AGENDA

NFPA Technical Committee for Fire Investigations (FIA-AAA)
NFPA 921 – Guide for Fire Investigations Second Draft Meeting (ERRS Consolidation Plan Group 3 Custom(F2023))

May 24-25, 2023
8:00 a.m. – 5:00 p.m. (Eastern) on the first day,
and at the discretion of the Chair for the remainder of the meeting dates.

DoubleTree by Hilton Hotel Orlando at Sea World
10100 International Drive
Orlando, FL 32821

MS Teams – Web/Teleconference
To join the meeting, please contact Elena Liolin – ELiolin@nfpa.org

1. **Call to order.** James Shanley.
2. **Welcome and Opening remarks.**
3. **Introductions.** See committee roster attached.
4. **Chair report.** James Shanley.
5. **Staff liaison report.** Robert Fash.
6. **Previous meeting minutes:**
   a. October 28th, 2022, Pre-Second Draft Meeting Web/Teleconference. See attached.
   b. February 15/16, 2023, Pre-Second Draft Meeting Web/Teleconference. See attached.
7. **NFPA 921 Second Draft.**
   a. **Public Comments.** See attached.
   b. **Task group report(s) by Chapter Leads.**
   c. **Committee Inputs.** See attached.
8. **Other Business.**
9. **Future meetings.**
10. **Adjournment.**

Address List No Phone

05/18/2023
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Robert Fash 8/2/2021
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NATIONAL FIRE PROTECTION ASSOCIATION

The leading information and knowledge resource on fire, electrical and related hazards

DATE: May 17, 2023

TO: Technical Committee on Fire Investigations (FIA-AAA)

FROM: Robert Fash, *Staff Liaison*
rfash@nfpa.org (617) 984-7637

SUBJECT: NFPA 921, First Draft Meeting MINUTES
Virtual, October 28, 2022, Microsoft Teams

October 28, 2022

Call to Order

I. The Chair called the meeting to order at 1400 Eastern.
II. Members and guests introduced themselves. Attendance is recorded in Table 1.
III. Introductory remarks by the chair Jim Shanley
IV. The NFPA staff liaison reviewed the meeting rules.
V. Minutes for the NFPA 921 First Draft Meeting, May-June, 2022 meeting approved with no amendments.
VI. Overview of the task group review process of the 1st draft prior to the closing date for Public Comment (PC) submittal. (see attached)

Meeting adjourned 1723 hrs. EST.

Table 1 Meeting Attendance.

	Name	Employer/Organization Represented	Int Cat	Oct 28
Chair	James Shanley	Travelers Insurance Company	I	Y
Secretary	Christopher Wood	FireLink, LLC	SE	Y
Principals	Vytenis “Vyto” Babrauskas	Fire Science and Technology In	SE	Y
	Quentin A. Baker	Baker Engineering & Risk Consultants, Inc.	SE	Y
	Michael Beasley	London Fire Brigade	E	
	Michael Joseph Cabral	Riverside County District Attorney	C	
	Steve Campolo	Leviton Manufacturing Company, Inc. *Rep. NEMA*	M	Y
	Karrie Clinkinbeard	Armstrong Teasdale Llp	C	Y
	Andrew T. Cox	US Bureau of Alcohol, Tobacco, Firearms & Explosives	E	Y

	Name	Employer/Organization Represented	Int Cat	Oct 28
	Richard A. Dyer	Dyer Fire Consulting *Rep. International Association of Fire Chiefs*	U	
	James Engel	National Wildfire Coordinating Group (NWCG) *Rep. National Wildfire Coordinating Group*	E	
	Daniel T. Gottuk	Jensen Hughes *Rep. Jensen Hughes*	SE	Y
	Mark S. Grotefeld	Grotefeld Hoffmann	C	
	Terry-Dawn Hewitt	McKenna Hewitt	C	Y
	Thomas W. Horton, Jr.	South Carolina Farm Bureau Insurance Company	I	Y
	Robin Jason	General Motors *Rep. Society of Automotive Engineers*	M	
	Richard W. Jones, Jr.	Forensic Investigations Group, LLC	SE	
	Jason Karasinski	Fire Research Technology, LLC	SE	Y
	Daniel Madrzykowski	UL Firefighter Safety Research Institute *Rep. UL LLC*	R/T	
	Peter Mansi	Fire Investigations UK, LLP	U	Y
	Mary Ann Maurath	City Of Huber Heights	U	Y
	Thomas Ost-Prisco	Pennsylvania Office of Attorney General	C	Y
	Brian Peterman	State Of Ohio Fire Marshal	E	Y
	Jason Poore	Tennessee Bureau of Investigation	E	Y
	Anthony D. Putorti, Jr.	National Institute of Standards & Technology (NIST)	R/T	Y
	Stephen Rinaldi	Chelan County- Fire Prevention & Investigation	E	Y
	Michael Rindt	Acuity Mutual Insurance	I	
	Mike Rushton	Office of Ontario Fire Marshal	E	
	Mark E. Sauls	Florida Division of State Fire Marshal (Retired) *Rep. International Fire Marshals Association*	U	Y
	Joseph J. Sesniak	Forensic Fire Consultants, Ltd. *Rep. International Association of Arson Investigators (IAAI)*	U	
	Thomas B. Sing, Sr.	Quest Fire Analysis	SE	Y
	Kathryn C. Smith	National Association of Fire Investigators *Rep. National Association of Fire Investigators*	U	Y
	Philip C. Smith	The Boeing Company	M	Y
	Joseph E. Thomas	State of Maine *Rep. National Association of State Fire Marshals*	E	Y
	Charles “Randy” Watson	S-E-A, Ltd.	SE	
	Russell M. Whitney	Salt Lake City Fire Department	E	
Alternates	Robert D. Banta *Alt. to Robin Jason*	Banta Technical Services LLC *Rep. Society of Automotive Engineers*	I	
	Randall E. Bills *Alt. to Charles “Randy” Watson*	SEA, Ltd.	SE	Y
	Philip E. Crombie, Jr. *Alt. to James H. Shanley, Jr.*	Travelers Insurance Company	I	Y

	Name	Employer/Organization Represented	Int Cat	Oct 28
	Scott G. Davis *Alt. to Vytenis "Vyto" Babrauskas*	GexCon US	SE	
	Jamie Ferrino-McAllister *Alt. to Peter Mansi*	FireTox, LLC	SE	Y
	Brian Henry *Alt. to Kathryn C. Smith*	Rolfes Henry Co. LPA *Rep. National Association of Fire Investigators*	U	
	Derek J. Hill *Alt. to Andrew T. Cox*	US Bureau of Alcohol, Tobacco, Firearms & Explosives	E	Y
	Bradley J Horn *Alt. to Quentin A. Baker*	Baker Engineering & Risk Consultants, Inc.	SE	Y
	Christel K. Hunter *Alt. to Steve Campolo*	Cerro Wire *Rep. National Electrical Manufacturers Association*	M	
	Laura Jacobsen *Alt. to Philip C. Smith*	*The Boeing Company*	M	Y
	Stephen Kerber *Alt. to Daniel Madrzykowski*	UL LLC *Rep. UL LLC*	R/T	
	Wayne J. McKenna *Alt. to Terry-Dawn Hewitt*	McKenna Hewitt	C	
	Matthew P Miller *Alt. to Russell M. Whitney*	Roswell Fire Department	E	
	Joel A. Moore *Alt. to Thomas W. Horton, Jr.*	Texas Farm Bureau Insurance	I	
	Douglas Nelson Alt. to Joseph Thomas	North Dakota SFM Office *Rep. National Association of State Fire Marshals*	E	
	Rodney J. Pevytoe *Alt. to Joseph J. Sesniak*	Kubitz and Associates *Rep. International Association of Arson Investigators, Inc.*	U	
	David W. Powell *Alt. to Jason Karasinski*	SYTEK Consultants	SE	Y
	Willard F. Preston, III *Alt. to Mark E. Sauls*	Goldfein & Joseph, PC *Rep. International Fire Marshals Association*	U	
	Laura Joy Ridenour *Alt. to Richard A. Dyer*	Dearborn Fire Department *Rep. International Association of Fire Chiefs*	U	
	Thomas M. Sing, Jr. *Alt. to Thomas B. Sing, Sr.*	Quest Fire Analysis	SE	

	Name	Employer/Organization Represented	Int Cat	Oct 28
	Robert Toth *Alt. to Richard W. Jones, Jr.*	IRIS Fire Investigations, Inc.	SE	
	Tyler Wendt *Alt to Dan Gottuk*	Jensen Hughes		
	Chad Wissinger *Alt. to Brian Peterman*	Ohio Division of State Fire Marshal Forensic Lab	E	
Staff Liaison	Robert Fash	National Fire Protection Association	-	Y
Guests	Keith Paffrath	Forensic Fire Consultants	-	Y
	Christopher Brown	NIST	-	Y

NFPA Task Group Work Process for Second Draft

[NFPA 921]

October 28, 2022

Bob Fash, Specialist

Technical Committee Meetings

Members and Guests

- Use of audio recorders or other means capable of reproducing verbatim transcriptions of this meeting are not permitted

Technical Committee Meeting

Members

- Please verify/update your contact information on your NFPA profile
- Members categorized in any interest category who have been retained to represent the interests of ANOTHER interest category (with respect to issues addressed by the TC) shall declare those interests to the committee and refrain from voting on those issues throughout the process
- All Principals are encouraged to have an Alternate

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Technical Committee Meetings

Guests

- All guests are required to sign in and identify their professional affiliations
- Participation is limited to TC members or those individuals who have previously requested time to address the committee
- Participation by other guests may be permitted at the Chair’s discretion

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Technical Committee Meetings

Legal and Ethical Issues

- Manner in which standards development activity is conducted can be important
- NFPA's standards development activities are based on openness, honesty, fairness, and balance
- Be sure to ask questions if you have them

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Technical Committee Meetings

Legal and Ethical Issues

- Participants must adhere to the Regulations Governing the Development of NFPA Standards
- Participants must adhere to the Guide for the Conduct of Participants in the NFPA Standards Development Process
- Read and understand NFPA's Antitrust Policy
- Read and understand NFPA's Patent Policy
- www.nfpa.org/regs

Technical Committee Meetings

Antitrust Guidance

- Participants are to conduct themselves in strict accordance with state and federal antitrust laws
- Additionally, follow guidance and direction from your employer or other organization you may represent

Technical Committee Meetings

Antitrust Behavior

- Participants must avoid any conduct, conversation, or agreement that would constitute an unreasonable restraint of trade
- Conversation topics that are off limits include:
  - Profit, margin, or cost data
  - Prices, rates, or fees
  - Selection, division or allocation of sales territories, markets or customers
  - Refusal to deal with a specific business entity

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Technical Committee Meetings

Patents

- Disclosures of essential patent claims should be made by the patent holder, early in the process
- Others may also notify NFPA if they believe that a proposed or existing NFPA standard includes an essential patent claim

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Technical Committee Meetings

Personal Opinions

- Participants are not entitled to speak on behalf of NFPA
- Participants must take appropriate steps to ensure their statements whether written or oral and regardless of the setting, are portrayed as personal opinions, not the position of NFPA

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NFPA Task Groups

- Authorized by 3.1.3.4 of Regulations Governing the Development of NFPA Standards
- Permitted for CCs & TCs
- Appointed and discharged by Committee Chair
- Members not required to be TC members
- Membership is not required to be balanced
- Guests are permitted and can participate in discussion
- TG chair controls the meeting and workflow
- Voting is simple majority of the appointed TG members in attendance at meeting
- No “standing” TGs

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Introduction

- Task Groups (TGs) are an essential element in the completion of your technical committee work.
- TGs will be appointed by the TC Chair to identify the public inputs that will be used as the basis of any revision
- TGs may also recommend a revision that is independent of any public input.
- Task Group Reports due at least two weeks prior to the first day of the Technical Committee Meeting
  - Circulate to whole TC
  - Editorial review

Task Group Considerations for 2nd Draft

New Material

- All Second Revisions (SR) must be related to a Public Input (PI), Committee Input (CI), or First Revision (FR) in the First Draft Report
- “New material” at the Comment Stage could be challenged at the Technical Session or through appeal to the NFPA Standards Council

Time Frame for 921 Guideline

General time frames for the NFPA 921 (www.nfpa.org/921next)

- First Draft issued October 4, 2022

- Pre-Second Draft Meeting: October 28, 2022
- Additional Pre-Second Draft Meetings (Virtual as necessary)

- Public Closing date: January 4, 2023

- Virtual Pre-Second Draft Meetings (Virtual as necessary)

- Second Draft Meeting: Week of May 8th, 2023

- Second Draft Report Posting Date: October 4, 2023

- NITMAM Closing Date: November 1, 2023
- NITMAM Posting Date: December 13, 2023

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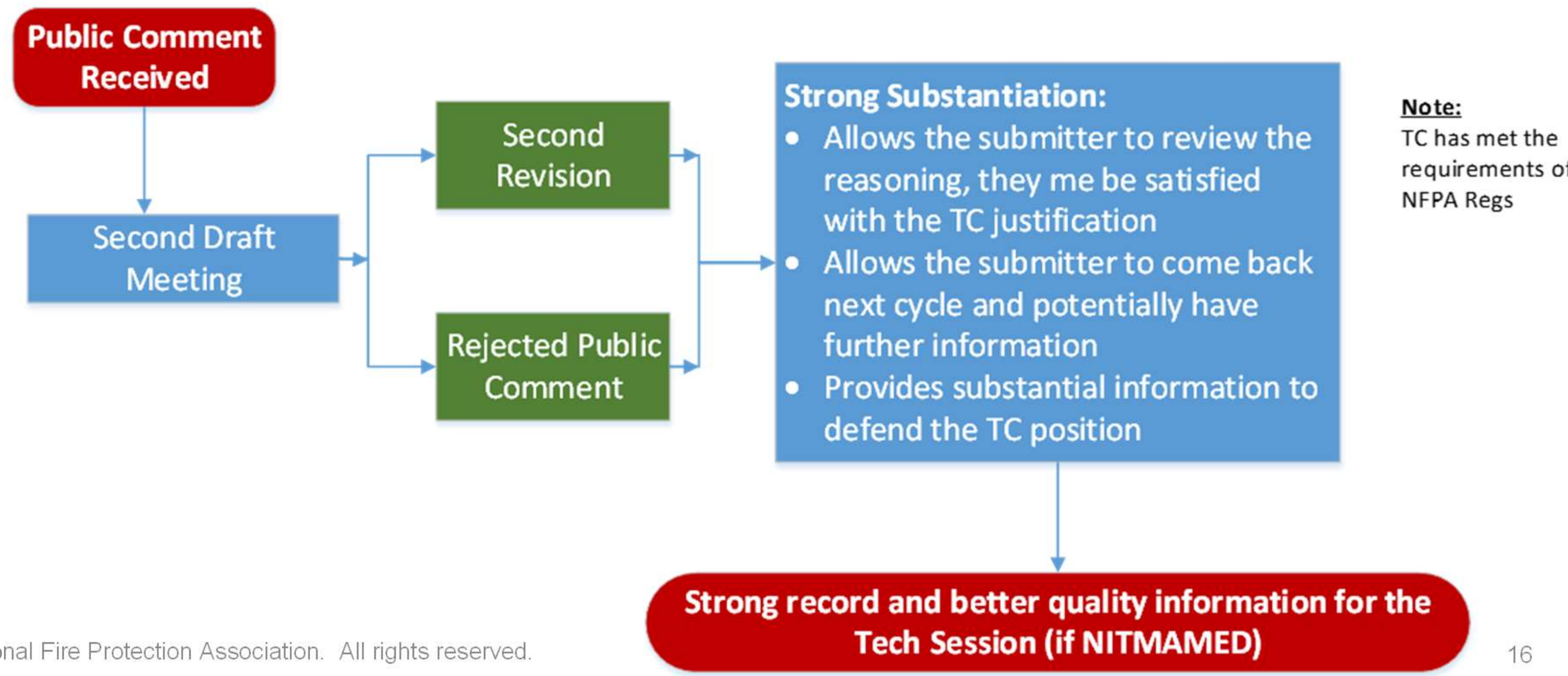
Task Group Actions Prior to PC Closing Date

- TGs can submit public comments (PCs) prior to the January 4th closing date
- Public Comments should not address new material.
- Public Comments should refine, correct or add to a previous first revision to enhanced the NFPA 921 guideline for the stakeholder.
- As with any public comment, a substantiation for the change should be based on technical or scientific reasoning, facts or data. The substantiation should not indicate it as the work product of the technical committee, the technical committee will make that determination, if and when, a second revision is created with an appropriate substantiation.

Comment Stage

Public Comment (PC) – Second Draft Meeting – Second Revision (FR) or Rejected PC



Second Draft Meeting Actions

- TGs propose recommendations for Second Revisions (SRs)
  - SRs are created by the TG for each change they wish to make to the document.
    - Create a Second Revision (SR) with related PCs
    - Create a SR with no related PC, but on a section previously addressed with an FR.
  - TC statements are the TG's substantiation to the revision
    - TC statements cannot simply refer to the PC substantiation. However, the PC substantiation may be used as the basis of the TC statement, as long as the TC ensures that the final statement is the position of the TC.
- TC must act upon all PCs (provide a response/committee statement)
- All meeting actions require a favorable vote of a simple majority of the members present.

Regulations

- **4.4.8.2 Committee Statements on Comments.** The TC shall develop a Committee Statement for all its Actions on Comments. Committee Statements supporting Committee Actions shall preferably be technical in nature and shall be sufficiently detailed so as to convey the Committee's rationale for its Action. Committee Statements may consist, in whole or in part, of a cross-reference to Committee Statements on other Comments and Second Revisions.

In front of the NFPA Membership (Tech Session)

- So what does that technically strong substantiation do in front of the NFPA Membership?
  - Provides complete historical record
  - Reflects the technical consideration of the TC
  - Shows consideration of industry viewpoints
  - Gives support to the Chair and defends the TC position
  - Shows guidance was given to the submitters
- If you go up to the microphone, supports your opinion
- Remember, this could be 12 months later

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NITMAMs

The submitter of a PI that did not result in a first revision must submit a public comment in order to proceed with filing a NITMAM.

If no PC is submitted, the PI is considered "resolved" and is not open for NITMAM submittal.

Table 1 found in the Regulations Governing the Development of NFPA Standards gives additional guidance on the permitted amending motions and who is authorized to submit them.

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NITMAM/Tech Session

- We (TC) plan on documents going to Tech Session
- If you don't get a NITMAM, you finish early (consent)
- The tech session doesn't delay issuance
- It prevents you from finishing early
- NITMAM period is a part of our process
- Many committees don't experience it (No NITMAMs)
- NITMAMs must be certified to go to Tech Session (CAMS)

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Appealed before the Standards Council

1.6 Appeals to the Standards Council.

1.6.1 General. Anyone can appeal to the Standards Council concerning **procedural** or substantive matters related to the development, content, or issuance of any NFPA Standard of the NFPA or on matters within the purview of the authority of the Standards Council, as established by the Bylaws and as determined by the Board of Directors. Such appeals shall be in written form and filed with the Standards Council Secretary in accordance with 1.6.3.

What is the Standards Council looking at?

- Everything, the complete record
- Has the TC met its obligations in accordance with NFPA Regs?
- How can we show that?
- A technically strong substantiation that shows:
  - The complete historical record
  - The technical consideration of the TC
  - Consideration of industry viewpoints
  - Gives support to the Chair and defends the TC position
  - Shows guidance was given to the submitters

 |

Assigning Task Groups

- Task Groups are essential to ensuring a successful SD meeting
- TGs are appointed so that the members can begin to develop actions based on Public Comments
- TG recommendations should reflect the interests of the full task group
- TG Chairs should encourage a balance of opposing views, making sure that both sides have the opportunity to participate in the deliberations to bring forward the best recommendations to the TC
- If TG recommendations are heavily influenced by one interest, they will most likely fail to receive full technical committee support and the task group will need to start from scratch

Assigning Task Groups (con't)

- Participation of guests is encouraged and welcomed. The TG chair needs to be prepared to manage guest participation
- The appointed TG members will determine the recommendation to present to the full committee
- TG's should include at least one TC member with previous experience in NFPA's standards development process
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- The technical committee chair will send out TG rosters to all members. Rosters should be revised and redistributed as necessary by TC chair.
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TG Work Process

- Task Groups will be asked to record their recommendations in a Word copy of their assigned Chapter(s) or Section(s) of the standard
  - No copy & paste from PDF files
  - Automatically generated markup from the existing text

What You Will Receive

TG Chairs will receive three files:

- PDF with the complete PCs including any attachments with recommended text or additional substantiation* (available at www.nfpa.org/921next)
- Excel list of all PCs (including globals) assigned to Task Group*

(*When PCs are available)

- Word document of NFPA 921 text that the Task Group will be working with that contains the Template for Task Groups to record recommended TC actions

Public Input No. 243-NFPA 921-2021 [Section No. 4.1]

4.1* Nature of Fire Investigations.

A fire or explosion investigation is a complex endeavor involving skill, technology, knowledge, and science. The compilation of factual data, as well as an analysis of those facts, and expressing opinions or conclusions in reports or testimony, should be accomplished objectively, truthfully, and without expectation bias, preconception, or prejudice. The basic methodology of the fire investigation should rely on the use of a systematic approach and attention to all relevant details. The use of a systematic approach often will uncover new factual data for analysis, which may require previous conclusions to be reevaluated. With few exceptions, the proper methodology for a fire or explosion investigation is to first determine and establish the origin(s), then investigate the cause: circumstances, conditions, or agencies that brought the ignition source, fuel, and oxidant together.

Statement of Problem and Substantiation for Public Input

This public input is submitted on behalf of the Certainty of Opinion Task Group of the Technical Committee on Fire Investigations responsible for NFPA 921.

Substantiation for proposed revision: It is not only the data collection and analysis aspects of a fire investigator's duties that should be "accomplished objectively, truthfully, and without expectation bias, preconception, or prejudice." The tasks of reporting and testimony should also meet these criteria. Therefore, we have revised s. 4.1 to reflect this.

Technical Committee	Fire Investigations (FIA-AAA)
Task Group	Certainty of Opinion TG
TG Chair	T.D. Hewitt
TG Members	Rusty Horton, Quentin Baker, Dan Gottuk, Kathryn Smith, Michael Cabral, Andrew Cox, Mike Rushton, Stephen Rinaldi, Wayne McKenna, Robert K. Toth, Mark Sauls, Chris Woodall, Tommy Sing Sr., Karrie Clinkinbeard, Jerry King, Randy Watson, Ed St. Onge Jr., Megan Ochs

Section	PI	Task Group Recommendation	TG Tag	Task Group Statement	FR/CI (Staff use only)
				Revisions based on public inputs	
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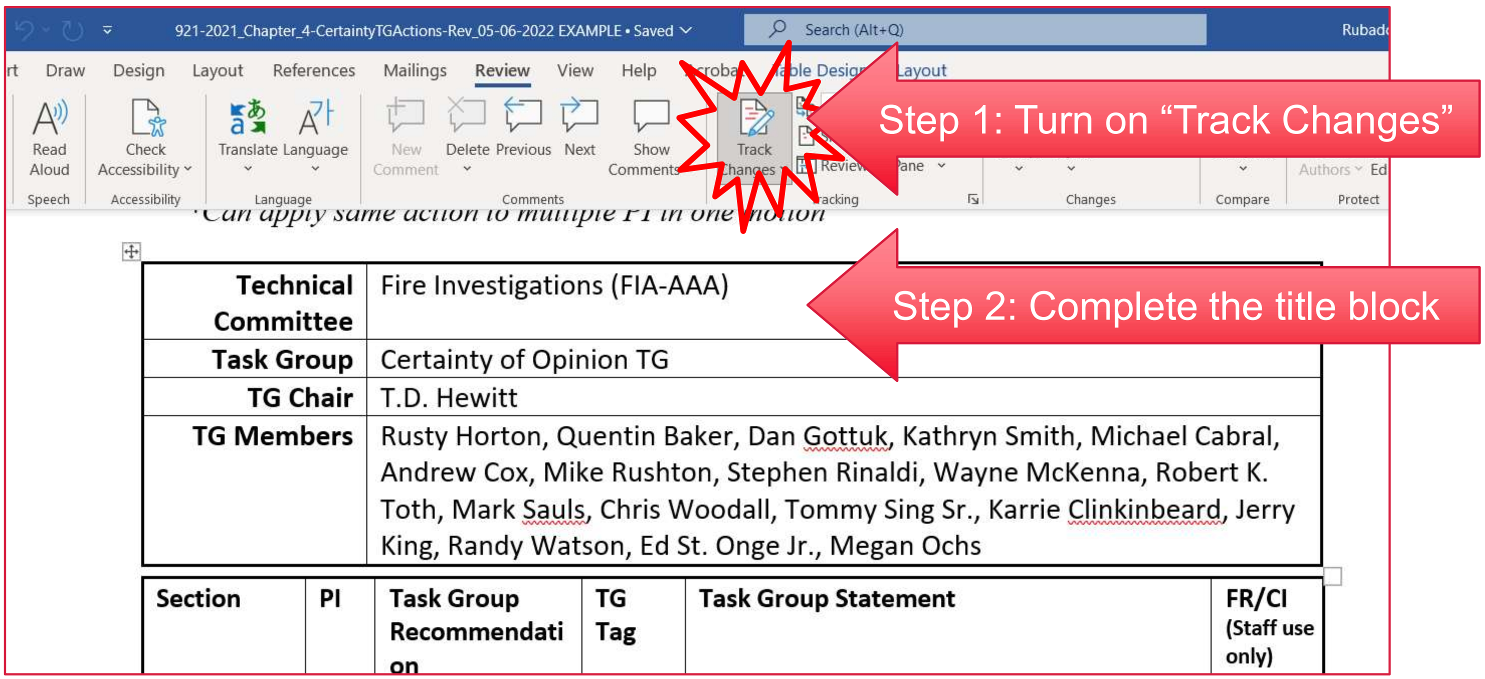

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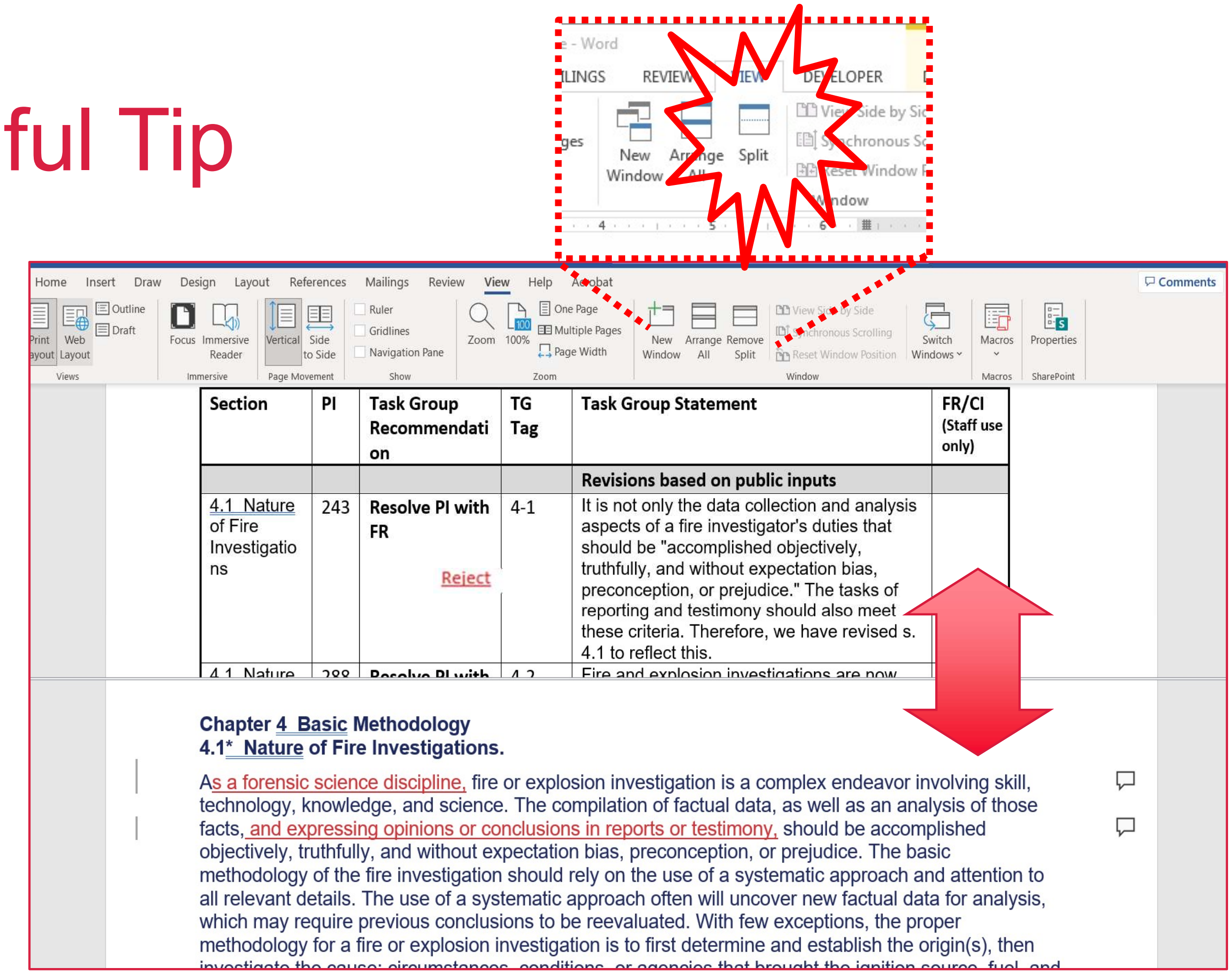

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- Jshanley@Travelers.com
- rfash@nfpa.org
- eliolin@nfpa.org

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TC chair must ensure that TGs complete their work prior to the start of the full technical committee meeting

 |

NATIONAL FIRE PROTECTION ASSOCIATION

The leading information and knowledge resource on fire, electrical and related hazards

DATE: May 17, 2023

TO: Technical Committee on Fire Investigations (FIA-AAA)

FROM: Robert Fash, *Staff Liaison*
rfash@nfpa.org (617) 984-7637

SUBJECT: NFPA 921, First Draft Meeting MINUTES

Virtual, Feb 15 (12pm-2pm) - Feb 16 (11am-1pm), 2023, Microsoft Teams

---

February 15, 2023

Call to Order

I. The Chair called the meeting to order at 1200 Eastern.
II. Members and guests introduced themselves. Attendance is recorded in Table 1.
III. Introductory remarks by the chair Jim Shanley
IV. The NFPA staff liaison reviewed the meeting rules.
V. Overview of the task group review process for Public Comments (PC). (see attached)
VI. Task Groups assigned by chapter.

Meeting adjourned 1723 hrs. EST.

February 16, 2023

Call to Order

I. The Chair called the meeting to order at 1100 Eastern.
II. Members and guests introduced themselves. Attendance is recorded in Table 1.
III. Introductory remarks by the chair Jim Shanley
IV. The NFPA staff liaison reviewed the meeting rules.
V. Overview of the task group review process for Public Comments (PC). (see attached)

Table 1 Meeting Attendance.

	Name	Employer/Organization Represented	Int Cat	Feb 15	Feb 16
Chair	James Shanley	Travelers Insurance Company	I	Y	Y
Secretary	Christopher Wood	FireLink, LLC	SE		Y

	Name	Employer/Organization Represented	Int Cat	Feb 15	Feb 16
Principals	Vytenis “Vyto” Babrauskas	Fire Science and Technology In	SE	Y	
	Quentin A. Baker	Baker Engineering & Risk Consultants, Inc.	SE		
	Michael Beasley	London Fire Brigade	E	Y	
	Michael Joseph Cabral	Riverside County District Attorney	C	Y	
	Steve Campolo	Leviton Manufacturing Company, Inc. *Rep. NEMA*	M		
	Karrie Clinkinbeard	Armstrong Teasdale Llp	C		Y
	Andrew T. Cox	US Bureau of Alcohol, Tobacco, Firearms & Explosives	E		Y
	Richard A. Dyer	Dyer Fire Consulting *Rep. International Association of Fire Chiefs*	U		
	James Engel	National Wildfire Coordinating Group (NWCG) *Rep. National Wildfire Coordinating Group*	E		
	Daniel T. Gottuk	Gottuk Engineering	SE	Y	
	Mark S. Grotefeld	Grotefeld Hoffmann	C	Y	
	Terry-Dawn Hewitt	McKenna Hewitt	C		
	Thomas W. Horton, Jr.	South Carolina Farm Bureau Insurance Company	I		Y
	Robin Jason	General Motors *Rep. Society of Automotive Engineers*	M	Y	
	Richard W. Jones, Jr.	Forensic Investigations Group, LLC	SE	Y	Y
	Jason Karasinski	Fire Research Technology, LLC	SE		
	Daniel Madrzykowski	UL Firefighter Safety Research Institute *Rep. UL LLC*	R/T		Y
	Peter Mansi	Fire Investigations UK, LLP	U	Y	
	Mary Ann Maurath	City Of Huber Heights	U	Y	
	Kevin Oliver	USFA/NFA	SE	Y	
	Thomas Ost-Prisco	Pennsylvania Office of Attorney General	C		
	Brian Peterman	State Of Ohio Fire Marshal	E	Y	
	Jason Poore	Tennessee Bureau of Investigation	E	Y	
	Anthony D. Putorti, Jr.	National Institute of Standards & Technology (NIST)	R/T	Y	
	Stephen Rinaldi	Chelan County- Fire Prevention & Investigation	E	Y	
	Michael Rindt	Acuity Mutual Insurance	I	Y	
	Mike Rushton	Office of Ontario Fire Marshal	E		Y
	Mark E. Sauls	Florida Division of State Fire Marshal (Retired) *Rep. International Fire Marshals Association*	U		Y
	Joseph J. Sesniak	Forensic Fire Consultants, Ltd. *Rep. International Association of Arson Investigators (IAAI)*	U	Y	
	Thomas B. Sing, Sr.	Quest Fire Analysis	SE		
	Kathryn C. Smith	National Association of Fire Investigators *Rep. National Association of Fire Investigators*	U	Y	
	Philip C. Smith	The Boeing Company	M		Y
	Charles “Randy” Watson	S-E-A, Ltd.	SE		
	Russell M. Whitney	Salt Lake City Fire Department	E		

	Name	Employer/Organization Represented	Int Cat	Feb 15	Feb 16
Voting Alternates	Douglas Nelson	North Dakota SFM Office *Rep. National Association of State Fire Marshals*	E	Y	
Alternate	Robert D. Banta Alt. to Robin Jason	Banta Technical Services LLC *Rep. Society of Automotive Engineers*	I		
	Randall E. Bills *Alt. to Charles "Randy" Watson*	SEA, Ltd.	SE	Y	
	Philip E. Crombie, Jr. *Alt. to James H. Shanley, Jr.*	Travelers Insurance Company	I	Y	
	Scott G. Davis *Alt. to Vytenis "Vyto" Babrauskas*	GexCon US	SE		Y
	Jamie Ferrino-McAllister *Alt. to Peter Mansi*	FireTox, LLC	SE		Y
	Brian Henry *Alt. to Kathryn C. Smith*	Rolfes Henry Co. LPA *Rep. National Association of Fire Investigators*	U		Y
	Derek J. Hill *Alt. to Andrew T. Cox*	US Bureau of Alcohol, Tobacco, Firearms & Explosives	E	Y	
	Bradley J Horn *Alt. to Quentin A. Baker*	Baker Engineering & Risk Consultants, Inc.	SE		
	Christel K. Hunter *Alt. to Steve Campolo*	Cerro Wire *Rep. National Electrical Manufacturers Association*	M		
	Laura Jacobsen *Alt. to Philip C. Smith*	*The Boeing Company*	M		
	James Kanavy *Alt to Stephen Rinaldi*	Scott County Fire Department	E		
	Stephen Kerber *Alt. to Daniel Madrzykowski*	UL LLC *Rep. UL LLC*	R/T		
	Wayne J. McKenna *Alt. to Terry-Dawn Hewitt*	McKenna Hewitt	C		
	Matthew P Miller *Alt. to Russell M. Whitney*	Roswell Fire Department	E		
	Joel A. Moore *Alt. to Thomas W. Horton, Jr.*	Texas Farm Bureau Insurance	I		
	Rodney J. Pevytoe *Alt. to Joseph J. Sesniak*	Kubitz and Associates *Rep. International Association of Arson Investigators, Inc.*	U		

	Name	Employer/Organization Represented	Int Cat	Feb 15	Feb 16
	David W. Powell *Alt. to Jason Karasinski*	SYTEK Consultants	SE	Y	
	Willard F. Preston, III *Alt. to Mark E. Sauls*	Goldfein & Joseph, PC *Rep. International Fire Marshals Association*	U		
	Laura Joy Ridenour *Alt. to Richard A. Dyer*	Dearborn Fire Department *Rep. International Association of Fire Chiefs*	U	Y	
	Thomas M. Sing, Jr. *Alt. to Thomas B. Sing, Sr.*	Quest Fire Analysis	SE		
	Robert Toth *Alt. to Richard W. Jones, Jr.*	IRIS Fire Investigations, Inc.	SE	Y	
	Tyler Wendt *Alt to Dan Gottuk*	Jensen Hughes			
	Chad Wissinger *Alt. to Brian Peterman*	Ohio Division of State Fire Marshal Forensic Lab	E		
Staff Liaison	Robert Fash	National Fire Protection Association	-	Y	Y
Guests	Christopher Brown	NIST	-	Y	

NFPA Task Group Work Process for Second Draft

[NFPA 921]

February 15-16, 2023

Bob Fash, Specialist

NFPA LiNK™

Technical Committee Meetings

Members and Guests

- Use of audio recorders or other means capable of reproducing verbatim transcriptions of this meeting are not permitted

Technical Committee Meeting

Members

- Please verify/update your contact information on your NFPA profile
- Members categorized in any interest category who have been retained to represent the interests of ANOTHER interest category (with respect to issues addressed by the TC) shall declare those interests to the committee and refrain from voting on those issues throughout the process
- All Principals are encouraged to have an Alternate

Technical Committee Meetings

Guests

- All guests are required to sign in and identify their professional affiliations
- Participation is limited to TC members or those individuals who have previously requested time to address the committee
- Participation by other guests may be permitted at the Chair's discretion

 |

Technical Committee Meetings

Legal and Ethical Issues

- Manner in which standards development activity is conducted can be important
- NFPA's standards development activities are based on openness, honesty, fairness, and balance
- Be sure to ask questions if you have them

Technical Committee Meetings

Legal and Ethical Issues

- Participants must adhere to the Regulations Governing the Development of NFPA Standards
- Participants must adhere to the Guide for the Conduct of Participants in the NFPA Standards Development Process
- Read and understand NFPA's Antitrust Policy
- Read and understand NFPA's Patent Policy
- www.nfpa.org/regs

 |

Technical Committee Meetings

Antitrust Guidance

- Participants are to conduct themselves in strict accordance with state and federal antitrust laws
- Additionally, follow guidance and direction from your employer or other organization you may represent

Technical Committee Meetings

Antitrust Behavior

- Participants must avoid any conduct, conversation, or agreement that would constitute an unreasonable restraint of trade
- Conversation topics that are off limits include:
  - Profit, margin, or cost data
  - Prices, rates, or fees
  - Selection, division or allocation of sales territories, markets or customers
  - Refusal to deal with a specific business entity

Technical Committee Meetings

Patents

- Disclosures of essential patent claims should be made by the patent holder, early in the process
- Others may also notify NFPA if they believe that a proposed or existing NFPA standard includes an essential patent claim

 |

Technical Committee Meetings

Personal Opinions

- Participants are not entitled to speak on behalf of NFPA
- Participants must take appropriate steps to ensure their statements whether written or oral and regardless of the setting, are portrayed as personal opinions, not the position of NFPA

NFPA Task Groups

- Authorized by 3.1.3.4 of Regulations Governing the Development of NFPA Standards
- Permitted for CCs & TCs
- Appointed and discharged by Committee Chair
- Members not required to be TC members
- Membership is not required to be balanced
- Guests are permitted and can participate in discussion
- TG chair controls the meeting and workflow
- Voting is simple majority of the appointed TG members in attendance at meeting
- No “standing” TGs

Introduction

- Task Groups (TGs) are an essential element in the completion of your technical committee work.
- TGs will be appointed by the TC Chair to identify the public inputs that will be used as the basis of any revision
- TGs may also recommend a revision that is independent of any public input.
- Task Group Reports due at least two weeks prior to the first day of the Technical Committee Meeting
    - Circulate to whole TC
    - Editorial review

Task Group Considerations for 2nd Draft

New Material

- All Second Revisions (SR) must be related to a Public Input (PI), Committee Input (CI), or First Revision (FR) in the First Draft Report
- “New material” at the Comment Stage could be challenged at the Technical Session or through appeal to the NFPA Standards Council

Time Frame for 921 Guideline

General time frames for the NFPA 921 (www.nfpa.org/921next)

- First Draft issued October 4, 2022
- Pre-Second Draft Meeting: October 28, 2022

- Public Closing date: January 4, 2023

- Virtual Pre-Second Draft Meetings (Virtual as necessary)
- Submittal deadline for Task Groups: May 1st, 2023

- Second Draft Meeting: May 24th & 25th, 2023

- Second Draft Report Posting Date: October 4, 2023
- NITMAM Closing Date: November 1, 2023
- NITMAM Posting Date: December 13, 2023

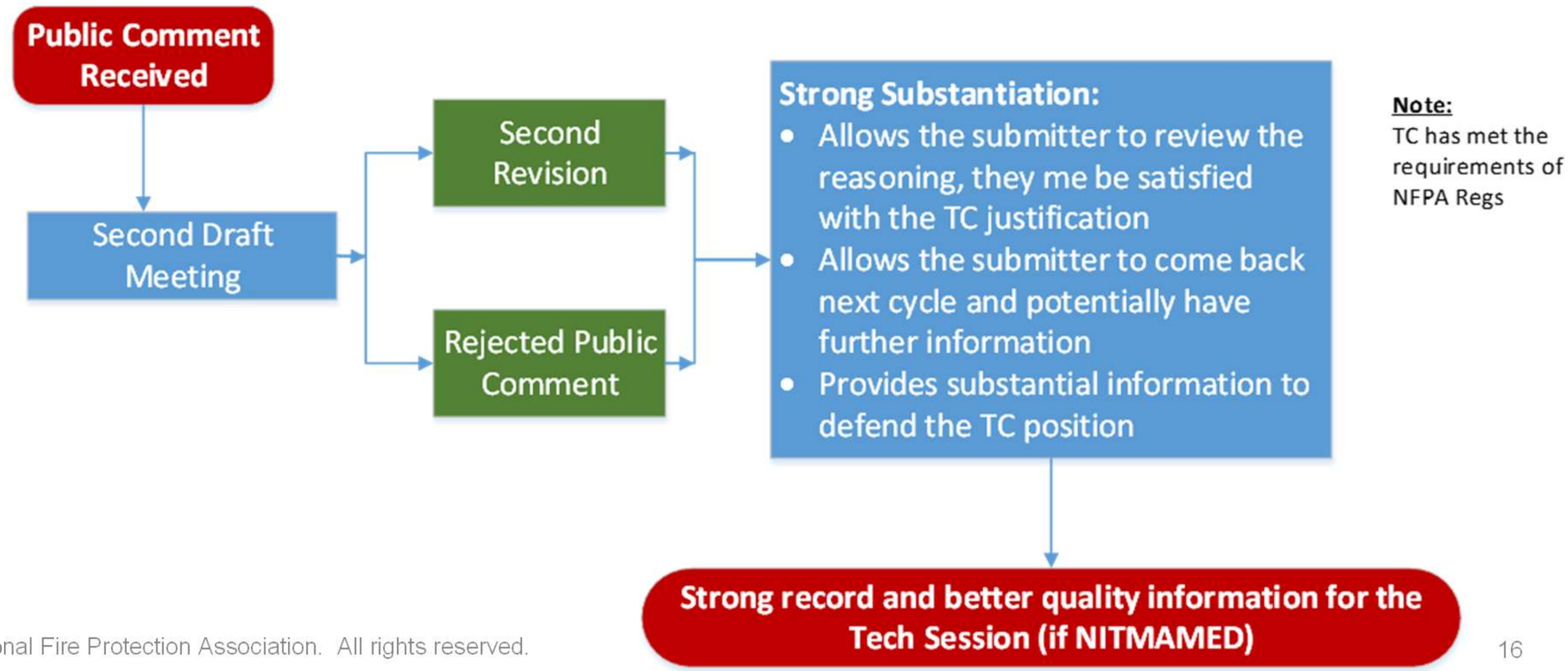
 |

Task Group Actions Prior to PC Closing Date

- TGs can submit public comments (PCs) prior to the January 4th closing date
- Public Comments should not address new material.
- Public Comments should refine, correct or add to a previous first revision to enhanced the NFPA 921 guideline for the stakeholder.
- As with any public comment, a substantiation for the change should be based on technical or scientific reasoning, facts or data. The substantiation should not indicate it as the work product of the technical committee, the technical committee will make that determination, if and when, a second revision is created with an appropriate substantiation.

Comment Stage

Public Comment (PC) – Second Draft Meeting – Second Revision (FR) or Rejected PC



Second Draft Meeting Actions

- TGs propose recommendations for Second Revisions (SRs)
  - SRs are created by the TG for each change they wish to make to the document.
    - Create a Second Revision (SR) with related PCs
    - Create a SR with no related PC, but on a section previously addressed with an FR.
  - TC statements are the TG's substantiation to the revision
    - TC statements cannot simply refer to the PC substantiation. However, the PC substantiation may be used as the basis of the TC statement, as long as the TC ensures that the final statement is the position of the TC.
- TC must act upon all PCs (provide a response/committee statement)
- All meeting actions require a favorable vote of a simple majority of the members present.

 |

Regulations

- **4.4.8.2 Committee Statements on Comments.** The TC shall develop a Committee Statement for all its Actions on Comments. Committee Statements supporting Committee Actions shall preferably be technical in nature and shall be sufficiently detailed so as to convey the Committee's rationale for its Action. Committee Statements may consist, in whole or in part, of a cross-reference to Committee Statements on other Comments and Second Revisions.

In front of the NFPA Membership (Tech Session)

- So what does that technically strong substantiation do in front of the NFPA Membership?
  - Provides complete historical record
  - Reflects the technical consideration of the TC
  - Shows consideration of industry viewpoints
  - Gives support to the Chair and defends the TC position
  - Shows guidance was given to the submitters
- If you go up to the microphone, supports your opinion
- Remember, this could be 12 months later

 |

NITMAMs

The submitter of a PI that did not result in a first revision must submit a public comment in order to proceed with filing a NITMAM.

If no PC is submitted, the PI is considered “resolved” and is not open for NITMAM submittal.

Table 1 found in the Regulations Governing the Development of NFPA Standards gives additional guidance on the permitted amending motions and who is authorized to submit them.

 |

NITMAM/Tech Session

- We (TC) plan on documents going to Tech Session
- If you don’t get a NITMAM, you finish early (consent)
- The tech session doesn't delay issuance
- It prevents you from finishing early
- NITMAM period is a part of our process
- Many committees don’t experience it (No NITMAMs)
- NITMAMs must be certified to go to Tech Session (CAMS)

Appealed before the Standards Council

1.6 Appeals to the Standards Council.

1.6.1 General. Anyone can appeal to the Standards Council concerning **procedural** or substantive matters related to the development, content, or issuance of any NFPA Standard of the NFPA or on matters within the purview of the authority of the Standards Council, as established by the Bylaws and as determined by the Board of Directors. Such appeals shall be in written form and filed with the Standards Council Secretary in accordance with 1.6.3.

What is the Standards Council looking at?

- Everything, the complete record
- Has the TC met its obligations in accordance with NFPA Regs?
- How can we show that?
- A technically strong substantiation that shows:
  - The complete historical record
  - The technical consideration of the TC
  - Consideration of industry viewpoints
  - Gives support to the Chair and defends the TC position
  - Shows guidance was given to the submitters

Assigning Task Groups

- Task Groups are essential to ensuring a successful SD meeting
- TGs are appointed so that the members can begin to develop actions based on Public Comments
- TG recommendations should reflect the interests of the full task group
- TG Chairs should encourage a balance of opposing views, making sure that both sides have the opportunity to participate in the deliberations to bring forward the best recommendations to the TC
- If TG recommendations are heavily influenced by one interest, they will most likely fail to receive full technical committee support and the task group will need to start from scratch

Assigning Task Groups (con’t)

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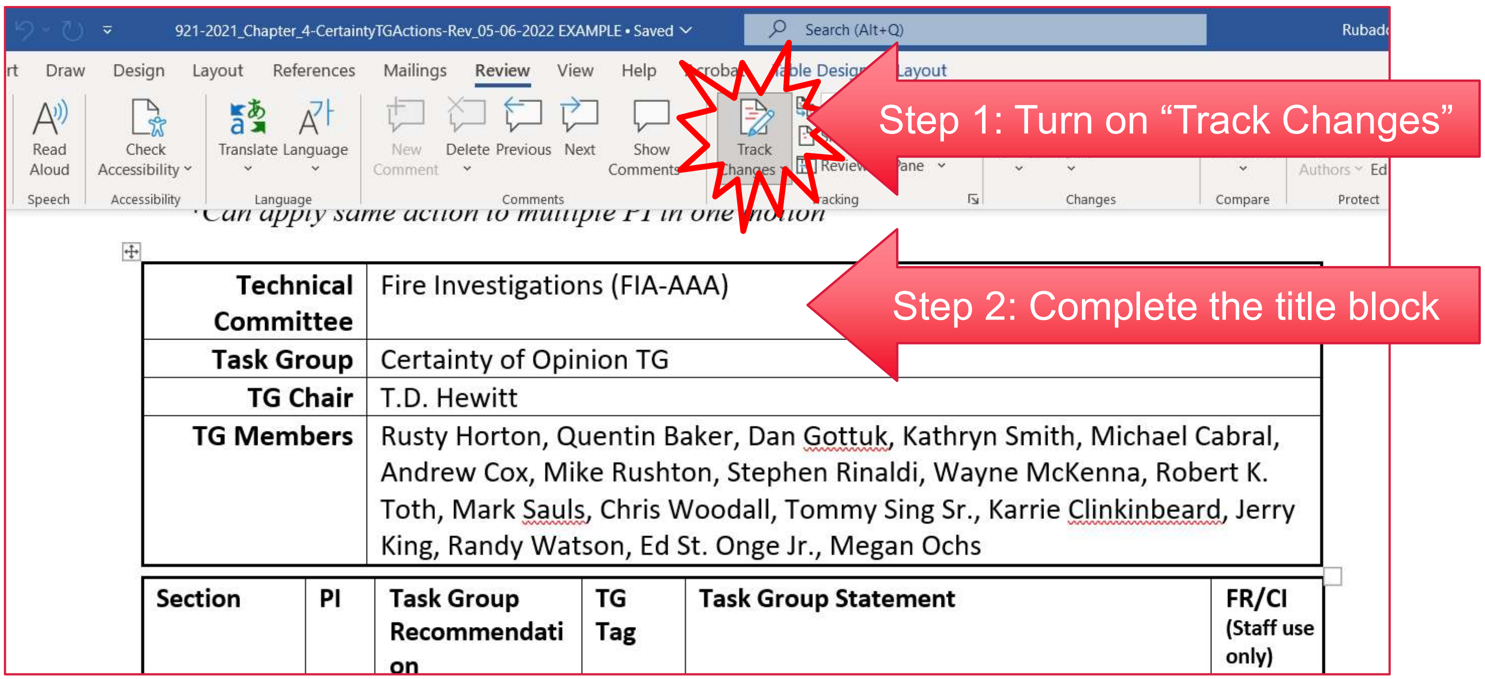

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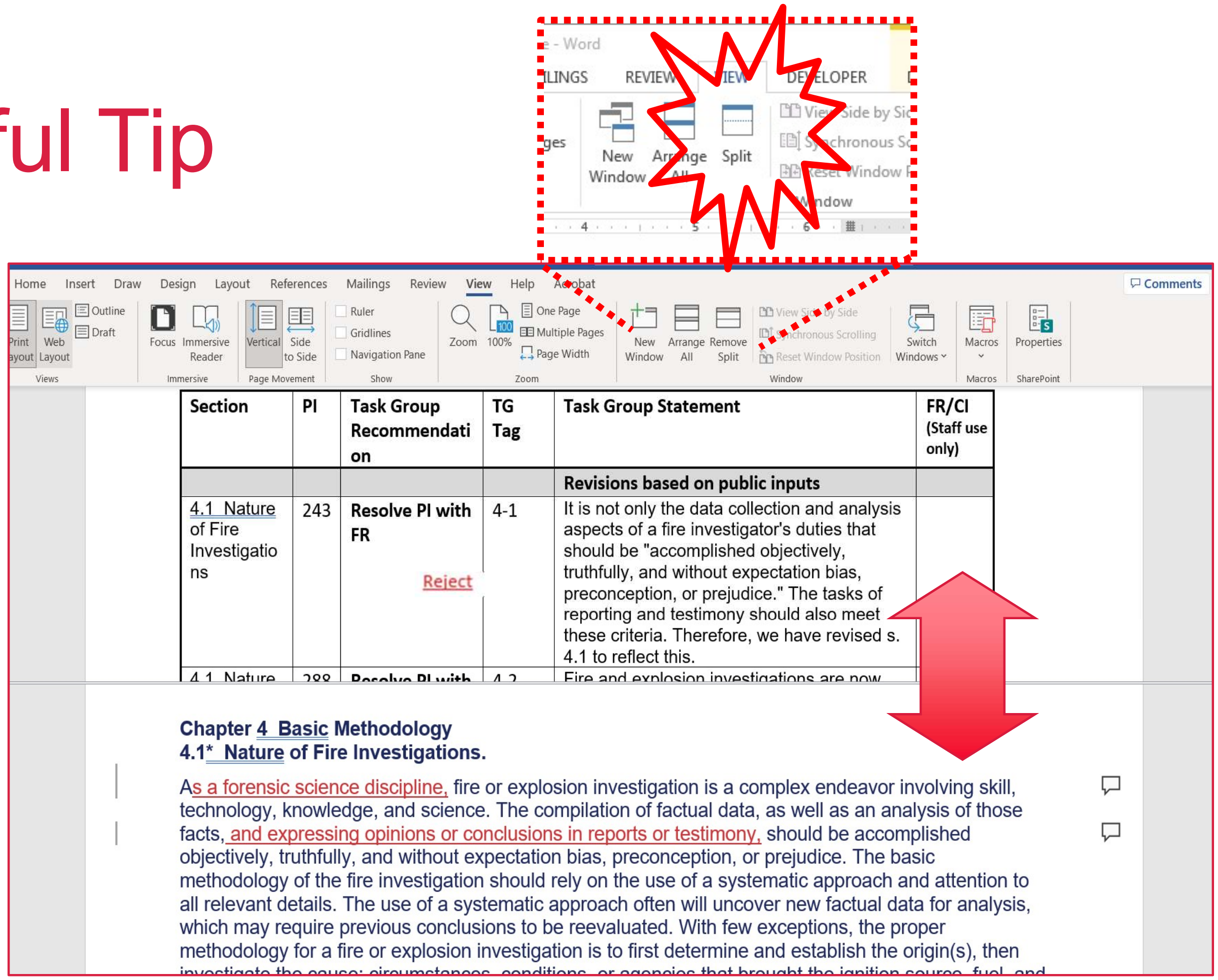

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TC chair must ensure that TGs complete their work prior to the start of the full technical committee meeting

 |

Public Comment No. 10-NFPA 921-2022 [Global Input]

NFPA 921 (Guidel) Section 12, Legal Considerations is not reflective of Canadian Law. It would be beneficial to have some reflection of both the Charter of Rights and Freedoms and the Canadian Criminal Code. As well as how spoliation laws differ from those in the United States.

This may be best dealt with by dealing with the Candadian Council of Fire Marshal's and Fire Commissioners that would develop a somewhat reflective edition of NFPA 921 that cold be utilized in Canada. The vast majority of 921 would apply but I believe we need some Canadian Content....maybe that's best dealt with in the Appendix format, and would include references to each Province and how those laws differ. But the heirarchy of law must remain and that federal law supersedes provincial law. Particularly when it comes to the Charter.

