

APPENDIX 'C'

SPECIFICATIONS FOR TRAFFIC SIGNALS

**SPECIFICATIONS
FOR THE
UNDERGROUND TRAFFIC SIGNAL PLANT AND
SURFACE TRAFFIC SIGNAL HARDWARE
INSTALLATION
ON
KENASTON BOULEVARD AND PTH #100 INTERSECTION**

INDEX

<u>SECTION</u>	<u>ITEM</u>	<u>PAGE No.</u>
1.0	Project Terms of Reference	1
2.0	Sequence of Work.....	1
3.0	Basis of Payment.....	1
4.0	Scope.....	2
5.0	Contract Drawings	2
6.0	Materials	3
7.0	Excavation / Backfill and Compaction	9
8.0	Underground Traffic Signal Plant Installation.....	12
9.0	Surface Traffic Signal Hardware Installation	21
10.0	Clean Premises.....	27
11.0	Special Provisions for the Underground Traffic Signal Plant and Surface Traffic Signal Hardware Installations.....	28
12.0	Traffic Signal Plant Commission Checklist	30

1.0 PROJECT TERMS OF REFERENCE

Provision of Services related to the Underground Traffic Signal Plant and Surface Traffic Signal Hardware Installation at the location listed: Kenaston Boulevard and PTH #100 Intersection

Provide Construction Services in accordance with Contract Drawings and Specifications as follows:

1. Installation of all underground electrical conduits in accordance with the contract drawings and specifications.
2. Installation of all concrete pile foundations, and underground splice / pull pits in accordance with the contract drawings and specifications.
3. Installation of waxed fish line in all electrical conduits in accordance with the contract drawings and specifications, and all electrical cables in accordance with the Canadian Electrical Code specifications.
4. Installation of all surface traffic signal hardware in accordance with the contract drawings and specifications.
5. Installation of all surface hand-hole wiring and connections of electrical equipment as required by the contract drawings and specifications.
6. Provisions for traffic control when required.
7. Responsible for site restoration and clean up.
8. Responsible to supply all non-Manitoba Infrastructure and Transportation (MIT) supplied material in accordance with the Contract Drawings and Specifications.

2.0 SEQUENCE OF WORK

Construction as follows:

1. Stage 1 – Install all electrical conduits, concrete pile foundations, and splice / pull pits as per Drawing 7994 – Traffic Signal Underground Plan.
2. Stage 2 – Install all surface traffic signal hardware, and traffic control devices as per Drawing 7994 – Traffic Signal Surface Plan.
3. Sub-contractor to work in conjunction with general contractor to coordinate the flow of work.

3.0 BASIS OF PAYMENT

- (a) Payment for the underground traffic signal plant, and surface traffic signal hardware installation will be paid as a lump sum price for “Traffic Signals” for completing all operations herein described and all other items incidental to the work included in this Specification. The amount to be paid for will be the total

percentage installed in accordance with this Specification and accepted by the Contract Administrator. A bill of materials is supplied in Section 6.5 to assist in developing a lump sum cost for the “Part A” Traffic Signal works.

4.0 SCOPE

This Specification shall cover the new underground traffic signal plant, new surface traffic signal hardware and traffic control device installations at the location listed.

5.0 CONTRACT DRAWINGS

Dimensional details of the specified traffic signal installation are shown in the contract drawings. Installations shall be performed in accordance with applicable drawings.

Minor deviations from the contract drawings may be required in the field where unknown underground obstructions are encountered. The Contractor shall not however, make such changes without the consent and approval of the Engineer.

The Engineer will mark termination points and concrete base locations before work commences.

5.1 Contract Drawing	Number	Date	No. of Pages
Standard Symbols for Traffic Signal Installations	E-000a	May 2009	1
Controller Base (“M” Controller Cabinet) – Type IV	E-004a	May 2004 - <i>modified</i>	1
Type V Controller / Power Pedestal Base	E-005	Jul 2004	1
Typical U/G Conduit Cable Fill, Urban Semi Actuated	E-014c	Jul 2004	1
Typical Signal Display	E-015	Jan 2001	1
Light Series 2.5m Davit	S-3 / E-016p	Apr 2012	1
Light Series Davit Stub (5.0m Davit)	S-4 / E-016f	Apr 2012	1
Light Series Davit Extension Arm	S-5 / E-016g	Apr 2012	1
Heavy Series Combination Cantilever Vertical Shaft	S-9 / E-016w	Apr 2012	1
Heavy Series Combination Cantilever Advance Warning Sign	S-10 / E-016r	Apr 2012	1
Heavy Series Combination Cantilever Traffic Signal Arm	S-11 / E-016s	Apr 2012	1
Luminaire Extension Shaft (multiple luminaire installations)	S-13 / E-016l	Apr 2012	1
Hydro Luminaire Adaptor (multiple luminaire installations)	S-14 / E-016t	Apr 2012	1
Access Panel – Mark AP1	S-15 / E-016a	Apr 2012	1

Handhole – Mark H1	S-15 / E-016b	Apr 2012	1
Tenon Cap – Mark TC1	S-15 / E-016z	Apr 2012	1
Conduit Splice Detail	E-027	Jun 2004	1
Trenching/ Backfill Detail for Traffic Signal Conduits	E-035	Mar 1995	1
Typical Communications Service	E-038	Jun 2004	1
Underground Slice/Pull Pit (Modified) to Unfinished Areas – Type III	E-039b	July 2007	1
Underground Slice/Pull Pit to Finished and Unfinished Areas – Type IV	E-039c	Apr 2009	1
Light Series 5 Meter Davit (Type 2)	E-112b	May 2006	1
Light Series 2.5 Meter Davit (Type 2)	E-112c	May 2006	1
Combination Luminaire Heavy Series Cantilever (Type 7)	E-112f	Sept 2006	1
29 mm (1 1/8”) Dia. Anchor Bolt	AB1	Mar 2012	1
51mm (2”) Dia. Anchor Bolt	AB3	Mar 2012	1
Light Series Foundation Type F1	F1	Mar 2012	1
Heavy Series Foundation Type F5	F4	Mar 2012	1
Typical Traffic Signal Specifications with Advance Warning Flashers	TO-057a	Aug 2008 - <i>modified</i>	4
Traffic Signal Plans (Underground and Surface)	7994	Apr 2014	2

6.0 MATERIALS

6.1 Supplied by the Contractor

The following materials shall be supplied by the Contractor where required:

- (a) Redi-Mix concrete
- (b) Backfill Material
- (c) Sand (for open trenches)
- (d) Hot or cold asphalt mix
- (e) Uni-stone sidewalk pavement
- (f) Top soil and grass seed, or sod
- (g) CSA approved cable pulling lubricant
- (h) Light gauge PVC electrical tape
- (i) Reinforcing steel
- (j) Concrete cure and protection system
- (k) 38 mm and 50 mm electrical conduit and couplings
- (l) Electrical Conduit plugs
- (m) Fish line (waxed twine)
- (n) 13 mm conduit (for ground wire in concrete pile foundations)
- (o) Concrete pile foundation templates

- (p) Applicable traffic signal electrical cables
- (q) Underground splice / pull pits
- (r) Traffic signal controller, adaptor pedestal, and cabinet
- (s) Traffic signal standards, as specified
- (t) Traffic signal heads and mounting hardware
- (u) Breakaway safety bases
- (v) #6 bare ground wire, and insulated green grounding wire
- (w) 3.0 m copper clad ground rods, and clamps
- (x) Applicable electrical service entry equipment
- (y) Applicable telemetry service equipment
- (z) Galvanized steel banding and fasteners
- (aa) Traffic signal head covers

6.1.1 Materials & Equipment Suppliers List

- (a) Anchor bolts; 29 mm c/w bottom anchor bolt setting template as per F1 foundation specification. 51 mm c/w bottom anchor bolt setting template as per F5 foundation specification. Distributor – Mallard Forestry Equipment at 379 Robertson Road in Bethel, Prince Edward Island, C1B 3T2
Phone: Blair Mallard at 902-569-3524
- (b) Safety bases complete with reaction plates & shroud for anchor bolts. Distributor – Safety Base at 1036 Waverley Street in Winnipeg, Manitoba, R3T 0P3
Phone: Brent Pooles at 204-896-1333
- (c) Traffic Signal Controller – Eight Phase Fully Actuated as per Province of Manitoba Specs ASC/3 (Slave) complete with “M” type cabinet. Distributor – Econolite Canada Inc. at 110 Travail Road in Markham, Ontario, L3S 3J1
Phone: Scott Sherlock at 905-294-9920
- (d) Polycarbonate 3 section 300mm signal heads complete with backboard and ITE Compliant red, green, and yellow LED smooth outer surface lenses; 6 Astro Brackets and 2 sets of yellow arms c/w shoes; one “2 – Approach Advance Digital Radar Detection System”; and one “2 – Approach Matrix Digital Radar Detection System” c/w special cable. Distributor – Fortran Traffic Systems Ltd at 470 Midwest Road in Scarborough, Ontario, M1P 4Y5
Phone: Dino Falco at 416-288-1320
- (e) Splice Boxes Duo Molding Polymer Concrete 13 X 24 – 18 inch c/w cover and mounting bolts & washers. Distributor – HD Supply Utilities at 7 – 1099 Wilkes Avenue in Winnipeg, Manitoba, R3P 2S2
Phone: Kimberley Mandziuk at 204-284-3834

- (f) Ground Rods copper clad c/w clamps and # 6 Bare Copper Ground Wire. Distributor – EECOL Electric Ltd at 1760 Wellington Avenue in Winnipeg, Manitoba, R3H 0E9
Phone: 204-784-6943
- (g) All Poles. Distributor – Valmont Westcoast Engineering at 1450 Saskatchewan Avenue in Winnipeg, Manitoba, R3E 0L3. Phone: 204-987-3113
- (h) 36 Conductor Cable, 7 Conductor Cable; (All conductors copper solid # 14 AWG .045 PVC Jacket with .025 P.E. Insulation Color Coded Latest I.M.S.A. Spec 19-1), #6 AWG Green Insulated Ground Wire; Communication Cable (6 Twisted Pair, 19 AWG Tinned Copper, Stranded, Plus Drain Wire, Color Coded and Insulated as per Manitoba Infrastructure & Transportation (MIT) Spec E-099 and I.M.S.S. Spec 39-2, 36 Conductor Cable (All Conductors shall be #14 AWG Solid Copper, except for White Conductor [Neutral] shall be # 10 AWG Stranded Copper. The 1st color is the base color and the 2nd color is the tracer color. I.M.S.A. Spec 19-1). Distributors: Anixter Canada Inc in Winnipeg; Phone 204-633-6631 or Texcan Cable also in Winnipeg; Phone 204-982-9290. **Must state that this cable must be color coded as per MIT Spec.**

6.2 Anchor Bolt Setting Templates

Manitoba Infrastructure and Transportation (MIT) shall loan out all concrete pile foundation templates required to install anchor bolts in the concrete pile foundations.

The Contractor shall sign out all the anchor bolt setting templates taken from MIT, and sign in the anchor bolt setting templates returned to the MIT. The anchor bolt setting templates, and sign out / in sheet are located at 8385 Wilkes Avenue, Headingley, Manitoba (Traffic Signal Workshop).

All anchor bolt setting templates shall be cleaned free of all concrete residue, and any other debris, and returned to the MIT Traffic Signal Workshop on completion of the contract.

The Contractor shall be charged the replacement cost of the anchor bolt setting templates not returned to the MIT Traffic Signal Workshop, or returned in poor condition i.e. (broken or bent arms on the anchor bolt setting templates).

6.3 Materials General

Materials supplied by the Contractor shall be new, conform to the requirements of the CSA Standard – CAN/CSA-A23.1 and be approved by the Engineer before any construction is undertaken.

Materials not specified particularly, and which are indicated elsewhere as being required (including minor accessories such as connectors, fasteners, tape, etc. which are considered incidental to the work) shall be of standard construction grade materials supplied in accordance with CSA Standard – CAN/CSA-A23.1 to suit the application as required by recognized trade practice.

All materials supplied under this Specification shall be subject to inspection and testing by the Engineer. There shall be no charge to the Engineer for any materials taken for testing purposes.

All testing of materials shall conform to CSA Standard – CAN/CSA-A23.2.

6.3.1 Cement

Cement shall be Type 50 (Type HS or HSb), Sulphate Resistant Cement, conforms to CSA Standard – CAN/CSA-A23.1.

6.3.2 Supplementary Cementing Materials

Use of pozzolans, fly ash, or silica fume will not be permitted for use in structural concrete supplied under this Specification

6.3.3 Water

It shall be equal to potable water in physical and chemical properties.

6.3.4 Admixtures

No admixtures other than air-entraining agent shall be used without the written authorization of the Engineer, unless otherwise specified in these Specifications. It shall be the Contractor's responsibility to ensure that any admixture is compatible with all other constituent materials.

6.3.5 Air-Entraining Agent

The air-entraining agent shall conform to the requirements of CSA Standard – CAN3-A266.1 and shall produce a satisfactory air-void system and an air content within the ranges specified in CSA Standard – CAN/CSA- A23.1 for each class of concrete.

6.3.6 Water-Reducing Agent

If the Engineer authorizes the use of a water-reducing agent, it shall be Type WN and shall conform to the requirements of CSA Standard – CAN3-A266.2.

6.3.7 Superplasticizing Agent

If the Engineer authorizes the use of a superplasticizing agent, the superplasticizing agent shall conform to the requirements of CSA

Standard – CAN3-A266.5 and CAN3-A266.6. The agent shall be free of chlorides and shall not affect the air-entraining agent's ability to produce a satisfactory air-void system.

The grout shall be a consistency suitable for the application intended, as approved by the Engineer.

6.3.8 Concrete Cure and Protection System

Concrete cure and protection system shall be CS 309 made by WR Meadows, as supplied by G.D. Johnston Ltd., or equal as approved by the Engineer.

6.3.9 Reinforcing Steel

Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.

All reinforcing steel shall conform to the requirements of CSA Standard – G30.18, Grade 400W, Billet-Steel Bars for Concrete Reinforcement. All reinforcing steel shall be new deformed billet steel bars.

Reinforcing steel supply and installation shall be incidental to concrete pile foundation installations and no separate payment will be made.

6.3.10 Conduit and Coupling Pipe

The 50 mm and 38 mm polyethylene pipe shall be Type 1, Grade 3 (i.e. low density) material as specified in ASTM Standard D1248 latest issue. The polyethylene pipe shall be Type 1, and shall be in accordance with CSA Standard B137.1 latest issue. The inside diameter of the 50 mm polyethylene pipe shall be 50 mm, and inside diameter of the 38 mm polyethylene pipe shall be 38 mm.

The coupling pipe shall be the same specifications as the 50 mm and 38 mm polyethylene pipe. The inside diameter of the coupling pipe shall not be greater than 1.5 mm and not less than 0.5 mm than the cable duct requested.

6.3.11 Miscellaneous Materials

Miscellaneous materials shall be of the type specified on the drawings or approved by the Engineer.

6.4 Transportation and Storage

The Contractor is responsible for transportation and storage of all materials and equipment required for this project or to make arrangements for pick-up of Manitoba Infrastructure and Transportation supplied materials (i.e. base templates). Finding a suitable storage area or compound is also the responsibility of the contractor.

The contractor shall not store material on the construction site if installation of said equipment is not complete within one day. The Contractor is responsible for finding a suitable storage location of materials and equipment as approved by all parties, including the Engineer, The City of Winnipeg and Manitoba Infrastructure and Transportation.

All materials shall be stored in accordance with CSA Standard - CAN/CSA-A23.1 or with the Engineer's instructions to prevent damage, soiling or finish spoilage.

6.5 Bill of Materials

LOCATION: PTH 100 at KENASTON		
PROJECT: INSTALL TRAFFIC SIGNALS		
MATERIAL	QUANTITY	UNIT
TRAFFIC SIGNAL CONTROLLER	1	EACH
HEAVY SERIES CANTILEVER UPRIGHTS	4	EACH
15 M HEAVY SERIES CANTILEVER SIGNAL ARM	2	EACH
10.5 M HEAVY SERIES CANTILEVER ADVANCE ARM	2	EACH
LIGHT SERIES DAVIT STUB	1	EACH
2.5 M LIGHT SERIES DAVIT ARM	1	EACH
2.5 M LEFT TURN DAVIT	1	EACH
GROUND ROD	9	EACH
BREAKAWAY BASE SHROUD	2	EACH
1 1/8 BREAKAWAY BASE	2	EACH
SPLICE PITS	11	EACH
1 1/8 REACTION PLATES	2	EACH
36 CONDUCTOR CABLE	300	METERS
3 SECTION SIGNAL HEAD C/W LEDS & BACKBOARD	8	EACH
YELLOW ARMS	2	EACH
LEFT TURN LED LENS	2	EACH
LUMINAIRE ADAPTERS	2	EACH
ASTRO BRACKETS	6	EACH
HEAD NUTS	12	EACH
THERMOSTAT	2	EACH
8.4 M LUMINAIRE EXTENSION SHAFT	2	EACH
200 MM SINGLE SECTION	4	EACH
29MM ANCHOR BOLT	8	EACH
51 MM ANCHOR BOLTS	16	EACH
200 MM AMBER LED LENS	4	EACH
7 CONDUCTOR CABLE	100	METERS
# 6 GREEN GROUND WIRE	300	METERS
2 CONDUCTOR LEAD IN CABLE	70	METERS
3 CONDUCTOR # 8	50	METERS
COMMUNICATION CABLE	100	METERS
WAVETRONIX DETECTION SYSTEM	1	EACH
3 CONDUCTOR # 14 CABLE	600	METERS
AAWD LIGHTING FIXTURE	2	EACH

MALE SLIP CONNECTORS	60	EACH
FEMALE SLIP CONNECTORS	60	EACH
MISCL MOUNTING HARDWARE	1	EACH
POWER PEDESTAL	1	EACH
ADVANCE WARNING SIGN	2	EACH
2 CONDUCTOR # 10 CABLE	600	METERS
M-1 ADAPTER PEDESTAL	1	EACH
MISCL SERVICE MATERIAL	1	EACH
# 6 BARE COPPER GROUND WIRE	45	METERS
INSTALLING TYPE F1 BASES	2	EACH
INSTALLING TYPE F5 BASES	4	EACH
BUILDING BERMS	4	EACH
INSTALLING TYPE V BASE	1	EACH
INSTALLING SPLICE/PULL PIT	11	EACH
TRAFFIC CONTROL & EXTRA WORK	1	EACH
INSTALLING TYPE IV BASE	1	EACH
MANITOBA HYDRO SERVICE INSTALLATION	1	EACH
INSTALLATION OF ABOVE GROUND HARDWARE	1	EACH
INSTALLING TYPE II CONDUIT	300	METERS
INSTALLING TYPE I CONDUIT	250	METERS

Note: Quantities for major items listed above (controller, cantilever/davit poles, signal heads etc.) are accurate based on traffic signal design drawings. Minor items listed above (conduit, conductors, connectors etc.) are approximate.

7.0 EXCAVATION / BACKFILL AND COMPACTION

7.1 Excavation

Excavation for traffic signal installations will involve the removal and disposal of material encountered in open trenching for placement of electrical conduit, installation of concrete traffic signal bases, concrete controller base, underground splice / pull pits, and screw anchor bases.

The full width of the bottom of excavations shall be trimmed to the required depth. Where specified by the Engineer, at locations where unsuitable soil is encountered or due to substandard condition of the bottom of the excavation, the Contractor shall remove such soil and replace same with approved granular material, the granular material shall be compacted to a minimum of 90% of Standard Proctor Density before placement of approved fill material.

Sub-grade compaction shall be permitted only when soil conditions are in a state favourable to compacting operations. Sub-grade compaction shall not be permitted where excess water has appeared, as a result of natural or artificial means, to form local or continuous pondage. The Contractor shall exercise the necessary precautions to protect the compacted area against excess wetting from any natural or artificial sources of water application.

7.2 Backfill Material

Backfill material shall consist of sound hard crushed rock or crushed gravel and shall be free from organic or soft material, which would disintegrate through decay or weathering. All backfill material shall be supplied by the Contractor, be well graded throughout and conform to the following grading requirements.

CANADIAN METRIC SIEVE SIZE	PERCENT OF TOTAL DRY WEIGHT PASSING EACH SIEVE	
	GRANULAR	CRUSHED LIMESTONE
25 000	100%	100%
20 000	80% - 100%	40% - 70%
5 000	40% - 70%	25% - 60%
2 500	25% - 55%	25% - 60%
315	13% - 30%	8% - 25%
80	5% - 15%	6% - 17%
The material passing the 315 sieve shall have a liquid limit not greater than twenty-five (25) and a plasticity index not greater than six (6).		

7.3 Backfill

The Contractor shall be responsible for all open trench work other than roadways. Electrical conduits shall be installed by licenced electricians as directed by the Engineer. Electrical conduits placed in all open trenches shall be surrounded by 300 mm of sand for protection purposes. Open trenches in grassed areas shall be backfilled and compacted in 150 mm layers with material excavated from the trench, and top soil and grass seed for site restoration. If the excavated material from the grassed area trench is too wet to compact in 150 mm layers then granular material shall be used. Open trenches in sidewalks (asphalt, concrete, or interlocking stone) shall be backfilled and compacted in 150 mm layers with granular material to within 150 mm of the existing grade, sidewalk replacement, and site restoration. Refer to contract drawing number E-035.

Open trench across paved (asphalt, concrete) or gravel roadway – The Contractor shall be required to get approval from MIT to open trench any roadway. The Sub-Contractor shall make all the necessary arrangements with the General Contractor of the contract to backfill and compact the open trench to the MIT Specifications. Immediate action shall be required to backfill and compact the open trench in the roadway. The General Contractor shall be paid at the applicable contract unit price for this item.

Underground splice / pull pits in grassed areas shall be backfilled and compacted in 150 mm layers with material removed from the excavation to within 150 mm of the grassed area grade. If the excavated

material from the grassed area trench is too wet to compact in 150 mm layers then granular material shall be used. The project engineer shall determine if the excavated material is suitable for backfill. Underground splice / pull pits in paved areas shall be backfilled and compacted in 150 mm layers with granular material, or with a lean unshrinkable concrete mix to within 150 mm of the paved surface.

Concrete pile foundations shall be backfilled and compacted with granular material, or with a lean unshrinkable concrete mix up to 50 mm from the top of the concrete pile foundation, and up to 100 mm from the top of the controller concrete pile foundation as directed by the Engineer.

No additional payment shall be made for backfill material as it will be considered incidental to the work of this specification.

7.4 Quality of Backfill

The Standard Proctor Density for the backfill materials shall be determined at the optimum moisture content in accordance with ASTM Standard D698.

Field Density Tests taken in accordance with ASTM Standard D2922, Test of Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) shall verify the field density of the backfill materials.

7.5 Compaction

Compaction shall be obtained by manual or mechanical tampers or other means approved by the Engineer.

Compaction shall reach a density level of 90% of the maximum dry density as determined by the Standard Proctor Compaction test or a density equivalent to that of the surrounding unexcavated material.

7.6 Disposal of Excavated Material

The Contractor shall dispose of unsuitable and surplus material at locations approved by the Engineer.

7.7 Site Restoration

All locations that involve traffic signal installations shall be restored to the satisfaction of the Engineer. Site restoration shall also include cleaning of the site upon completion of the work.

8.0 UNDERGROUND TRAFFIC SIGNAL PLANT INSTALLATION

8.1 Buried Utilities

The Contractor shall exercise extreme caution when installing underground electrical conduits and constructing the pile foundations in the vicinity of existing buried utilities. The Contractor shall be responsible for obtaining the exact location of the buried utilities from the appropriate Utility Authority prior to installing electrical conduits or concrete pile foundations.

The proposed locations of the underground electrical conduit installations, or concrete pile foundations may be changed by the Engineer if they interfere with buried utilities.

The Contractor shall be responsible for all costs that may be incurred for repair / rectification of any damage caused to the existing buried utilities as a result of the Contractor's operations in installing underground conduits, or constructing concrete pile foundations, as determined by the Engineer.

The Contractor shall be responsible for all underground utility clearances for the underground traffic signal plant installation. At the request of the Engineer the Contractor shall make available all the underground utility clearance documents for the underground traffic signal plant installation.

The Contractor shall expose all the underground utilities using hydro vac equipment before any installation of underground electrical conduits or concrete pile foundations. The Engineer on site shall inspect the exposed underground utility before any installations takes place. Minor deviations to the underground conduit installation or concrete pile foundation may be required for the installations to continue. Sand shall be used to backfill and compact the exposed underground utility excavation.

Installation of a concrete pile foundation at or near any underground utility shall be excavated using hydro vac equipment.

The Utility Authority shall determine the minimum distance from their equipment for the safe installation of the concrete pile foundation, or electrical conduit.

Underground utilities under existing roadways – the roadway surface shall be cored or saw cut, and hydro vac equipment used to expose the underground utility. Lean mix unshrinkable concrete shall be used to backfill the excavated area of the exposed underground utility, and asphalt or concrete used to match the existing roadway surface where it was cored or saw cut.

No additional payment shall be made for backfill material as it will be considered incidental to the work of this specification.

8.2 Installing Electrical Conduits

The Underground Traffic Signal Plant Installation – The Contractor shall supply all the electrical conduits and couplings (50 mm and 38 mm).

Electrical conduit shall be installed by licenced electricians as directed by the Engineer. The electrical conduit shall be identified as Type I (38 mm) or Type II (50 mm). Electrical conduit to be installed may consist of either a single length of electrical conduit or several lengths of electrical conduit up to four (4) maximum placed side by side as specified on the drawings.

The normal installation depth shall be a minimum of one meter below street level, however the Engineer may vary the depth of individual installations to avoid underground obstructions, or for any other purpose deemed necessary or advisable.

The drilling, auguring or open trenching for the electrical conduit installation shall be performed by an experienced equipment operator.

The following conditions shall apply for electrical conduit installations:

- (a) Electrical conduit shall be installed by drilling under paved sidewalks, and under highway surfaces, which are paved, or being prepared for pavement.
- (b) A maximum of (4 x 50 mm or 4 x 38 mm) or any combination of four i.e. (2 x 50 mm and 2 x 38 mm) electrical conduits shall be installed in a single drilling operation.
- (c) A maximum of (4 x 50 mm or 4 x 38 mm) or any combination of four i.e. (2 x 50 mm and 2 x 38 mm) electrical conduits shall be installed in a single trench.
- (d) Where electrical conduits are intended to be installed in open trenches or in previously excavated areas they shall be installed in accordance with the Canadian Electrical Code Standards.

In general, electrical conduits shall be installed without underground splices. Underground splices, which cannot be avoided, shall be installed by a licenced electrician as directed by the Engineer. Where electrical conduits are spliced they shall be spliced in accordance with contract drawing number E-027.

The electrical conduit splice shall be constructed using an oversize electrical conduit (minimum length 450 mm) and four (4) stainless steel screw type hose clamps.

Electrical conduit splices shall be regarded as incidental to the installation of underground electrical conduits.

Electrical conduit shall be terminated in one of the following ways:

- (a) Entry into a concrete pile foundation
- (b) Securing electrical conduits above ground to an existing wood pole
- (c) Entry into the underground splice / pull pit
- (d) Entry into a “screw anchor” base
- (e) Electrical conduit shall be blown clean or swabbed out prior to installing fish line, and electrical cables
- (f) Electrical conduit plugs, and or electrical tape shall be installed to prevent entrance of foreign material into the spare electrical conduits

Traffic Signal electrical cables shall be pulled into electrical conduits by licenced electricians as directed by the Engineer. .

Under no circumstances shall electrical cable splices be permitted between termination points.

Traffic Signal electrical cables shall not be pulled into electrical conduits until all concrete pile foundations, and underground splice / pull pits have been set to grade. These electrical cables shall be pulled by hand only. The use of winches or other Power Actuated Pulling Equipment shall not be permitted. Only electrical cable pulling lubricants specifically approved by the Canadian Standards Association for pulling electrical cables into electrical conduits shall be used.

When traffic signal electrical cables and pedestrian push button electrical cables are to be terminated in a pole base, a minimum of 2.0m of slack shall be left for each electrical cable, to allow for connections and proper dressing of the conductors.

When electrical cables are to be terminated in a controller base, a minimum of 3.0 m of slack shall be left for each electrical cable, to allow for connections and proper dressing of the conductors.

When electrical cables are to be terminated in an underground splice / pull pit, a minimum of 1.0 m shall be left for each electrical cable, to allow for connections and proper dressing of the conductors.

When electrical cables for (advance signals or warning flasher signs) pass through an underground splice / pull pit, an unbroken slack loop of 1.0 m minimum shall be left for each electrical cable to allow for proper dressing of the electrical cables within the underground splice / pull pit.

When electrical service cable is to be terminated at an approved service pole a minimum of 4.0 m shall be left to allow service entrance switching equipment to be attached at a height of 3.0 m above grade.

When communication cable is to be terminated at an approved service pole a "Termination Height" shall be obtained from "Manitoba Telecom Service". Sufficient slack shall be left to extend beyond that, "Termination Height" by a minimum of 1.5 m to allow for connections and proper dressing of the conductors.

8.3 Installing Concrete Pile Foundations

8.3.1 General

This specification covers all concreting operations related to construction of new cast-in-place traffic signal and controller concrete foundations.

The Work to be done by the Contractor under this specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and compliance of all Works as hereinafter specified.

No additional payment shall be made for cleanup and site restoration as it will be considered incidental to the Work for this Specification.

8.3.2 Layout of the Work

Pile Foundations shall be placed in the positions shown on the drawings and as directed by the Engineer.

The Engineer shall lay out the centre of the pile foundations and the elevation to the top of the concrete. The Contractor shall be responsible for providing offset markers or elevations prior to the start of construction.

The deviation of the axis of any finished pile foundation shall not differ by more than one percent from the vertical.

8.3.3 Materials General

Notwithstanding and in addition to *Specification No. 1018M "Specifications for Placing Cast-in-Place Concrete Piles"*, the following shall apply.

The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Engineer. Storage of materials shall be in accordance with CSA Standard A23.1 (latest edition).

