Proposed Amendments to Rule 8-102 of the Ontario Electrical Safety Code

“Revision to Voltage Drop Limits in Single Dwellings”

A CONSULTATION PAPER

Electrical Safety Authority
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EXECUTIVE SUMMARY

The Electrical Safety Authority (ESA) as the regulator of electrical safety in Ontario frequently reviews the current electrical safety requirements to ensure the regulatory framework continues to provide the appropriate balance between the need to ensure safety while supporting modernization and eliminating unnecessary impediment on industry.

Ontario Regulation 164/99 adopts, by reference, the Canadian Electrical Code (CEC) together with specific Ontario amendments; which collectively are referred to as the Ontario Electrical Safety Code (OESC). The regulation also establishes the requirement that electrical wiring installations conform to the OESC which describes in detail the minimum safety standards for electrical installations and adopts into law electrical product standards.

The current limits set out in Section 8 of the OESC regarding the maximum values that voltage is permitted to drop within an installation have for many years been seen by industry and certain industry stakeholders in the residential construction market as an unnecessary burden; a burden that adds little or no safety value.

Rule 8-102 of the OESC sets the limit of voltage drop permitted within any electrical installation. The purpose of the rule is to ensure that equipment operates properly within that voltage range and to ensure any protection device used to protect the circuit operates properly. However, given the evolution in modern construction and equipment standards, the current rule unnecessarily imposes greater requirements than needed in certain circumstances and does not distinguish between types of installations, such as single dwellings.

Proposed amendments are being considered at this time to recognize the changing new home construction market in order to reduce the negative impact on industry and address complaints that the rule is antiquated and unreasonably restrictive thereby creating additional cost for industry with no tangible safety value for homeowners and may needlessly be inflating the cost of new homes.

1. INTRODUCTION

1.1 ELECTRICAL SAFETY AUTHORITY

The Electrical Safety Authority (ESA) is the Delegated Administrative Authority designated by the Minister of Consumer Services under the Safety and Consumer Statutes Administration Act, 1997 to administer and enforce Part VIII of the Electricity Act, 1998 and regulations made under that Part including:

- O. Reg. 164/99 (Ontario Electrical Safety Code (OESC)),
- O. Reg. 22/04 (Distribution Safety),
- O. Reg. 570/05 (Licensing of Electrical Contractors and Master Electricians), and
- O. Reg. 438/07 (Product Safety)

ESA, as the regulator of electrical safety in Ontario, is responsible for regulating the safe use of electricity and electrical products and equipment in Ontario and to serve the public interest as it relates to electrical safety.
1.2 LEGISLATIVE AUTHORITY

Ontario Regulation 164/99 adopts, by reference, the Canadian Electrical Code (CEC) together with specific Ontario amendments; which together are referred to as the OESC. The OESC, which sets out the minimum safety standards for electrical installations in Ontario, is updated every three years. Amendments to the OESC may be warranted between code cycles to respond to changes in the marketplace or to address safety concerns through the issuance of a Director’s Order pursuant to subsection 113(5) (a) of the Electricity Act. Specifically, subsection 113(5) (a) of the Electricity Act states that:

113(5) A Director may, in writing,
(a) authorize, subject to such conditions as may be specified and for a limited time, the use of codes, standards, guidelines, plans, specifications and procedures or changes to codes, standards, guidelines, plans, specifications and procedures necessary to accommodate new developments or technological advances and require compliance with them and permit, subject to such conditions as may be specified, variances from them;

The authority given under subsection 113(5) (a) provides ESA with the regulatory flexibility to support regulatory activities and to facilitate marketplace changes. Since the Director’s Order functions as a temporary condition or requirement, typically amendments made through this process are formalized in the next code cycle.

1.3 OBJECTIVE AND PURPOSE OF THIS PAPER

The objective of this paper is to consult with affected stakeholders on proposed amendments being considered by the ESA regarding the voltage drop limits set out in the OESC as they relate to single dwellings.

This paper will provide the background, rationale and analysis for these proposed amendments, to which stakeholders are being asked to provide their input and feedback.

If approved, the proposal will result in amendments to Rule 8-102 of the OESC and would allow a higher percentage of voltage drop for branch circuits in single dwelling units so long as it does not compromise electrical safety.

Note: A “single dwelling”, as defined by the OESC, refers to a dwelling unit consisting of a detached house, one unit of row housing, or one unit of a semi-detached, duplex, triplex, or quadruplex house.
2. PROPOSAL UNDER CONSIDERATION AND IMPACT ANALYSIS

2.1 PROPOSED REVISION TO OESC RULE 8-102 RELATING TO VOLTAGE DROP

(A) Revise Rule 8-102 to read as follows:

(1) Voltage drop in an installation shall
   (a) be based upon the calculated demand load of the feeder or branch circuit;
   (b) not exceed 5% from the supply side of the consumer’s service (or equivalent) to
       the point of utilization; and
   (c) not exceed 3% in a feeder or branch circuit.

