		Channelizing De	vices		

TRAFFIC SIGNAL WORK BARRICADES AND SIGNS

SHEET 2 OF 2

Texas Department of Transportation

WZ (BTS-2) - 13

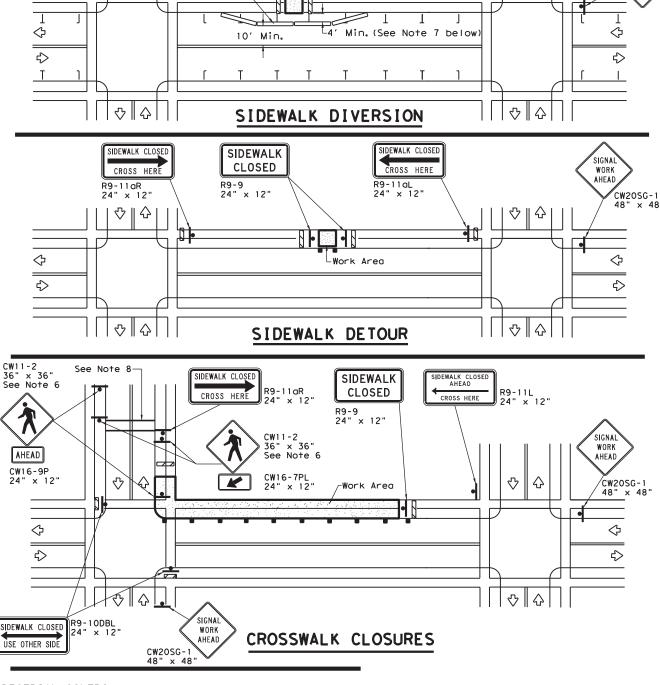
Operation: Division Standard

CW2OSG-

SIGNA

WORK

wzbts-13.dgn DN: TXDOT CK: TXDOT DW: TXDOT CK: TXDO CONT SECT JOB C) TxDOT April 1992 HIGHWAY 6427 57 001 US 67 2-98 10-99 7-13 4-98 3-03 23



Temporary Traffic Barrier

Note 4 below

PEDESTRIAN CONTROL

♡ || ☆

- Holes, trenches or other hazards shall be adequately protected by covering, delineating or surrounding the hazard with orange plastic pedestrian fencing or longitudinal channelizing devices, or as directed by the Engineer. "CROSSWALK CLOSURES" as detailed above will require the Engineer's approval
- prior to installation. R9 series signs shown may be placed on supports detailed on the BC standards or CWZTCD list, or when fabricated from approved lightweight plastic
- substrates, they may be mounted on top of a plastic drum at or near the location shown.
- For speeds less than 45 mph longitudinal channelizing devices may be used instead of traffic barriers when approved by the Engineer. Attenuation of blunt ends and installation of water filled devices shall be as per BC(9) and manufacturer's recommendations. Location of devices are for general guidance, Actual device spacing and
- location must be field adjusted to meet actual conditions. Where pedestrians with visual disabilities normally use the closed sidewalk
- Detectable Pedestrian Barricades should be used instead of the Type 3 Barricades shown. The width of existing sidewalk should be maintained if practical.
- Pavement markings for mid-block crosswalks shall be paid for under the appropriate bid items. When crosswalks or other pedestrian facilities are closed or relocated.
- temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian

GENERAL NOTES FOR ALL ELECTRICAL WORK

- 1. The location of all conduits, junction boxes, ground boxes, and electrical services is diagrammatic and may be shifted to accommodate field conditions.
- 2. Provide new and unused materials. Ensure that all materials and installations comply with the applicable articles of the National Electrical Code (NEC), TxDOT standards and specifications, National Electrical Manufacturers Association (NEMA), and are listed by Underwriters Laboratories (UL) or a Nationally Recognized Testing Lab (NRTL). NRTLs such as Canadian Standard Association (CSA), Intertek Testing Services NA Inc., or FM Approvals LLC can be considered equivalent to UL. Where reference is made to NEMA listed devices, International Electrotechnical Commission (IEC) listed devices will not be considered an acceptable equal to a NEMA listed device. Acceptable devices may have both a NEMA and IEC listing. Faulty fabrication or poor workmanship in any material, equipment, or installation is justification for rejection. Replace or reinstall rejected material or equipment at no additional cost to the Department.
- 3. Miscellaneous nuts, bolts and hardware, except for high strength bolts, may be stainless steel when plans specify galvanized, provided the bolt size is $\frac{1}{2}$ in, or less in diameter.
- 4. Provide the following test equipment as required by the Engineer to confirm compliance with the contract and the NEC: voltmeter, ammeter, megohm meter (1000 volt DC), ground resistance tester, torque wrenches, and torque screwdrivers. Ensure all equipment has been properly calibrated within the last year. Provide calibration certification to the Engineer upon request. Operate test equipment during inspection as requested by the Engineer.
- 5. Install grounding as shown on the plans and in accordance with the NEC. Ensure all metallic conduits; metal poles; luminaires; and metal enclosures are bonded to the equipment grounding conductor. Provide stranded bare copper or green insulated grounding conductors. Ground rods, connectors, and bonding jumpers are subsidiary to the various bid items.
- 6. When required by the Engineer, notify the Department in writing of materials from the Material Producers List (MPL) intended for use on each project. Prequalified materials are listed on the MPL on TxDOT's website under "Roadway Illumination and Electrical Supplies." No substitutions will be allowed for materials on this list.

CONDUIT

A. MATERIALS

- 1. Provide conduit, junction boxes, fittings, and hardware as per TxDOT Departmental Material Specification (DMS) 11030 "Conduit" and Item 618 "Conduit" of TxDOT's "Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges," latest edition. Provide conduits listed under Item 618 on the MPL under "Roadway Illumination and Electrical Supplies. Provide conduit types according to the descriptive code or as shown on the plans. Do not substitute other types of conduits for those shown. Provide Liquidtight flexible metal conduit (LFMC) when flexible conduit is called for on galvanized steel rigid metallic conduit (RMC) systems. Provide liquidtight flexible nonmetallic conduit (LFNC) when flexible conduit is called for on polyvinyl chloride (PVC) systems.
- 2. Provide galvanized steel RMC for all exposed conduits, unless otherwise shown on the plans. Properly bond all metal conduits.
- Unless otherwise shown on the plans, provide junction boxes with a minimum size as shown in the following table, which applies to the greatest number of conductors entering the box through one conduit with no more than four conduits per box. When a mixture of conductor sizes is present, count the conductors as if all are of the larger size. For situations not applicable to the table, size junction boxes in accordance with NEC.

AWG	3 CONDUCTORS	5 CONDUCTORS	7 CONDUCTORS
#1	10" x 10" x 4"	12" x 12" x 4"	16" × 16" × 4"
#2	8" × 8" × 4"	10" x 10" x 4"	12" x 12" x 4"
#4	8" × 8" × 4"	10" x 10" x 4"	10" × 10" × 4"
#6	8" × 8" × 4"	8" × 8" × 4"	10" × 10" × 4"
#8	8" × 8" × 4"	8" × 8" × 4"	8" × 8" × 4"

- 4. Junction boxes with an internal volume of less than 100 cu. in. and supported by entering raceways must have threaded entries or hubs identified for the intended purpose and supported by connection of two or more rigid metal conduits. Secure conduit within 3 ft. of the enclosure or within 18 in. of the enclosure if all conduit entries are on the same side. Mechanically secure all junction boxes with an internal volume greater than 100 cu. inches.
- 5. Provide hot dipped galvanized cast iron or sand cast aluminum outlet boxes for junction boxes containing only 10 AWG or 12 AWG conductors. Do not use die cast aluminum boxes. Size outlet boxes according to the NEC.
- 6. Do not use intermediate metal conduit (IMC) or electrical metallic tubing (EMT) unless specifically required by the plan sheets. When EMT is called for, provide junction boxes made from galvanized steel sheeting, listed and approved for outdoor use, unless otherwise noted on the plans. Size all galvanized steel junction boxes in accordance with the NEC. Provide junction boxes for IMC conduit systems that meet the same requirements for junction boxes used with RMC systems.
- 7. Provide PVC junction boxes intended for outdoor use on PVC conduit systems, unless otherwise noted on the plans.

- 8. Provide PVC elbows in PVC conduit systems, unless otherwise shown on the plans. Use only a flat, high tensile strength polyester fiber pull tape for pulling conductors through the PVC conduit system. When galvanized steel RMC elbows are specifically called for in the plans and any portion of the RMC elbow is buried less than 18 in., ground the RMC elbow by means of a grounding bushing on a rigid metal extension. Grounding of the rigid metal elbow is not required if the entire RMC elbow is encased in a minimum of 2 in. of concrete. PVC extensions are allowed on these concrete encased rigid metal elbows. RMC or PVC elbows are subsidiary to various bid items.
- 9. When required, provide High-Density Polyethylene (HDPE) conduit with factory installed internal conductors according to Item 622 "Duct Cable." At the Contractor's request and with approval by the Engineer, substitute HDPE conduit with no conductors for bored schedule 40 or schedule 80 PVC conduit bid under Item 618. Ensure bored HDPE substituted for PVC is schedule 40 and of the same size PVC called for in the plans. Ensure the substituted HDPE meets the requirements of Item 622. except that the conduit is supplied without factory-installed conductors. Make the transition of the HDPE conduit to PVC (or RMC elbow when required) at the bore pit. Provide conduit of the size and schedule as shown on the plans. Do not extend substituted conduit into ground boxes or foundations. Provide PVC or galvanized steel RMC elbows as called for at all ground boxes and foundations.
- 10. Use two-hole straps when supporting 2 in, and larger conduits. On electrical service poles, properly sized stainless steel or hot dipped galvanized one-hole standoff straps are allowed on the service riser conduit.
- B. CONSTRUCTION METHODS
- 1. Provide and install expansion joint conduit fittings on all structure-mounted conduits at the structure's expansion joints to allow for movement of the conduit. In addition, provide and install expansion joint fittings on all continuous runs of galvanized steel RMC conduit externally exposed on structures such as bridges at maximum intervals of 150 ft. When requested by the project Engineer, supply manufacturer's specification sheet for expansion joint conduit fittings. Repair or replace expansion joint fittings that do not allow for movement at no additional cost to the Department. Provide the method of determining the amount of expansion to the Engineer upon request. Do not use LFMC or LFNC as a substitute for the required expansion conduit fittings.
- 2. Space all conduit supports at maximum intervals of 5 ft. Install conduit spacers when attaching metal conduit to surface of concrete structures. See "Conduit Mounting Options" on ED(2). Install conduit support within 3 ft. of all enclosures and conduit terminations.
- 3. Do not attach conduit supports directly to pre-stressed concrete beams except as shown specifically in the plans or as approved by the Engineer.
- 4. Unless otherwise shown on the plans, jack or bore conduit placed beneath existing roadways, driveways, sidewalks, or after the base or surfacing operation has begun. Backfill and compact the bore pits below the conduit per Item 476 "Jacking, Boring, or Tunneling Pipe or Box" prior to installing conduit or duct cable to prevent bending of the connections.
- 5. When placing conduit in the sub-grade of new roadways, backfill all trenches with excavated material unless otherwise noted on the plans. When placing conduit in the sub-base of new roadways, backfill all trenches with cement-stabilized base as per requirements of Items 110 "Excavation", 400 "Excavation and Backfill for Structures", 401 "Flowable Backfill", 402 "Trench Excavation Protection", and 403 "Temporary Special Shoring."
- 6. Provide and place warning tape approximately 10 in. above all trenched conduit as per Item 618.
- 7. During construction, temporarily cap or plug open ends of all conduit and raceways immediately after installation to prevent entry of dirt, debris and animals. Temporary caps constructed of durable duct tape are allowed. Tightly fix the tape to the conduit opening. Clean out the conduit and prove it clear in accordance with Item 618 prior to installing any conductors.
- 8. Ensure conduit entry into the top of any enclosure is waterproof by installing conduit sealing hubs or using boxes with threaded bosses. This includes surface mounted safety switches, meter cans, service enclosures, auxiliary enclosures and junction boxes. Grounding bushings on water tight sealing hubs are not required.
- 9. Fit the ends of all PVC conduit terminations with bushings or bell end fittings. Provide and install a grounding type bushing on all metal conduit terminations.
- 10. Install a bonding jumper from each grounding bushing to the nearest ground rod, grounding lug, or equipment grounding conductor. Ensure all bonding jumpers are the same size as the equipment grounding conductor. Bonding of conduit used as a casing under roadways for duct cable is not required, if the duct extends the full length through the casing.
- 11. At all electrical services, install a 6 AWG solid copper grounding electrode conductor.
- 12. Place conduits entering ground boxes so that the conduit openings are between 3 in. and 6 in. from the bottom of the box. See the ground box detail on sheet ED(4).
- 13. Seal ends of all conduits with duct seal, expandable form, or by other methods approved by the Engineer. Seal conduit immediately after completion of conductor installation and pull tests. Do not use duct tape as a permanent conduit sealant. Do not use silicone caulk as a
- 14. File smooth the cut ends of all mounting strut and conduit. Before installing, paint the field cut ends of all mounting strut and RMC (threaded or non-threaded) with zinc rich paint (94% or more zinc content) to alleviate overspray. Use zinc rich paint to touch up galvanized material as allowed under Item 445 "Galvanizing," Do not paint non-galvanized material with a zinc rich paint as an alternative for materials required to be galvanized.

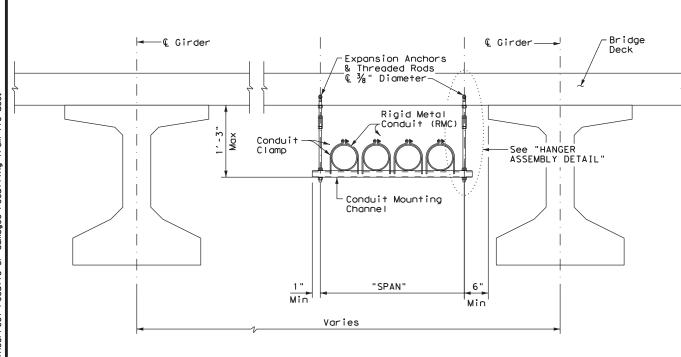


ELECTRICAL DETAILS **CONDUITS & NOTES**

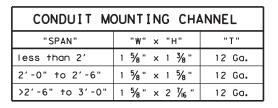
Division Standard

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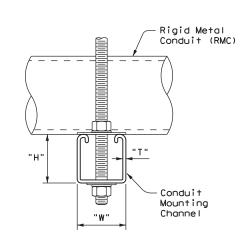
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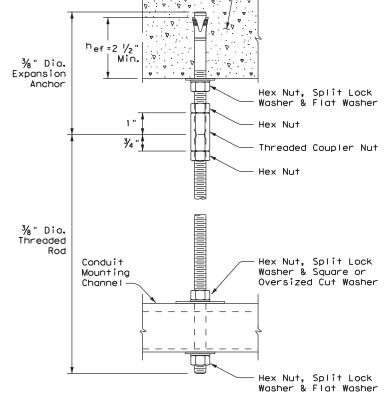


CONDUIT HANGING DETAIL



Channels with round or short slotted hole patterns are allowed, if the load carrying capacity is not reduced by more than 15%.

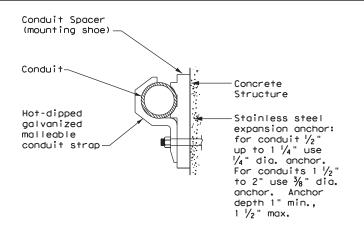


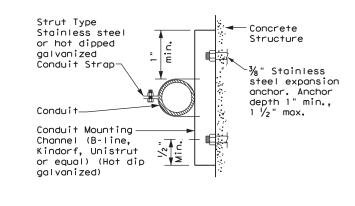


Bridge Deck

HANGER ASSEMBLY DETAIL

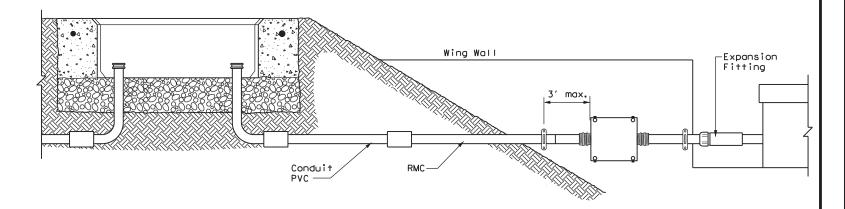
ELECTRIC CONDUIT TO BRIDGE DECK ATTACHMENT





CONDUIT MOUNTING OPTIONS

Attachment to concrete surfaces See ED(1)B.2



TYPICAL CONDUIT ENTRY TO BRIDGE STRUCTURE DETAIL

EXPANSION ANCHOR NOTES FOR BRIDGE DECK ATTACHMENT

- Use torque controlled mechanical expansion anchors that are approved for use in cracked concrete by the International Code Council, Evaluation Service (ICC-ES). The chosen anchor product shall have a designated ICC-ES Evaluation Report number, and its approval status shall be maintained on the ICC-ES website under Division 031600 for Concrete Anchors.
- Unless otherwise approved by the Engineer: do not use adhesive anchors; do not use expansion anchors that are not included in the ICC-ES approval list; and do not use expansion anchors that are only approved for use in uncracked concrete.
- 3. Use anchors manufactured with stainless steel expansion wedges. Anchors manufactured with carbon steel expansion wedges are not allowed. Anchor bodies can be either zinc-plated carbon steel or stainless steel. For application in marine environment, both the anchor body and expansion wedge shall be stainless steel.
- 4. Install anchors as shown on the plans and in accordance with the anchor manufacturer's published installation instructions. Arrange a field demonstration test to evaluate the procedures and tools. The test shall be witnessed and approved by the Engineer prior to furnishing anchors on the structure.
- 5. Prior to hole drilling, use rebar locator to ensure clearing of existing deck strands or reinforcement. Install anchors to ensure a minimum effective embedment depth, (hef), as shown. Increase (hef)as needed to ensure sufficient thread length for proper torqueing and tightening of anchors.
- 6. Use anchors of minimum 1600 Lbs tensile capacity (minimum of steel, concrete breakout, and concrete pullout strengths as determined by ACI 318 Appendix D) at the required minimum embedment depth (^hef). No lateral loads shall be introduced after conduit installation.



ELECTRICAL DETAILS CONDUIT SUPPORTS

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ELECTRICAL CONDUCTORS

- A. MATERIAL INFORMATION
- 1. Provide Type XHHW insulated conductors in accordance with Departmental Material Specification (DMS)11040 "Conductors" and Item 620 "Electrical Conductors." Provide conductors as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies" Item 620. Color code insulated conductors in conformance with the NEC. Identify grounded (neutral) conductors with white insulation. Identify grounding conductors (ground wires) with green insulation or bare conductors. Identify ungrounded (hot) conductors with any color insulation except green, white, or gray. Keep color scheme consistent throughout the wiring system. Identify conductors 6 American Wire Gauge (AWG) and smaller by continuous color jacket. Identify electrical conductors 4 AWG and larger by continuous color jacket or by colored tape. When identifying conductors with colored tape, mark at least 6 in. of the conductor's insulation with half laps of tape.
- 2. Provide a solid copper 6 AWG grounding electrode conductor to bond the electrical service equipment to the concrete encased grounding electrode or the ground rod at the service location. Connect the grounding electrode conductor to the ground rod with a UL listed connector in accordance with DMS 11040. Connect the grounding electrode conductor to the concrete encased grounding electrode as shown in the plans.
- 3. Where two or more circuits are present in one conduit or enclosure, permanently identify the conductors of each branch circuit by attaching a non-metallic tag around both circuit conductors at each accessible location. Provide tags with two straps, large enough to indicate circuit number, letter, or other identification as shown in the plans. Print circuit identification on the tag with a permanent marker.
- 4. Use listed compression or screw type pressure connectors, terminal blocks, or split bolt connectors for splicing as specified in DMS 11040. Use hot melt adhesive tape to fill the gap and seal the ends of heat shrink tubing. Provide UL listed gel-filled insulating splice covers. Splicing materials, insulating materials, breakaway disconnects, splice covers, and fuse holders are subsidiary to various bid items.
- B. CONSTRUCTION METHODS
- 1. Use only a flat, high tensile strength polyester fiber pull tape for pulling conductors through the conduit system. After installing conductors in conduit, perform conductor pull test. If a conductor cannot be freely pulled, make any needed alterations or repairs at no additional cost to the department. Perform insulation resistance tests in accordance with Item 620. Coordinate with the Engineer to witness the tests.
- 2. Leave 2 ft. minimum, 3 ft. maximum length for each conductor up to the splice in ground boxes. Leave 3 ft. minimum, 4 ft. maximum length of conductor in ground boxes when pulled through with no splice. Leave 1 ft. minimum, 1.5 ft. maximum length of conductor at enclosures, weatherheads and pole bases.
- 3. Make splices only in junction boxes, ground boxes, pole bases, or electrical enclosures and use only listed compression or screw type pressure connectors, terminal blocks, or split bolt connectors. Insulate splices with heavy wall heat shrink tubing or gel-filled insulating splice covers to provide a watertight splice. Overlap conductor insulation with heat shrink tubing a minimum of 2 in. past both sides of the splice. Where heat shrink tubing may not shrink sufficiently to provide a watertight seal around the individual conductors, prior to heating the tubing, increase the diameter of the conductor insulation using hot melt adhesive tape to provide a watertight seal between the individual conductors and the heat shrink tubing. Ensure the tape extends past the heat shrink tubing. Use hot melt adhesive tape to fill the gap and seal the ends of heat shrink tubing. Heat shrink tubing that appears to have been burned, or overheated, is considered defective and must be replaced.
- 4. Size and install gel-filled insulating splice covers according to manufacturer's specifications when used in place of heat shrink tubing.
- 5. Wire nuts with factory applied waterproof sealant may be used for 8 AWG or smaller conductors in above ground junction boxes, but not in pole bases or ground boxes. Install wire nuts in an upright position to prevent the accumulation of water.
- 6. Support conductors in illumination poles with a J-hook at the top of the pole.
- 7. When terminating conductors, remove the insulation and jacketing material without nicking the individual strands of the conductor. Conductors with nicked individual conductor strands or removed strands will be considered damaged.
- 8. Replace conductors and cables that are damaged beyond repair or that fail an insulation resistance test at no additional cost to the department.
- 9. Do not repair damaged conductors with duct tape, electrical tape, or wire nuts. Use only approved splicing methods.
- 10. Do not terminate more than one conductor under a single connector, unless the connector is rated for multiple conductors. Do not exceed the pressure connector's listing for maximum number and size of conductors allowed.
- 11. Install breakaway connectors on conductors bid under Item 620 whenever those conductors pass through a breakaway support device. Follow manufacturer's instructions when terminating conductors to breakaway connectors. Properly torque threaded connections. Proper terminations are critical to the safe operation of breakaway devices. Trim waterproofing boots on breakaway connectors to fit snugly around the conductor to ensure waterproof connection. Only one conductor may enter a single opening in a boot. Provide waterproof boots with the correct number of openings. Leave unused openings factory sealed. Use prequalified breakaway connectors as shown on the MPL.

12. Provide and install a separate stranded equipment grounding conductor (EGC) in all conduits that contain circuit wiring of 50 volts or more. Unless shown elsewhere, size the EGC to be the same size as the largest current carrying conductor contained in the conduit. Ensure all EGCs are bonded together at every accessible location. For traffic signal installations, provide a minimum size 8 AWG EGC. The EGC is paid for under Item 620.

