CERTIFICATION CURRICULUM MANUAL

CHAPTER FIVE

FIRE INVESTIGATOR

NFPA 921, 2021 Edition
NFPA 1033, 2022 Edition

Effective June 1, 2022

Revised May 1st 2023

Texas Commission on Fire Protection
P.O. Box 2286 Austin, Texas 78768-2286 (512) 936-3838

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

Certification Curriculum Manual. Austin, TX: Texas Commission on Fire Protection.

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 (8th ed.) (2016). Stillwater, OK: Fire Protection Publications. International Fire Service Training Association.

Fire Investigator: Principles and Practice (6th ed.) (2023). Burlington, MA: Jones and Bartlett Learning. ISBN:1284247724

Icove, David J., *Kirk's Fire Investigation*, (8th ed.) (2018). New York, NY: Pearson Education, Inc.

Lentini, John J., Scientific Protocols for Fire Investigation (3rd ed.) (2019). Boca Raton, FL: CRC Press.

NFPA 921: Guide for Fire and Explosion Investigations (2021 ed.) Quincy, MA: National Fire Protection Association. NFPA Publications.

NFPA 1033: Standard for Professional Qualifications for Fire Investigator (2022 ed.) Quincy, MA: National Fire Protection Association. NFPA Publications.

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

ASTM E620 *Standard Practice for Reporting Opinions of Scientific or Technical Experts* (current ed.)

ASTM E678 *Standard Practice for Evaluation of Scientific or Technical Data* (current ed.)

ASTM E860 *Standard Practice for Examining and Preparing Items That Are Or May Become Involved in Criminal or Civil Litigation* (current ed.)

ASTM E1188 *Standard Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator* (current ed.)

ASTM E1459 *Standard Guide for Physical Evidence Labeling and Related Documentation* (current ed.)

Recommended References

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

ASTM E1020 *Standard Practice for Reporting Incidents that May Involve Criminal or Civil Litigation* (current ed.)

ASTM E1492 *Standard Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory* (current ed.)

ASTM E2917 *Standard Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs* (current ed.)

Building Construction Related to the Fire Service (4th ed.) (2016). Stillwater, OK: Fire Protection Publications. International Fire Service Training Association.

Cole, Lee S., *Investigation of Motor Vehicles*, (current ed.). Lee Books.

Crime Scene Investigation: A Guide for Law Enforcement (current ed.). Largo, FL: National Forensic Science Technology Center. (On 5/06/21 this publication was available online at https://nist.gov/system/files/documents/forensics/crime-scene- investigation.pdf)

Emergency Field Guide, (current ed.). NFPA. https://catalog.nfpa.org/Emergency-Field-Guide-P13872.aspx

Crime Laboratory Service Manual Part II: Handbook. Texas Department of Public Safety. Current edition. https://txdpslabs.qualtraxcloud.com/showdocument.aspx?ID=67707

Fent, Kenneth. “Contamination of firefighter personal protective equipment and skin and the effectiveness of decontamination procedures.” *Journal of Occupational and Environmental Hygiene*. (2017).

Fire and Arson Scene Evidence: A Guide for Public Safety Personnel, (current ed.). Washington, DC: US Department of Justice, Office of Justice Programs.

(On 5/06/21 this publication was available online at https://www.ncjrs.gov/pdffiles1/nij/181584.pdf)

Fire Protection, Detection, and Suppression Systems (5th ed.)(2016). Stillwater, OK: Fire Protection Publications. International Fire Service Training Association (IFSTA).

Fire Protection Handbook (current ed.). National Fire Protection Association.

Fires in Texas, Annual Fire Statistics report (current ed.) Texas State Fire Marshals Office. Department of Insurance, TEXFIRS section. A link to the report can be found on their website: www.tdi.texas.gov/fire/

Gorbett, Gregory E. *Fire Dynamics* (2nd ed.) (2016). Boston: Pearson.

Guide to Wildland Fire Origin and Cause Determination (PMS 412)(current ed.), National Wildfire Coordinating Group. (On 5/06/21 this publication was available online at https://www.nwcg.gov/sites/default/files/publications/pms412.pdf)

Health Hazard Evaluation Report 96-0171-2692. Bureau of Alcohol, Tobacco, and Firearms. Washington D.C. May 1988.

Konefal, Joseph and Edward Nordskog. *Fire Death Scene Investigation.* (2019). Self-published. www.arsonprofiler.com.

Munday, James W., *Safety at Scenes of Fire and Related Incidents* (current ed.). London: The Fire Protection Association.

NFPA 170: Standard for Fire Safety and Emergency Symbols (current ed.) Quincy, MA: National Fire Protection Association. NFPA Publications.

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

NFPA 556: Guide on Methods for Evaluating Fire Hazard to Occupants of Passenger Road Vehicles (current ed.) Quincy, MA: National Fire Protection Association. NFPA Publications.

NFPA 1037: Standard on Fire Marshal Professional Qualifications (current ed.). Quincy, MA: National Fire Protection Association. NFPA Publications.

NFPA 1730: Standard on Organization and Deployment of Fire Prevention Inspection and Code Enforcement, Plan Review, Investigation, and Public

Education Operations (current ed.). Quincy, MA: National Fire Protection Association. NFPA Publications.

NIJ Research Report: *Death Investigation: A Guide for the Scene Investigator* (current ed.). US Department of Justice, Office of Justice Programs, National Institute of Justice. (On 5/06/21 this publication was available online at https://www.ncjrs.gov/pdffiles1/nij/234457.pdf)

Passenger Vehicle Identification Manual (current ed.) National Insurance Crime Bureau, 1111 E. Touhy Avenue, Suite 400, Des Plaines, IL 60018-2805.

Physical Evidence Handbook (current ed.). Texas Department of Public Safety. (On 5/06/21 this publication was available online at https://www.dps.texas.gov/CrimeLaboratory/documents/PEHmanual.pdf)

Pocket Guide to Fire and Arson Investigation (P7923) (current ed.). Factory Mutual Global.

Rules of Criminal Evidence, latest edition. (On 5/06/21, this information was available online at http://www.txcourts.gov/rules-forms/rules-standards.aspx).

Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward. 1 Apr. 2021, https://doi.org/10.29325/OSAC.TG.0005. Accessed 27 Apr. 2021.

Strengthening Forensic Science in the United States: A Path Forward, (current ed.) (Committee on Identifying the Needs for the Forensic Sciences Community. National Research Council. (On 5/06/21 this publication was available online at https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf)

Texas Code of Criminal Procedure, latest edition. (On 5/06/21, this information was available online at http://www.statutes.legis.state.tx.us/).

Texas Family Code, current ed. (On 5/06/21, this information was available online at http://www.statutes.legis.state.tx.us/).

Texas Insurance Code, current ed. (On 5/06/21, this information was available online at http://www.statutes.legis.state.tx.us/).

Texas Penal Code, current ed. (On 5/06/21, this information was available online at http://www.statutes.legis.state.tx.us/).

Texas Public Information Act Handbook, current ed. (On 5/06/21, this information was available online at 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 5/06/21, this information was available online at http://www.archives.gov/exhibits/charters/charters.html).

CHAPTER FIVE
FIRE INVESTIGATOR
COURSE OUTLINE

SECTION	SUBJECT	RECOMMENDED HOURS
501-1	Commission on Fire Protection Rules and Regulations	2
501-2	NFPA 1033 - Administration	
501-3	Definitions	
501-4	Basic Methodology	2
501-5	Basic Fire Science	16
501-6	Fire Effects and Fire Patterns	20
501-7	Building Systems	2
501-8	Active Fire Protection Systems	4
501-9	Electricity and Fire	8
501-10	Building Fuel Gas Systems	4
501-11	Fire-Related Human Behavior	4
501-12	Legal Considerations	12
501-13	Safety	4
501-14	Sources of Information	6
501-15	Planning the Investigation	2
501-16	Documentation of the Investigation	12
501-17	Physical Evidence	12
501-18	Origin Determination	8
501-19	Fire Cause Determination	4
501-20	Analyzing the Incident for Cause and Responsibility	4
501-21	Failure Analysis and Analytical Tools	8
501-22	Explosions	8
501-23	Incendiary Fires	8
501-24	Fire and Explosion Deaths and Injuries	4
501-25	Appliances	2
501-26	Motor Vehicle Fires	8
501-27	Wildfire Investigations	8
501-28	Management of Complex Investigations	2
501-29	Marine Fire Investigations	2
501-30	Practical Exercises	24
	TOTAL HOURS RECOMMENDED	**200**

* The recommended hours includes time for skills evaluation and 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.

NFPA 1033 MATRIX

2014 Objective	LOCATION IN CURRICULUM	SKILL
4.1	**GENERAL**	
4.1.1	1	None
4.1.2	4	None
4.1.3	13, 15, 26	None
4.1.4	14, 15	None
4.1.5	12	None
4.1.6	15, 28	None
4.1.7	4,5,7,8,9,10,13,16,17,20,21,22	None
4.2	**SCENE EXAMINATION**	
4.2.1	15, 17	1
4.2.2	13, 18	2, 26
4.2.3	18,	3
4.2.4	5, 6, 26	4, 5
4.2.5	5, 6, 7, 18, 26	5
4.2.6	5, 17, 26	6
4.2.7	6	7
4.2.8	7, 8, 9, 10, 14, 25	8
4.2.9	22	6
4.3	**DOCUMENTING THE SCENE**	
4.3.1	16, 17	9
4.3.2	16	10
4.3.3	12, 16	11
4.4	**EVIDENCE COLLECTION/PRESERVATION**	
4.4.1	11, 17, 24	12
4.4.2	12, 17	12
4.4.3	14, 17	12
4.4.4	12, 17	13
4.4.5	17	14
4.5	**INTERVIEW**	
4.5.1	14	15
4.5.2	14	16
4.5.3	14	17
4.6	**POST-INCIDENT INVESTIGATION**	
4.6.1	14, 16, 20, 21	18
4.6.2	16, 20, 21	19
4.6.3	12, 14, 15, 20, 21	20
4.6.4	11, 20, 21, 23	21
4.6.5	11, 18, 19, 20, 21, 23	22
4.7	**PRESENTATIONS**	
4.7.1	16, 30	23
4.7.2	30	24
4.7.3	12, 30	25
Annex A	**EXPLANATORY MATERIAL**	
A.1.1	26, 27, 29	

Course Instructor Information

Fire Investigator

Overview

The Fire Investigator curriculum is designed to provide clear guidance that ensures adequate presentation of the information required to meet the Job Performance Requirements (JPRs) of National Fire Protection Association (NFPA) 1033, *Standard for Professional Qualifications for Fire Investigator*, 2022 edition.

