



# Television, Film, Live Performance and Event Electrical Guidelines ESA Spec-003 R7 July 2013



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## ESA SPEC-003

This guideline deals with the installation of electrical equipment in the entertainment industry utilizing any source of power including generator sets. This includes events of a temporary nature held indoors, outdoors, in tents, such as film, television, live performance and other events.

The guideline is developed as a joint venture between the Electrical Safety Authority (ESA) and the Entertainment Electrical Safety Committee of Ontario (EESCO).

Much on the subject of electrical installations can be found in the current Ontario Electrical Safety Code (OESC). In most cases, where the specific aspect of the installation is not clear within the OESC, the installation should use alternate methods to achieve the equivalent level of safety required. Following the guidelines described herein should allow the production to achieve the desired result without ever compromising safety.

This guideline is intended to serve a very specific need and is in no way intended to be used as a substitute for the OESC, which is the law in Ontario. Omission herein of any requirements presently in the OESC does not in any way affect the OESC, nor should these omitted requirements be considered unimportant. They are essential to the OESC and its intended application, that is, its use by those who design, install, and inspect electrical installations. This is a best practice guideline, which is intended for use by entertainment industry employers, employees and ESA.

This guideline is a living specification (SPEC) and should be reviewed and rewritten on a three year cycle as appropriate, to reflect new or changed industry practices, technologies, equipment, ESA bulletins, as well as changes to the OESC.

References to code rules are at the time of the release of this SPEC, however any reference shall be taken as to the most current code at any time. Further, refer to the ESA website for current approval marks.

# Electrical Safety Authority

## Who We Are

The Electrical Safety Authority (ESA) is a stand-alone, financially self-sustaining not-for-profit corporation accountable to a Board of Directors and operating as an Administrative Authority under the Electricity Act 1998 and an administrative agreement with the Ministry of Consumer Services. ESA is responsible for public electrical safety in Ontario as designated by Ontario Regulation 89/99.

ESA is accountable to the public through the Ministry of Consumer Services for meeting its legislative and contractual obligations in the delivery of its delegated regulatory mandate. At the same time, it is accountable to its regulated sectors for results, sound management and efficiency.

## ESA's Authority

On April 1, 1999, Ontario Hydro's Electrical Inspection Division became the Electrical Safety Authority (ESA), assuming the responsibilities previously held by Ontario Hydro's Electrical Inspection Division. ESA was established as a not-for-profit corporation following the Ministry of Consumer Services' delegated administrative authority model that transfers the delivery of services previously provided by the Ministry to the private sector.

The Safety and Consumer Statutes Administration Act and an Administrative Agreement with the Ministry establish the legal framework for ESA's operation as an Administrative Authority. In addition, ESA is designated the Ontario authority responsible for electrical safety by Ontario Regulation 89/99 as the responsible authority for purposes of section 113 of the Electricity Act, 1998 and associated Ontario Regulation 453/08 (The Ontario Electrical Safety Code).

## The Electrical Safety Authority was established to:

- Respond to fatalities, injuries and fire losses associated with electricity.
- Promote the safe use of electricity.
- Increase public awareness of the dangers of electricity, and the requirements for ensuring safe electrical applications and use.
- Increase public awareness of the requirement to have all electrical work inspected in accordance with the Ontario Electrical Safety Code.

# 1 Definitions

## Job Title Definitions

**Best Boy (Film & TV):** 2nd or assistant to Gaffer in the lighting department. Generally responsible for designing and supervising the set-up and take-down of a single-pin based power distribution system for film or television production. Supervises crew on larger productions.

**C of Q:** A term describing the Certificate of Qualification as issued by the Ministry of Training, Colleges and Universities for a specific pertinent 'trade'

**Electrician (Theatre), Electric (film and television), Lighting Technician (Event, Television):** a term used by entertainment lighting personnel to refer to those working in the implementation of a lighting design, including set up and take down of power distribution systems, hanging and focus of luminaires, operation of equipment, wiring of practicals, etc. A member of a lighting crew, not necessarily holding a certificate of Qualification.

**Electrician (Trade):** a trades person, with a certificate of qualification (C of Q) under the Ontario College of Trades Qualifications and Apprenticeship Act. (Refer to the following)

**Construction and Maintenance Electrician:** Ontario Trade 309 A; a person holding a valid "C of Q" in the Electrical trade that lays out, maintains, connects and repairs a wide range of electrical equipment, from lighting to security systems.

**Domestic and Rural Electrician:** Ontario Trade 309 C & E; a person holding a valid "C of Q" in the Electrical trade that lays out, maintains, connects and repairs a wide range of electrical equipment, from lighting to security systems in residential buildings and structures used for farming.

**Industrial Electrician:** Ontario Trade 442 A; a person holding a valid "C of Q" in the Electrical trade that prepares, installs, maintains, tests, troubleshoots and repairs industrial equipment and associated electrical and electronic controls.

**Entertainment Industry Power Technician:** Ontario Trade 269E; a person holding a valid C of Q in the Entertainment Electrical trade (including but not limited to events, live performance, trade shows, movie (film), video and television productions) who lays out, maintains, connects and repairs a wide range of portable equipment, from portable power feeder cables, branch circuits, luminaires and accessories and apparatus used for the production of entertainment events.

**Gaffer (film):** the head of the lighting department for a film or video production. May design lighting positions; establish choice of luminaires and accessories. Reports to the Director of Photography for film and the Technical Director for video.

**Generator Operator:** Entertainment Industry Power Technician (C of Q holder) in charge of setting up, starting, monitoring, balancing the load, and shutting down an electrical generator set. On film locations, the Generator Operator is responsible for the layout, connection and monitoring of single pin & sub-distribution networks for support equipment.

**Grip (Film & Television):** see Appendix B.

**Head Electrician:** (a term used in the Theatre industry, but not necessarily holding a Certificate of Qualification ("C of Q")) the head of the lighting department for theatre. The supervising electrician on a production, trained in the lighting skills and techniques necessary for the implementation of the lighting design. The person responsible for all luminaires and related equipment.

**Lighting Director/Lighting Designer (television):** the head of the lighting department for a video production. Designs lighting and positions, establishes choice of luminaires and accessories. Reports to the Technical Director for video production.

**Lighting Designer (Theatre/Event):** see Appendix B

**Production Electrician (Theatre/Live show):** see Appendix B

**Registered trainee:** (Apprentice) recognized indentured worker, training to become an Entertainment Industry Power Technician. Able to perform assigned tasks under direct supervision of appropriate responsible certificate holder.

See Appendix B for additional job title definitions not specifically used in this SPEC.

### **General Definitions**

**Adaptor:** a device or cordset used to make a connection between non-mating connectors. (Refer to 4.19 of this SPEC)

**Ampacity:** is the current carrying capacity of electrical conductors expressed in amperes.

**Ampere (A):** unit of measure for the rate of current flow. One ampere equals one coulomb per second.

**Ballast:** a resistor, transformer, or electronic circuit used to limit the current to a discharge type of light source. Typically used with fluorescent tubes, HID, HMI, CID, XENON, etc. luminaires.

**Big Three:** set of crowfoot moulded single pin locking devices, arranged in vertical set of 5, in a freestanding metallic framework. Bond connection device is bonded to the metallic frame. Rated at 400 A. (Refer to **Multiple Connection Device** definition in this SPEC.)

**Bonding:** a low impedance path obtained by permanently joining all non-current-carrying metal parts to assure electrical continuity and having the capacity to safely conduct any current likely to be imposed on it.

**CSA:** the Canadian Standards Association sets standards for safe construction of electrical equipment. It also inspects and identifies equipment that meets the standards.

**CSA Z462-12 “Workplace Electrical Safety”:** A CSA Standard that provides guidance on the assessment of electrical hazards and design of safe work spaces around electrical power systems. It stipulates requirements for identifying hazardous equipment and for the development of safe work procedures around this equipment. This Standard also gives guidance to electrical workers on the selection of personal protective equipment and protective clothing.

**CSA Z195-09 “Protective Footwear”:** A CSA Standard that deals with new protective footwear and includes requirements for two grades of toe impact resistance, as well as special requirements for sole plate performance, metatarsal protection, electric-shock protection, sole flexation, conductivity, and chainsaw protection.

**CAM-LOK\*(™):** a trade name, which has become generic. A brand of single pin locking connectors, generally with moulded rubber or Santoprene\*(™) insulators, commonly used for mains portable power distribution on stage, studio and location projects. (Refer to **Single pin** definition in this SPEC)

**Certification Organization:** an organization accredited in accordance with the Standards Council of Canada Act to certify electrical equipment and is recognized by the Inspection Department. (Refer to Appendix D of this SPEC)

**Circuit:** A closed path through which an electric current flows or may flow.

**Competent:** one qualified by knowledge, training and experience to perform assigned work and has knowledge of any potential or actual danger to health and safety in the workplace.

**Company Panel/Switch:** a dedicated electrical supply, up to 400 A, provided in theatres and other event venues, for the connection of portable dimming or distribution equipment.

**Cordset:** an assembly of a suitable length of flexible cord or power supply cable provided with an attachment plug (cord cap) at one end and a cord connector at the other end.

**Crowfoot:(Three-fer)** a moulded single pin locking connection device with one supply and three load connections. Rated at 400 A.

**Crowfoot Tower:** set of crowfoot moulded single pin locking connection devices, arranged in vertical sets of 5, in a freestanding metallic framework. Bond connection device is bonded to the metallic framework. Rated at 400 A. (Refer to **Multiple Connection Device** definition in this SPEC)

**Damp Location:** an exterior or interior location that is normally or periodically subject to condensation of moisture in, on or adjacent to electrical equipment and includes partially protected locations under canopies, marquees, roofed open porches, and similar locations (per OESC Definitions).

**Device:** generally installed in an outlet box individually or in multi-outlet assemblies to provide control of apparatus through a switch(s), outlet(s) or spliced junction(s) with a protective cover.

**Device Box/Outlet Box:** Any number of assorted sizes and shapes of boxes used to house electrical devices such as switches, outlets, light fixtures or spliced junctions with a protective cover. Device/outlet boxes are available in metal and plastic.

**Dimmer:** a device used to regulate the intensity of a luminaire. When multiple units are encased together the result is referred to as a dimmer pack or dimmer rack.

**Electrical Safety Authority (ESA as an authority):** authority having jurisdiction over electrical installations and equipment in the province of Ontario which are within the scope of Section 113 of the Electricity Act of Ontario. In this regard, ESA may issue disconnection orders relating to any works or matters it considers necessary or advisable for the safety of persons or the protection of property.

**Electrical Cables:** often referring to main and/or sub-main conductors.

**Electrical Distribution Box (Distro):** a device that permits the branching of power to two or more downstream devices; either loads or additional distribution boxes. It usually consists of either a single pin, Joy\*, or pin and sleeve line connectors, with circuit breaker(s) (or fuse(s)) overcurrent protection feeding female load connectors. (Refer to Tables 1 & 1A of this SPEC) Other versions, bearing appropriate approval markings, are also available.

**Electrical Inspection:** all electrical installations covered by the scope of the Ontario Electrical Safety Code in the province of Ontario require an electrical inspection notification (permit) issued by ESA and must be inspected by ESA, whether of a temporary nature or not.

**Equipment Certification/Approval:** equipment bearing a valid and appropriate certification or field approval label indicating that it meets applicable standards. The Ontario Electrical Safety Code (OESC) and Ontario Regulation 438/07 require that all electrical products and devices (including equipment) be approved. (See ESA Bulletin or website for a current list of acceptable marks).

**Event:** a gathering, presentation, production, performance or activity for entertainment, business, education, sporting competitions, etc, utilizing production equipment and practices as a part of the event; such as equipment assembled, operated and disassembled by entertainment technical personnel.

**Feeder:** any portion of an electrical circuit between the service box or other source of supply and the branch circuit overcurrent devices. Often single conductor cables with single pin connectors used to provide power to dimmer racks or other distribution equipment.

**Ground Fault Circuit Interrupter (GFCI):** a device that functions to interrupt a circuit or portion of a circuit, within a predetermined time, when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit (per OESC Definitions).

**GFCI – Class A:** a ground fault circuit interrupter that will interrupt the circuit to the load, within a predetermined time, when the ground fault current is 6 mA or more but not when the ground fault current is 4 mA or less, in a time given by the equation specified in Appendix B note and not greater than 25 ms for fault currents over 260 mA (Refer to OESC Appendix B for full definition)

**Ground fault protection** — a means of detecting and interrupting a ground fault current at a level less than the current required to operate the circuit overcurrent device (per OESC Definitions).