C. TEMPORARY WIRING

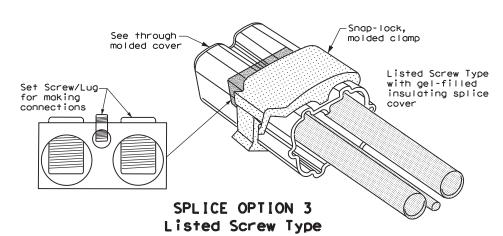
- Install temporary conductors and electrical equipment in accordance with the NEC article "Temporary Installations" and Department standard sheets.
- 2. Provide a ground fault circuit interrupter (GFCI) for power outlets for portable electrical equipment, power tools, ice machines, ice storage bins and refrigerators located outdoors at grade. GFCI may be any one of the following: molded cord and plug set, receptacle, or circuit breaker type.
- Use listed wire nuts with factory applied sealant for temporary wiring where approved.
- 4. Enclose conductor splices within a listed enclosure or ground box, or ensure the splices are more than 10 ft. above grade vertically and more than 5 ft. horizontally from any metal structure. Where installing temporary conductors in areas subject to vehicle traffic or mobile construction equipment, ensure the vertical clearance to ground is at least 18 ft. when measured at the lowest point. Ground messenger wires that support power conductors in conformance with the NEC.
- Protect and when necessary repair any existing electrical conduits uncovered during the construction process in a timely manner and in conformance with the NEC.

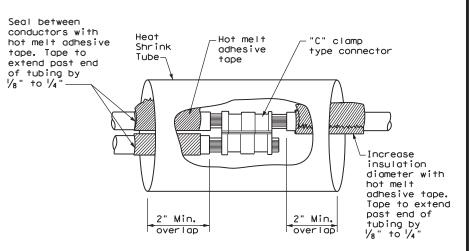
GROUND RODS & GROUNDING ELECTRODES

- A. MATERIAL INFORMATION
- Provide and install a grounding electrode at electrical services. Provide ground rods according to DMS 11040 and the plans. Larger diameter or longer length rods may be called for in some specific locations, see the individual plans sheets. Concrete encased grounding electrodes may be called for in specific locations including electrical service, see individual plan sheets.

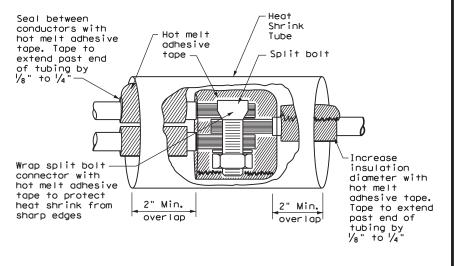
B. CONSTRUCTION METHODS

- 1. Furnish auxiliary ground rods for lightning protection and install in soil, concrete, or both, as called for in the plans. For ground rods installed in concrete, ensure the connection of the conductor to the ground rod is readily accessible for inspection or repairs. For ground rods installed in soil, ensure that the upper end is between 2 to 4 in. below finished grade.
- 2. Do not place ground rods in the same drilled hole as a timber pole.
- Install ground rods so the imprinted part number is at the upper end of the rod.
- 4. Remove all non-conductive coatings such as concrete splatter from the rod at the clamp location.
- Route all conductors as short and straight as possible for connection to lightning protection ground rods. When a bend is required, ensure a minimum radius bend of four inches for these conductors.
- 6. Unless otherwise called for in the plans, protect grounding electrode conductors with non-metallic conduit. When protecting grounding electrode conductors with metal conduit, provide and install a grounding type bushing and properly sized bonding jumper on each end of the metal conduit.
- 7. Written authorization is required before installing a ground rod in a horizontal trench for rocky soil or a solid rock bottom.

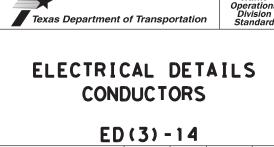


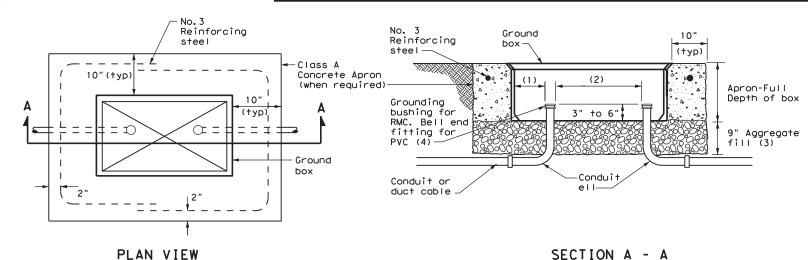


SPLICE OPTION 1 Compression Type



SPLICE OPTION 2 Split Bolt Type



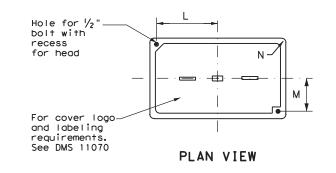


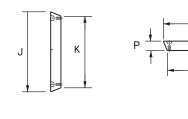
APRON FOR GROUND BOX

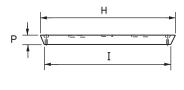
- (1) Uniformly space ends of conduits within the ground box. Position ends of conduits so that ground box walls do not interfere with the installation of grounding bushings or bell end fittings.
- (2) Maintain sufficient space between conduits to allow for proper installation of bushing.
- (3) Place aggregate under the box, not in the box. Aggregate should not encroach on the interior volume of the box.
- (4) Install a grounding bushing on the upper end of all RMC terminating in a ground box. Ground RMC elbows when any part of the elbow is less than 18 in. below the bottom of the ground box. Install a PVC bushing or bell end fitting on the upper end of all PVC conduits terminating in a ground box.

GROU	ND BOX DIMENSIONS
TYPE	OUTSIDE DIMENSIONS (INCHES) (Width x Length X Depth)
А	12 X 23 X 11
В	12 X 23 X 22
С	16 X 29 X 11
D	16 X 29 X 22
E	12 X 23 X 17

	GROL	JND B	ох со	VER D	IMENS	IONS		
TYPE			DIMEN	SIONS	(INCH	ES)		
ITPE	Н	Ι	J	К	L	М	N	Р
A, B & E	23 1/4	23	13 ¾	13 ½	9 %	5 1/8	1 3/8	2
C & D	30 ½	30 1/4	17 ½	17 1/4	13 1/4	6 ¾	1 3/8	2







SIDE

GROUND BOX COVER

END

GROUND BOXES

- A. MATERIALS
- Provide polymer concrete ground boxes measuring 16x30x24 in. (WxLxD) or smaller in accordance with Departmental Material Specification (DMS) 11070 "Ground Boxes" and Item 624 "Ground Boxes."
- 2. Provide Type A, B, C, D, and E ground boxes as shown in the plans, and as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies," Item 624.
- 3. Ensure ground box cover is correctly labeled in accordance with DMS 11070.
- 4. Provide larger ground boxes in accordance with Item 624 and as shown in the plans.
- B. CONSTRUCTION METHODS
- 1. Remove all gravel and dirt from conduit. Cap all conduits prior to placing aggregate and setting ground box. Provide Grade 3 or 4 coarse aggregate as shown on Table 2 of Item 302 "Aggregates for Surface Treatments." Ensure aggregate bed is in place and at least 9 inches deep, prior to setting the ground box. Install ground box on top of aggregate.
- 2. Cast ground box aprons in place. Reinforcing steel may be field bent. Ensure the depth of concrete for the apron extends from finished grade to the top of the aggregate bed under the box. Ground box aprons, including concrete and reinforcing steel, are subsidiary to ground boxes when called for by descriptive code.
- 3. Keep bolt holes in the box clear of dirt. Bolt covers down when not working in ground boxes.
- 4. Install all conduits and ells in a neat and workmanlike manner. Uniformly space conduits so grounding bushings and bell end fittings can easily be installed.
- 5. Temporarily seal all conduits in the ground box until conductors are installed.
- 6. Permanently seal conduits immediately after the completion of conductor installation and pull tests. Permanently seal the ends of all conduits with duct seal, expandable foam, or other method as approved. Do not use duct tape as a permanent conduit sealant. Do not use silicone caulk as a sealant.
- 7. When a ground rod is present in a ground box, bond all equipment grounding conductors together and to the ground rod with listed connectors.
- 8. When a type B or D ground box is stacked to meet volume requirements, it is allowable to cut an appropriately sized hole for conduit entry in the side wall at least 18 inches below grade.
- 9. If an existing ground box in the contract has a metal cover, bond the cover to the equipment grounding conductor with a 3 ft. long stranded bonding jumper the same size as the grounding conductor. The bonding jumper is subsidiary to various bid items. Verify existing ground boxes with metal covers are shown on the plans, with notes fully describing the work required.
- 10. If other ground boxes with metal covers are within the project limits but are not part of the contract, the Engineer may direct the Contractor to bond the metal covers, identifying the specific boxes in writing. This work will be paid for separately.
- 11. Bond metal ground box covers to the grounding conductor with a tank ground type lug.



Operations Division Standard

GROUND BOXES

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ELECTRICAL SERVICES NOTES

- 1. Provide new materials. Ensure installation and materials comply with the applicable provisions of the National Electrical Code (NEC) and National Electrical Manufacturers Association (NEMA) standards. Ensure material is Underwriters Laboratories (UL) listed. Provide and install electrical service conduits, conductors, disconnects, contactors, circuit breaker panels, and branch circuit breakers as shown on the Electrical Service Data chart in the plans. Faulty fabrication or poor workmanship in material, equipment, or installation is justification for rejection. Where manufacturers provide warranties and guarantees as a customary trade practice, furnish these to the State.
- 2. Provide electrical services in accordance with Electrical Details standard sheets, Departmental Material Specification (DMS) 11080 "Electrical Services, "DMS 11081 "Electrical Services-Type A," DMS 11082 "Electrical Services-Type C," DMS 11083 "Electrical Services-Type D," DMS 11084 "Electrical Services-Type T," DMS 11085 "Electrical Services-Pedestal (PS)", and Item 628 "Electrical Services" of the Standard Specifications. Provide electrical service types A, C, and D, as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies," Item 628. Provide other service types as
- Provide all work, materials, services, and any incidentals needed to install a complete electrical service as specified in the plans.
- 4.Coordinate with the Engineer and the utility provider for metering and compliance with utility requirements. Primary line extensions, connection charges, meter charges, and other charges by the utility company to provide power to the location are paid for in accordance with Item 628. Get approval for the costs associated with these charges prior to engaging the utility company to do the work. Consult with the utility provider to determine costs and requirements, and coordinate the work as approved.
- 5. The enclosure manufacturer will provide Master Lock Type 2 with brass tumblers keyed #2195 for all custom electrical enclosures. Installing Contractor is to provide Master Lock #2195 Type 2 with brass tumblers for "off the shelf" enclosures. Master Lock #2195 keys and locks become property of the State. Unless otherwise approved, do not energize electrical service equipment until
- 6. Enclosures with external disconnects that de-energize all equipment inside the enclosure do not need a dead front trim. Protect incoming line terminations from incidental contact as required by the NEC.
- 7. When galvanized is specified for nuts, screws, bolts or miscellaneous hardware, stainless steel may be used.
- 8. Provide wiring and electrical components rated for 75°C. Provide red. black. and white colored XHHW service entrance conductors of minimum size 6 American Wire Gauge (AWG). Identify size 6 AWG conductors by continuous color jacket. Identify electrical conductors sized 4 AWG and larger by continuous color jacket or by colored tape. Mark at least 6 inches of the conductor's insulation with half laps of colored tape, when identifying conductors. Ensure each service entrance conductor exits through a separately bushed non-metallic opening in the weatherhead. The lengths of the conductors outside the weatherhead are to be 12 inches minimum, 18 inches maximum, or as required by utility.
- 9. All electrical service conduit and conductors attached to the electrical service including the riser or the elbow below ground are subsidiary to the electrical service. For an underground utility feed, all service conduit and conductors after the elbow, including service conduit and conductors for the utility pole riser when furnished by the Contractor, will be paid for separately
- 10.Provide rigid metal conduit (RMC) for all conduits on service, except for the 1/2 in. PVC conduit containing the electrical service grounding electrode conductor. Size the service entrance conduit as shown in the plans. Ensure conduit for branch circuit entry to enclosure is the same size as that shown on the layout sheets for branch circuit conduit. Extend all rigid metal conduits minimum of 6 inches underground and then couple to the type and schedule of the conduit shown on the layout for that particular branch circuit. Install a grounding bushing on the RMC where it terminates in the service enclosure.
- 1.Use of liquidtight flexible metal conduit (LFMC) is allowed between the meter and service enclosure when they are mounted 90 to 180 degrees to each other. Size the LFMC the same size as service entrance conduit. LFMC must not exceed 3 feet in length. Strap LFMC within 1 foot of each end. LFMC less than 12 inches in length need not be strapped. Each end of LFMC must have a grounding bushing or be terminated with a grounding fitting. The LFMC must contain a grounded (neutral) conductor. Ensure any bend in LFMC never exceeds 180 degrees. A pull test is required on all installed conductors, with at least six inches of free conductor movement demonstrated to the satisfaction of the Engineer.
- 12.Ensure all mounting hardware and installation details of services conform to utility company specifications.
- 13.For all electrical service enclosures listed under Item 628 on the MPL, the UL 508 enclosure manufacturers will prepare and submit a schematic drawing unique to each service. Before shipment to the job site, place the applicable laminated schematic service. Before shipment to the job site, place the applicable laminated schematic drawings and the laminated plan sheet showing the electrical service data chart used to build the enclosure in the enclosure's data pocket. The installing contractor will copy and laminate the actual project plan sheets detailing all equipment and branch circuits supplied by that service. The laminated plan sheets are to be placed in the service enclosure's document pocket. Reduce 11 in. x 17 in. plan sheets to $8 \frac{1}{2}$ in. x 11 in. before laminating. If the installation differs from the plan sheets, the installing contractor is to redline plan sheets before laminating.
- 4. When providing an "Off The Shelf" Type D or Type T service, provide laminated plan sheets detailing equipment and branch circuits supplied by that service. Reduce 11 in. x 17 in. plan sheets to 8 $\frac{1}{2}$ in. x 11 in before laminating. Deliver these drawings before completion of the work to the Engineer, instead of placing in enclosure that has no door pocket.
- 15.Do not install conduit in the back wall of a service enclosure where it would penetrate the equipment mounting panel inside the enclosure. Provide grounding bushings on all metal conduits, and terminate bonding jumpers to grounding bus. rounding bushings are not required when the end of the metal conduit is fitted with a conduit sealing hub or threaded boss, such as a meter base hub.

SERVICE ASSEMBLY ENCLOSURE

- 1. Provide threaded hub for all conduit entries into the top of enclosure.
- 2. Type galvanized steel (GS) enclosures may be used for Type C panelboards and for Type D and T services that do not use an enclosure mounted photocell or lighting contactor. Provide GS enclosures in accordance with DMS 11080, 11082, 11083, and 11084.
- 3. Provide aluminum (AL) and stainless steel (SS) enclosures for Types A, C, and D in accordance with DMS 11080, 11081, 11082, 11083, and 11084. Do not paint stainless steel.
- 4. Provide pedestal service (PS) enclosures in accordance with ED(9) and DMS 11080 and 11085. Do not provide GS pedestal services. If GS is shown in the PS descriptive code, provide an AL enclosure.

MAIN DISCONNECT & BRANCH CIRCUIT BREAKERS

- 1. Field drill flange-mounted remote operator handle if needed, to ensure handle is lockable in both the "On" and "Off" positions.
- 2. When the utility company provides a transformer larger than 50 KVA. verify that the available fault current is less than the circuit breaker's ampere interrupting capacity (AIC) rating and provide documentation from the electric utility provider to the Engineer.

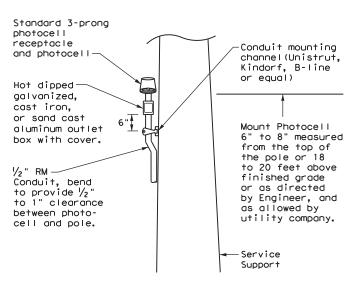
PHOTOELECTRIC CONTROL

1. Provide photocell as listed on the MPL. Move, adjust, or shield the photocell from stray or ambient night time light to ensure proper operation. Mount photocell facing north when practical. Mount top of pole photocells as shown on Top Mounted Photocell Detail.

			* ELE	CTRICAL	SERV	ICE DATA	4					
Elec. Service ID	Plan Sheet Number	Electrical Service Description	Service Conduit **Size	Service Conductors No./Size	Safety Switch Amps	Main Ckt. Bkr. Pole/Amps	Two-Pole Contractor Amps	Panelbd/ Loadcenter Amp Rating	Branch Circuit ID	Branch Ckt. Bkr. Pole/Amps	Branch Circuit Amps	KVA Load
SB 183	289	ELC SRV TY A 240/480 100(SS)AL(E)SF(U)	2"	3/#2	100	2P/100	100	N/A	Lighting NB	2P/40	26	28.1
									Lighting SB	2P/40	25	
									Underpass	1P/20	15	
NB Access	30	ELC SRV TY D 120/240 060(NS)SS(E)TS(0)	1 1/4"	3/#6	N/A	2P/60		100	Sig. Controller	1P/30	23	5.3
							30		Luminaires	2P/20	9	
									CCTV	1P/20	3	
2nd & Main	58	ELC SRV TY T 120/240 000(NS)GS(N)SP(O)	1 1/4"	3/#6	N/A	N/A	N/A	70	Flashing Beacon 1	1P/20	4	1.0
									Flashing Beacon 2	1P/20	4	

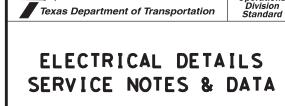
- * Example only, not for construction. All new electrical services must have electrical service data chart specific to that service as shown in the plans.
- ** Verify service conduit size with utility. Size may change due to utility meter requirements. Ensure conduit size meets the National Electrical Code.

EXPLANATION OF ELECTRICAL SERVICE DESCRIPTIVE CODE ELEC SERV TY X XXX/XXX XXX (XX) XX (X) XX (X) Schematic Type — Service Voltage V / V -Disconnect Amp Rating 000 indicates main lug only/ Typically Type T Safety Switch Ahead of Meter-Check with Utility No safety Switch Ahead of Meter-Check with Utility Enclosure Type GS= Galvanized steel("off the shelf") SS= Stainless steel(Custom Enclosure)See MPL AL = Aluminum (Custom Enclosure) See MPL Photocell Mounting Location (E) = Inside Service/Enclosure Mounted Top of pole Luminaire mounted (L)= None/No Photocell or (N) =Lighting Contactor Required Service Support Type GC= Granite concrete OC= Other concrete TP= Timber pole SP= Steel pole SF= Steel frame OT= Pole by others or paid for separately EX= Existing pole TS= Service on traffic signal pole PS= Pedestal Service Overhead Service Feed from Utility Underground Service Feed from Utility



TOP MOUNTED PHOTOCELL

Install conduit strap maximum 3 feet from box. 5 foot maximum spacing between straps supporting conduit.

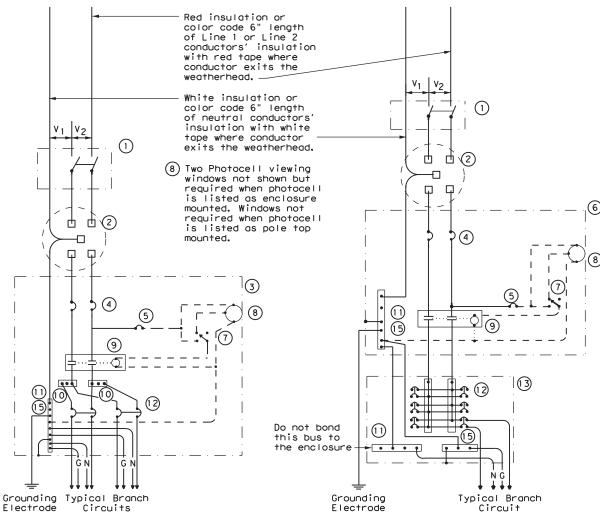


Texas Department of Transportation

Operation:

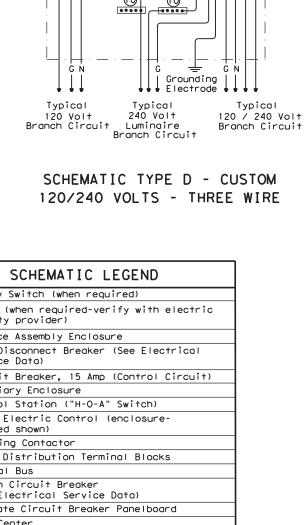
ED(5) - 14

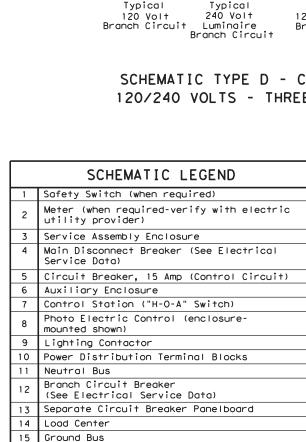
FILE:	ed5-14.dgn	DN: Tx	DOT	ck: TxDOT	DW:	TxDOT	ck: TxDOT
© TxD0T	October 2014	CONT	SECT	JOB		H10	GHWAY
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		DIST		COUNTY			SHEET NO.
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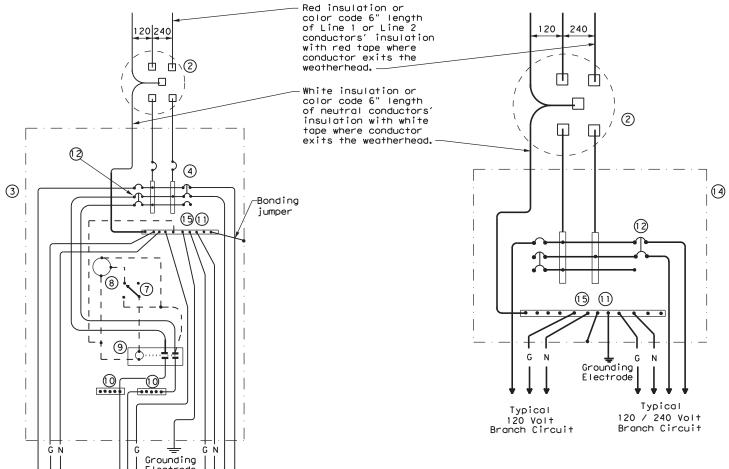


SCHEMATIC TYPE A THREE WIRE

SCHEMATIC	TYPE	С
THREE W	VIRF	







SCHEMATIC TYPE T

120/240 VOLTS - THREE WIRE Galvanized steel-"Buy Off The Shelf"

only. When required install photocell top of the pole or on luminaire only, no lighting contractor will be installed.



