For over two decades, aviation maintenance employers outside the major airlines have identified the failure of competency-based training to provide practical skills needed by the industry. This training deficiency came about when The Authority stopped promulgating national training syllabi for aircraft maintenance engineers based on ICAO international training standards. Instead of industry wide transportable skills, local RTOs geared their training to meet the needs of the largest employer and not the industry.

INTRODUCTION

TRAINING OBJECTIVES

Annex 1 and Annex 8 have two requirements affecting aircraft maintenance personnel and which can be met by means of training. These are:

Annex 1, Chapter 4, which concerns the issue of an aircraft maintenance licence compliant with Annex 1.

Annex 8, Part I, 8.7.5.3, which requires that within an AMO, "the competence of maintenance personnel (should) be established with a procedure and to a level acceptable to the State granting the approval."

When designing courses and associated syllabi in order to enable individuals and AMOs to meet the training requirements of Annex 1, an aviation training centre should have the following goals in mind:

to train an individual to enable him or her to meet the standard required for the issue of an AME licence by the State or its aviation regulatory body;

to train AMO maintenance personnel to meet the standard of competence required by Annex 1 for signatories of maintenance release; and

to train AMO maintenance personnel to meet the standard of competence required by that AMO and is approved by the State or its aviation regulatory body.

Many aviation training centres use different standards in training maintenance personnel for all operators or AMOs. While their training courses are not the subject of this manual, it is hoped that the use of training specifications outlined in this manual will enable individuals to gradually achieve the goals cited in 1.6.

The following are the international standards for practical skills that should be completed before the students begin working on airworthy aircraft, engines or equipment.

Practical Maintenance Skills: Avionics Electrical, Instrument, Autoflight and Radio

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PRACTICAL MAINTENANCE SKILLS: AVIONICS .....ELECTRICAL, INSTRUMENT, AUTOFLIGHT AND RADIO 1

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1.1	Basic Workshop & Maintenance Practices: Avionics — Electrical	Init
1.1.1	**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	
1.1.2	**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	
1.1.3	**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.	
1.1.4	**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.	
1.1.5	**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.	
1.1.6	**Generators and electric motors** – Dismantling, examination, and reassembly Demonstration of generator test	
1.1.7	**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	
1.1.8	**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	
1.1.9	**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	
1.1.10	**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	
1.1.11	**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	

1.1.12	**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	
1.2	**Basic Workshop & Maintenance Practices: Avionics — Instruments**	
1.2.1	**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	
1.2.2	**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, reassembly and calibration checks Rate-of-climb indicators: dismantling, inspection, reassembly and calibration checks	
1.2.3	**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.	
1.2.4	**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	
1.2.5	**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	
1.2.6	**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	
1.2.7	**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	
1.2.8	**Miscellaneous instruments** – Examination and demonstration of other types of instruments (flowmeters, navigation and landing aid presentations)	
1.3	**Basic Workshop & Maintenance Practices: Avionics — Autoflight**	
1.3.1	**Autopilots** Examination and demonstration of autopilot mock-up and components	
1.3.2	**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.	

1.4 Basic Workshop & Maintenance Practices: Avionics — Radio

1.4.1 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)
– Troubleshooting practice

1.4.2 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

1.4.3 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

1.4.4 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

1.4.5 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

1.5 Repair, Maintenance & Function Testing of Aircraft Systems/Component: Avionics

1.5.1 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

1.6	Job/Task Documentation & Control Practices	
1.6.1	**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	
1.6.2	**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	