**Ground:** a connection to earth obtained by a grounding electrode(s).

**Ground-proving device:** the device designed to verify system grounding.

**Grounding Conductor:** the conductor used to connect the service equipment or system or generator set to the grounding electrode(s).

**Grounding electrode(s):** a buried metal water piping system or metal object or device buried in, or driven into, the ground to which a grounding conductor is electrically and mechanically connected. (Refer to OESC Rule 10-700)

**Grounding:** a permanent and continuous conductive path to the earth with sufficient ampacity to carry any fault current liable to be imposed on it, and of a sufficiently low impedance to limit the voltage rise above ground and to facilitate the operation of the protective devices in the circuit.

**Head (Cap):** the portion of a luminaire or luminaire assembly that contains the light source.

**High Five:** vertical single pin connection splitter point, consisting of one set of supply connections, and five sets of load connections for a 5 wire system, arranged around a metallic hexagon. Rated at 400 A. (Refer to **Multiple Connection Device** definition in this SPEC.)

**Joy \***(<sup>TM</sup>): a trade name that has become generic. A brand of electrical connector employing low profile rubber moulded insulation and cylindrical pins, commonly used in the entertainment industry. The connector construction permits hard duty usage. Designed to be water resistant.

**Jumper (Stinger):** an electrical cable used from a distribution point to connect a load.

**Jumper set:** a set of single pin jumpers used from a distribution point to connect downstream devices.

**Live Performance:** generic nomenclature used to describe the industry of the performing arts involving theatre, dance, opera and music.

**Luminaire:** a lighting instrument consisting of a light source, socket, enclosure, electrical wiring and connector; and may include switches, reflectors, lenses, ballasts, supporting devices, and other apparatus for altering the quantity and quality of light emitted by the apparatus.

**Multi-pin Circular Connectors:** nineteen pin connectors (Socapex™) used in lighting circuit distribution in all areas. Refer to USITT recommended practice for Multi-pin Circular Pin Connectors PR-1.

**Multiple Connection Device:** a single pin splitting device with 1 line and 3 or more load connections per conductor, containing connections for a complete (5-wire; 3 phase-4 wire plus bond) set of grounded and ungrounded conductors of a system.

**Ontario Electrical Safety Code:** the standard for temporary or permanent electrical installations in Ontario is the Ontario Electrical Safety Code (OESC)(comprising CSA Standard C22.1 Canadian Electrical Code, Part 1 and Ontario amendments to the Canadian Electrical Code, Part. 1). Check with ESA for current version in effect.

**Personal Protection Equipment (PPE):** any equipment worn or used by a worker in order to provide protection from local hazards of the job (e.g. gloves, safety and/or flash glasses, work boots, etc).

**Polarized:** a device or connection arranged such that it allows attachment or connection in one manner or orientation only.

**Polarized receptacle/plug:** ensures correct connection by differentiation of pin (blade) sizes and/or arrangement.

**Polarized socket:** ensures correct alignment/orientation of a lamp by means of differently sized/arranged pins or locator.

**Portable generators:** a generator rated at not more than 12 kW and 240 V, intended to be used as an isolated system for the supply of cord connected electrical equipment and capable of being carried by personnel from one location to another.

**Power Source:** anything that has the potential to provide voltage and electrical current.

**Utility Source:** Electrical power supplied by the local electrical utility (supply authority). Often referred to as “house power” or “shore power”.

**Generator Source:** Electrical power supplied from an engine driven generator set, with or without an inverter system.

**Battery Source:** Electrical power supplied by storage batteries

**Practical:** a working "On - Set" luminaire may be standard or custom and receives its power from the portable distribution system. Unless it is an approved two wire fixture, it must be bonded to the ground. If installed on a set piece, it must be attached and connected with OESC Section 12, wiring methods excepting where Section 44 is applicable.

**Receptacle:** one or more female contact devices, on the same yoke, installed at an outlet for the connection of one or more attachment plugs. (Refer to OESC Diagram 1 and 2 for CSA configurations of receptacles)

**Single Receptacle:** one female contact device, with no other contact device on the same yoke, installed at an outlet for the connection of one attachment plug.

**Duplex Receptacle:** two female contact devices, on the same yoke, installed at an outlet for the connection of two attachment plugs.

**Split Receptacle:** a duplex receptacle having terminals adapted for connection to a grounded, 3-wire supply with the identified conductor common, e.g., 120/240 V or 120/208 V.

**Dual Circuit Fed Receptacle:** a duplex receptacle, or two receptacles in the same box, fed from two separate sources. The identified conductor is NOT common, and there MUST be an accepted warning label installed under the cover plate, clearly identifying that more than one source supplies this device(s). Utilized on sets for supplying line voltage and controlled (dimmed) voltage to the same device(s).

**Safety:** short form for safety cable. A non-meltable, non-combustible wire rope or chain with a connector and a loop used as a secondary means of retention to prevent suspended equipment from falling in the event of failure or damage to the primary attachment apparatus.

**Single pin:** (connector or connection) a single-conductor plug-in locking- type connector.

- a) A locking, one pin, approved for outdoor use connector, rated up to 400 A. Generally colour coded to designate phasing. (Refer to **CAM-LOK\***(<sup>TM</sup>) definition in this SPEC, & OESC Section 66); or,
- b) Broadly refers to an entire method and system of distribution.

**Standing Water:** a natural or artificially created body of water.

**Strain Relief:**

- a) an item mounted at a power supply entry on a piece of electrical equipment or luminaire, that is designed to protect and restrain the installed power supply cord such that any reasonable twist or pull on the power supply cord will not cause damage at the entry point or cause the cord to fall out or pull out, and will not adversely affect the conductors in the cord and not impose any strain on the electrical connection(s); or,
- b) a sling, choke, span set, tie line, or other non-permanent soft material of sufficient strength to adequately and safely, without damage to the cable, support the cable or cables to which it is attached to relieve any strain on electrical connection, or to support cables to flown systems. (Referred to in this SPEC as "Industry Standard Methods")

**Tee** (electrical, AKA T-off. See also **Crowfoot** and **Tee Tower** definitions in this SPEC): Moulded single pin device consisting of multiple connections, arranged in the form of a "T" for the purpose of connecting either:

- a) Tapping Tee: one supply (line) connection to two load connections; or,
- b) Tee Block: one supply (line) connection to six load connections; or,
- c) 3-fer: one supply (line) connection to three load connections; or,
- d) Paralleling Tee: one load connection to two supply (line) connections.

**Tee (mechanical):** see Appendix B.

**Tee Tower:** 5 wire splitter box with one set of supply and generally 5 sets of load connections of single pin connectors, arranged for linear continuation of single conductor cable runs. Usually allows some runs to change physical direction by 180° to the supply run. May also allow changeover between 1018 and 1016 connector styles. Rated at 400 A. (Refer to **Multiple Connection Device** definition in this SPEC.)

**Temporary:** refers to anything that is not fixed to a facility and is portable in nature. It usually refers to equipment that is rented or installed for a specific production that has a limited run and will be removed when such a production is over or moved.

**Tie-in:** a hardwire connection to a utility supplied switch, splitter, panel or switchboard.

**Twist Lock:** a generic term for a type of connector with locking blades with 2 or more poles (often referred to as TLG or TL)

**Volt (V):** the unit of EMF and potential difference. A volt is the amount of potential necessary to cause one coulomb to produce one joule of work.

**Volt-amperes (VA):** a mathematical product of voltage times current (volts times amperes) in an electrical circuit.

**Kilovolt-amperes (KVA):** one thousand Volt-amperes.

**Watt (W):** an international unit of power. The amount of energy expended per second by an unvarying current of one ampere across a potential difference of one volt.

**Wet Location:** a location in which liquids may drip, splash, or flow on or against electrical equipment. (per OESC Definitions)

**Wire Connector:** a device which connects two or more conductors together or one or more conductors to a terminal point for the purpose of connecting electrical circuits.

For other pertinent definitions not specifically used herein, see Appendix B.

## **General Practices**

### **2.1 Application for Inspection Notification (Permit) – Electrical Inspection**

The Ontario Electrical Safety Code (Rules 2-004 – Inspection & 44-100 – Travelling Shows) requires a wiring notification (permit) be obtained when any temporary wiring distribution system is to be set up.

All productions and events shall file an application for inspection with the ESA within 48 hours prior to commencement of any electrical activity. See Appendix G of this SPEC for an example of an Application for Inspection.

Permits may be obtained by contacting the ESA Customer Service Centre at 1-877-ESA SAFE or (877) 372-7233 or online at esasafe.com. The applicant must have all information such as location details, call sheets, and contact personnel etc. available at the time of the call.

Upon receipt of the notification or permit number, the production must display the notification or permit number in an area accessible to production staff and the Electrical Inspector in the vicinity of the central power distribution point. The permit shall be reasonably protected from environmental destruction.

### **2.2 Reporting of Serious Electrical Accidents or Incidents**

Any electrical accident or incident must be reported to ESA;

- a) as soon as possible and not more than 48 hours after the occurrence and;
- b) no person shall, except in the interests of public safety, saving life, relieving human suffering, continuity of service or preservation of property, interfere with or disturb any wreckage, article or thing at the scene of and connected with the occurrence, but in no case shall the wreckage, article or thing be carried away or destroyed by any person unless permission to do so is given by an inspector.

### **2.3 Personnel**

All electrical personnel shall have a thorough understanding of electrical theory and power distribution.

Only a certified Entertainment Industry Power Technician or a holder of a valid Certificate of Qualification as a Construction and Maintenance Electrician shall be the person responsible for designing, implementing, monitoring and disconnecting single pin and single pin based distribution systems.

In theatre, event, and related industry sectors, that responsible person shall be the member of the lighting, audio or video department, certified as described above. In film and television, that responsible person shall be a member of the lighting department.

Supervised registered apprentices of these designated trades may handle, connect and disconnect single pin distribution.

*Designing & implementing shall refer to any activity regarding or affecting the process of determining the nature or configuration of the relevant distribution system or network. No person who does not hold a valid of C of Q as described above, shall specify, design, create or dismantle any such system. The act of assisting the qualified person in charge by carrying and depositing, and wrapping cable as specifically directed may be excluded.*

## 2.4 Equipment & Operations

2.4.1 All electrical equipment (including cordsets) must by law, be approved by and bear an approval or certification mark of;

- a) one of the accredited certification organizations; or,
- b) special inspection (field approvals) under SPE1000; or,
- c) special acceptance under Appendix L of this SPEC, ESA SPEC-001; and, shall have such approval label or certification mark affixed to the electrical equipment.

These confirm to the user that the equipment is in compliance with Ontario regulations. (Refer to the OESC Rule 2-024; and Appendices D, E, F & L of this SPEC.)

### 2.4.2

2.4.2.1 Any multi-conductor cable attached to a device for use in an Entertainment Industry location or operation, shall be terminated in a proper approved multi-conductor cable cap or connector.

2.4.2.2 In-Line Single Pin connectors, for use in the Entertainment Industry, shall only be used on approved single conductor cables as per Table 11 and Section 66 of the OESC. (Refer to Appendix J of this SPEC)

2.4.3 The use of all distribution and utilization equipment shall conform to either:

Section 44, Section 66, Section 14, and other applicable sections of the OESC for theatrical shows; or Section 66 and, Section 14, and other applicable sections of the OESC, for events and productions not specifically covered under Section 44 of the OESC.

2.4.4 Dual Circuit Fed Receptacles (refer to **Receptacle** definition in this SPEC) may be installed on film, television, theatre or similar sets using only the following procedure, and using approved Section 12 wiring methods:

2.4.4.1 the two systems shall incorporate a bonding conductor from their respective supply points; and

2.4.4.2 the two system grounding conductors shall be bonded together; and,

2.4.4.3 the bond conductors from both systems shall be attached to the bond screw(s) in the device box; and

2.4.4.4 the bridging tabs from both sides of the receptacle shall be fully removed; and,

2.4.4.5 the (top) half of the receptacle shall be supplied with direct line voltage from the non-dimmed distribution system: and

2.4.4.6 the other half (bottom) shall be supplied from a remotely controlled dimmed source; and

2.4.4.7 the approved warning label must be installed, such that the device mounting screws also capture the label; and

2.4.4.8 for the purpose of controlled isolation, immediately adjacent and within sight of the dual-fed device box, (Refer to OESC Rule 14-414) one of the following methods shall be used:

a) the supply feeds for the device shall be limited to 30 cm (12" ) of portable cord protruding from the device box, with cord caps attached and labeled with the appropriate information: or

b) the dual-fed device box shall be supplied from a lockable 4 - pole isolation switch, rated at not less than 20 A, installed directly adjacent to the dual-fed

device, and connected with hard wire connections installed in a metallic raceway.

