Notification Appliance Circuit Voltage Calculations

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Voltage Drop Calculations: The Basics

- Performed to size conductor
- Ensures NAC voltage stays above appliance design
- Ensures NAC voltage is adequate at end of the useful life of battery

NFPA 72 Handbook Equation (1999)

- Appliance lump sum, end load evaluation:

$$V_{load} = V_{term} - (I_{load})(R_{conductors})$$

Where:

V_{load} = minimum operating voltage of the appliance

V_{term} = 20.4 (unless specified by mfr.)

I_{load} = Total Current draw of the connected appliances

$R_{conductors}$ = total conductor resistance

Proposed Universal Shop Drawing Formula

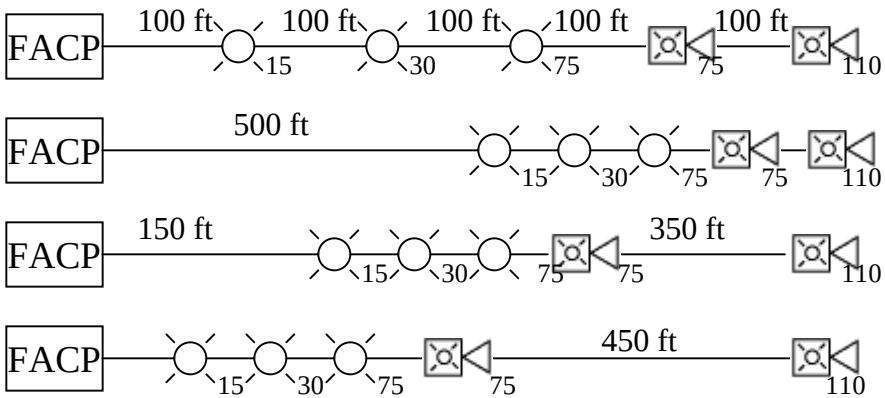
$$V_{DROP} = (I_{TOT} \cdot R \cdot 2 \cdot D_1) + \left[\left(\frac{2 \cdot I_{TOT} \cdot D_2}{n^2} \right) \cdot \sum_0^n n \cdot R \right]$$

Where:

V_{DROP}	= Voltage drop
n	= Number of devices
I_{TOT}	= Total current
R	= Conductor resistance per 1000 ft.
D_1[1]	= Distance from source to 1st device
D_2[1]	= Distance from 1st to last

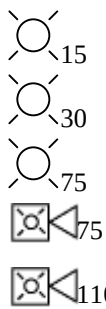
1) Add 20% to all lengths to account for necessary field corrections during install.

Scenarios Used to Validate Shop Formula



- Even loaded
- End loaded
- Middle loaded
- Front loaded

Devices Used:



- 15 cd strobe
- 30 cd strobe
- 75 cd strobe
- 75 cd Horn Strobe
- 110 cd Horn/strobe

Issues

- Not useful in retrofit applications where existing circuit features are unknown for example:
  - Existing conductor sizes may switch along circuit length
  - Distance between existing devices is unknown w/o detailed circuit mapping

Voltage Drop Test Results

14 AWG Wire

Loading	Proposed Formula (Volts DC)	NFPA 72 Formula (Volts DC)	Measured Test Results (Volts DC)	
			High to Low	Low to High
Front Loaded	1.5	2.35	0.26	0.56
Middle	1.7	2.35	0.62	0.88
End	2.35	2.35	1.17	1.55
Even	1.6	2.35	0.77	1.11

Voltage Drop Test Results

16 AWG Wire

Loading	Proposed Formula (Volts DC)	NFPA 72 Formula (Volts DC)	Measured Test Results (Volts DC)	
			High to Low	Low to High
Front Loaded	2.45	3.835	0.47	0.87
Middle	2.76	3.835	1.23	1.62
End	3.83	3.835	2.59	2.59
Even	2.61	3.835	1.23	1.83

Summary

- For new installs, proposed equation is more accurate while maintaining an adequate factor of safety.
- Add 20% to plan view conductor lengths to account for obstruction seen in the field.
- Proposed equation should be used within its limitations.