



Fire Alarms: Power Systems



WILLIAM HICKS

MSc, CFEI, CFPS, IAAI-CFI, MIFireE, EFO, CFOD, F-IAFI

Associate Professor

Eastern Kentucky University

William.Hicks@eku.edu



- **Plans Review Considerations**
- **NFPA 70 NEC**
- **Wiring Considerations**
- **Power Considerations**

Primary Power Supply

- **Primary power is provided by a dedicated branch circuit (120 VAC)**
- **Connected to low voltage transformer located in fire alarm control cabinet**
- **Generators are permissable**

Primary Power Supply

- **Circuit must be protected mechanical from damage**
- **Circuit breaker marked as “FIRE ALARM CIRCUIT”**
- **Protected from unauthorized access**
- **Overcurrent protection not exceeding 20 amps**

Secondary Power

- **Rechargeable batteries most common**
 - 24 hour/5 minute rule
- **Generators acceptable if automatically activated (with 4 hour battery back up)**
- **Must respond within 10 seconds of power loss**

Secondary Power

- **24/4 for residential**
- **7/4 rule if no commercial power supply available**
- **Recharged in 48 hours**
- **Battery “Issue” will cause trouble signal**

Back Up Power Calculations

- **Determine Battery Size**
- **Add up total stand by load**
- **Total Alarm load times 5 minutes**
- **20% Safety Margin**

Stand by Current

- All detectors (10) X 1mA = 10mA
 - Control Device (1) X 200mA=200mA
 - Failsafe Relays (4) X 50mA=200mA
 - Annunciator (1) X 100mA=100mA
- 410mA or .41 A**

$$.41 \times 24 = 9.84 \text{AH}$$

Alarm Current

- All detectors (10) X 50mA = 500mA
- Control Device (1) X 200mA=200mA
- Relays in alarm (4) X 50mA=200mA
- Annunciator (1) X 200mA=200mA
- Horns/Strobes (10) X 50mA=500mA

1600mA

1.6 A

1.6X.083=.13AH

Battery Set Size

- **Standby of 9.84AH + Alarm of .13AH=9.97AH**
- **9.97AH X .20=1.99AH + 9.97AH=11.96**

Calculating Voltage Drop

- **Devices must be capable of performing between 85% and %110 of the primary and secondary voltage**
- **Function of Current and resistance**
 - **Resistance is function of conductor size and distance from source to load.**

Voltage Drop Calculator

■ www.afaas.org

The screenshot shows an Excel spreadsheet with the following data and structure:

Formulas: This calculator provided voltage drop calculations in three formats (Point to Point, End of Line, and Load Centering).

Warning: Make sure that you know what method is accepted by, and the results do not exceed the limits set by the respective jurisdiction.

Project Name	Point to Point Method			End of Line Method			Load Centering Method		
	Current	Distance	Voltage Drop	Current	Distance	Voltage Drop	Current	Distance	Voltage Drop
	0.000	0	0.00	0.000	0	0.000	0.000	0	0.000
Totals	0.000	0	0.00	0.000	0	0.000	0.000	0	0.000

Input Fields:

- Project Name: [Empty]
- Date: [Empty]
- Circuit Number: [Empty]
- Area Covered: [Empty]
- Nominal System Voltage: [Empty]
- Minimum Device Voltage: [Empty]
- Total Circuit Current: 0.000
- Wire Gauge: 18
- Ohm's Per 1000: 7.77
- Distance from source to 1st device: [Empty]
- Wire Gauge for balance of circuit: 10
- 127
- Enter current in amps. Distance from previous device: [Empty]
- 150 = 150 ma
- Device Number: [Empty]
- Device Current: [Empty]
- At Drop from source: [Empty]
- Voltage Drop: [Empty]
- Percent Drop: [Empty]

Notes:

- Wire resistance is doubled in the calculations for two wires (Positive and Negative)
- The voltage calculated to the last device in any method must not be lower than the manufacturer's listed minimum operating voltage (IE: rated operating voltage 20-32 VDC).

Device Manufacturer Data:

Device Manufacturer	Genex	Current @Rated Voltage
Horn Strobes <td></td> <td></td>		
Model #		
Candela		

Totals: 0.000, 0, End of Line Voltage 0.00

Battery Types

- **Vented lead acid**
 - Used in high current/extended standby time at lower currents
- **Sealed lead acid**
 - All gases sealed in and recycled
 - Most common
- **NiCad**
 - Used with low, consistent volt draws

Remotely Located Power Needs

- **Must have its own Primary and secondary power**
- **Must be supervised**
- **Used to power remotely located NAC Power boosters, distributed voice evacuation amplifier**

Basics

- **Name, Scope etc.**
- **Scale 1/8" = 1'**
- **Your job is to confirm**
 - **Devices all function per MFG or NFPA 72**
 - **Installed Per NFPA 70**

Basics

- **NFPA 170 Symbols**
- **Require FULL Fire Alarm System Diagrams including control unit, power supplies, battery chargers, and annunciators**

Terms

- **Fire Alarm Circuit**
 - **Either Power Limited or non power limited**

- **Abandoned Fire Alarm Cable**
 - **Not terminated at equipment and not tagged for future use**

Terms

- **Power Limited Fire Alarm Circuit (PLFA)**
 - May use Class three transformer, Class three power supply or listed PLFA power supply
- **Non Power limited Fire Alarm Circuit (NPLFA)-**
 - Those meeting Article 760.41 and 760.43
 - Power source not more than 600 volts
- **Fire Alarm Circuit Integrity (CI) Cable**
 - Used to insure operation of Critical circuits

Installation Considerations

- **Must pass thru walls in an “Approved” manner (Fire Barrier)**
- **Must be supported in cable trays or attached in manner to structure which does not damage cable**
- **Must be installed in a neat manner**

- **Circuits must be identifiable**
- **Power NEVER supplied thur a GFCI or AFCI**

- **All raceway, conduits, and wire must meet the intent of the NEC**
 - **Must only be used in the manner designed (not over amped, etc)**
 - **Fused where necessary**

Careful around Air Handling Systems

- **Specific Requirements on different types of air handling equipment**
- **Restrictions on wiring in ducts**
 - **Horizontal runs**



References

- Design of Special Hazards and Fire Alarm Systems - 2nd Edition-Gagnon
- Fire Protection Systems-2nd Edition-Jones
- Fire Protection Handbook-20th Edition-NFPA
- NFPA Standard



Questions?