Refer to Appendix H of this SPEC for connection diagram and label detail.

Attachment of the cover plate will cover the label, without in any way disturbing its securely fastened nature.

***This is critical, so that any subsequent removal of the cover plate reveals the warning label, indicating the unusual and potentially dangerous condition of more than one source of supply, as per OESC Rule 14-414.***

- 2.4.5 A log shall be kept of all electrical maintenance performed during any show, event or other production.
- 2.4.6 Any equipment, cable, or box that has been maintained in the field shall be identified and carefully tested for safety and appropriate function before being re-used.
- 2.4.7 Equipment that has been repaired in the field shall have the details of the repair noted on the equipment so that the source supplier can verify that the repair has been properly completed.
- 2.4.8 During set-up or reconfiguration, the power supply to electrical installations, equipment or conductors shall be de-energized where practicable. (Refer to OESC Rules 2-304 & 2-306)
- 2.4.9 When not in use or unsupervised, temporary power distribution equipment shall be de-energized, locked out and tagged. (Refer to section 4.10 of this SPEC)
- 2.4.10 Utilization equipment shall only be installed in locations for which it is approved, unless suitable precautions are taken to protect it from inclement weather. (Refer to OESC Rule 66-402(5) and sections 4.36 & 4.37 of this SPEC).
- 2.4.11 Class A GFCI's shall be used on circuits supplying all utilization equipment such as, but not limited to, audio racks, luminaires, kitchen units, porta-potties, portable and stationary power tools and wash stations:
  - a) in wet or damp locations as defined above, per OESC, and in areas of high humidity; and,
  - b) when within 3 m of standing water such as; pools, hot tubs, or any other artificially created body of water, or of conductive liquids; and
  - c) when snow, salt, or slush is or is likely to be present; and
  - d) as required by the OESC; and

The GFCI device:

- a) shall not be located within 3 m of any water or conductive liquid; and
- b) shall be in a type 3R, type 4 or type 6 enclosure elevated a minimum of 100 mm. above the ground, with connections rated for wet location; or
- c) shall be mounted in an elevated weatherproof cabinet or box, constructed for distribution on the site; and
- d) as required by the OESC.

GFCI devices shall be tested according to manufacturer's instructions prior to use **each time** the unit is energized.

GFCI devices shall not be installed:

- a) In circuits supplying exit lighting; or
- b) In circuits supplying fire, smoke, or carbon monoxide detection and alarm systems; or

- c) In circuits supplying fire pumps; or
- d) In circuits where tripping of the GFCI may result in injury.

GFCI's on dimmed circuits:

GFCI's used on the output of dimmers shall be of the type utilizing a separate control voltage, and shall have that separate sinusoidal line voltage, as specified for the device, supplied to the control portion of the GFCI.

- 2.4.12 All non-current carrying metallic parts of electrical equipment shall be bonded to ground as per the OESC, Section 10 requirements.
- 2.4.13 Care should be taken not to walk on or drive over electrical cables. All cables subject to vehicular or extensive personnel traffic shall be protected in an appropriate manner. (Refer to OESC Rule 66-450(c)).
- 2.4.14 Electrical personnel shall wear appropriate Personal Protective Equipment (PPE) such as appropriately rated electro-resistive footwear displaying the Ohm symbol and green triangle, gloves and safety glasses. Refer to the OSHA (Occupational Health and Safety Act) and CSA Z462 (see Definitions in this SPEC).
- 2.4.15 Lamps shall be allowed to cool sufficiently before luminaires are moved. Appropriate PPE shall be worn when carrying, handling, or moving hot luminaires.
- 2.4.16 All personnel shall be made aware of high voltages used by gas discharge lamps such as neons, HMIs, CSIs and fluorescents. Anyone using these sources shall be familiar with the ballasts used and ensure that any safety devices are in proper working order.
- 2.4.17 Prior to "striking" an HMI, xenon or similar discharge lighting source, the operator shall make sure that no one is in contact with the unit, any support, or the ballast.
- 2.4.18 In damp or rainy conditions, ensure all personnel are clear of any HMI, xenon or similar discharge lamp head. Humid conditions increase the conductivity of the air and thus the likelihood of arcing.
- 2.4.19 All personnel shall be advised that various HMI, xenon or similar discharge lighting sources emit much larger amounts of ultraviolet (UV) light than tungsten lamps. Follow appropriate practices and manufacturer's recommendations. Never view an ignited discharge lamp directly.
- 2.4.20 Before a luminaire is re-lamped or otherwise worked on, the luminaire shall be switched off, allowed to cool and disconnected or isolated from the power source. If appropriate, implement lock-out/tag-out procedures.
- 2.4.21 When replacing lamps, utilize appropriate PPE and follow the manufacturer's recommendations.
- 2.4.22 Excepting luminaires specifically described in Appendix L of this SPEC, ESA SPEC-001 and operated as specified in Appendix L, any open-faced luminaire shall have protection in accordance with CSA standards covering such equipment, or to SPE 1000. (Consult CSA Standard C22.2 NO.166 Stage and Studio Luminaires, CSA TIL B-42A, UL standard 1573 for Stage and Studio Lighting Units and Appendix L of this SPEC, ESA SPEC-001).
- 2.4.23 Emergency lighting shall conform to Section 46 of the OESC.
- 2.4.24 Emergency lighting and exit signs shall be installed where none is present or functioning, and to augment the installation, as required by the Ontario Building Code and the Ontario Fire Code.

(Refer to Ontario Building Code section 3.2.7 for Lighting and Emergency Power Systems, section 3.4.5 for Exit Signs and Ontario Fire Code section 2.7, Safety to Life, and consult appropriate inspectors).

- 2.4.25 All flying or mounting of luminaires, projectors, loudspeaker enclosures, structural supports and other equipment shall be performed using hardware, equipment and safety factors consistent with safe practices and manufacturers specifications.
- 2.4.26 All raised electrical equipment (e.g. luminaires or loudspeakers) shall be adequately supported and weighted to prevent tipping.
- 2.4.27 Scaffolds and other metallic structures used to support electrical equipment or power distribution shall be effectively bonded to ground.
- 2.4.28 A non-meltable, non-combustible safety wire or chain shall be used for all suspended luminaires. This shall be in addition to the primary means of attachment or support.
- 2.4.29 Panel or chassis mount single pin connectors shall be:
- a) installed from the inside of enclosures, with attaching fasteners adequately clear of any possible contact with terminals or busses; and
  - b) if installed on the exterior of a generator or other vehicle, installed within an appropriately rated enclosure, as per Rule 2-400, such that when not in use or while traveling, the connectors cannot be exposed to rain, snow, slush, road salt or contaminants.
- 2.4.30 Connections for vehicle supply, where made with portable cord, shall be situated in readily accessible boxes or compartments, preferably on the curb side of the vehicle, and configured;
- a) with a bushed, non-conductive opening either independent of the access door; or
  - b) through the access door, with adequate provision to ensure that no metallic or sharp edges can contact the conductor(s); and
  - c) sufficient conductor length to allow the supply cord(s) to exit; and
  - d) with the resultant connection(s) adequately clear of the box or compartment, and not under the vehicle, and in any case, not less than 2 m in length; and
  - e) with provision for industry standard methods of attachment for strain relieving; and
  - f) strain relieved within 1 m of the connection point or point of entrance or exit from the compartment or cabinet. (Refer to **Strain Relief** definition in this SPEC)
- 2.4.31 Consult the most current OESC and Ontario Electrical Safety Code Bulletins for technical support.

## Power Sources

### 3.1 General

#### 3.1.1 Types of Sources:

- Diesel/Gasoline/Gaseous Fuel Engine Driven Generator Sets
- Utility
- Storage batteries

#### 3.1.2 Voltages and power distribution that may be encountered in Canada:

- 120 V single phase two wire
- 120/240 V single phase three wire
- 120/208 V three phase four wire "Y" (Wye or Star)
- 240 V three phase three wire "D" (Delta) – ungrounded system with ground fault indicating lights
- 277/480 V three phase four wire "Y" (Wye or Star) \*
- 347/600 V three phase four wire "Y" (Wye or Star)
- 600 V three phase three wire "D" (Delta) – ungrounded system with ground fault indicating lights

\* Often found on US manufactured equipment.

#### 3.1.3 Definitions

- a) **Single Phase Two Wire\*\***: One supply or phase conductor, and one identified, grounded conductor (commonly called the neutral), plus a bond conductor.
- b) **Single Phase Three Wire\*\***: Two supply or phase conductors, typically 180° apart electrically, and one common neutral conductor that is grounded and identified, plus a bond conductor. (Also referred to as Centre Tapped)
- c) **Three Phase Four Wire\*\***: Three supply or phase conductors, 120° apart electrically, and one common neutral conductor that is grounded and identified, plus a bond conductor.
- d) **Three Phase Three Wire\*\***: Three supply or phase conductors, 120° apart electrically, no common neutral conductor or intentional connection to ground.

\*\* In the above trade standard terminology, PLUS BOND is always assumed.

In portable power distribution, where the bond wire is a specific conductor either in multi conductor portable cord, or a specific conductor run with any single pin distribution system, the bond conductor is counted; therefore in:

- a) **Single Phase Two Wire** requires *three-conductor* portable cord.
- b) **Single Phase Three Wire** requires *four-conductor* portable cord, or *four wire* single pin.
- c) **Three Phase Four Wire** requires *five-conductor* portable cord, or *five wire* single pin.

### 3.2 Generator Sources

#### 3.2.1 All generator installations involving single conductor cable and/or downstream overcurrent devices shall:

- a) be installed in accordance with the OESC and/or this SPEC; and

- b) have overcurrent protection on any ungrounded conductor; and
  - c) be grounded; and
  - d) be inspected by ESA prior to use.
- 3.2.2 All portable generators (Refer to **Portable generators** definition in this SPEC) shall:
- a) be installed in accordance with the OESC and/or this SPEC; and
  - b) be rated at not more than 12 kW and 240 V; and
  - c) not be required to be connected to a grounding electrode if:
    - (i) the generator neutral is connected to the generator frame and marked "NEUTRAL BONDED TO FRAME" ; and
    - (ii) the generator supplies only cord and plug connected equipment through receptacles mounted on the generator; and
    - (iii) the non-current carrying conductive parts of the generator and associated equipment and the grounding terminals of the output receptacles are bonded to the frame of the portable generator assembly.
- 3.2.3 Generator sets shall be clearly and prominently labeled, with such label on the control panel or other readily visible location, with the rating showing their respective prime power rating in kW and A/phase. This rating shall be based on the relationship of the alternator to the SAE net continuous mechanical kW (or bhp) of the prime mover. See Appendix C of this SPEC for an example.
- 3.2.4 Generator sets, if installed inside a vehicle, shall provide single pin or other appropriate main connections at an externally accessible panel.
- 3.2.5 Where it is not practicable to provide an externally accessible connection panel due to the installation being of short duration and the equipment is not intended to stay in the vehicle, appropriate steps shall be taken to ensure that the cables can exit over smoothly rounded, non-conducting material, with readily available securement points for strain relieving the cables.
- 3.2.6 Generator sets shall have an emergency stop system, an accessible main circuit breaker shunt trip or other emergency isolation means (refer to OESC Rule 28-900). The emergency stop system must include means to simultaneously de-energize the ungrounded conductors by opening the overcurrent protective device or opening the main field of the alternator.
- 3.2.7 Generator sets with single pin load connectors shall have:
- a) a minimum of one dedicated single pin ground connector; and
  - b) one single pin bonding connector per 4 or 5 wire single pin connection set; and
  - c) at least one additional system single pin bonding connector.
- Refer to section 4.30 of this SPEC.
- 3.2.8 Generator sets shall be grounded per Section 10 of the OESC. Alternate grounding methods to Section 10 shall be verified using an approved ground-proving system.
- 3.2.9 A generator ground shall:
- a) be run directly, by the shortest practicable route, from the ground electrode or ground connection point to the generator; and
  - b) have no more than 2 in-line single pin connections, excepting those connections at the ground electrode or other ground connection point and the generator; and
  - c) not exceed 50 m in total length; and
  - d) utilize a dedicated grounding conductor as per Table 3 of this SPEC.
- 3.2.10 In urban areas, for an event of a temporary nature, grounding a generator set to a fire hydrant using a threaded connecting device that is not certified is only acceptable under the following

conditions:

