MARICOPA COUNTY

DEPARTMENT OF TRANSPORTATION

SUPPLEMENT TO THE

MARICOPA ASSOCIATION OF GOVERNMENTS'

UNIFORM STANDARD SPECIFICATIONS

AND DETAILS FOR

PUBLIC WORKS CONSTRUCTION

January 2011

MARICOPA COUNTY
Department of Transportation

INTEROFFICE MEMORANDUM

Date: December 29, 2010

To: Engineers, Contractors, Consultants, and Agency Staff

From: John B. Hauskins, P.E.
Transportation Director

1-3-2011

Subject: MCDOT Supplement to MAG Uniform Standard Specifications and Details for Public Works Construction

Work performed within Maricopa County rights of way shall comply with the MAG Uniform Standard Specifications and Details for Public Works Construction as modified by the Maricopa County Department of Transportation Supplement. The attached supplement dated January 2011 shall replace the MCDOT Supplement dated February 2010. The attached supplement shall be effective immediately and shall remain in effect until reissued or updated. Address specific issues or concerns to:

Robert Herz, MCDOT Engineering Division (602) 506-4760
(email: rherz@mail.maricopa.gov).

This document is available on the MCDOT web site:

http://www.mcdot.maricopa.gov/manuals/

or for purchase at Maricopa County Department of Transportation offices located at 2901 West Durango, Phoenix, Arizona 85009, Customer Service (602) 506-2055.

2901 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-4622 Fax: 602-506-4858

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SECTION 101

ABBREVIATIONS AND DEFINITIONS

101.1: ABBREVIATIONS

Add the following:

ADEQ	Arizona Department of Environmental Quality
CLR	Clear
HH	Hand hole
SWPPP	Stormwater Pollution Prevention Plan

101.2: DEFINITIONS AND TERMS:

Add the following:

Americans With Disabilities Act of 1990: "(ADA)" as the act that makes it unlawful to discriminate in employment and service provision, against a qualified individual with a disability.

Certified Laboratory: An AASHTO accredited laboratory, certified in the relevant engineering materials and testing specialty areas(s) referenced in the Contract Documents.

County: The Maricopa County Department of Transportation, acting through its legally constituted officials, officers, or designated employees.

Mailbox: The mail receptacle and its supporting post or structure.

Maximum Density: The maximum dry density of soil obtained from the procedures defined in Section 301.3.

Professional Geologist: A person who has a current registration as a geologist granted by the Arizona State Board of Technical Registration.

Superpave Mix: Asphalt mix in compliance with the design requirements of section 710.3.2.2.

The following definition is revised:

Force Account Work: Work performed in accordance with Section 109.5

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.5 PREPARATION OF PROPOSAL:

Revise the third paragraph of Section 102.5 to read:

102.5.1 Proposal Preparation:

Contractor shall submit the entire construction specifications document intact and shall complete and submit the following documents with its bid:

(A) No Collusion Affidavit - form must be filled out, signed and notarized.

(B) Verification of License - form must be filled out, dated and signed.

(C) Proposal - appropriate sections of the form must be filled out, addenda listed, if any, and signed.

(D) Bidding Schedule - must include unit costs, amounts per bid item, and total bid amount. Addenda, if any, must be listed. All notations in the bidding schedule must be legible and in pen or ink.

(E) Surety Bond - proposals must be accompanied by a certified check, cashiers check, or a surety bond for an amount equal to ten percent (10%) of the total amount bid.

(F) All addenda issued by the County for the specific project must be included with the bid and noted on the second page of the proposal.

Other forms - execution of the Contract, submittal of the Performance/Payment Bond and the Certificate of Insurance is not required at the time of bid submittal. These documents must be submitted to the County by the successful bidder at time of contract execution.

Contractor may be required to provide proof of satisfactory completion of similar public works projects.

Add the following to Section 102.5:

It shall be the responsibility of the prospective bidder to determine, prior to the submittal of its bid, if any addenda to the project have been issued by Maricopa County Department of Transportation. All addenda issued, if not already bound in the Special Provisions, shall be submitted by bidder with its bid and noted in the proposal section.

All quantity adjustment, required as a result of the addendum, shall be reflected on the bidding schedule in pen and ink.

Bids which do not reflect the appropriate changes on the bidding schedule, do not have all issued addenda attached and noted in the proposal section of the Contract, will be rejected by the County.

Prospective bidders may call Maricopa County Department of Transportation in order to ascertain if addenda have been issued for this project.

102.6 SUBCONTRACTORS' LIST, add the following:

The Contractor shall submit to the County with the Bid documents a listing of all major Subcontractors and Material Suppliers the Contractor intends to use in the performance of the work specified in this contract. In determining the amount of work assigned to each Subcontractor, the Contractor shall adhere to the mandates set forth in Section 108.2, Subsection E, of the MAG Uniform Standard Specifications.

SECTION 104

SCOPE OF WORK

104.1 WORK TO BE DONE:

104.1.1 General, add the following:

The work shall be as described in the specifications, as shown on the project plans, and in compliance with permit requirements. Specifications shall be the latest revision of the Maricopa County Association of Governments' Uniform Standard Specifications for Public Works Construction as modified by the Maricopa County Department of Transportation's Supplement to MAG and the project Special Provisions.

104.1.3 Cleanup and Dust Control, add the following:

Contractor shall dispose of construction debris on an as-needed basis in order to keep the site safe to Contractor's personnel and the general public. Construction debris shall be disposed of only in a manner or in a location approved by the Engineer.

Contractor shall be responsible for the safe and clean condition of the site during the entire period the site is under Contractor's care, custody and control.

104.3 VALUE ENGINEERING

Section 104 add the following:

104.3.1 Purpose:

This clause defines a Construction Incentive Change Order Proposal ("CICOP") and establishes the policy and procedure for the application of CICOP's in the Maricopa County construction process.

104.3.2 Definition:

A CICOP is a defined, written proposal for a change order during construction and shall be initiated, developed and identified by Contractor. The CICOP shall result in gross capital savings and a net capital improvement cost reduction, shall not increase the total maintenance cost of the project and shall meet the following requirements:

104.3.2.1 All Time Extensions for the project shall be agreed upon by both parties at the time the CICOP is approved. The County's determination shall be binding upon the Contractor and shall not be subject to challenge.

104.3.2.2 The CICOP shall not alter the initially intended function, quality and safety standards of the project.

104.3.2.3 The CICOP shall not change the overall scope of the work, which would require a re-bidding of the project.

104.3.2.4 The CICOP shall not conflict with any contract provisions regarding proprietary and restrictive specifications for bids in connection with Uniform Standard Specifications and details, or any other applicable specifications.

104.3.2.5 The CICOP shall not cause undue interruption of the contract work schedule.

104.3.2.6 The proposed changes in connection with the CICOP shall comply with all federal, state and local regulations, mandates and permits.

104.3.2.7 If the Contractor wishes to submit a CICOP, he shall submit a preliminary CICOP in writing, which shall address all components required for a final CICOP, in summary form. The County will review the preliminary CICOP and inform the Contractor in writing if the County wishes to implement the CICOP. The Contractor would then be requested to prepare a detailed final CICOP.

104.3.3 Applicability:

All Maricopa County construction contracts.

104.3.4 Content:

The CICOP shall contain pertinent information and support documentation to allow comprehensive review by the appropriate contracting agency. At a minimum, the CICOP shall include the following information:

104.3.4.1 Name and title of individuals associated with the design and preparation of the CICOP.

104.3.4.2 Detailed scope description with sealed plans and specifications. A comparison summary of present design, proposed changes and detailed description of the advantages and disadvantages for each change proposed. The CICOP shall be sealed and signed by a Professional Engineer.

104.3.4.3 Comprehensive procedure and schedule outlining implementation of CICOP, including all required contract amendments and the absolute latest approval date for the CICOP.

104.3.4.4 Estimated cost summary which shall include but not necessarily be limited to the following:

104.3.4.4.1 Project cost with and without CICOP, which shall include the following items:

104.3.4.4.1.1 Quantities of materials and equipment.

104.3.4.4.1.2 Unit prices for materials and equipment.

104.3.4.4.1.3 Hourly rates and total labor hours required for installation.

104.3.4.4.1.4 Overhead and fee percentage of Contractor and all subcontractors of any tier involved in the performance of the work outlined in the CICOP.

104.3.4.4.2 Operations and maintenance cost prior to and after implementation of CICOP.

104.3.4.4.3 Implementation cost of the CICOP not covered in Section 104.3.4.4.1.4, above.

104.3.4.4.4 Contractor's cost of the savings, based on the formula specified below.

104.3.4.4.5 Other pertinent data, as may be required by the County to prepare and execute a change order to the Contract.

104.3.4.4.6 If Contractor fails to notify the County of all required changes for the CICOP during the initial CICOP approval stage, Contractor shall absorb all costs connected with the implementation of changes of which the County was not made aware of. If conditions occur, which could not be foreseen by any prudent Contractor, the County may enter into negotiations with Contractor and make the necessary cost adjustments to the Contract.

104.3.4.4.7 All CICOP's become public record when submitted to the County for review and approval. Propriety information may be protected by Contractor.

104.3.4.4.8 For CICOP's accepted by the County, processing procedure for change orders shall be used.

104.3.4.4.9 If a CICOP is rejected by the County, Contractor may not appeal such a rejection.

104.3.5 Sharing Provisions:

Upon acceptance and implementation of a CICOP, Contractor will share the net capital savings derived from the implementation of the CICOP, in accordance with the formula outlined below:

104.3.5.1 Initial construction cost minus revised construction cost minus CICOP development cost and CICOP implementation cost equals Net Capital Savings.

104.3.5.1.1 The CICOP implementation cost shall include Contractor's actual cost and fee for reviewing and redesigning the CICOP, documented to the satisfaction of the County.

104.3.5.1.2 CICOP development cost shall include Contractor's cost directly associated with the preparation of the CICOP package, documented to the satisfaction of the County.

104.3.5.1.3 CICOP implementation and development costs shall include COUNTY costs for review and approval of the CICOP package.

104.3.5.2 Sharing Formula: Net Capital Savings, calculated in accordance with the formula outlined in Section 104.3.5.1, above, shall be shared with Contractor on an equal 50/50 percentage basis.

SECTION 105

CONTROL OF WORK

105.1 AUTHORITY OF THE ENGINEER, add the following:

The Engineer may adjust design grades or adjust the location of structures (especially drainage structures) prior to construction. Such adjustments are considered minor changes in the work and do not constitute extra work.

105.2 PLANS AND SHOP DRAWINGS, add the following:

Initial submittal for review – five copies, of which one copy will be returned to the Contractor within five working days.

Final submittal for approval – five copies, of which two copies will be returned to the Contractor within five working days.

105.4 COORDINATION OF PLANS AND SPECIFICATIONS:

Section 105.4 is replaced with the following:

Contractor shall perform the work under this Contract in accordance with the intent of the Plans and Specifications and shall not take advantage of any error or omission in the Plans and/or specifications. In the event Contractor discovers an error or omission in the

Plans and/or specifications, Contractor shall promptly advise the Engineer of such an error or omission. If Contractor fails to notify the Engineer of an error or omission in the Plans and/or specifications, which Contractor has discovered or should have discovered through the exercise of reasonable diligence, any additional work required as the result of such errors or omissions, shall be compensated by the County on a force account basis and such compensation shall be the exclusive compensation to Contractor for any costs, expenses or damages resulting directly or indirectly from the correction of such errors and omissions.

105.6 COOPERATION WITH UTILITIES, add the following:

Contractor is solely responsible for any damage to existing utilities resulting from Contractor's operations at the site. The use of hand tools to expose a marked facility is required when proposed excavation is within the 2.0-foot tolerance zone of a marked facility, or if uncertainty exists as to the exact location of a facility.

An attempt has been made by the County to identify the location of all underground utilities located within the perimeter of the site and to design the location and elevation of all irrigation and drainage pipes, culverts and structures to avoid interference with existing utilities. It shall be the Contractor's responsibility to cooperate with the appropriate utility companies in order to facilitate requested adjustments of obstructing utilities. (Please refer to the Special Provisions for specific telephone numbers and contact persons of utilities within the project area).

Contractor's installation of conduits, brackets, piping, valve adjustments or other material at the request and for the convenience of the utility shall be paid by the utility unless specifically identified otherwise in the plans or the Special Provisions. Contractor shall make all required arrangements for such construction and payment with the utility. The County will not extend the performance period of the contract to accommodate construction performed for the convenience of the utility.

105.8 CONSTRUCTION STAKES, LINES AND GRADES:

The first paragraph of Section 105.8 of the Uniform Standard Specifications is revised to read:

Maricopa County will furnish one time the necessary survey control for the Contractor's guidance. Staking shall consist of the following:

(A) Right-of-Way lines at 100 ft. intervals for clearing, fencing, and control of Contractor's operations.

(B) Slope stakes shall be offset from the edge of the embankment at 100 ft. intervals.

(C) Blue tops in subgrade at centerline and edge of pavement at 100 ft. intervals except on curves. Contractor shall have all material in place and compacted within 2.5 inches± prior to requesting the survey crew.

(D) Blue tops on aggregate base course at centerline, edge of pavement, and 1/4 points at 50 ft. intervals. Contractor shall have all material in place and compacted within 2.5 inches ± prior to requesting the survey crew.

(E) Catch basin stakes shall be offset at 10 ft. and 15 ft. to the center of the structure with cuts or fills shown to the top of grate.

(F) Grade and line stakes for all structures, pipe lines, culverts, and ditches.

(G) Straddle points for permanent monuments.

105.12 MAINTENANCE DURING CONSTRUCTION, add the following:

The Contractor shall be responsible to protect the construction site, construction activities, and new construction from the detrimental effects of weather, including flooding, until acceptance by the Engineer.

105.15 ACCEPTANCE, add the following:

The Contractor may request an inspection to establish substantial completion when all of the following have occurred:

- All pavement, pavement markings and signing are complete and accepted and traffic can move unimpeded through the project at the posted speed;
- All pedestrian pathways are completed and accepted and pedestrians are not restricted by any construction activity;
- All guardrails, drainage devices, ditches, excavation and embankment have been accepted;
- The only work left for completion is incidental, away from vehicle and pedestrian traffic, and does not affect the safety or convenience of the traveling public.

A notice of substantial completion shall be issued when the Engineer determines after an inspection that all conditions for substantial completion have been met. The decision whether the project is substantially complete is within the sole discretion of the Engineer. The inspection date requested by the Contractor for the substantial completion inspection shall be the date of substantial completion if the Engineer determines the conditions for substantial completion have been met. Liquidated damages shall not be assessed after the substantial completion date.

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF MATERIALS AND QUALITY, add the following:

All materials not specifically noted as provided by the County or other participating agency shall be obtained from commercial sources. Contractor shall pay all royalties or any other charges or expenses incurred in connection with the securing and hauling of the material. Contractor shall provide the Engineer with a list of proposed commercial sources prior to utilization of such sources and shall present satisfactory evidence that the material obtained from the commercial sources meets the specifications of this project.

The Contractor is responsible for providing quality control measures and testing necessary to provide acceptable quality in the production, handling, and placement of all materials. Engineer's testing is for quality assurance and acceptance. The cost of quality control measures and testing shall be included in the unit price of related items.

If the use of borrow material is required during the performance of the work outlined in the Construction Specifications, Contractor shall assure that the borrow material used for the project, if the source is other than that recommended by the County, does not contain any substances which may be harmful to humans, animals, vegetation, ground and surface water, and the environment and which are regulated under the Hazardous Material Transportation Act, the Toxic Substances Control Act, the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

106.4 TRADE NAMES AND SUBSTITUTES, replace with the following:

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the specification or description is intended to establish the type, function and quantity required. Unless the specification or description contains or is followed by words reading that no like equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment of other suppliers may be accepted by the Engineer under the following circumstances:

106.4.1 "Or-Equal":

(A) If in the Engineer's sole discretion an item of material or equipment proposed by the Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by the Engineer as an "or-equal" item, in which case review and approval of the proposed item may, at the Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

(B) Substitute Items: If in the Engineer's opinion an item does not qualify as an "or-equal" item under 106.4.1(A), it will be considered a proposed substitute item. The Contractor shall submit sufficient information, as provided below, to allow the Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. The procedure for review by the Engineer will include the following as supplemented in the Special Provisions and as the Engineer may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by the Engineer from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall first make written application to the Engineer for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice the Contractor's achievement of completion on time, whether or not acceptance of the substitute for use in the work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with County for work on the project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement services shall be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other Contractors affected by the resulting change, all of which will be considered by the Engineer in evaluation the proposed substitute. The Engineer may require Contractor to furnish additional data about the proposed substitute.

(C) All data provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's sole expense.

106.4.2 Substitute Construction Methods or Procedures:

If a specific means, method, technique, sequence or procedure of construction is shown or indicated and expressly required by the Contract Documents, Contractor may furnish or use a substitute means, method, technique, sequence or procedure of construction acceptable to the Engineer. Contractor shall submit sufficient information to allow the Engineer at the Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by the Engineer will be similar to that outlined in Section 106.4.1.

106.4.3 Engineers Evaluation:

The Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Sections 106.4.1 and 106.4.2, above. The Engineer will be the sole judge of acceptability. No "or-equal" or substitute shall be ordered, installed or used without the Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. The County may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. The Engineer will record time required by the Engineer and the County's consultants in evaluating substitutes proposed or submitted by Contractor pursuant to Sections 106.4.1 and 106.4.2, above and in making changes in the Contract Documents occasioned thereby. Whether or not Engineer accepts a substitute item so proposed or submitted by Contractor, Contractor shall reimburse the County for

cost incurred for the evaluation of the proposed substitute item by the Engineers and/or County's consultant.

SECTION 107

LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

107.1 LAWS TO BE OBSERVED, add the following:

Contractor, in connection with any activity under this Contract, shall not discriminate against any person on the grounds of race, color, religion, sex, national origin, age, disability, political affiliation or belief. Contractor shall include a clause to this effect in all subcontracts. Contractor shall also comply with all applicable provisions of the Americans with Disabilities Act of 1990.

Contractor and its subcontractors and their respective employees, agents, and representatives, when performing the work described in the Construction Specifications, shall comply with all rules and regulations set forth by the County, pertaining to the safety, loss control and environmental regulations, and shall perform the work in compliance with governmental laws and regulations pertaining to occupational health, and environmental protection, including any local sound control and noise level rules, regulations and ordinances which apply to any work performed pursuant to the contract.

Contractor is solely responsible for jobsite ("site") conditions during all phases of construction, beginning with Contractor's mobilization of equipment and/or personnel until the work has been accepted by the Engineer and a certificate of completion has been issued by the County. Contractor's responsibility for the site during the period specified above, shall not be limited to Contractor's working hours and shall include but not necessarily be limited to the following:

* Physical condition of the site;
* Safety of Contractor's personnel at the site and all other persons entering the site or areas adjacent to the site;
* Security of Contractor's equipment and material; and
* Reasonable aesthetic appearance of the site.

Contractor shall insure that internal combustion equipment is operated with a muffler of a type recommended by the manufacturer.

The Contractor shall insure that contract operations are in compliance with procedures and requirements of the Maricopa County Air Pollution Control Rules and Ordinances with special attention given to the fugitive dust requirements. The Contractor shall pay any penalties imposed upon MCDOT where the violation is a direct result of actions or inactions by the Contractor, the contractor's employees or subcontractors.

107.1.1 SMALL BUSINESS ENTERPRISE PROGRAM (SBE)

It is Maricopa County's policy to endeavor to ensure in every way possible that small business participation firms shall have the opportunity to provide professional services, materials, and contractual services to the County in a nondiscriminatory manner.

107.2 PERMITS, replace with the following:

It is the Contractor's responsibility to obtain all permits and licenses, pay all fees, charges, and taxes and prepare all required notices for the lawful execution of the work.

Permits for earth moving may be obtained from Air Pollution Control, Maricopa County Department of Environmental Management, 1001 North Central Avenue, Suite 100, Phoenix, Arizona 85004, Telephone Number (602) 506-6010, website http://www.maricopa.gov/aq/. A copy of the earthmoving permit and dust control plan shall be submitted to the Engineer prior to commencement of any earthmoving activities.

107.2.1 AZPDES (NPDES) Construction General Permit Requirements:

The Contractor shall comply with the Arizona Pollutant Discharge Elimination System (AZPDES) requirements and conditions administered by the Arizona Department of Environmental Quality (ADEQ). Compliance with AZPDES also includes compliance with the requirements of all municipal separate storm sewer systems (MS4) that are within the project limits. For projects that include Indian Tribal Lands, the Contractor shall also be responsible for compliance with the National Pollutant Discharge Elimination System (NPDES) requirements of the Environmental Protection Agency (EPA).

107.2.1.1 Regulation Compliance: The Contractor, contractor employees, and subcontractors shall not discharge stormwater or non-stormwater from the construction site that is not in compliance with requirements and conditions of the AZPDES Construction General Permit for Arizona (AZCGP) as well as all other applicable federal, state and local laws, ordinances, statutes, rules and regulations pertaining to stormwater discharge and air, ground water and surface water quality.

The Contractor shall be designated as the Operator, having day-to-day operational control of those activities at a project which are necessary to ensure compliance with a Stormwater Pollution Prevention Plan (SWPPP) for the site and other permit conditions. The Contractor is responsible for preparing, in a manner acceptable to the ADEQ and the EPA, all documents required by regulation, which shall include but not necessarily be limited to the following:

- Notice of Intent (NOI).
- Stormwater Pollution Prevention Plan (SWPPP).

- Notice of Termination (NOT).

107.2.1.2 NOI Submittal: The Contractor shall submit a Notice of Intent in accordance with the AZCGP. The Contractor shall identify on the NOI all non-stormwater discharges that are expected to be associated with the project's construction activities as required by the AZCGP.

Preliminary copies of the NOI and the SWPPP shall be available to the County during the pre-construction conference.

The Contractor shall ensure the completed and duly signed NOI form(s) are submitted in a timely manner to prevent a delay to project construction.

The AZPDES form shall be submitted to ADEQ's Phoenix office by certified mail or hand delivered to the address below:

Arizona Department of Environmental Quality
Surface Water Section - Stormwater and General Permits Unit
1110 West Washington Street, 5415A-1
Phoenix, AZ 85007

The form may also be faxed to ADEQ at 602-771-4528 or submitted via "smart NOI" accessible from the ADEQ's website:

http://www.azdeq.gov/environ/water/permits/stormwater.html

If the construction is near an impaired or unique water (a.k.a. an Outstanding Arizona Water), the SWPPP shall be submitted with the NOI. Permit activation may require 32 business days or more for construction sites near impaired or unique waters, as well as for construction sites with special concerns, therefore documentation is to be submitted to ADEQ as early as possible.

If the construction site is located within a municipal boundary or urbanized area of Maricopa County, the Contractor shall send a copy of the ADEQ certificate authorizing permit coverage to the local MS4 authority(s).

When Indian Tribal Land is involved a NOI shall be submitted to the EPA. Submittal requirements can be obtained through the website:
www.epa.gov/npdes/stormwater/cgp
A copy of all submitted NOI forms shall be posted at the construction site.

107.2.1.3 Time Extension: Failure by the Contractor or subcontractor of any tier to submit a NOI within the mandated time frame shall result in delay of the construction start date and no claims for extension of time will be granted for such a delay.

107.2.1.4 SWPPP: The Contractor shall develop, sign and certify, implement, update, amend, and revise the SWPPP, as necessary, to assure compliance with permit requirements. The Contractor shall address in the SWPPP, all non-stormwater discharges that are expected to be associated with the project's construction activities as required by the AZCGP.
The Contractor shall ensure that:

- The SWPPP indicates the areas of the project where the County or other entity has operational control over the project specifications, including the ability to make modifications in specifications.
- All other operators implementing portions of the SWPPP impacted by changes made to the SWPPP are notified of such modifications in a timely manner.
- The SWPPP indicates the parties with day-to-day operational control and parties responsible for implementation of the BMPs identified in the SWPPP.

The Contractor and subcontractors shall ensure that construction activities do not render another party's BMP(s) ineffective.

The Contractor shall post the SWPPP authorization number(s) in a conspicuous location near the entrance where most of the construction activity is occurring. A copy of the ADEQ authorization certificate shall be retained with the SWPPP. The SWPPP and a copy of the ADEQ authorization certificate shall be retained on the project site at all times during construction. Copies of forms and guidance for preparing the SWPPP are available in the "Drainage Design Manual for Maricopa County, Volume III Erosion Control." The manual is available at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009. In addition, a "Construction SWPPP Checklist" can be obtained from ADEQ for assisting in the preparation of the SWPPP.

107.2.1.5 Inspections: Contractor shall perform inspections, by qualified personnel, of all stormwater pollution control devices on the project at least once every fourteen (14) days and within twenty-four (24) hours of each 0.5-inch or greater storm event, as required under the provisions of the AZCGP. Contractor shall prepare reports, in accordance with the AZCGP, on such inspections and shall retain the reports for a period of at least three (3) years following the completion of the project. The Contractor shall maintain all stormwater pollution control devices on the project in proper working order, which shall include cleaning and/or repair during the duration of the project.

107.2.1.6 NOT Submittal: Upon project completion, acceptance and demobilization, Contractor shall submit to ADEQ a completed, duly executed Notice of Termination form for each NOI issued, with a copy of the NOT acknowledgement letter to appropriate MS4 authority(s), thereby terminating all AZPDES permit coverage for the project. Contractor shall then provide to the County copies of the SWPPP, inspection information and all other documents prepared and maintained by the Contractor in compliance with the AZPDES Construction General Permit, including records of all data used to complete the NOI to be covered by the AZCGP. Contractor shall retain the originals of such documents for a period of at least three (3) years following the completion of the project and make such documents available for inspection by

representatives of the Environmental Protection Agency, the Arizona Department of Environmental Quality, the County, and any municipality having jurisdiction, upon request.

107.2.1.7 Fines and Penalties: Fines and penalties imposed by the ADEQ, MS4 authority, or the EPA for Contractor's failure to comply with any of the AZPDES permit requirements and conditions shall be borne by the Contractor.

107.2.1.8 Payment: The lump sum price for AZPDES shall include all material, labor, and costs relating to the NOI, NOT, and the SWPPP. This includes but is not limited to the preparation, installation, maintenance, and removal of temporary SWPPP elements, assuring proper operation of the pollution control devices installed, and all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events, runoff or releases on the project. The lump sum price for AZPDES shall be inclusive of all related costs, and no additional claims shall be made by the Contractor under any other specification provision, including changed conditions. Contractor shall be compensated for this item at a rate of 25% of the total contract price paid with the first progress payment, the remaining 75% will be prorated over the entire length of the project.

107.3 PATENTED DEVICES, MATERIALS AND PROCESSES, add the following:

All materials not specifically noted as provided by the County or other participating agency shall be obtained from commercial sources. Contractor shall pay all royalties or any other charges or expenses incurred in connection with the securing and hauling of the material. Contractor shall provide the Engineer with a list of proposed commercial sources prior to utilization of such sources and shall present satisfactory evidence that the material obtained from the commercial sources meets the specifications of this project.

107.4 ARCHAEOLOGICAL REPORTS, add the following:

If previously unidentified archaeological, historical, or paleontological features are encountered during any activity related to construction of a County project, the Contractor shall stop work immediately at that location and shall notify the Engineer. The Engineer will notify MCDOT Environmental Planning Branch (602-506-8082) to evaluate the significance of the resources and determine the appropriate next action.

107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

Section 107.5 add the following:

All water for Contractor's own use, drinking water, temporary electric power, heat, and telephone services shall be arranged for or provided by Contractor, at Contractor's sole expense.

107.5.3 HAZARDOUS MATERIAL HANDLING

107.5.3.1 Material Safety Data Sheets: Contractor shall furnish to the County Material Safety Data Sheets (MSDS) for all regulated and/or hazardous substances which Contractor plans to bring to the site and which may be harmful to humans, animals, vegetation, ground and surface water, and the environment and which are regulated under the Hazardous Material Transportation Act, the Toxic Substances Control Act, the Resources Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.

107.5.3.2 Regulated and/or Hazardous Materials: Contractor shall further furnish to the County prior to the start date of the work a list of all regulated and/or hazardous materials, identified above, which Contractor intends to bring to the site. The list shall contain the following information:

Quantity of material
Description of material
Intended use of the material

Additionally, Contractor shall furnish the County with Material Safety Data Sheets for all regulated and/or hazardous substance Contractor plans to bring to the site or use during the performance of the work.

Contractor shall immediately report spills of oil, gasoline, diesel, lubricants, chemicals and other hazardous material or regulated substances to the County and to all federal, state and local agencies having jurisdiction. Accidental spills shall be immediately contained, the spilled material and contaminated soil removed in accordance with the guidelines established on the Material Safety Data Sheets and in accordance with all applicable federal, state and local laws, mandates, regulations and ordinances. After completion of the clean-up activities, Contractor shall restore the spill area to preexisting conditions.

107.5.3.3 Identify Potentially Hazardous Materials: The County will make reasonable effort to locate and identify potentially hazardous materials and/or underground storage tanks within the project area, prior to construction. In the event material is found by the Contractor or subcontractors of any tier, during the performance of the work, that is suspected to be hazardous, Contractor shall follow the following procedure:

(A) Call "911" in a life threatening situation.

(B) Stop work at the affected area and remove all personnel from that area.

(C) Barricade the area and provide traffic control to prohibit unauthorized entry.

(D) Notify the MCDOT Safety Office (602 506-8601) and the Engineer.

(E) Notify the appropriate regulatory agency(ies) and emergency services.

The Engineer, in consultation with the appropriate regulatory agencies and emergency services, will determine the necessary remediation plan for the Project.

Remediation activities shall only be performed by a certified hazardous waste disposal remediation company, approved by the County.

107.5.4 Energized Electric Power Lines: Whenever the Contractor has construction equipment and personnel in the immediate vicinity of energized aerial electric power lines, the Contractor shall not consider these lines to be insulated. Construction personnel working in proximity to these lines are exposed to extreme hazard from electrical shock. Contractors, their employees, and all other construction personnel working on this project must be warned of the danger and instructed to take adequate protective measures, including maintaining a minimum clearance between the lines and all construction equipment and personnel. Minimum clearances to be maintained are ten (10) feet from 12kv lines, eleven (11) feet from 69kv lines and sixteen (16) feet from 230kv lines (see OSHA Std. 1926.550 (a) 15 and Arizona Revised Statutes 40.360.41 through 45.). When it is necessary to work less than the designated distance from energized power lines the Contractor must notify the appropriate utility company and make necessary arrangements which will insure adequate protection of personnel, equipment and the utility company power lines. The cost of such temporary arrangement will be borne by the Contractor.

107.5.5 Safety Plan: The Contractor's Safety Plan, in accordance with 29CFR1926.20, must be completed by the contractor and submitted to the Construction Engineer no later than five (5) business days prior to the pre-construction conference. Contractor Safety Plan Guidelines are available on the MCDOT website at:

http://www.mcdot.maricopa.gov/manuals/home.htm

107.6 PUBLIC CONVENIENCE AND SAFETY, add the following:

107.6.3 Control of Airborne Pollutants and Sediment Tracking: Contractor shall cover dump trucks while transporting materials that may become airborne during transit. After dumping of such materials, Contractor shall either cover truck bed or take measures to remove all residues that may become airborne.

Contractor shall minimize off-site tracking of sediments by brushing or blowing off construction vehicles, or any other method deemed appropriate by Contractor, prior to exiting the construction site.

107.6.4 Protective Fencing: The Contractor shall furnish and install 6-foot high temporary chain link fencing, or approved equal, satisfactory to the Engineer, around all major structure construction areas (i.e., bridges, pump houses, drop structures, retaining walls, etc.) and around any unattended excavations with slopes steeper than

2:1. Temporary fencing shall completely enclose the construction activity and shall be secured after normal working hours to prevent unauthorized access.

Section 107, add the following new section:

107.15 COMMUNITY RELATIONS SUPPORT:

107.15.1 General: The Contractor for Maricopa County contracted work shall provide assistance for the project's community relations / public information program. The program assistance shall include, but not necessarily be limited to:

(A) Participate in public meetings as required by the Engineer.
(B) Provide informational signage.
(C) Distribution of community relations program notices and newsletters as required by the Engineer.
(D) Documenting existing property conditions prior to starting construction.

The Contractor shall assist the County's public information program by providing information needed to inform the local residents and businesses of hours of construction, necessary operations which create high noise levels, interruption of utilities, street closures, detour locations, disruption of bus routes, haul routes and material delivery routes, and other delivery/pick-up routes. Contractor shall assist the Engineer in responding to questions or complaints concerning construction operations or procedures.

If roadside memorials are located within the Contractor's designated work zone and present a potential conflict to operations, the Contractor shall contact the MCDOT Public Information Office at 602-506-8003 to arrange for relocation. County forces will be responsible for removal/relocation/replacement of roadside memorials within the work zone.

107.15.2 Meetings: Contractor shall attend and participate in public meetings deemed necessary by the Engineer. Meeting times, locations, and agenda will be determined by the Engineer with the assistance of the County's community relations' staff. Contractor may be required to attend a public pre-construction meeting at a location convenient to residents and business operators affected by the project. This meeting may be conducted after execution of contract documents and prior to the start of construction. The meeting if conducted prior to the Notice to Proceed shall not be included in the Contract Time.

107.15.3 Informational Signage: Contractor shall provide and install information signs. Signing shall be installed at least 14 days before beginning construction to inform the public of the forthcoming project, construction dates, and suggested alternate routes. Sign layout examples are available from the Engineer. Signs shall not be constructed or installed prior to approval by the Engineer of the designs, sizes and proposed

locations. Contractor shall maintain the signs as necessary and update the information as requested by the Engineer. Project information signs are not part of Section 401 Traffic Control but their location shall be shown in the Traffic Control Plan.

107.15.4 Existing Conditions Documentation: Contractor shall document existing property conditions within a 100-foot (minimum) radius of the project limits prior to construction. Documentation shall be Digital Video Disc (DVD) format supplemented with digital M-PEG photographs (180 DPI or greater). The DVD shall not be made from a moving vehicle. One (1) copy of the documentation package shall be provided to the Engineer within ten (10) calendar days of the Notice to Proceed date and at least one day prior to commencement of construction operations.

107.15.5 Payment: The County will pay, based upon approved time and material invoices, in accordance with Section 109.5 an amount not to exceed the ALLOWANCE shown in the Fee Schedule under Item COMMUNITY RELATIONS SUPPORT, for authorized work performed in assisting with the County's public information program.

SECTION 108

COMMENCEMENT, PROSECUTION AND PROGRESS

108.1 NOTICE TO PROCEED:
Add section 108.1.1 as follows:

108.1.1 Pre-Construction Conference: After execution of the Contract by both parties and prior to the commencement of the work, the Engineer will schedule a pre-construction conference at the facilities of the Maricopa County Department of Transportation located at 2901 West Durango Street, Phoenix, AZ 85009. Contractor shall be represented at a minimum by a company official with signature authority on behalf of its organization.

Contractor shall submit to the Engineer during the pre-construction conference the following documents:

(A) List of all subcontractors

(B) List of all material sources

(C) Assumptions and calculations used to determine each of the unit prices

(D) Preliminary work schedule

(E) Traffic control plans

(F) Emergency telephone numbers

(G) Signing authority letter

(H) Name and telephone number of the certified safety professional

(I) Copies of all Permits required for project Construction

(J) Preliminary SWPPP and NOI

The following items shall be submitted at the preconstruction conference when reasonably feasible. When not submitted at the preconstruction conference, the submittal(s) shall be specifically shown in the work schedule. The submittals shall be scheduled at least 45 days prior to intended use and/or material transport to the project site.

(K) Material safety data sheets

(L) Mix designs

(M) Manufacturer's certification for all materials

(N) Shop drawings

The pre-construction conference will cover topics such as critical elements of the work schedule, payment application and the processing of invoices. Additionally, a scheduled start date for the work will be determined.

108.2 SUBLETTING OF CONTRACT, add the following:

The Engineer will not consent to subletting of any portion of the contract if a copy of the subcontract or lower tier subcontract is not received. The Engineer's consent shall in no way be construed to be an endorsement of the subcontractor or its ability to complete the work in a satisfactory manner.

The subcontract, purchase order, or lease agreement shall be evidenced in writing and contain all pertinent provisions and requirements of the prime contract. The following data shall be submitted seven calendar days prior to the start of each subcontractor's work.

(A) A complete copy of each subcontractor agreement and each second tier subcontractor agreement.

(B) Verification that all required Federal Provisions; i.e., Federal Form 1273, Executive Order, and Wage Determination Decisions are attached to each subcontract in any federal-aid funded contract.

(C) Subcontracts must show the total price subcontracted. The items of work, and quantities of each item subcontracted shall be shown. Unit Prices or Extended Prices may be deleted except in the case of DBE subcontractors.

(D) DBE subcontracts shall include full extensions of all unit prices.

(E) Partial items shall be explained in detail and show the amount of each contract item being subcontracted. Non-contract item work shall be fully explained.

(F) The contractor shall certify to the County that all of its subcontractors have all required registrations.

108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE, replace with the following:

Contractor shall be solely responsible for the planning, scheduling and execution of the work to assure timely completion of the project.

108.4.1 The initial schedule shall be submitted to the County in triplicate for review at the pre-construction conference. The schedule shall be a schematic (arrow) or precedence diagram, reflecting the work stages and all activities required for the successful completion of the project. The schedule shall show enough detail to allow day to day monitoring of Contractor's operation and shall include major milestone dates for the work.

108.4.2 The schedule shall include a complete critical path schedule and shall include a detailed network diagram with the following elements:

108.4.2.1 Contractor's schedule shall be time scaled in calendar days and all activities shall be recorded from the initial start dates to their completion dates. Unless specific approval was given by the Engineer, the individual activities shall not exceed fifteen (15) calendar days in length. The plot size and scale shall be acceptable to the Engineer.

108.4.2.2 The schedule shall reflect the order and the individual categories for each activity described in section 108.4.2.7, below. Critical activities shall be highlighted by use of color or any other method acceptable to the Engineer.

108.4.2.3 The schedule shall include, in addition to all construction activities, such tasks as mobilization, demobilization, submittal and approval of material samples and shop drawings, procurement of major material and equipment items, fabrication of special items and the installation and testing of such items. The schedule shall also reflect coordination activities with other projects.

108.4.2.4 Activities shall show sufficient detail to allow the reviewer to easily follow the sequence of the work, for example, forming, reinforcing and placement of concrete on the specific calendar days such activities are scheduled.

108.4.2.5 The diagram shall show each activity, the preceding and the following activity, the activity description, the total float time, and the duration of the activity in working days.

108.4.2.6 Activity descriptions on the diagram shall be job-specific and not of a generic nature.

108.4.2.7 In addition to the diagram, Contractor shall submit a schedule report of the network outlining the following data for each activity:

(A) preceding and following event and activity numbers

(B) activity description

(C) activity duration

(D) earliest commencement date

(E) earliest completion date

(F) latest commencement date

(G) latest completion date

(H) total float times

(I) responsible party for specific activity

108.4.3 Contractor shall update its schedule as mandated by the following events or as requested by the Engineer.

108.4.3.1 Contractor shall submit to the County on the tenth (10th) working day of each month a construction progress report (three originals and three copies) describing all completed or in progress activities and the level of completion of all activities to date in connection with this project. Detailed information shall be given for all negative float time. If the Engineer determines that any or all parts of the network diagram requires revision, Contractor shall furnish the County with the requested revisions within ten (10) calendar days of such request.

108.4.3.2 The monthly report shall be accompanied by a brief description of the job progress, problems encountered, current and anticipated delaying factors and the potential impact on the project schedule, and a description of corrective measures taken or proposed. It shall also include any departures from earlier schedules, including but not limited to, logical sequence or logical ties, constraints, changes in scheduled activities and the duration of such changes, addition or deletion of event numbers, activity numbers and activity descriptions. Contractor shall outline the reason for the departure from the original schedule.

108.4.3.3 All costs and expenses incurred by the Contractor for the preparation of schedules and/or reports and all revisions thereto, are considered an overhead item and therefore not reimbursable as a separate pay item.

108.4.3.4 In addition to allowances for various activities in connection with the work, Contractor shall base the schedule on normal weather conditions and shall incorporate the following factors:

(A) procurement and shipping times for material
(B) concrete curing time
(C) reasonable allowances for relocation of utilities

108.4.3.5 The Engineer's review of the schedule shall not constitute an acceptance of responsibility by the County for the content of the schedule and shall not relieve Contractor of its obligations to commit all its resources to meet the schedule set forth in the specifications. Free float time within the project's stated contract time limit shall remain available for use by the project. The County or the Contractor may use as needed the available project free float time. The Engineer's review of the schedule shall not constitute a basis for additional time to complete the work specified in the scope of work nor shall it serve as basis for additional compensation.

108.5 LIMITATION OF OPERATIONS

Add the following:

Regular work hours vary depending on time of year, the Contractor shall submit proposed weekday regular work hours at the pre-construction meeting (pre-job conference) for approval. The Contractor shall be subject to additional inspection fees for overtime work when work is performed on weekends, legal holidays, or at times other than the approved regular work hours.

The Contractor shall comply with all local noise ordnances. For unincorporated areas the Contractor shall not conduct any work during the hours 7:00 p.m. to 6:00 a.m. without the written approval of the Engineer. Special noise abatement conditions and procedures may be required if nighttime work is approved.

108.8 GUARANTEE AND WARRANTEE PROVISIONS:

The first paragraph of the guarantee and warrantee provisions of the Uniform Standard Specifications shall be replaced with the following paragraphs:

Contractor warrants that the work performed and materials used shall be free of defects for the period of one (1) year from the date of final acceptance of the work, excluding ordinary wear and tear or unusual abuse and neglect. Additionally, Contractor warrants that all corrections made under the warranty provisions of Section 108.8 of the Uniform Standard Specifications shall be free of defects in workmanship or material for a period of one (1) year, commencing on the day of final acceptance of the corrections by the Engineer.

Failure by the Engineer to reject defective workmanship and/or material during construction shall not be construed as an acceptance of said workmanship and/or material and Contractor shall correct such workmanship and/or material at the request of the County at any time prior to final acceptance of the work or for a one (1) year period thereafter.

SECTION 109

MEASUREMENTS AND PAYMENTS

109.7 PAYMENT FOR BOND ISSUES AND BUDGET PROJECTS, add the following:

The County will accept securities in a form and from a financial institution acceptable to the County, in accordance with the Arizona Revised statutes, Section 34-221, as amended, in lieu of ten percent (10%) retainage on pay estimates, if requested by Contractor.

109.8.2 CONTRACTING AGENCY DELAYS, add the following:

Recovery of expenses incurred by Contractor for a delay for which the County is responsible, and which is unreasonable under the circumstances and which was not contemplated by the parties, shall be negotiated between Contractor and the County. This provision shall not be construed to void any provisions of the Contract which require notice of delays, provide for arbitration or other procedures for settlement, or provide for the assessment of liquidated damages.

SECTION 110

NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

Section 110 is deleted in its entirety and replaced with the disputes provision of Article 9 of the Maricopa County Procurement Code.

Part 100 add the following new Section:

SECTION 111

ENGINEER'S OFFICE FACILITIES

111.1 DESCRIPTION:
Contractor shall provide office space with adequate lighting, located on or near the project site for exclusive use by the Engineer during the project construction. Proposed offsite office locations shall be subject to approval by the Engineer. The facility shall be made available concurrent with the construction notice to proceed, and shall remain continuously available for the sole use of the Engineer until seven (7) days after project acceptance. The facility (meeting the requirements of Type I or Type II Engineer Office Facilities) may either be separate or in the same structure or trailer used by the Contractor. If a shared structure or trailer is provided, a separate lockable area, with floor to ceiling walls shall be provided. Trailer type facilities shall be equipped with tie-downs. Type I and Type II Engineer Office Facilities shall be exclusive use facilities for the Engineer. Type II Engineer Office Facilities will be required unless otherwise indicated by the Engineer or the project special provisions.

Contractor shall provide the same level of security for the Engineer's Office Facility as is being provided for the Contractor's field office. Protection against illegal entry, vandalism, and theft shall be provided.

Contractor shall provide a separate sanitary facility for the Engineer and inspectors. Contractor shall provide janitorial services to maintain cleanliness of office, meeting spaces, and sanitary facilities. Janitorial services shall be at least twice a week.

Heating and cooling facilities shall be adequate to maintain interior temperature of 72°-78° F.

Electrical power shall be available 24 hours a day.

111.2 Type I Engineer Office Facilities shall consist of a weatherproof insulated temporary office type trailer built to the uniform building code series of codes with floor plan and equipment layout similar to the following drawing and meeting or exceeding the following minimum requirements:

111.2.1 Facility:
Dimensions (minimum): 28 feet long x 8 feet wide with an inside room height of 7'- 6".
Windows: a minimum of four (4) with provisions for cross ventilation and locking.
Exterior doors: two – shall be reinforced and have dead bolt locks. An exterior landing with steps and handrails shall be located at each door.
Heating: a thermostat controlled forced air unit with a minimum input capacity of 200 BTU per 1.0 square foot of floor area.
Air conditioning: one unit with capacity equal to 8,300 BTU minimum.

Electrical: work shall conform to the national electrical code for 110/220 volts 60 HZ applications and provide reliable uniform power to properly operate all field office equipment.
Lighting: fluorescent lighting directly over all drafting tables and desk areas.
Fire extinguisher: one dry chemical 10 lb class ABC Underwriters Laboratories Inc. approved.
Drinking water: bottled drinking water dispensed from an acceptable cooling device.

111.2.2 Furnishings:
Desk: one desk top 30" deep x full inside room width x 30" high located at office end of the trailer. Supported along each adjacent wall and having one 2-drawer legal size metal filing cabinet center pedestal. Each desktop shall have an overhead shelf and two pen drawers.
Meeting table: one 96" x 30" or two 48" x 30".
Drafting table: one 36" x 72" hinged board. Board to be 37" high at front edge and slope upward at 12:1 (horiz:vert) rate.
Chairs: Two (2) chairs with rollers and two (2) drafting stools each of appropriate height. Ten (10) folding chairs.
Trash receptacles: Two (2) each.
Facsimile machine: One (1) plain paper FAX machine (including toner).
Copy machine: One (1) plain paper copier (including toner) with an automatic document feeder capable accepting multiple size sheets and of sorting 10 stacks.
Printer/scanner/copier: One (1) HP printer/scanner/copier 700 series (or equivalent) including installation software compatible with Windows NT or 2000 and one set of manufacture replacement printing cartridges.

Dry Marker Erase Board: wall mounted adjacent to meeting table, size = 3' x 6' with markers and eraser.

111.2.3 Telephones and Data Circuits:
Two telephones. Three private lines with touch tone service from the local service provider. One phone line is to be shared by the two telephones and have voice mail service from the local service provider. The second phone line is to be a dedicated line connected to the computer. The third phone line is to be a dedicated line connected to the facsimile machine. Trailer wiring shall include four boxes equipped with RJ –11 jacks (two wire pairs per jack) two at each end of trailer.

The dedicated computer line shall be a high-speed DSL line and include internet service. When high-speed internet service is available through a cable TV service, it shall be provided and the corresponding telephone line requirement deleted.

All initial hook up and basic monthly telephone charges, high-speed internet service, basic fax service, and electrical expenses for the Engineer's Office Facility shall be borne by the Contractor. The Contractor will be reimbursed for all long distance charges authorized by the Engineer.

111.3 Type II Engineer Office Facilities shall consist of a weatherproof insulated temporary office type trailer built to the uniform building code series of codes with floor plan and equipment layout similar to the following drawing and meeting or exceeding the following minimum requirements.

111.3.1 Facility:

Dimensions (minimum): 50 feet long x 12 feet wide with an inside room height of 7'- 6".

Windows: a minimum of six (6) with provisions for cross ventilation and locking.

Doors: Two inside doors may be located either at one side or at center of partition. The two exterior doors shall be reinforced and have deadbolt locks. An exterior landing with steps and handrails shall be located at each exterior door.

Heating and Air Conditioning: 3-ton capacity air conditioning and 80,000 BTU capacity heating, connected to ducting and be thermostat controlled.

Electrical: work shall conform to the national electrical code for 110/220 volts 60HZ application and provide reliable uniform power to properly operate all field office equipment.

Lighting: fluorescent lighting directly over all drafting tables and desk areas.

Fire extinguishers: Two (2) dry chemical 10 lb class ABC Underwriters Laboratories Inc. approved.

Drinking water: bottled drinking water dispensed from an acceptable cooling device.

Sanitary facilities consisting of a toilet and wash sink shall be located in a separately enclosed room inside the Type II Facility.

111.3.2 Furnishings:

Desk: one desk top 30" deep x full inside room width x 30" high located at each end of trailer. Desktops are to be supported along each adjacent wall and have two 2-drawer legal size metal filing cabinets acting as pedestals. Each desktop shall have an overhead shelf and two pen drawers.

Drafting table: one 36" x 72" table. Board to be 37" high at front edge and slope upward at 12:1 (horiz:vert) rate or have provision for adjusting the slope.

Tables: Three (3) 48" x 30" tables.

Chairs: Four (4) chairs with rollers and two (2) drafting stools, each of appropriate height. Fourteen (14) folding chairs.

Trash receptacles: Three (3) each.

Plan storage: a plan rack or file for full size plans.

Facsimile machine: One (1) plain paper FAX machine (including toner).

Copy machine: One (1) plain paper copier (including toner) with an automatic document feeder capable accepting multiple size sheets and of sorting 10 stacks.

Printer/scanner/copier: One (1) HP printer/scanner/copier 700 series (or equivalent) including installation software compatible with Windows NT or 2000 and one set of manufacture replacement printing cartridges.

Dry Marker Erase Board: wall mounted adjacent to meeting table, size = 3' x 6' with markers and eraser.

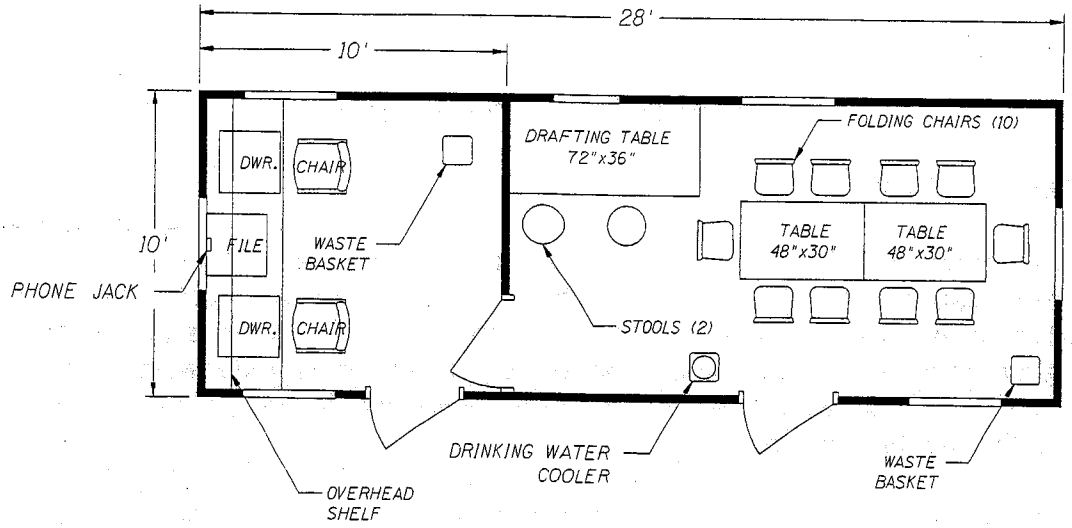
111.3.3 Telephones and Data Circuits:
Three (3) two-line telephones. Four private lines with touch tone service from the local service provider. Two lines are for telephone service with roll over capability for the three telephones and voice mail service from the local service provider. The third line is to be a dedicated line connected to a computer. The forth line is to be a dedicated line connected to the facsimile machine. Trailer wiring shall include six boxes equipped with RJ-11 jacks (two wire pairs per jack), two in each office and center area.

The computer line shall be a high-speed DSL line and include internet service. When high-speed internet service is available through a cable TV service, it shall be provided for the computer and the corresponding telephone line requirement deleted.

All initial hook up and basic monthly telephone charges, high-speed internet service, basic fax service and electrical expenses for the Engineer's Office Facility shall be borne by the Contractor. The Contractor will be reimbursed for all long distance charges authorized by the Engineer.

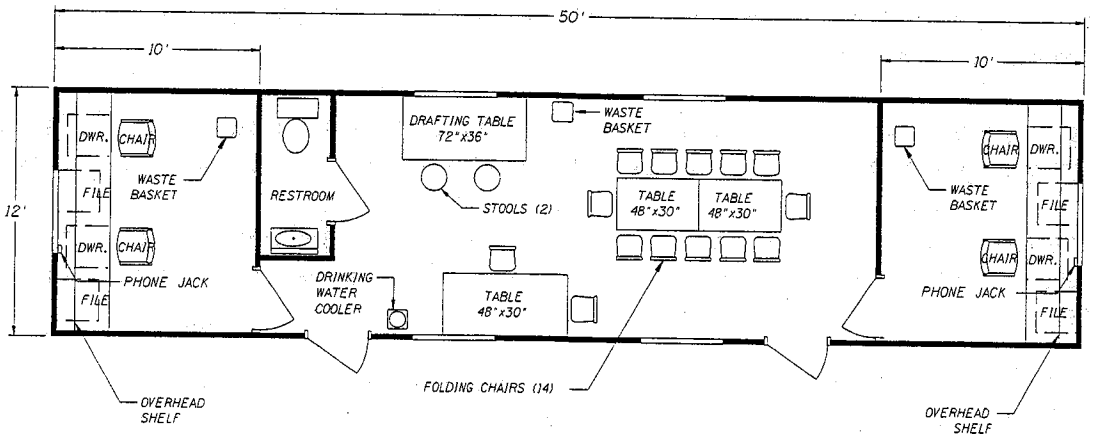
111.4 Payment:
Payment for Type I Engineer Office Facilities or Type II Engineer Office Facilities will be made at the contract lump sum price. Payment shall be made in equal one-third portions. The first payment shall be paid with Contractor's initial billing. The second payment shall be made when the total payments to the Contractor equals one-half of the initial contracted amount. The remaining one-third payment shall be paid as part of the final payment due the Contractor. No additional payment will be made for occupancy and services resulting from contract time extensions.

Payment reduction for incomplete facilities or unsatisfactory maintenance shall be made at a rate of 1% of the contract lump sum price for Engineer Office Facilities for each calendar day the facility remains out of compliance with the requirements of this specification. Payment reduction for incomplete facilities shall commence on the day following the notice to proceed date and shall continue until the facilities are brought into compliance with the specifications.



SAMPLE SCHEMATIC

Maricopa Co. Dept. of Transportation	CONSTRUCTION TRAILER (TYPE I)	5-21-03



SAMPLE SCHEMATIC

Maricopa Co. Dept. of Transportation	CONSTRUCTION TRAILER (TYPE II)	5-21-03

Part 200 add the following new Section:

SECTION 202

REMOVAL OF STRUCTURES

202.1 DESCRIPTION:

The work under this Section shall consist of the removal, wholly or in part, and satisfactory disposal of all structures within the right-of-way which have not been designated on the project Plans or specified in the Special Provisions to remain, except for those structures which are to be removed and disposed of under other items of work in the contract. The work shall also include salvaging of designated materials and backfilling the resulting cavities.

Existing structures, and other existing improvements which are to become an integral part of the planned improvements shall remain even though not specifically noted.

Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the Contractor.

202.2 BLANK

202.3 CONSTRUCTION REQUIREMENTS:

202.3.1 General: Bridges, culverts, retaining walls, and other structures in use by or facilitating traffic shall not be removed until satisfactory arrangements have been made to accommodate the traffic.

Blasting or other operations necessary for the removal of an existing structure, which may damage new construction, shall be completed prior to commencing the new work.

Items designated to be salvaged shall be carefully stockpiled or stored by the Contractor at locations designated in the Special Provisions or as requested by the Engineer.

Items which are to be salvaged or reused in the new construction, that are damaged or destroyed as a result of the Contractor's operations, shall be repaired or replaced by the Contractor at no additional cost to the County.

Holes, cavities, trenches and depressions resulting from the removal of major structures, except in areas to be excavated, shall be backfilled with suitable material which shall be compacted to a density of not less than 95 percent of maximum density, as requested and approved by the Engineer.

202.3.2 Removal of Bridges: The removal of existing bridges, either wholly or in part, shall be as shown on the project plans or as described in the Special Provisions. Bridge removal operations shall be conducted in such a manner as to cause the least interference to public traffic.

At least ten days before beginning bridge removal over or adjacent to public traffic or railroad property, the Contractor shall submit to the Engineer details of the removal operations showing the methods and sequence of removal and equipment to be used.

When total bridge removal is specified, all materials designated for salvage, such as structural steel, structural steel members, timber and other reusable materials shall be carefully dismantled, removed and salvaged in accordance with the requirements of Section 202.3.1. Steel members shall be match marked as requested by the Engineer.

Piling, piers, abutments, footings and pedestals shall be removed to at least 1.0 foot below ground line or 5 feet below finished subgrade elevation unless specified otherwise in the Special Provisions or on the project Plans.

When partial bridge removal is specified or alteration of an existing bridge requires removal of portions of the existing structure, such removal shall be performed with sufficient care as to leave the remaining portion of the structure undamaged.

In case of damage to the existing bridge structure, the Contractor shall make necessary repairs at no additional cost to the County. Reinforcing steel extending from the remaining portion of the structure shall be protected, cleaned and incorporated in the new portion of the structure in accordance with the details shown on the project plans or as requested by the Engineer.

Flame cutting and saw cutting may be used for removing, widening, or modifying bridges, provided the Contractor complies with all protection, safety and damage requirements.

Explosives shall not be used in bridge removal operations unless approved by the Engineer.

Before beginning concrete removal operations involving the removal of a portion of a monolithic concrete element, a saw cut a minimum of 1 inch deep shall be made to a true line along the limits of removal on all faces of the element which will be visible in the completed work.

Removed concrete shall be disposed of a provided in Section 350.

202.3.3 Removal of Minor Structures and Miscellaneous Structural Concrete: Minor structures and miscellaneous structural concrete shall be defined as all or portions of minor retaining walls, spillways, drainage structures, concrete box culverts, foundations, footings and all other Portland cement concrete construction, except

bridges. All existing miscellaneous concrete shall be removed to a depth of at least 5 feet below finished subgrade elevation, unless otherwise specified in the Special Provisions or on the project plans.

Where new concrete is to join existing concrete, the existing concrete shall be saw cut to a true line with straight planar edges free from irregularities.

Concrete removal operations shall be performed without damage to any portion that is to remain in place. All damage to the existing concrete which is to remain in place shall be repaired to a condition equal to that existing concrete damaged by the Contractor's operations shall be at no additional cost to the County.

Existing reinforcement that is to be incorporated in new work shall be protected from damage and shall be thoroughly cleaned of all adhering material before being embedded in new concrete.

Removed concrete shall be disposed of as provided in Section 350.

The floors of concrete basements, pits, and structures not required to be removed, and which are located within the roadway, shall be broken in a manner that will prevent the entrapment of water.

202.4 MEASUREMENT:

Removal of structures will be measured on a lump sum basis except, when the fee schedule contains specific items under this section on a unit basis, measurement will be made by the units designated in the fee schedule.

202.5 PAYMENT:

Payment for the accepted quantities of removal of structures will be made by lump sum, or by specific removal items, or by a combination of both. Payment for removal of structures and obstructions not listed in the fee schedule, but necessary to perform the construction operations designated on the project plans or specified in the Special Provisions, shall be considered as included in the prices of contract items.

The prices shall include all excavation and subsequent backfill related to the removals, and the salvaging, hauling, storing and disposing of all materials as provided herein.

SECTION 205

ROADWAY EXCAVATION

205.1 DESCRIPTION, add the following:

Roadway excavation shall also consist of the placement and compaction of excavated material in embankments as provided under Section 211 Fill Construction.

Part 200 add the following new Section:

SECTION 212

ROADWAY OBLITERATION

212.1 DESCRIPTION:

Roadway obliteration shall consist of removing abandoned roadway elements and grading the area to blend in with the surrounding terrain. In undeveloped areas the grading is to restore the natural contours.

212.2 CONSTRUCTION:

The Contractor shall remove existing pavement and base materials. The Contractor shall dispose of materials in fill areas or as approved by the Engineer. Grading and shaping operations shall consist of excavating prior filled areas and the placing of fill material as needed for terrain restoration. The roadway's native subgrade shall be scarified prior to placement of any fill. Fill material in excess of project construction requirements shall be placed in the area of the old roadway and shaped to blend with natural contours according to the obliteration detail or specified grades, to the satisfaction of the Engineer. Compaction of fill in the restored areas shall range between 85% and 90% when tested with methods defined in section 211.4. Care shall be taken to insure proper drainage. The area shall be seeded in accordance with Section 430 Landscaping and Planting.

212.3 MEASUREMENT:

Measurement of Roadway Obliteration will be the square yards of pavement designated to be removed within roadway obliteration limits.

212.4 PAYMENT:

Payment for Roadway Obliteration will be at the contract unit price. Payment shall be full compensation for removal of all asphalt pavement and base materials together with the grading and shaping operations, complete in place.

Part 200 add the following new Section:

SECTION 213

DEWATERING

213.1 DESCRIPTION:

The work under this Section consists of furnishing all necessary labor and materials, installing and maintaining all necessary pumps, piping and other equipment for removing water from various locations, and maintaining excavations free of water as required for construction.

213.2 AUTHORIZATION:

If high groundwater levels are encountered, the Engineer will determine whether to implement:

a) Dewatering, as specified herein, or
b) Demobilization and remobilization, with a contract time extension in accordance with Section 108.7 of the Specifications.

213.3 CONSTRUCTION REQUIREMENTS:

213.3.1 General Excavation: Prior to starting any work on removal of water from excavations, the Contractor shall have an approved Groundwater and Surface Water Handling Plan. The Plan shall include the Contractor's proposed method of removing water from excavations. The Plan may be placed into operation upon approval of the Engineer, but nothing in this section will relieve the Contractor from full responsibility for the adequacy of the water control.

Contractor shall furnish to the Engineer one set of dewatering calculations as part of the dewatering plan. These calculations shall include determination of well spacing, header sizing, pump selection, pump rating curves, typical well point cross-sections and depth of screened section. They shall include sketches and figures of sufficient detail to illustrate the layout of the dewatering system for the different portions or phases of the dewatering for the work areas. The Contractor shall furnish a listing of all equipment, including model numbers, vendors and suppliers, and catalogue cuts.

The dewatering calculations shall be prepared by a Professional Engineer or Professional Geologist.

The Contractor's Plan shall conform to all local, state and federal requirements. Any groundwater, stormwater or surface water encountered during construction shall be

disposed of in such a manner that will not cause damage to public or private property or constitute a nuisance or menace to the public.

213.3.2 Soil-Cement Construction: Where excavation for the soil-cement construction extends below the water table, the portions below the water table shall be dewatered in advance of excavation. The dewatering shall be accomplished in a manner that will prevent the loss of fines, maintain stability of the slopes and bottom of the excavation, and result in construction operations being performed under reasonably dry conditions.

During placement and compaction of the concrete, the water level at every point of the excavation shall be maintained a minimum of three (3) feet below the placement level until the soil-cement has been in place a minimum of 48 hours.

213.4 PAYMENT:

Payment for Dewatering or demobilization and remobilization will be based upon approved time and material invoices, in accordance with Section 109.5 in an amount not to exceed the ALLOWANCE shown in the fee Schedule under Item DEWATERING, for approved work performed for the project.

SECTION 215

EARTHWORK FOR OPEN CHANNELS

215.7 MEASUREMENT:

The second paragraph of this Section is revised to read:

Quantities will be computed by the average end area method.

Part 200 add the following new Section:

SECTION 222

CEMENT STABILIZED ALLUVIUM BANK PROTECTION

222.1 DESCRIPTION:

The work under this section consists of constructing cement stabilized alluvium (CSA) bank protection at the locations shown on the plans and in accordance with these specifications, including excavating, backfilling and grading the river bed and banks to the lines, grades and cross sections shown on the plans or established by the Engineer; furnishing, processing and mixing aggregate, cement, fly ash and water; spreading and compacting the mixture; and placement of curing seal.

222.2 MATERIALS:

222.2.1 Aggregate shall be clean, sound, durable, uniform in quality and free of any soft, friable material, organic matter, oil, alkali or other deleterious substances. Aggregate shall conform to the following requirements when tested in accordance with Section 701.1 of the Uniform Standard Specifications.

Aggregate Size	Percent Passing
3 inch	100
No. 4	30-65
No. 200	0-8

The plasticity index shall be no greater than 10 in accordance with the requirements of AASHTO T-90. Clay lumps larger than one inch shall be screened out of the raw soil prior to mixing.

Before placing aggregates upon the stockpile site, the site shall be cleared of vegetation, trees, stumps, brush, rocks and other debris, and the ground leveled to a smooth, firm, uniform surface.

Stockpiles shall be constructed upon prepared sites. The piles when completed shall be neat and regular in shape. The stockpile height shall be limited to a maximum of 13 feet.

Stockpiles in excess of 200 cubic yards shall be built up in layers not more than 4 feet in depth. Stockpile layers shall be constructed by trucks, "clamshells", or other methods approved by the Engineer. Pushing aggregates into a pile by a bulldozer will not be permitted. Each layer shall be completed over the entire layer of the pile before depositing aggregates in the next layer.

The aggregate shall not be dumped so that any part of it runs down and over the lower layers in the stockpile. The method of dropping from a bucket or spout in one location so as to form a cone shaped pile will not be permitted. Any method of placing aggregates in stockpiles, which, in the opinion of the Engineer, segregates, breaks, degrades or otherwise damages the aggregates will not be permitted.

Only pneumatic tired equipment shall be used on the processed or manufactured aggregates in constructing the stockpiles. When removing materials from the face of the stockpile, the equipment shall be operated in such a manner as to face-load from the floor to the top of the stockpile to obtain maximum homogeneity of materials.

Stockpiles shall not be constructed where traffic, vehicles or Contractor's equipment will either run over or through the stockpile, or cause foreign matter to be mixed with the aggregates.

222.2.2 Cement shall conform to the requirements for low alkali, Type II Portland Cement of Section 725.2.

222.2.3 Fly ash shall conform to the requirements of Section 725.2.1 for pozzolonic materials.

222.2.4 Water used for mixing shall be potable and free from oil, vegetable matter and any other deleterious matter; and shall conform to Section 725.4.

222.2.5 CSA shall have a minimum compressive strength of 0.75 ksi at seven days, determined in accordance with the requirements of Arizona Test Method 241 (Modification of AASHTO T-134). At least one test (two cylinders) shall be made for each 1,300 cubic yards of CSA placed.

222.2.6 Bedding Mortar shall consist of broomable, high Portland cement/fly ash content, heavily sanded mortar, with a compressive strength of 2.9 ksi at 28 days, and shall have a slump of approximately 8.0 to 9.0 inches. The sand shall satisfy Section 701.3 and the following gradation:

Aggregate Size	Percent Passing
3/8 inch	100
No. 4	95-100
No. 16	45-80
No. 50	0-30
No. 140	0-10
No. 200	0-4

222.2.7 Exterior Concrete shall be Class B, conforming to Section 725.1.

222.2.8 Forms shall be mortar tight and designed, constructed, braced and maintained so that the finished concrete will be true to line and elevation; and will conform to the required dimensions and contours. They shall be designed to withstand the pressure of concrete, use of set-retarding admixtures or pozzolonic materials in the concrete, effects of vibration as the concrete is being placed and all loads related to the construction operations, without distortion or displacement.

All forms shall be treated with an approved release agent before concrete is placed. Any material that will adhere to or discolor the concrete shall not be used.

222.3 CONSTRUCTION REQUIREMENTS:

222.3.1 Mix Design: Contractor shall determine the mix proportions of the aggregate, cement, fly ash and water; and shall furnish CSA conforming to the requirements specified herein. The job-mix design with supporting test results shall be submitted to the Engineer for review. The Engineers approval shall be obtained prior to incorporating any material into the work.

The mix design objective is to provide the minimum cement plus fly ash content (C+P), W/C ratio and mix proportions to meet the specified strength, plus 2% additional cementitious materials (same C+P content) for durability and material variations. At the same time, the mix shall be dry (stiff) enough to support heavy placement and compaction equipment, yet wet enough to permit effective consolidation by adequate distribution of the paste binder throughout the CSA mass, during the mixing and placing process. The C+P content during CSA production shall not be decreased nor increased from that of the approved job-mix design unless approved by the Engineer. Actual mix designs, used on this project, shall be determined from the Contractor's laboratory tests from material stockpiled after construction of the stockpiles is completed.

The mix design shall be performed in accordance with Arizona Test Method 220 (Determination of Cement Content Required for Cement Treated Mixtures, a modification of AASHTO T-144) to determine the cementitious (C+P) content necessary for the strength required for CSA.

Determination of the optimum moisture content for compaction of the CSA mixture, including the additional 2% cementitious material for durability, shall be in accordance with AASHTO T-134, Method B. The additional 2% cementitious materials shall be a mixture of cement and fly ash in the same proportions as used in the mix design to meet the strength requirement. The total weight of cement replaced by fly ash shall not exceed 15%.

The Contractor shall follow the general provisions in accordance with Arizona Test Method 220 and AASHTO T-99, Method D, with the following exceptions.

The AASHTO T-99, Method D, shall be used in determining maximum dry density, modified to the extent that a rock correction will be calculated to correct for aggregate

passing the 3.0-inch and retained on the 5/8 inch sieves. No correction will be used in determining the optimum moisture content.

Included in the job-mix design data shall be the grade of cement, brand of fly ash, and source of aggregate. A new mix design shall be submitted for approval at least two weeks prior to use, any time the Contractor requests a change in materials or proportioning of the materials from that given in the approved mix design.

222.3.2 Preparation of Subgrade: CSA shall be placed on a prepared subgrade shaped to the lines and grades shown on the plans, or be placed on existing CSA. The subgrade shall be compacted to a minimum of 95% of the maximum density in accordance with Section 301.3 of the Uniform Standard Specifications. When the embankment material is composed predominately of rock such that these compaction procedures will not achieve the required density, the Engineer will determine the amount of compaction required and the adequacy of equipment used to obtain the required compaction.

Immediately prior to placement of the CSA, the subgrade shall be uniformly moistened and maintained in an acceptable condition throughout the placement operation. Soft or yielding subgrade shall be corrected and made stable before construction proceeds. Saturated or submerged subgrade shall remain dewatered a minimum of 48 hours after placement of the CSA.

When CSA is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled or cut to approximate horizontal and vertical steps. Seams in the rock shall be grouted where determined by the Engineer.

When placed on existing CSA, the surface receiving the new CSA shall be cleaned to the satisfaction of the Engineer in the following manner:

After exposing the CSA structure, the surface shall be thoroughly cleaned of all loose materials foreign to the CSA. The surface shall be cleaned by sand-blast or hydro-blast (2.0 ksi maximum) to remove all foreign or loosened particles and hand scaled, if necessary, to provide a clean rough surface, free of loose materials, satisfactory to the Engineer.

The old CSA surface shall be moist at the time of placement and a ¼ inch layer of broomable bedding mortar (2.9 ksi) shall be used between the old and new CSA. A set retarding admixture shall be used in the mortar during hot weather placement.

222.3.3 Mixing, General Requirements: Aggregate, fly ash and cement shall be proportioned and mixed in a central mixing plant, unless otherwise permitted by the Engineer. The plant shall be either the batch mixing type (using revolving blade or rotary drum), or the continuous mixing type. The aggregate fly ash and cement shall be

proportioned by weight. Certification for each shipment of cement or fly ash shall be provided to the Engineer.

The fly ash and cement shall be added in such a manner so that they are uniformly distributed throughout the mixing operation.

There shall be safe, convenient facilities for sampling the cement and fly ash in the supply line to the weight hopper or pugmill. The charge in the batch mixer or continuous mixer shall not exceed that which will permit complete mixing of the materials.

The water shall be proportioned by weight or volume and there shall be some means to enable the Engineer to verify the amount of water in each batch or the rate of water flow for continuous mixing. The time of the addition of water or the points where it is introduced into the mixer shall be as approved by the Engineer.

Control of water content in the field shall be accomplished in two ways:

(1) The moisture-density relationship for the CSA shall be determined in accordance with AASHTO T-134, Method B, on a routine basis, or when any significant shift in the gradation or rock content occurs.

(2) The actual moisture content of the mixture at the time of compaction, or shortly thereafter, shall be determined in accordance with ASTM D2216 (oven dry) or AASHTO T 310 (nuclear method), to determine if the optimum moisture content as determined by AASHTO T 134, Method B, is being maintained. Water content in the aggregates is to be continuously monitored and the mixing water shall be adjusted as necessary to maintain proper moisture.

222.3.4 Batch Mixing: The mixer shall be equipped with a sufficient number of paddles of a type and arrangement to produce a uniformly mixed batch. The mixer shall be equipped with a timing device which will indicate, by a definite audible or visual signal, the expiration of the mixing period. The device shall be accurate to within two seconds. The time of mixing shall begin after all the ingredients are in the mixer and shall end when the mixer is half emptied. The allowable tolerance for weight batching of aggregates and cementitious material will be 2.0% and 0.5%, respectively, for each batch.

The batch mixing plant shall provide sampling facilities that are satisfactory to the Engineer and which will allow representative samples of the CSA to be obtained easily and safely.

222.3.5 Continuous Mixing: A control system shall be provided that will automatically close down the plant when the material in any storage facility approaches the strike-off capacity of the feed gate. The plant will not be permitted to operate unless this automatic control system is in good working condition.

The feeder for the aggregate shall be mechanically or electrically driven.

Aggregate shall be drawn from the stockpile by a feeder or feeders that will continuously supply the correct amount of aggregate.

The cement/fly ash and aggregate feeders shall be equipped with devices that can accurately determine the rate of feed while the plant is in full operation.

Continuous mix plants shall provide sampling facilities which are satisfactory to the Engineer, and that allow representative samples of the aggregate and CSA mixture to be obtained easily and safely.

222.3.6 Transporting/Spreading: Mixed materials shall be transported from the plant to the construction site in vehicles and spread on the prepared subgrade or previously completed CSA. Spreading shall be accomplished by the use of approved motor graders or crawler type equipment. The compacted lifts of CSA shall not exceed 8.0 inch or be less than 4.0 inch in thickness.

Aggregate shall not be mixed or placed when the air temperature is below 45° F in the shade, unless the air temperature is at least 45° F in the next 24 hours. CSA shall not be mixed or placed when the air temperature is greater than 109° F in the shade.

222.3.7 Compacting/Finishing: All completed CSA surfaces that will be covered with succeeding layers of CSA shall be kept continuously moist by fog spraying until placement of next lift.

CSA shall be uniformly compacted to a minimum of 98%, with an average of 100%, of maximum density as monitored by nuclear density tests in accordance with AASHTO T 238 and T 310. Maximum density shall be determined in the lab in accordance with the requirements of AASHTO T 99, Method D, for minus 0.75 inch material only, with rock correction at each density test location according to AASHTO T 224, Section 2.2.2. At least one density test shall be taken for each 460 cubic yards of CSA.

At the start of compaction of each lift, the mixture shall be in uniform, loose condition throughout its full depth. The moisture content shall be as previously specified herein. No section shall be left undisturbed for longer than thirty minutes during compaction operations. Compaction of each lift shall be accomplished in such a manner as to produce a dense surface, free of compaction planes, and shall be completed within one (1) hour from the time water is added to the mixture. After compaction, CSA shall be shaped to the required grades, cross sections and rolled to a reasonably smooth surface. Whenever the Contractor's operation is interrupted for more than two hours, the top surface of the completed layer, if smooth, shall be scarified to a depth of at least 1 inch with a spike-tooth instrument prior to placement of the next lift. The surface, after scarifying, shall be swept using a power broom or other method approved by the

Engineer, to completely free the surface of all loose material prior to the placement of the next lift.

At the time of compaction, the moisture content shall not be more than one percent (1%) below optimum and shall not be more than one percent (1%) above optimum when the mean air temperature during construction hours does not exceed 90° F.

When the mean air temperature does exceed 90° F, or there is a breeze or wind which promotes rapid drying of the CSA mixture, the moisture content shall be increased as needed, at the direction of the Engineer, but shall be less than the amount that will cause the CSA to become unstable during compaction and finishing operations.

Backfill shall not be placed within 40 inches of the top of the CSA surface. Construction joints shall be provided at the end of each day's work or when work is halted for two hours or more. The joints shall be trimmed to a straight line and vertical to the full depth of the lift. Before resuming placement of new material, the joints shall be roughened and loose material removed by power broom or compressed air.

Compaction equipment shall be capable of obtaining specified requirements without detrimentally affecting the compacted material. The equipment shall be modern, efficient compacting units approved by the Engineer. The units shall be of a type that is capable of compacting each lift of material as specified, and meet the minimum requirements as contained herein:

Self-propelled drum drive vibratory roller shall be of a type that will transmit dynamic impact to the surface to be compacted through a steel drum by means of revolving weights, eccentric shaft or other methods. The compactor shall have a gross mass of not less than 23,000 lbs. and shall produce a dynamic force of at least 13 lbs. per inch of drum width when operated at 2,400 cycles per minute (cpm). The dynamic force is defined as the force developed by revolving the eccentric weight at 2,400 cpm. The roller shall have a smooth drum or drums and the drum diameter shall be between 48 inches and 70 inches, and the width shall be between 28 inches and 100 inches. The frequency of vibration during operation shall be 2,400 cpm. The roller shall be operated at speeds not to exceed 15 mph in the forward direction. The engine driving the eccentric mass shall have a rating of not less than 90 kilowatts. Variation in speed, frequency and method of operation will be determined when found necessary to secure maximum compaction of materials.

Heavier compacting units may be required to achieve the required density.

222.3.8 Bedding Mortar: Bedding Mortar shall be used between CSA that has been in place more than seven (7) days and the new CSA after the existing CSA has been properly cleaned. The bedding mortar is to be used for achieving bond between the old and new CSA layers and to eliminate and prevent segregation or voids along the margins of CSA placements. Adjustment to the mix design may be required by the Engineer.

222.3.9 Control Strips: A control strip shall be constructed at the beginning of work on the CSA to be compacted. The control strip construction will be required to establish procedures necessary to obtain densities for the specific course plus use of portable nuclear moisture/density testing equipment to determine in-place densities.

Each control strip, constructed to acceptable density and surface tolerances shall remain in place and become a section of the completed CSA. Unacceptable control strips shall be corrected or removed and replaced at the Contractor's expense. A control strip shall cover an area of approximately 420 square yards and be of the same dimensions specified for the CSA course.

The materials used in construction of the control strip shall conform to the specification requirements. They shall be furnished from the same source and be of the same type as used in the CSA. The underlying surface for the control strip shall have prior approval of the Engineer.

The equipment used in the control strip shall be of the same type and weight as used for the CSA.

Compaction of control strips shall start immediately after the course has been placed to the specified thickness, and shall be continuous and uniform over the entire surface. Compaction of the strip shall continue until no discernable increase in density can be obtained by additional effort.

Upon completion of compaction, the mean density of the control strip will be determined by averaging the results of ten density tests taken at random sites within the strip. If the mean density of the control strip is less than 98% of the laboratory compacted specimens as determined by testing procedures appropriate for the material being placed, the Engineer may order the construction of another control strip.

A new control strip may be ordered by the Engineer, or requested by the Contractor when:

(1) A change in material or mix design.
(2) There is reason to believe that the control strip density is not representative for the material being placed.
(3) Ten days of production have passed without a new control strip.

222.3.10 Power Tampers and Small Vibratory Rollers: Small vibratory rollers that are capable of operating within a few millimeters of a vertical face shall be used for compaction adjacent to guide banks, next to utilities and drainage conduit, at transitions to previously constructed levee protection and at other areas where larger vibratory rollers cannot maneuver. The dynamic force produced by the small vibratory rollers shall be at least 140 lbs. per inch of drum width.
Tampers shall be a type capable of developing a force per blow of at least 1390 lbs. The amount of rolling and tamping required shall be whatever is necessary for the

particular equipment to provide the same degree of compaction as would be obtained by four passes of the large self-propelled vibratory roller. Standby replacement equipment shall be available within one hour if needed.

222.3.11 Curing: Temporarily exposed surfaces shall be kept continuously moist. Care must be exercised to ensure that no curing material other than water is applied to the surface that will be in contact with succeeding layers.

Permanently exposed surfaces shall be kept in a moist condition for seven days, or they may be covered with bituminous or other suitable curing material, subject to the Engineer's approval. Any damage to the protective covering within the seven days shall be repaired to the satisfaction of the Engineer.

Regardless of the curing material used, any permanently exposed surface shall be kept moist until the protective cover is applied. This protective cover is to be applied as soon as practical, with a maximum time limit of twenty-four hours between the finishing of the surface and the application of the protective cover.

222.3.12 Maintenance: The Contractor will be required, within the limits of the contract, to maintain the CSA and curing seal in good condition until the work is completed and accepted. Maintenance shall include repairs to any defects that may occur. This work will be done at the Contractor's expense and repeated as often as necessary. Faulty work shall be replaced for the full depth of the layer.

222.4 MEASUREMENT:

The work will be measured by the cubic yard of completed CSA bank protection constructed to the lines, grades and cross-sections shown on the plans.

The maximum limit for the placement of CSA due to over excavation or sloughing of existing soils shall be 4 inches. Any placement beyond these limits will not be included in the pay quantity.

222.5 PAYMENT:

The accepted quantities of CSA will be paid for at the contract price per cubic yard for CSA Bank Protection, subject to the following penalties for failure to achieve the required strength requirements:

Percent of Specified Strength	Percent of Contract Unit Price
≥100	100
97-99	92
94-96	85
90-94	77
85-89	68
80-84	60
75-79	50
<75	See Note

Note: Material represented by lots attaining seven day compressive strengths with a mean value less than 75% of the specified compressive strength will be evaluated as to acceptance. The Engineer will determine if the material can be left in place or removed and replaced at the Contractor's expense.

Part 300 add the following new Section:

SECTION 308

LIME SLURRY WITH FLY ASH STABILIZATION

308.1 DESCRIPTION:
This section shall consist of constructing a mixture of soil, lime slurry, fly ash and water for the stabilization of soils or base materials. The work shall be performed in conformity with the lines, grades, thickness, and typical cross sections shown on the plans.

308.2 MATERIALS:

308.2.1 Soil or Subgrade: The soil or subgrade material used for this work shall consist of materials on the site or imported and shall be free of roots, sod, weeds, and stones larger than 3 inches.

308.2.2 Quicklime and Hydrated Lime: Lime used to manufacture the Commercial Lime Slurry specified herein, shall be either Quicklime or Hydrated lime and shall conform to the requirements of ASTM C 977. Lime may only be used in the production of lime slurry. The direct use of dry hydrated lime or quicklime to the soil material is strictly prohibited. All lime shall come from a single source. If a source change is requested, a new mix design shall be submitted using lime from the proposed new source. The new design must be approved by the Engineer prior to use.

308.2.3 Commercial Lime Slurry: Commercial lime slurry shall be a pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity naturally injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of solids content, shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition and residue.

(A) Chemical Composition: The solids content of the lime slurry shall consist of a minimum of 90 percent by weight, of calcium and magnesium oxides (CaO and MgO), as determined by ASTM C-25.

(B) Residue: The percent by weight of residue retained in the solids content of lime slurry shall conform to the following requirements:

Residue retained on a No. 6 sieve	Max. 0.2%
Residue retained on a No. 30 sieve	Max. 4.0%

(C) Grade: Commercial lime slurry shall conform to a dry solids content as approved by the Engineer.

A certificate of compliance and a field summary of lime slurry produced shall be provided to the Engineer for each load of slurry.

308.2.4 Water: Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test.

308.2.5 Fly Ash: Fly ash shall meet the requirements of AASHTO M-295, Class C.

308.3 MIX DESIGN:
Before commencing lime / fly ash treatment work, the Contractor shall submit for approval by the Engineer, a proposed mix design. A testing laboratory under the direction and control of a registered Professional Engineer shall prepare the proposed mix design. The mix design shall be determined using the soils or subgrade material to be stabilized and lime and fly ash from the proposed suppliers and shall determine the following:

Percent of fly ash and rate of application.
Percent of lime and rate of application of lime slurry in the treated soil or subgrade material.
Optimum water content during mixing, curing and compaction.
Gradation of in-situ mixture after treatment.
Additional mixing or equipment requirements.
Mellowing time requirements, if needed.

The mix design shall comply with the following requirements:

Plasticity Index: Less than 3, per AASHTO T-89 & 90.
Swell Potential: One (1) percent or less vertical expansion of an air dried soil when inundated with water and allowed to swell at a confined pressure of 60 psi.
Unconfined Compressive Strength: Minimum 300 psi in five days curing at 100° F when tested in accordance with ASTM D-1633 Method A.

308.4 CONSTRUCTION:

308.4.1 General: The completed subgrade shall consist of a uniform lime / fly ash mixture, free from loose segregated areas, have a uniform density and moisture content, and be well bound for its full depth. A smooth surface suitable for placing subsequent courses is required if pavement is to be placed directly on the treated subgrade.

Prior to beginning stabilization, the subgrade shall be constructed and brought to grade and shall be shaped to conform to the typical sections, lines, and grades as shown on the plans.

When the design requires treatment to a depth greater than 12 inches, the subgrade soil shall be treated in equal layers. The top layer(s) of soil shall be removed and stockpiled. The lower layer of soil to be treated shall then be treated and allowed to cure in place. After final mixing, the lower layer shall be compacted in maximum 12 inch compacted lifts. The stockpiled soil shall then be placed, treated, mixed and compacted in successive maximum 12 inch compacted lifts.

308.4.2 Weather Limitation: Lime slurry / fly ash treated subgrade shall not be constructed if the atmospheric temperature is below 40° F or when conditions indicate that temperatures may fall below 40° F within 24 hours.

308.4.3 Equipment: Contractor shall provide all equipment necessary to complete the work, including grading and scarifying equipment, lime slurry spreader (gravity feed spreaders will not be permitted), fly ash spreader, mixing and pulverizing equipment, sheepsfoot and pneumatic rollers, sprinkling equipment, and trucks. When using dry hydrate to make slurry, agitators are mandatory in spreader. All equipment used for this work shall be subject to approval by the Engineer.

308.4.4 Application: Lime slurry and fly ash slurry shall be spread only on that area where the mixing operations can be completed during the same working day. The application and mixing of lime and fly ash with the soil shall be accomplished by the methods hereinafter described as Slurry Placing.

Slurry Placing: Fly ash shall be spread with trucks equipped with an approved distribution system on the prepared subgrade at the rate specified by the job mix design

in a single pass, just prior to the application of the lime slurry. The fly ash may be added to the lime slurry and placed together, if approved by the Engineer. Lime slurry / Lime slurry fly ash, shall be mixed in a portable mixing unit and spread with trucks equipped with an approved distribution system as a slurry. Commercial lime slurry shall be applied with a lime percentage not less than specified herein. The distribution of lime slurry shall be attained by successive passes over a measured section of subgrade until the proper amount of lime has been spread, as determined in the job mix design. The rate of application shall be verified using ASTM D-3155 methods.

Thickness: The thickness of the lime slurry treated subgrade shall be determined by visual inspection and/or by depth tests taken at intervals so that each test shall represent no more than 1000 square yards per layer, if more than one layer. The method used to remove material to determine depth of lime treatment may be by shovel and/or pick, coring or other method approved by the Engineer. Phenolphthalein solution shall be used to detect the presence of lime. When the grade deficiency is more than 1 inch, the Contractor shall correct such areas in a manner satisfactory to the Engineer. Contractor shall replace, at no cost to the Agency, the material where depth tests are taken.

No traffic other than the mixing equipment will be allowed to pass over the spread of lime slurry until after completion of mixing.

308.4.5 Mixing: The full depth of the treated subgrade shall be mixed with an approved mixing machine. The use of disc plows or blades are prohibited except in areas specified by the engineer. To insure a complete chemical reaction of the lime, fly ash and soil or subgrade, water shall be used as required to maintain a moisture content at or above the optimum prior to beginning compaction and held above optimum during compaction. During the interval of time between application and mixing, lime that has been applied, unmixed and exposed to the open air for 10 hours or more will not be accepted.

After mixing and prior to compaction, clay lumps shall meet the following criteria:

	Percent (by Weight)
Minimum of clay lumps passing 1½ inch sieve	100
Minimum of clay lumps passing No. 4 sieve	60

308.4.6 Compaction: Compaction of the mixture shall begin after final mixing. Sheepsfoot or segmented steel rollers shall be used during initial compaction. Steel wheel or pneumatic tired rollers shall be used only during final compaction, if pavement is to be placed directly on the treated subgrade. Areas inaccessible to rollers shall be compacted to the required density by methods approved by the Engineer.

The material shall be aerated or watered as necessary to provide and maintain required moisture content. The field density of the compacted mixture shall be a least 95 percent of the maximum density at 0-4 percent above optimum moisture. A composite of treated soil or subgrade materials from a minimum of five (5) random locations, per soil type, within the area to be stabilized shall be used to determine the maximum density and optimum moisture content in accordance with ASTM D-558. The in-place field density shall be determined in accordance with ASTM D-1556, ASTM D-2167 or ASTM D-2922.

After each section is completed, tests will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked to meet requirements.

If pumping subgrade should become evident at any time prior to paving, the Engineer may require proof rolling with a pneumatic-tire roller or other approved equipment in order to identify the limits of the unacceptable area. The proof rolling will be performed at no additional cost to the Contracting Agency.

All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts. Compaction and finishing shall be done in such a manner as to produce a smooth dense surface free of compaction planes, cracks, ridges, or loose materials.

Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion, shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density, and finish before the next course is placed or the work is accepted, it shall be recompacted and refinished at no cost to the County.

308.4.6.1 Tolerances: At final compaction, the lime, fly ash and water content for each course of subgrade treatment shall conform to the approved mix design with the following tolerances.

Material	**Tolerance**
Lime	+0.5% of design, (ASTM C-114)
Fly Ash	±1.0% of design, (ASTM C-114)
Water	+4%, -0% of optimum, (ASTM D-698)

308.4.7 Finishing and Curing: After the final layer or course of lime slurry / fly ash treated subgrade has been compacted, it shall be brought to the required lines and

grades in accordance with the plans. The completed section shall then be finished by rolling with a pneumatic or other suitable roller.

The final layer of lime slurry / fly ash treated subgrade shall be maintained in a moist condition until the next layer of pavement structure is placed. If required, a fog seal for curing, in compliance with Section 333, shall be furnished and applied to the surface of the final layer of the lime stabilized material as soon as possible after the completion of final rolling and before the temperature falls below 40° F. Curing seal shall be applied at a rate between 0.10 and 0.20 gallons per square yard of surface. The exact rate will be determined by the Engineer.

After curing begins, all traffic, except necessary construction equipment shall be kept off the lime slurry / fly ash stabilized subgrade for a minimum of 7 days or until the final pavement structure layer(s) are placed.

308.4.8 Maintenance: The Contractor shall maintain, at his / her own expense, the entire lime slurry treated subgrade in good condition from the start of work until all the work has been completed, cured, and accepted by the Engineer.

308.5 MEASUREMENT:

The quantity of lime slurry / fly ash treated soils shall be measured by the square yard, measured in place, treated, compacted, to the proper depth, and accepted.

The quantity of curing seal shall be measured by the ton, diluted.

308.6 PAYMENT:

The lime slurry / fly ash treated soils measured as provided above, will be paid for at the contract price per square yard, which price shall be full compensation for the item complete in place, as herein described and specified.

Payment for curing seal will be made at the contract price per ton for Fog Seal (Contingent Item) based on the rate of application as requested by the Engineer.

SECTION 310

UNTREATED BASE

310.1 DESCRIPTION, add the following:

Aggregate base shall conform to the requirements of Section 702 of the Uniform Standard Specifications. Aggregate base shall be crushed in accordance with Section 702.2.

310.4 PAYMENT, add the following:

The Contractor shall furnish the Engineer certified weight tickets for the aggregate base (AB) placed on the project. Final pay quantities for aggregate base will be based upon the scale tickets submitted to the Engineer for aggregate base specifically used to construct roadway untreated base as shown in the contract documents.

Part 300 add the following new Section:

SECTION 316

CRACK SEALING

316.1 DESCRIPTION:

Crack Sealing shall consist of furnishing crack seal material and applying this material to cracks in asphalt concrete pavement, in accordance with these specifications.

316.2 MATERIAL:

316.2.1 Material Specifications: The crack sealant material shall be a hot applied elastically polymer and rubber modified asphalt or rubber modified asphalt. The asphalt rubber sealant shall be a blend of asphalt cement, crumb rubber and/or virgin rubber, fillers, plasticizers, and/or polymers formulated for hot arid climates. The asphalt rubber modified compound shall:

(A) Be formulated to cure as it cools.
(B) Sufficiently cure after a twenty-minute set time to resist pick up and tracking by vehicular traffic.
(C) Not bleed or become tacky under traffic during summer temperatures.

The asphalt component shall be paving grade asphalt per MAG Section 711.

The supplied sealant material shall be formulated for use during hot climatic conditions and meet the following specifications:

PROPERTY	TEST METHOD	REQUIREMENT
Ductility @ 77° F, cm	ASTM D113	15 Min.
Flash Point, Degrees F	ASTM D92	450 Min.
Softening Point, Degrees F	ASTM D36	200 Min.
Cone Penetration @ 77° F, dmm	ASTM D5329	25-40
Resilience, %	ASTM D5329	30 Min.
Bitumen Content, %	ASTM D4	60 Min.
Brookfield Viscosity @ 375° F, Poise	ASTM D2196	40-90
Asphalt Compatibility	ASTM D5329	Pass
Material Unit Weight @ 60° F, lbs/gal	ASTM D70	10 Max.
Pouring Consistency		Self-Leveling
Safe Heating Temperature, Degrees F		400
Recommended Pour Temperature, Degrees F		380

Additionally, the specific gravity of the crumb rubber shall be 1.15 +/- 0.02 and free from fabric, wire, and other contaminating materials. The material shall contain a minimum of 18 percent crumb rubber by weight of total asphaltic components. The material containing

crumb rubber shall be reacted at the plant to provide a homogenous mix of components. A maximum of 4 percent calcium carbonate may be added to prevent particle clumping.

The crumb rubber shall comply with the following table:

SIEVE (see Note)	PERCENT PASSING
#8	100
#20	98-100
#40	0-10

Note: The sieves shall comply with the requirements of AASHTO M-92

The Contractor shall not change the crack sealant material or supplier unless authorized by the Engineer.

The Contractor shall submit copies of all invoices for crack sealant material to the Engineer within 24 hours of material receipt.

316.2.2 Material Testing: Crack sealant material will be sampled and tested for compliance. A box sample and a kettle/wand sample shall be obtained for testing at the beginning of the first day of production and for each new lot of material. Additional kettle/wand samples shall be taken and tested at a frequency of not less than one per each two week period. The complete lot will be rejected if the material fails to comply. No payment will be made for pavement area in which the rejected material was used.

316.3 CONSTRUCTION METHODS:

316.3.1 Equipment: The Engineer must approve all equipment designated for use by the Contractor. The equipment shall comply with all applicable OSHA, industry and local government safety procedures, rules, and regulations. The Contractor must use safe and serviceable equipment capable of transporting required material and equipment to each job site.

316.3.1.1 Melter Applicator: The melter applicator unit shall be capable of heating and applying without any further equipment modification, all grades of asphalt rubber sealant, specification joint sealant, and fiber modified sealant. The machine shall be capable of starting at ambient temperature and bringing the sealing material up to application temperature in one hour or less. All qualified bidders must have and maintain a complete inventory of repair parts as well as having experienced service personnel for this equipment. The tank shall be well insulated and equipped with suitable heating devices (burners and flues) to assure a uniform specified application viscosity and temperature. It shall have an internal mixing device to keep asphalt rubber from separating from the compound. It shall have a double boiler type jacket to create a reservoir, which shall hold a minimum capacity of 200 gallons at ambient temperature. The machine, heating chamber and wand shall be so designed and constructed that under day-to-day operation

no clean-out procedure is required. Diesel fuel or any other cleaning materials detrimental to the crack sealant product shall not be used to clean melter applicator equipment.

316.3.2 Weather: In no case shall sealant be placed during damp roadway conditions that exist such as wet roadway surfaces or damp material inside the cracks. Operations stopped by the Engineer, due to weather, shall be at no additional cost to the County.

316.3.3 Cleaning Cracks: Immediately before applying the sealant, cracks shall be thoroughly cleaned of loose particles, grass, grass roots, weeds, dust, and other deleterious substances by means of high velocity compressed air or by other methods approved by the Engineer. Compressed air alone may not be sufficient to clean the cracks properly. Additional handwork may be required.

The compressor used shall be capable of a sustained pressure of 90 psi. The crack cleaning equipment shall be capable of cleaning cracks to a minimum depth of 1/2 inch. The equipment shall also be capable of dust containment by filtering particulate matter 10 micrometers or less in diameter with no dust clouds visible to the naked eye as determined by the Engineer (i.e. vacuum).

During the cleaning of cracks, the Contractor shall protect against damage to items such as, but not limited to, cars, people, driveways, walkways, landscape materials, etc. in the work area. During and after placement of the sealant, the Contractor shall protect against harm to persons or animals that may be exposed to the hot material.

316.3.4 Application: The Contractor shall protect all utilities from damage. The Contractor shall immediately contact the appropriate utility company if damage should occur and shall be responsible for all claims for damage due to their operations.

All cracks, including the space between the asphalt concrete pavement and the curb and gutter, which have an average clear opening 1/8 inch or greater, shall be sealed for the entire length of the visible crack. Sealant is to include portions of the crack sections smaller than 1/8 inch. The maximum crack width to be sealed shall be 1-1/2 inches. All cracks that have an average clear opening greater than 1-1/2 inches shall not be sealed unless directed to do so by the Engineer.

The sealant shall be placed in a manner that will completely fill the crack and not form a lap of greater than 1 inch on each side after forcing material into the crack with a squeegee. Immediately after the application, a rubber squeegee, or other acceptable method, shall be used to force the material into the crack, level the sealant with roadway surface, and form the lap.

The sealant shall be heated to the written manufacturer specifications, or as directed by the Engineer, before starting any crack sealant application. The sealant shall only be applied to clean dry cracks that have been approved by the Engineer.

316.3.5 Inspection: Inspection will include, but not be limited to, the quality of workmanship, width of cracks filled, cleanliness of cracks, and lapping.

The Contractor, at no additional cost to the County, will correct unacceptable work. Unacceptable work shall include, but not be limited to, unsealed cracks, material wastage on the sides of the roadway, and such quantities of material on the roadway that driving is affected.

Correction of unacceptable workmanship shall be accomplished within five working days after notification from the Engineer of the unacceptable work. The Contractor shall not progress to a new area until the unacceptable work is corrected to the satisfaction of the Engineer.

The Contractor shall meet with the Engineer on a daily basis and supply a signed daily report indicating the amount of crack sealant material applied for the day in total pounds and total square yards. In addition, the Contractor shall supply the Engineer with the dates of completion for each segment of road.

316.4 MEASUREMENT:

Crack sealing shall be measured by the square yards of asphalt concrete pavement surface area sealed.

316.5 PAYMENT:

Payment shall be made at the contract price per square yard of road area sealed and accepted with crack sealant material. This price shall be full compensation for furnishing, preparation, and placing of this material, all labor, equipment, tools, and incidentals including taxes, necessary to complete the item. Also included as incidental items are cleaning of cracks, application of blotter material, and all costs associated with any construction water and clean up.

SECTION 321

ASPHALT CONCRETE PAVEMENT

321.8 PLACEMENT:

321.8.2 Joints:

Add the following:

> Traverse joints shall be cut on a 10 to 15 degree skew from a line perpendicular to the centerline of the roadway. The fresh face shall be tack coated prior to placement of the new asphalt concrete.

Revise the forth sentence in the second paragraph to read:

> The surface in the area of the joint shall not deviate more than ¼ inch from a 12-foot straightedge, when tested with the straightedge placed across the joint in any direction.

321.8.4 Compaction Base and Surface, delete the first sentence and add the following:

The minimum temperatures in Table 321.2 do not guarantee that the asphalt mix will be compacted to the required density. The contractor is responsible to achieve the required compaction.

321.8.6 Asphalt Concrete Overlay, add the following:

On roads without curb and gutter, the existing shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of the new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with section 301.3. Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of shoulder adjustment shall be included in the price paid for the asphalt concrete overlay or other related pay items. When the Engineer determines an insufficient amount of material is available for shoulder adjustment, the Engineer may require the Contractor to provide additional material. Acceptable material for shoulders includes the existing shoulder, millings, untreated base materials, or a granular material approved by the Engineer. Engineer requested imported material for shoulder adjustment is not included in the price paid for the asphalt concrete overlay.

321.8.8 Protection for Asphalt Base Course

Roadway traffic shall not be detoured onto any asphalt base course that is less than 5-inches in thickness without the written consent of the Engineer.

321.9 QUALITY CONTROL,

Replace the first sentence of the first paragraph with the following:

Quality control shall be the responsibility of the Contractor.

Add the following:

The Contractor shall provide testing at the frequencies listed in Table 321-A during production of asphalt concrete. A laboratory, accredited in each of the listed tests by the AASHTO Materials Reference Laboratory (AMRL), shall perform the testing.

TABLE 321-A
CONTRACTOR QUALITY CONTROL TESTING REQUIREMENT

Test	Sample Point	Frequency
Ignition Binder Calibration ASTM D6307-98	Stockpiles or storage tanks	1 per mix design per project
Ignition Binder Content & Gradation (ASTM D6307, C117 & C116)	Plant, or truck, or on-grade, etc.	1 per 1000 tons
Gyratory or Marshall Density, (ASTM D4013 or AASHTO T166)	Plant, or truck, or on-grade, etc.	1 per 1000 tons
Maximum Theoretical Density (ASTM D2041)	Plant, or truck, or on-grade, etc.	1 per day
Temperature	Storage silo or hot elevator	Continuous Reading
Aggregate Gradation (ASTM C117 & C136)	Cold Feed	1 per 750 Tons

Results of each test shall be provided to the Engineer's representative immediately upon completion, and in no case later than the end of the day the asphalt was produced. Test results shall be used to control the asphalt concrete production. Production of asphalt concrete on consecutive paving days shall not commence until the prior day's test results have been submitted to the Engineer, and appropriate actions have been taken in accordance with criteria listed in Table 321-A and Table 321-B.

The guidelines in Table 321-B and Table 321-C shall be used to determine if the plant will require adjustment or stoppage. If the contractor's test results indicate

the mixture does not comply with Criteria A in Table 321-B, an adjustment to the plant will be required to bring the production closer to the middle of the specification bands. The Contractor is responsible for determining the extent and the method of adjustment, and shall notify the Engineer's representative in writing of what adjustments were made.

If the Contractor's test results indicate the mixture is beyond the range established by Criteria S in Table 321-B, production shall cease immediately, and shall not resume (except as required to produce material for additional samples) until additional test results verify the adjustments will produce test results meeting Criteria A in Table 321-B. The Engineer may enforce the adjustment or stoppage criteria if the acceptance tests and the quality control tests are not in agreement.

TABLE 321-B		
CRITERIA FOR REQUIRED PLANT ADJUSTMENT		
Property	Criteria A-(Adjustment)	Criteria S-(Stoppage)
Binder Content	±0.3% of Mix Design	±0.4% of Mix Design
Gyratory Voids	4±1.5%	4±2.0%
Gradation	Table 321-C	Table 321-3 (MAG Specs)
Temperature	±10°C of Mix Design	±15°C of Mix Design

TABLE 321-C	
ALLOWABLE GRADATION VARIATION FROM MIX DESIGN TARGET	
Maximum Aggregate Size	+0%
Nominal maximum Aggregate Size (NMAS)	±5%
#8 (2.36 mm) Sieve to NMAS	±4%
#100 (0.150 mm) and #30 (0.600 mm) Sieves	±3%
#200 (0.075 mm) Sieve	±1.5%

The Contractor may make self-directed target changes to the approved mix design within the limits in Table 321-D. Requests for self directed target changes shall be made in writing and acknowledged by the Engineer prior to start of production for a lot. The self-directed target changes must meet contract requirements for mix design criteria and grading limits.

TABLE 321-D	
SELF DIRECTED TARGET CHANGES	
Measured Characteristics Gradation - sieve size	Allowable Target Changes
3/8" (9.5 mm)	±2%
#8 (2.36 mm)	±2%
#40 (0.425 mm)	±1%
#200 (0.075 mm)	None
Asphalt Cement Content	±0.2%
Effective Voids	None

The Contractor may propose target changes to the approved mix design for the engineer's approval. The Engineer will consider if the proposed target change will result in mix production that meets the contract requirements for mix design criteria and grading limits. For acceptance purposes, target changes will not be retroactive.

321.10 ACCEPTANCE:

321.10.1 Acceptance Criteria, replace with the following:

Asphalt concrete will be divided into lots for the purpose of acceptance. A lot shall be one day's production. Each lot shall be divided into sublots of 1,000 ton or fraction thereof. Tests used to determine acceptance will be performed by a laboratory accredited by the AASHTO Accreditation Program (AAP) for the tests being performed. The laboratory shall be employed by the Engineer. The acceptance laboratory will take representative samples of the asphalt concrete from each sublot to allow testing for gradation, binder content, air voids, pavement thickness and compaction of base and surface course. Each sublot will be accepted based on the test data from the sample(s) from that sublot. All acceptance samples shall be taken using random locations or times designated by the Engineer in accordance with ASTM D 3665.

321.10.2 Gradation, Binder Content, and Air Voids, add the following:

The supplemental procedure in AASHTO T209 is not to be used unless the mixture contains individual aggregate with water absorption equal to or greater than 1.5 percent.

321.10.5 Density:

Change the Table referenced in the last sentence of the 6th paragraph, from Table 321-6 to Table 321-7

TABLE 321-7 PAVEMENT DENSITY PENALTIES:

Replace "Less than 1.5 inches" from the first column in the third row with "Layer thickness equal to or greater than 1.5 inches".

321.11 REFEREE:

Replace the first paragraph with the following:

> If the Contractor has reason to question the validity of any of the acceptance test results, the Contractor may request that the Engineer consider verification tests for final acceptance. Any request for verification testing must describe the Contractor's reasons for questioning the validity of the original acceptance results and must clearly describe which set of acceptance tests are in question. The engineer may either accept or reject the request for verification testing. When verification testing is accepted, the Contractor (at the Contractor's own expense) will engage an independent laboratory accredited by AAP in all of the acceptance tests. The independent laboratory shall be acceptable to the Engineer and shall perform a complete new set of acceptance tests (as required by Section 321.10 representing the area or set of tests in questions).

In the third paragraph replace the word 'signed' with the word 'sealed'.

SECTION 325

ASPHALT-RUBBER CONCRETE OVERLAY, GAP GRADED

325.2 MATERIALS:

325.2.3 Mix Designs:

Replace the Asphalt Rubber Binder Content table with the following:

Traffic Condition	Asphalt Rubber Binder
Low Traffic	8.6-9.0
High Traffic	8.2-8.6

325.4 CONSTRUCTION METHODS:

325.4.2 Quality Control and Acceptance, replace with the following:

Production requirements for asphalt-rubber concrete shall be as specified in Section 321.9 Quality Control and Section 321.10 Acceptance except the acceptable production range for asphalt-rubber binder shall not vary more than 0.4 percent from the mix design target value. The production tolerances and corrective actions will be enforced for asphalt-rubber concrete.

325.5 MEASUREMENT, replace the third paragraph with the following:

Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of grading and compaction for shoulder adjustment shall be included in the price paid for the Asphalt-Rubber Concrete or other related pay items. When the Engineer determines an insufficient amount of material is available for shoulder adjustment, the Engineer may require the Contractor to provide additional acceptable material. Engineer requested imported material for shoulder adjustment is not included in the price paid for the Asphalt-Rubber Concrete.

SECTION 329

TACK COAT

329.1 DESCRIPTION, add the following:

Emulsified asphalt for tack coat shall be grade SS-1h.

SECTION 333

FOG SEAL COATS

333.1 DESCRIPTION, add the following:

Fog seal coats for curing seal purposes as specified in Section 308 or Section 309 shall consist of the application of emulsified asphalt.

333.6 APPLICATION OF ASPHALT EMULSION, add the following:

For curing seal applications over Lime Slurry Stabilization or Lime Slurry with Fly Ash Stabilization the application rate shall be between 0.10 to 0.20 gallons per square yard.

SECTION 336

PAVEMENT MATCHING AND SURFACE REPLACEMENT

336.2 MATERIALS AND CONSTRUCTION METHODS

336.2.3 Temporary Pavement Replacement, add the following:

Temporary pavement replacement that uses cold-mix asphalt concrete shall be replaced no later than seven (7) calendar days after initial placement.

336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT add the following:

The match point location for longitudinal trenches within asphalt pavements shall not be located within a lane wheel path. When the standard match point falls in a lane wheel path, the surface matching point shall be moved. The lane wheel path area is the entire lane width except the area within one foot of a lane line stripe and except the center two feet of the travel lane.

The match point for longitudinal trenches shall not be located within 48" of any asphalt pavement edge. When the required surface match point is located within 48" of an asphalt pavement edge, all asphalt surfacing shall be removed to the asphalt edge and the asphalt edge shall be the new asphalt surfacing match point location. When concrete curb and gutter exist adjacent to asphalt pavement, the lip of gutter shall be considered an edge of the asphalt pavement.

336.4 MEASUREMENT:
Add the following to paragraph (B):

The pay width for Type A and D pavement replacement will extend to the adjusted field width required when the surface match point is adjusted to be outside of a wheel path or is required to be relocated to the edge of the asphalt pavement.

SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, SIDEWALK RAMPS, DRIVEWAY AND ALLEY ENTRANCE

340.2 MATERIALS:

340.2.1 Detectable Warnings, add the following:

Approved products are posted on MCDOT's Procurement website:
http://www.mcdot.maricopa.gov/procurement/mcdot/aml.pdf
Surface applications dependent on an adhesive bonding agent(s) are not approved for use. Request for product approval are to include a) Product Specifications, b) Installation Instructions, c) Product Sample, and d) List of Locations of proposed use. Requests are to be directed to: MCDOT Operations and Maintenance Division, 2919 West Durango Street, Phoenix, 85009 Phone: (602) 506-8362.

340.3 CONSTRUCTION METHODS

Revise MAG Section 340.3 Paragraph 2 – Delete the second paragraph and replace with the following:

The subgrade shall be constructed and compacted true to grades and lines shown on the plans and as specified in Section 301. All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer.

When the Engineer suspects that the existing subgrade consists of soils with swelling characteristics, the soils shall be tested to determine if they are non-expansive,

marginally expansive, or expansive. This determination shall be based on a one-dimensional swell test (ASTM D-4546) remolded to 95% of maximum density at optimum moisture. Use ASTM D-698 for maximum density and optimum moisture determination. Results of this testing will be applied to Table 340-1 to determine the relative level of swell potential and the corrective action required.

Table 340-1

% Swell	Description	Corrective Action Required*
<1	Non-expansive	None
1 – 3	Marginally expansive	Compact to 90% (±3%) of maximum density at moisture content above optimum (ASTM D698).
>3	Expansive	Remove upper 24 inches of subgrade and replace with granular material meeting requirements of Section 601.4.6.

* Alternative corrective measures may be submitted to the County for review. The submittal must include recommendations affixed with the professional seal of an Arizona registered engineer.

340.3 CONSTRUCTION METHODS, add the following:

340.3.1 Detectable Warnings: Detectable warnings are to be installed at locations that represent potential hazards for pedestrians with vision impairments such locations include walkways that cross roads or railroad tracks. Detectable warnings shall be installed on walkways that adjoin or cross a roadway whenever the walking surface is not separated by curbs, railings or other approved elements.

340.5 MEASUREMENT, add the following:

Sidewalk ramp installations shall be measured as complete installed units and shall include the ramp curb and the walking surfaces between the ramp curb and back of curb and gutter or single curb. Single curb or curb and gutter shall be paid for separately. The surface area of sidewalk ramps shall not be included in the measured quantity for sidewalks.

Measurement for curb terminations and transitions shall be included with the linear measurement of the various types of curb or curb and gutter as shown on the plans and in the proposal.

Curb and gutter type shall be based on the configuration of the final exposed surfaces. The increased curb and gutter depth required at valley gutter aprons or driveways shall not be measured as a separate pay item; any additional Contractor cost shall be included in the unit cost associated with the valley gutter, driveway or other associated item.

340.6 PAYMENT, add the following:

Payment for sidewalk ramps shall include the ramp curb and the walking surfaces between the ramp curb and back of curb and gutter or single curb.

SECTION 350

REMOVAL OF EXISTING IMPROVEMENTS

350.1 DESCRIPTION, add the following:

The work under this Section shall consist of the disposal of any obstacle to construction, unless specifically noted on the Plans for removal or relocation by other entities.

Arrangements for disposal of all waste material shall be the responsibility of Contractor, except that all usable pipe culvert, as determined by the Engineer, shall be stockpiled within the right-of-way for salvage by the County. Removal and storage of traffic signs and other traffic control devices shall comply with section 401.2.5. Delivery of salvaged traffic signal and lighting equipment shall comply with section 470.6.

Removal of existing improvements shall be performed in a safe manner avoiding damage to improvements not designated for removal. Disposal of all construction debris shall be in a manner and in a location approved by the Engineer.

350.2 CONSTRUCTION METHODS, add the following:

Removal of traffic signal pole foundations unless otherwise indicated shall be to a depth of at least 18 inches below finished grade.

Remove and Salvage Traffic Sign shall consist of salvaging existing sign panels and posts, removing the existing foundations, backfilling and compacting all voids, and restoring the existing surface to match previous existing conditions. The sign panels and posts shall be dismantled in a manner that will prevent damage. Concrete sign foundations shall be disposed of by the contractor. Contractor shall pre-arrange delivery of sign panels and posts by calling (602) 506-8662. The sign panels and posts shall be transported to and unloaded at 2909 W. Durango Street in a manner that will prevent damage.

Part 300 add the following new Section:

SECTION 351

RELOCATION AND ADJUSTMENT OF EXISTING IMPROVEMENTS

351.1 DESCRIPTION:

This work shall consist of the movement of existing improvements and specialty items to accommodate project construction. Relocation is the horizontal movement or change in location of an existing improvement or item, as shown or described on the Project Plans. Adjustment is a change in the vertical position of an existing improvement or item, typically required to accommodate a change in grade at the location of the existing improvement.

351.2 MATERIALS:

All relocations and adjustments requiring reseating, replacement, or the use of additional materials shall be accomplished using materials of the same or better quality than found in the existing improvements, as approved by the Engineer.

For mailbox relocations the Contractor shall supply a replacement support post for any mailbox installation deemed hazardous by the Engineer. Hazardous mailbox installations may include but are not limited to support posts that act as fixed objects (i.e. rigid or non-deflecting posts that exceed the stiffness or breakaway characteristics of a nominal 4"x4" wood post buried 36 inches into the ground) and installations of multiple mailbox receptacles mounted on a horizontal beam.

351.3 CONSTRUCTION:

The work shall include the removal of posts, foundations, and other associated items directly related to the relocation or adjustment of the existing improvement; filling and compacting all holes left by such removals; and installing, adjusting, or reconstructing moved items in their new location.

Improvements shall be moved in such a manner that the moved elements and all remaining unmoved portions of previously attached improvements are not damaged. All portions of moved and remaining unmoved improvements that are damaged during the relocation or adjustment of the improvements shall be repaired, or shall be replaced in kind by the Contractor, as approved by the Engineer, at the Contractor's expense.

All relocated or adjusted improvements shall exhibit the same quality, integrity, function, and appearance as the improvements exhibited prior to relocation or adjustment. The unmoved portion of the moved improvement shall be repaired or restored to the same type, quality, appearance, and strength as existed prior to relocation or adjustment.

If for any reason the improvement cannot be removed, relocated, and adjusted within the same working day, the disturbed/removed portion shall be secured from theft and damage until such time that it can be permanently installed in its final location. Also, where the move cannot be accomplished within the same working day, a temporary substitute facility shall be provided to accomplish the required function, as approved by the Engineer. Example: security fencing is to be relocated and the relocation is incomplete at the end of a work day, the contractor is to provide appropriate temporary fencing or approved alternative measures to secure the fenced area.

Relocate Traffic Sign consists of salvaging the existing sign panel and post, removing the existing foundations, backfilling and compacting all voids, restoring the existing surface to match previous existing conditions and installing the traffic sign panel on a post or posts of appropriate length mounted on new post foundations. New post foundations shall be measured separately and not included as part of the Relocate Traffic Sign pay item.

351.4 MEASUREMENT:

Relocated or adjusted items will be measured by the number of improvements and/or the number of linear feet as designated in the fee proposal.

For linear items such as relocated fencing, the length measured shall be the installed length; no measurement of the removal length shall be made.

The measurement of relocated mailboxes will be the number of mailboxes relocated to a new permanent location as indicated by the project plans or directed by the Engineer and shall include replacement posts to correct conditions deemed hazardous, as required for an acceptable complete in place installation. No measurement will be made for temporary relocations made to maintain mail delivery during construction.

351.5 PAYMENT:

Payment will be made at the contract unit price for each relocated or adjusted improvement. Payment shall be full compensation for all tools, equipment, labor, materials, services, transportation, and incidentals necessary to relocate and adjust the improvement including additional new and replacement material, repairs, and adjustments to the unmoved remainder of fences and other facilities.

SECTION 401

TRAFFIC CONTROL

401.2 TRAFFIC CONTROL DEVICES:

Section 401.2 add the following:

All traffic control devices and their application shall conform to the Manual on Uniform Traffic Control Devices (MUTCD - United States Department of Transportation, Federal Highway Administration) as modified by the Arizona Department of Transportation's Supplement, the special provisions, and any field modifications made by the Engineer.

All traffic control devices shall meet the guidelines of NCHRP 350 or the AASHTO 2009 Manual for Assessing Safety Hardware.

If at any time the Engineer is unable to contact the Traffic Control Technician, the Engineer reserves the right to make contact with the traffic control subcontractor to request any materials or services deemed appropriate by a demonstrated or apparent need in accordance with the standards and guidelines established by the MUTCD as supplemented by the Arizona Department of Transportation for the safety of the public or workers. The cost of these materials or services shall be part of the cost of Traffic Control.

401.2.1 Installation of Temporary Traffic Control Devices: It shall be the responsibility of the Contractor to provide, erect, maintain, remove and/or relocate all temporary and existing traffic control devices and signal indications necessary to properly mark and control the construction area(s) for the safe and efficient movement of all roadway users.

The Contractor shall inspect and maintain all contractor installed temporary traffic control devices at least once during a twenty-four (24) hour period. More frequent intervals of inspection and maintenance shall be made during periods of high winds or other detrimental conditions including a continuing problem maintaining the signs and devices.

The Contractor shall install temporary traffic control warning signs and devices prior to the start of any work in accordance with the approved Traffic Control Plan (TCP). All existing signs in conflict with the construction signs shall be covered, removed, or relocated.

The Contractor shall provide additional devices as determined by the Engineer, to safely control traffic.

All advanced warning construction signs shall be mounted on channels driven into the ground or be mounted on temporary spring stands. Each mile and half-mile point of the

project shall be signed with construction and speed limit signs, mounted on channels driven into the ground or be mounted on temporary spring stands and placed at locations where the need for relocation during construction is minimized.

All temporary traffic control devices shall be ballasted with sandbags or other approved ballast. The amount of sandbags used shall be enough to provide adequate safety for the traveling public.

Ground mounted temporary traffic controls signs for rural and urban areas shall be mounted at a height of at least seven feet measured from the bottom of the sign to the near edge of the pavement.

The Contractor shall mount signs on wind resistant, spring-type bases when conditions warrant or as requested by the Engineer.

The Contractor shall place flags above all signs.

The Contractor shall use warning lights to mark traffic control devices at night.

The Contractor shall mount Type B high-intensity flashing warning lights on all stop signs within the work zone.

Temporary traffic control signs with orange background shall use high intensity retroreflective sheeting.

The Contractor shall use an arrow board for all stationary or moving lane closures.

The Contractor is responsible for all costs incurred in replacing lost or damaged traffic control devices and traffic control warning signs.

401.2.2 Traffic Cones: Traffic cones shall only be used during daylight hours and shall be a minimum of 28" high. Daylight hours are defined as ½ hour after sunrise to ½ hour before sunset.

401.2.3 Temporary Longitudinal Traffic Barriers: Temporary longitudinal traffic barrier installations shall be portable concrete barrier (PCB) or other segmented longitudinal barrier. The barrier and installation shall be in accordance with Chapter 9 of the AASHTO Roadside Design Guide. PCB shall use F-shape faces. Each barrier section shall be properly connected to the adjacent section to provide barrier continuity to resist movement, snagging, and/or instability of impacting vehicles. Panels and connections shall meet NCHRP 350 Test Level 3 or an approved test level of the AASHTO 2009 Manual for Assessing Safety Hardware.

401.2.4 Pavement Markings: Pavement markings used as an integral part of the traffic control plan shall be kept distinct and visible during their use. Temporary pavement markings shall match and meet the markings in place at both ends of their usage.

401.2.5 Removal of Permanent Traffic Control Devices: The Contractor shall notify the Engineer and obtain the Engineer's approval prior to the removal of any permanent traffic control device.

The Contractor shall remove (without damage) all permanent signs including signposts that are no longer applicable. The sign panels and posts shall be dismantled and transported to the MCDOT sign shop in a manner that will prevent damage. Concrete sign foundations shall be removed and disposed of by the Contractor. The Contractor shall coordinate with the MCDOT sign shop (602) 506-8662 to establish an acceptable delivery time during normal working hours. The sign panels and posts shall be delivered to:

2909 West Durango Street
Phoenix, Arizona 85009.

401.4 TRAFFIC CONTROL MEASURES, add the following:

401.4.1 Traffic Control Plan: Construction shall not commence without an approved Traffic Control Plan (TCP). At the time of the pre-construction meeting, the Contractor shall submit preliminary traffic control plans for each phase of the work for review. Plans shall be of an appropriate size and legible, plans found to be deficient by the Engineer shall be returned. The Contractor shall design the traffic control plan using the posted speed limit existing prior to commencement of work as the design speed. The TCP shall show all striping, signing, barricading and distances for all devices for all movements of roadway users during each phase of construction. The TCP shall show existing traffic control signs and temporary construction signs; shall identify conflicting signs to be covered/removed or relocated; and shall identify other features that may conflict with the placement of temporary signage. The TCP shall also show the duration with the start and end date of each phase. When requested by MCDOT, the Contractor shall supply a copy of the manufacturer's certification of compliance with NCHRP 350 test requirements (or compliance with a designated approved test level of the AASHTO 2009 Manual for Assessing Safety Hardware) for any of the Contractor proposed traffic control devises. The manufacturer's certification shall identify the NCHRP 350 or AASHTO test number. The County will within 10 working days review the plan and notify the Contractor of approval or note items to be revised.

401.4.2 Traffic Control Technician: The Contractor shall appoint a Traffic Control Technician (other than the superintendent/foreman or barricade subcontractor), who has been properly trained and certified in the application of work zone traffic control, to maintain all necessary traffic control devices. At the beginning and end of each workday, and periodically throughout the day, the Traffic Control Technician shall inspect the construction work site. The Traffic Control Technician shall ensure that all construction signs and barricades are standing upright in accordance with the approved traffic control plan, free of dirt and debris and visible to intended traffic. At the end of the workday all non-essential traffic control devices will be removed. The Contractor shall immediately correct deficiencies noted by the Engineer. The Contractor shall

provide an after-hours pager and telephone number for the Traffic Control Technician at the pre-construction meeting.

401.4.3 Intersection Restriction: Off-duty uniformed police officers are required at all major intersections when restrictions are present, and may be required at other locations as requested by the Engineer. Any work performed in the right of way within 300 feet of an intersection shall be considered as restricting the intersection.

401.4.4 Traffic Control Devices: The Contractor shall provide and maintain all necessary traffic control devices until acceptance of the project by the County. Pavement markings used as an integral part of the traffic control plan shall be kept distinct and visible during their use. Temporary pavement markings shall match and meet the markings in place at both ends of their usage.

401.4.5 Flaggers: All flaggers shall be properly trained and certified by a recognized source, such as the American Traffic Safety Services Association (ATSSA) and shall carry with them at all times proof that training and certification requirements have been completed within the last two years.

401.4.6 Failure to Provide Adequate Traffic Control Measures: If the Contractor fails to provide adequate traffic control measures, the Engineer may have the work accomplished by other sources. The cost of having this work accomplished by other sources will be computed in accordance with Section 109.5. The total cost will be deducted from monies due or to become due to the Contractor.

401.5 GENERAL TRAFFIC REGULATIONS, add the following:

The Sheriff's Department shall be provided with the name and phone number of the person responsible for 24-hour maintenance of all traffic control devices.

The Contractor shall notify all affected emergency services such as fire departments, police stations, and emergency management system by handbill a maximum of 48 hours and minimum of 24 hours in advance of any street restrictions.

401.5.1 Road Closure and Road Restrictions: A road closure for the convenience of the Contractor is not authorized. Traffic restrictions are not permitted on arterial or collector streets during peak traffic hours of 6:00 a.m. to 8:30 a.m. and 4:00 p.m. to 7:00 p.m.

401.5.2 Minimum Lane Requirements: At signalized intersections, during peak hours, four lanes shall be open on roads with five or more lanes, and three lanes shall be open on roads with four or less lanes with a center lane. During off-peak traffic hours, the minimum number of lanes shall be two lanes (one in each direction) on streets with four lanes or less, and three lanes on streets with five or more lanes.

401.5.3 Temporary Lane Diversions: For construction or trenching that requires movement of traffic from the normal travel lanes, temporary lane diversions may be used only during daylight hours and the normal traffic lanes shall be restored prior to the end of daylight hours. Traffic plates and temporary pavement shall be used to restore traffic lanes. The Engineer, under unusual conditions, may authorize exceptions.

401.5.4 Regulatory Speed Limit Signs: An appropriate regulatory speed limit sign shall be used where traffic is maintained on temporary detour roads, diversions, or on traffic lanes that are severely restricted.

401.5.5 Access to Adjacent Property: Access to all adjacent properties shall be maintained whenever possible. When access cannot be maintained, Contractor shall notify the adjacent residents at least 48 hours in advance of the access closure. In no case shall the access be closed for more than four hours. Access to fire stations, hospitals, sheriff stations and schools shall be maintained at all times.

401.5.6 Signal Equipment Repair: If existing signal equipment is damaged the Contractor shall notify the County Signals Supervisor at (602) 506-8660, in order to facilitate the prompt restoration of the traffic signal operation. All costs associated with the repair of damaged traffic signals, caused by Contractor construction activity, shall be borne by Contractor.

401.5.7 Temporary Longitudinal Traffic Barriers / Steel Plating: Open excavations and trenches within 10 feet of an active traffic lane shall be protected at night and during non-working hours from vehicle traffic by steel plating or the use of temporary longitudinal traffic barriers complying with requirements of section 401.2.3. Open excavations as may occur with reinforced concrete box culvert construction and other work shall require temporary longitudinal traffic barriers to separate vehicle traffic from the work site. The Contractor shall use temporary longitudinal traffic barriers when construction hazards warrant, or as requested by the Engineer. Impact attenuation devices shall be provided by the Contractor commensurate with barrier end treatment requirements.

401.5.8 Supplemental Safety Markings: Rope, flagging, fencing and woven plastic tape may be used between barricades and channeling devices to provide additional safety.

401.6 MEASUREMENT:

Section 401.6 is replaced with the following:

Measurement for Traffic Control shall be made on a Lump Sum basis. This lump sum measurement shall include all materials, equipment and labor necessary to facilitate traffic control per the contract documents. Traffic Control includes but is not limited to the application and removal of temporary pavement markings including related

modification of existing pavement markings, pilot cars, flagmen, barricades, sign panels, sign stands, warning lights, and related temporary pavements.

No direct measurement of individual traffic control elements or devices will be made. All traffic control devices, unless otherwise noted, shall be considered as included in the lump sum measurement for the Traffic Control pay item.

No direct measurement for temporary pavements will be made. All sawcutting, grading, aggregate base course materials, asphaltic concrete pavement, labor, and equipment shall be considered as included in the lump sum measurement for the Traffic Control pay item.

No direct measurement for removal of temporary pavements will be made. All sawcutting, and removal of aggregate base course materials and asphaltic concrete pavement shall be considered as included in the lump sum measurement for the Traffic Control pay item.

Uniformed Off-duty Law Enforcement Officers including vehicle and equipment will be measured by the hour for each hour required to perform traffic control duties. When an officer is used less than the agency's minimum number of hours and the Contractor is charged for the agency's minimum number of hours, the minimum hours charged will be approved for payment. Time over the agency's minimum number of hours will be measured by the hour.

When included as a separate pay item within the fee schedule, Portable Concrete Barrier shall be measured by the foot. Otherwise, portable concrete barrier shall not be measured and shall be considered a traffic control device.

401.7 PAYMENT:

Section 401.7 is replaced with the following:

Payment for Traffic Control other than Uniformed Off-duty Law Enforcement Officers shall be made at the lump sum contract price in equal payments distributed over the entire duration of the project. Payment for Traffic Control shall be full compensation for all labor, pilot cars, flagmen, materials, traffic control devices, and miscellaneous items necessary to complete the work.

Payment for Uniformed Off-Duty Officer will be based on approved time sheets or invoices for all actual hours Contractor provided a Uniformed Off-Duty Law Enforcement Officer for traffic control purposes at the request and with the approval of the County. Expenses, eligible for reimbursement, are labor costs, supported by approved time sheets or invoices and documented expenses such as taxes or bond cost charges to Contractor in connection with the Uniformed Off-Duty Law Enforcement Officer assignment. No additional mark-up for profit and/or fee for Contractor will be eligible for reimbursement.

Separate payment for Portable Concrete Barrier will only be made when Portable Concrete Barrier is included as a separate pay item within the fee schedule. Payment will be full compensation for the furnishing, transportation, installation, adjustment, maintenance, and removal of the temporary barrier system.

SECTION 415

FLEXIBLE METAL GUARDRAIL

Section 415 is replaced with the following:

415.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials, constructing new guardrail, and delineating guardrail sections at the locations shown on the project plans in accordance with the standard details or the details shown on the project plans, and as per the requirements of these specifications.

415.2 MATERIALS:

The rail elements, bolts, nuts and other fittings shall conform to the specifications of AASHTO M-180, except as modified in these specifications. The rail metal shall be open hearth, electric furnace, or basic oxygen steel and, in addition to conforming with AASHTO M-180, shall withstand a cold bend, without cracking of 180 degrees around a mandrel of a diameter equal to 2 ½ times the thickness of the plate.

Three certified copies of mill test reports of each heat from which the rail elements were formed shall be furnished to the Engineer.

All material shall be new.

Railing Parts furnished under these specifications shall be interchangeable with similar parts regardless of source. All surfaces of guardrail elements that are exposed to traffic shall present a uniform, pleasing appearance and shall be free of scars, stains or corrosion.

Nails shall be 16 penny common galvanized. Nails for retainer strap shall be 10 penny common, galvanized.

Bolts shall have shoulders of such a shape as to prevent the bolts from turning.

Unless otherwise specified the rail elements, terminal sections, bolts, nuts, and other fittings shall be galvanized in accordance with Section 771. Where galvanizing has been damaged, the coating shall be repaired in accordance with Section 771.

Prismatic guardrail reflector tabs shall have a minimum thickness of 3/16", and be either galvanized steel or ultraviolet-resistant plastic. Prismatic guardrail-mounted barrier markers shall have an ultraviolet-resistant reflective surface, be secured to the body in accordance with the manufacturer's recommendations, and have a trapezoidal-shaped body as shown in the Reflector Tab Detail of Detail 3002.

Timber for posts and blocks shall be rough sawn (unplanned) or S4S with the nominal dimensions indicated. Any species or group of woods graded in accordance with the requirements for Timber and Posts of the Western Wood Products Association may be used. Timber shall be No. 1 or better, and the stress grade shall be as follows:

6" by 8" Post and Block	1200 psi
8" by 8" Post and Block	900 psi
10" by 10" Post and Block	900 psi

When the plans show guardrail systems using 8" by 8" timber posts and blocks, the Contractor may use 8¼" nominal size posts and blocks with a stress grade of 825 pounds per square inch. Substitution of 8" by 8" posts for 6" by 8" post may be approved on a per project basis by the engineer.

