CIVIL AERONAUTICS AUTHORITY
WASHINGTON

MANUAL 53

MECHANIC SCHOOL RATING

MAY 1940

CONTENTS

INTRODUCTION

This manual prescribes in detail the curriculum, facilities, equipment and material which shall be provided by a civilian aviation school in order to be eligible for rating and certification as a mechanic school. Such curriculum, facilities, equipment and material will satisfy the requirements of Sec. 53.10 and Sec. 53.13, of Part 53, Civil Air Regulations.

When the curriculum provided for in Sec. 53.10 (a) of Part 53 has been approved, and all other requirements of Part 53 have been satisfied, a divided curricula as described below may be approved.

As provided for in Sec. 53.10 (b) (1) a separate aircraft curriculum may be approved which provides instruction in the pertinent Parts of the Civil Air Regulations as specified in Section 1, and the course of study specified in Section 2, of this manual.

As provided for in Sec. 53.10 (b) (2) a separate engine curriculum may be approved which provides for instruction in the pertinent Parts of the Civil Air Regulations as specified in Section 1, and the course of study specified in Section 3, of this manual.

The equipment, materials and facilities specified in Section 4 of this manual for the full course of study, will be deemed adequate for the divided curricula.

MANUAL 53. MECHANIC SCHOOL RATING

SECTION 1.—CIVIL AIR REGULATIONS

A. Proper instruction shall be provided in the following parts of the Civil Air Regulations:

Parts 01, 04, 13, 14, 15, 24 and 52 and Section 60.32 (including 60.320 and and 60.321) of Part 60.

SECTION 2.—AIRCRAFT CURRICULUM

A. Aircraft, Theory and Practice.

1. Elementary theory of flight.

2. Airfoils, controls, and their effect on flight.

3. Nomenclature of the aircraft, its component parts and appliances.

4. Aircraft stability and flight characteristics.

5. Weight and balance and its effect upon stability.

B. Mechanical Drawing.

1. The use of drafting instruments.

2. Projection of simple drawings.

3. Reading of drawings.

C. Wood Work.

1. Identification of woods, particularly those used in aircraft structure.

2. Inspection of woods for aircraft use for airworthiness and causes for rejection.

3. Structure of woods.

4. Drying and storing of woods.

5. Steaming and bending of woods.

6. Veneer, laminated wood and plywood.

7. Gluing of wood.

8. Kinds of glue, their preparation and when each is used.

9. Grain, annular rings, knots, pitchpockets, compression wood, decayed and warped wood; when acceptable and rejected.

10. Procedure to be followed in repair, splicing and gluing of wood joints. When and where acceptable.

11. Assembly and testing of glued joints.

12. Pressing and clamping, duration and measuring of pressure.

13. Stressed wood covered fuselages, wings and control surfaces, inspection and repair of.

14. Equipment and tools used in wood work, their use and care.

15. Jigs, trammels, levels, protractors, etc. Purpose and use of each.

16. Alignment, definition and how obtained in wood structure.

17. Construction, maintenance, repair and replacement of wing spars, wing tips, leading edges, ribs, etc.

18. Protective materials and finish, purpose, selection and application.

D. Welded Steel Structures and Fittings

1. Identification of aircraft structural tubing.

2. Properties of metals.

3. Cutting, fitting, welding and fabrication of aircraft structural tubing and fittings from drawings.

4. Protective materials and finish, purpose, selection and application, exterior and interior.

5. Proper equipment and tools for cutting, fitting, aligning, and welding of tubular structures.

6. Proper procedure used in common practice to replace or repair damaged steel tubular structure, including cluster joints and fittings.

7. Fabrication, assembly and alignment of tubular structures, the use of jigs, trammels, levels and protractors.

8. Warping caused by welding, cause, prevention and correction.

9. Fabrication of steel fittings, cutting, forming, bending, welding; heat treating, locating and installation; procedure and precautions to be observed.

10. Regulations pertaining to repair and replacement of damaged fittings.

11. Marking of fittings for bending, as scratching with a sharp pointed instrument, etc., prohibited practice.

E. Welding, Riveting and Heat Treating of Steel, Stainless Steel, Aluminum and Aluminum Alloy, Structure, Stock and Fittings.

1. Acetylene procedure and practice.

2. Equipment, proper use and care for welding equipment.

3. Limitations for use of electric welding.

4. Care and selection of proper materials to be used in making all types of welded joints such as fluxes, welding rods, etc.

5. All types of welded joints such as fillet welds, butt welds, spot welds, rosette welds, tack welds and angular welds.

6. Preparation of materials for welding.

7. Penetration and fusion of welds, hot, cold and burned welds, causes and prevention of.

8. Visual inspection of welded joints, general appearance of satisfactory and unsatisfactory welds.

9. Joints and Splices. Insert, sleeve, fishmouth, and angular.

10. Warping, cause and prevention.

11. Riveted joints and structures, fabrication of.

12. Procedure to be used in riveting, selection and inspection of materials and causes for rejection.

13. Rivets, heat treated and others, their identification, where used and limitations and precautions to be observed in the use of heat treated rivets.

14. Cutting, forming, drilling, fitting and alignment for riveting.

15. Rivets, heat treated, preparation, storage, care and use.

16. Heat treating, purpose, procedure, types, methods, usage, application and identification of.

17. Equipment for testing, as Rockwell or Brinell, use and care of.

18. Types of heat treatment and where applicable.

19. Repairs to heat treated structures, when permissible and re-heat treating.

F. Aluminum Alloy Structure and Fittings.

1. Identification of aluminum and aluminum alloy materials.

2. Fabrication of aluminum alloy structure and fittings.

3. Cutting, fitting and fabrication of aircraft structure and fittings from drawings.

4. Protective applications, purpose, selection, exterior and interior.

5. Aluminum and aluminum alloy metal, properties, strength, usage and weight.

6. Corrosion, causes and prevention and susceptibility of aluminum and its alloys to corrosion.

7. Precautions and limitations, no permissible repair of aluminum alloy fittings.

8. Heat treating of aluminum alloy fittings and structure.

9. Precautions to be observed for aluminum alloy materials when attached to and in contact with certain other materials and metals.

10. Equipment and tools necessary in the fabrication of aluminum alloy structure and fittings, their use and care.

11. Repair and maintenance of cowling and cowl fastening.

12. Cleaning of aluminum and aluminum alloys, care to be used in selection of materials for this purpose.

G. Sheet Metal, Steel, Stainless Steel, Terneplate, Aluminum and Aluminum Alloy.

1. Identification of sheet metal.

2. Protective applications, their selection and use.

3. Cutting, forming, bending and fitting, and fabrication of stressed skin metal covering.

4. Repair and replacement of stressed skin metal covering.

5. Manner and procedure of attaching to structure.

6. Heat treated sheet metals, identification and use.

7. Construction, repair and maintenance of fuel and oil tanks, and precautions to be observed in service and repair of fuel tanks.

8. Floats and hulls, construction, repair and protective applications.

9. Firewalls, installation, and regulations pertaining thereto.

10. Cowling, fairing, streamlining, covering, etc.; installation, care, repair and inspection.

H. Controls and Control Surfaces.

1. Types of control systems, nomenclature and identification of controls and control-operating mechanism.

2. Installation, rigging, operation, service, repair, adjustment and inspection of aircraft controls and control surfaces, including tabs with precautions to be observed in the installation and the rigging of tabs.

3. Types of control surfaces.

I. Miscellaneous.

1. Approved control cables, splicing, approved splices, fabrication and inspection.

2. Control cable service, care and replacement.

3. Bonding; purpose, methods and material.

4. Brazing and soldering, correct method of accomplishing and limitations of use in aircraft.

5. Hydraulic and vacuum systems as applying to the actuation of controls, flaps, retractable landing gear, propellers, instruments, et cetera.

J. Electrical System.

1. Installation, bonding, conduits, materials to be used and precautions to be observed in installation.

2. Lights and flares, installation, repair, maintenance and inspection.

3. Batteries, battery boxes, drains, vents, cables, switches and connections.

4. Lighting and ignition fuses, switches, their installation and inspection.

K. Fuel System.

1. Fuel line installation, annealing, bending; attachment, size and capacity, and precautions to be observed in installation.

2. Hose connections, liners, clamps, strainer fittings, drains and control valves.

3. Fuel tanks, installation, padding, ventilation, draining, cleaning, repairing and inspection.

4. Gauges, caps and markings for content and capacity.

L. Covering, Fabric and Stressed Skin.

1. Identification of fabrics to be used for covering.

2. Cutting and fitting.

3. Thread, cord, tapes, selection, use and application of.

4. Inspection before applying covering.

5. Machine sewing, hand sewing, tacking, and ribstitching, spacing, etc.

6. Inspection openings, location and number required.

7. Application of protective materials, their selection and purpose served.

8. Equipment required in the application of protective materials, use of same and precautions to be observed in applying.

9. Location, dimension and regulations pertaining to the application of symbols and marks for the identification of aircraft, procedure to be followed in applying.

10. Identification of stressed skin and materials used for covering.

11. Cutting, fitting, and attachment to structure.

12. Selection and application of protective materials.

M. Landing Gear Assembly.

1. Types, fabrication, materials used and installation, maintenance, repair and inspection.

2. Shock units, types, installation, maintenance, repair and inspection.

3. Alignment.

4. Brakes and controls, wheels, tires, etc.

N. Assembly and Rigging.

1. Method and procedure, specifications applying and how obtained.

2. Equipment, instruments and tools required, and their use.

3. Procedure to be followed in rigging, corrections for faulty flight characteristics, effect of tabs, their installation and precautions to be observed.

4. Procedure to be followed for the installation of floats and skis, regulation pertaining to selection of same for approved stressed load, etc.

5. Propeller installation, tracking, periodic servicing.

O. Instruments and Radio Equipment.

1. Installation and inspection of two-way radio.

2. Types of instruments, installation, purpose, correct reading in service, marking for limits of operation, actuation, etc.

P. Aircraft Appliances.

1. Floats and skis, installation, materials used, maintenance, repair and inspection.

2. Flares, installation, inspection and precautions to be observed in their installation, marking of controls, etc.

3. Safety belts, regulations pertaining thereto, installation, testing and inspection.

4. Cabin heaters, installation, repair and inspection.

Q. Inspection of Certificated Aircraft.

1. Manner of conducting a thorough and detailed inspection of a certificated aircraft.

2. Types of inspection, by whom conducted, when required and records of same, periodic, for renewal of certificate, following repair or alteration.

3. Use and preparation of Repair and Alteration forms following repairs or alterations, and other data, drawings, etc. which may be required.

SECTION 3.--ENGINE CURRICULUM

A. Engines, Theory and Principle of Operation.

1. The engine and its parts, nomenclature, etc.

2. The theory of operation of the 4-cycle engine.

3. Energy conversion to useful power, reciprocal to rotary motion.

4. Transmission of power, gears, gear reduction and ratio, etc.

5. Horsepower, meaning and how determined.

B. Mechanical Drawing.

Same as for aircraft.

C. Operation, Overhaul, Repair and Installation.

1. Thorough instruction in starting, stopping, operation and trouble shooting as applying to aircraft engines.

2. Detailed procedure and practice in complete disassembly of engines.

3. Instructions and practice in the procedure of cleaning for inspection and inspection of engine parts.

4. Specifications and tolerances, limitations and how determined, where obtained.

5. Progressive steps and procedure to be used in proper assembly of an engine, valve and ignition timing, adjustments and tolerances used; method, procedure and verification of adjustments.

6. Checking and testing of an overhauled engine.

7. Instruments, equipment, and special tools required for the proper overhaul of an engine and for determining tolerances and wear, and the use of these instruments.

