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Standard Guide for Aircraft Instrument Systems Technician Certification[1]

This standard is issued under the fixed designation F3526; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 The purpose of this guide is to address the basic fundamental subject knowledge activities and functions for avionics professionals to be titled Aircraft Instrument Systems (AIS) Technician.

1.2 This guide is the basis for the Aircraft Instrument Systems certification, an endorsement to the Aircraft Electronics Technician (AET) certification. Candidates must be a certified AET to take the certification exam associated with this guide.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F3060 Terminology for Aircraft

F3245 Guide for Aircraft Electronics Technician Personnel Certification

3. Terminology

3.1 See ASTM F3060, Standard Terminology for Aircraft.

3.2 See Table 1 for knowledge level definitions relating to the education requirements for AIS professionals.

4. Significance and Use

4.1 The guide is intended to be used to assess competencies of qualified individuals who wish to become certified as an AIS Technician through a certification program.

4.2 The guide is intended to be used in concert with a certification provider's structure and materials for management, exam delivery, and candidate preparation.

5. Test Knowledge Requirements

5.1 The following subject knowledge areas shall be assessed by levels (referenced in Table 1) of competency in the exam items.

5.2 *Risk Management – LEVEL 3*—Can describe in detail and perform tasks related to the following:

5.2.1 *Safety:*

5.2.1.1 See ASTM F3245, Standard Guide for Aircraft Electronics Technician Personnel Certification, Section 6, Core Competencies – Common Maintenance Practices, Fundamentals of On-Equipment Maintenance and Aircraft Fundamentals, Subsections 6.1, 6.2, 6.3, 6.6, and 6.13.

5.2.2 *Operational Considerations:*

5.2.2.1 Limitations related to testing pitot and static instruments including maximum vertical speed indicator limits and airspeed indicator differential pressure limits.

5.2.2.2 Proper and secure connection of air data test equipment to the aircraft to avoid inadvertent separation and subsequent damage to instruments.

5.2.2.3 Impact of using magnetic tools near magnetic sensitive devices to include compasses and magnetometers.

5.2.2.4 Safe operation of aircraft controls and control surfaces while testing/operating autopilot systems.

5.2.2.5 Proper operation of gyroscopic instruments to avoid damage caused by precession or gimbal lock, or both.

5.3 *General Aircraft Instrument System Theory of Operation – LEVEL 1*—Understands and can describe the following:

5.3.1 The purpose and function of sensors and displays used in aircraft instrument systems.

5.3.2 The theory of operation and the differences between direct-sensing instruments and remote-sensing instruments.

5.3.3 The categorization of instruments based on their function to include flight instruments, engine instruments, navigation instruments, and miscellaneous instruments.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Knowledge Level Definitions

Definition: Knowledge Level	
LEVEL 1	A familiarization with the principal elements of the subject. Objectives: • The applicant should be familiar with the basic elements of the subject. • The applicant should be able to give a simple description of the whole subject using common words and examples. • The applicant should be able to locate methods, procedures, instructions, and reference material. • The applicant should be able to use typical terms.
LEVEL 2	A general knowledge of the theoretical and practical aspects of the subject, and an ability to apply that knowledge in a practical manner. Objectives: • The applicant should be able to understand the theoretical fundamentals of the subject. • The applicant should be able to find and interpret maintenance data and information. • The applicant should be able to give a general description of the subject using, as appropriate, typical examples. • The applicant should be able to use mathematical formulae in conjunction with physical laws describing the subject. • The applicant should be able to read and understand sketches, drawings, and schematics describing the subject. • The applicant should be able to apply their knowledge in a practical manner using detailed procedures.
LEVEL 3	A detailed knowledge of the theoretical and practical aspects of the subject. To know, understand, and apply facts, principles, theories, and concepts. A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner. Objectives: • The applicant should know the theory of the subject and interrelationships with other subjects. • The applicant should be able to give a detailed description of the subject using theoretical fundamentals and specific examples. • The applicant should understand and be able to use mathematical formulae related to the subject. • The applicant should be able to read, understand, and prepare sketches, simple drawings, and schematics describing the subject. • The applicant should be able to apply their knowledge in a practical manner using manufacturer's instructions or other acceptable data. • The applicant should be able to interpret results from various sources and measurements and apply corrective action where appropriate. • The applicant should be able to perform all skill operations to a return-to-service standard using appropriate data, tools, and equipment. • The applicant should be able to perform inspections in accordance with acceptable or approved data.

