

## Voltage Flicker Limits



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### 1. Scope

This standard provides a definition of voltage flicker and the established limits that have been established by City Light for voltage flicker on the utility's electrical power system.

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### 2. Application

This standard is for customers who are either requesting new electrical service or adding to their existing load and who need to perform flicker calculations as part of their electrical service application.

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### 3. Discussion

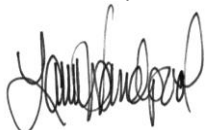
Industry best practices dictate that flicker be evaluated for all new electric service and changes to existing service. Therefore, it is recommended that SCL engineers adhere to this practice with all new and existing service requests.

Voltage flicker is defined as the subjective impression of fluctuating luminance caused by voltage fluctuations. It is caused by momentary motor starting currents, switching currents, or by fault current on the distribution system. The greater the current surge, the larger the voltage flicker. Likewise, the higher the impedance of the system, the higher the voltage flicker.

These fluctuations in system voltage can result in observable changes in the light output of electric lamps and is mostly a problem when it is observed by the human eye and is severe enough to be perceived as flicker. It can be an annoyance and hindrance to workplace productivity and affect visually induced worker discomfort.

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What constitutes visible or objectionable flicker is subjective. Customers will have different thresholds of perception and tolerance for visible flicker. This tolerance diminishes with an increase in fluctuations over time. A “perceptibility curve” was published by General Electric in 1925 developed from a collection of flicker studies. This diagram has been updated over the years to incorporate additional studies and has become the most widely adopted flicker curve in the utility industry. See Figure 3.

**Figure 3. Voltage Fluctuation Limits Allowed by Customers (GE Flicker Curve)**

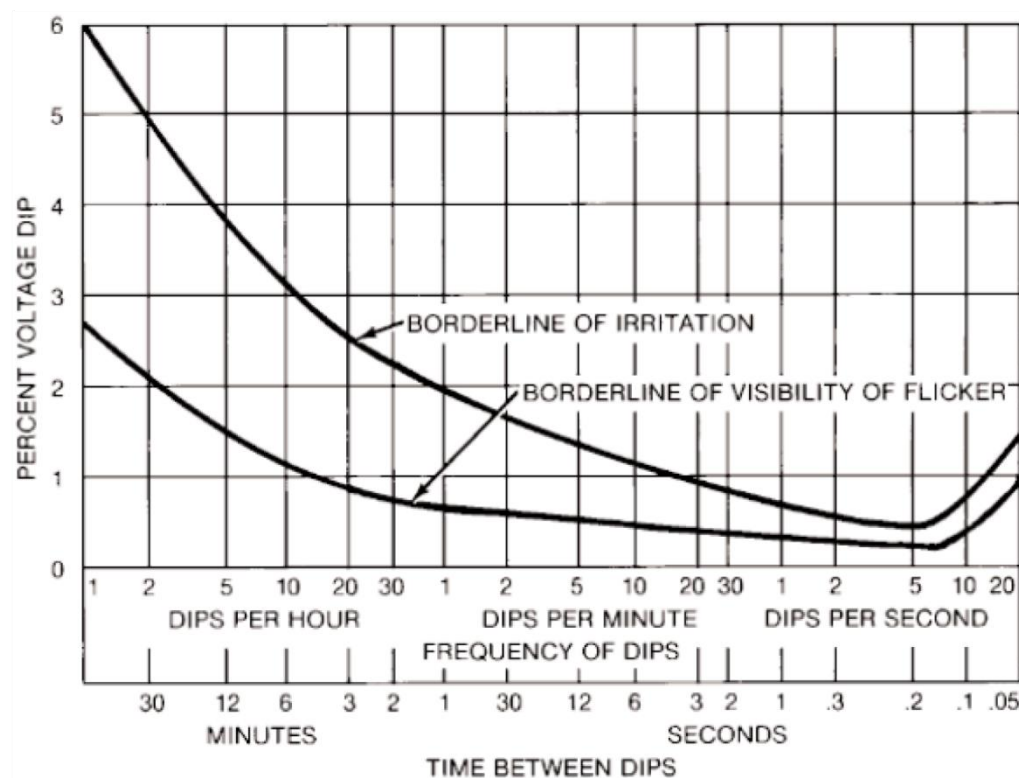


Table 3 shows the SCL-established limits for voltage flicker, using the GE Flicker Curve as a reference. While these limits may not eliminate flicker during motor starts, in most cases they will ensure flicker is kept to an acceptable level.

**Table 3. SCL-Established Voltage Flicker Limits by Customer Class**

<b>Customer Class</b>	<b>Motor Starting Load Description</b>	<b>Voltage Flicker Limit</b>
Single-family	All homes 80 A @ 120/240 V & 40% pf 0-1500 ft <sup>2</sup> homes 127 A @ 240 V & 40% pf 1501- 3000 ft <sup>2</sup> home 140 A @240 V & 40% pf 3001 ft <sup>2</sup> and up home 175 A @ 240 V & 40% pf	4% flicker at the service and 2.5% at any transformer secondary terminals or pedestal from which neighboring customers are, or could be, served.
Multifamily residential with no commercial, elevators, or three-phase service	80 A @ 120 V & 40% pf AND 127 A @ 240 V & 40% pf	4.0% flicker at the service and 2.5% at any transformer secondary terminals or pedestal from which neighboring customers are, or could be, served.
Multifamily residential with commercial, elevators, and single-phase service	80 A @ 120 V & 40% pf and the greater of the following: 5 HP motor at 40% pf OR largest motor installed	Flicker shall not exceed the Borderline of Visibility curve at the point of service, transformer secondary terminals or secondary pedestal.
Multifamily residential with commercial, elevators, and three-phase service	Largest motor and 80 A @208Y/120 V & 40% pf	Flicker shall not exceed the Borderline of Visibility curve at the point of service, transformer secondary terminals, or secondary pedestal.
Commercial and Industrial	Largest motor (Refer to RESC Chapter 12)	If a transformer serves a single customer, flicker shall not exceed the Borderline of Irritation at the transformer secondary terminals.  If a transformer serves multiple customers, flicker shall not exceed the Borderline of Visibility curve at the transformer secondary terminals or secondary pedestal. Flicker level for the customer with the motor load shall not exceed the Borderline of Irritation curve.

**4. Sources**

**City of Seattle Municipal Code Title 21**

**Kinney, Darrin**; SCL Engineer and subject matter expert for 0041.05  
(darrin.kinney@seattle.gov)

**National Electric Safety Code (NESC), 2017 Edition**

**SCL Work Practice 0035.13**; “Voltage Zones”

**Vanderpool, Laura**; Standards Technical Writer and originator of 0041.05  
(laura.vanderpool@seattle.gov)

**WAC 480-100-373** Standard Voltage and Permissible Variation National Codes