

**CHAPTER FIVE  
FIRE INVESTIGATOR  
COURSE OUTLINE**

<b>SECTION</b>	<b>SUBJECT</b>	<b>RECOMMENDED HOURS</b>
501-1	Commission on Fire Protection Rules and Regulations	0
501-2	INTENTIONALLY LEFT BLANK	0
501-3	Definitions	0
501-4	Basic Methodology	2
501-5	Basic Fire Science	8
501-6	Fire Patterns	12
501-7	Building Systems	2
501-8	Fire Protection Systems	2
501-9	Electricity and Fire	8
501-10	Building Fuel Gas Systems	4
501-11	Fire-Related Human Behavior	2
501-12	Legal Considerations	8
501-13	Safety	4
501-14	Sources of Information	8
501-15	Planning the Investigation	2
501-16	Documentation of the Investigation	8
501-17	Physical Evidence	8
501-18	Origin Determination	8
501-19	Fire Cause Determination	3
501-20	Classification of Fire Cause	1
501-21	Analyzing the Incident for Cause and Responsibility	4
501-22	Failure Analysis and Analytical Tools	4
501-23	Explosions	4
501-24	Incendiary Fires	8
501-25	Fire and Explosion Deaths and Injuries	4
501-26	Appliances	2
501-27	Motor Vehicle Fires	8
501-28	Wildfire Investigations	8
501-29	Management of Complex Investigations	2
501-30	Marine Fire Investigations	2
501-31	Practical Exercises	24
	<b>TOTAL HOURS RECOMMENDED</b>	<b>160</b>

\* The recommended hours for skills evaluation is based on 12 students. Actual hours needed will depend on the number of students, the number of examiners, availability of equipment, and the student skill level.

**CHAPTER FIVE  
FIRE INVESTIGATOR  
COURSE PHASE OUTLINE**

<b>SECTION</b>	<b>SUBJECT</b>	<b>RECOMMENDED HOURS</b>
<b>FIRE INVESTIGATOR I – PHASE I</b>		
501-4	Basic Methodology	2
501-15	Planning the Investigation	2
501-13	Safety	4
501-5	Basic Fire Science	8
501-6	Fire Patterns	12
501-7	Building Systems	2
501-18	Origin Determination	8
501-16	Documentation of the Investigation	8
501-17	Physical Evidence	8
	<b>Total Recommended Hours</b>	<b>54</b>
<b>FIRE INVESTIGATOR II – PHASE II</b>		
501-14	Sources of Information	8
501-12	Legal Considerations	8
501-10	Building Fuel Gas Systems	4
501-19	Fire Cause Determination	3
501-20	Classification of Fire Cause	1
501-11	Fire-Related Human Behavior	2
501-23	Explosions	4
501-25	Fire and Explosion Deaths and Injuries	4
501-9	Electricity and Fire	8
501-24	Incendiary Fires	8
501-21	Analyzing the Incident for Cause and Responsibility	4
501-26	Appliances	2
	<b>Total Recommended Hours</b>	<b>56</b>
<b>COMPLETER – PHASE III</b>		
501-8	Fire Protection Systems	2
501-27	Motor Vehicle Fires	8
501-30	Marine Fire Investigations	2
501-28	Wildfire Investigations	8
501-29	Management of Complex Investigations	2
501-22	Failure Analysis and Analytical Tools	4
501-31	Practical Exercises*	24
	<b>Total Recommended Hours</b>	<b>50</b>
<b>TOTAL HOURS RECOMMENDED</b>		<b>160</b>

\*The recommended hours for skills evaluation is based on 12 students. Actual hours needed will depend on the number of students, the number of examiners, availability of equipment, and the student skill level.

## RECOMMENDED REFERENCE LIST FOR THE FIRE INVESTIGATOR CURRICULUM

This Reference List is provided as a general guide for both instructors and students to locate information pertaining to the specific objectives in the TCFP Curriculum. This list is **not** all-inclusive and does not in any way limit TCFP development and use of questions to test the objectives of the curriculum:

### Required References

DeHaan, John D., *Kirk's Fire Investigation*, (7<sup>th</sup> ed.) (2012). Upper Saddle River, NJ: Brady/Prentice Hall.

*Emergency Response Guidebook*, (Current ed.) U.S. Department of Transportation Research and Special Programs Administration, Office of Hazardous Materials Initiatives and Training.

*Fire Inspection and Code Enforcement* (8<sup>th</sup> ed.) (2014). Stillwater, OK: Fire Protection Publications. International Fire Service Training Association.

*Fire Investigator* (2<sup>nd</sup> ed.) (2010). Stillwater OK: Fire Protection Publications. International Fire Service Training Association (IFSTA).

*Fire Investigator: Principles and Practices* (3<sup>rd</sup> ed.) (2012). Burlington, MA: Jones and Bartlett Learning.

*NFPA 921: Guide for Fire and Explosion Investigations* (2014 ed.) Quincy, MA: National Fire Protection Association. NFPA Publications.

*NFPA 1033: Standard for Professional Qualifications for Fire Investigator* (2014 ed.) Quincy, MA: National Fire Protection Association. NFPA Publications.

*Rules of Criminal Evidence*, latest edition. (On 04/03/14, this information was available online at <http://www.courts.state.tx.us/rules/tre-toc.asp>).

*Texas Code of Criminal Procedure*, latest edition. (On 04/03/14, this information was available online at <http://www.statutes.legis.state.tx.us/>).

Texas Commission on Fire Protection, *Fire Investigator Curriculum*.

*Standards Manual for Fire Protection Personnel*. Austin, TX: Texas Commission on Fire Protection.

*Texas Family Code*, latest edition. (On 04/03/14, this information was available online at <http://www.statutes.legis.state.tx.us/>).

*Texas Insurance Code*, latest edition. (On 04/03/14, this information was available online at <http://www.statutes.legis.state.tx.us/>).

*Texas Penal Code*, latest edition. (On 04/03/14, this information was available online at <http://www.statutes.legis.state.tx.us/>).

*Texas Public Information Act Handbook*, latest edition. (On 04/03/14, this information was available online at [http://www.oag.state.tx.us/AG\\_publications/pdfs/publicinfo\\_hb.pdf](http://www.oag.state.tx.us/AG_publications/pdfs/publicinfo_hb.pdf). It is available through the Texas Attorney General's office.)

*United States Constitution*. (On 04/03/14, this information was available online at <http://www.archives.gov/exhibits/charters/charters.html>).

### **Recommended References**

The most current edition of the following publications and media are recommended (not required) supplemental material for program use.

#### Texts

Cole, Lee S., *Investigation of Motor Vehicles*, (4<sup>th</sup> ed.) (2001). Lee Books.

*Fire in Texas*, Texas State Fire Marshals Office. Department of Insurance, TEXFIRS section.

Icove, David J., DeHaan, John D, and Haynes, Gerald A., *Forensic Fire Scene Reconstruction*, (3<sup>rd</sup> ed.) (2012). Upper Saddle River, NJ: Brady/Prentice Hall.

*NFPA 472: Standard for Professional Competence of Responders to Hazardous Materials Incidents* (2013 ed.). Quincy, MA: National Fire Protection Association. NFPA Publications.

Factory Mutual Insurance – *Fire Investigators Handbook*

*The VIN number book - Passenger Vehicle Identification Manual* (2013, 84th edition)  
National Insurance Crime Bureau, 1111 E. Touhy Avenue, Suite 400, Des Plaines, IL 60018-2805

TX State FMO Lab submittal guide (Forensic Arson Laboratory Guidelines for Evidence) (<http://www.tdi.state.tx.us/fire/documents/fmlabguideline.pdf>)

US DOJ (Fire and Arson Scene Evidence)  
(<http://www.ncjrs.gov/pdffiles1/nij/181584.pdf>)

## Fire Investigator

A Fire Investigator is an individual who has demonstrated the knowledge, skills and abilities necessary to conduct, coordinate, and complete a fire investigation employing all the elements of the scientific method as the operating analytical process throughout the investigation. A Fire Investigator can competently determine the origin and cause of a fire and has mastered all the job performance requirements of NFPA 1033: *Standard for Professional Qualifications for Fire Investigator*.

### SECTION 1

#### COMMISSION ON FIRE PROTECTION

#### RULES AND REGULATIONS

##### 4.1 General

**NFPA 1033 4.1.1** The fire investigator shall meet the job performance requirements defined in Sections 4.2 through 4.7.

**501-1.1**      ***The Investigator candidate shall describe the purpose of the NFPA standard and guide applicable to Fire Investigators.***

- 1.1.1      NFPA 1033 *Standard for Professional Qualifications for Fire Investigator*, 2014 edition.
- 1.1.2      NFPA 921 *Guide for Fire and Explosion Investigations*, 2014 edition.

**501-1.2**      ***The Investigator candidate shall identify rules applicable to the Fire/Arson Investigator certification adopted by the Texas Commission on Fire Protection.***

- 1.2.1      The Investigator candidate shall identify the requirements for certification as a Fire Investigator as stated in the *Standards Manual for Fire Protection Personnel*, Chapter 431.
- 1.2.2      The Investigator candidate shall identify the requirements for certification as an Arson Investigator as stated in the *Standards Manual for Fire Protection Personnel*, Chapter 431.
- 1.2.3      The Investigator candidate shall identify the various levels of certification for Fire and/or Arson Investigator,

as stated in the *Standards Manual for Fire Protection Personnel*, Chapter 431.

- 1.2.3.1 Basic
- 1.2.3.2 Intermediate
- 1.2.3.3 Advanced
- 1.2.3.4 Master

**SECTION 2**

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## **SECTION 3**

### **DEFINITIONS**

**501-3.1** ***The Investigator candidate shall define the terms used in Chapter 3 of NFPA 921, Guide for Fire and Explosion Investigation (2014 Edition).***

## SECTION 4

### BASIC METHODOLOGY

#### 4.1 General

**NFPA 1033 4.1.2** The fire investigator shall employ all elements of the scientific method as the operating analytical process throughout the investigation and for the drawing of conclusions.

**501-4.1**      ***The Investigator candidate shall describe the nature of fire investigations.***

**501-4.2**      ***The Investigator candidate shall apply the principles of the systematic approach of the scientific method.***

**501-4.3**      ***The Investigator candidate shall describe the steps of the scientific method relating to fire investigations.***

- 4.3.1      Recognize the need
- 4.3.2      Define the problem
- 4.3.3      Collect data
- 4.3.4      Analyze the data
- 4.3.5      Developing a hypothesis (inductive reasoning)
- 4.3.6      Test the hypothesis (deductive reasoning)
- 4.3.7      Avoid presumption
- 4.3.8      Expectation bias
- 4.3.9      Confirmation bias

**501-4.4**      ***The Investigator candidate shall describe the basic method of fire investigation.***

- 4.4.1      Receiving the assignment
- 4.4.2      Preparing for the investigation
- 4.4.3      Conducting the investigation
- 4.4.4      Collecting and preserving evidence

4.4.5 Analyzing the incident

4.4.6 Conclusions

**501-4.5** ***The Investigator candidate shall properly distinguish between the different levels of certainty.***

4.5.1 Probable versus possible

4.5.2 Suspected

4.5.3 Expert opinions

**501-4.6** ***The Investigator candidate shall develop “review procedures.”***

4.6.1 Administrative review

4.6.2 Technical review

4.6.3 Peer review

**501-4.7** ***The Investigator candidate shall describe different reporting procedures.***

## SECTION 5

### BASIC FIRE SCIENCE

#### 4.2 Scene Examination.

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.4** Interpret fire patterns, given standard equipment and tools and some structural or content remains, so that each individual pattern is evaluated with respect to the burning characteristics of the material involved and in context and relationship with all patterns observed and the mechanisms of heat transfer that led to the formation of the pattern..

**(A) Requisite Knowledge.** Fire dynamics, fire development, and the interrelationship of heat release rate, form, and ignitibility of materials.

**(B) Requisite Skills.** Ability to interpret the effects of burning characteristics on different types of materials.

**NFPA 1033 4.2.5** Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that fire development is determined, methods and effects of suppression are evaluated, false origin area patterns are recognized, and all areas of origin are correctly identified.

**(A) Requisite Knowledge.** Fire behavior and spread based on fire chemistry, fire dynamics, and physics, fire suppression effects, building construction.

**(B) Requisite Skills.** Ability to interpret variations of fire patterns on different materials with consideration given to heat release rate, form, and ignitibility; distinguish impact of different types of fuel loads; evaluate fuel trails; and analyze and synthesize information.

**NFPA 1033 4.2.6** Examine and remove fire debris, given standard equipment and tools, so that all debris is checked for fire cause evidence, potential ignition source(s) is identified, and evidence is preserved without investigator-inflicted damage or contamination.

**(A) Requisite Knowledge.** Basic understanding of ignition processes, characteristics of ignition sources, and ease of ignition of fuels; debris-layering techniques; use of tools and equipment during the debris search; types of fire cause evidence commonly found in various degrees of damage; and evidence-gathering methods and documentation.

**(B) Requisite Skills.** Ability to employ search techniques that further the discovery of fire cause evidence and ignition sources, use search techniques that incorporate documentation, and collect and preserve evidence.

#### **501-5.1**      **The Investigator candidate shall define and describe fire science.**

5.1.1      General

5.1.2      Identify and describe the elements of the fire tetrahedron.

5.1.2.1    Define fuel and describe the three states in which fuel exists.

- 5.1.2.2 Describe the action of oxidizing agents.
- 5.1.2.3 Describe the relationship of heat in the combustion process.
- 5.1.2.4 Describe the uninhibited chemical chain reaction of combustion.

**501-5.2**      ***The Investigator candidate shall be able to discuss fire chemistry as the study of chemical processes that occur in fires, including changes of state, decomposition, and combustion.***

- 5.2.1      General
- 5.2.2      The Investigator candidate shall define and describe phase changes and thermal decomposition.
- 5.2.3      The Investigator candidate shall describe combustion reactions, premixed burning, diffusion flames, and transactions from premixed burning to diffusion flame burning.

**501-5.3**      ***The Investigator candidate shall identify and describe products of combustion.***

**501-5.4**      ***The Investigator candidate shall identify and describe fluid flows generated by mechanical forces or by buoyant forces generated by temperature differences.***

- 5.4.1      General
- 5.4.2      Buoyant flows
- 5.4.3      Fire plumes
- 5.4.4      Ceiling jets
- 5.4.5      Vent flows

**501-5.5**      ***The Investigator candidate shall define and describe methods of heat transfer.***

- 5.5.1      General
- 5.5.2      Conduction

- 5.5.3 Convection
- 5.5.4 Radiation
- 5.5.5 Thermometry

**501-5.6**     ***The Investigator candidate shall define and describe the fuel load, fuel packages, and properties of flame.***

- 5.6.1 Fuel load
- 5.6.2 Fuel items and fuel package
- 5.6.3 Heat release rate
- 5.6.4 Properties of flames
- 5.6.5 Thermal structure of a flame
- 5.6.6 Heat fluxes from flames
  - 5.6.6.1 Heat fluxes from flames to contacted surfaces
  - 5.6.6.2 Heat fluxes from flames to remote surfaces

**501-5.7**     ***The Investigator candidate shall describe the different forms and mechanisms of ignition.***

- 5.7.1 Ignition in general
- 5.7.2 Ignition of flammable gases
- 5.7.3 Ignition of liquids
- 5.7.4 Ignition of solids

**501-5.8**     ***The Investigator candidate shall describe the different flame spreads and their characteristics.***

- 5.8.1 General
  - 5.8.1.1 Counterflow flame spread
  - 5.8.1.2 Concurrent flame spread
  - 5.8.1.3 Fire spread on sloped surfaces
- 5.8.2 Flame spread on liquids
- 5.8.3 Flame spread on solids

**501-5.9**      ***The Investigator candidate shall describe the different methods of fire spread in a compartment.***

- 5.9.1      General
- 5.9.2      Fire spread
  - 5.9.2.1    Fire spread by flame impingement
  - 5.9.2.2    Fire spread by remote ignition

**501-5.10**      ***The Investigator candidate shall describe compartment fire development.***

- 5.10.1     General
- 5.10.2     Compartment fire phenomena
- 5.10.3     Compartment vent flows
- 5.10.4     Flashover
- 5.10.5     Fully developed compartment fires
- 5.10.6     Effects of enclosures on fire growth
  - 5.10.6.1   Room volume and ceiling height
  - 5.10.6.2   Location of the fire in the compartment

**501-5.11**      ***The Investigator candidate shall identify fire spread between compartments.***

- 5.11.1     Fire spread via openings
- 5.11.2     Fire spread via barriers

**501-5.12**      ***The Investigator candidate shall describe the paths of smoke spread in buildings.***

## **SECTION 6**

### **FIRE PATTERNS**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.4** Interpret fire patterns, given standard equipment and tools and some structural or content remains, so that each individual pattern is evaluated with respect to the burning characteristics of the material involved and in context and relationship with all patterns observed and the mechanisms of heat transfer that led to the formation of the pattern.

**(A) Requisite Knowledge.** Fire dynamics, fire development, and the interrelationship of heat release rate, form, and ignitibility of materials.

**(B) Requisite Skills.** Ability to interpret the effects of burning characteristics on different types of materials.

**NFPA 1033 4.2.5** Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that fire development is determined, methods and effects of suppression are evaluated, false origin area patterns are recognized, and all areas of origin are correctly identified.

**(A) Requisite Knowledge.** Fire behavior and spread based on fire chemistry, fire dynamics, and physics, fire suppression effects, building construction.

**(B) Requisite Skills.** Interpret variations of fire patterns on different materials with consideration given to heat release rate, form, and ignitibility; distinguish impact of different types of fuel loads; evaluate fuel trails; and analyze and synthesize information.

**NFPA 1033 4.2.7** Reconstruct the area of origin, given standard and, if needed, special equipment and tools as well as sufficient personnel, so that all protected areas and fire patterns are identified and correlated to contents or structural remains, items potentially critical to cause determination and photo documentation are returned to their prefire location, and the area(s) or point(s) of origin is discovered.

