Developing New NFPA Standards: Initial Working Group Phase

Larry Konsin, Manager, Customer Development, MSA /
Working Group Chair, NFPA 1801 TIC Standard

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December 9 - 10, 2004 – Industry Meeting

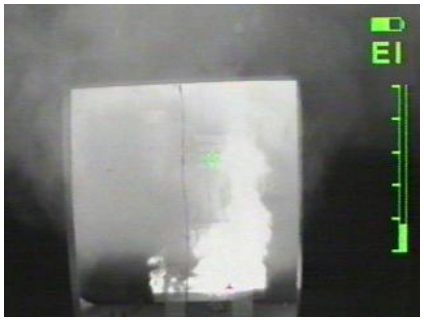
NIST Workshop on Thermal Imaging Research Needs

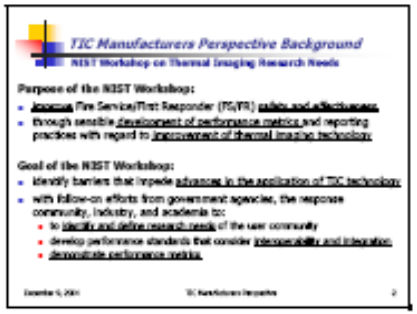
Meet the workshop participants, shown here in the long wavelength infrared (above) and visible (below) spectra.

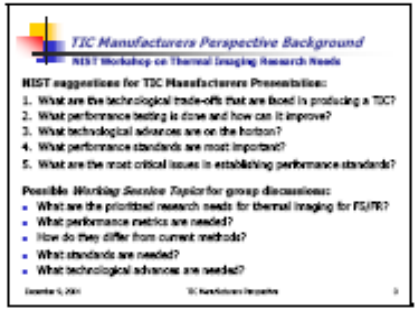
Goal of the NIST Workshop:

- to identify and define research needs of the user community
- develop performance standards that consider interoperability and integration
- demonstrate performance metrics

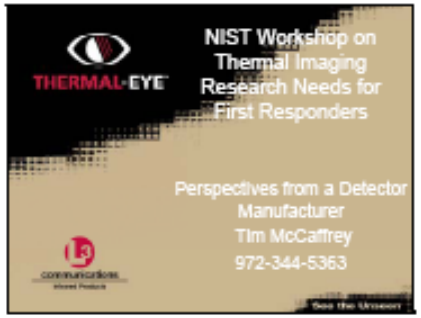
Thermal Imaging Cameras - 2004

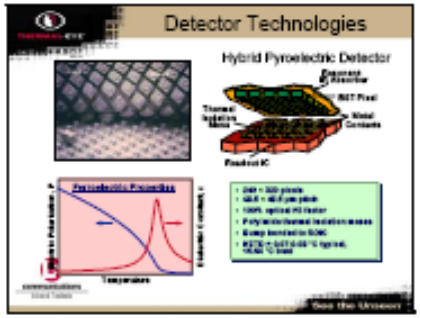


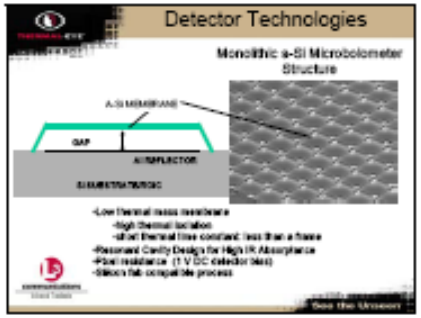




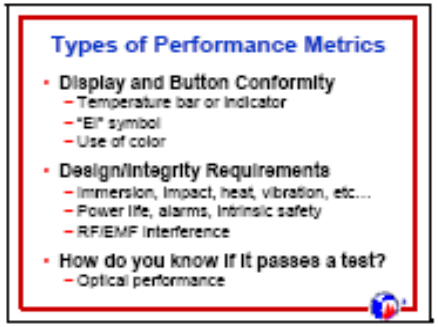
Larry Konsin, American Council for Thermal Imaging

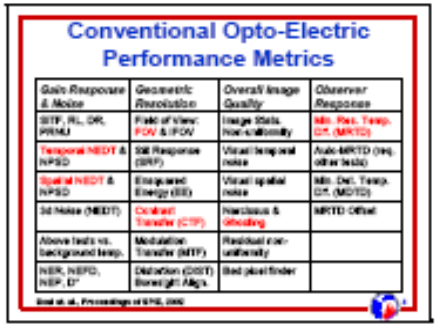




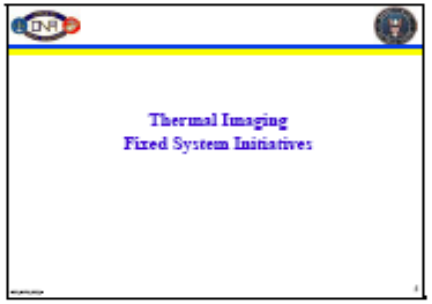


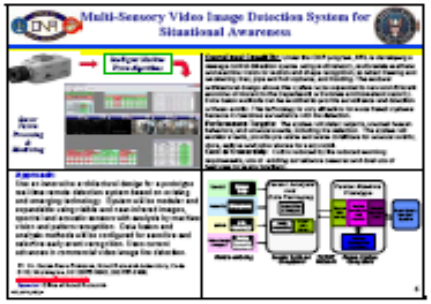
Tim McCaffrey, Raytheon Commercial Infrared