8.3.4 Testing and Approval

All materials supplied under this Specification shall be subject to inspection and testing by the Engineer. There shall be no charge to The City of Winnipeg or Manitoba Infrastructure and Transportation for any materials taken by the Engineer for testing purposes.

All materials shall be approved by the Engineer before any construction is undertaken. If, in the opinion of the Engineer, such materials in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such materials shall be rejected by the Engineer and replaced by the Contractor at his own expense.

8.3.5 Concrete Pile Foundation and Reinforcing Steel

The concrete pile foundation shall be drilled to the indicated depth ensuring that shaft is dry and free of debris until concrete is placed.

The reinforcing steel cage for the concrete pile foundation is then installed into the pile prior to the concrete being placed.

8.3.6 Forms

The top 600 mm of the concrete pile foundation shall be formed with tubular forms (Sonotube).

A minimum of 75 mm of clear cover shall be provided to all embedded reinforcing steel.

The forms shall be sufficiently rigid to prevent lateral or vertical distortions from the loading environment to which they shall be subjected. Forms shall be set to the design grades, lines, and dimensions, as shown on the drawings.

8.3.7 Installation of Anchor Bolts

The anchor bolts shall be aligned with the concrete pile foundation template matching the bolt holes in the signal structure base plate. The traffic signal arm alignment shall be determined by the Engineer on site.

29 mm, 32 mm, and 50 mm anchor bolts have a pre-fabricated anchor bolt setting template (top setting template) attached to the top of the anchor bolts supplied by MIT.

Prior to placement of concrete, the top setting template shall be oiled (both inside and out) for ease of removal and cleaning. Extreme care shall be used in this operation.

29 mm diameter and 50 mm diameter anchor bolts have a pre-fabricated anchor bolt brace (bottom setting template) attached to the bottom of the

anchor bolts. The bottom setting template is cast-in-place in the concrete foundation.

The pre-fabricated anchor bolt brace (bottom setting template) for 50 mm diameter anchor bolts shall be held in place by the extra nuts supplied with the 50 mm diameter anchor bolts. The bottom setting template is placed on the bottom threads of the 50 mm anchor bolt and the nuts are placed on the top and bottom of the bottom setting template. The 29 mm diameter anchor bolts - the bottom setting template sits on the curved ends of the 29 mm diameter anchor bolts.

Placement of anchor bolts without the steel concrete pile foundation template and pre-fabricated anchor bolt brace (bottom setting template) where required shall not be permitted.

The anchor bolts shall not be tied or otherwise in contact with the reinforcing steel.

The threaded portion of the anchor bolts projecting above the concrete surface shall be taped with light gauge PVC electrical tape, before the concrete is poured, to minimize the fouling of threads splattered by concrete residue.

8.3.8 Installation of Electrical Conduits in Concrete Pile Foundations

The installation of electrical conduits into the traffic signal concrete pile foundation shall be installed by licenced electricians. Four (4) electrical conduits consisting of (2 – 50 mm) and (2 – 38 mm) shall be installed in each concrete pile foundation as shown on the Drawings. The electrical conduits shall enter 900 mm minimum below ground level and shall protrude through the centre of the concrete pile foundation. The (2 – 38 mm) electrical conduits shall be installed as spares, shall be plugged with an approved electrical conduit plug or electrical tape at each end and protected to ensure future accessibility.

An additional (1 – 13 mm) electrical conduit shall be installed by licenced electricians in the the centre of each concrete pile foundation as directed by the Engineer The 13 mm electrical conduit is not shown on the concrete pile foundation drawings.

The supply and installation of electrical conduits shall be considered incidental to the Work of this Specification.

8.3.9 Installation of Grounding Conductor

The grounding conductor shall be installed by licenced electricians. The copper clad ground rod (3.0 m), and ground wire shall be installed adjacent (within 1.0 m) to each concrete traffic signal pile foundation. The #6 bare copper ground wire shall be connected to the ground rod with a ground rod clamp. The ground wire shall then be installed

through the (13 mm) conduit to the centre of the traffic signal concrete pile foundation, and terminated above the concrete pile foundation in a 1.0 m coil.

The installation of this grounding conductor shall be considered incidental to the Work of this Specification.

8.3.10 Placing Concrete

The threaded portion of the anchor bolts projecting above the concrete surface shall be taped with a light gauge PVC electrical tape before the concrete is poured, to minimize the fouling of threads splattered by concrete residue.

8.3.11 Concrete

Concrete shall conform to *Specification No. 1030 (I)*, “*Specifications for Reinforced Cast-in-Place Concrete*” and shall be the type therein described for cast-in-place piles.

8.3.12 Concrete Mix Design

Proportioning of fine aggregate, coarse aggregate, cement, water, and air entraining agent shall be such as to yield concrete having the required strength and workability as follows:

- (a) Class of Exposure: S-1
- (b) Minimum Compressive Strength at 28 days = 35 MPa
- (c) Maximum Water/Cement Ratio = 0.4
- (d) Minimum Cement Content = 340 kg/m³
- (e) Slump = 80 mm (± 20 mm)
- (f) Aggregate: 40 mm nominal
- (g) Air Content: Category 2 per Table 4 of CSA A23.1-04 (4 to 7%)
- (h) Cement: Type 50 (HS or HSb) high-sulphate-resistant hydraulic cement
- (i) Temperature of concrete at discharge: between 15C and 25C

Should compatible superplasticizing admixtures be approved by the Engineer, the slump after addition of the superplasticizer shall be 170 mm (± 40 mm)?

8.3.13 Concrete Testing

In addition to *Specification 1030 (I)* “*Specification for Reinforced Cast-in-Place Concrete*” the following shall apply.

All concrete delivered to the project site for new concrete pile foundations shall be tested. No concrete shall be discharged from the concrete truck until there is a third - party concrete technologist on site to perform concrete testing.

AMEC, Eng-Tech, and Stantec Consulting Ltd. (formerly National Testing Laboratories Limited), perform on site concrete tests, and laboratory tests.

All the concrete test results shall be e-mailed to the Engineer.

A minimum 26MPa (75%) compressive strength is required for the safe installation of the traffic signal pole on the new concrete pile foundation.

The Contractor shall be responsible for all the required concrete tests, and all costs incurred for the concrete tests.

No additional payment shall be made for concrete testing as it is considered incidental to the Work of this Specification.

8.3.14 Protection of Newly Placed Concrete

Freshly placed concrete shall be protected with a tarpaulin or other approved means.

8.3.15 Curing Concrete

The top of the freshly finished concrete pile foundations shall be covered and kept moist immediately following finishing operations and shall be maintained at or above 10C (Celsius) for at least three (3) consecutive days thereafter.

Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping or running water, vibration, and mechanical shock. Concrete shall be protected from freezing until at least twenty-four hours after the end of the curing period.

Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3C (Celsius) in one hour or 20C (Celsius) in twenty-four hours.

Concrete damaged due to negligence: i.e. chipped, cracked, left unprotected in adverse weather (rain or snow etc.). The Engineer on site shall request the concrete pile foundation be removed and replaced. The removal and replacement of the concrete pile foundation shall be at the Contractor's own expense.

8.3.16 Concrete Pile Foundation Template Removal

After the concrete has been placed the Contractor shall determine the length of time required for the safe removal of the concrete pile foundation template to complete a first class concrete finish on the surface of the concrete pile foundation. The template shall be placed back on the concrete pile foundation after the first class concrete finish has been completed. After the concrete has cured the Contractor shall determine if the template can be safely removed from the concrete pile

foundation. Removal of the template shall be done in a manner to avoid damage to, or spalling of, the concrete.

Any damage (i.e. cracking or chipping the concrete) of the concrete pile foundation surface during removal of the concrete pile foundation template shall be inspected by the Engineer on site. The Engineer on site shall determine the extent of the damage, and decide whether the concrete pile foundation shall be repaired or replaced. Any repair or replacement of the concrete pile foundation shall be at the Contractor's own expense.

8.3.17 Placement of Concrete in Cold Weather

Protection of concrete shall be considered incidental to its placement. The temperature of the concrete shall be maintained at or above 10C (Celsius) for a minimum of three (3) consecutive days or until the concrete has reached a minimum compressive strength of 20MPa, by whatever means are necessary. Concrete damaged as a result of inadequate protection against weather conditions (i.e. freezing rain or snow) shall be rejected and replaced by the Contractor at his own expense. Concrete allowed to freeze prior to (3) days will be rejected and replaced by the Contractor at his own expense.

8.3.18 Backfilling around Concrete Foundations

In addition to *Specification 1002 M "Specifications for Supplying and Placing Granular Backfill"*, the following provisions will apply. Placed concrete shall be allowed to cure for a minimum of 24 hours prior to backfilling and compaction of an approved granular material around the concrete pile foundation.

For traffic signal pole foundations, backfill shall be placed up to 50 mm from the concrete pile foundation surface. For controller foundations, backfill shall be placed up to 100 mm from the controller foundation surface.

No additional payment shall be made for the supply and placement of backfill material as it shall be considered incidental to the Work of this Specification.

8.4 Installing Underground Splice / Pull Pits

Underground Splice / Pull pits to be installed shall be identified on the contract drawings and shall be marked by the Engineer before work commences.

The Engineer shall determine the number of electrical conduits terminated in the underground splice / pull pit. The electrical conduits shall be installed by licenced electricians.

Underground Splice / Pull Pits shall be installed in accordance with contract drawing number: E-039c.

No additional payment shall be made for the supply and placement of backfill material, or site restoration as it shall be considered incidental for the Work of this Specification.

9.0 SURFACE TRAFFIC SIGNAL HARDWARE INSTALLATION

9.1 Electrical and Communication Service

Under no circumstances shall the Electrical Contractor perform any work on a Manitoba Hydro owned wood pole or service pedestal without the written permission of the Manitoba Hydro Engineering Department.

The Electrical Contractor shall apply for a Manitoba Hydro electrical permit for each service location. The Electrical Contractor shall install and connect that portion of the electrical service and communication service to be constructed on a Manitoba Hydro owned wood pole or service pedestal. The Department technicians shall install the traffic signal control pedestal. The Electrical Contractor shall install underground electrical conduits and electrical cables for the electrical and communication service from the wood pole or service pedestal to the base provided for the traffic signal control cabinet. The Department technicians shall complete all wiring connections within the traffic signal control cabinet.

9.2 Installation of Traffic Signal Standards

9.2.1 General

The Electrical Contractor shall install all the traffic signal standards on the concrete bases after the standard curing time minimum 26MPa (75%) compressive strength. The type and location of these standards will be specified on the location drawings. Type and location of standards shall be verified with the Engineer prior to installation.

Traffic signals and accessories shall be assembled in accordance with applicable drawings. Traffic signal heads, and “safety bases” shall be attached to the various standards as shown on the location drawings. Minor deviations from these drawings may be requested by the Engineer to suit field conditions.

No direct payment will be made to the Electrical Contractor for attaching the various traffic control devices to the standards, as it will be considered incidental to the unit price for “installation of standards”.

The price for the “installation of standards” will be payment in full for:

- (a) Transporting the standards and traffic control devices to the installation site.
- (b) Installing levelling nuts, washers and “safe-t-bases” where specified.
- (c) Erecting the standard.
- (d) Attaching the various traffic control devices, i.e. traffic signal heads, extension shafts and arms.
- (e) Drilling the standard to allow riser cables to enter the various devices.
- (f) Installing a separate riser cable to each signal head.
- (g) Providing sufficient slack for the riser electrical cables to be connected and dressed at the access panel.
- (h) Connecting the riser electrical cable at each device as directed by the Engineer.
- (i) Providing sufficient slack for the underground electrical cables at the access panel, stripping back the outer jackets approximately 300 mm, connecting all underground conductors (colour to colour) with No. 33 Murette connectors, under the direction of the Engineer.
- (j) Identifying and labelling the various underground and riser electrical cables at the access panel.
- (k) Providing a nylon or polypropylene ‘fish string’ from the luminaire tenon to the underground splice / pull pit at the base of the combination standards.
- (l) Dressing the conductors to allow easy access for the final inspection, tests and connections; securing the access panel and handhole cover plates in the closed position.
- (m) Installing the appropriate signal LED displays and aligning the traffic control devices with the appropriate pedestrian or vehicle paths.
- (n) Covering the traffic signal heads (with covers provided) until switch-on day.
- (o) Cleaning the site upon completion of the work.

9.2.2 Grounding

Install complete grounding system including conductors, connectors and accessories as indicated on drawings. Install connectors in accordance with manufacture’s instructions. Protect exposed grounding conductors from mechanical injury.

9.2.3 Fastenings

Prevent electrolytic action between dissimilar metals and materials. Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

9.2.4 Fastener Installation Instructions for Traffic Signal Poles

The following procedures should be used for tightening fasteners associated with traffic signal support structures. Structural bolts should be tightened in accordance with the turn-of-nut method. Turn-of-nut installation is a method of tightening bolts with no requirements for torque wrenches or calibration concerns.

9.2.4.1 Definitions

Turn- of-nut: Is a method of bolt installation whereby the nut is tightened relative to the bolt head by a set amount of rotation. It consists of a simple three-step process: 1) Snug-tighten all bolts in the joint, 2) Match-mark the nut and protruding end of the bolt, 3) Rotate the nut by the required amount.

Snug-Tight: The tightness that is required to bring the plies (i.e. plates) into firm contact, typically obtained by the full effort of an ironworker using an ordinary wrench, or a few impacts of an impact wrench.

9.2.4.2 Procedure for Anchor Bolts

For poles fixed to foundations (no breakaway base present), nuts and washers should be installed above and below the base plate. The lower “levelling” nuts should be as close to the concrete surface as possible. Once the structure is plumbed, both top and bottom nuts should be brought to a “snug-tight” condition. Then, the top nuts shall be tightened by the “turn-of-nut” method as follows:

- For anchor bolts less than or equal to 38 mm diameter (1.5”), 1/3 of a turn.
- For anchor bolts greater than 38 mm diameter, 1/6 of a turn.

The nuts and protruding end of the bolts should be match-marked with a permanent marker prior to final tightening to determine when the required rotation has been achieved. The lower levelling nut should be held to ensure it does not rotate relative to the top nut. Anchor bolt nuts can be turned using the following methods:

- Use an impact socket wrench.
- Use a standard wrench fitted with a pipe one or two meters in length and turn manually.

- Use a steel wrench fabricated from (1”) or thicker plate steel, together with a sledge hammer to turn by impacting the wrench with the hammer. Open wrenches (for levelling nuts) and closed end wrenches (top nuts) are typically available from the steel fabricator upon request. A sample anchor bolt nut may be required to determine the exact wrench size required.

If applicable, half nuts (i.e. jam nuts) should be installed above the full-size top nut, and after the full size top nut has been fully tightened. The half nut should be installed to a “snug-tight” condition.

Anchor bolts should be lubricated with beeswax or other high-wax lubricant prior to tightening.

Lock washers should not be used in anchor bolt connections.

9.2.4.3 Breakaway Base Assemblies

For installation of all breakaway base assembly components and fasteners, please follow the manufacturer’s directions. This is critical for the proper safe functioning of the breakaway base assembly.

9.2.4.4 Flange and Splice Bolts

Structural bolts (flange and splice bolts) connecting parts of the pole should be tightened as follows:

All nuts and bolts in the joint should be brought to a “snug-tight” condition. It is noted that once a particular bolt is brought snug-tight, it may subsequently become loose due to the tightening effect of other bolts. Both plies (i.e. flange plates) should be firmly in contact. It may take several passes around all bolts to achieve a “snug-tight” condition. Once all bolts are snug-tight and the connection is in firm contact, the nuts and the protruding end of the bolts should be match marked using permanent marker, and then tightened using the “turn-of-nut” method as follows:

- Bolt lengths up to 4 bolt diameters: 1/3 of a turn
- Bolt lengths between 4 and 8 bolt diameters: ½ of a turn
- Bolt lengths between 8 and 12 bolt diameters: 2/3 of a turn

The length of a bolt is defined as the distance from the underside of the bolt head to the tip of the bolt.

The bolt head should be held to ensure it does not rotate relative to the nut.

New bolts that do not come pre-lubricated should be lubricated with beeswax or other high-wax lubricant.

Once fully tightened structural bolts have been installed, they should not be removed and reinstalled / tightened. New nuts and bolts should be used in these cases.

9.2.4.5 Miscellaneous Fasteners

For miscellaneous fasteners (i.e. handhole bolts, grounding assemblies, etc.) these items are not structural bolts, therefore should be tightened in accordance with any applicable electrical standards and guidelines.

9.3 Testing and Documentation

All portions of the electrical work shall be tested and documented by the Electrical Contractor for satisfactory operation. The Engineer will provide the Electrical Contractor with one additional set of plans (hereafter referred to as “as-built plans”) to be used for recording work as actually installed. The Electrical Contractor shall record daily, on the “as-built” plans, accurate locations of the underground traffic signal plant and surface traffic signal hardware. Any deviations from the proposed plans shall also be documented. Clearance heights for all overhead traffic control devices shall be documented on the “as-built” plans as directed by the Engineer.

The Electrical Contractor shall conduct electrical field tests at various stages throughout the project and functional tests when the project has been energized. The results of the tests shall be documented by the Electrical Contractor on the “as-built” plans.

The tests shall be conducted in the presence of the Engineer. The Engineer shall certify the results of each test on the “as-built” plans.

The Electrical Contractor shall provide the necessary test instruments, equipment and qualified personnel to conduct the prescribed tests. Where any tests indicate faulty workmanship or unacceptable electrical measurements, the Electrical Contractor shall repair the fault to the satisfaction of the Engineer. Repeat tests may be requested by the Engineer where performance of the electrical system indicates a deficiency.

9.4 Electrical Field Tests

Prior to the start of the “Functional Testing” the Electrical Contractor shall perform the following electrical field tests:

9.4.1 Continuity Tests

Each conductor in the system shall be tested for continuity from its point of original to the point of termination.

9.4.2 Grounds and Short Circuits

Each conductor in the system shall be tested and proven free of unspecified ground faults and short circuits.

9.4.3 Resistance to Ground of Grounded Parts

The resistance to ground of all grounded equipment shall not exceed twenty-five (25) OHMS.

9.4.4 Insulation Resistance

An insulation resistance (Meggar test) at 500 volts D.C. shall be made between each conductor in the system and a suitable ground. This value shall not be less than ten (10) OHMS.

9.5 Requirements for Switch-On

The Engineer shall be the sole judge of the work performed by the Electrical Contractor with regard to quality of workmanship and quality of material supplied. Prior to switch on, all equipment as documented on the "as-built" plans shall be in place and operable. All traffic signal faces shall be aimed and directed to provide maximum visibility. Illumination at the intersection, existing or being installed in conjunction with the traffic signals, shall also be in place and operable before the traffic signals are energized.

The Electrical Contractor shall complete the attached Traffic Signal Plant Commission Checklist and have it signed by the Engineer for the entire installation before a switch-on day shall be considered. The Engineer shall advise the Electrical Contractor three working days in advance of the proposed switch-on date. Twenty-four (24) hours prior to the commencement of the functional test period the Electrical Contractor shall (under the direction of the Engineer) uncover the traffic signal heads and "stand by" while the Engineer switches the traffic signals into the "flashing" mode. The traffic signals shall remain in the "flashing" mode for a 24-hour period. The switch into "functional test" mode shall be made between 09:00 hours and 14:00 hours on any working day except a Friday or the day before a statutory holiday.

The Electrical Contractor shall also "stand by" while the Engineer switches the traffic signals into the "functional test" mode in the event that some overhead signal lamps should have failed and require immediate replacement.

9.6 Functional Test

A functional test shall be made in which it is demonstrated that each and every part of the contracted portion of the project functions as specified.

The functional test period for the project shall consist of not less than 5 days of continuous, satisfactory operation. If unsatisfactory performance of the system develops in that period and (in the opinion of the Engineer) the fault can be attributed to poor workmanship on the part of the Electrical Contractor, the condition shall be corrected by the MIT, at the Electrical Contractor's expense and the test period shall be repeated until 5 continuous days of satisfactory operation is obtained.

The installation shall only be considered "complete" when the Contractor has received written approval from the Engineer. At that time, the completed "as-built" plans shall be handed over to the Engineer to become the property of MIT.

9.6.1 Guarantee

The Contractor shall guarantee his work and any material supplied, against all defects for one full calendar year following the date the installation was accepted as complete by The City of Winnipeg and Manitoba Infrastructure and Transportation. If unsatisfactory performance of the system develops in this period and (in the opinion of the Engineer) the fault can be attributed to poor workmanship or poor quality material supplied by the Contractor, the condition shall be corrected by MIT Staff at the expense of the Contractor.

9.6.2 Payment for Testing

No additional payment shall be made to the Contractor for conducting the various tests or for documenting the "as-built" plans or for "standing by" for the switch-on periods as it will be considered incidental to the unit price for the "installation of the surface traffic signal hardware".

10.0 CLEAN PREMISES

During the course of the work, the Contractor shall keep the workplace in a neat and tidy condition satisfactory to the Engineer. The Contractor shall, upon the completion of the work, remove all temporary structures and clean away all rubbish, surplus and waste material remaining on or about the workplace satisfactory to the Engineer.

10.1 Pollution Control

The Contractor shall conduct the work in accordance with current legislation concerning pollution control, including The Clean Air Act, The Clean Water Act, and other related legislation.

The Contractor shall clean up any deposits of waste arising from work, which may cause subsequent pollution. Should the Contractor fail to do so, the Engineer shall without further notice, arrange for the clean up of such deposits at the expense of the Contractor.

11.0 SPECIAL PROVISIONS FOR THE UNDERGROUND TRAFFIC SIGNAL PLANT AND SURFACE TRAFFIC SIGNAL HARDWARE INSTALLATION

11.1 Traffic Control

The Contractor shall provide Traffic Control in accordance with The Manitoba Work Zone Manual (Edition 2003). See Section 1 of the General Contract; Special Provisions, Traffic Control.

The Contractor shall provide a traffic control plan which illustrates the Contractor's proposed sequence of operations to Stantec for review and endorsement with the project team, including The City of Winnipeg and Manitoba Infrastructure and Transportation. The Contractor shall provide the Engineer written verification that every flag person on the project has been trained by a qualified trainer.

11.2 Preconstruction Meeting

The General Contractor will advise the successful Contractor, shortly after the award of this contract of the place and time of the preconstruction meeting. The project engineer will discuss the tender and the proposed construction schedule.

11.3 Quality of Work

- (a) Ensure Quality of Work is of highest standard, executed by workers experienced, skilled, and licenced, in respective duties for which they are employed. Immediately notify Engineer if required Work is such as to make it impractical to produce the required results.
- (b) Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with the Engineer, whose decision is final.
- (c) Licenced Electricians shall be required to install the underground traffic signal plant, surface traffic signal hardware.

11.4 Contractors Equipment

All equipment shall be of a type approved by the Engineer and shall be kept in good working order.

The Contractor shall provide all necessary equipment to complete the work within the scheduled time frame. Failure to provide the necessary equipment for the project will result in work stoppage for the Contractor until all the necessary equipment is at the project site.

- (a) Auger / Coring equipment for drilling concrete pile foundations.
- (b) Sleeving equipment in the event that water is encountered while drilling concrete pile foundations.
- (c) Trenching equipment to provide a single trench (Minimum 100 mm to a Maximum 300 mm Wide x 1000 mm Deep).
- (d) Horizontal directional drill only for electrical conduit installations.

- (e) Backhoe and operator.
- (f) Compressor, (hose, jackhammer, and drill c/w drill bit capable of installing 38 mm and 50 mm conduits).
- (g) Plate Compactor or Jumping Jack Compactor
- (h) Soft exposure equipment (hydro vac) shall be used for all: underground utilities, Traffic Signal concrete bases near underground utilities, and the underground Traffic Signal plant.
- (i) Portable water pump and hose shall be on site for all concrete pile foundation installations in the event that water is encountered.
- (j) Portable electric concrete vibrator shall be on site for all concrete pile foundation installations – minimum length required 2 meters.
- (k) Portable generator to power all electrical equipment and tools.
- (l) Bucket truck – minimum 5 ton bucket truck with 10,000 lb. lifting capacity.

11.5 Open Trench in Paved and Gravel Roadways

When the Contractor has proven to the satisfaction of the Engineer that an electrical conduit installation cannot be made through the roadway, approval shall be granted to “Open Trench” the roadway. The Contractor shall make all the necessary arrangements with the General Contractor of the contract to backfill and compact the open trench to MIT Specifications. The General Contractor shall be paid at the applicable contract unit price for this item.

11.6 Supply and Placement of Concrete

Notwithstanding the terms of the Specifications for Concrete Pavement, the Contractor shall provide concrete and include the cost of it in his unit price for “Installing Concrete Pile Foundations”. The Contractor shall provide the Engineer with a copy of all “Concrete Delivery Slips” showing the type of concrete delivered to the project site.

11.7 Sequence of Work

The Contractor shall prepare a detailed schedule of work to be reviewed with the Traffic Signal Manager and Project Engineer prior to the commencement of work for the traffic signal installation. After the meeting, no further changes in the sequence of work shall be permitted without the approval of the Traffic Signal Manager and Project Engineer.

The Contractor shall complete the traffic signal plant commission checklist to the satisfaction of the project supervisor prior to final acceptance of the work.

12.0 MANITOBA INFRASTRUCTURE AND TRANSPORTATION

TRAFFIC SIGNAL PLANT COMMISSION CHECKLIST

AND APPROVAL FORM

CONTRACT NO. _____

PROJECT LOCATION: **Kenaston Boulevard and PTH#100 Intersection**

PROJECT START DATE: _____

PROJECT ENGINEER: _____

CONTRACTOR: _____

PROJECT SUPERVISOR: _____

INTRODUCTION

When work has been completed according to the plans and Specifications and upon certification by the Engineer, final acceptance of the work will be made by Manitoba Infrastructure and Transportation.

A work project will receive final acceptance only once it is commissioned (put into a state of readiness for service). For final acceptance, all aspects of the work project must meet MIT's Specifications and be signed off as such by the project supervisor. The following checklist serves as the criteria and all aspects pertinent to the project must be checked off as meeting MIT's Specifications before commissioning.

DESCRIPTION	QUANTITY	MIT SPECS		
		MEETS	DEFICIENT	DEFICIENCY REMOVED
1. Installation of Underground Electrical Conduit				
a. Type I (38 mm electrical conduits)				
b. Type II (50 mm electrical conduits)				
c. Excavation and Trench Backfill				
d. Compaction of Excavated Areas				

DESCRIPTION	QUANTITY	MIT SPECS		
		MEETS	DEFICIENT	DEFICIENCY REMOVED
2. Installation of Concrete Bases				
a. Controller Base (E-004a)				
b. Power Pedestal Base (E-005)				
c. F1 Foundation (Light Series Pole)				
d. F2 Foundation (Double Davit Pole)				
e. F3 Foundation (Medium Series Cantilever Pole)				
f. F5 Foundation (Heavy Series Cantilever Pole)				
g. Alignment of 29 mm Anchor Bolts				
h. Alignment of 32 mm Anchor Bolts				
i. Alignment of 51 mm Anchor Bolts				
j. Height of Anchor Bolts above concrete				
k. Bend Radius of Conduits entering base				
l. Ground Rod at Bases and Service Pole				
m. Concrete Tests on Items 2a to 2f				
n. Grout Pad for F3 Foundation Base				
o. Grout Pad for F5 Foundation Base				
p. Backfill and Compaction around Bases				
q. Screw Anchor Base				
3. Installation of Splice / Pull Pits				
a. Splice Pit for Vehicle Detection (Wavetronix)				
b. Splice Pit for Mb. Hydro Illumination				
c. Pull Pit for Advance Signals				
d. Splice / Pull Pit (Modified)				
e. Splice / Pull Pit Drainage Aggregate				
4. Installation of Cables in Electrical Conduit				
a. Cable, electrical, 14/3 conductor w/ground, NMW				
b. Cable ground, #6 bare copper (untinned), Class A				
c. Cable, electrical, NMW, 10/2				
d. Cable, ducted loop detector, 14AGA, IMSA spec #51-5,1				
e. Cable, control, 7-conductor, 14A NMW, colour coded, 30				
f. Cable, control, 25 conductor, 14 AGA, colour coded				

DESCRIPTION	QUANTITY	MIT SPECS		
		MEETS	DEFICIENT	DEFICIENCY REMOVED
g. Cable, lead in, 14 AWG, 600V, 1 Pr, shielded				
h. Cable, electrical, 6 twisted pair, 22 AWG				
i. Cable, electrical, 8 AWG, 3 conductor plus ground wire				
j. Cable, control, 36 conductor, 14 GA, colour coded				
k. Wire, ground, counterpoise				
l. Cable, electrical, 18/3 conductor for vehicle detection cameras				
m. Approved Electrical Cable Lubricant used				
5. Installation of Detection Equipment				
a. Type I – Vehicle Detector Loops (cut in)				
b. Type II - Prefab Vehicle Detector Loop				
c. Vehicle Detection (Wavetronix)				
c. Microwave Detectors				
d. Detector Loop insulation resistance				
e. Detector Loop sensitivity				
6. Traffic Signal Pole Installation				
a. Breakaway Base on F1 Concrete Bases				
b. Breakaway Base on Screw Anchor Bases				
c. Heavy Series Cantilever Poles				
d. Heavy Series J/U Cantilever Poles				
- Leveler Nuts on F5 Foundation Base				
- Turn-of-Nut Method for torqueing				
- Hydro Luminaires installed				
e. Medium Series Cantilever Poles				
f. Medium Series J/U Cantilever Poles				
- Leveler Nuts on F3 Foundation Base				
- Turn-of-Nut Method for torqueing				
- Hydro Luminaires installed				
g. Light Series 2.5 m Davits				
h. Light Series 5.0 m Davits				
- Turn-of-Nut Method for torqueing				
i. Light Series 3.0 m Straight Poles				
j. Light Series 5.0 m Straight Poles				
k. Poles Grounded to Ground Electrode				

DESCRIPTION	QUANTITY	MIT SPECS		
		MEETS	DEFICIENT	DEFICIENCY REMOVED
7. Installation of Signal & Pedestrian Fixtures				
a. Astro Bracket Hangers				
b. Traffic Signal Head Alignment				
c. Two Point Mount Pedestrian Heads and Alignment				
d. Backboards and Visors for Traffic Signals				
e. Covers Installed Over “Blanked” Heads				
f. Detection Camera or Microwave Detection c/w bracket and alignment				
8. Above Ground Electrical Wiring				
a. Inspect 7-conductor Cable in Traffic Signal Head				
b. Where Riser Cable Exits Pole (Approved Grommets Used)				
c. Where Riser Cable Exits Pole (Drip Loop Used)				
d. Hand Hole Wiring of Multi-Conductor				
e. Pigtails Attached to Multi-Conductor on Specified Colours				
f. Slip Connectors Used between Riser Cable and Pigtails				
g. Multi-Conductor Wires Tested Individually with Megohm meter for Shorts				
h. 18/3 conductor Detection Camera Riser Cable				
9. Installation of Electrical Service				
a. Erected as per Electrical Code and Inspected and approved by Manitoba Hydro				
b. Typical Grounding System Specification Used				
10. Installation of Warning and Regulatory Signs and Traffic Control in the work zone				
a. All Signs in Place as Specified for the work zone				
b. Inspection of all Construction Signs and Stands				
c. Traffic Control plan, certified flag persons, hand held stop / slow signs				
11. Site Restoration & Surplus Material Removed				
a. Site Restoration Complete				
b. Landscaping Complete				

DESCRIPTION	QUANTITY	MIT SPECS		
		MEETS	DEFICIENT	DEFICIENCY REMOVED
c. All Surplus Material Removed from Site				

In the space below list any item which does not meet MIT Specification and give reasons for variance and /or follow-up action proposed.

