

APPENDIX F

TRAFFIC SIGNAL SPECIFICATIONS



DOUGLAS COUNTY

TRAFFIC SIGNAL

SPECIFICATIONS

UPDATED JULY 2003

NOTICE

Beginning January of 2004, Douglas County will enforce the following requirements for all Traffic Signal Construction Projects and roadway construction projects requiring traffic signal modifications or installations.

1. IMSA Level II Traffic Signal Bench Technician/Signal Technician certification (BB certification) for any work within the traffic signal cabinet. This includes corrective maintenance and signal turn-on. Signal CONTRACTOR shall produce copies of certificates at the pre-construction meeting.
2. IMSA Level II Traffic Signal Field Technician/Electrician (BE certification) or Traffic Signal Bench Technician/Signal Technician Certification (BB Certification) for any work external to the traffic signal cabinet. An IMSA Level II Traffic Signal Electrician (minimum BE certification) must be the job-site at all times to supervise construction.
3. The United States Department of Labor – Bureau of Apprenticeship and Training can be substituted for the IMSA Level II Traffic Signal Electrician. Signal CONTRACTOR shall produce copies of certificates at the pre-construction meeting.

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1.00: GENERAL REQUIREMENTS

1.10: SCOPE AND INTENT

1.10a: These specifications describe the installation of necessary material, equipment and work procedures to complete traffic signals and/or other electrical systems as shown on the drawings, in the special contract provisions, or herein, for projects in Douglas County, Colorado. These specifications provide minimum functional requirements that must be satisfied for all such work.

1.20: ROADWAY WORK AND PERMIT

1.20a: Unless stated otherwise, all roadway and sidewalk work shall be in accordance with the latest version of the *Douglas County Roadway Design and Construction Standards*. For all work, the CONTRACTOR shall obtain a permit from the Douglas County Department of Public Works, and shall pay the required County construction fees.

1.30: ENGINEER

1.30a: Douglas County Project Engineer or authorized county personnel (ENGINEER) shall be the responsible person overseeing all work on the County's behalf.

1.40: PRIVATE ACCESS AND TRAFFIC CONTROL PLAN

1.40a: The CONTRACTOR will be required to maintain access to all private drives throughout the period of construction. The CONTRACTOR shall be required to erect, maintain, and remove all barricades, traffic control signs and devices. Such barricades and traffic control signs and devices shall be in accordance with the latest version of the *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)* published by the U.S. Department of Transportation, Federal Highway Administration, and as directed by the ENGINEER. Construction signs not applicable during non-construction times shall be set so traffic can not see the signs, as per Section 630 of the latest edition of the *Colorado Department of Transportation Standard Specifications for Road and Bridge Construction*. Should this not occur, Section 8.30 shall be enforced.

1.40b: A Traffic Control plan prepared by a certified traffic control supervisor shall be submitted and approved prior to issuance of the permit by the Douglas County Department of Public Works. The Traffic Control plan shall be submitted along with a set of construction drawings signed and approved by Douglas County. The CONTRACTOR shall submit the plan at least 5 working days in advance of the intended start date. A Douglas County approved copy will be kept at the site and shall be exhibited upon request to any authorized representative of the County. Douglas County reserves the right to require the CONTRACTOR to modify the traffic control in the field as necessary. Douglas County also reserves the right to issue a stop work order.

1.50: TESTING

1.50a: The County may at its option and cost retain the services of an independent testing lab to perform all testing consultation and to assist in the review of the work and equipment.

1.50b: See Section 9.200g for requirements regarding early delivery of controller and cabinet to County, for testing purposes.

1.60: EQUIPMENT SALVAGE

1.60a: All traffic signal equipment that is removed shall remain the property of Douglas County. Such property is to be removed from the work site, tagged with date removed and location, and returned by the CONTRACTOR to the County at 3080 North Industrial Way, Castle Rock, CO 80104. When signal pole and mast arm assemblies are removed, all components shall be marked as a set with permanent markings. The equipment shall be returned in the same condition as removed. Contact Traffic Signal Supervisor to coordinate delivery (303-660-7490)

1.70: EXISTING TRAFFIC SIGNALS

1.70a: When existing traffic signal installations are modified or completely rebuilt, the CONTRACTOR shall work around existing traffic signal equipment until the new or modified traffic signal system has been installed and put into operation. Signal heads installed on standards or poles for new installation, which are not ready for actual electrical operation, shall be bagged with orange plastic. The CONTRACTOR shall at all times maintain a minimum of two (2) three-

section (red, yellow, and green) traffic signal heads and pedestrian heads (if required) for each roadway approach. Special consideration shall be made to avoid the left turn trap situation.

1.80: INTERSECTION POWER

1.80a: Unless otherwise directed in the plans, CONTRACTOR shall be responsible for coordinating with the power company to obtain power hook-up to the intersection and luminaires two weeks prior to signal flash. See section 13.70.

1.90: UTILITIES

1.90a. Utilities are shown on the plans to the extent that they can be, based upon records and surface field indications. All utility locations will require field verification in cooperation with the affected utility companies and public agencies. The CONTRACTOR shall be responsible for locating all valve boxes, manholes, etc., and insuring that they are properly protected and that signal equipment locations are adjusted accordingly, with approval from the ENGINEER.

1.100: WORK HOURS

1.100a: The CONTRACTOR shall work only on weekdays between the hours of 7:00 a.m. to 4:00 p.m. Lane closures shall only be allowed between 8:30a.m. and 3:00 p.m. The CONTRACTOR must receive written approval from the ENGINEER to work at any other time.

1.110: PROJECT SCHEDULE

1.110a: The following schedule shall apply:

Item	Schedule
Pole foundation installation (Site specific per Douglas County)	See Section 14.30
Shop Drawing Submittals	At the pre-construction meeting, which normally will be about 2-3 weeks from the Notice to Proceed.
Ground Work (conduit, loop detectors, mast arm pole foundations, etc.)	May start within 30 calendar days after Notice to Proceed but no less than 30 calendar days prior to essential equipment delivery date.
100 Percent Completion	Prior to signal flash
Overall Project	90 calendar days for mast arm project. 60 calendar days for span wire project.

1.120: FAILURE TO COMPLETE WORK ON TIME

1.120a: A daily charge will be made against the CONTRACTOR for each calendar day that any work remains uncompleted after the elapse of contract time. This daily charge will be deducted from any money due the CONTRACTOR. This deduction will not be considered a penalty but as liquidated damages.

1.120b: The schedule of liquidated damages set forth below is an amount, agreed to by the CONTRACTOR and the County, as reasonably representing additional construction engineering costs incurred by the County if the CONTRACTOR fails to complete performance within the contract time.

1.120c: The schedule of liquidated damages shall be:

Original Contract Amount		Daily Charge
From More Than	To and Including	
\$0	\$25,000	\$270
\$25,000	\$50,000	\$465
\$50,000	\$100,000	\$540
\$100,000	\$500,000	\$950
\$500,000	\$1,000,000	\$1,250

1.120d: Due account shall be taken of any adjustment of the contract time for completion of the work granted by the ENGINEER at the ENGINEER'S discretion, due to supplier delays beyond the control of the CONTRACTOR. CONTRACTOR shall provide written documentation of such delays.

1.120e: Permitting the CONTRACTOR to continue and finish the work or any part thereof after elapse of contract time will not operate as a waiver on the part of the County of any of its rights under the contract.

1.120f: Any deduction assessed as liquidated damages under this subsection shall not relieve the CONTRACTOR from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed CONTRACTOR to complete the work according to contract times.

1.130 JOB SITE CONDITIONS

1.130a: CONTRACTOR shall maintain a safe and clean job site throughout construction. Upon project completion, the job site shall be neat and clean with all trash and dirt picked up and barricades removed. Landscaping shall be restored and sidewalks swept as needed. The intent is that the job site appears as good or better than it appeared before construction.

2.00: REGULATIONS AND CODES

2.10: REFERENCE DOCUMENTS

2.10a: All equipment and material shall conform to the standards of the Institute of Transportation Engineers (ITE), International Municipal Signal Association (IMSA), Qwest Communications, and *Colorado Department of Transportation Standard specifications for Road and Bridge Construction (latest edition)*. In addition to requirements of these specifications, the plans, standard details, and the special contract provisions, all material and work shall conform to the requirements of the *MUTCD*, *National Electrical Code (N.E.C.)*, *National Electrical Safety Code (N.E.S.C.)*, the *Rules for Overhead Electrical Line Construction of the Colorado Public Utilities Commission (Rules)*, the *standards of the American Society for Testing and Materials (ASTM)* and of the *American National Standards Institute (ANSI)*, and local ordinances which may apply.

2.10b: Wherever reference is made in these specifications or in the special contract provisions to the *MUTCD*, *NEC*, *NESC*, *Rules*, or the standards mentioned above, the reference shall be construed to mean the document that is in effect at the date of bidding.

3.00 EQUIPMENT LIST, APPROVALS AND AS-BUILT DRAWINGS

3.10: BID REQUIREMENTS

3.10a: Shop drawings are not required for the bid, but the CONTRACTOR shall submit with his bid a list of equipment and materials which he proposes to furnish for those items listed in 3.10b, including all equipment and materials as identified on the plans or in the specifications, by the manufacturer's name that is necessary or customary in the trade to identify such equipment and material. The list shall be complete as to name of manufacturer, unit name.

3.10b: The items to which paragraph 3.10a applies are: traffic signal poles and mast arms, traffic signal controller and cabinet, UPS, vehicle and pedestrian signal heads, pedestrian signs, pre-emption devices, mounting hardware for signal heads, street name signs, pull boxes, wire (fiber optic cable shall include interconnect schematic diagram), and any additional items indicated in the project special provisions or requested at the pre-construction meeting. Sign panel layouts for both illuminated and aluminum street names signs shall also be submitted for approval by the County.

3.20: SAMPLING AND SUBSTITUTIONS

3.20a: Inspection or sampling of any materials, other than those already approved, must be made by the ENGINEER prior to installation. Whenever particular material or equipment is identified by manufacturer name in the plans or specifications, the term "or approved equivalent" is implied. If the CONTRACTOR proposes a substitution, CONTRACTOR shall provide additional information with the bid to prove the substitution item is of equal or superior quality, and it shall be at the ENGINEERS sole discretion whether to approve such substitution. If not approved, CONTRACTOR shall agree to supply the originally stated material or equipment at no additional cost. Otherwise, ENGINEER may reject the bid as non-responsive.

3.20b: The CONTRACTOR shall attach to the bid a statement that all material to be supplied is either in exact accordance with the specifications, or shall list in detail any and all substitutions and request the approval of the ENGINEER for the substitutions. The ENGINEER may request further technical information to support the substitution.

3.20c: During execution of the work, the supplying of equipment that is not in accordance with the specifications and on which the CONTRACTOR has not received the ENGINEER's approval shall be cause for rejection. Correction of the non-specification items will be entirely at the CONTRACTOR'S expense.

3.30: AS-BUILTS

3.30a: Upon completion of the work, the CONTRACTOR shall submit an "as-built" or corrected plan showing, in detail, all construction changes including, but not limited to, wiring, cable, poles, controller cabinet, loop detectors, and location of conduit. Red lined signed, stamped plans may be submitted as "as-built" plans.

4.00: EXCAVATING AND BACKFILLING

4.10: GENERAL

4.10a: Street cuts for conduit on existing pavements shall not be allowed unless approved by the Douglas County Roadway Inspector. Excavations for the installation of conduit, foundations, and other equipment shall be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other improvements/landscape and sprinklers. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations, and shall be kept clean and as free of moisture as possible. Excavations shall be backfilled or poured with concrete within 24 hours of opening, unless otherwise approved in writing by the ENGINEER. The material from the excavation shall be removed as the trenching progresses.

4.10b: Excavations, after backfilling, shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

4.10c: Excavating and backfilling for foundations shall be incidental to the pay item for which a foundation is required. Excavating and backfilling for conduit trenches shall be paid for under the appropriate conduit trenching pay item.

4.10d: At the preconstruction meeting, the CONTRACTOR will be provided contacts for landscape and sprinkler repair. The CONTRACTOR is responsible for contacting these entities when damage occurs and coordinating repairs. Any necessary repairs will not be paid for separately but shall be included in the cost of the project. Damages found subsequent to project completion, and related costs, will be the responsibility of the CONTRACTOR.

4.20: MAINTENANCE OF TRAFFIC

4.20a: At the end of each day's work and any other time construction operations are suspended, all construction equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic. Construction signs not applicable during non-construction times shall be set so traffic can not see the signs, per Section 630 of the latest version of the *Colorado Department of*

Transportation Standard Specifications for Road and Bridge Construction.
Should this not occur, Section 8.30 shall be enforced.

4.20b: Excavations in streets or highways shall be performed in such a manner that at least one (1) lane of traffic in each direction shall be open to public traffic at all times. All lane closures shall be approved by ENGINEER prior to closure.

4.20c: When excavations must remain open overnight, they shall be properly marked to warn motorists and/or pedestrians according to the *MUTCD*. Flashing barricades shall be provided, unless otherwise authorized in writing by the ENGINEER.

5.00: REMOVING, REPLACING AND RESETTING IMPROVEMENTS

5.10: GENERAL

5.10a: The CONTRACTOR shall at his sole expense, replace or reconstruct sidewalks, curbs, gutters, rigid or flexible pavement, and any other improvements removed, broken, or damaged by him with material and methods that conform to current County standards.

5.10b: Whenever a part of a square or slab of existing concrete, sidewalk, or driveway is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

5.10c: Concrete pavement and sidewalk designated for removal shall be removed as marked by the ENGINEER.

The concrete pavement or sidewalk shall be cut to the existing depth of concrete prior to removal. Any overbreak, separation or other damage to the existing concrete outside of the designated removal limits shall be replaced at the CONTRACTOR'S expense. Payment for removal of concrete pavement or sidewalk shall be based on square yards of surface area regardless of the concrete thickness.

5.10d: Removal items shall be as indicated in the pay item list. Removal of poles and controllers shall include foundation removal to the depth indicated by the ENGINEER. Otherwise, removal shall consist of complete elimination of the specified items.

5.10e: The "REMOVAL OF TRAFFIC SIGNAL EQUIPMENT" pay item shall consist of the items specifically identified on the plans, or in writing by the ENGINEER. It shall be the CONTRACTOR's responsibility to assure that he has a full and complete understanding of included items prior to bidding.

5.10f: Reset pay items shall be as indicated in the pay item list. These items are to be initially removed, then adjusted or modified as directed by the ENGINEER, and finally reinstalled to full operational capability. Modifications and adjustments shall be detailed on the plans or project special provisions, and shall be incidental to the reset pay item.

5.10g: The "RESET TRAFFIC SIGNAL EQUIPMENT" pay item shall consist of the items specifically identified in the plans or in the project special provisions.

6.00: UNDERGROUND FACILITIES

6.10: FOUNDATIONS

6.10a: All foundations shall be Portland cement concrete conforming to the applicable requirements of construction standards of Douglas County, except as herein provided.

6.10b: The bottom of concrete foundations shall rest on firm ground. Cast-in-place foundations shall be poured monolithically where practicable. The exposed portions shall be formed to present a neat appearance. Concrete shall be Class BZ per the latest edition of the Colorado Department of Transportation's *Standard Specifications for Road and Bridge Construction*.

6.10c: Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade or as ordered by in ENGINEER. Forms shall be rigid and securely braced in place and inspected prior to the pouring of concrete. Conduit ends and anchor bolts shall be placed in proper position and in a template until the concrete sets.

6.10d: Anchor bolts shall conform to the manufacturer's specifications and each individual bolt shall have two (2) flat washers and two (2) nuts. Shims or other similar devices for plumbing or raking will not be permitted. Stirrups shall be

installed on all foundations. See Douglas County Standard Signal Details for additional requirements.

6.10e: Both forms and ground that will be in contact with the concrete shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.

6.10f: Whenever excavation for a foundation requires removal of excess ground materials, the excavation shall be backfilled to within 12" of ground level with 60-120 PSI Class M concrete, and then backfilled to ground level with native material compacted per the ENGINEER's direction.

6.10g: Any abandoned foundation shall be fully or partially removed and disposed of by the CONTRACTOR per the direction of the ENGINEER. Any conduit runs associated with an abandoned foundation shall be extended or abandoned as called for on the plans.

6.10h: All foundations (concrete and fiberglass) shall be incidental to the pay item for which a foundation is required. Ground rods shall be provided as indicated in the standard details, and shall be incidental to the installation pay item.

6.20: CONDUIT

6.20a: All intersections undergoing initial development or construction that are anticipated to require future signalization shall include signal conduit at the time of initial road construction, in conformance with this section. In this case, pull boxes made of fiberglass reinforced polymer concrete (See section 6.30b) shall be used at termination points, as shown in the standard details. Roadway developers should consult with the Douglas County Department of Public Works to identify intersections to which this requirement applies.

6.20b: All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, or mast arms. All metal conduit referred to in the specifications and shown on the plans shall be the rigid pipe type of ductile steel that is adequately galvanized. All PVC conduit shall be Schedule 80 or heavier. Poly pipe commonly used for boring shall be Schedule 80 or heavier. All transitions from poly pipe to PVC shall be by means of an

aluminum threaded coupling or Etco "E-LOC" couplings. These couplings shall be the only approved method for connecting the 90-degree sweep.

6.20c: The following conduit schedule is in effect unless otherwise specified in the plans:

Run Type	Quantity	Size	Use
Street Crossings	1	3"	120 voltage load wiring
	1	2"	Low voltage detection
	1	2"	Luminaire load
Signal Pole	1	3"	All signal cables
	1	2"	Luminaire load
Controller Cabinet	2	3"	120 voltage load wiring
	2	2"	or Low voltage detection - size per Code
Interconnect	1	2"	Interconnect run only
Service Points			
Signal Power	1*	2"	Utility company service run
Luminaire Power	1*	2"	Utility company service run
Telephone	1	2"	Phone company service run

*Combine if run length exceeds 30 feet.

6.20d: The CONTRACTOR, at his sole expense, may use larger conduit if desired. Where larger conduit is used, it shall be for the entire length of the run. No reducing couplings will be permitted underground.

6.20e: The ends of all metal conduit, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed tight until the ends of the metal conduits are brought together.

6.20f: Where a "stub out" is called for on the plans, a sweeping ell shall be installed in the direction indicated and sealed with a metallic cap to facilitate future locating. The locations of ends of all conduits in structures or terminating

at curbs shall be marked by a "Y" at least three inches (3") high cut into the face of the curb, gutter, or wall directly above the conduit.

6.20g: Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable. Conduit bends feeding pull boxes and foundations shall be as shown on the standard details, typically 18".

6.20h: Conduit under railroad tracks shall be at the minimum depth below the bottom of tie required by the particular railroad company.

6.20i: Conduit shall always enter a pedestal base, pull box, or any other type structure from the direction of the run only. Conduit connections at junction boxes shall be tightly secured.

6.20j: Conduit terminating in a standard or pedestal shall extend approximately two inches (2") above foundation vertically.

6.20k: All conduit runs that exceed ten feet (10') in length shall have a continuous 1/8" or 1/4" nylon rope (blow line cannot be substituted but can be in addition to) pulled into the conduit along with the specified electrical cables. The line shall be firmly secured at each end of the conduit run with a minimum slack of four feet (4'). The purpose of this rope is to be able to pull future electrical cable through the existing conduit runs and the rope shall not be tangled or twisted around cables.

6.20l: Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or blown out with compressed air.

6.20m: New conduit runs shown on the plans are for bidding purposes only and may be changed at the direction of the ENGINEER.

6.20n: Any spare or unused conduits installed for future use shall be sealed with a metallic cap and a single 14 AWG stranded THHN wire through the entire run to facilitate future locating.

6.20o: All conduit installed, including poly pipe, shall be at full depth for the entire conduit run. 90 degree sweeps shall not be cut to achieve proper entrance to pull box. Conduit runs shall have no more than a 180 degree bend.

6.20p: All conduit in pull boxes shall extend a minimum of 3" above crushed rock.

6.20q: All conduit shall terminate in pull boxes such that when cable is pulled and coiled within the pull box, there is a minimum clearance of 3" between the pull box lid and the conduit and cable. Cable and conduit shall not be crushed or damaged.

6.20r: All underground conduit runs shall have a single 14 AWG stranded THHN wire installed from pull box to pull box for locating purposes.

6.30: PULL BOXES

6.30a: A pull box shall be installed at all locations shown on the plans and at such additional points as ordered by the ENGINEER. The CONTRACTOR shall install County provided delineators at all pull box locations. The delineators shall be anchored into the ground with minimum 1/4" diameter bolt, minimum 2 inches in length so they cannot be easily pulled out of the ground.

6.30b: At new roadway construction sites where conduit for future traffic signals is installed, temporary pull boxes shall be installed at conduit termination points and detector tape through the entire run to facilitate future locating. These pull boxes shall be fiberglass reinforced polymer concrete. (See standard details)

6.30c: At sites where operational traffic signals are being installed, permanent precast pull boxes shall be installed (See standard details).

6.30d: Pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The entire excavation required to install 90 degree sweeps into a future pull box shall be backfilled from the full depth of the conduit run to the bottom of the pull box with crushed rock. The depth of crushed rock from the bottom of the excavation to the bottom of the pull box shall be a minimum of 18 inches.

6.30e: The interior of the pull box shall be backfilled with crushed rock from the base of the pull box to a minimum depth of 3" below the conduit runs. The area of the excavation surrounding the pull box may be backfilled with excavated soil.

6.30f: When a new conduit run enters an existing pull box, the CONTRACTOR shall temporarily remove the pull box, or tunnel under the side at no less than eighteen inches (18") below the pull box bottom and enter from the direction of the run. All backfill shall be gravel. No new conduit will be allowed to enter a new or existing pull box in any other manner than that shown on the standard details.

6.40: LOOP AND MICRO LOOP DETECTORS

6.40a: Each individual loop or micro loop is to be terminated and spliced within a side-of-road pull box as specified on the standard details. Each loop shall consist of one continuous wire, without splicing, to this termination point, and each micro loop detector shall include two continuous wires, without splicing, to this termination point. Each loop or micro loop shall have its own dedicated lead in pair (of wires) to the cabinet from the side of road pull box. Detector lead-in wire shall be continuous from the controller to the side-of-road pull box.

6.40b: All detectors shall have a color-coded tag attached to the lead-in to indicate the relative location and the direction served by the detector. See paragraphs 7.10j-7.10l.

6.40c: Loop sealant is to be used in all sawcuts whether or not the roadway is to be overlaid. See standard details.

7.00: CONDUCTOR AND CABLE

7.10: GENERAL

7.10a: Wiring shall conform to appropriate articles of the N.E.C. Wiring within cabinets, junction boxes, etc., shall be neatly arranged.

7.10b: Powdered soapstone, talc, or other approved lubricant shall be used in placing conductors in conduit. Unless otherwise approved by the ENGINEER, wiring shall not occupy more than 40% of the inside area of all conduit. If more than 40% of the inside area is occupied, the CONTRACTOR shall provide additional conduit to satisfy this requirement.

7.10c: A 1/8" or 1/4" nylon pull rope shall be installed in all new conduit and in all existing conduit where a cable is added or an existing cable is replaced. A minimum of four feet (4') of slack shall be left in each conduit at each termination.

7.10d: At least five feet of slack shall be left for each conductor at each span wire support pole.

7.10e: Except per paragraph 6.40a, splices will not be allowed in pull boxes. Splices shall be kept to a minimum and will only be allowed in handholes at pole bases. A minimum of twenty-four inches (24") of slack shall be left on each splice wire. In no case shall any shellac compounds be used.

7.10f: Signal load splices shall utilize copper crimp sleeves that compress from four directions, for example, as manufactured by the Buchanan Company. The crimped sleeve shall then be protected within a flexible rubber insulating cover, for example, an Ideal Wrap Cap.

7.10g: Detector loop lead-in splices in pull boxes (see Paragraph 6.40a) shall be fully waterproofed using a splice kit or epoxy wire nuts (Buchanon BTS2 or BTS4 or approved equal). A minimum of twelve inches (12") of slack shall be left on the detector loop.

7.10h: When conductors and cables are pulled into the conduit, all ends of conductors and cables shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped and marked.

7.10i: All wiring shall use either 19 conductor or 21 conductors per cable for high voltage (exceeding 50 volts). Conductor cable shall be installed where required in the plans. Overhead cable shall be secured to messenger cable with cable rings or stainless steel wire wrap only.

7.10j: A small permanent tag on which the direction and phase is printed, using the codes given in "Conductor Schedule" below, shall be securely attached near the end of each conductor or group of conductors grouped per phase or function at each controller and signal pole. Loop detector lead-ins shall be tagged in the splice pull box behind the curb.

7.10k: Conductor Schedule

Key-Phase: Color of Signal Load Conductor, "Code" (on tag at each end of conductor)

1. Northbound Left Turn: Red/White, "x-NBLT"
2. Northbound: Red, "x-NB"
3. Southbound Left Turn: Green/White, "x-SBLT"
4. Southbound: Green, "x-SB"
5. Eastbound Left Turn: Orange/White, "x-EBLT"
6. Eastbound: Orange, "x-EB"
7. Westbound Left Turn: Blue/White, "x-WBLT"
8. Westbound: Blue, "x-WB"
9. Pedestrian: Yellow, "x-PED"
10. Supplemental: Purple, "Advance detection"

NOTE: x = phase number. This is a typical conductor schedule and shall be used for the wiring of all signal installations. A new conductor schedule will be noted on the plans at each intersection where different phasing and/or special equipment is required. It should be noted that a band of white is used to indicate a left turn, and yellow is used for a pedestrian movement.

7.10l: Detector conductors shall be tagged at their ends with color-coded electrical tape following the above schedule, including the movement "Codes" (e.g., "1-NBLT").

7.10m: Each pedestrian push button shall have a dedicated wire pair lead-in to the 170 controller cabinet.

7.10n: Where hardwire telephone interconnect is required, see Section 9.80g for cable characteristics. Where overhead interconnect wire is required, see section 9.80h for cable characteristics. Where fiber optic cable is required, see section 9.80k for cable characteristics.

7.10o: Separate luminaire wire shall be two conductor, black and white in color.

7.10p: Signal heads mounted on mast arms are to be wired individually from the head to the handhole at the bottom of the pole.

7.10q: Four-approach intersections shall be initially wired to all poles to handle eight vehicle phases plus four pedestrian phases. "TEE" intersections shall be initially wired to all poles to handle at least five (5) vehicle phases and three (3) pedestrian phases. At least three spare conductors shall be provided from the controller cabinet to the handhole of each signal pole.

7.10r: Span wire and tether cable shall be affixed to the pole using short bail strand vices. If required by the ENGINEER insulators shall be provided, in which case long bail strand vices shall be used.

7.20: BONDING AND GROUNDING

7.20a: Metal poles, pedestals and cabinets shall be made mechanically and electrically secure to form a system of isolated grounded components. Each pole and pedestal shall have a separate ground rod, located either through the foundation into surrounding ground, or in an adjacent pull box and connected to the system component. The controller cabinet shall have a ground rod located in its foundation. Separate ground rod locations shall not be directly connected to one another with ground wire, in order to minimize transient distribution among the components.

7.20b: Bonding and grounding jumpers shall be copper wire, No. 8 AWG, for all systems. Loop lead-in drain wire is to be grounded in the control cabinet only. The other end of the sheath to be taped and left ungrounded.

7.20c: *Bonding of standards and ground rods shall be by means of connecting to the ground rod, a bonding strap attached to an anchor bolt or a 3/16" diameter or larger brass or bronze bolt installed in the lower portion of the shaft. (per the latest CDOT specifications)*

7.20d: At each grounded pull box, the ground electrode shall be a one-piece copper ground rod driven into the ground so that the top is at least two to four inches (2" to 4") below the bottom of the pull box lid. The ground rod connector shall be placed so that the bare copper wire, No. 8, can be pulled into a pole, pedestal, or attached to the control cabinet ground buss.

8.00: FIELD TESTING AND MAINTENANCE

8.10: FIELD TESTING

8.10a: Prior to completion of the work, the CONTRACTOR shall run the following tests on all traffic signals in the presence of the ENGINEER or the County signal maintenance contractor.

8.10b: Each circuit shall be tested for continuity and for grounds.

8.10c: A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for each traffic signal system shall consist of not less than twenty (20) days of continuous, satisfactory operation commencing with full operation of all electrical facilities.

8.10d: When fiber optic cable is installed, the fiber optic cable test shall consist of the testing of both multimode and single mode fiber optic cable. The testing procedures involve an OTDR test and an Optical Power Meter Test.

The guidelines for fiber optic cable testing include:

- (1) Test jumpers and patch cords must be of the same fiber core size and connector type as the cable system:
 - i) Multimode fiber 62.5/125 μ m
 - ii) Singlemode fiber 8.3/125 μ m
- (2) The light source and OTDR must operate within the range of 850 \pm 30 nm or 1300 \pm 20 nm for multimode testing in accordance with ANSI/EIA/TIA-526-14.
- (3) The light source and OTDR must operate with the range of 1310 \pm 10 nm or 1550 \pm 20 nm for singlemode testing in accordance with ANSI/EIA/TIA-526-7.
- (4) The power meter and the light source must be set to the same wavelength during testing.
- (5) The power meter must be calibrated and traceable to the National Institute of Standards and Technology (NIST).

- (6) All system connectors, adapters and jumpers must be cleaned as per manufacturer's instructions before measurements are taken.

MATERIALS

- A) **Fiber Optic Cable Testing Equipment.** The following is required to perform fiber optic cable tests:
- (1) an OTDR
 - (2) a test reel, if necessary
 - (3) a light source at the appropriate wavelength
 - (4) Optical Power Measurement Equipment
 - (5) test Jumpers as specified below
 - (i) Multimode Fiber Testing
 - (a) CPR Test Jumper-1 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested.
 - (b) CPR Test Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter. Test Jumper-2 shall contain Class IVa single-mode fiber for tests on 1300 nm light sources and from which is single-moded at 850 μm for tests on 850 nm light sources.
 - ii) Singlemode Fiber Testing
 - (a) CPR Test Jumper-1 and Test Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being tested.
- B) **Optical Fiber Cable Testing with OTDR.** The CONTRACTOR shall perform an OTDR test of all fibers in all tubes on the reel, prior to installation of the fiber. The test results shall be supplied to the ENGINEER prior to installation of the cable.

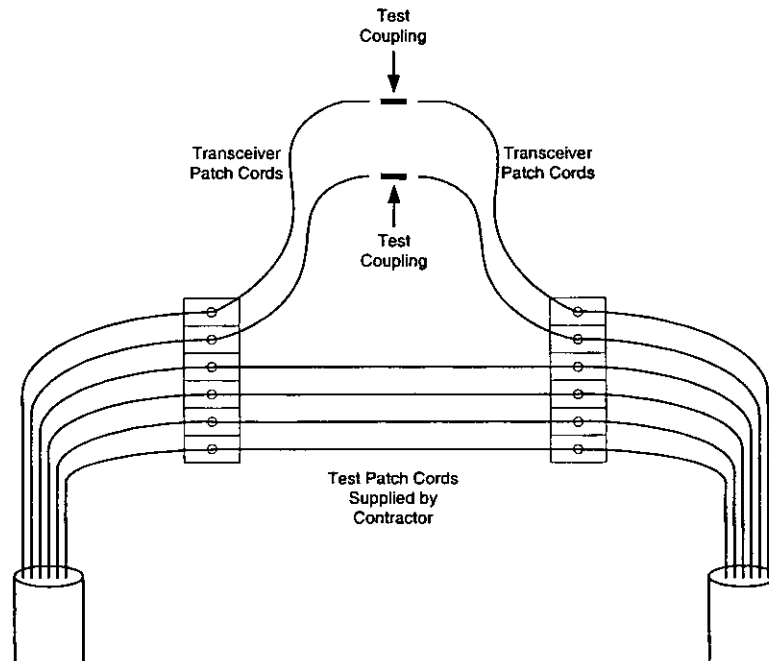
If the fiber is specified as "Install Only", the CONTRACTOR shall test the fiber on the reel and provide the test results to the ENGINEER prior to accepting the cable. After installation, if there are unused portions of cable remaining on the reel, the ENGINEER may request the CONTRACTOR or other qualified technician to perform a reel test. The CONTRACTOR shall provide the

ENGINEER the test results prior to delivering the cable to the ENGINEER. Any cable damaged while in the CONTRACTOR'S possession shall be replaced at the CONTRACTOR'S expense.

All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional end-to-end OTDR trace performed per TIA/EIA-455-61. The system margin loss measurements shall be provided at 850 and 1300 nm for multimode fibers and 1310 and 1550 for singlemode fibers.

Segmented end to end testing shall not be less than 1 kilometer (1 mile). Patches for testing shall not exceed five (5).

If the Plans require installation of a fiber optic patch panel, the CONTRACTOR shall supply patch cords to patch all terminated fibers through the panel for all fiber testing. If patch cords are specified in the Plans for final equipment installation, these patch cords shall be connected using a test coupling for the end-to-end test.



OTDR readings will be used to ensure proper installation and to troubleshoot faults. OTDR signature traces will be used for documentation and maintenance. An OTDR provides an indirect estimate of the loss of the cable plant; generally, more accurate or reliable values will be obtained by using an Optical Power Meter. For fibers that are identified in the Plans to be left unterminated, an OTDR shall be used to test end-to-end attenuation.

Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.

The CONTRACTOR shall use an OTDR that is capable of storing traces electronically and shall save each final trace.

To ensure the traces identify the end points of the fiber under test and the fiber designation, the CONTRACTOR shall use a test reel, if required, to eliminate the "dead zone" at the start of the trace so that the start of the fiber under test can be identified on the trace. Indicate the length of the test reel for all test results.