At the time of installation, the dimensions of timber posts and blocks shall vary no more than plus or minus ½" from the nominal dimensions as specified on the project plans.

The size tolerance of rough sawn block in the direction of the bolt holes shall vary no more than plus or minus 3/8". Only one type of post and block shall be used for any one continuous length of guardrail.

All timber shall have a preservative treatment as per the requirements of Section 779.

415.3 CONSTRUCTION REQUIREMENTS

415.3.1 General: The construction of the various types of guardrail shall include the assembly and erection of all component parts complete at the locations shown on the project plans or as requested by the Engineer. All Materials shall be new except as provided for under the project plans.

Terminal sections shall be installed in accordance with the manufacturer's recommendations.

Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, burrs, sharp edges and protrusions.

The various types of guardrail shall be constructed with wood posts and wood blocks, except where other post materials to be used are noted on the plans.

The bolted connection of the rail element to the post shall withstand a 5,000 lb. pull at right angles to the line of the railing. All metal work shall be fabricated in the shop. No punching, drilling, cutting or welding shall be done in the field, except as provided for by project plans. All metal cut in the field shall be cleaned and the galvanizing repaired in accordance with Section 771.

Where field cutting or boring of wood posts and blocks is permitted, the affected areas shall be thoroughly swabbed with at least two passes of the same type of wood preservative as initially used.

Where Wood posts with rectangular sections are used, the posts shall be set so that the longest dimension is perpendicular to the rail.

All bolts shall extend beyond the nuts a minimum of two threads, except that all bolts adjacent to pedestrian traffic shall be cut off flush to the nut.

Bolts extending more than 2" beyond the nut shall be cut off to less than ½" beyond the nut.

Unless otherwise shown on the plans, bolts shall be torqued as follows:

Diameter of Bolt	Torque, Foot/Pounds
5/8"	45-50
3/4"	70-75
7/8" and larger	120-125

All bolts, other than those specified to be torqued, shall be securely tightened.

When guardrail is being constructed under traffic, the work shall be conducted so as to constitute the least hazard to the public. Guardrail work shall be performed in the direction of traffic flow when feasible.

Any section of guardrail that is removed for modification shall be replaced within five calendar days of the date the guardrail is removed, unless otherwise directed by the Engineer. At the end of each day, incomplete guardrail sections having an exposed end toward oncoming traffic, shall have a buffer end section (MAG Standard Detail 135-4, Detail No. 5 Buffer End Section) bolted securely in place together with approved overnight traffic control devices in place.

415.3.2 Delineation: The maximum spacing between reflector tabs shall not exceed six posts. The slotted part of the tab shall be installed under the mounting bolt head so that the Reflectorized surface of the tab faces oncoming traffic. The exposed ends of the slotted part of the tab shall be bent up against and then over the top of the bolt head. The color of the reflective portion of the barrier markers shall conform to the color of the adjacent edge line. Silver-faced reflector tabs shall be installed on the right hand side of all roadways, and yellow-faced tabs shall be installed on the left-hand side of one-way, or median divided roadways.

All guardrail delineation shall be installed in accordance with the manufacturer's recommendations and as specified herein.

415.3.3 Roadway Guardrail: Wood posts shall either be driven, or placed in manually or mechanically dug holes; however, driven posts will not be permitted at locations where damage to the curb, gutter, sidewalk, buried items, shoulders or pavement might occur. The Engineer will be the sole judge as to whether driving of posts will be allowed. Driving of posts shall be accomplished in a manner that will prevent battering, burring, or distortion of the post. Any post which is damaged to the extent it is unfit for use in the finished work, as determined by the Engineer, shall be removed and replaced at no additional cost to the County.

The posts shall be firmly placed in the ground. The space around the posts shall be backfilled with selected earth, free of rock, placed in layers approximately 4" thick and each layer shall be moistened and thoroughly compacted to the density of the surrounding material.

Where pavement is disturbed in the construction of guardrail, the damaged surfacing shall be repaired as approved by the Engineer. Where a culvert or other obstacle is at an elevation, which would interfere with full depth post placement, guardrail installation shall comply with requirements of Section 415.3.4 Bolted Guardrail Anchors or Section 415.3.5 Nested Guardrail.

Wood blocks shall be toe nailed to the wood post with one 16 penny galvanized nail on each side of the top of the block. Wood blocks shall be set so that the top of the block is no more than ½" above or below the top of the post, unless otherwise shown on the project plans.

Rail elements shall be spliced at 25 foot intervals or less. Rail elements shall be spliced at posts unless otherwise shown on the project plans. Rail elements at joints shall have full bearing. When the radius of curvature is 150 foot or less, the rail elements shall be shop curved.

The Contractor shall dispose of surplus excavated material remaining after the guardrail has been constructed.

415.3.4 Bolted Guardrail Anchors: Where the elevation of the top surface of a box culvert or other similar installation prevents the placement of a post of the specified length, the posts shall be shortened and anchored in accordance with MCDOT Standard Detail 3010 at the locations shown on the plans.

415.3.5 Nested Guardrail: This work shall consist of furnishing and constructing nested guardrail, Type 1, 2, or 3, as shown in MCDOT Standard Detail 3008 including all materials, in accordance with the requirements of the project plans.

Nested guardrail consists of additional steel W-beam sections attached as an appurtenance to guardrail.

415.3.6 Guardrail to Structure Transitions: Guardrail transitions shall be constructed in accordance with the details shown on the project plans, at the locations shown on the plans.

415.4 MEASUREMENT:

The limits of measurement for roadway guardrail shall be as detailed in MCDOT Standard Detail 3016 and as shown on the project plans. Guardrail, of the type shown on the project plans, will be measured by the linear foot along the face of the rail element from center to center of end posts, exclusive of guardrail terminals, guardrail end terminal assemblies, and guardrail transitions and anchor assemblies.

Delineation is considered a part of installation of guardrail and hence will not be measured as a separate item.

The accepted quantities of bolted guardrail anchors, will be measured by the unit each, complete in place, including steel brackets, hardware, excavation, backfill, removing and replacing surfacing, cutting and fitting steel beam posts or timber posts, drilling anchor bolt holes in steel posts, timber posts, and box culverts, and disposal of surplus materials.

Nested guardrail, Type 1, 2, or 3, installed as an appurtenance to new guardrail, shall be measured by the linear foot of additional steel W-beam, installed using guardrail hardware, complete in place and accepted, as shown on the plans.

Guardrail transitions will be measured by the unit each, complete and accepted as shown on the project plans.

415.5 PAYMENT:

Payment for accepted quantities of each type of guardrail will be made at the contract unit price. Payment shall be full compensation for furnishing materials and installing guardrails, complete in place including excavation, backfill, and disposal of surplus material.

Payment for Bolted Guardrail Anchors will be at the contract unit price, and shall be full compensation for the work, complete in place, including steel brackets, hardware, excavation, backfill, removing and replacing surfacing, cutting and fitting steel beam posts or timber posts, drilling anchor bolt holes in steel posts, timber posts, and box culverts, and disposal of surplus materials.

Payment for Additional Steel W-beam will be at the contract unit price.

Payment for guardrail transitions will be at the contract unit price.

Part 400 add the following new Section:

SECTION 416

GUARDRAIL END TREATMENTS

416.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and constructing new guardrail end treatments at the locations shown on the project plans and in accordance with specified details and the requirements of these specifications.

This work shall also include all the work and materials to delineate guardrail end treatments, including all necessary components and markings, installed new.

416.2 MATERIALS:

End treatment materials shall conform to Section 415.2 Materials. Adhesive materials for applying reflective sheeting to guardrail terminals shall be in accordance with the sheeting manufacturer's recommendations.

All guardrail extruded terminal sections and guardrail transition sections shall be compliant to NCHRP 350 Test Level 3, published by the Federal Highway Administration or compliant with a test level of the AASHTO 2009 Manual for Assessing Safety Hardware as approved by the County. End terminals shall be type ET-PLUS as supplied by Trinity Industries, 2525 Stemmons Freeway, Dallas Texas, 75207. Manufacturer's specification and installation instructions shall be submitted to the Engineer for approval and shall be available at the worksite during installation and inspection.

416.3 CONSTRUCTION REQUIREMENTS:

The construction of the various types of guardrail end treatments shall include the assembly and erection of all component parts complete at the locations shown on the project plans or as requested by the Engineer. All Materials shall be new except as provided for under the Contract Plans.

Workmanship shall be equivalent to good commercial practice and all edges; bolt holes and surfaces shall be free of torn metal, burrs, sharp edges and protrusions.

416.3.1 Guardrail Extruder Terminals: Guardrail Extruder Terminal shall be installed at the locations shown on the project plans as per the manufacturer's specifications.

Further information regarding assembly and installation of the ET-PLUS Guardrail End Treatment may be obtained from Trinity Industries, Inc 1-800-644-7976. The manufacturer will provide in-field assistance for first time contractors for this item.

Damaged end treatments shall be repaired or replaced immediately.

The approach surface in front of all Guardrail Extruder Terminals shall be leveled and paved as shown on the project plans and MCDOT Standard Details. The approach surface slope shall not exceed 1:10.

416.3.2 Delineation: The configuration of reflective sheeting object markers on the approach and departure sides of the ET-PLUS shall conform to manufacturer's recommendations. At a minimum, delineation for the ET-PLUS will have a Prismatic Barrier Marker on Post Numbers 2, 4, 6, 8 and the normal reflector tab spacing will begin with post number 10.

416.3.3 Guardrail Anchor Assembly: Installation of guardrail anchor assembly shall be as per MCDOT Standard Detail 3007.

Foundation tubes shall be installed with an approved driving head. The tubes shall not be driven with the wood post in place. If approved by the Engineer, foundation tubes may also be installed in drilled holes. When foundation tubes are placed in drilled holes, the space around and under the tubes shall be backfilled with selected earth, free of rock, placed in layers approximately 4" thick and each layer shall be moistened and thoroughly compacted to the density of the surrounding soil.

The foundation tube shall not protrude more than 4" above the ground as measured along a 5-foot cord.

416.4 MEASUREMENT

416.4.1 Guardrail Extruder Terminals: Measurement for furnishing materials and installing the ET-PLUS terminal section will be per each, complete in place, including 37.5 feet or 50 feet of guardrail, guardrail extruder, offset strut, anchor assembly, steel tubes, posts, hardware and delineation as required, excavation, backfill, and disposal of surplus material.

Delineation is considered part of the installation of guardrail end terminals and will not be measured.

416.4.2 Guardrail Anchor Assemblies: The accepted quantities of guardrail anchor assemblies will be measured by the unit each, complete in place, including excavation, backfill, and disposal of surplus material.

416.5 PAYMENT:

416.5.1 Guardrail Extruder Terminals: Payment for furnishing materials and installing the ET-PLUS terminal section will be for each unit of the designated length, complete in place, including guardrail, guardrail extruder, offset strut, anchor assembly, steel tubes, posts, hardware and delineation as required, excavation, backfill, and disposal of surplus material.

416.5.2 Guardrail Anchor Assembly: The accepted quantities of guardrail anchor assemblies, measured as provided above, will be paid for at the contract unit price each, complete in place.

Part 400 add the following new Section:

SECTION 417

CRASH CUSHIONS

417.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and installing new crash cushions or impact attenuators at the locations shown on the project plans in accordance with these specifications.

417.2 MATERIALS:

All impact attenuation devices and transition components shall be compliant to NCHRP 350 Test Level 3, published by the Federal Highway Administration or a County approved test level of the AASHTO 2009 Manual for Assessing Safety Hardware. Attenuation devices shall be TRACC™ Crash Cushions as supplied by Trinity Industries, 2525 Stemmons Freeway, Dallas Texas, 75207 unless otherwise approved by the Engineer. Manufacturer's specification and installation instructions shall be submitted to the Engineer for approval and shall be available at the worksite during installation and inspection.

417.3 CONSTRUCTION REQUIREMENTS:

The construction of crash cushions shall include the assembly and erection of all component parts complete at the locations shown on the project plans and incompliance with the manufacturer's specifications. Information regarding assembly and installation of the TRACC™ attenuating crash cushions may be obtained from Trinity Industries, Inc 1-800-644-7976.

417.4 MEASUREMENT:

Measurement for crash cushions will be for each type of unit installed and accepted by the Engineer.

417.5 PAYMENT:

Payment for crash cushions will be for furnishing and installing each type, complete in place including any required foundation, transition, and delineation.

SECTION 430

LANDSCAPING AND PLANTING

430.4 DECOMPOSED GRANITE AREA, add the following

Polyethylene film shall not be placed under decomposed granite areas.

430.5 TREE SHRUB AND GROUND COVER PLANTING, add the following:

430.5.7 Water Truck Irrigation:

When trees, shrubs, and groundcover are planted, they shall immediately be started on an irrigation schedule. All trees, shrubs, and groundcover shall receive ½" of water weekly. The water is to broadcast evenly by a 2200 gallon water truck with a wand. All cacti and hydro seeded areas are to be omitted from the irrigation schedule. The Contractor is responsible for irrigating the above mentioned plant material for a period of no less then (6) six months after the start of the maintenance period. Watering truck shall place a "Watering in Progress" warning sign a minimum of 400 ft. away and a maximum of 2,000 ft. away from the watering truck. There shall be a "Watering in Progress" sign placed at the beginning of that day's work area. Cones shall be used to divert traffic away from the lane the watering truck occupies.

430.5.8 Hydro Seeding:

The Contractor shall Hydro seed with the indicated seed mix the areas indicated by the plans or special provisions. The various seed is to be mixed thoroughly and spread evenly throughout the designated area. Seed shall be broadcast at a rate equal to the amount shown on the plans or as specified. Water truck irrigation shall not be used for hydro seeded areas.

430.5.8.1 Seed Mixture:

Deliver seed packaged with identification of mixtures, weights, analysis and source.

Protect from moisture, heat and sunlight until application.

Do not soak seed in hydro seeder tank for more than 20 minutes before application.

Provide seed mixture as shown on the landscape plans or as specified.

Application rates of seed as specified are for pure live seed (PLS).

Seed source shall be from elevations below 3,000 feet.

Deliver in sealed undamaged containers labeled in accordance with Arizona Revised Statutes and the U.S. Department of Agriculture regulations under the Federal Seed Act. Labels shall indicate the variety of strain of seed, the percentage of germination, purity and weed content, and the date of analysis which shall not be more than nine months prior to the delivery date.

Weed content shall not exceed 0.5%.

Seed that has become wet, moldy, or otherwise contaminated or damaged is not acceptable.

430.5.8.2 Seeding Materials and Equipment:

Wood pulp or similar organic material suitable for application with mulch blower equipment shall be applied at the rate of 1,500 pounds per acre.

Binder: Free flowing, non-corrosive powder produced from natural plant gum.

Chemical fertilizer: Ammonium phosphate (16-20-0) standard commercial grade, suitable for application with standard equipment shall be applied at the rate of 300 lbs. per acre. Ammonium phosphate shall have the minimum analysis and in the physical form of 16-20-0. The first number shall represent minimum percent soluble nitrogen; the second, the minimum percent available phosphoric acid; and the third, the minimum percent water soluble potash. Furnish in sealed containers labeled with name, weight and guaranteed analysis of contents.

Seeding equipment: Standard grass seeding equipment with double disk openers, disk bands, packer wheels or drag chains, rate control adjustments, seed boxes with agitators, and separate boxes for small seed.

Part 400 add the following new Section:

SECTION 432

GRAVEL MULCH

432.1 DESCRIPTION:

The work consists of the preparation of subgrade, placement and water settlement of gravel mulch to the lines and grades shown on the plans.

432.2 MATERIALS:

Gravel and crushed rock shall meet the requirements of Section 701.

Gravel mulch shall consist of a combination of crushed rock and gravel free of debris, fines and soil particles. A minimum of 50 percent by weight shall be crushed rock. Crushed rock shall have at least three fractured faces. A sample of the gravel mulch must be approved by the engineer prior to delivery to the site.

Material durability of gravel mulch shall be tested in accordance with ASTM C-535. The percentage of wear shall not exceed 40 after 500 revolutions.

The gradation shall be within the following limits when tested in accordance with ASTM C-136:

Sieve Size	Percentage by Weight Passing Sieve
3-inch	100
2-inch	25-60
1½-inch	0-15
1-inch	0

432.3 CONSTRUCTION:

432.3.1 Subgrade Preparation: The subgrade surfaces shall conform to the neat lines and grades indicated by the plans. The prepared subgrade surface shall be a loose roughened surface that will keep the gravel mulch in place. This is the normal surface resulting from tillage operations.

The area designated for gravel mulch shall have surface vegetation removed as directed by the Engineer, and the soil loosened. Motorized equipment shall be used where it can be safely operated (generally slopes 3.5:1 or flatter). Areas where equipment cannot safely operate shall be hand-tilled. Rocks larger than 3 inches in diameter, trash, weeds, and other debris shall be removed.

Subgrade preparation shall be discontinued when soil moisture conditions are not suitable for the preparation of a satisfactory subgrade as determined by the Engineer.

Gravel mulch shall not be placed until the subgrade surfaces of both equipment and hand-tilled areas have been inspected and approved by the Engineer.

432.3.2 Placement: Gravel mulch shall only be placed on approved surfaces. The gravel mulch shall be delivered and placed in a manner that will ensure the in-place layer remains reasonably homogeneous. The mulch shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. Hand placing of gravel mulch shall be required to the extent necessary to prevent damage to permanent works. The average thickness of the gravel mulch shall be 3 inches. In no case shall the thickness of the gravel mulch layer be less than 2.5 inches.

The gravel mulch shall be hand raked and smoothed to the satisfaction of the Engineer prior to water spray settling. The application of a uniform spray of water shall be at a rate not exceeding the infiltration rate of the underlying soils to minimize run off. All sprinkling equipment shall be equipped with pressure pumps and spray bars. The use of gravity flow spray bars and splash plates will not be permitted.

432.4 PAYMENT:

Payment for gravel mulch shall be at the contract unit price per square yard. Payment shall be considered full compensation for the item complete-in-place including all labor, materials, equipment, and all other items necessary and incidental to the placement of the gravel mulch. No separate payment will be made for water spray settling.

Part 400 add the following new Section:

SECTION 460

REMOVAL OF PAVEMENT MARKINGS AND RAISED PAVEMENT MARKERS

460.1 DESCRIPTION:

The Contractor shall furnish experienced supervision, labor, all materials, equipment, tools, transportation and supplies required accomplish the pavement marking removal in accordance with these specifications, where indicated on the Striping Plans, or where determined by the Engineer.

460.2 CONSTRUCTION:

The Contractor shall determine the type of pavement markings that exist in the field and the appropriate removal methods specified in this Section.

Existing traffic pavement markings shall not be covered over with slurry seal, black paint or stain of any kind.

The Contractor shall accomplish pavement marking obliteration as per the requirements indicated on the Plans or where determined by the Engineer. The Contractor shall be responsible for verifying the striping removal limits of the project before commencement of the work. The striping removal limits may exceed the construction project limits, or new striping limits in order to match and tie into the existing striping.

Existing pavement markings shall be removed to the fullest extent possible from the pavement by one of the methods identified in this Section, unless another method is approved by the Engineer. The method used shall not materially damage the surface or texture of the pavement.

Material deposited on the pavement as a result of removing pavement markings shall be collected and removed as the work progresses. Accumulations of material, which might interfere with drainage or might constitute adverse safety conditions to traffic, will not be permitted.

Where blast cleaning is used for the removal of pavement markings or for removal of objectionable material, the residue produced shall be removed immediately after contact between the blast material and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Engineer. Blasting shall not be used within 12 ft. of a lane occupied by traffic.

Removed pavement markers and debris resulting from removed markings shall be collected and disposed of by the Contractor.

Any damage to the pavement caused by pavement marking removal shall be repaired by methods acceptable to the Engineer. When asphalt slurry is used to repair damage to the pavement caused by pavement marking removal or the obliteration of the marks remaining after the markings have been removed, the asphalt slurry shall be placed parallel to the new direction of travel and shall not be less than two feet in width.

460.2.1 Approved Methods of Removal: The following methods have been approved by the County for the removal of traffic paint, thermoplastic markings, Type 1 (Permanent) preformed plastic tape, raised pavement markers and barrier/guardrail markers.

460.2.1.1 Traffic Paint:

(1) Water blasting

(2) Turbo-blaster (Steel shot method)

(3) Chip Seal: When using this method, the entire roadway surface, edge of asphalt to edge of asphalt, shall be covered.

(4) Asphalt Overlay: The asphalt overlay thickness and dimensions shall meet County specifications.

460.2.1.2 Thermoplastic:

(1) Grinding followed by water blasting.

(2) Chip Seal: The application of this method depends on the length of time the Thermoplastic Marking has been on the roadway surface. The use of a chip seal before grinding / water blasting is at the discretion of Contractor. If the chip seal does not adhere to the existing thermoplastic markings, the Contractor shall grind and / or water blast the thermoplastic markings off and chip seal the exposed area. All costs for this work shall be borne by the Contractor.

When applying the chip seal method, the entire roadway surface, edge of asphalt to edge of asphalt, shall be covered.

Chip seal shall not be applied to a Portland cement surface.

(3) Asphalt Overlay: The asphalt overlay thickness and dimensions shall meet the County specifications.

460.2.1.3 Type I - Preformed Plastic Pavement Marking Tape:

(1) Grinding

(2) Chip Seal: The application of this method depends on the length of time the Tape has been on the roadway surface. The use a chip seal before grinding is at the discretion of Contractor. If the chip seal does not adhere to the existing tape markings, Contractor shall grind off the tape markings and chip seal over the exposed area. All costs for this work shall be borne by the Contractor.

When applying chip seal, the entire roadway surface, edge of asphalt to edge of asphalt, shall be covered

Chip seal shall not be applied to a Portland cement surface

(3) Asphalt Overlay: The asphalt overlay thickness and dimensions shall meet the County specifications

460.2.1.4 Raised Pavement Markers:

(1) Hammer and Chisel

(2) Blade (Use of Heavy Duty Equipment)

460.2.1.5 Barrier Markers for Bridges, Concrete and Guardrail:

(1) Hammer and Chisel

460.3 MEASUREMENT:

Measurement for removing painted stripe, removing thermoplastic stripe and Type 1 – preformed plastic marking tape will be by the linear foot along the centerline of the pavement stripe to be removed. Skips in dashed lines will not be included in the measurement. Measurement for removing striping with a plan width greater or less than the basic 4" wide stripe will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Foot}}{\text{4.0 (inches)}}$$

Double marking lines, consisting of two 4" wide stripes will be measured as two individual marking lines. Crosswalk lines, stop bars, stop lines, gore lines, cross hatch lines, chevron lines and railroad marking transverse lines will be measured for centerline length and adjusted for widths other than 4" as defined above.

Thermoplastic pavement symbols and legends will be measured by each unit removed.

Measurement for the removal of raised pavement markers and barrier markers for bridges, concrete, and guardrail will be by the unit for each marker removed.

460.4 PAYMENT:

Payment for Removing Painted Stripe will be at the unit contract price per linear foot for the length of painted line applied to the nearest foot.

Payment for Removing Painted Symbols and Removing Painted Legends will be per each for each symbol or legend removed.

Payment for Removing Thermoplastic Stripe and Removing Type 1 – Preformed Plastic Marking Tape will be per linear foot of striping removed.

Payment for Removing Raised Pavement Markers and for Removing Barrier Markers for Bridges, Concrete and Guardrail will be per each marker removed.

All damage to the surface of the road caused by pavement marking removal shall be repaired by the Contractor at his expense.

Part 400 add the following new Section:

SECTION 461

PAINTED PAVEMENT MARKINGS

461.1 Description:

The work under this section shall consist of cleaning and preparing the pavement surface, furnishing all materials, experienced supervision, labor, equipment, tools, transportation, supplies and applying white or yellow, water-borne, lead-free, rapid-dry traffic paint and reflective glass beads at the locations and in accordance with the details shown on the plans, MUTCD, the requirements of these specifications, or where determined by the Engineer.

461.2 Materials:

461.2.1 Pavement Marking Paint:

(A) General:

All material used in the formulation of the pavement marking paint shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

Certificates of Compliance conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction 2000 edition, section 106-05 shall be submitted for each lot or batch of paint prior to its use.

(B) Composition Requirements:

The pavement marking paint shall be a ready-mixed, one component, water-borne lead-free traffic line paint, of the correct color, to be applied to either asphaltic or Portland cement concrete pavement. The composition of the paint shall be a cross link polymer emulsion equivalent to or better than PervoPlastic™ 6050 Series, acceptability of proposed equivalency to be determined by the Engineer. The marking paint shall be a pigmented water-borne paint containing all the necessary co-solvents, dispersant, wetting agents, preservatives and all other additives, so that the paint shall retain its

viscosity, stability and all of the properties as specified herein. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, ethylene-based glycol ethers and their acetates, and not any carcinogen, as defined in 29 CFR 1910.1200. Lead content shall not exceed 0.06 percent of weight of the dry film, and the test for chromium content shall be negative.

No glass beads will be allowed in the pavement marking paint. Glass beads will be applied after the paint has been applied.

(C) Manufacturing Formulations:

The manufacturer shall formulate the pavement marking paint in a consistent manner and notify the Engineer of any change of formulation. The formulation of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to formulate paint which will meet the quantitative and qualitative requirements of this specification. Any change in the formulation of the paint must be approved by the Engineer.

(D) Quantitative Requirements of Mixed Paints:

	White	**Yellow**
Pigment: percent by weight, ASTM D 3723, allowable variation from qualifying sample	± 2.0	± 2.0
Non-volatile Content: percent by weight, ASTM D 2369, allowable variation from qualifying sample	± 2.0	± 2.0
Viscosity: Krebs Units at 77° ± 1°F, ASTM D 562	80 - 95	80 - 95
Weight per Gallon pounds per gallon at 77° ± 1°F, ASTM D 1475P, allowable variation from qualifying sample	± 0.3	± 0.3
Vehicle Composition: Vehicle Infrared Spectra, ASTM D 2621, allowable variation from qualifying sample	None	None
pH: ASTM E 70, allowable variation from qualifying sample	± 1.0	± 1.0
Fineness of Dispersion: HEGMAN, minimum, ASTM D 1210	3.0	3.0

Volatile Organic Compounds: pounds per gallon of paint, maximum, ASTM D 3960 according to 7.1.2.	2.1	2.1
Flash Point: °F, minimum, ASTM D 93, Method A	100	100
Dry Time to No Pick Up: with no beads, minutes, maximum ASTM D 711	10	10
Dry Through Time: minutes, ASTM D 1640 except no thumb pressure is used when thumb is rotated 90 degrees on paint film	20	20
Flexibility: TT-P-1952D	Pass	Pass

(E) Qualitative Requirements:

(1) Color of Yellow Paint:

The color of the yellow paint shall closely match Federal Standard 595b, Color No. 33538. The color shall be checked visually, and will be checked against Tristimulus Values for the color according to Federal Test Method Standard No. 141.

(2) Dry Opacity:

Dry opacity for the paint will be determined using a black-white Leneta Chart, Form 2C Opacity and a Photovolt 577 Reflectance Meter or equal. Using a 10-mil gap doctor blade, a film of paint is drawn down, covering both black and white portions of the chart. The film shall be allowed to dry 24 hours. After calibrating the Reflectance Meter according to the manufacturer's instructions, measure the reflectance over the white and black portions with the green Tristimulus filter. Dry Opacity is calculated as follows:

$$\text{Dry Opacity} = \frac{\text{Reflectance over black}}{\text{Reflectance over white}}$$

Dry Opacity for both white and yellow paint shall be a minimum 0.90.

(3) Yellowness Index:

Yellowness Index for white paint will be determined as described for dry opacity, only use a 15-mil gap doctor blade to draw down the paint. After 24 hours for drying, measure the reflectance of the paint film, using the green, blue, and amber Tristimulus filters. Calculate the Yellowness Index as follows:

$$\text{Yellowness Index} = \frac{\text{Amber} - \text{Blue}}{\text{Green}} \times 100$$

Yellowness Index for the white paint shall be a maximum of 10.

(4) Reflectance:

Reflectance for both white and yellow paint will be determined using the same 15-mil drawdown film as for the Yellowness Index. For white paint the same sample may be used for both the Yellowness Index and Reflectance. Measure the reflectance of the paint film using the green Tristimulus filter. Reflectance for the white paint shall be a minimum of 85. Reflectance for the yellow paint may range from 42 to 59, inclusive.

(5) UV Color Durability:

UV Color Durability shall be determined using a QUV Weatherometer, with Ultra Violet Light and Condensate Exposure according to ASTM G 53, for 300 hours total. The repeating cycle shall be four hours UV exposure at 60 °C followed by four hours condensate exposure at 40 °C. After 300 hours of exposure, the Yellowness Index for white paint shall not exceed 12, and yellow paint must still match Federal Standard 595b, Color No. 33538.

(6) Static Heat Stability:

To determine static heat stability for the paint, place one pint of paint in a sealed can and heat in an air circulation oven at 120° ±1° F for a period of one week. Remove the paint from the oven and check the viscosity in Krebs Units at 77° ±1° F according to ASTM D 562. The viscosity measured must be in the range from 68 to 90, inclusive. Also, check for any signs of instability.

(7) Heat-Shear Stability:

To determine heat-shear stability for the paint, one pint of the paint is sheared in a Waring Blender at high speed to 150° F. The blender should have a tight fitting lid taped onto it to minimize volatile loss. When the paint reaches 150° F, stop the blender, immediately pour the paint into a sample can, and apply a cover to seal the can. Let the paint cool overnight and examine for jelling or other signs of instability. Measure viscosity in Krebs Units at 77° ±1° F according to ASTM D 562. The viscosity measured must be in the range from 68 to 95 inclusive. If not within the upper limit, run total solids on the sheared paint and adjust solids, if necessary, by adding water to reach the original solids content. If the solids content required adjustment, again check the viscosity of the paint. The viscosity must be in the range from 68 to 95 inclusive.

(8) Scrub Resistance:

Scrub Resistance will be determined according to ASTM D 2486. Use an appropriate doctor blade to provide a dry film thickness of 3 to 4 mils. Allow the paint to cure for 24 hours. Perform the scrub resistance test at 77° ±1° F and 50 ± five percent humidity. Record the number of cycles to remove the paint film. The number of cycles recorded must be a minimum of 800.

(9) Spraying Properties:

The paint shall be applied at a 15-mil wet film thickness in the field. The paint shall show the following properties at ambient temperatures of 50° to 100° F with a paint spray temperature of 150° F, maximum, and 6 to 8 pounds of post-applied glass beads per gallon of paint. Beads shall conform to Section 461.2.2.

(a) Dry to a no-track condition in five minutes or less when the line is crossed over in a passing maneuver with a standard-sized automobile.

(b) Produce a clean-cut, smooth line with no overspray or puddling.

(c) Paint immediately after application shall accept glass beads so that the spheres shall be embedded into the paint film to a depth of 50 percent of their diameter.

(d) Paint when heated to the temperature necessary to obtain the specified dry time, shall show no evidence of instability such as viscosity increase, jelling, or poor spray application.

(10) Freeze-Thaw Properties:

The paint viscosity or consistency shall not change significantly when the paint is tested for resistance to five cycles of freeze-thaw according to ASTM D 2243.

(11) Road Service Rating:

Test stripes of the paint shall be applied transversely across the road, 4" in width and approximately 12 ft. long at a location approved by the Engineer.

Wet film thickness of the test stripes shall be approximately 15-mils as determined according to ASTM D 4414 and ASTM D 713 prior to test stripe application. To aid in obtaining the correct film thickness, a length of roofing paper placed by the side of the road can be used. Place a rigid metal test panel on the roofing paper in the path of a test line. Immediately after the test line is applied by the striper, measure the wet film thickness. If not satisfactory, adjust the spray pressure and repeat until the target wet film thickness is attained. It is important that no glass beads be present that would give a false wet film thickness. When the wet film thickness is correct, apply a test line across a tarred metal test panel. After this, apply another test line across a different

tarred metal test panel, this time also adding the beads. These samples are necessary to determine the initial bead retention.

Glass beads conforming to the requirements of Section 461.2.2 shall be applied after the paint has been applied, but during the same striping operation at a rate such that the initial bead retention on the test line is a minimum of 6 pounds of beads per gallon of wet paint. The initial bead retention will be determined analytically by MCDOT concurrently with the determination of the dry paint thickness utilizing tarred metal test panels. The paint shall accept the glass beads so that the spheres are embedded into the paint film to a depth of 50 percent of their diameter. Test stripes will be observed for a period of 180 days from date of application. Paints will be evaluated for wear according to ASTM D 913.

After 180 days of service, on a visual rating scale of 0 to 100 percent, paints must have a rating of 92 percent or better to be acceptable. All ratings will be taken in the wheel track area. Glass beads shall show no more than a 30 percent loss after 180 days of test. This will be determined by taking close-up photographs of the paint film and by count determining the average bead loss.

The road service test may be waived at the option of the Engineer or evaluated for a period of time less than 180 days.

(12) Workmanship:

Paint shall be free from foreign materials, such as dirt, sand, fibers from bags, or other material capable of clogging screens, valves, pumps, and other equipment used in a paint striping apparatus.

The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container, and shall not become granular or curdled. Any settlement of pigment in the paint shall result in a thoroughly wetted, soft mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sidewise manual motion of a paddle across the bottom of the container, to form a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement as described above or due to any other cause, the paint shall be considered unfit for use.

The paint shall retain all specified properties under normal storage conditions for 12 months after acceptance and delivery. The Contractor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The properties of any replacement paint, as specified herein, shall remain satisfactory for eight months from the date of acceptance and delivery.

(F) Manufacturing Requirements:

(1) Inspection:

The manufacturer of the paint shall advise the Engineer when paint is to be manufactured, shall furnish the Engineer free access to all parts of the plant involved in the paint manufacture, and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacturing.

All materials used in formulation shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

All manufactured paint shall be prepared at the factory ready for application.

When paint is shipped to a distributor or paint applicator who will store the paint prior to its use, the distributor or paint applicator shall furnish the Engineer free access to all parts of the facility where paint is stored and shall furnish every reasonable facility for sampling the paint.

Paint shall normally be sampled at the place of storage either at a warehouse or on the site prior to application of the paint. Application of the paint will not be permitted until the paint has been approved by the Engineer. It is the Contractor's responsibility to notify the Engineer a minimum of 14 working days prior to any traffic painting operation and to allow access at that time for paint sampling at the storage location.

A minimum of one paint sample shall be obtained from each lot of paint.

Check-samples of finished paint while being applied will be taken at intervals as determined by the Engineer.

(2) Testing:

All tests will be conducted in accordance with the latest test methods of the American Society for Testing and Materials, Federal Test Method Standard No. 141, and methods in use by the Materials Group, Highways Division, and the Arizona Department of Transportation as specified herein.

Evidence of adulteration or improper formulation shall be cause for rejection.

(3) Packaging:

All shipping containers for paint must comply with the Department of Transportation Code of Federal Regulations, Hazardous Materials and Regulation Board, Reference 49 CFR. The container and lids must be lined with a suitable coating so as to prevent attack by the paint or by agents in the air space above the paint. The lining must not come off the container or lid as skins.

Containers shall be colored white, including lids, and containers shall have an identifying band of the appropriate color around and within the top one third of the container.

All containers shall be properly sealed with suitable gaskets, shall show no evidence of leakage, and shall remain in satisfactory condition for a period of 12 months after delivery to a distributor or paint applicator. The Contractor shall be responsible for all costs and transportation charges incurred in replacing paint and containers.

(4) Marking:

All containers of paint shall be labeled showing the manufacturer's name, date of manufacture, paint color, product code, manufacturer's batch number, and quantity or weight of paint on both the side of the container and also the lid. Containers shall be clearly marked or labeled Rapid or Fast Dry lead-free Water-Borne Traffic Paints.

All containers of paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of Arizona, Maricopa County.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are toxic, corrosive, flammable, etc., as outlined in the U.S. Department of Transportation, Hazardous Materials Regulations, Reference 49 CFR.

(5) Unused Paint:

Disposal of unused quantities of traffic paint shall be the responsibility of the Contractor and must meet all applicable Federal regulations for waste disposal. Paint which is saved to be used later shall be packaged as specified previously and shipped to a storage location. Unused paint must be identified on the container. Unused paint may be used on a future project provided the paint still conforms to all specifications contained herein.

461.2.2 Reflective Glass Beads (Spheres):

(A) General:

The term "glass bead" shall be synonymous with the term "glass sphere" as used herein.

The beads shall be manufactured from glass of a composition designated to be highly resistant to traffic wear and to the effects of weathering.

The glass beads shall be moisture-proof; contain less than 0.25 percent moisture by

weight; and be free of trash, dirt, or other deleterious materials.

Beads shall be essentially free of sharp angular particles showing milkiness or surface scoring or scratching. Beads shall be water white in color.

(B) Physical Requirements:

(1) Gradation:

When tested by the method provided in ASTM D 1214, the grade sizes of the beads shall be as follows:

Size of Sieve	Percent Passing
No. 30	100
No. 50	15 - 35
No. 70	0 - 15
No. 100	0 - 5

(2) Roundness:

When tested by the method provided in ASTM D 1155 (Procedure B except paragraphs (F) and (G) are deleted), beads retained on any screen specified in the gradation requirements shall contain a minimum of 75 percent true spheres.

(3) Index of Refraction:

When tested by a liquid immersion method at a temperature of 25 °C, the beads shall have an index of refraction of 1.50 to 1.57.

(4) Specific Gravity:

The specific gravity of the beads shall be in the range 2.40-2.60 when tested in accordance with the following procedures:

Place 100 grams in an oven at 110 °C for one hour.

Remove beads and place in a desiccator until the sample is cool.

Remove approximately 60 grams of beads from the desiccator and weigh the sample accurately.

Pour the beads slowly into a clean 100-milliliter graduated cylinder containing 50 milliliters of isopropyl alcohol. Make certain that air is not entrapped among the beads.

The total volume, minus 50, will give the volume of the beads.

Calculate the specific gravity as follows:

$$\text{Specific Gravity} = \frac{\text{Weight of the sample}}{\text{Volume of the sample}}$$

(5) Chemical Stability:

Beads which show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids, or alkalis or paint film constituents, may be required to demonstrate satisfactory reflectance behavior, prior to acceptance, under such tests as may be prescribed.

(C) Moisture Proofing:

All glass beads shall have a moisture-proof overlay consisting of water repellent material applied during the process of bead manufacture. The beads so treated shall not absorb moisture in storage and shall remain free of clusters and lumps and shall flow freely from dispensing and testing equipment.

The beads shall pass the test for water repellency and free flow using the following equipment:

(1) Test bag:

The bag used is approximately 10½" by 17½" after sewing. The material used in the construction of the bag is unbleached cotton sheeting with a thread count of 48 by 48. The material before sewing is approximately 18" by 22". The cloth is folded in half lengthwise and stitched in the shape of an "L" with the short side left open at the top. The material can be obtained from selected manufacturers of cloth and paper packaging. The finished bag may also be obtained from the manufacturer of the glass beads.

Newly fabricated bags must be thoroughly washed with hot water and detergent and rinsed before use to remove the sizing which may be present in the cloth. Subsequent to the initial washing, the bags need only be rinsed clean of beads from previous tests and dried thoroughly before use.

(2) Funnel:

The funnel used is a standard laboratory funnel with a top opening diameter of 125 millimeters and a 150-millimeter stem length. The inside diameter of the stem is between nine and 10 millimeters. This funnel is available from most laboratory

glassware supply houses, Corning No. 6100 or equal.

(3) Ring Stand and Clamp.

(4) Balance accurate to 0.1 grams.

(5) Distilled water.

MOISTURE TESTING PROCEDURE:

Glass beads shall be tested for compliance with specification requirements. Testing shall be conducted at standard conditions of temperature (25 ± one degrees Celsius) and humidity (50 ± five percent Relative Humidity) and shall consist of the following procedure or an approved alternate:

Weigh 900.0 grams of glass beads into a clean, dry, flat-bottomed pan.

Dry beads at 150 °C for two hours.

Cool beads to room temperature (25 ± one degrees Celsius) in a desiccator.

Using the clean, pre-washed bag described under apparatus section, turn the bag inside out so that the sewn seam and seam-allowance are on the outside.

Quantitatively transfer the beads into the inverted cotton bag.

Grasp the gathered top of the bag with one hand and lower the bag into a container of distilled water until the beads are approximately 25 millimeters below the water level. The container shall be of such dimensions that the bag does not contact the bottom or sides during immersion. Each bag shall be immersed individually. Do not allow one bag to contact another if multiple tests are run.

Remove the bag after 30 seconds of immersion time.

Cradle the bottom of the bag uniformly in the palm of one hand and twist the top neck of the bag until the twisted bag is compressed firmly against the beads. Twist until excess water no longer drips from the bag.

After the excess water has been squeezed from the bag, allow the bag to unwind.

Gather the top of the bag and clamp. Suspend the bag on a ring stand or other support such that the bottom or sides of bag do not contact the support.

After a standing time of two hours at room temperature (25 ± one degrees Celsius), remove bag from support. Mix sample thoroughly by holding the

bottom seam allowance in one hand and gathered neck of the bag in the other, invert bag and shake up and down five times. Transfer the sample into a clean, dry funnel of the type described under apparatus. If consecutive tests are run, be sure the funnel is clean, dry and free of beads from prior tests.

The entire sample shall flow through the funnel without stoppage.

At the start of the test only, it is permissible to lightly tap the stem of the funnel to initiate flow.

Small quantities of beads which have adhered to the side of the funnel or stem shall not be cause for failure.

461.3 Construction Requirements

461.3.1 Equipment: The traffic paint and beads shall be placed on the pavement by a spray-type, self-propelled pavement marking machine except that temporary striping during construction may be placed with other equipment designed for application of paint and beads with the approval of the Engineer.

The application equipment to be used on roadway installation shall have, as a minimum, the following characteristic and/or apparatus:

The machine shall be capable of applying clear-cut lines of the width specified on the project plans.

The machines shall be equipped with a mechanical device capable of placing a broken reflectorized line with a 10 foot painted segment and a 30-foot gap.

The machine shall be equipped with an air-operated glass bead drop-in dispenser controlled by the spray gun mechanism.

A glass bead dispenser which is capable of placing the glass beads into the paint line as the paint is applied to the pavement shall be used. This dispenser shall provide satisfactory marking and delineation.

461.3.2 Application

(A) Pavement Surface

Pavement markings shall not be applied to any new asphalt pavement surface within the first 72 hours after pavement placement or after the placement of a surface treatment. Pavement markings shall be applied when the pavement surface is dry and the weather is not foggy, rainy, or otherwise adverse to the application of markings. The surface shall be free from excess asphalt or other deleterious substances before

traffic paint, beads or primer are applied. The Contractor shall remove dirt, debris, grease, oil, rocks or chips from the pavement surface before applying markings. Any area that cannot otherwise be satisfactorily cleaned shall be scrubbed with a biodegradable chemical. The method of cleaning the pavement surface and removal of detrimental material is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray.

(B) Temperature Conditions:

Painting shall not be performed when the atmospheric temperature is below 50° F when using water-borne paint, nor when it can be anticipated that the atmospheric temperature will drop below said 50° F temperature during the drying period. Water-borne paints shall not be applied if rain is expected within one hour of its application, unless otherwise approved by the Engineer. Water-borne paint shall not be heated to a temperature greater than 150° F to accelerate drying.

(C) Placement Locations:

The placing of traffic markings shall be done only by personnel who are experienced in this work. Pavement markings shall be positioned as defined on the plans and in the specifications. When it becomes necessary for proper installation, the Engineer may revise individual marking locations as necessary.

When the use of temporary chip seal pavement markers have been approved for use they shall be augmented by spot marks. Temporary chip seal pavement markers shall be collected and disposed of by the Contractor prior to the final inspection.

The Contractor shall spot mark the entire project at 10-foot intervals in conformance with the striping plans. Removal of existing pavement markings shall be completed prior to the spot marking. Upon completion of the spot marking, the Contractor shall notify the Engineer that the project is ready for inspection. County will conduct an inspection after the spot marking is completed, within three working days from notification of Contractor.

Approval of the spot marking shall not relieve the Contractor from obtaining a final inspection. Upon final inspection, if the Engineer decides that more than one coat is required, it will be done at the Contractor's expense.

The final striping inspection will be made by the Engineer within three working days after all pavement markings and markers have been installed.

The Striping in the field may exceed the construction project limits in order to match and/or tie into the existing striping. Contractor shall perform a field inspection and determine if the striping exceeds the construction project limits.

If a conflict exists between actual field conditions and the pavement marking plans, the Contractor shall cease work and notify the Engineer immediately.

(D) Paint Application

The Contractor shall provide the necessary personnel and equipment to divert traffic from the installation area where the work is in progress and during drying time when, in the opinion of the Engineer, such diversion of traffic is necessary.

The volume of paint in place shall be determined by measuring the paint tank with a calibrated rod. At the option of the Engineer, if the striping machine is equipped with air-atomized spray units (not airless) and paint gauges, the volume of paint may be determined by utilizing said gauges.

The quantity of glass reflectorizing beads in place shall be determined by measuring the glass reflectorizing bead tank with a calibrated rod.

The paint shall not bleed, curl, or discolor when being applied to the roadway surface. If bleeding, curling or discoloration occurs, the unsatisfactory areas shall be given additional coats of paint to correct the problem. In the event that the additional coats are not sufficient, the Engineer will determine what method of correction may be used. Such corrections will be at the Contractor's expense.

The paint shall not be applied over the decorative design in the median.

If a seal is required, sufficient drying time, minimum forty-eight (48) hours, shall be allowed before applying any pavement markings.

After the forty-eight (48) hour drying time has passed and the seal remains tacky, or excessive oil has risen to the roadway surface, a sand blotter shall be applied to absorb the excess oil. If the seal remains tacky, no pavement markings shall be applied.

If a sand blotter is applied after the installation of pavement markings, then all markings affected shall be removed and re-applied at the Contractor's expense.

(E) Tolerances for Placing Paint, Beads, and Primer:

The length of painted segment and gap shall not vary more than 6 inches in a 40-foot cycle.

The finished line shall be smooth, aesthetically acceptable and free from undue waviness.

Painted lines shall be 4.0", 8.0", or 12.0" wide as shown on the plans with a tolerance of plus or minus 1/8 inch and shall be placed at a minimum rate of 16 gallons per mile for a solid 4.0 inch line and 4 gallons for a broken 4.0 inch line, based on a 10 foot stripe and a 30 foot gap (40 foot cycle).

New pavement striping shall not vary more than ½ inch in 50 feet from the striping plans. Existing pavement markings requiring re-stripe shall be re-striped to completely cover existing markings within ¼ inch and be within a longitudinal tolerance of 6 inches at the beginning and at the end of each stripe.

Glass reflectorizing beads shall be applied on the wet paint at a minimum rate of 6 lbs. to each gallon of paint.

Wet thickness shall not be less than 15 mils.

461.4 Measurement:

Pavement marking paint will be measured by the linear foot along the centerline of the pavement stripe. Skips in dashed lines will not be included in the measurement. Length of pavement markings will be based on 4-inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or requested by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Feet}}{\text{4 (inches)}}$$

Symbols, legends, painted medians, painted curbing, and painted islands will be measured by each unit applied. Each legend, regardless of the number of letters, will be considered as a single unit.

No separate measurement will be made for cleaning and preparing the pavement surface, including abrasive sweeping and high-pressure air spray. The cost of disposal of excess materials, cleaning fluids, and empty material containers, will be considered as included in contract items

461.5 Payment:

Pavement striping of the type specified, measured as provided above, will be paid for at the contract price per linear foot for the total length of painted line applied to the nearest foot, which price shall be full compensation for the work complete, including cleaning and preparing the pavement surface and glass beads, as described and specified herein and on the project Plans.

Pavement symbols, legends, painted medians, painted curbing, and painted islands measured as provided above, will be paid for at the contract price for each painted symbol or legend, which price shall be full compensation for the work complete, including cleaning and preparing the pavement surface, and glass beads, as described and specified herein and on the project Plans.

Part 400 add the following new Section:

SECTION 462

THERMOPLASTIC PAVEMENT MARKINGS

462.1 DESCRIPTION:

The work under this section shall consist of cleaning and preparing pavement surfaces and furnishing and applying either white or yellow hot-sprayed thermoplastic reflectorized stripes or pavement markings to the prepared pavement at the locations and in accordance with the details shown on the project plans and the requirements of these specifications and the Special Provisions.

Screed or extrusion application of thermoplastic may be allowed, if approved by the Engineer, for short application work such as intersections.

The Contractor shall furnish all materials, supervision, labor, equipment, tools, transportation and supplies required to complete the work according to the striping plans, these specifications and the Special Provisions.

462.2 MATERIALS:

462.2.1 General Requirements: The thermoplastic reflectorized material shall consist of a solid mixture of heat-stable resins, white or yellow pigment, inter-mixed glass beads, filler, and other materials in granular or block form specifically compounded for reflectorized pavement markings to be applied to the pavement in a molten state. The characteristics of the liquefied material shall be such that complete and even coverage of specified areas to the required thickness is provided by the required application method and rate. Upon cooling to normal pavement temperature, this material shall produce an adherent reflectorized marking capable of resisting deformation and wear in the roadway.

Certificates of Compliance conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for each lot or batch of thermoplastic reflectorized material prior to its use.

Only thermoplastic materials currently shown on the Arizona Department of Transportation's Approved Products List shall be used. The current Approved Products List is available from the Engineering Records Office, 1655 West Jackson, Phoenix, AZ 85007, Phone (602) 255-8216.

462.2.2 Composition: The thermoplastic composition shall conform to the following requirements:

	Percent by Weight	
	White	**Yellow**
Binder	18 - 26	18 - 26
Titanium dioxide	8 - 15	-----
Basic lead chromate	-----	4 - 10
Reflective glass spheres	30 - 40	30 - 40
Calcium carbonate or equivalent filler	20 - 40	25 - 45

The ingredients of the thermoplastic composition shall be thoroughly mixed and in a free flowing granular form. The material shall readily melt into a uniform mixture and be free from all skins, dirt, foreign objects or any other ingredient which would cause bleeding, staining or discoloration when applied to the bituminous or concrete pavement.

The thermoplastic shall be one of the following two types based on the binder composition:

Hydrocarbon: Shall consist mainly of synthetic petroleum hydrocarbon resins with appropriate fillers and pigments.

Alkyd: Shall consist mainly of maleic modified glycerol ester of tall oil resin for the binder.

(A) Reflective Glass Beads: In addition to incorporating glass beads in the thermoplastic mix, glass beads shall be applied to the surface of the molten material at a uniform minimum rate of 10 pounds of glass beads per 100 square feet of line (300 feet of 4-inch stripe).

(B) Filler: The filler shall be a white calcium carbonate or equivalent filler with a compressive strength of at least 5.0 ksi.

(C) Titanium Dioxide: Titanium Dioxide shall conform to the requirements of ASTM D 476 for Type II (92 percent).

(D) Lead Chromate Pigment: The lead chromate pigment shall be silica encapsulated heat resistant lead chromate pigment.

462.2.3 Physical Characteristics of the Composition:

(A) General Requirements: The thermoplastic material shall not exude fumes which are toxic, injurious, or require specialized breathing apparatus when heated to the temperature range specified by the manufacturer for

application. The material shall remain stable when held for four hours at this temperature, or when subjected to four reheatings, not exceeding a total of four hours, after cooling to ambient temperature. The temperature viscosity characteristics of the plastic material shall remain constant throughout the reheatings and shall show like characteristics from batch to batch. There shall be no obvious change in color of the thermoplastic material as a result of reheating, and the color of the material shall not vary from batch to batch.

(B) Color: The thermoplastic material, after heating for four hours ± five minutes at 425° F ± 3° F and cooled to 77° F ± 3° F, shall meet the following:

White: Daylight reflectance at 45 degrees - 0 degrees shall be 75 percent minimum.

The color shall match Federal Test Standard Number 595, Color Chip No. 17925.

Yellow: Daylight reflectance at 45 degrees - 0 degrees shall be 45 percent minimum.

The color shall match Federal Test Standard Number 595, Color Chip No. 13538.

(C) Retroreflectance: The white and yellow thermoplastic materials shall have the following minimum retroreflectance values at 86.5 degrees illumination angle and 1.5 degrees observation angle as measured by a Mirolux 212 portable retroreflectometer 30 days after application to the roadway surface:

Product	Retroreflectance (Millicandelas)
White	200
Yellow	150

(D) Water Absorption and Specific Gravity: The thermoplastic material shall not exceed 0.5 percent by weight of retained water when tested in accordance with the requirements of ASTM D 570.

The specific gravity of the material, as determined by Section 11 of AASHTO T 250, shall be between 1.85 and 2.3.

(E) Bond Strength: After heating the thermoplastic material for four hours ± five minutes at 425° F ± 3° F, the bond strength to Portland cement concrete shall be not less than 0.18 ksi. The bond strength shall be determined in accordance with the procedures specified in Section 7 of AASHTO T 250.

(F) **Cracking Resistance at Low Temperature:** After heating the thermoplastic material for four hours ± five minutes at 425° F ± 3° F, applying to concrete blocks, and cooling to 15° F ± 3° F, the material shall show no cracks when observed from a distance exceeding 1 foot. Testing for low temperature crack resistance shall be in accordance with the procedures specified in Section 8 of AASHTO T 250.

(G) **Impact Resistance:** After heating the thermoplastic material for four hours ± five minutes at 425° F ± 3° F and forming test specimens, the impact resistance shall be not less than 10 inch-pounds when tested in accordance with Section 9 of AASHTO T 250.

(H) **Softening Point:** After heating the thermoplastic material for four hours ± five minutes at 425° F ± 3° F and testing in accordance with ASTM D 36, the thermoplastic materials shall have a softening point of 215° F ± 15° F.

(I) **Flowability:** After heating the thermoplastic material for four hours ± five minutes at 425° F ± 3° F, and testing for flowability in accordance with Section 6 of AASHTO T 250, the white thermoplastic shall have a maximum percent residue of 18 and the yellow thermoplastic shall have maximum percent residue of 21.

(J) **Yellowness Index:** The white thermoplastic material shall not exceed a yellowness index of 0.12 when tested in accordance with Section 4 of AASHTO T 250.

(K) **Flowability (Extended Heating):** After heating the thermoplastic material for eight ± one-half hours at 425° F ± 3° F, with stirring the last six hours, and testing for flowability in accordance with Section 12 of AASHTO T 250, the thermoplastic shall have a maximum percent residue of 28.

(L) **Abrasion Resistance:** The abrasion resistance of the thermoplastic material shall be determined by forming a representative lot of the material at a thickness of 1/8 inch on a 4" by 4" square monel panel (thickness 0.05 inch ± 0.001 inch), on which a suitable primer has been previously applied, and subjecting it to 200 revolutions on a Taber Abraser at 77° F, using H-22 calibrated wheels weighted to 0.55 lbs. The wearing surface shall be kept wet with distilled water throughout the test.

The maximum loss of thermoplastic material shall be 0.0011 lbs.

(M) **Flash Point:** The thermoplastic material shall have a flash point not less than 475° F when tested in accordance with the requirements of ASTM D 92.

(N) **Storage Life:** The materials shall meet the requirements of this specification for a period of one year from the date of manufacture. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for this one-year period. Any material which does not meet the above requirements, or which is no longer within this one year period at the time of application, shall be replaced by the Contractor at no additional cost to the County

(O) **Primer Sealer:** Primer Sealers for use on Portland cement concrete or hot mix asphaltic concrete surfaces prior to application of the thermoplastic material shall be either as recommended by the thermoplastic material manufacturer or especially compounded for use with the specified thermoplastic material.

462.2.4 Physical Requirements for Glass Beads: Inter-mix and drop-on reflective glass beads shall conform to the requirements of Section 461.2.2, except as noted herein.

The inter-mix beads shall conform to AASHTO M 247-81 (1986), type I, and may be coated or uncoated as recommended by the manufacturer. If uncoated beads are used, the thermoplastic formulation shall be configured to minimize settling of the intermix beads when the material is heated and applied.

462.3 CONSTRUCTION REQUIREMENTS:

462.3.1 Equipment: The equipment used to install hot applied thermoplastic material shall be constructed to provide continuous uniform heating to temperatures exceeding 400°F while mixing and agitating the material. The heating mechanism of the kettle shall be equipped with a heat transfer medium consisting of oil or air. The burner flame shall not directly contact the material vessel surface. The mixing and agitating mechanism shall be capable of thoroughly mixing the material at a rate which ensures constant uniform temperature distribution. The kettle shall be equipped with two temperature gauges: one to indicate the temperature of the oil or air heat transfer medium, and the other to indicate the temperature of the thermoplastic material. The kettle shall also be equipped with an automatic thermostatic control device that allows for positive temperature control to prevent overheating or underheating of the material.

The conveying portion of the equipment, between the main material reservoir and the line dispensing device, shall be configured to prevent accumulation. All parts of the equipment which will come in contact with the material shall be constructed for easy accessibility for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the line dispensing device, will maintain the material at the plastic temperature. The use of pans, aprons or similar appliances which the dispenser overruns will not be permitted. The equipment shall provide for varying traffic marking application widths.

All melting and application equipment shall have functioning and calibrated temperature sensing devices to verify that temperature requirements are being met. Upon request of the Engineer, the Contractor shall provide proof that the temperature sensing devices and verification thermometers are fully functional.

The application equipment to be used on roadway installations shall consist of either truck-mounted units, motorized ride-on equipment or manually pushed equipment, depending on the type of marking required. The truck-mounted or motorized ride-on units for center lines, lane lines and edge lines shall consist of a mobile self-contained unit carrying its own material capable of operating at a minimum speed of five miles per hour while applying striping. The hand applicator equipment shall be longitudinally and transversely.

The application equipment to be used on roadway long line installations shall consist of either truck-mounted units or motorized ride-on equipment. The truck-mounted or motorized ride-on units used for center lines, lane lines, gore lines, and edge lines shall consist of a mobile self-contained unit carrying its own material capable of operating at a minimum speed of five miles per hour while applying striping, and shall be sufficiently maneuverable to install curved and straight lines, both longitudinally and transversely.

The truck shall be equipped with high pressure air spray jets in front of the pavement marking material applicators to remove loose matter from the pavement surface where the marking material is to be applied.

Hand applicator equipment, to be used for all other roadway installations, shall be either self-contained melter application units or reservoir application units that are filled from a separate melter unit. Both types of units shall be equipped to maintain and measure the required application temperatures. The hand applicator equipment shall be sufficiently maneuverable to install symbols and legends, and curved and straight lines, both longitudinally and transversely.

The application equipment shall be so constructed as to assure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off square stripe ends and shall provide a method of applying "skip" lines. The equipment shall be constructed so as to provide varying widths of traffic markings. The application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment operator shall be located in such a position as to enable full visibility of the striping apparatus.

A glass bead top dressing shall be applied to the completed thermoplastic stripe by an automatic glass bead dispenser attached to the striping machine in such a manner that the beads are applied to the molten thermoplastic material immediately after it has been applied. The bead dispenser shall use pressure type spray guns which will embed the beads into the stripe surface to at least one-half of the bead diameter. The bead dispenser shall be equipped with an automatic cut-off synchronized with the cut-off of the thermoplastic material.

A special kettle shall be provided for uniformly melting and heating the thermoplastic material. The kettle must be equipped with an automatic thermostat control device and material thermometer for positive temperature control to prevent overheating or underheating of the material.

The heating kettle and application equipment shall meet the requirements of the National Fire Underwriters and the National Fire Protection Association and of the state and local authorities. Thermoplastic melting units, trucks or trailers, shall be equipped with foam-type fire extinguishers suitable for application to thermoplastic material that is at the flash point.
If screed or extrusion application of thermoplastic is allowed by the Engineer for short applications, the screed/extrusion application method shall be used wherein one side of the shaping die is the pavement and the other three sides are contained by equipment suitable for heating or controlling the flow of material. The equipment shall form an extruded line which shall be uniform in shape having clear and sharp dimensions.

For handliner applications, a gravity bead dispenser may be allowed by the Engineer if it properly gauges and dispenses the correct amount of glass spheres.

462.3.2 Application:

(A) Placement:

Thermoplastic pavement markings shall not be applied to any new asphalt pavement surface within the first 72 hours after pavement placement or after the placement of a surface treatment. During hot weather if the Engineer determines that the asphalt surface is prone to tracking, the Engineer may direct the contractor to provide painted pavement markings complying with section 462.

Thermoplastic pavement markings shall not be applied to any new asphalt-rubber pavement surface within the first 30-days after pavement placement. Temporary painted markings complying with Section 461 may be used prior to placement of the thermoplastic markings.

Pavement markings shall be positioned as defined on the plans and in the specifications. The Engineer may revise individual marking locations as necessary.

When the use of temporary chip seal pavement markers have been approved for use they shall be augmented by spot marks. Temporary chip seal pavement markers shall be collected and disposed of by the Contractor prior to the final inspection.

The Contractor shall spot mark the entire project at 10-foot intervals in conformance with the striping plans. Upon completion of the spot marking, the Contractor shall notify the Engineer that the project is ready for inspection. County will conduct an inspection after the spot marking is completed, within three working days from notification of Contractor.

Approval of the spot marking shall not relieve the Contractor from obtaining a final inspection. Upon final inspection, if the Engineer decides that more than one coat is required, it will be done at the Contractor's expense.

The final striping inspection will be made by the Engineer within three working days after all pavement markings and markers have been installed.

The Striping in the field may exceed the construction project limits in order to match and tie into the existing striping. Contractor shall perform a field inspection and determine if the striping exceeds the construction project limits.

If a conflict exists between actual field conditions and the pavement marking plans, the Contractor shall cease work and notify the Engineer immediately.

(B) Materials Selection and Compatibility:

All thermoplastic material, drop-on glass beads, and primer-sealer will be inspected and approved by the Engineer prior to their application. The Contractor shall also provide samples of said materials if requested by the Engineer.

All materials shall be properly packaged and stored. Each container to be used on the project shall be clearly labeled to indicate the following information:

- Nature, type, and formulation of the material, including whether it is an alkyd or hydrocarbon;
- Manufacturer, batch number, and date of manufacture;
- Application requirements and constraints; and
- Compatibility requirements and constraints, particularly those pertaining to equipment, storage, and other materials to be used.

Preparation and application equipment shall be in accordance with the plans and specifications, and shall conform to the recommendations of the materials manufacturer.

Incompatible materials shall not be used together. The Contractor shall not combine alkyd and hydrocarbon materials in preparation or application equipment. The Contractor shall completely clean preparation and application equipment when materials are changed.

The Contractor shall dispose of excess materials, cleaning fluids, and all empty material containers at a site in conformance with the state and federal requirements.

(C) Equipment Inspections and Deficiencies

The Contractor shall make daily maintenance and operation inspections of all application equipment to ensure that it is operable within the requirements of the specifications. The Contractor shall inform the Engineer of any equipment breakdowns, intermittent malfunctions, or other conditions that may impact the proper application of specified markings. Any equipment judged to be unsuitable by the Engineer shall be repaired or replaced.

(D) Pavement Surface

The Contractor shall remove all dirt, grease, oil or other detrimental material from the road surface prior to application of the thermoplastic stripes, arrows, legends or symbols. Any area that cannot be satisfactorily cleaned shall be scrubbed with a biodegradable chemical called Citrus Solv Plus or approved equal.

The method of cleaning the surface is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. The method of surface preparation shall also be in accordance with the recommendations of the thermoplastic material manufacturer. Loose material including all grindings and obliterated markings shall be removed from the pavement surface and disposed of properly.

When thermoplastic markings are to be applied to new Portland cement concrete pavement, any curing compound present shall be removed by means of a high-pressure water jet followed by sweeping and high-pressure air spray. The curing compound shall be removed at least two inches beyond the entire perimeter of each marking to be installed.

At the time of application of primer-sealer and thermoplastics, the road surface shall be absolutely dry with no detectable or measurable surface or near-surface dampness. If precipitation or other surface wetting is imminent, all marking operations shall be stopped. If any surface dampness is detected during marking activities, marking operations shall be stopped until the pavement dries. If the hot-applied thermoplastic marking blisters upon application, marking operations shall be stopped until the cause, potentially including subsurface moisture, is determined and corrected.

(E) Primer Application

On both old and new Portland cement concrete pavement, a primer-sealer shall be used if recommended by the thermoplastic manufacturer. The primer-sealer shall be applied at the manufacturer's recommended application rates prior to placing the thermoplastic material. The primer-sealer shall be allowed to set up for the manufacturer's specified cure or evaporation time, and shall be free of solvent and water when the thermoplastic is applied.

The thermoplastic material shall be applied to primed pavement surfaces within the working time specified by the primer-sealer and thermoplastic materials manufacturers. If the primed surfaces are not marked within these time limits, the Contractor shall re-prime the surfaces as required by the manufacturer at no additional cost to the Department. If an epoxy primer is used, the thermoplastic application shall be completed before the epoxy has cured.

Improper primer-sealer application may result in bond failure between the thermoplastic and the pavement surface and may cause the thermoplastic surface to pinhole or blister. Should these conditions occur, all application operations shall stop until the cause is determined and corrected. All such defective markings shall be removed and replaced at no additional cost to the Department.

(F) Pavement Temperatures

The air and road surface temperature at the time of application shall not be less than 55°F, and the pavement surface shall be absolutely dry. If at any time during marking operations the air or pavement temperature falls below these requirements, all marking operations shall stop. To insure optimum adhesion, the thermoplastic material shall be installed in a melted state at a temperature from 400° F to 440° F.

The Contractor shall measure pavement surface temperatures one half hour prior to the start of the striping installation activities and as deemed necessary by the Engineer until the end of the application period. For elevation changes greater than 1000 feet temperature readings at the highest elevation shall govern unless otherwise requested by the Engineer. The lowest temperature so measured shall govern, unless otherwise requested by the Engineer. The temperature measurements shall be recorded in a log book and provided to the Engineer when required. The pavement surface temperature shall be measured with a standard surface temperature thermometer or a non-contact infrared thermometer.

(G) Thermoplastic Application

The thermoplastic pavement marking material shall be extruded or sprayed on to the pavement surface at a material temperature between 400° F and 440° F, depending on manufacturer's recommendations, ambient air and pavement temperatures, and the nature of the pavement surface. The Contractor shall verify temperature requirements with a non-contact infrared thermometer where determined by the Engineer.

The alkyd and hydrocarbon thermoplastic material temperatures shall not exceed 450°F. Material temperatures exceeding 440° F shall be allowed for short periods of time; however, in no case shall the material be held for more than four hours at temperatures above 440° F. Total heating time for any batch of material shall not exceed six hours. The Contractor shall note in the temperature log the time when each batch of thermoplastic material is first heated. The start of heating time shall also be marked on the side of the kettle to which it applies.

Specified temperature requirements shall be maintained at all times during application. The Contractor shall monitor material temperature at thirty-minute intervals, unless otherwise requested by the Engineer, and maintain a log of temperature readings taken. Readings shall be taken at the melting kettle or the application outlet point, as determined by the Engineer.

The Contractor shall minimize the thermoplastic material remaining in the kettle at the end of the work day and shall blend a minimum of 80 percent fresh material the start of each day. During project delays, the Contractor may transfer heated thermoplastic material into approved containers for later re-use, subject to specified limits on total acceptable heating time for each batch.

Drop-on glass beads shall be mechanically deposited, at the specified rate, into the thermoplastic material immediately after the thermoplastic marking is applied. The bead dispenser shall evenly distribute the beads such that they embed in the surface of the thermoplastic to a depth of between 50 and 60 percent of the bead diameter. If the glass beads do not adhere to the thermoplastic marking, operations shall be stopped until the problem has been corrected. All markings which do not meet the requirements of Section 461.2.3(C), as determined by the Engineer, shall be removed by the Contractor and replaced at no additional cost to the Department.

Unless otherwise specified, thermoplastic pavement markings crosswalks, stop bars, railroad markings, chevrons, hatching, legends, symbols and arrows shall be installed at a thickness of 90 mils. Longitudinal markings, such as lane lines, edge lines, centerlines, taper lines, and holding bars shall be installed at a thickness of 60 mils. The thermoplastic thickness shall be uniform and consistent throughout the total length of the marking project. Thermoplastic markings shall not be used for bike lane markings.

The Contractor shall perform periodic spot checks of thermoplastic material to verify that the required thickness has been attained. Random spot checks of the thermoplastic thickness will be made by the Engineer to ensure conformance with the required criteria. Suggested spot check procedures include the following:

Wet: Thickness can be field tested immediately after the thermoplastic marking is applied by inserting a thin, graduated machinist rule or similar instrument into the molten thermoplastic to the depth of the pavement surface. The thickness is then determined visually by noting on the scale the depth of the penetration or coating of the instrument.

Dried: Thickness can be field tested by placing a small flat sheet of metal with a known thickness immediately ahead of the striping apparatus. After striping, remove the sample and use a suitable measuring device, such as a caliper or micrometer, to determine the thickness of the dried marking.

Longitudinal lines shall be offset at least 12 inches clear from construction joints unless otherwise requested by the Engineer.

The finished thermoplastic line shall have well defined edges and be free from waviness. Lateral deviation of the thermoplastic stripe shall not exceed 1.0 inches in 100 feet. The longitudinal deviation of a painted segment and gap shall not vary more than 6 inches in a 40-foot cycle. The actual width of stripe shall be within the limits specified in the following table, according to the width of stripe called for on the plans:

Plan Width	Actual Width
4 inches	4 to 4½ inches
8 inches	8 to 9 inches
Over 8 inches	± 1.0 inches

If a preservative or fog seal is required, sufficient drying time, minimum of forty-eight (48) hours, shall be allowed before applying any pavement markings.

After the forty-eight (48) hour drying time has passed and the seal remains tacky, or excessive oil has risen to the roadway surface, a sand blotter shall be applied to absorb the excess oil. The Contractor shall sweep the roadway surface free of sand prior to pavement marking applications.

If a seal or blotter is applied after the installation of thermoplastic pavement markings, any pavement markings affected by the seal or blotter shall be removed and re-applied at the Contractor's expense.

After application and sufficient drying time, the thermoplastic marking shall show no appreciable deformation or discoloration under local traffic conditions in an air and/or road temperature ranging from -10° F to 180° F. The drying time shall be defined as the minimum elapsed time, after application, when the thermoplastic pavement markings shall have and shall retain the characteristics required herein and after which normal traffic will leave no impression or imprint on the newly applied marking. When applied at a temperature range of 412.5° F ± 12.5° F and thickness of 60 to 90 mils, the material shall set to bear traffic in not more than two minutes when the air and road surface temperature is approximately 50° F ± 3° F, and not more than ten minutes when the air and road surface temperature is approximately 90° F ± 3° F. The Engineer may conduct field tests in accordance with ASTM D 711 to verify actual drying times.

The thermoplastic shall not be applied over the decorative design in the median.

462.4 MEASUREMENT:

Thermoplastic pavement markings, longitudinal and transverse lines, such as edge lines, lane lines, gore lines, cross-walks and stop bars, will be measured by the linear

foot along the center line of the pavement stripe and will be based on a 4 inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or requested by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Feet}}{\text{4 (inches)}}$$

No measurement will be made of the number of linear feet of skips in the dashed line.

Double marking lines, consisting of two 4-inch wide stripes will be measured as two individual marking lines. Crosswalk lines, stop bars, stop lines, gore lines, cross hatch lines, chevron lines and railroad marking transverse lines will be measured for centerline length and adjusted for widths other than 4 inches as defined above.

Thermoplastic pavement symbols and legends will be measured by each unit applied. Each pavement symbol and each legend, as shown on the Plans, will be considered a unit.

No separate measurement will be made for cleaning and preparing the pavement surface, including abrasive sweeping and high-pressure air spray. The cost of disposal of excess material, cleaning fluids, and empty material containers will be considered as included in the contract items.

Removal of curing compound from new Portland cement concrete pavement and the application of primer-sealer, which is to be applied to both old and new Portland cement concrete pavement, prior to application of thermoplastic striping or marking, shall be measured by the linear foot or unit each, respectively, depending on the nature of the work to be done, and in accordance with the items of work established in the contract fee schedule.

462.5 PAYMENT:

The accepted quantities of thermoplastic pavement markings of the type specified, measured as provided above, will be paid for at the contract unit price, complete in place, including pavement surface preparation and glass beads.

The accepted quantities for removal of curing compound from new Portland cement concrete pavement and the application of primer-sealer, measured as provided above, will be paid for at the contract unit price.

Pavement marking stripes, including surface preparation, will be paid for at the contract unit price complete in place for the total length of painted lines applied rounded to the nearest foot. If the Engineer determines that additional striping beyond the project limits is required to tie into and meet the existing striping, then this striping will be paid for at the contract unit price for the total length of lines applied.

Part 400 add the following new Section:

SECTION 463

RAISED PAVEMENT MARKERS

463.1 DESCRIPTION:

The work under this section shall consist of cleaning and preparing the pavement surface; furnishing all materials, equipment, tools and labor; and placing raised pavement markers of the type specified at the locations and in accordance with the details shown on the plans and the requirements of these specifications.

463.2 MATERIALS:

463.2.1 General: Certificates of Compliance for raised pavement markers and adhesive conforming to the Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05, shall be submitted to the Engineer at least 10 days prior to use. A minimum of one sample per lot per type of marker shall be made available to the Engineer for compliance testing.

The base of the pavement markers shall be free from glass glaze or from substances which may reduce its bond to the adhesive. The base shall be flat and it's deviation from a flat surface shall not exceed 0.05 inches.

463.2.2 Reflective Pavement Markers: Reflective markers shall be non-adhesive with an adhesive surface. Pavement markers shall be both wet and dry retro-reflective, impact resistant, abrasion resistant, water resistant and have molded-in body colors.

Reflective pavement markers shall be of the following type:

Type D	Yellow, two-way
Type G	Clear, one-way
Type H	Yellow, one-way
Type BB	Blue, two-way

Reflective pavement markers shall be of the prismatic reflector type consisting of a polycarbonate body and a polycarbonate lens with built-in micro-cube corners. The lens shall have a protective hard-coat.

The exterior surface of the shell shall be smooth and shall contain one or two prismatic reflector faces of the color specified.

When illuminated by an automobile headlight, the color of the reflectors shall be an approved clear or yellow as designated. Reflectors not meeting the required color may be rejected.

Permanent reflective pavement markers will be tested for compressive strength, abrasion resistance and specific intensity. Permanent reflective pavement markers shall have thin untempered glass or other abrasion resistant material bonded to the prismatic reflector face to provide an extremely hard and durable, abrasive resistant reflector surface.

The area covered by the glass, or other abrasion resistant surface, shall not be less than (3) three square inches.

The strength by compressive loading shall be at least 2,000 lbs. for both permanent and temporary reflective pavement markers.

The original specific intensity of each reflecting surface for both temporary and permanent reflective markers shall not be less than the following:

Reflectance	Specific Intensity: candelas/foot-candle		
	Clear	Yellow	Red
0 Degrees Incidence	3.0	1.8	0.75
20 Degrees Incidence	1.2	0.72	0.30

Permanent reflective pavement markers shall be subject to an abrasion resistance test as follows:

Steel Wool Abrasion Procedure: Form a 1.0 inch diameter flat pad using No. 3 coarse steel wool per Federal Specification FF-W1825. Place the steel wool pad on the reflector lens face. Apply a force of 50 lbs. and rub the entire lens surface 100 times. After the lens surface has been abraded, the specific intensity of each clear and yellow reflective surface shall be not less than that required above for the original specific intensity.

463.2.3 Non-Reflective Pavement Markers and Reflectorized Dagmars:
Non-reflective pavement markers shall be, Type A - white

Reflectorized Dagmars shall be of the following types:

Type J	white
Type JY	yellow

Non-reflective pavement markers and reflectorized dagmars shall consist of a heat-fired, vitreous ceramic base and a heat-fired, opaque glazed surface which will produce the required properties. Markers shall be produced from any suitable

combination of intimately mixed clays, shales, flints, feldspars, or other inorganic material which will meet the properties herein required. Markers shall be thoroughly and evenly matured and free from defects which will affect appearance or serviceability.

The top surface of the marker shall be in reasonably close conformity with the configuration shown on the plans. Markers shall be convex and the radius of curvature shall be between 3.5 inches and 6.0 inches, except that the radius of the ½ inch nearest the edge may be less. All edges shall be rounded and any change in curvature shall be gradual. The top and sides shall be smooth and free of mold marks, pits, indentations, air bubbles, or other objectionable marks or discolorations.

Non-reflective pavement markers and dagmars shall meet the following requirements:

Glaze Thickness, minimum, inches	0.005
Moh Hardness, minimum	6
Directional Reflectance (White Only), minimum Glazed Surface Body of Marker	 75 70
Yellowness Index (White Only), maximum Glazed Surface Body of Marker	 0.07 0.12
Color (Yellow Only) Purity, percent, range Dominant Wave Length, mu, range Total Lummous Reflectance (Y valve), minimum	 75 - 96 579 - 585 0.41
Compressive Strength, pounds, minimum	1,500
Water Absorption, percent, maximum	2.0
Autoclave	Glaze shall not spall, craze or peel

Reflectorized dagmars shall have encapsulated lens reflectors conforming to standard manufacturing practices.

463.2.4 Bituminous Adhesive:

Crafco, Incorporated
6975 West Crafco Way
Chandler, Arizona 85226

Materials by manufacturers other than the above listed may be used when approved by the Engineer prior to use.

463.3 CONSTRUCTION REQUIREMENTS:

Raised pavement markers shall be installed after the permanent pavement striping has been completed and approved.

The portion of the highway to which the markers are to be attached shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers and any other material which could adversely affect the bond of the adhesive. The pavement must be clean and dry. If rainfall or other pavement wetting event occurs, the pavement shall be allowed to dry for at least twenty-four (24) hours before proceeding with the installation of markers.

Markers shall not be placed on asphalt that is cracking or showing signs of failure.

Chip Seal surfaces shall be swept of excess aggregate and open to traffic for 30 days prior to installation of the markers. Markers shall not be installed on chip seal surfaces with large, void spaces and/or loose aggregate with a weak bond to the underlying road surface.

Slurry Seal and Fog Seal surfaces shall be allowed to cure at least twenty-four (24) hours prior to placement of the markers. Excess sand applied to soak up surface emulsions must be swept clean prior to installation of the markers.

The method of cleaning the pavement surface and removal of detrimental material is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. On Portland cement concrete pavement and old asphalt concrete pavements, cleaning shall be accomplished by water blasting, followed by sweeping and/or air blowing. Newly placed asphalt concrete pavement need not be water blasted unless, in the opinion of the Engineer, the surface is contaminated with materials that would adversely affect the bond of the adhesive.

The adhesive shall be placed uniformly on the cleaned pavement surface in an amount sufficient to result in complete coverage of the area of contact of the markers, with no voids present and with a slight excess after the markers have been placed. The markers shall be placed in position and pressure applied until firm contact is made with the pavement. The markers shall be protected against impact until the adhesive has set to the degree acceptable to the Engineer.

Excess adhesive on the pavement and on the exposed surfaces of the markers shall be immediately removed. Thinners or solvents which may be detrimental to either the markers or the bond provided by the adhesive shall not be used in removing excess adhesive.

Markers shall not be installed when the temperature of the pavement surface or the atmosphere is less than 40° F, when the relative humidity is 80 percent or higher or

when the pavement surface is not dry.

All markers shall be installed to the line approved by the Engineer and in such manner that the reflective face of the markers is perpendicular to a line parallel to the roadway centerline. No pavement markers shall be installed over longitudinal or transverse joints of the pavement surface.

463.4 MEASUREMENT:

Pavement markers will be measured as a unit for each marker furnished and placed.

463.5 PAYMENT:

The accepted quantities of pavement markers, measured as provided above, will be paid for at the contract unit price for the type designated, complete in place, including adhesive and surface preparation.

Part 400 add the following new Section:

SECTION 464

ROADSIDE SIGN SUPPORTS

464.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing square perforated tube sign post, U-channel sign post, and foundations.

Sign post and foundations shall conform to the requirements of MCDOT Standard Details.

464.2 MATERIALS

464.2.1 General: Certificates of Analysis conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for all square perforated tube sign posts and U-channel sign posts.

Excessive damage to the finish of the posts during shipping, handling, or installation will result in rejection of the damaged posts.

464.2.2 Perforated Sign Posts: Single and telescoping perforated posts shall be square tube fabricated from 0.105 inch cold-rolled sheet carbon steel conforming to the requirements of ASTM A 366/A 366M. Posts shall be welded directly in the corner by high frequency resistance welding or equal. The outside edges of the posts shall be

externally scarfed to agree with standard corner radii of 5/32 inch ± 1/64 inch. Bolts, nuts and washers shall conform to the requirements of ASTM A 307, Grade A.

Perforated posts shall be galvanized after fabrication in accordance with the requirements of ASTM A 525M, Coating Designation 275. Bolts, nuts and washers shall be zinc coated in accordance with the requirements of ASTM A 153 or cadmium plated in accordance with the requirements of ASTM B 766.

The diameter of holes on perforated sign post shall be 7/16 inch ±1/64 inch on 1.0 inch centers, on four opposite sides for the entire length of the post. Holes shall be on the centerline of each side on true alignment and opposite to each other. All material cuts must be centered between hole patterns and at a 90-degree angle to the length of material.

The finished sign posts shall be straight and have a smooth uniform finish. All consecutive sizes of posts shall be freely telescoping for not less than 120 inches of their length without the necessity of matching any particular face to any other face.

464.2.3 U-Channel Sign Posts: U-channel sign post shall be used for temporary signing only.

U-channel posts shall be fabricated from rerolled rail steel conforming to the requirements of ASTM A 499 or hot-rolled carbon steel bars.

Prior to rerolling the rail steel, the rail nominal weight shall be 91 pounds per yard and shall meet the requirements of ASTM A 1 pertaining to quality assurance.

Yield Point of the steel shall be 80,000 psi minimum.

The cast heat analysis of the steel shall conform to the following requirements:

Element	Composition (Percent)
Carbon	0.67 - 0.82
Manganese	0.70 - 1.10
Phosphorus, max.	0.04
Sulphur, max.	0.05
Silicon	0.10 - 0.25

Posts shall be a uniform, modified, flanged channel section as shown in MCDOT Standard Detail 2059. Weight of the posts shall be 2.00 lbs. per lineal foot, plus or minus five percent. The post shall be punched with continuous 3/8-inch diameter holes on 1.0-inch centers. The first hole shall be 1.0 inches from top and bottom of post.

The post shall consist of two parts, a sign post and a base post. The sign post lengths shall be supplied in 6-inch increments up to 12.0 feet as required for the installation location. The base posts shall be 3.5 feet in length, pointed at one end, and have at least eighteen holes in the base post, starting 1.0 inches from the top and continuing at 1.0-inch increments.

Posts shall be machine straightened to have a smooth uniform finish, free from defects. All holes and edges shall be free from burrs. Permissible tolerance for straightness shall be within 1/16 inch in 36 inches.

Posts shall be galvanized after fabrication in accordance with the requirements of ASTM A 123. Bolts, nuts, washers and spacers shall be cadmium plated in accordance with the requirements of ASTM B 766 or zinc plated in accordance with the requirements of ASTM B 633.

U-channel base posts shall be driven into the ground to a minimum depth of 36 inches.

464.2.4 Concrete: Concrete for perforated sign post foundations shall be Class B in accordance with Section 725.

464.3 CONSTRUCTION REQUIREMENTS:

Foundations for perforated sign posts and U-channel posts shall be constructed to the details and dimensions shown on the plans.

Sign posts shall be erected plumb.

464.4 MEASUREMENT:

Perforated sign posts and U-channel sign posts shall be measured by the foot, to the nearest inch for each post furnished and installed. The total length of all posts of the same type will be rounded to the nearest foot. Telescoping post members will be considered as one post after installation and will not be measured separately. The length of perforated sign post will be measured from the top of the concrete post foundation to the top of the post. The length of U-channel sign posts shall not include the U-channel base post.

Perforated sign post foundations shall be measured by the unit each.

U-channel base post installations shall be measured by the unit each.

464.5 PAYMENT:

The accepted quantities of perforated sign posts, U-channel sign posts, perforated sign post foundations, and U-channel base post installations measured as provided above, will be paid for at the contract unit prices.

The contract unit prices paid shall include full compensation for furnishing all labor, excavation, materials, tools, equipment and incidentals, and for doing all the work involved in constructing foundations, furnishing and erecting the sign posts including galvanizing and furnishing all metal plates and hardware, as shown on the plans and as specified herein, complete in place.

Part 400 add the following new Section:

SECTION 465

SIGN PANELS

465.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing sign panels in accordance with the details shown on the plans and the requirements set forth herein.

465.2 MATERIALS:

465.2.1 General: Certificates of Compliance conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for all materials, including reflective sheeting, required for fabricating sign panels.

Shipment, storage, and handling of sign panels shall conform to the recommendations of the manufacturers of the sign panel components. Fabricated signs and overlay sheets shall be shipped on edge. Damage to the sign panel or legend resulting from banding, crating or stacking shall be cause for rejection of the signs.

465.2.2 Flat Sheet Aluminum Sign Panels with Direct Applied or Silk Screened Characters: Panels shall be fabricated from 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209M.

Panel facing shall be prepared and covered with retroreflective sheeting in accordance with the recommendations of the sheeting manufacturer. Color and type of sheeting shall be as specified or shown on the plans.

All surfaces not covered shall be etched to reduce glare from reflected sunlight.

The retroreflective sheeting and color shall conform to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction 2008 edition, section 1007. Splicing of retroreflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including 4 feet.

Messages on these sign panels shall be reflectorized white or, if called for in the plans, opaque black and produced by silk screening or direct applied characters or lettering.

465.2.3 Reflective Sheeting: Panels to be installed on Roadside Sign Supports shall be fabricated from flat sheet aluminum and shall be reflectorized as specified herein.

All surfaces of panels to be covered with retroreflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer.

(A) WARNING SIGNS:

Warning signs shall be reflectorized with yellow retroreflective High Intensity Prismatic grade sheeting or as specified by the Traffic Engineer. The following will be the exceptions to this rule:

1. Stop Ahead symbol signs (W3-1a), Yield Ahead symbol signs (W3-2a), No Passing Zone pennant signs (W14-3), and Advanced Railroad Crossings signs (W10-1) shall be reflectorized with yellow Diamond grade retroreflective sheeting.
2. School Advanced Warning signs and supplemental plaques and School Crosswalk Warning Assembly signs shall be reflectorized with fluorescent yellow-green Diamond grade retroreflective sheeting.

(B) REGULATORY SIGNS:

Regulatory signs shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting or as specified by the Traffic Engineer.

Reflectorized red signs shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting. The red color shall be produced by silk screening.

Regulatory signs with reflectorized red circles and slashes shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting as background. The red color shall be produced by silk screening.

All Stop Signs (R1-1), 4-Way plaques (R1-3), 3-Way plaques (R1-3a), All-Way plaques (R1-4), and Cross Traffic Does Not Stop signs (W16-1) shall be reflectorized with red/white/yellow Diamond grade retroreflective sheeting.

(C) ROUTE MARKERS:

Interstate route markers shall be cut to shape. The colors and legend shall conform to the plans and shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting. The Interstate route colors shall be silk screened and the hue of the colors shall be within the limits established for the Interstate Route Marker sign color standards. The numerals may be silk screened or direct applied characters.
United States, State Route, and Cardinal Direction markers shall be reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting unless otherwise shown on the project plans.

(D) STREET NAME SIGNS:

All Street Name Signs shall be manufactured with ASTM D-4956-04 Type IV Sheeting (3M 3930 series or equivalent) attached to the standard signage aluminum plates. Street Name sign imaging shall consist of an acrylic based electronic cuttable film (3M 1170 Series or equivalent) or silk screened with standard highway colors (High Intensity Prismatic).

Street Name Signs shall be reflectorized with green or blue retroreflective High Intensity Prismatic grade sheeting as background. The characters shall be direct applied lettering reflectorized with silver-white retroreflective High Intensity Prismatic grade sheeting or as requested by the Traffic Engineer. Street Name Signs fabrication and installation shall conform to the requirements of MCDOT Standard Detail 2054-1 and 2054-2.

(E) METRO STREET NAME SIGNS:

Metro Street Name Sign panels shall be reflectorized with green retroreflective Diamond grade sheeting as background. The characters shall be direct applied lettering reflectorized with silver-white retroreflective Diamond grade sheeting or as requested by the Traffic Engineer. Metro Street Name Signs fabrication and installation shall conform to the requirements of MCDOT Standard Detail 4780. Internally illuminated Metro Street Name Signs shall comply with project special provision sections 470 and 477.

465.2.4 Silk Screened and Direct Applied Characters: Silk screened letters, numerals, arrows, symbols, and borders, shall be applied on the retroreflective sheeting background of the sign by direct or reverse screen process. Messages and borders of a color darker than the background shall be applied to the reflective sheeting by direct process. Messages and borders of a color lighter than the sign background shall be produced by the reverse screen process.

Opaque or transparent colors, inks, and paints used in the screen process shall be of the type and quality recommended by the manufacturer of the retroreflective sheeting.

The screening shall be performed in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use.

Signs after screening shall be air dried or baked in accordance with the manufacturer's recommendations to provide a smooth hard finish. Any signs on which blisters appear during the drying process will be rejected.

Direct Applied letters, numerals, symbols, borders, and other features of the sign message shall be cut from black opaque or retroreflective sheeting of the color specified and applied to the retroreflective sheeting of the sign background in accordance with the

instructions of the manufacturer of the retroreflective sheeting and shall be applied by heat activation of the adhesive.

Retroreflective sheeting shall meet or exceed the minimum Specific Intensity Per Unit Area (SIA) requirements of AASHTO M 268.

465.3 CONSTRUCTION REQUIREMENTS:

465.3.1 Fabrication: Fabrication of the sign panels shall be in accordance with the details shown on the project plans and the requirements of these specifications. Panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication. Sign panel colors, lettering, and symbols shall be in accordance with requirements established by the Manual of Uniform Traffic Control Devices (MUTCD).

Fabricated signs and overlay sheets shall be stored indoors and kept dry during storage. If packaged signs become wet, all packaging material shall be removed immediately and the signs allowed to dry. The signs may be repackaged using new dry materials. If outdoor storage is necessary, all packaging materials shall be removed. Signs shall be stored on edge, above ground, in an area where dirt and water will not contact the sign face. Materials used to support stored signs shall not contact sign faces.

465.3.2 Installation of Sign Panels: The sign panels shall be installed on roadside sign supports in accordance with the details shown on the plans.

Minor scratches and abrasions resulting from fabrication, shipping and installation of panels may be patched; however, patching shall be limited to one patch per 54 square feet of sign area with the total patched area being less than five percent of the sign area. Panels requiring more patching than the specified limit will be rejected. Patches shall be edge sealed by a method approved by the retroreflective sheeting manufacturer.

The face of bolts on the panel face shall be anodized or painted to match the background or legend color in which they are placed. The zinc coated or cadmium plated washers on the panel face shall be the color of, or shall be painted to match, the background or legend color in which they are placed. The sign manufacturer's name and date of installation shall be placed on the back of each sign in black, one-inch block letters. Use of felt markers for this purpose will not be permitted. Bolts shall be tightened from the back by holding the bolt head stationary on the face of the panel. Twisting of the bolt head on the panel face shall not be allowed.

465.3.3 Permanent Road Closures using Type III Barricades: Permanent Type III barricades shall be installed in accordance with MCDOT Standard Details 2057 Series as deemed appropriate to the field conditions.

465.3.4 Inspection: An inspection of the completely installed sign panels will be made by the Traffic Engineer during the daytime and at night for proper appearance, visibility, color, specular gloss and proper installation.

Each sign panel face shall be cleaned thoroughly just prior to the inspection as recommended by the manufacturer. The cleaning solvent and cleaning material shall in no way scratch, deface or have any adverse effect on the sign panel components.

The Contractor at no additional cost to the County shall correct all apparent defects disclosed by the inspection. If color variations or blemishes between aluminum extruded sign panel increments are visible from a distance of 50 feet either during the day or at night, the panels shall be removed and replaced at the Contractor's expense.

465.4 MEASUREMENT:

Sign panels will be measured by the square foot for each type or types of sign panels furnished and installed. The area of each sign panel, except for warning, regulatory and marker sign panels will be measured per Plans dimensions.

For warning, regulatory and marker sign panels, the area of each sign panel will be measured to the nearest 0.1 square foot. The areas of each rectangular, square or triangular sign panel will be determined from the dimensions shown on the project Plans. The area of irregular shaped signs, such as stop signs and route markers, will be determined by multiplying the maximum height in feet by the maximum width in feet, using the dimensions shown on the project Plans.

The total area of all sign panels of the same type will be rounded to the nearest square foot.

Metro Street Name Sign Installation shall be measured by the unit each for every installed and approved Metro Street Name Sign.

465.5 PAYMENT:

The accepted quantities of each type of sign panel, measured as provided above, will be paid for at the contract unit price.

Payment will be made for the total rounded area of each type of sign panel.

The contract unit price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for performing all the work involved in furnishing and installing the sign panels, except for Metro Street Name Sign panels, complete in place, including furnishing and applying all retroreflective sheeting, all fastening hardware, all necessary sign support accessories, stringers and post ties, all as shown on the plans and as specified.

The contract unit price for Metro Street Name Sign Installation shall be full compensation for furnishing all labor, materials, tools, equipment, fastening hardware, all necessary sign support accessories, stringers, post ties and incidentals, and for performing all the work involved in installing the Metro Street Name Sign panels, complete in place, as shown on the plans and as specified.

Part 400 add the following new Section:

SECTION 470

GENERAL REQUIREMENTS FOR TRAFFIC SIGNAL AND INTERSECTION LIGHTING SYSTEMS

470.1 DESCRIPTION:

It is the purpose of this section to provide general information necessary for completion of the installation of traffic signals and intersection lighting in accordance with the details shown on the Traffic Signal Plan and the MCDOT Details.

All electrical systems and appurtenances shall be complete, functional and in operating condition at the time of acceptance.

470.2 DEFINITIONS:

The words defined in the following section shall for the purpose of these specifications have the meanings ascribed to them pertaining to signals and lighting.

470.2.1 Actuation: The operation of any type of controller initiated by a detector.

470.2.2 Back Plate: A thin metal strip extending outward parallel to the signal face on all sides of a signal housing to provide suitable background for the signal indications.

470.2.3 Controller: That part of the controller assembly, which performs the basic timing and logic functions for the operation of the traffic signal.

470.2.4 Controller Assembly: The complete assembly for controlling the operation of a traffic signal, consisting of a controller unit, and all auxiliary and external equipment housed in a weatherproof cabinet.

470.2.5 Coordinated Traffic Signal System: A group of signals timed together to provide a specific relationship among signal phases.

470.2.6 Cycle: A complete sequence of signal indications.

470.2.7 Detector: A device for indicating the passage or presence of vehicles or pedestrians.

(A) Inductive Loop Detector: A detector capable of sensing the passage or presence of a vehicle by a change in the inductance characteristics of the wire loop.

(B) Magnetometer Vehicle Detector: A detector capable of being actuated by the magnetic disturbance cause by the passage or presence of a vehicle.

(C) Pedestrian Detector: A detector for pedestrians, usually of the push button type.

(D) Video Detector: Video Camera capable of detecting the presence or passage of vehicles or pedestrians.

470.2.8 Flasher: A device used to open and close signal circuits at a repetitive rate.

470.2.9 Flashing Feature: This feature, when operated, discontinues normal signal operation and causes a predetermined combination of flashing signal lights.

470.2.10 Interval: The part or parts of the signal cycle during which signal indications do not change.

470.2.11 Luminaire: The assembly, which houses the light source and controls the light emitted from the light source. Luminaires consist of a housing, lamp socket, reflector and glass globe or refractor when specified.

470.2.12 Manual Operation: The operation of a signal controller unit by means of a hand-operated switch.

470.2.13 Mounting Assembly: The framework and hardware required to mount the signal face(s) and pedestrian signal(s) to the pole.

470.2.14 Pedestrian Signal: A traffic control signal for the exclusive purpose of directing pedestrian traffic at signalized locations.

470.2.15 Pre-timed Controller Assembly: A controller assembly for operating traffic signals in accordance with a predetermined fixed-time cycle.

470.2.16 Red Clearance Interval: A clearance interval, which follows the yellow, change interval during which both the terminating phase and the next right-of-way phase display red.

470.2.17 Signal Face: An assembly controlling traffic in a single direction and consisting of one or more signal sections. Circular and arrow indications may be included in a signal assembly. The signal face assembly shall include back plate and visors.

470.2.18 Signal Indication: The illumination of a signal section or other device, or of a combination of sections or other devices at the same time.

470.2.19 Signal Section: A complete unit for providing a signal indication, consisting of a housing, lens, reflector, lamp receptacle and lamp, or LED unit.

470.2.20 Traffic Phase: A part of the time cycle allotted to any traffic movement or combination of movements receiving the right-of-way during one or more intervals.

470.2.21 Traffic-Actuated Controller Assembly: A controller assembly for operating traffic signals in accordance with the varying demands of traffic as registered with the controller unit by detectors.

470.2.22 Vehicle: Any motor vehicle normally licensed for highway use.

470.2.23 Yellow Change Interval: The first interval following the green right-of-way interval in which the signal indication for the phase is yellow.

470.3 REGULATIONS AND CODES: All electrical equipment shall conform to the current standards of the National Electrical Manufacturers Association (NEMA), National Electric Safety Code (NESC), Underwriters' Laboratory Inc. (UL), when applicable. All material and workmanship shall conform to the requirements of the National Electric Code (NEC), Illumination Engineers Society (IES), Standards of the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), requirements of the Traffic Signal Plan, these specifications, the special provisions, and to any other codes, standards, or ordinances which may apply. Whenever references are made to any of the standards mentioned, the reference shall be interpreted to mean the code, ordinance, or standard that is in effect at the time of the bid advertisement.

470.4 SOURCE OF SUPPLY:

The Contractor shall furnish all traffic signal material and equipment required to complete the work except as noted otherwise.

470.4.1 Quality Requirements: Only materials and equipment conforming to the requirements of these specifications shall be incorporated into the work. Material and equipment shall be new except as may be provided in the special provisions.

Maricopa County Department of Transportation reserves the right to reject proposed traffic signal material or equipment if, in the judgment of the Engineer any or all the following may apply:

1) The equipment does not meet the requirements of the specifications.

2) The material or equipment is not in the best interest of Maricopa County Department of Transportation and the public.

3) The material or equipment past field performance has been unsatisfactory.

4) The material or equipment is not compatible with the material or equipment presently in use, which may cause the need to purchase additional spare parts, provide additional training, and/or long term maintenance problems.

In addition, Maricopa County Department of Transportation reserves the right to pre-approve traffic signal material and equipment by brand name model or part number which in the judgment of the Engineer meets the intended purpose of these specifications. Pre-approved items are posted on MCDOT's Procurement website:
http://www.mcdot.maricopa.gov/procurement/mcdot/aml.pdf
Deviations from the pre-approved materials list, if any, will be listed in the project special provisions or construction plans.

470.4.2 Approval Of Material And Equipment: All traffic signal materials and equipment shall be approved by the Engineer prior to incorporation in the work. Any work in which materials or equipment not previously approved are used shall be

performed at the Contractor's risk and may be considered as unauthorized and unacceptable and not subject to the payment provisions of the contract. Such materials or equipment may be subject to removal at the discretion of the Engineer.

The Contractor shall obtain the Engineer's approval before ordering or installing any material or equipment. The Contractor shall submit four (4) copies of each proposed material and/or equipment list, including shop drawings. Submittal shall be to the County at the pre-construction conference. To be acceptable, the list shall be complete and comprehensive containing all items to be supplied on the project by the Contractor, including pre-approved items. MCDOT reserves the right to reject any incomplete or unclear material submittal. All items on the list shall be identified by manufacturer's part number, model, specification or other pertinent catalogue information. The materials from any catalog cuts shall be clearly indicated by the contractor. One (1) copy will be returned to the Contractor for further action.

All equipment or material specified or shown on signal plans, or other drawings, by brand name, part number, or model number is intended to be descriptive of the type and quality of material or equipment desired. Another equal brand name, part number, or model number may be substituted so long as it is in accordance with these specifications and is equal in form, fit, function, performance, reliability, and is approved by the Engineer.

The contractor shall provide complete wiring diagrams for controller assemblies and auxiliary controller cabinets at the time of delivery for testing. A mylar original and four sets of prints shall be provided with each controller assembly. The wiring diagram shall illustrate all circuits and components in detail. All components shall be identified by name or number so as to be clearly noted in the drawings.

It is the Contractor's responsibility to ensure adequate lead time in ordering signal equipment to prevent project delay. The Contractor shall notify the Engineer in the event signal equipment is not received in a timely manner.

470.4.3 Warranties and Guaranties: In addition to the requirement of Section 108.8 manufacturers warranties and guaranties furnished for material and equipment used in the work, shall be delivered to the Engineer prior to acceptance of the project.

470.5 MARICOPA COUNTY FURNISHED MATERIAL AND EQUIPMENT:

Traffic signal material and equipment furnished by Maricopa County Department of Transportation or tested by Maricopa County Department of Transportation will be made available at the following address:

Maricopa County Department of Transportation Warehouse
Procurement Distribution Center
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

The Contractor shall contact the MCDOT Traffic Signal Supervisor (602) 506-8660 five working days prior to desired pick-up date to confirm the item list, availability, date and time. Warehouse hours for pick-up and delivery are 6:00 am – 2:00 pm Monday

through Thursday. A map of the warehouse loading area will be made available upon request.

The cost of handling and placing all material and equipment, including pick-up by the Contractor is included in the contract price of the associated pay item. The Contractor using the Contractor's equipment shall load the furnished materials (poles, mast arms, etc.) onto the Contractor's vehicle for transportation to the project site. MCDOT personnel shall not load the materials. The Contractor shall be responsible for any damage that occurs during the loading process.

The Contractor will be held responsible for all material and equipment received. The Traffic Signal Supervisor or designee will issue a receipt for the materials provided. All materials will be issued in serviceable condition; the Contractor will note any exceptions on the receipt. The receipt will be placed in the project file and a copy given to the Contractor. The cost to make good any shortages or deficiencies, from any cause whatsoever and for any damage which may occur after receipt will be deducted from any monies due or becoming due to the Contractor.

470.6 REMOVAL AND SALVAGE OF EXISTING FACILITIES:

All removals shall be done in accordance with Section 350, and as shown on the Traffic Signal Plan. Any item noted on the Traffic Signal Plan to be salvaged shall be delivered to the County warehouse or as directed by the Engineer. Delivery to the County warehouse shall include unloading the salvaged materials at a designated warehouse location by the Contractor using the Contractor's own equipment. Two working days (forty-eight hours minimum) in advance of the intended date of delivery, the Contractor shall coordinate the proposed date, time and items to be delivered with the MCDOT Traffic Signal Supervisor (602) 506-8660. Warehouse hours for receiving deliveries are 6:00 am – 2:00 pm Monday through Thursday. The address for the County warehouse is:

Maricopa County Department of Transportation Warehouse
Procurement Distribution Center
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

470.6.1 Measurement: Removal or salvaging of existing facilities will be measured on a unit or lump sum basis as noted on the payment schedule.

470.6.2 Payment: Removal or salvaging of existing facilities, measured as provided above, will be paid for at the contract price, said price shall be full compensation for the removal and delivery of salvaged items and the disposal of removed items not scheduled to be salvaged as specified and shown on the project plans.

470.7 INSTALLATION OF TRAFFIC SIGNALS AND RELATED ITEMS

470.7.1 General: The Contractor shall furnish labor and supervision with experience in the construction of the traffic signals and all materials, equipment, tools, transportation and supplies required to complete the work in an acceptable manner; within the time specified, and in full compliance to these specifications, terms of the contract, the Traffic Signal Plan and special provisions.

The contractor shall have on the work site at all times a competent supervisor capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the construction of traffic signals. Unless waived by the special provisions, the Contractor's supervisor shall possess an International Municipal Signal Association (IMSA) Level II Traffic Signal Electrician Certification.

470.7.2 Traffic Signal Plan: The Traffic Signal Plan graphically describes the location of signal component parts, the equipment and materials to be used, and the standards for construction. The plans shall be supplemented by MCDOT Details or other drawing(s) deemed necessary for the acceptable completion of the work.

Where dimensions on the plans are given or can be computed from other given dimensions, they shall govern over scaled dimension.

After completion of the project the Contractor shall provide the Engineer with a set of as-built drawings on clean prints of the original drawings. The as-built drawing shall indicate in a neat and accurate manner all changes and revisions in the original design. As-built drawings shall be submitted before final payment for completed work will be made.

Part 400 add the following new Section:

SECTION 471

ELECTRICAL UNDERGROUND INSTALLATION

471.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing electrical conduit, and pull boxes for traffic signals and intersection lighting including jacking, drilling, excavating placing and compacting backfill material in accordance with the locations shown on the Traffic Signal Plan, requirements of these specifications, and MAG specifications.

471.2 MATERIALS:

471.2.1 Electrical Conduit: All conduit and conduit fittings shall be listed by UL, and conform to NEC standards. Except as specified below, all conduit to be installed underground or in concrete structures shall be rigid polyvinyl chloride (PVC) conforming to the requirements of UL 651 for Rigid Nonmetallic Conduit. PVC conduit and conduit fittings shall be Schedule 40, heavy wall, manufactured from high impact material and shall be rated for use at 90° C. High Density Polyethylene (HDPE) conduit will be considered for approval for directional boring applications.

All exposed conduit and conduit fittings to be installed above ground shall be rigid metallic type manufactured of galvanized steel conforming to requirements of UL 6 for Rigid Metallic Conduit and to NEC standards.

471.2.2 Conduit Warning Tape: Conduit warning tape shall be a four (4) mil inert plastic film specially formulated for prolonged use underground and shall be a minimum of 3 inches wide. All tape shall be highly resistant to alkalis, acids, and other destructive agents found in the soil.

Tape shall have a continuous printed message warning of the location of underground conduits. The message shall be in permanent ink formulated for prolonged underground use and shall bear the words, 'CAUTION--ELECTRIC LINE BURIED BELOW' in black letters on a red background.

471.2.3 Pull Boxes: Pull boxes, pull box covers and pull box extensions shall be constructed of polymer concrete with reinforced heavy-weave fiberglass in accordance with MCDOT Details 4711 and 4712. Pull boxes and covers shall be concrete gray color and rated for no less than 8,000 lbs. over a 10" x 10" area and be designed and tested to temperatures of -55° F. Material compressive strength shall be no less than 1584 ksf. Covers shall have a minimum coefficient of friction of 0.5. Pull boxes shall be stackable for extra depth. Covers shall be secured with two (2) 3/8 inch corrosion resistant metallic hex bolts with corrosion resistant metallic washers. The bolts shall be in accordance with the requirements of MCDOT Detail 4711.

The words "TRAFFIC SIGNAL" shall be cast in the pull box covers in 1-inch high letters.

At the request of the Engineer the Contractor shall furnish pull box plans and specifications.

Chipped or cracked pull boxes, covers and extensions will not be accepted.

471.2.4 Metal Junction Boxes: Metal junction boxes and covers for installation in concrete structures shall be fabricated from a minimum of 59 mils thick type 304 stainless steel. All seams shall be continuously welded and shall conform to the dimensions and details called out for or shown on the project plans. A neoprene gasket with a thickness of 1/8 inch shall fit between the box and the cover. The cover shall be made to fit securely and shall be held in place with a minimum of four stainless steel machine screws. Tabs for ease of installation may be attached to the junction box at the option of the contractor.

471.3 CONSTRUCTION REQUIREMENTS:

471.3.1 Installation Of Electrical Conduit:

(A) General Requirements: Conduit shall be furnished and installed at the locations and of the sizes shown on the Traffic Signal Plan. Unless changes are necessary to avoid underground obstructions all underground conduit shall be installed in a straight line from pull box to pull box and/or from foundation to pull box and shall be of one continuous size. Any change in conduit routing must be approved by the Engineer and documented by the Contractor on as-built traffic signal plans.

All PVC conduit shall be stored and handled in an approved manner to minimize ultraviolet deterioration due to exposure to sunlight.

The PVC conduit shall be cut square and trimmed to remove all rough edges. PVC conduit connections shall be of the solvent weld type. Purple primer conforming to the requirements of ASTM F 656 shall be applied to the joined surfaces prior to use of cement. The joint cement shall be the gray PVC cement conforming to the requirements of ASTM D 2564. Where a connection is made to rigid metallic conduit, the coupling used shall be a PVC female adapter.

Expansion joint fittings shall not be installed in PVC conduit runs between pull boxes unless specified. Expansion joint fittings shall be installed in conduit runs in which both ends of the conduit are fixed in place, such as conduit runs between two foundations. Expansion joint fittings shall be installed in conduit runs which cross a concrete structure expansion joint. Approved expansion fittings shall allow for a linear thermal expansion of up to 6 inches.

Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at intervals of approximately 12 inches. Expansion fittings shall be installed where conduit crosses expansion joints in the structure. Where bonding is not continuous, expansion fittings shall be provided with a bonding jumper of number 6 AWG flexible wire. Where it is not possible to use expansion fittings, sleeves of sufficient size shall be installed to provide a minimum ½ inch clearance between the conduit and the inside wall of the sleeve. The sleeve shall be discontinuous at the expansion joints.

All existing conduits and conduit embedded in concrete structures shall be cleaned out with a mandrel and blown out with compressed air.

Field PVC conduit bends shall be made without crimping or flattening, using the longest radius practical but not less than specified by the NEC. Collapsed conduit, no matter how small, is not acceptable. The number of bends between pull boxes or between pull box and foundations shall not contain more than equivalent of two quarter bends (180 degrees, total), including the bends at the pull boxes or foundations, unless authorized by the Engineer.

Conduit entering a pull box or foundation shall be fitted with a factory made 90 degree elbow with a minimum sweep radius per the table below:

Conduit Size	Sweep Radius
2 inches	10 inches
3 inches	13 inches

Conduit entering pull boxes shall terminate a minimum of 3" inside the box wall. The conduit shall be between 2" and 4" above the bottom of the pull box and shall be sloped to facilitate the pulling of conductors. Conduit entering through the bottom of a pull box shall be located near the sides and ends and extend no more than 4" above the bottom of the pull box including the length of the conduit bell end in order to leave the major interior portion clear. At all outlets, conduits shall enter from the direction of the run and allow for expansion and contraction.

Conduit for future use shall have a ¼ inch nylon rope and a No. 8 AWG bare copper wire installed that extends 24 inches beyond each end of the PVC conduit run. The pull rope and bond wire shall be coiled and inserted into the conduit so as to be easily recovered from either end. Conduit ends shall be capped with conduit end cap fittings after the pull rope is installed. Conduit end cap shall remain in place until wiring is started. When end caps are removed, PVC ends shall be provided with an approved conduit end bell. End bells shall be installed prior to the installation of the conductors. Approved insulated grounding bushings shall be used on steel conduit ends.

The Contractor shall place warning tape (as specified in Section 471.2.2) in all open trenches in which conduit is placed. All warning tape shall be buried at a depth of 6" to 8" below final grade.

Where conduit is to be installed under existing roadway pavement by jacking or drilling methods, the jacking and/or drilling pits shall be kept 2 feet clear of the edge of the pavement.

Conduit stub-outs under curbs or roadway edges for loop detection lead-in conductors shall conform to the requirements of MCDOT Details 4758 and 4759. Loop detection conduit stub-outs shall not be installed until completion of curb and gutter work. A 3-inch "X" shall be chiseled into the curb directly over conduit located under curbs.

Installation of conduit for underground electrical service shall be in accordance with the Standard Details, as shown on the Traffic Signal Plan and in accordance with the requirements of the utility company providing electrical service. Conduit installed in railroad right-of-way shall be installed in accordance with the requirements of the railroad company.

(B) Conduit Depth Requirements: Conduits installed in protected areas such as behind curbs, under side-walks, etc., that are not subject to any vehicular traffic shall be at a minimum depth of 24 inches below final grade. Conduits installed under roadways, driveways, or any open area where there is the possibility of vehicular traffic, shall be installed at a minimum depth of 36 inches below final grade. When conduit cannot be installed at the minimum depth, it shall be completely encased in 3" of class C concrete in accordance with Section 725.

(C) Trenching, Backfilling and Compaction: Trenches shall not be excavated wider than necessary for the proper placement of conduit and pull boxes. Trenching shall be done in accordance with MAG Section 601. Backfilling, compaction and bedding of conduit runs shall be in accordance with MAG Section 601.4.9.

Open trench excavation across any existing paved areas, shall have two (2) parallel cuts made at a distance not to exceed 16 inches. All removal and replacement of existing paved areas shall be in accordance with Section 336.

Open trench excavation across an existing Portland concrete area shall have two (2) parallel cuts made at a distance not to exceed 16 inches. All removal and replacement of existing Portland concrete areas shall be done in accordance with Section 336.

After each excavation is complete and materials in place, the Contractor shall notify the Engineer for inspection, and under no circumstances shall any underground material or equipment be covered with fill without proper approval.

471.3.2 Installation of Pull Boxes: Pull boxes of the type specified on the Traffic Signal Plan shall be furnished and installed at the locations shown on the Plan. Pull boxes shall be installed in accordance with MCDOT Detail 4713. All relocation of pull boxes to avoid driveways and/or other structures shall be approved by the Engineer and documented by the Contractor on the as-built traffic signal plans.

Pull boxes shall be set and adjusted so that they are flush at curb or sidewalk grade. When no grade is established pull boxes shall be set as requested by the Engineer.

All pull box covers shall be secured with the required bolts and washers before final acceptance of the project.

All pull boxes shall be left in a clean condition, free of dirt and debris upon completion of the work.

471.4 MEASUREMENT:

Conduit will be measured by the linear foot for each diameter size.

Pull boxes will be measured as a unit for each pull box size.

471.5 PAYMENT:

The accepted quantities of conduit, measured as provided above, will be paid for at the contract unit price per linear foot, which shall be full compensation for the item, COMPLETE IN PLACE, including excavation, backfill, warning tape, pull rope or bond wire and any incidentals necessary to complete the work. No direct payment will be made for rigid metal conduit bends or rigid non-metallic conduit bends at pull boxes, expansion fittings and coupling fittings, the cost being considered as included in the contract price for the conduit items.

The accepted quantities for pull boxes, measured as provided above, will be paid for at the contract unit price, each, which shall be full compensation for the item, COMPLETE IN PLACE, including any excavating, backfilling and landscaping necessary to complete the work.

Part 400 add the following new Section:

SECTION 472

TRAFFIC SIGNAL FOUNDATIONS

472.1 DESCRIPTION:

The work under this section shall consist of furnishing all materials and constructing all traffic signal foundations and other designated pole foundations including signal poles, cabinet and electrical service pedestal foundations for the traffic signals, and intersection lighting system in accordance with the locations and details designated on the Traffic Signal Plan, MAG Specifications, and the requirements of these specifications.

Pole foundations shall include all conduit, conduit elbows, anchor bolts, re-bar cages, grounding electrode, and forms required for construction of the foundation. The traffic signal pole foundations shall conform to the requirements of MCDOT Details 4720 and 4721.

The controller and combination service pedestal and battery back-up system cabinet foundations shall conform to the requirements of MCDOT Details 4723 and 4724.

472.2 MATERIALS:

472.2.1 Excavation and Backfill: Trenches shall not be excavated wider than necessary for the proper placement of conduit and pull boxes. Trenching, backfilling and compaction shall be done in accordance with Section 601.

All excavations within the roadway shall be backfilled and compacted in accordance with Section 211.

472.2.2 Concrete: Concrete used for all foundations shall be class 'A' concrete and shall be in accordance with the requirements of Section 725.

472.2.3 Anchor Bolts: All anchor bolts shall be in accordance with referenced details, for traffic signal foundations see Details 4725 and 4726.

All anchor bolts shall be threaded at the top and shall conform to the plans.

472.2.4 Rebar Cage: All rebar cages shall be in accordance with MCDOT Detail 4721.

472.2.5 Electrical Conduit: All electrical conduit and conduit fittings shall be in accordance with these specifications.

472.2.6 Grounding Electrode: The grounding electrode shall be in accordance with these specifications and MCDOT Details 4720, 4721, 4723 and 4724.

472.3 CONSTRUCTION REQUIREMENTS:

The excavations required for the installation of foundations and other items shall be performed in such a manner as to avoid any unnecessary damage to streets, sidewalks, landscaping and other improvements. Any damage by the contractor's operation shall

be replaced or reconstructed where determined by the Engineer at the expense of the contractor. The trenches shall not be excavated wider than necessary for the proper construction of the foundations and other equipment. Excavation shall not be performed until immediately before construction of foundations. The material from the excavation shall be placed in a position that will minimize obstructions to traffic and interference with surface drainage.

All surplus excavated material shall be removed and properly disposed of within 48 hours by the contractor, as directed by the Engineer. After each excavation is completed, the contractor shall notify the Engineer for inspection, and under no circumstances shall any underground materials or equipment be covered with fill without the approval of the Engineer.

Excavation and backfill shall be in accordance with the requirements of Section 105.12. At the end of each working period, all excavations shall be barricaded or covered, or both, to provide safe passage for pedestrian and vehicular traffic.

Excavations in the street or highway shall be performed in such a manner that not more than one traffic lane is restricted at any time, unless otherwise provided in the Special Provisions.

Sidewalk and pavement excavations shall be kept well covered and protected to provide safe passage for pedestrian and vehicular traffic until permanent repairs are made.

The elevation of signal and lighting pole foundations shall be set as follows unless otherwise noted within the construction plans or special provisions. Signal and lighting pole foundations shall be set flush with the existing or new sidewalk when sidewalk is present. Where curb exists without sidewalk, the foundations shall be set flush with a surface defined by a 1.5% upward slope from the top of curb. Where there is no curb or sidewalk pole foundations shall be as shown on the project plans. The dimensions and locations of foundations shall be as specified on the project plans; however, the Engineer may direct that changes be made in locations due to obstructions or other existing conditions. Any change in locations shall be documented by the contractor on as-built traffic signal plans. The contractor shall verify top of foundation elevations with the Engineer prior to foundation construction.

Concrete shall be placed in holes which have been augured against undisturbed earth. If the material in the bottom of the hole is not firm and stable, it shall be compacted or treated as directed by the Engineer. The walls and the bottoms of the holes shall be thoroughly moistened prior to placing concrete.

If the soil is not stable, a deeper foundation than specified may be required or forms shall be used as determined by the Engineer. The forms shall be of the proper size and dimensions and shall be rigid and securely braced

Foundation forming material shall extend no more than 20 inches below the foundation final grade and shall be removed after placement and curing of concrete.

Anchor bolts shall be oriented such that the bolt pattern sides are both parallel and perpendicular to the roadway centerlines unless otherwise specified on the Traffic Signal Plan. A 25-foot coil of No. 4 AWG bare copper conductor shall be installed below the foundation and covered with fill material such that no part of the coils will be in contact with the concrete foundation. An extension of the No. 4 AWG bare copper wire shall extend into the pole. Anchor bolts, conduit and rebar cage shall be centered

within the foundation, set at the specified height and plumb within ±1/2 degree. During placement of concrete, anchor bolts shall be securely held in proper alignment, position, and height with a suitable template.

After excavations are completed and anchor bolts and conduit installed, the Contractor shall notify the Engineer for inspection. Under no Circumstances shall concrete be placed without approval of the Engineer.

The concrete pour shall be continuous and consolidated by means of vibrators. All exposed surfaces of the foundation shall receive a finish that is smooth, level, and free of form marks.

Type 'A' and 'SB' pole foundations, type 'P' cabinet foundation, and type 'SP' service pedestal foundation shall set for a minimum of three (3) days prior to installation of poles and/or cabinets. Type 'E', 'F', 'J', 'Q', 'K' and 'R' pole foundations shall set for seven (7) days prior to installation of poles.

Before the concrete for the cabinet foundation has set, depressions shall be made around the anchor bolts for adjustment of the cabinet leveling nuts in accordance with MCDOT Detail 4723.

472.4 MEASUREMENT:

Foundations for traffic signals and intersection lighting system will be measured as a unit for each type of foundation constructed.

472.5 PAYMENT:

The accepted quantities of foundations for traffic signal and intersection lighting system, measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE, including excavations, backfill and incidentals necessary to complete the work.

No measurement or direct payment will be made for anchor bolts or re-bar cages, the cost being included in the unit price paid for foundations.

Part 400 add the following new Section:

SECTION 473

DETECTORS

473.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing vehicular and pedestrian detectors at the locations shown on the Traffic Signal Plan and in accordance with the requirements of these specifications.

473.2 MATERIALS:

473.2.1 Loop Detector Sensor: Loop detector sensors shall be of the size and type specified on the Traffic Signal Plan and shall conform to the requirements of MCDOT Detail 4757. The conductors for inductive loop detection and the loop detector lead in cable shall be as specified by Section 478.2.1.

Roadway loop detector sensor wire shall conform to IMSA specification 51-5 and installed in accordance with the requirements of these specifications and MCDOT Details 4757, 4758, and 4759.

473.2.2 (A) Hot Applied Rubberized Sealant: The saw cut loop sealant shall be a hot applied rubberized asphalt formulated specifically for use as a loop sensor saw cut sealant. The sealant shall be non-tracking during application and relatively stiff but flexible after application at low pavement temperatures. At application temperatures the sealant shall be a thin, free flowing fluid which penetrates the saw cut, encapsulating the loop conductors and self-levels permitting uniform and easy application.

The sealant shall be applied using a pressure feed melter/applicator equipped with a heated hose and handgun control.

When heated in accordance with ASTM D3407 the sealant shall meet the following physical properties:

SPECIFICATIONS

TEST PARAMETER	LIMITS	TEST METHOD
Cone Penetration, TIF 150g, 5 sec; .004 inch	35 max	ASTM D 3407, Sec. 5
Flow, 140F, SM; inch	0.2 max	ASTM D 3407, Sec. 6
Resilience, TIF	30% min	ASTM D 3407, Sec. 8
Softening Point	180°F min	ASTM D 2398
Ductility, TIF 2"/min	12" min	ASTM D 113
Mandril Bend	Pass	SEE NOTE BELOW
Pour Temperature	379°F	
Safe Heating Temperature	410°F	

NOTE: A sample of sealant is poured in a 0.12 inch thick by 1.0 inch wide and 4.0 inches long configuration on a glycerin coated brass plate using appropriate molds.

The specimen is removed from the molds, placed in a freezer maintained at 0°F ±2°F for one (1) hour. To test, remove the specimen from the freezer and immediately bend over a 1-inch diameter mandrel through a 180-degree arc in five (5) seconds at a uniform rate. To pass the test, the sample shall not show any cracks.

473.2.2(B) Optional Cold Applied Emulsion Sealant: As an alternative sealant, the loop sealant shall be a single component asphaltic emulsion sealant designed to fill and seal inductive loop saw cuts. Loop sealant shall be "Tri-American TA-500" or approved equal.

SPECIFICATIONS

TEST PARAMETER	LIMITS	TEST METHOD
Residue by evaporation, weight percent	70 min	ASTM D 2939
Ash content, weight percent	50 min	ASTM D 2939
Firm set time, hours	4 max	ASTM D 2939
Brookfield viscosity, Poise RVT Spindle #3, 10 RPM at 75 ± 2 ° F	50 to 125 °F	
Tensile strength, psi,	20 min	ASTM D 2523
Elongation, %	2.0 min	ASTM D 2523
Flexibility	No full depth cracks	ASTM D 2939 SEE NOTE BELOW
Resistance to water	No blistering, re-emulsification or loss of adhesion	ASTM D 2939, Alternative B

NOTE: Flexibility: Except air-dry specimens to constant weight at 75° ± 5° F and 50° ± 10° F relative humidity. Condition the mandrel and specimens for 2 hours at 75° ± 2° F before test.

473.2.3 Pedestrian Detectors: All pedestrian push buttons shall be in accordance with the Americans with Disabilities Act Accessibility Guidelines (latest revision). The pedestrian detector shall be a push-button switch mounted inside an approved push-button housing. The switch shall be the phenolic-enclosed SPST-type with momentary contacts. The contacts shall be rated at 15 amps and 125 volts AC. The switch shall have screw-type terminals and shall have a rated life of not less than one million operations. The switch shall operate in the normally open position.

The housing of the push-button station shall be of substantial tamper-proof construction made of cast aluminum. The assembly shall be weather-proof and so constructed that it will be impossible to receive any electrical shock under any weather conditions. The housing shall be shaped to fit the curvature of the pole to which it is attached and shall provide a rigid installation. The housing body shall contain a direct push-type actuator button, microswitch-type or approved equal. The housing cover shall contain the push-button sign as described below.

Pedestrian push-button signs shall be fabricated from 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B 209M, 6 inches by 12 inches in size. Corners

of the sign shall be finished round for safety and neat appearance. Panel facing shall be prepared and covered with High Intensity retroreflective sheeting. Instructions on the signs shall be black letters and orange symbols on a white background. The legend shall be as shown on Detail 4797-1 unless otherwise indicated by the plans.

473.2.4 Video Detectors: Video detectors for signalized intersections shall comply with the specification as set forth in Section 485.

473.3 CONSTRUCTION REQUIREMENTS:

473.3.1 Vehicular Loop Detector Sensors:

(A) General: Vehicular loop detector sensors of the size and type specified on the Traffic Signal Plan shall be installed in accordance with the locations shown on the Traffic Signal Plan and the requirements of these specifications. Any change in loop detector sensor location or deviation in loop detector sensor installation not in accordance with these specifications must be approved by the Engineer and documented by the Contractor on as-built signal plans. The installation of the detectors shall be such that the operation shall not be affected by temperature changes, water, ice, rain, snow, chemicals, or electromagnetic noise.

(B) Loop Detector Sensor Conductor Installation: The loop detector sensor conductors shall be installed prior to the placement of a finishing course or overlay when the project includes the installation of a finishing course or overlay. The loop detector sensor conductors shall be installed in accordance with MCDOT Detail 4757. All saw cuts shall be made with an abrasive type saw. The sawed slot shall extend to the curbside PVC conduit for each loop sensor. Separate lead-in sawed slots extending from the loop to the stub-out conduit shall be cut for each loop sensor. To insure that all saw cuts are true and straight a loop sensor layout shall first be made on the pavement surface.

All corner points shall be cored drilled at full depth of the loop saw cut or have diagonal and corner saw cuts with overlap such that the sawed slot is at full depth through all turn points.

The sawed loop sensor slot and drill points shall be flushed clean of all debris with a high-pressure stream of water and completely dried by means of an air stream prior to installation of loop sensor conductors.

After the sawed slot is dry and free of debris, wind the specified number of wire turns into the sawed slot in accordance with the details shown on MCDOT Detail 4757. Wind loops which are in close proximity in opposite directions, (i.e. No. 1 clockwise, No. 2 counter clockwise, etc.). This may be accomplished by reversing loop "start-finish" lead-in conductors at the curb-side pull box.

The lead-in conductors from the loop sensor to curb-side pull box shall be continuous and twisted a minimum of six turns per foot in the lead-in saw cut and under curb stub out conduit.

(C) Sawcut Sealant: The loop sensor conductors shall be permanently anchored in the sawed slot using the hot applied rubberized asphalt or cold applied single component emulsion sealant as specified. The sealant shall completely surround the loop sensor

conductors and fill the sawed slot to within 1/8 inch of the pavement surface. Surplus sealant shall be removed from the road surface without the use of solvents. Traffic lane closure shall remain in place until the sealant is set up; Contractor shall cleanup sealant tracking problems at no additional cost to the County. During hot weather, when approved by the Engineer, a sand blotter may be used.

(C.1) Hot Application: The sealant shall be applied with a sealant melter/applicator which melts the sealant and pressure applies the sealant at 379° F via a heated hose and applicator handgun control. The handling of the sealant melter/applicator and the filling of the saw slot shall be in accordance with the directions of the melter/applicator manufacturer.

(C.2) Cold Application: The emulsion sealant shall be thoroughly mixed per the manufacturer's recommendations. The emulsion sealant may be poured directly from container or any other suitable applicator, applied into sawcuts.

(D) Loop Detector Sensor Connection: Each pair of loop sensor conductors entering the curb-side pull box shall be identified as to which loop it represents (i.e. inside lane, outside lane, through lane, or left turn lane). Each conductor pair shall also be marked to signify its winding direction, "S" for start and "F" for finish. Marking identification tags shall be in accordance with Section 478.2.1.

The loop sensor conductors shall be spliced to the detector lead-in cables in the adjacent curb-side pull box. Detector lead-in cable shall run continuous and unspliced from curb-side pull box to the controller cabinet.

Unless otherwise specified or requested, the maximum number and size of loop detector sensors connected to a detection channel shall be as follows:

LOOP SIZE	LEAD-IN LENGTH	LOOPS PER CHANNEL	LOOP USE
6.0 ft. x 6.0 ft.	500 ft. or less	1	Advance detection
6.0 ft. x 6.0 ft.	500 ft. or greater	1	Advance detection
6.0 ft. x 40.0 ft.	200 ft. or less	1	Call detection
6.0 ft. x 40.0 ft.	200 ft. or greater	1	Call detection
6.0 ft. x 50.0 ft.	As required and greater	1	Left turn detection

All detector wire splices will be made by the MCDOT Signal Shop at time of acceptance of the detectors

(E) Loop Detector Sensor Field Test: Before and after sealing the saw cut the Contractor shall perform an insulation resistance to ground test. The insulation

resistance to ground shall be at least 50 mega-ohms measure at a voltage between 400 and 500 volts D.C. Any loop detector sensor not meeting the above insulation test or fails to tune when connected to a loop detector amplifier unit shall be replaced by the Contractor at no cost to Maricopa County Department of Transportation.

473.3.2 Video Detectors Camera Installation: Video detection cameras shall be installed per the manufacturer's installation requirements and as shown in MCDOT Detail 4755.

Video detectors for signalized intersections shall comply with the specification as set forth in Section 485.

473.4 MEASUREMENT:

Vehicular and pedestrian detectors will be measured as a unit for each type of detector furnished and installed.

473.5 PAYMENT:

The accepted quantities of detectors measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 474

TRAFFIC SIGNAL POLE INSTALLATION

474.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing traffic signal poles, mast arms, and modifying multi-use poles in accordance with the plans, the referenced details, the special provisions, and these specifications.

Poles shall include a shaft, base, anchor bolts, mast arms (if required), and other hardware required to support the traffic signal apparatus or other supported item.

474.2 GENERAL STANDARD:

Steel poles for traffic signals and highway lighting shall include pole shafts, mast arms, and pole bases.

Material standards for traffic signal and lighting supports shall be in conformance with the current edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. All pole supports shall be designed to withstand 80 mph winds.

All welding design, fabrication and inspection of welding for structural steel shall be performed in accordance with the requirements of the latest edition of the American

Welding Society (AWS) Structural Welding Code AWS D1.1-Steel, and the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges. In the event of any conflict, the latter specifications shall govern.

The use of electro-slag welding process on structural steel will not be permitted.

474.3 TYPES OF POLES:

Types of poles to be furnished are as follows:

1. Type 'A', Standard Detail 4738
2. Type 'E', Standard Detail 4740
3. Type 'F', Standard Detail 4741-1
4. Type 'J', Standard Detail 4742
5. Type 'Q', Standard Detail 4743
6. Type 'K', Standard Detail 4748
7. Type 'R', Standard Detail 4749-1
8. Type 'PB' Standard Detail 4750

(A) Pole Shafts: The tapered pole shafts shall be fabricated from sheet steel of weldable grade which shall meet or exceed the minimum strength requirements of ASTM A 36 for all poles except the Type K and the Type R poles. The Type K and Type R poles shall be constructed from sheet steel that has a minimum yield stress after fabrication of 48 ksi. A tapered rate of 1/8 inch change in diameter per linear foot shall be required unless otherwise specified. Pole shafts shall be fabricated according to the thickness requirements shown on the Standard Details.

Standard pipe pole shafts for Type A poles shall be fabricated from standard weight structural steel which conforms to the minimum strength requirements of ASTM A 53, Grade B and an outside diameter in inches as indicated on the Standard Details. Each section shall be fabricated from not more than two pieces of sheet steel. When two pieces are used, the longitudinal welded seams shall be directly opposite one another. When the sections are butt-welded, seams shall be directly opposite one another. When the sections are butt-welded together, the longitudinal welded seams on adjacent sections shall be placed to form continuous straight seams from base to top of pole. Pole shafts shall be straight, with a permissive variation not to exceed 1-inch measured at the midpoint.

