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. The Authority assumed NVET competency-based training would encompass industry wide training. Without a national syllabi based on international training standards, training went back to State government apprenticeship skilling with 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.

# Chapter 11

## PRACTICAL MAINTENANCE SKILLS: ENGINE AND PROPELLER

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| **11.1 Basic Workshop & Maintenance Practices: Engine and Propeller** | **Init** |
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| **11.1.1 Introduction**<br>*Note.— The basic practical training specified in this section is very similar to that described in Chapter 10 for airframe trainees.* | |
| **11.1.2 Bench fitting**<br>– Cutting and filing: exercises in cutting metal with hacksaws, filing, drilling, drill grinding, thread cutting with taps and dies, and scraping<br>– Measurements: use of steel rule, dividers, calipers, micrometers, vernier, combination set, surface place, and dial test indicator | |
| **11.1.3 Forging, heat treatment, soldering and welding**<br>– Forging by hand simple specimens such as chisels, punches and others.<br>– Hardening and tempering carbon steel by using forge.<br>– Tin soldering, tin-plating, and use of proper flux.<br>– Silver soldering and brazing.<br>– Welding: oxyacetylene and metallic arc welding of different materials.<br>– Inspection of welded joints for flaws. | |
| **11.1.4 Sheet metalwork**<br>– Sheet aluminium alloy: cutting, marking out, drilling, forming, bending, bending allowances, shrinking & flashing<br>– Forming sheet metal by pressing and rolling<br>– Riveting: types of rivets, riveting with hand tools, rivet spacing, countersinking and dimpling<br>– Use of pneumatic riveting hammer<br>– Blind riveting<br>– Inspection of rivets, removal of rivets, use of oversized rivet and rivet jackets<br>– Tube work: use of taper pins and tubular rivets<br>– Exercises in sheet metal patching and repair work<br>– Heat treatment of aluminium alloy and alloy rivets: use of salt baths and furnaces; annealing and solution treatment | |
| **11.1.5 Machine shop**<br>– Drilling: using machine drills to drill close tolerance holes in various materials; reaming holes to close tolerances; others<br>– Turning: exercises in turning steel, aluminium alloy and brass parts; use of lathe for thread cutting; others<br>– Grinding: use of grinding wheels for tool sharpening | |

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| **11.1.6 Wire and cable work**<br>– Inspection of aircraft cables for defects<br>– Splicing exercises<br>– Swagging exercise: attachment of standard end fittings to engine control cables<br>– Demonstration of proof test on engine control cable | |
| **11.1.7 Tube work**<br>– Tube bending, with and without heat treatment<br>– Tube flaring<br>– Fitting of different kinds of unions used in fuel, oil and hydraulic systems<br>– Inspection and testing of tubes and flexible hoses | |
| **11.1.8 Familiarization**<br>– 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, turbofan and turboprop aero engines; others | |
| **11.1.9 Initial inspection**<br>– Examination of complete engine and propeller for identification to manufacturers' service publications<br>– Confirmation of external accessories and features<br>– Recognition of visible defects<br>– Ground run of engines (if possible) and recording of performance<br>– Ensured availability of manuals, workshop tools and equipment<br>– Identification of safety precautions to be observed | |
| **11.1.10 Dismantling**<br>– Removal of accessories as appropriate (i.e. starters, generators and electrical equipment, pressure transmitters, transducers, thermocouples, magnetos, carburettors and spark plugs)<br>– Dismantling of core engine to a specified level according to manufacturer's service publications<br>– 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<br>– Partial dismantling of larger engines: removal of accessories, reduction gear, cylinders, and pistons (without disturbing crankshaft or crankcase)<br>– Partial dismantling of gas turbines: removal of accessories, jet pipe assembly, and combustion chambers (without disturbing turbine/compressor assembly) | |
| **11.1.11 Inspection of dismantled engine**<br>– Visual inspection in accordance to manufacturer's service publications<br>– 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<br>– Checking of cylinder valves, pistons and piston rings as directed in overhaul manual: checking of fits and clearances; practise on repair schemes, as applicable<br>– Non-destructive crack detection: electromagnetic, dye penetrant, etc. on crankshafts and camshafts<br>– Checking for cracks and distortion on exhaust manifolds, jet pipes, and combustion chamber flame tubes<br>– Inspection of gas turbine and turbo-supercharger compressor and turbine assemblies; inspection of blades for deposits, damage and distortion | |
| **11.1.12 Repair and reconditioning of engine parts**<br>– Repairs by machining and grinding; checks for fits and clearances; fitting of oversized or undersized parts<br>– Castings: checks and rectification of cracks, porosity and corrosion<br>– Rigid and flexible pipes and hoses: testing and reconditioning<br>– Inspection and repair of gears, accessory drives, and torque metre components<br>– Welding repairs to nickel alloy components (e.g. jet pipes) | |
| **11.1.13 Reassembly**<br>– 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) | |
| **11.1.14 Engine test bed running and fault finding**<br>– Installation of engine on test bed, checking of instrumentation, control runs, and fuel supplies<br>– Fan testing of piston engines: calibration of test fan for test site, and engine type<br>– 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 test, strip inspection, reassembly and final test<br>– Interpretation of engine performance based on test results<br>– Experience in starting, running and ground testing of aero engines<br>– Inspection of powerplant installed in aircraft<br>– Fault finding and rectification | |

