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10.01 ROADWAY LIGHTING

.1 Lighting Levels:

- (a) Roadways, bikeways and pedestrian walkways shall be illuminated for nighttime safety and comfort of motorists, cyclists and pedestrians.
- (b) Required roadway illuminance levels and uniformity ratios are listed in Table 1 below. Illuminance levels and uniformity ratios listed in Table 1 are based on the most current edition of the ANSI/IESNA RP-8 - Roadway Lighting standard practices. Road classifications are described in Section 9 - Streets, Traffic Signs and Markings Design Criteria. **(REVISED NOVEMBER 2016)**
- (c) Required sign illuminance levels and uniformity ratios shall be in accordance with the most current edition of the ANSI/IESNA RP-19 - Roadway Sign Lighting. **(REVISED NOVEMBER 2016)**
- (d) Illumination levels for intersecting roadways shall be the sum of each roadway.
- (e) The maintained average horizontal illuminance level, average to minimum uniformity ratios and roadway classification for each roadway shall be noted on the Design Drawings.
- (f) The designer shall calculate all illuminance levels and uniformity ratios as noted under 10.01.4 Lighting Calculations.

TABLE 1		
Road Classification	Maintained (*) average horizontal illumination level to meet or exceed	Average to minimum uniformity ratio not to exceed
Urban Arterial	17 Lux	3 : 1
Major Collector / Minor Collector	12 Lux	3 : 1
Industrial/Commercial	12 Lux	3 : 1
Neighbourhood Collector	9 Lux	4 : 1
Urban Local	4 Lux	6 : 1
Rural Local	4 Lux	6 : 1
Lane	4 Lux	6 : 1
Walkway	4 Lux	6 : 1

(*) Maintained levels shall include a total Light Loss Factor (LLF) of 0.79 as discussed in Table 4.

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.2 Pole Spacings:

- (a) Spacing and location of poles shall be governed by road width, road configuration, intersecting property lines, luminaire photometrics, mounting heights and required illumination levels. In addition maintaining clearances to overhead BC Hydro power lines in accordance with the *Canadian Electrical Code*, *WorkSafeBC* and the *BC Electrical Safety Act* shall also govern pole spacing.
- (b) Generally, poles shall be arranged in a one sided or staggered spacing based on the road classifications listed in Table 2. In circumstances where overhead BC Hydro power lines are in conflict with streetlight poles, one sided spacings may be considered if the required illumination levels and uniformity ratios can be achieved. Alternate pole spacings shall meet the approval of the City Engineer.
- (c) Where possible locate poles on property lines to avoid driveway conflicts.
- (d) Streetlight poles shall be offset as shown on the "Typical Cross Section Standard Drawings" in Section 9 - Streets, Traffic Signs and Markings.

TABLE 2	
Road Classification	Pole Arrangement
Urban Arterial	Staggered
Major Collector / Minor Collector	Staggered
Industrial / Commercial	Staggered
Neighbourhood Collector	One Sided
Urban Local	One Sided
Rural Local	One Sided
Lane	One Sided
Walkway	One Sided

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SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS DESIGN CRITERIA

.3 Luminaire types, Pole types and Wattages:

- (a) Luminaire types, pole types and wattages are as listed in *Table 3*.
- (b) Where tying into an existing system or area luminaire types, wattages and mounting heights should match those previously installed.
- (c) Luminaire wattages, distributions, voltage, Northing, Easting and elevation shall be noted on the Design Drawings. Refer to Section 1.0 Standard Drawing No. G-7.
- (d) Post top and flat glass luminaires shall be listed on the City of Nanaimo Approved Product List.

TABLE 3				
Road Classification	11.0m High Davit Pole with Flat Glass Luminaire	9.0m High Davit Pole with Flat Glass Luminaire	7.5m High Davit Pole (*) with Flat Glass Luminaire	4.5m High Post Top Pole with Post Top Luminaire
Urban Arterial	250W	150W		-
Major Collector / Minor Collector	250W	150W		-
Industrial / Commercial		150W		
Neighbourhood Collector		150W		
Urban Local		100W	100W (*)	
Rural Local		100W	100W (*)	100W
Lane		100W	100W (*)	100W
Walkway				100W

(REVISED NOVEMBER 2016)

- (*) For use to avoid conflicts with overhead powerlines or on local streets or lanes. In all cases the use of 7.5m high davit poles must meet the approval of the City Engineer.

The Cobra Head Luminaire with semi-cutoff optics (drop refractor) may be used in special cases as directed by the City Engineer.

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS DESIGN CRITERIA

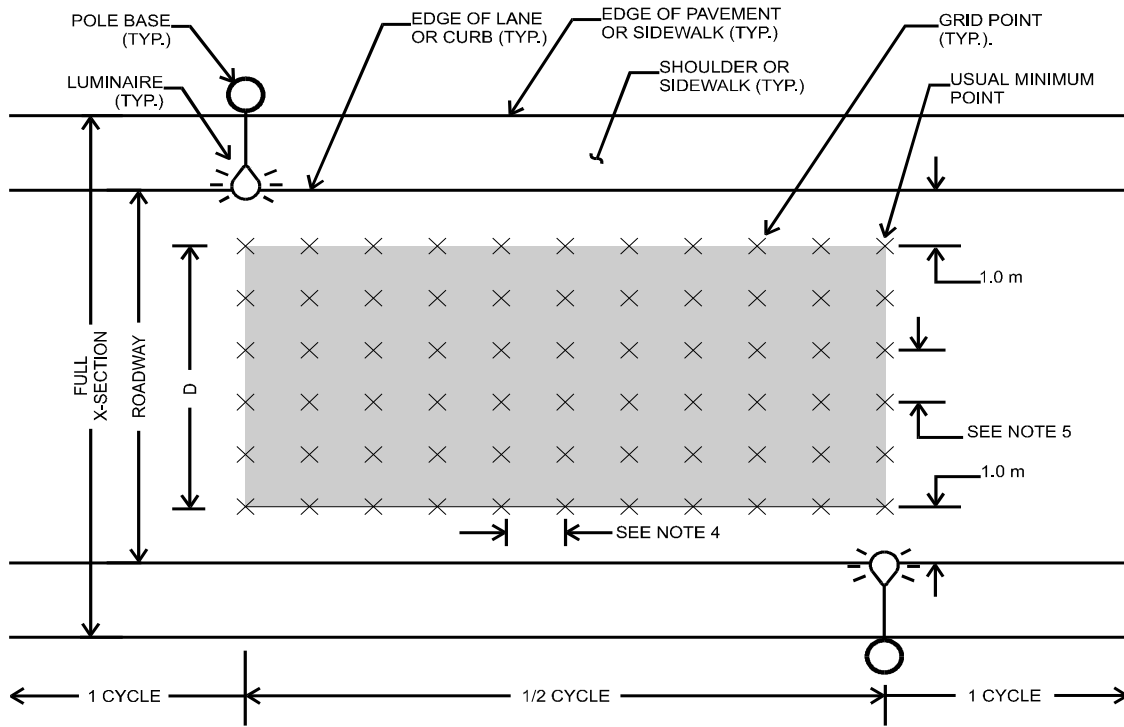
.4 Lighting Calculations:

- (a) Lighting calculations are based on the illuminance methods described in *ANSI/IESNA RP-8 Roadway Lighting*, lighting calculations shall be done using a computer lighting program designed to carry out the required calculations and the luminaire manufacturers IES formatted photometrics. The IES photometric files for the City approved luminaires are available in electronic format, through the luminaire manufacturers. **(REVISED NOVEMBER 2016)**
- (b) Computer lighting calculation shall be performed using the grid spacing shown on Figures 1 – Grid Spacing for Calculating Point of Minimum Illuminance and Figure 2 – Grid Spacing for Calculating Average Illuminance. The traveled roadway x-section shown shaded on Figure 1, shall be used for calculating the minimum illuminance. The full roadway x-section shown shaded on Figure 2, shall be used for calculating the average illuminance. The average to minimum uniformity ratio shall be calculated using the minimum illuminance calculation from Figure 1 divided by the average illuminance calculation from Figure 2. For example, if the lowest point of illuminance within the shaded area shown on Figure 1 is 4 Lux and the average illuminance of all the points within the shaded area shown on Figure 2 is 12 Lux, then the average to minimum uniformity ratio would be 3:1.
- (c) Grid spacing for walkways or bikeways shall be maximum 1m.
- (d) Lighting calculations shall be based on maintained levels using initial rated lamp lumens and the total light loss factor (LLF) of 0.79. Refer to *Table 4* for the factors included in the LLF. The LLF shall be considered as the total maintenance factor.

TABLE 4				
Lamp Lumen Depreciation (LLD)⁽¹⁾	Lamp Dirt Depreciation (LDD)⁽¹⁾	Luminaire Component Depreciation (LCD)⁽²⁾	Equipment Factor (EF)⁽³⁾	Total Light Loss Factor (LLF)
0.90	0.94	0.98	0.95	0.79
<p><u>Notes</u></p> <p>⁽¹⁾ Based on a 4 year maintenance cycle</p> <p>⁽²⁾ Degradation of the reflector and refractor</p> <p>⁽³⁾ Effect of ambient temperature on the lamp including the ballast and lamp factors</p> <p>LLF = LLD x LDD x LCD x EF</p>				

- (e) A hardcopy of the lighting calculations shall be submitted to the City along with the Design Drawings. Refer to Section 1.07 Ornamental Street Lighting Traffic Control Signals, Hydro, Phone, Gas and Cablevision Fibre Optics (Commercial and Private) for design drawing requirements. **(REVISED NOVEMBER 2016)**

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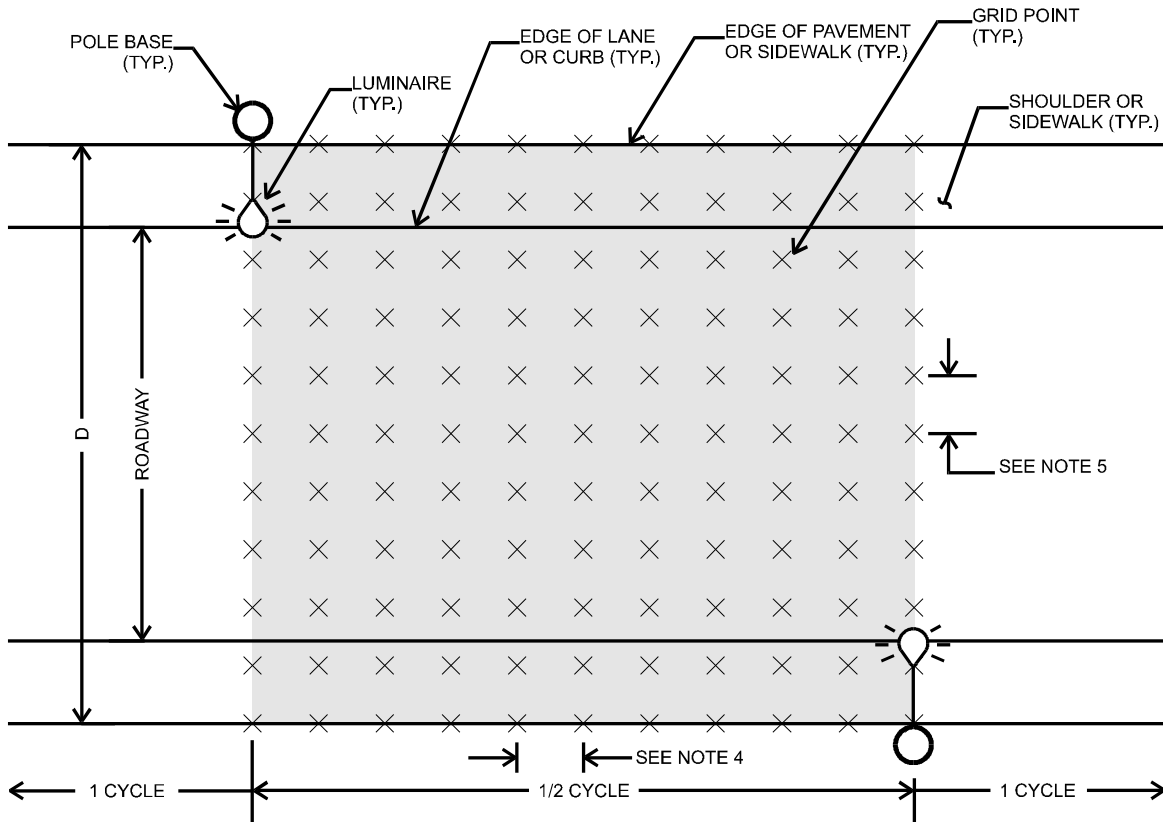
GRID SPACING FOR CALCULATING POINT OF MINIMUM ILLUMINANCE

NOTES:

1. ONE LUMINAIRE CYCLE IS DEFINED AS THE DISTANCE BETWEEN TWO CONSECUTIVE LUMINAIRES WHICH ARE LOCATED ALONG ONE SIDE OF THE ROAD.
2. CALCULATION AREA IS DEFINED AS THE AREA BOUNDED BY THE GRID POINTS CONTAINED WITHIN A 1/2 CYCLE.
3. CALCULATION SHALL TAKE INTO ACCOUNT 1 CYCLE ON EACH SIDE OF THE CALCULATION AREA. (TOTAL 6 LUMINAIRES)
4. LONGITUDINAL GRID SPACING EQUALS LUMINAIRE SPACING (1/2 CYCLE) DIVIDED BY 10, NOT TO EXCEED 5 METRES.
5. TO OBTAIN THE GRID POINTS ACROSS THE ROADWAY DIVIDE THE DISTANCE "D" BY THE NEXT INTEGER (WHOLE NUMBER) GREATER THAN "D". (EG. IF D=10.8m THEN THE GRID SPACING = $10.8/11 = 0.98\text{m}$).
6. THIS CALCULATION SHALL BE USED TO DETERMINE THE POINT OF MINIMUM ILLUMINANCE WITHIN THE SHADED AREA.

Figure 1

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GRID SPACING FOR CALCULATING AVERAGE ILLUMINANCE

NOTES:

1. ONE LUMINAIRE CYCLE IS DEFINED AS THE DISTANCE BETWEEN TWO CONSECUTIVE LUMINAIRES WHICH ARE LOCATED ALONG ONE SIDE OF THE ROAD
2. CALCULATION AREA IS DEFINED AS THE AREA BOUNDED BY THE GRID POINTS CONTAINED WITHIN A 1/2 CYCLE.
3. CALCULATION SHALL TAKE INTO ACCOUNT 1 CYCLE ON EACH SIDE OF THE CALCULATION AREA. (TOTAL 6 LUMINAIRES)
4. LONGITUDINAL GRID SPACING EQUALS LUMINAIRE SPACING (1/2 CYCLE) DIVIDED BY 10, NOT TO EXCEED 5 METRES.
5. TO OBTAIN THE GRID POINTS ACROSS THE ROADWAY DIVIDE THE DISTANCE "D" BY THE NEXT INTEGER (WHOLE NUMBER) GREATER THAN "D". (EG. IF D=10.8m THEN THE GRID SPACING = $10.8/11 = 0.98\text{m}$).
6. THIS CALCULATION SHALL BE USED TO DETERMINE THE AVERAGE ILLUMINANCE WITHIN THE SHADED AREA.

Figure 2

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS DESIGN CRITERIA

10.02 TRAFFIC SIGNALS

- .1 Traffic signal controllers and cabinets and siren pre-emption equipment shall be supplied through the City of Nanaimo.
- .2 For development projects requiring traffic signals the cost for the design and the supply of traffic controllers, signs and siren pre-emption equipment shall be borne by the Developer.
- .3 Traffic signals shall be designed in general accordance with Sections 402.6 of the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual. Contrary to this manual the City of Nanaimo uses NEMA phase designations as opposed to the Ministry movement designations (i.e.; A1, A2, B1 etc.)
- .4 Traffic signal designs shall also conform to the British Columbia Motor Vehicle Act and the Uniform Traffic Control Devices for Canada.

10.03 CONDUIT

- .1 Conduits shall be parallel or perpendicular to the roadway, and routed to run in a direct line between adjacent poles or junction boxes. Street lighting conduits shall be run under sidewalks, unless otherwise noted.
- .2 There shall be a maximum 2 - 90° bends in a conduit run. Where this can not be avoided junction boxes shall be used as noted under Section 10.04 - Junction Boxes.
- .3 Street lighting conduit shall be minimum 38mm diameter.
- .4 Where conduit(s) cross an existing road, they shall be installed by horizontal directional drilling to avoid cutting pavement and interrupting traffic. Prior to specifying drilling confirm soil condition will accommodate drilling.

10.04 JUNCTION BOXES

- .1 Large round plastic junction boxes shall generally be used as follows:
 - (a) where the maximum number of 90° bends in a conduit run is exceeded
 - (b) where branch conduit runs are required
 - (c) in conduit runs over 100m
 - (d) at service panels
 - (e) at post mounted flashers
- .2 Rectangular plastic junction boxes shall be used in narrow traffic islands where a round box will not fit.
- .3 Concrete junction boxes shall be used for traffic signals only.

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS DESIGN CRITERIA

10.05 CONDUCTORS

- .1 For the purpose of standardization and to accommodate future expansion, street lighting conductors shall be No. 6 RW90. The use of alternate conductor sizes will require the approval of the City Engineer.

10.06 SERVICE EQUIPMENT

- .1 The designer shall confirm service locations with BC Hydro.
- .2 Street lighting systems are controlled with a lighting contactor and photocell. The photocell shall be located on the luminaire nearest the service panel.
- .3 Service panels for street lighting systems shall have a 60A - 2P breaker, contactor and photocell bypass switch and shall be mounted in a service base as shown on Standard Drawing No. E-10.1 and wired as shown on Standard Drawing No. E-10.3.
- .4 Where possible traffic signal and street lighting systems shall be fed from the same service panel. The combination street lighting and traffic signal service panel shall have a 100A -2P main breaker, sub-breakers, contactor, photocell by-pass switch and where required a flasher control unit. The service panel shall be mounted in a service base or on the side of the traffic controller refer to Standard Drawings No. E-10.1, E-10.3, E-10.4 and E-10.5 for details.
- .5 All services shall be 120/240V single phase, 3 wire. Alternate service voltage must meet the approval of the City Engineer.

10.07 CONCRETE BASES

- .1 The Engineer shall assess the existing soil conditions at the proposed concrete base installations to determine if modifications to the standard drawings are required.
- .2 The Engineer shall submit for approval by the City Engineer, the design modifications to the standard drawings that are required to meet the existing soil conditions.
- .3 Avoid running more than two conduits into a streetlight pole base. Where this situation can not be avoided a junction box shall be used.
- .4 When selecting pole base locations search out proposed or existing utility locations to avoid conflicts.