Traffic Operations Division Standard

ELECTRICAL DETAILS SERVICE ENCLOSURE AND NOTES

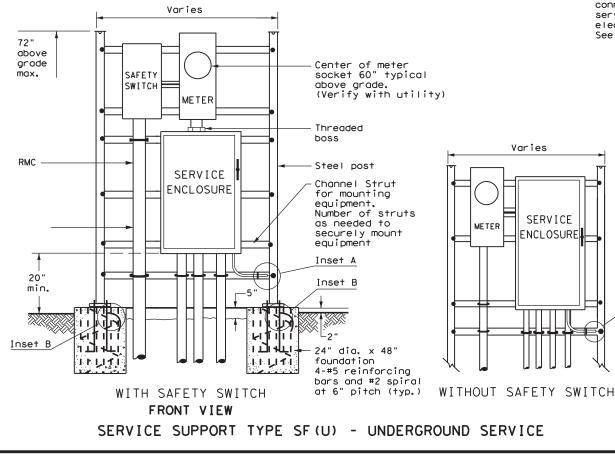
ED(6) - 14

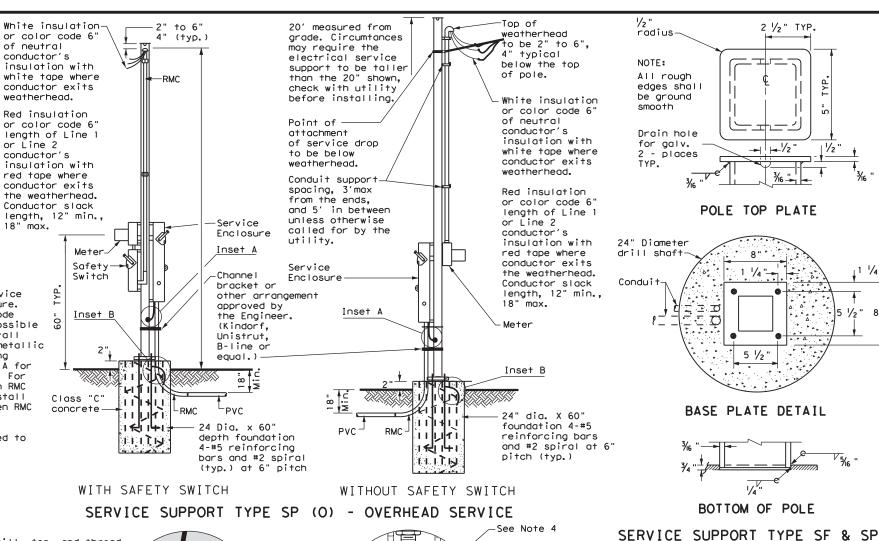
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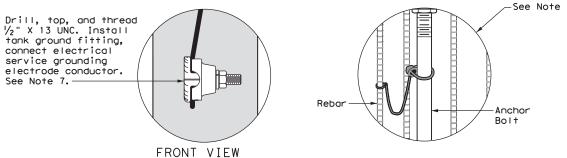
	WIRING LEGEND
	Power Wiring
	Control Wiring
— N —	Neutral Conductor
— G—	Equipment grounding conductor-always required

SUPPORT TYPE STEEL POLE (SP) AND STEEL FRAME (SF)

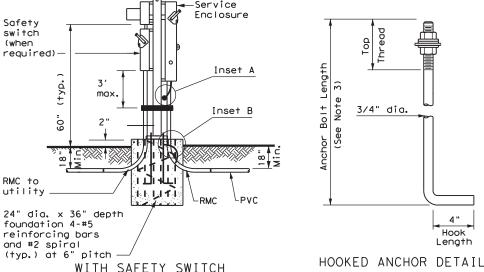
- 1.Provide steel pole and steel frame supports as per TxDOT Departmental Material Specification (DMS)11080 "Electrical Services." Mount all equipment and conduit on 12 gauge galvanized steel or stainless steel channel strut, 1 $\frac{1}{2}$ in. or 1 $\frac{5}{8}$ in. wide by 1 in. up to 3 $\frac{3}{4}$ in. deep Unistrut, Kindorf, B-line or equal. Bolt or weld all channel and hardware to vertical members as approved. Do not stack channel. File smooth and paint field cut ends of all channel with zinc-rich paint before installing.
- 2. Provide poles for overhead service with an eyebolt or similar fitting for attachment of the service drop to the pole in conformance with the electric utility provider's specifications.
- 3. Provide and install galvanized $\frac{y_4}{4}$ in. x 18 in. x 4 in. (dia. x length x hook length) anchor bolts for underground service supports. Provide and install galvanized $\frac{3}{4}$ in. x 56 in. x 4 in. anchor bolts for overhead service supports. Ensure anchor bolts have 3 in of thread, with $3 \frac{1}{4}$ in, to $3 \frac{1}{2}$ in, of the exposed anchor bolt projecting above finished foundation. Provide and install leveling nuts for all anchor bolts.
- 4. Bond one of the anchor bolts to the rebar cage with 6 AWG bare stranded copper conductor. Use listed mechanical connectors rated for embedment in concrete. See Inset B.
- 5. Furnish and install rigid metallic ells in all steel pole and steel frame foundations for all conduits entering the service from underground.
- 6.Use class C concrete for foundations. Ensure reinforcing steel is Grade 60 with 3" of unobstructed concrete cover.
- 7. Drill and tap steel poles and frames for $\frac{1}{2}$ in. X 13 UNC tank ground fitting. For steel pole service supports, provide and install tank ground fitting 4 in. to 6 in. below electrical service enclosure. Provide properly sized hole through the bottom of the enclosure for the service grounding electrode conductor. Ensure electrical service grounding electrode conductor is as short and straight as possible from the enclosure to the tank ground fitting. For steel frame service supports, provide and install tank ground fitting on steel frame post. Install service grounding electrode conductor in a non-metallic conduit or tubing from the enclosure to the steel frame post. Connect electrical service grounding electrode conductor to the tank ground fitting. See steel frame and steel pole details and Inset A for more information. Size service entrance conduit and branch circuit conduit as shown in the plans. For underground conduit runs from the electrical service, extend RMC from the service enclosure to an RMC elbow, and then connect the schedule type and size of conduit shown in the plans. Provide and install grounding bushings where RMC terminates in the enclosure. Grounding bushings are not required when RMC is fitted into a sealing hub or threaded boss.
- 8. If Steel pole or frame is painted, bond each separate painted piece with a bonding jumper attached to a tapped hole.
- 9. Provide $\frac{1}{4}$ " 20 machine screws for bonding. Do not use sheet metal screws. Remove all nonconductive material at contact points. Terminate bonding jumpers with listed devices. Install minimum size 6 AWG stranded copper bonding jumpers. Make up all threaded bonding connections wrench tight.
- 10. Avoid contact of the service drop and service entrance conductors with the metal pole to prevent abrasion of the insulated conductors.
- 11. Shop drawings are not required for service support structure unless specifically stated elsewhere or directed by the Engineer.







INSET B INSET A



Inset A

SERVICE SUPPORT TYPE SP(U) - UNDERGROUND SERVICE

Texas Department of Transportation

TYPES SF & SP

DN: TXDOT CK: TXDOT DW: TXDOT CK: TXDO © TxDOT October 2014 JOB 6427 57 001 US 67

TOP VIEW

SERVICE SUPPORT TY SF (0) & SF (U)

equipment

2 1/2" TYP.

→ /₁/₂

POLE TOP PLATE

1 1/4 "--

5 ½"

BASE PLATE DETAIL

BOTTOM OF POLE

expansion

ioint material

Dimension varies,

install only as

to accommodate

wide as required

1/2"

1 1/4'

Operation

Division Standard



5" thick

concrete

pad (class C

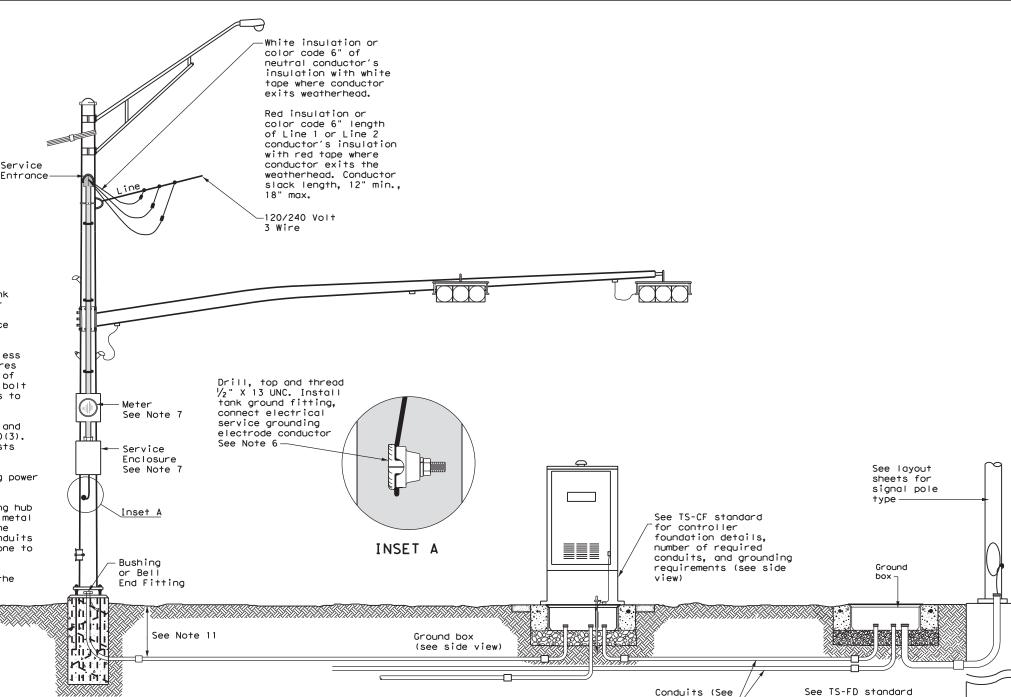
concrete and

6" X 6" #6

wire mesh)

TRAFFIC SIGNAL NOTES

- 1. Do not pass luminaire conductors through the signal controller cabinet.
- Include an equipment grounding conductor in all conduits throughout the electrical system. Bond all exposed metal parts to the grounding conductor.
- 3. Provide roadway luminaires, when required, in accordance with the material and construction sections of Item 610, "Roadway Illumination Assemblies," except for performance testing of luminaires. Test installed roadway luminaires for proper operation as a part of the associated traffic signal system test.
- 4. If internally illuminated street name signs are approved for use, ground the fixture to the pole with a 12 AWG green XHHW conductor.
- Bond anchor bolts to rebar cage in two locations using #3 bars or 6 AWG stranded copper conductors. Use Listed mechanical connectors rated for embedment in concrete. See TXDOT standard TS-FD for further details.
- 6. Drill and tap signal poles for ½ in. X 13 UNC tank ground fitting. Provide and install tank ground fitting 4 in. to 6 in. directly below electrical service enclosure. Provide properly sized hole through the bottom of the enclosure for the service grounding electrode conductor. Connect the electrical service grounding electrode conductor to the tank ground fitting. Ensure electrical service grounding electrode conductor is as short and straight as possible from the enclosure to the tank ground fitting. See Inset A detail for further information. Size service entrance conduit and branch circuit conduit as shown in the plans.
- 7. Mount electrical service enclosure and meter to signal pole with stainless steel bands. Ensure bands are a minimum width of $\frac{3}{4}$ in. Secure enclosures to bands using two-bolt brackets. Install brackets near top and bottom of each enclosure. Install properly sized stainless steel washers on each bolt in the enclosure. Band or drill and tap properly sized stand-off straps to signal pole for attaching conduit.
- 8. Conduct pull tests and insulation resistance tests on all illumination and power conductors as required in Item 620 "Electrical Conductors" and ED(3). To prevent electronics damage, do not conduct insulation resistance tests on traffic signal cables after termination.
- Lock all enclosures and bolt down all ground box covers before applying power to the signal installation.
- 10. Terminate conduits entering the top of enclosures with a conduit-sealing hub or threaded boss such as meter hub. Install a grounding bushing on all metal conduits not connected to conduit-sealing hub or threaded boss. Bond the grounding bushing to the ground bus with a bonding jumper. Seal all conduits entering enclosures with duct seal or expanding foam. Do not use silicone to seal conduit ends.
- 11. For all conduits, ensure the burial depth is a minimum of 18". Ensure the minimum burial depth for conduit placed under a roadway is 24".



SIGNAL POLE WITH SERVICE

Type T electrical service mounted on signal pole shown as an example. See electrical details, layout sheets, and electrical service data chart for additional details.

SIGNAL CONTROLLER FRONT VIEW

layout sheet

for details)-

SIGNAL POLE

Texas Department of Transportation

sheet for foundation

and conduit details

Traffic Operations Division Standard

ELECTRICAL DETAILS
TYPICAL TRAFFIC SIGNAL
SYSTEM DETAILS

ED(8) - 14

| Company | Comp

SIGNAL CONTROLLER SIDE VIEW

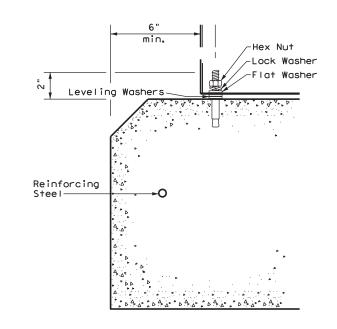
See TS-CF standard for conduit and grounding requirements. See layout sheets for ground box locations and any additional conduits that are required.

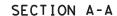
PEDESTAL SERVICE NOTES

- 1. Manufacture pedestal electrical services in accordance with Departmental Material Specifications (DMS)11080 "Electrical Services", 11085 "Electrical Services-Pedestal (PS)" and Item 628 "Electrical Services. "Provide pedestal electrical services as listed on the Material Producers list (MPL) on the Department's web site under "Roadway Illumination and Electrical Supplies," Item 628. Ensure all mounting hardware and installation details of services meet utility company specifications. Contact the local utility company for approval of pedestal details prior to installing the electrical pedestal service. Submit any changes required by the utility company prior to manufacturing the pedestal enclosure.
- 2. When a meter socket is required, provide a socket with a minimum 100 amp rating that complies with local utility requirements.
- 3. Provide Class A or C concrete for pedestal service foundations in accordance with Item 420, "Concrete Substructures," except that concrete will not be paid for directly but is considered subsidiary to Item 628.
- 4. Provide #4 reinforcing steel for foundations in accordance with Item 440, "Reinforcement for Concrete.'
- 5. Install $\frac{1}{2}$ in. X 2 $\frac{1}{16}$ in. minimum length concrete single expansion type anchors for mounting pedestal enclosure to foundation. Anchor location to match mounting holes in each corner of enclosure. Secure each of the four corners of the pedestal enclosure to the anchors in the foundation with a $\frac{1}{2}$ in, galvanized or stainless steel machine thread bolt, a properly sized locknut and a flat washer.
- 6. Finish top of concrete foundation in a neat and workmanlike manner. If leveling washers are used, ensure no more than $\frac{1}{8}$ in. gap at any corner. Do not exceed a maximum dip or rise in the foundation of $\frac{1}{8}$ in. per foot. When properly installed, ensure the top of the service enclosure is level front to back and side to side within $\frac{1}{4}$ in. Repair rocking or movement of the service enclosure at no additional cost to the department.
- 7. Do not use liquidtight flexible metal conduit (LFMC) on pedestal type services.

min.

8. Ensure all elbows in the foundation are sized as per utility provider's conduit requirements for underground conduit and feeders. PVC extensions may be installed provided the ends of the rigid metal conduits are more than 2 in. below the top of the concrete foundation. Where extension conduits are metal, grounding bushings must be installed with a bonding jumper properly terminated.



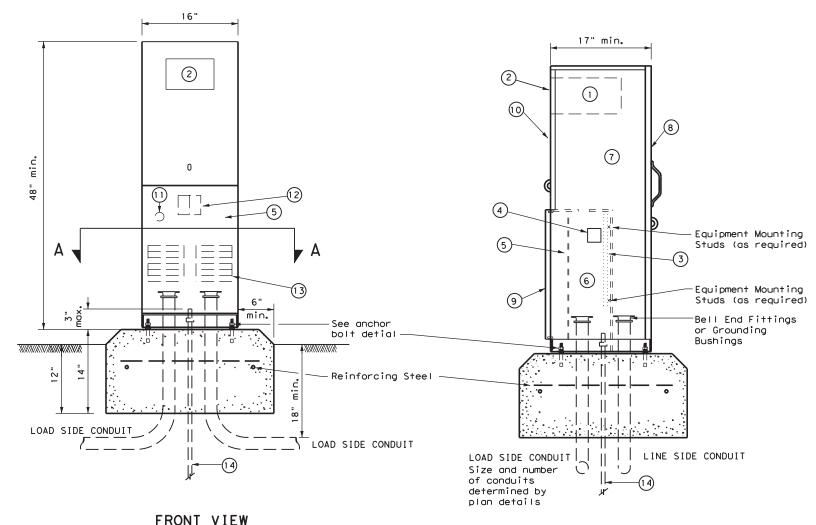


900 LOAD

LOAD

min.

ANCHOR BOLT DETAIL



TYPE C shown, TYPE A similar except that TYPE A shall have individual circuit breakers (CB) mounted on an equipment mounting panel. CB Handles shall protrude through hinged deadfront trim.

	LEGEND
1	Meter Socket, (when required)
2	Meter Socket Window, (when required)
3	Equipment Mounting Panel
4	Photo Electric Control Window, (When required)
5	Hinged Deadfront Trim
6	Load Side Conduit Trim
7	Line Side Conduit Area
8	Utility Access Door, with handle
9	Pedestal Door
10	Hinged Meter Access
11	Control Station (H-O-A Switch)
12	Main Disconnect
13	Branch Circuit Breakers
14	Copper Clad Ground Rod - 5/8" X 10'

SIDE VIEW



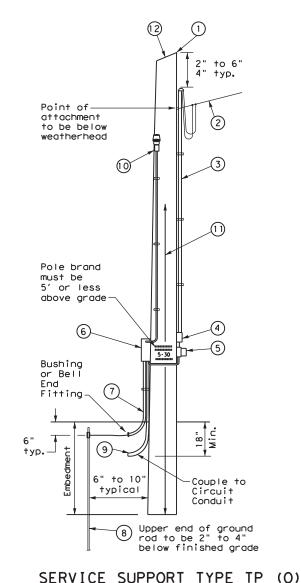
ELECTRICAL DETAILS ELECTRICAL SERVICE SUPPORT PEDESTAL SERVICE TYPE PS

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		DIST		COUNTY			SHEET NO.
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TIMBER POLE (TP) SERVICE SUPPORT NOTES

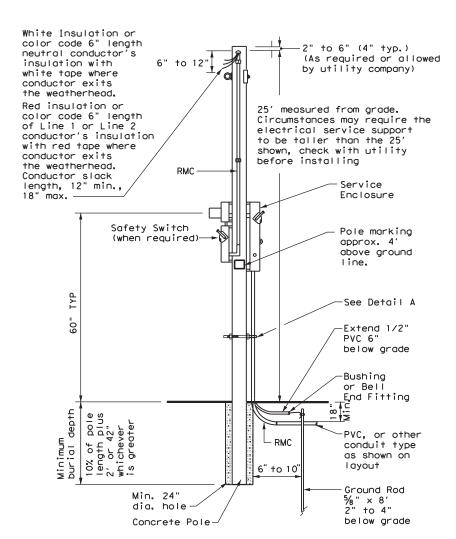
- Ensure electrical service support is a class 5 treated timber pole as per Item 627 "Treated Timber Poles." Embed timber pole to depth required in Item 627.
- Conduit and electrical conductors attached to the electrical service pole and underground within 12 in. of service pole are not paid for directly but are subsidiary to the electrial service.
- Install pole-top mounted photocell (T) on north side of pole, or in service enclosure (E) as required. See Electrical Service Data chart in plan set.
- 4. Gain pole as required to provide flat surface for each channel. Gain timber pole to $\frac{5}{8}$ in. max. depth and 1 $\frac{7}{8}$ in. max. height. Gain pole in a neat and workmanlike manner.
- 5. Mount meter and service equipment on stainless steel or galvanized channel (Unistrut, Kindorf, or equal). Provide channel sized 1 in. to 3 $\frac{3}{4}$ i maximum depth, and $1\frac{1}{2}$ in. to $1\frac{5}{6}$ in. maximum width. File smooth the cut ends of galvanized channel and paint with zinc rich paint before installing on pole. Secure each channel section to timber pole with two galvanized or SS lag bolts, $\frac{1}{4}$ in. minimum diameter by $\frac{1}{2}$ in. minimum length. Use a galvanized or SS flat washer on each lag bolt. Do not stack channel.
- When excess length must be trimmed from poles, trim from the top end only.
- (1) Class 5 pole, height as required
- ② Service drop from utility company (attached below weatherhead)
- 3 Service conduit (RMC) and service entrance conductors - One Red, One Black, One White (See Electrical Service Data)
- (4) Safety switch (when required)
- (5) Meter (when required)
- (6) Service enclosure
- (7) 6 AWG bare grounding electrode conductor in ½ in. PVC to ground rod extend ½ in. PVC 6 in. underground.
- (8) % in. x 8 ft. Copper clad ground rod - drive ground rod to a depth of 2 in. to 4 in. below grade.
- (9) RMC same size as branch circuit conduit.
- See pole-top mounted photocell detail on ED(5).
- (1) When required by the serving utility provide bare 6 AWG copper conductor. Run wire from pole top to butt wrap or copper butt plate. Protect conductor with non-conductive material to a height of 8 ft. above finished grade.
- (2) When required by utility, cut top of pole at an angle to enhance rain run off.



GRANITE CONCRETE (GC) & OTHER CONCRETE (OC) NOTES

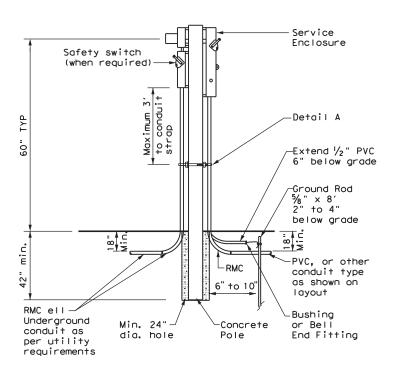
Ensure electrical service support structures bid as type Granite Concrete (GC) or Other Concrete (OC) meet the following requirements.

- Provide GC and OC poles that meet the requirements of DMS 11080 "Electrical Services."
- 2. Provide prestressed concrete poles suitable for direct embedment into the ground without special foundations.
- 3. Verify poles are marked as required on DMS 11080. Location of marking should be approximately 4' above final grade. Use the two-point pickup locations when handling pole in horizontal position, and one-point pickup location for use in raising the pole to a vertical position. These marks are small but conspicuous.
- 4. Embed poles 42 in. or 10% of the length plus 2 ft., whichever is greater.
- Ensure all installation details of services are in accordance with utility company specifications.
- Install a one point rack or eye bolt bracket 6 inches to 12 inches below the weatherhead as an overhead service drop anchoring point for the electric utility.
- 7. Furnish and install galvanized or stainless steel channel strut 1 $\frac{1}{2}$ in, or 1 $\frac{5}{8}$ in, wide by 1 in, up to 3 $\frac{3}{4}$ in, deep (Unistrut, Kindorf, B-line or equal). Attach channel strut with stainless steel concrete anchors (max. 1" depth), square U-bolts or back to back channel strut with long bolts, or other secure mounting as approved by the Engineer. Ensure bolts are galvanized in accordance with ASTM A153. Do not stack channel struts.
- 8. Backfill the holes thoroughly by tamping in 6 in. lifts. After tamping to grade, place additional backfill material in a 6 inch high cone around the pole to allow for settling. Use material equal in composition and density to the surrounding area. Backfilling will not be paid for directly but is subsidiary to various bid items.



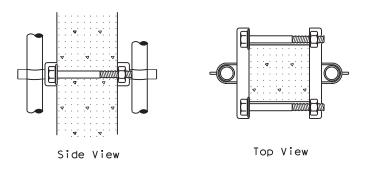
CONCRETE SERVICE SUPPORT

Overhead(0)



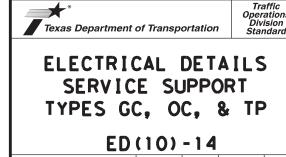
CONCRETE SERVICE SUPPORT

Underground(U)



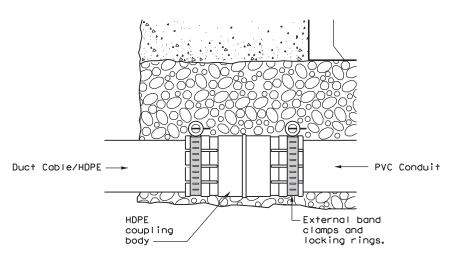
DETAIL A

See Note 7. Before installing channel that has been cut, file sharp edges and paint with zinc-rich paint. Ensure there is no paint splatter on the pole.