If the fiber designation is not indicated on the trace itself, the CONTRACTOR shall provide a cross-reference table between the stored trace file name and the fiber designation.

In compliance with EIA/TIA-455-61 "Measurement of Fiber or Cable Attenuation Using an OTDR" the CONTRACTOR shall record the following information during the test procedure:

- (1) Names of personnel conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
- (3) Date test is being performed.
- (4) Optical source wavelength and spectral width.
- (5) Fiber identification.
- (6) Start and end point locations.
- (7) Launch conditions
- (8) Method of calculation for the attenuation or attenuation coefficient.
- (9) Acceptable link attenuation.

C) Optic Fiber Cable Testing with Optical Power Meter. The CONTRACTOR shall conduct an Optical Power Meter Test for each fiber installed.

Multimode segments shall be tested in one direction at both the 850 nm and the 1300 nm wavelength.

Singlemode segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.

In compliance with TIA/EIA-526-14A "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant" and TIA/EIA-526-7 "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant," the following information shall be recorded during the test procedure:

- (1) Names of personnel conducting the test.
- (2) Type of test equipment used (manufacturer, model, serial number, calibration date).
- (3) Date test is being performed.
- (4) Optical source wavelength, spectral width, and for multimode, the coupled power ratio (CPR).
- (5) Fiber identification.
- (6) Start and end point locations.
- (7) Test direction.
- (8) Reference power measurement (when not using a power meter with a Relative Power Measurement Mode).
- (9) Measured attenuation of the link segment.
- (10) Acceptable link attenuation.

The minor attenuation differences due to test direction are on par with the accuracy and repeatability of the test method. Lateral segments within a building are limited to 90 meters. Therefore, attenuation differences caused by wavelength are insignificant, and as a result, single wavelength testing is sufficient.

D) Acceptable Attenuation Values. Acceptable attenuation values shall be calculated for each fiber tested. These values represent the maximum acceptable test values.

- (1) *Multimode Fiber.* The general attenuation equation for any multimode link segment is as follows:

Acceptable Link Attn.=Cable Attn.+Connection Attn.+Splice Attn.+CPR
Adj.62.5 μ m Multi-mode Attenuation Coefficients:

- i) Cable Attn.=Cable Length (km) x (3.40 dB/km@850 nm or 1.00 dB/km@1300 nm)
- ii) Connection Attn. (ST or SC connectors)=(No. of Connections x 0.39 dB)+0.42 dB.
- iii) Connection Attn. (LC connectors)=(No. of Connections x 0.14 dB)+0.24 dB.
- iv) Splice Attn. (Mechanical or Fusion)=Splices x 0.30 dB.
- v) CPR Adj.=See table below.

A connection is defined as the joint made by mating two fibers terminated with re-mateable connectors (e.g. ST, SC, LC).

Multi-mode Light Source CPR Adjustment					
	Cat. 1 Overfilled	Cat. 2	Cat. 3	Cat. 4	Cat. 5 Underfilled
Links with ST or SC Connections	+0.50	0.00	-0.25	-0.50	-0.75
Links with LC Connections	+0.25	0.00	-0.10	-0.20	-0.30

The Coupled Power Ratio of a light source is a measure of the modal power distribution launched into a multimode fiber. A light source that launches a higher percentage of its power into the higher order modes of a multimode fiber produces a more over-filled condition and is classified as a lower category than a light source that launches more of its power into just the lower order modes producing an under-filled condition. Under-filled conditions result in lower link attenuation, while over-filled conditions produce higher attenuation. Therefore, adjusting the acceptable link attenuation equation to compensate for a light source's launch characteristics increases the accuracy of the test procedure.

- (2) *Singlemode Fiber.* The general attenuation equation for any singlemode link segment is as follows:

$$\text{Acceptable Link Attn.} = \text{Cable Attn.} + \text{Connector Attn.} + \text{Splice Attn.}$$

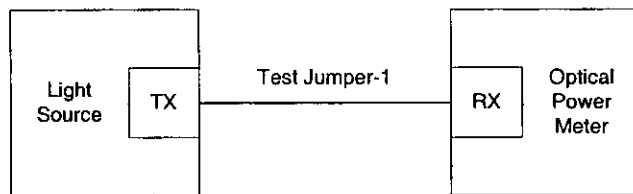
8.3 μm Single-mode Attenuation Coefficients:

- (i) Cable Attn.=Cable Length (km) x (0.34 dB/km@1310 nm or 0.25 dB/km@1550 nm)

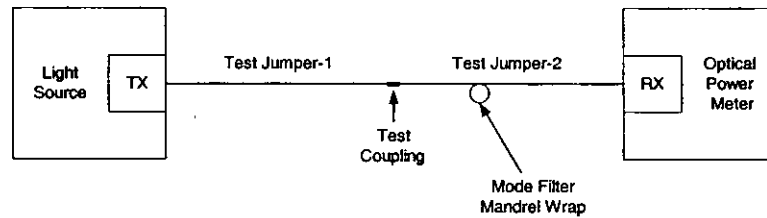
- (ii) Connection Attn. (ST or SC connectors)=(No. of Connections x 0.39 dB)+0.42 dB.
- (iii) Connection Attn. (LC connectors)=(No. of Connections x 0.14 dB)+0.24 dB.
- (iv) Splice Attn. (Mechanical or Fusion)=Splices x 0.30 dB.

E) Test Procedures. All fiber testing shall be performed on all fibers in the completed end-to-end system.

- (1) *Multimode Fiber.* The multimode fiber cable test shall be conducted as follows:
 - i) Clean the test jumper connectors and the test coupling per manufacturer's instructions.
 - ii) Follow the test equipment manufacturer's initial adjustment instructions.
 - iii) Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4 inches) in diameter.



- iv) If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement (P_{ref}). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
- v) Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.
- vi) Connect Test Jumper-2 between the power meter and Test Jumper-1 using the test coupling. Test Jumper-2 should include a high order mode filter. This can be accomplished by wrapping the jumper three times around a 30 mm (1.2 inches) diameter mandrel.



vii) Record the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the CPR value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:

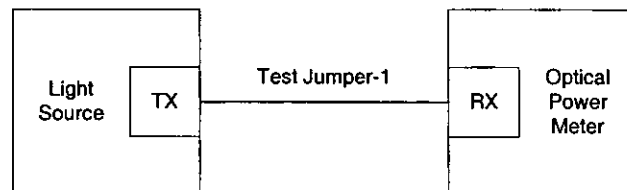
- a) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.):

$$CPR (dB) = P_{sum} - P_{ref}$$
- b) If P_{sum} and P_{ref} are in watts:

$$CPR (dB) = 10 \times \log_{10} [O_{sum}/P_{ref}]$$

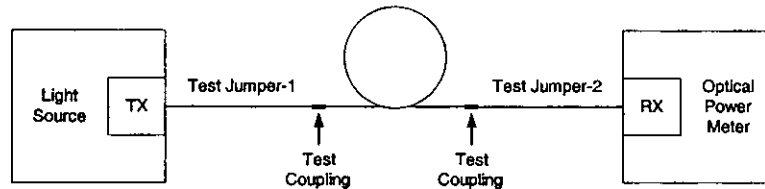
(2) *Singlemode Fiber.* The singlemode Optical Power Meter fiber test shall be conducted as follows:

- i) Clean the test jumper connectors and the test coupling per manufacturer's instructions.
- ii) Follow the test equipment manufacturer's initial adjustment instructions.
- iii) Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4 inches) in diameter.



- iv) If the power meter has a Relative Power Measurement Mode, select it. If it does not, reduce the Reference Power Measurement (P_{ref}). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
- v) Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.

- vi) Attach Test Jumper-1 to one end of the cable plant to be measured and Test Jumper-2 to the other end.



- vii) Record the Power Measurement (P_{sum}). If the power meter is in Relative Power Measurement Mode, the meter reading represents the true value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:

- a) If P_{sum} and P_{ref} are in the same logarithmic units (dBm, dBu, etc.):
$$CPR (dB) = P_{sum} - P_{ref}$$
- b) If P_{sum} and P_{ref} are in watts:
$$CPR (dB) = 10 \times \log_{10} [O_{sum}/P_{ref}]$$

- F) Test Acceptance.** The CONTRACTOR shall demonstrate that each Optical Power Test results in acceptable attenuation values.

The CONTRACTOR, solely at the CONTRACTOR'S cost, shall remake any fusion splices that have test results exceeding acceptable attenuation values. The CONTRACTOR, solely at the CONTRACTOR'S cost, shall retest any fiber links that have been re-spliced.

The CONTRACTOR, solely at the CONTRACTOR'S cost, shall bring any link not meeting the requirements of this specification into compliance.

- G) Submittals.** The CONTRACTOR shall submit test results documentation as both a hard copy and electronic copy.

After each reel test, the CONTRACTOR shall submit one hard copy of the OTDR trace for every fiber on the reel. After installation, the CONTRACTOR shall submit one hard copy of the OTDR trace for every spliced fiber. Hard copy traces shall be organized and bound in logical order in an 8 1/2" x 11" hard cover binder.

The CONTRACTOR shall submit, after approval of the hard copy traces, electronic copies of all traces and appropriate software, if needed, to allow reading the traces.

The CONTRACTOR shall submit one copy of the complete contract Plans, including additional drawings issued as part of any change orders, with any deviations clearly marked in color. Deviations to be noted and shall include but not be limited to the following:

- (1) Fiber Splice location
- (2) Fiber Splice configuration
- (3) Termination layout

H) Testing After Repair. Repairs to fiber optic cable shall be tested according to the requirements determined by the County and could include fusion splicing.

8.10e: During the twenty-day period, the CONTRACTOR shall maintain the system or systems. The cost of any maintenance necessary, except electricity, damage by public or act of God, shall be borne by the CONTRACTOR and will be considered as included in the price paid for the contract item involved, and no additional compensation will be allowed therefore.

8.10f: Where required by the utility company, it will be the CONTRACTOR's responsibility to obtain the electrical and Right of Way permits from Douglas County. (Building department and Engineering department respectively 100 Third St. Castle Rock)

8.20: MAINTENANCE DURING CONSTRUCTION

8.20a: The CONTRACTOR shall have full maintenance responsibility of the traffic signal from the time of the Notice to Proceed to the initial walk-through and/or completion of removals in the case of rebuild of modifications. Continuous maintenance and emergency service shall be provided by the CONTRACTOR 24 hours each day during the time period defined above. The CONTRACTOR shall provide and maintain a 24-hour continuous telephone answering service with one number with a respond time of 2 hours or less. Should this not occur, section 8.30c shall be invoked.

8.30: EMERGENCY AND NON-EMERGENCY REPAIRS

8.30a: During the one-year (1) warranty period of full maintenance responsibility, 1) all hazardous conditions or 2) all malfunctions of a controller and its accessory equipment following turn on shall be considered an EMERGENCY unless otherwise identified by the ENGINEER. Site conditions, equipment malfunctions and/or damage, which in the opinion of the ENGINEER constitutes a serious hazard or inconvenience to the public, shall be considered an EMERGENCY. Such malfunctions or damage may include, but not necessarily be limited to, situations where:

- (1) All indications are out including bulbs and lenses, for any one traffic movement;
- (2) Signal heads give conflicting indications to any intersection approach or approaches;
- (3) Any signal head or sign becomes loose and or twisted;
- (4) Any accessory equipment malfunction.

CONTRACTOR shall dispatch personnel to undertake each such repair no later than one half hour after the County notifies CONTRACTOR of the EMERGENCY. Personnel responding shall arrive within one hour after notification during regular working hours and within two hours during non-working hours after notification.

8.30b: In instances of repairs that are of a non-emergency nature and determined to be the CONTRACTORS responsibility by the ENGINEER, such repairs shall be undertaken at the site within one working day after the ENGINEER notifies the CONTRACTOR of the needed repair.

8.30c: Should the CONTRACTOR fail to perform any maintenance responsibilities within the prescribed time periods, the ENGINEER shall employ the services of the County's traffic signal maintenance contractor to perform said maintenance work. The CONTRACTOR shall reimburse the County for labor and equipment charges plus ten percent (10%) for administration associated with the utilization of the County's traffic signal maintenance. Labor and materials and ten percent (10%) will be subtracted from the total contract amount.

9.00: TRAFFIC SIGNAL MATERIAL SPECIFICATIONS

9.10: VEHICLE SIGNAL HEAD

9.10a: All vehicle signal heads shall be the modular section type and shall be adjustable with respect to positioning and lens replacement. Heads shall be polycarbonate and black in color and shall meet the requirements of the latest version of the ITE standard, "Vehicle Traffic Control Signal Heads". Unless otherwise indicated, traffic signal faces shall be LED. Refer to Section 9.70 for LED requirements and Section 9.60 for lamp specifications.

9.10b: Visors shall be the detachable tunnel type and black in color.

9.10c: Reflectors shall be silvered glass or Alzak aluminum type units. Sockets shall be fixed focus.

9.10d: Doors on the signal heads for the installation of lamps and lens replacement or other maintenance shall not require use of any tool whatsoever to be opened. Doors and lenses shall be equipped with neoprene weatherproof gaskets to insure against infiltration of moisture, road film, and dust. Each three-color signal unit shall have the socket leads from all signal sections connected to a terminal board stamped with identifiable terminals. There shall be a terminal for color indication plus a common terminal where one lead from each socket shall terminate. The terminal board shall be mounted in the middle section and be fully insulated. Gaskets shall be supplied for top and bottom openings.

9.10e: Traffic signal heads shall be attached using standard ASTRO-BRAC Assembly or approved equivalent. Side of pole signal heads shall be installed with banding blocks and 90 degree elbows with nipple length determined by the size of the head so as not to interfere with closing doors.

9.20: PEDESTRIAN SIGNAL HEAD

9.20a: Pedestrian signal heads shall be sixteen-inch (16") of the "clam shell" type, one-way, Indicator Controls Corp. or approved equal, and shall be adjustable with respect to positioning. Heads shall be black in color, and shall meet the requirements of the latest version of the ITE standard, "Pedestrian Traffic Control Signal Indications". "Walk/Don't Walk" indications shall be the symbol type and side-by-side, with a minimum height of 11". "Walk/Don't Walk" indications shall

be LED with solid (filled in) indications. Doors and lenses shall be installed with weatherproof gaskets to insure against infiltration of moisture, road film and dust. Visors shall be egg crate type. Pedestrian stick-on signs shall match symbol type.

9.30: COUNTDOWN PEDESTRIAN SIGNAL HEAD

9.30a: Single, self-contained retrofit module for clamshell housing.

9.30b: Two message overlay combining Portland Orange LED for the "Hand: and White LED for "Walking Man."

9.30c: Double digit display for countdown made of Red LED's.

9.30d: Timing is derived directly from the controller and no timing shall be programmed, or otherwise initiated.

9.30e: Countdown numerals shall be illuminated continuously during countdown and not alternating.

9.30f: Pedestrian signal head shall blank out countdown portion if the countdown is different than the controller.

9.30g: Hand/Man indications shall be solid style, not outline.

9.40: BLANK-OUT REGULATORY/WARNING SIGN

9.40a: General Description

- Fiber Optic Blank Out Signs are designed to display single or multiple messages. The messages must be clear and legible, under any lighting conditions. When not energized the sign must completely blank out without any ghost images.
- Illumination of the messages provided by an assembly of Fiber Optic Pixels.
- When energized, the messages shall be visible within a 60 degree cone centered about the optical axis.

9.40b: Fiber Optic Harness

- Fiber Optic harnesses consist of multi-branched step indexed glass fibers ground smooth at both ends and optically polished for maximum light transmission.
- Each light guide consists of a minimum of 600 glass fibers protected by a PVC jacket. Individual fibers have a minimum core diameter of 50 microns.
- Each harness comprises a minimum of 5% spare light guides for replacement of damaged guides.
- Each light guide is terminated by a brass ferule, secured with epoxy adhesive and crimped on the PVC jacket.
- Each message constituted of at least two independent harnesses with their pixels mounted alternatively.
- Each message illuminated by at least two distinct light sources to provide 100% light intensity to at least 50% of the pixels in case of a single bulb burn out.

9.40c: Color Filters

- Filters are made of tempered UV treated glass.
- Filter wavelengths in accordance to chromacity coordinates defined in section 8.04 of the latest ITE (VTCHS) specification.
- Filters secured with removable spring clips for easy field maintenance.

9.40d: Lamps

- MR16 style quartz halogen lamps with internal diachronic reflectors.
- Forward luminous intensity of 850 lumens and a color temperature of 3050 Kelvins.
- Lamps secured in place by a lamp holder allowing for easy field replacement.

9.40e: Lens

- Sign face protected by a non-reflective Matt/Clear .125 lexan lens.
- Face lens is UV treated for protection from direct sunlight.

9.40f: Housing

- Weatherproof 8" deep housing made entirely of aluminum. Sign face and body are .125" thick, back plate is 0.80" thick.
- All corners of the body are "tig" (tungsten inert gas) welded to their full length.
- Front lens is fixed to an aluminum frame which is mounted on the housing by a full length aluminum hinge on the left and secured to the right by two stainless steel locks. The front panel is sealed tight against a neoprene gasket

fixed to the housing body. When closed, the front panel frame covers a gutter surrounding the housing and fits flush to the outside of the housing body.

- The sign face plate is mounted inside the housing by a full length aluminum hinge on the left and secured to the right by two ¼ turn link locks.
- A three-sided visor made of .063" aluminum is provided for maximum visibility.
- Surface finish: two component vinyl wash primer, two component epoxy activated primer and two coats of polyurethane Dupont "IMRON" industrial enamel for commercial vehicles and aircraft.

9.40g: Optional Feature

- Optional dimming control can provide up to three levels of luminosity depending on ambient lighting. Automatic dimming reacts with a 20 sec. delay to eliminate interference from headlights and shadows.
- Sign may be equipped with burnt lamp detector to send alarms or to activate an indicator.

9.40h: Remote Control

- Signs may be equipped with a cellular phone remote control. Messages can be controlled remotely from any touchtone phone using a pre-determined password.
- When equipped with a cellular system, the sign can dial up a pre-determined number in case of malfunction such as burnt bulb.

9.40i: Electrical

- Voltage rating: 117 VAC, 60 Hz.
- Power: 42 Watts per lamps.
- Lamps are powered by 10.8 VAC CSA + UL listed transformers.
- Ambient temperature operating range (-40°C to +80°C).

9.40j: Quality Assurance

- All products manufactured under "Quality Assurance Program" as defined in ISO9002-94, article 4.9.
- Copies of "Quality programs" and "Inspection reports" are available to customers upon request.

9.50: ILLUMINATED STREET NAME SIGN

With the exception of allowances listed below, plans for any variances must be submitted to and reviewed by the Douglas County Department of Public Works.

Only Metro Districts may apply for variances. The Metro District must submit a draft of a "save harmless" letter to be reviewed by the Engineering Division and the County Attorney. The letter is to be addressed to the Department of Public Works and the Douglas County Commissioners. It must identify that the Metro District's responsibility for maintenance and supply in perpetuity of their specific signs and materials. It must stipulate the District will respond within 48 hours after notification by this Department to maintain or repair. All specific variances from County standards shall be listed in the special footnote box on the first page of the plans.

Allowances:

When indicated on the plans, illuminated street name signs shall be used, conforming to the following requirements:

9.50a: Illuminated street name sign housings shall be constructed of extruded aluminum. All ferrous hardware parts shall be galvanized or cadmium plated.

9.50b: The sign panel shall be Plexiglas 1/8" clear covered with 3M Scotchlite Diamond Grade 3990T translucent reflective sheeting or equivalent. The sign colors shall not fade when exposed to an accelerated test of ultraviolet light equivalent to five years of outdoor exposure. The E.C. (ElectroCut) film shall be 3M 1177 Green. The font type is FHWA Hwy. Series "C" unless otherwise specified. The street name shall be 10" upper caps and the designator shall be 5" upper caps.

9.50c: The entire surface of the sign panel shall be evenly illuminated. The average of brightness reading for the letters shall be 150 ft. - lamberts minimum. The light transmission factor of the sign panel shall provide a letter-to-background brightness ratio between 10:1 and 20:1.

9.50d: The sign ballasts shall be the high power factor type, rated at 110-125 V. at 60 Hz., and there shall be a separate ballast for each fluorescent lamp. Fuses shall be miniature slow-blowing type, with a separate fuse provided for each ballast. Fluorescent lamps shall meet ANSI Standard C78. One lampholder for each lamp shall be the spring-loaded type. The entire sign and its components shall be operated over a temperature range of -30°F to +160°F.

9.50e: Terminal blocks shall be the molded, phenolic, barrier type rated at 15 amp., 1,000 V. and shall have waterproof marking strips. No wiring splices will be allowed within the sign without the permission of the ENGINEER.

9.50f: The photoelectric control shall be a unit that plugs into an EEL-NEMA twist lock receptacle mounted on top of the housing.

9.50g: The overall weight of the complete sign assembly including mounting hardware shall not exceed 70 lb. for a 6 foot sign and 95 lb. for an 8 foot sign.

9.50h: Sign fixture and panels shall withstand 90 MPH (mile per hour) wind loading, with structural requirements meeting AASHTO "Standard Specifications for structural supports for highway signs, luminaries and traffic signals," Latest edition.

9.50i: Housing shall be constructed of aluminum unless otherwise directed by the ENGINEER or other authorized county personnel.

9.50j: Light source shall be readily accessible through hinged doors or sliding panels. Neoprene gaskets shall be installed between the sign panel and fixture housing to prevent water or other debris from entering. Screened weep holes shall be provided on housing bottom for drainage.

9.60: TRAFFIC SIGNAL LAMP

9.60a: When approved by the County for use, traffic signal lamps shall meet the requirements of the latest version of the ITE standard, "Traffic Signal Lamps". Size of lamps to be used in traffic signal units shall be as follows:

- 69 watt, 130 volt, lamps for all pedestrian heads; 116 watt, 130 volt, lamps for all twelve-inch (12") traffic signals; 60 to 69 watt, 130 volt, lamps for all eight inch (8") traffic signals.

9.60b: All lamps shall have an average rated life of 8,000 hours or more. If the manufacturer recommends a lower rating, the County shall be advised of this recommendation and will have the option to decide which rating will be used.

9.70: TRAFFIC SIGNAL FACES (LED'S)

All traffic signal faces (vehicular and pedestrian) shall be LED type, unless otherwise specified by Douglas County.

The LED traffic signal faces shall conform to the following requirements:

9.70a: The LED optical units shall be installed in accordance with the manufacturer's instructions.

9.70b: LED optical units shall meet or exceed ITE Adjustable Face Vehicular Traffic Control and Pedestrian Signal Head Standards. In addition to this, LED optical units shall conform to the following requirements:

9.70c: Wattage

- Max. 35 watts, +/-5 watts for 12 inch red, yellow, or green ball
- Max. 15 watts, +/-5 watts for 12 inch red, yellow or green arrow
- Max. 15 watts, +/-5 watts for PED hand and man symbol
- Maximum total harmonic current distortion (THD) shall be < 20%.
- Power factor shall be > 90%.
- Load balance requirement: load in one phase shall not exceed the load in any other phase by 15%.

The wattages shown in the following table are wattages agreed to by XCEL Energy, and are the wattages to be provided to XCEL for billing purposes at new traffic signal installations. The CONTRACTOR is required to provide this information to XCEL when requesting service. These wattages are accepted as of April 2003 and shall be used for all traffic signal installations.

<i>Color/Type</i>	<i>Wattage</i>
Countdown	16
Green Arrow	9
Green Ball	14
Hand/Man	10
Ped Hand	15
Red Arrow	7
Red Ball	11
Yellow Arrow	9
Yellow Ball	18
Red Ball	11

Note: THD and power factor requirements shall be waived for products designed to operate at less than 14 watts.

9.70d: Voltage

Operating shall be between 85 and 130 VAC. Electronic circuitry shall assure proper operation of the load switch and monitor in the control cabinet.

9.70e: Minimum Number of LEDs Per Optical Unit

The minimum number of LEDs per optical unit shall be as specified by the manufacturer to meet ITE luminance specifications for signal installation. No less than 125 LED's per optical unit will be allowed.

The LED traffic signal lamps shall have a high number of LED's.

9.70f: Circuit Configuration

The LEDs shall be connected to form multiple series circuits. All series circuits shall be interconnected at intervals, forming subcircuits not exceeding 15 LEDs for the red ball and arrow signals, and 10 LEDs for the pedestrian hand symbol. In the event of an LED failure, these subcircuits shall limit the number of extinguished LEDs to no more than 4% of the total on the red ball and pedestrian hand signal lamps, and 6% of the total on the red arrow lamp.

9.70g: Enclosure

Shall be dust and water-resistant.

9.70h: Operating Temperature

Between -40 degrees F and +185 degrees F.

9.70i: Lens

Shall be replaceable, polycarbonate (UV stabilized "Lexan") convex lens; meet ITE color standards; minimum of 1/8 inch thickness; and minimum light transmittance of 92%, free from bubbles, flaws and other imperfections. Non-polycarbonate red tinted lenses will be accepted provided that these meet ITE color standards. Chromacity shall be measured uniform across the face of the lens. Non-polycarbonate lenses shall also meet 3-1/2 foot drop tests.

9.70j: Candlepower Distribution

Shall meet minimum ITE specifications. Intensity shall be measured uniform across the face of the lens. Brightness shall be maintained in the event of voltage fluctuations or voltage drops.

9.70k: Beam Spread
30 degrees to each side.

9.70l: Manufacturer's Warranty
Repair or replacement guarantee of five (5) years covering all but accidental damage.

9.80: ELECTRICAL CABLE

9.80a: Signal cable shall be No. 14 AWG multi-conductor, stranded, copper wire manufactured to meet IMSA Specification 19-1. Each conductor in the cable shall be individually insulated and rated at 600 volts. There shall be a minimum of four (4) and a maximum of nine (9) strands per conductor. The number of conductors per cable may be specified in the plans for the project in question, but in no case shall be no less than nineteen (19).

9.80b: Power service conductors shall be THWN soft drawn copper, installed per the NEC and shall be black and white in color.

9.80c: Loop detector wire shall be single conductor No. 14 AWG, stranded THHN. Loop detector wire shall be encased in 1/4" OD PVC or polyethylene tubing.

9.80d: Detector loop and pedestrian push-button lead-in cable shall be shielded single or multiple twisted pairs in jacketed cable. Conductors shall be No. 16 or 18 AWG stranded copper. The pairs shall be twisted at least six turns per foot. The cable jacket shall consist of black high density polyethylene. The jacket shall not be degraded by prolonged exposure to typical pavement runoff components. A stranded tinned copper drain wire shall be provided. The cable shall be suitable for operation at temperatures of -70°F to +170°F.

9.80e: Ground wire shall be single conductor, No. 8 AWG, soft-drawn bare copper wire.

9.80f: Optical detector lead-in cable for the emergency vehicle pre-emption optical detectors shall be 3M Model M138 or approved equivalent.

9.80g: Where specified on plans, underground interconnect wire shall be No. 19 AWG minimum, with 6 twisted pairs minimum, shielded cable, with petrolatum-

polyethylene gel filling compound. The cable shall meet Rural Electrification Administration (REA) Specification PE-39 (Clifford of Vermont Catalog #6P19-B1-BJFC). No splicing of the interconnect cable will be allowed. The cable shall be installed between two adjacent controller cabinets in continuous runs. All cable pairs will be connected to either active or spare terminal points provided in the controller cabinet. The CONTRACTOR shall identify and label all terminal points. At the terminal points the jackets shall be stripped and the ends taped. Gel filling compound shall be removed using filled cable cleaner. A warning ribbon shall be installed above the interconnect wire.

9.80h: Where specified on the plans, overhead interconnect wire shall be a 1/4" strand galvanized steel messenger cable integrated into the jacket to form a Figure 8 cross-section and shall meet REA Specification PE-38.

9.80i: All twisted pair and overhead interconnect wires shall be checked after installation to determine their resistance and resistance to ground. Each pair shall be shorted together at one end and a resistance check will be made at the other end. Resistance will also be checked between each conductor and ground. All resistance readings shall be recorded showing value, color and location of wire. Data is to be supplied to the County Department of Public Works within 30 days of completion of the project.

9.80j: Luminaire wire shall be 12-2 plus ground and UL listed.

9.80k: Where specified on the plans, interconnect wire connecting traffic signal controller cabinets shall be fiber optic type. Fiber optic cable runs consist of a main cable, which runs the length of the project, and connects to the individual local controller cabinets and is explained in detail in this specification: Fiber optic cable shall be loose tube non-armored outdoor cable consisting of twenty-four (24) single mode fibers and twelve (12) multi-mode fibers and complying with the following specification for fiber optic cable. Fiber optic cable for installation in conduit shall meet the applicable portions of I.M.S.A. Specification 60-2 or approved equal. A 16 ga (min) stranded trace wire shall be installed in conduit with fiber.

1. General Considerations

- A. The fiber optic cable shall meet all requirements stated in the specification. The cable shall be an accepted product of the United States

Department of Agriculture Rural Electrification Administration (REA) as meeting requirements of 7CFR1755.900.

- B. The cable shall be new, unused and of current design and manufacture.
- C. Connectors shall be "ST" single mode type

2. Fiber Characteristics

- A. All fibers in the cable must be usable fibers and meet this specification.
- B. All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical and environmental requirements of this specification.
- C. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.
- D. The single-mode fiber utilized in the cable specified herein shall conform to the following specifications:
 - Typical Core Diameter: 8.3 μm .
 - Cladding Diameter: 125.0 \pm 1.0 μm .
 - Core-to-Cladding Offset: \leq 0.8 μm .
 - Cladding Non-Circularity: 1.0%.
Defined as: [1-(min. Cladding dia. + max. Cladding dia.)] X 100
 - Coating diameter: 245 \pm 10 μm .
 - Colored Fiber Diameter: nominal 250 μm .
 - Attenuation Uniformity – No point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm.
 - Attenuation at the Water Peak – The attenuation at 1383 \pm 3 nm shall not exceed 2.1 dB/km.
 - Cutoff Wavelength – The cabled fiber cutoff wavelength shall be \leq 1250 nm.

- Mode-field Diameter (Petermann II) –
9.30 ± 0.50 μm at 1310 nm
10.50 ± 1.00 μm at 1550 nm
- Zero Dispersion Wavelength (λ_0)-1301.5 nm ≤ (λ_0) ≤ 1321.5 nm.
- Zero Dispersion Slope (S_0)- ≤ 0.092 ps/(nm²·km).
- The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer.
- The coating shall be mechanically strippable without damaging the fiber.

3. Fiber Specification Parameters

All fibers in the cable shall meet the following requirements:

- A. When tested in accordance with FOTP-3, “Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable and Other Passive Fiber Optic Components”, (single-mode only), the average change in attenuation at extreme operational temperatures (-40°C to +70°C) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm.
- B. Required Fiber Grade – Maximum Individual Fiber Attenuation
- C. The maximum dispersion for single mode optical fibers shall be ≤ 3.3 ps/(nm.km) for 1285 nm through 1330 nm and shall be ≤18 ps/(nm km) at 1550 nm.
- D. Specifications for Outdoor Cables
 1. Optical fibers shall be placed inside a loose buffer tube.
 2. Each buffer tube shall contain up to 6 fibers.
 3. The fibers shall not adhere to the inside of the buffer tube.
 4. Each fiber shall be distinguishable from others by means of color coding or numbers according to the following:

- a. Blue
- b. Orange
- c. Green
- d. Brown
- e. Slate
- f. White

These colors shall meet EIA/TIA-598, "Color Coding of Fiber Optic Cables".

- E. Buffer tubes containing fibers shall also be color coded or numbered with distinct and recognizable colors or numbers according to the following:

- | | |
|-----------|-----------|
| 1. Blue | 6. Red |
| 2. Orange | 7. Black |
| 3. Green | 8. Yellow |
| 4. Brown | 9. Violet |
| 5. Slate | 10. Rose |

These colors shall meet EIA/TIA-598, "Color coding of Fiber Optic Cables".

- F. In buffer tubes containing multiple fibers, the colors or numbers shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.
- G. Buffer tubes shall be of a dual-layer construction with the inner layer made of polycarbonate and the outer layer made of polyester.
- H. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
- I. The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.
- J. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be

free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

- K. Buffer tubes shall be stranded around a central member using the reverse oscillation, or "SZ", stranding process.
- L. The cable core interstices shall be filled with a water-blocking compound. The compound shall be a thixotropic gel containing a Super Absorbent Polymer (SAP) material. The gel shall be non-nutritive to fungus, electrically non-conductive and homogenous. The gel shall be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.
- M. Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.
- N. The cable shall contain at least one ripcord under the sheath for easy sheath removal.
- O. Tensile strength shall be provided by high tensile strength aramid yarns, fiberglass yarns, or both.
- P. The high tensile strength aramid yarns and/or fiberglass yarns shall be helically stranded evenly around the cable core.
- Q. All-dielectric cables (with no armoring) shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and flooding compound. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
- R. The jacket or sheath shall be free of holes, splits and blisters.
- S. The cable jacket shall contain no metal elements and shall be of a consistent thickness.
- T. Cable jackets shall be marked with sequential meter or foot markings, year of manufacture and a telecommunication handset symbol, as

required by Section 350G of the National Electrical Safety Code (NESEC). The actual length of the cable shall be within $-0/+1\%$ of the length markings. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm.

- U. The maximum pulling tension shall be 2700 N (608 lbf) during installation (short term) and 890 N (200 lbf) long term installed.
- V. The shipping, storage and operating temperature range of the cable shall be -40°C to $+70^{\circ}\text{C}$. The installation temperature range of the cable shall be -30°C to $+70^{\circ}\text{C}$.