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| **11.1.15 Aircraft installation**<br>– Preparation of powerplant for installation in aircraft: functional checks on controls and interconnections<br>– Flow tests of fuel system<br>– Checks on pyrometry and on fire warning system<br>– Checks on engine bearers and alignment<br>– Slinging and installation of powerplant<br>– Ground running tests after installation | |
| **11.1.16 Storage and transit of engines**<br>– Protection against corrosion<br>– Engine stands, crating, lifting and tie-down points<br>– Storage bags/covers and use of desiccant<br>– Preparation of engines for running after long-term storage | |
| **11.1.17 Propeller maintenance tasks**<br>– Practice in removal and replacement of propellers on engine propeller shaft<br>– Dismantling and inspection of typical variable pitch propeller<br>– Checking of blades and blade root bearings for damage and permissible repairs<br>– Reassembly, resetting of blade angles, blade torque loadings, static balance of propeller, and inspection | |
| **11.2 Basic Workshop & Maintenance Practices: Engine/Propeller Systems/Components & Function Testing** | |
| **11.2.1 Components: Ignition**<br>– Dismantling, reassembly and testing of various kinds of magnetos and distributors<br>– Renewal of cables in an ignition harness<br>– Continuity and insulation tests<br>– Cleaning and testing of spark plugs<br>– Inspection and testing of igniter equipment for turbine engines<br>– Safety precautions associated with ignition equipment | |
| **11.2.2 Components: Fuel And Control**<br>– Float and Injection Carburettors: partial dismantling and inspection; reassembly and flow tests; others<br>– propeller control devices, governors and feathering pumps: partial dismantling, reassembly and bench tests<br>– fuel pumps, oil pumps, oil coolers, gearboxes, flow, pressure and other tests as specified in manufacturer's manuals<br>– 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 | |
| **11.3 Job/Task Documentation and Control Practices** | |
| **11.3.1 Heavy maintenance check or overhaul of engine/propeller**<br>– 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<br>– Selected major operations (e.g. turbine blade inspection either by dismantling or by optical probe techniques)<br>– Adherence to the aircraft maintenance manual and to a typical airline check or overhaul schedule for each job<br>– 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 | |
| **11.3.2 Engine/propeller repair**<br>– Selection of repair scheme: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings or repair manual<br>– Selection of material to be checked for compliance with specification<br>– Embodiment of repairs according to prepared drawings or repair manual<br>– Testing to destruction of selected repair specimens to demonstrate strength of repair<br>– 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)<br>– Acceptance tests and final inspection engine run<br>– Completion of documentation | |