10.08 -NOT USED-

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS SPECIFICATIONS

10.20 SCOPE

- .1 This specification refers to the materials for street lighting and traffic signal installations. Only those products approved by the City Engineer and listed on the City of Nanaimo Approved Product List will be accepted for an installation. When the City of Nanaimo Approved Product List does not list a product, the Ministry of Transportation and Infrastructure's Recognized Product List shall be referenced. Only those products approved by the City Engineer will be accepted for an installation. **(REVISED NOVEMBER 2016)**
- .2 All materials shall be new unless otherwise noted.
- .3 All materials shall meet or exceed the Canadian Electrical Code Requirements and the Canadian Standards Association Standards, where applicable, and are subject to the approval of the Electrical Safety Branch Inspector prior to installation.
- .4 All similar items of materials shall be of one type and from the same manufacturer.
- .5 Unless otherwise noted, the following materials shall be supplied by the City of Nanaimo at the Developers expense:
 - (a) Traffic Controllers/Cabinets;
 - (b) Padlocks;
 - (c) Siren pre-emption systems;

10.21 CONDUIT

- .1 Exposed Conduit:
 - (a) All exposed conduit shall be rigid steel unless otherwise noted on the Standard Drawings.
 - (b) Rigid steel conduit shall be hot-dipped galvanized and shall conform to CSA C22.2 No. 45.
 - (c) Rigid steel conduit clamps and fitting shall be hot dip galvanized.
 - (d) All rigid conduit ends shall be reamed and all necessary bushings, locknuts, elbow and bends shall be provided.
 - (e) All joints shall be made with threaded couplers.
- .2 Buried Conduit:
 - (a) Buried conduit couplings, adaptors, bends and fittings shall be rigid unplasticized PVC.
 - (b) Rigid PVC conduit shall conform to CSA C22.2 No. 211.2.
 - (c) Rigid PVC couplings , adaptors, bends and fittings shall conform to CSA C22.2 No. 85.
 - (d) Only factory conduit bends are acceptable.
 - (e) Conduit cement shall be CSA certified type.
 - (f) Each standard length of conduit, couplings, adaptors, bends and fittings shall bear a CSA certification label.

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- .3 Concrete for conduit encasement shall have a minimum compressive strength of 15 MPa at twenty-eight (28) days and be in accordance with Section 11 - Plain and Reinforced Concrete Works. Concrete encasement will only be required where specially noted on the Contract Drawings or where directed by the Engineer.
- .4 In locations where concrete encasement is not required, bedding sand shall be used in accordance with Section 4 – Trench Excavation, Bedding and Backfill.

10.22 TRENCH MARKER TAPE

- .1 Trench marker tape shall be 150 mm wide yellow and shall be labeled "CAUTION - ELECTRICAL LINE BURIED BELOW".
- .2 Tape shall be minimum 3.5 mils thick heavy duty polyethylene material.

10.23 JUNCTION BOXES

- .1 Large round and rectangular plastic junction boxes and lids shall be manufactured in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**
- .2 Concrete junction boxes shall be in accordance with Standard Drawing No. E-3.2 and Standard Drawing No. E-3.3.
- .3 All junction boxes shall have steel lids.

10.24 CONCRETE BASES

- .1 Concrete bases shall be in accordance with the Standard Drawings.
- .2 Concrete bases shall be pre-cast. Poured in place concrete bases shall meet the approval of the City Engineer.
- .3 Concrete and rebar shall meet the requirements of Section 11 - Reinforced and Plain Concrete Works with the exception of the following:
 - (a) Concrete shall develop a minimum compressive strength of 30Mpa at 28 days.
 - (b) Concrete strength tests will only be required for poured in place pole bases.
- .4 Top of concrete bases shall be trowelled smooth and level with beveled edges. Top surface shall not vary by more than 3mm in depth as measured across the widest surface.
- .5 All concrete shall be fully vibrated.
- .6 Anchor bolts shall be as shown on Standard Drawing No. E-1.9 to Standard Drawing No. E-1.11. Anchor bolts shall be manufactured in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS SPECIFICATIONS

10.25 POLES AND RELATED EQUIPMENT

- .1 Poles, arms, extensions, brackets and clamps shall be as shown on Standard Drawing No. E-5.1 to Standard Drawing No. E-5.19 and Standard Drawing No. E-5.21. This material shall be manufactured in accordance with the Ministry of Transportation and Infrastructure Electrical and Traffic Engineering Manual. The nominal height of a pole on a service base shall be 0.9m shorter to allow for the height of the service base. **(REVISED NOVEMBER 2016)**
- .2 Service bases shall be designed to meet or exceed the capacity of the pole. Service bases shall meet or exceed the Ministry of Transportation and Infrastructure material standards for the fabrication of poles as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**
- .3 Post top poles shall meet or exceed the Ministry of Transportation and Infrastructure Material standards for the fabrication of poles as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**
- .4 All poles, arms, extensions, brackets, clamps and service bases shall be hot dip galvanized.

10.26 CONDUCTORS

- .1 Single conductors shall be stranded copper with type RW90 XLPE insulation unless otherwise noted on the Contract Drawings.
- .2 Multi-conductor traffic signal cable shall be 19 conductor IMSA specification 19-1 (stranded copper) unless otherwise noted on the Contract Drawings. **(REVISED NOVEMBER 2016)**
- .3 Colour coding and gauges (AWG) shall be as noted on the Contract Drawings.
- .4 Shielded detector loop cable shall be 2 conductor No. 16 stranded copper and shall meet California Type B Lead in Cable specifications or IMSA specification 50-2 (1984).

10.27 LOOP SEALANTS AND BACKEROD

- .1 Loop sealants shall be hot tar.
- .2 Backerod shall be foam material. Backerod shall be sized to hold down conductor in loop slot and to resist melting during the pouring of hot tar.

10.28 TRAFFIC AND PEDESTRIAN SIGNAL HEADS AND LAMPS

- .1 Traffic and pedestrian signal heads and lamps including backboards and visors shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS SPECIFICATIONS

- .2 Signal head layout, size and lamp requirements shall be as follows.

ITEM	LENS	REQUIRED DIAMETER	LAMP
PRIMARY HEADS (Overhead mount)	Red	300mm	LED
	Yellow	300mm	LED
	Green	300mm	LED
	Left Turn (Gr, Yell)	300mm	LED
SECONDARY HEADS (Side mount)	Red	200mm	LED
	Yellow	200mm	LED
	Green	200mm	LED
	Left Turn (Gr, Yell)	300mm	LED
PEDESTRIAN HEADS	Combination Walk/Don't Walk Overlay Graphic	300mm square	LED
PEDESTRIAN COUNTDOWN DISPLAY	Countdown Graphic	300mm square	LED
Notes: 1. All heads shall be mounted vertically. 2. All primary heads shall have backboards with fluorescent yellow reflective sheeting as per the approved product list.			

