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HNTB Corporation
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WILLIAMSON COUNTY, TEXAS
CHANGE ORDER NUMBER: 31

1. CONTRACTOR: **Dan Williams Company**

2. Change Order Work Limits: Sta. **234+50 BL** Sta. **235+00 BL**

3. Type of Change(on federal-aid non-exempt projects): **Minor** (Major/Minor)

4. Reasons: **3F** (3 Max. - In order of importance - Primary first)

Project:	***09WC720***
Roadway:	***US 183***
CSJ Number:	***0151-04-063, etc.***

5. Describe the work being revised:

3F: County Convenience. Additional work desired by the County. This change order provides for the installation of permanent traffic counters to quantify traffic on Northbound and Southbound US 183 for Williamson County reimbursement in accordance with the Pass Through Financing Agreement with TxDOT.

6. Work to be performed in accordance with Items: **See Attached**
7. New or revised plan sheet(s) are attached and numbered: **Sheets 605 through 614**
8. New Special Provisions to the contract are attached: ☐ Yes ☑ No
9. New Special Provisions to Item N/A No. N/A, Special Specification Item N/A are attached.

Each signatory hereby warrants that each has the authority to execute this Change Order (CO).

The contractor must sign the Change Order and, by doing so, agrees to waive any and all claims for additional compensation due to any and all other expenses; additional changes for time, overhead and profit; or loss of compensation as a result of this change.

THE CONTRACTOR Date 8/29/11

By

Typed/Printed Name GEORGE MAYFIELD

Typed/Printed Title PM

The following information must be provided

Time Ext. #: **N/A** Days added on this CO: **0**

Amount added by this change order: **$40,021.92**

RECOMMENDED FOR EXECUTION:

P.E. 9/7/11
Project Manager Date

N/A
Design Engineer Date

9/7/2011
Program Manager Date

Design Engineer's Seal:

See Revised Sheets

County Commissioner Precinct 1 Date
☐ APPROVED ☐REQUEST APPROVAL

County Commissioner Precinct 2 Date
☐ APPROVED ☐REQUEST APPROVAL

County Commissioner Precinct 3 Date
☐ APPROVED ☐REQUEST APPROVAL

County Commissioner Precinct 4 Date
☐ APPROVED ☐REQUEST APPROVAL

☐ County Judge Date
APPROVED

WILLIAMSON COUNTY, TEXAS

CHANGE ORDER NUMBER: ***31*** ***Project #*** ***09WC720***

TABLE A: Force Account Work and Materials Placed into Stock

	LABOR	HOURLY RATE			HOURLY RATE

TABLE B: Contract Items

				ORIGINAL + PREVIOUSLY REVISED		ADD or (DEDUCT)	NEW		
ITEM	DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	ITEM COST	QUANTITY	QUANTITY	ITEM COST	OVERRUN/ UNDERRUN
416-WC01	DRILL SHAFT (RDWY ILLUM POLE) (30 IN)	LF	$132.56	0.00	$0.00	16.00	16.00	$2,121.00	$2,121.00
432-2084	RIPRAP (CONC)(CL B)(4")	CY	$1,272.60	0.00	$0.00	0.70	0.70	$890.82	$890.82
610-WC01	INS RDWY ILL ASSEM (30')(SHOE-BASE)	EA	$2,067.98	0.00	$0.00	1.00	1.00	$2,067.98	$2,067.98
610-WC02	INS RDWY ILL ASSEM (30')(T-BASE)	EA	$2,862.00	0.00	$0.00	1.00	1.00	$2,862.00	$2,862.00
999-0030	ASSIST TRAFFIC COUNTER PROVIDER WITH INSTALL	LS	$3,446.63	0.00	$0.00	1.00	1.00	$3,446.63	$3,446.63
999-0031	RADAR VEHICLE SENSING DEVICE ASSEMBLY	EA	$14,316.75	0.00	$0.00	2.00	2.00	$28,633.50	$28,633.50
TOTALS					$0.00			$40,021.92	$40,021.92

CHANGE ORDER REASON(S) CODE CHART

1. Design Error or Omission	1A. Incorrect PS&E 1B. Other
2. Differing Site Conditions (unforeseeable)	2A. Dispute resolution (expense caused by conditions and/or resulting delay) 2B. Unavailable material 2C. New development (conditions changing after PS&E completed) 2D. Environmental remediation 2E. Miscellaneous difference in site conditions (unforeseeable)(Item 9) 2F. Site conditions altered by an act of nature 2G. Unadjusted utility (unforeseeable) 2H. Unacquired Right-of-Way (unforeseeable) 2I. Additional safety needs (unforeseeable) 2J. Other
3. County Convenience	3A. Dispute resolution (not resulting from error in plans or differing site conditions) 3B. Public relations improvement 3C. Implementation of a Value Engineering finding 3D. Achievement of an early project completion 3E. Reduction of future maintenance 3F. Additional work desired by the County 3G. Compliance requirements of new laws and/or policies 3H. Cost savings opportunity discovered during construction 3I. Implementation of improved technology or better process 3J. Price adjustment on finished work (price reduced in exchange for acceptance) 3K. Addition of stock account or material supplied by state provision 3L. Revising safety work/measures desired by the County 3M. Other
4. Third Party Accommodation	4A. Failure of a third party to meet commitment 4B. Third party requested work 4C. Compliance requirements of new laws and/or policies (impacting third party) 4D. Other
5. Contractor Convenience	5A. Contractor exercises option to change the traffic control plan 5B. Contractor requested change in the sequence and/or method of work 5C. Payment for Partnering workshop 5D. Additional safety work/measures desired by the contractor 5E. Other
6. Untimely ROW/Utilities	6A. Right-of-Way not clear (third party responsibility for ROW) 6B. Right-of-Way not clear (County responsibility for ROW) 6C. Utilities not clear 6D. Other

Williamson County Pass Through Financing

US 183 Riva Ridge Drive to SH 29
Williamson County Project No. 09WC720

Change Order No. 31

Reason for Change

This project is part of the Pass Through Financing program between Williamson County and TxDOT. As such, Williamson County will get reimbursed by TxDOT for project costs based on the number of vehicles that travel the completed roadway. Therefore, this change order provides payment for work related to the installation of two permanent traffic counters that will track the number of vehicles that travel on Northbound and Southbound US 183, just south of Riva Ridge Drive.

Following is a summary of the new items required for this Change Order.

Item	Description	Unit	Qty
416-WC01	DRILL SHAFT (RDWY ILLUM POLE) (30 IN)	LF	16.00
432-2084	RIPRAP (CONC)(CL B)(4")	CY	0.70
610-WC01	INS RDWY ILL ASSEM (30') (SHOE-BASE)	EA	1.00
610-WC02	INS RDWY ILL ASSEM (30') (T-BASE)	EA	1.00
999-0030	ASSIST TRAFFIC COUNTER PROVIDER WITH INSTALL	LS	1.00
999-0031	RADAR VEHICLE SENSING DEVICE ASSEMBLY	EA	2.00

This Change Order results in a net increase of $40,021.92 to the Contract amount, for an adjusted total Contract amount of $15,439,974.58. The original Contract amount was $14,677,727.84. As a result of this and all Change Orders to date, $762,246.74 has been added to the Contract, resulting in a 5.2% net increase in the Contract Cost. No additional days will be added to or deducted from the Contract as a result of this Change Order.

HDR Engineering, Inc.

J. Paul Bowen, S.E.T
Resident Representative

ITEM	DESCRIPTION	UNIT	QTY	UNIT PRICE	AMOUNT
416-2029	DRILL SHAFT (RDWY ILLUM POLE 30")	16.00	LF	$132.56	$2,121.00
432-2084	RIP RAP (CL B 4")	0.70	CY	$1,272.60	$890.82
610-XXX	INS RDWY ILL ASSEM (30') (T-BASE)	1.00	EA	$2,862.00	$2,862.00
610-XXX	INS RDWY ILL ASSEM (30" SHOE BASE)	1.00	EA	$2,067.98	$2,067.98
XXX-XXX	ASSIST TRAFFIC COUNTER PROV	1.00	LS	$3,446.63	$3,446.63
XXX-XXX	RADAR VEHICLE SENSING DEVICE ASSM	2.00	EA	$14,316.75	$28,633.50
					$40,021.92

EXCLUSIONS **AS PER ATTACHED**
ALSO MONTHLY BARRICADES ARE NOT INCLUDED

P.O. Box 760
Cedar Park, Texas 78630-0760

(512) 258-1025
Fax (512) 258-1026

8/16/2011

Control No: 0151-04-063
Project: PTF 2009 (886)
County: Williamson
Highway: US 183

We at G. Carter Construction Company, Inc. are pleased to quote the bid items below on the above referenced project:

Item No.	Bid Item	Description	Qty	Unit	Unit Price	Extension
1	416-2029	DRILL SHAFT (RDWY ILLUM POLE) (30 IN)	16	LF	$ 125.00	$ 2,000.00
2	432-2084	RIPRAP (CONC) (CL B) (4")	0.7	CY	$ 1,200.00	$ 840.00
3	610-xxxx	INS RDWY ILL ASSEM (30') (SHOE-BASE)	1.0	EA	$ 1,950.00	$ 1,950.00
3A	610-xxxx	INS RDWY ILL ASSEM (30') (T-BASE)	1.0	EA	$ 2,700.00	$ 2,700.00
4	xxx-xxxx	ASSIST TRAFFIC COUNTER PROV	1.0	LS	$ 3,250.00	$ 3,250.00
5	xxx-xxxx	RADAR Vehicle Sensing Device Assm	2.0	EA	$ 13,500.00	$ 27,000.00
		TOTAL			**$**	**37,740.00**

These prices do not include any Bond, Traffic Control or Engineering. If Bond is required, the General Contractor will add 3 1/2% to the Bid. These prices are contingent on being awarded all items bid.

G. Carter Construction Company, Inc. is a State Certified WBE and HUB.

If additional information is needed, please contact me at (512) 258-1025.

Sincerely,

Pete Smith

Pete Smith
Vice President

WILLIAMSON COUNTY
1848

WILLIAMSON COUNTY
ENGINEERING DEPARTMENT
3151 SE INNER LOOP
GEORGETOWN, TEXAS 78626

US 183

PERMANENT TRAFFIC COUNTERS
REQUEST FOR PROPOSAL

GENERAL CONDITIONS

1. PURPOSE AND LOCATIONS

   a) Purpose : The County's goal is to accurately count amounts of vehicle traffic on roadways. The County seeks proposals from firms that are trained, experienced, and qualified in providing, installing, and servicing permanent traffic counters.

   b) Location : A permanent traffic counter is needed on US 183 approximately 3 miles south of SH 29.

2. SCOPE OF WORK

   It is the intent of this contract to provide permanent traffic counters for Williamson County. The contractor shall provide traffic counters as described herein including all labor, supplies, materials, and equipment, and must meet all specifications and plans listed in this Request for Proposal.

3. ITEMS and PRICING

   Proposal Items will include the following:

Description	Quantity	Unit Measure
Drill Shaft (Rdwy III Pole) (30 In)	16	LF
Riprap (Conc) (Cl B) (4")	0.70	CY
Ins Rdwy III Assem (30') (Shoe)	2	Each
Assist Traffic Counter Provider with Installation of Counter Assemblies	1	Lump Sum
Radar Vehicle Sensing Device Assembly	2	Each
Radar Vehicle Sensing Device (RSVD)	2	*
Surge Protector	2	*
40' Pigtail	2	*
Cabinet with Mounting Bracket	2	*
Wireless Modem	2	*
Modem Cable	2	*
Solar Assembly	2	*
Battery (Valve-Regulated, Gelled-Electrolyte Battery, MK Battery 8G31 or pre-approved equal)	6	*

*Subsidiary to RVSD Assembly

Each RVSD Assembly consists of installation of one (1) Radar Vehicle Sensing Device, one (1) Surge Protector, one (1) 40' Pigtail, one (1) Cabinet with Mounting Brackets, one (1) Wireless Modem, one (1) Modem Cable, one (1) Solar Assemblies, and three (3) Batteries, including all materials, equipment, labor, tools, and incidentals to complete the assembly and testing in accordance with the plans and specifications.

4. GOVERNING SPECIFICATIONS AND PLANS

GOVERNING SPECIFICATIONS
The following specifications will be applicable to this project and are identified as follows:

ITEM 416	Drilled Shaft Foundations
ITEM 432	Riprap
ITEM 610	Roadway Illumination Assemblies
ITEM WC-620	Electrical Conductors
ITEM 6011	Testing, Training, Documentation, Final Acceptance, and Warranty
ITEM 6013	Electronic Components
ITEM WC-0001	Radar Vehicle Sensing Device (RVSD) – Solar Powered with Cell Modem Communication
ITEM WC-0002	Surge Suppression Model

PLANS
Plan Sheets for the Construction of Radar Vehicle Sensing Devices: 605-614
Plan Sheets for the Construction of Poles, Pole Foundations and RVSD: 605-614

5. GENERAL NOTES

Install Solar Panel. Orient the solar panel for optimum exposure to sunlight (face to the south). Prior to installation, check the location to ensure there is not overhead obstruction that would block the solar panel from receiving full sunlight.

Install RVSD. Orient RVSD per manufacturer's requirements.

Install Battery Cabinet, Batteries, Equipment Cabinet, Cables, Surge Protector, Modem and Mounting Brackets

Install wireless modem and surge protector.

Pull cables in pole and cabinets. Verify all cables are installed correctly and connected to appropriate equipment.

Configure sensor, wireless modem and data collector for communication over wireless network to Williamson County Central Maintenance Facility.

Set up cell phone service under name provided by Williamson County. The contractor will pay for service until the installation is completed and Williamson County take ownership.

Verify the system is complete and functional per manufacturer's specifications.

Provide testing, training, documentation, final acceptance and warranty per Special Specification 6011.

Meet weekly with the Engineer to notify him or her of planned work for the upcoming week.

Equip all construction equipment in roadway work with a permanently mounted 3600 revolving or strobe warning light with amber lens. Light will have a minimum lens height and diameter of 5 in. and mounting height of not less than 6 ft. above the roadway surface and be visible from all sides. Attach at each side of the rear end of the construction equipment an approved orange warning flag mounted not less than 6 ft. above the roadway surface.

Overhead and underground utilities exist in the vicinity of the project. The exact location of underground utilities is not known. Contact the Texas Excavation Safety Systems (TESS) or DIG TESS at 1-800-344-8377 or the area utility companies for exact locations at least 48 hours before commencing any work that might affect present utilities.

Remove all litter, construction debris and surplus material on the right of way within the project limits to keep the jobsite in a neat and presentable condition at all times. Consider subsidiary to pertinent Items.