**(A) Requisite Knowledge.** The effects of fire on different types of material and the importance and uses of reconstruction.

**(B) Requisite Skills.** Ability to examine all materials to determine the effects of fire, identify and distinguish among different types of fire-damaged contents, and return materials to their original position using protected areas and fire patterns.

**501-6.1**      ***The Investigator candidate shall define fire patterns.***

**501-6.2**      ***The Investigator candidate shall be able to identify fire effects.***

6.2.1      Identify fire patterns

6.2.2      Temperature estimation using fire effects

- 6.2.3 Mass loss of material
- 6.2.4 Char
  - 6.2.4.1 Introduction
  - 6.2.4.2 Surface effect of char
  - 6.2.4.3 Appearance of char
  - 6.2.4.4 Rate of wood charring
  - 6.2.4.5 Depth of char
  - 6.2.4.6 Nature of char
- 6.2.5 Spalling
- 6.2.6 Oxidation
- 6.2.7 Color changes
- 6.2.8 Melting of materials
- 6.2.9 Thermal expansion and deformation of materials
- 6.2.10 Deposition of smoke on surfaces
- 6.2.11 Clean burn
- 6.2.12 Calcination
- 6.2.13 Window glass
  - 6.2.13.1 Breaking of glass
  - 6.2.13.2 Tempered glass
  - 6.2.13.3 Staining of glass
- 6.2.14 Collapsed furniture springs
- 6.2.15 Distorted light bulbs
- 6.2.16 Rainbow effect
- 6.2.17 Victim injuries

**501-6.3** ***The Investigator candidate shall be able to identify the following fire patterns.***

- 6.3.1 Introduction
  - 6.3.1.1 Dynamics of pattern production
  - 6.3.1.2 Lines or areas of demarcation

- 6.3.2 Causes of fire patterns
  - 6.3.2.1 Plume-generated patterns
  - 6.3.2.2 Ventilation-generated patterns
  - 6.3.2.3 Hot gas layer-generated patterns
  - 6.3.2.4 Full room involvement-generated patterns
  - 6.3.2.5 Suppression-generated patterns
- 6.3.3 Locations of patterns
- 6.3.4 Location of objects
  - 6.3.4.1 Heat shadowing
  - 6.3.4.2 Protected areas
- 6.3.5 Penetrations of horizontal surfaces
- 6.3.6 Depth of char patterns with fuel gases
- 6.3.7 Pattern geometry
  - 6.3.7.1 V patterns on vertical surfaces
  - 6.3.7.2 Inverted cone (triangular) patterns
  - 6.3.7.3 Hourglass patterns
  - 6.3.7.4 U-shaped patterns
  - 6.3.7.5 Truncated cone patterns
  - 6.3.7.6 Pointer and arrow patterns
  - 6.3.7.7 Circular-shaped patterns
  - 6.3.7.8 Irregular patterns
  - 6.3.7.9 Doughnut-shaped patterns
  - 6.3.7.10 Linear patterns
  - 6.3.7.11 Area patterns
  - 6.3.7.12 Saddle burns

**501-6.4      *The Investigator candidate shall be able to identify and analyze fire patterns.***

- 6.4.1 Types of fire patterns
  - 6.4.1.1 Fire spread (movement) patterns
  - 6.4.1.2 Heat (intensity) patterns
  - 6.4.1.3 Combination of patterns

## **SECTION 7**

### **BUILDING SYSTEMS**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.5** Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that fire development is determined, methods and effects of suppression are evaluated, false origin area patterns are recognized, and all areas of origin are correctly identified.

**(A) Requisite Knowledge.** Fire behavior and spread based on fire chemistry, fire dynamics, and physics, fire suppression effects, building construction.

**(B) Requisite Skills.** Interpret variations of fire patterns on different materials with consideration given to heat release rate, form, and ignitability; distinguish impact of different types of fuel loads; evaluate fuel trails; and analyze and synthesize information.

**NFPA 1033 4.2.8** Inspect the performance of building systems, including detection, suppression, HVAC, utilities, and building compartmentation, given standard and special equipment and tools, so that a determination can be made as to the need for expert resources, an operating system's impact on fire growth and spread is considered in identifying origin areas, defeated and/or failed systems are identified, and the system's potential as a fire cause is recognized.

**(A) Requisite Knowledge.** Different types of detection, suppression, HVAC, utility, and building compartmentation such as fire walls and fire doors; types of expert resources for building systems; the impact of fire on various systems; common methods used to defeat a system's functional capability; and types of failures.

**(B) Requisite Skills.** Ability to determine the system's operation and its effect on the fire; identify alterations to, and failure indicators of, building systems; and evaluate the impact of suppression efforts on building systems.

**501-7.1**      ***The Investigator candidate shall recognize the reaction of buildings and building assemblies to fire.***

**501-7.2**      ***The Investigator candidate shall evaluate the features of design, construction and structural elements in evaluating fire development.***

7.2.1      General

7.2.2      Building design

7.2.2.1    General

7.2.2.2    Building loads

7.2.2.3    Room size

7.2.2.4    Compartmentation

- 7.2.2.5 Concealed and interstitial spaces
- 7.2.2.6 Planned designs as compared to “as-built” conditions
- 7.2.3 Materials
  - 7.2.3.1 Ignitability
  - 7.2.3.2 Flammability
  - 7.2.3.3 Thermal inertia
  - 7.2.3.4 Thermal conductivity
  - 7.2.3.5 Toxicity
  - 7.2.3.6 Physical state and heat resistance
  - 7.2.3.7 Orientation, position and placement
- 7.2.4 Occupancy
- 7.2.5 Computer fire model survey of building component variations
- 7.2.6 Explosion damage

**501-7.3      *The Investigator candidate shall identify the different types of building construction.***

7.3.1      General

**\*\*Note\*\* (Only 501-7.3.1)**

**The following section is not contained in NFPA 921, *Guide for Fire and Explosion Investigation*. The reference for this material is found in IFSTA, *Fire Inspection and Code Enforcement and Fire Investigator*.**

- 7.3.1.1 Type I – fire resistive
- 7.3.1.2 Type II – non-combustible
- 7.3.1.3 Type III – ordinary
- 7.3.1.4 Type IV – heavy timber
- 7.3.1.5 Type V – wood frame
- 7.3.2 Wood Frame (Type V)
  - 7.3.2.1 Platform frame construction
  - 7.3.2.2 Balloon frame
  - 7.3.2.3 Plank and beam
  - 7.3.2.4 Post and frame
  - 7.3.2.5 Heavy timber
  - 7.3.2.6 Alternative residential construction
    - 7.3.2.6.1      Manufactured homes
    - 7.3.2.6.2      Modular homes

- 7.3.2.6.3 Steel frame residential construction
- 7.3.2.7 Manufactured wood structural elements
- 7.3.3 Ordinary construction (Type III)
- 7.3.4 Mill construction (Type IV)
- 7.3.5 Non-combustible construction (Type II)
  - 7.3.5.1 General
  - 7.3.5.2 Metal construction
  - 7.3.5.3 Concrete or masonry construction

**501-7.4**     ***The Investigator candidate shall identify the different construction assemblies.***

- 7.4.1 General
- 7.4.2 Floor/ceiling/roof assemblies
- 7.4.3 Walls
- 7.4.4 Doors
- 7.4.5 Concealed spaces

**501-7.5**     ***The Investigator candidate shall describe the different construction materials.***

- 7.5.1 Structural steel
- 7.5.2 Reinforced concrete
- 7.5.3 Wood

**501-7.6**     ***The Investigator candidate shall analyze the impact of passive fire protection systems on the investigation.***

**501-7.7**     ***The Investigator candidate shall analyze the design and installation parameters of the system.***

**501-7.8**     ***The Investigator candidate shall produce the additional documentation and data collection.***

**501-7.9**      ***The Investigator candidate shall perform the required additional analysis.***

- 7.9.1      Code analysis
- 7.9.2      Design analysis
- 7.9.3      Installation analysis
- 7.9.4      System performance
- 7.9.5      Testing and maintenance analysis
- 7.9.6      Origin and cause determination

## SECTION 8

### FIRE PROTECTION SYSTEMS

#### 4.2. Scene Examination

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire

**NFPA 1033 4.2.8** Inspect the performance of building systems, including detection, suppression, HVAC, utilities, and building compartmentation, given standard and special equipment and tools, so that a determination can be made as to the need for expert resources, an operating system's impact on fire growth and spread is considered in identifying origin areas, defeated and/or failed systems are identified, and the system's potential as a fire cause is recognized.

**(A) Requisite Knowledge.** Different types of detection, suppression, HVAC, utility, and building compartmentation such as fire walls and fire doors; types of expert resources for building systems; the impact of fire on various systems; common methods used to defeat a system's functional capability; and types of failures.

**(B) Requisite Skills.** Ability to determine the system's operation and its effect on the fire; identify alterations to, and failure indicators of, building systems; and evaluate the impact of suppression efforts on building systems.

**501-8.1**      **The Investigator candidate shall develop basic understanding of active fire protection systems.**

**501-8.2**      **The Investigator candidate shall identify the basic components and operation of a fire alarm system.**

- 8.2.1      General information
  - 8.2.1.1      Purpose of systems
  - 8.2.1.2      System components
  - 8.3.1.3      General system operation
  
- 8.2.2      Key components of systems
  - 8.2.2.1      Fire Alarm Control Unit (FACU)
  - 8.2.2.2      Power supply
  - 8.2.2.3      Initiating devices
  - 8.2.2.4      Smoke detection
  - 8.2.2.5      Heat detection
  - 8.2.2.6      Other types of detectors
  - 8.2.2.7      Notification appliances
  
- 8.2.3      Operations and installation parameters of the system
  - 8.2.3.1      FACU features
  - 8.2.3.2      Location and spacing of devices
  - 8.2.3.3      Internal system communication

- 8.2.3.4 Means of alarm transmission
- 8.2.3.5 Systems monitored and controlled
- 8.2.4 Analysis
  - 8.2.4.1 Fire alarm system components, locations, and conditions should be documented and analyzed.
  - 8.2.4.2 Installation considerations
  - 8.2.4.3 Operability
  - 8.2.4.4 Analysis of smoke alarm response
  - 8.2.4.5 Analysis of smoke deposition

**501-8.3**     ***The Investigator candidate shall identify the basic components and operation of a water-based fire suppression system.***

- 8.3.1 General Information
  - 8.3.1.1 Purpose of systems
  - 8.3.1.2 General system operation
- 8.3.2 Key components of water-based systems
  - 8.3.2.1 Sprinklers/nozzles
  - 8.3.2.2 Piping
  - 8.3.2.3 Systems valves
  - 8.3.2.4 Water supply
- 8.3.3 Operations and installation parameters of the system
  - 8.3.3.1 Location and spacing of sprinklers
  - 8.3.3.2 Pipe sizing and arrangement
  - 8.3.3.3 Sprinkler coverage and distribution
  - 8.3.3.4 Water flow rate and pressure
  - 8.3.3.5 Activation mechanisms and criteria
  - 8.3.3.6 Systems monitored and controlled
- 8.3.4 Analysis
  - 8.3.4.1 Code analysis
  - 8.3.4.2 Design analysis
  - 8.3.4.3 Hazard protected

**501-8.4**     ***The Investigator candidate shall identify the basic components and operation of a non-water-based fire suppression system.***

- 8.4.1 General information
  - 8.4.1.1 Purpose of systems
  - 8.4.1.2 System components
  - 8.4.1.3 Suppression agents

- 8.4.2 Key components of systems
  - 8.4.2.1 Suppression agent supply
  - 8.4.2.2 Pressure sources
  - 8.4.2.3 Distribution piping
  - 8.4.2.4 Valves, hoses and fittings
  - 8.4.2.5 Proportioners
  - 8.4.2.6 Distribution nozzles
  - 8.4.2.7 Actuation system
  - 8.4.2.8 System monitoring and control
- 8.4.3 Operations and installation parameters of the system
  - 8.4.3.1 Location and spacing of nozzles
  - 8.4.3.2 Pipe sizing and arrangement
  - 8.4.3.3 Nozzle coverage and distribution
  - 8.4.3.4 Activation mechanisms and criteria
  - 8.4.3.5 Systems monitored and controlled
- 8.4.4 Analysis
  - 8.4.4.1 General information and codes
  - 8.4.4.2 Design analysis

**501-8.5** ***The Investigator candidate shall identify the key components of proper documentation of a fire suppression system.***

- 8.5.1 Design documentation
- 8.5.2 Permit history
- 8.5.3 Invoices and contracts
- 8.5.4 Installation documentation
- 8.5.5 Inspection and maintenance records
- 8.5.6 Product literature
- 8.5.7 Alarm/activation history

**501-8.6** ***The Investigator candidate shall identify spoliation issues regarding the documentation of the fire protection system.***

**\*\*Note\*\***

The following sections (501-8.7 through 501-8.12) are not contained in NFPA 921, *Guide for Fire and Explosion Investigation*. The reference for this material is found in IFSTA, *Fire Inspection and Code Enforcement*.

**501-8.7**      ***The Investigator candidate shall describe the types and characteristics of automatic sprinkler systems.***

- 8.7.1      Identify various types of automatic sprinkler systems
  - 8.7.1.1      Wet pipe
  - 8.7.1.2      Dry pipe
  - 8.7.1.3      Pre-action
  - 8.7.1.4      Deluge
  - 8.7.1.5      Residential
- 8.7.2      Identify reasons for unsatisfactory performance of an automatic sprinkler system.
- 8.7.3      Describe fire sprinkler components and operations.

**501-8.8**      ***The Investigator candidate shall describe the types, operations, capabilities and the effects of proper application of "special agent" fire extinguishing systems.***

- 8.8.1      Dry chemical
- 8.8.2      Wet chemical
- 8.8.3      Halogenated agent
- 8.8.4      Carbon dioxide
- 8.8.5      Foam
- 8.8.6      Gaseous agent

**501-8.9**      ***The Investigator candidate shall identify the classes and capabilities of standpipe and hose systems.***

- 8.9.1      Class I systems
- 8.9.2      Class II systems
- 8.9.3      Class III systems

**501-8.10**     ***The Investigator candidate shall identify alarm-initiating devices.***

- 8.10.1     Local system
- 8.10.2     Auxiliary system
- 8.10.3     Remote station
- 8.10.4     Proprietary system
- 8.10.5     Central station system

**501-8.11**     ***The Investigator candidate shall identify fire detection systems.***

- 8.11.1     Smoke
- 8.11.2     Flame
- 8.11.3     Heat
- 8.11.4     Gas

**501-8.12**     ***The Investigator candidate shall describe Heating Ventilation and Air Conditioning (HVAC) system components and their relation to smoke and fire spread.***

- 8.12.1     Smoke dampers
- 8.12.2     Automatic shutoffs
- 8.12.3     Ductwork
- 8.12.4     Pipe and duct chases

## **SECTION 9**

### **ELECTRICITY AND FIRE**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.8** Inspect the performance of building systems, including detection, suppression, HVAC, utilities, and building compartmentation, given standard and special equipment and tools, so that a determination can be made as to the need for expert resources, an operating system's impact on fire growth and spread is considered in identifying origin areas, defeated and/or failed systems are identified, and the system's potential as a fire cause is recognized.

**(A) Requisite Knowledge.** Different types of detection, suppression, HVAC, utility, and building compartmentation such as fire walls and fire doors; types of expert resources for building systems; the impact of fire on various systems; common methods used to defeat a system's functional capability; and types of failures.

**(B) Requisite Skills.** Ability to determine the system's operation and its effect on the fire; identify alterations to, and failure indicators of, building systems; and evaluate the impact of suppression efforts on building systems.