Pole shafts shall be galvanized in accordance with the requirements of ASTM A 123. The visual appearance of the galvanized finish shall be uniform. Discoloration of the galvanized finish such as dark areas, dark streaks, dark rings or transportation handling marks, which are considered excessive by the Engineer, shall not be allowed. Pole shafts that have a finish unacceptable to the Engineer shall either be repaired or replaced to the satisfaction of the Engineer at no additional cost to the Department.

Hand holes in the base of the poles shall conform to the details shown on the Standard Details. All welds shall be continuous and any exposed welds, except fillet welds, shall be ground flush with the base metal.

A metal tag shall be permanently attached to the pole above the hand hole stating the manufacturer's name, pole type per the Department's plan, pole drawing number, shaft length and inches of material thickness.

(B) Standard Bases: Poles shall have standard bases fabricated from structural steel plates per MCDOT Details, and conform to the minimum strength requirements of ASTM A 36. Exposed surfaces shall be finished smooth and all exposed edges shall be neatly rounded to a 1/8 inch radius. Standard bases shall be galvanized in accordance with the requirements of ASTM A 123.

(C) Anchor Bolts: All anchor bolts shall be threaded at the top and shall conform to the plans.

High strength anchor bolts, washers and nuts shall be fabricated from steel which meets or exceeds the minimum requirements of ASTM A 325 and shall be electro-galvanized in accordance with the requirements of ASTM B 633. Welding shall not be performed on any portion of the body of these anchor bolts. Certificates of Analysis conforming to the requirements of Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted for high strength anchor bolts, washers and nuts.

(D) Mast Arms: The tapered mast arms shall be fabricated from sheet steel conforming to the requirements of ASTM A 36. The mast arms for the Type K and Type R poles shall be constructed of sheet metal with a minimum yield stress of 48 ksi after fabrication. Mast arms shall be fabricated according to the thickness requirements shown on the MCDOT Details. A tapered rate of 1/8 inch change in diameter per foot shall be required unless otherwise specified. All bolts, washers and nuts for mast arms shall be fabricated from steel conforming to the requirements of ASTM A 325 and shall be electro-galvanized in accordance with the requirements of ASTM B 633.

Mast arms shall be galvanized in accordance with the requirements of ASTM A 123. The visual appearance of the galvanized finish shall be uniform. Discoloration of the galvanized finish such as dark areas, dark streaks, dark rings or transportation handling marks which are considered excessive by the Engineer shall not be allowed. Mast arms that have a finish unacceptable to the Engineer shall either be repaired or replaced to the satisfaction of the Engineer at no additional cost to the County.

Mast arms shall be bent to the dimensions and curvature shown on the MCDOT Details.

A metal tag shall be permanently attached on the side of the mast arm near the base stating the manufacturer's name, pole type per the Department's plan, mast arm or pole drawing number, length and material thickness.

(E) Luminaire Mast Arms: The tapered mast arms for the luminaires shall be fabricated from sheet steel conforming to the requirements of ASTM A 36. Mast arms shall be fabricated according to the thickness requirements shown on the MCDOT Details. A tapered rate of 1/8 inch change in diameter per foot shall be required unless otherwise specified. All bolts, washers and nuts for mast arms shall be fabricated from steel conforming to the requirements of ASTM A 325 and shall be electro-galvanized in accordance with the requirements of ASTM B 633.

Luminaire mast arms shall be galvanized in accordance with the requirements of ASTM A 123.

Mast arms shall be bent to the dimensions and curvature shown on the MCDOT Details.

A metal tag shall be permanently attached on the side of the mast arm near the base stating the manufacturer's name, pole type as required on the plans, mast arm or pole drawing number, length and thickness in inches.

474.4 WARRANTIES:

Each type 'A', 'E', 'F', 'J', 'Q', 'K', 'R' and 'PB' signal pole shall be warranted by the manufacturer against all defects in material and workmanship for a period of twelve (12) months and in accordance with the requirements of Section 108.8.

474.5 CONSTRUCTION REQUIREMENTS:

474.5.1 Base Plates and Poles:

High strength bolts, nuts, and washers for bases shall be assembled as specified in the Standard Details and shall be torqued as required by the Standard Details. Anchor bolts, washers, and nuts required for relocating existing poles shall be furnished by the contractor.

Poles shall be drilled and tapped for mounting hardware as shown on the Standard Details.

Sidewalks, curbs, gutters, pavement, base material, lawns, plants, and any other improvements removed, broken, or damaged by the contractor's operations shall be replaced or reconstructed with materials in accordance with these specifications. The replaced or reconstructed improvements shall be left in a serviceable condition satisfactory to the Engineer, and shall conform to these specifications where applicable.

Where existing pole installations are to be modified, materials and equipment shall be used, salvaged, or disposed of as specified in the Special Provisions and as directed by the Engineer.

Existing poles shall be either relocated or used in place as specified in the project plans. The contractor shall inspect the poles and provide the materials and work necessary to recondition the poles so they can be reused. Holes left in the shafts of existing poles, due to removal of items such as signal mounting assemblies, shall be repaired and painted with zinc galvanized paint.

If any poles are damaged by the contractor's operations, such repairs or replacements shall be at no additional cost to the Department.

New poles that are damaged by improper drilling of holes will be rejected.

474.5.2 Signal Poles and Mast Arms: Poles and mast arms shall be of the type shown on the Traffic Signal Plan and shall be installed in accordance with the MCDOT Details.

Poles shall be drilled and tapped for mounting of hardware. The use of a welding torch is not authorized.

All poles shall be plumbed to the vertical with all mast arms, signal heads, and luminaires installed. When mast arms are bolted to the pole shaft, the mast arm end over the roadway shall adjust to the horizontal.

474.6 MEASUREMENT:

Poles for traffic signals will be measured as a unit for each type pole installed, COMPLETE IN PLACE. The poles including signal and luminaire mast arms, base plates and all materials required shall be furnished by the contractor unless otherwise indicated.

474.7 PAYMENT: The accepted quantities of poles will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 475

ELECTRICAL POWER SERVICE AND CONTROLLER CABINET INSTALLATION

475.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing electrical power service equipment in accordance with the location and details on the Traffic Signal Plan, MCDOT Details, and the requirements of these specifications, and the specifications of the utility company serving the location, and the picking up, installing and wiring of the controller cabinet assembly in accordance with the type and location as designated on the Traffic Signal Plan and the requirements of these specifications

475.2 MATERIALS:

475.2.1 Electrical Service Pedestal System: Each electrical service pedestal system consists of the cabinet, electrical service equipment wiring and wiring devices.

Combination Electrical Service Pedestal and Battery Back-Up Cabinet: The combination underground service meter pedestal and battery back-up cabinet shall be TESCO catalog number 27-000/22-000 or pre-approved equal, consisting of the meter socket, circuit breaker panel, test bypass facilities, pedestal locking device, ground mount enclosure, batteries, full power by-pass, isolation module and necessary fittings all of which shall conform to the requirements of Detail 4731-1 Traffic Signal Plans, and the project Special Provisions.

Service Pedestal Cabinet: The underground service meter pedestal cabinet shall be TESCO catalog number 26-000 or pre-approved equal, consisting of the meter socket, circuit breaker panel, test bypass facilities, pedestal locking device, ground mount enclosure and necessary fittings all of which shall conform to the requirements of Detail 4829-1, Traffic Signal Plans, and the project Special Provisions.

Electrical service equipment wiring and wiring devices shall be in conformance with NEMA, the NEC, MCDOT Details and the specifications of the utility company providing electrical service.

(A) Breakers: All circuit breakers shall have an interruption capacity of 10,000 amperes and supplied as indicated in the wiring schematic diagram.

(B) Meter Loop Assembly: The meter loop assembly shall be bonded and grounded in accordance with the requirements of these specifications.

(C) Conductors: Conductor size and color shall be as specified on the Traffic Signal Plan conductor schedule and in accordance with the requirements of these specifications. All electrical apparatuses shall be UL listed.

475.2.2 Control Cabinet Assembly: The Controller Cabinet Assembly shall include a weatherproof cabinet furnished by Maricopa County Department of Transportation.

Cabinet types and configurations shall be supplied as specified on the Traffic Signal Plans, Standard Details, and in accordance with these specifications.

475.3 CONSTRUCTION REQUIREMENTS:

475.3.1 Electrical Service Pedestal System

Combination Service Pedestal and Battery Back-Up System: The electrical service meter pedestal and battery back-up system shall be assembled and installed on a concrete foundation at the location shown on the Traffic Signal Plan and in accordance with Detail 4724.

Service Pedestal System: The electrical service meter pedestal shall be assembled and installed on a concrete foundation at the location shown on the Traffic Signal Plan and in accordance with Detail 4829-2.

475.3.2 Control Cabinet Assembly: The Contractor shall notify the Engineer five (5) days in advance of the intended date the Contractor is to pick up the Control Cabinet Assembly. The wired cabinet shall be in accordance with the requirements of these specifications.

The Control Cabinet Assembly shall be picked up at the following address:

Maricopa County Department of Transportation
Traffic Signal Operations
2909 W. Durango Street
Phoenix, Arizona 85009-6357

Contractor shall install the control cabinet assembly. After the installation and leveling of a 'P' cabinet an approved non-shrink type grout shall be placed between the cabinet and foundation.

Contractor shall be responsible for connecting all of the field wiring, except the loop detector lead-ins, to the cabinet terminals. The Engineer will test the connections before accepting the Controller Cabinet Assembly pay item.

475.4 MEASUREMENT:

Controller cabinet assemblies will be measured as a unit for each type installed.

Each type of Electrical Service Pedestal System installed and accepted will be measured as a unit .

475.5 PAYMENT:

The accepted quantities for the installation of the controller cabinet assemblies, measured as above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

The accepted quantities for each type of electrical service pedestal system will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 476

SIGNAL INDICATIONS AND MOUNTINGS

476.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing vehicular and pedestrian traffic signal indications and mounting assemblies in accordance with the types and locations shown on the Traffic Signal Plan, MCDOT Details 4773, 4774, 4775, 4776, 4778-1, 4778-2, 4794, and 4795 and the requirements of these specifications. Signals, except pedestrian type, for newly signalized intersections shall be of the same manufacturer and of the same material.

476.2 MATERIALS:

476.2.1 Vehicular Traffic Signal Heads: Vehicular traffic signal heads shall be assembled of standard 12 inch lens size signal sections with the number of sections or combination of sections specified on the Traffic Signal Plan, MCDOT Detail 4773 and the requirements of the Manual on Uniform Traffic Control Devices.

The optical performance and design of signal heads shall conform to the requirements of the Institute of Transportation Engineers Standards for Vehicular Traffic Control Signal Heads (ITE Publication No. ST-008B), the Traffic Signal Plan and the provisions of these specifications.

(A) Housing: A standard 12 inch signal section shall be a one (1) piece housing with hinged door for housing all optical and electrical components.

Both the one (1) piece signal section housing and door shall be fabricated of corrosive resistant die cast aluminum conforming to Institute of Transportation Engineers Standards. The top and bottom of the housing shall have openings to accommodate

standard 1½ inch pipe fitting. Each opening shall have a locking "Shurlock" boss integrally cast into the housing section.

A snap-in, swing-out cast aluminum reflector ring, supported by stainless steel hinge pins shall be provided. The hinge pins shall be supported by mounting lugs integrally cast on the left side of the housing.

The housing door shall be hinged to the signal section housing by stainless steel roll pins and hinge lugs integrally cast in the door and housing. The door shall be latched by means of integrally cast door latch slots, housing hinge bolt lugs and stainless steel hinge bolts and wing nuts. The 12-inch sections require two (2) latching bolts.

A gasket groove on the inside of the door shall accommodate a neoprene gasket to form a positive seal between the door and signal housing when the door is closed and latched. Four (4) quick change type lens clips and four (4) stainless steel screws shall be provided for securing the lens and lens gasket in the door lens opening. Four (4) stainless steel washer head type screws shall be provided to secure the signal visor.

Signal section housings shall be fastened together by two (2) cadmium plated, (clover leaf type) clamping washers and three (3) carriage bolts and lock washers. Each complete signal head assembly shall be pre-drilled for mounting of signal backplates.

All signal sections and the outside surfaces of visors shall be painted gloss black. The inside of the visor shall be painted dull black. All painting shall be done by the manufacturer.

(B) Visors: Each signal section shall have a tunnel type visor with a 5 to 7 degree downward tilt. Unless otherwise specified the 12-inch signal sections shall be furnished with 12-inch by 12-inch long visors. All visors shall be retained to the housing section door with stainless steel washer head type screws.

(C) Backplates: Louvered backplates and backplate mounting hardware shall be furnished with each vehicular signal head assembly. The backplate shall be fabricated of anodized sheet aluminum. The 5.0 inch border backplates shall be provided for the 12-inch signal head assemblies. All backplates shall be painted dull black. All painting shall be done by the manufacturer.

(D) Mounting Assemblies: An elevator plumbizer conforming to the requirements of MCDOT Detail 4778-2 shall be installed with all mast arm mounted 12 inch signal heads, as shown on the Traffic Signal Plan. The plumbizer elongated bolt hole shall be positioned to align with the bolt hole drilled 2 3/8 inches from the end of the tenon on the mast arm. The plumbizer shall be held in place with a 3/8 inch bolt with a nut and two (2) washers per MCDOT Detail 4778-2. The plumbizer signal head mounting position shall be in accordance with the requirements of MCDOT Detail 4778-1.

Pole top and side mount mounting assemblies shall consist of 1⅞" outside diameter (1½" nominal size) standard pipe and fittings. All members shall be so fabricated that they shall provide plumb, symmetrically arranged and securely fabricated assemblies.

Terminal Compartments – A terminal compartment shall be assembled in the mounting brackets as shown in the Standard Details and as called for on the plans. The terminal compartment shall be manufactured of bronze.

A rainproof cover shall be provided for all terminal compartments which will provide ready access to the internal terminal block wiring.

The types of mounting assemblies used, and the methods of mounting them, shall be as shown on the Traffic Signal Plan and shall conform to MCDOT Details.

476.2.2 Led Signal Lamps

(A) General: LED traffic signal modules shall be designed to fit traffic signal housings that meet MCDOT specifications. The module shall be weather tight and shall fit securely in the housing and shall have wire leads long enough for easy connection to the traffic signal head wire terminal block. The wire shall have crimped on terminal connectors. The LED signal module shall be a single, self-contained device. The power supply shall be integral to the sealed LED module.

(B) Module Identification: The Contractor shall ensure that the date of installation is filled in on the module label on each LED module.

(C) Physical and Mechanical Requirements: The LED lamp unit shall be a single self-contained device, not requiring on site assembly for installation. The assembly and manufacturing process for LED Traffic Signal Lamp unit assembly shall be such as to withstand mechanical shock, and vibration caused by winds up to 80 mph.

Signal lens shall be convex to minimize sunlight reflectance.

(D) Optical and Light Output Requirements: The LED shall be manufactured using AlInGaP Technology or other LEDs with low susceptibility to temperature degradation (AlGaS LEDs will not be allowed).

The LED signal lamps shall be in three colors: red, yellow, and green. Multiple color modules shall not be used.

Each LED traffic signal lamp shall meet the minimum laboratory light intensity values, color (chromatically), and light output distribution as described in ITE Standards as shown in Section 11.04, Table I and Section 8.04, Figure 1 of the Vehicle Traffic Control Signal Head Standard. Each LED traffic signal lamp shall meet the minimum requirements for light output for the entire range of allowed voltage.

(E) Electrical: Each unit shall incorporate a regulated power supply engineered to electrically protect the LEDs and maintain a safe and reliable operation. The power supply shall provide capacitor filtered DC regulated current to the LEDs per the LEDs manufacturer's specification. MCDOT does not require the unit be dimmable.

The LED traffic signal lamp shall operate on a 60Hz AC line voltage ranging from 80 volts RMS to 135 volts RMS. The Circuitry shall prevent flickering over this voltage range. Nominal rated voltage for all measurements shall be 117 volts RMS.

The LED traffic signal lamp unit shall be operationally compatible with controllers and conflict monitors used by MCDOT.

Two, captive, color coded, 3 feet long, 600 V, 18 AWG minimum jacketed wires, conforming to the NEC, rated for service at 105° C, are to be provided for an electrical connection.

One Schematic diagram shall be provided for each LED lamp unit along with any necessary installation instructions.

LEDs shall be arranged in no less than 6 loaded circuits.

The LED shall operate with a minimum 0.90 power factor.

Total harmonic distortion (current and voltage) induced into an AC power line by a signal module shall not exceed 20 percent.

LED modules shall have female quick-disconnect type terminals.

476.2.3 Pedestrian Signal Head: The pedestrian signal head shall include an aluminum housing with swing down door frame, a plug-in sealed LED message module, and visor. The pedestrian signal shall be energy efficient with a power consumption of less than 12 watts at 120 volts.

Optically, the pedestrian signal head shall display brightly and uniformly, the alternate symbol messages "HAND" in Portland orange, **"COUNTDOWN NUMERALS" IN Portland orange** and "WALKING PERSON" in lunar white under all ambient light conditions. The message symbols shall not be seen (blank-out) when the message symbol is not energized.

The HAND-WALKING PERSON symbol shall be a minimum of 11 inches high and 7 inches wide and the COUNTDOWN NUMERALS shall be 9" high and 7" wide conforming to the requirements of the Manual of Uniform Traffic Control Devices, Institute of Transportation Engineering Standards for Pedestrian Traffic Control Signal Indications, the Signal Plan and the requirements of these specifications.

(A) Housing and Door Frame: The housing and door frame shall be a one piece corrosion resistant aluminum die casting. The maximum overall dimensions of the pedestrian unit signal housing including door and visor shall be 18 inches wide, 16 inches high, and 9 inches deep. The top and bottom of the housing shall have openings to accommodate standard 1½ inch pipe size fittings. The bottom opening shall have a locking "Shurlock" boss integrally cast into the housing. The distance between the mounting surfaces of the upper and lower opening shall be 15.75 inches.

The housing door frame shall be hinged to the housing by stainless steel pins and hinge lugs integrally cast in the housing and door frame. The swing down door shall be latched by two integrally cast housing hinge bolts lugs, two door latch slots and two stainless steel hinge bolts with wing nuts.

The housing shall be dust proof and weatherproof with the plug-in LED module installed and the door closed and latched. The housing and door shall be painted gloss black by the manufacturer.

(B) LED Message Module: The lunar white and Portland orange LED, solid state controls, and transformers for energizing the LED shall be encased in a plug-in module. The HAND and WALKING PERSON symbol message lens shall be ultraviolet stabilized polycarbonate. The HAND and WALKING SYMBOL message shall be full indications only.

The rear of the module shall have three male quick disconnect lugs for connection of the AC+HAND signal and AC+WALKING PERSON signal. The HAND and WALKING PERSON power consumption shall be less than 12 watts. The COUNTDOWN NUMERALS power consumption shall be less than 7 watts.

476.2.4 Warranties: All LED signal lamps and heads shall be warranted for five (5) years against defects in workmanship and materials and the requirements of Section 108.8.

476.3 MEASUREMENT:

Vehicular and pedestrian signal indications completely (including wiring and mounting assemblies) will be measured as a unit for each type of signal installed.

476.4 PAYMENT:

The accepted quantities of vehicular and pedestrian signal indications, measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE, including visors, louvered backplates, LED's and all hardware necessary to provide a complete, and functional signal installation.

Part 400 add the following new Section:

SECTION 477

INTERSECTION LIGHTING

477.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing luminaires for intersection lighting in accordance with the location shown on the Traffic Signal Plan and the requirements of these specifications.

477.2 MATERIALS:

477.2.1 General: Intersection lighting materials shall conform to the type and location of the luminaire as indicated on the Traffic Signal Plan. All luminaires shall be supplied with lamps.

The luminaire shall be 250 watt, high pressure sodium with an internal ballast and shall be capable of operating on primary voltages of 110 and 220 volts, 60 Hz AC. The

luminaire shall be of the horizontal cut-off type. The light distribution pattern shall be Type III medium cut-off unless otherwise specified and shall conform to the Illumination Engineering Society Standards (IES).

Each luminaire shall be furnished with an instruction sheet which clearly shows installation procedures and instructions for adjusting the lamp socket. This instruction sheet shall include complete information on all socket positions and the IES light distribution produced from each setting.

477.2.2 Luminaire Housing: The luminaire housing shall be fabricated from a corrosive resistant metal material and have a baked on enamel finish. The housing shall be composed of three (3) sections, an upper housing section and two (2) lower housing sections. The upper housing section retains the reflector, lamp socket, and when specified the photo electric control receptacle. One (1) of the lower housing sections is the lens door frame and shall retain the 90-degree cut-off type flat glass lens. The other lower housing section shall be the ballast module door. The ballast module door shall contain the major electrical components.

The ballast module door shall be lowered by loosening a single stainless steel captive screw. After lowering, the ballast module door shall be removed by unplugging a quick-disconnect electrical plug and lifting the module off its hinges. The hinged lens door housing shall be latched to the upper housing by a spring loaded, single-action latch.

The housing shall have a slipfitter for mounting on a 2-inch mast arm tenon and shall be adjustable for leveling ±3 degrees from the horizontal.

477.2.3 Luminaire Optical Assembly and Gaskets: The optical assembly shall incorporate a snap-on high specular, anodized reflector and shall contain a filter which effectively absorbs gaseous contaminates or particulate matter. The flat glass lens of the optical assembly shall be manufactured of high quality, heat resistant glass.

A gasket of an approved neoprene material that will maintain a watertight and dust-tight seal throughout the temperature ranges inherent with high intensity discharge (HID) lamps, shall be securely fastened to the reflector. The gasket between the lamp socket and the reflector shall be polyester fiber that will maintain a dust-tight seal throughout the above specified temperature ranges.

The lamp socket shall be of rugged, high grade porcelain securely mounted on a support bracket which is adjustable in both the vertical and the horizontal directions. Each adjustment shall be clearly and permanently coded for each light distribution setting. The coding shall directly relate to the instruction sheet furnished with each luminaire.

477.2.4 Luminaire Ballast: The ballast shall be pre-wired to the lamp socket and terminal board. The ballast shall be mounted on the ballast module door and rated to the circuit voltage and size of the lamp specified. The ballast shall be a regulator type capable of starting lamps at -20 degrees Fahrenheit and operating them within the limits specified by the lamp manufacturer. The ballast shall limit lamp wattage variations to a maximum of five (5) percent even when the ballast voltage input varies ten (10) percent from the normal values. At the rated line voltage, the ballast shall have a minimum power factor of 90 percent. The starting amperes shall be less than operating amperes. The ballast shall provide the lamp voltage shown in the lamp table of Section 477.2.5.

477.2.5 Luminaire Lamps: The lamps shall be universal burning, clear, high pressure sodium type. Each lamp shall be clearly and permanently marked, giving the wattage and the American Standard Association number or the manufacturer's reference number. Lamps of the wattage specified shall conform to the following:

Wattage	Lamp Voltage	Minimum Initial Lumens	Rated Life
250	100	30,000	24,000 hr.

477.2.6 Photo Electric Control:

Remote Mounted PEC: The remote mounted photo electric control (PEC) shall be rated at 120 volt, 60 Hz AC 3000 volt-ampere. The operating temperature range shall be from -65° F to +158° F and 100 percent relative humidity. The PEC shall be a conventional glass-faced hermetically sealed ½" cell. A time delay shall be incorporated into the PEC circuit to prevent cycling at night by transient lights which might be focused on the PEC.

The PEC shall turn-on at 1.0 ±0.2 foot candles and turn-off at 1.8 foot candles. The PEC shall be UL listed for rain-tight applications. A built-in surge protector shall be provided to protect the PEC from lightning induced and line voltage transients.

The PEC shall be mounted on the controller cabinet with a ½" diameter threaded fitting. PEC shall be (Tork 2105) or approved equal.

The PEC and a luminaire test switch shall be wired in accordance with MCDOT Detail 4737.

477.3 CONSTRUCTION REQUIREMENTS:

Luminaires of the size specified shall be furnished and installed at the locations shown on the Signal Plan. Unless otherwise specified the luminaire shall be adjusted to the horizontal. Field adjustment of the lamp socket shall not be made unless specified on the signal plan or approved by the Engineer. The lamp socket shall be adjusted at the factory to achieve the light distribution as specified herein. All wiring shall be in compliance with the NEC, the requirements of MCDOT Detail 4737 and as shown on the plans. The intersection lighting circuit shall not be connected to the same service leg to which the controller cabinet assembly is connected.

477.4 MEASUREMENT:

Luminaires will be measured as a unit for each type of luminaire furnished and installed.

477.5 PAYMENT:

The accepted quantities of luminaires measured as provided above, will be paid for at the contract unit price. Payment shall be full compensation for the work, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 478

ELECTRICAL CONDUCTORS

478.1 DESCRIPTION:

The work under this section shall consist of furnishing and installing electrical conductors for traffic signals and intersection lighting in accordance with the Traffic Signal Plan, requirements of these specifications, and MAG specifications

478.2 MATERIALS

478.2.1 Electrical Conductors: The wire shall be annealed copper and shall be uncoated unless otherwise specified. The wire shall be solid for number 10, 12 and 14 AWG and smaller diameter wire, conforming to the requirements of ASTM B 3 for annealed bare copper wire. Conductors for sizes number 8 AWG and larger diameter wire shall be stranded and shall conform to ASTM B 8 for Class B stranding, unless otherwise specified, the conductors shall be insulated with THW grade thermoplastic compound and shall meet the requirements of UL 83. Insulation colors shall be permanent and an integral part of the insulation and shall not be applied as a surface treatment of coating. The insulation thickness shall conform to the requirements of the NEC. Conductor insulation shall be a solid color unless otherwise specified. The color shall be continuous over the entire length of the conductor.

Wire and cable shall be UL listed and rated at 600 volts. The UL label shall be present on each reel, coil or container of wire or cable. When requested, the Contractor shall submit to the Engineer the manufacturer's written certification that the product conforms to the requirements of these specifications.

All single conductors shall have plain, distinctive and permanent markings on the outer surface throughout their entire length showing the manufacturer's name or trademark, insulation type, conductor size, voltage rating and the number of conductors in the cable. Insulation colors shall be permanent and an integral part of the insulation and shall not be applied as a surface treatment coating.

Conductor colors and sizes for use in traffic signal and intersection lighting shall be as specified on the Traffic Signal Plan conductor schedule, and MCDOT Details 4799-1 and 4799-2.

(A) Loop Detector Lead-In Cables: Loop detector lead-in shielded cables shall be two conductor, stranded, twisted pair, tinned copper, polyethylene insulated cable with a polyethylene jacket, rated at 600 volts and 140 degrees Fahrenheit and shall be in conformance with IMSA Specification 50-2.

(B) Wire Tagging: Individual conductors for each vehicular and pedestrian phase group shall be secured together by two layers of plastic electrical tape and tagged with an approved wire I.D. marker (3M Scotchcode Wire Marker Tape or approved equal). Cables for each vehicular and pedestrian phase group shall be wrapped with two layers of plastic electrical tape and tagged with an approved wire I.D. marker (Scotchcode

Wire Marker Tape or approved equal). Wires and cables shall be individually marked in all cabinets and in pull boxes.

When IMSA cable is specified, wire insulation color assignment shall be in accordance with MCDOT Details 4799-1 and 4799-2.

(C) IMSA Cables: IMSA cable shall be used when specified on the plans. IMSA cables shall be polyethylene insulated copper conductors, polyvinyl chloride jacketed, rated at 600 volts for use in underground conduit or as aerial cable conforming to IMSA Specification 19-1.

The IMSA 19-1 cable shall be provided with the number and size of conductors as specified on the plans. The colors and tracers shall be permanent and an integral part of the insulation and shall not be painted, surface coated or adhered to surface. Ink strips are unacceptable. Conductor insulation colors shall be standard IMSA colors (as shown by the following table). Cable conductor color, phase and interval assignments shall be in accordance with MCDOT Details 4799-1 and 4799-2.

(D) Telephone Communication Cable: Telephone communication cable shall be used when specified on the plans. Telephone communication cable shall be in accordance with IMSA Specification 40-2. Cable shall be 19 AWG, 25 conductor, solid, twisted pair, polyethylene jacketed, with a rating of 300 volts.

Conductor Number	Insulation Color	Stripe Color	Conductor Number	Insulation Color	Stripe Color
1	Black	---	11	Blue	Black
2	White	---	12	Black	White
3	Red	---	13	Red	White
4	Green	---	14	Green	White
5	Orange	---	15	Blue	White
6	Blue	---	16	Black	Red
7	White	Black	17	White	Red
8	Red	Black	18	Orange	Red
9	Green	Black	19	Blue	Red
10	Orange	Black	20	Red	Green

478.3. WIRING PROCEDURES:

478.3.1 General Requirements: All wiring shall be in conformance with the NEC and the requirements of these specifications. All wire nuts and other wiring devices shall be UL listed. Conductor sizes and colors shall be as specified on the Traffic Signal Plan conductor schedule. Conductors shall be pulled into runs in a smooth continuous

manner, avoiding contact with sharp objects that might damage the insulation. Approved lubricants shall be used for inserting conductors in conduit. Before installation, conductors' ends shall be taped for moisture protection until connections are made. Splices are permitted in pull boxes, pedestals and cabinets.

Conductors shall have a minimum of 36 inches of slack from the conduit end bell in the pull box.

All phase wiring shall be boxed at the intersection, terminated and spliced in the number seven (# 7) pull boxes.

478.3.2 Conductor Splices: Splices shall be made utilizing wire nut connectors (Ideal model numbers 451, 452 and 454, or approved equal). Wire stripping length and wire size combinations shall be in accordance with the manufacturer's instructions supplied with the wire nut connector. Soldered connections will not be permitted. All phases shall be spliced in all pull boxes and unused phase wiring shall be spliced to the ground rod in the controller cabinet.

Splices shall be dipped or brushed with a minimum of three coats of liquid waterproof splicing compound (3M Scotch Kote or approved equal). The finished splices shall be such that their electrical and mechanical characteristics and insulation quality are equal to those of the original cable.

478.3.3 Bonding and Grounding: All metallic enclosures such as cabinets, pedestals, poles, conduit and cable sheaths shall be bonded to form a continuous grounded system. Non-metallic portions of the system, such as PVC conduit, shall have a No. 8 AWG bare copper bond wire installed with suitable connections to form a continuous grounded system.

At each service disconnect, cabinet foundation, or where otherwise specified, an approved copper-plated ground rod shall be installed. Each ground rod shall be a one-piece solid rod of the copper weld type or approved equal and shall be a minimum of 5/8 inch in diameter and 10.0 feet long. The rod shall be driven vertically into the ground to a minimum 9.0 feet below the surface. If the rod cannot be driven vertically it shall be installed in accordance with article 250-83 of the NEC. The ground rod may be located in a pull box. The service equipment neutral (grounded conductor) and the system grounding conductor (No. 8 AWG bond, solid) shall be connected to the ground rod with a copper-plated bolt or a brass bolt on the ground clamp.

The grounding electrode system shall be in accordance with articles 250-81 and 250-83 of the NEC.

Pole foundations shall have 25 feet of number 4 AWG bare copper conductor coiled and placed at the bottom of the excavation before concrete is poured. Pole foundation grounding electrodes shall be connected to the pole grounding screw in the hand hole with an approved lug connector.

A ground resistance test shall be performed for each installed ground rod prior to final connection of the utility service. Pole foundation coil grounds shall be tested as determined by the Engineer in the field.

The ground resistance shall be measured with a three terminal, fall of potential, direct reading, battery powered earth tester with a 0.50 to 500 ohm scale or digital read-out. The 25 ohm reading shall be approximately at mid scale.

The test shall be performed according to the manufacturer's instructions and OSHA requirements. Two auxiliary copper clad ground rods shall be driven into the ground a minimum of 3 feet. The lateral spacing for each test rod shall be given in writing on the test report form and the spacing shall be approved by the Engineer.

All tests shall be performed in the presence of the Engineer and the test results shall be written down, dated and given to the Engineer for approval.

Each ground rod or foundation ground shall be isolated with the bond wires disconnected when the test is being performed. The resistance to ground shall be 25 ohms or less. If it is not, additional ground rods shall be installed as required at least 15 feet from the original ground and shall be bonded to it. The test shall then be repeated for multiple grounds as necessary to achieve proper grounding below 25 ohms. As many additional ground rods shall be installed as is necessary to achieve proper grounding of 25 ohms or less.

The test shall be performed when the soil is dry. The contractor shall not add any chemical, or salt solutions to any portion of the grounding system. All grounding rods and foundation grounds to be tested shall be installed a minimum of ten days prior to testing unless otherwise determined by the Engineer in the field.

478.4 MEASUREMENT:

Conductors for traffic signals and intersection lighting will be measured on a lump sum basis.

478.5 PAYMENT:

Conductors, measured as provided above, will be paid for at the contract lump sum price, which price shall be full compensation for the item, COMPLETE IN PLACE.

Part 400 add the following new Section:

SECTION 480

INTELLIGENT TRANSPORTATION SYSTEM GENERAL REQUIREMENTS

480.1 DESCRIPTION:

This work shall consist of furnishing and installing complete, functional and operating Intelligent Transportation System (ITS) field devices, such as fiber optic cable and infrastructure, closed circuit television cameras (CCTV), dynamic message signs (DMS), and video image detectors (VID).

480.2 MATERIAL/ EQUIPMENT REQUIREMENTS AND TECHNICAL QUALIFICATIONS

480.2.1 Environmental: All electronic equipment installed in the field shall meet the minimum environmental requirements of NEMA Standards Publication No. TS-2, Section 2, Environmental Standards and Test Procedures, including, but not limited to:

1. Power Interruption;
2. Temperature and Humidity;
3. Transients, Power Service and Input Terminals;
4. Nondestruct Transient Immunity;
5. Vibration; and
6. Shock.

All equipment exposed to the environment shall be corrosion resistant and designed to withstand 80 mph winds with a 30% gust factor, and withstand the effects of sand, dust, and hose-directed water per the hose down test described in the latest edition of the NEMA Standards Publication 250. All connections shall be watertight.

480.2.2 Grounding: Grounding shall meet the requirements of Section 478.3.3 except as modified herein.

Electrolytic grounding may be used in lieu of ground electrodes for the cabinet grounding system. Electrolytic grounding systems shall be self-activating, sealed and maintenance free. Electrolytic ground systems shall hydroscopically extract moisture from the air to activate the electrolytic process without addition of chemicals or water. Hazardous material shall not be used to improve the performance of the electrolytic ground. Electrolytic systems shall be UL listed and have a minimum life expectancy of 30 years.

Following installation, the Contractor shall verify the resistance to ground of the cabinet grounding system is less than 5 ohms using the 3 terminal fall of potential method. If the tested resistance is greater than 5 ohms, the Contractor shall install as many ground electrodes as is necessary to meet the requirement.

480.2.3 Power: Electronic equipment and power supply shall meet the minimum requirements of NEMA Standards Publications No. TS-2, Section 2 Environmental Standards and Test Procedures.

The Contractor shall provide step-up/step-down transformers and AC to DC power conversion as needed to match the power requirements of each component.

480.2.4 Control of Material and Equipment

480.2.4A Source of Supply: The Contractor shall furnish all material and equipment required to complete the work.

480.2.4B Quality Requirements: Only materials and equipment conforming to the requirements of the specifications shall be incorporated into the work. Material and equipment shall be new.

480.2.4C Regulations and Codes: All electrical equipment shall conform to the current standards of the National Electrical Manufacturers Association (NEMA), National Electric Safety Code (NESC), and Underwriters' Laboratory Inc. (UL). All material and workmanship shall conform to the requirements of the National Electric Code (NEC), Illumination Engineers Society (IES), Standards of the American Society for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), requirements of the project plans, these specifications, the special provisions, and to any other codes, standards, or ordinances which may apply. Whenever references are made to any of the standards mentioned, the reference shall be interpreted to mean the code, ordinance, or standard that is in effect at the time of the bid advertisement.

480.2.5 Approval of Material, Equipment, and Technical Qualifications: All materials, equipment, and ITS technical qualifications shall be approved by the Engineer prior to proceeding with the ITS work.

480.2.5(A) Materials and Equipment: Any work in which materials or equipment not previously approved are used shall be performed at the Contractor's risk and may be considered as unauthorized and unacceptable and not subject to the payment provisions of the contract. Such materials or equipment may be subject to removal at the discretion of the Engineer.

Before ordering or installing any material or equipment, the Contractor shall submit four (4) copies of each proposed material and/or equipment list, including shop drawings and warranty information to the County at the pre-construction conference for approval by the Engineer. To be acceptable, the list shall be complete and contain all items supplied on the project by the Contractor, including pre-approved items. MCDOT reserves the right to reject an incomplete or unclear material submittal. All items on the list shall be identified by manufacturer's part number, model, included or excluded options, specification or other pertinent catalogue information. The materials from any catalog cuts shall be clearly indicated by the Contractor. One (1) copy will be returned to the Contractor for further action.

Substitution of brand name, part number, or model number may be made if it is in accordance with the specifications and is equal in form, fit, function, performance, reliability, and is approved by the Engineer. All proposed substitutions shall be identified in the material and/or equipment list submitted for approval.

The Contractor shall provide complete wiring diagrams for controller assemblies and auxiliary controller cabinets at the time of delivery for testing. A mylar original and four sets of prints shall be provided with each controller assembly. The wiring diagram shall illustrate all circuits and components in detail. All components shall be identified by name or number so as to be clearly noted in the drawings.

480.2.5(B) Technical Qualifications: The Contractor shall submit the technical qualifications of personnel to be used for construction of ITS facilities to the Engineer at the pre-construction conference. The Contractor or subcontractor personnel must be certified by the manufacturer or have an industry standard certification prior to the installation and / or integration of the designated ITS equipment. The installation and configuration personnel shall have a predetermined number of years of experience in addition to the certification levels as outlined below:

1. Fiber Technician – Minimum is Electronics Technicians Association (ETA) Fiber Optical Installer (FOI) certification or manufacturer fiber certification with five years of hands-on experience

A year of experience can be waived if a higher level of certification in the appropriate field is possessed.

A copy of a resume with five project references and three professional references may be submitted for consideration of approval for individuals not meeting the required certification and experience levels.

The technical qualifications listed above will be waived for equipment that is designated as "furnish only".

480.2.6 Certificate of Compliance: The Contractor shall submit an original or copy of a Certificate of Compliance along with required equipment lists and supporting material, including warranty information to the Engineer for approval as part of the material and/or equipment list.

If requested by the Engineer, the Contractor shall furnish laboratory results or independent certifications that substantiate compliance with the stated requirements. Materials or equipment covered by the certificate may be sampled and tested at any time, and, if found not in conformity with the requirements of the project plans or specifications, will be subject to rejection, whether in place or not.

Certificate of Compliance shall contain the following information:

1. A description of the material or equipment supplied;
2. Means of material identification, such as label, lot number, or marking;
3. Statement that the material complies in all respects with the requirements of these Specifications. When identified in the Specifications, Certificates shall state compliance to specific cited standards, such as RUS 1755.900, NEMA TS-2, etc. and specific required tests, such as burn-through testing for fiber optic conduit;
4. Clearly state any exceptions to the requirements of the Specifications; and
5. The name, title, and signature of a person having legal authority to bind the manufacturer or the supplier of the material. The date of the signature shall also be given. The name and address of the manufacturer or supplier of the material shall be shown on the certificate. A copy or facsimile reproduction (FAX) will be acceptable; however, the original certificate shall be made available upon request. The person signing the certificate shall be in one of the following categories:

   - An officer of a corporation.
   - A partner in a business partnership or an owner.
   - A general manager
   - Any person having been given the authority in writing by one of the three listed above.

480.2.7 Maricopa County Furnished Material and Equipment: Field Devices material and equipment furnished by Maricopa County Department of Transportation will be made available to the Contractor as specified in the Special Provisions. All specified items will be available at the following address:

Maricopa County Department of Transportation Warehouse
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

The Contractor shall call (602) 506-4885 forty-eight hours prior to pick-up.

The cost of handling and placing all material and equipment, after transfer to the Contractor, shall be considered as included in the contract price for the item in connection with which they are used.

The Contractor shall be held responsible for all material and equipment dispersed to the Contractor. The cost to make good any shortages or deficiencies, from any cause whatsoever and for any damage which may occur after transfer will be deducted from any monies due or becoming due to the Contractor.

480.3 METHOD OF CONSTRUCTION:

480.3.1 Cable and Active Electronics Labeling and Management: The Contractor shall provide labeling for all Contractor installed cables. Labeling shall be done in a neat, professional manner using permanent methods and products specifically designed and approved by the Engineer for each label scenario. At a minimum, provide the following labeling:

1. Trunkline and branch cables at pull boxes, cabinets, racks, and other points of entry with the appropriate cable identification number. Use permanently marked, removable cable sleeves;
2. Both ends of jumper cables and pigtails;
3. Sequentially label the jumper cable (front) side of patch panels in a consistent manner throughout the project; and
4. Labeling for all active electronics consisting of the device location, name, IP address, subnet mask, gateway and VLAN.

Provide cable routing and management in a neat and professional manner. Group and neatly tie cables to the sides of racks when applicable. Slack or excess cables shall be neatly coiled, tied, and stowed. Strain relief shall be provided for fiber optic cable, jumpers, and pigtails.

480.3.2 Labor and Supervision: The Contractor shall furnish technically qualified labor and supervision with experience in the construction of the ITS field devices and communications equipment encompassed by the project, to include all materials, equipment, tools, transportation and supplies required to complete the work in an acceptable manner; and in full compliance with the Specifications, the project plans, and Special Provisions.
The Contractor shall have on the work site at all times a competent supervisor capable of reading and thoroughly understanding the plans and specifications and be experienced in the construction of ITS field devices and communications encompassed by the project. When construction involves traffic signals, the Contractor's supervisor shall possess an International Municipal Signal Association (IMSA) Level II Traffic Signal Electrician Certification.

480.3.3 Plans: The Plans may graphically describe the location of component parts. Where dimensions on the plans are given or can be computed from other given dimensions, they shall govern over scaled dimension.

After completion of the project the Contractor shall provide the Engineer with a set of as-built drawings on clean prints of the original drawings. The as-built drawing shall indicate in a neat and accurate manner all changes and revisions in the original design. As-built drawings shall be submitted before final payment for completed work will be made.

480.3.4 Testing: The Contractor shall demonstrate that the equipment and the systems furnished and installed under the contract function in full compliance with the requirements of the contract documents. The Contractor shall furnish and maintain all required test equipment. Conduct tests in the presence of the Engineer using approved test procedures and submit the test results to the Engineer using approved test data forms. The Engineer will review the test results for conformance with the requirements of the contract documents. If the equipment or systems fail any part of the test, the Contractor shall make necessary corrections and repeat the entire test.

Notify the Engineer of the time, date and place of all tests at least 14 calendar days prior to the date on which a test is planned.

The Engineer may waive the right to witness certain tests.

The Contractor shall ensure that all equipment to be tested is ready for testing prior to the performance of, and Engineer's witnessing of the tests. Costs for transportation, meals, and lodging for the Engineer and his representatives that are associated with delays in the testing will be deducted from monies due, or to become due, or owed to the Contractor.

All test data forms shall be signed by the Contractor or authorized representative. When tests are witnessed by the Engineer, the Contractor shall obtain the witnessing Engineer's signature on the test data form.

The contract period will not be extended for time loss or delays related to testing.

Failure of any item to meet the requirements for any test will be counted as a defect and the equipment under test will be subject to rejection by the Engineer. Rejected equipment may be re-tested provided all areas of non-compliance have been corrected and evidence thereof is submitted to the Engineer by the Contractor.

For equipment that has failed and subsequently been repaired or modified, the Contractor shall prepare and deliver a report to the Engineer that describes the nature of the failure and the corrective action taken. Re-design and modification of failed equipment shall be done at no additional cost.

The Contractor shall conduct or support tests in the following stages of implementation:

1. Design Approval Test (DAT);
2. Factory Demonstration Test (FDT) (when required);
3. Factory Acceptance Test (FAT);
4. Stand-Alone Test;
5. Subsystem Test (SST);
6. Systems Integration Test (SIT) (when required); and
7. System Acceptance Test (SAT).

DAT verify that certain design parameters are satisfied prior to going to production. FDT are performed on a production unit and verify that the equipment meets the functional requirements. FAT verify that each unit of equipment as it comes off the production line operates as specified. Stand-alone tests verify that after installation but prior to interconnection, the equipment operates as specified. SSTs verify that units forming a subsystem continue to operate as specified when they are interconnected. The SIT is performed when previously untested hardware or software is developed and/or added to an existing system to verify that all system interfaces perform properly prior to final acceptance. The duration of the SIT shall be based on the complexity of the design. The SAT verifies that all the interconnected subsystems operate together

as one system. Upon successful completion and acceptance of the SAT, the project will advance to the warranty and operational support period.

480.3.4(A) Design Approval Tests (DAT): A DAT shall be conducted when required by the Specifications. The Contractor shall provide certification from the manufacturer for the following:

1. The equipment has been laboratory tested and meets or exceeds the environmental requirements of the Specifications. Specifically list test results and passing criteria for each required test.

2. The equipment meets the functional requirements stated in the Specifications, and is suitable for the intended application.

The certification shall state any requirements that are not met or have not been laboratory tested. Test procedures and results, or independent laboratory certification shall be made available upon request.

DAT certification shall meet the requirements stated in Section 480.2.6 for Certificates of Compliance. If a DAT and a Certificate of Compliance is required for the same equipment, both requirements may be satisfied by a single Certificate of Compliance.

Submit DAT certification with the equipment submittal data for Engineer's approval.

The Engineer may waive the DAT requirement for equipment that has been previously tested by the Maricopa County Department of Transportation (MCDOT) or certified for use in prior projects where the application is consistent and results deemed favorable. The Contractor should contact MCDOT for information regarding the DAT or certification status of a particular device.

480.3.4(B) Factory Demonstration Tests (FDT): A FDT shall be conducted when required by the Specifications. A FDT shall be conducted on a prototype model before going to production. The FDT requirement for models of equipment previously tested and/or certified by the MCDOT for the types of applications required in the project may be waived by the Engineer.

To gain a waiver, the Contractor shall submit certification from the manufacturer that states that the equipment has been tested and meets all the project requirements. State any exceptions or requirements not covered by testing. Provide supporting information such as test procedures, data, and results.

Costs for lodging and transportation for the Engineer and his representatives to witness the FDT, will be borne by MCDOT, for one visit lasting for up to five (5) consecutive days. In the event, the FDT requires multiple visits by the Engineer or lasts longer than five consecutive days, the Contractor shall be responsible for the added cost of transportation and lodging beyond what is covered by the County.

480.3.4(C) Factory Acceptance Tests (FAT): A FAT shall be conducted on each unit of equipment. The FAT shall verify proper operation of all required functions. The Contractor shall submit FAT results for approval and shall not deliver equipment until FAT results have been approved by MCDOT.

480.3.4(D) Stand-Alone Tests: The stand-alone test verifies after installation, but prior to connection to the system, that the equipment is capable of performing the function for which it was designed. The Contractor shall conduct approved stand-alone tests on each equipment group that performs a specific function. Testing is to use the manufacturer's approved software after the on-site installation of the equipment group is completed. The Contractor shall furnish all necessary test equipment and test software.

480.3.4(E) Subsystem Tests (SST): SST verify that units forming a subsystem continue to operate as specified when they are interconnected. A subsystem is defined as a logical grouping of field devices and/or central equipment that when interconnected and communicating, is capable of performing the function for which it was designed (i.e. – CCTV cameras, communications to/from the cameras, central control and display of the video images). The Contractor shall conduct approved SST for the field equipment and related equipment at the hubs and the Traffic Management Center (TMC). Conduct SST on the groups of equipment as identified in the project Special Provisions after the equipment has been installed and interconnected.

Subsystem tests shall not be considered successful until all equipment being tested is operational without failure for 72 consecutive hours.

480.3.4(F) System Integration Test (SIT): The SIT is performed when previously untested hardware or software is developed and/or added to an existing system to verify that all system interfaces perform properly prior to final acceptance. The Contractor shall begin the SIT upon completion of all the SSTs. The Contractor is responsible to keep the installed equipment operational during the system final integration as determined by the Engineer. The Contractor shall identify the SIT in the project schedule. The Contractor shall work with the Engineer to troubleshoot all problems related to non-specification compliant equipment and interfaces.

480.3.4(G) System Acceptance Test (SAT): The SAT verifies that all the interconnected subsystems operate together as one system. The SAT may commence upon completion of the SIT. The SAT consists of a 30-day test period demonstrating that the total system (hardware, software, materials and construction) is properly installed, is free from identified problems, exhibits stable and reliable performance, and complies with the contract documents.

The Contractor shall demonstrate all system functions using live control equipment. Test all normal and backup functions of redundant system equipment and include in the SAT any emergency conditions for which the equipment is designed to respond.

The Contractor shall troubleshoot, diagnose, identify, and isolate hardware and software problems and inconsistencies. Formulate possible solutions and implement all corrections needed for the Contractor installed equipment.

The Contractor shall make available on-site, key technical personnel familiar with the design and construction of each major system component within 48 hours of notification of a problem.

The Contractor shall correct all system documentation errors, omissions, and changes discovered and resulting from the SAT and previous testing. System acceptance will not be complete until corrected documentation is submitted.

In the event of a failure of a single piece of equipment during the SAT, the Contractor shall replace or repair the equipment and restart the 30-day test only for that piece of equipment. If the failure of the single piece of equipment prevents the proper operation of other equipment (e.g. – failure of the video encoder prevents proper camera control), all devices affected by the failure will have the test extended by however many days they were out of service.

The following conditions constitute a minor system failure and will result in a suspension of time during the 30-day SAT. After satisfactory remedial action, the 30-day test will be resumed and extended one additional day:

1. Interference with project operations due to vandalism, traffic accident, power failure, or lightning for which lightning protection devices as specified are not sufficient protection;
2. Failure to complete the objective of any test scenario due to lack of adequate documentation for equipment supplied by the Contractor. The Contractor shall re-test using revised documentation; and
3. Intermittent hardware, software, communication, or operation control malfunctions.

The following constitutes a major system failure. Any one of the following conditions shall result in re-initialization of the SAT from day zero:

1. Failure of 5% of any hardware or performance item within a 14-day period; and
2. Failure to correct any problem that adversely impacts the safety of the traveling public, the Engineer, or his representatives within four hours of notification.

480.3.4(H) Test Procedures, Software, and Data Forms: The Contractor shall prepare test procedures, software (when needed) and data forms for all required DAT, FDT, FAT, stand-alone, SST, and SAT procedures.

Submit test procedures, software, and data forms to the Engineer for approval at least 45 calendar days before the scheduled testing. The Engineer will review the submitted procedures, software, and data forms and return them within 14 calendar days after

receipt. If approved, tests may be conducted as scheduled. If rejected, reschedule the test, revise the submittal accordingly and resubmit for another review. Highlight the portions of the submittal that have changed to aid the Engineer's re-review of the material. Extension of the schedule will not be granted for rejected test procedures, software, and data forms.

As a minimum, prepare test procedures and data forms that include the following:

1. A step-by-step outline of the test sequence to be followed, showing a test of every function of the equipment or system to be tested;
2. A description of the expected operation, pass/fail criteria, and test results;
3. A data form to be used to record all data and quantitative results obtained during the test; and
4. A description of any special equipment, setup, manpower, or conditions required for the test.

480.4 WARRANTIES AND GUARANTIES:

The Contractor shall comply with the requirements of Section 180.8 and the following modifications:

If specific warranty requirements apply, they are listed under specific equipment requirements of the specifications. The cost of warranties and repairs are included as part of the contract unit price.

Within 60 days following approval of material and equipment, the Contractor shall submit a preliminary Warranty Administration Plan (WAP) to the Engineer for approval. The WAP is to address how the warranty period shall be administered, including the following requirements:

1. A 24 hour, seven day a week telephone number for MCDOT initiated warranty requests;
2. Repair or replace failed items that prevent normal operation of the system or any of the subsystems within 5 calendar days after notification. Respond to all other warranty requests within 14 calendar days;
3. Track each repair performed during the warranty period by serial number. Account for removals, replacements, and repaired items put back in service or into the spare inventory. Reset the warranty period for all repaired or replaced items. Establish a new warranty period for all new items;
4. Perform routine maintenance during the warranty period per vendor recommendations.
5. Provide a summary of all routine maintenance activities required, whether or not they fall within the one-year warranty period;
6. When used, replenish spare equipment inventory within 2 weeks, or stated vendor lead-time, whichever is greater;

7. Provide a complete list of equipment and vendor warranty periods, including spare equipment. Use Figure 480.1 or similar approved form; and
8. Provide copies of all warranty paperwork.

Submit a final WAP to the Engineer for approval at least 45 days prior to final acceptance. An approved WAP is required prior to final acceptance.

Prior to final acceptance, furnish an inventory of spare parts.

Within 90 days and no later than 30 days prior to the end of the one-year warranty period, submit the following to the Engineer for approval:

1. A complete list of all equipment (by serial number) that have warranties extending beyond the one year warranty period, including spare equipment. Use Figure 480.1 or similar approved form; and
2. All warranty paperwork extending beyond the one-year period, transferring ownership of the warranties to MCDOT.

Figure 480.1 – Equipment Warranties

Project Name
Equipment Warranties

Submitted by: _____

_____

Date: _____

Project No.: _____

Federal Project No.: _____

Serial #	Description	Location	Warranty Duration	Expiration Date	Date Received	Other Information

480.5 DOCUMENTATION:

Deliver a minimum of two sets of maintenance manuals to the Engineer for all furnished equipment. The manuals shall be supplied in durable, loose-leaf, three ring binders of appropriate size. All sections shall be permanently titled and have pages numbered and indexed for easy and efficient removal and replacement. In addition, an electronic copy of all manuals shall be provided for all equipment and software.

Format maintenance manuals in two sections that include the following material for all furnished equipment and components:

Section 1

- Description for each type of equipment and its components.
- Description of operation.
- Troubleshooting procedures at system and device levels.
- Preventative maintenance and adjustment procedures.
- "As-built" drawings including block diagrams, signal path, and detailed device and system connection diagrams (reference Section 480.3.3).
- Equipment source reference including manufacturer and nearest authorized service centers along with associated addresses and telephone numbers.
- Final warranty administration plan.

Section 2

- Manufacture's operation and installation.
- Manufacture's service and repair guides.

480.6 TRAINING:

When required, training shall be provided in two sessions.

The first training session shall be for maintenance and troubleshooting. This session shall be a minimum of four hours in length for each type of field device installed, including communications. This session shall be oriented for the County maintenance staff.

The second training session shall be for operations. This session shall be a minimum of four hours in length for each type of field device installed. This session shall be oriented for the County Traffic Management staff.

Part 400 add the following new Section:

SECTION 481
FIBER OPTIC CONDUIT AND PULL BOXES:

481.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing fiber optic conduit, warning tape, duct plugs, and pull boxes.

In lieu of trenching as indicated on the project plans, the Contractor may propose to install fiber optic conduit by means of directional drilling at no additional charge to the County. If the Contractor proposes such a substitution, the flowing conditions shall be met:

1. High Density Polyethylene (HDPE) conduit shall comply with the requirements listed herein,
2. The contractor shall provide original data sheets or a Certification of Compliance letter from the HDPE conduit manufacturer stating that the product meets the requirements listed herein, and
3. The Contractor shall obtain the written approval of the Engineer prior to procuring and installing HDPE conduit.

481.2 MATERIALS

481.2.1 Fiber Optic Conduit: All conduit and conduit fittings shall be listed by UL, and conform to NEC standards. Conduit to be installed underground by means of trenching or in concrete structures shall be rigid polyvinyl chloride (PVC) conforming to the requirements of UL 651 for Rigid Nonmetallic Conduit. PVC conduit and conduit fittings shall be Schedule 40, heavy wall, manufactured from high impact material and shall be rated for use at 90° C. PVC conduit bends shall be factory made in increments of 11.25°, 22.5°, 45°, and 90°. Field bending of PVC conduit is not permitted.

Conduit to be installed by means of directional drilling shall be HDPE conduit with a Standard Dimensional Ratio (SDR) of SDR 11 or better. The HDPE formulations used by the manufacturer must be specifically for conduit applications in accordance with ASTM F 2160: Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD) and ASTM D3035 Polyethylene (PE) Plastic Pipe (SDR) Based on Controlled Outside Diameter. It shall have a cell classification of PE334470C (for black conduit) and PE334470E (for colored conduit) per ASTM D3350: Standard Specification for Polyethylene Pipe and Fittings Materials. The HDPE conduit shall have a minimum Flexural Modulus, MPa (PSI) of 80,000 per ASTM D 790 and a minimum tensile strength at yield (PSI) of 3,000 per ASTM D 638.

All rigid metallic type conduits shall be manufactured of galvanized steel conforming to requirements of UL 6 for Rigid Metallic Conduit and to NEC standards. All exposed conduit and conduit fittings to be installed above ground shall be rigid metallic type.

Bends used for fiber optic conduit runs shall comply with the following requirements:

Conduit Size	Min. Radius
2"	24"
2½"	30"
3"	36"
4"	48"

481.2.2 Multiduct Conduit: Multiduct conduit (multiduct) shall be manufacturer-assembled conduit sections consisting of an outerduct, 4 factory-installed innerducts, coupling bodies, and spacers.

Bends used for multiduct conduit shall have a minimum radius of 4' and shall be available from the multiduct manufacturer in increments of 11.25°, 22.5°, 45°, and 90°.

Multiduct conduit shall be marked with a longitudinal print line with the wording "Install This Side Up" or approved equivalent to assure proper innerduct/conduit orientation and alignment. Male ends of multiduct conduit shall have circumferential insertion depth marks to provide a visual indication that proper insertion is achieved.

481.2.2(A) Multiduct Conduit with Outerduct: Multiduct with outerducts shall meet the following requirements:

Outerducts shall be constructed of metal, fiberglass, or polyvinyl chloride (PVC).

- Metal outerducts shall be Schedule 40 and galvanized. Male and female ends shall be threaded.
- Fiberglass outerducts shall have a minimum wall thickness of 0.7", with an integral coupling of 5" minimum length.
- PVC outerducts shall be Schedule 40 with an integral coupling of 5" minimum length. PVC outerducts shall comply with NEMA TC-2 and ASTM F512.

Innerducts shall be fabricated using either High Density Polyethylene (HDPE) or PVC for straight sections, and either HDPE or nylon66 for bends. Innerducts shall contain, or be factory treated with a friction reducing material that is dry-to-the-touch. Innerducts shall meet the requirements of Bellcore GR-356.

- Innerducts shall have a nominal inside diameter of 1.2". HDPE innerducts shall have a minimum wall thickness of 0.1". PVC innerducts shall have a minimum wall thickness of 0.06".

- Each length of multiduct shall have one white and three gray colored innerduct. Colors as indicated above shall be oriented in a clockwise direction when viewing the male end of the multiduct. Innerducts shall be aligned in the outerduct with the white innerduct located directly below the outerduct longitudinal print line.

- Bends may use the same color for all innerducts, provided that the bend does not terminate in a junction box. Colors shall be impregnated within the innerducts and shall be consistent throughout the Project.

- Innerducts shall be held together in a square configuration by a system of spacers that provides a rigid internal system to hold the innerducts in formation, without twists and sags. Spacing of the spacers shall not exceed 5'.

Geotextile Innerduct shall be fabricated using an engineered, geotextile mesh fabric material composed of nylon and polyester.

Each length of conduit that requires geotextile innerduct as shown on the project Plans shall be equipped with one three-inch three-cell innerduct. The innerduct shall be continuously marked with red stitching.

All geotextile innerduct shall be furnished with a pull rope within each of the cells.

Coupling bodies shall be incorporated in all lengths of multiduct, bends, and fittings to seal between the outerduct and innerducts. Coupling bodies shall facilitate field assembly of the multiduct sections without the use of lubricants. Sealing components within the coupling bodies shall be of an anti-reversing design to keep the multiduct conduits together without the use of cement. Coupling bodies shall allow for innerduct movement due to expansion/contraction without affecting the innerduct sealing.

Multiduct terminations used at end of multiduct runs at junction boxes, cabinets, etc. to seal the innerduct to the outerduct shall be durable and fabricated from no metallic parts except nuts, bolts, washers and fasteners which shall be stainless steel. Terminations shall provide a watertight and airtight seal of at least 20 psi.

481.2.2(B) Multiduct with No Outerduct: Multiduct with no outerduct shall consist of multiple PVC, HDPE or metal conduits locked together in formation using spacers and tie downs located no more than 5' apart along the multiduct.

PVC and metal conduit that comprise the multiduct shall be Schedule 40. HDPE shall be SDR 13.

481.2.3 Conduit and Innerduct Plugs: Conduit plugs, caps, or sealing fittings for sealing empty conduit and occupied conduit shall be durable, easily removable, reusable, and produce a watertight seal. Plugs, caps, and sealing fittings shall be designed for the diameter of the conduit and cable, shall cause no damage to the cable when installed, and shall have a rope tie on the inside end for connection of a pull rope. Plugs, caps, or sealing fittings used for fiber optic conduit shall provide a watertight and airtight seal of at least 20 psi. Plugs that seal conduits containing fiber optic cable shall be of the split design to allow installation and removal around in-place cables. Plugs, caps, or sealing fittings shall be approved by the Engineer.

481.2.4 Conduit Spacers and Tie Downs: Conduit spacers and tie downs shall be dielectric and have sufficient strength to support the conduits in a straight line above the bottom of the trench.

481.2.5 Fiber Optic Conduit Warning Tape: Conduit warning tape shall be a four (4) mil inert plastic film specially formulated for prolonged use underground and shall be a minimum of 3 inches wide. All tape shall be highly resistant to alkalis, acids, and other destructive agents found in the soil.

Tape shall have a continuous printed message warning of the location of underground conduits. The message shall be in permanent ink formulated for prolonged underground use and shall bear the words, 'FIBER OPTIC CABLE BURIED BELOW' in black letters on a orange background.

481.2.6 Fiber Optic Pull Boxes: Pull boxes shall be traffic rated for H20-44 loading and conform to the dimensions shown in MCDOT Standard Details.

Pull box covers shall have the message "MCDOT ATMS" cast in the pull box covers in 1" letters.

Appropriately sized knockouts shall be provided on each side of the pull box. Knockouts on opposite sides shall be aligned.

The ITS Number 7 pull box shall consist of an upper and lower section. The lower section shall be a stackable extension and contain the required knockouts. The non-traffic rated pull box and extension shall be encased in concrete as shown in MCDOT Detail 4810.

Number 9 pull boxes shall have provisions for lashing coiled cable and installation of underground splice closures.

481.3 CONSTRUCTION REQUIREMENTS

481.3.1 Fiber Optic Conduit: Installation of fiber optic conduit shall meet the following requirements:

481.3.1(A) General Requirements: Conduit shall be furnished and installed at the locations and of the sizes shown on the plan. Unless changes are necessary to avoid underground obstructions all underground conduit shall be installed in a straight line from pull box to pull box and/or from foundation to pull box and shall be of one continuous size. Any change in conduit routing must be approved by the Engineer and documented by the Contractor on as-built plans.

When obstructions are encountered during installation and fiber optic conduit cannot be economically located elsewhere, the obstruction shall be bypassed by deflecting the conduit at a rate of at least 10:1. Minimum 4' radius, maximum 90° bends may be used to avoid obstructions at locations where 10:1 deflection is not possible, provide the least degree bend needed to clear the obstruction. Flexible bends may be used when needed to facilitate proper location of the fiber optic conduit, only at locations approved by the Engineer. Fiber optic conduit runs between any two pull boxes shall not employ more than 4 bends, or exceed an angular sum of 270°.

High-performance fiber optic cable lubricant shall be used to lubricate the conduit for long cable duct pulls beyond 700' or pulls with numerous turns totaling over 180 degrees. The lubricant must be suitable for outdoor temperatures, flame retardant, unable to affect the properties of the cable jacket, and produce a coefficient of friction that does not exceed 0.25 when used on PE jacketed or other types of cables.

The lubricant shall be approved by UL or CSA. The lubricant should be present at all points of the duct, cable feed locations, intermediate pull locations, bend locations. The lubricant shall be applied with a lubricant collar and pump. The quantity of lubricant required for installation shall be determined using the formula provided by the lubricant manufacturer.

Fiber optic conduit shall enter fiber optic pull boxes through sidewall or endwall knockouts. The use of 90 degree elbows at pull boxes in new construction is subject to the Engineer's approval.

Conduit spacers shall be used to arrange multiple conduits in the trench to provide a minimum of 1½" between conduits. The conduit spacers shall be used at intervals not exceeding 5' on-center, or the conduit manufacturer's recommendations. Conduit spacers shall remain upright and not collapse during backfilling, compaction, and pavement installation operations.

The PVC conduit shall be cut square and trimmed to remove all rough edges. PVC conduit connections shall be of the solvent weld type. Purple primer conforming to the requirements of ASTM F 656 shall be applied to the joined surfaces prior to use of

cement. The joint cement shall be the gray PVC cement conforming to the requirements of ASTM D 2564. Where a connection is made to rigid metallic conduit, the coupling used shall be a PVC female adapter. Expansion joint fittings shall not be installed in PVC conduit runs between pull boxes unless specified. Expansion joint fittings shall be installed in conduit runs in which both ends of the conduit are fixed in place, such as conduit runs between two foundations.

Expansion joint fittings shall be installed in conduit runs which cross a concrete structure expansion joint. Approved expansion fittings shall allow for a linear thermal expansion of up to 6 inches.

Fiber optic warning tape shall be installed above fiber optic conduit installed in open trenches. The message side shall face up. If electrical conduit shares the same trench, the conduit warning tape for the electrical conduit is not required.

A detectable locator #8 AWG solid copper wire and a pull tape shall be installed in each non-metallic fiber optic conduit to facilitate locating underground fiber optic cables. One #8 AWG wire is required to run continuously with splices in each conduit.

Geotextile innerduct shall only be installed by the cable/conductor installer.

Pull tape shall be installed in populated and unpopulated fiber optic conduit and innerduct to facilitate future installations. The pull tape used shall be the flat type, each meter or foot marked sequentially for easy identification of distance, Kevlar weave, designed and constructed not to stretch or spring, and shall have a minimum tensile strength of 1250 lbs.

Conduit embedded in concrete structures shall be securely attached to the reinforcing steel at intervals of approximately 12 inches. Expansion fittings shall be installed where conduit crosses expansion joints in the structure. Where bonding is not continuous, expansion fittings shall be provided with a bonding jumper of number 6 AWG flexible wire. Where it is not possible to use expansion fittings, sleeves of sufficient size shall be installed to provide a minimum ½ inch clearance between the conduit and the inside wall of the sleeve. The sleeve shall be discontinuous at structure expansion joints. Sleeves and conduit embedded in concrete structures shall be cleaned out with a mandrel and blown out with compressed air.

PVC conduit shall be stored and handled in an approved manner to minimize ultraviolet deterioration due to exposure to sunlight.

All empty fiber optic conduits and innerducts shall be sealed with a cap or plug at each end.

Pull tape shall be attached to the plug, cap, or sealing fitting on each end of the conduit.

During shipping and while on the job site, the open ends of all runs of ducts, conduit, and multiduct conduit shall be sealed with removable caps, plugs, or sealing fittings to

prevent the entry of rodents, dirt, sand and other foreign materials. These caps, plugs, or sealing fittings shall be removed only when the Contractor is in the act of joining sections together, testing, or pulling cable. The open ends shall be immediately recapped or resealed after completion of these activities. This requirement shall be met for all empty or occupied ducts, conduit, and multiduct conduit located anywhere on the Project site, including but not limited to those at equipment enclosures and pull boxes.

If temporary caps or seals are used, the methods and materials shall be approved by the Engineer. Temporary caps and seals shall be replaced with caps, sealing fittings, or plugs conforming to the requirements of the Specifications prior to acceptance.

481.3.1(B) Multiduct Conduits: Multiduct conduit shall be installed in accordance with the Specifications and the manufacturer's recommended installation procedures.

Visually inspect each section of multiduct prior to installation and verify that the innerducts are straight and do not sag.

Cutting of multiduct shall not be allowed, except to obtain proper lengths at bridge structures, junction boxes, and when needed for connection of bends at specific points along the multiduct runs.

Multiduct shall be joined in such a manner that colored innerducts match up.

Should connection of multiduct to existing multiduct be required, the joining multiduct shall be of the same manufacturer of multiduct as the stub out. This requirement does not preclude use of a different manufacturer of multiduct in areas where there are no existing multiduct or areas where multiducts meet at a pull box. At the Contractor's option, a pull box may be installed in order to meet the above requirement; however, the cost of furnishing and installing the pull box shall be included in the cost of the multiduct.

Field bending of multiduct shall not be permitted.

Terminations that provide a watertight seal between the innerduct and outerduct shall be installed for all multiduct ends terminated at junction boxes.

481.3.1(C) Depth Requirements: Fiber optic conduit shall be installed at a minimum depth of 4' to the top of the conduit except at pull box locations.

481.3.1(D) Railway Crossings: Fiber optic conduit shall be installed in a steel sleeve or conduit specially designed for a jack/bore.

Sleeves shall be installed by a method approved by the Engineer.

Sleeves shall be a minimum of 6" for one 4" conduit, and 10" for two 4" conduits.

The depth of the sleeve installation varies depending on conflicts with existing utilities and obstructions.

Expansion fittings shall be installed on all conduits at one end of the steel pipe sleeve when the sleeve is less than 100' in length, and at both ends if the steel sleeve is 100' or greater in length. The expansion fittings shall be installed a minimum of 3' from the end of the steel pipe sleeve.

481.3.1(E) Directional Drilling: For all Directional Drill (DD) conduit installations the contractor shall use HDPE conduit along the prescribed bore path from the surface with minimal impact to the surrounding area. The pulling tension for installing the HDPE conduit shall not exceed 75% of the manufacturer's tensile strength rating for each size and configuration of conduit to prevent elongation or "necking down" during installation.

When joining segments of HDPE conduit, the contractor shall use non-corrosive, sit-tight, water-tight couplings. Heat fusion, electrofusion fittings and mechanical connections shall be permitted provided the HDPE conduit and joining device manufacture's recommendations are observed and the internal diameter of the HDPE conduit is not reduced. Extrusion welding and hot gas welding to join HDPE conduits is not permitted.

Prior to any conduit installation by DD the contractor shall submit bore profiles showing the proposed fiber optic conduit locations with relation to all existing utilities and finished grade. All utilities and the proposed conduit shall be shown with their sizes and elevations dimensioned. Bore profiles shall be submitted and approved by the Engineer prior to installation.

Upon completion of joining HDPE conduit sections and setting the pull boxes, the contractor shall clean the HDPE conduit with compressed air and then conduct a mandrel test as outlined in 481.4.2.

481.3.1(F) Trenching, Backfilling, and Compaction: Trenching, bedding, backfilling, and compaction shall be in accordance with Section 601. Trenches shall not be excavated wider than necessary for the proper placement of conduit and pull boxes. Minimum trench clear width at each side of conduit at spring line is two inches (2").

After conduits, spacers, and tie downs are in place, the Contractor shall notify the Engineer for inspection. The conduit and underground material or equipment shall be approved by the Engineer before placement of CLSM or fill.

One-sack Controlled Low Strength Material (CLSM) shall be installed in the bottom 24" of fiber optic conduit trenches. The CLSM 24" depth will vary at pull boxes to remain six inches clear of the finished grade. CLSM shall be placed in compliance with the requirements of Section 604.

481.3.2 Fiber Optic Pull Boxes: Pull boxes of the type specified shall be furnished and installed at the locations shown on the plans.

Pull boxes shall be set and adjusted to be flush with the top of the adjacent curb or sidewalk grade.

All pull box covers shall be secured with tamper proof bolts with washers before final acceptance of the project.

All pull boxes shall be left in a clean condition, free of dirt and debris upon completion of the work.

Following installation of fiber optic conduit, neatly seal the knockout area.

481.4 TESTING REQUIREMENTS:

Contractor testing shall comply with requirements of Section 480.3.4 and the following:

481.4.1 Design Approval Tests (DAT): The Contractor shall furnish DAT certification for the following tests:

481.4.1(A) Fiber Optic Conduit: Bends for fiber optic conduit and innerduct shall conform to the requirements of the following tests for burn resistance and friction:

1. Burn resistance: Perform the burn resistance test on conduit bend or innerduct wrapped around and secured to a rigid form. Thread an appropriate length of 0.25" diameter braided polyethylene pull tape through the conduit/innerduct and sew the ends together to create a continuous loop. The loop of pull tape shall be wrapped around a powered capstan and drawn away from the test sample to provide a continuous tension of 450 lb. Draw the tape continuously through the sample with the powered capstan at a rate of 480' per minute. The sample shall not burn through within 90 minutes.

2. Friction: Conduit and innerducts shall have a coefficient of friction of 0.09 or less when tested in accordance with Bellcore GR-356.

Coupling bodies, for multiduct, shall be tested for water tightness and air tightness at 73°F ± 4° with a relative humidity of 50 percent, in accordance with the following procedures:

1. Water tightness (outerduct): Two lengths of multiduct (one factory bell and one factory spigot end) shall be joined without the use of force other than that required by hand. The center of the section of the multiduct conduit containing the joint shall be enclosed within a housing suitable for containing water at or above a positive pressure of 20 psi or a water column of 12'. The enclosure shall be sufficiently filled with water to completely cover the conduit joint within. A regulated air pressure of 20 psi or a water column of 12' above

the joint shall be applied to the interior of the enclosure by way of a sealed connection. The ends of the multiduct shall protrude through the sealed exterior of the housing in order to facilitate inspection for leakage of water to the inside. The multiduct assembly shall not show signs of leakage for a period of 24 hours.

2. Air tightness (innerducts): Two lengths of multiduct (one factory bell and one factory spigot end) shall be fully joined without the use of force other than that required by hand. One end of an innerduct shall be sealed with a plug. The opposite end of the same innerduct shall be fitted with a plug and hose assembly for application of air pressure. Air pressure shall be applied until the pressure within the test sample is 480 psi. The coupling assembly shall not allow more than a 20 percent air pressure drop in 2 minutes from the initial pressure of 480 psi. The above procedure shall be repeated on each remaining innerduct.

481.4.1(B) Fiber Optic Pull Boxes: The Contractor shall provide DAT certification that demonstrate pull boxes and covers comply with the loading requirements.

481.4.2 Stand-Alone Tests:
The Contractor shall demonstrate by pulling a cleaning mandrel or ball mandrel, correctly sized for the conduit, through all new conduit runs to insure that the conduit was not deformed during installation. The conduit may be brushed or swabbed, if deemed necessary, prior to pulling the mandrel through the conduit. No separate measurement or payment shall be made for this activity. If the mandrel passes through the conduit the contractor shall install pull tape in the conduit. If the mandrel encounters a deformity in the conduit, the contractor shall replace the entire segment of conduit between pull boxes with new conduit at no additional cost to the County

481.5 WARRANTY REQUIREMENTS:

All equipment furnished under this section shall meet the one year warranty requirements identified in Section 480.4.

481.6 DOCUMENTATION:

The contractor shall provide maintenance manuals for multiduct conduit, plugs, pull boxes, and other equipment per the requirements of Section 480.5.

The contractor shall provide as-built drawings of all installed conduit, innerduct, pull boxes, fiber optic cable, and fiber optic termination equipment. All vertical and horizontal conduit adjustments made shall be recorded on as-built drawings. **481.7 TRAINING:**

When required by special provision, the contractor shall meet the training requirements of Section 480.6.

481.8 MEASUREMENT:

Approved installations of fiber optic conduit, innerduct and multiduct will be measured by the linear foot for each type and size. Measurement will be the horizontal distance along the installed centerline from center of pull box to center of pull box, from center of pull box to center of pole foundation, from center of pull box to center of cabinet foundation or from center of pull box to edge of building as applicable..

Pull boxes will be measured as a unit for each pull box size.

481.9 PAYMENT:

The accepted quantities of conduit, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the item, COMPLETE IN PLACE, including but not limited to excavating, placement of CLSM, backfilling, compacting, fittings, end closures, marking tape, detectable locator wire, testing, warranty, documentation, and training. No separate measurement or payment will be made for rigid metal conduit bends or rigid non-metallic conduit bends at pull boxes.

The accepted quantities for pull boxes, measured as provided above, will be paid for at the contract unit price, which shall be full compensation for the COMPLETE IN PLACE installation.

Part 400 add the following new Section:

SECTION 482
FIBER OPTIC CABLE AND EQUIPMENT:

482.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing underground and indoor fiber optic cable and related equipment, including trunkline cable, branch cable, jumper cable, pigtails, connectors, patch panels, splice trays, splice units, termination units, splice and termination units, and underground splice closures.

482.2 MATERIAL REQUIREMENTS:

482.2.1 Fiber Optic Cable: Unless otherwise stated, all fiber optic cable shall be single mode fiber optic (SMFO) cables that are of loose tube construction, filled with a water-blocking material, and constructed by a certified ISO 9001 or 9002 manufacturer.

Fiber optic cable shall be dielectric and comply with the requirements of US Department of Agriculture Rural Utility Services specification RUS 1755.900, IEC 60793, and ITU G652.D except as modified by the Specifications. The fiber optic cable shall comply with GR20-CORE, EIA/TIA, and REA/RUS PE-90. The color code shall comply with ANSI/EIA 359-A, 598-A, IEC 60304. Indoor fiber optic cable shall also comply with the requirements of Article 770 of the NEC.

482.2.1(A) Fiber Optic Cable Performance and Construction: Use fiber optic cable that complies with the following requirements:

Cladding diameter:	125 ± 0.7 μm
Core-to-cladding offset:	≤ 0.8 μm
Cladding non-circularity:	≤ 0.5%
Maximum attenuation:	≤0.35 dB/km at 1310 nm; ≤0.25 dB/km at 1550 nm
Microbend attenuation (1 turn, 32 mm diameter):	≤ 0.05 dB at 1550 nm
Microbend attenuation (480 turns, 75 mm diameter):	≤ 0.05 dB at 1310 nm
Allowable Bending Radius for Fiber	≥ 15 mm
Attenuation uniformity:	No point discontinuity greater than 0.05 dB at either 1310 nm or 1550 nm.
Mode-field diameter (matched cladding):	8.6 ± 0.4 μm at 1310 nm; 10.5 ± 1.0 μm at 1550 nm

Maximum chromatic dispersion:	≤ 3.5 ps/(nm x km) from 1285 nm to 1330 nm and < 18 ps/(nm x km) at 1550 nm
Fiber polarization mode dispersion:	≤ 0.2 ps/(km)1/2
Fiber coating:	Dual layered, UV cured acrylate applied by the fiber manufacturer
Coating diameter:	245 µm ± 5 µm
Minimum storage temperature range for Cable:	-40°C to +75°C (-40°F to 167°F)
Minimum operating temperature range for Cable:	-20°C to +70°C (-4°F to 158°F)
Rated life:	Certify a 25 year life expectancy when installed to manufacturer's specifications
Ensure the change in attenuation for single-mode from -20°C to +70°C (-4°F to 158°F) does not exceed 0.2 dB/km at 1550 nm, with 80% of the measured values no greater than 0.1 dB/km at 1550 nm.	

Buffer Tubes: Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel that is free from dirt and foreign matter. The gel shall allow free movement of the fibers, without loss of performance, during installation and normal operation including expansion and contraction of the buffer tubes. The gel shall be readily removable with conventional nontoxic solvents.

Buffer tubes shall be stranded around a central member using the reverse oscillation or "S-Z", stranding process. Use filler rods when needed in trunkline cable to lend symmetry to the cable section.

The nominal outer diameter of the tubes shall be 2.7mm for tubes with 12 fibers or less.

Central Strength Member: The fiber optic cable shall have a central strength member designed to prevent buckling of the cable. The central member shall be covered with a super absorbent polymer in order to prevent water migration through the center of the cable core should the core become exposed.

Cable Core: The fiber optic cable shall use a dry water-blocking material to block the migration of moisture in the cable interstices.

Two polyester yarn binders shall be applied counter-helically in order to secure the buffer tubes to the central member. The binders shall not crush or deform the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

For single layer cables, the yarn binders shall contain super absorbent polymers to prevent water migration.

Tensile Strength Members: The fiber optic cable shall have tensile strength members designed to minimize cable elongation due to installation forces and temperature variation.

Underground fiber optic cable shall withstand a 600 lb tensile load applied per EIA-455-33 where the change in attenuation does not exceed 0.2 dB during loading and 0.1 dB after loading. Use cable rated for an installed tensile service load of 200 lbs or more.

Cable Jacket: The fiber optic cable jacket shall be constructed of medium density polyethylene (MDPE) that has been applied directly over the tensile strength members and water-blocking material. The jacket shall have at least one ripcord designed for easy sheath removal.

Cable Markings: Provide cable with markings that include cable length markings (in feet) and the year of manufacture. In addition, provide cable with markings approved by MCDOT, to distinguish between trunkline (between communication hubs) and branch cables (spliced to trunkline cables). All cable markings shall be labeled with indelible markings.

Environmental: Cable shall be capable of withstanding the following conditions without damage or decrease in function:

1. Cable operating temperature per EIA/TIA-455-03;
2. Total immersion in water with natural mineral and salt contents;
3. Salt spray or salt water immersion for extended periods; and
4. Wasp and hornet spray.

482.2.1(B) Cable Length and Shipping: Base the length of each fiber optic cable on field measurements. Include in the measurement, the required amount of slack cable at pull boxes, field cabinets, hubs, and equipment racks as required by the Plans.

Stencil, letter, or provide the following information on a weatherproof tag firmly attached to the reel:

1. Factory order number;
2. Job number;
3. Ship date;
4. Manufacturer's cable code;
5. Type of cable (single mode, outdoor, indoor);
6. Beginning and ending length markings; and
7. Measured length and attenuation.

482.2.1(C) Trunkline Fiber Optic Cable: Trunkline fiber optic cable shall have a minimum of 96 fibers, with 12 fibers per buffer tube.

482.2.1(D) Branch Fiber Optic Cable: Branch fiber optic cable shall have a minimum of 12 fibers, with 12 fibers per buffer tube, and factory installed male Ultra Physical Contact (UPC) LC connectors on one end for each fiber in the cable. Leave the other end of the branch cable bare for splicing to the trunkline fiber.

482.2.1(E) Fiber Optic Jumper Cable: Jumper cables shall meet the following requirements:

1. 250 μm buffering of each fiber;
2. 900 μm buffering of each fiber applied after the initial 250 μm buffering;
3. Maximum factory measured insertion loss of 0.5 dB per EIA/TIA 455-171;
4. Less than 0.2 dB loss when subjected to EIA/TIA-455-1B, 300 cycles, 0.5 kg;
5. Aramid yarn strength member;
6. Rugged 0.12" (approximate) PVC sheathing;
7. Minimum bend radius of 12" following installation, 25" during installation;
8. Minimum tensile strength of 480 lbs;
9. UPC LC Connectors that are factory terminated; and
10. Lanyard dust caps for fiber optic connectors.

482.2.1(F) Fiber Optic Pigtail: Fiber optic pigtails shall meet the requirements for jumper cable, except as amended by this section. Pigtails that are totally contained within a fiber optic splice or termination unit, need not have a 0.12" PVC jacket. All fiber optic pigtails shall be UPC type LC. The other end shall be left bare for splicing to fiber.

482.2.1(G) Fiber Optic Connectors: Fiber optic connectors shall meet the following requirements:

1. Pre-installed by the cable manufacturer;
2. Type shall be machine polished UPC LC;
3. Designed for terminating single mode fiber with 125 μm cladding;
4. Return loss factory-measured – 55 dB (UPC) or less from -40°C to +70°C (-40°F to 158°F);
5. Factory-measured attenuation less than 0.5 dB; and
6. Connector attenuation will not change more than 0.2 dB following 4800 re-matings; and
7. Lanyard dust caps for fiber optic connectors.

Connectorized cable shall have strain relief boots that can withstand an axial pull of 25 lbs with no physical damage to the connector or performance of the fiber.

Hand polished connectors are not authorized for use.

482.2.2 Fiber Optic Splice And Distribution Equipment

482.2.2(A) Fiber Optic Patch Panels: Fiber optic patch panels shall have protective covers for all unused couplers.

482.2.2(B) Splice Trays: Splice trays shall be designed specifically for housing single-mode fusion splices protected by heat-shrink sleeves. Splice trays shall be easy to install and remove, and have provisions for a minimum entry of four buffer tubes.

482.2.2(C) Fiber Optic Splice and Termination Units: Fiber optic splice and fiber optic termination units shall be properly sized for the required number of splices and terminations subject to the minimum requirements stated for each configuration. Fiber optic splice and termination units shall meet the following requirements:

1. Have provisions for minimum of 6 fiber optic cable entries;
2. Rack mounted;
3. Have front and rear doors or removable panels;
4. Have a top, bottom, and 4 sides that fully enclose the interior and protect its contents from physical damage;
5. Manufactured using 16 gauge aluminum or approved equivalent and corrosion resistant;
6. Provisions for neatly routing cables, buffer tubes, and fan-out tubing;
7. Have internal feed-through provisions that allow cables to be internally routed between two units installed adjacent to each other; and
8. Have provisions for externally securing the fiber optic cable, sheath, and central strength member.
9. Suited for Patch and Splice Modules
10. Include removable front and rear fiber routing guides
11. Textured black powered coat finish
12. 4RU Panels conforming to 15.5x17x15x7 (in)
13. Aluminum construction per ASTMB209
14. Unloaded weight of 9 lbs (4RU), 5lbs (2RU), and 4 lbs (1RU)
15. Use LGX interconnect platform

Fiber Optic Splice Units: Fiber optic splice units shall consist of a single housing with provisions for installation of multiple splice trays as required. The splice unit shall have provisions for future installation of 2 splice trays of minimum 12 splice capacity each, in addition to the required amount.

The splice unit shall have a pull-out shelf that allows easy access to the splice tray, buffer tube and fiber storage area that permits fusion splicing to be conducted at a minimum distance of 16 feet from the housing. Units with hinged shelves are not acceptable. The following permanent marking shall be provided on the door or front access panel: "Communication Fiber Optic Cable Splice Area Inside".

Fiber optic splice units shall consist of a single modular housing that has LGX interconnect adaptability. Each Patch and Splice module should use sr-15e fiber that can be configured for up to 24 fiber splices to LC connectors and corresponding bulkheads. These patch and splice modules should be self-contained with the bulkheads providing one connection interface and the internal splice chips providing the other connection interface.

Mounting provisions for the patch and splice modules should include individual rack or wall-mountable brackets that allow for setup in limited-space applications.

Fiber Optic Termination Units: Fiber optic termination units shall consist of a single housing with provisions for installation of one or more patch panels as required. Patch panels shall face to the front of the rack.

Fiber optic termination units shall have cable management brackets or rings, integral to the unit, that secure and support cables between patch panels or splice trays to the vertical rack members while maintaining a minimum 1.5" cable radius. Jumper cable troughs may be provided in lieu of this requirement.

The following permanent marking shall be provided on the front of the unit: "Communication Fiber Optic Cable Termination Area Inside".

Integrated Fiber Optic Splice and Termination Units: Integrated fiber optic splice and termination units shall consist of a single housing with provisions for patch panels and splice trays. Integrated splice and termination units shall meet the requirements stated herein for splice units and termination units.

The following permanent marking shall be provided on the door or front access panel: "Communication Fiber Optic Cable Termination and Splice Area Inside".

482.2.2(D) Jumper Cable Troughs: Jumper cable troughs shall be designed to secure, support, store, and horizontally route jumper cables and other fiber optic cables from vertical frame members on one side of the rack, to vertical frame members on the other side of the rack. Jumper cable troughs shall be designed to maintain the manufacturers minimum bend radius for jumper cables cable bend radius when transitioning from the trough to vertical frame member. The capacity of each cable trough shall exceed the number of jumpers it houses. The finish of the jumper cable troughs shall match the finish of the fiber optic termination equipment.

482.2.2(E) Underground Splice Closures: Underground splice closures shall be cylindrical, butt-end style, corrosion resistant, water-tight, and meet the requirements of GR-771-CORE. Underground splice closures shall seal, bond, anchor, and provide efficient routing, storage, organization, and protection for fiber optic cable and splices. Internal configuration shall have end cap with a minimum of two express ports for entry and exit of uncut trunkline cable and a minimum of three additional ports for branch cables.

The splice enclosure shall be designed to seal terminations using gel-sealing technology. The use of heat-shrink is no longer authorized. The gel seal cable terminations shall automatically adjust to the cable size and shape, and require no special tools, tapes or mastics to install. The splice enclosure shall support a minimum of 96 splices.

Splice closures shall have a reliable seal design with both the cable jackets and core tube sealed, without the use of water-blocking materials. The gel seals shall be re-usable and cabling shall be easy to remove. The splice closure shall be opened and completely resealed without loss of performance. Use splice closures that are at least 12" shorter in length than the inside long dimension of the pull box.

482.3 CONSTRUCTION REQUIREMENTS

482.3.1 Fiber Optic Cable: Approval of the fiber pulling plan is required prior to any installation of fiber optic cable. See Section 482.6 for pulling plan requirements. The ITS inspector shall be present at all times during the installation of fiber optic cable.

The pull tape shall be threaded through the pulling eye and sewn back onto itself to reduce the possibility of breakage. A swivel shall be used between the tape and cable to prevent cable twisting. Tension-sensitive, breakable links shall be used to protect the fiber optic cable from over-tension for pulls over 700'.

The Contractor shall install fiber optic cable continuous and without splices between allowable splice points as identified on the Plans and in the Specifications. Only splice fibers in splice closures and at fiber optic splice units that are housed at hub locations and/or the Traffic Management Center (TMC). The Contractor shall perform all final length measurements and order cable accordingly.

The Contractor shall:

- Carefully handle fiber optic cable;
- Not pull cable along the ground or over or around obstructions;
- Not pull cable over edges or corners, over or around obstructions or through unnecessary curves or bends;
- Not exceed fiber optic cable bend radius at any time;
- Not exceed the maximum pulling tensions at any time; and
- Use manufacturer approved pulling grips, cable guides, feeders, shoes and bushings to prevent damage to the cable during installation.

When removing cable from the reel prior to installation, shall be placed in a "figure-eight" configuration to prevent kinking or twisting. The Contractor shall take care to relieve pressure on the cable at crossovers by placement of cardboard shims (or approved equivalent method) or by creating additional "figure-eights". If storing cable, use a cable reel for long lengths and for short lengths store in a "figure eight" pattern larger than the fibers minimum bend radius.

The Contractor shall furnish the Engineer with the cable manufacturer's recommended procedures, maximum pulling tension, a list of the cable manufacturer's approved pulling lubricants, and the lubricant manufacturer's procedures for use. The Contractor shall adhere to the manufacturer's installation procedures when installing fiber optic cable. The pulling tension shall be monitored using a strip chart recorder when mechanical pulling techniques are used. If at any time during the pull the cable tension is at 85% of the maximum allowed, the Contractor shall stop the pull and troubleshoot the problem to determine if there is an obstruction, low lubricant, or other difficulties that may cause a high-tension problem. After the tension problem has been thought to have been resolved, continue the pull, and closely monitor the cable tension. If the problem continues, the Contractor shall notify the Engineer of the problem and cease installation until the problem can be identified.

High-performance fiber optic cable lubricant shall be used to lubricate the conduit for long cable duct pulls beyond 700' or pulls with numerous turns totaling over 180 degrees. The lubricant must be suitable for outdoor temperatures, flame retardant, unable to affect the properties of the cable jacket, and have a low coefficient of 0.25 when used on PE jacketed or other types of cables. The lubricant should be present at all points of the duct, cable feed locations, intermediate pull locations, bend locations and approved by UL or CSA. The lubricant shall be applied with a lubricant collar and pump. The Contractor shall use lubricants in quantities and in accordance with the procedures recommended by the lubricant manufacturer.

The Contractor shall furnish attachment hardware, installation guides, and other necessary equipment, not specifically listed herein, as necessary to install the fiber optic cable.

482.3.1(A) Underground Fiber Optic Cable: At each splice point, coil 150 ft of slack fiber optic cable per cable entry. Each #9 pull box without a splice closure shall have a minimum of 300 ft of fiber optic cable slack installed. At each intermediate No. 7 ITS Pull Box the Contractor shall install 50 ft of slack per cable. At each field cabinet, provide a minimum of 16 ft of slack for each fiber optic cable. All cable shall be stowed per project plans and MCDOT Standard Details.

Underground fiber optic cable shall be installed only in fiber optic conduit, unless shown otherwise in the plans. Do not direct bury underground fiber optic cable.

If the cable is pulled by mechanical means, the Contractor shall obtain the Engineer's approval for the cable pulling equipment. Cable pulling equipment shall have a mechanism to ensure that the maximum allowable pulling tension is not exceeded at any time during installation.

482.3.1(B) Indoor Fiber Optic Cable: For indoor fiber optic cable installations shall follow the requirements of local building codes and NEC Article 770, inclusive of the Fine Print Notes.

Splices for indoor fiber cable shall be housed in a rack-mounted fiber optic splice unit or integrated fiber optic termination unit. Coil 16' of slack fiber optic cable and stow it in the rack.

482.3.1(C) Fiber Optic Jumper Cable: Install jumper cables only in field cabinets and indoor locations. Provide permanent markings on duplex jumper cables that provide a visual distinction between the two fibers. Provide strain relief for jumper cables at both ends and elsewhere as needed. Adhere to manufacturer recommended installation and minimum bend radius requirements.

482.3.1(D) Fiber Optic Pigtails: Install fiber optic pigtails only in enclosed fiber optic splice and termination units located in field cabinets and indoor locations. When splicing pigtails to individual fibers, match the color of single fiber pigtails with the color of the fiber. Alternatively, single fiber pigtails may be routed through colored fan-out tubing that matches the color of the fiber.

482.3.2 Splicing and Terminations: Only splice fibers at locations that are identified on the splice tables in the Plans. Splice tables in the Plans shall not be revised without approval from the Engineer. All splices shall be protected and stored in underground splice closures for outdoor installations, and in fiber optic splice units or integrated fiber optic splice and termination units for indoor installations.

For indoor installations, the fiber optic cable shall enter the rear of the fiber optic splice unit or integrated fiber optic splice and termination unit. The fiber optic cable sheath and central member shall be secured inside the unit prior to buffer tube fan-out. All entry holes not used shall be plugged. Buffer tubes with fiber designated for splicing shall be routed into and secured in a splice tray. Remaining buffer tubes shall be secured within the splice unit and not accessed.

482.3.2(A) Splicing Methods: All splices shall be accomplished by means of the fusion splice technique. Each splice shall not add more than 0.1 dB attenuation when splicing new fiber to new fiber, and 0.3 dB attenuation when splicing new fiber to existing fiber. Splices found to exceed the maximum allowed dB attenuation when tested with an OTDR shall be re-spliced, at no additional cost, until this requirement is met.

Each splice shall be packaged in a protective heat-shrink sleeve and secured in the splice tray. The heat-shrink sleeve shall be approved for use by the fiber optic cable manufacturer and installed in such a manner as to protect the fiber from scoring, dirt accumulation, moisture intrusion, and microbending.

All fibers in a buffer tube shall be spliced within the same splice tray. When splicing to fiber optic pigtails, use spiral wrap (or similar approved method) to group and protect pigtails routed from each splice tray to the corresponding patch panel.

Fiber optic cable splices will fall into one of the following categories:

Mid-cable splices: Perform mid-cable splices when splices are not required for all fibers of a cable. Only fibers within a buffer tube that are designated for splicing shall be accessed, spliced, and secured neatly within the splice tray. The remaining fibers in the buffer tube that are not designated for splicing shall be secured neatly within the splice tray and not cut. Removal of the buffer tube to access the fibers shall be accomplished using equipment specifically designed for buffer tube removal without damaging the individual coated fibers.

Full-cable splice: Perform full-cable splices when the distance exceeds the maximum length of fiber optic cable available on a reel. All fibers, including spares, shall be spliced together to provide a continuous optical path. All fibers shall be secured neatly within the splice trays.

482.3.2(B) Termination Methods: Use LC connectors for terminating fiber optic cables to equipment and patch panels in field cabinets. Use cables with LC type connectors for terminating fiber optic cables at patch panels located at hubs and the TMC.

All connector types shall use an Ultra Physical Contact (UPC) machine polished connector. No hand polishes are permitted or authorized.

Measured attenuation at each termination (inclusive of 2 connectors and coupler) shall not exceed 0.5 dB.

Fiber terminations shall be neatly, and permanently labeled on the connector module to designate transmit or receive (when appropriate) and the fiber optic strand number or other designation as determined by the Engineer. Spare fibers shall be terminated when called for by the Plans, and labeled as determined by the Engineer.

Protective covers shall be used on all optical connectors and terminations at all times until terminated.

Field Termination: Factory installed connectorized branch cables shall be used for field termination of fiber optic cable in equipment cabinets. LC connectors with strain relief boots shall be attached at the factory. The factory connectorized branch cables shall be supplied in sufficient lengths to be spliced to the trunk cable in the splice vault and installed in conduit to the equipment cabinet without intermediate splices.

Termination at Hubs and TMC: Termination of fiber optic cable at hubs and the TMC shall be accomplished by fusion splicing fiber to factory prepared, fiber optic pigtails with LC connectors terminated at patch panels. Jumper cables shall have LC connectors. Field termination of fibers to connectors shall not be permitted.

482.3.3 Fiber Optic Distribution Equipment: The Contractor shall install a sufficient number of patch panels to terminate all fibers. Blank patch panel covers, of same finish

and manufacture as the patch panel, shall be installed for all unused patch panel spaces on fiber optic termination units.

Fiber optic patch panels shall have couplers to allow applications to be easily installed and removed from the termination housing.

482.3.4 Labeling: Comply with the requirements of Section 480. 3.1.

482.4 TESTING REQUIREMENTS:

Fiber optic cable and distribution equipment shall meet the following certification, factory and stand-alone test requirements. General test requirements are covered in Section 480.3.4. See figure 482.4-1 for a Sample Fiber Test Report.

The ITS inspector shall be present at all times during the testing of fiber optic cable.

482.4.1 Design Approval Tests (DAT): Submit certification or test results for all required factory testing of fiber optic cable. Submittal of RUS certification will satisfy this requirement for the tests that are required by RUS 1755.900.

482.4.2 Factory Acceptance Tests (FAT): Test all fiber optic cable, pigtails, jumper cables and patch panels in the factory to demonstrate compliance with specification requirements. Submit a copy of the results of factory tests to the Engineer.

482.4.3 Stand-Alone Tests:

482.4.3(A) Pre-Installation Testing: The Contractor shall visually inspect all cable and equipment upon delivery and again prior to installation. Test any equipment that is found to have visual damage. The Contractor shall perform pre-installation on-reel testing of all fiber optic cable strands prior to installation. Test using an OTDR to ensure fiber optic cable strands are free of breaks and micro bends

482.4.3(B) Post-Installation Testing: The Contractor shall purchase legal copies of the testing standards listed below and provide them to the Engineer a minimum of 7 days prior to any fiber optic cable testing. The standards that are required to be purchased include:

- EIA/TIA-526-7– "Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant"
- TIA/EIA-455-8 (FOTP8) – "Measurement of Splice or Connector Loss and Reflectance Using an OTDR"

Prior to testing, the Contractor shall furnish the Engineer with a fiber optic testing plan and procedures. Testing of spare fiber is required. The Contractor shall identify any unacceptable losses and make corrective actions at no additional cost. Failed splices may be remade and re-tested for compliance. Replace any cable in its entirety that is found not compliant to the Specifications. Perform the following post-installation tests using the

procedures of TIA/EIA-526-7A and all standards and procedures invoked therein, subject to the following clarification:

Power Meter Tests: The contractor shall conduct uni-directional power meter tests for each fiber to measure installed fiber cable attenuation, demonstrate connectivity, and correct splicing. The contractor shall perform Power Meter Tests on each fiber strand in accordance with Method A.3 of TIA/EIA-526-7 – "Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant" and submit test results for each fiber to the Engineer as required by TIA/EIA-526-7. Submit test results for each link to the Engineer. Power meter tests shall be conducted after all splices have been made and all connectors, jumper cables, and pigtails are in place. Each link shall be tested separately from each field cabinet to the respective trunk cable termination panel in the Hub(s) and from field cabinet to field cabinet for fiber links that do not go directly to a hub. The use of fiber optic jumpers to couple the connectors together in equipment cabinets to create a continuous end to end link shall not be permitted.

OTDR Tests: The contractor shall conduct bi-directional tests using an OTDR in accordance with TIA/EIA-455-8 (FOTP8)for each fiber strand from field cabinet to hub location, between hub locations, between field cabinet locations, inclusive of all branch cables, pigtails, and patch panels to demonstrate that attenuation for each fiber strand, termination, and splice, individually and as a whole, comply with allowable losses in accordance with the fiber assignment tables. Test fibers at 1310 nm and 1550 nm.
The OTDR shall be set to operate in auto event mode with the event threshold set at 0.1dB or lower. The Contractor shall submit printed and electronic OTDR traces for approval. Any electronic traces submitted that were shot without the auto events feature shall be re-tested by the Contractor at no additional cost. The Contractor shall clearly annotate each event (connector, pigtail, splice, etc.), event location, and identify the measured loss.

Following completion of all testing, and approval by the Engineer, the Contractor shall compile and submit two organized test notebooks that include all required test results, summary tables, OTDR traces, and electronically saved test data. Test notebooks shall at a minimum, include the following:

1. Identification of each fiber by cable (as it is identified in the field), buffer tube, color, and string number as appropriate;
2. A summary sheet with each submittal that clearly illustrates length and measured loss versus budgeted loss for each fiber or connected fiber string as appropriate; and
3. Calculations and notations for each fiber and wavelength that include total loss, measured dB/km loss, the number of connectors/terminations, pigtails, and jumper cables and any anomalies over 0.1 dB.

PROJECT:_____

SAMPLE FIBER TEST REPORT

FIBER TEST SUMMARY REPORT

Fiber ID	From	To	Wavelength	Length	Number of Splices	Number of Connectors	Loss Budget (dB)	Loss A > B (dB)	Loss B > A (dB)	Loss Average (dB)	Pass/Fail
			1310 nm								
			1550 nm								
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Figure 482.4-1 Sample Fiber Test Report

482.5 WARRANTY REQUIREMENTS:

The following requirements apply in addition to the warranty requirements identified in Section 480.4:

Repair or replace defective fiber optic cable and equipment for a period of two years following final acceptance of the system.

482.6 DOCUMENTATION:

Provide maintenance manuals for fiber optic cable and equipment per the requirements of Section 480.5.

Prior to installing fiber optic cable the Contractor shall provide a fiber pulling plan showing reel setup, assist winch, "figure eight", and assist wheel locations. The fiber pull plan shall identify the estimated pulling tension, route length, number of turns, pull direction, splice enclosure locations, and accessibility. The fiber pulling plan should also include cable pulling lubricants, pulling grips, breakaway swivel, dynamometer, and any other hardware that will be used to assist in maintaining cable's minimum bend radius. The Contractor shall submit the fiber pulling plan to the Engineer for review and approval two weeks prior to install. The Contractor shall not install fiber optic cable without prior approval of the fiber pulling plan.

The Contractor shall provide post installation as-built drawings that document fiber distances between manhole/handholes, splice locations, amount and location of coiled slack, and type, size, and number of installed fiber optic cables.

482.7 TRAINING:

When required by special provision, the contractor shall meet the training requirements of Section 480.6.

482.8 MEASUREMENT:

Fiber optic cable will be measured by the linear foot for actual cable length installed, for each type installed. The length of cable required to be coiled for cable slack will be measured and included in the total measured amount.

Fiber optic splice units, termination units, integrated splice and termination units, and underground splice closures will be measured as a unit for each type installed.

Fiber optic jumper cables, pigtails, patch panels, terminations, splice trays, and splices are included as part of and considered incidental to the listed pay items.

482.9 PAYMENT:

The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE. The cost of testing, warranty, documentation, and training are included in the unit price of the each item.

Part 400 add the following new Section:

SECTION 483
CLOSED CIRCUIT TELEVISION:

483.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing CCTV equipment including camera assemblies (camera systems and cables, lightning and surge protection), cabinets, software, and various accessories as needed.

483.2 MATERIALS

483.2.1 Functional Requirements (Camera Assembly): Provide a camera assembly that interoperates with an existing central software driver, available from 360 Surveillance. A list of available software drivers may be found at: http://360surveillance.com. All components of the camera assembly shall be off-the-shelf items.

Provide certificate of compliance per the requirements of Section 480.2.6 that certifies all functional requirements listed herein for camera, lens system are met.

The total weight of pole mounted CCTV equipment shall not exceed 45 lbs.

483.2.2 Camera and Lens: Cameras shall produce quality video that is clear, low-bloom, low-lag, video with no jitter, interlace, pairing, or ghosting when viewed at the TMC. Cameras and lenses shall be provided that meet the following requirements:

Function/Feature	Requirement
Camera	Day/Night (35X), DSP, color, solid state
Signal Format	NTSC
Scanning System	2:1 Interlace
Image Sensor	¼" charged coupled device (CCD)
Effective Pixels	768 (H) X 494 (V) (NTSC)
Horizontal Resolution	> 520 TV Lines (NTSC)
Lens Mount	C-type lens mount or integrated camera/lens combination
Lens	f/1.2 (f = 3.8 - 91.2 mm optical) or better
Zoom	35X optical, 12X digital or better
Zoom speed (optical range)	3.2 / 4.6 / 6.6 seconds
Horizontal	55.8° at 3.4 mm wide zoom;
Angle of view	1.7° at 119 mm telephoto zoom
Focus	Automatic with manual override

Function/Feature	Requirement
Maximum Sensitivity @35 IRE NTSC/EIA	0.063 lux at 1/4 sec shutter (color) 0.55 lux at 1/60 sec shutter (color) 0.00018 lux at 1/2 sec shutter (B-W)
Sync System	Internal / AC line lock, phase adjustable via remote control, V-Sync
White Balance	Automatic with manual override
Shutter Speed NTSC	Automatic (electronic iris) / Manual 1/2 ~1/30,000
Iris Control	Automatic Iris Control with manual override
Gain Control	Automatic / OFF
Video Output	1 Vp-p, 75 ohms
Video Signal to Noise	> 50 dB
Presets	60 minimum
Wide Dynamic Range	128 X
Cable length	The supported length of cable between the camera mounted CCTV and the cabinet equipment is 500' minimum distance using RG59/U

Cameras shall have power input circuitry designed to protect the internal electronics from damage from power surge and from under voltage conditions per the guidelines of IEEE C62.36-1991.

Cameras and lens combinations shall automatically recover from over and under voltage conditions, when the prime power is returned to values defined by the Specifications, by returning to the last position prior to the over/under voltage condition.

Lenses shall mechanically or electrically protect the motor from overrunning in extreme positions.

483.2.3 Pan/Tilt Unit: Pan/tilt units shall be designed specifically for the environmental conditions that they will be subjected to while meeting the following minimum requirements:

Function/Feature	Minimum Requirement
Pan range	0° to 360°
Tilt range	10° up and 83° down from the horizontal axis
Pan/tilt minimum speed (manual)	40° pan/second and 20° tilt/second.
Presets	60 minimum

Pan/tilt units that pan or tilt at speeds in excess of 30°/second shall have variable speed operation.

Pan/tilt units shall use housings that are corrosion resistant, rated NEMA 4 or better, and provide for feed through cabling.

Pan/tilt units shall have either adjustable worm gears drives or stepper motors that are capable of instantaneous reverse motor action, are corrosion resistant, do not require lubrication, and meet the following minimum requirements:

Description	Minimum Requirement
Allowable load (worm gear motor)	40 lbs
Allowable load (stepper motor)	20 lbs
Bearings	Heavy-duty ball or roller bearings.
Gears	Hardened steel.
Finish	Light color baked enamel or anodized.
Cabling	Internal feed through cabling.

483.2.3(A) Precision Pan/Tilt Units: Precision pan/tilt units shall meet the requirements stated for pan/tilt units except that they shall have stepper motors and stop on a programmed pan/tilt preset within an accuracy of 1/4°. The pan/tilt unit shall provide the remote user with variable pan and tilt speeds. The minimum rate of pan shall be 80°/second. The minimum rate of tilt shall be 40°/second.

483.2.4 Environmental Enclosure: Environmental enclosures shall be used to house the camera and lens. Environmental enclosures shall be sealed and corrosion resistant. The interface with the pan/tilt unit shall be achieved in a manner that leaves no exposed cabling.

The environmental enclosure shall be equipped with a thermostatically controlled heater/fan.

The environmental enclosure shall have a corrosion resistant sun shield that covers the upper half of the enclosure. The sun shield shall permit air to freely circulate between the sun shield and the environmental enclosure.

Environmental enclosure shall be cylindrical in shape (or approved equal) not exceeding 5.2" outside diameter, or hemispherical dome no larger than 15" for the lower half.

The enclosure shall have an optically clear, impact resistant front window (for cylindrical enclosure) or dome acrylic lens (for dome enclosures). The front window or acrylic lens shall not yellow, introduce appreciable light loss, or distort over a 10-year service life when exposed to a desert environment.

483.2.4(A) Cylindrical Enclosure: The finish of the environmental enclosure and sun shield and the finish of the pan/tilt unit housing shall match.

483.2.4(B) Dome Enclosure: Either the upper or lower half of the dome enclosure shall be easy to remove without the use of tools.

A safety wire (or approved equivalent) shall be used to hold the removed half when disconnected. Bond the dome enclosure to mounting arm/bracket, and ensure that the mounting arm/bracket is bonded to the CCTV pole or structure. It is preferred to have an exterior corrosion resistant pin connector that enables testing of the camera assembly within the dome without unsealing the dome.

483.2.5 Mounting: Provide all mounting equipment and adapter plates needed to securely mount the pan/tilt unit or dome assembly to the CCTV pole or other structure as required. Mounting shall comply with MCDOT Standard details or approved alternative drawings.

All cylindrical cameras shall be mounted to the top of the pole using a custom signal cap. The diameter of the signal cap shall be determined by the size of the pole. The signal cap shall have a 2" hole where the cylindrical camera will be mounted to the top of the pole.

All cylindrical cameras shall be pole top cameras unless otherwise specified by the Engineer.

All dome cameras shall be mounted to the pole using a pendant arm and strapped to the pole using 3/4" BAND-IT® type 201 stainless steel bands or approved equal. Straps utilizing a worm gear to tighten and hold the strap shall not be used.

483.2.6 Cables: Power and control cables shall comply with IMSA 20-1 specification requirements (latest revision).

Coaxial cable shall be RG-59/U and shall meet or exceed the following characteristics:

- Solid copper conductor
- Braided copper shield with 95% coverage
- Attenuation not to exceed 0.65dB/100 feet from 1MHz through 5MHz
- Outdoor rated

The coaxial cable may be replaced by an optical fiber.

A composite cable shall be used for power, camera control, and video between the camera and the cabinet unless otherwise approved by the Engineer.

Each pull box, cabinet, or conduit entry point shall have a minimum of 6' feet of cable slack.

Strain relief shall be used to hold the weight of the electrical, video, and data cables when they hang in a vertical, sloping or horizontal position. The Contractor shall submit a proposed method of strain relief for approval by the Engineer.

An 8' service loop is required at the top of the CCTV camera pole or signal pole. A cable grip shall be placed at the beginning and the end of the service loops to support the weight of the cable and the loop inside the pole.

Drilling of a 1" hole into the signal pole to accommodate the cable is authorized for dome cameras.

A grommet shall be used at each hole to prevent the cable from being frayed or damaged.

There shall be no visible cables hanging from the pole or the CCTV Camera enclosure and mounting arm.

483.2.7 Surge Suppression: Install surge protectors in the CCTV cabinet for all conductors (power, data, and video) between pole mounted and cabinet mounted CCTV equipment. Ground each surge protector to a terminal block mounted to the cabinet rack. Bond the terminal block directly to the cabinet ground using a #8 AWG copper ground wire. Surge protector leads shall be a minimum 3' in length and installed straight as possible.

Wire, ground, and bond equipment shall be in accordance with Section 250-86 of the NEC.

483.2.7(A) Coaxial Cable Surge Protector: One coaxial cable surge protector shall be installed on the coaxial cable that meets the following requirements:

Class	Coaxial Cable Protector
Connector:	BNC type
Attenuation:	<0.3 dB @ 0.3 KHz to 1.1 MHz; <-3.0 dB loss @ 3.0 to 4.0 MHz
Input/Output impedance:	75 ohms nominal
Peak Surge Current:	1000 amperes minimum
Response Time:	5 nanosecond or less
Operating Temperature:	-40° C to +85° C
Band Pass:	0 - 2 GHz
Operation Environment:	Outdoor use, out of direct weather (5% to 100% non-condensing)

The equipment shall be the DITEK DTK-VSP-BNC-A, or approved equal.

483.2.7(B) Power Cable Surge Protector: Power cable surge protectors shall be installed on all power conductors. Power cable surge protectors shall meet the following requirements:

Class:	AC Hard Wired Transient Voltage Surge Suppressor
Connection Method:	Hardwire parallel connection
Continuous Current:	Unlimited (Parallel Connection)
Peak Surge Current:	20,000-amperes
Response Time:	< 0.5 nanoseconds installed, < 1 nanosecond Component Level
Suppressed Voltage Rating:	600V
EMI / RFI Noise Filter:	Yes
Max Continuous Operating Voltage (MCOV)	130 VRMS / 185 VPK
Operating Temperature:	-40° C to +85° C
Operation Environment:	Outdoor use, out of direct weather (5% to 100% non-condensing)

The equipment shall be the DITEK DTK-120HW, or approved equal.

483.2.7(C) Low Voltage Camera Control Cable Surge Protector: Low voltage control cable surge protectors shall be installed on each data conductor. Low voltage control cable surge protectors shall meet the following requirements:

Class	Low voltage surge protection for RS422 and RS485 systems
Connection Method:	Screw Terminals
Continuous Current:	< 180mAmps @ 2 ohms
Peak Surge Current	120A (per pair)
Response Time:	< 1 nanosecond
Service Voltage:	< 5 V
Wiring Configuration:	8 pair

The equipment shall be the DITEK, 8-wire DTK-Z8-LVLP, or approved equal.

483.2.8 CCTV Camera Panel: A CCTV Camera panel shall be used to mount all CCTV equipment located in one door cabinets.

The CCTV camera panel shall be mounted in the lower left hand corner of the cabinet. The aluminum panel size shall be no less than 11" x 17".

The panel shall be mounted using the existing vertical "C" channels in the cabinet.

The following equipment shall be mounted onto the (11" x 17") panel per MCDOT Standard Details:

1. Single gang outlet box with RJ45 test jack;
2. Video Encoder, refer to Section 486.2.9 for Video Encoder requirements;
3. Coaxial Cable Surge Protector;
4. Low Voltage Camera Control Cable Surge Protector;
5. Electrical Bus Bar (ground);
6. Power Cable Surge Protector;
7. 110 Volt Duplex Receptacle Outlet;
8. 6 Outlet Surge Protection;
9. Camera Power; and
10. Video Encoder Power Supply.

The cable shall be tested on the reel and wired directly to the CCTV camera panel.

The CCTV camera panel shall be bench tested with the camera for no-less-than 24 hours as a unit to include the CCTV camera, all cabling, all surge suppression, the CCTV Remote Monitor Port, and Video Encoder.

Installation shall conform to MCDOT standard details.

483.2.9 Lightning Protection: An air terminal that is fabricated of galvanized steel or copper-clad steel shall be mounted to the top of the pole such that it does not hinder the ability of the camera to view areas deemed critical by the Engineer. Directly ground the air terminal to the pole ground rod using a ½" woven copper ground wire.

483.2.10 Environmental: Camera equipment shall meet the environmental requirements of Section 480.2.1, except that the camera assembly shall perform to the stated specifications over an ambient temperature range of -30°F to +158°F.

483.2.11 Text Generation: Camera assemblies shall have the capability to generate and superimpose two lines of text on the video stream, one for camera ID text and one for preset text. Provide a minimum of 20 alphanumeric characters per line that are between 20 and 30 horizontal TV lines in height. Provide the remote user with the ability to enable, disable, and edit the text messages. Store text messages within the camera assembly using non-volatile memory.

Camera location ID text consists of a single, user defined text message that is unique to each camera location.

483.2.12 Maintenance Software Requirements: Provide software that can be used to provide local operation and full diagnostic support for each different camera assembly

configuration supplied on the project using the County maintenance laptops and video monitor.

During submittals, furnish a list of minimum requirements for the County maintenance laptop computers. If local software requires an operating system that is not offered by the County laptops, then furnish and install the necessary operating system including a start-up screen that allows the user to choose the appropriate operating system.

Software requirements will be waived if identical software is already loaded on the County's maintenance laptop computers, or if the CCR provides local operation and diagnostic capabilities.

483.2.13 Maintenance Laptop Computer Interface: Provide a data/control interface and a video interface in the CCTV cabinet for the County's maintenance laptop computer. The interface between the maintenance laptop computer, video monitor, and the camera assembly may be accomplished by disconnecting the data and video cables from the communication end equipment, and connecting them to the laptop computer and monitor respectively.

483.2.14 Communication Requirements: The communication signal format shall be matched to the central system.

483.2.15 Communication Protocol: The camera communication protocol shall be compatible with an existing driver available to MCDOT from 360 Surveillance of Vancouver, British Columbia and with the existing CCTV camera system.

483.2.16 CCTV Cabinet: The Contractor will furnish and install a pole mounted Type G cabinet for each CCTV location, per MCDOT Detail 4825.

All equipment shall be mounted to the signal cabinet either by the use of a panel or din mount railings.

483.3 CONSTRUCTION REQUIREMENTS:

The Contractor shall set electrical or mechanical pan and tilt limit stops at positions determined by the Engineer. The Contractor shall program in camera location identification text labels obtained from the Engineer.

The cables in the cabinet from device to device shall not be longer than required. The cables shall be routed for permanent installation and any excess will be cut to remove the slack. The only exception is the 6' slack at the cable entry point for the cabinet.

The Contractor shall provide post installation pictures in electronic format of the mounted CCTV camera, the slack for each pull box, the CCTV Camera Panel, and the cabinet as part of the inspection. Each photo shall be clearly labeled with the photo

location and equipment shown. Any discrepancies with the installation shall be resolved by the Contractor.

483.4 TESTING REQUIREMENTS:

Testing shall comply with requirements of Section 480.3.4 and the following:

483.4.1 Design Approval Tests (DAT): Provide DAT certification for the camera, lens, pan/tilt unit, environmental enclosure, and camera control receiver for equipment the Contractor desires to have as an approved equal.

483.4.2 Stand-Alone Tests: For each unit of equipment, conduct approved stand-alone tests that exercise all stand-alone (non-network) functional operations of the equipment including the following:

1. Control of focus, iris, and power on/off;
2. Range of pan, tilt, zoom and digital zoom;
3. Presence and quality of video signal;
4. Camera ID and preset text generation; and
5. Pan and tilt limit stops are set to the Engineer's specification.

The CCTV camera assembly shall be bench tested for no-less-than 24 hours as a unit to include the CCTV camera, all cabling, all surge suppression, and Video Encoder. Refer to Sections 483.2.2, 483.2.6, 483.2.7, 483.2.8, and 486.2.9. The Contractor shall request the active electronics configuration information from the Engineer prior to the 24 hour bench test.

After the 24 hour bench test the Contractor shall notify the Engineer that the system is ready for the pre-inspection. The Engineer will schedule the ITS Inspector to conduct the pre-inspection at the Contractor's facility.

The ITS Inspector will inspect the camera system on the reel using the pre-installation CCTV Local Field Operations Test.

After the completion of the pre-installation CCTV Local Field Operations Test the Contractor shall submit the pre-inspection test and the CCTV Camera installation plan to the Engineer. The installation plan shall consist of the camera location, estimated cable lengths, cable route, cable slack, wiring diagram, and camera configuration.

Once the installation plan is approved by the Engineer an ITS Inspector will be scheduled to meet with the Contractor onsite for installation. The ITS inspector will be present for all stages of the camera installation.

483.4.3 Subsystem Tests: For each camera location that is installed and interconnected in a system, the Contractor shall conduct approved SST from a workstation at the Traffic Management Center that includes the following:

1. All items in the stand-alone test;
2. Transmission of quality video to the Traffic Management Center;
3. Response to all central software commands identified under functional requirements;
4. Horizontal and vertical resolution*; and
5. Signal to noise (S/N) ratio of 48 dB or greater*.

* Perform these tests if in the opinion of the Engineer the picture quality is substandard. Measure the horizontal/vertical resolution and the S/N ratio on a monitor in the Traffic Management Center for a picture generated by the CCTV camera installation furthest from the Traffic Management Center and at two other locations specified by the Engineer to verify compliance.

483.5 WARRANTY REQUIREMENTS:

Warranty requirements shall comply with Section 480.4 except as follows:

The front window (cylindrical enclosure) or acrylic lens (dome enclosure) shall have a 5-year warranty against yellowing, appreciable light loss, or distortion.

483.6 DOCUMENTATION:

The Contractor shall provide maintenance manuals for CCTV equipment per the requirements of Section 480.5. Include the following diagrams (as appropriate):

1. Video system block diagram showing all components;
2. Video signal path diagram;
3. Control signal path diagram;
4. System connection diagram; and
5. Detailed connection diagrams.

483.7 TRAINING:

When required by special provision, the contractor shall meet the training requirements of Section 480.6.

483.8 MEASUREMENT:

CCTV camera assembly, including the camera, lens, pan/tilt, camera control receiver, sun shield, environmental enclosure, CCTV camera panel, cables, lightning and surge protection, and any other required accessories, will be measured as a unit for each installed.

CCTV cabinets will be measured as a unit for each type installed.

Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

483.9 PAYMENT:

The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described.

Part 400 add the following new Section:

SECTION 484
DYNAMIC MESSAGE SIGNS

484.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing of structure mounted dynamic message sign (DMS) equipment including DMS cases, displays, controllers, cables, surge protection, cabinets, software, and various accessories as needed.

DMS shall be constructed by a company that is ISO 9001 or ISO 9002 registered. At the Engineer's discretion, the ISO requirements may be waived for companies with comparable quality control programs.

484.2 MATERIALS:

Provide certificate of compliance per the requirements of Section 480.2.6 that certify all functional requirements listed herein for the DMS case, display, sign controller unit, dimming system, software, and communication protocols are met. The DMS unit shall be such as to withstand the mechanical shock, and vibration caused by winds up to 80 mph.

484.2.1 DMS Case

484.2.1(A) General: The DMS case shall be NEMA 3R rated.

484.2.1(B) Structural Steel and Aluminum: The sign case shall be manufactured using 480% extruded aluminum. Sheet aluminum shall be a minimum of 0.126" thick. Aluminum members shall be seamless with continuous welds in the corner and shall be 6063-T6, 5052-T3, or 6061-T6 aluminum or approved equal.

484.2.1(C) Ventilation: The sign case shall have convection and fan cooling that is activated via temperature sensor to cool the case in high heat conditions.

The fan cooling system shall create a positive pressure ventilation system, wherein one or more fans are continuously in operation to draw air into the case through filtered drain holes and inlets. The pressure created shall be sufficient to prevent air from entering the sign enclosure, except through filtered inlets. Filters shall be cleanable and changeable.

A multiple fan system shall be used, with at least twice as many fans provided than are needed to maintain the positive pressure. The fan(s) used to provide the positive pressure shall be automatically swapped every 8 hours to extend the mean time between failures. If a fan fails, it shall automatically be deselected and another fan selected and an error message shall be sent to the SCU. The SCU shall transmit the failure state back to the central control location.

The ventilation system shall be thermostatically controlled, and of sufficient quantity and size, as to not permit temperatures inside the enclosure to exceed 135°F or 35°F above the ambient temperature, whichever is higher, when the sign is in full sun, and all equipment in operation.

Current temperature readings for inside the case shall be transmitted to the central system via the SCU.

484.2.1(D) Heating: Thermostatically controlled heater strips, or other approved method, shall be used to keep the front face free from condensation.

484.2.1(E) Front Face: The front of the sign case shall be covered by an impact resistant, non-glare, polycarbonate face with an ultra-violet (UV) inhibitor to protect the pixels from fading and to reduce yellowing of the sign face.

The face of the display shall be easily opened from the front, hinged from the top, and shall be assisted and held into position by gas springs or approved equal. A locking system shall be provided for the front face and keyed as directed by the Engineer. Furnish one key for every DMS installed.

484.2.1(F) Mounting Provisions: Provide mounting hardware needed to securely mount the sign case to the DMS sign structure.

484.2.1(G) Convenience Outlets: Two 120 VAC, duplex convenience outlets shall be provided with integral ground fault interrupt and shall be protected by a circuit breaker. The receptacles shall be NEMA Type 5-15 R and shall have a spring-loaded cap and be positioned so that no electrical hazard shall exist when used by service personnel. One duplex outlet shall be located on each end of the DMS case.

484.2.2 DMS Display

484.2.2(A) General: The DMS display shall be full matrix LED. The LED shall be manufactured using AlInGap Technology or other LEDs with low susceptibility to

temperature degradation (AlGaS LEDs will not be allowed). The display shall support letter heights of 10.5" to 32", single stroke or double stroke.

The minimum matrix size is 24x80 pixels. The space between pixels shall be the same horizontally and vertically, and the columns shall be perpendicular to the rows (i.e. no pitch or slant)

Character sets shall match CIE or FHWA human factors for real-time displays or approved substitute.

Characters forming words shall be readable at a distance of at least 600' and at a distance of 600 times the character height by persons with 20/20 vision, an eye height of 3.5', under normal atmospheric conditions and under any lighting condition, day or night.

Operating contrast values between 6 and 25 shall be demonstrated for each lighting condition. An example of the contrast calculation is as follows:

[Candela (on) - Candela (off)]/Candela (off)

Writing speed shall be 80 characters per second, minimum.

The display shall be capable of producing graphics and an inverted display of black characters on yellow background.

484.2.2(B) Pixels: Pixels may be round or square. Round pixels shall have a nominal diameter of approximately 1". Square pixels shall have a nominal height and width of approximately 1".

Each pixel shall be AlInGap technology. Each pixel shall have a minimum 60° viewing angle (30° on either side of the central axis that is perpendicular to the display) wherein the readability requirements of Section 484.2.2(A) are met.

The LEDs in each pixel shall be clustered to maximize long range visibility. All pixels shall have equal color and on-axis intensity and shall be a yellow LED (590 nm) that is rated for a minimum of 80,000 MBTF.

The LED pixels shall be powered by a DC power source that maintains a constant power to the pixels operating on a 60Hz AC line voltage ranging from 80 volts RMS to 135 volts RMS.

484.2.2(C) Display Modules: The DMS sign display shall be composed of a minimum of 15 display modules that can be easily removed for maintenance, replacement, or cleaning.

484.2.2(D) Tilt: The DMS display shall be tilted up to 6° forward to optimize the viewing angle for the motorist approaching the sign. The degree of tilt, if any, will be provided by the Engineer.

484.2.3 Sign Controller Unit (SCU): The SCU shall perform the following minimum functions:

1. Respond to all commands and inquiries supported by the central software;
2. Control all sign functions;
3. Store messages;
4. Monitor sign status;
5. Communicate using NTCIP compliant software with the central computer and maintenance laptop computer using the specified protocol;
6. Display pre-programmed or customized messages programmed from either the maintenance laptop computer that is interfaced at the DMS cabinet, or from the central software; and
7. Provide failure detection for the power supply(s), fan(s), lamp(s), photocell, and absence of current to the LED.

The SCU shall be located either within the DMS case or in the DMS cabinet.

Cabinet SCUs shall be designed to be shelf mounted. All displays shall face the front of the cabinet. All connections shall be accessible without necessitating removal of the SCU from the shelf.

The SCU shall have the means to store a library of at least 16 pre-determined messages in non-volatile memory. Each of the messages shall be addressable from the central software, locally via the maintenance laptop computer, and through a keypad interface located in the DMS cabinet. The Contractor shall obtain messages from the Engineer and pre-program them into non-volatile memory. Each pre-programmed message shall be documented on a laminated card affixed to the inside of the DMS cabinet door.

484.2.4 Dimming System: A dimming system shall be provided that automatically dims or brightens the LEDs based on lighting conditions as determined by the photoelectric sensors. The dimming system shall support at least 4 different brightness levels than can be configured from both the central software and local software on the maintenance laptop computer.

The photoelectric sensors shall be positioned to sense in three directions (behind the sign, in front of the sign, and alongside the sign).

Photoelectric sensors shall be provided integral to the DMS. These devices shall direct the SCU to modify the intensity of the light produced by the pixel elements. The mounting devices for the photoelectric sensors shall allow full adjustment of the sensor orientation. Unless otherwise noted, the sensors shall be aimed north.

The photoelectric sensors shall be located such that they are easily accessible for maintenance.

If the photoelectric sensor fails, the sign shall remain in the normal brightness mode and an error message shall be transmitted to the central software in response to the next system poll.

484.2.5 Surge Suppression: Surge protectors shall be installed in the DMS cabinet for all conductors (power and data) between pole mounted and cabinet mounted DMS equipment. Each surge protector shall be grounded to a terminal block mounted to the cabinet rack. The terminal block shall be bonded directly to the cabinet ground using an #8 AWG copper ground wire. Surge protector leads shall be a maximum of 3' in length and installed straight as possible. Surge protectors shall meet the requirements of Sections 483.2.7(A), 483.2.9(B) and 483.2.9(C).

Wire, ground, and bond equipment shall be in accordance with Section 250-86 of the NEC.

484.2.6 Environmental: DMS equipment shall meet the environmental requirements of Section 480.2.1.

484.2.7 Maintenance Software Requirements: The Contractor shall furnish and install non-proprietary maintenance software that can be used to provide local operation, message uploading, and full diagnostic support for each DMS location. At a minimum, the maintenance software shall provide the following functions:

1. Maintain a library of text messages;
2. Download and upload of library text messages to the DMS;
3. Command messages for display;
4. Set the SCU clock;
5. Set all user-adjustable sign parameters;
6. Mimic the sign display operation on the maintenance laptop display;
7. Initiate and monitor the results of diagnostic functions; and
8. Permit simulation of all DMS commands without actually implementing the displays on the DMS.

During submittals, the Contractor shall furnish a list of minimum requirements for the County maintenance laptop computers. If the maintenance software requires an operating system that is not offered by the County laptops, then the Contractor shall furnish and install the necessary operating system including a start-up screen that allows the user to choose the appropriate operating system.

The maintenance software shall provide the means for a user to upload messages in a what-you-see-is-what-you-get format.

Maintenance software requirements will be waived if identical software is already loaded on the County's maintenance laptop computers.

484.2.8 Maintenance Laptop Computer Interface: An interface shall be provided in the DMS cabinet for the County's maintenance laptop computer. The interface between the maintenance laptop computer and the DMS assembly may be accomplished by disconnecting the data cable from the communication end equipment, and connecting it to the laptop computer.

484.2.9 Communication Protocol: Local software shall respond to system polling in a manner that is NTCIP compliant and conforms to the protocol and message structure of the County's central system. Proprietary protocols shall not be used. Protocol converters may be used provided that all functionality and general requirements of the Specifications are met.

484.2.10 DMS Cabinet: A Type G cabinet shall be used for each DMS location, per MCDOT Detail 4825.

484.3 CONSTRUCTION REQUIREMENTS:

All conduit entries into the sign case shall be watertight.

All conductors installed between the DMS cabinet and DMS case shall be contained in a watertight environment.

Provide strain relief for conductors within the DMS structure. Strain relief (such as wire mesh grip) and any connectors or splices within the DMS structure shall be located within 6" of a handhole.

The DMS case and contents shall be grounded to the DMS support structure using a # 8 solid copper wire.

The DMS cabinet shall be mounted to the DMS structure per MCDOT Standard Details.

484.4 TESTING REQUIREMENTS:

Meet the requirements of Section 480.3.4 and the following:

484.4.1 Design Approval Tests (DAT): The Contractor shall provide DAT certification for the DMS assembly, including the case, display, SCU, and all electronic equipment.

DAT for the DMS assembly shall also state compliance with the following tests/requirements for operation, chromaticity, NTCIP compliance, and readability.