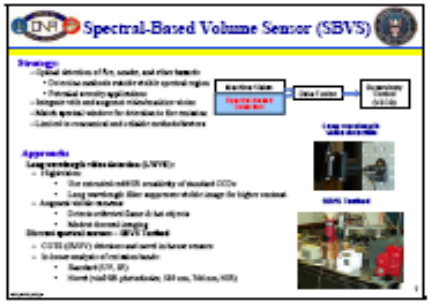


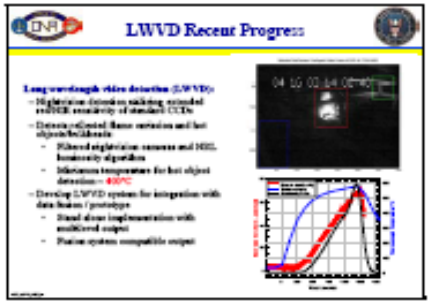


Francine Amon, Building and Fire Research Laboratory, NIST

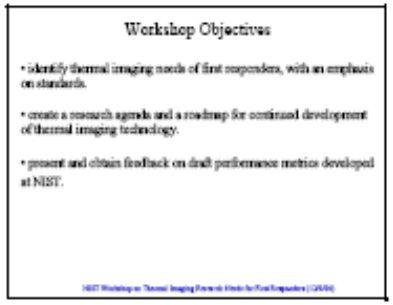


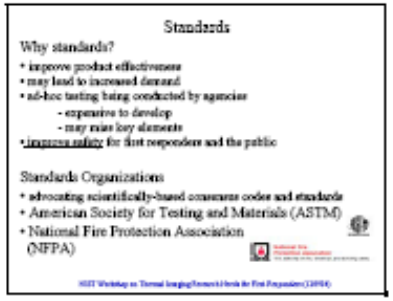


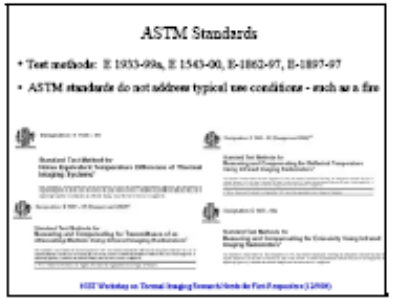




John P. Farley, Navy Safety and Survivability, Naval Research Laboratory, Washington DC

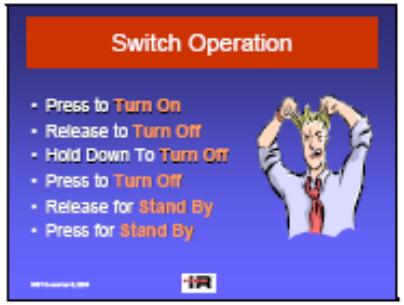


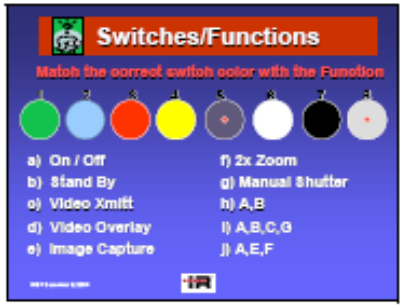




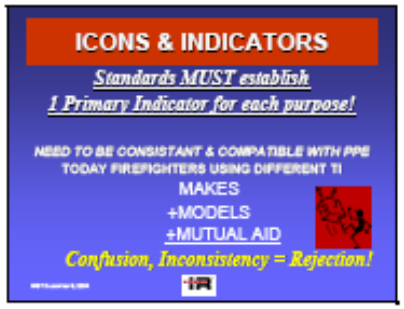
Anthony Hamins, Building and Fire Research Laboratory, NIST

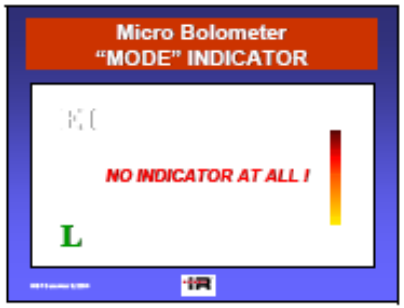
Brian Duggan, Fire Chief, City of Northampton Fire Department, MA





Bruce Varner, Fire Chief, City of Santa Rosa Fire Department, CA





Bob Athanas, President, SAFE-IR, Inc.

Chief Brian Duggan representing IAFC

1. Initially search/rescue tool - now indispensable tool – multiple applications.
2. Battery life issue – failures after doing everything you were to do
3. Chargers need to be just as reliable as a good battery system
4. TIC down – must have a fall back – trained on what to do

Chief Bruce Varner, Santa Rosa FD

1. Hands free – helmet or facepiece mount
2. Low cost - light weight - high quality image
3. Easy to interchange between users
4. Firefighter friendly - intuitive
5. Low maintenance - very very rugged
6. Unfailingly reliable – mission critical
7. Long battery life – low cost replacements
8. Lifetime unlimited warranty
9. Certification and testing - NFPA

Firefighter Bob Athanas, Special Operation FDNY

1. Inconsistency with cameras because of lack of standards
2. Training issues – under utilization of the tool
3. There has to be a way to simplify TICs for the end user
4. Simplicity + consistency = safety
5. Inadequate, inconsistent and inaccurate information
6. Make + models + mutual aid = confusion, inconsistency = rejection
7. Different color buttons – match the colors with the features
8. Temperature and color – What does it mean?
9. Bob has used TIC since 1991

Developing New NFPA Standards: Initial Working Group Phase

May 19, 2005 – Initial Meeting

Fire Service TIC Operational Standards Working Group

Fire Service TIC Operational Standard Working Group

Meeting 1: May 19, 2005 Meeting, Jersey City, NJ

In attendance:
Bob Athanas, FDNY
Bob Knabbe, FDNY
Scott Law, ISG
David Little, ISG
Larry Konsin, MSA (Chair)

Summary of Progress:

Standardized Graphics Concept:

Thermal Imaging Cameras (TICs) shall default to a standard graphical user interface (GUI) so that any user trained on a specific brand of TIC could effectively activate and operate any other brand of TIC through the same GUI.

In addition to the default GUI, TIC manufacturers may allow users to manually activate additional features and functions that are not contained in this TIC Operational Standard, through a user-selectable GUI. The user-selectable GUI may also be configurable by the user.

The TIC shall default to the standard GUI at:
1. power-off
2. manual deactivation of the user-selectable GUI

The default GUI is defined as a standardized set of informational alpha numerics and/or symbols that provide information on the status, operation, condition or use of the TIC.

The user-selectable GUI is defined as unique set of informational alpha numerics and/or symbols that provide information on the non-standard features and functions of the TIC. There shall be indication of the status, operation, condition and use of those non-standard features and functions through the user-selectable GUI.

The GUI area may consist of both the TIC display, and a one inch tall area that runs horizontally directly above and below the display, being on the same plane as the display, for effortless viewing by the user.

Default GUI Layout Concept:

On the TIC display, the GUI area shall consist of three vertical columns, each consisting of one-third of the total area of the display. In addition, the one inch tall area that runs directly above and below the display, being on the same plane as the display, is considered part of each of the three columns. Each of the three columns shall contain specific, assigned TIC operational information:

(Note: Each Column item is listed in order from top to bottom)

1. Left Column Area is for “Additional Information” indicators:
   a. Mode Indicator (display)
   b. Shutter Indicator (display)
   c. Transmitter Indicator (display)
   d. Video or Image Capture Indicator (display)
   d. Additional room for new indicators (display)
   e. Sensor Over Temp Warning (below the display)

2. Center Column Area is for “Alarm” indicators:
   a. Battery (above the display)
   b. Temperature Measurement Crosshair (center of display)
   c. Additional room for Battery Indicator (bottom of display)
   d. Additional room for Battery Indicator (below the display)
   e. Camera Status LED (below the display)

3. Right Column Area is for Temperature Sensing indicators:
   a. Vertical Temperature Bar Graph (display)
   b. Digital Temperature Measurement Readout (bottom of display)
   c. Additional room for Battery Indicator (bottom of display)

Default GUI Indicators Concept:

Investigations of firefighter fatalities in structural fires show that most are caused by the firefighter not being aware of the changing fire environment and their personal situation. There is an opportunity for firefighters using thermal imaging cameras to better understand the changing fire environment in a new and better way. TIC operational color indicators could help firefighters better understand the often rapid changes in the firefighting environment and the status of their TIC. Simply put, green is good, yellow cautions, and red alarms.

The concept extends to the vertical temperature bar graph which will be broken down into three sections, with green at the bottom for cooler temperatures, yellow at cautious moderate heat and red at high heat.