Statement of Problem and Substantiation for Public Comment

NFPA 921 should have Canadian Content and may best be served by an Appendix approach? Each province has somewhat differing laws that should be reflected.

Related Item

- Canadian Criminal Code and Charter of Rights and Freedoms

Submitter Information Verification

Submitter Full Name:	Mark Nowlan
Organization:	Office of the Fire Marshal
Affiliation:	Office of the Fire Marshal, Province of New Brunswick
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Nov 09 12:31:10 EST 2022
Committee:	FIA-AAA

Public Comment No. 25-NFPA 921-2022 [Global Input]

Due to the rewrite of Chapter 13, I believe it is important to add the following reference to Section 2.3.8 and renumber subsequent references

Add: 2.3.8 International Association of Arson Investigators. Inc

IAAI Health and Safety Committee, 16901 Melford Boulevard, Suite 101, Bowie, MD 20715

Fire Investigator Health and Safety Best Practices, 2022

Link added below has bee added for administrative purposes of the committee to review the document.

https://www.firearson.com/Publications-Resources/Fire-Investigation-Resources/Health-Safety.aspx

Statement of Problem and Substantiation for Public Comment

The rewrite of Chapter 13, should include a new reference to Chapter 2 Section 2.3.8 with current references 2.3.8 sequentially references renumber accordly.
ADD:
2.3.8 International Association of Arson Investigators Inc.
IAAI Heath and Safety Committee, 16901 Melford Boulevard, Suite 101, MD 20715
Fire Investigator Health and Safety Best Practices, Third Edition 2022

Related Item

- Public Comment

Submitter Information Verification

Submitter Full Name: James Caton
Organization: Donan Fire Investigation
Street Address:
City:
State:
Zip:
Submittal Date: Fri Dec 02 11:20:25 EST 2022
Committee: FIA-AAA

Public Comment No. 1-NFPA 921-2022 [Section No. 2.3.6]

2.3.6 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D56, *Standard Test Method for Flash Point by Tag Closed Tester*, Revision 21A.

ASTM D86, *Standard Test Method for Distillation of Petroleum*, Revision 21B.

ASTM D92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*, 2018.

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ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, ~~2021a~~ 2022 .

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ASTM E119, *Standard Methods for Fire Tests of Building Construction and Materials*, ~~2020A~~ 2022 .

ASTM E582, *Standard Test Method for Minimum Ignition Energy and Quenching Distance in Gaseous Mixtures*, 2021.

ASTM E603, *Standard Guide for Room Fire Experiments*, 2017.

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ASTM E659, *Standard Test Method for Autoignition Temperature of Liquid Chemicals*, 2015.

ASTM E678, *Standard Practice for Evaluation of Scientific or Technical Data*, 2007 (2013).

ASTM E681, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gasses)*, 2009 (2015).

ASTM E800, *Standard Guide for Measurement of Gases Present or Generated During Fires*, 2020.

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ASTM E906/E906M, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using a Thermopile Method*, ~~2017~~ 2021 .

ASTM E1188, *Standard Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator*, 2011 (2017).

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ASTM E1355, *Standard Guide for Evaluating the Predictive Capability of Deterministic Fire Models*, 2012 (2018).

ASTM E1459, *Standard Guide for Physical Evidence Labeling and Related Documentation*, 2013 (2018).

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ASTM E1618, *Standard Test Method for Ignitible Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography–Mass Spectrometry*, 2014.

ASTM E2019, *Standard Test Method for Minimum Ignition Energy of a Dust Cloud in Air*, 2003 (2019).

ASTM E2021, *Standard Test Method for Hot-Surface Ignition Temperature of Dust Layers*, 2015.

ASTM E2067, *Standard Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests*, 2020.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, ~~2017~~ 2022 .

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Statement of Problem and Substantiation for Public Comment

date updates

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 2-NFPA 921-2022 [Section No. C.1.2.2]	
Public Comment No. 43-NFPA 921-2022 [Section No. A.3.3.139]	

Related Item

- fr149

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Public Comment No. 26-NFPA 921-2022 [Section No. 3.3.4]

3.3.4 Active Fire Protection System.

A system that uses moving mechanical or electrical parts to achieve a fire protection goal. [**3,** 2021]

3.3.4 Active Fire Protection System

A system that uses moving mechanical or electrical parts to perform an action to achieve a fire protection goal. These include fire detection, fire alarm, and fire suppression systems.

Statement of Problem and Substantiation for Public Comment

Incorporate the definition with Annex 8.1 for a clear definition and example, eliminating A.8.1

Related Item

- Public Input

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Public Comment No. 119-NFPA 921-2023 [Section No. 3.3.16]

3.3.16 Arson.

~~The~~ Generally, the crime of maliciously and intentionally, or recklessly, starting a fire or causing an explosion. Note, however, that the definition of the crime of arson varies by jurisdiction.

Statement of Problem and Substantiation for Public Comment

will help legal actors

Related Item

- raised previously

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Public Comment No. 30-NFPA 921-2022 [Section No. 3.3.57]

3.3.57 Energy.

~~A property of matter manifested as an~~
Available energy is the ability to

~~perform work, either by moving an object against a force or by transferring heat.~~
do work. This is the simplest possible not-inaccurate statement about energy. See section 5.1.2 for a better understanding of energy, and work. Generally, when one sees a physical manifestation of energy, like a hot object or light or feels the warmth of the sun , or a heavy object suspended at height, or movement in machinery or sees the wood in a fireplace burning, one easily recognizes it has some sort of potential, or ability. The concept of energy that is separate from, and that indeed unites all observable physical manifestations of energy, this concept, is more elusive. More explanation is needed to bridge between what we can see, and a not-inaccurate understanding of the concept of energy.

Statement of Problem and Substantiation for Public Comment

It is a fallacy that energy is exclusively a property of matter, and it prevents one from understanding the true nature of energy as a concept, which is the proper understanding for energy conversions and doing energy calculations or estimates. I have seen investigators make hypotheses that were orders of magnitude-sized errors in energy, and they did not catch these errors by simple estimation, did not eliminate the hypothesis, and as a result reach a non-physical conclusions. Investigators require a greater understanding of energy, or they will continue to make errors like a child would with only a pennies and gumballs understanding of money. I have introduced a not inaccurate understanding of energy, hitting the main points necessary to not make completely unrealistic conclusions. I have tried to keep it comprehensible to a non-engineer, by using the examples of the counting numbers and money.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 31-NFPA 921-2022 [Section No. 5.1.2]	The definition 3.3.57 the definition edit is linked to the 5.1.2 main section on energy.
Public Comment No. 31-NFPA 921-2022 [Section No. 5.1.2]	

Related Item

- The definition 3.3.57 the definition edit is linked to the 5.1.2 main section on energy.

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Public Comment No. 42-NFPA 921-2022 [Section No. 3.3.139]

3.3.139* Noncombustible Material.

A material that ~~, in the form in which it is used and under the condition anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.~~ meets the requirements of ASTM E136.

(Also, add ASTM E136, **Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C, 2022, into chapter 2 on referenced ASTM standards)**

Statement of Problem and Substantiation for Public Comment

There is an inconsistency between this definition and the associated annex note in NFPA 921 and the requirements contained in ASTM E136, which govern the requirements for noncombustible materials in NFPA 921. Materials that pass ASTM E136 are acceptable in NFPA 921 as noncombustible materials even if they ignite and exhibit some flaming.

Moreover, the use of a requirement that a material be noncombustible simply by passing ASTM E136 is much more useful for NFPA 921 because it is easily verifiable.

ASTM E136 (2022) states (in part) as follows:
"15.1 Report the material as passing the test if at least three of the four test specimens tested meet the individual test specimen criteria detailed either in 15.2 or in 15.3. The three individual test specimens do not need to meet the same individual test specimen criteria.
15.2 If the weight loss of an individual the test specimen is 50 % or less, that test specimen is considered as having met the individual test specimen criteria when all the criteria in 15.2.1 through 15.2.3 are met:
15.2.1 For the duration of the test, the recorded temperature of the surface thermocouple does not rise more than 30°C (54°F) above the stabilized furnace temperature established at T2 prior to the test.
15.2.2 For the duration of the test, the recorded temperature of the interior thermocouple does not rise more than 30°C (54°F) above the stabilized furnace temperature established at T2 prior to the test.
15.2.3 There is no flaming from the test specimen after the first 30 s."

That means that the definition presently in NFPA 921 is more restrictive than ASTM E136-2022 (which allows some ignition and some flaming for noncombustible materials) and yet the annex note associated with this definition says that "Materials that are reported as passing ASTM E136 shall be considered noncombustible materials." Leaving aside the fact that the annex is not supposed to have requirements (such as "shall be considered") and neither does the terminology section, at least what is needed is to get it technically correct.

Many other NFPA codes and standards have created a section in the body of the standard with the requirements for noncombustible materials. NFPA 921 prefers that the requirements be in the definition. In that case, the definition needs to have the technically correct requirements and the annex the associated information. A parallel PC to this one to Annex note A.3.3.139, will complete the cycle.
This could be solved by creating a section in chapter 5 that states as follows:
5.13 Noncombustible material A material that complies with any one of the following shall be considered a noncombustible material:
(1) The material, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
(2) The material is reported as passing ASTM E 136, Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.

The language described above from ASTM E136 is new as is the title and the language in section 5 of ASTM E136, which reads:
5. Significance and Use
5.1 Materials that pass this test by complying with the criteria in Section 15 are typically classified as noncombustible materials.
5.2 While actual building fire exposure conditions are not duplicated, this test method will assist in indicating those materials which do not act to aid combustion or add appreciable heat to an ambient fire.
5.3 Materials passing the test are permitted limited flaming and other indications of combustion."

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 2-NFPA 921-2022 [Section No. C.1.2.2]	
Public Comment No. 43-NFPA 921-2022 [Section No. A.3.3.139]	

Related Item

• FR149

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Public Comment No. 3-NFPA 921-2022 [Section No. 3.3.179]

3.3.179 Short Circuit.

An abnormal connection of low resistance between normal circuit conductors where the resistance is normally much greater; this is an overcurrent situation but it is not an overload.

This definition should be corrected to align and reference NFPA document 70, 2023 edition, National Electrical Code, International Electrical Code Series. NFPA 70 was reorganized and added new material addressing the definition of a "Short Circuit"

It reads as follows : ***Short Circuit. An abnormal connection (including and arc) of relatively low impedance, whether made accidently or intentionally, between two or more points of different potential. (CMP-10).***

The NFPA 70 definition is less restrictive than the current NFPA 921 definition. The NFPA 70 definition describes the overall condition accurately and completely. NFPA 921 is titled as a guide and not a code. Code documents as published by NFPA, are often adopted as maters of law, thus forming the basis for substation, reason and decision.

Conflicting definitions are confusing to the reader and open the door to misinterpretation by stakeholders involved in fire and/or explosive investigations. While document 70 includes a highly technical concept *"relevantly low impedance"* , this could be addressed in table 9.2.2.1(b) and section 9.2.2.4 of NFPA 921. I will address changes to those sections of 921 separately.

Statement of Problem and Substantiation for Public Comment

Conflicting definitions for the same concept and term known as "Short Circuit" . It appers to be an oversite by the correlating committee.

The NFPA 70 definition verses the NFPA 921 definition for "Short Circuit" are not worded identically. The NFPA 70 definition describes the overall condition accurately and completely.

Conflicting definitions are confusing to the reader and open the door to misinterpretation by stakeholders involved in fire and/or explosive investigations.

Related Item

- PI Definition of Short Circuit in NFPA 70 , 2023 edition

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Public Comment No. 125-NFPA 921-2023 [Section No. 3.5]

3.5 Terminology Specific to Wildland Fire Investigations.

The community of wildland fire investigators has developed discipline-specific terminology to address detailed aspects of the wildland fire environment and processes. This includes terms such as *general origin area*, *specific origin area*, and *ignition area*, which have been established to address important areas of the wildland fire investigation process. These terms, and other wildland-fire-investigation-specific terms can be found in the NWCG *Guide to Wildland Fire Origin and Cause Determination, the NWCG Glossary of Wildland Fire Terminology, and the Glossary: Guide to Wildland Fire Origin and Cause Determination PMS 412*.

3.5.1 ~~1-Hour Timelag Fuels.~~

~~Fuels consisting of dead herbaceous plants, roundwood less than 0.635 cm (1/4 in.) in diameter, and the uppermost layer of needles or leaves on the forest floor.~~

~~**3.5.2** – 10-Hour Timelag Fuels.~~

~~Dead fuels consisting of roundwood 0.635 to 2.5 cm (1/4 to l in.) in diameter and, roughly, the layer of litter extending from immediately below the surface to 1.9 cm (3/4 in.) below the surface.~~

~~**3.5.3** – 100-Hour Timelag Fuels.~~

~~Dead fuels consisting of roundwood in the size range of 2.5 to 7.6 cm (1 to 3 in.) in diameter and, roughly, the layer of litter extending from approximately 1.9 cm to 10 cm (3/4 to 4 in.) below the surface.~~

~~**3.5.4** – 1000-Hour Timelag Fuels.~~

~~Dead fuels consisting of roundwood .95 cm (3/8 in.) in diameter and the layer of the forest floor more than about 10 cm (4 in.) below the surface.~~

~~**3.5.5**~~ – Advancing Fire.

Fire characterized by rapid fire spread with higher intensity, normally burning with the wind or up slope—also known as a forward fire or a run.

3.5.~~6~~ 2 Aerial Fuels.

Those flammable materials located from approximately 2 m (6 ft) above the surface to the crowns of the canopy, and which can include tree branches, leaves, needles, snags, moss, and tall brush.

3.5.7 ~~– Air Attack.~~

~~The deployment of fixed-wing or rotary aircraft on a wildland fire to drop retardant or extinguishing agents, provide video or photographic data useful in the investigation, shuttle and deploy crews and supplies, or perform aerial reconnaissance of the overall fire situation.~~

3.~~5.8~~ Backing Fire.

A fire spreading against the wind or downslope.

3.5.~~9~~ 4 Crown Fire.

A fire that advances from top to top of trees or shrubs more or less independent of a surface fire—also classed as passive, active, or independent to distinguish the degree of independence from a surface fire.

3.5.10 5 Directional Vectors.

The physical characteristics of the indicators that show the direction of fire spread, i.e., advancing, backing, or lateral.

3.5.11 6 Duff.

The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles, and leaves and immediately above the mineral soil.

3.5.12 7 Ember.

See 3.5.14, Firebrand.

3.5.13 * – Fine Dead Wood.

Fine dead wood consists of twigs, small limbs, bark particles, and rotting material.

3.5.14 – 8 Firebrand.

Flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or by gravity into unburned fuels.

3.5.15 – Fire Breaks.

Fire breaks, fire lines, or control lines are any natural or man-made barriers used to slow, stop, or reroute the direction of the fire spread by separating the fuel from the fire.

3.5.16 9 * Fire Flanks Flank .

The parts of part of a fire's perimeter that are is roughly parallel to the main direction of fire spread located on either side of the head.

3.5.17 10 * Fire Head.

The portion of a fire moving most rapidly.

3.5.18 11 * Fire Heel.

The opposite end of the fire from the head.

3.5.19 – Firestorms.

An intense and violent fire created by strong convective winds produced by a large plume associated with atmospheric instability.

3.5.20 – Firing Out.

The process of burning the fuel between a fire break and the approaching fire to extend the width of the fire barrier, normally started at a fire control line (normally on the downwind side of the fire) and burned back toward the leading edge of the fire.

3.5.21 – Fuel Class.

Part of the National Fire Danger Rating System (NFDRS), a group of fuels possessing common characteristics where dead fuels are grouped according to 1-, 10-, 100-, and 1000-hour timelag and living fuels are grouped as herbaceous (annual or perennial) or woody.

3.5.22 – Grass Fire.

Any fire in which the predominant fuel is grass or grasslike.

3.5.23 – 12 Ground Fuels.

All flammable materials located between the mineral soil layer and the ground surface, which typically include twig, leaf, and needle litter and decomposing vegetation such as duff, peat moss, buried limbs, and roots.

3.5.24 – Humus.

Layer of decomposed organic matter on the forest floor beneath the fermentation layer and directly above the soil that is part of the duff in which decomposition has rendered vegetation unrecognizable and mixing of soil and organic matter is underway.

3.5.25 – Initial Run.

The direction of fire propagation prior to being influenced by wind shifts and suppression activities.

3.5.26 – Ladder Fuels.

Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease, which helps initiate and assure the continuation of crowning.

3.5.27 – 13 _ Lateral Fire.

Rate or spread and intensity of a fire usually falling somewhere in between advancing and backing with spread lateral to the main direction of fire travel—also known as a flanking fire.

3.5.28 14 Prescribed Fire.

A wildland fire intentionally ignited to meet specific land management objectives.

3.5.29 15 Run (Of a Fire).

Rapid advance of the head of a fire, characterized by a marked transition in fire intensity and rate of spread with respect to that noted before and after the advance.

3.5.30 – Spot Fire.

Fire ignited outside the perimeter of the main fire by a firebrand.

3.5.31 – 16 _ Surface Fuels.

Flammable materials located from the surface of the ground to approximately 2 m (6 ft) above the surface, which includes grasses, leaves, twigs, needles, field crops, slash, and downed limbs.

3.5.32 * – Transition Area.

Where random or erratic fire travel transitions to fire effects causing patterns to indicate a directional spread of fire, which may be lateral, advancing, or backing.

3.5.33 – 17 _ Wildland Fire.

A fire that occurs in vegetation or natural fuels and includes prescribed fires.

Statement of Problem and Substantiation for Public Comment

The Wildland Chapter Task Group removed terms not utilized in Chapter 27.

Related Item

• TC comment from the first draft indicating that the terminology for Chapter 27 would be reviewed and new content provided during the second draft.

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Public Comment No. 86-NFPA 921-2023 [Chapter 4]

Chapter 4 Basic Methodology

4.1* Nature of Fire Investigations.

As a forensic science discipline, fire or explosion investigation is a complex endeavor involving skill, technology, knowledge, and science. The compilation of factual data, as well as an analysis of those facts, and expressing opinions or conclusions in reports or testimony, should be accomplished objectively, truthfully, and without expectation bias, preconception, or prejudice. The basic methodology of the fire investigation should rely on the use of a systematic approach and attention to all relevant details. The use of a systematic approach often will uncover new factual data for analysis, which may require previous conclusions to be reevaluated. With few exceptions, the proper methodology for a fire or explosion investigation is to first determine and establish the origin(s), then investigate the cause: circumstances, conditions, or agencies that brought the ignition source, fuel, and oxidant together.

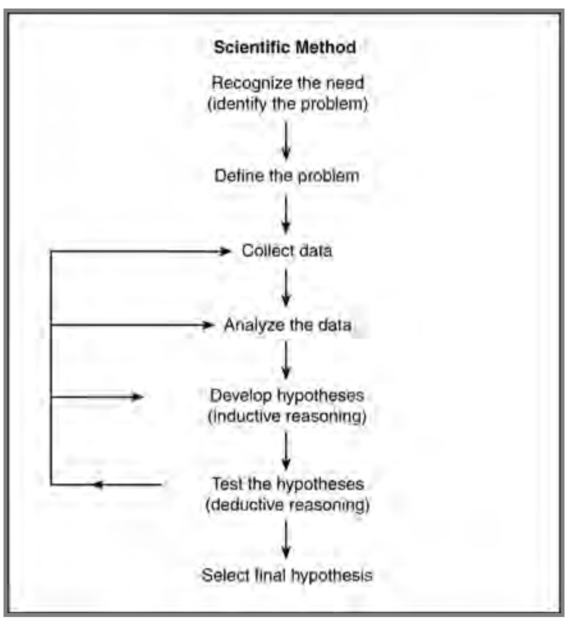
4.2 Systematic Approach.

The systematic approach recommended is based on the scientific method, which is used in the physical sciences. This method provides an organizational and analytical process that is desirable and necessary in a successful fire investigation.

4.3 Relating Fire Investigation to the Scientific Method.

The scientific method *(see Figure 4.3)* is a principle of inquiry that forms a basis for legitimate scientific and engineering processes, including fire incident investigation. It is applied using the following steps outlined in 4.3.1 through 4.3.10.

Figure 4.3 Use of the Scientific Method.



4.3.1 Recognize the Need(s).

First, one should determine the problem statement(s) or the question(s) that needs to be addressed.

4.3.2 Define the Problem.

Having determined that a problem exists, the investigator or analyst should define the manner in which the problem can be solved. In this case, a proper origin and cause investigation should be conducted. This is done by an examination of the scene and by a combination of other data collection methods, such as the review of previously conducted investigations of the incident, the interviewing of witnesses or other knowledgeable persons, and the results of scientific testing.

4.3.3 Collect Data.

Information about the fire or explosion incident is now collected by observation, experiment, or other direct data-gathering means. The data collected is called empirical data because it is based on observation or experience and is capable of being verified or known to be true. Data collection can occur at nearly every stage of the fire investigation.

4.3.4* Analyze the Data.

The scientific method requires that all data collected be analyzed. This is an essential step that must take place before the formation of the final hypothesis. The identification, gathering, and cataloging of data does not equate to data analysis. Analysis of the data is based on the knowledge, training, experience, and expertise of the individual doing the analysis. If the investigator lacks expertise to properly attribute meaning to a piece of data, then assistance should be sought. Understanding the meaning of the data will enable the investigator to form hypotheses based on the evidence, rather than on speculation.

4.3.5* Develop Hypotheses (Inductive Reasoning).

Based on the data analysis, the investigator produces hypotheses to explain the phenomena, whether it be the nature of fire patterns, fire spread, identification of the origin, the ignition sequence, the fire cause, or the causes of damage or responsibility for the fire or explosion incident. This process is referred to as inductive reasoning. These hypotheses should be based solely on the empirical data that the investigator has collected through observation and then developed into explanations for the event, which are based upon the investigator's knowledge, training, experience, expertise, and research.

4.3.6* Test the Hypotheses (Deductive Reasoning).

The investigator does not have a valid or reliable conclusion unless the hypothesis can stand the test of careful and serious challenge. Testing of the hypothesis is done by the principle of deductive reasoning, in which the investigator compares the hypothesis to all known facts as well as the body of scientific knowledge associated with the phenomena relevant to the specific incident. Testing of a hypothesis should be designed to disprove, or refute, the hypothesis. This may also be referred to as falsification of the hypothesis. Working to disprove a hypothesis is an attempt to find all the data or reasons why the hypothesis is not supported or not true, rather than simply finding and relying on data that support the hypothesis or why the hypothesis is true. This method of testing the hypothesis can prevent “confirmation bias,” which can occur when the hypothesis or conclusion relies only on supporting data *(see 4.3.10)*. A hypothesis can be tested physically by conducting experiments, analytically by applying accepted scientific principles, or by referring to scientific research. When relying on the research of others, the investigator or analyst must ensure that the conditions, circumstances, and variables of the research and those of the hypothesis are sufficiently similar. Whenever the investigator relies on research as a means of hypothesis testing, references to the research relied upon should be acknowledged and cited. If the hypothesis is refuted or not supported, it should be discarded and alternate hypotheses should be developed and tested. This may require the collection of new data or the reanalysis of existing data. The testing process needs to be continued until all feasible hypotheses have been tested and one is determined to be uniquely consistent with the facts and with the principles of science. If no hypothesis can withstand an examination by deductive reasoning, the issue should be considered undetermined.

4.3.6.1*

Any hypothesis that is incapable of being tested either physically or analytically, is an invalid hypothesis. A hypothesis developed based on the absence of data is an example of a hypothesis that is incapable of being tested. The inability to refute a hypothesis does not mean that the hypothesis is true.

4.3.7 Select Final Hypothesis.

The final step in applying the scientific method is to select the final hypothesis. Once the hypothesis has been tested, the investigator should review the entire process to ensure that all credible data are accounted for and all feasible alternate hypotheses have been considered and eliminated. When using the scientific method, the failure to consider alternate hypotheses is a serious error. A critical question to be answered is, "Are there any other hypotheses that are consistent with the data?" The investigator should document the facts that support the final hypothesis to the exclusion of all other reasonable hypotheses.

4.3.8 Avoid Presumption.

No specific hypothesis can be reasonably formed or tested until some data have been collected. All investigations of fire and explosion incidents should be approached by the investigator without presumption as to origin, ignition sequence, cause, fire spread, or responsibility for the incident. All hypotheses should be subject to rigorous testing through the scientific method.

4.3.9 Expectation Bias.

Expectation bias is a phenomenon that occurs when investigator(s) reach a particular conclusion based on expectations without having examined or considered all of the relevant data. Instead of collecting and examining all of the data in a logical and unbiased manner, the investigator(s) uses the premature determination to influence analysis and investigative processes, including suggestive questioning of witnesses, which in turn might influence conclusions in a way that is not scientifically valid. The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation or the discarding of data that does not support the original opinion. Investigators are strongly cautioned to avoid expectation bias through proper use of the scientific method.

4.3.10* Confirmation Bias.

Confirmation bias occurs when the investigator relies on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupporting data. The same data may support alternate and even opposing hypotheses. The failure to consider alternate or opposing hypotheses, or prematurely discounting seemingly contradictory data without appropriate analysis and testing can result in incorrect conclusions. Testing a hypothesis is a process that considers all the data and alternative hypotheses to ascertain whether the tested hypothesis is inconsistent with data and, if inconsistent, whether an alternative hypothesis might also be true. When using the scientific method, testing of hypotheses should be designed to disprove a hypothesis (i.e., falsification of the hypothesis), rather than relying only on confirming data that support the hypothesis.

4.4 Basic Method of a Fire Investigation.

Using the scientific method in most fire or explosion incidents should involve the steps shown in 4.4.1 through 4.4.6.

4.4.1 Receiving the Assignment.

The investigator should be notified of the incident, told what his or her role will be, and told what he or she is to accomplish. For example, the investigator should know if he or she is expected to determine the origin, cause, and responsibility; produce a written or oral report; prepare for criminal or civil litigation; make suggestions for code enforcement, code promulgation, or changes; make suggestions to manufacturers, industry associations, or government agency action; or determine some other results.

4.4.2 Preparing for the Investigation.

The investigator should marshal his or her forces and resources and plan the conduct of the investigation. Preplanning at this stage can greatly increase the efficiency and therefore the chances for success of the overall investigation. Estimating what tools, equipment, and personnel (both laborers and experts) will be needed can make the initial scene investigation, as well as subsequent investigative examinations and analyses, go more smoothly and be more productive.

4.4.3 Conducting the Investigation.

4.4.3.1

It is during this stage of the investigation that an examination of the incident fire or explosion scene is conducted. The fundamental purpose of conducting an examination of any incident scene is to collect all of the available data and document the incident scene. The investigator should conduct an examination of the scene if it is available and collect data necessary to the analysis.

4.4.3.2

The actual investigation may include different steps and procedures, which will be determined by the purpose of the assignment. These steps and procedures are described in detail elsewhere in the document. A fire or explosion investigation may include all or some of the following tasks: a scene inspection or review of previous scene documentation done by others; scene documentation through photography and diagramming; evidence recognition, documentation, and preservation; witness interviews; review and analysis of the investigations of others; and identification and collection of data from other appropriate sources.

4.4.3.3

In any incident scene investigation, it is necessary for at least one individual/organization to conduct an examination of the incident scene for the purpose of data collection and documentation. While it is preferable that all subsequent investigators have the opportunity to conduct an independent examination of the incident scene, in practice, not every scene is available at the time of the assignment. The use of previously collected data from a properly documented scene can be used successfully in an analysis of the incident to reach valid conclusions through the appropriate use of the scientific method. Thus, the reliance on previously collected data and scene documentation should not be inherently considered a limitation in the ability to successfully investigate the incident.

4.4.3.4

The goal of all investigators is to arrive at accurate determinations related to the origin, cause, fire spread, and responsibility for the incident. Improper scene documentation can impair the opportunity of other interested parties to obtain the same evidentiary value from the data. This potential impairment underscores the importance of performing comprehensive scene documentation and data collection.

4.4.4 Collecting and Preserving Evidence.

Valuable physical evidence should be recognized, documented, properly collected, and preserved for further testing and evaluation or courtroom presentation.

4.4.5 Analyzing the Incident.

All collected and available data should be analyzed using the principles of the scientific method. Depending on the nature and scope of one’s assignment, hypotheses should be developed and tested explaining the origin, ignition sequence, fire spread, fire cause or causes of damage or casualties, or responsibility for the incident.

4.4.6 Conclusions.

Conclusions, which are final hypotheses, are drawn as a result of testing the hypotheses. Conclusions should be drawn according to the principles expressed in this guide and reported appropriately.

4.5 Expert Opinions.

Investigators should understand that there are various legal requirements for the admissibility of expert opinions in different jurisdictions. For example, some courts have set a threshold of certainty for the investigator to be able to render opinions in court. The substantive content of expert reports or testimony should comply with any legal rules imposed by the court or the jurisdiction in which they are provided. *[See Chapter 12 for more information regarding expert witnesses and the admissibility of expert opinions.]* Where experts express their opinions in reports or testimony, they need to articulate how they applied the scientific method and effectively communicate their hypothesis development and testing, disclosing the data collected and utilized. In both reports and testimony, experts should make their opinions transparent. If an expert report is required, it should be complete and comprehensive. For further guidance on reporting and testimony, see 16.5.8.

4.5.1 Expressions of Certainty.

Someone may express an opinion to a higher or lower level of certainty. The expression is determined by the investigator's confidence in the data, in the analysis of that data, and testing of hypotheses formed.

4.5.1.1

Two expressions of certainty commonly used are probable and possible, as follows:

(1) *Probable.* This expression corresponds to being more likely true than not.

(2) *Possible.* The hypothesis may be demonstrated to be feasible but cannot be either ruled out or declared probable. If two or more hypotheses are equally likely, then the expression must be “possible.”

4.5.1.2

If the level of certainty of an opinion is merely “suspected,” the opinion does not qualify as an expert opinion. If the level of certainty is only “possible,” the opinion should be specifically expressed as “possible.” Only when the level of certainty is considered “probable” should an opinion be expressed with reasonable certainty.

4.5.2 Fire Investigation Certainty.

Fire investigators achieve reasonable fire investigation certainty when they have properly applied all of the steps of the scientific method to reach a unique and reliable final hypothesis.

4.6 Review Procedure.

A review of a fire investigator’s work product (e.g., reports, documentation, notes, diagrams, photos, etc.) by other persons may be helpful, but there are certain limitations. This section describes the types of reviews and their appropriate uses and limitations.

4.6.1 Administrative Review.

An administrative review is one typically carried out within an organization to ensure that the investigator’s work product meets the organization's quality assurance requirements. An administrative reviewer will determine whether all of the steps outlined in an organization's procedure manual, or required by agency policy, have been followed and whether all of the appropriate documentation is present in the file, and may check for typographical or grammatical errors.

4.6.1.1 Limitations of Administrative Reviews.

An administrative reviewer may not necessarily possess all of the knowledge, skills, and abilities of the investigator or of a technical reviewer. As such, the administrative reviewer may not be able to provide a substantive critique of the investigator's work product.

4.6.2 Technical Review.

A technical review can have multiple facets. If a technical reviewer has been asked to critique all aspects of the investigator's work product, then the technical reviewer should be qualified and familiar with all aspects of proper fire investigation and should, at a minimum, have access to all of the documentation available to the investigator whose work is being reviewed. If a technical reviewer has been asked to critique only specific aspects of the investigator's work product, then the technical reviewer should be qualified and familiar with those specific aspects and, at a minimum, have access to all documentation relevant to those aspects. A technical review can serve as an additional test of the various aspects of the investigator's work product.

4.6.2.1 Limitations of Technical Reviews.

While a technical review may add significant value to an investigation, technical reviewers may be perceived as having an interest in the outcome of the review. Confirmation bias (attempting to confirm a hypothesis rather than attempting to disprove it) is a subset of expectation bias *(see 4.3.9)*. This kind of bias can be introduced in the context of working relationships or friendships. Investigators who are asked to review a colleague's findings should strive to maintain a level of professional detachment.

4.6.3 Peer Review.

Peer review is a formal procedure generally employed in prepublication review of scientific or technical documents and screening of grant applications by research-sponsoring agencies. Peer review carries with it connotations of both independence and objectivity. Peer reviewers should not have any interest in the outcome of the review. The author does not select the reviewers, and reviews are often conducted anonymously. As such, the term "peer review" should not be applied to reviews of an investigator's work by coworkers, supervisors, or investigators from agencies conducting investigations of the same incident. Such reviews are more appropriately characterized as "technical reviews," as described above.

4.6.3.1

The methodologies used and the fire science relied on by an investigator are subject to peer review. For example, NFPA 921 is a peer-reviewed document describing the methodologies and science associated with proper fire and explosion investigations.

4.6.3.2 Limitations of Peer Reviews.

Peer reviewers should have the expertise to detect logic flaws and inappropriate applications of methodology or scientific principles, but because they generally have no basis to question an investigator's data, they are unlikely to be able to detect factual errors or incorrectly reported data. Conclusions based on incorrect data are likely to be incorrect themselves. Because of these limitations, a proper technical review will provide the best means to adequately assess the validity of the investigation's results.

4.7 Reporting Procedure.

The reporting procedure may take many written or oral forms, depending on the specific responsibility of the investigator. Pertinent information should be reported in a proper form and forum to help prevent recurrence.

Additional Proposed Changes

File Name	Description	Approved
Global_comments_and_added_section.docx	OSAC Human Factors Task Group recommendations on scientfic method	

Statement of Problem and Substantiation for Public Comment

The document is structured around the idea that the core process of fire investigation is "the scientific method," but the description of the scientific method is overly simplified, formalistic, and misleading in important ways. The OSAC Human Factors Task Group comprises researchers with extensive experience in the develop and application of the scientific method and scientific analysis in many different fields. The comment attempts to highlight ways in which the current language is likely to mislead investigators about the requirements for reliable application of the scientific method, and to suggest a new section that can address some of those concerns.

Related Item

• Scientific method • Cognitive biases

Submitter Information Verification

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Submittal Date:	Wed Jan 04 15:09:55 EST 2023
Committee:	FIA-AAA

Comments on behalf of the OSAC Human Factors Task Group:

1. A global concern is that the document frequently relies on statements that are merely aspirational, e.g., stating that an investigator should avoid bias or conduct an appropriate investigation, without providing specific, substantive criteria that specify what the investigator must do to ensure reliable and accurate conclusions. This has been referred to as the "vacuous standard" problem. Procedures or steps that lack concrete procedures or criteria for analysis leave the implementation of the standard up to the subjective judgment of individual practitioners, which increases the potential for influence by cognitive biases and other human factors.

2. The document is structured around the idea that the core process of fire investigation is "the scientific method," but the description of the scientific method is superficial, formalistic, and misleading in important ways. One major concern is that the document does not identify specific procedures or analytical criteria that tell an investigator how to apply the broadly defined steps that the draft describes. This misleads readers, including fire investigators themselves, by telling them that the simplified account outlined in the documents is sufficient to ensure that their investigation is "scientific." This is more than a lack of detail. It actively prevents investigators from understanding that "the scientific method" involves specific types of procedural controls and a substantive understanding of rigorous analysis and causal inference.
   A second major concern is that hypothesis testing is described as a kind of all-or-none process of elimination, leading eventually to the right answer. This is a serious misrepresentation of modern scientific approaches for testing alternative hypotheses. There is no mention of core concepts in any scientific analysis, such as the construction of alternative testable hypotheses, limitations and uncertainty of conclusions, identifying assumptions, or methods for expressing the relative likelihood of alternative explanations.

3. Recommendation:

   Add a section on scientific reasoning and logical inference, identifying the need for investigators to understand and apply fundamental elements of scientific reasoning that are routinely taught and used in other areas of scientific, medical, or technical analysis. These might include, for example:

   - Best practices for construction of alternative, testable hypotheses
   - Human factors in data collection and sampling, e.g.
     - Selective attention
     - Perception, observation
     - Selective memory/recall
     - Contextual biases

- Procedures for mitigating cognitive biases and other negative effects of human factors, e.g.
    - Checklists
    - Documentation
    - Systematic data collection
    - Blinding procedures, e.g., linear sequential unmasking procedures, separation of scene investigation/screening and analytical teams
    - Critical hypothesis testing
    - Explicit statement of logical steps
    - Statement of uncertainty/relative likelihood of alternative
- Causal inference
    - Training in causal inference
    - Common errors in causal inference
    - Heuristics and biases in reasoning
    - Statistical/probabilistic thinking

Definitions:

Expectation bias: Expectation bias is a well-established phenomena that affects analyses when the anticipated results of an inquiry affect what it's learned in the inquiry or how what is learned is interpreted. For example, a fire investigator who thinks he knows how a fire likely started or spread may, without realizing it, question a fire scene witness in ways that encourage the witness to report information consistent with what the investigator believes happened while not mentioning information inconsistent with the investigator's expectations. Or an analyst examining fire debris may be more likely to notice subtle cues consistent with what he expected to find while ignoring equally subtle clues that are inconsistent with his expectations. The same may occur with laboratory analyses.

Ways of minimizing expectation biases include awareness of one's expectations and the resulting need to search for expectation-inconsistent information, by training, like training in how to avoid leading witnesses when questioning them, by following standard procedures or protocols for collecting and analyzing data regardless of expectations, and by employing the scientific method to generate and test hypotheses. A particularly effective method of limiting expectation bias is blinding an investigator to information that might create expectations without aiding in the scientific evaluation of evidence. In some settings, like a laboratory assessment of whether fire debris contains chemical evidence of a propellant, blinding should not be problematic but often complete blinding will not be feasible in other fire investigation tasks. In these situations, sequential unmasking will sometimes, though not always be a possibility. Sequential unmasking withholds information from an investigator until a certain phase of an investigation has been completed and documented. For example, a fire investigator examining burn patterns to determine the origin of a fire should, if possible, complete a first examination of the scene without learning of witness statements that might suggest a particular origin. Once an initial assessment has been made and documented, the investigator after learning of witness statements might choose to reassess the scene with the witness statements in mind to see if the original assessment is affected by the new knowledge. One or more of the preceding approaches to limiting expectation bias should be employed in seeking information or analyzing data

Substantiation: This definition, adapted to provide examples related to fire investigations, is consistent with definitions one can find elsewhere (See, e.g. Jason Hreha, "What is Expectation Bias in Behavioral Economics" (https://www.thebehavioralscientist.com/glossary/expectation-bias).

The definition corrects errors made in the revision of 4.3.9. For example, the revised version states: "The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation and/or the discarding of data that does not support the original opinion." While expectation bias may have the consequences suggested, it need not. The signal from inconsistent information may be strong enough that it is not discarded even if more credence is given to expected results than they deserve. Or expectation bias may distort what information is received or how it is perceived without leading to premature or scientifically invalid conclusions. Indeed, an expectation may be correct and may not lead to a mistaken conclusion even if it results in more confidence in the correct conclusion than an investigator might otherwise have. Similarly, although it may help, the proper use of the scientific method will not necessarily eliminate expectation bias. The scientific method does not eliminate the need for judgments, and expectation bias can influence the judgments made.

Confirmation Bias: The class of effects by which an individual's preexisting beliefs, expectations, motives, and situational contexts may influence their collection, perception or interpretation of information or their resulting judgments, decisions or confidence. It is typically characterized by a selective focus on observations or data that support a prior suspicion or belief while ignoring or unduly discounting information or evidence that might support an alternative conclusion. The first sentence of this definition draws in part on a definition, later refined by an author, in S.M. Kissing, I.E. Dror, & J. Kukucka, "The forensic confirmation bias: problems, perspectives and proposed solutions", Journal of Applied Research in memory and cognition, 2 (1)(2013) 42-52, at p. 45. The second sentence is drawn from a suggested clarification of the definition focusing on mechanism that was offered by the Chair of the OSAC Human Factors Resource Committee.

This change is suggested because portions of the revised definition and the discussion that follows are not necessarily correct. E.g., "Confirmation bias occurs when the investigator relies exclusively on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupporting data. " This sentence errs in that confirmation bias can exist and influence analyses even when an investigator does not rely exclusively on data that supports the investigator's hypothesis. Contradictory information may be considered but deemed not as powerful as evidence which confirms a favored hypothesis. The discussion also suggests that the investigator must only acknowledge one possibility, but an investigator could conclude that a particular hypothesis is most likely to be true given the evidence - say with a 95% probability of being an explanation for a fire - while acknowledging that another hypothesis cannot be entirely dismissed. But the estimate may reflect confirmation bias if a scientifically sounder estimate might give the favored hypothesis only a 75% chance of being true. Also questionable is the sentence, "A hypothesis can be said to be valid only when rigorous testing has failed to disprove the hypothesis." Surviving rigorous testing doesn't mean an hypothesis is valid because an alternative mutually exclusive hypothesis may also survive rigorous testing given the data available. If confirmation bias is affecting the investigation, an investigator may prematurely halt a search for other hypotheses that are also not excluded by the data. Hence, confirmation bias may make an investigator overtly certain of a conclusion or explanation.

Methods for limiting the likelihood and effects of expectation bias provided in the above definition of that term are also ways of minimizing the likelihood and effects of confirmation bias.

Public Comment No. 44-NFPA 921-2022 [Section No. 4.3.3]

4.3.3 Collect Data.

Information about the fire or explosion incident is now collected by observation, experiment, or other direct data-gathering means. The data collected is called empirical data because it is based on observation or experience and is capable of being verified or known to be true. Data collection can occur at nearly every stage of the fire investigation.

4.3.3.1* It is the responsibility of the investigator to properly document and preserve all data relevant to the investigation of origin, cause, and responsibility as dictated by their assignment.

A 4.3.3.1 The quality and reliability of a fire investigation is based upon the quality and completeness of the data collected. As such, the investigator needs to properly document and preserve all data relevant to determine origin, cause, and responsibility. The failure to properly document and preserve all relevant data can lead to an erroneous finding or conclusion regarding the fire incident.

In scene processing, the investigator needs to take an expansive view of data relevance. The full relevance of a piece of data or physical evidence may not be clear during the scene examination, so investigators need to view data relevance in terms of the potential of data to be relevant, even if only recognized later in the investigation. All investigators have had the experience of identifying relevant data in a photograph that was not recognized at the time the photograph was taken. Investigators should carry out their scene examination with the expectation that the quality and completeness of the data will be judged by in-house reviewers and other parties. Failures in data preservation may be the subject of legal proceedings in terms of spoliation issues (see Legal Considerations chapter).

Scene fire investigation by its very nature destroys potential data, so later investigators may not have access to data required by the scope of their investigation if it was destroyed by earlier investigators. It is the duty of fire investigators to protect and collect all available data, so that data is not lost for subsequent investigations that may be undertaken.

Preserving and collecting data takes many forms. While digging out an area, damage is done, and data is destroyed. Photographing and videoing the excavation process and systematically organizing excavated debris will preserve knowledge of the in-situ position and condition of evidence, and makes the debris searchable by later investigators. Physical evidence can be preserved by several methods. If the relevance of the evidence is recognized, the item can be collected and preserved. When the potential relevance is recognizable, the item can be left in place without tampering. When this is not possible, the item can be photographed during excavation and set aside for subsequent examination. The subsequent examination of the item may occur in the context of the current investigation as it proceeds or may be undertaken in a subsequent investigation.

Interviews need to be well documented. It is well known that memories fade and change over time, so that the probative value of early interview data is high. Inquiring into all aspects of the scene and fire event within the witness's knowledge is essential.

Statement of Problem and Substantiation for Public Comment

The Technical Committee rejected this proposed change using the rationale that it was adequately covered in other Sections. The Subcommittee on Fire and Explosion Investigation disagrees. We believe that, while data collection and evidence preservation is discussed in various sections, the concept of “responsibility” is not explicitly nor adequately addressed. We believe that it is important as part of the discussion of methodology to affirmatively assign responsibility. If responsibility is not assigned then there will be no accountability if all relevant data is not documented and preserved.

Related Item

- Public Input 114

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Committee:	FIA-AAA

Public Comment No. 79-NFPA 921-2023 [Section No. 4.3.9]

4.3.9 Expectation Bias.

Expectation bias is a phenomenon that occurs when investigator(s) reach a particular conclusion based on expectations without having examined or considered all of the relevant data. Instead of collecting and examining all of the data in a logical and unbiased manner, the investigator(s) uses the premature determination to influence analysis and investigative processes, including suggestive questioning of witnesses, which in turn might influence conclusions in a way that is not scientifically valid. The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation or the discarding of data that does not support the original opinion. Investigators are strongly cautioned to avoid expectation bias through proper use of the scientific method.

Expectation bias: Expectation bias is a well-established phenomena that affects analyses when the anticipated results of an inquiry affect what it's learned in the inquiry or how what is learned is interpreted. For example, a fire investigator who thinks he knows how a fire likely started or spread may, without realizing it, question a fire scene witness in ways that encourage the witness to report information consistent with what the investigator believes happened while not mentioning information inconsistent with the investigator's expectations. Or an analyst examining fire debris may be more likely to notice subtle cues consistent with what he expected to find while ignoring equally subtle clues that are inconsistent with his expectations. The same may occur with laboratory analyses. Ways of minimizing expectation biases include awareness of one's expectations and the resulting need to search for expectation-inconsistent information, by training, like training in how to avoid leading witnesses when questioning them, by following standard procedures or protocols for collecting and analyzing data regardless of expectations, and by employing the scientific method to generate and test hypotheses. A particularly effective method of limiting expectation bias is blinding an investigator to information that might create expectations without aiding in the scientific evaluation of evidence. In some settings, like a laboratory assessment of whether fire debris contains chemical evidence of a propellant, blinding should not be problematic but often complete blinding will not be feasible in other fire investigation tasks. In these situations, sequential unmasking will sometimes, though not always be a possibility. Sequential unmasking withholds information from an investigator until a certain phase of an investigation has been completed and documented. For example, a fire investigator examining burn patterns to determine the origin of a fire should, if possible, complete a first examination of the scene without learning of witness statements that might suggest a particular origin. Once an initial assessment has been made and documented, the investigator after learning of witness statements might chose to reassess the scene with the witness statements in mind to see if the original assessment is affected by the new knowledge. One or more of the preceding approaches to limiting expectation bias should be employed in seeking information or analyzing data

Statement of Problem and Substantiation for Public Comment

Substantiation: This definition, adapted to provide examples related to fire investigations, is consistent with definitions one can find elsewhere (See, e.g. Jason Hreha, "What is Expectation Bias in Behavioral Economics" (https://www.thebehavioralscientist.com/glossary/expectation-bias). The definition corrects errors made in the revision of 4.3.9. For example, the revised version states: "The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation and/or the discarding of data that does not support the original opinion." While expectation bias may have the consequences suggested, it need not. The signal from inconsistent information may be strong enough that it is not discarded even if more credence is given to expected results than they deserve. Or expectation bias may distort what information is received or how it is perceived without leading to premature or scientifically invalid conclusions. Indeed, an expectation may be correct and may not lead to a mistaken conclusion even if it results in more confidence in the correct conclusion than an investigator might otherwise have. Similarly, although it may help, the proper use of the scientific method will not necessarily eliminate expectation bias. The scientific method does not eliminate the need for judgments, and expectation bias can influence the judgments made..

Note: I am a member of the OSAC Fire & Explosion and Human Factors Committees. The F&E Committee began discussing this proposed change but did not have time to complete its discussion before the deadline for submission. The HUman Factors Committee tried to submit this along with other comments but could not figure out how to navate the NFPA portal never having done it before. So I am submitting this on my own behalf and on behalf of the human factors committee, though they may find a way to submit before the deadline this evening.

Related Item

- 921-4.3.9

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Public Comment No. 80-NFPA 921-2023 [Section No. 4.3.9]

4.3.9 Expectation Bias.

Expectation bias is a phenomenon that occurs when investigator(s) reach a particular conclusion based on expectations without having examined or considered all of the relevant data. Instead of collecting and examining all of the data in a logical and unbiased manner, the investigator(s) uses the premature determination to influence analysis and investigative processes, including suggestive questioning of witnesses, which in turn might influence conclusions in a way that is not scientifically valid. The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation or the discarding of data that does not support the original opinion. Investigators are strongly cautioned to avoid expectation bias through proper use of the scientific method.

Additional Proposed Changes

File Name	Description	Approved
4.3.9_Expectation_bias.docx	OSAC Human Factors Task Group Expectation Bias	

Statement of Problem and Substantiation for Public Comment

Comment on behalf of the OSAC Human Factors Task Group:

The suggested definition corrects errors in the proposed language for the revision of 4.3.9. For example, the revised version states:
"The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation and/or the discarding of data that does not support the original opinion." While expectation bias may have the consequences suggested, it need not. The signal from inconsistent information may be strong enough that it is not discarded even if more credence is given to expected results than they deserve. Or expectation bias may distort what information is received or how it is perceived without leading to premature or scientifically invalid conclusions. Indeed, an expectation may be correct and may not lead to a mistaken conclusion even if it results in more confidence in the correct conclusion than an investigator might otherwise have. Similarly, although it may help, the proper use of the scientific method will not necessarily eliminate expectation bias. The scientific method does not eliminate the need for judgments, and expectation bias can influence the judgments made.

Substantiation: This definition, adapted to provide examples related to fire investigations, is consistent with definitions one can find elsewhere (See, e.g. Jason Hreha, "What is Expectation Bias in Behavioral Economics" (https://www.thebehavioralscientist.com/glossary/expectation-bias).

Related Item

• Scientific method • Cognitive biases

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Committee:	FIA-AAA

Definitions:

Expectation bias: Expectation bias is a well-established phenomena that affects analyses when the anticipated results of an inquiry affect what it's learned in the inquiry or how what is learned is interpreted. For example, a fire investigator who thinks he knows how a fire likely started or spread may, without realizing it, question a fire scene witness in ways that encourage the witness to report information consistent with what the investigator believes happened while not mentioning information inconsistent with the investigator's expectations. Or an analyst examining fire debris may be more likely to notice subtle cues consistent with what he expected to find while ignoring equally subtle clues that are inconsistent with his expectations. The same may occur with laboratory analyses.

Ways of minimizing expectation biases include awareness of one's expectations and the resulting need to search for expectation-inconsistent information, by training, like training in how to avoid leading witnesses when questioning them, by following standard procedures or protocols for collecting and analyzing data regardless of expectations, and by employing the scientific method to generate and test hypotheses. A particularly effective method of limiting expectation bias is blinding an investigator to information that might create expectations without aiding in the scientific evaluation of evidence. In some settings, like a laboratory assessment of whether fire debris contains chemical evidence of a propellant, blinding should not be problematic but often complete blinding will not be feasible in other fire investigation tasks. In these situations, sequential unmasking will sometimes, though not always be a possibility. Sequential unmasking withholds information from an investigator until a certain phase of an investigation has been completed and documented. For example, a fire investigator examining burn patterns to determine the origin of a fire should, if possible, complete a first examination of the scene without learning of witness statements that might suggest a particular origin. Once an initial assessment has been made and documented, the investigator after learning of witness statements might choose to reassess the scene with the witness statements in mind to see if the original assessment is affected by the new knowledge. One or more of the preceding approaches to limiting expectation bias should be employed in seeking information or analyzing data

Substantiation: This definition, adapted to provide examples related to fire investigations, is consistent with definitions one can find elsewhere (See, e.g. Jason Hreha, "What is Expectation Bias in Behavioral Economics" (https://www.thebehavioralscientist.com/glossary/expectation-bias).

The definition corrects errors made in the revision of 4.3.9. For example, the revised version states: "The introduction of expectation bias into the investigation results in the use of only that data that supports this previously formed conclusion and often results in the misinterpretation and/or the discarding of data that does not support the original opinion." While expectation bias may have the consequences suggested, it need not. The signal from inconsistent information may be strong enough that it is not discarded even if more credence is given to expected results than they deserve. Or expectation bias may distort what information is received or how it is perceived without leading to premature or scientifically invalid conclusions. Indeed, an expectation may be correct and may not lead to a mistaken conclusion even if it results in more confidence in the correct conclusion than an investigator might otherwise have. Similarly, although it may help, the proper use of the scientific method will not necessarily eliminate expectation bias. The scientific method does not eliminate the need for judgments, and expectation bias can influence the judgments made.

Public Comment No. 72-NFPA 921-2023 [Section No. 4.3.10]

4.3.10* Confirmation Bias.

Confirmation bias occurs when the investigator relies on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupporting data. The same data may support alternate and even opposing hypotheses. The failure to consider alternate or opposing hypotheses, or prematurely discounting seemingly contradictory data without appropriate analysis and testing can result in incorrect conclusions. Testing a hypothesis is a process that considers all the data and alternative hypotheses to ascertain whether the tested hypothesis is inconsistent with data and, if inconsistent, whether an alternative hypothesis might also be true. When using the scientific method, testing of hypotheses should be designed to disprove a hypothesis (i.e., falsification of the hypothesis), rather than relying only on confirming data that support the hypothesis.

Confirmation Bias : The class of effects by which an individual's preexisting beliefs, expectations, motives, and situational contexts may influence their collection, perception or interpretation of information or their resulting judgments, decisions or confidence. It is typically characterized by a selective focus on observations or data that support a prior suspicion or belief while ignoring or unduly discounting information or evidence that might support an alternative conclusion. The first sentence of this definition draws in part on a definition, later refined by an author, in S.M. Kissing, I.E. Dror, & J. Kukucka, "The forensic confirmation bias: problems, perspectives and proposed solutions", Journal of Applied Research in memory and cognition, 2 (1)(2013) 42-52, at p. 45. The second sentence is drawn from a suggested clarification of the definition focusing on mechanism that was offered by the Chair of the OSAC Human Factors Resource Committee.

Statement of Problem and Substantiation for Public Comment

Substantiation: This change is suggested because portions of the revised definition and the discussion that follows are not necessarily correct. E.g., "Confirmation bias occurs when the investigator relies exclusively on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupportingnonsupporting data. " This sentence errs in that confirmation bias can exist and influence analyses even when an investigator does not rely exclusively on data that supports the investigator's hypothesis. Contradictory information may be considered but deemed not as powerful as evidence which confirms a favored hypothesis. The discussion also suggests that the investigator must only acknowledge one possibility, but an investigator could conclude that a particular hypothesis is most likely to be true given the evidence - say with a 95% probability of being an explanation for a fire - while acknowledging that another hypothesis cannot be entirely dismissed. But the estimate may reflect confirmation bias if a scientifically sounder estimate might give the favored hypothesis only a 75% chance of being true. Also questionable is the sentence, "A hypothesis can be said to be valid only when rigorous testing has failed to disprove the hypothesis." Surviving rigorous testing doesn't mean an hypothesis is valid because an alternative mutually exclusive hypothesis may also survive rigorous testing given the data available. If confirmation bias is affecting the investigation, an investigator may prematurely halt a search for other hypotheses that are also not excluded by the data. Hence, confirmation bias may make an investigator overtly certain of a conclusion or explanation.

Methods for limiting the likelihood and effects of expectation bias provided in the suggested revision for 4.3.9 above are also ways of minimizing the likelihood and effects of confirmation bias.

Related Item

- 921.4.3.10

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Committee:	FIA-AAA

Public Comment No. 84-NFPA 921-2023 [Section No. 4.3.10]

4.3.10* Confirmation Bias.

Confirmation bias occurs when the investigator relies on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupporting data. The same data may support alternate and even opposing hypotheses. The failure to consider alternate or opposing hypotheses, or prematurely discounting seemingly contradictory data without appropriate analysis and testing can result in incorrect conclusions. Testing a hypothesis is a process that considers all the data and alternative hypotheses to ascertain whether the tested hypothesis is inconsistent with data and, if inconsistent, whether an alternative hypothesis might also be true. When using the scientific method, testing of hypotheses should be designed to disprove a hypothesis (i.e., falsification of the hypothesis), rather than relying only on confirming data that support the hypothesis.