4. General Cable Performance Specifications

- A. The unaged cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for 24 hours. No water shall leak through the open cable end. When a one meter static head or equivalent continuous pressure is applied at one end of a one meter length of aged cable for one hour, no water shall leak through the open cable end. Testing shall be done in accordance with FOTP-82, "Fluid Penetration Test for Filled Fiber Optic Cable".
- B. When tested in accordance with FOTP-81, "Compound Flow (Drip) Test for Filled Fiber Optic Cable", Method A; the cable shall exhibit no flow (drip or leak) of filling or flooding compound at 80°C . If material flow is detected, the weight of any compound that drips from the sample shall be less than 0.05 grams (0.002 ounce).
- C. The cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) for non-armored cables applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41 "Compressive Loading Resistance of Fiber Optic Cables", except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for 10 minutes. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (single-mode). The average increase in attenuation for the fibers shall be ≤ 0.02 dB at 1300 nm (multimode). The repeatability of the measurement system is

typically ± 0.05 dB or less. No fibers shall exhibit a measurable change in attenuation after load removal.

- D. When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test", the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycles per minute, with a sheave diameter not greater than 20 times the cable diameter. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (single-mode). The repeatability of the measurement system is typically ± 0.05 dB or less. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.
- E. When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies", the cable shall withstand 25 impact cycles. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm (single-mode). The repeatability of the measurement system is typically ± 0.05 dB or less. The average increase in attenuation for fibers shall be ≤ 0.04 dB at 1300 nm (multimode). The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.
- F. When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test", using maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a tensile load of 2700 N (608 lbf) applied for one hour (using "Test Condition II" of the procedure). In addition, the cable sample, while subjected to a minimum load of 2660 N (600 lbf), shall be able to withstand a twist of 360 degrees in a length of less than 3 meters. The magnitude of the attenuation change shall be within the repeatability of the measurement system of 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm. The repeatability of the measurement system is typically ± 0.05 dB or less. The average increase in attenuation for fibers shall be ≤ 0.40 dB at 1300 nm (multimode). The cable shall not experience a measurable increase in

attenuation when subjected to the rated residual tensile load, 890 N (200 lbf).

- G. When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test", a length of cable no greater than 2 meters will withstand 10 cycles of mechanical twisting. The magnitude of the attenuation change will be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers will not experience an attenuation change greater than 0.1 dB at 1550 nm. The repeatability of the measurement system is typically ± 0.05 dB or less. The average increase in attenuation for fibers shall be ≤ 0.40 dB at 1300 nm (multimode). The cable jacket will exhibit no cracking or splitting when observed under 5X magnification after completion of the test.
- H. When tested in accordance with the proposed FOTP-181, "Lighting Damage Susceptibility Test for Fiber Optic Cables with Metallic Components", the cable shall withstand a simulated lighting strike with a peak value of the current pulse ≥ 105 kA. The test current used shall be damped oscillatory with a maximum time-to-peak value of 15 μ s (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time of half-value of the waveform envelope (t_2) shall be from 40 – 70 μ s. In addition to the analysis criterion set forth in FOTP-181, the integrity of the buffer tubes (or analogous loose tube, i.e., core tube) and strength members must be intact after removal of the cable specimens from the test box.

5. Quality Assurance Provisions

- A. All optical fibers shall be proof tested by the fiber manufacturer at a minimum load of 100 ksi.
- B. All optical fibers shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

6. Packaging

- A. The complete cable shall be packaged for shipment on non-returnable wooden reels.
- B. Top and bottom ends of the cable shall be available for testing.

- C. Both ends of the cable shall be sealed to prevent the ingress of moisture.
- D. Each reel shall have a weatherproof reel tag attached identifying the reel and cable.
- E. Each cable shall be accompanied by a cable data sheet that contains significant information on the cable.

7. Miscellaneous

- A. The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification.

9.80l: Fiber optic cable shall be tested per section 8.10d.

9.90: RADIO COMMUNICATIONS EQUIPMENT

9.90a: Where specified in the plans, radio communication shall be included on the project. The radio communication system shall be compatible with the existing spread spectrum radio system, and meet the following requirements.

9.90b: Data Radio Requirements

The spread spectrum radio transceiver shall be 9810, 902-908 MHz Frequency Hopping spread Spectrum Transceiver or approved equal. The radio shall operate under FCC Part 15 rules for unlicensed radio operation in the 902-908 MHz band range. The radio shall interface with the local software W4IKS latest revision and the W70SM Wapiti Master Software. Additionally, the interface with the county's Central TransLink software shall be seamless. The radios shall mount directly in standard cabinets, Model 332 and Model 336S or Model 303, be rack mounted with power supply and shall have swing away capabilities. Other requirements include the following:

- 1220, 2400, 4800, 9600, 19200 bps data through out
- Protocol transparent
- End to end delays of less than 10 milliseconds.
- RS-232 Interface
- Maximum Allowable Transmit Power – 1 Watt
- Transparent Data Communications

9.90c: Diagnostic Requirements:

The computer interface software shall be provided. The system shall include a hand-held terminal or computer, utilizing the interface with the radio's internal diagnostic monitor. The interface software shall be operable with the county's existing radios. The diagnostics monitor shall include the following:

- Repeated Diagnostics: Enables link tests to be run on any system radio with the results viewed for any other radio system.
- Remote Radio Link Survey: Initiates multiple link tests to a remote radio to obtain a "Long-Term" channel frequency analysis.
- Radio System Link Test: Initiates a poll of all remote radios to receive "Short-Term" channel frequency analysis.
- Remote Radio Link Test: Initiates a "One-Shot" link check on a selected remote to test each channel's 64 Hop frequencies.

9.90d: Unidirectional Antenna:

The unidirectional antenna shall be a Yagi with dB gain suitable for the locations with a frequency range of 890 to 960 MHz and be supplied with an acceptable mounting arrangement.

9.90e: Master Antenna:

The Master antenna shall be an Omni and the mounting arrangement shall be with the appropriate degree tilt to assure communications to all local transceivers.

9.90f: Antenna Cables:

The antenna cables shall be coaxial with less than 4db per 100 Ft. loss at 900 MHz. The cable shall be RG8u (LMR400) 3/8" flexible coaxial cable. All connectors shall be supplied. A ratcheting coaxial tool kit shall be supplied which shall include the following:

- Ratcheting Crimp Tool
- Coaxial Cutter
- Coaxial Stripper

9.90g: Lightning Arrestor:

The lightning arrestor shall have the following requirements:

- Surge Protection to 5,000 amperes
- Constant line impedance of 50 Ohms
- Typical insertion loss of 0.25 db or less at 500 MHz

- Replaceable gas discharge tube to clamp surge voltages to less than 50 volts (+) nanoseconds.
- Standard N-type male plugs
- Max. dimension N-type 4" by 1.5" x 2.5"

9.90h: Radio and Controller Cables:

Cabinet cables for the radio, power supply, 170E controller and antenna shall be furnished. Power supply shall be 12V DC.

9.90i: Supplier On Site Service:

The supplier shall have a qualified, factory-trained, ENGINEER or Technician on site when requested during the install of the Omni Antenna.

9.90j: Delivery Requirements: 60 Days After Receipt of an order.

9.100: MICRO LOOP DETECTOR

9.100a: Micro loop detectors shall be 3M Canoga M701.

9.100b: Lead-in cable shall be 3M Canoga Model 30003, and of a sufficient length to reach the pull box behind the curb.

9.110: EMERGENCY VEHICLE DETECTOR

9.110a: Optical detectors for emergency vehicle pre-emption shall be the 3M Model M711 or M721 Optical Detector or latest model, as needed. Placement of the detectors shall be determined by the ENGINEER.

9.110b: Timer modules for emergency vehicle pre-emption shall be the 3M Discriminator, Model M562, which handle two channels of detection.

9.110c: Optical emitter for emergency vehicle pre-emption shall be the 3M Model latest model. The emitter shall be programmable for priority and identification purposes via internal switches.

9.110d: The CONTRACTOR shall notify the County, ENGINEER, and the local fire department when optical detectors are operational for testing prior to final acceptance.

9.120: VIDEO DETECTION

9.120a: Where specified on the plans, video detection shall be installed. The following describes the minimum requirements for providing a complete Video Detection System. Initially, the system shall be capable of providing presence vehicle detection at selected intersections. The video system shall be expandable without removing or replacing existing units.

9.120b: Acceptable systems include that of any manufacturer, provided such equipment meets all qualifying specifications identified herein. Using standard image sensor optics and in the absence of occlusion, the system shall be able to detect vehicle presence with 98% accuracy under normal conditions (days and nights), and 96% accuracy under adverse conditions (fog, rain, snow).

All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The products algorithms shall have a proven record of field use at other installations for at least two (2) years of service i.e., not including prototype field trials prior to installation.

9.120c: Video Vehicle Detection System:

General: These technical specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all licensed vehicles on the roadway, providing video detection for areas outlined in the construction drawings. The entire video detection system shall consist of the following:

- Video Image processing unit(s)
- Video camera(s) with IR filter, enclosure, and sunshield
- Camera Lens
- Surge suppresser
- All other necessary equipment for operation

9.120d: Video Image Processing Unit

VIP3.2 specifications

1. Software Specs:

The Video Image Processing Unit shall be Traficon Model VIP3.1 or VIP3.2, the second releases of the VIP3 board. The new boards shall fit directly into the 170 and NEMA racks without an interface box. The VIP3.1 shall monitor one camera

and the VIP3.2 shall monitor two (2) separate cameras. Video inputs to either unit shall enter through the input file or detector rack edge connector. The Video Image Processing Unit shall be located on one module, daughter PC cards connected through ribbon cables shall not be allowed.

On each camera the presence is detected on 24 zones. Counting data can be stored for up to 6 different lanes. The up to 4000 records stored on board can be retrieved via a RS232 port on the front. All probes (24 for two cameras) can be combined in different relationships (AND, OR, NOT) to 24 outputs. 20 digital inputs allow to expand the conditional output with external equipment. Also conditional count is possible.

All probes and parameters can be changed without stopping the detection. For example: when one probe is modified all probes continue to work, including the one that is being modified. When the new position is confirmed, the new probe will enter a learning phase. Once the new probe is in function it will take over the job of the old one. In this way, the detector is always full operational with no interrupt on any probe, even during modification.

Four detector configurations can be stored on board. Software download from PC via serial port is possible.

Specifications:

- 1 or 2 camera inputs
- 24 digital outputs
- 20 digital inputs
- Fits direct into the 170 and NEMA rack without additional adapter
- 24 direction sensible detector probes per camera, including up to 6 counting probes per camera
- Stores counts for 4000 intervals.
- Detection results of all detection probes can be combined with the inputs to the related outputs. AND, OR, NOT
- 4 configurations stored on board
- Modifications with no interruption on all probes
- Setup via keypad and monitor (no pointing device needed)
- Software update via RS232

The video detection board will have only 4 outputs and will use expansion boards for additional input and output.

The video detection (Main) board will have the following on the front:

- One Male DB9 for connection with the first expansion board
- One Female DB9 for setup with keypad (Service port)
- Leds for outputs on board (2 for cam 1 and 2 for camera 2), power, Video Cam 1 and Video Cam2, Communication with expansions
- One video output for setup via keypad
- A switch to select which image to be on the service output

The input/output expansion board will have the following on the front:

- LED's for power, Expansion communication, In/output activity
- 2 DB9 ports for communication with Master or other expansion boards
- A 8-dipswitch device to select the following:
 - Input or Output
 - Range: 1-12 or 13-24
 - Input or Output number (see example for more info)

2. PIN usage on 170

a. Video detection (Main) board

The master is 2 slots wide. There are 4 outputs free selectable over the 2 cameras. The master cannot have inputs.

The master has a DB9 connector to be connected to the first slave (Exp Comm IN). The first slave (Exp Comm OUT) is then connected to the second one. DB9 means you can use flat or round cables.

	TB2	TB1
SP	1. SPARE	1.SPARE
F	2. DET.#1 Out	2. DET.#2 Out
W	3. DET.#3 Out	3. DET.#4 Out
D	4. VIDEO #1 IN (+)	4. VIDEO #2 IN (+)
E	5. VIDEO #1 IN (-)	5. VIDEO #2 IN (-)
J	6. VIDEO OUT (+)	6. RS485 (+)
K	7. VIDEO OUT (-)	7. RS485 (-)
L	8. EQ GND	8. EQ GND

Input file connector	Function
A	DC-GND
B	+ 24 VDC
C	Not USED
D	VIDEO #1 IN (+)
E	VIDEO #1 IN (-)
F	DET #1 OUTPUT
H	LOGIC GROUND
J	VIDEO OUT (+)
K	VIDEO OUT (-)
L	EQUIPMENT GROUND
M	AC -
N	AC +
P	VIDEO #1 IN (+)
R	VIDEO #1 IN (-)
S	DET #2 OUTPUT
T	LOGIC GROUND
U	RS485 (+)
V	RS485 (-)
W	DET #3 OUTPUT
X	LOGIC GROUND
Y	DET #4 OUTPUT
Z	LOGIC GROUND

b. Input/output expansion board

The slave card is only 1 slot wide. You can use 2 or 4 in/outputs. Using the dispswitches one can select which output (defined in the VIP3) will be connected on the expansion board.

	TB2	TB1
SP	1. SPARE	1.SPARE
F	2. DET.#A In / Out	2. DET.#C In / Out
W	3. DET.#B In / Out	3. DET.#D In / Out
D	4. NC	4. NC
E	5. NC	5. NC
J	6. NC	6. NC

K	7. NC	7. NC
L	8. EQ GND	8. EQ GND

Input file connector	Function
A	DC-GND
B	+ 24 VDC
C	Not USED
D	Not USED
E	Not USED
F	DET #A INPUT / OUTPUT
H	LOGIC GROUND
J	Not USED
K	Not USED
L	EQUIPMENT GROUND
M	AC -
N	AC +
P	Not USED
R	Not USED
S	DET #C INPUT / OUTPUT
T	LOGIC GROUND
U	Not USED
V	Not USED
W	DET #B INPUT / OUTPUT
X	LOGIC GROUND
Y	DET #D INPUT / OUTPUT
Z	LOGIC GROUND

9.120e: Video Camera

The unit shall be a high resolution, 1/3 image format CCD camera, designed for professional video surveillance systems. Incorporating the latest in CCD technology, the video camera shall provide detailed video without lag, image retention, or geometric distortion.

- Temperature range -20 to + 55 degrees C
- Humidity 0% to 95% relative, non-condensing
- Dimensions 152mm X 64mm X 54mm
- Weight 0.7kg
- Camera mounting slots 1/4-20, top and bottom
- Connectors BNC for video out
- Lens mount CS
- Power-in / pressure screw
- Lens / 6-pin miniature "DIN" style
- Finish Off-white semi-gloss polyurethane

- Construction All metal housing
- Rated input voltage 24 VAC, 60 Hertz
- Voltage range 21 to 30 VAC
- Nominal power 6 Watts
- Imager Interline transfer CCD 1/3" format
- Imager spectral response 100% @ 550nm:
30% @ 400nm and 800nm
- Sync system EIA RS-170
- Active picture elements 768 H X 494 V
- Horizontal resolution 580 TVL
- 17. Sensitive (2856 K) Usable Full
(Scene illumination with Picture Video
F1.2 lens @ 75% highlight fc 0.012 0.08
Reflectance) lx 0.12 0.8
- Signal to noise ratio 54 dB minimum
58 dB typical
- AGC 30 dB
- Light range (AGC on) 1,000,000:1 min. with f/1.4 to
360 auto-iris lens
- Video out 1.0 volts peak-to-peak +/- 0.1
volt @ 75 Ohms
- Gray scale At least 10 steps

9.120f: Video Camera Housing

The environmental housing shall be an aluminum enclosure designed for outdoor CCD camera installations.

- Temperature range -40 to +50 degrees C
- Dimensions 449mm x 96mm x 111mm
- Weight 1350 g
- Housing mounting Three 1/4-20 tapped holes
- Camera mounting Removable cradle assembly
- Cable entry Three liquid-tight fittings that will accept cable
diameters of:
One fitting - 2 to 7 mm
Two fittings - 3 to 10 mm
- Finish Off-white semi-gloss polyurethane
- Construction Extruded aluminum housing,

- Window Aluminum rear-end cap,
Aluminum front cap with glass faceplate, and
aluminum cradle
A sunshield shall be included
3 mm thick glass that includes a
Thermostatically controlled window
Heater/defogger strip
- Rated input voltage 115 VAC 60 Hertz
- Voltage range 108 VAC to 132 VAC
- Output voltage 24 VAC 60 Hertz
- Nominal power 30 Watts
- Enclosure protection Waterproof and dust-tight in a
NEMA-4, IP65, enclosure Type 3

**Camera Lens (Option (1) One – Manual)
(Option (2) Two – Motorized Zoom)**

Manual:

The camera lens shall be a Vari-Focal 5mm – 50mm. The lens shall use (2) two aspherical lenses for high-quality optics. The unit design shall be compacted utilizing a DC-iris and manual focus and zoom control.

- Image format 1/3 inch
- Focal length 5 – 50mm
- Iris range f /1.4 – f/185
- Focus range 1m (3.3ft.) to infinity
- Back focus distance 10.05mm (0.4in.) in air
- Weight 97g (0.213lb.)
- Lens mount CS
- Angle of view
- Wide 53.4 X 40.1 degrees
- Tele 5.3 – 4.1 degrees
- Iris control 6 pin DC control
- Focus control Manual
- Zoom Manual

Motorized:

The camera lens shall be a motorized zoom-auto iris 6.3mm to 38mm.

- Image format 1/3 inch
- Focal length 6.3 – 38mm
- Iris range f/1.2 – f/360
- Focusing range Inf. To 1.8m
- Back focus length 9.25mm
- Weight 410g
- Lens mount CS
- Angle of view
- Wide 42.36 X 32.36
- Tele 7.41 X 5.49
- Iris control Auto
- Focus control Motorized
- Focus control Motorized

9.120g: Surge Suppressor

A video interface panel shall be available for installation inside the traffic signal controller cabinet. The panel shall provide coaxial cable connection points and an EDCO CX06-BNCY or approved equal transient suppresser for each image sensor.

- Peak Surge Current (8 x 20 us) 5KA
- Technology Hybrid, Solid State
- Attenuation 0.1db @ 10Mhz
- Response Time <1 nanosecond
- Protection Line to Ground
- Shield to Ground (isolated shield modules)
- Clamp Voltage 6 volts
- Connectors BNC
- Impedance 75 Ohms
- Temperature -40 to +85 degrees C
- Humidity 0-95% non-condensing
- Dimensions 4.5" x 1.5" x 1.25"
- UL Listed UL 497B

9.120h: Installation and Training

The product supplier of the video detection system shall supervise the installation and the testing of the video equipment. A factory certified representative from the manufacturer shall be on-site during installation. The factory representative shall

install, make fully operational, and test the system as indicated on the intersection drawings and this specification.

Two days training shall be provided to personnel of the contracting agency in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be produced for a maximum of 10 persons and shall be conducted at a location selected by the contracting agency. The contracting agency shall be responsible for travel, room and board expenses for its own personnel.

9.120i: Warranty

The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of one year from date of installation or eighteen months from date of shipment, whichever comes first. The video detection Supplier shall provide all documentation necessary to maintain and operate the system.

9.130: MICROWAVE VEHICLE RADAR DETECTOR

9.130a: Where specified on the plans, microwave vehicle radar detection shall be installed. Presence detection at the intersection shall be side-fire microwave radar vehicle detection. The Microwave Radar Vehicle Detector shall be an ELECTRONICS INTEGRATED SYSTEMS, REMOTE TRAFFIC MICROWAVE SENSOR or approved equivalent meeting the following requirements:

Area Coverage

Elevations Angle = 50 degrees

Azimuth = 15 degrees

Range = 60 meters (200 ft.)

Measurement Resolution

Detection Zones: Up to 12 zones

Range (zone length) = 2 meters (7 ft.)

Zone Width: 1 to 10 meters (3 to 33 ft.)

Time Events = 10 mSec

Power Requirements

115 ± 20 Volts AC 60 Hz @ 0.25 A
Surges: Per IEEE C62.41-1980 category C

Interface

Single MS multi-pin connector provides power and output signals:

- a) 12 isolated o.c. contact pairs rated for 50 mA at 30 volts
- b) A serial RS-232 data bus at 9600 baud rate

Mechanical

The unit shall be encased in a durable watertight box. It shall have a universal mounting bracket capable of securing to poles with the ability to tilt in both axes and quick locking mechanism.

Approximate Size

16cm X 24cm X 28cm (6in. X 9in. X 11in.)

Approximate Weight

4.5 Kg (10 lbs.)

Reliability

Mean time between failures designed to be 90,000 hours (10 years)

Maintainability

Shop Repairable

Set-up or replacement time: 15 minutes

Environmental Conditions

Temperature Range = -37 to +74 degrees Celsius

Humidity: up to 95%

Vibration = 2g up to 200Hz

Shock = 5g 10mSec half sine wave

9.140: PEDESTRIAN DETECTOR

9.140a: Pedestrian push buttons shall be the direct push-button contact type (micro-switch) and shall meet Federal ADA Requirements. They shall operate on a voltage not to exceed 32 volts DC. They shall be of tamper-proof design and the housing shall be black in color.

9.140b: The assembly shall be weatherproof and constructed to prevent electrical shock under any weather conditions. The housing shall be shaped to fit the curvature of the pole to which it is attached to provide a rigid installation. Saddles shall be provided to make a neat fit as required.

9.140c: At locations where countdown pedestrian heads are indicated on the plans or if otherwise noted **9.140a** and **9.140b** shall be replaced with the following:

The pedestrian detector shall be a push-button assembly made from virgin UHMW polyethylene formulated with UV properties. The assembly housing shall be formulated with an antistatic property. The switching mechanism shall consist of an Alnico type permanent magnet with a normally open reed switch. The sending and receiving assemblies shall be hermetically sealed. Ambient exposure between the sending and receiving assemblies shall be through the plunger travel space only.

The push button shall be a minimum of 2 inches in at least one direction. The magnetic plunger button will provide 80% visual contrast to the housing body. The face of the plunger button will include a cane cup depression. The force required to activate the push button shall be no greater than 3.5lbf. The push button will be operable with a closed fist.

The reed switch shall be rated for 24VDC with a rated life not less than 5 million operations. Terminals will be screw-type. Elongated mounting holes will be provided to allow installation to various cast aluminum mounts (or pedestrian push button detector will be provided with an approved cast aluminum mount).

9.150: PEDESTRIAN PUSH BUTTON SIGN

9.150a: Pedestrian push button signs shall normally be the stick-on label type, as indicated in the plan and the standard Douglas County signal details. If a separate pedestrian push button pedestal is provided, the sign shall be metal and mounted in a frame integral with the pedestrian push button, as shown in the standard details. Payment for pedestrian push button signs shall be incidental to the pedestrian push button pay item.

9.160: MAST ARM AND POLE

9.160a: Mast arms and poles shall meet the requirements of the standard details, which indicate the critical dimensions that must be met exactly or within stated tolerances. The intent is to provide mast arms and poles that match the overall appearance as illustrated and meet the performance requirements of the details and these specifications. Pole supplier submittals shall demonstrate conformity with this intent.

9.160b: Mast arms and poles shall be wrapped for shipping from the factory in heavy duty paper or plastic, to protect them from scratches and abrasions in transit.

9.160c: Mast arms and poles shall be factory painted with a rust inhibitive epoxy primer (minimum dry film thickness of 2.0 mils) and a compatible polyurethane top coat liquid coating (minimum dry film thickness of 2.0 mils). All accessible interior surfaces shall be coated with a rust inhibitive primer (minimum dry film thickness of 1.0 mils). All surfaces to be treated shall be abrasive blasted to a near white finish.

The prime coat shall be Valmont corrosion inhibiting polyamidoamine epoxy or approved equivalent, top coat shall be aliphatic acrylic polyurethane semi-gloss, black in color, (Valmont spec. F274D or approved equivalent). Prior to the installation of poles and mast arms, CONTRACTOR shall wipe them clean. Following installation of poles, CONTRACTOR shall use factory supplied paint to touch up nicks and abrasions.

9.160d: Specialty signal poles, such as modular or nostalgia designs, may only be installed with approval from the ENGINEER. The entity paying for the signal will be required to have spare components available and stored in the vicinity of Douglas County in case of pole failure, required replacement, or other emergency.

9.160e: Mast arms shall not be installed and left unloaded for an extended period of time. If, at the discretion of the ENGINEER, the mast arms are installed and loading cannot occur by installing signal heads or mast arm signing, the mast arms shall be loaded with a minimum of two sign panels on each mast arm. These sign panels shall be mounted with Astro brackets so a gap is maintained between the mast arm and the sign panel. These sign panels shall be spaced at one-third intervals on the mast arm. The sign panels shall be mounted parallel with the

roadway on the top of the mast arm. The CONTRACTOR shall then contact the ENGINEER so the mast arm and signal pole can be inspected for excessive vibration. Additional sign panels or adjustments in sign panel spacing may be required at the discretion of the ENGINEER.

9.170: SPAN WIRE POLE

9.170a: Unless otherwise specified in the plans and specifications, span wire poles are intended for temporary use only, prior to installation of permanent mast arm signals or for emergency use. In all cases, span wire signals will be allowed only with written authorization of the ENGINEER.

9.170b: Span wire poles and cable shall be designed to meet the structural requirements given in the latest edition of "Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals", published by AASHTO, for a wind velocity of 90 MPH. The minimum pole weights and span wire cable rating given in the standard details shall be increased as necessary in accordance with the AASHTO requirements.

9.170c: Span wire pole may be seamless, or may be fabricated as one piece without transverse joints or welds and with only one longitudinal seam which shall be either continuously welded and ground, or rolled flush.

9.170d: Span wire cable shall be seven wire stranded, common galvanized, and utilities grade. The cable shall have a minimum wire diameter of 3/8 inch, and shall be rated at 13,000 pounds minimum. Tether cable shall have a maximum diameter of 1/4 inch and shall be stranded, galvanized steel. Both span wire cable and tether cable shall be incidental to the span wire pole pay item.

9.180: PEDESTAL POLE

9.180a: Pedestal poles shall be designed to meet the structural requirements given in the latest edition of "Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals", published by AASHTO, for a wind velocity of 90 MPH. The pole base shall be frangible.

9.180b: The pedestal pole shall also meet the requirements as stated in section 9.160 of these specifications.

9.190: PEDESTRIAN PUSH BUTTON POLE

9.190a: Pedestrian push button pole shall be as illustrated in the standard details and installed at locations shown on the plans. When indicated on the plans, push buttons, pedestrian signs and instructional signs shall be mounted on the pedestrian push button pole.

9.200: CONTROLLER AND CABINET - (LOCAL/MASTER)

9.200a: Each controller and cabinet assembly shall be in conformance with the latest edition of the *Colorado Department of Transportation Standard Specifications for Road and Bridge Construction*, as clarified by the following.

9.200b: Each controller and cabinet assembly shall include:

1. When a 170E controller is required the following shall be provided: 170E controller with HC11 CPU board in conformance with FHWA IP-78-16 Specification, programmed with the W4IKS traffic program compatible with the State of Colorado's intersection timing program.
2. When a 2070 controller is required the following shall be provided instead of the 170E controller: 2070 LITE controller per CALTRANS standards with software compatible with signal system software.
3. A 332 natural aluminum cabinet with anti-graffiti coating shall be used. Paint shall **NOT** be applied to aluminum controller cabinets or galvanized poles, pedestals, standards, hardware, conduit, etc. unless specifically approved by County representative (Modified CDOT spec. 614.10h). Cabinet shall be furnished with a "BEST" door lock kit. Lock and core is "BEST" 5L6R left and right.
4. When a master is required, an ICM with latest version of firmware is also required.
5. FO512 Modem as indicated on the plans.

9.200c: The cabinet shall contain the CalTrans PDA#2 power distribution assembly. Other specific items shall be:

- Dual Fans
- (1) Software License
- (1) Dual input file
- (4) Model 430 transfer relays
- (2) Model 204 2-circuit flashers (25 amp cube type)
- (12) Model 200 I/O load switches (25 amp cube type)
- (3) Model 242 D.C. isolators
- (10) Model EDI Oracle 2-channel dual loop amplifiers or approved equivalent (unless all video detection)
- (1) Model 210N or 210E conflict monitor with absence of red monitoring and Molex block selection system
- (1) New York 330 pull-out drawer assembly
- (2) Internal (front/back) fluorescent lamp assemblies
- (1) Porch style base CDOT S-614-40 with anti-skid paint (fiberglass), break-away type
- (1) Set of anchor bolts
- (1) Transient voltage surge suppression system per Caltrans requirements
- (1) Model 400 Modem (to be compatible with interconnect)
- (1) Modem protector
- (1)*** Panduit FMT24 (rack mounted drawer), Fiber Adaptor Patch Panel CFAPPBL1 with FAP6WST panels with 6-port panel preloaded with 6 ST single mode adaptors and FAPB adaptor panel blank as needed. When approved by the Engineer, a wall mount Universal panel adapter, "ST" type, may be substituted.
- (1)** DB-25 to C2S interface cable (3 feet)
- (1)** Auto-dial auto/answer modem MNP Class 5
- (1)** RJ-11 telephone jack (telephone connection point)
- (1) PC-642 surge protector for interconnect
- (1) External modem connection
- (1) Electronic copy of all cabinet documentation, including the cabinet manual and cabinet prints, shall be provided on a 3 ¼" IBM compatible Floppy Disk in DXF format
- ** *These items not needed on satellite controllers connected to a master controller.*
- *** *Installed with fiber optic interconnect*

9.200d: 332/332D Cabinet Equipment Layout – Top to Bottom

1. 170/2070L Controller

2. Fiber fan out box 2"
3. UPS – 5.5" standard EIA 19" rack
4. CalTrans/CDOT pullout drawer
5. "T" File
6. "J" File
7. PDA Assembly
8. Output file

9.200e: Notes:

1. All products provided, excluding Model 204, Model 200, Model 222, and Model 210N and 210E, shall be on the State of California's latest qualified products listing (QPL).
2. The cabinet drawings shall be non-fading prints using the xerography method. No blue line drawings will be acceptable.
3. The County shall be supplied a computer printout of the complete environmental testing results.
4. The cabinet shall have (8) red flash jumper blocks with 4 (four) additional jumpers to accommodate yellow flash.
5. The cabinet field terminals shall be silk screened with the appropriate phase/color designations.
6. The controller shall have printout capabilities.
7. Field wire attachment point in the cabinet shall be a 12 position terminal block with screw down plugs.
8. After award, the supplier will provide on-site instruction and installation programming of the 170E/Local and Master assembly, including the implementation of coordination.

9.200f: Modems shall be fully wired and interconnected to the phone company network, unless otherwise directed by the ENGINEER. Operation satisfactory to

the ENGINEER shall be demonstrated during the normal twenty (20) day testing period. (See paragraph 8.10c).

9.200g: The controller and cabinet shall be delivered to the Douglas County Traffic Signal Shop for testing, programming, and operational checking. No testing shall commence until cabinet is completely assembled by the CONTRACTOR (UPS, communication equipment, etc). Douglas County Traffic Signal Section will have the complete cabinet available for pickup no more than 10 working days after final assembly. CONTRACTOR is responsible for delivery and pick-up. Any malfunctions or problems with the testing and programming will be reported to the CONTRACTOR for immediate repair. Any malfunctions or problems will not count against the 10 working days.

9.210 UNINTERRUPTED POWER SOURCE

9.210a: Unless otherwise indicated, an interrupted power source (UPS) shall be installed in the controller cabinet. The uninterrupted power source shall be Reliable's Signal Power (RPS) by Reliable Power Systems, Inc. or the Powerback Standard Series UPS by Myers Power Products.

9.210b: Documentation and Warranty

The manufacturer shall furnish the owner an instruction manual covering the installation, operation and maintenance of the UPS and batteries.

The UPS shall be covered by a parts and labor warranty per the manufacturer's Standard Terms and Conditions. The warranty period shall be for 2 years from date of shipment.

9.215: WEATHER MONITORING SYSTEM (WMS)

9.215a: Where indicated on the plans, a Weather Monitoring System (WMS) shall be installed. The WMS shall be a SURFACE SYSTEMS, INC. SYSTEM or approved equivalent.

9.220: MISCELLANEOUS HARDWARE

9.220a: All ferrous mounting hardware and weatherheads shall be galvanized, cadmium plated, or made of stainless steel to resist corrosion. Payment for

miscellaneous hardware, including pole plates for side-of-pole mounting, shall be incidental to the pay item to which the miscellaneous hardware items are attached.

9.230: INSTRUCTIONS AND WIRING DIAGRAMS

9.230a: All equipment shall be provided with a minimum of two sets of complete installation and operating instructions, including a chart of field connections, as well as a service manual for the controller containing service instructions, wiring diagrams, and trouble-shooting procedures. Each and every component used shall be clearly referenced in the service manual, and its value, ratings and manufacturer part number shall be given.

9.240: SCHOOL FLASHING BEACON ASSEMBLY

9.240a: A school flashing beacon assembly shall be as shown in the standard details. Payment for this item shall be inclusive of all work to provide an operational flashing assembly, including materials, installation, and electrical service connection (if not a solar installation). Fluorescent yellow-green signs shall be installed as an integral part of the flashing assembly.

9.250: WARNING OR REGULATORY SIGN FLASHING BEACON ASSEMBLY

9.250a: A warning or regulatory sign flashing beacon assembly shall be as shown in the standard details. Payment for this item shall be inclusive of all work to provide an operational flashing assembly, including materials, installation, and electrical service connection. Signs shall be installed as an integral part of the flashing assembly.