**501-9.1**      ***The Investigator candidate shall understand the basic principles of physics that relate to electricity and fire, including systems and equipment.***

**501-9.2**      ***The Investigator candidate shall describe basic electrical theory.***

- 9.2.1      General
- 9.2.2      Comparing electricity to hydraulics
- 9.2.3      Ampacity
- 9.2.4      Conductivity of conductors
- 9.2.5      Ohm's Law
- 9.2.6      Electrical power
- 9.2.7      Ohm's Law Wheel
- 9.2.8      Applying Ohm's Law

**501-9.3**      ***The Investigator candidate shall describe the typical building electrical systems and its components.***

- 9.3.1      General
- 9.3.2      Electrical service
  - 9.3.2.1    Single phase service
  - 9.3.2.2    Three phase service
- 9.3.3      Meter and base
- 9.3.4      Significance

**501-9.4**      ***The Investigator candidate shall identify the functions of service equipment.***

- 9.4.1      To provide means for turning off power to the entire electrical system
- 9.4.2      To provide protection against electrical malfunctions
- 9.4.3      To divide the power distribution into several branch circuits

**501-9.5**      ***The Investigator candidate shall identify the principle of grounding.***

- 9.5.1      General
- 9.5.2      Floating neutral (open neutral)

**501-9.6**      ***The Investigator candidate shall describe the components of overcurrent protection.***

- 9.6.1      General
- 9.6.2      Fuses
  - 9.6.2.1    Operations
  - 9.6.2.2    Plug fuses
  - 9.6.2.3    Type S fuses
  - 9.6.2.4    Time-delay fuses
  - 9.6.2.5    Cartridge fuses
- 9.6.3      Circuit breakers

- 9.6.3.1 Operations
- 9.6.3.2 Main breakers
- 9.6.3.3 Branch circuit breakers
- 9.6.3.4 Ground fault circuit interrupters (GFCI)
- 9.6.3.5 Arc fault circuit interrupters (AFCI)

9.6.4 Circuit breaker panels

**501-9.7**     ***The Investigator candidate shall describe a branch circuit and its components.***

- 9.7.1 Conductors
- 9.7.2 Size of conductors
- 9.7.3 Copper conductors
- 9.7.4 Aluminum conductors
- 9.7.5 Insulation

**501-9.8**     ***The Investigator candidate shall identify and describe the different types of outlets and devices found in a branch circuit.***

- 9.8.1 Switches
- 9.8.2 Receptacles
- 9.8.3 Other outlets, devices or equipment

**501-9.9**     ***The Investigator candidate shall describe how the use of improper electrical components can create sufficient heat for ignition.***

- 9.9.1 General
- 9.9.2 Resistance heating
- 9.9.3 Overcurrent and overload
- 9.9.4 Arcs
  - 9.9.4.1 General
  - 9.9.4.2 High voltage arcs
  - 9.9.4.3 Static electricity
  - 9.9.4.4 Parting arcs

9.9.4.5 Arcing across a carbonized path

9.9.5 Sparks

9.9.6 High-resistance faults

**501-9.10** ***The Investigator candidate shall identify and describe types of damage encountered in electrical systems.***

9.10.1 General

9.10.2 Short circuit and ground fault parting arcs

9.10.3 Arcing through a carbonized path due to thermal means  
(arcing through char)

9.10.4 Overheating connections

9.10.5 Overload

9.10.6 Effects not caused by electricity

9.10.6.1 Conductor surface colors

9.10.6.2 Melting by fire

9.10.6.3 Alloying

9.10.6.4 Mechanical gouges

**501-9.11** ***The Investigator candidate shall identify arc melting of electrical conductors.***

9.11.1 Melting caused by electrical arcing

9.11.2 Melting caused by fire

9.11.3 Eutectic melting

9.11.4 Extraneous melting

9.11.5 Undersized conductors

9.11.6 Nicked or stretched conductors

9.11.7 Arc mapping procedure

9.11.8 Deteriorated insulation

9.11.9 Over driven or misdriven staple

9.11.10 Short circuit

9.11.11 Beaded conductor

**501-9.12** ***The Investigator candidate shall describe the role of static electricity in an ignition sequence.***

9.12.1 Introduction to static electricity

9.12.2 Generation of static electricity

9.12.2.1 General

9.12.2.2 Ignitable liquids

9.12.2.3 Charges on the surface of a liquid

9.12.2.4 Switch loading

9.12.2.5 Spraying operations

9.12.2.6 Gases

9.12.2.7 Dusts and fibers

9.12.2.8 Static electric discharge from the human body

9.12.2.9 Clothing

9.12.3 Incendive arc

9.12.4 Ignition energy

9.12.5 Controlling accumulations of static electricity

9.12.5.1 Humidification

9.12.5.2 Bonding and grounding

9.12.6 Conditions necessary for static arc ignition

9.12.7 Investigating static electric ignitions

9.12.8 Lightning

9.12.8.1 General

9.12.8.2 Lightning bolt characteristics

9.12.8.3 Lightning strikes

9.12.8.4 Lightning damage

9.12.8.5 Lightning detection networks

## **SECTION 10**

### **BUILDING FUEL GAS SYSTEMS**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.8** Inspect the performance of building systems, including detection, suppression, HVAC, utilities, and building compartmentation, given standard and special equipment and tools, so that a determination can be made as to the need for expert resources, an operating system's impact on fire growth and spread is considered in identifying origin areas, defeated and/or failed systems are identified, and the system's potential as a fire cause is recognized.

**(A) Requisite Knowledge.** Different types of detection, suppression, HVAC, utility, and building compartmentation such as fire walls and fire doors; types of expert resources for building systems; the impact of fire on various systems; common methods used to defeat a system's functional capability; and types of failures.

**(B) Requisite Skills.** Ability to determine the system's operation and its effect on the fire; identify alterations to, and failure indicators of, building systems; and evaluate the impact of suppression efforts on building systems.

**501-10.1**     **The Investigator candidate shall describe building fuel gas systems.**

10.1.1     Impact of fuel gases on fire and explosions investigations.

10.1.2     Additional fire spread.

**501-10.2**     **The Investigator candidate shall identify the different fuel gases.**

10.2.1     Natural gas

10.2.2     Commercial propane

10.2.3     Other fuel gases  
           10.2.3.1     Commercial butane  
           10.2.3.2     Propane HD5  
           10.2.3.3     Manufactured gases

10.2.4     Odorization

**501-10.3**     ***The Investigator candidate shall identify different natural gas systems.***

- 10.3.1     Transmission pipelines
- 10.3.2     Main pipelines (mains)
- 10.3.3     Service lines
- 10.3.4     Metering

**501-10.4**     ***The Investigator candidate shall identify different LP-Gas Systems.***

- 10.4.1     LP-Gas storage containers
  - 10.4.1.1     Tanks
  - 10.4.1.2     Cylinders
- 10.4.2     Container appurtenances
  - 10.4.2.1     Pressure relief devices
  - 10.4.2.2     Connections for flow control
  - 10.4.2.3     Liquid level gauging devices
  - 10.4.2.4     Pressure gauges
- 10.4.3     Pressure regulation
- 10.4.4     Vaporizers

**501-10.5**     ***The Investigator candidate shall identify common fuel gas system components.***

- 10.5.1     Pressure regulations (reduction)
- 10.5.2     Service piping systems
- 10.5.3     Valves
- 10.5.4     Gas burners
  - 10.5.4.1     Manual ignition
  - 10.5.4.2     Pilot lights
  - 10.5.4.3     Pilotless igniters

**501-10.6**     ***The Investigator candidate shall identify the common piping in buildings.***

- 10.6.1     Size of piping
- 10.6.2     Piping materials
- 10.6.3     Joints and fittings
- 10.6.4     Piping installation
- 10.6.5     Main shut-off valves
- 10.6.6     Prohibited locations
- 10.6.7     Electrical bonding and grounding

**501-10.7**     ***The Investigator candidate shall identify common appliance and equipment requirements.***

- 10.7.1     Installation
- 10.7.2     Venting and air supply
- 10.7.3     Appliance controls

**501-10.8**     ***The Investigator candidate shall identify common fuel gas utilization equipment.***

- 10.8.1     Air heating
- 10.8.2     Water heating
- 10.8.3     Cooking
- 10.8.4     Refrigeration and cooling
- 10.8.5     Engines
- 10.8.6     Illumination
- 10.8.7     Incinerators, toilets, and exhaust afterburners

**501-10.9**     ***The Investigator candidate shall explain investigating fuel gas systems.***

- 10.9.1     Recognize limitations
- 10.9.2     Fuel gas system analysis
- 10.9.3     Compliance with codes and standards
- 10.9.4     Leakage
- 10.9.5     Pressure testing
- 10.9.6     Locating leaks
- 10.9.7     Testing flow rates and pressures
- 10.9.8     Collection of gas piping
- 10.9.9     Underground migration of fuel gases

## SECTION 11

### FIRE-RELATED HUMAN BEHAVIOR

#### 4.4 Evidence Collection/Preservation

Duties shall include using proper physical and legal procedures to identify, document, collect, and preserve evidence required within the investigation.

**NFPA 1033 4.4.1** Utilize proper procedures for managing victims and fatalities, given a protocol and appropriate personnel, so that all evidence is discovered and preserved and the protocol procedures are followed.

**(A) Requisite Knowledge:** Types of evidence associated with fire victims and fatalities and evidence preservation methods.

**(B) Requisite Skills:** Observational skills and the ability to apply protocols to given situations.

#### 4.6 Post-Incident Investigation.

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.4:** Establish evidence as to motive and/or opportunity, given an incendiary fire, so that the evidence is supported by documentation and meets the evidentiary requirements of the jurisdiction.

**(A) Requisite Knowledge:** Types of motives common to incendiary fires, methods used to discover opportunity, and human behavioral patterns relative to fire-setting.

**(B) Requisite Skills:** Financial analysis, records gathering and analysis, interviewing, and interpreting fire scene information and evidence for relationship to motive and/or opportunity.

**NFPA 1033 4.6.5** Formulate an opinion concerning origin, cause, or responsibility for the fire, given all investigative findings, so that the opinion regarding origin, cause, or responsibility for a fire is supported by the data, facts, records, reports, documents, and evidence.

**(A) Requisite Knowledge:** Analytical methods and procedures (e.g., hypothesis development and testing, systems analysis, time lines, link analysis, fault tree analysis, and data reduction matrixing).

**(B) Requisite Skills:** Analytical and assimilation skills.

**501-11.1**      ***The Investigator candidate shall recognize that the analysis of fire related human behavior will often be an integral part of the investigation.***

**501-11.2**      ***The Investigator candidate shall recall the history of research as related to fire related human behavior.***

**501-11.3**      ***The Investigator candidate shall identify and describe general considerations of human response to fires.***

- 11.3.1 Individual
  - 11.3.1.1 Physical limitations
  - 11.3.1.2 Cognitive comprehension limitations
  - 11.3.1.3 Familiarity and physical setting
- 11.3.2 Groups
  - 11.3.2.1 Group size
  - 11.3.2.2 Group structure
  - 11.3.2.3 Group permanence
  - 11.3.2.4 Roles and norms
- 11.3.3 Characteristics of the physical setting
  - 11.3.3.1 Location of exits
  - 11.3.3.2 Number of exits
  - 11.3.3.3 Height of the structure
  - 11.3.3.4 Fire alarm systems
  - 11.3.3.5 Fire suppression systems
- 11.3.4 Characteristics of the fire
  - 11.3.4.1 Presence of flames
  - 11.3.4.2 Presence of smoke
  - 11.3.4.3 Effects of toxic gases and oxygen depletion

**501-11.4** ***The Investigator candidate shall identify and describe the factors related to fire initiation.***

- 11.4.1 Factors involved in accidental fires
  - 11.4.1.1 Improper maintenance and operations
  - 11.4.1.2 Housekeeping
  - 11.4.1.3 Product labels, instructions and warnings
  - 11.4.1.4 Purpose of labels
  - 11.4.1.5 Purpose of instructions
  - 11.4.1.6 Purpose of warnings
  - 11.4.1.7 Key elements of a proper warning
  - 11.4.1.8 Standards on labels, instructions and warnings
- 11.4.2 Recalls
- 11.4.3 Other considerations
- 11.4.4 Violations of fire safety codes and standards

**501-11.5** ***The Investigator candidate shall identify and describe the factors related to children and fire.***

- 11.5.1 Child firesetters (ages 2 to 6)
- 11.5.2 Juvenile firesetters (ages 7 to 13)
- 11.5.3 Adolescent firesetters (ages 14 to 16)

**501-11.6** ***Incendiary fires – see SECTION 501-24.4 for additional information.***

**501-11.7** ***The Investigator candidate shall identify and describe human factors related to fire spread.***

**501-11.8** ***The Investigator candidate shall identify the basic concepts in recognition and response to fires.***

- 11.8.1 Perception of the danger (sensory cues)
- 11.8.2 Decision to act (response)
- 11.8.3 Action taken
- 11.8.4 Escape factors
- 11.8.5 Information received from survivors

## **SECTION 12**

### **LEGAL CONSIDERATIONS**

#### **4.1 General**

**NFPA 1033 4.1.5\*** The fire investigator shall adhere to all applicable legal and regulatory requirements.

#### **4.3 Documenting the Scene**

Duties shall include diagramming the scene, photographing, and taking field notes to be used to compile a final report.

**NFPA 1033 4.3.3** Construct investigative notes, given a fire scene, available documents (e.g., prefire plans and inspection reports), and interview information, so that the notes are accurate, provide further documentation of the scene, and represent complete documentation of the scene findings.

**(A) Requisite Knowledge.** Relationship between notes, diagrams, and photos, how to reduce scene information into concise notes, and the use of notes during report writing and legal proceedings.

**(B) Requisite Skills.** Data-reduction skills, note-taking skills, and observational and correlating skills.

#### **4.4 Evidence Collection/Preservation.**

Duties shall include using proper physical and legal procedures to identify, document, collect and preserve evidence required within the investigation.

**NFPA 1033 4.4.2** Locate, document, collect, label, package and store evidence, given standard or special tools and equipment and evidence collection materials, so that evidence is identified, preserved, collected, packaged and stored for use in testing, legal, or other proceedings and examinations, ensuring cross-contamination and investigator-inflicted damage and the chain of custody is established.

**(A) Requisite Knowledge.** Types of evidence, authority requirements, impact of removing evidentiary items on civil or criminal proceedings (exclusionary or fire-cause supportive evidence), types, capabilities, and limitations of standard and special tools used to locate evidence, types of laboratory tests available, packaging techniques and materials, and impact of evidence collection on the investigation.

**(B) Requisite Skills.** Ability to recognize different types of evidence and determine whether evidence is critical to the investigation.

**NFPA 1033 4.4.4** Maintain a chain of custody, given standard investigative tools, marking tools, and evidence tags or logs, so that written documentation exists for each piece of evidence and evidence is secured.

**(A) Requisite Knowledge.** Rules of custody and transfer procedures, types of evidence (e.g., physical evidence obtained at the scene, photos, and documents), and methods of recording the chain of custody.

**(B) Requisite Skills.** Ability to execute the chain of custody procedures and accurately complete necessary documents.

#### **4.6 Post-Incident Investigation.**

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.3** Coordinate expert resources, given the investigative file, reports, and documents, so that the expert's competencies are matched to the specific investigation needs, financial expenditures are justified, and utilization clearly furthers the investigative goals of determining cause or affixing responsibility.

**(A) Requisite Knowledge.** How to assess one's own expertise, qualification to be called for expert testimony, types of expert resources (e.g., forensic, CPA, polygraph, financial, human behavior disorders, and engineering), and methods to identify expert resources.

**(B) Requisite Skills.** Ability to apply expert resources to further the investigation by networking with other investigators to identify experts, questioning experts relative to their qualifications, and developing a utilization plan for use of expert resources.

#### **4.7 Presentations.**

Duties shall include the presentation of findings to those individuals not involved in the actual investigations.

**NFPA 1033 4.7.3** Testify during legal proceedings, given investigative findings, contents of reports, and consultation with legal counsel, so that all pertinent investigative information and evidence are presented clearly and accurately and the investigator's demeanor and attire are appropriate to the proceedings.

**(A) Requisite Knowledge.** Types of investigative findings, types of legal proceedings, professional demeanor requirements, and an understanding of due process and legal proceedings.

**(B) Requisite Skills.** Communication and listening skills and ability to differentiate facts from opinion and determine accepted procedures, practices, and etiquette during legal proceedings.

**501-12.1**     ***The Investigator candidate shall recognize the legal consideration impact on every phase of the fire investigation.***

**501-12.2**     ***The Investigator candidate shall ensure that constitutional considerations are observed.***

12.2.1     Amendment Four

12.2.2     Amendment Five

12.2.3     Amendment Six

**501-12.3**     ***The Investigator candidate shall observe all legal considerations during the investigation.***

12.3.1     Authority to conduct the investigation

- 12.3.2 Right of entry
- 12.3.3 Method of entry
  - 12.3.3.1 Consent
  - 12.3.3.2 Exigent circumstance
  - 12.3.3.3 Administrative search warrant
  - 12.3.3.4 Criminal search warrant
- 12.3.4 The questioning of suspects
- 12.3.5 Spoliation of evidence
  - 12.3.5.1 Responsibility
  - 12.3.5.2 Documentation
  - 12.3.5.3 Remedies for spoliation
  - 12.3.5.4 Notification to interested parties
  - 12.3.5.5 Documentation prior to alteration
  - 12.3.5.6 Alteration and movement of evidence
  - 12.3.5.7 Notification prior to destructive testing

**501-12.4**     ***The Investigator candidate shall recognize pretrial legal considerations.***

- 12.4.1 Introduction
- 12.4.2 Forms of discovery
  - 12.4.2.1 Request to produce
  - 12.4.2.2 Interrogatories
  - 12.4.2.3 Depositions
    - 12.4.2.3.1 Procedure
    - 12.4.2.3.2 Discovery depositions
    - 12.4.2.3.3 Trial depositions
  - 12.4.2.4 Reports
- 12.4.3 Motions

**501-12.5**     ***The Investigator candidate shall identify the trial procedures in criminal and civil cases.***

- 12.5.1 Rules of evidence
- 12.5.2 Types of evidence
  - 12.5.2.1 Demonstrative evidence
    - 12.5.2.1.1 Photographs/illustrative forms of evidence
    - 12.5.2.1.2 Samples

- 12.5.2.2 Documentary evidence
- 12.5.2.3 Testimonial evidence
  - 12.5.2.3.1 Fact witness
  - 12.5.2.3.2 Expert witness
  - 12.5.2.3.3 Admissibility of expert testimony
  - 12.5.2.3.4 Relevance
  - 12.5.2.3.5 Qualifications of expert
  - 12.5.2.3.6 Reliability of opinion
- 12.5.3 Forms of examination
  - 12.5.3.1 Direct examination
  - 12.5.3.2 Cross-examination
- 12.5.4 Forms of testimony
  - 12.5.4.1 Affidavits
  - 12.5.4.2 Answers to interrogatories
  - 12.5.4.3 Depositions and trial testimony
- 12.5.5 Burden of proof
- 12.5.6 Criminal prosecution
  - 12.5.6.1 Arson
  - 12.5.6.2 Arson statutes
  - 12.5.6.3 Factors to be considered
  - 12.5.6.4 Other fire related criminal acts
  - 12.5.6.5 Arson reporting/immunity statutes
- 12.5.7 Civil litigation
  - 12.5.7.1 Negligence
  - 12.5.7.2 Codes, regulations, and standards
  - 12.5.7.3 Product liability
  - 12.5.7.4 Strict liability

## SECTION 13

### SAFETY

#### 4.1 General

**NFPA 1033 4.1.3\*** Because fire investigators are required to perform activities in adverse conditions, site safety assessments shall be completed on all scenes and regional and national safety standards shall be followed and included in organizational policies and procedures.

#### 4.2 Scene Examination.

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.2\*** Conduct an exterior survey, given standard equipment and tools, so that evidence is identified and preserved, fire damage is interpreted, hazards are identified to avoid injuries, accessibility to the property is determined, and all potential means of ingress and egress are discovered.