(2) For the purposes of Subrule (1) voltage drop calculation, the demand load on a
    branch circuit shall be the connected load, if known; otherwise it shall be 80% of the
    rating of the overload or overcurrent devices protecting the branch circuit, whichever is
    smaller.

(3) Notwithstanding subrule (1), for single dwelling units, the voltage drop in a branch
    circuit shall be permitted to exceed the values in item (b) and (c) provided that it does
    not exceed a value that will prevent the overcurrent device protecting that circuit from
    operation in the event of a fault or in no case exceed 10%.

(B) Add the following Appendix B note to Rule 8-102(3)

The intent of the rule is to ensure circuit impedance does not prevent the operation of an
overcurrent device in the case of a fault, as required by Rule 10-500.

As a guide for code users, Table DXX provides circuit lengths for common conductor sizes
that will satisfy Subrule (3). For conductor sizes not listed, a calculation will be required to
demonstrate compliance.

(C) Add the following Appendix D note to Rule 8-102(3)

Table DXX

Maximum distance (meter) from overcurrent protection to the furthest point of
utilization on a circuit using 90°C rated copper conductor at 30°C ambient temperature
for 120V single phase ac circuits (2 wire circuits)

<table>
<thead>
<tr>
<th>AWG (Cu)</th>
<th>Overcurrent Protection Setting/Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15A</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

- For 240V single phase ac, 3-wire circuit, multiply lengths above by correction factor of 2
## 2.2 Background & Rationale

Voltage drop refers to the amount of voltage loss that occurs through all or part of a circuit due to wire resistance. Wires carrying current always have inherent resistance, or impedance, to current flow. Although the amount of voltage drop could be mitigated by the length of the circuit and size of wire used, a certain level of voltage loss will always occur.

The existing rules were put in place to limit the amount of voltage drop permitted within an installation. The purpose of the rule was to ensure that equipment operated properly within that voltage range and to ensure any protection device used to protect the circuit operated properly. The original proposal submitted for this Rule in the late 1970s referenced a similar proposal made under the National Electrical Code (NEC) in the United States as a rational for inclusion in the CEC. The NEC at that time rejected the proposal on the basis that voltage drop is a performance issue and not a safety hazard. However, despite what occurred in the United States, the Rule remained in the CEC.

During the last 40 years not only has the new home construction market changed and evolved, but so have the types of electrical equipment and devices that are being used in residential settings.

When the Rule was first brought into effect in Ontario, new home construction occurred in a very different environment. Homes were typically much smaller, conductor runs which could impact voltage drop were much shorter, and homes generally incorporated fewer, albeit less efficient, electrical appliances and devices. Given the size of the homes and the lower anticipated energy demands (or loads), ensuring a less than 5% voltage drop was not seen as a significant requirement for industry as, at that time, meeting this performance requirement was not onerous or costly to construction.

Today, however, new homes are generally larger in size and the industry practice of wiring single dwellings has evolved over the years where current wiring methods provide for more receptacles to be installed on longer conductor runs which at times can come into conflict with the current application of the voltage drop rules. Given the increase in the relative size of average homes, the cost to comply with the current voltage drop requirements has significantly increased for industry. This increase in cost to comply with an overly restrictive Rule is not justified by the safety or even the performance value.

Additionally, the current Rule does not distinguish between types of installations, and thereby unnecessarily imposes greater requirements than needed in certain circumstances, such as single dwellings. Moreover, the Rule does not take into consideration the technological advancements and energy efficiency of present-day appliances and devices and the voltage limits within which they are designed and certified to operate. Typically electrical equipment is not voltage sensitive and can operate normally with voltage fluctuations of +/- 10%.

Given that equipment are designed to allow for a variance in the level of voltage received, the current requirements in single dwellings are seen by industry as unnecessarily restrictive and costly and do not add to the safety of the electrical installation. They argue that the requirements impose additional unnecessary costs for builders with little or no value to consumers as the safeguards in the event of any fault will be mitigated by the over-current...
device protecting the circuit. With the innovation in equipment and devices, and their ability to adapt to small variances in power supply; the impact is even more pronounced.

ESA has had only a handful of voltage drop issues arise in single dwelling installations over the last half dozen years all of which dealt with complaints regarding the length of conductors used in an installation or equipment/device performance issues and not with the safety of the electrical installation.

Since 2008 electrical contractors and homebuilder groups have broached the issue of voltage drop values in new home construction through their local associations and ultimately through ESA’s various stakeholder committees; requesting that this rule be amended to reflect modern wiring practices in Ontario, as well as those in other jurisdictions, and new technological advancements.

In response to complaints and the requests to amend the current requirements, in 2009 ESA conducted a study on standard wiring practices in new single dwellings as it related to their compliance with the existing voltage drop rules. The study concluded that the installations under review did not all comply with the OESC in regards to the voltage drop limits as established in Section 8. In spite of this, further voltage drop testing concluded that, for other than general purpose branch circuits, there were no voltage drop issues. That is to say, all branch circuits for dedicated loads, example; kitchen, laundry, heating and cooling, etc., complied with the Rule. It was found that the bathroom, outdoor receptacles and bedroom branch circuits had the highest voltage drop measurements of up to 9% and based on the study there was only 1 circuit which was over 10%.