10.00: PAINT EQUIPMENT

10.10: PAINT EXISTING STRUCTURES

10.10a: Previously installed signal poles shall be field painted when indicated on the plans. When so indicated, all exterior surfaces shall be cleaned and examined for damaged paint, and any such damage shall be given a spot coat of primer and the entire exterior surface re-painted. Previously painted surfaces, whether finish

or prime coated, shall be scuff sanded with particular attention paid to the lower eight feet (8') of the pole.

10.10b: Inspection of the poles by the ENGINEER prior to application of the finish coats is required. Two finish coats of paint selected by the ENGINEER shall be applied over the primer or previously painted surfaces.

10.10c: The painting shall be done in a neat and workmanlike manner and may be applied either by hand brushing or spraying. The ENGINEER reserves the right to require the use of brushes for the application of paint should the work done by the paint spraying machine prove unsatisfactory or objectionable.

10.10d: Touch up painting shall be completed at the direction of the ENGINEER. Nicks and abrasions shall be cleaned and the ENGINEER shall designate the appropriate primer coat, and finish coat if applicable.

10.10e: When indicated on the plans, traffic and pedestrian signal heads shall be painted black.

11:00: PAVEMENT MARKING

See the latest edition of the Douglas County Signage and Striping Supplement for additional criteria and requirements.

11.10: MATERIALS

11.10a If pavement overlay or reconstruction is programmed within three years of marking installation, the ENGINEER may approve use of alternate marking materials.

11.20: SURFACE PREPARATION

11.20a: New concrete pavement shall have all residues removed, such as mud, dirt, curing compound, etc. Removal shall be by water blasting, sand blasting or other method approved by the ENGINEER.

11.20b: New asphalt pavements shall be dry and free of dirt.

11.20c: For all restriping on existing concrete or asphalt pavement, the surface shall be clean and dry. Cleaning shall be by water sweeping, air blasting, or other method approved by the ENGINEER. When directed by the ENGINEER, the surface shall be ground.

11.20d: Surface temperature shall be 50° F and rising for all pavement marking applications except preformed plastic. Surface temperature shall be 60° F and rising for preformed plastic markings.

11.20e: When the surface temperature does not reach 50 degrees (seasonal), the CONTRACTOR may, on approval of ENGINEER, substitute designated pavement markings with temporary marking materials to be replaced with permanent materials when weather dictates. Temporary pavement markings shall be refurbished by the developer or CONTRACTOR, at their own cost, as determined by the ENGINEER.

11.30: INSTALLATION

11.30a: All pavement markings shall be applied per the manufacturer's recommendations, unless otherwise authorized by the ENGINEER.

11.40: PAY ITEM

11.40a: Pavement markings shall be measured and paid for on a lineal foot basis, Arrows and Legends shall be paid for on a per unit basis unless otherwise authorized by the ENGINEER.

12.00: GUARANTEES AND WARRANTIES

12.10: GENERAL

12.10a: All work completed by the CONTRACTOR shall be guaranteed against defects in workmanship or materials for a period of one (1) year from the date of Acceptance, excepting ordinary wear and tear, abuse or neglect. Labor and Performance bonds shall remain in effect for the one-year period.

12.20: MATERIALS AND PARTS

12.20a: The CONTRACTOR shall supply the County with all manufacturer warranties and/or guarantees covering materials and parts.

13.00: GENERAL SIGNAL DESIGN REQUIREMENTS

13.10: SCOPE

13.10a: This section describes general signal design requirements for use in Douglas County. Variances from these requirements require written approval of the ENGINEER. Refer to Section 1.70 for additional design requirements.

13.20: SIGNAL HEAD PLACEMENT AND SIZES

13.20a: For all installations, one signal head shall be provided centered over each exclusive left turn and through lane. If mast arms do not reach the left turn lane(s), the number and configuration of signal heads should be adjusted in consultation with the ENGINEER. Far left and far right pole-mounted signal heads shall also be provided. The traffic signal design engineer (Engineer of Record) is responsible for coordinating the mast arm loads with the manufacturer to assure the arms are not overloaded.

13.20b: The need for one signal head per right turn lane should be determined on a site specific basis. Pedestrian signal heads shall be provided for all marked crosswalks. Where pedestrian signal heads are provided, corresponding pedestrian push buttons shall be provided if normal vehicle phasing and timing do not guarantee sufficient pedestrian crossing time.

13.20c: Where left turn arrows are included, at least two signal heads with left arrow sections shall be provided, with one of these located on the far left pole.

13.20d: All mast arm and span wire mounted signal heads shall have aluminum louvered backplates, black in color.

13.20e: All vehicle signal sections shall be 12-inch LED. Pedestrian indications shall be LED. (See 9.20)

13.20f: Where mast arms extend over the left turn lane(s), left turn only sign(s) (R3-5) shall be provided. Double lefts may be covered with one left turn only

sign (R3-5) per lane, or one double left turn only sign located over the lane line between the double lefts.

13.30: POLE AND CABINET PLACEMENT

13.30a: All signal poles, pedestals and cabinets shall be placed a minimum of 3 feet from face of traffic signal item to face of curb where curbing is present, with a desired separation of 5 feet. The traffic control cabinet and base shall be placed on level ground with adequate room to access and maneuver around the cabinet. The cabinet location shall be such that it guarantees adequate visibility of intersection and approaching traffic from all directions. The same separations apply from face of traffic signal item to outside edge of shoulder where pavement and shoulder exist with no curbing. Where only pavement exists without shoulder and curbing, a minimum of 5 feet from face of traffic signal item to edge of pavement shall be maintained, with a desired separation of 7 feet.

See section 14.30 for further details.

13.40: STREET NAME SIGNS

13.40a: Rigidly affixed street name signs shall be provided for all approaches. They shall be on U.100 Aluminum Sign and shall consist of Diamond Grade LDP reflective material or equivalent. The E.C. (ElectroCut) film shall be 3M 1177 Green. The font type is FHWA Hwy. Series C unless otherwise specified. The street name shall be 10" upper caps and the designator shall be 5" upper caps.

13.40b: Internally illuminated street name signs may be provided at the discretion of the traffic signal designer, Douglas County, or other agency. Internally illuminated street name signs will then be maintained by the agency paying for the installation of the traffic signal and shall bear the appropriate agency's logo to determine maintenance responsibilities. Such signs shall be in conformance with standard specifications Section 9.50 and the standard details. Sign panel layouts shall be submitted to Douglas County Traffic Services for approval prior to manufacture.

13.50: SIGNAL CONDUIT

See section 6.0 for requirements.

13.60: INTERCONNECT

13.60a: Requirements for traffic signal interconnect shall be determined on a site specific basis. The traffic signal designer shall coordinate with Douglas County to determine the need for interconnect.

13.70: LUMINAIRES

13.70a: Unless otherwise indicated, the CONTRACTOR shall provide a luminaire extension and luminaire wiring. The final power hook-up and the actual luminaire shall be provided by the utility company.

13.80: VEHICLE DETECTORS

13.80a: Stopline detection for designated phases shall be provided. The locations and type of detection shall be indicated in the plans.

13.80b: Counting detectors shall be provided for each approach lane of traffic unless specifically excluded in the plans per the direction of the ENGINEER. These detectors shall be located 20 feet (+) upstream of stopbar detectors, or 10 feet (+) upstream of the closest water type pull box where no stopbar detector exists. See Douglas County Standard Signal Details.

13.80c: On all approaches with free-flow speeds of 40 to 45 MPH and greater, consideration should be given to providing advance detection for dilemma zone protection. Site-specific conditions such as grades or sight distance obstructions may also justify use of advance detection. The potential need for advance detection in these cases should be reviewed with the ENGINEER.

13.80d: Advance Detection Loop placement shall be per the following table:

Posted Speed	Loop Placement (measured from back edge of crosswalk or stop bar)
25 mph	100 ft.
30 mph	150 ft.
35 mph	205 ft.
40 mph	235 ft.
45 mph	270 ft.
50 mph	300 ft.

13.80e: When video detection is required, a note shall be included on the signal plans that requires the CONTRACTOR to contact the ENGINEER to determine placement and orientation of video detection and that the video detection supplier's representative must be present for camera setup and initial operation.

13.90: SIGNAL POWER

13.90a: The traffic signal design engineer (Engineer of Record) shall coordinate power source location and requirements as part of the signal design. Coordination shall include determination of, and initial contact with, the appropriate power company, indication of the power source location on the signal plans and the Power Company's contact name and number.

When IREA is the governing Power Company, the Engineer of Record shall identify the electrical meter requirements and IREA inspection requirements on the signal plans.

13.90b: In general, circuit breakers and power disconnects should be located internal to service meter assemblies and signal controller cabinets, and should not be readily accessible to the public.

13.90c: Typically, the County electrical inspector will be responsible for inspecting service installations and certifying acceptability to the utility company for hook-up. Douglas County Traffic personnel shall be responsible for all inspections from the point of connection of power inside the cabinet out thru the intersection.

14:00: CONSTRUCTION REQUIREMENTS

14.10: SCOPE

14.10a: This section describes general signal construction requirements for use in Douglas County. Variances from these requirements require written approval of the ENGINEER.

14.20: INSPECTIONS

14.20a: For all County field inspections, the CONTRACTOR shall give at least 48-hour prior notice to the Traffic Engineering Division 303-660-7490,

Engineering Inspectors - 303-660-7487 and the Douglas County Building Division for electrical inspections at 303-660-7497. Inspections will normally be completed by County staff or the Contract Administrator.

14.20b: The CONTRACTOR shall contact the ENGINEER at least one day prior to placing the pole foundations.

14.20c: The CONTRACTOR shall notify the ENGINEER at least one day prior to standing the traffic signal poles.

14.30: FIELD LOCATION

14.30a: Prior to initiating the traffic signal design, the Engineer of Record (or authorized representative) shall schedule and attend a field meeting with the ENGINEER, and/or the authorized county personnel, and the utility location company to field locate the signal pole foundation locations and determine the appropriate mast arm lengths.

On a site-specific basis the Engineer of Record will be required to produce a stamped and signed pole location plan in order to expedite the foundation locations and installation. The Engineer of Record shall supply a plan illustrating the pole foundation locations that have been located versus complete utility locates and verified by Douglas County. The developer or agency responsible for the traffic signal installation shall pay for and install the pole foundations immediately upon completion of the pole foundation locations.

14.30b: All detector loops (stop-line and count), poles, control cabinets, and pull boxes shall be field located by the ENGINEER. The CONTRACTOR shall contact the ENGINEER two days prior to field location.

14.40: INTERCONNECT CABLE INSTALLATION

14.40a: Interconnect Cable Installation. The CONTRACTOR shall provide the ENGINEER with two copies of the cable manufacturers installation instructions for fiber optic cable in conduit. All installation shall be in accordance with these practices except as directed by the ENGINEER. Additional cable costs due to damage caused by the CONTRACTOR'S neglect of recommended procedures shall be the responsibility of the CONTRACTOR.

Fiber optic cable shall be installed in continuous runs except where cable type changes or where maximum pull lengths govern. The manufacturers recommended limits for cable lengths shall not be exceeded. Cable ends shall be stored in controller cabinets or pull boxes immediately adjacent to cabinets or as directed by the ENGINEER. Only active (lit) fibers need to be spliced in cabinets. All other (dark) fibers shall be sealed in a manner recommended by the manufacturer.

Under no conditions shall the single-mode fibers be cut or spliced at intermediate points without express written direction from the ENGINEER.

Prior to installation of interconnect cable, the CONTRACTOR shall submit an interconnect schematic diagram to the ENGINEER for approval. The diagram shall clearly indicate cable routing, splice points and fiber connections including identifying the color coded fibers and buffer tubes. Installation of the cable will not be permitted until the schematic diagram has been approved by the ENGINEER.

The same color coded pairs of fibers shall be used throughout the entire project. At the terminal point the jackets shall be stripped and the ends taped. Gel filling compound shall be removed using filled cable cleaner.

For fiber optic cables, each fiber shall be checked with an OTDR and full traces documenting fiber performance shall be provided to the ENGINEER within 30 days. All optical fibers shall be within the manufacturer's recommended tolerances. In addition, any other acceptance testing recommended by the manufacturer shall be provided. Data is to be supplied to the ENGINEER prior to completion of the project.

The CONTRACTOR shall leave two (2) coils of extra fiber in each pull box and a minimum of 30 feet of extra fiber within the controller cabinet.

14.50: SIGNAL TURN-ON

14.50a: Signal heads installed on standards or poles at new signal locations which are not ready for actual electrical operation shall be bagged with orange plastic.

14.50b: Traffic signal construction and all associated work, including operational luminaries, shall be 100 percent complete prior to flashing operation.

14.50c: Immediately prior to signal turn-on, signals shall be flashed from two to five days, with the exact duration of flashing determined by the ENGINEER.

14.50d: The CONTRACTOR'S Project Manager, IMSA Level II Traffic Signal Bench Technician/Signal Technician (BB Certification), opticom emitter, Foreman (BE Certification) and a bucket truck are required at all signal turn-ons.

14.50e: The CONTRACTOR must contact the ENGINEER and/or the County's authorized personnel two days PRIOR to signal flash. At the scheduled signal flash, the date and time for full operation will be determined. **Failure to contact these parties will result in the forfeiture of retainage or liquidated damages equal to retainage.**

14.60: CONDITION OF EQUIPMENT

14.60a: The CONTRACTOR shall verify that the traffic signal cabinet is in good condition upon delivery. Any surface areas damaged during the handling and installation shall be repaired immediately per the manufacturer's specifications.

14.60b: Prior to the installation of the mast arms and poles, the CONTRACTOR shall wipe them clean. Following installation of the poles, the CONTRACTOR, shall use factory supplied paint to touch up nicks and abrasions, per Section 10.10.

14.70: CABINET BASE INSTALLATION

14.70a: At the cabinet base location, CONTRACTOR shall install gravel in the excavation for the conduit, set the cabinet base, and fill the riser portion of the base with gravel.

15:00: BASIS OF PAYMENT

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Douglas County Traffic Signal Specifications
Updated July 2003

Pay Item	Unit
Removal of Traffic Signal Equipment	LS
Reset Traffic Signal Equipment	LS
PVC Conduit 2" Trenched	LF
PVC Conduit 3" Trenched	LF
PVC Conduit 2" Bored	LF
PVC Conduit 3" Bored	LF
Common Trench	LF
Common Boring	LF
PVC Conduit 2" (within common boring, trench, and/or sleeve)	LF
PVC Conduit 3" (within common boring, trench, and/or sleeve)	LF
Traffic Signal Light Pole, xx' mast arm w/o luminaire (Install Only)	EA
Traffic Signal Pole, xx' mast arm (Install Only)	EA
Traffic Signal Pedestal Pole (Install Only)	EA
Street Name Signs (Aluminum) (Illuminated)	EA
Sign Panel (Class I)	EA
Sign Panel (Class II)	EA
Traffic Signal Head, 3-section, 12" lenses	EA
Traffic Signal Head, 3-section, 12" lenses "Arrow"	EA
Traffic Signal Head, 5-section, 12" lenses "Vertical"	EA
Traffic Signal Head, 5-section, 12" lenses "Dog House"	EA
Pedestrian Head (16-inch) (Countdown)	EA
Pedestrian Push Buttons	EA
Loop Detector (6x40) (6x6) (3x3)	EA
3M Micro Loop Model 701	EA
Intersection Detection System (Camera)	EA
Microwave Radar Vehicle Detector	EA
Traffic Signal Controller Cabinet (332) (with Dual Input File)	EA
Traffic Signal Controller (I70E) (2070)	EA
Traffic Signal Master Controller	EA
Uninterrupted Power Source	EA
Telephone Interconnect Wire	LF
Fiber Optic Cable	LF
Fiber Termination	EA
Series 400 Modem	EA
Fiber Optic Modem (FO 512)	EA
ICM	EA
Test Fiber Optic Cable	LS
Pull Box (Type I)	EA
Pull Box (Type II)	EA
Pull Box (Type III)	EA
Pull Box (Special)	EA
Opticom 3M 562 Card	EA
Opticom 3M (721) (711) Head	EA

Pay Item	Unit
Weather Monitoring System	LS
Radio Communications System	LS
Telephone Drop	EA
Furnish and Install Electrical Service Connection	LS
Traffic Control, Mobilization, and Start-up	LS
Douglas County Permit	LS
Concrete Sidewalk	SY
Remove Striping	LF
10'x1' Crosswalks	LF
Arrows	EA
Only's	EA
Striping (Double Yellow)	LF
Striping (White)	LF

15.10: PAY ITEM NOTES AND CLARIFICATIONS

15.10a: Removal of Traffic Signal Equipment shall include all poles, mast arms, signals heads, span wires, footings, all attachment items and other incidental items. Removal of signal poles or pedestal poles shall include the pole, span wire, cable, signal heads, overhead sign support wire, foundations and pedestrian push buttons. Removal of the traffic signal controller and cabinet shall include the removal of the base and all auxiliary equipment contained within the cabinet.

All LED signal lenses in existing signal faces shall be removed prior to the removal of the signal faces. These LED lenses shall be protected from damage and delivered to Douglas County

All salvageable traffic signal equipment, including but not limited to interconnect wire, fiber optic cable, and LED lenses, shall be delivered to Douglas County. Contact Traffic Signal Supervisor at 303-660-7490 two days prior to delivery for location and time verification.

Backfilling for removal of traffic signal equipment, delivery of traffic signal equipment, and removal of LED lenses from existing signal faces will not be measured and paid for separately but shall be included in the work.

15.10b: When indicated on the plans, traffic signal equipment shall be reset. Reset Traffic Signal Equipment shall include the traffic signal poles, arms, controllers, cabinets, signal and pedestrian heads, opticoms, coordination and

interconnect equipment and all other related equipment and materials necessary to remove the items from their existing location and reset them at the new location. This shall include all mounting hardware, caissons, bases, other electrical equipment and service, including temporary power, and all other materials and work necessary to complete the reset item in service at the new location.

Equipment and materials shall be cleaned and touched-up prior to reset. This work shall be included in the cost of Reset Traffic Signal Equipment.

15.10c: Common-trench is the trench itself not including conduit

15.10d: Common boring is the boring itself not including conduit.

15.10e: Conduit shall include signal cable, elbows, pull wire, weatherheads, adaptors, condulets, saw cutting, excavation, backfill, jacking and drilling pits, removal of pavement, sidewalks, gutters, curbs and their replacement in kind to match existing grade and all work necessary to complete the item.

15.10f: The cost of the traffic signal light pole/mast arm, traffic signal pole/mast arm and the traffic signal pedestal pole shall include the cost of the concrete foundations and all items associated with the installation and construction of the foundations, unless the foundations are existing. See the standard details for concrete foundation size requirements.

15.10g: Micro loop detectors shall be paid for on a unit price basis including micro loop, lead-in wire, saw cutting, and sealant for a complete installation to the termination point behind the curb. Quadrapole loop detectors shall be measured and paid for on an "each" basis and shall include loopwire, saw cutting, sealant, the lead-in wire up to the termination point behind the curb, excavation, backfill, and all other work necessary to complete the item.

15.10h: Fiber optic cable installation shall include all labor and materials required to install the cable including the following items:

- All required splice kits, splicing tools, ancillary hardware and labor to accomplish the splices.
- All required Patch Cords.
- All required fan-out kit tools, ancillary hardware and labor to accomplish the fan-out.

Fiber optic termination shall include all labor and materials required to terminate the interconnect cable and make a complete and operational system including, but not limited to, the following:

- All required termination enclosures (including specified features), connectors, adaptors, jumpers, pigtails, ancillary hardware, and labor required to accomplish the termination.
- All other work necessary to complete the item.

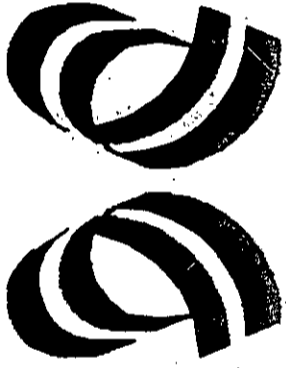
15.10i: Microwave Radar Vehicle Detector shall be measured and paid for based on the detector unit and enclosure mounting assembly, conduit, excavation, backfill, and all other work necessary to complete the item.

15.10j: Test Fiber Optic Cable – LS includes the complete end-to-end OTDR test on one fiber, including document submission and the complete end-to-end optical power meter test on one fiber, including document submission.

15.10k: Furnish and Install Electrical Service Connection – LS. When IREA is the power company, this pay item shall include IREA meter service and required inspections. This information shall be clarified on the plans.

15.10l: Striping Material (Crosswalks, Arrows, Onlys, Lines) – Striping materials shall be as determined by Douglas County and indicated on the plans.

15.10m: The latest version of firmware shall be included in the cost of the ICM and will not be measured and paid for separately.



DOUGLAS COUNTY STANDARD SIGNAL DETAILS

UPDATED JULY 2003

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3-4	MAST ARM ATTACHMENT AND POLE BASE
5-6	MAST ARM LENGTHS
7	PEDESTRIAN POLE
8	MAST ARM POLE FOOTINGS (15' THROUGH 60')
9	65' AND 70' MAST ARM POLE FOOTING
10	SPAN WIRE POLE
11	PEDESTRIAN PUSH BUTTON POLE PEDESTAL POLE
12	CONTROLLER CABINET INSTALLATION
13	SIGNAL HEADS & MOUNTING GENERAL WIRING NOTES
14	PERMANENT (PRECAST) PULL BOX TEMPORARY (PLASTIC) PULL BOX
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17	UNDERGROUND POWER SCHEMATIC-- SIGNALS / GROUND TRENCHING
18	UNDERGROUND POWER FEED OVERHEAD POWER FEED
19	SCHOOL FLASHING BEACONS SIDE OF ROAD
20	SCHOOL FLASHING BEACON - OVERHEAD
21	WARNING / REGULATORY FLASHING BEACON TYPICAL CROSSWALK MARKING
22	ILLUMINATED STREET NAME SIGN
23	BLANK-OUT REGULATORY / WARNING SIGN
24	SIGNAL PHASING



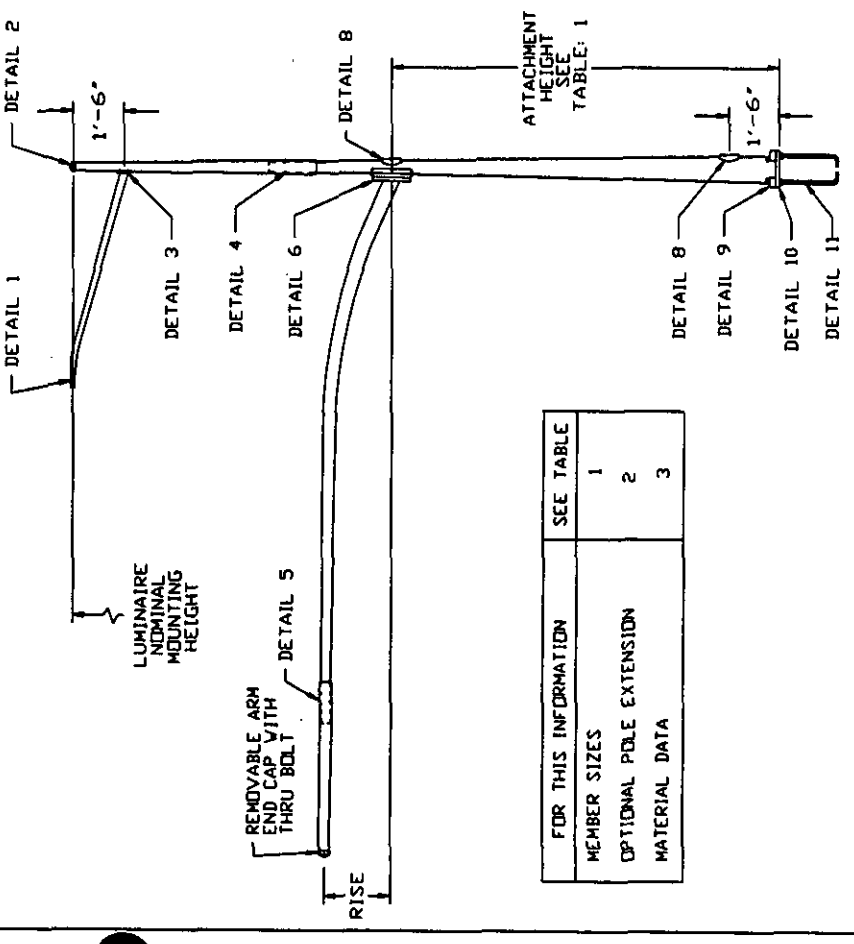
DOUGLAS COUNTY
PUBLIC WORKS
ENGINEERING DIVISION
100 THIRD STREET
CASTLE ROCK, COLORADO 80104
303-660-7490

DOUGLAS COUNTY STANDARD SIGNAL DETAILS

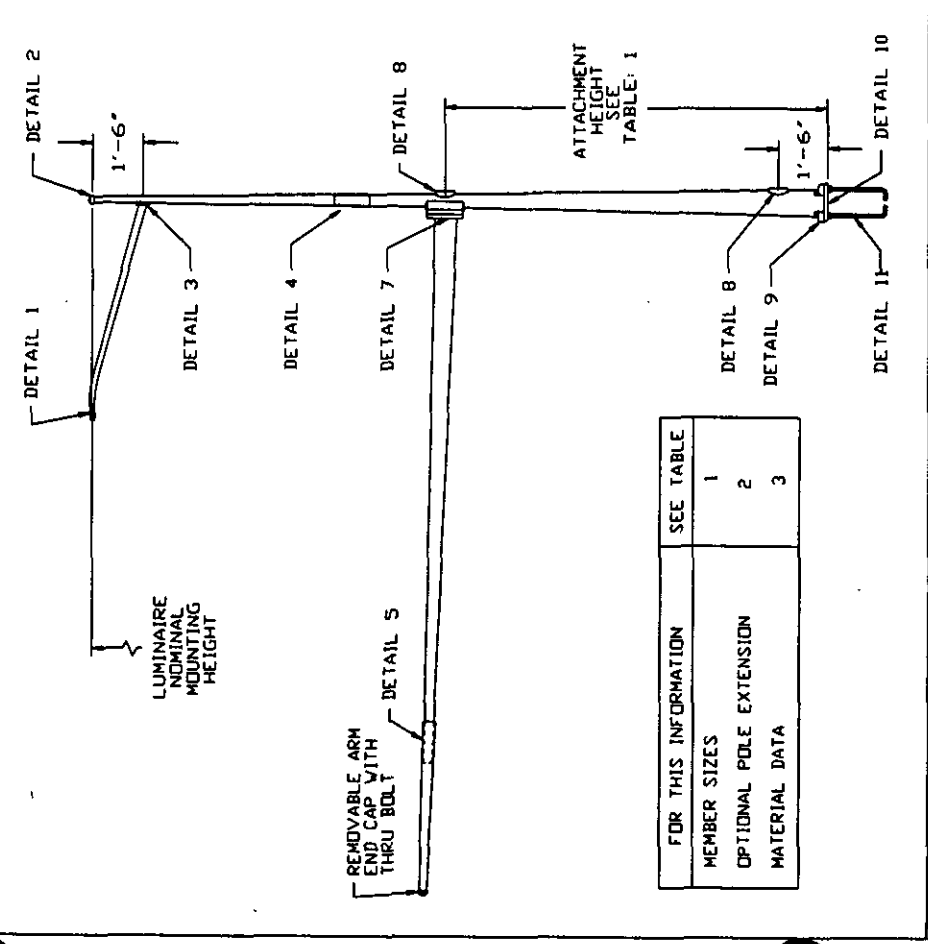
TITLE SHEET

DESIGNED BY: JHB/ML	DATE: 07/18/03
DRAWN BY: JHB/ML	SCALE: AS SHOWN
CHECKED BY: JHB/ML	DATE: 07/18/03
REVISION: 1	SHEET NO. 24

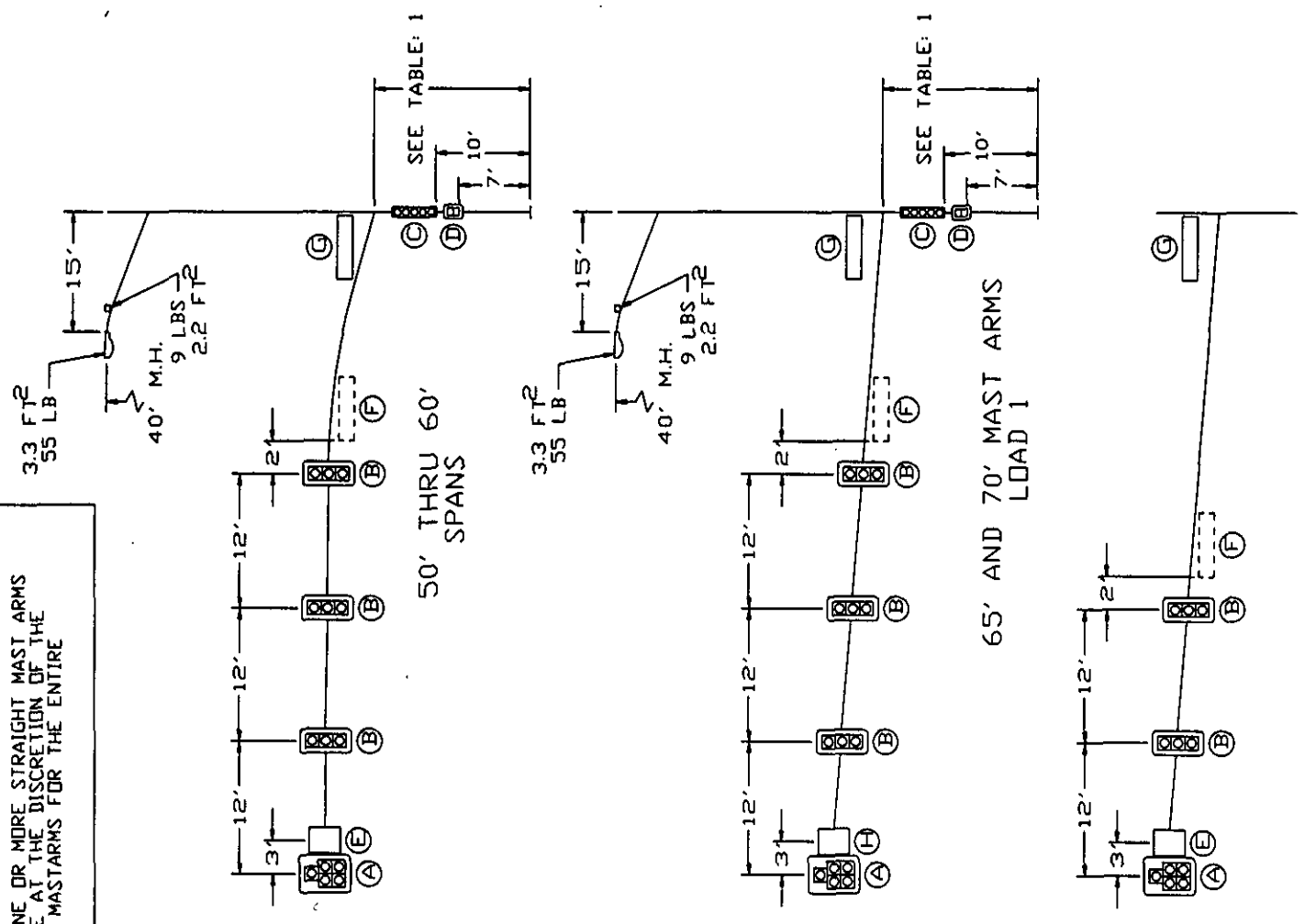
ON INTERSECTIONS WHERE ONE OR MORE STRAIGHT MAST ARMS ARE REQUIRED, IT SHALL BE AT THE DISCRETION OF THE ENGINEER TO USE STRAIGHT MAST ARMS FOR THE ENTIRE INTERSECTION.



DOUG 1, 2 & 3
DOUGLAS COUNTY POLE SERIES



DOUG 4 & 5



65' AND 70' MAST ARMS
LOAD 2

DESIGN CRITERIA:
 1994 ASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS.
WIND VELOCITY:
 90MPH ISOTACH.
IMPORTANT NOTE:
 20' THRU 70' STRUCTURES DESIGNED FOR EITHER (A) OR (B) BUT NOT FOR BOTH.