10.29 SIGNAL HEAD AND SIGN MOUNTING HARDWARE

- .1 Signal and sign mounting hardware shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**

10.30 -NOT USED-

10.31 -NOT USED-

10.32 AUDIBLE SIGNALS

- .1 Audible signals shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**

10.33 CONNECTORS

- .1 Conductor connections shall be screw on type solderless connectors sized to suit conductor size with the exception of those used inside traffic controllers which shall be compression type spade connectors.
- .2 Ground clamps shall be copper with bolt down compression connection.

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10.34 CONDUCTOR TAGS

- .1 Conductor tags in traffic controllers and pole handholes shall be sleeve type markers. Tags shall be designed so they can snapped onto a conductor.
- .2 Conductor tags in junction boxes shall be yellow and shall be a minimum of 60mm x 50mm x 0.5mm thick . Tags shall be rigid and waterproof. Tags shall be supplied with a ty-rap to connect to bundle of conductors. Tags shall be designed to be permanently labeled with a black indelible pen.

10.35 FUSES AND FUSE HOLDERS

- .1 Fuses shall be a 10 amp ferrule type to suit fuse holder.
- .2 Fuse holders to be inline type with 2 'L' type rubber insulating boots.

10.36 GROUNDING RODS

- .1 Ground Rods shall be 20mm Ø x 3000mm long steel with hot forged point, hot-dipped galvanized full length.

10.37 PEDESTRIAN PUSHBUTTONS

- .1 Pedestrian pushbuttons shall have an integral sign with a raised walk symbol.
- .2 Pushbutton unit shall be white with black tactile actuation hand walking symbol and directional arrow. Pushbutton symbols and arrows shall be available in both left and right hand directions.
- .3 Pushbutton housing shall be designed to mount against a flat surface and shall be supplied with a rubber gasket for a watertight seal to the pole.
- .4 Pushbutton head shall be ultra-high molecular weight polyethylene.
- .5 Pushbutton shall be supplied with 2 - 3/8" stainless steel head mounting bolts and stainless steel flat washers for mounting to the pole.
- .6 Pushbutton shall be **actuated** via a magnetic proximity switch. A 2200mm length of purple No. 14 RW90 stranded copper conductor shall be supplied soldered to each switch terminal. Contacts shall be hermetically sealed.
- .7 Extend sidewalk to pushbutton, (wheelchair accessible).

10.38 RECEPTACLES

- .1 Receptacles shall be 15A-120V corrosion resistant spec grade duplex mounted in cast F.S. box.
- .2 Covers shall be double spring door type for wet location

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS SPECIFICATIONS

10.39 LUMINAIRES

- .1 Flat glass and sign luminaires shall be manufactured in accordance with the Ministry of Transportation and Highways Material Standards.
- .2 Post top luminaires shall be:
 - (a) 100 W high pressure sodium with IES type 2 distribution;
 - (b) Cast aluminum with a glass or polycarbonate refractor;
 - (c) Vandal proof;
 - (d) Equipped with a integral CWA or CWI type ballast;
 - (e) Equipped with a quick disconnect ballast starter and capacitor unit;
 - (f) Equipped with a knockout for photocell;
 - (g) Powder paint finished;
- .3 Luminaire wattage and distribution type shall be as noted on the Contract Drawings.
- .4 Luminaire voltage, wattage and distribution type to shall as noted on the Contract Drawings.

10.40 SERVICE PANELS

- .1 Service panels shall be as follows:
 - (a) 60A - 120/240V street lighting;
 - (b) 100A - 120/240V street lighting and traffic signal;
- .2 Service wiring shall contain equipment shown on Standard Drawing No. E-10.3 to Standard Drawing No. E-10.4.
- .3 Service panel enclosures shall be stainless steel or powder coated aluminum and shall be waterproof with a EEMAC 3 rating.
- .4 Service panels shall be designed to fit into a standard service base. Refer to Standard Drawing No. E-5.18 or as shown on Standard Drawing No. E-5.18A to Standard Drawing No. 5.18C.
- .5 Service panels shall be designed for long life and easy maintenance.

10.41 POST MOUNTED FLASHER LUMINAIRES

- .1 Post mounted flasher luminaires shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**

10.42 PHOTOCELL AND RECEPTACLE

- .1 Photocells shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS SPECIFICATIONS

10.43 HID LAMPS

- .1 Lamps shall be manufactured in accordance with the Ministry of Transportation and Infrastructure material standards as per the Electrical and Traffic Engineering Manual. **(REVISED NOVEMBER 2016)**
- .2 HID lamps shall be high pressure sodium with the exception of 175W sign luminaires which shall be mercury vapor.

10.44 NUTS, BOLTS AND WASHERS

- .1 Nuts, bolts and washers 3/8" Ø or smaller shall be type 18-8 or 316 stainless steel hex head.
- .2 Nuts, bolts and washers larger than 3/8" Ø shall be as follows:
 - (a) Nuts to be galvanized SAE grade 2 heavy hex.
 - (b) Bolts to be galvanized SAE grade 5.
 - (c) Washers to be galvanized.
- .3 Screws shall be stainless steel Robertson No. 10.

10.45 COLD GALVANIZING COMPOUND

- .1 Cold galvanizing compound shall be spray type and shall contain a minimum of 93% zinc in the finished film.

10.46 -NOT USED-

10.47 TRAFFIC CONTROLLERS

- .1 Traffic controllers shall be designed to operate signalized intersections
- .2 Traffic Controller Unit (CU) and assembly shall be Type-1 as per *National Electrical Manufacturers Association (NEMA) Standards Publication No. TS-2*. CU and assembly shall be capable of a minimum 12 fully-actuated phases, and siren pre-emption in all directions.
- .3 Malfunction Management Unit (MMU) shall be TS2-Type16 and shall be configured for the required signal phasing.

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS SPECIFICATIONS

- .4 The controller cabinet shall be base mount, size 6, made of sheet aluminum in accordance with *Section 7 of NEMA Standards Publication No. TS2-1992, "Traffic Controller Assemblies"*. The controller cabinet shall be supplied complete with all mounting hardware and shall be fully wired for the required signal phasing. Cabinets shall be equipped with a GFI receptacle, a heater, a fan, thermostat controls, a light and a 40A-1P breaker for the power supply feeders. Cabinets shall be primed and finished inside and out with a finish coat of a polyester baked enamel paint, Munsel 70 in color. A durable waterproof document pouch shall be located on the cabinet door, containing as built cabinet wiring diagrams and user manuals for the controller and all auxiliary equipment. The cabinet shall be equipped with a police door with key lock access for the following switches:
- Signals on/off switch
 - Manual/automatic switch
 - Flash/automatic switch
 - Extendible police cord to 2 metres
- .5 All auxiliary devices such as Bus Interface Units (BIU's), Cabinet Power Supply, loadswitches, flash switches, shall be *NEMA TS-2 Standard*. Detector modules shall be rack mount type.
- .6 All traffic signal controller assemblies shall be shop tested prior to delivery and come with a minimum two year warranty on all parts and labor.
- .7 The traffic controller manufacturer shall enter all signal timings. In addition the manufacturer shall have technician on site to check all field wiring connections and put the controller into operation during the signal start-up.

10.48 SIREN PRE-EMPTION SYSTEM

- .1 Siren pre-emption systems shall be designed to provide exclusive right of way for police, fire, or ambulance vehicles in lieu of the regular sequence of phases. Siren detectors mounted on the signal pole arms shall detect the sound of the siren send a signal to the traffic controller through a hard wire connection. Lights on digital detectors indicate direction of pre-emption to the drivers.
- .2 A siren pre-emption system shall consist of sound-based detectors with indication lights, shielded cables and rack mount interface cards. Refer to Standard Drawing No. E-6.6.
- .3 Sound-based detectors shall be supplied with suitable hardware to mount on signal pole arms.
- .4 Rack mount interface cards shall be installed inside the traffic controller cabinet

SECTION 10 - ROADWAY LIGHTING AND TRAFFIC SIGNALS INSTALLATION

10.60 CONTRACTOR QUALIFICATIONS

- .1 All electrical work to be performed by Registered Electrical and Inspection Contractor under provisions of *British Columbia Safety Standards Act*. **(REVISED NOVEMBER 2016)**

10.61 PERMITS

- .1 The Contractor shall obtain and pay for all permits, arrange for electrical inspections covering all work, pay all other fees and charges, and make all deposits that are in any way connected with the installation. The Contractor shall give all necessary notices to authorities having jurisdiction and shall be responsible for complying with all applicable public ordinances.

10.62 CODES AND REGULATIONS

- .1 Electrical work shall conform to the latest edition of Canadian Electrical Code. In addition, any bulletins published by the Ministry of Natural Gas Development, Building and Safety Standards Branch, shall also apply. **(REVISED NOVEMBER 2016)**
- .2 All work shall conform to all applicable regulations of WorkSafeBC and if required, a Notice of Project Form 52E49 must be submitted prior to commencing construction. The Contractor shall ensure compliance with the following sections:
 - (a) WorkSafeBC form 30M33 must be completed prior to working in vicinity of overhead power lines.
 - (b) Notice of construction projects, WorkSafeBC Industrial Health and Safety Regulations, Section 34.16(3).

10.63 CERTIFICATE OF INSPECTION

- .1 Prior to requesting final inspection the Contractor shall submit to the Engineer the Certificate of Inspection signed by the local Safety Officer of the British Columbia Safety Authority. **(REVISED NOVEMBER 2016)**

10.64 ELECTRICAL POWER SUPPLY

- .1 Power shall be supplied from the BC Hydro secondary distribution system at location(s) shown on the Drawings.
- .2 Prior to construction the Contractor shall confirm the exact service location(s) with BC Hydro.
- .3 The Contractor shall arrange with BC Hydro for connection and disconnection of service, through BC Hydro Street Light Information Management System (SLIM) online at www.bchydro.com/ex/streetlight. For sample forms of SLIM, refer to Appendix J. All connections and disconnections to be made by BC Hydro.

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10.65 TRENCH EXCAVATION, BEDDING AND BACKFILL

- .1 Refer to Section 4 - Trench Excavating, Bedding and Backfill for installation requirements.
- .2 Backfill in accordance with Section 4.19 - Backfill and Compaction.
- .3 Where soil conditions and/or foundations are unstable, the Contractor shall notify the Engineer in order that a special pole base design change can be considered.

10.66 CONCRETE BASES

- .1 Concrete bases shall be installed as shown on Standard Drawing No. E-1.1 to Standard Drawing No. E-1.14 and Standard Drawing No. E-2.1 to Standard Drawing No. E-2.3.
- .2 Minimize disturbance to surrounding soil when excavating.
- .3 Concrete base installation tolerances to be as follows:
 - (a) Horizontal location to be within 150mm of specified.
 - (b) Vertical elevation to be within 10mm of specified.
 - (c) Top surface variation from level shall not exceed 3mm.
- .4 Where poured in place are proposed the Contractor shall provide details of how they plan to carry out the work. In all cases wooden formwork shall be removed prior to poured in place backfilling bases. Where sonotube foundations have been utilized, round sonotube forms may be buried.
- .5 Concrete bases shall have a compressive strength of 30MPa and all backfill shall be fully compacted prior to pole installation.
- .6 No concrete base shall be installed closer than 3m from a fire hydrant.

10.67 JUNCTION BOXES

- .1 Install junction boxes in accordance with the Standard Drawings No. E-3.1 through to Standard Drawing No. E-3.4. Only concrete junction boxes shall be installed in driveways, roadways, sidewalks or other travelled surfaces.

10.68 CONDUITS

- .1 Underground conduits shall be installed in an open trench as shown on Standard Drawing No. E-4.1 and Standard Drawing No. E-4.2 unless otherwise noted on the Contract Drawings.
- .2 Minimum cover over conduits shall be 600mm, except that cover for street light conduits placed under concrete sidewalk may be reduced to 300mm.
- .3 Where indicated on the Contract Drawings conduits to be installed through a hole drilled under the pavement. Drilling equipment to be fully directional.
- .4 Empty conduits shall be provided with a nylon pull string and capped.

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- .5 Conduits laid near underground shall maintain the required minimum clearances.
- .6 Crossing over of conduits shall be kept to a minimum.

10.69 TRENCH MARKER TAPE

- .1 Trench marker tape shall be installed above and directly over the conduit as shown on Standard Drawing No. E-4.1 and Standard Drawing No. E-4.2.