5.3.3.1 The typical location and purpose of flight instruments to include those that make up the basic "T" configuration and the common "six-pack" configuration.

5.3.3.2 The typical location and purpose of engine instruments.

5.3.3.3 The types and purpose of navigation instruments.

5.3.3.4 The types and purpose of miscellaneous instruments.

5.4 *Pressure Measuring Instruments – LEVEL 2*—Understands and can apply the theory related to the following:

5.4.1 The theory of operation of pressure measuring instruments to include both direct-sensing and remote-sensing instruments.

5.4.2 The theory of operation of bourdon tubes used to sense and measure pressure.

5.4.3 The theory of operation of diaphragm/bellows used to sense and measure pressure.

5.4.4 The theory of operation of solid-state pressure sensing and measuring devices.

5.4.5 The various types of pressures sensed and measured in an aircraft to include absolute, gauge, differential, and standard reference atmospheric pressure.

5.4.6 The purpose, types, theory of operation, and markings of the following pressure measuring instruments:

5.4.6.1 Oil Pressure

5.4.6.2 Manifold Pressure

5.4.6.3 Engine Pressure Ratio

5.4.6.4 Fuel Pressure

5.4.6.5 Hydraulic Pressure

5.4.6.6 Vacuum Pressure

5.4.7 The theory of operation and applications for pressure switches.

5.4.8 The theory of operation of pitot-static systems.

5.4.8.1 The purpose and function of the pitot system and the basic instruments that use pitot pressure.

5.4.8.2 The purpose and function of the static system and the basic instruments that use static pressure.

5.4.8.3 The purpose and function of an alternate static system.

5.4.8.4 The basic flow of pressures in the pitot and static systems.

5.4.9 The purpose, function, and theory of operation of an Altimeter.

5.4.10 The purpose, function, and theory of operation of a Vertical Speed Indicator (VSI) and an Instantaneous Vertical Speed Indicator (IVSI).

5.4.11 The purpose, function, and theory of operation of a Variometer.

5.4.12 The purpose, function, and theory of operation of an Airspeed Indicator and a True Airspeed Indicator.

5.4.13 The purpose, function, and theory of operation of a Machmeter.

5.5 *Remote Sensing and Indication – LEVEL 2*—Understands and can apply the theory related to the following:

5.5.1 The theory of operation of d'Arsonval meter movements.

5.5.2 The theory of operation of various types of DC and AC synchro systems to include AutoSyns, Selsyns, and Magnesyns.

5.5.3 The application of remote sensing indication systems to include oil pressure, fuel pressure, and navigation indicators.

5.6 *Mechanical Movement Indicators – LEVEL 2*—Understands and can apply the theory related to the following:

5.6.1 The theory of operation of mechanical movement indicators to include both direct-sensing and remote-sensing instruments.

5.6.2 The theory of operation of various types of tachometers to include flyweight, drag-cup, and electric tach generator systems.

5.6.3 The theory of operation and use of a Synchroscope.

5.6.4 The theory of operation and use of an Accelerometer.

5.6.5 The theory of operation and use of the various types of Angle-of-Attack (AOA) and Stall Warning Systems to include reed-type, switch-type, and True Angle-of-Attack systems.

5.6.6 The integration of Angle-of-Attack systems with Stick Shaker and Stick Pusher systems.

5.7 *Temperature Measuring Instruments – LEVEL 2*—Understands and can apply the theory related to the following:

5.7.1 The theory of operation of various types of non-electric temperature indication systems to include bi-metallic strips and bourdon tubes.

