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ABSTRACT

This document reports on Phase I of a project that examined the occupation of avionics technician, established appropriate committees, and conducted task verification. Results of this phase provide the basic information required to develop the program standards and to guide and set up the committee structure to guide the project. Section 1 contains such general information as description of the occupation (nature of work, working conditions, related occupations), direction of the occupation (employment; training, other qualifications, and advancement; job outlook; earnings), avionics technology program developmental committee, areas of concern to the committee, and Program Developmental Committee recommendations. Section 2 provides research findings: accreditation and certification, typical job titles, and listings of appropriate trade resources--97 references and textbooks, instructional materials and sources, 11 periodicals and sources, audiovisuals, safety manuals and equipment, and sources of additional information. A verified duty and task list covers these areas: English, mathematics, physics, basic electronics, advanced electronics, overview of aircraft maintenance, avionics communications systems, Federal Communications Commission requirements, avionics microprocessors, avionics navigation systems, avionics shop practices, aircraft instrument system, and aircraft instruments. Other contents include a list of tools and equipment, tool kit, and information on staff and facilities. (YLB)

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AVIONICS TECHNOLOGY

PROJECT REPORT

PHASE I

WITH

RESEARCH FINDINGS

AVIONICS TECHNOLOGY CONTRACT

PROJECT REPORT

PHASE I

WITH

RESEARCH FINDINGS

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Table of Contents

SECTION ONE: General Information

Purpose of Phase I	2
Description of Occupation	3
Direction of Occupation	4
Avionics Program Development Committee	7
Areas of Concern	9
Program Development Committee Recommendations	10

SECTION TWO: Research Findings

Accreditation and Certification	12
Typical Job Title	13
Appropriate Trade Resources	14
Verified Duty and Task List	29
Tools and Equipment	34
Staff and Facilities	38

SECTION ONE

GENERAL INFORMATION

PURPOSE OF PHASE I

Phase I focused on researching the occupation, establishing appropriate committees, and conducting task verification. The results of this phase have provided the basic information required to develop the program standards and guide and set up the committee structure to guide the project.

The program is designed to address the needs of the avionics field that use or plan to use graduates as avionics technicians.

DESCRIPTION OF OCCUPATION

Nature of the Work

The ability to communicate quickly and easily is a necessity in modern society. Because communication is vital to a healthy economy, it is essential that communications systems operate properly. Installing, repairing, and maintaining the wide array of complex and sophisticated communications equipment are the responsibilities of communications equipment mechanics. Most communications equipment mechanics-sometimes referred to as telecommunication technicians-work either in telephone company central offices or on customers' premises installing and repairing complex telephone switching and transmission systems.

Other communications equipment mechanics include *instrument repairers*, sometimes referred to as shop repairers or shop technicians, who use handtools and power tools to repair, test, and modify communications equipment such as telephones, teletypewriters, and switchboards. In addition, they may paint various types of equipment and cut and weld iron for special work equipment.

Avionics technicians inspect and repair aircraft communication, navigation, and flight control systems.

Working Conditions

Because most communications systems operate 24 hours a day, 7 days a week, many communications equipment mechanics have work schedules that include shifts, weekends, and holidays. Where shift work is required, the assignments are made on the basis of seniority. To cope with any emergency that may arise, these workers are subject to 24-hour call. Mechanics generally work in clean, well-lighted, air-conditioned surroundings. Depending on the job, they may have to stand for long periods, climb ladders, and do some reaching, stooping, and light lifting. They also must take precautions to avoid electrical shocks. Some wear headsets most of the time and communicate with others over telephone circuits. Some headsets may produce a high-pitched, shrill noise known as "acoustic shock," which over a prolonged period may lead to hearing loss. Because much of the older communications equipment continually produces sounds, these workers must learn to "block out" noise.

Related Occupations

Other workers who have the skills needed to do technical, manual work with tools and electrical or electronic machines include computer service technicians, office machine repairers, biomedical equipment technicians, electronics technicians, electricians, telecommunications technicians, and sound technicians.

DIRECTION OF THE OCCUPATION

Employment

Communications equipment mechanics held about 109,000 jobs in 1986. Most worked for telephone and telegraph companies. A small number worked for cable television and related companies, as well as for railroad companies and electrical repair shops.

Training, Other Qualifications, and Advancement

In the past, trainees were selected from both inside and outside the company. However, since the deregulation of the American Telephone and Telegraph Company (AT&T) in 1984, this pattern has changed. In the new competitive environment, companies increasingly are reducing the size of their internal training programs and looking for workers who have developed these skills in another job or in the Armed Forces. For example, experience in data systems technology or computer maintenance is very good preparation for work with electronic switching systems. After relevant work experience, employers look for persons who have completed associate degree or postsecondary vocational school programs in telecommunications technology, electronics, computer maintenance, or related subjects. When enough applicants with these preferred credentials are not available, some companies still promote from within and provide training on company time. However, companies are trying to reduce operating costs by minimizing in-house training, and the trend is clearly toward phasing out such training altogether.

Persons considering a job as a communications equipment mechanic should have the analytical skills and judgment to resolve mechanical difficulties. Self-discipline is needed to follow detailed instructions without close supervision. Prospective workers should be able to work as part of a team, because cooperation with others often is essential in solving complex problems. Reading comprehension, logic, and arithmetic ability are necessary to understand company manuals and circuit wiring diagrams. Verbal skills are needed for those jobs that require contact with the public and coordination of activities with other employees.

Because wires usually are color coded, applicants must be able to distinguish colors. Physical strength and agility are needed for carrying equipment and climbing and working from ladders. These workers also need manual dexterity in order to handle small tools. Applicants generally must undergo a physical examination. For many jobs, driving may be necessary. If so, a valid State driver's license and a good driving record are required.

New workers may receive a combination of formal instruction and on-the-job training. More and more telephone companies are replacing their traditional classroom training programs with modular ones. Modular training programs include entry tests, videotapes, movies, computer terminals, and programmed workbooks that allow employees to learn new skills at their own pace, cover only the material they need, and provide tests upon completion of training. Trainees without experience or formal training gain practical experience by observing and helping experienced frame wirers. After 1 or 2 years of satisfactory performance, frame wirers may be selected to train for a more skilled job, such as trouble locator, central office repairer, or instrument repairer.

The more demanding repair jobs usually are filled by workers who have previous electrical or electronic experience or appropriate training. Communications equipment mechanics must continue to study throughout their careers. They receive periodic training to learn about new types of equipment, which may include electronic switching systems, data

transmission equipment, and picturephones. This training is offered by the employer or equipment manufacturers.

These workers have a number of opportunities for advancement, which usually involve further technical training. They may be promoted to jobs maintaining more sophisticated equipment, or to jobs as engineering technicians. Some advance to sales or personnel work.

Job Outlook

Employment of communications equipment mechanics is expected to decline through the year 2000 due to the tremendous productivity increases associated with computerization. Therefore, job openings will result exclusively from the need to replace workers who transfer to other occupations or leave the labor force.

The telephone industry is in the midst of a dramatic transformation from the traditional electromechanical system to a completely electronic one. This transition began some time ago and accelerated following deregulation in 1984. While this change has had an impact on practically all occupations in the telephone industry, among the most affected have been communications equipment mechanics. Employment of these workers is expected to decline because the new technology and equipment make each worker much more productive. For example, once a digital electronic switching system has replaced an electromechanical one, fewer service technicians are needed for maintenance and repair because the new systems are better and more reliable. Conversion to electronic switching requires fewer installers because much of this equipment is prefabricated and, therefore, is easier to install. It also permits a greater use of centralized maintenance. As telephone companies use more computer-based support programs to automate central offices, maintenance and repair personnel can be stationed at various control centers. Mobile crews of repairers then can provide the necessary modifications by rotating among several automated central offices. Considerably fewer maintenance and repair workers will be needed with centralized maintenance. Moreover, these new electronically equipped central offices use sophisticated, self-diagnosing test equipment that requires fewer repair and maintenance personnel. Such equipment detects the source of a problem and directs the technician to the defective part, which usually can simply be removed and replaced.

Decreased labor requirements in central offices have caused layoffs in recent years. As technology continues to displace communications equipment mechanics, competition for available openings should intensify, making it much more difficult for other telephone workers to move into these positions without experience or formal training and virtually impossible for "outsiders" without the necessary skills to compete for jobs.

Earnings

Wage rates for communications equipment mechanics vary by employer and locality: specific information may be obtained from local telephone companies. Central office installers, central office technicians, and PBX installers employed by AT&T and the Bell Operating Companies and represented by the Communications Workers of America earned an average weekly salary of $621 in 1986: frame attendants averaged $518. Central office telephone craft workers and PBX installers and repairers usually earn more than other communications equipment mechanics.

Most communications equipment mechanics are members of the Communications Workers of America or the International Brotherhood of Electrical Workers. For these

workers, union contracts determine wage rates, wage increases, and the time needed to advance from one step to the next. Contracts also require extra pay for work beyond the normal 8 hours a day or 5 days a week, and for all work on Sundays and holidays. Additional pay for nightwork is provided for in most contracts. Paid vacations are based on time in service. Generally, contracts provide for a 1-week vacation beginning with 6 months of service: 2 weeks for 1 to 6 years; 3 weeks for 7 to 14 years; 4 weeks for 15 to 24 years; and 5 weeks for 25 years and over. Depending on the locality, holidays range from 9 to 12 days a year. Other contract provisions include the following: Paid sick leave; group life, medical, and dental insurance; vision care; sickness and accident benefits; educational benefits; retirement and disability pensions; a savings plan; and an employee stock ownership plan.

The information presented in **Description of the Occupation** and **Direction of the Occupation** is adapted from public domain material, originally published in the *Occupational Outlook Handbook*, Bulletin 2300, by the Bureau of Labor Statistics, U.S. Department of Labor, Washington, DC 20212.

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AREAS OF CONCERN

The Program Development Committee expressed concern on the following items.

a. Most job applicants lack familiarity with aircraft maintenance requirements.

b. Job applicants with knowledge of avionics components often lack an understanding of systems operation and its interface with other aircraft systems.

c. The grouping of exact tasks which avionics technicians perform will be defined by the job location, i.e., flight line or hanger (shop); and, commercial, military or general aviation.

d. The Georgia standardized Electronics Technology is presently answering the need for avionics technicians who work in a shop environment or in general aviation.

e. This program must focus primarily on the commercial airline industry need for avionics technicians.

PROGRAM DEVELOPMENTAL COMMITTEE RECOMMENDATIONS

The committee recommended that:

a. this be a diploma program.

b. a program graduate with course work in this area should be called an avionic technician.

c. admission requirements be the same as those established in the approved Aviation Maintenance Technology standard.

d. the student should not enter specialized avionic course work until having completed introductory aircraft maintenance courses.

e. the specialization for the Avionics Technology program be developed to include competencies in the following areas:

1. General Aircraft Maintenance:

    a. occupationally related Mathematics
    b. occupationally related English
    c. occupationally related Physics
    d. aircraft structures
    e. aircraft maintenance regulations
    f. fluid, power and landing gear systems
    g. aircraft assembly and rigging

2. Avionic Systems:

    a. flight direction and autopilot
    b. aircraft navigational
    c. aircraft communication
    d. avionics maintenance techniques
    e. aircraft environmental control
    f. aircraft electrical
    g. aircraft instruments

SECTION TWO

RESEARCH FINDINGS

ACCREDITATION AND CERTIFICATION

There are no established national or state requirements for avionics program accreditation or certification. Depending upon the employer and the specific job duties some job applicants must meet Federal Communications Commission and/or Federal Aviation Administration certification requirements prior to entry into occupations in avionics.

The Avionics Technology program must conform to the institutional accreditation requirements of the Southern Association of Colleges and Schools by meeting Commission on Colleges (COC) or Commission on Occupational Education Institutions (COEI) accreditation requirements and must not conflict with the accreditation criteria established by COC or COEI.

TYPICAL JOB TITLES

Phase I research has included an examination of the occupational areas for the Avionics Technology field and has revealed one job title for which training may be required. The *Dictionary of Occupational Titles* code and title follow:

823.281-010 AVIONICS TECHNICIAN (aircraft-aerospace mfg.; air transportation) airplane-radio tester; radio-and-electrical mechanic; radio-equipment installer; radio-maintenance repairer.

Inspects, tests, adjusts, and repairs aircraft communication, navigation, and flight control systems: Tests and replaces defective instruments, such as microphones, headsets, dopplers, selcall, transceivers, transponders, and autopilots, using electricians' tools, circuit analyzers, oscilloscopes, and other testing devices. Calibrates installed or repaired equipment to prescribed specifications. Signs overhaul documents for signaling ground station and turning setscrews. Required to hold Radiotelephone License issued by Federal Communications Commission or Federal Aviation Agency.

APPROPRIATE TRADE RESOURCES

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APPROPRIATE TRADE RESOURCES

Instructional Materials

The following materials are available from:

Mid-American Vocational Curriculum Consortium
1500 West Seventh Avenue
Stillwater, OK 74074-4364
1-800-654-3988

Format: Teacher's Guide, Student Manual, Transparency Set

Basic Electronics 1986
General Electronics Technician 1986
Communications Electronics 1988

APPROPRIATE TRADE RESOURCES

Instructional Materials

Source: Curriculum Instructional Materials Center
1500 West Seventh
Stillwater, OK 74074-4364

Titles: Aviation Mathematics and Physics

Format: Teachers Manual, Student Manual

Title: Fundamentals of Aircraft Maintenance

Format: Teacher Manual, Student Manual

Title: Fundamentals of Regulators, Publications, and Records

Format: Teacher Manual, Student Manual

Title: Technical Mechanics, Including Ground Handling and Servicing, Hand Power Tools and Precision Measuring Instruments, Aircraft Hardware, Fabrication and Installation of Rigid and Flexible Fluid Lines, and Computation and Recording of Aircraft Weight and Balance.

Format: Teacher Manual, Student Manual

Title: Aviation Electricity & Electronics

Format: Teacher Manual, Student Manual

Title: Aviation

Format: Competency Procedures

Title: Aviation Maintenance Technology

Format: General Section Implementation Guide

Title: Sheet Metal Structural Repair

Format: Teachers Manual, Student Manual

APPROPRIATE TRADE RESOURCES

Periodicals

AMFI Industry News

Aviation Maintenance Foundation, Inc.
Box 2826
Redmond, WA 98073

Aerospace Products

Gordon Publications Inc.
Box 1952
Dover, NJ 08801

Air Transport World

Penton Publishing, Reinhold Division
600 Summer St. Box 1361
Stamford, CT 06904

Aviation Equipment Maintenance

Irving-Cloud Publishing Co.
7300 N. Ciero Ave.
Lincolnwood, IL 60646

Aviation Mechanics Bulletin

Flight Safety Foundation Inc.
5510 Columbia Place
Arhington, VA 22204-3194

Avionics

Atlantic Communications, Inc.
Executive Air Center, Braimaid Airport
Hartford, CT 06114-1609

Avionics News Magazine

Aircraft Electronics Association
Box 1981
Independence, MO 64055

APPROPRIATE TRADE RESOURCES

Periodicals continued

Directory of Aviation and Space Education

American Society for Aerospace Education
1810 Michael Faraday Dr. No 101
Reston, VA 22090-5391

International Aviation Mechanics Journal

Aviation Maintenance Publishers, Inc.
Box 36
Riverton, WY 82501-0036

Overview of the FAA Engineering & Development Programs

U.S. Federal Aviation Administration
800 Independance Ave. S.W.
Washington, D.C. 20591

PAMA News

Professional Aviation Maintenance Assocation
500 Northwest Plaza Suite 912
St. Ann, MO 63074

APPROPRIATE TRADE RESOURCES

Audiovisuals

The following materials are available from:

Vocational Media Associates
Box 1050
Mount Kisco, NY 10549-0050
1-800-431-1242

Format: Filmstrip-on-video or Filmstrip

Titles: Electrical Circuits
Components of AC Circuits
Measuring Electrical Quantities
Safety at Work

Format: Filmstrip

Titles: Introduction to Electricity
Fundamentals of Alternating Current
Discovering Electricity
Solving Basic DC Circuit Problems
Safety in Electrical Work
Tools and Equipment
Electric Motors
Electrical Fundamentals
Electrical Safety: Systems and procedures

Format: Filmstrips or Sound Slides

Titles: Power Supplies and Amplifiers
Basic Electronics
Electronic Test Equipment

APPROPRIATE TRADE RESOURCES

Audiovisuals

The following materials are available from:

Bergwall Productions, Inc.
P.O. Box 238
Garden City, NY 11530-0238
1-800-645-3565

Format: Video

Titles Multimeters Explained
Basic Electricity: Direct Current
Understanding Digital Electronics

Format: Computer Assisted Instruction

Titles: Basic Electricity and Electronics: Direct Current
Basic Electricity and Electronics: Alternating Current
Digital Codes and Numbering Systems

Format: Filmstrip

Titles: Basic Electricity and Electronics: Direct Current
Basic Electricity and Electronics: Alternating Current
Basic Electronic Test Instruments
Micro Computer Circuits Explained
Soldering for Electronic Repair
Microchip Technology
Programmable Controllers Explained
Basic Electricity and Electronics: Reactive Circuits
Electronic Power Supplies
Transistors
Transistors II
Digital Electronics Explained
Digital Electronics Explained II
Rotating Machinery Explained: DC Motors
Rotating Machinery Explained: Motor Control Fundamentals
Solid-State Motor Control
Tools for the Electrical Trades
Digital Codes and Numbering Systems Explained

APPROPRIATE TRADE RESOURCES

Audiovisuals

The following materials are available from:

American Association for Vocational Instructional Materials
120 Driftmeir Engineering Center
Athens, GA 30602
1-800-228-4689

Format: Videotape

Titles: Basic Electric Circuits (VHS-26 min.)
Semi-Conductor Materials and Diodes (VHS-25 min.)
Bipolax Transistors (VHS-34 min.)

Format & Code: Manual (M) Teacher guide (TG) Student workbook (SW)
Filmstrip (F) Slides (S) Transparency masters (TM) Teacher key (TK)

Titles: Understanding Electricity and Electrical Terms (M, TK, S)
Electric Motors (M, TG, SW, S, TM)
How Electric Motors Start and Run (M, S, F)
Developing Shop Safety Skills (M, TC, SW, S)

APPROPRIATE TRADE RESOURCES

Safety Manuals

Bartsch, J.H. (1987). *School materials safety manual.* Schenectady, NY: Genium.

Safety Equipment

Michigan First Aid and Safety Co.
22900 E. Industrial Dr.
St. Clair Shores, MI 48080
1-800-221-9222
FAX (313)774-2760

APPROPRIATE TRADE RESOURCES

Sources of Additional Information

For more details about employment opportunities, contact commercial, general aviation companies and military agenicies that have need for avionics technicians.

Information about jobs in a particular airline may be obtained by writing to the personnel manager of the company. For addresses of airline companies and information about job opportunities and salaries, contact:

Future Aviation Professionals of America
4291 J. Memorial Dr.
Atlanta, GA 30032

For general information about aircraft mechanics, write to:

Aviation Maintenance Foundation
P.O. Box 2826
Redmond, WA 98073

Professional Aviation Maintenance Association
P.O. Box 248
St. Ann, MO 63074

For information on jobs in a particular area, contact employers at local airports or local offices of the state employment service.

AVIONICS TECHNOLOGY
VERIFIED TASK LIST

DUTY A: ENGLISH

01 **Use standard grammar for oral and written presentations.**
02 **Identify writing techniques for correspondence.**
03 **conduct research of occupational resources.**
04 **prepare technical reports.**

DUTY B: MATHEMATICS

01 Algebraic Functions & Powers of Ten.
02 Trigonometry.
03 Vectors, Exponents, & Phaser Algebra.
04 Algebraic Fractions & Logarithms.
05 **Quadratic Equations. (MOVED HERE FROM DUTY M)**
06 **Network Simplification.(MOVED HERE FROM DUTY M)**

DUTY C: PHYSICS

01 Measurement, Force, Energy, & Machines.
02 Atoms, Solids, Liquids, Gases & Temperatures.
03 Heat, Sound, & Light
04 **Dissimilar metals** (ADDED)

DUTY D: (DROPPED)

04 (DROPPED) Aircraft power distribution

DUTY E: BASIC ELECTRONICS (TITLE CHANGED)

01 Safety, Basic Electricity, & Batteries.
02 Magnetism, Basic AC, & Measuring Instruments.
04 Reactive Circuits.
05 Vacuum Tube Theory.
06 Solid State Theory, Diodes, & Transistors.
07 Soldering Practices.
08 **Electronic** Symbols & Schematics.

DUTY F: (TITLE CHANGED) ADVANCED ELECTRONICS

01 Special Purpose Solid State Devices.
02 Operational Amplifiers & Pulse Circuits.
03 Power Supplies & Regulators.
04 **Electronic** Test Equipment.
05 Radio Systems & Typical Amplifiers.
06 Amplitude Modulation.
07 AM Receivers [**& Intro to Basic Avionics. (MOVED TO DUTY I)**]
08 **(DROPPED)**Avionics II Lab Experiments.
09 **Frequency Modulation. (MOVED HERE FROM DUTY I)**
10 **Antennas & Transmission Lines. (MOVED HERE FROM DUTY I)**
11 **Logic Devices. (MOVED HERE FROM DUTY K)**
12 **Introduction to D-A & A-D Concepts. (MOVED HERE FROM DUTY K)**
13 **Introduction to Digital Computers. (MOVED HERE FROM DUTY K)**

DUTY G: (TITLE CHANGE) OVERVIEW OF AIRCRAFT MAINTENANCE

01 Inspection, Corrosion Control, Hardware, & Federal Aviation Regulations.
02 Hydraulics, Pneumatics, Position, Protection and Indicating Systems.
03 Aircraft Instrument Systems.
04 **Aviation Basics, and Weight & Balance. (MOVED HERE FROM DUTY D)**
05 **Aircraft Drawing & Blueprint Reading. (MOVED HERE FROM DUTY D)**
06 **Aircraft Power Systems, DC & AC. (MOVED HERE FROM DUTY E)**
07 **Introduction to Digital Concepts. (MOVED HERE FROM DUTY H)**
08 **Combinatorial Logic & Logic Families. (MOVED HERE FROM DUTY H)**
09 **Sequential Logic & Arithmetic Circuits. (MOVED HERE FROM DUTY H)**
10 **(ADDED) Fluid lines and fittings.**

DUTY H: (DROPPED - CONTENT MOVED/DELETED) DIGITAL TECHNIQUES I

04 **(DROPPED)Digital Techniques I Lab**

DUTY I: (TITLE CHANGED) AVIONICS COMMUNICATIONS SYSTEMS

03 **(DROPPED)** Citizens Band Radio Theory.
04 HF Communications **(DROPPED) & E L Ts.**
05 VHF Communications.
06 **(DROPPED) Primary (MOVED TO DUTY N)** Navigational Principles.
07 **(DROPPED)** AM/FM Lab Experiments.
08 **(DROPPED)** AM/FM Radio Kit Construction.
09 **(DROPPED)** CB Radio Shop Practices.
10 **Introduction to Basic Avionics. (MOVED HERE FROM DUTY I)**
11 **Aircraft Public Address Systems. (MOVED HERE FROM DUTY P)**

DUTY J: [(ADDED) F A A AND] F C C REQUIREMENTS

01 Maritime Law, Voice Communications, and Broadcast.
02 **Federal Aviation Requirements (REPLACES)** F C C Practice Exams.
03 **Documentation**

DUTY K: (CONTENT MOVED TO DUTY F) DIGITAL TECHNIQUES II

DUTY L: (TITLE CHANGE) AVIONICS MICROPROCESSORS

01 Introduction to Microprocessor Architecture & Instruction.
02 Machine/assembly Language Programming.
03 **(DROPPED)** Microprocessors I Lab Experiments.
04 **Microprocessor Programming & Interfacing. (MOVED HERE FROM DUTY O)**
05 **Advanced Input/Output & Peripheral Interface Adapters. (FROM DUTY O)**
06 **(DROPPED) Microprocessor Interfacing Lab Experiments. (FROM DUTY O)**
07 **D-A & A-D Conversion With Microprocessors. (MOVED HERE FROM R)**
08 **Sensors & Transducers. (MOVED HERE FROM DUTY R)**
09 **Control Devices & Actuators. (MOVED HERE FROM DUTY R)**
10 **Microprocessors III Lab Experiments. (MOVED HERE FROM DUTY R)**

DUTY M: ADVANCED MATHEMATICS (moved to DUTY B, mathematics)

DUTY N: (TITLE CHANGE) AVIONICS NAVIGATION SYSTEMS

01 Marker Beacon & ADF.
02 Radar & Microwave Principles.
03 ATC Transponders.
04 DME & RNAV Systems.
05 Pitot-Static & Air Data Systems.
06 Gyroscopic Principles & Instruments.
07 Basic Controls.
08 Avionics Shop/Lab Practices.
09 **Navigational Principles. (MOVED HERE FROM DUTY I)**
10 **(ADDED) V H F Navigation systems**
11 **EFIS, IEICAS, Databus Systems, & Fiber Optics.**
12 **Weather Avoidance BITE, ARINC Systems.**
13 **Radar Altimeters.**
14 **Ground Proximity Warning Systems.**
15 **Microwave Landing Systems.**
16 **Automatic Flight Control Systems.**
17 **Inertial Navigation Systems.**
18 **Laser Navigation Systems.**

DUTY O: (CONTENT NOW IN DUTY L) MICROPROCESSORS II

DUTY P: (CONTENT TO OTHER DUTIES) Avionics V (Avionics Status Systems)

DUTY Q: AVIONICS SHOP PRACTICES

01 Basic Avionics Systems.
02 Advanced Avionics Systems.
03 Equipment Repair.
04 Radio Repair Station Practices.
05 **Shop Management. (MOVED HERE FROM DUTY P)**

DUTY R: (CONTENT MOVED TO DUTY I) MICROPROCESSORS III

DUTY S: (DROPPED) INTRODUCTION TO AIRCRAFT INSTRUMENT SYSTEM

01 **(DROPPED)** Review of Physics Concepts.
02 **(DROPPED)** Characteristics of the Atmosphere.
03 **(DROPPED)** Pitot-Static System Review.
04 **(DROPPED)** Development of Common Mechanical Concepts.
05 **(DROPPED)** Review of Common Electrical Concepts.
06 **(DROPPED)** Review of Common Electronic Concepts.
07 **(DROPPED)** ATA & ARINC Standards.

DUTY T: (DROPPED) FLUID LINES AND FITTINGS

DUTY U: (CONTENT MOVED OR DELETED) MECHANICAL INSTRUMENTS

05 (DROPPED) Altimeters.
06 (DROPPED) Vertical Speed Indicators.
07 (DROPPED) Airspeed Indicators.
08 (DROPPED) Pitot-Static & Air Data Systems.

DUTY V: (TITLE CHANGED) AIRCRAFT INSTRUMENTS

01 Basic Common Electrical Indicator Movements.
02 Electrical Temperature Indicators.
03 Self-Synchronous Indicating Systems.
04 Electrical Flowmeters.
05 Electrical Angle-of-Attack & Stall Warning Systems.
06 Remote-Indicating Compasses.
07 Turn & Bank/Turn & Slip Indicators.
08 Directional Gyros.
09 Horizon Gyros.
10 Vertical Gyros.
11 Rate Gyros.
12 **Instrument Panel configuration. (MOVED HERE FROM DUTY D & MODIFIED)**
13 **Basic Pressure Gauges. (MOVED HERE FROM DUTY U)**
14 **Mechanical Temperature Indicators. (MOVED HERE FROM DUTY U)**
15 **Direct-Reading Fuel Quantity Gauges. (MOVED HERE FROM DUTY U)**
16 **Direct-Reading Tachometers. (MOVED HERE FROM DUTY U)**
17 **Electronic Tachometers.**
18 **Servo-Type Altimeters.**

AIRCRAFT INSTRUMENT (CONTINUED)

19 Capacitive Type Fuel Quantity Indicator Systems.
20 Attitude Director Indicators (ADI).
21 Compass Direction Indicators (CDI).
22 Flight Director Systems and Indicators (FDI).
23 Radio Magnetic Indicators (RMI).
24 Engine Analyzers.

DUTY W: (CONTENT TO DUTY V OR DROPPED) ELECTRONIC INSTRUMENTS

09 **(DROPPED)** Engine Indication and Crew Alerting System (EICAS).

DUTY X: (DROPPED) INSTRUMENT SHOP PRACTICES

01 **(DROPPED)** Fluid Lines & Fittings.
02 **(DROPPED)** Mechanical Instruments.
03 **(DROPPED)** Electrical Instruments.
04 **(DROPPED)** Gyroscopic Instruments.
05 **(DROPPED)** Electronic Instruments.

TOOLS AND EQUIPMENT

AC generators and controls
AC motors
acetone
air compressor
air filler fittings
air hose, fluid line
air pressure regulator
air transformer
aircraft chocks
aircraft control surfaces
aircraft fire detection and extinguishing system
aircraft fuelage, fins, and stabilizer
aircraft metal
aircraft oils and grease
aircraft prints
aircraft rivets
aluminum tubing
amp meter
anti-icer fluid
audio-visual equipment
auger bit files
auger bits
auxiliary power unit
aviation fuels
aviation snips
axial flow jet engine
bar folder
basic hand tools
battery cart
battery charger
battery test equipment
beading machine
Bendix magneto overhaul tools
bolt gage
booster coils
bore scope power saws
box brake
brake and wheel mock ups
brake bleeder pot
brazing rod
bucking bars
bungee shock cords
cable
cable splicing clamps and tools
cable swagine tools
cable thimbles
capacitor tester
carbon-pile generator controls
carburetors
centrifugal flow jet engine
chalk line
chemical inspection kits
clamps
cleaning agents
cleco fasteners
cold cylinder indicator
compression tester
conrnish break
copper tubing
counter sinks
counter weight propeller
cutting torch
DC motors
depth gages and dial indicators
dial bore gage
dimpling tools
dopes thinners
drafting equipment
drill motors, bits, and files
drill press
dry sump engines
dzus fasteners
electric step-head governors
electrical propellers
electrical terminals
electronics teaching aids and boards
enamel paint
enamel thinner
engine instruments
etching material
exhaust systems
FAA forms
fabric tester
fastener installing tools
fiberglass
50' tape
finishing tape
fire extinguishers
fixed pitch metal propeller

fixed pitch wood propeller
flashlights
flexible hose
flow bench
flux
forming roll
fuel injection systems
fuel pump test stand
fungicidal dope
generator and control test stand
generator mock-up board
glass bead blaster
grease
grease gun
grease pencils
grinding wheel
grommets
ground adjustable propeller
hack saws
Hamilton Standard propellers, hydromatic
Hamilton Standard removal tools
hardness tester
hardwood for forming metal
harness tester
hi shear rivets
high tension Bendix magnetos, 1200 series
high tension Bendix magnetos, 200 series
high tension Bendix magnetos, 54 & 56 series
high tension Bendix magnetos, SF series
high tension Eiseman magnetos
high tension Slick magnetos
honeycomb structure
humidity indicator
hydraulic fluid
hydraulic lines
hydraulic mock-up board
hydraulic seals
induction system cutaways
induction vibrators
inspection forms
inspection mirrors
inspection rings
instrument cutaways
instrument test bench
instrument test stand
jacks
jointer
landing gear cutaway
layout dye
lettering stencil
leveling equipment
lever
live aircraft
log books
low tension Bendix magnetos, 600 series
M. ethyl ketone
magnaflux machine
magneto test stand
masking tape
metal cutting band saw
micrometers
miter box and saw
mock-up board of aircraft electrical system
multimeters
nails and screws
natural aspirated engines
oil cooler
oil cooler test bench
oil dilution system
oil tanks
opposed engines
oscilloscope
oven
oxygen mask
oxygen regulator
oxygen tank
paint strainers
penetrant inspection kits
plastic cement and plastic cleaner
plexiglass
plumb bobs
portable torch dead weight tester
pressure pot spray gun
prop protractor
propeller bench
propeller bench protractor

propeller portable blade
protractor
pulley
radial engines
respirators
rigging pins
right angle drill attachment
rigid line flaring equipment
riv-nut installing tools
rivet cutters
rivet squeezer
riveting guns
rotary shear
rotary wing aircraft
safety goggles
safety wire, locking devices,
and cotter keys
sander
sandpaper
saw horses
scales
schematics
selection of aircraft hardware
and components
sheet metal screws
shrinking machine
signal generator
silver solder, soft solder
single and double magnetos
slitting shear
soldering copper and flux
soldering irons
spar varnish
spark plug cleaner and tester
spark proof paint room
special engine tools
spirit level
squaring shear
stainless steel tubing
stakes
steam cleaner
stranas and hoist
strut pump
suction cup spray gun
switches and relays
taps and dies
telescoping gages
tensiometer

TOOL KIT FOR
AVONICS TECHNICIANS

Safety goggles
Spring dividers
7" diagonal cut pliers
6" needle nose pliers
Service mirror
3-Drawer tool chest
1/2" dr. flex handle 15"
1/2" dr. 7/8 deep socket
Hex wrench set 20 pc
Pliers wire cutter 8"
Arc joint pliers
8 oz. ball pein hammer
Plastic tip hammer
#1 phillips screwdriver 3"
#2 phillips screwdriver 4"
Reed/Prince screwdriver
Stubby screwdriver
17 pc set - combination wrenches
9 pc punch and chisel set
3 pin punches
3/8 center punch, 4 cold chisels
5/32 pin punch
3/16 pin punch
1/4 dr. socket std. 12 pt. 1/4"
1/4 dr. socket std. 12 pt. 3/16"
1/4 dr. socket std. 12 pt. 7/32"
1/4 dr. socket std. 12 pt. 9/32"
1/4 dr. socket std. 12 pt. 5/16"
1/4 dr. socket std. 12 pt. 11/32"
1/4 dr. socket std. 12 pt. 3/8"
1/4 dr. socket std. 12 pt. 7/16"
1/4 dr. socket std. 12 pt. 1/2"
(9/16" size see 3/8" drive
1/4" dr. quick release ratchet)
1/4" dr. socket (see 1/4" dr.) 1/4"
3/8 dr. socket std. 12 pt. 3/8"
3/8 dr. socket std. 12 pt. 7/16"
3/8 dr. socket std. 12 pt. 1/2"
3/8 dr. socket std. 12 pt. 9/16"
3/8 dr. socket std. 12 pt. 5/8"
3/8 dr. socket std. 12 pt. 11/16"
3/8 dr. socket std. 12 pt. 3/4"
3/8 dr. socket std. 12 pt. 13/16"
16" speed handle
3" ext 3/8 dr
5" ext 3/8 dr
10" ext
Quick release ratchet
1/4" socket rack
3/8" socket rack
Right snips
Left snips
Straight snips
Combination square
Multi-tester
Flat smooth file, 10"
1/2 round file, smooth 10"
Hacksaw

STAFF

It is anticipated that the revision to the program standards and the program guide developed as a result of this project will not change present staffing levels and certification requirements.

FACILITIES

The State Technical Committee members recommended that facilities be maintained in accordance with or exceed industry standards for the consumer electronics field and those established in the Institutional Standards and General Program Standards.