ITEM #	REASON AND FOLLOW-UP ACTION

DATE COMPLETED: _____

CONTRACTOR SIGNATURE: _____

DATE: _____

PROJECT SUPERVISOR SIGNATURE: _____

DATE: _____

Engineer's Seal




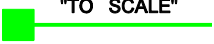


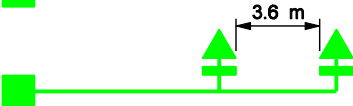
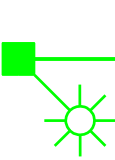











I, the undersigned, hereby agree that, to be best of my knowledge, all aspects of the above project are complete and meet Manitoba Infrastructure and Transportation Specifications.

Traffic Operations Engineer: _____

Date: _____

STANDARD SYMBOLS FOR TRAFFIC SIGNAL INSTALLATIONS NEW AND EXISTING

MAY 2009

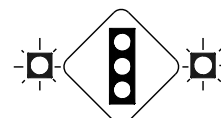
-  BASE (F1, F2, F3, F5) (SHOWN GREEN)
-  STANDARD CONTROLLER
-  PEDESTRIAN SIGNAL ON STANDARD POLE AND BASE (SHOWN GREEN/PED. HEAD SHOWN RED)
-  "TO SCALE" STANDARD BASE WITH DAVIT POLE (SIGNAL HEAD NOT INSTALLED) (SHOWN GREEN)
-  BASE WITH STRAIGHT POLE AND MULTI-SECTION 300 mm SIGNAL HEAD (SHOWN GREEN)
-  BASE WITH DAVIT POLE AND MULTI-SECTION 300 mm SIGNAL HEAD (SHOWN GREEN)
-  3.6 m
BASE WITH CANTILEVER/DAVIT STANDARD AND 2 - MULTI-SECTION 300 mm SIGNAL HEADS (SHOWN GREEN)
-  BASE WITH JOINT USE POLE STREET ILLUMINATION (SHOWN GREEN)
-  BASE WITH CANTILEVER AND "PREPARE TO STOP" ADVANCE SIGNALS (SHOWN GREEN)
-  50 mm UNDERGROUND ELECTRICAL CONDUIT (SHOWN BLUE)
-  38 mm UNDERGROUND ELECTRICAL CONDUIT (SHOWN RED)
-  50 mm HYDRO UNDERGROUND ELECTRICAL CONDUIT (SHOWN GREEN)
-  VEHICLE DETECTOR LOOP (SHOWN BLUE)
-  VEHICLE DETECTOR SPLICE PIT (SHOWN RED)
-  ADVANCE SIGNAL PULL-IN PIT
-  M.T.S. (PEDESTAL)
-  MANITOBA HYDRO (PEDESTAL)
-  MANITOBA HYDRO SERVICE/TRANSFORMER POLE
-  MANITOBA HYDRO OVERHEAD LINE



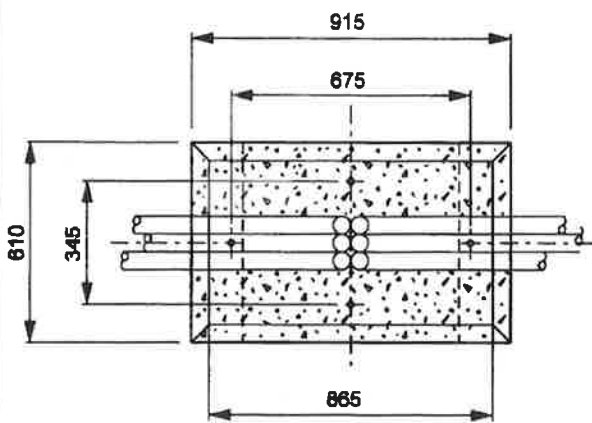
RED FLASHER



AMBER FLASHER



SIDE MOUNT
'PREPARE TO STOP'
ADVANCE SIGN



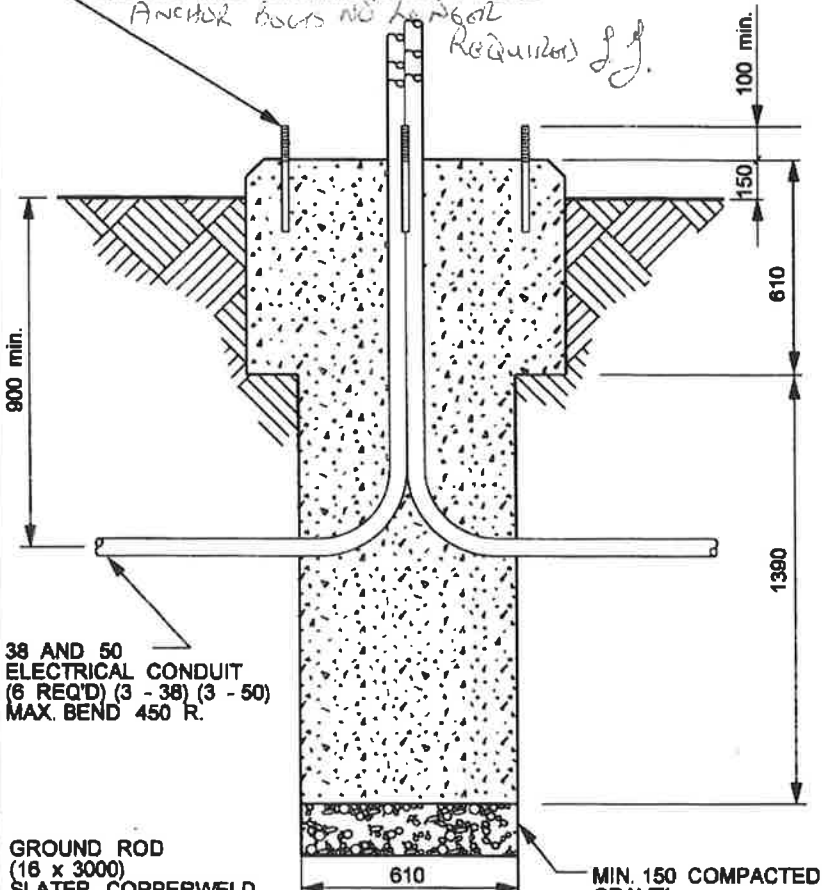
PLAN VIEW

NOTES:

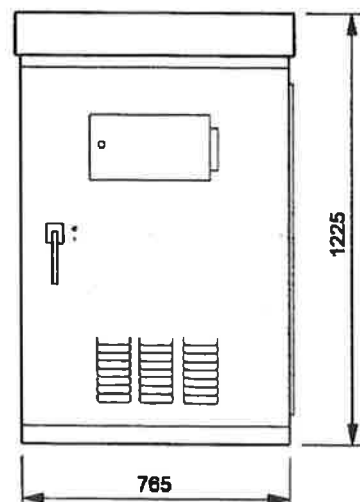
1. CEMENT SHALL BE "TYPE 50" ALKALI-SULPHATE RESISTANT.
2. CONCRETE SHALL HAVE A CLASS 1 FINISH.
3. THE ULTIMATE COMPRESSIVE STRENGTH OF CONCRETE SHALL BE 35 MPa AT 28 DAYS.
4. AIR CONTENT OF CONCRETE SHALL BE 4-7%.
5. CONCRETE SLUMP SHALL BE 80 ± 20 mm.
6. MAXIMUM SIZE OF COARSE AGGREGATE 25 mm.
7. CONTROLLER BASE AND GROUND ROD LOCATION SHALL BE MARKED BY THE ENGINEER.
8. APPROXIMATE CONCRETE VOLUME: 1.20 m³
9. ALL DRAWING DIMENSIONS IN MILLIMETERS.
10. INSTALLATION OF GROUND ROD, CLAMP, AND #6 BARE COPPER GROUNDWIRE SHALL BE INSTALLED BY A LICENCED ELECTRICIAN ON SITE.
11. CONTROLLER BASE INSTALLATION SHALL ALSO INCLUDE 2 SPARE ELECTRICAL CONDUITS (1 - 38 mm) AND (1 - 50 mm).

15 x 300 ANCHOR BOLT,
TOP 100 THREADED TOP 150 GALV.
CW NUT AND WASHER (GALV.) 4 REQ'D.

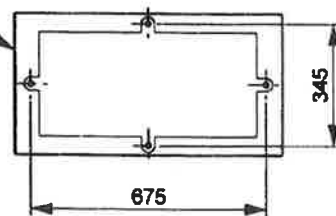
*ANCHOR BOLTS NO TO BE REQ'D
Required L.J.*



SECTION VIEW



PAD MOUNTING PATTERN



38 AND 50
ELECTRICAL CONDUIT
(6 REQ'D) (3 - 38) (3 - 50)
MAX. BEND 450 R.

GROUND ROD
(16 x 3000)
SLATER COPPERWELD.
(1 REQ'D) SEE NOTE 10.

MIN. 150 COMPACTED
GRAVEL

REVISIONS	BY	DATE	DESCRIPTION

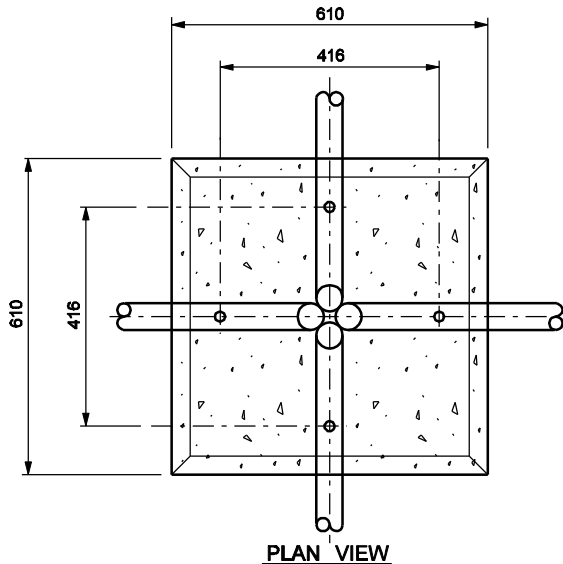
Manitoba
Infrastructure and
Transportation
TRAFFIC ENGINEERING

TYPE IV CONTROLLER BASE
("M" CONTROLLER CABINET)

APPROVED BY: LUCIEN GAGNON

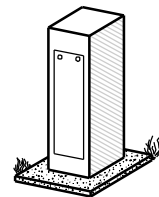
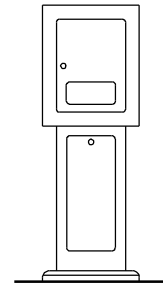
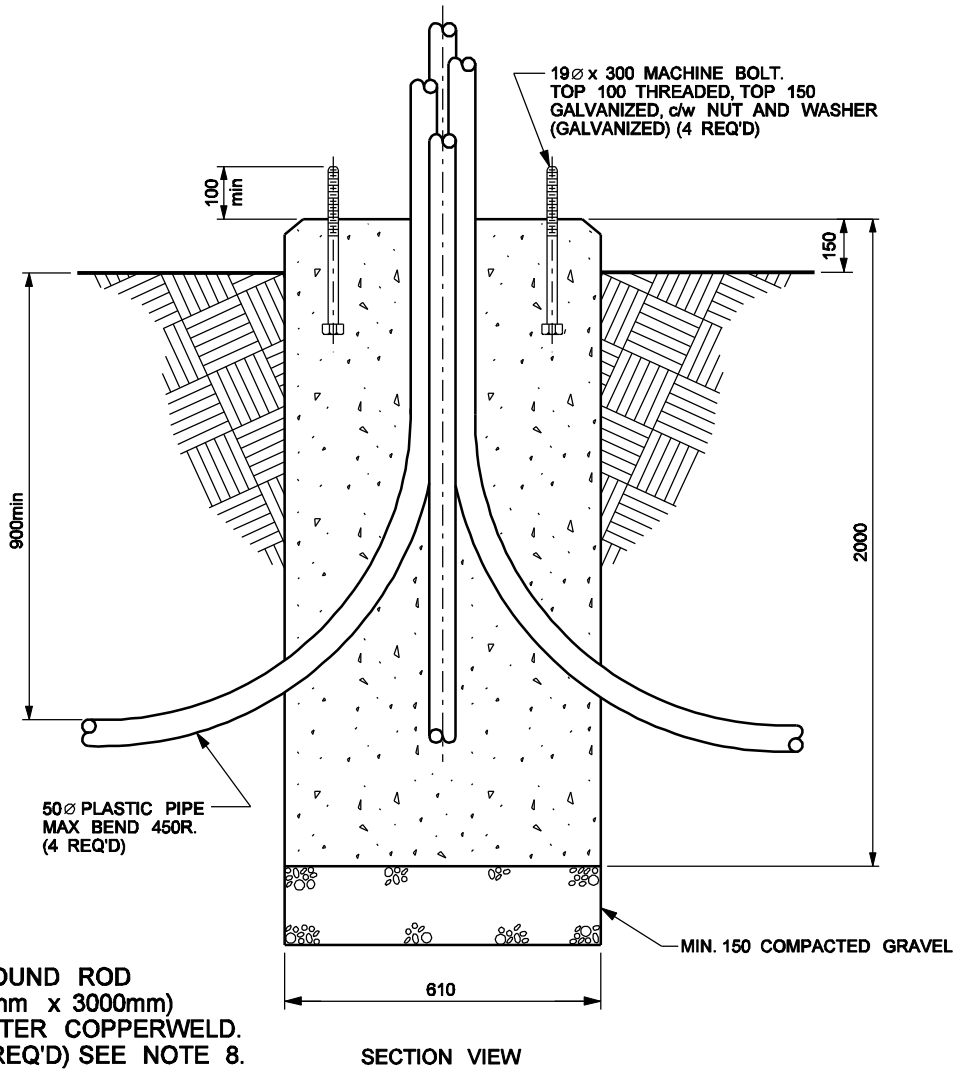
SCALE: N.T.S.
DATE: 05-2004
PREP. BY: D.G.C.

E-004a




NOTES:

1. CEMENT SHALL BE ALKALI-SULFATE RESISTANT TYPE.
2. CONCRETE SHALL HAVE A CLASS 1 FINISH.
3. (a) THE ULTIMATE COMPRESSIVE STRENGTH OF CONC. SHALL BE 35 MPa AT 28 DAYS.
(b) AIR CONTENT OF CONC. TO BE 3%- 4%.
(c) CONC. SLUMP SHALL BE 75-100mm.
(d) MAX. SIZE OF COARSE AGGREGATE 25mm.
4. BASE LOCATION MUST BE STAKED BY THE ENGINEER.
5. APPROX. CONCRETE VOLUME: 0.75m³.
6. BASE DEPTH INCREASED TO 2000mm JULY 92.
7. ALL DIMENSIONS IN MILLIMETERS.
8. INSTALLATION OF GROUND ROD, CLAMP, AND #6 BARE COPPER GROUNDWIRE TO BE INCLUDED IN THE PRICE OF INSTALLING CONTROLLER BASE. LOCATION TO BE MARKED BY THE ENGINEER ON SITE.



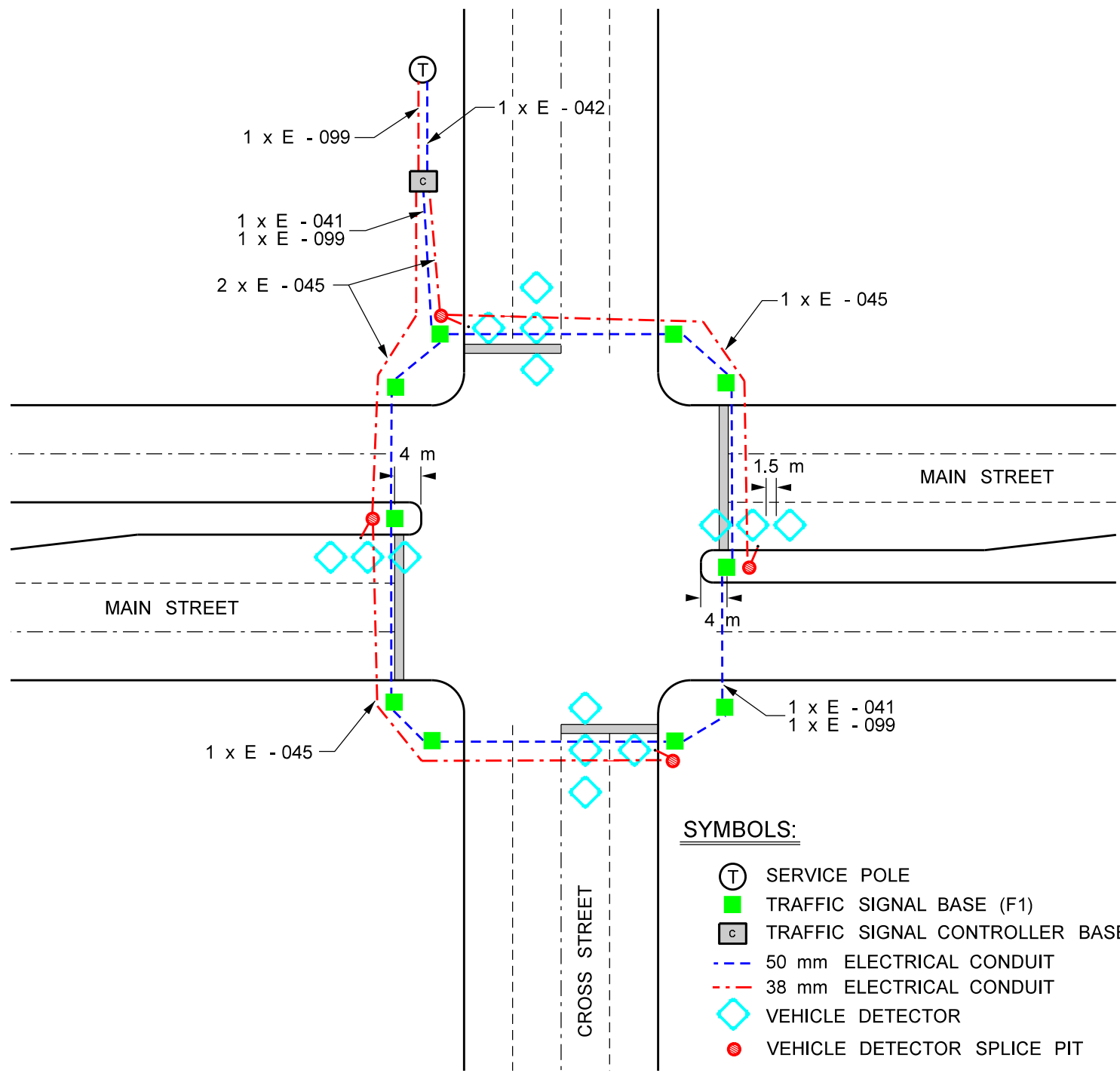
REVISIONS	DATE	DESCRIPTION	BY
	07-02	PAPER ORIGINAL	BJ
	04-08	NOTE REVISIONS	DOC


Manitoba
Infrastructure and
Transportation
 TRAFFIC ENGINEERING

TYPE V CONTROLLER /
POWER PEDESTAL BASE
 APPROVED BY: LUCIEN GAGNON

SCALE:	N.T.S.
DATE:	07-2004
PREP. BY:	D.G.C.
E-005	


SPEC. NO.	GENERAL DESCRIPTION
E - 041	25 CND OR 36 CND CABLE AND 1 CND # 6 GREEN GROUND WIRE
E - 042	2 CND # 8 OR # 10 SERVICE CABLE
E - 045	1 PAIR # 14 DETECTOR LEAD-IN CABLE
E - 099	6 PAIR # 22 COMMUNICATION CABLE



SYMBOLS:

- T SERVICE POLE
- TRAFFIC SIGNAL BASE (F1)
- C TRAFFIC SIGNAL CONTROLLER BASE
- 50 mm ELECTRICAL CONDUIT
- 38 mm ELECTRICAL CONDUIT
- VEHICLE DETECTOR
- VEHICLE DETECTOR SPLICE PIT

REVISIONS	DATE	DESCRIPTION	BY	DC
	98-09	ELECTRONIC FILE	DC	

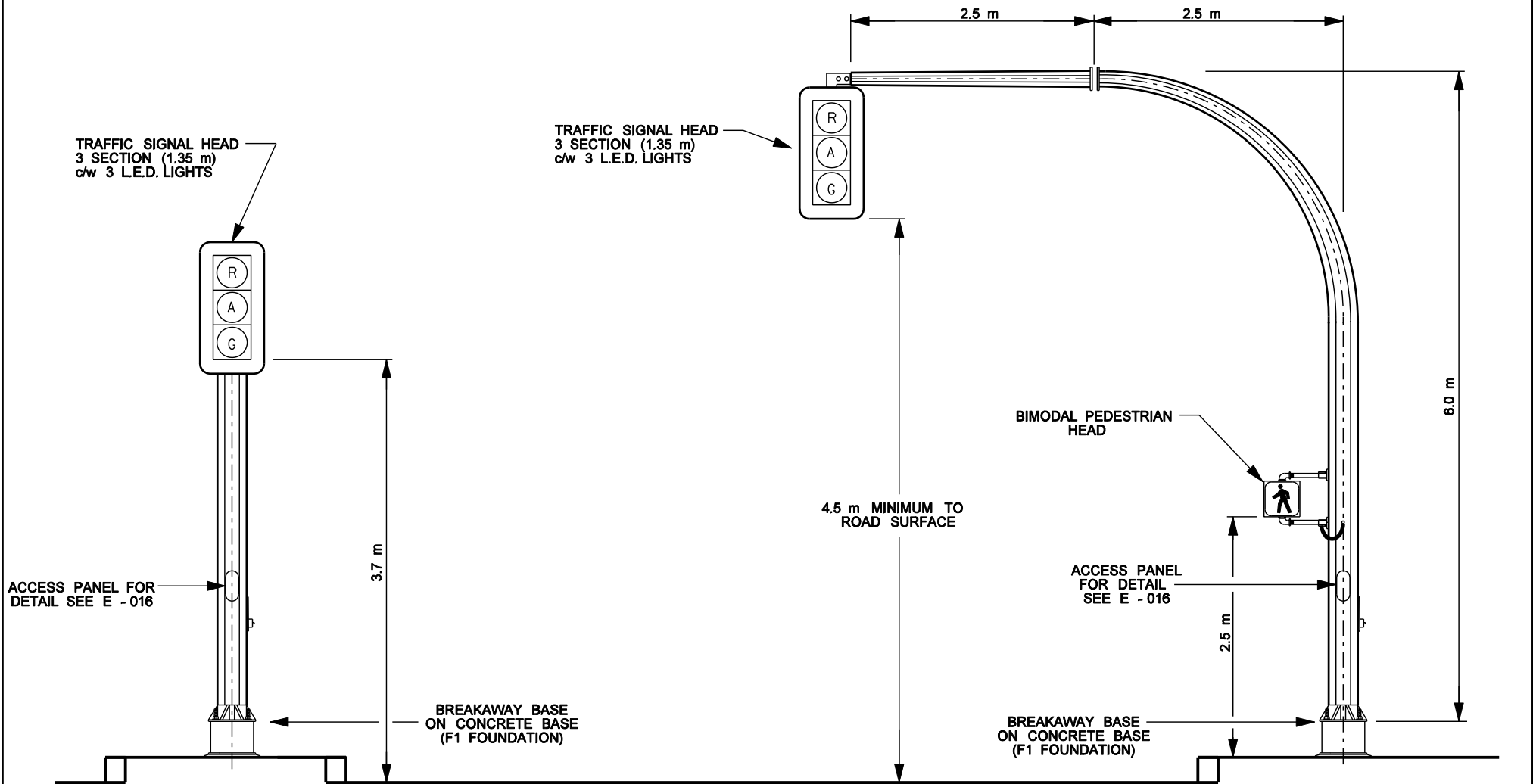

Manitoba
Infrastructure and Transportation
 TRAFFIC ENGINEERING

TYPICAL U/G CONDUIT
 CABLE FILL, URBAN SEMI-ACTUATED

APPROVED BY: **LOU GAGNON**

SCALE:	N.T.S.
DATE:	07-2004
PREP. BY:	D.G.C.
E-014c	

NOTE: CROSS STREET WILL HAVE A SHORT DAVIT ARM WITH ONLY ONE TRAFFIC SIGNAL HEAD 3 SECTION (1.35 m).



FOR UNDERGROUND LAYOUT SEE E - 014

REVISIONS	DATE	DESCRIPTION	BY	ORIGINAL
	06-08	PAPER		

Manitoba 
**Infrastructure and
 Transportation**
 TRAFFIC ENGINEERING

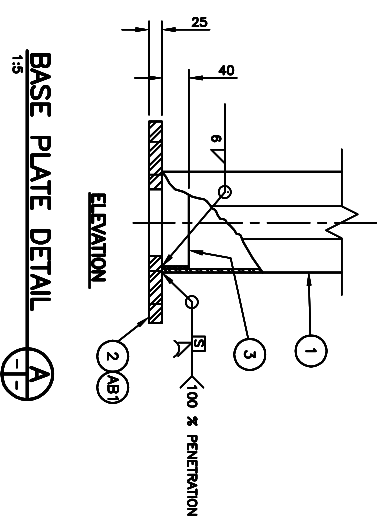
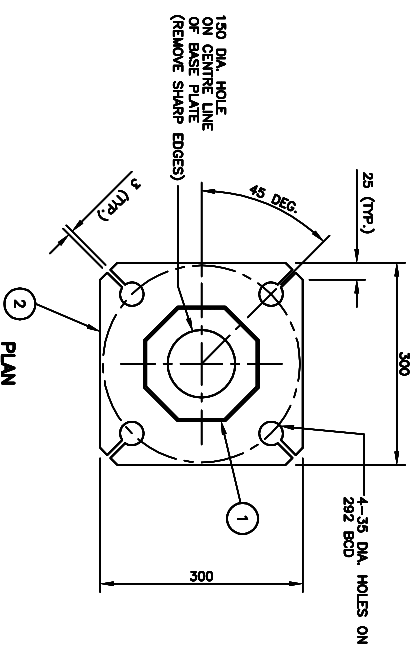
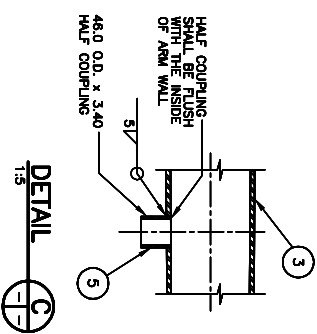
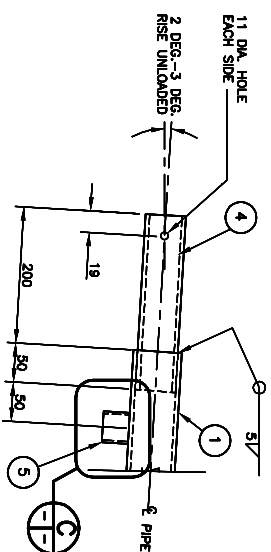
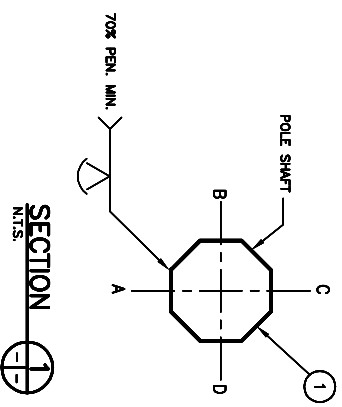
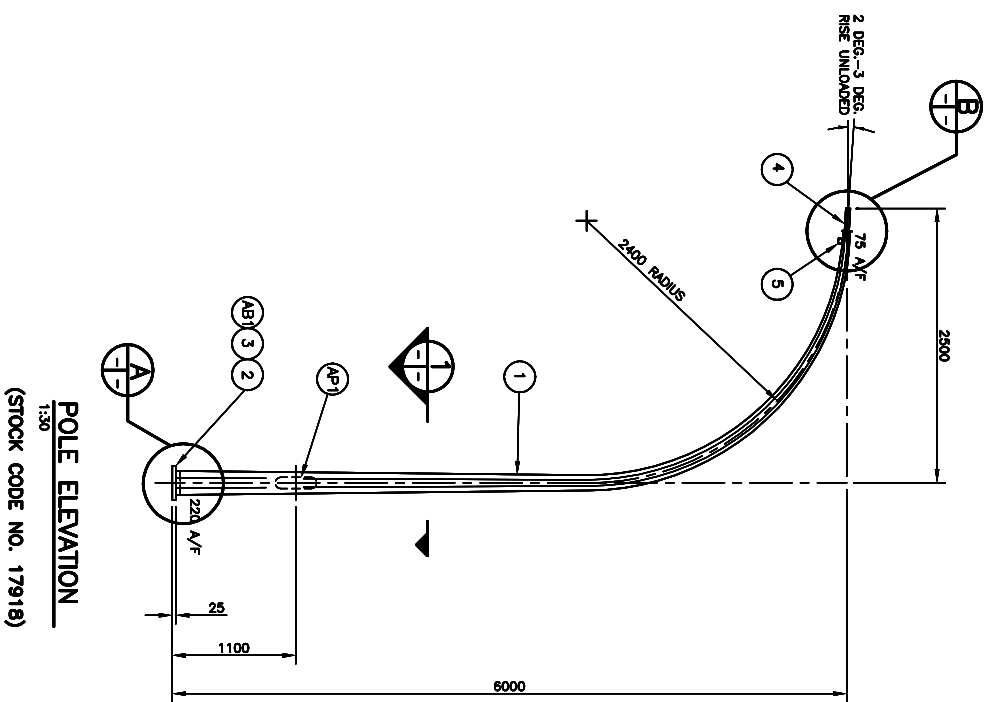
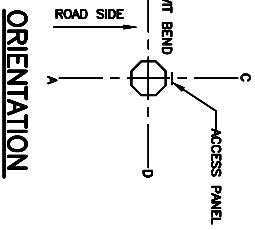
**TYPICAL SIGNAL
 DISPLAY**

ORIGINAL
 APPROVED BY:

TOM McDERMOTT

SCALE: N.T.S.
 DATE: 01-2005
 PREP. BY: D.G.C.