Protect all areas of the right of way which are not included in the actual limits of the proposed construction areas from destruction. Exercise care to prevent damage to trees, vegetation, and other natural surroundings. Areas not to be disturbed will be as directed. Restore any area disturbed as a result of the Contractor's operations to a condition as good as, or better than before the beginning of work.

All locations used for storing construction equipment, materials, and stockpiles of any type within the right of way will be as directed. Use of right of way for these purposes will be restricted to those locations where driver sight distance to businesses and side street intersections is not obstructed and at other locations where an unsightly appearance will not exist. At no time will material and equipment be stored within State ROW without prior written approval from the Engineer, who will coordinate with the Texas Department of Transportation.

ITEM 416

Stake all pole foundation locations for approval before beginning drilling operations.

ITEM 432

Provide Class B concrete for riprap with 6" x 6" (W2.9 x W2.9) welded wire fabric reinforcement.

ITEM 610

Use materials from prequalified material producers list as shown on the Texas Department of Transportation (TxDOT) Construction Division's (CST) Materials Producers List. See http://www.dot.state.tx.us/txdot_library/publications/producer_list.htm for list of pre-qualified manufacturers. Category is "Roadway Illumination and Electrical Supplies".

Neatly stockpile the assemblies upon removal as directed at the Austin District Headquarter located at 7901 N. IH 35.

Fabricate steel roadway illumination poles in accordance with TxDOT standards RIP-07 (Roadway Illumination Poles – 2007). Poles fabricated according to RIP-07 require no shop drawings.

Alternate designs to RIP-07 or the use of aluminum to fabricate poles will require the submission of shop drawings.

Inspection of all completed work provided in the contract will be performed. The Contractor will be released from further maintenance if the work is found to be satisfactory. Partial acceptance will be made and will be in no way void or alter any items of the contract.

ITEM 620

Do not use non-certified persons to perform electrical work. See Item 7.15 "Electrical Requirements" for additional details.

Provide breakaway disconnects in all breakaway poles including ped poles and flashing beacons installed within the project. Use Bussman HEBW, Littlefuse LEB, Ferraz-Shawmut FEB, or equal on ungrounded conductors. For 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.

Identify the conductors, when two or more conductors are present in one conduit or enclosure. Use a tag with a single plastic strap as directed when the identification tag with two plastic straps is too large for the conductors. Each tag will indicate circuit number, letter, or other identification as shown on the plans.

Bond grounding conductors which share the same conduit, junction box or structures together at every accessible point in accordance with the Electrical Detail Standard Sheets and the latest edition of the National Electric Code.

All wiring will be in accordance with the National Electric Code and the appropriate Texas Department of Transportation standard sheets.

SPECIAL SPECIFICATION

WC-620

ELECTRICAL CONDUCTORS

1. **Description.** Furnish and place electrical conductors, except conductors specifically covered by other Items.

2. **Materials.** Provide new materials that comply with the details shown on the plans and the requirements of this Item. Use stranded insulated conductors that are rated for 600 volts; approved for wet locations; and marked in accordance with UL, NEC, and CSA requirements. Furnish electrical conductors in accordance with DMS-11040, "Electrical Conductors."

Provide electrical conductors from manufacturers prequalified by the Department. The Traffic Operations Division maintains a list of prequalified electrical conductor manufacturers.

Ensure that all grounding conductors size AWG No. 8 and larger are stranded, except for the grounding electrode conductor, which will be a solid conductor.

Use white insulation for grounded (neutral) conductors, except that grounded conductors AWG No. 8 and larger may be black with white tape marking at every accessible location. Do not use white insulation or marking for any other conductor except control wiring specifically shown on the plans.

Ensure that insulated grounding conductors are green except that insulated grounding conductors AWG No. 8 and larger may be black with green tape marking at every accessible location. Do not use green insulation or marking for any other conductor except control wiring specifically shown on the plans.

3. **Construction.** Splice conductors only in junction boxes, ground boxes, and transformer bases, and in poles and structures at the hand holes. Splice as shown on the plans. Do not exceed the manufacturer's recommended pulling tension. Use lubricant as recommended by the manufacturer. Install conductors in accordance with the NEC.

Make insulation resistance tests on the conductors prior to making final connections, and ensure that each continuous run of insulated conductor has a minimum DC resistance of 5 megohms when tested at 1,000 volts DC. The Engineer may require verification testing of all or part of the conductor system. The Engineer will witness these verification tests. Replace conductors exhibiting an insulation resistance of less than 5 megohms.

4. **Measurement and Payment.** The work performed and materials furnished in accordance with this Item will be will be subsidiary to pertinent Items, including furnishing, installing, and testing electrical conductors and for equipment, labor, tools, and incidentals.

SPECIAL SPECIFICATION

6011

Testing, Training, Documentation, Final Acceptance, and Warranty

1. **Description.** Perform or furnish testing, training, documentation, final acceptance, and warranty on the applicable equipment or systems.

2. **Testing.** Unless otherwise shown on the plans, perform the following tests on the applicable equipment or systems.

   A. **Test Procedures Documentation.** Provide 5 copies of the test procedures and blank data forms 60 days prior to testing for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will approve test procedures prior to submission of equipment for tests. Conduct all tests in accordance with the approved test procedures.

   Record test data on the data forms, as well as quantitative results. Ensure the data forms are signed by an authorized representative (company official) of the equipment manufacturer. Submit 1 copy of the completed and signed data forms for acceptance or rejection of the test or equipment.

   B. **Design Approval Test.** Conduct a Design Approval Test on randomly selected units from the prototype design manufacturing run. If only 1 design prototype is manufactured, perform this test on that unit. If supplying multiple types of the equipment, provide and test a sample of each type.

   Certification from an independent testing laboratory of a successfully completed Design Approval Test is acceptable. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification. Failure of independent tests to comply with the requirements of this specification will be grounds for rejection of any certification.

   Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

   1. **Power Service Transients.** The equipment shall meet the performance requirements, specified in the parent specification, when subjected to the power service transients as specified in Section 2.2.7.2, "Transient Tests (Power Service)" of the NEMA TS 2 standard, latest edition.

   2. **Temperature and Condensation.** The equipment shall meet the performance requirements, specified in the parent specification, when subjected to the following conditions in the order specified below:
      - Stabilize the equipment at -30°F and test as specified in Sections 2.2.7.3, "Low-Temperature Low-Voltage Tests" and 2.2.7.4, "Low-Temperature High-Voltage Tests" of the NEMA TS 2 standard, latest edition.
      - Allow the equipment to warm up to room temperature in an atmosphere having relative humidity of at least 40%. Operate the equipment for 2 hr., while wet, without degradation or failure.
      - Stabilize the equipment at 165°F and test as specified in Sections 2.2.7.5, "High-Temperature High Voltage Tests" and 2.2.7.6, "High-Temperature Low-Voltage Tests" of the NEMA TS 2 standard, latest edition.

   3. **Relative Humidity.** The equipment shall meet the performance requirements, specified in the parent specification, within 30 min. of being subjected to a temperature of 165°F and a relative humidity of 18% for 48 hr.

   4. **Vibration.** The equipment shall show no degradation of mechanical structure, soldered components, or plug-in components and shall operate in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in Section 2.2.8, "Vibration Test" of the NEMA TS 2 standard, latest edition.

   5. **Power Interruption.** The equipment shall meet the performance requirements, specified in the parent specification, when subjected to nominal input voltage variations as specified in Section 2.2.10 "Power Interruption Test" of the NEMA TS 2 standard, latest edition.

C. **Demonstration Test.** Conduct a Demonstration Test on applicable equipment at an approved Contractor facility. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

1. **Examination of Product.** Examine each unit carefully to verify that the materials, design, construction, markings and workmanship comply with the requirements of the parent specification.

2. **Continuity Tests.** Check the wiring to determine conformance with the requirements of the appropriate paragraphs in the parent specification.

3. **Operational Test.** Operate each unit for at least 15 min. to permit equipment temperature stabilization and an adequate number of performance characteristics to ensure compliance with the requirements of the parent specification.

D. **Stand-Alone Tests.** Conduct a Stand-Alone Test for each unit after installation. The test shall exercise all stand-alone (non-network) functional operations. Notify the Engineer 5 working days before conducting this test. The Department may witness all the tests.

E. **System Integration Test.** Conduct a System Integration Test on the complete functional system. Demonstrate all control and monitor functions for each system component for 72 hr. Supply 2 copies of the System Operations manual before the System Integration Test. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests.

F. **Final Acceptance Test.** Conduct a Final Acceptance Test on the complete functional system. Demonstrate all control, monitor, and communication requirements for 90 days. The Engineer will furnish a Letter of Approval stating the first day of the Final Acceptance Test. The completion of the Final Acceptance Test occurs when system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects as required in Article 2.G.5.

G. **Consequences of Test Failure.** If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation prior to modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be sufficient cause for rejection of the unit.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures without additional cost or extension of the contract period.

1. **Consequences of Design Approval Test Failure.** If the equipment fails the Design Approval Test, correct the fault and then repeat the Design Approval Test until successfully completed.

2. **Consequences of Demonstration Test Failure.** If the equipment fails the Demonstration Test, correct the fault and then repeat the Demonstration Test until successfully completed.

3. **Consequences of Stand-Alone Test Failure.** If the equipment fails the Stand-Alone Test, correct the fault and then repeat the Demonstration Test until successfully completed.

4. **Consequence of System Integration Test Failure.** If the equipment fails the System Integration Test, correct the fault and then repeat the Systems Integration Test until successfully completed.

5. **Consequences of Final Acceptance Test Failure.** If a defect within the system is detected during the Final Acceptance Test, document and correct the source of failure. Once corrective measures are taken, monitor the point of failure until a consecutive 30 day period free of defects is achieved.

   If after completion of the initial test period, the system downtime exceeds 72 hr. or individual points of failure have not operated for 30 consecutive days free of defects, extend the test period by an amount of time equal to the greater of the downtime in excess of 72 hr. or the number of days required to complete the performance requirement of the individual point of failure.

3. **Training.** When required on the plans, provide a minimum of 24 hr. of instruction to 10 designated personnel in the operation and maintenance procedures of equipment or systems installed. Provide the training during installation, testing, and integration. Provide the training through practical demonstrations, seminars, and other related technical procedures.

   Furnish a training session agenda, a complete set of training material (manuals and schematics), and the names and qualifications of proposed instructors for approval 60 days before the training. Provide a training location. Provide 1 copy of the course material for each person. Provide training in the following areas of interest and as shown on the plans:

   - The "Hands-on" operation for each type of equipment.
   - Explanation of all system commands, their function and usage.
   - Required preventative maintenance procedures.
   - All equipment servicing procedures.
   - System "troubleshooting"/problem identification procedures.

4. **Documentation.** Provide "as-built" documentation for the entire system and all of its individual components. Supply 1 mylar reproducible copy of the wiring diagrams. Supply 3 copies of the following in a manual for each equipment component:

   - Complete and accurate schematic diagrams.
   - Complete and accurate cabinet, enclosure, and building wiring diagrams.
   - Complete installation procedures.
   - Complete performance specifications (functional, electrical, mechanical and environmental) on the unit.
   - Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
   - Pictorial of component layout on circuit board.
   - Complete maintenance and trouble-shooting procedures.
   - Complete stage-by-stage explanation of circuit theory and operation.
   - Complete and detailed system operations manuals.

   Furnish additional information as shown on the plans.

5. **Final Acceptance.** Final acceptance is made when all work is complete, the system has successfully completed all test requirements, and the Engineer, in writing, accepts all work for the work locations in the Contract in accordance with Item 5, Article 8, "Final Acceptance." Final acceptance relieves the Contractor from further Contract responsibilities.

6. **Warranty.** Guarantee equipment furnished and installed to perform according to the manufacturer's published specifications. Warrant equipment against defects or failure in design, materials, and workmanship in accordance with the manufacturer's standard warranty. Supply equipment with no less than 95% of the manufacturer's warranty remaining on the date that equipment invoices are submitted for final payment. Any equipment with less than 95% warranty remaining will be rejected.

   The Contractor shall warrant or guarantee all such electronic, electrical, and mechanical equipment, materials, technical data, and products furnished and installed for a period of 1 year after final acceptance of the project by the Department. The Contractor's warranty or guarantee shall provide for the "on-site" repair or replacement, at the Contractor's option, within 2 working days and at no cost to the Department.

   Once the Contractor's warranty or guarantee expires, assign to the Department any manufacturer's standard warranty or guarantee coverage still remaining on all such electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project. Repair or replace defective equipment, at the manufacturer's option, at no cost to the Department.

7. **Measurement and Payment.** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be considered subsidiary to items of the Contract.

SPECIAL SPECIFICATION

6013

Electronic Components

1. **Description.** Use electronic components to manufacture electronic equipment.

2. **Materials and Construction Methods.** Use electronic components that comply with Electronic Industries Association (EIA) and Joint Electronic Device Engineering Council (JEDEC) Specifications. Provide industry standard electronic components available from several manufacturers. When special monolithic integrated circuits are necessary for cost-effective designs, waiving the multi-source requirements will be as directed.

   Design the electronic circuitry to ensure an adjustment range from normal adjustment settings of variable components. Provide a range of adjustment to compensate for composite variations in the associated circuitry due to changes in part values during the normal or specified life of the device. Ensure the range of adjustment can compensate for variations in replacement parts within the specified tolerances. Unless otherwise shown on the plans, design the components to be under operating conditions 24 hr. a day for 10 yr. Derate electronic components by 20% with regard to ambient temperature, applied voltage, and power dissipation.

   On electronic components weighing more than 2 oz., use supports other than the component's pins or electrical connectors. Solder electronic components of 2 or more leads in place. Mark the circuit reference symbol next to the component.

   Meet the above requirements and satisfy the following specific requirements for the different components:

   A. **Capacitors.** Provide industrial grade capacitors. Insulate the capacitors. Mark capacitors with their capacitance value, working voltage, and polarity.

      Provide capacitor encasements resistant to cracking, peeling, and discoloration due to humidity and changes in temperature. Provide electrolytic capacitors capable of operating at least 185°F. Do not use electrolytic capacitors of less than 1.0 microfarad.

Use a clamp or fastener to support a capacitor to avoid damage by shock or vibration. Use a capacitor with a specific ripple or AC voltage rating, if possibly subjected to a ripple voltage in excess of 10% of the actual DC voltage across the capacitor. Use an aluminum electrolytic capacitor only when continually energized.

B. **Diodes.** If low forward drop is required in logic circuit applications, furnish justification for use of Germanium diodes prior to incorporation in the design. Mark diodes with the JEDEC part number, using an industry approved color code or clearly legible printing. Indicate the diode polarity on the diode case by the use of the diode symbol, by the 360° band on the cathode end, or by the shape of case.