Additional Proposed Changes

File Name	Description	Approved
4.3.10_Confirmation_bias.docx	OSAC Human Factors Task Group comment on confirmation bias	

Statement of Problem and Substantiation for Public Comment

This change is suggested because portions of the revised definition and the discussion that follows are not necessarily correct. E.g., “Confirmation bias occurs when the investigator relies exclusively on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupporting data. “ This sentence errs in that confirmation bias can exist and influence analyses even when an investigator does not rely exclusively on data that supports the investigator’s hypothesis. Contradictory information may be considered but deemed not as powerful as evidence which confirms a favored hypothesis. The discussion also suggests that the investigator must only acknowledge one possibility, but an investigator could conclude that a particular hypothesis is most likely to be true given the evidence - say with a 95% probability of being an explanation for a fire - while acknowledging that another hypothesis cannot be entirely dismissed. But the estimate may reflect confirmation bias if a scientifically sounder estimate might give the favored hypothesis only a 75% chance of being true. Also questionable is the sentence, “A hypothesis can be said to be valid only when rigorous testing has failed to disprove the hypothesis.“ Surviving rigorous testing doesn’t mean an hypothesis is valid because an alternative mutually exclusive hypothesis may also survive rigorous testing given the data available. If confirmation bias is affecting the investigation, an investigator may prematurely halt a search for other hypotheses that are also not excluded by the data. Hence, confirmation bias may make an investigator overtly certain of a conclusion or explanation.

Methods for limiting the likelihood and effects of expectation bias (provided in the above definition for that term) are also ways of minimizing the likelihood and effects of confirmation bias.

Related Item

- Cognitive biases

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Confirmation Bias: The class of effects by which an individual's preexisting beliefs, expectations, motives, and situational contexts may influence their collection, perception or interpretation of information or their resulting judgments, decisions or confidence. It is typically characterized by a selective focus on observations or data that support a prior suspicion or belief while ignoring or unduly discounting information or evidence that might support an alternative conclusion. The first sentence of this definition draws in part on a definition, later refined by an author, in S.M. Kissing, I.E. Dror, & J. Kukucka, "The forensic confirmation bias: problems, perspectives and proposed solutions", Journal of Applied Research in memory and cognition, 2 (1)(2013) 42-52, at p. 45. The second sentence is drawn from a suggested clarification of the definition focusing on mechanism that was offered by the Chair of the OSAC Human Factors Resource Committee.

This change is suggested because portions of the revised definition and the discussion that follows are not necessarily correct. E.g., "Confirmation bias occurs when the investigator relies exclusively on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory or nonsupporting data. " This sentence errs in that confirmation bias can exist and influence analyses even when an investigator does not rely exclusively on data that supports the investigator's hypothesis. Contradictory information may be considered but deemed not as powerful as evidence which confirms a favored hypothesis. The discussion also suggests that the investigator must only acknowledge one possibility, but an investigator could conclude that a particular hypothesis is most likely to be true given the evidence - say with a 95% probability of being an explanation for a fire - while acknowledging that another hypothesis cannot be entirely dismissed. But the estimate may reflect confirmation bias if a scientifically sounder estimate might give the favored hypothesis only a 75% chance of being true. Also questionable is the sentence, "A hypothesis can be said to be valid only when rigorous testing has failed to disprove the hypothesis." Surviving rigorous testing doesn't mean an hypothesis is valid because an alternative mutually exclusive hypothesis may also survive rigorous testing given the data available. If confirmation bias is affecting the investigation, an investigator may prematurely halt a search for other hypotheses that are also not excluded by the data. Hence, confirmation bias may make an investigator overtly certain of a conclusion or explanation.

Methods for limiting the likelihood and effects of expectation bias (provided in the above definition for that term) are also ways of minimizing the likelihood and effects of confirmation bias.

Public Comment No. 96-NFPA 921-2023 [Section No. 4.5 [Excluding any Sub-Sections]]

Investigators should understand that there are various legal requirements for the admissibility of expert opinions in different jurisdictions. For example, some courts have set a threshold of certainty for the investigator to be able to render opinions in court. The substantive content of expert reports or testimony should comply with any legal rules imposed by the court or the jurisdiction in which they are provided. *[See Chapter 12 for more information regarding expert witnesses and the admissibility of expert opinions.]* Where experts express their opinions in reports or testimony, they need to articulate how they applied the scientific method and effectively communicate their hypothesis development and testing, disclosing the data collected and utilized. In both reports and testimony, experts should make their opinions transparent, which includes disclosing known limitations that are necessary to understand the significance of the findings . If an expert report is required, it should be complete and comprehensive. For further guidance on reporting and testimony, see 16.5.8.

Statement of Problem and Substantiation for Public Comment

What is required to make opinions "transparent" is not sufficiently clear and is subject to various interpretations. This sentence should be clarified to indicate that the an expert's report or testimony should not only disclose the strength of the data supporting the opinions, but also the sources of any limitations or uncertainties. The proposed revision is from the National Commission on Forensic Science, National Code of Professional Responsibility for Forensic Science and Forensic Medicine Service Providers, Rule 12 which states that expert opinions and conclusions should disclose "known limitations that are necessary to understand the significance of the findings."

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 89-NFPA 921-2023 [Section No. 16.5.8]	

Related Item

• PI No. 150 (section 4.5)

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Public Comment No. 31-NFPA 921-2022 [Section No. 5.1.2]

5.1.2 Energy, Conservation of Energy, Calculating Energy and Conversion Between Forms of Energy .

~~Energy is a property of matter that manifests as an ability to perform work, either by moving over a distance against a force or by transferring heat. Energy can be changed in form (e.g., from chemical to mechanical energy), or transferred to other matter, but it can neither be created nor destroyed. Energy is measured in joules~~
A vailable energy is the ability to do work.

A large fraction of investigation is knowing that combustibles contain chemical energy, and, when there is an ordinary fire, most of the chemical energy ends up as heat in matter, the majority of which, in most cases, escapes the fire in the form of hot gases, which leave patterns. A not-inaccurate understanding of the concept of energy is required to test hypotheses of ignition where the potential ignition is not an overwhelmingly-competent one. A not-inaccurate understanding of energy is required for devices or machinery where there are energy conversions occurring in normal operation, and one seeks to test an hypothesis that there were possibly different energy conversions occurring in abnormal operations. A better, not-inaccurate understanding of energy provides the investigator with more tools to test hypotheses.

5.1.2.1 Conservation of Energy

E nergy is a n abstract concept . Particular manifestations of energy are real, observable, and measurable. For instance, h eat in a solid raising its temperature is a particular manifestation of energy. The mechanical motion of a machine is a different particular manifestation of energy . Prior to the discovery of the law of the conservation of energy in 1740 by Émilie du Châtelet , and until its final general acceptance about 100 years later , different manifestations of energy had different names , and little association. Those burning fuel thought they were working with a different quantity (caloric) than those experimenting with electricity. The concept of energy as we use it today was created after it was finally accepted that energy is conserved , that energy is neither created nor destroyed , it only changes from one manifestation of energy to other s .

As an abstract concept, energy is not connect to matter . We are intentionally not specifying what form the energy is manifesting as . There is no weight, no number of atoms, no length, area or volume, nor a temperature specified when one states there are 100 Joules of energy present. The concept of energy is a tool to reduce a problem to only one essential quantity, “how much work could this do”, regardless of its manifestation. This process of valuation in terms of energy is not that different than valuation in commerce, to assist in transactions. Say one has an agricultural product one wants to sell, and a finished good that one wishes to buy. How does one know how much of the product ones needs to trade for the purchase? The concept of monetary value allows one to evaluate the agricultural product in dollars, and the desired product in dollars, then use a calculator to answer the question. Just like we “know” that goods have value, when we see manifestations of energy, we know there is something quantifiable there. For conservation of energy calculations , an abstract concept of energy was needed just like the number 1 is an abstract concept that is used in the process of counting, or money is the abstract concept used in commerce. One cannot scoop up a cup of numbers without the objects they are counting, or of monetary value without the products they are valuing, or energy without manifestation -- all are concepts. As a concept, abstract energy is an important tool to do physics calculations when there is a change, like a fire . Energy is a way of thinking, a starting point, like the number 1, or the concept of monetary value .

The conservation of energy allows us to write equations where the total energy on one side of the equation before a change, like a fire, equals the total energy on the other side of the equation, after th e fire . Energy equations are an important part of the physics that we use to mathematically predict and calculate. With a not-inaccurate understanding of energy, an understanding of how to evaluate the energy present , and an awareness that rigorous scientific calculations are possible , then also valid and available to the investigator are the approximate tools of estimation. Estimation can take the form of simple appraisals like more than enough , or not enough energy. An investigator might compare the relative energy content of different fuel packages with other observations in a particular case. For instance, The Ignition Handbook provides some ignition thresholds directly as an amount of energy. These are examples of valid impressions and appraisals one can form in the field, without a calculator, based on a not-inaccurate understanding of energy and how it is calculated .

5.1.2.2 Calculating Energy

Energy is measured in Joules (J), calories (cal), or British thermal units (Btu). A

~~joule~~
Joule is the heat produced where one

~~ampere~~
A mpere is passed through a resistance of one

~~ohm~~
Ohm for one second . A Watt is an energy delivery rate of one Joule delivered every second. A 1 ,

~~or it is the~~
000 Watt heater delivers 1,000 Joules per second, or 60,000 Joules per minute. The electrical energy consumption rate of appliances is measured in Watts but the delivery of radiant heat, a heat flux, can be measured in Watts also . A kiloWatt-hour is 3.6 MegaJoules. For batteries, an Ampere-hour, times a battery's nominal voltage gives Watt-hours, which multiplied by 3,600 gives Joules. A Joule is also the work required to move over a distance of one meter against a force of one

~~newton.~~
Newton. T he force of gravity causes a kilogram to exert a force of weight of about 9.806 Newtons, so, lifting a 1 kilogram 1 meter is about 9.806 Joules of work . A calorie is the amount of energy required to raise the temperature of

~~1 g~~
1 g of water by 1°C (e.g., from 14°C to 15°C); a calorie is equal to 4.

~~184 J~~
184 J . A Btu is the quantity of heat required to raise the temperature of

~~1 lb~~
1 lb of water 1°F at a pressure of 1 atmosphere and temperature of 60°F; a British thermal unit is equal to

~~1055 J~~
1055 J and 252.15 cal. Reading appliance labels, or technical data sheets may allow an investigator to acquire information relevant to energy. A comfort with simple energy calculations from source material is a powerful tool for an investigator .

The reader will notice that the energy contained as heat in hot materials by mass and temperature is, for quantities and changes that are customary , large compared to the energy of elevation of the same mass – for water, hundreds of meters are comparable to only 1 °C . The energy in burning propane is about 50 MJ/kg, which is an even more enormous amount of energy per kilogram. A not-inaccurate understanding of energy, and such l arge differences in magnitudes mean that estimation may be a very powerful way to form accurate impressions.

5.1.2.3 Work, the Limits Imposed by Thermodynamics and Some Examples for Illustration

Work is merely the desired outcome in an energy conversion. Say for instance one wishes to lift a weight. In the process of lifting the weight one is doing work on the weight and transforming the energy used into an energy of elevation, a potential energy. There is an important caveat in " Available energy is the ability to do work" . The "available" qualifier is added to not be in disagreement with the physics of Thermodynamics. If "work" is the outcome of interest of an energy conversion, when trying to change energy in one form into a particular form of work, for some conversions, there is a fraction of the original energy that must be paid (like a tax) in the form of different manifestations of energy that are not productive to the desired work. When only a small fraction of the original manifestation of energy is able to be changed into a particular type of work, we call that conversion inefficient. The amount of energy that can be turned into work is the available energ y , the "after-taxes" amount of energy .

For example, say we are investigating a fire and we are interested in the spread of the fire. W hen a material burns at a fire scene , not all of the material's stored chemical energy is transformed into heat in the gases and the solid materials around it – that part of the energy which contributes to the work of perpetuating and spreading the fire. In the process of combustion and creating hot gases, part of the energy is used in creating the new volume in the atmosphere for those gases to occupy. One can think about it as the fire is jacking up a column of the atmosphere, and putting a bubble of combustion gases under the column, which is a different type of work. This portion of the original energy is not available to heat the materials around the fire, so for the work of interest, spreading the fire, that energy is not available. Generally, the conversion of chemical energy to radiant heat and heat in matter in a fire is relatively efficient, with comparatively less energy converted to other forms. The efficiency of converting energy to heat favors estimation as a powerful tool for the fire investigator.

For comparison, the situation inside a piston combustion engine is the exact opposite – creating pressure and volume from expanding gases contributes to the desired work, to push the piston and turn the engine. Heating up the inside of the engine does not contribute to turning the crank shaft, so, it is considered wasted energy relative to the useful work. Piston engines are notoriously inefficient, with a large fraction of the initial energy of the fuel going to waste heat.

In summary, what portion of the total energy is available depends on what one considers valuable work. The key point is, though energy is conserved and the same amount of energy exists after as there was before a change, an investigator should be careful never to assume a perfect conversion of energy to a *particular type of work*.

For instance, when a full BBQ propane cylinder BLEVEs and the fuel burns rapidly, the total energy released is similar to that required to elevate the empty tank well into space. The reality is, the conversion of energy into elevation by a BLEVE is very poor; far more of the energy of a BLEVE is released as heat and light. A comparatively smaller amount is released as a destructive pressure wave. Relevant to post-fire investigation, the variation in how far propane tanks are thrown might have more to do with variations that couple a small fraction more of the original energy on top of a small conversion of energy to movement. For instance, a propane tank in a corner or other confinement might be thrown farther because the pressure wave is reflecting back on the tank, for added push. For instance, it would in general not be a safe assumption that full tanks are thrown farther than partially full tanks in different situations, or use the distance thrown to try to guess how full the tank was -- this sort of reasonable-sounding reasoning is just one example of analysis that might follow from an inaccurate understanding of energy and the limits on its conversions.

Different energy sources can have different couplings to a particular type of work. For instance, TNT (4.6 MJ/kg) is over 10 times less energy dense than propane (50MJ/kg) so more than 10 times as much TNT is needed to have the same energy as a mass of propane. TNT is better-suited to produce a destructive pressure wave, explaining why 200 pounds of TNT would be more destructive to structures than the BLEVE of a 20 pound BBQ propane tank, even though the tank might contain more energy. Extreme examples have been taken to caution the investigator – many other energy-to-work conversions are far more efficient. For instance, electricity converts potentially perfectly/only into heat energy in solids or liquids.

5.1.2.4 Energy is Not Exclusively a Property of Matter, With Examples

Abstract energy is more than a useful concept with units that can be compared across different manifestations of energy – it is actually an inescapable consequence of our universe. In 1915 Emmy Noether proved that if physics experiments produce the same results independent of when they are conducted (physics is time-invariant), then, without knowing anything else about the physics of the universe or whether it contains any matter, energy will be conserved in that universe. We write books on physics with the expectation the universe will not alter its physics with time and make them incorrect. So the concept of energy and conservation of energy is a fundamental property of our universe, more fundamental it turns out than the matter we see. Energy is nearly as fundamental to physics as the number 1 is to mathematics.

Therefore, energy is not exclusively a property of matter, though matter makes a convenient place to store and manifest forms of energy most of the time. Saying that energy is exclusively a property of matter is like saying money is exclusively a property of things, like pennies and gumballs, which would make a bank account not money. In reality, one's bank account and other not-tangible forms of money, and the abstract concept of money is pivotal in understanding and using money. The same is true of energy.

Separate from matter, energy can be stored in electric fields associated with high voltages. For safety reasons, voltages high enough to make electric fields relevant to origin or cause are generally not found on a fire scene. High voltages and powers are present in the high power amplifier cabinet of an air-broadcast radio or television station and in the downstream waveguides leading to the antenna. Internal components can catch fire if they start absorbing energy from the electric fields. Strong electric fields are important to every investigator in another way. The filter respirator one wears as PPE that captures the finest particulate is working by the locally very strong electric fields in the empty space around microscopic fibres.

Energy can be stored in magnetic fields associated with high currents. A ceramic may not interact with either an electric or magnetic field, but other materials might, therefore the conversion of energy from fields into energy in a material dependents on the material. Reversing magnetic fields are exploited in induction heaters, both on the residential stove top and in industry. On the stovetop, the material of the pan is chosen to convert the magnetic field energy in the space above the element into heat. Laying an ordinary combustible on an induction heater will typically not convert the energy from the magnetic field into heat and not lead to combustion. The energy is still present in the magnetic field, unconverted.

Energy can radiate across distances, whether there is air present or not, as electromagnetic radiation. There is heating-relevant microwave electromagnetic radiation pre-fire in some industrial locations. Visible light and radiant heat are two types of electromagnetic radiation common in fires. Radiant heat energy is a significant manifestation of energy in most fires.

Other forms of energy separate of ordinary matter do exist but are not of interest to fire investigators.

5.1.2.4 Summary of Energy

In conclusion, "available energy is the ability to do work" is the simplest not-inaccurate definition of the abstract concept of energy. Though energy may manifest in many different ways, it is the abstract concept of energy that is key to physics. Physics and its equations are key to analysis and prediction; which means that approximate analysis, like estimation, consistent with an accurate understanding of energy, may enable the investigator to forming accurate impressions in investigations. A comfort with simple energy calculations from source material is a powerful tool for an investigator. The magnitudes of energies from various sources are often not even close to comparable, meaning simple estimation can frequently result in accurate impressions. Lastly, the investigator is cautioned not to assume that all of the original energy present will convert into a particular type of work; generally some of the original energy goes on to manifest as different forms of energy that do nothing to contribute to the work of interest.

Statement of Problem and Substantiation for Public Comment

First I have to say, the editing interface is irritating. Between saving and editing again, for some reason the occasional space between words is removed, concatenating two words together. If creating a space between words that is persistent is more complicated that my using the space bar on my computer, then there is a problem. The red underlines help me find most of the errors introduced, however, I caught one where "as a" was concatenated into "asa" and it was not underlined, so, I nearly missed it. I cannot imagine that this will lead to less frustration by those receiving my comments, and editing them for what look like grammatical errors where I did not press the space bar.

The fallacy that energy is exclusively a property of matter limits one's ability to comprehend its true nature as a concept used for counting, like the natural numbers are used for counting, or money is used for counting value. One has to clearly separate the real physical manifestations of energy from the concept of energy to truly understand energy. To do otherwise leaves investigators with an understanding of energy that is equivalent to a child's understanding of money on the scale of pennies and gumballs. I think most investigators have already easily comprehended that money is much more than that, and comparisons to money I believe is a shortcut for investigators to reach the same mature understanding and comfort with energy has they have with money. What is money, really, is a very difficult question to answer, that most people cannot answer, but, they have a working knowledge of money. Most people are satisfied and comfortable with a working understanding of money and simply do not ask harder questions. Similarly, what is energy, really, is a question that is difficult to answer in the same way, however, but drawing parallels with something people have a working knowledge and comfort with the question can be functionally answered.

The danger of having an inaccurate understanding of energy as a concept used to compute conversions from one manifestation of energy to another is, it is easy to implicitly make orders of magnitude errors in energy in a hypothesis. I have seen this happen, particularly in appliances and machinery, particularly by non-engineer investigators. Simple estimations consistent with a proper understanding of energy would have allowed the investigator to eliminate a hypothesis that is wrong by orders of magnitude (a factor of 10, 100, 1000, 10000 etc). I point out how there are natural orders of magnitude difference between the scale of energy present in different manifestations of energy with chemical energy being largest, heat energy being in the middle and mechanical energy being the smallest.... Sound energy is even smaller, but not relevant to investigation so is left out. Without comfort and tools to understand how to estimate energy, appreciate the conversion between forms, and understand that is the purpose of energy, errors like this will continue to be made.

I truly believe that investigators are ready to understand energy as well as they understand money, and mentally evaluate two hypotheses and understand how far different they really are when measured in energy. That does not mean that a single stone cannot start a landslide, but, examining the large falling things, the nearby blasting, the 400hp compaction machines as better candidates recognizes the disparate energies.

Finally, it looks bad on NFPA921 that such inaccurate understandings of something properly understood for more than 100 years are part of the document. I would sooner see my submission edited by a butcher than see a hobbled understanding of one of the most important concepts lead to wrong-by-orders-of-magnitude conclusions for another 3 years.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 30-NFPA 921-2022 [Section No. 3.3.57]	The definition 3.3.57 the definition edit is linked to the 5.1.2 main section on energy.
Public Comment No. 30-NFPA 921-2022 [Section No. 3.3.57]	

Related Item

• The definition 3.3.57 the definition edit is linked to the 5.1.2 main section on energy.

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Public Comment No. 9-NFPA 921-2022 [Section No. 5.1.5.1 [Excluding any Sub-Sections]]

A fuel is any substance that can undergo combustion. The majority of fuels encountered are organic, which simply means that they are carbon-based and may contain other elements such as hydrogen, oxygen, and nitrogen in varying ratios. Examples of organic fuels include wood, plastics, gasoline, alcohol, and natural gas. Inorganic fuels contain no carbon and include combustible metals, such as magnesium or sodium. All matter can exist in nature in one of

~~three~~
four natural low energy states: solid, liquid, gas, or

~~gas~~
plasma . The state of a given material depends on the temperature and pressure and can change as conditions vary. If cold enough, carbon dioxide, for

~~example~~
ex ample , can exist as a solid (dry ice). The normal state of a material is that which exists at NTP (normal temperature and pressure) conditions: 20°C (68°F) temperature, and a pressure of 101.6 kPa (14.7 psi), or 1 atmosphere at sea level.

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Statement of Problem and Substantiation for Public Comment

The issue with the text, ("All matter can exist in one of three states: solid, liquid, or gas."), is that it is widely regarded in the scientific community that there are four naturally occurring fundamental states of matter here on earth. The current passage neglects to mention plasma. Plasma, though not as common as the first three, is a state of matter all around us in everyday life. It is the state of matter that a lightning bolt consists of. It is in our plasma TV's, plasma coatings, plasma cutting torches, neon signs and our ionosphere.
There are many additional states of low energy matter such as Bose-Einstein condensate, supercritical fluid, degenerate matter, Fermionic condensate, superconductivity, superfluid, supersolid, heavy Fermion materials, string-net liquid, dropton, quantum spin liquid, black superionic ice, Rydberg polaron, and time crystals. There is also a high energy state of matter that is quark-gluon plasma. However, all of these states of matter are man-made or at least on this earth they are.
I feel the man made states of matter need not be addressed in the text of 921. That said, for what is held as the worlds most authoritative scientific document on fire investigation it is a glaring lack of scientific knowledge to negate the plasma state of matter.
I am aware that there are four subcategories of solids but again that likely does need to be addressed in 921.

Related Item

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Public Comment No. 11-NFPA 921-2022 [Section No. 5.3.3]

5.3.3

Combustion products exist in ~~all~~ three <u>of the four low energy natural</u> states of matter: solid, liquid, and gas. Solid material makes up the ash and soot products that represent the visible "smoke." Many of the other products of incomplete combustion exist as vapors or as extremely small tarry droplets or aerosols. These vapors and droplets often condense on surfaces that are cooler than the smoke, resulting in smoke patterns that can be used to help determine the origin and spread of the fire. Such surfaces include walls, ceilings, and glass. Because the condensation of residue results from temperature differences between the smoke body and the affected surface, the presence of a deposit is evidence that smoke did engulf the surface, but the lack of deposit or the presence of a sharp line of demarcation is not evidence of the limits of smoke involvement.

Statement of Problem and Substantiation for Public Comment

The problem with the statement"Combustion products exist in all three states of matter: solid, liquid, and gas." is that it is widely regarded in the scientific community that there are four naturally occurring fundamental states of matter here on earth. The current passage neglects to mention plasma. Plasma, though not as common as the first three, is a state of matter all around us in everyday life. It is the state of matter that a lightning bolt consists of. It is in our plasma TV's, plasma coatings, plasma cutting torches, neon signs and our ionosphere.

There are many additional states of low energy matter such as Bose-Einstein condensate, supercritical fluid, degenerate matter, Fermionic condensate, superconductivity, superfluid, supersolid, heavy Fermion materials, string-net liquid, dropton, quantum spin liquid, black superionic ice, Rydberg polaron, and time crystals. There is also a high energy state of matter that is quark-gluon plasma. However, all of these states of matter are man-made or at least on this earth they are.

I feel the man made states of matter need not be addressed in the text of 921. That said, for what is held as the worlds most authoritative scientific document on fire investigation it is a glaring lack of scientific knowledge to negate the plasma state of matter.

I am aware that there are four subcategories of solids but again that likely does need to be addressed in 921.

This proposal is related to a proposal to 5.1.5.1

<u>Related Item</u>

- 5.3.3 and 5.1.5.1

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Public Comment No. 41-NFPA 921-2022 [Section No. 6.1.2.2]

6.1.2.2

Fire effects are the observable or measurable changes in or on a material or a system as a result of a fire. They can be documented as an observation or measurement of smoke or heat affecting individual materials or items (e.g., wood, gypsum board, glass, light bulbs). Examples of this type of fire effect would be observing soot deposition on gypsum board, charred wood, or mass loss to a sofa. Subparagraphs 6.1.2.2.1 to 6.1.2.2.4 serve as examples of fire effect categories that are routinely observed.

6.1.2.2.1 Deformation.

The visible or measurable change in shape represented as bending, buckling, or distortion of an item is known as deformation. Many materials change shape temporarily or permanently during fires. Nearly all materials expand when heated. That expansion can affect the integrity of the structure, which results in observations of bending, buckling, or distortion.

6.1.2.2.2 Deposition.

Soot, which is predominantly carbon, is produced from combustion of carbon-based fuels. Smoke and soot can deposit and settle out of the heated gases from the fire as they encounter cooler surfaces. Deposition of soot and smoke changes the color and texture of the surface. The observation of the lack of soot and smoke deposition is also important for fire investigators for reconstruction and location purposes.

6.1.2.2.3 Discoloration.

Materials that are increased in temperature, change phase, and are chemically changed by exposure to heat often result in a change of color to the affected surface.

6.1.2.2.4 Mass Loss.

As liquid and solid materials are heated and undergo physical and chemical changes, the original material is being converted to a gas. This loss of mass from the original material results in an observable change to the material.

REFERENCE: Gorbett, G. E., Meacham, B. J., Wood, C. B., and Dembsey, N. A., Use of Damage in Fire Investigation: A Review of Fire Patterns Analysis, Research, and Future Direction, *Fire Science Reviews* **4**:4 (2015).

Statement of Problem and Substantiation for Public Comment

Add an important reference to the new material

Related Item

- 6.1.2.2

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Public Comment No. 28-NFPA 921-2022 [Section No. 6.2.1.3]

6.2.1.3

Exposure of materials to the products of combustion can also lead to damage that may be useful to the investigator. Smoke contains particulates, liquid aerosols, and gases. The deposition of smoke/soot onto surface linings and contents within an enclosure stems from the following:

(1) Inertial impaction

(2) Sedimentation

(3) Thermophoresis (temperature gradient)

6.2.1.3

Exposure of materials to the products of combustion can also lead to damage that may be useful to the investigator. Smoke contains particulates, liquid aerosols, and gases. The deposition of smoke/soot onto surface linings and contents within an enclosure stems from the following:

(1)* Inertial impaction

(2) Sedimentation

(3)* Thermophoresis (temperature gradient)

Statement of Problem and Substantiation for Public Comment

A.6.3.1.4 (1) Inertial impaction

The word or definition does not appear in the current edition of 921 or the Merriam-Webster Dictionary. The definition was found at https://www.sciencedirect.com/topics/engineering/inertial-impaction

A.6.3.1.4 (3) Thermophoresis (temperature gradient)

The word or definition does not appear in the current edition of 921 or the Merriam-Webster Dictionary. The definition was found at https://www.sciencedirect.com/topics/chemical-engineering/thermophoresis

Adding the words to the appendix section directing where the approved definition could be located should be considered.

Related Item

- Public Input

Submitter Information Verification

Submitter Full Name: Brian Gordon

Organization: Palm Beach County Fire Rescue

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Submittal Date: Tue Dec 06 10:05:25 EST 2022

Committee: FIA-AAA

Public Comment No. 48-NFPA 921-2022 [Section No. 6.6.2.1]

6.6.2.1 Visual Characteristics of Melting Caused by Fire.

Conductors melted by fire commonly exhibit the following characteristics:

(1) Blistering and distortion of the surface *[see Figure 6.6.2.1(a) and Figure 6.6.2.1(b)]*

(2) The flow of molten material due to the effects of gravity *[see Figure 6.6.2.1(c)]*

(3) Extended area of damage *[see Figure 6.6.2.1(d)]*

(4) Absence of a sharp line of demarcation *[see Figure 6.6.2.1(e)]*

(5) Gradual thinning or necking of the conductor — assuming this is not due to a mechanical break *[see Figure 6.6.2.1(f)]*

(6) Loss of strand integrity in stranded wiring (i.e., strands fused together) *[see Figure 6.6.2.1(g)]*

(7) Round or irregular globules *[see Figure 6.6.2.1(h)]*

(8) Loss of surface characteristics and tool makrs created during the manufacturing process, such as lines created by drawing the wire through a die [see Figure 6.6.2.1(i)]

(9) Low internal porosity when viewed in a cross section *[see Figure 6.6.2.1(i j)]*

Figure 6.6.2.1(a) Copper Conductors Heated by Fire and Exhibiting Blistering and Distortion on their Surface. This damage was created during a test burn.

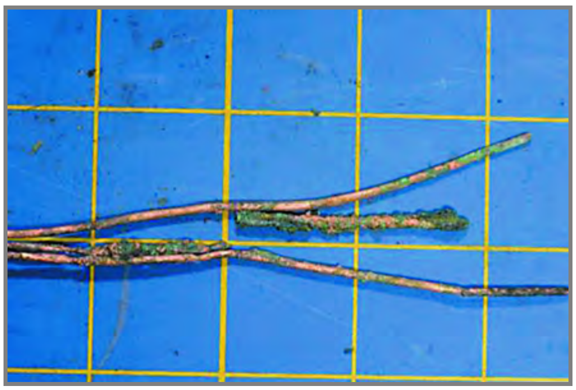


Figure 6.6.2.1(b) Closer View of the Blistering and Distortion of the Conductors in Figure 6.6.2.1(a).

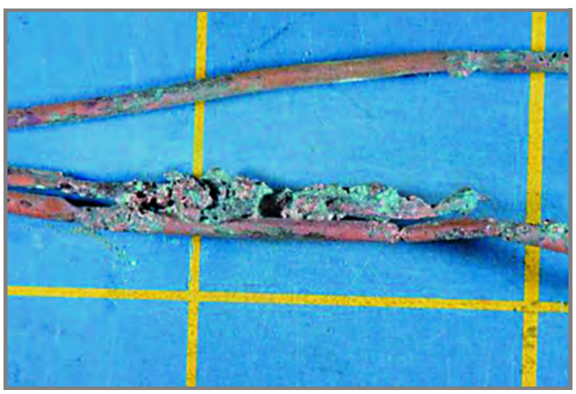


Figure 6.6.2.1(c) Copper Conductors Heated by Fire and Exhibiting the Flow of Molten Material Due to Gravity. This damage was created during a test burn.

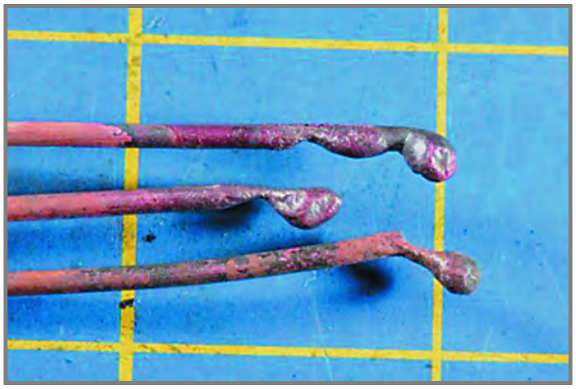


Figure 6.6.2.1(d) Copper Conductors Heated by Fire and Exhibiting an Extended Area of Damage. This damage was created during a test burn.

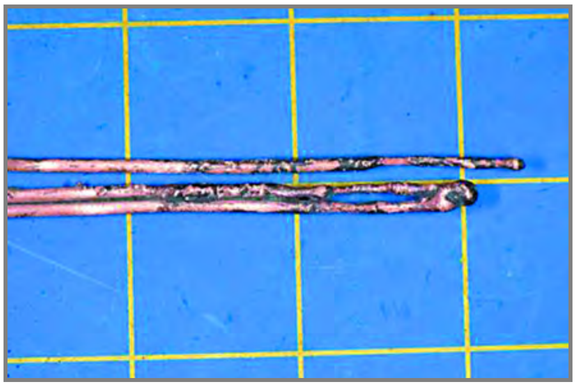


Figure 6.6.2.1(e) Copper Conductors Heated by Fire and Exhibiting the Absence of a Clean Line of Demarcation. This damage was created during a test burn.

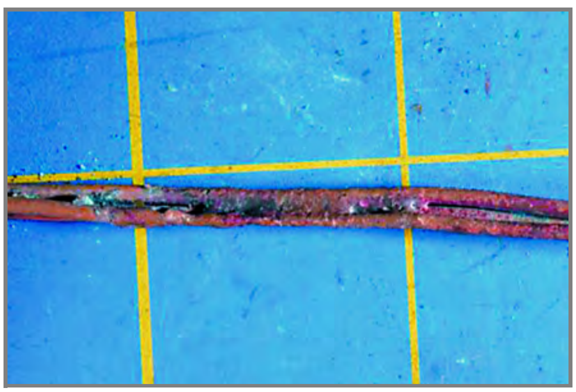


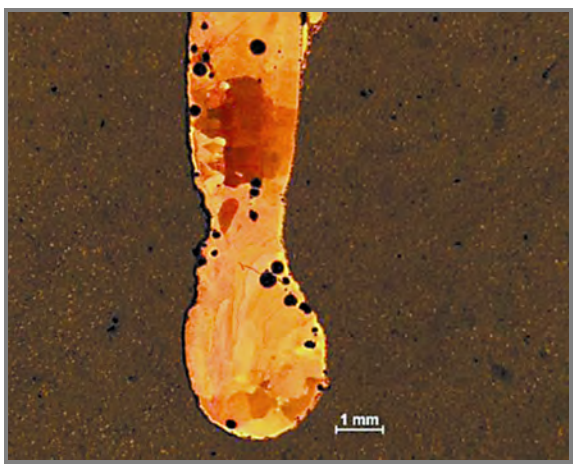
Figure 6.6.2.1(f) Copper Conductors Heated by Fire and Exhibiting Gradual Thinning of the Conductor.

Figure 6.6.2.1(g) Stranded Copper Conductors Heated by Fire and Exhibiting the Loss of Strand Integrity of the Individual Strands.

Figure 6.6.2.1(h) Copper Conductors Heated by Fire and Exhibiting Round or Irregular-Shaped Globules. This damage was created during a test burn.

<u>Figure 6.6.2.1(i) Copper conductors heated by fire and exhibiting a loss of surface characteristics and tool marks from the manufacturing process. This damage was created during a test burn.</u>

Figure 6.6.2.1(~~i~~ j) Copper Conductors Heated by Fire and Exhibiting Low Internal Porosity When Viewed in Cross- Section. This damage was created during a lab test.



Additional Proposed Changes

File Name	Description	Approved
P6140005.JPG		
Permissions_Letter_-_C._Novak_12-2022_Signed.pdf		

Statement of Problem and Substantiation for Public Comment

This comment is submitted on behalf of the Arc Mapping Task Group.

The Chapter 6 Task Group requested that a different photograph be submitted for this characteristic during the first revision. Characteristics #8 in the list for 6.6.2.1 was deleted improperly, as TG6 requested that the figure and caption be removed only. However, with a replacement photograph, everything can be put back in the document. Adding a new color figure provides a new photograph showing each characteristic of fire melting, which did not previously exist.

Related Item

- Public Input 205

Submitter Information Verification

Submitter Full Name:	Cameron Novak
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Submittal Date:	Thu Dec 29 13:34:45 EST 2022
Committee:	FIA-AAA

Public Comment No. 51-NFPA 921-2022 [Section No. 6.6.2.2]

6.6.2.2 ~~Copper Conductors~~ Conductor Sizes and Materials .

The fire effects in 6.6.2.1 apply to copper conductors of the size commonly used in structural electrical systems, typically no smaller than 0.75 mm^2 (18 AWG) stranded.

Statement of Problem and Substantiation for Public Comment

This is submitted on behalf of the Arc Mapping Task Group.

The title in the first draft was not created by the Arc Mapping Task Group. The updated title is more consistent with the subject being discussed.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 52-NFPA 921-2022 [Section No. 6.6.5.4]	

Related Item

- Public Input 207

Submitter Information Verification

Submitter Full Name:	Cameron Novak
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Submittal Date:	Thu Dec 29 13:54:07 EST 2022
Committee:	FIA-AAA

Public Comment No. 53-NFPA 921-2022 [Section No. 6.6.5.2]

6.6.5.2 ~~Parting Arcs.~~

~~The parting arc~~

Arcing melts the metal only at the point of ~~initial~~ contact of the arc. The adjacent surfaces will be unmelted unless fire or some other event causes subsequent melting. In the event of subsequent melting, it may be difficult to identify the site of the initial arcing event~~, short circuit, or ground fault~~ . If the conductor or other metal object involved in the arcing ~~event, short circuit, or ground fault was~~ event was bare of insulation at the time of the ~~faulting~~ fault , there may be spatter of metal onto the otherwise unmelted adjacent surfaces.

Statement of Problem and Substantiation for Public Comment

This is submitted on behalf of the Arc Mapping Task Group.

This is related to PI 213. The title should be removed because the text was updated by the task group to generically discuss all arcing, not just parting arcs. The text was also updated in the PI, though the updates were not captured in the first draft. The updated text reflects the text submitted in the PI.

Related Item

- Public Input 213

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 15-NFPA 921-2022 [Section No. 6.6.5.3.2]

6.6.5.3.2 Arc Damage.

The following characteristics are commonly exhibited for arc-damaged conductors:

(1) Sharp line of demarcation between damaged and undamaged area *[see Figure 6.6.5.3.2(a)]*

(2) Round, smooth shape of the artifact *[see Figure 6.6.5.3.2(b)]*

(3) Localized point of contact *[see Figure 6.6.5.3.2(c)]*

(4) Identifiable corresponding area of damage on the opposing conductor or conducting materials *[see Figure 6.6.5.3.2(d)]*

(5) Molten particles (i.e., sparks) sprayed from the arc location and deposited on nearby surfaces *[see Figure 6.6.5.3.2(e)]*

(6) Resolidification waves *[see Figure 6.6.5.3.2(f)]*

(7) Copper drawing lines visible outside the damaged area; surface characteristics and tool marks created during the manufacturing process, such as lines created by drawing the wire through a die, are visible outside the damaged area *[see Figure 6.6.5.3.2(g)]*

(8) Localized, round depressions or notches in the sides of conductors *[see Figure 6.6.5.3.2(h)]*

(9) Small beads and divots over a limited area *[see Figure 6.6.5.3.2(i)]*

(10) Rounded or irregular-shaped beading on the remains of a conductor *[see Figure 6.6.5.3.2(j)]*

(11) A bead within a notch *[see Figure 6.6.5.3.2(k)]*

(12) High internal porosity when viewed in a cross section *[see Figure 6.6.5.3.2(l) and Figure 6.6.5.3.2(m)]*

(13) Locally enlarged grain size in the resolidifed material *[see Figure 6.6.5.3.2(n)]*

Figure 6.6.5.3.2(a) Nonmetallic Sheathed (Type NM) Cable Exhibiting a Sharp Line of Demarcation Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

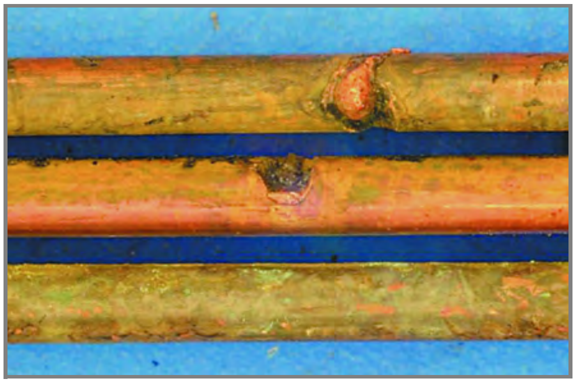


Figure 6.6.5.3.2(b) Nonmetallic Sheathed (Type NM) Cable Exhibiting a Round, Smooth Shape Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(c) Nonmetallic Sheathed (Type NM) Cable Exhibiting Localized Contact Areas of Damage Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(d) Nonmetallic Sheathed (Type NM) Cable Exhibiting Corresponding Areas of Damage Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(e) Mass Transfer in the Form of Molten Material Sprayed from the Arc Location in a Steel Enclosure.

Figure 6.6.5.3.2(f) An Arc Site on a Nonmetallic Sheathed (Type NM) Cable that Exhibits Resolidification Waves. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

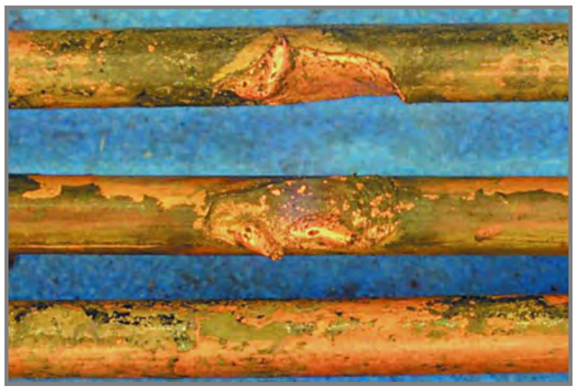


Figure 6.6.5.3.2(g) Nonmetallic Sheathed (Type NM) Cable Exhibiting Manufacturing Toolmarks Visible Outside the Arc-Damaged Area. This damage was created during a lab test.

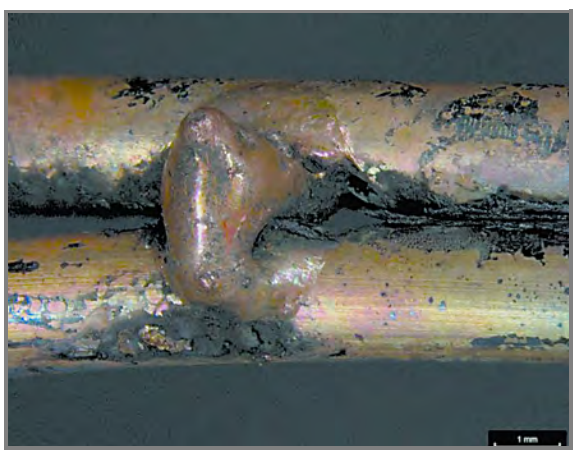


Figure 6.6.5.3.2(h) Nonmetallic Sheathed (Type NM) Cable Exhibiting Localized, Round Depressions/Notches in the Sides of the Conductors Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

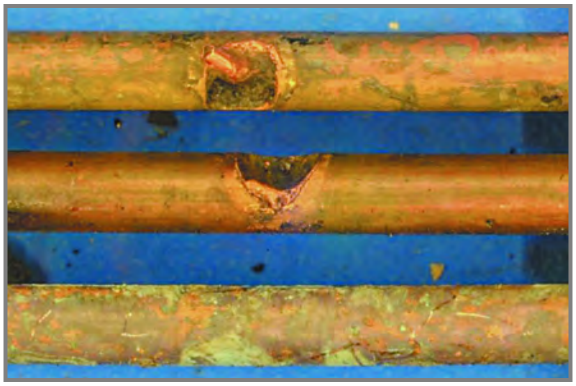


Figure 6.6.5.3.2(i) Copper Conductors Exhibiting Small Beads and Divots over a Limited Area Created by an Electrical Arc. This damage was created during a lab test.

Figure 6.6.5.3.2(j) Nonmetallic Sheathed (Type NM) Cable with Rounded or Irregular-Shaped Beading Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(k) A Bead Within a Notch Created by an Electrical Arc on a Nonmetallic Sheathed (Type NM) Cable. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(l) Overall View of an Arc Site with High Internal Porosity Visible ~~aAfter~~ After Cross-Sectioning. This damage was created during a lab test.

Figure 6.6.5.3.2(m) Close-Up View of Figure 6.3.21.5.3(l) with High Internal Porosity.

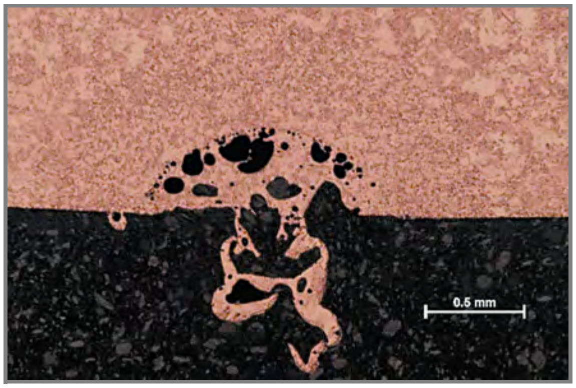
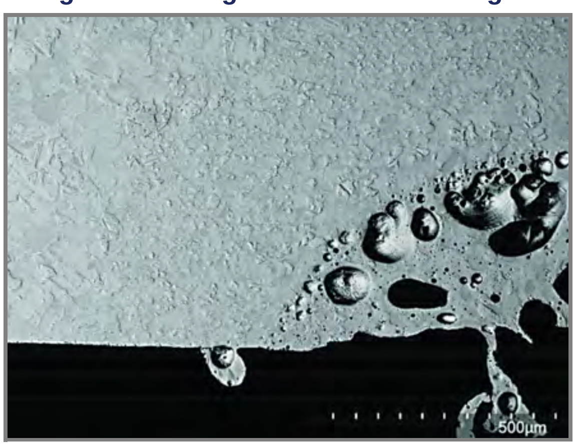


Figure 6.6.5.3.2(n) Locally Enlarged Grain Size of the Resolidified Material of an Arc Site after Cross-Sectioning. This damage was created during a lab test.



Statement of Problem and Substantiation for Public Comment

Fix spelling

Related Item

- Figure title

Submitter Information Verification

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Submittal Date:	Thu Dec 01 17:52:52 EST 2022
Committee:	FIA-AAA

Public Comment No. 55-NFPA 921-2022 [Section No. 6.6.5.3.2]

6.6.5.3.2 Arc Damage.

The following characteristics are commonly exhibited for arc-damaged conductors:

(1) Sharp line of demarcation between damaged and undamaged area *[see Figure 6.6.5.3.2(a)]*

(2) Round, smooth shape of the artifact *[see Figure 6.6.5.3.2(b)]*

(3) Localized point of contact *[see Figure 6.6.5.3.2(c)]*

(4) Identifiable corresponding area of damage on the opposing conductor or conducting materials *[see Figure 6.6.5.3.2(d)]*

(5) Molten particles (i.e., sparks) sprayed from the arc location and deposited on nearby surfaces *[see Figure 6.6.5.3.2(e)]*

(6) Resolidification waves *[see Figure 6.6.5.3.2(f)]*

(7) Copper drawing lines visible outside the damaged area; surface characteristics and tool marks created during the manufacturing process, such as lines created by drawing the wire through a die, are visible outside the damaged area *[see Figure 6.6.5.3.2(g)]*

(8) Localized, round depressions or notches in the sides of conductors *[see Figure 6.6.5.3.2(h)]*

(9) Small beads and divots over a limited area *[see Figure 6.6.5.3.2(i)]*

(10) Rounded or irregular-shaped beading on the remains of a conductor *[see Figure 6.6.5.3.2(j)]*

(11) A bead within a notch *[see Figure 6.6.5.3.2(k)]*

(12) High internal porosity when viewed in a cross section *[see Figure 6.6.5.3.2(l) and Figure 6.6.5.3.2(m)]*

(13) Locally enlarged grain size in the resolidifed material *[see Figure 6.6.5.3.2(n)]*

Figure 6.6.5.3.2(a) Nonmetallic Sheathed (Type NM) Cable Exhibiting a Sharp Line of Demarcation Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

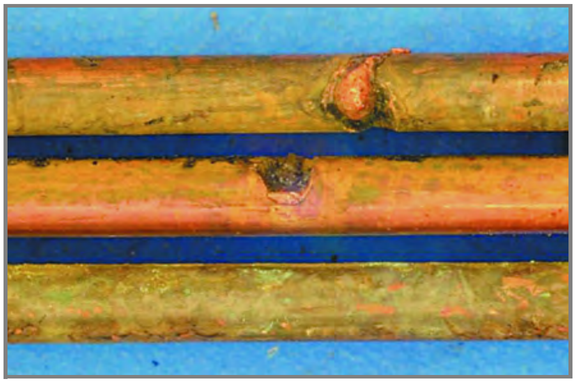

Figure 6.6.5.3.2(b) Nonmetallic Sheathed (Type NM) Cable Exhibiting a Round, Smooth Shape Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(c) Nonmetallic Sheathed (Type NM) Cable Exhibiting Localized Contact Areas of Damage Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(d) Nonmetallic Sheathed (Type NM) Cable Exhibiting Corresponding Areas of Damage Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(e) Mass Transfer in the Form of Molten Material Sprayed from the Arc Location in a Steel Enclosure.

Figure 6.6.5.3.2(f) An Arc Site on a Nonmetallic Sheathed (Type NM) Cable that Exhibits Resolidification Waves. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

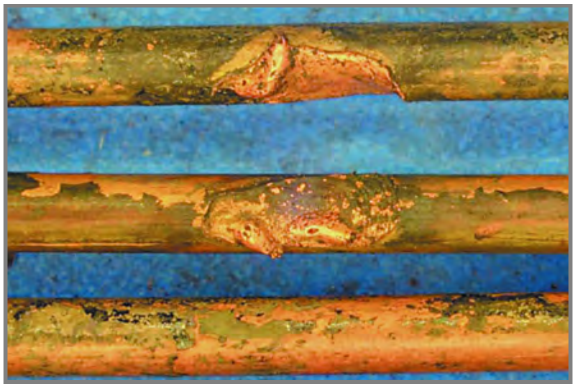

Figure 6.6.5.3.2(g) Nonmetallic Sheathed (Type NM) Cable Exhibiting Manufacturing Toolmarks Visible Outside the Arc-Damaged Area. This damage was created during a lab test.

Figure 6.6.5.3.2(h) Nonmetallic Sheathed (Type NM) Cable Exhibiting Localized, Round Depressions/Notches in the Sides of the Conductors Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

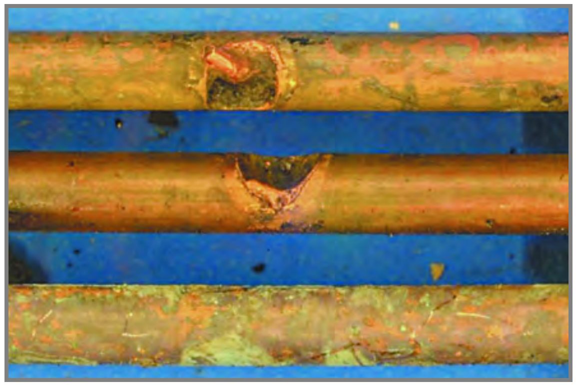

Figure 6.6.5.3.2(i) Copper Conductors Exhibiting Small Beads and Divots over a Limited Area Created by an Electrical Arc. This damage was created during a lab test.

Figure 6.6.5.3.2(j) Nonmetallic Sheathed (Type NM) Cable with Rounded or Irregular-Shaped Beading Created by an Electrical Arc. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(k) A Bead Within a Notch Created by an Electrical Arc on a Nonmetallic Sheathed (Type NM) Cable. The ungrounded (i.e., hot) conductor is at the top of the image. This damage was created during a lab test.

Figure 6.6.5.3.2(l) Overall View of an Arc Site with High Internal Porosity Visible aAfter Cross-Sectioning. This damage was created during a lab test.

Figure 6.6.5.3.2(m) Close-Up View of Figure 6.3.21.5.3(l) with High Internal Porosity.

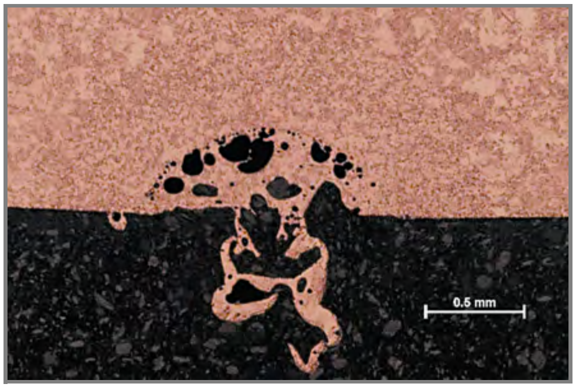

Figure 6.6.5.3.2(n) Locally Enlarged Grain Size of the Resolidified Material of an Arc Site after Cross-Sectioning. This damage was created during a lab test.

Additional Proposed Changes

File Name	Description	Approved
Grain_elongation.jpeg		
Permissions_Letter_-_Cavaroc_signed.pdf	Photograph permissions form	

Statement of Problem and Substantiation for Public Comment

This is submitted on behalf of the Arc Mapping Task Group.

The original photograph provided in PI 227 was rejected by TG6. This photograph should replace it. Adding color photographs allows each characteristic to have an accompanying figure for reference.

Related Item

- Public Input 227

Submitter Information Verification

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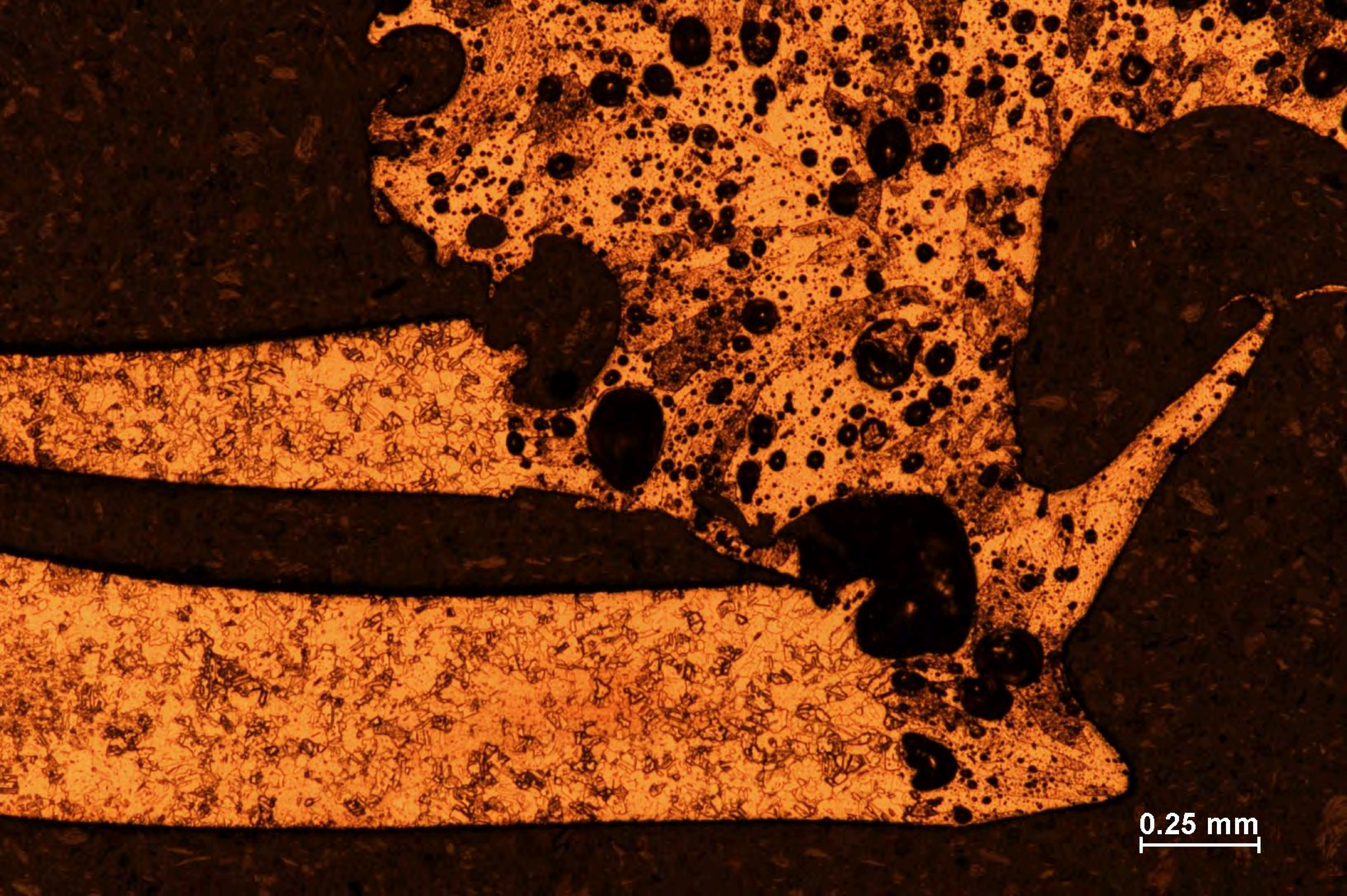
Submittal Date:	Thu Dec 29 14:31:29 EST 2022
Committee:	FIA-AAA


0.25 mm

Public Comment No. 52-NFPA 921-2022 [Section No. 6.6.5.4]

6.6.5.4 ~~Common Size~~ Conductor Sizes and Materials .

The visual effects in 6.6.5.3 only apply to copper conductors of the size commonly used in structural electrical systems, typically no smaller than $0.75 mm^2$ (18 AWG) stranded.

Statement of Problem and Substantiation for Public Comment

This is submitted on behalf of the Arc Mapping Task Group.

A title for this section was not provided by the Task Group. However, it was thought that the suggested title was more appropriate given the subject matter. It also makes the title consistent with the identical text following the section on melting by fire.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 51-NFPA 921-2022 [Section No. 6.6.2.2]	Sections with identical text and headings.

Related Item

- Public Input 228

Submitter Information Verification

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Submittal Date: Thu Dec 29 13:57:15 EST 2022

Committee: FIA-AAA

Public Comment No. 18-NFPA 921-2022 [New Section after 6.6.7]

Arc mapping results

Before discussion of details is commenced, there needs to be some introductory paragraph which explains that, next, we are going to consider the interpretation of fire patterns as found on an arc survey (and direct user to Ch. 9 for arc survey details).

Statement of Problem and Substantiation for Public Comment

There is a logical leap here. All of a sudden, the interpretation of severed wiring is undertaken, with no lead-in to explain the context. Need some paragraph to explain that next, fire patterns found from an arc survey will be discussed.

Related Item

- Ch. 9 arc surveys

Submitter Information Verification

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Submittal Date: Thu Dec 01 18:07:57 EST 2022

Committee: FIA-AAA

Public Comment No. 16-NFPA 921-2022 [Section No. 6.6.7 [Excluding any Sub-Sections]]

Need to add some introductory text here.

The start of this section assumes that severing has taken place. But does not happen every time that fire impinges on energized building wires. Suggest maybe:

"A possible effect of fire impinging upon energized structure wiring is that conductors can get severed. If this happens, ..."

The conductors downstream from the power source and the point where the conductors are severed may become de-energized. Those conductors will likely remain in the debris with part or all of their insulation destroyed. The upstream remains of the conductors between the point of arc severing and the power supply may remain energized if the overcurrent protection does not function. Those conductors can sustain further arcing through the char. In a situation with multiple arc severing on the same circuit, arc severing farthest from the power supply occurred first, but only in the cases where the ungrounded (i.e., hot) conductor is severed. If the ungrounded conductor remains intact downstream of the sever location [i.e., the grounded (neutral) or grounding (ground) conductors are severed], arcing can continue to occur. Investigators must determine what conductors were severed during the arcing event to fully evaluate this scenario. It is necessary to find as much of the conductors as possible to gather all available data. This arcing damage will indicate where the circuit was compromised by fire and thermal attack and may be useful in determining the area of origin. In branch circuits, holes extending for several inches may be seen in the conduit or in metal panels to which the conductor arced.

Statement of Problem and Substantiation for Public Comment

Some introductory text is missing from the start of this section

Related Item

- Paragraph start

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Submittal Date: Thu Dec 01 17:58:40 EST 2022
Committee: FIA-AAA

Public Comment No. 54-NFPA 921-2022 [Section No. 6.6.7.2]

6.6.7.2 ~~Assumptions.~~

Note that the situation described in 6.6.7.1 is not equivalent to concluding that "arcing moves upstream toward the power source." The latter is an erroneous assumption and not supported by science. A direction can only be imputed if there is a sever arc site and an arc site(s) downstream of the sever arc site.

Statement of Problem and Substantiation for Public Comment

This is submitted on behalf of the Arc Mapping Task Group.

The title is not necessary and is not fully representative of the following text. No title was provided in PI 253 from the task group.

Related Item

• Public Input 253

Submitter Information Verification

Submitter Full Name:	Cameron Novak
Organization:	ATF FRL
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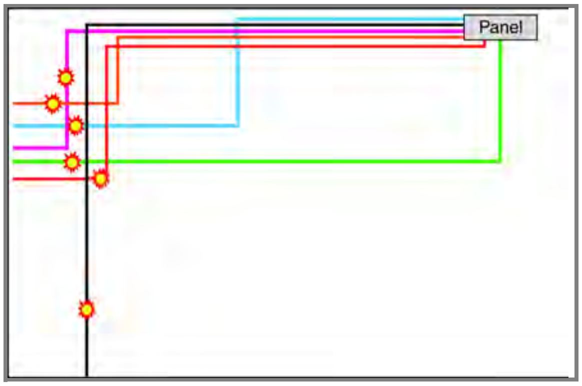
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Dec 29 14:07:38 EST 2022
Committee:	FIA-AAA

Public Comment No. 17-NFPA 921-2022 [Section No. 6.6.7.8]

~~**6.6.7.8** – Unfinished Conmpartments.~~

~~Figure 6.6.7.8 is an example of an arc map of a fire in a single, unfinished compartment with exposed wiring.~~

~~**Figure 6.6.7.8 Arc Map of an Unfinished Compartment with the Arc Sites Denoted by the Starburst Shapes.**~~



Statement of Problem and Substantiation for Public Comment

This section breaks the flow of the chapter and does not add any usable instructions.

Related Item

• Remove section

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Submittal Date: Thu Dec 01 18:05:25 EST 2022
Committee: FIA-AAA

Public Comment No. 49-NFPA 921-2022 [New Section after 6.6.11]

Self-Actuation of Switches

Research has demonstrated that residential grade, single-pole light switches which were originally in the OFF position pre-fire may self-actuate during a compartment fire. Such self-actuation can result in unenergized circuits controlled by the switch becoming energized as the compartment fire grows in magnitude. This may result in arcing in a circuit and fixtures downstream from a light switch that was originally in the OFF position prior to the fire.

Statement of Problem and Substantiation for Public Comment

This is submitted on behalf of the Arc Mapping Task Group.

The Chapter 6 Task Group initially rejected this PI due to the reference it was based on not being publicly available. The reference has since been posted online (https://nyfireinvestigators.org/wp-content/uploads/2022/06/Preliminary-Results-of-the-Investigation.pdf).

This is based on PI 163.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 12-NFPA 921-2022 [Section No. A.6.6.12]	Annex material related to the new text.

Related Item

- Public Input 163

Submitter Information Verification

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Submittal Date: Thu Dec 29 13:46:50 EST 2022

Committee: FIA-AAA

Public Comment No. 19-NFPA 921-2022 [Section No. 6.6.11.1]

6.6.11.1

Arc surveys can identify areas where the fire had damaged energized electrical conductors at some time in the fire's development. Likewise, the spatial relationship of arc sites can identify a specific space where the fire occurred before electrical energy to that space was de-energized. This information can be helpful in the analysis of origin determination and fire spread. The accuracy of the effort, however, is directly dependent upon the investigator correctly identifying the cause of the damage on electrical system components. Damage caused by nonelectrical means (e.g., fire melting, alloying, mechanical damage) can ~~mimic~~ resemble arc melting, and visual inspection at the fire scene may not be sufficient to correctly identify arc sites. If the analysis of the circuits incorrectly identifies damage on electrical system components, hypotheses formed from the analyses will be based on flawed data and will be incorrect. The investigator may need to consider collecting each perceived arc site for a more detailed evaluation and verification.

Statement of Problem and Substantiation for Public Comment

Resemble is a better word. Mimicking is normally done by animate beings.

Related Item

- 6.6.11.1

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Submittal Date: Thu Dec 01 18:15:02 EST 2022
Committee: FIA-AAA

Public Comment No. 50-NFPA 921-2022 [New Section after 6.6.11.7]

TITLE OF NEW CONTENT

6.3.21.8.9 Research has demonstrated that residential grade, single-pole light switches which were originally in the OFF position pre-fire may self-actuate during a compartment fire. Such self-actuation can result in unenergized circuits controlled by the switch becoming energized as the compartment fire grows in magnitude. This may result in arcing in a circuit and fixtures downstream from a light switch which was originally in the OFF position prior to the fire.

Statement of Problem and Substantiation for Public Comment

Substantiation: Material to be here was originally in Public Input No. 163-NFPA 921-2021 but was rejected by the TG as the material was not publicly available. It is available to the public at: https://nyfireinvestigators.org/wp-content/uploads/2022/06/Preliminary-Results-of-the-Investigation.pdf and can be found on Google.

This is the result of FEMA sponsored research. See: Powell, D., Karasinski, J., Robin, D. (2015). “Preliminary Results of the Investigation into Self- Actuation of Light Switches During Fire Exposure,” Fire Scene - Journal of the New York Fire Investigators Association, 16–26.

Related Item

- Public Input No. 163-NFPA 921-2021

Submitter Information Verification

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Submittal Date:	Thu Dec 29 13:52:53 EST 2022
Committee:	FIA-AAA

Public Comment No. 20-NFPA 921-2022 [Section No. 6.6.12]

Move this whole section on how to do arc mapping, so it comes before the section that tells you how to interpret the arc survey.

6.6.12* Arc Mapping Procedure.

6.6.12.1

Arc mapping involves several processes including arc identification, as discussed in 6.6.12.2. The arc sites first need to be found and then documented. There are a number of ways to do this work, but all seek to develop relationships among the location of the arc sites themselves as well as the relationship of the arc sites to other evidence, such as ignition sources, in the fire scene. Depending upon the requirements, some fire scenes may only be partially arc mapped or arc mapping may only be applied to a particular piece of equipment.

6.6.12.1.1

If a complete arc map is not performed in the fire-damaged areas (i.e., portions of the building or portions of conductors are not examined), conclusions drawn from the arc mapping are limited to the area that was actually examined. Unobserved locations may include behind staples or where the conductors pass through holes in studs so that the entire circumference cannot be examined.

6.6.12.2

An electrical engineer is not required to perform arc mapping. Arc mapping is fundamentally pattern recognition, which fire investigators routinely perform in other areas of fire investigation. In some cases, however, an electrical engineer may be required for calculation of available short circuit current or circuit tracing activities, but these are not necessarily required for arc mapping performed for origin determination. Similarly, a metallurgist may assist in determining whether a particular conductor anomaly is the result of an arc, as discussed in 6.6.12.3.

6.6.12.3 Locating Arc Marks.

6.6.12.3.1

Arc marks can be found on conductors, on conduit, and on grounded surfaces or surfaces of a different potential. In some cases, arcing may involve material that is not normally considered typical electrical conductors. Large arc marks through conduit can be observed particularly when they involve higher voltages and fault current associated with electrical distribution within a large plant or commercial building. Power from such circuits, still considered low voltage (<600 V) under *NFPA 70*, can provide sufficient power for substantial damage to both conductors and conduit. These can provide good locations of initial heat assaults to the conduit by examining the conduit for blowholes where the dissipated energy is sufficient to melt the conduit. Blowholes are typically large enough to be easily seen during a thorough examination of the conduit. The presence of a blowhole in conduit is indicative of arcing, but the absence of blowholes does not indicate the absence of arcing. A conduit survey that looks for blowholes is not arc mapping. Some conduit damage that appears to be a blowhole may actually be the result of alloying or external effects.

6.6.12.3.2

Conductors and conduit require a thorough examination to locate the arc marks. An adequate examination requires visual and tactile access to the entire circumference of the conduit or conductor. In addition, the examination requires bright, task-oriented lighting. The most frequently used method of examination involves running lightly gloved hands along the length of the examination subject while using bright, oblique lighting to visually observe shadows cast by the light source. This sensory input provides two inputs to assist in locating anomalies. Because arc marks as small as 1 mm (0.04 in.) have been documented, it is important that the examiner has full and ready access to the entire circumference of the subject.

6.6.12.3.3

In some cases, affirmative determination whether a particular anomaly is an arc site cannot be made in the field. In such cases, an analysis can be conducted considering the anomaly as both an arc site and as a nonelectrical artifact. The examiner can then determine if the anomaly has a significant influence on the hypotheses when applied in conjunction with other data collected during the investigation. This may be most useful for those that do not have access to experts with advanced training or equipment. The anomaly can also be collected for examination by another expert, such as a metallurgist or materials scientist.

6.6.12.3.4

For conductors in conduit, it is necessary to remove the conductors from the conduit to perform the examination. In this case, the conductor sections should be maintained in the same orientation as the conduit. They may be laid out next to the conduit so that comparisons can be made between any sites of interest and the conduit.

6.6.12.3.4.1

Maintaining the orientation also assists in documenting any findings. Caution is required when removing conductors from conduit because the conductors may be adhered to the conduit either at an arc site or as the result of corrosion. In addition, brittle conductors may break during removal. After removal of conductors from conduit, they should be thoroughly examined as described in 6.6.12.3.2.

6.6.12.3.4.2

Retention of the conductors may be accomplished either by using wire ties and securing them to the conduit from which they were removed or, if their ductility permits, rolling them into a coil.

6.6.12.3.5

Removal of loose insulation and similar material is acceptable to view the conductors. Due to copper's relatively low hardness, extreme care should be taken in using any harder tools, such as steel pliers. Non-damaging tools, such as nylon brushes and bamboo skewers, may be used for removal of this material with relatively little risk of copper damage.

6.6.12.3.6

A balance may be struck between trying to provide information in the field to the team attempting to discern origin and the necessity to get conductors into the appropriate environment for proper examination. This may necessitate marking so that conductors can be removed and examined later while maintaining appropriate orientation with respect to the scene or the circuit.

Statement of Problem and Substantiation for Public Comment

It is more logical to tell the investigator first what the should do, and only then tell them how to interpret the work product. As it is written, it first tells you how to interpret, then tells you what task you should have done. It is better to put the horse before the cart.

Related Item

- 6.6.12

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Submittal Date:	Thu Dec 01 18:17:19 EST 2022
Committee:	FIA-AAA

Public Comment No. 22-NFPA 921-2022 [Section No. 6.6.12]

6.6.12* Arc Mapping Procedure.

6.6.12.1

Arc mapping involves several processes including arc identification, as discussed in 6.6.12.2. The arc sites first need to be found and then documented. There are a number of ways to do this work, but all seek to develop relationships among the location of the arc sites themselves as well as the relationship of the arc sites to other evidence, such as ignition sources, in the fire scene. Depending upon the requirements, some fire scenes may only be partially arc mapped or arc mapping may only be applied to a particular piece of equipment.

6.6.12.1.1

If a complete arc map is not performed in the fire-damaged areas (i.e., portions of the building or portions of conductors are not examined), conclusions drawn from the arc mapping are limited to the area that was actually examined. Unobserved locations may include behind staples or where the conductors pass through holes in studs so that the entire circumference cannot be examined.

6.6.12.2

An electrical engineer is not required to perform arc mapping. Arc mapping is fundamentally pattern recognition, which fire investigators routinely perform in other areas of fire investigation. In some cases, however, an electrical engineer may be required for calculation of available short circuit current or circuit tracing activities, but these are not necessarily required for arc mapping performed for origin determination. Similarly, a metallurgist may assist in determining whether a particular conductor anomaly is the result of an arc, as discussed in 6.6.12.3.

6.6.12.3 Locating Arc Marks.

6.6.12.3.1

Arc marks can be found on conductors, on conduit, and on grounded surfaces or surfaces of a different potential. In some cases, arcing may involve material that is not normally considered typical electrical conductors. Large arc marks through conduit can be observed particularly when they involve higher voltages and fault current associated with electrical distribution within a large plant or commercial building. Power from such circuits, still considered low voltage (<600 V) under *NFPA 70*, can provide sufficient power for substantial damage to both conductors and conduit. These can provide good locations of initial heat assaults to the conduit by examining the conduit for blowholes where the dissipated energy is sufficient to melt the conduit. Blowholes are typically large enough to be easily seen during a thorough examination of the conduit. The presence of a blowhole in conduit is indicative of arcing, but the absence of blowholes does not indicate the absence of arcing. A conduit survey that looks for blowholes is not arc mapping. Some conduit damage that appears to be a blowhole may actually be the result of alloying or external effects.

6.6.12.3.2

Conductors and conduit require a thorough examination to locate the arc marks. An adequate examination requires visual and tactile access to the entire circumference of the conduit or conductor. In addition, the examination requires bright, task-oriented lighting. The most frequently used method of examination involves running lightly gloved hands along the length of the examination subject while using bright, oblique lighting to visually observe shadows cast by the light source. This sensory input provides two inputs to assist in locating anomalies. Because arc marks as small as 1 mm (0.04 in.) have been documented, it is important that the examiner has full and ready access to the entire circumference of the subject.

6.6.12.3.3

In some cases, affirmative determination whether a particular anomaly is an arc site cannot be made in the field. In such cases, an analysis can be conducted considering the anomaly as both an arc site and as a nonelectrical artifact. The examiner can then determine if the anomaly has a significant influence on the hypotheses when applied in conjunction with other data collected during the investigation. This may be most useful for those that do not have access to experts with advanced training or equipment. The anomaly can also be collected for examination by another expert, such as a metallurgist or materials scientist.

6.6.12.3.4

For conductors in conduit, it is necessary to remove the conductors from the conduit to perform the examination. In this case, the conductor sections should be maintained in the same orientation as the conduit. They may be laid out next to the conduit so that comparisons can be made between any sites of interest and the conduit.

6.6.12.3.4.1

Maintaining the orientation also assists in documenting any findings. Caution is required when removing conductors from conduit because the conductors may be adhered to the conduit either at an arc site or as the result of corrosion. In addition, brittle conductors may break during removal. After removal of conductors from conduit, they should be thoroughly examined as described in 6.6.12.3.2.

6.6.12.3.4.2

Retention of the conductors may be accomplished either by using wire ties and securing them to the conduit from which they were removed or, if their ductility permits, rolling them into a coil.

6.6.12.3.5

Removal of loose insulation and similar material is acceptable to view the conductors. Due to copper's relatively low hardness, extreme care should be taken in using any harder tools, such as steel pliers. Non-damaging tools, such as nylon brushes and bamboo skewers, may be used for removal of this material with relatively little risk of copper damage.

6.6.12.3.6

A balance may be struck between trying to provide information in the field to the team attempting to discern origin and the necessity to get conductors into the appropriate environment for proper examination. This may necessitate marking so that conductors can be removed and examined later while maintaining appropriate orientation with respect to the scene or the circuit.

Statement of Problem and Substantiation for Public Comment

A few cycles back, NFPA 70 was changed so that "low voltage" is now below 1000 V, not 600 V. NFPA 921 should be consistent with this. By the way, the reason was due to the needs of the photovoltaic array folks, where they may have outputs above 600 V, but below 1000 V. See NEC Sec. 110.34

Related Item

- 6.6.12.3.1

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Submittal Date: Thu Dec 01 18:25:00 EST 2022
Committee: FIA-AAA

Public Comment No. 21-NFPA 921-2022 [Section No. 6.6.12.3.1]

6.6.12.3.1

Arc marks can be found on conductors, on conduit, and on grounded surfaces or surfaces of a different potential. In some cases, arcing may involve material that is not normally considered typical electrical conductors. Large arc marks through conduit can be observed particularly when they involve higher voltages and fault current associated with electrical distribution within a large plant or commercial building. Power from such circuits, still considered low voltage (~~<600 V~~ <1000 V) under *NFPA 70*, can provide sufficient power for substantial damage to both conductors and conduit. These can provide good locations of initial heat assaults to the conduit by examining the conduit for blowholes where the dissipated energy is sufficient to melt the conduit. Blowholes are typically large enough to be easily seen during a thorough examination of the conduit. The presence of a blowhole in conduit is indicative of arcing, but the absence of blowholes does not indicate the absence of arcing. A conduit survey that looks for blowholes is not arc mapping. Some conduit damage that appears to be a blowhole may actually be the result of alloying or external effects.

Statement of Problem and Substantiation for Public Comment

A few cycles back the NEC was changes so that now low voltage is below 1000 V, not 600 V. See NEC Sec. 110.34
NFPA 921 should be consistent with this.

Related Item

- 6.6.12.3.1

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Committee:	FIA-AAA

Public Comment No. 59-NFPA 921-2023 [New Section after 9.10.3.1]

TITLE OF NEW CONTENT

Type your content here ...(Below is a proposed re-write of the poor connection section with just what we propose. I tried to paste in the entire section with cross-outs, but the cross-outs would not copy, so we deleted them for this submittal. A Word document will be emailed to Dave Powell that shows the cross-outs. Text in this body in parentheses are comments and not proposed to be in 921.)

9.10.3* Overheating Connections.

Connection points are one of the most likely places for overheating to occur on a circuit. A common cause of the overheating can be a loose connection that develops resistive oxides in series with the circuit load at the point of connection. Oxides may be created during the overheating process due to electrical conduction through solid oxides or molten oxides (called a filament). [See Figure 9.10.3.]

Figure 9.10.3 Filament of Liquid Oxide Present During the Overheating Process After Two Solid Wires Were Severed and Then Brought Back into Contact While Carrying Electrical Current.

(Use photo of filament previously submitted by CK)

9.10.3.1

Overheated connections may include one or more of the following characteristics on conductors located at or near electrical connections:

(1) Metals at an overheating connection will be more severely oxidized than similar metals with equivalent exposure to the fire. For example, an overheated connection on a duplex receptacle will be more severely damaged than the other connections on that receptacle.

(2) The conductor and terminal parts may have pitted surfaces or may have sustained a loss of mass where poor contact has been made.

(3) A loss of mass can appear as missing metal or tapering of the conductor.

(4) A gain in mass may appear as an expanded conductor due to the growth of oxide and the addition of oxygen to the solid materials present.

(5) Overheating at a connection can result in the thermal damage and charring of materials adjacent to the connection.

(6) Heat can be transferred along conductors attached to the overheated connection, resulting in charring or loss of the conductor's insulation. The charring or loss of plastic insulation may allow arcing to occur.

(7) A sharp line of demarcation between damaged and undamaged areas on the conductors. For example, surface characteristics and tool marks created during the manufacturing process, such as lines created by drawing the wire through a die, are visible outside the damaged area. [See Figure 9.10.3.2(a).]

(8) Evidence of molten oxide ejecta or spatter on adjacent surfaces.

(9) Remnant of an oxide filament.

(10) Evidence of series or parting arcs.

(11) The oxide mass involved in a glowing connection is brittle when solid and may fracture away from the adjacent metallic conductors during or after a fire.

(12) Banding or ripples on the exterior surface of a formerly molten mass of oxide. These ripples are indicative of a molten pool and can resemble the appearance of a weld bead surface. The ripples are created when the filament moves to different locations of the connection area. This can occur slowly over the course of several hours. The example shown in Figures 9.10.3.3(a) and 9.10.3.3(b) display these ripples on the surface of the circumferential oxide mass around the screw.

(13) Damage mates in series

(14) A formerly molten oxide mass may exhibit visually as a globule with an appearance similar to a metallic conductor melted by parallel arcing or fire heat alone. [See Figure 9.10.3.1.]

Figure 9.10.3.1 Rounded globule of formerly molten oxide formed after the molten oxide on a stranded conductor severed while carrying the load current.

(A new photo of a rounded globule on stranded wire to be added. I will attempt to add this to the later page for graphics and this will be included in the Word document to be sent to Dave Powell.)

9.10.3.2

These effects are more likely to survive the fire when copper conductors are connected to steel terminals. Where brass or aluminum are involved at the connection, the metals are more likely to be melted than pitted. This melting can occur either from resistance heating or from the fire. Pitting also can be caused by alloying. (See 6.6.3.) Such arc damage may survive the fire. [See Figure 9.10.3.2(a) through Figure 9.10.3.2(d).]

Figure 9.10.3.2(a) Overheated Connection on 208 V 3-Phase Fuse Terminal.

(Use same photo as is shown in 921 altready)

Figure 9.10.3.2(b) Overheated Connections on Two-Pole Circuit Breakers.

(Use same photo as is shown in 921 altready)

Figure 9.10.3.2(c) Overheated Connection on 240 V Dryer Outlet.

(Use same photo as is shown in 921 altready)

Figure 9.10.3.2(d) Overheated Connection on 120 V Duplex Outlet.

(Use same photo as is shown in 921 altready)

9.10.3.3* Overheating in Duplex Receptacles

Overheating of poor electrical connections in duplex receptacles can lead to glowing connections [see Figure 9.10.3.2(d)]. Persistence of glowing connections can produce distinct evidence including copper conductors transformed into molten oxide masses around steel screw terminals [see Figure 9.10.3.3(a)], melted-open and severed conductors at or near the screw head [see Figure 9.10.3.3(b)], and enlarged screw heads due to severe high-temperature oxidation [see Figure 9.10.3.3(c)]. IThese types of evidence can be unique in appearance compared to melting and arcing events from external fire exposure. Poor connections may also exist at the point where the male plug blade contacts the internal receiver, or bus, of the duplex receptacle. The investigator should also find evidence of a loose or poor electrical connection.

Figure 9.10.3.3(a) Melted Circumferential Oxide Mass Resulting from Glowing Connection Between a Copper Pigtail Conductor Around a Steel Screw Terminal

(Use same photo as is shown in 921 altready)

Figure 9.10.3.3(b) Melted Open Oxide Mass and Severed Copper Conductor Near Screw Terminal Resulting from Glowing Connection.

(Use same photo as is shown in 921 altready)

Figure 9.10.3.3(c) Enlarged Screw Head on Duplex Outlet Resulting from Severe High-Temperature Oxidation Adjacent to Glowing Connection.

(Use same photo as is shown in 921 altready)

Additional Proposed Changes

File Name	Description	Approved
Final_redline_First_Revision_No._84-NFPA_921-2022_Section_No._23.1.3_ck_comments.docx	Final redlined revision for poor connection section	
Final_clean_copy_First_Revision_No._84-NFPA_921-2022_Section_No._23.1.3_ck_comments.docx	Final clean revision for poor connection section	

Statement of Problem and Substantiation for Public Comment

These changes will add more accurate and newly published information on how poor connections are formed and how this relates to what an investigator might find at a fire scene after a poor connection occurred to ignite the fire. This information is based upon research performed by Chris and Tim Korinek. Tim's recent paper, "Investigation and Analysis of Poor Electrical Connections", published through NAFE will be sent to NFPA as supplementary material.

Related Item

- PI

Submitter Information Verification

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Submittal Date:	Tue Jan 03 18:57:32 EST 2023

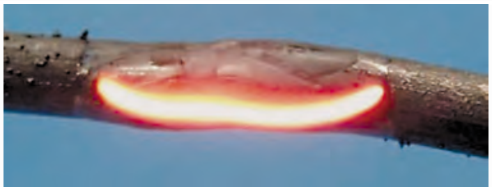
Committee:	FIA-AAA

First Revision No. 84-NFPA 921-2022 [Section No. 9.10.4]

9.10.3* Overheating Connections.

Connection points are one of the most likely places for overheating to occur on a circuit. ~~The most likely~~A common cause of the overheating ~~will~~can be a loose connection~~, or~~ that developes~~the presence of~~ resistive oxides in series with the circuit load at the point of connection. ~~Metals at an overheating connection will be more severely oxidized than similar metals with equivalent exposure to the fire. For example, an overheated connection on a duplex receptacle will be more severely damaged than the other connections on that receptacle. The conductor and terminal parts may have pitted surfaces or may have sustained a loss of mass where poor contact has been made. This loss of mass can appear as missing metal or tapering of the conductor. These effects are more likely to survive the fire when copper conductors are connected to steel terminals. Where brass or aluminum are involved at the connection, the metals are more likely to be melted than pitted. This melting can occur either from resistance heating or from the fire. Pitting also can be caused by alloying. *(See 9.10.6.3.)* Overheating at a connection can result in the thermal damage and charring of materials adjacent to the connection. Heat can be transferred along conductors attached to the overheated connection, resulting in charring or loss of the conductor's insulation. The charring or loss of plastic insulation may allow arcing to occur. Such arc damage may survive the fire. *[See Figure 9.10.4(a) through Figure 9.10.4(d).]*~~, ~~or~~ ~~o~~Oxides may be created during the overheating process due to electrical conduction through solid oxides or molten oxides (called a filament). *[See Figure 9.10.3.]*

Figure 9.10.3 Filament of Liquid Oxide Present During the Overheating Process After Two Solid Wires Were Severed and Then Brought Back into Contact While Carrying Electrical Current.



9.10.3.1

Overheated connections may include one or more of the following characteristics on conductors located at or near electrical connections:

(1) Metals at an overheating connection will be more severely oxidized than similar metals with equivalent exposure to the fire. For example, an overheated connection on a duplex receptacle will be more severely damaged than the other connections on that receptacle.

(2) The conductor and terminal parts may have pitted surfaces or may have sustained a loss of mass where poor contact has been made.

(3) ~~This~~A loss of mass can appear as missing metal or tapering of the conductor.

(4) A gain in mass may appear as an expanded conductor due to the growth of oxide and the addition of oxygen to the solid materials present.

(5) Overheating at a connection can result in the thermal damage and charring of materials adjacent to the connection.

(6) Heat can be transferred along conductors attached to the overheated connection, resulting in charring or loss of the conductor's insulation. The charring or loss of plastic insulation may allow arcing to occur.

(7) A sharp line of demarcation between damaged and undamaged areas on the conductors. For example, surface characteristics and tool marks created during the manufacturing process, such as lines created by drawing the wire through a die, are visible outside the damaged area. *[See Figure 9.10.3.2(a).]*

(8) Evidence of molten oxide ejecta or ~~splatter~~ spatter on adjacent surfaces.

Commented [KC1]: We've standardized on this word

(9) Remnant of an oxide filament.

(10) Evidence of series or parting arcs.

(11) ~~Fracture~~The oxide mass involved in a glowing connection is brittle when solid ~~cool~~ and may fracture away from the adjacent metallic conductors during or after a fire.

(12) Banding or ripples on the exterior surface of a formerly molten mass of oxide. These ripples are indicative of a molten pool or filament and can resemble the appearance of a weld bead surface. The ripples are created when the filament moves to different locations of the connection area. This can occur slowly over the course of several hours. The example shown in Figures 9.10.3.3(a) and 9.10.3.3(b) display these ripples on the surface of the circumferential oxide mass around the screw. ~~(which can be thought of as a remnant of an oxide filament)~~

(13) Damage mates in series

(14~~3~~) ~~Round or smooth shape~~ A formerly molten oxide mass may exhibit visually as a globule with an appearance similar to a metallic conductor melted by parallel arcing or fire heat alone. *[See Figure 9.10.3.1.]*

Figure 9.10.3.1 Rounded globule of formerly molten oxide formed after the molten oxide on a stranded conductor severed while carrying the load current.

9.10.3.2

These effects are more likely to survive the fire when copper conductors are connected to steel terminals. Where brass or aluminum are involved at the connection, the metals are more likely to be melted than pitted. This melting can occur either from resistance heating or from the fire. Pitting also can be caused by alloying. *(See 6.6.3.)* Such arc damage may survive the fire. *[See Figure 9.10.3.2(a) through Figure 9.10.3.2(d).]*

Figure 9.10.3.2(a) Overheated Connection on 208 V 3-Phase Fuse Terminal.

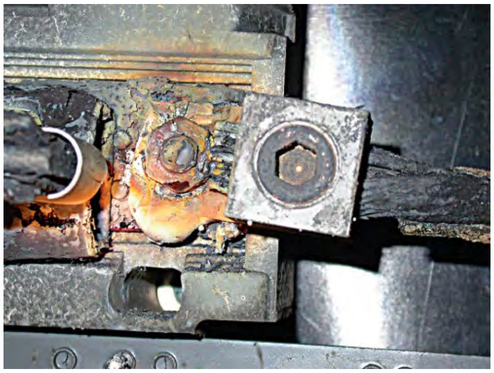
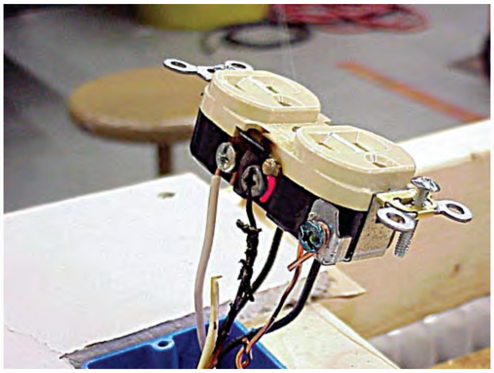


Figure 9.10.3.2(b) Overheated Connections on Two-Pole Circuit Breakers.

Figure 9.10.3.2(c) Overheated Connection on 240 V Dryer Outlet.

Figure 9.10.3.2(d) Overheated Connection on 120 V Duplex Outlet.



9.10.3.3* Overheating in Duplex Receptacles

Overheating of poor electrical connections in duplex receptacles can lead to glowing connections *[see Figure 9.10.3.2(d)]*. Persistence of glowing connections can produce distinct evidence including ~~melted~~ copper conductors transformed into molten oxide masses around steel screw terminals *[see Figure 9.10.3.3(a)]*, melted-open and severed ~~copper~~ conductors at or near the screw head *[see Figure 9.10.3.3(b)]*, and enlarged screw heads due to severe ~~corrosion~~ high-temperature oxidation *[see Figure 9.10.3.3(c)]*. These types of evidence ~~are~~ can be unique in appearance compared to melting and arcing events from external fire exposure. Poor connections may also exist at the point where the male plug blade contacts the internal receiver, or bus, of the duplex receptacle. The investigator should also find evidence of a loose or poor electrical connection.

Figure 9.10.3.3(a) Melted Circumferential Oxide Mass Resulting from Glowing Connection Between a Copper Pigtail Conductor Around a Steel Screw Terminal ~~Resulting from Glowing Connection.~~

Commented [KT2]: It would not be correct to represent this as being molten copper.

Figure 9.10.3.3(b) Melted Open Oxide Mass and Severed Copper Conductor Near Screw Terminal Resulting from Glowing Connection.

Commented [KT3]: Nothing in this photo that is visible on the surface is composed of metallic copper. Practically speaking, the only metallic copper in this photo is the core of the wire on the left hand side, which is hidden under a layer of oxide. The tip of the wire has a cap of formerly molten oxide with a crater in the center from a series parting arc that occurred when the molten oxide bridge melted open.

Figure 9.10.3.3(c) Enlarged Screw Head on Duplex Outlet Resulting from Severe High-Temperature Oxidation ~~Corrosion and~~ Adjacent to Glowing Connection.

Supplemental Information

File Name	Description	Approved
Chapter_9_9_10_4_FR_84.docx	Chapter 9 9_10_4 FR_84	
Chapter_9_FR_84.docx	Chapter_9 9_10_4 FR_84 - Track Changes	

Submitter Information Verification

Committee: FIA-AAA

Submittal Date: Mon Jun 20 14:07:21 EDT 2022

Committee Statement

Committee Statement: This information should be in the text, but needed to be re-written in proper format and language was cleaned up.

Response Message: FR-84-NFPA 921-2022

Public Input No. 6-NFPA 921-2021 [Section No. 9.10.4]

Ballot Results

This item has passed ballot

x

35 Eligible Voters

3 Not Returned

32 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

X

Not Returned

Cabral, Michael Joseph

Grotefeld, Mark S.

Mansi, Peter

X

Affirmative All

Babrauskas, Vytenis (Vyto)

Baker, Quentin A.

Beasley, Michael

Campolo, Steve

Clinkinbeard, Karrie J.

Cox, Andrew T.

Crombie, Jr., Philip E.

Dyer, Richard A.

Gottuk, Daniel T.

Hewitt, Terry-Dawn

Horton, Jr., Thomas W.

Jason, Robin

Jones, Jr., Richard W.

Karasinski, Jason

Madrzykowski, Daniel

Maurath, Mary Ann

Ost-Prisco, Thomas

Peterman, Brian

Poore, Jason

Putorti, Jr., Anthony D.

Rinaldi, Stephen P.

Rindt, Michael

Rushton, Mike

Sauls, Mark E.

Sesniak, Joseph J.

Sing, Jr., Thomas M.

Smith, Philip C.

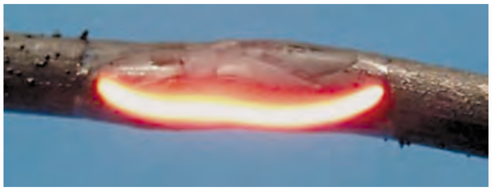
Smith, Kathryn C.
Thomas, Joseph E.
Watson, Charles (Randy)
Whitney, Russell M.
Wood, Christopher B.

First Revision No. 84-NFPA 921-2022 [Section No. 9.10.4]

9.10.3* Overheating Connections.

Connection points are one of the most likely places for overheating to occur on a circuit. A common cause of the overheating can be a loose connection that develops resistive oxides in series with the circuit load at the point of connection. Oxides may be created during the overheating process due to electrical conduction through solid oxides or molten oxides (called a filament). *[See Figure 9.10.3.]*

Figure 9.10.3 Filament of Liquid Oxide Present During the Overheating Process After Two Solid Wires Were Severed and Then Brought Back into Contact While Carrying Electrical Current.



9.10.3.1

Overheated connections may include one or more of the following characteristics on conductors located at or near electrical connections:

(1) Metals at an overheating connection will be more severely oxidized than similar metals with equivalent exposure to the fire. For example, an overheated connection on a duplex receptacle will be more severely damaged than the other connections on that receptacle.

(2) The conductor and terminal parts may have pitted surfaces or may have sustained a loss of mass where poor contact has been made.

(3) A loss of mass can appear as missing metal or tapering of the conductor.

(4) A gain in mass may appear as an expanded conductor due to the growth of oxide and the addition of oxygen to the solid materials present.

(5) Overheating at a connection can result in the thermal damage and charring of materials adjacent to the connection.

(6) Heat can be transferred along conductors attached to the overheated connection, resulting in charring or loss of the conductor's insulation. The charring or loss of plastic insulation may allow arcing to occur.

(7) A sharp line of demarcation between damaged and undamaged areas on the conductors. For example, surface characteristics and tool marks created during the manufacturing process, such as lines created by drawing the wire through a die, are visible outside the damaged area. *[See Figure 9.10.3.2(a).]*

(8) Evidence of molten oxide ejecta or spatter on adjacent surfaces.

(9) Remnant of an oxide filament.

(10) Evidence of series or parting arcs.

(11) The oxide mass involved in a glowing connection is brittle when solid and may fracture away from the adjacent metallic conductors during or after a fire.

(12) Banding or ripples on the exterior surface of a formerly molten mass of oxide. These ripples are indicative of a molten pool and can resemble the appearance of a weld bead surface. The ripples are created when the filament moves to different locations of the connection area. This can occur slowly over the course of several hours. The example shown in Figures 9.10.3.3(a) and 9.10.3.3(b) display these ripples on the surface of the circumferential oxide mass around the screw.

(13) Damage mates in series

(14) A formerly molten oxide mass may exhibit visually as a globule with an appearance similar to a metallic conductor melted by parallel arcing or fire heat alone. *[See Figure 9.10.3.1.]*

Figure 9.10.3.1 Rounded globule of formerly molten oxide formed after the molten oxide on a stranded conductor severed while carrying the load current.

9.10.3.2

These effects are more likely to survive the fire when copper conductors are connected to steel terminals. Where brass or aluminum are involved at the connection, the metals are more likely to be melted than pitted. This melting can occur either from resistance heating or from the fire. Pitting also can be caused by alloying. *(See 6.6.3.)* Such arc damage may survive the fire. *[See Figure 9.10.3.2(a) through Figure 9.10.3.2(d).]*

Figure 9.10.3.2(a) Overheated Connection on 208 V 3-Phase Fuse Terminal.

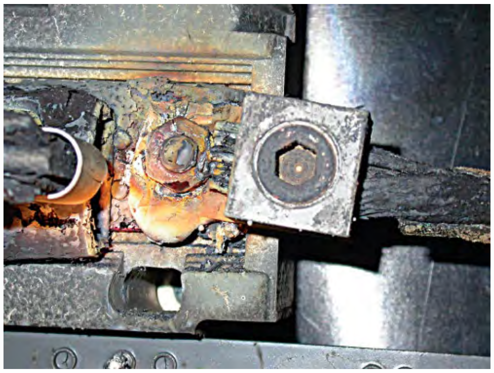
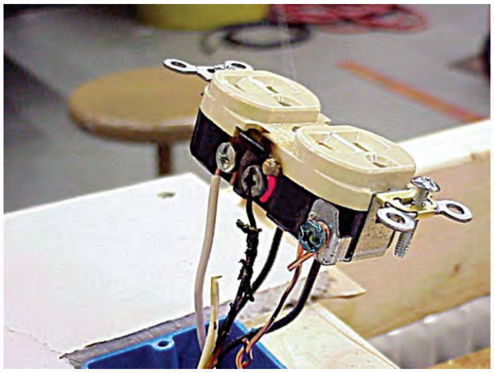


Figure 9.10.3.2(b) Overheated Connections on Two-Pole Circuit Breakers.

Figure 9.10.3.2(c) Overheated Connection on 240 V Dryer Outlet.

Figure 9.10.3.2(d) Overheated Connection on 120 V Duplex Outlet.



9.10.3.3* Overheating in Duplex Receptacles

Overheating of poor electrical connections in duplex receptacles can lead to glowing connections *[see Figure 9.10.3.2(d)]*. Persistence of glowing connections can produce distinct evidence including copper conductors transformed into molten oxide masses around steel screw terminals *[see Figure 9.10.3.3(a)]*, melted-open and severed conductors at or near the screw head *[see Figure 9.10.3.3(b)]*, and enlarged screw heads due to severe high-temperature oxidation *[see Figure 9.10.3.3(c)]*. IThese types of evidence can be unique in appearance compared to melting and arcing events from external fire exposure. Poor connections may also exist at the point where the male plug blade contacts the internal receiver, or bus, of the duplex receptacle. The investigator should also find evidence of a loose or poor electrical connection.

Figure 9.10.3.3(a) Melted Circumferential Oxide Mass Resulting from Glowing Connection Between a Copper Pigtail Conductor Around a Steel Screw Terminal

Figure 9.10.3.3(b) Melted Open Oxide Mass and Severed Copper Conductor Near Screw Terminal Resulting from Glowing Connection.

Figure 9.10.3.3(c) Enlarged Screw Head on Duplex Outlet Resulting from Severe High-Temperature Oxidation Adjacent to Glowing Connection.

Commented [KT1]: It would not be correct to represent this as being molten copper.

Commented [KT2]: Nothing in this photo that is visible on the surface is composed of metallic copper. Practically speaking, the only metallic copper in this photo is the core of the wire on the left hand side, which is hidden under a layer of oxide. The tip of the wire has a cap of formerly molten oxide with a crater in the center from a series parting arc that occurred when the molten oxide bridge melted open.

Supplemental Information

File Name	Description	Approved
Chapter_9_9_10_4_FR_84.docx	Chapter 9 9_10_4 FR_84	
Chapter_9_FR_84.docx	Chapter_9 9_10_4 FR_84 - Track Changes	

Submitter Information Verification

Committee: FIA-AAA

Submittal Date: Mon Jun 20 14:07:21 EDT 2022

Committee Statement

Committee Statement: This information should be in the text, but needed to be re-written in proper format and language was cleaned up.

Response Message: FR-84-NFPA 921-2022

Public Input No. 6-NFPA 921-2021 [Section No. 9.10.4]

Ballot Results

This item has passed ballot

x

35 Eligible Voters

3 Not Returned

32 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

X

Not Returned
Cabral, Michael Joseph
Grotefeld, Mark S.
Mansi, Peter
X
Affirmative All
Babrauskas, Vytenis (Vyto)
Baker, Quentin A.
Beasley, Michael
Campolo, Steve
Clinkinbeard, Karrie J.
Cox, Andrew T.
Crombie, Jr., Philip E.
Dyer, Richard A.
Gottuk, Daniel T.
Hewitt, Terry-Dawn
Horton, Jr., Thomas W.
Jason, Robin
Jones, Jr., Richard W.
Karasinski, Jason
Madrzykowski, Daniel
Maurath, Mary Ann
Ost-Prisco, Thomas
Peterman, Brian
Poore, Jason
Putorti, Jr., Anthony D.
Rinaldi, Stephen P.
Rindt, Michael
Rushton, Mike
Sauls, Mark E.
Sesniak, Joseph J.
Sing, Jr., Thomas M.
Smith, Philip C.
Smith, Kathryn C.
Thomas, Joseph E.
Watson, Charles (Randy)
Whitney, Russell M.
Wood, Christopher B.

Public Comment No. 34-NFPA 921-2022 [Section No. 9.12.9]

9.~~12~~ 13 .~~9~~ 1 Arc Surveys.

As part of the examination of an electrical system, an investigator should conduct an arc survey by examining the structure's electrical system for arc sites to aid in the determination of the fire's origin and to determine its spread. This methodology is based on the behavior of energized electrical circuits exposed to a spreading fire. The spatial relationship of the arc sites to the structure and to each other can be used in an analysis of the sequence in which the parts of the electrical system were impinged by heat or flame. This sequential data can be used in combination with other data to define the area of origin.

9.~~12.9.1~~ – 13.2

The identification of arc sites in the area of fire origin may help to identify a potential ignition source(s) for consideration. The locations of arc sites on conductors that are exposed to the developing fire, such as appliance cords, branch circuit conductors, or feeders that are in the compartment of the fire, may provide the most useful information.

9.~~12.9.2~~ – 13.3

Arc surveying involves several processes, including arc identification. The arc sites first need to be found and then documented. There are a number of ways to do this work, but all seek to develop relationships among the location of the arc sites themselves as well as the relationship of the arc sites to other evidence, such as ignition sources, in the fire scene. Depending upon the requirements, some fire scenes may only be partially arc surveys or arc surveys may only be applied to a particular piece of equipment.

9.~~12.9.3~~ – 13.4

If a complete arc survey is not performed in the fire-damaged areas (i.e., portions of the building or portions of conductors are not examined), conclusions drawn from the arc survey are limited to the area that was actually examined.

9.~~12.9.4~~ – 13.5

The arc survey involves the identification and recognition of the characteristics of arc melting and knowledge of the electrical system. A metallurgist or materials scientist may assist in determining whether a particular conductor anomaly is the result of an arc or other damage.

Statement of Problem and Substantiation for Public Comment

Arc mapping has nothing to do with static electricity. So it should be a new section, not a continuation of the static electricity section.

Related Item

- 9.12.9

Submitter Information Verification

Submitter Full Name: Vytenis "Vyto" Babrauskas

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Street Address:

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State:

Zip:

Submittal Date: Wed Dec 28 16:32:41 EST 2022

Committee: FIA-AAA

Public Comment No. 33-NFPA 921-2022 [Section No. 9.12.9 [Excluding any Sub-Sections]]

As part of the examination of an electrical system, an investigator should conduct an arc survey by examining the structure's electrical system for arc sites to aid in the determination of the fire's origin and to determine its spread. This methodology is based on the behavior of energized electrical circuits exposed to a spreading fire. ~~The~~ <u>In some cases, the</u> spatial relationship of the arc sites to the structure and to each other can be used in an analysis of the sequence in which the parts of the electrical system were impinged by heat or flame. This sequential data can be used in combination with other data to define the area of origin.

Statement of Problem and Substantiation for Public Comment

The statement is only occasionally true, not always, as it is implied. If a room on fire has two branch circuits, a fire-caused arc occurs on each, and the pertinent circuit breaker for each trips, there is no way to use this information to derive a time sequence.

If two arcs occur on one circuit, one of them is a sever arc, while the second one is downstream of the sever arc, then it may be deduced that the second one did not occur after the first one. But this is a special case, not a feature that can be utilized in any arc mapping activity

<u>Related Item</u>

- 9.12.9

Submitter Information Verification

Submitter Full Name: Vytenis "Vyto" Babrauskas
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Submittal Date: Wed Dec 28 16:26:15 EST 2022
Committee: FIA-AAA

Public Comment No. 35-NFPA 921-2022 [Section No. 9.12.10.1]

9.12.10.1

Several pieces of data should be recorded when creating an arc map. This includes information about conductor damage resulting from the arc. The arc may have caused conductors to sever, weld together, or locally melt. ~~The arc map should indicate which arc sites are either upstream or downstream from the power source feeding the circuit.~~ In addition, for the arc map to be useful in evaluating fire patterns, the arc map should indicate if there are any factors which would protect the circuits from arcing such as thermal barriers. Some examples might include where appliance cords are behind furniture, or where building conductors are behind compartment walls or ceilings.

Statement of Problem and Substantiation for Public Comment

The power source for a particular branch circuit is generally understood to be the circuit breaker feeding that circuit. There cannot be any branch circuit wiring upstream of this place, since this is where the circuit begins. Upstream is the branch circuit breaker, the main circuit breaker, and the service entrance wiring. None of these are part of the branch circuit.

Related Item

• 9.12.10.1

Submitter Information Verification

Submitter Full Name:	Vytenis “Vyto” Babrauskas
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Submittal Date:	Wed Dec 28 16:36:29 EST 2022
Committee:	FIA-AAA

Public Comment No. 36-NFPA 921-2022 [Section No. 9.12.11.1]

9.12.11.1

Arc sites ~~can~~ may potentially be found on conductors, on conduit, and on grounded surfaces or surfaces of a different voltage potential. In some cases, arcing may involve materials that are not normally considered typical electrical conductors. Large arc sites through conduit can be observed, particularly when they involve higher voltages and fault currents associated with electrical distribution within a large plant or commercial building. Power from such circuits, still considered low-voltage (~~<600~~ <1000 V) according to *NFPA 70*, can provide sufficient energy for substantial arcing damage to both conductors and conduit. Holes created by arcing are typically large enough to be easily seen during a thorough examination of the conduit. The presence of a hole in conduit may be indicative of arcing, but the absence of holes does not indicate the absence of arcing. A conduit survey that only looks for holes is not an arc survey. Alloying or external effects may also create holes in conduit.

Statement of Problem and Substantiation for Public Comment

The first sentence implies that that these locations will contain arc site. A milder wording is needed to indicate that sometimes this may be found to occur, but there should not be an expectation that such findings need to be obtained.

NFPA 70 has changed its definition of the break of high/low voltage from 600 V to 1000V, so NFPA 921 should be made consistent.

Related Item

- 9.12.11.1

Submitter Information Verification

Submitter Full Name: Vytenis “Vyto” Babrauskas

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Street Address:

City:

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Submittal Date: Wed Dec 28 16:41:16 EST 2022

Committee: FIA-AAA

Public Comment No. 37-NFPA 921-2022 [Section No. 9.14.1.1]

9.14.1.1* State-of-Charge (SOC).

~~The level~~ SOC is the level of charge of an electric battery relative to its capacity is a measure of the stored chemical energy in the battery. A fully-charged battery has SOC = 100%. Batteries at a higher SOC are more susceptible to failure due to abuse, and have a higher heat release rate compared to batteries at a lower SOC.

Statement of Problem and Substantiation for Public Comment

To clarify how the term SOC is used.

Related Item

- 9.14.1.1

Submitter Information Verification

Submitter Full Name:	Vytenis “Vyto” Babrauskas
Organization:	Fire Science and Technology In
Street Address:	
City:	
State:	
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Submittal Date:	Wed Dec 28 16:48:49 EST 2022
Committee:	FIA-AAA

Public Comment No. 120-NFPA 921-2023 [Section No. 12.1]

12.1* Introduction.

Legal considerations impact every phase of a fire investigation. Whatever the capacity in which a fire investigator functions (public or private), it is important that the investigator be informed regarding all relevant legal restrictions, requirements, obligations, standards, and duties. Failure to do so could jeopardize the reliability of any investigation and could subject the investigator to civil liability or criminal prosecution. It is the purpose of this chapter to alert the investigator to those areas that usually require legal advice, knowledge, or information. The legal considerations contained in this chapter and elsewhere in this guide pertain to the law in the United States. This chapter does not attempt to state the law as it is applied in each country or other jurisdiction. Such a task exceeds the scope of this guide. To the extent that statutes or case law are referred to, they are referred to by way of example only, and the user of this guide is reminded that “the law” is in a constant state of flux. As an analogy, both case law and statutory law can be compared to a living thing. They are constantly subject to creation (by new enactment or decision), change (by modification or amendment), and death (by being repealed, overruled, or vacated). It is recommended that the investigator seek legal counsel to assist in understanding and complying with the legal requirements of any particular jurisdiction. Recognition of applicable legal requirements and considerations will help to ensure the reliability and admissibility of the investigator's records, data, and opinions.

Statement of Problem and Substantiation for Public Comment

help legal actors

Related Item

- issue raised previously at OSAC

Submitter Information Verification

Submitter Full Name:	Andrea Roth
Organization:	UC Berkeley School of Law
Street Address:	
City:	
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Zip:	
Submittal Date:	Wed Jan 04 16:23:02 EST 2023
Committee:	FIA-AAA

Public Comment No. 122-NFPA 921-2023 [Section No. 12.2]

12.2 Constitutional Considerations.

Within the US and its territories, investigators should be aware of the constitutional safeguards that are generally applicable to criminal investigations and prosecutions as set forth in the Fourth, Fifth, and Sixth Amendments, as well as the Due Process Clause of the Fifth and Fourteenth Amendments (i.e., as reflected in the "Brady Rule") of the United States Constitution. The text of these three amendments is shown in Figure 12.2. The application of these constitutional amendments has been extended to state action under section 1 of the Fourteenth Amendment to the United States Constitution, which states " ... No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty or property without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws."

Figure 12.2 Fourth, Fifth, and Sixth Amendments to the US Constitution, and the Due Process Clauses of the Fifth and Fourteenth Amendments .

Amendment IV

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

Amendment V

No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the Militia, when in actual service in time of War or public danger; nor shall any person be subject for the same offence to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

Amendment VI

In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and to have the Assistance of Counsel for his defense.

Statement of Problem and Substantiation for Public Comment

help legal actors

Related Item

• issue raised previously at OSAC

Submitter Information Verification

Submitter Full Name: Andrea Roth
Organization: UC Berkeley School of Law
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City:
State:
Zip:

Submittal Date: Wed Jan 04 16:23:45 EST 2023

Committee: FIA-AAA

Public Comment No. 130-NFPA 921-2023 [Section No. 12.3.3]

12.3.3 Method of Entry.

Whereas "right of entry" refers to the legal authority to be on a given premise or fire scene, this section concerns itself with how that authority is obtained. There are four general methods by which entry may be obtained: consent, exigent circumstance, administrative search warrant, and criminal search warrant.

12.3.3.1 Consent.

The person in lawful control of the property can grant the investigator permission or consent to enter and remain on the property. This is a voluntary act on the part of the responsible person and can be withdrawn at any time by that person. When consent is granted, the investigator should document it. One effective method is to have the person in lawful control sign a written consent form. The investigator ~~may choose to make inquiries to~~ should inquire to ensure that the person giving consent has lawful control of the property. For example, if a tenant has rights to control leased property under a rental agreement, the property owner (landlord) may not have the immediate right to access that property, and may therefore lack the power to consent.

12.3.3.2 Exigent Circumstance.

12.3.3.2.1

It is generally recognized that the fire department has the legal authority to enter a property to control and extinguish a hostile fire. It also has been held that the fire department has an obligation to determine the origin and cause of the fire in the interest of the public good and general welfare.

12.3.3.2.2

The time period in which the investigation may continue or should conclude has been the subject of a Supreme Court decision (*Michigan v. Tyler*, 436 US 499), when the Court held that the investigation may continue for a "reasonable period of time," which may depend on many variables. When the investigator is in doubt as to what is a "reasonable time," legal advice should be sought.

12.3.3.3 Administrative Search Warrant.

12.3.3.3.1

The purpose of an administrative search warrant is generally to allow those charged with the responsibility, by ordinance or statute, to investigate the origin and cause of a fire and to fulfill their obligation according to the law. An administrative search warrant may be obtained from a court of competent jurisdiction upon a showing that consent has not been granted or has been denied. It is not issued on the traditional showing of "probable cause," as is the criminal search warrant, although it is still necessary to demonstrate that the search is reasonable. The search should be justified by a showing of reasonable governmental interest, and supported by a statute, ordinance, or regulation. If a valid public interest justifies the intrusion, then valid and reasonable probable cause has been demonstrated.