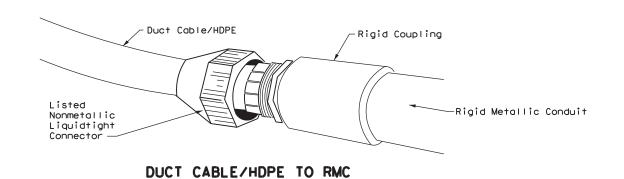


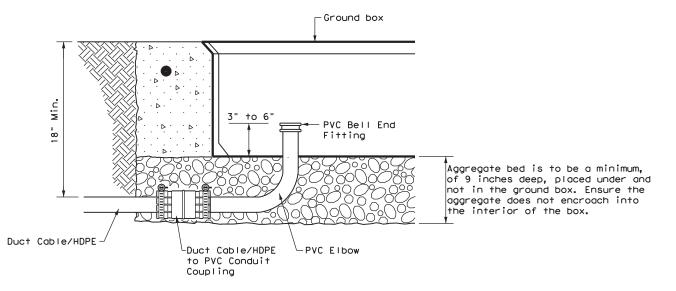
DUCT CABLE & HDPE CONDUIT NOTES

- Provide duct cable in accordance with Departmental Material Specification (DMS) 11060
 "Duct Cable" and Item 622 "Duct Cable." Provide duct cable as listed on the Material
 Producer List (MPL) on the Department web site under "Roadway Illumination and Electrical
 Supplies" Item 622.
- Provide High-Density Polyethylene (HDPE) conduit in accordance with DMS 11060 and Item 618, "Conduit." Provide HDPE as listed on the MPL on the Department web site under "Roadway Illumination and Electrical Supplies," Item 618.
- 3. Supply duct cable with a minimum 2 in, diameter, unless otherwise shown in the plans. Provide duct cable and HDPE conduit as shown by descriptive code or on the plans. Bend duct cable and HDPE conduit as recommended by the manufacturer, with a minimum bending radius of 26 in. for 2 in. duct. Follow manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.
- 4. Do not splice conductors within duct cable or HDPE conduit. Couple duct cable and HDPE entering a ground box or foundation to a PVC elbow. When galvanized steel RMC elbows are called for in the plans and any portion of the RMC elbow is buried less than 18" from possible contact, ground the RMC elbow.
- 5. Furnish and install duct cable with factory installed conductors, sized as shown in the plans and as required by the National Electrical Code (NEC). The NEC contains specific requirements for duct cable in Article, "Nonmetallic Underground Conduit with Conductors: Type NUCC."
- 6. When conduit casing is called for in the plans, extend duct cable or HDPE conduit through the conduit casing in one continuous length without connection to the casing.
- 7. Seal the ends of duct cable or HDPE conduit with duct seal, expandable foam, or other approved method after completing the pull tests required by Item 622.
- 8. Provide minimum cover of 24 in. under roadways, 18 in. in other locations, or as shown on the plans.
- 9. Furnish and install listed fittings to couple duct cable or HDPE conduit to other types of conduit. Duct cable and HDPE conduit may be field-threaded and spliced with PVC or RMC threaded couplings; connected with listed tie-wrap fittings; connected using listed coupling made of HDPE with stainless steel external banding clamps and locking rings; connected with approved electrofusion conduit couplings; or connected using an approved chemical fusion method using an epoxy or adhesive specifically designed for HDPE couplings and connectors all installed in accordance with their manufacturer's instructions. Do not use PVC glue on HDPE. Do not use water pipe fittings, or connect conduit with heat shrink tubing.



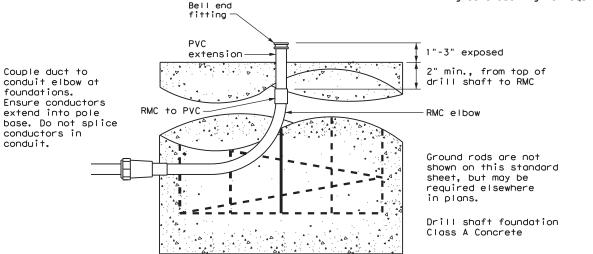
DUCT CABLE/HDPE TO PVC



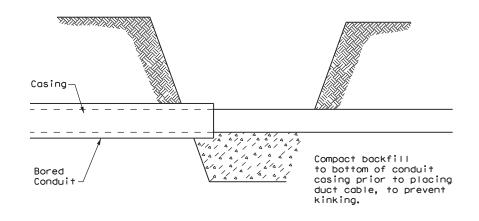


DUCT CABLE/HDPE AT GROUND BOX

When the upper end of an RMC EII does not enter the ground box, it may be extended with a SCH-40 PVC conduit nipple and bell end, provided there is a minimum of 18" of cover over all parts of the elbow. If not, a rigid extension and ground bushing is required.



DUCT CABLE / HDPE AT FOUNDATION



BORE PIT DETAIL



Traffic Operations Division Standard

DUCT CABLE/ HDPE CONDUIT

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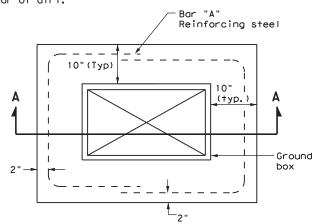
BATTERY BOX GROUND BOXES NOTES

A. MATERIALS

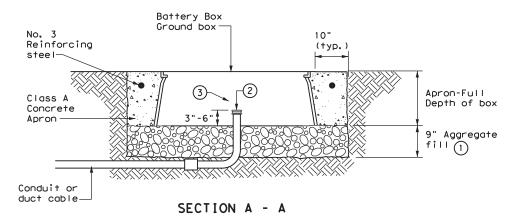
- Provide polymer concrete or fiberglass reinforced plastic (FRP) battery box ground box and cover in accordance with Departmental Material Specification (DMS) 11071 "Battery Box Ground Boxes." Battery box will accommodate up to 4 batteries, each measuring 8 in. x 13.5 in. x 10 in. (W x L x D). Label battery box ground box cover in accordance with DMS 11071.
- 2. Supply a marine grade batteries with covers. Secure the marine grade batteries with covers to the stainless steel rack in the bottom of the ground box with tie down straps.

B. CONSTRUCTION METHODS

- Ensure conduit entry will not interfere with placement of the batteries in the battery box ground box.
- 2. Remove all gravel and dirt from conduit. Cap all conduits prior to placing aggregate and setting bottery box ground box. Provide Grade 3 or 4 coarse aggregate as shown on Table 2 of Item 302 "Aggregates for Surface Treatments." Ensure the aggregate bed is in place and is a minimum of 9 in, deep prior to setting the box. Install battery box ground box on top of aggregate.
- 3. Cast battery box aprons in place. Reinforcing steel may be field bent. Ensure the depth of concrete for the apron extends from finished grade to the top of the aggregate bed under the box. Battery box ground box aprons, including concrete and reinforcing steel, are subsidiary to battery box ground boxes when called for by descriptive code.
- 4. Bolt covers down when not working in battery box ground boxes. Keep bolt holes in the box clear of dirt.

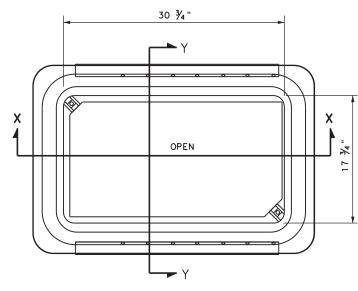


PLAN VIEW

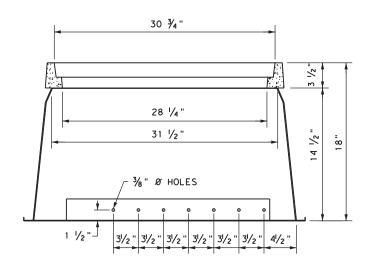


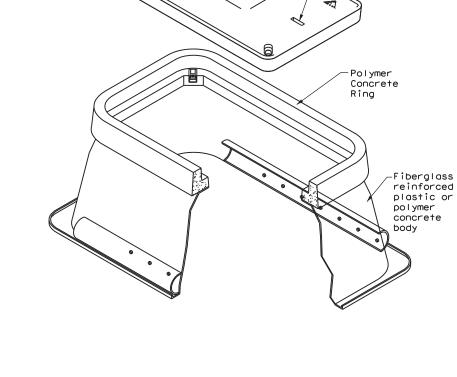
APRON FOR BATTERY BOX GROUND BOXES

- 1) Place aggregate under the box and not in the box.
 Aggregate should not encroach on the interior volume of the box.
- 2 Install bushing or bell end fitting on the upper end of all ells.
- (3) Install all conduits in a neat and workmanlike manner.

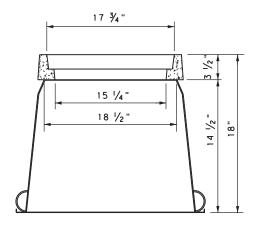


BATTERY BOX TOP VIEW





SECTION X-X



SECTION Y-Y



ELECTRICAL DETAILS BATTERY BOX GROUND BOXES

Lift Pin

ED	(12) -	14
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© TxD0T	October 2014		CONT	SECT	JOB		H1GHWAY	
	REVISIONS		642	7 57	001		US 67	
		DIST		COUNTY		SHEET NO.		
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ROADWAY ILLUMINATION ASSEMBLY NOTES

- 1. Details apply to roadway lighting installations bid or referenced under Item 610, "Roadway Illumination Assemblies." Provide, furnish, and install all other materials not shown on the plans which may be necessary for complete and proper construction. Where manufacturers provide warranties or guarantees as a customary trade practice, furnish to the State such warranties or quarantees.
- 2. The locations of poles and fixtures may be shifted by the Engineer to accommodate local conditions. Install or remove poles and luminaires located near overhead electrical lines using established industry and utility safety practices and in accordance with laws governing such work. Consult with the appropriate utility company prior to beginning such work.
- 3. Provide new and unused materials. Ensure that all materials and installations comply with the applicable articles of the National Electrical Code (NEC), TxDOT standards and specifications, National Electrical Manufacturers Association (NEMA), and are listed by Underwriters Laboratories (UL) or a Nationally Recognized Testing Lab (NRTL). NRTLs such as Canadian Standard Association, Intertek Testing Services NA Inc., or FM Approvals LLC can be considered equivalent to UL. Faulty fabrication or poor workmanship in any material, equipment, or installation is justification for rejection.
- 4. Provide Roadway Illumination Light Fixtures as per TxDOT Departmental Material Specification (DMS) 11010, Item 610, and as shown on the Material Producers List (MPL) for Roadway Illumination and Electrical Supplies.
- 5. Fabricate steel roadway illumination poles in accordance with Roadway Illumination Poles (RIP) standards and Item 610. Poles fabricated according to RIP standards do not require shop drawing submittals.
 - a. Alternate designs to RIP standards or the use of aluminum to fabricate poles will require the submission of shop drawings electronically. For instructions on submitting shop drawings electronically see "Guide to Electronic Shop Drawing Submittal" on the TxDOT web site.
 - b. Limitations on use of the RIP standard: The RIP standard details were developed for installations in locations where the 3-second gust basic maximum wind speed is 110 mph, and where the elevation of the base of the pole is less than (i.e. not more than) 25' above the elevation of the surrounding terrain, in accordance with the "AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," 6th Edition (2013) of the AASHTO Design Specifications. For poles to be installed in regions where the maximum basic wind speed exceeds 110 mph or to be mounted more than 25' above the surrounding terrain, provide poles meeting the following requirements:
 - i. Submittals. Following the electronic shop drawing submittal process (see Guide to Electronic Shop Drawing Submittal on the TxDOT web site), submit to the Engineer for approval fabrication drawings and calculations for the poles, sealed by a Texas licensed professional engineer (P.E.).
 - ii. Luminaire Structural Support Requirements. Provide light poles, arms, and anchor bolt assemblies with a 25 year design life to safely resist dead loads, ice loads and the required basic wind speeds at the location of installation in accordance with the 6th edition (2013) of the AASHTO Design Specifications. For transformer base poles, include transformer base and connecting hardware in calculations and shop drawing submittals. Structurally test all transformer bases to resist the theoretical plastic moment capacity of the pole. Submit certification of the plastic moment load test and FHWA breakaway requirement test of the model of base being furnished with the shop drawings. Show breakaway base model number, manufacturer's name, and logo on shop drawings. Include on manufacturer's shop drawings the ASTM designations for all materials to be used.
- 6. For both transformer and shoe-base type illumination poles, provide and install double-pole breakaway fuse holders as specified by DMS-11040. Breakaway fuse holders are listed on the MPL for Roadway Illumination and Electrical Supplies under Items 610 & 620. Provide 10 amp time delay fuses for breakaway connectors in light poles, or inside the light fixture for underpass luminaires. In each pole, connect luminaires to the breakaway connector with continuous stranded 12 AWG copper conductors as listed on the MPL. Bond all equipment grounding conductors together and to the ground lug in the transformer base or hand hole.
- 7. Tighten anchor bolts for shoe base, concrete traffic barrier base, and bridge mount roadway illumination poles, in accordance with Item 449.
- 8. Install T-Base with following procedure:
 - a. Anchor Bolt Tightening.
 - i. Coat the threads of the anchor bolts with electrically conductive lubricant.
 - ii. Place the T-base over the anchor bolts. Foundation must be level and flat. The maximum permissible gap under any one corner of the t-base is 1/8" before nuts are tightened.
 - iii.Coat the bearing surfaces of the nuts and washers with electrically conductive lubricant. Install (1) 1/2" hold down washer, (1) lock washer, and (1) nut on each anchor bolt. Turn the nuts onto the bolts so that each is hand-tight against the washer.
 - iv. Using a torque wrench, tighten each nut to 150 ft-lb. Uniform contact is required between the foundation and the T-base in the corner regions of the T-base, and all corner gaps must be closed after applying torque. If a gap still exists after torquing to 150 ft-lbs, continue torquing each bolt incrementally until gap is closed or maximum allowable torque of 250 ft. pound is reached, whichever comes first. If 250 ft-lbs is not enough to close the gap the foundation must be leveled. Gaps along the straight sides of the T-bases and the foundation are permissible. Ensure that no high point of contact occurs between the straight sides of the T-base and the
 - v. Check top of T-base for level. If not level then foundation must be leveled.
 - b. Top Bolt Procedure
 - i. Erect pole over T-base with crane. Coat bolts, nuts, washers, and lock washers with electrically conductive

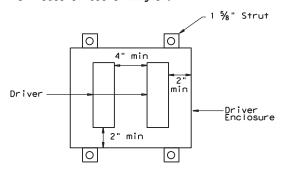
- ii. Install bolts and 1/2" connecting washers from the inside of the T-base, thread up through the pole base. Install flat washers, lock washers and nuts snug tight according to Item 447, "Structural Bolting."
- iii. Tighten each nut to 150 ft-Ib. using a torque wrench.
- c. Level and Plumb
 - i. Ensure pole is plumb and mast arm is perpendicular to the roadway according to plans to within 5
- 9. Construct luminaire pole foundations in accordance with Item 416, "Drilled Shaft Foundations," and TxDOT standard sheet RID(2).
- 10. Provide and install underpass luminaires in accordance with Item 610, DMS-11010, and TxDOT standard sheet RID(3). Typical luminaire size for underpass luminaires is 150W HPS or 150W EQ LED.
- 11. Mount luminaires on arms level as shown by the luminaire level indicator.
- 12. Orient luminaires perpendicular to the roadway intended to be lit unless otherwise shown on the plans.

Wiring Diagram Notes:

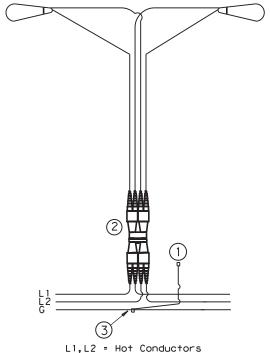
- Use 1/2 in. -13 UNC threaded, copper or tin-plated copper, pole bonding connector, sized appropriately for conductors, bonded to T-base, or use ground lug in handhole as available.
- Use pre-qualified two-pole breakaway connectors for all luminaire pole installations. For luminaires fed by a circuit with a neutral conductor, use double pole breakaway connectors with the neutral side unfused and marked white.
- Split Bolt or other connector.

Decorative LED Lighting Notes:

- 1. LED Drivers in Remote Outdoor enclosures (for drivers that do not include an enclosure as part of a factory assembly):
 - a. Provide NEMA 3R outdoor enclosure or as approved.
 - b. Install enclosure at least 12" above ground or other horizontal surface. Mount vertically or on ceiling, and avoid direct sun where possible.
 - c. Install drivers with at least 2 inches of space from enclosure walls.
 - d. For multiple drivers in an enclosure, provide at least 4 inches side to side and 1 inch end to end from other drivers or electronic equipment
 - e. For drivers mounted on back wall of enclosure, mount enclosure on 1 5/8" strut or other standoff to dissipate heat, or mount driver to side of the enclosure or to the metal cover.
 - f. Provide remote drivers with a maximum of 100 watts
 - g. Provide drivers with documentation of 100,000 hr lifetime at Tcase of 65C or higher.



Driver Spacing In Remote Enclosure



G = Grounding Conductor

TYPICAL WIRING DIAGRAM

LUMINAIRES SERVED AT 480V ON 240/480 VOLT SERVICE OR LUMINAIRES SERVED AT 240V FOR 120/240 VOLT SERVICE.



ILLUMINATION DETAILS

Traffic Safety Division Standard

RI	D (1) -	20
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© TxDOT January 2007	CONT	SECT	JOB		ніс	SHWAY
REVISIONS	6427	57	001		US	67
-17	DIST		COUNTY		:	SHEET NO.
-20	23		BROW	N		35

4 Anchor

#

]|<u>___1</u>"

FOUNDATION DETAIL

Bolts-

When required 4" concrete riproc

 $(W2.9 \times W2.9)$ welded wire fabric reinforcement

with 6"x 6"

When shown on the plans 4" concrete riprap with 6"x 6" $(W2.9 \times W2.9)$ 1/4 " welded wire fabric tooled reinforcement radius --Level finish -Foundation 24" -Conduit ht. even with finished 2"(±1.0) . . - #4 Bors

-**√**-1 -1 + 1

30"

SECTION A-A

SHOWING CONSTANT GRADE

Template

2" minimum

(Typical)

#3 at 6" pitch. 2 flat turns

top and bottom.

Condui

- #4 Bars

Grade break

lines

for conduit size.

Match duct cable

2" Cover (Typ)

RECOMMENDED FOUNDATION LENGTHS (See note 1)						
MOUNTING TEXAS CONE PENETROMETER N Blows/ft						
IIL I GITT	10	15	40			
<20 ft.	6′	6′	6′			
>20 ft. to 30 ft.	8′	6′	6′			
>30 ft. to 40 ft.	8′	8′	6′			
>40 ft. to 50 ft.	10'	8′	6′			

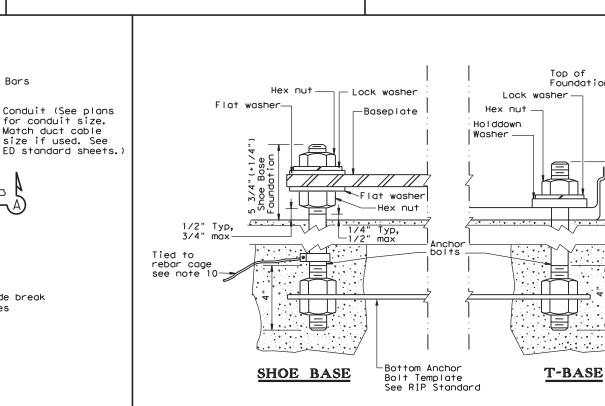
TABLE 3						
		PER FOUNDATION on the plans)				
Foundation Diameter	RIPRAP (CONC) (CL B)					
30 in.	78 in.	0.35 CY				

Top of

Foundation

(-1/2" -Base

All others



ANCHOR BOLT DETAIL

TABLE 1				
ANCHOR BOLTS				
POLE BOLT CIRCLE ANCHOR MOUNTING BOLT				
HE I GHT	Shoe Base	T-Base	SIZE	
<40 ft.	13 in.	14 in.	1in.x 30in.	
40-50 ft.	15 in.	17 ¼in.	1 ¼in. × 30in.	

TABLE 2						
RECOMMENDED FOUNDATION LENGTHS (See note 1)						
MOUNT ING HE I GHT	TEXAS CONE PENETROMETER N Blows/ft					
116 1 0111	10	15	40			
<20 ft.	6′	6′	6′			
>20 ft. to 30 ft.	8′	6,	6′			
>30 ft. to 40 ft.	8′	8′	6,			
>40 ft.	10'	8'	6'			

7. Use 4 hold down and 4 connecting washers on transformer base poles as recommended by the manufacturer and supplied with base.

nuts to plumb shoe base poles. Do not use shims or leveling nuts under

transformer bases. Do not grout between baseplate and the foundation.

3. Ensure Class 2A and 2B fit for anchor bolts and nuts. Tap and chase nuts

Concrete for riprap may be upgraded to Class C at no extra cost to the

5. Place riprap around the foundation when called for elsewhere in the plans.

6. Locate breakaway roadway illumination assemblies as shown in the placement table, unless otherwise dimensioned on the plans. Protect non-breakaway

illumination assemblies from vehicular impact (i.e. 2.5 ft. behind guard rail or mounted on traffic barrier), or located outside the clear zone,

except that 2.5 ft. from curb face is minimum desired for light poles on city streets, 45 mph or less. See Roadway Design Manual for further

4. Use appropriate class of concrete as specified in Items 416 and 432.

after galvanizing. Anchor bolt body with rolled threads need not be full

- 8. Install a minimum of 2 conduits in each foundation. See lighting layout sheets for locations of foundations with more than 2 conduits. Cap unused conduits in foundations on both ends.
- 9. Conduit location in foundations is critical for breakaway devices. Place conduits 2 in. apart on centerline as shown.
- Bond anchor bolt to rebar cage with #6 bare stranded copper conductor. Use listed mechanical connectors rated for embedment in concrete. The bonded steel in the foundation creates a concrete encased grounding electrode which replaces the ground rod.
- Grade earthwork around T-base foundations even with the finished grade as shown in Section A-A to ensure proper function of the breakaway device. Use riprap on T-base foundations that are located on sloped grades, and as shown on the plans for level grades.

10 ft. minimum*(15 ft.

desirable) from lane edge

TABLE 4 BREAKAWAY POLE PLACEMENT (See note 6) ** POLE OFFSET (DISTANCE TO FACE OF TRANSFORMER BASE) ROADWAY FUNCTIONAL CLASSIFICATION Freeway Mainlanes 15 ft. (minimum and (roadway with full control of access) typical) from lane edge All curbed, 45 mph 2.5 ft. minimum (15 ft. or less design speed desirable) from curb face

- * or as close to ROW line as is practical
- ** provide 2/5 of the luminaire mounting height behind the pole for "falling area" to prevent encroachment on the other travel lanes. See design auidelines.

Texas Department of Transportation

Traffic Safety Division Standard

ROADWAY ILLUMINATION DETAILS (RDWY ILLUM FOUNDATIONS)

RID(2) - 20

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7-17	DIST		COUNTY		5	SHEET NO.	
12-20	23		BROW	N		36	

2. Erect roadway illumination assembly poles plumb and true. Form and level the top 6" of the foundation so the pole will be plumb. Use leveling

Riprap will be paid for under Item 432.

1. "Recommended Foundation Lengths" table is for information purposes only. Foundation lengths shall be as shown on the plans, or as directed by the Engineer. Foundations will be paid for under Item 416, "Drilled Shaft Foundations." unless otherwise shown on the plans.

information.