DATs shall include verification of proper operation of the DMS assembly for at least two hours after having been stabilized at the maximum specified temperature, humidity and

voltage; two hours after having been stabilized at the minimum temperature, humidity and voltage; and two hours after having been stabilized at 70°F and nominal input voltage of 120/240 ±15 VAC, 60 ±3Hz.

Chromaticity shall be certified by an independent testing laboratory using a Minolta XY-1 Chromatometer. The chromaticity tests shall be conducted for the following minimum states:

1. Night (approximately 0.2 ft candles);
2. Low light (overcast)*;
3. Direct sunlight*;
4. Sunlight directly behind the DMS*; and
5. Sunlight directly in front of the DMS*.

* Daytime tests shall be performed during ambient temperature conditions greater than 80°F.

NTCIP compliance shall be certified using the NTCIP exerciser available from the FHWA transportation laboratory to demonstrate that no proprietary protocols have been used, and that the SCU/software is NTCIP compliant.

The readability test shall be conducted using five individuals approved by the Engineer with 20/20 corrected vision. Messages comprised of 12" upper case letters shall be read at a distance of 600' with the sun at a low angle both in front and behind the sign, and at night. Eighty-percent correct response shall be considered passing.

484.4.2 Stand-Alone Test: The stand-alone test shall exercise all stand-alone (non-network) functional operations of the installed equipment.

The stand-alone test for the DMS assembly shall be performed using both the SCU front display panel and the County maintenance laptop computer. At a minimum, the test shall verify the following:

1. Downloading of messages;
2. Placing messages in memory and verifying content;
3. Display of all characters in the sign;
4. Display of static, alternating, and flashing messages of 54 characters;
5. Selection of messages;
6. Resumption of normal operations after power is restored;
7. Diagnostic activation of all pixels at selectable intervals; and
8. Diagnostic routines and failure reporting.

484.4.3 Subsystem Tests (SST): For each DMS location that is installed and interconnected in the system, conduct approved SSTs from the Traffic Operations Center that includes the following:

1. All items in the stand-alone test; and
2. Communication to/from all signs and the Traffic Management Center.

484.5 WARRANTY REQUIREMENTS:

The following requirements apply, in addition to the warranty requirements identified in Section 480.4:

The LED used for the pixels shall be warranted by the Manufacturer for a minimum 5-year period and for a minimum of 1-year by the Contractor. The Contractor shall purchase an extended warranty to obtain the required 5 years when the standard Manufacturer warrantee does not provide the required warranty duration. If during the warranty period, the LEDs deteriorate due to natural causes to the extent that the sign is unreadable as defined in Section 484.2.2(A), then the LEDs shall be replaced or restored to original effectiveness by the Contractor for 1-year, thereafter replaced/restored by the Department or Manufacturer.

484.6 DOCUMENTATION:

The Contractor shall provide maintenance manuals for DMS equipment per the requirements of Section 480.5. Include the following diagrams (as appropriate):

1. DMS system block diagram showing all components;
2. Control signal path diagram;
3. System connection diagram; and
4. Detailed connection diagrams.

484.7 TRAINING:

When required by special provision, the contractor shall meet the training requirements of Section 480.6.

484.8 MEASUREMENT:

DMS assemblies, including the DMS case, display, SCU, mounting, cables, surge protection, software, and any other required accessories, will be measured as a unit for each installed.

DMS cabinets will be measured as a unit for each type installed.

Testing, warranty, documentation, and training are considered incidental to the item requiring the work.

484.9 PAYMENT:

The accepted quantities of items, measured as above, will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described.

Part 400 add the following new Section:

SECTION 485
VIDEO IMAGE DETECTORS

485.1 DESCRIPTION:

The work under this section shall consist of furnishing, installing, and testing video image detection (VID) equipment including the video detector (camera), image processor, cabinet, cables, mounting, surge suppression, lightning protection, local software, and various accessories as needed, for the purposes of obtaining accurate vehicle data at mid-block or highway locations.

485.2 MATERIALS

Certificate of compliance per the requirements of Section 480.2.6 shall be submitted to the Engineer. Certify that all functional requirements listed herein for VID image processor, video detector, software, and communication protocols are met.

The Video Image Detector shall be Iteris Vantage video detection system using the following equipment:

Vantage Edge®2 Processor or approved equal
RZ-4C Advanced™ Camera or approved equal

485.2.1 Functional Requirements: VID equipment shall comply with the following requirements:

1. Collects and stores for retrieval, real time calculation of speed, volume, and occupancy to an accuracy within ±5% of actual speed, volume, and occupancy under the following conditions:

- Average traffic flow between 5 mph and 75 mph for speed and volume;
- Day or night operation;
- During fog or haze when the visible meteorological range is at least 0.5 mile;
- During rainfall up to 0.2" /hr;
- When experiencing as much as 3.0" deflection or sway due to wind, vibration, or other means; and

- When the cable distance between the video detector and the cabinet is 650' or less.

Volume, speed, and occupancy are defined as:

- Volume: The number of vehicles per lane, during a specified time period;
- Speed: The average vehicle speed, per lane, during a specified time period; and
- Occupancy: The average percentage of time a detection zone is occupied by vehicles during a specified time period.

2. Detects vehicle presence, per lane.

3. Transmits stored data to the central system in response to system polls that may vary in length, no closer than 5 seconds apart. Include with the transmission, the time elapsed since the data accumulation was zeroed at the last transmission.

4. Transmit status information to central in response to a central status query.

5. Supports local monitoring and diagnostic activities from a local user at the VID cabinet via software loaded on the County's maintenance laptop computers.

6. Continues to respond to the central system polls for status and data when interfaced to the County's maintenance laptop computer.

The VID shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.3: 10BASE-T
2. IEEE 802.3u: 100BASE-TX
3. RFC768: UDP
4. RFC791: IP
5. RFC792: ICMP
6. RFC793: TCP
7. RFC826: ARP
8. RFC854: Telnet
9. RFC894: IP over Ethernet
10. RFC1112: IGMP v1
11. RFC 1157: SNMP
12. RFC1541: DHCP (client)
13. RFC2068: HTTP
14. RFC2236: IGMP v2
15. RFC 2246: SSL / TLS
16. RFC2660: HTTP-S
17. RFC 2821: SMTP

The VID equipment physical design shall provide the following requirements:

1. One 10/100 Mbps Ethernet port

2. A single DB-9 female connector port for Detector Communications that can communicate up to a speed of 230,400 bps to the signal controller
3. A single DB-9 male connector port for local supervisor that can communicate up to a speed of 230,400 bps
4. Four standard 75-ohm BNC video output connectors
5. Four sets of compression terminals to support up to four detector sensors

485.2.2 Environmental: VID equipment shall meet the environmental requirements of Section 480.2.1, except that the VID camera equipment shall perform to the stated specifications over an ambient temperature range of -31°F to +140°F.

485.2.3 Image Processor: The image processor may be located either with the video detector on the pole or in the VID cabinet. The image processor shall have the capability to analyze the video signal at a minimum rate of 25 frames per second.

The image processor shall perform the following functions:

1. Synchronize with the central system's time and date;
2. Establish or change the controller's operational parameters to match those downloaded from the central system;
3. Upload the current operational parameters to the central system; and
4. Reset detector data accumulators to zero following transmission to the central system.

485.2.4 Video Detector: The video detector shall obtain video and process data for up to 4 lanes of traffic.

485.2.5 Cables: Power and control cables shall comply with the VID manufacturer's specification requirements.

485.2.6 Mounting: All mounting equipment and adapter plates needed to securely mount the video detector to the VID pole or other structure shall be provided by the Contractor.

485.2.7 Surge Suppression: Surge protectors shall be installed in the VID cabinet for all conductors (power, data, and video) between pole mounted and cabinet mounted VID equipment. Each surge protector shall be grounded to a terminal block mounted to the cabinet rack. The terminal block shall be bonded directly to the cabinet ground using a #8 AWG copper ground wire. Surge protector leads shall be a minimum 3' in length and installed straight as possible. Surge protectors shall meet the requirements of Section 483.2.7.

Wire, ground, and bond equipment shall comply with Section 250-86 of the NEC.

485.2.8 Maintenance Software Requirements: The Contractor shall furnish and install maintenance software on the County maintenance laptop computers that can be used

to provide local operation and full diagnostic support for video detection. The maintenance software shall enable the local user to obtain current volume, occupancy and speed data on a per lane basis.

During submittals, the Contractor shall furnish a list of minimum requirements for the County maintenance laptop computers. If the maintenance software requires an operating system that is not offered by the County laptops, then furnish and install the necessary operating system including a start-up screen that allows the user to choose the appropriate operating system.

The maintenance software shall provide the means for a user to define detection zones through interactive graphics by placing lines or boxes on an image of the detection area that is displayed at the field cabinet. The software shall use graphics that provide visual confirmation when a vehicle has been detected as it passes through the detection zone. In addition, the software shall produce a visual read-out for individual vehicle speed that can be selected or turned-off by lane.

Maintenance software requirements will be waived if identical software is already loaded on the County's maintenance laptop computers.

485.2.9 Maintenance Laptop Computer Interface: A data and video interface shall be provided in the VID cabinet for the County's maintenance laptop computer. The interface shall respond to central system polls for status and data while local control, monitoring, configuration, and diagnostic routines are occurring.

485.2.10 Communication Requirements: The communication signal format shall match the County's central system.

485.2.11 Communication Protocol: The VID equipment shall respond to system polling in a manner that conforms to the protocol and message structure of the County's central system. Proprietary protocols shall not be used. Protocol converters may be used provided that all functionality and general requirements of the Specifications are met.

485.3 CONSTRUCTION REQUIREMENTS:

The Contractor shall install local software on the County's maintenance laptop computers. Configure/calibrate the local software for each location and enter data in all pertinent fields.

The Contractor shall install terminals and connectors on cabling at the camera and controller cabinet and bond the video detector to the mounting bracket or pole.

The Contractor shall coordinate programming of video by factory approved technical staff. All video shall be operational on the day of signal activation.

485.4 TESTING REQUIREMENTS:

Meet the requirements of Section 480.3.4 and the following:

485.4.1 Design Approval Tests (DAT): Provide DAT certification for the video detector (camera) and image processor for equipment the Contractor desires to have as an approved equal.

485.4.2 Subsystem Tests: Using the County's software at the Traffic Management Center, verify that all detector data is received. The Contractor shall demonstrate correct responses to all message formats of the County protocol, detector processing, and all functions required in the Specifications.

485.5 WARRANTY REQUIREMENTS:

Warranty shall comply with requirements of Section 480.4.

485.6 DOCUMENTATION:

The Contractor shall provide maintenance manuals for VID equipment per the requirements of Section 480.5. Include the following diagrams (as appropriate):

- VID system block diagram showing all components;
- Video and control signal path diagram;
- System connection diagram; and
- Detailed connection diagrams.

485.7 TRAINING:

When required by special provision, the contractor shall meet the training requirements of Section 480.6.

485.8 MEASUREMENT:

VID equipment assembly, including the video detector (camera), image processor, cables, mounting, surge suppression, lightning protection, local software, and various accessories as needed, will be measured as a unit for each installed.

485.9 PAYMENT:

The accepted quantities VID equipment assemblies will be paid for at the contract unit price, COMPLETE IN PLACE, which price shall be full compensation for the work described including testing, warranty, documentation, and training.

Part 400 is supplemented with the following new Section:

SECTION 486
COMMUNICATIONS EQUIPMENT

486.1 DESCRIPTION OF WORK: The work under this section shall consist of furnishing, installing, and testing communications equipment systems including, cabinet, cables, mounting, surge suppression, lightning protection, software, and accessories as indicated.

486.2 MATERIALS AND EQUIPMENT

486.2.1 Frequency Hopping 900 MHz Spread Spectrum Radio:

Certificate of compliance per the requirements of Section 480.2.6 shall be submitted to the Engineer. Certify that all functional requirements listed herein for hardware, software, and communication protocols are met.

486.2.1.1 Functional Requirements: Spread Spectrum Radio equipment shall meet the following requirements:

1. Operate in the license-free, Spread Spectrum band (902-928 MHz) or frequencies compatible with the system, utilizing Frequency Hopping technology
2. Use 50 user-selectable channels with automatic generated hopping sequences, (2 shall be non-overlapping)
3. Operating modes of Point-to-Point, Point-to-Multipoint, Store & Forward Repeater, and Peer-to-Peer.
4. Completely configurable via software
5. Software to provide: remote diagnostics, remote maintenance and spectrum analyzer
6. A maximum 8 mSec. end-to-end latency
7. Receiver Sensitivity of -110 dBm @ 10^{-6} BER
8. Operating temperature of -40 to +75 degrees C.
9. Operate with voltages between 6 VDC and 30 VDC, with a typical current draw of <100mA
10. Programmable for RF output levels of 1mW, 10mW, 100mW or 1 Watt
11. Provide 32-bit CRC error checking with auto re-transmit
12. Compatible with standard signal controller hardware and software
13. Built-in store-and-forward repeater (One radio repeater c/w live local comm. port)
14. Ability to function in a wireless network configuration that may include a mix of RS232, RS485
15. Sleep Mode with a maximum current draw of <1uA
16. 50 Ohm Impedance

Comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.3: 10BASE-T
2. IEEE 802.3u: 100BASE-TX
3. RFC768: UDP
4. RFC791: IP
5. RFC792: ICMP
6. RFC793: TCP
7. RFC826: ARP
8. RFC854: Telnet
9. RFC894: IP over Ethernet
10. RFC959: FTP
11. RFC1112: IGMP v1
12. RFC1157: SNMP
13. RFC1541: DHCP (client)
14. RFC2068: HTTP
15. RFC2236: IGMP v2

486.2.1.2 Physical Requirements:

1. One RP TNC antenna connector
2. One 10/100 Mbps Ethernet port
3. One DB-9 female connector port for RS232 / RS485 communications up to a speed of 230,400 bps or Ethernet port for IP communications
4. LED indicators for radio communications: PWR, TX DATA, RX DATA (3 LED Bar graph for RX Signal Strength Indication)
5. LED indicators for network communications: 100 Mbps, 10 Mbps, and Activity
6. Available in a rack mounted version, and a pole mounted version

486.2.1.3 Shelf Mount Unit

1. Size shall not exceed 8.0" Depth x 2.5" Wide x 6.5"
2. Shall have power cable supplied with radio modem
3. Shall have RSSI signal strength LEDS

486.2.1.4 Surge Suppression: Internal surge protectors shall protect the Radio all conductors (power and data) between pole mounted antenna and cabinet mounted equipment. Each surge protector shall be grounded to a terminal block mounted to the cabinet rack. The terminal block shall be bonded directly to the cabinet ground using an #8 AWG copper ground wire. Surge protector leads shall be a minimum 3' in length and installed straight as possible. Surge protectors shall meet the requirements of Section 483.2.7.

Wire, ground, and bond equipment shall comply with Section 250-86 of the NEC.

486.2.1.5 Maintenance Software Requirements: The Contractor shall furnish maintenance software for all County maintenance laptop computers. The software shall provide local operation and full diagnostic support for Spread Spectrum Radio. The maintenance software shall enable the local user to test the radio, analyze the interference and select appropriate operational bands. The Contractor shall provide documented installation instructions to enable installation on all County maintenance laptop computers and demonstrate installation of the maintenance software on at least one County maintenance laptop computer.

During submittals, the Contractor shall furnish a list of minimum requirements for the County maintenance laptop computers. If the maintenance software requires an operating system that is not on the County laptops, then the Contractor shall furnish and install on the County laptop computers the necessary operating system including a start-up screen that allows the user to choose the appropriate operating system. This will involve less than twelve laptop computers.

Maintenance software requirements will be waived if identical software is already loaded on the County's maintenance laptop computers.

486.2.1.6 Communication Requirements: The communication signal format shall match the County's central system.

486.2.1.7 Cables: Cabling shall have preinstalled connections for interconnecting the antenna with the transceiver. The cable shall be a low loss Hyperlinc CA-400 or better with a maximum attenuation 3.9 dB per 100 feet @ 900 MHz

An RS-232 interconnect or CAT5 Ethernet cable, 4-foot minimum, shall be provided with the spread spectrum equipment for interconnecting directly with the local controller or the terminal server.

Cables shall be labeled and tied down in a manner that portrays a professional and neat appearance.

486.2.1.8 Lightning Suppressor:

A cabinet mounted lightning suppressor shall be provided as part of the spread spectrum radio system.

Install an RF Transmission Line Surge Suppressor that meets the following requirements:

Class:	RF Transmission Line Surge Suppressor
Connector:	RP TNC type
Frequency Range:	DC, 0 – 6 GHz

VSWR:	1:1.5 Max
Insertion Loss:	0.5 dB Max
Input/Output impedance:	50 ohms
RF Voltage Rating:	90 volts (maximum) for radios that transmit less than 10W Output Power
Gas Tube Insulation Resistance:	10,000 MΩ
Max.Withstand Current:	5 KA
Additional Features:	Multistrike, bi-directional protection with easily replaceable gas tube
Operating Temperature:	-40° C to +75°C
Operation Environment:	Outdoor use, out of direct weather (5% to 100% non-condensing)

The equipment shall be the ALTELICON, Standard 90V Lightning Protector AL6-NFNFB-9, or approved equivalent.

486.2.2 Direct Spread Spectrum Radios: The spread spectrum radio equipment shall provide a high reliability, bi-directional, multi-point, multi-platform communication link between field devices and service crews.

486.2.2.1 Functional Requirements The Direct Spread Spectrum Radio equipment shall meet the following requirements.

1. Operate in both the licensed and unlicensed bands: 2.3 GHZ, 2.4 GHz, 2.5 GHz, 4.9 GHz, and 5.25 - 5.825 frequency ranges.
2. Provide a max modulation of 54 Mbps for unlicensed frequencies and 40 Mbps for Licensed frequencies
3. Modular architecture that can support from two to four radios for communication nodes and up to two radios for backhaul or end nodes.
4. Operating modes of Point-to-point, Point-to-Multipoint, and Multipoint-to-Multipoint
5. Completely configurable via a web interface, command line interface (CLI), and software.
6. Software to provide: remote diagnostics, remote maintenance, and spectrum analyzer
7. Radio shall support any combination of roles such as Access Radio, Backhaul Radio, and WiMax Radio
8. Provide Layer 2 and Layer 3 Switch Router functionality
9. Operating temperature of -40° C to +50 ° C
10. Programmable for RF output levels of 1mW, 10mW, or 100mW

The spread spectrum radio equipment shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.3i: 10BASE-T
2. IEEE 802.3u: 100BASE-TX, 100BASE-FX

3. IEEE 802.1d: MAC Bridging
4. IEEE 802.1Q: VLANs
5. IEEE 802.1p: Prioritization
6. IEEE 802.1x: Radius
7. RFC768: UDP
8. RFC791: IP
9. RFC792: ICMP
10. RFC793: TCP
11. RFC826: ARP
12. RFC854: Telnet
13. RFC894: IP over Ethernet
14. RFC959: FTP
15. RFC1112: IGMP v1
16. RFC1157: SNMP
17. RFC1350: TFTP
18. RFC1541: DHCP (client)
19. RFC2030: SNTP
20. RFC2068: HTTP
21. RFC2236: IGMP v2

486.2.2.2 Physical Requirements:

1. One 10/100 Mbps Ethernet port
2. One 100Base-FX Ethernet Interface (SMFO)
3. LED indicators for radio communications: PWR, TX DATA, RX DATA
4. LED indicators for network communications: 10 Mbps, 100 Mbps, and Activity
5. The radio shall comply with IP56, NEMA4, and NEMA4X for wet and dusty conditions

All system components shall provide for a fully functional operation. The spread spectrum assembly shall include all communication equipment and accessories necessary to support the spread spectrum radio site that provides transmitting, receiving, and repeating (for extending range beyond line of sight to the first cabinet on the drop) capabilities for point-to-point, point-to-multipoint, and multipoint-to-multipoint bi-directional configurations.

486.2.2.3 Transceiver: The spread spectrum radio (SSR) shall be off-the-shelf equipment that operates within the licensed and unlicensed bands of 2.3 GHz, 2.4 GHz, 2.5 GHz, 4.9 GHz, and 5.25-5.825 GHz frequency range. The unit shall also support an Ethernet interface. The unit shall be FCC certified.

Radio	Frequency	Transmit Power	Receive Sensitivity	Channel Size
Access Radio	2.4 to 2.4835 GHz	up to 27.6 dBm	-100 dBm (DSSS) -94 dBm (OFDM)	**20 MHz**
Backhaul Radio	4.940 to 4.990 GHz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps	**20 MHz**
Backhaul Radio	5.25 to 5.35 GHz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	**20 MHz**
Backhaul Radio	5.725 to 5.825 GHz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	**20 MHz**
Backhaul Radio	5.825 to 5.875 GHz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	**20 MHz**
WiMax Radio	2.300 to 2.360 GHz	12 dBm @ 10 MHz	-93 dBm @ 6 Mbps	**10 MHz**
WiMax Radio	2.495 to 2.690 GHz	12 dBm @ 10 MHz	-93 dBm @ 6 Mbps	**10 MHz**
Backhaul Radio	5.47 to 5.725 GHz	17 dBm (48, 54 Mbps)	-90 dBm @ 6 Mbps -71 dBm @ 54 Mbps	**20 MHz**

486.2.2.4 External System Antenna:

Yagi 900 MHz Antenna: Shall be a directional Yagi and provide a nominal gain of at least 8.5 dB. The antenna shall be approximately 24" (height) by 6.4" (width). The antenna shall operate within a temperature range of -40°F to +165°F and be non-condensing up to 95% humidity.

5.8 GHz Panel Antenna: Shall be a directional panel and provide a nominal gain of at least 19 dB. The antenna shall be approximately 7.45" (height) by 7.45" (width) by (1.37" (width). The antenna shall operate within a temperature range of -40°F to +165°F and be non-condensing up to 95% humidity.

486.2.2.5 Cables: Cabling shall have preinstalled connections for interconnecting the antenna with the transceiver. The cable shall be a low loss Hyperlink CA-400or approved equal with a maximum attenuation of 3.9 dB per 100 feet @ 900 MHz.

Cabling shall have preinstalled connections for powering the transceiver. The power cable shall be Penn Wire AQ29612 or approved equal with an overall shield and Aquaseal tape.

Cabling shall have preinstalled connections for 10/100 Mbps Ethernet connectivity for the transceiver. All Ethernet cable shall be Belden 7921A or approved equal with the specifications of CAT5e, outdoor rated, waterproof, bonded pairs, foil + braid shielding and black outer jacket.

An interconnect cable, 6-foot minimum, shall be provided with the spread spectrum equipment for interconnecting directly to the Field Hardened Ethernet Switch (FHEAS).

Installed cables shall be labeled and fastened in an appropriate manner to portray a professional and neat appearance.

486.2.2.6 Lightning Suppressor: A cabinet mounted lightning suppressor shall be provided as part of the spread spectrum radio system.

Install an RF Transmission Line Surge Suppressor that meets the following requirements:

Class:	RF Transmission Line Surge Suppressor
Connector:	RP TNC type
Frequency Range:	DC, 0 – 6 GHz
VSWR:	1:1.5 Max
Insertion Loss:	0.5 dB Max
Input/Output impedance:	50 ohms
RF Voltage Rating:	90 volts (maximum) for radios that transmit less than 10W Output Power
Gas Tube Insulation Resistance:	10,000 MΩ
Max. Withstand Current:	5 KA
Additional Features:	Multistrike, bi-directional protection with easily replaceable gas tube
Operating Temperature:	-40° C - +75°C
Operation Environment:	Outdoor use, out of direct weather (5% to 100% non-condensing)

The equipment shall be the ALTELICON, Standard 90V Lightning Protector AL6-RTPRTJB, or approved equivalent.

486.2.3 Twisted-Wire Pair Modems (TWP)

486.2.3.1 Functional Requirements: Twisted Pair Modem equipment shall comply with the following requirements:

1. Modems shall communicate over a copper twisted wire pair (TWP) communication medium.

2. The twisted-wire pair modems shall provide high reliability, bi-directional Ethernet data, multipoint ("daisy-chained") communication link between field devices.
3. Completely configurable via software
4. Software shall provide: remote diagnostics, remote maintenance, graphical interface for operators to manage and troubleshoot the network.
5. The TWP modem shall also operate as a network interface to the T1 router and/or other network devices.
6. Modems shall communicate at a minimum send speed of 2.3 Mbps over private line applications with a receive distance of 22,000 feet.
7. Modems shall be selectable for operation on private line 2-wire, half-duplex and 4-wire full-duplex communications circuits.
8. Modems shall support 10/100 Mbps Ethernet connections for network devices.
9. Operating modes of Point-to-point and Point-to-Multipoint
10. Compatible with standard signal controller hardware and software
11. The twisted pair model shall be complaint with the Symmetric High-Bitrate Digital Subscriber Loop standard (SHDSL)

Twisted Pair Modem equipment shall comply with the following International Telecommunication Union (ITU) and Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. ITU G.994.1 G.handshake
2. IEEE 802.3: 10BASE-T
3. IEEE 802.3u: 100BASE-TX
4. IEEE802.3ah
5. RFC768: UDP
6. RFC791: IP
7. RFC792: ICMP
8. RFC793: TCP
9. RFC826: ARP
10. RFC854: Telnet
11. RFC894: IP over Ethernet
12. RFC959: FTP
13. RFC1058: RIP
14. RFC1112: IGMP v1
15. RFC1157: SNMP
16. RFC2068: HTTP
17. RFC2236: IGMP v2

486.2.3.2 Physical Requirements:

1. Four Twisted Pair interfaces for interconnect cable
2. Four 10/100 Mbps Ethernet ports
3. LED indicators for communications: PWR, TX DATA, RX DATA
4. LED indicators for network communications: 10 Mbps, 100 Mbps, and Activity

A TWP modem shall be used in conjunction with a terminal server provided by the Contractor for serial communications to the Traffic Management Center. This includes, but is not limited to the serial data for Video Detection, Wireless Radio system, and the Signal Controller.

Modems shall include at least the following LED indicators:

TWP Communications:

- Power (PWR);
- Transmit Data (TXD);
- Receive Data (RXD);

Ethernet Communications:

- 100 Mbps
- 10 Mbps
- Activity

Modems shall support anti-streaming by turning the transmitter off after a selectable period of time.

Modems shall also be fully functional over an ambient outdoor temperature range of –40°F to +165°F and an outdoor ambient humidity of 5% to 95% non-condensing.

Modems shall be standalone units with an aluminum housing that is treated to prevent corrosion. External markings shall include the product name, model number, part number, serial number, manufacturer's name, connection labels, and indicator labels.

A voltage converter shall be provided with each standalone modem. The power converter shall operate from a prime power with the following characteristics:

Input Voltage:	115	VAC	±15%
Frequency:	60	Hz	±10%
Phase:	Single		
Maximum Load:	200 mA		

The use of a terminal server between the modem and the controller will be necessary. Each modem shall be provided with an internal terminal server for the signal controller and an external terminal server for other RS232 devices.

The interconnect cable shall have a connector on one end that directly mates to the TWP modem. The TWP modem shall have an Ethernet port that directly connects to the Terminal Server. The terminal server shall connect directly to the RS-232 port on the TS-2 signal controller.

Documentation on the assigned pin-out configuration for each end of the interconnect cable shall be provided. In the event that a loop through between the RTS and CTS pins are necessary and this function is accommodated within the interconnect cable configuration, it shall be clearly identified in the interconnect cable documentation.

486.2.4 Telephone Modems

Telephone modems shall provide for point-to-point communications, via a dial-up telephone line, between the central equipment at the TMC and the field cabinet location.

Telephone modems shall be commercial off-the-shelf (COTS) external modems that meet the V.34 standard.

Modems shall be fully functional over an ambient outdoor temperature range of -40°F to +165°F and an outdoor ambient humidity of 5% to 95% non-condensing.

Modems shall include at least the following LED indicators:

1. Power (PWR);
2. Transmit Data (TXD); and
3. Receive Data (RXD).

Modems shall be stand alone units with an aluminum housing that is treated to prevent corrosion. External markings shall include the product name, model number, part number, serial number, manufacturer's name, connection labels, and indicator labels.

An interconnect cable, 6-foot minimum, shall be provided with each modem for interconnecting to the local controller directly or for interconnecting to the ITS network equipment.

486.2.5 ITS Network Equipment: Certificate of compliance per the requirements of Section 480..2.6 shall be submitted to the Engineer. Certify that all functional requirements listed herein for hardware, software, and communication protocols are met.

486.2.5.1 Functional Requirements: The network equipment shall interface with a combination of T1 leased lines, fiber, Ethernet, wireless, and/or EIA-232 devices to provide communications service to the MCDOT Traffic Management Center (TMC).

486.2.5.1(A) Multifunction T1 Router: A multi-function network device such as the Industrial Frame Router (single T1 CSU/DSU, Ethernet switch, and Terminal Server) shall receive Ethernet and EIA-232 channels from a Qwest provided T1. The router's internal devices shall provide a port for interfacing the local controller and provide another port for interfacing the multi-point communications transceiver (OTR, TWP modem or spread spectrum equipment). Additional devices such as a CCTV camera

assembly, Dynamic Message Signs and Video detection when installed shall receive an Ethernet or EIA-232 port.

486.2.5.1(B) Field Hardened Network Gateway Router (FHNGR) with four port T1 Multiplexer, and Field Hardened Ethernet Backbone Switch (FHEBS) / Field Hardened Ethernet Access Switch (FHEAS): A multi-function network device such as the FHNGR (four T1 CSU/DSUs, Ethernet switch, and Terminal Server) shall receive Ethernet and EIA-232 channels from the Qwest provided multi port T1s. The FHNGR for each location shall interface with up to four T1s and will act as the gateway to the MCDOT TMC. Each FHEBS/FHEAS shall provide a pathway to a terminal server for interfacing with the local controller and other analog devices using EIA-232. Additional devices such as a CCTV camera assembly, Dynamic Message Signs and Video detection when installed shall receive an Ethernet or EIA-232 port. This configuration of terminal servers shall be installed in each cabinet.

486.2.5.1(C) Layer 3 Router, T1 Multiplexer, and Ethernet Switch: A network device such as a Layer 3 router shall route Ethernet traffic across Local Area Networks (LANs), Virtual Local Area Networks (VLANs), and Wide Area Networks (WANs) to the MCDOT TMC. The Layer 3 router for each side shall interface with the eight-port T1 Multiplexer/Demultiplexer at each Traffic Management Center or Network Operations Center. Each Ethernet switch shall provide a pathway to the Field Hardened Ethernet Access Switches (FHEAS) which will provide a communication link to each cabinet. Devices such as the local controller, CCTV camera assembly, Dynamic Message Signs, and Video detection when installed shall receive an Ethernet or EIA-232 port. This configuration of terminal servers shall be installed in each cabinet.

Two interconnect cables, 4-foot minimum, shall be provided with the line-sharing unit; one for interconnecting to the local controller directly and the other for interconnecting directly to the communication transceiver (OTR, TWP modem or spread spectrum equipment).

486.2.6 Industrial Frame Router:

486.2.6.1 Functional Requirements: Industrial frame routers to be located in the traffic signal controller cabinet shall comply with the following minimum requirements:

1. Eight (8) RS232 DTE serial interfaces with DB9 female connectors;
2. Five (5) 10/100 Base TX Ethernet ports;
3. T-1 CSU/DSU interface;
4. Functions to include terminal server, Ethernet switch, IP router, Frame Relay Access Device (FRAD), and CSU/DSU;
5. Operating temperature range from -40 °F to 160 °F;
6. High voltage power range of 90 to 250 VAC;
7. Frequency range of 50 to 60 Hz; and
8. Power consumption: 85 W.

Industrial frame routers shall be supplied with all necessary cabling to provide a functional system.

The industrial frame router shall be Dymec DynaStar 1500 IFR, or approved equivalent.

486.2.7 Field Hardened Network Gateway Router (FHNGR):

486.2.7.1 Functional Requirements: The fiber equipment shall meet the following requirements

1. High-performance Network Router supporting standard OSI Layer 3 functionality.
2. Router shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.
3. All FHNGR, FHEAS, and FHEBS are to be from the same manufacturer.
4. Equipment shall have licenses for all software or hardware in the system.
5. Configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper based Ethernet networks.
6. Designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.
7. Designed with an operating system that allows for the collection of statistics on a per port basis and provides for full support of RMON statistics, history, alarms, and event groups.
8. Designed with an operating system that provides port security to prevent unknown devices from gaining access to the network. Unauthorized attempts to access the network shall result in the port being shut down for a period of time along with Simple Network Management Protocol (SNMP) trap and alarm generation.
9. High-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.
10. All modules and assemblies are to be clearly identified with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

The equipment shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.3-10BaseT
2. IEEE 802.3d-MAC Bridges
3. IEEE 802.3u-100BaseTX, 100BaseFX
4. IEEE 802.3x-Flow Control
5. IEEE 802.3z-1000BaseLX
6. RFC1294-Frame Relay

7. RFC1305-NTP
8. RFC1321-PPP (MD5)
9. RFC1332-PPP (IPCP)
10. RFC1334-PPP Authentication
11. RFC1490-Frame Relay
12. RFC1519-CIDR
13. RFC1541-DHCP (client)
14. RFC1661-PPP
15. RFC2068-HTTP
16. RFC2338-VRRP
17. RFC2819-RMON MIB
18. RFC768-UDP
19. RFC783-TFTP
20. RFC791-IP
21. RFC792-ICMP
22. RFC793-TCP
23. RFC826-ARP
24. RFC854-Telnet

486.2.7.2 FHNGR Physical Requirements:

1. Operates as a Layer 3 to serve as network gateways between the MCDOT TMC, Field Hardened Ethernet Backbone Switch, and the Field Hardened Ethernet Switches in the field.
2. Two built-in 100 MB full-duplex or higher switched Ethernet single-mode fiber ports with the ability to reach the necessary distance.
3. Two switched 10/100 MB Ethernet or higher copper (RJ 45) ports.
4. Four T1/E1 unchannelized WAN ports.

A FHNGR shall be used in conjunction with a terminal server to interface with Video Detection, Wireless Radio system, and the Signal Controller.

486.2.8 Serial Expansion Device:

Serial expansion device shall comply with the following minimum requirements:

1. One (1) 10/100 Ethernet LAN port with RJ45 connector;
2. Four (4) RS-232 serial ports;
3. Surge protection on all ports;
4. 230 Kbps throughput on all ports;
5. LEDs for serial and Ethernet activity;
6. Port buffering up to 64 Kbps per port;
7. Power requirement: 100 to 250 VAC;
8. Frequency range of 47 to 63 Hz;
9. Power consumption 12 W; and
10. Operating temperature range of -29 °F to 165 °F.

The serial expansion device shall be supplied with all necessary cabling to provide full operation. The terminal server shall be compatible with the ASC2/2100 Signal Controller.

486.2.9 Video CODEC:

486.2.9.1 General: The video CODEC shall allow for the transmission of live video, data, and audio over an existing Ethernet network, requiring an Internet Protocol (IP) address or Internet Explorer 5.5 or higher, or shall work as an analog-to-Ethernet "bridge" controlling matrices, multiplexers, and pan/tilt/zoom cameras. The video CODEC shall operate in a box-to-box configuration allowing for the encoded video to be decoded and displayed on an analog monitor.

486.2.9.2 Operational Requirements:

Video:

Compression algorithm: Dual Stream, MPEG-4, H.264
Video format: 1x NTSC / PAL (Auto detect)
Connector type: BNC
Data rate (bandwidth): 9.6 kbps to 4 Mbps
Encoding-decoding latency: 200 ms
Frame rate: 1 to 30 fps
Video Decoder: Used to display the video on a standard analog NTSC or PAL monitor
In-/output level: 1 Vpp (±3 dB)
Input impedance: 75Ω/Hi-Z selectable
Number of output streams: 5 (multi- and/or unicast)
Image Resolution NTSC: D1 720x480, HD1 352x480, 2CIF 720x240, CIF 352x240, QCIF 176x144

Audio:

Connector Type: RJ45
In-/output level: 0 dBV (+6 dBV max.)
Input impedance: >50 kΩ or 600 Ω bal.
Max. bandwidth: 20 Hz to 20 kHz
Number of channels: 2 (full duplex)
Number of streams: 3 (multi- and/or unicast)
Output impedance: <50 Ω bal.
Sampling rate: 44, 16 or 8 kHz (selectable)
Sampling resolution: 16-bits (linear PCM or G.711)
Signal to Noise Ratio: >75 dBA
Total harmonic distortion: <0.25% at nom. level

Transmission Interface:

Connector: RJ45
Interface: 10/100Base-TX Fast Ethernet
Number of interfaces: 1
Protocols: MPEG-ES or TS, RTP, UDP, IP, DHCP, IGMP, MX/IP, HTTP, and SNMPv2
Selectable: Auto Negotiation, Half Duplex/Full Duplex, 10/100 Mb

Management:

Network Management & Control: SNMPv2, SNM™, MX™, HTTP (password protected)
PC Software: Manages the installation and maintenance of all hardware transmitters and receivers on the network

Environmental:

Operating temperature: -40 to +74° C (–40° to +165.2° F)
Relative humidity: <95% (no condensation)
Five Year Warranty

Mechanical:

Dimensions (h x w x d): 5.0 x 1.4 x 7.5 in.
Housing: Rack-mount or standalone
Weight (approx.): 1.0 lbs

Contact Closure:

Connector type: RJ45
Input: +3 V pull-up, 2 kΩ
Latency: <5 ms
Number of channels: 2 (full duplex)
Number of streams: 2x 3 (multi- and/or unicast)
Output Fail-safe, potential-free
Switch rating: 2 A at 30 Vdc
Threshold 1.5 V

Data:

Connector: RJ45
Data rate: UART mode 300 to 230.4k baud, Latency <5 ms
Data rate sampling mode: DC to 19.2 kbps
Format: Asynchronous, serial
Interfaces: 1x RS232, 1x RS422/485 (2- or 4-wire)
Latency: 10 ms
Number of channels: 2 (full duplex)

Number of streams: 2x 3 (multi- and/or unicast)
Sampling rate: 153 k samples/sec

486.2.9.3 Material Requirements: The Video CODEC shall interoperate with an existing central software driver, available from 360 Surveillance. A list of available software drivers may be found at: http://360surveillance.com. All components of the Video CODEC shall be off-the-shelf items

The video CODEC shall be constructed using the latest available techniques with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality in the equipment design.

Equipment shall be designed for ease of maintenance, with all component parts being readily accessible for inspection and maintenance. Test points shall be provide for checking essential voltages and waveforms.

All external screws, nuts, and locking washers shall be stainless steel. Self-tapping screws shall not be used unless specifically approved by the Engineer.

All parts shall be made out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

All materials shall be protected from fungus growth and moisture deterioration.

All dissimilar metals shall be separated by an inert dielectric material.

486.2.9.4 MEASUREMENT: Video CODEC shall be measured per unit furnished, installed, made fully functional and tested or as otherwise directed by the Engineer.

486.2.9.5 PAYMENT: The accepted quantities of Video CODEC, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the item, COMPLETE IN PLACE, including all equipment described under this item with all cables and connectors; all documentation and testing, including the cost of furnishing all labor, materials, software, warranty, training, and equipment necessary to complete the work.

486.2.10 Field Hardened Ethernet Access Switch (FHEAS):

486.2.10.1 Material Requirements: All FHEAS shall be of the same manufacturer. All equipment shall be new and in strict accordance with the details shown on the plans and the specifications.

A high-performance managed Field Hardened Ethernet Switch shall support standard Open System Interconnection (OSI) Layer 2. FHEAS shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

All equipment shall include licenses, where required, for any software or hardware in the system.

FHEAS shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.1d: Spanning Tree Protocol
2. IEEE 802.1p: Class of Services
3. IEEE 802.1q: VLAN Tagging
4. IEEE 802.1w: Rapid Spanning Tree Protocol
5. IEEE 802.3: 10BASE-T
6. IEEE 802.3ab: 1000BASE-TX
7. IEEE 802.3d: MAC Bridges
8. IEEE 802.3u: 100BASE-TX, 100BASE-FX
9. IEEE 802.3x: Flow Control
10. IEEE 802.3z: 1000BASE-LX
11. RFC768: UDP
12. RFC783: TFTP
13. RFC791: IP
14. RFC792: ICMP
15. RFC793: TCP
16. RFC826: ARP
17. RFC854: Telnet
18. RFC894: IP over Ethernet
19. RFC1112: IGMP v1
20. RFC1493: Bridge MIB
21. RFC1519: CIDR
22. RFC1541: DHCP (client)
23. RFC1907: SNMP v2 MIB
24. RFC2012: TCP MIB
25. RFC2013: UDP MIB
26. RFC2030: SNTP
27. RFC2068: HTTP
28. RFC2236: IGMP v2
29. RFC2578: SNMP v2 SMI
30. RFC2579: SNMP v2 TC
31. RFC2819: RMON MIB
32. RFC2863: IF MIB

All FHEAS shall have a physical design that conforms to the following requirements:

1. Two Gigabit Ethernet full-duplex switched Ethernet single-mode fiber ports.
2. Eight switched 10/100 MB Ethernet or higher copper (RJ 45) ports.

3. Be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper based Ethernet networks.
4. Designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.
5. Designed with an operating system allows for the collection of statistics on a per port basis and provides for full support of Remote Monitoring (RMON) statistics, history, alarms, and event groups.
6. Designed with an operating system that provides port security to prevent unknown devices from gaining access to the network. Unauthorized attempts to access the network shall result in the port being shut down for a period of time along with Simple Network Management Protocol (SNMP) trap and alarm generation.
7. Have high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.
8. Clearly identify all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

The equipment shall have the following functionality and features:

1. Ports Performance
   - Provide Ethernet Single-mode Fiber ports that operate at 1000 Mbps with a link loss budget sufficient for the fiber link it will use.
   - Provide Ethernet RJ-45 ports that auto-negotiate operation at 10/100Mbps or higher if available.
   - Provide external optical attenuators as necessary to support interconnectivity with close range devices upstream or downstream.
2. Packet-Processing:
   - Processing type: store and forward
   - Auto-learning: 8192 Media Access Control (MAC) address
   - Frame buffer memory: 2 Mbit
   - Switching Latency: 7 microsecond
   - Priority queues: 4
   - Virtual Local Area Networks (VLANs): 8192
   - Internet Group Management Protocol (IGMP) multicast groups: 256
   - Switching bandwidth: 5.6 Gbps
3. Ethernet Network Connectors:
   - Eight RJ-45 connector ports for 10/100 Mbps or higher
   - Two dual LC connector 1000 Mbps ports for single-mode fiber
4. LED Indicators: One LED for power; three LEDs per Ethernet port for link, Tx, and Rx activity.
5. Power Supply:
   - AC power connector: Terminal block at rear of power supply chassis

- Input Voltage: 85 to 264 VAC (auto-ranging)
- Power Consumption: 8 watts (max)
- Fast Transient Protection: Compliant with IEEE C37.90.1

6. Mechanical:
   - Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for stand-alone, shelf, pedestal or wall mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

   - Meet all of its specified requirements when the input power is 115 VAC ± 10%, 60 ± 3 Hz, for any Field Hardened Ethernet Access Switch furnished or installed under this item.

   - Design the equipment such that the failures of the equipment shall not cause the failure of any other unit of equipment connected upstream or downstream of the device.

   - Make all parts out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

   - Protect all materials used in construction from fungus growth and moisture deterioration.

   - Meet all specified requirements during uncontrolled environmental operations characterized by an operating temperature range of -34°C (-29°F) to +74°C (165°F) and a humidity range of 10% to 95% (non-condensing).

The FHEAS shall be RuggedComm RS900G, or approved equivalent.

486.2.10.2 Construction Requirements: Minimum requirements for the Contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment are:

1. Five years experience in the installation and configuration of Ethernet equipment.

2. Two years direct experience in the configuration and deployment of the Rapid Spanning Tree protocol.

3. Two installed systems where Ethernet switches are installed and the system has been in continuously satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the communication system.

4. Necessary documentation of contractor qualifications must be approved by the Engineer prior to purchasing the FHEAS.

Installation of the equipment shall provide for ease of maintenance, all component parts shall be readily accessible for inspection and maintenance.

All external screws, nuts and locking washers shall be stainless steel. Self-tapping screws shall not be used unless specifically approved by the Engineer.

Comply with all requirements of the National Electrical Code for all wiring external to the FHEAS switch. Cut all wires to proper length before assembly. Neatly lace wires into cable with nylon lacing or plastic straps. Secure cables with approved clamps for both fiber and copper cable types. Provide service loops at all connections.

Connecting harnesses (i.e. jumper cables) shall be of appropriate length and terminated with matching connectors for interconnection with the FHEAS switches.

Dissimilar metals shall be separated by an inert dielectric material.

Testing, warranties, documentation, and training shall conform to the requirements of Sections 480.3.4, 480.4, 480.5, and 480.6, respectively.

486.2.10.3 Measurement: Field Hardened Ethernet Access Switch shall be measured per unit furnished, installed, made fully functional, tested, and accepted by the Engineer.

486.2.10.4 Payment: The accepted quantities of Field Hardened Ethernet Access Switch measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the item, COMPLETE IN PLACE, including all equipment described under this Item with all cables and connectors; all documentation and testing and also includes the cost of furnishing all labor, materials, software, warranty, training and equipment necessary to complete the work.

486.2.11 Field Hardened Ethernet Backbone Switch (FHEBS)

486.2.11.1 Material Requirements: All FHEBS and FHEAS shall be from the same manufacturer. All equipment shall be new.

A high-performance and Field Hardened Ethernet Backbone Switch shall support standard OSI Layer 2 functionality. The FHEBS shall support direct connectivity to existing networks configured in ring and mesh fault tolerant topologies enabling applications to operate reliably, and with low latency.

FHEBS shall include all equipment licenses, where required, for any software or hardware in the system.

FHEBS shall comply with the following Institute of Electrical and Electronics Engineers (IEEE) Standard Specifications:

1. IEEE 802.1d: Spanning Tree Protocol
2. IEEE 802.1p: Class of Services
3. IEEE 802.1q: VLAN Tagging
4. IEEE 802.1w: Rapid Spanning Tree Protocol
5. IEEE 802.3: 10BASE-T
6. IEEE 802.3ab: 1000BASE-TX
7. IEEE 802.3d: MAC Bridges
8. IEEE 802.3u: 100BASE-TX, 100BASE-FX
9. IEEE 802.3x: Flow Control
10. IEEE 802.3z: 1000BASE-LX
11. RFC768: UDP
12. RFC783: TFTP
13. RFC791: IP
14. RFC792: ICMP
15. RFC793: TCP
16. RFC826: ARP
17. RFC854: Telnet
18. RFC894: IP over Ethernet
19. RFC1112: IGMP v1
20. RFC1493: Bridge MIB
21. RFC1519: CIDR
22. RFC1541: DHCP (client)
23. RFC1661: PPP
24. RFC1907: SNMP v2 MIB
25. RFC2012: TCP MIB
26. RFC2013: UDP MIB
27. RFC2030: SNTP
28. RFC2068: HTTP
29. RFC2236: IGMP v2
30. RFC2578: SNMP v2 SMI
31. RFC2579: SNMP v2 TC
32. RFC2819: RMON MIB
33. RFC2863: IF MIB

FHEBS shall have a physical design that conforms to the following requirements:

1. Operates as a Layer 2 interface to the Network Gateway Router for all Field Hardened Ethernet Switches.
2. Provide three built-in SFP 1000 MB full-duplex switched Ethernet single-mode fiber ports with the ability to reach the necessary distance.
3. Provide six switched 10/100/1000 MB Ethernet copper (RJ 45) ports.

4. Be configurable in point-to-point, daisy-chain, ring, and mesh topologies for connectivity into new and existing fiber optic and copper based Ethernet networks.
5. Designed with an operating system that allows individual ports to be configured for port mirroring, speed, duplex, auto-negotiation, and flow control. The operating system shall also provide for broadcast storm frame filtering with user defined thresholds.
6. Designed with an operating system allows for the collection of statistics on a per port basis and provides for full support of RMON statistics, history, alarms, and event groups.
7. Have high-strength 18-gauge galvanized steel enclosure to seal out insects, dirt, smoke, and other contaminants.
8. Clearly identify all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

FHEBS shall have the following functionality and features:

1. Ports Performance
   - Provide Ethernet Single-mode Fiber ports that operate at 1000 Mbps with a link loss budget sufficient for the link it will use.
   - Provide Ethernet RJ-45 ports that auto-negotiate operation at 10/100/1000 Mbps.
   - Provide external optical attenuators as necessary to support interconnectivity with close range devices upstream or downstream.
2. Packet-Processing:
   - Frame buffer memory: 2 Mbit
   - IGMP multicast groups: 256
   - MAC address table size: 64kbytes
   - MAC addresses: 8192
   - Priority Queues: 4
   - Switching bandwidth: 9.2 Gbps
   - Switching latency: 7 us
   - Switching method: Store & Forward
   - VLANs: 4094
3. Ethernet Network Connectors:
   - Six RJ-45 connector ports for 10/100/1000 Mbps
   - Three dual LC connector 1000 Mbps ports for single-mode fiber
4. LED Indicators: One LED for power; three LEDs per Ethernet port for link, Tx, and Rx activity
5. Power Supply:
   - AC power connector: Terminal block at rear of power supply chassis
   - Input Voltage: 85 to 264 VAC (auto-ranging)
   - Power Consumption: 20 watts (max)
   - Fast Transient Protection: Compliant with IEEE C37.90.1

6. Mechanical:
    - Enclosure: Rugged 18-gauge high-strength galvanized steel case with metal mounting plate included. Suitable for stand-alone, rack, shelf, pedestal or wall mounting. Enclosure shall be permanently and clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

FHEBS shall comply with all specified requirements when the input power is 115 VAC ± 10%, 60 ± 3 Hz, for any FHEBS furnished or installed under this item.

The equipment shall be designed such that the failures of the equipment shall not cause the failure of any other unit of equipment connected upstream or downstream of the device.

All parts shall be made out of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

All materials used in construction shall be protected from fungus growth and moisture deterioration.

All specified requirements shall be met during uncontrolled environmental operations characterized by an operating temperature range of -34°C (-29°F) to +74°C (165°F) and a humidity range of 95% (non-condensing).

The FHEBS shall be RuggedComm RSG2200, or approved equivalent.

486.2.11.2 Construction Requirements: Minimum requirements for the Contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment are:

Five years experience in the installation and configuration of Ethernet equipment.
Two years direct experience in the configuration and deployment of the Rapid Spanning Tree protocol

Two installed systems where Ethernet switches are installed and the system has been in continuously satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the communication system.

Necessary documentation of subcontractor qualifications must be approved by the Engineer prior to purchasing the FHEBS.

Installation of the equipment shall provide for ease of maintenance, with all component parts being readily accessible for inspection and maintenance.

Ensure that all external screws, nuts and locking washers are stainless steel. Do not use any self-tapping screws unless specifically approved by the Engineer.

Meet all requirements of the National Electrical Code for all wiring external to the ES switch. Cut all wires to proper length before assembly. Neatly lace wires into cable with nylon lacing or plastic straps. Secure cables with approved clamps for both fiber and copper cable types. Provide service loops at all connections.

Provide connecting harnesses (i.e., jumper cables) of appropriate length and terminated with matching connectors for interconnection with the ES switches.

Separate dissimilar metals by an inert dielectric material.

Testing, warranties, documentation, and training shall conform to the requirements of Sections 480.3.4, 480.4, 480.5, and 480.6, respectively.

486.2.11.3 Measurement: Field Hardened Ethernet Backbone Switch shall be measured per each unit furnished, installed, made fully functional, tested, and accepted by the Engineer.

486.2.11.4 Payment: Field Hardened Ethernet Backbone Switch, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the item, COMPLETE IN PLACE, including all equipment described under this Item with all cables and connectors; all documentation and testing and also includes the cost of furnishing all labor, materials, software, warranty, training and equipment necessary to complete the work.

486.2.12 Ethernet Communications Module For The ASC/2S Controller:

486.2.12.1 General: The work under this item consists of furnishing all materials and equipment to install a plug-in Ethernet Communications Module for the ASC/2S Signal Controller. The Ethernet Communications Module acts as a Terminal Server allowing transmission of signal data across an Ethernet network. The Ethernet module requires an Internet Protocol (IP) address to communicate to the Traffic Management System (TMS) located at the MCDOT TMC. The Ethernet module allows the TMS to poll the signal controller one time a second for status of the signal, push/pull traffic timing plans, and collect logs.

486.2.12.2 Material Requirements:

Ethernet Module:

1. Exceeds NEMA TS2 and TS1 requirements.
2. Ethernet Version 2.0
3. IEEE 802.3 compliant
4. 10/100 Base-T Auto Sensing

5. Static IP or DHCP Configuration
6. Field Upgradeable firmware via HTTP
7. Configuration and Management through SNMP (read and write)
8. Strong SSL V3.0/TLS V1.0 based encryption (DES, 3DES, AES)
9. 32-bit NET+ARM RISC Processor (55 MHz)
10. Status/Diagnostic LED indicators
11. The Ethernet Module shall be an Econolite ASC/2S Ethernet Module.

486.2.13 Leased Line Communications Demarcation Point:

486.2.13.1 General: The work under this item consists of furnishing all materials to install a wooden post and connect 1½ inch conduit to the post for a leased line communications Demarcation Point. The Contractor shall consult MCDOT Standard Details for installation requirements. Conduit shall be paid as a separate item.

486.2.13.2 Material Requirements:

- 4 inch by 4 inch by 5 foot long treated wood post
- 1½ inch conduit straps securing conduit to wooden post

486.3 MEASUREMENT:

Communications equipment systems will be measured as a unit for each type furnished, installed, and accepted complete in place. Items such as cables, mounting, excavation, surge suppression, lightning protection, local software, and various accessories as needed are included as part of the system.

Radios shall be measured by each type furnished, installed, and accepted complete in place.

Modems shall be measured by each type furnished, installed, and accepted complete in place.

Routers shall be measured by each type furnished, installed, and accepted complete in place.

Video CODEC shall be measured by each type furnished, installed, and accepted complete in place.

Switches shall be measured by each type furnished, installed, and accepted complete in place.

Leased Line Communications Demarcation Point will be measured as a unit for each accepted installation complete in place.

486.4 PAYMENT:

The accepted quantity of items will be paid for at the contract unit price which shall be full compensation for the work described including testing, warranty, documentation, and training.

Part 500 add the following new Section:

SECTION 502

DRILLED SHAFT FOUNDATIONS

502.1 DESCRIPTION:

502.1.1 General: The work under this Section shall include furnishing all materials and constructing reinforced concrete shafts formed within a drilled excavation. Each Drilled Shaft Foundation shall consist of a shaft section with or without casing left in place, as specified or requested, with or without a rock socket or bell footing. Each Drilled Shaft Foundation shall be constructed to conform to the details and dimensions shown on the Project Plans, and the requirements of these Specifications and the Special Provisions.

502.1.2 Installation Plan: The Contractor shall submit to the Engineer, for review and approval, a detailed Installation Plan. The Installation Plan shall be based on available geotechnical information. To assist in plan evaluation and upon request by the Engineer, the Contractor shall provide copies to the Engineer of the geotechnical information used to develop the Installation Plan. The Installation Plan shall contain the following information:

(1) Equipment: List of proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, sampling equipment, tremies or concrete pumps, casing, and any other equipment essential to the successful installation of the proposed Drilled Shaft Foundations. Information provided on each proposed equipment unit shall be sufficient to identify the unit in the current edition of the Rental Rate Blue Book.

(2) Personnel: List of all personnel to be committed to the installation of the Drilled Shaft Foundations on the project, and a summary of the relevant experience of each individual, including their involvement in the projects listed under (11).

The On-Site Supervisor in charge of the installation of the Drilled Shaft Foundations shall have not less than five (5) years of comparable in-charge experience with drilled shaft installations similar in nature and magnitude to the foundation requirements for the specified project. The On-Site Supervisor shall be on or immediately available to the project during all foundation construction activities.

At least one (1) Drill Operator, having not less than five (5) years of experience on the equipment that the Contractor proposes to use, working on drilled shaft foundation installations similar to those for the specified project, shall be on or available to the project during all foundation construction activities.

(3) Construction Sequence: Details of the overall construction operation sequence, and the sequence of shaft installation in bents or groups. Supporting

justification shall be provided for all variations between the Contractor's proposed sequence of shaft installation, and shaft sequence requirements called out on the Project Plans.

(4) Shaft Excavation: Details of shaft excavation methods, including equipment and procedures for checking the location, alignment, and dimensions of each shaft excavation.

(5) Slurry: When slurry is required, details of the method proposed to mix, circulate and desand the slurry, and methods proposed to comply with the requirements of Sections 502-3.4(A) and 502-3.7(C), including disposal of the slurry.

(6) Excavation Cleaning: Details of methods to clean the shaft excavation.

(7) Steel Reinforcement: Details of reinforcement placement, including support and centering methods.

(8) Concrete Mixes: Details of concrete mix designs, and the mitigation of possible loss of slump during placement.

(9) Concrete Placement: Details of concrete placement.

(10) Casing: Details of casing dimensions, material, and splice details.

(11) Construction Experience: List of all drilled shaft construction experience by the Contractor on previous projects of a similar nature, from the present and covering the past 3 to 5 years, highlighting major features of the drilled shaft operations and installations, describing any complexities and/or problems, and their subsequent resolution.

(12) Additional Information: Other information shown on the plans or requested by the Engineer.

(13) Emergency Shaft Joints: Emergency horizontal construction joint method if unforeseen stoppage of work occurs.

(14) Safety Plan: List of safety equipment, and the Contractor's Safety Plan for the drilled shaft construction.

The detailed Installation Plan for the Drilled Shaft Foundations, complete with all required information relevant to the project, and any supplemental information the Contractor believes relevant, shall be submitted to the Engineer not less than four (4) weeks before the work on the drilled shafts is to begin. The Engineer will review the submittal package and return comments to the Contractor within ten (10) working days. No drilled shaft work shall be performed until the Contractor's final submittal has been approved by the Engineer. Such approval will not relieve the Contractor of

responsibility for results obtained by use of the Installation Plan, or any other responsibilities under the Project Contract.

Based on the Contractor's experience, the project Contract Documents, and the Geotechnical and Foundation Report, including the Foundation Boring logs, if the Contractor reasonably concludes that slurry will not be required for shaft installation, information required under (5) Slurry may be omitted from the Installation Plan, subject to the approval of the Engineer. If it is subsequently determined that slurry will be required for shaft installation, the approval of the omission by the Engineer in no way relieves the Contractor of responsibility for constructing acceptable Drilled Shaft Foundations, in accordance with the requirements of Section 502.3.1(A).

The Contractor shall submit shop drawings in accordance with Section 105.2 for drilled shaft reinforcing steel, casings, and all other drilled shaft elements to remain in place and requiring prefabrication.

502.2 MATERIALS

502.2.1 Concrete: Concrete shall conform to the requirements of Section 725 for the class and strength shown on the plans, with the following additions or modifications:

(A) Cement: Concrete placed in drilled shaft excavations containing slurry or water shall have a cement content between 660 and 750 lbs/C.Y.

(B) Aggregate: Maximum aggregate size shall be limited to 1/5 of minimum clear bar spacing (vertical and horizontal), not to exceed one inch.

502.2.2 Reinforcing Steel: Reinforcing steel shall conform to the requirements of Section 727. Welded splices will not be allowed, except as shown on the Project Plans.

502.2.3 Casing: The casing shall be steel, and may be of unit or sectional construction. The casing shall be of sufficient strength to withstand handling and driving stresses, to withstand the pressure of concrete and the surrounding earth, and to prevent seepage of water. Steel shall conform to the requirements of AASHTO M 270M/M 270 (ASTM A 709/A 709M), Grade 36 (Metric Grade 250), unless otherwise specified in the Special Provisions.

When telescoped casing is used, the Contractor shall not allow concrete to overfill any interior casing. Spillage shall be removed from the annulus, or the shaft shall be declared deficient.

Temporary casing shall be clean, inside and out, prior to placement in the excavation. All casing shall be handled so as to limit distortion to plus or minus two percent (2%) of the diameter. No side shear capacity will be allowed where an installed temporary casing becomes permanent. If conditions permit, and if approved by the Engineer, temporary casings may be corrugated and non-watertight.

The Contractor shall be responsible to compensate for loss of frictional capacity in the cased zone if temporary casing is abandoned in the shaft. Such modifications shall be at no additional cost to the County.

502.3 CONSTRUCTION REQUIREMENTS:

502.3.1 General: The construction methods and equipment used shall be suitable for the intended purpose and materials encountered. Construction shall be by either the dry method, wet method, temporary casing method or permanent casing method, as defined by the current AASHTO LRFD Bridge Construction Specifications with Interim revisions as applicable. Drilled shafts shall be sound, durable concrete foundation shafts free of defects, subject to approval of the Engineer. The permanent casing method shall be used only when required by the Project Plans and Special Provisions, or authorized by the Engineer.

(A) Installation Changes: If at any time during the construction of the drilled shafts, the Engineer determines that the equipment, materials, personnel, or procedures are such that defects in the work may occur, the Engineer may stop the work until appropriate changes are made by the Contractor. The Contractor shall also revise the Installation Plan, as approved by the Engineer. In no case shall the Contractor be relieved of responsibility for constructing acceptable Drilled Shaft Foundations.

(B) Adjacent Drilled Shafts: The successive installation of Adjacent Drilled Shafts shall not be allowed, to minimize any potential disturbance to newly cast drilled shafts. An Adjacent Drilled Shaft is defined as being any drilled shaft to be located within four (4) diameters of an installed shaft, measured center to center of shafts. Drilling for an Adjacent Drilled Shaft shall not be started within 48 hours of the completion of casting concrete for the installed drilled shaft, unless otherwise approved by the Engineer. The Contractor's sequence of shaft installation, detailed as required in Section 502.1.2(3), shall also conform to shaft sequence requirements called out on the Project Plans, unless otherwise approved by the Engineer in the Contractor's Installation Plan.

502.3.2 Confirmation Shafts: When called out on the Project Plans, or when required in the Contract Special Provisions, the Contractor shall construct a Confirmation Shaft. The Confirmation Shaft is constructed to determine the adequacy of the Contractor's equipment, materials, personnel, and procedures for completion of the Drilled Shaft Foundations, in accordance with the requirements of the Project Plans, these Specifications and the project Special Provisions, and the Installation Plan. The Confirmation Shaft normally will be the first production Drilled Shaft Foundation developed, subject to the approval of the Engineer.

The location of all Confirmation Shafts shall be as shown on the Project Plans, or as approved by the Engineer. All Confirmation Shaft holes and shaft installations shall be completed in the same manner as proposed for other similar production shafts. The Contractor shall revise drilled shaft installation methods and equipment, at any time

during the installation of each Confirmation Shaft, as required. Such revisions may be made during the drilling of the Confirmation Shaft hole, and/or the placement of shaft reinforcement and concrete. Such revisions shall result in satisfactory installation of the Confirmation Shaft, COMPLETE IN PLACE, as approved by the Engineer.

When the Contractor fails to satisfactorily demonstrate the adequacy of his installation methods, procedures, or equipment; or when unforeseen conditions require revision, such as the need for slurry, the Installation Plan shall be revised. The next shaft to be constructed in accordance with the Contractor's approved installation sequence shall be designated as the Confirmation Shaft for the approved, revised Installation Plan, or the Confirmation Shaft shall be installed at a location approved by the Engineer.

When shown on the Project Plans, or when ordered by the Engineer in writing, the reaming of shaft bell footings or the development of shaft rock sockets at the specified Confirmation Shaft holes shall be required to establish installation feasibility in specific soil strata.

502.3.3 Excavation: The Contractor shall perform all excavation required for the shafts, rock sockets, and/or bell footings, through whatever materials encountered, to the dimensions and elevations shown on the Project Plans, or as approved by the Engineer. Unless otherwise shown on the Project Plans, the maximum deviation from plumb shall be not more than one and one-half percent (1 1/2%). The maximum permissible variation of the longitudinal center axis of both the shaft hole and reinforcing steel cage, from the Project Plan location at the top of the Drilled Shaft Foundation, shall be five percent (5%) of the Project Plan shaft diameter, not to exceed 3 inches. The Contractor shall determine shaft hole verticality by plumb lines in dry excavations, and by Kelly bar position readings at 10' intervals in wet excavations, or as approved by the Engineer. The Contractor shall provide the Engineer with these readings for each drilled shaft constructed, to verify verticality. When bell footings or rock sockets are required, they shall be excavated so as to form a bearing area of the size and shape shown on the Project Plans.

Temporary surface casings may be used to aid shaft location and alignment, and to prevent sloughing of the top of the shaft excavation, if approved by the Engineer.

If satisfactory foundation materials are not encountered when a shaft excavation has been advanced to the Bottom of Shaft Elevation shown on the Project Plans, the bottom of the drilled hole may be lowered, at the direction of the Engineer. Any lowering of the Bottom of Shaft Elevation will be based on the completed Drilled Shaft Foundation complying with foundation design requirements. Reinforcing steel and shaft concrete shall not be placed in the shaft excavation until the revised, final Bottom of Shaft Elevation has been established, and the shaft excavation completed. Similarly, the raising of any Bottom of Shaft Elevation, from the elevation shown on the Project Plans, shall require approval by the Engineer.

When a Drilled Shaft Foundation includes a Rock Socket, the actual Bottom of Shaft Elevation in the field will be established by the shaft excavation encountering competent bedrock stratum, as determined by the Engineer or a geotechnical specialist. The required Rock Socket length will be verified by the Engineer, based on foundation design requirements. Reinforcing steel and shaft concrete shall not be placed until the Rock Socket length has been verified, and the drilled/cored socket completed.

If caving conditions are encountered, no further drilling will be allowed until a method of construction is employed that prevents excessive caving, and which is acceptable to the Engineer. If casing is proposed, the shell shall be clean and shall extend to the top of the drilled shaft excavation. The inside diameter of the casing shall be not less than the dimensioned size of the shaft on the Project Plans, unless approved by the Engineer. The outside diameter of the shaft shall not exceed the Project Plan dimension by more than 6 inches, unless the use of telescoping casing or surface casing is allowed by the installation plan.

If the Engineer determines that the amount of excavation caving is within acceptable limits and the Contractor elects to drill under the same methods and procedures, the shaft excavation shall be filled with concrete at no additional cost to the County, regardless of the extent. Any excavation beyond the dimensions shown on the plans where casings are not used shall be filled with concrete at no additional cost to the County.

If the use of drilling slurry is to be employed, either with or without the use of casing, the Contractor shall use a method of construction that allows completion of the drilled shaft in a continuous manner without any mixing between the shaft concrete and the drilling slurry.

Material excavated from drilled shafts, bell footings, and rock sockets, that is not placed elsewhere on the project, shall be disposed of as approved by the Engineer.

When the Project Plans indicate that Drilled Shaft Foundations are to be constructed within embankments, the embankments shall be constructed prior to drilling, except when approved otherwise by the Engineer.

After the completion of the drilled shaft excavation, and prior to the placement of the reinforcing steel cage and shaft concrete, all loose material shall be machine cleaned from the shaft. A flight auger or other equipment, approved by the Engineer, shall be used for cleaning dry excavations where slurry or ground water is not present. Where slurry or ground water is present, the excavation shall be cleaned with a clean-out bucket or similar type of equipment, as approved by the Engineer.

Each open shaft excavation shall be covered in a manner approved by the Engineer, at all times when there is no hole excavation activity and/or shaft construction activity at that hole.

Drilled shaft excavation inspections shall be performed by the Contractor and will be reviewed by the Engineer. The Contractor shall provide suitable facilities, equipment, and associated safety measures for required excavation inspections that enable the Engineer to safely and completely evaluate drilled shaft excavations for correct location, alignment, and dimensions.

Reinforcing steel cages and shaft concrete shall not be placed in the drilled shaft excavation until the Engineer has made an evaluation and given approval.

502.3.4 Drilling Slurry:

(A) General Requirements: The Contractor shall provide a specialist experienced in the slurry drilling process to design and monitor the slurry. The specialist shall be present at all times when the slurry method is used, and shall supervise the slurry inspection and testing required in Section 502-3.4(B). Commercially prepared mineral slurries shall be employed when slurry is used in the drilling process. Commercially prepared synthetic slurry may be used only when specifically approved by the Engineer. The mineral slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. During construction, the level of the mineral slurry in the shaft excavation shall be maintained at a level not less than 4 feet above the highest expected piezometric pressure head along the depth of the shaft. In the event of a sudden significant loss of slurry to the hole, the construction of that foundation shall be stopped, until either a method to stop slurry loss or an alternative construction procedure has been approved by the Engineer.

The mineral slurry shall be premixed thoroughly with clean, fresh water. Adequate time, as prescribed by the mineral manufacturer, shall be allotted for hydration prior to the introduction of the mineral slurry into the shaft excavation. Slurry tanks of adequate capacity shall be required for slurry circulation, storage, and treatment. No excavated slurry pits shall be allowed in lieu of slurry tanks. No mixing of slurry shall be allowed in the drilled shaft excavation. Slurry shall not stand for more than four hours in the shaft excavation without agitation. If this is not possible, excavation sidewalls shall be cleaned to remove filter cake, and the slurry tested for compliance with Table 502-3.4(A). Slurry density shall be increased by adding barite only when sodium bentonite is the slurry mineral.

Desanding equipment shall be provided by the Contractor as necessary to control slurry sand content within the acceptable values shown in Table 502-3.4(A) at any point in the bore hole. Desanding will not be required for setting casing. The Contractor shall take all steps necessary to prevent the slurry from "setting up" in the shaft. Such methods may include agitation, circulation and/or adjusting the properties of the slurry. The Contractor shall dispose of all slurry off site at an approved disposal site.

TABLE 502-3.4(A):

TABLE (Sodium Bentonite or Attapulgite in Fresh Water)			502-3.4(A)
Property, units	Range of Values*		Test Method
	At Time of Introduction of Slurry	In Hole at Time of Concreting	
Density, (pcf)	64.3 - 69.1	64.3 – 75.0**	Density Balance
Yield Point, psf Or Viscosity, seconds/quart	Bentonite 0.026 – 0.21 Attapulgite 0.042 – 0.31 28 – 45	10 Maximum 15 Maximum 28 - 45	Rheometer Rheometer Marsh Cone
pH	8 – 11	8 – 11	pH Paper or pH Meter
Sand Content, % by volume	0 – 4	0 – 10	API Sand Content Kit
* Above 68 degrees F ** 85 pcf maximum when using Barite.			

(B) Slurry Inspection and Testing: The Contractor shall have suitable inspection and testing apparatus available at the site, including a sampling tool capable of extracting slurry samples at any depth within the drilled shaft excavations. All equipment required for tests specified in this Section shall be provided by the Contractor, and the tests shall be performed by the Contractor, under the observation of the Engineer.

Control tests using suitable apparatus shall be carried out by the Contractor on the mineral slurry to determine density, viscosity or yield point, pH, and sand content. A range of values for those physical properties is shown in Table 502-3.4(A); but in all cases, no less than the minimum values necessary to achieve and maintain stability of the drilled shaft excavation shall be used.

The Contractor shall do tests during the shaft excavation, in the presence of the Engineer, to determine slurry density, viscosity or yield point, and pH value, to establish a consistent working pattern. A minimum of four sets of tests shall be made during the first eight hours of slurry use. When the results show consistent behavior, the testing frequency may be decreased to one set every four hours of slurry use.

The Contractor shall ensure that heavily contaminated slurry suspension, which could impair the free flow of shaft concrete, has not accumulated in the bottom of the completed shaft excavation. Prior to placing concrete in the completed shaft excavation, the Contractor shall take slurry samples in the shaft excavation, from the base of the shaft excavation, and 10' (3.0m) above the base of the excavation. When

any slurry samples are found to be unacceptable, the Contractor shall take whatever action is necessary to bring the mineral slurry within specification requirements. Shaft concrete shall not be placed until re-sampling and testing results produce acceptable values for density, viscosity or yield point, pH, and sand content.

Reports of all tests required above, signed by an authorized representative of the Contractor, shall be furnished to the Engineer on completion of each drilled shaft.

502.3.5 Integrity Testing: All drilled shaft foundations shall be constructed to allow integrity testing by gamma ray density logging and by cross-hole sonic logging survey. Unless otherwise noted, the Contractor shall provide integrity testing using gamma ray density logging for all drilled shaft foundations. The gamma ray density logging shall be conducted and results submitted for each drilled shaft no later than three days after placement of the drilled shaft concrete. In addition all drilled shafts 4' diameter and larger constructed in wet conditions shall be tested using cross-hole sonic logging. All tests using cross-hole sonic logging shall be conducted no later than six days after placement of the drilled shaft concrete. When inconclusive or bad results are obtained from the gamma ray density test, the Contractor shall conduct, at no additional cost to the County, cross-hole sonic logging within six days after placement of the drilled shaft concrete.

The Contractor shall furnish and install 2½", Schedule 80 PVC pipe for integrity testing. Each logging pipe shall be joined to provide a clean and unobstructed pipe opening from the top of the drilled shaft foundation to within one foot of each shaft tip or as shown on the Project Plans. All logging pipes shall be capped top and bottom. Logging pipes shall be tied to the inside of the reinforcing cages in a longitudinal straight line, located as detailed on the Project Plans. The logging pipes shall be securely fastened to the reinforcing steel cage, to ensure that the pipes remain straight after handling and shaft concrete placement, to permit the logging device to pass from top to bottom of pipe. PVC pipes shall be filled with water prior to concrete placement. The Contractor shall provide the testing equipment, perform the inspection, and furnish test results to the Engineer.

If the testing indicates the presence of voids, intrusions, or zones of unconsolidated concrete in the Drilled Shaft Foundation, or if the Engineer determines that construction defects may have occurred, or if testing cannot be performed because of blockage of the tubes, the Contractor shall core-drill or otherwise determine the extent of any defects in the concrete, as approved by the Engineer. The Contractor shall repair, replace, or supplement the defective work in a manner approved by the Engineer, at no additional cost to the County.

In case the above described testing methods provide inconclusive or deficient results and the situation is difficult or impossible to repair, the geotechnical engineer shall assess the amount of loss to the drilled shaft safety factor*. Any drilled shaft with a safety factor less than 80% of the required value shall be replaced or repaired in a satisfactory manner at no additional cost to the County. Payment for drilled shafts with

safety factor between 80% and 100% of the required value shall be reduced as indicated in Table 502-1.

Table 502-1 Payment Factors for Defective Drilled Shafts	
Percentage of required value of Safety Factor*	Percent of Payment
100% and above	100%
<100% to 96%	95%
<96% to 92%	90%
<92% to 88%	85%
<88% to 84%	80%
<84% to 80%	75%
<89%	Replacement Required

* Safety factor, as used in section 502, is the reciprocal of the combined resistivity factor weighted for side friction and tip bearing capacities. For resistivity factors see AASHTO LRFD Bridge Design Specifications, Section 10.

After all inspection and testing has been completed, all holes and test pipes in all Drilled Shaft Foundations shall be filled with a grout approved by the Engineer.

502.3.6 Reinforcing Steel, Cage Construction and Placement: The reinforcing steel cage for the drilled shaft, consisting of longitudinal bars and spiral reinforcement or lateral ties, shall be completely assembled and placed in the shaft excavation as a unit. The reinforcing steel cage shall not be installed in the shaft excavation until immediately before the placement of shaft concrete is to be started. The reinforcing steel cage shall be positioned in accordance with the details shown on the Project Plans.

All reinforcing cages shall be fabricated and supported to avoid damage during lifting and installing the cages. All temporary bracing and supports shall be removed from reinforcing cages prior to the final placement in the shaft excavation.

The reinforcing steel cage shall be adequately supported and anchored from the top, to prevent movement from the required location during the placement of shaft concrete, and for four hours after completion of concrete placement. The reinforcing cage shall not rest directly on the bottom of the excavation. Spacers shall be at sufficient intervals along the shaft to ensure concentric location of the reinforcing cage for the entire length of shaft. Only noncorrosive, rolling spacers approved by the Engineer shall be allowed. In no case shall "dobies" or other rectangular "blocks" tied to the reinforcing cage or sliding reinforcing bar spacers be allowed.

If the Bottom of Shaft Elevation of a Drilled Shaft Foundation, with or without a Rock Socket, is lowered in accordance with Section 502.3.3, and the Project Plans indicate full depth reinforcement, the Engineer shall be notified to determine if extension and/or modification of the reinforcing cage is required. The Engineer will provide details for changes in the shaft reinforcing cage, if required. Such changes in the shaft reinforcing

steel cage will be paid for in accordance with Sections 109.4 and 109.5 of the Specifications.

If the Bottom of Shaft Elevation of the Drilled Shaft Foundation, with or without a Rock Socket, is raised in accordance with Section 502.3.3, the Engineer will determine if modification of the reinforcing steel cage is required.

The Contractor shall submit a written request to the Engineer for approval of any variation from the reinforcing steel splices specified in the contract documents.

502.3.7 Concrete Placement:

(A) General: The Contractor shall begin placement of shaft concrete within 24 hours after the completion of the drilled shaft excavation. All concrete shall be placed in accordance with Section 505 and as specified herein. If slurry-assisted excavation is used, concrete shall be placed the same day the excavation is completed.

Unless otherwise specified in the project Special Provisions, or as requested by the Engineer, the slump shall be between 5 and 6 inches for dry, uncased excavations. For all other shaft excavations, with water and/or using slurry and/or casing during excavation, the shaft concrete slump shall be 8 ± 1 inches at the time shaft concrete placement begins.

Prior to shaft concrete placement, the Contractor shall make all necessary arrangements to ensure the uninterrupted delivery of concrete, so that all Drilled Shaft Foundations will be constructed without cold joints. During shaft concrete placement, from start to finish, the rate of rise of the top of concrete in the drilled shaft shall be at least 40' / hour.

Tremie downpipes and pump pipes shall be made of steel; no aluminum shall be allowed. The inside diameter of the tremie pipe shall be at least 10 inches. The inside diameter of the pump pipe shall be at least 5 inches.

(B) Placement in Dry Excavations: For placement in dry excavations, shaft concrete may be placed by free fall, except in cohesionless soils or where other caving conditions exist. The Contractor shall place the shaft concrete so that during free fall, the concrete does not strike the reinforcing cage or the excavation sidewalls. Where free fall cannot be used, concrete shall be placed through a suitable, clean downpipe.

Vibration of the shaft concrete for the full height of the shaft is not required to achieve proper consolidation of the concrete. However, the shaft concrete shall be vibrated in the top 10' of the shaft.

(C) Wet Conditions, Placement under Slurry or Water: Shaft concrete placed under slurry or water shall be placed by tremie methods or by pumping. Care shall be taken to

ensure that all the fluid and suspended solids are expelled from the shaft excavation during concrete placement.

Where shaft concrete is conveyed and placed by mechanically applied pressure, the equipment shall be of suitable type and shall have adequate capacity for the work. The concrete shall not flow over or through any piping, fittings or equipment which is fabricated of aluminum or aluminum alloys. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. Excessive segregation due to high velocity discharge of the concrete will not be permitted. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or segregation of the ingredients. Standby equipment shall be readily available to replace initial pumping equipment should a breakdown occur.

The Contractor's Installation Plan shall demonstrate the procedures used to determine when the tremie pipe is to be raised during shaft concrete placement. The procedure shall ensure that the opening of the tremie pipe will be deeper than 5 feet below the surface of the concrete at all times, and that a void will not be created by lifting the tremie when there is an insufficient head of concrete. A rapid raising or lowering of the tremie will not be permitted.

To prevent contamination of the shaft concrete placed initially, the lower end of the pump or tremie pipe shall be provided with a valve, sealable cap, or plug ("pig"). The discharge end shall be placed at the bottom of the excavation prior to starting shaft concrete placement. If a plug is used, it shall be inserted at the top of the tremie pipe after the pipe has been set in place. Shaft concrete shall then be placed by pushing the plug ahead, with the plug separating the concrete from the drilling slurry/water. The bottom end of the tremie pipe shall not be lifted off the bottom of the shaft excavation until the pipe is completely filled with concrete. The first portion of the concrete flow that comes to the top of the shaft shall be displaced out of the shaft excavation until clean, fresh concrete is expelled.

Slurry ejected during shaft concrete placement may be reused provided that it is screened to remove gravel chips or other granular materials, and providing the slurry meets acceptance criteria. After use, slurry to be discarded shall be disposed of in a manner that complies with all applicable laws and requirements, including the National Pollutant Discharge Elimination System (NPDES) requirements.

Concrete placed under slurry or water shall not be vibrated, except that the top 5 feet of the shaft shall be vibrated after the slurry or water and contaminated concrete have been totally expelled from the shaft. If temporary casing is used, the vibration shall occur after the casing has been removed.

502.3.8 Casing Removal: During removal of any casing, a sufficient head of not less than 5 feet of fluid concrete in the tremie pipe shall be maintained above the level of concrete in the shaft (outside the tremie pipe), except at the top of the shaft. All

contaminated concrete shall be removed from the shaft. Temporary casings shall be removed while the concrete slump is not less than 4 inches. The Contractor shall maintain a minimum 5 foot head of concrete in the casing as it is being removed. Movement of the casing by exerting downward pressure and tapping to facilitate extraction, or extraction with a vibratory pile hammer will be permitted. Casing extraction shall be at a slow, uniform rate with the force in-line with the shaft axis.

Due care shall be exercised to prevent upward movement of the shaft concrete and reinforcing steel during casing extraction. Upward movement beyond one inch, excluding movement due solely to tension on the top anchoring system, may indicate serious concrete separation or necking problems at the bottom of the casing. The Contractor shall be responsible for corrective action which may include leaving the casing in place and compensating for the loss of frictional capacity in the resulting cased zone.

502.4 MEASUREMENT:

Drilled Shafts and accepted Confirmation Shafts will be measured to the nearest linear foot, from the top elevation of each completed Drilled Shaft Foundation to:

(A) The elevation of the surface of the rock stratum, when Rock Sockets are used, or
(B) The Bottom of Shaft Elevation shown on the Project Plans, or
(C) The elevation of the shaft-bell juncture, when Bell Footings are used,

or as determined in the field by the Engineer or a geotechnical specialist.

The length of Rock Sockets will be measured to the nearest linear 0.1 foot from the actual surface elevation of the rock socket bedrock stratum to the actual Bottom of Shaft Elevation, as shown on the Project Plans, or as determined in the field by the Engineer or a geotechnical specialist.

Bell Footings will be measured by the unit each, for each configuration of Bell Footing constructed.

502.5 PAYMENT:

The accepted quantities of Confirmation/Drilled Shafts and Rock Sockets, measured as provided above, will be paid for at the contract unit price COMPLETE IN PLACE for placement in Dry Excavations. The contract unit price shall include all excavation; drilling; metal casing; steel reinforcing; Portland cement concrete; any needed forming, curing and finishing; exposing in-place shaft concrete and the subsequent repair of shaft foundations; furnishing all materials, equipment, and labor for splicing of reinforcing steel; conduit for integrity testing and integrity testing.

No additional payment will be made for metal casing that is to remain in place, or for temporary casing left in place.

No supplemental payment will be made for Confirmation Shafts; the cost of the confirmation process is considered as included in the overall cost of constructing production Drilled Shaft Foundations, including all Confirmation Shafts.

Bell Footings will be paid for at the contract unit price per each, for each configuration of Bell Footing constructed and accepted.

Payment for Obstructions will be made in accordance with the provisions of Section 109.4. Obstructions are defined as either material or objects of excessive dimensions that could not be reasonably inferred from the Geotechnical and Foundation Report, including the Foundation Boring Logs. Drilling tools lost in shaft excavations will not be considered Obstructions.

Drilled Shaft Wet Conditions Extra Cost (Contingency Item) is an additional payment made for each drilled shaft installed under wet conditions. This contingency payment will only be made with the approval of the Engineer when warranted by ground water intrusion into the drilled hole, which requires application of special wet drilling methods such as those that use slurry. This payment will be in addition to the contract unit price for Drilled Shafts and shall be full compensation for all additional work and materials required for installation of drilled shafts under wet conditions.

SECTION 505

CONCRETE STRUCTURES

505.6 PLACING CONCRETE

505.6.3 Bridge Deck Joint Assemblies

505.6.3.3 Construction Requirements, add the following:

(7) Welding: All welding and inspection of welding for structural steel, except for tubular structures, shall be performed in accordance with the requirements of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code. All other references to the American Welding Society (AWS) Structural Welding Code AWS D1.1-80 and the AASHTO Standard Specifications for the Welding of Structural Steel Highway Bridges are deleted.

The use of electro-slag welding process on structural steel will not be permitted.

SECTION 506

PRECAST PRESTRESSED CONCRETE MEMBERS

Section 506 is supplemented with the following:

506.1 DESCRIPTION:

Elastomeric Bearing Pads shall conform to the requirements of the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 18.2, and shall be Grade 3, 60 durometer elastomer, unless otherwise specified in the Special Provisions.

Prestressing of all precast concrete I-girder, box beam, voided and solid slab bridge members shall be by the pretensioning method only.

Prior to initiating girder fabrication, shop drawings for the proposed precast concrete members shall be submitted in accordance with Section 105.2, and approved by the Engineer.

506.2 CONCRETE:

506.2.1 Reinforcing Steel: Non-prestressed reinforcement shall conform to the provisions of Section 727; placement shall conform to the provisions of Section 505.5.

506.2.2 Dimensional Tolerances: Precast Prestressed Concrete Bridge Members that do not comply with the dimensional tolerances specified herein will be rejected. Precast

members that show evidence of cracks, pop-outs, voids or other evidence of structural inadequacy, or imperfections that will reduce the aesthetics of the member after final placement, will be rejected.

(1) Precast Prestressed Concrete I-girders: The maximum allowable tolerances or deviations from dimensions and details shown on the project plans and shop drawings shall be as follows:

Girder Length	± 3/4"
Width (flanges and fillets)	+ 3/8", -1/4"
Girder Depth (overall)	+1/2", -1/4"
Width (web)	+ 3/8", -1/4"
Depth (flanges and fillets)	± 1/4"
Bearing plates (center to center)	±1/8" per 10 feet but not greater than ±3/4"
Horizontal alignment (deviation from straight line parallel to centerline of girder)	1/8" per every 10 feet in length
Stirrup bars (deviation from top of girder)	+ 1/4", - 3/4"
Position of strands	± 1/4" for strands and center of gravity of strand group
Longitudinal position of deflection points for deflected strands	± 10"
Position of handling devices	± 6"
Bearing plates (center to end of girder)	± 1/4"
Side inserts (center to center and center to end of girder)	± 1/2"
Girder ends (deviation from square or designated skew)	Horz. ± 1/4" Vert. ± 1/8" per 12 foot of beam depth
Bearing area deviation from plane	± 1/8"
Stirrup bars (longitudinal spacing)	± 1"
Position of weld plates	± 1"

(2) Precast Prestressed Concrete Box Beams, Voided Slabs, and Flat Slabs: The maximum allowable tolerances or deviations from dimensions and details shown on the project plans and shop drawings shall be:

Member Length	± 3/4"
Member Width (overall)	± 1/4"
Member Depth (overall)	± 1/4"
Width (web)	± 3/8"
Depth (top slab)	± 1/4"
Depth (bottom slab)	+ 1/4", -1/8"
Horizontal alignment (deviation from straight line parallel to centerline of member)	1/8" per every 10 feet in length
Camber differential between adjacent members	Not greater than 3/4"
Position of strands	± 1/4" for center of gravity for strand group
Stirrup bars (longitudinal spacing)	± 1"
Position of handling devices	± 6"
Member void position	± 1/2" from end of void to center of tie hole, + 1" adjacent to end block.
Member ends (deviation from square and/or designated skew)	± 1/2"
Bearing area deviation from plane (straight edge through middle half)	± 1/8"
Dowel tubes (spacing between centers of tubes, and centers of tubes to the ends and sides of members)	± 1/2"
Tie rod tubes (spacing between centers of tubes, and centers of tubes to ends of members)	± 1/2"
Tie rod tubes (spacing from centers of tubes to bottom of member)	± 3/8"
Position of side inserts	± 1/2"

506.3 PRESTRESSING STEEL:

Prestressing Steel Strand for precast concrete bridge members shall conform to the requirements of AASHTO Specification M 203 (ASTM A 416) for Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement, and shall be Low-Relaxation Strand, Grade 270.

506.6 PRESTRESSING:

Unless otherwise shown on the project plans, the stresses in the prestressing strands shall not exceed those specified in the current edition of the AASHTO LRFD Bridge Construction Specifications, Section 10.10.

When concrete has not been placed within 72 hours of the tensioning of the prestressing strands, all strands shall be re-tensioned prior to placing concrete.

Prestressing steel at the end of the members shall be cut and bent in accordance with details on the project plans. Exposed strand ends shall not be coated, but shall be clean and free of all rust, corrosion, dirt, scale, oil, grease, and other deleterious substances, in accordance with Sections 506.3 and 506.7 of these Specifications, before encasement in the cast-in-place concrete pier and abutment diaphragms of the superstructure.

506.8 SAMPLES FOR TESTING:

Sampling and testing of prestressing strand for bridge members shall conform to the specifications of AASHTO M 203.

506.9 HANDLING:

Precast prestressed concrete bridge members shall not be transported from the fabricating yard to the bridge site until attaining full design compressive strength, and not less than seven (7) days after the total transfer of prestressing force.

506.10 PAYMENT:

A partial payment administered in accordance with the provisions of Section 109.7(A), will be allowed for stockpiled precast prestressed concrete bridge members that have been approved by the Engineer for conformance with the project plans and these specifications. The partial payment shall not exceed eighty percent of the contract complete in place unit price,

An adjustment in the contract unit price, to the nearest cent, will be made for precast prestressed concrete bridge members having cylinder strength test results less than the specified 28-day compressive strength. Strength tests will be conducted in accordance with Section 725.8. The adjustment in contract unit price, if the precast prestressed concrete bridge member is accepted, will be based on the schedule in Section 725.8.3 Table 725-2 using values for Class AA and Class A.

SECTION 601

TRENCH EXCAVATION, BACKFILLING AND COMPACTION

601.4 .3 Backfill, add the following:

Backfill material for pipes, pipe-arches, or arches made of metal shall have a value of resistivity not less than 2000 ohm-cm or of the value shown on the project Plans. When resistivity is not shown on the Plans, the backfill material shall have a value of resistivity not less than that of the existing in-place material or 2000 ohm-cm, whichever is greater. Backfill material for all metal pipe installations shall have a pH value between 6.0 and 9.0 inclusive. Backfill material for all concrete or plastic pipe installations shall have a pH value between 6.0 and 12.0. Tests for pH and resistivity shall be in accordance with the requirements of Arizona Test Method 236.

Trenches within existing paved areas and unpaved roadways shall use ½ sack CLSM for backfill unless use of an alternative material has received prior approval. For trenches within paved areas the CSLM shall extend from the top of bedding to the bottom of the aggregate base as defined for Trench Repair of MAG Detail 200. For trenches within unpaved roadway areas the CSLM shall extend from the top of bedding to six (6) inches below the finished grade, material for the top six (6) inches shall match the existing roadway surfacing. The unpaved roadway area includes the travelled way plus shoulders or five foot beyond the travelled way whichever is greater.

SECTION 603

INSTALLATION FOR HIGH DENSITY POLYETHYLENE PIPE

Section 603.4.2 is modified as following:

Controlled low strength material (CLSM) shall be used for bedding of HDPE. The CLSM shall be ½ Sack per Section 728 unless otherwise noted. Placement of the CLSM bedding shall be per Section 604 and extend to 12 inches above the pipe crown line.

Part 600 add the following new Section:

SECTION 635

CONCRETE LINED IRRIGATION DITCH

635.1 DESCRIPTION:

Work under this Section consists of constructing cast-in-place Concrete Lined Ditch (CLD) in conformance with the details shown on the project plans, the applicable provisions of Section 505, and these Specifications.

635.2 MATERIALS:

Concrete shall be air-entrained Class B Portland cement concrete conforming to the requirements of Section 725. All other materials incorporated in the CLD installation shall conform to the project plans, to the project Special Provisions, to the MAG Standard Details, and/or to appropriate Part 700 materials specifications.

635.3 CONSTRUCTION:

Subgrade for the concrete ditch shall be shaped to conform to the elevations and dimensions shown on the project plans. The subgrade shall be compacted in accordance with the requirements of Section 301.3 (C), except that the depth of compaction shall be 12 inches below the flow line of the completed ditch.

The CLD shall be slip-formed, or cast as approved by the Engineer.

The finished surface of the concrete shall be free from rock pockets and surface voids, and shall be comparable to the finish obtained by the use of a long-handled steel trowel, as approved by the Engineer. Transverse grooves 1/8 inch in width and 5/8 inch in depth shall be made in the placed concrete lining at intervals of 10 feet, and maintained to the required dimensions until the concrete has set.

The placed concrete shall be cured by the use of a white pigmented membrane-forming compound (AASHTO M-148 Type 2) conforming to the requirements of Section 726.

635.4 MEASUREMENT:

Measurement for this work will be by the linear foot of Concrete Lined Ditch.

635.5 PAYMENT:

Payment for this work shall be made at the contract unit price for Concrete Lined Ditch. Such payment will be full compensation for the item, complete in place, including all necessary materials, excavation, subgrade preparation, concrete, labor, and equipment.

SECTION 710

ASPHALT CONCRETE

710.3 MIX DESIGN REQUIREMENTS:

710.3.1 General, add the following to paragraph (7) of the mix design report requirements:

Provide a recommended compaction temperature range for paving operations.

710.3.2 Mix Design Criteria, add the following:

The design asphalt binder content shall be expressed as a percentage of the total mix weight and shall be stated to the nearest 0.1 percent. Table 710-A is the allowable range of design asphalt binder contents for each mix designation.

TABLE 710-A		
MIX DESIGN RANGE FOR ASPHALT BINDER CONTENT (%)		
Mix Designation	Low Traffic	High Traffic
3/8" and 1/2"	5.8 to 6.5	5.3 to 6.0
3/4"	5.3 to 6.0	4.8 to 5.5
Base mix 1"	4.0 to 5.0	3.8 to 5.0

SECTION 711

PAVING ASPHALT

711.2 TESTING REQUIREMENTS:

In Table 711-1, Column 1, Row 11, The Dynamic Shear parameter for aged binder (PAV method) replace "G*/sin δ" with "G*·sin δ" (G* multiplied by "sin δ"). The requirement description is to read:

Dynamic Shear TP5
G*·sin δ, Max., 5000 kPa
Test Temp. @ 10 rad/s, °C

SECTION 717

ASPHALT- RUBBER

Replace all of Section 717 of the MAG Standard Specifications with the following:

717.1 DESCRIPTION:

The work under this section shall consist of furnishing, proportioning and mixing all the ingredients necessary to produce an asphalt-rubber material.

717.2 MATERIALS:

717.2.1 Asphalt-Rubber:

Asphalt Cement: Asphalt cement shall conform to the requirements of Section 711.

Rubber: Rubber shall meet the following gradation requirements when tested in accordance with Arizona Test Method 714. Type B shall be used unless otherwise specified.

Sieve Size	Percent Passing	
	Type A	Type B
#8 (2.36 mm)	100	
#10 (2.00 mm)	95 - 100	100
#16 (1.18 mm)	0 - 10	65 - 100
#30 (600 µm)		20 - 100
#50 (300 µm)		0 - 45
#200 (75 µm)		0 - 5

The rubber shall have a specific gravity of 1.15 ± 0.05 and shall be free of wire or other contaminating materials, except that Type A rubber shall contain not more than 0.1 percent fabric and Type B shall contain not more than 0.5 percent fabric. Calcium carbonate, up to four percent by weight of the granulated rubber, may be added to prevent the particles from sticking together.

Certificates of Compliance conforming to Arizona State Department of Transportation Standard Specifications for Road and Bridge Construction Section 106.05 shall be submitted. In addition, the Certificates shall confirm that the rubber is a crumb rubber, derived from processing whole scrap tires or shredded tire materials; and the tires from which the crumb rubber is produced is taken from automobiles, trucks, or other equipment owned and operated in the United States. The Certificates shall also verify that the processing does not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above the ground.

717.2.2 Asphalt-Rubber Proportions: Ground rubber in asphalt-rubber shall be a minimum of 20 percent and a maximum of 22 percent by weight of the asphalt cement.

717.2.3 Asphalt-Rubber Properties: Asphalt-rubber shall be Type 1 unless otherwise specified and conform to the following:

Property	Requirement		
	Type I	Type 2	Type 3
Grade of base asphalt cement	**PG 64-16**	**PG 58-22**	**PG 52-28**
Rotational Viscosity*; 350°F (177°C); cps (Pascal seconds)	1500-4000 (1.5-4.0)	1500-4000 (1.5-4.0)	1500-4000 (1.5-4.0)
Penetration; 39.2°F (4°C), 200g, 60 sec. (ASTM D 5); dmm (in), min	10 (0.04)	15 (0.06)	25 (0.10)
Ductility; 39.2°F (4°C), 1 cpm (ASTM D 113); cm (in), min.	5 (2)	5 (2)	5 (2)
Softening Point; (ASTM D 36); °F (°C), min.	135 (57)	129 (54)	126 (52)
Resilience; 77°F (25°C) (ASTM D 3407);%,min	25	20	15
* The Viscometer used must be a Haake Viscometer, Model VT – 04, Rotor No. 1, or viscometer correlated.			

717.2.4 Asphalt-Rubber Design: At least two weeks prior to the use of asphalt-rubber, the Contractor shall submit an asphalt-rubber design prepared by an approved laboratory. Such design shall meet the requirements specified herein. The design shall show the values obtained from the required tests, along with the following information: percent, grade and source of the asphalt cement used; and percent, gradation and source(s) of rubber used.

717.3 CONSTRUCTION REQUIREMENTS:

717.3.1 Mixing of Asphalt-Rubber: The temperature of the asphalt-cement shall be between 375°F (191°C) and 425°F (218°C) prior to the addition of rubber. No agglomerations of rubber particles in excess of 2" in the least dimension shall be allowed in the mixing chamber. The ground rubber and asphalt-cement shall be accurately proportioned in accordance with the design and thoroughly mixed prior to the beginning of the one-hour reaction period. Reaction time may be decreased to 45-minutes if documentation is provided that the physical properties of the mix design requirements are consistently met using a 45-minute reaction period. The Contractor shall document that the proportions are accurate and that the rubber has been uniformly incorporated into the mixture. Additionally, the Contractor shall demonstrate that the rubber particles have been thoroughly mixed such that they have been "wetted." The occurrence of rubber floating on the surface or agglomerations of rubber particles shall be evidence of insufficient mixing. The temperature of the asphalt-rubber immediately after mixing shall be between 350°F (177°C) and 400°F (204°C). Reaction time shall

start after all of the material for the batch has been mixed and the minimum reaction temperature of 350°F (177°C) has been achieved.

Prior to use, the viscosity of the asphalt-rubber shall be tested by the use of a rotational viscometer, which is to be furnished by the Contractor or supplier. The Contractor shall provide a qualified person to perform the testing.

717.3.2 Handling of Asphalt-Rubber: Once the asphalt-rubber has been mixed, it shall be kept thoroughly agitated during periods of use to prevent settling of the rubber particles. During the production of asphaltic concrete the temperature of the asphalt-rubber shall be maintained between 325°F (163°C) and 375°F (191°C). However, in no case shall the asphalt-rubber be held for more than 10 hours at these temperatures. It shall be allowed to cool to a temperature of 250°F (121°C) or less and held at that temperature for not more than four days. The process of cooling and reheating shall not be allowed more than one time for a batch of asphalt rubber binder.

For each load or batch of asphalt-rubber, the Contractor shall provide the Engineer with the following documentation:

(A) The source, grade, amount and temperature of the asphalt cement prior to the addition of rubber.

(B) The source and amount of rubber and the rubber content expressed as percent by the weight of the asphalt cement.

(C) Times and dates of the rubber additions and resultant viscosity test.

(D) A record of the temperature, with time and date reference for each load or batch. The record shall begin at the time of the addition of rubber and continue until the load or batch is completely used. Readings and recordings shall be made at every temperature change in excess of 52°F (11°C), and as needed to document other events which are significant to batch use and quality.

SECTION 725

PORTLAND CEMENT CONCRETE

725.8 TESTS AND TEST METHODS:

725.8.2 Concrete Cylinder Test, add following:

A cylinder strength test for concrete with a design strength of 4,000 psi or higher shall be the average of the strengths of at least two 6 inch by 12 inch cylinders or at least three 4 inch by 8 inch cylinders made from the same sample of concrete and tested at 28 days.

SECTION 727

STEEL REINFORCING

Section 727 is supplemented with the following:

727.1 GENERAL:

All reinforcing steel shall be deformed, and conform to the current requirements of AASHTO M 31 (ASTM A 615) – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

Reinforcing steel bars shall be Grade 60.

Revise requirements for the bending of steel to read:
Bending of reinforcing steel shall conform to the requirements Section 505.5.2.

727.2 WIRE REINFORCEMENT:

Wire reinforcement shall conform to the current requirements of AASHTO M 32 (ASTM A 82) – Steel Wire, Plain, for Concrete Reinforcement.

727.3 WIRE MESH REINFORCEMENT:

Wire mesh reinforcement shall conform to the current requirements of AASHTO M 55 (ASTM A 185).

SECTION 738

HIGH DENSITY POLYETHYLENE PIPE & FITTINGS FOR STORM DRAIN & SANITARY SEWER

Section 738.1 is modified as following:

HDPE pipe size shall be limited to sizes 8-inch through 60-inch diameter. Sizes greater than 60-inch diameter shall not be used within Maricopa County rights-of-way without specific approval from MCDOT.

MARICOPA COUNTY

SUPPLEMENT

TO THE

MAG STANDARD DETAILS

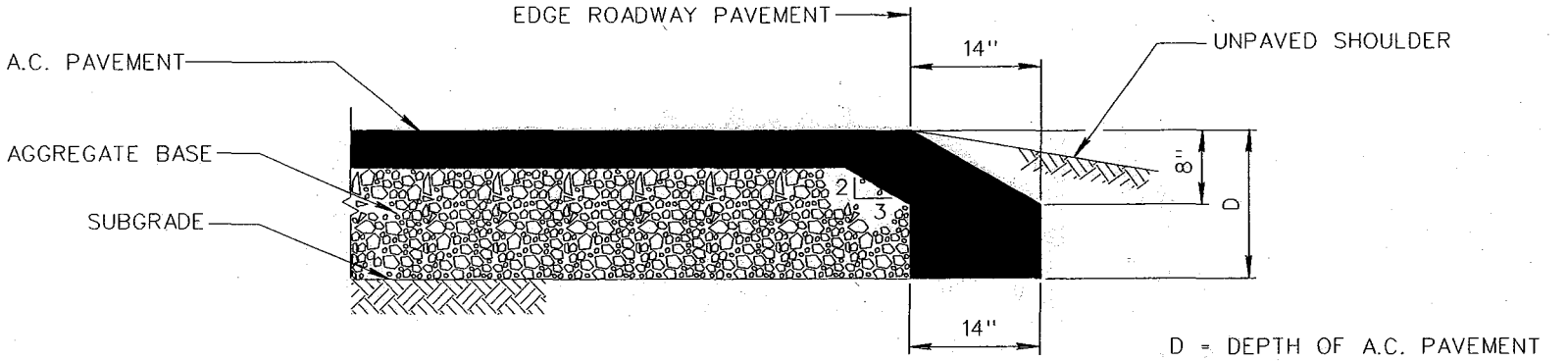
Maricopa County
Department of Transportation
2901 W. Durango Street
Phoenix, AZ 85009

Maricopa County Standard Details

Number	Description
2001	Asphalt Pavement Safety Edge
2010-1	Residential Speed Hump Without Curb and Gutter
2010-2	Residential Speed Hump With Curb and Gutter
2013	Milling for Overlay
2030-A	Sidewalk Ramp Retrofit – Method A
2030-B	Sidewalk Ramp Retrofit – Method B
2030-C	Sidewalk Ramp Retrofit – Use Requires Special Approval
2031-A	Sidewalk Ramp Arterial Intersections
2031-B	DELETED, replaced by MAG Detail 235
2032-A	DELETED, replaced by MAG Detail 235
2032-B	DELETED, replaced by MAG Detail 235
2035	Return Type Driveways with Detached Sidewalk
2036	Return Type Driveways with Attached Sidewalk
2054	Street Name Sign Installation Details (4 pages)
2055	Barricade (Portable)
2056	Roadway Markers
2057	Permanent Road Closure Using Type III Barricades (4 pages)
2058	Square Perforated Tube Sign Post Foundation & Splice Details
2059	U-Channel Post Selection and Installation Details
2060	Offsets, Clearances and Mounting Details for Signs on County Roadways (2 pages)
2061	Sign Blanks – Layouts (23 pages)
2062	Street Sign – Post Caps and Brackets (6 pages)
2065	Mailbox Relocation Detail for Curb Section without Sidewalk
2067	Mailbox Relocation Detail for Shoulder Section
2069	Recommended Mailbox Clearances at Intersections
2070	Typical Mailbox Turnout
3001	Typical Guardrail
3002	Guardrail Installation
3003	DELETED
3005	End Terminal Layout with Curb and Gutter
3006	End Terminal Layout without Curb and Gutter
3007	Departure End Terminal
3008	Nested Guardrail (3 pages)
3010	Bolted Guardrail Anchors (2 pages)
3012	Guardrail Transition (3 pages)
3016	Guardrail Measurement
4701	Traffic Signal Symbols
4702	Traffic Signal Symbols

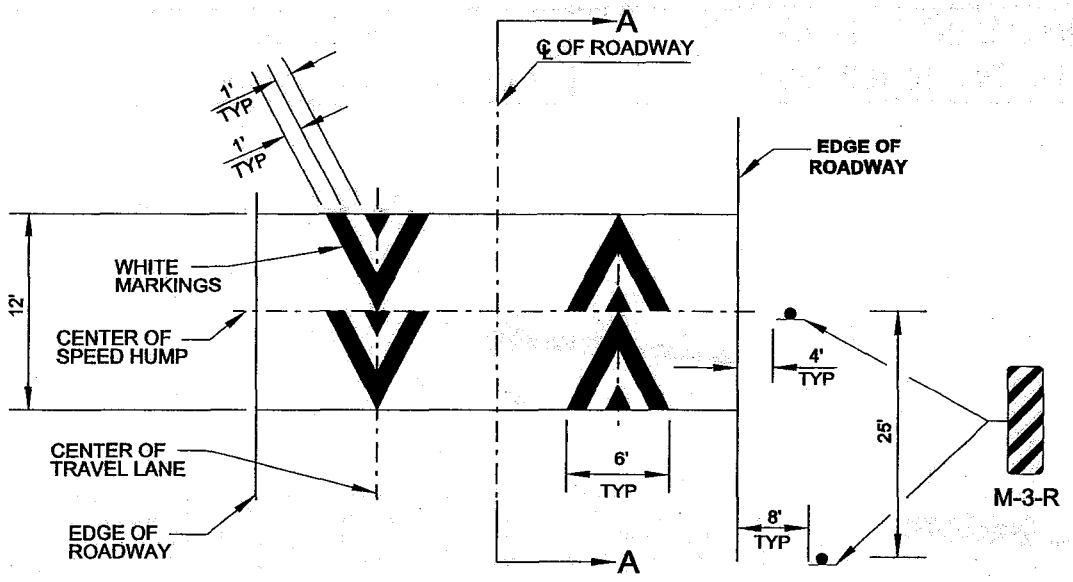
Number	Description
4711	Traffic Signal Pull Box Detail
4712	Traffic Signal Pull Box Extension
4713	Typical Traffic Signal Pull Box Installation
4716	Typical Traffic Signal Pull Box and Conduit Run Layout
4717	ITS Interconnect Conduit and Pull Box Layout
4720	Signal Pole Foundations (Pole Types A, E, F & PB)
4721	Signal Pole Foundations (Pole Types J, Q, K & R)
4723	'P' Cabinet Foundation
4724	Combination Service Pedestal and Battery Backup Foundation Detail
4725	Anchor Bolt with Hook
4726	Anchor Bolt with Plate
4730	'P' Cabinet
4731-1	'SP' Electrical Service Pedestal & 'BBS' Battery Backup System Cabinet
4731-2	Service Pedestal and Battery Backup Wiring Schematic
4735	Controller Cabinet Wiring Schematic
4737	Luminaire Circuit
4738	Type 'A' Pole
4739-1	Pole Lower Hand Hole Details
4739-2	Pole Upper Hand Hole Details
4740	Type 'E' Pole
4741-1	Type 'F' Pole
4741-2	'E' & 'F' Pole Details
4742	Type 'J' Pole
4743	Type 'Q' Pole
4744	'J' & 'Q' Pole Details
4748	Type 'K' Pole
4749-1	Type 'R' Pole
4749-2	'K' & 'R' Pole Details
4750	Type 'PB' Pole
4755	Video Detection Camera Installation
4757	Loop Installation Details
4758	Conduit Stub-Out Detail Without Curb & Gutter
4759	Conduit Stub-Out Detail With Curb & Gutter
4773	Standard Signal Faces
4774	Signal Head Visor
4775	Side Mount (Type XI) Assembly (Vehicle & Pedestrian)
4776	Pole Top (Type III) Mounting Assembly
4778-1	Mast Arm Signal Head Mount (Type II)
4778-2	Elevator Plumbizer Detail
4780-1	Metro Street Sign Layout Sheet Installation on Signal Poles
4780-2	Metro Street Sign Layout and Installation
4780-3	Metro Street Sign Clamp
4780-4	Metro Street Name Sign Mounted on Type "J" or "K" Signal Poles

Number	Description
4785	Pole Plate
4786	Pole Top Mount Adaptor
4788	Elbow
4789	Tee
4791	Ornamental Cap
4792	Side Mounted Terminal Compartment
4793	Terminal Compartment Cover
4794	Type V Mounting Assembly
4795	Type VII Mounting Assembly
4797-1	Type PB Pedestrian Push-Button Mount
4797-2	Pedestrian Push-Button Housing
4797-3	Pedestrian Push-Button Adapter Plate
4798	Underground Combination Power Service / Battery Backup System Layout
4799-1	Color Code – 2, 4 and 7 Conductor Cable
4799-2	Color Code - 20 Conductor Cable
4801	Typical ITS PVC Conduit Installation
4805	ITS No. 7 Pull Box
4806-1	ITS Fiber Optic No. 9 Pull Box
4806-2	ITS Fiber Optic No. 9 Pull Box Cover Assembly
4810	ITS Conduit and ITS No. 7 Pull Box Installation
4811	ITS Conduit and No. 9 Pull Box Installation
4821	Fiber Optic Cable Installed in No. 9 Pull Box
4825-1	ITS Pedestal Post Top Mounting (G-1)
4825-2	ITS Square Base ('SB') Pole Foundation Detail
4825-3	ITS Square Base 'SB' Pedestal
4825-4	ITS Type 'SB' Pole
4825-5	ITS Pedestal Pole Top Mounting Adapter
4825-6	ITS Type 'G' Cabinet
4827	ITS Post Side Mount (G-2)
4829-1	Service Pedestal
4829-2	Service Pedestal Foundation
4829-3	Service Pedestal Wiring Schematic
4830	CCTV Camera Installation on Signal Pole
4831-1	ITS CCTV Camera Panel Location
4831-2	ITS CCTV Camera Panel Details
4831-3	CCTV Camera Wiring Schematic
4833	Multiservice Radio Installation on Signal Pole
4835	4"X4" Post with Conduit for T1 Demarcation Point



D = DEPTH OF A.C. PAVEMENT PLUS AGGREGATE BASE, MINIMUM DEPTH = 8"

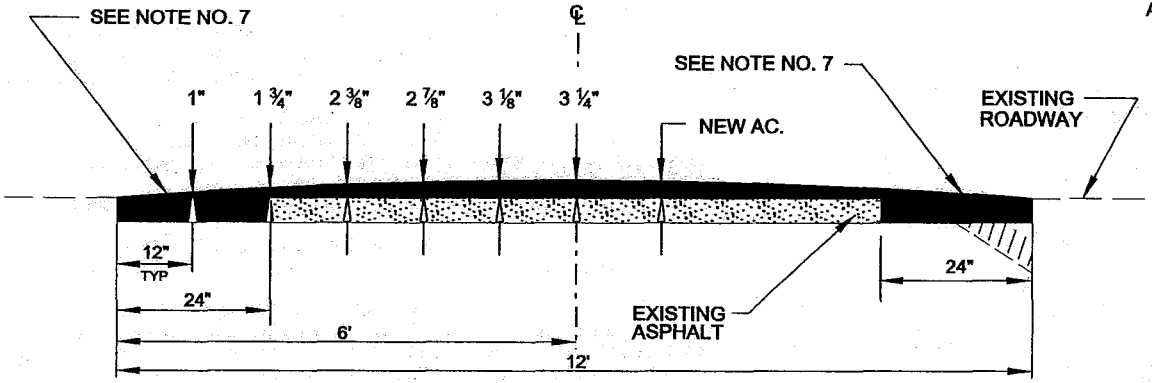
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ASPHALT PAVEMENT SAFETY EDGE	DATE: 12/10	DETAIL NO. 2001



PLAN VIEW

NOT TO SCALE

SIGNING TYPICAL AT EACH APPROACH OR AS DIRECTED



SECTION A-A

NOT TO SCALE

NOTES:

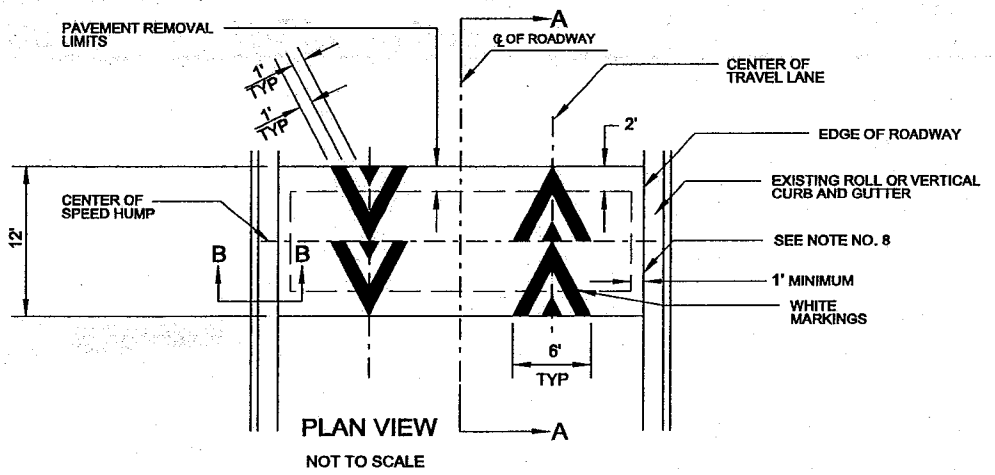
1. SECTION A-A FINISHED SURFACE DIMENSIONS ARE DISTANCES FROM THE SURFACE OF THE EXISTING ROADWAY. THE CONSTRUCTION TOLERANCE FOR THESE CROSS SECTION DIMENSIONS IS + 0.25 INCHES.
2. SPEED HUMPS THAT DO NOT COMPLY WITH CONSTRUCTION TOLERANCES SHALL BE REMOVED AND REPLACED AT CONTRACTOR'S EXPENSE.
3. THE CONTRACTOR SHALL WARRANT THAT THE MID-POINT HEIGHT TO BE AT LEAST 3 INCHES FOR 12 MONTHS. IF THE SPEED HUMP HEIGHT IS LESS THAN 3 INCHES AT THE 12 MONTH WARRANTY REVIEW, THE SPEED HUMP SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.
4. SPEED HUMPS SHALL NOT BE PLACED OVER MANHOLES, VALVE BOXES, SURVEY MONUMENTS, ETC. OR AT DRIVEWAYS.
5. SPEED HUMPS SHALL ONLY BE PLACED AT LOCATIONS APPROVED BY MCDOT.
6. SPEED HUMPS SHALL BE CONSTRUCTED WITH 1/2" MARSHALL MIX FOR HIGH TRAFFIC. COMPACTION SHALL BE PER SECTION 321. TACK COAT PER SECTION 713 SHALL BE APPLIED PRIOR TO PAVING.
7. TRAVERSE EDGE JOINTS (ACROSS ROADWAY)
   A. FOR EXISTING ASPHALT PAVEMENTS EQUAL TO OR GREATER THAN 1.5 INCHES IN THICKNESS: SAWCUT AND REMOVE A 24 INCH WIDTH AT THE MATCHING SPEED HUMP EDGE. REPLACE THE FULL DEPTH OF REMOVED ASPHALT WITH SPEED HUMP ASPHALT AS A SINGLE OPERATION DURING CONSTRUCTION OF THE SPEED HUMP.
   B. FOR EXISTING ASPHALT PAVEMENTS LESS THAN 1.5 INCHES IN THICKNESS: REMOVE A 24 INCH WIDTH OF PAVEMENT AT THE MATCHING SPEED HUMP EDGE AND CONSTRUCT THICKENED EDGES PER MAG DETAIL 201, TYPE B ALONG THE TRAVERSE EDGES OF THE SPEED HUMP.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RESIDENTIAL SPEED HUMP WITHOUT CURB AND GUTTER	DATE: 12/09	DETAIL NO. 2010-1

NOTES:

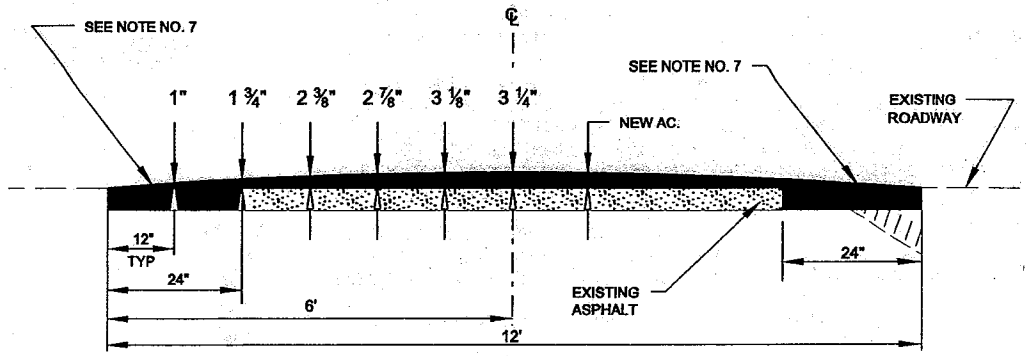
1. SECTION A-A FINISHED SURFACE DIMENSIONS ARE DISTANCES FROM THE SURFACE OF THE EXISTING ROADWAY. THE CONSTRUCTION TOLERANCE FOR THESE CROSS SECTION DIMENSIONS IS ± 0.25 INCHES.
2. SPEED HUMPS THAT DO NOT COMPLY WITH CONSTRUCTION TOLERANCES SHALL BE REMOVED AND REPLACED AT CONTRACTOR'S EXPENSE.
3. THE CONTRACTOR SHALL WARRANT THAT THE MID-POINT HEIGHT TO BE AT LEAST 3 INCHES FOR 12 MONTHS. IF THE SPEED HUMP HEIGHT IS LESS THAN 3 INCHES AT THE 12 MONTH WARRANTY REVIEW, THE SPEED HUMP SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.
4. SPEED HUMPS SHALL NOT BE PLACED OVER MANHOLES, VALVE BOXES, SURVEY MONUMENTS, ETC. OR AT DRIVEWAYS.
5. SPEED HUMPS SHALL ONLY BE PLACED AT LOCATIONS APPROVED BY MCDOT.
6. SPEED HUMPS SHALL BE CONSTRUCTED WITH 1/2" MARSHALL MIX FOR HIGH TRAFFIC. COMPACTION SHALL BE PER SECTION 321. TACK COAT PER SECTION 713 SHALL BE APPLIED PRIOR TO PAVING.
7. TRAVERSE EDGE JOINTS (ACROSS ROADWAY)
   A. FOR EXISTING ASPHALT PAVEMENTS EQUAL TO OR GREATER THAN 1.5 INCHES IN THICKNESS: SAWCUT AND REMOVE A 24 INCH WIDTH AT THE MATCHING SPEED HUMP EDGE. REPLACE THE FULL DEPTH OF REMOVED ASPHALT WITH SPEED HUMP ASPHALT AS A SINGLE OPERATION DURING CONSTRUCTION OF THE SPEED HUMP.

   B. FOR EXISTING ASPHALT PAVEMENTS LESS THAN 1.5 INCHES IN THICKNESS: REMOVE A 24 INCH WIDTH OF PAVEMENT AT THE MATCHING SPEED HUMP EDGE AND CONSTRUCT THICKENED EDGES PER MAG DETAIL 201, TYPE B ALONG THE TRAVERSE EDGES OF THE SPEED HUMP.
8. LONGITUDINAL EDGE JOINTS (ALONG THE LIP OF GUTTER): REMOVE THE EXISTING PAVEMENT FOR A MINIMUM WIDTH OF TWELVE INCHES (12"). THE NEW ASPHALT SPEED HUMP PAVEMENT GRADE SHALL TAPER IN A DISTANCE OF 12 INCHES FROM THE SPEED HUMP PROFILE GRADE TO MATCH 1/4" ABOVE THE LIP OF GUTTER.



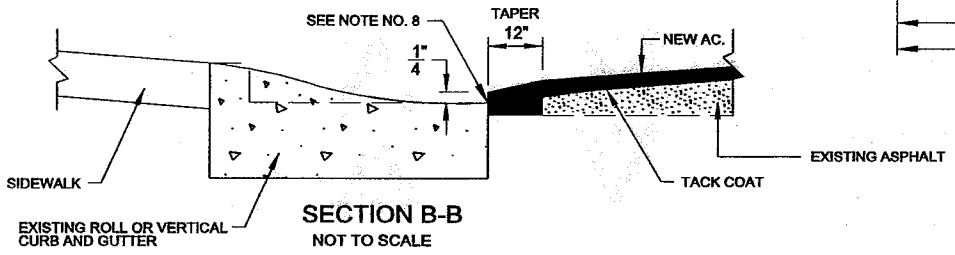
PLAN VIEW

NOT TO SCALE



SECTION A-A

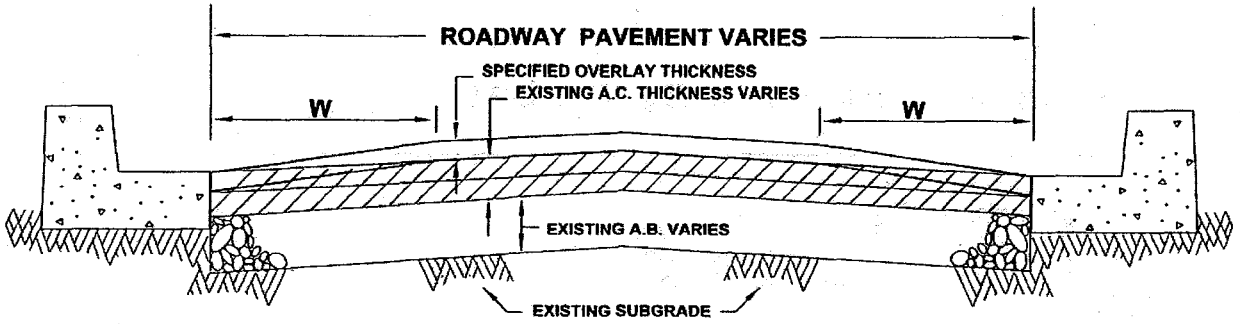
NOT TO SCALE



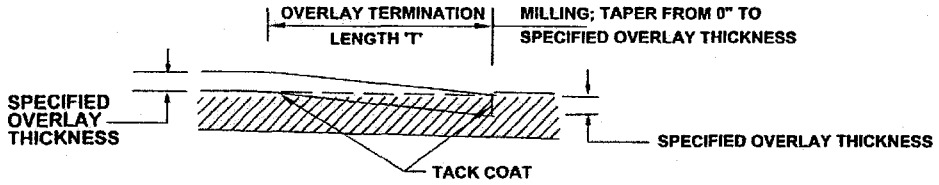
SECTION B-B

NOT TO SCALE

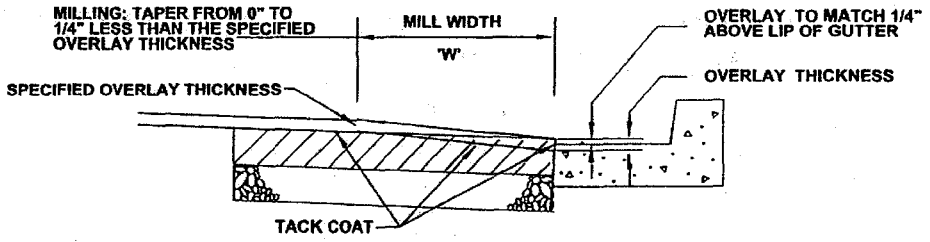
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RESIDENTIAL SPEED HUMP WITH CURB AND GUTTER	DATE: 12/09	DETAIL NO. 2010-2



TYPICAL CROSS SECTION
(N.T.S.)



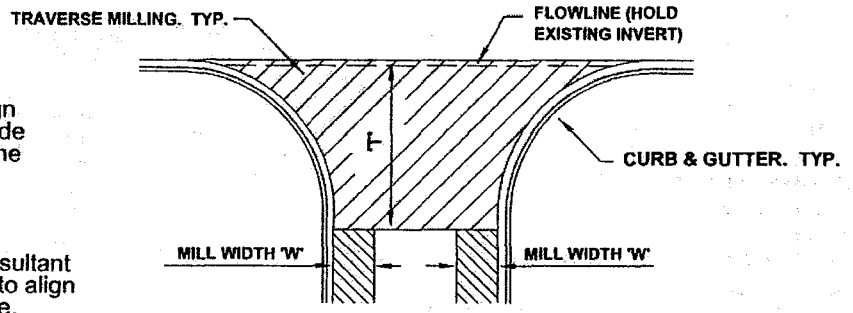
LONGITUDINAL TERMINATION OF OVERLAY
(N.T.S.)



EDGE MILLING & OVERLAY DETAIL
(N.T.S.)

DESIGN NOTES:

1. Length of termination taper shall be determined based on roadway design speed and the allowable vertical grade break as defined in section 5.11 of the Roadway Design Manual.
2. Width of longitudinal milling shall be determined such that the final cross slope does not exceed 3.0%. The resultant angle point in the overlay surface is to align (approximately) with a traffic lane line.
3. The roadway logitudinal slope at pedestrian crossings shall not exceed 2%.

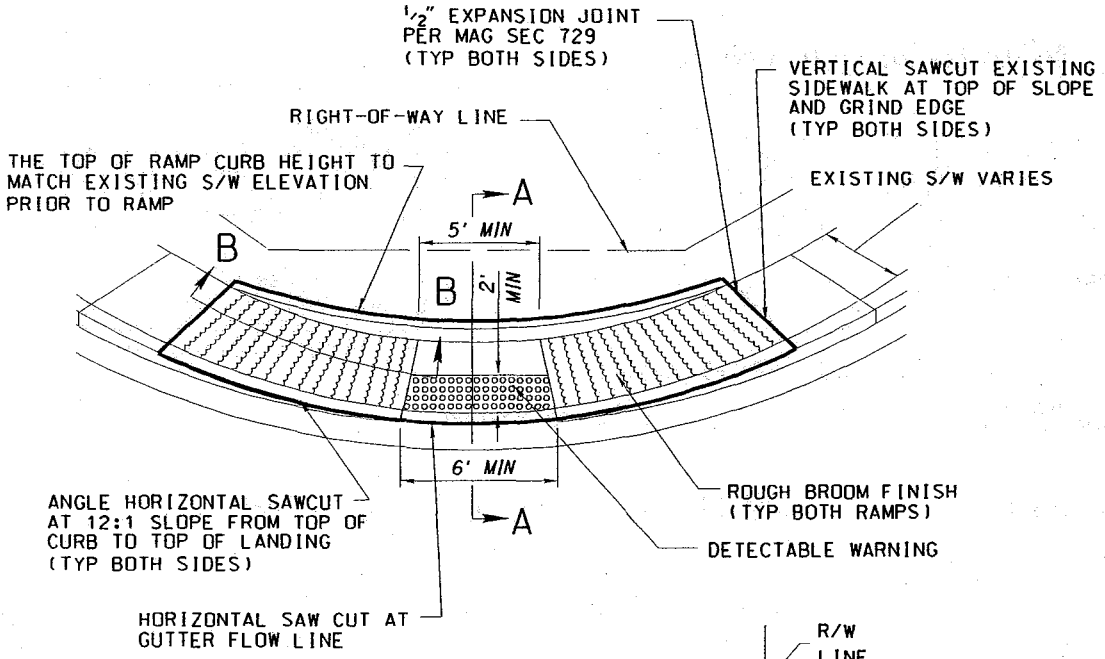


TERMINATION PLAN VIEW
(N.T.S.)

NOTES:

1. See project milling schedule for dimensions of longitudinal milling width 'W' and milling termination taper length 'T'.
2. Overlay is not to change flowline elevations at asphalt valley gutter. Provide traverse termination to match flowline grade.

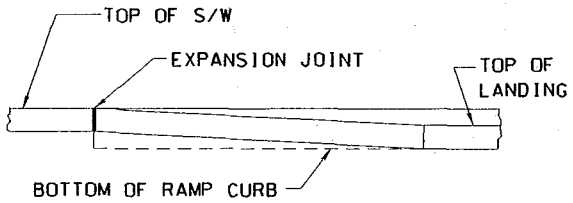
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MILLING FOR OVERLAY	DATE 01-02-09	DETAIL NO. 2013



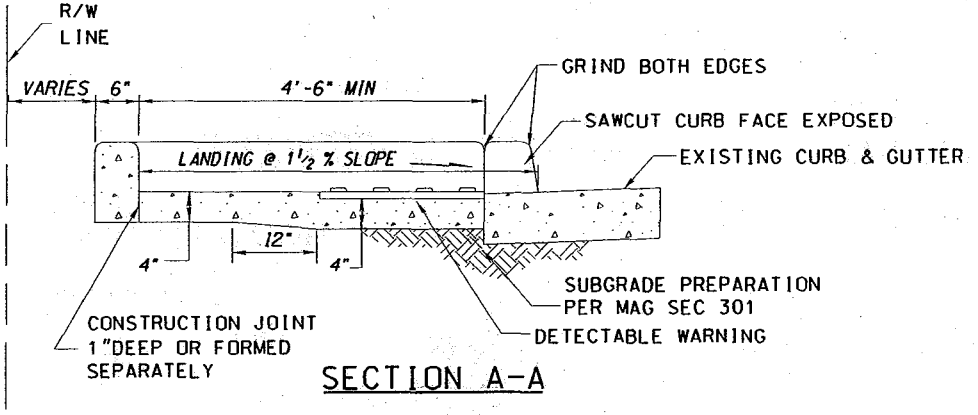
GENERAL NOTES

SIDEWALK RAMP CONSTRUCTION METHOD 'A' INCLUDES BUT NOT LIMITED TO:

1. AFTER SAWCUTS HAVE BEEN MADE ALL EXCESS MATERIAL SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR DAILY.
2. ALL SAW CUT EDGES WHICH WILL BE EXPOSED SHALL BE ROUNDED BY GRINDING.
3. CONTRACTOR SHALL REMOVE AND REPLACE SIDEWALK TO THE NEAREST EXPANSION JOINT BEYOND THE OUTLINED PAY LIMITS SHOWN. IF THE 12:1 SLOPE DISTANCE IS 24 INCHES OR LESS FROM AN EXPANSION JOINT. THE COST OF THE ADJUSTMENT SHALL BE INCLUDED IN THE COST OF THE RAMP.
4. SIDEWALK AND RAMP CURB MAY BE CONSTRUCTED TOGETHER.
5. CONCRETE SHALL BE MAG 725 CLASS B.
6. PAY LIMITS ARE DENOTED BY HEAVY OUTLINED AREA.
7. DETECTABLE WARNING PER SECTION 340.

