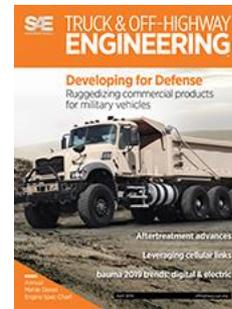


# PROPOSED GUIDELINES FOR RESILIENT PNT RECEIVERS

Bill Woodward, P.E.

# About SAE International

- Our Mission: To advance mobility knowledge and solutions for the benefit of humanity.
- Our Vision: SAE is the leader in connecting and educating mobility professionals to enable safe, clean, and accessible mobility solutions.
- We are a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive and commercial-vehicle industries.
- Our core competencies are life-long learning and voluntary consensus standards development.
- Throughout our more than 110-year history, our track record is one of dependability, a true partner to the industries we serve.



# About the PNT Committee

- ION GNSS 2008: I meet a mentor (James Farrell) in Savanna, GA
- September 2016: Aerospace Council approves AS-5 in Savanna, GA
- May 2017: First AS-5 meeting
- July 2017: Moved under the Systems Management Council
- August 2018: First standard published
- September 2018: Fifth standard published



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## SAE Aerospace Council Organization Chart

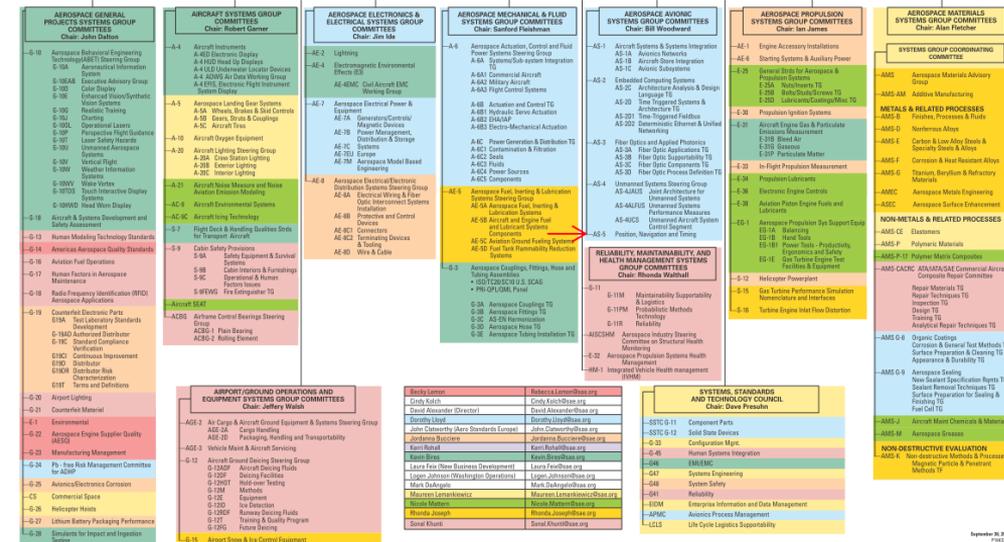
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**Preserving a Legacy**  
Integration of SAASM and Commercial GPS Receivers with Existing Shipboard Systems

SAE International is pleased to announce the publication of the new standard, AS-5, which provides a common framework for the integration of SAASM and Commercial GPS receivers with existing shipboard systems. This standard is a result of the collaborative efforts of the SAE Aerospace Council and its members, who have worked together to address the challenges of integrating these systems into existing shipboard infrastructure. The standard covers the requirements for the integration of SAASM and Commercial GPS receivers with existing shipboard systems, including the requirements for the integration of SAASM and Commercial GPS receivers with existing shipboard systems. This standard is a result of the collaborative efforts of the SAE Aerospace Council and its members, who have worked together to address the challenges of integrating these systems into existing shipboard infrastructure.

## SYSTEMS MANAGEMENT COUNCIL ORGANIZATION CHART

[www.sae.org/standards/](http://www.sae.org/standards/)

**SYSTEMS MANAGEMENT COUNCIL (SMC)**  
CHAIR: Gregory Saunders  
Logan Johnson +1 202 434 8943 | Maureen Lemakiewicz +1 724 772 7147

- SMCG33 Configuration Management
- SMCG41 Reliability
- SMCG45 Human Systems Integration
- SMCG46 EM/EMC
- SMCG47 Systems Engineering
- SMCG48 Systems Safety
- SMCE0M Enterprise Information and Data Management
- SMCLLS Life Cycle Logistics Supportability
- SMCPNT Position Navigation and Timing

# Completed Work



## PNT Position, Navigation, and Timing 5 Year Review

[Standards Status  
Definitions](#)