The Fire Investigator curriculum is Chapter 5 of the Texas Commission on Fire Protection (TCFP) Curriculum Manual.

Certification Level	TCFP Chapter Number	NFPA 1033 Chapter
Fire Investigator	5	4

Layout

The NFPA numbering sequence is mirrored to allow easy correlation between this document and the NFPA Standard. For example, 501-5.5.1 identifies the section in Fire Investigator that corresponds to *NFPA 921, Guide for Fire and Explosion Investigation (2021 Edition)* section 5.5.1.

TCFP Standards Manual

It is critical that the Course Instructor review the chapters in the TCFP Standards Manual that apply to this curriculum. Of primary importance are the following chapters: Chapter 421, Standards for Certification; Chapter 437, Fees; Chapter 431, Fire Investigator Certification; Chapter 439, Examinations for Certification; Chapter 449.5, Certification as Head of a Prevention Only Department. These chapters do not address every issue that could impact this curriculum; therefore, the Course Instructor is encouraged to become familiar with the TCFP Standards Manual.

Supplemental Information

Instructors are expected to provide supplemental information if the main reference text does not provide adequate information to ensure successful completion of the Job Performance Requirements as listed in the curriculum.

Components of the Curriculum

Each section of the curriculum identifies the NFPA JPR in NFPA 1033, *Standard for Professional Qualifications for Fire Investigator*, 2022 Edition and knowledge components in *NFPA 921, Guide for Fire and Explosion Investigations, 2021 Edition* and subdivides them into learning components.

For example:

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.***

19.1.1 Consideration of Data

19.1.2 Sequence of Activities

19.1.3 Point and Area of Origin

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

Skills

NFPA's "Requisite Skills" requirements are addressed in the corresponding Skill Sheets and are based on the JPRs in National Fire Protection Association (NFPA) 1033, *Standard for Professional Qualifications for Fire Investigator*, 2022 edition.

Descriptions of Certification Levels

A Fire Investigator is an individual who has demonstrated the skills and knowledge necessary to conduct, coordinate, and complete a fire investigation.

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.

References:
Certification Curriculum Manual
Standards Manual for Fire Protection Personnel

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,* 2022 edition.

1.1.2 NFPA 921 *Guide for Fire and Explosion Investigations,* 2021 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

NFPA 1033

NFPA 1033 1.1* Scope. This standard shall identify the professional level of job performance requirements for fire investigators.
1.2 * Purpose. This standard shall specify the minimum JPRs for serving as a fire investigator in both the private and public sectors.
1.2.1 This standard shall define the fire investigator position.
1.2.2 The intent of this standard shall be to ensure that individuals who serve as fire investigators are qualified to do so.
1.2.3 It shall not be the intent of this standard to restrict any jurisdiction from exceeding or combining these minimum requirements.
1.2.4 JPRs for each duty are the tasks personnel shall be able to perform to successfully carry out that duty.
1.2.5 Fire investigators who perform or support fire investigations shall remain current with the general knowledge, skills, and JPRs.
1.2.6 Fire investigators who perform or support fire investigations shall remain current with practices and applicable standards.
1.3 Application.
The application of this standard shall be to specify the JPRs that shall apply to specific personnel who perform and support fire investigations.
1.3.1 The JPRs shall be accomplished in accordance with the requirements of the AHJ and all applicable NFPA and other standards development organization (SDO) standards.
1.3.2 Priority.
1.3.2.1 * It shall not be required that the JPRs be mastered in the order in which they appear.
1.3.2.2 The AHJ shall establish instructional priority and the training program content to prepare personnel to meet the JPRs of this standard.
1.3.2.3 * The performance of each requirement of this chapter shall be evaluated by personnel approved by the AHJ.
1.3.2.4 The JPRs for fire investigators shall be completed in accordance with recognized practices and procedures or as defined by law or by the AHJ.
1.3.2.5 Fire investigators who perform or support fire investigations shall meet the requirements of this standard for each fire investigation performed.
1.3.2.6 The AHJ shall provide the necessary personal protective equipment (PPE), force protection, and clothing to conduct assignments.
1.3.2.7 JPRs involving exposure to products of combustion shall be performed in approved PPE.
1.3.2.8 Prior to training to meet the requirements of this standard, personnel shall meet the following requirements:

(1) Be at least age 18
(2) Have a high school diploma or equivalent
(3) Be subjected to a thorough background and character investigation by the AHJ prior to being accepted as an individual candidate for certification as a fire investigator

4.1.1 * The fire investigator shall meet the job performance requirements defined in Sections 4.2 through 4.7. (see below)

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.

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.

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

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

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

4.1.7 * In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following:

(1) Fire science:
1. Fire chemistry
2. Thermodynamics
3. Fire dynamics
4. Explosion dynamics

(2) Fire investigation:
5. Fire analysis
6. Fire investigation methodology
7. Fire investigation technology
8. Evidence documentation, collection, and preservation
9. Failure analysis and analytical tools

(3) Fire scene safety:
10. Hazard recognition, evaluation, and basic mitigation procedures
11. Hazardous materials
12. Safety regulations

(4) Building systems:
13. Types of construction
14. Fire protection systems
15. Electricity and electrical systems
16. Fuel gas systems

4.1.7.1 The fire investigator shall remain current in the subjects listed as "requisite knowledge" for the JPRs and as summarized in 4.1.7.

4.1.7.2 The fire investigator shall remain current by attending formal education courses, workshops, in-person or online seminars, and/or through professional publications, journals, and treatises.

4.1.7.3 The fire investigator shall complete and document a minimum of 40 hours of continuing education training every five years by attending formal education courses, workshops, and seminars.

28 Job Performance Requirements (Annex C, Table C.1)

1- Secure the fire ground (4.2.1)
2- Conduct an exterior survey (4.2.2)
3- Conduct an interior survey (4.2.3)
4- Interpret fire patterns (4.2.4)
5- Interpret and analyze fire patterns (4.2.5)
6- Examine and remove fire debris (4.2.6)
7- Reconstruct the area of origin (4.2.7)
8- Inspect the performance of building systems (4.2.8)
9- Discriminate the effects of explosions (4.2.9)
10- Diagram the Scene (4.3.1)
11- Photographically document the scene (4.3.2)
12- Construct investigative notes (4.3.3)
13- Utilize proper procedures for managing victims and fatalities (4.4.1)
14- Locate, document, collect, label, package, and store evidence (4.4.2)
15- Select evidence for analysis (4.4.3)
16- Maintain a chain of custody (4.4.4)
17- Dispose of evidence (4.4.5)
18- Develop an interview plan (4.5.1)
19- Conduct interviews (4.5.2)
20- Evaluate interview information (4.5.3)
21- Gather reports and records (4.6.1)
22- Evaluate the investigative file (4.6.2)
23- Coordinate expert resources (4.6.3)
24- Establish evidence as to motive and/or opportunity (4.6.4)
25- Formulate an opinion concerning origin, cause, or responsibility for the fire (4.6.5)
26- Prepare a written report (4.7.1)
27- Express investigative findings verbally (4.7.2)
28- Testify during legal proceedings (4.7.3)

SECTION 3

DEFINITIONS

References:
NFPA 921 2021 edition

501-3.1 ***The Investigator candidate shall define the terms used in Chapter 3 of NFPA 921, Guide for Fire and Explosion Investigations (2021 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.

4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (2)(b) Fire Investigation Methodology.

References:
J & B, chapter 2
Lentini, chapter 4

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 Develop a Hypotheses (Inductive Reasoning)

4.3.6 Test the Hypotheses (Deductive Reasoning)

4.3.7 Select Final Hypothesis

4.3.8 Avoid Presumption

4.3.9 Expectation Bias

4.3.10 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

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (1)(a) Fire Chemistry, (b) Thermodynamics, (c) Fire Dynamics.

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

NFPA 1033 4.2.4 Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that each pattern is identified and analyzed with respect to the burning characteristics of the material involved, the stage of fire development, the effects of ventilation within the context of the scene, the relationship with all patterns observed, and the understanding of the methods of heat transfer that led to the formation of the patterns identified and analyzed, and the sequence in which the patterns were produced is determined.
(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.

References:
J&B, chapter 3
Kirk's, chapter 2
Lentini, chapter 1-2

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

5.1.1 Fire and Energy

5.1.2 Energy

5.1.3 Power

5.1.4 Heat Flux

5.1.5 Identify and describe the elements of the fire tetrahedron.
- 5.1.5.1 Define fuel and describe the three states in which fuel exists.
- 5.1.5.2 Describe the action of oxidizing agents.
- 5.1.5.3 Describe the relationship of heat in the combustion process.
- 5.1.5.4 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 Phase Changes and Thermal Decomposition

5.2.2 Combustion

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
- 5.5.5.1 Different systems
- 5.5.5.2 Empirical Temperature Scales
- 5.5.5.3 Thermodynamic (Absolute) Temperature Scales

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
- 5.6.5.1 Continuous Flaming Region
- 5.6.5.2 Intermittent Flame Region
- 5.6.5.3 Plume Region

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 EFFECTS AND FIRE PATTERNS

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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. Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that each pattern is identified and analyzed with respect to the burning characteristics of the material involved, the stage of fire development, the effects of ventilation within the context of the scene, the relationship with all patterns observed, and the understanding of the methods of heat transfer that led to the formation of the patterns identified and analyzed, and the sequence in which the patterns were produced is determined.
(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 potential area(s) 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; and items potentially critical to cause determination are returned to their prefire location as a means of hypothesis testing, such that 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.