10.70 POLES

- .1 Install poles and related equipment as shown on the Standard Drawings.
- .2 Poles shall be erected plumb.
- .3 Where minimum pole to powerline clearances as shown on Standard Drawing No. E-5.20 cannot be maintained advise the Engineer and defer further work pending instruction.
- .4 Take all precautions necessary to ensure adequate protection of existing works and personnel during installation of poles.
- .5 Install davit pole arms at right angles to the street centreline unless otherwise noted on the Contract Drawings.
- .6 Confirm pushbutton and signal head locations prior to drilling and assembling poles.
- .7 Field drilling of holes larger than 33mm diameter are not allowed in type 1, 3, 6, 7, & L shafts, and all arms and extensions. Where larger holes are required, they shall be reinforced with a welded bushing prior to galvanizing.
- .8 All poles and related hardware to be handled with care to prevent stress to components through bending or twisting. Use nylon slings to transport and erect components. Use of steel chains as slings are not permitted. The Contractor shall repair or replace any damage to the components through overstress, scratching or denting to the satisfaction of the Engineer.
- .9 Tighten all nuts and bolts to 1/3 past snug tight. "Snug-tight" is tightness attained by a few impacts of an impact wrench or full effort of a person using a spud wrench.
- .10 All scratches in poles and field drilled holes shall be coated with cold galvanizing compound.
- .11 Poles shall be cleaned after erection.

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10.71 TRAFFIC AND PEDESTRIAN SIGNAL HEADS

- .1 Install traffic and pedestrian signal heads as shown on Standard Drawing No. E-6.1 to Standard Drawing No. E-6.5.
- .2 Securely attach traffic and pedestrian signal heads and mounting hardware to the pole.
- .3 Confirm final traffic and pedestrian signal head aiming on site with Engineer.
- .4 Completely cover all traffic and pedestrian signal heads with burlap sacking from the time they are installed until system startup.

10.72 AUDIBLE SIGNALS

- .1 Install audible signals as shown on Standard Drawing No. E-7.1.
- .2 Aim, tune and adjust audible signal as per manufacturers instructions.
- .3 Wire each audible pedestrian signal through the pole and connect into the pedestrian signal head which controls the audible signal.
- .4 Audible tones and decibel levels should meet the recommended tones as outlined in the Canadian National Institute for the Blind – CNIB Position for Accessible Pedestrian Signals in Canada (www.cnib.ca/en/about/who/believe/documents/cnib) and then go to **Accessible Pedestrian Signals - CNIB.doc**.

10.73 PEDESTRIAN PUSHBUTTONS

- .1 Install pedestrian pushbuttons as shown on Standard Drawing No. E-8.1.
- .2 Securely attach pedestrian pushbuttons and signs to the pole.
- .3 Completely cover pushbutton signs with burlap sacking from time they are installed until system start-up.
- .4 Extend sidewalk to pushbutton, (wheelchair accessible).

10.74 LUMINAIRES AND PHOTOCELLS

- .1 Install luminaires and photocells in accordance with manufacturers instructions.
- .2 Luminaires shall be cleaned after pole erection and plumbing is complete.
- .3 Securely attach the luminaire to the pole.
- .4 Install cobra head luminaire levels.
- .5 Aim photocells north.

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10.75 MEDIAN SIGNAGE AND POST MOUNTED FLASHERS

- .1 Install median signage as shown on the Standard Drawings.
- .2 Install post mounted flashers as shown on the Standard Drawings.

10.76 UNDERGROUND DIP SERVICE

- .1 Install underground dip service as shown on Standard Drawing No. E-9.1.

10.77 SERVICE PANELS

- .1 Service panels shall be mounted in a service base as shown on the Standard Drawings.
- .2 Wiring shall be in accordance with Standard Drawing No. E-10.3 to Standard Drawing No. E-10.4.
- .3 Service panels and the electrical equipment inside shall be protected against the entrance of dust, dirt, moisture, and mechanical damage during construction.
- .4 Unused openings in the sheet steel panels shall be plugged with suitable corrosion resistant plugs.
- .5 Securely attach service panels inside the service base or on the side of the controller.

10.78 WIRING

- .1 Before pulling conductors through the conduit, the conduit shall be blown out with compressed air from both ends and then swabbed out to remove all stones, dirt, water and other foreign material from the conduit.
- .2 No conductor shall be drawn into any raceway until all work of any nature that may cause damage to the conductor or its insulation has been completed. During pulling, the conductors shall be fed carefully into the raceway to prevent stretching, twisting, kinking or looping. Only talc or other CSA approved lubricants shall be used to assist in the pulling operations. Grease type lubricants shall not be permitted.
- .3 Wiring to conform to requirements of the Canadian Electrical Code.
- .4 Wiring shall be installed in pole handholes as shown on Standard Drawing No. E-12.1 and Standard Drawing No. E-12.2.
- .5 With exception of detector loop conductor to shielded cable splices, all conductor splices shall be made in pole handholes. Splices of detector loop conductor to shielded cable shall be made in junction boxes. See Standard Drawing No. E-14.4 for detector loop splice details.
- .6 Signal cable colour coding shall be as shown on the Contract Drawings.
- .7 Shielded cables shall run with no splices from controller to the respective loop.

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- .8 Single conductor sizes and colours shall be as shown on the Contract Drawings.
- .9 With the exception of detector loop cables, bundle and label conductors in junction boxes with tags specified in Section 10.34 – Conductor Tags, *clause 10.34.2*. Labels shall be as follows:
 - (a) Street Lighting - STLTG
 - (b) Photocell - PEC
 - (c) Controller Power - CONT PWR
 - (d) Signal Cable - SIGNAL CABLE No. 1, No. 2, ETC.
 - (e) Post Mounted Flasher - FLASH
 - (f) Advance Warning Sign - AWS1, AWS2, ETC.
- .10 Label individual conductors in controllers and pole handholes with sleeve type markers as specified in Section 10.34 – Conductor Tags, *clause 10.34.1*. Labels shall be as follows:
 - (a) Street Lighting - STLTG
 - (b) Photocell - PEC
 - (c) Controller Power - CONT PWR
 - (d) Signal Phase - 2R, 2Y, 2G, 2N (where '2' indicates the Signal Phase and 'R' indicates Red, 'Y' indicates Yellow, 'G' indicates Green and 'N' indicates Neutral).
 - (e) Pedestrian Phase - P2W, P2DW, P2N (where 'P2' indicates the Pedestrian Phase, 'W' indicates Walk, 'DW' indicates Don't Walk and 'N' indicates Neutral).
 - (f) Detector Loop - L1, L2, ETC.
 - (g) Post Mounted Flasher - FLASH
 - (h) Advance Warning Sign - AWS1, AWS2, ETC.
- .11 Wire each traffic signal and pedestrian signal head separately from base of pole. Run a separate neutral and bonding conductor from base of pole to each signal head or luminaire.
- .12 Neatly arrange, bundle and ty-rap wiring in the traffic controller, junction boxes, vaults, pole handholes and service panels to satisfaction of the Engineer.
- .13 Secure conductor splices with the exception of detector loop to shielded cable with solderless type connectors. Where number and/or size of conductors exceeds the capacity of the solderless connector use split bolt connectors.
- .14 Sealing of connections, with exception of detector loop to shielded cable splices, shall be performed using one of the following methods:
 - (a) Double dipping the connection in an approved liquid product as referenced in the City of Nanaimo's Approved Products List. Dipping shall be performed strictly adhering to the Manufacturer's specification.
 - (b) Each conductor shall have a wrap of the self-holding tape conforming to products listed in the City of Nanaimo's Approved Products List, then the complete splice shall be wrapped. PVC Tape shall then be applied to cover the complete splice.
- .15 Seal detector loop to shielded cable splices in accordance with Standard Drawing No. E-14.4.