*(F) TYPICAL SIGN APPLICATION *(G) OCCASIONAL SIGN APPLICATIONS

DEVICE	DESCRIPTION	PROJ AREA (FT²)	WEIGHT (LBS)
(A)	12'-5 SEC. SIGNAL WITH BACKPLATE	13.72	71.00
(B)	12'-3 SEC. SIGNAL WITH BACKPLATE	8.67	38.00
(C)	12'-5 SEC. SIGNAL WITHOUT BACKPLATE	6.81	48.00
(D)	DUAL-2 SEC-PEDESTRIAN	8.00	60.00
(E)	30' X 36' REGULATORY SIGN	7.50	25.00
(F)	18' X 72' STREET NAME SIGN	9.00	27.00
(G)	21' X 96' LIMITED-SWINGING I.I.S.	EFFECTIVE 9.92	95.00
(H)	30' X 30' REGULATORY SIGN	6.25	22.50

SEE SHEET 2 & 3 OF 5 FOR TRAFFIC SIGNAL STRUCTURE DETAILS

REV.	DATE	REVISION
A	2-21-94	REVISED AS REQUESTED-GGL
B	1-31-96	REVISED AS REQUESTED-BDS
C	5-10-00	REVISED AS REQUESTED-GSM
D	2-01-01	REVISED AS REQUESTED-GSM

VALMONT.
 VALMONT INDUSTRIES, INC.
 VALLEY, NEBRASKA 68064
 (402) 359-2501

DATE: 10-25-93	DRWN: GGL	CHK:	SHEET 1 OF 5
TITLE: DOUGLAS COUNTY, COLORADO TRAFFIC SIGNAL STRUCTURES			DRAWING NO: DB00349

LOADING INFORMATION

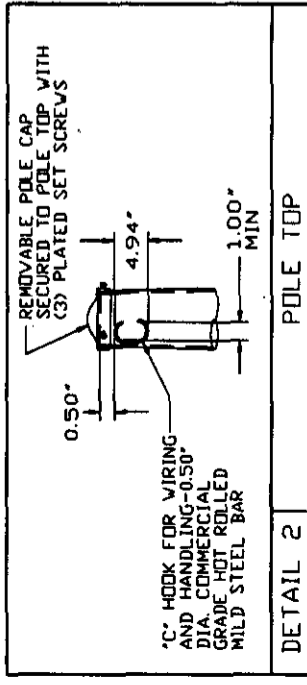
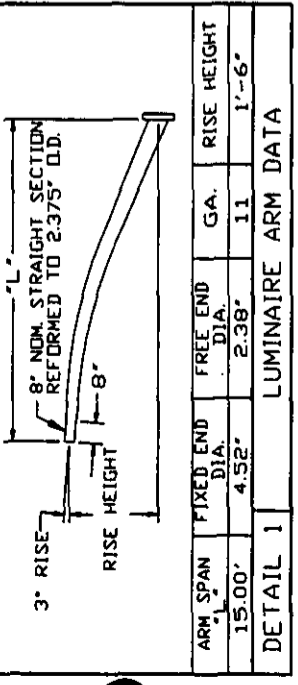


TABLE 3: MATERIAL DATA

COMPONENT	ASTM DESIGNATION	MIN YIELD (KSI)	MIN TENSILE (KSI)	ASTM DESIGNATION	MIN YIELD (KSI)	MIN TENSILE (KSI)
POLE SHAFT (3 GA)	A595 GRA	55	55	LUMINAIRE TUBE	A595 GRA	55
POLE SHAFT (2.58x.31 THK)	A572 GR.65	65	65	LUMINAIRE ATTACHMENT	A36	36
BASE PLATE	A36	36	36	LUMINAIRE CONNECT BOLTS	SAE GR.5	--
SIGNAL ARM TUBE 3 & 7 GA	A595 GRA	55	55	LUMINAIRE CONNECT BOLT	SAE GR.5	--
SIGNAL ARM TUBE ALL OTHERS	A572 GR.65	65	65	SIGNAL ARM ATTACHMENT	A36	36
SIGNAL ARM ATTACHMENT	A36	36	36	SIGNAL ARM CONNECT BOLT	A325	--
SIGNAL ARM CONNECT BOLT	A325	--	--	ANCHOR BOLTS	F1554	55

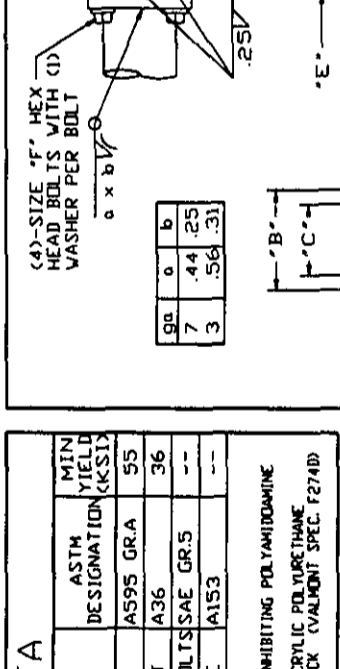
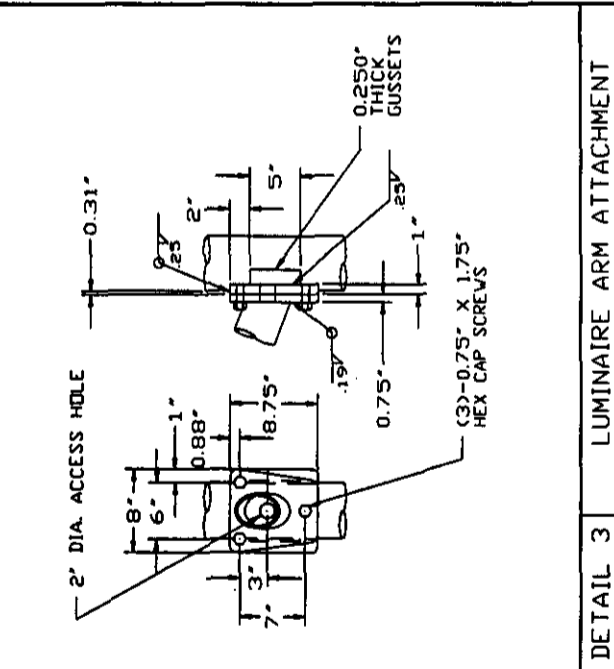
STRUCTURE FINISH: PRIME COAT - ALIPHATIC ACRYLIC POLYURETHANE; EPXY; TOP COAT - SEMI-GLOSS BLACK (VALMONT SPEC. F274D)

TABLE 2: OPTIONAL POLE EXTENSION

LUMINAIRE NOMINAL MT-HT	LUMINAIRE ARM SPAN	POLE TYPE	BASE DIA. (IN)	TOP DIA. (IN)	LENGTH (FT)	GAUGE
40'-0"	15'-0"	1	9.72	7.26	17.60	7
40'-0"	15'-0"	2	11.27	8.81	17.60	7
40'-0"	15'-0"	3	12.27	9.81	17.60	7
40'-0"	15'-0"	4	12.27	9.81	17.60	7
40'-0"	15'-0"	5	13.00	10.51	17.82	7

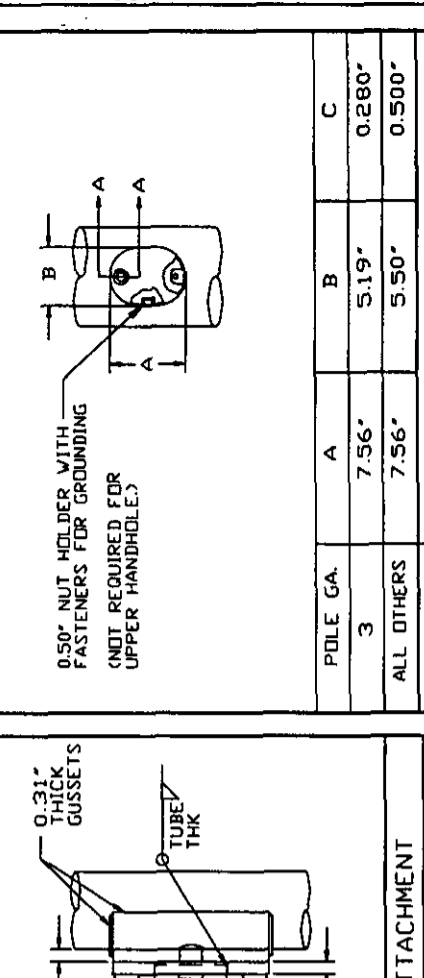
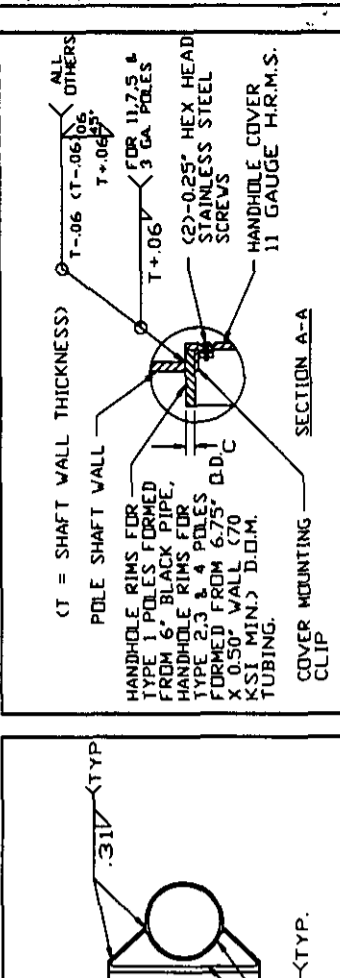
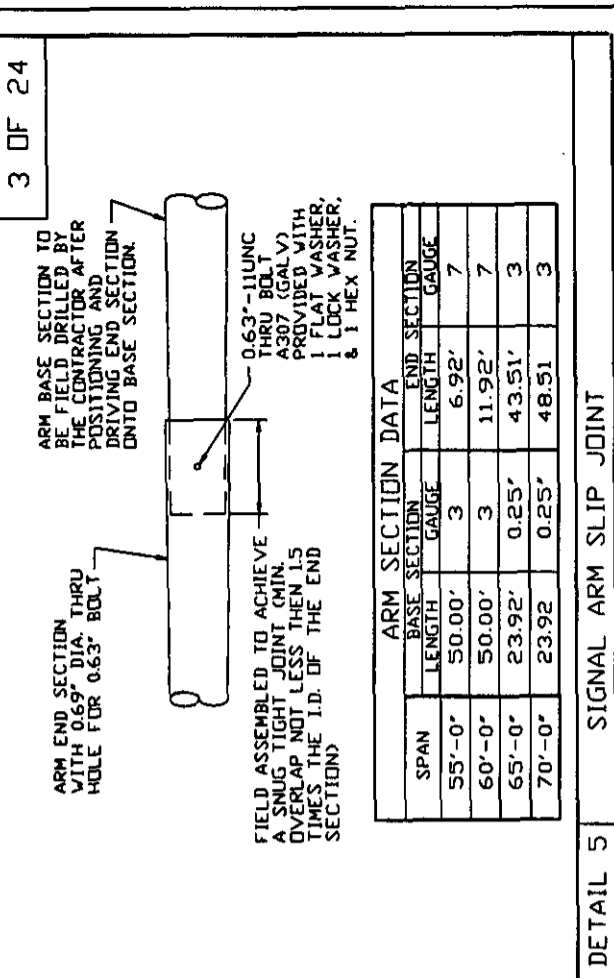
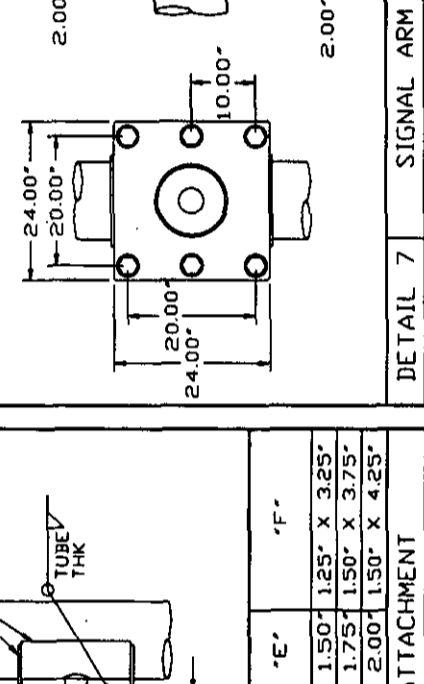
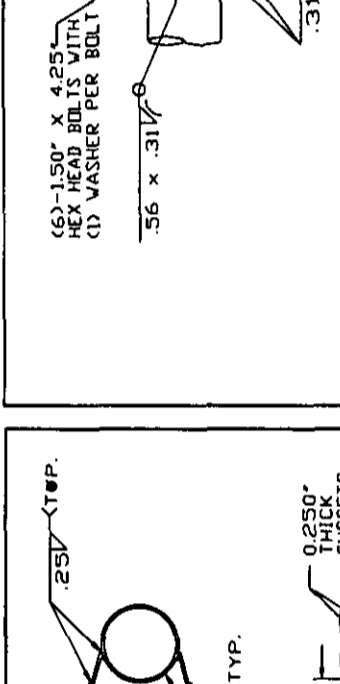
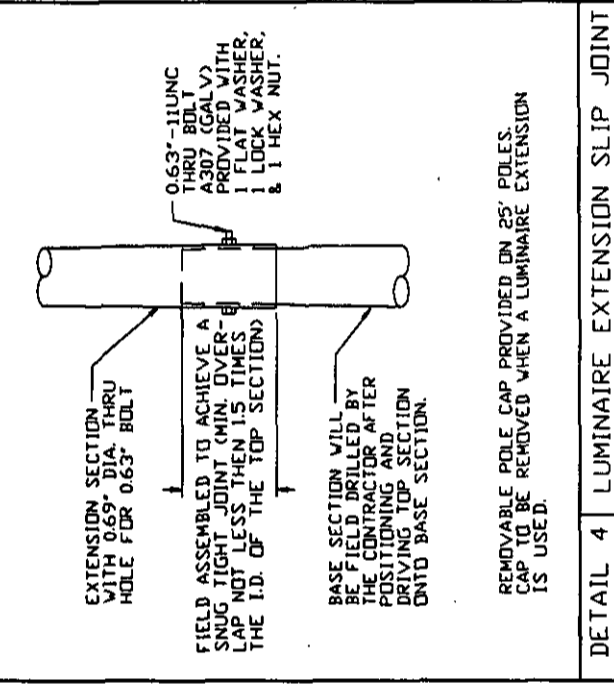
TABLE 1: POLE AND MAST ARM SCHEDULE

POLE DESIGNATION	POLE DATA				BASE PLATE DATA				ANCHOR BOLT DATA				MAST ARM DATA					
	POLE SERIES	SIGNAL ARM SPAN (Y,N)	LUM SPAN (Y,N)	BASE DIA. (IN)	TOP DIA. (IN)	LENGTH (FT)	GAUGE OR THK.	SQUARE (IN)	BOLT CIRC (IN)	THK (IN)	DIA. (IN)	LENGTH (IN)	HOOK DIA. (IN)	THREAD LENGTH (IN)	FIXED END DIA. (IN)	FREE END DIA. (IN)	RISE (FT)	ATTACHMENT HEIGHT (FT)
DOUG 1	15	Y,N	12.50	9.00	25.00	3	21.00	20.00	1.75	2.00	84.00	6.00	10.00	6.00	3.90	3.00	3.00	17.00
DOUG 2	20	Y,N	12.50	9.00	25.00	3	21.00	20.00	1.75	2.00	84.00	6.00	10.00	7.00	4.20	3.00	3.00	17.00
DOUG 3	25	Y,N	12.50	9.00	25.00	3	21.00	20.00	1.75	2.00	84.00	6.00	10.00	8.00	4.50	3.00	3.00	17.00
DOUG 4	30	Y,N	12.50	9.00	25.00	3	21.00	20.00	1.75	2.00	84.00	6.00	10.00	9.00	4.80	3.00	3.00	17.00
DOUG 5	35	Y,N	12.50	9.00	25.00	3	21.00	20.00	1.75	2.00	84.00	6.00	10.00	10.00	5.10	3.00	3.00	17.00
DOUG 6	40	Y,N	14.00	10.50	25.00	0.25	21.00	20.00	1.75	2.00	84.00	6.00	10.00	10.00	4.40	4.00	4.00	16.00
DOUG 7	45	Y,N	14.00	10.50	25.00	0.25	21.00	20.00	1.75	2.00	84.00	6.00	10.00	10.50	4.20	4.00	4.00	16.00
DOUG 8	50	Y,N	14.00	10.50	25.00	0.25	21.00	20.00	1.75	2.00	84.00	6.00	10.00	11.00	4.00	4.00	4.00	16.00
DOUG 9	55	Y,N	15.00	11.50	25.00	0.31	21.00	20.00	1.75	2.00	84.00	6.00	10.00	12.50	5.15	5.00	5.00	15.00
DOUG 10	60	Y,N	15.00	11.50	25.00	0.31	21.00	20.00	1.75	2.00	84.00	6.00	10.00	13.00	4.95	5.00	5.00	15.00
DOUG 11	65	Y,N	15.00	11.50	25.00	0.31	21.00	20.00	1.75	2.00	84.00	6.00	10.00	13.53	4.91	5.00	5.00	15.00
DOUG 12	70	Y,N	15.75	12.25	25.00	0.31	23.00	22.00	2.00	2.25	89.00	7.00	12.00	13.53	4.21	6.50	0.00	20.00



DETAIL 6: SIGNAL ARM ATTACHMENT

POLE BASE DIA.	'A'	'B'	'C'	'D'	'E'	'F'
12.50"	13.25"	12.00"	9.00"	10.25"	1.50"	1.25" X 3.25"
14.00"	16.25"	15.00"	11.00"	12.25"	1.75"	1.50" X 3.75"
15.00"	17.75"	17.00"	13.00"	13.50"	2.00"	1.50" X 4.25"



DOUG - 1 - 15 - Y - 15 - C

MAST ARM C = CURVED S = STRAIGHT

LUMINAIRE ARM (10' OR 15')

SIGNAL ARM SPAN REQUIRED (Y=YES, N=NO)

(15,20,25,30,35,40, 45,50,55,60,65,70 FT)

POLE TYPE (1,2,3, 4 DR 5)

DOUGLAS COUNTY POLE SERIES

DESIGNATION EXAMPLE

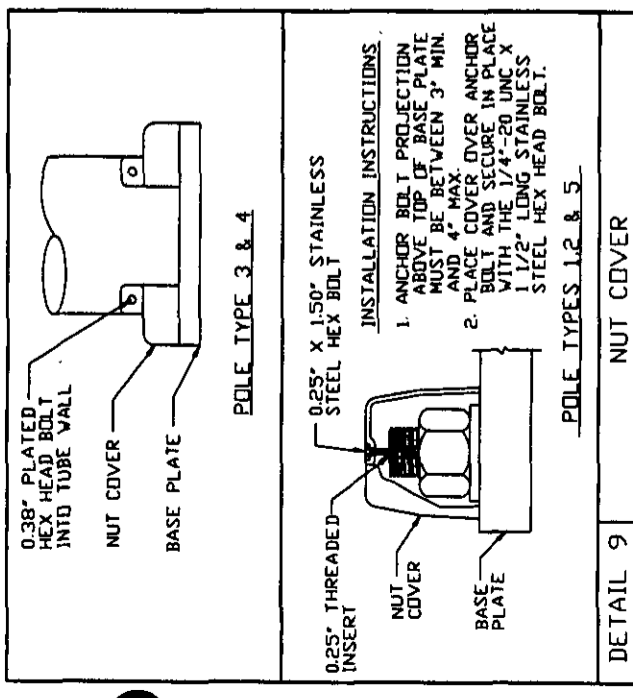
VALMONT

VALMONT INDUSTRIES, INC.
VALLEY VIEW, MISSOURI 64082-3592-2201

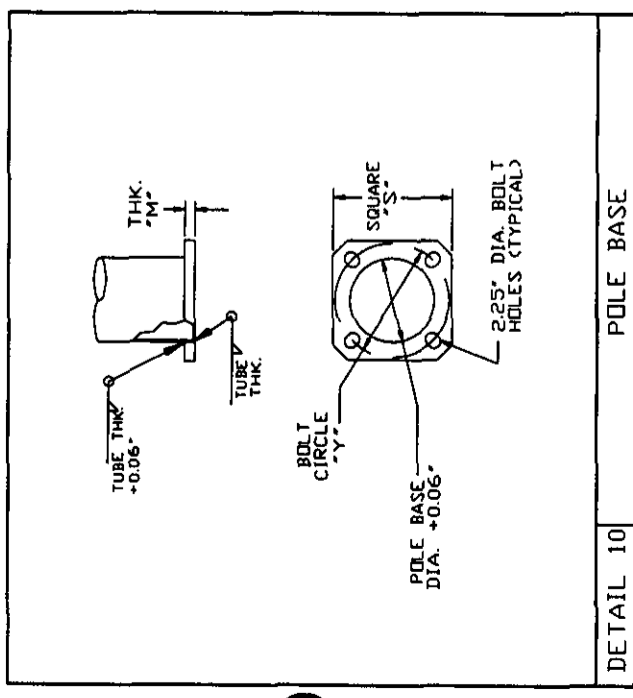
REVISION

DATE: 10-25-93
DRAWN: GGL
TITLE: DOUGLAS COUNTY, COLORADO TRAFFIC SIGNAL STRUCTURES

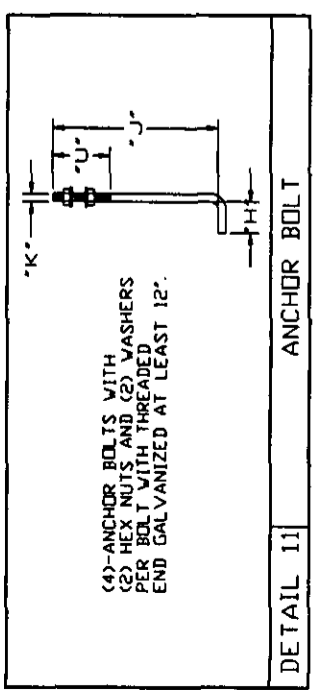
SHEET 2 OF 5
DRAWING NO. DB00349
REV. D



DETAIL 9 NUT COVER



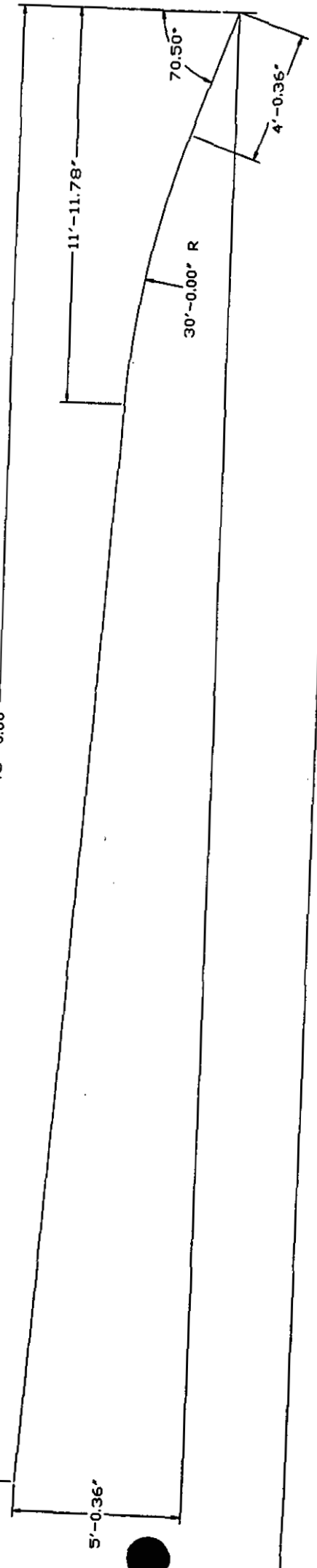
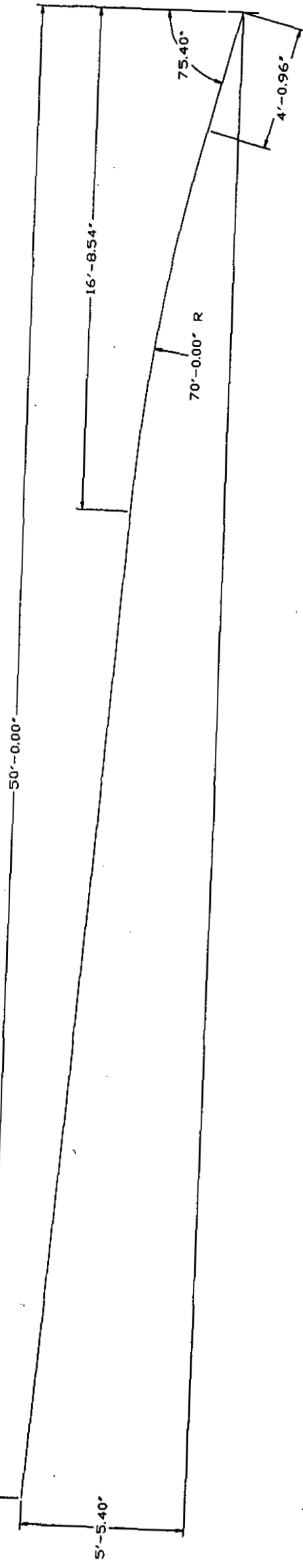
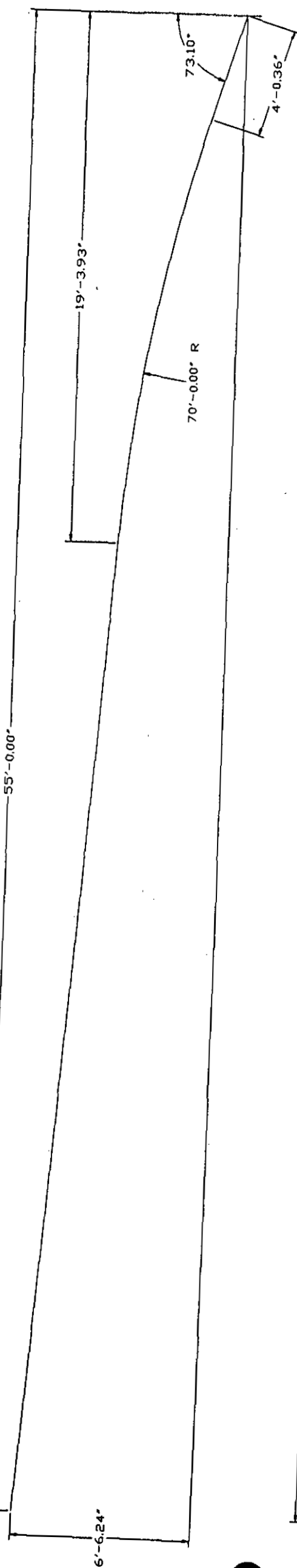
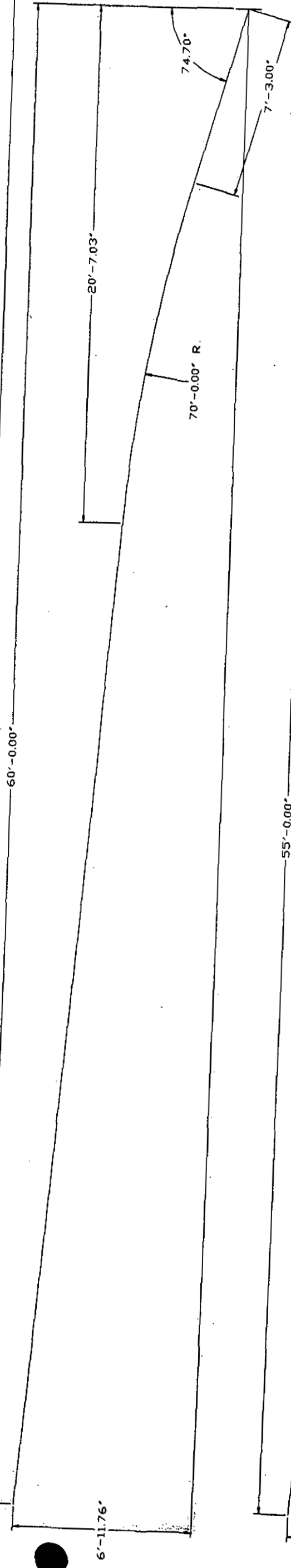
DETAIL 10 POLE BASE



DETAIL 11 ANCHOR BOLT

REV.	DATE	REVISION	SHEET 3 OF 5	REV.
			DATE: 10-25-93	DRVN: GGL
			TITLE: DOUGLAS COUNTY, COLORADO TRAFFIC SIGNAL STRUCTURES	
			DRAWING NO. DB00349	
			D	

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VALLEY, NEBRASKA 68064
(402) 339-2201



NOMINAL MANUFACTURING TOLERANCES
APPLY TO ALL DIMENSIONS

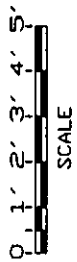
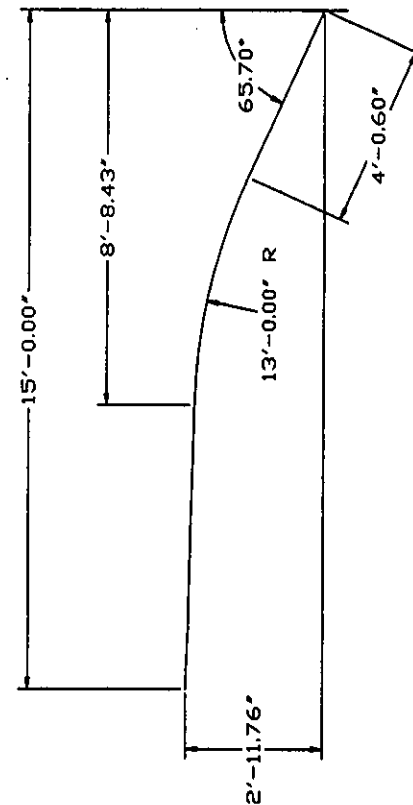
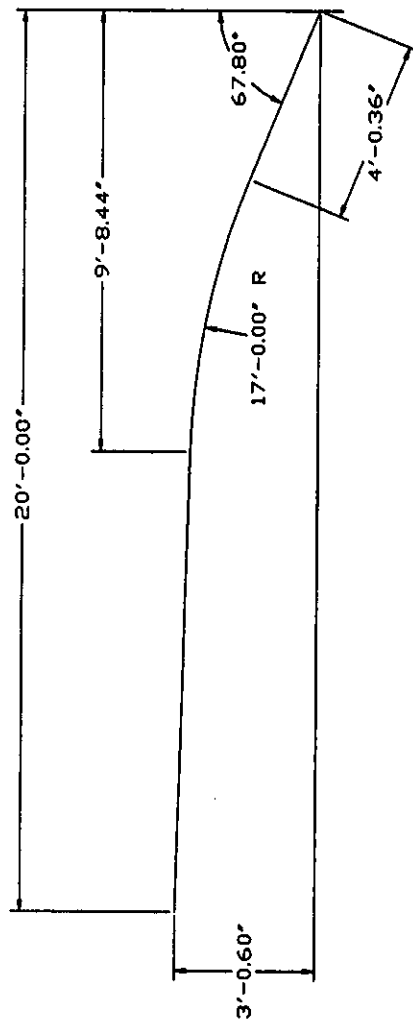
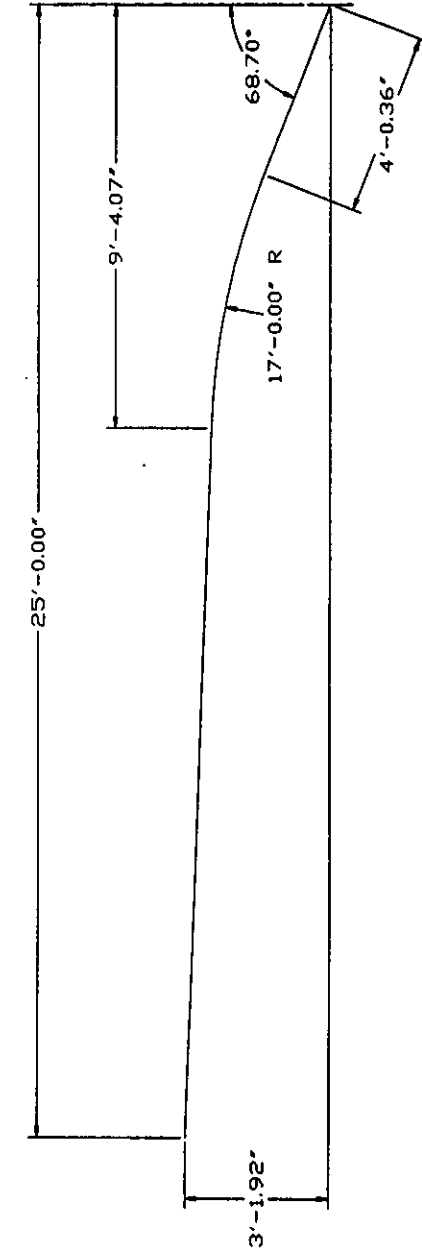
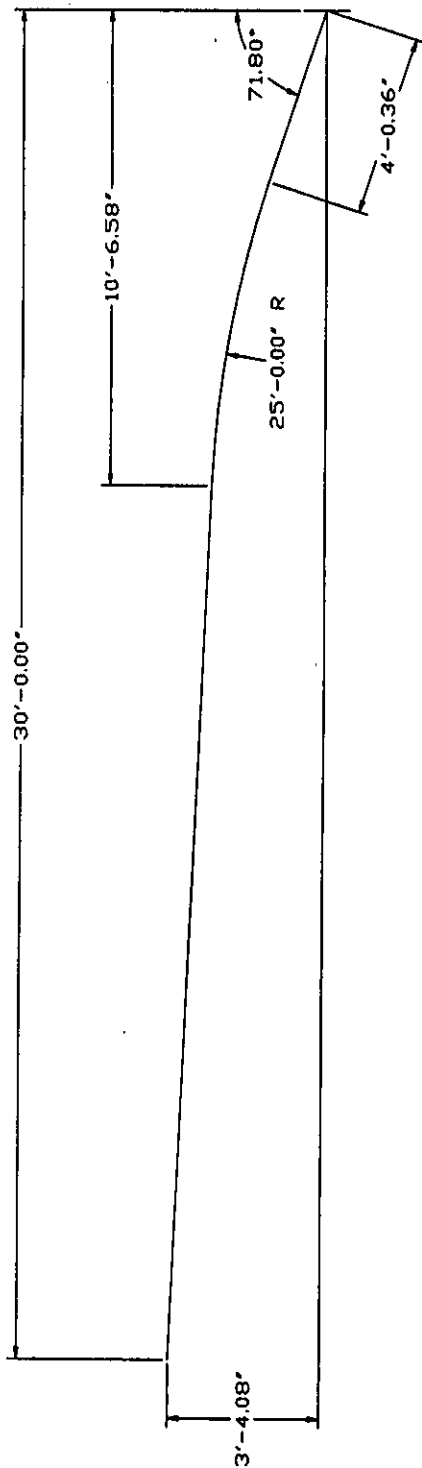
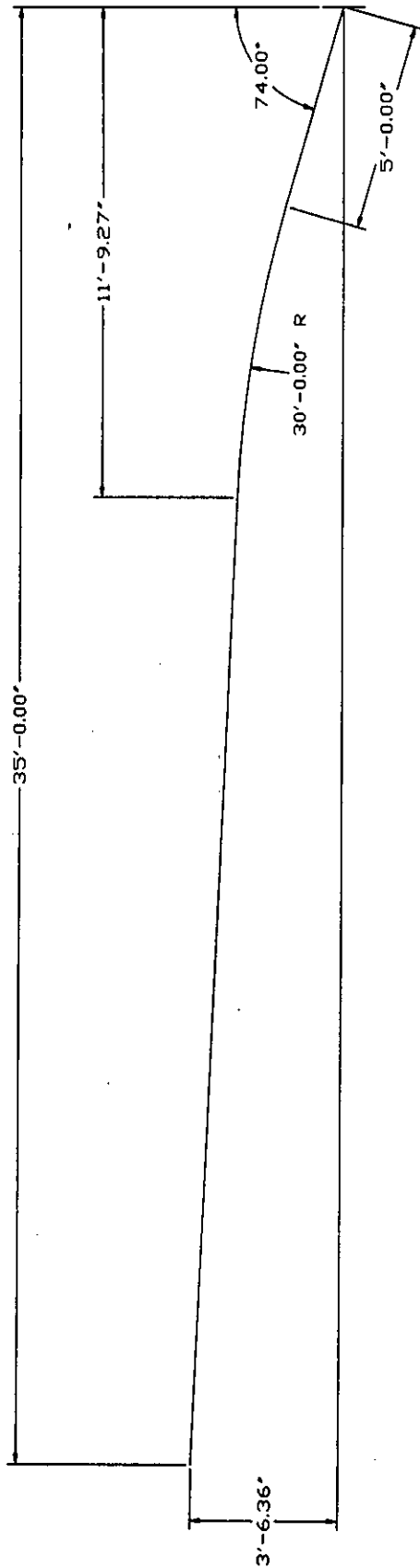
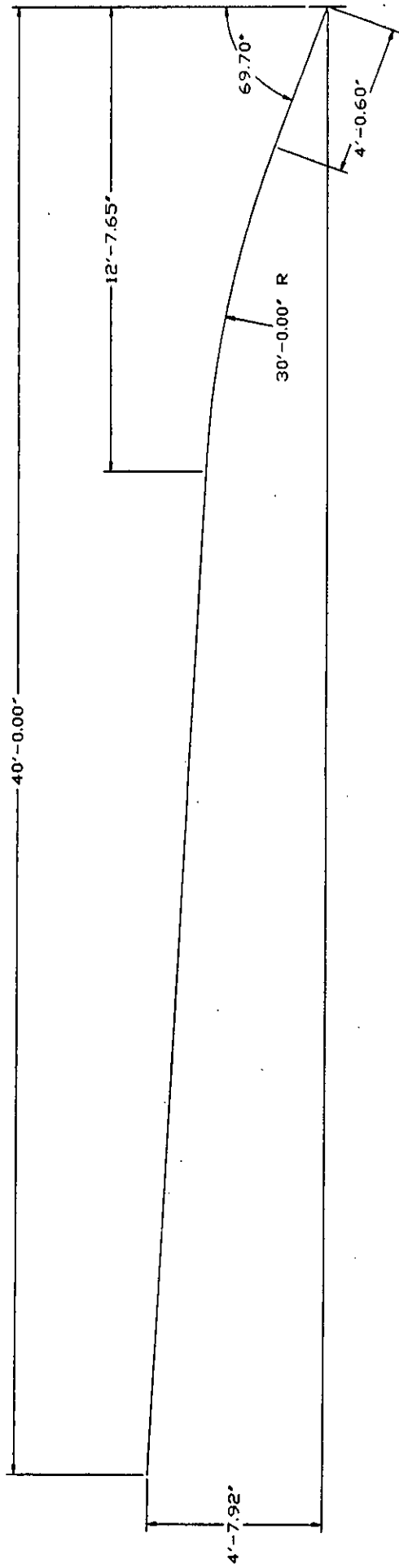
NOTE:

THE MAST ARMS SHOWN HERE ARE DIMENSIONED AS THE MAST ARM IS IN THE NON-LOADED CONDITION (BEFORE ANY REFLECTIONS THAT MAY OCCUR AFTER ERECTION OR ANY SIGNALS ATTACHED).

REV	DATE	REVISION



DATE: 10-25-93	DRWN: GGL	SHEET 4 OF 5	REV
TITLE: DOUGLAS COUNTY, COLORADO		DRAWING NO.	D
TRAFFIC SIGNAL STRUCTURES		DB00349	



NOMINAL MANUFACTURING TOLERANCES APPLY TO ALL DIMENSIONS

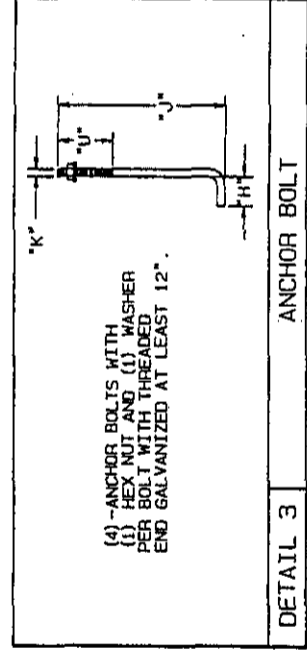
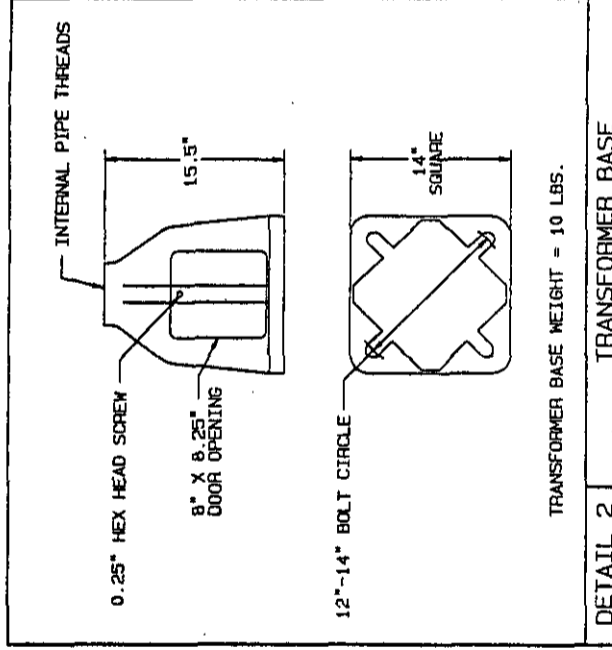
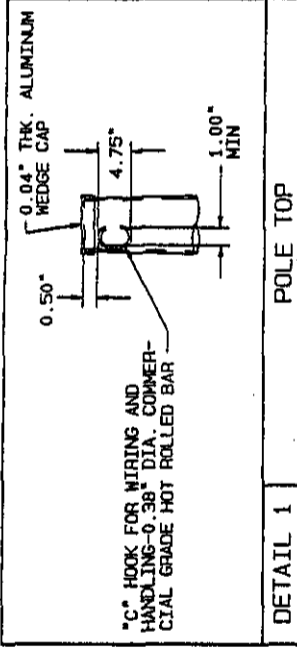
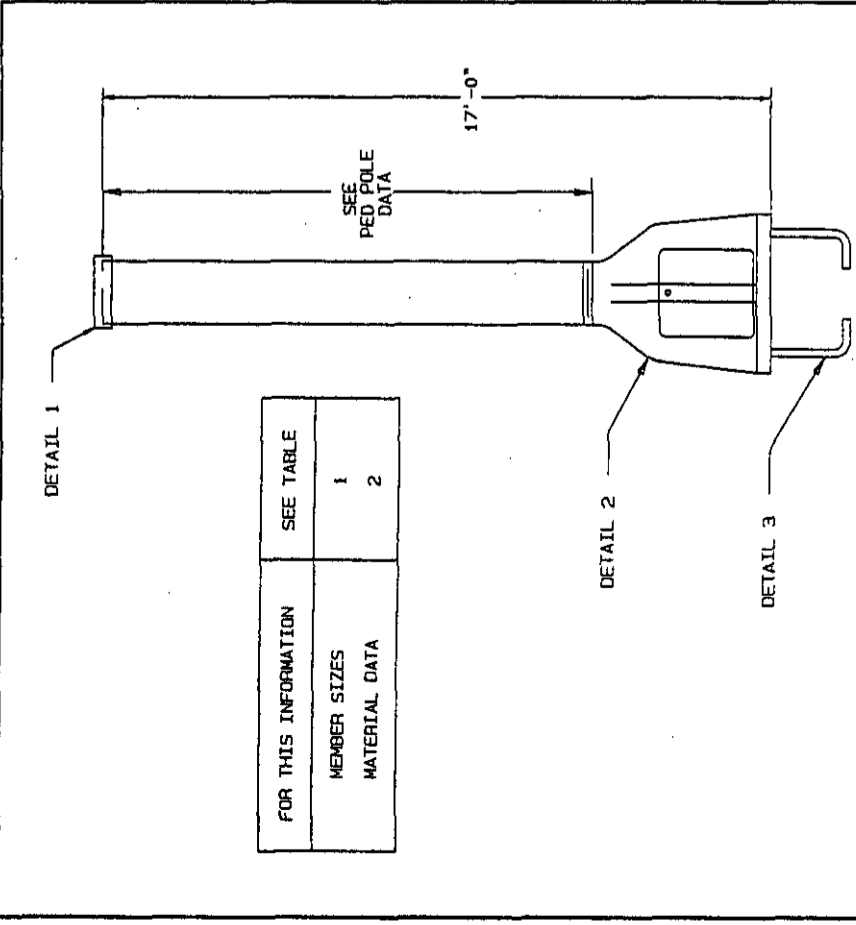
NOTE:

THE MAST ARMS SHOWN HERE ARE DIMENSIONED AS THE MAST ARM IS IN THE NON-LOADED CONDITION BEFORE ANY DEFLECTIONS THAT MAY OCCUR AFTER ERECTION OR ANY SIGNALS ATTACHED.

REV.	DATE	REVISION



DATE: 10-25-93	DRWN: GGL	SHEET 5 OF 5	REV
TITLE: DOUGLAS COUNTY, COLORADO TRAFFIC SIGNAL STRUCTURES		DRAWING NO.	D
		DB00349	



DOUG - PP
 L-POLE TYPE (PP=PED. POLE)
 L-DOUGLAS COUNTY POLE SERIES

DESIGNATION EXAMPLE

DOUG POLE SERIES


TABLE 2: MATERIAL DATA

COMPONENT	ASTM DESIGNATION	MIN. YIELD (KSI)
4" SCH. 40 PIPE	A501, A513, A618 OR A500 GR. B	36
ALUM. TRANSFORMER BASE	CLASS 356.0-T6	
ANCHOR BOLTS	AASHTO M314 GR. 55	55

FINISH NOTE: PRIME COAT - CORROSION INHIBITING POLYAMIDE EPOXY
 TOP COAT - ALIPHATIC ACRYLIC POLYURETHANE
 COLOR - SEMI-GLOSS BLACK (VALMONT SPEC. F274D)

TABLE 1: POLE SCHEDULE

QTY.	DESIGNATION	POLE DATA				ANCHOR BOLT DATA			
		POLE SERIES	POLE TYPE	LENGTH (FT)	THICK (IN)	TRANSFORMER BASE TYPE	DIA. (IN)	LENGTH (IN)	HOOK LENGTH (IN)
1	DOUG PP			15.88	0.297	TUCKER	0.75	17	3



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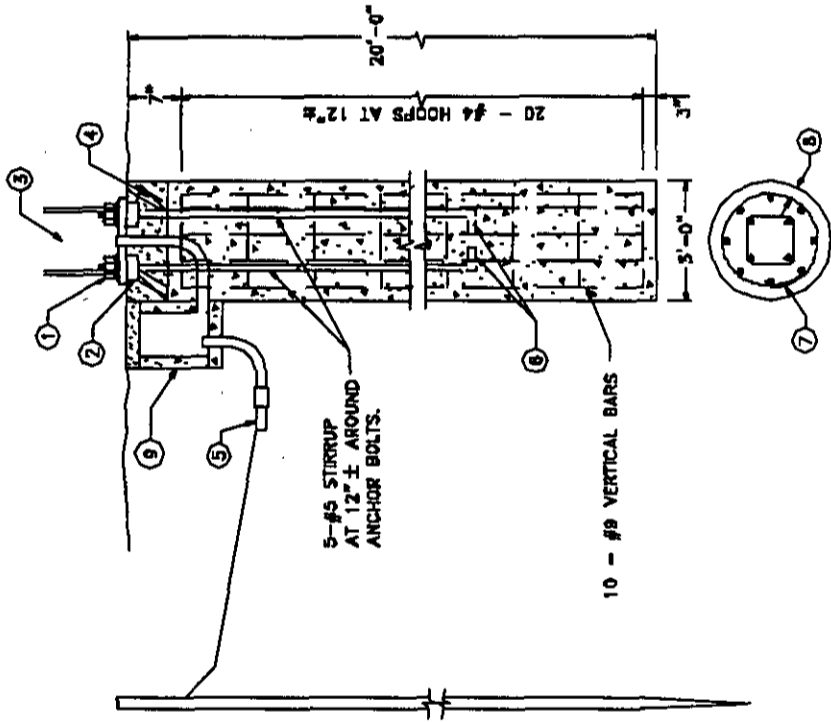
REV. DATE REVISION

JOB NAME: LUCENT BLVD. & PLAZA DR.
 SOLD TO: HIGHLANDS RANCH
 SHOP TO: HIGHLANDS RANCH
 P.O. NO.: 12684

AGENT: M/H LIGHTING
 DATE: 11/30/99 DRWN: NAM JWC 12/08/99
 ORDER NO.: 42381-99
 SHEET 2 OF 2 REV
 DRAWING NO. C04238199
 TITLE: TRAFFIC SIGNAL STRUCTURES

DESIGN NOTES

- DESIGN ASSUMES CAISSON DRILLED IN APPROXIMATELY LEVEL NATIVE SOIL WITH A LATERAL MODULUS OF ELASTICITY OF 100 PCF AND AN ALLOWABLE LATERAL BEARING STRESS OF 1000 PSF. IF MORE THAN 3 FEET OF FILL IS PRESENT OR IF BY VISUAL REVIEW OF THE HOLE, MATERIAL OF LESSER QUALITY IS PRESENT, THE CAISSON DESIGN SHALL BE MODIFIED AS DETERMINED BY THE ENGINEER.
- MAXIMUM LOADS FOR 65-FOOT TRAFFIC SIGNAL FOOTING PROVIDED BY VALMONT INDUSTRIES ARE AS FOLLOWS:
 P = 5185 LBS.
 V = 5115 LBS.
 M = 132,003 LB-FT
 T = 129,488 LB-FT
 MAXIMUM LOADS FOR 70-FOOT TRAFFIC SIGNAL FOOTING PROVIDED BY VALMONT INDUSTRIES ARE AS FOLLOWS:
 P = 5186 LBS.
 V = 4654 LBS.
 M = 129,080 LB-FT
- BASED ON AN EQUIVALENT FLUID PRESSURE OF 51.6 PCF AND A SOIL/CONCRETE COEFFICIENT OF 0.5, THE FACTOR OF SAFETY AGAINST ROTATIONAL SLIDING OF THE FOOTING IS 1.30.
 A ROUGH CAISSON/SOIL INTERFACE IS THUS DESIRABLE PROVIDED CAISSON VERTICALITY AND MINIMUM REINFORCING STEEL CLEARANCES ARE MAINTAINED.



5/8" x 12" COPPER WELD GROUNDING ROD. LOCATE IN PULL BOX AND BOND DIRECTLY TO POLE, OR ANGLE THROUGH FOUNDATION

65 FOOT AND 70 FOOT MAST ARM TRAFFIC SIGNAL POLE FOOTING

GENERAL NOTES

- CONCRETE f'_c = CLASS BZ, PER THE COLORADO DEPT. OF TRANSPORTATION. REINFORCING STEEL: PER AASHTO M31 SPECIFICATION, GRADE 60 FOR #9, #5 & #4 BARS.
- SHAFT FOR CONCRETE FOUNDATION TO BE DRILLED BY MECHANICAL AUGER.
- FOUNDATION DESIGN REQUIRES THAT THE SHAFT BE FOUNDED IN COMPACT SAND, CLAY, OR SANDY CLAY. IF BY VISUAL INSPECTION OF THE HOLE OTHER MATERIAL IS PRESENT, THE FOUNDATION DESIGN SHALL BE MODIFIED AS DETERMINED BY THE ENGINEER.
- SHOULD ROCK BE ENCOUNTERED, THE SHAFT SHOULD EXTEND 6 FT. MINIMUM INTO ROCK. THE ALLOWABLE SAFE LATERAL BEARING CAPACITY OF ROCK TO BE 4,300 LBS./SQ. FT. THE SOIL (INCLUDING ROCK) SURROUNDING THE SHAFT SHOULD BE INVESTIGATED TO ENSURE IT WILL RESIST THE TORSIONAL MOMENT OF 93,435 FT. LBS.
- CONCRETE SHALL BE POURED IN LIFTS NOT EXCEEDING 3 FEET IN DEPTH. AT THE POURING OF EACH LIFT, CONCRETE SHALL BE MECHANICALLY VIBRATED TO REMOVE AIR POCKETS.
- FOUNDATIONS SHOULD BE POURED 10 TO 20 DAYS IN ADVANCE OF POLE INSTALLATION. SEE PROJECT SPECIAL PROVISIONS FOR SPECIFIC DIRECTIONS.
- WHEN AMBIENT TEMPERATURE IS BELOW 40° F., POURED FOUNDATIONS SHALL BE COVERED WITH BLANKETS AND/OR STRAW PER DIRECTION OF THE ENGINEER.

FOOTING NOTES

- HEX NUTS
- SQUARE NUTS
- HAND HOLE SHALL BE PROVIDED
- 4" MIN. NON-SHRINKABLE GROUT OVER ROUGH FOUNDATION
- RIGID CONDUIT (24" MIN. DEPTH, 30" MIN. DEPTH UNDER ROADWAY) CONDUIT STUB FROM PULL BOX TO POLE SHALL BE 3" DIAMETER.
- INSTALL ANCHOR BOLTS (FURNISHED WITH POLE) PER MANUFACTURER'S TEMPLATE PRINT (FURNISHED WITH ORDER)
- MINIMUM OVERLAP OF 12"
- 1-1/2" CLEARANCE FOR HOOPS
- PULL BOX
- CONCRETE IS CDDT CLASS BZ, f'_c = 4000 PSI
- DRILLED CAISSONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH CDDT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, SECTION 503. CONCRETE SHALL NOT BE PLACED IN MORE THAN 3 INCHES OF STANDING WATER.

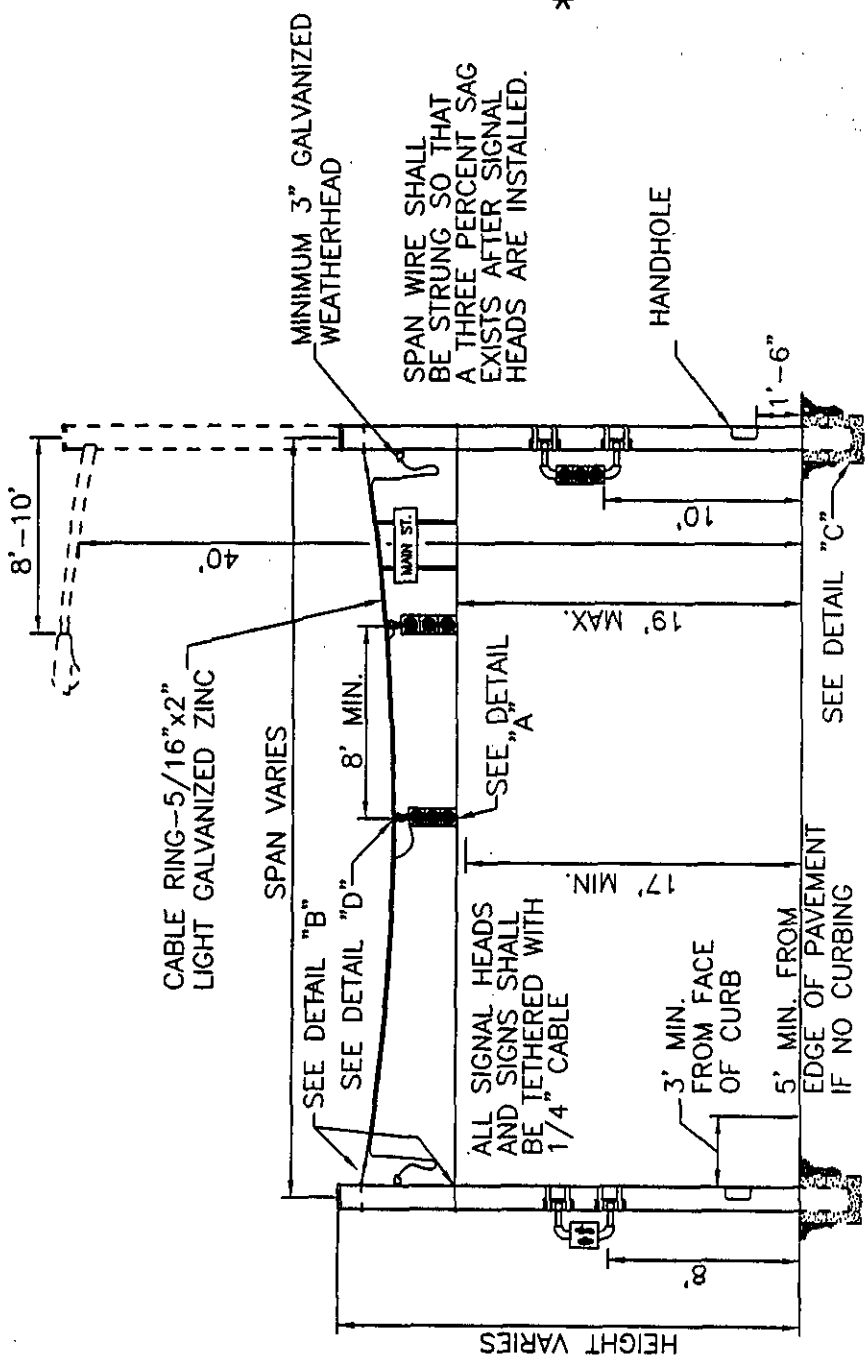


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 CASTLE ROCK, COLORADO 80104
 303-660-7490

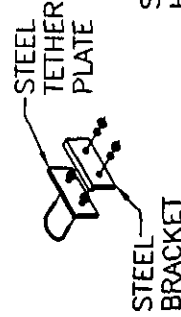
DOUGLAS COUNTY STANDARD SIGNAL DETAILS

65' AND 70' MAST ARM POLE FOOTING

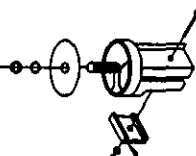
ORIGINAL 3-06	2/19 DATE:	DESIGNED BY: JCB NO.
REVISION 3-06	SCALE:	DRAWN BY: SHEET NO.
REVISION 3-06	SCALE:	DATE: 5 OF 24



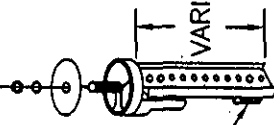
BREAK-AWAY TETHER ASSEMBLY, 1 1/2" PIPE



BREAK-AWAY ASSEMBLY

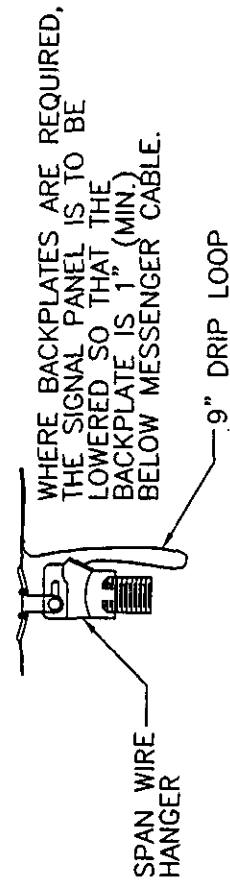


ADJUSTABLE BREAK-AWAY ASSEMBLY



DETAIL "A"

TETHERING OPTIONS



DETAIL "D"

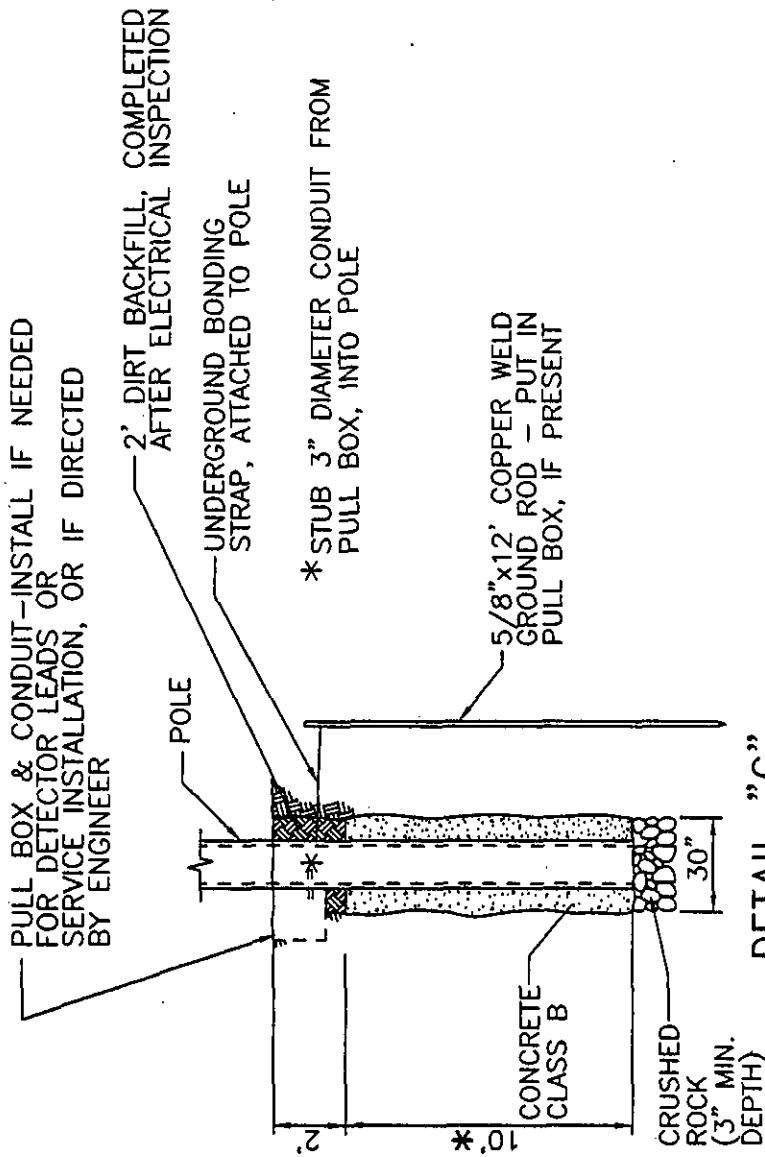
TYPICAL SPAN WIRE MOUNTING

DETAIL "B"

TYPICAL CABLE AND TETHER INSTALLATION

TEMPORARY SPAN WIRE POLE DETAIL

(FOR SPECIAL USE, WITH PRIOR APPROVAL OF COUNTY ONLY)



DETAIL "C"
TYPICAL TRAFFIC SIGNAL SPAN WIRE POLE FOOTING (CAST IN PLACE)

GENERAL NOTES

- SPAN WIRE POLES SHALL BE FINISHED WITH 1 COAT OF RUST INHIBITIVE PRIMER AND 1 COAT OF A COMPATIBLE TOP COAT SUITABLE FOR LONG-WEARING OUTDOOR USE, SEMI-GLOSS BLACK IN COLOR. POLE SURFACE SHALL BE WIPE CLEAN AND FREE OF DEBRIS PRIOR TO FINISH APPLICATION. FINISH APPLICATION SHALL BE COMPLETED PRIOR TO INSTALLATION OF SIGNAL/PEDESTRIAN HEADS AND PEDESTRIAN PUSH BUTTONS. FOLLOWING INSTALLATION OF THESE ITEMS, CONTRACTOR SHALL TOUCH UP NICKS AND ABRASIONS AS NEEDED.
- DESIGN CRITERIA SHALL MEET LATEST AASHTO EDITION OF "STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS," FOR A WIND VELOCITY OF 90 MPH.
- SPAN WIRE POLES SHALL BE FABRICATED OF STEEL WITH A MIN. YIELD STRENGTH OF 35 KSI, AND A MIN. WEIGHT PER LINEAR FOOT AS FOLLOWS: 40.4 LB. FOR 10" DIA. POLES AND 49.5 LB. FOR 12" DIA. POLES. POLES SHALL BE INSTALLED SO THAT THEY WILL BE PLUMB WHEN DEFLECTED BY THE INSTALLED LOAD. SPAN WIRE CABLE SHALL BE A MINIMUM OF 3/8 INCH DIAMETER, RATED AT A MINIMUM OF 13,000 POUNDS.
- SPAN WIRE SIGNAL HEADS SHALL HAVE ONE POWER FEED WIRE IN AND OUT PER HEAD. CONNECTIONS SHALL BE MADE ONLY ON THE SIGNAL HEAD TERMINALS, WITH NO EXTERNAL SPLICES.



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**DOUGLAS COUNTY
STANDARD SIGNAL DETAILS**

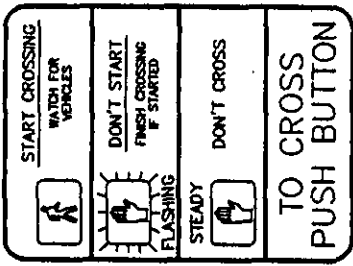
SPAN WIRE POLE

ORIGINAL	6-93	3/18 DATE	DESIGNED BY: DOB NO.
REVISION	APRIL 2007	SCALE	DRAWN BY:
REVISION	APRIL 2003		SHEET NO. 10 OF 24

FINISH REQUIREMENTS

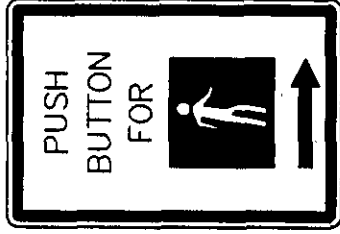
ALL PEDESTRIAN PUSH BUTTON AND PEDESTAL POLES SHALL BE FACTORY PAINTED WITH A RUST INHIBITIVE EPOXY PRIMER (MIN. DRY FILM THICKNESS OF 2.0 MILS) AND A COMPATIBLE POLYURETHANE TOP COAT LIQUID COATING (MIN. DRY FILM THICKNESS OF 2.0 MILS). ALL ACCESSIBLE INTERIOR SURFACES SHALL BE COATED WITH A RUST INHIBITIVE PRIMER (MIN. DRY FILM THICKNESS OF 1.0 MILS). ALL SURFACES TO BE TREATED SHALL BE ABRASIVE BLASTED TO A NEAR WHITE FINISH.

THE TOP COAT SHALL BE AMERON AMERSHIELD, TMEMEC ENDURA-SHIELD III, NICKLAD 105, OR APPROVED SUBSTITUTE, AND SHALL BE SEMI-GLOSS BLACK IN COLOR. FOLLOWING INSTALLATION OF POLES, CONTRACTOR SHALL USE FACTORY SUPPLIED PAINT TO TOUCH UP NICKS AND ABRASIONS.