C. **Indicators.** Use solid-state (LED) indicators with a useful life at least 25,000 hr.

D. **Integrated Circuits.** Print the manufacturer's part number and any information required to install the integrated circuit assembly upon the package. Test integrated circuits with at least 1 test from each group below:

1. **Group 1**
   - ☐ Stabilization Bake
   - ☐ Temperature Cycling
   - ☐ Power Burn-In

2. **Group 2**
   - ☐ Functional test with the device at the manufacturer's maximum specified temperature
   - ☐ Static and dynamic test per manufacturer's data sheet

E. **Potentiometers and Rheostats.** Use industrial grade potentiometers. Use potentiometers with a power rating at least 100% greater than the maximum power requirements of the circuit.

F. **Printed Circuit Boards.**

1. **Design, Fabrication and Mounting.** Use NEMA Grade G-10 glass epoxy or equivalent for printed circuit boards (refer to NEMA Publications No. L1 1-1982, Industrial Laminated Thermosetting Products). Provide a nominal thickness of 1/32 in. for circuit boards not exceeding 2 in. in any dimension. Provide a nominal thickness of 1/16 in. for circuit boards exceeding 2 in. in any dimension.

   Coat the printed circuit board assembly with a protective coating to combat mildew, moisture, and fungus. Plate the through holes that carry electrical connections from one side of the board to the other. Use 1 oz./sq. ft. of copper to plate through holes. Use non-corrosive material for electrical mating surfaces.

   Design and fabricate printed circuit boards and the mounting of parts and assemblies in accordance with MIL-STD-275 (latest revision) except as follows:
   - ☐ Mount semiconductor devices on spacers or transipads if the device dissipates more than 250 mW. or if the case temperature will rise 20°F above ambient.
   - ☐ Remove residual flux from the printed circuit board.
   - ☐ Provide a resistance between any 2 isolated, independent conductor paths of at least 100 megohms when a 500 VDC potential is applied.

   Mark operating circuit components mounted on the circuit boards. Reference the identifying characters to their respective components in the schematic diagram and in the parts list.

2. **Soldering.** Hand solder in accordance with MIL-STD-55110. Use of automatic flow soldering is acceptable.

G. Relays. Install diodes across the coils for transient suppression in DC relays. Provide replaceable relays that do not require special tools for replacement.

H. Resistors. Use fixed composition insulated resistors in accordance with the performance requirements of MIL-R-11. Provide industrial grade resistors with a 15 yr. design life. Mark with their resistance value, using EIA color codes or industry approved marking technique.

Use resistors with a 10% tolerance or better and a resistance variation of no more than 5% over the temperature range 0°F to 165°F. Do not use resistors with a power rating greater than 2 w., unless special ventilation or heat sinking is provided. Insulate these resistors from the printed circuit board.

I. Transistors. Use JEDEC registered transistors. Mark the JEDEC part number on the case. Designate the emitter or collector by use of an industry approved marking technique.

J. Transformers. Mark transformers with the manufacturer's part number on the case or frame, using a Radio-Electronics-Television Manufacturers Association (RETMA) color code or numbered in a manner to facilitate proper installation.

K. Switches. Derate switch contacts 50% from their maximum current ratings.

3. **Measurement and Payment.** The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to the items of the Contract.

SPECIAL SPECIFICATION

WC-0001

Radar Vehicle Sensing Device (RVSD) – Solar Powered with Cell Modem Communication

1. **Description.** Furnish and install overhead microwave vehicle detection system as shown in the plans, as detailed in the special specifications and as directed. Provide all equipment required to interface with an existing/proposed infrastructure as subsidiary.

Ensure after the setup, there are no external tuning controls of any kind, which will require an operator.

Furnish all new equipment and component parts of the latest proven design and manufacture, and in an operable condition at the time of delivery and installation. Provide all parts that are of high quality workmanship.

Provide design to prevent reversed assembly or improper installation of connectors, fasteners, etc. Design each item of equipment to protect personnel from exposure to high voltage during equipment operation, adjustments, and maintenance.

Include licenses for all equipment, where required, for any software or hardware in the RVSD system.

Provide all RVSD from the same manufacturer.

Provide RVSD firmware that is upgradeable by external local or remote download.

2. **Materials.** Ensure the RVSD is easy to install and will automatically configure up to 10 lanes by determining lane boundaries, concrete or metal barriers and detection thresholds. Ensure sensor will automatically configure the number of lanes in the presence of barriers, medians and work zones. Ensure sensor will automatically calibrate vehicle speed, detection levels, and sensitivity. Ensure the RVSD detects vehicle volume, speed and occupancy in all weather conditions without performance degradation. Provide RVSD that operates in side-fire installations. Ensure the RVSD is remote accessible; provides multiple connectivity options for easy integration into the existing system, and supports the communications protocols identified in Section 2.D "Communication". Ensure the RVSD is manufactured to the strictest industry standards to ensure product quality and minimizes the risk of unit failure.

   Provide the RVSD that requires less than 10 of the largest vehicles expected on the roadway be allowed to pass the RVSD and tunes out stationary objects, such as traffic barriers and retaining walls, prior to completing the configuration.

   Provide documentation on the auto-configuration and auto-calibration processes.

   Provide an RVSD that does not cause interference or alter the performance of any known equipment.

   A. **Sensor Performance.** Ensure the RVSD provides accurate, real-time volume, average speed and occupancy data. Ensure the RVSD provides user configurable settings for a collection interval from 20 sec. to 15 min. and polling intervals from 20 sec. to 1 hr. Ensure the detections are correctly categorized into a minimum of 8 user definable length-based classifications. Ensure vehicle detections occur at a range of 9 ft. to 250 ft. Detections within this range must be accomplished simultaneously and maintain the accuracies as required in this section. Ensure the RVSD unit or accompanying field equipment provides a minimum of 48 hours of local storage for detection interval settings of 20 seconds to 15 minutes in local storage to reduce data loss during communications outages. Ensure the RVSD transfers locally stored data to the Traffic Management Center's Transportation Sensor System (TSS) when communication is restored.

      Ensure the RVSD maintains accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light. Ensure RVSD operation continues in rain or snow up to 4 in. per hour, and the device will not experience degraded performance when encased in 1/2 in. of ice.

      Ensure side-fire volume data is accurate within 5% of actual for any direction of travel in nominal conditions. Ensure individual lane accuracy is within 10% of actual during nominal conditions. Nominal conditions exist when traffic is flowing at speeds greater than 10 miles per hour, with less than 10% truck traffic per lane and at least 30% of each vehicle visible above roadway barriers for true sensor detection.

      Ensure side-fire average speed data is accurate within 5 MPH for any direction of traffic for all conditions involving more than 16 vehicles in an averaging interval. Ensure speed accuracy for individual lanes is within 10 MPH of actual for all traffic conditions and similar intervals. Provide true speed detection without the requirement to enter average vehicle lengths for the speed calculation. To achieve the specified accuracy in a variety of conditions, the resolution shall not be larger than ten ft. null to null and four ft. at the half-power level. This reduces the problem of vehicle responses being drowned out by brighter vehicles in adjacent lanes and improves performance for moving and stopped vehicles near barriers.

      Ensure occupancy data is accurate within 10% of actual for any direction of travel when occupancy is less than 30%. For example, if the true occupancy in a lane is 20%, the measured occupancy must be between 14% and 26%. Ensure lane occupancy is accurate within 20% in similar conditions.

      Ensure classification data is accurately determined for 90% of detected vehicles.

Provide test data, using methods required in Section 3.G.3, demonstrating or proving performance.

B. **Performance Maintenance.** Provide RVSD that does not require cleaning or adjustment to maintain performance. Ensure it does not rely on battery backup to store configuration information. Ensure the RVSD, once calibrated, does not need recalibration to maintain performance over entire operational temperature range unless the roadway configuration changes. Provide remote connectivity to the RVSD to allow operators to change the unit's configuration, update the unit's firmware programming and recalibrate the unit automatically from a centralized facility.

C. **Cabling.** Supply the RVSD with a connector cable of the appropriate length for each installation site.

Ensure the connector meets the MIL-C-26482 specification. Provide an environmentally sealed shell backshell that offers excellent immersion capability, and is designed to interface with the appropriate MIL-C-26482 connector. Encase all conductors that interface with the connector in a single jacket and ensure the outer diameter of this jacket is within the backshell's cable O.D. range to ensure proper sealing. Ensure the backshell has a clampbar style strain relief with enough strength to support the cable slack under extreme weather conditions. Provide the MIL-C-26482 connector that provide contacts for all data and power connection.

If communication is conducted over the RS-485 or RS-232 bus, the communication cable must be Belden 9331 or an equivalent cable with the following specifications:

- Shielded, twisted pairs with a drain wire
- Nominal Capacitance Conductor to Conductor @ 1Khz <= 26pF/Ft
- Nominal Conductor DC Resistance @ 68°F <= 15 ohms/1000Ft
- Single continuous run with no splices allowed
- Terminated only on the two farthest ends of the cable

D. **Communication.** Ensure that the RVSD provides communication options that include RS-232, RS-485 or TCP/IP. Provide a RVSD which has the ability to support a variety of baud rates from 9600 to 115200.

The RVSD shall provide two or more communication ports that can be accessed simultaneously using any RVSD-supported protocol. This will enable multiple operators to collect data from the RVSD at the same time without interrupting or interfering with each other.

Ensure the RVSD provides built in RS-232, RS-485 and an internal serial communication port. Each communication port must support all of the following baud rates: 9600, 19200, 38400, 57600 and 115200. Additionally, the RS-232 port must be full-duplex and must support true RTS/CTS hardware handshaking for interfacing to various communication devices.

Interval Data Packets. The RVSD must produce interval data packets containing, as a minimum:

- One or more detection zones of data per packet
- Sensor ID
- 32-bit or larger time stamps in one second or smaller increments that indicate the end of time interval
- Total volumes of more than 65536 (necessary for time intervals greater than 10 minutes)
- Speed values in either "Miles Per Hour" or "Kilometers Per Hour"
- Occupancy in 0.1 percent increments
- Volume in up to eight length based vehicle classification bins
- Volume in up to fifteen speed bins (bin by speed)
- Volume for both directions of traffic (bin by direction)

As part of this item, a wireless cellular modem shall be included for communications to the RVSD. This modem shall be capable of operating on either the Sprint, Verizon, or AT&T networks within the

specified project limits. Direction will be given upon purchase as to what service the modem should be configured for.

Event Data Packets. The RVSD must produce interval data packets containing, as a minimum:

- Sensor ID
- 32-bit time stamps in 2.5 millisecond increments or less that indicate the time the vehicle left the detection zone
- Speed values in either "Miles Per Hour" or "Kilometers Per Hour"
- Resolution of vehicle duration in the detection zone in 2.5 ms increments or less
- Up to eight length based vehicle classification bins

Data Buffering. The RVSD shall store 24,000 (or more) Interval (bin) data packets that record volume, average speed, eighty-fifth percentile speed, occupancy, and class for each detection zone with at least ten zones and no groups per packet in non-volatile memory.

E. **Operating System Software.** Provide the RVSD to also include graphical user interface software that displays all configured lanes and provides visual representation of all detected vehicles. The graphical interface must operate on current department core operating system software. The software must automatically select the correct baud rate and serial communication port from up to 15 serial communication ports. The software must also operate over a TCP/IP connection and support a dial-up modem connection.

When required to interface with Traffic Management Center software, the RVSD system software must meet Transportation Sensor Subsystem Protocol requirements as documented in latest version available on the Department's website.

The software must give the operator complete control over the configuration process.

The operator must have the ability to save the configuration information to a file or reload the RVSD configuration from a file using the graphical user interface software.

Using the installation software the operator must be able to:

- easily change the baud rate on the sensor by selecting baud rates from a drop-down list
- add response delays for the communication ports to allow for communication stabilization.
- switch between data pushing and data polling, and
- change the RVSD's settings for Flow Control from none to RTS/CTS and vice versa.

The operator must be able to upload new firmware into non-volatile memory of the RVSD over any supported communication channel including TCP/IP networks.

F. **Software.** Provide any and all programming and software required to support the RVSD system. Install the programming and software in the appropriate equipment at the time of acceptance testing. Complete and pass acceptance testing using a stable release of the programming and software provided.

Provide software update(s) free of charge during the warranty period.

G. **Manufacturing Requirements.** Ensure the assembly of the units adheres to industrial electronic assembly practices for handling and placement of components.

The RVSD must undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Include the following tests:

- Functionality testing of all internal subassemblies
- Unit level burn-in testing of 24 hours duration or greater
- Final unit functionality testing prior to shipment

Provide test results and all associated data for the above testing, for each purchased RVSD by serial number. Additionally, maintain and make available manufacturing quality data for each purchased RVSD by serial number.

Externally, the RVSD must be modular in design to facilitate easy replacement in the field. Ensure the total weight of the RVSD does not exceed 5 lbs.

Ensure all external parts are protected against corrosion, fungus growth and moisture deterioration.

H. **FCC.** Ensure the RVSD has Federal Communications Commission (FCC) certification. Display the FCC-ID number on an external label. Ensure each RVSD is Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.245 or 15.249 as a field disturbance sensor. Display this certification on an external label on each device according to the rules set out by the FCC.

Provide the RVSD system that is FCC certified under Part 15, Subpart C, Section 15.245 or 15.249 for low-power, unlicensed, continuous radio transmitter operation. Assure that the RVSD system will not cause harmful interference to radio communication in the area of installation. If the operation of the RVSD system causes harmful interference, correct the interference at the Contractor's expense.

Provide the RVSD that transmits in the 24.00 – 24.25 GHZ frequency band and meets the power transmission and frequency requirements specified under sections 15.245 and 15.249 of CFR 47 across the operating temperature of the device and over time as the sensor ages.

Provide documentation proving compliance to all FCC specifications.

I. **Support.** Ensure installers and operators of the RVSD are fully trained in the installation, auto-configuration and use of the device.

The manufacturer must thoroughly train installers and operators to correctly perform the tasks required to ensure accurate RVSD performance. The amount of training necessary for each project will be determined by the manufacturer (not less than 4 hours) and must be included, along with training costs, in the manufacturer's quote. In addition, provide technical support to provide ongoing operator assistance.

J. **Power Requirements.** Provide the RVSD that operates either at 12 VDC to 28 VDC via a solar power assembly to be included as part of this item. The solar power plant shall be capable of providing safe and reliable power generation for 12 volt DC powered equipment without assistance of commercial AC power. The system shall be a rugged, corrosion resistant and low maintenance design with a minimum of five days battery bank autonomy and solar array maintaining a 1% annual statistical loss of load probability for the site location. Items included in the assembly shall include at minimum, solar panels, mounting brackets, cabinet, solar controller, batteries, and circuit breakers.