NFPA 1801 TIC Operation

2 Operational Formats

TIC Basic

Default at Power On:

1. Black and White Imaging
2. Battery Indicator
3. Over-Temp Indicator
4. Camera On Indicator
5. Temperature Indicators
6. Heat Indicating Color
7. Heat Color Reference Bar

- Basic TIC training:

Firefighters with NFPA certified Basic TIC training can operate any other TIC regardless of brand, make or model. This allows for "mix and match" of TICs at a FD or Mutual Aid.

Restricted Access

TIC Basic Plus

All 7 Basic functions Plus:

8. Additional functions
   - Image/Video Capture
   - User Selectable color settings
9. Enhancements
   - Must follow Basic guidelines
10. Innovations:
    - Firefighter Location
    - Identification/Accountability
    - Text Messaging, Information
    - Distance Finder, Gas Detect

- Basic Plus may be proprietary
- Advanced Department training
- To go back to Basic: Power Off/On

Icons Description and Location

Additional Information

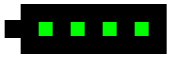
Low Sensitivity Mode Indicator

Basic Plus mode

Alarm and Operational Indicators

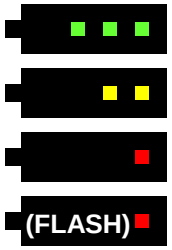
Over-Temp Indicator

\+ Crosshairs



Battery Indicator

Battery Power Indicators



75% Power

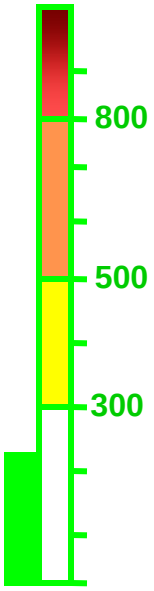
50% Power

25% Power

5% Power

TIC On/Off Indicator

Temperature Sensing Indicators

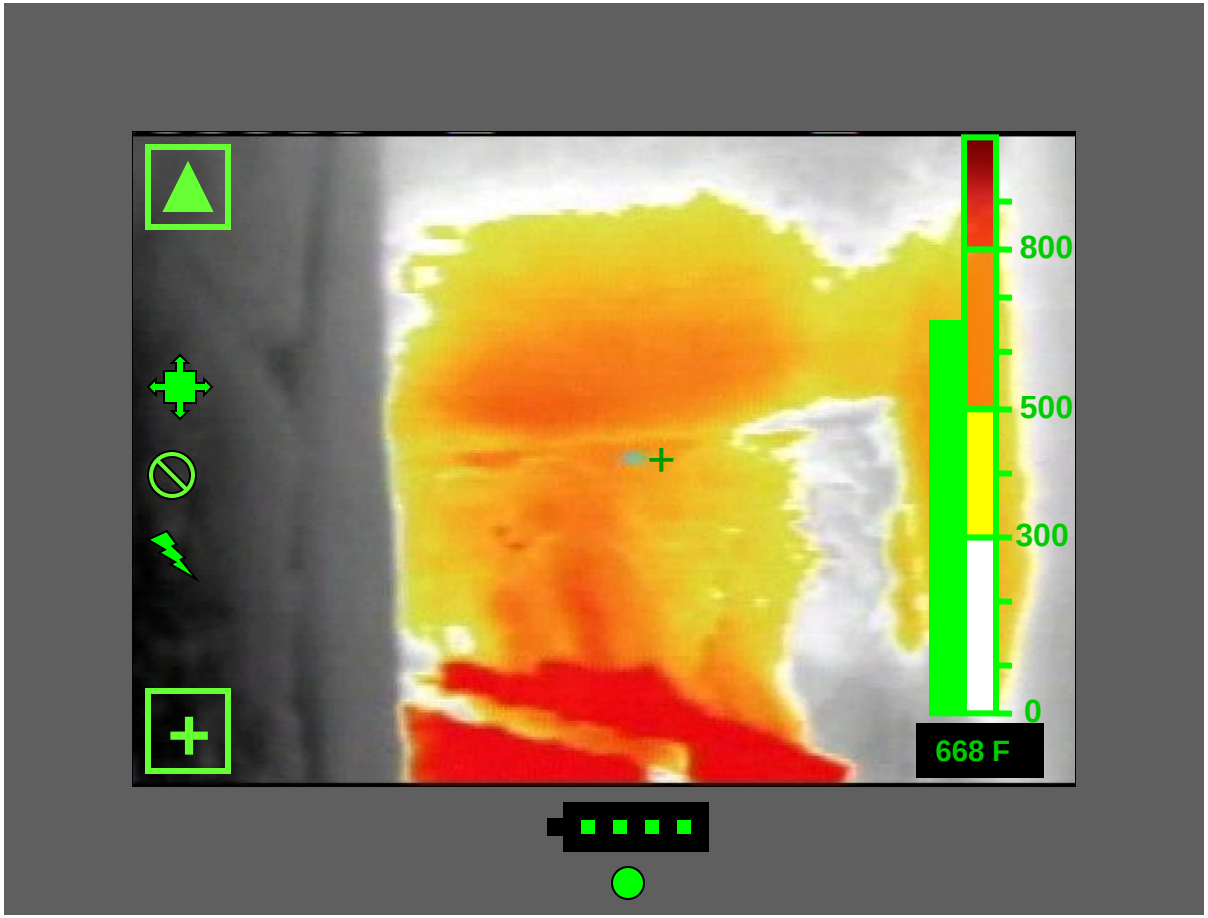


Temperature Bar and Heat Color Reference Bar

Temperature readout

TIC Basic Plus with Optional feature Icons

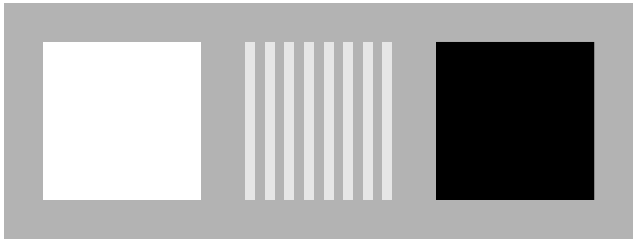
Optional
Added
Features



Restricted Access

Performance Metrics Tests

- **Contrast & Spatial Resolution**
  - Contrast Transfer Function (CTF)
  - Random MTF target?



- **Thermal Sensitivity**
  - Perceivable thermal sensitivity viewing targets in various thermal classes
  - Camera itself exposed to elevated temperatures