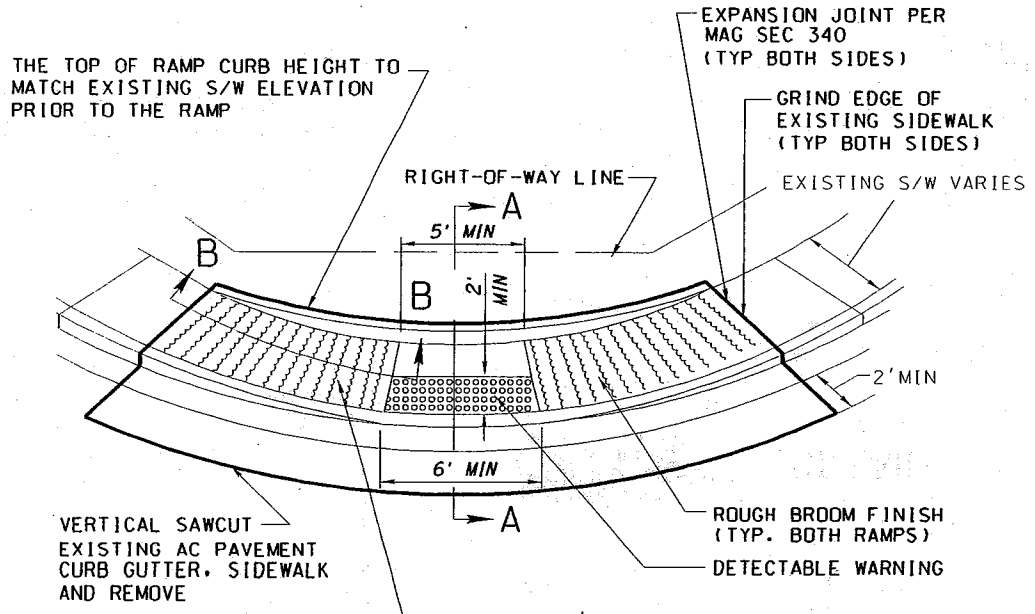


SECTION B-B



SECTION A-A

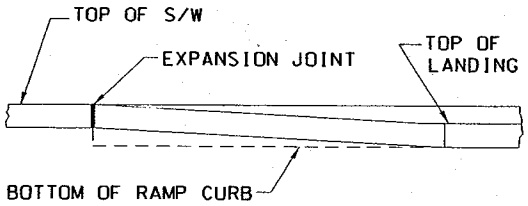
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIDEWALK RAMP RETROFIT - METHOD A	DATE: 6/1/05	DETAIL NO. 2030-A



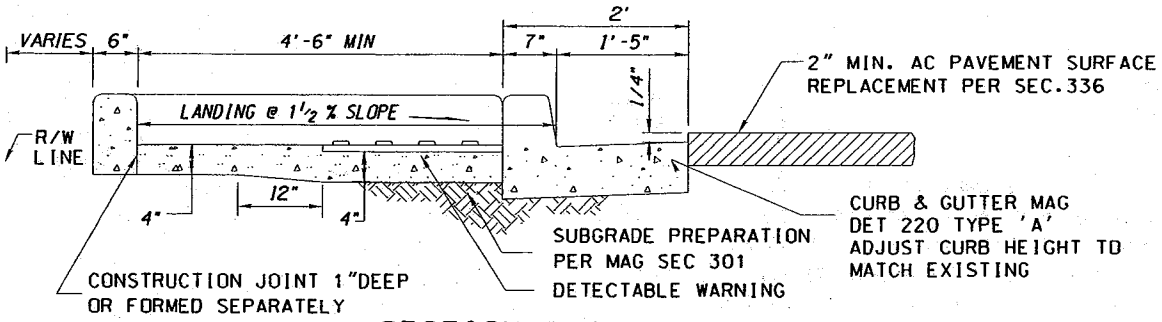
GENERAL NOTES

SIDEWALK RAMP CONSTRUCTION METHOD 'B' INCLUDES BUT NOT LIMITED TO:

1. AFTER SAWCUTS HAVE BEEN MADE ALL EXCESS MATERIAL SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR DAILY.
2. ALL SAW CUT EDGES WHICH WILL BE EXPOSED SHALL BE ROUNDED BY GRINDING.
3. CONTRACTOR SHALL HAVE THE OPTION OF REMOVING AND REPLACING THE EXISTING SIDEWALK, CURB AND GUTTER TO THE NEAREST EXPANSION JOINT BEYOND THE OUTLINE PAY LIMITS SHOWN AS AN ALTERNATE TO VERTICAL SAWCUTTING THE USE OF THIS OPTION SHALL NOT BE AN ADDITIONAL COST.
4. CURB AND GUTTER SHALL BE REPLACED IN A SEPARATE OPERATION FROM SIDEWALK AND PAVEMENT. SIDEWALK AND BACK RAMP CURB MAY BE CONSTRUCTED TOGETHER. PAVEMENT SHALL BE REPLACED AFTER CURB AND GUTTER HAVE CURED FOR SEVEN (7) DAYS
5. CONCRETE SHALL BE MAG 725 CLASS B.
6. PAY LIMITS ARE DENOTED BY HEAVY OUTLINED AREA.
7. DETECTABLE WARNING PER SECTION 340.

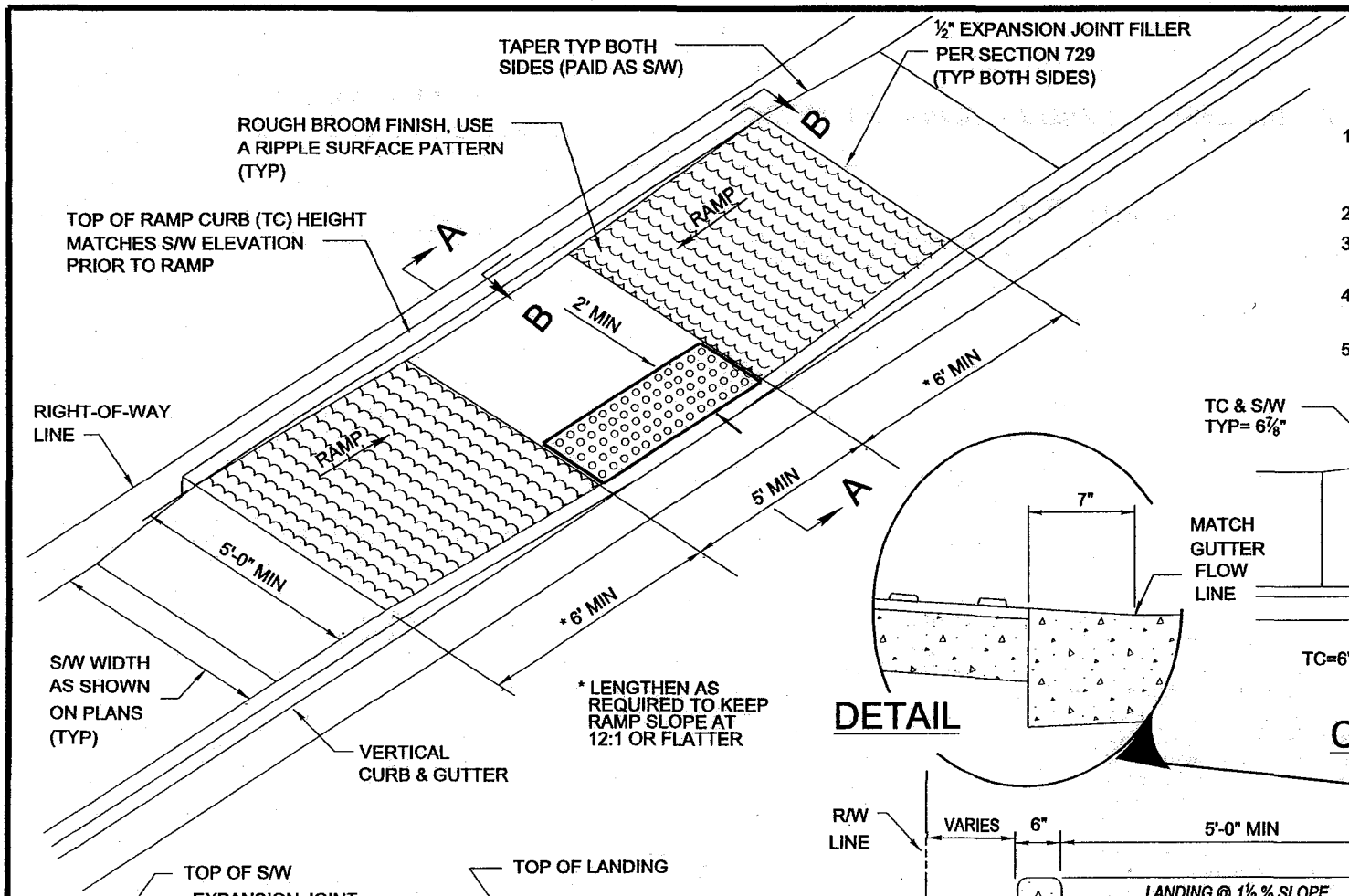


SECTION B-B



SECTION A-A

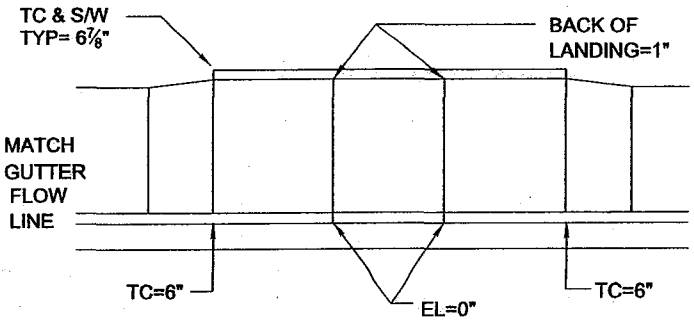
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIDEWALK RAMP RETROFIT – METHOD B	DATE: 6/1/05	DETAIL NO. 2030–B



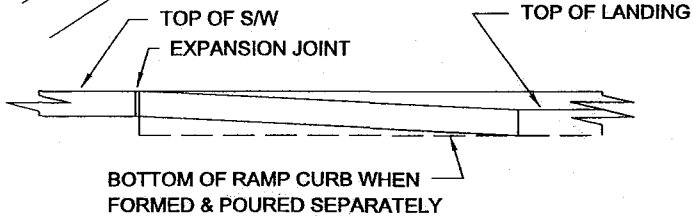
GENERAL NOTES

1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER. GUTTER ELEV.= 0.
2. CLASS 'B' CONCRETE PER SECTION 725.
3. DESIGN FOR WATER TO FLOW ALONG GUTTER OUT OF RAMP AREA.
4. DETECTABLE WARNING SHALL EXTEND THE FULL WIDTH OF THE DEPRESSED CURB.
5. DETECTABLE WARNING PER SECTION 340.

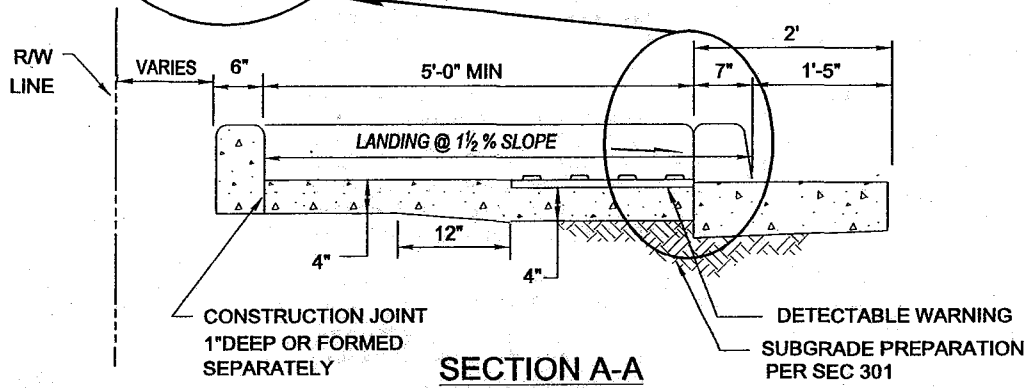
DETAIL



CONTROL ELEVATIONS

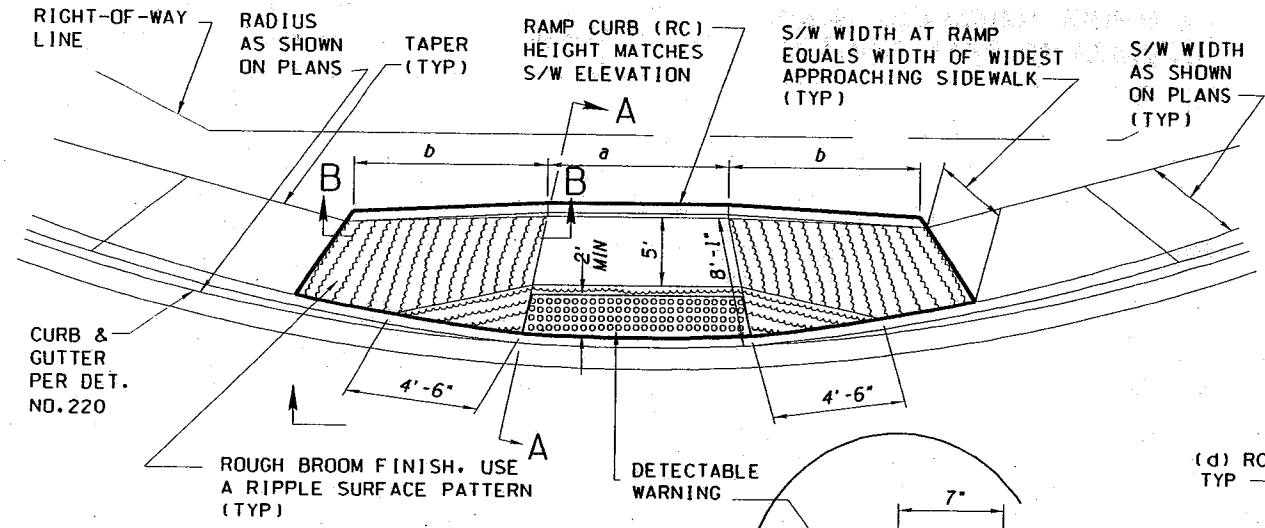


SECTION B-B



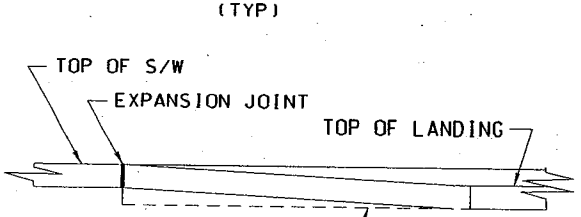
SECTION A-A

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIDEWALK RAMP RETROFIT (USE REQUIRES SPECIAL APPROVAL)	DATE: 1/1/2011	DETAIL NO. 2030-C

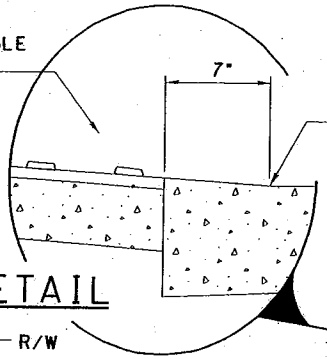


GENERAL NOTES

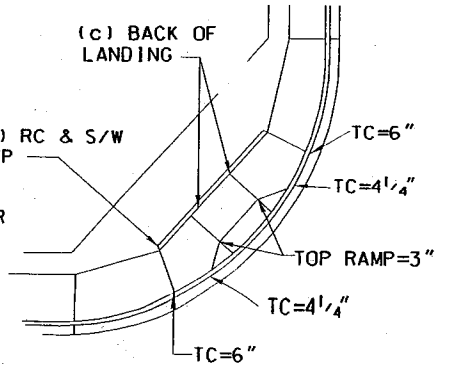
1. CONTROL ELEVATIONS SHOWN ARE IN RELATION TO THE GUTTER AND ARE LOCATED RADIALLY. GUTTER ELEV.= 0
2. CLASS 'B' CONCRETE PER SEC 725.
3. DESIGN FOR WATER TO FLOW ALONG GUTTER OUT OF RAMP AREA.
4. LOCATE CENTERLINE OF RAMP AT MIDPOINT OF CURB RETURN (1/2 △)
5. DETECTABLE WARNING PER SECTION 340.



SECTION B-B



DETAIL

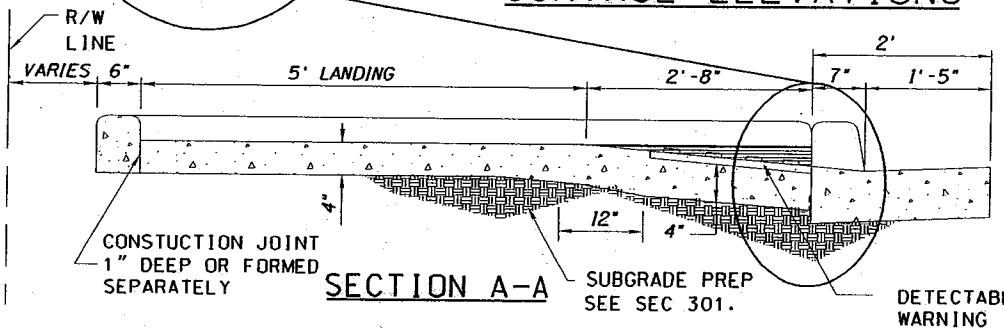


CONTROL ELEVATIONS

DATA TABLE

F/C RADII	S/W WIDTH	a*	b*	CONTROL EL'S c	CONTROL EL'S d
30'	5'	5'	8.60'	3⅞"	6⅞"
35'	5'	6'	9.24'	3⅞"	6⅞"

* FOR DELTA = 90° ONLY



SECTION A-A

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIDEWALK RAMP ARTERIAL INTERSECTIONS	DATE: 6/1/05	DETAIL NO. 2031-A

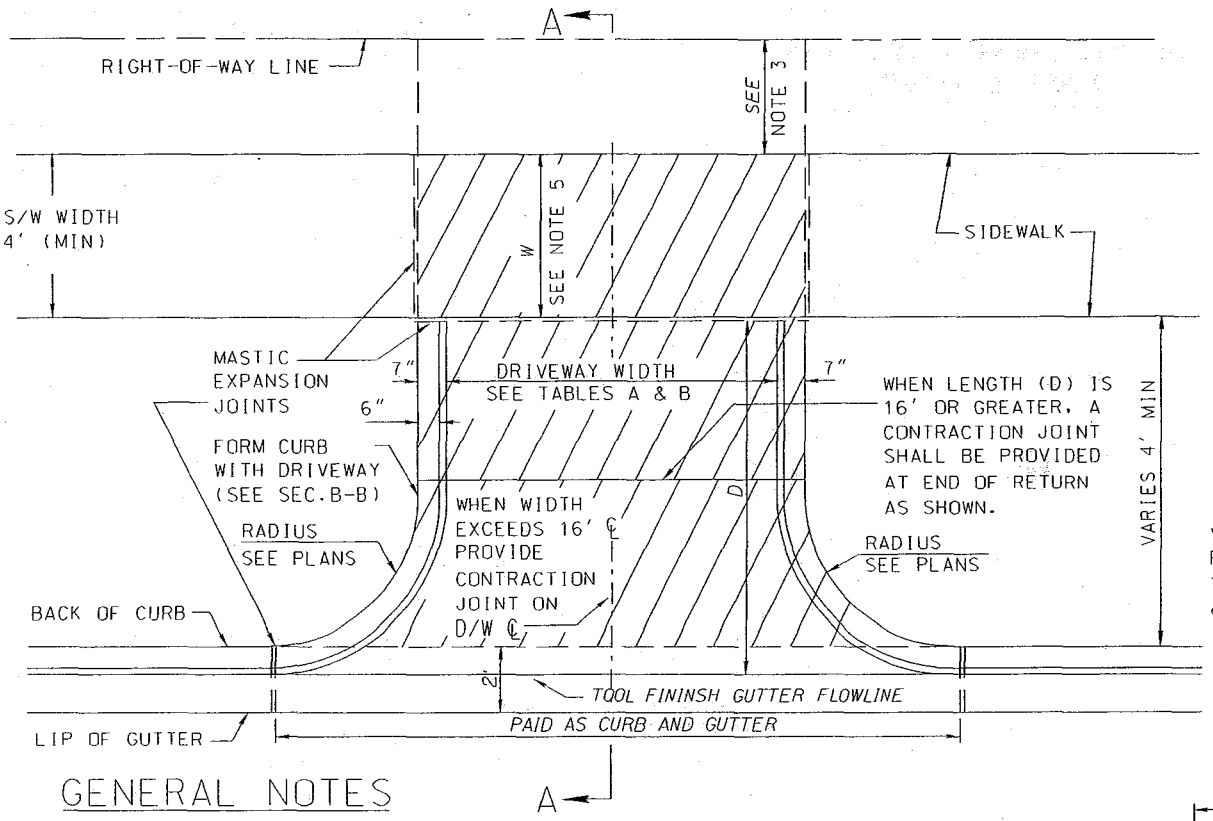
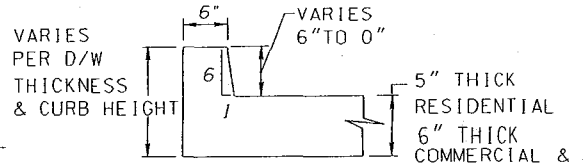
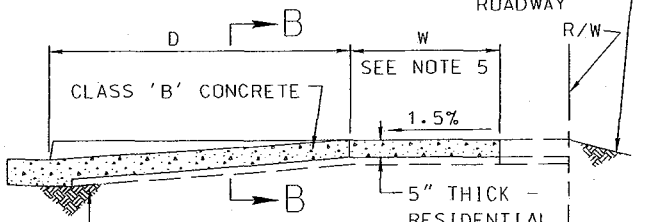


TABLE A		
ZONING	DRIVEWAY WIDTH	
	MIN	MAX
COMMERCIAL	16' *	40'
INDUSTRIAL	16' *	40'
* 24' WHERE 2-WAY TRAFFIC IS ANTICIPATED		

TABLE B		
ZONING	DRIVEWAY WIDTH	
RESIDENTIAL:	MIN	MAX
MAJOR STREET	16'	30'
COLLECTOR STREET	12' *	30'
LOCAL STREET	12' *	30'
* 16' WIDTH IS DESIRABLE		



D/W CURB
SECTION B-B



SECTION A-A

GENERAL NOTES

1. EXPANSION JOINT FILLER SHALL BE ½" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, ASTM D-1751.
2. THIS TYPE D/W TO BE USED ONLY UPON APPROVAL OF TRANSPORTATION AGENCY.
3. EXTEND CONCRETE DRIVEWAY TO R/W LINE WHEN R/W LINE IS LESS THAN 2' FROM BACK OF S/W
4. CROSSHATCH AREA REPRESENTS DRIVEWAY PAYMENT AREA.
5. IF SIDEWALK WIDTH ≥5' THEN W = SIDEWALK WIDTH IF EXISTING SIDEWALK WIDTH = 4' THEN W = 5' MIN.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RETURN TYPE DRIVEWAYS WITH DETACHED SIDEWALK	DATE: 12/07/06	DETAIL NO. 2035

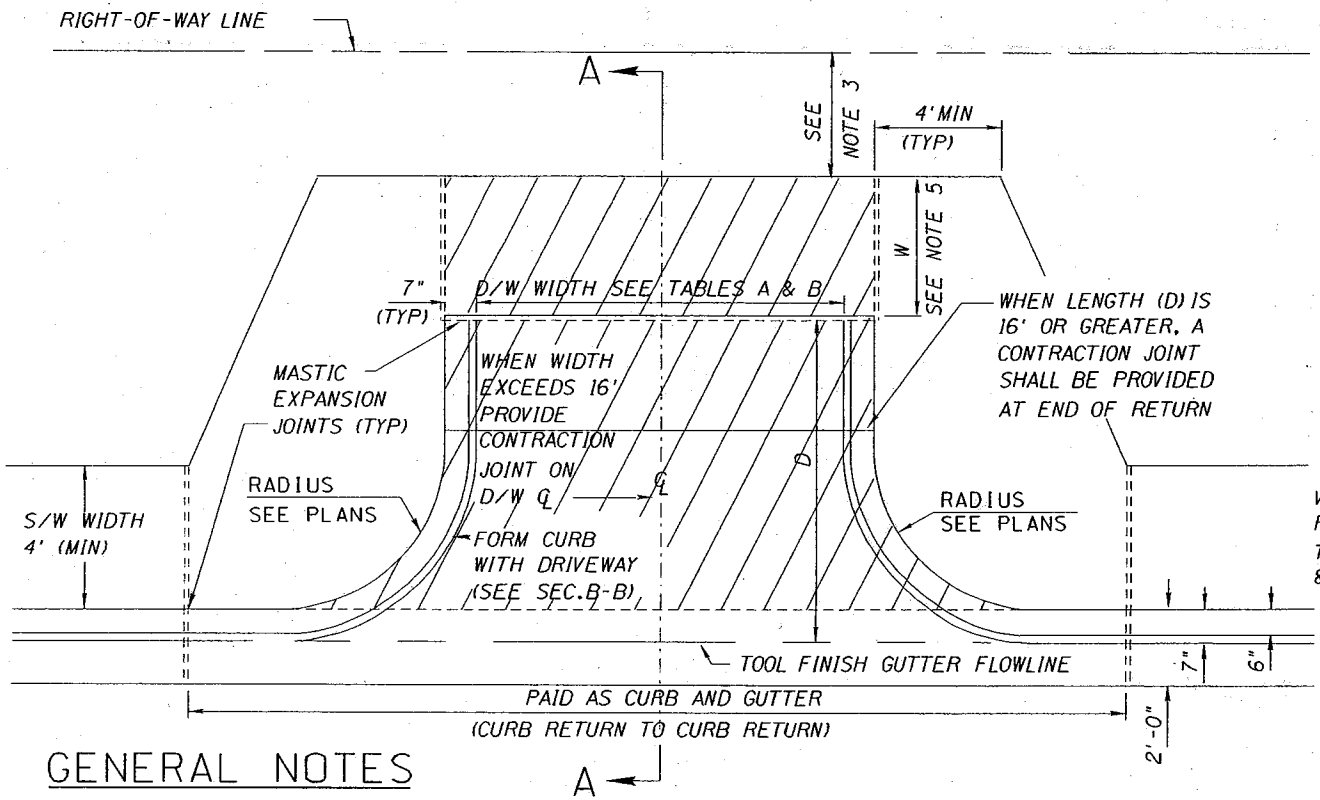
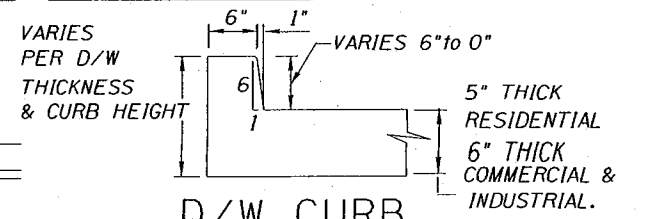


TABLE A		
ZONING	DRIVEWAY WIDTH	
	MIN *	MAX
COMMERCIAL	16'	40'
INDUSTRIAL	16'	40'
*24' WHERE 2-WAY TRAFFIC IS ANTICIPATED		

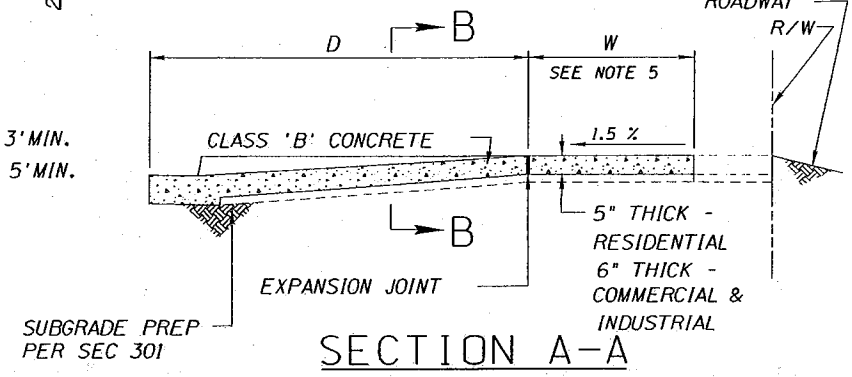
TABLE B		
ZONING	DRIVEWAY WIDTH	
RESIDENTIAL:	MIN *	MAX
MAJOR STREET	16'	30'
COLLECTOR STREET	12'	30'
LOCAL STREET	12'	30'
*16' WIDTH IS DESIRABLE		



D/W CURB
SECTION B-B

GENERAL NOTES

1. THIS TYPE D/W TO BE USED ONLY UPON APPROVAL OF TRANSPORTATION AGENCY.
2. EXPANSION JOINT FILLER SHALL BE ½" BITUMINOUS TYPE PERFORMED EXPANSION JOINT FILLER, A.S.T.M D-1751
3. EXTEND CONCRETE DRIVEWAY ENTRANCE TO R/W LINE WHEN R/W LINE IS LESS THAN 2' FROM BACK OF S/W.
4. HATCHED AREA REPRESENTS DRIVEWAY PAYMENT AREA
5. IF EXIST. SIDEWALK WIDTH ≥ 5' THEN W = 3' MIN. IF EXIST. SIDEWALK WIDTH = 4' THEN W = 5' MIN.



SECTION A-A

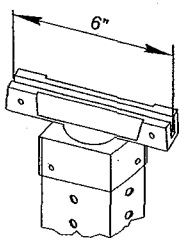
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RETURN TYPE DRIVEWAYS WITH ATTACHED SIDEWALK	DATE: 05/12/02	DETAIL NO. 2036

Street Name Sign blank for Speed Limit of 25 MPH or less

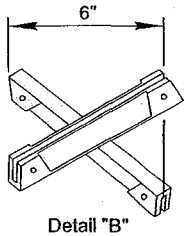
Letter size 4 inch capital letters with 4 inch lower case letters

Superscripts shall be 2 inch capital letters

Clearview Hwy Font 2-W



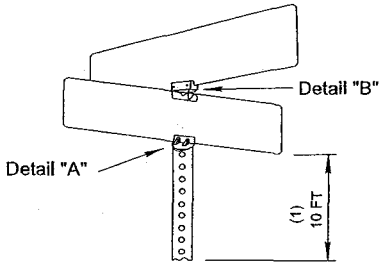
Detail "A"
Street Name Sign bracket to square tube post
(MCDOT Detail 2062-1)



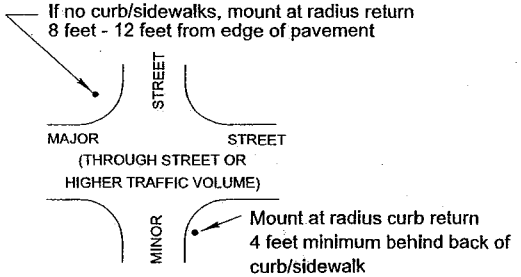
Detail "B"
Sign to Sign bracket
(MCDOT Detail 2062-2)

NOTES

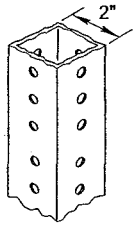
1. Sign lengths shall be determined by the number of letters and spacing requirements.
2. All signs shall be fabricated with 4 inch white capital letters and 4 inch lower case letters.
3. High Intensity Prismatic sheeting shall be used for all letters and background.
4. Background color shall be:
   Blue - Private Roadways
   Green - Open and Declared Public Roads
5. All signs shall be mounted on 2.6 LB/FT square perforated tube sign post.
6. Thickness of all sign blanks shall be .125 inches.
7. Square tubing shall be assembled as shown in MCDOT Standard Detail 2058.
8. Signs shall be installed per standard location shown below left.
9. All dimensions are in inches, except as noted.
10. Refer to MCDOT Standard Detail 2061-10A for sign blanks.
11. Use Grade # 2, Zinc coated, 18 NC thread, 3" x 5/16" bolt with flat washer under nut and flat washer under head to attach sign to bracket.



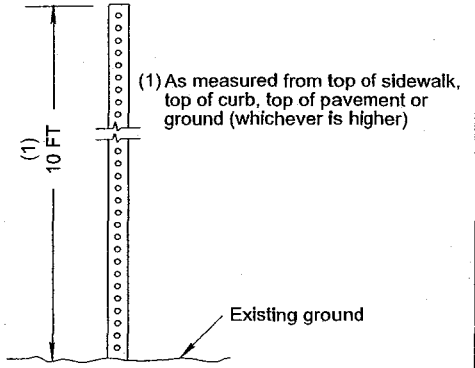
Height to bottom of sign



Standard Location of Street Name Signs

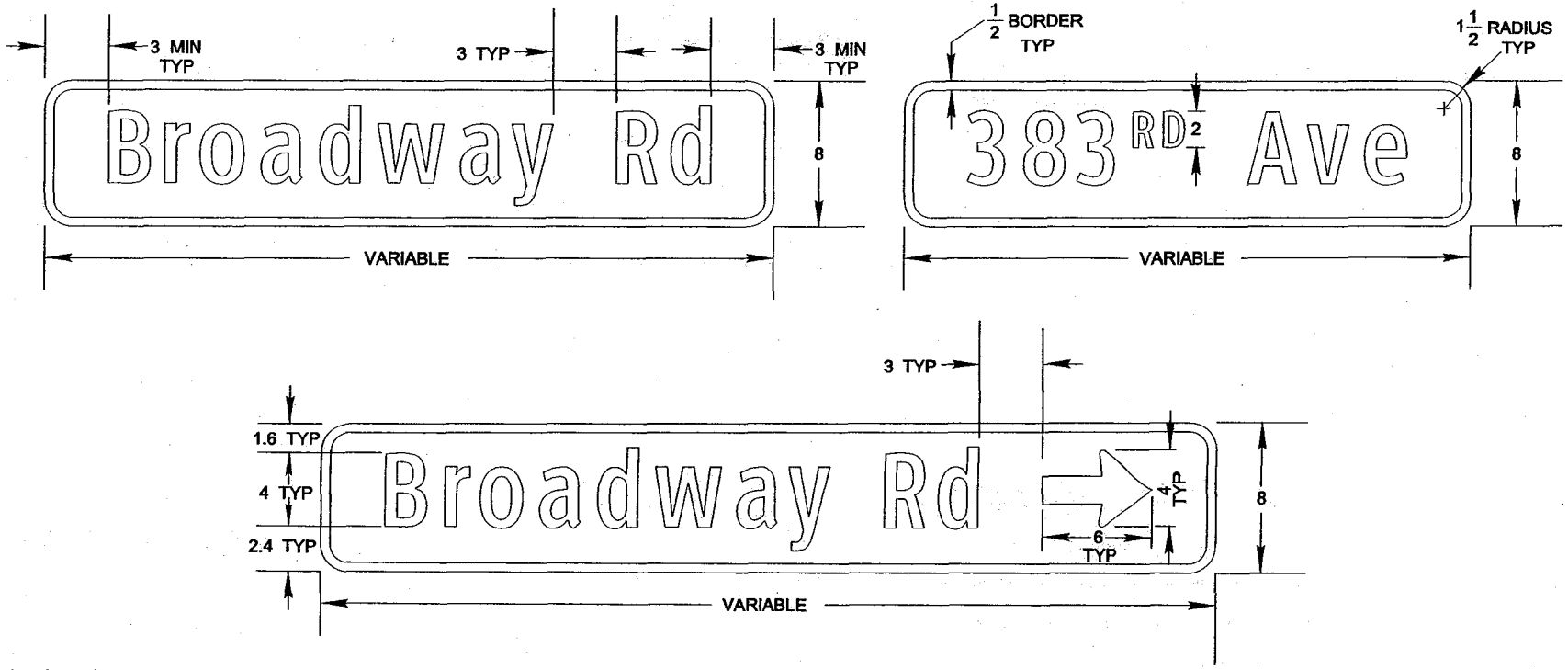


Square Tube Post
(2.6 LB/FT)



Sign Post Installation

REVISED DATE	12/2010	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	STREET NAME SIGN INSTALLATION DETAILS POSTED SPEED LIMIT OF 25 MPH OR LESS	DATE: 6/2002	DETAIL NO. 2054-1



1. Clearview Hwy Font 2-W

2. All signs shall be fabricated with 4 inch white initial capital letter. The proportion ratio of lower case Clearview legends to the initial capital letter is 0.817x. This ratio is critical and is not to be modified.

3. High Intensity Prismatic sheeting shall be used for all letters and background.

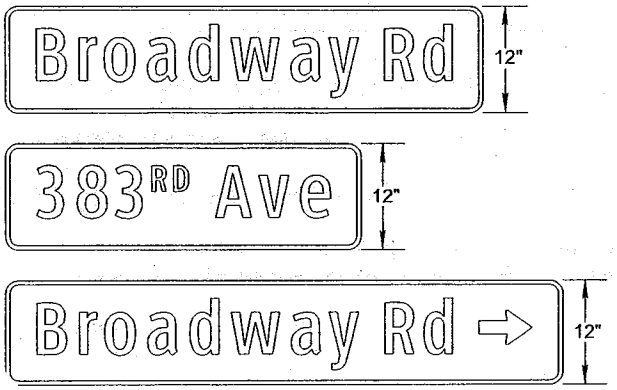
4. Background color shall be:
   Blue - Private Roadways
   Green - Open and Declared Public Roads

(Not to scale)

(All dimensions are in inches)

REVISED DATE	12/2010

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SAMPLE STREET NAME SIGN FOR POSTED SPEED LIMIT OF 25 MPH OR LESS	DATE: 7/2006	DETAIL NO. 2054-1A

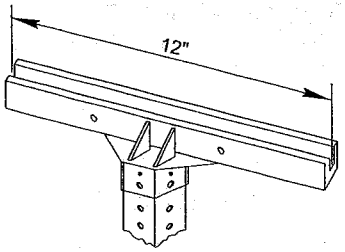


Street Name Sign blank for
Speed Limit of 30 MPH and greater

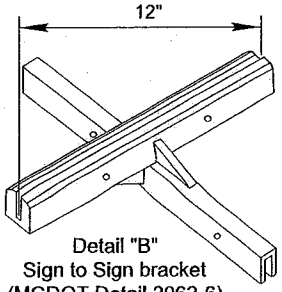
Letter size 6 inch capital letters
4 1/2" lower case letters

Superscripts shall be 3 inch capital letters

Clearview Hwy Font 2-W



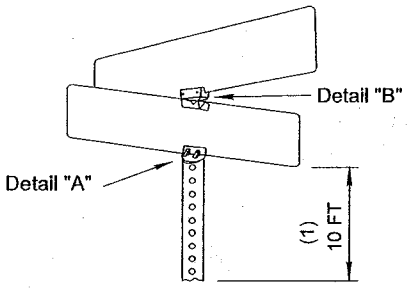
Detail "A"
Street Name Sign bracket
to square tube post
(MCDOT Detail 2062-5)



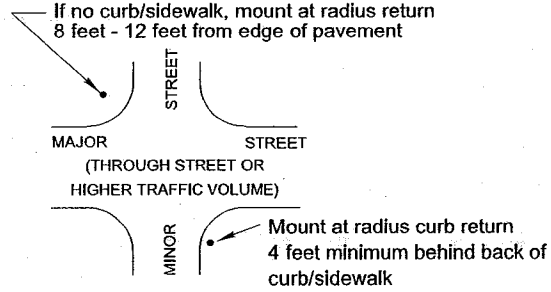
Detail "B"
Sign to Sign bracket
(MCDOT Detail 2062-6)

NOTES

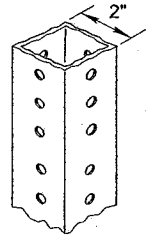
1. Sign lengths shall be determined by the number of letters and spacing requirements.
2. All signs shall be fabricated with 6 inch white capital letters and 4 1/2 inch lower case letters.
3. High Intensity Prismatic sheeting shall be used for all letters and background.
4. Background color shall be:
   Blue - Private Roadways
   Green - Open and Declared Public Roads
5. All signs shall be mounted on a 2.6 LB/FT square perforated tube sign post.
6. Thickness of all sign blanks shall be .125 inches.
7. Square tubing shall be assembled as shown in MCDOT Standard Detail 2058.
8. Signs shall be installed per standard location shown below left.
9. All dimensions are in inches, except as noted.
10. Refer to MCDOT Standard Detail 2061-10B for sign blanks.
11. Use Grade #2, Zinc coated, 18 NC thread, 3" x 5/16" bolt with flat washer under nut and flat washer under head to attach sign to bracket.



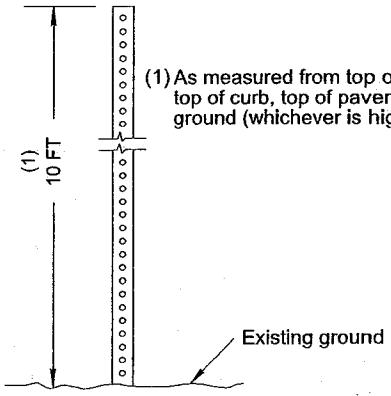
Height to bottom of sign



Standard Location of
Street Name Signs

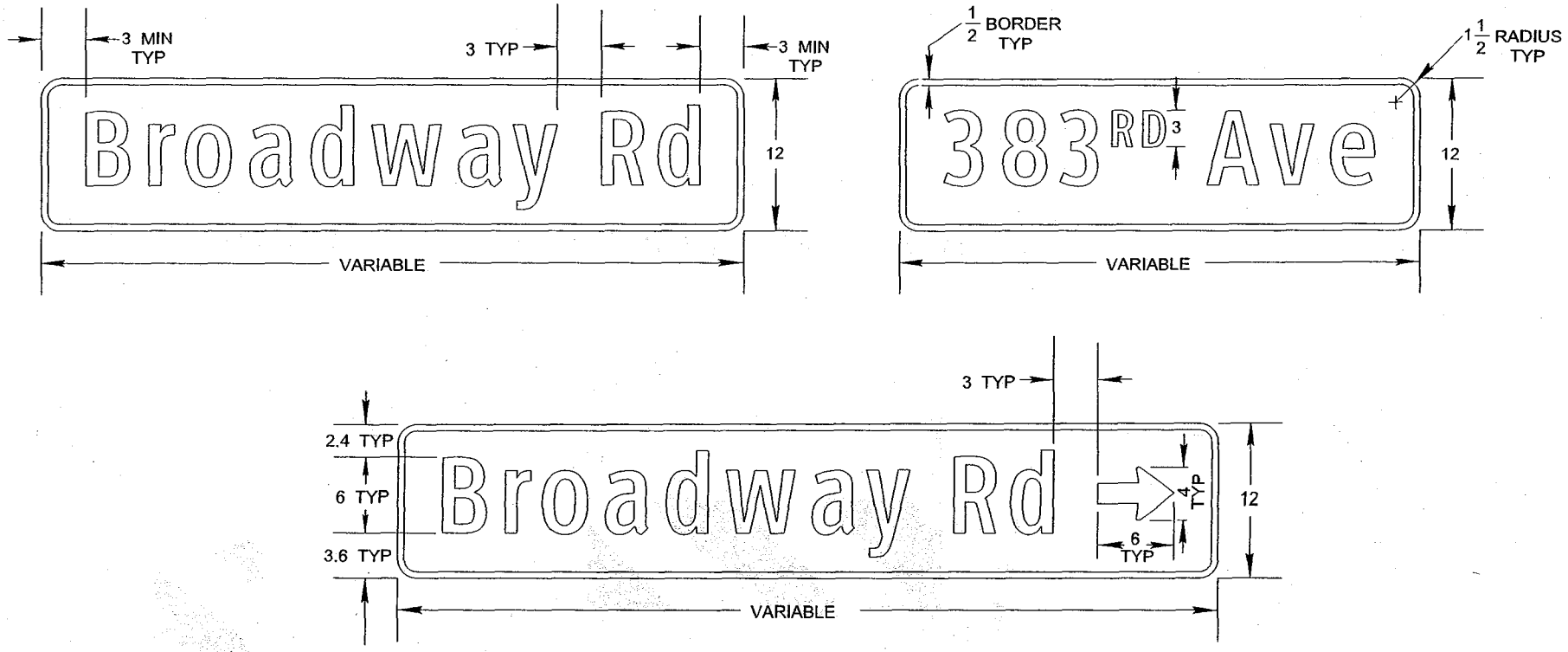


Square Tube Post
(2.6 LB/FT)



Sign Post Installation

REVISED DATE	12/2010	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	STREET NAME SIGN INSTALLATION DETAILS POSTED SPEED LIMIT OF 30 MPH OR GREATER	DATE: 6/2002	DETAIL NO. 2054-2



1. Clearview Hwy Font 2-W

2. All signs shall be fabricated with 6 inch white initial capital letter. The proportion ratio of lower case Clearview legends to the initial capital letter is 0.817. This ratio is critical and is not to be modified.

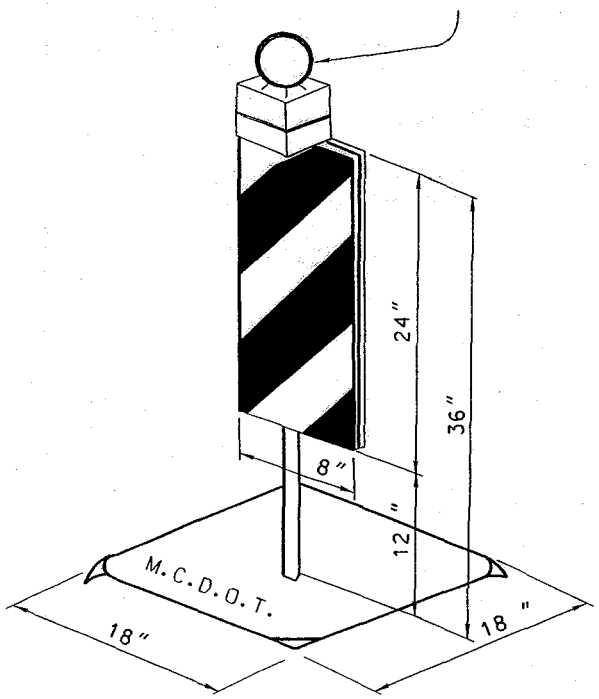
3. High Intensity Prismatic sheeting shall be used for all letters and background.

4. Background color shall be:
   Blue - Private Roadways
   Green - Open and Declared Public Roads

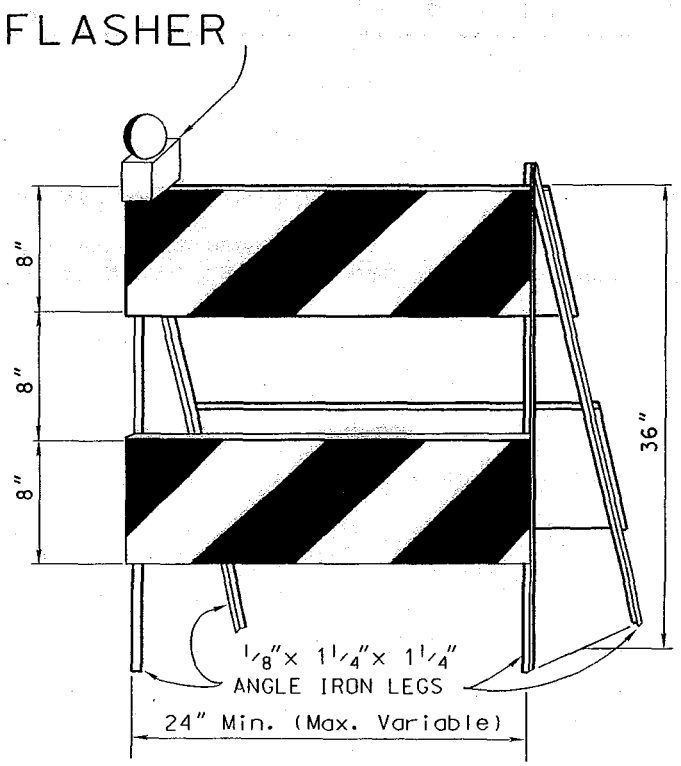
(Not to scale)

(All dimensions are in inches)

REVISED DATE	12/2010	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SAMPLE STREET NAME SIGN FOR POSTED SPEED LIMIT OF 30 MPH AND GREATER	DATE: 7/2006	DETAIL NO. 2054-2A



VERTICAL BARRICADE

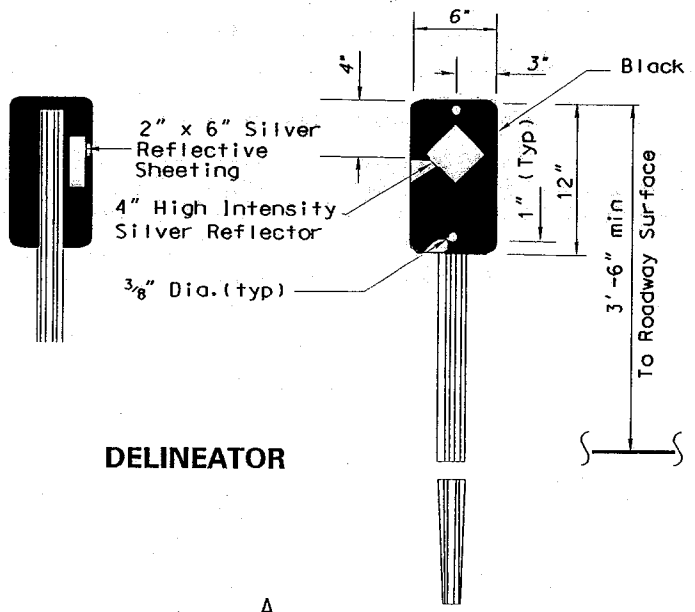


HINGED BARRICADE

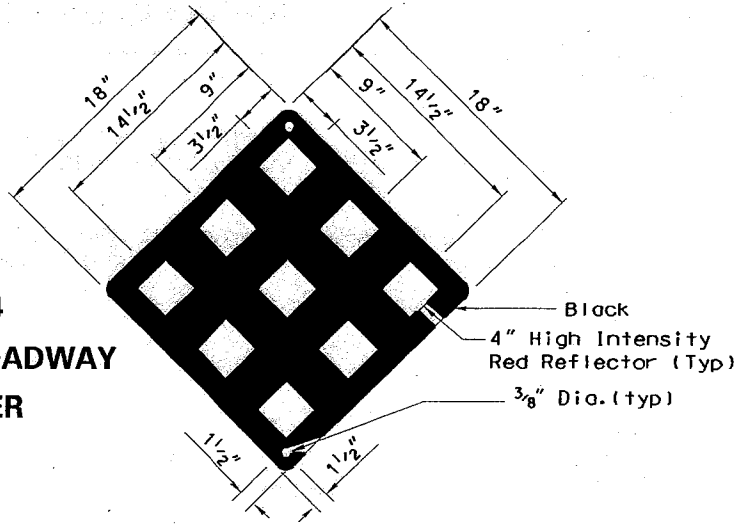
NOTES

1. PANELS TO BE CONSTRUCTED OF WOOD, METAL OR OTHER COMPONENTS OR A COMBINATION THEREOF: FRAME "A" TYPE.
2. STRIPES TO BE ALTERNATING ORANGE AND WHITE, 6" WIDTH AT 45° ANGLE IN THE DIRECTION TRAFFIC IS TO PASS.
3. THE ENTIRE AREA OF WHITE AND ORANGE SHALL BE REFLECTORIZED.
4. RAIL WIDTH: 8" MIN, 12" MAX
   RAIL LENGTH: 2' MIN, VARIABLE MAX
5. FLASHER TO BE 12 VOLT, HAVE A SOLAR SWITCH AND HAVE A CONCEALED MANUAL ON-OFF SWITCH. FLASHER LENS TO BE MIN 7" DIA. AMBER 2 WAY AND BE ABLE TO ROTATE 360°
6. ALL OTHER PARTS TO BE PAINTED WHITE.

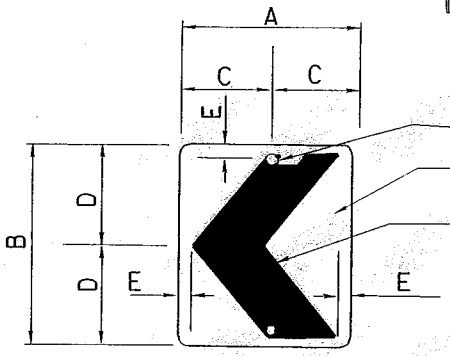
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**BARRICADE (PORTABLE)**	DATE: 11/3/93	DETAIL NO. 2055



DELINEATOR



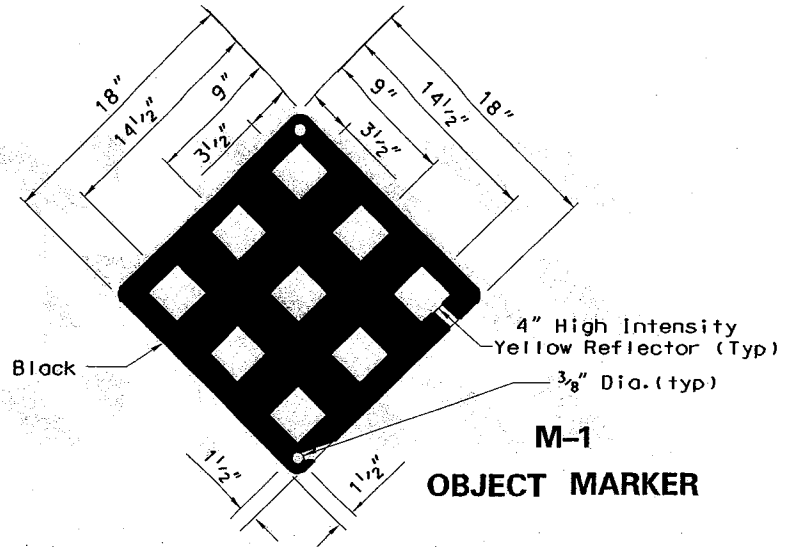
M-4
END OF ROADWAY MARKER



W1-8
CHEVRON

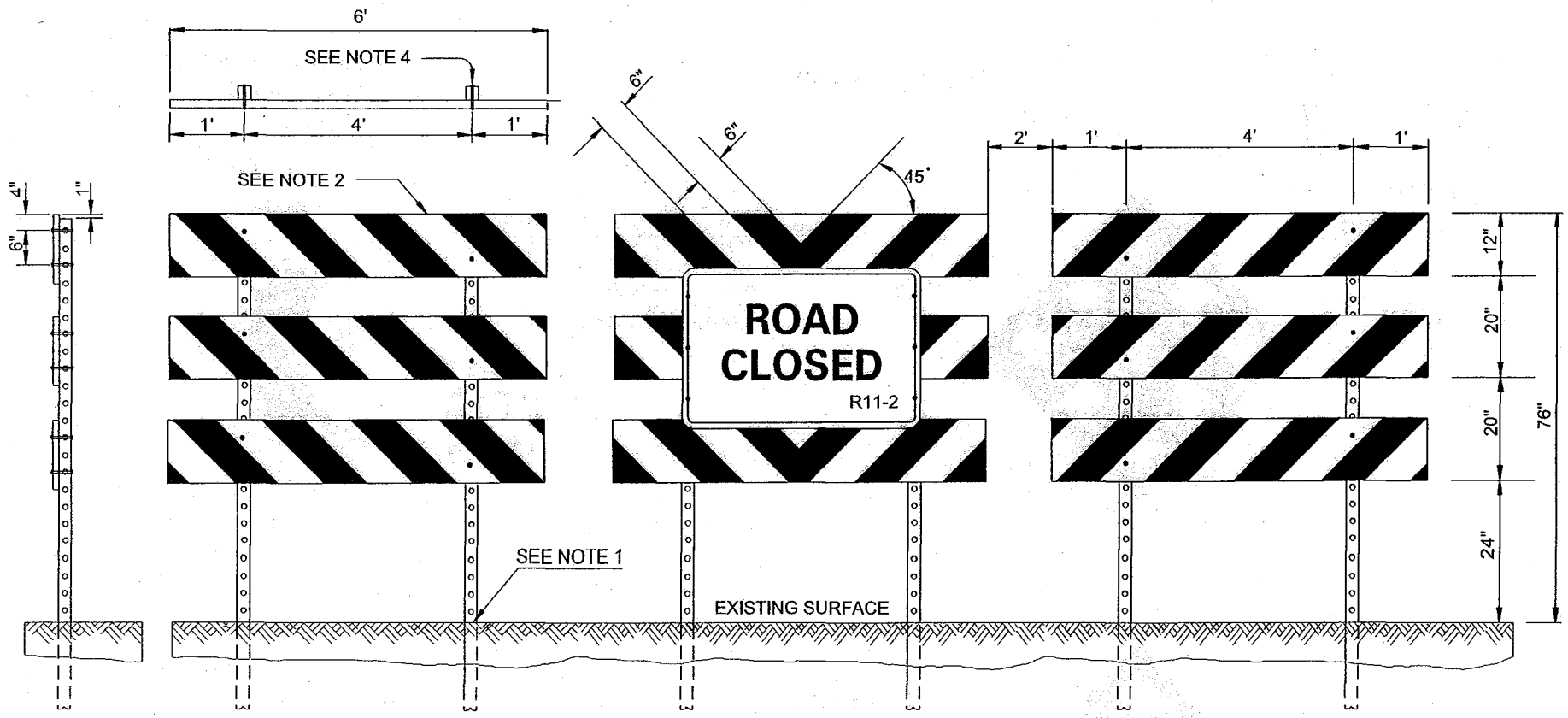
W1-8 CHEVRON

Sign	Dimensions (inches)				
	A	B	C	D	E
Min.	12	18	6	9	1/2
Std.	18	24	9	12	3/4
Special	24	30	12	15	7/8



M-1
OBJECT MARKER

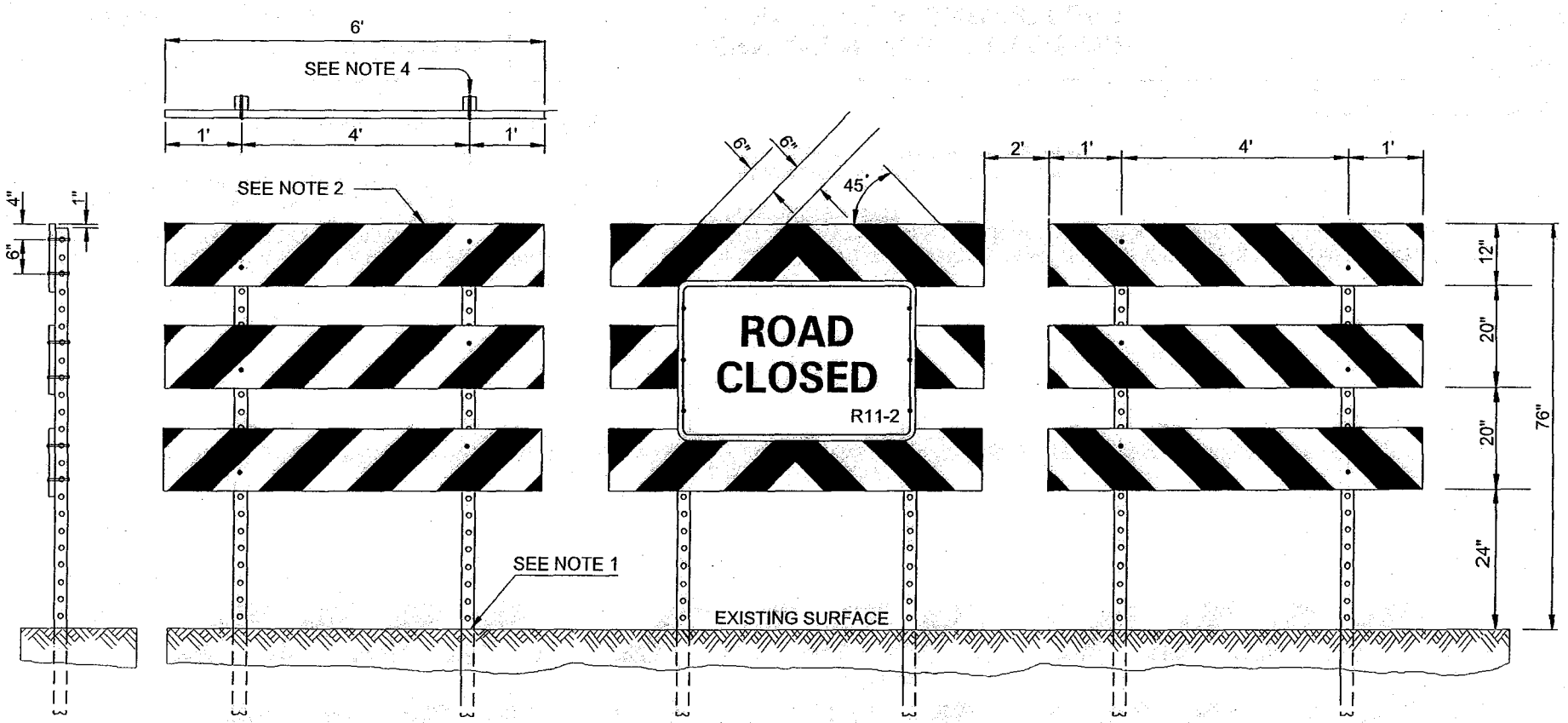
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ROADWAY MARKERS	DATE: 11/3/02	DETAIL NO. 2056



NOTES

1. SEE STANDARD DETAIL # 2058 FOR SQUARE PERFORATED TUBE POST AND FOUNDATION DETAILS.
2. BARRICADE RAIL MARKINGS SHALL BE ALTERNATE RED AND WHITE DIAMOND GRADE RETROREFLECTIVE STRIPES (SLOPING DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS OR STOP).
3. USE 12" X 6' X .125 GA. ALUMINUM FOR THE BARRICADE RAILS.
4. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 3" X 3/8" BOLT WITH LOCK WASHER UNDER NUT AND FLAT WASHER UNDER HEAD; TO ATTACH BARRICADE RAILS & SIGN TO SQUARE PERFORATED POST.
5. THE NUMBER OF TYPE III BARRICADES SHALL VARY TO OBTAIN THE DESIGNATED TOTAL BARRICADE WIDTH SHOWN ON THE PLANS.

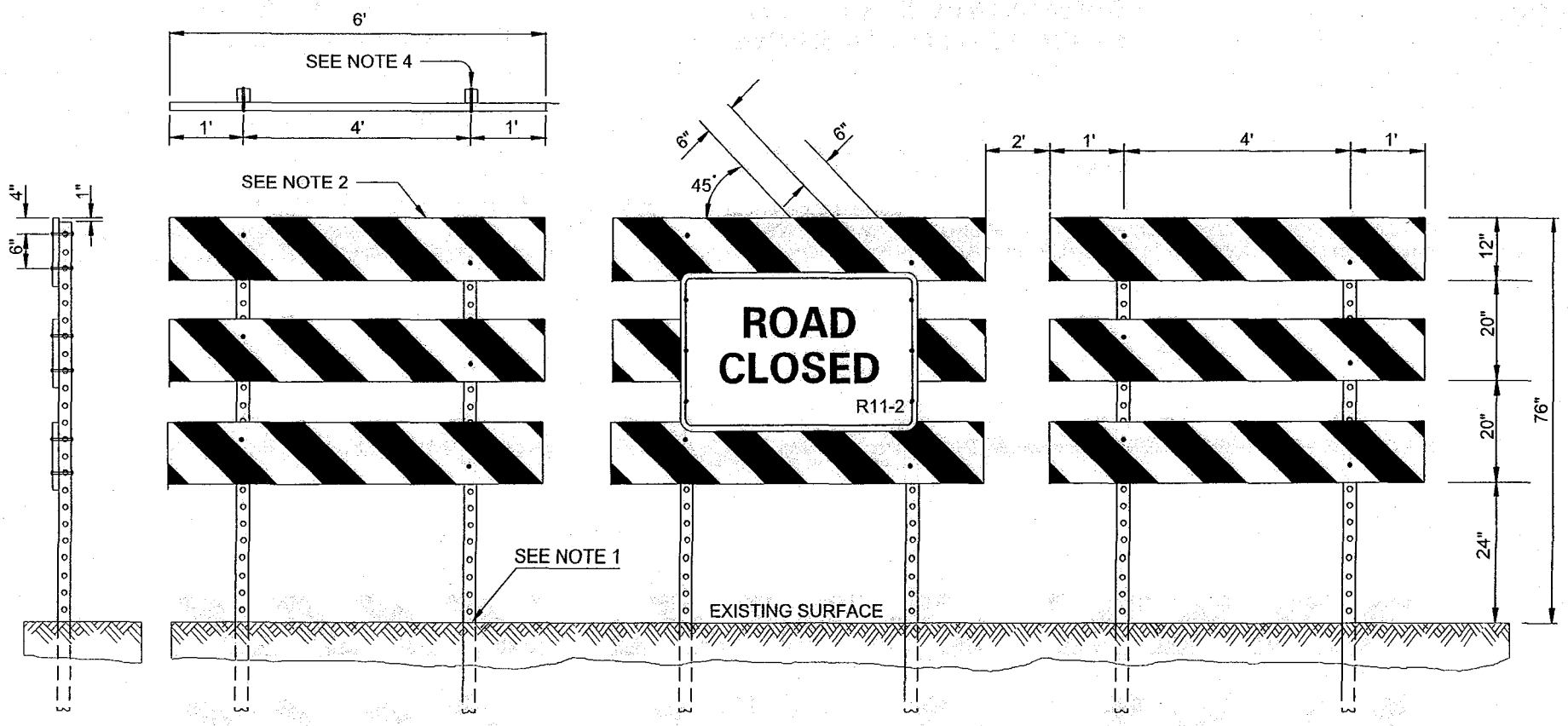
REVISED DATE	12/2009	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**PERMANENT ROAD CLOSURE USING TYPE III BARRICADES**	DATE: 05/2006	DETAIL NO. **2057A**



NOTES

1. SEE STANDARD DETAIL # 2058 FOR SQUARE PERFORATED TUBE POST AND FOUNDATION DETAILS.
2. BARRICADE RAIL MARKINGS SHALL BE ALTERNATE RED AND WHITE DIAMOND GRADE RETROREFLECTIVE STRIPES (SLOPING DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS OR STOP).
3. USE 12" X 6' X .125 GA. ALUMINUM FOR THE BARRICADE RAILS.
4. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 3" X 3/8" BOLT WITH LOCK WASHER UNDER NUT AND FLAT WASHER UNDER HEAD; TO ATTACH BARRICADE RAILS & SIGN TO SQUARE PERFORATED POST.
5. THE NUMBER OF TYPE III BARRICADES SHALL VARY TO OBTAIN THE DESIGNATED TOTAL BARRICADE WIDTH SHOWN ON THE PLANS.

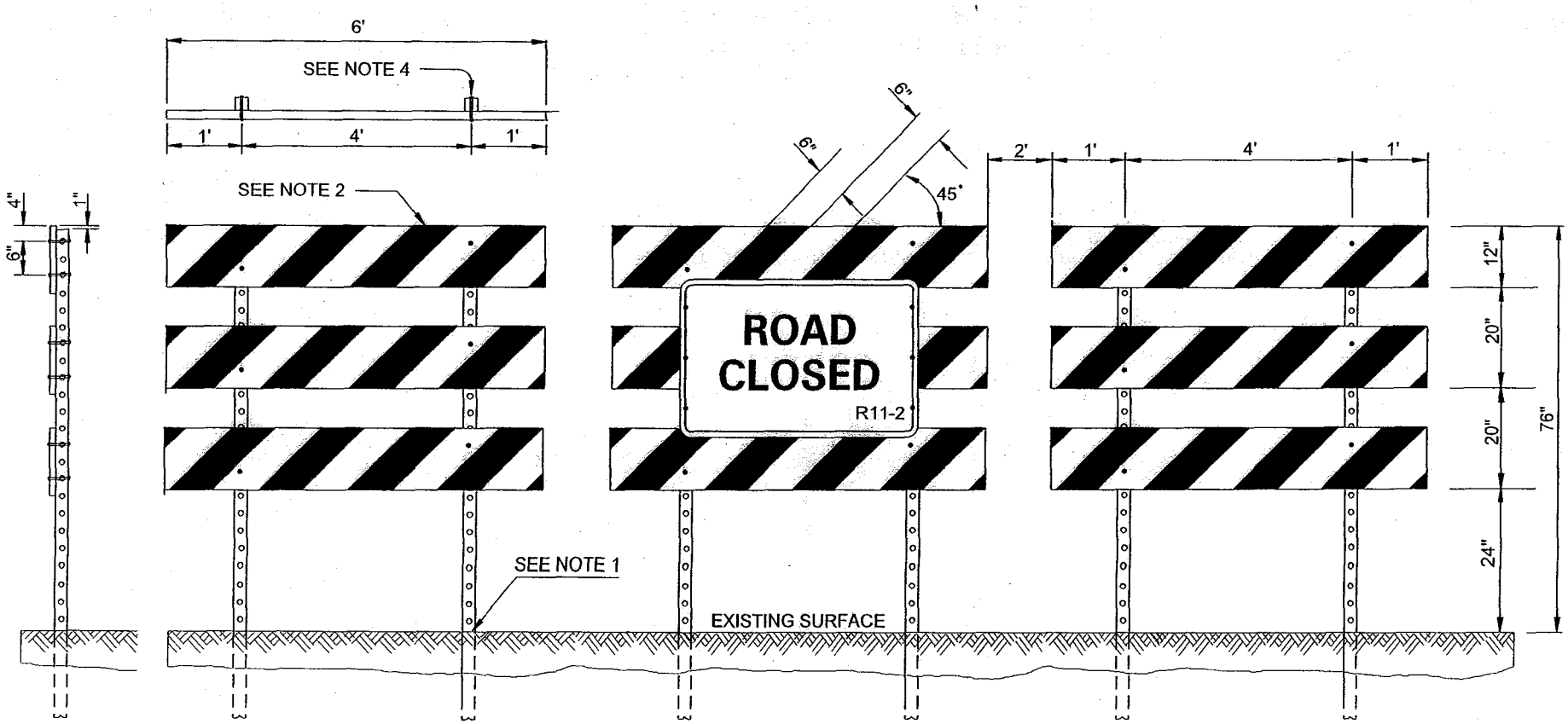
REVISED DATE	12/2009	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**PERMANENT ROAD CLOSURE USING TYPE III BARRICADES**	DATE: 05/2006	DETAIL NO. **2057B**



NOTES

1. SEE STANDARD DETAIL # 2058 FOR SQUARE PERFORATED TUBE POST AND FOUNDATION DETAILS.
2. BARRICADE RAIL MARKINGS SHALL BE ALTERNATE RED AND WHITE DIAMOND GRADE RETROREFLECTIVE STRIPES (SLOPING DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS OR STOP).
3. USE 12" X 6' X .125 GA. ALUMINUM FOR THE BARRICADE RAILS.
4. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 3" X 3/8" BOLT WITH LOCK WASHER UNDER NUT AND FLAT WASHER UNDER HEAD; TO ATTACH BARRICADE RAILS & SIGN TO SQUARE PERFORATED POST.
5. THE NUMBER OF TYPE III BARRICADES SHALL VARY TO OBTAIN THE DESIGNATED TOTAL BARRICADE WIDTH SHOWN ON THE PLANS.

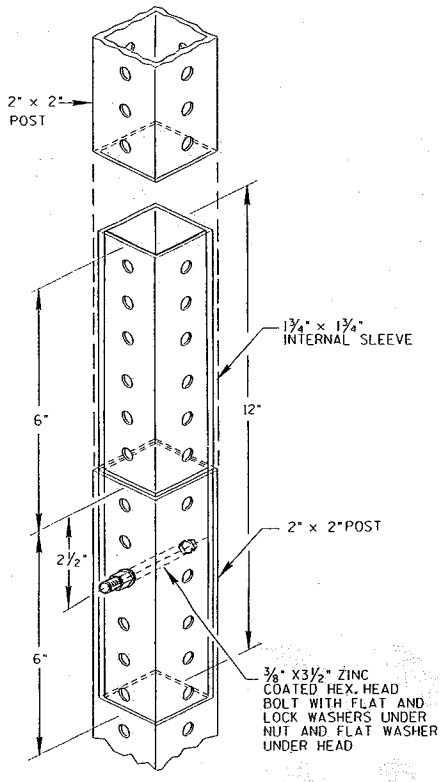
REVISED DATE	12/2009	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**PERMANENT ROAD CLOSURE USING TYPE III BARRICADES**	DATE: 05/2006	DETAIL NO. **2057C**



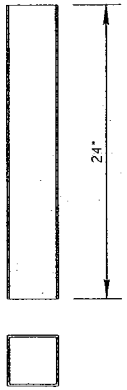
NOTES

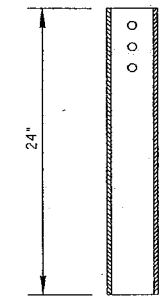
1. SEE STANDARD DETAIL # 2058 FOR SQUARE PERFORATED TUBE POST AND FOUNDATION DETAILS.
2. BARRICADE RAIL MARKINGS SHALL BE ALTERNATE RED AND WHITE DIAMOND GRADE RETROREFLECTIVE STRIPES (SLOPING DOWNWARD IN THE DIRECTION TRAFFIC IS TO PASS OR STOP).
3. USE 12" X 6' X .125 GA. ALUMINUM FOR THE BARRICADE RAILS.
4. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 3" X 3/8" BOLT WITH LOCK WASHER UNDER NUT AND FLAT WASHER UNDER HEAD; TO ATTACH BARRICADE RAILS & SIGN TO SQUARE PERFORATED POST.
5. THE NUMBER OF TYPE III BARRICADES SHALL VARY TO OBTAIN THE DESIGNATED TOTAL BARRICADE WIDTH SHOWN ON THE PLANS.

REVISED DATE	12/2009	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**PERMANENT ROAD CLOSURE USING TYPE III BARRICADES**	DATE: 05/2006	DETAIL NO. **2057D**

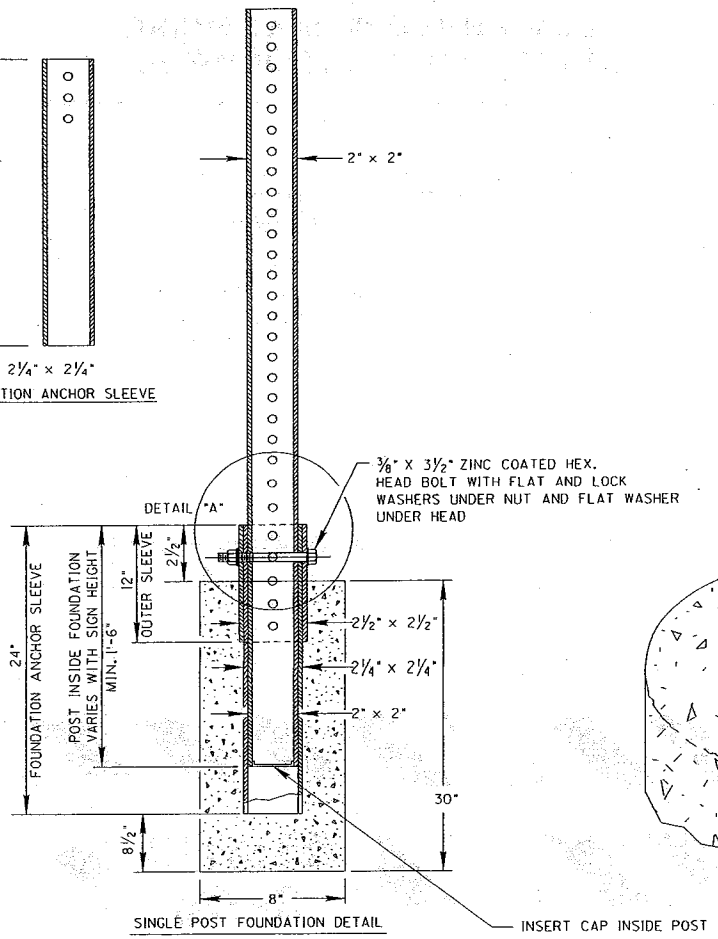


SINGLE POST PERMISSIBLE FIELD SPLICE
(NOT ALLOWED ON TELESCOPING POSTS)

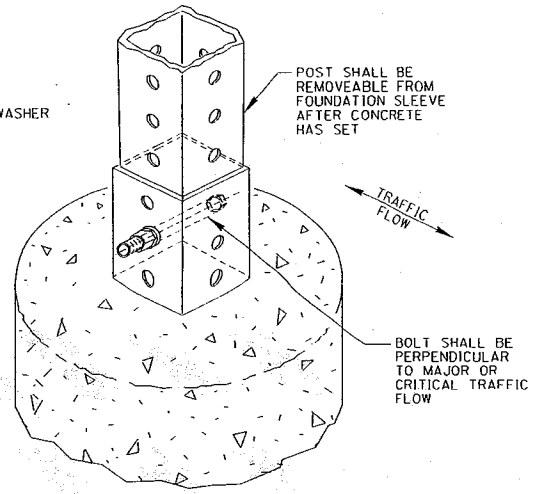




2¼" x 2¼"
FOUNDATION ANCHOR SLEEVE



SINGLE POST FOUNDATION DETAIL



DETAIL "A"

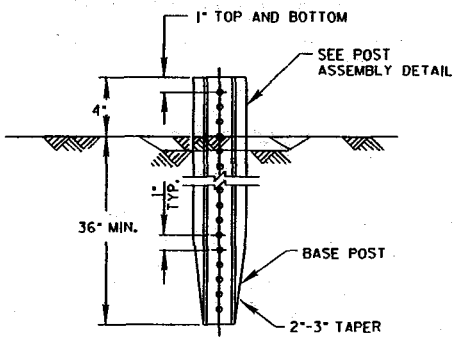
NOTES:

1. IF ANY POST SECTION IS SHORTER THAN THE PANEL HEIGHT, THE FIELD SPLICE SHALL BE BEHIND THE PANEL.
2. FIELD SPLICES ARE NOT PERMITTED ON TELESCOPING POSTS.

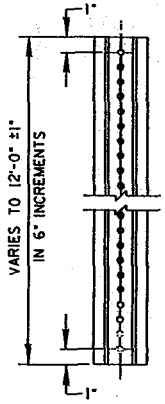
NOTES:

1. ALL DIMENSIONS ARE IN INCHES, EXCEPT AS NOTED.
2. ALL SQUARE PERFORATED POSTS SHALL BE 2" x 2".
3. FOR ESTIMATING PURPOSES, CONCRETE QUANTITY PER POST IS 1.0 CU/FT.
4. FOUNDATION ANCHOR SLEEVE TO BE SOLID ON ALL FOUR SIDES EXCEPT FOR THREE HOLES AT TOP OF SLEEVES SHOWN IN DETAIL "A".
5. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 3" X $\frac{5}{16}$" BOLT WITH FLAT WASHER UNDER NUT AND FLAT WASHER UNDER HEAD TO ATTACH SIGN TO BRACKET.
6. A YELLOW PLASTIC SLEEVE SHALL BE INSTALLED AT THE BASE OF ALL SIGN POSTS.

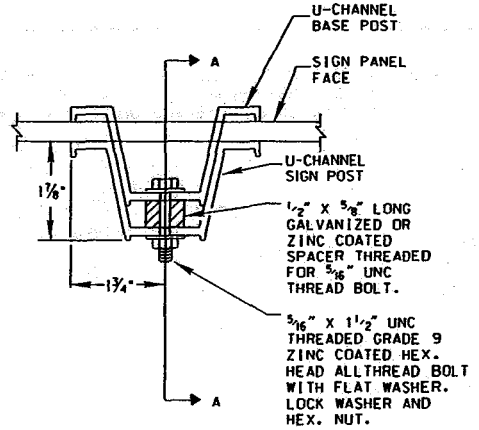
REVISED DATE	12/2007	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SQUARE PERFORATED TUBE SIGN POST FOUNDATION & SPLICE DETAILS	DATE: 12/2006	DETAIL NO. 2058

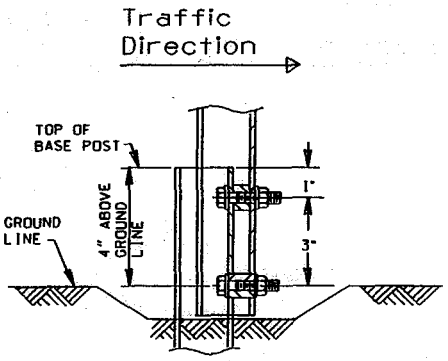


BASE POST AND INSTALLATION

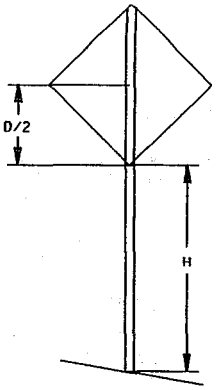


SIGN POST

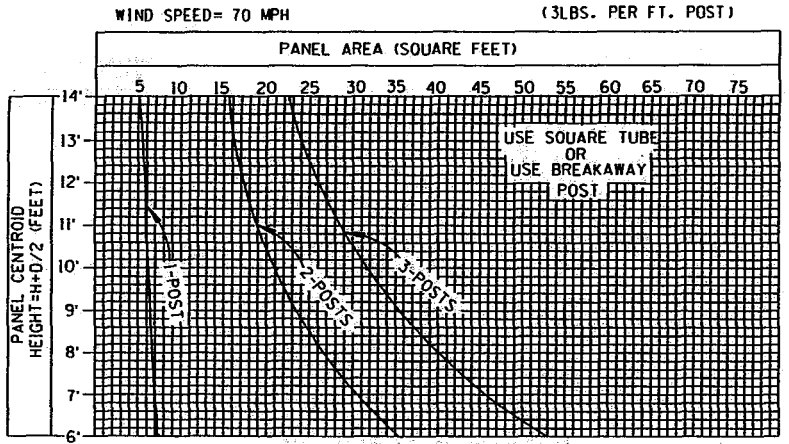




POST ASSEMBLY
SECT. A-A

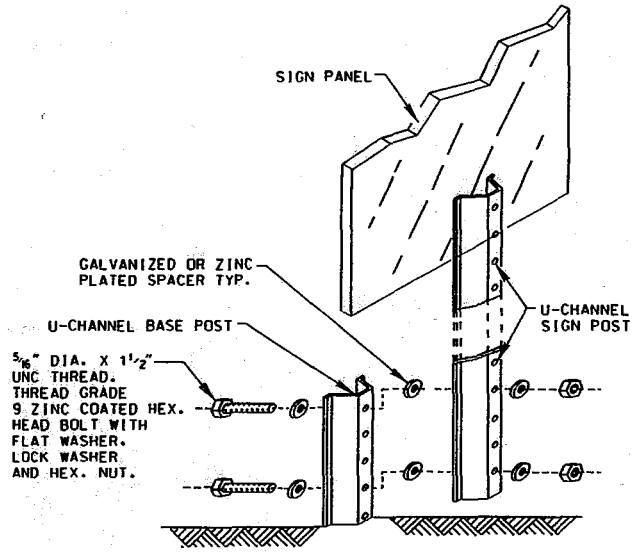


U-CHANNEL SELECTION



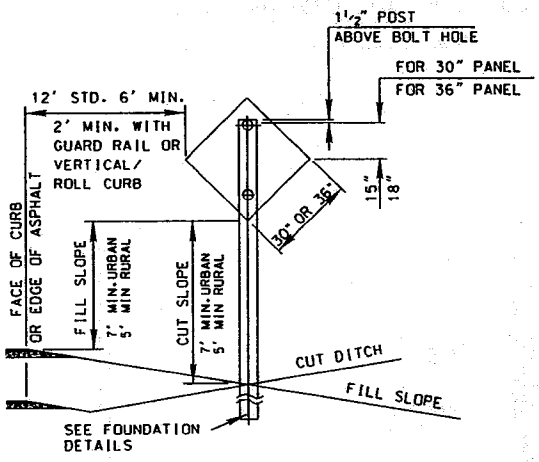
LIMIT SIGNS ON ONE POST TO 36 INCHES OR LESS IN WIDTH

NOTE: ALL DIMENSIONS IN INCHES EXCEPT AS NOTED.

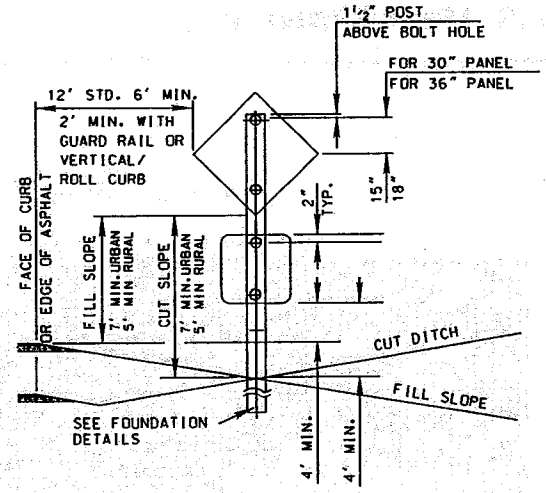


INSTALLATION PICTORIAL

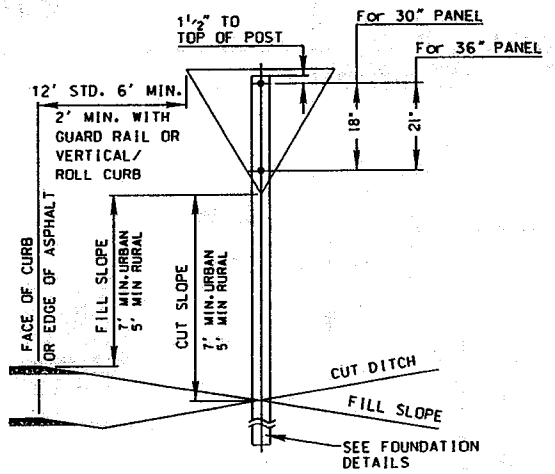
REVISED DATE 07/2006		
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	U-CHANNEL POST SELECTION AND INSTALLATION DETAILS	DATE: 05/2004 / DETAIL NO. 2059



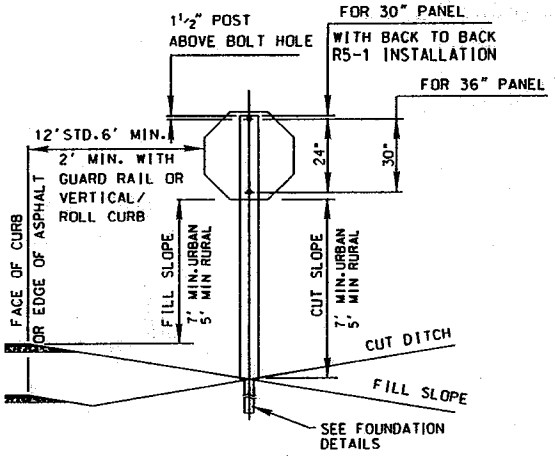
WARNING SIGN



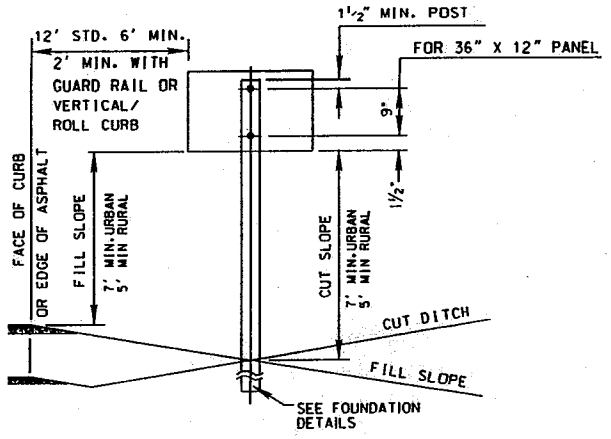
WARNING SIGN
WITH ADVISORY PLATE



YIELD SIGN



REGULATORY (STOP) SIGN

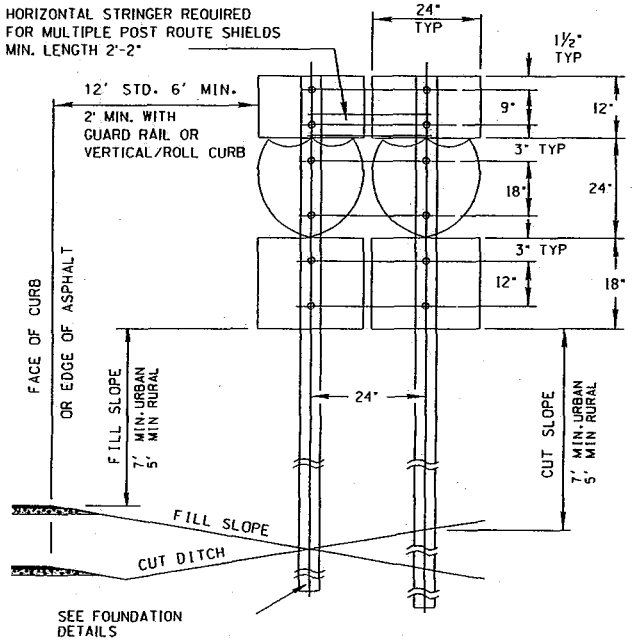


REGULATORY SIGN
SINGLE POST

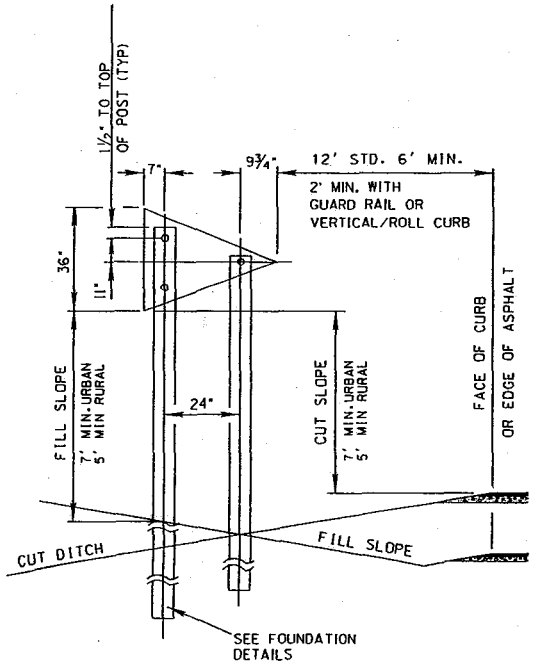
NOTES:

1. SEE FHWA STANDARD HIGHWAY SIGNS BOOKLET FOR PANEL BOLT HOLE. SPACING NOT SHOWN.
2. ALL DIMENSIONS IN INCHES EXCEPT AS NOTED.
3. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 3" X $\frac{5}{16}$" BOLT WITH FLAT WASHER UNDER NUT AND FLAT WASHER UNDER HEAD. TO ATTACH SIGN TO BRACKET.

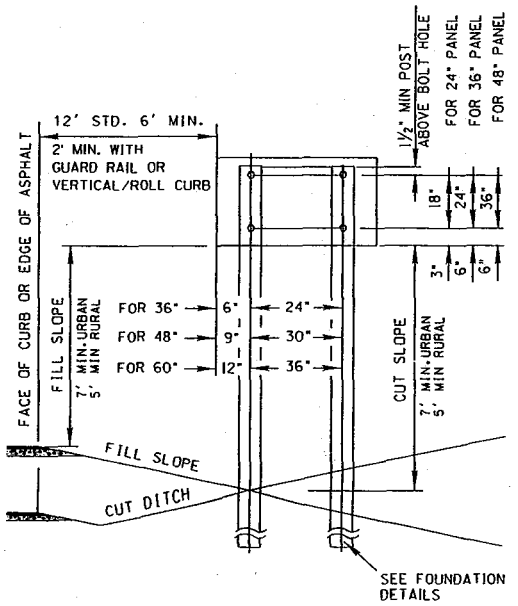
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	OFFSETS, CLEARANCES AND MOUNTING DETAILS FOR SIGNS ON COUNTY ROADWAYS	DATE: 05/2004	DETAIL NO. 2060–1



MULTIPLE ROUTE MARKER



NO PASSING PENNANT



REGULATORY SIGN

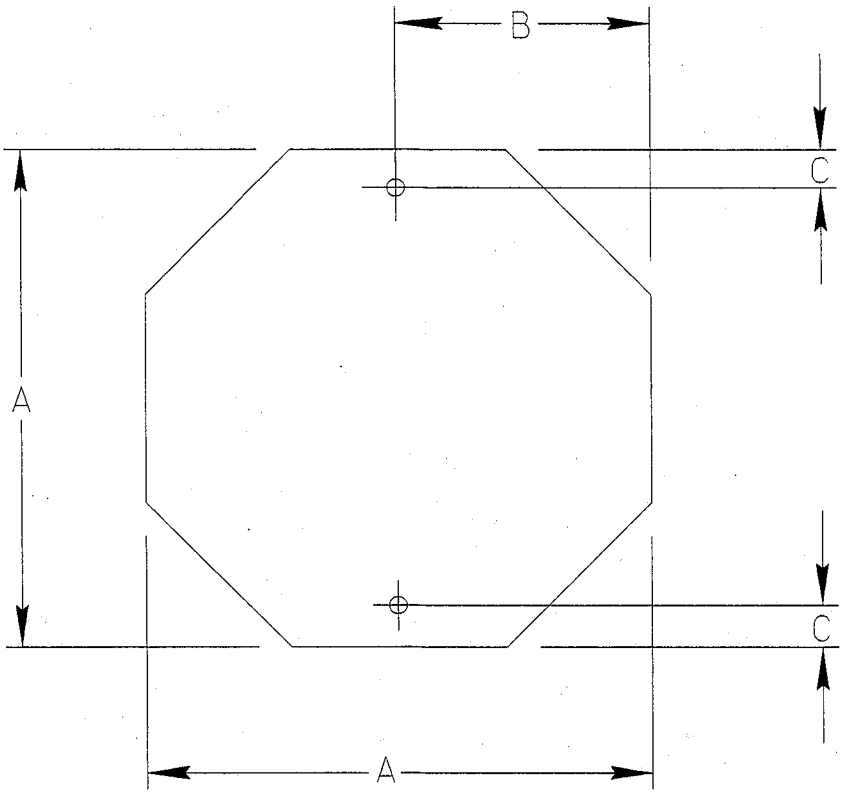
TWO POST

NOTES:

1. SEE FHWA STANDARD HIGHWAY SIGNS BOOKLET FOR PANEL BOLT HOLE. SPACING NOT SHOWN.
2. ALL DIMENSIONS IN INCHES EXCEPT AS NOTED.
3. USE GRADE # 2. ZINC COATED. 18 NC THREAD. 3" X $\frac{5}{16}$" BOLT WITH FLAT WASHER UNDER NUT AND FLAT WASHER UNDER HEAD. TO ATTACH SIGN TO BRACKET.

REVISED DATE	12/2009

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	OFFSETS, CLEARANCES AND MOUNTING DETAILS FOR SIGNS ON COUNTY ROADWAYS	DATE: 05/2004	DETAIL NO. 2060-2



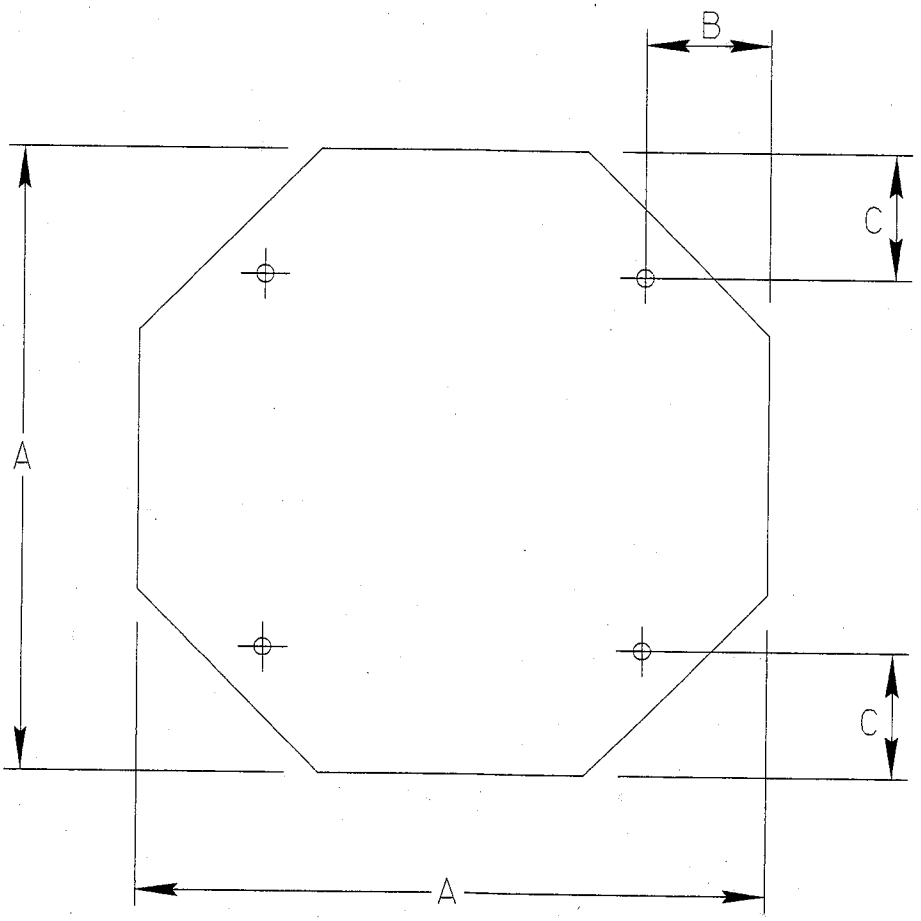
A	B	C	THICKNESS
30	15	3	.080
36	18	3	.100

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	OCTAGON	DATE: 05/2004	DETAIL NO. 2061-1



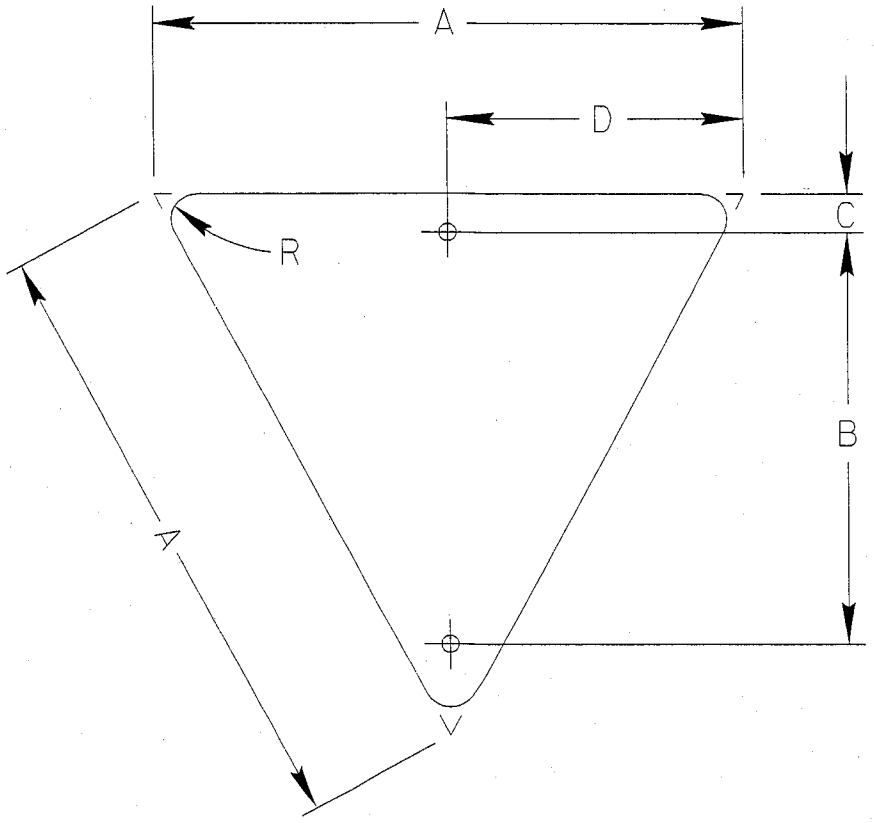
A	B	C	THICKNESS
48	9	9	.125

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	OCTAGON	DATE: 05/2004	DETAIL NO. 2061-1A



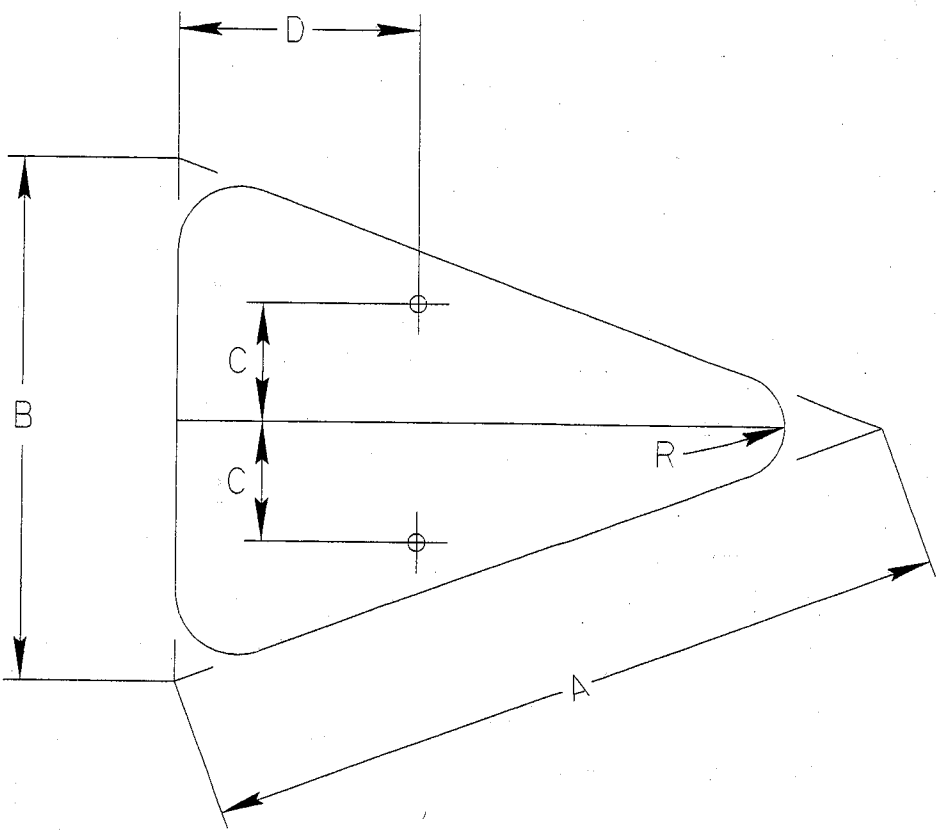
A	B	C	D	R	THICKNESS
36	21	3	18	1	.100

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	EQUILATERAL TRIANGLE	DATE: 05/2004	DETAIL NO. 2061-2



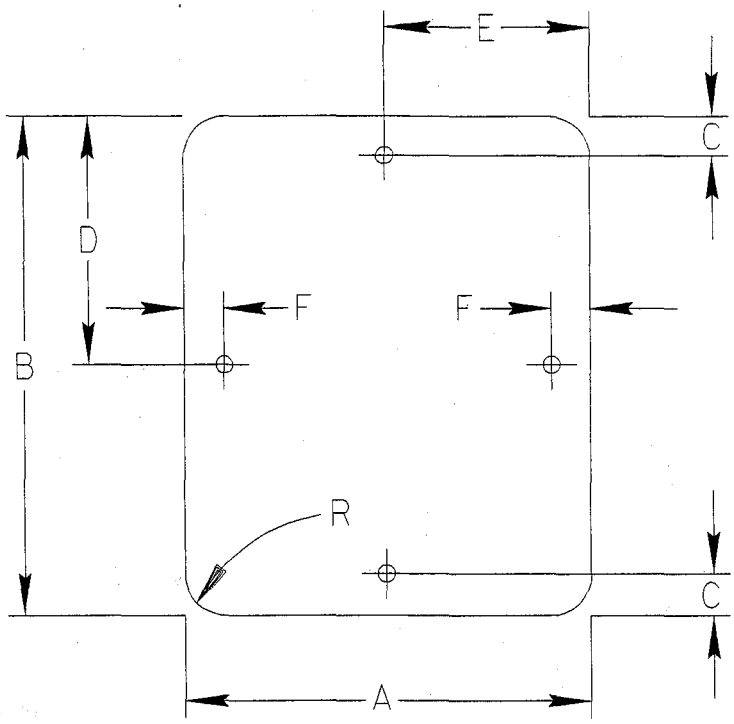
A	B	C	D	R	THICKNESS
48	36	9	15	$2^{1}/_{4}$	.100

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ISOSCELES TRIANGLE	DATE: 05/2004	DETAIL NO. 2061-3



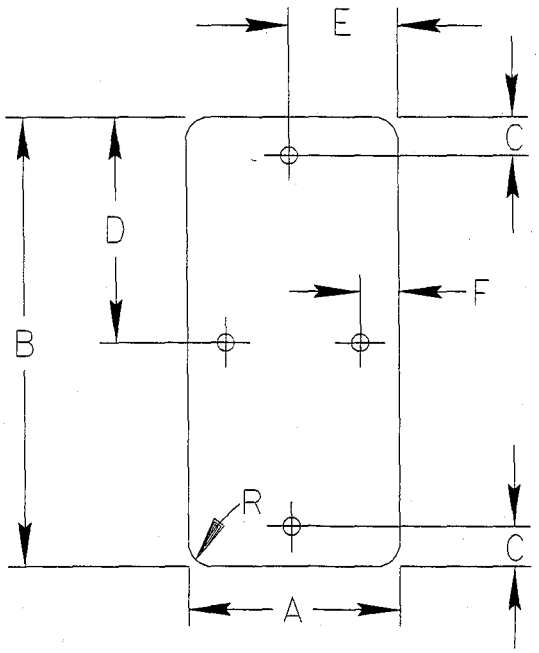
A	B	C	D	E	F	R	THICKNESS
6	12	1	6	3	1	1	.080
6	18	1	9	3	1	1	.080
7	48	1	24	1	1	1 1/2	.100
11	48	1	24	1	1	1 1/2	.100
12	48	3	24	6	3	1 1/2	.100
24	30	2	15	12	2	1 1/2	.100
24	36	3	18	12	2	1 1/2	.100
30	36	2	18	15	2	1 1/2	.100

(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	VERTICAL RECTANGLE	DATE: 05/2004	DETAIL NO. 2061-4



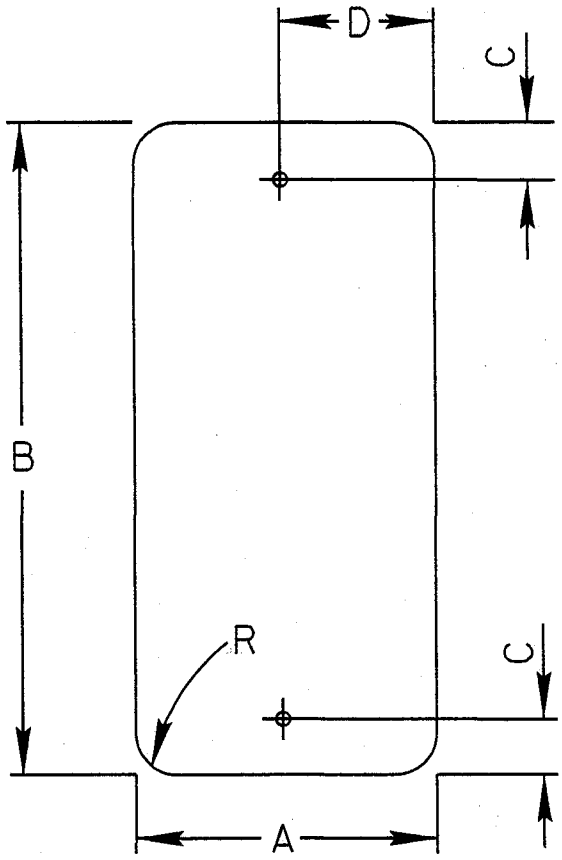
A	B	C	D	E	F	R	THICKNESS
6	24	2	12	3	2	1	.080
6	30	3	15	3	2	1	.100
8	24	2	12	4	2	1 1/2	.100
12	60	3	30	6	3	1 1/2	.100
12	72	6	36	6	3	1 1/2	.100
18	36	3	18	9	3	1 1/2	.100
18	30	3	15	9	3	1 1/2	.100
20	36	3	18	10	3	1 1/2	.100

(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	VERTICAL RECTANGLE	DATE: 05/2004	DETAIL NO. 2061-5



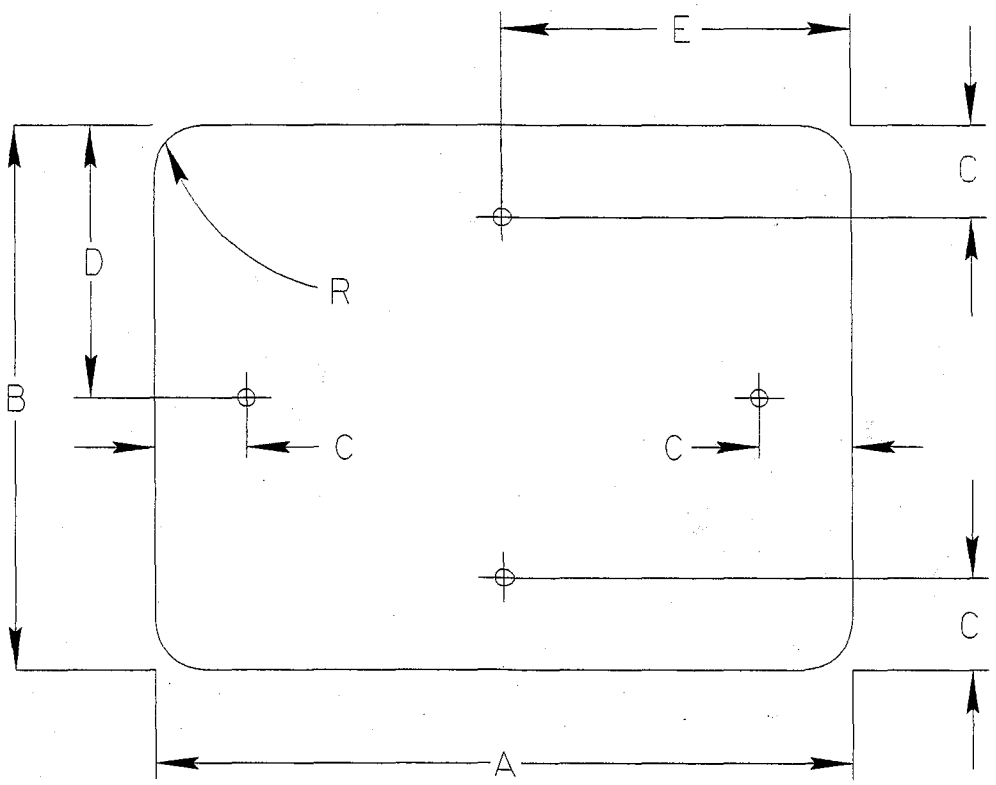
A	B	C	D	R	THICKNESS
18	48	2	9	1 1/2	.125
24	60	6	12	1 1/2	.125
10	18	1	5	1 1/2	.080
10	27	1	5	1 1/2	.080
10	36	1	5	1 1/2	.080

(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RECTANGLE & MILE POST BLANK	DATE: 10/2004	DETAIL NO. 2061-6



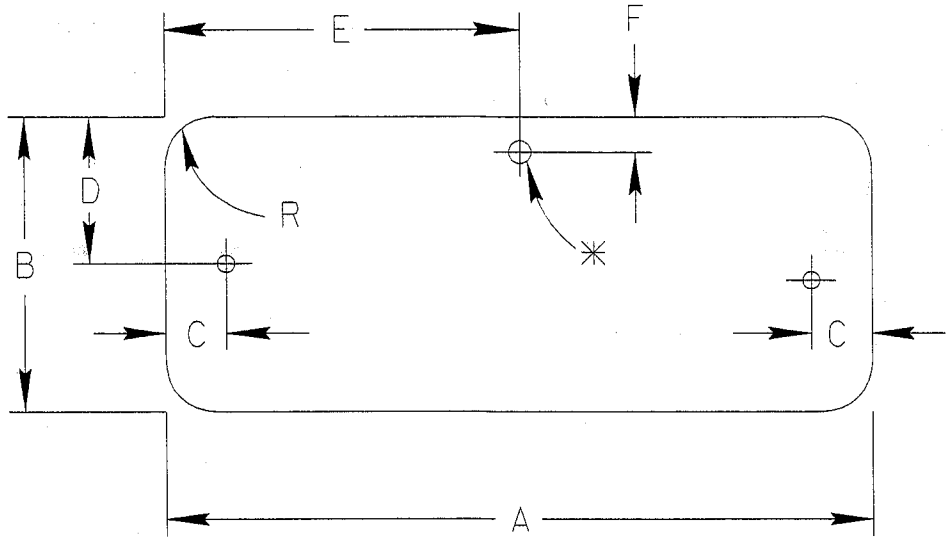
A	B	C	D	E	R	THICKNESS
18	12	1 1/2	6	9	1 1/2	.063
24	18	3	9	12	1 1/2	.100
30	18	2	9	15	1 1/2	.100
36	12	1 1/2	6	18	1 1/2	.100
36	20	2	10	18	1 1/2	.125

(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RECTANGLE	DATE: 05/2004	DETAIL NO. 2061-7



A	B	C	D	E	F	R	THICKNESS
48	30	9	15	24	3	$1\frac{7}{8}$	.125

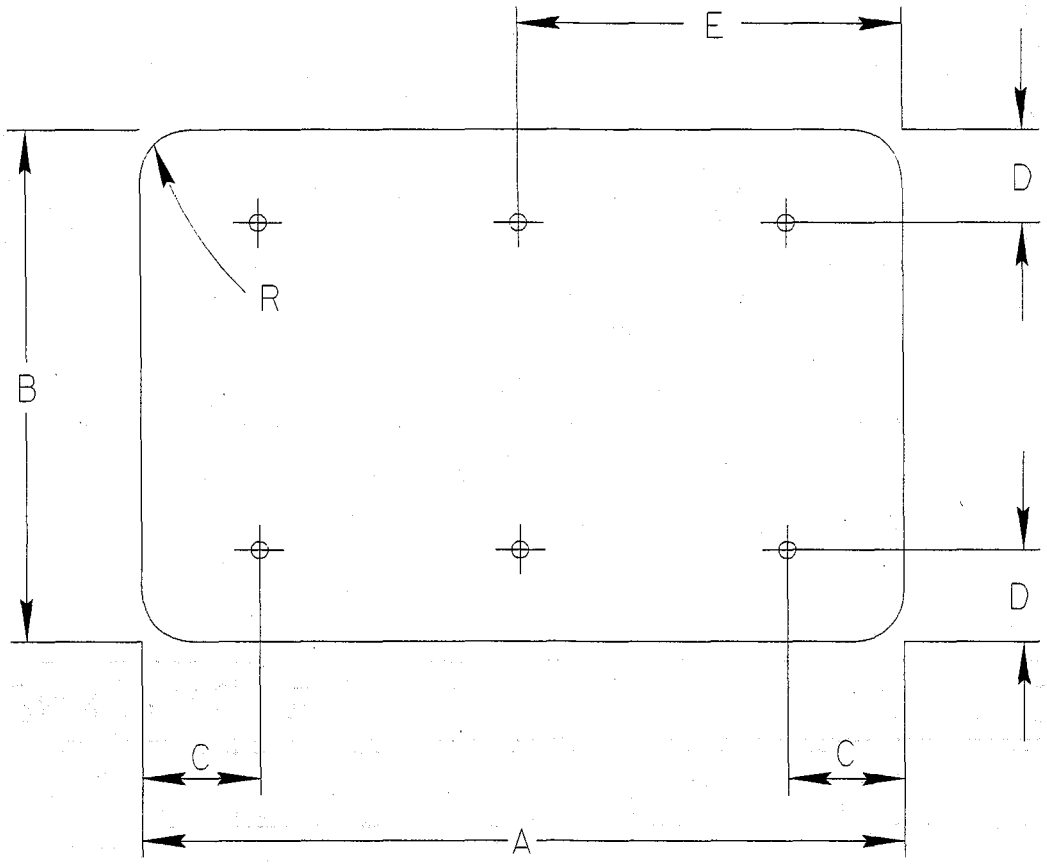
(All dimensions are in inches)

Hole diameter is $\frac{3}{8}$ inches unless otherwise noted

✳ = Hole diameter is $\frac{9}{16}$ inches

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RECTANGLE	DATE: 05/2004	DETAIL NO. 2061-8



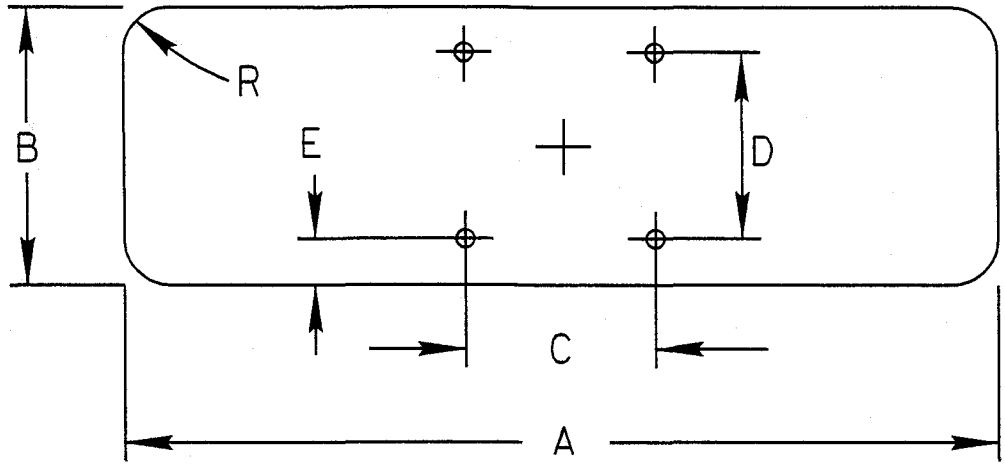
A	B	C	D	E	R	THICKNESS
48	24	9	3	24	$1\frac{7}{8}$	.125
48	36	6	6	24	3	.125
60	30	12	3	30	3	.125
60	36	12	3	30	3	.125
72	48	6	3	36	3	.125
96	48	6	6	48	3	.125

(All dimensions are in inches)

Hole diameter is $\frac{3}{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RECTANGLE	DATE: 05/2004	DETAIL NO. 2061-9



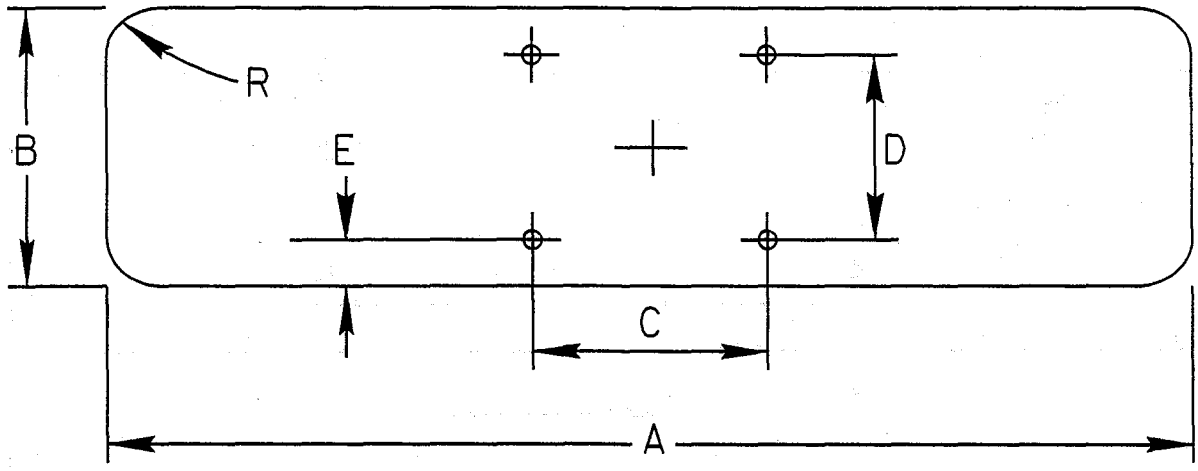
A	B	C	D	E	R	THICKNESS
24	8	$4\frac{11}{16}$	$5\frac{7}{8}$	$\frac{9}{16}$	$1\frac{1}{2}$	.125
30	8	$4\frac{11}{16}$	$5\frac{7}{8}$	$\frac{9}{16}$	$1\frac{1}{2}$	.125
36	8	$4\frac{11}{16}$	$5\frac{7}{8}$	$\frac{9}{16}$	$1\frac{1}{2}$	.125
42	8	$4\frac{11}{16}$	$5\frac{7}{8}$	$\frac{9}{16}$	$1\frac{1}{2}$	.125
48	8	$4\frac{11}{16}$	$5\frac{7}{8}$	$\frac{9}{16}$	$1\frac{1}{2}$	.125

(ALL DIMENTIONS ARE IN INCHES)

HOLE DIAMETER IS $\frac{3}{8}$ INCHES UNLESS OTHERWISE NOTED

(NOT TO SCALE)

REVISED DATE 07/2006		
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	STREET NAME SIGN	DATE: 05/2004 / DETAIL NO. 2061-10A



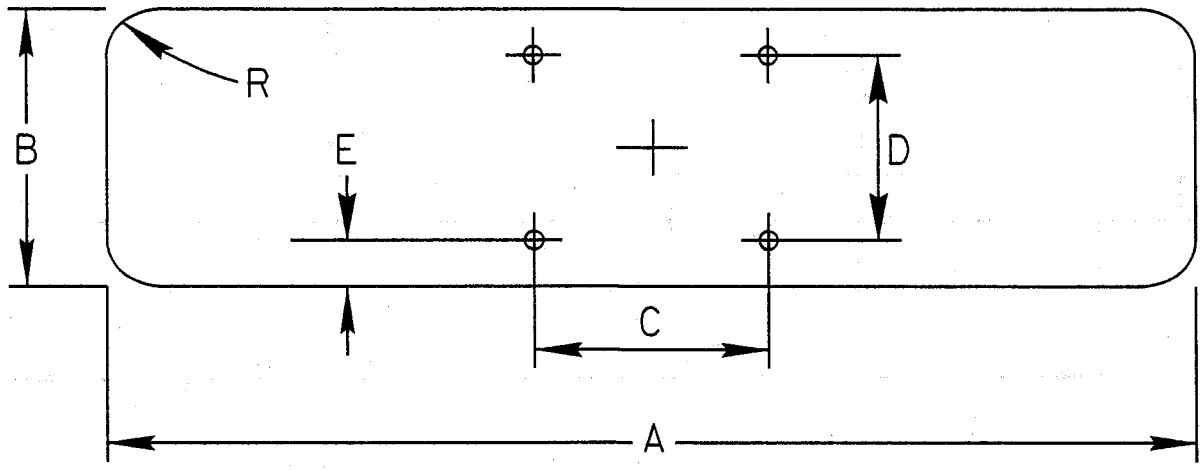
A	B	C	D	E	R	THICKNESS
24	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125
30	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125
36	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125
42	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125
48	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125
54	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125
60	12	6	$9\,^{7}/_{8}$	$^{9}/_{16}$	$1\,^{1}/_{2}$	.125

(ALL DIMENTIONS ARE IN INCHES)

HOLE DIAMETER IS $^{3}/_{8}$ INCHES UNLESS OTHERWISE NOTED

(NOT TO SCALE)

REVISED DATE 07/2006		
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	STREET NAME SIGN	DATE: 05/2004 / DETAIL NO. 2061-10B



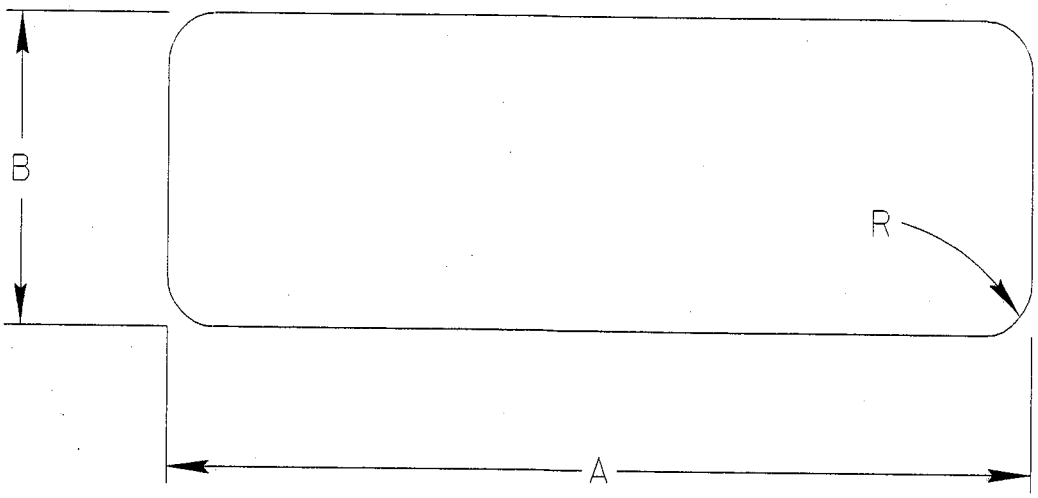
A	B	C	D	E	R	THICKNESS
36	8	$4\frac{11}{16}$	$9\frac{7}{8}$	$\frac{9}{16}$	$1\frac{7}{8}$	.125
42	12	6	$9\frac{7}{8}$	$\frac{9}{16}$	$1\frac{7}{8}$	.125

(All dimensions are in inches)

Hole diameter is $\frac{3}{8}$ inches unless otherwise noted

(Not to Scale)

		REVISED DATE 07/2006	
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	DEAD END NO OUTLET	DATE: 05/2004	DETAIL NO. 2061-11

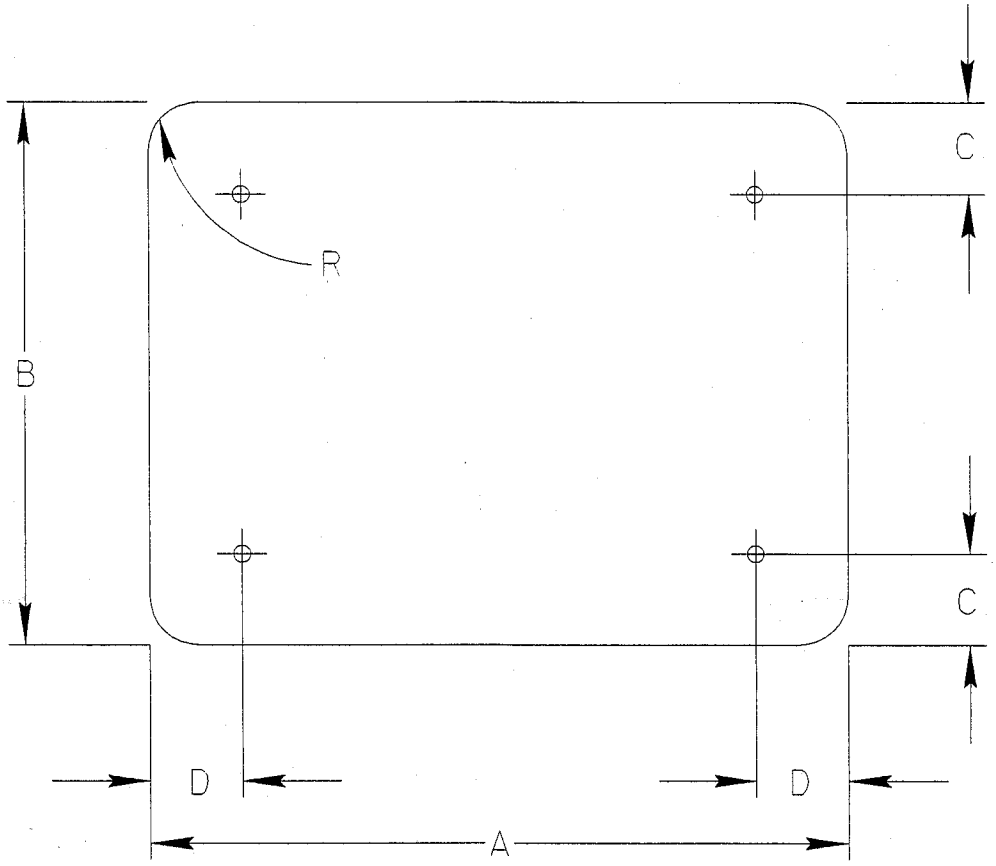


A	B	R	THICKNESS
60	18	1 1/2	.125
72	18	1 1/2	.125
84	18	1 1/2	.125
96	18	1 1/2	.125
108	18	1 1/2	.125

(All dimensions are in inches)

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	OVERHEAD STREET NAME SIGN	DATE: 05/2004	DETAIL NO. 2061-12



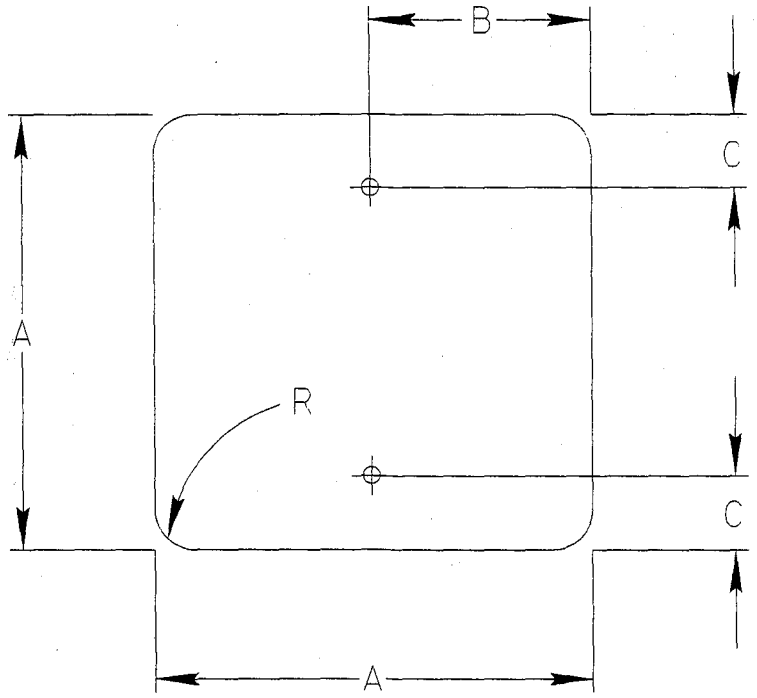
A	B	C	D	R	THICKNESS
60	48	9	6	3	.125

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	RECTANGLE	DATE: 05/2004	DETAIL NO. 2061-13



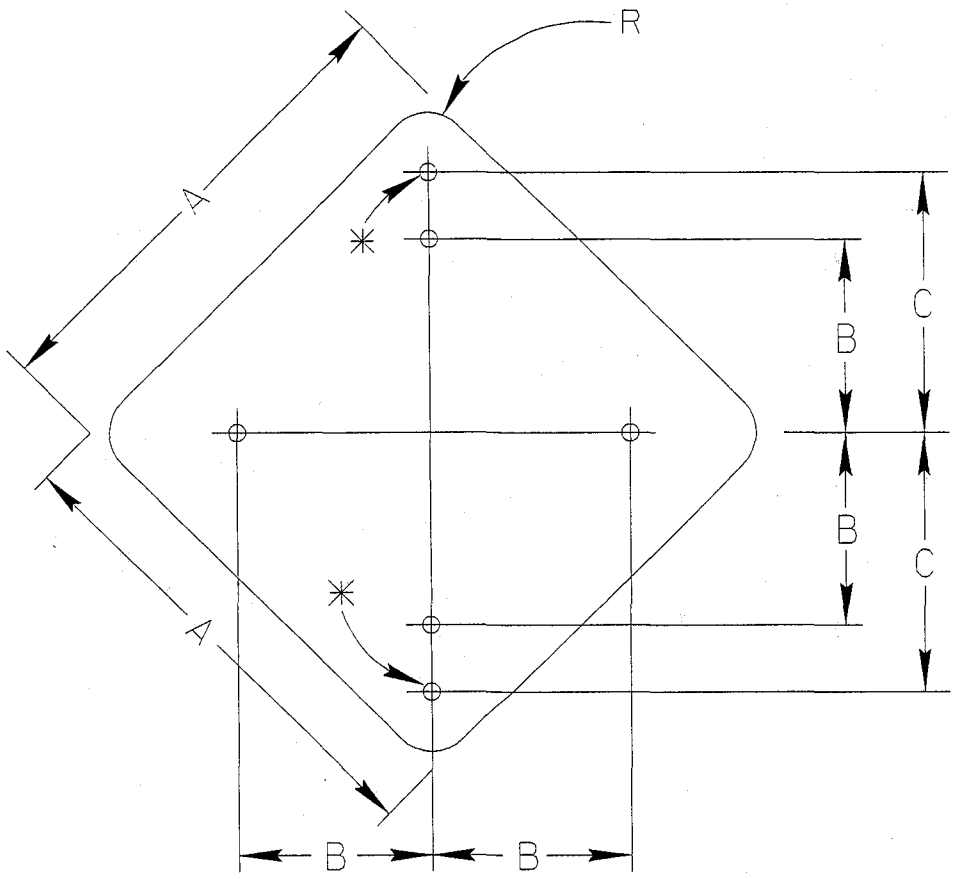
A	B	C	R	THICKNESS
6	3	1	1	.080

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SQUARE	DATE: 05/2004	DETAIL NO. 2061-14