K. **Wiring.** Provide wiring that meets the requirements of the National Electric Code. Provide wires that are cut to proper length before assembly. Provide cable slacks to facilitate removal and replacement of assemblies, panels, and modules. Do not double-back wire to take up slack. Lace wires neatly into cable with nylon lacing or plastic straps. Secure cables with clamps. Provide service loops at connections.

L. **Transient Suppression.** Provide DC relays, solenoids and holding coils that have diodes or other protective devices across the coils for transient suppression.

M. **Power Service Protection.** Provide equipment that contains readily accessible, manually re-settable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

Provide and size circuit breakers or fuses such that no wire, component, connector, PC board or assembly must be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element or wiring.

N. **Fail Safe Provision.** Provide equipment that is designed such that the failures of the equipment will not cause the failure of any other unit of equipment. Ensure automatic recovery from power failure will be within 15 sec. after resumption of power.

O. **Mechanical Requirements.** Enclose the RVSD in a Lexan polycarbonate, ultraviolet resistant material. The unit must be classified as watertight according to the NEMA 250 Standard.

Provide the RVSD that will withstand a drop of up to 3 ft. without compromising its functional and structural integrity.

Do not use silicone gels or any other material for enclosure sealing that will deteriorate under prolonged exposure to ultraviolet rays. Ensure the overall dimensions of the box, including fittings, do not exceed 13 In. x 9 in. x 9 in. Ensure the overall weight of the box, including fittings, does not exceed 15 lbs.

Coat all printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).

Ensure external connection for telecommunications and power be made by means of a single military style multi-pin connector, keyed to preclude improper connection.

1. ***Modular Design.*** Provide equipment that is modular in design to allow major portions to be readily replaced in the field. Ensure modules of unlike functions are mechanically keyed to prevent insertion into the wrong socket or connector.

   Identify modules and assemblies clearly with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

2. ***Connectors and Harnesses.*** Provide external connections made by means of connectors. Provide connectors that are keyed to preclude improper hookups. Color code and appropriately mark wires to and from the connectors.

   Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment.

   Provide pins and mating connectors that are plated to improve conductivity and resist corrosion. Cover connectors utilizing solder type connections by a piece of heat shrink tubing securely shrunk to insure that it protects the connection.

3. ***Environmental Requirements.*** Provide RVSD capable of continuous operation over a temperature range of –35°F to +165°F and a humidity range of 5% to 95% (non-condensing).

3. **Construction.**

A. **General.** Provide equipment that utilizes the latest available techniques for design and construction with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

B. **RF Design.** The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time. All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 parts per million (ppm) stable over the specified temperature range, and ages less than 6 ppm per year. Any upconversion of a digitally-generated modulated signal shall preserve the phase stability and frequency stability inherent in the digitally-generated signal. These specifications ensure that, during operation, the RVSD strictly conforms to FCC requirements and that the radar signal quality is maintained for precise algorithmic quality.

C. **Mounting and Installation.** Install the RVSD according to manufacturer's recommendations to achieve the specified accuracy and reliability.

Verify, with manufacturer assistance, the final RVSD placement if the RVSD is to be mounted near large planar surfaces (sound barrier, building, parked vehicles, etc.) that run parallel to the monitored roadway.

Include, at a minimum, radar detector unit, enclosures, connectors, cables, junction box, mounting equipment and hardware, controller interface boards and assemblies, local and remote software, firmware, power supply units and all other support, calibration, and test equipment for the RVSD system.

Furnish the RVSD with bracket or band designed to mount directly to a pole or overhead mast-arm or other structure. Ensure the mounting assembly has all stainless steel, or aluminum construction, and supports the load of the RVSD. Incorporate for the mounting assembly a mechanism that can be tilted in both axis, then locked into place, to provide the optimum area of coverage. Ensure the mounting bracket is designed and installed to prevent sensor re-positioning during 80 mph wind conditions.

Proper placement, mounting height and orientation of the RVSD systems are critical to the overall performance and accuracy of the systems and must conform to the manufacturer's published requirements for the system provided. Install the RVSD units as shown on the plans. Analyze each proposed pole location to assure that the RVSD installation will comply with the manufacturer's published installation instructions. Advise the Engineer, before any trenching or pole installation has taken place, of any need to move the pole from the location indicated in the plans in order to achieve the specified detector performance. Confirm equipment placement with the manufacturer before installing any equipment.

Ensure alignment, configuration and any calibration of the RVSD takes less than 15 minutes per lane once mounting hardware and other installation hardware are in place. Install RVSD units such that each unit operates independently and that detectors do not interfere with other RVSD units or other equipment in the vicinity.

D. **Electronic Components.** Provide electronic components in accordance with Special Specification, "Electronic Components".

E. **Mechanical Components.** Provide external screws, nuts and locking washers that are stainless steel. Provide parts made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass. Protect materials from fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material.

F. **Documentation Requirements.** Provide documentation in accordance with Article 4, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty".

G. **Testing.** Perform testing in accordance with Article 2, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty." Test all RVSD to ensure that they comply with all FCC and Department specifications.

Supply a medical statement as to the safety of the unit to the general public (example: Pacemakers, etc.).

Additional testing requirement is as follows:

1. ***NEMA 4X Testing.*** The RVSD enclosure must conform to test criteria set forth in the NEMA 250 Standard for Type 4X enclosures. Provide third party enclosure test results for each of the following specific Type 4X criteria:

   - External Icing (NEMA 250 Clause 5.6)
   - Hose-down (NEMA 250 Clause 5.7)
   - 4X Corrosion Protection (NEMA 250 Clause 5.10)
   - Gasket (NEMA 250 Clause 5.14)

2. ***NEMA TS2-1998 Testing.*** The RVSD must comply with the applicable standards stated in the NEMA TS2-1998 Standard. Provide third party test results for each of the following specific tests:

   - Shock pulses of 10g, 11 ms half sine wave
   - Vibration of .5 Grms up to 30 Hz
   - 300 V positive/negative pulses applied at 1 pulse per second at minimum and maximum DC supply voltage
   - Cold temperature storage at -49°F for 24 hours
   - High temperature storage at +185°F for 24 hours
   - Low temp, low DC supply voltage at -30°F and 10.8 VDC
   - Low temp, high DC supply voltage at -30°F and 26.5 VDC
   - High temp, high DC supply voltage at 165°F and 26.5 VDC
   - High temp, low DC supply voltage at 165°F and 10.8 VDC

3. ***Performance Testing.*** Ensure the RVSD meets functional performance requirements of Section 2.A by the following methods:

   Verify volume accuracy by comparing recorded video to the RVSD detections. Record the number of missed vehicles and false detections. Calculate errors by dividing the difference between missed and false detections, obtained over a minimum of 24 hours, by the total number of vehicles. To ensure low variability in performance, missed and false detections must not exceed 15%. Provide such performance analysis for the following environments:

   - Free flowing traffic (speeds greater than 45 MPH)
   - Congested traffic (speeds from 15 to 40 MPH)
   - Traffic in lanes adjacent to a concrete barrier
   - 10 ft. and 200 ft. lateral offset- simultaneous performance
   - Occluded vehicle error must not exceed 15%

   Verify speed accuracy with laser speed gun, or by video speed trap using the frame rate as a time reference.

H. **Experience Requirements.** The contractor or subcontractor involved in the installation and testing of the RVSD must, as a minimum, meet the following experience requirements:
Two years continuous existence offering services in the installation of RVSD systems.

Two installed RVSDs where systems have been in continuously satisfactory operation for at least 1 year. Submit as proof, photographs or other supporting documents, and the names, addresses and

telephone numbers of the operating personnel of the business or agency owning the system who can be contacted by the Department regarding the system.

Provide necessary documentation of contractor or subcontractor qualifications pursuant to contract award.

I. **Technical Assistance.** Ensure that a manufacturer's technical representative is available on site to assist the Contractor's technical personnel at each installation site and with RVSD equipment installation and communication system configuration.
Do not execute the initial powering up of the RVSD without the permission of the manufacturer's representative.

J. **Training.** Provide training in accordance with Article 3, Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty."

K. **Warranty.** Provide a warranty in accordance with Article 6, Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty."

4. **Measurement.** This Item will be measured as each unit complete in place.

5. **Payment.** The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price for "Radar Vehicle Sensing Device". This price is full compensation for furnishing all equipment described under this Item with all cables, connectors, and mounting assemblies; all documentation and testing; all labor, materials, tools training, warranty, equipment, and incidentals.

SPECIAL SPECIFICATION

WC-0002

Surge Suppression Module

1.0 General. This Item shall govern the purchase and installation of a Surge Suppression Module (SSM). Test results and other documentation demonstrating performance and capabilities shall be provided.

The SSM shall:

Requirement	Section
Include three-stage protection with gas tubes.	3.0
Have passed testing for IEC 61000-4-5 surge specifications for power lines. Common and Differential Mode surge protection for DC power up to 4kV.	4.0
Have passed testing for IEC 61000-4-5 surge specifications for communication lines. Common and Differential Mode surge protection for RS-485 communication up to 4kV and clamping voltage at 8 VDC.	5.0
Have passed testing for IEC 61000-4-5 surge specifications for communication lines: Common and Differential Mode surge protection for RS-232 DTE communication with CTS/RTS up to 4kV and clamping voltage at 11 VDC.	6.0
Have passed testing for the NEMA TS2 –1998 Environmental specification.	7.0
Include pluggable screw terminals, RS-232 DTE DB-9 connector and RS-485 RJ-11 connector for easy installation.	8.0
Mount to a DIN rail with hot swappable power and communication buses.	9.0
Have a burn-in test conducted prior to shipment.	10.0
Have extended support options available.	11.0
Be warranted for a period of one (1) year from date of shipment.	12.0

2.0 Product Description. The SSM shall suppress electrical surges up to 4 kV on DC power lines, RS-485 and RS-232 with CTS/RTS communication lines to any device connected to the SSM. The SSM shall be designed to protect a Radar Vehicle Sensing Device from surges coming from a traffic cabinet, or protect a cabinet from surges coming from the RVSD.

3.0 Three-Stage Protection. The SSM shall have a three-stage surge suppression design. The first stage shall be gas tubes followed by a second stage using inductors on the DC power lines and TVS diodes on the communication buses. The third stage shall have a resettable fuse (PTC) on the DC power line and varistors on all communication buses.

4.0 DC Power Protection. The SSM shall comply with the applicable standards stated in the IEC 61000-4-5 Standard for DC power lines. Test results shall be made available for the following test conditions:

- Surge voltages ±0.5kVA, 1kVA, 2kVA and 4kVA
- Common mode (input to ground)
- Differential mode (input to input)
- 8x20µs waveform
- 2 ohm generator impedance
- 1-minute pause between surges

5.0 RS-485 Protection. The SSM shall comply with the applicable standards stated in the IEC 61000-4-5 Standard for communication lines. The RS-485 communication bus shall have a clamping voltage of 8 VDC and a 12 VDC differential clamping voltage. Test results shall be made available for the following test conditions:

- Surge voltages ±0.5kVA, 1kVA, 2kVA and 4kVA
- Common mode (input to ground)
- Differential mode (input to input)
- 8x20µs waveform
- 12 ohm generator impedance
- 1-minute pause between surges

6.0 RS-232 with CTS/RTS Protection. The SSM shall comply with the applicable standards stated in the IEC 61000-4-5 Standard for communication lines. The RS-232 communication bus shall have a clamping voltage of 11 VDC. Test results shall be made available for the following test conditions:

- Surge voltages ±0.5kVA, 1kVA, 2kVA and 4kVA
- Common mode (input to ground)
- Differential mode (input to input)
- 8x20µs waveform
- 12 ohm generator impedance
- 1-minute pause between surges

7.0 NEMA TS2-1998 Testing. The SSM shall comply with the applicable standards stated in the NEMA TS2-1998 Standard. Test results shall be made available for each of the following tests:

- Shock pulses of 10g, 11 ms half sine wave
- Vibration of .5 Grms up to 30 Hz
- 300 V positive/negative pulses applied at 1 pulse per second at minimum and maximum DC supply voltage
- Cold temperature storage at -45° C for 24 hours
- High temperature storage at +85° C for 24 hours
- Low temp, low DC supply voltage at -34° C and 10.8 VDC

- Low temp, high DC supply voltage at -34° C and 26.5 VDC
- High temp, high DC supply voltage at 74° C and 26.5 VDC
- High temp, low DC supply voltage at 74° C and 10.8 VDC

8.0 Pluggable Terminals. The SSM shall have pluggable screw terminals allowing the user to wire a contact closure data collector to the SSM before installation to make installation easy and to minimize incorrect wiring. The SSM shall also have an unprotected 9-pin D-sub connector for the RS-232DTE with CTS/RTS communication bus and an unprotected RJ-11 connector for the RS-485 communication bus for quick connectivity.

9.0 DIN Rail Mounted. The SSM shall mount to a DIN rail with hot swappable surge protected power and communication buses for quick installation and replacement.

10.0 Burn-In Testing. Before shipping, each SSM shall have a burn-in test period of not less than one (1) day while connected to a surge-protected device. After the burn-in testing is completed, the SSM shall be re-tested for proper functionality.

11.0 Extended Support. Extended support options shall be available. Contact the manufacturer's representative for more information.

12.0 Warranty. The SSM shall be warranted to be free from material and workmanship defects for a period of one (1) year from date of shipment.