References:
J&B, chapter 4
Kirk's, chapter 5
Lentini, chapter 3

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

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

6.2.1 Fire Effects
- 6.2.1.1 Deformation
- 6.2.1.2 Deposition
- 6.2.1.3 Discoloration
- 6.2.1.4 Mass Loss

6.2.2 Characteristics and context of fire effects

501-6.3 ***The Investigator candidate shall be able to analyze the following fire effects.***

6.3.1 Introduction

6.3.2 Char
- 6.3.2.1 Char Observations
- 6.3.2.2 Material Sciences – Surface Effect of Char
- 6.3.2.3 Pyrolysis
- 6.3.2.4 Analysis of Char
- 6.3.2.5 Depth of Char Diagram
- 6.3.2.6 Measuring Depth of Char
- 6.3.2.7 Measuring Depth of Char
- 6.3.2.8 Missing Wood
- 6.3.2.9 Depth of Char Surveys with fuel Gases
- 6.3.2.10 Appearance of Char
- 6.3.2.11 Limitations with Char
- 6.3.2.12 Rate of Wood Charring

6.3.3 Clean Burn
- 6.3.3.1 Clean Burn Observations
- 6.3.3.2 Material Sciences Related to Clean Burn
- 6.3.3.3 Analysis of Clean Burn
- 6.3.3.4 Limitations

6.3.4 Color Change
- 6.3.4.1 Color Changes Observations
- 6.3.4.2 Material Sciences Related to Color Changes

- 6.3.4.3 Fabric Dyes
- 6.3.4.4 Light
- 6.3.4.5 Analysis of Color Changes
- 6.3.4.6 Limitations

- 6.3.5 Deposition of Smoke on Surfaces
  - 6.3.5.1 Deposition of Smoke on Surfaces Observations
  - 6.3.5.2 Smoke Characteristics
  - 6.3.5.3 Material Sciences for Deposition of Smoke
  - 6.3.5.4 Analysis Related to Deposition of Smoke on Surfaces
  - 6.3.5.5 Location of Objects
  - 6.3.5.6 Position of Switches
  - 6.3.5.7 Limitations

- 6.3.6 Distorted Lightbulbs
  - 6.3.6.1 Observations for Distorted Lightbulbs
  - 6.3.6.2 Material Science for Distorted Lightbulbs
  - 6.3.6.3 Distorted Lightbulb Analysis
  - 6.3.6.4 Limitations

- 6.3.7 Furniture Springs
  - 6.3.7.1 Furniture Springs Observations
  - 6.3.7.2 Material Science Related to Furniture Springs
  - 6.3.7.3 Analysis of Furniture Springs
  - 6.3.7.4 Limitations

- 6.3.8 Gypsum Wallboard
  - 6.3.8.1 Gypsum Wallboard Observations
  - 6.3.8.2 Material Science related to Gypsum Wallboard
  - 6.3.8.3 Analysis of Gypsum Wallboard
  - 6.3.8.4 Mass Loss and Density
  - 6.3.8.5 General Indications of Calcination
  - 6.3.8.6 Depth of Calcination Survey
  - 6.3.8.7 Depth of Calcination Diagram
  - 6.3.8.8 Measuring Depth of Calcination
  - 6.3.8.9 Limitations

- 6.3.9 Mass Loss of Material
  - 6.3.9.1 Mass Loss Observations
  - 6.3.9.2 Fire-Damaged Materials and Exemplar Materials

6.3.9.3 Material Science Related to Mass Loss
6.3.9.4 Analysis of Mass Loss Observations
6.3.9.5 Limitations
6.3.9.6 Other conditions of nonuniformity

6.3.10 Melting of Materials
6.3.10.1 Melting Observations
6.3.10.2 Material Science Related to Melting
6.3.10.3 Common Metals
6.3.10.4 Thermoplastics
6.3.10.5 Glass
6.3.10.6 Alloying of Metals
6.3.10.7 Analysis of Melting Effects in Fires
6.3.10.8 Limitations

6.3.11 Oxidation
6.3.11.1 Observations
6.3.11.2 Galvanized Steel
6.3.11.3 Uncoated Iron or Steel
6.3.11.4 Oxidation Versus Melting
6.3.11.5 Stainless Steel
6.3.11.6 Copper
6.3.11.7 Rocks and Soil
6.3.11.8 Materials Science Related to Oxidation
6.3.11.9 Analysis of Oxidation Observations
6.3.11.10 Limitations

6.3.12 Rainbow Effect
6.3.12.1 Rainbow Effect Observations
6.3.12.2 Material Science for Rainbow Effects
6.3.12.3 Analysis of Rainbow Effect
6.3.12.4 Limitations

6.3.13 Smoke Alarms - Enhanced Soot Deposition, or Acoustic Soot Agglomeration
6.3.13.1 Smoke Alarm Observations
6.3.13.2 Enhanced Soot Deposition, or Acoustic Agglomeration
6.3.13.3 Analysis of Smoke Alarms
6.3.13.4 Limitations

- 6.3.14 Spalling
  - 6.3.14.1 Observations
  - 6.3.14.2 Material Science Related to Spalling
  - 6.3.14.3 Analysis for Spalling
  - 6.3.14.4 Limitations
- 6.3.15 Thermal Expansion and Deformation of Materials
  - 6.3.15.1 Observations of Thermal Expansion and Deformation of Materials
  - 6.3.15.2 Material Science of Thermal Expansion and Deformation of Materials
  - 6.3.15.3 Bending and Buckling
  - 6.3.15.4 Metal Construction Elements
  - 6.3.15.5 Analysis of Thermal Expansion and Deformation
  - 6.3.15.6 Piping Systems
  - 6.3.15.7 Plastered Surfaces
  - 6.3.15.8 Limitations
  - 6.3.15.9 Collapse
- 6.3.16 Victim Injuries
  - 6.3.16.1 Victim Injuries Observations
  - 6.3.16.2 Material Science of Victim Injuries
  - 6.3.16.3 Skin
  - 6.3.16.4 The Body as Fuel
  - 6.3.16.5 Analysis of Victim Injuries
  - 6.3.16.6 Limitations
- 6.3.17 Window Glass
  - 6.3.17.1 Window Glass Observations
  - 6.3.17.2 Material Science of Glass
  - 6.3.17.3 Tempered Glass
  - 6.3.17.4 Analysis of Glass
  - 6.3.17.5 Limitations
- 6.3.18 Fire Patterns
  - 6.3.18.1 Introduction
  - 6.3.18.2 Location of Patterns
  - 6.3.18.3 Location of Objects
  - 6.3.18.4 Penetrations of Horizontal Surfaces
  - 6.3.18.5 Depth of Char Patterns with Fuel Gases

6.3.19 Fire Pattern Generation
- 6.3.19.1 Plume-Generated Patterns
- 6.3.19.2 Ventilation-Generated Patterns
- 6.3.19.3 Hot Gas Layer-Generated Patterns
- 6.3.19.4 Full Room Involvement-Generated Patterns
- 6.3.19.5 Suppression-Generated Patterns
- 6.3.19.6 Undetermined-Generated Patterns

6.3.20 Fire Pattern Geometry
- 6.3.20.1 V Patterns on Vertical Surfaces
- 6.3.20.2 Inverted Cone (Triangular) Patterns
- 6.3.20.3 Hourglass Patterns
- 6.3.20.4 U-Shaped Patterns
- 6.3.20.5 Circular-Shaped Patterns
- 6.3.20.6 Truncated Cone Patterns
- 6.3.20.7 Irregular Patterns
- 6.3.20.8 Doughnut-Shaped Patterns
- 6.3.20.9 Linear Patterns
- 6.3.20.10 Area Patterns

6.3.21 Arc Mapping

6.3.22 Pointer and Arrow Patterns

501-6.4 ***The Investigator candidate shall be able to 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

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (4)(a) Types of Construction, (b) Fire Protection Systems, (c) Electricity and Electrical Systems, (d) Fuel Gas Systems.

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

NFPA 1033 4.2.5 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 4.2.8 Inspect and analyze the performance of building systems, including fire protection, detection and suppression systems, HVAC, electricity and electrical systems, fuel gas systems, 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 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.

References:
J&B, chapter 5

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" Condition

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.***

****Note** (Only 501-7.3.1)**
The following section is not contained in NFPA 921, *Guide for Fire and Explosion Investigations*. The reference for this material is found in IFSTA, *Fire Inspection and Code Enforcement* and *Fire Investigator*.

- 7.3.1 General
  - 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 (Mobile 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 Noncombustible 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 should analyze the design and installation parameters when the passive fire protection system is determined to be a factor.***

501-7.8 ***The Investigator candidate should produce the additional documentation and data collection when the passive fire protection system is determined to be a factor.***

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

501-7.10 ***The Investigator candidate shall maintain a basic***

understanding of heating systems commonly encountered in residential and light commercial fire incidents.

7.10.1 Systems components
- 7.10.1.1 Fuel Storage and Supply
- 7.10.1.2 Heat Producing Devices
- 7.10.1.3 Chimney/Vent
- 7.10.1.4 Control and Safety Devices

7.10.2 Installation

7.10.3 Operation and maintenance

7.10.4 Potential fire causes
- 7.10.4.1 Improper Installation of Fuel Delivery Systems
- 7.10.4.2 Improper Installation of Heat Producing Systems
- 7.10.4.3 Improper Installation of Control and Safety Devices
- 7.10.4.4 Improper Installation of Chimneys and Vents
- 7.10.4.5 Airspace Requirement Violations
- 7.10.4.6 Utilizing Non-Listed Devices and Accessories
- 7.10.4.7 Circumvented or Failed Control and Safety Components
- 7.10.4.8 Inadequate Maintenance or Cleaning
- 7.10.4.9 Improper Usage
- 7.10.4.10 Electrical Events

7.10.5 Documentation and Data Collection

7.10.6 Analysis of Origin and Causes

SECTION 8

ACTIVE FIRE PROTECTION SYSTEMS

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (4)(b) Fire Protection Systems.

4.2. Scene Examination

Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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 and analyze the performance of building systems, including fire protection, detection and suppression systems, HVAC, electricity and electrical systems, fuel gas systems, 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 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.