E-015



BILL OF MATERIALS

LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1	1	STUB LIGHT SERIES DAWT (NO ARM EXTENSION) (#17918)			
2	1	OCTAGONAL SECTION SHAFT	220 A/F-75 A/F x 4,763		
3	1	BASE PLATE	25 x 300 x 300		
4	1	BACK-UP STRIP PLATE	6 x 40 x 888		
5	1	TENON PIPE	60.3 O.D. x 250	SCH. 40, ASTM A53 GR. B	SEE DETAIL C
6	1	HALF COUPLING	45.0 O.D. x 3.40 x 44	ASTM A105 - 3000 lb	RE-TAP AFTER GALVANIZING
7					
8	1	ACCESS PANEL			SEE SHEET NO. S15
9					
10	1	TENON CAP			SEE SHEET NO. S15
11					
12	4	ANCHOR BOLT ASSEMBLY	28 DIA. x 1650	G40.21-M-300W	SUPPLIED BY OWNER SEE ANCHOR BOLT DIMS.
13					
14					
15					
16					
17					
18					
19					
20					

- NOTES:**
- ALL MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A723-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 910 g/m²
 - PROVIDE 'RAISED' STOCK CODE NUMBER WITH WELDING ELECTRODE.
 - SHIP WITH HANDHOLE COVERS INSTALLED.
 - STRUCTURE INSTALLED ON SAFE-T-BASE (BREAKAWAY BASE) WITH 4-25 DIA. GR. B7 BOLTS ON 292 BCD.
 - GRIND ALL SHARP POINTS AND EDGES.

DATE	BY	DESCRIPTION

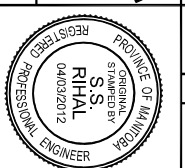
TRAFFIC SIGNAL STRUCTURE

LIGHT SERIES
2.5 m DAWT

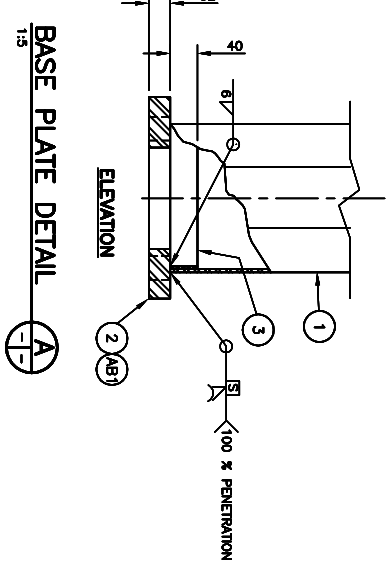
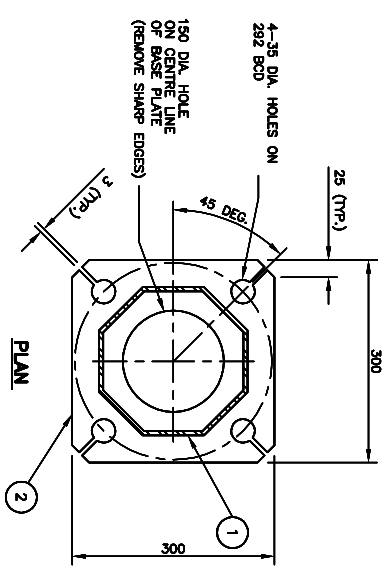
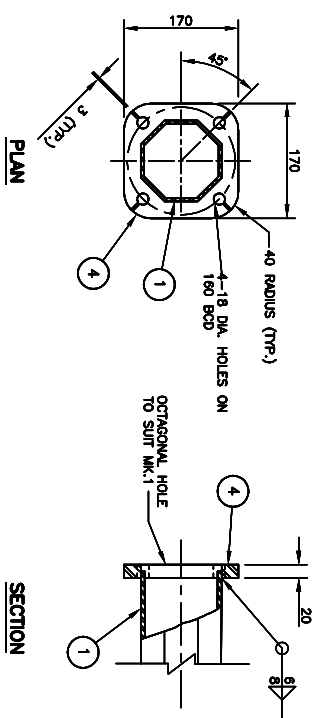
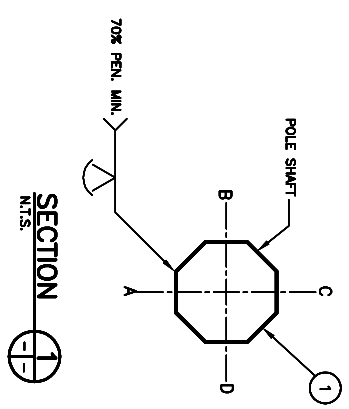
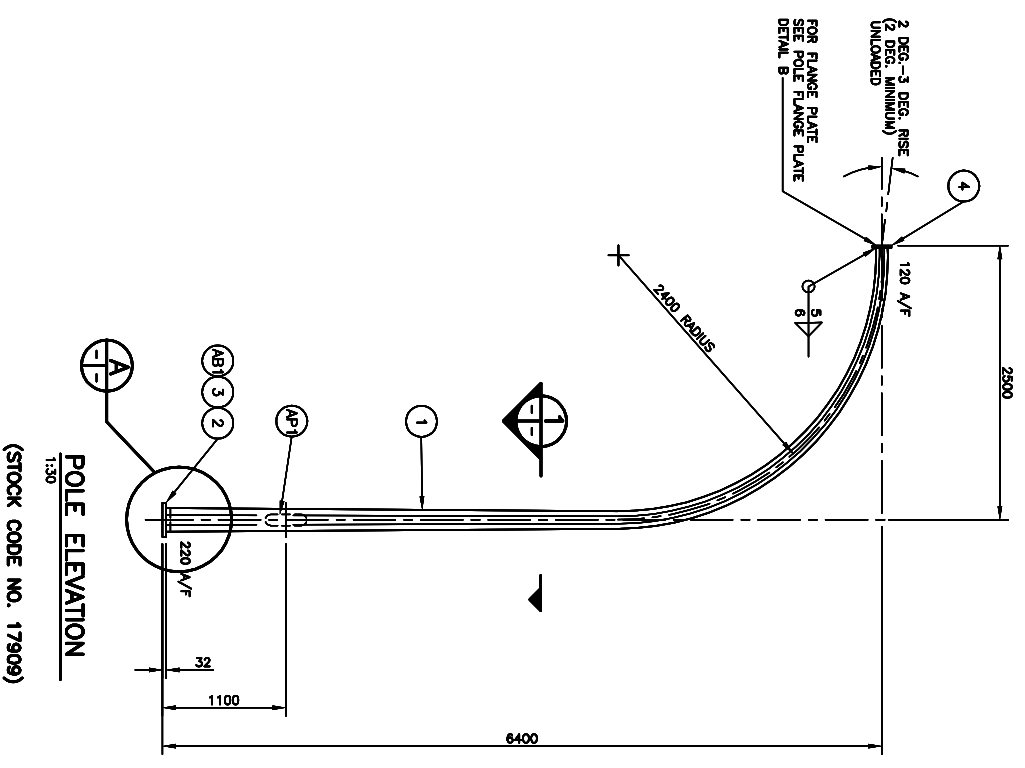
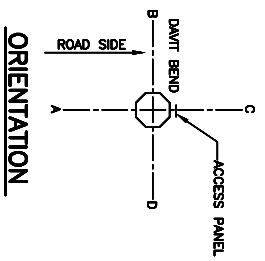
RELEASED FOR CONSTRUCTION
BY: _____



REDUCED DRAWING
N.T.S.



DESIGN	BR: _____	CDM	DATE
CHECKED	SSR	TRAFFIC ENGINEERING	COMPONENT NO.
BY	JGW	SCALE	E-018, P.
CHECKED	SSR	AS SHOWN	
			SHEET NO. S3



LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1	1	STUB LIGHT SERIES DAWT (#17909)			
2	1	OCTAGONAL SECTION SHAFT	220 A/F-120 A/F x 6.350		
3	1	BASE PLATE	32 x 300 x 300		
4	1	BACK-UP STRIP PLATE	6 x 40 x 887		
5	1	FLANGE PLATE	20 x 170 x 170		
6					
7	1	ACCESS PANEL			SEE SHEET NO. S15
8					
9	4	ANCHOR BOLT ASSEMBLY	29 DIA. x 1850	G40.21-M-300W	SUPPLIED BY OWNER SEE ANCHOR BOLT DWGS.
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

- NOTES:**
- ALL MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
 - PROVIDE 'RAISED' STOCK CODE NUMBER WITH WELDING ELECTRODE.
 - SHIP WITH HANDHOLE COVERS INSTALLED.
 - STRUCTURE INSTALLED ON SAFE-T-BASE (BREAKAWAY BASE) WITH 4-25 DIA. GR. B7 BOLTS ON 282 BOD WHERE INSTRUCTED BY ENGINEER.
 - GRIND ALL SHARP POINTS AND EDGES.
 - RELATED COMPONENTS AND DRAWINGS :
* EXTENSION ARM (E-016 G)

DATE	BY	DESCRIPTION



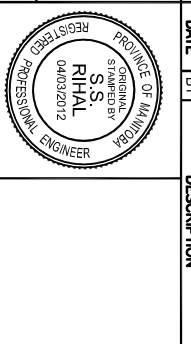
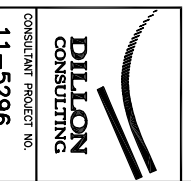
TRAFFIC SIGNAL AND PEDESTRIAN CORRIDOR STRUCTURES
LIGHT SERIES
DAWT STUB

RELEASED FOR CONSTRUCTION
BY: _____
DIRECTOR
TRAFFIC ENGINEERING
SCALE: AS SHOWN
COMPONENT No. E-016.F
DATE: _____

CHECKED: SSR
DATE: _____



REDUCED DRAWING
N.T.S.

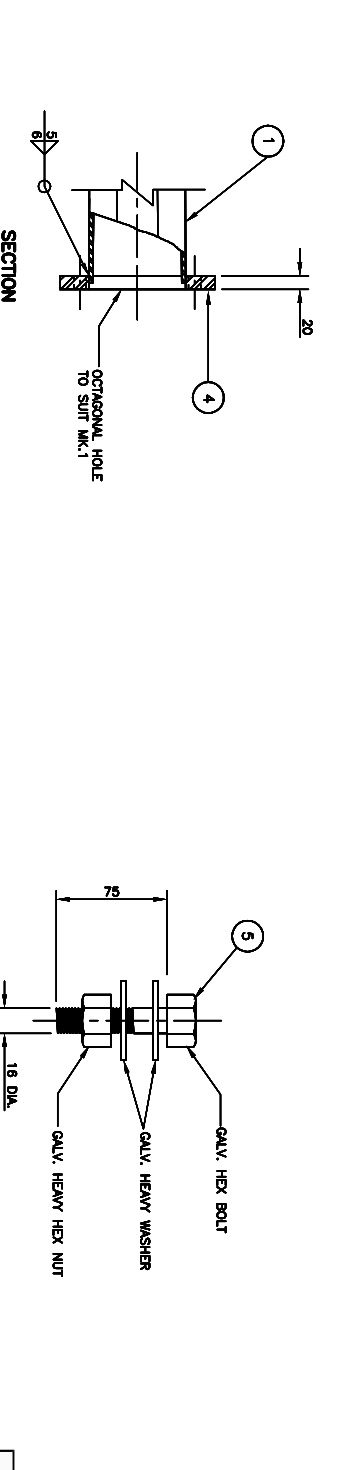
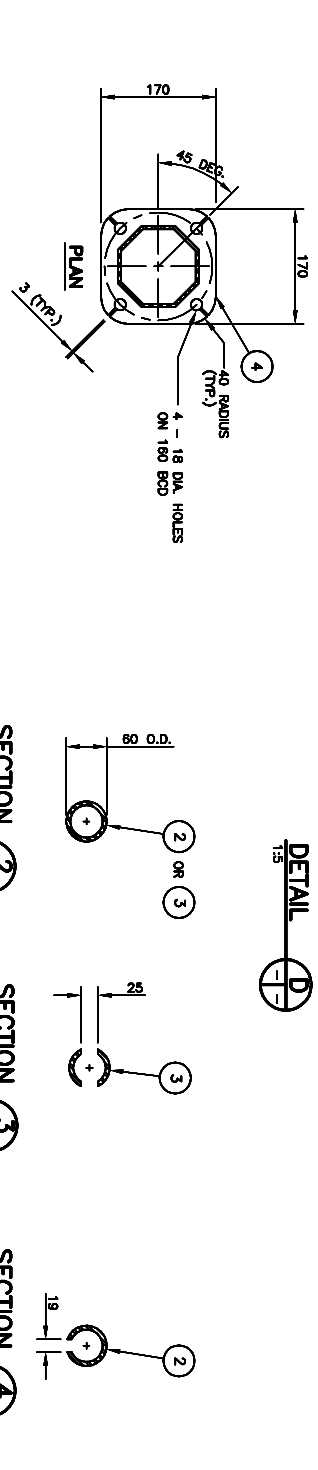
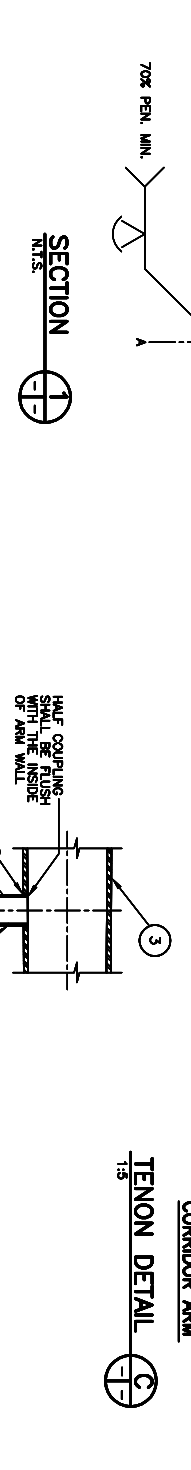
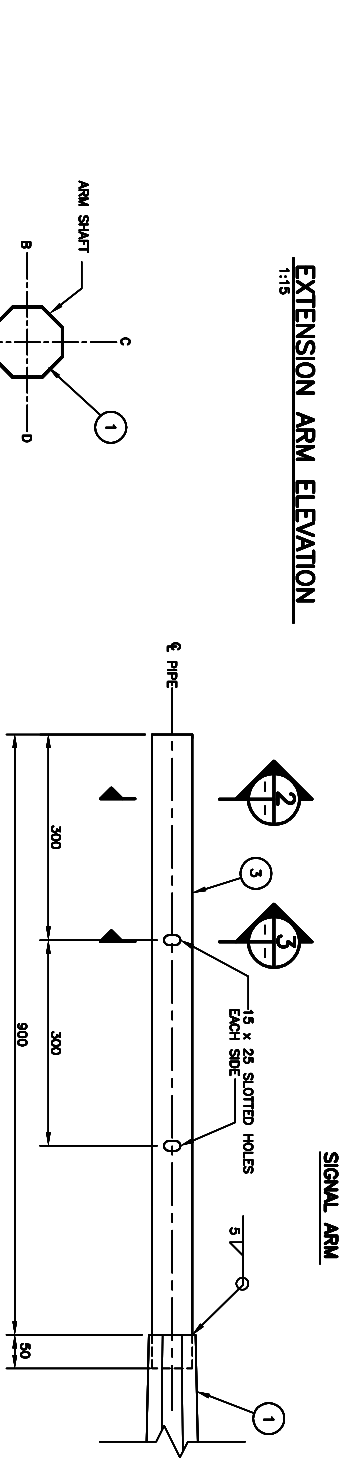
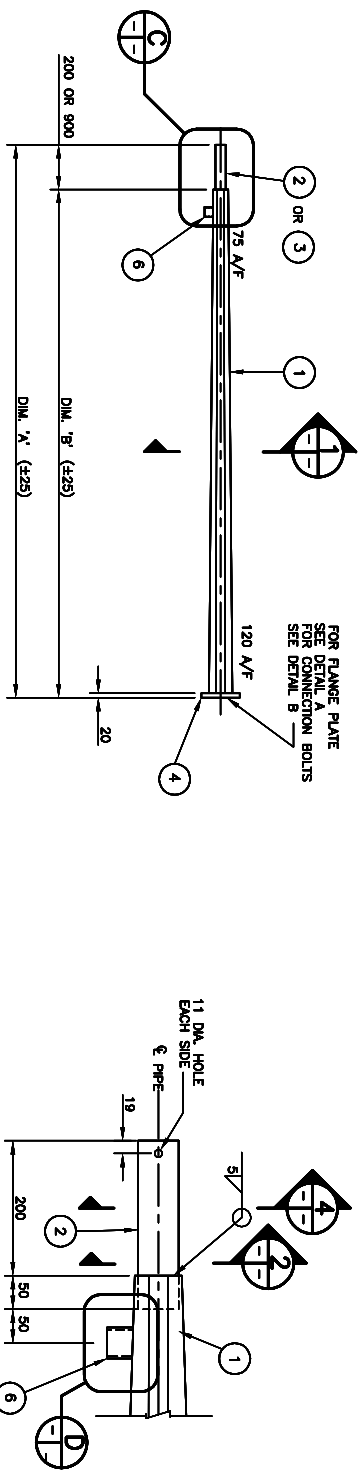


BILL OF MATERIALS

LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1		2.5 m LONG EXTENSION ARM - CORRIDOR (#40373)			
2	1	OCTAGONAL SECTION SHAFT	120 A/F-75 A/F x 4,763		CORR. ARM 1600 LONG
3	1	TENON PIPE	60.3 O.D. x 3.91 x 950	SCH. 40, A53 GR. B	FOR CORRIDOR ARM ONLY SEE TENON DETAIL C
4	1	FLANGE PLATE	20 x 170 x 170		
5	4	FLANGE BOLTS	16 DIA. x 75	A325	SEE FLANGE BOLT DETAIL B
6					
7		2.5 m LONG EXTENSION ARM - SIGNAL ARM (#17910)			
8	1	OCTAGONAL SECTION SHAFT	120 A/F-75 A/F x 4,763		SIGNAL ARM 2300 LONG
9	1	TENON PIPE	60.3 O.D. x 3.91 x 290	SCH. 40, A53 GR. B	FOR SIGNAL ARM ONLY SEE TENON DETAIL C
10	1	FLANGE PLATE	20 x 170 x 170		
11	4	FLANGE BOLTS	16 DIA. x 75	A325	SEE FLANGE BOLT DETAIL B
12	1	HALF COUPLING	46.0 O.D. x 3.40 x 44	ASTM A105 - 3000 lb	SEE DETAIL D RE-TAP AFTER GALVANIZING
13	1	TENON CAP			SEE SHEET NO. S15
14					
15					
16					
17					
18					
19					
20					

- NOTES:**
- MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE ALL HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 810 g/m²
 - PROVIDE 'RAISED' STOCK CODE NUMBER WITH WELDING ELECTRODE.
 - SHIP WITH BOLTS C/W NUTS AND WASHERS IN FLANGE.
 - PROVIDE 'RAISED' 'T' ON TOP OF ARM NEAR FLANGE PLATE USING WELDING ELECTRODE.
 - GRIND ALL SHARP POINTS AND EDGES.
 - TO BE USED WITH LIGHT SERIES DART STUB (E-16 F).

STOCK CODE	DESCRIPTION	DIM. 'A'	DIM. 'B'
40373	2.5m CORRIDOR ARM	2500	1800
17910	2.5m SIGNAL ARM	2500	2300



TRAFFIC SIGNAL AND PEDESTRIAN CORRIDOR STRUCTURES

LIGHT SERIES DAVIT EXTENSION ARM

DATE	BY	DESCRIPTION

RELEASED FOR CONSTRUCTION
BY: _____

APEGIN
Certificate of Authorization
Dillon Consulting Limited (MS)
No. 1789 Date: 04/03/2012

REDUCED DRAWING
N.T.S.

DILLON CONSULTING
CONSULTANT PROJECT NO. 11-5296

PROVINCE OF MANITOBA
REGISTERED PROFESSIONAL ENGINEER
S.S. RIHAL
04/03/2012

Manitoba Infrastructure and Transportation
Traffic Engineering

DESIGN: _____
CHECKED: _____
BY: _____

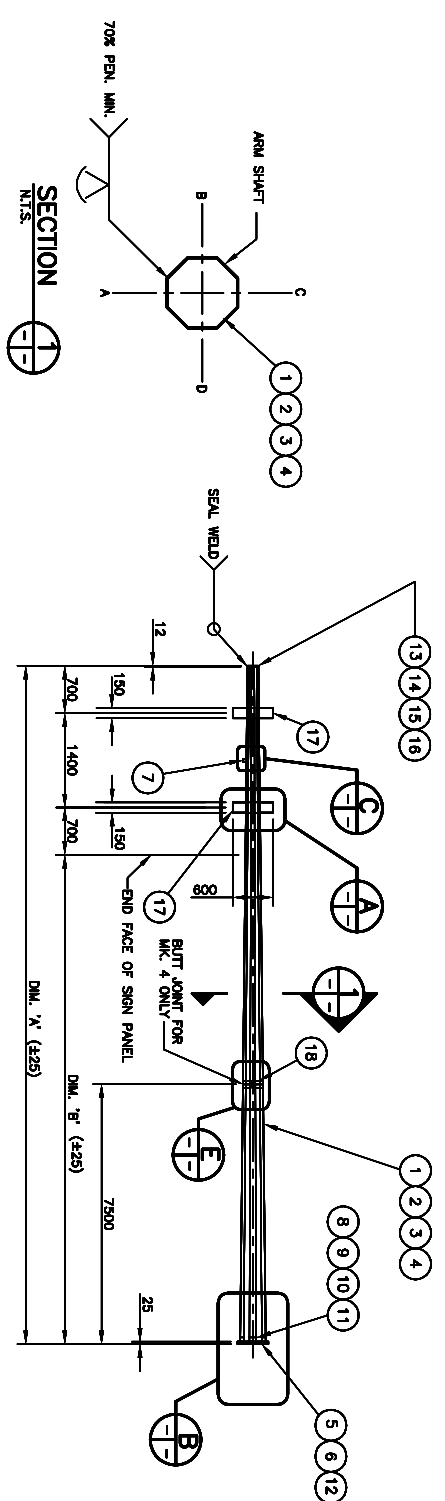
CDM
SSR
JGW

RELEASED FOR CONSTRUCTION
DIRECTOR: _____
TRAFFIC ENGINEERING
SCALE: _____
COMPONENT NO. E-018.G
DATE: _____
SHEET NO. S5

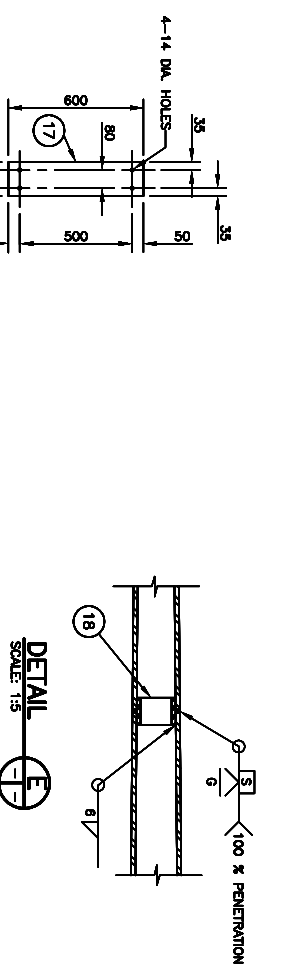
BILL OF MATERIALS

LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1	1	7.5 m ADVANCE SIGNAL ARM (#58528)			
2	1	OCTAGONAL SECTION SHAFT	320 A/F--100 A/F x 6.350		
3	1	FLANGE PLATE	25 x 457 x 610	ASTM A325	SEE FLANGE BOLT DETAIL D
4	8	FLANGE BOLTS	25 DIA. x 100	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
5	1	HALF COUPLING	46.0 O.D. x 3.40 x 44		
6	1	BACK-UP STRIP PLATE	6 x 40		
7	1	CAP PLATE	12 x 140 DIA.		
8	1	SIGN MOUNTING PLATE	6 x 150 x 800		
9	2	9.0 m ADVANCE SIGNAL ARM (#58529)			
10	1	OCTAGONAL SECTION SHAFT	350 A/F--125 A/F x 6.350		
11	1	FLANGE PLATE	25 x 457 x 610	ASTM A325	SEE FLANGE BOLT DETAIL D
12	8	FLANGE BOLTS	25 DIA. x 100	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
13	1	HALF COUPLING	46.0 O.D. x 3.40 x 44		
14	1	BACK-UP STRIP PLATE	6 x 40		
15	1	CAP PLATE	12 x 170 DIA.		
16	1	SIGN MOUNTING PLATE	6 x 150 x 800		
17	2	10.5 m ADVANCE SIGNAL ARM (#58530)			
18	1	OCTAGONAL SECTION SHAFT	380 A/F--125 A/F x 6.350		
19	1	FLANGE PLATE	25 x 457 x 610	ASTM A325	SEE FLANGE BOLT DETAIL D
20	1	FLANGE BOLTS	25 DIA. x 100	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
21	8	FLANGE BOLTS	46.0 O.D. x 3.40 x 44		
22	1	HALF COUPLING	46.0 O.D. x 3.40 x 44		
23	1	BACK-UP STRIP PLATE	6 x 40		
24	1	CAP PLATE	12 x 170 DIA.		
25	1	SIGN MOUNTING PLATE	6 x 150 x 800		
26	2	15.0 m ADVANCE SIGNAL ARM (#58531)			
27	1	OCTAGONAL SECTION SHAFT	430 A/F--150 A/F x 7.928		
28	1	FLANGE BOLTS	25 DIA. x 100	ASTM A325	SEE FLANGE BOLT DETAIL D
29	12	HALF COUPLING	46.0 O.D. x 3.40 x 44	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
30	1	BACK-UP STRIP PLATE	6 x 40		
31	1	FLANGE PLATE	25 x 801 x 610		
32	1	CAP PLATE	12 x 170 DIA.		
33	1	SIGN MOUNTING PLATE	6 x 150 x 800		
34	2				
35	2				
36	2				
37	2				

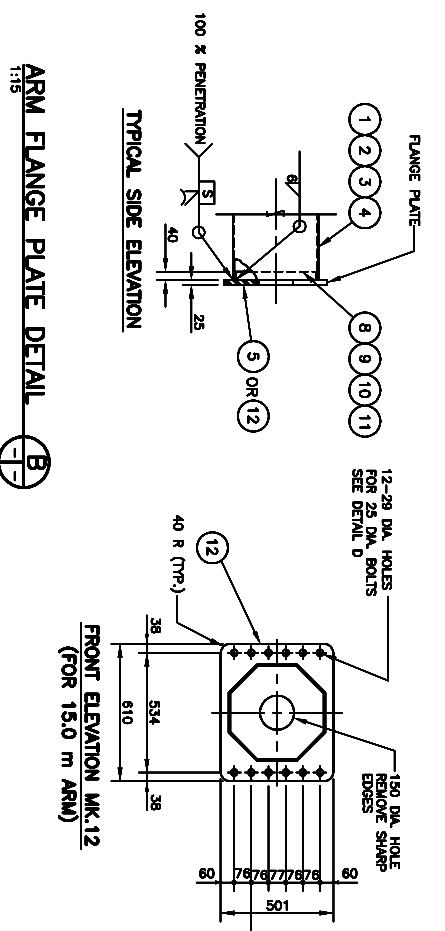
- NOTES:**
- ALL MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
 - PROVIDE 'RAISED' STOCK CODE NUMBER WITH WELDING ELECTRODE.
 - PROVIDE 'RAISED' T ON TOP OF ARM NEAR FLANGE PLATE USING WELDING ELECTRODE.
 - SHIP WITH BOLTS C/W NUTS AND WASHERS IN FLANGE.
 - GRIND ALL SHARP POINTS AND EDGES.
 - TO BE USED WITH HEAVY SERIES COMBINATION CANTILEVER ADVANCE WARNING SIGN (E-16 W).



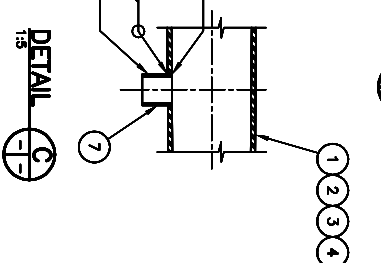
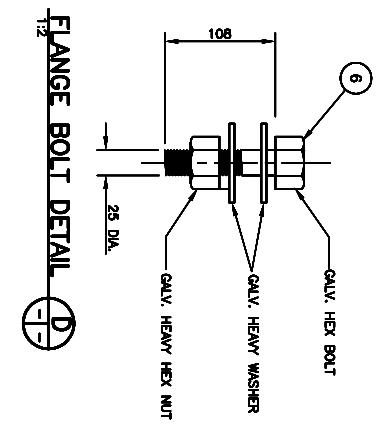
EXTENSION ARM ELEVATION
SCALE: 1:30



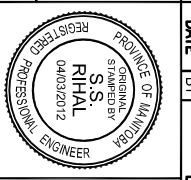
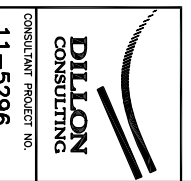
STOCK CODE	DESCRIPTION	DIM. 'A'	DIM. 'B'
58528	7.5 m ADVANCE SIGNAL	7500	4700
58529	9.0 m ADVANCE SIGNAL	9000	6200
58530	10.5 m ADVANCE SIGNAL	10500	7700
58531	15.0 m ADVANCE SIGNAL	15000	12200
58524	VERTICAL SHAFT SEE COMPONENT NO. E-016 W. 59		SHAFT SHALL BE INTER-CHANGEABLE WITH TRAFFIC SIGNAL ARM & ADVANCE SIGNAL ARM



ARM FLANGE PLATE DETAIL
SCALE: 1:15



REDUCED DRAWING
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DATE	BY	DESCRIPTION

Manitoba
Infrastructure and Transportation
Traffic Engineering

HEAVY SERIES COMBINATION CANTILEVER ADVANCE WARNING SIGN

7.5 m, 9.0 m, 10.5 m, and 15.0 m ARMS

RELEASED FOR CONSTRUCTION

DATE: _____

DESIGN: _____

CHECKED: _____

BY: _____

SCALE: AS SHOWN

COMPONENT NO. E-016 R.

CHECKER: _____

SHEET NO. S10

BILL OF MATERIALS

LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1	1	7.5 m TRAFFIC SIGNAL ARM (#58516)			
2	1	OCTAGONAL SECTION SHAFT	300 A/F-100 A/F x 4.763		
3	1	FLANGE PLATE	25 x 457 x 810	ASTM A325	SEE FLANGE BOLT DETAIL B
4	8	FLANGE BOLTS	25 DIA. x 100	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
5	2	HALF COUPLING	46.0 O.D. x 3.40 x 44	SCH. 40, ASTM A53 GR.B	
6	1	TENON PIPE	60.3 O.D. x 3.91 x 250	SCH. 40, ASTM A53 GR.B	
7	1	TENON PIPE	12 x 140 DIA.		
8	1	TENON PIPE	6 x 40		
9	1	BACK-UP STRIP PLATE	6 x 40		
10	1	9.0 m TRAFFIC SIGNAL ARM (#58517)			
11	1	OCTAGONAL SECTION SHAFT	300 A/F-125 A/F x 4.763		
12	1	FLANGE PLATE	25 x 457 x 810		
13	8	FLANGE BOLTS	25 DIA. x 100	ASTM A325	SEE FLANGE BOLT DETAIL B
14	2	HALF COUPLING	46.0 O.D. x 3.40 x 44	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
15	1	TENON PIPE	60.3 O.D. x 3.91 x 250	SCH. 40, ASTM A53 GR.B	
16	1	TENON PIPE	12 x 170 DIA.		
17	1	BACK-UP STRIP PLATE	6 x 40		
18	1	BACK-UP STRIP PLATE	6 x 40		
19	1	10.5 m TRAFFIC SIGNAL ARM (#58518)			
20	1	OCTAGONAL SECTION SHAFT	300 A/F-125 A/F x 4.763		
21	1	FLANGE PLATE	25 x 457 x 810		
22	8	FLANGE BOLTS	25 DIA. x 100	ASTM A325	SEE FLANGE BOLT DETAIL B
23	2	HALF COUPLING	46.0 O.D. x 3.40 x 44	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
24	1	TENON PIPE	60.3 O.D. x 3.91 x 250	SCH. 40, ASTM A53 GR.B	
25	1	TENON PIPE	12 x 170 DIA.		
26	1	BACK-UP STRIP PLATE	6 x 40		
27	1	15.0 m TRAFFIC SIGNAL ARM (#58515)			
28	1	OCTAGONAL SECTION SHAFT	380 A/F-150 A/F x 6.350		
29	6	FLANGE BOLTS	25 DIA. x 100	ASTM A325	SEE FLANGE BOLT DETAIL B
30	2	HALF COUPLING	46.0 O.D. x 3.40 x 44	ASTM A105 - 3000 lb	SEE DETAIL C RE-TAP AFTER GALVANIZING
31	1	TENON PIPE	60.3 O.D. x 3.91 x 250	SCH. 40, ASTM A53 GR.B	
32	1	TENON PIPE	12 x 192 DIA.		
33	1	FLANGE PLATE	25 x 457 x 810		
34	1	BACK-UP STRIP PLATE	6 x 40		
35	1	BACK-UP STRIP PLATE	6 x 40		FOR BUTT JOINT
36	1	BACK-UP STRIP PLATE	6 x 40		

- NOTES:**
1. MATERIALS EXCEPT STAINLESS STEEL ITEMS SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-06 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
 2. PROVIDE 'RAISED' STOCK CODE NUMBER WITH WELDING ELECTRODE.
 3. PROVIDE 'RAISED' 'T' ON TOP OF ARM NEAR FLANGE PLATE USING WELDING ELECTRODE.
 4. SHIP WITH BOLTS C/W NUTS AND WASHERS IN FLANGE.
 5. GRIND ALL SHARP POINTS AND EDGES.
 6. TO BE USED WITH HEAVY SERIES COMBINATION CANTILEVER VERTICAL SHAFT (E-18 W).

TRAFFIC SIGNAL STRUCTURE

HEAVY SERIES COMBINATION CANTILEVER
7.5 m, 9.0 m, 10.5 m, AND 15.0 m
TRAFFIC SIGNAL ARMS

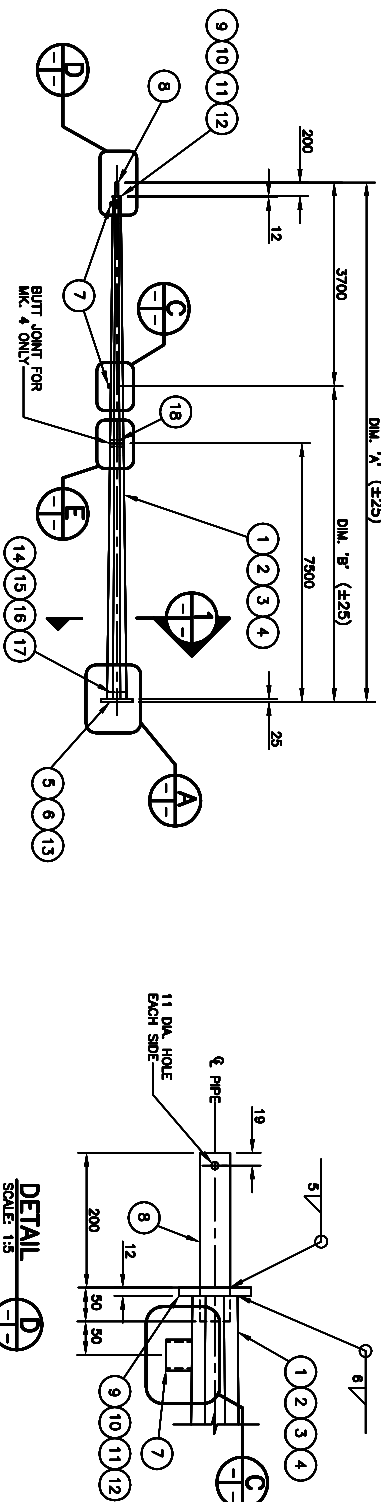
REVISIONS

NO.	DATE	BY	DESCRIPTION

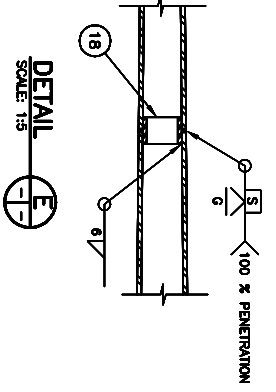


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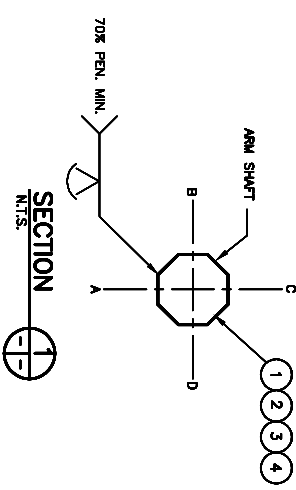
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APPROVED	BY: _____	DATE: _____



EXTENSION ARM ELEVATION
SCALE: 1:30

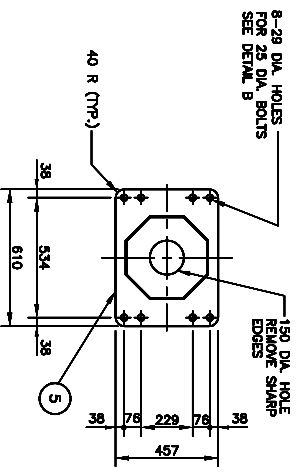


DETAIL
SCALE: 1:5

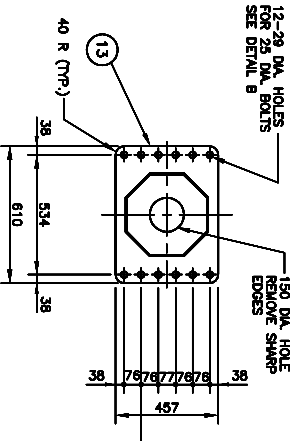
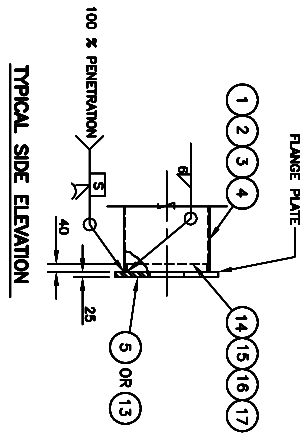


SECTION
N.T.S.

STOCK CODE	DESCRIPTION	DIM. 'A'	DIM. 'B'
58516	7.5m TRAFFIC SIGNAL EXTENSION ARM	7500	3800
58517	9.0m TRAFFIC SIGNAL EXTENSION ARM	9000	5300
58518	10.5m TRAFFIC SIGNAL EXTENSION ARM	10500	6800
58515	15.0m TRAFFIC SIGNAL EXTENSION ARM	15000	11300
58524	VERTICAL SHAFT SEE COMPONENT NO. SHEET NO. 29		

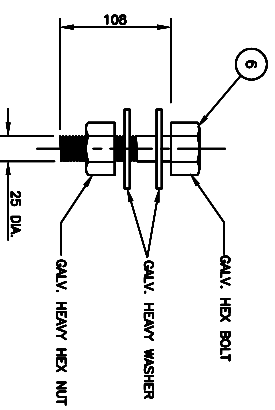


FRONT ELEVATION MK.5
(FOR 7.5, 9.0 & 10.5 m ARMS)

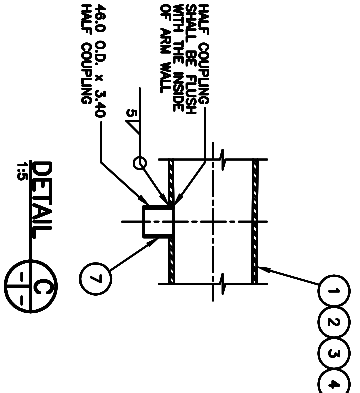


FRONT ELEVATION MK.15
(FOR 15.0 m ARM)

ARM FLANGE PLATE DETAIL
1:15



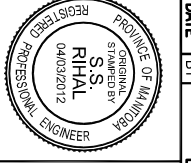
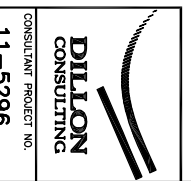
FLANGE BOLT DETAIL
1:2



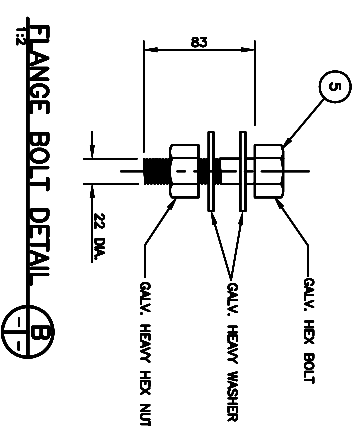
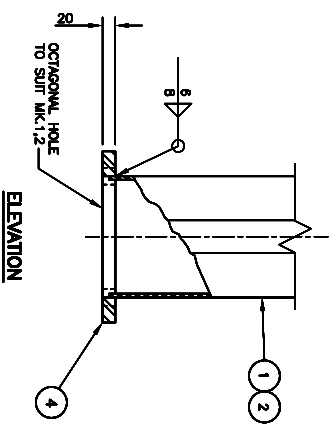
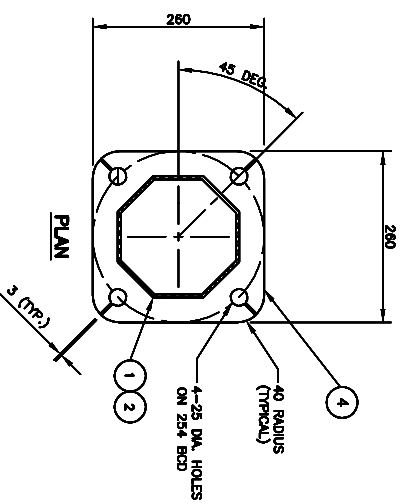
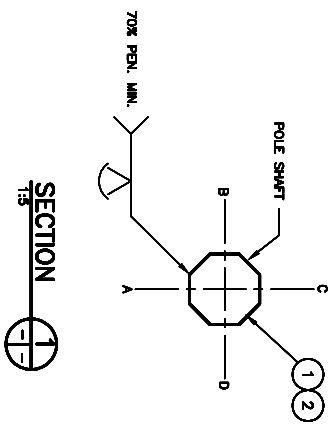
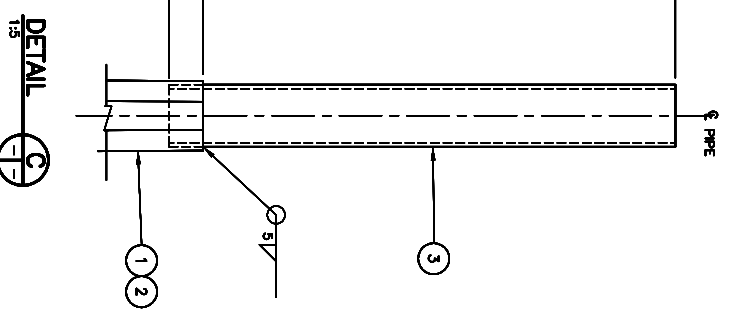
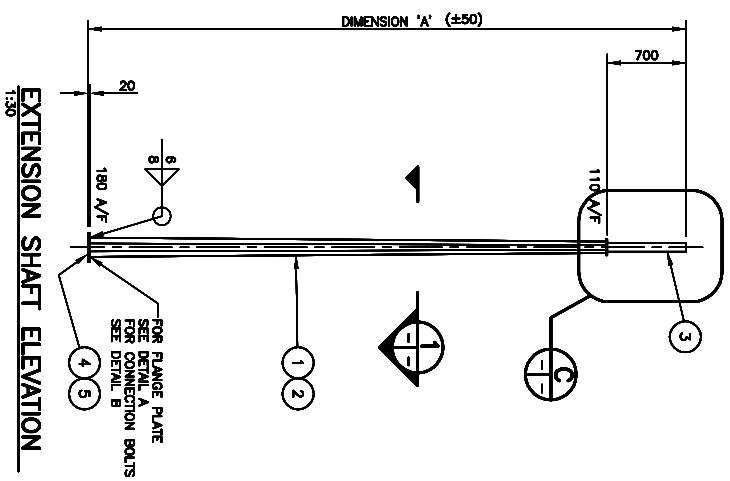
DETAIL
1:5



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N.T.S.



DESIGN	BY: _____	DATE: _____
CHECKED	BY: _____	DATE: _____
APPROVED	BY: _____	DATE: _____



STOCK CODE	DESCRIPTION	DIMENSION 'A'
17800	LUMINAIRE EXT. SHAFT 5.4m	5400
17901	LUMINAIRE EXT. SHAFT 8.4m	8400

LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1	1	5.4 m LUMINAIRE EXTENSION SHAFT (#17900)			
2	1	OCTAGONAL SECTION SHAFT	180 A/F-110 A/F x 4.763		
3	1	TENON PIPE	101.6 O.D. x 5.74 x 750	SCH. 40, ASTM A53 GR. B	
4	1	FLANGE PLATE	20 x 280 x 280		
5	4	FLANGE BOLTS	22 DIA x 83	ASTM A325	SEE FLANGE BOLT DETAIL B
6					
7		8.4 m LUMINAIRE EXTENSION SHAFT (#17901)			
8	1	OCTAGONAL SECTION SHAFT	180 A/F-110 A/F x 4.763		
9	1	TENON PIPE	101.6 O.D. x 5.74 x 750	SCH. 40, ASTM A53 GR. B	
10	1	FLANGE PLATE	20 x 280 x 280		
11	4	FLANGE BOLTS	22 DIA x 83	ASTM A325	SEE FLANGE BOLT DETAIL B
12					
13					
14					

- NOTES:**
1. MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE ALL DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 810 g/m²
 2. PROVIDE 'RAISED' STOCK CODE NUMBER WITH WELDING ELECTRODE.
 3. SHIP WITH BOLTS C/W NUTS AND WASHERS IN FLANGE.
 4. GRIND ALL SHARP POINTS AND EDGES.
 5. TO BE USED WITH:
 - * 5.4 m - MEDIUM SERIES COMBINATION CANTILEVER VERTICAL SHAFT (E-16 H)
 - * 8.4 m AND 8.4 m - HEAVY SERIES COMBINATION CANTILEVER VERTICAL SHAFT (E-16 W)

SHAFT FLANGE PLATE DETAIL

DETAIL

SECTION

PLAN

FLANGE BOLT DETAIL

ELEVATION

ELEVATION

REVISIONS

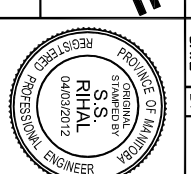
DATE	BY	DESCRIPTION

TRAFFIC SIGNAL AND PEDESTRIAN CORRIDOR STRUCTURES
EXTENSION SHAFTS
5.4 m AND 8.4 m LUMINAIRE

RELEASED FOR CONSTRUCTION
BY: _____



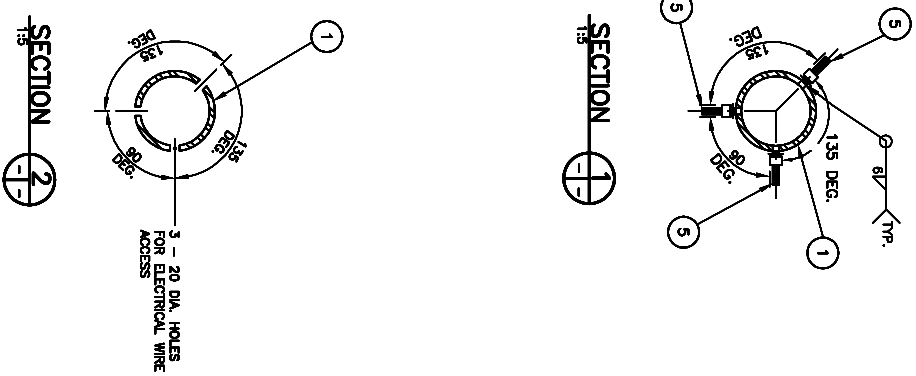
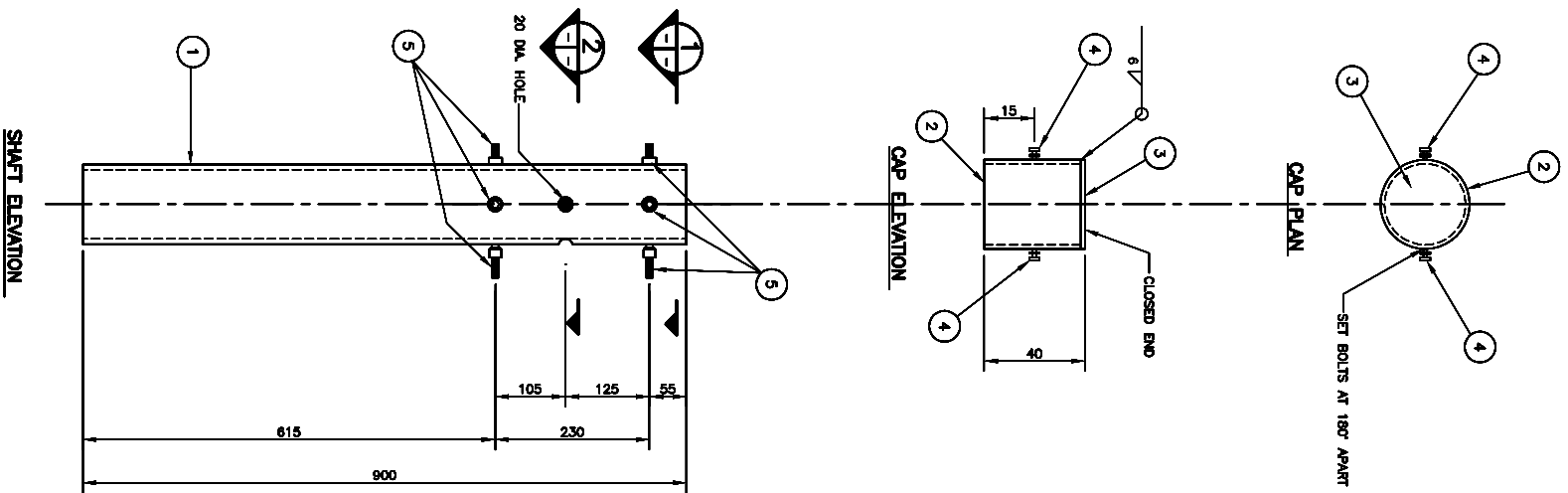
REDUCED DRAWING
N.T.S.



DESIGN	BY: _____	CDM	DIRECTOR	DATE
CHECKED	BY: _____	SSR	TRAFFIC ENGINEERING	COMPONENT No.
CHECKER	BY: _____	JGW	SCALE	E-018 L.
CHECKER	BY: _____	SSR	SHEET No.	S13

LUMINAIRE ADAPTOR

1:5



BILL OF MATERIALS

LINE NO.	QTY. REQ'D.	DESCRIPTION	SIZE	MATERIAL (G40.21-M-300W U/N)	REMARKS
1	1	HYDRO LUMINAIRE ADAPTOR			
2	1	LUMINAIRE ADAPTOR	119 O.D. x 6.35 x 900		
3	1	CAP	132 O.D. x 4.763 x 38		
4	1	CAP COVER PLATE	6 x 136 DIA.		
5	2	BOLT	6 DIA. x 15	TYPE 316 S/S	C/W LOCKWASHERS & LOCKWASHER EACH BOLT
6	6	THREADED ROD	16 DIA. x 50	G40.21-M-300W	C/W 1-NUT & 1-LOCKWASHER EACH ROD
7					
8					
9					
10					

- NOTE:**
- ALL MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
 - ROUND ALL SHARP POINTS AND EDGES.
 - TO BE USED WITH 8.4 m AND 8.4 m LUMINAIRE EXTENSION SHWTS (E-016 L).

DATE	BY	DESCRIPTION

TRAFFIC SIGNAL AND PEDESTRIAN
CORRIDOR STRUCTURES
HYDRO LUMINAIRE ADAPTOR



DILLON CONSULTING
CONSULTANT PROJECT NO. 11-5296

APEGM
Certificate of Authorization
Dillon Consulting Limited (MB)
No. 1789 Date: 04/03/2012

REDUCED DRAWING
N.T.S.

RELEASED FOR CONSTRUCTION
BY: _____
DATE: _____

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SCALE: AS SHOWN

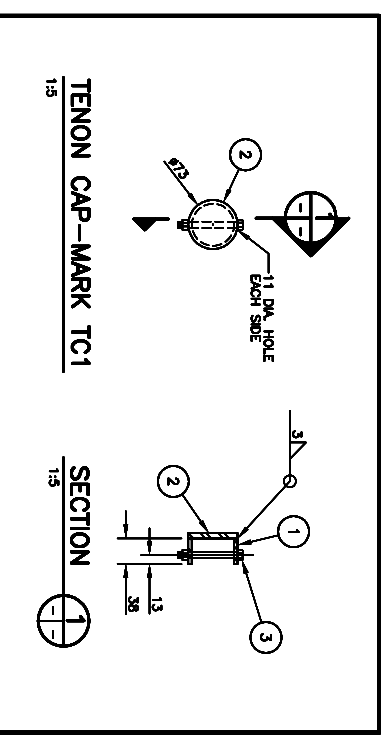
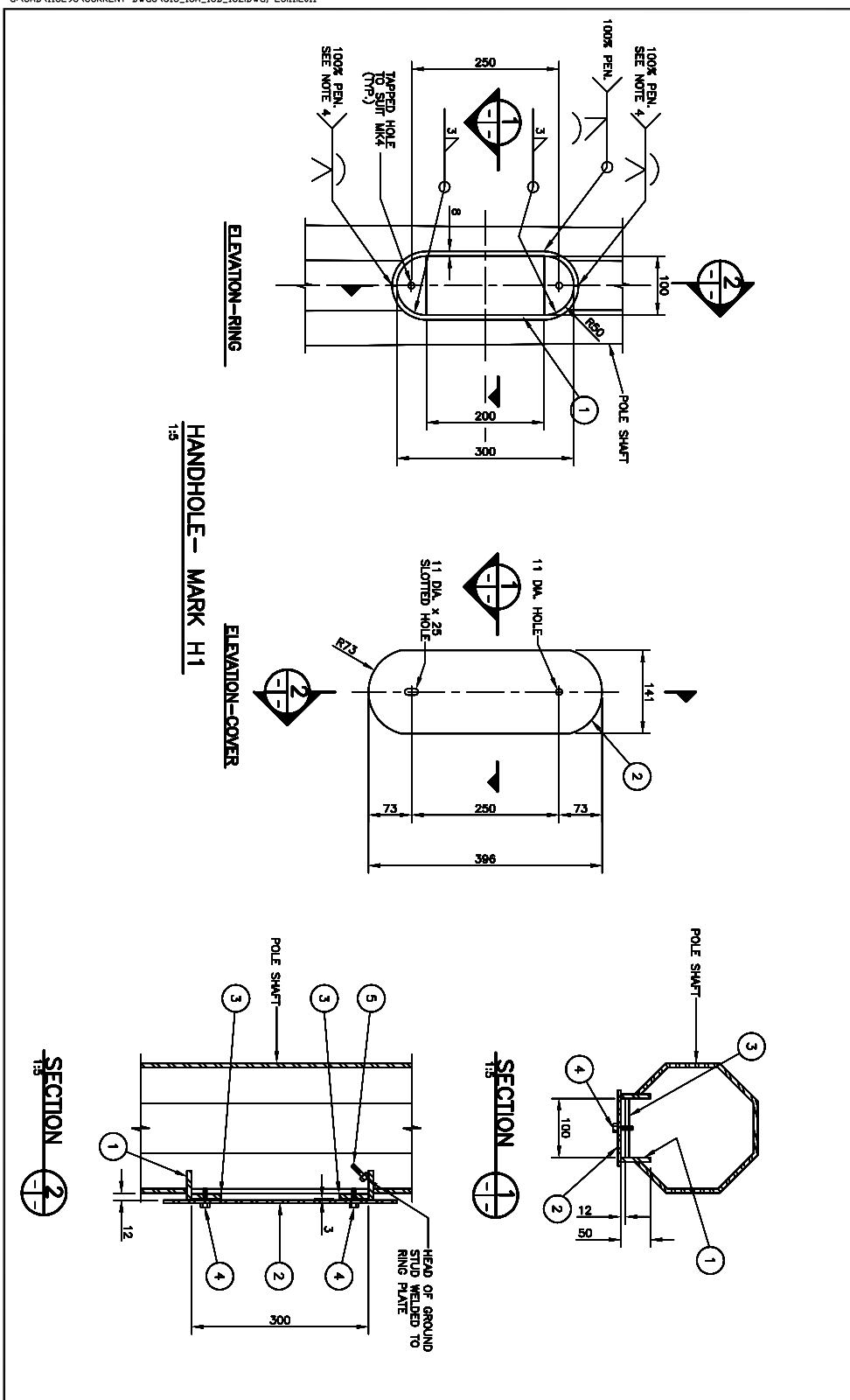
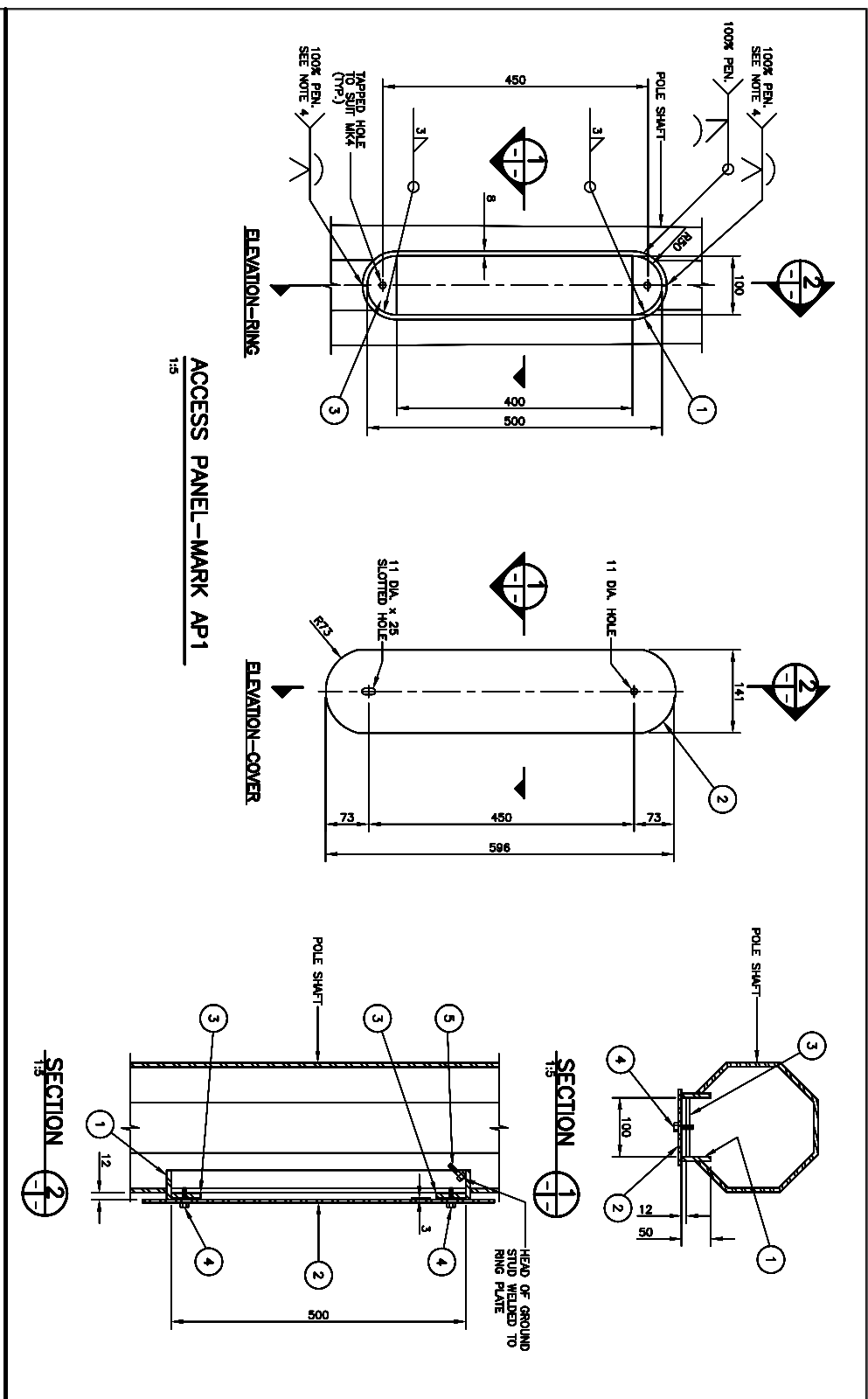
DETAILS: _____
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COMPONENT NO. E-016.T
SHEET NO. S14