MK Battery Valve-Regulated, Gelled-Electrolyte Battery 8G31

8G31

SPECIFICATIONS

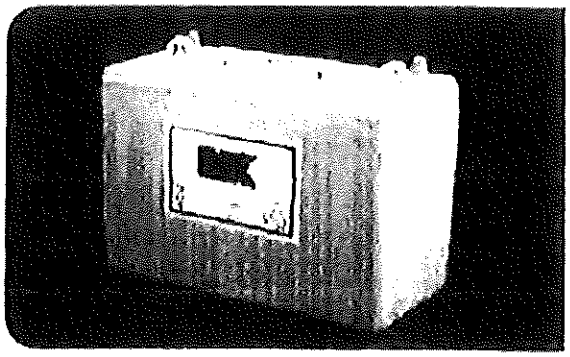
Nominal Voltage (V)	12V
Capacity at C/100	108Ah
Weight	71.7 Lbs. (32.5 kg)
Plate Alloy	Lead Calcium
Posts	Forged terminals & bushings
Container/Cover	Polypropylene
Operating Temperature Range	-76°F (-60°C) – 140°F (60°C)
Charge Voltage @ 68°F (20°C)	
Cycle	2.30 - 2.35 VPC
Float	2.25 - 2.30 VPC
Vent	Self-sealing (2 PSI operation)
Electrolyte	Sulfuric acid thixotropic gel
Resistance	4.0 Milliohms (full charge)
Terminal	T876

Rated non-spillable by ICAO, IATA and DOT
Approved by CEC

Made in the U.S.A by East Penn Manufacturing

Distributed by:

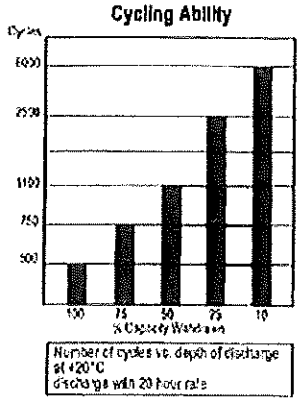
Valve-Regulated, Gelled-Electrolyte Battery



DIMENSIONS

Length (mm)	**12.94 (328 mm)**
Width (mm)	**6.75 (171 mm)**
Height (mm)	**9.76 (248 mm)**

Cycling Ability



Number of cycles vs. depth of discharge at 120°C discharge with 20 hour rate

MK Battery
1645 South Sinclair Street • Anaheim, California 92806
Toll Free: 800-372-9253 • Fax: 714-937-0818 • E-Mail: sales@mkbattery.com

WILLIAMSON COUNTY PROPOSAL FORM

TRAFFIC COUNTING EQUIPMENT FOR US 183

Item	Qty	Price/Ea	Extended Price
Drill Shaft (Rdwy III Pole) (30 In)	16	$ /LF	$
Riprap (Conc) (Cl B) (4")	0.70	$ /CY	$
Ins Rdwy III Assem (30') (Shoe)	2	$ /Ea	$
Assist Traffic Counter Provider with Installation of Counter Assemblies	1	$ /LS	$
Radar Vehicle Sensing Device	2	$ /Ea	$
Surge Protector	2	*Subsidiary to RVSD*	*Subsidiary to RVSD*
40' Pigtail	2	*Subsidiary to RVSD*	*Subsidiary to RVSD*
Cabinet with Mounting Bracket	2	*Subsidiary to RVSD*	*Subsidiary to RVSD*
Wireless Modem	2	*Subsidiary to RVSD*	*Subsidiary to RVSD*
Modem Cable	2	*Subsidiary to RVSD*	*Subsidiary to RVSD*
Solar Assembly	2	*Subsidiary to RVSD*	*Subsidiary to RVSD*
Batteries	6	*Subsidiary to RVSD*	*Subsidiary to RVSD*
Total Assembly and Installation Cost			**$**

Does your proposed product meet **all** listed specifications? **yes** or no (please circle)

GENERAL NOTES

1. INSTALL SOLAR PANEL (PROVIDED BY TRAFFIC COUNTER PROVIDER). ORIENT THE 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.
2. INSTALL RADAR VEHICLE SENSING DEVICE (RVSD) (PROVIDED BY TRAFFIC COUNTER PROVIDER). ORIENT THE RVSD PER MANUFACTURER'S REQUIREMENTS.
3. INSTALL CABINET (PROVIDED BY TRAFFIC COUNTER PROVIDER).
4. INSTALL BATTERIES AND BATTERY CABINET (PROVIDED BY TRAFFIC COUNTER PROVIDER).
5. PULL CABLES (PROVIDED BY TRAFFIC COUNTER PROVIDER) IN POLE AND CABINETS.
6. SET UP CELL PHONE SERVICE UNDER NAME PROVIDED BY WILLIAMSON COUNTY. THE CONTRACTOR WILL PAY FOR SERVICE UNTIL THE COMPLETE INSTALLATION AND WILLIAMSON COUNTY TAKES OWNERSHIP.
7. PROVIDE AND INSTALL POLE FOUNDATIONS. ALL POLE FOUNDATIONS WILL INCLUDE RIPRAP PER STANDARD RID(FND)-07.
8. PROVIDE AND INSTALL POLES.
9. INSTALL WIRELESS MODEM AND SURGE PROTECTOR.
10. CONFIGURE SENSOR, WIRELESS MODEM AND DATA COLLECTOR FOR COMMUNICATION OVER WIRELESS NETWORK TO WILLIAMSON COUNTY CENTRAL MAINTENANCE FACILITY.
11. VERIFY THE SYSTEM IS COMPLETE AND FUNCTIONAL PER MANUFACTURER'S SPECIFICATIONS.
12. PROVIDE TESTING, TRAINING, DOCUMENTATION, FINAL ACCEPTANCE AND WARRANTY PER SPECIAL SPECIFICATION 6011.

ITEM 416 DRILLED SHAFT FOUNDATIONS

STAKE ALL POLE FOUNDATION LOCATIONS FOR APPROVAL BEFORE BEGINNING DRILLING OPERATIONS.

ITEM 432 RIPRAP

PROVIDE CLASS C CONCRETE FOR RIPRAP WITH 6" X 6" (W2.9 X W2.9) WELDED WIRE FABRIC REINFORCEMENT.

ITEM 6 0 ROADWAY ILLUMINATION ASSEMBLIES

USE MATERIALS FROM PREQUALIFIED MATERIAL PRODUCERS LIST AS SHOWN ON THE TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT) ------ CONSTRUCTION DIVISION'S (CST) MATERIALS PRODUCERS LIST. SEE

HTTP://WWW.DOT.STATE.TX.US/BUSINESS/PRODUCERLIST.HTM

FOR LIST OF PRE-QUALIFIED MANUFACTURERS, CATEGORY IS "ROADWAY ILLUMINATION AND ELECTRICAL SUPPLIES."

FABRICATE STEEL ROADWAY ILLUMINATION POLES IN ACCORDANCE WITH TXDOT STANDARDS RIP-07 (ROADWAY ILLUMINATION POLES -2007). POLES FABRICATED ACCORDING TO RIP-07 REQUIRE NO SHOP DRAWINGS.

ALTERNATE DESIGNS TO RIP-07 OR THE USE OF ALUMINUM TO FABRICATE POLES WILL REQUIRE THE SUBMISSION OF SHOP DRAWINGS ELECTRONICALLY. FOR INSTRUCTIONS ON SUBMITTING SHOP DRAWINGS ELECTRONICALLY GO TO
HTTP://WWW.DOT.STATE.TX.US/PUBLICATIONS/BRIDGE.HTM

FILE IS TITLED: GUIDE TO ELECTRONIC SHOP DRAWING SUBMITTAL.

INSPECTION OF ALL COMPLETED WORK PROVIDED IN THE CONTRACT WILL BE PERFORMED. THE CONTRACTOR WILL BE RELEASED FROM FURTHER MAINTENANCE ON THAT PROJECT IF THE WORK IS FOUND TO BE SATISFACTORY. PARTIAL ACCEPTANCE WILL BE MADE AND WILL BE IN NO WAY VOID OR ALTER ANY TERMS OF THE CONTRACT.

ITEM	DESC. CODE	DESCRIPTION	UNIT	QUANTITY
416	[illegible]	DRILL SHAFT (RDWY ILL POLE) (30 IN)	[illegible]	[illegible]
432	[illegible]	RIPRAP (CONC)(CL B)(4 IN)	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	EA	[illegible]
[illegible]	XXXX	RVSD ASSEMBLY*	EA	[illegible]

* EACH RVSD ASSEMBLY INCLUDES: (1) RADAR VEHICLE SENSING DEVICE, (1) SURGE PROTECTION, (1) [illegible] PIGTAIL, (1) CABINET WITH MOUNTING BRACKET, (1) WIRELESS MODEM, (1) MODEM CARD, (1) SOLAR ASSEMBLY, (2) BATTERIES

WILLIAMSON COUNTY
1848

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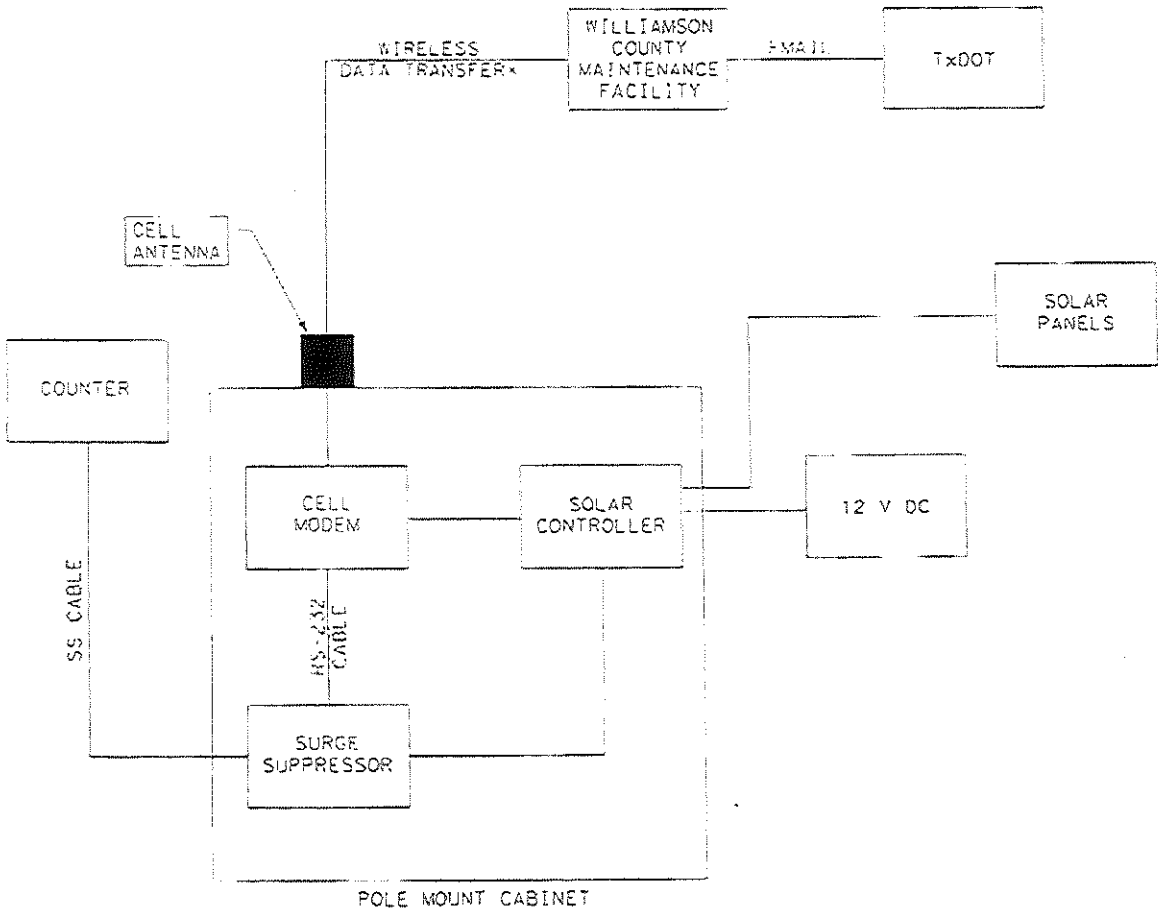
PERMANENT TRAFFIC COUNTERS
US 183
GENERAL NOTES & QUANTITIES