Document List		Display: <input type="text" value="All Documents"/>	
Document	Title	Date	Status
<a href="#">SAE1002</a>	U.S. National Grid Standard	Aug 22, 2018	Issued
<a href="#">SAE6857</a>	Requirements for a Terrestrial Based Positioning, Navigation, and Timing (PNT) System to Improve Navigation Solutions and Ensure Critical Infrastructure Security	Apr 24, 2018	Issued
<a href="#">SAE9990</a>	Transmitted Enhanced Loran (eLoran) Signal Standard	Sep 13, 2018	Issued
<a href="#">SAE9990/1</a>	Transmitted Enhanced Loran (eLoran) Signal Standard for Tri-State Pulse Position Modulation	Sep 17, 2018	Issued
<a href="#">SAE9990/2</a>	Transmitted Enhanced Loran (eLoran) Signal Standard for 9th Pulse Modulation	Sep 17, 2018	Issued

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SYSTEMS MANAGEMENT STANDARD	SAE9990™	
	Issued	2018-09
Transmitted Enhanced Loran (eLoran) Signal Standard		

### RATIONALE

There is a need for an independent, complementary, multi-domain positioning, navigation, and timing (PNT) system that may interoperate with the Global Positioning System (GPS), other Global Navigation Satellite Systems (GNSS), or PNT sources.

### FOREWORD

Long-Range Navigation (LORAN) is an internationally-recognized PNT system used by many modes of transport and in other applications. eLoran is the latest in the longstanding and proven series of low-frequency systems that takes full advantage of state-of-the-art hardware and software technologies that provide a data channel and time of transmission capability not implemented in legacy LORAN systems.

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SAE WEB ADDRESS: <http://www.sae.org>

SAE values your input. To provide feedback on this Technical Report, please visit <http://standards.sae.org/SAE9990>

# Listening to the PNT Community



Homeland Security

NCCIC  
National Cybersecurity & Communications  
Integration Center

NCC  
National Coordinating Center for Communications

## Improving the Operation and Development of Global Positioning System (GPS) Equipment Used by Critical Infrastructure



### PRIORITIZING DANGERS TO THE UNITED STATES FROM THREATS TO GPS

#### Ranking Risks and Proposed Mitigations

##### WHITE PAPER

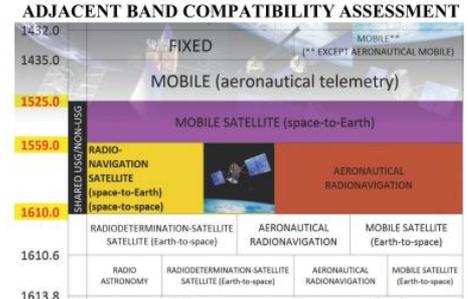
This paper examines risks to the United States, its Global Positioning System (GPS) and GPS signals. Other Global Navigation Satellite Systems (GNSS) have very similar characteristics as GPS. This high-level risk model may be of use when considering risks to other nations and to GNSS more generally.



The Resilient Navigation and Timing Foundation is a 501(c)3 educational and scientific charity registered in Virginia.  
This paper is available on line at [www.rntfnd.org/Library](http://www.rntfnd.org/Library)



### UNITED STATES DEPARTMENT OF TRANSPORTATION GLOBAL POSITIONING SYSTEM (GPS) ADJACENT BAND COMPATIBILITY ASSESSMENT



FINAL REPORT

APRIL 2018

1

UNCLASSIFIED  
EIP-WHITE

## PNT Position, Navigation, and Timing

[WIPs Older Than 5 Years.](#)

Works in Progress			
Project	Title	Sponsor	Date
<a href="#">SAE1004</a>	Raw Measurements from Global Navigation Satellite System (GNSS) Receivers	William R. Woodward	May 09, 2018
<a href="#">SAE1012</a>	Global eLoran User Equipment Interface Standard	William R. Woodward	Dec 18, 2018
<a href="#">SAE1012/1</a>	Global eLoran User Equipment Interface Standard for Timing	William R. Woodward	Apr 16, 2019
<a href="#">SAE1012/2</a>	Loran or Enhanced Loran (e)Loran Position, Navigation, and Timing (PNT) Interface Specification for the Embedded Global Positioning System and Inertial Navigation System (EGI)	William R. Woodward	Apr 18, 2019
<a href="#">SAE1013</a>	Guidelines for Resilient GNSS Receivers	William R. Woodward	Apr 18, 2019
<a href="#">SAE1014</a>	Standard for Interfacing Resilient GNSS Receivers	William R. Woodward	Apr 18, 2019
<a href="#">SAE1015</a>	Improving the Accuracy, Availability, Integrity, Continuity, or Coverage of Positioning, Navigation, and/or Timing Solutions Using Raw Measurements from Global Navigation Satellite System (GNSS) Receivers	James L. Farrell	Apr 18, 2019
<a href="#">SAE9980</a>	Specification of The Transmitted Loran-C Signal	William Struth	Oct 19, 2018
<a href="#">SAE9991</a>	Receiver Standard for the Transmitted eLoran Signal (SAE9991)	William R. Woodward	Apr 18, 2019
<a href="#">SAE9992</a>	Introduction to the Operation and Use of the Transmitted Enhanced Loran (eLoran) Signal	William R. Woodward	Apr 18, 2019
<a href="#">SAE9993</a>	A Guideline for Using the Transmitted Enhanced Loran (eLoran) Signal for Timing, Phase, and Frequency	Steve Bartlett	Apr 18, 2019