- a) It is not possible to install or use a grounding electrode as specified by OESC Rule 10-700.
  - b) Proof of ground continuity is verified.
  - c) The connection device is made of copper, bronze or brass as per requirement of CSA C22.2 No. 41 (Grounding and Bonding Equipment in Wet Locations) and Rule 10-908(2). See Appendix K for examples of the connection device.
  - d) The installer obtains approval from municipal owners and the local Fire Department to attach to the hydrant.
- 3.2.11 Ground Fault Indicators, visible and/or audible, shall be readily available to the operator of generator sets supplied for entertainment prime power, where the intent is to supply single conductor distribution networks. Such equipment shall be adjusted to the lowest practicable settings of time and current consistent with general portable power distribution systems.
- 3.2.12 Where more than one generator set is used to supply any set or support equipment or where more than one generator is used, such that its distribution network or supplied load(s) is or could come into contact with that of any other, such generators shall have their grounds bonded together. (Refer also to section 3.2.7 of this SPEC).
- 3.2.13 Grounding connection to a building or structure supplied by two or more sources: when temporary leads enter a building, the generator shall be either grounded to the building electrode or to the separate generator grounding electrode(s). The building and the separate grounding electrode(s) shall be bonded together in accordance with OESC Rule 10-702. Acceptable methods of connecting to the building grounding electrode(s) shall be by connection to the effectively grounded structural metal members (Refer to OESC Rule 10-206 and 10-500) of the building structure, effectively grounded conduit system or effectively grounded metal water pipe of the building. The minimum conductor size for the grounding jumper shall be as per Table 3 of this SPEC.
- 3.2.14 On locations where mobile generators are placed on a street or location that is open to vehicular traffic, connection panels, controls and any downstream distribution cable or devices must be situated on a side of the generating equipment that is not exposed to that traffic.
- 3.2.15 Generator sets shall only be started under a no load condition and, unless under an emergency condition, stopped under a no load condition.
- 3.2.16 All generator sets shall be operated and maintained by a competent operator who holds a valid C of Q as an Entertainment Industry Power Technician.
- 3.2.17 In conjunction with the Ministry of Labour, Safety Guidelines for the Film and Television Industry in Ontario; the operator or competent assistant shall supervise the generator set at all times while it is running and shall be available to operate the emergency stop or isolation system.
- 3.2.18 Notwithstanding the above, if more than one generator set is located adjacent to the principal unit or is reasonably within line of sight or adequate oversight and can be satisfactorily monitored by the operator then, one operator may oversee more than one generator set.

### **3.3 Utility Sources**

- 3.3.1 Where utility supplies are utilized, care must be taken to ensure that available fault currents do not exceed 10,000 A (10 kA). Where available fault current could exceed this level, appropriate steps must be taken to limit the fault current on single conductor cables to this level. (Refer to OESC, 66-452).
- 3.3.2 Connections (tie-in) to utility sources shall only be performed by either:
- a) a licensed electrical contractor; or
  - b) where in an industrial establishment, with in-house supplied personnel
- 3.3.3 Where connections to existing utility distribution systems are made, the production's responsible person shall identify potential hazards created by a shutdown due to a system overload and notify the appropriate people. The aforementioned responsible person shall take suitable precautionary actions.
- 3.3.4 Conductors exiting a distribution panel shall be secured such that the weight of any cable does not put a strain on any electrical terminal or device. Such strain relieving shall be within 1 m of the point at which the conductors exit the panel. (Refer to OESC Rule 12-120 and also to **Strain Relief** definition in this SPEC.)
- 3.3.5 Conductors shall have overcurrent protection installed in accordance with Section 14 of the OESC.
- 3.3.6 Where temporary connections are made and the panel covers cannot be replaced, the panel shall be left in a dead front condition. The names of the electrical contractor and the production person responsible for the installation shall be clearly marked on any such temporary cover and the hazard identified. If the panel is in an electrical room, all doors opening directly into the room shall be posted with the above warning. (Refer to OESC Rules 2-200 & 2-202).
- 3.3.7 When utilizing a transformer, it must be ensured that the Xo (secondary neutral) is connected to ground and that a grounding conductor, correctly sized to meet the requirement of Table 3 of this SPEC, is connected to an appropriate grounding electrode(s). It must be ensured that the transformer enclosure is also bonded to the Xo of the transformer with a conductor based on Table 16 of the OESC. (Refer to OESC Sections 10 and 66).

## 4 Temporary Power Distribution

- 4.1 No work is to be performed on any live electrical system (Refer to OESC rule 2-304). Connection and disconnection of single pin connectors, to or from any part of an energized system, is working live.
- 4.2 Single conductor cables such as indent printed Type PPC/SC that are intended for temporary installations such as portable stage lighting and outdoor functions shall be permitted to be used in the entertainment industry.

Welding cable shall not be permitted for this use. Welding cables are only intended for use with electric welders having an open circuit secondary voltage of 100 V or less (OESC Table D1).

- 4.3 With the circuit de-energized, single pin connections shall be made in the following order:
- connect the bond (green)
  - connect the neutral (white)
  - connect the phases (red, black, blue)

Connections shall be made working from the load end of the system to the supply. The last connection shall be to the power source, with the system completed.

- 4.4 Disconnect the temporary electrical distribution system in reverse sequence of 4.3, with any connections de-energized before breaking.
- 4.5 Any single conductor home run or branch feeder circuit shall have one isolation switch provided for subsequent expansion of the system to prevent working live on energized systems.
- 4.6 Continuous bonding shall be provided throughout any electrical distribution system (refer to OESC Rule 66-458) and no down stream bonding of the neutral shall be used (Refer to OESC Rules 10-200 and 10-624).
- 4.7 Connectors and cabling of single pin distribution systems shall be provided with standard colour coding:

a) For 120/240 V or 120/208 V systems only:

- Red, Blue, Black *Line*
- White (or grey) *Neutral (identified conductor)*
- Green *Ground or Bond*

b) For nominal 480 V systems (refer also to section 4.8 of this SPEC)

- Orange, Brown, Yellow *Line*
- White (or grey) *Neutral (identified conductor)*
- Green *Ground or Bond*

c) For nominal 600 V systems only (refer also to section 4.8 of this SPEC):

- Orange, Brown, Yellow *Line*
- White (or grey) *Neutral (identified conductor)*
- Green *Ground or Bond*

- 4.8 Any power distribution system operating above 150 volts-to-ground and utilizing single pin connectors shall:

- a) have all inline connectors made inaccessible by placing the connector(s) in a secured enclosure or equivalent; and
  - b) be marked with the supply voltage of the circuit outside and, if practicable, inside the secured enclosure(s) or connection(s).
- 4.9 Any single phase power supply shall have its load connectors connected:
- a) bond to bond direct connection only; and
  - b) neutral to neutral direct connection only; and
  - c) phase to line (Phase A to Line 1, Phase B to Line 2), direct connection only; and
  - d) any remaining Phase "C" or third line from the load that cannot be supplied directly from a dedicated power supply line without resort to a Tee fitting or similar device shall be capped off and remain unconnected and unenergized.

A warning label shall be provided as follows:

"WARNING" Phase "C" is not connected and not energized. Single phase source supplies only Phase "A" and "B" of three phase system.

Refer to Appendix I of this SPEC.

- 4.10 Single pin and single pin based distribution systems, stage and studio lighting and/or power distribution systems shall only be energized when the responsible certificate holder, as determined by the OHSA, or designee of equivalent certification is present.
- 4.11 Single pin distribution, where used to supply a panelboard or grouped set of panelboards, for the purpose of power distribution to shop tools and similar equipment, without additional down stream single conductor cables and not connected to any supply that simultaneously energizes stage and studio lighting and/or machinery, shall be exempt from this requirement.
- 4.12 Where single conductor cables (not already identified with coloured connectors) are used, i.e. not bundled, the colour codes specified in 4.7 shall be applied with coloured phasing (PVC electrical-isolating) tape at **both** ends of **each** cable, before the cables are connected. Length colour coding shall **not** use the colour codes specified in 4.7.
- 4.13 Where plug-in connections are used, they are required to have the female connector attached to the load end of the line (or phase) conductor (OESC Rule 66-400(3)). It is permitted that the neutral and the bonding conductor have the male connectors attached to the load end of the cord, in order to prevent the inadvertent interconnection of a phase conductor with a neutral or a bond, when connecting the single pin connectors (OESC Rule 66-400(4)).
- 4.14 Single conductor cables shall have overcurrent protection not exceeding the ratings set out in the recommended practice for Portable Power Cable Usage in Ontario in this SPEC. No allowance or other easement shall be given, due to the ability to bundle and the consideration of free air ratings (Refer to Table 5 of this SPEC).
- 4.15 Single conductor cables that are bundled or installed in close proximity to one another shall be rated for ampacity as multi conductor cables (Refer to OESC Section 4 & Rule 66-454(1)), except that bundled single conductor cables of any one circuit shall be permitted to be free air rated, without correction factors, if different circuits are kept a minimum of a bundle diameter apart (Refer to OESC Rule 66-454(2)).
- 4.16 All electrical personnel shall be aware of the ampacity rating of each type of cable, adaptor or distribution box to ensure the use of appropriate overcurrent protection.

Refer to OESC Rules 4-040 & 4-042 and OESC Tables 12 & 12A, regarding portable power cable and also to recommended practice, Table 5 of this SPEC for overcurrent protection on Portable Power Cable (PPC).

- 4.17 All Electrical Distribution Boxes, as shown in Tables 1 & 1A of this guideline, shall be labelled as to the rated voltage, current and the CSA type, as per Table 65 of the OESC.
- 4.18 Luminaire overcurrent protection (Refer to OESC sections 14 & 44)
- 4.18.1 All luminaires shall be connected to a circuit having overcurrent protection;
- a) from dimming or other control equipment; or
  - b) from distribution boxes, as per Tables 1 & 1A of this SPEC;
- 4.18.2 Large luminaires supplied from distribution connections shall have overcurrent protection not exceeding 100 A.
- 4.19 Consistent with item 2.4.3, adaptors shall only be used where it is necessary to convert configurations between connectors of the same rating or where, for the purposes of temporary convenience, a plug (attachment cap) of lesser rating is supplied from an appropriately protected circuit, to supply a differing configuration (connector body) of a higher rating.
- Example: A 60 A female connector such as a 3 pin “JOY” may be connected to a 15 A supply.
- 4.20 Multi conductor cables with 19 pin circular connectors (refer to USITT RP-1) utilizing 12 AWG/ 14C (12 AWG/19 C), when connected to non-dimmed load centres or panelboards, shall have overcurrent protection not exceeding 15 A. Where the non-dimmed load centre or panelboard has 20 A overcurrent protection, cable assemblies as described above shall have a maximum of three of their six circuits energized when using 2 kW loads. The remaining circuits shall remain unenergized with their respective overcurrent protection set in the open position (Refer to OESC Rule 4-016).
- 4.21 Multi conductor cables with 19 pin circular connectors (refer to USITT RP-1) utilizing 16 AWG/ 19 C shall only be used:
- a) with circuits not exceeding 10 A; and
  - b) in conjunction with dimming apparatus or from hoist motor distribution panels; and
  - c) not used for any system supplying power directly from a panelboard or other distribution equipment (Refer to OESC Rule 4-016).
- 4.22 All cables shall be protected from mechanical damage. In high traffic areas, cable shall be laid in troughs, covered or suspended. Care must be taken to ensure that all cables are appropriately protected or located to ensure that they are not a trip hazard for personnel.
- 4.23 Flexible cords and portable power cables are not rated for direct burial. Where subject to physical damage, cords and cables shall be provided with appropriate mechanical protection, such as, rigid PVC conduit or matting.
- 4.24 Where it is necessary to run temporary cables through doorways, positive protection shall be provided in the form of a substitute doorframe or portion of doorframe that allows door closing, with appropriate bushed non-conductive passage for the conductors (Refer to sections 2.4.13 and 4.22 of this SPEC).
- 4.25 All connections to elevated panel mounted connectors on sets, company panels, gensets, trucks, trailers and similar equipment shall be adequately strain relieved. Strain relief shall be installed within 1 m of any connection point (Refer to **Strain Relief** definition in this SPEC).