BILL OF MATERIALS

LINE NO.	QTY.	DESCRIPTION	SIZE	MATERIAL (C40.21-M-300W U/N)	REMARKS
1	1	ACCESS PANEL MARK AP1			
2	1	RING PLATE	8 x 50 x 955		TAP AFTER GALVANIZED
3	1	COVER PLATE	11 GA. x 141 x 596		TAP AFTER GALVANIZED
4	2	BACKING PLATE	6 x 50 x 100		TAP AFTER GALVANIZED
5	2	HEX BOLT	6 DIA. x 19	ASTM 276, TYPE 316 S/S	C/W OVERSIZE FLAT WASHER
6	1	GROUND STUD ASSEMBLY	10 DIA. x 40		C/W 2-10 DIA. HEX NUT 2-TERMINAL WASHER & 1-LOCKWASHER
7					
8		HANDHOLE MARK H1			
9	1	RING PLATE	8 x 50 x 545		TAP AFTER GALVANIZED
10	1	COVER PLATE	11 GA. x 141 x 396		TAP AFTER GALVANIZED
11	2	BACKING PLATE	6 x 50 x 100		TAP AFTER GALVANIZED
12	2	HEX BOLT	6 DIA. x 19	ASTM 276, TYPE 316 S/S	C/W OVERSIZE FLAT WASHER
13	1	GROUND STUD ASSEMBLY	10 DIA. x 40		C/W 2-10 DIA. HEX NUT 2-TERMINAL WASHER & 1-LOCKWASHER
14					
15		TENON CAP MARK TC1			
16	1	PIPE	73 O.D. x 5.16 x 36	SCH. 40, ASTM A53 GR. B	
17	1	CAP PLATE	73 DIA. x 6		
18	3	HEX BOLT	10 DIA. x 99	ASTM 276, TYPE 316 S/S	C/W NUT/ON NUT
19					
20					

- NOTE:**
- ALL MATERIALS, EXCEPT STAINLESS STEEL ITEMS, SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
 - RE-TAP THREADED HOLES AND GROUND STUD AFTER HOT-DIP GALVANIZING.
 - GRIND ALL SHARP POINTS AND EDGES.
 - RING PLATE MAY BE FABRICATED FROM ONE OR TWO PIECES CONNECTED TOP AND/OR BOTTOM BY COMPLETE PENETRATION WELD.



REDUCED DRAWING
N.T.S.

APEGIN
Certificate of Authorization
Dillon Consulting Limited (MB)
No. 4789 Date: 04/03/2012

TRAFFIC SIGNAL AND PEDESTRIAN CORRIDOR STRUCTURES

DETAILS
ACCESS PANEL (AP1)
HANDHOLE (H1)
TENON CAP (TC1)

RELEASED FOR CONSTRUCTION
BT:

REVISIONS

DATE	BY	DESCRIPTION

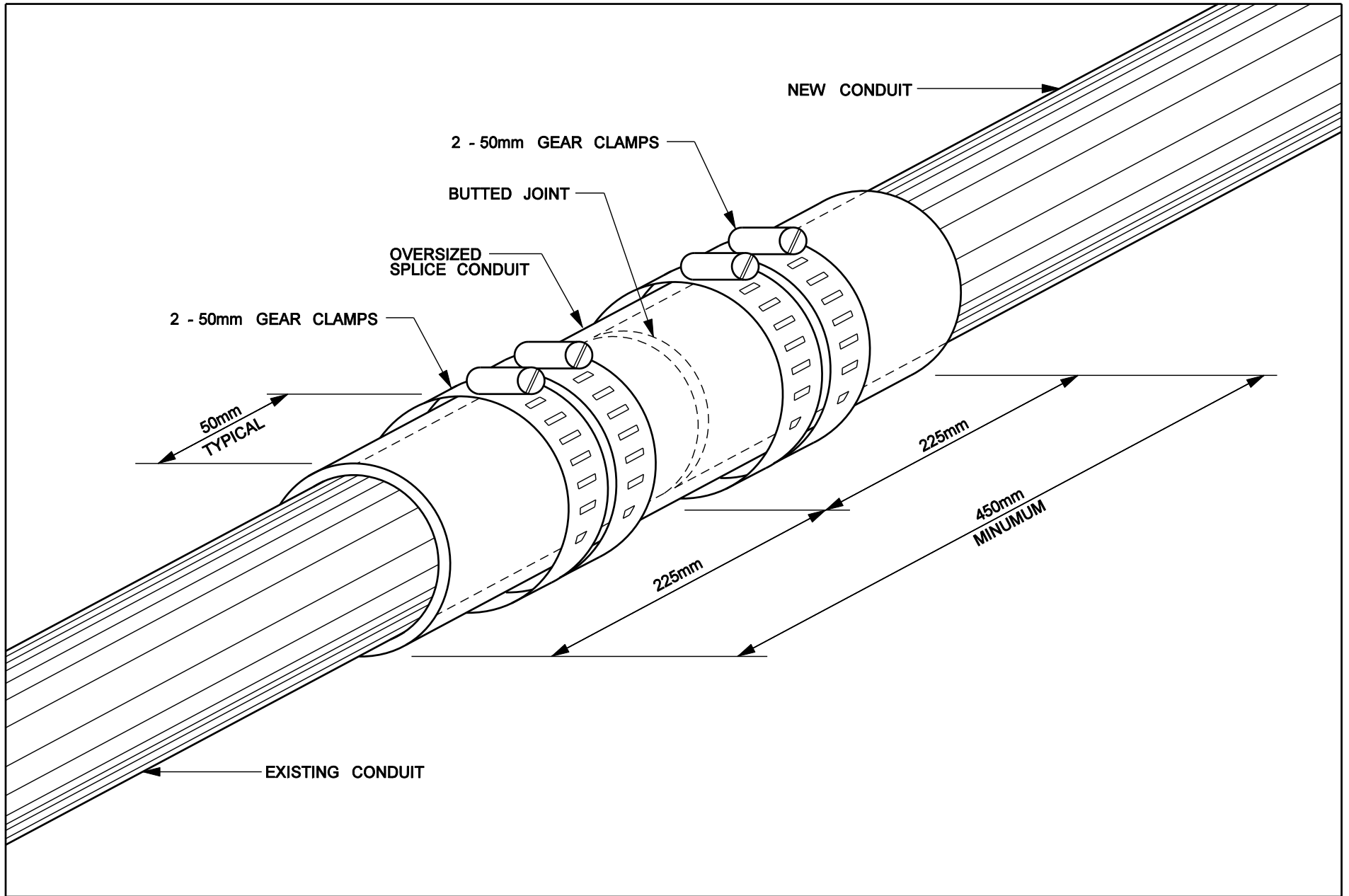
Manitoba
Infrastructure and Transportation
Traffic Engineering

DILLON CONSULTING
CONSULTANT PROJECT NO. 11-5296

PROVINCE OF MANITOBA
REGISTERED PROFESSIONAL ENGINEER
S.S. RIHAL
04/03/2012

DESIGN	CDM	DATE
CHECKED	SSR	SCALE
BY	JW	AS SHOWN
CHECKED	SSR	SHEET NO. S15

COMPONENT NO. E-016 A, B & Z



REVISIONS	DESCRIPTION	BY
DATE	11-75	PAPER ORIGINAL
11-75	PAPER ORIGINAL	AWM
08-06	CLAMPS ADDED	DGC

Manitoba
Infrastructure and
Transportation
 TRAFFIC ENGINEERING

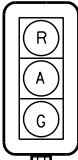
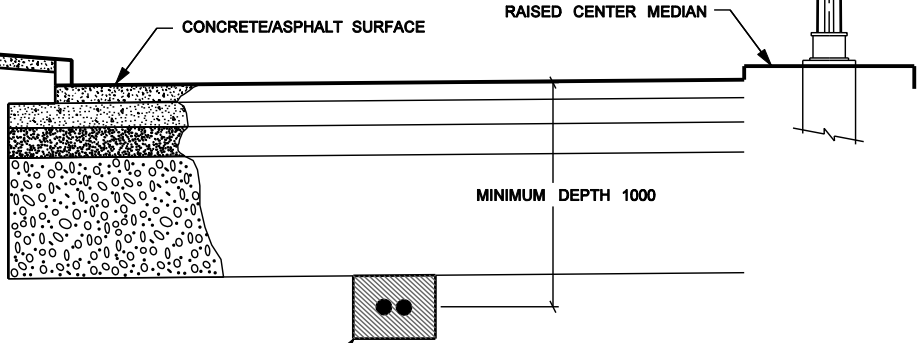
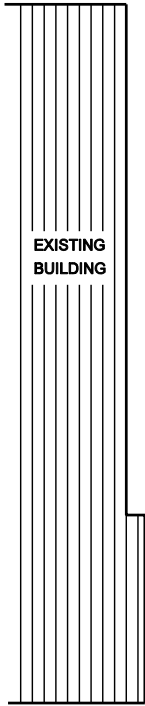
CONDUIT SPLICE DETAILS

ORIGINAL DRAWING
 APPROVED BY:

LUCIEN GAGNON

SCALE:	N.T.S.
DATE:	06-2004
PREP. BY:	D.G.C.


E-027



ONE OR MORE 50mm TRAFFIC SIGNAL CONDUITS SURROUNDED BY 300 mm OF FINE SAND.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS INDICATED OTHERWISE

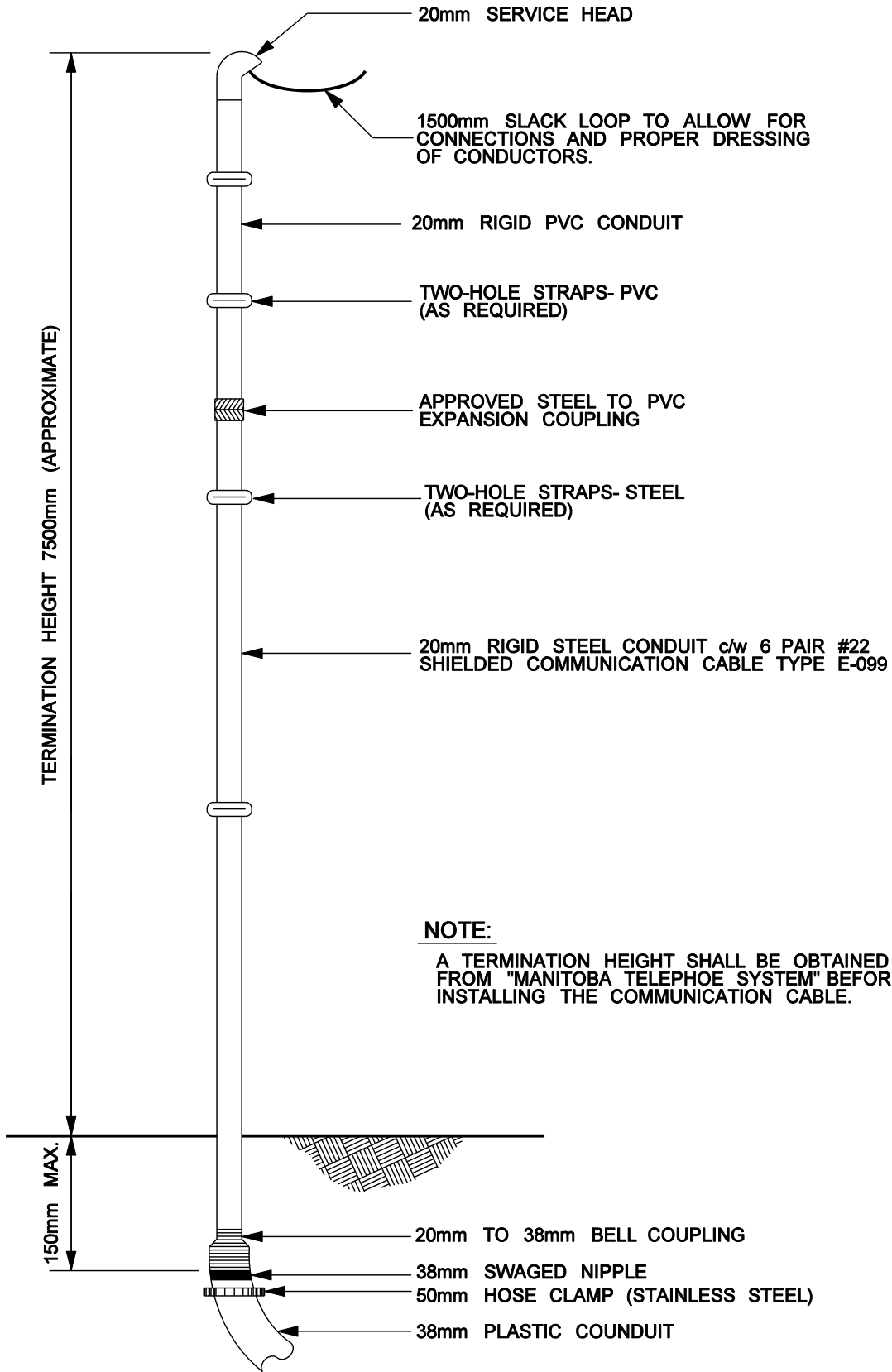
REVISIONS	DESCRIPTION	BY	DC			
DATE	08-04					

Manitoba 
Infrastructure and Transportation
 TRAFFIC ENGINEERING

TRENCHING / BACKFILL DETAIL
 FOR TRAFFIC SIGNAL CONDUITS

ORIGINAL DRAWING
 APPROVED BY: TOM McDERMOTT

SCALE:	N.T.S.
DATE:	03-1995
PREP. BY:	B.J.
E-035	



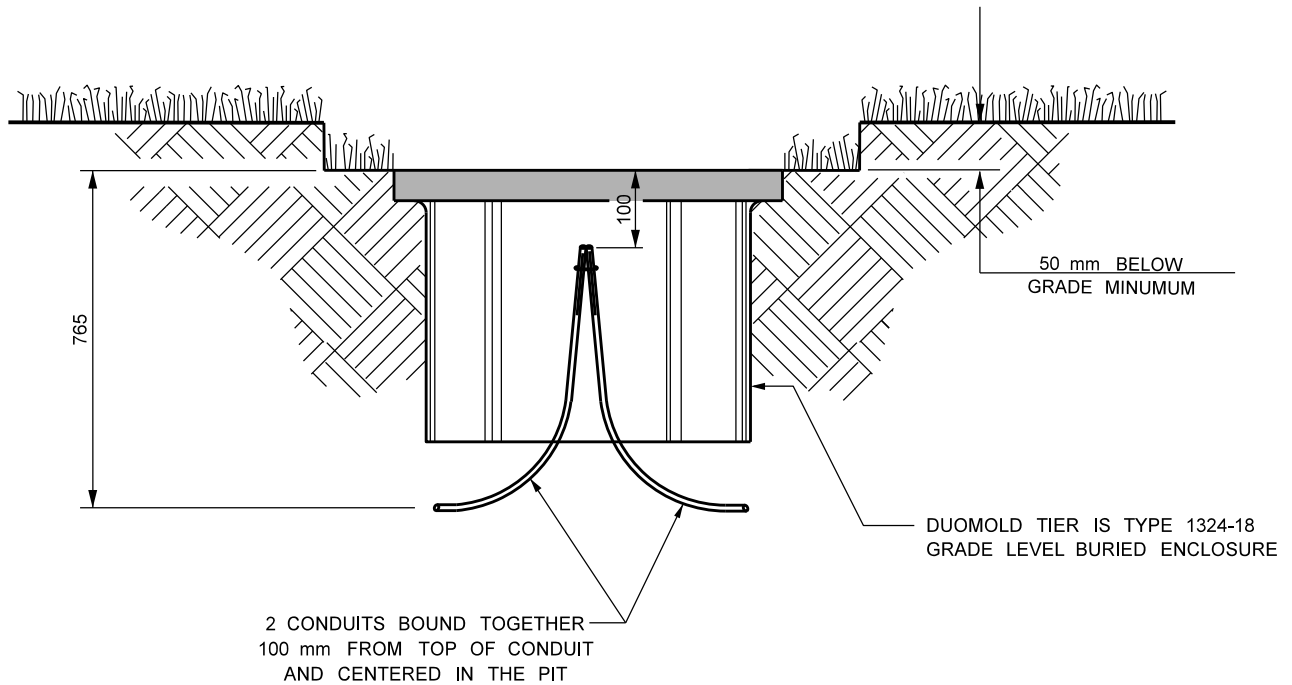
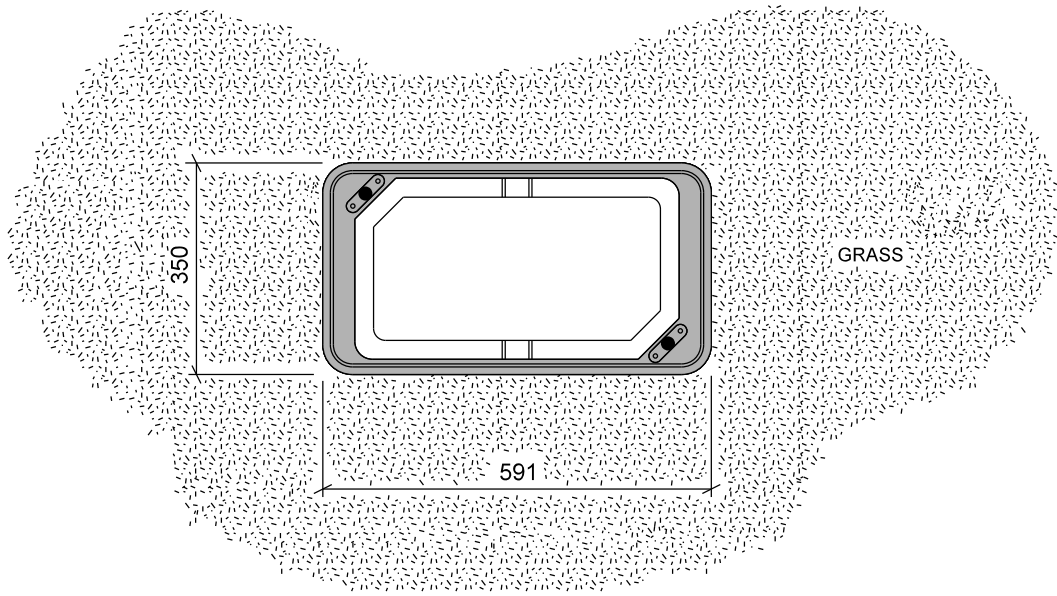
REVISIONS	DESCRIPTION	BY	DATE

Manitoba 
Infrastructure and Transportation
 TRAFFIC ENGINEERING

TYPICAL COMMUNICATIONS SERVICE


APPROVED BY: **LUCIEN GAGNON**

SCALE:	N.T.S.
DATE:	06-2004
PREP. BY:	D.G.C.
E-038	



ALL DIMENSIONS ARE IN MILLIMETRES UNLESS INDICATED OTHERWISE

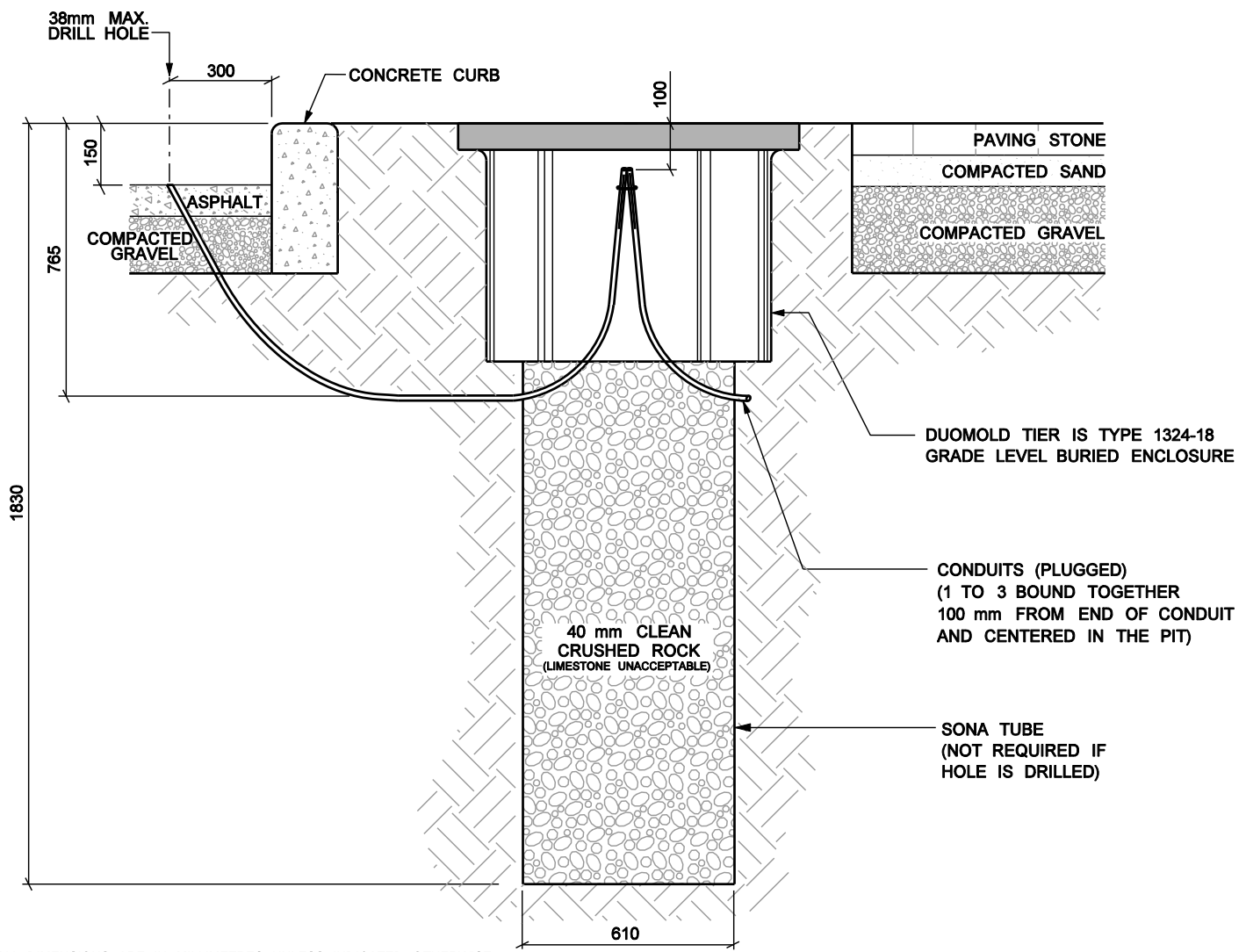
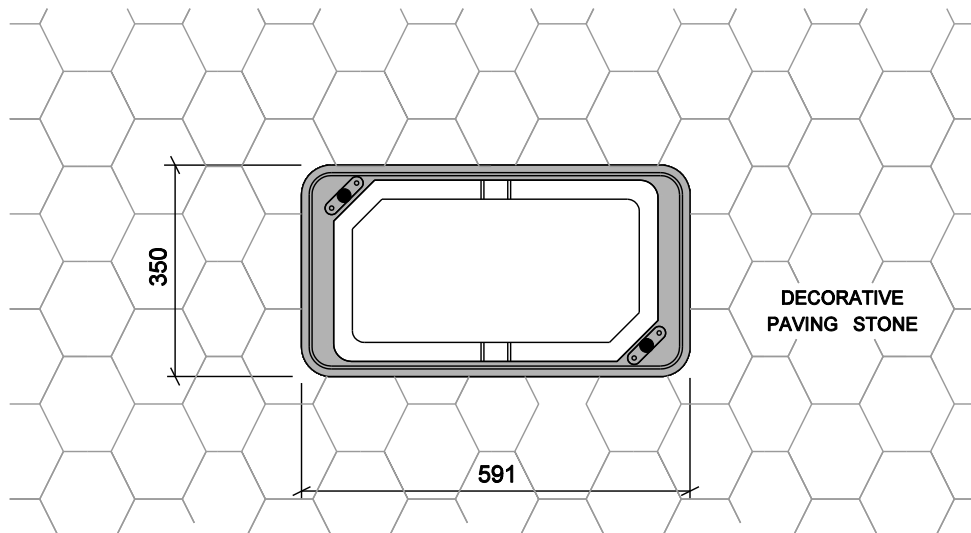
REVISIONS	DATE	DESCRIPTION
	06-2012	SPLICE PIT CHANGED

Manitoba 
Infrastructure and Transportation
 TRAFFIC ENGINEERING

UNDERGROUND SPLICE/PULL PIT
 (MODIFIED) TO UNFINISHED AREA
 (TYPE III)


ORIGINAL DRAWING
 APPROVED BY: LOU GAGNON

SCALE:	N.T.S.
DATE:	07-2007
PREP. BY:	D.C.
E-039b	



ALL DIMENSIONS ARE IN MILLIMETRES UNLESS INDICATED OTHERWISE

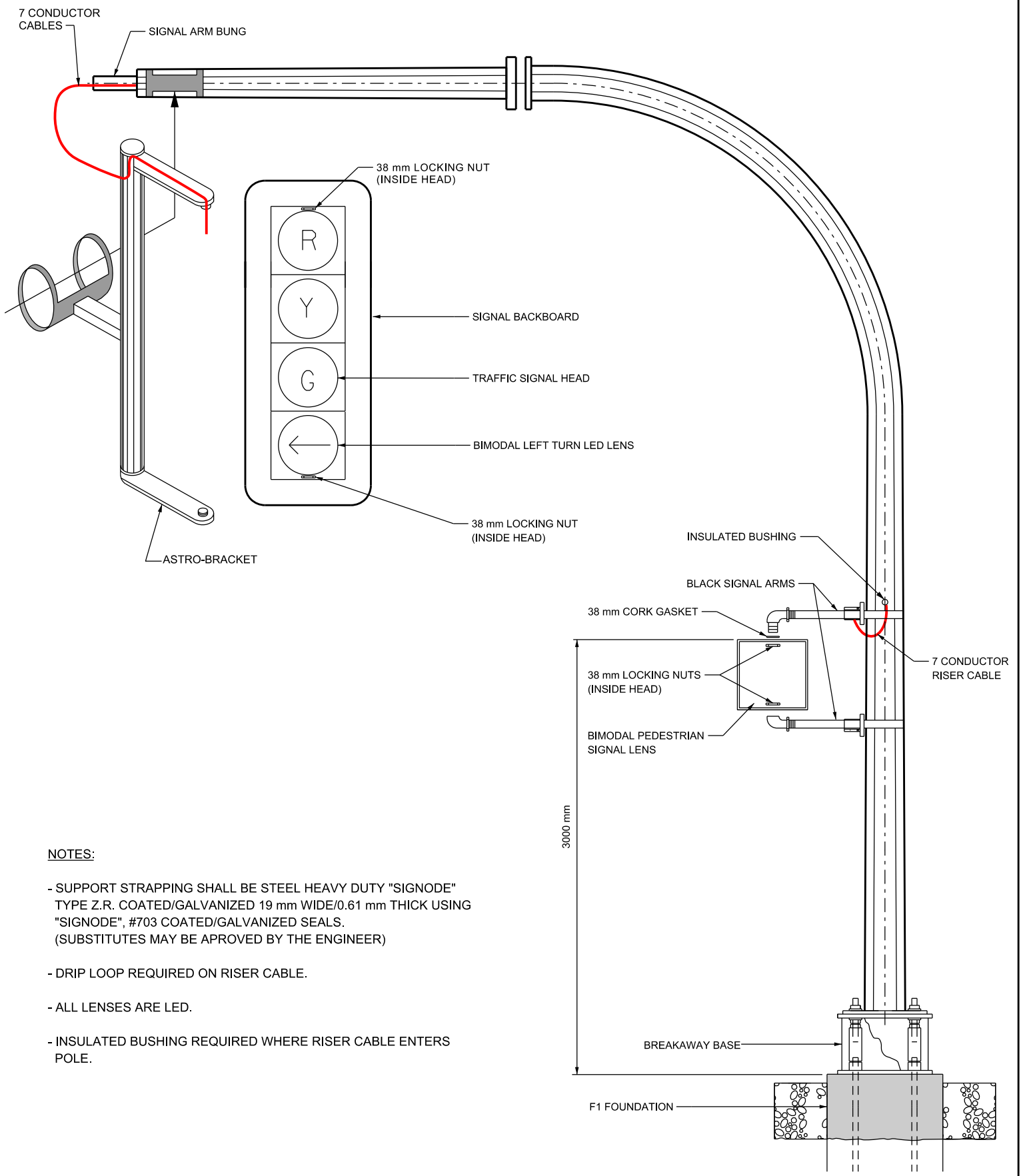
REVISIONS	DATE	DESCRIPTION

Manitoba 
Infrastructure and Transportation
 TRAFFIC ENGINEERING

UNDERGROUND SPLICE/PULL PIT
 TO FINISHED AND UNFINISHED AREAS
 (TYPE IV)

ORIGINAL DRAWING APPROVED BY: LOU GAGNON


SCALE:	N.T.S.
DATE:	04-2009
PREP. BY:	DGC
E-039c	



NOTES:

- SUPPORT STRAPPING SHALL BE STEEL HEAVY DUTY "SIGNODE" TYPE Z.R. COATED/GALVANIZED 19 mm WIDE/0.61 mm THICK USING "SIGNODE", #703 COATED/GALVANIZED SEALS. (SUBSTITUTES MAY BE APPROVED BY THE ENGINEER)
- DRIP LOOP REQUIRED ON RISER CABLE.
- ALL LENSES ARE LED.
- INSULATED BUSHING REQUIRED WHERE RISER CABLE ENTERS POLE.