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# Creating a PNT Workforce

- PNT resilience requires a skilled workforce.
- The rapid development of PNT technology places great challenges on educators to train and certify personnel in a timely way.



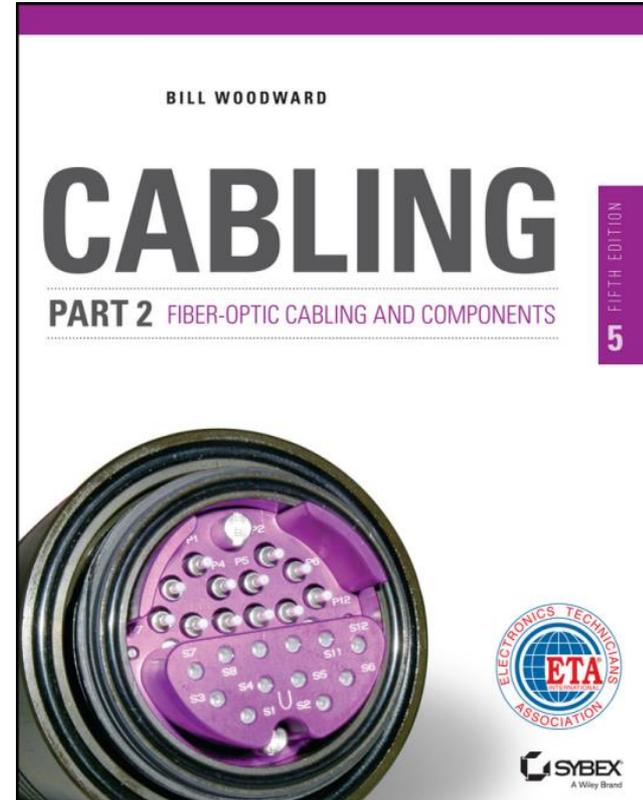
# Creating a PNT Workforce

- As PNT technology rapidly evolves, the intellectual property associated with that technology typically can only be found within a small group of subject matter experts located in various parts of the world.



# Creating a PNT Workforce

- The details of the technology do not typically find their way into the classroom until a textbook is published and the ancillary package is completed.
- With all the advances in publishing, this process can still take years and there is no guarantee that information available to instructors is complete.



# Following a Successful Model

- The Aerospace industry has always required the highest standards of workmanship to be maintained.
- 17 years ago, to ensure that the aerospace fiber optics industry adopted these same high standards, AS-3B created ARP5602, A Guideline for Aerospace Platform Fiber Optic Training and Awareness Education.

<b>SAE Aerospace</b> <small>An SAE International Group</small>	<b>AEROSPACE RECOMMENDED PRACTICE</b>	ARP5602/1	
		Issued	2007-10
A Guideline for Aerospace Platform Fiber Optic Training and Awareness Education Introduction to Aerospace Fiber Optics Knowledge Competencies			

#### RATIONALE

The Aerospace industry has always required the highest standards of workmanship to be maintained. To ensure that the Aerospace fiber optics industry adopts these same high standards, it's essential that minimum training and certification requirements be established. This document outlines the minimum training requirements for all personnel working or associated with fiber optic components or systems in accordance with aerospace industry best practices.

#### 1. SCOPE

This document establishes training guidelines applicable to fiber optic safety training, technical training and fiber awareness for individuals involved in the manufacturing, installation, support, integration and testing of fiber optic systems. Applicable personnel include:

Managers

Engineers

Technicians

Logisticians

Trainers/Instructors

Third Party Maintenance Agencies

Quality Assurance

Shipping

Receiving

Production

Purchasing

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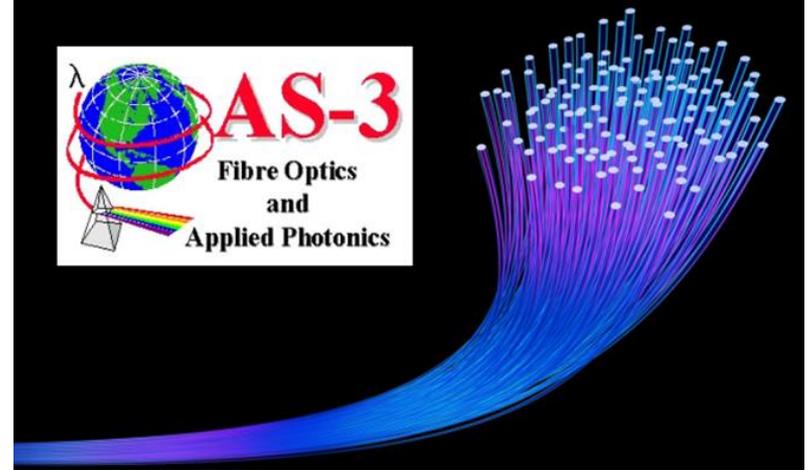
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# Following a Successful Model

- Working with SAE International the ARINC Airlines Electronic Engineering Committee (AEEC) published ARINC Report 807, Fiber Optics Training Requirements.



# Following a Successful Model

- ARINC Report 807 and ARP5602 apply to:
  - Managers
  - Engineers
  - Technicians
  - Logisticians
  - Trainers/Instructors
  - Third Party Maintenance Agencies
  - Quality Assurance
  - Shipping
  - Receiving
  - Production
  - Purchasing

**ARINC**

**FIBER OPTIC TRAINING REQUIREMENTS**

**ARINC REPORT 807  
FIBER OPTIC SET**

PUBLISHED: November 22, 2006

AN **ARINC** DOCUMENT  
Prepared by  
ARINC ELECTRONIC ENGINEERING COMMITTEE  
Published by  
ARINC/UTECAL, BAEHS, INC.  
2551 RIVA ROAD, ANNAPOLIS, MARYLAND 21401-7433

# Certifying a PNT Workforce

- ARINC Report 807, provides detailed knowledge and hands-on competencies for four certifications that include:
  - Aerospace Fiber Optic Fundamentals
  - Aerospace Fiber Optic Fabricator
  - Aerospace Fiber Optic Installer
  - Aerospace Fiber Optic Technician and Quality Assurance
- ARP5602 provides detailed knowledge and hands-on competencies for six certifications that include:
  - Introduction to Aerospace Fiber Optics
  - Aerospace Fiber Optics Fabricator
  - Aerospace Fiber Optics Installer
  - Aerospace Fiber Optics Technician
  - Aerospace Fiber Optics Quality Assurance Inspector
  - Aerospace Fiber Optics Engineer

# Certifying a PNT Workforce

- ETA International is the certification body for the SAE and ARINC certifications.



# Certifying a PNT Workforce

- Fiber optics training standards and certifications have worked extremely well for the global aerospace and avionics industries.
- PNT training standards are a natural fit for this successful model.
- PNT resilience requires a skilled workforce.
- Training standards and certifications ensure you contract with a skilled workforce.

The screenshot displays the ETA International website page for Fiber Optics and Data Cabling certifications. The page features the ETA logo and navigation links. The main content area is titled "ETA Fiber Optics and Data Cabling Certifications" and contains two side-by-side panels:

- ARINC Installer, Technician (AFI/AFT)**
  - ARINC organizes aviation industry committees and participates in related industry activities that benefit aviation at large by providing technical leadership and guidance. These activities directly support aviation industry goals: promote safety, efficiency, regularity, and cost-effectiveness in aircraft operations. ARINC recognizes ETA International as the fiber optics industry training certification entity in regards to the aerospace industry. The ARINC certifications are based on the ARINC 807-3 report and SAE International-recognized standards.
  - Additional Information**
    - ✓ FREE retake! ETA allows one free retake with all ETA certification exams after a 30-day waiting period.\*
    - ✓ ACCREDITED by the International Certification Accreditation Council (ICAC)
    - \*Does not apply to FCC exams. Retakes must be completed within one year of the first exam session.
- AFI/AFT Exam Info**

Price:	\$175
Type of Certification:	Stand-Alone
Maintenance Required:	Yes
Certification Term:	1 Yr
Hands-On Required:	Yes
Questions on Exam:	75
Passing Score:	75%
Time Allowed to Test:	2 hours

Buttons: Competencies - What's covered? (yellow), Find a test site (green)

# Questions & Contact Information

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