References:
J&B, chapter 6
IFSTA, Fire Inspection, chapter 12-14

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

501-8.2 ***The Investigator candidate shall develop basic understanding of documentation of fire protection systems.***

8.2.1 Design Documentation

8.2.2 Permit History

8.2.3 Invoices and Contracts

8.2.4 Installation Documentation

8.2.5 Inspection and Maintenance Records

8.2.6 Product Literature

8.2.7 Alarm / Activation History

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

8.3.1 General information
- 8.3.1.1 Purpose of Systems
- 8.3.1.2 System Components
- 8.3.1.3 General System Operation

8.3.2 Key Components of Systems
- 8.3.2.1 Fire Alarm Control Unit (FACU)
- 8.3.2.2 Power Supply
- 8.3.2.3 Initiating Devices
- 8.3.2.4 Smoke Detection
- 8.3.2.5 Heat Detection
- 8.3.2.6 Other Types of Detectors
- 8.3.2.7 Notification Appliances

8.3.3 Operations and Installation Parameters of the System
- 8.3.3.1 FACU Features
- 8.3.3.2 Location and Spacing of Devices
- 8.3.3.3 Internal System Communication
- 8.3.3.4 Means of Alarm Transmission
- 8.3.3.5 Systems Monitored and Controlled

8.3.4 Analysis
- 8.3.4.1 System Documentation and Data Collection
- 8.3.4.2 Code Analysis
- 8.3.4.3 Design Analysis
- 8.3.4.4 Installation Analysis
- 8.3.4.5 Testing and Maintenance Analysis
- 8.3.4.6 System Performance
- 8.3.4.7 Development of Timeline
- 8.3.4.8 Thermal Damage
- 8.3.4.9 Fire Alarm Effectiveness
- 8.3.4.10 Impact on Human Behavior

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

8.4.1 General Information
- 8.4.1.1 Purpose of Systems
- 8.4.1.2 General System Operation

8.4.2 Key Components of Water-Based Systems
- 8.4.2.1 Sprinklers/Nozzles
- 8.4.2.2 Piping
- 8.4.2.3 Systems Valves
- 8.4.2.4 Water Supply

8.4.3 Operation and Installation Parameters of the System
- 8.4.3.1 Location and Spacing of Sprinklers
- 8.4.3.2 .3.2 Pipe Sizing and Arrangement
- 8.4.3.3 .3.3 Sprinkler Coverage and Distribution
- 8.4.3.4 .3.4 Water Flow Rate and Pressure
- 8.4.3.5 .3.5 Activation Mechanisms and Criteria

8.4.4 Analysis
- 8.4.4.1 System Documentation and Data Collection
- 8.4.4.2 Code Analysis
- 8.4.4.3 Design Analysis
- 8.4.4.4 Hazard Protected

501-8.5 ***The Investigator candidate shall identify the basic components and operation of a non-water-based fire suppression system.***

8.5.1 General Information
- 8.5.1.1 Purpose of Systems
- 8.5.1.2 Method of Application
- 8.5.1.3 Suppression Agents

8.5.2 Key Components of Systems
- 8.5.2.1 Suppression Agent Supply
- 8.5.2.2 Pressure Sources
- 8.5.2.3 Distribution Piping
- 8.5.2.4 Valves, Hoses, and Fittings

8.5.2.5 Proportioners
8.5.2.6 Distribution Nozzles
8.5.2.7 Actuation System
8.5.2.8 System Monitoring and control

8.5.3 Operation and Installation Parameters of the System
8.5.3.1 Location and Spacing of Nozzles
8.5.3.2 Pipe Sizing and Arrangement
8.5.3.3 Nozzle Coverage and Distribution
8.5.3.4 Activation Mechanisms and Criteria
8.5.3.5 Systems Monitored and Controlled

8.5.4 Analysis
8.5.4.1 General Information and Codes
8.5.4.2 Design Analysis

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 Investigations*. The reference for this material is found in IFSTA, *Fire Inspection and Code Enforcement, chapter 12-14*.

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

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (4)(c) Electricity and Electrical Systems.

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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 and analyze the performance of building systems, including fire protection, detection and suppression systems, HVAC, electricity and electrical systems, fuel gas systems, 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 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.

References:
J&B, chapter 7
Kirk's, chapter 3-4
Lentini, chapter 6

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.

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 Interrupter (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

9.10.7 Insulation Damage

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 Deteriorated Insulation

9.11.8 Overdriven or Misdriven Staple

9.11.9 Short Circuit

9.11.10 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 Characteristics
- 9.12.8.3 Lightning Strikes
- 9.12.8.4 Lightning Damage
- 9.12.8.5 Lightning Detection Networks

501-9.13 ***The Investigator candidate shall describe characteristics common to most lithium-ion batteries.***

SECTION 10

BUILDING FUEL GAS SYSTEMS

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (4)(d) Fuel Gas Systems.

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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 and analyze the performance of building systems, including fire protection, detection and suppression systems, HVAC, electricity and electrical systems, fuel gas systems, 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 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.

References:
J&B, chapter 8
Kirk's, chapter 4
Lentini, chapter 6

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 Shutoff 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.

References:
J&B, chapter 9

501-11.1 The Investigator candidate shall recognize that the analyses 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 Locations of Exits
- 11.3.3.2 Number of Exits
- 11.3.3.3 Height of 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 youth fire-setting behavior.***

11.5.1 Developmental Stages

11.5.2 Mental Health

501-11.6 ***Incendiary fires – see SECTION 501-23.4 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.

References:
J&B, chapter 10

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 Witnesses
    - 12.5.2.3.2 Expert Witnesses
    - 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 Opinions
- 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.

NFPA 1003 4.1.7

4.2 Scene Examination.

Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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. Ability to assess fire ground and structural condition, observe the damage from and effects of the fire, and interpret fire patterns.

References:

J&B, chapter 11

Journal of Occupational and Environmental Hygiene, "Contamination of Firefighter Personal Protective Equipment and Skin and the Effectiveness of Decontamination Procedures"

The Bureau of Alcohol, Tobacco and Firearms, HETA 96-0171-2692, Health Hazard Evaluation Report

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 Hazzard 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 hazards 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 Personal Protective Equipment (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 Effect
- 13.5.1.2 Systemic Effect

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 Investigations*. 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) OX (or OXY)
b) COR
c) ALK
d) 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, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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. Inspect and analyze the performance of building systems, including fire protection, detection and suppression systems, HVAC, electricity and electrical systems, fuel gas systems, 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 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. Ability to adjust interviewing strategies based on deductive reasoning, interpret, and analyze verbal, and nonverbal communications, apply appropriate legal requirements, 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.

References: J&B, chapter 12 ASTM E678 ASTM E860 ASTM 1188

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 Number and Diversity of Informational Sources

14.1.3 Data Relevance, Accuracy, and Reliability

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

14.2.4 Privacy Considerations

14.2.5 Authorizations for Release of Information

501-14.3 ***The Investigator candidate shall identify the ASTM standards for collecting, preserving and evaluating data.***

501-14.4 ***The Investigator candidate shall distinguish differing forms of information.***

14.4.1 Verbal Information

14.4.2 Written and Printed Information

14.4.3 Visual Information

14.4.4 Digital Information

501-14.5 ***The Investigator candidate shall identify sources of non-scene data.***

14.5.1 Witness Data

14.5.2 Property Data

14.5.3 Electronically Stored Information

14.5.4 Existing Research and Publications

14.5.5 Experimentation and Testing

14.5.6 Governmental Sources of Information

14.5.7 Federal Government

14.5.8. Other Federal Agencies

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 Investigations 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 News Organizations

14.6.16 Lightning Detection Networks

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, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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.

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.

References:
J&B, chapter 13
Kirk's, chapters 1 and 5
Lentini, chapter 4

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

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (2)(c) Fire Investigation Technology.

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.

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, so that the report accurately reflects the facts, data, and scientific principles on which the investigator relied; clearly identifies and expresses the investigator's opinions and conclusions; and contains the reasoning by which each opinion or conclusion was reached in order to meet the 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.

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.

References:
J&B, chapter 14
Kirk's, chapter 6
Lentini, chapter
4 ASTM E860
ASTM E620

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 Types of Cameras

16.2.4 Understanding the Parts of a Camera
- 16.2.4.1 Lenses
- 16.2.4.2 Focal Length
- 16.2.4.3 Depth of Field
- 16.2.4.4 Filters
- 16.2.4.5 Shutter Speed

16.2.5 Lighting

16.2.6 Special Types of Photography
- 16.2.6.1 Composition and Techniques
- 16.2.6.2 Sequential Photographs
- 16.2.6.3 Mosaic Photographs
- 16.2.6.4 Photo Diagram
- 16.2.6.5 Assisting Photographer
- 16.2.6.6 Photography and the Courts

16.2.7 Video

16.2.8 Suggested Activities to Be Documented
- 16.2.8.1 During the Fire
- 16.2.8.2 Overhaul Photographs
- 16.2.8.3 Bystander Photographs
- 16.2.8.4 Exterior Photographs
- 16.2.8.5 Structural Photographs
- 16.2.8.6 Interior Photographs
- 16.2.8.7 Utility Photographs
- 16.2.8.8 Evidence Photographs
- 16.2.8.9 Victim Photographs
- 16.2.8.10 Witness Viewpoint Photographs
- 16.2.8.11 Aerial Photographs
- 16.2.8.12 Satellite Imagery

16.2.9 Photography Tips

16.2.10 Presentation of Photographs

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 plans
- 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 (3D) 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 Appliances 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 Purpose

16.5.2 Report Organization

16.5.3 Descriptive Information

16.5.4 Opinions and Conclusions

16.5.5 Pertinent Facts

16.5.6 Reference to Methodology

****Note: The following part of Section 16 does not come from NFPA 921****
The reference for this material is found in ASTM E620 *Standard Practice for Reporting Opinions of Scientific or Technical Experts* (current ed.)

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

SECTION 17

PHYSICAL EVIDENCE

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (2)(d) Evidence Documentation, Collection, and Preservation.

4.2 Scene Examination.

Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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

(C) 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.

Lentini, chapter 4 ASTM E1188 ASTM E1459

References:
J&B, chapter 15
Kirk's, chapter 7

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 Responsibilities 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

17.3.6 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

17.5.5 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 understand the benefits and limitations of utilizing Canine-Handler Teams.

17.7.1 Preferred Designation

17.7.2 Other Designations for IGL Canines

17.7.3 Investigators' Discretion

17.7.4 Handlers' Expertise

17.7.5 Canine-Handler Teams

17.7.6 Purpose of Canine-Handler Team

17.7.7 Limitations on the Use of Alerts by Canine-Handler Teams

17.7.8 Canine-Handler Teams and Accelerant Detection

17.7.9 Coordinating the Investigation with the Handler

17.7.10 Safety of Canine, Handler, and Others

501-17.8 The Investigator candidate shall identify the ASTM standards related to physical evidence.

501-17.9 The Investigator candidate shall describe the proper methods of transportation and storage of physical evidence.