Since this Rule deals primarily with performance issues there tends to be a greater inconsistency in its compliance and enforcement. Contractors have raised concerns regarding their ability to comply with the current voltage drop requirements without significant additional and unnecessary cost to consumers. Moreover, should a contractor be found to be in violation of the current voltage drop requirements, the cost of correcting the issue after a single dwelling unit has been occupied is significant, thereby creating an environment of uncertainty for the industry in establishing competitive wiring practices.

Taking into account the safety measures currently in place, the technological advancements and efficiencies in electrical equipment and devices, as well as anticipating future needs; the present proposal to amend Rule 8-102 considers setting parameters for allowing a higher voltage drop limit (in no case to exceed 10%) for branch circuits in single dwelling units. This limit does not impede the operation of the over-current device protecting the circuit and hence does not compromise electrical safety.

2.3 Analysis and Safety Impact

Voltage drop is regarded primarily as a performance issue and as such the revised limit is not seen to pose any safety risk. Voltage drop on a circuit can cause incandescent lighting to slightly dim when other demand loads such as appliances or equipment turn on. Although it may be perceived as an annoyance, if noticed, it is not viewed as a safety hazard and can be mitigated by the use of new technologies including energy efficient lighting and appliances.
The proposed amendment does not eliminate any safety requirements; installations that stay within the defined parameters of the proposed change pose no negative impact on safety as any fault would be mitigated by the required over-current device protecting the circuit.

The existing Rule, which is seen to be overly restrictive, causes inconsistent compliance and enforcement. The proposed amendment would establish a reasonable limit on voltage drop thereby resulting in better compliance while maintaining appropriate safety requirements.

The proposed amendment is also based on engineering analysis that takes the safety of the electrical installation as a prime factor. The analysis takes into consideration the minimum requirement for an over-current protection device to operate considering the characteristics of the circuit it protects.

The proposal, if passed, would alleviate uncertainty for industry and reduce burden on electrical contractors and the construction industry while maintaining appropriate safety requirements and reducing costs for consumers.

### 2.4 Other Jurisdictions

The NEC in the United States does not generally consider voltage drop to be a safety issue and thus currently does not mandate voltage drop requirements for electrical installations. The information in the NEC is contained in the Fine Print Notes (FPN) and as such is neither mandatory nor enforceable by the inspection authority. The NEC does, however, require that equipment be installed so that it operates within its voltage rating as specified by the manufacturer.

As well, the International Electrotechnical Commission (IEC) has not set parameters for voltage drop limitations in its international standards for electrical installations in building, but identifies it as a performance requirement for economic and reliable design of an installation.

The CEC as adopted by each Canadian province and territory includes the existing voltage drop requirements. As in Ontario, many of the other provinces and territories are also experiencing the same inconsistent compliance and enforcement issues related to this Rule.

The Ontario Building Code includes Energy Efficiency requirements for buildings, and outlines different options for compliance. For housing within the scope of Part 9 (including single dwellings) there is no mention of voltage drop affects on energy efficiency of a house. Compared with using energy efficient appliances and lighting in a house, voltage drop is not a significant parameter. For other types of buildings, e.g. high rise apartment buildings, commercial and industrial facilities, some of the compliance options include requirements for limiting the voltage drop. For these types of buildings voltage drop could affect their energy efficiency (e.g. compliance with ANSI/ASHRAE/IES 90.1-2010 - Energy Standard for Buildings except Low-Rise Residential Buildings- with some amendments). Given the difference between the impact of voltage drop in single dwellings and other types of buildings and facilities, the ESA is only considering a change to the voltage drop limits for single dwelling homes at this time.
Proposed Amendments to OESC Section 8: “Voltage Drop Limits in Single Dwellings”

The amendments proposed in this paper are similar to a 2011 proposal by Ontario industry stakeholders recently presented at the Canadian level for inclusion in the CEC. However, as it was not tabled for the recent 2012 CEC changes and in view of the importance of this change to the Ontario residential construction industry, ESA is proposing an Ontario amendment to address this issue at this time.

3. Stakeholder Input

ESA is seeking the views of consumers, industry (e.g., electrical contractors, home builders), and other stakeholders regarding the proposed amendments presented in this paper.

In order to assist stakeholders in providing their views, ESA has provided a template for comments.

ESA thanks you for taking the time to read this paper and would very much appreciate your input. Stakeholders wishing to provide comment/feedback on the proposal are invited to send their response to ESA by March 26, 2013 via e-mail, fax, or mail.

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Mail: Proposed Amendments to OESC Consultations
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4. Privacy and Personal Information

Any personal information you might provide in this consultation process is subject to ESA’s Privacy Policy. The information will be used to assist us in conducting and evaluating the results of the consultation, which may involve disclosing your comments to other participants, institutions and interested parties during and after the consultation. Your name will not be disclosed without your consent.

If you have any questions about the collection, use or disclosure of this information, please contact: Chief Privacy Officer, 155A Matheson Blvd. W., Mississauga, ON L5R 3L5
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