- 4.26 Any connection not supported by truss, pipe, scaffold, set-piece, elevating plate or similar support shall be adequately strain relieved (Refer to **Strain Relief** definition in this SPEC).
- 4.27 Vertical cable runs shall be adequately strain relieved within 1 m of the fall point and every 10 m thereafter. Cable pickups shall be made in such a way to avoid lateral movement of any pipe, truss, scaffold or other structure (Refer to **Strain Relief** definition in this SPEC).
- 4.28 Cable pickups for multiple runs of multi-conductor cables shall pick up no more than 4 (four) cables in each individual wrap or choke point.
- 4.29 To prevent accidental electrical contact, any tee or other connection that is not in use shall be sealed or capped with a seal or cap that is manufactured for the purpose.
- 4.30 Tapping tees, paralleling tees, or rigid turnarounds shall
- a) not be directly connected to any single-pin plug or connector rigidly housed or mounted in a multiple connection device;
  - b) not be directly connected to a panel mount inlet or outlet or to a multiple connection device with a cable less than 2 m in length; and
  - c) be arranged so that no mechanical strain is imposed on the connection.
- 4.31 Consistent with section 4.30 of this SPEC, no more than one tapping or parallel tee per conductor shall be used at any one point in a power distribution system. Any distribution breakout, takeoff or splitting requiring more than 2 (two) load connections per conductor shall use a single, approved multiple connection device at that point.
- 4.32 "Tap" points used in a single conductor power distribution system, which go from a higher ampacity conductor set to a lower ampacity conductor set and extend beyond 3 m in total length (distance being calculated from the tap point to the downstream device bus), shall have an appropriately sized overcurrent protection at the tap point.  
(Refer to OESC Rule 14-100(b))
- 4.33 Single conductor jumper sets, of no less than # 2 AWG – PPC, may be utilized to facilitate the connection of distribution devices to the tap point, without the addition of overcurrent protection, providing that their length, combined with any supply tail or lead on the downstream device, does not exceed the 3 m total, as described above. This shall not be interpreted to include any type of adaptor, but shall be limited solely to single pin connectors.  
(Refer to OESC Section 66)
- 4.34 When connecting to a power source, suitable overcurrent protection and a means of isolation, either internal or external to the source panel, shall be used between the power source and the "on-set" distribution:
- a) in a location readily accessible to the "set", a control device capable of safely establishing and interrupting the "on-set" distribution loads either directly or by remote control (OESC definitions & OESC Rule 14-406); and
  - b) any control device used in combination with an overcurrent device shall be connected so that the overcurrent device is dead when the control device is open (OESC Rule 14-404).
- (Refer to OESC Section 14).
- 4.35 Each set of feeder cables that is supplied from a limited access location such as a locked electrical room shall be provided with the following:

- a) a lockable disconnecting means that is readily accessible, outside of and within 5 m of the limited access location; and
  - b) any line side connectors between the limited access location and the lockable disconnecting means shall be secured.
- 4.36 All cable connections shall be kept clear of water or wet surfaces by use of appropriate elevation, but no less than 100 mm (4").
- 4.37 Distribution boxes shall be used in accordance with the requirements of their respective rating types with covers securely closed. When used outdoors or subjected to water, usage shall be as follows:
- a) No distribution box shall be placed in standing water or in a location likely to collect water in conditions of heavy rain or flooding; and
  - b) Type 1 boxes and boxes with installed non-waterproof devices shall be covered to prevent intrusion of water, snow, sleet or slush; and
  - c) All boxes shall be elevated a minimum of 150 mm (6"); and
  - d) Outdoor use boxes shall be installed such that they will repel water as designed.

# Appendix A

## OESC References

### Sections:

2-004	Inspection
2-007	Reporting of Serious Electrical Incidents
2-024	Approval of electrical equipment
2-200	Protection of Persons and Property, General
2-202	Guarding of Bare Live Parts
2-304	Disconnection
2-306	Shock and arc flash protection
4-016	Ampacity of flexible cords
4-040	Uses of Portable Power Cables
4-042	Ampacity of Portable Power Cable
10-106	Alternating-Current Systems
10-204	Grounding Connections for Alternating-Current Systems
10-206	Grounding Connections for different systems at a facility
10-210	Conductor to be Grounded
10-700	Grounding electrodes
10-702	Spacing and interconnection of grounding electrodes
10-812	Grounding conductor size for alternating-current systems and for service
12-120	Supporting of Conductors
14	Protection and Control
14-100	Overcurrent protection of conductors
14-112	Overcurrent Devices in Parallel
14-404	Control devices ahead of overcurrent devices
14-406	Location of control devices
28-900	Disconnecting Means Required for Generators
44-100	Travelling shows
46	Emergency power supply, unit equipment, exit signs, and life safety systems
66	Amusement Parks, Midways, Carnivals, Film and TV Sets, TV Remote Broadcasting Locations, and Traveling Shows
66-200	Grounding
66-400	Wiring Methods
66-402	Equipment
66-450	Single Conductor Cables
66-452	Fault current limiting
66-454	Free Air Ampacity
66-456	Single-Conductor Cable Connections
66-458	Bonding

**Tables:**

12	Allowable Ampacity of Flexible Cord and Equipment Wire
12A	Allowable ampacities for portable power cables (amperes per conductor)
17	Minimum size of grounding conductor
65	Enclosure Selection Table for Nonhazardous Locations
D1	Type designations, voltage ratings, and construction of wires and cables other than flexible cords

## Appendix B

### Glossary of Other Job Titles – (not specifically in the SPEC)

**Audio Technician/Tech:** person involved in set-up and/or strike of audio equipment and power distribution for audio equipment

**Video Technician/Tech:** person involved in set-up and/or strike of video equipment and power distribution for video equipment

**Crew Chief:** person in charge of a number of other people involved in the set-up or tear down of equipment

**Grip (film & television):** A technician who places and adjusts accessories that alter the quality and quantity of light. The Grip also assembles dolly track, scaffold, legs, etc. and handles the camera dolly during shoots. The Supervisor or Department Head of a number of grips is referred to as the “Key Grip”.

**LX:** see Lighting Tech or Electrician

**Labourer:** Non-certified entertainment industry worker.

**Lighting Designer (theatre/event):** Responsible for the creation of the visual look of a production through designing, plotting and focusing the lighting. Not normally responsible for operating the lighting, although may in amateur theatre.

**Lighting Tech:** A technician involved in the set-up and/or strike of lighting equipment and power distribution

**Responsible Person in charge:** generally the head of the department or his/her designate.

**Production Electrician:** designs and packages/assembles the electrical and lighting components of a production

**Spot Op:** follow spot operator

**Stagehand:** person involved in general set-up or strike. Could handle lighting, audio, staging, props, scenery, etc.

## **Glossary of Industry Related Terms – (not specifically in the SPEC)**

**AMX (AMX192):** protocol for analogue multiplexed control to dimming systems.

**AV:** Audio Visual

**AWG:** American Wire Gauge

**Balcony Rail:** A position in the Front of House at the front of a Balcony used for hanging fixtures

**Boom:** A piece of pipe used to support luminaires usually on the sides of the stage attached to the floor by a Flange or a Bell base and generally attached to the grid or another position above the pipe.

**Box Boom:** A position in the Front of house of a theatre usually on the sides of the house close to the stage

**Break-in:** A female multi-pin circular connector with male supply cord caps

**Breakout:** A male multi-pin circular connector with female load cord caps to supply power to instruments or other electrical devices

**Bridge:** A hanging position either on stage or in the FOH that resembles a bridge.

**C Wrench:** adjustable wrench

**CITT:** Canadian Institute of Theatre Technology

**Colour:** A generic term for Gel

**Cove:** A position in the FOH in the ceiling at the back of the theatre

**DMX (DMX512):** an industry recognized protocol for digital multiplexed control of dimming systems and related equipment

**Dimmer Beach:** an area at an event where lighting dimmers and/or power distribution are located

**Dry Ice:** frozen Carbon Dioxide

**FOH:** front of house

**Fresnel:** a luminaire using a fresnel lens.

**Ladder:** A device used to hang luminaires from above without ground support.

**Leko:** generic name for ellipsoidal luminaire

**Moving Light/Intelligent Light:** generic name for luminaire that can be remotely controlled: intensity, beam direction, beam angle, colour, other effects

**PAR:** generic name for PAR (parabolic aluminized reflector) type luminaire

**Patch Panel:** A permanently installed circuit board to patch dimmers to circuits to various locations in a theatre

**Pani:** A trade name for a projector but generically used for all projectors.

**Pin + Sleeve Connectors:** Devices where the voltage rating is determined by the location of the female ground contact relative to the housing keyway. Used for equipment power distribution. Manufactured and approved to CSA standard C22.2 No. 182.1.

**Pyro:** Pyrotechnics

**Scroller:** An automated device for changing colours on a luminaire

**Side Arm:** A piece of pipe attached to a boom from which a fixture may be attached. See T (Tee).

**Soca:** multi conductor cable usually 19 conductor utilizing Socapex™ multi-pin circular connectors

**Stage Pin Connector:** three pin connector available in various amperage sizes prevalent in US Theatres and used in some Canadian Theatres. Refer to ANSI E1.24-2012 Dimensional Requirements for Stage Pin Connectors.

**Stiffener:** A piece of pipe attached to a fly pipe with a C clamp and tied to the steel suspension cables attached to the fly pipe to stop the pipe from turning

**Strike:** the tear-down or removal of equipment from an event

**T (Tee):** A cast fitting which attaches to a side arm in order to support a fixture

**Tee (mechanical):** A cast metal coupling like device used on a side arm to attach a luminaire to a vertical pipe.

**Testlight:** A single or double low wattage lamp with plug cap for testing circuits.

**Turnaround:** gender similar adaptor, usually only on single pin ground, bond or neutral

**Two-fers + Three-fers:** are single male y-cords wired with either 5-15 or L5-20 or stage pin connectors to split two or three ways to connect smaller loads to a dimmer or circuit.

**USITT:** United States Institute for Theatre Technology.

**VAC:** Volts Alternating Current.

**Zip cord:** (lamp cord, 2 conductor cable) A 2 conductor cable usually used with low amperage devices (practicals).

## Appendix C

A Generator Set is an assembly that consists of the internal combustion engine (prime mover) and generator/alternator.

### **Rating of Generator Sets – Example**

An alternator/generator connected for 3 phase power is labeled as follows:

67.5 kVA      Volts: 120/208      Amps: 187      pf: 0.8

### **What is its rating in Amperes based on this information?**

The nameplate current rating in Amps is 187 A. This current rating is calculated based on the formula:  $(kVA \times 1000) / V$ . This rating is used to determine the conductor size and/or overcurrent device (if not provided with generator).

The generator rated power (Real power) is 54 kW. Real power (kW) can be calculated based on Apparent Power (kVA) and Power Factor using the formula:  $kW = kVA \times PF$ .

The mechanical power of the prime mover (kW) required to spin the alternator or the mechanical power of the engine brake (when the generator is producing the rated power) is calculated using generator Real Power (kW) and Generator efficiency (EFF GEN) as:  
 $kW / EFF GEN$ .

Note: to convert mechanical kW to horsepower, the formula is:  $HP = kW \times 1.34$

Therefore, if the efficiency of the alternator is 90%, the MECHANICAL kW required to spin it to full capacity is:

$\frac{54}{0.9}$  equals 60 kW, (plus any parasitic loss or other deration)

If expressed in horsepower, the formula is  
 $\frac{54 \times 1.34}{0.9}$  equals 80.4 HP, (plus any losses or other deration)

*Taking all of the above, the prime mover has a NET CONTINUOUS MECHANICAL kW of at least 60 (or a NET CONTINUOUS bhp of 80).*

## Appendix D

### CERTIFICATION MARKS ACCEPTABLE UNDER THE OESC

(Refer to OESC Bulletins for most current list and ESA website, [www.esasafe.com](http://www.esasafe.com))

Canadian Standards Association (CSA)			
Curtis Strauss		Entela	
FM Approvals			
Intertek Testing Services			
Labtest Certification (LC)			
Met Laboratories (MET)		Nemko	
NSF International		OMNI Environmental Services Inc	
Quality Auditing Institute		QPS	
TUV America		TUV Rheinland	
Underwriters' Laboratories of Canada (ULC)			
Underwriters' Laboratories Inc.			

The above marks apply to complete products or systems.

# Appendix E

## FIELD APPROVAL MARKS ACCEPTABLE UNDER THE OESC

(Refer to OESC Bulletins for most current list and ESA Website, [www.esasafe.com](http://www.esasafe.com))

<p><b>Canadian Standards Association (CSA)</b></p>		
<p><b>Electrical Safety Authority (ESA)</b></p>	 <p style="text-align: center;">See Note 2</p>	
<p><b>Entela</b></p>	 <p style="text-align: center;">See Note 2</p>	
<p><b>Intertek Testing Services</b></p>		<p><b>MET Laboratories</b></p> 
<p><b>Nemko</b></p>		
<p><b>QPS</b></p>	 <p style="text-align: center;">See Note 2</p>	
<p><b>TUV America</b></p>		<p><b>Underwriters Laboratories of Canada (ULC)</b></p> 

**Note** -“PANEL ONLY” label identifies that the panel has been evaluated to the SPE-1000. It does not cover equipment that is added or connected to the panel.

The above marks apply to complete products or systems.