A	B	C	R	THICKNESS
48	24	28	3	.125

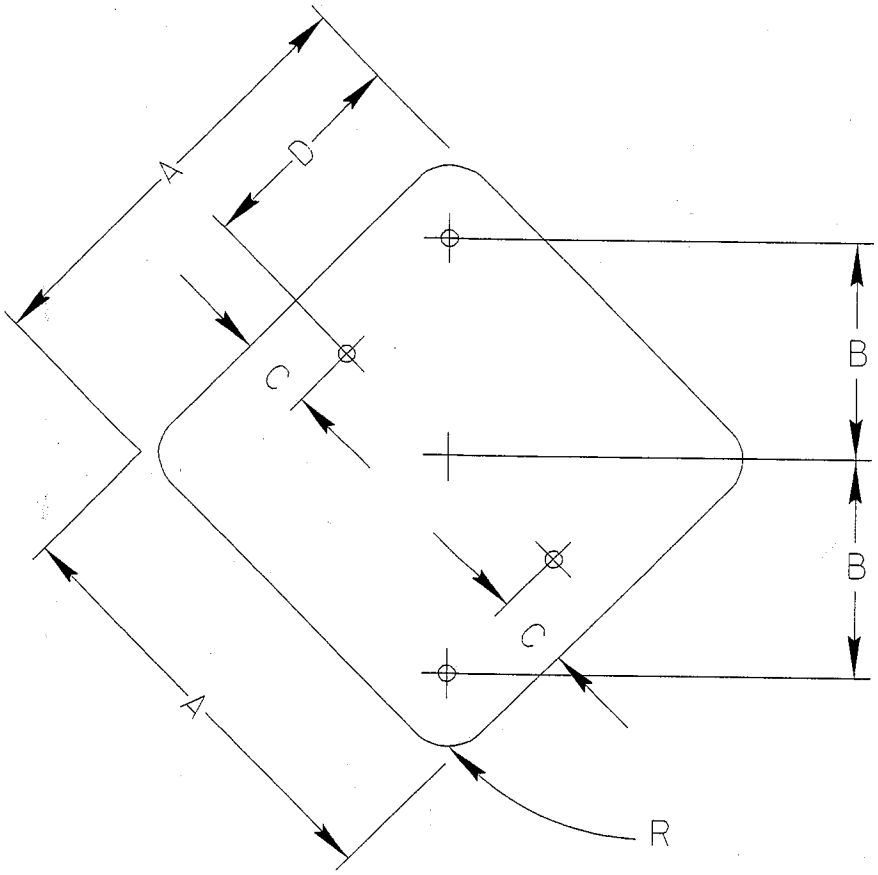
(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

✳ = Hole diameter is $^{9}/_{16}$ inches

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	DIAMOND	DATE: 05/2004	DETAIL NO. 2061-15



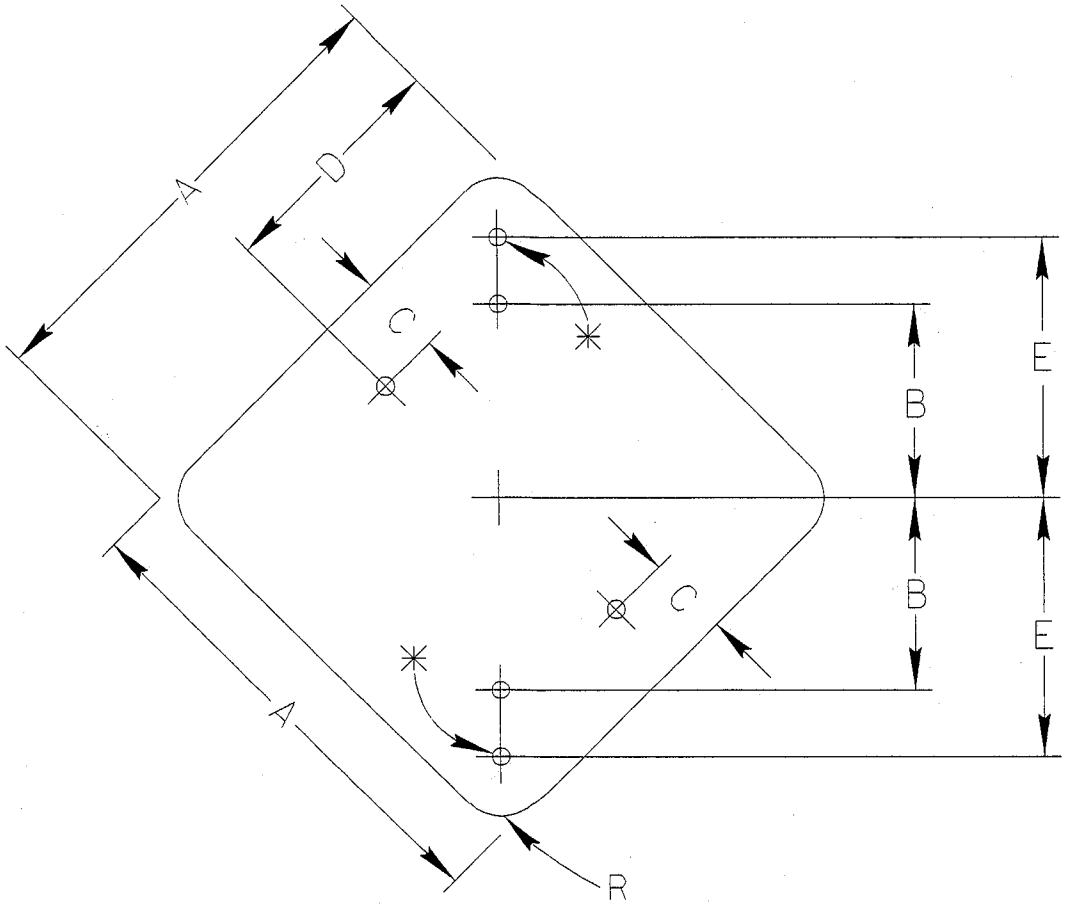
A	B	C	D	R	THICKNESS
18	9	3	9	1 1/2	.080

(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MULTIPURPOSE	DATE: 05/2004	DETAIL NO. 2061-16



A	B	C	D	E	R	THICKNESS
24	10	2	12	13	1 1/2	.080
30	15	2	15	18	1 1/2	.080
36	18	2	18	22	1 1/2	.100

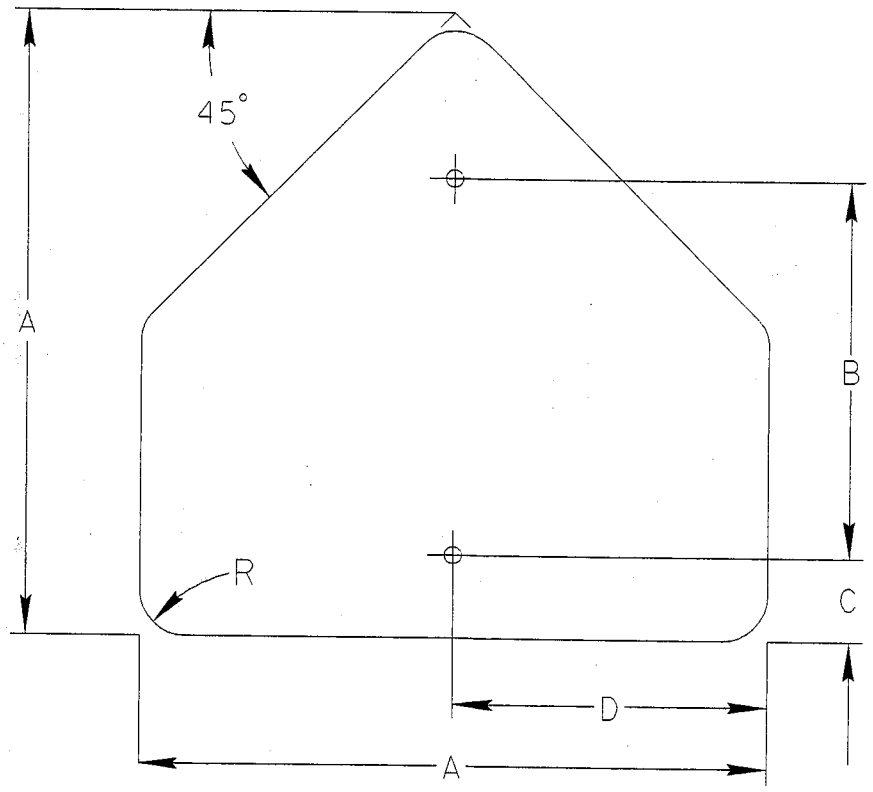
(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

✳ = Hole diameter is 9/16 inches

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MULTIPURPOSE	DATE: 05/2004	DETAIL NO. 2061-17



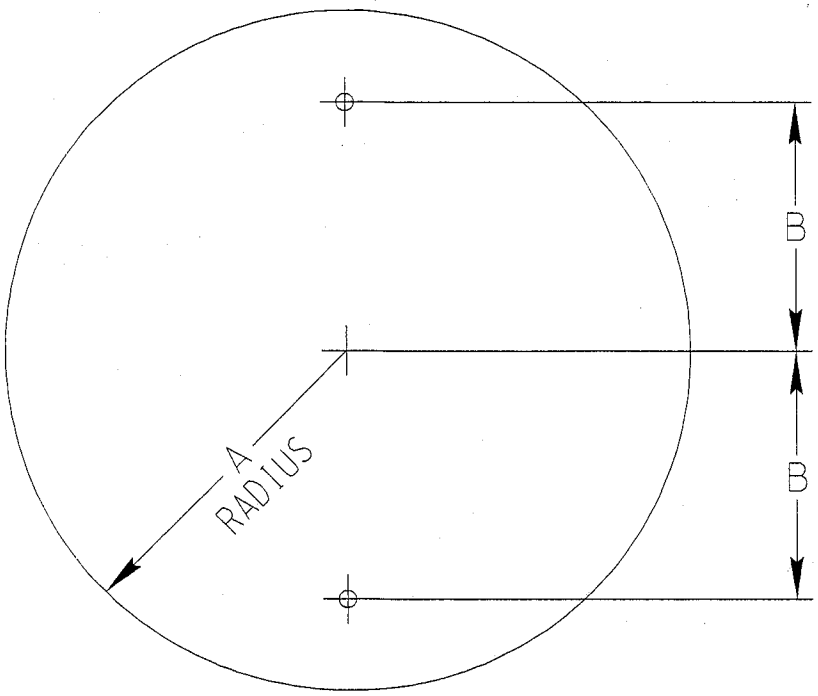
A	B	C	D	R	THICKNESS
36	24	3	18	2 1/4	.100

(All dimensions are in inches)

Hole diameter is 3/8 inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	PENTAGON	DATE: 05/2004	DETAIL NO. 2061-18



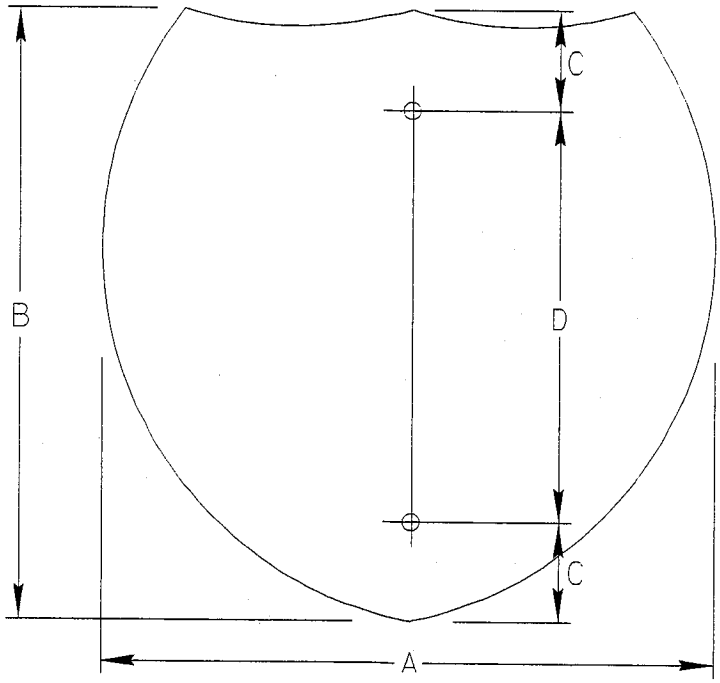
A	B	THICKNESS
18	15	.125

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CIRCLE	DATE: 05/2004	DETAIL NO. 2061-19



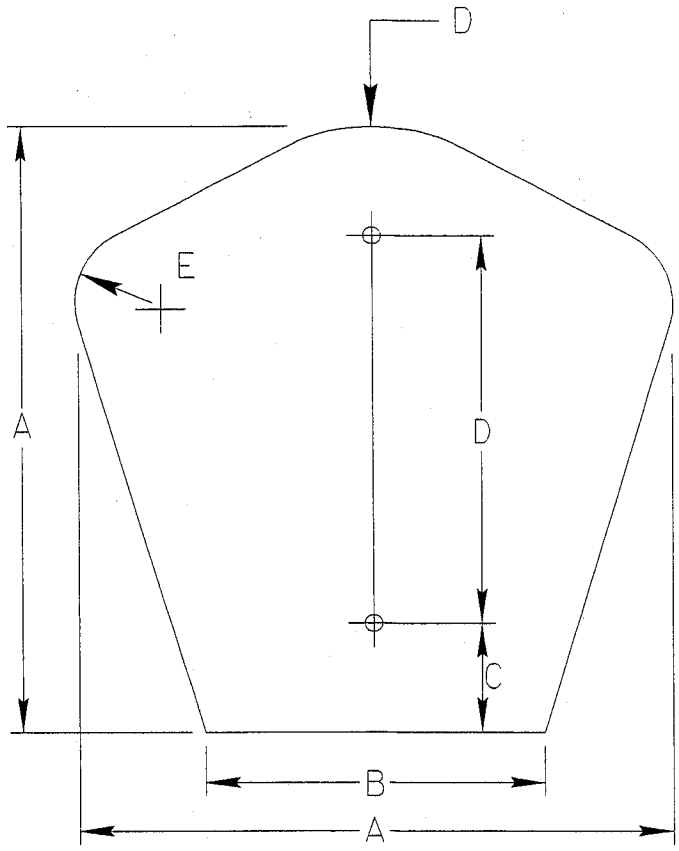
A	B	C	D	THICKNESS
24	24	3	18	.125
30	24	3	18	.125
36	36	6	24	.125
45	36	6	24	.125

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	INTERSTATE SHIELD	DATE: 05/2004	DETAIL NO. 2061-20



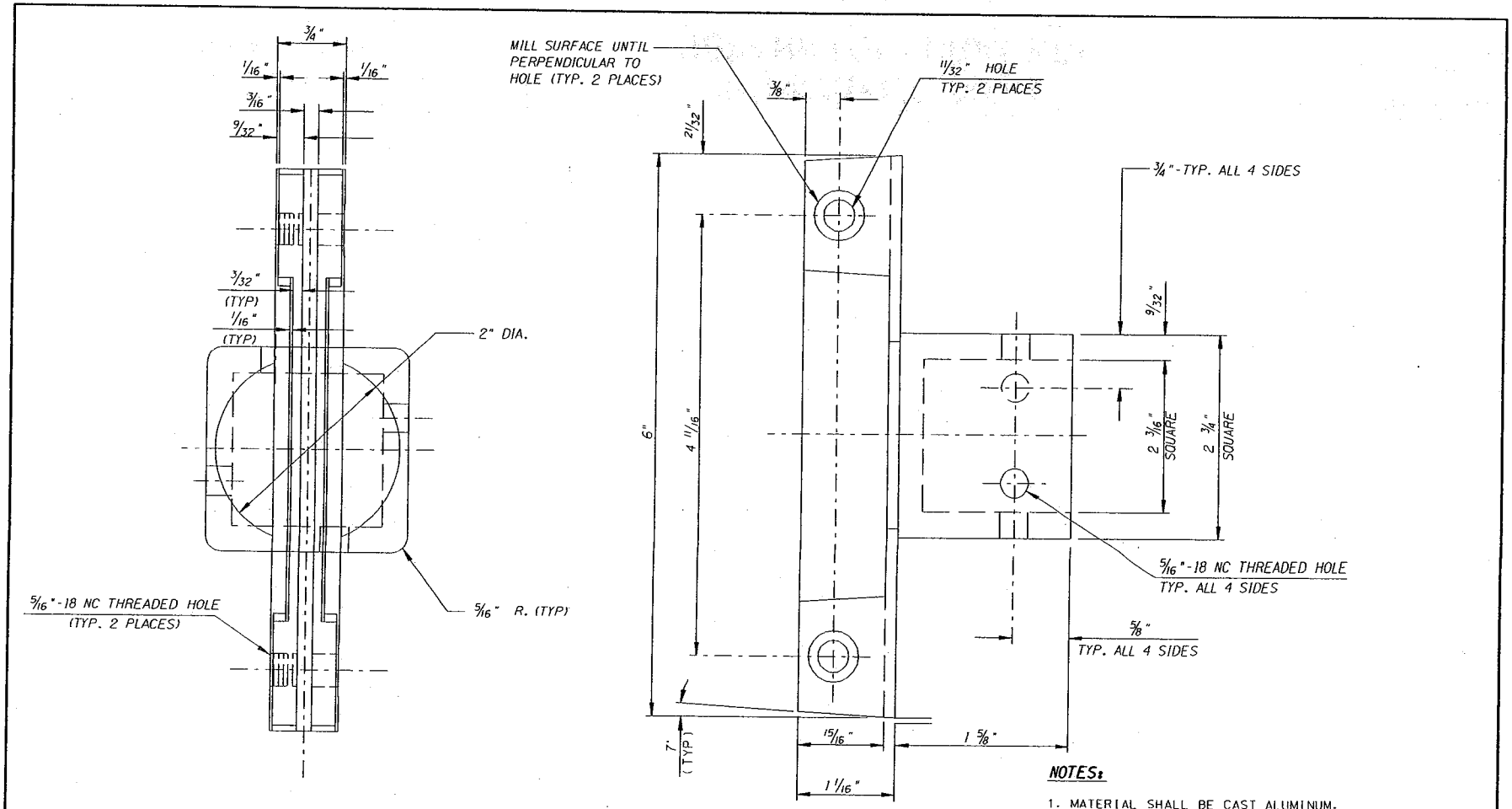
A	B	C	D	E	THICKNESS
18	15	1	5	2	.125
24	18	2	5.313	2	.125
30	24	2	6.625	2	.125

(All dimensions are in inches)

Hole diameter is $^{3}/_{8}$ inches unless otherwise noted

(Not to Scale)

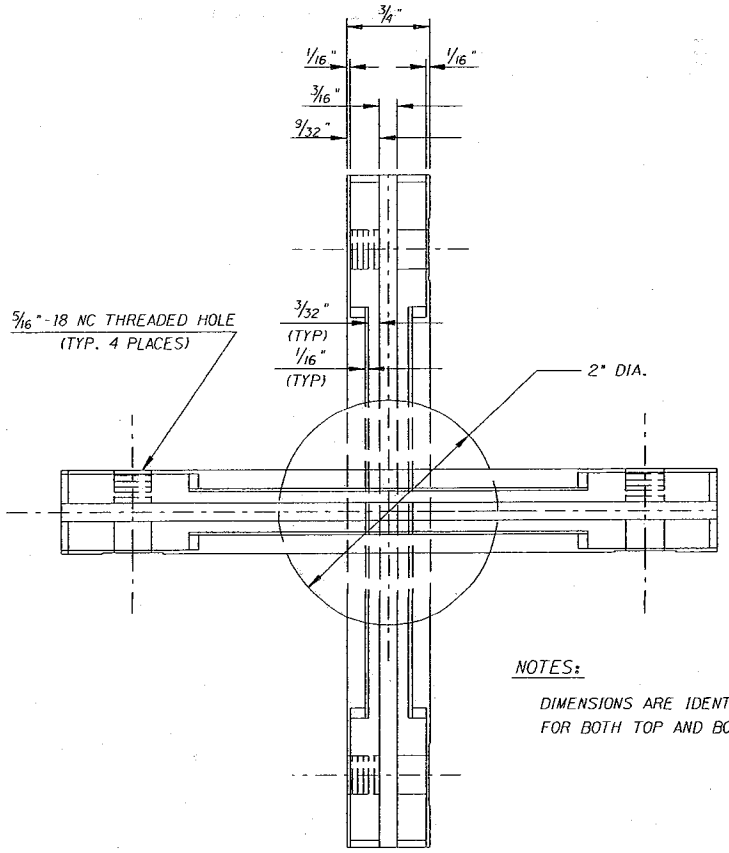
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	COUNTY SHIELD	DATE: 05/2004	DETAIL NO. 2061-21



NOTES:

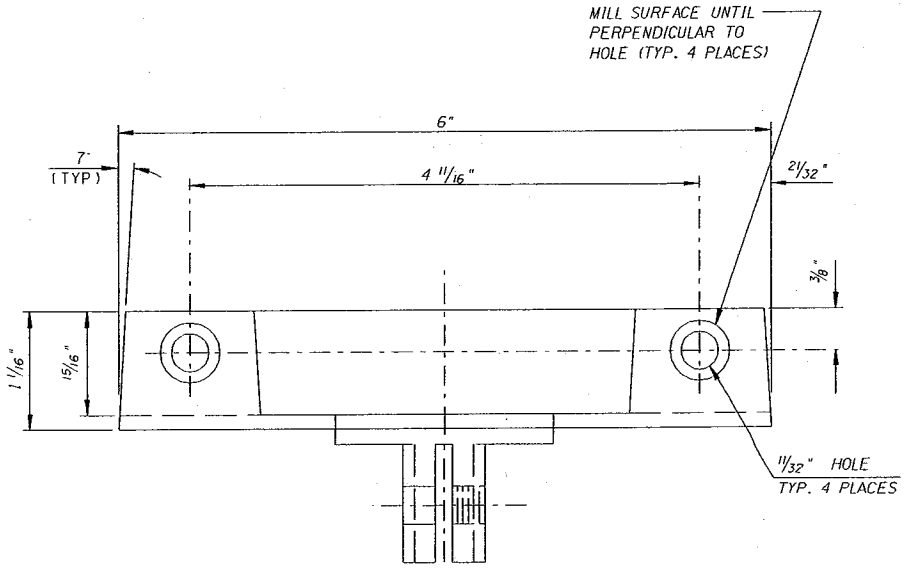
1. MATERIAL SHALL BE CAST ALUMINUM.
2. POST CAP MAY BE SUPPLIED WITH TWO (2) VANDAL PROOF $5/16$" X $3/4$"-18 NC MACHINE SCREWS AND TWO (2) 'VANDAL PROOF' $5/16$" X $3/16$"-18 SET SCREWS.
3. USE GRADE # 2, ZINC COATED, 18 NC THREAD, $1\frac{1}{2}$" X $5/16$" BOLT TO ATTACH POST CAP TO THE POST.
4. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 1" X $5/16$" BOLT TO ATTACH SIGN TO BRACKET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**(6") STREET SIGN POST CAP** *(FOR 2" SQUARE TUBING)*	**DATE:** 05/2004	**DETAIL NO.** 2062-1



NOTES:

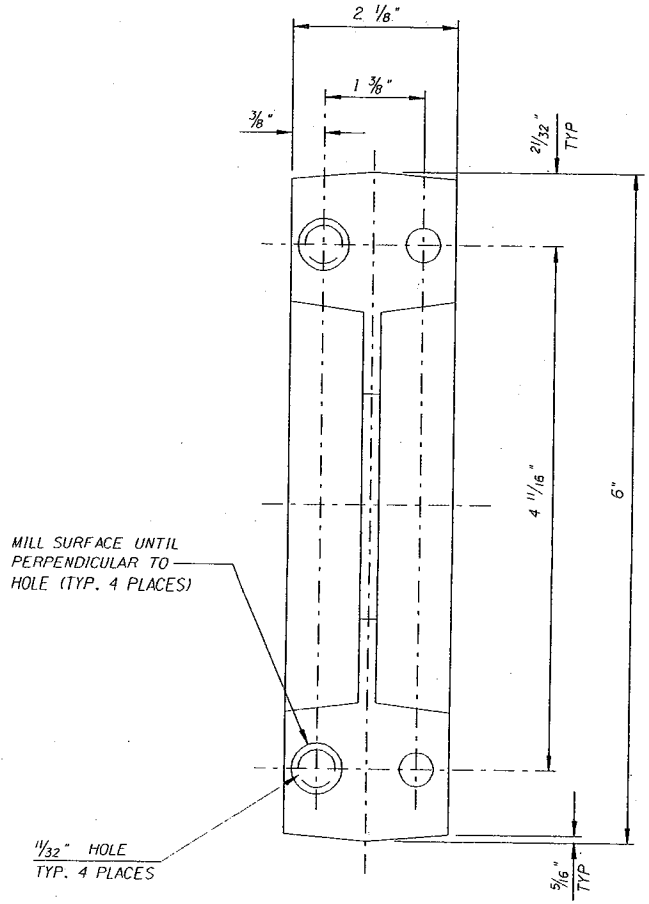
DIMENSIONS ARE IDENTICAL FOR BOTH TOP AND BOTTOM.

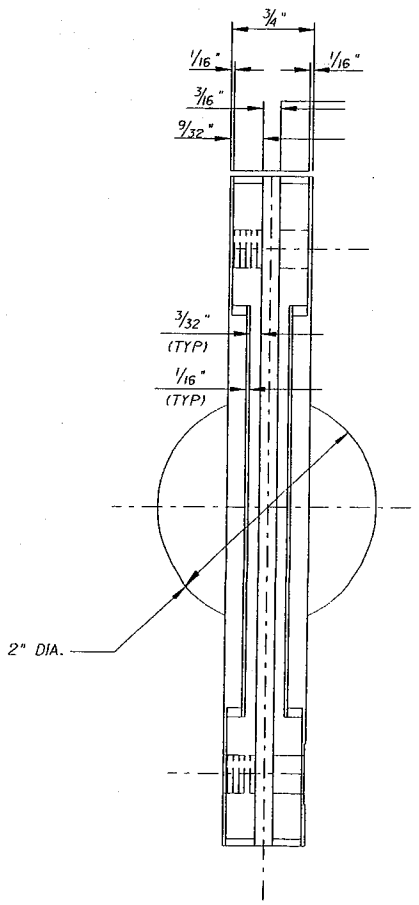


NOTES:

1. MATERIAL SHALL BE CAST ALUMINUM.
2. SEPERATOR SHALL BE SUPPLIED WITH FOUR (4)' VANDAL PROOF '5/16" X 3/4"-18 NC MACHINE SCREWS
3. USE GRADE # 2, ZINC COATED, 18 NC THREAD. 1" X 5/16" BOLT TO ATTACH SIGN TO BRACKET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	(6") STREET SIGN SEPARATOR BRACKET	DATE: 05/2004	DETAIL NO. 2062-2

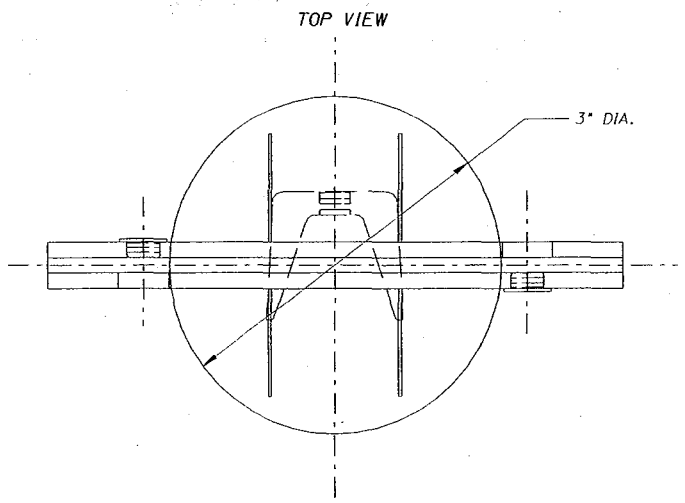


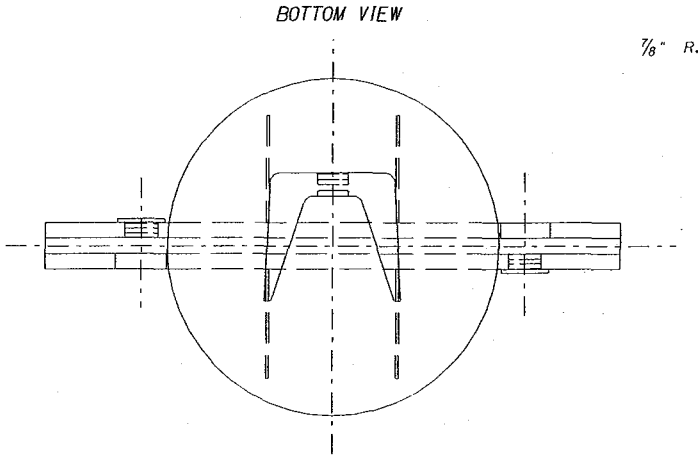


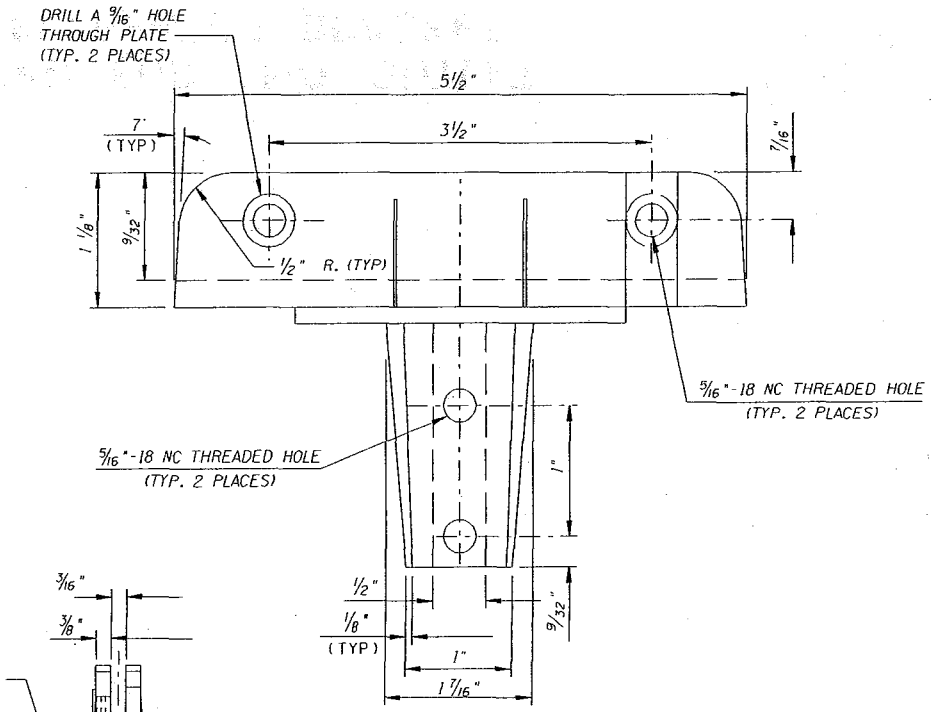
NOTES:

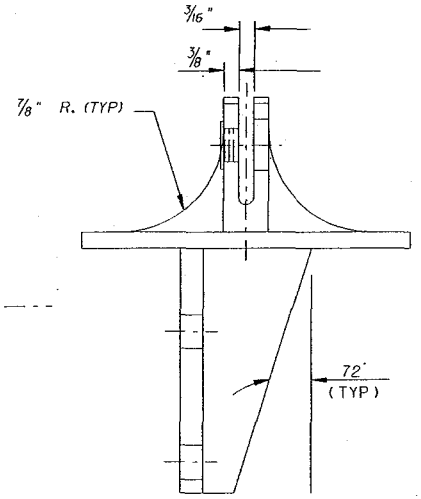
1. MATERIAL SHALL BE CAST ALUMINUM.
2. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 1" X 5/16" BOLT TO ATTACH SIGN TO BRACKET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	DEAD END / NO OUTLET SEPARATOR BRACKET	DATE: 05/2004	DETAIL NO. 2062-3





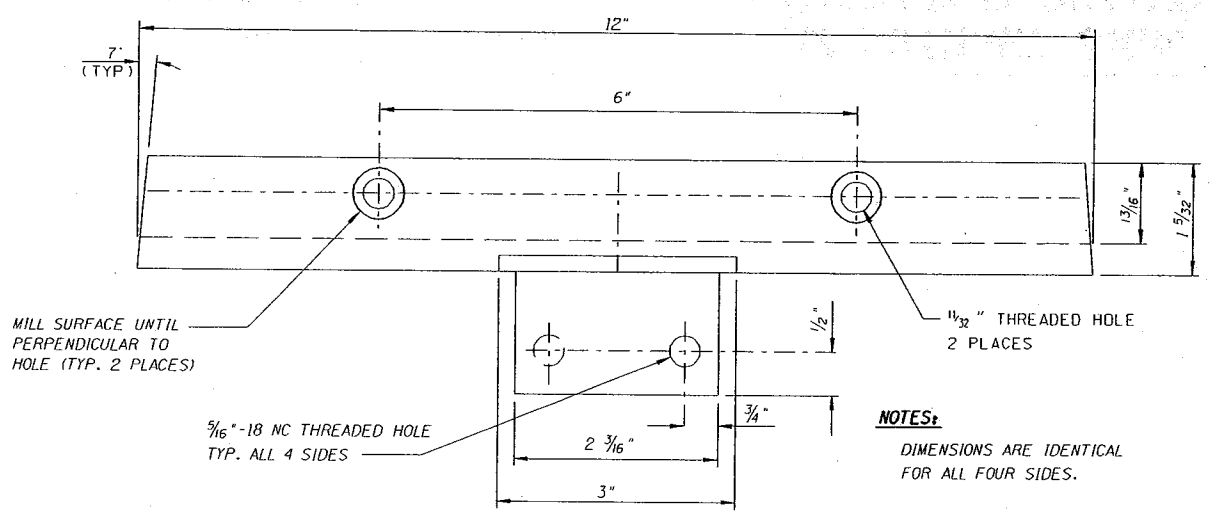




NOTES:

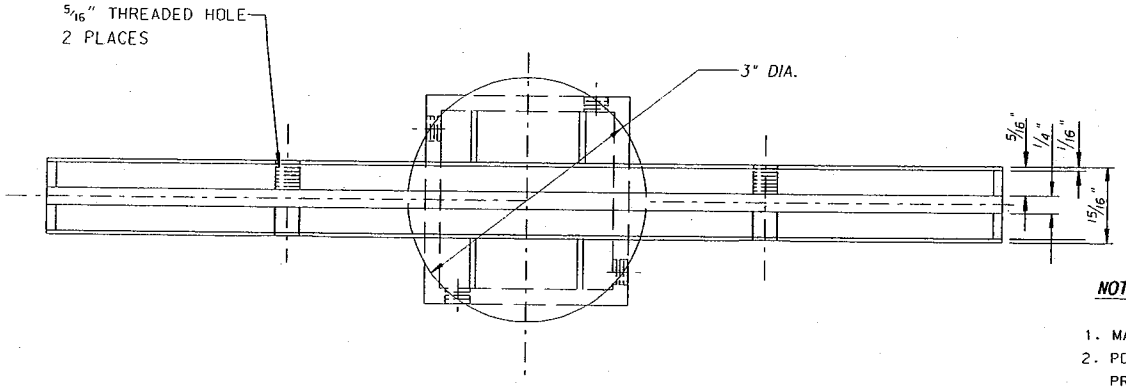
1. MATERIAL SHALL BE CAST ALUMINUM.
2. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 1" X 5/16" BOLT TO ATTACH SIGN TO BRACKET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	STREET SIGN POST CAP (FOR " U " CHANNEL POST)	DATE: 05/2004	DETAIL NO. 2062-4



NOTES:

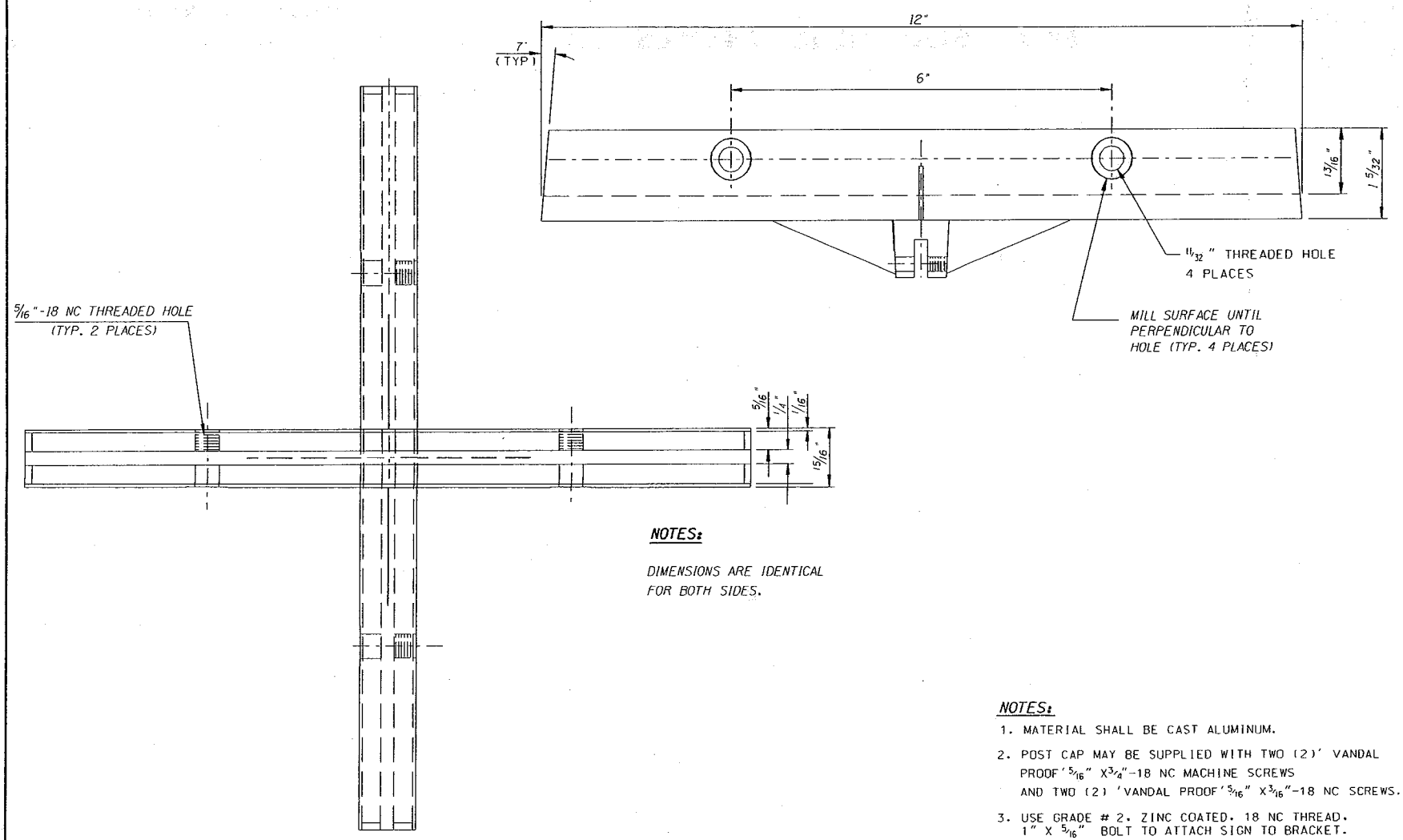
DIMENSIONS ARE IDENTICAL FOR ALL FOUR SIDES.



NOTES:

1. MATERIAL SHALL BE CAST ALUMINUM.
2. POST CAP MAY BE SUPPLIED WITH TWO (2)' VANDAL PROOF' 5/16" X3/4"-18 NC MACHINE SCREWS AND TWO (2) 'VANDAL PROOF' 5/16" X3/16"-18 SET SCREWS.
3. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 1 1/2" X 5/16" BOLT TO ATTACH POST CAP TO THE POST.
4. USE GRADE # 2, ZINC COATED, 18 NC THREAD, 1" X 5/16" BOLT TO ATTACH SIGN TO BRACKET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	(12") STREET SIGN POST CAP	DATE: 05/2004	DETAIL NO. 2062-5



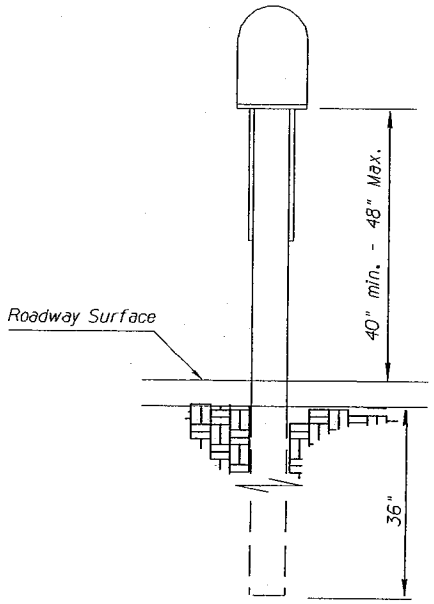
NOTES:

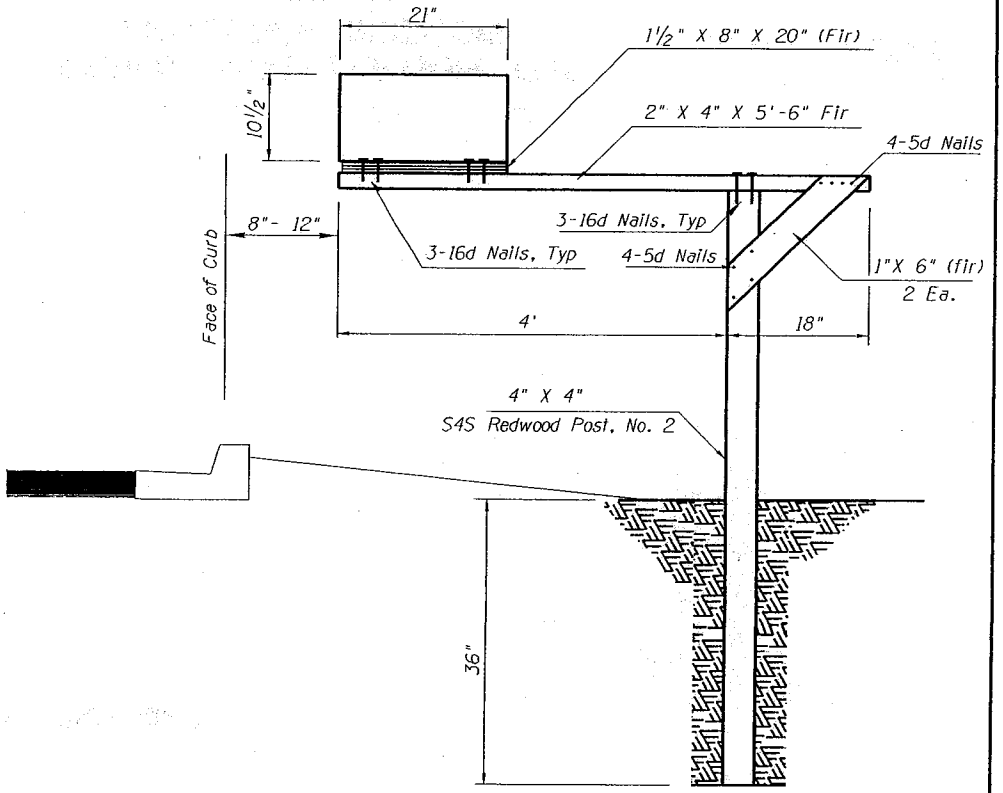
DIMENSIONS ARE IDENTICAL FOR BOTH SIDES.

NOTES:

1. MATERIAL SHALL BE CAST ALUMINUM.
2. POST CAP MAY BE SUPPLIED WITH TWO (2)' VANDAL PROOF '5/16" X 3/4"-18 NC MACHINE SCREWS AND TWO (2) 'VANDAL PROOF '5/16" X 3/16"-18 NC SCREWS.
3. USE GRADE # 2. ZINC COATED. 18 NC THREAD. 1" X 5/16" BOLT TO ATTACH SIGN TO BRACKET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	(12") STREET SIGN SEPARATOR BRACKET	DATE: 05/2004	DETAIL NO. 2062-6



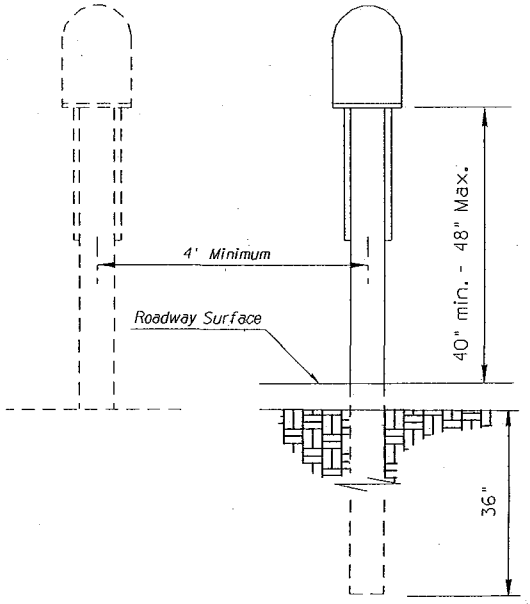


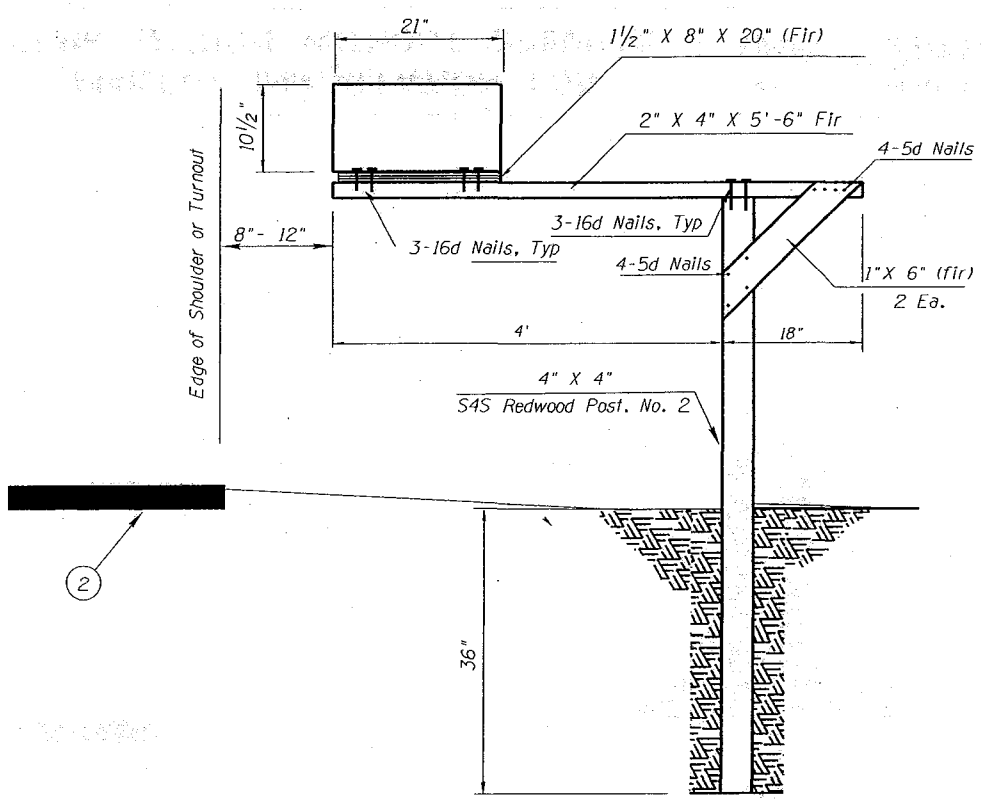
Notes:

1 Mailbox suppports shall be a 4"X4" S4S Redwood post, No. 2 pena-treated southern pine, or equivalent

2 Cantilevered mailbox is shown, non-cantilevered post is acceptable.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MAILBOX INSTALLATION FOR CURB SECTION WITHOUT SIDEWALK	DATE: 6/04/02	DETAIL NO. 2065





Notes:

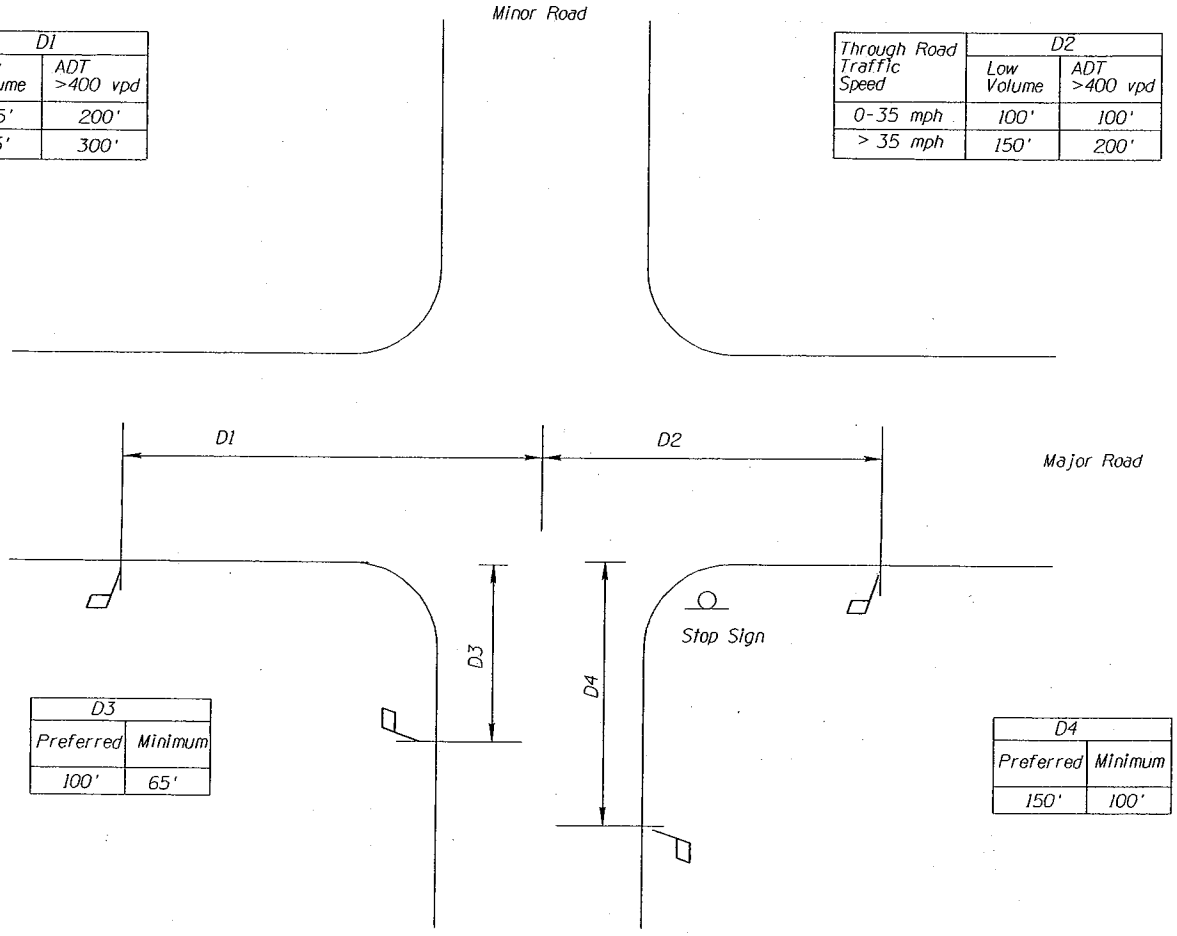
1 Mailbox support shall be a 4"X4" S4S redwood post, No. 2 pena-treated southern pine, or equivalent.

(2) Design shoulder to have a minimum of 4 inch depth of ABC for width of shoulder to allow all weather access.

3 Multiple installation of single mailboxes shall be spaced at 4' (minimum) on center.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MAILBOX INSTALLATION FOR SHOULDER SECTION	DATE: 6/04/03	DETAIL NO. 2067

Through Road Traffic Speed	D1	
	Low Volume	ADT >400 vpd
0-35 mph	65'	200'
> 35 mph	65'	300'

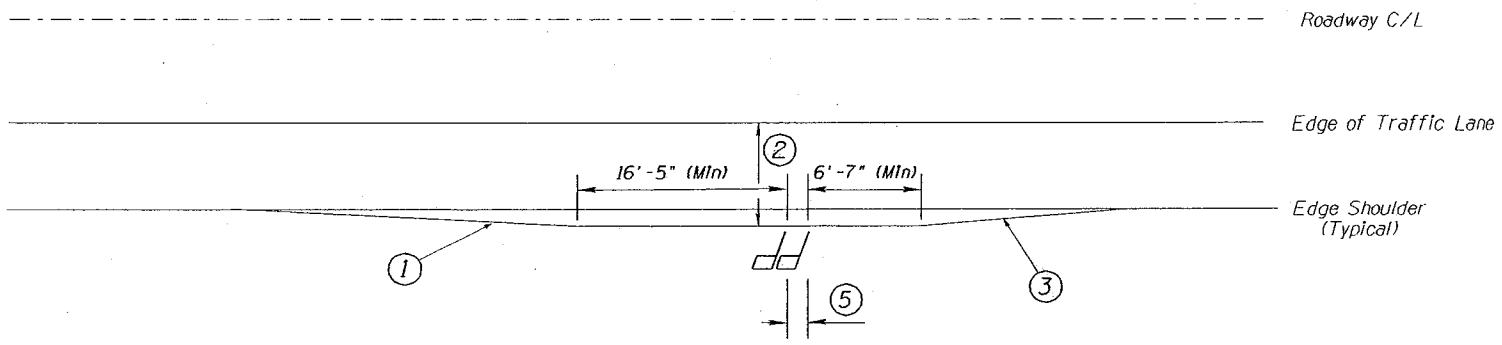


Through Road Traffic Speed	D2	
	Low Volume	ADT >400 vpd
0-35 mph	100'	100'
> 35 mph	150'	200'

D3	
Preferred	Minimum
100'	65'

D4	
Preferred	Minimum
150'	100'

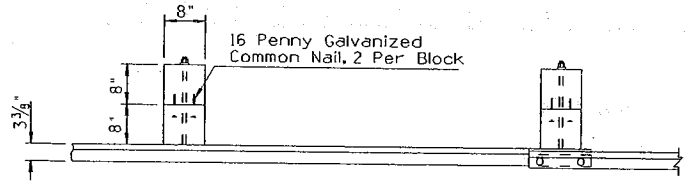
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAILS	RECOMMENDED MAILBOX CLEARANCE AT INTERSECTIONS	DATE: 6/04/03	DETAIL NO. 2069



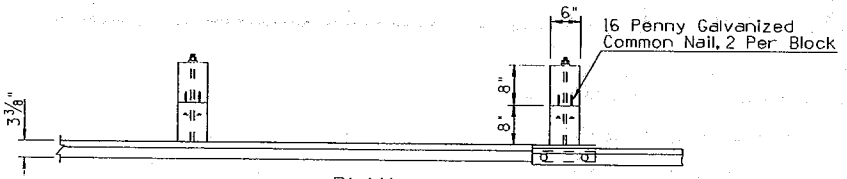
NOTES:

1. Taper 20:1 for speeds of 40 mph or greater, 4:1 for less than 40 mph.
2. Pullout Width 12' for speeds of 40 mph or greater, 10' for speeds less than 40 mph.
3. Taper 12:1 for speeds of 40 mph or greater, 5:1 for less than 40 mph.
4. Provide stabalized surface (as minimum) for all mailbox turnouts (paved turnouts are preferred).
5. Use at least 4' spacing between mailboxes.

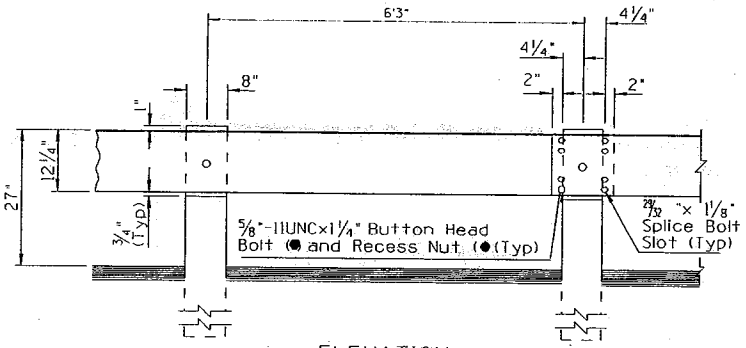
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPICAL MAILBOX TURNOUT	DATE: 6/04/03	DETAIL NO. 2070



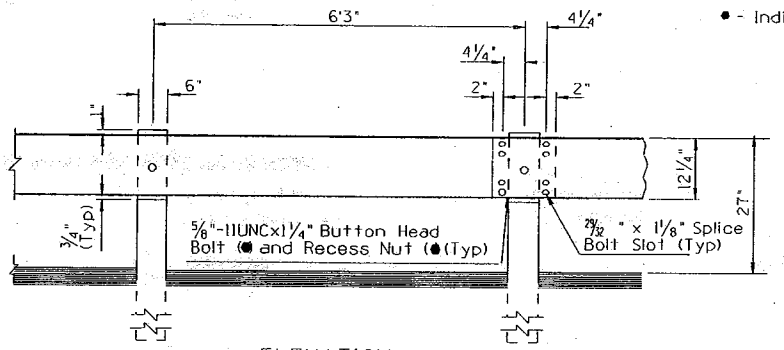
PLAN
G4 (1W) SYSTEM



PLAN
G4 (2W) SYSTEM



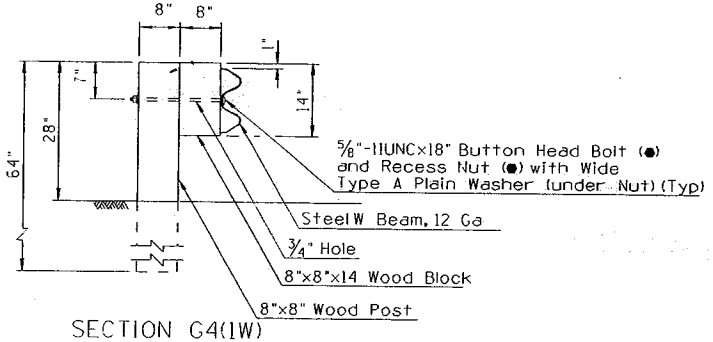
ELEVATION
G4 (1W) SYSTEM



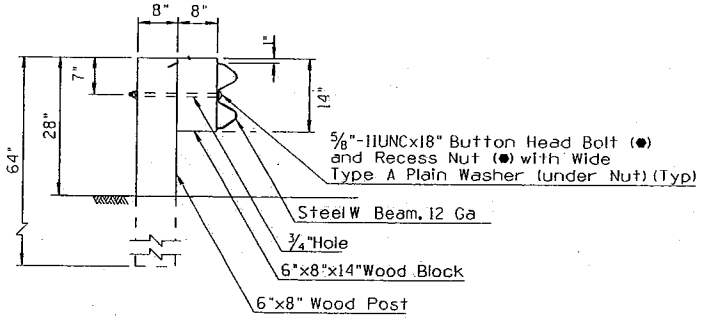
ELEVATION
G4 (2W) SYSTEM

GENERAL NOTES

● - Indicates ARTBA designation



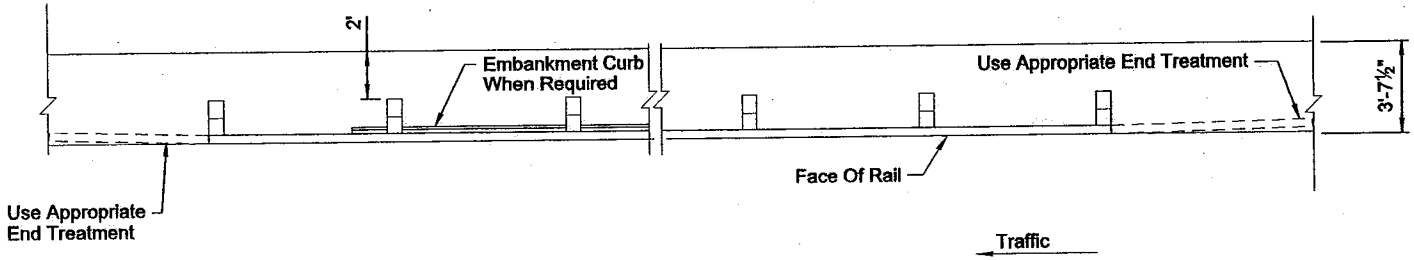
SECTION G4(1W)



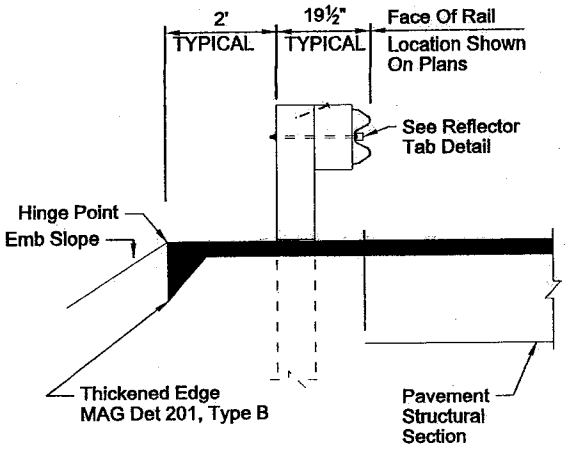
SECTION G4(2W)

Base Drawing Courtsey of ADOT 2/25/00

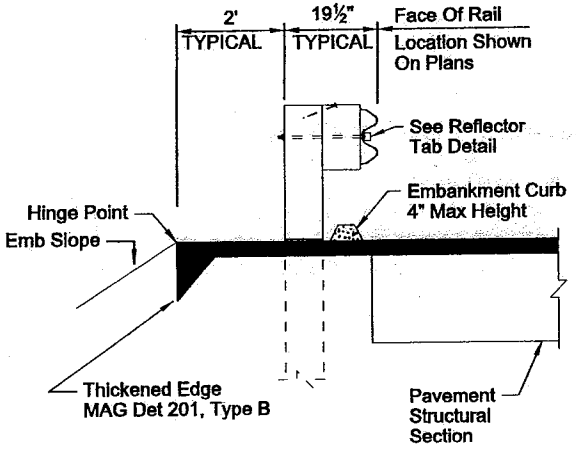
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPICAL GUARDRAIL	DATE: 4/30/01	DETAIL NO. 3001



PLAN

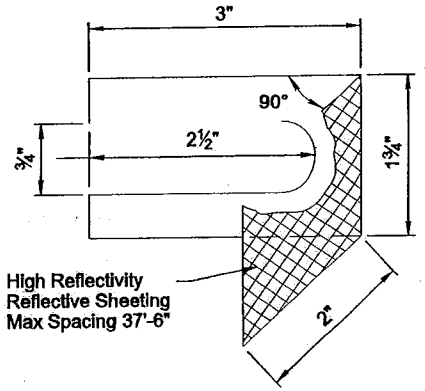


Without Curb



With Curb

SECTION

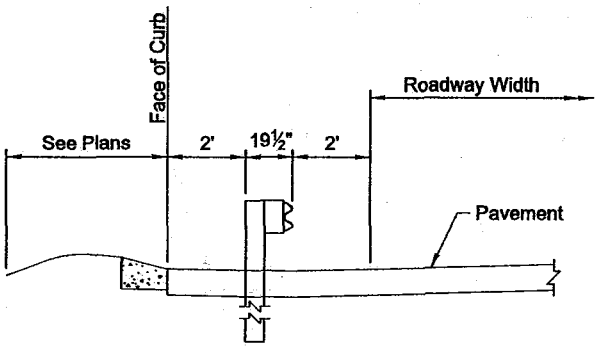


REFLECTOR TAB DETAIL

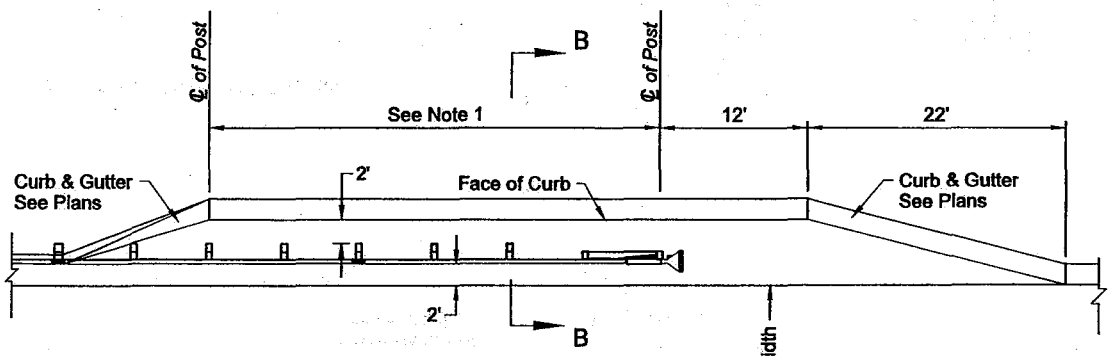
GENERAL NOTES

1. All Embankment Curb Shall Be Protected By Guard Rail.
2. Guard Rail Shall Extend Beyond The Limits Of Embankment Curb.
3. See Std. 3016 For Measurement Limits.
4. Asphalt Pavement Behind Face Of Rail Shall Be ≥ 2 Inches in Thickness

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	GUARDRAIL INSTALLATION	DATE: 1/1/2011	DETAIL NO. 3002

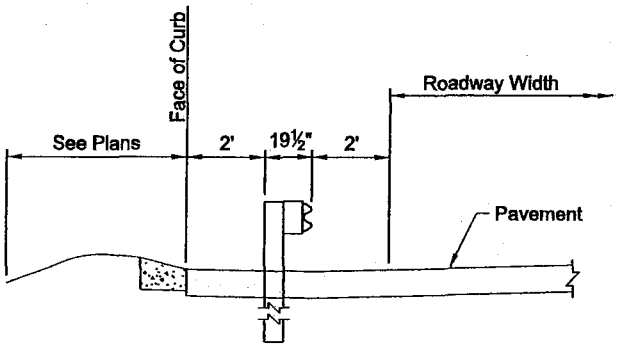


SECTION B-B

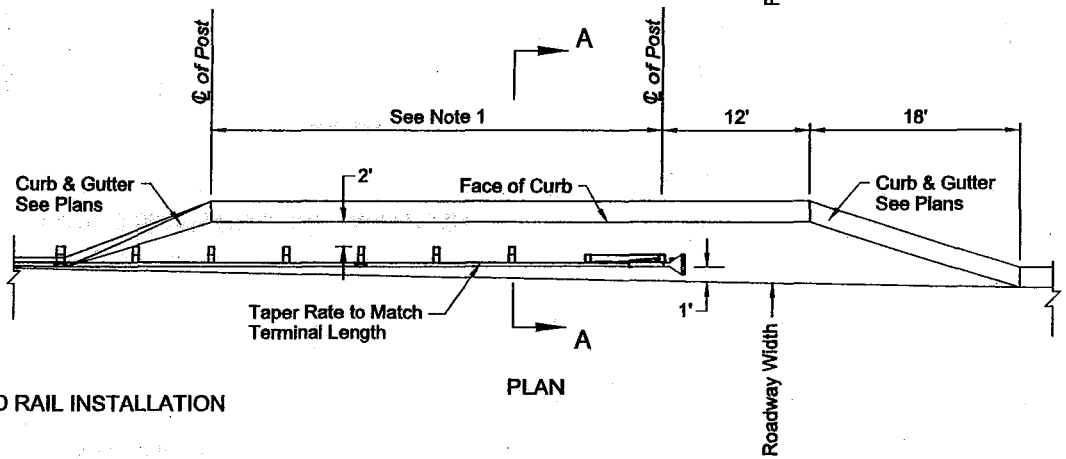


TYPE B GUARD RAIL INSTALLATION

PLAN



SECTION A-A



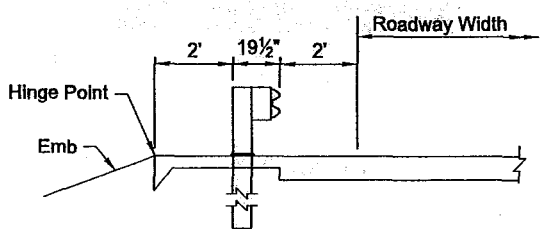
TYPE A GUARD RAIL INSTALLATION

PLAN

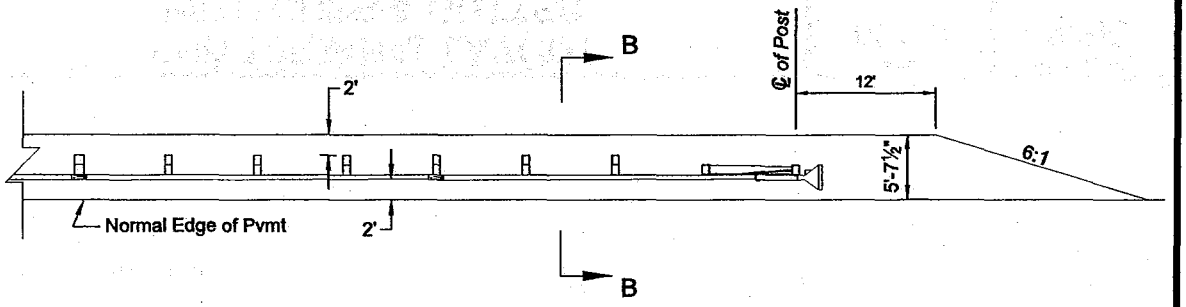
NOTES:

1. Distance = 37.5' for 50.0' Terminal Length
   Distance = 25.0' for 37.5' Terminal Length
   Distance = 12.5' for 25.0' Terminal Length

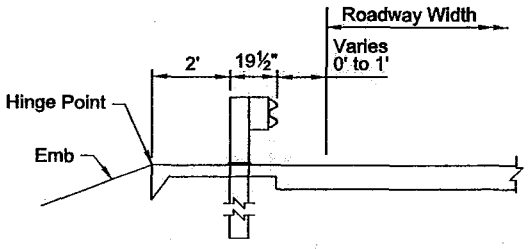
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	END TERMINAL LAYOUT WITH CURB & GUTTER	DATE: 02/10	DETAIL NO. 3005



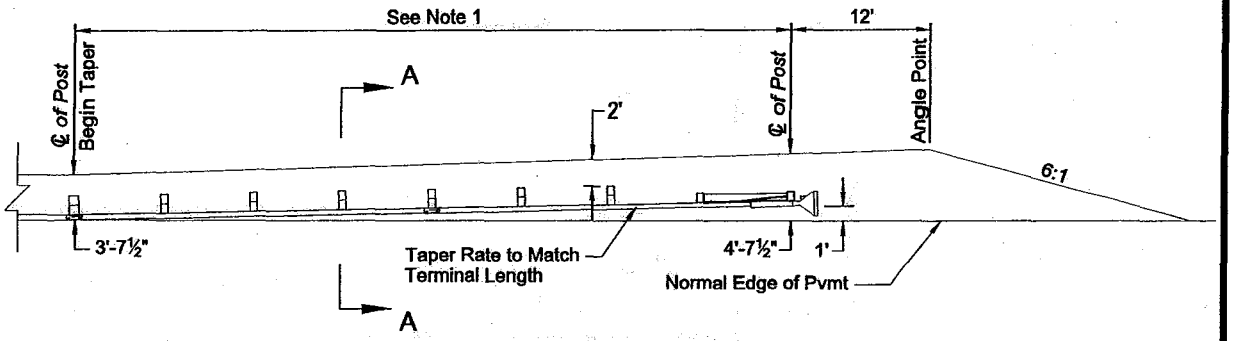
SECTION B-B



TYPE B GUARDRAIL INSTALLATION



SECTION A-A

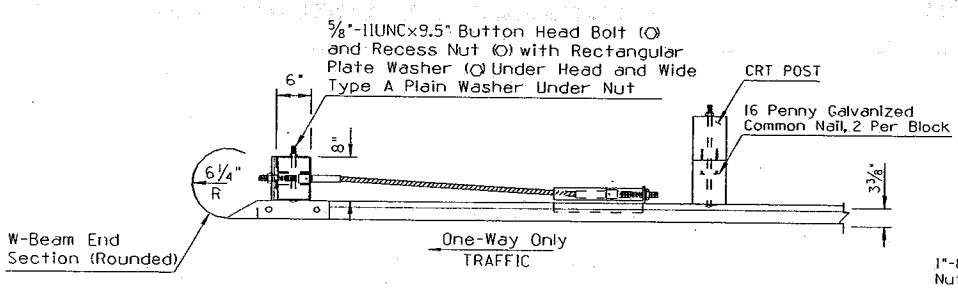


TYPE A GUARDRAIL INSTALLATION

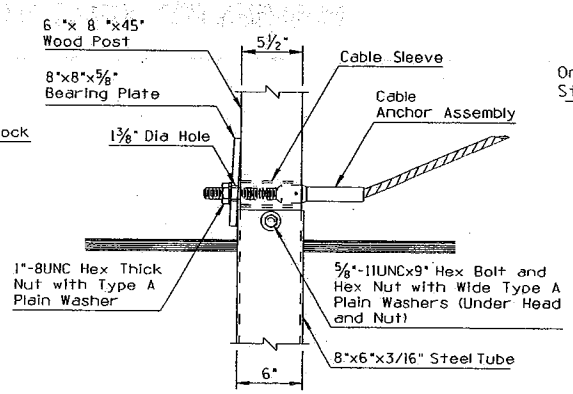
NOTES:

1. Distance = 50' for 50' Terminal Length
   Distance = 37.5' for 37.5' Terminal Length
   Distance = 25' for 25' Terminal Length

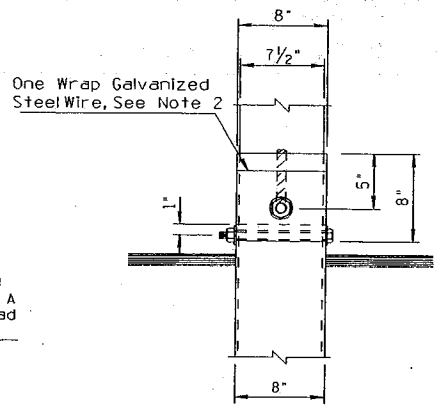
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	END TERMINAL LAYOUT WITHOUT CURB AND GUTTER	DATE: 02/10	DETAIL NO. 3006



PLAN

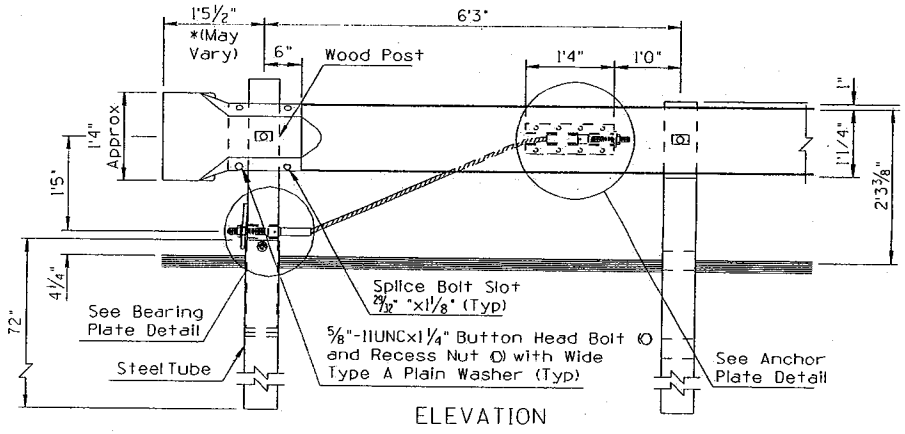


FRONT VIEW

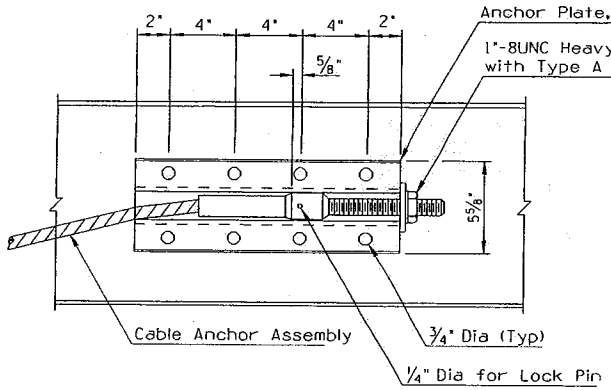


SIDE VIEW

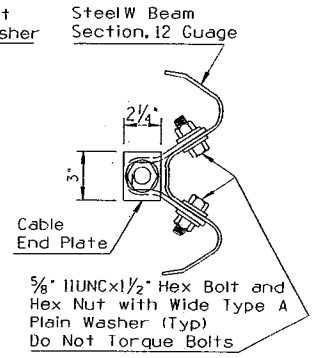
BEARING PLATE DETAIL



ELEVATION



FRONT VIEW



SIDE VIEW

ANCHOR PLATE DETAIL

GENERAL NOTES

1. The cable assembly shallbe tightened to remove slack.
2. To ensure that the bearing plate remains in position, one wrap of 14 gauge galvanized steelwire shallbe wrapped around the terminalpost near the top of the plate.
3. See W-Beam End Section (Rounded), ARTBA Std. RE-6-79, for dimension variables.

* See Std. 3016 for measurement limits.

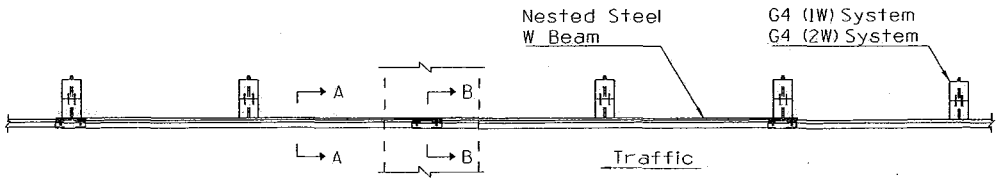
o Indicates ARTBA designation

Base Drawing Courtsey of ADOT 2/25/00

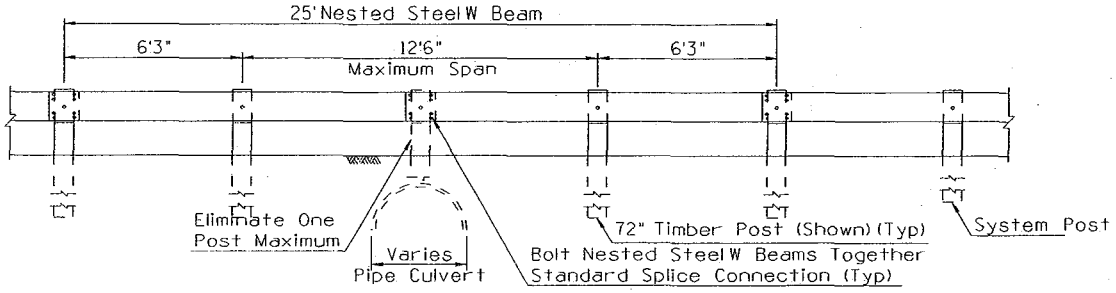
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	DEPARTMENT END TERMINAL	DATE: 6/20/01	DETAIL NO. 3007

GENERAL NOTES

1. ● - Indicates ARTBA designation.

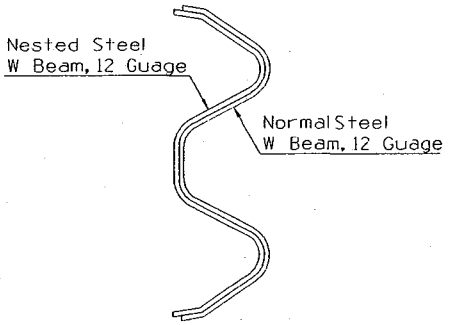


PLAN

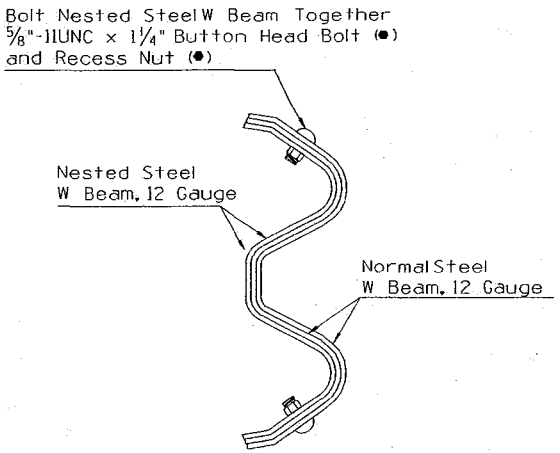


NESTED STEEL W BEAM - TYPE 1 - SHORT SPAN
(Splice Connection Inside Span) Length = 25'

ELEVATION



SECTION A-A



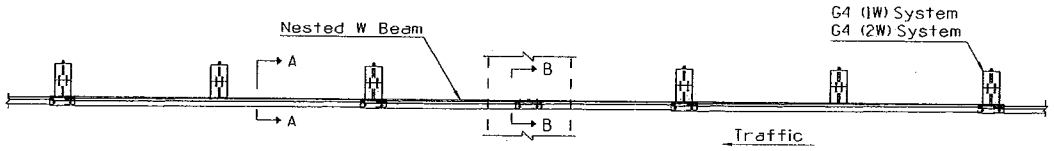
SECTION B-B

Base Drawing Courtsey of ADOT 2/25/00

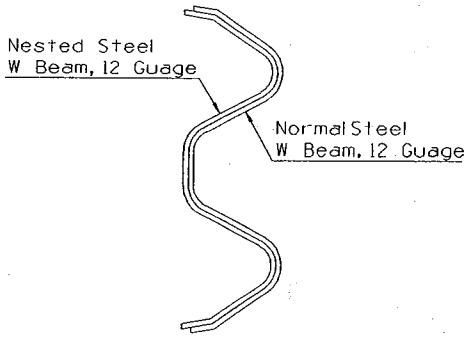
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	NESTED GUARDRAIL TYPE 1	DATE: 5/02/01	DETAIL NO. 3008-1

GENERAL NOTES

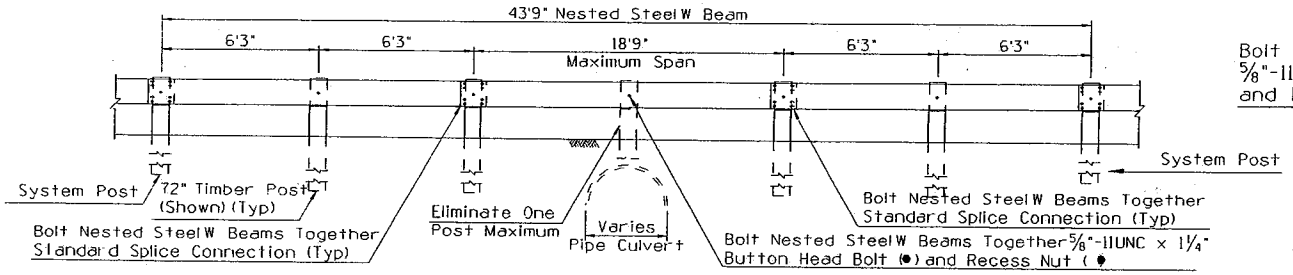
1. ● - Indicates ARTBA designation.



PLAN



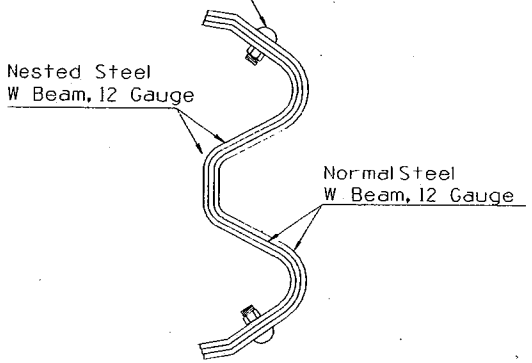
SECTION A-A



NESTED STEEL W BEAM - TYPE 2 - LONG SPAN
(Splice Connection Outside Span) Length = 43'9"

ELEVATION

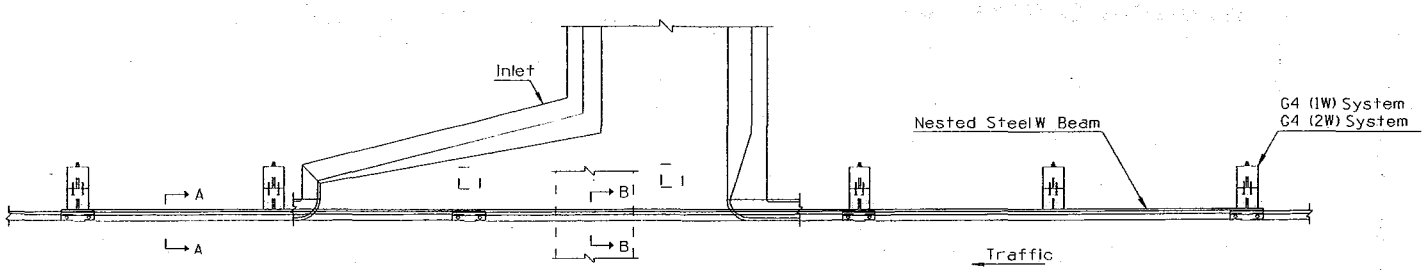
Bolt Nested Steel W Beam Together
5/8"-11UNC x 1 1/4" Button Head Bolt (●)
and Recess Nut (●)



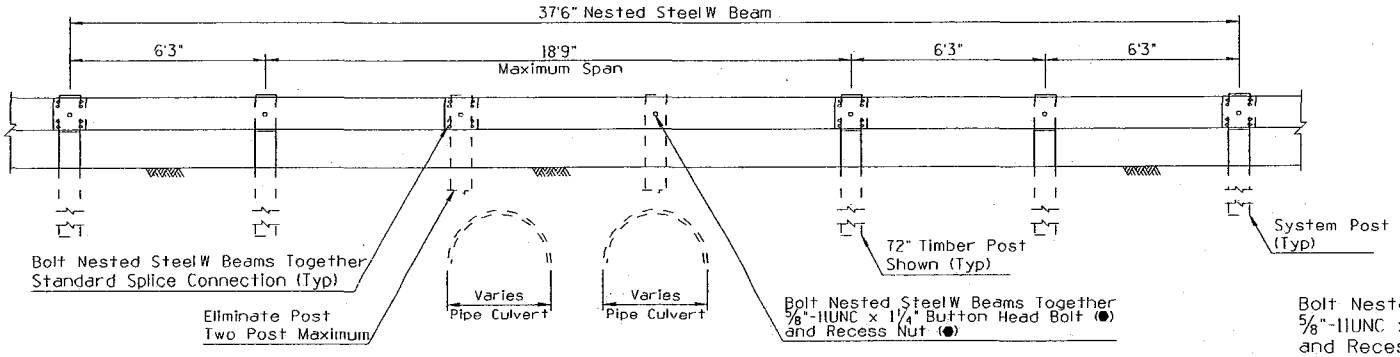
SECTION B-B

Base Drawing Courtsey of ADOT 2/25/00

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	NESTED GUARDRAIL TYPE 2	DATE: 6/27/01	DETAIL NO. 3008-2



PLAN

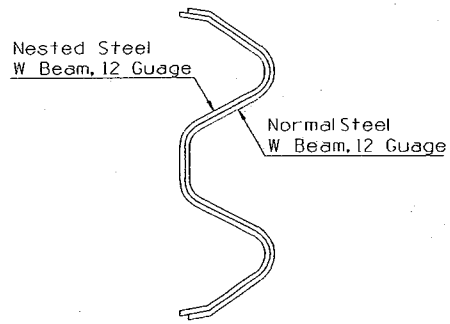


NESTED STEEL W BEAM - TYPE 3 - LONG SPAN
Length = 37'6"

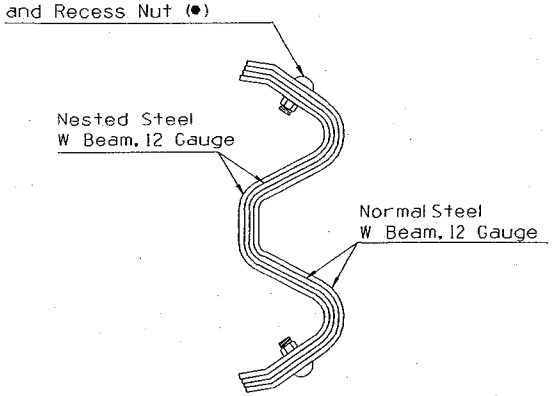
ELEVATION

GENERAL NOTES

1. Use Type 3 Nested Steel W Beam to span downdrain or spillway inlets as shown in the plan view.
2. Use Type 3 to span multiple obstructionsas shown in the elevation view.
3. See Std 3008-1 for additional information and dimensions



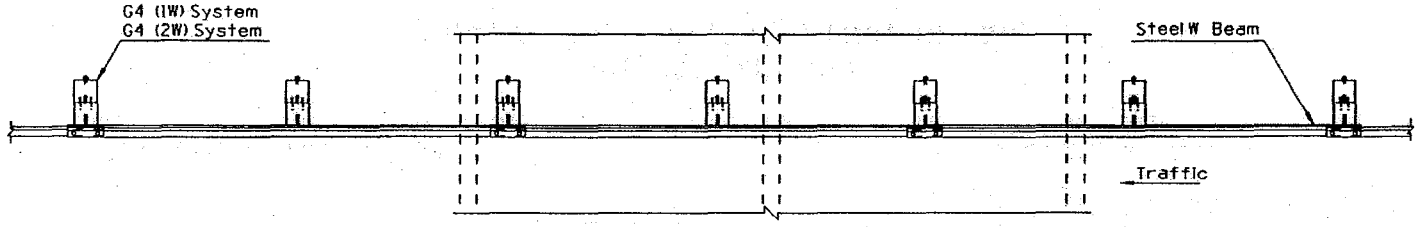
SECTION A-A



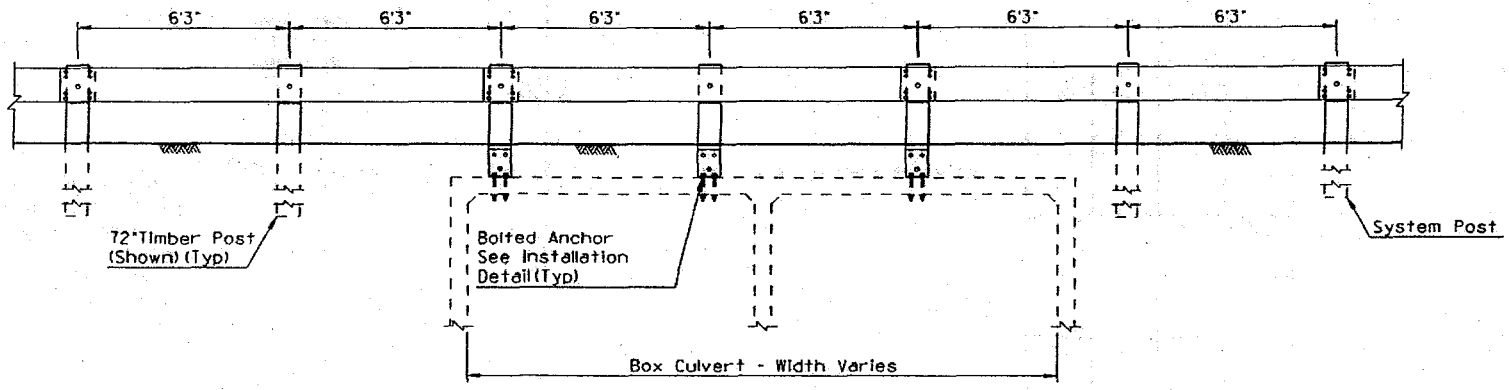
SECTION B-B

Base Drawing Courtsey of ADOT 2/25/00

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION **STANDARD DETAIL**	**NESTED GUARDRAIL TYPE 3**	**DATE: 5/01/01**	**DETAIL NO. 3008–3**



PLAN



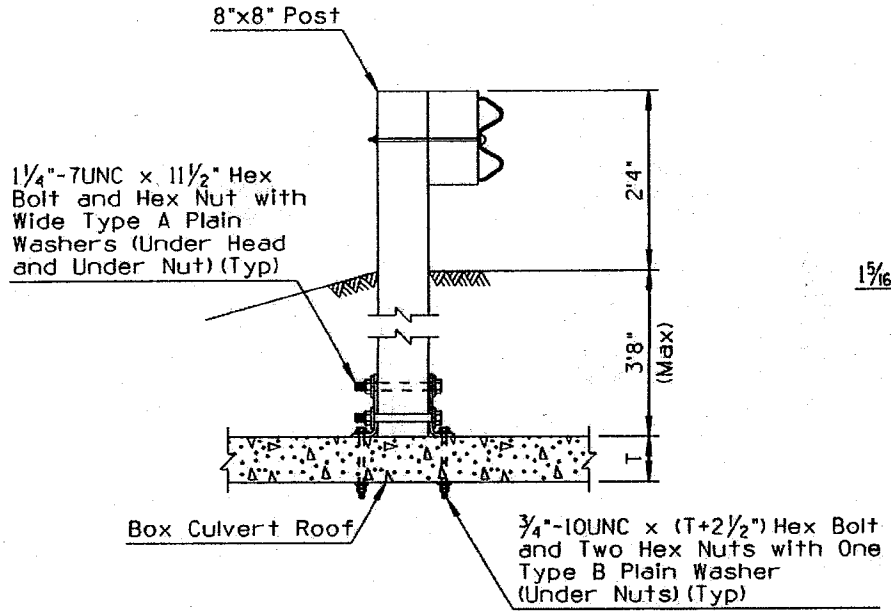
ELEVATION

BOLTED ANCHOR
BOX CULVERT INSTALLATION

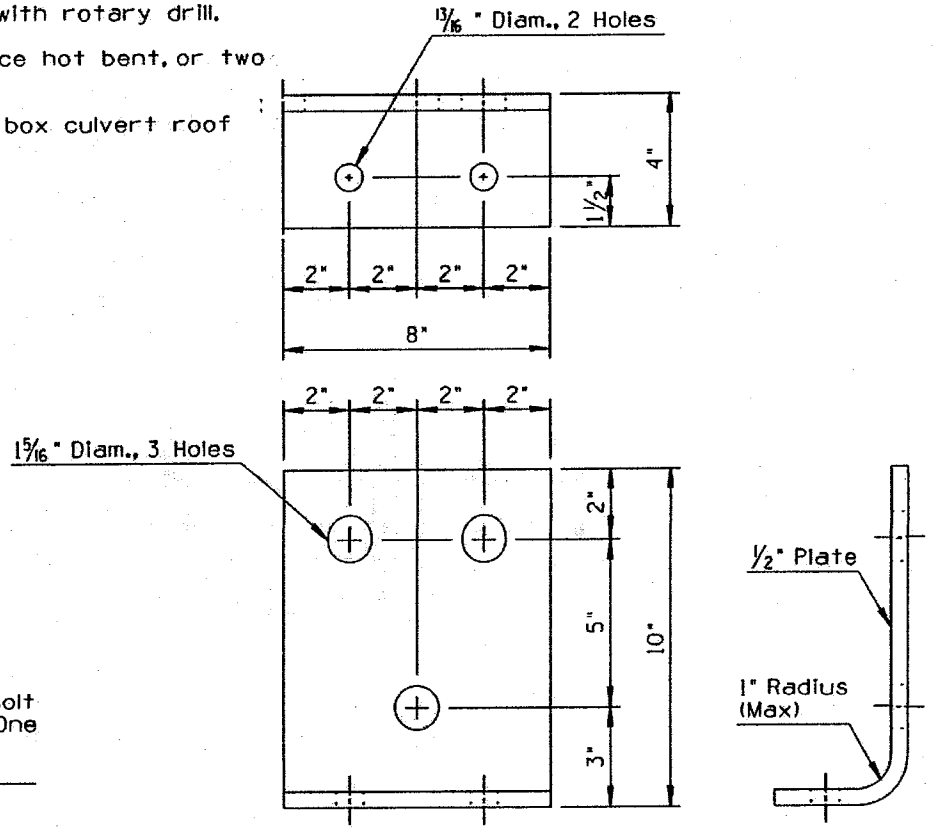
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	BOLTED GUARDRAIL ANCHORS	DATE: 11/19/09	DETAIL NO. 3010–1

GENERAL NOTES

1. Drill through top of box culvert with rotary drill.
2. Bracket may be made of one piece hot bent, or two pieces welded together.
3. Short timber posts anchored to box culvert roof shall be 8" x 8" only.



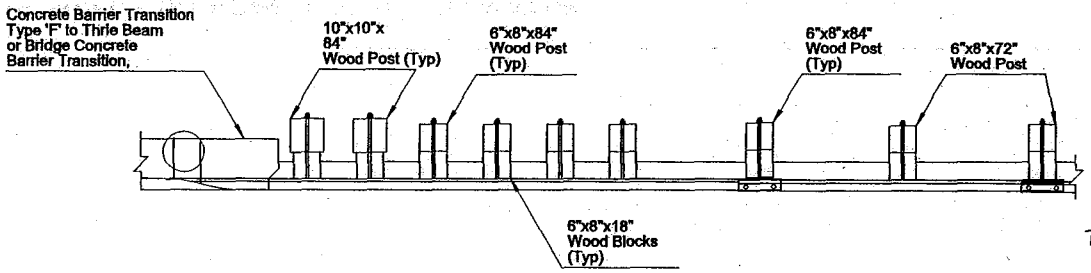
INSTALLATION DETAIL



BRACKET DETAIL

BOLTED ANCHOR
TIMBER POST INSTALLATION DETAIL

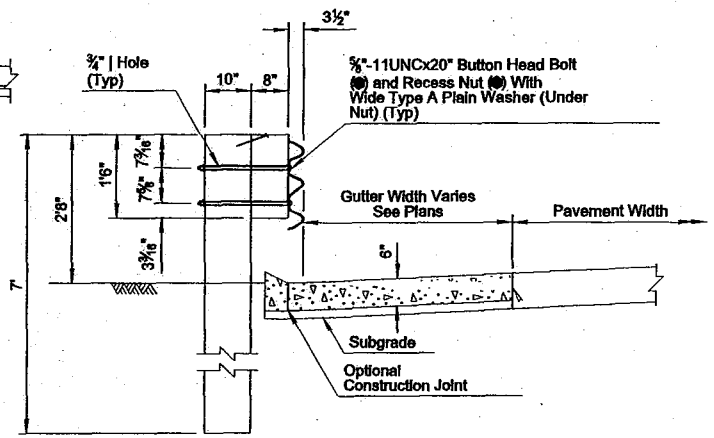
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	BOLTED GUARDRAIL ANCHORS	DATE: 11/19/09	DETAIL NO. 3010-2



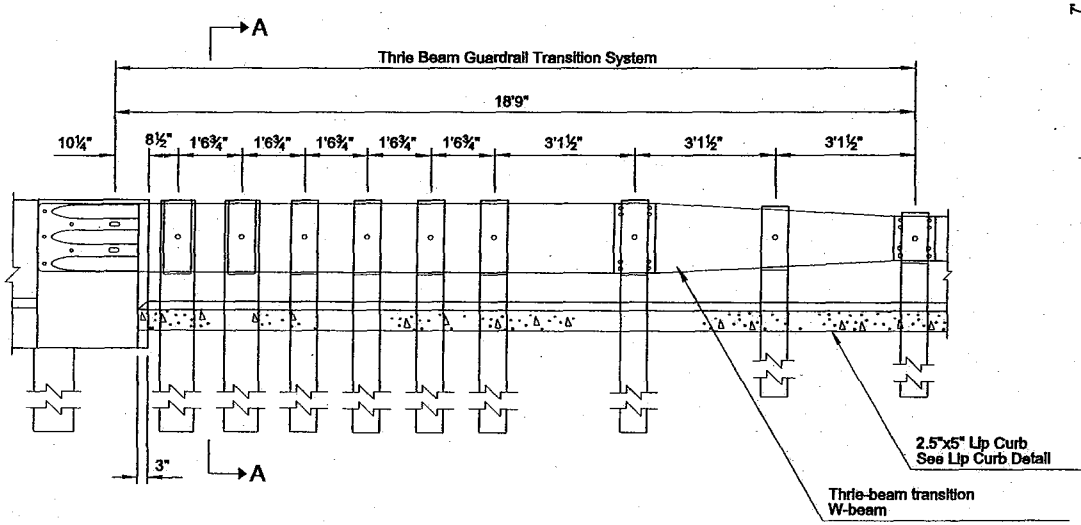
PLAN

GENERAL NOTES

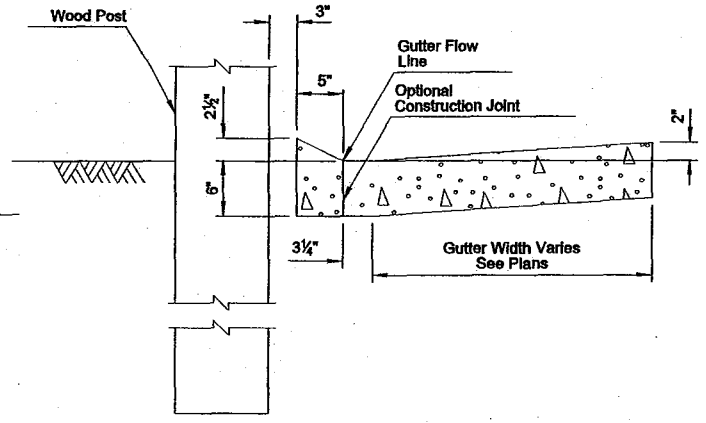
● - Indicate ARTBA designation.



SECTION A-A

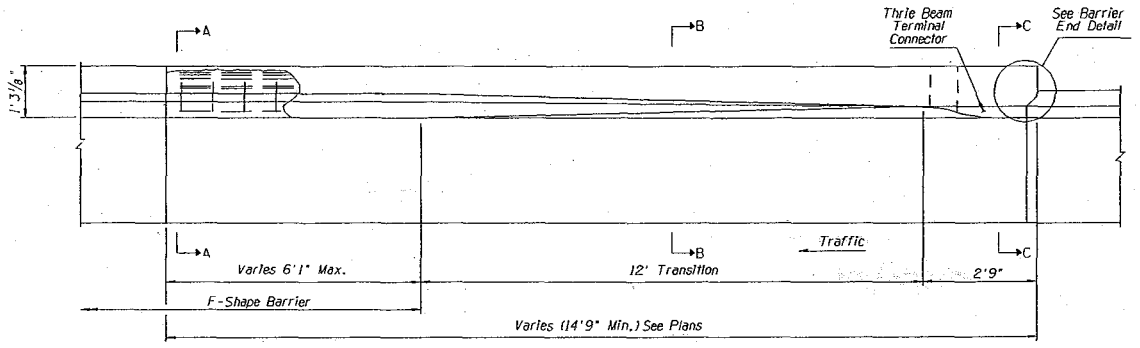


ELEVATION



LIP CURB DETAIL

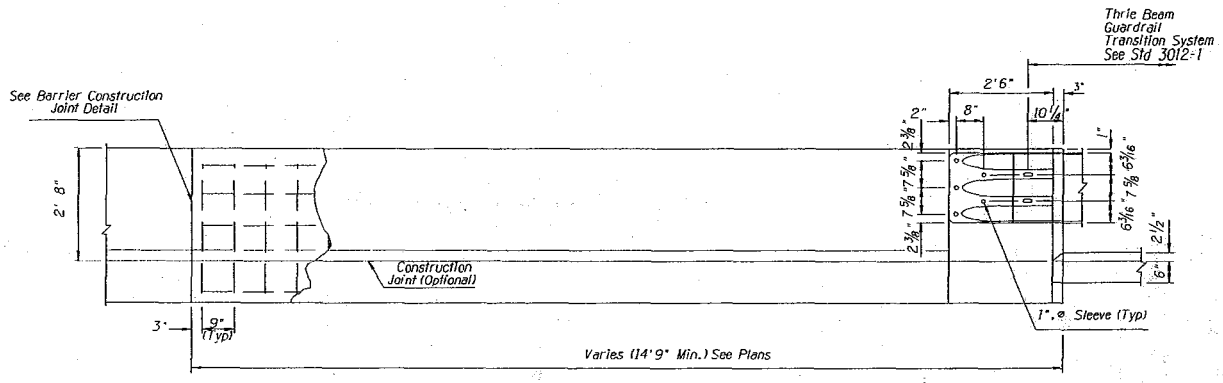
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	THRIE BEAM GUARDRAIL TRANSITION	DATE: 06/01	DETAIL NO. 3012-1



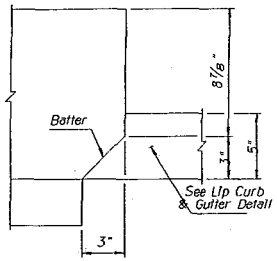
PLAN

GENERAL NOTES

1. Concrete shall be constructed by the Fixed Form Cast-In-Place method.
2. Concrete shall be Class A, design strength ≤ = 3000 psi.
3. All reinforcing steel shall have 2" minimum clear cover unless otherwise noted.
4. All bend dimensions for reinforcing steel shall out-to-out of bars.
5. See Plans for approach slab details



ELEVATION
BARRIER WITH CURB AND GUTTER

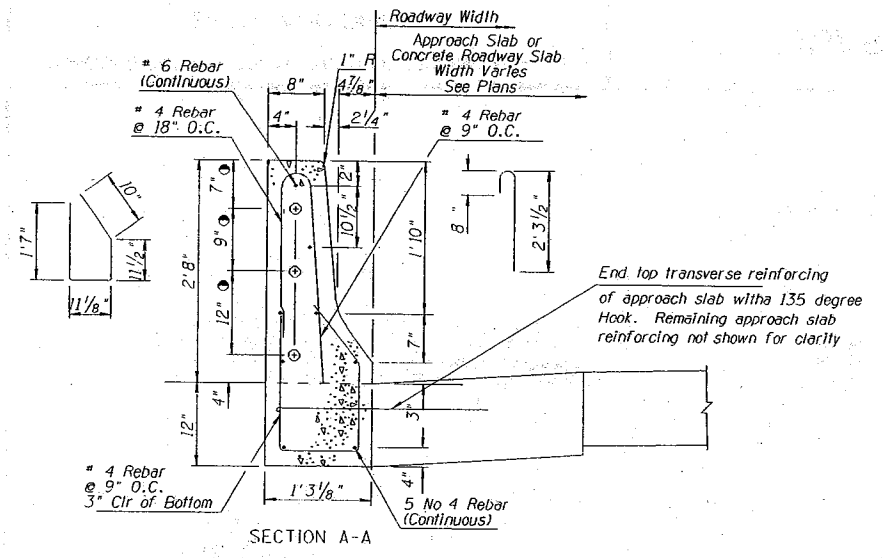


BARRIER END DETAIL

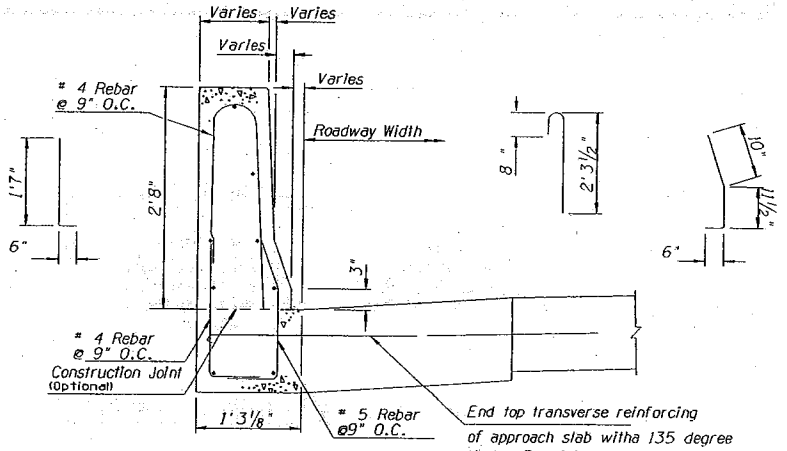
BARRIER END DETAIL

Base Drawing Courtsey of ADOT 2/25/00

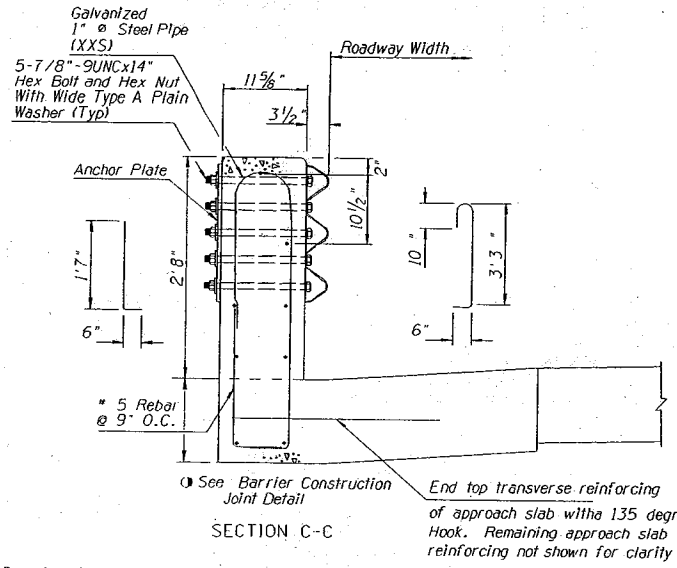
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CONCRETE HALF BARRIER TRANSITION	DATE: 5/02/01	DETAIL NO. 3012-2



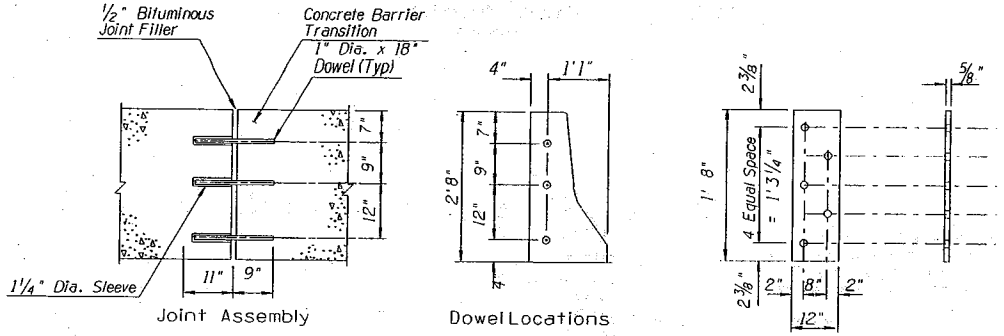
SECTION A-A



SECTION B-B



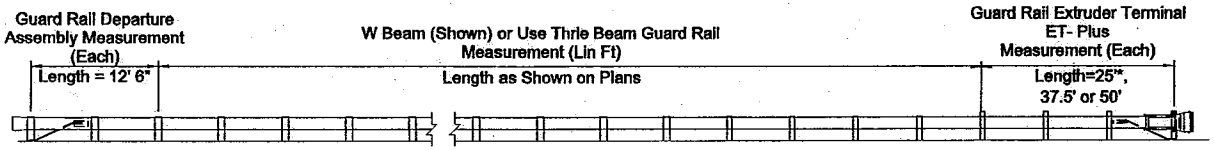
SECTION C-C

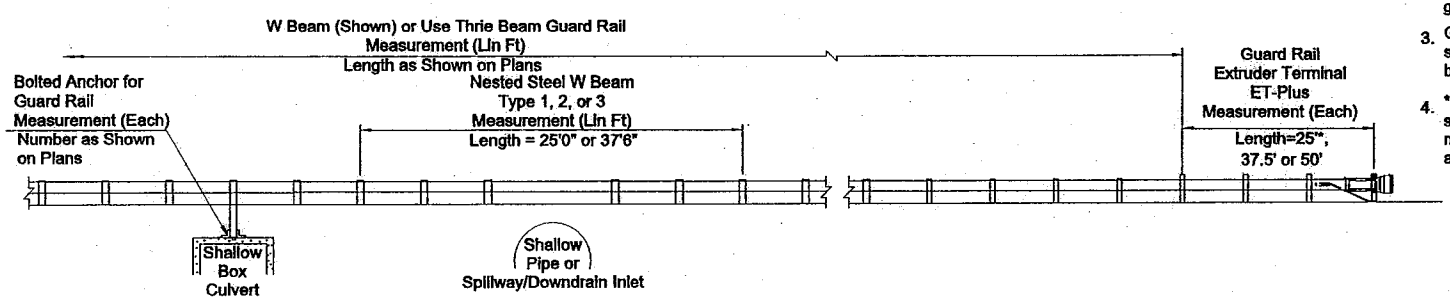


BARRIER CONSTRUCTION JOINT DETAIL

Base Drawing Courtsey of ADOT 2/25/00

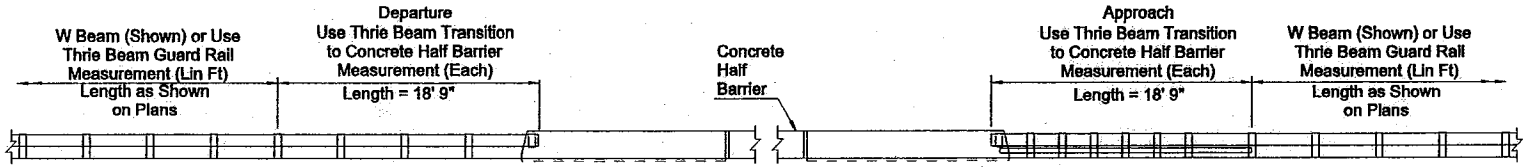
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	BARRIER DETAIL	DATE: 8/06/01	DETAIL NO. 3012-3



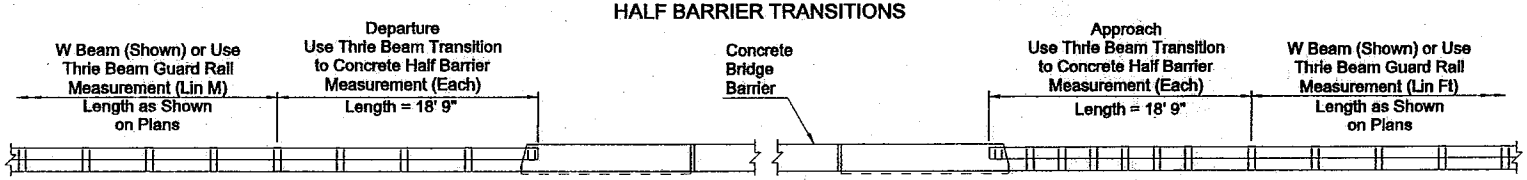


GENERAL NOTES

1. Length shall be as shown unless otherwise indicated on project plans.
2. Post type for transitions shall match post type of adjoining guardrail.
3. Guardrail Extruder Terminals may be shortened to 37' 5" as approved by the Engineer.
4. * 25' Length can be used for design speed @ or below 45 mph and as per manufacture's recomendations for TL2 and as approved by the engineer.



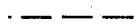
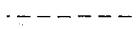
HALF BARRIER TRANSITIONS



BRIDGE BARRIER TRANSITIONS

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	GUARDRAIL MEASUREMENT	DATE: 6/09	DETAIL NO. 3016

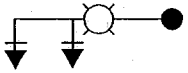
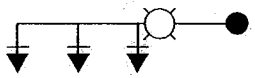
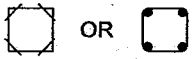
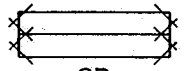
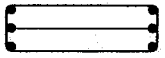
SYMBOLS

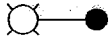
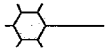
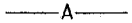
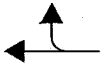
SYMBOL	DESCRIPTION
	NO. 3½ PULL BOX
	NO. 3½ PULL BOX NUMBER
	NO 5 PULL BOX
	NO. 5 PULL BOX W / EXTENTION
	NO. 5 PULL BOX NUMBER
	NO 7 PULL BOX
	NO. 7 PULL BOX W / EXTENTION
	NO. 7 PULL BOX NUMBER
	2", 2½" AND 3" PVC CONDUIT RUN
	LOOP DETECTOR LEAD
	CONDUIT RUN NUMBER
	POLE FOUNDATION
	POLE FOUNDATION LETTER
	COMBINATION ELECTRICAL SERVICE PEDESTAL (SP) AND BATERRY BACK-UP (BBS) FOUNDATION LETTERS
	TRAFFIC SIGNAL POLE
	MULTI-USE TRAFFIC SIGNAL POLE (EXISTING)
	'P' CABINET FOUNDATION W/ CONCRETE PAD
	'G' CONTROL CABINET (EXISTING OR ITS ONLY)
	METER SOCKET W / CIRCUIT BREAKER BOX (EXISTING)
	COMBINATION ELECTRICAL SERVICE PEDESTAL (SP) AND BATERRY BACK-UP (BBS) FOUNDATION AND CABINET

SYMBOL	DESCRIPTION
	TRAFFIC SIGNAL INDICATION (TYPE 'F')
	TRAFFIC SIGNAL INDICATION W / DIRECTIONAL ARROWS (TYPE 'Q')
	TRAFFIC SIGNAL INDICATION W / DIRECTIONAL ARROWS (TYPE 'R')
	FLASHER SIGNAL INDICATION
	TYPE 'A' POLE W / SIGNAL INDICATION
	VIDEO DETECTION CAMERA OR CCTV CAMERA

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TRAFFIC SIGNAL SYMBOLS	DATE: 4/09	DETAIL NO. 4701

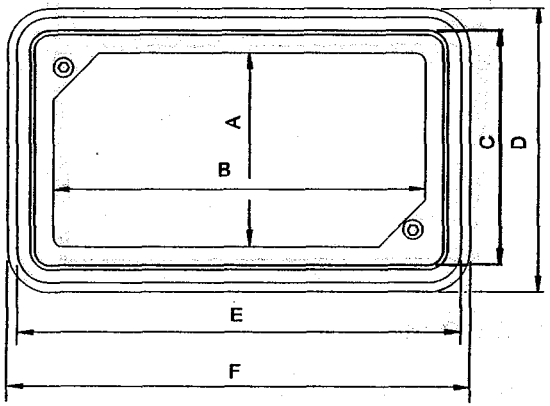
SYMBOLS

SYMBOL	DESCRIPTION
	TYPE 'E' OR 'J' POLE W/ SIGNAL MAST ARM & TRAFFIC SIGNAL INDICATIONS 1-EACH AERIAL INDICATION FOR TYPE 'E' POLES 2-EACH AERIAL INDICATIONS FOR TYPE 'J' POLES
	TYPE 'F' OR 'Q' POLE W/ SIGNAL MAST ARM, LUMINAIRE MAST ARM & TRAFFIC SIGNAL INDICATIONS 1-EACH AERIAL INDICATION FOR TYPE 'F' POLES 2-EACH AERIAL INDICATIONS FOR TYPE 'Q' POLES
	TYPE 'K' POLE W/ SIGNAL MAST ARM & TRAFFIC SIGNAL INDICATIONS 3-EACH AERIAL INDICATION FOR TYPE 'K' POLES
	TYPE 'R' POLE W/ SIGNAL MAST ARM, LUMINAIRE MAST ARM & TRAFFIC SIGNAL INDICATIONS 3-EACH AERIAL INDICATION FOR TYPE 'R' POLES
	PEDESTRIAN SIGNAL INDICATION
	PEDESTRIAN PUSH BUTTON W/ SIGN MOUNTED ON SIGNAL POLE
	ELECTRICAL POINT OF SERVICE
 OR	ADVANCE LOOP DETECTOR (SIZE AS INDICATED) (DIAGONAL OR CORNER POINTS ARE CORE DRILLED)
 OR 	PRESENCE/CALL LOOP DETECTOR (SIZE AS INDICATED) (DIAGONAL OR CORNER POINTS ARE CORE DRILLED)

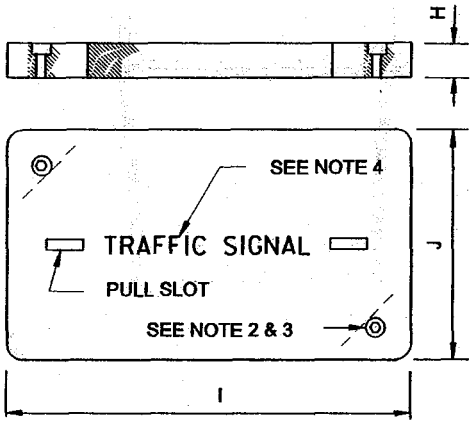
SYMBOL	DESCRIPTION
	MCDOT LUMINAIRE ON MAST ARM
	LUMINAIRE ON MAST ARM (BY OTHERS)
	AERIAL CABLE
	PEDESTRIAN MOVEMENT
	VEHICLE MOVEMENT

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TRAFFIC SIGNAL SYMBOLS	DATE: 4/09	DETAIL NO. 4702

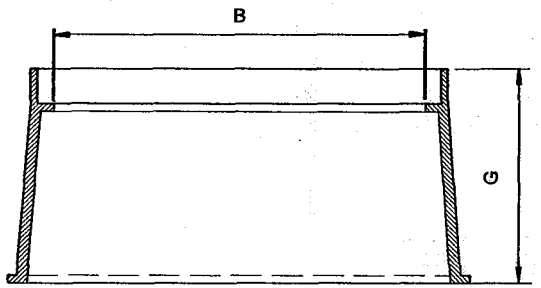
PULL BOX TYPE	A	B	C	D	E	F	G	H	I	J	PLAN SYMBOL
# 3½	8¾"	14"	12½"	14 7/16"	18"	19¾"	12"	1⅝"	15⅜"	10"	◇
# 5	12½"	22"	17"	19⅝"	26"	29"	12"	2"	23⅛"	13¾"	□
# 7	16¼"	29⅜"	20¾"	23¼"	34"	36⅞"	12"	2"	30½"	17⅝"	▭



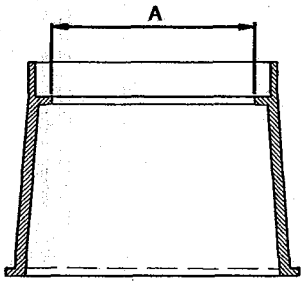
PULL BOX PLAN



COVER



FRONT VIEW



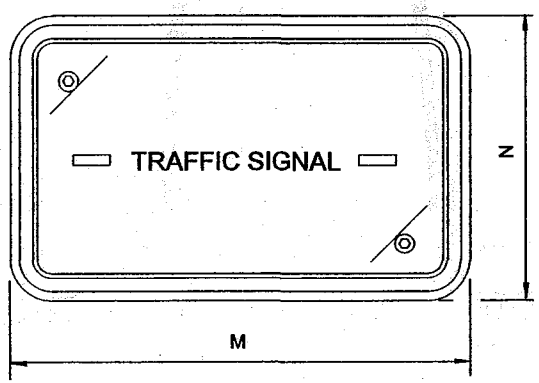
SIDE VIEW

NOTES:

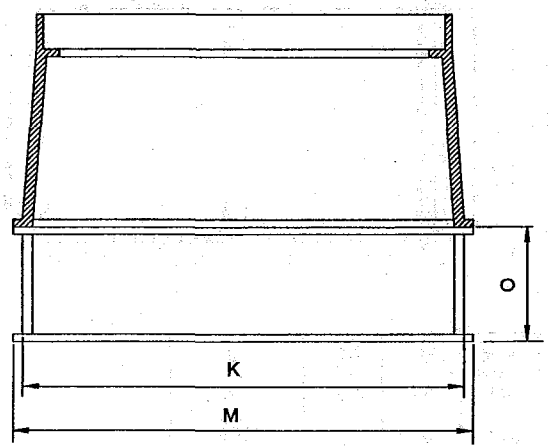
1. PULL BOX SHALL BE CONSTRUCTED OF POLYMER CONCRETE REINFORCED WITH HEAVY-WEAVE FIBERGLASS. CHRISTY FIBERLYTE FL9 (#3 1/2 PULLBOX), FL30 (# 5 PULL BOX), FL36 (# 7 PULL BOX) OR APPROVED EQUAL. SEE MCDOT SUPPLEMENT SECTIONS 470 THRU 478.
2. COVERS SHALL BE SECURED WITH ⅜" BOLTS AND WASHERS WHICH SHALL BE OF BRASS, STAINLESS STEEL, OR OTHER CORROSION RESISTANT MATERIALS.
3. INSERTS IN BOX, FOR COVER BOLTS, SHALL BE OF BRASS, STAINLESS STEEL OR OTHER CORROSION RESISTANT MATERIALS.
4. THE WORDS 'TRAFFIC SIGNAL' SHALL BE CAST ON PULL BOX COVER IN 1" HIGH LETTERS.
5. FOR TYPICAL TRAFFIC SIGNAL PULL BOX INSTALLATION SEE MCDOT STANDARD DETAIL NO. 4713.
6. FOR PULL BOX EXTENSIONS SEE MCDOT STANDARD DETAIL NO. 4712.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TRAFFIC SIGNAL PULL BOX DETAIL	DATE: 4/09	DETAIL NO. 4711

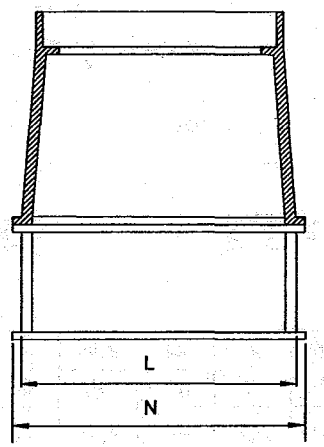
PULL BOX TYPE	K	L	M	N	O	PLAN SYMBOL
#5	26¼"	16⅞"	29"	19⅝"	8"	⊠
#7	33⅞"	21"	36⅞"	24¼"	8"	⊠



PULL BOX PLAN



FRONT VIEW



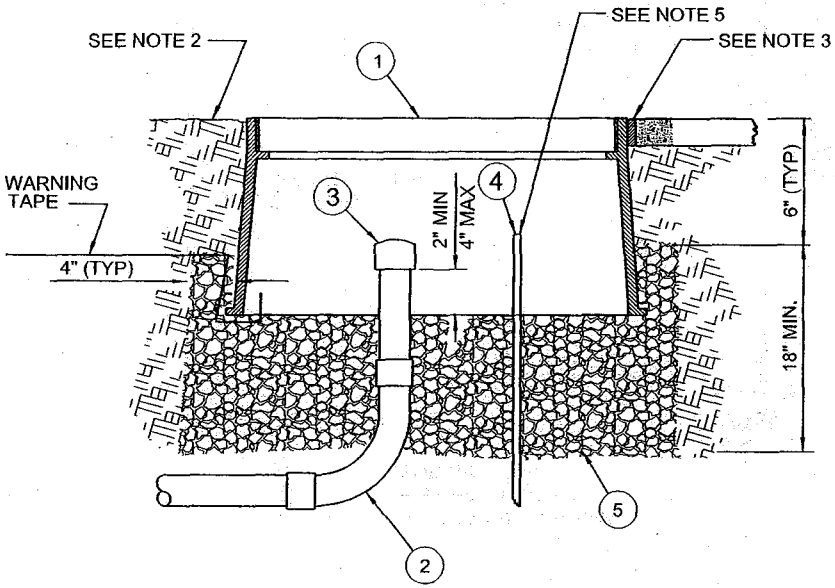
SIDE VIEW

NOTES:

1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS, SEE MCDOT SUPPLEMENT SECTIONS 471 THRU 478,
2. PULL BOX SHALL BE CONSTRUCTED OF POLYMER CONCRETE REINFORCED WITH HEAVY-WEAVE FIBERGLASS. CHRISTY FIBERLYTE FL30 (#5 PULL BOX), FL36 (#7 PULL BOX) OR APPROVED EQUAL.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TRAFFIC SIGNAL PULL BOX EXTENSION	DATE: 4/09	DETAIL NO. 4712

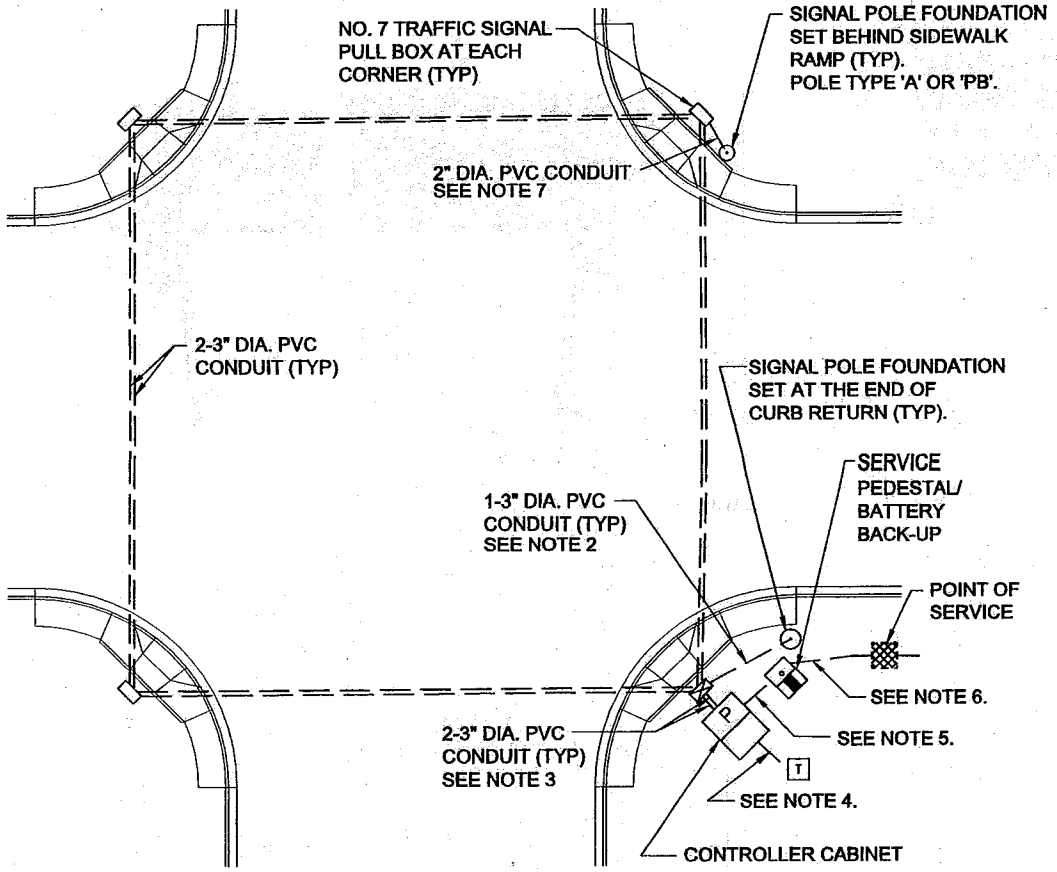
ITEM	QTY.	DESCRIPTION
①	1	PULL BOX (SEE STD. DWG. 4711)
②	1	PVC ELECTRICAL CONDUIT, SCH. 40
③	1	PVC CAP
④	1	5/8" x 8' LONG GROUNDING ELECTRODE
⑤	1	1" SHORT GRADE ROCK



NOTES:

1. FOR MATERIAL AND CONSTRUCTION INSTALLATION SPECIFICATIONS SEE SECTION 471
2. BACKFILL WITH EXCAVATED MATERIAL AND COMPACT.
3. EXPANSION JOINT MATERIAL SHALL BE USED AROUND PULL BOX WHEN INSTALLED IN CONCRETE AREA.
4. WHEN INSTALLING PVC CONDUIT IT SHALL ENTER NEAR SIDES OF PULLBOX.
5. GROUNDING ELECTRODE.