**(A) Requisite Knowledge.** The types of building construction and the effects of fire on construction materials, types of evidence commonly found in the perimeter, evidence preservation methods, the effects of fire suppression, fire behavior and spread, fire patterns, and a basic awareness of the dangers of hazardous materials.

**(B) Requisite Skills.** Ability to assess fire ground and structural condition, observe the damage from and effects of the fire, and interpret fire patterns.

**501-13.1**      ***The Investigator candidate shall describe the safety issues as they relate to the fire investigation.***

13.1.1      General injury/health statistics

13.1.2      Health and safety programs

13.1.2.1    Five critical elements of safety and health programs

13.1.2.1.1    Management commitment and employee participation

13.1.2.1.2    Hazard and risk assessment

13.1.2.1.3    Hazard prevention and control

13.1.2.1.4    Safety and health training and education

13.1.2.1.5    Long-term commitment

**501-13.2**      ***The Investigator candidate shall describe factors that have an influence on general fire scene safety.***

- 13.2.1 Investigating the scene alone
- 13.2.2 Investigator fatigue
- 13.2.3 Working above or below grade level
- 13.2.4 Working around mechanized equipment
- 13.2.5 Safety of bystanders
- 13.2.6 Status of suppression
- 13.2.7 First aid kit and emergency notification numbers
- 13.2.8 Emergency notification signal

**501-13.3**    ***The Investigator candidate shall describe general and particular dangers of the fire scene.***

- 13.3.1 Physical hazards
- 13.3.2 Structural stability hazards
- 13.3.3 Electrical hazards
- 13.3.4 Chemical hazards
- 13.3.5 Biological hazards
- 13.3.6 Mechanical hazards
- 13.3.7 Miscellaneous hazards
  - 13.3.7.1 Radiological hazards
  - 13.3.7.2 Utilities
  - 13.3.7.3 Mechanized equipment hazards

**501-13.4**    ***The Investigator candidate shall describe safety plans that may be part of the investigative process.***

- 13.4.1 Hazard and risk assessment
  - 13.4.1.1 Identify the hazards
  - 13.4.1.2 Determine the risk of the hazard
  - 13.4.1.3 Control the hazard
    - 13.4.1.3.1 Engineering controls

- 13.4.1.3.2 Administrative controls
- 13.4.1.3.3 Proper selection and use of PPE

- 13.4.2 Site-specific safety plans
  - 13.4.2.1 Hazard communication site plan (HazCom Plan)
  - 13.4.2.2 Confined space program
- 13.4.3 Management of plans and site safety
- 13.4.4 Safety meetings and briefings

**501-13.5** ***The Investigator candidate shall describe factors associated with chemical and contaminant exposure.***

- 13.5.1 Types of exposure effects
  - 13.5.1.1 Local effects
  - 13.5.1.2 Systemic effects
- 13.5.2 Routes of exposure
  - 13.5.2.1 Inhalation
  - 13.5.2.2 Cutaneous
  - 13.5.2.3 Ingestion
  - 13.5.2.4 Injection
  - 13.5.2.5 Ocular exposure route
- 13.5.3 Toxicity exposure levels
  - 13.5.3.1 Acute exposure
  - 13.5.3.2 Chronic exposure
  - 13.5.3.3 Cumulative exposure
  - 13.5.3.4 Latency period

**501-13.6** ***The Investigator candidate shall understand the utilization of personal protective equipment on fire and explosion scenes.***

- 13.6.1 Proper selection and use of personal protective equipment (PPE)
  - 13.6.1.1 Safety clothing and equipment
  - 13.6.1.2 PPE use
  - 13.6.1.3 Decontamination
- 13.6.2 Examples of personal protective equipment (PPE)
  - 13.6.2.1 Respiratory protection
  - 13.6.2.2 Hand protection
  - 13.6.2.3 Other specialized equipment

**501-13.7** ***The Investigator candidate shall describe the potential emergency situations that could occur while processing a fire scene and the different types of emergency action plans needed.***

- 13.7.1 Emergency evacuation plans
- 13.7.2 Medical emergency plans
- 13.7.3 Severe weather plans
- 13.7.4 Fire emergency plan
- 13.7.5 Additional emergency action plans

**501-13.8** ***The Investigator candidate shall describe post-scene safety activities.***

- 13.8.1 Decontamination
- 13.8.2 Medical screening

**501-13.9** ***The Investigator candidate shall describe safety considerations in off-scene investigation activities.***

**501-13.10** ***The Investigator candidate shall identify the special hazards associated with investigating the fire scene.***

- 13.10.1 Criminal acts or acts of terrorism
  - 13.10.1.1 Secondary devices
- 13.10.2 Residue chemicals
- 13.10.3 Biological and radiological terrorism
- 13.10.4 Drug labs

**\*\*Note\*\***

The following part of Section 13 (501-13.11 through 501-13.15) is not contained in NFPA 921, *Guide for Fire and Explosion Investigation*. The reference for this material is found in IFSTA, *Fire Inspection and Code Enforcement*. See also the *Emergency Response Guidebook (ERG)*.

**501-13.11** ***The Investigator candidate shall demonstrate knowledge of safety principles applicable to hazardous materials response.***

**501-13.12** ***The Investigator candidate shall identify the difference between hazardous materials incidents and other emergencies.***

**501-13.13** ***The Investigator candidate, utilizing the Emergency Response Guidebook, shall:***

- 1) Identify the three methods for determining the appropriate guide page for a specific hazardous material.
  - a) Locate UN number in the yellow-bordered pages.
  - b) Locate name of material in the alphabetic listing in the blue-bordered pages.
  - c) Locate a matching placard in the table of placards and consult the two-digit guide number located next to the similar placard.
- 2) Identify two general types of hazards found on each guide page.
  - a) Fire/Explosive
  - b) Health

**501-13.14** ***The Investigator candidate, given an example of an NFPA 704 marking, shall identify the significance of the following components.***

- 1) Three categories of hazard
  - a) Health - Blue color
  - b) Flammability - Red color
  - c) Instability - Yellow color
- 2) Special hazards that may be indicated
  - a) W
  - b) OX (or OXY)
  - c) COR
  - d) ALK
  - e) ACID

- 3) Numerical rating system of hazards

**501-13.15** ***The Investigator candidate shall identify the following information from safety data sheets (SDS).***

- 1) The Investigator candidate shall list four organizations from which to obtain a safety data sheet (SDS)
  - a) Manufacturer of the material
  - b) Supplier
  - c) Facility hazard and communication plan
  - d) Local emergency planning committee (LEPC)
- 2) The Investigator candidate shall be familiar with the different SDS chapters

## SECTION 14

### SOURCES OF INFORMATION

#### 4.1 General

**NFPA 1033 4.1.4** The fire investigator shall maintain necessary liaison with other interested professionals and entities.

#### 4.2 Scene Examination.

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.8** Inspect the performance of building systems, including detection, suppression, HVAC, utilities, and building compartmentation, given standard and special equipment and tools, so that a determination can be made as to the need for expert resources, an operating system's impact on fire growth and spread is considered in identifying origin areas, defeated and/or failed systems are identified, and the system's potential as a fire cause is recognized.

**(A) Requisite Knowledge.** Different types of detection, suppression, HVAC, utility, and building compartmentation such as fire walls and fire doors; types of expert resources for building systems; the impact of fire on various systems; common methods used to defeat a system's functional capability; and types of failures.

**(B) Requisite Skills.** Determine the system's operation and its effect on the fire; identify alterations to, and failure indicators of, building systems; and evaluate the impact of suppression efforts on building systems.

#### 4.4 Evidence Collection/Preservation.

Duties shall include using proper physical and legal procedures to identify, document, collect, and preserve evidence required within the investigation.

**NFPA 1033 4.4.3** Select evidence for analysis given all information from the investigation, so that items for analysis support specific investigation needs.

**(A) Requisite Knowledge.** Purposes for submitting items for analysis, types of analytical services available, and capabilities and limitations of the services performing the analysis.

**(B) Requisite Skills.** Evaluate the fire incident to determine forensic, engineering, or laboratory needs.

#### 4.5 Interview.

Duties shall include obtaining information regarding the overall fire investigation from others through verbal communication.

**NFPA 1033 4.5.1** Develop an interview plan, given no special tools or equipment, so that the plan reflects a strategy to further determine the fire cause and affix responsibility and includes a relevant questioning strategy for each individual to be interviewed that promotes the efficient use of the investigator's time.

**(A) Requisite Knowledge.** Persons who can provide information that furthers the fire cause determination or the affixing of responsibility, types of questions that are pertinent and efficient to ask of different information sources (first responders, neighbors, witnesses, suspects, and so forth), and pros and cons of interviews versus document gathering.

**(B) Requisite Skills.** Planning skills, development of focused questions for specific individuals, and evaluation of existing file data to help develop questions and fill investigative gaps

**NFPA 1033 4.5.2** Conduct interviews, given incident information, so that pertinent information is obtained, follow-up questions are asked, responses to all questions are elicited, and the response to each question is documented accurately.

**(A) Requisite Knowledge.** Types of interviews, personal information needed for proper documentation or follow-up, documenting methods and tools, and types of nonverbal communications and their meaning.

**(B) Requisite Skills.** Adjust interviewing strategies based on deductive reasoning, interpret verbal and nonverbal communications, apply legal requirements applicable, and exhibit strong listening skills.

**NFPA 1033 4.5.3** Evaluate interview information, given interview transcripts or notes and incident data, so that all interview data is individually analyzed and correlated with all other interviews, corroborative and conflictive information is documented, and new leads are developed.

**(A) Requisite Knowledge.** Types of interviews, report evaluation methods, and data correlation methods.

**(B) Requisite Skills.** Data correlation skills and the ability to evaluate source information (e.g., first responders and other witnesses).

#### **4.6 Post-Incident Investigation.**

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.1** Gather reports and records, given no special tools, equipment, or materials, so that all gathered documents are applicable to the investigation, complete, and authentic; the chain of custody is maintained; and the material is admissible in a legal proceeding.

**(A) Requisite Knowledge:** Types of reports needed that facilitate determining responsibility for the fire (e.g. police reports, insurance policies, financial records, deeds, private investigator reports, outside photos, and videos) and location of these reports.

**(B) Requisite Skills:** Identify the reports and documents necessary for the investigation, implement the chain of custody, and organizational skills.

**NFPA 1033 4.6.3** Coordinate expert resources, given the investigative file, reports, and documents, so that the expert's competencies are matched to the specific investigation needs, financial expenditures are justified, and utilization clearly furthers the investigative goals of determining cause or affixing responsibility.

**(A) Requisite Knowledge:** How to assess one's own expertise, qualification to be called for expert testimony, types of expert resources (e.g., forensic, CPA, polygraph, financial, human behavior disorders, and engineering), and methods to identify expert resources.

**(B) Requisite Skills:** Apply expert resources to further the investigation by networking with other investigators to identify experts, questioning experts relative to their qualifications, and developing a utilization plan for use of expert resources.

**501-14.1**     ***The Investigator candidate shall identify sources of information and assistance available to the Investigator during a fire investigation.***

14.1.1     Purpose of obtaining information.

14.1.2     Reliability of information obtained.

**501-14.2**     ***The Investigator candidate shall describe the legal considerations on sources of information.***

14.2.1     Freedom of Information Act

14.2.2     Privileged communications

14.2.3     Confidential communications

**501-14.3**     ***The Investigator candidate shall describe the different forms of information.***

14.3.1     Verbal information

14.3.2     Written information

14.3.3     Visual information

14.3.4     Electronic information

**501-14.4**     ***The Investigator candidate shall be able to gather both useful and accurate information through the process of interviewing.***

14.4.1     Purpose of interviews

14.4.2     Preparation for the interview

14.4.3     Documenting the interview

**501-14.5**     ***The Investigator candidate shall identify governmental sources of information useful during a fire investigation.***

- 14.5.1 Municipal government
- 14.5.2 County government
- 14.5.3 State government
- 14.5.4 Federal government

**501-14.6** ***The Investigator candidate shall identify private sources of information useful during a fire investigation.***

- 14.6.1 National Fire Protection Association (NFPA)
- 14.6.2 Society of Fire Protection Engineers (SFPE)
- 14.6.3 American Society for Testing and Materials (ASTM)
- 14.6.4 American National Standards Institute (ANSI)
- 14.6.5 National Association of Fire Investigators (NAFI)
- 14.6.6 International Association of Arson Investigators (IAAI)
- 14.6.7 Regional fire investigation organizations
- 14.6.8 Real estate industry
- 14.6.9 Abstract and title companies
- 14.6.10 Financial institutions
- 14.6.11 Insurance industry
- 14.6.12 Educational institutions
- 14.6.13 Utility companies
- 14.6.14 Trade organizations
- 14.6.15 Local television stations
- 14.6.16 Lightning detection networks
- 14.6.17 Other private sources

## SECTION 15

### PLANNING THE INVESTIGATION

#### 4.1 General

**NFPA 1033 4.1.3** Because fire investigators are required to perform activities in adverse conditions, site safety assessments shall be completed on all scenes and regional and national safety standards shall be followed and included in organizational policies and procedures.

**NFPA 1033 4.1.4** The fire investigator shall maintain necessary liaison with other interested professionals and entities.

**NFPA 1033 4.1.6** The fire investigator shall understand the organization and operation of the investigative team within an incident management system.

#### 4.2 Scene Examination.

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.1** Secure the fire ground, given marking devices, sufficient personnel, and special tools and equipment, so that unauthorized persons can recognize the perimeters of the investigative scene and are kept from restricted areas and all evidence or potential evidence is protected from damage or destruction.

**(A) Requisite Knowledge.** Fire ground hazards, types of evidence, and the importance of fire scene security, evidence preservation, and issues relating to spoliation.

**(B) Requisite Skills.** Use of marking devices.

#### 4.6 Post-Incident Investigation

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.3** Coordinate expert resources, given the investigative file, reports, and documents, so that the expert's competencies are matched to the specific investigation needs, financial expenditures are justified, and utilization clearly furthers the investigative goals of determining cause or affixing responsibility.

**(A) Requisite Knowledge.** How to assess one's own expertise, qualifications to be called for expert testimony, types of expert resources (e.g. forensic, CPA, polygraph, financial, human behavior disorders, an engineering), and methods to identify expert resources.

**(B) Requisite Skills.** Apply expert resources to further the investigation by networking with other investigators to identify experts, questioning experts relative to their qualifications, and developing a utilization plan for use of expert resources.

**501-15.1**     ***The Investigator candidate shall identify basic considerations of concern prior to beginning the incident scene investigation.***

15.1.1     Number of investigators

15.1.2     Resources

15.1.3     “Team concept”

**501-15.2**     ***The Investigator candidate shall identify basic incident information necessary to plan and conduct an investigation.***

15.2.1     Location

15.2.2     Date and time of incident

15.2.3     Weather conditions

15.2.4     Size and complexity of the incident

15.2.5     Type and use of structure

15.2.6     Nature and extent of damage

15.2.7     Security of the scene

15.2.8     Purpose of the investigation

**501-15.3**     ***The Investigator candidate shall be able to organize the basic investigation functions that are commonly performed in each investigation.***

**501-15.4**     ***The Investigator candidate shall identify the goals of a pre-investigation team meeting.***

15.4.1     Equipment and facilities

15.4.2     Personal safety equipment

15.4.3     Tools and equipment

**501-15.5**     ***The Investigator candidate shall identify the specialized personnel and technical consultants that may be needed to provide technical assistance.***

**501-15.6** ***The Investigator candidate shall identify a method to organize information generated throughout the investigation and coordinate the efforts of the various people involved.***

## SECTION 16

### DOCUMENTATION OF THE INVESTIGATION

#### 4.3 Documenting the Scene.

Duties shall include diagramming the scene, photographing, and taking field notes to be used to compile a final report.

**NFPA 1033 4.3.1** Diagram the scene, given standard tools and equipment, so that the scene is accurately represented and evidence, pertinent contents, significant patterns, and area(s) or point(s) of origin are identified.

**(A) Requisite Knowledge.** Commonly used symbols and legends that clarify the diagram, types of evidence and patterns that need to be documented, and formats for diagramming the scene.

**(B) Requisite Skills.** Ability to sketch the scene, basic drafting skills, and evidence recognition and observational skills.

**NFPA 1033 4.3.2** Photographically document the scene, given standard tools and equipment, so that the scene is accurately depicted and the photographs support scene findings.

**(A) Requisite Knowledge.** Working knowledge of high-resolution camera and flash, the types of film, media, and flash available, and the strengths and limitations of each.

**(B) Requisite Skills.** Ability to use a high-resolution camera, flash, and accessories.

**NFPA 1033 4.3.3** Construct investigative notes, given a fire scene, available documents (e.g., prefire plans and inspection reports), and interview information, so that the notes are accurate, provide further documentation of the scene, and represent complete documentation of the scene findings.

**(A) Requisite Knowledge.** Relationship between notes, diagrams, and photos, how to reduce scene information into concise notes, and the use of notes during report writing and legal proceedings.

**(B) Requisite Skills.** Data-reduction skills, note-taking skills, and observational and correlating skills.

#### 4.6 Post-Incident Investigation.

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.1** Gather reports and records, given no special tools, equipment, or materials, so that all gathered documents are applicable to the investigation, complete, and authentic; the chain of custody is maintained; and the material is admissible in a legal proceeding.

**(A) Requisite Knowledge.** Types of reports needed that facilitate determining responsibility for the fire (e.g., police reports, fire reports, insurance policies, financial records, deeds, private investigator reports, outside photos, and videos) and location of these reports.

**(B) Requisite Skills.** Ability to identify the reports and documents necessary for the investigation, implement the chain of custody, and organizational skills.

**NFPA 1033 4.6.2** Evaluate the investigative file, given all available file information, so that areas for further investigation are identified, the relationship between gathered documents and information is interpreted, and corroborative evidence and information discrepancies are discovered.

**(A) Requisite Knowledge.** File assessment and/or evaluation methods, including accurate documentation practices, and requisite investigative elements.