17.9.1 Hand Delivery

17.9.2 Shipment

17.9.3 Storage of Evidence

501-17.10 The Investigator candidate shall identify and describe the evidence chain of custody of physical evidence.

501-17.11 ***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.***

17.11.1 Evidence Collection or Inspections Involving Alteration Without Changes to the Evidentiary Value of the Artifacts

17.11.2 Test Methods

17.11.3 Sufficiency of Samples

17.11.4 Comparative Examination and Testing

501-17.12 ***The Investigator candidate shall describe the proper procedure for evidence disposition.***

SECTION 18

ORIGIN DETERMINATION

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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.

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.

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.

References:
J&B, chapter 16
Kirk's, chapters 1 and 5
Lentini, chapter 4

501-18.1 ***The Investigator candidate shall identify witness information and/or electronic data, fire patterns, and fire dynamics used in origin determination***.

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
- 18.3.1.8 Determination of the Safety of the Fire Scene

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 Weather Conditions
- 18.3.3.5 Electrical Systems
- 18.3.3.6 Electrical Loads
- 18.3.3.7 HVAC Systems
- 18.3.3.8 Fuel Gas Systems
- 18.3.3.9 Liquid Fuel Systems
- 18.3.3.10 Fire Protection Systems
- 18.3.3.11 Fire Protection Systems Data
- 18.3.3.12 Security Cameras
- 18.3.3.13 Intrusion Alarm Systems
- 18.3.3.14 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
- 18.4.1.6 Evaluation of Every Pattern

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 Analysis of Sequential Events

18.4.4 Fire Dynamics

18.4.5 Origin Matrix Analysis

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

18.5.1 Initial Hypothesis

18.5.2 Modifying the Initial Hypothesis

501-18.6 ***The Investigator candidate shall identify means and methods for testing the validity of the origin hypothesis.***

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.

References:
J&B, chapter 17
Kirk's, chapters 1 and 5

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
- 19.4.1.1 Geometry and Orientation
- 19.4.1.2 Ignition Temperature
- 19.4.1.3 Quantity of Fuel

19.4.2 Ignition Source Analysis

19.4.3 Oxidant

19.4.4 Ignition Sequence

501-19.5 ***The Investigator candidate shall develop cause hypotheses.***

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

19.6.1 Scientific Method

19.6.2 Deductive Reasoning

19.6.3 Hypotheses 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 or 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

501-19.8 ***The Investigator candidate shall use a set of prescribed incident classification system when classification is required of the investigator.***

(1) NFIRS - National Fire Incident Reporting System

(2) NFPA 901 – Standard Classifications for Fire and Emergency Services Incident Reporting

(3) BATS – Bombs Arson Tracking System

(4) UCR – Uniform Crime Reporting Program

(5) The Canadian Code Structure

(6) NIBRS – National Incident Based Reporting System

SECTION 20

ANALYZING THE INCIDENT FOR CAUSE AND RESPONSIBILITY

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (2)(a) Fire Analysis, (e) 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.

References:
J&B, chapter 19
Kirk's, chapters 1 and 5

(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.

501-20.1 ***The Investigator candidate shall describe methods for analyzing the incident for cause and responsibility.***

20.1.1 (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 20.1.1(1), 20.1.1(2), and 20.1.1(3).

20.1.2 Based on the scope of the assignment, an individual investigator may not have responsibility or be required to address all of the aspects of this chapter.

20.1.3 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.

501-20.2 ***The Investigator candidate shall identify the competent ignition source, the fuel first ignited, and the events that brought them together.***

501-20.3 ***The Investigator candidate shall describe the causes of damage to property resulting from the Incident.***

20.3.1 Considerations

20.3.2 Fire/Smoke Spread
- 20.3.2.1 Compartmentation
- 20.3.2.2 Change of occupancy/hazard
- 20.3.2.3 Detection/alarm systems
- 20.3.2.4 Human behavior
- 20.3.2.5 Fire suppression
- 20.3.2.6 Fuel loads
- 20.3.2.7 Housekeeping
- 20.3.2.8 Ventilation
- 20.3.2.9 Code violations
- 20.3.2.10 Structural failure

20.3.3 Other consequential damage

501-20.4 ***The Investigator candidate shall describe the causes of bodily injury or loss of life. See Chapters 11 and 24.***

20.4.1 Fire/Smoke Spread
- 20.4.1.1 Toxicity
- 20.4.1.2 Hazardous materials
- 20.4.1.3 Compartmentation
- 20.4.1.4 Change of occupancy/hazard
- 20.4.1.5 Detection/alarm systems
- 20.4.1.6 Human behavior
- 20.4.1.7 Fire suppression
- 20.4.1.8 Housekeeping
- 20.4.1.9 Fuel loads
- 20.4.1.10 Ventilation
- 20.4.1.11 Code violations
- 20.4.1.12 Means of egress/refuge
- 20.4.1.13 Structural failure
- 20.4.1.14 Intentional acts

20.4.2 Emergency Preparedness

501-20.5 The Investigator candidate shall describe the determination of responsibility.

20.5.1 Nature of Responsibility

20.5.2 Definition of Responsibility

20.5.3 Assessing of Responsibility

20.5.4 Degrees of Responsibility

SECTION 21

FAILURE ANALYSIS AND ANALYTICAL TOOLS

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (2)(e) 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.

References:
J&B, chapter 20
Kirk's, chapters
1 and 5

501-21.1 ***The Investigator candidate shall describe failure analysis and the use of analytical tools.***

501-21.2 ***The Investigator candidate shall describe time lines available for use in analyzing fire cause.***

21.2.1 General

21.2.2 Hard Time (Actual)

21.2.3 Soft Time (Estimated)

21.2.4 Benchmark Events

21.2.5 Multiple Time Lines

501-21.3 ***The Investigator candidate shall describe system analysis techniques.***

21.3.1 Fault Trees

21.3.2 Failure Mode and Effects Analysis (FMEA)

501-21.4 ***The Investigator candidate shall describe the purpose for mathematical modeling.***

21.4.1 General and Limitations of Mathematical Modeling

21.4.2 Heat Transfer Analysis

21.4.3 Flammable Gas Concentrations

21.4.4 Hydraulic Analysis

21.4.5 Thermodynamic Chemical Equilibrium Analysis

21.4.6 Structural Analysis

21.4.7 Egress Analysis

21.4.8 Fire Dynamics Analysis

21.4.9 Guidelines for Selection and Use of a Fire Model

501-21.5 The Investigator candidate shall describe the role of fire testing.

21.5.1 Role of Fire Testing

21.5.2 Fire Test Methods

21.5.3 Limitations of Fire Testing

501-21.6 The Investigator candidate shall identify the data required for modeling and testing.

21.6.1 Materials and Contents

21.6.2 Ventilation

SECTION 22

EXPLOSIONS

NFPA 1033 4.1.7 In order to successfully complete the tasks identified in the JPRs of Sections 4.2 through 4.7, the fire investigator shall remain current in the subjects listed as "requisite knowledge" as they relate to fire investigations, which include the following: (1)(e) Explosion Dynamics.

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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.

References:
J&B, chapter 21
Kirk's, chapter 3

501-22.1 The Investigator candidate shall define the term "explosion".

501-22.2 The Investigator candidate shall identify the different types of explosions.

22.2.1 Mechanical Explosions

22.2.2 Boiling Liquid Expanding Vapor Explosion (BLEVE)

22.2.3 Chemical Explosions

22.2.4 Electrical Explosions

22.2.5 Nuclear Explosions

501-22.3 The Investigator candidate shall distinguish between the characterization of explosion damage.

22.3.1 Low-Order Damage

22.3.2 High-Order Damage

501-22.4 ***The Investigator candidate shall be able to describe the effects of explosions.***

22.4.1 Blast Overpressure and Wave Effect
- 22.4.1.1 General
- 22.4.1.2 Positive Pressure Phase
- 22.4.1.3 Negative Pressure Phase
- 22.4.1.4 Shape of Blast Wave (Front)
- 22.4.1.5 Rate of Pressure Rise versus Maximum Pressure

22.4.2 Shrapnel Effect (Projectiles)

22.4.3 Thermal Effect

22.4.4 Seismic Effect (Ground Shock)

501-22.5 ***The Investigator candidate shall identify the factors controlling explosion effects***.

22.5.1 Fuel

22.5.2 Turbulence

22.5.3 Nature of Confining Space

22.5.4 Location and Magnitude of Ignition Source

22.5.5 Venting

22.5.6 Blast Pressure Wave (Blast Pressure Front) Modification by Reflection

22.5.7 Blast Pressure Front Modification by Refraction and Blast Focusing

501-22.6 ***The Investigator candidate shall be able to identify a seated explosion.***

22.6.1 General

22.6.2 Explosives

22.6.3 Boiler and Pressure Vessels

22.6.4 Confined Fuel Gas and Liquid Vapor

22.6.5 Boiling Liquid Expanding Vapor Explosion (BLEVE)

501-22.7 ***The Investigator candidate shall be able to identify a non-seated explosion.***

22.7.1 Fuel Gases

22.7.2 Pool Flammable/Combustible Liquids

22.7.3 Dusts

22.7.4 Backdraft (Smoke Explosion)

501-22.8 ***The Investigator candidate shall be able to describe the characteristics of gas/vapor combustion explosions.***

22.8.1 Ignition of Gases and Vapors

22.8.2 Interpretation of Explosion Damage
- 22.8.2.1 Fuel-to-Air Ratio
- 22.8.2.2 Specific Gravity

22.8.3 Underground Migration of Fuel Gases

22.8.4 Multiple Explosions

501-22.9 ***The Investigator candidate shall describe the characteristics of dust explosions.***

22.9.1 General

22.9.2 Particle Size

22.9.3 Concentration

22.9.4 Turbulence in Dust Explosions

22.9.5 Moisture

22.9.6 Minimum Temperature and Ignition Energy for Dust

22.9.7 Multiple Explosions

501-22.10 ***The Investigator candidate shall be able to describe backdraft (smoke explosions).***

501-22.11 ***The Investigator candidate shall be able to identify an unconfined vapor cloud explosion.***

501-22.12 ***The Investigator candidate shall be able to distinguish the two types of explosives.***

22.12.1 Low Explosives

22.12.2 High Explosives

501-22.13 ***The Investigator candidate shall describe the complexity of the investigation of explosive incidents.***

501-22.14 ***The Investigator candidate shall be able to investigate the explosion scene.***

22.14.1 General

22.14.2 Securing the Scene
- 22.14.2.1 Establishing the Scene
- 22.14.2.2 Obtain Background Information
- 22.14.2.3 Establish the Scene Search Pattern
- 22.14.2.4 Safety at the Explosion Scene

22.14.3 Initial Scene Assessment
- 22.14.3.1 General
- 22.14.3.2 Identify Explosion or Fire
- 22.14.3.3 Document Damage
- 22.14.3.4 Seated or Nonseated Explosion
- 22.14.3.5 Identify Type of Explosion
- 22.14.3.6 Identify Potential General Fuel Type
- 22.14.3.7 Establish the Origin
- 22.14.3.8 Establish Ignition Source

22.14.4 Detailed Scene Assessment
- 22.14.4.1 Identify Damage Effects of Explosion
- 22.14.4.2 Identify Pre-Blast and Post-Blast Fire Damage
- 22.14.4.3 Locate and Identify Articles of Evidence
- 22.14.4.4 Identify Force Vectors

501-22.15 The Investigator candidate shall analyze the origin (epicenter) of an explosion scene.