WILLIAMSON COUNTY

605

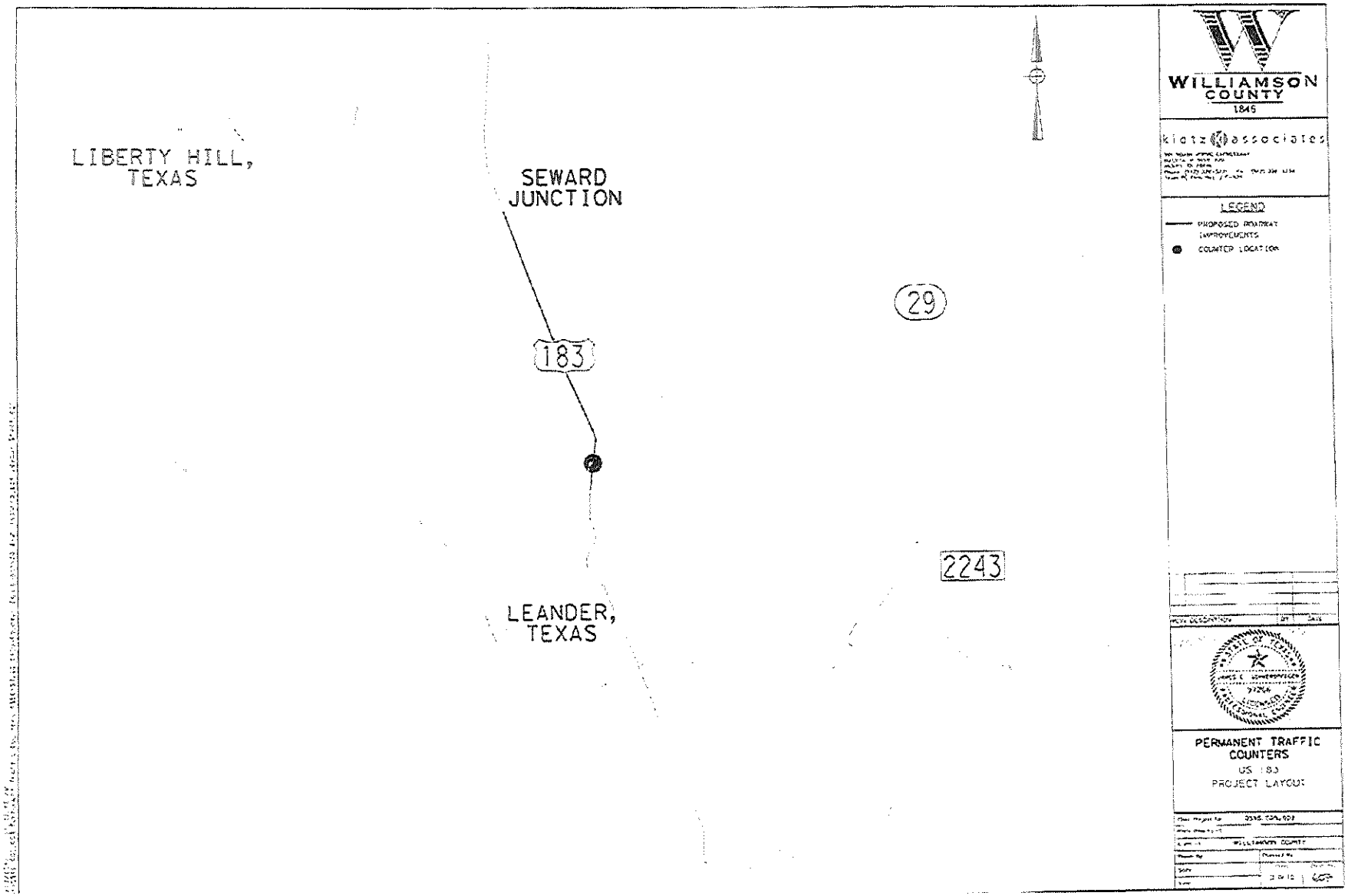


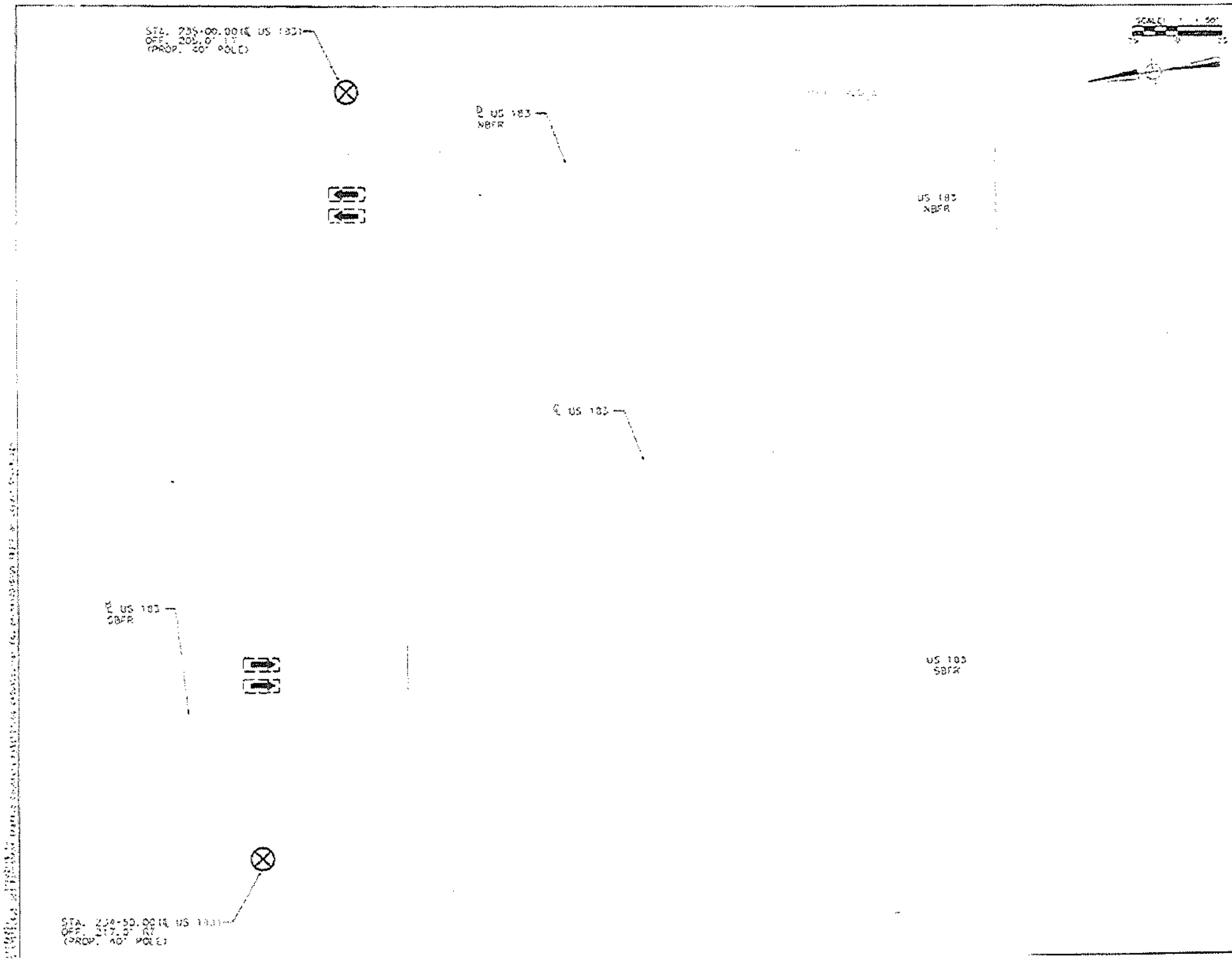
*FREQUENCY OF DATA TRANSFER TO BE DETERMINED BY WILLIAMSON COUNTY

WILLIAMSON COUNTY
1848

klotz associates

PERMANENT TRAFFIC COUNTERS
US 183
SCHEMATIC LAYOUT


LIBERTY HILL,
TEXAS
SEWARD
JUNCTION
183
29
2243
LEANDER,
TEXAS
WILLIAMSON
COUNTY
1848
kiatz associates
LEGEND
PROPOSED ROADWAY
IMPROVEMENTS
COUNTER LOCATION
PERMANENT TRAFFIC
COUNTERS
US 183
PROJECT LAYOUT



WILLIAMSON COUNTY

1848

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LEGEND

⊗ PROPOSED COUNTER LOCATION

[ ] PROPOSED DETECTION ZONE

NOTES:

1. CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL EXISTING UTILITIES BEFORE BEGINNING ANY TYPE OF WORK.

REV. DESCRIPTION | BY | DATE

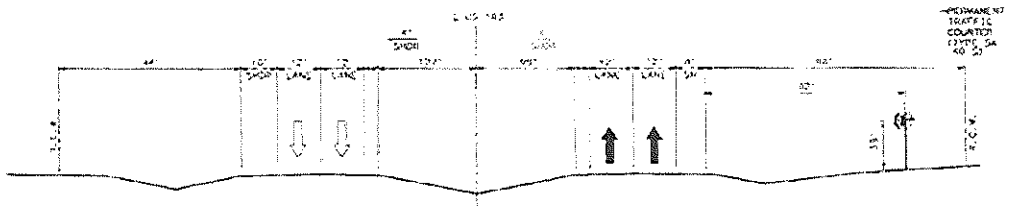
PERMANENT TRAFFIC COUNTERS

US 183

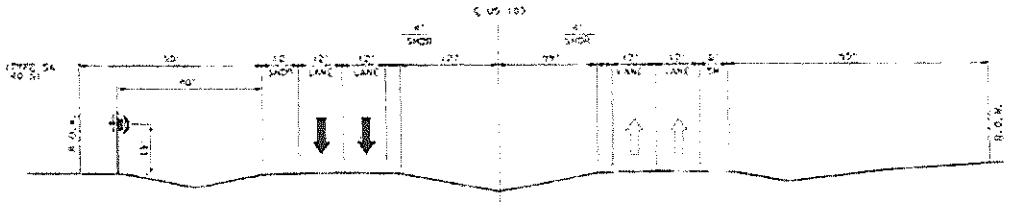
PLAN LAYOUT

WILLIAMSON COUNTY

60S



PERMANENT TRAFFIC COUNTER
TYPICAL SECTION
STATION 234+50



PERMANENT TRAFFIC COUNTER
TYPICAL SECTION
STATION 235+00

WILLIAMSON COUNTY
1848

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LEGEND

DIRECTION OF TRAVEL DETECTED BY RADAR

DIRECTION OF TRAVEL

PERMANENT TRAFFIC COUNTERS
US 183
TYPICAL SECTIONS

SHIPPING PARTS LIST ~ POLES AND LUMINAIRE ARMS

Nominal Mounting Ht. (ft)	Shoe Base Designation (Pole, A1, A2, Luminaire)	Quantity	T-Base Designation (Pole, A1, A2, Luminaire)	Quantity	CSB/SSCB Mounted Designation (Pole, A1, A2, Luminaire)	Quantity
20	(Type SA 20 S - 4) (.15KW) S		(Type SA 20 T - 4) (.15KW) S			
	(Type SA 20 S - 4 - 4) (.15KW) S		(Type SA 20 T - 4 - 4) (.15KW) S			
30	(Type SA 30 S - 4) (.25KW) S		(Type SA 30 T - 4) (.25KW) S		(Type SP 28 S - 4) (.25KW) S	
	(Type SA 30 S - 4 - 4) (.25KW) S		(Type SA 30 T - 4 - 4) (.25KW) S		(Type SP 28 S - 4 - 4) (.25KW) S	
	(Type SA 30 S - 8) (.25KW) S		(Type SA 30 T - 8) (.25KW) S		(Type SP 28 S - 8) (.25KW) S	
	(Type SA 30 S - 8 - 8) (.25KW) S		(Type SA 30 T - 8 - 8) (.25KW) S		(Type SP 28 S - 8 - 8) (.25KW) S	
40	(Type SA 40 S - 4) (.25KW) S		(Type SA 40 T - 4) (.25KW) S		(Type SP 38 S - 4) (.25KW) S	
	(Type SA 40 S - 4 - 4) (.25KW) S		(Type SA 40 T - 4 - 4) (.25KW) S		(Type SP 38 S - 4 - 4) (.25KW) S	
	(Type SA 40 S - 8) (.25KW) S		(Type SA 40 T - 8) (.25KW) S		(Type SP 38 S - 8) (.25KW) S	
	(Type SA 40 S - 8 - 8) (.25KW) S		(Type SA 40 T - 8 - 8) (.25KW) S		(Type SP 38 S - 8 - 8) (.25KW) S	
	(Type SA 40 S - 10) (.25KW) S		(Type SA 40 T - 10) (.25KW) S		(Type SP 38 S - 10) (.25KW) S	
	(Type SA 40 S - 10 - 10) (.25KW) S		(Type SA 40 T - 10 - 10) (.25KW) S		(Type SP 38 S - 10 - 10) (.25KW) S	
	(Type SA 40 S - 12) (.25KW) S		(Type SA 40 T - 12) (.25KW) S		(Type SP 38 S - 12) (.25KW) S	
	(Type SA 40 S - 12 - 12) (.25KW) S		(Type SA 40 T - 12 - 12) (.25KW) S		(Type SP 38 S - 12 - 12) (.25KW) S	
50	(Type SA 50 S - 4) (.4KW) S		(Type SA 50 T - 4) (.4KW) S		(Type SP 48 S - 4) (.4KW) S	
	(Type SA 50 S - 4 - 4) (.4KW) S		(Type SA 50 T - 4 - 4) (.4KW) S		(Type SP 48 S - 4 - 4) (.4KW) S	
	(Type SA 50 S - 8) (.4KW) S		(Type SA 50 T - 8) (.4KW) S		(Type SP 48 S - 8) (.4KW) S	
	(Type SA 50 S - 8 - 8) (.4KW) S		(Type SA 50 T - 8 - 8) (.4KW) S		(Type SP 48 S - 8 - 8) (.4KW) S	
	(Type SA 50 S - 10) (.4KW) S		(Type SA 50 T - 10) (.4KW) S		(Type SP 48 S - 10) (.4KW) S	
	(Type SA 50 S - 10 - 10) (.4KW) S		(Type SA 50 T - 10 - 10) (.4KW) S		(Type SP 48 S - 10 - 10) (.4KW) S	
	(Type SA 50 S - 12) (.4KW) S		(Type SA 50 T - 12) (.4KW) S		(Type SP 48 S - 12) (.4KW) S	
	(Type SA 50 S - 12 - 12) (.4KW) S		(Type SA 50 T - 12 - 12) (.4KW) S		(Type SP 48 S - 12 - 12) (.4KW) S	

Other				
Designation				Quantity
Pole	A1	A2	Luminaire	

GENERAL NOTES:

All work, materials and services not shown on the plans which may be necessary for complete and proper construction shall be performed, furnished and installed by the Contractor. Faulty fabrication or poor workmanship in any material, equipment or installation will be considered justification for rejection. Where manufacturers provide warranties or guarantees as a customary trade practice, Contractor shall furnish to the Department such warranties or guarantees.

The location of poles and fixtures are diagrammatic only and may be shifted by the Engineer to accommodate local conditions. Erection and/or removal of poles and luminaires located near overhead electrical lines shall be accomplished using established industry and utility safety practices and in accordance with laws governing such work. The Contractor shall consult with the appropriate utility company prior to beginning such work.

A. Standard Steel Pole Designs. Steel poles fabricated in accordance with the details and dimensions shown herein, shall be considered standard designs. Submission of shop drawings and design calculations for standard designs is not required.

B. Optional Steel Pole Designs. Multi-sided steel poles may be allowed as optional designs, if steel poles are permitted or required, pending approval by the Department as outlined below.
1. Shop Drawings. Optional designs require submission of shop drawings and design calculations bearing the seal of an engineer registered in the State of Texas, in accordance with Item 441, "Steel Structures." The Department may elect to pre-approve some shop drawings for optionally designed poles. Submission of shop drawings and design calculations is not required for structures fabricated in accordance with the details of shop drawings on the pre-approved list maintained by the TxDOT Traffic Operations Division. Any deviation from the pre-approved shop drawings will require submission of shop drawings of the complete assembly and design calculations as described above.
2. Structural Support Design for Luminaires. Lighting support structures shall be designed for a 25 year design life in accordance with the 2001 Edition of the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals." All poles shall be designed for 110 mph 3-second gust wind speeds. An additional 1.14 gust factor shall be applied to the wind loads. For transformer base poles, fabricator shall include transformer base and connecting hardware in design calculations and shop drawing submittals. All transformer bases shall have been structurally tested to resist the theoretical plastic moment capacity of the pole. Certification of the plastic moment load test and FHWA breakaway requirement test of the model of base being furnished shall be submitted with the shop drawings. Shop drawings shall show breakaway base model number, and manufacturer's name and logo. Manufacturer's shop drawings shall include the ASTM designations for all materials to be used.
3. Mast Arm Attachments. All poles and attachments shall be structurally designed to support two 12-foot mast arms and luminaires. Poles shall be supplied with mast arm combinations as shown in the plans. All mast arms shall be designed for a 60-pound luminaire having an effective projected area of 1.6 square feet.
4. Anchor Bolt Assembly. Anchor bolt assemblies for optionally designed poles shall be the same as those shown herein.

C. Aluminum Pole Designs. Aluminum pole designs may be allowed, if aluminum poles are permitted or required, pending approval by the Department as outlined below.
1. Meet all of the requirements stated above for optional steel pole designs and the following:
   a. Aluminum poles shall be fabricated in accordance with "Structural Welding Code-Aluminum" AWS D1.2.
   b. Aluminum pole designs shall use the same anchor bolt assembly and be subject to the same geometric restraints and other requirements for steel poles specified herein.
   c. Aluminum poles shall be equipped with vibration mitigation devices, as approved by the engineer.
   d. Pole components shall be constructed using the following material:
   Shaft: ASTM B221 or B241 Alloy 6063-T6, ASTM B209 Alloy 5086-H34, ASTM B221 Alloy 6005-T5.
   Base Flange: ASTM B26 Alloy 356.0-T6 or ASTM B108 Alloy 356.0-T6 (Yield strength test required).
   Mast Arm Fittings: ASTM B209 Alloy 6061-T6 or ASTM B221 Alloy 6005-T5.
   Mast Arms: ASTM B241 Alloy 6061-T6 or Alloy 6063-T6.
   Pole Cap: ASTM B209 Alloy 5086-H32 or ASTM B108 or B26 Alloy 356.0-T6.
   Bolts: Stainless Steel AISI 300 series. Bolts threading into aluminum threads shall be treated with anti-seize compound, Never-Seez Compound, Permatex 133K or equal.