R10-3b
9" x 12"

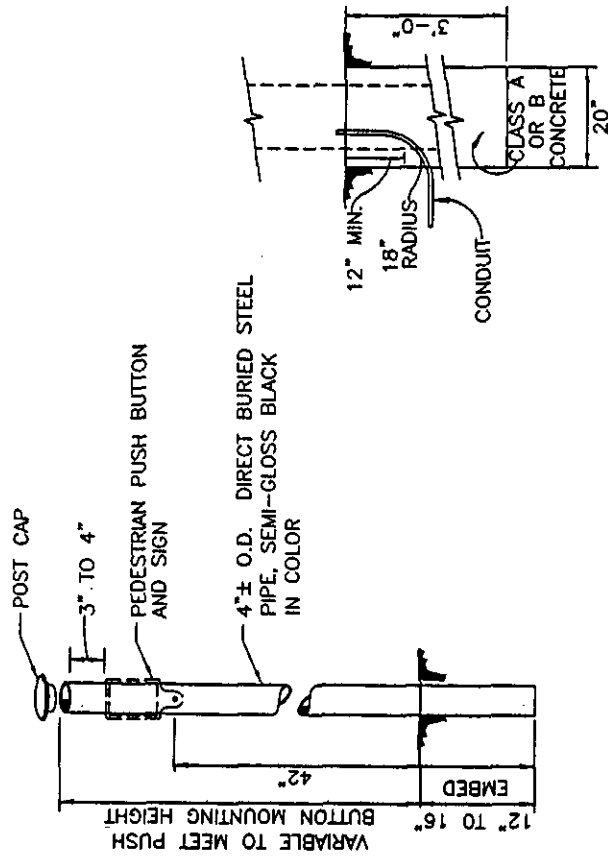
SIGNS SHALL BE LABEL (STICK-ON) TYPE



R10-4b (L or R)
9" x 12"

TYPICAL PEDESTRIAN PUSH-BUTTON SIGN

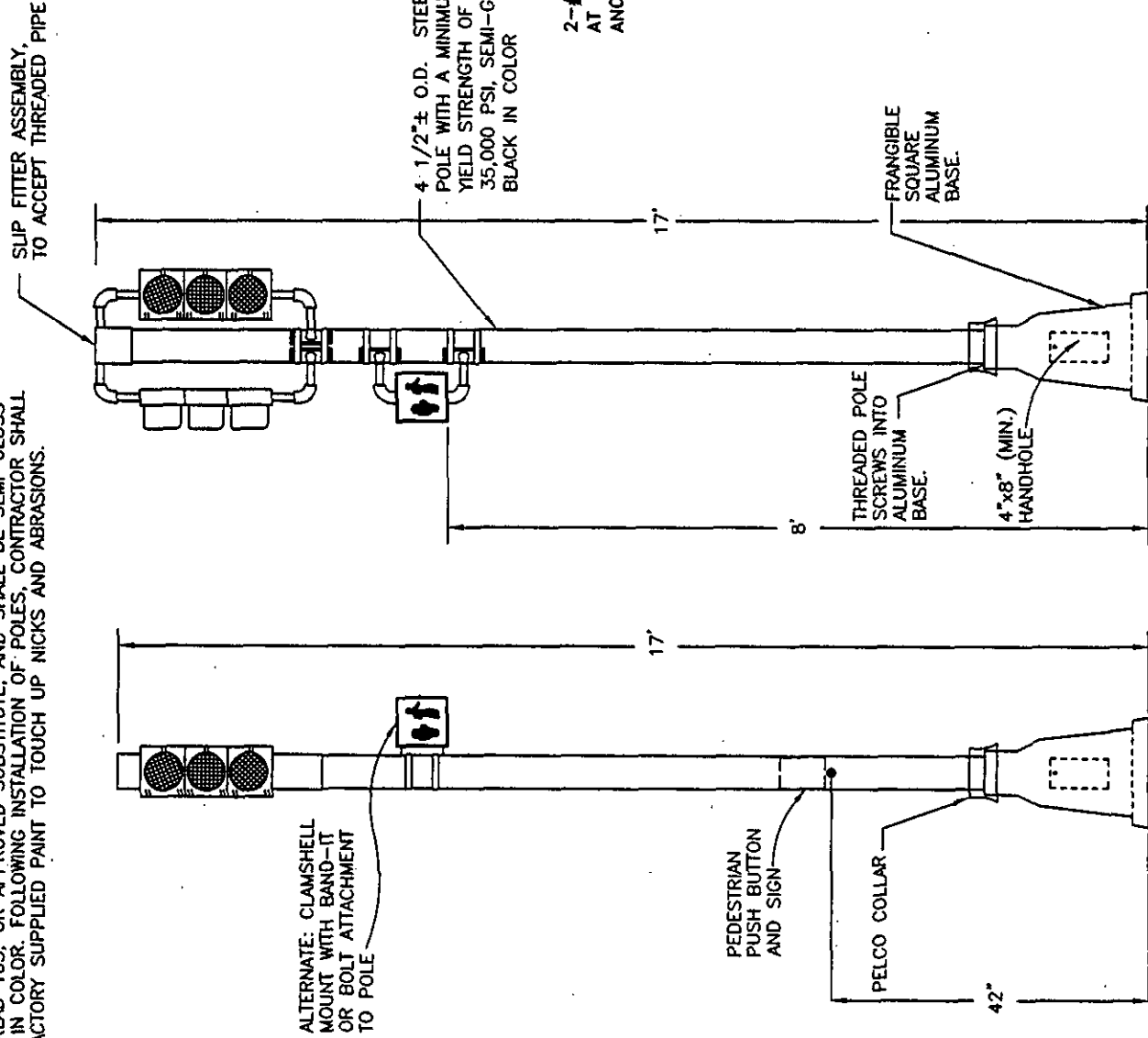
SIGNS SHALL BE MOUNTED SQUARE TO POLE.



FOUNDATION
DETAIL

PEDESTRIAN PUSH BUTTON POLE

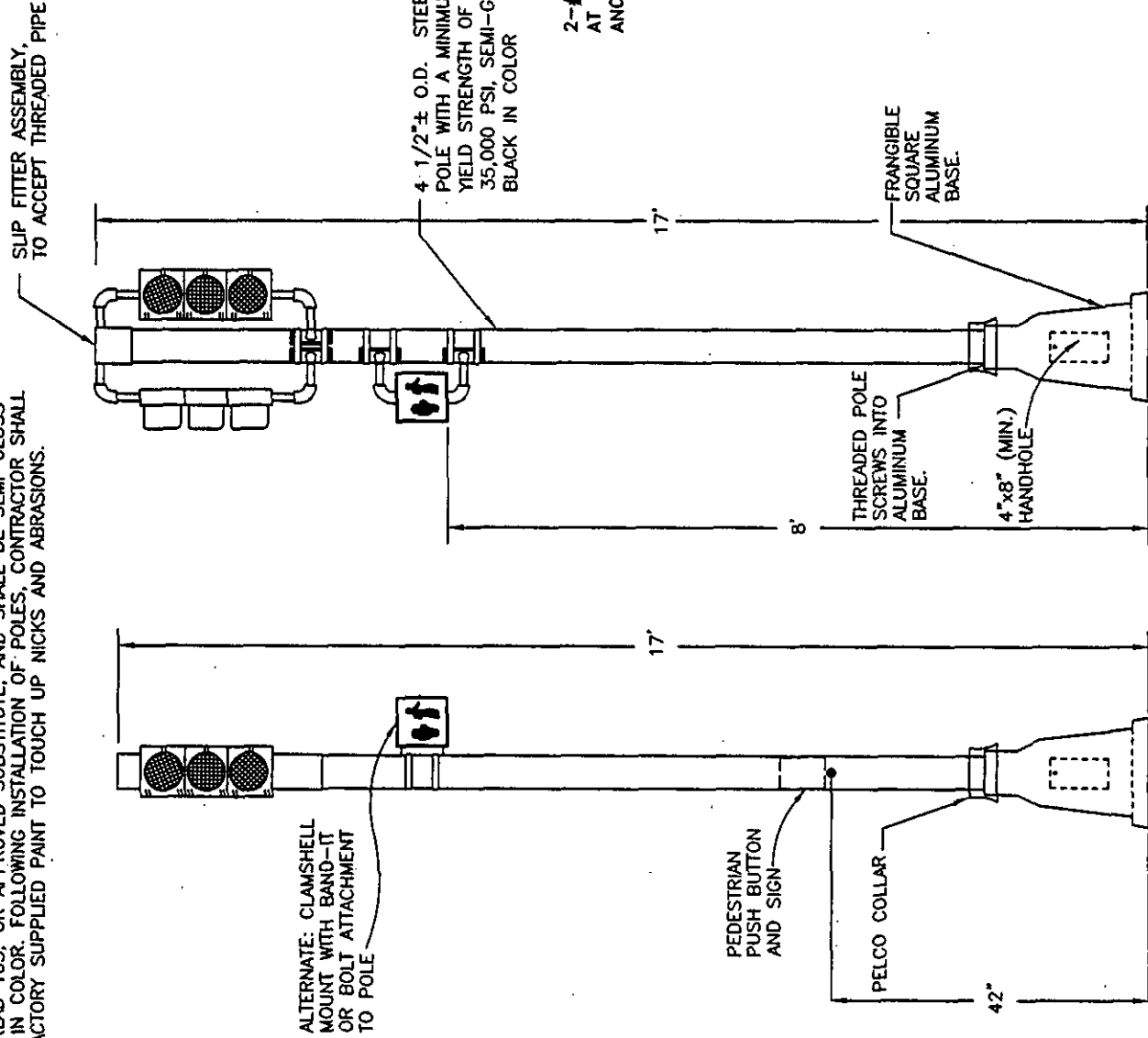
1/4" SPLIT PIN SHALL BE INSTALLED IN THE UPPER PORTION OF THE ALUMINUM BASE AND SHALL COMPLETELY PENETRATE BASE AND POLE TO SECURE POLE TO PREVENT MOVEMENT OR TWISTING. PELCO COLLAR TO BE INSTALLED.



TYPICAL PEDESTAL POLE DETAIL

ALL PEDESTRIAN PUSH BUTTON AND PEDESTAL POLES SHALL BE FACTORY PAINTED WITH A RUST INHIBITIVE EPOXY PRIMER (MIN. DRY FILM THICKNESS OF 2.0 MILS) AND A COMPATIBLE POLYURETHANE TOP COAT LIQUID COATING (MIN. DRY FILM THICKNESS OF 2.0 MILS). ALL ACCESSIBLE INTERIOR SURFACES SHALL BE COATED WITH A RUST INHIBITIVE PRIMER (MIN. DRY FILM THICKNESS OF 1.0 MILS). ALL SURFACES TO BE TREATED SHALL BE ABRASIVE BLASTED TO A NEAR WHITE FINISH.

THE TOP COAT SHALL BE AMERON AMERSHIELD, TMEMEC ENDURA-SHIELD III, NICKLAD 105, OR APPROVED SUBSTITUTE, AND SHALL BE SEMI-GLOSS BLACK IN COLOR. FOLLOWING INSTALLATION OF POLES, CONTRACTOR SHALL USE FACTORY SUPPLIED PAINT TO TOUCH UP NICKS AND ABRASIONS.

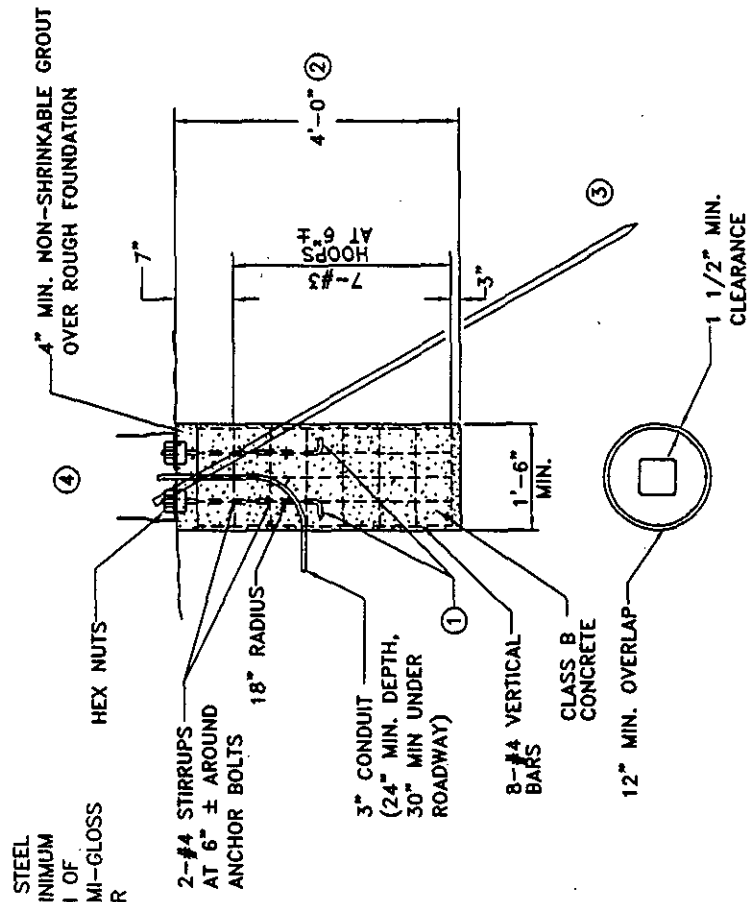


TYPICAL PEDESTAL POLE DETAIL

1/4" SPLIT PIN SHALL BE INSTALLED IN THE UPPER PORTION OF THE ALUMINUM BASE AND SHALL COMPLETELY PENETRATE BASE AND POLE TO SECURE POLE TO PREVENT MOVEMENT OR TWISTING. PELCO COLLAR TO BE INSTALLED.

FOOTING NOTES

- ① ANCHOR BOLTS (FURNISHED WITH POLE) PER MANUFACTURER'S TEMPLATE.
- ② THESE DESIGNS REQUIRE THAT THE FOOTING BE FOUNDED IN COMPACT SAND, CLAY OR SANDY CLAY, AND BE LOCATED ABOVE THE WATER TABLE. IF, BY VISUAL INSPECTION OF THE HOLE OTHER MATERIAL IS PRESENT, THE FOUNDATION DESIGN MAY NEED TO BE MODIFIED.
- ③ 5/8"x8" COPPERWELD GROUND ROD THROUGH FOUNDATION INTO GROUND, OR DRIVEN IN ADJACENT PULL BOX AND BONDED TO POLE WITH UNDERGROUND STRAPPING.
- ④ HANDHOLE SHALL BE PROVIDED.



TYPICAL PEDESTAL POLE FOOTING
(CAST IN PLACE)

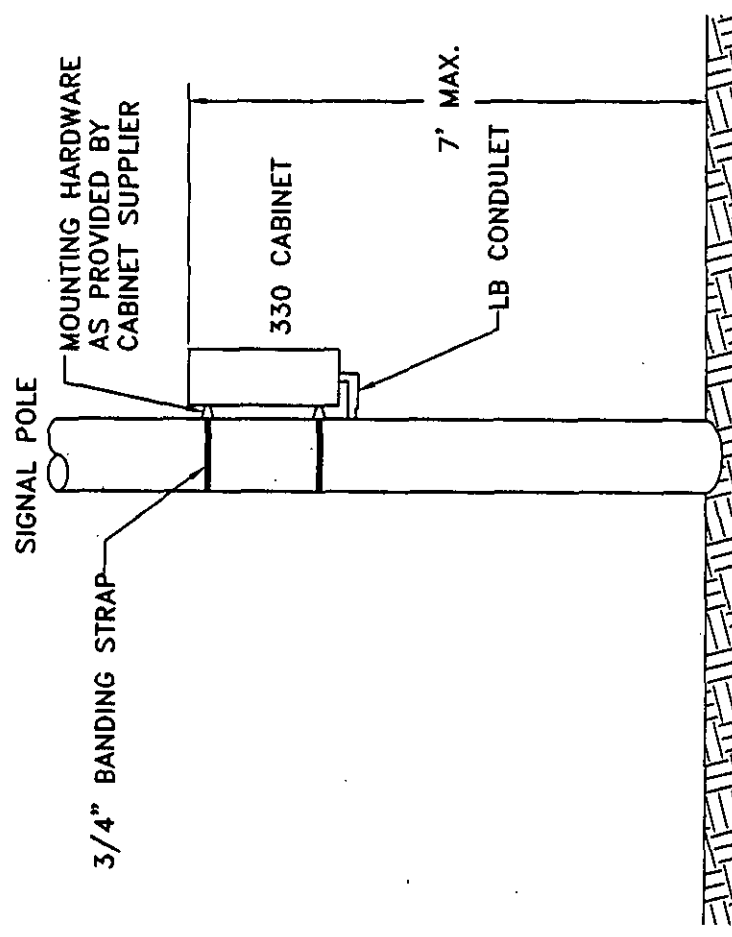


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**DOUGLAS COUNTY
STANDARD SIGNAL DETAILS**

PEDESTRIAN PUSH BUTTON POLE
PEDESTAL POLE

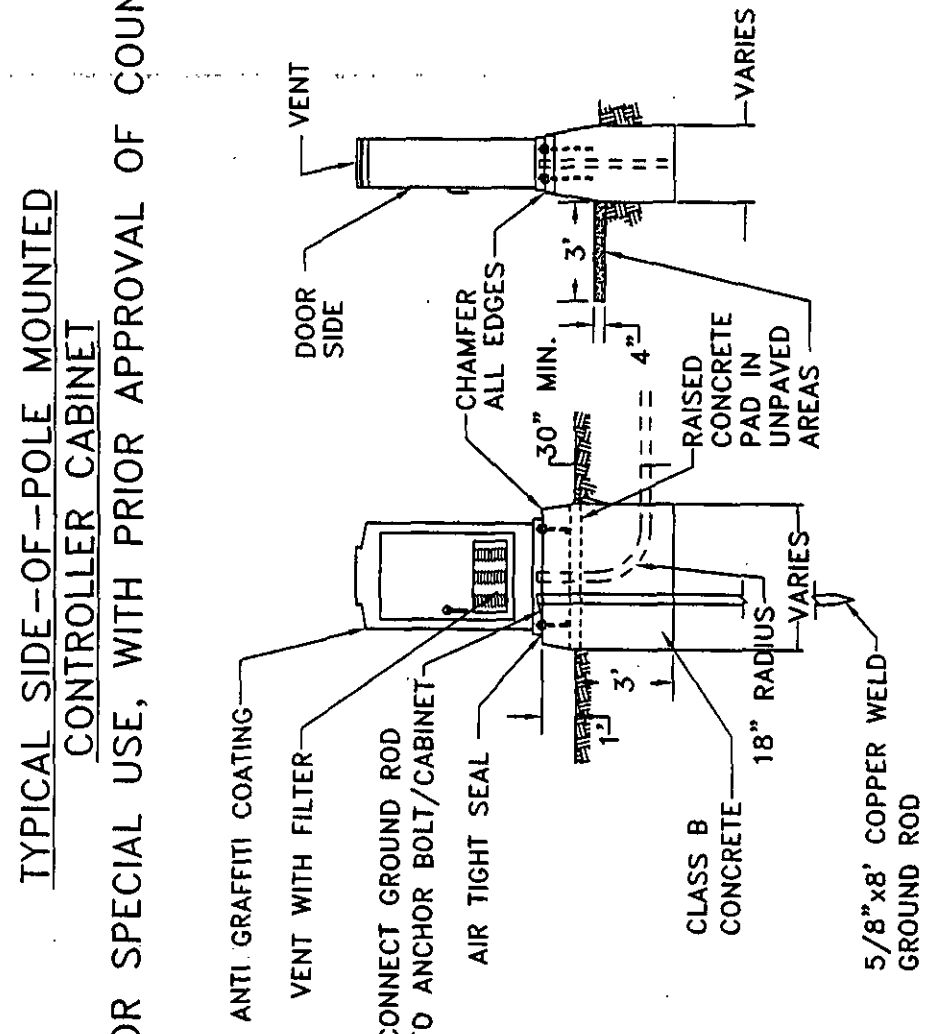
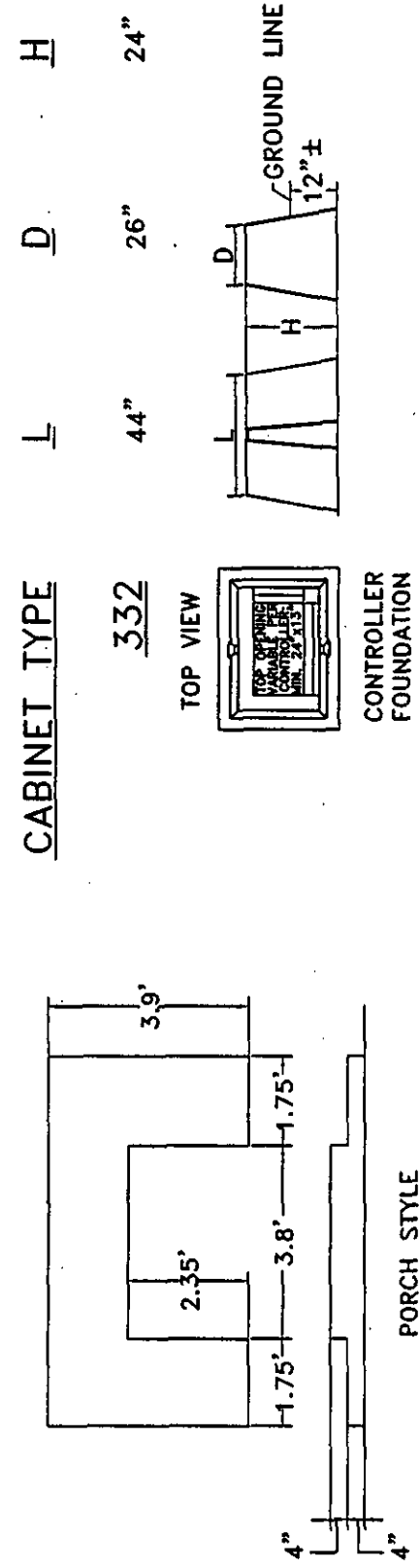
DESIGNED BY: DOB NO.	DESIGNED BY: DOB NO.
DATE: APRIL 2004	DATE: APRIL 2004
SCALE: 1" = 1'-0"	SCALE: 1" = 1'-0"
REVISION: APRIL 2004	REVISION: APRIL 2004
REVISION: APRIL 2003	REVISION: APRIL 2003
SHEET NO. 11	SHEET NO. 11
OF 24	OF 24



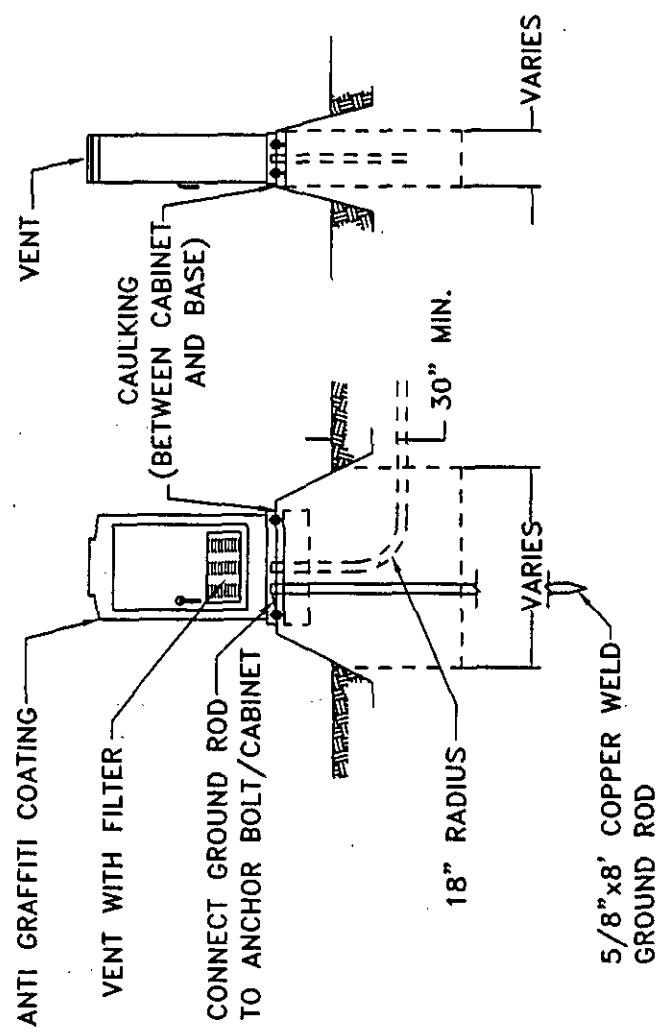
TYPICAL SIDE-OF-POLE MOUNTED CONTROLLER CABINET
(FOR SPECIAL USE, WITH PRIOR APPROVAL OF COUNTY ONLY)

NOTES

CONTROLLER FOUNDATION SHALL BE PREFORMED TYPE, MANUFACTURED WITH FIRE RETARDANT RESIN AND A COMBINATION OF CHOPPED GLASS STRAYUP AND HAND LAYUP OF GLASS REINFORCEMENT. A 1/2" SHEET OF PLYWOOD SHALL BE EMBEDDED IN THE TOP SURFACE OF THE FOUNDATION. COLOR SHALL BE CEMENT GRAY. FOUNDATION DIMENSIONS (MINIMUMS) SHALL BE AS FOLLOWS:



TYPICAL BASE MOUNTED CONTROLLER CABINET INSTALLATION AND CONCRETE FOUNDATION
(FOR SPECIAL USE, WITH PRIOR APPROVAL OF COUNTY ONLY)



BASE MOUNTED CONTROLLER CABINET INSTALLATION AND FIBERGLASS FOUNDATION



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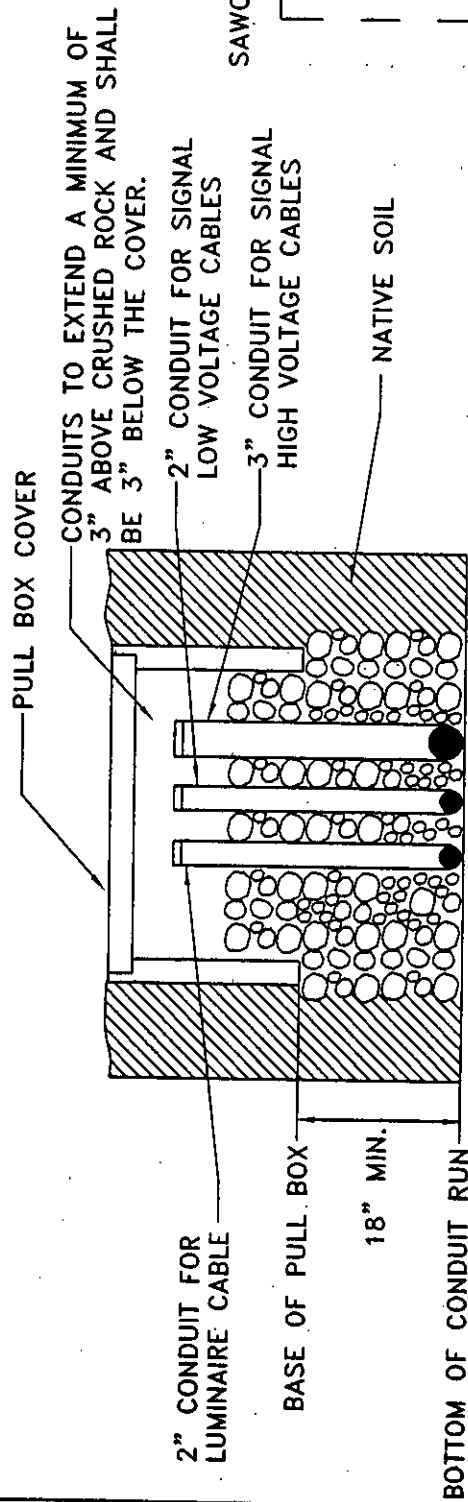
DOUGLAS COUNTY STANDARD SIGNAL DETAILS	
CONTROLLER CABINET INSTALLATION	
ORIGINAL: 6-93	5/18 DATE
DESIGNED BY: DOB NO.	
REVISION: APRIL 2002	SCALE:
APRIL 2003	DRAWN BY: SHEET NO.
APRIL 2003	12 OF 24

TABLE OF DIMENSIONS (MINIMUMS)

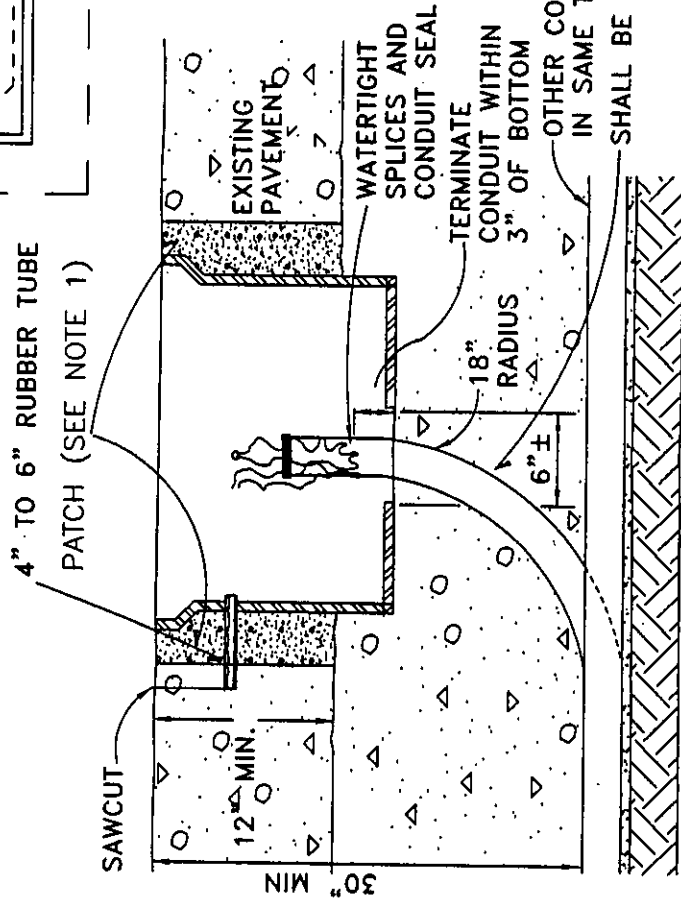
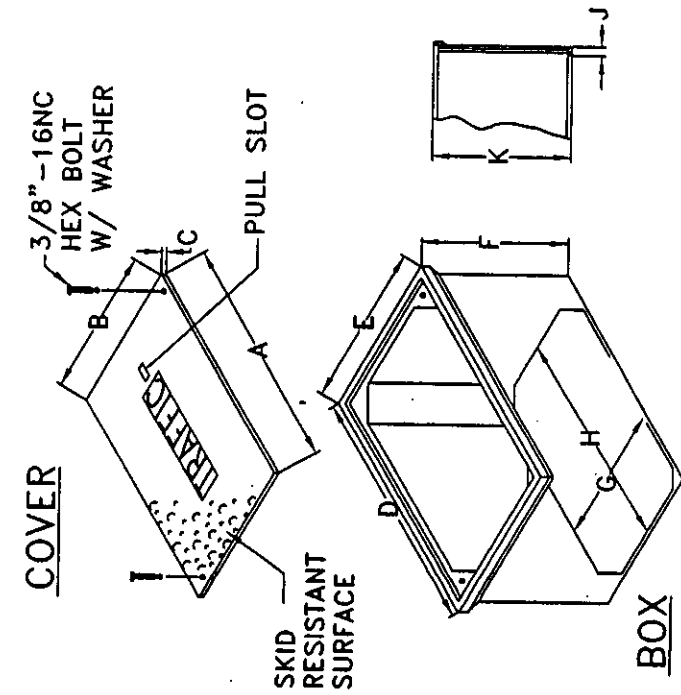
TYPE	DESCRIPTION	DIMENSIONS (IN.)										
		A	B	C	D	E	F	G	H	J	K	
I	LARGE 18x30 FOR CONTROLLERS	31 1/4	18 1/4	3/4	33 1/8	20 1/8	12	16 3/8	29 3/8	1/2	11 1/4	
II	MEDIUM 12x18 FOR SIGNAL POLES	11 1/2	18 1/2	5/8	20 1/2	13 1/2	12	10 1/4	17 1/4	3/8	11 1/4	
III	SMALL 12x12-FOR DETECTORS & ELECTRICAL SERVICE	12 7/8	12 7/8	5/8	14	14	12 3/4	10 1/2	10 1/2	1	12	

PERMANENT (PRECAST) PULL BOX
 (FOR USE WITH ALL OPERATIONAL SIGNALS)

FIBERGLASS REINFORCED POLYMER CONCRETE DESIGNED FOR SERVICE LOAD (MINIMUM) OF 15,000 LBS. OVER A 10" SQUARE



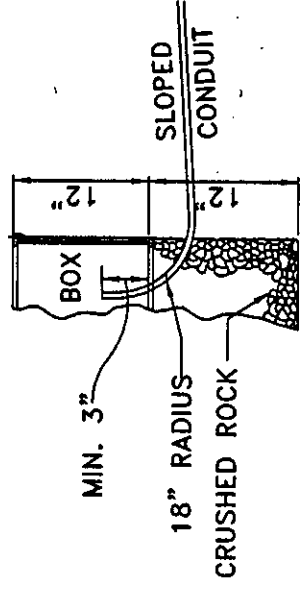
TYPICAL PULL BOX



SECTION A-A

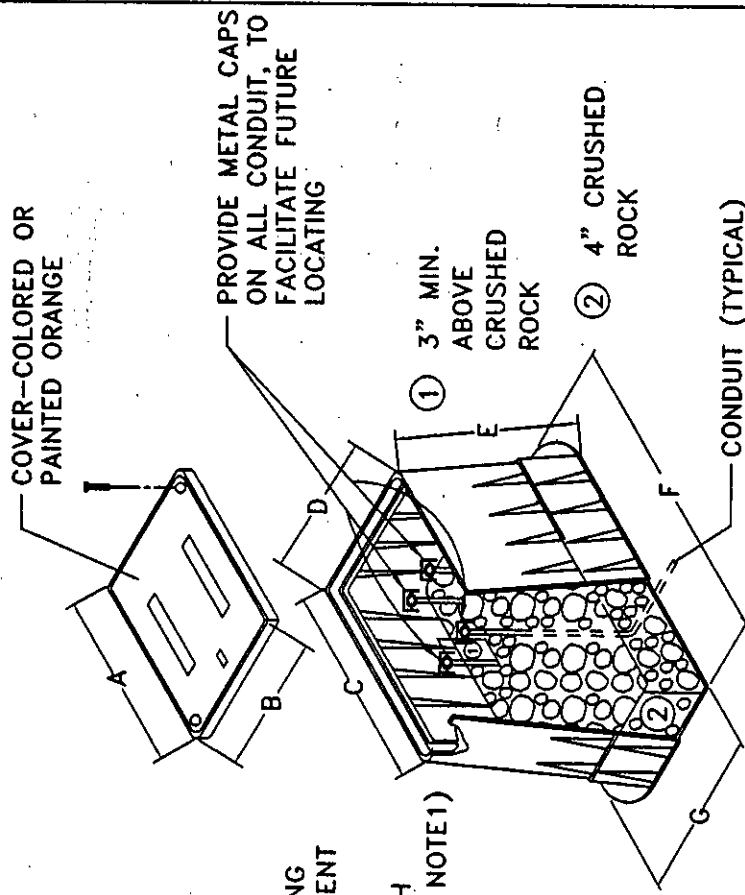
GENERAL NOTES

- PAVEMENT HOLE FOR PULL BOX SHALL BE SAWCUT TO FULL DEPTH, IN A RECTANGLE THAT EXTENDS 6" BEYOND THE EXPANSE OF THE PULL BOX.