501-22.16 The Investigator candidate shall analyze a fuel source.

501-22.17 The Investigator candidate shall analyze the ignition source.

501-22.18 The Investigator candidate shall analyze to establish cause.

22.18.1 General

22.18.2 Time Line Analysis

22.18.3 Damage Pattern Analysis
- 23.18.3.1 Debris Analysis
- 23.18.3.2 Relative Structural Damage Analysis

22.18.4 Correlation of Explosion Type and Energy with Damage Incurred

22.18.5 Analysis of Damaged Items and Structures

22.18.6 Correlation of Thermal Effects

SECTION 23

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.

References:
J&B, chapter 21
Kirk's, chapter 11
Lentini, chapter 8

501-23.1 ***The Investigator candidate shall define "incendiary" fires.***

501-23.2 ***The Investigator candidate shall identify and describe indicators of incendiary fires.***

23.2.1 Multiple Fires

23.2.2 Trailers

23.2.3 Lack of Expected Fuel Load and Ignition Sources

23.2.4 Unusual Fuel Load or Configuration

23.2.5 Burn Injuries

23.2.6 Incendiary Devices

23.2.7 Assessment of Fire Growth and Fire Damage

501-23.3 ***The Investigator candidate shall identify and explain potential indicators of incendiary fires not directly related to combustion.***

23.3.1 Remote Locations with View Blocked or Obscured

23.3.2 Forced Entry

23.3.3 Fires Near Service Equipment and Appliances

23.3.4 Removal or Replacement of Contents Prior to the Fire
- 23.3.4.1 Replacement
- 23.3.4.2 Removal
- 23.3.4.3 Absence of Personal Items Prior to the Fire

23.3.5 Entry Blocked or Obstructed

23.3.6 Sabotage to the Structure or Fire Protection Systems
- 23.3.6.1 Definition of Sabotage
- 23.3.6.2 Damage to Fire-Resistive Assemblies
- 23.3.6.3 Damage to Fire Protection Systems

23.3.7 Open Windows and Exterior Doors

501-23.4 ***The Investigator candidate shall identify and describe other evidentiary factors associated with incendiary fires.***

23.4.1 Evidentiary Factors that should be recorded and examined

23.4.2 Analysis of Confirmed Incendiary Fires
- 23.4.2.1 Geographic Areas, or Clusters
- 23.4.2.2 Temporal Frequency
- 23.4.2.3 Materials and Method

23.4.3 Evidence of Other Crimes, Crime Concealment

23.4.4 Indications of Financial Stress

23.4.5 Existing or History of Code Violations

23.4.6 Owner with Fires at Other Properties

23.4.7 Overinsurance

23.4.8 Timed Opportunity
- 23.4.8.1 Fires During Severe Natural Conditions
- 23.4.8.2 Fires During Civil Unrest
- 23.4.8.3 Fire Department Unavailable

23.4.9 Motives for Firesetting Behavior
- 23.4.9.1 Define “Motive”
- 23.4.9.2 Motive Versus Intent
- 23.4.9.3 Classifications of Motive
  - 23.4.9.3.1 Introduction
  - 23.4.9.3.2 Vandalism
    - 23.4.9.3.2.1 Willful and Malicious Mischief
    - 23.4.9.3.2.2 Peer or Group Pressure
  - 23.4.9.3.3 Excitement
    - a. Thrill Seeking
    - b. Attention Seeking
    - c. Recognition
    - d. Sexual Gratification or Perversion
  - 23.4.9.3.4 Revenge
    - a. Personal Retaliation
    - b. Societal Retaliation
    - c. Institutional Retaliation
    - d. Group Retaliation
  - 23.4.9.3.5 Crime Concealment
    - a. Murder Concealment
    - b. Burglary Concealment
    - c. Destruction of Records or Documents
  - 23.4.9.3.6 Profit
  - 23.4.9.3.7 Extremism
    - a. Terrorism
    - b. Riot/Civil Disturbance

SECTION 24

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.

References:
J&B, chapter 23
Kirk's, chapter 12
Konefal, Fire Death Scene Investigation
ASTM E678

501-24.1 The Investigator candidate shall demonstrate the ability to utilize specialized skills associated with death and injuries from fire and explosions.

501-24.2 The Investigator candidate shall identify the mechanisms of death and injury.

24.2.1 Carbon Monoxide

24.2.2 Cyanide

24.2.3 Other Toxic Gases

24.2.4 Hyperthermia

24.2.5 Skin Burns

24.2.6 Inhalation of Hot Gases

24.2.7 Soot and Smoke

24.2.8 Hypoxia

24.2.9 Sublethal Inhalation Exposure Effects on the Individual

24.2.9.1 Narcotic Gases
24.2.9.2 Irritant Gases
24.2.9.3 Smoke

24.2.10 Explosion-Related Injuries
24.2.10.1 Blast Pressure Injuries
24.2.10.2 Shrapnel Injuries
24.2.10.3 Thermal Injuries
24.2.10.4 Building Collapse Injuries

501-24.3 The Investigator candidate shall describe the consumption of the body by fire.

24.3.1 Skin

24.3.2 Muscle

24.3.3 Bone

24.3.4 Fat

501-24.4 The Investigator candidate shall describe the postmortem changes that a deceased body will undergo when exposed to heat and to death.

24.4.1 Lividity

24.4.2 Rigor Mortis

501-24.5 The Investigator candidate shall describe the considerations to be made before the investigation of a fatal fire.

24.5.1 Notification

24.5.2 The Fire Department

24.5.3 Team Investigation

24.5.4 Safety

24.5.5 Scene Documentation

24.5.6 Victim Documentation

24.5.7 Recovery of Bodies and Evidence
- 24.5.7.1 Layering of Debris
- 24.5.7.2 Sifting of Debris
- 24.5.7.3 Body Removal
- 24.5.7.4 Victim Clothing

24.5.8 Collection of Other Physical Evidence

501-24.6 The Investigator candidate shall describe the steps of investigating fire scenes with injuries.

24.6.1 Notification Laws

24.6.2 Scene Documentation

24.6.3 Victim Documentation

24.6.4 Victim Timeline

24.6.5 Physical Evidence

501-24.7 The Investigator candidate shall describe the documentation of an explosion incident where injury and/or death has occurred.

24.7.1 Collecting Physical Evidence from Explosions

501-24.8 The Investigator candidate shall describe post scene investigation of injuries.

24.8.1 Burns
- 24.8.1.1 Degree of Burns
- 24.8.1.2 Body Area (Distribution)

24.8.2 Inhalation Medical Evidence

24.8.3 Hospital Tests and Documentation

24.8.4 Access to Medical Evidence

501-24.9 The Investigator candidate shall describe the fire death pathological and toxicological examination.

24.9.1 The Coroner or Medical Examiner

24.9.2 Identifying the Remains
- 24.9.2.1 Human vs. Animal Remains
- 24.9.2.2 Visual Identification
- 24.9.2.3 Identification by Clothing and Personal Effects
- 24.9.2.4 Fingerprint Identification
- 24.9.2.5 X-ray Identification
- 24.9.2.6 DNA Identification

24.9.3 X-ray Examination

24.9.4 Carbon Monoxide Levels

24.9.5 Cyanide Levels

24.9.6 Presence of Other Toxicants

24.9.7 Smoke and Soot Exposure

24.9.8 Burns

24.9.9 Physical Trauma and Wounds

24.9.10 Stomach Contents

24.9.11 Internal Body Temperature

24.9.12 Pre-Existing Medical Conditions

24.9.13 Death Pre-Fire

24.9.14 Death from a Medical Condition

501-24.10 ***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.***

24.10.1 Timeline Development

24.10.2 Victim Activity

24.10.3 Pre-Fire Victim Impairment

24.10.4 Medical History

24.10.5 Fire Pattern

24.10.6 Burns

24.10.7 Clothing

24.10.8 Applications of Toxicology in Fire Investigation
- 24.10.8.1 Toxicological Analysis Techniques
- 24.10.8.2 Physiological Models
  - 24.10.8.2.1 The Steward Equation
  - 24.10.8.2.2 The Colburn Forster Kane (CFK) Equation

SECTION 25

APPLIANCES

4.2 Scene Examination.
Duties shall include inspecting, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action 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 and analyze the performance of building systems, including fire protection, detection and suppression systems, HVAC, electricity and electrical systems, fuel gas systems, 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 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.