D. Special Designs. Poles with architectural treatments shall meet the requirements shown elsewhere in the plans.

EXPLANATION OF ROADWAY ILLUMINAION ASSEMBLY DESIGNATIONS

(TYPE SA 50 T - X - X) (.4KW) S

SA: Pole and mast arm may be steel or aluminum.
ST: Pole and mast arm must be steel.
AL: Pole and mast arm must be aluminum.
SP: Squashed (ovalized) steel or aluminum pole for installing on CSB or SSCB. See standard sheet CSB (5), or SSCB (4).

Two numerical digits denote mounting height in feet.

Next letter denoted type of base. (S-Shoe Base, T-Transformer Base, or B-Shoe Base Bridge Mount)

First number denotes length of mast arm in feet.

Use of second mast arm is indicated by second dashed number which denotes length in feet.

Next three figures indicate luminaire rating (1 KW= 1000 watts, .4 KW= 400 watts, etc.) Fixtures for U/P (SPL-CO) (.150KW)S(TYPE 1) and (TYPE 2) as shown on RID(UP) shall be "cobra head" style fixtures that meet the specifications shown on RID(UP) sheets 1 and 2. Fixtures bid under the descriptive code RDWY ILL ASSM U/P TYPE 1F shall meet the specifications shown on RID(IT). All other fixtures bid under Item 610 shall meet specifications shown elsewhere in the plans.

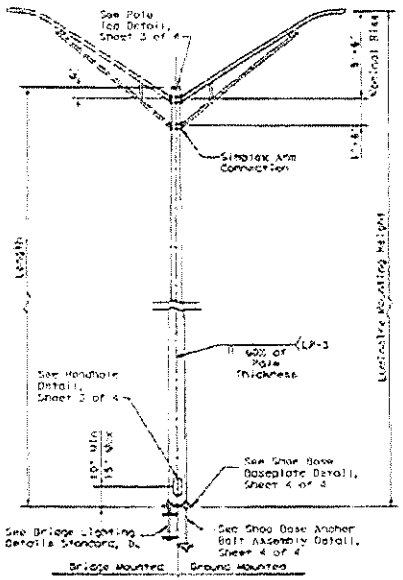
Last letter indicates the type of lamp (M- Metal Halide, S- High Pressure Sodium, L- Low Pressure Sodium).

SHEET 1 of 4

Texas Department of Transportation
Traffic Operations Division

ROADWAY ILLUMINATION POLES

RIP(1)-07



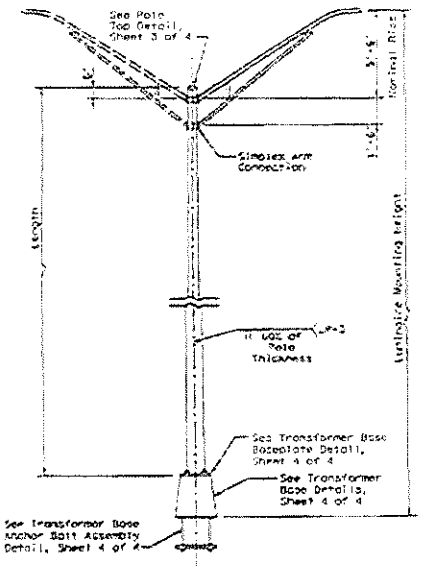
SHOE BASE POLE

SHOE BASE POLE					
Luminaire Mounting Height (Ft)	Base Diameter (In)	Top Diameter (In)	Length (Ft)	Pole Thickness (In)	Design Moment (K-Ft)
20.00	7.00	4.90	15.00	0.1196	7.1
30.00	7.50	4.00	25.00	0.1196	13.2
40.00	8.50	5.00	35.00	0.1196	20.7
50.00	10.50	4.20	45.00	0.1196	30.3

Designs conform to 2001 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals and Interim Specifications. Design 3-Second Gust Wind Speed equal 110 mph with a 1.14 gust factor. A wind importance factor of 0.80 is applied to adjust the wind speed to a 25 year recurrence interval. Design moments listed in table assume base of pole is less than 25' above natural ground level.

Design structures to support two 10' luminaire mast arms and luminaires. Design mast arms for a 60-pound luminaire having an effective projected area of 1.6 square feet.

Fabrication shall be in accordance with the Specifications and with the details, dimensions, and weld procedures shown herein. Do not submit shop drawings for roadway illumination pole assemblies fabricated in accordance with the details, dimensions, and weld procedures shown herein. Weld references call for prequalified weld procedures which the Fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and shipping practices shall meet the requirements of these sheets and the Specifications. In the absence of specified fabrication tolerances, dimensions shall be within the tolerances generally obtainable in normal fabrication practice.



TRANSFORMER BASE POLE

TRANSFORMER BASE POLE					
Luminaire Mounting Height (Ft)	Base Diameter (In)	Top Diameter (In)	Length (Ft)	Pole Thickness (In)	Design Moment (K-Ft)
20.00	7.00	5.43	13.50	0.1196	7.1
30.00	7.50	4.81	23.50	0.1196	13.2
40.00	8.50	5.81	33.50	0.1196	20.7
50.00	10.00	5.41	43.50	0.1196	30.3

For mounting heights between values shown in the tables, use base diameter and thickness values for the larger pole.

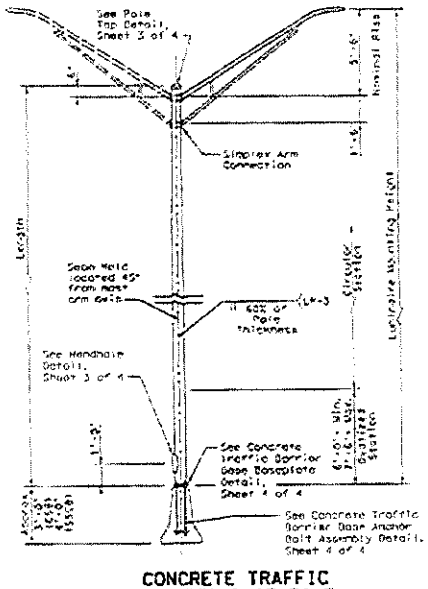
Unless otherwise noted, all steel parts shall be galvanized in accordance with Item 445, "Galvanizing."

Steel poles shall be fabricated in accordance with Item 441, "Steel Structures." Longitudinal seam welds for pole sections shall have 60% minimum penetration. All welding shall be in accordance with the ANSI/AWS Structural Welding Code D1.1.

Two-section poles joined by circumferential welds will not be permitted, unless otherwise shown on the plans. Poles may be fabricated in two sections and field-assembled by the lap-joint method. The two sections shall telescope together with a lap length of not less than 1-1/2 times the shaft diameter at the lap joint.

Alternate material equal to or better than material specified may be substituted with the approval of the Engineer.

Lubricate and tighten anchor bolts, when erecting shoe base poles and concrete traffic barrier base poles, in accordance with Item 449, "Anchor Bolts."



CONCRETE TRAFFIC BARRIER BASE POLE

CONCRETE TRAFFIC BARRIER BASE POLE (CSB/SSCB)						
Luminaire Mounting Height (Ft)	Base② Diameter (In)	Top Diameter (In)	Length (Ft)	Pole Thickness (In)	Design Moment (K-Ft)	
					About ℄ of Bolt	Perp. to Roll
28.00	9.00	5.78	23.00	0.1196	10.3	10.2
38.00	9.00	4.36	33.00	0.1196	16.6	20.8
48.00	10.50	4.46	43.00	0.1345	29.1	30.5

All poles, except Transformer Base Poles, shall have hand holes with reinforcing frames and covers. Except for poles mounted on a concrete traffic barrier, hand holes shall be placed 90 degrees to mast arm unless otherwise noted on the plans. For poles mounted on a concrete traffic barrier with one luminaire arm, hand holes shall be located 180 degrees from luminaire arm. For poles mounted on a concrete traffic barrier with two luminaire arms, all hand holes shall be on the same side of the barrier.

The finished pole shall have a smooth, uniform finish free of pits, blisters, or other defects. Scratched, chipped, and other damaged galvanized areas on poles and mast arms shall be repaired in accordance with Item 445, "Galvanizing."

MATERIAL DATA

COMPONENT	ASTM DESIGNATION	MIN. YIELD (KSI)
Pole Shaft (0.14"/ft, Taper)	A572 Gr 50, A595 Gr A, A1011 HSLAS Gr 50 Cl 2 ③, or A1008 HSLAS Gr 50 Cl 2	50
Base Plate and Handhole Frame	A572 Gr.50, or A36	36
T-Bolt Connecting Bolts	A325 ①	92
Anchor Bolt Nut (T-Base, Shoe)	F1554 Gr 55	55
Anchor Bolts (CSB/SSCB)	A325, A193-B7, or A321	105
Anchor Bolt Templates	A36	36
Heavy Hex (H.H.) Nuts	A194 Gr 2H, or A563 Gr DH	
Flat Washers	F436	

① Lubricate in the field if necessary in lieu of the requirements in ASTM A325.

② Before ovalized as shown on Concrete Traffic Barrier Base Baseplate details, Sheet 4 of 4.

③ A1011 SS Gr 50 may be used in lieu of HSLAS, provided the material meets the elongation requirements for HSLAS.

POLE ASSEMBLY FABRICATION TOLERANCES TABLE

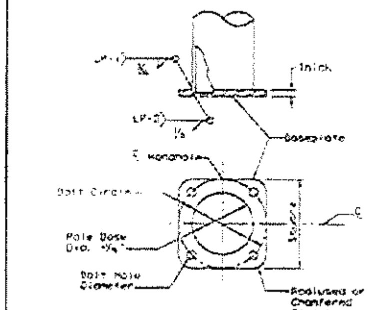
DIMENSION	TOLERANCE
Shaft length	+2"
I.D. of cumulative stack of slip fitting pieces	+1/8", -1/16"
O.D. of mating piece of slip fitting pieces	+1/32", -1/8"
Shaft diameters other	±3/16"
Out of "round"	1/4"
Straightness of shaft	±1/4" in 10 ft
Twist in shaft	4° in 50 ft
Perpendicular to baseplate	1/8" in 24"
Pole centered on baseplate	±1/4"
Location of attachments	±1/4"
Bolt hole spacing	±1/16"

Texas Department of Transportation
Traffic Operations Division

ROADWAY ILLUMINATION POLES

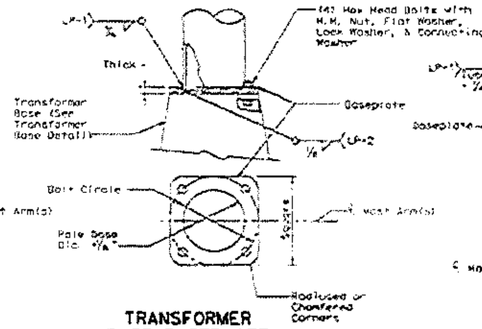
RIP(2)-07

01 JAN 2001



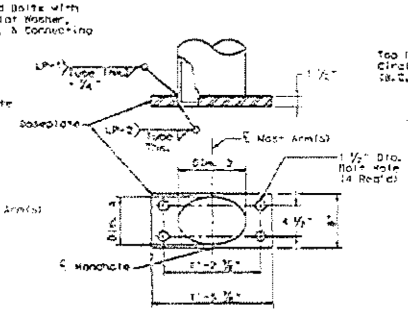
SHOE BASE BASEPLATE

SHOE BASE BASEPLATE TABLE				
MOUNTING HEIGHTS	BOLT CIRCLE	SQUARE	THICK	BOLT HOLE DIAMETER
20' - 30'	13"	13"	1 ¼"	1 ¼"
40'	15"	15"	1 ¼"	1 ½"
50'	15"	15"	1 ½"	1 ½"



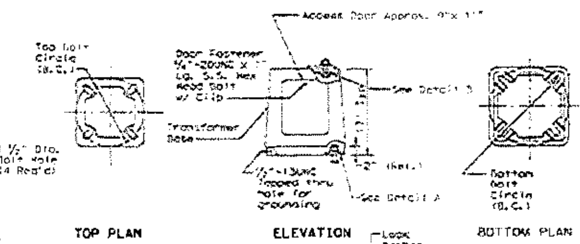
TRANSFORMER BASE BASEPLATE

TRANSFORMER BASE BASEPLATE TABLE						
MOUNTING HEIGHTS	BOLT CIRCLE	SQUARE	THICK	CONNECTING BOLT DIA.	BOLT HOLE DIAMETER	TRANSFORMER BASE TYPE
20' - 30'	13"	13"	1 ¼"	1"	1 ¼"	A
40'	15"	15"	1 ¼"	1 ¼"	1 ½"	B
50'	15"	15"	1 ½"	1 ¼"	1 ½"	B

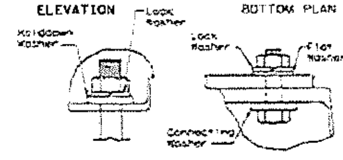


CONCRETE TRAFFIC BARRIER BASE BASEPLATE

CONCRETE TRAFFIC BARRIER BASE BASEPLATE TABLE			
MOUNTING HEIGHTS	POLE DIA.(2)	DIM. A	DIM. B
20' - 30'	9"	7" ± ¼"	10" ± ¼"
40'	10 ½"	7" ± ¼"	13" ± ¼"



TRANSFORMER BASE TABLE		
TYPE	TOP B.C.	BTM. B.C.
A	13"	14"
B	15"	17 ¼"



TRANSFORMER BASE DETAILS

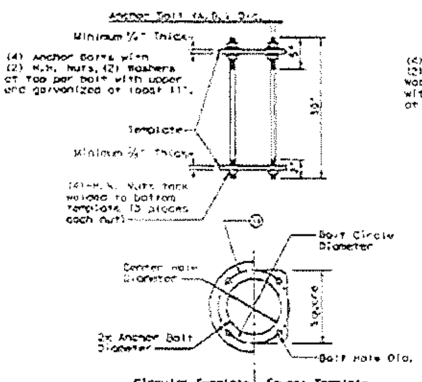
For mounting heights between those shown in the table, use the values in the table for the larger mounting height.

All breakaway bases shall meet the breakaway requirements of the Latest Edition of the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," and shall have been tested by FHWA-approved methods. All bases shall have been structurally tested to resist 150% of the design moment.

Transformer bases shall be cast from aluminum, ASTM B108 or B26 Alloy 356.0-T6, or other material approved by the Engineer. Four hex head bolts with four H.H. nuts, four lock washers, four flat washers, and connecting and hold-down washers as recommended by the manufacturer, galvanized to ASTM A153 Class C or D, or B695 Class 50, shall be provided with each transformer base for connecting the pole. Bolts shall be ASTM A325 or approved equal. Nuts shall be ASTM A563 grade DH galvanized.

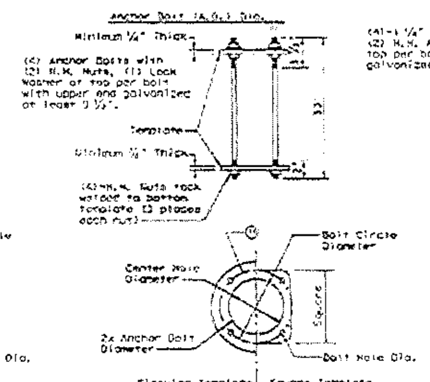
Bases shall be stamped, inclsed or by other approved permanent means, marked to show fabricator's name or logo, and model number. Such information shall be placed in a readily seen location, inside or outside the base, but shall not be placed on the door.

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.



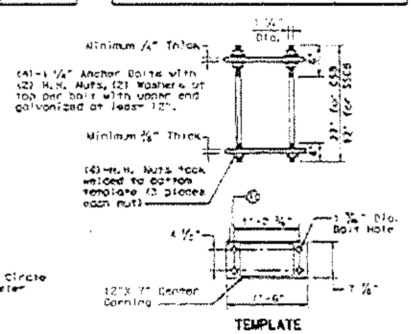
SHOE BASE ANCHOR BOLT ASSEMBLY

SHOE BASE ANCHOR BOLT ASSEMBLY TABLE					
MOUNTING HEIGHTS	A.O. DIA.	BOLT CIRCLE DIAMETER	SQUARE	CTR. HOLE DIAMETER	BOLT HOLE DIAMETER
20' - 30'	1"	13"	13"	11"	1 ¼"
40' - 50'	1 ¼"	15"	14 ½"	12 ½"	1 ¾"



TRANSFORMER BASE ANCHOR BOLT ASSEMBLY

TRANSFORMER BASE ANCHOR BOLT ASSEMBLY TABLE					
MOUNTING HEIGHTS	A.O. DIA.	BOLT CIRCLE DIAMETER	SQUARE	CTR. HOLE DIAMETER	BOLT HOLE DIAMETER
20' - 30'	1"	14"	14"	12"	1 ¼"
40' - 50'	1 ¼"	17 ¼"	16 ¾"	14 ¾"	1 ¾"



CONCRETE TRAFFIC BARRIER BASE ANCHOR BOLT ASSEMBLY

(1) Anchor Bolt Templates need not be galvanized.

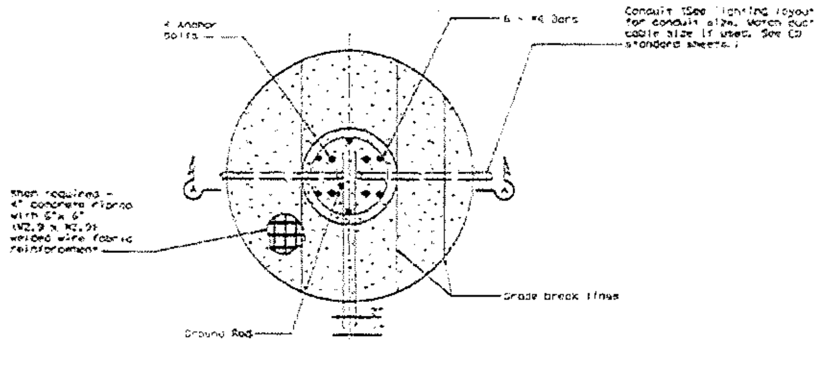
ANCHOR BOLT FABRICATION TOLERANCES TABLE	
DIMENSION	TOLERANCE
Length	± ½"
Threaded length	± ½"
Galvanized length (if required)	+ ¼"

SHEET 4 of 4

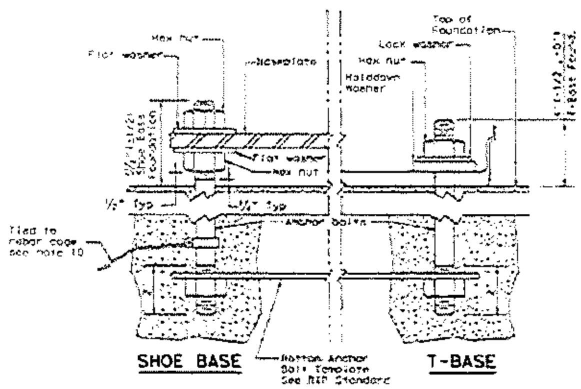
Texas Department of Transportation
Traffic Operations Division

ROADWAY ILLUMINATION POLES

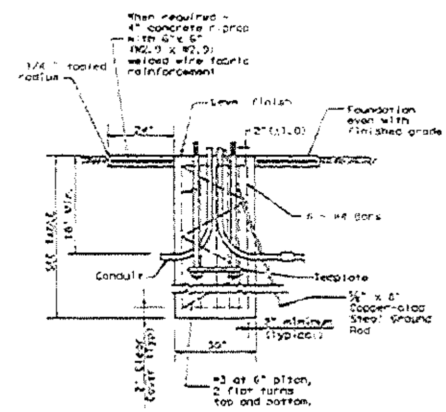
RIP(4)-07



FOUNDATION DETAIL

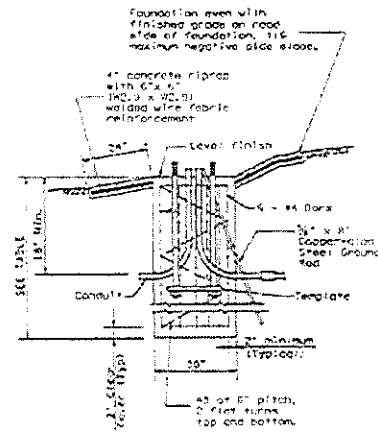


ANCHOR BOLT DETAIL



SECTION A-A

SHOWING CONSTANT GRADE



SECTION A-A

SHOWING SLOPED GRADE

PAY QUANTITY OF RIPRAP PER FOUNDATION (Install only when shown on the plans)		
Foundation Diameter	RIPRAP DIAMETER	RIPRAP (CONC) (CL B)
30 in.	78 in.	0.35 CY

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

RECOMMENDED FOUNDATION LENGTHS (See note 1)			
MOUNTING HEIGHT	TEXAS CONE PENETROMETER N Blows/ft		
	10	15	40
≤20 ft.	6'	6'	6'
>20 ft. to 30 ft.	8'	6'	6'
>30 ft. to 40 ft.	9'	8'	6'
>40 ft. to 50 ft.	10'	8'	6'

BREAKAWAY POLE PLACEMENT (See note 6)	
Roadway Functional Classification	** Pole offset (distance to transformer base, tolerance + 6in.,-0in.)
Freeway Mainlanes (roadway with full control of access)	15 ft. (minimum and typical) from lane edge
All curbed, 45 mph or less design speed	2.5 ft. minimum (15 ft. desirable) from curb face
All others	10 ft. minimum* (15 ft. desirable) from lane edge

* 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 guidelines.

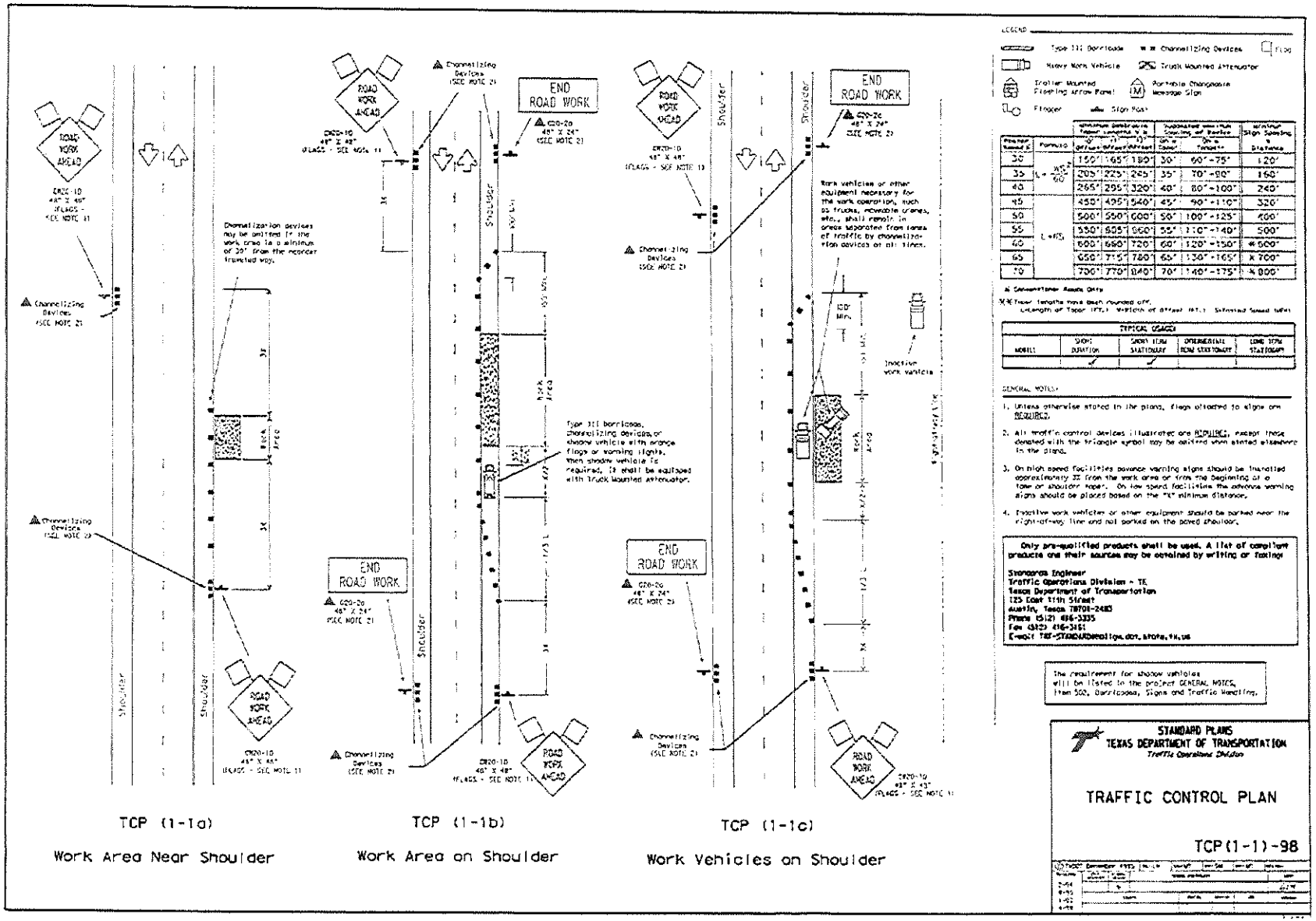
1. "Recommended Foundation Lengths" table is for information purposes only. Foundation lengths shall be as shown on the plans, or as directed by the Engineer. Foundations will be paid for under Item 416, "Drilled Shaft Foundations," unless otherwise shown on the plans.
2. Erect roadway illumination assembly poles plumb and true. Form and level the top 6" of the foundation so the pole will be plumb. Use leveling 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 after galvanizing. Anchor bolt body with rolled threads need not be full size.
4. Use appropriate class of concrete as specified in Items 416 and 432.
5. Place riprap around the foundation when called for elsewhere in the plans. Riprap will be paid for under Item 432.
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 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 design guidelines for further information.
7. Use 4 hold down washers on transformer base poles as recommended by the manufacturer and supplied with base.
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.
10. Bond anchor bolt to rebar cage with #6 bare stranded copper conductor. Use listed mechanical connectors rated for embedment in concrete.
11. Use rip rap on T-base foundations that are located on sloped grades.

Texas Department of Transportation
Traffic Operations Division

ROADWAY ILLUMINATION DETAILS

(RDWY ILLUM FOUNDATIONS)

RID(FND)-07



LEGEND

Type III Barricade | Channelizing Devices | Flag | Heavy Work Vehicle | Truck Mounted Attenuator | Trailer Mounted Flashing Arrow Panel | Portable Changeable Message Sign | Flagger | Sign Post

Posted Speed S	Formula	Minimum Desirable Taper Length L =			Suggested Minimum Spacing of Devices		Minimum Sign Spacing = Distance
		On a Grade			On a Tangent	On a Tangent	
30	L = WS²/60	150'	165'	180'	30'	60'-75'	120'
35		205'	225'	245'	35'	70'-90'	160'
40		265'	295'	320'	40'	80'-100'	240'
45		450'	495'	540'	45'	90'-115'	320'
50	L = WS	500'	550'	600'	50'	100'-125'	400'
55		550'	605'	660'	55'	110'-140'	500'
60		600'	660'	720'	60'	120'-150'	* 600'
65		650'	715'	780'	65'	130'-165'	* 700'
70		700'	770'	840'	70'	140'-175'	* 800'

* Conventional Roads Only

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

TYPICAL USAGES				
MOBILE	SHORT DURATION	SHORT TERM STATIONARY	INTERMEDIATE TERM STATIONARY	LONG TERM STATIONARY
	✓	✓		

GENERAL NOTES:

1. Unless otherwise stated in the plans, flags attached to signs 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.
3. On high speed facilities advance warning signs should be installed approximately 3S from the work area or from the beginning of a lane or shoulder taper. On low speed facilities the advance warning signs should be placed based on the "X" minimum distance.
4. Inactive work vehicles or other equipment should be parked near the right-of-way line and not parked on the paved shoulder.

Only pre-qualified products shall be used. A list of compliant products and their sources may be obtained by writing or faxing:

Standards Engineer
Traffic Operations Division - TE
Texas Department of Transportation
125 East 11th Street
Austin, Texas 78701-2483
Phone (512) 486-5335
Fax (512) 416-3151
E-mail: TEF-STANDARDS@dot.state.tx.us

The requirement for shadow vehicles will be listed in the project GENERAL NOTES, Item 502, Barricades, Signs and Traffic Handling.

STANDARD PLANS
TEXAS DEPARTMENT OF TRANSPORTATION
Traffic Operations Division

TRAFFIC CONTROL PLAN

TCP(1-1)-98