- **Effective Temperature Range**
  - Determine the point at which the *displayed image* becomes saturated
  - Determine mode shift(s)
- **Image Uniformity**
  - Measure consistency of *displayed image*, given uniform input
- **Electro-Optical Transfer Function (EOTF)**
  - Relationship between displayed image and captured video output

Tests Needed for Different Classes of Fires

Class	**Class I** *(water, fog, or snow possible, minimal heat, smoke and flames)*	**Class II** *(elevated temperatures, water, dust, smoke and flames may be present)*	**Class III** *(high temperatures and smoke concentrations, flames, dust, and water are likely)*
Activity	Hazmat Medical Motor vehicle accident Search	Overhaul Size up Tactics Forensics Preventative maintenance Search	Forensics Wildland fires Size up Tactics Communication Search
Proposed Metric/Test	Measure thermal sensitivity with surfaces having temperatures of **0 ºC** and **100 ºC** in FOV. Ambient temperature near **30 ºC**. Also, measure the contrast and spatial resolution using a **ΔT of 10 ºC** and surface temperatures near **30 ºC**.	Measure thermal sensitivity with surfaces having temperatures of **25 ºC** and **160 ºC** in FOV. Ambient temperature near **100 ºC.** Also, test effective temperature range by measuring the ***largest* ΔT** at which the target pattern is discernible, one target temperature is set at **30ºC**.	Measure thermal sensitivity with surfaces having temperatures of **160 ºC** and **260 ºC** in FOV. Ambient temperature near **210 ºC**. 

Developing New NFPA Standards: Initial Working Group Phase

September 29 - 30, 2006 – NFPA Meeting

NFPA Technical Committee on ESE Presentation

Fire Service Thermal Imaging Camera Standards Considerations

Presented to the:

NFPA Technical Committee on Electronic Safety Equipment

29 – 30 September 2006

St. Louis, Missouri

By the:

Fire Service TIC Standard Working Group

Larry Konsin, Chair - Robert Athanas, Secretary

TIC Working Group Makeup

TIC Manufacturers

Bullard
It's your life and you're worth it™

Dräger safety

e2v
e2v technologies

FireFLIR

ISG

ISI

MSA
The Safety Company

SCOTT

TOTALFIREGROUP™
ADVANCED PERSONAL PROTECTION

TIC Working Group Makeup

Technology, Training and Testing

BAE SYSTEMS

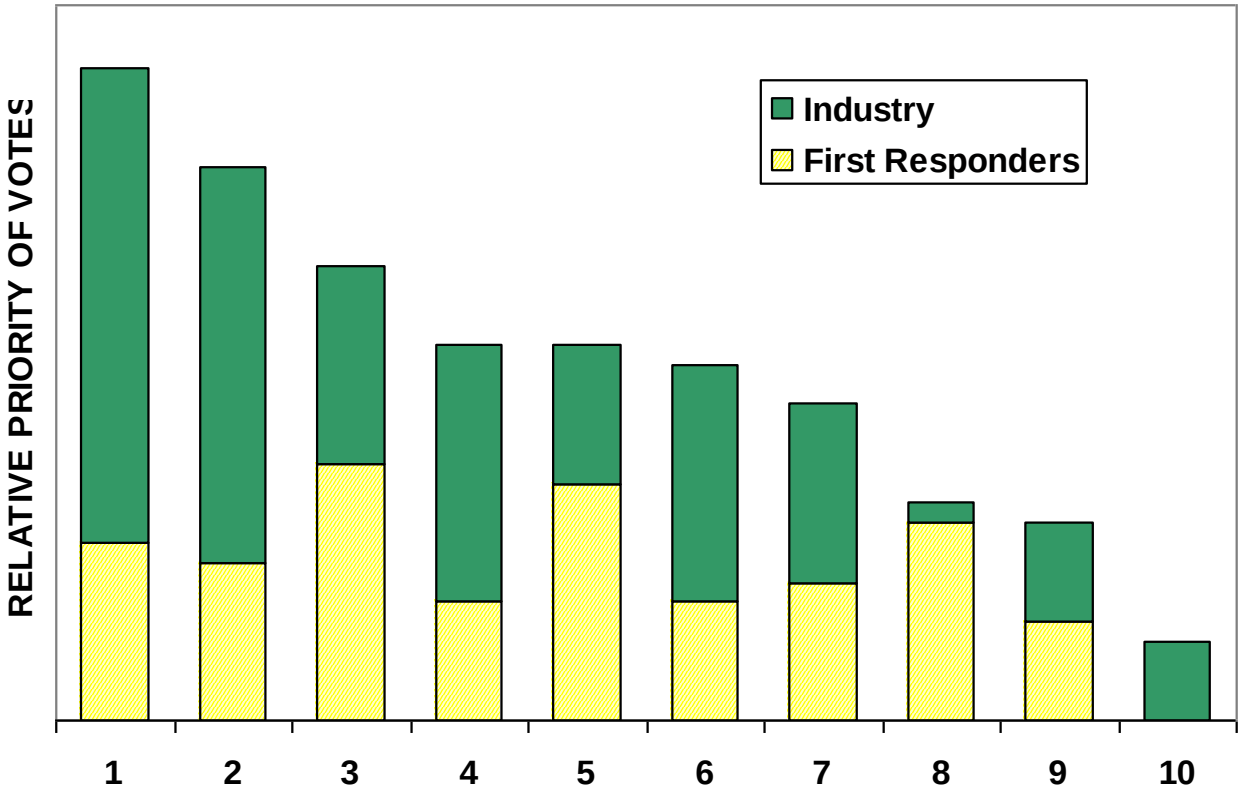
L3 communications

REDSHIFT

SAFE™

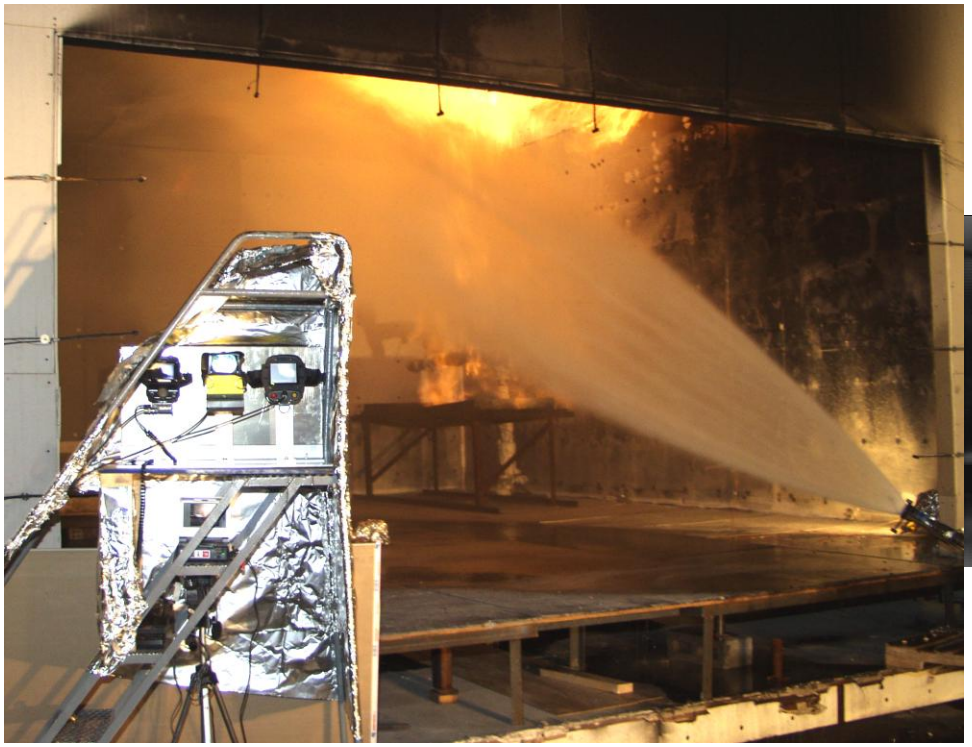
NIST National Institute of Standards and Technology