GENERAL NOTES:

UNDERPASS LIGHTING TYPE 1

2 13/16 " (2" RMC) ¾" U-Bo∣+. 1/2 4 1/2 Each with 3 % "(2 1/2" RMC) 6 1/2" | 1 1/2 1 1/2" 2 nylon throat SS lock nuts, 2 - 3/4 2 flat washers, Dia. Drill 2 lock washers Saddle Holes 4 ~ % Ø Drill Holes 9 1/2" 1/2" 9 1/2 ' CLAMP DETAIL **PLAN VIEW** (2 Req'd) FRONT SIDE BRACKET DETAIL Make from $\frac{1}{2}$ " plate (ASTM A-36 or better) Liquid tight 6 1/2" Drill 1/16" dia. / Flexible Metal Conduit (Typ)-Rotate as -¾" RMC to necessary Type 2 Luminaire to place Luminairefixture perpendicular to roadway **PLAN VIEW SIDE** PLAN VIEW **FIXTURE** ARM DETAIL **ORIENTATION** Connect conduit on tapered section of beam. $2 - \frac{5}{8}$ " Dia. thru-bolts (A325 or A193 B7), each 3 - No. 12 XHHW (See note C.2)in 3/4" RMC for 3/8" Dia. bolt (4 1/2" Min), w/ w/ 1 nylon throat lock nut, 2 flat washers, Branch Circuit runs from fused SS Cotter Pin-1 Lock washer disconnect to underpass Luminaires See Clamp Detail 2 1/2" Min to 4" Max 2 1/2 "RMC CONDUIT DETAIL Reducing bushing 9 1/2" Radius 2"RMC Reducer Appropriate Accessible bottom of Conduit Body fixture **FRONT** (Beam height greater than 54") Connect conduit on tapered section of beam. (See note C.2)

2 - 5/8" Dia. bolts, each w/ 1 nylon

-2 ½" Min to

bottom of

fixture

throat lock nut,

2 flat washers,

1 lock washer

FRONT

(Beam height equal to or less than 54")

IN RD IL AM (U/P) (TY 2)

 $\frac{3}{8}$ " Dia. bolt (4 $\frac{1}{2}$ " Min), w/ SS Cotter Pin—

See Clamp

Detail

9 ½" Radius

2"RMC

CONDUIT CONNECTION PROFILE

Reinforcina Strands Minimum Distance 🕽 (See Table Below)

TABLE 5 LOCATION OF UNDERPASS LIGHT MOUNTING BRACKET TABLE

SPAN LENGTH	MINIMUM DISTANCE
≤ 50′	10'-0"
50' - 70'	15′-0"
70′ - 90′	20' -0"
> 90'	25′-0"

DETAILS (UNDERPASS LIGHT FIXTURES)

RID(3) - 20

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ROADWAY

ILLUMINATION

UNDERPASS LIGHTING TYPE 2

LOCATION OF UNDERPASS LIGHT MOUNTING BRACKET

C) TxDOT H I GHWAY 6427 57 001 US 67 37

GENERAL NOTES:

11

Φ-

used Disconnec-

-Ground Box

(As shown on

layout sheets

A. ALL 150 watt HPS and 150 watt equivalent LED Luminaires

- 1. Luminaire locations, conduit and conductor sizes and routing are typical and diagrammatic only. See project layout sheets for specific details.
- 2. Conduit will be paid for under Item 618, "Conduit" and conductors will be paid for under Item 620, "Electrical Conductors," unless otherwise shown on the plans.
- 3. Adjust conduit in saddles to place fixture height and orientation as required. See fixture orientation detail and plans. Where practicable, place luminaires so the bottom of luminaire is above the bottom of the beam, maximum of 3 in. (See detail UNDERPASS LIGHTING ARM TYPE 2)
- 4. Except as noted, galvanize all structural steel and exposed bolts, nuts, and washers in accordance with Item 445 'Galvanizing"
- 5. Fabrication of brackets and support arms will not be paid for directly but is subsidiary to Item 610, "Roadway Illumination
- 6. Install a heavy duty NEMA 3R fused disconnect or breaker enclosure rated at 30 amps and 480 volts to switch underpass luminaires as shown on plans, with at least one per bridge circuit. Install 20 amp time-delay fuses or inverse-time circuit breakers. Mount disconnect or breaker enclosure 10 ft. (min) above grade on columns or bent caps as approved by the Department. Modify disconnect to allow padlocking in the "ON" and "OFF" positions. Padlocks and disconnect switches or circuit breakers for underpass fixtures will not be paid for directly but are subsidiary to the various bid items of the contract.
- Conduit on columns, caps, and slab is shown surface mounted. For new columns and caps, embed PVC conduit in concrete. Bond and ground metal junction boxes and conduit.

B. TYPE

- 1. Provide 2 in, rigid metal conduit (2.375" O.D., 0.146" wall) for Type 1 arm shaft.
- $rac{3}{8}$ in. stainless steel bolt or stud non-epoxy type expansion anchors for concrete for Type 1 mounting. Except as noted, provide an allowable 2650 lbs minimum pull-out force (after consideration of adjustment factors for edge distance and bolt spacing) for each anchor. Install each anchor to the embedment depth recommended by the manufacturer.
- 3. Attach conduit to plate with 4 saddles, four $\frac{3}{8}$ in. diameter bolts, nylon throat lock nuts, and lock washers.

C. TYPE 2

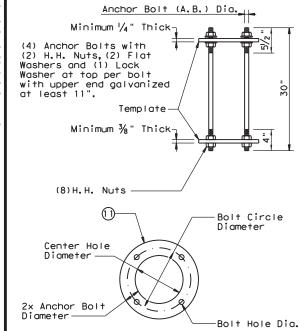
- 1. Provide 2 in. rigid metal conduit (2.375" O.D., 0.146" wall) or provide a combination of 2 $\frac{1}{2}$ in. (2.875" O.D., 0.193" wall) and 2 in. (2.375" O.D., 0.146" wall) rigid metal conduits with a reducing bushing as beam height stipulated for Type 2 arm shaft. Field cutting and threading will be permitted. Paint cut and threaded areas with zinc rich paint after conduit is connected to adjacent fitting.
- 2. Connecting conduit may be strapped to tapered section only of precast beams as shown. Anchor as approved by the Engineer. Maximum anchor depth is 1 in.
- Indiscriminate drilling into precast concrete beams may result in reduced beam strength. Use drilling location and method as directed by the Engineer. See Location of Underpass Lighting Mounting Bracket detail. The locations shown in the table are such that reinforcing strands will not be damaged.

Texas Department of Transportation

Traffic Safety Division Standard

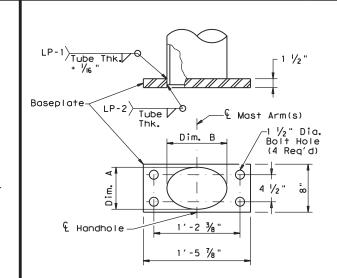
SHOE BASE BASEPLATE

SHO	SHOE BASE BASEPLATE TABLE								
MOUNTING HEIGHTS (noming)	BOLT CIRCLE	SQUARE	THICK	BOLT HOLE DIAMETER					
20' - 39'	13"	13"	1 1/4"	1 1/4"					
40′	15"	15"	1 1/4"	1 1/2"					
50′	15"	15"	1 ½"	1 1/2"					



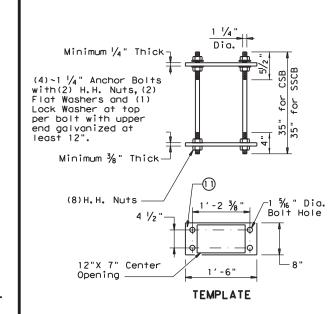
SHOE BASE ANCHOR BOLT ASSEMBLY

SHOE BA	SE A	NCHOR E	OLT ASSEM	BLY TABLE
MOUNTING HEIGHTS (nominal)	A.B. Dia.	BOLT CIRCLE DIAMETER	CTR. HOLE DIAMETER	BOLT HOLE DIAMETER
20′-39′	1 "	13"	11"	1 1/16 "
40′-50′	1 1/4"	15"	12 ½"	1 % "



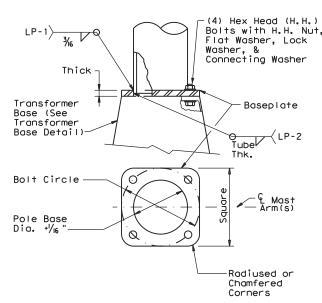
CONCRETE TRAFFIC BARRIER BASE BASEPLATE

CONCRETE TRAFFIC BARRIER BASE BASEPLATE TABLE						
MOUNTING HEIGHTS (nominal)	POLE DIA.	DIM. A	DIM. B			
28' - 38'	9"	7"± 1/4"	10"± 1/4"			
48′	10 ½"	7"± 1/4"	13"± 1/4"			



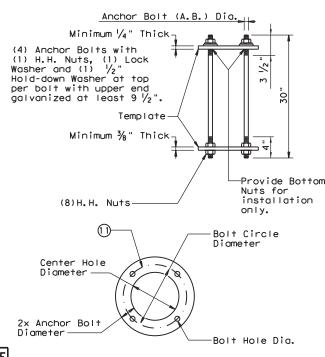
CONCRETE TRAFFIC BARRIER BASE ANCHOR BOLT ASSEMBLY

TRANSFORM	ER BA	SE ANCH	OR BOLT AS	SEMBLY TABLE
MOUNTING HEIGHTS (nominal)	A.B. Dia.	BOLT CIRCLE DIAMETER	CTR. HOLE DIAMETER	BOLT HOLE DIAMETER
20' - 39'	1 "	14"	12"	1 1/16 "
40'- 50'	1 1/4"	17 1/4"	14 ¾"	1 1/6 "



TRANSFORMER BASE BASEPLATE

	TRANSFORMER BASE BASEPLATE TABLE											
MOUNTING HEIGHTS (noming)	BOLT CIRCLE	SQUARE	THICK	CONNECTING BOLT DIA.	BOLT HOLE DIAMETER	TRANSFOMER BASE TYPE						
20' - 39'	13"	13"	1 1/4"	1"	1 1/4"	A						
40′	15"	15"	1 1/4"	1 1/4"	1 1/2"	В						
50′	15"	15"	1 1/2 "	1 1/4"	1 1/2"	В						



TRANSFORMER BASE ANCHOR BOLT ASSEMBLY

GENERAL NOTES:

TRANSFORMER BASE TABLE TOP B.C.

13"

15"

DETAIL A

DETAIL B

TOP PLAN

-Bottom

Bolt Circle

(B.C.)

BOTTOM PLAN

14"

17 1/4

Lock

Washer

TYPE

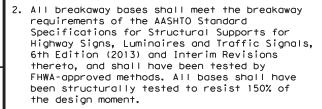
½" thk Hold-down

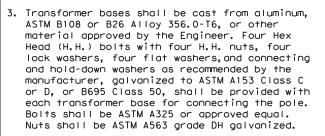
Lock

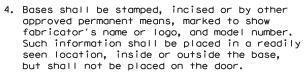
Connecting

Top Bolt Circle

١.	For	mountir	ng he	i ght ؛	s betwe	en	thos	se shov	vn ir	١
	the	table,	use	the	values	in	the	table	for	
	the	larger	mour	nting	height	٠.				





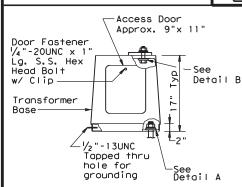


5. Doors for transformer bases shall be made of plastic, fiberglass or other non-metallic material approved by the Engineer and shall be attached with stainless steel screws or bolts. Transformer bases shall be cleaned by grit blast cleaning after heat treatment. Certification by the manufacturer of heat treatment shall be furnished with transformer bases. The certification shall show the metal alloy and temper and that the base meets those requirements, chemical and physical. The certification shall also show the material ASTM specification. Transformer bases shall be cast with a removable tab bar for material testing. Some bars may have been removed by the manufacturer for testing.

NOTES:

- (1) Anchor Bolt Templates do not need to be aalvanized.
- (2) Pole diameter before ovalized.

ANCHOR BOLT FABRICATION TOLERANCES TABLE DIMENSION TOLERANCE Length ± 1/2' Threaded length ± 1/2" Galvanized length (if required) - 1/4"



ELEVATION

TRANSFORMER BASE **DETAILS**



SHEET 4 OF 4

Traffic Safety Division Standard

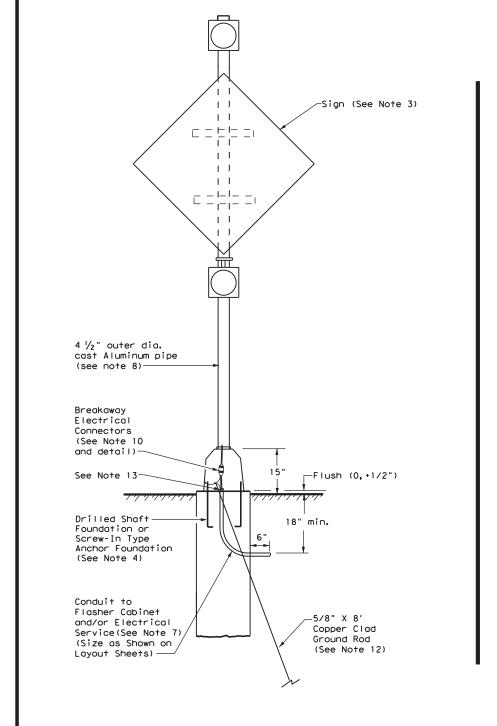
RIP(4) - 19

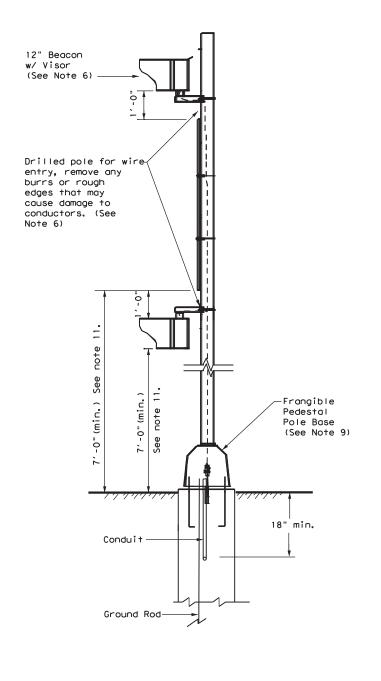
POLES

- 1	_					
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	© TxDOT January 2007	CONT	SECT	JOB		HIGHWAY
ı	REVISIONS	6427	7	001		US 67
ı	7-17 12-19	DIST		COUNTY		SHEET NO.
ı	12 19	23		BROW	N	38

GENERAL NOTES:

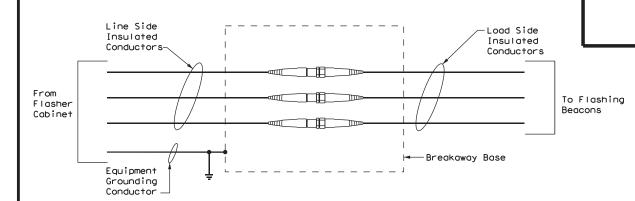
- Details show a typical warning sign with two flashing beacon heads, other arrangements are possible. When only one beacon is required, install the upper beacon.
- 2. See Item 685, "Roadside Flashing Beacon Assemblies" for further requirements.
- 3. See SMD standard sheets for lateral and vertical clearances and sign mounting details. Install signs as shown on the sign layout sheets.
- 4. Use either a Screw-In Type Anchor Foundation or a Drilled Shaft Foundation as shown elsewhere in the plans. When plans require a Drilled Shaft Foundation, see standard sheet TS-FD. Install the Screw-In Type Anchor Foundation as per manufacturer's recommendations. On a slope, install one edge at ground level. Screw-In/Drilled Shaft Foundation is subsidiary to Item 685. Installation of a ground rod is not required for solar powered flashing beacon assemblies.
- 5. When used, provide Screw-In Type Anchor Foundations as shown on TxDOT's Material Producer List (MPL) in the file "Highway Traffic Signals".
- Install beacon heads as shown here, as shown elsewhere on the plans, or as directed. Use hardware specifically designed for mounting beacon heads on poles.
- 7. Conduit in foundation and within 6 in. of foundation is subsidiary to the Item 685, "Roadside Flashing Beacon Assemblies."
- 8. Unless otherwise shown on the plans, pole shaft shall be one piece, Schedule 40 Aluminum pipe, ASTM B429 or B221 (Alloy 6061-T6 only). Aluminum conduit will not develop the necessary strength and will not be allowed.
- Per manufacturer's recommendations, engage all threads on the pedestal pole base and pipe unless the pipe is fully seated into base. In high winds, use a pole and base collar assembly to add strength and prevent loosening of connection.
- 10. Provide single pole non-fused watertight breakaway electrical connectors for frangible pedestal pole bases, as shown on TxDOT's MPL in the file "Roadway Illumination and Electrical Supplies." Approved models are listed under Item 685. For ungrounded (hot) conductors, install a breakaway connector with a dummy fuse slug). For grounded (neutral) conductors, install a breakaway connector with a white colored marking and a permanently installed dummy fuse (slug).
- 11. Provide clearance as shown above the sidewalk or pavement grade at the edge of the road. When a bottom beacon is not used, mount the bottom of the sign at least 7 ft. above the sidewalk or pavement grade at the edge of the road.
- 12. Make connections to ground rods according to NEC. Ground rod clamps shall be listed for their intended purpose.
- 13. Ensure height of conduit and ground rod is below top of anchor bolts.



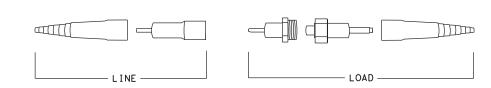


FRONT

SIDE



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS
EXPLODED VIEW



ROADSIDE FLASHING
BEACON ASSEMBLY

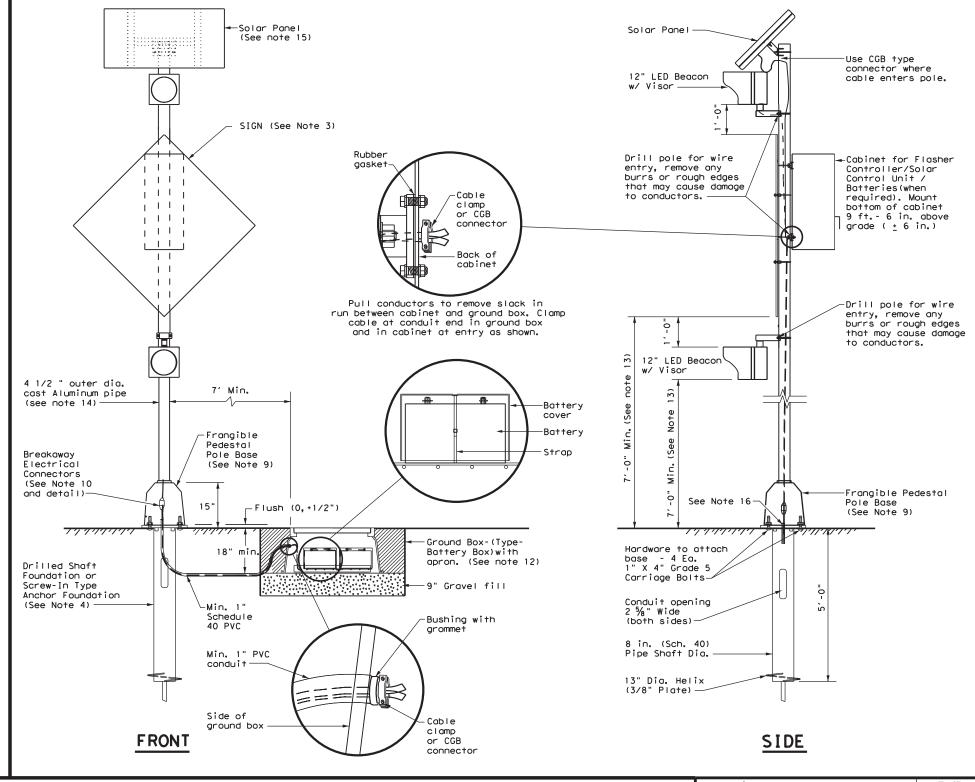
Traffic Operations Division Standard

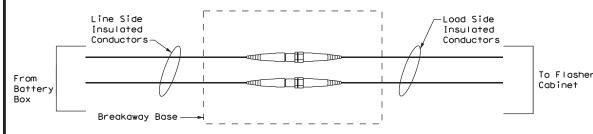
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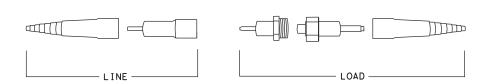
GENERAL NOTES:

- Details show a typical warning sign with two flashing beacon heads, other arrangements are possible. When only one beacon is required, install the upper beacon.
- See Item 685, "Roadside Flashing Beacon Assemblies" for further requirements.
- 3. See SMD standard sheets for lateral and vertical clearances and sign mounting details. Install signs as shown on the sign layout sheets.
- 4. Use either a Screw-In Type Anchor Foundation or a Drilled Shaft Foundation as shown elsewhere in the plans. When plans require a Drilled Shaft Foundation, see standard sheet TS-FD. Install the Screw-In Type Anchor Foundation as per manufacturer's recommendations. On a slope, install one edge at ground level. Screw-In/Drilled Shaft Foundation is subsidiary to Item 685. Installation of a ground rod is not required for solar powered flashing beacon assemblies.
- When used, provide Screw-In Type Anchor Foundations as shown on TxDOT's Material Producer List (MPL) in the file "Highway Traffic Signals".
- 6. Use materials specifically designed for attaching cabinets, beacon heads, solar panels, etc., to poles.
- Install beacon heads as shown here, as shown elsewhere on the plans, or as directed. Use hardware specifically designed for mounting beacon heads on poles.
- 8. Conduit in foundation and within 6 in. of foundation is subsidiary to the Item 685, "Roadside Flashing Beacon Assemblies."
- 9. Per manufacturer's recommendations, engage all threads on the pedestal pole base and pipe unless the pipe is fully seated into base. In high winds, use a pole and base collar assembly to add strength and prevent loosening on connection.
- 10. Provide single pole non-fused watertight breakaway electrical connectors for frangible pedestal pole bases, as shown on TxDOT'S MPL in the file "Roadway Illumination and Electrical Supplies." Approved models are listed under Item 685. For ungrounded (hot) conductors, install a breakaway connector with a dummy fuse slug). For grounded (neutral) conductors, install a breakaway connector with a white colored marking and a permanently installed dummy fuse (slug).
- 11. Install the batteries in a battery box. Place the batteries on a $\frac{3}{16}$ "thick plastic sheet and connect together. Place a plastic cover (battery bell jar) over the top of each battery and secure the battery bell jar to the battery with a strap. The batteries, bell jars, straps and $\frac{3}{16}$ "plastic sheet are subsidiary to the Item 685, "Roadside Flashing Beacon Assemblies." When required, install batteries in the flasher cabinet. Wire batteries according to manufacturers recommendations. Provide the number of batteries as required by the manufacturer.
- 12. See standard sheet Electrical Details (ED) for additional requirements regarding the installation of ground boxes/battery boxes, conduit, and cabinets.
- 13. Provide clearance as shown above the sidewalk or pavement grade at the edge of the road. When a bottom beacon is not used, mount the bottom of the sign at least 7 ft. above the sidewalk or pavement grade at the edge of the road.
- 14. Unless otherwise shown on the plans, pole shaft shall be one piece, Schedule 40 Aluminum pipe, ASTM B429 or B221 (Alloy 6061-T6 only). Aluminum conduit will not develop the necessary strength and will not be allowed.
- 15. Orient solar panel for optimum exposure to sunlight (face to the south). Prior to installation, check the location to ensure there is no overhead obstruction that would block the solar panel from receiving full sunlight. Unless specified elsewhere, mount a minimum of 14' above grade.
- 16. Ensure height of conduit is below top of anchor bolts.





NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS
EXPLODED VIEW



Traffic Operations Division Standard

SOLAR POWERED ROADSIDE FLASHING BEACON ASSEMBLY DETAILS

SPRFBA(1)-13

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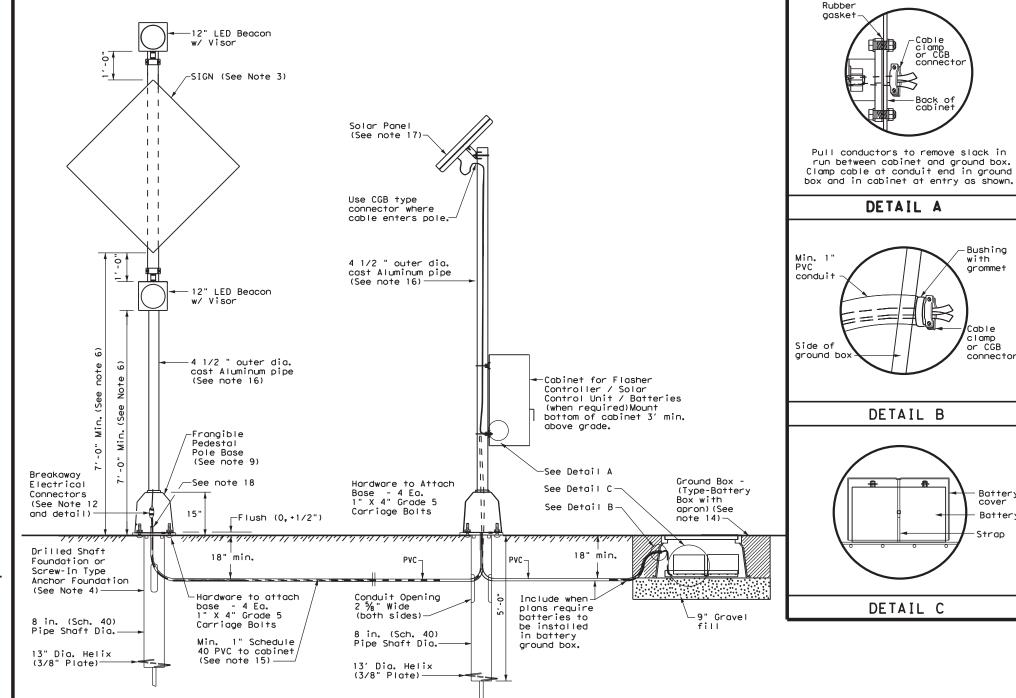
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GENERAL NOTES:

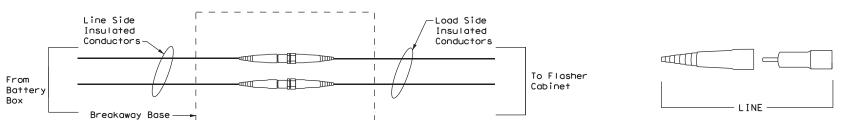
- Details show a typical warning sign with two flashing beacon heads, other arrangements are possible. When only one beacon is required, install the upper beacon.
- 2. See Item 685, "Roadside Flashing Beacon Assemblies" for further requirements.
- See SMD standard sheets for lateral and vertical clearances and sign mounting details. Install signs as shown on the sign layout sheets.
- 4. Use either a Screw-In Type Anchor Foundation or a Drilled Shaft Foundation as shown elsewhere in the plans, When plans require a Drilled Shaft Foundation, see standard sheet TS-FD. Install the Screw-In Type Anchor Foundation as per manufacturer's recommendations. On a slope, install one edge at ground level. Screw-In/Drilled Shaft Foundation is subsidiary to Item 685. Installation of a ground rod is not required for solar powered flashing beacon assemblies.
- 5. When used, provide Screw-In Type Anchor Foundations as shown on TxDOT's Material Producer List (MPL) in the file "Highway Traffic Signals".
- 6. Provide clearance as shown above the sidewalk or pavement grade at the edge of the road. When a bottom beacon is not used, mount the bottom of the sign at least 7 ft. above the sidewalk or pavement grade at the edge of the road.
- Use materials specifically designed for attaching cabinets, beacon heads, solar panels, etc., to poles.
- 8. Conduit in foundation and within 6 in. of foundation is subsidiary to the Item 685, "Roadside Flashing Beacon Assemblies."
- Per manufacturer's recommendations, engage all threads on the pedestal pole base and pipe unless the pipe is fully seated into base. In high winds, use a pole and base collar assembly to add strength and prevent loosening on connection.
- Install beacon heads as shown here, as shown elsewhere on the plans, or as directed. Use hardware specifically designed for mounting beacon heads on poles.
- 11. Install the cable clamp in the bottom third of the back of the cabinet. See Detail A.
- 12. Provide single pole non-fused watertight breakaway electrical connectors for frangible pedestal pole bases, as shown on TxDOT'S MPL in the file "Roadway Illumination and Electrical Supplies". Approved models are listed under Item 685. For ungrounded (hot) conductors, install a breakaway connector with a dummy fuse (slug). For grounded (neutral) conductors, install a breakaway connector with a white colored marking and a permanently installed dummy fuse (slug).
- 13. Install the batteries in a battery box. Place the batteries on a 3/16" thick plastic sheet and connect together. Place a plastic cover (battery bell jar) over the top of each battery and secure the battery bell jar to the battery with a strap. The batteries, bell jars, straps and 3/16 " plastic sheet are subsidiary to the Item 685, "Roadside Flashing Beacon Assemblies." When required, install batteries in the flasher cabinet. Wire batteries according to manufacturers recommendations. Provide the number of batteries as required by the manufacturer.
- 14. See standard sheet Electrical Details (ED) for additional requirements regarding the installation of ground boxes/battery boxes, conduit, and cabinets.
- 15. Unless otherwise shown on the plans or recommended by the manufacturer, use the following table to determine the wire size from cabinet to beacons.

Distance from Cabinet	Minimum Required					
to Beacons (ft.)	Wire Size (AWG)					
0 - 35	#14					
35 - 60	#12					
60 - 100	#10					
> 100	#8					

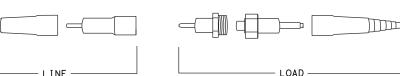
- 16. Unless otherwise shown on the plans, pole shaft shall be one piece, Schedule 40 Aluminum pipe, ASTM B429 or B221 (Alloy 6061-T6 only). Aluminum conduit will not develop the necessary strength and will not be allowed.
- 17. Orient solar panel for optimum exposure to sunlight (face to the south). Prior to installation, check the location to ensure there is no overhead obstruction that would block the solar panel from receiving full sunlight. Unless specified elsewhere, mount a minimum of 14' above grade.
- 18. Ensure height of conduit is below top of anchor bolts.



DETAIL FOR SOLAR PANEL, CABINET, AND BATTERIES LOCATED
OUT OF CLEAR ZONE ON SEPARATE ALUMINUM POLE ASSEMBLY



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS



NON-FUSED BREAKAWAY ELECTRICAL CONNECTORS
EXPLODED VIEW

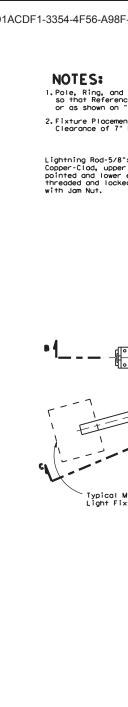


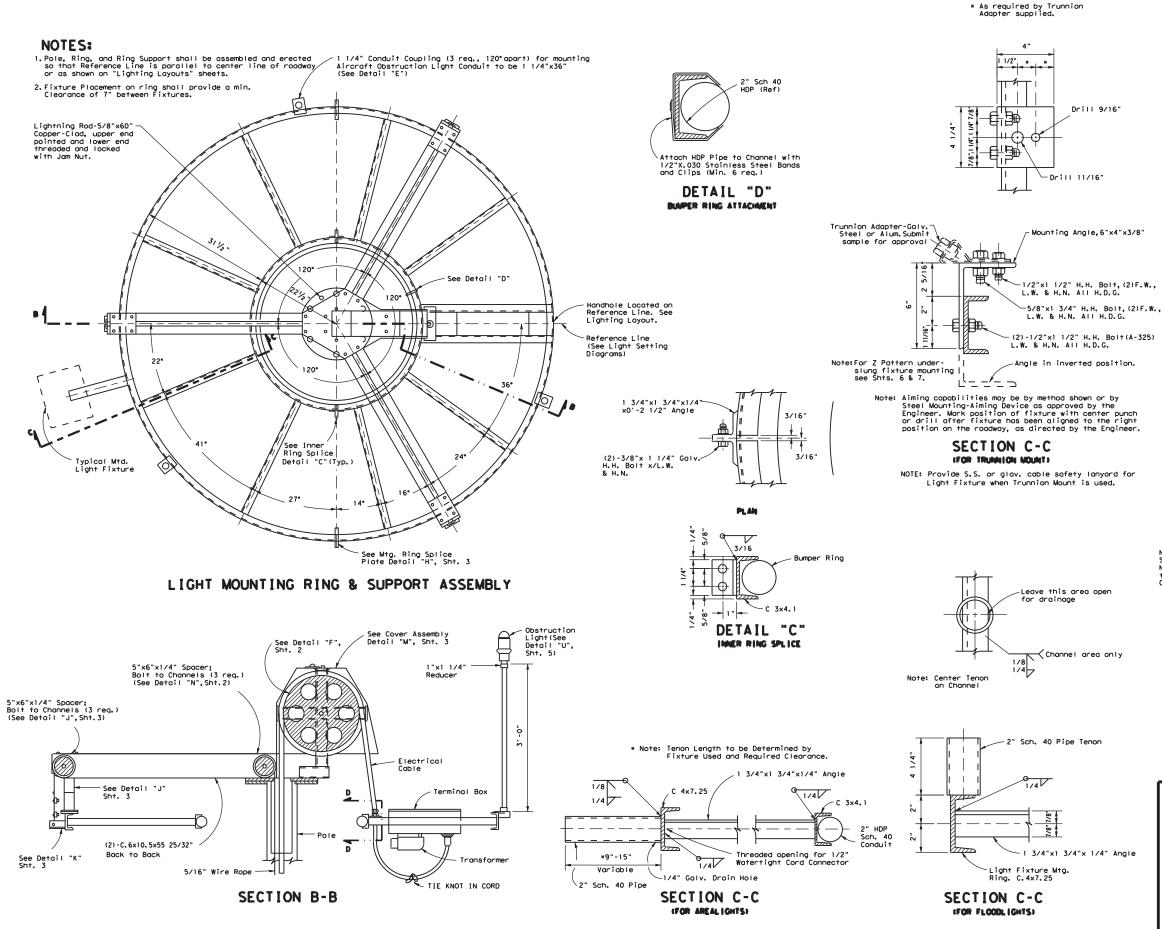
Traffic Operations Division Standard

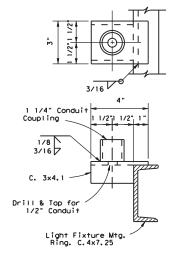
SOLAR POWERED ROADSIDE FLASHING BEACON ASSEMBLY DETAILS (ALUMINUM)

SPRFBA(3)-13

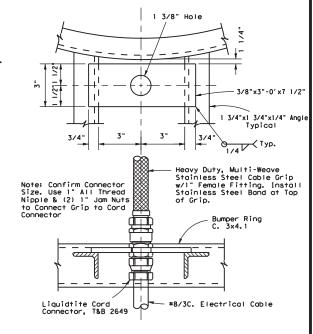
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DETAIL "E" CONDUIT ATTACHMENT FOR OBSTRUCTION LIGHTS, TYPICAL (3) PLACES)



SECTION D-D

NOTE: COVER CORD WITH HEAT SHRINK TUBING FROM CABLE GRIP
TO WITHIN ONE INCH OF GRIP TO CONNECTOR TRANSITION PRIOR
TO INSTALLING CABLE GRIP.



HIGH MAST ILLUMINATION DETAILS

HMID(1) - 03

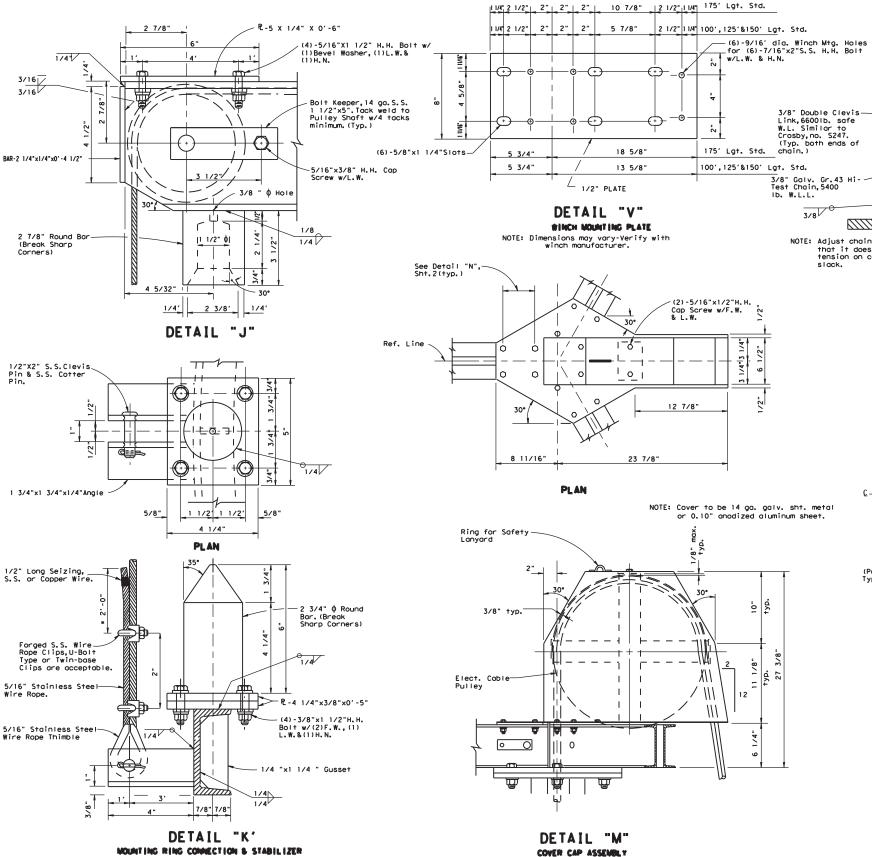
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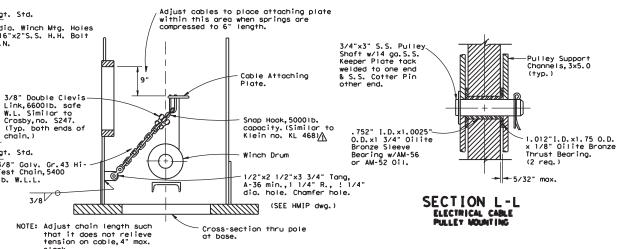
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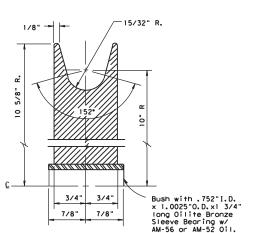
23

* EXTRA 2'-0" of wire cable to be attached to ring with

SS Bands as directed by Engineer.



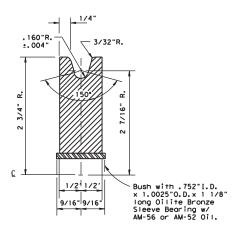




SECTION F-F ELECTRICAL CABLE PULLEY

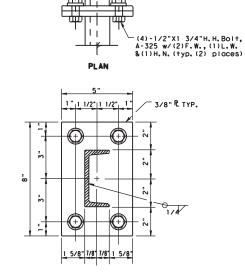
SAFETY LANYARD DETAIL

(Pulley material to be aluminum alloy, Type 356-T6 or equal)



SECTION G-G WIRE ROPE PULLEY

(Pulley material to be plated steel or Stainless Steel)



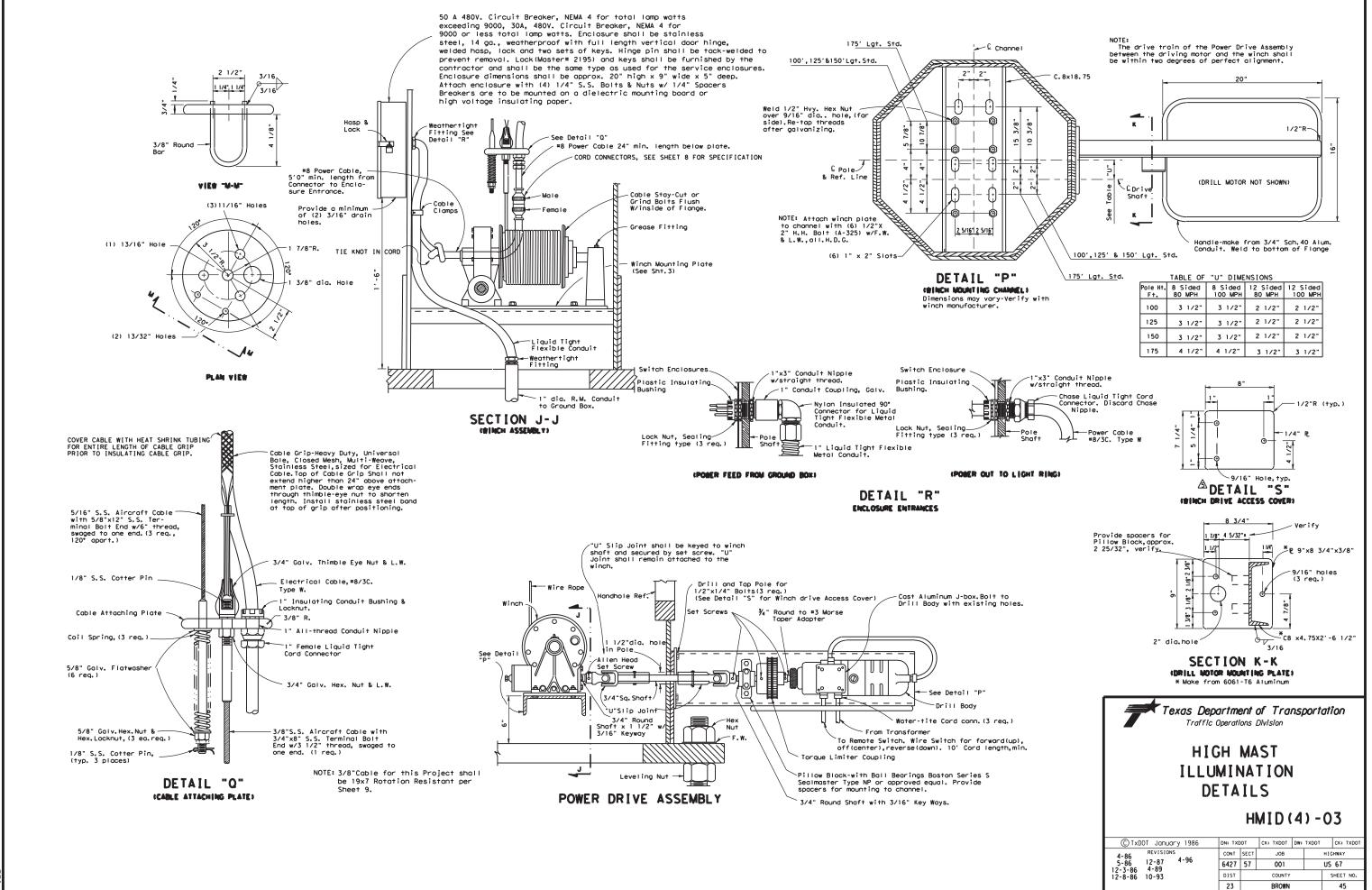
DETAIL "H"
MOUNTING RING
SPLICE PLATE

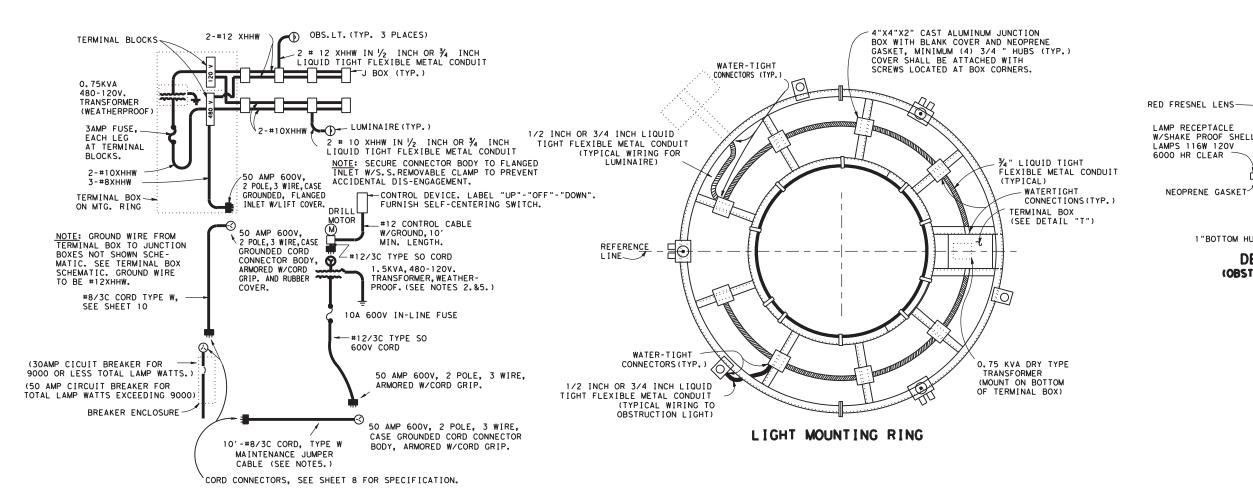


HIGH MAST ILLUMINATION DETAILS

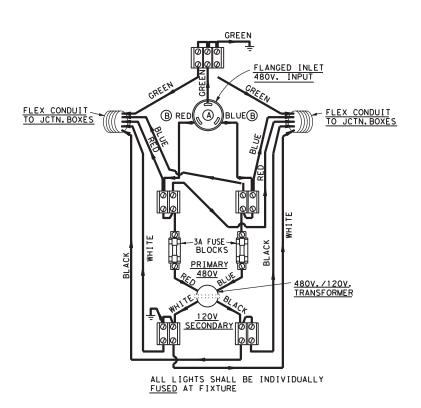
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		23		BROWN			44	





ONE-LINE SCHEMATIC



TERMINAL BOX SCHEMATIC

1. OBSTRUCTION LIGHTS COLOR CODE: FROM SECONDARY SIDE OF TRANSFORMER THROUGH-OUT-CIRCUIT TO SOCKET, WHITE-NEUTRAL, BLACK-LOAD.

BLACK-LOAD.

2. POWER SUPPLY CORD TO FLANGED INLET:
GREEN-GROUND, WHITE LINE, BLACK LINE.
FROM FLANGED INLET (A) TO TERMINAL
BLOCKS: GREEN-GROUND, RED LINE, BLUE-LINE. FROM THERE ON ALL 480V. CIRCUIT WIRES TO BE RED AND BLUE TO JUNCTION BOXES.

3. WIRE SIZE FROM POWER SUPPLY TO TERMINAL BLOCKS SHALL BE #8 AWG-SEE .
4. WIRE SIZE FROM TERMINAL BLOCKS TO

JUNCTION BOXES SHALL BE #12 AWG.
5. MOUNT TERMINAL BLOCKS ON 3/4" EXTERIOR

6. FOR 2-WIRE, 480V. SERVICE, OMIT FUSE IN GROUNDED CONDUCTOR IN LEADS TO TRANSFORMER.

ATTACH WITH (4)10-24 MACHINE SCREWS, FW AND LW COVER TO HAVE 1/2" MIN. LIP ALL AROUND. 0 TRANSFORMER DETAIL "T'

1 - 1/2 "CLR. ALL

AROUND (TYP.)

¾" EXTERIOR

PLYWOOD

DRILL ¼" DIA. HOLE FOR DRAINAGE (TYP.) OPPOSITE CORNERS

PLAN

(TERMINAL BOX)

600 VOLT TERMINAL BLOCKS

BUSHED CONNECTION
TO TRANFORMER

Ø

NOTES:

-6" x 18" x 6" TERMINAL BOX, 14 GUAGE STAINLESS STEEL

W/ RAINTIGHT COVER

50 AMP 600 VOLT FLANGED INLET

1. PLUGS, CONNECTOR BODIES AND FLANGED INLETS AT CORD TO RING CONNECTION SHALL BE "TWIST LOCK" TYPE, 3-PRONG, RATED 50 AMPS AT 600V, AND 20 AMPS FOR 120 V. 50 AMP CONNECTORS SHALL BE 3 WIRE CASE GROUNDED, ARMORED, WITH CORD GRIP, 20 AMP CONNECTOR SHALL BE 3 WIRE GROUNDING WITH CORD GRIP, NEMA TYPE L5-20.
2. PROVIDE HANDLE ON 1.5KVA TRANSFORMER FOR PORTABILITY.

