

International AME Practical Skill

(Adapted from ICAO AME Training Standards.)

For over two decades, aviation maintenance employers outside the major airlines have identified the failure of competency based training to provide the practical skills needed by the industry. This training deficiency came about when the federal government stopped promulgating national training syllabi for aircraft maintenance engineers based on ICAO training standards thinking NVET competency based training would encompass industry wide training. Without a federal syllabi, training went back to State government apprenticeship skilling that are local industry based outcomes. Instead of industry wide transportable skills, local RTOs geared their training to meet the needs of the largest employer and not the industry. The following are the international standards for practical skills that should be completed before the students begin working on airworthy aircraft, engines or equipment. **This is pre-employment training.**

Chapter 10 (ICAO Manual)

PRACTICAL MAINTENANCE SKILLS: AIRFRAME

10.1 INTRODUCTION (chapters 11 (engines) & 12 (avionics) virtually the same)

- 10.1.1** In order to be able to satisfactorily assimilate the training on individual aircraft and systems, the Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs) must have good fundamental practical skills and understand the maintenance processes and principles generally used in aircraft hangars and workshops.
- 10.1.2** In order to be able to perform or supervise “hands-on” tasks of mechanic/technician on the aircraft, the aircraft engines and systems, the AME must have a very complete knowledge of all the tools and associated maintenance processes that are likely to be used in hangars and workshops.
- In order to be able to perform or supervise “hands-on” tasks of mechanic/technician on the engines, propellers and systems, the AME must have a very complete knowledge of all the tools and associated maintenance processes that are likely to be used in hangars and workshops
- 10.1.3** For future aircraft hangar and workshop technicians, their basic workshop training should commence with *Phase Two — Skills* and should be completed before the students begin working on airworthy aircraft, engines or equipment in *Phase Three — Experience*. For this purpose, the Performance parameters required to meet the Training Objectives outlined in 10.2 of this chapter are divided into two sections: Section a) requires basic manual skills and Section b) refers to the application of these skills to non-airworthy aircraft, components or specially-designed practice rigs. The level of manual skills to be developed also varies according to the category of technicians being trained. For example, bench fitting is of importance to all categories of technicians, while radio technicians may require skills in soldering but they only need an introduction to welding.
- For this purpose, the Performance parameters required to meet the Training Objectives outlined in 11.2 of this chapter are divided into two sections: Section a) requires basic manual skills and Section b) refers to the application of these skills to non-airworthy engines, propellers, components or specially designed practice rigs. The level of manual skills to be developed varies according to the category of technicians being trained. For example, bench fitting is of importance to all categories of technicians, while radio technicians may require skill in soldering but they only need an introduction to welding.
- 10.1.4** The recommended facilities, tools and equipment are described in Appendix 1 to this chapter.

10.2 TRAINING OBJECTIVES

Conditions:

The trainees will be provided with appropriate facilities; tools (both hand and machine); materials; a selection of airframe assemblies, component or parts; specially- made repair, assembly and rigging test exercises. (See Appendix 1 to Chapter 10.)

Performance:

- a) The trainees will practice repair schemes on airframe components as well as assemble and adjust test exercise pieces and/or assemblies by using simple engineering drawings and aircraft maintenance test (real or simulated).
- b) The trainees will practice fault finding, dismantling, inspecting, repairing, decision-making regarding repair or replacement, reassembly and testing. They will also use engineering drawings as well as engine manufacturers’ maintenance, overhaul and repair manuals.

Standard of accomplishment:

During workshop training, the standard is a function of the variety of exercises completed and the time spent in workshop training. The trainees/students should work individually on airframe exercises so that they have “ownership” of the standard. If necessary, they should practice and repeat increasingly complex exercises to develop greater manual skills within their respective areas of competence. Finally, they should carry out tests or operate the system exercise rigs.

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10.3 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AIRFRAME

10.3.1 Introduction

- a) Training in workshop practice should begin with exercises in the use of hand tools to make a series of simple shapes to specified dimensions from various metals. Each shape should be progressively more complicated with more precise tolerances. From the start, instructors should ensure that students develop the habit of handling basic hand or machine tools in the correct manner, and action should be taken to correct any bad or potentially dangerous practices before they become habitual. At all times, and particularly during the early stages of training, the importance of producing accurate and careful work must be stressed. These exercises can be used to develop the trainees' inspection ability, i.e. the necessary judgement and sense of responsibility required to assess the accuracy of their own work and that of others.
- b) It is desirable that licensed AME students should have the opportunity to remove and replace major components. Practice in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase.

10.3.2 Bench fitting

- Cutting and filing: exercises in cutting metal with hacksaws; filing; drilling; drill grinding; thread cutting with taps and dies; and scraping
- Measurements: use of steel rule, dividers, calipers, micrometers, vernier, combination set, surface plate, and dial test indicator

10.3.3 Forging, heat treatment, soldering and welding

- Forging by hand simple specimens such as chisels, punches and others
- Hardening and tempering carbon steel by using forge
- Tin soldering, tin-plating, and use of proper flux
- Silver soldering and brazing
- Welding: oxyacetylene and metallic arc welding of different materials
- Inspection of welded joints for flaws

10.3.4 Sheet metal work

- Sheet aluminium alloy: cutting, marking out, drilling, forming, bending, bending allowances, shrinking and flashing
- Forming sheet metal by pressing and rolling
- Riveting: types of rivets, riveting with hand

tools, rivet spacing, countersinking and dimpling

- Use of pneumatic riveting hammer
- Blind riveting
- Inspection of rivets, removal of rivets, use of oversized rivet and rivet jackets
- Tube work: use of taper pins and tubular rivets
- Exercises in sheet metal patching and repair work
- Heat treatment of aluminium alloy and alloy rivets: use of salt baths and furnaces; annealing and solution treatment

10.3.5 Machine shop

- Drilling: using machine drills to drill close tolerance holes in various materials; reaming holes to close tolerances; others
- Turning: exercises in turning steel, aluminium alloy and brass parts; use of lathe for thread cutting; others
- Grinding: use of grinding wheels for tool sharpening

10.3.6 Woodwork

- Cutting and smoothing of wood: marking out, sawing and planing wood, and exercises in woodwork involving tenon and scarf joints
- Selection of aircraft woods: defects of timber, timber, tests for moisture content, and straightness of grain
- Plywoods and laminated woods: bending, patching, and standard repairs to aircraft woodwork
- Gluing: approved glues (casein and synthetic resin); mixing; uses; drying times
- Varnishing and protection of aircraft woodwork
- Environmental aspects

10.3.7 Wire and cable work

- Inspection of aircraft cables for defects
- Splicing exercises
- Swagging exercise: attachment of standard end fittings to flying control cables
- Demonstration of proof test on flying control cable

10.3.8 Tube Work

- Tube bending, with or without heat treatment
- Tube flaring
- Fitting of different kinds of unions used in fuel, oil and hydraulic systems
- Inspection and testing of tubes and flexible hoses

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10.3.9 Airframe familiarization

- Airframe structures: detailed examination of various types of wing and fuselage construction, including primary and secondary structures
- Use of forged, extruded, cast and sheet material
- Main joints: methods of riveting, spot welding, and adhesive bonding
- Doors and cut-outs, positions of inspection panels, removal of fairings, and methods of gaining access to all parts of structure
- Landing gear: examination of control system; checking of control surface movements and cable tensions; interconnections of autopilot to control systems; examination (by visiting airline, if necessary) of power-operated control systems

10.3.10 Ground handling of aircraft

- Pre-flight inspection with aircraft on apron
- Starting and running of engines and auxiliary power unit (APU); observation of instrument readings; function check(s) of electrical components and radios; stopping of engines
- Compass swinging and automatic direction finder (ADF) loop swinging
- Use of ground equipment for moving, lifting or servicing aircraft

10.3.11 Installation and testing of equipment

- Removal, replacement, in situ inspection, and function testing
- Testing for leaks, errors and electrical faults of electrical equipment, instruments, autopilots, communication and navigation equipment as appropriate

10.3.12 Small aircraft

- Dismantling of aircraft: removal of engine, control surfaces, landing gear, wings, tail plane and fin, and seats
- Inspection: inspection of condition of fuselage alignment checks, freedom from distortion, and symmetry
- Checking of wings and other airframe components for condition, and freedom from distortion
- Reassembly of aircraft: replace wings, empennage, control surfaces, and engine; check rigging angles of wings and tail plane; adjust flying controls and check control surface movements; replace landing gear and check alignment track

10.3.13 Fabric and dope

- Exercises in covering frames with hand-sewn

fabric; doping; stringing; repairing cuts in fabric; patching

10.3.14 Wheels and tyres

- Complete wheel assemblies: dismantling, inspection (including crack detection of wheels) and reassembly
- Inner tubes: puncture repairs
- Outer covers: inspection, identification of defects, and spot vulcanizing
- Brake units: inspection and salvage of brake pads and discs
- Inspection and testing of anti-skid devices

10.3.15 Control surfaces

- Overhaul and repair: repairs to typical fabric-covered and metal-skinned ailerons, and elevators
- Hinges and actuating mechanisms: inspection, and renewal of ball races
- Correction of mass balance after repair
- Adjustment of balance tabs, and servo-tabs on aircraft (to correct for hinge moments and flying faults)

10.3.16 Multi-engined aircraft

- Simulated airline check: familiarization with maintenance schedule
- Performance of sequence of major periodic inspection by the students, including signing of check sheets for each job done and recording of and, if possible, rectification of all defects
- Full functioning checks after replacement of components, including ground testing of hydraulic system with retraction of landing gear and function testing of electrical system; ground running of engines; weighing of the aircraft and calculation of centre of gravity

10.4 BASIC WORKSHOP AND MAINTENANCE PRACTICES: REPAIR, MAINTENANCE AND FUNCTION TESTING OF AIRCRAFT SYSTEMS/COMPONENT

10.4.1 Hydraulic systems

- Demonstration of hydraulic system rig
- Dismantling and reassembly of typical components such as hydraulic pumps, regulators, selectors, control valves, accumulators and actuators
- Dismantling and examination of control and actuating devices from powered flying control systems
- Dismantling, reassembly and recharging of

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selection of landing gear shock struts, nose-wheel steering mechanisms, anti-shimmy devices and other landing gear components

10.4.2 Pneumatic systems

- Demonstration of pneumatic system rig, examination of typical components such as compressors, regulators, selectors and actuators
- Dismantling, reassembly and testing of representative selection of pneumatic components: selectors, thrust reversal rams, and others

10.4.3 Environmental control systems

- Demonstration of pressurization system models or rigs
- Dismantling and reassembly of selected components such as cabin superchargers, mass flow controllers, cabin pressure controllers, discharge valves and safety valves
- Demonstration and partial dismantling of cabin heating, cooling and humidifying devices
- Dismantling, reassembly and testing of selected components
- Familiarization with the servicing and inspection of various types of pressure and mass flow control devices; heat exchangers, combustion heaters and electrical heaters; cold air units (air cycle machines), vapour cycle coolers, cabin temperature sensing and regulating devices; humidifying and dehumidifying equipment; crew and passenger emergency oxygen equipment

10.4.4 Fire control systems

- Inspection, weighing and recharging of fire extinguisher bottles
- Demonstration of fire detection and extinguishing system principles by using simulators, individual components, and operation
- Practice in controlling aircraft and shop fires
- Familiarization with different types of alarm systems, extinguishers and their uses

10.4.5 De-icing systems

- Demonstration of rigs and individual de-icing system components
- Dismantling, reassembly and testing of air control devices for mechanical de-icing systems; repairs to inflatable leading-edge overshoes/boots
- Hot air systems: overhaul procedures for combustion heaters, and hot air control valves
- Repair schemes for air-to-air heat exchangers,

and mixing valves

- Repair schemes for electrically heated overshoes, and spray-mats

10.4.6 Miscellaneous systems

- Demonstrations and inspection of vacuum systems, water/methanol, drinking and washing water systems
- Inspection and tests, as necessary, of fuel system components: cocks, line booster pumps, filters, and refueling valves
- Tests and repairs, as necessary, of safety equipment: inspection of dinghies, life jackets, survival kits, safety belts etc.

10.5 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

10.5.1 Aircraft heavy maintenance check

- Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; emptying and inserting fuel tanks, draining oil and other systems; selection and display of equipment; tools required
- Selected major operations: internal inspection of internal tanks; detailed examination of cabin structure followed by pressurization and leak rate test; change of main landing gear
- Adherence to aircraft maintenance manual and a typical airline major check schedule for each job
- Conclusion of Heavy Maintenance Check: replacement of components, function tests, restoration of internal and external finish, weighing and calculation of centre of gravity, preparation for flight test, and completion of documentation

10.5.2 Aircraft or helicopter repair

- Selection of repair scheme: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings or structural repair manual (SRM)
- Selection of material to be checked for compliance with specification
- Embodiment of repairs according to prepared drawings or SRM
- Testing to destruction of selected repair specimens to demonstrate strength of repair
- Experience in workshop processes as applicable to repair and reconditioning of aircraft parts (e.g. enlargement or reduction of dimensions to accept oversized or undersized parts; chemical or electro-chemical treatments for the protection of metals; metal depositing processes; special

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methods of heat treatment; special methods of welding; advanced metal processing techniques, surface texture measurement)

- Acceptance tests and final inspection
- Completion of documentation

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Chapter 11

PRACTICAL MAINTENANCE SKILLS: ENGINE AND PROPELLER

11.1 INTRODUCTION

- Basically the same as 10.1 above

11.2 TRAINING OBJECTIVES

- Basically the same as 10.2 above

11.3 BASIC WORKSHOP AND MAINTENANCE PRACTICES: ENGINE AND PROPELLER

11.3.1 Introduction

11.3.1.1 Training in workshop practice should begin with exercises in the use of hand tools to make a series of simple shapes to specified dimensions from various metals. Each shape should be progressively more complicated with more precise tolerances. From the start, instructors should ensure that students develop the habit of handling basic hand or machine tools in the correct manner, and action should be taken to correct any bad or potentially dangerous practices before they become habitual. At all times, and particularly during the early stages of training, the importance of producing accurate and careful work must be stressed. These exercises can be used to develop the trainees' inspection ability, i.e. the necessary judgment and sense of responsibility required to assess the accuracy of their own work and that of others.

11.3.1.2 It is desirable that licensed AME students should have the opportunity to remove and replace major components. Practise in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase.

Note.— The basic practical training specified in this paragraph is very similar to that described in 10.3 of Chapter 10 for airframe trainees.

11.3.2 Bench fitting

- Cutting and filing: exercises in cutting metal with hacksaws, filing, drilling, drill grinding, thread cutting with taps and dies, and scraping
- Measurements: use of steel rule, dividers, calipers, micrometers, vernier, combination set, surface plate, and dial test indicator

11.3.3 Forging, heat treatment, soldering and welding

- Forging by hand simple specimens such as

chisels, punches and others

- Hardening and tempering carbon steel by using forge
- Tin soldering, tin-plating, and use of proper flux
- Silver soldering and brazing
- Welding: oxyacetylene and metallic arc welding of different materials
- Inspection of welded joints for flaws

11.3.4 Sheet metalwork

- Sheet aluminium alloy: cutting, marking out, drilling, forming, bending, bending allowances, shrinking and flashing
- Forming sheet metal by pressing and rolling
- Riveting: types of rivets, riveting with hand tools, rivet spacing, countersinking and dimpling
- Use of pneumatic riveting hammer
- Blind riveting
- Inspection of rivets, removal of rivets, use of oversized rivet and rivet jackets
- Tube work: use of taper pins and tubular rivets
- Exercises in sheet metal patching and repair work
- Heat treatment of aluminium alloy and alloy rivets: use of salt baths and furnaces; annealing and solution treatment

11.3.5 Machine shop

- Drilling: using machine drills to drill close tolerance holes in various materials; reaming holes to close tolerances; others
- Turning: exercises in turning steel, aluminium alloy and brass parts; use of lathe for thread cutting; others
- Grinding: use of grinding wheels for tool sharpening

11.3.6 Wire and cable work

- Inspection of aircraft cables for defects
- Splicing exercises

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- Swagging exercise: attachment of standard end fittings to engine control cables
- Demonstration of proof test on engine control cable

11.3.7 Tube work

- Tube bending, with and without heat treatment
- Tube flaring
- Fitting of different kinds of unions used in fuel, oil and hydraulic systems
- Inspection and testing of tubes and flexible hoses

11.3.8 Familiarization

- Practical explanation of the mechanical arrangement of the engines available for work and practice (e.g. 2-stroke and 4-stroke spark ignition and compression ignition engines); air-cooled and water-cooled piston engines; piston aero engines of various types; turbojet, turboshaft, turboprop and turboprop aero engines; others

11.3.9 Initial inspection

- Examination of complete engine and propeller for identification to manufacturers' service publications
- Confirmation of external accessories and features
- Recognition of visible defects
- Ground run of engines (if possible) and recording of performance
- Ensured availability of manuals, workshop tools and equipment
- Identification of safety precautions to be observed

11.3.10 Dismantling

- Removal of accessories as appropriate (i.e. starters, generators and electrical equipment, pressure transmitters, transducers, thermocouples, magnetos, carburettors and spark plugs)
- Dismantling of core engine to a specified level according to manufacturer's service publications
- Complete dismantling of smaller engines: removal of all accessories, manifolds, cylinders, pistons, connecting rods, crankshaft and bearings; cleaning and laying out of these components for inspection
- Partial dismantling of larger engines: removal of accessories, reduction gear, cylinders, and pistons (without disturbing crankshaft or crankcase)
- Partial dismantling of gas turbines: removal of

accessories, jet pipe assembly, and combustion chambers (without disturbing turbine/compressor assembly)

11.3.11 Inspection of dismantled engine

- Visual inspection in accordance to manufacturer's service publications
- Dimensional checks in accordance with procedures given in manufacturers' manuals for deterioration in accordance to manufacturer's service publications on blades, vanes, shafts, bearings, and connecting rods for wear, ovality, twist and distortion
- Checking of cylinder valves, pistons and piston rings as directed in overhaul manual: checking of fits and clearances; practise on repair schemes, as applicable
- Non-destructive crack detection: electromagnetic, dye penetrant, etc. on crankshafts and camshafts
- Checking for cracks and distortion on exhaust manifolds, jet pipes, and combustion chamber flame tubes
- Inspection of gas turbine and turbo-supercharger compressor and turbine assemblies; inspection of blades for deposits, damage and distortion

11.3.12 Repair and reconditioning of engine parts

- Repairs by machining and grinding; checks for fits and clearances; fitting of oversized or undersized parts
- Castings: checks and rectification of cracks, porosity and corrosion
- Rigid and flexible pipes and hoses: testing and reconditioning
- Inspection and repair of gears, accessory drives, and torque metre components
- Welding repairs to nickel alloy components (e.g. jet pipes)

11.3.13 Reassembly

- Rebuilding of totally or partially dismantled engines (with particular attention to be paid to cleanliness, correct torqueing and safety, correctness of working clearances, and accuracy of valve and ignition timing)

11.3.14 Engine test bed running and fault finding

- Installation of engine on test bed, checking of instrumentation, control runs, and fuel supplies
- Fan testing of piston engines: calibration of test fan for test site, and engine type
- Full "after overhaul" test programme as specified in the State's airworthiness requirements and in the manufacturer's approved test schedule, using a method appropriate to the type of engine: initial

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test, strip inspection, reassembly and final test

- Interpretation of engine performance based on test results
- Experience in starting, running and ground testing of aero engines
- Inspection of powerplant installed in aircraft
- Fault finding and rectification

11.3.15 Aircraft installation

- Preparation of powerplant for installation in aircraft: functional checks on controls and interconnections
- Flow tests of fuel system
- Checks on pyrometry and on fire warning system
- Checks on engine bearers and alignment
- Slinging and installation of powerplant
- Ground running tests after installation

11.3.16 Storage and transit of engines

- Protection against corrosion
- Engine stands, crating, lifting and tie-down points
- Storage bags/covers and use of desiccant
- Preparation of engines for running after long-term storage

11.3.17 Propeller maintenance tasks

- Practice in removal and replacement of propellers on engine propeller shaft
- Dismantling and inspection of typical variable pitch propeller
- Checking of blades and blade root bearings for damage and permissible repairs
- Reassembly, resetting of blade angles, blade torque loadings, static balance of propeller, and inspection

11.4 BASIC WORKSHOP AND MAINTENANCE PRACTICES: ENGINE/PROPELLER SYSTEMS/COMPONENTS AND FUNCTION TESTING

11.4.1 Components: Ignition

- Dismantling, reassembly and testing of various kinds of magnetos and distributors
- Renewal of cables in an ignition harness
- Continuity and insulation tests
- Cleaning and testing of spark plugs
- Inspection and testing of igniter equipment for turbine engines
- Safety precautions associated with ignition

equipment

11.4.1 Components: Fuel and control

- Float and injection carburetors: partial dismantling and inspection; reassembly and flow tests; others
- Propeller control devices, governors and feathering pumps: partial dismantling, reassembly and bench tests
- Fuel pumps, oil pumps, oil coolers, gearboxes, flow, pressure and other tests as specified in manufacturer's manuals
- Gas turbine fuel system components: pumps, pressure and flow control units, metering devices, automatic valves, and burners; partial dismantling to view and understand mechanism; reassembly testing; others

11.5 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

11.5.1 Heavy maintenance check or overhaul of engine/propeller

- Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; draining oil and other systems; selection and display of equipment; tools required
- Selected major operations (e.g. turbine blade inspection either by dismantling or by optical probe techniques)
- Adherence to the aircraft maintenance manual and to a typical airline check or overhaul schedule for each job
- Conclusion of Heavy Maintenance Check or overhaul: replacement of components, function tests, restoration of internal and external finish, preparation for engine run, and completion of documentation

11.5.2 Engine/propeller repair

- Selection of repair scheme: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings or repair manual
- Selection of material to be checked for compliance with specification
- Embodiment of repairs according to prepared drawings or repair manual
- Testing to destruction of selected repair specimens to demonstrate strength of repair
- Experience in workshop processes as applicable to repair and reconditioning of aircraft parts (e.g. enlargement or reduction of dimensions to accept oversized or under-sized parts; chemical or electrochemical treatments for the protection of metals; metal depositing processes; special methods of heat treatment; special methods of welding; advanced metal processing techniques; surface texture measurement)

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- Acceptance tests and final inspection engine run
- Completion of documentation

Chapter 12

PRACTICAL MAINTENANCE SKILLS: AVIONICS — ELECTRICAL, INSTRUMENT, AUTOFLIGHT AND RADIO

12.1 INTRODUCTION

12.1.1 In order to be able to satisfactorily assimilate training on individual types of aircraft avionics systems, the Aircraft Maintenance (Technicians/Engineers/Mechanics) (AMEs) must have good fundamental practical skills and understand the maintenance processes and principles generally used in aircraft hangars and workshops.

12.1.2 In order to be able to perform or supervise “hands-on” tasks of mechanic/technician on the aircraft and avionics systems, the AME must have a very complete knowledge of all the tools and associated maintenance processes that are likely to be used in hangars and workshops.

12.1.3 For future aircraft hangar or workshop technicians, their basic workshop training should commence with Phase Two — Skills and should be completed before the students begin working on airworthy aircraft and avionics equipment in Phase Three — Experience. For this purpose, the Performance parameters required to meet the Training Objectives outlined in 12.2 of this chapter are divided into two sections: Section a) requires basic manual skills and Section b) refers to the application of these skills to non-airworthy avionics components, systems or specially-designed practice rigs. The level of manual skills to be developed varies according to the category of technician being trained. For example, bench fitting is of importance to all categories of technicians, while radio technicians may require skill in soldering but they only need an introduction to welding.

12.1.4 The recommended facilities, tools and equipment are described in Appendix 1 to this chapter.

12.2 TRAINING OBJECTIVES

Conditions: The trainees will be provided with appropriate facilities; tools (both hand and machine); materials; test/demonstration avionics, electrical, instrument, autoflight items of equipment, necessary parts and raw materials or specially-made repair, assembly and rigging test exercises. (See Appendix 1 to Chapter 12.)

Performance:

- The trainees will practice equipment removal, replacement, dismantling, inspection, decision-making regarding repair or replacement, reassembly and function testing using simple engineering drawings and manufacturers’ maintenance, overhaul and repair tests (real or simulated).
- The trainees will practice fault finding, dismantling, inspecting, repairing, decision-making regarding repair or replacement, reassembly and testing of avionics units. They will also use engineering drawings and engine manufacturers’ maintenance, overhaul and repair manuals.

Standard of accomplishment:

During workshop training, the standard is a function of the variety of exercises completed and the time spent in workshop training. The trainees/students should work individually on the avionics exercises so that they have “ownership” of the standard. If necessary, they should practice and repeat increasingly complex exercises to develop greater manual skills within their respective areas of competence. Finally, they should function test the units or systems on a test rig.

12.3 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — ELECTRICAL

12.3.1 Lead acid batteries

- Checking of battery condition, adjustment of specific gravity of electrolyte, battery charging practise; capacity, discharge and insulation tests; others
- Overhaul procedures, including leak test of cells and cell replacement

- Safety precautions

12.3.2 Nickel cadmium batteries

- Checking of battery condition: determining state of charge, cell balancing, charging, etc.
- Checking of electrolyte level and insulation tests
- Safety precautions
- Cell replacement
- Deep cycling of nickel cadmium units

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12.3.3 Wire and cable work

- Making up of wire lengths and specimen cable looms: soldering and crimping ends, identification of cables, using routing charts, and fitting plugs and sockets
- Cable tracing practise: continuity and insulation checks on cable runs
- Practice in aircraft wiring as carried out during modification or repair work: full tests of circuit

12.3.4 Bonding, continuity and insulation testing

- Bonding checks: use of bonding tester
- Continuity and insulation tests on aircraft circuit; use of Megger testers
- Millivolt drop checks at cable joints and terminal ends

12.3.5 Generators and electric motors

- Dismantling, examination and reassembly
- Demonstration of generator test

12.3.6 Voltage regulators, cut-outs and relays

- Partial dismantling, followed by examination and reassembly, of carbon pile and other types of voltage regulators
- Dismantling, examination and reassembly of accumulator cut-outs, reverse current relays, solenoids and relays from various circuits, and thermal circuit breakers

12.3.7 Generators and alternators

- Strip inspection: undercutting of commutators, checks for brush wear, brush spring loading and brush bedding
- Testing of generator elements: armature testing, continuity tests on field coils, armature shaft alignment, and wear of ball races and housings
- Reassembly and insulation test of generator
- Testing of generators and alternators on test rig
- Voltage regulators: overhaul procedure, correction of basic setting and adjustments making
- Adjustment and rig testing of cut-outs and relays
- Current balancing adjustments of DC power circuits on simulator of multi-engined aircraft electrical system
- Electromagnetic relays: inspection and polishing of contacts, setting and adjustment, and millivolt drop tests on test rig
- Constant speed drives (CSD): removal from alternator and testing
- Integrated drive generator (IDG): dismantling, inspection, and overhaul

12.3.8 Electric motors

- Starter motors for piston and turbine aero engines: dismantling, examination for condition and wear, check for brush gear and commutator, check of clutches and geared drives; reassembly and test

- Dismantling, inspection, reassembly and test of motors for fuel line pumps, hydraulics, propeller feathering, and windscreen wipers
- Linear and rotary actuators: dismantling, reassembly, and bench testing

12.3.9 Inverters and converters

- Rotary inverters and converters: dismantling and check for brushes and commutators, cleaning and testing of armature, and reassembly and adjustment
- Testing: checking of input and output voltages; adjustment of frequency control
- Static inverters and converters: inspection, adjustment and testing of output voltage and frequency

12.3.10 Equipment

- Magnetos: overhaul and test procedure for high and low tension systems
- Spark/igniter plug testing, ignition lead testing and inspection, and booster coil testing
- Engine high-energy ignition units: overhaul and test procedure
- Safety precautions

12.3.11 Electrical circuit equipment

- Examination and partial overhaul of a wide range of miscellaneous electrical components such as transducers, magnetic amplifiers, rectifiers, transformers, Wheatstone bridge and other balancing devices, and sensing elements
- Adherence of all testing in accordance with manufacturers' instructions
- Dismantling (as appropriate), examination and reassembly of electrical components, including converters, inverters, switchgear, heating units, and actuators

12.4 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — INSTRUMENT

12.4.1 Pressure indication

- Mechanically-operated gauges (e.g. Bourdon tube gauges): partial dismantling, examination, strip inspection, reassembly and calibration with dead weight c tester
- Pressure transducers, electrically-operated transmitters, ratio metres, etc.: strip inspection, reassembly and calibration
- Electrically-operated gauges: strip inspection, reassembly and calibration

12.4.2 Flight instruments

- Calibration checks of flight instruments
- Pitot heads and static vents: maintenance checks
- Altimeters: dismantling, inspection, reassembly and calibration checks
- Air speed indicators (ASI): dismantling, inspection, reassembly and calibration checks
- Machmeters: dismantling, inspection,

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reassembly and calibration checks

- Rate-of-climb indicators: dismantling, inspection, reassembly and calibration checks

12.4.3 Gyroscopic instruments

- Air-driven gyroscopic instruments: partial dismantling, examination and reassembly
- Electrically-driven gyroscopic instruments: partial dismantling, examination and reassembly
- Artificial horizon: dismantling, inspection and reassembly
- Directional gyro: dismantling, inspection and reassembly
- Turn and bank indicator: dismantling, inspection and reassembly
- Zero reader: dismantling, inspection and reassembly
- Calibration checks on gyroscope test turntable

12.4.4 Engine speed indication (ESI)

- ESI generators (DC and AC types): partial dismantling, inspection and reassembly
- ESI gauges: partial dismantling, inspection and reassembly
- Engine speed synchronizing gear: examination and demonstration of principles
- Generators and gauges: dismantling, inspection, reassembly and calibration checks

12.4.5 Thermometers and temperature indication

- Engine temperature thermocouples: demonstration of cylinder head, jet-pipe temperature and other types
- Radiometer temperature gauges: partial dismantling, examination and reassembly of transmitter and indicator units
- Dismantling, reassembly and testing of temperature, and measuring instruments of various kinds
- Tests on various kinds of temperature sensing units (e.g. fire and overheating detectors, cabin air duct stats, and inching controls for cooler shutters)
- Use of portable test kits for checking gas turbine powerplant thermocouple installations

12.4.6 Fuel contents indication

- Float-operated desynn contents gauges: examination and demonstration of operation dismantling, inspection, reassembly and test
- Capacitance type contents gauges: examination and demonstration of operation reassembly and test
- Flowmeters: dismantling, inspection, reassembly and test

12.4.7 Compass systems

- Magnetic compasses: friction and damping tests, practice compass swing, and compensation
- Remote compass: examination and demonstration
- Tests of compass swinging site
- Swing of compass in available aircraft: compensation practice
- Remote compass: partial dismantling, inspection, reassembly and test

12.4.8 Miscellaneous instruments

- Examination and demonstration of other types of instruments (flowmeters, navigation and landing aid presentations)

12.5 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — AUTOFLIGHT

12.5.1 Autopilots

- Examination and demonstration of autopilot mock-up and components

12.5.2 Flight control systems

- Autopilots (electrical or electronic): dismantling, examination of components, reassembly, and installation in aircraft or on simulator by following manufacturer's test programme; practise with portable test kit
- Autopilots (pneumatic or hydraulic actuation): dismantling of component parts, reassembly, installation in aircraft or simulator, and function tests
- Examination and testing of elements of flight director systems, automatic flare and automatic landing systems, as required

12.6 BASIC WORKSHOP AND MAINTENANCE PRACTICES: AVIONICS — RADIO

12.6.1 Radio workshop: fundamental techniques

- Safety precautions associated with radio equipment hazards: high voltages, radio frequency (RF) emissions and microwave emissions, electrostatic discharge, etc.
- Wiring and cabling: demonstration and practice in wiring and soldering radio circuits
- Multimeters, Megger and bonding testers: demonstrations and practice
- Identification and inspection of antenna: external wire aerials, blade, rod and rail aerials, D/F loops, and suppressed aerials; viewing on aircraft, and inspection for physical condition
- Aerial masts, static dischargers, etc.: inspection and servicing
- Chassis: sheet metalwork using drawings
- Simple receiver assembly kit: study of circuit, demonstration of assembly, operation and testing
- Measurements and experiments with circuit demonstration units simulating the following system elements:
 - TRF receiver
 - intermediate frequency amplifier
 - frequency converter
 - superheterodyne alignment
 - buffer-doubler amplifier
 - RF amplifier
 - modulation
 - transmission lines
 - reactance tube modulators
 - interference (filtering and shielding)

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- Troubleshooting practice

12.6.2 Demonstration of test procedures on airborne equipment

- Identification: identity and location of principal types of airborne communication and navigation equipment: racking systems, power supplies, antennae and other interconnections
- Demonstrations of bench tests on sample equipment, including use of screened rooms

12.6.3 Wiring, cabling and soldering techniques

- Wiring: practice in stripping insulation; splicing; wiring to lugs; terminals and tube sockets; and dismantling, soldering and reassembly of connectors
- Cables: lacing of wires to form a cable, termination and soldering of cable ends, and serving of coaxial cables
- Soldering: practice with different sizes of soldering irons, different grades of solder, fluxes and types of connectors
- Micro-miniature precision soldering techniques
- Handling of electrostatic sensitive devices

12.6.4 Instrumentation

- Multimeter: practice in measuring and calculating series and parallel resistance; voltage and current measurements on various circuits; others
- Megger: continuity and insulation tests on aircraft cable assemblies structure; practice with circuit boards; others
- Simple valve voltmeter
- Frequency metres, absorption and heterodyne: practice in frequency measurement
- “Q” metres: practice in measuring L, R, C and Q
- Signal generators: demonstration of cathode ray oscilloscope; demonstration of use to examine wave-forms, wave envelopes, and DC measurements

12.6.5 Antennae

- External wire aerials: splicing, tensioning and making connections
- Static dischargers: inspection, servicing and renewal procedures
- Fibreglass and resin laminate aerial masts: maintenance and repair
- External blade, rod and rail aerials: removal, maintenance and repair, and replacement
- Suppressed aerials: care and maintenance, maintenance and repair of dielectric covers
- DF loops: inspection, routine maintenance, ground calibration, and preparation of correction chart
- Reflectors and directors: care and maintenance

12.7 REPAIR, MAINTENANCE AND FUNCTION TESTING OF AIRCRAFT SYSTEMS/COMPONENT: AVIONICS

12.7.1 Airborne and test equipment practice

- Use of representative airborne radio and radar equipment and practice in servicing, installation and overhaul according to procedures laid down in the manufacturers’ approved manuals
- Removal and replacement of equipment from aircraft racks, checks on power supplies, and remote controls
- Routine maintenance inspections of equipment in situ
- Operational checks
- Bench tests, measurement of performance characteristics, tuning, adjusting, fault finding, aligning and repairing
- Understanding and use of remote specialist communications, navigation and radio test equipment for both ramp and workshop
- Understanding and use of system built-in test equipment (BITE), including comprehension of output data
- Power supplies, installation and wiring, signal tracing, and use of cathode ray oscilloscope (CRO)
- Audio amplifier, installation and wiring, fault tracing and rectification

12.8 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

12.8.1 Aircraft heavy maintenance check: Avionics

- Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records,
- modification instructions; selection and display of equipment; tools required
- Selected heavy maintenance operations
- Compliance to the aircraft maintenance manual and typical airline major check schedule for each job
- Conclusion of Heavy Maintenance Check: replacement of components; function tests; preparation for flight test; completion of documentation

12.8.2 Aircraft repair or modification: Avionics

- Selection of repair scheme or modification: damage to be studied and related to approved repair scheme as shown on manufacturers’ drawings
- Selection of material (to be checked for compliance with specification)
- Embodiment of repairs according to prepared drawings or manufacturers’ manuals
- Testing to destruction of selected repair specimens to demonstrate strength of repair
- Experience in workshop processes as applicable to testing, repair and reconditioning of aircraft parts
- Acceptance tests and final inspection
- Completion of documentation