Overall Workshop Results



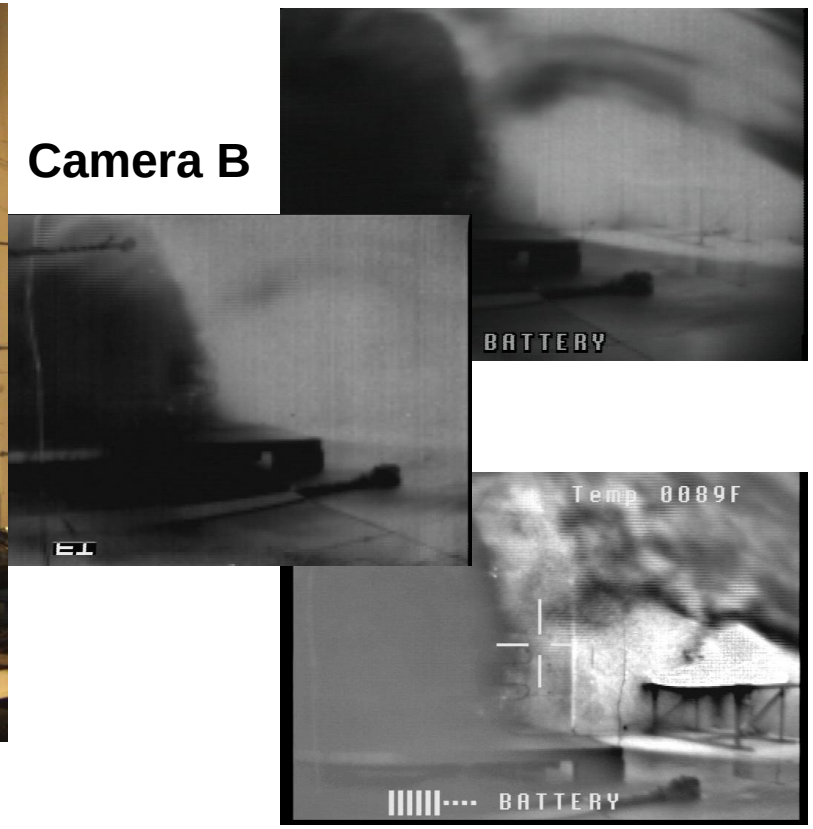
1. Image quality
2. Durability
3. Training and certification
4. Establish test environments
5. Human factor/ergonomic research
6. Image display
7. Battery and charger
8. Reduction in imager cost
9. Standard field target
10. Imager self-test procedure

Full-Scale Tests (III)