TWO BOXES & EXTENSION

(FOR MODIFICATIONS ONLY)



A	B	C	D	E	F	G
11"	11"	12"	12"	13"	12"	12"

TEMPORARY (PLASTIC) PULL BOX DETAIL
 (FOR USE WHEN APPROVED BY COUNTY FOR SPECIAL INSTALLATIONS)

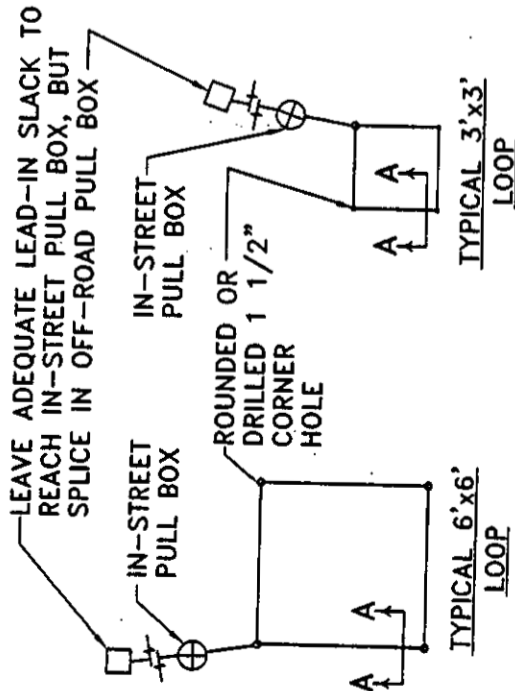


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**DOUGLAS COUNTY
 STANDARD SIGNAL DETAILS**

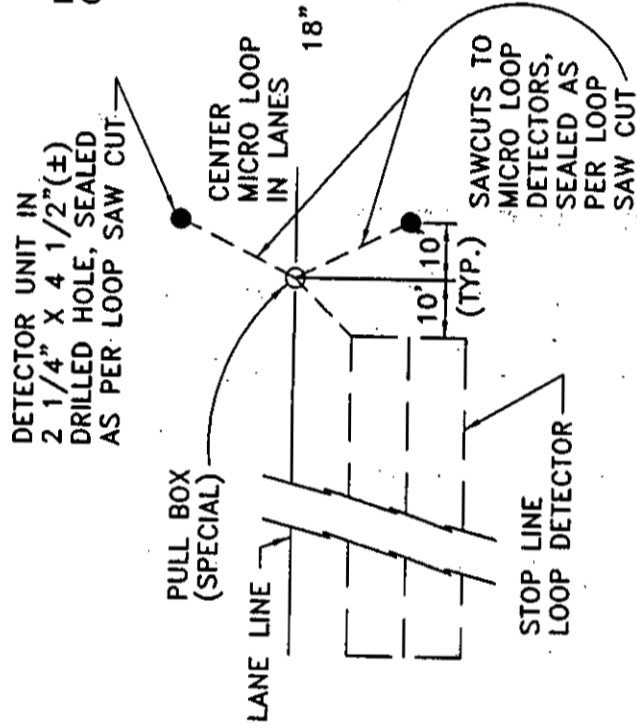
PERMANENT (PRECAST) PULL BOX
 TEMPORARY (PLASTIC) PULL BOX

ORIGINAL 6-93	7/16	DATE	DESIGNED BY: JOB NO.
REVISION 1	APRIL 2002	SCALE	DRAWN BY: SHEET NO.
REVISION 2	APRIL 2003		14 OF 24



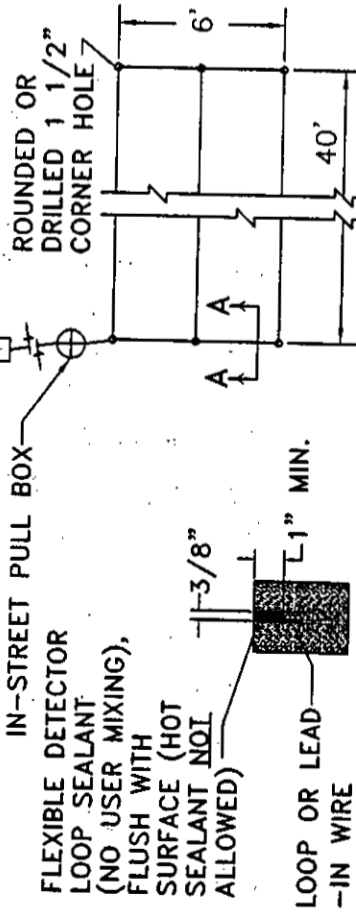
SIZE OF LOOP	NO. OF TURNS
6'x6'	4
3'x3'	4

NO. OF TURNS MAY BE ADJUSTED BY ENGINEER IN FIELD. WIRING CONNECTIONS TO BE FIELD DETERMINED.



MICRO LOOP DETECTOR

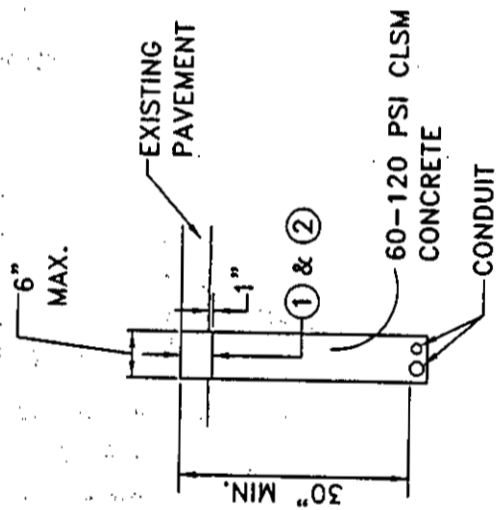
LEAVE ADEQUATE LEAD-IN SLACK TO REACH IN-STREET PULL BOX, BUT SPLICE IN OFF-ROAD PULL BOX



LOOP SAW CUT AND INSTALLATION

NOTES

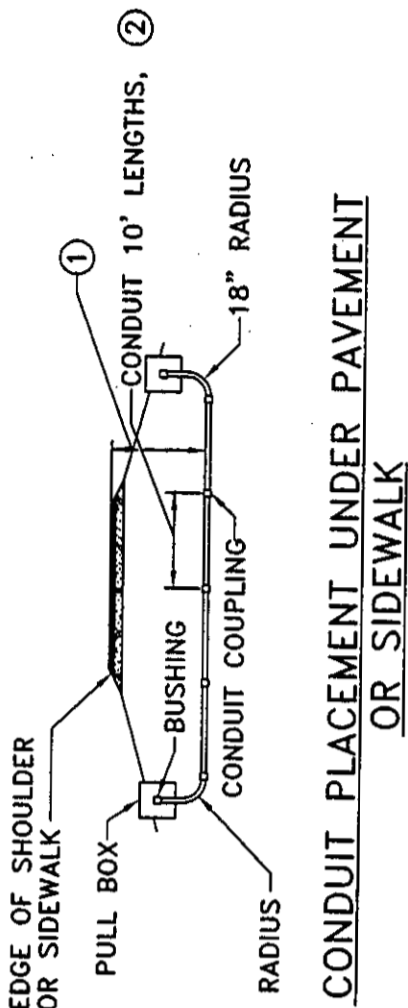
- ALL DETECTOR LOOPS SHALL BE #14 AWG THIN WIRE ENCASED IN PVC OR POLYETHYLENE TUBING.
- IMMEDIATELY BEFORE LAYING THE LOOP CABLE, THOROUGHLY CLEAN WITH HIGH PRESSURE OIL-FREE COMPRESSED AIR.
- LOOP WIRE IN ADJACENT LOOPS SHALL BE LAID UNIFORMLY IN EITHER A CLOCKWISE OR COUNTER-CLOCKWISE DIRECTION AND THE LOOP TAGGED TO INDICATE THE DIRECTION.
- USE A BLUNT, NON-METALLIC INSTRUMENT TO PUSH WIRE INTO SLOT. DO NOT COIL LEADS.
- LOOP WIRE SHALL BE CONTINUOUS (NO SPLICES) FROM THE PULL BOX. SPLICES IN PULL BOX SHALL BE WATERPROOFED WITH SPLICE KIT.
- CONTINUITY TEST FOR EACH LOOP SHALL BE CONDUCTED 1) BEFORE ANY LOOP SEALER IS INSTALLED AND 2) AFTER LOOP SEALER IS INSTALLED AND LEAD-IN CABLE IS SPLICED AND TRAINED TO THE CONTROLLER. "RESISTANCE-TO-GROUND" AND "INDUCTANCE" SHALL BE MEASURED AND RECORDED FOR EACH TEST.
- DETECTOR WIRE ACROSS BRIDGE JOINTS SHALL BE ENCASED IN A 12" SECTION OF 3/4" PVC PIPE THAT SPANS THE JOINT AREA.



CONDUIT TRENCH DETAIL— WITHOUT PAVEMENT FABRIC

NOTES

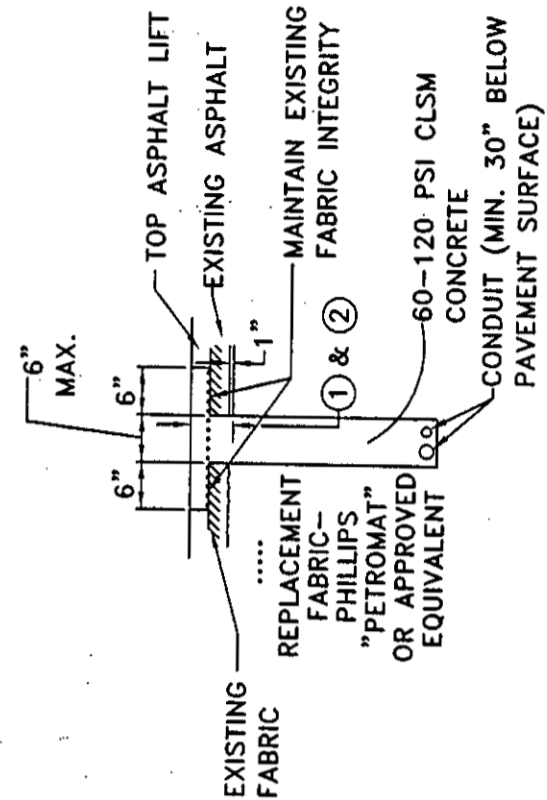
- HOT BITUMINOUS PAVEMENT (PATCHING) OR PORTLAND CEMENT CONCRETE PATCH, FULL DEPTH PLUS 1" (4" MIN), MATCH EXISTING PAVEMENT TYPE.
- FOR ASPHALT PATCH, 48 HOUR NOTICE TO THE ENGINEER REQUIRED PRIOR TO INSPECTION



CONDUIT PLACEMENT UNDER PAVEMENT OR SIDEWALK

NOTES

- MINIMUM UNDER PAVEMENT 30" UNDER SIDEWALK 24"
- ALL PVC CONDUIT SHALL BE SCHEDULE 80



CONDUIT TRENCH DETAIL— WITH PAVEMENT FABRIC



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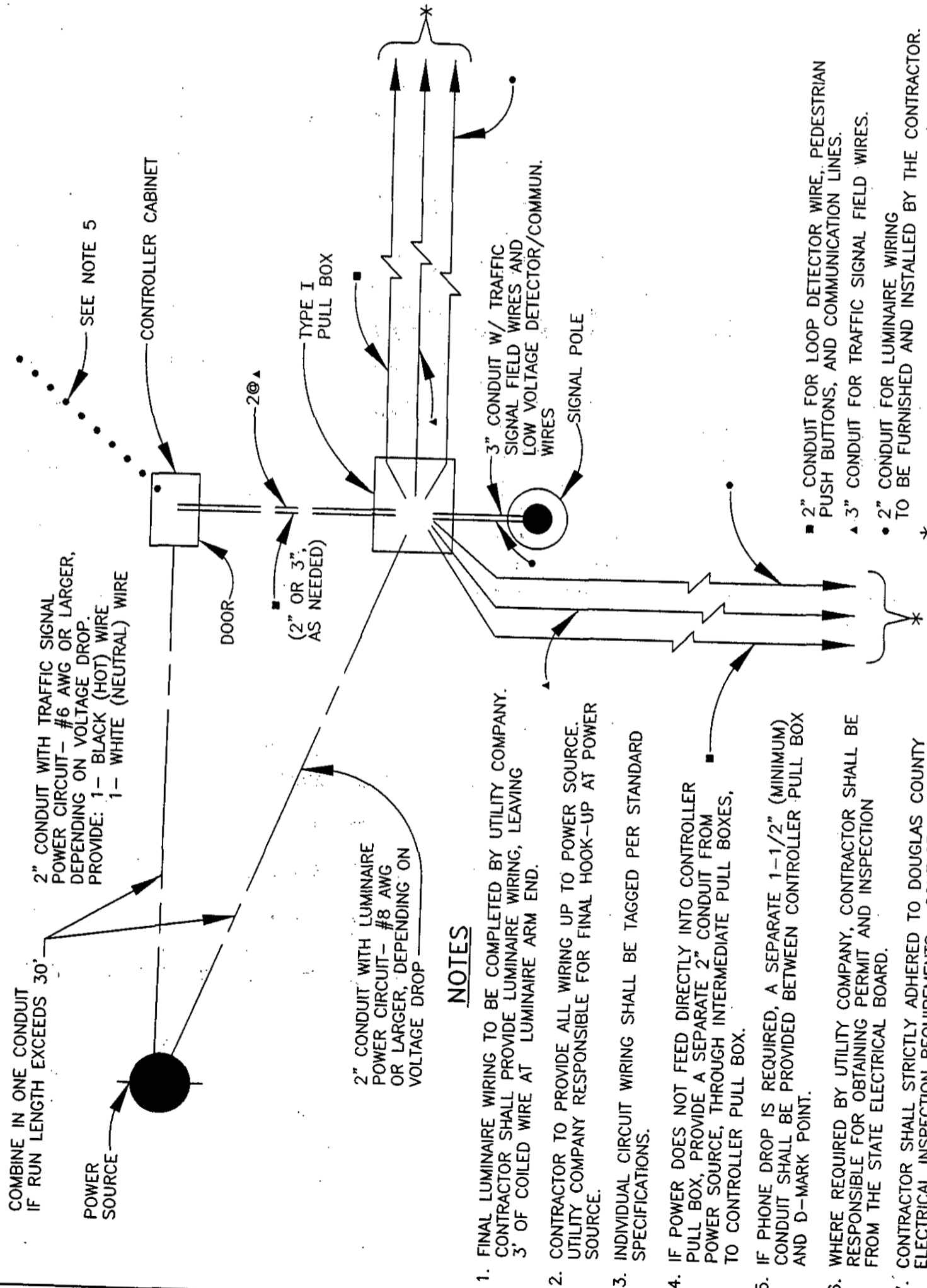
DOUGLAS COUNTY STANDARD SIGNAL DETAILS

DETECTORS
CONDUIT INSTALLATIONS

ORIGINAL 6-83	9/16/16 DATE	DESIGNED BY: JOB NO.
REVISION APRIL 2002	SCALE	DRAWN BY: SHEET NO.
REVISION APRIL 2003		15 OF 24

UNDERGROUND POWER SOURCE SCHEMATIC FOR SIGNALS WITH LUMINAIRES

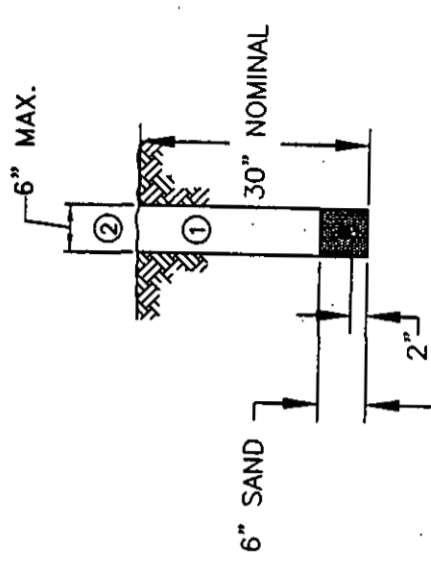
(NO SCALE)



NOTES

1. FINAL LUMINAIRE WIRING TO BE COMPLETED BY UTILITY COMPANY. CONTRACTOR SHALL PROVIDE LUMINAIRE WIRING, LEAVING 3' OF COILED WIRE AT LUMINAIRE ARM END.
2. CONTRACTOR TO PROVIDE ALL WIRING UP TO POWER SOURCE. UTILITY COMPANY RESPONSIBLE FOR FINAL HOOK-UP AT POWER SOURCE.
3. INDIVIDUAL CIRCUIT WIRING SHALL BE TAGGED PER STANDARD SPECIFICATIONS.
4. IF POWER DOES NOT FEED DIRECTLY INTO CONTROLLER PULL BOX, PROVIDE A SEPARATE 2" CONDUIT FROM POWER SOURCE, THROUGH INTERMEDIATE PULL BOXES, TO CONTROLLER PULL BOX.
5. IF PHONE DROP IS REQUIRED, A SEPARATE 1-1/2" (MINIMUM) CONDUIT SHALL BE PROVIDED BETWEEN CONTROLLER PULL BOX AND D-MARK POINT.
6. WHERE REQUIRED BY UTILITY COMPANY, CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING PERMIT AND INSPECTION FROM THE STATE ELECTRICAL BOARD.
7. CONTRACTOR SHALL STRICTLY ADHERED TO DOUGLAS COUNTY ELECTRICAL INSPECTION REQUIREMENTS. CONTACT DOUGLAS COUNTY BUILDING DIVISION AT 303-660-7497 FOR FURTHER INFORMATION.

- 2" CONDUIT FOR LOOP DETECTOR WIRE, PEDESTRIAN PUSH BUTTONS, AND COMMUNICATION LINES.
 - ▲ 3" CONDUIT FOR TRAFFIC SIGNAL FIELD WIRES.
 - 2" CONDUIT FOR LUMINAIRE WIRING TO BE FURNISHED AND INSTALLED BY THE CONTRACTOR.
- * OVERHEAD WIRE FOR SPAN WIRE INSTALLATION



UNDER GRASS/GROUND TRENCHING DETAIL

- ### NOTES
1. BACKFILL AND TAMP WITH NATIVE MATERIAL TO MATCH COMPACTION OF SURROUNDING GROUND.
 2. RESEED OR RESOD SURFACE AT DIRECTION OF THE ENGINEER.



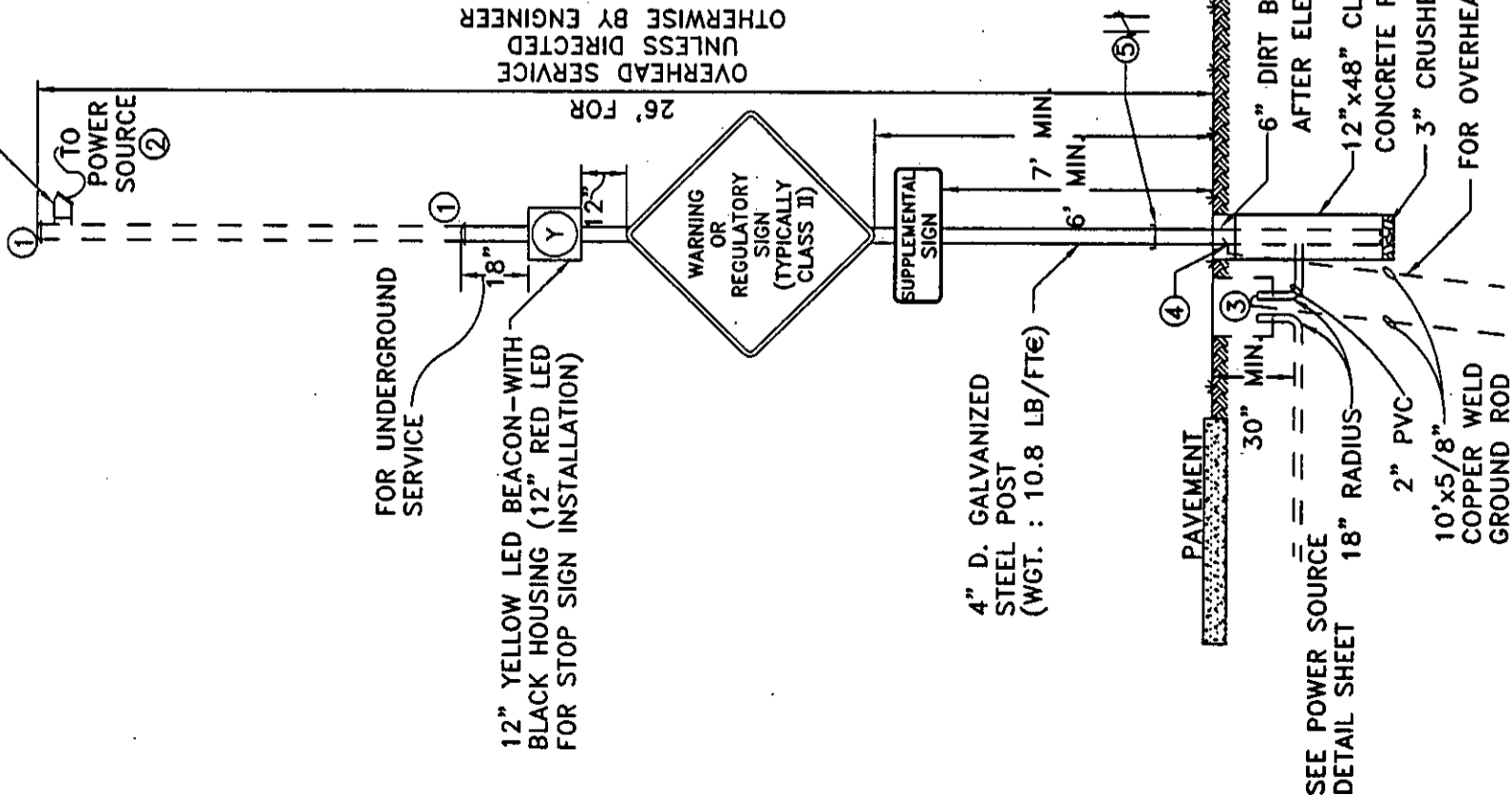
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DOUGLAS COUNTY STANDARD SIGNAL DETAILS

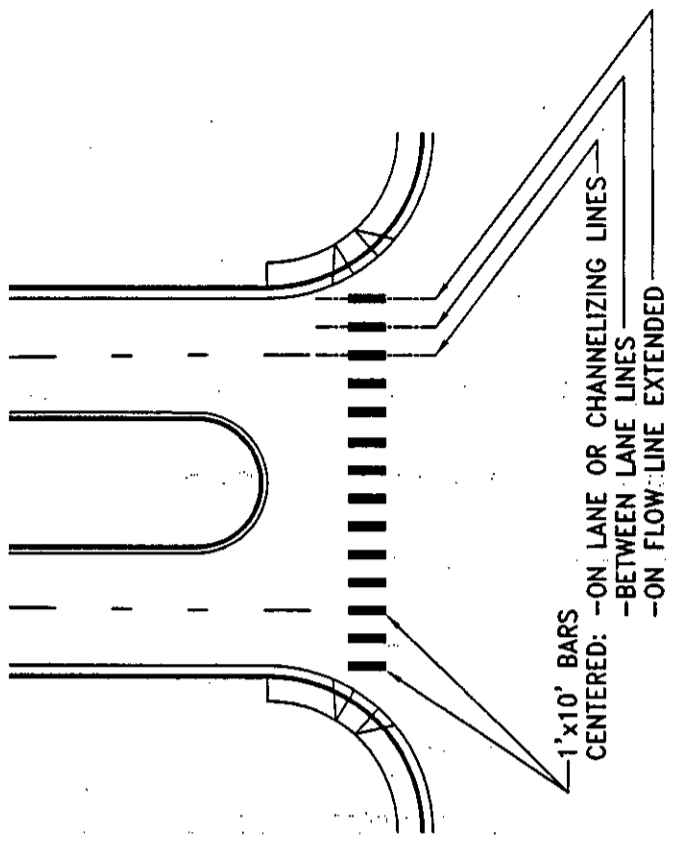
UNDERGROUND POWER SCHEMATIC -
SIGNALS / GROUND TRENCHING

ORIGINAL	6-83	10/16	DATE	DESIGNED BY	JOB NO.
REVISION	APRIL 2003	SCALE	DRAWN BY	SHEET NO.	17 OF 24
REVISION	APRIL 2003				

GALVANIZED STEEL WEATHERHEAD



BEACON SIDE VIEW



NOTES

- ① WATERTIGHT GALVANIZED STEEL POLE CAP
- ② LEAVE 8' COILED WIRE FOR UTILITY COMPANY CONNECTION
- ③ PROVIDE CONDUIT AND TYPE III PULL BOX FOR UNDERGROUND SERVICE ONLY
- ④ BONDING STRAP IN BACKFILL
- ⑤ GALVANIZED STEEL POLE SHALL BE BREAKAWAY STYLE

TYPICAL CROSSWALK MARKING

WARNING OR REGULATORY SIGN FLASHING BEACON ASSEMBLY

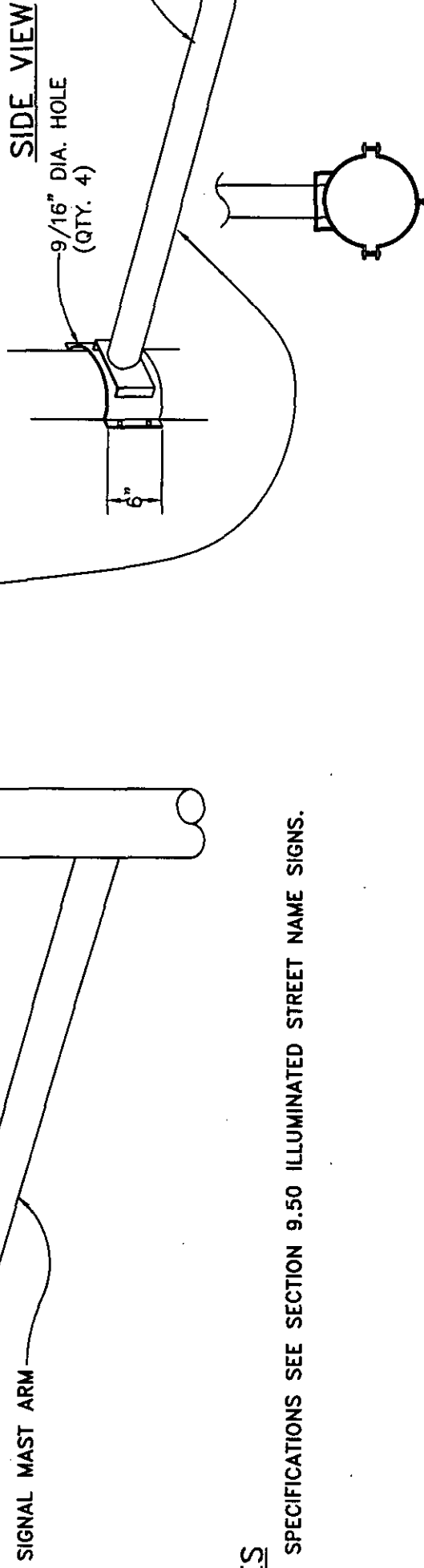
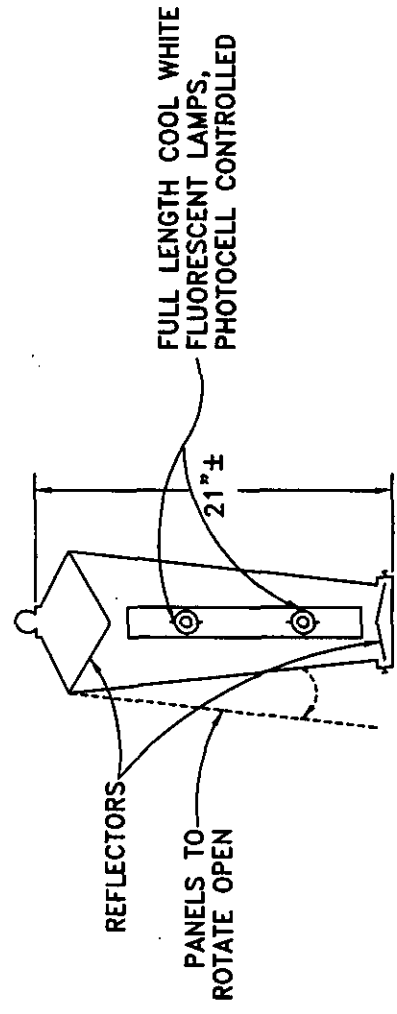
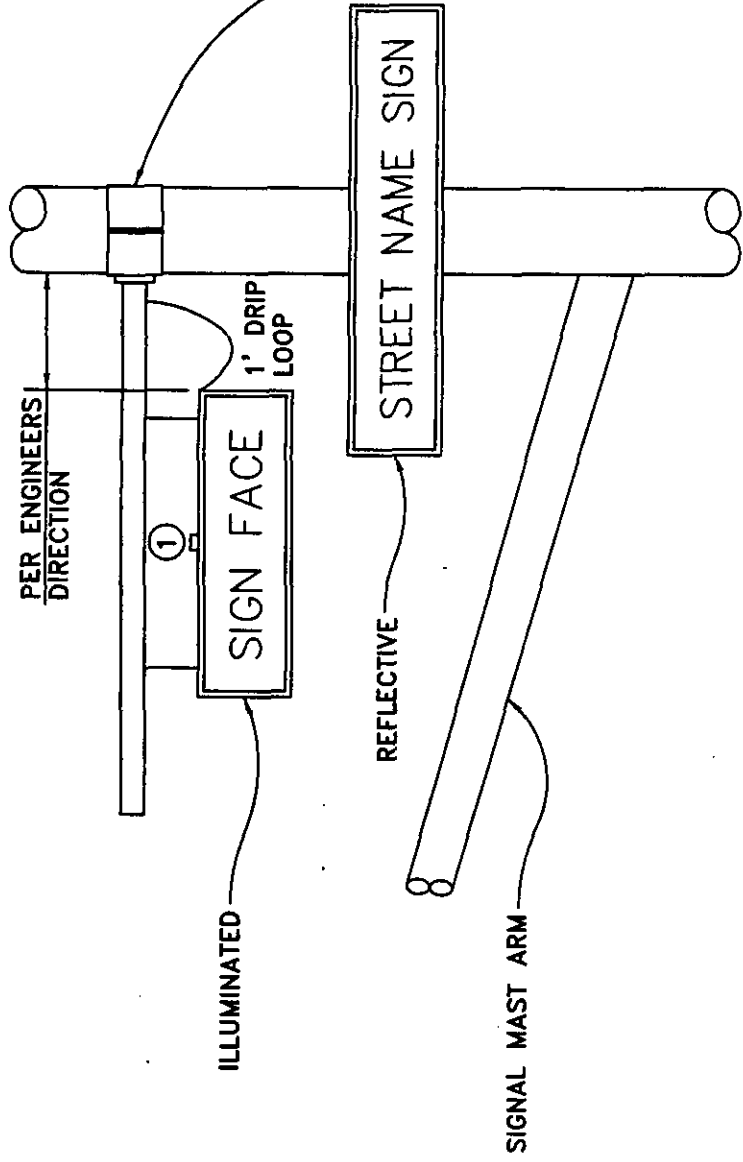


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DOUGLAS COUNTY
STANDARD SIGNAL DETAILS

WARNING/REGULATORY FLASHING BEACON TYPICAL CROSSWALK MARKING	
DESIGNED BY: DOB NO.	DESIGNED BY: DOB NO.
DATE: APRIL 2002	DATE: APRIL 2002
SCALE:	SCALE:
REVISION: APRIL 2002	REVISION: APRIL 2002
DRAWN BY:	DRAWN BY:
SHEET NO. 21 OF 24	SHEET NO. 21 OF 24

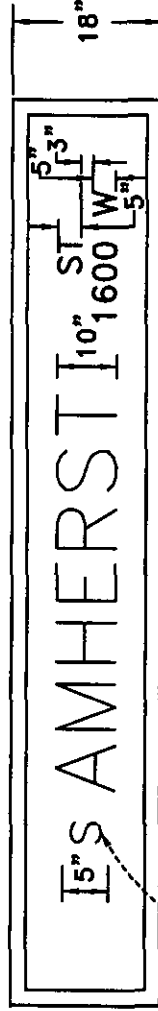
① PHOTOELECTRIC CELL



NOTES

1. FOR SPECIFICATIONS SEE SECTION 9.50 ILLUMINATED STREET NAME SIGNS.

STANDARD MOUNT (OVER MAST ARM)



VARIES
FOR NORTH/SOUTH OR EAST/WEST STREET INCLUDE LETTER DESIGNATION (5" LETTER) BETWEEN LOGO AND STREET NAME

TYPICAL SIGN LAYOUT

GENERAL NOTES

1. STREET NAME SIGN TO BE FREE-SWINGING OR LIMITED-SWINGING. SIGN FIXTURE AND PANELS SHALL WITHSTAND 90 MPH WIND LOADING, WITH STRUCTURAL REQUIREMENTS MEETING AASHTO "STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS," LATEST EDITION.
2. HOUSING TO BE CONSTRUCTED OF ALUMINUM.
3. NEOPRENE GASKETS SHALL BE INSTALLED BETWEEN THE SIGN PANEL FRAME AND FIXTURE HOUSING TO PREVENT WATER ENTRANCE. SCREENED WEEP HOLES SHALL BE PROVIDED ON HOUSING BOTTOM FOR DRAINAGE.



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**DOUGLAS COUNTY
STANDARD SIGNAL DETAILS**

ILLUMINATED STREET NAME SIGN

ORIGINAL: 06-93	15/18 DATE:	DESIGNED BY: JOB NO.
REVISION:	SCALE:	DRAWN BY: SHEET NO.
REVISION:	APRIL 2003	APRIL 2003
REVISION:	APRIL 2003	22 OF 24