SAFETY CHAIN

CAST ALUMINUM

LATCH AND SPRING

ASSEMBLY (TYP.)

SQUARE HEAD

HOUSING

DETAIL "U"

(OBSTRUCTION LIGHT)

(SEE ONE-LINE SCHEMATIC)
3. CIRCUIT BREAKERS SHALL BE ITE #E43B030 OR #E43B050,

NEOPRENE GASKET

1"BOTTOM HUE

SQUARE "D" #FAL24030 S/N OR #FAL24050 S/N, OR EQUAL. 4. CONDUIT ENTRIES INTO TERMINAL BOX SHALL BE INTO

THE SIDE OF THE BOX.

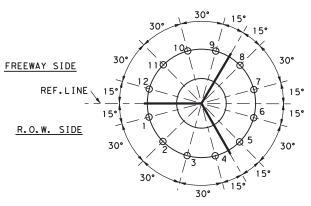
5. A MINIMUM OF ONE (1) MAINTENANCE JUMPER CABLE SHALL BE SUPPLIED FOR EACH PROJECT. SUPPLY ONE (1) PORTABLE TRANSFORMER FOR EACH POWER DRIVE UNIT REQUIRED FOR PROJECT.



HIGH MAST ILLUMINATION DETAILS

HMID(5) - 03

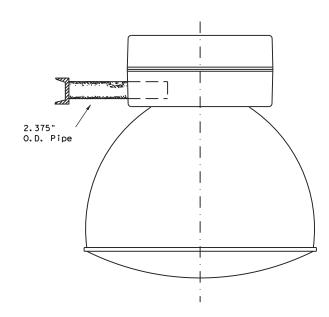
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	23		BROWN			46



12-LIGHT SETTING

LUMINAIRE LOCATIONS

NOTE: AIRCRAFT OBSTRUCTION LIGHT LOCATIONS NOT SHOWN.
THREE ARE REQUIRED LOCATED APPROX.120° APART.
LOCATIONS WILL VARY DEPENDENT ON THE LIGHT
SETTING USED.

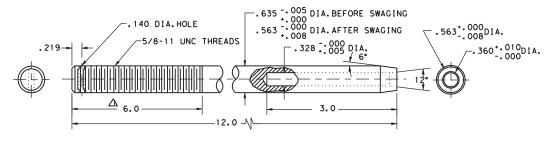


AREALIGHT MOUNTING ASSEMBLY (SYMMETRIC AND ASYMMETRIC)

 \bigvee

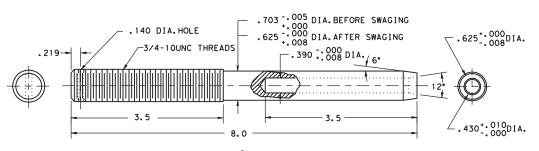
NOTES: IF ASYMMETRIC FIXTURES ARE USED, THE REFRACTORS SHALL BE ORIENTED TO PROPERLY ILLUMINATE THE ADJACENT ROADWAYS. ORIENTION SHALL BE AS SHOWN IN PLANS.

NOTE: MIN. SWAGE LENGTH = 2.06 MAX. SWAGE LENGTH = 2.94



TERMINAL FOR % "WIRE ROPE MATERIAL: STAINLESS STEEL, TYPE 303SE OR 304 WITH 115,000 P.S.I. MAX.ULTIMATE TENSILE STRENGH.

NOTE: MIN. SWAGE LENGTH = 3.12 MAX. SWAGE LENGTH = 3.44



TERMINAL FOR % "WIRE ROPE MATERIAL: STAINLESS STEEL, TYPE 303SE OR 304 WITH 115,000 P.S.I. MAX.ULTIMATE TENSILE STRENGH.

GENERAL NOTES:

 AFTER FINAL AIMING HAS BEEN COMPLETED AND APPROVED BY THE ENGINEER, FIXTURES MUST BE LOCKED IN POSITION. CON-TRACTOR MUST SUBMIT PROPOSED LOCKING SCHEME WITH THE FIXTURE SUBMITTAL. (FLOODLIGHTS ONLY).



Texas Department of Transportation

Traffic Operations Division

HIGH MAST ILLUMINATION DETAILS

HMID(6)-03

Removed obsolete diagrams and updated drawings.

3/03 Revision

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3-03		DIST		COUNTY		5	SHEET NO.
		23		BROWN			47

- 1. AREA LIGHTING (Bid under Item 614, "High Mast Illumination Assemblies")
 - A. Area lighting shall be symmetric or asymmetric, as shown on the descriptive code. The number and wattage of the fixtures on each pole shall be as shown on the lighting layouts. The lighting pattern for symmetric fixtures shall be IES Type V; for asymmetric fixtures, it shall be IES Type II, III, or IV.
 - B. All luminaires shall be pre-qualified before installation. A sample of each type of luminaire to be considered for pre-qualification shall be submitted to TXDOT's Traffic Operations Division - Traffic Engineering Section (TRF-TE).

Traffic Operations Division - TE Texas Department of Transportation 125 East 11th Street Austin, TX 78701-2483

Sample luminaires are non-returnable. A list of pre-qualified luminaires may be obtained by contacting TRF-TE. In addition, luminaires will be sampled and tested in accordance with Item 614. Luminaires that inconsistently pass testing or that are inconsistent with published photometric information will be removed from the pre-qualified list at the discretion of the Engineer. Once a fixture has been approved, no changes shall be made in any material or manufacturing methods without prior approval of the Department. Unapproved changes will result in rejection of all fixtures.

- C. Symmetric and Asymmetric fixtures shall meet the following requirements unless otherwise approved by the Engineer:
- 1. Luminaire Construction
- a) The luminaire housing shall be formed, cast or drawn from low copper aluminum and shall be free of cracks and excessive porosity. Formed aluminum shall have a minimum thickness of 0.090, and shall have all seams welded. The minimum thickness of cast parts shall be as approved by the Engineer. Nuts, screws, and washers shall be made of Type 316 stainless steel. The housing shall be marked with minimum 2" letters to indicate the photometric type as being either A, B, C, or S as specified. Marking shall be permanent and shall be by stencil or stick on labels similar to "wattage" label on cobra heads. Wattage label will not be required on high mast fixtures. The fixture housing shall be constructed separate from the fixture reflector.
- b) Fixtures shall be natural aluminum in color or shall be painted gray.
- c) The slipfitter shall securely attach the luminaire to the tenon on the ring assembly with a minimum of 2 bolts and clamp. A positive means of vertical adjustment shall be
- d) For optical assemblies with lenses, reflectors shall be polished aluminum with Alzak or equal coating and shall not be painted. The optic assembly shall be sealed. The lens shall be tempered glass or prismatic glass, either flat or sag. The optic assembly shall be provided with a resilient seamless or sonically welded silicone rubber gasket, and constructed so that a positive seal against weather and other contaminants will be maintained. The latches shall be stainless steel, spring loaded, and hand operated (2 latches minimum, 3 attachment points), and shall provide a positive means of maintaining closure of the luminaire.
- e) For optical assemblies without lenses, optical assembly shall consist of an open ventilated borosilicate glass reflector. The reflecting prisms shall be protected from dirt depreciation by a spun on hermetically sealed aluminum cover. There shall be no glass lens/refractor on this optical assembly.
- f) Asymmetric fixtures shall have field rotatable optics with accurate degree of rotation markings. Reflector shall have "house side" and "street side" markings.
- g) The socket shell shall be nickel plated and shall be rigidly attached to a high grade porcelain magul base, which shall extend and enclose the metal shell. A locking means shall be incorporated in the shell of the socket to positively resist the removal of the lamp. This locking means shall be a spring loaded center tip. Lamp socket shall be non-adjustable and shall be riveted, welded, or otherwise permanently installed. Lamps shall be held securely in the proper position with a lamp support.
- h) The terminal block shall use nickel plated brass connectors.
- i) Fixture weight including ballast shall not exceed 80 pounds, and effective projected area (EPA) shall not exceed 2.62 square feet.
- j) The Contractor may be responsible for fixture testing costs. See TXDOT's "Manual of Testing Procedures, "Chapter 11 - "Traffic Systems and Illumination, "TEX-1110-T -"Sampling Lighting Assemblies," at http://manuals.dot.state.tx.us/dynaweb/.
- 2. Photometrics
- a) The Contractor shall submit a computer generated light level array of the area to be lighted by high most poles. All computer generated arrays shall have 400 watt fixtures derated to 40,000 lumens per lamp.
- b) The Type "A" 400 watt asymmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a computer simulation:

- (1) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 340 ft. by 50 ft., the fixture shall pass the following tests:
 - (a) The fixture shall provide a measured minimum intensity of 0.15 horizontal foot-candles at any point on the surface of this area.
 - (b) The fixture shall provide a measured maximum to minimum light ratio, based on horizontal foot-candles, of less than 25.
 - (c) The fixture shall provide an average measured intensity of 0.6 horizontal foot-candles on the surface area.
- (2) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 260 ft. by 30 ft., the fixture shall provide a measured minimum intensity of 0.30 horizontal foot-candles at any point on the surface of this area.
- c) The Type "B" 400 watt asymmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a
- (1) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 260 ft. by 65 ft., the fixture shall pass the following tests:
 - (a) The fixture shall provide a measured minimum intensity of 0.15 horizontal foot-candles at any point on the surface of this area.
 - (b) The fixture shall provide a measured maximum to minimum light ratio, based on horizontal foot-candles, of less than 25.
 - (c) The fixture shall provide an average measured intensity of 0.6 horizontal foot-candles on the surface area.
- (2) When mounted in the level position, 50 ft. above the midpoint and 20 ft outside of either long side of a rectangular area measuring 200 ft. by 40 ft., the fixture shall provide a measured minimum intensity of 0.30 horizontal foot-candles at any point on the surface of this area.
- d) The Type "C" 400 watt asymmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a computer simulation:
- (1) When mounted in the level position, 50 ft. above the midpoint and 20 ft. outside of either long side of a rectangular area measuring 220 ft. by 80 ft., the fixture shall pass the following tests:
 - (a) The fixture shall provide a measured minimum intensity of 0.15 horizontal foot-candles at any point on the surface of this area.
 - (b) The fixture shall provide a measured maximum to minimum light ratio, based on horizontal foot-candles, of less than 25.
 - (c) The fixture shall provide an average measured intensity of 0.6 horizontal foot-candles on the surface area.
- (2) When mounted in the level position, 50 ft. above the midpoint and 20 ft. outside of either long side of a rectangular area measuring 160 ft. by 50 ft., the fixture shall provide a measured minimum intensity of 0.30 horizontal foot-candles at any point on the surface of this area.
- e) The Type "S" 400 watt Symmetric fixture shall be IES cutoff. The Department will use the measured photometric data of sampled fixtures to run the following tests on a
- (1) When mounted in the level position at 50 foot mounting height, the fixture shall provide the minimum light levels as shown below:
 - (a) 0.15 horizontal foot-candles within a 130 foot radius.
 - (b) 0.30 horizontal foot-candles within a 100 foot radius.
- (c) 0.50 horizontal foot-candles within a 60 foot radius.
- a) All ballasts shall be isolated-winding lag-type magnetic regulators designed to operate 400 watt high pressure sodium lamps rated 480 volts. Ballasts shall be capable of starting lamps at an ambient temperature of -20 degrees F. Ballast wiring shall include a grounding terminal bonded to metal housing. Ballasts shall be fused with a 5 amp time-delay fuse in an insulated fuse holder. Fuse holders shall be internal to the housing. Ballast wiring to the terminal board shall be through a quick-disconnect plug. Windings shall be made from copper wire.
- b) When the circuit voltage indicated on the plans is applied, the ballast input wattage during fluctuations of the test voltage of +10% and -10% shall not exceed 552 watts for a 400 watt HPS lamp.

Texas Department of Transportation Traffic Operations Division

> HIGH MAST ILLUMINATION DETAILS

> > HMID(7) - 03

Revised Area 9-91 Requirements

3/03 Revision

Reviseu ... Lighting

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- c) During fluctuation of the line voltage of +10% or -10%, the lamp wattage fluctuation shall not exceed a total of 20%. Ballast shall maintain lamp wattage between 280 and 475 watts for a 400 watt HPS lamp.
- d) The power factor of any ballast when tested at the circuit voltage indicated in the plans shall not be less than 90% at any point in life. Ballast factor shall be between
- e) The electronic starting aid shall provide a starting pulse with an amplitude of 2500 volts minimum, 4000 volts maximum. The pulse width shall be a minimum of 0.8 microseconds at 2250 volts. The pulse shall occur when the open-circuit voltage is equal to or greater than 90 percent of peak open-circuit voltage. Pulse repetition rate shall be a minimum of one per cycle and pulse current shall be a minimum of 0.18 amperes. Electronic starting aids shall be replaceable without the use of tools. The starting aid shall discontinue to pulse when the lamp starts. Starter shall sense an inoperative or missing HPS lamp and automatically shut down luminaire to protect ballast
- f) Ballasts shall permanently and clearly indicate the following: lamp type, catalog number, voltage rating, connection diagram, and manufacturer. Capacitors in all luminaires shall be non-PCB type.

- a) All lamps shall be new and of recent manufacture.
- b) Lamps shall be high pressure sodium and shall meet ANSI C78 requirements. Lamps shall be the type that extinguish at the end of usable lamp life and remain extinguished without cycling. 400 watt lamps shall contain less than 4.0 mg of mercury. Lamps shall be lead free and shall pass the Federal Toxic Characteristic Leachate Procedure (TCLP). Lamp shall be Osram-Sylvania LU400/Eco Plus. No alternatives will be approved.
- c) 400 watt high pressure sodium lamps shall have average initial lumens of 50000 and average rated life of 24000 hours.

2. GENERAL

- A. All material shall be in accordance with the applicable sections of the NEC. All conduit and conductors shall be in accordance with the materials and construction methods requirements of Items 618 and 620. Heat shrink tubing for use with cable grips and cable splicing shall meet the requirements of Item 620.
- B. Where stainless steel bands are called for on the HMID sheets, stainless steel hose clamps may be provided. Stainless steel bands and stainless steel hose clamps shall be provided with stainless steel clips or stainless steel screws.
- C. Obstruction Lights
- 1. When obstruction lights are required by layout sheets, summary sheets or general notes, the entire high most assembly shall be controlled by an FAA approved photocell mounted inside the service enclosure. Ring mounted luminaires shall be controlled by up to 4 additional ring mounted photocells, with each photocell controlling up to 3 fixtures. Photocells shall meet the following requirements:
- a) All photocells shall consist of a photoelectric cell, an internal lightning arrestor, and a relay or bimetallic switch mounted inside a weather proof enclosure with standard 3-prong twist lock photocell plug and receptacle. The enclosure shall be made of poly-acrylic with clear acrylic window. Enclosure chassis shall be molded thermosetting plastic. The photocell shall have an arrestor rated 2.0kV sparkover with 5000 amps follow-through. Relay or switch shall be time delay type with normally closed contacts. Photocell shall be rated a minimum of 1800 VA.
- b) Service enclosure mounted photocell (FAA photocell) shall turn on at light levels below 35 foot-candles and off at levels above 58 foot-candles, in accordance with FAA requirements. This photocell shall be rated for operation at 240 volts. A permanent placard shall be installed on the inside of the service enclosure door to indicate that an FAA approved photocell is required.
- c) High most assembly ring mounted photocells (one foot-candle photocells) shall turn on at light levels below 1.0 (plus or minus 0.5) foot-candle, and shall turn off at 2 foot-candles higher than this level. These photocells shall be rated for operation at 480 volts. Photocells shall be mounted upright on the terminal box or on various junction boxes around the ring as approved by the Engineer. Conduit entries shall not be made into the top of the terminal box or junction boxes. The Contractor shall submit mounting details to the Engineer for approval.
- 2. When obstruction lights are not required, eliminate the 3 obstruction light fixtures, 3 mounting posts, 480/120 volt transformer, 120 volt wiring, and 3 mounting post support connections shown on detail "E", sheet 1.
- D. The male cord connector on the lower end of the Type W cord running up the pole, the female cord connector for the Type W cord running to the circuit breaker enclosure and the male connector on the maintenance jumper shall meet the following or approved equal specifications:
- 1. Arrow Hart pin and sleeve watertight connectors UL listed, catalog numbers AH330C7W and AH330P6W.
- 2. Bryant watertight pin and sleeve connectors UL listed, catalog numbers 330C6W and

- 3. Hubble pin and sleeve connectors UL listed, catalog numbers HBL330C7W and HBL 330P7W.
- 4. The male connector for use with the Type W maintenance jumper shall be a pin and sleeve connector of one of the above types. The Contractor shall attach a 50 amp twist lock receptable to the opposite end of the maintenance jumper to match the flange mounted plug on the ring and the portable transformer.
- 5. The Contractor shall make a brochure submittal on the cord connectors.
- E. When shown on the plans, spill light shall be restricted to less than 0.15 horizontal
- F. The Contractor shall provide shop drawings for high mast illumination assemblies in accordance with this Item and Item 441. An Engineer licensed in the State of Texas shall seal the

3. TESTING

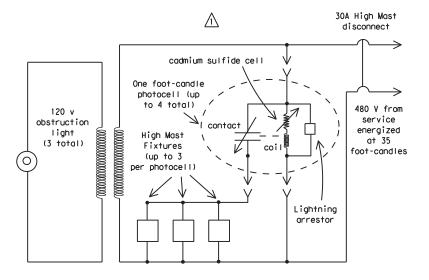
- A. Fixtures, lamps and ballasts will be sampled and tested in accordance with the Department "Manual of Testing Procedures" except as noted in these specifications.
- B. Ballasts and fixtures will be tested using a reference lamp.
- C. The Department will bear the cost of all testing of equipment that complies with the specification requirements. However, the source of supply of fixtures and ballasts must be approved as required in Article 6.1 of the Standard Specifications. Such approval will be contingent on the supplier agreeing to bear the cost of testing any equipment that fails to comply with the specification requirements listed in this specification.
- D. All other equipment will be tested in accordance with Item 614 of the Standard Specifications and Materials and Test Division Test Standards.
- E. After High Most Assembly has been completely assembled, the Engineer may require Contractor to fully lower and raise each high mast ring one time to demonstrate proper operation of the lowering mechanism, or may require the ring to be lowered for ring or fixture inspection. If any malfunction occurs, the problem shall be corrected at the Contractor's expense and the lowering test will be repeated.
- 4. MOUNTING RING AND SUPPORT ASSEMBLY
- A. Ring and support assembly shall be fabricated from steel having a minimum yield strength of
- B. Cover assemblies, fittings and miscellaneous parts shall be as outlined on the plans.
- C. All hardware shall be hot-dipped galvanized per ASTM A153 or shall be stainless steel, unless noted otherwise on the plans.

5. WINCH

- A. Housing shall be high tensile strength die-cast silicon aluminum. Cable drum shall be fabricated from seamless steel tubing with stamped steel flanges and shall be hot-dipped galvanized. Drum shall have a minimum diameter of 4.5 inches. Drum shall be keyed to drum shaft. Drum and flanges shall be sized so that, when the fixture mounting ring is in the raised position, the cable including one full layer will fill the drum to no more than two-thirds of full capacity. Drum shaft shall be ground from stainless steel and mounted on lubricated bronze bearings with seals. Wormgear shall be made of nickel-bronze and worm shaft shall be high-strength stress-proofed steel, ground and polished and supported by tapered roller bearings.
- B. Gear ratio shall be 36:1 with safe hoisting capacity of not less than 4000 pounds.
- C. Winch shall incorporate adjustable automatic brake to assure positive load suspension. Brake shall be multiple disc with friction plates running in oil bath and one-direction clutch which operates only when load is suspended or lowered. Winch shall not have throw-out clutch.
- D. Any winch that is operated without oil shall be considered damaged and shall be replace by the contractor at the contractor's expense.

6. WIRE ROPE AND TERMINALS

- A. 5/16 and 3/8 wire rope shall be 19x7 Rotation Resistant IWRC stainless steel. 19x7 rotation resistant wire rope shall meet the construction requirements of Fed. Spec. RR-W-410D, Type IV, class 2, modified for stainless steel with a nominal breaking strength of 11,100 lbs. All wire rope shall be pre-formed and factory lubricated. Wire rope shall meet the requirements of the applicable specification except where modified by this specification. Quality Assurance testing shall be the responsibility of the manufacturer and shall meet recognized wire rope industry standards. No special tensile or torsion testing will be required. Mill Test Reports shall be furnished.
- B. Winch cable shall be of sufficient length to leave a minimum of one full layer of cable on the drum when the fixture mounting ring is in the full down position.
- C. Wire rope terminals shall be stainless steel, solid stud type as shown on Sheet 7. All terminals shall be drilled for cotter pin. Material to be 303 SE or 304 stainless steel with a maximum tensile strength of 115,000 p.s.i. Mill Test Reports shall be furnished.



One foot-candle photocell keeps High Mast fixtures off when FAA photocell energizes circuit at 35 foot-candles. Fixtures come on when sun goes down at 1 foot-candle.

One Foot-candle Photocell Schematic

Use on ring when obstruction lights are installed and FAA photocell is installed in electrical service.



HIGH MAST ILLUMINATION DETAILS

HMID(8) - 03

4-89 10-93 4-96 and Terminals 3-03

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3/03 Revision

Revised General requirements: add diagram

Revised Wire Rope Revised

- D. All terminals shall be proof-tested by the manufacturer to 40% of rated strength of the wire rope. Each terminal shall be identified by manufacturer's logo permanently incised on terminal. Manufacturer shall furnish certification of tests. Contractor shall also furnish one sample of each size of terminal with 5 ft. of wire rope for load tests by the State. Samples tested must withstand test load not less than 100% of rated breaking strength of wire rope. If sample fails test, all terminals of same size will be rejected.
- E. Wire rope shall be delivered from the manufacturer on a reel.

7. SPRINGS

- A. Provide three steel springs as shown on plans.
- B. Springs shall have an uncompressed length of approximately 8 inches and shall compress 3 inches under 700-pound load.
- C. Springs shall contain approximately 19 total coils with ID of 0.875 and OD of 1.375 inches. Ends shall be closed and ground. Springs shall be zinc-plated.
- D. Springs shall be made from 1/4" diameter oil-tempered MB Steel treated for overstress. Springs shall not develop permanent set from 3-inch compression.