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- .16 If conductor connections require use of split bolts or similar style devices due to wire size, completely cover splice with tape then Duct Seal to form a ball over connection. Duct Seal shall be thick enough to prevent the sharp ends of the conductors and/or points of the connector from protruding through the taped connection. Once the Duct Seal has been applied, the splice shall to be taped with self-holding and PVC tape.
- .17 Bond all luminaires, signal heads, steel junction box lids and vault lids with a No. 12 RW90 conductor.
- .18 Bundle ty-rapped conductors every 75mm and route neatly inside the controller. Tag the conductors at the terminal blocks. Wiring inside of controller shall generally consist of:
 - (a) Connection of the traffic controller power to the terminals supplied.
 - (b) Connection of all the traffic and pedestrian phases to the terminals supplied.
 - (c) Connection of the detector loops to the terminal supplied.
 - (d) Connection of the bond conductor.
- .19 Make connections in traffic controller with insulated spade type crimp-on connectors.
- .20 Flash-out and check all signal and pedestrian heads at the terminal block in controller cabinet prior to system start-up.

10.79 TRAFFIC CONTROLLER

- .1 Install the traffic controller as shown on the Standard Drawings.
- .2 The type of traffic controller shall be indicated on the Contract Drawings.

10.80 POLE MOUNTED RECEPTACLES

- .1 Pole mounted receptacles shall be installed as shown on Standard Drawing No. E-13.1.
- .2 Receptacles shall be installed to the elevation and orientation shown on the Contract Drawings.

10.81 DETECTOR LOOPS

- .1 Detector loops shall be installed in accordance with Standard Drawing No. E-14.1 to Standard Drawing No. E-14.7.

10.82 GROUNDING

- .1 All grounding shall conform to the Canadian Electrical Code and latest Electrical Safety Branch Amendments.
- .2 Connect all ground rods, conductors, and galvanized steel conduits together. Connect only one wire to any one ground bushing.
- .3 Ground rigid steel conduits.

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10.83 COLD GALVANIZING COMPOUND

- .1 Repair damage to the galvanized surfaces with cold galvanizing compound. Application of cold galvanizing compound shall conform to manufacturer's instructions and the following:
 - (a) Surface to be mechanically cleaned with a wire brush or grinder and chemically cleaned to remove all welding flux, paint, grease, oil, rust, scale or other detrimental foreign matter.
 - (b) Surface shall be absolutely dry and the ambient temperature shall be over 10°C.
 - (c) Apply uniform coats as thick as possible without causing runs on the finished surface.

10.84 OVERHEAD SIGNS

- .1 Overhead street name signs mounted on signal poles shall be bolted to the arms in accordance with Standard Drawing No. E-15.1.
- .2 Overhead regulatory and warning signs 750mm X 750mm or smaller shall be mounted on signal poles in accordance with Standard Drawing No. E-15.2 to Standard Drawing No. E-15.4.
- .3 Extruded aluminum signs 1220mm(H) X 2440mm(W) such as advance warning signs or guide signs shall be mounted on sign poles in accordance with Standard Drawing No. E-15.5 to Standard Drawing No. E-15.14.
- .4 Signs shall be securely attached to the pole.
- .5 Temporary signs shall be plywood, unless otherwise noted.

10.85 TESTING AND COMMISSIONING

- .1 The Contractor shall carry out all adjustments and tests necessary to ensure that the entire electrical installation and all its equipment, material and components are in satisfactory physical condition and perform the intended function and operations. Any adjustments required to make the system operate in the manner intended by the Engineer shall be made by the Contractor.
- .2 At the completion of the job, proper system operation shall be demonstrated to the Engineer and the City of Nanaimo.
- .3 Traffic signal startup shall be carried out as follows:
 - (a) Upon completion of the installation, prior to start-up, the Contractor shall advise the Engineer and the City of Nanaimo to carry out their final inspection. After the final inspection is completed a written list of deficiencies will be sent to the contractor.
 - (b) All deficiencies noted during the final inspection shall be corrected to the satisfaction of the Engineer and the City of Nanaimo prior to signal start-up.
 - (c) After the deficiencies are corrected (prior to the signal start-up) the contractor shall put the signal into flash for a period of seven (7) days.
 - (d) The contractor shall provide the City with the proposed signal start-up date and time. Upon approval from the City the Contractor shall advise the Engineer and the controller manufacturer a minimum of 72 hours in advance of the approved start-up

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date and time. Where a siren pre-emption system is installed the Contractor shall arrange to have the manufacturer test the operation of their system prior to start-up. The fire chief shall all be present during the final testing of the siren pre-emption system.

- (e) The controller manufacturer's representative shall inspect all field wiring connections and controller operation on site prior to signal start-up.
- (f) In the presence of the Engineer, the controller manufacturer and the City the contractor shall put the signal into full operation.
- (g) The contractor shall supply all the necessary traffic control personnel required during the signal start-up. A minimum of 2 qualified flag persons are required.
- (h) The signal start-up shall be done during non-peak traffic periods.

10.86 CLEANUP

- .1 Any areas where work has been performed shall be restored to original condition, or better.
- .2 Existing equipment designated as being removed shall be returned to the City of Nanaimo works yard or disposed off-site as noted on the Contract Drawings.
- .3 The interior of enclosures, pole handholes and wiring areas shall be cleaned of dust, dirt and loose materials, vacuum-cleaned and all water and moisture removed.
- .4 All fastening screw holes provided in enclosures shall have a fastening screw installed.
- .5 Any spots where the galvanizing is damaged due to drilling, tapping, reaming, welding, or surface damage during transportation and erection, shall be refinished with cold galvanizing compound in accordance with Section 10.83 – Cold Galvanizing Compound.