5.7.2 The theory of operation of electric-type temperature measuring systems to include Wheatstone Bridge- and Ratiometer-type indicator mechanisms.

5.7.3 The theory of operation and purpose of a Total Air Temperature (TAT) system.

5.7.4 The theory of operation of thermocouple temperature indication systems.

5.7.5 The application of temperature measuring devices and mechanisms to various aircraft temperature measuring systems to include Turbine Gas Temperature, Exhaust Gas Temperature (EGT), Cylinder Head Temperature (CHT), and Turbine Inlet Temperature (TIT) systems.

5.8 *Direction Indicating Instruments – LEVEL 2*—Understands and can apply the theory related to the following:

5.8.1 The theory of operation and purpose of aircraft heading and direction indicating systems.

5.8.2 The theory of operation of liquid-filled magnetic compass, and vertical compass systems.

5.8.3 The various errors related to magnetic compasses, and the effect of the errors on indicated direction.

5.8.4 The theory of operation of a gyro-stabilized, slaved compass system using a flux-gate sensor.

5.8.5 The theory of operation of solid-state electronic compass systems using a magnetometer.

5.9 *Gyroscopic Instruments – LEVEL 2*—Understands and can apply the theory related to the following:

5.9.1 The various methods for powering gyroscopic instruments to include vacuum, pressure, and electric.

5.9.2 The theory of operation of various types of vacuum systems to include venturi, wet-pump, and dry-pump systems.

5.9.3 The theory of operation of pressure systems and the differences between pressure and vacuum systems used to power gyroscopic instruments.

5.9.4 The theory of operation of electrically powered gyroscopic instruments.

5.9.5 Gyroscopic principles to include rigidity in space and the factors affecting gyroscopic rigidity.

5.9.6 The effects of gyroscopic precession and its impact on the indications of gyroscopic instruments.

5.9.7 The theory of operation of various types of solid-state gyros to include Ring-Laser Gyros (RLGs) and Microelectromechanical Systems (MEMS) gyros.

5.9.8 The application of gyroscopic theory to various instruments in an aircraft to include vacuum-driven and electric attitude indicators, direction indicators, turn coordinators, and turn-and-slip indicators.

5.9.9 The purpose and categorization of autopilot systems to include 1-, 2-, and 3-axis systems.

5.9.10 The elements of an autopilot system to include sensing, computing, output, command, and follow-up elements.

5.9.11 The system components and their purpose that make up each element of an autopilot system.

5.9.12 The theory of operation and purpose of a flight director system.

5.10 *Electronic Instruments – LEVEL 2*—Understands and can apply the theory related to the following:

5.10.1 The theory of electronic instruments and how they differ from analog instruments of the same type.

5.10.2 The theory of operation of an Electronic Flight Instrument System (EFIS).

5.10.3 The theory of operation of an Electronic Attitude Direction Indicator (EADI).

5.10.4 The theory of operation of an Electronic Horizontal Situation Indicator (EHSI).

5.10.5 The purpose and architecture of an Electronic Flight Information System (that is, “Glass Cockpit”).

5.10.6 The theory of operation and purpose of an Electronic Centralized Aircraft Monitor (ECAM).

5.10.7 The theory of operation and purpose of an Engine Indicating and Crew Alerting System (EICAS).

5.10.8 The theory of operation and purpose of a Flight Management System (FMS).

5.10.9 The theory of operation and purpose of an Electronic Standby Instrumentation System (ESIS) and requirements for sustained operation following a loss of input power.

5.10.10 The theory of operation of various types of touchscreens to include capacitive- and resistive-touch display technologies.

5.11 *Warning and Caution Instruments – LEVEL 2*—Understands and can apply the theory related to the following:

5.11.1 The purpose of warning and caution indicating systems.

5.11.2 The purpose, function, and operation of the Master Caution annunciator.

5.11.3 The application of aural alerts used in conjunction with visual warnings and cautions.

5.12 *Time Measuring Instruments – LEVEL 2*—Understands and can apply the theory related to the following: