



**Precision Indoor Personnel Location and Tracking for Emergency Responders**  
**Technology Workshop August 2-3, 2010**  
**Worcester Polytechnic Institute, Worcester, MA**

***National Fire Protection Association  
Standards for Electronic Safety Equipment***

**Bruce H. Varner, Chairman**  
**NFPA Technical Committee Electronic Safety Equipment For Fire and Emergency Services**  
**Fire Chief, Santa Rosa, CA**



# Fire Service Perspective

- FF – transparent to the individual – automatic on, very accurate
- IC – in background until needed (or desired)  
very accurate
  - Alerts
    - for crew separation [more than 10 ft]
    - Lack of motion
    - Distress (Mayday) alarm
    - High heat
- Fire Chief – very accurate, low cost, low maintenance, life time warranty (I know I'm dreaming)

# The real world

- The majority of operational fire fighter deaths occur at a fire scene during the first 20 minutes within 20 ft. of an exit point.
- There is with a single IC and 15 or less personal at the scene.
- RF signal is a problem in buildings for
  - Voice
  - Data
  - location

How do we assure that it all works?

Product standards

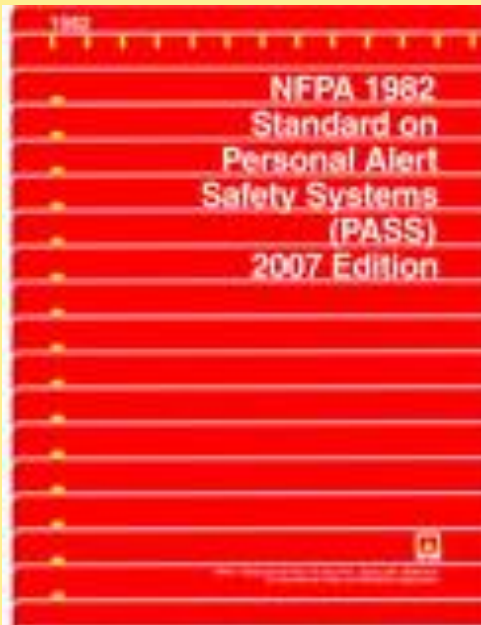
Testing

Certification

and that gets to the point of this presentation.



## Technical Committee on Electronic Safety Equipment

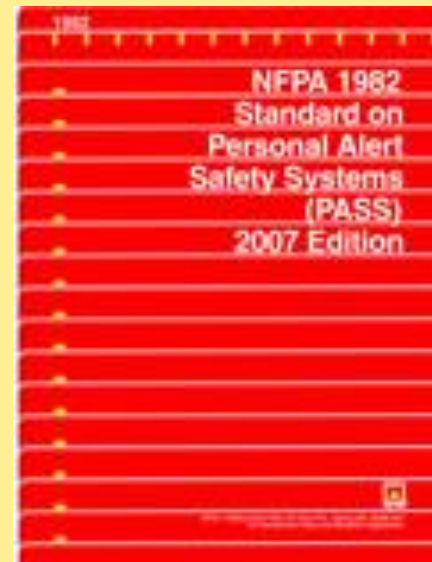


- NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, 2007 Edition (in revision process for 2013 Edition)
- NFPA 1800, *Standard on Electronic Safety Equipment for Emergency Services*
- NFPA 1801, *Standard on Thermal Imagers for the Fire Service*, 2010 Edition
- Portable Radios



# National Fire Protection Association Standards Making Process

**How are NFPA  
documents created?  
[a really, really short version]**





# Standards Making Process

## Technical Committee Membership

Carefully balanced & monitored

Reviewed continually

Nine interest categories

Applied Research/Testing Laboratory

Consumer

Enforcing Authority

Installer/Maintainer

Insurance

Labor

Manufacturer

Special Expert

User





## Five main steps in the process:

1. Call for Proposals
2. Report on Proposals (ROP)
3. Report on Comments (ROC)
4. Association Technical Meeting
5. Standards Council



# Essentials of the NFPA System

- § Balanced committee membership
- § A consistent process
- § Openness
- § Developing consensus
- § Extensive opportunities for public input





## Important Points!

*§NFPA is a Standards writing organization NOT an enforcement authority*

*§If we want changes to standards we have to participate*

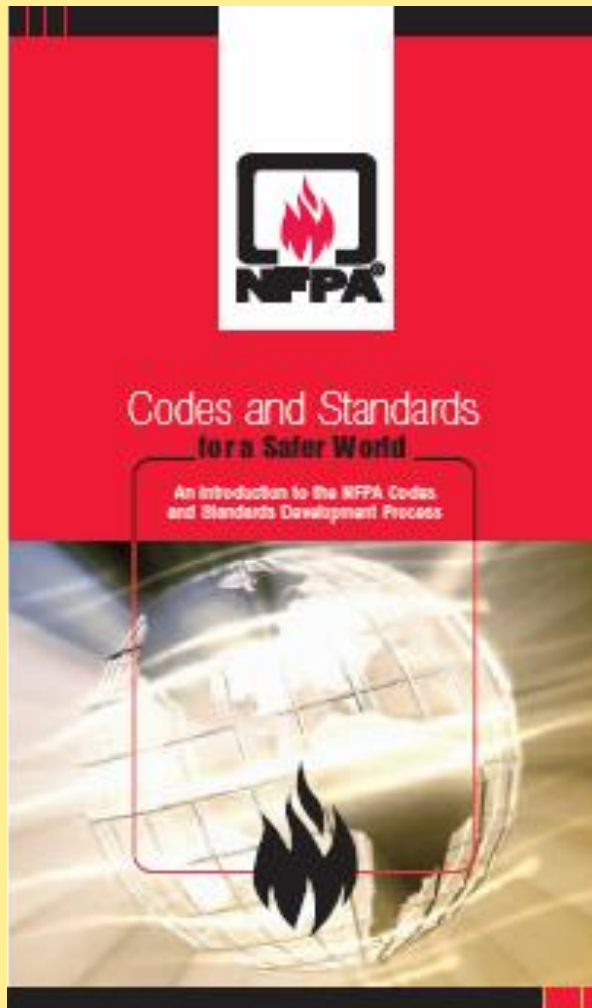
*§NFPA is a Member Organization*



## NFPA Standards Making Process

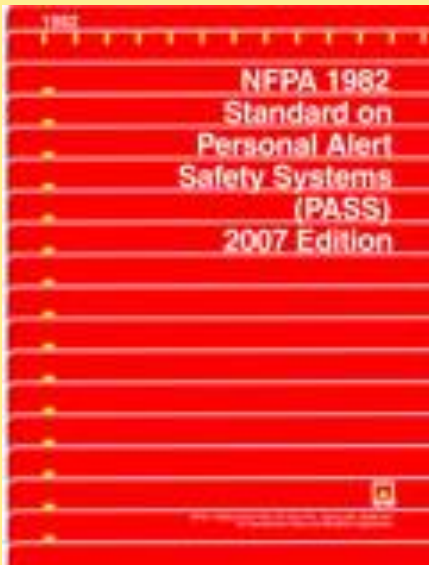
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[www.nfpa.org](http://www.nfpa.org)





## TC on Electronic Safety Equipment



- NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, 2007 Edition
- NFPA 1800, *Standard on Electronic Safety Equipment for Emergency Services*  
(Document is currently on hold)
- NFPA 1801, *Standard on Thermal Imaging Cameras for the Fire Service*  
(Available for Public Comment December 29, 2008)



# Technical Committee on Electronic Safety Equipment

## Committee Scope

**This Committee shall have primary responsibility for documents on the design, performance, testing, and certification of electronic safety equipment used by fire and emergency services personnel during emergency incident operations, and shall also have primary responsibility for documents on the selection, care, and maintenance of electronic safety equipment.**

What are some examples of the kinds of tests required for a Electronic Safety Equipment Product to be certified to an NFPA standard?

Glad you asked!

<b>Test Order</b>	<b>Specimens 1-3</b>	<b>Specimens 4-6</b>	<b>Specimens 7-9</b>	<b>Specimens 10-12</b>	<b>Specimens 13-15</b>	<b>Specimens 16-18</b>
1	Image Recognition Test Section 8.2 specimens 1-3	Pullout Test Section 8.10 Specimens 4-6	Field of View Section 8.13 Specimens 7-9	Heat Resistance Test Section 8.7 Specimen 10	Vibration test Section 8.3 Specimens 13-15	Durability Test Section 8.14 Specimens 16-18
2	Image Non-uniformity Test Section 8.12 Specimens 1-3	Impact acceleration — ambient Section 8.4 Specimen 4	Corrosion Section 8.5 Specimens 7-9	Heat Resistance Test Section 8.7 Specimen 11	Vibration test Section 8.3 Specimens 13-15	Product label durability Section 8.9 Specimens 16-18
3	Image Color and Effective Temperature Range Test Section 8.11 Specimens 1-3	Impact acceleration — cold Section 8.4 Specimen 5	Product label durability Section 8.9 Specimens 7-9	Heat Resistance Test Section 8.7 Specimen 12	Vibration test Section 8.3 Specimens 13-15	
4	Thermal Sensitivity Section 8.13 Specimens 1-3	Impact acceleration — elevated Section 8.4 Specimen 6		Product label durability Section 8.9 Specimens 10-12		
5	Heat/flame Test Section 8.8 Specimen 1					
6	Heat/flame Test Section 8.8 Specimen 2					
7	Heat/flame Test Section 8.8 Specimen 3					

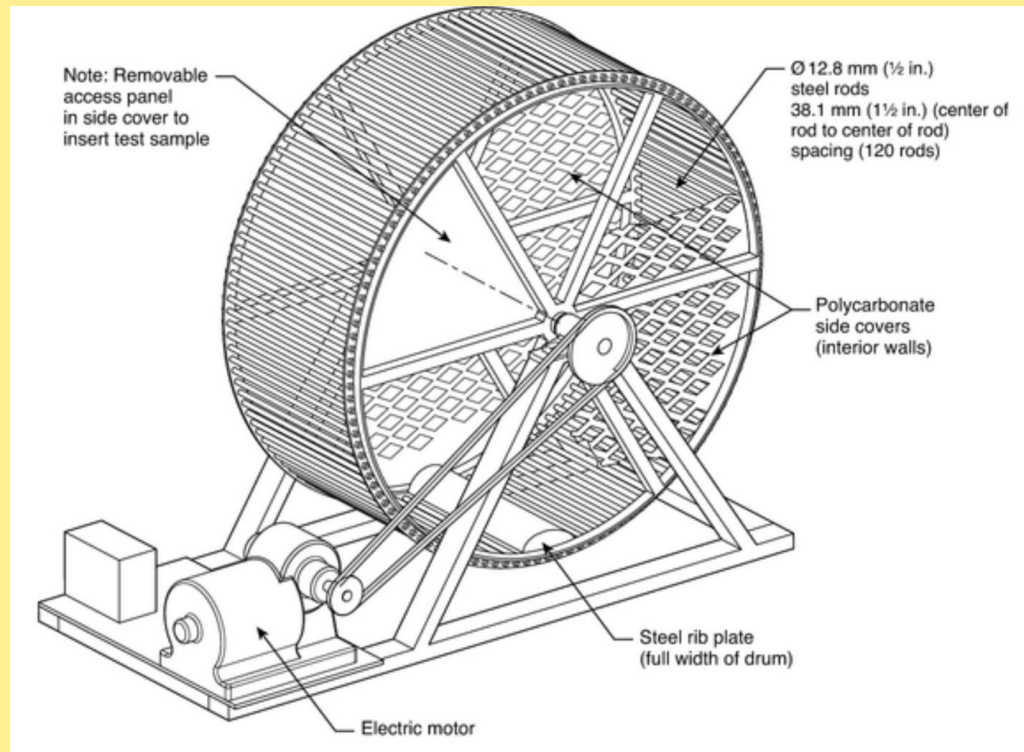
# Examples of testing required for a Electronic Safety Equipment Product

- Heat Resistance – 500° F (260° C) for 5 minutes
- Impact Acceleration – Dropped on each surface from 3 meters
- Cable pull-out – 89N force
- Vibration – 3 hours
- Corrosion – 48 hr Salt Spray



# Examples of testing required for a Electronic Safety Equipment Product

- Tumble Test (Durability) heated, immersed in water – chilled, immersed in water – tumbled 30 minutes, immersed in water.



# Examples of testing required for a Electronic Safety Equipment Product

- Heat and Flame immersion test  
10 seconds at 1500 – 2102°F  
(815 – 1115°C)
- Other testing specific  
to particular product  
performance





## Proposed Transmission Quality Tests

- Tests are based on the five building types as described in NFPA 220, *Standard on Types of Building Construction*.
- The same tests will be completed in test fixtures built to model each of those five building types.





## Five NFPA Building Types

Type I - Fire-Resistive

Type II - Noncombustible

Type III - Ordinary

Type IV - Heavy Timber

Type V - Wood Frame



## Proposed Tests

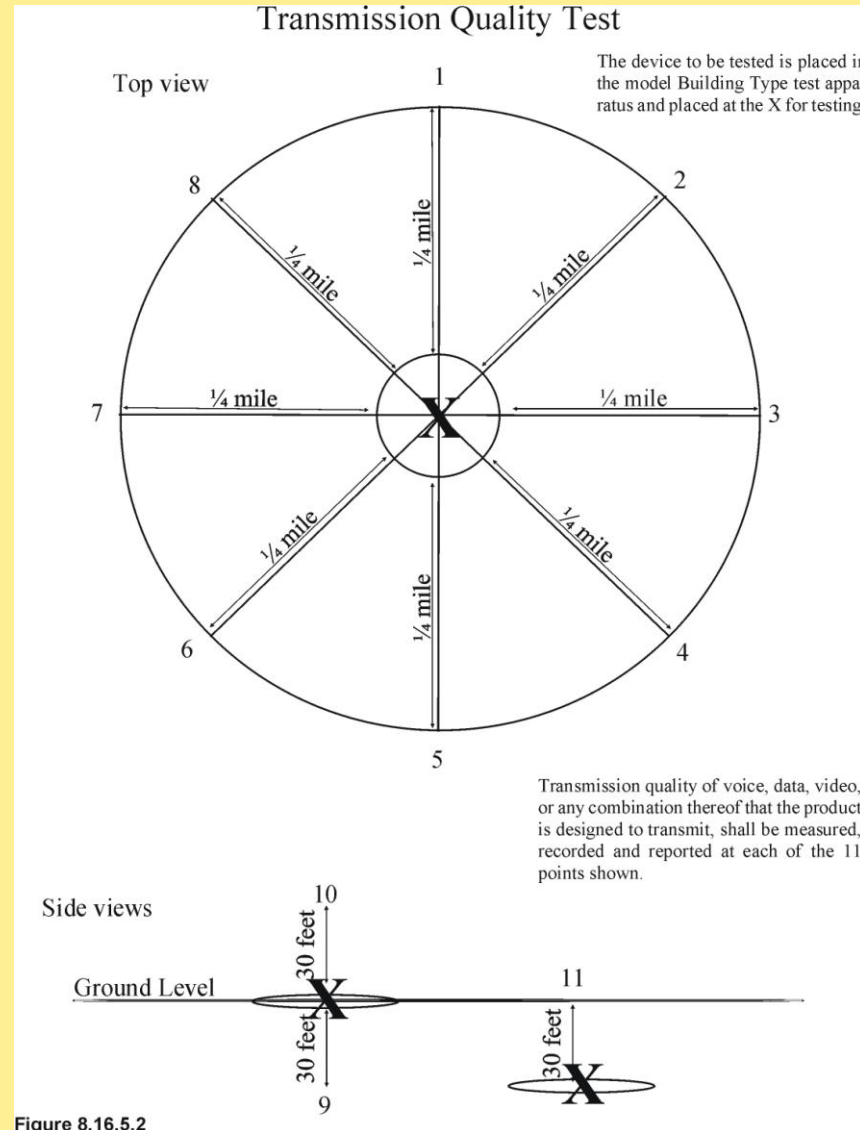
### Test Procedure 1

- Specimens shall be operated according to manufacturer's instructions, and transmission quality of voice, data, video, or any combination thereof that the product is designed to transmit, shall be measured at the 11 points specified in the diagram.



# Transmission Quality

**Pass/ Fail performance shall be determined as all voice, data, video, or any combination thereof, shall be received in a manner usable to the receiver at each of the 11 points specified in the diagram.**



# **NIST Preliminary Work on RF-Based PASS Performance Metrics\***

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Homeland  
Security

\*Funding provided by DHS Standards Office

# Outline:

- **Results of electromagnetic field tests to date**
- **Characteristics of key environmental features**
- **Proposed propagation channel classification**
- **Link to proposed transmission quality tests**
- **Discussion**

# Electromagnetic Field Tests:

## Compare

- RF-based PASS device
- signal strength
- time-delay spread (multipath)
  - with and without building penetration
  - with and without repeater

## Equipment:

- PASS system operating in the 902-927 MHz ISM frequency band
- PASS system operating in the 450 MHz band

# Structures:

**Building corridor: receiver inside and outside**



**Two-story concrete and steel building**

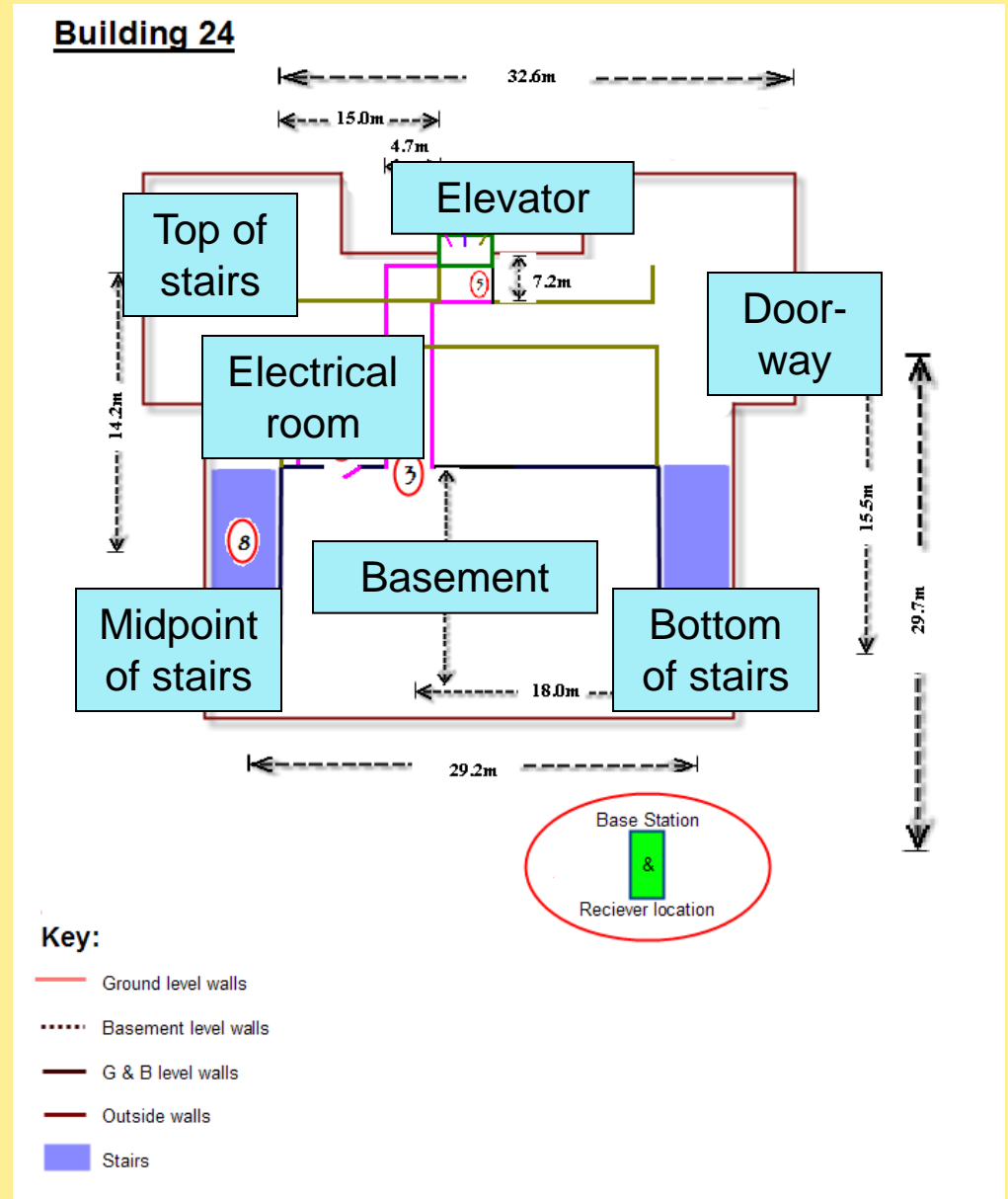


# Preliminary Findings:

- Corridor transmissions can present difficulties at lower frequencies
- Repeater extends range
- Building penetration successful above grade, less so below grade
- Multipath delay spread not significant for frequency hopping signal for moderately sized corridors

# Measurements in Two-Story Building:

- Building footprint approx. 30m x 30m
- Cinder block walls, few windows, lab space and offices
- Two stories plus basement level



# Preliminary Findings:

- Basement penetration difficult when in rooms, corridors
- Elevator penetration difficult
- Repeater extends range
- Need to carry out additional measurements (delay spread, signal strength with receiver outside)

# Questions or Comments?

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*Thank  
you*

For the opportunity to be here today and share information about the work of the NFPA Technical Committee on Electronic Safety Equipment.