

# **Fire Investigation Independent Study Continuing Education**

## **NFPA 921 UNIT #6 – Study Guide**

**NFPA 921 Guide for Fire and Explosion Investigations 2004 Edition**

**Objective:** Given an examination the participant shall demonstrate a knowledge and understanding of electricity and fire.

**Reading/study assignment:** NFPA 921 Guide for Fire and Explosion Investigations, 2004 Edition, pp. 921-56 through 921-80 (Chapter 8)

### **Study/reference questions:**

What must be done before a fire can properly be determined to have been caused by electricity?

What causes a floating neutral?

What shapes can be seen in melted aluminum conductors?

Does the presence of arcing in a circuit breaker panel indicate the panel as the source of ignition?  
Why or why not?

What is ampacity of a conductor?

What is Ohm's Law wheel and how do we use it?

How should electrical equipment be considered as an ignition source?

What type electrical conductors and equipment do not normally present a fire hazard?

Study Figures 8.10.3.1(a) through 8.10.3.1(f).

What type system is compared to an electrical system to help us understand the electrical system?

Study Tables 8.2.2.1(a) and 8.2.2.1(b).

What are conductors compared to in the hydraulic system and what are their purposes?

Is the electrical system an open or closed system and how does this control the current flow?

Why is heat generated in an electrical system and what does the amount of heat depend on?

In what way do we compare pipe size in a hydraulic system with conductor size in an electrical system? Why?

What happens when PVC ages or is exposed to fire?

What does AGW stand for?

What are the considerations when collecting potential electrical evidence?

How do wire sizes correspond to the gauge numbers?

Where would an AGW 22 conductor be used?

What size conductors are used in residential circuits?

How do AGW numbers compare with the resistance of a conductor?

What is an incendive arc?

What type of path does lightning follow to ground and what are some examples?

Why should melted electrical conductors be examined?

How does type and geometry of fuel relate to electrical energy ignition?

Will overdriven or misdriven staples cause a fire? Why or why not?

How does heat production compare to wattage?

**Thoroughly study *Interpreting Damage to Electrical Systems* - Section 8.10**

General

Short Circuit and Ground Fault Parting Arcs

Arcing Through Char

Overheating Connections

Overload

Effects Not Caused by Electricity

Conductor Surface Colors

Melting by Fire

Alloying

Mechanical Gouges

What are copper-clad aluminum conductors, are they used and what is their melting temperature?

What is the melting temperature of pure aluminum?

What is the investigator cautioned to review about scientific studies and research?

What do the ampacity values for a conductor depend on?

How does heat production of current passing through an aluminum conductor compare with the heat production of current passing through a copper conductor?

What is static electricity?

What is bonding, how and why is it done?

Can copper and silver form alloys? If so, where may they be seen?

How is energy measured?

How does current conduction compare in steel, copper, aluminum and silver?

What is Ohm's Law? What are the symbols and what do they represent? How do we use Ohm's Law?

What cause plastic materials in a circuit breaker panel to melt or decompose?

What do we call the rate of energy used and how do we express it?

How would we determine total amperes being used?

Will an overload always cause a fire? What if the overload occurred on a conductor where the heat was confined or trapped? Is an overload on a conductor proof that it caused an ignition?

Why will a short circuit not normally cause a conductor to overheat?

The main emphasis of NFPA 921 is placed on what common building electrical service?

Where are the terms hot, neutral, and ground used and what are the proper terms for these?

In what direction can current flow and what frequency is used in the US for one of these flows of current?

What is static electricity and what causes it?

How may charges on a liquid's surface relate to a fire cause? Explain.

What is three-phase service and what does it consist of?

What are the meter and base, what are the components of this assembly, where are they found and what do they do?

What is the significance of the service entry in a fire investigation?

What is service equipment, where is it found, and what is its function?

What must be grounded, how and why is it done?

What are switches used for, where should they be installed, and how do conductors connect?

What may happen if an electrical system is not properly grounded, what is it called, what may be an indication of this condition?

What is overcurrent protection and where is it installed?

What does a beaded conductor indicate?

What are fuses, what types of fuses are there, how do they operate, and if they function to protect a circuit may they be used again?

What are plug type fuses, what sizes are they usually found in, where are they used and how may they be by-passed/

How does electrical conductor melting caused by electrical arcing differ from melting caused by fire?

What are Type S Fuses, why were they developed, how are they used, and in what sizes?

The National Electrical Code carries what NFPA document number?

What are time delay fuses, why are they used, and how do they operate?

What are cartridge fuses, what types are there, how do they work and where are they found?

What is a circuit breaker, how do they operate, and what type of material are they made of?

What are main breakers, where are they found, and what sizes are common in residences?