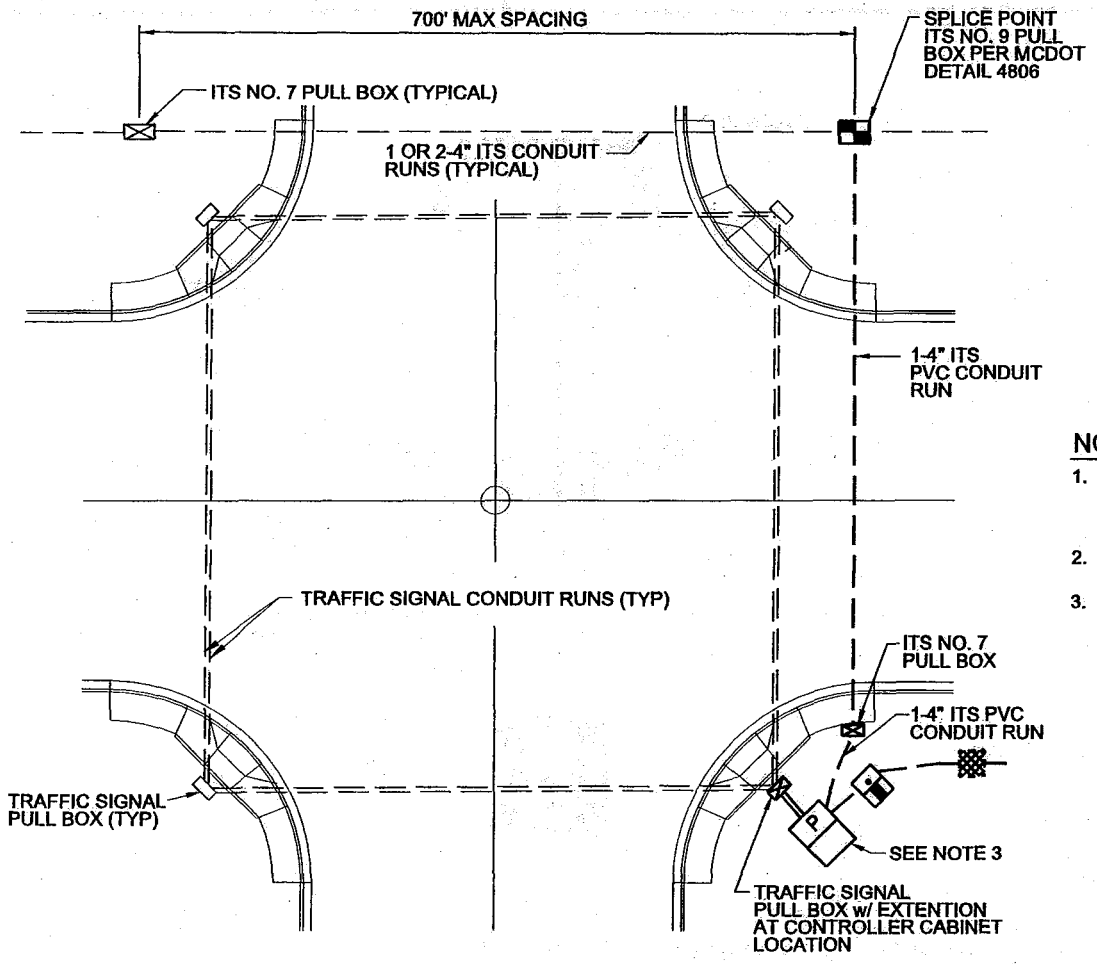
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPICAL TRAFFIC SIGNAL PULL BOX INSTALLATION	DATE: 1/1/2011	DETAIL NO. 4713



NOTES:

1. FOR MATERIAL AND SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478
2. INSTALL 3" DIA. PVC CONDUIT BETWEEN TYPE "E", "F", "J", "Q", "K" or "R" POLE FOUNDATION LOCATIONS AND NO. 7 SIGNAL PULL BOXES. (TYP).
3. INSTALL 2-3" DIA. PVC CONDUIT BETWEEN CONTROL CABINET AND NO. 7 SIGNAL PULL BOX WITH EXTENTION.
4. INSTALL 3" DIA. PVC CONDUIT BETWEEN TELEPHONE SERVICE PEDESTAL AND CONTROLLER CABINET.
5. INSTALL 2" DIA. PVC CONDUIT BETWEEN SERVICE PEDESTAL/ BATTERY BACK-UP CABINET FOUNDATION AND CONTROLLER CABINET FOUNDATION. MINIMUM SPACING SHALL BE 10'.
6. INSTALL 2½" OR 3" DIA. PVC CONDUIT BETWEEN POINT OF SERVICE SERVICE PEDESTAL/BATTERY BACK-UP FOUNDATIONS REQUIRED BY THE ELECTRICAL SERVICE COMPANY.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPICAL TRAFFIC SIGNAL PULL BOX AND CONDUIT RUN LAYOUT	DATE: 4/09	DETAIL NO. 4716

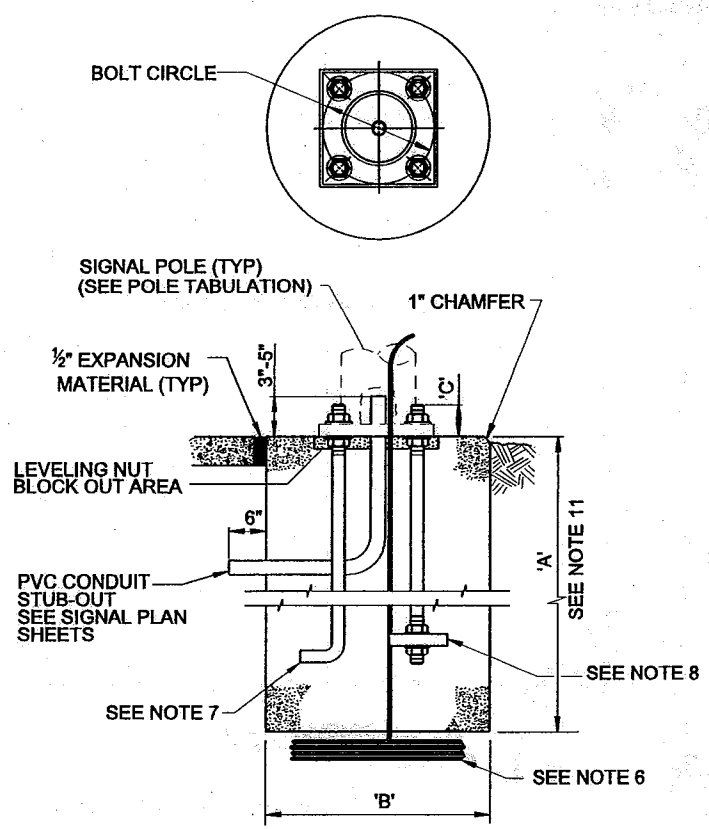


NOTES:

1. FOR ITS CONDUIT AND PULL BOXES, SEE MCDOT SUPPLEMENT, SECTION 481AND MCDOT DETAILS 4801, 4805 AND 4806.
2. ITS CONDUIT CONTENTS AS PER THE PLANS AND DETAIL 4801.
3. CONTROLLER CABINEET LOCATION MAY VARY. ADJUST ITS PULL BOX AND CONDUIT LAYOUT AS NEEDED TO PROVIDE A DIRECT PATH FROM SPLICE POINT TO CONTROLLER CABINET.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS INTERCONNECT CONDUIT AND PULL BOX LAYOUT	DATE: 4/09	DETAIL NO. 4717

POLE TYPE	BOLT CIRCLE	ANCHOR BOLTS	BLOCK OUT AREA	DIM. A	DIM. B	DIM. C
A-14'	10½"	1"x36"x4"	11" x 11" x 1"	3'	2'	3"
E	11½"	1¼"x 52" w/PLATE	12" x 12" x 1"	5'	3'	3"
F	11½"	1¼"x 52" w/PLATE	12" x 12" x 1"	5'	3'	3"
PB	10½"	¾"x 16"x4"	11" x 11" x 1"	2'	2'	2½"

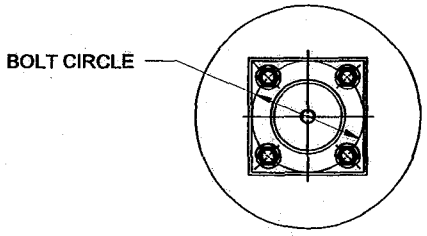


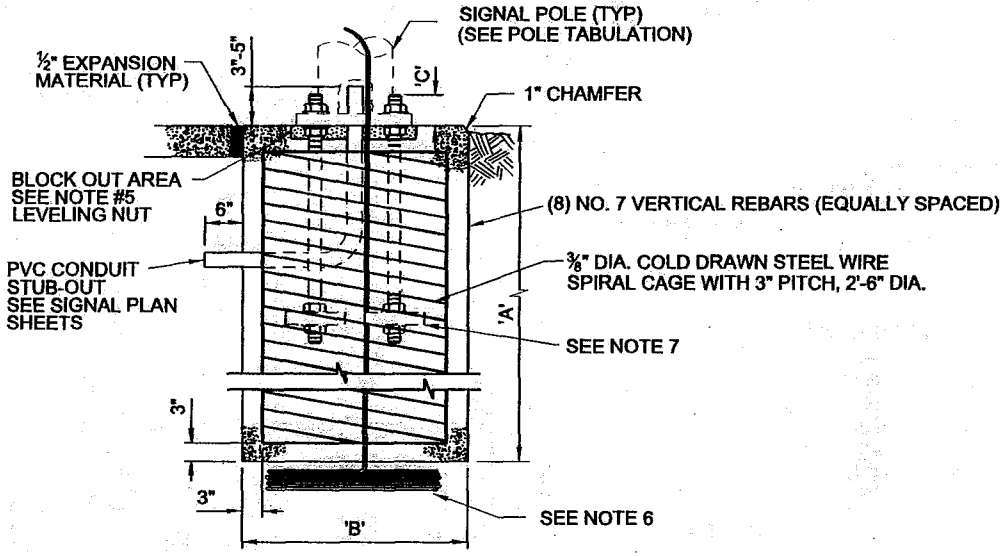
NOTES:

1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS SEE SECTIONS 470 THRU 478.
2. UNLESS OTHERWISE SPECIFIED, SET ANCHOR BOLTS PARALLEL TO ROADWAY CENTERLINE.
3. ANCHOR BOLTS SHALL BE PLUMBED.
4. SECURE NUTS AND FLAT WASHERS WRENCH TIGHT ON ANCHOR BOLTS.
5. AFTER POLE IS SET AND PLUMBED, GROUT BLOCK OUT AREA.
6. INSTALL 25 FOOT COIL OF # 4 AWG BARE COPPER GROUNDING ELECTRODE AS SHOWN. EXTEND END OF GROUNDING ELECTRODE 2 FEET ABOVE TOP OF FOUNDATION.
7. FOR TYPE 'A' POLE ANCHOR BOLTS SEE DETAIL 4725.
8. FOR TYPE 'E' & 'F' POLE ANCHOR BOLTS SEE DETAIL 4726.
9. INSTALL 3" DIA. PVC CONDUIT STUB-OUT FOR TYPE 'E' & 'F' POLES.
10. INSTALL 2" DIA. PVC CONDUIT STUB-OUT FOR TYPE 'A' & 'PB' POLES.
11. UNSTABLE SOIL CONDITIONS FOR INSTALLING TYPE 'A' FOUNDATIONS MAY OCCUR. DEEPER FOUNDATION MAYBE REQUIRED.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIGNAL POLE FOUNDATION	DATE: 4/09	DETAIL NO. 4720

POLE TYPE	BOLT CIRCLE	ANCHOR BOLTS	BLOCK OUT AREA	DIM. A	DIM. B	DIM. C
'J'	18"	2" x 70" w/PLATE	19 x 19 x 2"	10'	3'	5"
'Q'	18"	2" x 70" w/PLATE	19 x 19 x 2"	10'	3'	5"
'K'	18"	2" x 70" w/PLATE	19 x 19 x 2"	10'	3'	5"
'K'	18"	2" x 70" w/PLATE	19 x 19 x 2"	10'	3'	5"

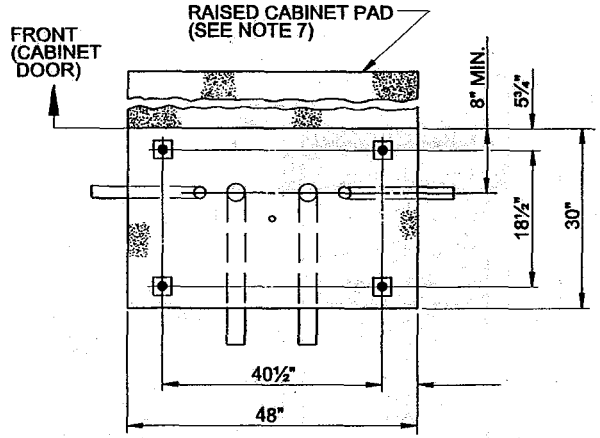


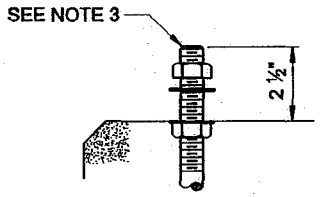


NOTES:

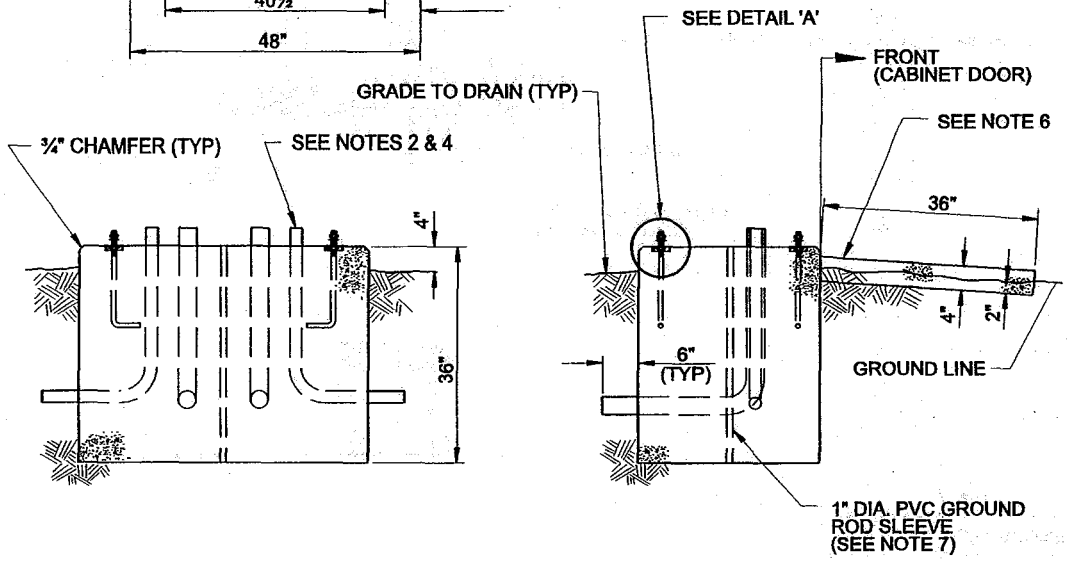
1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. UNLESS OTHERWISE SPECIFIED, SET ANCHOR BOLTS PARALLEL TO ROADWAY CENTERLINE.
3. ANCHOR BOLTS AND REPAIR CAGE SHALL BE PLUMBED.
4. SECURE NUTS AND FLAT WASHERS WRENCH TIGHT ON ANCHOR BOLTS.
5. AFTER POLE IS SET AND PLUMBED, GROUT BLOCK OUT AREA.
6. INSTALL 25 FOOT COIL OF # 4 AWG BARE COPPER GROUNDING ELECTRODE AS SHOWN. EXTEND END OF GROUNDING ELECTRODE 2 FEET ABOVE TOP OF FOUNDATION.
7. FOR ANCHOR BOLT INFORMATION SEE MCDOT DETAIL 4726.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIGNAL POLE FOUNDATIONS	DATE: 4/09	DETAIL NO. 4721





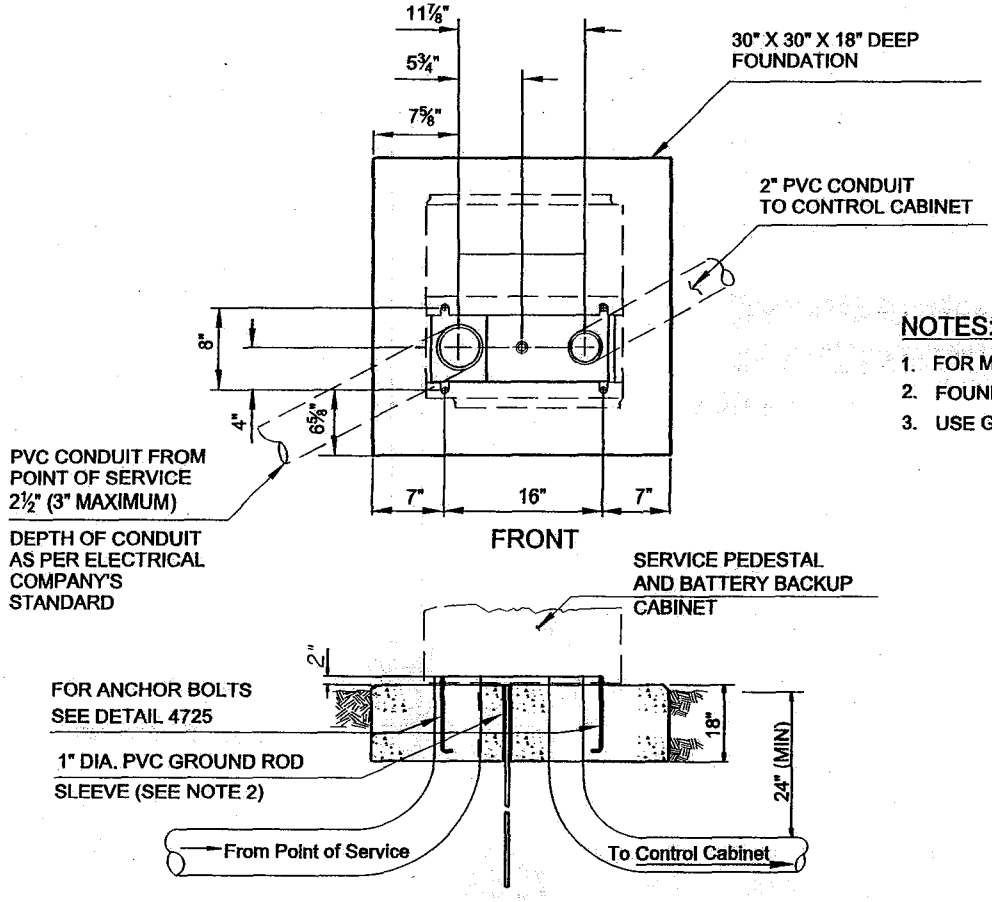
DETAIL 'A'



NOTES:

1. FOR MATERIAL AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT SECTIONS 470 THRU 478.
2. FOR CONDUIT SIZE, LOCATION, AND QUANTITY, SEE TRAFFIC SIGNAL PLAN.
3. FOR ANCHOR BOLT INFORMATION SEE MCDOT DETAIL 4725.
4. CONDUIT SHALL EXTEND A MINIMUM OF 2" AND A MAXIMUM OF 4" ABOVE THE TOP OF THE FOUNDATION EXCEPT THE CONDUIT FOR THE GROUND ROD, WHICH SHALL BE FLUSH WITH THE TOP OF THE FOUNDATION.
5. GROUT OR MASTIC SHALL BE USED TO SEAL GAP BETWEEN THE CABINET AND FOUNDATION.
6. IN UNPAVED AREAS A RAISED CABINET PAD, 36' X 4' X 48", SHALL BE PLACED IN FRONT OF CABINET AND FACED AWAY FROM INTERSECTION. PAD SHALL BE SET 2" BELOW THE FOUNDATION ELEVATION AND SLOPED AWAY FROM CABINET.
7. THE CABINET FOUNDATION SHALL HAVE A ⅝ X 8' BONDING COPPER ROD.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	'P' CABINET FOUNDATION	DATE: 4/09	DETAIL NO. 4723



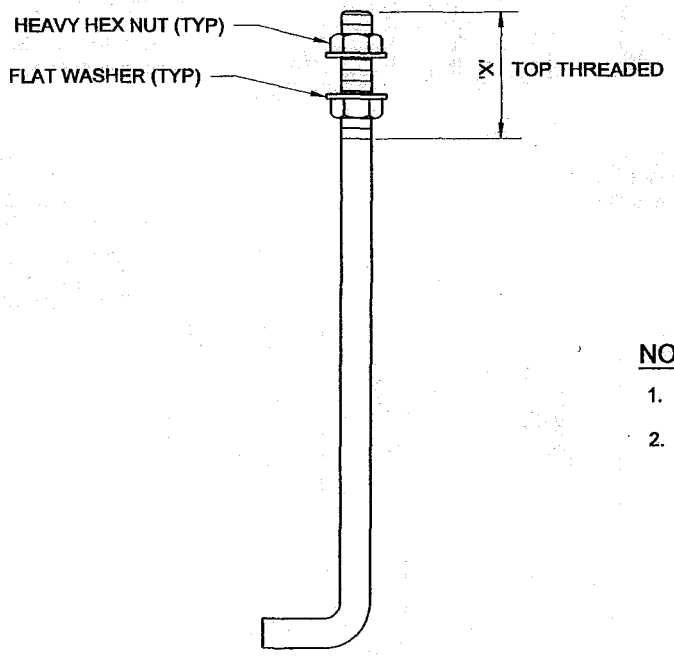
NOTES:

1. FOR MATERIAL AND CONSTRUCTION SPECIFICATION SEE SECTION 472.
2. FOUNDATIONS SHALL HAVE A ⅝" x 10' BONDED COPPER GROUNDING ROD.
3. USE GROUT OR MASTIC TO SEAL GAP BETWEEN THE CABINET AND FOUNDATION.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	COMBINATION SERVICE PEDESTAL AND BATTERY BACKUP FOUNDATION	DATE: 1/1/2011	DETAIL NO. 4724

CABINET OR PEDESTAL	DETAIL	ANCHOR BOLTS	DIM. X
'P' (CABINET)	4723	¾"x 16"x 4"	3"
COMBINATION 'SP'(PEDESTAL) & 'BBS'(CABINET)	4724	½"x 12"x 3"	3"
SERVICE PEDESTAL	4829	½"x 12"x 3"	3"

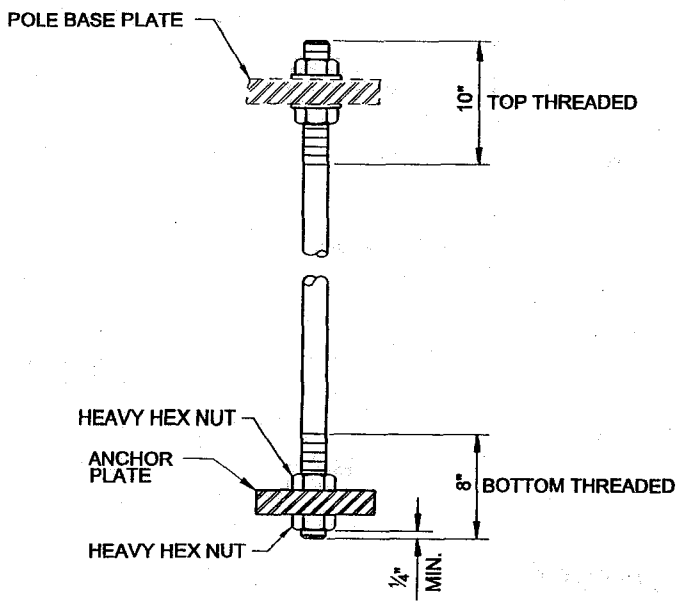
POLE TYPE	DETAIL	ANCHOR BOLTS	DIM. X
'A'	4720	1"x 36"x 4"	6"
'SB'	4825-2	¾"x 18"x 4"	3"
'PB'	4750	¾"x 16"x 4"	3"



NOTES:

1. ALL ANCHOR BOLTS, WASHERS, AND NUTS SHALL BE FABRICATED FROM STEEL CONFORMING TO THE STRENGTH REQUIREMENTS OF ASTM A-325.
2. EACH ANCHOR BOLT SHALL INCLUDE TWO FLAT WASHERS AND TWO NUTS, AND SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM B-633.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ANCHOR BOLT WITH HOOK	DATE: 1/1/2011	DETAIL NO. 4725

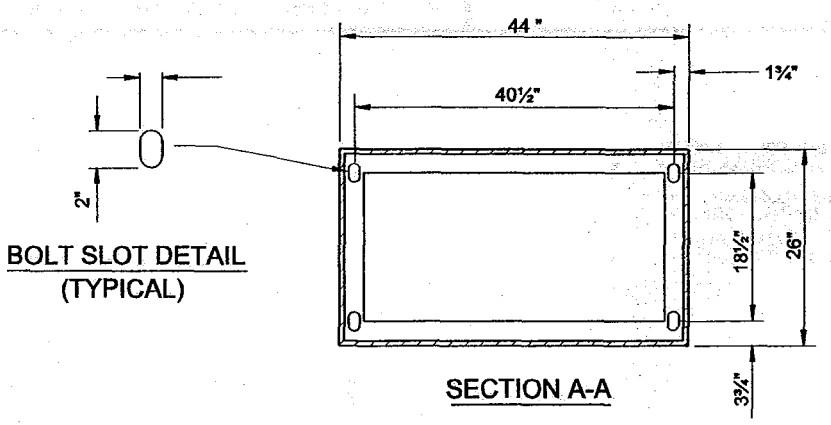


ANCHOR BOLT WITH PLATE				
POLE TYPE	DRAWING NO.	NOMINAL DIA.(In.)	TOTAL LENGTH(In.)	PLATE SIZE
'E'	4740	1¼"	52"	⅞" x 3½" x 3½"
'F'	4741-1	1¼"	52"	⅞" x 3½" x 3½"
'J'	4742	2"	70"	1½"x 5½"x 5½"
'Q'	4743	2"	70"	1½"x 5½"x 5½"
'K'	4748	2"	70"	1½"x 5½"x 5½"
'R'	4749-1	2"	70"	1½"x 5½"x 5½"

NOTES:

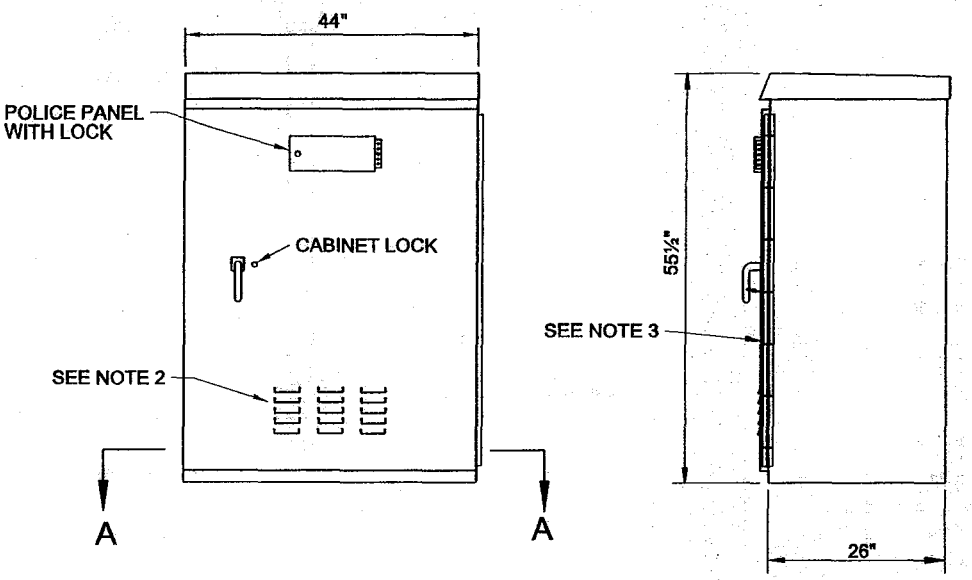
1. FOR INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. ALL ANCHOR BOLTS, WASHERS, AND NUTS SHALL BE FABRICATED FROM STEEL CONFORMING TO THE STRENGTH REQUIREMENTS OF ASTM A-325.
3. EACH ANCHOR BOLT SHALL INCLUDE FOUR (4) FLAT WASHERS AND FOUR (4) NUTS, AND SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM B-633.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ANCHOR BOLT WITH PLATE	DATE: 4/09	DETAIL NO. 4726



BOLT SLOT DETAIL
(TYPICAL)

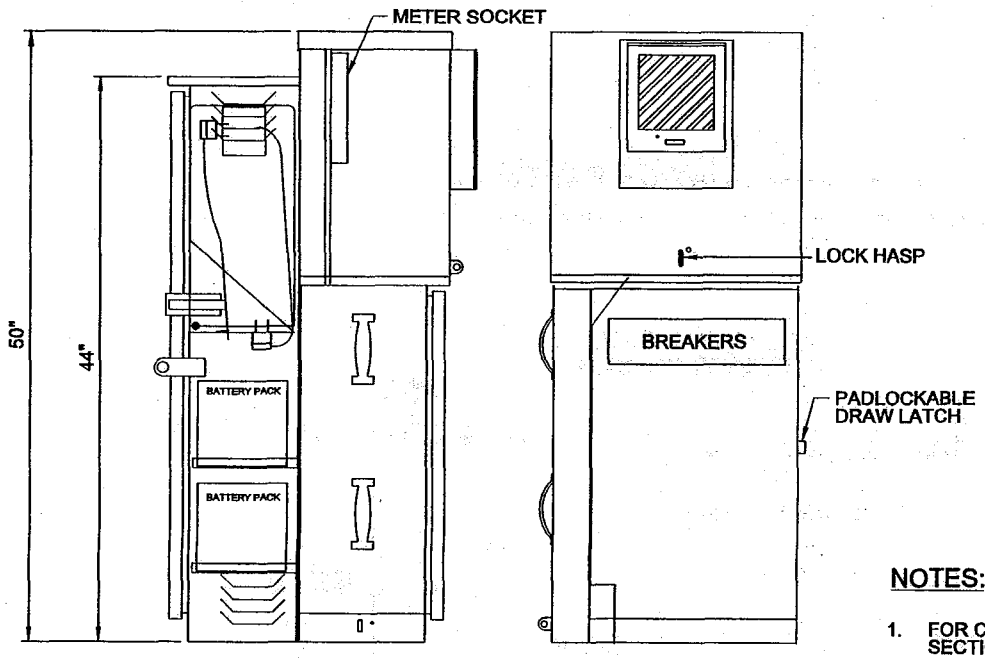
SECTION A-A



NOTES:

1. FOR MATERIAL AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT SECTIONS 470 THRU 478.
2. VENTILATING AIR INLET LOUVERS 12" X 24" X 1" AIR FILTER.
3. FRONT OF CABINET SHALL FACE AWAY FROM INTERSECTION.

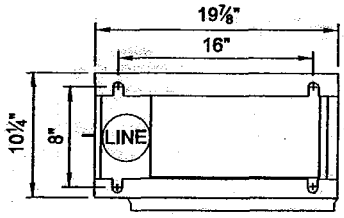
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	'P' CABINET	DATE: 4/09	DETAIL NO. 4730



LEFT SIDE

FRONT VIEW

PLAN SYMBOL

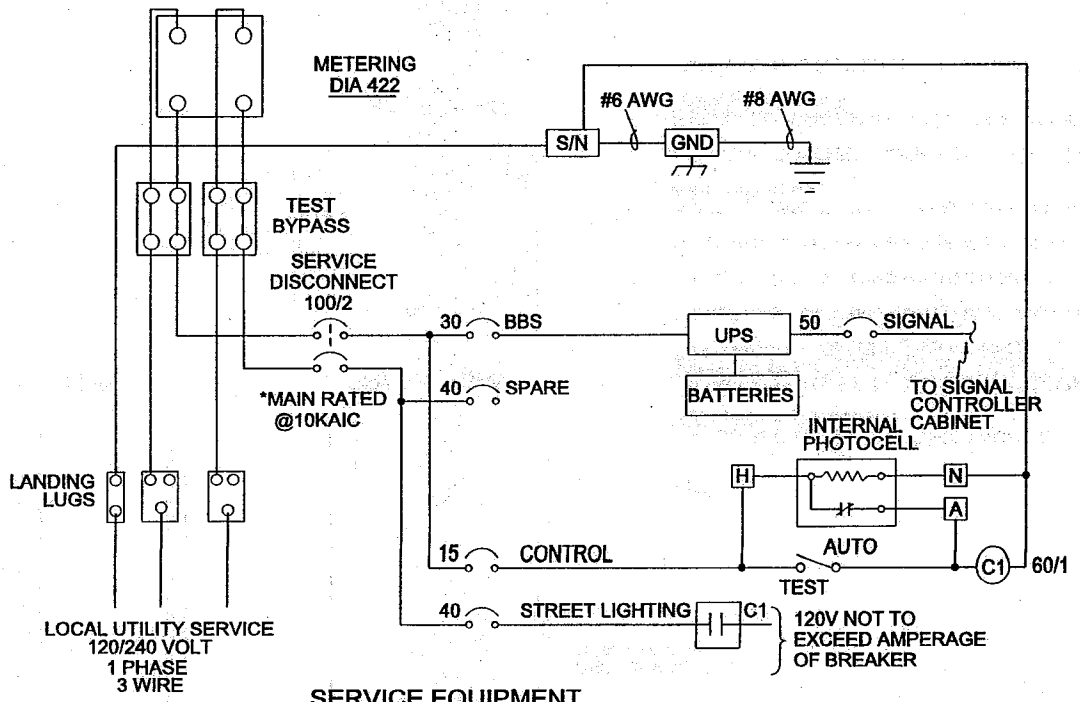


BASE PLAN

NOTES:

1. FOR CONSTRUCTION SPECIFICATIONS SEE MCDOT SUPPLEMENT SECTIONS 470 THRU 478.
2. EXTERIOR SHALL BE 12 GA. H.D. GALVANIZED STEEL, THE INTERIOR SHALL BE 14 GA. COLD ROLLED STEEL. ALL WELDS SHALL BE ELECTRICALLY WELDED AND REINFORCED WHERE REQUIRED.
3. CONSTRUCTION SHALL BE NEMA 3R AND 12. RAINTIGHT AND DUSTTIGHT.
4. ALL NUTS, BOLTS, SCREWS AND HINGES SHALL BE STAINLESS STELL.
5. NUTS, BOLTS AND SCREWS SHALL NOT BE VISIBLE FROM OUTSIDE OF ENCLOSURE.
6. CONTROL WIRING SHALL BE MARKED AT BOTH ENDS WITH PERMANENT WIRE MARKERS.
7. A PLASTIC COVERED WIRING DIAGRAM SHALL BE SUPPLIED WITH ENCLOSURE.
8. THE ENCLOSURE SHALL BE FACTORY WIRED AND CONFORM TO REQUIRED NEMA STANDARDS.
9. FRONT OF CABINET ENCLOSURE SHALL FACE TOWARDS THE INTERSECTION.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	'SP' ELECTRICAL SERVICE PEDESTAL & 'BBS' BATTERY BACKUP SYSTEM CABINET	DATE: 4/09	DETAIL NO. 4731-1

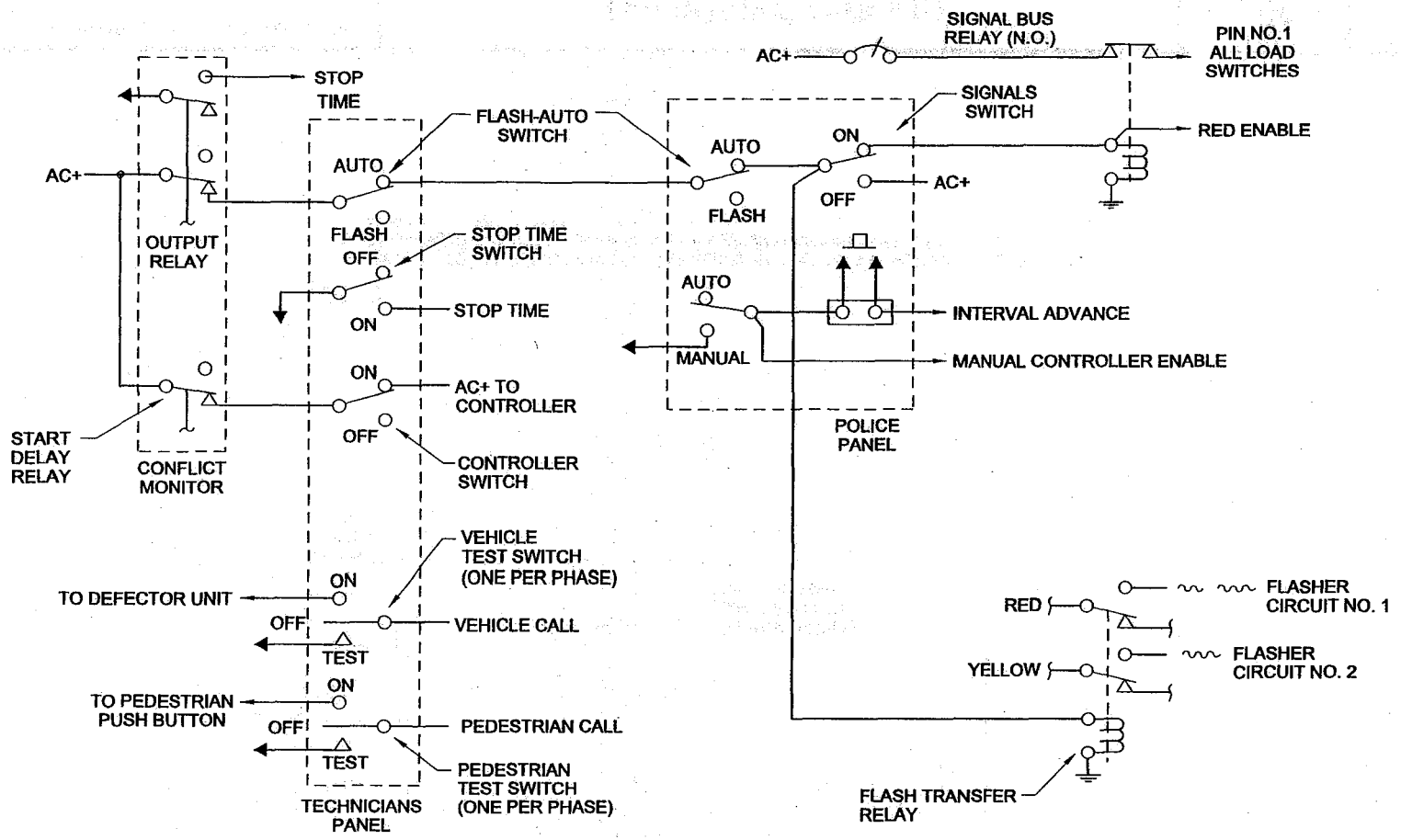


SERVICE EQUIPMENT
WIRING DIAGRAM

NOTES:

1. SIGNAL AND LIGHTING SHALL BE WIRED ON SEPARATE PHASES.
2. LOAD CURRENT FOR ALL BREAKERS SHALL NOT EXCEED 80% OF BREAKER AMPERAGE.

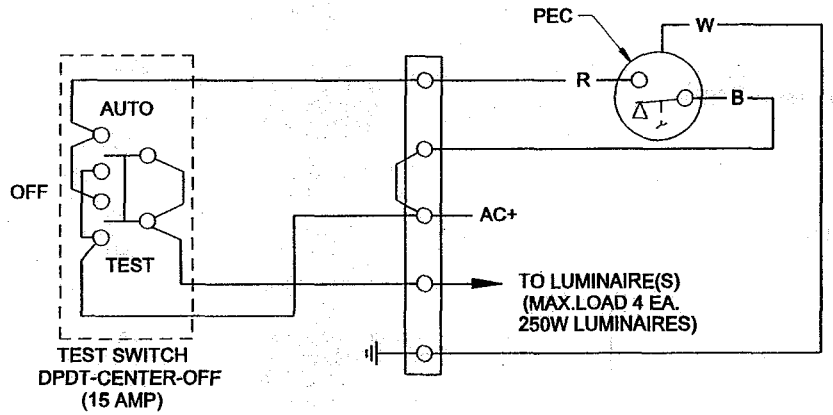
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SERVICE PEDESTAL AND BATTERY BACKUP WIRING SCHEMATIC	DATE: 4/09	DETAIL NO. 4731-2



NOTES:

1. MOV OR RC NETWORK REQUIRED ACROSS RELAY COILS.
2. CIRCUIT SHOWN WITH POWER APPLIED.

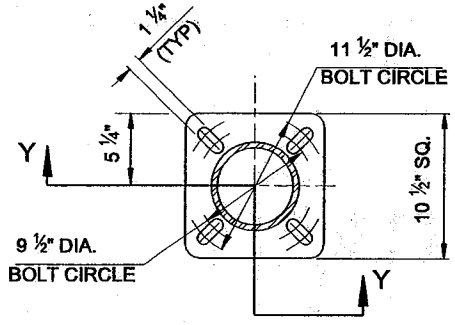
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CONTROLLER CABINET WIRING SCHEMATIC	DATE: 4/09	DETAIL NO. 4735



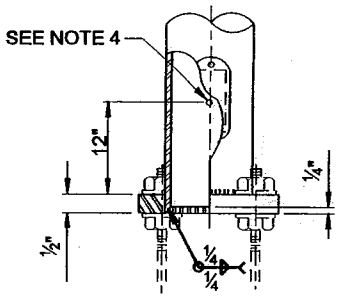
NOTES:

1. THE PHOTO ELECTRIC CELL (PEC) SHALL BE MOUNTED ON THE CONTROLLER EQUIPMENT CABINET. IT SHALL BE A PRECISION MODEL T-30 OR ALR MODEL AT 30-120V AND RATED AT 3000 VA, 120 VOLTS.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	LUMINAIRE CIRCUIT	DATE: 4/09	DETAIL NO. 4737

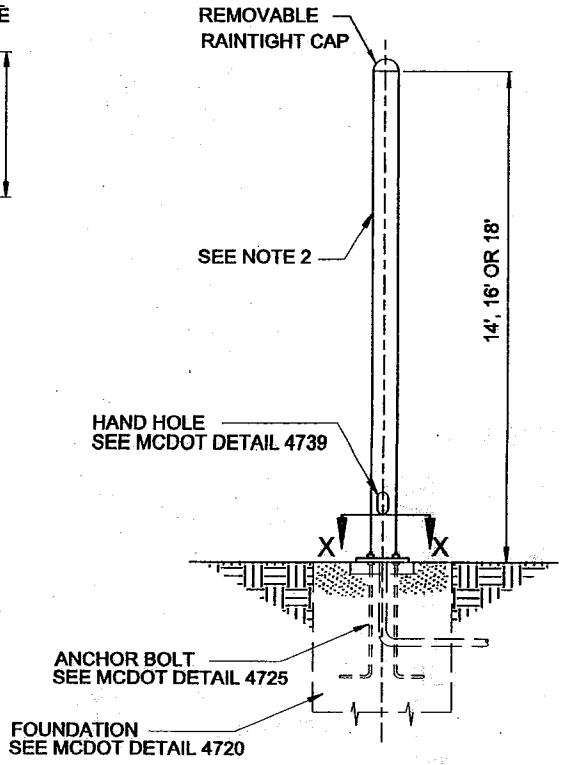


SECTION X-X



SECTION Y-Y

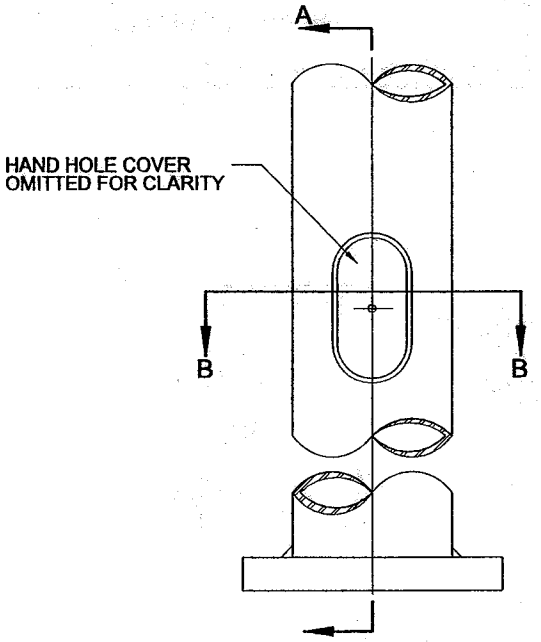
BASE PLATE DETAILS

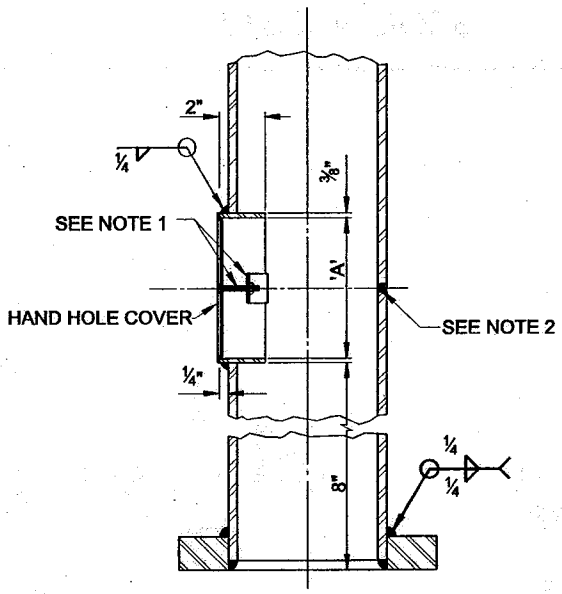


NOTES:

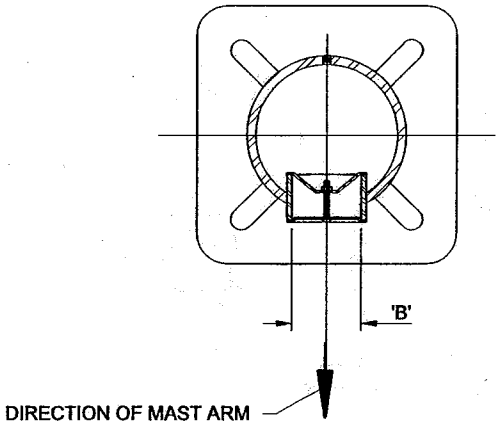
1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS, SEE MCDOT SUPPLEMENT SECTIONS 470 THRU 478.
2. THE POLE SHALL BE A STANDARD 4" GALVANIZED PIPE, SCHEDULE 40, (0.237" WALL THICKNESS).
3. THE POLE BASE PLATE SHALL BE ½" STEEL CONFORMING TO THE REQUIREMENTS OF ASTM A36.
4. A ¼" TAPPED HOLE FOR A GROUND CONNECTION SHALL BE PROVIDED.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'A' POLE	DATE: 4/09	DETAIL NO. 4738





SECTION A-A

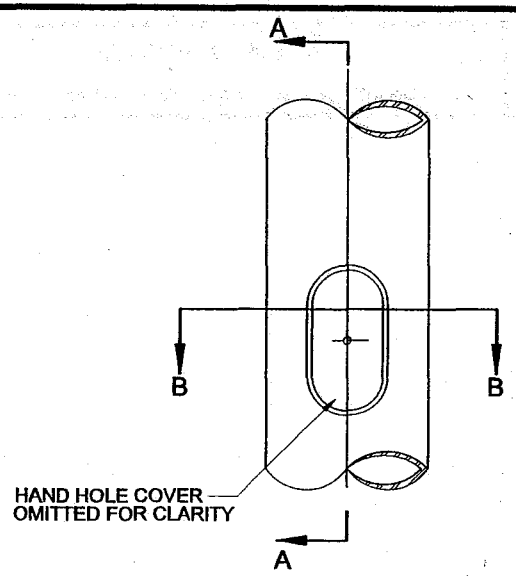


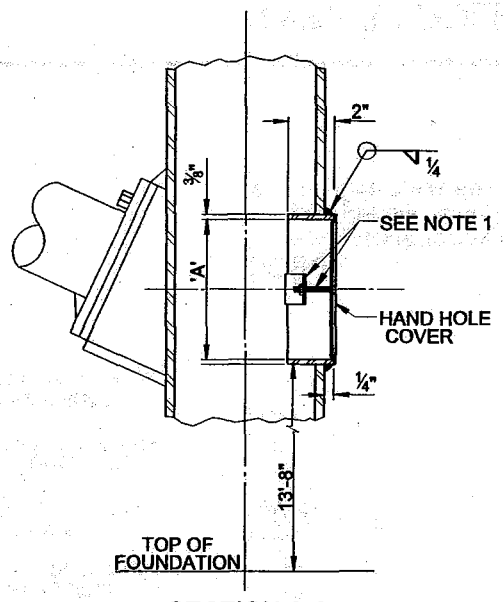
HAND HOLE DIM'S.		
Pole Type	'A'	'B'
"A"&"PB"	5"	3"
All Others	6½"	4"

NOTES:

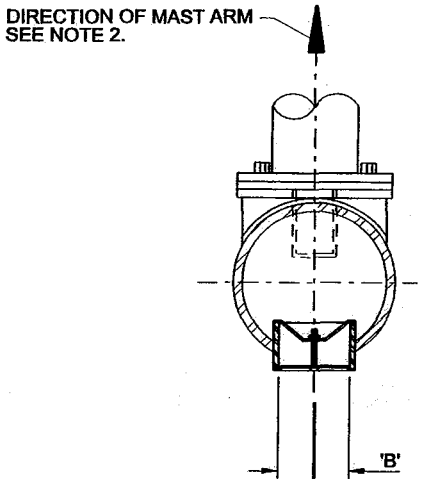
1. HAND HOLE COVER SHALL BE SECURED BY A BRASS MACHINE SCREW AND HOLDING CLEAT.
2. POLE GROUND SHALL BE ¼ - 20 TAPPED HOLE LOCATED AS SHOWN.
3. LOWER HAND HOLE SHALL BE ORIENTED SO IT IS ALIGNED WITH THE MAST ARM.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	POLE LOWER HAND HOLE DETAILS	DATE: 4/09	DETAIL NO. 4739-1





SECTION A-A



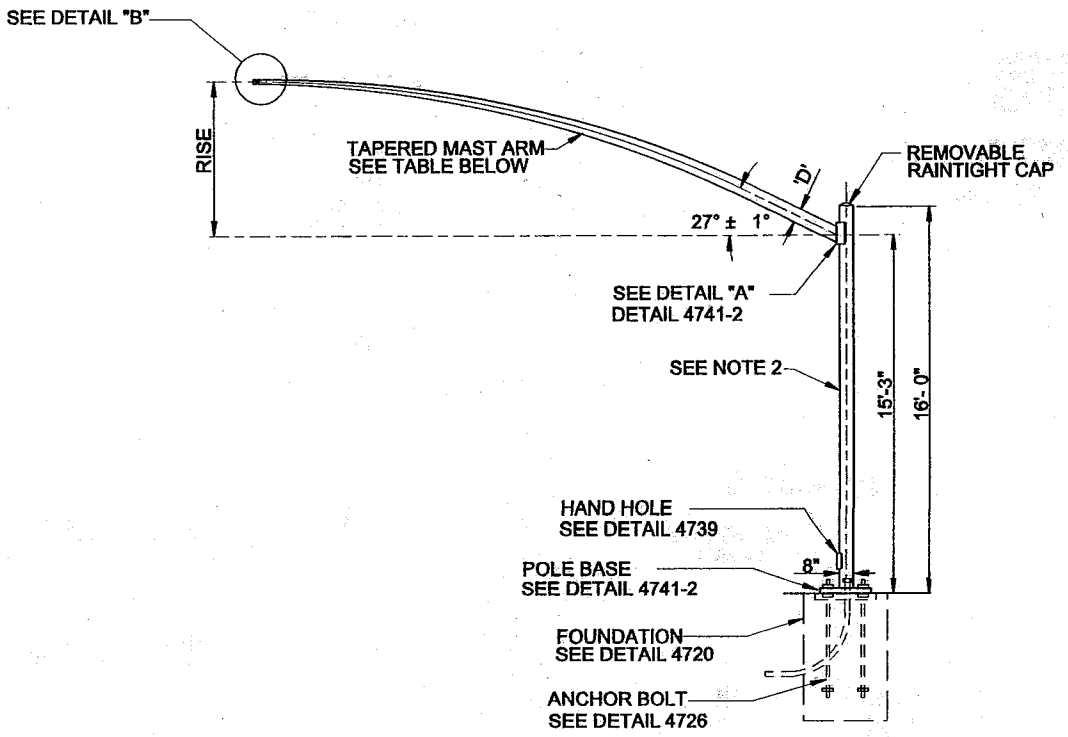
SECTION B-B

HAND HOLE DIM'S.		
Pole Type	'A'	'B'
"Q"&"R"	6½"	4"

NOTES:

1. HAND HOLE COVER SHALL BE SECURED BY A BRASS MACHINE SCREW AND HOLDING CLEAT.
2. UPPER HAND HOLE SHALL BE ORIENTED SO THAT IT IS ALIGNED WITH THE SIGNAL MAST ARM AND OPPOSITE FROM THE SIGNAL MAST ARM.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	POLE UPPER HAND HOLE DETAIL	DATE: 4/09	DETAIL NO. 4739-2

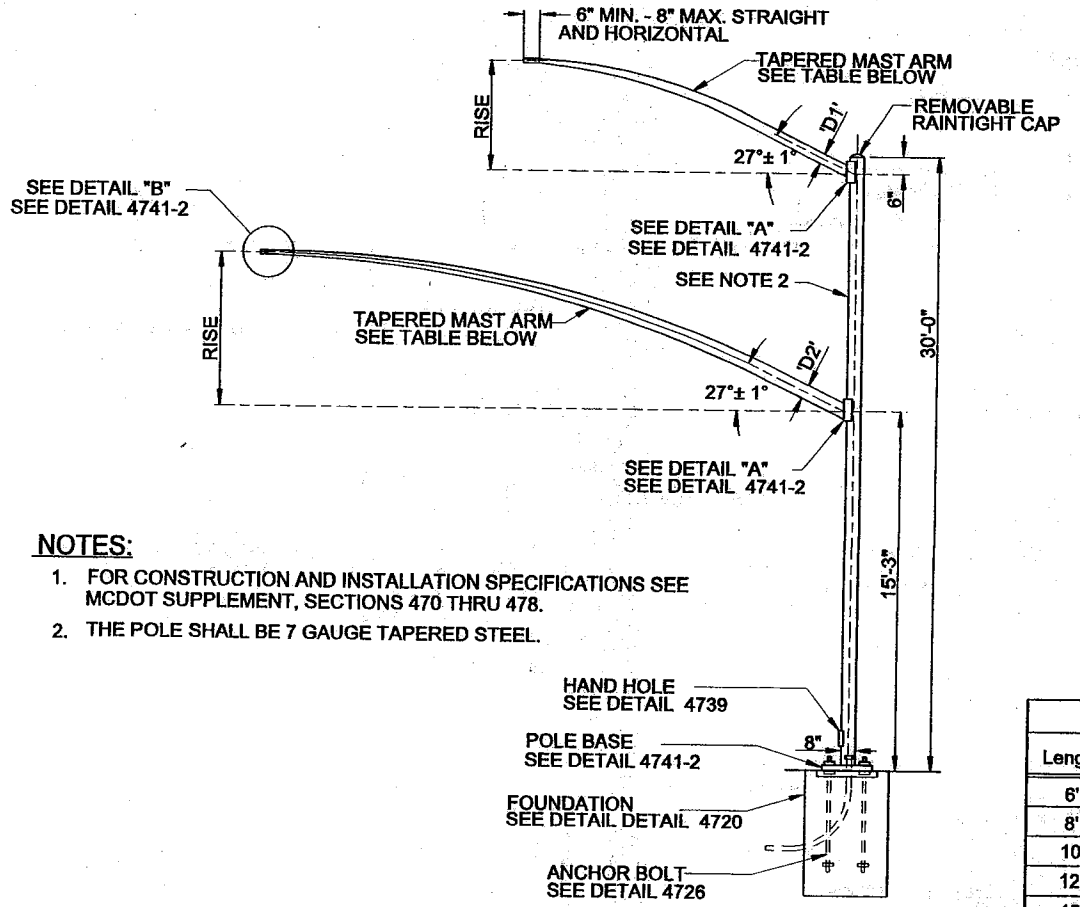


MAST ARM INFORMATION					
Length	Rise	Ga.	"D"Min.	Ga.	"D"Min.
12'	4'-3"	11	4 15/16"	10	4 5/16"
15'	4'-9"	11	5 5/16"	10	4 3/4"
18'	5'-9"	11	5 13/16"	10	5 3/16"
20'	5'-9"	7	5 1/4"	7	5 1/4"

NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. THE POLE SHALL BE 7 GAUGE TAPERED STEEL.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'E' POLE	DATE: 4/09	DETAIL NO. 4740



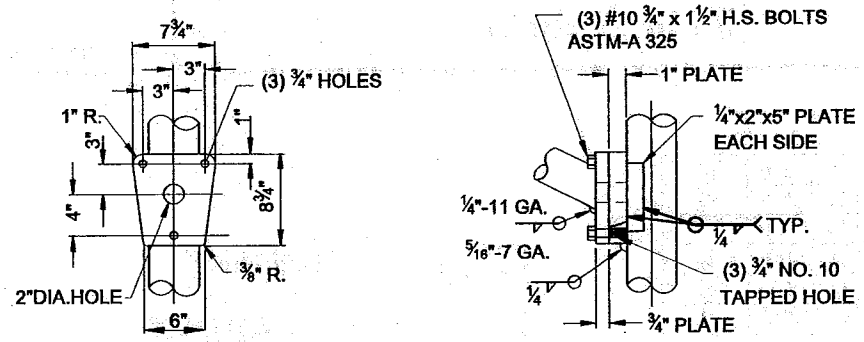
NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. THE POLE SHALL BE 7 GAUGE TAPERED STEEL.

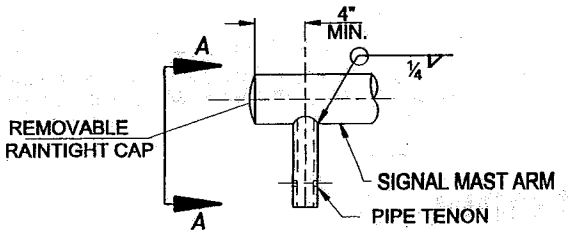
MAST ARM INFORMATION

Length	Rise	Ga.	"D1" Min.	"D2"Min.	Ga.	"D1 & D2"Min.
6'	2'-0"	11	3 1/4"	---	10	3 3/8"
8'	2'-6"	11	3 1/2"	---	10	3 5/8"
10'	3'-4"	11	3 13/16"	---	10	3 7/8"
12'	4'-3"	11	4 1/16"	4 15/16"	10	4 5/16"
15'	4'-9"	11	4 1/4"	5 5/16"	10	4 3/4"
18'	5'-9"	11	5 3/4"	5 13/16"	10	5 3/16"
20'	5'-9"	7	5 1/4"	5 1/4"	7	5 1/4"

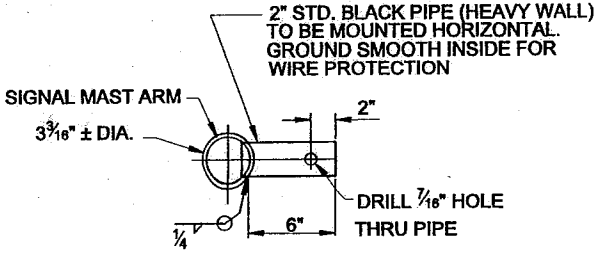
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'F' POLE	DATE: 4/09	DETAIL NO. 4741-1



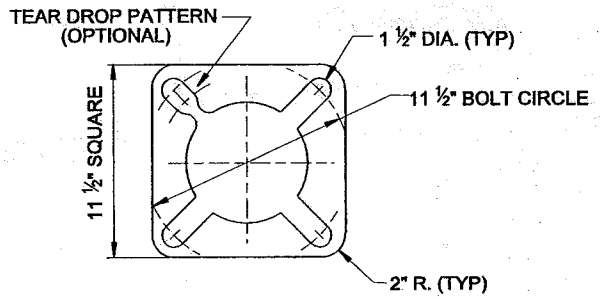
DETAIL "A"

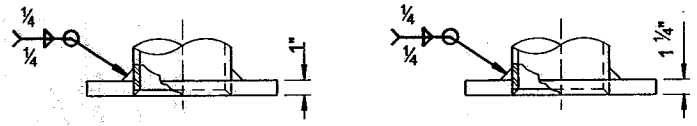


DETAIL "B"



SECTION A-A



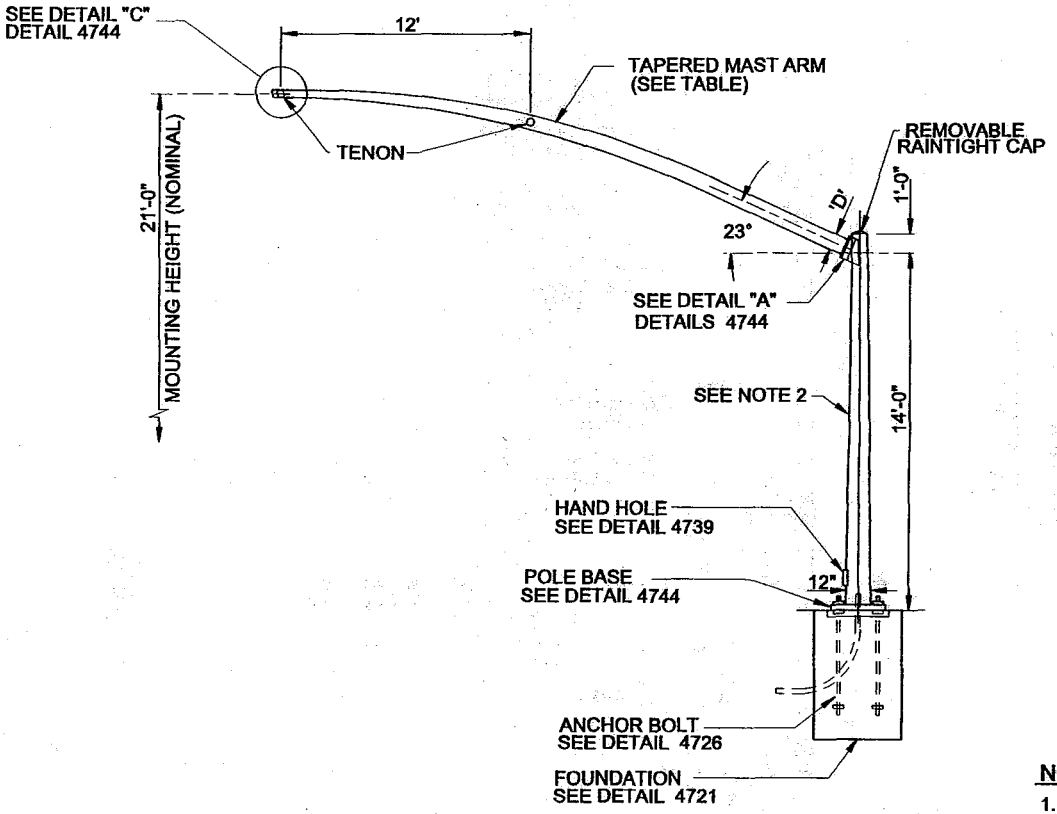


'E' POLE

'F' POLE

POLE BASE DETAIL

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	'E' & 'F' POLE DETAILS	DATE: 4/09	DETAIL NO. 4741-2

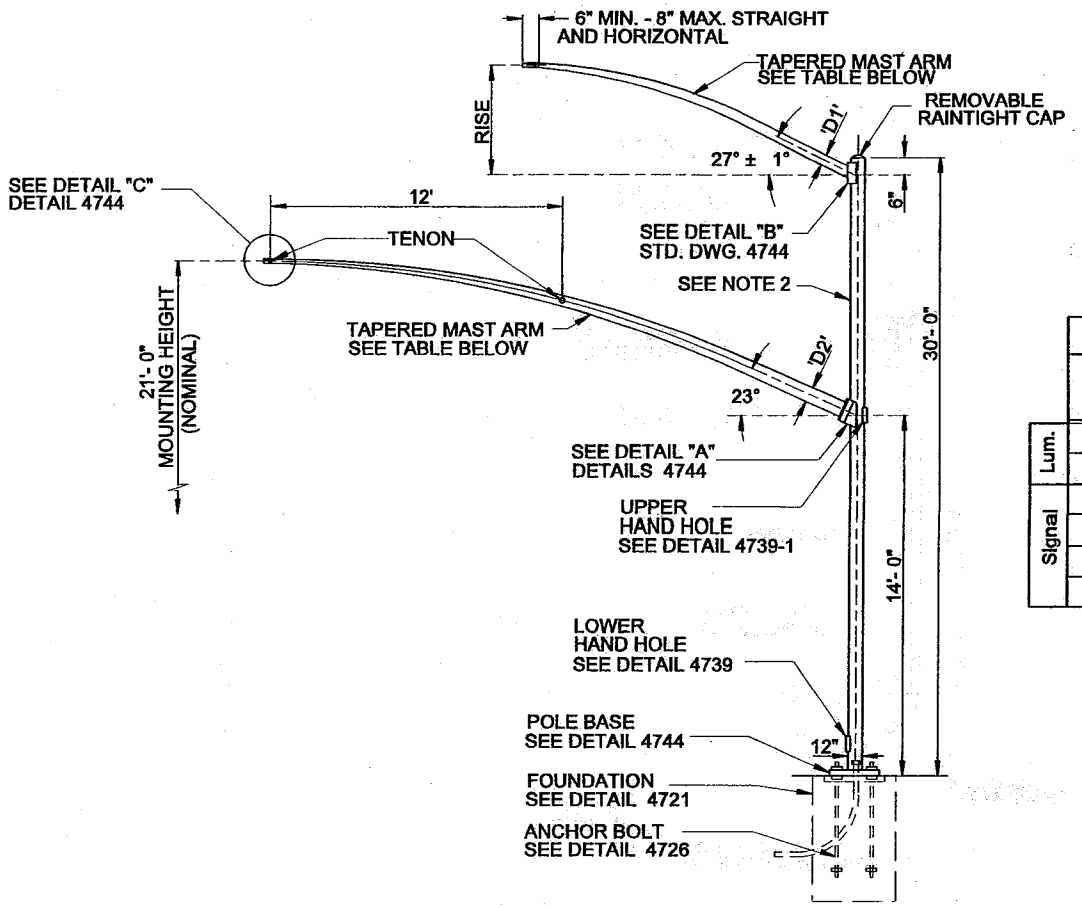


MAST ARM INFORMATION			
Length	Ga.	'D' Dim.	Tenon
25'	7	7"	2
30'	7	8"	2
35'	3	8 11/16"	2
40'	3	9 3/8"	2

NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. THE POLE SHALL BE 3 GAUGE TAPERED STEEL.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'J' POLE	DATE: 4/09	DETAIL NO. 4742

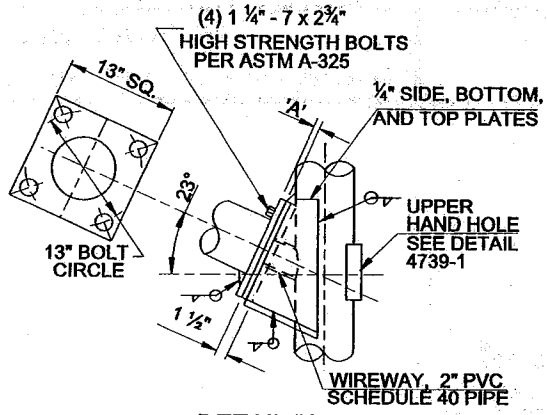


MAST ARM INFORMATION							
		Lum. M.A.		'D1' Min.			
	Length	Rise	Gauge	10 Ga.	11 Ga.	'D2'Min.	Tenon
Lum.	15'	4'-9"	10 or 11	4 ¼"	4 ¾"	—	—
Lum.	20'	5'-9"	7	5 ¼"	5 ¼"	—	—
Signal	25'	----	7	----	----	7"	2
Signal	30'	----	7	----	----	8"	2
Signal	35'	----	3	----	----	8 1½"	2
Signal	40	----	3	----	----	9 ⅜ "	2

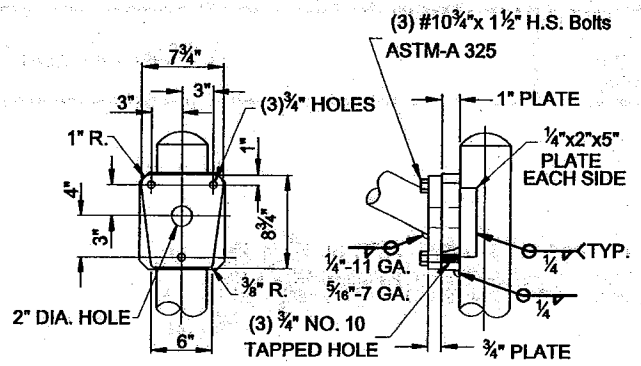
NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT SECTIONS, 470 THRU 478.
2. THE POLE SHALL BE 3 GAUGE TAPERED STEEL.

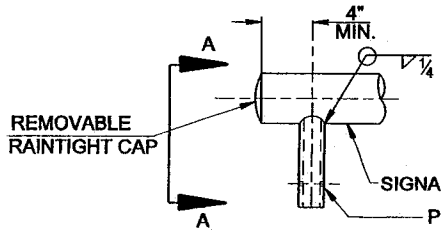
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'Q' POLE	DATE: 4/09	DETAIL NO. 4743



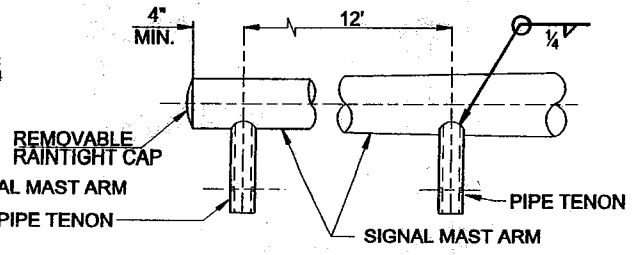
DETAIL "A"



DETAIL "B"

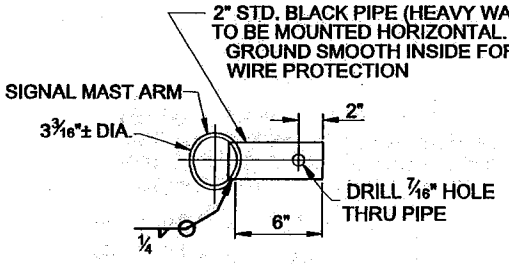


SINGLE TENON

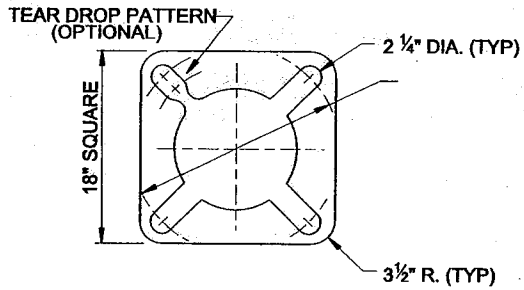


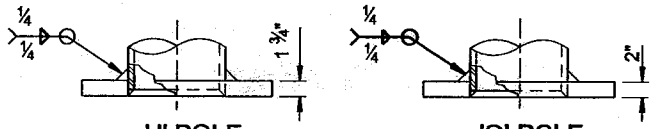
DOUBLE TENON

DETAIL "C"



SECTION A-A

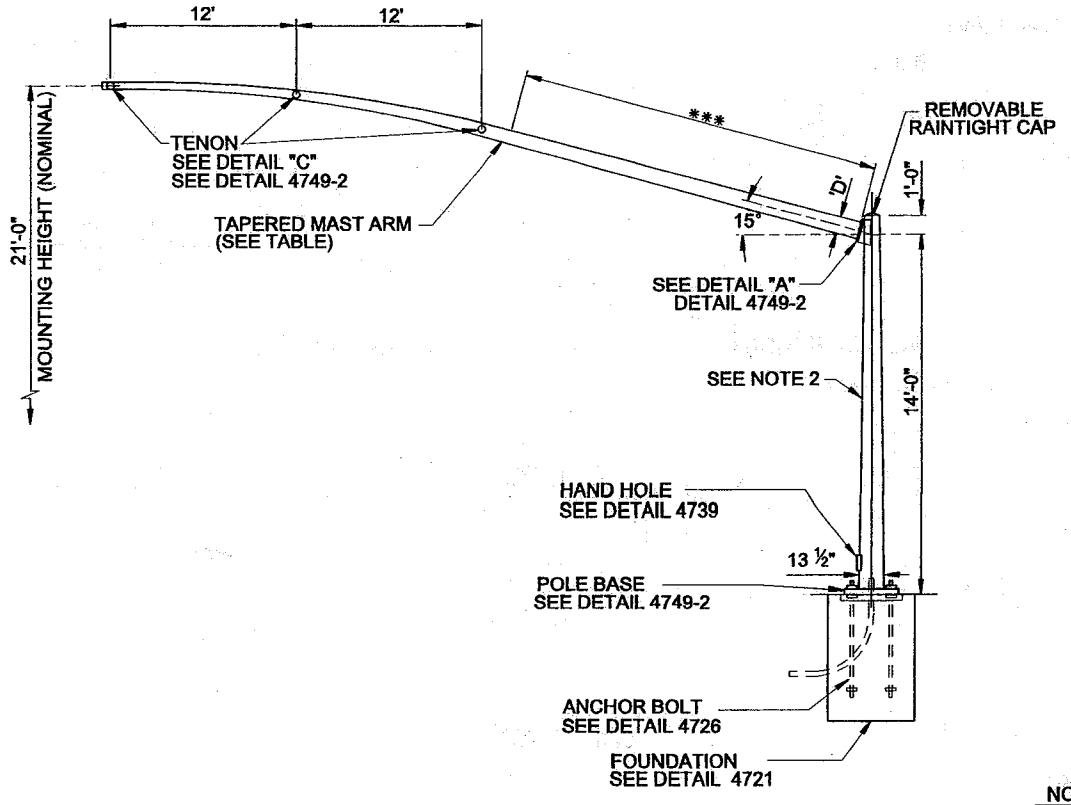




'J' POLE 'Q' POLE

POLE BASE DETAIL

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	'J' & 'Q' POLE DETAILS	DATE: 4/09	DETAIL NO. 4744



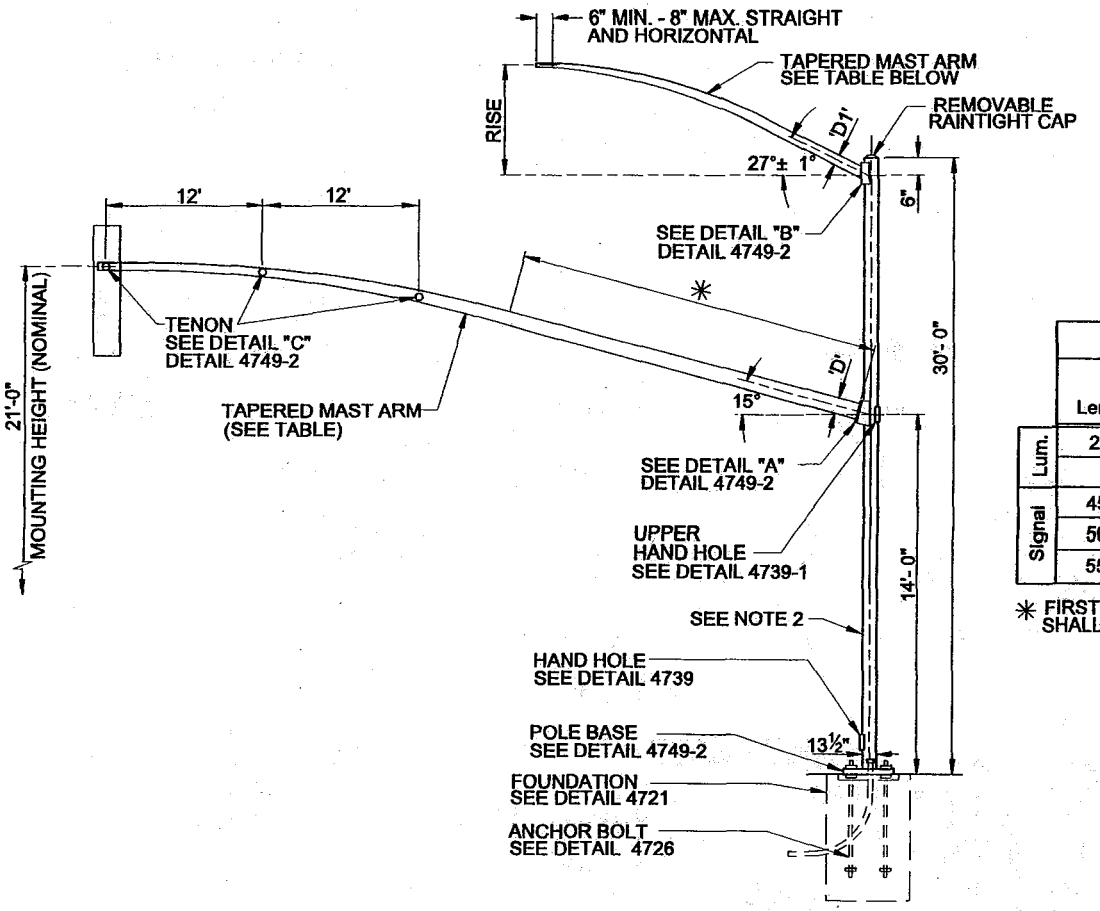
MAST ARM INFORMATION			
Length	Gauge	'D'Dim.	Tenon
45'	0 & 3	10 1/16"	3
50'	0 & 3	10 3/4"	3
55'	0 & 3	11 7/16"	3

*** FIRST 25' OF THE 50' & 55' MAST ARM AND THE FIRST 20' OF THE 45' MAST ARM SHALL BE 0 GAUGE. THE REMAINDER OF THE MAST ARMS SHALL BE 3 GAUGE.

NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. THE POLE SHALL BE 0 GAUGE TAPERED STEEL.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'K' POLE	DATE: 4/09	DETAIL NO. 4748



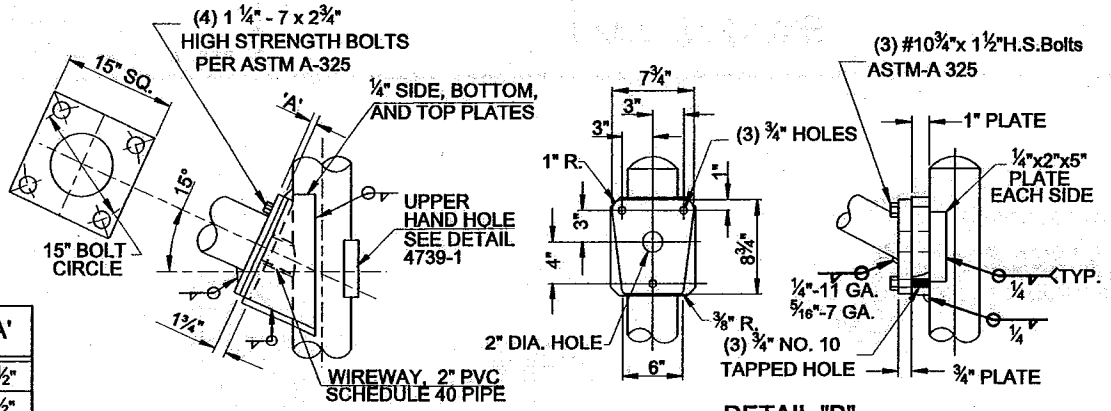
MAST ARM INFORMATION						
	Length	Lum.M.A. Rise	Gauge	'D1'Min.	'D2'Min.	Tenon
Lum.	20'	5'-9"	7	5 ¼"	----	----
					----	----
Signal	45'	----	0 & 3 ✳	----	10 1/16"	3
	50'	----	0 & 3 ✳	----	10 ¾"	3
	55'	----	0 & 3 ✳	----	11 7/16"	3

✳ FIRST 25' OF THE 50' & 55' MAST ARM AND THE FIRST 20' OF THE 45' MAST ARM SHALL BE 0 GAUGE. THE REMAINDER OF THE MAST ARM SHALL BE 3 GAUGE.

NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. THE POLE SHALL BE 0 GAUGE TAPERED STEEL.

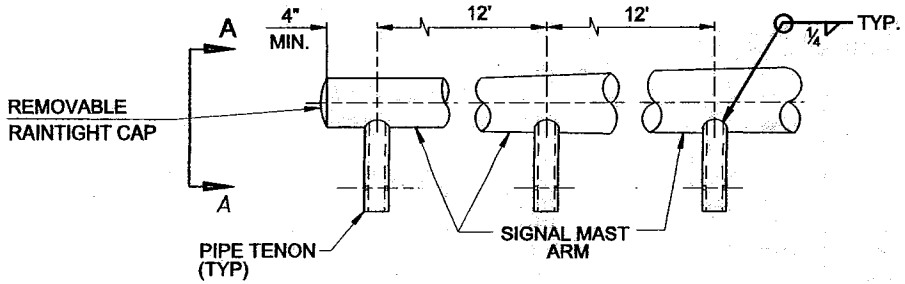
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'R' POLE	DATE: 4/09	DETAIL NO. 4749-1



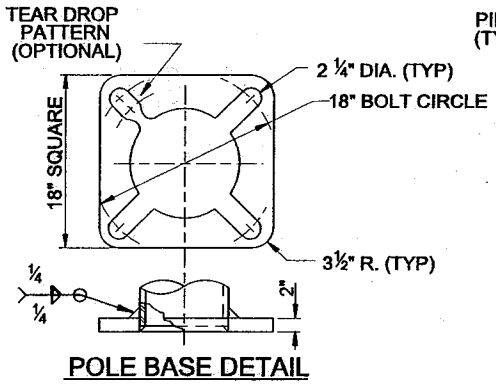
M. A. Length	'A'
45'	1 ½"
50'	1 ½"
55'	1 ½"

DETAIL "A"

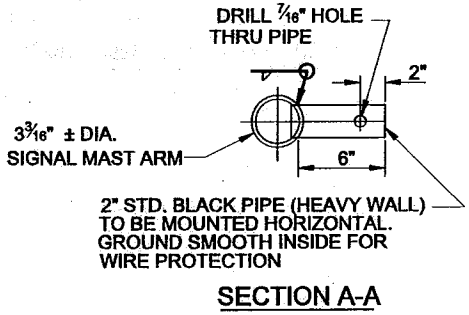
DETAIL "B"



DETAIL "C"

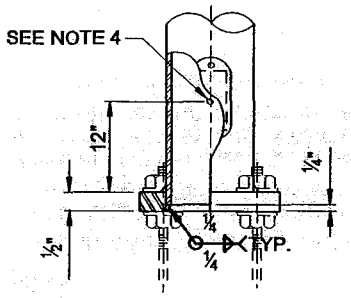


POLE BASE DETAIL

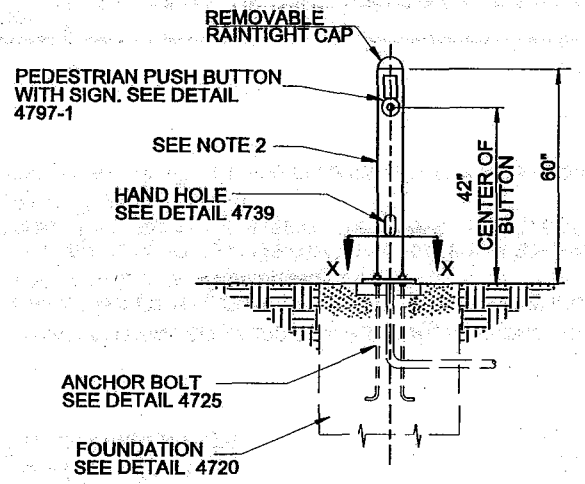


SECTION A-A

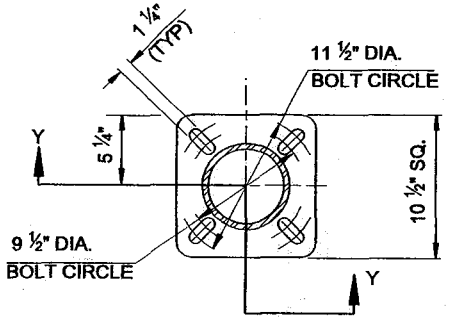
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'K' & 'R' POLE DETAILS	DATE: 4/09	DETAIL NO. 4749-2



SECTION Y-Y



BASE PLATE DETAILS

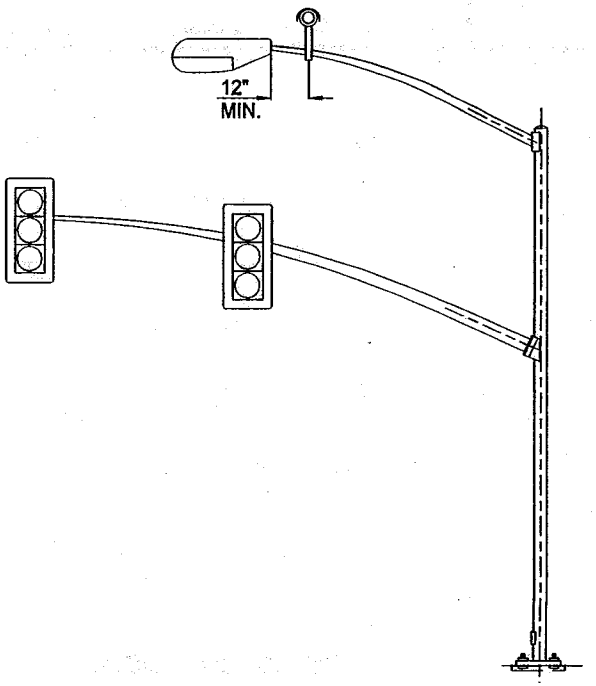


SECTION X-X

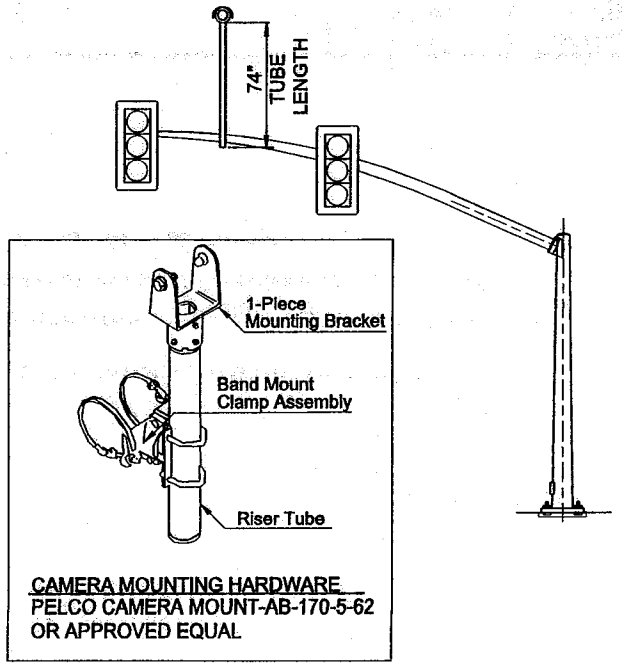
NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. THE POLE SHALL BE A STANDARD 4" GALVANIZED PIPE, SCHEDULE 40, (0.237" WALL THICKNESS).
3. THE POLE PLATE SHALL BE ½" STEEL CONFORMING TO THE REQUIREMENTS OF ASTM A36.
4. A ¼" TAPPED HOLE FOR A GROUND CONNECTION SHALL BE PROVIDED.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE 'PB' POLE	DATE: 4/09	DETAIL NO. 4750



CAMERA MOUNTED ON TYPES F, Q AND R POLES
TYPICAL VIDEO DETECTION CAMERA INSTALLATION

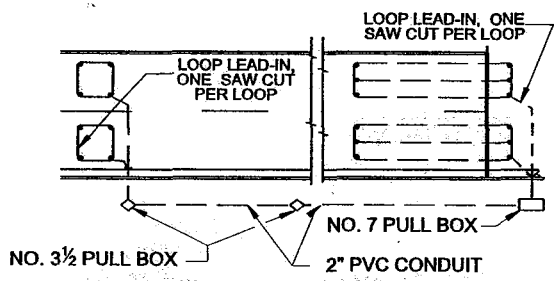


CAMERA MOUNTED ON TYPES E, J AND K POLES
NON - TYPICAL VIDEO DETECTION CAMERA INSTALLATION

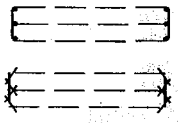
NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. VIDEO DETECTION CABLE SYSTEM SHALL BE ATTACHED TO THE STRAIN RELIEF SUPPORT HOOK LOCATED AT THE TOP OF THE POLE (INSIDE). CABLE SHALL BE SUPPORTED WITH FACTORY CABLE STRAIN RELIEF DEVICE.
3. VIDEO DETECTION CABLE SHALL BE OF 1-PIECE AND SUFFICIENT LENGTH TO EXTEND FROM THE BASE OF THE POLE WITH MIN. 6' LENGTH AT HAND HOLE. A DRIP LOOP SHALL BE FORM AT THE BASE OF THE CAMERA INSTALLATION. CAMERA CABLE SHALL BE 1 CONTINOUS LENGTH FROM CAMERA TO CONTROLLER CABINET.
4. PLACEMENT OF CAMERAS SHALL BE APPROVED BY THE MCDOT TRAFFIC ENGINEER PRIOR TO INSTALLATION.

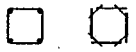
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	VIDEO DETECTION CAMERA INSTALLATION	DATE: 4/09	DETAIL NO. 4755



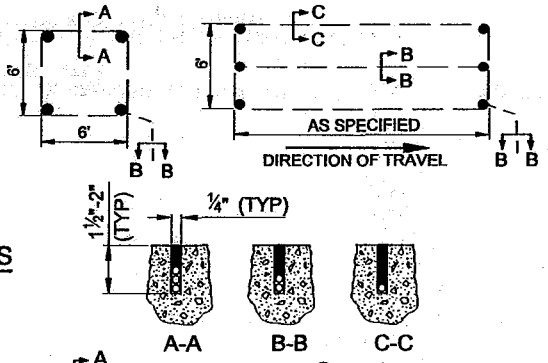
TYPICAL LOOP LAYOUT

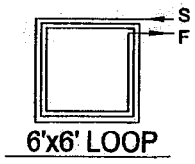


CALL LOOP PLAN SYMBOLS

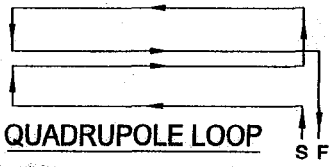


ADVANCE LOOP PLAN SYMBOLS



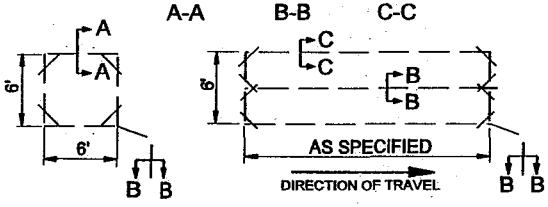


6'x6' LOOP



QUADRUPOLE LOOP

LOOP WIRING DETAILS



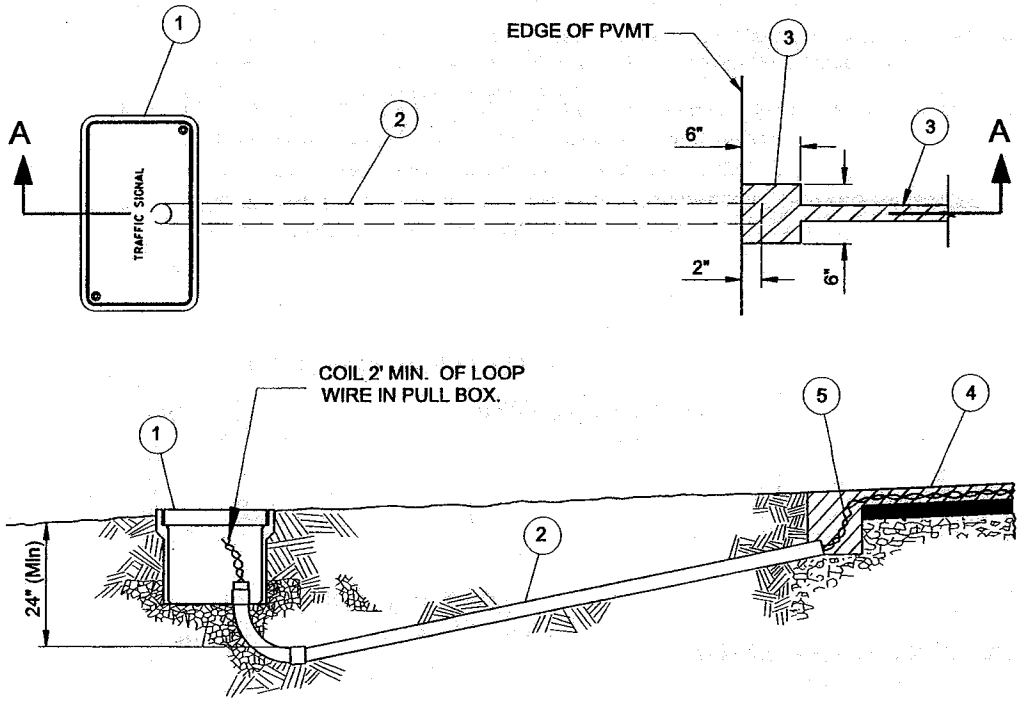
SAW CUT DETAILS

NOTES:

1. FOR MATERIALS AND INSTALLATION SPECIFICATIONS SEE SECTION 473.
2. WIRE QUADRUPOLE LOOP IN 1-2-1 CONFIGURATION UNLESS OTHERWISE SPECIFIED.
3. 6'x 6' LOOPS TO BE 3-TURN UNLESS OTHERWISE SPECIFIED.
4. LOCATE LOOPS AND PULL BOXES PER TRAFFIC SIGNAL PLANS.
5. CORE DRILL TURN POINTS, WITH A 2½" DIAMETER AND AT A FULL DEPTH OF SAW CUT OR SAWCUT AT 45° ANGLES. OBTAIN CONTINUOUS SAW CUT AT FULL DEPTH THROUGH ALL TURN POINTS.
6. IDENTIFY START (S) AND FINISH (F) WIRE IN PULL BOX FOR EACH LOOP.
7. FOR INSTALLATION OF PULL BOXES AND LEAD-INS FOR LOOPS SEE DETAILS 4758 AND 4759.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	LOOP INSTALLATION DETAILS	DATE: 1/1/2011	DETAIL NO. 4757

ITEM	QTY.	DESCRIPTION
1	1	PULL BOX (SEE DETAIL 4711)
2	–	2" PVC ELECTRICAL CONDUIT, SCH. 40
3	–	SAW CUT FOR LOOP DETECTION SENSORS
4	–	LOOP SEALANT
5	–	LOOP DETECTION WIRES



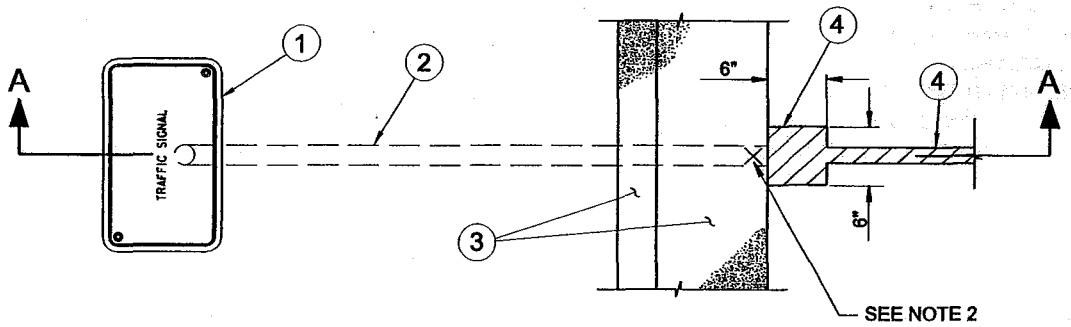
SECTION A-A

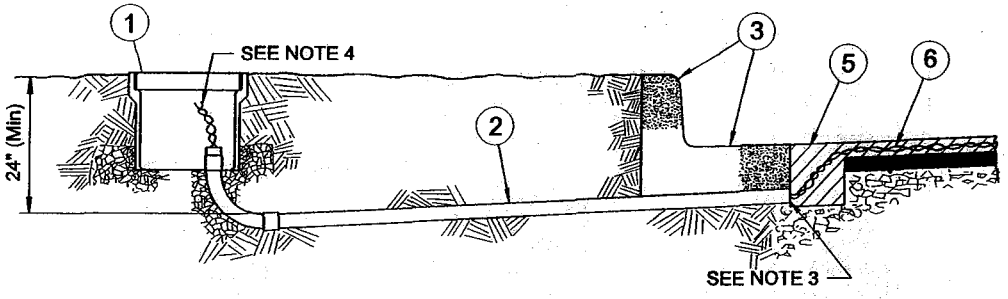
NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. FILL LOOP SAWCUT FROM THE TOP OF CONDUIT STUB-OUT TO THE PAVEMENT SURFACE WITH LOOP SEALANT.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CONDUIT STUB-OUT DETAIL WITHOUT CURB & GUTTER	DATE: 4/09	DETAIL NO. 4758

ITEM	QTY.	DESCRIPTION
1	1	PULL BOX (SEE DETAIL 4711)
2	–	2" PVC ELECTRICAL CONDUIT, SCH. 40
3	–	CURB & GUTTER
4	–	SAW CUT FOR LOOP DETECTION SENSORS
5	–	LOOP SEALANT
6	–	LOOP DETECTION WIRES (SEE NOTE 4)



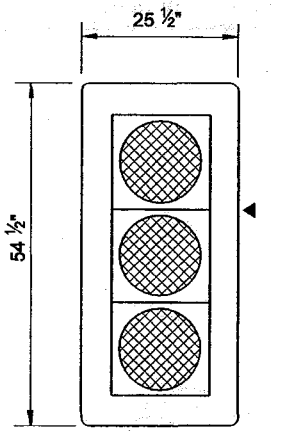


SECTION A-A

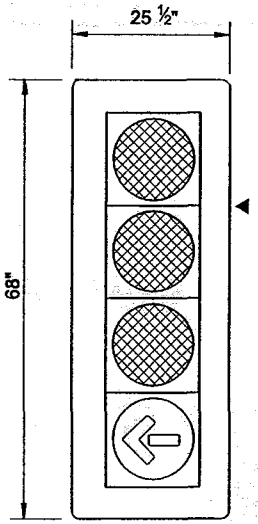
NOTES:

1. FOR CONSTRUCTION AND INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. CHISEL 'X' MARK ON LIP OF GUTTER TO MARK END OF CONDUIT LOCATION.
3. END OF PVC TO BE CUT FLUSH WITH GUTTER.
4. COIL 2' MIN. OF LOOP WIRE IN PULL BOX.
5. FILL LOOP SAWCUT FROM THE TOP OF CONDUIT STUB-OUT TO THE PAVEMENT SURFACE WITH LOOP SEALANT.

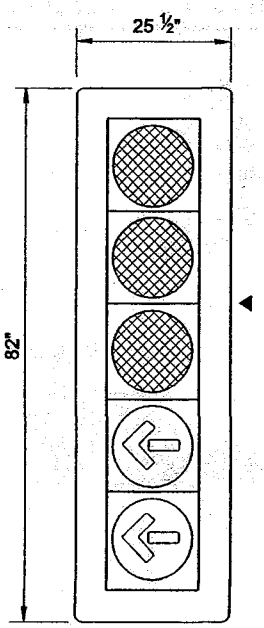
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CONDUIT STUB-OUT DETAIL WITH CURB & GUTTER	DATE: 4/09	DETAIL NO. 4759



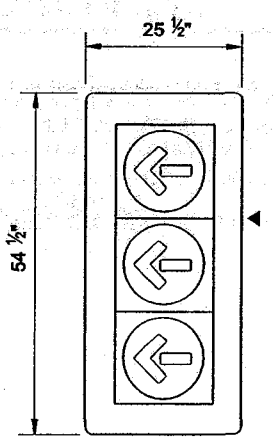
TYPE 'F' INDICATION



TYPE 'G' INDICATION



TYPE 'Q' INDICATION

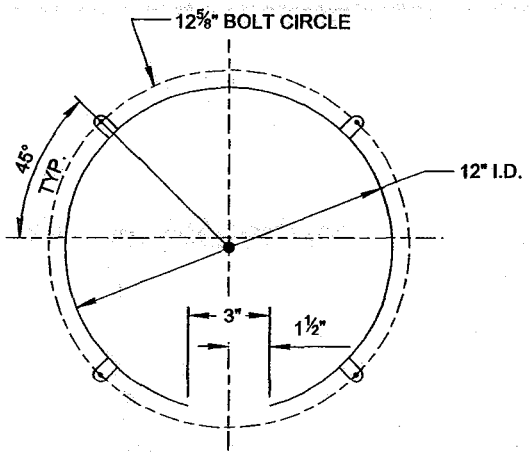


TYPE 'R' INDICATION

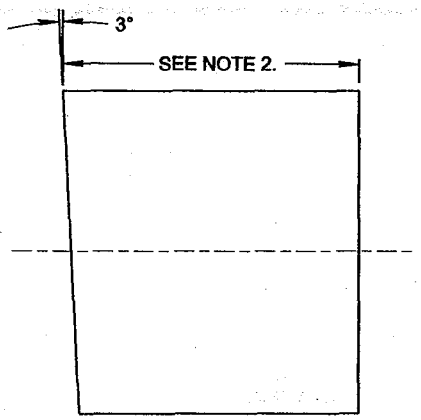
NOTES:

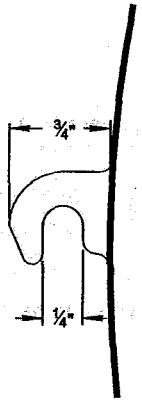
1. ALL DIMENSIONS SHOWN ARE NOMINAL.
2. ◀ DENOTES LOCATION OF ELEVATOR PLUMBIZER FOR MAST ARM INSTALLATIONS.
3. ALL SIGNAL ARRANGEMENTS SHALL BE FURNISHED WITH LOUVERED BACKPLATES.
4. ALL INDICATIONS AS PER THE MCDOT SUPPLEMENT, SECTIONS 470-478.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	STANDARD SIGNAL FACES	DATE: 4/09	DETAIL NO. 4773



12" UNIT VISOR
TUNNEL TYPE





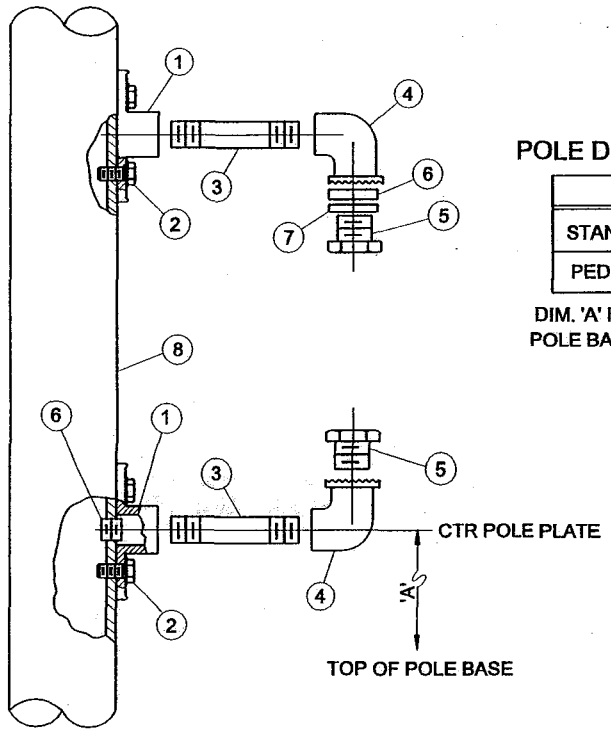
TOP VIEW
TYPICAL VISOR
ATTACHING TAB

NOTES:

1. ALL MATERIALS AND CONSTRUCTION SHALL CONFORM TO THE REQUIREMENTS OF THE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. VISORS SHALL BE 12" LONG, UNLESS SPECIFIED OTHERWISE.
3. THE VISOR SHALL BE ATTACHED TO THE SIGNAL HOUSING EITHER WITH TABS AS SHOWN OR WITH THE VISOR PROJECTING INSIDE THE SIGNAL HOUSING ALONG THE EDGE OF THE SIGNAL LENS AND SECURED IN PLACE WITH FOUR SCREWS TAPPED INTO THE SIGNAL HOUSING.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIGNAL HEAD VISOR	DATE: 4/09	DETAIL NO. 4774

ITEM	QTY.	DESCRIPTION
1	1	POLE PLATE (See Detail 4785)
2	4	BOLTS-½" x 20 x 1½"
3	1	1 1/2 " x 12" NIPPLE
4	2	1½" ELBOW (See Detail 4788)
5	2	1 ½" LOCK NIPPLE
6	1	NEOPRENE WASHER
7	1	WASHER, GALVANIZED
8	-	SIGNAL POLE SHAFT
9	1	¾" CHASE NIPPLE (INSULATING BUSHING)

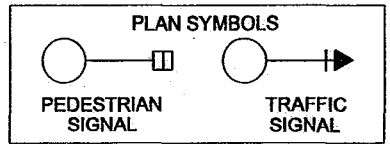


SIDE MOUNT DETAIL

POLE DRILLING INFORMATION

ITEM	DIM.'A'
STANDARD SIGNAL	118"
PEDESTRIAN SIGNAL	87"

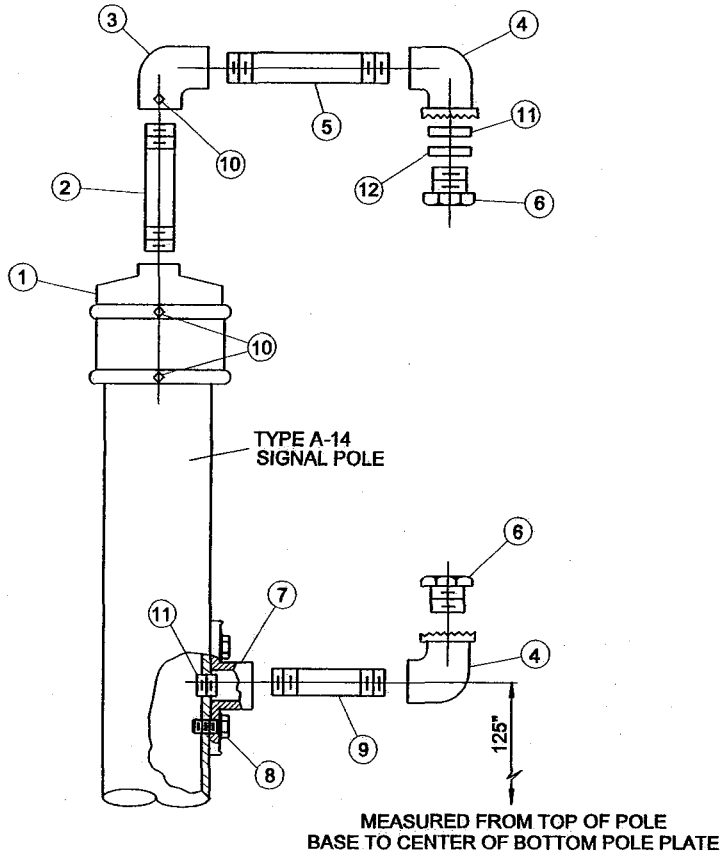
DIM. 'A' IS MEASURED FROM TOP OF POLE BASE TO CENTER OF BOTTOM POLE PLATE



NOTES:

1. SEE DETAIL 4773, FOR SIGNAL INDICATION COMBINATIONS.
2. SEE DETAIL 4785, FOR POLE PLATE DETAILS.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIDE MOUNT (TYPE XI) ASSEMBLY (VEHICLE & PEDESTRIAN)	DATE: 4/09	DETAIL NO. 4775

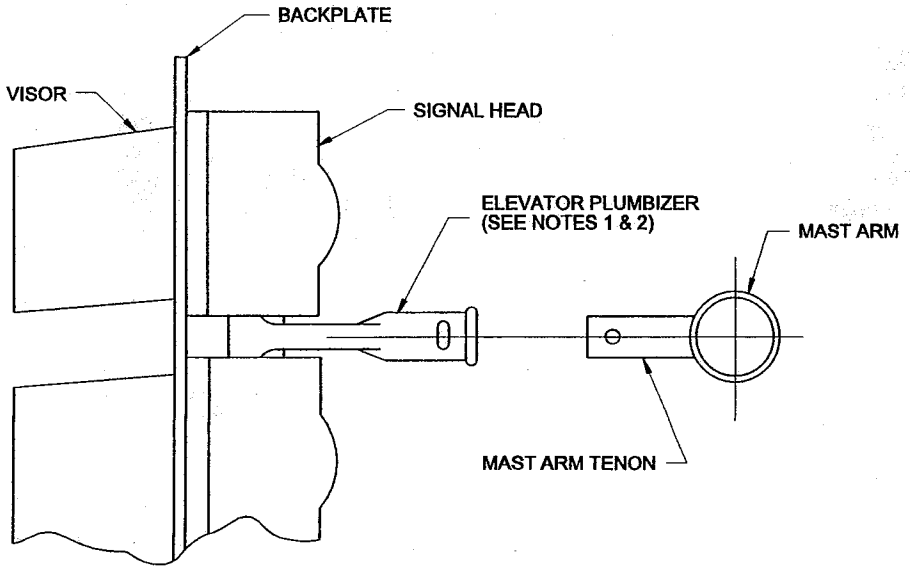


ITEM	QTY.	DESCRIPTION
1	1	POST TOP MOUNT ADAPTER (SEE DETAIL 4786)
2	1	1 ½" NIPPLE
3	1	1 ½" x 90° ELBOW
4	2	1½" ELBOW (See Detail 4788)
5	1	1 ½" NIPPLE
6	2	1 ½" LOCK NIPPLE
7	1	POLE PLATE (See Detail 4785)
8	4	BOLT- ½"x 20 x 1½"
9	1	1 ½" x 12" NIPPLE
10	7	⅜" x ⅝" SQ. HD. SET SCREWS
11	2	NEOPRENE WASHER
12	1	WASHER, GALVANIZED

NOTES:

1. FIELD CUT NIPPLE ② TO OBTAIN CORRECT SIGNAL HEAD MOUNTING HEIGHT. CUT NIPPLE ⑤ SUCH THAT THE SIGNAL HEAD IS PLUMB.
2. POLE TOP MOUNTING ASSEMBLY SHALL BE USED FOR TYPE 'Q' SIGNAL FACE ONLY. SEE DETAIL 4773 FOR SIGNAL INDICATION HEAD COMBINATION.

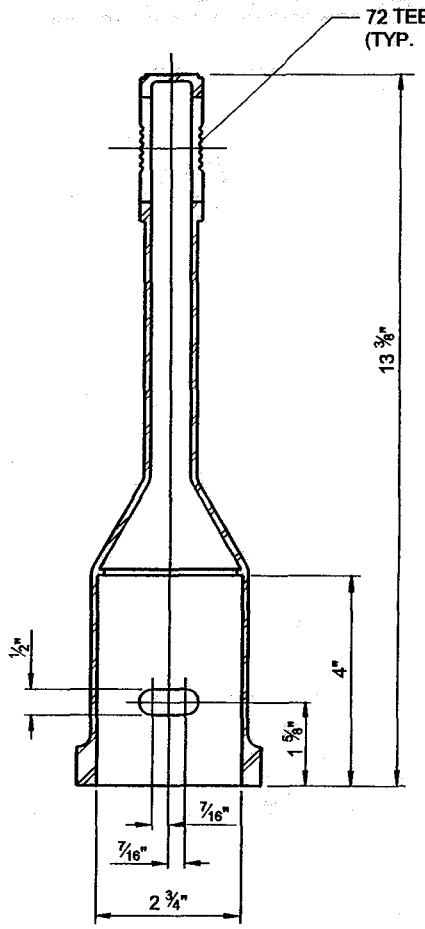
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	POLE TOP (TYPE III) MOUNTING ASSEMBLY	DATE: 4/09	DETAIL NO. 4776



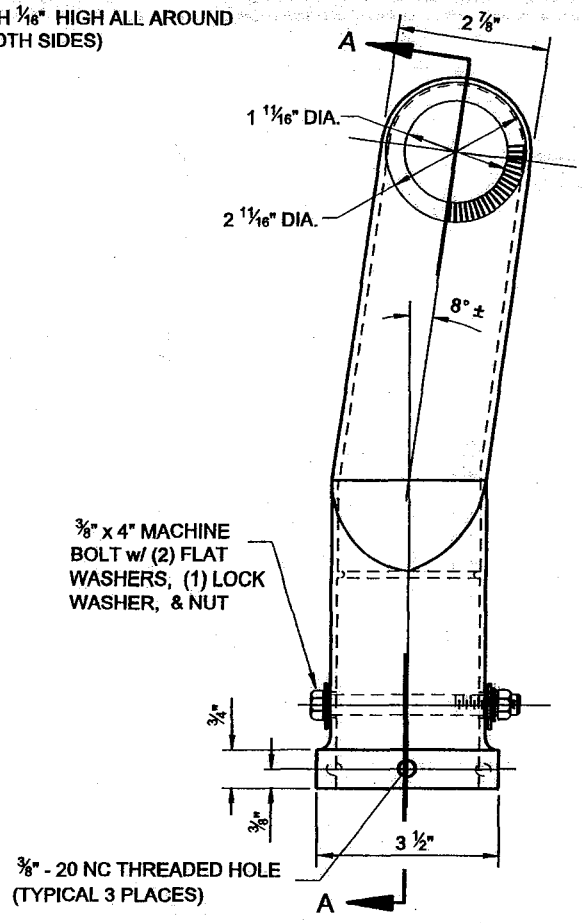
NOTES:

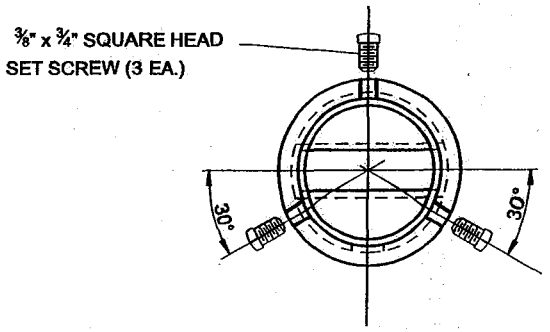
1. USE ⅜" x 4" BOLT WITH TWO (2) NUTS AND TWO (2) WASHERS (SUPPLIED WITH ELEVATED PLUMBIZER) TO ATTACH SIGNAL INDICATION. FOR PLUMBIZER SEE DETAIL 4778-2.
2. FOR LOCATION OF ELEVATOR PLUMBIZER FOR VARIOUS SIGNAL INDICATIONS. SEE DETAIL 4773.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MAST ARM SIGNAL HEAD MOUNT (TYPE II)	DATE: 4/09	DETAIL NO. 4778-1



SECTION A-A

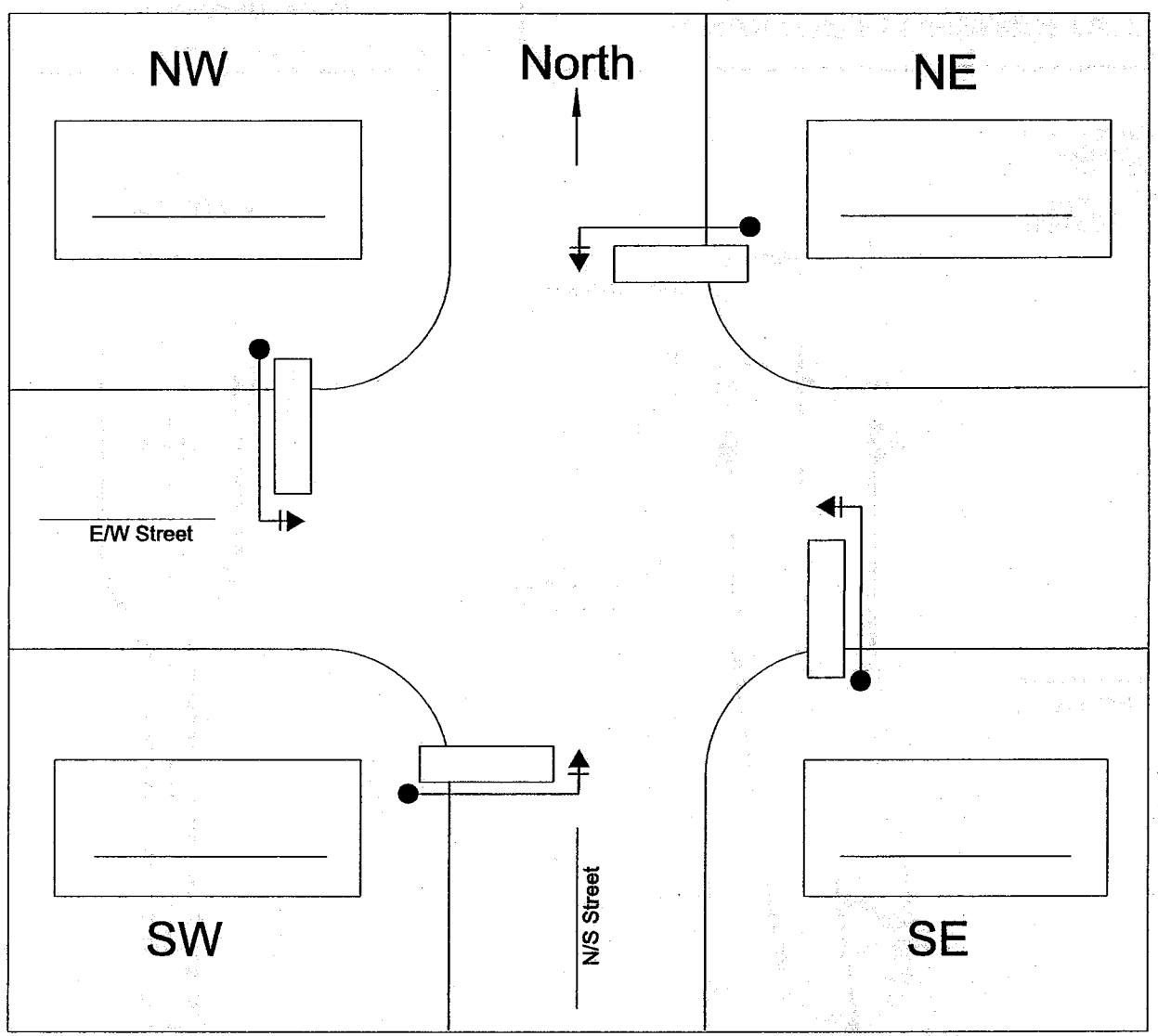




NOTES:

1. MATERIAL TO BE BRONZE OR ALUMINUM
2. FOR CONSTRUCTION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
3. PLUMBIZER TO BE PAINTED A FLAT BLACK

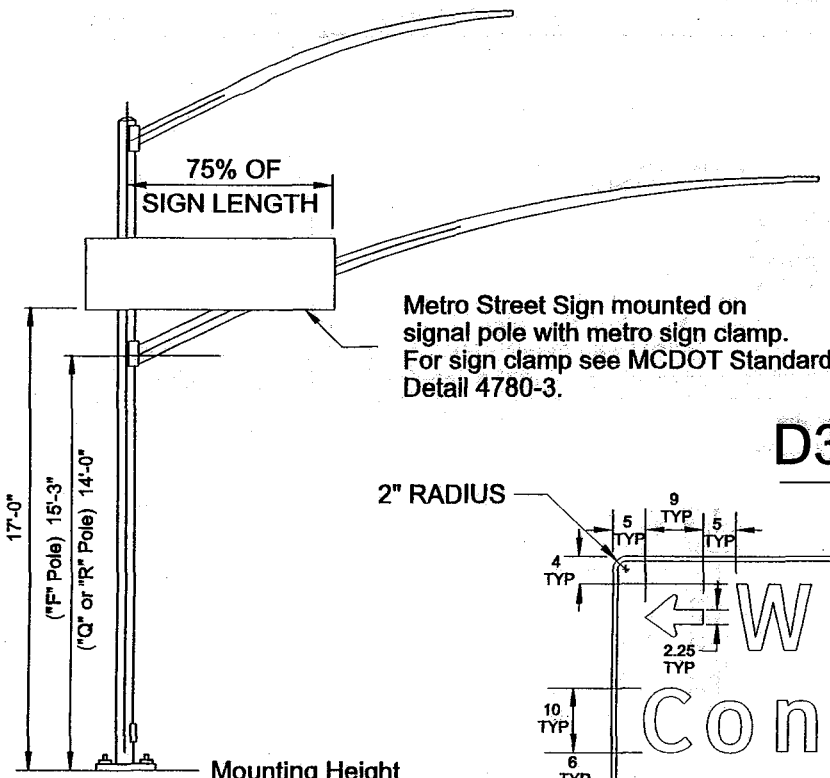
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ELEVATOR PLUMBIZER DETAIL	DATE: 4/09	DETAIL NO. 4778-2



NOTES:

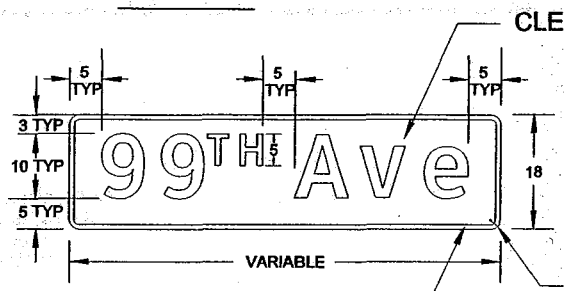
1. NON-ILLUMINATED METRO STREET NAME SIGNS SHALL BE FURNISHED AND INSTALLED IN ACCORDANCE WITH THE MCDOT SUPPLEMENT SECTION 465 AND THE SIGNAL AND SIGNING PLANS.
2. SEE DETAILS 4780-2 AND 4780-3.
3. SEE PROJECT PLANS AND SPECIAL PROVISIONS FOR INTERNALLY-ILLUMINATED METRO STREET NAME SIGNS.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	METRO STREET SIGN LAYOUT SHEET INSTALLATION ON SIGNAL POLES	DATE: 4/09	DETAIL NO. 4780-1

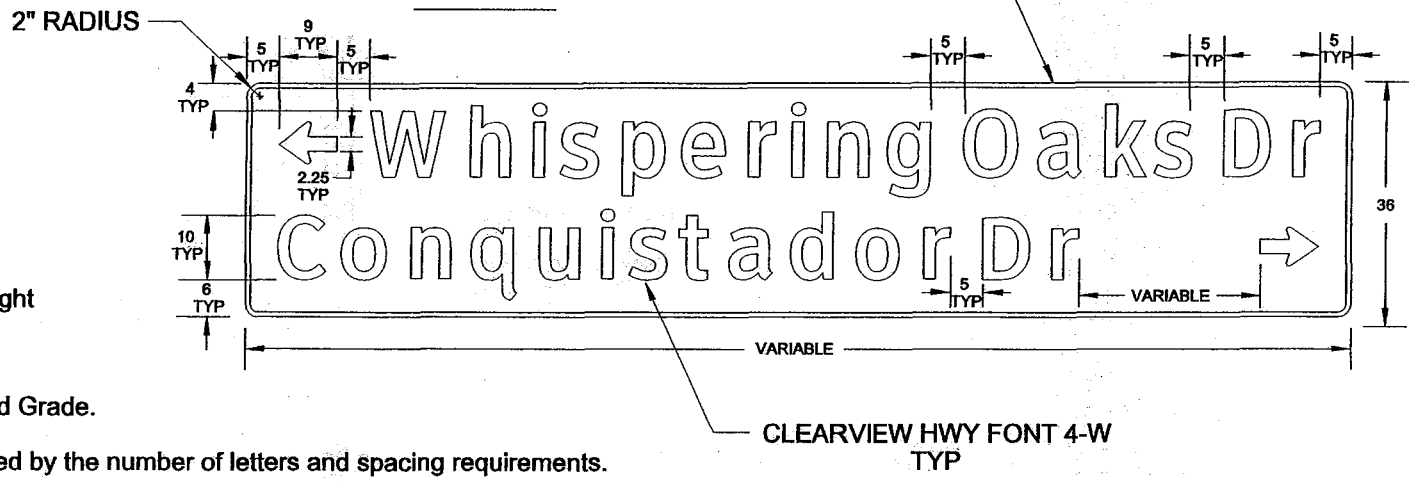


Metro Street Sign mounted on signal pole with metro sign clamp. For sign clamp see MCDOT Standard Detail 4780-3.

D3-2d



D3-2e



Notes:

1. Sign sheeting shall be Diamond Grade.
2. Sign lengths shall be determined by the number of letters and spacing requirements.
3. All signs shall be fabricated with 10 inch white initial capital letter. The proportion ratio of lower case Clearview legends to the intitial captial letter is 0.817x. This ratio is critical and is not to be modified.
4. Lettering shall be placed on a green background using Clearview Hwy Font 4-W.