8. ELECTRICAL POWER CABLE

- A. Power cable shall be No. 8 AWG three-conductor round Type W, rated 90 degrees C, 600 volt or 2000 volt. Each conductor shall be tinned copper and shall consist of 133 strands. Insulation shall be ethylene propylene rubber. Jacket shall be chlorosulfonated polyethylene (CSPE), with glass fiber or nylon reinforcing mesh between two layers of CSPE. Nominal diameter shall be 0.91". Filler shall be rubber compound or other approved non-hygroscopic compound. Jacket shall be Hypalon Power Flex 90, with no substitutions allowed.
- 9. POWER DRIVE ASSEMBLY (ONE ONLY THIS CONTRACT UNLESS OTHERWISE SHOWN ELSEWHERE ON THE PLANS)
- A. Drive Motor
- Drive motor shall be 1-1/4" heavy-duty reversible portable electric drill modified as shown on plans.
- 2. Shall have a minimum of 6 radial ball bearings, one thrust bearing, and one needle bearing.
- 3. Shall have No. 3 Morse Taper socket.
- 4. Shall be designed for 115 volt 60 Hertz single phase operation 250 RPM at no load.
- Shall be designed for continuous rated duty of 160 RPM and 15 amperes at 115 volts with delivery of 33-pound-feet of torque. Drill motor to be operated only at low speed range. (i.e. 150 to 160 RPM)
- 6. Shall develop 240 pound-feet of torque at stalled rotor condition.
- B. Torque Limiter Coupling
- Torque limiter coupling shall consist of standard torque limiter with Type A sprocket center member coupled to a Type B sprocket by an ASA double strand roller chain. Type A sprocket shall be chrome-plated.
- Coupling shall have torque capacity minimum of 15 pound-feet and a maximum of 55 pound-feet.
- 3. Limiter section of coupling shall consist of integral hub and pressure plate, two friction facings, sintered iron bushing, pilot plate, disk spring, lock washer and hex adjustment nut. All major components except spring and friction facings shall be cadmium-plated with dichromate treatment.
- 4. Type A center sprocket shall have ground face (63 micro-inch) and shall be run-in for 4 minutes at approximately 60 RPM at a torque setting 70% to 80% of spring rating. Contractor shall provide written certification that run-in has been accomplished.
- 5. The torque limiter coupling shall, after run-in, be set to a torque limit of 35 pound-feet or as directed by the Engineer. The proper setting of the coupling shall be demonstrated to the Engineer.
- C. Universal Joints
- Shall be slip-type with 4-inch barrel. A grease fitting shall be so located in the spider that all caps and needle bearings may be adequately serviced. The assembly shall be disassembled and zinc-plated, then reassembled and properly lubricated.
- 2. Shall have a minimum torque rating of 1270 inch-pounds at 200 RPM.
- 3. Shall have set screw and keyed coupling as shown on plans.

10. CONSTRUCTION METHODS

- A. Fabrication
- 1. Fabrication and welding shall be in accordance with Item 441, "Steel Structures".
- 2. All holes supporting pulley shafts shall be drilled (not punched) prior to galvanizing.
- 3. All component parts shall be galvanized where galvanizing is applicable, after fabrication.
- 4. Galvanizing on all parts which have become scratched, chipped or otherwise damaged shall be thoroughly cleaned and the cleaned area painted with two coats of zinc dust-zinc oxide paint conforming to the requirements of repair compounds meeting Federal Specification TT-P-641 b.
- Mounting rings and ring support assemblies shall be fabricated with the use of jigs that have been inspected and approved by Material and Test Division personnel prior to their usage.
- The fabricator shall submit his proposed welding procedures in accordance with Item 441, "Steel Structures".
- B. Installing Wire Rope
- Extreme care shall be used to prevent wire rope from kinking, nicking, or from sustaining other damage during installation. Rope shall not be installed by pulling from flat coil, but shall be carefully unrolled its full length or placed on a horizontal axis and unreeled according to wire rope industry standards.
- 2. For right lay rope, the rope shall be attached to the drum on the end opposite the winch gear train, and wound on drum so that the free end of the rope comes off the backside of the drum during normal operation of the winch. Rope must be unreeled carefully as stated above. Care must be taken to insure that all layers lay full and tight on drum.
- 3. Installation of all wire rope shall be accomplished only under direct supervision of the Engineer or his authorized representative. Contractor shall not remove wire rope from manufacturer's reel until authorized by the Engineer. Installation of wire rope on winch shall be in accordance with the above and accepted industry practice. Installation of the three hoist cables shall be made from the top end of the pole and as directed by the Engineer or his representative.
- C. Installing Wire Rope Clips
- 1. Turn back approx. 2' 3" of rope, measured from the top of thimble. Apply seizing to pigtail end of wire rope prior to cutting to length. See detail "K", Sheet 3. Apply first clip approx. 3" from the dead end of the wire rope with U-bolt over dead end and live end in clip saddle. Tighten nuts evenly to 30 pound-feet of torque, or as recommended by manufacturer.
- Install second clip as near loop as possible, take out slack and torque nuts evenly to 30 pound-feet or as recommended by manufacturer.
- After final erection and assembly of the pole and high most assembly, retighten nuts to required torque.
- D. Installing Light Ring and Luminaires
- Prior to mounting luminaires to the light ring, Contractor shall ensure the ring is level. Luminaires shall be mounted level on the light ring. Luminaires shall be oriented as shown

Texas Department of Transportation

Traffic Operations Division

HIGH MAST
ILLUMINATION
DETAILS

HMID(9)-03

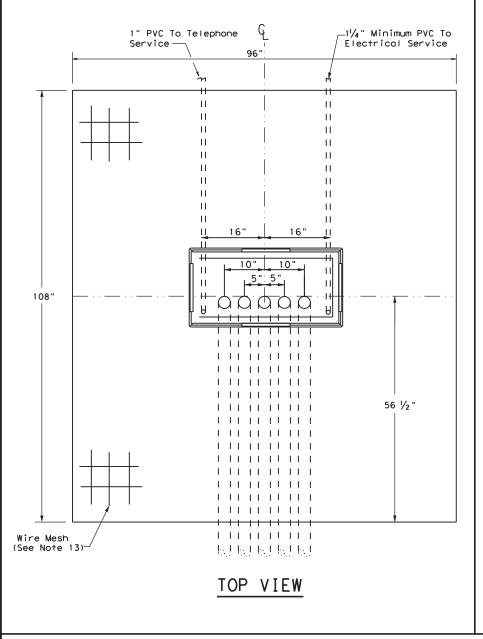
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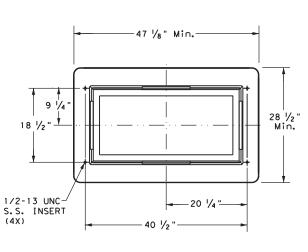
3/03 Revision

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Construction
Methods.

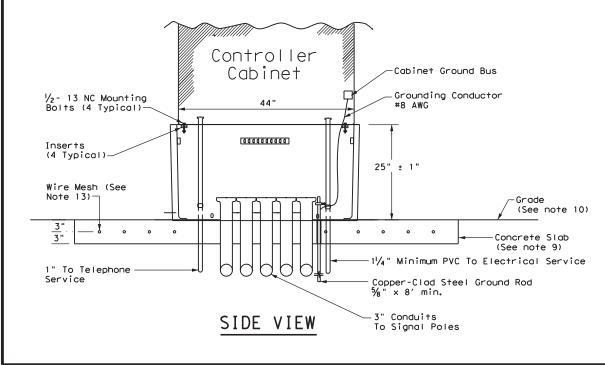
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CABINET BASE



TRAFFIC SIGNAL CONTROLLER BASE:

- Provide a traffic signal controller base (cabinet base) manufactured of polymer concrete material consisting
 of calcareous and siliceous stone; glass fibers and thermoset polyester resin. The polymer concrete cabinet
 base must be reinforced on the inside of the cabinet base with fiberglass matting. Provide one of the
 following bases: Armorcast Part # A6001848X24, Quazite Model # PG3048Z709, or other as approved by TxDOT
 Traffic Safety Division.
- 2. The polymer concrete material must have a minimum compressive strength of 10,300 pounds per square inch (psi), minimum flexural strength of 3600 psi, and minimum shear strength of 3600 psi.
- The polymer concrete cabinet base must conform to the dimensions shown and must accommodate a standard TxDOT basemount cabinet.
- 4. Supply the cabinet base with four 1*2"-13 UNC stainless steel inserts for attachment of the cabinet to the base. Inserts must withstand a minimum torque of 50 ft-1b and a minimum straight pull out strength of 750 lbs.
- 5. Provide the cabinet base with 4 cable racks mounted one on each side of the base 2" to 7 " from the top edge of the base. Unless approved otherwise, cable racks must be 1-1/2 x 9#16x 3#16inch steel channel with eight T-slots spaced at 1-1/2 inches. The cable racks must easily accommodate the insertion of tie wraps to attach field wiring to the racks to serve as strain relief. Secure cable racks to the base using 1#2"-13 UNC stainless steel screws and inserts.
- 6. The cabinet base, when secured to the concrete slab with controller cabinet attached, must withstand a minimum wind load of 125 mph or a 850 lb force applied at 49" above the bottom of the base without causing the base or cabinet to come out of their anchored position or cause any permanent deformation. The manufacturer must supply certification by an independent testing laboratory or sealed by a Texas Licensed Professional Engineer. Provide the cabinet base with hardware for attachment to a concrete slab.
- 7. The traffic signal base must be permanently marked either by impress or by permanent ink with the manufacturer's model number and name or logo.
- 8. Seal the base to the concrete with a silicone caulk bead and fastened to the slab per manufacturer's instructions.

CONCRETE SLAB:

- 9. Traffic signal controller pad must be a portland cement concrete slab poured in place, must conform to the dimensions shown, and must be level.
- 10. Grade earthwork such that it is flush with the concrete pad on all four sides, unless otherwise shown on the plans. Subsidiary to ITEM 680, four inch rip rap may be used in lieu of earthwork. Slopes shall gradually contour to match plans.
- 11. Bond a #8 AWG copper ground wire and an 8 ft ground rod bonded to the reinforcing mesh by a suitable UL Listed clamp and terminated to the cabinet grounding bus for the purpose of providing a local ground for the electrical grounding conductor. The electrical grounding conductor specified in Item 680-3.A.4 is required and must be terminated to the cabinet ground bus.
- 12. Install a PVC sleeve to prevent the ground rod from direct embedment in the slab.
- 13. Provide welded wire mesh 6X6-W2.9 X W2.9 for reinforcement. Provide joints and splices in the mesh with a minimum 6-inch overlap. Center the mesh between top and bottom and provide a minimum 3 inch cover on the edges.
- 14. Provide Class B concrete minimum for the slab in accordance with Item 421. Construct the slab in accordance with Item 531.

CONDUITS:

- 5. Stub up and run 3-inch conduits through the slab to the various traffic signal poles and ground boxes as shown on the layouts. Install the number of conduits as shown on layouts plus two additional 3 inch conduits for future use. Terminate the conduits with a bushing between 2 and 4-inches above the slab.
- 16. Extend conduits for future use at least 18-inches from the edge of the slab, terminate underground with a coupling, and cap and seal so that the seal can be removed without damaging the coupling. This must also apply to unused telephone conduit.
- 17. Stub up two separate conduits through the slab from the electrical and telephone services. Run the conduit for the electrical feed directly to the electrical service enclosure. Run the conduit for the telephone line directly to the telephone service, usually located on the same pole as the electrical service. Telephone must not under any circumstance share a conduit with any other function.
- 18. Terminate electric and telephone conduits above the slab with a coupling. After the base is installed, extend the conduits above the top of the base and secure to the base using a steel one-hole strap or similar suitable substitute.

CONTROLLER CABINET:

- 19. Anchor the controller cabinet to the base using four stainless steel 1/2-13 NC bolts.
- 20. The silicone caulk bead specified in Item 680.3.B must be RTV 133.

PAYMENT:

21. Bid TS-CF as subsidiary to Item 680.



TRAFFIC SIGNAL

Traffic Safety Division Standard

CONTROLLER CABINET
BASE AND PAD
TS-CF-21

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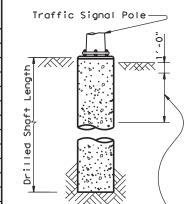
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FOUNDATION DESIGN TABLE RE I NF ORC I NG EMBEDDED DRILLED FOUNDATION
DESIGN
LOAD LOAD EXAS CONE PENETROMETER BOL T CIR TYPE SHAFT TYPICAL APPLICATION Fy (ksi) SPIRAL ANCHOR VERT BARS MOMENT SHEAR N blows/ft **BOLT** DIA TYPE 10 DIA 15 40 K-ft Kips DIA Pedestal pole, pedestal mounted 24-A 24" 3/4" 36 12 3/4 10 4- #5 | #2 a+ 12 5.7 5.3 4.5 controller. 30 - A 30" 8- #9 |#3 at 6 11.3 10.3 8.0 1 1/2' 55 17" 87 3 Mast arm assembly. (see Selection Table) Mast arm assembly. (see Selection Table) 30' strain pole with or without luminaire 36-A 36" #3 at 6 13.2 12.0 9.4 1 3/4" 55 19" 2 131 Mast arm assembly. (see Selection Table) Strain pole taller than 30' & strain pole with mast arm 2" 55 21" 36-B 36" 12-#9 #3 at 6" 15.2 13.6 10.4 2 190 42-A 42" 14- #9 #3 at 6" 17.4 15.6 11.9 2 1/4" 55 23" 2 271 Mast arm assembly. (see Selection Table)

	FOUNDATION SELE ARM PLUS IL	CTION TABL SN SUPPORT	E FOR STANDA ASSEMBLIES	ARD MAST (ft)	
		FDN 30-A	FDN 36-A	FDN 36-B	FDN 42-A
80 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH	32'	48′		
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS	24' X 24'			
		28' X 28'			
		32' X 28'	32' X 32'		
			36′ X 36′		
			40' X 36'		
~			44′ X 28′	44′ X 36′	
z	MAX SINGLE ARM LENGTH		36′	44'	
200	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS		24' X 24'		
			28' X 28'		
100 MPH DESIGN WIND SPEED			32' X 24'	32' X 32'	
				36′ X 36′	
				40′ ×24′	40′ X 36′
-					44′ × 36′



Use average N value over the top third of the

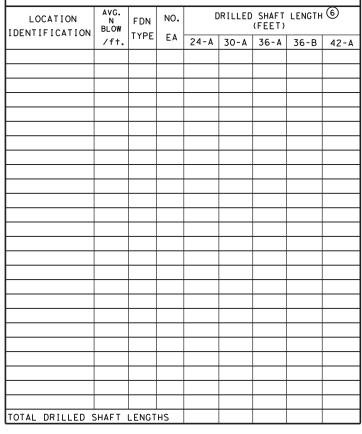
embedded shaft.

NOTES:

- 1 Anchor bolt design develops the foundation capacity given under Foundation Design Loads.
- (2) Foundation Design Loads are the allowable moments and shears at the base of the structure.
- 3 Foundations may be listed separately or grouped according to similarity of location and type. Quantities are for the Contractor's information only.
- 4 Field Penetrometer readings at a depth of approximately 3 to 5 feet may be used to adjust shaft lengths.
- (5) If rock is encountered, the Drilled Shaft shall extend a minimum of two diameters into solid rock.
- (6) Decimal lengths in Design Table are to allow interpolation for other penetrometer values. Round to nearest foot for entry into Summary Table.

ANCHOR BOLT & TEMPLATE SIZES								
BOLT DIA IN.	7 BOLT LENGTH	TOP THREAD	BOTTOM THREAD	BOLT CIRCLE				
¾ "	1'-6"	3"	_	12 ¾"	7 1/8"	5 % "		
1 1/2 "	3′-4"	6"	4"	17"	10"	7"		
1 3/4"	3'-10"	7"	4 1/2"	19"	11 1/4"	7 3/4"		
2"	4'-3"	8"	5"	21"	12 ½"	8 ½"		
2 1/4"	4'-9"	9"	5 1/2"	23"	13 3/4"	9 1/4"		

(7) Min dimensions given, longer bolts are acceptable.



FOUNDATION SUMMARY TABLE

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and interim revisions thereto.

Reinforcing Steel shall conform to Item 440, "Reinforcing Steel".

Concrete shall be Class "C".

Threads for anchor bolts and nuts shall be rolled or cut threads of 8UN series up to 2" in diameter or UNC series for all sizes. Bolts and nuts shall have Class 2A and 2B fit tolerances. Galvanized nuts shall be tapped after galvanizing.

Anchor bolts that are larger than 1" in diameter shall conform to "alloy steel" or "medium-strength mild steel" per Item 449, "Anchor Bolts". Anchor bolts that are 1" in diameter or less shall conform to ASTM A36. Galvanize a minimum of the top end thread length plus 6" for all anchor bolts unless otherwise noted. Exposed washers and exposed nuts shall be galvanized. All galvanizing shall be in accordance with Item 445, "Galvanizing".

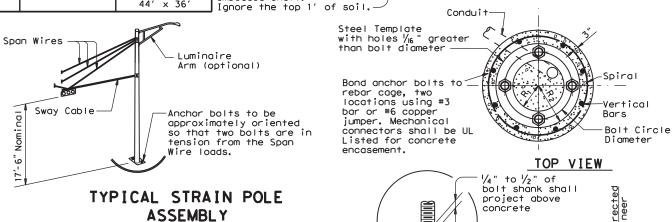
Templates and embedded nuts need not be galvanized. Lubricate and tighten anchor bolts when erecting the structure in accordance with Item 449, "Anchor Bolts".

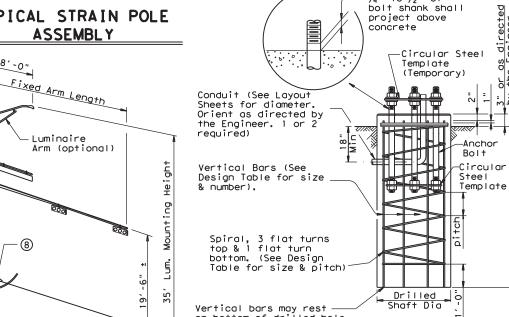


TRAFFIC SIGNAL POLE FOUNDATION

TS-FD-12

	C TxDOT August 1995	DN: MS		CK: JSY	DW:	MAO/MMF	CK: JSY/TEB	ı
16	REVISIONS	CONT	SECT	JOB	HIGHWAY		GHWAY	ı
2		6427	57	001		US 67		
		DIST		COUNTY			SHEET NO.	ı
		23		BROWN	1		52	ı





(TYPE 1) ANCHOR BOLT ASSEMBLY

(8) Orient anchor bolts orthogonal with the fixed arm direction to ensure that two bolts are in tension under dead load.

EXAMPLE:

¼" thk. min. Circular Steel

Top Template

vanîze L Top Thr Jus 6" №

(Omit bottom template for FDN 24-A)

Type

R=d-

1 ½" Min

Circular Steel Bottom Template

HOOKED ANCHOR

another arm up to 28°

-Heavy Hex Nut (Typ)

1. For 80mph design wind speed, foundation

30-A can support up to a 32' arm with

2. For 100mph design wind speed, foundation 36-A can support a single 36' mast arm.

-Type 2

Thickness =

d/4 (inch) min.

2 Flat Washers

per Anchor Bolt

Supporting Luminaire Arm (optional) <2 Sides</p> **NUT ANCHOR** (TYPE 2) 8

TYPICAL MAST ARM

ASSEMBLY

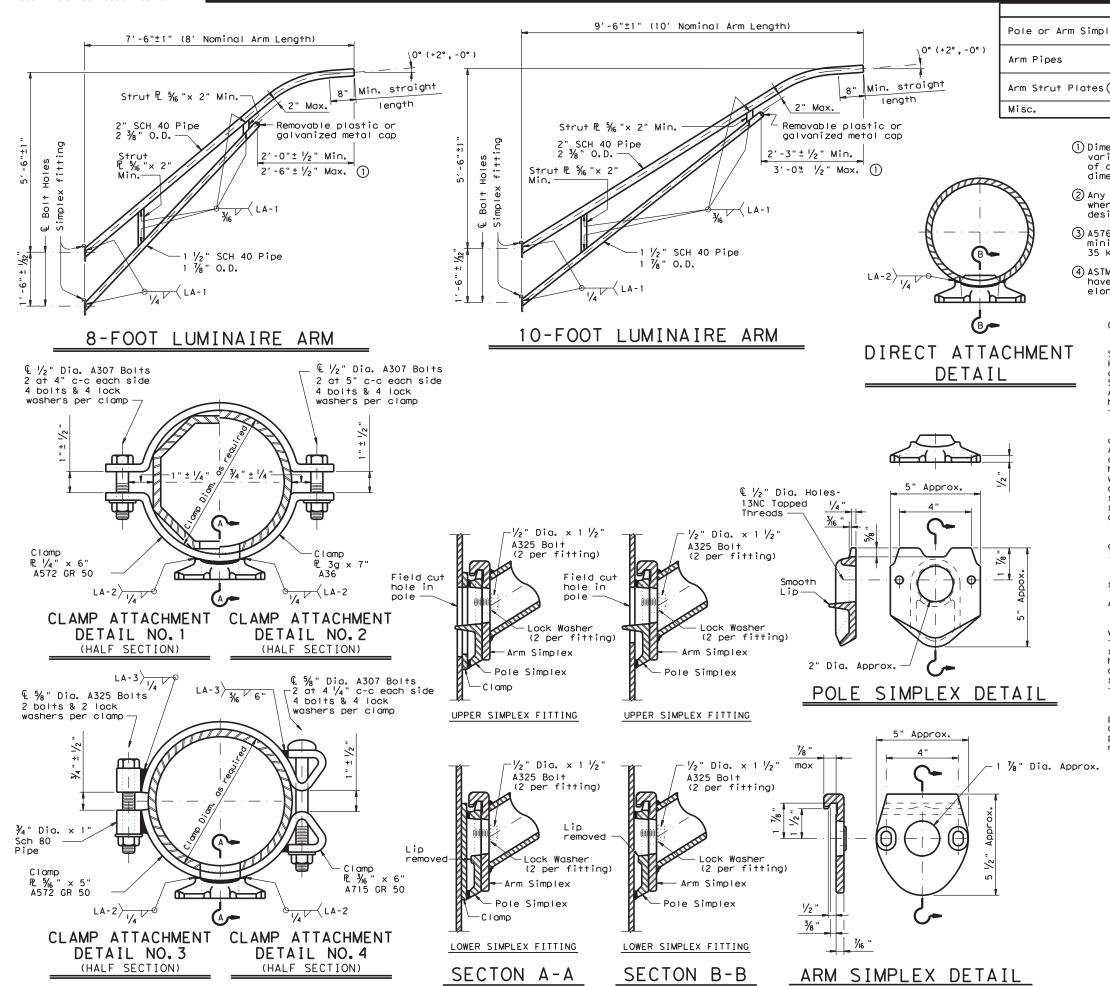
Clamp Arm Length

TI SN

8'-0"

on bottom of drilled hole if material is firm enough to do so when concrete is placed.

ELEVATION FOUNDATION DETAILS



- (1) Dimensional limits are given to show acceptable variation in design. All of a Fabricator's production of a particular arm length shall have the same dimensions within specified tolerances.
- ② Any of the materials listed for plates may be used where the drawings do not specify a particular ASTM designation.
- (3) A576 must be suitable for forging and also meet minimum tensile strength of 65 ksi, minimum yield of 35 ksi, and elongation in 2 inches of 22 percent.
- (4) ASTM A572, A1008 HSLAS-F, and A1011 HSLAS-F may have higher yield strengths but shall not have less elongation than the grade indicated.

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Revisions thereto. Design Wind Speed equals 90 mph plus a 1.3 gust factor. Arms are designed to support a 60 lb. luminaire having an effective projected area (actual area times drag coefficient) of 1.6 sq. ft.

Materials and fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the Fabricator must obtain prior to fabrication. In the absense of specified Fabricaton tolerances, dimensions shall be within the tolerances generally obtainable in normal fabrication practice.

Unless otherwise noted, all parts shall be galvanized after fabrication in accordance with Item 445, "Galvanizing".

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.

Each pole simplex fitting shall be supplied with 2 ASTM A325 bolts and 2 lock washers of the size specified. The bolts and lock washers shall be secured to the pole with the other hardware items called for in the plans. When clamp attachment is specified, the Fabricator shall ship the clamp assembly securely attached to the pole at the location shown on the plans.

If clamp assemblies are ordered without poles, the Fabricator shall ship one upper and one lower clamp assembly together in a single package, including all nuts and washers required for the clamps and simplex fittings.



ARM DETAILS

LUM-A-12

CTxDOT August 1995	DN: LEH	1	CK: JSY	DW: LTT	CK: TEB	
96 REVISIONS	CONT	SECT	JOB		HIGHWAY	
-99 -12	6427	57	001		US 67	
	DIST	COUNTY			SHEET NO.	
	23		BROWN	l	53	