What size general lighting branch circuit breakers should be found in residences?

How are branch circuit breakers rated?

Residential large appliances may have what size branch circuit breakers?

May a small appliance have a dedicated branch circuit breaker? Usually what size?

What is a GFCI, what is it designed for and where is it used?

What are branch circuits and what conductors exist in these circuits?

Do all branch circuits have a grounding conductor?

What material are conductors of most electrical installations made of? Why?

Branch circuit conductors are what size for what ampacity?

Is aluminum branch wiring used, when, where?

How does conductor size relate to resistance?

How should a circuit breaker panel be secured and recovered after a fire? Why?

Why is size of conductors regulated?  
Study Figures 8.10.2 through 8.10.6.2.2.

Does aluminum have greater or less conductivity than copper?

How are sizes of conductors measured?

What is resistance heating? Explain.

Do arcs occur between conductors and between conductors and insulation? How and what may happen?

What is the melting temperature of pure copper?

What are the two characteristic properties of lightning that cause damage?

If copper conductors oxidize in a fire how will they look?

Why may copper conductors melt along their surface at a temperature lower than the melting point of pure copper?

How do we measure pressure in an electrical system and what do we compare this to in the hydraulic system?

Friction loss in a hydraulic system is compared to what in an electrical system?

Does the presence of sufficient energy for ignition assure the ignition? Why or why not?

How will the conductor size a copper compare to aluminum carrying the same ampacity?

What are the specific colors of conductor insulation and what do the various colors mean?

What is PVC and where is it commonly used in electrical circuits?

What happens as PVC ages and what occurs with PVC in a fire?

When was rubber commonly used as conductor insulation, how does it age and act in fire?

What is a polarized receptacle and why are they used?

What materials other than PVC and rubber may be used as conductor insulation? Where and why?

What are duplex receptacles and what ampacity are they usually?

How do conductors connect to receptacles and what color conductors connect to what?

Where are single receptacles used?

What may happen with arcing involving uninsulated conductors?

What is conductor insulation and what is it designed to do?

What is a high resistance fault and can they cause a fire? Why or why not?

What must be maintained long enough for electrical energy to be an ignition source?

How is electrical flow measured and what do we compare this to in a hydraulic system?

How may poor connections be an electrical energy ignition source? Explain.

What is overcurrent?

How may Lightning Detection Networks be used?

What is a single-phase service and what does it consist of?

Is ignition by overload common? Why or why not?

What is overload?

How may overcurrent or overload be an electrical energy ignition source? Explain.

What must occur for ignition from an electrical source?

What other outlets, devices or equipment are used in electrical systems and why?

What may happen with overdriven or misdriven staples?

How does conductor size and overcurrent protection relate to overload? Explain.

What are high voltage arcs and how may they cause a fire?

How may high-pressure spraying operations be involved in a fire cause?

What high voltage arc has extremely high voltage where arcs can jump many places?

What is arc tracking, how does it occur and how may it cause a fire?

What are sparks, when do they occur and how may they cause a fire?

What is surface charge?

How may heat producing devices be an electrical energy ignition source?

What are parting arcs, how and when do they occur? What are some examples and how would they start a fire?

Which sparks may have they greater ability to cause a fire, aluminum, copper, or steel? Why?

What has laboratory experiments and knowledge indicated about some prior beliefs?

Will undersize conductors always cause a fire? Why or why not?

Do nicked or stretched conductors usually cause a fire? Why or why not?

Why are copper conductors used?

Will a short circuit cause a fire? Why or why not? If so, under what conditions?

Lightning Detection Networks may establish time and location within what distance?

What is the purpose of the basic electrical section?

How may accumulations of static electricity be controlled? Give examples.

What voltage/type systems are typical in residential and commercial buildings and NFPA 921 focuses on?

What are arcs? What fuels may arcs ignite? What fuels will arcs not ignite? Why?

What are some common sources of static electricity?

How is static electricity generated by ignitable liquids and how does a fire occur?

What is switch loading and how may it be involved in a fire cause?

Does current always flow through the meter?

How may flowing gases being involved as a fire cause?

How can dusts and fibers generate static electricity and how may this relate to a fire cause?

How and when may the human body and clothing generate static electricity? Are they a potential ignition source? Why or why not?

What governs the ability of an arc to produce ignition? How does this relate to fire cause?

How is static electricity generated? What does charged mean?

What conditions are necessary for static arc ignition?

What are some of the things a fire investigator needs to do when investigating static arc ignition?

What is lightning?

What are some of the characteristics of a lightning bolt?

In what ways may lightning enter a structure?

How does deteriorated insulation relate to fire causes?

What are some examples of lightning damage? Explain how the damage was caused.

How and why should arc damage to a circuit breaker panel be analyzed?