## Appendix F

### COMPONENT CERTIFICATION MARKS

ACCEPTABLE UNDER THE OESC WHICH ARE SPECIFICALLY USED ON COMPONENT PARTS THAT ARE PART OF A LARGER PRODUCT OR SYSTEM

(Refer to OESC Bulletins for most current list and ESA website, [www.esasafe.com](http://www.esasafe.com))

<b>Canadian Standards Association (CSA)</b>	
<b>Underwriters Laboratories Inc. (UL)</b>	 

Note: Electrical components bearing these marks may have restrictions on their performance or may be incomplete in construction, and are intended to be used as part of a larger approved product or system. The recognized component marks are found on a wide range of products, including some switches, power supplies, printed wiring boards, some kinds of industrial control equipment and thousands of other products.

## Appendix G

### **ENTERTAINMENT INDUSTRY** **ELECTRICAL INSPECTION / CONSULTATION**

#### **Notice of Legal Requirement**

Under the provisions of the Ontario Electrical Safety Code, an Application for Inspection must be filed with the Electrical Safety Authority for any electrical equipment installed in Ontario, temporary or otherwise. This includes all Film, Television, Live Performance or Event Productions including but not limited to Live Productions regardless of site or location.

Failure to comply could result in unsafe working sites, production downtime and/or fines.

#### **Inspection Process**

##### **Step 1**

Fill in an Application for Electrical Inspection.

##### **Step 2**

Fax or email the Application to the ESA Customer Service Centre a minimum of 48 hours prior to the production set-up.

#### **Optional**

Phone in your request for an Electrical Inspection to the ESA Harm Reduction Services centre a minimum of 48 hours prior to the production set-up.

##### **ESA Customer Service Centre**

400 Sheldon Drive, Unit 1

Cambridge, Ontario N1T 2H9

Fax: (800) 667-4278

Email: [esa.Cambridge@electricalsafety.on.ca](mailto:esa.Cambridge@electricalsafety.on.ca)

Phone: (877) 372-7233



400 Sheldon Drive, Unit 1  
Cambridge, Ontario, N1T 2H9

Phone: 1-877-ESA-SAFE (372-7233)  
Fax: 1-800-667-4278  
esa.Cambridge@electricalsafety.on.ca

### Entertainment Industry Application for Electrical Inspection

**Date:** \_\_\_\_\_ **Acct #:** \_\_\_\_\_ **ECRA / ESA Lic #:** \_\_\_\_\_ **ACP #:** \_\_\_\_\_

Under the provisions of the Ontario Electrical Safety Code (OESC), an Application for Inspection must be filed with the Electrical Safety Authority for any electrical equipment installed in Ontario, temporary or otherwise. This includes all Television, Film, Commercial, Live Performance, Carnivals, or Event Productions including but not limited to Live Productions regardless of site or location. Failure to comply could result in unsafe working sites, production downtime and/or fines.

Applicant Information		PO/Job #
Name _____ Email _____		
Address _____ Unit / Suite _____		
City _____ Province/State _____ Country _____		
Postal Code _____ Phone # _____ Fax # _____		
<b>Date Ready</b>		

Location Information	
Name _____	
Civic / 911 # _____ Street _____ Sub Lot _____ Other _____	
If street is a #d Regional Rd, County Rd, Hwy - note the alternate street name (if appl) _____	
City/Town/PPN _____ Twp/RMN _____ Rural Lot _____ Con _____	
City/Town/Populated Place Name _____ Township/Regional municipal name _____	
Site Contact Name: _____ Phone # _____ Main Intersection _____	
Work location in building : _____	

**Complete this section for: Commercials / Television / Movie Shoots / Video / Theatre Productions / Travelling Shows**

<input type="checkbox"/> Commercials [C041]	<input type="checkbox"/> Television [C032]	<input type="checkbox"/> Movie / Film [C032]	<input type="checkbox"/> Video [C032]	<input type="checkbox"/> Theatre [C032]	<input type="checkbox"/> Travelling Shows [C032]
Production Name: _____			Number of Locations _____ [MI06]	Approximate # of Months of Shoot _____ [C066]	
<b>Locations:</b> (If list is longer than space provided, please attach the list)	<b>Site Type</b>	<b># of Sets</b>	<b>Contact Phone #</b>	<b>Contact Phone #</b>	<b>Best time for Inspection</b>
	<input type="radio"/> On Location <input type="radio"/> On Studio				
	<input type="radio"/> On Location <input type="radio"/> On Studio				
	<input type="radio"/> On Location <input type="radio"/> On Studio				
	<input type="radio"/> On Location <input type="radio"/> On Studio				

Electrical Workers Certification of Qualifications? <input type="checkbox"/> 309 <input type="checkbox"/> 269e <input type="checkbox"/> Licensed Electrical Contractor Shoot Times: <input type="checkbox"/> AM <input type="checkbox"/> PM <input type="checkbox"/> After 5pm <input type="checkbox"/> Weekend <b>Daily call sheets should be emailed to <a href="mailto:metroresource@electricalsafety.on.ca">metroresource@electricalsafety.on.ca</a></b>	<b>Equipment included with Inspection (Quantity) [C023]</b> _____ Generators > 12KW _____ Heating or A/C Units _____ Transformers >= 1KVA _____ Other: _____
--	--

**Complete this section for: Special Events such as Live Performance / Concerts / Outdoor Festivals and for Carnivals**

<input type="checkbox"/> Live Performance [C075]	<input type="checkbox"/> Concerts [C075]	<input type="checkbox"/> Outdoor Festivals [C075]	<input type="checkbox"/> Carnivals [C030]	<input type="checkbox"/> Other (specify): _____
Show or Event Name: _____			Number of Locations: _____ [MI06]	
What DATE and TIME will the Show be open to the public? _____			What TIME will the Show be ready for Inspection? _____ AM _____ PM	
What are the hours of operation for this event? _____				
Please provide opening and closing times. _____				
Electrical Workers Certification of Qualifications? <input type="checkbox"/> 309 <input type="checkbox"/> 269e <input type="checkbox"/> Licensed Electrical Contractor <b>Weekend, holiday and evening inspections are subject to additional fees.</b>	<b>Equipment included with Inspection (Quantity) [C023]</b> _____ Generators >12KW _____ Heating or A/C Units _____ Transformers >= 1KVA _____ Other: _____ _____ Rides [C030] _____ Booths [C030]			

Driving Directions / Comments / Work Details	

<b>Payment Method</b>	<input type="checkbox"/> Cheque <input type="checkbox"/> Credit Card <input type="checkbox"/> ESA Account	Account # : _____	<b>Fee Estimate incl HST</b>
Card # _____	Expiry _____		\$ _____
Name _____			

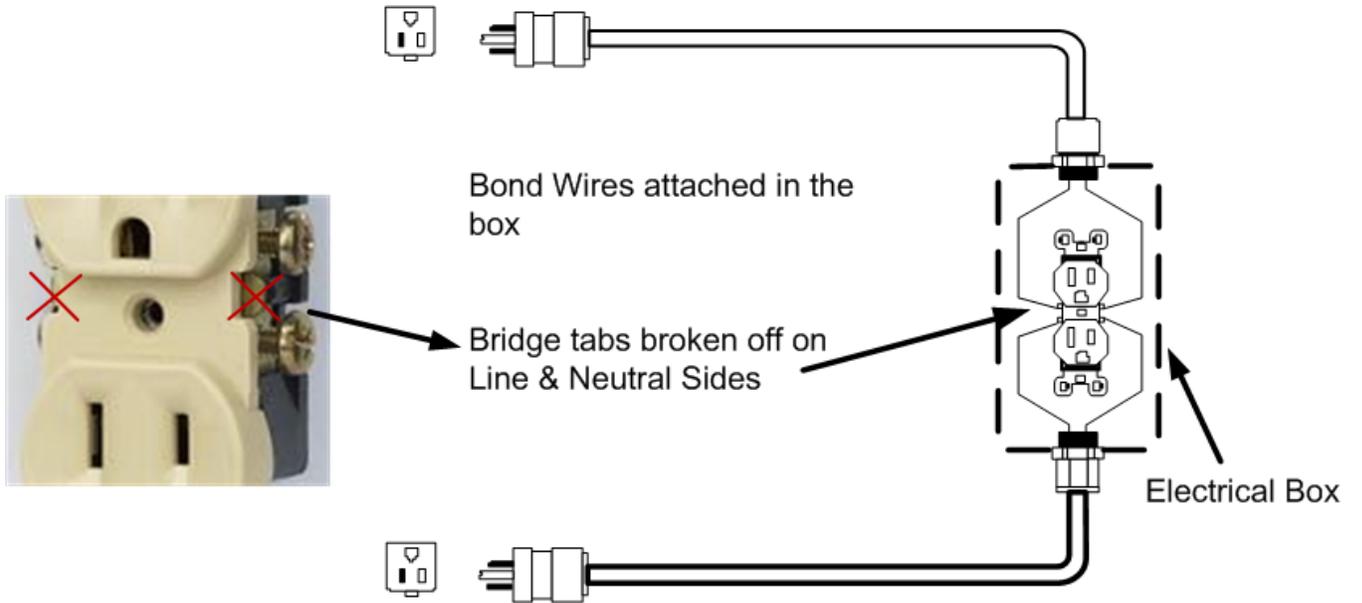
By submitting personal information to the Electrical Safety Authority, or its agents and service providers, you agree that ESA may collect, use and disclose such personal information in accordance with its privacy policy, applicable laws or pursuant to our administrative agreement with the Province of Ontario. If you provide us with the personal information on behalf of another individual, you represent that you have all necessary authority and/or have obtained all necessary consents from such individual to enable us to collect, use and disclose such personal information for the purposes set forth in our Privacy Policy. A copy of our policy is located on our website at [www.esasafe.com](http://www.esasafe.com)

\*See 2013 Electrical Inspection Fee Schedule Section for Details Form 1432 (11/12) The total cost may change pending a site visit.

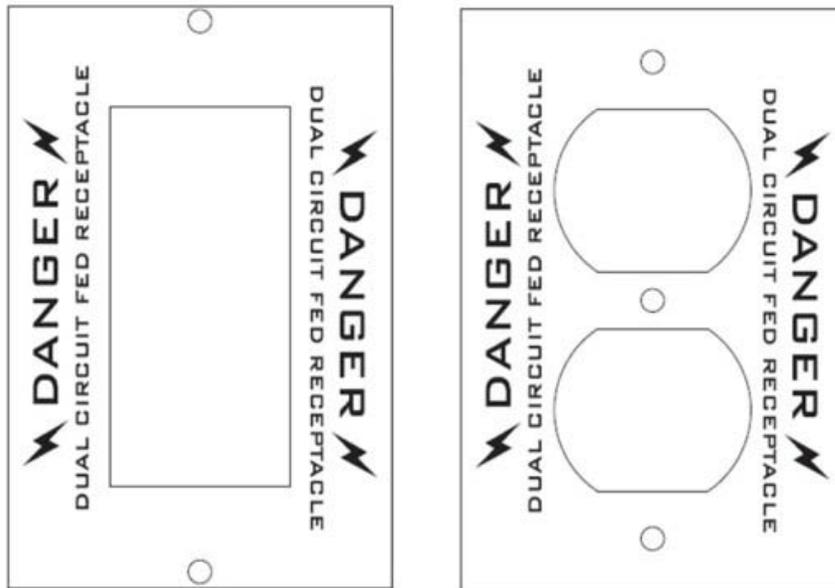
# Appendix H

## DUAL CIRCUIT FED RECEPTACLE

### CONNECTION DIAGRAM



### WARNING LABELS



Material – Nomex  
Dimensions - to standard device and cover plate

# Appendix I

## THE USE OF THREE-PHASE DISTRIBUTION EQUIPMENT ON SINGLE-PHASE THREE WIRE SOURCES

Figures 1 & 1A – incorrect practices

Figures 2 & 2A – correct practices

Figure 1

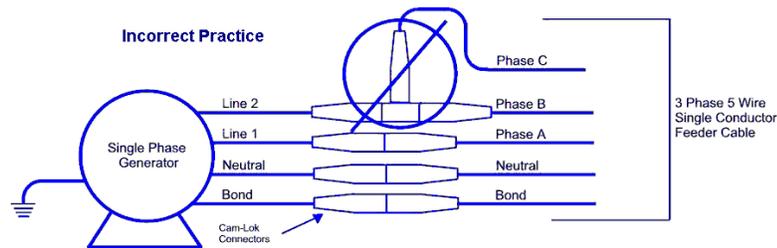


Figure 1A

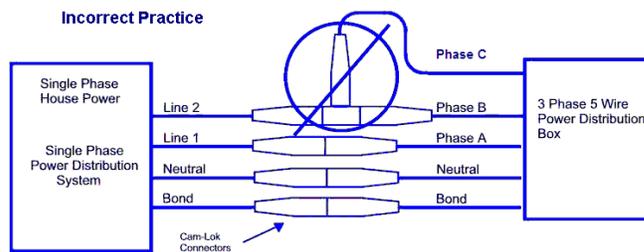


Figure 2

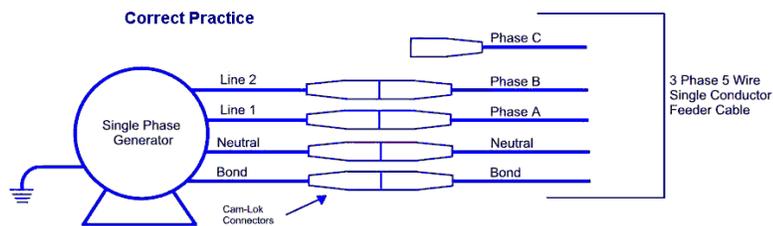
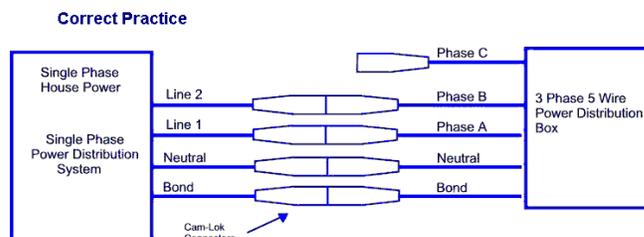


Figure 2A



## Appendix J

### IMPROPER USE OF SINGLE PIN CONNECTORS ON MULTI-CONDUCTOR CABLES



## Appendix K

### FIRE HYDRANT GROUNDING DEVICE



Refer to 3.2.10 of this document for conditions of use.