References:
J&B, chapter 24
Kirk's, chapter 4
Lentini, chapter 6

501-25.1 ***The Investigator candidate shall analyze appliances as it relates to investigation of the cause of fires.***

501-25.2 ***The Investigator candidate shall record the scene involving an appliance.***

25.2.1 Recording Specific Appliances

25.2.2 Measurements of the Location of the Appliances

25.2.3 Positions of Appliance Controls

25.2.4 Document Appliance Information

25.2.5 Gathering All of the Parts from the Appliance

501-25.3 ***The Investigator candidate shall analyze the origin of fires involving appliances.***

25.3.1 Relationship of the Appliance to the Origin

25.3.2 Fire Patterns

25.3.3 Plastic Appliance Components

25.3.4 Reconstruction of the Area of Origin

501-25.4 ***The Investigator candidate shall analyze the cause of fires involving appliances.***

25.4.1 How the Appliance Generated Heat

25.4.2 The Use and Design of the Appliance

25.4.3 Electrical Appliances as Ignition Sources

25.4.4 Photographing Appliance Disassembly

25.4.5 Obtaining Exemplar Appliances

25.4.6 Testing Exemplar Appliances

501-25.5 ***The Investigator candidate shall describe each of the common parts or components that might be found in various appliances.***

25.5.1 Appliance Housings

25.5.2 Power Sources
- 25.5.2.1 Power Cords
- 25.5.2.2 Voltages Less than 120
- 25.5.2.3 Batteries
- 25.5.2.4 Overcurrent Protection

25.5.3 Switches
- 25.5.3.1 Manual Switches
- 25.5.3.2 Automatic Switches

25.5.4 Solenoids and Relays

25.5.5 Transformers

25.5.6 Motors

25.5.7 Heating Elements

25.5.8 Lighting
- 25.5.8.1 Fluorescent Lighting Systems
- 25.5.8.2 High Intensity Discharge Lighting Systems

25.5.9 Miscellaneous Components

501-25.6 The Investigator candidate shall describe the operation and components of common residential appliances.

25.6.1 Range or Oven

25.6.2 Coffee Makers

25.6.3 Toaster

25.6.4 Electric Can Opener

25.6.5 Refrigerator

25.6.6 Dishwasher

25.6.7 Microwave Oven

25.6.8 Portable Space Heater

25.6.9 Electric Blanket

25.6.10 Window Air Conditioner Unit

25.6.11 Hair Dryer and Hair Curler

25.6.12 Clothes Iron

25.6.13 Clothes Dryer

25.6.14 Consumer Electronics

25.6.15 Lighting

SECTION 26

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, evaluating, and analyzing the fire scene or evidence of the scene, and 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 action or activity that brought the ignition source and materials together and to assess the subsequent progression, extinguishment, and containment of the fire.

NFPA 1033 4.2.4 Interpret and analyze fire patterns, given standard equipment and tools and some structural or content remains, so that each pattern is identified and analyzed with respect to the burning characteristics of the material involved, the stage of fire development, the effects of ventilation within the context of the scene, the relationship with all patterns observed, and the understanding of the methods of heat transfer that led to the formation of the patterns identified and analyzed, and the sequence in which the patterns were produced is determined.

(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 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. 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.

References:
J&B, chapter 25
Kirk's, chapter 7

501-26.1 ***The Investigator candidate shall describe the factors related to the investigation of fires involving motor vehicles.***

501-26.2 ***The Investigator candidate shall describe the differences, in safety related concerns, that burned vehicles pose as compared to those found in structure fires.***

501-26.3 ***The Investigator candidate shall describe and identify the different types of fuels that may be involved in vehicle fires.***

26.3.1 Ignitable Liquids
26.3.1.1 Hot Surface Ignition

26.3.2 Gaseous Fuels

26.3.3 Solid Fuels

501-26.4 ***The Investigator candidate shall describe and identify the different ignition sources that can be present in vehicle fires.***

26.4.1 Open Flames

26.4.2 Electrical Sources
26.4.2.1 Recreational Vehicles
26.4.2.2 Overloaded Wiring
26.4.2.3 Electrical High Resistance Connections
26.4.2.4 Electrical Short Circuits and Arcs - Electric Discharge
26.4.2.5 Arc, Carbon, Tracking
26.4.2.6 Lamp Bulbs and Filaments
26.4.2.7 External Electrical Sources Used in Vehicles

26.4.3 Hot Surfaces

26.4.4 Mechanical Sparks

26.4.5 Smoking Materials

501-26.5 ***The Investigator shall identify the different types of systems that a motor vehicle may possess and their respective functions.***

26.5.1 Fuel Systems
- 26.5.1.1 Vacuum/Low-Pressure Carbureted Systems
- 26.5.1.2 High-Pressure Fuel-Injected Systems
- 26.5.1.3 Diesel Fuel System
- 26.5.1.4 Natural Gas
- 26.5.1.5 Propane Fuel
- 26.5.1.6 Turbochargers

26.5.2 Emission Control System

26.5.3 Motor Vehicle Electrical Systems

26.5.4 Mechanical Power Systems

26.5.5 Mechanical Power Distribution

26.5.6 Accessories to the Mechanical Power System

26.5.7 Hydraulic Braking System

26.5.8 Windshield Washer Systems

501-26.6 ***The Investigator candidate shall identify the different body systems that can be found within or upon motor vehicles.***

26.6.1 Interior Finishes and Accessories

26.6.2 Cargo Areas

501-26.7 ***The Investigator candidate shall identify and employ the proper technique for investigating motor vehicle fires.***

26.7.1 Vehicle Identification

26.7.2 Vehicle Fire Scene History

26.7.3 Vehicle Particulars

26.7.4 Documenting the Vehicle at the Fire Scene

26.7.5 Documenting the Vehicle Away from the Scene

501-26.8 The Investigator candidate shall identify factors related to the examination of motor vehicles after they have burned.

26.8.1 General

26.8.2 Examination of Vehicle Systems

26.8.3 Switches, Handles, and Levers

501-26.9 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.

501-26.10 The Investigator candidate shall identify factors related to incendiary vehicle fires.

501-26.11 The Investigator shall identify components of the vehicle's ignition system as they relate to the fire investigation.

501-26.12 The Investigator candidate shall identify factors concerning vehicle fires in structures and evaluate them as a potential source of fire ignition.

501-26.13 The Investigator candidate shall identify and describe the factors relative to the investigation of recreational vehicle fires.

501-26.14 The Investigator candidate shall identify the factors related to fire investigations involving heavy equipment.

26.14.1 Medium- and Heavy-Duty Trucks, and Buses

26.14.2 Mass Transit Vehicles

26.14.3 Earth-Moving Equipment

26.14.4 Forestry/Logging Equipment

26.14.5 Landfill Equipment

26.14.6 Agricultural Equipment

501-26.15 ***The Investigator candidate shall identify the factors related to fire investigations involving self-propelled agricultural equipment and drawn implements.***

26.15.1 Agricultural Equipment Investigation Safety

26.15.2 Equipment Classification and Description

26.15.3 Unique Safety Concerns

26.15.4 Unique Fire Cause Concerns

26.15.5 Fuels

26.15.6 Ignition Sources

501-26.16 ***The Investigator candidate shall identify factors related to the investigation of fires involving hybrid vehicles.***

26.16.1 Hybrid Vehicle Investigation Safety

26.16.2 Hybrid Vehicle Technology

26.16.3 Investigation of Hybrid Vehicle Fires

501-26.17 ***The Investigator candidate shall identify factors related to towing or vehicle transport as it relates to fire investigations.***

501-26.18 ***The Investigator candidate shall identify factors related to the investigation of fires involving hydrogen fueled vehicles.***

SECTION 27

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.

References:
J&B, chapter 26
Kirk's, chapter 7

501-27.1 ***The Investigator candidate shall identify the specialized techniques, practices, equipment, and terminology associated with the investigation of wildfires.***

501-27.2 ***The Investigator candidate shall identify and describe wildfire fuels.***

27.2.1 Fuel Condition Analysis

27.2.2 Ground Fuels
- 27.2.2.1 Duff
- 27.2.2.2 Roots

27.2.3 Surface Fuels
- 27.2.3.1 Fine Dead Wood
- 27.2.3.2 Dead Leaves and Coniferous Litter
- 27.2.3.3 Grass
- 27.2.3.4 Downed logs, Stumps, and Large Limbs
- 27.2.3.5 Low Brush and Reproduction

27.2.4 Aerial Fuels
- 27.2.4.1 Tree Branches and Crowns
- 27.2.4.2 Tree Moss
- 27.2.4.3 High Brush

27.2.5 Species

27.2.6 Fuel Size

27.2.7 Fuel Moisture Content

27.2.8 Oil Content

501-27.3 ***The Investigator candidate shall identify and describe the effects of weather on fire spread.***

27.3.1 Weather History

27.3.2 Temperature

27.3.3 Relative Humidity

27.3.4 Wind Influences
- 27.3.4.1 Meteorological Winds
- 27.3.4.2 Diurnal Winds
- 27.3.4.3 Foehn Winds
- 27.3.4.4 Fire Winds

501-27.4 ***The Investigator candidate shall identify, describe and interpret the effect of topography on fire spread.***

27.4.1 Slope

27.4.2 Aspect

501-27.5 ***The Investigator candidate shall be able to describe fire shape.***

27.5.1 Fire Head

27.5.2 Fire Flanks

27.5.3 Fire Heel

27.5.4 Factors Affecting Fire Spread
- 27.5.4.1 Lateral Confinement
- 27.5.4.2 Fuel Influence
- 27.5.4.3 Suppression

27.5.5 Other Natural Mechanisms of Fire Spread
- 27.5.5.1 Embers and Firebrands
- 27.5.5.2 Fire Storms
- 27.5.5.3 Animals

501-27.6 ***The Investigator candidate shall identify and describe indicators of a wildfire.***

27.6.1 Wildfire V-Shaped Patterns

27.6.2 Degree of Damage

27.6.3 Grass Stems

27.6.4 Angle of Char

27.6.5 White Ash Deposit

27.6.6 Cupping

27.6.7 Die-Out Pattern

27.6.8 Exposed and Protected Fuels

27.6.9 Staining and Sooting

27.6.10 Depth of Char

27.6.11 Spalling

27.6.12 Foliage Freeze

27.6.13 Curling

501-27.7 The Investigator candidate shall identify the area of origin of a wildfire.

27.7.1 Initial Area of Investigation

27.7.2 General Origin Area

27.7.3 General Origin Investigation Techniques

27.7.4 Specific Origin Investigation Techniques

27.7.5 Search Equipment

501-27.8 The Investigator candidate shall determine the cause of a wildfire.

27.8.1 Natural Fire Cause

27.8.2 Human Fire Cause

501-27.9 ***The Investigator candidate shall recognize that evidence protection, preservation, collection, and documentation at wildfires are similar to other fires.***

501-27.10 ***The Investigator candidate shall identify special safety considerations associated with investigation of wildfires.***

501-27.11 ***The Investigator candidate shall identify sources of information as prescribed in Annex B and Section B.11. .***

SECTION 28

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.

References:
J&B, chapter 27

501-28.1 ***The Investigator candidate shall distinguish those issues that are unique to managing investigations that are complex due to size, scope, or duration.***

28.1.1 Governmental Inquiry

28.1.2 Intent

28.1.3 Purpose

28.1.4 Interested Parties

28.1.5 Chapter Definitions

501-28.2 ***The Investigator candidate shall describe the basic information and documents associated with complex investigations.***

501-28.3 ***The Investigator candidate shall recognize the importance of communications among interested parties.***

28.3.1 Notice to Interested Parties
- 28.3.1.1 Entity in Control
- 28.3.1.2 All Interested Parties
- 28.3.1.3 Roster of Interested Parties
- 28.3.1.4 Notification of Changes
- 28.3.1.5 Making Notification
- 28.3.1.6 Content of Notification
- 28.3.1.7 Subsequent Notifications

28.3.2 Meetings
- 28.3.2.1 Preliminary Meeting
- 28.3.2.2 Meetings as the Investigation Progresses

28.3.3 Website

28.3.4 Additional Dissemination of Information

501-28.4 ***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.***

28.4.1 Purposes

28.4.2 Scheduling

28.4.3 Cost Sharing

28.4.4 Nondisclosure Agreements

28.4.5 Protocols

28.4.6 Information Sharing

28.4.7 Interviews

28.4.8 Amendments to Agreements

28.4.9 Disagreements

501-28.5 ***The Investigator candidate shall identify and describe the components of managing a complex investigation.***

28.5.1 Organizational Models

28.5.2 Control of the Site and Scene
- 28.5.2.1 Securing the Site and Scene
- 28.5.2.2 Delegation of Control
- 28.5.2.3 Transfer of Control
- 28.5.2.4 Site and Scene Access
- 28.5.2.5 Site-Specific Restrictions or Requirements
- 28.5.2.6 Scene Integrity
- 28.5.2.7 Release of Information

501-28.6 ***The Investigator candidate shall recognize the unique components of handling evidence of a complex investigation.***

28.6.1 Evidence Control
- 29.6.1.1 Evidence Custodian
- 29.6.1.2 Interested Party Responsibility

28.6.2 Evidence Removal from the Scene

28.6.3 Evidence Storage

28.6.4 Evidence Inspections
- 28.6.4.1 Nondestructive Inspections
- 28.6.4.2 Destructive Inspections
- 28.6.4.3 Testing of Evidence

501-28.7 The Investigator candidate shall identify logistical support needs involving the complex investigation.

28.7.1 Transportation

28.7.2 Equipment

28.7.3 Investigation Site Security

28.7.4 Decontamination

28.7.5 Environmental

28.7.6 Communications

28.7.7 Sanitary and Comfort Needs

28.7.8 Trash Disposal and Removal

28.7.9 Snow and Ice Removal

28.7.10 Lighting

28.7.11 Evidence Storage

501-28.8 The Investigator candidate shall distinguish the unique characteristics of safety at the complex investigation site.

SECTION 29

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.

References:
J&B, chapter 28
Kirk's, chapter 7

501-29.1 ***The Investigator candidate shall identify the factors related to the investigations of fires involving recreational boats.***

501-29.2 ***The Investigator candidate shall define the following terms as they relate to Power Boat and Sailboat terminology***.

29.2.1 Accommodation space

29.2.2 Adrift

29.2.3 Afloat

29.2.4 Aft

29.2.5 Aground

29.2.6 Beam

29.2.7 Below

29.2.8 Bilge

29.2.9 Boat

29.2.10 Bulkhead

29.2.11 Cabin

29.2.12 Capsize

29.2.13 Chain plate

29.2.14 Deck

29.2.15 Dock

29.2.16 Dorade Vent

29.2.17 Fender

29.2.18 Forward

29.2.19 Freeboard

29.2.20 Galley

29.2.21 Gear

29.2.22 Gunwale

29.2.23 Hatch

29.2.24 Hold

29.2.25 Hull

29.2.26 Inboard

29.2.27 Inboard/Out-Drive (I/O)

29.2.28 Outboard

29.2.29 Overboard

29.2.30 Port

29.2.31 Rub Rail

29.2.32 Shore Power

29.2.33 Shroud

29.2.34 Sole

29.2.35 Starboard

29.2.36 Superstructure

29.2.37 Topside

29.2.38 Transom

29.2.39 Underway

29.2.40 Vessel

29.2.41 Waterline

501-29.3 ***The Investigator candidate shall recognize the importance of boat investigation safety***.

29.3.1 Safety Assessment

29.3.2 Inspection of Boats on Land

29.3.3 Inspection of Boats Afloat

29.3.4 Underwater Inspections

29.3.5 Specific Safety Concerns
- 29.3.5.1 Confined Spaces
  - 29.3.5.1.1 Automatic Fire Suppression Systems Inactive/Deactivated
- 29.3.5.2 Airborne Particulates
- 29.3.5.3 Identify and Assess Energy Sources
  - 29.3.5.3.1 Batteries
  - 29.3.5.3.2 Inverters
  - 29.3.5.3.3 Shore Power
- 29.3.5.4 Fuel Leaks
- 29.3.5.5 Sewage Holding Tank
- 29.3.5.6 Hydrogen Gas
- 29.3.5.7 Other Hydrocarbon Contaminants
- 29.3.5.8 Stability
- 29.3.5.9 Damage to the Structure of the Boat
- 29.3.5.10 Wharves, Docks, and Jetties
- 29.3.5.11 Submerged Boat
- 29.3.5.12 Visual Distress Signals and Pyrotechnics

29.3.6 Openings

501-29.4 ***The Investigator candidate shall identify the different marine systems and functions***.

29.4.1 Fuel Systems: Propulsion and Auxiliary
- 29.4.1.1 Vacuum/Low Pressure Carbureted
- 29.4.1.2 High-Pressure/Marine Fuel Injection Systems, Including Return Systems
- 29.4.1.3 Diesel

29.4.2 Fuel Systems: Cooking and Heating
- 29.4.2.1 Liquefied Petroleum Gases
- 29.4.2.2 Compressed Natural Gas
- 29.4.2.3 Alcohol
- 29.4.2.4 Solid Fuels
- 29.4.2.5 Diesel

29.4.3 Turbochargers/Super Chargers

29.4.4 Exhaust System
- 29.4.4.1 Dry Exhaust Systems
- 29.4.4.2 Wet Exhaust Systems
- 29.4.4.3 De-watered Exhaust Systems

29.4.5 Electrical Systems
- 29.4.5.1 Alternating Current (AC)
- 29.4.5.2 Direct Current (DC)

29.4.6 Engine Cooling Systems

29.4.7 Ventilation

29.4.8 Transmissions
- 29.4.8.1 Mechanical Gear Transmissions
- 29.4.8.2 Hydraulic-Geared Transmissions

29.4.9 Accessories

501-29.5 ***The Investigator candidate shall identify the exterior construction of the vessel.***

29.5.1 Hull Construction

29.5.2 Superstructure Construction Material

29.5.3 Deck

29.5.4 Exterior Accessories

501-29.6 ***The Investigator candidate shall identify the interior construction of the vessel.***

29.6.1 Construction Materials

29.6.2 Finishes
- 29.6.2.1 Accommodation Furnishings
- 29.6.2.2 Interior Accessories
- 29.6.2.3 Engine/Machinery Compartments
- 29.6.2.4 Flammable/Explosive Vapor Detectors
- 29.6.2.5 Storage and Holds
- 29.6.2.6 Fuel Tanks

501-29.7 ***The Investigator candidate shall identify the propulsion system of the vessel***.

29.7.1 Electric Systems

29.7.2 Fuels for Boats with Motorized Propulsion Systems
- 29.7.2.1 Fuel Systems
  - 29.7.2.1.1 Engines
    - 29.7.2.1.1.1 Outboard Engines (Outboard Motors)
    - 29.7.2.1.1.2 Inboard Gasoline Engines
    - 29.7.2.1.1.3 Diesel Engines
    - 29.7.2.1.1.4 Propulsion System Fluids
- 29.7.2.2 Appliance Fuel Systems
- 29.7.2.3 Electric Generators

29.7.3 Other Fuel Systems Used for Propulsion

501-29.8 ***The Investigator candidate shall identify common ignition sources found in marine vessels***.

29.8.1 Open Flames

29.8.2 Electrical Sources
- 29.8.2.1 Overloaded Wiring
- 29.8.2.2 Electrical Short Circuiting and Arcs
- 29.8.2.3 Electrical Connections
- 29.8.2.4 Lightning
- 29.8.2.5 Static Electricity and Incendive Arcs

29.8.3 Hot Surfaces
- 29.8.3.1 Manifolds
- 29.8.3.2 Exhaust Systems
- 29.8.3.3 Cooking Surfaces
- 29.8.3.4 Heating Systems

29.8.4 Mechanical
- 29.8.4.1 Bearing Failures
- 29.8.4.2 Friction

29.8.5 Smoking Materials

501-29.9 The Investigator candidate shall describe proper documentation of the boat fire scene.

29.9.1 On Land

29.9.2 In Water
- 29.9.2.1 Moored
- 29.9.2.2 Anchored and Underway
- 29.9.2.3 Underwater

29.9.3 Boat Identification
- 29.9.3.1 Hull Identification Number (HIN)
- 29.9.3.2 Registration Numbers
- 29.9.3.3 U.S. Coast Guard Documentation Numbers
- 29.9.3.4 Boat Name and Hailing Port
- 29.9.3.5 Boat History
- 29.9.3.6 Fire Scene History
  - 29.9.3.6.1 Actions Before the Fire
  - 29.9.3.6.2 Actions During the Fire
  - 29.9.3.6.3 Actions After the Fire

29.9.4 Boat Particulars

501-29.10 The Investigator candidate shall identify the steps of a proper boat examination.

29.10.1 General

29.10.2 Examination of Boat Systems

501-29.11 The Investigator candidate shall describe marine fire investigations of boats in structures.

501-29.12 ***The Investigator candidate shall describe legal considerations related to marine fire investigations***.

SECTION 30

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, so that the report accurately reflects the facts, data, and scientific principles on which the investigator relied; clearly identifies and expresses the investigator's opinions and conclusions; and contains the reasoning by which each opinion or conclusion was reached in order to meet the 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.

501-30.1 ***The Investigator candidate shall demonstrate proficiency in all required skills in the TCFP Fire Investigator Skills Manual.***