12.3.3.3.2

The scope of an administrative search warrant is limited to the investigation of the origin and cause of the fire. If during the search permitted by an administrative search warrant, evidence of a crime is discovered, the search should be stopped and a criminal search warrant should be obtained (*Michigan v. Clifford*, 464 US 287).

12.3.3.4 Criminal Search Warrant.

The purpose of a criminal search warrant is to allow the entry of government agents to search for and collect evidence of a crime, as specified in the warrant. The warrant may authorize the search of the premises, a vehicle, or a person. Government agents with the authority to apply for a search warrant as well as the court to which the application must be made are specified by federal and state laws. A government agent authorized to apply for a warrant is not necessarily authorized by statute to execute the warrant. Seeming minor defects in the application or warrant can result in the suppression of evidence. The applicant should consider consulting with legal counsel when making an application.

12.3.3.4.1

The application for obtaining a criminal search warrant typically includes the following:

(1) The kind or character of the property sought

(2) The place or person to be searched

(3) Allegations of fact, based upon the personal knowledge of the applicant or upon information and belief of the applicant, with the grounds for such belief stated, that reasonable cause exists to support statements (1) and (2)

12.3.3.4.2

The application may also contain a request that it be executed at any time of the day or night and that entry may be made without giving notice, if supported by sufficient facts.

Statement of Problem and Substantiation for Public Comment

help legal actors

Related Item

• issue raised previously at OSAC

Submitter Information Verification

Submitter Full Name: Andrea Roth

Organization: UC Berkeley School of Law

Street Address:

City:

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Submittal Date: Wed Jan 04 16:33:46 EST 2023

Committee: FIA-AAA

Public Comment No. 131-NFPA 921-2023 [Section No. 12.3.5]

12.3.5 Spoliation of Evidence.

Spoliation of evidence refers to the loss, destruction, or material alteration of an object or document that is evidence or potential evidence in a legal proceeding by one who has the responsibility for its preservation. Spoliation of evidence may occur when the movement, change, or destruction of evidence, or the alteration of the scene significantly impairs the opportunity of other interested parties to obtain the same evidentiary value from the evidence, as did any prior investigator.

12.3.5.1 Responsibility.

It is the responsibility of the investigator (or anyone who handles or examines evidence) to avoid spoliation of evidence, and the scope of that responsibility varies according to such factors as the investigator's jurisdiction, whether he or she is a public official or private sector investigator, whether criminal conduct is indicated, and applicable laws and regulations. However, regardless of the scope and responsibility of the investigation, care should be taken to avoid destruction or material destruction of evidence that later may be considered spoliation. If artifacts will be altered, the investigator should use the techniques contained in this guide to preserve the evidentiary value of those items for others who may later examine the artifacts.

12.3.5.2 Documentation.

Efforts to photograph, document, or preserve evidence should apply not only to evidence relevant to an investigator's opinions, but also to evidence inconsistent with the investigator's opinions and evidence of reasonable alternate hypotheses that were considered and ruled out.

12.3.5.3 Remedies for Spoliation.

Criminal and civil courts have applied various remedies when there has been spoliation of evidence. Remedies employed by the courts may include discovery sanctions, monetary sanctions, application of evidentiary inferences, limitations under the rules of evidence, exclusion of expert testimony, dismissal of a claim or defense, independent tort actions for the intentional or negligent destruction of evidence, and even prosecution under criminal statutes relating to obstruction of justice. Investigators should conduct their investigations so as to minimize the loss or destruction of evidence and thereby to minimize allegations of spoliation.

12.3.5.4 Notification to Interested Parties.

Claims of spoliation of evidence can be minimized when notice is given to all known interested parties that an investigation at the site of the incident is going to occur so as to allow all known interested parties the opportunity to retain experts and attend the investigation. Such notice may be made by telephone, letter, or email. Oral notification should be confirmed in writing. Notification should include the date of the incident; the nature of the incident; the incident location; the nature and extent of loss; damage, death, or injury to the extent known; the interested party’s potential connection to the incident; next action date; circumstances affecting the scene (such as pending demolition orders or environmental conditions); a request to reply by a certain date; contact information as to whom the notified person is to reply; and the identity of the individual or entity controlling the scene. The notification should also include a roster of all parties to whom notice has been provided. Public sector investigators may have different notification responsibilities than the private sector investigators. Responsibility for notification varies based on jurisdictions, scope, procedures, and the circumstances of the fire. Interested parties should make public officials aware of their interest. A private sector consent to search does not constitute notice unless it conforms with this section.

12.3.5.5 Documentation Prior to Alteration.

Anytime the investigator determines that significant alteration of the fire scene will be necessary to complete the fire investigation, it should be done, only after notification to all known interested parties has been given, and the interested parties have been afforded the opportunity to be present. Special care should be taken to photograph and document the scene and preserve relevant evidence. The scene should be properly documented prior to any alteration, and relevant evidence should be preserved. Destructive disassembly of any suspected or potential ignition sources should be avoided whenever possible to permit later forensic examination after notice is given to all known interested parties.

12.3.5.6 Alteration and Movement of Evidence.

12.3.5.6.1

Fire investigation usually requires the movement of evidence or alteration of the scene. In and of itself, such movement of evidence or alteration of the scene should not be considered spoliation of evidence. Physical evidence may need to be moved prior to the discovery of the cause of the fire. Additionally, it is recognized that it is sometimes necessary to remove the potential causative agent from the scene and even to carry out some disassembly in order to determine whether the object did, in fact, cause the fire, and which parties may have contributed to that cause. For example, the manufacturer of an appliance may not be known until after the unit has been examined for identification. Such activities should not be considered spoliation. Because all interested parties may not be identifiable prior to the alteration or movement of evidence, the investigator should use the techniques contained in this guide to preserve the evidentiary value of those items by documenting the fire scene and the artifacts prior to alteration or movement to preserve the evidentiary value of those items for others who may later become involved in the investigation.

12.3.5.6.2

Still another consideration is protection of the evidence. There may be cases where it is necessary to remove relevant evidence from a scene in order to ensure that it is protected from further damage or theft. Steps taken to protect evidence should also not be considered spoliation.

12.3.5.7 Notification Prior to Destructive Testing.

Once evidence has been removed from the scene, it should be maintained and not be destroyed or altered until others who have a reasonable interest in the matter have been notified. Any destructive testing or destructive examination of the evidence that may be necessary should occur only after all reasonably known parties have been notified in advance and given the opportunity to participate in or observe the testing. This section is not intended to apply to evidence collected as part of a criminal investigation. Once the evidence is no longer required for a criminal investigation it should be appropriately released. Guidance regarding notification can be found in ASTM E860, *Standard Practice for Examining and Preparing Items that Are or May Become Involved in Criminal or Civil Litigation,* and ASTM E1188, *Standard Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator*. Guidance for disposal of evidence may be found in Section 17.12 of this guide. Guidance for labeling of evidence can be found in ASTM E1459, *Standard Guide for Physical Evidence Labeling and Related Documentation*.

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

Submitter Full Name: Andrea Roth

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Submittal Date:	Wed Jan 04 16:34:48 EST 2023
Committee:	FIA-AAA

Public Comment No. 124-NFPA 921-2023 [Section No. 12.3.5.2]

12.3.5.2 Documentation and the "Brady Rule ."

Efforts to photograph, document, or preserve evidence should apply not only to evidence relevant to an investigator's opinions, but also to evidence inconsistent with the investigator's opinions and evidence of reasonable alternate hypotheses that were considered and ruled out. Investigators should be aware of the constitutional requirement, called the "Brady Rule," that the government violates due process by failing to disclose favorable material evidence to the defense. If an investigator works with police or prosecutors on a criminal investigation and fails to make Brady evidence known to the prosecutor, and the prosecutor fails to disclose the information, the case might end up being dismissed or reversed as a result. **Not all evidence inconsistent with the opinion may appear to rise to the level of an alternative theory based on the information the investigator has at the time but this evidence should nonetheless be preserved as it may be Brady information or otherwise information the government is required to provide.**

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date:	Wed Jan 04 16:25:33 EST 2023
Committee:	FIA-AAA

Public Comment No. 132-NFPA 921-2023 [New Section after 12.4]

12.4.1.1 Speaking with Parties Before Trial

Once a report is issued and the adjudicative process has commenced, investigators should communicate fully with all parties when requested, except when instructed that a legal privilege, protective order or law prevents disclosure.

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Related Item

- issue raised previously at OSAC

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Submittal Date: Wed Jan 04 16:38:19 EST 2023

Committee: FIA-AAA

Public Comment No. 127-NFPA 921-2023 [New Section after 12.4.2]

12.4.2.4. The Brady Rule

The "Brady" rule imposes a constitutional requirement on the prosecution team to disclose certain evidence.

12.4.2.4.1. The basic rule. In Brady v. Maryland, 373 U.S. 83, 87 (1963), the Supreme Court interpreted the Due Process Clause of the Fifth and Fourteenth Amendments to the United States Constitution to require that the prosecution team disclose to the defense all information favorable to the defense that is material to guilt or punishment. Specifically, the Court held that "the suppression by the prosecution of evidence favorable to an accused . . . violates due process where the evidence is material either to guilt or to punishment, irrespective of the good faith or bad faith of the prosecution." The failure to disclose favorable information requires reversal of a defendant's conviction whenever that evidence is "material," i.e., "if there is a reasonable probability that, had the evidence been disclosed to the defense, the result of the proceeding would have been different." United States v. Bagley, 473 U.S. 667, 682 (1985).

12.4.2.4.2. Definitions

Favorable evidence includes the following:

- Exculpatory evidence. Evidence that, if credited, tends to prove a suspect or defendant in a criminal case is factually innocent. To be exculpatory, such evidence need only be relevant in proving innocence, meaning that it makes innocence more likely than it would be without having heard the evidence. It need not itself establish innocence.
- Impeachment evidence. Evidence that, if credited, tends to cast doubt on the credibility of one or more witnesses. To be impeachment evidence, such evidence need only be relevant to a witness's lack of credibility, meaning that it makes the witness's account less credible than it would be without having heard the evidence. It need not itself establish that the witness is not credible.
- Mitigating evidence. Evidence that, if credited, tends to diminish the seriousness of the accused's alleged conduct.

12.4.2.4.3. Critical aspects of the Brady rule for investigators include:

Who is the "prosecution team." For Brady purposes, the "government" includes not only the prosecutors themselves, but other members of the prosecution team, such as police officers and, where applicable, forensic experts consulted by the prosecution, even if not reporting directly to the prosecution. See, e.g., Kyles v. Whitley, 514 U.S. 419, 437 (1995) ("[T]he individual prosecutor has a duty to learn of any favorable evidence known to the others acting on the government's behalf in the case."); In re Sealed Case (Brady Violations), 185 F.3d 887, 896 (D.C. Cir. 1999) (imputing knowledge to prosecutors in state and federal court, as well as to the Drug Enforcement Administration or any other agency operating on behalf of the same government); United States Attorney's Manual § 9-5.001(B)(2) ("Members of the prosecution team include . . . government officials participating in the investigation . . . of the criminal case.") (citing Kyles). Thus, investigators cooperating with the state in a criminal case should diligently assist the prosecutor in identifying, locating, and disclosing information favorable to the accused; and to avoid non-disclosures that could jeopardize the integrity of the proceedings and possibly require reversal of a conviction.

Err on the side of disclosure. Brady rule directs prosecutors and those on the prosecution team to "resolv[e] doubtful questions in favor of disclosure." Cone v. Bell, 129 S. Ct. 1769, 1783 n.15 (2009).

Include impeachment as well as affirmatively exculpatory evidence. "Brady" information

includes not only "exculpatory" information that directly tends to show a defendant's factual innocence (such as the absence of an accelerant under circumstances where one would expect the an accelerant to be present), but also "impeachment" evidence tending to cast doubt on the credibility or reliability of government evidence. See, e.g., Bagley, 473 U.S. 667, 676-78 (1985) (fact that police had offered a reward to two government witnesses); Giglio v. United States, 405 U.S. 150 (1972) (fact that a government witness was testifying pursuant to an agreement not to prosecute him).

Statement of Problem and Substantiation for Public Comment

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Related Item

• issue raised previously at OSAC

Submitter Information Verification

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Submittal Date: Wed Jan 04 16:31:07 EST 2023

Committee: FIA-AAA

Public Comment No. 133-NFPA 921-2023 [Section No. 12.4.2.3]

12.4.2.3* Depositions.

A deposition is a method of obtaining oral testimony under oath, whereby the witness (deponent) must answer questions of one or more of the attorneys representing the parties to a lawsuit. There are several purposes for taking a deposition. They include discovering what facts, opinions, or evidence a witness has and may offer at trial; obtaining testimony to be used in later court proceedings, such as motions; or to preserve the testimony of a witness who may be unavailable to testify at trial. A court stenographer (court reporter), who may later produce a transcript of the deposition proceedings, records depositions. It is common for depositions to also be videotaped. During a deposition the investigator should be **candid, truthful, and accurately present both the strengths of the methods used and any limitations or uncertainty associated with the methods used or the opinions researched.**

12.4.2.3.1 Procedure.

Regardless of the purpose of a deposition, the procedure for taking a deposition is almost always the same. In a deposition, the witness is obligated to swear or affirm under penalty of perjury that the testimony to be given will be the truth. The court reporter will administer the oath and record everything that is said by the witness and attorneys during the deposition. A deposition proceeds in a question-and-answer format. An attorney will ask questions of the witness, who is obligated to provide answers, unless otherwise instructed.

12.4.2.3.2 Discovery Depositions.

A discovery deposition is one that is taken to learn or discover what facts, opinions, or information a witness has. The attorney who requested the deposition will begin the questioning. Often, but not always, after the first attorney is finished asking questions, the attorneys for the other parties may also ask questions. In general, the strategy in a discovery deposition is to learn all of the facts and opinions that a witness has, the contents of the witness's file, the bias, if any, of the witness, and what testimony the witness may offer at trial. If the witness later testifies at trial in a way different from or inconsistent with his deposition testimony, the deposition testimony may be used to impeach the witness. Discovery depositions may cover a wide range of topics, including the witness's background, training, experience, qualifications, and the methodologies used by the witness in formulating any expert opinions. In these situations, a fire investigator must communicate opinions clearly and understandably. The difficulty in communicating opinions in this setting is that the investigator must communicate facts and opinions in response to questions posed by an attorney who may represent an adverse party in a proceeding in which the investigator has little control. Therefore, the investigator should understand how deposition testimony may be used in the future, and the importance of creating a record that clearly establishes an opinion and a valid basis for that opinion.

12.4.2.3.3 Trial Depositions.

A trial deposition is usually taken to preserve the testimony of a witness who may be unavailable to testify in person at the time of trial. Unlike a discovery deposition, a trial deposition is conducted by the attorney for the party wanting to offer the witness's testimony during trial, either in the case in chief, or rebuttal. Rather than taking the deposition to discover facts and opinions, the strategy in a trial deposition is to question the investigator to establish their credentials, to establish a foundation for what the investigator did, and to allow the investigator to render opinions. The investigator giving a trial deposition should be aware that cross-examination is part of the trial deposition process.

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

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Committee:	FIA-AAA

Public Comment No. 135-NFPA 921-2023 [Section No. 12.5.1.1]

12.5.1.1

Rules of evidence regulate the admissibility of proof at a trial. The purpose of rules of evidence is to ensure that the proof offered is reliable. A goal of every fire investigation is to produce reliable documents, samples, statements, information, data, and conclusions. It is not necessary that every fire investigator become an expert on rules of evidence. If the practices and procedures recommended within this guide are complied with, the results of the investigation should be reliable.

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date:	Wed Jan 04 16:42:46 EST 2023
Committee:	FIA-AAA

Public Comment No. 46-NFPA 921-2022 [Section No. 12.5.1.1]

12.5.1.1

Rules of evidence regulate the admissibility of proof at a trial. The purpose of rules of evidence is to ensure that the proof offered is reliable. A goal of every fire investigation is to produce reliable documents, samples, statements, information, data, and conclusions. It is not necessary that every fire investigator become an expert on rules of evidence. If the practices and procedures recommended within this guide are complied with, the results of the investigation should be reliable.

Revert to wording proposed in Public Input 126 with the changes as noted

12.5.1.1

Rules of evidence regulate the admissibility of proof at a trial. ~~The~~ One purpose of rules of evidence is to ensure that the proof offered is reliable. A goal of every fire investigation is to produce reliable documents, samples, statements, information, data, and conclusions. It is not necessary that every fire investigator become an expert on rules of evidence. If the practices and procedures recommended within this guide are complied with, these indices of reliability and credibility are met. Conversely, failing to follow these guidelines ~~may result in evidence or opinions being excluded.~~ may result in evidence or opinions being challenged and possibly excluded.

Statement of Problem and Substantiation for Public Comment

The Subcommittee on Fire & Explosion Investigation believes that the Technical Committee misunderstood the reasons for the proposed change. The point is to explain to investigators what they need to do so that their testimony is not excluded. The goal of this Section is to provide guidance to the investigator so that their opinions are reliable and can withstand a challenge and avoid potential exclusion.

Related Item

- First Revision 66

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 136-NFPA 921-2023 [Section No. 12.5.2.3.4]

12.5.2.3.4 Relevance.

A court will find that expert testimony is relevant if scientific, technical, or other specialized knowledge will assist the court or jury in understanding the evidence or decide the facts in the case. For example, in a case where the origin and cause of a fire is at issue, the testimony of an expert in fire origin and cause issues will typically be relevant in assisting the court or jury in understanding the issues in the case.

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date:	Wed Jan 04 16:43:45 EST 2023
Committee:	FIA-AAA

Public Comment No. 134-NFPA 921-2023 [Section No. 12.5.2.3.5]

12.5.2.3.5 Qualifications of Expert.

The court determines if a witness that is going to give expert testimony possesses the necessary qualifications to give such opinions. Typically, the court will look at the education, training, experience, or skill of the expert. Investigators should be **cautioned to render interpretations, opinions, or conclusions only when within the practitioner's proficiency or expertise.**

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date:	Wed Jan 04 16:41:38 EST 2023
Committee:	FIA-AAA

Public Comment No. 8-NFPA 921-2022 [Section No. 13.1.1]

13.1.1* Safe Workplace Duty.

Under the General Duty Clause of the US Occupational Safety and Health Administration Act of 1970 (OSHA), all ~~public~~ <u>private sector employers</u> and some ~~private~~ <u>public</u> sector employers have a responsibility to provide a safe workplace and to protect their employees from recognized hazards. Investigators and their employers are expected to comply with all OSHA regulations, standards, and practices applicable to the tasks and activities conducted at their workplace which, for fire investigators, includes fire and explosion scenes. The key to compliance with occupational safety and health regulations, and the foundation of an organization's standard operating procedures, policies, and employee training programs, is a comprehensive, written, occupational safety and health program. It is recognized that OSHA regulations may not be applicable to all readers of this guide, (e.g., investigators operating outside of the US, sole proprietors). Putting aside regulatory mandates, all fire investigators and fire investigation units (FIUs) are strongly encouraged to have written safety, health, and wellness policies.

Statement of Problem and Substantiation for Public Comment

The first draft had the public/private portions reversed. This comment is made to correct that error and to provide an accurate statement as to who is protected (i.e. all private and some public sector). See PI-86 for further clarification.

Related Item

- PI-86

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Submittal Date: Tue Oct 25 13:14:43 EDT 2022
Committee: FIA-AAA

Public Comment No. 137-NFPA 921-2023 [Section No. 14.1.1]

14.1.1 Purpose of Obtaining Information.

The scientific method requires the collection and analysis of data. This chapter is intended to provide a framework for collecting and analyzing data from sources other than the scene of the incident (non-scene data) using the scientific method. Examining the fire scene or evaluating prior documentation of the fire scene, interviewing witnesses, and conducting research and analysis of information from other sources all provide the fire investigator with additional data to establish origin and cause of a particular fire. Subsequent to the origin and cause determination, non-scene data may be helpful to evaluate responsibility for a fire. T **he investigator should come to their own independent determination based on the scene before acquiring evidence from outside the scene to prevent the investigator's opinion from being tainted by confirmatory or other bias.**

Statement of Problem and Substantiation for Public Comment

reduce bias

Related Item

- issue raised previously at OSAC

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Submittal Date: Wed Jan 04 16:45:07 EST 2023

Committee: FIA-AAA

Public Comment No. 139-NFPA 921-2023 [Section No. 14.5.1.1]

14.5.1.1 Purpose of Interviews.

Witnesses are a primary source of non-scene data in almost every incident. The investigator should identify and interview any witnesses who may have data relevant to the incident, including eyewitnesses who observed the incident and individuals familiar with the characteristics of the property or with the activities of individuals prior to, during, and after the incident. ~~Suspects~~ **Both interested and disinterested witnesses may provide** ~~incriminating statements or clearly false alibis~~ **false or misleading information .**

Statement of Problem and Substantiation for Public Comment

reduce bias

Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date: Wed Jan 04 16:46:37 EST 2023
Committee: FIA-AAA

Public Comment No. 140-NFPA 921-2023 [Section No. 14.5.1.3.1]

14.5.1.3.1

It is the responsibility of the investigator to evaluate the quality of the data obtained from the witness at the time of the interview. Both in preparing for the interview and in assessing the value of data from witness statements afterwards, the investigator should consider factors that affect the accuracy and reliability of data given by witnesses, such as the following:

(1) Matters that may have affected the witness' perception of events such as physical, mental, emotional, or circumstantial attributes of the witness — for example, witnesses of a very young or old age, witnesses with poor eyesight or hearing, witnesses affected by shock or trauma, witnesses who have mental or emotional impairments, or witnesses impaired by drugs or alcohol, or whose perceptions might be affected by other factors such as when one is awakened suddenly from sleep.

(2) Environmental circumstances that may have affected the witness' perception of events such as poor lighting, bad weather conditions, distance from places or events of interest, distractions, or actions of others.

(3) Whether the witness has access to a writing or recording that might have influenced the witness' account of events. For example, did the witness record his/her perceptions during or shortly after the incident in writing, or through audio or video means such as a phone or computer, from which they can refresh the memory of events? Did someone else make a written record or audio- or video -recording that the witness relies on to refresh their memory? Did the witness access news media, social media, or other accounts of the event before being interviewed?

(4) If the witness has accessed a writing or recording of the incident, who created it? Is it accurate or reliable (when compared with other data collected about the incident)?

(5) Was the witness able to understand the language(s) being spoken by others present at the incident?

(6) Does the witness have a personal or business interest in the incident that could affect their perceptions or description of the incident? For example, does the witness have a financial interest in the property that was the subject of the incident? Is the witness related to or somehow otherwise connected to a victim or another witness in the incident? If an offense was involved, is the witness related or connected to a suspect in the incident?

(7) Is the witness biased in some manner or being intentionally deceitful?

(8) How consistent is the witness' account of perceptions or events with data gathered from other witnesses, documents, photos, recordings, and other ESI? For example, do videos or photos of the scene corroborate that the witness had the line of sight alleged?

All information obtained, regardless of the investigator's evaluation of the quality of that information, should be retained and documented.

Statement of Problem and Substantiation for Public Comment

help legal actors

Related Item

• issue raised previously at OSAC

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Submittal Date: Wed Jan 04 16:47:18 EST 2023
Committee: FIA-AAA

Public Comment No. 141-NFPA 921-2023 [Section No. 14.5.1.5]

14.5.1.5 Documenting the Interview.

All interviews, regardless of their type, should be documented. Audio recording the interview or taking written notes during the interview are two of the most common methods of documenting the interview. An alternative method used to document interviews can be accomplished through the use of video recording. All of these methods, however, may distract or stress the person being interviewed, resulting in some information not being obtained. All recordings must be done in accordance with applicable laws and regulations. In addition, **all information obtained from non-witness sources must also be documented. Documentation should include what information was provided, who provided it and when it was provided and all documentation should be preserved for disclosure.**

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date: Wed Jan 04 16:48:02 EST 2023
Committee: FIA-AAA

Public Comment No. 142-NFPA 921-2023 [Section No. 15.1 [Excluding any Sub-Sections]]

The intent of this chapter is to identify and document basic considerations of concern to the investigator prior to beginning the incident scene investigation.

Statement of Problem and Substantiation for Public Comment

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Related Item

- issue raised previously at OSAC

Submitter Information Verification

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Submittal Date:	Wed Jan 04 16:49:08 EST 2023
Committee:	FIA-AAA

Public Comment No. 104-NFPA 921-2023 [Section No. 16.5 [Excluding any Sub-Sections]]

The decisive step in the documentation of the investigation may be the preparation and submittal of a report. The format and content of the report will depend in part on the needs of the organization or client on whose behalf the investigation was performed. When the investigator's role is that of an expert witness, it will also depend on the legal requirements for expert reports or testimony in the specific jurisdiction or court where the case is pending. Because of the variability of these requirements, no report format is prescribed here. For guidance on court-mandated reports, see Chapter 12. Generally, for guidance on reporting opinions of experts, see, *e.g.* ASTM E620 Standard Practice for Reporting Opinions of Scientific or Technical Experts (current edition) . An investigator's reports and testimony are inherently linked. Whether an investigator is providing testimony as an expert, as a layperson acting as a fact witness, or both, the investigator's report usually provides the foundations for an investigator's testimony. To the extent that this section addresses how an expert's opinions should be expressed, it deals with both reporting and testimony.

Statement of Problem and Substantiation for Public Comment

As chair of the Certainty of Opinion Task Group dealing with section 16.5, my notes indicate that this reference to ASTM E620 was approved by the Task Group and the Technical Committee. Even if my notes are incorrect, this reference to ASTM E620 is a valuable one for the users of NFPA 921 and should be included in section 16.5.

Related Item

- PI No. 254 (section 16.5)

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Committee:	FIA-AAA

Public Comment No. 89-NFPA 921-2023 [Section No. 16.5.8]

16.5.8* Expert Opinions.

When expressing expert opinions in reports or in testimony, experts should apply the following principles and those in 16.5.10:

(1) Experts' reports should be complete and comprehensive with respect to the opinions that the reports contain.

(2) Experts should prepare reports and testify using clear and straightforward terminology, clearly distinguishing data from interpretations, opinions, and conclusions and disclosing known limitations that are necessary to understand the significance of the findings.

(3) Experts should render interpretations, opinions, or conclusions only when within the practitioner's proficiency or expertise.

(4) Experts should explain how they applied the scientific method and any analyses or techniques used (such as fire pattern analysis, depth of char analysis, or arc mapping).

(5) The data collected and utilized should be disclosed.

(6) If an attorney or a court insists that experts state that an opinion is held to any threshold of certainty, experts should ask for a definition of the term as it applies in that court and ensure that the expert has sufficient confidence in the opinion to satisfy the definition provided.

(7) An expert's audience may consist of people who do not have expertise in the fire investigation discipline so experts' opinions, including how the scientific method was applied, should be communicated in terms that laypersons can understand.

(8) Where reasonably possible, experts should record sufficient detail during their investigation that would allow another fire investigation expert with proper training and experience to conduct an independent and rigorous technical review. To do so, there should be sufficient information recorded about the original investigation so that the reviewer can understand and evaluate all the work performed and independently analyze and interpret the data and draw conclusions or form opinions. This level of detail does not necessarily have to be included in the expert's report but should be recorded.

Statement of Problem and Substantiation for Public Comment

These proposed revisions are appropriate for fire investigation experts and consistent with the revisions made by the NFPA 921 Technical Committee in the First Draft. These revisions are adopted from the National Commission on Forensic Science, National Code of Professional Responsibility for Forensic Science and Forensic Medicine Service Providers, Rule 12, which states, "Prepare reports and testify using clear and straightforward terminology, clearly distinguishing data from interpretations, opinions, and conclusions and disclosing known limitations that are necessary to understand the significance of the findings." And Rule 11, which states that investigators should be cautioned to "[r]ender interpretations, opinions, or conclusions only when within the practitioner's proficiency or expertise." See https://www.justice.gov/archives/ncfs/page/file/839711/download.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 96-NFPA 921-2023 [Section No. 4.5 [Excluding any Sub-Sections]]	

Related Item

• PI No. 290 (new section in 16.5)

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Committee:	FIA-AAA

Public Comment No. 14-NFPA 921-2022 [New Section after 18.4]

Comment: After discussions and a meeting with the original submitter of this public input (No #113) which was originally rejected, I would like to re-introduce the input with further substantiation. The referenced document provides a study which provide statistical evidence to support the use of this method. The cited material shows that the use of the POD method increases the reliability and accuracy of the fire origin conclusions.

The original substantiation for the rejection of the PI was that many of the topics already exist in 921. Whilst this substantiation is still applicable, it fails to realize the value of the input in terms of reliability and validity. The PI comes with a referenced study which shows that the reliability and validity of the POD method are significantly better than without. Fire investigation has a need for research which address the topics of reliability and validity, and this public input addresses some of those needs.

Original PI:

18.4.6* Process for Origin Determination (POD)

18.4.6.1 Another method that an investigator may consider is to implement the Process for Origin Determination (POD), a seven-step reasoning process for evaluating damage in the context of fire dynamics. This systematic approach has been tested and shown to be reliable and valid. The seven steps outlined in this process for origin determination includes:

(1) Value: Every lining surface (e.g. walls, partitions, floors, ceiling) and content surfaces (e.g. furniture, appliances) within the compartment should be evaluated for fire damage. The surfaces that have not sustained fire damage do not require further evaluation within the origin determination decision process.

(2) Identify Varying Degree of Fire Damage : Identify varying degrees of fire damage to all surfaces.

(3) Identifying Fire Patterns : Each surface that exhibits a cluster of damage will be ascribed as a single pattern or grouped with other damage that has been shown to extend along other surfaces as a pattern. Thus, providing the decision maker with a discrete number of patterns that must be analyzed through step four of the process.

(4) Fire Pattern Generation : Each pattern identified should be evaluated and classified as to the likelihood of the causal link to the fire dynamic variables or other background factors that generated the fire pattern.

(5) Development of Hypothetical Area(s) of Origin : The fire patterns that are classified as plume-generated or undetermined are considered hypothetical area(s) of origin.

(6) Tests of Hypothetical Area(s) of Origin : The hypothetical area(s) of origin are established for their likelihood as being the area of origin through a series of tests to evaluated whether a fire could have originated at this location. Each hypothetical area of

origin should be evaluated considering logical considerations, witness statements, fire dynamics, and electrical system evaluation.

(7) Selection of the Final Area of Origin Conclusion : All the areas of damage that are identified to be consistent as a hypothetical area of origin in step 6 and any clusters of damage that cannot be explained are to be combined into a single, larger area that becomes the final area of origin determination.

A.18.4.6 For more information, see the following: Gorbett, G.E., Meacham, B.J., Wood, C.B. et al. Structure and Evaluation of the Process for Origin Determination in Compartment Fires. Fire Technol 53, 301–327 (2017). https://doi.org/10.1007/s10694-015-0553-3

Additional Proposed Changes

File Name	Description	Approved
gorbett2015.pdf		
gorbett2016.pdf		

Statement of Problem and Substantiation for Public Comment

The inclusion of a process for origin determination which is tested and found to be reliable. The process is not fundamentally groundbreaking or different from the approach that is encompassed in 921 Chapter 18 but it is complete and shown to be reliable (annexed document reference).

The original substantiation was that many of the concepts already exist in 921. This substantiation fails to recognize that the POD method is shown to be reliable and valid, and therefore supports many of the concepts in 921. Fire investigation has a need for studies of this type that show that the methods are in fact reliable and valid (internally and externally valid).

Related Item

- PI #113

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 56-NFPA 921-2023 [New Section after 18.4.5.2]

18.4.6* Process for Origin Determination (POD)

Public Input #113 was rejected by the TC because "it does not offer new material to the chapter". This is incorrect. The public input was outlining a specific process (Process for Origin Determination) that has underwent testing and was shown to be reliable and valid in a published, peer-reviewed journal. The simplified process summarized for purposes of the public input may have similar words/phrases, but the Process for Origin Determination is not in NFPA 921. Currently, there is no peer-reviewed, published research supporting the use of fire patterns and fire dynamics for origin determination within NFPA 921. The Process for Origin Determination summarized in the original public input is published and peer-reviewed. I cannot fathom why the TC would purposefully reject published scientific research that supports the document just because a few words/phrases can be found in other places of the text. Please reconsider adding the original Public Input #113 into the document as a new section 18.4.6.

Below is the original Public Input #113-Add New Section after 18.4.5.2

18.4.6* Process for Origin Determination (POD)

18.4.6.1 Another method that an investigator may consider is to implement the Process for Origin Determination (POD), a seven-step reasoning process for evaluating damage in the context of fire dynamics. This systematic approach has been tested and shown to be reliable and valid. The seven steps outlined in this process for origin determination includes:

(1) *Value:* Every lining surface (e.g. walls, partitions, floors, ceiling) and content surfaces (e.g. furniture, appliances) within the compartment should be evaluated for fire damage. The surfaces that have not sustained fire damage do not require further evaluation within the origin determination decision process.

(2) *Identify Varying Degree of Fire Damage* : Identify varying degrees of fire damage to all surfaces.

(3) *Identifying Fire Patterns* : Each surface that exhibits a cluster of damage will be ascribed as a single pattern or grouped with other damage that has been shown to extend along other surfaces as a pattern. Thus, providing the decision maker with a discrete number of patterns that must be analyzed through step four of the process.

(4) *Fire Pattern Generation* : Each pattern identified should be evaluated and classified as to the likelihood of the causal link to the fire dynamic variables or other background factors that generated the fire pattern.

(5) *Development of Hypothetical Area(s) of Origin* : The fire patterns that are classified as plume-generated or undetermined are considered hypothetical area(s) of origin.

(6) *Tests of Hypothetical Area(s) of Origin* : The hypothetical area(s) of origin are established for their likelihood as being the area of origin through a series of tests to evaluated whether a fire could have originated at this location. Each hypothetical area of origin should be evaluated considering logical considerations, witness statements, fire dynamics, and electrical system evaluation.

(7) *Selection of the Final Area of Origin Conclusion* : All the areas of damage that are identified to be consistent as a hypothetical area of origin in step 6 and any clusters of damage that cannot be explained are to be combined into a single, larger area that becomes the final area of origin determination.

A.18.4.6

For more information, see the following:

Gorbett, G.E., Meacham, B.J., Wood, C.B. *et al.* Structure and Evaluation of the Process for Origin Determination in Compartment Fires. *Fire Technol* **53,** 301–327 (2017). https://doi.org/10.1007/s10694-015-0553-3

Statement of Problem and Substantiation for Public Comment

Public Input #113 was rejected by the TC because "it does not offer new material to the chapter". This is incorrect. The public input was outlining a specific process (Process for Origin Determination) that has underwent testing and was shown to be reliable and valid in a published, peer-reviewed journal. The simplified process summarized for purposes of the public input may have similar words/phrases, but the Process for Origin Determination is not in NFPA 921. Currently, there is no peer-reviewed, published research supporting the use of fire patterns and fire dynamics for origin determination within NFPA 921. The Process for Origin Determination summarized in the original public input is published and peer-reviewed. I cannot fathom why the TC would purposefully reject published scientific research that supports the document just because a few words/phrases can be found in other places of the text. Please reconsider adding the original Public Input #113 into the document as a new section 18.4.6.

Related Item

- PI 113

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 129-NFPA 921-2023 [Section No. 19.8.2]

19.8.2* Fire Cause Classification for Reports.

Some entities or jurisdictions may be required to classify the cause of a fire in an investigative report. The classification of a fire cause occurs after the cause has been determined. The fire cause classification is a process where the investigator, based on the fire cause determination and other relevant data, assigns the fire cause a classification category. Where the fire cause as defined in this Guide has not been determined, no "fire cause" classification can be assigned.

Additional Proposed Changes

File Name	Description	Approved
FISC-FireCauseClassificationRemoved-Part1-Apr_2020.pdf	IAAI Article "Fire Cause Classification Removed" (Part 1)	
FISC-FireCauseClassificationRemoved-PartII-Jul_2020.pdf	IAAI Article "Fire Cause Classification Removed" Part 2	

Statement of Problem and Substantiation for Public Comment

Reinserting "fire cause classification" back into Ch. 19 and adding annex material to reinstate the old classification system is subject to all of the problems the Technical Committee tried to avoid when it made the changes dealing with fire cause classification in the 2021 edition. For the reasoning behind the TC's actions, the history of the fire cause classification in NFPA 921 and the pros and cons of having a fire cause classification system in NFPA 921, See "Fire Cause Classifications Removed from NFPA 921, 2021 Edition" - a 2 part article published in the IAAI Fire & Arson Investigator Journal, in April 2020 and July 2020.

Related Item

- FR 74 (section 19.8.2 and A.19.8.2)

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Committee: FIA-AAA

by Terry Dawn Hewitt, Esq., Chair
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Fire Cause Classifications Removed from NFPA 921, 2021 Edition (Part I)

CONTENTS: PART I

1. Introduction[1]

The 2021 edition of *NFPA 921 Guide for Fire and Explosion Investigations* (NFPA 921) is almost finished and will be issued in late 2020. In this article we will first briefly recap the steps that have been completed to develop NFPA 921, 2021 ed., which is an open process that encourages involvement of any interested party. We also direct you to the NFPA 921 Document Information Page, Next Edition tab,[2] where the content of the 2021 edition and underlying information about the revisions are available for free access.

The main purpose of this article is to pique your interest in the 2021 edition by reviewing one of its many changes. Dating back to its first edition in 1992, NFPA 921 has included a four-category system for classifying fire causes. In the current (2017) edition, Chapter 20 "Classification of Fire Cause," states that "the cause of a fire may be classified as accidental, natural, incendiary, or undetermined."[3] These classifications, in place since the 1992 edition, have been removed in the 2021 edition. In their place, NFPA 921 points to examples of other national classification systems that are available for incident reporting of fires and explosions. In other words, NFPA 921 will no longer offer fire cause classifications in the 2021 edition.

This article is published in two parts. Part I summarizes the history of this classification system and some of its problems. It explains the distinction between "incident reporting," which includes coding fire cause data for classification purposes, and "investigation reports," which apply the scientific method for determining fire cause. Finally, Part I explains the reasons that NFPA 921 was revised in the 2017 edition to state that the completion of NIFRS incident reports are outside the scope of NFPA 921. This revision, made to accommodate the public sector, became a significant factor in the decision to delete Chapter 20 in the 2021 edition.

Part II of this article provides the background leading up to the decision by the Technical Committee responsible for NFPA 921 (NFPA 921 TC) to remove fire cause classifications from NFPA 921. We also cite revisions in other chapters in the 2021 edition related to the deletion of Chapter 20. Finally, we touch on some of the implications of this change.

2. Overview of Steps in the Development of NFPA 921, 2021 Edition

The 2021 edition of NFPA 921 has followed the NFPA's Standards Development Process,[4] which encourages public participation in the revision of all of its standards[5] including NFPA 921. In a nutshell, the new edition has proceeded through the necessary steps in this process,[6] as follows:

- The new edition was open for Public Inputs from when the 2017 edition was published until mid-2018 when the Public Input period closed.
- In late 2018 the NFPA 921 TC met twice to consider all Public Inputs, provide a response to each one and prepare First Revisions for the new edition. The TC also composed a TC Statement to substantiate each revision.
- The NFPA 921 TC was balloted on the First Revisions. All First Revisions that received a two-thirds majority vote on the ballot were included as First Revisions in the First Draft Report.
- In June 2019, the First Draft Report was posted publicly on the www.NFPA.org website, opening the period for review and Public Comments. The First Draft Report is available on the NFPA 921 Document Information Page (Next Edition tab).[7] It contains the legislative text showing changes each First Revision makes to NFPA 921, 2017 ed. Also available in the report are all of the Public Inputs received from interested persons, the TC Statements responding to Public Inputs and providing substantiation for each revision, ballot results, and any comments submitted by TC members on their ballots.
- After the Second Draft Report was posted, Public Comments were received, addressing revisions in the First Draft. The Public Comment period provided an opportunity for anyone who wanted to raise objections or submit changes to the text of the revisions in the First Draft.
- The NFPA 921 TC met again in October 2019 to review and respond to all Public Comments and prepare Second Revisions for the new edition.
- Following the Second Draft meeting, the TC was balloted on the Second Revisions. Like the procedure in the First Draft stage, all Second Revisions that received a two-thirds majority vote on the ballot were included as Second Revisions in the Second Draft Report.
- The Second Draft Report was then posted on the

NFPA 921 Document Information Page, Next Edition tab.[8] This report is available online and is comprised of: a) legislative text showing how the Second Revisions change the First Draft of the new edition, b) Public Comments and the TC's actions on each one, c) TC Statements, and; d) ballot results together with any comments submitted by TC members on their ballots.

- After the posting of the Second Draft Report, there is a process called a "Notice of Intent to Make a Motion" (NITMAM) available to anyone not satisfied with the work of the TC and who qualifies pursuant to the NFPA regulations. A NITMAM is notice of a motion a person plans to make in an effort to change the results of the TC's work as published in the Second Draft. The intent is to have the motion heard by the NFPA Membership at the annual NFPA Technical Meeting.
- No NITMAMs were filed by the March 11, 2020 deadline, meaning that none of the changes proposed in the Second Draft were challenged. Thus, according to the NFPA regulations, the new edition will be sent directly to the NFPA Standards Council to be issued as a "Consent Standard" once work by the NFPA editorial staff has been completed later this year.

In summary, after hundreds of contributions from members of the public and years of work by the TC, NFPA 921, 2021 ed. is nearing completion. You can see what the new edition will look like by reviewing the Second Draft available online in the NFPA 921 Document Information Page, Next Edition tab.[9] To fully understand the evolution of the 2021 edition, including the substantiation for the revisions as well as all of the public's submissions, review both the First Draft Report and the Second Draft Report. To access these reports, you will need to create a free NFPA account and sign in.

The remaining sections of this article will focus on revisions to NFPA 921 relating to the TC's decision to delete Chapter 20 "Classification of Fire Cause."

3. History of Fire Cause Classifications and Related Provisions in NFPA 921

There are three related concepts that help to understand the role of fire cause classifications in NFPA 921. Below we briefly highlight the progression of each of these concepts from their inception to NFPA 921, 2017 edition.

3.1. Fire Cause Determination

The first concept is "fire cause determination." In the 1992 ed. "fire cause" was defined as, "The circumstances or agencies that bring a fuel and an ignition source together with proper air or oxygen."[10] Chapter 12 "Cause Determination" was merely two pages. This chapter contained only four sections directly relating to fire cause including: a) a general section discussing the circumstances and factors that are necessary for a fire to have occurred, b) the source and form of heat of ignition, c) the first material ignited, and; d) the ignition factor (cause).[11]

By the time the 2017 edition was produced, the scientific understanding of fire cause had evolved, and the cause determination chapter had been revised many times. In NFPA 921, 2017 ed., Chapter 19 "Fire Cause Determination" has grown to five and a half pages and recommends the use of the scientific method for determining the cause of a fire. Cause determination is now more clearly defined, calling for the investigator to identify factors that include: a) the presence of a competent ignition source, b) the type and form of first material ignited, c) the oxidizing agent, d) the ignition sequence; and, e) the circumstances that allowed these factors to come together and start a fire.[12]

Fire cause determination is to be distinguished from a second concept — classifying the cause of a fire — which we examine next.

3.2. Classification of Fire Cause

In its short two pages, the 1992 ed. "Fire Cause" chapter included section 12-2 "Classification of Fire Cause." That section stated, "The cause of a fire may be classified as accidental, natural, incendiary (arson), or undetermined."[13] Subsections defined these four classifications, providing brief examples of each.

This four-category classification system has persisted through to the 2017 ed. Revisions were made over time in an effort to clarify the application of each classification. In the 2014 edition "Classification of Fire Cause" was moved into its own chapter, where it remained in later editions, retaining the same four-category classification system that dates back to 1992.[14]

The third of the concepts associated with, but distinct from fire cause determination and fire cause classification is known by the heading, "Analyzing the Incident for Cause and Responsibility."

3.3. Analyzing the Incident for Cause and Responsibility

"Analyzing the Incident for Cause and Responsibility" (the subject of Chapter 21 in NFPA 921, 2017 ed.) first appeared in NFPA 921, 1998 ed. It was initially conceived in an effort to remove the four-category fire cause classification system and recognized that an investigator's task might be much broader than determining just the "cause" of an incident. This concept grouped the unwanted outcomes of a fire incident under four headings, or features:

(1) The cause of the fire or explosion.

(2) The cause of damage to property resulting from the incident.

(3) The cause of bodily injury or loss of life.

(4) The degree to which human fault contributed to any one or more of the causal issues described in (1), (2), or (3), above.[15]

The above list of significant causal features of a fire or explosion was the result of a public proposal submitted to the NFPA in 1996 by one of the authors of this column. The proposal was the first challenge to NFPA 921's four-category classification system.[16] It recommended deleting NFPA 921's classification system and to include instead a description of the features of a fire or explosion incident for the purposes of determining responsibility for a fire (its cause, spread, damage, or injuries). Further, rather than incorporating fire cause classifications in NFPA 921, the proposal encouraged fire investigators to employ the classification system in NFPA 901 *Standard Classifications for Incident Reporting and Fire Protection Data* to classify fire incidents.

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This proposal was accepted in principle[17] and implemented in NFPA 921, 1998 ed.[18] While the TC declined to delete NFPA 921's existing classification system, it added new text to the introductory section of the "Cause Determination" chapter to describe the significant features of a particular fire or explosion incident.[19] This revision ultimately gave rise to a new chapter in NFPA 921 2004 ed. entitled "Analyzing the Incident for Cause and Responsibility." This chapter originally included a section on "Classification of the Cause," which as mentioned above, was separated into its own chapter ten years later.

Thus, by the time NFPA 921 2017 ed. was published, the above three interrelated concepts had taken root in NFPA 921 and evolved over time.

4. Overview of Problems with the Classification System

While the NFPA 921 TC has fine-tuned the language of the classification system over the last 20 years, it continues to be problematic. Below are the definitions of the four classifications followed by scenarios that endeavor to apply the first three. As you read these definitions, remember that what Chapter 20 of NFPA 921, 2017 ed. purports to classify is "fire cause."

> **"Accidental Fire Cause Classification."** Accidental fires involve all those for which the proven cause does not involve an intentional human act to ignite or spread fire into an area where the fire should not be.[20] *Note that the investigator must decide of whether an **intentional human act** is involved. Also, this classification goes beyond fire cause and addresses intentional human action to **spread** the fire.*

> **"Natural Fire Cause Classification."** Natural fire causes involve fires caused without direct human intervention or action, such as fires resulting from lightning, earthquake, wind, and flood.[21]

> **"Incendiary Fire Cause Classification."** An incendiary fire is a fire that is intentionally ignited in an area or under circumstances where and when there should not be a fire.[22] *Note that central to the application of this classification are a determination of an **intentional ignition** by someone and a judgment about **where and when there should not be a fire.***

> **"Undetermined Fire Cause."** Whenever the cause cannot be proven to an acceptable level of certainty, the proper classification is undetermined.[23]

Studying the first three definitions, several issues are readily apparent. First, the application of the classifications can be ambiguous when applied to particular circumstances. Second, while the classifications purport to apply to "fire cause," they go beyond the definition of fire cause (defined as "the circumstances, conditions, or agencies that bring together a fuel, ignition source, and oxidizer resulting in a fire or combustion explosion")[24]. The definitions instead contemplate factors such as fire spread and the existence of rules as to when and where there should or should not be a fire. Third, although NFPA 921 describes the scientific methodology for determining fire cause, it does not provide a scientific methodology for determining human intent. Yet, determining the intent of those involved with the fire is an integral part of this classification system.

Following are several scenarios. Imagine each one becomes the subject of civil or criminal litigation. Assume a lawyer is taking the investigator to task over the classification assigned in each scenario. Can you see where the classification system may cloud the issues, even where the investigator makes a solid case that the fire cause is determined based on other chapters of NPFA 921 such as "Origin Determination" and "Fire Cause Determination"?

The first scenario: what is the classification when a fireplace overloaded with combustibles is ignited and the fire spills out causing damage to the building that housed the fireplace? Assume the cause is determined (a match held to a piece of crumpled newspaper in the presence of sufficient oxygen to allow ignition). But, based on the classifications available, is the *determination* of fire cause enough to *classify* the fire cause using this classification system? Here, the damage causing civil or criminal liability arises from the fire spread, not the fire cause. Notwithstanding its label, "accidental fire cause classification" goes beyond "fire cause" and requires a determination of what was in the mind of those involved, as well as the factors causing the fire to spread.

Next, consider whether the above scenario should be classified as an incendiary fire "cause." There does not appear to be anything inherently wrong with lighting a fire in a fireplace. That is what fireplaces are designed for. However, to classify this example as an "incendiary fire cause classification," the central factor is fire spread, not fire cause — whether the person's intent was to facilitate the spread of the fire beyond the hearth. It is confusing to label a classification using the word "cause" when cause is not the seminal factor.

But what if you could look in the mind of those involved. Assume the person who loaded the fireplace and lighted the fire was somehow impaired or ill-informed about the likely consequences? Is this sufficient for an incendiary fire cause classification? What if the person who ignited the fire walked away and another person failed to take action to prevent the fire's spread once it escaped the hearth? Are the circumstances of either situation sufficient to assign an incendiary fire cause classification (after all, the cause of the fire has not changed in any of these scenarios).

These analyses suggest that the classifications of accidental fire cause and incendiary fire cause arguably conflate fire cause with fire spread. Further, an investigator would have to determine the intent of the person who ignited the fire and the person who loaded the fireplace. NFPA 921 provides no scientific methodology to determine human intent.

Consider another scenario. If a person intentionally disables lightning protection equipment and a lightning-caused fire occurs, should this be an accidental, natural, or incendiary fire cause classification? By definition, a "natural fire cause classification" "involve fires caused without direct human intervention or action." In this scenario the fire is "caused" by lightning, so arguably it should be a natural fire cause classification because the fault of the person involved relates to fire prevention, not fire cause (as defined by NFPA 921). Would the classification change if the investigator could prove the person who disabled the lightning rod benefitted from the fire? What if the fire started in a lightning-prone area of the country? In either case the fire cause has not changed so should the classification change?

What if a person strikes a match, lighting a cigarette in a strictly "no-smoking" building, and either the match or the cigarette causes a fire? The smoker knows the no-smoking rule and deliberately disobeys it. The striking of the match to light a cigarette appears to meet the definition of an incendiary fire cause because the person is "intentionally igniting" a fire "in an area or under circumstances" where there should not be a fire, since there is a strict no-smoking rule. Is the proper classification incendiary or accidental fire cause?

As one of the submitters of a Public Input for the new edition points out, even the example given in Chapter 20 of an accidental fire cause classification is confusing (a wind gust spreading a trash fire beyond its container). Such a situation might better be classified as natural (caused by wind). So, even the simple example provided by NFPA 921, 2017 ed. of an accidental fire cause classification is ambiguous.

While no classification system is perfect, NFPA 921's four-category system is arguably too simplistic. The incendiary and accidental fire cause classifications require the investigator to meld factors such as fire cause, spread, and human intent under a single classification. Other classification systems better reflect the complexity of the factors that contribute to fire cause, property damage, casualties, or human involvement.

5. Classifying Fire Cause Where the Ignition Source is Unknown

Three Public Inputs by Captain Steven Avato identified another problem — an internal inconsistency within Chapter 20 concerning the classification of incendiary vs. accidental fire causes. Subsection 20.1.4 provides that if the fire cause "cannot be proven to an acceptable level of certainty," it should be classified as "undetermined."[27] However, an exception is made for the incendiary fire cause classification. Subsection 20.1.4(B) provides:

> In the instance in which the investigator fails to identify the ignition source, the fire need not always be classified as undetermined. For example, if the evidence establishes one factor, such as the use of an accelerant, that evidence may be sufficient to establish an incendiary fire cause classification even where other factors, such as ignition source, cannot be identified. [28]

In recommending additional text be added in Chapter 20 that would permit an investigator to classify the fire cause as accidental if all reasonable fire causes would fall into that category, even if the exact cause was undetermined, Captain Avato provided the following explanation:

> Investigators often conflate the process of classification and cause - partly because this [NFPA 921] document also seems to conflate the issues. When all reasonable, potential fire causes would fall into the "Accidental" classification, the investigator should be allowed to classify the fire as "Accidental" even if the exact "Cause" cannot be specifically defined. For example, a fire occurs in a copying machine in an unattended office. There [are] no plausible incendiary scenarios. The investigator cannot reliably describe whether a circuit board failed and ignited surrounding material or the platen caused the ignition; while the cause may be "Undetermined," the classification should clearly be "Accidental". With the current wording many investigators would classify the fire as "Undetermined".[29]

In noting that the changes he proposed recognize that classification and cause are separate processes, Captain Avato went on to observe the significance of this proposal for the public sector:

> This is especially important for public sector investigators whose agencies may not allow the investigator to "close" an undetermined fire classification. Investigations where all possible causes are accidental would be allowed to be closed with the classification of "Accidental" rather than "Undetermined" if the exact ignition scenario could not be demonstrated. Some agencies even restrict public access to reports of fires classified as "Undetermined" or "Incendiary" — this proposal should reduce the number of improperly classified fires and allow for more information sharing between the public and private sector.[30]

The broader issue — *i.e.* considering the impact particular revisions will have on the public sector — has been a recurring theme in each revision cycle of NFPA 921. The NFPA 921 TC is sensitive to this issue and the public sector is well-represented in the TC's membership. By way of example, and as described in the next section of this article, a revision to the "Scope" of NFPA 921 in the 2017 edition was a direct response to a plea from the public sector concerning incident reporting, which encompasses classification. This revised NFPA 921 scope statement had a direct bearing on the fate of Chapter 20, so we address it next.

6. Incident Reporting vs. Investigation Reports

Some of the Public Inputs that submitted changes to Chapter 20[31] noted that "classifying" a fire cause (as compared with "determining" a fire cause) is not necessarily a required responsibility of all fire investigators. The process of cause determination and cause classification may fall to different people.

The distinction between a) classifying a fire for the purposes of incident reporting, and b) preparing an investigation report after investigating or analyzing a fire incident, was the subject of an important change in NFPA 921's 2017 edition. This distinction was drawn in response to concerns raised in Public Inputs and Public Comments received in the 2017 edition revision cycle stemming from a 2014 report prepared by the National Association of State Fire Marshals (NASFM) Fire Research Education Foundation. The main focus of this report is aptly captured in its title, *Conquering the "Unknowns" Research and Recommendations on the Chronic Problem of Undetermined and Missing Data in the Casual Factors Sections of the National Fire Incident Reporting System.*[32] The report revealed that fire cause data is being underreported to the National Fire Incident Reporting System (NIFRS).

In the report summary, the authors noted that one of the main factors that had affected whether fire cause data was reported in NIFRS was a "Litigation Cloud" attributed to NFPA 921:

> Departments were reluctant to specify causal information in the incident report due to fear of being contradicted by more experienced investigators or challenged in court. We refer to this as the "Litigation Cloud" that seems to hang over fire department decisions about whether to report causal factors."[33]

The "Litigation Cloud" arose largely because of concerns that the recommendations in NFPA 921 set a benchmark that fire department members responsible for incident reporting could not reasonably achieve. As a consequence, they enter "undetermined" or "unknown" as a fire cause rather than risk

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being called to court to testify, even when they have enough data to ascertain the causal factors of an incident. [34]

In response, the NFPA 921 TC revised the guide's "Scope" in Chapter 1. The scope of each of NFPA's standards,[35] including the NFPA 921 Guide, is very important and is governed by the *Manual of Style for NFPA Technical Committee Documents* (the MOS).[36] The MOS provides that the scope of the document must be within the scope of the TC's work as approved by the NFPA Standards Council. Further, the document's scope "shall describe in general terms what the document covers and shall include sufficient details to indicate the range or limits of what is covered."[38] In other words, the content of NFPA 921 is governed by its scope statement.

In revising NFPA 921's scope, two new subsections were added in the 2017 edition in an effort to lift the "litigation cloud" from fire department members classifying fire causes in NIFRS incident reports. Subsection 1.1.1 states, "The completion of reports for . . . NFIRS are outside the scope of this guide."[39] Subsection 1.1.2 goes on to say that NFIRS reports are incident reports and distinguishable from fire investigation reports, (inferring that the latter are covered by NFPA 921).40

NFIRS is a fire classification system. If completing NFIRS incident reports that classify fire incidents are outside the scope of NFPA 921, what about other incident reports that classify fires, such as those contemplated by Chapter 20? As we will see in the following sections of this article, this becomes a prominent issue in the ultimate decision to remove Chapter 20 from NFPA 921.