**(B) Requisite Skills.** Information assessment, correlation, and organizational skills.

#### **4.7 Presentations**

Duties shall include the presentation of findings to those individuals not involved in the actual investigations.

**NFPA 1033 4.7.1** Prepare a written report, given investigative findings, documentation, and a specific audience, so that the report accurately reflects the investigative findings, is concise, expresses the investigator's opinion, contains facts and data that the investigator relies on in rendering an opinion, contains the reasoning of the investigator by which each opinion was reached, and meets the needs or requirements of the intended audience(s).

**(A) Requisite Knowledge.** Elements of writing, typical components of a written report, and types of audiences and their respective needs or requirements.

**(B) Requisite Skills.** Writing skills, ability to analyze information and determine the reader's needs or requirements.

**501-16.1**     ***The Investigator candidate shall describe the purpose of recording the fire scene.***

**501-16.2**     ***The Investigator candidate shall describe the purpose of fire scene photography and the importance of timing.***

16.2.1     General

16.2.2     Timing

16.2.3     Basics

16.2.3.1    General

16.2.3.2    Types of cameras

16.2.3.3    Image authentication

16.2.3.4    Lenses

16.2.3.5    Filters

16.2.3.6    Shutter speed

16.2.3.7    Lighting

16.2.3.8    Special types of photography

16.2.4     Composition and technique

16.2.4.1    General

16.2.4.2    Sequential photos

16.2.4.3    Mosaics

- 16.2.4.4 Photo diagram
- 16.2.4.5 Assisting photographer
- 16.2.4.6 Photography and the courts
- 16.2.5 Video
- 16.2.6 Suggested activities to be documented
  - 16.2.6.1 During the fire
  - 16.2.6.2 Overhaul phase
  - 16.2.6.3 Bystander photographs
  - 16.2.6.4 Exterior photographs
  - 16.2.6.5 Structural photographs
  - 16.2.6.6 Interior photographs
  - 16.2.6.7 Utility and appliance photographs
  - 16.2.6.8 Evidence photographs
  - 16.2.6.9 Victim photographs
  - 16.2.6.10 Witness viewpoint photographs
  - 16.2.6.11 Aerial photographs
  - 16.2.6.12 Satellite photography
- 16.2.7 Photography tips
- 16.2.8 Presentation of photographs
  - 16.2.8.1 Computer-based presentations
  - 16.2.8.2 Hard copy

**501-16.3**     ***The Investigator candidate shall describe the importance of note taking.***

- 16.3.1 Forms of incident field notes
- 16.3.2 Forms for collecting data
- 16.3.3 Dictation of field notes

**501-16.4**     ***The Investigator candidate shall explain the importance of diagrams and drawings.***

- 16.4.1 Types of drawings
  - 16.4.1.1 Sketches
  - 16.4.1.2 Diagrams
- 16.4.2 Selection of drawings
- 16.4.3 Drawing tools and equipment

- 16.4.4 Diagram elements
  - 16.4.4.1 General information
  - 16.4.4.2 Identification of compass orientation
  - 16.4.4.3 Scale
  - 16.4.4.4 Symbols
  - 16.4.4.5 Legend
- 16.4.5 Drawings
  - 16.4.5.1 Site or area plan
  - 16.4.5.2 Floor plans
  - 16.4.5.3 Elevations
  - 16.4.5.4 Details and sections
  - 16.4.5.5 Exploded view diagrams
  - 16.4.5.6 Three-dimensional representations
  - 16.4.5.7 Specialized fire investigation diagrams
- 16.4.6 Prepared design and construction drawings
  - 16.4.6.1 General
  - 16.4.6.2 Architectural and engineering drawings
  - 16.4.6.3 Architectural and engineering schedules
  - 16.4.6.4 Specifications
  - 16.4.6.5 Appliance and building equipment

**501-16.5** ***The Investigator candidate must understand the purpose of the report to effectively communicate the observations analyses and conclusions made during an investigation.***

- 16.5.1 Descriptive information
- 16.5.2 Pertinent facts
- 16.5.3 Opinions and conclusions

**\*\*Note: The following part of Section 16 does not come from NFPA 921\*\***

**501-16.6** ***The Investigator candidate shall identify and describe the process of preparing and completing a final, accurate and concise report.***

- 1) National Fire Incident Reporting System (NFIRS) forms
- 2) Fire reports required by the AHJ

## SECTION 17

### PHYSICAL EVIDENCE

#### 4.2 Scene Examination.

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene, and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.1** Secure the fire ground, given marking devices, sufficient personnel, and special tools and equipment, so that unauthorized persons can recognize the perimeters of the investigative scene and are kept from restricted areas and all evidence or potential evidence is protected from damage or destruction.

**(A) Requisite Knowledge.** Fire ground hazards, types of evidence, and the importance of fire scene security, evidence preservation, and issues relating to spoliation.

**(B) Requisite Skills.** Use of marking devices.

**NFPA 1033 4.2.6** Examine and remove fire debris, given standard equipment and tools, so that all debris is checked for fire cause evidence, potential ignition source(s) is identified, and evidence is preserved without investigator-inflicted damage or contamination.

**(A) Requisite Knowledge.** Basic understanding of ignition processes, characteristics of ignition sources, and ease of ignition of fuels; debris-layering techniques; use of tools and equipment during the debris search; types of fire cause evidence commonly found in various degrees of damage; and evidence-gathering methods and documentation.

**(B) Requisite Skills.** Employ search techniques that further the discovery of fire cause evidence and ignition sources, use search techniques that incorporate documentation, and collect and preserve evidence.

#### 4.3 Documenting the Scene.

Duties shall include diagramming the scene, photographing, and taking field notes to be used to compile a final report.

**NFPA 1033 4.3.1** Diagram the scene, given standard tools and equipment, so that the scene is accurately represented and evidence, pertinent contents, significant patterns, and area(s) or point(s) of origin are identified.

**(A) Requisite Knowledge.** Commonly used symbols and legends that clarify the diagram, types of evidence and patterns that need to be documented, and formats for diagramming the scene.

**(B) Requisite Skills.** Ability to sketch the scene, basic drafting skills, and evidence recognition and observational skills.

#### 4.4 Evidence Collection/Preservation.

Duties shall include using proper physical and legal procedures to retain evidence required within the investigation.

**NFPA 1033 4.4.1** Utilize proper procedures for managing victims and fatalities, given a protocol and appropriate personnel, so that all evidence is discovered and preserved and the protocol procedures are followed.

**(A) Requisite Knowledge.** Types of evidence associated with fire victims and fatalities and evidence preservation methods.

**(B) Requisite Skills.** Observational skills and the ability to apply protocols to given situations.

**NFPA 1033 4.4.2\*** Locate, collect, and package evidence, given standard or special tools and equipment and evidence collection materials, so that evidence is identified, preserved, collected, and packaged to avoid contamination and investigator-inflicted damage and the chain of custody is established.

**(A) Requisite Knowledge.** Types of evidence, authority requirements, impact of removing evidentiary items on civil or criminal proceedings (exclusionary or fire-cause supportive evidence), types, capabilities, and limitations of standard and special tools used to locate evidence, types of laboratory tests available, packaging techniques and materials, and impact of evidence collection on the investigation.

**(B) Requisite Skills.** Ability to recognize different types of evidence and determine whether evidence is critical to the investigation.

**NFPA 1033 4.4.3** Select evidence for analysis given all information from the investigation, so that items for analysis support specific investigation needs.

**(A) Requisite Knowledge.** Purposes for submitting items for analysis, types of analytical services available, and capabilities and limitations of the services performing the analysis.

**(B) Requisite Skills.** Evaluate the fire incident to determine forensic, engineering, or laboratory needs.

**NFPA 1033 4.4.4** Maintain a chain of custody, given standard investigative tools, marking tools, and evidence tags or logs, so that written documentation exists for each piece of evidence and evidence is secured.

**(A) Requisite Knowledge.** Rules of custody and transfer procedures, types of evidence (e.g., physical evidence obtained at the scene, photos, and documents), and methods of recording the chain of custody.

**(B) Requisite Skills.** Ability to execute the chain of custody procedures and accurately complete necessary documents.

**NFPA 1033 4.4.5** Dispose of evidence, given jurisdictional or agency regulations and file information, so that the disposal is timely, safely conducted, and in compliance with jurisdictional or agency requirements.

**(A) Requisite Knowledge.** Disposal services available and common disposal procedures and problems.

**(B) Requisite Skills.** Documentation skills.

**501-17.1** ***The Investigator candidate shall describe the recommended and accepted methods of processing physical evidence.***

**501-17.2** ***The Investigator candidate shall define physical evidence.***

**501-17.3**     ***The Investigator candidate shall describe the importance of preservation of the fire scene and physical evidence.***

- 17.3.1     General
- 17.3.2     Fire patterns as physical evidence
- 17.3.3     Artifact evidence
- 17.3.4     Protecting evidence
- 17.3.5     Role and responsibility of fire suppression personnel in preserving the fire scene
  - 17.3.5.1     General
  - 17.3.5.2     Preservation
  - 17.3.5.3     Caution in fire suppression operations
    - 17.3.5.3.1     Use of water lines and hose streams
    - 17.3.5.3.2     Overhaul
    - 17.3.5.3.3     Salvage
    - 17.3.5.3.4     Movement of knobs and switches
    - 17.3.5.3.5     Use of power tools
    - 17.3.5.3.6     Limiting access of firefighters and other emergency personnel
- 17.3.6     Roles and responsibilities of the fire investigator
- 17.3.7     Practical considerations

**501-17.4**     ***The Investigator candidate shall describe contamination of physical evidence.***

- 17.4.1     Contamination of evidence containers
- 17.4.2     Contamination during collection
- 17.4.3     Contamination by fire fighters

**501-17.5**     ***The Investigator candidate shall describe methods of collection.***

- 17.5.1     General
- 17.5.2     Documenting the collection of physical evidence

- 17.5.3 Collection of traditional forensic physical evidence
- 17.5.4 Collection of evidence for accelerant testing
  - 17.5.4.1 Liquid accelerant characteristics
  - 17.5.4.2 Canine/handler teams
  - 17.5.4.3 Collection of liquid samples for ignitable liquid testing
  - 17.5.4.4 Collection of liquid evidence absorbed by solid materials
  - 17.5.4.5 Collection of solid samples for accelerant testing
  - 17.5.4.6 Comparison samples
  - 17.5.4.7 Canine teams
- 17.5.5 Collection of gaseous samples
- 17.5.6 Collection of electrical equipment and system components
- 17.5.7 Collection of appliances or small electrical equipment

**501-17.6** ***The Investigator candidate shall identify and describe different types of evidence containers.***

- 17.6.1 General
- 17.6.2 Liquid and solid accelerant evidence containers
  - 17.6.2.1 Metal cans
  - 17.6.2.2 Glass jars
  - 17.6.2.3 Special evidence bags
  - 17.6.2.4 Common plastic bags

**501-17.7** ***The Investigator candidate shall describe the methods of identifying physical evidence.***

**501-17.8** ***The Investigator candidate shall describe the proper methods of transportation and storage of physical evidence.***

- 17.8.1 Hand delivery
- 17.8.2 Shipment
- 17.8.3 Storage of evidence

**501-17.9** **The Investigator candidate shall identify and describe the evidence chain of custody of physical evidence.**

**501-17.10** **The Investigator candidate shall identify types of analytical methods and tests applicable to certain fire investigations, and the capabilities and limitations of the services that perform the analysis.**

17.10.1 Evidence collection or inspections involving alteration without changes to the evidentiary value of the artifacts

17.10.2 Test methods

17.10.3 Sufficiency of samples

17.10.4 Comparative examination and testing

**501-17.11** **The Investigator candidate shall describe the proper procedure for evidence disposition.**

## **SECTION 18**

### **ORIGIN DETERMINATION**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.2\*** Conduct an exterior survey, given standard equipment and tools, so that evidence is identified and preserved, fire damage is interpreted, hazards are identified to avoid injuries, accessibility to the property is determined, and all potential means of ingress and egress are discovered.

**(A) Requisite Knowledge.** The types of building construction and the effects of fire on construction materials, types of evidence commonly found in the perimeter, evidence preservation methods, the effects of fire suppression, fire behavior and spread, fire patterns, and a basic awareness of the dangers of hazardous materials.

**(B) Requisite Skills.** Assess fire ground and structural condition, observe the damage from and effects of the fire, and interpret fire patterns.

**NFPA 1033 4.2.3** Conduct an interior survey, given standard equipment and tools, so that areas of potential evidentiary value requiring further examination are identified and preserved, the evidentiary value of contents is determined, and hazards are identified in order to avoid injuries.

**(A) Requisite Knowledge.** The types of building construction and interior finish and the effects of fire on those materials, the effects of fire suppression, fire behavior and spread, evidence preservation methods, fire patterns, effects of building contents on fire growth, the relationship of building contents to the overall investigation, weather conditions at the time of the fire, and fuel moisture.

**(B) Requisite Skills.** Assess structural conditions, observe the damage and effects of the fire, discover the impact of fire suppression efforts on fire flow and heat propagation, and evaluate protected areas to determine the presence and/or absence of contents.

#### **4.6 Post-Incident Investigation.**

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.5\*** Formulate an opinion concerning origin, cause, or responsibility for the fire, given all investigative findings, so that the opinion regarding origin, cause, or responsibility for a fire is supported by the data, facts, records, reports, documents, and evidence.

**(A) Requisite Knowledge:** Analytical methods and procedures (e.g., hypothesis development and testing, systems analysis, time lines, link analysis, fault tree analysis, and data reduction matrixing).

**(B) Requisite Skills:** Analytical and assimilation skills.

**501-18.1**     ***The Investigator candidate shall identify the following sources used in origin determination.***

- 18.1.1     Witness information
- 18.1.2     Fire patterns
- 18.1.3     Arc mapping
- 18.1.4     Fire dynamics

**501-18.2**     ***The Investigator candidate shall identify and describe the overall methodology of conducting a scene assessment.***

- 18.2.1     Scientific method
- 18.2.2     Sequence of activities
- 18.2.3     Sequential pattern analysis
- 18.2.4     Systematic procedure
- 18.2.5     Recommended methodology

**501-18.3**     ***The Investigator candidate shall identify the data collection process for origin determination.***

- 18.3.1     Initial scene assessment
  - 18.3.1.1     Safety assessment
  - 18.3.1.2     Scope of the examination
  - 18.3.1.3     Order of the examination
  - 18.3.1.4     Surrounding areas
  - 18.3.1.5     Structure exterior
  - 18.3.1.6     Structure interior
  - 18.3.1.7     Post-fire alterations
- 18.3.2     Excavation and reconstruction
  - 18.3.2.1     Scope of excavation and reconstruction
  - 18.3.2.2     Safety
  - 18.3.2.3     Excavation
  - 18.3.2.4     Heavy equipment
  - 18.3.2.5     Avoiding spoliation
  - 18.3.2.6     Avoiding contamination
  - 18.3.2.7     Washing floors
  - 18.3.2.8     Contents

- 18.3.3 Additional data collection activities for origin determination
  - 18.3.3.1 Pre-fire conditions
  - 18.3.3.2 Description of fuels
  - 18.3.3.3 Structure dimensions
  - 18.3.3.4 Building systems and ventilation
  - 18.3.3.5 Weather conditions
  - 18.3.3.6 Electrical systems
  - 18.3.3.7 Electrical loads
  - 18.3.3.8 HVAC systems
  - 18.3.3.9 Fuel gas systems
  - 18.3.3.10 Liquid fuel systems
  - 18.3.3.11 Fire protection systems
  - 18.3.3.12 Fire protection systems data
  - 18.3.3.13 Security cameras
  - 18.3.3.14 Intrusion alarm systems
  - 18.3.3.15 Witness observations

**501-18.4**     ***The Investigator candidate shall recognize the importance of analyzing the following data.***

- 18.4.1 Fire patterns analysis
  - 18.4.1.1 Consideration of all patterns
  - 18.4.1.2 Sequence of patterns
  - 18.4.1.3 Pattern generation
  - 18.4.1.4 Ventilation
  - 18.4.1.5 Movement and intensity patterns
  
- 18.4.2 Heat and flame vector analysis
  - 18.4.2.1 Complementary vectors
  - 18.4.2.2 Heat source
  - 18.4.2.3 Additional tools for pattern visualization
  
- 18.4.3 Depth of char analysis
  - 18.4.3.1 Depth of char diagram
  - 18.4.3.2 Measuring depth of char
  - 18.4.3.3 Location of measurements
  - 18.4.3.4 Missing wood
  - 18.4.3.5 Depth of char surveys with fuel gases
  
- 18.4.4 Depth of calcination survey
  - 18.4.4.1 Depth of calcination diagram
  - 18.4.4.2 Measuring depth of calcination

- 18.4.5 Arc surveys or arc mapping
  - 18.4.5.1 Suggested procedure
  - 18.4.5.2 Arc survey diagrams
  - 18.4.5.3 Documenting arc sites
  - 18.4.5.4 Arc survey evidence collection
  - 18.4.5.5 Arc survey utilization
  - 18.4.5.6 Arc survey limitations
- 18.4.6 Analysis of sequential events
- 18.4.7 Fire dynamics

**501-18.5** ***The Investigator candidate shall identify the process of developing an origin hypothesis.***

- 18.5.1 Initial hypothesis
- 18.5.2 Modifying the initial hypothesis

**501-18.6** ***The Investigator candidate shall identify the proper scientific method of testing of origin hypotheses.***

- 18.6.1 Means of hypothesis testing
- 18.6.2 Analytical techniques and tools
  - 18.6.2.1 Time line analysis
  - 18.6.2.2 Fire modeling
  - 18.6.2.3 Experimental testing

**501-18.7** ***The Investigator candidate shall select a final hypothesis.***

- 18.7.1 Defining the area of origin
- 18.7.2 Inconsistent data
- 18.7.3 Case file review

**501-18.8** ***The Investigator candidate shall identify when there is insufficient data to define the origin.***

- 18.8.1 Large area adequate for determination
- 18.8.2 Justification of a large area of origin
- 18.8.3 Eyewitness evidence of origin area

## SECTION 19

### FIRE CAUSE DETERMINATION

#### **4.6 Post-Incident Investigation.**

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.5\*** Formulate an opinion concerning origin, cause, or responsibility for the fire, given all investigative findings, so that the opinion regarding origin, cause, or responsibility for a fire is supported by the data, facts, records, reports, documents, and evidence.

