

2015

ROADWAY ILLUMINATION  
POLICIES AND DESIGN  
GUIDELINES

ENGINEERING DEPARTMENT



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## FOREWORD

This document was prepared by the City of Barrie under the direction of a Technical Review Committee consisting of the following members:

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This manual was developed to better reflect current and emerging standards and technology, legislation and best practices as they exist in 2015. It will be necessary to update the manual from time to time as regulations, design practices and technologies continue to evolve. Current legislation shall be followed at all times.



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## 1 Introduction

### 1.1 Purpose

The purpose of this Roadway Illumination Policy and Design Guideline Manual is to provide guidance to designers, developers, consulting engineers and contractors for the design and construction of roadway illumination systems within the City of Barrie. The information used to develop the manual was gathered from recognized lighting and roadway authorities such as, the Illuminating Engineering Society of North America (IESNA), Transportation Association of Canada (TAC) and Guide for Roadway Illumination, 2006 Edition.

The information found in this manual shall be used in conjunction with the terms pertinent in the Subdividers Agreements and/or Site Plan Agreements issued by the City of Barrie. Also, this information will be a supplement to any additional or updated specification, approved by the City of Barrie.

It is the responsibility of the roadway illumination designer to ensure they have the latest revisions of the City's roadway illumination policies and design guidelines including standard details and the current list of approved manufacturers' list prior to constructing the roadway illumination system.

### 1.2 Definitions

In this document the following definitions shall apply:

The word "City" shall mean the City of Barrie.

The word "operating authority" shall mean the City of Barrie.

The word "contractor" shall mean the person, partnership or corporation undertaking the work as identified in the agreement (OPS General Conditions of Contract).

The words "developer(s)/owner(s)" shall mean the person(s) appearing on the last revised assessment role of the corporation of the City of Barrie to be the owner(s) of the land.

The words "City representative" shall mean any person assigned to a project by the City to carry out work on their behalf. The name of the representative shall be specified prior to the start of construction on any project.

The word "consultant" shall mean professional engineers authorized to practice in Ontario, and they shall be responsible for the preparation of drawings and specifications for the proposed roadway illumination system to the satisfaction of the City's Roads, Parks and Fleet Department and Engineering Department. The consultant shall act on behalf of the developer/owner.

The word "contract administrator" shall mean the person, partnership or corporation designated by the owner to be the owner's representative for purposes of the contract (OPS General Conditions of Contract).

The word "maintenance contractor" means the current electrical contractor under contract to perform roadway illumination maintenance work for the City of Barrie.

### 1.3 Abbreviations

OPSS                    Ontario Provincial Standard Specifications

CSA                     Canadian Standards Association

TAC	Transportation Association of Canada
IESNA	Illuminating Engineering Society of North America
ANSI	American National Standards Institute
RP	Recommended Practice for Roadway Illumination
HPS	High Pressure Sodium
LED	Light Emitting Diode
AISI	American Institute of Steel and Iron
IMSA	International Municipal Signal Association
ITE	Institute of Transportation Engineers
MTO	Ministry of Transportation of Ontario
NEMA	National Electrical Manufacturers Association
OPSD	Ontario Provincial Standard Drawings
ESA	Electrical Safety Authority

## 2 Legislation- Acts and Regulations

This document does not supersede, nor replace any legislation governing the design or installation of roadway illumination systems. Designers, consultants and contractors must be fully familiar with legislation such as the current Electrical Safety Authority Requirements when carrying out the design and construction of lighting projects within the City of Barrie.

Although this document is often referred to as policies, the design portion should be considered as minimum guidelines. This document provides the City's design preferences under normal circumstances. The engineer however, should use their best judgment to find innovative solutions when abnormal design conditions are encountered. Deviation from these design guidelines requires written approval of the Director of Roads, Parks and Fleet or designate. The proponent shall consider infrastructure asset management principles in any decision-making process.

All roadway illumination components shall comply with all applicable current industry standards and specifications for quality management and quality control, such as:

- The Canadian Standards Association (CSA);
- Electrical Safety Code;
- Ontario Provincial Standard Specifications.

## 3 Liability

The developer/owner shall save harmless, the City, its agents and employees from and against all claims, demands, losses, costs, damages, actions, suits and proceedings arising out of or attributable to any act or omission in connection with the development of roadway illumination infrastructure.

## **4 Roadway Illumination Policies and Design Guidelines**

### **4.1 Servicing Responsibilities**

Private land developers developing within the City are required to:

- a) Provide a roadway illumination system which will incorporate all demands within or being directed through the site as approved by the City.

These requirements are all the responsibility of, and at the expense of the developer.

### **4.2 Professional Design**

The developer/owner shall employ a licenced professional engineer, authorized to practice in Ontario, to design the roadway illumination system in conjunction with all other infrastructure including: the power system, right-of-way infrastructure and other services, in order that all services will be properly engineered and co-ordinated. The developer/owner shall submit detailed stamped engineered drawings for the roadway illumination system design.

### **4.3 Standard Detail Drawings**

In addition to these written guidelines, reference should also be made to the City's standard detail drawings (BSD's).

### **4.4 Approved Manufacturers' Products for Roadway Illumination Systems**

In addition to these written guidelines, reference should also be made to the approved manufacturers' products list for roadway illumination systems.

### **4.5 General Design Considerations**

#### **4.5.1 Benefits of Lighting**

The most important benefit of a roadway illumination system is to provide an enhanced level of visibility for motorists and pedestrians during low-light or nighttime conditions. Enhanced levels of visibility can increase the contrast between objects and their backgrounds, thereby enabling motorists and pedestrians to correctly distinguish roadway details, unexpected obstacles and hazards. Enhanced roadway illumination can reduce the number of accidents and help increase traffic flow at night. When lighting is designed and installed to nationally recognized standards, safety and security is improved. Also, the secondary benefits to good night-time lighting include enhancement of the City's image, improved commerciality of our business areas, an increased feeling of comfort and public night-time usage/enjoyment.

In addition to providing driving related benefits, roadway illumination systems can contribute to public areas in the following ways:

- Security – Effective roadway illumination systems can help deter potential criminals and aid in the prevention of vandalism. Thus providing the public user of the roadway with a safer environment.
- Economics – By providing a safer environment, roadway illumination can encourage people to visit commercial areas. Decorative lighting can revitalize an area and promote the development of new businesses.

- Aesthetics – Roadway illumination may draw attention to the architectural and landscape features of an area, thereby encouraging the nighttime use of an area.