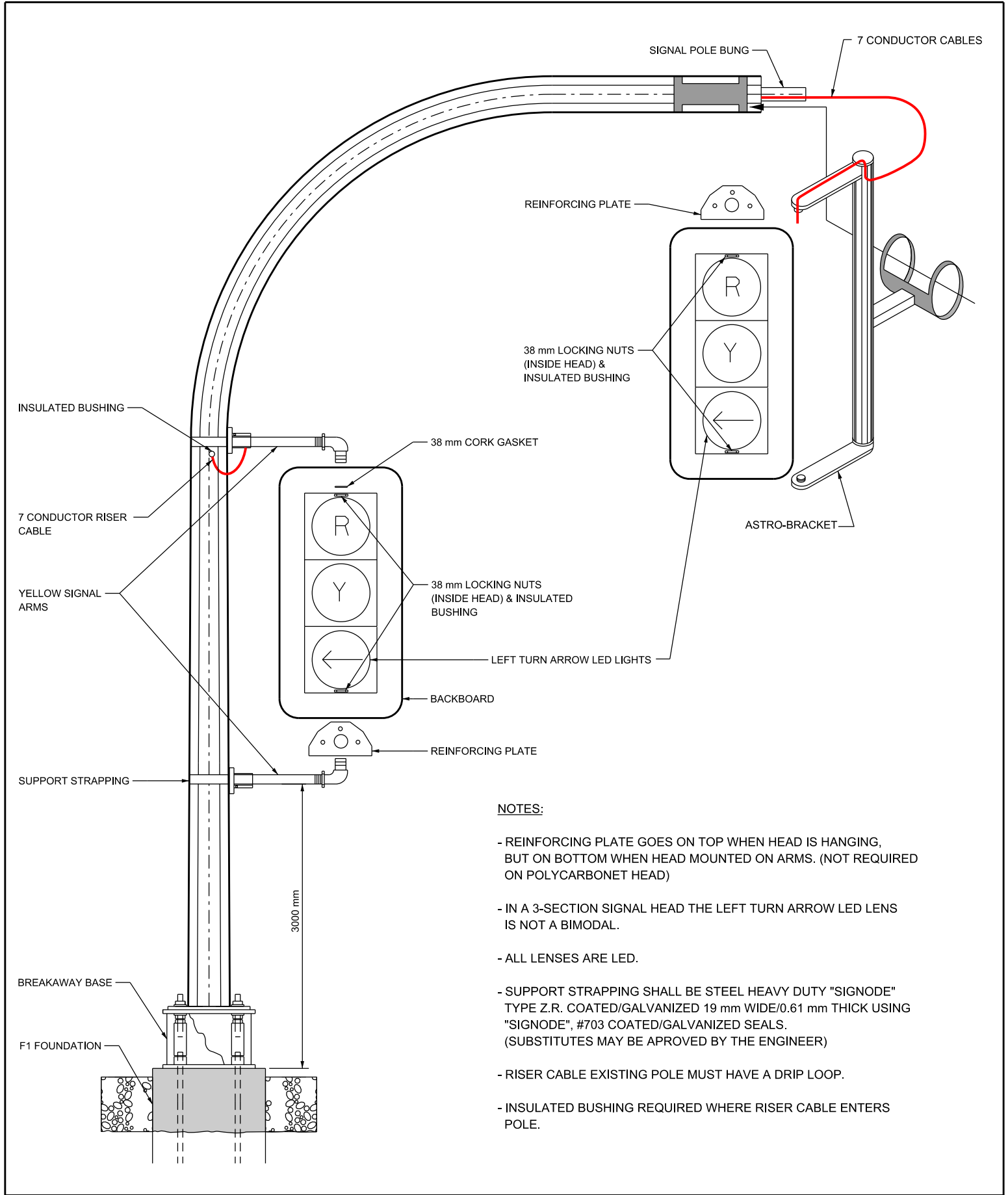
REVISIONS	DATE	DESCRIPTION	BY

Manitoba 
Infrastructure and Transportation
 TRAFFIC ENGINEERING

LIGHT SERIES 5 METER DAVIT
 Type 2

ORIGINAL APPROVED BY: **LUCIEN GAGNON**

SCALE:	N.T.S.
DATE:	MAY/06
PREP.BY:	H.A.E.
E-112b	



NOTES:

- REINFORCING PLATE GOES ON TOP WHEN HEAD IS HANGING, BUT ON BOTTOM WHEN HEAD MOUNTED ON ARMS. (NOT REQUIRED ON POLYCARBONET HEAD)
- IN A 3-SECTION SIGNAL HEAD THE LEFT TURN ARROW LED LENS IS NOT A BIMODAL.
- ALL LENSES ARE LED.
- SUPPORT STRAPPING SHALL BE STEEL HEAVY DUTY "SIGNODE" TYPE Z.R. COATED/GALVANIZED 19 mm WIDE/0.61 mm THICK USING "SIGNODE", #703 COATED/GALVANIZED SEALS. (SUBSTITUTES MAY BE APPROVED BY THE ENGINEER)
- RISER CABLE EXISTING POLE MUST HAVE A DRIP LOOP.
- INSULATED BUSHING REQUIRED WHERE RISER CABLE ENTERS POLE.

REVISIONS	DATE	DESCRIPTION	BY

Manitoba 
Infrastructure and Transportation
 TRAFFIC ENGINEERING

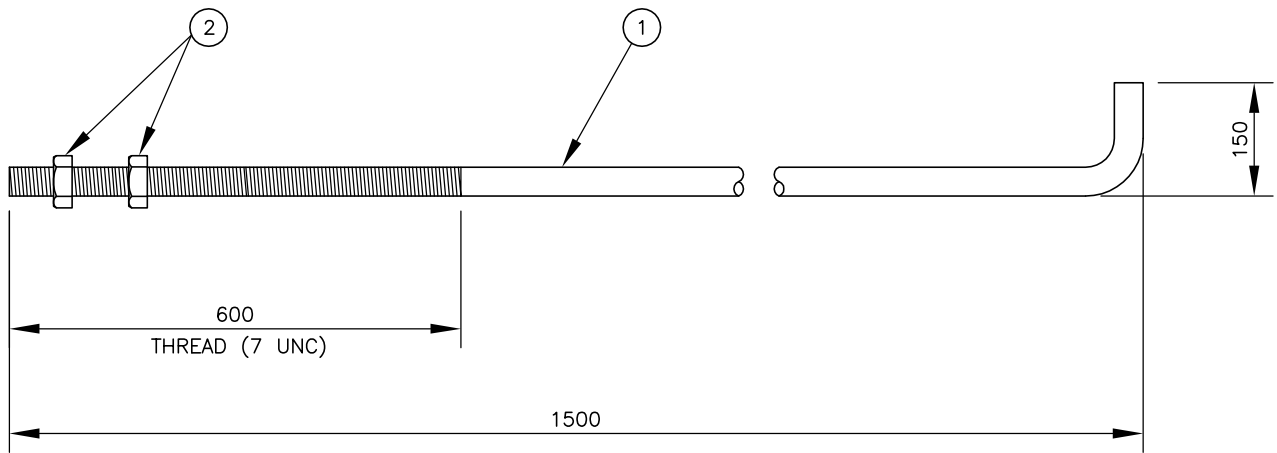
LIGHT SERIES 2.5 METER DAVIT
Type 2

ORIGINAL APPROVED BY: **LUCIEN GAGNON**

SCALE:	N.T.S.
DATE:	MAY/06
PREP. BY:	H.A.E.
E-112c	

BILL OF MISCELLANEOUS METAL

MK. NO.	QTY. REQ'D.	DESCRIPTION	SIZE	
1	1	ANCHOR BOLT	29 (1 1/8") DIA. x 1650	G40.21-M-300W GALV. FULL LENGTH
2	2	HALF NUTS	29 (1 1/8") DIA.	ASTM A194 GRADE 2H



ANCHOR BOLT ASSEMBLY MK. AB1
(STOCK CODE NO. 7558)

NOTES:

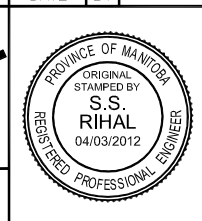
1. ANCHOR BOLTS SHALL BE SOLID ROUNDS G40.21-M-300W.
2. ALL PARTS OF ANCHOR BOLT ASSEMBLY SHALL BE HOT DIP GALVANIZED (FULL LENGTH) IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
3. ALL NUTS SHALL BE TAPPED OVERSIZE PRIOR TO GALVANIZING.
4. ALL NUTS AND WASHERS SHALL BE ASSEMBLED BY THE SUPPLIER PRIOR TO DELIVERY.
5. ANCHOR BOLTS AB1 TO BE USED WITH LIGHT SERIES FOUNDATION TYPE F1.



REVISIONS		
DATE	BY	DESCRIPTION

**TRAFFIC SIGNAL AND
PEDESTRIAN CORRIDOR
STRUCTURES**

29 mm (1 1/8") DIA.
ANCHOR BOLT AB1

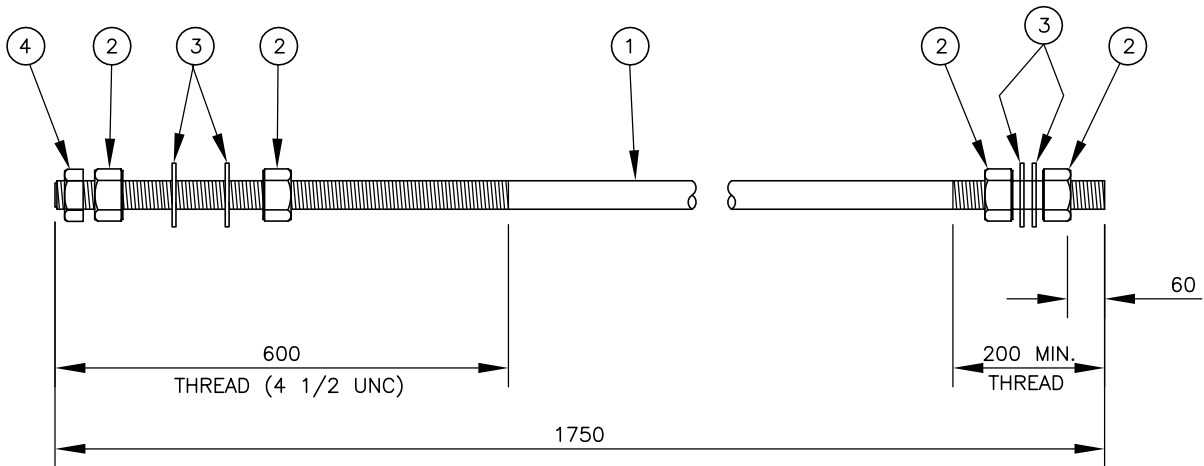


DESIGN	BY: <u>CDW</u>	CHECKED: <u>SSR</u>	RELEASED FOR CONSTRUCTION BY: _____
DETAILS	BY: <u>JGW</u>	SCALE: <u>NTS</u>	DIRECTOR TRAFFIC ENGINEERING _____
	CHECKED: <u>SSR</u>	COMPONENT No. <u>AB1</u>	DATE _____

SHEET No. <u>AB1</u>

BILL OF MISCELLANEOUS METAL

MK. NO.	QTY. REQ'D.	DESCRIPTION	SIZE	MATERIAL
1	1	ANCHOR BOLT THREADED BOTH ENDS	51 (2") DIA. x 1750	AISI/SAE 4140 GALV. FULL LENGTH
2	4	HEAVY HEX NUT	51 (2") DIA.	ASTM A194 GRADE 2H
3	4	HEAVY WASHER	51 (2") DIA.	G40.21-M-300W
4	1	LOCK HEX NUT	51 (2") DIA.	ASTM A194 GRADE 2H



ANCHOR BOLT ASSEMBLY MK. AB3
(STOCK CODE NO. 7585)

NOTES:

1. ANCHOR BOLTS SHALL BE SOLID ROUNDS AISI/SAE 4140 STEEL IN THE ANNEALED CONDITION.
2. ALL PARTS OF ANCHOR BOLT ASSEMBLY SHALL BE HOT DIP GALVANIZED (FULL LENGTH) IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m.²
3. ALL NUTS SHALL BE TAPPED OVERSIZE PRIOR TO GALVANIZING.
4. ALL NUTS AND WASHERS SHALL BE ASSEMBLED BY THE SUPPLIER PRIOR TO DELIVERY.
5. ANCHOR BOLTS AB3 TO BE USED WITH HEAVY SERIES FOUNDATION TYPE F5.



REVISIONS		
DATE	BY	DESCRIPTION

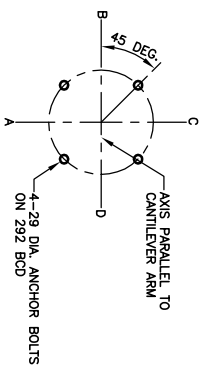
**TRAFFIC SIGNAL AND
PEDESTRIAN CORRIDOR
STRUCTURES**

**51 mm (2") DIA.
ANCHOR BOLT AB3**

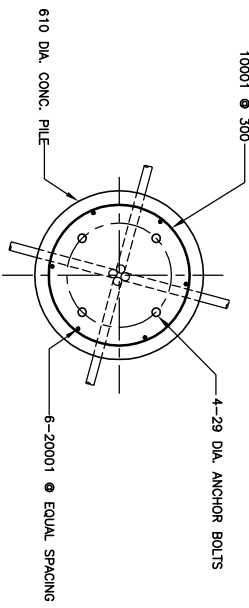


DESIGN	BY: <u>CDW</u>
	CHECKED: <u>SSR</u>
DETAILS	BY: <u>JGW</u>
	CHECKED: <u>SSR</u>

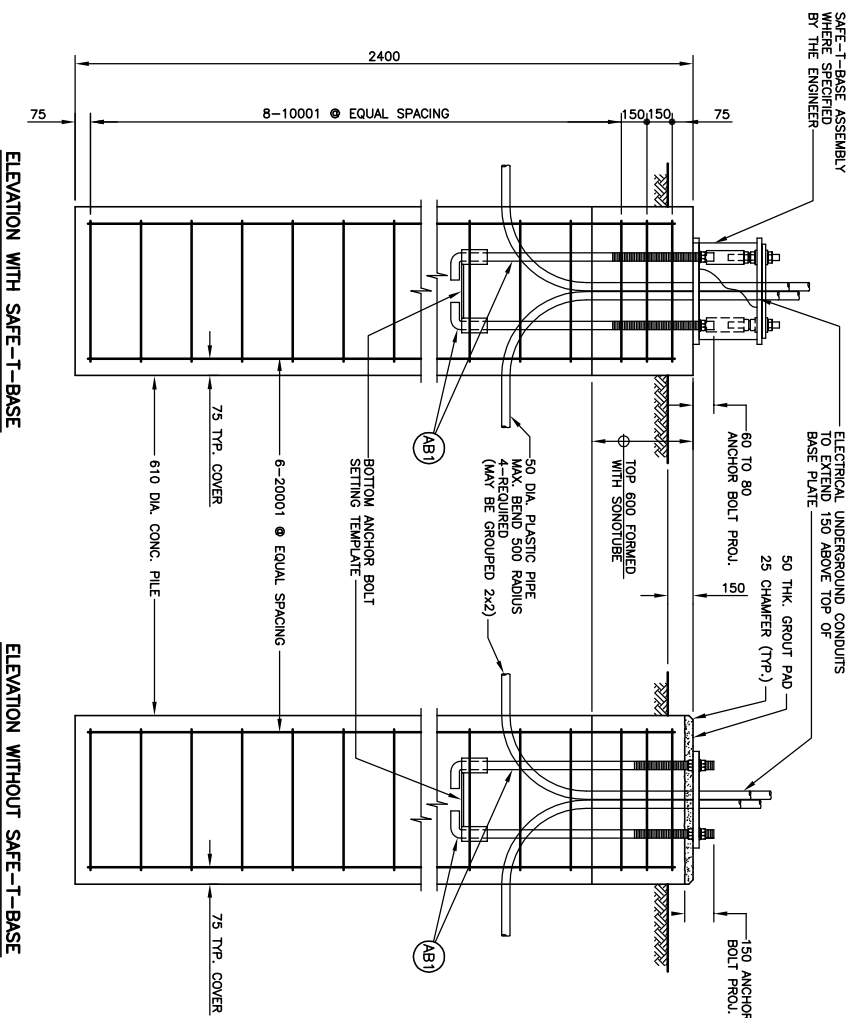
RELEASED FOR CONSTRUCTION BY:	
DIRECTOR TRAFFIC ENGINEERING	DATE
SCALE: NTS	COMPONENT No. AB3
	SHEET No. AB3



ANCHOR BOLTS LAYOUT



PLAN / CONCRETE SECTION



ELEVATION WITH SAFE-T-BASE

ELEVATION WITHOUT SAFE-T-BASE

FOUNDATION DETAIL

N.T.S.

GENERAL NOTES:
CONCRETE FOUNDATION PILES

1. PRIOR TO DRILLING PILES, CONTRACTOR SHALL ENSURE THERE ARE NO CONFLICTING SURFACE OR SUBSURFACE UTILITIES.
2. DRILL PILES TO INDICATED DEPTHS ENSURING THAT SHAFTS ARE DRY AND FREE OF DEBRIS UNTIL CONCRETE IS PLACED.
3. CONCRETE
- 1) CSA A23.1 EXPOSURE CLASS S-1
- 2) COMPRESSIVE STRENGTH ϕ 28 DAYS = 35 MPa
- 3) AIR CONTENT: CATEGORY 1

4. NOTIFY THE OWNER AND TESTING FIRM A MINIMUM OF TWENTY FOUR HOURS PRIOR TO COMMENCEMENT TO CONCRETE OPERATIONS.
5. REFER TO SPECIFICATIONS FOR CONCRETE TESTING REQUIREMENTS.
6. REINFORCING STEEL TO BE GRADE 400W, DEFORMED BILLET STEEL BARS FOR CONCRETE REINFORCEMENT CONFORMING TO CSA G30.18.
7. ANCHOR BOLTS, NUTS AND WASHERS WILL BE SUPPLIED BY THE DEPARTMENT AND SET BY THE CONTRACTOR.

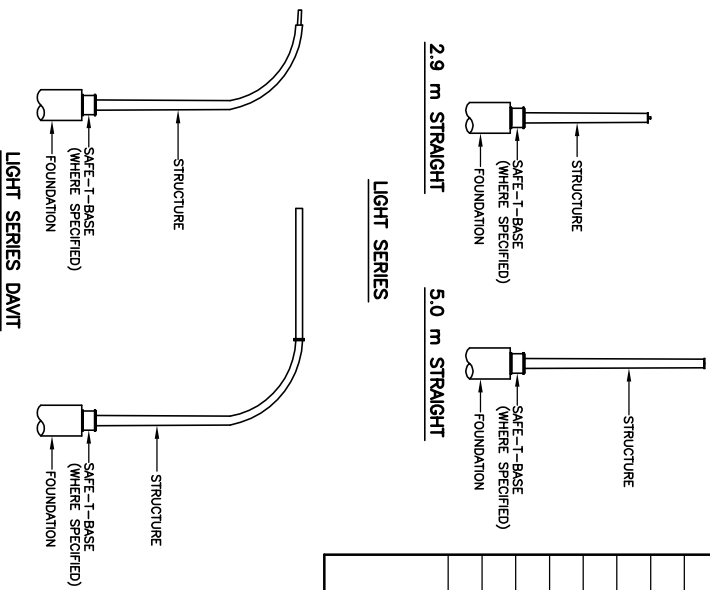
8. THE ANCHOR BOLTS SHALL BE ALIGNED WITH TOP AND BOTTOM SETTING TEMPLATES AND THE ANCHOR BOLTS SHALL BE SUPPLIED WITH THE ANCHOR BOLTS WITHOUT THE SETTING TEMPLATES WILL NOT BE PERMITTED.

TOP SETTING TEMPLATE

- TEMPORARY STEEL TEMPLATE LOANED TO THE CONTRACTOR BY THE DEPARTMENT.
- AFTER COMPLETION OF CONCRETE PILE FOUNDATION WORKS, THE CONTRACTOR SHALL CLEAN THE TEMPLATE BY SANDBLASTING AND RETURN IT TO THE DEPARTMENT.
- IF THE TEMPLATE IS DAMAGED DURING CONSTRUCTION DUE TO NEGLIGENCE, THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING A NEW 10 mm THICK STEEL TEMPLATE TO THE DEPARTMENT AT HIS OWN EXPENSE.

BOTTOM SETTING TEMPLATE

- PERMANENT HOT DIP GALVANIZED STEEL ASSEMBLY FABRICATED FROM CSA G40.21 GRADE 300W AND ASTM A53 GR. B, SCH. 40 PIPE MATERIAL.
- SUPPLIED BY THE DEPARTMENT, SEE DETAIL ON THIS SHEET.
- 9. SOILS INFORMATION AT SITE IS AVAILABLE FROM THE OWNER.

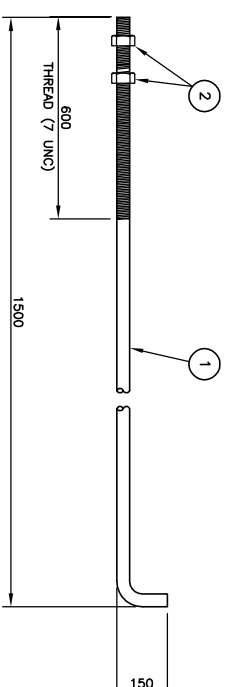


LIGHT SERIES DAVIT

STRUCTURES FOR LIGHT SERIES FOUNDATION TYPE F1

BILL OF MISCELLANEOUS METAL

LINE NO.	QTY.	REQ'D.	SIZE	MATERIAL	REMARKS
1	4		ANCHOR BOLT	G40.21-M-300W GALV. FULL LENGTH	SEE DETAIL BELOW
2	8		HALF NUTS	ASTM A194 GRADE 2H	
3					
4					
5					



ANCHOR BOLT ASSEMBLY MK. AB1
(STOCK CODE NO. 7558)

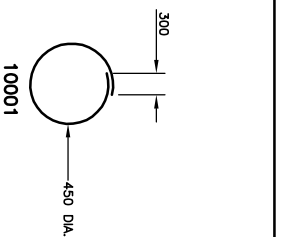
NOTES:

1. ANCHOR BOLTS SHALL BE SOLID ROUNDS G40.21-M-300W.
2. ALL PARTS OF ANCHOR BOLT ASSEMBLY SHALL BE HOT DIP GALVANIZED (FULL LENGTH) IN ACCORDANCE WITH ASTM A123-09 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 810 g/m².
3. ALL NUTS SHALL BE TAPPED OVERSIZE PRIOR TO GALVANIZING.
4. ALL NUTS AND WASHERS SHALL BE ASSEMBLED BY THE SUPPLIER PRIOR TO DELIVERY.

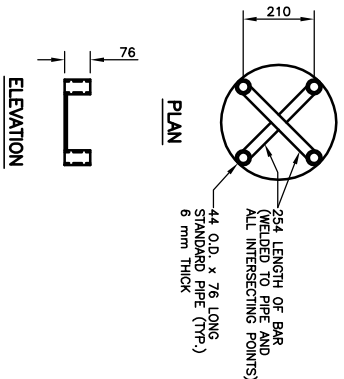
BILL OF REINFORCING STEEL

MK. NO.	SIZE	QTY.	LENGTH (mm)	MASS (kg)	LINE NO.
20001	20M	6	2250	32.40	1
10001	10M	10	1715	13.72	2
					3
					4
					5
					6
					7
					8
					9
					10
TOTAL MASS OF REINFORCING STEEL =				46.12 kg	
TOTAL VOLUME OF C.I.P. CONC. PILES =				0.700 m ³	

BENDING DIAGRAM



BOTTOM ANCHOR BOLT SETTING TEMPLATE



REVISIONS

DATE	BY	DESCRIPTION

TRAFFIC SIGNAL AND PEDESTRIAN CORRIDOR STRUCTURES
LIGHT SERIES FOUNDATION TYPE F1
ANCHOR BOLTS, CONC. PILE, & PILE REINFORCEMENT



RELEASED FOR CONSTRUCTION



CONSULTANT PROJECT NO. 11-5296



No. 1789 Date: 04/03/2012

REDUCED DRAWING
N.T.S.



DATE

BY

DESCRIPTION

DESIGN

CHECKED

BY

CHECKER

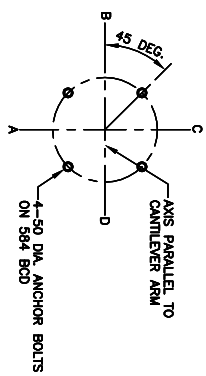
SCALE

AS SHOWN

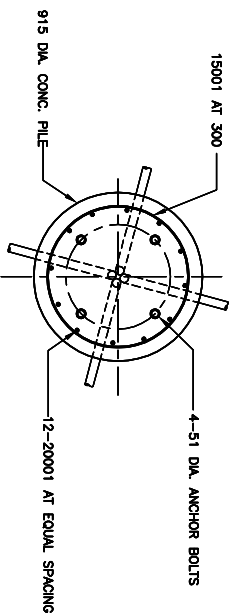
COMPONENT NO.

DATE

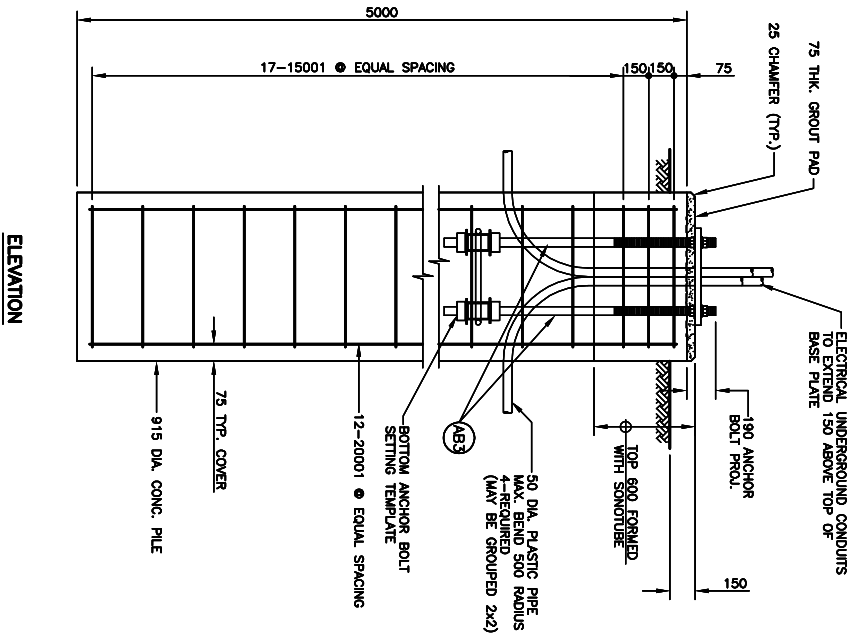
SHEET No. F1



ANCHOR BOLTS LAYOUT



PLAN / CONCRETE SECTION



ELEVATION

FOUNDATION DETAIL N.T.S.

GENERAL NOTES:

CONCRETE FOUNDATION PILES

1. PRIOR TO DRILLING PILES, CONTRACTOR SHALL ENSURE THERE ARE NO CONFLICTING SURFACE OR SUBSURFACE UTILITIES.
2. DRILL PILES TO INDICATED DEPTHS ENSURING THAT SHAFTS ARE DRY AND FREE OF DEBRIS UNTIL CONCRETE IS PLACED.
3. CONCRETE

- 1) CSA A23.1 EXPOSURE CLASS S-1
- 2) COMPRESSIVE STRENGTH ϕ 28 DAYS = 35 MPa
- 3) AIR CONTENT: CATEGORY 1

4. NOTIFY THE OWNER AND TESTING FIRM A MINIMUM OF TWENTY FOUR HOURS PRIOR TO COMMENCEMENT TO CONCRETE OPERATIONS.

5. REFER TO SPECIFICATIONS FOR CONCRETE TESTING REQUIREMENTS.

6. REINFORCING STEEL TO BE GRADE 40MM, DEFORMED BILLET STEEL BARS FOR CONCRETE REINFORCEMENT CONFORMING TO CSA G30.18.

7. ANCHOR BOLTS, NUTS AND WASHERS WILL BE SUPPLIED BY THE DEPARTMENT AND SET BY THE CONTRACTOR.

8. THE ANCHOR BOLTS SHALL BE ALIGNED WITH TOP AND BOTTOM SETTING TEMPLATES MATCHING THE BOLT HOLE LAYOUT. THE TOP SETTING TEMPLATE SHALL BE HELD IN PLACE BY THE NUTS SUPPLIED WITH THE ANCHOR BOLTS. PLACEMENT OF ANCHOR BOLTS WITHOUT THE SETTING TEMPLATES WILL NOT BE PERMITTED.