# Appendix L – SPEC 001

## SPECIAL LUMINAIRES IN ENTERTAINMENT INDUSTRY

### 1. Objective

The objective of this document is to establish safety guidelines for the maintenance and use of luminaires used in the motion picture, television, and entertainment industry which are difficult to approve under the requirements of CSA C22.2 No. 166 or SPE-1000, current versions of the standards, and which will allow a method of electrical acceptance. In its preparation, consideration has been given to the prevention of fire and shock hazards, as well as proper maintenance and operation.

Compliance with this guideline and proper maintenance will ensure for essentially safe operation.

This guideline is not intended as a design specification nor as a replacement for CSA C22.2 No. 166 Stage and Studio Luminaires or SPE-1000 Model Code for Field Evaluation of Electrical Equipment, current versions of the standards.

This equipment is to be used subject to the guidelines found in this document.

The ESA label identifies that luminaires are approved only when installed in accordance with this guideline, and shall be allowed to be used or rented when provisions of this guideline are followed.

This Guideline is intended to serve a very specific need of OHSA and is in no way intended to be used as a substitute for the Ontario Electrical Safety Code. Omission of any requirements presently in the OESC does not in any way affect the OESC, nor should these omitted requirements be considered unimportant. They are essential to the OESC and its intended application, that is, its use by those who design, install, and inspect electrical installations. This guideline on the other hand, is intended for use by employers, employees, and OHSA.

### 2. Scope

**This guide applies to incandescent, fluorescent, and gas discharge luminaires, specifically for film & television 'set' lighting, suitable for use in dry locations, for operation at 750 volts or less, whose external surface temperature may exceed 90 degrees Celsius and which are to be installed and maintained in accordance with the rules in the Ontario Electrical Safety Authority Code.**

Luminaires accepted under this document are for use only by authorized persons and must be used within the guidelines and attached work rules of this document.

Luminaires accepted under this document will be accepted before they are used in any location. Such locations will be inspected by an ESA inspector, as per OESC Rule 2-024(3):

Conditions for qualification:

- (a) manufactured before August 1, 2001, or
- (b)

where the type of luminaire is such that manufacture and approval to the normally applicable equipment standards (CSA C22.2 No. 166 Stage and Studio Luminaires or SPE-1000 Special Inspection, current versions of the standards) are impossible. This is limited to:

- Space Light;
- Skypan;
- Chicken Coop or
- M.I. Light.

If any manufacturer makes a particular luminaire type included in the above list that does meet CSA C22.2 No. 166 or SPE-1000, then all new luminaires of that type shall also meet CSA 166 or SPE-1000, current versions of the standards.

It is the user's responsibility to protect luminaires from adverse environments and to ensure the luminaires are not a heat, shock or fire hazard to people or property.

### 3. Definitions

**Acceptable:** to the Electrical Safety Authority (ESA)

**Authorized Person:** means a qualified person who, by the nature of their duties or occupation, is obliged to approach or handle electrical equipment or a person who, having been warned of the hazards involved, has been instructed or authorized to do so by someone having authority to give the instruction or authorization.

**Chicken Coop:** Fabricated from a metallic non-flammable enclosure. This luminaire is used as an overhead soft light. Often this luminaire is found with a black fabric drape hung around the bottom so as to direct light straight down.

**Dry Location:** a location not normally subject to dampness, but may include a location subject to temporary dampness, provided ventilation is adequate to prevent accumulation of moisture.

**Identified:**

- (a) When applied to a conductor means that the conductor has:
  - (i) A white or natural grey covering; or
  - (ii) A raised longitudinal ridge or ridges on the surface of the extruded covering on certain flexible cords, either of which indicates that the conductor is either a grounded conductor or a neutral; and
- (b) When applied to other electrical equipment means that the terminals to which grounded or neutral conductors are to be connected have been distinguished for identification by being tinned, nickel plated, or otherwise suitably marked.

**Luminaire:** a lighting instrument consisting of a light source, socket, enclosure, electrical wiring and connector and may include switches, reflectors, lenses, ballasts, supporting devices and other apparatus for altering the quantity and quality of light emitted by the apparatus.

**M.I. Light:** Most commonly fabricated from aluminum square tubing. This luminaire is used as an overhead soft light. Sides are normally covered with a black shroud so as most of the light is directed straight down through a white drape.

**Monitor:** to observe or watch for purposes of control.

**Qualified Person:** means one familiar with the construction and operation of the apparatus and the hazards involved.

**Skypan:** Used in lighting a large cyc. Washes light evenly across a large area. Available in 2K, 5K, and 10K. Looks like a large metal wok with a socket and a lamp in the centre. Most commonly used with a metal shroud (skirt) around the outside.

**Space Light:** this is a 6 lamp unit, typically 6 x 1000 W, designed to be used with 3200 °K Quartz lamps (for example T-3 lamps such as FCM, FHM, etc.....). It is constructed so that all light passes indirectly through a diffusion shroud with a large unobstructed surface, to provide a very soft, virtually shadow free field of light. Most often used in conjunction with a black fabric drape around the outside.

#### **4. Reference publications (current versions of the standards)**

- Ontario Electrical Safety Code
- SPE-1000, Model Code for the Field Evaluation of Electrical Equipment
- C22.2 No. 0, General Requirements-Canadian Electrical Code, Part 2
- C22.2 No. 166, Stage & Studio Luminaires

#### **5. Preface**

This approval service is provided by the Electrical Safety Authority.

Equipment labeled under this program is accepted for use in Ontario and is not to be considered certified.

The object of this guide is the control of fire, shock, and heat hazards. Evaluation of equipment is limited to these safety considerations.

In this guide, control of hazards is recognized to occur in four ways:

- (1) By the use of acceptable installation methods.
- (2) Through the use of equipment that is inherently safe.
- (3) Safety through the use of appropriate signage.
- (4) Safety through application of work rules (attached to this document).

\* An ESA inspector shall do the testing and labeling of the luminaires. As an alternative to testing, the ESA inspector may agree to accept submitted test data for the luminaires.

\* The luminaires shall be inspected as part of the wiring installation each and every time they are being used.

#### **6. Power supply cords**

Power supply cords shall be suitable for the purpose, and be protected from physical damage. They shall be provided with strain relief where they enter into the enclosure, and where found worn or damaged, the cable and/or strain relief shall be replaced.

## **7. Internal wiring**

- (a) Conductors shall be suitable for the purpose.
- (b) Terminations shall not be subject to injurious strain and shall be suitable for the application.
- (c) Openings through which conductors pass shall be bushed or shall have smooth surface.
- (d) Internal wiring ratings must exceed the temperatures, as determined under test, as per section 20.1 of Appendix K - SPEC 001.

## **8. Components**

Components shall be suitable for their intended purpose and in good working order.

## **9. Switches**

- (a) A single-pole switch shall not be connected in an identified conductor.
- (b) On/off positions of switches shall be clearly marked.

## **10. Receptacles**

- (a) Receptacles mounted on luminaires shall be of the grounding type or polarized.
- (b) A bonding jumper shall be connected between the receptacle grounding screw and the grounded metal of the luminaire.
- (c) Receptacles shall have suitable overcurrent protection.

## **11. Lampholders**

Exposed current carrying surfaces of lampholders shall connect to the identified conductor, unless other precautions will prevent accidental contact with live surfaces (i.e., the exposed top of a screw shell lampholder).

## **12. Overcurrent devices**

An overcurrent device shall not be connected in an identified conductor, unless its operation opens all conductors of the circuit.

## **13. Cord connectors**

- (a) Power supply cord connectors shall be approved.
- (b) Notwithstanding "(a)", non-approved connectors may be acceptable under limited circumstances such as 'head to ballast' wiring, provided the connectors are suitable and correctly polarized.
- (c) Cord connectors for single-conductor cable shall be properly colour-coded.
- (d) Cord connectors for 2K luminaires shall be permitted to be 15 A hospital grade.

## **14. Spacing**

Bare live parts and non-current carrying metal parts shall be suitably spaced or otherwise insulated.

## **15. Grounding and bonding**

- (a) The bonding conductor in the supply cable shall be suitably attached to the independent bonding terminal.
- (b) The bonding terminal shall be suitably connected to the metal enclosure of the luminaire or the other non-current carrying metal parts, if the enclosure is non-metallic.

All exposed non-current carrying metal parts of luminaires that could become energized shall be in good electrical contact with each other for bonding purposes.

## 16. Strain relief

A device (or assembly) shall be in or on the enclosure or a component assembly, so that mechanical strain on the supply cord, including rotation, will not be transmitted to terminals, splices, or interior wiring. Knots in supply cords or conductors are not acceptable as a method of strain relief.

## 17. Enclosures

- (a) Enclosures shall be sufficiently durable and rigid to withstand the stresses of normal use.
- (b) Non-metal enclosures shall pass the flame test (as per Section 20.2 ).
- (c) Metallic parts shall be protected from corrosion.
- (d) Luminaires without enclosures, where there is possibility of contact with single insulated conductors or bare live parts, shall be mounted sufficiently out of reach so as to prevent contact. Such luminaires must be labeled "**Danger Live Parts.**"

### 17.1 Openings in enclosures

- (a) Openings shall be located or baffled to prevent accidental contact with bare live parts.
- (b) If contact with bare live parts is possible, such luminaires must be labeled "**Danger live parts**".

## 18. Mounting and supporting luminaires

Supports shall have the strength to withstand any mechanical loads associated with normal use.

## 19. Marking

Luminaires shall be marked in a permanent and legible manner with the following information:

- The manufacturer or rebuilder's name, trademarks or symbol:
- A model or serial number:
- Input rating in amps or watts:
- Rated voltage: and
- Rated frequency, except for incandescent loads.
- Lamp type & maximum watts
- "**To be used by authorized personnel only**"
- If any exterior part of a luminaire exceeds 90 °C, the following notice must be conspicuously placed on the luminaire:
  - o DANGER INTENSE HEAT
  - o MAINTAIN A SAFE DISTANCE FROM PEOPLE AND *PROPERTY*.
  - o ENERGIZED LUMINAIRES *MUST* BE MONITORED BY AN AUTHORIZED PERSON
- The letters shall be at least 1/8" high (where practicable).
- The effects of temperature shall be considered in the placement of markings.
- Source of supply (this should detail the # or #'s of sources of supply i.e. number of cords: for example, 2 X 3000 W, or 1 X 6000 W, or 6 X 1000 W)

## 20. Tests

### 20.1 Temperature test

- (a) Luminaires shall be positioned to produce the highest temperature.
- (b) Light reducing devices shall be adjusted to produce the highest temperature in the luminaire.

- (c) Luminaires shall be tested using intended types and sizes of lamps.
- (d) Temperature measurements must be taken after temperature has stabilized for 1 hour.

## **20.2 Flame test**

The tip of the flame from a paper match, a wooden match or a butane lighter shall be applied to the material under evaluation, for not less than 15 seconds, at a vulnerable spot such as an edge or reinforcing rib. The material shall not burn for more than 5 seconds after removal of the flame.

## **20.3 Dielectric test**

- (a) For equipment rated 250 V and less, 1000 ac V shall be applied for 1 minute between live parts and exposed non-current carrying metal parts. The material shall not break down during the test.
- (b) For equipment rated over 250 V, 1000 ac V plus 2x rated voltage shall be applied for 1 minute between live parts and exposed non-current carrying metal parts. The material shall not break down during the test.
- (c) Alternatively, an ac test voltage 20% higher may be applied for 1 second.

## **20.4 Supporting Device Test**

Equipment supporting devices shall be capable of supporting for 1 hour, a steady pull of six times the total mass of the equipment supported, applied vertically regardless of actual loading conditions.

## **21. Routine Maintenance of Approved Luminaires**

When replacing like for like components i.e. same ratings, plug for a plug, a log must be maintained and will be made available to an ESA Inspector upon request. The log should consist of the following data:

- (1) Serial number of the ESA label.
- (2) Type of equipment.
- (3) Type of work done.
- (4) Date.
- (5) Name of person doing the maintenance.

## **22. Work procedure for using or maintaining Luminaires**

### **Intent**

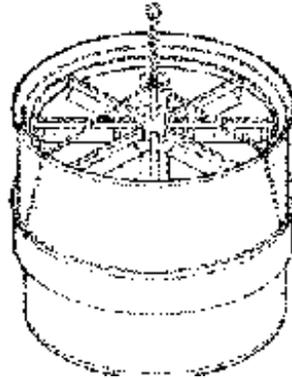
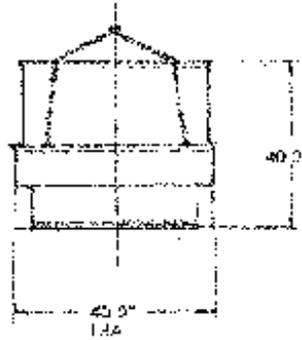
The work rules are for the use of authorized persons who are using/monitoring or maintaining the designated luminaires.

## Work Rules

- (1) When in use, luminaires whose external surface temperature exceeds 90 °C, shall be monitored by a person, who shall:
  - (a) be authorized by the persons responsible for the luminaires and who shall ensure that people and property are kept at a safe distance from the luminaires; and
  - (b) ensure that if the luminaires are not monitored they are de-energized; and
  - (c) in the case of hand-held luminaires, the person using the luminaire shall be responsible for its safe use.
- (2) Companies who repair luminaires for the entertainment industry shall be recognized by the Electrical Safety Authority
- (3) There shall be at least one company authorized person per shift during maintenance operations of the type in Rule 2.
- (4) All persons who do electrical work on luminaires shall be qualified.
- (5) The persons mentioned in Rule 3 shall provide guidance and assistance as electrical work is being done.
- (6) Replacement of lamps in luminaires shall only be done by qualified persons. Anyone who replaces lamps in luminaires whose surface temperature exceeds 90 °C shall wait a minimum of 5 minutes after the luminaire is de-energized before changing the lamp.
- (7) Anyone who handles high pressure lamps (eg. high pressure Xenon - high pressure sodium etc.....) shall wear protective clothing of a type specified by the manufacturer.
- (8) Structures used to support luminaires shall possess the stability and strength necessary to minimize the possibility of the support tipping over in normal use.
- (9) Wiring between luminaires and other equipment shall comply with the Ontario Electrical Safety Code (current version).
- (10) Dry location luminaires shall be suitably protected from inclement weather
- (11) Exposed lamps shall be protected from damage by use of a suitable guard/enclosure or by position or location of the luminaire.
- (12) Exposed tungsten-halogen lamps shall be used in a manner to minimize the hazard to persons or property, should a lamp shatter.
- (13) Combustible lampshades or other devices placed in a beam of light shall be a sufficient distance from the lamp so as not to be a fire hazard. Alternatively, such devices shall be made of or shall be protected by non-combustible material.
- (14) Openings located in the bottom of luminaires and through which molten or flaming matter might pass shall be closed or restricted to prevent such passing or shall be monitored in accordance with work Rule 1.
- (15) Persons who repair and rebuild luminaires and who may clean enclosures by sandblasting or other means, shall be permitted to have acceptance labels placed on removable plates.
  - (a) After the repair, rebuild or cleaning, the plate shall be reattached to the luminaire from which it was removed.
  - (b) The rebuilt luminaire shall be similar, in mechanical and electrical detail, to its predecessor.
  - (c) If there are substantial changes to the luminaire, it shall be re-approved.
  - (d) Instances of label removal and replacement shall be recorded and maintained in an acceptable manner.
  - (e) Electrical work associated with label removal and reapplication shall be performed as per work Rule 3.
- (16) Luminaires without enclosures shall be disconnected from power supply before handling.



# SPACELIGHT



## Specifications:

The unit is a 6-1000 W Space Light, designed to be used with 3200 °K Quartz lamps. It is constructed so that all light passes indirectly through a diffusion shroud with a large unobstructed surface, to provide a very soft, virtually shadow free field of light. Most often used in conjunction with a black fabric drape around the outside (shown in drawing not photo).

Lamps: FDF, FDN, EFG, FCM, FHM, etc.....

Rating: 120/240 V ac or dc  
16.7 A Max per circuit  
Cable: 3 feet of 3 #10 SEW leads, sheathed, tails/circuit.  
Socket: Two compressible contacts per lamp  
Weight: 11 Kg, 27.5 Lbs.



## SKYPAN

Specifications: Used in lighting a large cyc. Washes light evenly across a large area. Available in 2K, 5K, & 10K. Looks like a large metal wok with a socket and lamp in the centre. Most commonly used with a metal shroud around outside.

Lamps:      CYX   2K  
              DPY   5K  
              DTY   10K

## CHICKEN COOP



Specifications: Fabricated from a metallic non flammable enclosure. This fixture is used as an overhead softlight. Often this fixture is found with a black fabric drape hung around the bottom so as to direct light straight down.

Rating:	120/240 V ac or dc 12.5 A Max per circuit
Cable:	3 feet high heat cable, 12/3
Socket:	mogul base

Also available as a 4000 W HMI

## M.I. LITE



Specifications: Most commonly fabricated from aluminum square tubing. This fixture is used as an overhead soft light. Sides are normally covered with a black shroud so as most of the light is directed straight down through a white drape.

Rating:	120/240 V ac or dc A Max. per circuit
Lamps:	FDF, EDN, EFG, FCM FHM, etc.....
Cable:	Min 14/3 high heat cable

**TABLE 1**  
**Film & Television Main Distribution Boxes**

<b>BOX #</b>	<b>PHASE</b>	<b>SUPPLY</b>	<b>LINE CONNECTOR</b>	<b>LOAD CONNECTOR</b>	<b>BREAKER(S)</b>	<b>NOTE</b>
1	3	120/208V	CAM-LOK*	CAM-LOK*	400A 3 Pole	100%
2	Single****	120/240V	CAM-LOK*	140A 4 pin Joy**	2: 100A 2 Pole	CBC TV Mobile
3	Single****	120/208V	CAM-LOK*	140A 4 pin Joy**	1: 100A 2 Pole	CBC TV Mobile
3A	3	120/208V	CAM-LOK*	140A 4 pin Joy**	3: 100A 2 Pole	CBC TV Mobile
2A	Single****	120/240V	125A 4 pin Joy***	60A 4 pin Joy***	1: 60A 2 Pole	CBC Mobile Unit Adapter box
9	Single****	120/240V	CAM-LOK*	60A 4 pin Joy***	1: 60A 2 Pole	CBC Radio Truck
	3	120/208V	CAM-LOK*	CAM-LOK*	250A 3 Pole	100%
	3	120/208V	CAM-LOK*	CAM-LOK*	200A 3 Pole	GFCI
	3	120/208V	CAM-LOK*	CAM-LOK*	175A 3 Pole	100%
	3	120/208V	CAM-LOK*	CAM-LOK*	100A 3 Pole	100%
	3	120/208V	CAM-LOK*	CAM-LOK*	100A 3 Pole	GFCI
Tee Tower	3	120/208V	CAM-LOK*	CAM-LOK*	NONE	Various versions, rated at 400A
Crow Foot	3	120/208V	CAM-LOK*	CAM-LOK*	NONE	Rated at 400A

\* "CAM-LOK"™ – Trade name which has become generic; moulded water resistant SINGLE PIN Connector

\*\* 140 A round moulded 4 pin water resistant connector (TV Mobile)

\*\*\* "Joy"™ - Trade Name which has become generic; moulded water resistant hard usage connectors

\*\*\*\* "Single" – single phase, 3 wire ground

**TABLE 1A**  
**Film & Television Load Distribution Boxes**

<b>BOX #</b>	<b>PHASE</b>	<b>SUPPLY</b>	<b>LINE CONNECTOR</b>	<b>LOAD CONNECTOR</b>	<b>BREAKER(S)</b>	<b>NOTE</b>
4	Single***	120/240V	CAM-LOK*	60A 3 pin Joy**	4: 60A 1 Pole	May be 6 circuit
4A	3	120/208V	CAM-LOK*	60A 3 pin Joy**	6: 60A 1 Pole	
4AW	3	120/208V	CAM-LOK*	60A 3 pin Joy**	6: 60A 1 Pole	Weatherproof
5	Single***	120/240V	CAM-LOK*	60A 4 pin Joy**	2: 60A 2 Pole	
5A	3	120/208V	CAM-LOK*	60A 4 pin Joy**	3: 60A 2 Pole	
6A	Single***	120/240V	4 pin Joy**	15A <b>Hospital Grade</b> type 5-15	6: 20A 1 Pole	Per 66-400(5)
“Load Centre”	Single***	120/240V	CAM-LOK*	15A <b>Hospital Grade</b> type 5-15	8: 20A 1 Pole	Per 66-400(5)
7	Single***	120/240V	4 pin Joy**	60A 3 pin Joy**	2: 60A 1 Pole	
	Single***	120/240V	4 pin Joy**	14-50 Receptacle	50A 2 Pole	Stove or equipment with 14-50 connector
8A (3 x 20)	Single 2w + grd	120V	3 pin Joy**	15A <b>Hospital Grade</b> type 5-15	3: 20A 1 Pole	Per 66-400(5)
	Single 2w + grd	120V	3 pin Joy**	15A <b>Hospital Grade</b> type 5-15	3: 20A 1 Pole GFCI	GFCI
	Single 2w + grd	120V	3 pin Joy**	60A 3 pin Joy**	1: 60A 1 Pole GFCI	GFCI
	Single***	120/240V	4 pin Joy**	60A 3 pin Joy**	2: 60A 1 Pole GFCI	GFCI
RV	Single 2w + grd	120V	3 pin Joy**	RV Receptacle (Non-NEMA)	30A 1 Pole	For equipment with non-NEMA RV connector
RV	Single***	120/240V	4 pin Joy**	14-50 Receptacle	50A 2 Pole	CSA/NEMA 14-50 configuration
10	3	120/208V	CAM-LOK*	CAM-LOK*	3: 100 A 1 pole	10k incandescent

\* “CAM-LOK”™ – Trade name which has become generic; moulded water resistant SINGLE PIN Connector

\*\* “Joy”™ - Trade Name which has become generic; moulded water resistant hard usage connectors

\*\*\* “Single” – single phase, 3 wire ground

**TABLE 3**  
**Minimum Size of Grounding Conductor for Generator**  
**AC Systems Utilizing Single Pin Connectors on the Ground Conductor**

<b>1.1 Ampacity of Overcurrent Protection</b>	<b>Size of Copper Grounding Conductor AWG</b>
100 or less <sup>1</sup>	4
101 to 200 <sup>1</sup>	2
201 to 300 <sup>1</sup>	2/0
301 and above	4/0

**Notes:**

<sup>1</sup>	For runs in excess of 30 m, increase conductor size to next size up in this table
<sup>2</sup>	Minimum sizes in Table 3 are industry standard and exceed the OESC Requirements

<b>TABLE 5</b>		
<b>Recommended Practice for Portable Power Cable Usage in Ontario. *</b>		
<b>Conductor Size AWG</b>	<b>Protect at</b>	<b>Description</b>
4	100 A	"Load Centre" (Bundled)
2	175 A	"Seaway" (Bundled)
1/0	200 A	Singles – Not bundled
2/0	250 A	Singles – Not bundled
4/0	400 A	Singles – Not bundled
* 600 V or 2 kV PPC (entertainment cable)		
** Refer to Table 12A of the OESC		

***EESCO***

**ENTERTAINMENT ELECTRICAL SAFETY COMMITTEE OF ONTARIO**

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