#### **4.5.2 Negative Impacts of Improper Design**

Although there are many benefits to installing roadway illumination systems, improper design can have negative effects on the environment in which the lighting system is installed. When designing a roadway illumination system the designer shall make a conscious effort to limit these negative effects, while still achieving the minimum required lighting levels. Meeting the required lighting levels shall not be compromised, as the safety of motorists and pedestrians is the primary goal. Some of the negative impacts of improper design are as follows:

- Spill Light – Illuminance that extends beyond the desired area to be lighted. Spill light is unavoidable when roadway illumination systems are installed. However, where possible, steps shall be taken to mitigate the level of spill light. Choosing the correct luminaire light distribution pattern ensures that majority of light will be directed to the appropriate areas.
- Glare – Light that creates discomfort for the human eye. Glare can be limited by shielding or cutting the view of bright light sources from the view of the observer.
- Sky Glow – Illumination of the night sky by lighting systems. The most effective way of reducing sky glow is to use luminaires with full cut-off properties. These luminaires emit no light above 90 degrees and are very effective at limiting light pollution from entering the atmosphere.
- Excessive Energy Consumption – Over lighting roadways can result in increased energy costs. The illuminance levels shall be designed as close to the minimum values as possible.

#### **4.5.3 Lighting Warrants**

As mentioned, roadway illumination systems improve safety, promote business development and encourage the use of public areas. Due to budget constraints, however, it may not be beneficial to develop every unlit or underlit roadway. A warrant system is an effective way of defining and prioritizing the roadways that will benefit most from a lighting system. Warrants indicate probable need, but should not be interpreted as an obligation of the City of Barrie to install a roadway illumination system. The City through its business planning process, incorporates a warrant system to determine capital and operating needs.

The warrant system shall be interpreted as defined by the *Guide to the Design of Roadway Illumination* (Transportation Association of Canada (TAC), 2006 Edition).

#### **4.5.4 Land Use Area Classifications**

Certain land uses, such as office and industrial parks, may fit into any of the below classifications. The classification selected shall be consistent with the expected nighttime pedestrian activity.

- Commercial - A business area of a municipality where ordinarily there are many pedestrians during night hours. This definition applies to densely developed business areas outside, as well as within, the central part of a municipality. The area contains land use which attracts a relatively heavy volume of nighttime vehicular and/or pedestrian traffic on a frequent basis.

- Intermediate - Those areas of a municipality often characterized by moderately heavy nighttime pedestrian activity such as in blocks having libraries, community recreation centers, large apartment buildings, industrial buildings, or neighborhood retail stores.
- Residential - A residential development or a mixture of residential and small commercial establishments, characterized by a few pedestrians at night. This definition includes small homes, town houses, and/or small apartment buildings.

#### **4.6 Roadway Illumination Design Criteria**

##### **4.6.1 Conversion to LED Roadway Illumination**

The City of Barrie is dedicated to the migration from High Pressure Sodium (HPS) to Light-Emitting Diode (LED) lighting for both retrofit upgrades and new capital construction including development work. All new design submissions shall incorporate the use of LED lighting to support the City of Barrie's initiative to move towards energy efficient LED lighting.

##### **4.6.2 Replacement and Upgrade**

The replacement and upgrade of existing roadway illumination systems shall be designed and installed in accordance with the specifications outlined in this manual. Approval from the City must be obtained in the event that a designer wishes to use materials or specifications not approved in this manual. All replacements and upgrades shall support the City of Barrie's initiative to migrate towards LED lighting in all designs.

##### **4.6.3 Road Illumination Design Methodology**

Roadway classifications, pedestrian conflict classification, and recommended roadway illumination levels outlined in the following sections are taken from *ANSI/IES RP-8-00 Roadway Illumination ANSI Approved* (Illuminating Engineering Society of North America (IESNA)). The acceptable method of lighting design calculations shall be the illuminance method. The illuminance method will be the standard calculation method for roadways, sidewalks/pathways, intersections and parking areas. The following design criteria will be utilized to provide a lighting design that meets the performance requirements of ANSI/IES RP-8 for roadways, sidewalks/pathways, intersections and parking areas.

##### **4.6.4 The Illuminance Method**

The illuminance method determines the amount of light provided by the lighting system to the surface of the roadway. This method gives acceptable levels for average maintained lux for the different roadway classifications, based on various pavement types. The driver of a vehicle is affected by the light that reflects from the pavement surface towards the driver. Different types of pavement have different levels of reflectance; therefore, different illuminance levels must be used to match the pavement reflectance. The recommended illuminance values and the uniformity ratios are provided in Table 1 (page 12) and shall be used to check luminance design values.

##### **4.6.5 Roadway Classifications**

- Freeway/Provincial Highway - A divided major roadway with full control of access (no crossings at grade). This definition applies to toll as well as non-toll roads.

- *Freeway A:* Roadways with greater visual complexity and high traffic volumes. Usually this type of freeway will be found in major metropolitan areas in or near the central core and will operate through some of the early evening hours of darkness at or near design capacity.
- *Freeway B:* All other divided roadways with full control of access.
- *Expressway/Parkway* - A divided major roadway for through traffic, with partial control of access and generally with interchanges at major crossroads. Expressways for noncommercial traffic within parks and park-like areas are generally known as parkways.
- *Major/Arterial* - That part of the roadway system that serves as the principal network for through-traffic flow. The routes connect areas of principal traffic generation and important rural roadways leaving the city. These routes are often known as "arterials." They are sometimes subdivided into primary and secondary; however, such distinctions are not necessary in roadway illumination.
- *Collector* - Roadways servicing traffic between major and local streets. These are streets used mainly for traffic movement within residential, commercial, and industrial areas. They do not handle long, through trips. Collector streets may be used for truck or bus movements and give direct service to abutting properties.
- *Local* - Local streets are used primarily for direct access to residential, commercial, industrial, or other abutting property. They make up a large percentage of the total street system, but carry a small proportion to abutting properties.

#### **4.6.6 Pedestrian Conflict Classifications**

- *High* - Areas with significant numbers of pedestrians expected to be on sidewalks, walkways or crossing the streets during darkness. Examples are downtown office areas, near theaters, concert halls, stadiums, and transit terminals.
- *Medium* - Areas where lesser numbers of pedestrians utilize the streets at night. Typical are downtown office areas, blocks with libraries, apartments, neighborhood shopping, industrial, older city areas, and streets with transit lines.
- *Low* - Areas with very low volumes of night pedestrian usage. These can occur in any of the cited roadway classifications but may be typified by suburban single-family streets, very low-density residential developments, and rural or semi-rural areas.

Guidelines for possible conflict classifications, based on one hour pedestrian counts of a typical street block or 200 meter section, are as follows:

- High – Over 100
- Medium – 11 to 100
- Low – 10 or fewer

These volumes represent the total number of pedestrians walking on both sides of the street plus those crossing the street at non-intersection locations.

**4.6.7 Roadway Illumination Levels Targets**

Table 1 provides the designer with the recommended values for illuminance design. The Roadway Surface Classifications R1 to R4 are defined in the *ANSI/IES RP-8-00 Roadway Illumination ANSI Approved* (Illuminating Engineering Society of North America (IESNA)).

**Table1: Illuminance Method – Recommended Values**

Road and Pedestrian Conflict Area		Pavement Classification (Minimum Maintained Average Values)			Uniformity Ratio $E_{avg}/E_{min}$	Veiling Luminance $L_{vmax}/L_{avg}$
Road	Pedestrian Conflict area	R1 lux/ftc	R2 & R3 lux/ftc	R4 lux/ftc		
Freeway Class A		6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Freeway Class B		4.0/0.4	6.0/0.6	5.0/0.5	3.0	0.3
Expressway	High	10.0/1.0	14.0/1.4	13.0/1.3	3.0	0.3
	Medium	8.0/0.8	12.0/1.2	10.0/1.0	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Major	High	12.0/1.2	17.0/1.7	15.0/1.5	3.0	0.3
	Medium	9.0/0.9	13.0/1.3	11.0/1.1	3.0	0.3
	Low	6.0/0.6	9.0/0.9	8.0/0.8	3.0	0.3
Collector	High	8.0/0.8	12.0/1.2	10.0/1.0	4.0	0.4
	Medium	6.0/0.6	9.0/0.9	8.0/0.8	4.0	0.4
	Low	4.0/0.4	6.0/0.6	5.0/0.5	4.0	0.4
Local	High	6.0/0.6	9.0/0.9	8.0/0.8	6.0	0.4
	Medium	5.0/0.5	7.0/0.7	6.0/0.6	6.0	0.4
	Low	3.0/0.4	4.0/0.4	4.0/0.4	6.0	0.4

**4.6.8 Sidewalk Lighting**

Area classifications and recommended sidewalk lighting levels shall be taken from *ANSI/IES RP-8-00 Roadway Illumination ANSI Approved* (Illuminating Engineering Society of North America (IESNA)).

**4.6.9 Intersection Lighting Levels**

Roadway classifications, pedestrian conflict classification, and recommended intersection illuminance levels outlined in Table 2 are taken from *ANSI/IES RP-8-00 Roadway Illumination ANSI Approved* (Illuminating Engineering Society of North America (IESNA)). Table 2 (page 13) defines the recommended levels of illuminance for intersection lighting applications.

**Table 2: Intersection Illuminance – Recommended Values**

Illuminance for Intersections				
Functional Classifications	Average Maintained Illumination at Pavement by Pedestrian Area Classification			E <sub>avg</sub> /E <sub>min</sub>
	Lux/ft <sup>2</sup>			
	High	Medium	Low	
Major/Major	34.0/3.4	26.0/2.6	18.0/1.8	3.0
Major/Collector	29.0/2.9	22.0/2.2	15.0/1.5	3.0
Major/Local	26.0/2.6	20.0/2.0	13.0/1.3	3.0
Collector/Collector	24.0/2.4	18.0/1.8	12.0/1.2	4.0
Collector/Local	21.0/2.1	16.0/1.6	10.0/1.0	4.0
Local/Local	18.0/1.8	14.0/1.4	8.0/0.8	6.0

**4.6.10 Parking Lot Lighting**

Parking Lots shall be designed for enhanced security to the lighting levels as shown in Table 3. Full cut-off options shall be used as approved by the City of Barrie to ensure minimum spill light on adjacent properties. Refer to IESNA RP-20-98 for lighting for parking facilities.

**Table 3: Recommended Maintained Illuminance Values for Parking Lots**

		Enhanced Security
Minimum Horizontal Illuminance	lux	5
Average Maintained Illuminance	lux	25
Uniformity Ratio, Maximum to Minimum	lux	15:1
Minimum Vertical Illuminance	lux	2.5

**4.6.11 Special Areas**

Special Areas are to receive decorative style lighting equipment. A specific lighting design and the associated calculations must be submitted to the City for review. All Special Areas must meet the recommended lighting levels defined in this manual. The following locations are to be considered Special Areas:

- City Center (limits defined in the City's Official Plan)

**4.6.12 Temporary Lighting**

Where possible, an existing roadway illumination system shall remain in operation until the new roadway illumination system is fully operational. Where a new temporary lighting system is required to be installed, due to the existing lighting system unavoidably being removed prior to the new lighting system becoming fully operational, the temporary lighting system is required to meet the recommended lighting levels defined in this manual.

**4.7 Roadway Illumination General Criteria**

All electrical works shall conform to Ontario Provincial Standard Specification OPSS 106.

**4.7.1 Roadway Illumination Location Within Right-of-Ways**

Street lights are typically located in the boulevard on the east or south side of the right-of-way. Refer to the City's typical road cross-section detailed drawings (BSD's).

**4.7.2 Lighting Pole Locations**

The designer of the roadway illumination system shall strategically place the lighting poles to achieve the required levels of illumination outlined in this manual, while minimizing the adverse effects on the travelling public and infrastructure.

#### **4.7.3 Use of Hydro Utility Poles**

Where possible, it is favorable to utilize the hydro utilities' poles for the installation of luminaires. However, if the lighting levels cannot be achieved due to excess spacing of the utility poles, an alternate lighting design which does achieve the recommended lighting levels must be submitted to the City for approval. The use of hydro utility poles as part of the roadway illumination system must be coordinated and approved by the hydro authority.

#### **4.7.4 Layout of Electrical Equipment**

Layout of electrical equipment shall be as per OPSS 106. Subsection 106.07.07 is deleted and replaced with the following:

The layout of equipment shown in the contract drawings is a schematic indication of the general requirements only. Equipment shall be located in accordance with the listed stations, offsets, and dimensions shown in the contract drawings and are to be reviewed by the contract administrator. The contract administrator, at their option, may revise the locations of equipment as required by field conditions, prior to installation.

#### **4.7.5 Materials**

OPSS Subsection 106.05 is amended to include the following:

Unless otherwise specified in the contract or by the contract administrator, all roadway illumination components for installation shall be new, fabricated and supplied by recognized equipment manufacturers to meet the requirements of the operating authority. All materials, components or custom equipment shall be CSA approved, where applicable, and comply with the requirements of ESA with respect to their application.

All materials shall be stored in accordance with manufacturers' instructions to prevent damage, soiling, or finish spoilage. New poles shall be stacked to prevent bending or warping and shall be protected against any condition that may cause chipping or pitting in the finish.

The contractor shall supply all materials as specified in the form of tender and any miscellaneous hardware and material (electrical tape, marrettes, connectors, etc.) required for each installation.

#### **4.7.6 Illumination Systems**

OPSS Subsection 106.05 is amended to include the new subsection 106.05.01 as follows:

While the specifications include specific requirements for the work, it shall be understood and acknowledged by the contractor that complete illumination systems are required. Minor items or accessories not specified, but obviously required for such systems, shall be provided as if specified and in conformance with modern practice and workmanship. Any omission or errors or misinterpretations of the specifications or contract order shall not relieve the contractor of the responsibility of providing all the equipment necessary to complete the work.

#### **4.7.7 Protection of Existing Infrastructure**

It shall be the contractor's responsibility to protect and support existing underground/overhead infrastructure, which may be encountered during the progress of the work. Any existing infrastructure, which has to be relocated, shall be at the contractor's expense with no cost to the City. Utility poles, which require support, shall be held with the appropriate equipment as supplied by the contractor, at their

expense. The attachment of this equipment shall be made by the utility company. The contractor must have a qualified person on-site at all times to operate any vehicle used to support utility poles. The contractor must arrange for locates of all infrastructure by contacting the appropriate operating authority prior to any excavation on road allowance.

#### **4.7.8 Removal and Abandoning**

Where possible and/or as directed by the City, the contractor shall completely remove above ground structures, handwells and pole base per OPSS 510 (Construction Specification for Removals).

### **4.8 Construction Specifications**

#### **4.8.1 General**

This specification covers the requirements for the installation of electrical equipment and is applicable to all electrical work in the contract. Unless otherwise amended herein, the provisions of the Ontario Provincial Standard Specifications listed under Section 4.8.2 shall apply to this work.

#### **4.8.2 References**

This specification refers to the following standards, specifications or publications:

- Ontario Provincial Standard Specifications:

Construction Specification for Electrical Chambers	In accordance with OPSS 602,
Construction Specification Duct Systems	In accordance with OPSS 603,
Construction Specification Cable Systems	In accordance with OPSS 604,
Construction Specification Grounding Systems	In accordance with OPSS 609,
Construction Specification Removal of Electrical Equipment	In accordance with OPSS 610,
Construction Specification Power Supply Equipment	In accordance with OPSS 614,
Construction Specification for Erection of Poles	In accordance with OPSS 615,
Construction Specification Footings and Pads for Electrical Equipment	In accordance with OPSS 616,
Construction Specification Roadway Luminaries and Brackets	In accordance with OPSS 617,
- OPS General Conditions of Contracts
- Ontario Traffic Manual – OTM: Books 1, 1A, 1B, 1C, 5, 6, 7, 11 & 12
- Electrical Utilities Safety Association of Ontario Rule Books
- Electrical Utility Safety Rules
- Ontario Electrical Safety Code, 24th Edition, 2009 and bulletins

#### **4.8.3 OPSS 106.07 Work Force Criteria**

##### **4.8.3.1 OPSS 106.07.01 Qualification of Workers**

OPSS Subsection 106.07.01 is amended to include the following:

Electrical Contractors shall have a minimum of five (5) previous years of experience in the construction of roadway illumination systems and approved by the Operating Authority prior to the submission of tender.

#### **4.8.4 OPSS 106.07.01 Contractor's Workers**

OPSS Subsection 106.07.01.01 is amended by deleting the first paragraph and replacing it with the following:

For electrical work, the contractor or subcontractor shall have a licensed master electrician on staff, and shall use workers qualified to do work in accordance with OPSS 106 and the following:

- a) All electrical work shall be performed under the supervision of a licensed (Construction and Maintenance 309A) electrician.
- b) Personnel certified under "The Apprenticeship and Tradesman's Qualification Act" shall perform all electrical work. All personnel performing electrical work shall carry proof of their certification under the Act on their person at all times while on the work site.
- c) Electrical work at roadway illumination system equipment installations shall be performed by a licensed electrician who has completed the IMSA Roadway Lighting Level 1 Certification Program.
- d) Personnel shall have related experience in the overall field of roadway illumination installations.
- e) A qualified representative must be present and on-site whenever work is being carried out under the Contract.

#### **4.8.5 OPSS 106.07.06 Temporary Electrical Work**

OPSS Subsection 106.07.06 is amended to include the following:

Existing lighting systems are to remain in operation until new or temporary systems are in operation.

#### **4.8.6 OPSS 106.07.08 Adjustment of Electrical Equipment**

OPSS Subsection 106.07.08 is deleted and replaced with the following:

The contractor shall adjust all luminaires, photoelectric controllers and other devices, which may be adjusted to give optimum performance. All equipment shall be installed in a neat and orderly manner to the satisfaction of the contract administrator. Minor adjustments to equipment, which in the opinion of the contract administrator are required to improve the appearance of the site, shall be carried out at the contractor's expense.

The contractor shall also make adjustments in luminaires during nighttime conditions, and if so required, to any equipment that can be adjusted to provide optimum performance. All such adjustments shall be carried out to the satisfaction of the contract administrator at the contractor's expense.

#### **4.8.7 Construction Specification for the Installation of Ducts OPSS 603**

##### **4.8.7.1 OPSS 603.05.08 Ducts and Fittings**

OPSS Subsection 603.05.08 of OPSS 603 is amended by deleting the first paragraph and replaced with the following:

The following minimum size conduit shall be installed in the following areas, unless otherwise specified on the Contract Drawings:

- a) Road Crossings – Handwell to Handwell - 2/50 mm

- |   |           |
|---|-----------|
| b) Boulevard – Handwell to Pole Footing   | - 50 mm   |
| c) Boulevard – Handwell to Power Supply   | - 2/50 mm |
| d) Boulevard – Handwell to Light Standard | - 50 mm   |
| e) Boulevard – Pole to Pole               | - 50 mm   |

The type and number of conduit shall be laid out and constructed as shown in the Contract Drawing.

Subsection 603.05.08 of OPSS 603 is amended by adding new subsection 603.05.08.01 as follows:

**4.8.7.2 OPSS 603.05.08.01 Open Cut Installation**

Flexible duct installed by direct buried method and used for roadway illumination applications between the pole and adjacent handwell shall be Electrical Non-metallic Tubing in accordance with CSA Standards C22.2 No. 227.1, except where otherwise indicated. Rigid ducts installed by open cut, direct buried, concrete encased and subsurface installation shall be rigid polyvinyl chloride (RPVC) unplasticized conduit conforming to CSA Standards C22.2 No. 211.2, except where otherwise indicated.

**4.8.7.3 OPSS 603.05.08.02 Directional Boring**

OPSS Subsection 603.05.08 of OPSS 603 is amended by adding new subsection 603.05.08.02 as follows:

Rigid ducts installed by directional boring shall be rigid polyvinyl chloride (RPVC) unplasticized conduit conforming to CSA Standards C22.2 No. 211.2-06.

**4.8.7.4 OPSS 603.07.01.09 Backfill**

OPSS Subsection 603.07.01.09 of OPSS 603 is amended by adding the following:

The bore pits in boulevards areas when the method of directional boring is used shall be backfilled with native material. Granular material shall be compacted to 100% standard proctor maximum dry density and earth to 95% standard proctor maximum dry density. All grassed areas in boulevards will be reinstated with a minimum of 200 mm of select topsoil and sod as required under the contract.

The bore pits in roadway surface areas when the method of directional boring is used shall be backfilled to the requirements of:

- a) OPSS Form 1010, for granular “A” and granular “B” Type 1 and compacted to 100% standard proctor maximum dry density. Granular “B” Type 1 backfill shall be used up to the elevation where granular “A” is shown on the typical sections or elsewhere on the contract drawings. Granular “A” shall be used in the upper section as trench backfill.
- b) Utilizing unshrinkable backfill material.

OPSS Subsection 603.07.02.03 of OPSS 603 is amended by adding the following:

All grassed areas in boulevards will be reinstated with a minimum of 200 mm of good topsoil and sod as required under the contract.

**4.8.7.5 Basis of Payment – Subsection 603.10**

OPSS Subsection 603.10.01 of OPSS 603 is amended with the addition of the following:

- Flexible Ducts, Direct Buried - Item

- Rigid Ducts, Concrete Encased - Item
- Rigid Duct Direct Buried - Item
- Rigid Ducts by Subsurface Installation - Item

No additional payment will be made for bends, risers, etc., unless specifically indicated.

Payment for conduit shall be per meter of conduit placed and shall include the supply and installation of the conduit, fish line, all bends, risers, caps, couplings, end bells, concrete, excavation of trenches, removal and disposal of materials, bedding, backfill and compaction.

#### **4.8.8 Construction Specification for the Installation of Cable – OPSS 604**

OPSS Subsection 604.01 of OPSS 604 deleted and replaced by the following:

This specification is intended to govern the supply, delivery and installation of the following cables including splicing and termination:

- a) Low voltage Cable

The installation of cables shall be carried out in the following manner and according to drawings:

- a) The contract administrator must approve materials used to facilitate the pulling of cables in conduit. Cable shall not be pulled at temperatures below -6 degrees C.
- b) Cable runs shall be continuous between poles. Cable splices shall only be made within a steel/concrete pole handhole or junction boxes on a wooden pole. No cable splices are permitted below ground level.
- c) Sufficient length of free cable shall be left in pole handholes or junction boxes to permit proper connection to be made with cable coming from streetlights.
- d) Cable from roadway illuminations on steel/concrete poles shall run inside the mast arms and carry down inside the pole to the handhole.

If, in the opinion of the contract administrator, any material used in the construction of any part of the cable is defective, or otherwise unsuitable, or if, in their opinion, the workmanship does not conform to accepted standards, the contractor shall replace such defective cable at their own expense.

Any errors or omissions in, or misinterpretation of the specifications, or order shall not relieve the contractor of the responsibility of providing cable conforming to modern practices and the best workmanship.

Cable type and sequential length markings shall be printed every one (1) meter on the surface of the outer jacket.

The contractor must provide the contract administrator a schedule of the material supplier's delivery dates.

#### **4.8.8.1 Cable References – Subsection 604.02**

OPSS Subsection 604.02 of OPSS 604 is amended by deleting the references under the heading "Others" and replacing them with the following:

#### **Others:**

- Electrical Utilities Safety Association of Ontario Rule Book

- Ontario Electrical Safety Code, 24th Edition, 2009 and Bulletins

#### **4.8.8.2 Materials – Subsection 604.05**

OPSS Subsection 604.05.02.01 of OPSS 604 is deleted and replaced with the following:

Low-voltage multi-conductor cables shall be according to CAN/CSA C22.2 No. 239.

Low-voltage single conductor cables for underground installations shall be type RWU90 copper with cross-linked polyethylene insulation according to CSA C22.2 No. 38.

Low-voltage single conductor cables for aerial installations on messenger cable shall be type RW90 stranded aluminum with cross-linked polyethylene insulation according to CSA C22.2.

Low-voltage neutral supported cables with one, two, or three insulated aluminum conductors and ACSR neutral shall be 300 V type NS-90 or 600 V type NSF-2 and shall be according to CSA C22.2 No. 129.

The contractor shall install cable runs as per wiring diagram and wiring chart as provided in the contract.

#### **4.8.9 Construction Specification for the Installation of Electrical Chambers – OPSS 602**

OPSS Subsection 602.01 of OPSS 602 is amended by adding the following:

Electrical maintenance holes, handholes and splicing service boxes shall be installed as shown on the contract drawings and in the standard specification drawings.

##### **4.8.9.1 Electrical Handholes – Subsection 602.07.11.02**

Subsection 602.07.11.02.01 of OPSS 602 is amended by deleting the paragraph titled “Cast in Place Concrete Handhole” and replacing it with the following:

OPSS 602.07.11.02.01 Precast Concrete Handwells

Precast concrete handwells shall be constructed as shown in standard specification drawings and installed plumb, firmly bedded on the drainage pocket backfill, and in accordance with standard specification drawing [BSD-806](#).

##### **4.8.9.2 Prefabricated Service Boxes – Subsection 602.07.11.02.**

OPSS Subsection 602.07.11.02. of OPSS 602 is amended by adding the following:

Prefabricated services boxes shall be installed as shown in the standard specification drawings [BSD-807](#) and set plumb and firmly bedded on the drainage pocket backfill.

Electrical handwells, when used for roadway illumination shall be installed as shown in the standard specification drawing [BSD-808](#), set plumb and firmly bedded on the drainage pocket backfill.

##### **4.8.9.3 Grounding of Electrical Chambers**

Subsection 602.07.13 of OPSS 602 is amended by adding the following:

Where a ground rod or plate is required in or adjacent to the maintenance handhole or prefabricated handwell, the system #6 AWG bare copper ground wire shall exit out of the maintenance handhole or prefabricated handwell to enable ground rod connection as indicated in the contract.

#### **4.8.10 Construction Specification for the Removal Of Electrical Equipment And Materials - OPSS 610**

##### **4.8.10.1 OPSS 610.07.09.03 Shipping of Salvaged Electrical Equipment and Materials**

OPSS Subsection 610.07.09.03 of OPSS 610 is amended with the addition of the following:

Delivery to the City of Barrie Operations Centre, 165 Ferndale Drive North shall be made between 9:00 a.m. and 3:30 p.m. local time. The contract administrator shall be notified three working days in advance of delivery to the City of Barrie as specified below:

##### **Salvaged Equipment**

- Steel Poles
- Concrete Poles
- Mast arms
- Luminaires

Concrete poles will be salvaged unless directed by the City representative to dispose of off- site.

Where salvaged equipment is required for re-use under the contract, the contractor shall be responsible for a clean and safe storage facility; the equipment shall be stored as per the manufacturer's requirements to avoid damage prior to re-installation.

The contractor shall remove and dispose of all street lighting conductors from existing conduits. All pole bases and handwells are to be removed in their entirety and disposed of.

#### **4.8.11 Construction Specification for Installation Of Power Supply Equipment – OPSS 614**

##### **4.8.11.1 OPSS 614.05.08 - Meter Base**

New OPSS subsection 614.05.08 is added to subsection 614.05 as follows:

When required, the contractor shall supply and install a socket type, 100 amp meter base, as per local hydro authority requirements, complete with top entry hub. The meter base shall be installed as per the standard specification drawings [BSD-810](#).

##### **4.8.11.2 OPSS 614.05.09 Power Supply Pedestal Assembly**

New OPSS subsection 614.05.09 is added to subsection 614.05 as follows:

Circuit breakers shall be installed as shown on the wiring schematics and in accordance with the operating authority standard drawings. The contractor shall install three (3), copper stranded RWU90 conductors (Black, Red & White) (size as per Contract drawings) from the hydro supply point to the load centre, leaving a sufficient length of cable coiled for connection to the hydro feed. Each conductor must be one continuous piece, with no splices. The Power Supply Pedestal and Base Assembly shall be installed as per Standard Specification Drawing [BSD-817](#).

##### **4.8.11.3 OPSS 614.05.10 Supply Control Cabinet Assembly**

New OPSS subsection 614.05.10 is added to subsection 614.05 as follows:

The contractor shall supply and install a TYPE 3M (LS3M), 120/240 V, 100 Amp, 1Ø, 3 wire supply control cabinet assembly or a supply control cabinet assembly complete with stainless steel enclosure as per City of Barrie standard drawings [BSD-811](#) to [BSD-816](#).

#### 4.8.11.4 **OPSS 614.07.02.01 Pole Mounted Power Supply Equipment**

Subsection 614.07.02 is amended with the addition of new subsection 614.07.02.01 as follows:

The contractor shall supply and install equipment for the power supply on the service pole as per the standard specification drawings [BSD-810](#). The contractor shall leave sufficient wire coiled at the weather head for the connection to the secondary supply on the service pole.

The installation of the power supply equipment and the power connections must be completed early in the contract to ensure there is no delay to the roadway illumination turn on. Therefore, the contractor must have early communication with the respective hydroelectric authority to ensure that the requirements (i.e. permits, inspection and payments) have been satisfied and the earliest power connection can be made.

The contractor will arrange approval by ESA prior to the respective hydroelectric authority being able to connect power feed. The contractor is responsible for the cost of the ESA inspection and power hookup by the respective hydroelectric authority. The contractor shall contact the respective hydroelectric authority two (2) weeks before power to the service is required to ensure that all of the hydroelectric authority's requirements have been fulfilled and that a power connection date is scheduled.

#### **4.8.12 Construction Specification for the Erection of Poles – OPSS 615**

OPSS Subsection 615.02 of OPSS 615 is amended to include the following:

CSA Standards:

CAN/CSA C22.2 No. 206-M1987(R2004) Lighting Poles

#### **OPSS 614.07.02.01 Pole Mounted Power Supply Equipment**

##### **4.8.12.1 OPSS 615.05.03 - Poles**

OPSS Subsection 615.05.03 of OPSS 615 is deleted and replaced with the following:

OPSS 615.05.03.02 Steel Poles, Base Mounted

New OPSS subsection 615.05.03.02 is added to subsection 615.05.03 as follows:

Steel base mounted poles shall be per standard specification drawings [BSD-820](#) and installed as per the contract drawings. The poles shall be erected in accordance with procedures specified by the manufacturer and/or the contract administrator.

OPSS 615.05.03.03 Wood Poles

New OPSS subsection 615.05.03.03 is added to subsection 615.05.03 as follows:

Wood poles shall meet the requirements of OPSS 2420.

Concrete Poles

Concrete poles, direct buried shall be installed as per standard specification drawings [BSD-830](#), [BDS-827](#) and [BSD-829](#). The poles shall be erected in accordance with procedures specified by the manufacturer and/or the contract administrator.

##### **4.8.12.2 OPSS 615.05.04 - Frangible Bases**

OPSS Subsection 615.05.04 is deleted and replaced with the following:

Frangible bases shall be grooved coupler type as detailed in OPSS 2428.01 and suited for the pole base being mounted.

#### **4.8.12.3 OPSS 615.05.04.03 - Pole Erection**

OPSS Subsection 615.07.04.03 amended with the addition of the following:

Base mounted lighting poles shall be installed as per the contract drawings and standard specification drawings [BSD-819](#) and [BSD-820](#).

#### **4.8.12.4 OPSS 615.05.06 Anchorage Assemblies and Hardware**

OPSS Subsection 616.05.06 is deleted and replaced with the following:

All steel components shall be hot dip galvanized conforming to CSA G164M.

The complete anchorage assembly shall be as shown in the standard specification drawings [BSD-823](#). A wood template shall be provided with each assembly.

Studs shall be factory inserted and held in place with a pre-applied threaded locking compound. The nuts on studs shall be installed finger-tight only by the fabricator. Any threads of the studs and bolts exposed above the ferrule shall be coated with factory applied white lithium grease.

#### **4.8.12.5 OPSS 615.07.01.06 - Concrete**

OPSS Subsection 616.07.01.06 of OPSS 616 is amended by deleting the first paragraph and adding the following paragraphs:

Concrete shall be placed, vibrated, cured, protected and finished conforming to OPSS 904 and shall be formed as one monolithic slab. The alignment of the sleeves and/or duct entry points shall be scribed marked with indentations on the top of the concrete footing or slab.

The pole bases shall be constructed as shown on contract drawings and standard specification drawings [BSD-821](#) and [BSD-822](#). The setting of elevation for and finish grading around the pole bases shall be in accordance with standard specification drawings [BSD-824](#)

The anchor assembly shall be spaced and supported by means of a template. Before the concrete is poured, the contractor shall "spin" the studs in the anchor assembly down to full depth in the assembly. The anchor assemblies shall be adjusted level by use of a carpenter's level used at several angles on the wood templates. Upon initial setting of concrete the wood template shall be removed and the drainage channels, marking the entry points of conduits and other features shall be completed. Once the top surface of the concrete is finished, the wooden template and the nuts shall be reset and hand tightened to secure it on the assembly.

The integrity of the compound shall be maintained throughout the installation and under no conditions shall the studs or bolts be removed and left out of the ferrules while the concrete sets. If removed, the studs or bolts and ferrules shall be cleaned of residue prior to the studs or bolts being reinserted to full depth in the assembly ferrules.

After the setting of the concrete, the template shall be removed and the projecting threads of the studs or bolts shall be greased and protected until the metal pole is mounted in place. The formwork shall be completely removed on the external surface area at least 200 mm below grade.

#### **4.8.12.6 OPSS 615.07.03.02.02 Anchorage Assemblies**

OPSS Subsection 616.07.03.02.02 is amended by adding the following:

The anchorage assembly shall be manufactured by NCA / Acrow-Richmond, in the size and configuration shown in the standard specification drawing [BSD-823](#) and supplied with studs as specified in the contract. Anchor assemblies of the size and type indicated in the contract shall be accurately positioned in the footings. For alignment of the assemblies refer to the contract drawings.

#### **4.8.13 Construction Specification for Footings and Pads For Electrical Equipment – OPSS 616**

OPSS 616 is amended by the following:

OPSS Subsection 616.05.01 is deleted and replaced with the following:

Concrete shall conform to OPSS 1350, be 30 MPa class and supplied by an approved ready mix concrete supplier with a ready mixed concrete operation.

##### **4.8.13.1 OPSS 616.07.03.02 Concrete**

OPSS Subsection 616.07.03.02 is amended by deleting the first paragraph and adding the following paragraphs:

Concrete shall be placed, vibrated, cured, protected and finished conforming to OPSS 904 and shall be formed as one monolithic slab. The alignment of the sleeves and/or duct entry points shall be scribed marked on the top of the concrete slab.

##### **4.8.13.2 OPSS 616.08 QUALITY ASSURANCE**

OPSS Subsection 616.08 is deleted and replaced with the following:

The contract administrator will inspect each pole footing. A maximum tolerance of 15 mm will be allowed from the top elevation of the footing to the adjacent grades or contract detail information.

#### **4.8.14 Construction Specification for the Installation Of Roadway Luminaires – OPSS 617**

##### **4.8.14.1 OPSS 617.07.04 - Brackets**

OPSS Subsection 617.07.04.01 of OPSS 617 is amended by the addition of the following:

The contractor shall supply and install the following type of aluminum tapered elliptical brackets or approved equivalent in quantities as outlined on the form of tender. The Contractor shall install the roadway lighting fixtures and brackets at the locations specified on the contract drawings, or as directed by the Contract Administrator or their representative.

##### **4.8.14.2 OPSS 617.07.04.01 Roadway Illumination Type**

Installation of these brackets shall be per OPSD 2420.01 by use of 16 mm diameter galvanized machine bolt through the upper pole plate aperture. A 16 mm stainless steel band strap shall be installed around the lower portion of the pole bracket. Pole apertures for steel poles shall be field drilled, deburred and touched up with zinc rich paint for this operation.

#### **4.9 Material Specifications**

This specification covers the requirements for electrical materials and is applicable to all electrical materials in the proposed roadway illumination system. Unless otherwise amended herein, the provisions

of the Ontario Provincial Standard Specifications shall apply. Refer to the Approved Manufacturers' Products for Linear Roadway Illumination Systems for current approved material.

- a) All roadway illumination materials used shall be new and shall conform to those listed in the City of Barrie Approved Manufacturers' Products for Linear Roadway Illumination Systems list, and the latest revision of the OPSS. Manufacturers shall provide confirmation of certification if requested.
- b) The City reserves the right to select any materials or product it deems appropriate for the application. The City also reserves the right to remove from the approved list any product previously approved but found inappropriate for the application. The designer shall clearly indicate on the drawings and contract documents the materials which are acceptable for use in a particular application where the use of one or more of the approved list is not acceptable.
- c) A complete list of materials and manufacturers, which will be used to install the roadway illumination system shall be sent to the City Representative for approval before construction commences.
- d) The contractor shall inspect all materials before installation and reject any pieces showing breaks, cracks or other defects.

#### **4.9.1 References**

This document refers to the following standards, specifications or publications:

- Ontario Provincial Standard Specifications:

Electrical Handholes	In accordance with OPSS 2401,
Power Supply Equipment	In accordance with OPSS 2414,
Wood Poles	In accordance with OPSS 2420,
Spun Concrete Poles Class 'B'	In accordance with OPSS 2421,
Steel Poles, Base Mounted	In accordance with OPSS 2423,
Aluminum Tapered Elliptical Brackets	In accordance with OPSS 2428,
LED Luminaires for Highway Lighting	In accordance with OPSS 617,
Aluminum Poles, Base Mounting	In accordance with OPSS 2452,
Photoelectric Controllers	In accordance with OPSS 2485

- OPS General Conditions of Contracts
- Ontario Traffic Manual – OTM: Books 1, 1A, 1B, 1C, 5, 6, 7, 11 & 12
- Electrical Utilities Safety Association of Ontario Rule Books
- Electrical Utility Safety Rules
- Ontario Electrical Safety Code, 23<sup>rd</sup> Edition, 2002 and Bulletins

## **5 Acceptance Protocol for Roadway Illumination System**

### **5.1 General Requirements**

The developer/owner shall retain the services of a professional engineer experienced in the design and installation of roadway illumination services. The professional engineer retained shall be authorized to practice in the province of Ontario and shall be responsible for the preparation of drawings and specifications for the proposed roadway illumination services to the satisfaction of the City. The services of the professional engineer shall continue until the work provided for on the site is completely developed.

The developer/owner is responsible for the City's service connection charges arising out of, or attributable to the development of the subdivision or site plan including, but not limited to; field inspection, testing and connection of the roadway illumination services. The City reserves the right to order field revisions, as deemed required by the City's representative, at the expense of the developer/owner.

The developer/owner shall relocate, support or modify any existing infrastructure required to develop the site, at their expense.

The developer/owner shall obtain all necessary permits and consents associated with excavation and installation of roadway illumination services on existing City of Barrie road allowances and to discharge any applicable City of Barrie Act charges or local improvement charges.

The developer/owner shall make a capital contribution towards the extension of the roadway illumination services to the site and across its frontage if the present servicing is not adequate to accommodate the development. The amount of the capital contribution will be determined by the City.

Should the developer/owner propose to "phase" the servicing of this development, the City reserves the right to comment and/or alter the proposal, in order to service the development in a logical order.

The Developer/Owner shall place with the City of Barrie Finance Department a cash deposit to cover the cost of electric power to supply all streetlights within any proposed development, or each phase of a development, from the date the hydro utility energizes such facilities, until sixty percent (60%) of the lots or units are occupied. Upon meeting this condition, the Owner/Applicant shall request in writing that the Engineering Department release them from any further obligation for electrical costs, and that the balance of their cash deposit for electric power be refunded.

Should the electrical costs be greater than the sum deposited, the Developer/Owner shall be invoiced for the difference. Any outstanding invoices must be paid prior to acceptance of the development and subsequent Letter of Credit reductions.

The roadway illumination system within the limits of this site plan is privately owned and shall be maintained by the developer/owner.

### **5.2 Electrical Equipment Working Drawings Submission Requirements**

OPSS Subsection 106.04.01.01 is amended to include the following:

The contractor shall submit three copies of shop drawings to the contract administrator for review. Shop drawings are required for the following equipment:

- a) Poles
- b) Anchorage Assemblies

- c) Luminaires
- d) Electrical Handholes
- e) Power Supply Assemblies

### **5.3 Approvals**

The City of Barrie will not release consent for the issue of building permits prior to the roadway illumination mains and services being installed, approved and connected to the existing municipal roadway illumination distribution system.

Approval for construction shall be given if:

1. The City has approved all drawings and materials;
2. The City has received a complete set of mylars;
3. The City has received a copy of the Ministry of the Environment and Climate Change Certificate of Approval, and number;
4. The Subdividers Agreements have been signed;
5. All Letters of credit have been placed;
6. All cash contributions have been made between the City of Barrie and the developer(s)/owner(s);
7. All drawings pertaining to roads, sanitary, and storm sewer locations have been signed by the City of Barrie;
8. All Municipal Consents have been approved by the City of Barrie;
9. The City has received 48 hours' notice prior to construction; and
10. The required liability insurance has been taken out.

Should the Subdivider's Agreement not be signed, the developer/owner will be permitted to start work on their own lands once the following conditions are met:

11. The Engineering Fee is paid to the City;
12. Insurance requirements are in place;
13. All drawings pertaining to roads, sanitary, and storm sewer locations have been signed by the City of Barrie;
14. All Letters of Credit have been placed, in accordance with the City of Barrie Development Manual; and,
15. The housekeeping deposit is paid.

The Development Agreement must be signed by the developer/owner and a Letter of Credit in place prior to the start of construction.

No connection to existing municipal services or work on City property will be permitted until after registration of the plan of subdivision. No tie-ins to the existing municipal roadway illumination distribution system will be allowed until the Subdivider's Agreement has been signed by all parties.

Should demolition permits be required, the developer/owner must sign the appropriate forms and forward to all applicable parties.

The City's representative shall complete site plan roadway illumination servicing conditions that are to be incorporated into a site specific development agreement and forward a copy to the civil consultant and the developer/owner.

The developer/owner shall supply a drawing, indicating roadway illumination servicing for the project, including a professional engineer's stamp and signature. All field or design changes affecting servicing drawings shall be forwarded to the City representative for comment prior to any further work proceeding. Requirements for roadway illumination servicing drawings are listed in the City of Barrie Development Manual.

#### **5.4 Testing**

OPSS Subsection 106.07.10.01 is deleted and replaced with the following:

Tests on electrical wiring and material shall, unless otherwise specified, conform to the Canadian Electrical Code Part 1 and Ontario Electrical Safety Code.

Testing shall be performed by qualified personnel only and shall be done in the presence of the contract administrator or an ESA Inspector.

The contractor shall provide all necessary instruments, equipment and personnel required to satisfactorily carry out prescribed tests at their own expense.

The following tests shall be performed as directed by the contract administrator:

- a) All conduits and duct systems shall be proven free of stones, dirt, roadway illumination or other debris by pulling a test mandrel 6mm smaller in diameter than the nominal conduit or duct size through each individual conduit or duct.
- b) All circuits shall be proven continuous and free of short circuits or ground faults.
- c) All circuits shall be proven operable. Each control or switching device shall be operated no less than five (5) times and each circuit no less than eight (8) hours.
- d) The resistance to ground for all grounded equipment shall be proven to not exceed ten (10) ohms.

In addition to the above tests, the contractor shall, where directed by the contract administrator, perform any tests called for where performance of the electrical system indicates a deficiency.

The contract administrator shall provide for tests on materials other than electrical measurements. The contractor shall repair or replace the faulty equipment at their expense, and to the satisfaction of the contract administrator.

All installations shall be made in a workmanlike manner to the satisfaction of the contract administrator. The contractor shall take all necessary measurements in the field in order to enable him to completely dimension all contract drawings. The contractor shall demonstrate that the materials supplied meet the standards set forth in the specifications. The contractor at their expense shall correct all defects.

The contractor shall provide an unconditional warranty on the work done by the contractor for a period of one year from the date of acceptance by the operating authority.

#### **5.5 Work to be Inspected by Electrical Safety Authority**

OPSS Subsection 106.07.02 is deleted and replaced with the following:

The contractor shall obtain a "Right of Way Activity Permit" from the City of Barrie prior to the commencement of any project within the City.

The contractor shall obtain permits for all work requiring ESA Inspection and shall file applications for inspection with ESA as necessitated by the progress of the work. The contractor shall pay all fees related to permits, applications, inspections and connections.

The contractor shall correct all defects in their workmanship and electrical equipment that is not approved by ESA. This work shall be done within such time and in such a manner as indicated by notices of deficiency from the ESA.

Upon completion of all work, the contractor shall obtain a final certificate of approval from ESA and shall furnish one copy of the certificate to the owner.