**(A) Requisite Knowledge.** Analytical methods and procedures (e.g., hypothesis development and testing, systems analysis, time lines, link analysis, fault tree analysis, and data reduction matrixing).

**(B) Requisite Skills.** Analytical and assimilation skills.

**501-19.1**      **The Investigator candidate shall define fire cause and identify fire cause factors.**

- 19.1.1      Fire cause factors
- 19.1.2      First fuel ignited
- 19.1.3      Ignition source
- 19.1.4      Oxidant
- 19.1.5      Ignition sequence

**501-19.2**      **The Investigator candidate shall utilize the scientific method as the overall methodology.**

- 19.2.1      Consideration of data
- 19.2.2      Sequence of activities
- 19.2.3      Point and area of origin

**501-19.3**      **The Investigator candidate shall identify the data that needs to be collected for fire cause determination.**

- 19.3.1      Identify fuels in the area of origin
- 19.3.2      Identify source and form of the heat of ignition

19.3.3 Identify items and activities in area of origin

19.3.4 Identify the oxidant

19.3.5 Identify ignition sequence data

**501-19.4** ***The Investigator candidate shall demonstrate the proper use of the scientific method to analyze the data.***

19.4.1 Fuel analysis

19.4.2 Ignition source analysis

19.4.3 Oxidant

19.4.4 Ignition sequence

**501-19.5** ***The Investigator candidate shall develop a cause hypothesis.***

**501-19.6** ***The Investigator candidate shall test the cause hypothesis.***

19.6.1 Using the scientific method

19.6.2 Deductive reasoning

19.6.3 Hypothesis testing questions

19.6.4 Means of hypothesis testing

19.6.4.1 Scientific literature

19.6.4.2 Fundamental principles of science

19.6.4.3 Physical experiments of testing

19.6.4.4 Cognitive experiments

19.6.4.5 Time lines

19.6.4.6 Fault trees

19.6.4.7 Additional techniques

19.6.5 Appropriate use of the process of elimination

19.6.5.1 Cause undetermined

19.6.5.2 Ignition source vs. fire cause

**501-19.7** ***The Investigator candidate shall demonstrate the proper selection of a final hypothesis.***

19.7.1 Establishing the cause

19.7.2 Inconsistent data

19.7.3 Safety devices and features

19.7.4 Undetermined fire cause

## SECTION 20

### CLASSIFICATION OF FIRE CAUSE

#### 4.2. Scene Examination

**NFPA 1033 4.2.6** Examine and remove fire debris, given standard equipment and tools, so that all debris is checked for fire cause evidence, potential ignition source(s) is identified, and evidence is preserved without investigator-inflicted damage or contamination.

**(A) Requisite Knowledge.** Basic understanding of ignition processes, characteristics of ignition sources, and ease of ignition of fuels; debris-layering techniques; use of tools and equipment during the debris search; types of fire cause evidence commonly found in various degrees of damage; and evidence-gathering methods and documentation.

**(B) Requisite Skills.** Employ search techniques that further the discovery of fire cause evidence and ignition sources, use search techniques that incorporate documentation, and collect and preserve evidence.

**501-20.1**     **The Investigator candidate shall describe the classifications of fire cause.**

- 20.1.1     Accidental fire cause classification
- 20.1.2     Natural fire cause classification
- 20.1.3     Incendiary fire cause classification
- 20.1.4     Undetermined fire cause classification

## SECTION 21

### ANALYZING THE INCIDENT FOR CAUSE AND RESPONSIBILITY

#### 4.6 Post-Incident Investigation.

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.1** Gather reports and records, given no special tools, equipment, or materials, so that all gathered documents are applicable to the investigation, complete, and authentic; the chain of custody is maintained; and the material is admissible in a legal proceeding.

**(A) Requisite Knowledge.** Types of reports needed that facilitate determining responsibility for the fire (e.g., police reports, fire reports, insurance policies, financial records, deeds, private investigator reports, outside photos, and videos) and location of these reports.

**(B) Requisite Skills.** Ability to identify the reports and documents necessary for the investigation, implement the chain of custody, and organizational skills.

**NFPA 1033 4.6.2** Evaluate the investigative file, given all available file information, so that areas for further investigation are identified, the relationship between gathered documents and information is interpreted, and corroborative evidence and information discrepancies are discovered.

**(A) Requisite Knowledge.** File assessment and/or evaluation methods, including accurate documentation practices, and requisite investigative elements.

**(B) Requisite Skills.** Information assessment, correlation, and organizational skills.

**NFPA 1033 4.6.3** Coordinate expert resources, given the investigative file, reports, and documents, so that the expert's competencies are matched to the specific investigation needs, financial expenditures are justified, and utilization clearly furthers the investigative goals of determining cause or affixing responsibility.

**(A) Requisite Knowledge.** How to assess one's own expertise, qualification to be called for expert testimony, types of expert resources (e.g., forensic, CPA, polygraph, financial, human behavior disorders, and engineering), and methods to identify expert resources.

**(B) Requisite Skills.** Ability to apply expert resources to further the investigation by networking with other investigators to identify experts, questioning experts relative to their qualifications, and developing a utilization plan for use of expert resources.

**NFPA 1033 4.6.4** Establish evidence as to motive and/or opportunity, given an incendiary fire, so that the evidence is supported by documentation and meets the evidentiary requirements of the jurisdiction.

**(A) Requisite Knowledge.** Types of motives common to incendiary fires, methods used to discover opportunity, and human behavioral patterns relative to fire-setting

**(B) Requisite Skills.** Financial analysis, records gathering and analysis, interviewing, and interpreting fire scene information and evidence for relationship to motive and/or opportunity.

**NFPA 1033 4.6.5** Formulate an opinion concerning origin, cause, or responsibility for the fire, given all investigative findings, so that the opinion regarding origin, cause, or responsibility for a fire is supported by the data, facts, records, reports, documents, and evidence.

**(A) Requisite Knowledge.** Analytical methods and procedures (e.g., hypothesis development and testing, systems analysis, time lines, link analysis, fault tree analysis, and data reduction matrixing).

**(B) Requisite Skills.** Analytical and assimilation skills.

**501-21.1**     ***The Investigator candidate shall describe methods for analyzing the incident for cause and responsibility.***

- 21.1.1     (1) The cause of the fire or explosion.
- (2) The cause of damage to property resulting from the incident.
- (3) The cause of bodily injury or loss of life.
- (4) The degree to which human fault contributed to any one or more of the causal issues described in (1), (2), and (3).
- 21.1.2     The cause of a fire or the causes of damage or casualties may be grouped in broad categories for general discussion, for assignment of legal responsibility or culpability, or for reporting purposes.

**501-21.2**     ***See Chapter 20.***

**501-21.3**     ***The Investigator candidate shall describe the causes of damage to property resulting from the Incident.***

- 21.3.1     Considerations
- 21.3.2     Fire / smoke spread
  - 21.3.2.1    Compartmentation
  - 21.3.2.2    Change of occupancy/hazard
  - 21.3.2.3    Detection/alarm systems
  - 21.3.2.4    Human behavior
  - 21.3.2.5    Fire suppression
  - 21.3.2.6    Fuel loads
  - 21.3.2.7    Housekeeping
  - 21.3.2.8    Ventilation
  - 21.3.2.9    Code violations
  - 21.3.2.10   Structural failure
- 21.3.3     Other consequential damage

**501-21.4**     ***The Investigator candidate shall describe the causes of bodily injury or loss of life. See Chapters 11 and 25.***

- 21.4.1     Fire/smoke spread
  - 21.4.1.1     Toxicity
  - 21.4.1.2     Hazardous materials
  - 21.4.1.3     Compartmentation
  - 21.4.1.4     Change of occupancy/hazard
  - 21.4.1.5     Detection/alarm systems
  - 21.4.1.6     Human behavior
  - 21.4.1.7     Fire suppression
  - 21.4.1.8     Housekeeping
  - 21.4.1.9     Fuel loads
  - 21.4.1.10     Ventilation
  - 21.4.1.11     Code violations
  - 21.4.1.12     Means of egress/refuge
  - 21.4.1.13     Structural failure
  - 21.4.1.14     Intentional acts
  
- 21.4.2     Emergency preparedness

**501-21.5**     ***The Investigator candidate shall describe the determination of responsibility.***

- 21.5.1     Nature of responsibility
  
- 21.5.2     Definition of responsibility
  
- 21.5.3     Assessing of responsibility
  
- 21.5.4     Degrees of responsibility

## SECTION 22

### FAILURE ANALYSIS AND ANALYTICAL TOOLS

#### 4.6 Post-Incident Investigation.

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.1** Gather reports and records, given no special tools, equipment, or materials, so that all gathered documents are applicable to the investigation, complete, and authentic; the chain of custody is maintained; and the material is admissible in a legal proceeding.

**(A) Requisite Knowledge.** Types of reports needed that facilitate determining responsibility for the fire (e.g., police reports, fire reports, insurance policies, financial records, deeds, private investigator reports, outside photos, and videos) and location of these reports.

**(B) Requisite Skills.** Ability to identify the reports and documents necessary for the investigation, implement the chain of custody, and organizational skills.

**NFPA 1033 4.6.2** Evaluate the investigative file, given all available file information, so that areas for further investigation are identified, the relationship between gathered documents and information is interpreted, and corroborative evidence and information discrepancies are discovered.

**(A) Requisite Knowledge.** File assessment and/or evaluation methods, including accurate documentation practices, and requisite investigative elements.

**(B) Requisite Skills.** Information assessment, correlation, and organizational skills.

**NFPA 1033 4.6.3** Coordinate expert resources, given the investigative file, reports, and documents, so that the expert's competencies are matched to the specific investigation needs, financial expenditures are justified, and utilization clearly furthers the investigative goals of determining cause or affixing responsibility.

**(A) Requisite Knowledge.** How to assess one's own expertise, qualification to be called for expert testimony, types of expert resources (e.g., forensic, CPA, polygraph, financial, human behavior disorders, and engineering), and methods to identify expert resources.

**(B) Requisite Skills.** Ability to apply expert resources to further the investigation by networking with other investigators to identify experts, questioning experts relative to their qualifications, and developing a utilization plan for use of expert resources.

**NFPA 1033 4.6.4** Establish evidence as to motive and/or opportunity, given an incendiary fire, so that the evidence is supported by documentation and meets the evidentiary requirements of the jurisdiction.

**(A) Requisite Knowledge.** Types of motives common to incendiary fires, methods used to discover opportunity, and human behavioral patterns relative to fire-setting.

**(B) Requisite Skills.** Financial analysis, records gathering and analysis, interviewing, and interpreting fire scene information and evidence for relationship to motive and/or opportunity.

**NFPA 1033 4.6.5** Formulate an opinion concerning origin, cause, or responsibility for the fire, given all investigative findings, so that the opinion regarding origin, cause, or responsibility for a fire is supported by the data, facts, records, reports, documents, and evidence.

**(A) Requisite Knowledge.** Analytical methods and procedures (e.g., hypothesis development and testing, systems analysis, time lines, link analysis, fault tree analysis, and data reduction matrixing).

**(B) Requisite Skills.** Analytical and assimilation skills.

**501-22.1**     ***The Investigator candidate shall describe failure analysis and the use of analytical tools.***

**501-22.2**     ***The Investigator candidate shall describe time lines available for use in analyzing fire cause.***

22.2.1     General

22.2.2     Hard time (actual)

22.2.3     Soft time (estimated)

22.2.4     Benchmark events

22.2.5     Multiple time lines

**501-22.3**     ***The Investigator candidate shall describe system analysis techniques.***

22.3.1     Fault trees

22.3.2     Failure mode and effects analysis (FMEA)

**501-22.4**     ***The Investigator candidate shall describe the purpose for mathematical modeling.***

22.4.1     General and limitations of mathematical modeling

22.4.2     Heat transfer analysis

22.4.3     Flammable gas concentrations

22.4.4     Hydraulic analysis

22.4.5     Thermodynamic chemical equilibrium analysis

22.4.6     Structural analysis

22.4.7     Egress analysis

22.4.8 Fire dynamics analysis

22.4.9 Guidelines for selection and use of a fire model

**501-22.5** ***The Investigator candidate shall describe the role of fire testing.***

22.5.1 Role of fire testing

22.5.2 Fire test methods

22.5.3 Limitations of fire testing

**501-22.6** ***The Investigator candidate shall identify the data required for modeling and testing.***

22.6.1 Materials and contents

22.6.2 Ventilation

## **SECTION 23**

### **EXPLOSIONS**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene, and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.9** Discriminate the effects of explosions from other types of damage, given standard equipment and tools, so that an explosion is identified and its evidence is preserved.

**(A) Requisite Knowledge.** Different types of explosions and their causes, characteristics of an explosion, and the difference between low- and high-order explosions.

**(B) Requisite Skills.** Identify explosive effects on glass, walls, foundations, and other building materials; distinguish between low- and high-order explosion effects; and analyze damage to document the blast zone and origin.

**501-23.1**     ***The Investigator candidate shall define the term “explosion”.***

**501-23.2**     ***The Investigator candidate shall identify the different types of explosions.***

23.2.1     Mechanical explosion

23.2.2     Boiling liquid expanding vapor explosion (BLEVE)

23.2.3     Chemical explosion

23.2.4     Combustion explosion

23.2.5     Electrical explosion

23.2.6     Nuclear explosion

**501-23.3**     ***The Investigator candidate shall distinguish between the characterization of explosion damage.***

23.3.1     Low-order damage

23.3.2     High-order damage

**501-23.4**     ***The Investigator candidate shall be able to describe the effects of explosions.***

- 23.4.1 Blast overpressure and wave effect
  - 23.4.1.1 General
  - 23.4.1.2 Positive pressure phase
  - 23.4.1.3 Negative pressure phase
  - 23.4.1.4 Shape of blast wave (front)
  - 23.4.1.5 Rate of pressure rise versus maximum pressure
- 23.4.2 Shrapnel effect (projectiles)
- 23.4.3 Thermal effect
- 23.4.4 Seismic effect (ground shock)

**501-23.5** ***The Investigator candidate shall identify the factors controlling explosion effects.***

- 23.5.1 Fuel
- 23.5.2 Turbulence
- 23.5.3 Nature of confining space
- 23.5.4 Location and magnitude of ignition source
- 23.5.5 Venting
- 23.5.6 Blast pressure wave (blast pressure front) modification by reflection
- 23.5.7 Blast pressure front modification by refraction and blast focusing

**501-23.6** ***The Investigator candidate shall be able to identify a seated explosion.***

- 23.6.1 General
- 23.6.2 Explosives
- 23.6.3 Boiler and pressure vessels
- 23.6.4 Confined fuel gas and liquid vapor

23.6.5 Boiling liquid expanding vapor explosion (BLEVE)

**501-23.7** ***The Investigator candidate shall be able to identify a non-seated explosion.***

23.7.1 Fuel gases

23.7.2 Pool flammable/combustible liquids

23.7.3 Dusts

23.7.4 Backdraft (smoke explosion)

**501-23.8** ***The Investigator candidate shall be able to describe the characteristics of gas/vapor explosions.***

23.8.1 Ignition of gases and vapors

23.8.2 Interpretation of explosion damage

23.8.2.1 Fuel-air ratio

23.8.2.2 Specific gravity (air) (vapor density)

23.8.3 Underground migration of fuel gases

23.8.4 Multiple explosions

**501-23.9** ***The Investigator candidate shall describe the characteristics of dust explosions.***

23.9.1 General

23.9.2 Particle size

23.9.3 Concentration

23.9.4 Turbulence in dust explosions

23.9.5 Moisture

23.9.6 Minimum ignition energy for dust

23.9.7 Multiple explosions

**501-23.10** ***The Investigator candidate shall be able to describe backdraft (smoke explosions).***

**501-23.11** **The Investigator candidate shall be able to identify an outdoor vapor cloud explosion.**

**501-23.12** **The Investigator candidate shall be able to distinguish the two types of explosives.**

23.12.1 Low explosives

23.12.2 High explosives

**501-23.13** **The Investigator candidate shall describe the complexity of the investigation of explosive incidents.**

**501-23.14** **The Investigator candidate shall be able to investigate the explosion scene.**

23.14.1 General

23.14.2 Securing the scene

23.14.2.1 Establishing the scene

23.14.2.2 Obtain background information

23.14.2.3 Establish the scene search pattern

23.14.2.4 Safety at the explosion scene

23.14.3 Initial scene assessment

23.14.3.1 General

23.14.3.2 Identify explosion or fire

23.14.3.3 Document damage

23.14.3.4 Seated or nonseated explosion

23.14.3.5 Identify type of explosion

23.14.3.6 Identify potential general fuel type

23.14.3.7 Establish the origin

23.14.3.8 Establish ignition source

23.14.4 Detailed scene assessment

23.14.4.1 Identify damage effects of explosion

23.14.4.2 Identify pre-blast and post-blast fire damage

23.14.4.3 Locate and identify articles of evidence

23.14.4.4 Identify force vectors

**501-23.15** **The Investigator candidate shall analyze the origin (epicenter) of an explosion scene.**

**501-23.16** ***The Investigator candidate shall analyze a fuel source.***

**501-23.17** ***The Investigator candidate shall analyze the ignition source.***

**501-23.18** ***The Investigator candidate shall analyze to establish cause.***

23.18.1 General

23.18.2 Time line analysis

23.18.3 Damage pattern analysis

23.18.3.1 Debris analysis

23.18.3.2 Relative structural damage analysis

23.18.4 Correlation of explosion type and energy with damage incurred

23.18.5 Analysis of damaged items and structures

23.18.6 Correlation of thermal effects

## **SECTION 24**

### **INCENDIARY FIRES**

#### **4.6 Post-Incident Investigation.**

Duties shall include the investigation of all factors beyond the fire scene at the time of the origin and cause determination.

**NFPA 1033 4.6.4** Establish evidence as to motive and/or opportunity, given an incendiary fire, so that the evidence is supported by documentation and meets the evidentiary requirements of the jurisdiction.

**(A) Requisite Knowledge.** Types of motives common to incendiary fires, methods used to discover opportunity, and human behavioral patterns relative to fire-setting.

**(B) Requisite Skills.** Financial analysis, records gathering and analysis, interviewing, and interpreting fire scene information and evidence for relationship to motive and/or opportunity.

**NFPA 1033 4.6.5** Formulate an opinion concerning origin, cause, or responsibility for the fire, given all investigative findings, so that the opinion regarding origin, cause, or responsibility for a fire is supported by the data, facts, records, reports, documents, and evidence.

**(A) Requisite Knowledge:** Analytical methods and procedures (e.g., hypothesis development and testing, systems analysis, time lines, link analysis, fault tree analysis, and data reduction matrixing).

**(B) Requisite Skills:** Analytical and assimilation skills.

**501-24.1**     ***The Investigator candidate shall define “incendiary” fires.***

**501-24.2**     ***The Investigator candidate shall identify and describe indicators of incendiary fires.***

- 24.2.1     Multiple fires
- 24.2.2     Trailers
- 24.2.3     Lack of expected fuel load and ignition sources
- 24.2.4     Exotic accelerants
- 24.2.5     Unusual fuel load or configuration
- 24.2.6     Burn injuries
- 24.2.7     Incendiary devices
  - 24.2.7.1   Examples of incendiary devices
  - 24.2.7.2   Delay devices

24.2.7.3 Presence of ignitable liquids in area of origin

24.2.8 Assessment of fire growth and fire damage

**501-24.3** ***The Investigator candidate shall identify and explain potential indicators of incendiary fires not directly related to combustion.***

24.3.1 Remote locations with view blocked or obscured

24.3.2 Fires near service equipment and appliances

24.3.3 Removal or replacement of contents prior to the fire

24.3.3.1 Replacement

24.3.3.2 Removal

24.3.3.3 Absences of personal items prior to the fire

24.3.4 Entry blocked or obstructed

24.3.5 Sabotage to the structure or fire protection systems

24.3.5.1 Definition of sabotage

24.3.5.2 Damage to fire-resistive assemblies

24.3.5.3 Damage to fire protection systems

24.3.6 Open windows and exterior doors

**501-24.4** ***The Investigator candidate shall identify and describe other evidentiary factors associated with incendiary fires.***

24.4.1 Evidentiary factors that should be recorded and examined

24.4.2 Analysis of confirmed incendiary fires

24.4.2.1 Geographic areas or clusters

24.4.2.2 Temporal frequency

24.4.2.3 Materials and method

24.4.3 Evidence of other crimes, crime concealment

24.4.4 Indications of financial stress

24.4.5 Existing or history of code violations

24.4.6 Owner with fires at other properties

- 24.4.7 Overinsurance
- 24.4.8 Timed opportunity
  - 24.4.8.1 Fires during severe natural conditions
  - 24.4.8.2 Fires during civil unrest
  - 24.4.8.3 Fire department unavailable
- 24.4.9 Motives for firesetting behavior
  - 24.4.9.1 Define “motive”
  - 24.4.9.2 Motive versus intent
  - 24.4.9.3 Classifications of motive
    - 24.4.9.3.1 Introduction
    - 24.4.9.3.2 Vandalism
      - 24.4.9.3.2.1 Willful and malicious mischief
      - 24.4.9.3.2.2 Peer or group pressure
    - 24.4.9.3.3 Excitement
      - a. Thrill seeking
      - b. Attention seeking
      - c. Recognition
      - d. Sexual gratification or perversion
    - 24.4.9.3.4 Revenge
      - a. Personal retaliation
      - b. Societal retaliation
      - c. Institutional retaliation
      - d. Group retaliation
    - 24.4.9.3.5 Crime Concealment
      - a. Murder concealment
      - b. Burglary concealment
      - c. Destruction of records or documents
    - 24.4.9.3.6 Profit
    - 24.4.9.3.7 Extremism
      - a. Terrorism
      - b. Riot/civil disturbance

## SECTION 25

### FIRE AND EXPLOSION DEATHS AND INJURIES

#### **4.4 Evidence Collection/Preservation.**

Duties shall include using proper physical and legal procedures to identify, document, collect and preserve evidence required within the investigation.

**NFPA 1033 4.4.1** Utilize proper procedures for managing victims and fatalities, given a protocol and appropriate personnel, so that all evidence is discovered and preserved and the protocol procedures are followed.

**(A) Requisite Knowledge.** Types of evidence associated with fire victims and fatalities and evidence preservation methods.

**(B) Requisite Skills.** Observational skills and the ability to apply protocols to given situations.

**501-25.1**     **The Investigator candidate shall demonstrate the ability to utilize specialized skills associated with death and injuries from fire and explosions.**

**501-25.2**     **The Investigator candidate shall identify the mechanisms of death and injury.**

- 25.2.1     Carbon monoxide
- 25.2.2     Cyanide
- 25.2.3     Other toxic gases
- 25.2.4     Hyperthermia
- 25.2.5     Skin burns
- 25.2.6     Inhalation of hot gases
- 25.2.7     Soot and smoke
- 25.2.8     Hypoxia
- 25.2.9     Sublethal inhalation exposure effects on the individual
  - 25.2.9.1    Narcotic gases
  - 25.2.9.2    Irritant gases
  - 25.2.9.3    Smoke
- 25.2.10    Explosion related injuries
  - 25.2.10.1   Blast pressure injuries

- 25.2.10.2 Shrapnel injuries
- 25.2.10.3 Thermal injuries
- 25.2.10.4 Building collapse injuries

**501-25.3**     ***The Investigator candidate shall describe the consumption of the body by fire.***

- 25.3.1     Skin
- 25.3.2     Muscle
- 25.3.3     Bone
- 25.3.4     Fat

**501-25.4**     ***The Investigator candidate shall describe the postmortem changes that a deceased body will undergo when exposed to heat and to death.***

- 25.4.1     Lividity
- 25.4.2     Rigor mortis

**501-25.5**     ***The Investigator candidate shall describe the considerations to be made before the investigation of a fatal fire.***

- 25.5.1     Notifications
- 25.5.2     The fire department
- 25.5.3     Team investigation
- 25.5.4     Safety
- 25.5.5     Scene documentation
- 25.5.6     Victim documentation
- 25.5.7     Recovery of bodies and evidence
  - 25.5.7.1     Layering of debris
  - 25.5.7.2     Sifting of debris
  - 25.5.7.3     Body removal
  - 25.5.7.4     Victim clothing

25.5.8 Collection of other physical evidence

**501-25.6** ***The Investigator candidate shall describe the steps of investigating fire scenes with injuries.***

- 25.6.1 Notification laws
- 25.6.2 Scene documentation
- 25.6.3 Victim documentation
- 25.6.4 Victim timeline
- 25.6.5 Physical evidence

**501-25.7** ***The Investigator candidate shall describe the documentation of an explosion incident where injury and/or death has occurred.***

25.7.1 Collecting physical evidence from explosions

**501-25.8** ***The Investigator candidate shall describe post scene investigation of injuries.***

- 25.8.1 Burns
- 25.8.2 Inhalation medical evidence
- 25.8.3 Hospital tests and documentation
- 25.8.4 Access to medical evidence

**501-25.9** ***The Investigator candidate shall describe the fire death pathological and toxicological examination***

- 25.9.1 The coroner or medical examiner
- 25.9.2 Identifying the remains
  - 25.9.2.1 Human vs. animal remains
  - 25.9.2.2 Visual identification
  - 25.9.2.3 Identification by clothing and personal effects
  - 25.9.2.4 Fingerprint identification
  - 25.9.2.5 X-ray identification
  - 25.9.2.6 DNA identification

- 25.9.3 X-ray examination
- 25.9.4 Carbon monoxide levels
- 25.9.5 Cyanide levels
- 25.9.6 Presence of other toxicants
- 25.9.7 Smoke and soot exposure
- 25.9.8 Burns
- 25.9.9 Physical trauma and wounds
- 25.9.10 Stomach contents
- 25.9.11 Internal body temperature
- 25.9.12 Pre-existing medical conditions
- 25.9.13 Death pre-fire
- 25.9.14 Death from a medical condition

**501-25.10** ***The Investigator candidate shall describe how to analyze the data developed from the death or injury investigation and correlate it with the other data from the investigation.***

- 25.10.1 Timeline development
- 25.10.2 Victim activity
- 25.10.3 Pre-fire victim impairment
- 25.10.4 Medical history
- 25.10.5 Fire patterns
- 25.10.6 Burns
- 25.10.7 Clothing

- 25.10.8 Applications of toxicology in fire investigation
  - 25.10.8.1 Toxicological analysis techniques
  - 25.10.8.2 Physiological models
    - 25.10.8.2.1 The Steward Equation
    - 25.10.8.2.2 The Colburn Forster Kane (CFK) Equation

## **SECTION 26**

### **APPLIANCES**

#### **4.2 Scene Examination.**

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene, and/or conducting a comprehensive review of documentation generated during the examination(s) of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.8** Inspect the performance of building systems, including detection, suppression, HVAC, utilities, and building compartmentation, given standard and special equipment and tools, so that a determination can be made as to the need for expert resources, an operating system's impact on fire growth and spread is considered in identifying origin areas, defeated and/or failed systems are identified, and the system's potential as a fire cause is recognized.

**(A) Requisite Knowledge.** Different types of detection, suppression, HVAC, utility, and building compartmentation such as fire walls and fire doors; types of expert resources for building systems; the impact of fire on various systems; common methods used to defeat a system's functional capability; and types of failures.

**(B) Requisite Skills.** Determine the system's operation and its effect on the fire; identify alterations to, and failure indicators of, building systems; and evaluate the impact of suppression efforts on building systems.

**501-26.1**     ***The Investigator candidate shall analyze appliances as it relates to investigation of the cause of fires.***

**501-26.2**     ***The Investigator candidate shall record the scene involving an appliance.***

26.2.1     Recording specific appliances

26.2.2     Measurements of the location of the appliances

26.2.3     Positions of appliance controls

26.2.4     Document appliance information

26.2.5     Gathering all of the parts from the appliance

**501-26.3**     ***The Investigator candidate shall analyze the origin of fires involving appliances.***

26.3.1     Relationship of the appliance to the origin

- 26.3.2 Fire patterns
- 26.3.3 Plastic appliance components
- 26.3.4 Reconstruction of the area of origin

**501-26.4** ***The Investigator candidate shall analyze the cause of fires involving appliances.***

- 26.4.1 How the appliance generated heat
- 26.4.2 The use and design of the appliance
- 26.4.3 Electrical appliances as ignition sources
- 26.4.4 Photographing appliance disassembly
- 26.4.5 Obtaining exemplar appliances
- 26.4.6 Testing exemplar appliances

**501-26.5** ***The Investigator candidate shall describe each of the common parts or components that might be found in various appliances.***

- 26.5.1 Appliance housings
- 26.5.2 Power sources
  - 26.5.2.1 Power cords
  - 26.5.2.2 Voltages less than 120
  - 26.5.2.3 Batteries
  - 26.5.2.4 Overcurrent protection
- 26.5.3 Switches
  - 26.5.3.1 Manual switches
  - 26.5.3.2 Automatic switches
- 26.5.4 Solenoids and relays
- 26.5.5 Transformers
- 26.5.6 Motors
- 26.5.7 Heating elements

- 26.5.8 Lighting
  - 26.5.8.1 Fluorescent lighting systems
  - 26.5.8.2 High intensity discharge lighting systems
- 26.5.9 Miscellaneous components

**501-26.6** ***The Investigator candidate shall describe the operation and components of common residential appliances.***

- 26.6.1 Range or oven
- 26.6.2 Coffee makers
- 26.6.3 Toaster
- 26.6.4 Electric can opener
- 26.6.5 Refrigerator
- 26.6.6 Dishwasher
- 26.6.7 Microwave oven
- 26.6.8 Portable space heater
- 26.6.9 Electric blanket
- 26.6.10 Window air conditioner unit
- 26.6.11 Hair dryer and hair curler
- 26.6.12 Clothes iron
- 26.6.13 Clothes dryer
- 26.6.14 Consumer electronics
- 26.6.15 Lighting

## SECTION 27

### MOTOR VEHICLE FIRES

#### Annex A Explanatory Material

**NFPA 1033 A.1.1** The intent of this standard applies to all fire investigation, including outside, wildland, vehicle, and structural fires.

#### 4.1 General

**NFPA 1033 4.1.3** Because fire investigators are required to perform activities in adverse conditions, site safety assessments shall be completed on all scenes and regional and national safety standards shall be followed and included in organizational policies and procedures.

#### 4.2 Scene Examination.

Duties shall include inspecting and evaluating the fire scene, or evidence of the scene if the scene is no longer available, so as to determine the area or point of origin, source of ignition, material(s) ignited, and act or activity that brought ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

**NFPA 1033 4.2.4** Interpret fire patterns, given standard equipment and tools and some structural or content remains, so that each individual pattern is evaluated with respect to the burning characteristics of the material involved and in context and relationship with all patterns observed in the mechanisms of heat transfer that lead to the formation of the pattern.

**(A) Requisite Knowledge.** Fire dynamics, fire development, and the interrelationship of heat release rate, form, and ignitability of materials.

**(B) Requisite Skills.** Ability to interpret the effects of burning characteristics on different types of materials.

**NFPA 1033 4.2.5** Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that fire development is determined, methods and effects of suppression are evaluated, false origin area patterns are recognized, and all areas of origin are correctly identified.

**(A) Requisite Knowledge.** Fire behavior and spread based on fire chemistry, fire dynamics, and physics, fire suppression effects, building construction.

**(B) Requisite Skills.** Interpret variations of fire patterns on different materials with consideration given to heat release rate, form, and ignitability; distinguish impact of different types of fuel loads; evaluate fuel trails; and analyze and synthesize information.

**NFPA 1033 4.2.6** Examine and remove fire debris, given standard equipment and tools, so that all debris is checked for fire cause evidence, potential ignition source(s) is identified, and evidence is preserved without investigator-inflicted damage or contamination.

**(A) Requisite Knowledge.** Basic understanding of ignition processes, characteristics of ignition sources, and ease of ignition of fuels; debris-layering techniques; use of tools and equipment during the debris search; types of fire cause evidence commonly found in various degrees of damage; and evidence-gathering methods and documentation.

**(B) Requisite Skills.** Employ search techniques that further the discovery of fire cause evidence and ignition sources, use search techniques that incorporate documentation, and collect and preserve evidence.

**501-27.1** **The Investigator candidate shall describe the factors related to the investigation of fires involving motor vehicles.**

**501-27.2** **The Investigator candidate shall describe the differences, in safety related concerns, that burned vehicles pose as compared to those found in structure fires.**

**501-27.3** **The Investigator candidate shall describe and identify the different types of fuels that may be involved in vehicle fires.**

27.3.1 Ignitable liquids

27.3.2 Gaseous fuels

27.3.3 Solid fuels

**501-27.4** **The Investigator candidate shall describe and identify the different ignition sources that can be present in vehicle fires.**

27.4.1 Open flames

27.4.2 Electrical sources

27.4.2.1 Recreational vehicles

27.4.2.2 Overloaded wiring

27.4.2.3 Electrical high resistance connections

27.4.2.4 Electrical short circuits and arcs (electric discharge)

27.4.2.5 Arc (carbon) tracking

27.4.2.6 Lamp bulbs and filaments

27.4.2.7 External electrical sources used in vehicles

27.4.3 Hot surfaces

27.4.4 Mechanical sparks

27.4.5 Smoking materials

**501-27.5** **The Investigator shall identify the different types of systems that a motor vehicle may possess and their respective functions.**

27.5.1 Fuel system

27.5.1.1 Vacuum/low pressure carbureted systems

27.5.1.2 High-pressure fuel-injected systems

27.5.1.3 Diesel fuel system

- 27.5.1.4 Natural gas
- 27.5.1.5 Propane fuel
- 27.5.1.6 Turbochargers
  
- 27.5.2 Emission control system
  
- 27.5.3 Motor vehicle electrical systems
  
- 27.5.4 Mechanical power systems
  - 27.5.4.1 Lubrication systems
  - 27.5.4.2 Liquid cooling systems
  - 27.5.4.3 Air-cooled systems
  - 27.5.4.4 Electric motors
  
- 27.5.5 Mechanical power distribution
  - 27.5.5.1 Mechanically geared transmissions
  - 27.5.5.2 Hydraulically geared transmission
  
- 27.5.6 Accessories to the mechanical power system
  
- 27.5.7 Hydraulic braking system
  
- 27.5.8 Windshield washer systems

**501-27.6** ***The Investigator candidate shall identify the different body systems that can be found within or upon motor vehicles.***

- 27.6.1 Interior finishes and accessories
- 27.6.2 Cargo areas

**501-27.7** ***The Investigator candidate shall identify and employ the proper technique for investigating motor vehicle fires.***

- 27.7.1 Vehicle identification
- 27.7.2 Vehicle fire scene history
- 27.7.3 Vehicle particulars
- 27.7.4 Documenting the vehicle at the fire scene
- 27.7.5 Documenting the vehicle away from the scene

**501-27.8** **The Investigator candidate shall identify factors related to the examination of motor vehicles after they have burned.**

- 27.8.1 General
- 27.8.2 Examination of vehicle systems
- 27.8.3 Switches, handles, and levers

**501-27.9** **The Investigator candidate shall define total burns as it relates to motor vehicle fires and describe the actions that should be taken when these types of fires are encountered.**

**501-27.10** **The Investigator candidate shall identify factors related to incendiary vehicle fires.**

**501-27.11** **The Investigator shall identify components of the vehicle's ignition system as they relate to the fire investigation.**

**501-27.12** **The Investigator candidate shall identify factors concerning vehicle fires in structures and evaluate them as a potential source of fire ignition.**

**501-27.13** **The Investigator candidate shall identify and describe the factors relative to the investigation of recreational vehicle fires.**

**501-27.14** **The Investigator candidate shall identify the factors related to fire investigations involving heavy equipment.**

- 27.14.1 Medium and heavy-duty trucks and buses
- 27.14.2 Mass transit vehicles
- 27.14.3 Earth-moving equipment
- 27.14.4 Forestry/logging equipment
- 27.14.5 Landfill equipment
- 27.14.6 Agricultural equipment

**501-27.15** **The Investigator candidate shall identify the factors related to fire investigations involving self-propelled agricultural equipment and drawn implements.**

27.15.1 Agricultural equipment investigation safety

27.15.2 Equipment classification and description

27.15.3 Unique safety concerns

27.15.4 Unique fire cause concerns

27.15.5 Fuels

27.15.6 Ignition sources

**501-27.16** ***The Investigator candidate shall identify factors related to the investigation of fires involving hybrid vehicles.***

27.16.1 Hybrid vehicle investigation safety

27.16.2 Hybrid vehicle technology

27.16.3 Investigation of hybrid vehicle fires

**501-27.17** ***The Investigator candidate shall identify factors related to towing or vehicle transport as it relates to fire investigations.***

**501.27.18** ***The Investigator candidate shall identify factors related to the investigation of fires involving hydrogen fueled vehicles.***

## SECTION 28

### WILDFIRE INVESTIGATIONS

#### Annex A Explanatory Material

**NFPA 1033 A.1.1** The intent of this standard applies to all fire investigation, including outside, wildland, vehicle, and structural fires.