Camera A

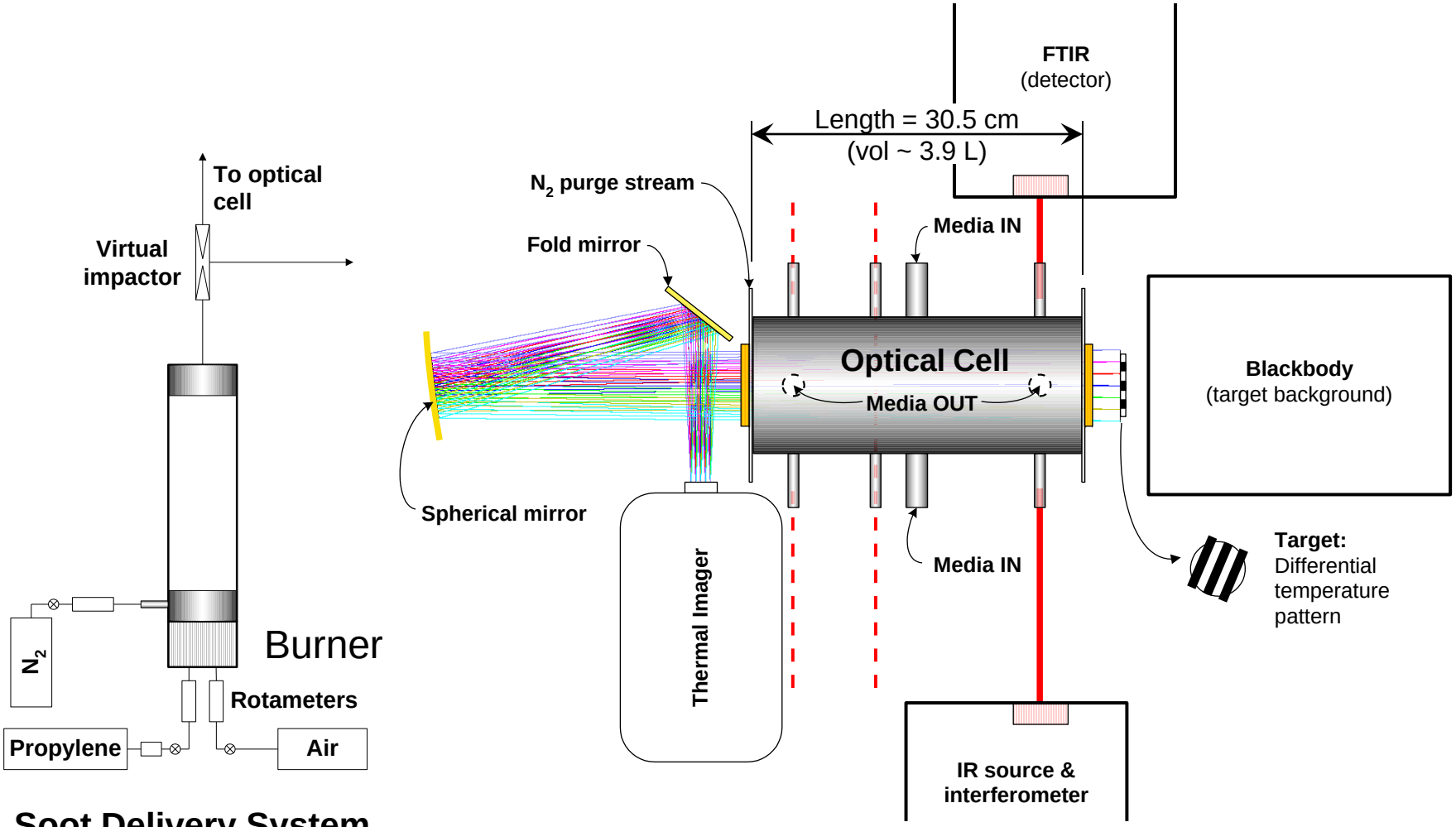
Camera B



Camera C

- **Hose stream tests: fog vs. jet**
- **Surfaces: wetted, initially dry, reflective**

Bench-Scale Testing Facilities (I)



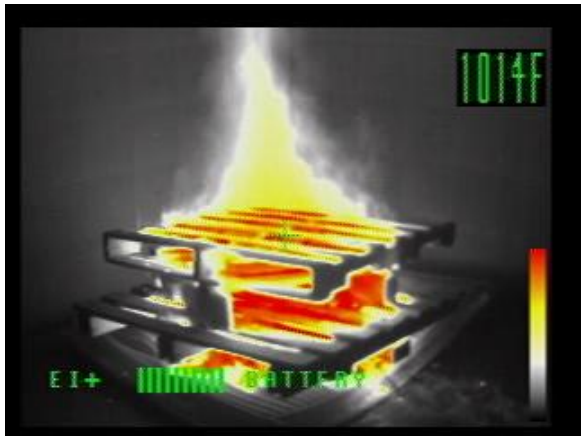
What do you use your TIC for?

Apps in which TICs had been used

9 Q7

	COUNT	%	0 50 100
Size-up	63	33.9	|********
Search / Rescue	111	59.7	|***************
Interior Attack	120	64.5	|****************
Overhaul	165	88.7	|**********************
HazMat	14	7.5	|**
Exterior Search	52	28.0	|*******
Wildland FF	7	3.8	|*
Non-labeled codes	0	0.0	|

186 Total Respondents
532 Total Responses



Bottom Line:

First Responders understand the basic uses of TICs. However, they remain materially underutilized.

Colorizing the image is important

Colorizing hot objects is important

(Percents based on responses)		TECHNOLOGY TYPES USED BST	PEV	ASI	VOX	PBZR
Total Respondents	213	40	2	10	38	1
	100.0	100.0	100.0	100.0	100.0	100.0
Strongly Agree	55	7		1	13	1
	25.8	17.5		10.0	34.2	100.0
Somewhat Agree	53	10	1	2	13	
	24.9	25.0	50.0	20.0	34.2	
Neither	59	7		1	6	
	27.7	17.5		10.0	15.8	
Somewhat Disagree	21	9		5	3	
	9.9	22.5		50.0	7.9	
Strongly Disagree	25	7	1	1	3	
	11.7	17.5	50.0	10.0	7.9	
Mean	3.43	3.02	2.50	2.70	3.79	5.00
Median	3.53	3.07	3.50	2.30	4.04	4.75
Std Dev (n-1)	1.2927	1.3865	2.1213	1.2517	1.2337	0.0000
Standard Error	0.0886	0.2192	1.5000	0.3958	0.2001	0.0000
F (t if only 2 cols)		2.8497				
F Deg of freedom		4, 86				
F Probability		0.0198				

68.4%

40%

Bottom Line:

BST users, who typically do not have colorization, or temp dependent color, do not see the usefulness of color. VOx users, who have access to it, do.

The TIC Working Group Thanks You