Although the NFPA 921 TC has the authority to change the scope as set forth in Chapter 1 of NFPA 921 (subject to the MOS rules outlined above), there were no revisions made to the above provisions in this revision cycle, therefore these subsections will remain in the 2021 edition.

7. Conclusion to Part I

To this point, we have covered the steps in the NFPA Standards Development Process that NFPA 921 has completed, which will bring the 2021 edition to completion later in 2020. We have directed you to the NFPA 921 Document Information Page, Next Edition tab,[41] where the content of the 2021 edition and complete underlying information about all of the revisions are available for free access.

Part I, above, also describes the four-category system for classifying fire causes (accidental, natural, incendiary, or undetermined,)[42] which has been in the document for many years. The history of this system is addressed, as well as some of its problems. At the end of this Part, the important distinction between incident reporting (which involves fire cause classification) and investigation reporting is addressed.

In Part II of this article, we will continue to highlight the considerations that went into the NFPA 921 TC's decision to delete Chapter 20, "Classification of Fire Cause" from the 2021 edition, as well as discuss some of the implications of this change.

Acknowledgements

Our thanks to everyone who contributed their insights to the issues covered in this article: Charles (Randy) Watson, IAAI-CFI, CFEI, F-IAFI (NFPA 921 TC Chair and Member IAAI Board of Directors), and to the following Fire Investigation Standards Committee (FISC) members: Captain Steven J. Avato, Mark A. Beavers, IAAI-CFI, Ross Brogan, AFSM, MA (Fire Investigation), IAAI-CFI, First V.P. Rick Jones, IAAI-CFI(V), MIAAI, Raymond J. Kuk, Major J. Ron McCardle, Paul Messner, Fellow-American Academy of Forensic Sciences, IAAI-FIT, Joe Sesniak, IAAI-CFI, IAAI-CI, CFEI, GIFireE, Joe Toscano, IAAI-CFI, IAAI-CI, and George Wendt, IAAI-CFI (former NFPA 1033 TC Chair).

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[1] Disclaimer: To the extent that this article contains opinions, they are the opinions of the authors and not of the International Ass'n of Fire Investigators (IAAI), the IAAI Fire Investigation Standards Committee (FISC), or the National Fire Protection Association.

[2] NFPA Codes & Standards/ All codes & standards/ List of NFPA codes & standards/ NFPA 921, NAT'L FIRE PROT. ASS'N (2020), https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921&tab=nextedition.

[3] Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, NFPA 921 Guide for Fire and Explosion Investigations [hereinafter NFPA 921] (2017 ed.), sec. 20.1. We use the short form, "NFPA 921" when referring generally to this document, in whatever edition is applicable in the context. When referring to a specific edition of NFPA 921, the edition is also cited.

[4] For more information on the NFPA Standards Development Process, see the webpage: How the NFPA standards development process works, NAT'L FIRE PROT. ASS'N (2020), https://www.nfpa.org/Codes-and-Standards/Standards-development-process/How-the-process-works.

[5] In this context, we are using the term "standards" generically. When used in a generic sense, NFPA 921, 2017 ed., s. 3.2.5 states that the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

[6] These steps as taken with respect to NFPA 921, 2021 edition are summarized from the booklet available from NFPA.org: NAT'L FIRE PROT. ASS'N, An Introduction to the NFPA Standards Development Process, (2018) available at https://www.nfpa.org/-/media/Files/Codes-and-standards/Regulations-directory-and-forms/Stds_Dev_Process_Booklet_2018.ashx.

[7] NFPA 921 Document Information Page, Next Edition tab, supra note 2.

[8] NFPA 921 Document Information Page, Next Edition tab, supra note 2.

[9] NFPA 921 Document Information Page, Next Edition tab, supra note 2.

[10] NFPA 921 (1992 ed.) sec. 1-3.

[11] NFPA 921 (1992 ed.) ch. 12, secs. 12-1, 12-3, 12-4, & 12-5.

[12] NFPA 921 (2017 ed.) ch. 19, sec. 19-1.

[13] NFPA 921 (1992 ed.), sec. 12-2.

[14] NFPA 921 (2014 ed.), ch. 20.

[15] NFPA 921, 2017 ed., subsec. 21.1.1 (1), (2), (3), & (4).

[16] Hewitt, Terry-Dawn, Public Proposal Log # 262, published in Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, Report of the Committee on Fire Investigations, F1997 Report on Proposals (ROP), at pp. 414-415, available at NFPA 921 Document Information Page, Archived Revision Information for NFPA 921 1998 ed. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921&year=1998.

[17] Id.

[18] NFPA 921 (1998 ed.), sec. 12-1.

[19] NFPA 921 (1998 ed.), sec. 12-1.

[20] NFPA 921, 2017 ed., subsec. 20.1.1.

[21] NFPA 921, 2017 ed., subsec. 20.1.2.

[22] NFPA 921, 2017 ed., subsec. 20.1.3, as revised by TIA 17-1 issued August 17, 2017. The Tentative Interim Amendment (TIA) brings the definition in subsec. 20.1.3 into conformity to the definition in subsec. 3.3.116.

[23] NFPA 921, 2017 ed., subsec 20.1.4. Levels of certainty are addressed in section 4.5.

[24] NFPA 921, 2017 ed., subsec. 3.3.69.

[25] William Perdue, ATF, Public Input No. 237-NFPA 921-2017 [Section No. 20.1.1].

[26] Steven Avato, Loudoun County (VA) Fire Marshal's Office, Affiliation "Public Sector," Public Input No. 256-NFPA 921-2017 [Section No. 20.1], Public Input No. 257-NFPA 921-2017 [Section No. 20.1.4], and Public Input No. 258-NFPA 921-2017 [Section No. 20.1.4(B)].

[27] NFPA 921, 2017 ed., subsec. 20.1.4.

[28] NFPA 921, 2017 ed., subsec. 20.1.4(B).

[29] Steven Avato, Loudoun County (VA) Fire Marshal's Office, Affiliation "Public Sector," Public Input No. 257-NFPA 921-2017 [Section No. 20.1.4].

[30] Steven Avato, Loudoun County (VA) Fire Marshal's Office, Affiliation "Public Sector," Public Input No. 256-NFPA 921-2017 [Section No. 20.1].

[31] Robert Toth, Iris Fire Investigations Inc., Public Input No. 43-NFPA 921-2017 [New Section after 20.1] and Public Input No. 102-NFPA 921-2017 [Section No. 20.1]; Robert Schaal, Gulf Coast Fire, Public Input No. 532-NFPA 921-2018 [Section No. 20.1].

[32] Nat'l Ass'n of State Fire Marshals (NASFM) Fire Res. Ed. Found, "Conquering the 'Unknowns' Research and Recommendations on the Chronic Problem of Undetermined and Missing Data in the Casual Factors Sections of the National Fire Incident Reporting System," (2014) available at http://www.firemarshals.org/resources/Documents/Fire%20Incident%20Data%20Collectin/NASFM-FoundationFinalReportConqueringtheUnknowns.pdf.

[33] Id. at 33.

[34] See, e.g. Anthony Apfelbeck, Altamonte Springs Building/Fire Safety Division, Public Input No. 4-NFPA 921-2014 [New Section after 1.1]; and JAMES NARVA, NASFM, Public Comment No. 71-NFPA 921-2015 [New Section after 1.1].

[35] See the definition of "standard," supra. note 5.

[36] Nat'l Fire Prot. Ass'n, Manual of Style for NFPA Technical Committee Documents, 4th ed. (2004).

[37] Supra. note 33, subpara. 1.6.1.2.1.

[38] Supra. note 33, subpara. 1.6.1.2.2.

[39] NFPA 921 (2017 ed.), subsec. 1.1.1.

[40] NFPA 921 (2017 ed.), subsec. 1.1.2.

[41] NFPA Codes & Standards/ All codes & standards/ List of NFPA codes & standards/ NFPA 921, NAT'L FIRE PROT. ASS'N (2020), https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921&tab=nextedition.

[42] NFPA 921 (2017 ed.), sec. 20.1.

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Fire Cause Classifications Removed from NFPA 921, 2021 Edition (Part II)

CONTENTS: PART II

8. Introduction to Part II[1]

This is the second Part of an article that explores the important decision to remove Chapter 20, "Classification of Fire Cause" from the upcoming 2021 edition of NFPA 921. To better appreciate the material that follows, you are encouraged to first read Part I. We began by summarizing the steps in the NFPA Standards Development Process that NFPA 921 has completed for this revision cycle. The 2021 edition will be issued in late 2020. Part I lists the type of information that is available concerning the content of the 2021 edition. This information is available for free access in the NFPA 921 Document Information Page, Next Edition tab.[2]

Part I also describes the four-category system for classifying fire causes (accidental, natural, incendiary, or undetermined),[3] as well as some problems with this system. It explains the important distinction between incident reporting (which involves fire cause classification) and investigation reports (which result from applying the scientific method to determine fire cause). This distinction is reflected in a 2017 edition revision to NFPA 921's "scope."[4] The earlier change in NFPA 921's scope became a significant factor in the ultimate decision to remove Chapter 20 from NFPA 921 in the 2021 edition.

Part II of this article provides further background leading up to the decision by the Technical Committee responsible for NFPA 921 (NFPA 921 TC) to remove fire cause classifications from NFPA 921. Part II begins with the position of the Organization of Scientific Area Committees for Forensic Science (OSAC) on this issue. The actions of the NFPA 921 TC in revising Chapter 20 in the First Draft of the 2021 edition are then summarized, together with the TC's reasons.

Next, the article looks at steps leading up to the NFPA 921 TC's action in deleting Chapter 20 in the Second Draft, and includes comments by those voting negative on the ballot for this action. Finally, we cite revisions in other chapters in the 2021 edition related to the deletion of Chapter 20, and suggest some implications of this change.

9. OSAC's Public Input

In considering the value of Chapter 20 to NFPA 921, of particular interest was the Public Input submitted on behalf of OSAC.[5] It is noteworthy that this is the first revision cycle of NFPA 921 that OSAC has provided input. To evaluate any input, it is appropriate for the NFPA 921 TC to consider the identity of the submitter and the entity that he or she represents. We have introduced OSAC in previous articles. Below we reiterate some salient points relevant to OSAC's stake in the development of NFPA 921.

The OSAC Subcommittee on Fire and Explosion Investigations focuses on standards and guidelines related to the investigation, analyses and interpretation of crime scenes where arson or use of explosives is suspected.

One of the Subcommittee's early priorities was to identify standards and guidelines that should be included in the OSAC Registry. The Registry "serves as a trusted repository of high-quality, technically sound standards and guidelines for the practice of forensic science."[6] As a result of the Subcommittee's recommendations, NFPA 921 and NFPA 1033 were among the first to be approved by OSAC and added to the OSAC Registry.

Another of the Subcommittee's activities is preparing proposals for future editions of NFPA 921 and NFPA 1033. The OSAC subcommittee submitted four Public Inputs for 2021 edition of NFPA 921, and Public Input 282 is one of these four. It calls for the TC to delete Chapter 20 in its entirety.

In considering removing the classification system in Chapter 20, the substantiation of Greg Gorbett Ph.D. on behalf of OSAC in support of this Public Input is instructive:

> The Classification of Fire Cause chapter attempts to assist the fire investigator with regard to the assignment of responsibility and with regard to reporting/compilation of statistics. These are quite disparate activities that are not well served by a single system. Further, modern reporting and compilation of fire statistics does not use a simple four category classification system as is advocated by NFPA 921. For instance, the NFIRS system uses a 16 category cause classification system. The four class system simply provides inadequate discrimination of causes to be useful to the fire prevention community. Given the inadequacy of the 921 categories and the inconsistency of 921 with modern fire reporting and classification systems, there is no point in providing the simplified method reported in chapter 20. Further, 921 has divorced itself from NFIRS explicitly. It would be contradictory and confusing to address NFIRS in Chapter 20 after having divorced 921 from NFIRS. In this regard it is wise to put cause classification for statistics outside the scope of 921.
>
> With regard to the assignment of responsibility for the starting of a fire, the salient question is that of intent. Chapter 20 as currently configured provides

> no guidance to the fire investigator toward the determination of intent. The incendiary chapter of 921 includes extensive discussions of indicators as well as motives and motive classifications, but provides no information or methodology for the determination of intent. Since nowhere in NFPA 921 is there methodology or guidance on the determination of intent, investigators are left to their own devices in the determination of intent. The incendiary fire cause classification is simply a means to memorialize their subjective opinions in a manner that creates credibility that is not inherently deserved. This does not serve the community.[7]

As the above substantiation for OSAC's Public Input underscores, the four-category classification system in NFPA 921 is inadequate.

10. NFPA 921 Technical Committee Action: The First Revision and Public Comments

The NFPA 921 TC initially acted with a First Revision of Chapter 20. Below are highlights of the matters addressed in the revised chapter:

- √ The revised chapter made a clear distinction between fire cause determination and classification, noting that cause determination requires an application of the scientific method. By contrast, the classifications described in Chapter 20 are used by governmental agencies for incident reporting[8] and "may not be sufficient to describe the cause adequately."[9]
- √ Reinforcing the above distinction, the revised chapter aimed at classifying the "fire incident" (rather than the "fire cause," as it does in the 2017 edition). However, the title of the revised chapter remained "Classification of Fire Cause." The revised chapter limited the purposes of the classification system to incident reporting and compiling statistics. This diverged from the 2017 ed. text that described classifying the "cause of the fire," which could be used for assignment of responsibility (the subject of Chapter 21).
- √ A new section described the nature of a classification system and listed five national classification systems by way of example.[10]
- √ Consistent with the NFPA 921 2017 ed. revision of section 1 "Scope,"[11] the revised chapter distinguished between an incident report and an investigation report. It noted that classifying a fire incident in an incident report may be outside a fire investigator's duties and NFPA 921 does not require investigators to classify a fire for the purposes of conducting an investigation.[12]
- √ The classification names were changed as follows:[13]
  - o Accidental Fire ~~Cause Classification~~ Incident,
  - o Natural Fire ~~Cause Classification~~ Incident,
  - o Incendiary Fire ~~Cause Classification~~ Incident; and,
  - o ~~Undetermined~~ Unclassified Fire ~~Cause~~ Incident.
- √ The new category of "unclassified" (replacing Undetermined Fire Cause) was also added to deal with situations where an incident is still under investigation or where there is insufficient data to classify the incident.[14]
- √ The chapter also permitted a classification of accidental where the exact nature of the incident could not be determined, but "all remaining working hypotheses would fall into the "accidental" classification."[15]

The TC Statement that accompanied the First Revision explains the reasoning of the TC in making the proposed changes:

> Chapter 20 is revised to be consistent with the 2017 ed. revision to Chapter 1 by distinguishing the responsibilities of fire investigators as stated in s. 1.1 from classifying fire incidents and completing incident reports as described in 1.2. Since classifying fires for incident reporting is not the same as fire cause determination as addressed throughout this guide or assigning responsibility as addressed in chapter 21, we adjusted the classifications to indicate that it is the fire incident that is being classified (which may include fire cause), rather than conflating the process of classification with cause determination, which is a problem with Chapter 20 in the 2017 edition.
>
> With respect to classifying an accidental fire incident as such in the absence of a known ignition source, the wording in the 2017 edition allows for an incendiary classification based on single factors but does not address similar accidental events. The revision allows an accidental classification when the specific ignition source cannot be identified but other factors indicate that the ignition source is not an intentional / incendiary act.
>
> The TC has decided to leave the word "wind" in the definition of natural fire incident classification because wind is a well-known factor in the ignition scenario of some wildfires.
>
> The classification of incendiary fire incident is revised to be consistent with the definition of incendiary fire.
>
> A new category of "unclassified" is added to allow for situations where the fire incident is still under investigation or where there is insufficient data to make a classification.

As required by the NFPA's Standards Development Process, the TC was balloted on the First Revisions. 31 of 32 TC members voted in favor of this revision. NFPA 921 TC Chair Charles (Randy) Watson voted against it, providing the following comment to explain his negative vote:

> The name of the chapter remains Fire Cause Classification. All of the classifications are related to the fire causes. Stating we are classifying the fire would communicate the type of fire it is. That is not what the discussion infers. Either the chapter should be eliminated, or the existing text should remain.

As at least two thirds of TC members were in favor of the First Revision, it passed the ballot and was published in the First Draft Report, initiating the opportunity for interested persons to file Public Comments.

Public Comments were received following the publication of the First Draft Report causing the TC to revisit its action on Chapter 20. Craig Beyler, Ph.D. submitted a Public Comment on behalf of OSAC renewing its position that Chapter 20 be deleted.[16] A key point made in his substantiation was that preparing incident reports like NFIRS are outside of the scope of NFPA 921, as provided by subsections 1.1.1 and 1.1.2 in the 2017 edition. By contrast, Chapter 20 is dedicated to preparing incident reports — inconsistent with the scope statement in these subsections. Further, the four-category classification system in NFPA 921 is generally inconsistent with the classification systems used by the five organizations listed in the revised Chapter 20.[17]

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Other Public Comments also identified problems in assigning classifications using the revised text in Chapter 20 of the First Draft and offered wording intended to clarify how an incident should be classified if the ignition source is not identified.[18]

11. NFPA 921 Technical Committee's Further Action: The Second Revision

Upon further consideration, the TC decided to delete Chapter 20. It added a new section 19.8 to Chapter 19 "Fire Cause Determination" that generally describes the nature of incident classification and provides a non-exclusive list of six national classification systems for incident reporting. Below is the TC's Statement substantiating this action:

> The scope of NFPA 921 specifically states that the completion of reports for the United States National Fire Incident Reporting System (NFIRS) are outside the scope of this guide. However, the classification of incidents is a topic that is addressed by various entities for various reasons. As such, there is a need to provide guidance on where incident classification information can be found and to clarify that incident classification is not the same as cause determination. The technical committee has fielded debates over Chapter 20 text over the past editions and has determined that the Chapter creates more issues than benefits. Since incident classification is addressed in other standards and is dependent on jurisdiction/ organization use, providing specific definitions for incident classifications in NFPA 921 is not necessary.1[9]

The TC also revised other sections of NFPA 921 that referred to fire cause classification to coordinate the deletion of Chapter 20. Cross-references to Chapter 20 were removed, mentions of classifying fire cause were removed,20 and all chapters following the deleted Chapter 20 were renumbered. Below are a few examples of revisions resulting from the deletion of Chapter 20. (Revisions are emphasized in bold font.)

> s. 19.6.5 *(in Chapter 19 Fire Cause Determination)* … Negative corpus has **~~typically~~** been used in classifying fires as incendiary, **although the process has also been used to characterize fires classified as accidental.** ….[21]
>
> 19.6.5.1 Cause Undetermined. In circumstances where all hypotheses have been rejected, or if two or more hypotheses cannot be rejected, the only choice for the investigator is to conclude that the fire cause, or specific causal factors, is undetermined. It is improper to base hypotheses on the absence of any supportive evidence. That is, it is improper to opine a specific fire cause, ignition source, or fuel, **~~or cause classification~~** that has no evidence to support it even though all other such hypothesized elements were eliminated.[22]
>
> 20.5.1 *(formerly in Chapter 21 "Analyzing the Incident for Cause and Responsibility)* Nature of Responsibility. The nature of responsibility in a fire or explosion incident may be in the form of an act or omission. It may be something that was done, accidentally or intentionally, that ultimately brought about the fire or explosion, or it may be some failure to act to correct or prevent a condition that caused the incident, fire/smoke spread, injuries, or damage. **Responsibility may be attributed to a fire or explosion event notwithstanding the ~~classification~~ determination of the fire cause: ~~natural, accidental, incendiary, or undetermined.~~** Responsibility may be attributed to the accountable person or other entity because of negligence, reckless conduct, product liability, arson, violations of codes or standards, or other means.[23]
>
> 23.3.3 *(formerly in Chapter 24 "Incendiary Fires")* Fires Near Service Equipment and Appliances. A fire near gas or electrical equipment, appliances, or fireplaces **may be intended to make the fire appear to be from an ~~accidental cause~~ accident.**[24]
>
> 25.4.1.1 Before it can be concluded that a particular appliance has caused the fire, it should first be established how the appliance generated sufficient heat energy to cause ignition. The type of appliance will dictate whether this heat is possible under normal operating conditions or as a result of abnormal conditions. The next step is to determine the first material ignited and how ignition took place. The most likely ignition scenario(s) will remain after less likely or impossible ignition scenarios have been eliminated. **If no likely ignition scenario exists, ~~either accidental or intentional, then~~ the cause ~~should be classified as~~ is undetermined.**[25]

The full text and TC substantiations for all of the Second Revisions are available for review in the Second Draft Report available in NFPA 921 Document Information Page (Next Edition tab).[26]

The NFPA regulations require that the NFPA 921 TC be balloted on each Second Revision. The Second Revision deleting Chapter 20 passed the ballot. Of 33 eligible voters on the TC, two ballots were not returned, 28 members voted affirmative, and three voted negative with comments. Those TC members casting negative votes on any of the Second Revisions are required to provide a comment with their reasons. These comments are available for review in the First Draft Report.[27] The comments of two TC members are instructive and provide insights into their negative votes:

> **Cox, Andrew T:** It is a practical reality that public fire investigators are regularly called upon to fulfill the important community service of classifying the fires they investigate. When a community experiences a fire, the most immediate public concern is classification of the fire, namely whether or not the fire was an accident or the result of an intentional criminal act. The more technical specifics of cause (ignition source, first fuel, oxidizer and immediate circumstances that brought them together) are not necessarily as important to the general public. As a result, someone must serve the community need to make a judgement about classification, and in real-world practice, the public fire investigator is often the most informed and professionally capable person to do so. This is true because making a judgement about classification of a fire is inextricably linked to the determination of cause.

While I can appreciate and understand the academic desire to limit a fire investigator's role to the more technical issues of fire cause, a complete deletion of Chapter 20 Classification of Fire Cause from NFPA 921 fails to recognize the practical reality that exists for public fire investigators. Removal of Chapter 20 is at best likely to cause confusion and a lack of uniformity, and at worst result in a reluctance for public fire investigators to exercise their professional judgment in serving the critical community need for classification of fires. The result may then be that responsibility of classification is left to lesser informed public officials, which can lead to failure of a community to pursue actual fire-related crimes, or worse yet, erroneous determinations of accidental fires to be criminal in nature. Note that I am NOT necessarily endorsing Chapter 20 in its current form in the 2017 Edition of NFPA 921. I believe the existing Chapter 20 could be significantly improved, but I cannot support a complete removal of the Chapter as it undermines the significance and practical reality of a public fire investigator's role in classifying fires for the communities they serve. As a guide, NFPA 921 should continue to provide guidance to public fire investigators on the issue of classification.[28]

> **Ost-Prisco, Thomas:** I believe the Committee is making a significant mistake by removing all references to fire cause classification from the next Edition. The stated reason in support of this revision is to "decrease confusion." In my opinion this revision will actually create more confusion. In particular, investigators, attorneys and courts depend on fire cause classification in many legal proceedings. Removing all references to classification from the next edition may lead investigators, attorneys and court to conclude that investigators are no longer permitted to classify fires because it is "beyond the scope" of their expertise. Indeed, some attorneys have already begun to argue that fire investigators are not "qualified" to classify fire cause. I strongly recommend the committee reject this removal of the chapter and reconsider revisions instead.[29]

The deletion of Chapter 20 from NFPA 921, 2021 ed. is a major change. The history of NFPA 921 has shown that any time a major change has taken place it could take another one or two revision cycles to work out related issues. The NFPA 921 TC welcomes interested persons to submit Public Inputs on this or other topics. After the publication of the 2021 edition, watch for the public notice on the NFPA 921 Document Information Page, Next Edition tab,[30] indicating that the next edition is open for Public Input and follow the instructions provided if you want to submit a Public Input.

12. Conclusion

In conclusion, NFPA 921, 2021 edition will no longer have a chapter devoted to fire cause classification. As we have noted in previous articles, change can be stressful and for those who rely on the four-category classification system that has been in NFPA 921 since the guide's inception, there will be some adjustments needed. However, the situation is not as extreme as it may first appear. Following are some implications of this revision:

- √ It does not prevent investigators from characterizing fires as an accident, an accidental fire or an incendiary fire. These definitions remain in NFPA 921, 2021 ed. (See, *e.g.*, the revisions to sections 19.6.5 and 23.3.3, quoted above.) It simply means that NFPA 921 no longer provides its own "classification" system.
- √ Nor does this change prevent an investigator from concluding that a fire cause is undetermined. (See, *e.g.*, the change to 25.4.1.1, quoted above)
- √ It does not prevent investigators from classifying fires. It just removes the four-category classification system from NFPA 921. Government agencies and private organizations are free to select the classification system that best suits their needs, either from those now listed in 19.8 or elsewhere.
- √ It does not prevent the person completing the classifications in an incident report from relying on data from the investigation report, whether the incident report is prepared by the fire investigator or another person.
- √ NFPA 921, 2021 ed. does not say investigators are not "qualified" to classify fires. NFPA 921 is not a qualification standard. If investigators feel a special need to determine if they are qualified for completing incident reports, they should look to the guidelines of the relevant incident reporting system or to NFPA 1033 *Standard for Professional Qualifications of Fire Investigator.*
- √ Some investigators might feel a loss because the weight of NFPA 921, which some courts have called a "gold standard" will no longer be available to support an investigator's classification of a fire cause. However, the national classification systems are also developed by reputable organizations. Further these other classification systems are revised with the advancement of knowledge about fire incidents, whereas the four-category classification system in NFPA 921 was largely stagnant.

In closing, while there will be some adjustments needed to transfer to a different classification system for those who have been using NFPA 921's four-category system, the bottom line should be that we are all committed to the continued refining of NFPA 921 to become a scientifically sound standard.[31] This change moves the guide closer to that goal.

13. Acknowledgements

Our thanks to everyone who contributed their insights to the issues covered in this article:
Charles (Randy) Watson, IAAI-CFI, CFEI, F-IAFI (NFPA 921 TC Chair and Member IAAI Board of Directors), and to the following Fire Investigation Standards Committee (FISC) members: Captain Steven J. Avato, Mark A. Beavers, IAAI-CFI, Ross Brogan, AFSM, MA (Fire Investigation), IAAI-CFI, First V.P. Rick Jones, IAAI-CFI(V), MIAAI, Raymond J. Kuk, Major J. Ron McCardle, Paul Messner, Fellow-American Academy of Forensic Sciences, IAAI-FIT, Joe Sesniak, IAAI-CFI, IAAI-CI, CFEI, GIFireE, Joe Toscano, IAAI-CFI, IAAI-CI, and George Wendt, IAAI-CFI (former NFPA 1033 TC Chair).

End Notes

1 **Disclaimer:** To the extent that this article contains opinions, they are the opinions of the authors and not of the International Ass'n of Fire Investigators (IAAI), the IAAI Fire Investigation Standards Committee (FISC), or the National Fire Protection Association.

2 *NFPA Codes & Standards/ All codes & standards/ List of NFPA codes & standards/ NFPA 921*, NAT'L FIRE PROT. ASS'N (2020), https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921&tab=nextedition.

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3 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *NFPA 921 Guide for Fire and Explosion Investigations* [hereinafter NFPA 921] (2017 ed.), sec. 20.1. We use the short form, *"NFPA 921"* when referring generally to this document, in whatever edition is applicable in the context. When referring to a specific edition of *NFPA 921*, the edition is also cited.

4 NFPA 921 (2017 ed.), subsecs. 1.1.1 and 1.1.2.

5 For more information about OSAC, *see OSAC Organizational Structure,* NAT'L INSTITUTE OF SCI. & TECH., https://www.nist.gov/topics/organization-scientific-area-committees-forensic-science/osac-organizational-structure (last updated Jan. 14, 2020)

6 *OSAC Registry Webpage,* NAT'L INSTITUTE OF SCI. & TECH., https://www.nist.gov/topics/organization-scientific-area-committees-forensic-science/osac-registry (last updated Nov. 19, 2019).

7 Gregory Gorbett on behalf of OSAC, Public Input No. 282-NFPA 921-2018 [Chapter 20].

8 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *First Draft Report*, First Revision No. 111, NFPA 921-2019 (Chapter 20), s. 20.3.2.

9 *Supra.* note 8, at s. 20.2.

10 *Supra.* note 8, at s. 20.3.1

11 *See* NFPA 921 (2017 ed), subsecs. 1.1.1 & 1.1.2 (distinguishing NFIRS incident reports from investigation reports and stating that the former are outside the scope of the NFPA 921 guide).

12 *Supra.* note 8, at s. 20.4.

13 *Supra.* note 8, at s. 20.5.

14 *Supra.* note 8, at s. 20.5.5.1.

15 *Supra.* note 8, at s. 20.5.5.

16 Craig Beyler on behalf of OSAC, Public Comment No. 198-NFPA 921-2019 [Chapter 20].

17 *Id.*

18 Steven Avato, Loudoun County (VA) Fire Marshal's Office, Affiliation "Public Sector," Public Comment No. 247-NFPA 921-2019 [Section No. 20.5.5.2]; Robert Schaal, Gulf Coast Fire, Public Comment No. 248-NFPA 921-2019 [Section No. 20.5.5.2]; Karl Morgan, Division of Investigative and Forensic Services (Florida), Public Comment No. 28-NFPA 921-2019 [Section No. 20.5.5.2].

19 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, TC Committee Statement, Second Revision No. 15-NFPA 921-2019 [Chapter 20] (substantiating the action of deleting Chapter 20 "Classification of Fire Cause").

20 There is one exception to removing all mention of classifying fire causes. In the First Draft Report a proposed revision to Chapter 28 "Wildfire Investigations" was put forward as a First Revision. Amid substantial debate that followed, the TC decided at the Second Draft meeting not to make any changes to the "Wildfire Investigation" chapter at this time and to keep the text as it currently exists in NFPA 921, 2017 ed.. Thus, section 27.8.2 "Human Fire Cause" (formerly 28.8.2) which refers to fire cause classification was reinstated into NFPA 921 as a Second Revision:

> 27.8.2 *(formerly in chapter 28)* Human Fire Cause. Human-caused fires are a result of human action or omission and **are classified as accidental or incendiary.** Accidental fires involve all those for which the proven cause does not involve an intentional human act to ignite or spread fire into an area where the fire should not be.

See Second Revision No. 56-NFPA 921-2019 [Chapter 28]. Further revisions to this section will have to await the next revision cycle of NFPA 921.

21 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 43-NFPA 921-2019 [Section No. 19.6.5].

22 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 11-NFPA 921-2019 [Section No. 19.6.5.1].

23 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 12-NFPA 921-2019 [Section No. 21.5.1].

24 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 45-NFPA 921-2019 [Section No. 24.3.3].

25 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 13-NFPA 921-2019 [Section No. 26.4.1.1].

26 *NFPA Codes & Standards/ All codes & standards/ List of NFPA codes & standards/ NFPA 921*, NAT'L FIRE PROT. ASS'N (2020), https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921&tab=nextedition.

27 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 15-NFPA 921-2019 [Chapter 20], Ballot Results.

28 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 15-NFPA 921-2019 [Chapter 20], Ballot Results, Comment by Andrew T. Cox, US Bureau of Alcohol, Tobacco, Firearms & Explosives, submitted with his Negative Vote.

29 Nat'l Fire Prot. Ass'n Technical Comm. on Fire Investigations, *Second Draft Report*, Second Revision No. 15-NFPA 921-2019 [Chapter 20], Ballot Results, Comment by Thomas Ost-Prisco, District Attorney's Office, West Chester, PA, submitted with his Negative Vote.

30 *NFPA Codes & Standards/ All codes & standards/ List of NFPA codes & standards/ NFPA 921*, NAT'L FIRE PROT. ASS'N (2020), https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=921&tab=nextedition.

31 In this context, we are using the term "standards" generically. When used in a generic sense, NFPA 921, 2017 ed., s. 3.2.5 states that the term "standards" includes

Public Comment No. 27-NFPA 921-2022 [Section No. 23.4.9.3.2 [Excluding any Sub-Sections]]

Vandalism-motivated firesetting is defined as mischievous or malicious firesetting that results in damage to property. Common targets include educational facilities and abandoned structures, but also include trash fires and grass fires. Vandalism firesetting categories include willful and malicious mischief and peer or group pressure.

Vandalism-motivated firesetting is defined as mischievous or malicious firesetting that results in damage to property. Common targets include educational facilities and abandoned structures, but also include **dumpster** , trash and grass fires. Vandalism firesetting categories include willful and malicious mischief and peer or group pressure.

Statement of Problem and Substantiation for Public Comment

Adding dumpster to the common targets of vandalism list.

Related Item

- Public Input

Submitter Information Verification

Submitter Full Name: Brian Gordon
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Submittal Date: Tue Dec 06 09:19:11 EST 2022
Committee: FIA-AAA

Public Comment No. 61-NFPA 921-2023 [Chapter 27 [Title Only]]

~~Wildfire Fire Investigations~~ Wildfire Investigations

Statement of Problem and Substantiation for Public Comment

Having the word "Fire" in the chapter title is redundant with Wildfire.

Related Item

- Whole chapter was revised

Submitter Information Verification

Submitter Full Name:	James Shanley
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Submittal Date:	Wed Jan 04 13:07:31 EST 2023
Committee:	FIA-AAA

Public Comment No. 63-NFPA 921-2023 [Section No. 27.5.1]

27.5.1 Origin and Cause.

The objective of every origin and cause investigation is to identify where a fire started and the factors that were necessary for the fire to have occurred, including identifying a competent ignition source, first fuel(s) ignited, and the circumstances that resulted in the ignition of the fuel(s).

Statement of Problem and Substantiation for Public Comment

As written the sentence ignores determination of the origin, which is a critical step.

Related Item

- Revised chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
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Submittal Date: Wed Jan 04 13:18:32 EST 2023
Committee: FIA-AAA

Public Comment No. 64-NFPA 921-2023 [Section No. 27.5.5]

27.5.5 Sequential Pattern Analysis.

The area of origin may be determined by ~~examining the~~ examining the fire effects and fire patterns. The surfaces of materials at the fire scene ~~record all the~~ may display fire effects and fire patterns generated during the lifetime of the event, from ignition through suppression, although these effects and patterns may be altered, overwritten, or obliterated after they are produced. The key to determining the origin of a fire is to determine the sequence in which these effects and patterns were produced. Investigators should strive to identify and collect sequential data and, once collected, organize the information into a sequential format.

Statement of Problem and Substantiation for Public Comment

As written the sentence is incomplete and too broad. The revision provides needed clarification.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
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Submittal Date: Wed Jan 04 13:20:38 EST 2023
Committee: FIA-AAA

Public Comment No. 123-NFPA 921-2023 [Section No. 27.5.7]

27.5.7 Recommended Methodology.

This chapter discusses a recommended methodology for the examination of the wildland fire scene. This methodology is based on the scientific method and consists of an initial scene assessment, development of ~~a preliminary~~ one or more preliminary fire spread hypothesis, an in-depth examination of the fire scene, development of final fire spread hypothesis, ~~and~~ identification of the fire's origin and cause .

Statement of Problem and Substantiation for Public Comment

Edited for consistency with other sections and chapters.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
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Zip:	
Submittal Date:	Wed Jan 04 16:25:17 EST 2023
Committee:	FIA-AAA

Public Comment No. 121-NFPA 921-2023 [Section No. 27.5.8]

27.5.8 Guidance.

This chapter provides general guidance for the fire investigator. Descriptions of more detailed steps for processing the wildland fire scene can be found in National Wildfire Coordinating Group (NWCG) PMS 412, *Guide to Wildland Fire Origin and Cause Determination*. This document is periodically revised, and the investigator should consult the most recent edition.

Statement of Problem and Substantiation for Public Comment

Providing a more complete citation to PMS 412.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
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Submittal Date:	Wed Jan 04 16:23:30 EST 2023
Committee:	FIA-AAA

Public Comment No. 65-NFPA 921-2023 [Section No. 27.6.1]

27.6.1 Behavior at the Fire Origin.

While physics and chemistry are universal, the fire dynamics of wildland fires have substantial differences from structure fires. The most significant difference is the fire dynamics around the area of origin. In wildland ~~fires, the~~ fires the area of origin ~~is typically well~~ may be relatively well -preserved and ~~can have little damage~~ exhibit less damage than away from the origin . The primary reason for this is the influence of wind. Under most conditions, the wildland fire will be wind driven, influenced by terrain or fuel type. Once the wildland fire is established, the fire will advance away from the area of origin, advancing ~~ahead and~~ with the wind and moving laterally depending on the availability of fuels and slope. This has significant implications to the fire investigation ~~. In a wildland fire, the fire will~~ because the wildland fire will typically not become large until the fire has advanced downwind of the origin. As a result, the investigator may find patterns or artifacts indicating the cause of the fire at the origin area which are only slightly burned or consumed. The role of radiation is also different in wildland fires. In a wildland fire, the flame volume has to become sizable before radiation becomes ~~important~~ significantly large to affect exposed objects . This is due to the absence of surfaces such as walls or ceilings that would confine a hot layer closer to exposed objects .

Statement of Problem and Substantiation for Public Comment

The proposed revisions provide needed clarification or detail to the language or intent of the material and should make it easier to understand.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
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Zip:
Submittal Date: Wed Jan 04 13:23:48 EST 2023
Committee: FIA-AAA

Public Comment No. 67-NFPA 921-2023 [Section No. 27.6.4 [Excluding any Sub-Sections]]

Apart from the roles of wind and of bounding surfaces, fuels are also different in wildland fires. In these fires, the fuels are primarily trees and vegetation, which can be both dead and or alive. The moisture content can vary significantly and ~~play~~ this also plays an important role. Fuels of smaller diameter or lesser density respond more quickly to ambient moisture changes than denser fuels. Keen observation of variations in wildland fuels is essential to accurately analyze fire behavior. The investigator should ~~be aware of man~~ look for and dicument man -made ~~combustible/flammable materials deposited in~~ ignitable materials found in the area of fire origin.

Statement of Problem and Substantiation for Public Comment

Editing provided for clarity, accuracy and completeness.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
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Zip:
Submittal Date: Wed Jan 04 13:31:19 EST 2023
Committee: FIA-AAA

Public Comment No. 68-NFPA 921-2023 [Section No. 27.6.4.3]

27.6.4.3 Aerial Fuels.

Aerial fuels are standing and supported live and dead combustibles not in direct contact with the ground and consist mainly of foliage, twigs, branches, stems, cones, bark, moss, and vines located from approximately 2 m (6 ft) above the surface to, and including, the crowns of the canopy. These fuels include tree branches, leaves, needles, snags, moss, tall brush, and draped fuels that have fallen from above and have lodged on lower branches or brush. These fuels are only infrequently the materials first ignited and typically require significant amounts of heat from surface fuels to ignite. ~~Combining steep~~ <u>However the combination of steep</u> slopes or higher wind speeds can easily transition the fire to a crown fire. ~~Aerial~~ <u>In addition the burning of aerial</u> fuels can contribute to rapid fire ~~spread, primarily~~ <u>spread by the ignition of adjacent aerial fuels and</u> through the generation of aerial firebrands.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarification and better understanding of the content.

Related Item

- Revision to Chapter 27

Submitter Information Verification

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Submittal Date: Wed Jan 04 13:34:41 EST 2023
Committee: FIA-AAA

Public Comment No. 102-NFPA 921-2023 [Section No. 27.7]

~~**27.7** – Indicators and Patterns.~~

~~**27.7.1** – Indicators.~~

~~The indication of the direction of a fire's spread is imprinted on partially burned fuels and noncombustible objects. These visual fire effects may include differential damage, char patterns, discoloration, carbon staining, shape, location, and condition of residual unburned fuel. Analysis of the directional pattern shown by multiple indicators in a specific area will identify the path of fire spread through this site. By applying a systematic approach to backtrack the spread of the fire, the investigator can retrace the path of the fire to the point of origin.~~

~~**27.7.1.1** – Wildland Fire V-Shaped Patterns.~~

~~Wildland fire V-shaped patterns, as shown in Figure 27.7.1.1 , are horizontal ground surface burn patterns generated by the fire spread. When viewed from above, they are generally shaped like the letter "V." These are not to be confused with the traditional plume-generated vertical V patterns associated with structure fires. These V-shaped patterns are affected by wind direction or the slope on which the fuel is located. As the fire spreads in the direction of the wind or up a slope, the widening legs of the V are created. The width of the pattern increases as the fire advances from the area of ignition. The origin of the heat source that created the pattern often is found at or near the base or most narrow point of the pattern. Therefore, the analysis of these horizontal V-shaped patterns can be useful in identifying a general location of the fire origin.~~

~~**Figure 27.7.1.1 V-Shaped Pattern.**~~

27.7.2 – Degree of Damage.

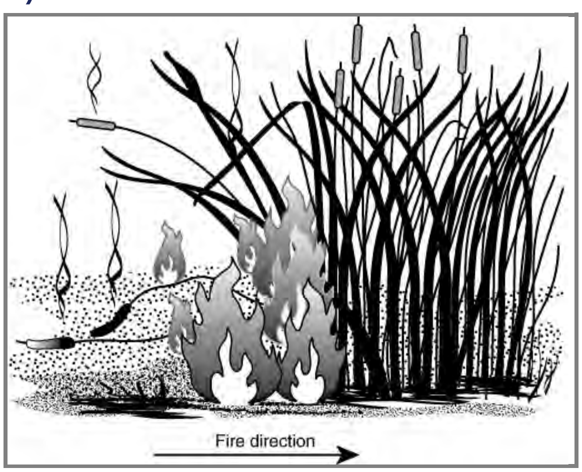
The degree of damage to a fuel is an indication of the fire's intensity, duration, and direction. Leaves, branches, and limbs will show greater damage on the side from which the fire approached. As shown in Figure 27.7.2 , this is one of the useful indicators in determining the direction of advancing fire spread. Also, items lying on and protecting fuels leave a pattern that can assist in locating the origin. Vegetation on the side of an object exposed to an oncoming fire front will be burned away, while the basal stems of vegetation adjacent to the reverse (i.e., shielded) side will remain only partially burned. Also, items lying on and protecting fuels leave a similar pattern on residual vegetation. This indicator is closely related to the indicator discussed in 27.7.8 .

Figure 27.7.2 Degree of Damage.

27.7.3 – Grass Stems.

The charred remains of grass stems left in the fire's wake will have different appearances depending upon the direction of the fire's travel. In advancing fire areas, the flames will attack the stem from the top and burn them to ground level, completely consuming all but the very base of the stem. Advancing areas are typically characterized by an absence of residual stems. Grass that grows in clumps may not be entirely consumed, showing protection on the side opposite the direction the fire came from. When this occurs in advancing areas, the residual basal stalks in the clump may show an angle of char that is steeper than the slope and exhibit cupping on the tips, with the low side of the cup on the side facing the direction the fire came from. In areas of backing fire spread, and occasionally in the lateral areas, the flames will first attack the stalk at the base, toppling the remainder of the stalk into the burned area as shown in Figure 27.7.3 . The remaining grass heads will point generally in the direction the fire came from.

Figure 27.7.3 An Example of Grass Stems Indicating the Direction of Backing Fire Movement (left to right).



27.7.4 – Angle of Char.

Angle of char indicators are divided into two groups based on the types of fuels they occur in. Angle of char can occur in pole-type fuels (tree trunks, utility poles, fence posts, and so on) or in the foliage crowns of brush or timber-type fuels.

~~**27.7.4.1** – Angle of Char, Pole-Type Fuels.~~

Standing, pole-type fuels are burned at an angle that corresponds to the flame angle and height associated with the area of fire progression. Reliability is generally greater on individual specimens in open canopy settings. On pole-type vertical fuels, an eddy vortex creates flame-wrap on the side opposing the oncoming fire, leaving a characteristic angle of char. On fires backing against the wind or down slope, the char angle will be parallel to the slope angle, see Figure 27.7.4.1(a) . Accumulation of debris may cause char up the side of the tree above the debris, but it will have little effect on the char pattern around the rest of the tree. A fire advancing with the wind or upslope will exhibit a char pattern that is steeper than the slope, see Figure 27.7.4.1(b) . Patterns indicating the movement of the fire are depicted in Figure 27.7.4.1(c) .

Figure 27.7.4.1(a) A Fire Burning Uphill or with the Wind, Creating Char Patterns That Slope Greater Than the Ground Slope.

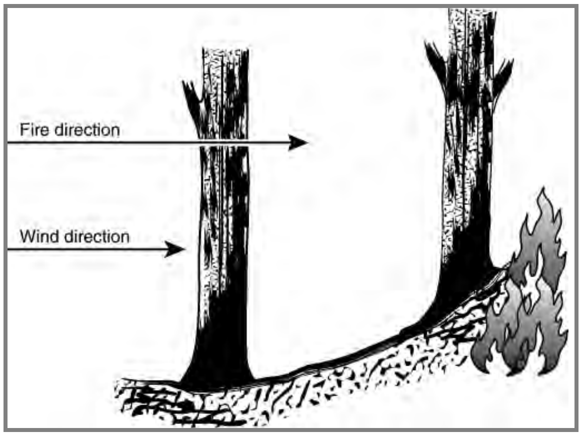


Figure 27.7.4.1(b) A Fire Burning Downslope or Against the Wind, Creating Char Patterns That Are Even or Parallel to the Ground Slope.

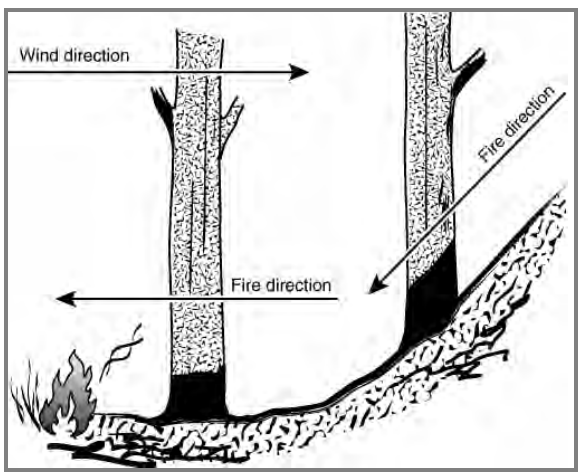


Figure 27.7.4.1(c) Char Patterns on Tree and Fence Post Indicating Fire Movement.

27.7.4.2 – Angle of Char, Foliage Crown.

On foliage crowns, the flaming front will consume or char fuels at an angle that is consistent with the fire's direction of travel. Backing fire will leave angle of char patterns parallel to the slope. Advancing fire will leave angle of char steeper than the slope due to the flame front entering low on the exposed side and exiting high on the back side see Figure 27.7.4.2(a) . Height of char angle is often correlated to fire intensity. This pattern is best viewed from the side of the object. Figure 27.7.4.2(b) shows the typical effect on the crown of trees or brush as a fire starts at point “A” and moves out, slowly building up heat and speed. At the point of origin (point A), the fire is still relatively cool as surface fuels are burned, but the tree’s crown is left mostly intact. Farther from the point of origin, the fire has become more intense, and more crown is burned. All the crowns may be burned as the fire intensifies.

Figure 27.7.4.2(a) Example of Char Patterns Created by the Way a Fire Moves Through Trees and Brush.

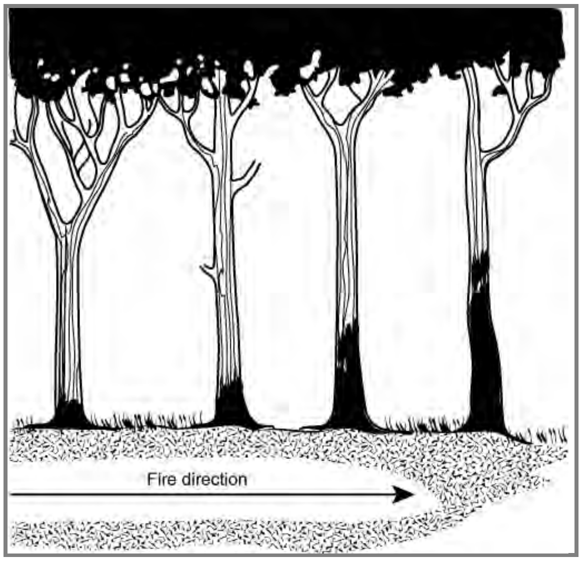
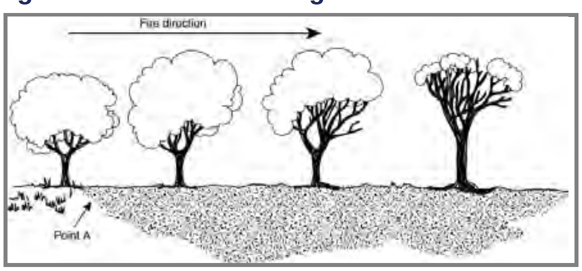


Figure 27.7.4.2(b) Progressive Crown Burning from the Point of Origin (Point A).



27.7.5 – White Ash Deposit.

White ash can be the byproduct of combustion. More white ash will be created on the sides of objects exposed to greater amounts of heat and flame. Ash is often dispersed downwind and deposited on the windward sides of objects. Ash can also be used to reconstruct probable fuel volumes. Fuels facing the advancing fire will appear lighter on the side facing the oncoming fire and darker on the side opposite the direction the fire came from. Ash indicators can begin to quickly degrade and lose reliability after only a few hours or when exposed to moisture or high winds. White ash deposits on tree boles will be on the side facing the oncoming advancing fire. By comparing and contrasting the two opposing sides, the investigator can distinguish the side facing the oncoming fire as it has more white ash present. White ash can also reveal the direction of fire travel in grass fuels. White ash can remain on the exposed sides of grass stems and clumps. When looking in the direction of the advancing fire spread, the burned area will appear lighter. When viewed looking back toward the area the fire came from, the burned area will appear darker.

27.7.6 – Cupping.

Cupping is a concave or cup-shaped char pattern on grass stem ends, small stumps and the terminal ends of brush and tree limbs. Limbs and twigs on the side facing the oncoming fire will have their tips burned off by the approaching flames leaving a rounded or blunt end. On the opposing side, twigs and limbs will be exposed to flames from underneath, along the base to the terminal end, creating a tapered point. Therefore, in advancing areas of the fire, twigs and limbs on the side opposite the direction the fire came from will show a sharply pointed or tapered end. Limbs of the brush or tree on the side facing the oncoming fire will usually be blunt or rounded off. Stumps, terminal ends of upright twigs, and the remains of grass stems can also exhibit a tapered point, with the sharp end on the nonexposed side, as shown in Figure 27.7.6 . The low side of the cup will face the oncoming fire. This indicator is usually not associated with backing areas of the fire, except in areas of steep slopes or under high-wind conditions. Partially charred branch tips may sometimes be found on the ground on the oncoming fire side of brush and small trees, where they have fallen after being burned off. Large-diameter stumps and limbs should not be considered when using this indicator due to their longer term fire residency.

Figure 27.7.6 Cupping.

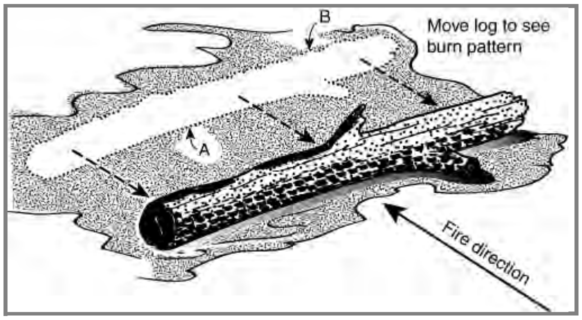
27.7.7 – Die-Out Pattern.

As a fire enters different fuel types, areas where there is increased fuel moisture or other locations where conditions cause a decrease in rate of spread and intensity, progress may slow or the fire may self-extinguish. These areas will exhibit fingers and islands of unburned or partially burned fuels. This pattern is most often associated with the lateral and backing areas of the fire; however, these areas should not be assumed to be the origin of the fire. These areas may be useful as macroscale indicators to establish general fire progression.

27.7.8 – Exposed and Protected Fuels.

A noncombustible object or the fuel itself shields the unexposed side of a fuel from heat damage. Fuels will be unburned or exhibit less damage on the side shielded from the advancing fire. Look for charring, staining, white ash, and clean burn lines on exposed sides of fuels and noncombustible objects. Compare and contrast to the opposing sides of objects. Lift or remove objects to detect the exposed and protected fuels. Objects resting on top of ground and surface fuels will protect the fuels on the unexposed side. Surface fuels on the exposed side will exhibit a clean burn line, see point "A" in Figure 27.7.8 . Surface fuels on the protected side will appear ragged and uneven, see point "B" in Figure 27.7.8 .

Figure 27.7.8 Clean Burn Line on the Front Side (Point A) and a Ragged Burn Line (Point B) on the Other Side, Showing That the Fire Moved from Point A to Point B.



27.7.9 – Staining and Sooting.

Staining is caused by hot gases, resins and oils condensing on the surface of objects. This occurs most commonly with non-combustible objects such as metal cans, glass bottles, or rocks. Stains will appear on the side of the object exposed to the flames as shown in Figure 27.7.9(a) . These yellow-to-dark-brown stains will often feel tacky to the touch and may be covered with a thin layer of white ash. Closely related to staining is sooting. Carbon soot is caused by incomplete combustion and the natural fatty oil content in some vegetation. Carbon soot is typically more heavily deposited on the side facing the approaching fire. Soot will be deposited on the side of fence wires facing toward the origin and can be detected by rubbing your fingers along the wire. On larger objects, soot deposits can also be noticed by rubbing your hand across the surface. In many cases there will be other indicators, such as protected fuel or staining. When checking a wire fence for soot, check the lower wires as they will show more evidence of soot than higher wires as shown in Figure 27.7.9(b) .

Figure 27.7.9(a) Staining (Shaded Area) of Noncombustible Objects by Vaporized Fuels and Minute Particles Carried by the Fire.

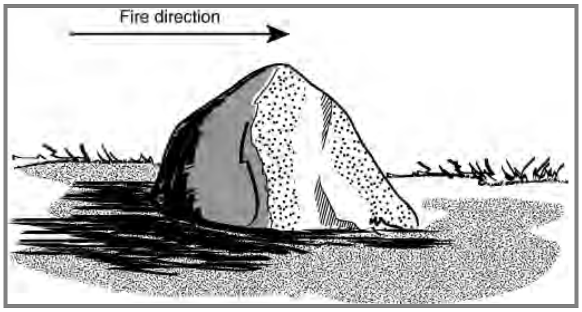
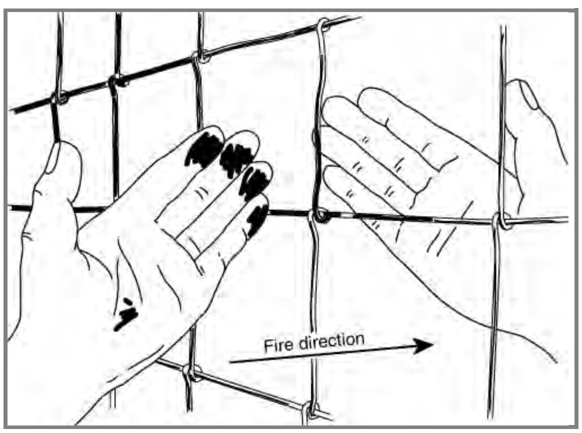


Figure 27.7.9(b) Soot Deposited on the Side of Fences Facing the Approaching Fire. The soot can be noticed by rubbing a hand along the wire.



27.7.10 Spalling.

Spalling will appear as shallow, light-colored craters or chips in the surface of rocks, as shown in Figure 27.7.10 , within the fire area. They will usually be accompanied by slabs or flakes exfoliated from the surface of the rock. Spalling is caused by a breakdown in the tensile strength of the rock's surface that has been exposed to heat. Spalling is generally associated with advancing fire areas and will appear on the side of the rock exposed to the flames.

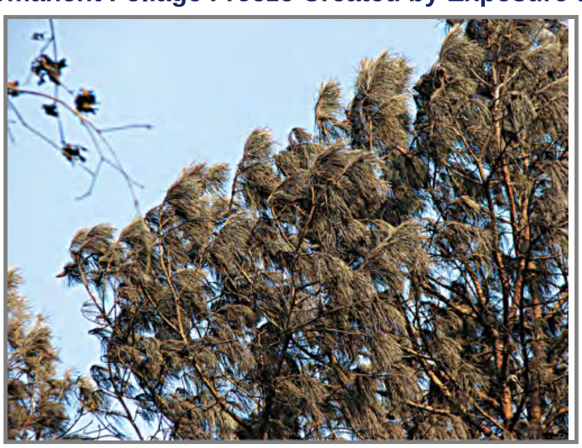
Figure 27.7.10 Spalling.

27.7.11 – Foliage Freeze.

When leaves and small stems are heated, especially in the advancing areas of the fire, they tend to become soft and pliable and are easily bent in the direction of the prevailing wind or drafts created by the fire. They often remain pointed in this direction (i.e., freeze) as they cool following the passage of the flame front. While this indicator is almost always an accurate reflection of wind direction at that precise point, it may not always coincide with fire direction. Validate freezing indicators with other indicator categories nearby to confirm the fire's direction. *[See Figure 27.7.11(a) and Figure 27.7.11(b) .]*

Figure 27.7.11(a) Foliage Freeze.

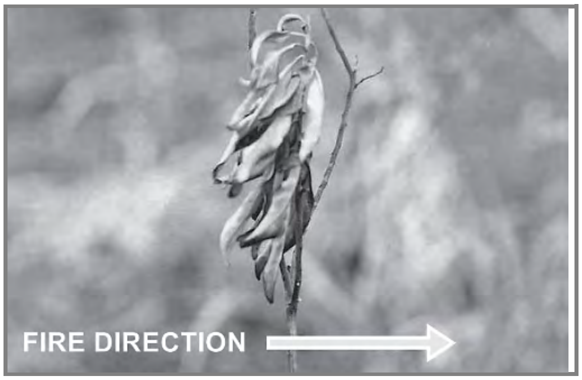
Figure 27.7.11(b) Permanent Foliage Freeze Created by Exposure to Heat.



~~**27.7.12** – Curling.~~

~~Curling occurs when green leaves curl inward toward the heat source. They fold in the direction the fire is coming from. This usually occurs with slower moving, lighter burns associated with backing and lateral fire movement. *[See Figure 27.7.12(a) and Figure 27.7.12(b) .]*~~

~~**Figure 27.7.12(a) Curling.**~~



~~**Figure 27.7.12(b) Permanent Foliage Freeze Created by Exposure to Heat.**~~

Replace 27.7 with revised version as uploaded file provided by Wildland Chapter Task Group

Additional Proposed Changes

File Name	Description	Approved
921-2021_Chapter_27.6_27.7_SD_TG.docx	Proposed revision to 27.6 & 27.7	

Statement of Problem and Substantiation for Public Comment

The changes provided are the work of the task group assigned under the Wildland Chapter Task Group that was assigned by the NFPA 921 Technical Committee Chairman to review and update Chapter 27. This section of Chapter 27 was indicated as a TC comment for additional information to be added in the second draft based on further review of materials and resource information.

	Related Item
• TC comment regarding the revision of this section during the second draft with additional materials.	

Submitter Information Verification

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Submittal Date:	Wed Jan 04 15:52:29 EST 2023
Committee:	FIA-AAA

Second Draft Motions

- Accept the Comment (PC)* with a Statement
  (1) Action: The technical committee takes this action when it decides to accept the text proposed in the Public Comment exactly as submitted.
  (2) Result: The Public Comment is marked as "Accept," and the proposed text is incorporated into one or more second revisions.
- Reject the Comment (PC), But See Related Second Revision
  (1) Action: The technical committee takes this action when it agrees with the concept of the Public Comment in whole or in part but has developed related text in one or more second revisions that is different from the text in the Public Comment.
  (2) Result: The Public Comment is marked as "Reject But See" and a reference is provided to the related second revision(s).
- Reject the Comment (PC)*
  (1) Action: The technical committee takes this action when it disagrees with the proposed changes in the Public Comment.
  (2) Result: The Public Comment is marked as "Reject" and no second revision is developed.
- Reject but Hold the Comment Input (PC) [state specific revision]
  (1) Action: The technical committee takes this action when it decides to reject the Public Comment, but hold it for processing as a Public Input for the next revision cycle in accordance with Section 4.4.8.3.
  (2) Result: The comment is marked as "Reject But Hold," and no second revision is developed
- Create a Second Revision (SR) [state specific revision]
  (1) Action: The technical committee takes this action when it decides to change the first draft as a result of the committee's own review. [4.4.9.2]
  (2) Result: The second revision(s) must be related to material that has received public review as the first draft of the document.
  .

**Can apply same action to multiple PCs in one motion*

Technical Committee	Fire Investigations (FIA-AAA)
Task Group	Chapter 27
TG Chair	TBD
TG Members	TBD

Section	PC	Task Group Recommendation	TG Tag	Task Group Statement	SR (Staff use only)
27.6.7			TG	**Removed from 27.7 not an indicator**	
27.6.8			TG	**Removed from 27.7 not an indicator**	
27.7			TG	**Indicator section revised with more correct information**	

~~Chapter 27 Wildfire Fire Investigations~~

~~**27.1 Introduction.**~~
~~This chapter is an introduction to the unique nature of wildland fire investigations. It includes specialized principles, techniques, practices, equipment, and terminology specific to wildland fires and wildland fire investigations. In order to maintain a common, consistent, and tested overall methodology for wildland fire investigation, the materials within this chapter are presented to be consistent with materials taught throughout this guide, including the application of the scientific method, and with other materials taught specifically within the wildland fire investigation community.~~
~~**27.2 Scope.**~~
~~This chapter is designed to assist individuals with the responsibility of investigating and analyzing wildland fire incidents and rendering opinions as to the origin, cause, responsibility, or prevention of such incidents and the damage and injuries that arise from such incidents.~~
~~**27.3 Purpose.**~~
~~The purpose of this chapter is to establish guidelines and recommendations for the safe and systematic investigation or analysis of wildland fire incidents. It is also intended to identify and explain those aspects unique to wildland fire investigations. This chapter is intended as a basic introduction and the user is urged to consult the reference material listed in Annex B and Annex C. As with other types of fire investigations covered in this guide, specialized personnel may be needed to provide technical assistance.~~
~~**27.4 Terminology Specific to Wildland Fire Investigations.**~~
~~To avoid confusion and challenges, wildland fire investigators should apply terminology located in Section 3.5 whenever possible during their investigation, including while note taking, while report writing, on diagrams and sketches, during testimony, and on other forms during the documentation process. If, however, a term is not used in the recommended context, or if another term is used that readers may not be familiar with, the wildland fire investigator should define the term in the report for clarity. Refer to additional terms in Chapter 3 for additional general fire investigation terminology that may also apply to a wildland fire investigation.~~
~~**27.5 Basic Methodology.**~~
~~**27.5.1 Origin and Cause.**~~
~~The objective of every origin and cause investigation is to identify the factors that were necessary for the fire to have occurred, including identifying a competent ignition source, first fuel(s) ignited, and the circumstances that resulted in the ignition of the fuel(s).~~
~~**27.5.2 Investigation.**~~

The investigation of wildland fires includes the consideration of many types of potential fire causes, including those that may lead to civil or criminal actions. The overall methodology for determining the origin of a wildland fire is the scientific method as described in Chapter 4 and the application of the specialized principles, methods, and terminology specific to the wildland fire investigation discipline.

27.5.3 Methodology for Origin Determination.

The overall methodology for determining the origin of a wildland fire is based on the scientific method as shown schematically in Figure 18.2.

27.5.4 Sequence of Activities.

The various activities required to determine the origin using the scientific method occur continuously, including recording the scene, accounting for weather factors, identification of fuel types, note taking, photography, evidence identification, and witness interviews.

27.5.5 Sequential Pattern Analysis.

The area of origin may be determined by examining the fire effects and fire patterns. The surfaces of the fire scene record all the fire effects and fire patterns generated during the lifetime of the event, from ignition through suppression, although these effects and patterns may be altered, overwritten, or obliterated after they are produced. The key to determining the origin of a fire is to determine the sequence in which these effects and patterns were produced. Investigators should strive to identify and collect sequential data and, once collected, organize the information into a sequential format.

27.5.6 Systematic Procedure.

Investigators should establish a systematic procedure to avoid overlooking significant evidence and forming premature conclusions about the origin.

27.5.7 Recommended Methodology.

This chapter discusses a recommended methodology for the examination of the wildland fire scene. This methodology consists of an initial scene assessment, development of a preliminary fire spread hypothesis, an in-depth examination of the fire scene, development of final fire spread hypothesis, and identification of the fire's origin.

27.5.8 Guidance.

This chapter provides general guidance for the fire investigator. Descriptions of more detailed steps for processing the wildland fire scene can be found in PMS 412, *Guide to Wildland Fire Origin and Cause Determination*. This document is periodically revised, and the investigator should consult the most recent edition.

27.6 Fire Science.

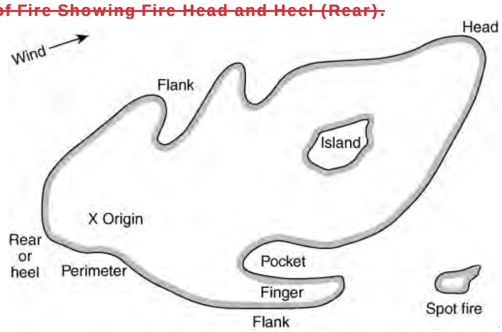
27.6.1 Behavior at the Fire Origin.

While physics and chemistry are universal, the fire dynamics of wildland fires have substantial differences from structure fires. The most significant difference is fire dynamics around the area of origin. In wildland fires, the area of origin is typically well-preserved and can have little damage. The primary reason for this is the influence of wind. Under most conditions, the wildland fire will be wind driven, influenced by terrain or fuel type. Once the wildland fire is established, the fire will advance away from the area of origin, advancing ahead and moving laterally depending on the availability of fuels and slope. This has significant implications to the fire investigation. In a wildland fire, the fire will typically not become large until the fire has advanced downwind of the origin. As a result, the investigator may find artifacts indicating the cause of the fire at origin which are only slightly burned or consumed. The role of radiation is also different in wildland fires. In a wildland fire, the flame volume has to become sizable before radiation becomes important. This is due to the absence of surfaces such as walls or ceilings.

27.6.2 Fire Shape.

The parts of a wildland fire are generally described in relation to the type of fire spread occurring at that portion of the perimeter as illustrated in Figure 27.6.2.

Figure 27.6.2 Anatomy of Fire Showing Fire Head and Heel (Rear).



27.6.3* References.

~~It is recommended that wildland fire investigators acquaint themselves with principles of fire science and technology as they pertain specifically to wildland fires. Several references are listed in A.27.6.3.~~

~~**27.6.4 Wildland Fuels.**~~

~~Apart from the roles of wind and of bounding surfaces, fuels are also different in wildland fires. In these fires, the fuels are primarily trees and vegetation, which can be both dead and alive. The moisture content can vary significantly and play an important role. Fuels of lesser density respond more quickly to ambient moisture changes than denser fuels. Keen observation of variations in wildland fuels is essential to accurately analyze fire behavior. The investigator should be aware of man-made combustible/flammable materials deposited in the area of fire origin.~~

~~**27.6.4.1 Ground Fuels.**~~

~~Ground fuels include all flammable materials located between the mineral soil layer and the ground surface. These fuels typically include twig, leaf and needle litter, and decomposing vegetation such as duff, peat moss, buried limbs and roots. Buried limbs and roots can burn along their entire length and ignite a surface fire in a different location. When sufficiently dry, ground fuels can be a very receptive fuel bed for a wide variety of ignition sources due to their high surface-area-to-volume ratio. They can also smolder for long periods of time before transitioning to open flame. Ground fuels by themselves are not typically associated with rapid fire progression; however they can contribute to significant long-term fire residency, depending upon the depth of the materials.~~

~~**27.6.4.2 Surface Fuels.**~~

~~Surface fuels are those combustible materials located from the surface of the ground to approximately 2 m (6 ft) above the surface. Surface fuels include grasses, leaves, twigs, needles, field crops, slash, and downed limbs. Surface fuels contribute to rapid fire propagation and the rate of fire spread. They also serve as the primary fuel ladder to aerial fuels.~~

~~**27.6.4.3 Aerial Fuels.**~~

~~Aerial fuels are standing and supported live and dead combustibles not in direct contact with the ground and consist mainly of foliage, twigs, branches, stems, cones, bark, moss, and vines located from approximately 2 m (6 ft) above the surface to, and including, the crowns of the canopy. These fuels include tree branches, leaves, needles, snags, moss, tall brush, and draped fuels that have fallen from above and have lodged on lower branches or brush. These fuels are only infrequently the materials first ignited and typically require significant amounts of heat from surface fuels to ignite. Combining steep slopes or higher wind speeds can easily transition the fire to a crown fire. Aerial fuels can contribute to rapid fire spread, primarily through the generation of aerial firebrands.~~

~~**27.6.5 Weather.**~~

~~Weather plays a substantial role in the behavior of wildland fires. Weather elements can be described as the state of the atmosphere with respect to atmospheric stability, temperature, relative humidity, wind velocity, cloud cover, and precipitation. The investigator should ensure that the local weather data is researched and reviewed for the time leading up to the fire and afterward.~~

~~**27.6.6 Topography.**~~

~~Topography relates to the form of natural or man-made earth surfaces. Topography and its aspect affect the intensity and spread of a fire. Winds and their effects on fire behavior are affected by the topography, including valleys, canyons, steep slopes, and ridges.~~

27.6.7 Degree of Damage.

The damage data used by fire investigators in origin determination begins with the ability of the investigator to observe varying degrees of fire damage. The degree of damage to a fuel is an indication of the fire's intensity, duration, and direction. Leaves, branches, and limbs will show greater damage on the side from which the fire approached. As shown in Figure 27.6.7, the degree of damage is useful in determining the direction of advancing fire spread. Also, items lying on and protecting fuels leave a pattern that can assist in locating the origin. Vegetation on the side of an object exposed to an oncoming fire front will be burned away, while the basal stems of vegetation adjacent to the reverse (i.e., shielded) side will remain only partially burned. Also, items lying on and protecting fuels leave a similar pattern on residual vegetation. The degree of damage observations is closely related to the Protection Fire Pattern Indicator discussed in 27.7.8.

Figure 27.6.7

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27.6 .8 Die-Out

As a fire enters different fuel types, areas where there is increased fuel moisture or other locations where conditions cause a decrease in rate of spread and intensity, progress may slow or the fire may self-extinguish. These areas will exhibit fingers and islands of unburned or partially burned fuels. Die Out is most often associated with the lateral and backing areas of the fire; however, these areas should not be assumed to be the origin of the fire.

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27.7 27.7 Fire Pattern Indicators and Patterns.

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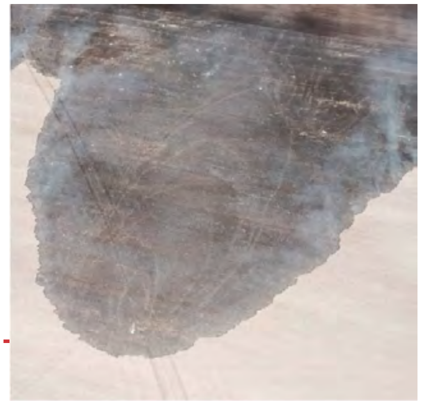
27.7.1 Indicators.

The indication of the direction of a fire's spread is imprinted on partially burned fuels and noncombustible objects. These visual fire effects may include differential damage, char patterns, discoloration, carbon staining, shape, location, and condition of residual unburned fuel. Analysis of the directional pattern shown by multiple indicators in a specific area will identify the path of fire spread through this site. The direction of fire travel can usually be determined by examining the appearance of the fire pattern indicator. These include advancing, backing and lateral directions. When analyzed within the fire behavior context, they will form distinct overall fire patterns. By applying a systematic approach to backtrack the spread of the fire, the investigator can retrace the path of the fire to the point of originfire's ignition area.

27.7.1.1 Wildland Fire V-Shaped Fire Pattern Indicatorss.

Wildland fire V-shaped patterns, as shown in Figure 27.7.1.1, are horizontal ground surface burn patterns generated by the fire spread. When viewed from above, they are generally shaped like the letter "V." These are not to be confused with the traditional plume-generated vertical V patterns associated with structure fires. These V-shaped patterns are affected by wind direction or the slope on which the fuel is located. As the fire spreads in the direction of the wind or up a slope, the widening legs of the V are created. The width of the pattern increases as the fire advances from the area of ignition. The origin of the heat source that created the pattern often is found at or near the base or most narrow point of the pattern. Therefore, the analysis of these horizontal V-shaped patterns can be useful in identifying a general location of the fire origin.

Figure 27.7.1.1 V-Shaped Pattern. If you look closely at this photo you can see the individual Elliptical runs



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27.7.2 Degree of Damage.

The degree of damage to a fuel is an indication of the fire's intensity, duration, and direction. Leaves, branches, and limbs will show greater damage on the side from which the fire approached. As shown in Figure 27.7.2, this is one of the useful indicators in determining the direction of advancing fire spread. Also, items lying on and protecting fuels leave a pattern that can assist in locating the origin. Vegetation on the side of an object exposed to an oncoming fire front will be burned away, while the basal stems of vegetation adjacent to the reverse (i.e., shielded) side will remain only partially burned. Also, items lying on and protecting fuels leave a similar pattern on residual vegetation. This indicator is closely related to the indicator discussed in 27.7.8.

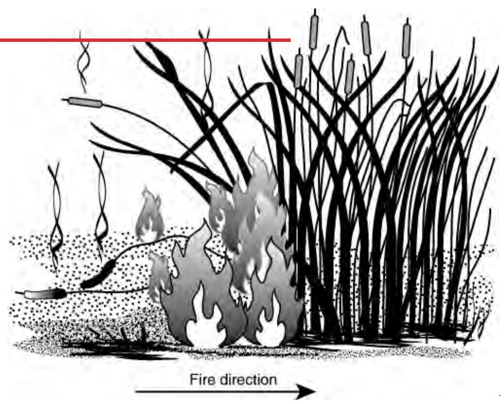
Figure 27.7.2 Degree of Damage.

Commented [SR1]: This section moved to 27.6.7 and the photo was replaced.

27.7.3 Grass Stems.

~~The charred remains of grass stems left in the fire's wake will have different appearances depending upon the direction of the fire's travel. In advancing fire areas, the flames will attack the stem from the top and burn them to ground level, completely consuming all but the very base of the stem. Advancing areas are typically characterized by an absence of residual stems. Grass that grows in clumps may not be entirely consumed, showing protection on the side opposite the direction the fire came from. When this occurs in advancing areas, the residual basal stalks in the clump may show an angle of char that is steeper than the slope and exhibit cupping on the tips, with the low side of the cup on the side facing the direction the fire came from. In areas of backing fire spread, and occasionally in the lateral areas, the flames will first attack the stalk at the base, toppling the remainder of the stalk into the burned area as shown in Figure 27.7.3. The remaining grass heads will point generally in the direction the fire came from.~~

~~**Figure 27.7.3 An Example of Grass Stems Indicating the Direction of Backing Fire Movement (left to right).**~~



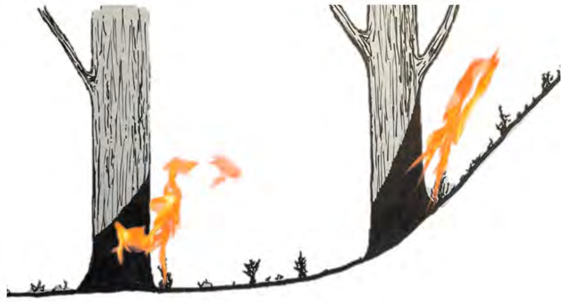
27.7.4 Angle of Char Fire Pattern Indicators.

The ~~a~~Angle of char fire pattern indicator~~s~~ is formed when burns up to, past and beyond a standing fuel; such as a tree, utility pole, grass clumps or bush. Flame height and angle corresponding to advancing, lateral and backing fire directions and intensities char the fuel at an angle compared to both the unburned portion of the object and the slope. Angle of char indicators are divided into two groups based on the types of fuels they occur in. Angle of char can occur in pole-type fuels (tree trunks, utility poles, fence posts, ~~and so on~~) or in the foliage crowns of brush or timber-type fuels, or in grass stems.

27.7.4.1 Angle of Char, Pole-Type Fuels.

Standing, pole-type fuels are burned at an angle that corresponds to the flame angle and height associated with the area of fire progression. Reliability is generally greater on individual specimens in open canopy settings. On pole-type vertical fuels, a~~n~~ wind eddy vortex creates flame-wrap on the side opposing the oncoming fire, leaving a characteristic angle of char. The wind vortex flame wrap pattern can be used to assist in establishing the wind direction at the scene. Generally, the stronger the wind, the higher the wind vortex flame wrap. On fires backing against the wind or down slope, the char angle will be parallel to the slope angle, see Figure 27.7.4.1(a). Accumulation of debris may cause char up the side of the tree above the debris, but it will have little effect on the char pattern around the rest of the tree. A fire advancing with the wind or upslope will exhibit a char pattern that is steeper than the slope, see Figure 27.7.4.1(b). Patterns indicating the movement of the fire are depicted in Figure 27.7.4.1(c).

Figure 27.7.4.1(~~a) A~~a) A Fire Burning Uphill or with the Wind, Creating Char Patterns That Slope Greater Than the Ground Slope.



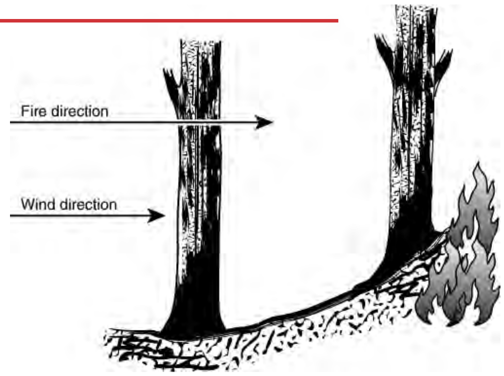
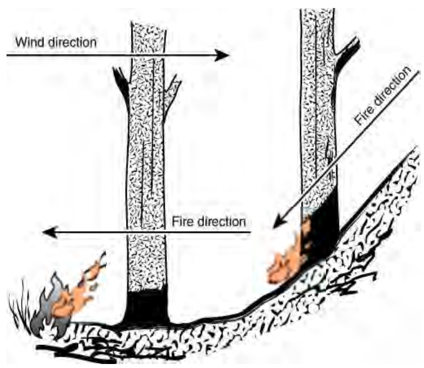


Figure 27.7.4.1(b) A Fire Burning Downslope or Against the Wind, Creating Char Patterns That Are Even or Parallel to the Ground Slope.



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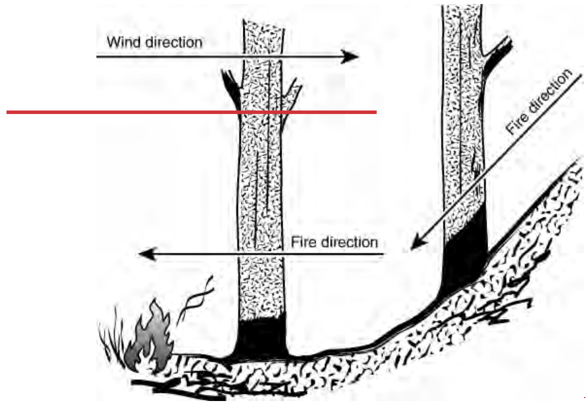

Figure 27.7.4.1(c~~) Char~~) Char Patterns on Tree and Fence Post Indicating Fire Movement.

27.7.4.2 Angle of Char, Foliage Crown.

On foliage crowns, the flaming front will consume or char fuels at an angle that is consistent with the fire's direction of travel. Backing fire will leave angle of char patterns parallel to the slope. Advancing fire will leave angle of char steeper than the slope due to the flame front entering low on the exposed side and exiting high on the back side see Figure 27.7.4.2(a). Height of char angle is often correlated to fire intensity. This pattern is best viewed from the side of the object. Figure 27.7.4.2(b) shows the typical effect on the crown of trees or brush as a fire starts at point “A” and moves out, slowly building up heat and speed. At the point of origin (point A), the fire is still relatively cool as surface fuels are burned, but the tree’s crown is left mostly intact. Farther from the point of origin, the fire has become more intense, and more crown is burned. All the crowns may be burned as the fire intensifies.

Figure 27.7.4.2(~~a) Example~~a) Example of Angle Char Patterns Created by the Way a Fire Moves Through Trees and Brush.

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Fire Direction

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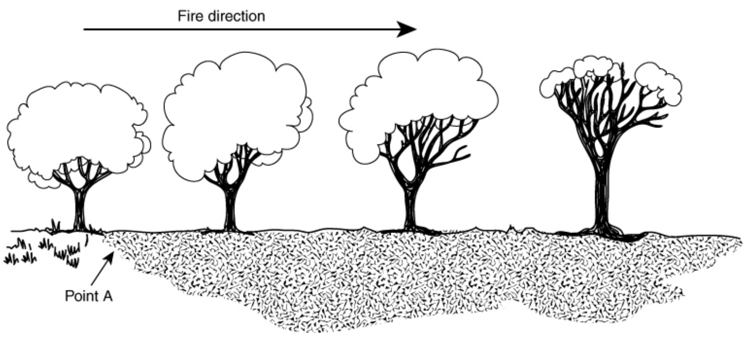
Figure 27.7.4.2(b) Progressive Crown Burning from the Point of Origin (Point A).



27.7.3 Angle of Char **Grass Stems.**

The charred remains of standing grass stems left in the fire's wake will have different appearances depending upon the direction of the fire's travel. In advancing fire areas, the flames will attack the stem from the top and burn them to ground level, completely consuming all but the very base of the stem. Advancing areas are typically characterized by an absence of residual stems. Grass that grows in clumps may not be entirely consumed, showing protection on the side opposite the direction the fire came from. When this occurs in advancing areas, the residual basal stalks in the clump may show an angle of char that is steeper than the slope and exhibit cupping on the tips, with the low side of the cup on the side facing the direction the fire came from as shown in Figure 27.7.3. (c). In areas of backing fire spread, and occasionally in the lateral areas, the flames will first attack the stalk at the base, toppling the remainder of the stalk into the burned area as shown in Figure 27.7.3. (a) & (b). The remaining grass heads will point generally in the direction the fire came from.

Figure 27.7.3 (a) An Example of Grass Stems Indicating the Direction of Backing Fire Movement (left to right).

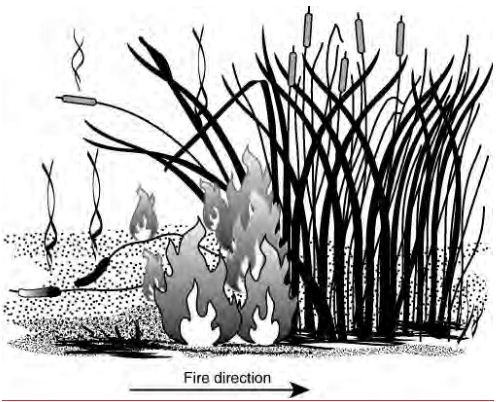


Figure 27.7.3 (b) Grass Stems Laid Down with Heads Pointing to the Direction the Fire Came From

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Figure 27.7.3 (c) An Example of Angle of Char on Indicating the Direction of Backing Fire (right to left).

← Fire Direction

27.7.5 White Ash Deposit.

White ash can be the byproduct of combustion. More white ash will be created on the sides of objects exposed to greater amounts of heat and flame. Ash is often dispersed downwind and deposited on the windward sides of objects. ~~Ash can also be used to reconstruct probable fuel volumes.~~ Fuels facing the advancing fire will appear ~~lighter~~ white on the side facing the oncoming fire (exposed side), as shown in Figure27.7.5 (a) and darker on the side opposite the direction the fire came from(unexposed side), as shown in Figure27.7.5 (b). Ash indicators can begin to quickly degrade and lose reliability after only a few hours or when exposed to moisture or high winds. White ash deposits on tree boles will be on the side facing the oncoming advancing fire. By comparing and contrasting the two opposing sides, the investigator can distinguish the side facing the oncoming fire as it has more white ash present. White ash can also reveal the direction of fire travel in grass fuels. White ash can remain on the exposed sides of grass stems and clumps. When looking in the direction of the advancing fire spread, the burned area will appear ~~lighter~~more white. When viewed looking back toward the area the fire came from, the burned area will appear darker. In the advancing area, windmay place white ash deposits on objects over wide areas. Look for consistency within an area and identify clusters of fire pattern indicators. Concentrated areas of white ash on the ground are the result of more complete combustion of fuels.

Figure 27.7.5 (a) An Example of White Ash Deposits Indicating the Direction of Fire Movement (Bottom to Top)

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Figure 27.7.5 (b) An Example of White Ash Deposits Indicating the Direction of Fire Movement (Top to Bottom)

27.7.6 Cupping.

Cupping is a concave or cup-shaped char pattern on grass stem ends, small stumps and the terminal ends of brush and tree limbs. Cupping may be found oin horizontal or vertical fuel, Vertical cupping tends to represent a chair-like shape. Horizontal cupping represents pointed and blunted ends of opposing sides of vegetation.
Horizontal Cupping: Limbs and twigs on the side facing the oncoming fire will have their tips burned off by the approaching flames leaving a rounded or blunt end. On the opposing side, twigs and limbs will be exposed to flames from underneath, along the base to the terminal end, creating a tapered point.

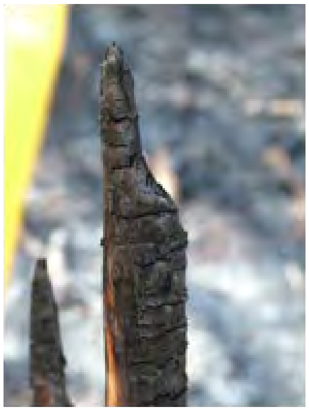
Vertical Cupping: Therefore, in advancing areas of the fire, twigs and limbs on the side opposite the direction the fire came from will show a sharply pointed or tapered end. Limbs of the brush or tree on the side facing the oncoming fire will usually be blunt or rounded off. Stumps, terminal ends of upright twigs, and the remains of grass stems can also exhibit a tapered point, with the sharp end on the nonexposed side, Is a concave char pattern that results in a cup shape with its lower portion facing the direction the fire came from. AAs shown in Figure 27.7.6. The low side of the cup will face the oncoming fire. This indicator is usually not associated with backing areas of the fire, except in areas of steep slopes or under high-wind conditions. Partially charred branch tips may sometimes be found on the ground on the oncoming fire side of brush and small trees, where they have fallen after being burned off. Large

~~diameter stumps and limbs should not be considered when using this indicator due to their longer term fire residency.~~

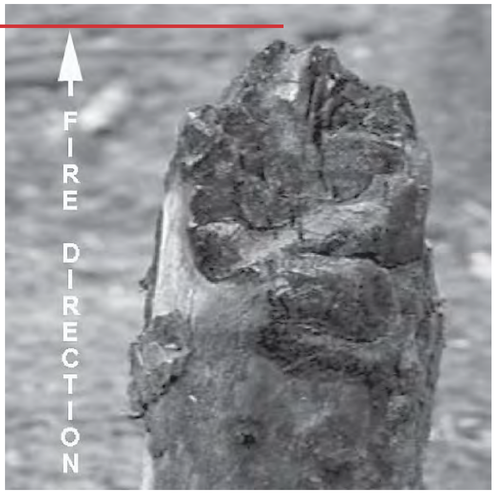
Figure 27.7.6 Cupping.

Fire Direction

Fire Direction



Fire Direction



27.7.7 Die-Out Pattern.

As a fire enters different fuel types, areas where there is increased fuel moisture or other locations where conditions cause a decrease in rate of spread and intensity, progress may slow or the fire may self-extinguish. These areas will exhibit fingers and islands of unburned or partially burned fuels. This pattern is most often associated with the lateral and backing areas of the fire; however, these areas should not be assumed to be the origin of the fire. These areas may be useful as macroscale indicators to establish general fire progression.

27.7.8 Exposed and Protected FuelsProtection Fire Pattern Indicators.

A noncombustible object or the fuel itself shields the unexposed side of a fuel from heat damage. Fuels will be unburned or exhibit less damage on the side shielded from the advancing fire. Look for charring, staining, white ash, and clean burn lines on exposed sides of fuels and noncombustible objects. Compare and contrast to the opposing degree of damage on all sides of objects. Photograph objects in place prior to moving to compare and contrast the damage and protection. Lift or remove objects to detect the exposed and protected fuels. Objects resting on top of ground and surface fuels will protect the fuels on the unexposed side. Surface fuels on the exposed side will exhibit a clean burn line, see point "A" in Figure 27.7.8. and s Surface fuels on the protected side will appear ragged and uneven, see point "B" in Figure 27.7.8 (b).

Figure 27.7.8 (a) Clean Burn Line on the Front Side (Point A) and a Ragged Burn Line (Point B) on the Other Side, Showing That the Fire Moved from Point A to Point BProtection under object.

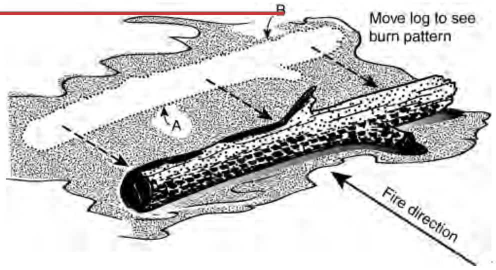


Figure 27.7.8 (b) Clean Burn Line on the Front Side and a Ragged Burn Line on the Other Side, Showing That the Fire Moved from Left to Right.

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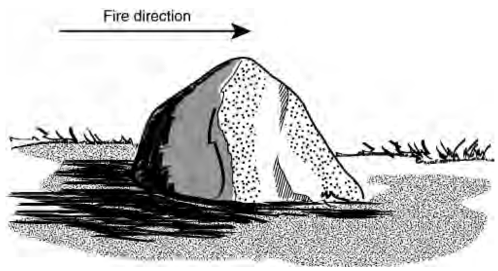
27.7.9 Staining ~~and Sooting~~Fire Pattern Indicators .

Staining is caused by the products of incomplete combustion being deposited on surfaces of objects, unlike soot, staining cannot be wiped off the surface of the object. ~~by hot gases, resins and oils condensing on the surface of objects.~~ This occurs most commonly with non-combustible objects such as metal cans, glass bottles, or rocks. Stains will appear on the side of the object exposed to the flames as shown in Figure 27.7.9~~(a)~~. These yellow-to-dark-brown stains will often feel tacky to the touch and may be covered with a thin layer of white ash. Staining is commonly a microscale indicator and is more pronounced in advancing fire areas and is often subtle. Closely related to staining is sooting. ~~Carbon soot is caused by incomplete combustion and the natural fatty oil content in some vegetation. Carbon soot is typically more heavily deposited on the side facing the approaching fire. Soot will be deposited on the side of fence wires facing toward the origin and can be detected by rubbing your fingers along the wire. On larger objects, soot deposits can also be noticed by rubbing your hand across the surface. In many cases there will be other indicators, such as protected fuel or staining. When checking a wire fence for soot, check the lower wires as they will show more evidence of soot than higher wires as shown in Figure 27.7.9(b).~~

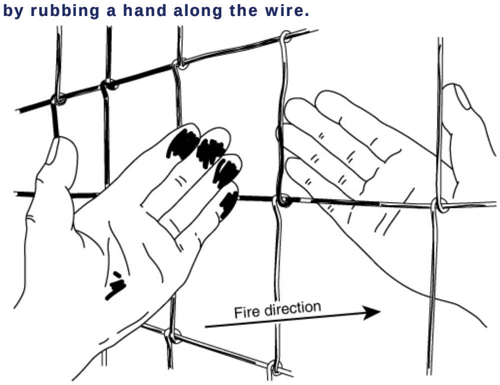
Figure 27.7.9(a) Staining (Shaded Area) of Noncombustible Objects by Vaporized Fuels and Minute Particles Carried by the Fire.



27.7.10 Sooting Fire Pattern Indicator

Sooting is a carbon-based deposit created by incomplete combustion. Soot is typically more heavily deposited on the side facing the approaching fire, unlike staining, sooting can typically be wiped off the surface of an object. On larger objects, soot deposits can also be noticed by rubbing your hand across the surface. In many cases, there will be other indicators, such as protected fuel or staining. Soot will be d eposited on the side of fence wires facing toward the origin and can be detected by rubbing your fingers along the wire. When checking a wire fence for soot, check the lower wires as they will show more evidence of soot than higher wires as shown in Figure 27.7.10.

Figure 27.7.~~109(b)~~10 Soot Deposited on the Side of Fences Facing the Approaching Fire. The soot can be noticed by rubbing a hand along the wire.



27.7.1~~0~~1 Spalling Fire Pattern Indicators.

Spalling will appear as shallow, light-colored craters or chips in the surface of rocks, as shown in Figure 27.7.10, within the fire area. They will usually be accompanied by slabs or flakes exfoliated from the surface of the rock. Spalling is caused by a breakdown in the tensile strength of the rock's surface that has been exposed to heat. Spalling is generally associated with advancing fire areas and will appear on the side of the rock exposed to the flames.

Figure 27.7.1~~0~~1 Spalling.

27.7.121 Foliage Freeze.

When needles, leaves and small stems are heated, especially in the advancing areas of the fire, they tend to become soft and pliable and are easily bent in the direction of the prevailing wind or drafts created by the fire. They often remain pointed in this direction (i.e., freeze) as they cool following the passage of the flame front. While this indicator is almost always an accurate reflection of wind direction at that precise point, it may not always coincide with fire direction. Validate freezing indicators with other indicator categories nearby to confirm the fire's direction. *[See Figure 27.7.11(a) and Figure 27.7.11(b).]* Foliage freeze may include the curling of broadleaf plants as a result of a low intensity fire moving through an area. It is a reliable indicator of fire intensity . Heat exposure causes a broadleaf to dry out and curl. These leaves may move and freeze with the wind. This usually occurs with slower moving, lighter burns associated with backing and lateral fire movement.

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Figure 27.7.121(a) Foliage Freeze.

Figure 27.7.121 (b) Permanentb) Permanent Foliage Freeze Created by Exposure to Heat.

27.7.12 Curling.

Curling occurs when green leaves curl inward toward the heat source. They fold in the direction the fire is coming from. This usually occurs with slower-moving, lighter burns associated with backing and lateral fire movement. *[See Figure 27.7.12(a) and Figure 27.7.12(b).]*

Figure 27.7.12(a) Curling.

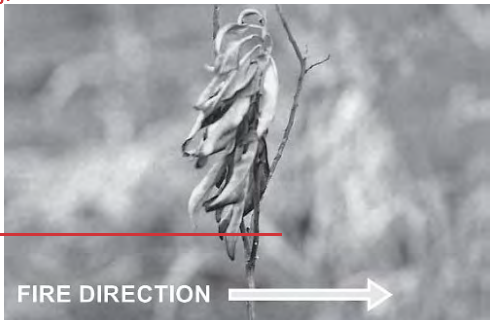

Figure 27.7.12(b) Permanent Foliage Freeze Created by Exposure to Heat.

27.8 Safety.

27.8.1 Safety Assessment.

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Prior to beginning the investigation, the investigator should first make an initial safety assessment. The investigator should determine if it is safe to enter the wildland fire scene. If it is not safe to enter, the investigator must determine what steps are required to provide for personal safety or to render the scene safe to enter.

27.8.2 Hazards.

Each of the hazards discussed within this chapter should be assessed. There is no reason the investigator should compromise safety. Investigators must be aware of areas where the fire appears to have been extinguished but could become active again. Underground burning can ignite surface fuels and create hazards where the ground collapses under the weight of an investigator causing thermal or other types of injuries. Overhead hazards may also be present in the form of toppled trees or falling branches. Injured or frightened wildlife can also become a hazard. Many wildland investigators use boots that are specially rated for wildland fire. NFPA 1977 establishes requirements for protective clothing and equipment to protect against the adverse environmental effects encountered by personnel performing wildland operations. Additional information of fire scene safety is provided in Chapter 13.

27.9 Determining the Origin Area.

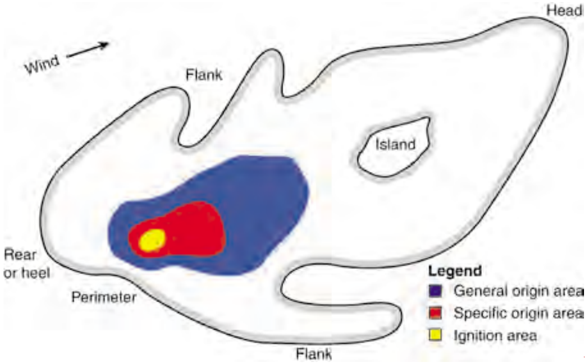
27.9.1 Systematic Approach.

Wildland fire ignition area determination is conducted using a systematic approach (i.e., the scientific method) *(see Sections 18.2 and 19.2 and Figure 18.2)*. The general area of origin is determined based on analysis of the fire behavior, witness observations, and macroscale fire pattern indicators. Entry into the area should be made systematically through a process of locating (in order) the boundary of the general origin area (GOA), the specific origin area (SOA), and the ignition area (IA). This is a continuous sequence of working through the unique nature of each area by following the physical evidence of the fire pattern indicators.

27.9.2 Initial Area of Investigation.

The initial area of investigation may be determined from information from first-arriving firefighters and eyewitnesses. The firefighters and witnesses may verify the location and size of the fire during its early involvement. These accounts will assist the investigator in narrowing down the search area.

Figure 27.9.2 Anatomy of Origin Area—Blue Represents the General Origin Area, Red Represents the Specific Origin Area, and Yellow Represents the Ignition Area, All Within the Overall Fire Area.



27.9.3 General Origin Area.

A general origin area may be a limited area or several acres in size. The size of the general origin area is going to be dictated by what the indicators show, not the potential ignition sources. Once the general origin area has been identified, a boundary may be determined and marked *(see Figure 27.9.2)*.

27.9.4 Working the General Origin Area.

A suggested method for working the general origin area is as follows: Enter from the advancing area. Work across the run until the lateral transition zone is reached. Move several feet closer toward the origin and recross the advancing run to the opposing lateral transition zone. Repeat these steps until the specific origin area is reached. *(See Figure 27.9.4.)* Document each indicator located with a visible marker. Color-coded surveyors' flags have been found to be the most visible and easiest markers to use. Standard recommended colors are red for advancing fire indicator, yellow for lateral fire indicator, blue for backing fire indicator, and white for evidence.

Figure 27.9.4 Working the General Origin Area.

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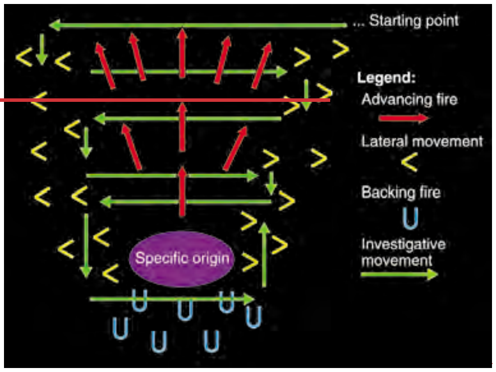

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27.9.5 Specific Origin Area.

The specific origin area is the area within the general origin area. The specific origin area is where the transition zones between the advancing and backing indicators come together with the lateral indicators on the flanks influenced by wind, fuel, or slope. Within this area, microscale fire pattern indicators can be identified and utilized in determining the ignition area.

27.9.6 Ignition Area.

The ignition area is within the perimeter of the specific origin area. The ignition area is the location where the fire specifically originated, and evidence of the fire cause may be found.

27.10 Determining the Cause.

The objective of every origin and cause investigation is to identify the factors that were necessary for the fire to have occurred, including identifying a competent ignition source, first fuel(s) ignited, and the circumstances that resulted in the ignition of the fuel(s). An investigator should receive the proper education and meet the standards set forth in NFPA 1033 before conducting criminal fire investigations. The investigation of wildland fires includes the consideration of many types of potential fire causes, including those that may lead to civil or criminal actions. The safety of the public remains a primary objective of fire prevention and includes attention to all potential causes of wildland fires.

27.10.1 Ignition Sources.

Wildland fires are not always started by actions of people. Many are ignited by natural causes such as lightning, volcanoes, coal seam fires, meteorites, rocks falling, and so on. Fire suspected of being caused by natural heat sources should be investigated to ensure that the correct cause is determined. Experience has shown that other types of causes are still present during varying events, such as lightning storms. Specific examples are the occasional incendiary fire ignited under the cover of a lightning storm or an escaped ember from a debris burn.

27.10.1.1 Lightning.

Lightning is a discharge of static electricity associated with thunderstorm/cloud activity. Lightning strikes can possess either positive or negative charges. Both types are capable of starting fires, but positive strokes/charges have a greater probability of igniting fires. Ninety percent to ninety-five percent of the lightning that occurs across the country is considered negative strikes. Negative strikes have been recorded to be typically about 300,000,000 volts and 30,000 amps of power. Positive lightning strikes make up the remaining five percent to 10 percent of all strikes. Positive strikes originate high in the storm, some 9144 to 18,288 m (30,000 to 60,000 ft) high. Under normal storm conditions, the ground is usually shielded from the positive charges by the negative charges in the middle part of the storm. That changes when winds are strong in the lower levels, or when the storm becomes tilted, or when the anvil shape of a storm spreads out ahead or behind the updraft of the storm. Once that occurs, the ground is no longer shielded from those upper positive charges and a positive charge leader can form. Due to the sheer distance that the positive bolt has to travel to get to the ground, it can be up to 10 times more powerful and last 10 times longer than a negative strike, which means it can reach 1 billion volts and nearly 300,000 amps. Positive strikes contain stronger voltage and longer length of the bolt, which causes more damage to be done, more deaths to occur, and more fires to ignite from these type of charges. Many web-based lightning documentation companies have programs that provide relevant lightning strike information that can be very helpful to the fire investigator.

27.10.1.2 Campfires and Debris Burning.

Fire escaping from campfires is a common cause of wildland fires. Winds can carry burning embers significant distances from their source and easily ignite if they end up landing in receptive fuel beds. Campfires can continue to smolder for long periods of time and eventually transition to flaming combustion once conditions become favorable. Wind changes, temperature, and humidity can all become potential contributors in a receptive fuel bed.

27.10.1.2.1

Both supervised and unsupervised campsites are found throughout our state and national forests, as well as in other areas inhabited by individuals. Campfires are used for recreation, warmth, cooking, light, and religious or ceremonial purposes. Campfire usage can sometimes be determined by a circle of rocks, an area with a large amount of ash, leftover pieces of wood, discarded food containers, or other items used for camping.

27.10.1.2.2

Outdoor fires, such as bonfires, burn barrels, debris burning, and recreational fires also pose a risk of fire when used in wildland areas. Sparks, embers, winds, and unexpected fuel loads can contribute to the spreading of an outdoor fire. Improper fire extinguishment of an outdoor fire or campfire can lead to the ignition of ignitable fuels hours, days, weeks, or months later. Underground snags, roots, and other debris have been known to ignite fires after smoldering for months, even after heavy rains and winter conditions.

27.10.1.2.3

Fires occur from all types of outdoor debris burning such as dump sites, timber harvesting operations, land cleaning/clearing, burn barrels, incinerators, and debris piles. Debris fires lit too close to wildland areas can easily become the heat source for a major wildland fire. Even hours after the fire has been extinguished, an unexpected wind can bring a smoldering ember to open flame ignition and spread the fire to nearby fuels.

27.10.1.3 Smoking.

27.10.1.3.1

Discarded smoking materials, such as cigarettes, cigars, pipe tobacco, and matches can ignite wildland fires. Often, evidence of these types of ignitions may have survived at or near the point of origin. The burning characteristics of the varying smoking materials, the position of those smoking materials on or in the fuel load, the type of fuel, the moisture content and arrangement of the fuel load, the relative humidity, and the wind speed are a few of the factors that need to be considered by the investigator. Many scientific tests, by a variety of qualified individuals following the proper scientific parameters related to smoking materials, have been conducted. The conclusions gathered by these individuals vary depending upon the specific conditions of each experiment. The fire investigator should research and be aware of these studies and their findings before reaching a final opinion relating to his or her case..

27.10.1.3.2

Ignition of wildland fuels by intentional or accidentally discarded smoking materials is very dependent on environmental conditions at the point of ignition. These factors include the heat source, type of fuel load, density of the fuel load, relative humidity, outside temperature, and wind speed along with many other factors.

27.10.1.4 Incendiary.

27.10.1.4.1

An incendiary fire is a fire that was willfully, maliciously, and intentionally ignited under circumstances or in an area where there should not be a fire. Motives listed for adults who set fires include vandalism, revenge, profit, crime, concealment, and terrorism/extremism.

27.10.1.4.2

Identification of the motive related to causing the arson/incendiary fire is usually not a requirement in the prosecution of the crime, but it often helps the case by identifying the arsonist. Arsonists range from individuals who ignite an incendiary fire once to serial arsonists who set multiple fires, sometimes hundreds or more, before being apprehended.

27.10.1.4.3

Incendiary fires are limited only to the mind of the arsonist. Common ignition sources such as matches, cigarettes, candles, lighters, fireworks, hypergolic mixtures, and many other items can be rigged to be used as heat sources to ignite incendiary fires. The use of elaborate incendiary or ignition devices is not uncommon.

27.10.1.4.4

Youth fire-setting behavior can often lead to incendiary fires. Rules and guidelines used for the investigation of juvenile-set fires vary depending upon jurisdiction. Psychologists have identified the following motivations for juvenile fire setting: curiosity/accidental, cry for help, delinquency, severely disturbed, cognitively impaired, and sociocultural.

27.10.1.5 Vehicles and Equipment Use.

Equipment such as welders, grinders, and vehicles of all types can create heat sources hot enough to ignite flashy (i.e., 1 hour) ground fuels. Combustion engines, catalytic converters, exhaust systems, sparks, carbon, and soot all become heat sources capable of igniting wildland vegetation.

27.10.1.6 Railroad.

Locomotives can cause friction, exhaust particles, hot brake shoes, hot sparks, and overheated wheel bearings, and fires from derailments are all competent heat sources under the right conditions. New construction, repairs, cutting or grinding on rails, warning flares/devices, and many other operations associated with the railroad companies generate heat sources capable of igniting wildland fires.

27.10.1.7 Fireworks.

Fireworks provide means of ignition through sparks and flaming debris. Sparklers are a smaller hazard, but may ignite dry grass or other fuels. Most sparklers include a metal (i.e., wire) or wood core that may be found at or near the point of fire origin. The remains of fireworks or their packaging may be found within or near the general origin area. Some fireworks have the potential to create small indentations in the ground due to their explosive force. Fireworks and pyrotechnic devices produce sparks and flames that can serve as a competent ignition source of vegetation. Some devices may create sparks, which can travel varying distances from the device.

27.10.1.8 Electricity.

Energized equipment may be a source of electrical energy resulting in ignition of combustible materials. Public or private overhead power lines may cause wildland fires when trees contact a conductor and ignite the branch or foliage involved. This contact may leave unique fire damage on the portion of the tree that made contact and create a pit or flash mark on the power conductor. After ignition, burning portions of the tree may fall to the ground and ignite surface fuels. Conductor arcing may create molten globules or ejecta that fall to the ground and ignite surface fuels. Additionally, conductors, fuses, overhead switches, insulators, and transformers can fail and drop flaming or hot material onto the ground. Severed energized overhead conductors can arc as they fall or come into conduct with other materials. Surface or underground conductors can be damaged by heavy equipment or digging operations and may result in a fire.

27.10.1.9 Oil and Gas Drilling.

Oil and gas drilling activities in wildland fire areas can cause a fire. Hazardous activities associated with fire take place during the drilling operations; however, fire potential can persist after equipment has been abandoned or taken out of service. A number of these hazards have been discussed in 27.10.1.3, 27.10.1.5, and 27.10.1.8. A well blowout and subsequent ignition may cause a wildland fire to ensue. Depending on the minerals to be extracted, gas-fired equipment such as separators may be present at the well site after the drilling process has been completed. Likewise, the proximity of pipelines carrying gas or liquid fuel may provide sources of the initial fuel or may be a contributing factor to wildland fire spread.

27.10.1.10 Operational or Abandoned Mines.

Mining operations have potential ignition sources that may lead to underground or surface fires. Among potential ignition sources, underground coal seam fires can produce high surface temperatures, which could provide an ignition source for surface fires. Most of these coal seam fire locations are well documented and should be considered if a wildland fire develops in an area of a known underground fire or mining operations.

27.10.1.11 Spontaneous Heating.

27.10.1.11.1

Some types of fuel can ignite spontaneously from internal heating caused by biological and chemical action. This action is most likely to occur on warm, humid days in decomposing piles of organic material such as hay, grains, feeds, manure, sawdust, wood chip piles, and harvested piled peat moss.

27.10.1.11.2

Spontaneous ignition of some organic materials can occur due to heat-generating biological or chemical processes. Common sources of self-heating are fertilizers, hay, piles of woodchips, peat moss, and some types of grain. They are usually enhanced by the presence of moisture. If the heat generated cannot be effectively dissipated, the material can eventually ignite. Piles of material subject to self-heating may internally smolder undetected for long durations. Any fuel with proper organic oil content can self-heat. Self-heating is the exothermic (i.e., heat releasing) oxidation reaction of susceptible materials.

27.10.1.12 Sunlight Refraction and Reflection.

The sun's rays can be focused to a point of intense heat if concentrated or focused by either a transparent object that is spherical or cylindrical in its cross section or by a concave, highly reflective surface. This refraction or reflection process bends light rays, similar to that which occurs with a magnifying glass or mirror. The focusing of solar radiation onto a receptive fuel can serve as an ignition source. Vegetation has been shown to ignite by focusing or reflecting sunlight with glass jugs and bowls and metal containers. Fires started by these items are very rare occurrences; however, objects possessing these characteristics recovered from the specific origin area may need to be carefully examined for purposes of exclusion or inclusion.

27.10.1.13 Firearms and Exploding Targets.

27.10.1.13.1

The use of black-powder firearms, and modern firearms discharging tracer, incendiary, and steel core ammunition can cause wildland fires. Black-powder-caused fires are frequently the result of burning patch material rather than wildland fuels ignited directly by the burning black powder. The burning chemical compounds contained within the projectile of tracer and incendiary ammunition can ignite wildland fuels. Ammunition with steel cores, such as armor-piercing and other types of ammunition, can cause fires when the steel core strikes a rock or other material hard enough to cause sparks.

27.10.1.13.2

The operation of firearms can cause wildland fires by several means. Some types of ammunition employ burning pyrotechnic compounds to enhance visibility (i.e., tracer ammunition) or intentionally start fires (i.e., incendiary ammunition). These rounds can burn for several seconds, presenting a fire hazard if they land in a receptive fuel.

27.10.1.13.3

Rifle ammunition consisting of steel or copper components has been demonstrated to fragment after striking hard surfaces, such as steel and granite. Fragment temperatures exceeding 800°C (1472°F) for short durations have been measured.

27.10.1.13.4

Muzzle-loading firearms present two potential sources of ignition: the ejection of burning powder and burning patches or "wads" that are used to create a gas seal between the burning gunpowder and projectile.

27.10.1.13.5

Exploding targets are used to enhance the visibility of targets for long-range shooting. They are typically produced as a "binary" explosive consisting of ammonium nitrate/perchlorate and aluminum powder. When the two materials are mixed, they form an explosive composition that can be detonated by the impact of high-velocity bullets. A limited number of tests performed by the USDA Forest Service demonstrated that exploding target detonations were capable of igniting nearby vegetation.

Public Comment No. 69-NFPA 921-2023 [Section No. 27.7.1 [Excluding any Sub-Sections]]

The indication of Fire and exposure to products of combustion can create effects on exposed surfaces. These effects can visually form patterns that indicate the direction of a fire's spread is imprinted on partially burned fuels and noncombustible objects . These visual fire effects may include differential damage, char patterns, discoloration, carbon staining, shape, location, and condition of residual unburned fuel. Analysis of the directional pattern shown by created by multiple indicators in a specific area will identify may be useful to identify the path of fire spread through this site the affected area . By applying a systematic approach to backtrack the spread of the fire, the investigator can retrace the path of the fire to the point of origin.

Statement of Problem and Substantiation for Public Comment

Edits provided to accurately describe the phenomena and mechanism.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
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Submittal Date:	Wed Jan 04 13:38:43 EST 2023
Committee:	FIA-AAA

Public Comment No. 70-NFPA 921-2023 [Section No. 27.7.1.1]

27.7.1.1 Wildland Fire V-Shaped Patterns.

Wildland fire V-shaped patterns, as shown in Figure 27.7.1.1, are horizontal ground surface burn patterns generated by the fire spread. When viewed from above, they are generally shaped like the letter "V." These are not to be confused with the traditional plume-generated vertical V patterns associated with structure fires. These V-shaped patterns are affected by wind direction ~~or the~~ and the slope on which the fuel is located. As the fire spreads in the direction of the wind or up a slope, the widening legs of the V are created. The width of the pattern increases as the fire advances from the area of ignition. The ~~origin of the~~ heat source that ~~created~~ ignited the ~~pattern often~~ fire is ~~found~~ often found at or near the base or most narrow point of the pattern. Therefore, the analysis of these horizontal V-shaped patterns can be useful in identifying ~~a general location of the fire origin~~ a general origin area .

Figure 27.7.1.1 V-Shaped Pattern.

Statement of Problem and Substantiation for Public Comment

Edits provided to clarify the meaning of the text. Mostly editorial in nature.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley

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Submittal Date: Wed Jan 04 13:42:56 EST 2023

Committee: FIA-AAA

Public Comment No. 71-NFPA 921-2023 [Section No. 27.7.2]

27.7.2 Degree of Damage.

The degree of damage to a fuel or exposed item is an indication of the fire's intensity, duration, and direction. ~~Leaves,~~ Damage may be in the form of consumption, charring, staining or other effects. Generally leaves, branches, and limbs will show greater damage on the side from which the fire approached. As shown in Figure 27.7.2, this ~~is one of the useful indicators in~~ can be a useful indicator in determining the direction of advancing fire spread. Also, items lying on and protecting fuels can leave a protected area pattern that can indicate direction of spread and assist in locating the origin. ~~Vegetation~~ For example, vegetation on the side of an object providing protection and exposed to an oncoming fire front will be burned away, ~~while the~~ however the basal stems of vegetation adjacent to the reverse (i.e., shielded) side ~~will remain only~~ may be less or partially burned. ~~Also, items lying on and protecting fuels leave a similar pattern on residual vegetation.~~ This indicator is closely related to the indicator discussed in 27.7.8.

Figure 27.7.2 Degree of Damage.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and to remove absolutes.

Related Item

- Revision to Chapter 27

Submitter Information Verification

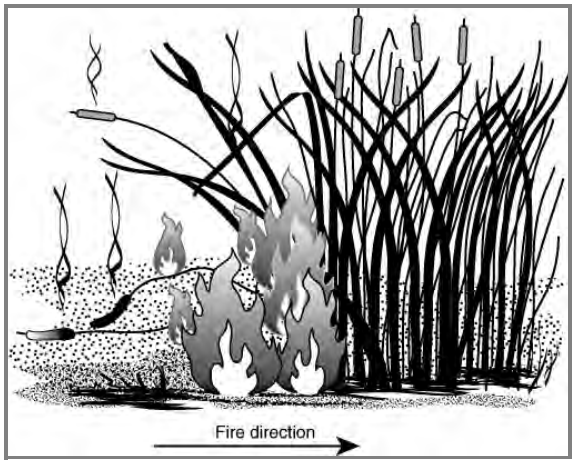
Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 13:46:36 EST 2023
Committee: FIA-AAA

Public Comment No. 118-NFPA 921-2023 [Section No. 27.7.3]

27.7.3 Grass Stems.

The charred remains of grass stems left in the fire's wake will have different appearances depending upon the direction of the fire's travel. In advancing fire areas, the flames will attack the stem from the top and burn them to ground level, completely consuming all but the very base of the stem. Advancing areas are typically characterized by an absence of residual stems. ~~Grass~~ However, grass that grows in clumps may not be entirely consumed, showing protection on the side opposite the direction the fire came from. When this occurs in advancing areas, the residual basal stalks in the clump may show an angle of char that is steeper than the slope and exhibit cupping on the tips, with the low side of the cup on the side facing the direction the fire came from. In areas of backing fire spread, and occasionally in the lateral areas, the flames will first attack the stalk at the base, toppling the remainder of the stalk into the burned area as shown in Figure 27.7.3. The remaining grass heads will point generally in the direction the fire came from.

Figure 27.7.3 An Example of Grass Stems Indicating the Direction of Backing Fire Movement (left to right).



Statement of Problem and Substantiation for Public Comment

Editorial change for clarity.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 16:21:22 EST 2023
Committee:	FIA-AAA

Public Comment No. 117-NFPA 921-2023 [Section No. 27.7.4 [Excluding any Sub-Sections]]

Angle of char indicators are divided into two groups based on the types of fuels they occur in. Angle of char can occur in pole-type fuels (i.e. tree trunks, utility poles, fence posts, ~~and so on~~ etc.) or in the foliage crowns of brush or ~~timber-type fuels~~ timber fuels .

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and readability.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 16:19:46 EST 2023
Committee:	FIA-AAA

Public Comment No. 73-NFPA 921-2023 [Section No. 27.7.4.2]

27.7.4.2 Angle of Char, Foliage Crown.

On foliage crowns, the flaming front will consume or char fuels at an angle that is consistent with the fire's direction of travel. Backing fire will leave angle of char patterns parallel to the slope. Advancing fire will leave angle of char steeper than the slope due to the flame front entering low on the exposed side and exiting high on the back side see Figure 27.7.4.2(a). Height of char angle is often correlated to fire intensity. This pattern is best viewed from the side of the object. Figure 27.7.4.2(b) shows the typical effect on the crown of trees or brush as a fire starts at point "A" and moves out, slowly building up heat and speed. At the point of origin (point A), the fire is still relatively cool as surface fuels are burned, but the tree's crown is left mostly intact. Farther from the point of origin, the fire has become more intense, and more crown is burned. All the crowns may be burned as the fire intensifies away from the origin .

Figure 27.7.4.2(a) Example of Char Patterns Created by the Way a Fire Moves Through Trees and Brush.

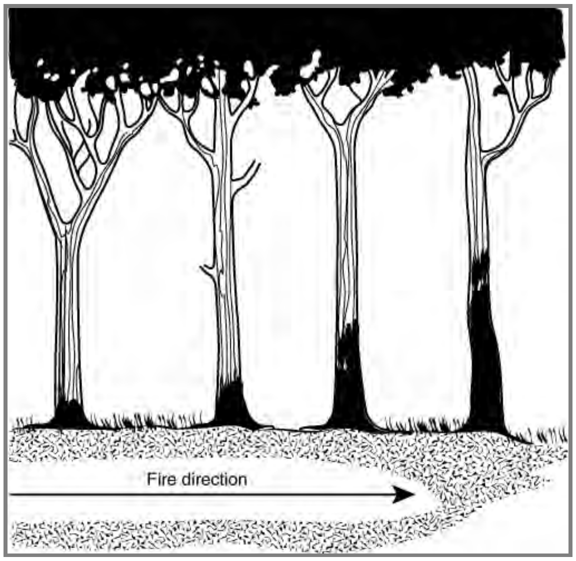
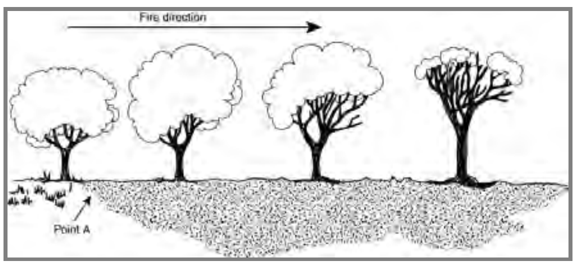


Figure 27.7.4.2(b) Progressive Crown Burning from the Point of Origin (Point A).



Statement of Problem and Substantiation for Public Comment

Edit provided for clarity.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 13:51:56 EST 2023
Committee: FIA-AAA

Public Comment No. 115-NFPA 921-2023 [Section No. 27.7.5]

27.7.5 White Ash Deposit.

White ash

~~can~~

may be

~~the byproduct of combustion~~

found in the fire area and is a product of complete combustion of a carbon-based fuel such as wood . More white ash will be created on

~~the sides of objects~~

burningobjects exposed to greater amounts of heat and flame

~~. Ash~~

because of the more completeness or duration of combustion. However, white ash is often dispersed downwind and deposited on the windward sides of objects

~~. Ash can also be used to reconstruct probable fuel volumes. Fuels facing the advancing fire will appear lighter on the side facing the oncoming fire and darker on the side opposite the direction the fire came from. Ash indicators can begin to quickly~~

which can confuse it as an indicator of direction of fire spread . White ash indicators can quickly degrade and lose reliability after only a few hours post-fire or when exposed to moisture or high winds. White ash deposits on tree boles will often be on the side facing the oncoming advancing fire.

~~By~~

White ash as an indicator for fire spread direction is determined by comparing and

~~contrasting the two~~

contrasting two opposing sides, with the

~~investigator can distinguish the~~

side facing the oncoming fire

~~as it has~~

having more white ash present. White ash can also reveal the direction of fire travel in grass fuels. White ash can remain on the exposed sides of grass stems and clumps. When looking in the direction of the advancing fire spread, the burned area will appear

~~lighter~~

whiter due to the white ash . When viewed looking back toward the area the fire came from, the burned area will appear darker due to there being less white ash . White ash on grass is particularly vulnerable to disturbance by wind or by being walked on.

Statement of Problem and Substantiation for Public Comment

Edit for clarity and accuracy. As written the paragraph had confusing or conflicting statements.

Related Item

• Revision to Chapter 27

Submitter Information Verification

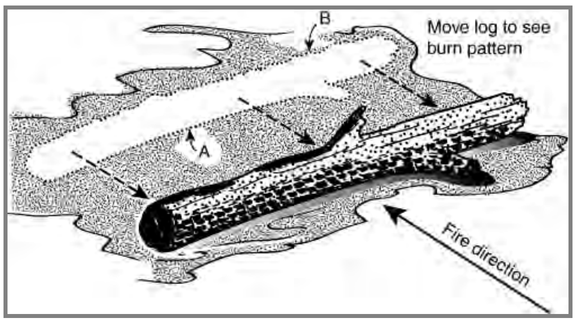
Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 16:16:01 EST 2023
Committee:	FIA-AAA

Public Comment No. 113-NFPA 921-2023 [Section No. 27.7.8]

27.7.8 Exposed and Protected Fuels.

A noncombustible object or the fuel itself ~~shields the~~ may shield the unexposed side of a fuel from heat damage or ignition . Fuels will be unburned or exhibit less damage on the side shielded from the advancing fire. Look for charring, staining, white ash, ~~and clean~~ or clean burn lines on exposed sides of fuels and noncombustible objects. Compare and contrast ~~to~~ the opposing sides of objects. Lift or remove objects to detect the exposed and protected fuels. Objects resting on top of ground and surface fuels will protect the fuels on the unexposed side. Surface fuels on the exposed side will exhibit a clean burn line, see point "A" in Figure 27.7.8. Surface fuels on the protected side will appear ragged and uneven, see point "B" in Figure 27.7.8.

Figure 27.7.8 Clean Burn Line on the Front Side (Point A) and a Ragged Burn Line (Point B) on the Other Side, Showing That the Fire Moved from Point A to Point B.



Statement of Problem and Substantiation for Public Comment

Edited for clarity and accuracy.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 16:13:43 EST 2023
Committee: FIA-AAA

Public Comment No. 74-NFPA 921-2023 [Section No. 27.7.10]

27.7.10 Spalling.

Spalling will appear in the fire area as shallow, often light-colored craters or chips in the surface of rocks, as shown in Figure 27.7.10~~, within the fire area~~ . They will usually be accompanied by slabs or flakes exfoliated from the surface of the rock. Spalling is caused by a breakdown in the tensile strength of the rock's surface on the side that has been exposed to heat. Spalling is generally associated with advancing fire areas and will appear on the side of the rock exposed to the flames.

Figure 27.7.10 Spalling.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity.

Related Item

- Revision to Chapter 27

Submitter Information Verification

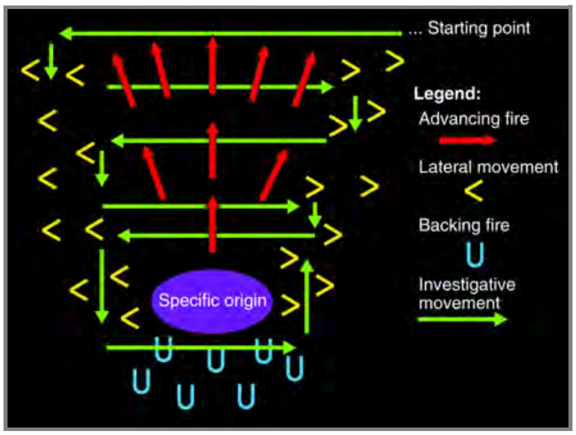
Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 13:53:36 EST 2023
Committee: FIA-AAA

Public Comment No. 75-NFPA 921-2023 [Section No. 27.9.4]

27.9.4 Working the General Origin Area.

A suggested method for working the general origin area is as follows: Enter from the advancing area side . Work across the advancing run until the lateral transition zone is reached. Move several feet ~~closer toward the origin~~ away from the advinacing area start and recross the advancing run to the opposing lateral transition zone. Repeat these steps until indicators of the specific origin area ~~is reached~~ are observed . *(See Figure 27.9.4.)* Document each indicator located with a visible marker. Color-coded surveyors' flags have been found to be the most visible and the easiest markers to use. Standard recommended colors are red for advancing fire indicator, yellow for lateral fire indicator, blue for backing fire indicator, and white for evidence.

Figure 27.9.4 Working the General Origin Area.



Statement of Problem and Substantiation for Public Comment

Edits provided to clarify the language.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 13:55:36 EST 2023
Committee: FIA-AAA

Public Comment No. 112-NFPA 921-2023 [Section No. 27.9.6]

27.9.6 Ignition Area.

The ignition area is within the perimeter of the specific origin area. The ignition area is the location where the fire specifically ~~originated~~ began , and evidence of the fire cause may be found. The ignition area is characterized by microscale indicators consistent with a small fire and low rate of spread.

Statement of Problem and Substantiation for Public Comment

Edited for clarity and to provide a more complete description of the ignition area.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 16:10:56 EST 2023
Committee:	FIA-AAA

Public Comment No. 81-NFPA 921-2023 [Section No. 27.10 [Excluding any Sub-Sections]]

The objective of ~~every origin and cause investigation~~ fire investigation is to identify the factors that were necessary for the fire to have ~~occurred~~ started at the ignition area , including identifying a competent ignition source, first fuel(s) ignited, and the circumstances that resulted in the ignition of the fuel(s). ~~An investigator should receive the proper education and meet the standards set forth in NFPA 1033 before conducting criminal fire investigations.~~ The investigation of wildland fires includes the consideration of many types of potential fire causes, including those that may lead to civil or criminal actions. The safety of the public remains a primary objective of fire prevention and includes attention to all potential causes of wildland fires.

Statement of Problem and Substantiation for Public Comment

Edit tot eh first sentence for clarity.

Deleted the 2nd sentence regarding proper education of fire investigators because this was not written well, and is outside the scope of this document.

Related Item

- Revision of Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 14:55:40 EST 2023
Committee:	FIA-AAA

Public Comment No. 82-NFPA 921-2023 [Section No. 27.10.1 [Excluding any Sub-Sections]]

Wildland fires are

~~not always started by actions of people. Many~~

caused by a variety of circumstances, some natural and some human related. Many are ignited by natural causes

~~such as~~

including lightning,

~~volcanoes~~

volcanos , coal seam fires, meteorites, and rocks falling

~~, and so on. Fire suspected of being caused by natural heat sources should be investigated to ensure that the correct cause is determined~~

. Fires may also be caused by human related activities including camp fires, fireworks, discharge of firearms, transportation, power transmission and incendiarism . Experience has shown that

~~other~~

more than one types of

~~causes are still~~

cause may be present during varying events

~~, such as lightning storms. Specific examples are the occasional~~

. An example of this is an incendiary fire ignited under the cover of a lightning storm or an escaped ember from a debris burn.

Statement of Problem and Substantiation for Public Comment

Section needed a rewrite to better present the concepts and to provide clear examples.

Related Item

- Revision of Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 14:58:56 EST 2023
Committee:	FIA-AAA

Public Comment No. 83-NFPA 921-2023 [Section No. 27.10.1.1]

27.10.1.1 Lightning.

Lightning is a discharge of static electricity associated with thunderstorm ~~/~~ and cloud activity. Lightning strikes can possess either positive or negative charges. Both types are capable of starting fires, but positive strokes/charges have a greater probability of igniting fires because of their higher energy . Ninety percent to ninety-five percent of the lightning that occurs across the country is considered negative strikes. Negative strikes have been recorded to be typically about 300,000,000 volts and 30,000 amps of ~~power~~ current . Positive lightning strikes make up the remaining five ~~percent~~ to 10 percent of all strikes. Positive strikes originate high in ~~the~~ a storm, ~~some~~ 9144 to 18,288 m (30,000 to 60,000 ft) ~~high~~ above ground level . Under normal storm conditions, the ground is usually shielded from the positive charges by the negative charges in the middle part of the storm. That changes when winds are strong in the lower levels, or when the storm becomes tilted, or when the anvil shape of a storm spreads out ahead or behind the updraft of the storm. Once that occurs, the ground is no longer shielded from those upper positive charges and a positive charge leader can form. Due to the sheer distance that the positive bolt has to travel to get to the ground, it can be up to 10 times more powerful and last 10 times longer than a negative strike, which means it can reach 1 billion volts and nearly 300,000 amps. Positive strikes ~~contain stronger voltage~~ have higher voltage and longer ~~length of the~~ bolt lengths , which causes more damage ~~to be done~~ , ~~more~~ more deaths to occur, and more ~~fires to ignite from these type of charges. Many web-based lightning documentation companies have programs~~ fire ignitions. There are several lightning detection and documentation service companies available via the internet that provide relevant lightning strike information that can be very helpful to the fire investigator. The effects of lighting strikes on ground objects include physical damage, burn scars, and melted metal objects. If observed these should be documented as evidence of a strike.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity or accuracy.

New sentence added to remind the investigator to look for physical effects of lightning.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 15:01:53 EST 2023
Committee: FIA-AAA

Public Comment No. 85-NFPA 921-2023 [Section No. 27.10.1.2 [Excluding any Sub-Sections]]

Fire escaping from campfires or debris piles is a common cause of wildland fires. Winds can carry burning embers significant distances from their source and easily ignite if they end up landing in receptive fuel beds. Campfires or debris piles can continue to smolder for long periods of time and eventually transition to flaming combustion once conditions become favorable. ~~Wind changes,~~ Changes in wind velocity or direction, increasing temperature, and decreasing relative humidity can all ~~become~~ increase the potential ~~contributors in a receptive fuel bed~~ for a campfire or debris pile escaping its confinement or reigniting .

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and accuracy.

Related Item

- Revision to Chapter 27

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Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:09:45 EST 2023
Committee:	FIA-AAA

Public Comment No. 87-NFPA 921-2023 [Section No. 27.10.1.2.1]

27.10.1.2.1

Both supervised and unsupervised campsites are found throughout our ~~state~~ forests and ~~national forests~~ recreational areas , as well as in other outdoor areas inhabited by individuals. Campfires are used for recreation, warmth, cooking, light, and religious or ceremonial purposes. Campfire usage can sometimes be determined by a circle of rocks, an area with a large amount of ash, leftover pieces of wood, discarded food containers, or other items used for camping.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 15:12:33 EST 2023
Committee: FIA-AAA

Public Comment No. 88-NFPA 921-2023 [Section No. 27.10.1.2.2]

27.10.1.2.2

Outdoor fires, such as bonfires, burn barrels, debris burning, land clearing, and recreational fires also pose a risk of ~~fire~~ starting a wildfire when ~~used~~ present in wildland areas. ~~Sparks~~ An outdoor fire can spread beyond its intended area because of sparks , embers, changing winds, and ~~unexpected fuel loads can contribute to the spreading of an outdoor fire. Improper fire~~ unexpectedly high flame heights or fuel loads. Inadequate fire extinguishment of an outdoor fire or campfire can lead to the ignition of ~~ignitable fuels~~ available fuels hours, days, weeks, or months later. Underground ~~snags,~~ fuels such as roots, duff and other organic material or debris have been known to ~~ignite fires after smoldering for~~ be ignited by surface fires and smolder for months, even after heavy rains and winter conditions.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and accuracy.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:

Submittal Date: Wed Jan 04 15:14:22 EST 2023
Committee: FIA-AAA

Public Comment No. 90-NFPA 921-2023 [Section No. 27.10.1.2.3]

~~**27.10.1.2.3**~~ –

~~Fires occur from all types of outdoor debris burning such as dump sites, timber harvesting operations, land cleaning/clearing, burn barrels, incinerators, and debris piles. Debris fires lit too close to wildland areas can easily become the heat source for a major wildland fire. Even hours after the fire has been extinguished, an unexpected wind can bring a smoldering ember to open flame ignition and spread the fire to nearby fuels.~~

Statement of Problem and Substantiation for Public Comment

Edit is to delete whole section as it is redundant with other material or does not contribute to the information provided.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:19:13 EST 2023
Committee:	FIA-AAA

Public Comment No. 91-NFPA 921-2023 [Section No. 27.10.1.3.1]

27.10.1.3.1

Discarded smoking materials, such as cigarettes, cigars, pipe tobacco, and matches can ignite wildland fires. Often, evidence of these types of ignitions may ~~have survived at~~ survive at or near the ~~point of origin~~ ignition area . The burning characteristics of the varying smoking materials, the position of those smoking materials on or in the fuel load, the type of fuel, the moisture content and arrangement of the fuel load, the relative humidity, and the wind speed are ~~a few of the~~ factors that need to be considered by the investigator. ~~Many scientific tests, by~~ Cigarette ignition tests by a variety of ~~qualified~~ individuals following the proper scientific parameters related to smoking materials, have been conducted. ~~The conclusions gathered by these individuals vary~~ However, the conclusions of these efforts vary depending upon the specific conditions of each experiment. The fire investigator should research and be aware of these studies and their findings before reaching a final opinion relating to his or her case..

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and accuracy.

Is a reference available for the cigarette ignition tests cited?

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 15:20:57 EST 2023
Committee: FIA-AAA

Public Comment No. 92-NFPA 921-2023 [Section No. 27.10.1.3.2]

~~**27.10.1.3.2**~~ –

~~Ignition of wildland fuels by intentional or accidentally discarded smoking materials is very dependent on environmental conditions at the point of ignition. These factors include the heat source, type of fuel load, density of the fuel load, relative humidity, outside temperature, and wind speed along with many other factors.~~

Statement of Problem and Substantiation for Public Comment

Edit is to delete whole section as it is redundant with other material and not needed.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
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Zip:	
Submittal Date:	Wed Jan 04 15:24:34 EST 2023
Committee:	FIA-AAA

Public Comment No. 93-NFPA 921-2023 [Section No. 27.10.1.4.1]

27.10.1.4.1

An incendiary fire is a fire that was willfully, maliciously, and intentionally ignited under circumstances or in an area where there should not be a fire. Motives listed for ~~adults who~~ persons who set fires include vandalism, revenge, profit, crime, concealment, and terrorism/extremism.

Statement of Problem and Substantiation for Public Comment

Edit for clarity and to avoid confusion between adults and juveniles.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:25:38 EST 2023
Committee:	FIA-AAA

Public Comment No. 94-NFPA 921-2023 [Section No. 27.10.1.4.2]

27.10.1.4.2

Identification of the motive related to causing the ~~arson/~~ incendiary fire is usually not a requirement in the prosecution of the crime, but it often helps the case by identifying the arsonist. Arsonists range from individuals who ignite an incendiary fire once to serial arsonists who set multiple fires, sometimes hundreds or more, before stopping or being apprehended.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and legal accuracy.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:27:03 EST 2023
Committee:	FIA-AAA

Public Comment No. 95-NFPA 921-2023 [Section No. 27.10.1.4.3]

27.10.1.4.3

~~Incendiary~~ How incendiary fires are caused is limited ~~only~~ to the ~~mind of~~ imagination and creativity of the arsonist. ~~Common~~ But the most common ignition sources for incendiary fires include everyday items such as matches, cigarettes, candles, lighters, ~~fireworks, hypergolic mixtures, and many other items can be~~ and fireworks. More elaborate and complex ignition sources include hypergolic chemical mixtures and electronic devices rigged to be ~~used as~~ heat sources ~~to ignite incendiary fires. The use of~~ . However, because of their complexity the use of these and other elaborate incendiary or ignition devices is not ~~uncommon~~ common .

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and accuracy

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:28:25 EST 2023
Committee:	FIA-AAA

Public Comment No. 97-NFPA 921-2023 [Section No. 27.10.1.4.4]

27.10.1.4.4

~~Youth fire~~ Fire setting behavior at an early age can ~~often~~ lead to incendiary fires set by adults . Rules and guidelines used for the investigation of juvenile-set fires vary depending upon jurisdiction and investigators should be aware of these if applicable . Psychologists have identified the following motivations for juvenile fire setting: curiosity~~/~~ , accidental, cry for help, delinquency, severely disturbed, cognitively impaired, and sociocultural.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley

Organization: Travelers Insurance Company

Street Address:

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Zip:

Submittal Date: Wed Jan 04 15:38:00 EST 2023

Committee: FIA-AAA

Public Comment No. 98-NFPA 921-2023 [Section No. 27.10.1.5]

27.10.1.5 Vehicles and Equipment Use.

Equipment such as welders, grinders, and vehicles of all types can create ~~heat sources~~ <u>ignitiopn sources</u> hot enough to ignite flashy (i.e., 1 hour) ground fuels. ~~Combustion~~ <u>Examples of these sources include hot surfaces on internal combustion</u> engines, catalytic converters, exhaust systems, sparks <u>from metal strikes</u> , ~~carbon,~~ and soot ~~all become heat sources capable of igniting wildland vegetation~~ <u>ejected from exhaust systems</u> .

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and readability.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:40:41 EST 2023
Committee:	FIA-AAA

Public Comment No. 99-NFPA 921-2023 [Section No. 27.10.1.6]

27.10.1.6 Railroad Operations .

~~Locomotives can cause friction, exhaust particles~~ The operation of locomotives can create competant ignition sources including frictional heating of moving parts, soot or metal particles ejected from exhaust systems , hot brake shoes, ~~hot~~ sparks created from metal strikes , and overheated wheel bearings ~~, and fires from derailments are all competent heat sources~~ under the right conditions. New construction, repairs, cutting or grinding on rails, warning flares/devices, and many other operations associated with ~~the railroad companies generate heat sources capable of igniting wildland~~ railroads can also create competant ignition sources for wildland fires.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and accuracy.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 15:43:34 EST 2023
Committee: FIA-AAA

Public Comment No. 100-NFPA 921-2023 [Section No. 27.10.1.7]

27.10.1.7 Fireworks.

Fireworks provide ~~means of~~ ignition sources through ~~sparks~~ the ejection of sparks and flaming debris. ~~Sparklers~~ Aerial fireworks may start fires a considerable distance from their launch point and for this reason the search area needs to account for this. While sparklers are a smaller hazard ~~, but~~ they may ignite dry grass or other fuels. Most sparklers include a metal (i.e., wire) or wood core that may be found at or near the point of fire origin. The remains of fireworks or their packaging may be found within or near the general origin area. Some fireworks have the potential to create small indentations in the ground due to their explosive force. ~~Fireworks and pyrotechnic devices produce sparks and flames that can serve as a competent ignition source of vegetation. Some devices may create sparks, which can travel varying distances from the device.~~

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity. Last sentence was redundant.

Related Item

• Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 15:49:00 EST 2023
Committee: FIA-AAA

Public Comment No. 101-NFPA 921-2023 [Section No. 27.10.1.8]

27.10.1.8 Electricity.

Energized equipment may be a source of electrical energy resulting in ignition of combustible materials. electric equipment often has sufficient energy to cause the igniton of wildland fuels. This equipment includes generation and distribution functions for a utility as well as service lines, meters and boxes for buildings. Public or private overhead power lines may cause wildland fires when trees contact a conductor and ignite the branch or foliage involved. This contact may leave unique fire damage on the portion of the tree that made contact and create a pit or flash mark on the power conductor. After ignition, burning portions of the tree may fall to the ground and ignite surface fuels. Conductor arcing may Conductors that touch or slap due to wind may arc and may create molten metal globules or ejecta that fall to the ground and ignite surface fuels. Additionally, conductors, fuses, overhead switches, insulators, and transformers can fail and drop or eject flaming or hot material onto the ground. Severed energized overhead conductors can arc as they fall or come into conduct with other materials. Surface or underground conductors can be damaged by heavy equipment or digging operations and may result in a fire.

Statement of Problem and Substantiation for Public Comment

Edits provided for accuracy and clarity.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:

Submittal Date: Wed Jan 04 15:52:27 EST 2023
Committee: FIA-AAA

Public Comment No. 105-NFPA 921-2023 [Section No. 27.10.1.10]

27.10.1.10 Operational or Abandoned Mines.

Mining operations have potential ignition sources that may lead to underground or surface fires. Among potential ignition sources, persistent underground coal seam fires can produce high surface temperatures, which could provide an ignition source for surface fires. Most of these coal seam fire locations are ~~well~~ documented and should be considered if a wildland fire develops in an area of a known underground fire or mining operations.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 15:56:20 EST 2023
Committee:	FIA-AAA

Public Comment No. 106-NFPA 921-2023 [Section No. 27.10.1.11.2]

27.10.1.11.2

~~Spontaneous ignition~~ Self-heating of some organic materials can occur due to heat-generating biological or chemical processes. Common sources of self-heating are fertilizers, hay, piles of woodchips, peat moss, and some types of grain. They are usually enhanced by the presence of moisture. If the heat generated cannot be effectively dissipated, the material can eventually ignite. Piles of material subject to self-heating may internally smolder undetected for long durations. Any fuel with ~~proper~~ sufficient specific organic oil content can self-heat under specific conditions . ~~Self~~ When self -heating ~~is the exothermic (i.e., heat releasing) oxidation reaction of susceptible materials.~~ transitions to a fire it is termed spontaneous combustion. Once ignited by self-heating most fuels smolder for a period of time and only convert to flaming condition under favorable conditions. For example a pile of wood chips may smolder for hours or days but convert to flaming ignition after the wind speed increases. .

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity and accuracy.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley

Organization: Travelers Insurance Company

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 04 15:57:33 EST 2023

Committee: FIA-AAA

Public Comment No. 111-NFPA 921-2023 [Section No. 27.10.1.12]

27.10.1.12 Sunlight Refraction and Reflection.

The sun's rays can be focused to a point of intense heat if concentrated or focused by either a transparent object that is spherical or cylindrical in its cross section or by a concave, highly reflective surface. This refraction or reflection process bends light rays, similar to that which occurs with a magnifying glass or mirror. The focusing of solar radiation onto a receptive fuel can serve as an ignition source. Vegetation has been shown to ignite by focusing or reflecting sunlight with glass jugs and bowls and metal containers, as well as transparent containers containing a clear liquid . Fires started by these items are very rare occurrences; however, objects possessing these characteristics recovered from the ~~specific origin area may need to be~~ ignition area should be carefully examined for purposes of exclusion or inclusion.

Statement of Problem and Substantiation for Public Comment

Edited for clarity and to include other examples.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name: James Shanley
Organization: Travelers Insurance Company
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 04 16:08:12 EST 2023
Committee: FIA-AAA

Public Comment No. 107-NFPA 921-2023 [Section No. 27.10.1.13.1]

27.10.1.13.1

The use of black-powder firearms, and modern firearms especially those discharging tracer, incendiary, and steel core ammunition can cause wildland fires. Black-powder-caused fires are frequently the result of the ejection of burning patch material rather than wildland fuels ignited directly by the burning black powder. The burning chemical compounds contained within the projectile of tracer and incendiary ammunition can ignite wildland fuels. Ammunition with steel cores, such as armor-piercing and other types of ammunition, can cause fires when the steel core strikes a rock or other material hard enough to cause sparks.

Statement of Problem and Substantiation for Public Comment

Edits provided for clarity.

Related Item

- Revision to Chapter 27

Submitter Information Verification

Submitter Full Name:	James Shanley
Organization:	Travelers Insurance Company
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Jan 04 16:02:46 EST 2023
Committee:	FIA-AAA

Public Comment No. 108-NFPA 921-2023 [Section No. 27.10.1.13.2]

~~**27.10.1.13.2**~~ –

~~The operation of firearms can cause wildland fires by several means. Some types of ammunition employ burning pyrotechnic compounds to enhance visibility (i.e., tracer ammunition) or intentionally start fires (i.e., incendiary ammunition). These rounds can burn for several seconds, presenting a fire hazard if they land in a receptive fuel.~~

Statement of Problem and Substantiation for Public Comment

Edit is to delete entire section as it is redundant with prior and not needed.

Related Item

- Revision to Chapter 27

Submitter Information Verification

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Committee: FIA-AAA

Public Comment No. 109-NFPA 921-2023 [Section No. 27.10.1.13.3]

27.10.1.13.3

Rifle ammunition consisting of steel or copper components has been demonstrated to fragment after striking hard surfaces, such as steel and granite. Fragment temperatures exceeding 800°C (1472°F) for short durations have been measured.

Statement of Problem and Substantiation for Public Comment

Second sentence implies data from a reference. Can this be provided?

Related Item

• Revision to Chapter 27

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 110-NFPA 921-2023 [Section No. 27.10.1.13.5]

27.10.1.13.5

Exploding targets are used to enhance the visibility of targets for long-range shooting. They are typically produced as a “binary” explosive consisting of ammonium nitrate/perchlorate and aluminum powder. When the two materials are mixed, they form an explosive composition that can be detonated by the impact of high-velocity bullets. A limited number of tests performed by the USDA Forest Service demonstrated that exploding target detonations were capable of igniting nearby vegetation.

Statement of Problem and Substantiation for Public Comment

Provide the reference for the USDA tests.

Related Item

- Revision to Chapter 27

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Committee: FIA-AAA

Public Comment No. 43-NFPA 921-2022 [Section No. A.3.3.139]

A.3.3.139 Noncombustible Material.

~~Materials that~~ One way in which noncombustible materials are described is as follows: A material that, in the form in which it is used and under the condition anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.

In this guide, materials that are reported as passing ASTM E136, *Standard Test Method for ~~Behavior~~ Assessment of Combustibility of Materials ~~in~~ Using a Vertical Tube Furnace at 750°C*, ~~shall be~~ are also considered noncombustible materials. Materials that pass ASTM E136 are permitted by that test method to exhibit ignition and small amounts of flaming.

Statement of Problem and Substantiation for Public Comment

See associated PC 42 for the substantiation. The present language and the present language in chapter 3 are inconsistent with each other and with ASTM E136-2022.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 42-NFPA 921-2022 [Section No. 3.3.139]	
Public Comment No. 1-NFPA 921-2022 [Section No. 2.3.6]	

Related Item

- fr149

Submitter Information Verification

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Committee: FIA-AAA

Public Comment No. 45-NFPA 921-2022 [Section No. A.4.3.10]

A.4.3.10

For a discussion of concrete examples of confirmation bias and its potential for causing erroneous interpretations of data, see Nickerson, R. S., (1998) “Confirmation bias: A ubiquitous phenomenon in many guises,” *Review of General Psychology* 2(2), 175–220. . https://pages.ucsd.edu/~mckenzie/nickersonConfirmationBias.pdf

Statement of Problem and Substantiation for Public Comment

There was an omission in the citation. The date (1998) was not included. The F&EI Subcommittee has also provided a link to the document.

Related Item

- First Revision 92

Submitter Information Verification

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Public Comment No. 12-NFPA 921-2022 [Section No. A.6.6.12]

A.6.6.12

The following detailed studies may be reviewed for further information on arc mapping:

C. Wood and A. Kimball, “A Preliminary Report of Full-Scale Arc Mapping Test Results,” Proceedings of International Symposium of Fire Investigation Science and Technology (ISFI 2010), National Association of Fire Investigators (NAFI), Sarasota, FL, Held at the University of Maryland, 27–29 September, 2010.

Carey, Nicholas, Nic Daeid, Niamh, “The Metallic Damage to Electrical Conductors at Fire Scenes,” Interflam '07, 2, 1151–1162, (2007).

Churchward, Daniel L., Cox, Ryan M., Reiter, David, “Arc Surveys as a Means to Determine Fire Origin in Residential Structures,” International Symposium on Fire Investigation Proceedings, National Association of Fire Investigators, Sarasota, FL, (2004).

West, L, Reiter, D.A., “Full-Scale Arc Mapping Tests,” Fire and Materials Conference, pp. 325–339, (2005).

Powell, D., Karasinski, J., Robin, D. (2015). Preliminary Results of the Investigation into Self Actuation of Light Switches During Fire Exposure. Fire Scene - Journal of the New York Fire Investigators Association, 16-26.

Statement of Problem and Substantiation for Public Comment

This is related to PI 163, which was rejected due to the reference not being publicly available. The reference has now been posted on the web for viewing at the following URL

https://nyfireinvestigators.org/wp-content/uploads/2022/06/Preliminary-Results-of-the-Investigation.pdf

The thermal activation of light switches can cause a circuit that was originally de-energized to have arc melting present because of fire impingement.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 49-NFPA 921-2022 [New Section after 6.6.11]	

Related Item

- PI 163

Submitter Information Verification

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Submittal Date: Tue Nov 15 10:05:43 EST 2022

Committee: FIA-AAA

Public Comment No. 13-NFPA 921-2022 [Section No. A.6.6.12]

A.6.6.12

The following detailed studies may be reviewed for further information on arc ~~mapping~~ surveys :

C. Wood and A. Kimball, "A Preliminary Report of Full-Scale Arc Mapping Test Results," Proceedings of International Symposium of Fire Investigation Science and Technology (ISFI 2010), National Association of Fire Investigators (NAFI), Sarasota, FL, Held at the University of Maryland, 27–29 September, 2010.

Carey, Nicholas, Nic Daeid, Niamh, "The Metallic Damage to Electrical Conductors at Fire Scenes," Interflam '07, 2, 1151–1162, (2007).

Churchward, Daniel L., Cox, Ryan M., Reiter, David, "Arc Surveys as a Means to Determine Fire Origin in Residential Structures," International Symposium on Fire Investigation Proceedings, National Association of Fire Investigators, Sarasota, FL, (2004).

West, L, Reiter, D.A., "Full-Scale Arc Mapping Tests," Fire and Materials Conference, pp. 325–339, (2005).

Babrauskas, V., "Arc Mapping - A Critical Review," *Fire Technology* 54, 749-780 (2018).

ATF FRL Technical Bulletin ATFFRL-TB-170001: Arc Mapping as a Tool for Fire Investigations (2017).

Babrauskas, V., "Arc Mapping - A Review of Findings and a Reply to the ATF Laboratory," National Association of Fire Investigators (2018).

Novak, C., "Letter to the Editor - A Response to Arc Mapping: A Critical Review," *Fire Technology 54,* (2018).

Carey, N., Daeid, N., "Arc Mapping Research - A Clarification," *Fire & Arson Investigator 71* , (2020).

Statement of Problem and Substantiation for Public Comment

This is related to PIs 253, 46, and 146.

The term "arc survey" is now the preferred term, as the arc map is the product of an arc survey.

The "Arc Mapping: A Critical Review" paper was supposed to move into this list of references per PI 253.

However, this reference was recently criticized as having misrepresented the work of one of the original researchers. This reference also generated a significant amount of discussion after publication, including several published responses. NFPA 921 has only published "one side" of the argument. If the Technical Committee thinks that this reference should stay, then it should also include all sides of the argument. Chronologically, all of these papers would be required.

Arc Mapping - A Critical Review by Vyto Babrauskas (Fire Technology)
ATF FRL Technical Bulletin ATFFRL-TB-170001: Arc Mapping as a Tool for Fire Investigations
Arc Mapping - A Review of Findings and a Reply to the ATF Laboratory by Vyto Babrauskas (Fire Technology)
Letter to the Editor - A Response to Arc Mapping: A Critical Review by Cameron Novak, P.E. (Fire Technology)
Arc Mapping Research - A Clarification by Nick Carey and Niamh Nic Daeid (Fire & Arson Investigator)

Furthermore, the authors of the original work (Carey and Daeid) distributed a letter to the editor of Fire

Technology at the ITC in Frisco, TX (2018) explaining the issues behind the Critical Review paper. The editor would not allow them to publish this letter.

Related Item

• PI 46 • PI 253 • PI 146 • PI 276

Submitter Information Verification

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Committee: FIA-AAA

Public Comment No. 32-NFPA 921-2022 [Section No. A.9.10.3]

A.9.10.3

For more information, see:

Babrauskas, V., *Electrical Fires and Explosions* , Fire Science Publishers, New York (2021).

Ettling, B. “Glowing Connections,” *Fire Technology* 18(4) (1982): 344–349.

Statement of Problem and Substantiation for Public Comment

Adds a newer reference giving details on this phenomenon.

Related Item

- 9.10.3

Submitter Information Verification

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Submittal Date: Wed Dec 28 16:13:59 EST 2022
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Public Comment No. 114-NFPA 921-2023 [Section No. A.16.5]

A.16.5

For further information see Smith, Dennis W., “Must Fire Investigators Prepare a Written Investigation Report?” *NFPA Fire Journal* May/June 2005, p . 65.

Statement of Problem and Substantiation for Public Comment

The Certainty Task Group reviewed the journal article cited in A.16.5 and recommended to the Technical Committee that this reference be left as it is in the 2021 ed. No change was made by the Technical Committee. For some reason, in the First Draft, the citation to the Smith article was omitted. Users will have a difficult time finding this article without a citation. Note that citations are used elsewhere in Annex A, for example, in the new A.16.5.8 (2). Therefore, the citation to the Smith article should be retained in the next edition.

Related Item

- PI 254

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 138-NFPA 921-2023 [Section No. A.19.8.2]

A.19.8.2

Investigators may use a national classification system such as those listed in 19.8.1 .

However, in

Determining the cause of a fire and classifying the fire incident are two separate processes that should not be confused with each other. Classification of a fire incident may be used for reporting purposes or compilation of statistics. When a fire investigator is determining the cause of a fire or assigning responsibility, the scientific method as described in this guide should be followed . Classifying a fire incident is a different from cause determination or analyzing it for the purpose of assigning responsibility. For statistical reporting purposes, a "fire incident" (as contrasted with fire cause as used in this Guide) may be broadly classified as accidental, natural, incendiary, or unclassified. These four classifications are general categories that are commonly recognized. In circumstances where it is necessary for an investigator to assign a classification to a fire

cause classification

incident and no specific classification system is provided, general fire

cause

incident classifications may include the following:

(1) **Accidental Fire** Cause Classification. Involves **Incident.** Accidental fires involve all those for which the probable fire proven cause does not involve an intentional human act to ignite or spread the fire into an area where the fire should not be. In circumstances where When the intent of the person's actions person's action cannot be determined or proven to an acceptable level of certainty , the proper fire cause classification is undetermined.

Natural Fire Cause Classification. Involve fires caused without direct human intervention or action, such as fire

(2) fire incident should be unclassified. In most cases, this classification will be clear, but some deliberately ignited fires can still be accidental. For example, a trash barrel fire might be spread by an individual inadvertently knocking over the barrel. The spread of fire was accidental even though the initial fire was deliberate.

(3) **Natural Fire Incident.** Natural fire incidents involve fires resulting from lightning, earthquake, wind, and flood.

(4) *Incendiary Fire Cause Classification Incident* . A fire that is intentionally ignited in an area or under circumstances where and when there should not be a fire.

(5) Undetermined Unclassified Fire Cause Classification. Whenever the fire cause cannot be proved, the proper classification of the fire cause is undetermined. In the instance in which the investigator cannot identify the specific ignition source, the fire cause classification need not always be listed as undetermined. For example, if the evidence establishes one factor, such as the use of an accelerant or multiple unconnected origins, that evidence may be sufficient to establish an incendiary fire cause classification even where other factors, such as ignition source, cannot be identified. Incident. Fires which cannot be classified as accidental, natural, or incendiary should remain unclassified. However, if all remaining working hypotheses would fall into the "Accidental" classification, the fire incident may be classified as "Accidental."

Statement of Problem and Substantiation for Public Comment

It is scientifically incorrect to assign classify a fire cause where the cause has not been determined. If it is seen by the Technical committee as necessary to include a classification system, call it "incident" classification rather than "cause" classification and distinguish it from the scientific method. The wording in this public comment has been adapted from the work of a Classification Task Group that was developed in 2018 for the first draft of the 2021 ed. See Public Comment 129 re: section 19.8.2

Related Item

- FR 74 (A.19.8.2)

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Public Comment No. 38-NFPA 921-2022 [Section No. B.2]

B.2 Fire Science.

For more information on fire science, see the following:

Babrauskas, V., *Electrical Fires and Explosions,* Fire Science Publishers, New York, 2021.

Babrauskas, V., *Ignition Handbook,* Fire Science Publishers/Society of Fire Protection Engineers, Issaquah WA, 2003.

Babrauskas, V., *Smoldering Fires,* Fire Science Publishers, New York, 2021.

Drysdale, D. *An Introduction to Fire Dynamics*, ~~2nd~~ 3d ed., ~~1999~~ Wiley, Chichester, England, 2011 .

Gann, R. G., and Friedman, R., *Principles of Fire Behavior and Combustion,* 4th ed., Jones & Bartlett, Burlington MA, 2015.

NFPA *Fire Protection Handbook*, 18th ed., Section 1, 1997.

Quintiere, J. G., *Principles of Fire Behavior*, Delmar Publishers, 1997.

Statement of Problem and Substantiation for Public Comment

Update the Drysdale reference to the current edition of the book.

Related Item

- B.2

Submitter Information Verification

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Committee: FIA-AAA

Public Comment No. 126-NFPA 921-2023 [Section No. B.5]

B.5 Pattern Geometry.

See the following sources:

Patorti, A. D. Jr. (NIST), “Full Scale Room Burn Pattern Study,” *NIJ Report 601-97, Publication #169 281*, National Institute of Justice, National Criminal Justice Reference Service, Washington DC, 1997.

~~Stanley~~ Shanley , J. H. Jr., Alletto, W. C., Corry, R., Herndon, J., Kennedy, P. M., Ward, J. “Federal Emergency Management USFA Fire Burn Pattern Tests,” *Report of the United States Fire Administration Program for the Study of Fire Patterns.* FA 178, p. 221, July 1997.

Statement of Problem and Substantiation for Public Comment

Typographical error

Related Item

- Chapter revision

Submitter Information Verification

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Public Comment No. 40-NFPA 921-2022 [Section No. B.11]

B.11 Carbon Monoxide.

For information on carbon monoxide, see the following:

Gottuk, D. T. and Lattimer, B., "Effect of Combustion Conditions on Species Production," *SFPE Handbook of Fire Protection Engineering*, 5th edition, ed. M. Hurley, Gaithersburg, MD, 2016.

Khan, M., Tewarson, A. and Chaos, M., "Combustion Characteristics of Materials and Generation of Fire," *SFPE Handbook of Fire Protection Engineering*, 5th edition, ed. M. Hurley, Gaithersburg, MD, 2016.

Purser, D., "Combustion Toxicity," and Purser D. & Mc Allister McAllister , L J .M. , "Assessment of Hazards to Occupants from Smoke, Toxic Gases, and Heat," *SFPE Handbook of Fire Protection Engineering*, 5th edition, ed. M. Hurley,. Gaithersburg, MD, 2016.

Nelson, G. L. "Carbon Monoxide and Fire Toxicity: A Review and Analysis of Recent Work," *Fire Technology*, 34(1), 1998.

Hirschler, M. M., S. M. Debanne, J. B. Larsen, and G. L. Nelson, eds. *Carbon Monoxide and Human Lethality: Fire and Non-Fire Studies*, New York: Elsevier Applied Science, 1993.

Hall, J. R., and B. Harwood, "Smoke or Burns — Which Is Deadlier?" *NFPA Journal*, January/February 1995.

Gann, R. J., V. Babrauskas, and R. D. Peacock, "Fire Conditions for Smoke Toxicity Measurements," *Fire and Materials*, 18(3), May/June 1994.

DeHaan, J., "The Dynamics of Flash Fires Involving Flammable Hydrocarbon Liquids," *American Journal of Forensic Medicine and Pathology*, 7(1), 1996, 24–31.

DeHaan, J. D., Campbell, S. J., and Nurbaksh, S., "Combustion of Animal Fat and Its Implications for the Consumption of Human Bodies in Fires," *Science and Justice*, 39 (1), 1999, 27–38.

Statement of Problem and Substantiation for Public Comment

Correct the authorship of a reference.

Related Item

- B.11

Submitter Information Verification

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Submittal Date:	Wed Dec 28 17:03:59 EST 2022
Committee:	FIA-AAA

Public Comment No. 39-NFPA 921-2022 [Section No. B.12]

B.12 Wildland Fires.

For sources on wildland fires, see the following:

Babrauskas, V., *Electrical Fire and Explosions,* New York, Fire Science Publishers, 2021.

Babrauskas, V., *Ignition Handbook,* Fire Science Publishers/Society of Fire Protection Engineers, 2003.

Babrauskas, V., *Smoldering Fires,* New York, Fire Science Publishers, 2021.

Finney, M. A., McAllister, S. S., Brumstrup, T. P., and Forthofer, J. M., **Wildland Fire Behaviour** , CSIRO Publishing, Australia (2021).

Ford, R. T. *Investigation of Wildfires*. Bend, OR: Maverick Publications, 1995.

International Fire Service Training Association. *Fundamentals of Wildland Firefighting.* 3rd edition. Stillwater, OK: IFSTA, 1998.

NWCG, *Fireline Handbook*, National Wildfire Coordinating Group, Handbook 3, March 2004.

NWCG, *Fireline Handbook Appendix B Fire Behavior*, National Wildfire Coordinating Group, April 2006.

NWCG, *Intermediate Wildland Fire Behavior S-290 Student Workbook & CD-ROM*, National Wildfire Coordinating Group, 2007.

NWCG, *Wildfire Origin & Cause Determination Handbook*, National Wildfire Coordinating Group, Handbook 1, 2005.

NWCG, *Wildland Fire Origin and Cause Determination FI-210 Student Workbook*, National Wildfire Coordinating Group, 2005.

Schroeder, Mark J.; Charles C. Buck, "Fire Weather," *USDA Agriculture Handbook 360*, May 1970.

Teie, W. C. *Firefighters Handbook on Wildland Firefighting Strategy, Tactics & Safety.* Rescue, CA: Deer Valley Press, 3rd edition, 2005.

Uman, M. A. All About Lightning. New York, NY, Dover Publications, 1986.

Statement of Problem and Substantiation for Public Comment

Add an important new textbook.

Related Item

• B.12

Submitter Information Verification

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Committee:	FIA-AAA

Public Comment No. 2-NFPA 921-2022 [Section No. C.1.2.2]

C.1.2.2 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM D56, *Standard Test Method for Flash Point by Tag Closed Tester*, ~~2016a~~ 2021a .

ASTM D92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*, ~~2016b~~ 2018 .

ASTM D93, *Standard Test Method for Flash Point by Pensky-Martens Closed Cup Tester*, ~~2016a~~ 2020 .

ASTM D1230, *Standard Test Method for Flammability of Apparel Textiles*, ~~2017~~ 2022a .

ASTM D1310, *Standard Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus*, 2014(2021) .

ASTM D1929, *Standard Test Method for Determining Ignition Temperature of Plastics*, ~~2016~~ 2020 .

ASTM D2859, *Standard Test Method for Flammability of Finished Textile Floor Covering Materials*, 2016 (2021) .

ASTM D3065, *Standard Test Methods for Flammability of Aerosol Products*, 2001 (2013) (withdrawn 2022) .

ASTM D3828, *Standard Test Methods for Flash Point by Small Scale Closed Tester*, 2016a (2021).

ASTM D4809, *Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)*, ~~2013~~ 2018 .

ASTM D5305, *Standard Test Method for Determination of Ethyl Mercaptan in LP-Gas Vapor*, 2018.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, ~~2018~~ 2022 .

ASTM E108, *Standard Test Method for Fire Tests of Roof Coverings*, ~~2017~~ 2020a .

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, ~~2018~~ 2022 .

ASTM E136, *Standard Test Method for ~~Behavior~~ Assessment of Combustibility of Materials ~~in~~ Using a Vertical Tube Furnace at 750°C*, ~~2016a~~ 2022 .

ASTM E603, *Standard Guide for Room Fire Experiments*, 2017.

ASTM E620, *Standard Practice for Reporting Opinions of Scientific or Technical Experts*, 2018.

ASTM E648, *Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*, ~~2017a~~ 2019 a e1 .

ASTM E659, *Standard Test Method for Autoignition Temperature of Liquid Chemicals*, 2015.

ASTM E678, *Standard Practice for Evaluation of Scientific or Technical Data*, 2007 (2013).

ASTM E681, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)*, 2009 (2015).

ASTM E800, *Standard Guide for Measurement of Gases Present or Generated During Fires*, ~~2014~~ 2020 .

ASTM E860, *Standard Practice for Examining and Preparing Items That Are or May Become Involved in Criminal or Civil Litigation*, 2007 (2013)e2.

ASTM E906/E906M, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products*, ~~2017~~ 2021 .

ASTM E1188, *Standard Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator*, 2011 (2017).

ASTM E1226, *Standard Test Method for Explosibility of Dust Clouds*, ~~2012a~~ 2019 .

ASTM E1354, *Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter*, ~~2017~~ 2022c .

ASTM E1459, *Standard Guide for Physical Evidence Labeling and Related Documentation*, 2013 (2018).

ASTM E1492, *Standard Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory*, 2011 (2017).

ASTM E1515, *Standard Test Method for Minimum Explosible Concentration of Combustible Dusts*, 2014 (2022) .

ASTM G145, *Standard Guide for Studying Fire Incidents in Oxygen Systems*, 2008.

Statement of Problem and Substantiation for Public Comment

date updates

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1-NFPA 921-2022 [Section No. 2.3.6]	

Related Item

- fr149

Submitter Information Verification

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Submittal Date:	Fri Oct 07 18:58:09 EDT 2022
Committee:	FIA-AAA

Committee Input No. 133-NFPA 921-2022 [Detail]

The technical committee requests input of any new material or potential changes to section of 27.3 Terminology – Specific to Wildland Fire Investigations. A comparison of terms specific to wildland fire investigation is currently being conducted as part of a study and the results could provide better alignment for those terms that will be used in NFPA 921 and those utilized in many other documents associated with the suppression and investigative approaches used for wildland fires as well as forest management. The completion of this study is anticipated to be available for the second draft and will be reviewed by the TC for potential recommendations of the removal, additional or modification of terminology within Chapter 27.

Submitter Information Verification

Committee: FIA-AAA

Submittal Date: Fri Jun 24 17:11:57 EDT 2022

Committee Statement

Committee Statement: The technical committee is evaluating the definitions specific to wildfire investigation currently used in NFPA 921 and other documents for relevancy to the content of the chapter.

Response Message: CI-133-NFPA 921-2022

Ballot Results

This item has not been balloted

Committee Input No. 134-NFPA 921-2022 [Detail]

The technical committee requests public comment of any new material or potential changes to section on Indicators and Patterns. A study of the reliability of indicators specific to wildland fire investigation is currently being conducted as part of ongoing research. The results of the study could provide more relevant material for use in NFPA 921 and other documents associated with the investigative approaches used for wildland fires. The study is anticipated to provide some recommendations for the second draft and will be reviewed by the TC for potential recommendations of the removal, addition or modification of material within Chapter 27 specific to section on Indicators and Patterns.

Submitter Information Verification

Committee: FIA-AAA

Submittal Date: Fri Jun 24 17:16:00 EDT 2022

Committee Statement

Committee Statement: The technical committee is considering additional changes to the patterns and indicators section of the wildfire chapter. Ongoing research will be evaluated along with any public comments.

Response Message: CI-134-NFPA 921-2022

Ballot Results

This item has not been balloted