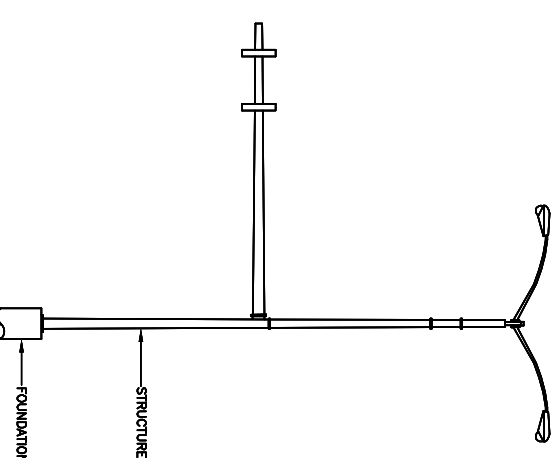
TOP SETTING TEMPLATE

- TEMPORARY STEEL TEMPLATE LOANED TO THE CONTRACTOR BY THE DEPARTMENT.
- AFTER COMPLETION OF CONCRETE PILE FOUNDATION WORKS, THE CONTRACTOR SHALL CLEAN THE TEMPLATE BY SANDBLASTING AND RETURN IT TO THE DEPARTMENT.
- IF THE TEMPLATE IS DAMAGED DURING CONSTRUCTION DUE TO NEGLIGENCE, THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING A NEW 10 mm THICK STEEL TEMPLATE TO THE DEPARTMENT AT HIS OWN EXPENSE.

BOTTOM SETTING TEMPLATE

- PERMANENT HOT DIP GALVANIZED STEEL ASSEMBLY FABRICATED FROM CSA G40.21 GRADE 300W AND ASTM A53 GR. B, SCH. 40 PIPE MATERIAL.
- SUPPLIED BY THE DEPARTMENT, SEE DETAIL ON THIS SHEET.

9. SOILS INFORMATION AT SITE IS AVAILABLE FROM THE OWNER.

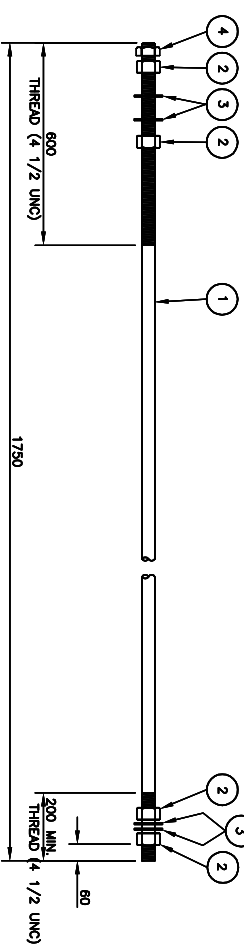


HEAVY SERIES COMBINATION CANTILEVER (FOR ADVANCE WARNING SIGN & TRAFFIC SCREW)

STRUCTURES FOR HEAVY SERIES FOUNDATION TYPE F5

BILL OF MISCELLANEOUS METAL

LINE NO.	QTY. REQ'D.	DESCRIPTION	SIZE	MATERIAL	REMARKS
1	4	ANCHOR BOLT THREADED BOTH ENDS	51 (27) DIA. x 1750	AS1/S/AE 4140 GALV. FULL LENGTH	SEE DETAIL BELOW
2	16	HEAVY HEX NUT	51 (27) DIA.	ASTM A194 GRADE 2H	
3	16	HEAVY WASHER	51 (27) DIA.	G40.21-M-300W	
4	4	LOCK HEX NUT	51 (27) DIA.	ASTM A194 GRADE 2H	
5					
6					
7					



ANCHOR BOLT ASSEMBLY MK AB3 (STOCK CODE NO. 7585)

NOTES:

1. ANCHOR BOLTS SHALL BE SOLID ROUNDS AISI/AE 4140 STEEL IN THE ANNEALED CONDITION.
2. ALL PARTS OF ANCHOR BOLT ASSEMBLY SHALL BE HOT DIP GALVANIZED (FULL LENGTH) IN ACCORDANCE WITH ASTM A123-08 (PLUS LATEST REVISIONS) WITH NET RETENTION OF 610 g/m²
3. ALL NUTS SHALL BE TAPPED OVERSIZE PRIOR TO GALVANIZING.
4. ALL NUTS AND WASHERS SHALL BE ASSEMBLED BY THE SUPPLIER PRIOR TO DELIVERY.

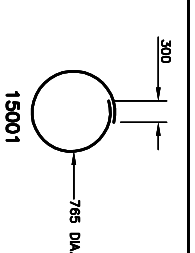
BILL OF REINFORCING STEEL

MK. NO.	SIZE	QTY. REQ'D.	LENGTH (mm)	MASS (kg)	LINE NO.
20001	20M	12	4850	137.06	1
15001	15M	19	2705	90.77	2
					3
					4
					5
					6

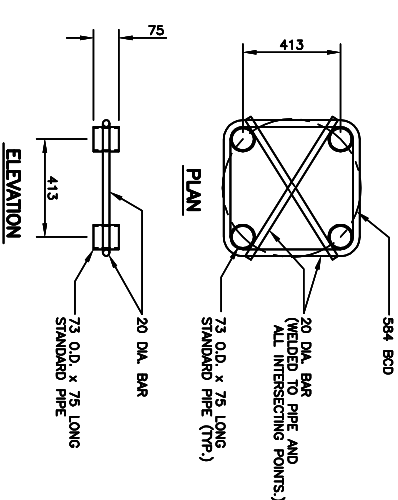
TOTAL MASS OF REINFORCING STEEL = 227.83 kg

TOTAL VOLUME OF C.I.P. CONC PILES = 3.32 m³

BENDING DIAGRAM



BOTTOM ANCHOR BOLT SETTING TEMPLATE



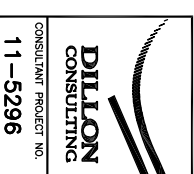
REVISIONS

DATE	BY	DESCRIPTION

TRAFFIC SIGNAL AND ADVANCE WARNING STRUCTURES
HEAVY SERIES FOUNDATION TYPE F5
ANCHOR BOLTS, CONC. PILE, & PILE REINFORCEMENT



Manitoba Infrastructure and Transportation

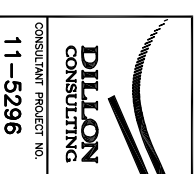


DILLON CONSULTING
CONSULTANT PROJECT NO. 11-5296



APEGIN
Certificate of Authorization
Dillon Consulting Limited (MB)
No. 1789 Date: 04/03/2012

REDUCED DRAWING N.T.S.

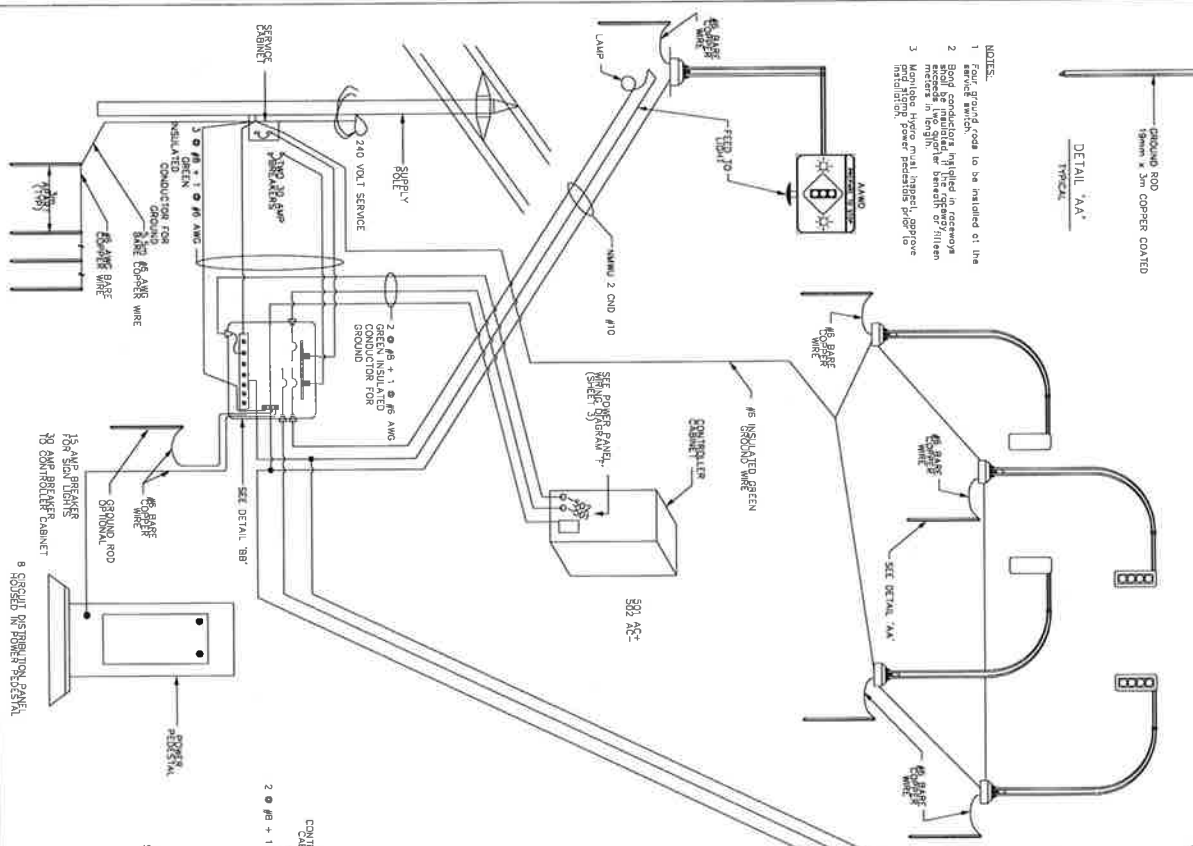


S.S. RIHAL
PROFESSIONAL ENGINEER
REGISTERED PROFESSIONAL ENGINEER
04/03/2012

DESIGN	CHECKER	DATE

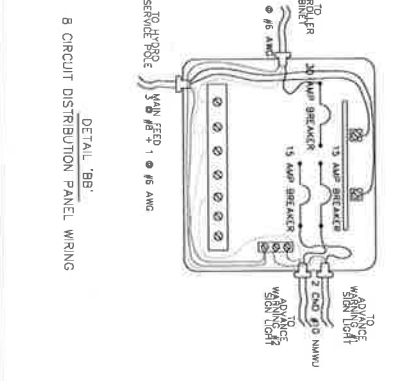
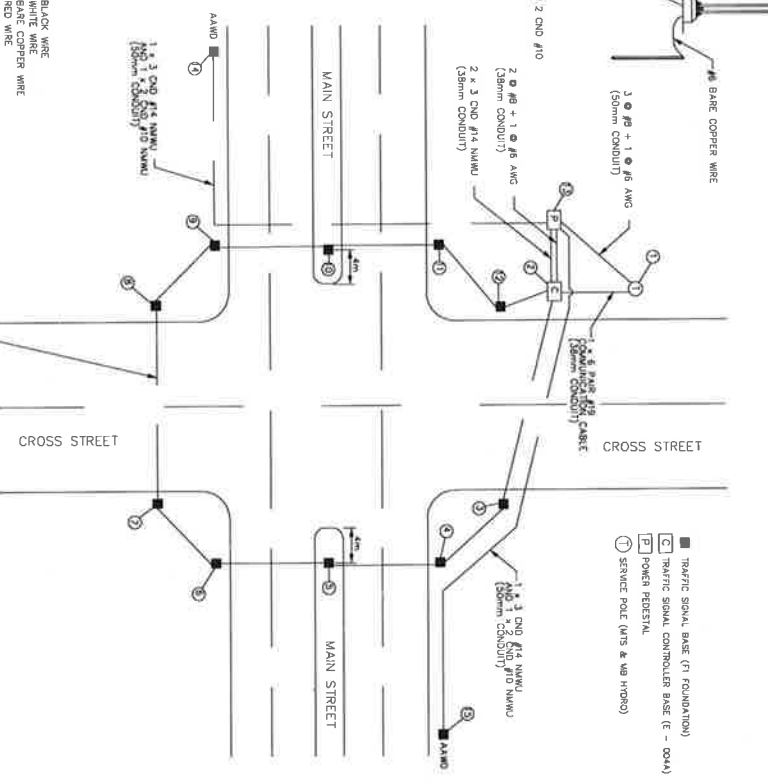
RELEASED FOR CONSTRUCTION
BY: _____
DIRECTOR TRAFFIC ENGINEERING
SCALE: AS SHOWN
COMPONENT NO. F5
DATE: _____
CHECKER: SSR
SHEET No. F4

TYPICAL GROUNDING DIAGRAM
INTERSECTION WITH ADVANCE WARNING SIGNALS
DIAGRAM 'A'



- NOTES:
1. Force ground rods to be installed at the service switch.
 2. Bond conductors required in raceways according to the manufacturer's instructions. Use proper bonding methods.
 3. Monitor bare metal, inspect, approve and stamp power pedestals prior to installation.

TYPICAL AAMD INTERSECTION WIRING DIAGRAM
DIAGRAM 'B'



- Legend:
- Black Wire
 - White Wire
 - Bare Copper Wire
 - Red Wire

REVISIONS

DATE	BY	DESCRIPTION
APR 15	REDA	REVISION FOR CONSTRUCTION
APR 15	REDA	REVISION FOR CONSTRUCTION
APR 15	REDA	REVISION FOR CONSTRUCTION

Manitoba
TRAFFIC ENGINEERING

TYPICAL TRAFFIC SIGNAL SPECIFICATIONS WITH ADVANCE WARNING FLASHERS

SCALE: N.T.S.

DATE: 08 2009

PREPARED BY: D.C.C.

REGION: N/A

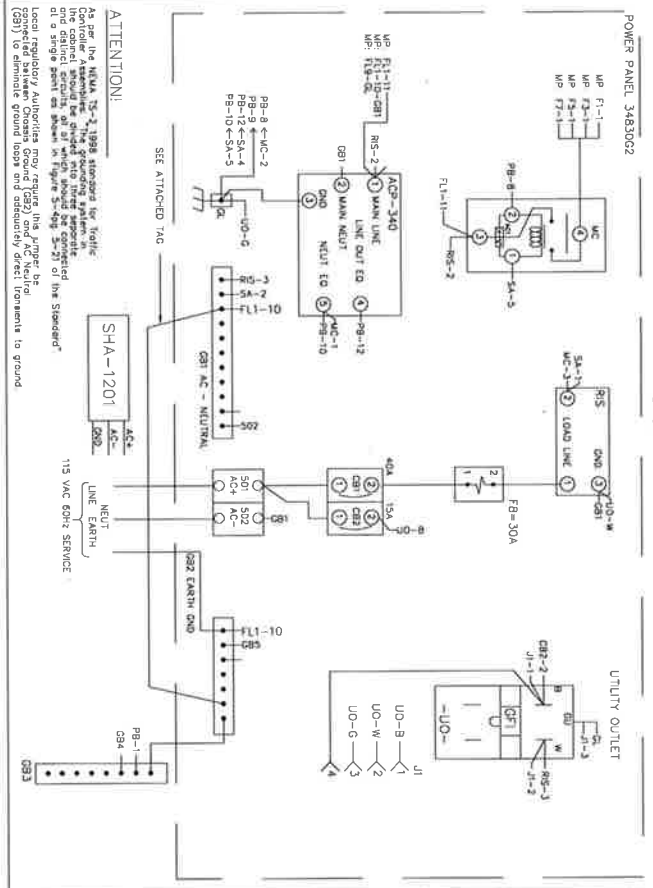
TRAFFIC SIGNALS

SHEET 1 OF 4

TO-0570

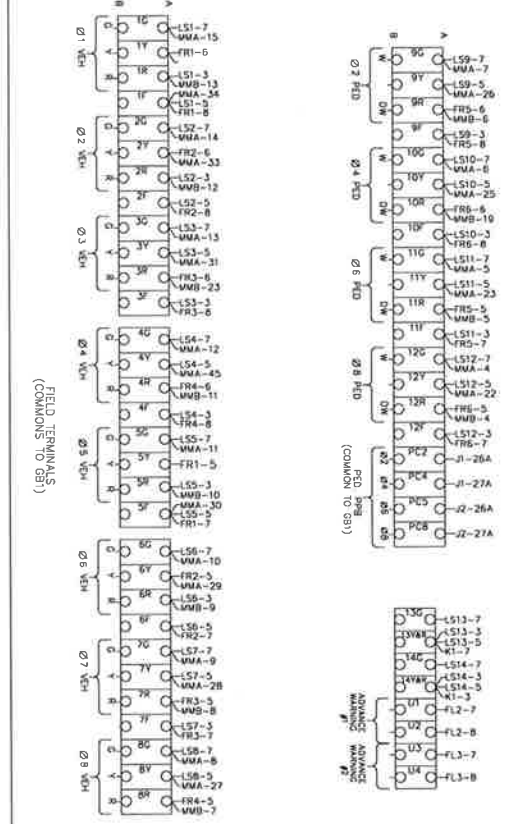


CONTROLLER CABINET POWER PANEL WIRING DIAGRAM 'F'



ATTENTION:
 As per the NEMA 3S-3 1998 standard for Traffic Controller Applications, the grounding system in the cabinet shall be bonded to the ground plane and distinct earth, all of which should be connected at a single point as shown in Figure 3-499-3-21 of the Standard.
 Local regulatory Authorities may require this point be bonded to the ground plane and distinctly direct terminals to ground (G31) to eliminate ground loops.

CONTROLLER CABINET FIELD OUTPUT TERMINALS
 DIAGRAM 'G'



FIELD TERMINALS
 (COMMONS TO G31)

CODE: control traffic signs, 36 conductor
 the white conductor carrying phase 1
 the white conductor carrying phase 2
 the white conductor carrying phase 3
 the white conductor carrying phase 4
 the white conductor carrying phase 5
 the white conductor carrying phase 6
 the white conductor carrying phase 7
 the white conductor carrying phase 8
 the white conductor carrying phase 9
 the white conductor carrying phase 10
 the white conductor carrying phase 11
 the white conductor carrying phase 12
 the white conductor carrying phase 13
 the white conductor carrying phase 14
 the white conductor carrying phase 15
 the white conductor carrying phase 16
 the white conductor carrying phase 17
 the white conductor carrying phase 18
 the white conductor carrying phase 19
 the white conductor carrying phase 20
 the white conductor carrying phase 21
 the white conductor carrying phase 22
 the white conductor carrying phase 23
 the white conductor carrying phase 24
 the white conductor carrying phase 25
 the white conductor carrying phase 26
 the white conductor carrying phase 27
 the white conductor carrying phase 28
 the white conductor carrying phase 29
 the white conductor carrying phase 30
 the white conductor carrying phase 31
 the white conductor carrying phase 32
 the white conductor carrying phase 33
 the white conductor carrying phase 34
 the white conductor carrying phase 35
 the white conductor carrying phase 36

Phase	Signal	Color	Conductor
Phase 1:	Left Turn Green Arrow	White - Black Conductor	W-B
	Left Turn Amber Arrow	White - White Conductor	W-W
	Red Ball	White - Red Conductor	W-R
Phase 2:	Green Ball	White - Green Conductor	W-G
	Amber Ball	White - Orange Conductor	W-O
	Red Ball	White - Red Conductor	W-R
Phase 3:	Left Turn Green Arrow	Green - White Conductor	G-W
	Left Turn Amber Arrow	Green - Black Conductor	G-B
	Red Ball	Green - Red Conductor	G-R
Phase 4:	Green Ball	Green - Green Conductor	G-G
	Amber Ball	Green - Orange Conductor	G-O
	Red Ball	Green - Red Conductor	G-R
Phase 5:	Left Turn Green Arrow	Red - Green Conductor	R-G
	Left Turn Amber Arrow	Red - Orange Conductor	R-O
	Red Ball	Red - Red Conductor	R-R
Phase 6:	Green Ball	Red - Green Conductor	R-G
	Amber Ball	Red - Orange Conductor	R-O
	Red Ball	Red - Red Conductor	R-R
Phase 7:	Left Turn Green Arrow	Black - Green Conductor	B-G
	Left Turn Amber Arrow	Black - Orange Conductor	B-O
	Red Ball	Black - Red Conductor	B-R
Phase 8:	Green Ball	Orange - Green Conductor	O-G
	Amber Ball	Orange - Orange Conductor	O-O
	Red Ball	Orange - Red Conductor	O-R
Phase 9:	Blue - Black Conductor	Blue - Black Conductor	B-B
Phase 10:	Blue - Blue Conductor	Blue - Blue Conductor	B-B
Phase 11:	Orange - Blue Conductor	Orange - Blue Conductor	O-B
Phase 12:	Orange - White Conductor	Orange - White Conductor	O-W
Phase 13:	Black - Blue Conductor	Black - Blue Conductor	B-B
Phase 14:	Black - Orange Conductor	Black - Orange Conductor	B-O
Phase 15:	Black - Red Conductor	Black - Red Conductor	B-R
Phase 16:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 17:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 18:	White - Red Conductor	White - Red Conductor	W-R
Phase 19:	Green - Black Conductor	Green - Black Conductor	G-B
Phase 20:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 21:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 22:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 23:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 24:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 25:	White - Red Conductor	White - Red Conductor	W-R
Phase 26:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 27:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 28:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 29:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 30:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 31:	White - Red Conductor	White - Red Conductor	W-R
Phase 32:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 33:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 34:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 35:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 36:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 37:	White - Red Conductor	White - Red Conductor	W-R
Phase 38:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 39:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 40:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 41:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 42:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 43:	White - Red Conductor	White - Red Conductor	W-R
Phase 44:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 45:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 46:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 47:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 48:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 49:	White - Red Conductor	White - Red Conductor	W-R
Phase 50:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 51:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 52:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 53:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 54:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 55:	White - Red Conductor	White - Red Conductor	W-R
Phase 56:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 57:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 58:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 59:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 60:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 61:	White - Red Conductor	White - Red Conductor	W-R
Phase 62:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 63:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 64:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 65:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 66:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 67:	White - Red Conductor	White - Red Conductor	W-R
Phase 68:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 69:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 70:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 71:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 72:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 73:	White - Red Conductor	White - Red Conductor	W-R
Phase 74:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 75:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 76:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 77:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 78:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 79:	White - Red Conductor	White - Red Conductor	W-R
Phase 80:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 81:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 82:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 83:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 84:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 85:	White - Red Conductor	White - Red Conductor	W-R
Phase 86:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 87:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 88:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 89:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 90:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 91:	White - Red Conductor	White - Red Conductor	W-R
Phase 92:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 93:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 94:	Green - Red Conductor	Green - Red Conductor	G-R
Phase 95:	White - Blue Conductor	White - Blue Conductor	W-B
Phase 96:	White - Orange Conductor	White - Orange Conductor	W-O
Phase 97:	White - Red Conductor	White - Red Conductor	W-R
Phase 98:	Green - Blue Conductor	Green - Blue Conductor	G-B
Phase 99:	Green - Orange Conductor	Green - Orange Conductor	G-O
Phase 100:	Green - Red Conductor	Green - Red Conductor	G-R

Legend: Wiring Setup for 1/2 Conductor Cable

REVISIONS	DATE	BY	DESCRIPTION
1	08/15/09	DDC	ISSUED FOR CONSTRUCTION
2	08/15/09	DDC	REVISED FOR CONSTRUCTION

Manhoba
 TRAFFIC ENGINEERING
 TYPICAL TRAFFIC SIGNAL SPECIFICATIONS WITH ADVANCE WARNING FLASHERS

SCALE: N.T.S.
 DATE: 08/20/09
 PREPARED BY: D.C.C.
 REGION: N/A

TRAFFIC SIGNALS
 SHEET 3 OF 4
 10-0570




Typical Grounding and Wiring for a Highway Intersection with Advance Warning Signals

NOTES:

- Four (4) ground rods shall be installed at the supply cabinet. Spacing shall be as follows - first ground rod shall be 5.5m from the supply cabinet, remaining three (3) rods shall be located 3m from each other either in a line pattern or in a square pattern with no rod being closer than the 5.5m from the supply pole and bonded to the ground lug in the service box by a #6 bare copper stranded wire (Diagram A).
- A ground rod at the distribution pedestal is not required if the pedestal is located within 3m of the power supply cabinet; if a ground rod is required it will be as Diagram A.
- The supply cabinet shall be located at a minimum distance of 10m from the traffic controller cabinet and 5.5m from the supply ground rods.
- Each pole in the traffic intersection is to be grounded using one (1) ground rod (Diagram A).
- All ground wires in the system are to be #6 AWG, insulated inside the conduits and bare copper direct buried.
- A #6 green insulated ground wire bonds all poles, power pedestal and power supply together (Diagram A).
- On poles not containing breakaway bases (Diagram D - Details 'AA' & 'BB'), the #6 green insulated and the #6 bare copper wires are attached to the ground stud either at the edge of the hand access hole (Detail 'AA') or at the back of the pole (Detail 'BB') depending on type of pole.
- On poles containing a breakaway base (Diagram D - Detail 'CC'), the #6 bare copper and #5 green insulated wires are attached to the reaction plate by means of a ground lug which is drilled and topped into the plate.
- The breakaway base assembly then forms a mechanical grounding bond between the reaction plate and the pole (this is done to prevent cable shearing when pole is hit by vehicle).
- Breakaway bases only to be used when deemed safe to do so.
- A 36 conductor (Diagram B) is installed originating at the controller and going through poles 3 to 12 and then back to controller.
- A continuous loop of 36 conductor cable is installed for accident purposes. If an accident occurs during winter months causing damage to one stretch of 36 conductor cable, the damaged stretch may be disconnected while still maintaining a power source to each pole.
- Typical wiring configuration for the 36 conductor cable (Sheet 3). The green - black conductor is the equipment ground and is hooked up continuous around the intersection but not bonded to the reaction plates or ground studs in the poles.
- The green - black wire is grounded only at the controller (GB3 - Diagram F).
- The 36 conductor cables are joined together at each pole - color to color by means of marrettes at the hand access hole (Diagram D - Detail 'AA'). All conductors are terminated.
- The 36 conductor cable originates at the controller output terminals (Diagram G) and is wired according to the 36 conductor wiring setup and forms a complete loop around the intersection.
- At each pole's hand access hole where the two 36 conductor cables are terminated, appropriate pigtails with female slip connectors are added to the proper phase or vehicle movement wire colors.
- A 7 conductor riser cable (Diagram E - Detail 'AA') is then attached to the pigtails on the 36 conductors (Diagram D - Detail 'AA') by means of male slip connectors and routed through the pole (Diagram C) to control the traffic signal displays.

- All traffic signal equipment shall be grounded to the equipment ground to ensure safety of maintenance staff.
- Grounding is done by bonding the white - black conductor of the 7 conductor cable to the signal display head, and connecting it to the green - black conductor in the 36 conductor cable (equipment ground), but not to the system ground (#6 insulated green wire).
- The violet conductor in the 7 conductor cable is used to control the green light or walk, the orange conductor the amber light, the red conductor the red light or don't walk and the white conductor is the neutral. The black and blue conductors are for directional arrows.
- A 6 twisted pair 19 gauge communication cable is also installed around the intersection (Diagram B), and is used to control low voltage audible devices or ground contact closure push buttons.
- The drain wire and cable shield on the communication cable are bonded together at each pole and made continuous around intersection, but are only grounded at the controller GB3 (Diagram F).
- A grounding electrode or rod is installed at each Advance Warning (AWWD) Signal pole, and is bonded to the pole ground stud by a #6 bare copper stranded wire.
- There is no #6 green insulated ground wire installed between the AAWD and the controller.
- A 2 conductor #10 NMWU cable is installed from the distribution panel (Diagram A - Detail 'BB') to feed the sign illumination lamp at the AAWD. The bare copper conductor in the 2 conductor is attached to the ground lug in the distribution panel and to the AAWD pole ground stud.
- A 3 conductor #14 NMWU cable is also installed from the controller, through the power pedestal (Diagram B), and terminated in the AAWD pole to control the sign flashing signals. The bare copper conductor is attached to GB2 (Diagram F) and the AAWD pole ground stud.
- 2 @ #6 with 1 @ #6 insulated ground cable are installed between the power pedestal and the controller cabinet to supply power to the controller from the distribution panel. The #6 insulated ground conductor is attached to the ground lug in the distribution panel and to GB2 (Diagram F) in the controller cabinet.
- 3 @ #8 with 1 @ #6 insulated ground cable are installed between the service box on the supply pole (Diagram A) and the distribution panel in the power pedestal.
- The neutral bar in the service box is bonded to the ground lug.
- The #6 insulated ground conductor is attached to the ground lug at the service point and to the ground lug in the distribution panel.
- The neutral bars in the distribution panel and in the controller cabinet are not bonded to ground. This is only done at the service point.
- The jumper wire between GB1 and GB2 (Diagram F) is removed.
- The #6 bare copper stranded wire can be attached to the ground rods or electrodes by bolted clamp or copper welding by thermic process.

REVISIONS		
DATE	BY	DESCRIPTION



Traffic Engineering

TYPICAL TRAFFIC SIGNAL SPECIFICATIONS WITH ADVANCE WARNING FLASHERS

SCALE: N.T.S.	DATE: 08-20-09
PREPARED BY: D.C.C.	REGION: N/A
TRAFFIC SIGNALS	
SHEET 4 OF 4	
10-0570	