**501-28.1**     ***The Investigator candidate shall identify the specialized techniques, practices, equipment, and terminology associated with the investigation of wildfires.***

**501-28.2**     ***The Investigator candidate shall identify and describe wildfire fuels.***

28.2.1     Fuel condition analysis

28.2.2     Ground fuels

28.2.2.1     Duff

28.2.2.2     Roots

28.2.3     Surface fuels

28.2.3.1     Fine dead wood

28.2.3.2     Dead leaves and coniferous litter

28.2.3.3     Grass

28.2.3.4     Downed logs, stumps and large limbs

28.2.3.5     Low brush and reproduction

28.2.4     Aerial fuels

28.2.4.1     Tree branches and crowns

28.2.4.2     Tree moss

28.2.4.3     High brush

28.2.5     Species

28.2.6     Fuel size

28.2.7     Fuel moisture content

28.2.8     Oil content

**501-28.3**     ***The Investigator candidate shall identify and describe the effects of weather on fire spread.***

28.3.1     Weather history

- 28.3.2 Temperature
- 28.3.3 Relative humidity
- 28.3.4 Wind influences
  - 28.3.4.1 Meteorological winds
  - 28.3.4.2 Diurnal winds
  - 28.3.4.3 Foehn winds
  - 28.3.4.4 Fire winds

**501-28.4** ***The Investigator candidate shall identify, describe and interpret the effect of topography on fire spread.***

- 28.4.1 Slope
- 28.4.2 Aspect

**501-28.5** ***The Investigator candidate shall be able to describe fire shape.***

- 28.5.1 Fire head
- 28.5.2 Fire flanks
- 28.5.3 Fire heel
- 28.5.4 Factors affecting fire spread
  - 28.5.4.1 Lateral confinement
  - 28.5.4.2 Fuel influence
  - 28.5.4.3 Suppression
- 28.5.5 Other natural mechanisms of fire spread
  - 28.5.5.1 Embers and firebrands
  - 28.5.5.2 Fire storms
  - 28.5.5.3 Animals

**501-28.6** ***The Investigator candidate shall identify and describe indicators of a wildfire.***

- 28.6.1 Wildfire V shaped patterns
- 28.6.2 Degree of damage
- 28.6.3 Grass stems
- 28.6.4 Angle of char
- 28.6.5 White ash deposit
- 28.6.6 Cupping

- 28.6.7 Die out pattern
- 28.6.8 Exposed and protected fuels
- 28.6.9 Staining and sooting
- 28.6.10 Depth of char
- 28.6.11 Spalling
- 28.6.12 Foliage freeze
- 28.6.13 Curling

**501-28.7** ***The Investigator candidate shall identify the area of origin of a wildfire.***

- 28.7.1 Initial area of investigation
- 28.7.2 General origin area
- 28.7.3 General origin investigation techniques
- 28.7.4 Specific origin investigation techniques
- 28.7.5 Search equipment

**501-28.8** ***The Investigator shall determine the cause of a wildfire.***

- 28.8.1 Natural causes
- 28.8.2 Human fire causes

**501-28.9** ***The Investigator candidate shall recognize that evidence protection, preservation, collection, and documentation at wildfires are similar to other fires.***

**501-28.10** ***The Investigator candidate shall identify special safety considerations associated with investigation of wildfires.***

**501-28.11** ***The Investigator candidate shall identify sources of information pertaining to wildfire investigation.***

## SECTION 29

### MANAGEMENT OF COMPLEX INVESTIGATIONS

**NFPA 1033 4.1 General**

**NFPA 1033 4.1.6** The fire investigator shall understand the organization and operation of the investigative team within an incident management system.

**501-29.1**     ***The Investigator candidate shall distinguish those issues that are unique to managing investigations that are complex due to size, scope, or duration.***

- 29.1.1     Governmental inquiry
- 29.1.2     Intent
- 29.1.3     Purpose
- 29.1.4     Interested parties
- 29.1.5     Definitions

**501-29.2**     ***The Investigator candidate shall describe the basic information and documents associated with complex investigations.***

**501-29.3**     ***The Investigator candidate shall recognize the importance of communications among interested parties.***

- 29.3.1     Notice to interested parties
  - 29.3.1.1     Entity in control
  - 29.3.1.2     All interested parties
  - 29.3.1.3     Roster of interested parties
  - 29.3.1.4     Notification of changes
  - 29.3.1.5     Making notification
  - 29.3.1.6     Content of notification
  - 29.3.1.7     Subsequent notifications
- 29.3.2     Meetings
  - 29.3.2.1     Preliminary meeting
  - 29.3.2.2     Meetings as the investigation progresses
  - 29.3.2.3     Website
  - 29.3.2.4     Additional dissemination of information

**501-29.4**     ***The Investigator candidate shall recognize the complexity of the investigation and ensure that all known interested parties are afforded an opportunity to investigate the incident and protect their respective interests, understandings or agreements.***

- 29.4.1     Purposes
- 29.4.2     Scheduling
- 29.4.3     Cost sharing
- 29.4.4     Non-disclosure agreements
- 29.4.5     Protocols
- 29.4.6     Information sharing
- 29.4.7     Interviews
- 29.4.8     Amendments to agreement
- 29.4.9     Disagreements

**501-29.5**     ***The Investigator candidate shall identify and describe the components of managing a complex investigation.***

- 29.5.1     Organizational models
- 29.5.2     Control of the site and scene
  - 29.5.2.1     Securing the site and scene
  - 29.5.2.2     Delegation of control
  - 29.5.2.3     Transfer of control
  - 29.5.2.4     Site and scene access
    - 29.5.2.4.1     Control of the site
    - 29.5.2.4.2     Establishing procedures for access
    - 29.5.2.4.3     Monitoring entry to the site
    - 29.5.2.4.4     Access control
    - 29.5.2.4.5     Escorts
    - 29.5.2.4.6     Public sector concerns
    - 29.5.2.4.7     Occupant access and control
    - 29.5.2.4.8     Decontamination in and out
  - 29.5.2.5     Site-specific restrictions or requirements
  - 29.5.2.6     Scene integrity

## 29.5.2.7 Release of information

**501-29.6** ***The Investigator candidate shall recognize the unique components of handling evidence of a complex investigation.***

- 29.6.1 Evidence control
  - 29.6.1.1 Evidence custodian
  - 29.6.1.2 Interested party responsibility
- 29.6.2 Evidence removal from the scene
- 29.6.3 Evidence storage
- 29.6.4 Evidence inspections
  - 29.6.4.1 Non-destructive inspections
  - 29.6.4.2 Destructive inspections
  - 29.6.4.3 Testing of evidence

**501-29.7** ***The Investigator candidate shall identify logistical support needs involving the complex investigation.***

- 29.7.1 Transportation
- 29.7.2 Equipment
- 29.7.3 Investigation site security
- 29.7.4 Decontamination
- 29.7.5 Environmental
- 29.7.6 Communications
- 29.7.7 Sanitary and comfort needs
- 29.7.8 Trash disposal and removal
- 29.7.9 Snow and ice removal
- 29.7.10 Lighting
- 29.7.11 Evidence storage

**501-29.8** ***The Investigator candidate shall distinguish the unique characteristics of safety at the complex investigation site.***

## SECTION 30

### MARINE FIRE INVESTIGATION

#### Annex A Explanatory Material

**NFPA 1033 A.1.1** The intent of this standard applies to all fire investigation, including outside, wildland, vehicle, and structural fires.

**501-30.1**     ***The Investigator candidate shall identify the factors related to the investigations of fires involving recreational boats.***

**501-30.2**     ***The Investigator candidate shall define the following terms.***

30.2.1     Accommodation space

30.2.2     Adrift

30.2.3     Afloat

30.2.4     Aft

30.2.5     Aground

30.2.6     Beam

30.2.7     Below

30.2.8     Bilge

30.2.9     Boat

30.2.10    Bulkhead

30.2.11    Cabin

30.2.12    Capsize

30.2.13    Chain plate

30.2.14    Deck

30.2.15    Dock

30.2.16    Dorade vent

- 30.2.17 Fender
- 30.2.18 Forward
- 30.2.19 Freeboard
- 30.2.20 Galley
- 30.2.21 Gear
- 30.2.22 Gunwale
- 30.2.23 Hatch
- 30.2.24 Hold
- 30.2.25 Hull
- 30.2.26 Inboard
- 30.2.27 Inboard/Out-Drive (I/O)
- 30.2.28 Outboard
- 30.2.29 Overboard
- 30.2.30 Port
- 30.2.31 Rub Rail
- 30.2.32 Shore power
- 30.2.33 Shroud
- 30.2.34 Sole
- 30.2.35 Starboard
- 30.2.36 Superstructure
- 30.2.37 Topside
- 30.2.38 Transom
- 30.2.39 Underway

30.2.40 Vessel

30.2.41 Waterline

**501-30.3** ***The Investigator candidate shall recognize the importance of boat investigation safety.***

30.3.1 Safety assessment

30.3.2 Inspection of boats on land

30.3.3 Inspection of boats afloat

30.3.4 Underwater inspections

30.3.5 Specific safety concerns

30.3.5.1 Confined spaces

30.3.5.1.1 Automatic fire suppression systems inactive/deactivated

30.3.5.2 Airborne particulates

30.3.5.3 Identify and assess energy sources

30.3.5.3.1 Batteries

30.3.5.3.2 Inverters

30.3.5.3.3 Shore power

30.3.5.4 Fuel leaks

30.3.5.5 Sewage holding tank

30.3.5.6 Hydrogen gas

30.3.5.7 Other hydrocarbon contaminants

30.3.5.8 Stability

30.3.5.9 Damage to the structure of the boat

30.3.5.10 Wharves, docks, and jetties

30.3.5.11 Submerged boat

30.3.5.12 Visual distress signals and pyrotechnics

30.3.6 Openings

**501-30.4** ***The Investigator candidate shall identify the different marine systems and functions.***

30.4.1 Fuel systems: propulsion and auxiliary

30.4.1.1 Vacuum/low pressure carbureted

30.4.1.2 High pressure/marine fuel injection (including return systems)

30.4.1.3 Diesel

- 30.4.2 Fuel systems: cooking and heating
  - 30.4.2.1 Liquefied petroleum gases
  - 30.4.2.2 Compressed natural gas
  - 30.4.2.3 Alcohol
  - 30.4.2.4 Solid fuels
  - 30.4.2.5 Diesel
- 30.4.3 Turbochargers/super chargers
- 30.4.4 Exhaust system
  - 30.4.4.1 Dry exhaust systems
  - 30.4.4.2 Wet exhaust systems
  - 30.4.4.3 De-watered exhaust systems
- 30.4.5 Electrical system
  - 30.4.5.1 Alternating current (AC)
  - 30.4.5.2 Direct current (DC)
- 30.4.6 Engine cooling system
- 30.4.7 Ventilation
- 30.4.8 Transmissions
  - 30.4.8.1 Mechanical gear transmissions
  - 30.4.8.2 Hydraulic-gear transmissions
- 30.4.9 Accessories

**501-30.5** ***The Investigator candidate shall identify the exterior construction of the vessel.***

- 30.5.1 Hull construction
- 30.5.2 Superstructure construction material
- 30.5.3 Deck
- 30.5.4 Exterior accessories

**501-30.6** ***The Investigator candidate shall identify the interior construction of the vessel.***

- 30.6.1 Construction materials

- 30.6.2 Finishes
  - 30.6.2.1 Accommodation furnishings
  - 30.6.2.2 Interior accessories
  - 30.6.2.3 Engine/machinery compartments
  - 30.6.2.4 Flammable/explosive vapor detectors
  - 30.6.2.5 Storage and holds
  - 30.6.2.6 Fuel tanks

**501-30.7** ***The Investigator candidate shall identify the propulsion system of the vessel.***

- 30.7.1 Electric systems
- 30.7.2 Fuels for boats with motorized propulsion systems
  - 30.7.2.1 Fuel systems
    - 30.7.2.1.1 Engines
      - 30.7.2.1.1.1 Outboard engines (outboard motors)
      - 30.7.2.1.1.2 Inboard gasoline engines
      - 30.7.2.1.1.3 Diesel engines
      - 30.7.2.1.1.4 Propulsion system fluids
  - 30.7.2.2 Appliance fuel systems
  - 30.7.2.3 Electric generators
- 30.7.3 Other fuel systems used for propulsion

**501-30.8** ***The Investigator candidate shall identify common ignition sources found in marine vessels.***

- 30.8.1 Open flames
- 30.8.2 Electrical sources
  - 30.8.2.1 Overloaded wiring
  - 30.8.2.2 Electrical short circuiting and arcs
  - 30.8.2.3 Electrical connections
  - 30.8.2.4 Lightning
  - 30.8.2.5 Static electricity and incendive arcs
- 30.8.3 Hot surfaces
  - 30.8.3.1 Manifolds
  - 30.8.3.2 Exhaust systems
  - 30.8.3.3 Cooking surfaces
  - 30.8.3.4 Heating systems

- 30.8.4 Mechanical
  - 30.8.4.1 Bearing failures
  - 30.8.4.2 Friction

- 30.8.5 Smoking materials

**501-30.9**     ***The Investigator candidate shall describe proper documentation of the boat fire scene.***

- 30.9.1 On land
- 30.9.2 In water
  - 30.9.2.1 Moored
  - 30.9.2.2 Anchored and underway
  - 30.9.2.3 Underwater
- 30.9.3 Boat identification
  - 30.9.3.1 Hull Identification Number (HIN)
  - 30.9.3.2 Registration numbers
  - 30.9.3.3 US Coast Guard documentation numbers
  - 30.9.3.4 Boat name and hailing port
  - 30.9.3.5 Boat history
  - 30.9.3.6 Fire scene history
    - 30.9.3.6.1 Actions before the fire
    - 30.9.3.6.2 Actions during the fire
    - 30.9.3.6.3 Actions after the fire
- 30.9.4 Boat particulars

**501-30.10**     ***The Investigator candidate shall identify the steps of a proper boat examination.***

- 30.10.1 General
- 30.10.2 Examination of boat systems

**501-30.11**     ***The Investigator candidate shall describe marine fire investigations of boats in structures.***

**501-30.12**     ***The Investigator candidate shall describe legal considerations related to marine fire investigations.***

## SECTION 31

### PRACTICAL EXERCISES

#### 4.7 Presentations.

Duties shall include the presentation of findings to those individuals not involved in the actual investigations.

**NFPA 1033 4.7.1** Prepare a written report, given investigative findings, documentation, and a specific audience, so that the report accurately reflects the investigative findings, is concise, expresses the investigator's opinion, contains facts and data that the investigator relies on in rendering an opinion, contains the reasoning of the investigator by which each opinion was reached, and meets the needs or requirements of the intended audience(s).

**(A) Requisite Knowledge.** Elements of writing, typical components of a written report, and types of audiences and their respective needs or requirements.

**(B) Requisite Skills.** Writing skills, ability to analyze information and determine the reader's needs or requirements.

**NFPA 1033 4.7.2** Express investigative findings verbally, given investigative findings, notes, a time allotment, and a specific audience, so that the information is accurate, the presentation is completed within the allotted time, and the presentation includes only need-to-know information for the intended audience.

**(A) Requisite Knowledge.** Types of investigative findings, the informational needs of various types of audiences, and the impact of releasing information.

**(B) Requisite Skills.** Communication skills and ability to determine audience needs and correlate findings.

**NFPA 1033 4.7.3** Testify during legal proceedings, given investigative findings, contents of reports, and consultation with legal counsel, so that all pertinent investigative information and evidence are presented clearly and accurately and the investigator's demeanor and attire are appropriate to the proceedings.

**(A) Requisite Knowledge.** Types of investigative findings, types of legal proceedings, professional demeanor requirements, and an understanding of due process and legal proceedings.

**(B) Requisite Skills.** Communication and listening skills and ability to differentiate facts from opinion and determine accepted procedures, practices, and etiquette during legal proceedings.

**501-31.1** ***The Investigator candidate shall demonstrate proficiency in all required skills in the TCFP Fire Investigator Skills Manual.***