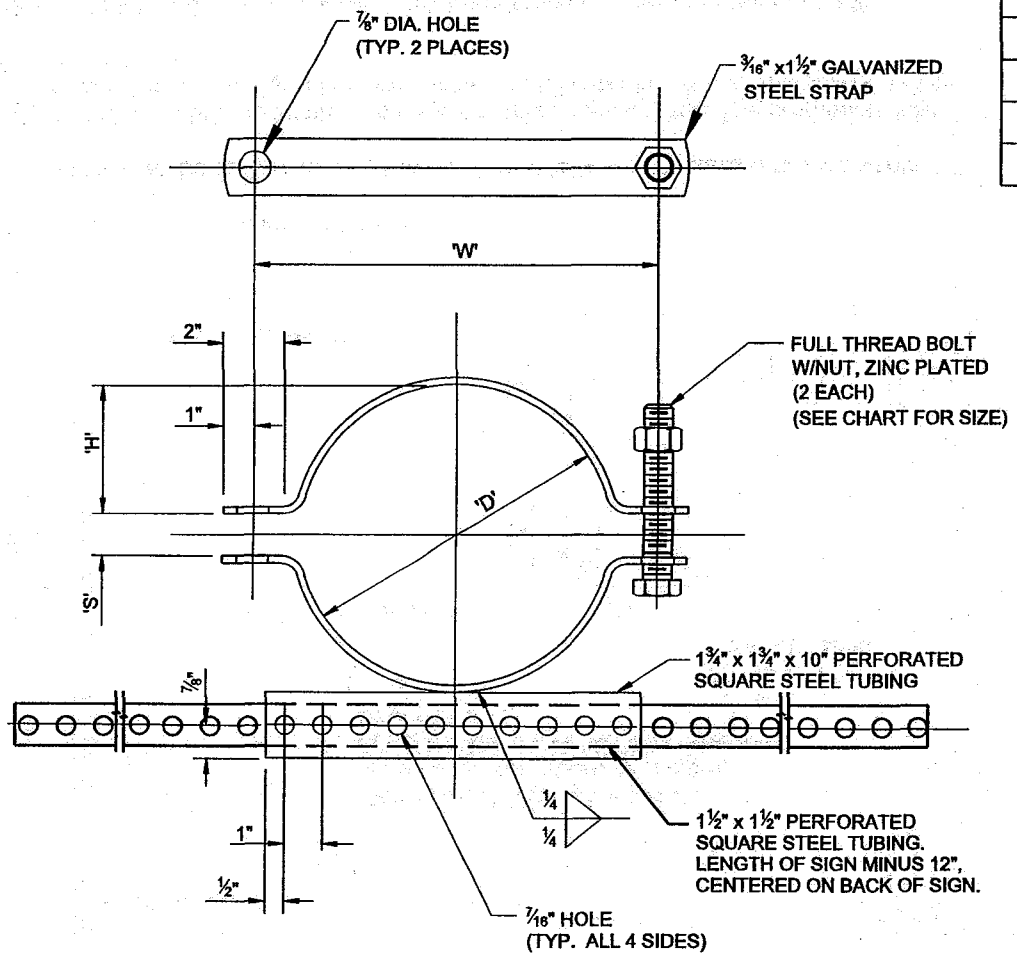
(Not to scale)

(All dimensions are in inches)

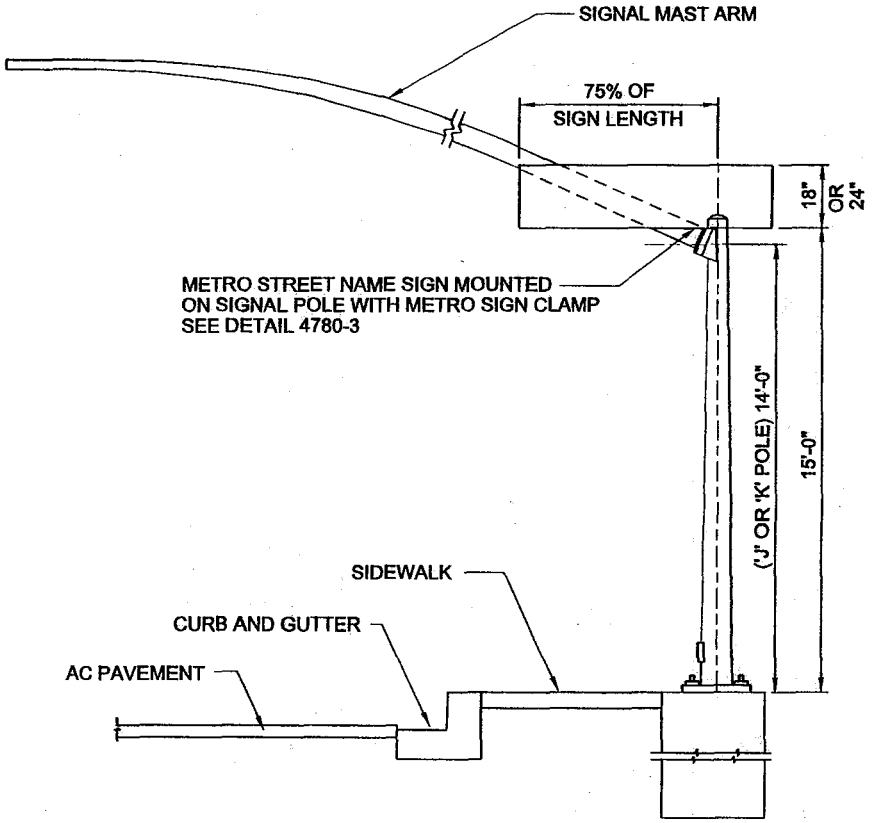
REVISED DATE 12/2010

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	METRO STREET SIGN LAYOUT AND INSTALLATION ON TRAFFIC SIGNAL POLES	DATE: 01/2005	DETAIL NO. 4780-2

POLE TYPE	PART NO.	'D'	'H'	'S'	'W'	BOLT SIZE
F	4780-A	4"	1½"	1"	5¼"	¾" x 3"
E	4780-B	6"	2¼"	1½"	7 15/16"	¾" x 4"
M	4780-C	9"	3½"	2½"	11½"	¾" x 5"
J/Q	4780-D	10"	3¾"	2½"	13⅛"	¾" x 6"
K/R	4780-E	11½"	4½"	2½"	14"	¾" x 6"



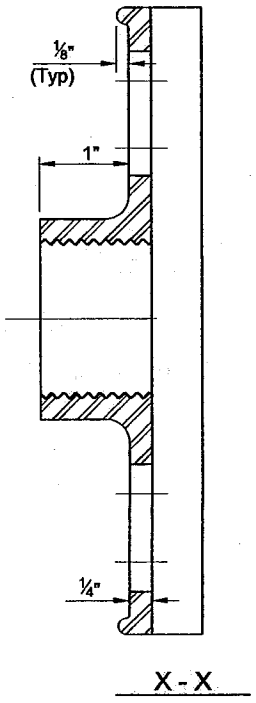
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	METRO STREET SIGN CLAMP	DATE: 4/09	DETAIL NO. 4780-3

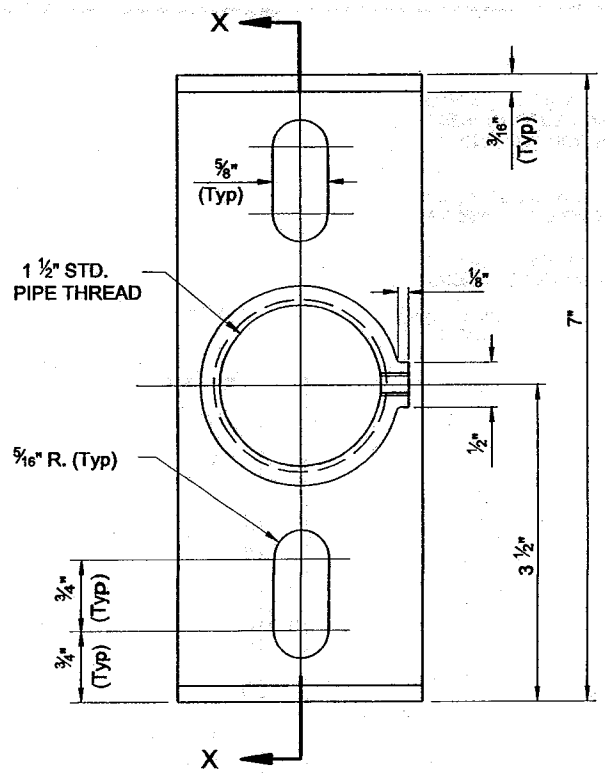


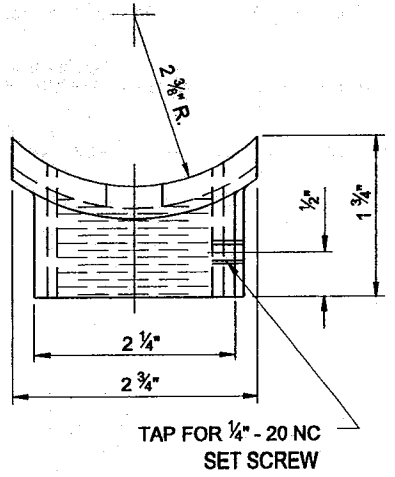
NOTES:

1. WHERE CURB AND GUTTER IS LOCATED, METRO SIGN SHALL NOT OVERHANG ABOVE OUTSIDE TRAVEL LANE, (EDGE OF GUTTER LIP).
2. WHERE EDGE OF PAVEMENT IS LOCATED, METRO SIGN SHALL NOT OVERHANG ABOVE OUTSIDE TRAVEL LANE, (EDGE OF PAVEMENT).
3. TO OBTAIN PROPER CLEARANCE BETWEEN METRO SIGNS AND TRAVEL LANES, SIGNAL POLES AND FOUNDATIONS MAYBE LOCATED AWAY FROM ROADWAY. RANGE UP TO 5', PRIOR TO INSTALLING LONGER SIGNAL MAST ARM LENGTH.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	METRO STREET NAME SIGN MOUNTED ON TYPES 'J' OR 'K' SIGNAL POLES	DATE: 4/09	DETAIL NO. 4780-4



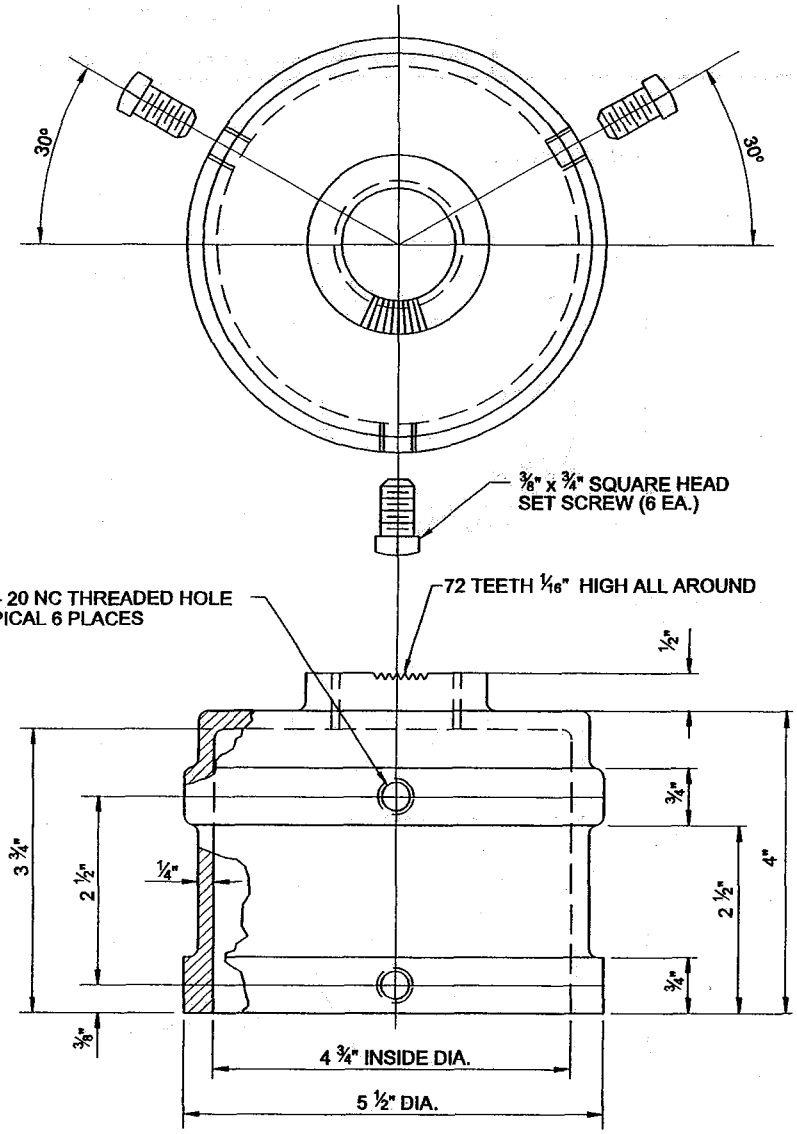




NOTES:

1. MATERIAL TO BE ALUMINUM.
2. POLE PLATE TO BE PAINTED A FLAT BLACK.
3. ALL FILLETS ARE ⅛" RAD.

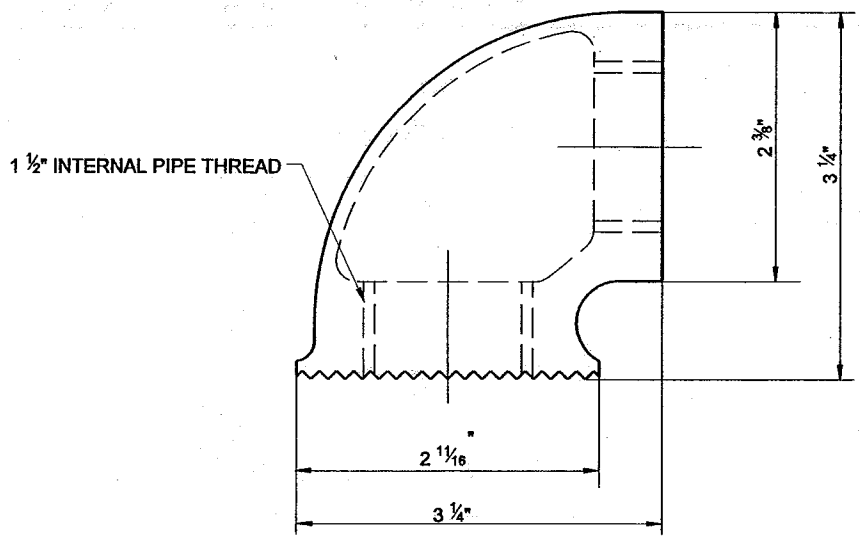
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	POLE PLATE	DATE: 4/09	DETAIL NO. 4785

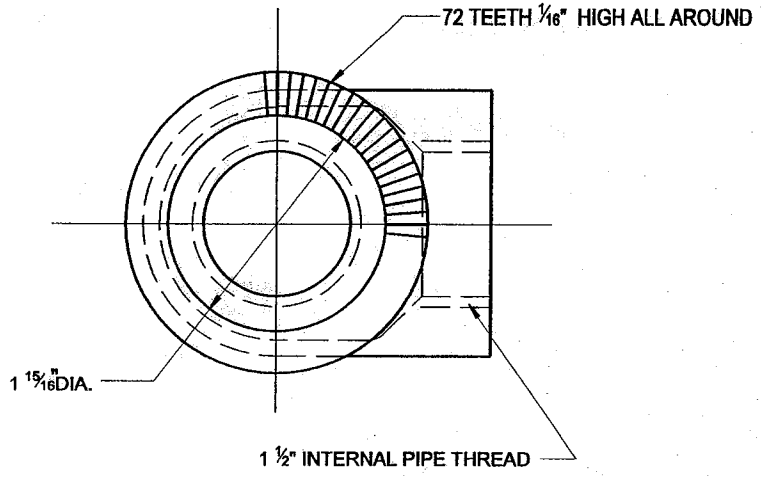


NOTES:

1. MATERIAL TO BE ALUMINUM.
2. POLE PLATE TO BE PAINTED A FLAT BLACK.
3. ALL FILLETS ARE 3/16" RAD.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	POLE TOP MOUNT ADAPTOR	DATE: 4/09	DETAIL NO. 4786

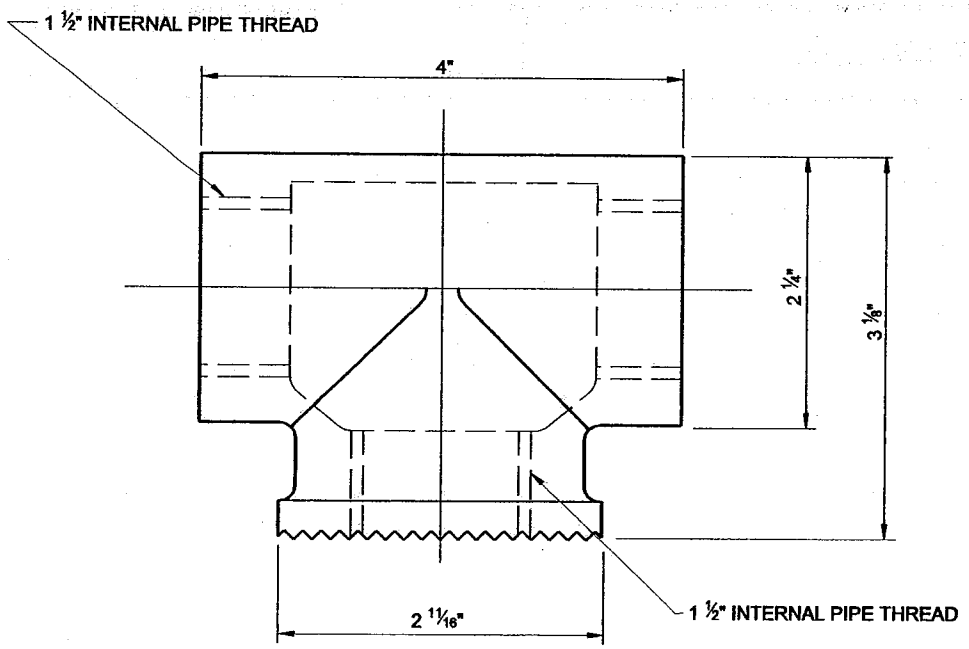


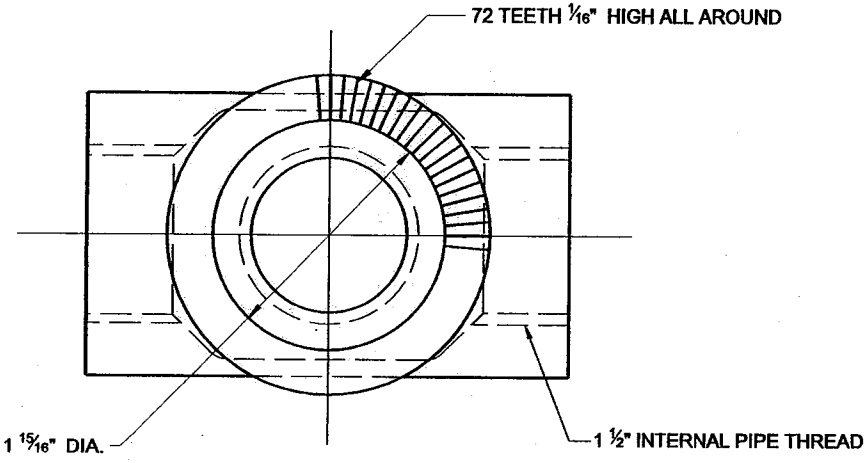


NOTES:

1. MATERIAL TO BE FERROUS.
2. ELBOW TO BE PAINTED A FLAT BLACK.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ELBOW	DATE: 4/09	DETAIL NO. 4788

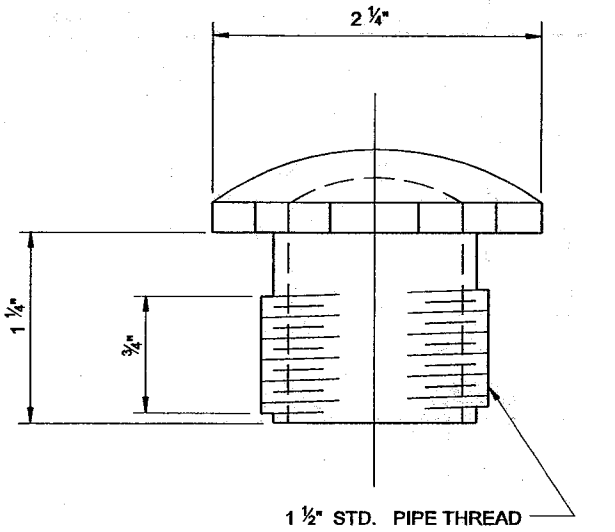


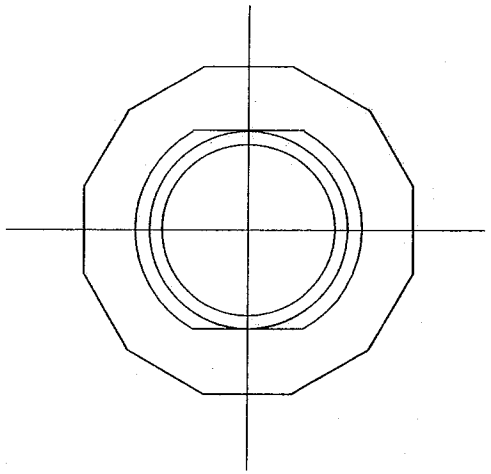


NOTES:

1. MATERIAL TO BE FERROUS.
2. TEE TO BE PAINTED A FLAT BLACK.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TEE	DATE: 4/09	DETAIL NO. 4789

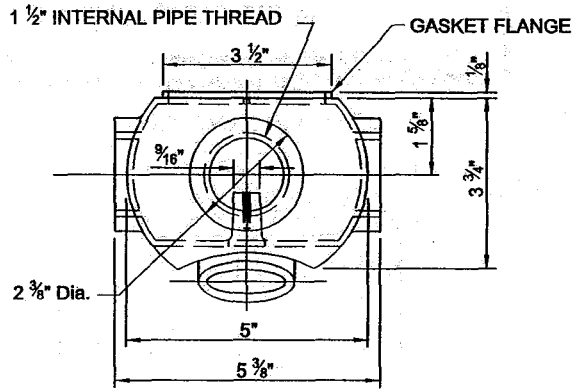




NOTES:

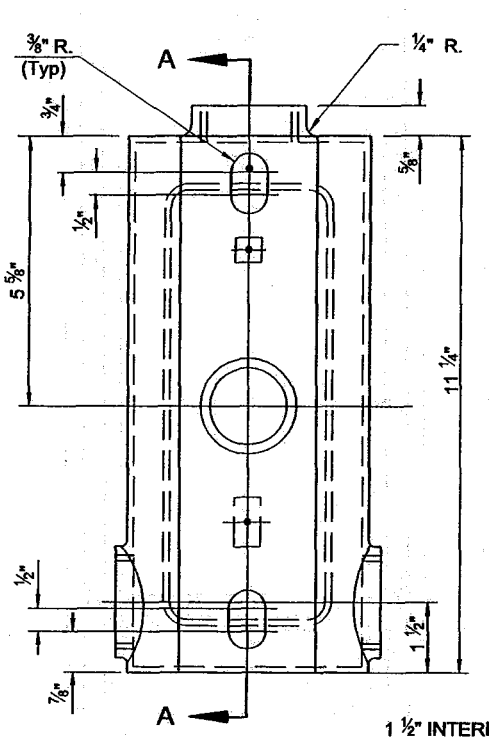
1. MATERIAL TO BE ALUMINUM.
2. CAP TO BE PAINTED A FLAT BLACK.

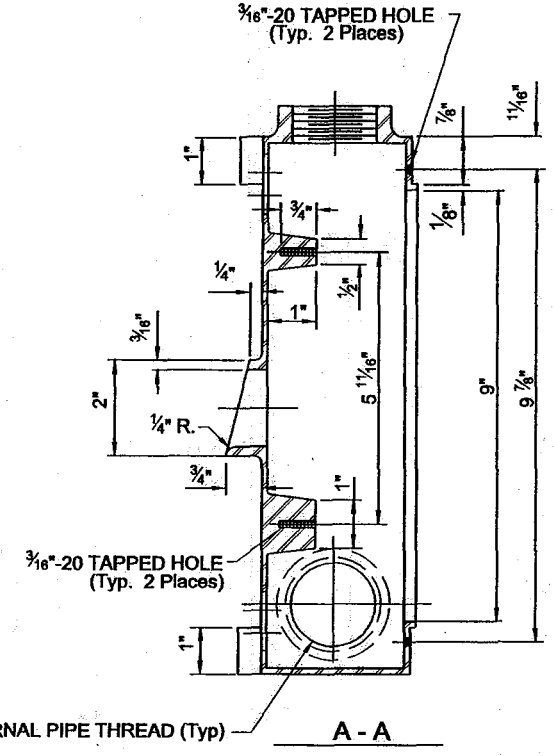
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ORNAMENTAL CAP	DATE: 4/09	DETAIL NO. 4791



NOTES:

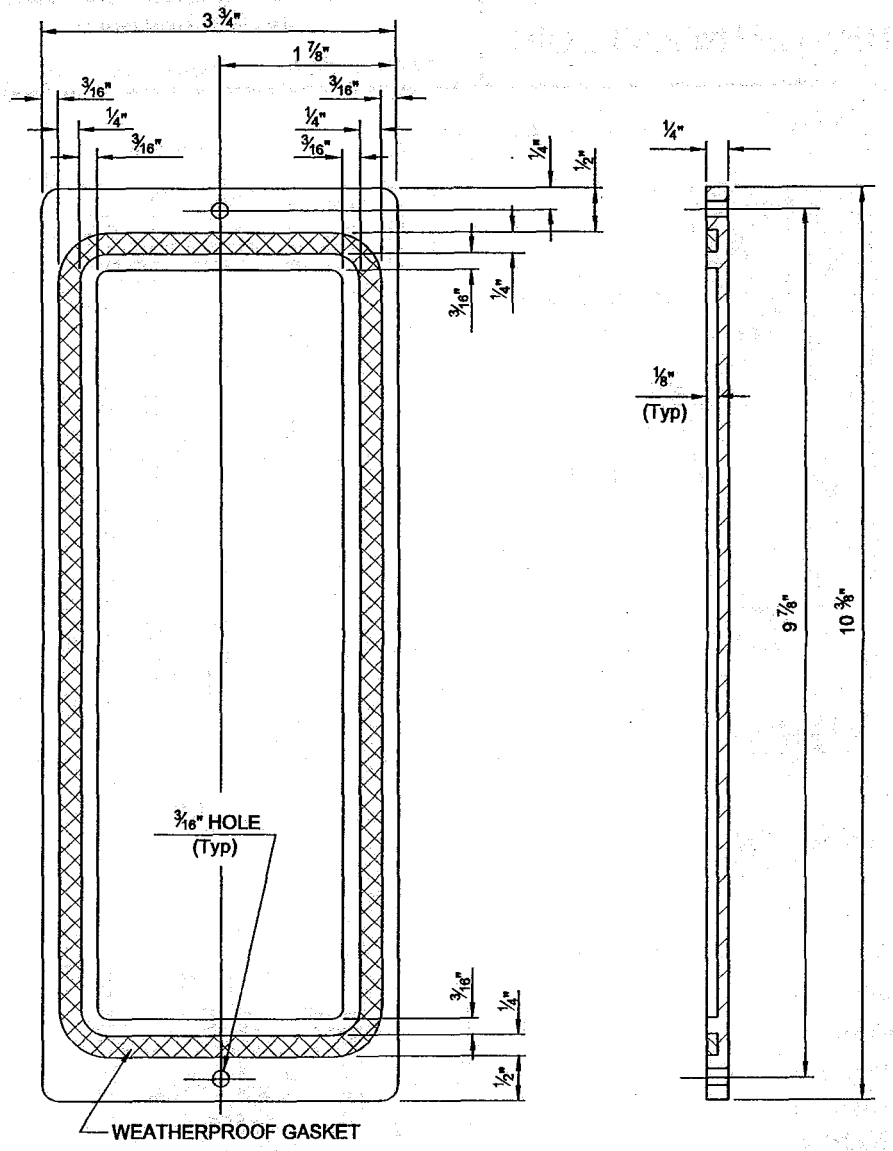
1. MATERIAL TO BE ALUMINUM OR BRASS.
2. TERMINAL COMPARTMENT TO BE PAINTED A FLAT BLACK.
3. ALL FILLETS ARE ⅛" RAD. EXCEPT AS NOTED.
4. TERMINAL TO BE SUPPLIED WITH TWO (2) 3/16" x ⅝" - 20 PHILLIPS HEAD MACHINE SCREWS.





A - A

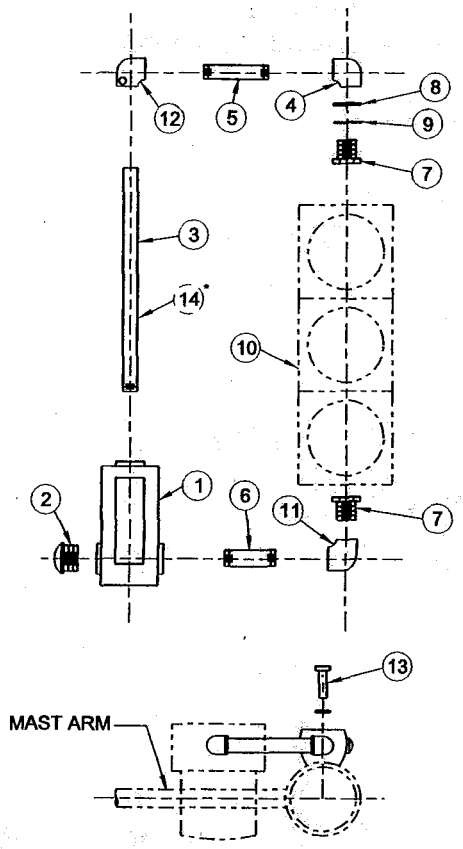
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SIDE MOUNTED TERMINAL COMPARTMENT	DATE: 4/09	DETAIL NO. 4792



NOTES:

1. MATERIAL TO BE ALUMINUM OR BRASS.
2. COVER TO BE PAINTED A FLAT BLACK.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TERMINAL COMPARTMENT COVER	DATE: 4/09	DETAIL NO. 4793



MOUNTING ORIENTATION PLAN
(SEE NOTE 3)

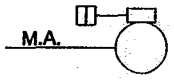
ITEM	QTY.	DESCRIPTION
1	1	TERMINAL COMPARTMENT FOR SIDE MOUNTING, (4792)
2	1	ORNAMENTAL CAP, (SEE 4791)
3	1	1½" I.D. PIPE, SEE TABLE
4	1	1½" I.D. PIPE, 90° ELBOW
5	1	1½" I.D. PIPE NIPPLE, 24½" LONG
6	1	1½" I.D. PIPE NIPPLE, 24" LONG
7	1	1 ½" LOCK NIPPLE, SEE NOTE 1
8	1	FLAT WASHER
9	1	NEOPRENE WASHER
10	1	SIGNAL HEAD, SEE PLANS
11	1	90° ELBOW WITH LOCKING DEVICE, (SEE 4788)
12	1	1½" I.D. PIPE, 90° ELBOW, DRILL & TAP FOR SET SCREW
13	2	½" x 2" GALVANIZED STEEL BOLT 13-UNC WITH FLAT AND LOCK WASHERS
* 14	1	1½" PIPE NIPPLE, 9½" LONG FOR PED. SIGNAL, FOR ILLUMINATED MESSAGE UNITS USE 25⅜" PIPE

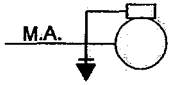
* SPECIAL NIPPLE LENGTH FOR USE ONLY WITH PED.
SPECIAL SINGLE HEAD UNITS.

NIPPLE LENGTH
(ITEM 3)

Signal Face	Q	F/R	G
Nipple Length	70"	37⅞"	52⅝"

THREADS ON ONE END ONLY.



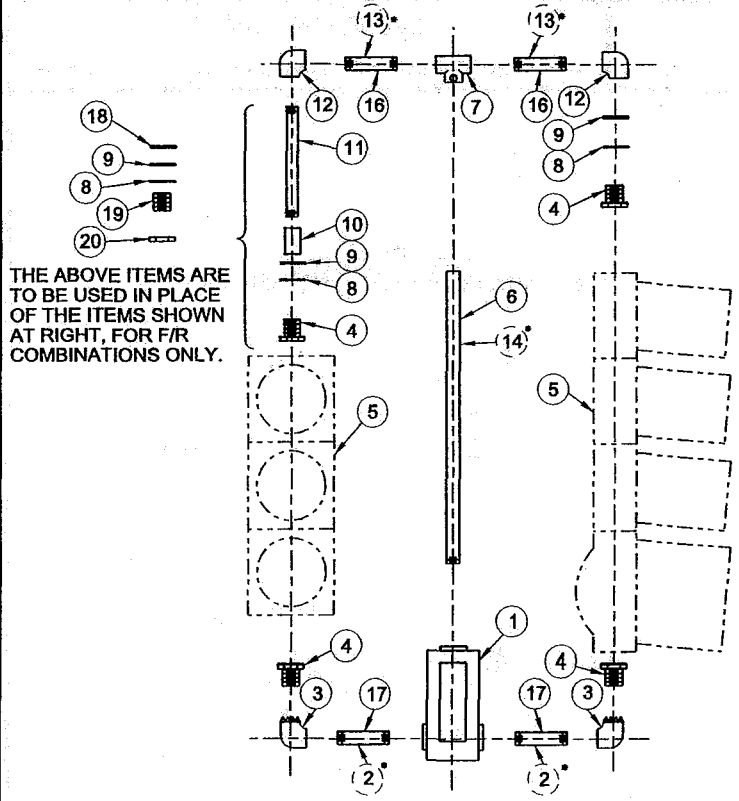


PLAN SYMBOLS

NOTES:

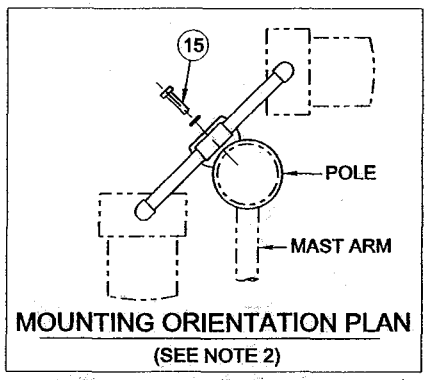
1. LOCK NIPPLE LENGTH SHALL BE 1¾" FOR 12" HEADS.
2. FOR POLE DRILLING DETAIL SEE MCDOT STD. DRAWING (4775).
3. MOUNTING ORIENTATION MAY DIFFER FROM WHAT IS SHOWN. SEE PLANS FOR DESIRED ORIENTATION.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE V MOUNTING ASSEMBLY	DATE: 4/09	DETAIL NO. 4794



ITEM	QTY.	DESCRIPTION
1	1	TERMINAL COMPARTMENT FOR SIDE MOUNTING, (4792)
* 2	2	1½" PIPE NIPPLE, 11½" LONG FOR PED. SIGNAL HEADS
3	2	90° ELBOW WITH LOCKING DEVICE (4777)
4	4	1½" LOCK NIPPLE, SEE NOTE 1
5	2	SIGNAL HEADS, SEE PLANS
6	1	CENTER PIPE, SEE TABLE
7	1	TEE, DRILL & TAP FOR SET SCREW
8	2	NEOPRENE WASHER
9	2	FLAT WASHER
10	1	1½" PIPE COUPLING, AS REQUIRED
11	1	1½" PIPE NIPPLE, SEE TABLE
12	2	90° ELBOW
* 13	2	1½" PIPE NIPPLE, 12" LONG FOR PED. SIGNAL HEADS
* 14	1	1½" PIPE NIPPLE, 9½" LONG FOR PED SIGNAL HEADS
15	2	½" x 2" GALVANIZED STEEL BOLT 13 UNC WITH FLAT & LOCK WASHERS
16	2	1½" PIPE NIPPLE, 24½" LONG
17	2	1½" PIPE NIPPLE, 24" LONG
18	1	CONDUIT LOCK NUT (FOR 'F' & 'R' COMBINATION ONLY)
19	1	1½" PIPE NIPPLE, 3" LONG (FOR 'F' & 'R' COMBINATION ONLY)
20	1	MALLEABLE HEX NUT (FOR 'F' & 'R' COMBINATION ONLY)

* SPECIAL NIPPLE LENGTH FOR USE ONLY WITH PED. SIGNAL SPECIAL SINGLE HEAD UNITS.



MOUNTING ORIENTATION PLAN
(SEE NOTE 2)

(ITEM 11)

SIGNAL FACES COMBINATION	Q	F/R	G
Q	∅	29½"	16¼"
F/R	29½"	∅	13¾"
G	16¼"	13¾"	∅

TABLES TO BE USED FOR FINDING NIPPLE LENGTHS.

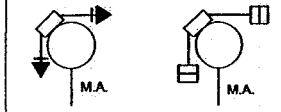
(ITEM 6)

SIGNAL FACES COMBINATION	Q	F/R	G
Q	70"	70"	70"
F/R	70"	37⅞"	52⅝"
G	70"	52⅝"	52⅝"

THREADS ON ONE END ONLY.

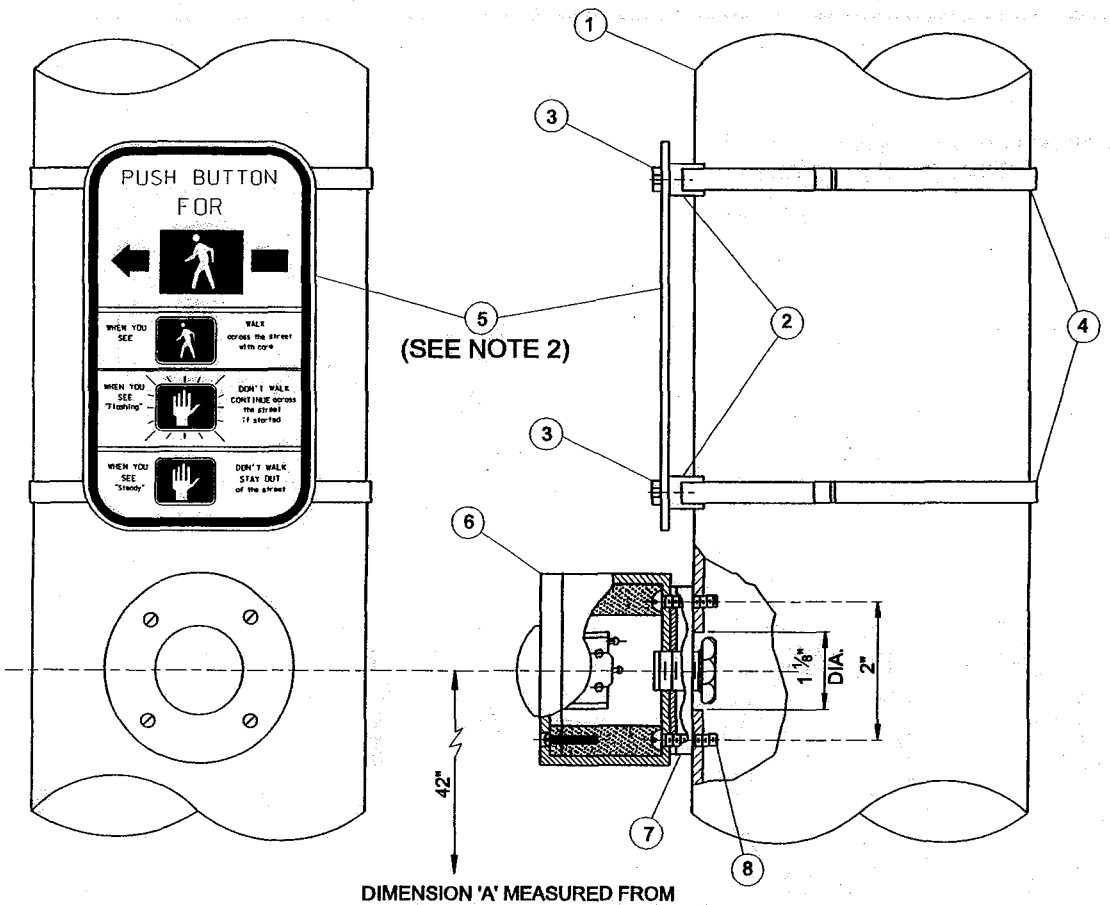
NOTES:

1. LOCK NIPPLE LENGTH SHALL BE 1¾" FOR 12" HEADS.
2. MOUNTING ORIENTATION MAY DIFFER FROM WHAT IS SHOWN. SEE PLANS FOR DESIRED ORIENTATION.



PLAN SYMBOLS

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE VII MOUNTING ASSEMBLY	DATE: 4/09	DETAIL NO. 4795



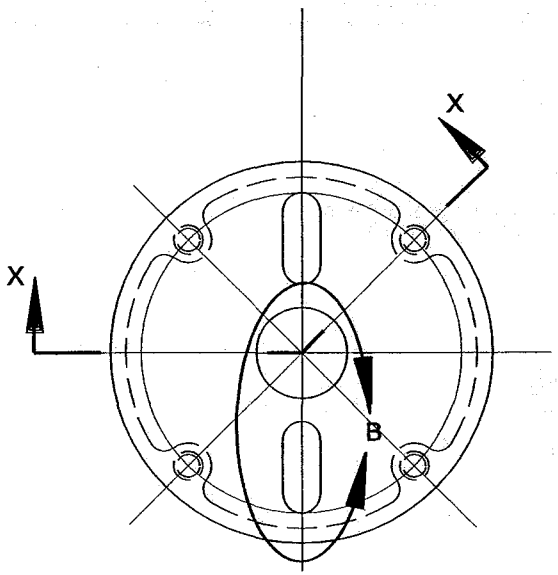
DIMENSION 'A' MEASURED FROM CENTER OF HOLE TO TOP OF SIDEWALK ELEVATION FOR POLE TYPES, 'A', 'E', 'F', 'J', 'Q', 'K', 'R', AND 'PB'.

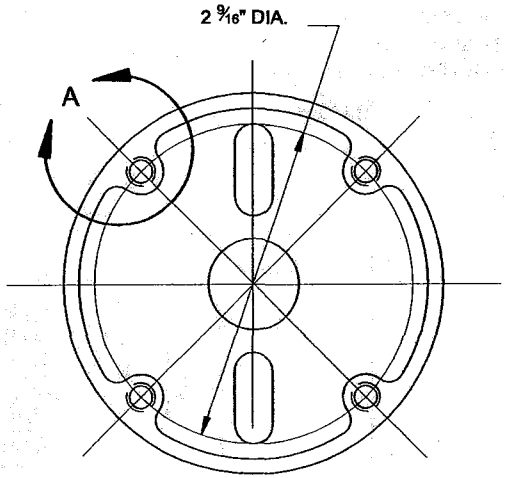
ITEM	QTY.	DESCRIPTION
1	-	SIGNAL POLE SHAFT
2	2	STAINLESS STEEL MINI-BRACKET
3	2	5/16"-24 x 1/2" LONG STAINLESS STEEL BOLT
4	2	1/2" STAINLESS STEEL BAND W/BUCKLE, (BAND-IT TYPE 201 OR EQUAL)
5	1	6" x 12" PEDESTRIAN PUSH-BUTTON SIGN. (SEE MCDOT SIGN MANUAL FOR SIGN NUMBERS R10-4CL, R10-4CR OR R10-4CB)
6	1	3" DIA. ROUND PED. PUSH-BUTTON, PAINTED GLOSS BLACK (TRAFFIC PARTS INC. NO PB 502-B03-B OR EQUAL)
7	1	POLE CURVATURE MOUNTING ADAPTER
8	2	1/4"-20 x 1" LONG SLOTTED R.H. SCREW, DRILLED AND TAPPED

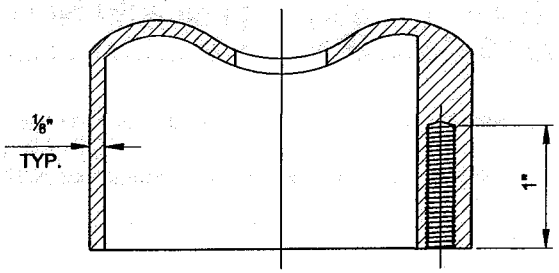
NOTE:

1. FOR INSTALLATION SPECIFICATIONS SEE MCDOT SUPPLEMENT, SECTIONS 470 THRU 478.
2. FOR CORRECT ARROW DIRECTION, SEE TRAFFIC SIGNAL PLANS.

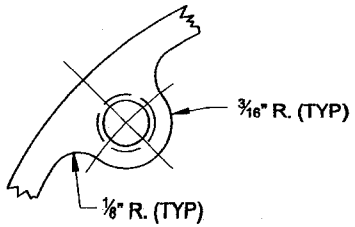
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPE PB PEDESTRIAN PUSH BUTTON MOUNT	DATE: 4/09	DETAIL NO. 4797-1



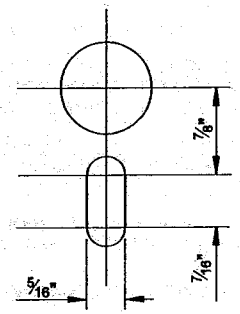




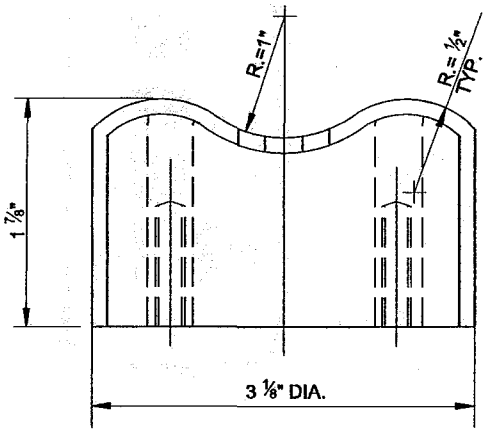
SECTION X-X



DETAIL A



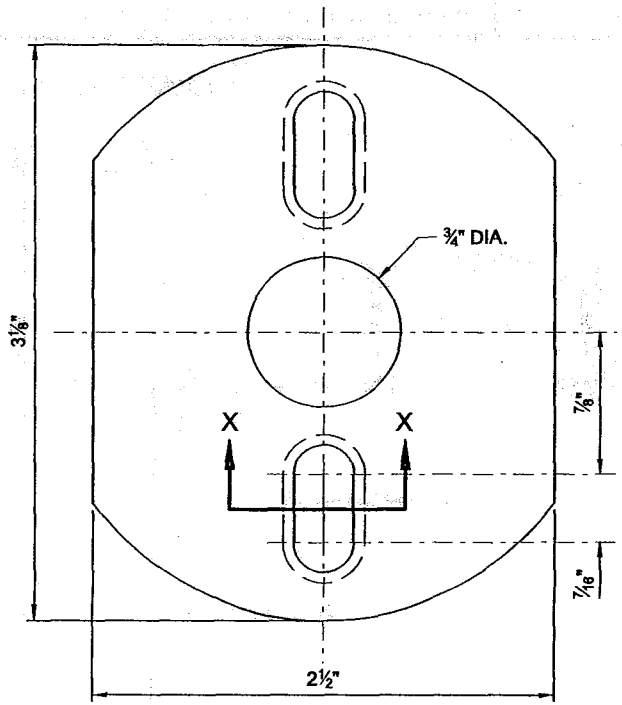
DETAIL B

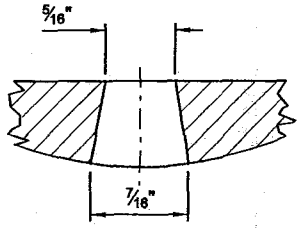


NOTES:

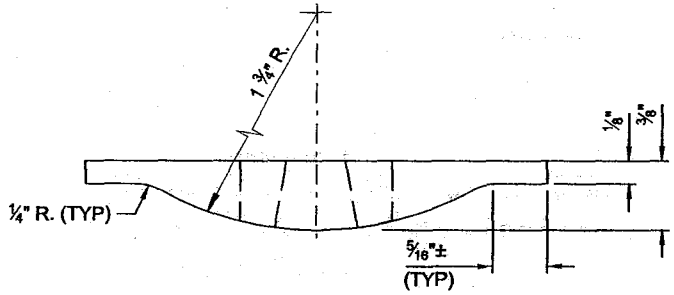
1. MATERIAL TO BE ALUMINUM
2. HOUSING TO BE PAINTED A FLAT BLACK

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	PEDESTRIAN PUSH-BUTTON HOUSING	DATE: 4/09	DETAIL NO. 4797-2





SECTION X-X



NOTES:

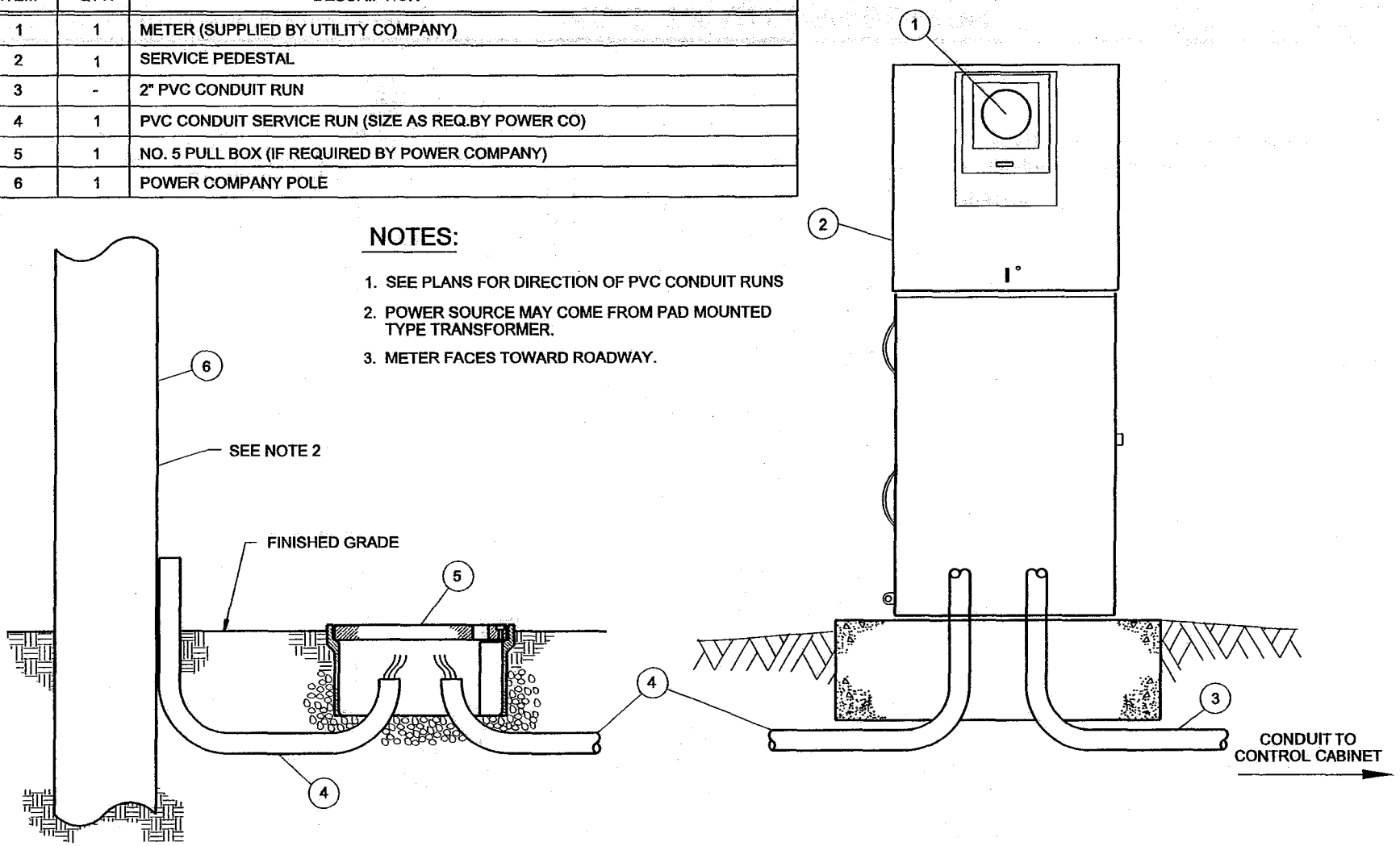
1. MATERIAL TO BE ALUMINUM
2. ADAPTOR TO BE PAINTED A FLAT BLACK

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	PEDESTRIAN PUSH-BUTTON ADAPTOR PLATE	DATE: 4/09	DETAIL NO. 4797-3

ITEM	QTY.	DESCRIPTION
1	1	METER (SUPPLIED BY UTILITY COMPANY)
2	1	SERVICE PEDESTAL
3	-	2" PVC CONDUIT RUN
4	1	PVC CONDUIT SERVICE RUN (SIZE AS REQ.BY POWER CO)
5	1	NO. 5 PULL BOX (IF REQUIRED BY POWER COMPANY)
6	1	POWER COMPANY POLE

NOTES:

1. SEE PLANS FOR DIRECTION OF PVC CONDUIT RUNS
2. POWER SOURCE MAY COME FROM PAD MOUNTED TYPE TRANSFORMER.
3. METER FACES TOWARD ROADWAY.



TYPE 5 (SERVICE)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	UNDERGROUND POWER SERVICE TO SERVICE PEDESTAL	DATE: 1/1/2011	DETAIL NO. 4798

IMSA CABLE 19-1, #14 AWG, 2 CONDUCTOR

PEDESTRIAN PUSH BUTTON STATION	
BASIC COLOR	SIGNAL INDICATION
BLACK	PUSH BUTTON
WHITE	PUSH BUTTON COMMON

IMSA CABLE 19-1, #14 AWG, 4 CONDUCTOR

SIGNAL HEADS	
BASIC COLOR	SIGNAL INDICATION
RED	RED
BLACK	YELLOW
GREEN	GREEN
WHITE	VEH. COMMON

PEDESTRIAN HEADS	
BASIC COLOR	SIGNAL INDICATION
RED	DON'T WALK
GREEN	WALK
WHITE	PED. COMMON
BLACK	SPARE

IMSA CABLE 19-1, #14 AWG, 7 CONDUCTOR

SIGNAL HEADS	
BASIC COLOR	SIGNAL INDICATION
RED	RED
BLACK	YELLOW
GREEN	GREEN
ORANGE	YELLOW ARROW
BLUE	GREEN ARROW
WHITE	VEH. COMMON
BLACK/WHITE	SPARE

NOTES:

1. FOR MATERIAL AND INSTALLATION SPECIFICATIONS SEE SECTION 478.
2. FOR EACH PEDESTRIAN PUSH BUTTON ONE (1) 2-CONDUCTOR CABLE SHALL BE PULLED CONTINUOUSLY FROM THE CONTROL CABINET TO THE PUSH BUTTON STATION.
3. INSTALL ONE (1) 7-CONDUCTOR CABLE FOR ALL OUTBOARD MAST ARM AND TYPE 'Q' SIGNAL INDICATION LOCATION ONLY.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	COLOR CODE - 2, 4 AND 7 CONDUCTOR CABLE	DATE: 4/09	DETAIL NO. 4799-1

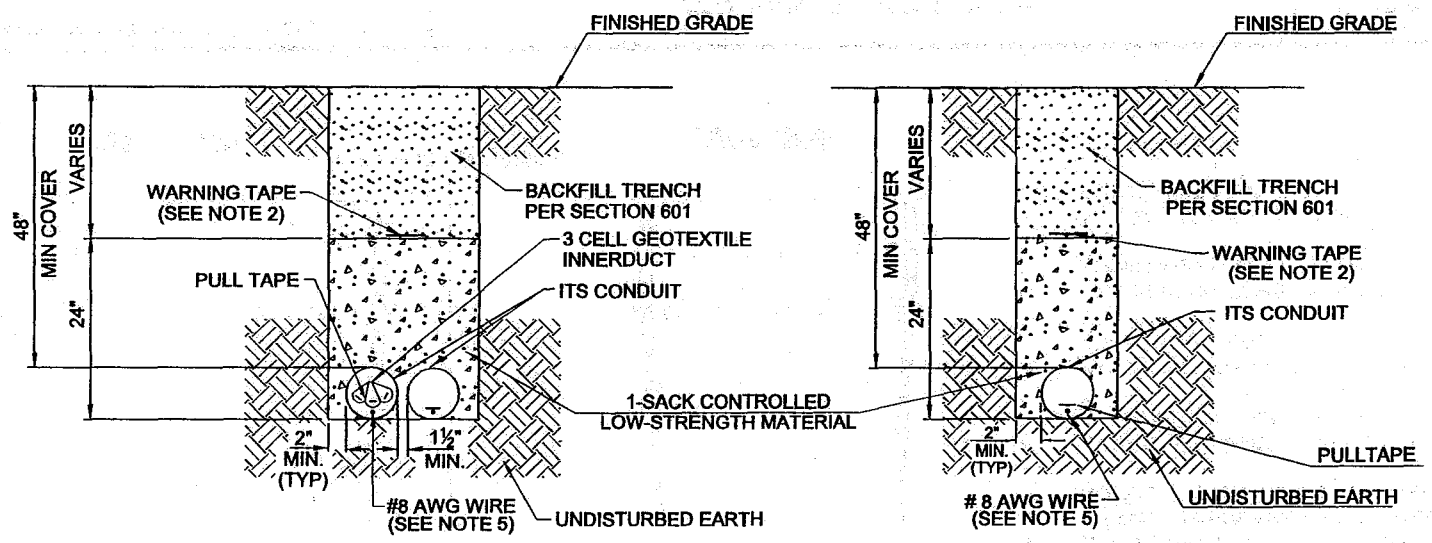
IMSA CABLE 19-1, #14 AWG, 20 CONDUCTOR

CABLE #1	CABLE #2	CONDUCTOR COLOR		SIGNAL INTERVAL
		BASIC COLOR	TRACER STRIPE	
ϕ1	ϕ5 OR OVERLAP A	RED	—	RED
		ORANGE	—	YELLOW
		GREEN	—	GREEN
ϕ2	ϕ6 OR OVERLAP B	RED	BLACK	RED
		ORANGE	BLACK	YELLOW
		GREEN	BLACK	GREEN
ϕ3	ϕ7 OR OVERLAP C	BLACK	RED	RED
		ORANGE	RED	YELLOW
		BLUE	RED	GREEN
ϕ4 (SEE NOTE 7)	ϕ8 OR OVERLAP D	RED	WHITE	RED
		BLACK	WHITE	YELLOW
		GREEN	WHITE	GREEN
ϕ1 PED. OR ϕ2 PED.	ϕ6 PED.	BLUE	—	WALK
		BLACK	—	DON'T WALK
ϕ2 PED. OR ϕ4 PED.	ϕ8 PED.	BLUE	WHITE	WALK
		RED	GREEN	DON'T WALK
ALL ϕ 'S	ALL ϕ 'S	BLUE	BLACK	SPARE
		WHITE	BLACK	SPARE
		WHITE	RED	SPARE

NOTES:

1. FOR MATERIAL AND INSTALLATION SPECIFICATIONS SEE MCDOT TRAFFIC SIGNAL AND INTERSECTION LIGHTING CONSTRUCTION SPECIFICATIONS.
2. A THWN, #10 AWG, WHITE CONDUCTOR SHALL BE PULLED WITH EACH IMSA CABLE AS A SIGNAL COMMON.
3. FOR THE LUMINAIRE CIRCUIT, TWO (2) CONDUCTORS, THWN #12 AWG, SHALL BE PULLED, A BLACK AND A WHITE.
4. CABLE #1 FOR RING 1.
5. CABLE #2 FOR RING 2. (CABLE #2 SHALL BE MARKED BY TWO (2) WRAPS OF WHITE TAPE)
6. FOR PHASES 1 THRU 4, ONLY CABLE #1 SHALL BE USED.
7. FOR 8 PHASES, CABLES #1 AND #2 ARE REQUIRED.
8. ϕ4 MAY BE ASSIGNED AS AN OVERLAP PHASE IN THREE (3) PHASE APPLICATIONS.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	COLOR CODE - 20 CONDUCTOR CABLE	DATE: 4/09	DETAIL NO. 4799-2

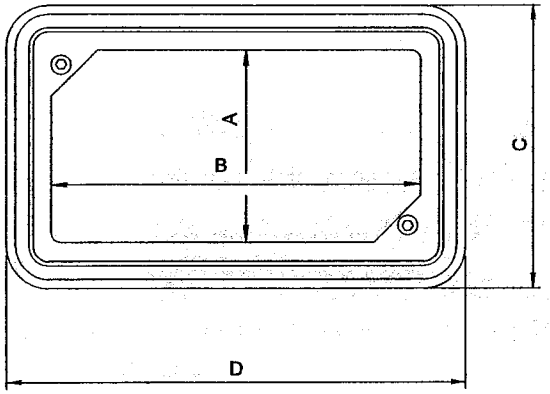


NOTES:

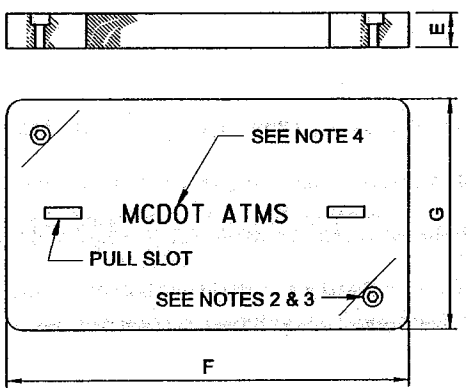
1. PULL TAPE SHALL BE INSTALLED IN ALL EMPTY CONDUITS AND ALL UNOCCUPIED INNERDUCT CELLS.
2. WARNING TAPE SHALL BE CENTERED OVER CONDUIT AND INSTALLED AT A DEPTH OF 24" FROM FINISHED GRADE. TAPE SHALL MEET THE REQUIREMENTS OF SECTION 481.2.5.
3. AFTER COMPLETION OF TRENCH BACKFILL, CONDUIT SHALL BE BLOWN OUT WITH COMPRESSED AIR AND HAVE A METAL DISK MANDREL 90% OF THE INSIDE DIAMETER OF THE CONDUIT PULLED THROUGH THE CONDUIT PRIOR TO ACCEPTANCE.
4. CONDUIT ALIGNMENT OFFSETS ARE TO BE ACCOMPLISHED BY A UNIFORM RATE OF CONDUIT DEFLECTION OVER A DISTANCE EQUAL TO OR GREATER THAN TEN (10) TIMES THE OFFSET DISTANCE.
5. BAREBOND #8 AWG WIRE SHALL BE INSTALLED CONTINUOUSLY IN ALL CONDUITS AND SHALL BE SPLICED AS NEEDED TO ESTABLISH AN UNBROKEN PATH FOR LOCATING PURPOSES.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	TYPICAL ITS PVC CONDUIT INSTALLATION	DATE: 4/09	DETAIL NO. 4801

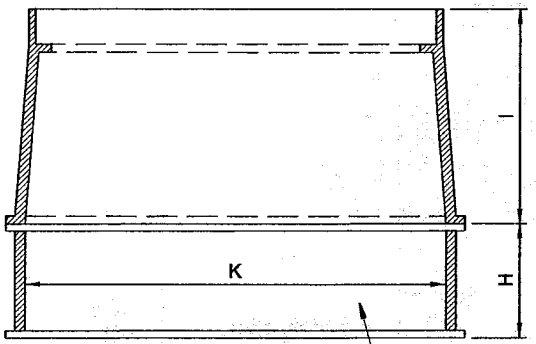
PULL BOX TYPE	A	B	C	D	E	F	G	H	I	J	K
#7 ITS	16¼"	29⅜"	23¼"	36⅞"	2"	30½"	17⅝"	8"	12"	21"	33⅞"



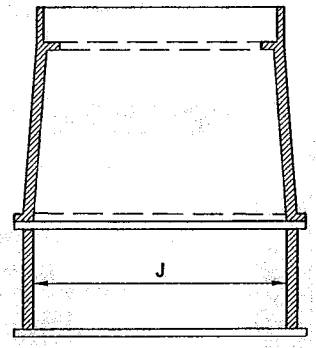
PULL BOX PLAN



COVER



FRONT VIEW

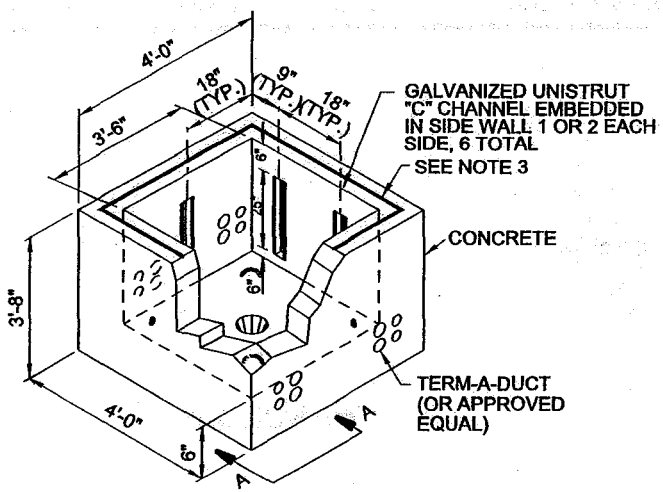


SIDE VIEW

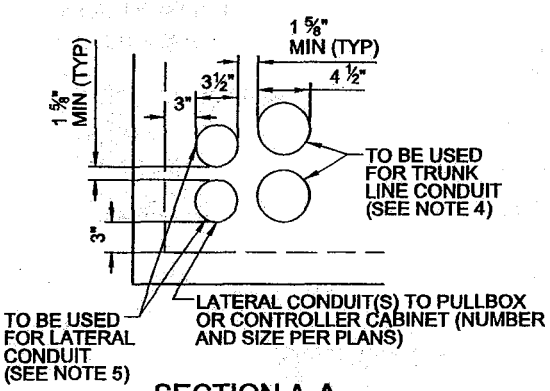
NOTES:

1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS, SEE SECTION 481.
2. PULL BOX SHALL BE CONSTRUCTED OF POLYMER CONCRETE REINFORCED WITH HEAVY-WEAVE FIBERGLASS CHRISTY FIBERLYTE FL36 (#7 PULL BOX) OR APPROVED EQUAL. (NOT TRAFFIC RATED)
3. COVERS SHALL BE SECURED WITH 3/8" BOLTS AND WASHERS WHICH SHALL BE OF BRASS, OR STAINLESS STEEL CORROSION RESISTANT MATERIALS.
4. INSERTS IN BOX FOR COVER BOLTS SHALL BE BRASS OR STAINLESS STEEL CORROSION RESISTANT MATERIALS.
5. PULL BOX COVER SHALL HAVE THE WORDS 'MCDOT ATMS' IN 1" HIGH LETTERS.
6. FOR ITS CONDUIT AND ITS NO. 7 PULL BOX INSTALLATION SEE DETAIL 4810.
7. PULL BOX COVERS SHALL BE TRAFFIC RATED FOR AN H20-44 DESIGN LOAD.

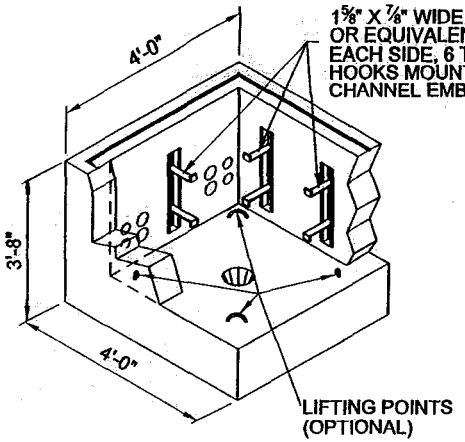
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS NO. 7 PULL BOX	DATE: 1/1/2011	DETAIL NO. 4805



PLAN SYMBOL



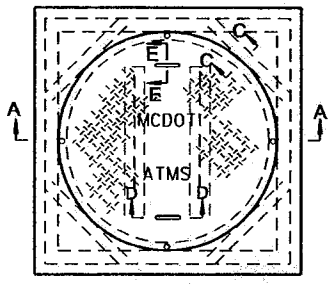
SECTION A-A



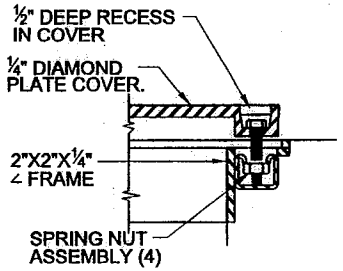
NOTES:

1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS SEE SECTION 481
2. ALL PULL BOXES SHALL BE FURNISHED WITH RACKS INSTALLED.
3. PULL BOX SHALL BE INSTALLED WITH A LOCKING LIP WITH SEAL BETWEEN WALL & COVER ASSEMBLY.
4. TERM-A-DUCT (OR APPROVED EQUAL) SHALL ACCEPT A 4" DIA. PVC CONDUIT.
5. TERM-A-DUCT (OR APPROVED EQUAL) SHALL ACCEPT A 3" DIA. PVC CONDUIT.
6. FOR COVER ASSEMBLY, SEE DETAIL 4806-2.

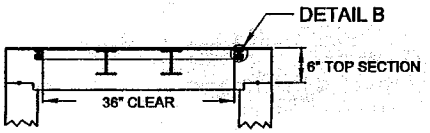
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS FIBER OPTIC NO. 9 PULL BOX	DATE: 4/09	DETAIL NO. 4806-1



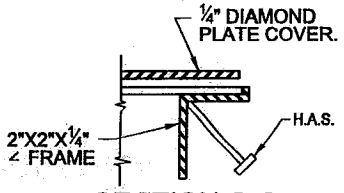
COVER ASSEMBLY



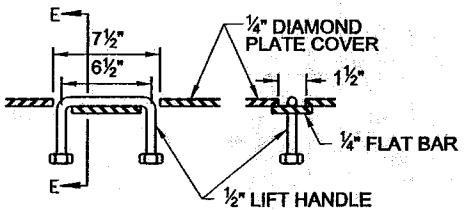
DETAIL B
(BOLT DOWN)



SECTION A-A



SECTION C-C
(TYPICAL)



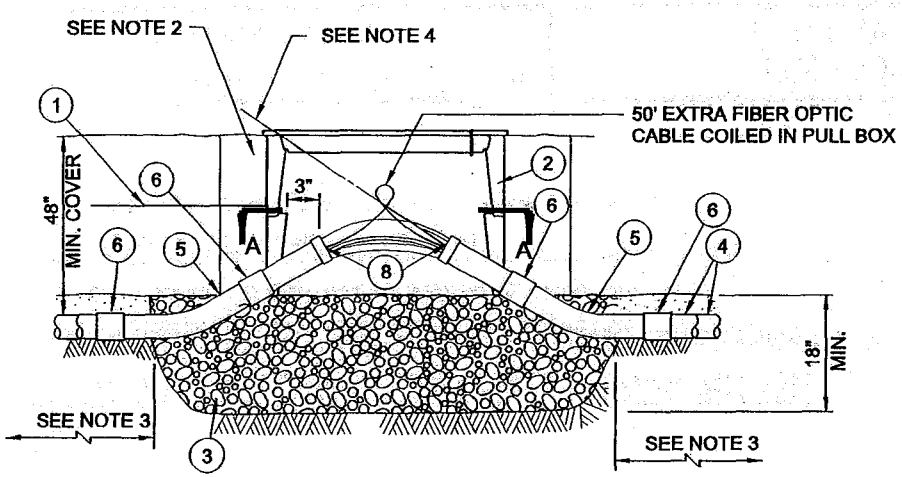
SECTION D-D
(LIFT HANDLE)

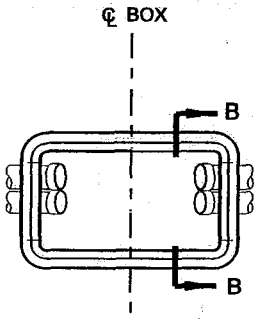
SECTION E-E
(LIFT HANDLE)

NOTES:

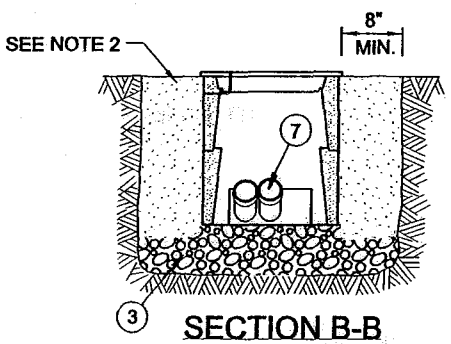
1. "MCDOT ATMS" SHALL BE THE TITLE EMBOSSED ON THE LID.
2. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS SEE SECTION 481.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS FIBER OPTIC NO. 9 PULL BOX COVER ASSEMBLY	DATE: 4/09	DETAIL NO. 4806-2



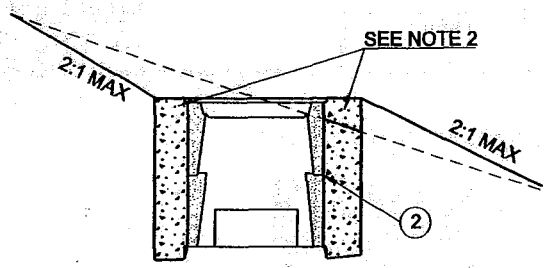


SECTION A-A



SECTION B-B

MATERIAL LIST	
ITEM	DESCRIPTION
①	WARNING TAPE
②	ITS NO. 7 PULLBOX, DETAIL 4805
③	1" SHORT GRADE ROCK
④	4" DIA SCHEDULE 40 P.V.C. CONDUIT
⑤	30 DEGREE R.M.C. ELBOW, 15" RADIUS
⑥	R.M.C. TO P.V.C. COUPLING
⑦	CONDUIT PLUG
⑧	BELL END FOR PVC - SEE NOTE 6

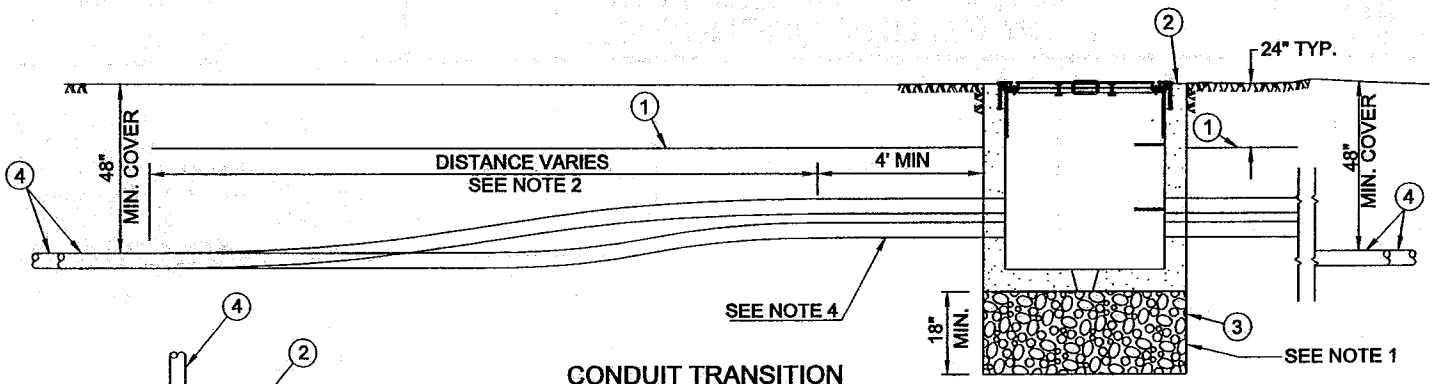


INSTALLATION IN SLOPED AREAS

NOTES:

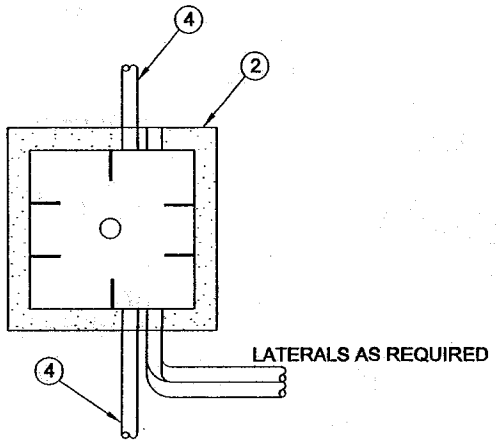
1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS SEE SECTION 481.
2. BACKFILL WITH CLASS "B" CONCRETE ALL AROUND AND TO BOTTOM OF THE PULL BOX.
3. CONDUIT ALIGNMENT OFFSETS ARE TO BE ACCOMPLISHED BY A UNIFORM RATE OF CONDUIT DEFLECTION OVER A DISTANCE EQUAL TO OR GREATER THAN TEN (10) TIMES THE OFFSET DISTANCE.
4. CONDUIT C/L SHALL BE ALIGNED TO TOP EDGE OF PULL BOX TO FACILITATE CABLE PULLING.
5. ALL POWER AND COMMUNICATIONS CABLE SHALL BE TAGGED WITH CABLE IDENTIFICATION.
6. USE PVC TO EXTEND INTO PULL BOX.WITH SEALED CAP PER SECTION 481.3.1(A)

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS CONDUIT AND ITS NO. 7 PULL BOX INSTALLATION	DATE: 4/09	DETAIL NO. 4810

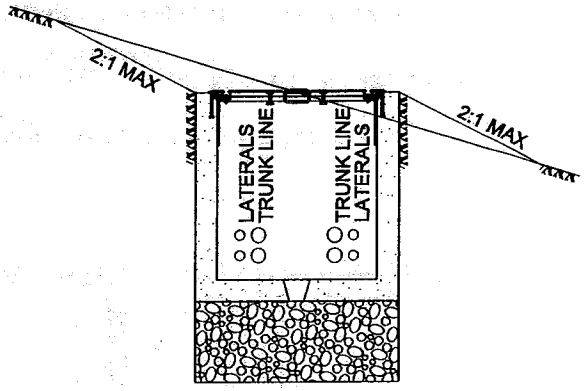


CONDUIT TRANSITION AND INSTALLATION

MATERIAL LIST	
ITEM	DESCRIPTION
①	WARNING TAPE
②	NO. 9 PULL BOX, DETAIL 4806
③	1" SHORT GRADE ROCK
④	PVC CONDUIT



LATERAL CONDUIT INSTALLATION

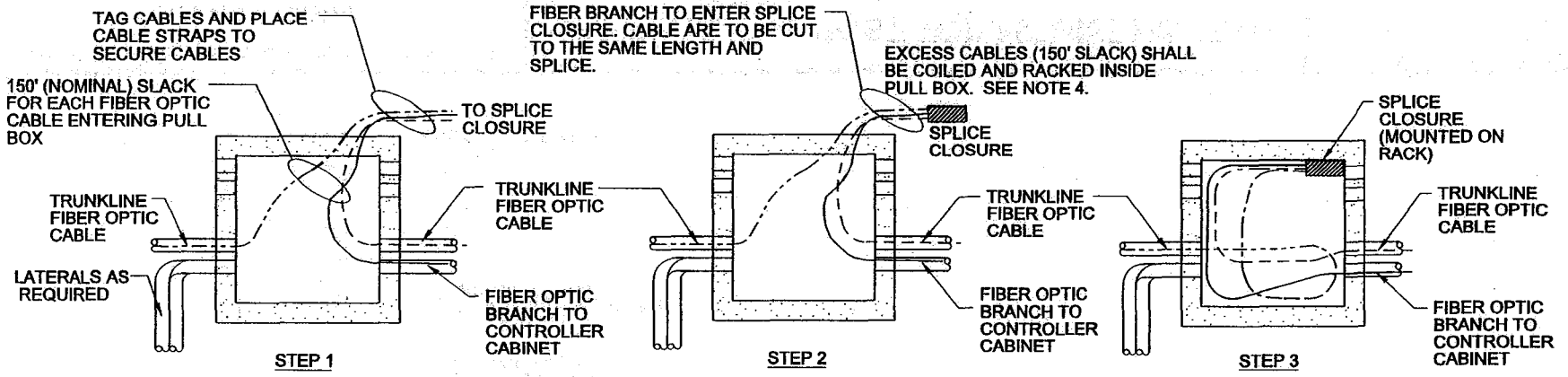


INSTALLATION IN SLOPED AREAS

NOTES:

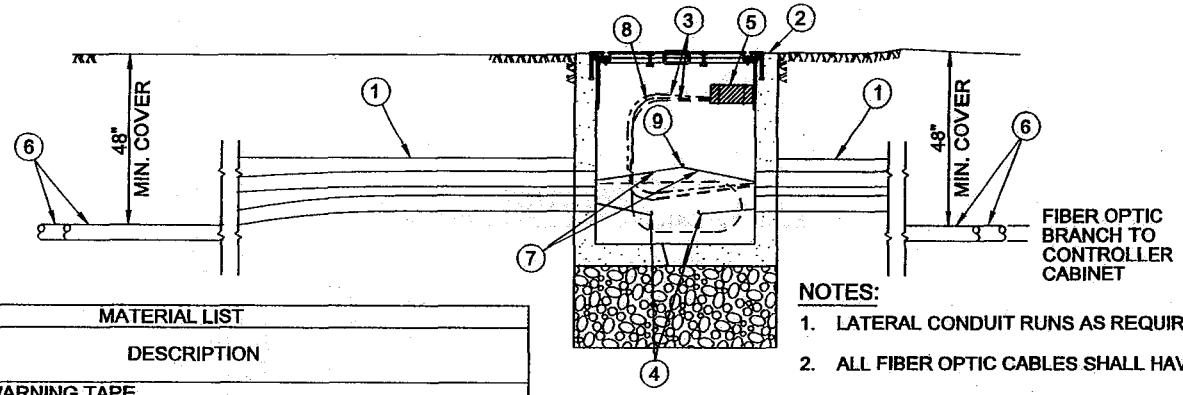
1. BACKFILL WITH 1" SHORT GRADE ROCK BELOW PULLBOX. BACKFILL AROUND SIDES OF PULL BOX WITH EXCAVATED MATERIAL AND COMPACT TO 90% OF MAXIMUM DENSITY.
2. CONDUIT ALIGNMENT OFFSETS ARE TO BE ACCOMPLISHED BY A UNIFORM RATE OF CONDUIT DEFLECTION OVER A DISTANCE EQUAL TO OR GREATER THAN TEN (10) TIMES THE OFFSET DISTANCE.
3. PLUG EACH CONDUIT END WITH APPROVED, WATERPROOF DUCT PLUG.
4. USE BOTTOM ACCESS POINT IN WALL OF PULL BOX WHEN ONLY A SINGLE 4" PVC CONDUIT IS REQUIRED FOR TRUNK LINE.
5. TO INSTALL FIBER OPTIC CABLE IN NO. 9 PULL BOX SEE DETAIL 4821.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS CONDUIT AND NO. 9 PULL BOX INSTALLATION	DATE: 4/09	DETAIL NO. 4811



FIBER OPTIC SPLICE PROCEDURE

(TOP VIEW)

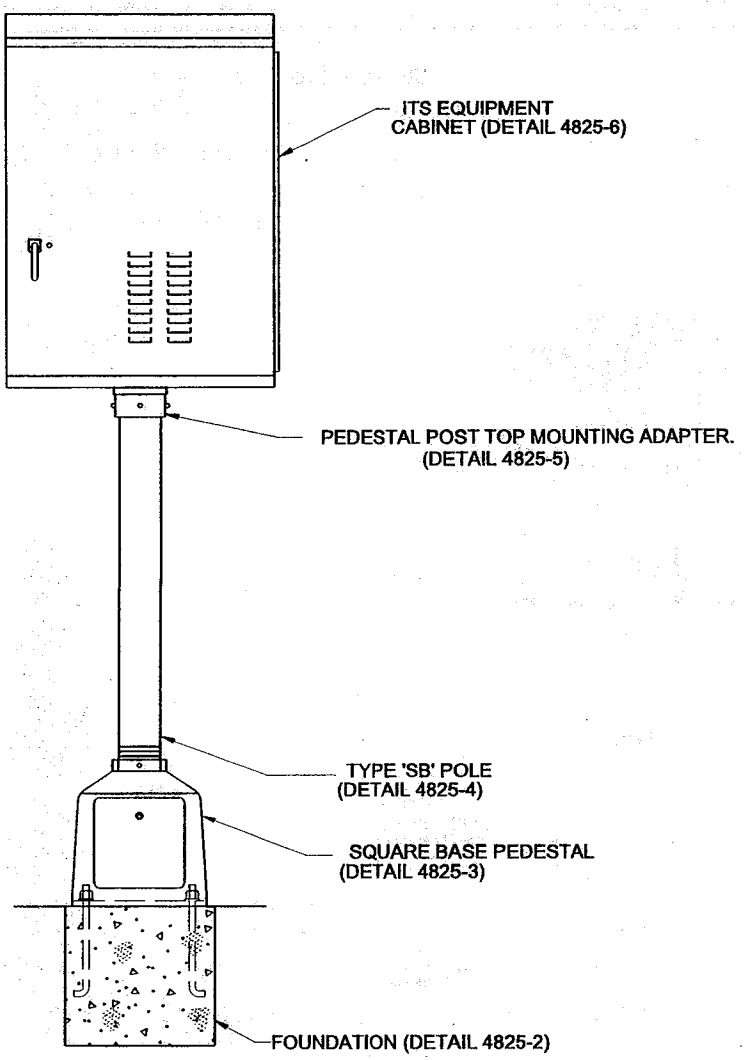


MATERIAL LIST	
ITEM	DESCRIPTION
①	WARNING TAPE
②	NO. 9 PULL BOX
③	SINGLE MODE FIBER OPTIC CABLE (SMFO)
④	PULL TAPE SEE NOTE 3
⑤	FIBER OPTIC CLOSURE
⑥	SCHEDULE 40 PVC OR HDPE CONDUIT, SIZE AND QUANTITY AS INDICATED ON THE PLANS
⑦	#8 AWG SOLID COPPER WIRE
⑧	SINGLE MODE FIBER OPTIC BRANCH WHERE REQUIRED
⑨	WIRE NUT

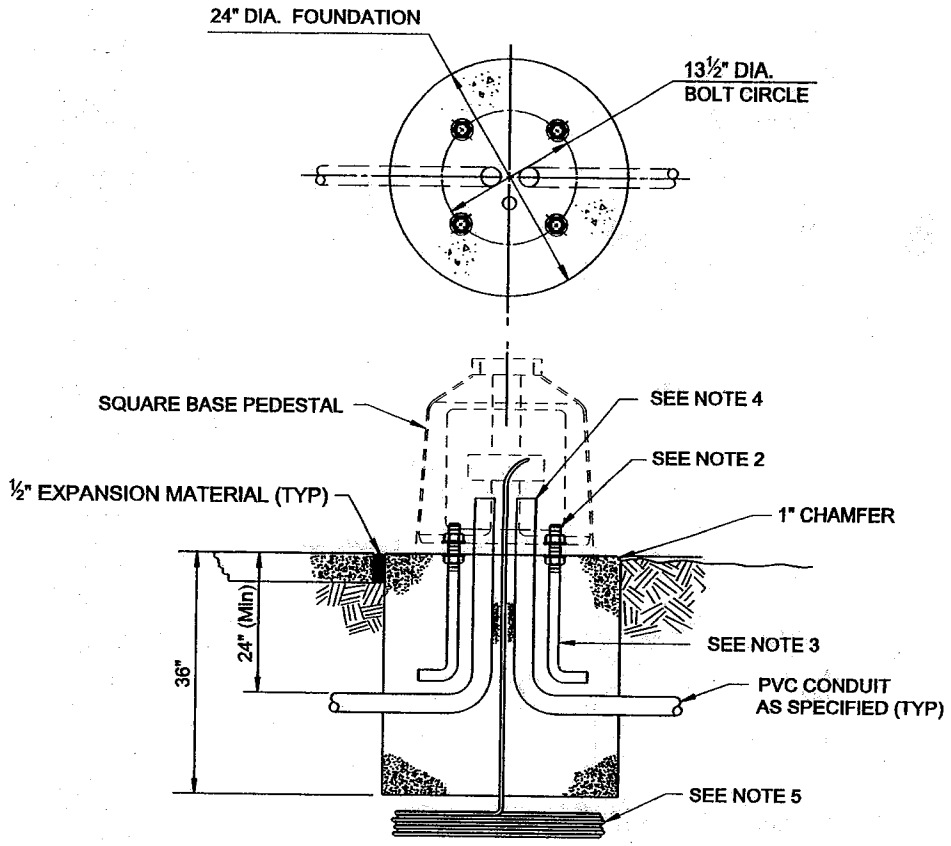
NOTES:

1. LATERAL CONDUIT RUNS AS REQUIRED.
2. ALL FIBER OPTIC CABLES SHALL HAVE PERMANENT TO/FROM LABELING ON CABLES.
3. FIBER OPTIC CABLES SHALL BE INSTALLED WITH PULL TAPE. PULL TAPE SHALL BE REPLACED WHEN USED FOR INSTALLAION.
4. PROVIDE 150' (NOMINAL) SLACK FOR EACH FIBER OPTIC CABLE ENTERING ALL NO. 9 PULL BOXES. 300 FEET OF SLACK SHALL BE PROVIDED FOR EACH FIBER OPTIC CABLE PASSING THROUGH NO. 9 PULL BOX WITHOUT A SPLICE CLOSURE. ALL CABLE SLACK SHALL BE COILED AND RACKED INSIDE PULL BOX.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	FIBER OPTIC CABLE INSTALLED IN NO. 9 PULL BOX	DATE: 4/09	DETAIL NO. 4821



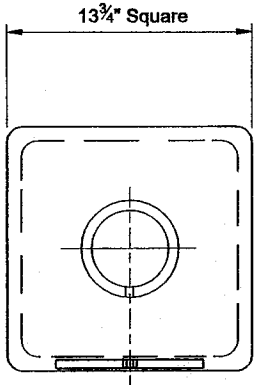
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS PEDESTAL POST TOP MOUNTING (G-1)	DATE: 4/09	DETAIL NO. 4825-1

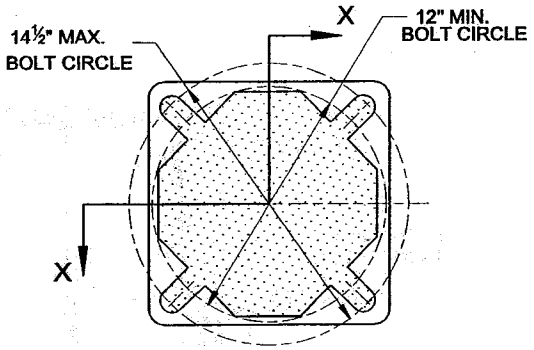


NOTES:

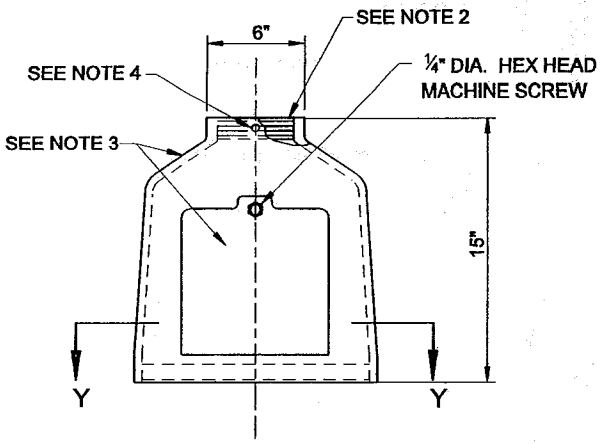
1. FOR MATERIAL AND CONSTRUCTION SEE SECTIONS 471 AND 472.
2. ANCHOR BOLTS SHALL EXTEND 2" ABOVE THE FOUNDATION.
3. FOUR ¾" X 18" X 4" ANCHOR BOLTS. TOP THREADED LENGTH OF ANCHOR BOLTS SHALL BE MINIMUM OF 3". SEE DETAIL 4725
4. CONDUIT SHALL EXTEND A MINIMUM OF 3" AND A MAXIMUM OF 5" ABOVE THE TOP OF THE FOUNDATION.
5. INSTALL 25 FOOT COIL OF NO. 4 AWG BARE COPPER GROUNDING ELECTRODE 2 FEET ABOVE TOP OF FOUNDATION.
6. FOR CONDUIT SIZE, LOCATION AND QUANTITY, SEE PLANS.

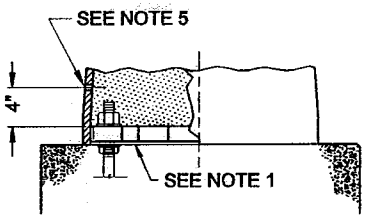
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS SQUARE BASE ('SB') POLE FOUNDATION DETAIL	DATE: 4/09	DETAIL NO. 4825-2





SECTION Y - Y



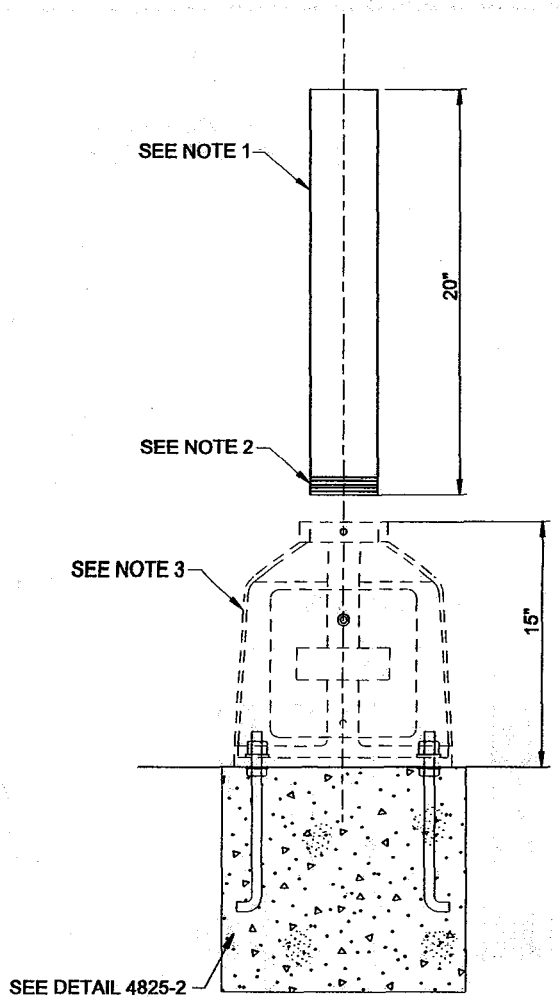


SECTION X - X

NOTES:

1. USE GROUT OR MASTIC TO SEAL GAP BETWEEN SQUARE BASE PEDESTAL AND FOUNDATION.
2. 4 INCH N.P.T. AT 8 THREADS/INCH.
3. THE SQUARE BASE PEDESTAL AND DOOR SHALL BE CONSTRUCTED OF CAST ALUMINUM.
4. A THREADED HOLE WITH ⅜" - 16 x 1" SET SCREW SHALL BE PROVIDED IN BASE COLLAR AS SHOWN.
5. A THREADED HOLE FOR ¼" - 20 SCREW SHALL BE PROVIDED FOR GROUND CONNECTION.

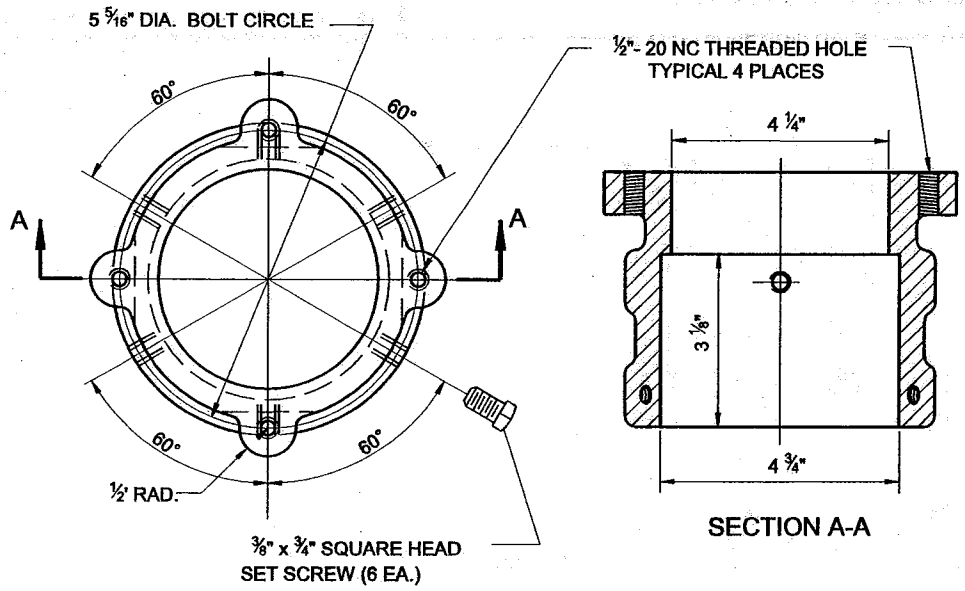
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS SQUARE BASE (SB) PEDESTAL	DATE: 4/09	DETAIL NO. 4825-3



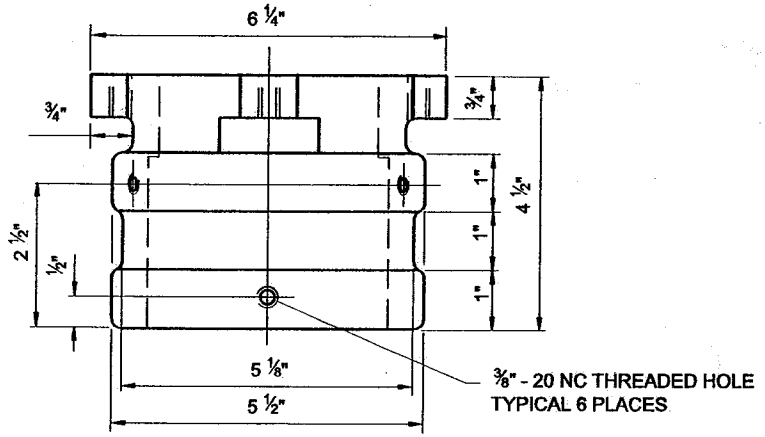
NOTES:

1. THE POLE SHAFT SHALL BE 4 ½" O.D. x 0.237 WALL (SCHEDULE 40) 6063-T6 ALUMINUM, SPUN FINISH.
2. 4-INCH N.P.T. AT 8 THREADS/INCH.
3. FOR SQUARE BASE PEDESTAL SEE DETAIL 4825-3

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS TYPE 'SB' POLE	DATE: 4/09	DETAIL NO. 4825-4



SECTION A-A

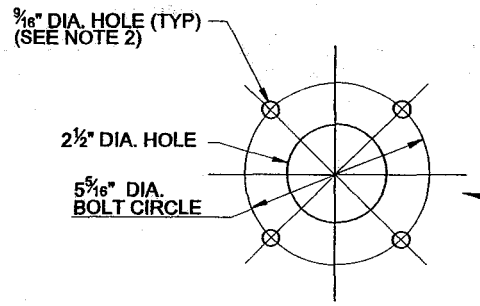


ALL FILLETS ARE 3/16" RAD.

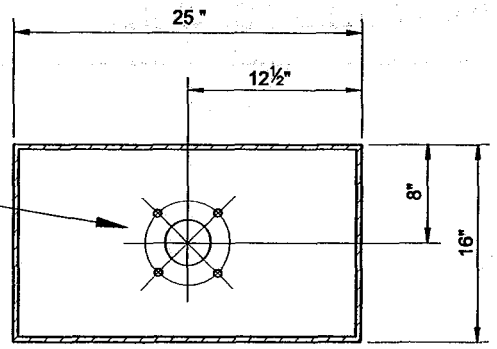
NOTES:

1. MATERIAL SHALL BE CAST ALUMINUM.
2. ADAPTER SHALL BE TRAFFIC SIGNAL HARDWARE (TSH) 0184 OR APPROVED EQUAL.

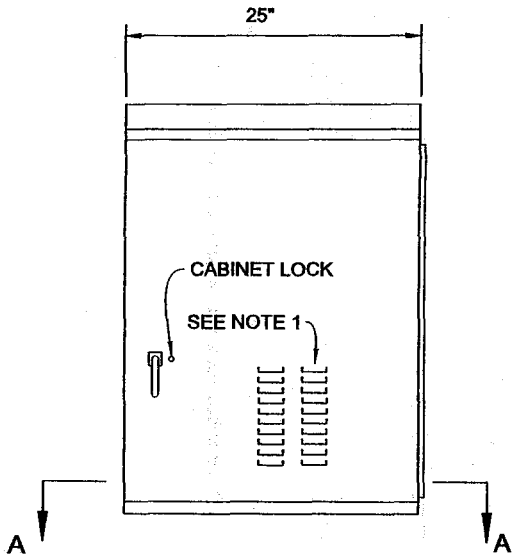
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS PEDESTAL POLE TOP MOUNTING ADAPTER	DATE: 4/09	DETAIL NO. 4825-5

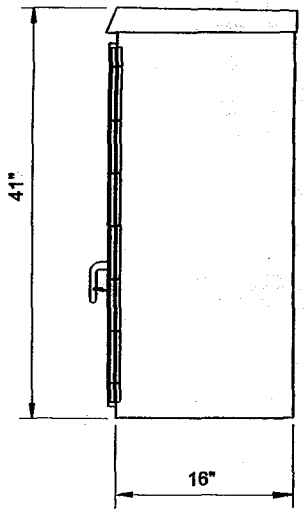


BOLT CIRCLE DETAIL



SECTION A-A

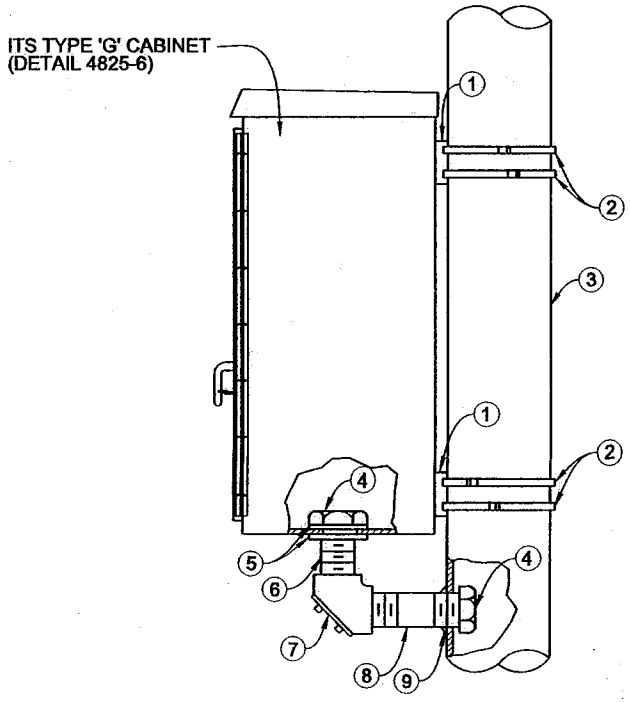




NOTES:

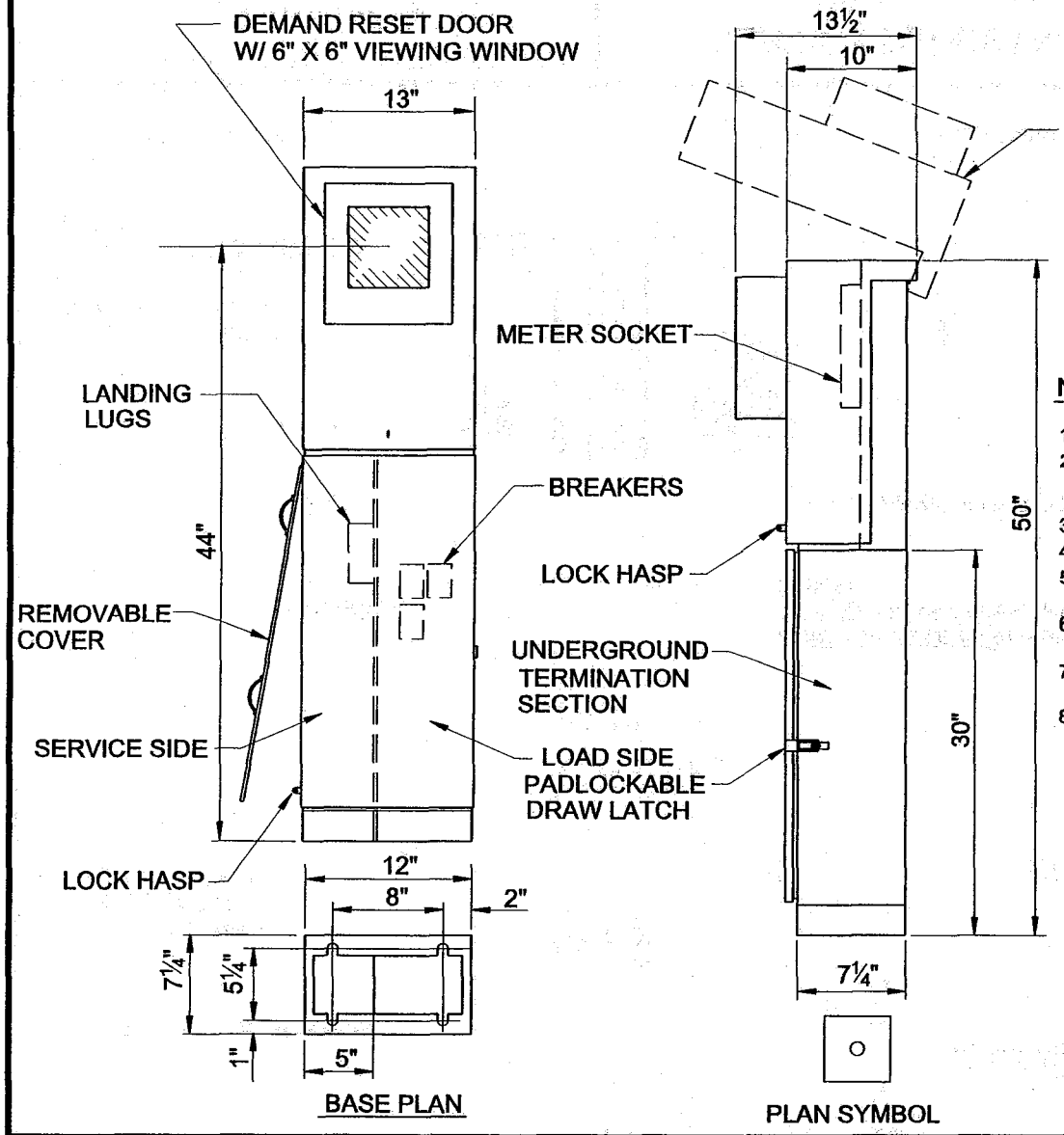
1. VENTILATING AIR INLET LOUVERS WITH 12"x12"x1" AIR FILTER
2. OMIT 9/16" DIAMETER HOLES FOR SIDE MOUNT INSTALLATION (DETAIL 4827).

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS TYPE 'G' CABINET	DATE: 4/09	DETAIL NO. 4825-6



ITEM	QTY	DESCRIPTION
①	2	POLE CLAMP (ECONOLITE NO. 9463480G1 OR EQUAL)
②	4	½" STAINLESS STEEL BAND W/BUCKLE (BAND-IT TYPE 201 OR EQUAL)
③	1	TYPE 'A' POLE OR MULTI-USE POLE
④	2	INSULATING BUSHING
⑤	2	LOCKNUT
⑥	1	2" x 2" NIPPLE
⑦	1	2" x 90° PULLING ELBOW
⑧	1	2" NIPPLE (LENGTH AS REQUIRED)
⑨	—	SEALING COMPOUND

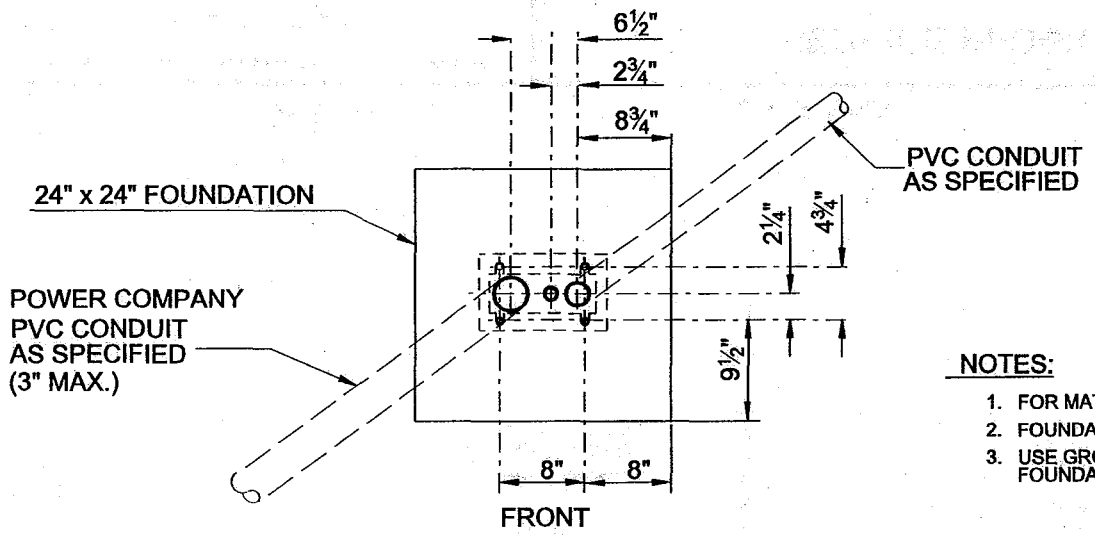
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS POST SIDE MOUNT (G-2)	DATE: 4/09	DETAIL NO. 4827



NOTES:

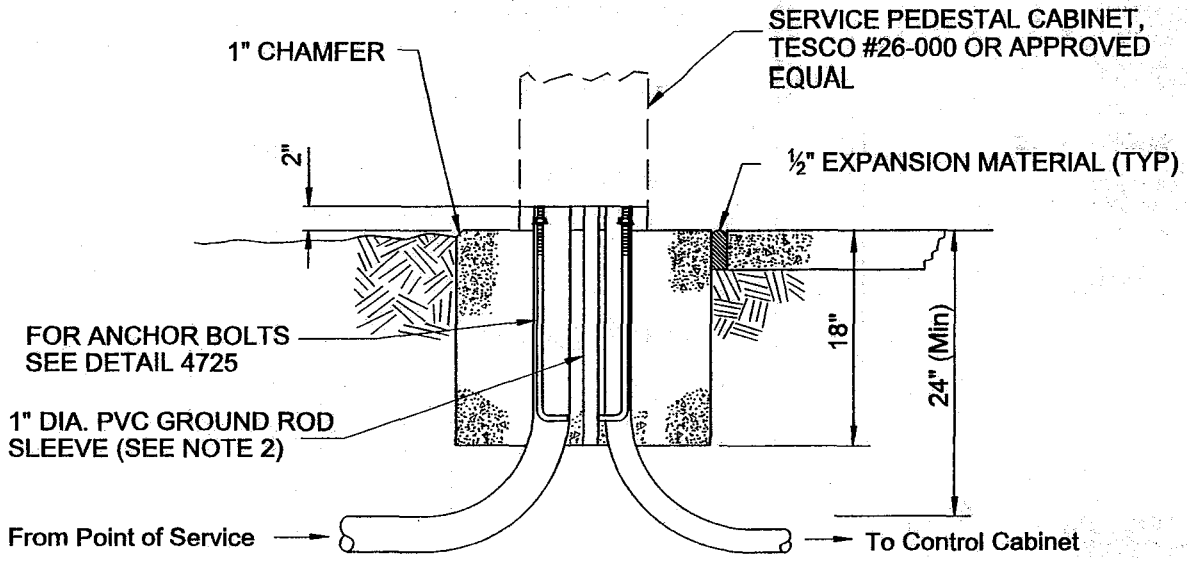
1. FOR CONSTRUCTION SPECIFICATIONS SEE SECTION 475.
2. EXTERIOR SHALL BE 12 GA. H. D. GALVANIZED STEEL, THE INTERIOR SHALL BE 14 GA. COLD ROLLED STEEL. ALL WELDS SHALL BE ELECTRICALLY WELDED AND REINFORCED WHERE REQUIRED.
3. CONSTRUCTION SHALL BE NEMA 3R AND 12. RAINTIGHT AND DUST TIGHT.
4. ALL NUTS, BOLTS, SCREWS AND HINGES SHALL BE STAINLESS STEEL.
5. NUTS, BOLTS AND SCREWS SHALL NOT BE VISIBLE FROM OUTSIDE OF ENCLOSURE.
6. CONTROL WIRING SHALL BE MARKED AT BOTH ENDS WITH PERMANENT WIRE MARKERS.
7. A PLASTIC COVERED WIRING DIAGRAM SHALL BE SUPPLIED WITH ENCLOSURE.
8. THE ENCLOSURE SHALL BE FACTORY WIRED AND CONFORM TO REQUIRED NEMA STANDARDS.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SERVICE PEDESTAL	DATE: 1/1/2011	DETAIL NO. 4829-1

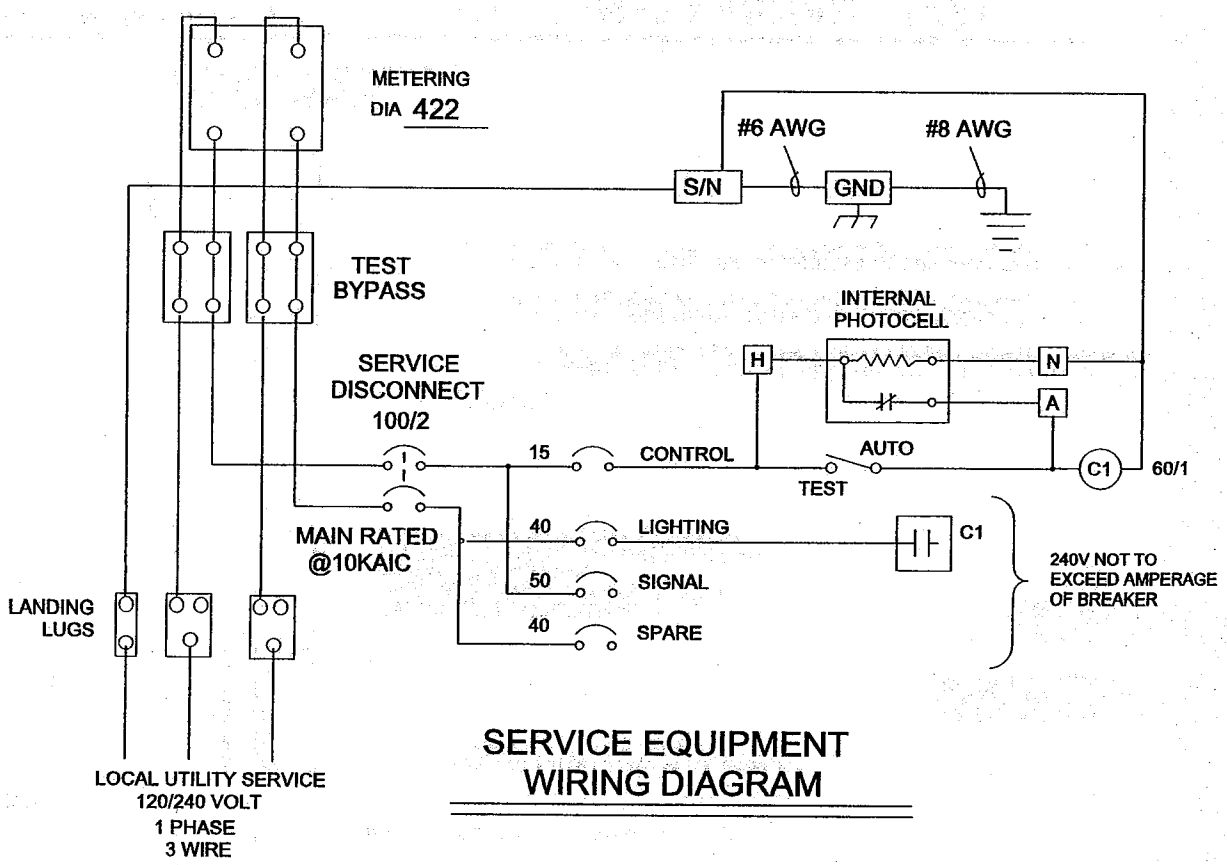


NOTES:

1. FOR MATERIAL AND CONSTRUCTION SPECIFICATIONS SEE SECTION 472.
2. FOUNDATIONS SHALL HAVE A ⅝" x 8' BONDED COPPER GROUND ROD.
3. USE GROUT OR MASTIC TO SEAL GAP BETWEEN SERVICE PEDESTAL AND FOUNDATION.



MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SERVICE PEDESTAL FOUNDATION	DATE: 1/1/2011	DETAIL NO. 4829-2

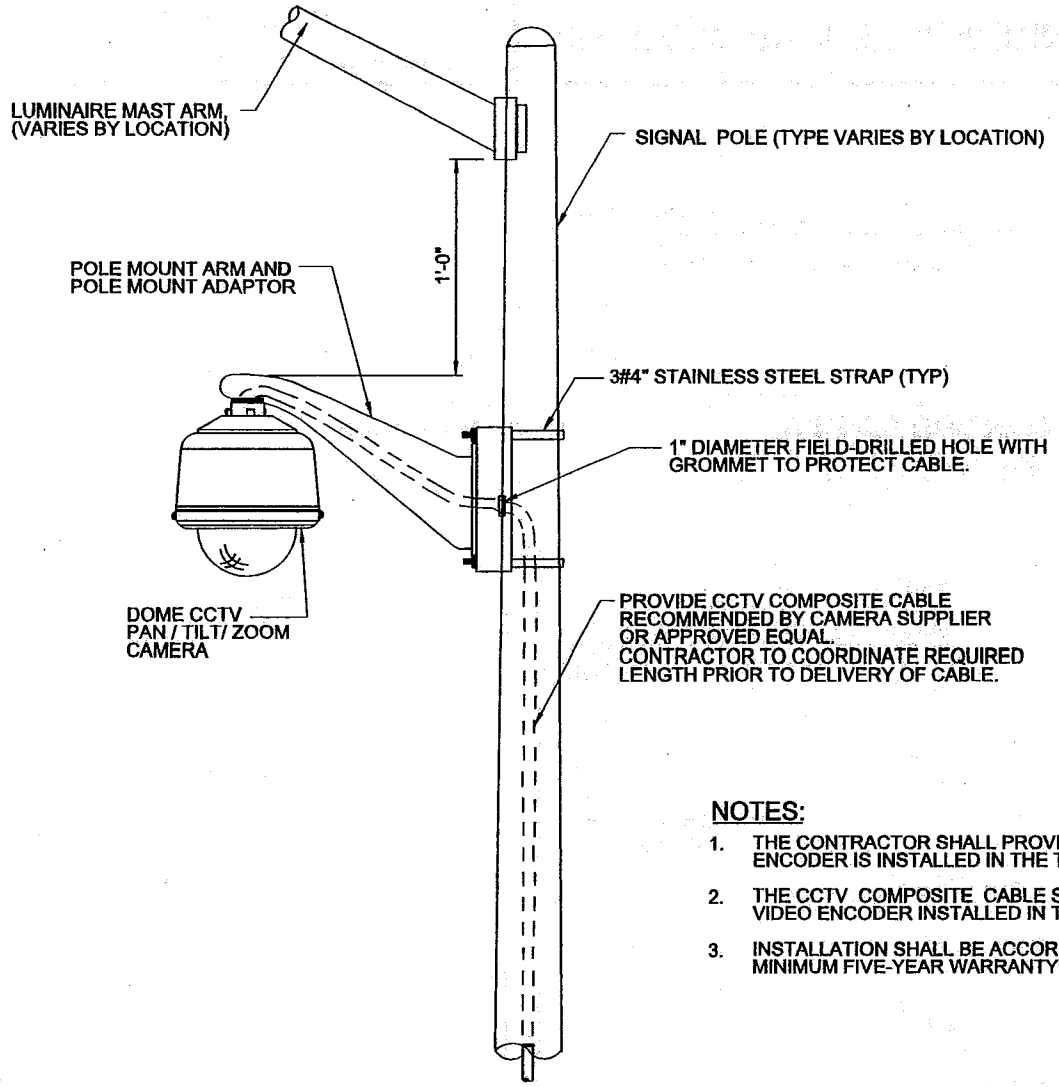


SERVICE EQUIPMENT WIRING DIAGRAM

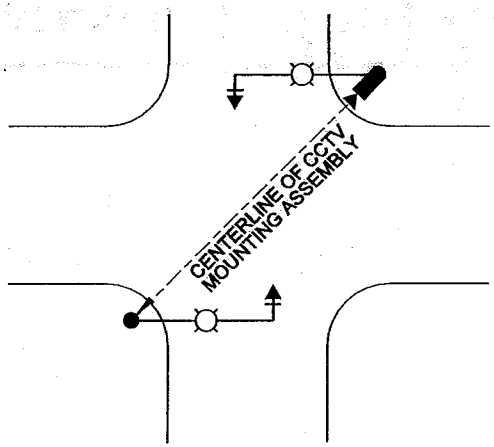
NOTES:

1. SIGNAL AND LIGHTING SHALL BE WIRED ON SEPARATE PHASES.
2. LOAD CURRENT FOR ALL BREAKERS SHALL NOT EXCEED 80% OF BREAKER AMPERAGE.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	SERVICE PEDESTAL WIRING SCHEMATIC	DATE: 1/1/2011	DETAIL NO. 4829-3



CCTV CAMERA
POLE MOUNTIING DETAIL



THE ROTATION OF THE CCTV CAMERA SHALL BE ALIGNED TO POINT AT THE TRAFFIC SIGNAL POLE ON THE DIAGONALLY OPPOSITE CORNER.

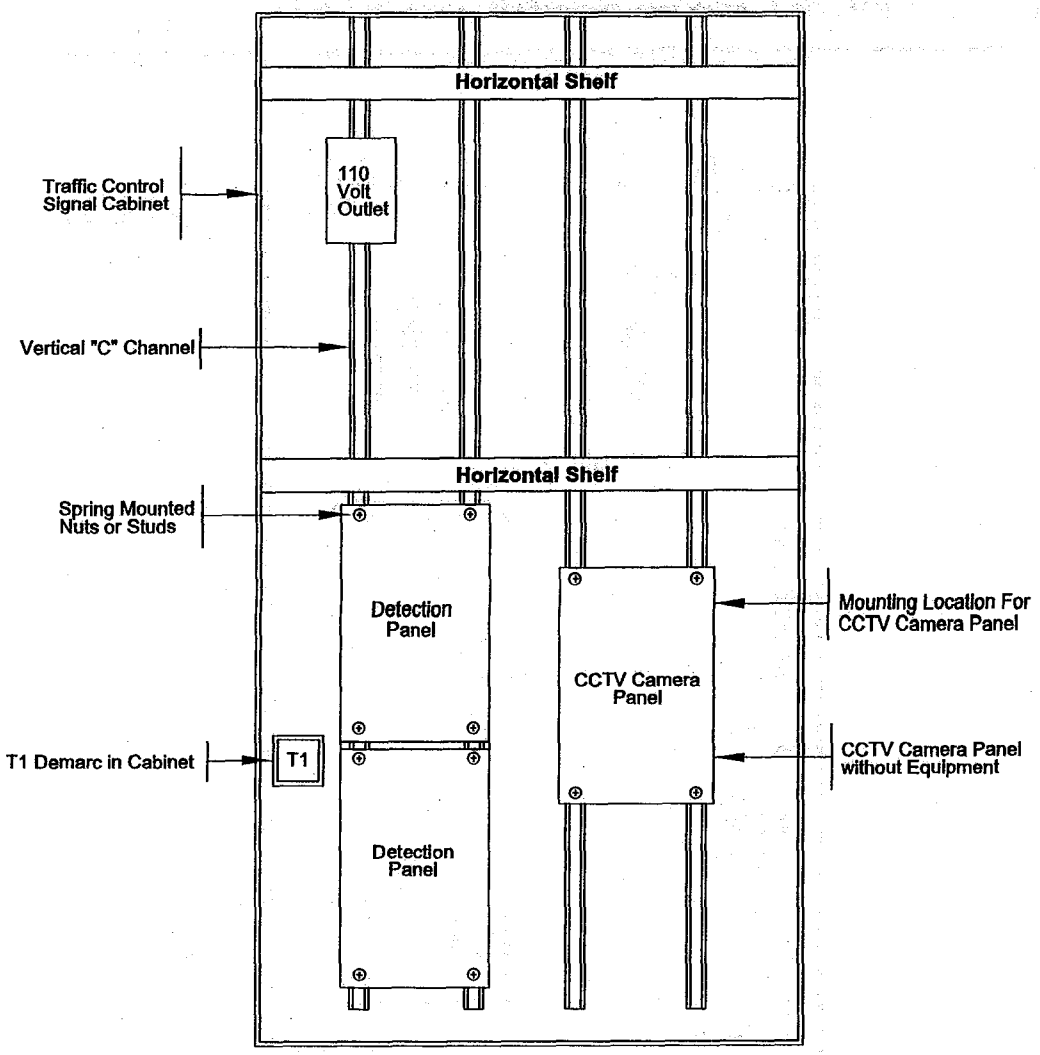
CCTV MOUNTING ASSEMBLY
ORIENTATION DETAIL

NOTES:

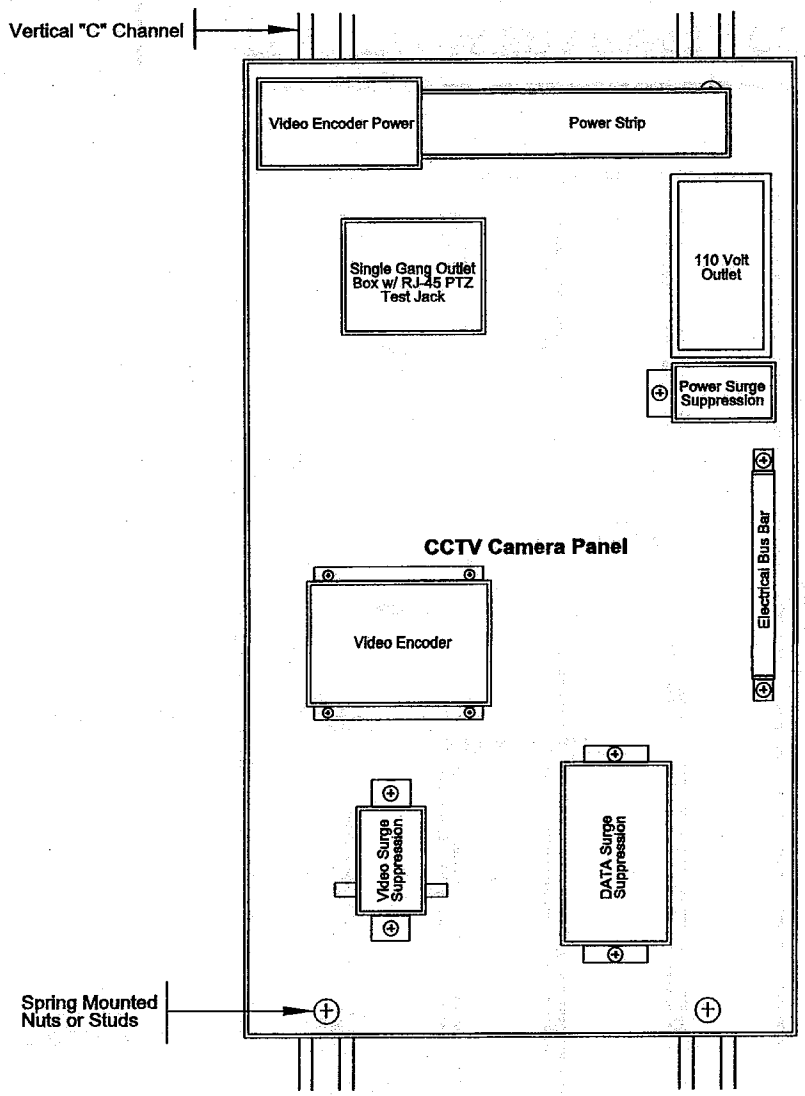
1. THE CONTRACTOR SHALL PROVIDE AND INSTALL A VIDEO ENCODER, AS SPECIFIED IN THE PLANS. ENCODER IS INSTALLED IN THE TRAFFIC SIGNAL CONTROL CABINET.
2. THE CCTV COMPOSITE CABLE SHALL RUN UNSPLICED FROM THE CCTV BACKBOX TO THE VIDEO ENCODER INSTALLED IN THE CONTROL CABINET.
3. INSTALLATION SHALL BE ACCORDING TO THE MANUFACTURE'S SPECIFICATIONS AND SHALL CARRY A MINIMUM FIVE-YEAR WARRANTY OF PARTS AND LABOR.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CCTV CAMERA INSTALLATION ON SIGNAL POLE	DATE: 4/09	DETAIL NO. 4830

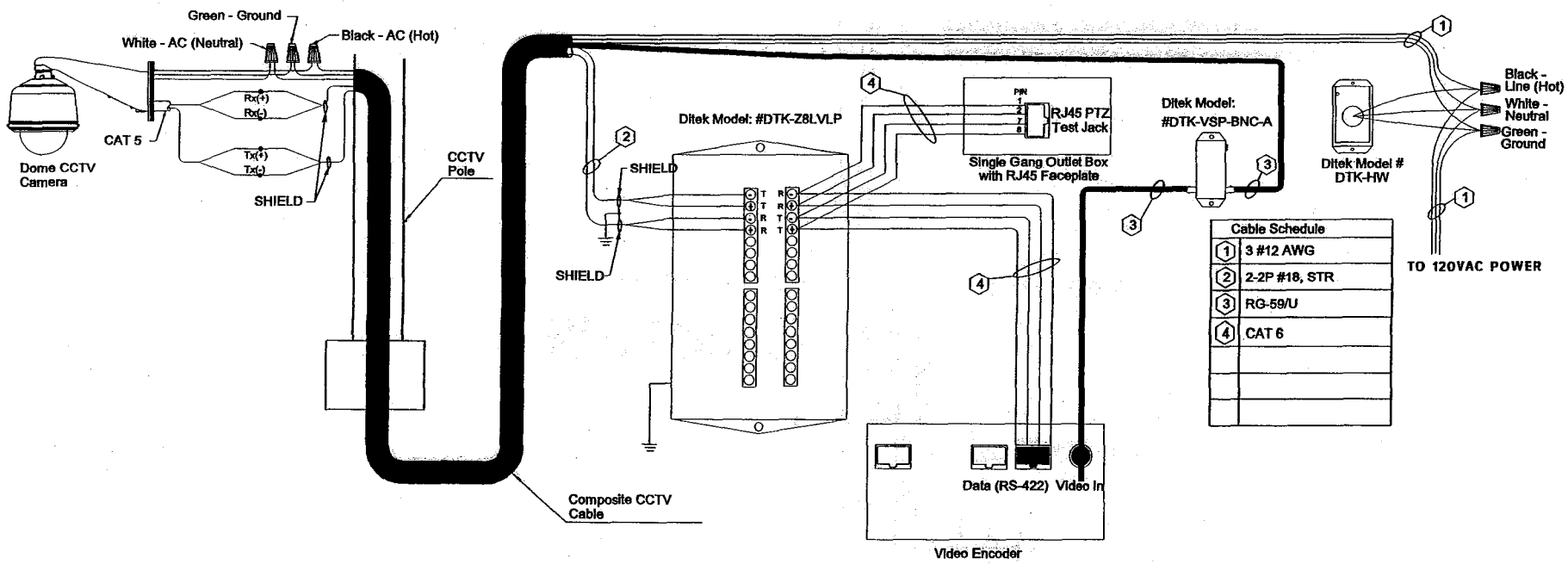
LEFT SIDE OF CABINET



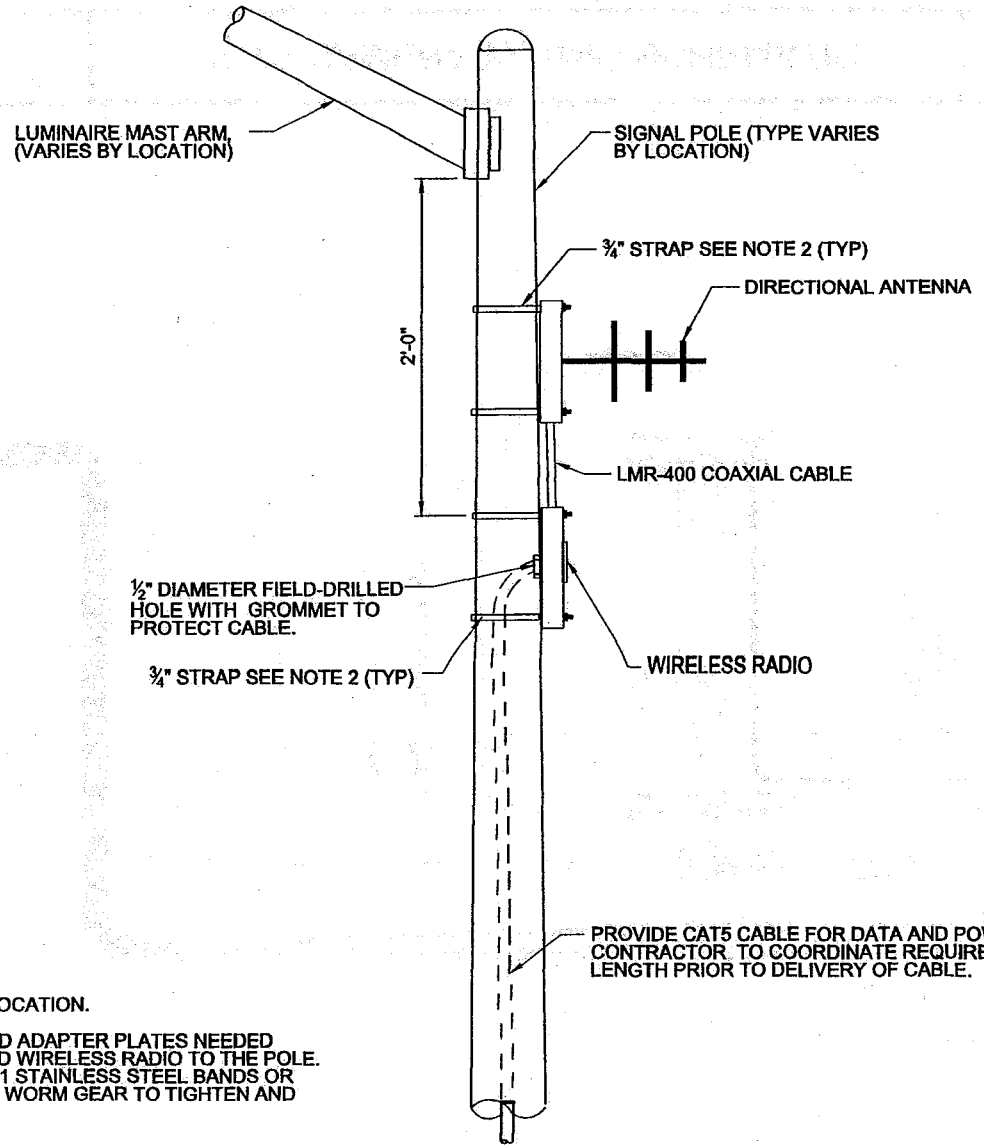
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS CCTV CAMERA PANEL LOCATION	DATE: 4/09	DETAIL NO. 4831-1



MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	ITS CCTV CAMERA PANEL DETAILS	DATE: 4/09	DETAIL NO. 4831-2



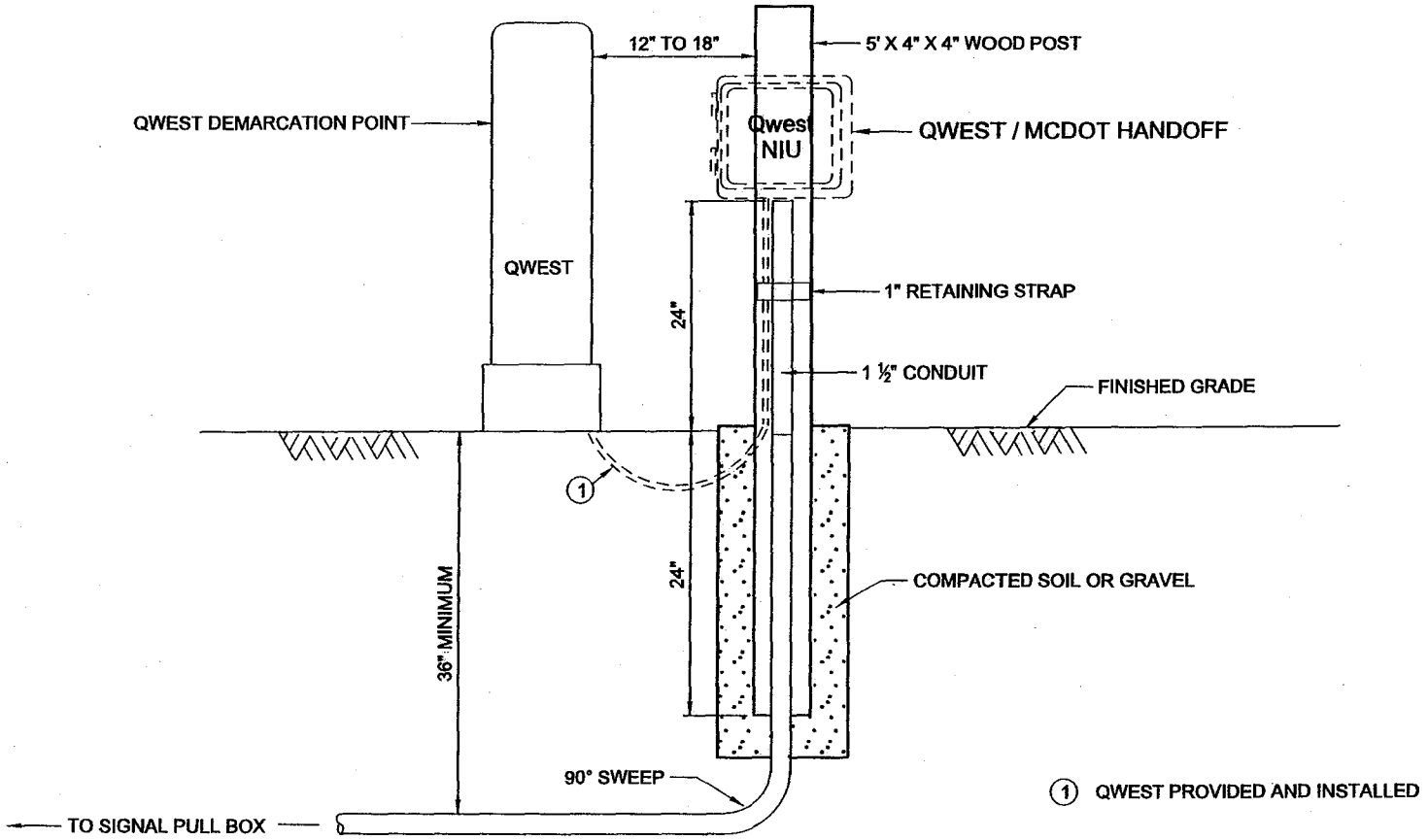
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	CCTV CAMERA WIRING SCHEMATIC	DATE: 4/09	DETAIL NO. 4831-3



NOTES:

1. ORIENTATION OF ANTENNA VARIES BY LOCATION.
2. PROVIDE ALL MOUNTING HARDWARE AND ADAPTER PLATES NEEDED TO SECURELY MOUNT THE ANTENNA AND WIRELESS RADIO TO THE POLE. STRAPS SHALL BE 3/4" BAND-IT®TYPE 201 STAINLESS STEEL BANDS OR APPROVED EQUAL. STRAPS UTILIZING A WORM GEAR TO TIGHTEN AND HOLD THE STRAP SHALL NOT BE USED.

MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	MULTISERVICE RADIO INSTALLATION ON SIGNAL POLE	DATE: 4/09	DETAIL NO. 4833



MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION STANDARD DETAIL	4" X 4" POST WITH CONDUIT FOR T1 DEMARCATION POINT	DATE: 4/09	DETAIL NO. 4835