8. Instructions pertaining to the use of magnafluxing, its purpose, where used and procedure for use.

9. Parts most susceptible to wear and failure.

10. Regulations pertaining to replacement parts, airworthiness, proof of conformity, etc., as applying to the overhaul of certificated aircraft engines.

11. Regulations pertaining to welding of engine structural parts.

12. Installation in aircraft including all connections and controls, precautions to be observed, etc.

13. Cooling, types, purpose, means obtained, failures, service, repairs, and inspection.

D. Carburetion.

1. Carburetion, theory and principle of.

2. Carburetors, types, their construction and operation, repair, maintenance, adjustment and inspection.

3. Effect on carburetion by variation in temperature, humidity, and atmospheric pressure.

4. Induction systems, diffusers, blowers, and superchargers, types, construction and operation, purpose, maintenance, and repair, precautions in use of and inspection.

5. Carburetor heaters and air mazes, purpose, construction, installation, operation, care and maintenance.

6. Installation of carburetors. Procedure and precautions to be observed.

7. Carburetor troubles and failures and corrective measures.

8. Carburetor parts and nomenclature, and purpose of each.

E. Electrical Appliances and Ignition

1. Ignition system, theory of.

2. Ignition, magneto and battery, single and dual, types of each, their construction, operation, maintenance, repair and inspection.

3. Ignition systems, parts and nomenclature, location, construction, and purpose of each, common failures, causes and corrections.

4. Boosters, types, purpose, location, installation, operation, grounding, and precautions in the use of.

5. Ignition system, timing and synchronization, shielding and wiring.

6. Starters, types, construction, installation, operation, maintenance, repair and inspection.

7. Generators, types, purpose, operation, installation, maintenance, repair and inspection.

8. Batteries, types, construction, installation, maintenance, and precautions to be observed in the installation and use of.

9. Spark plugs, types, hot and cold, high compression, etc., adjustment, maintenance, repair and inspection.

F. Lubrication.

1. Theory, purpose and history of lubrication.

2. Oils and lubricants, types, grades and properties.

3. Lubrication systems, dry and wet sump, splash and pressure.

4. Pumps, types, installation, location, actuation, operation, construction, maintenance, repair and inspection.

5. Lines, hose connection, tanks, drains, vents, filters, etc., their installation, care and inspection.

6. Heating and cooling, radiators, lagging, etc. Installation, maintenance, repair and inspection.

7. Pressure relief valves. Types, location, purpose, adjustments, maintenance, repair and inspection.

G. Propellers.

1. Types, wood and metal, fixed, adjustable, controllable, automatic, feathering, etc.

2. Diameter and pitch, ground and structure minimum clearance.

3. RPM and HP rating, and limitations in use.

4. Propeller, including hub and blade, identification data, location, etc.

5. Maintenance and servicing of propellers, extent of and by whom to be made.

6. Civil Air Regulations pertaining to modification, extent of and by whom to be made, including changes in markings.

7. Theory of local etching and magnafluxing, procedure, purpose and extent.

8. Tracking of propellers, purpose and procedure.

9. Regulations pertaining to repairs to damaged wood propellers and metal propeller blades and hubs. Extent of repairs permissible and by whom to be made. Records, where recorded and by whom made. Ground for rejection.

10. Propeller installation and proper fitting, changes in installation to reduce vibration.

11. Equipment, tools and instruments necessary to properly adjust, service and make such repairs as are permissible, and the use and care of this equipment.

H. *Shop Work, Practice and Procedure.*

1. Bench and shop equipment, instruments and hand tools, their use and care.

2. Proper use and care of all tools, equipment, instruments, et cetera, as listed in *Facilities, Equipment and Material prescribed for the use of*, and required for the construction, maintenance, repair, overhaul and inspection, including the rigging of an aircraft and its appliances, and/or the construction, maintenance, operation, overhaul, repair and inspection of an aircraft engine and propeller and their appliances.

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SECTION 4.--FACILITIES, EQUIPMENT, AND MATERIAL

A. A drafting room with drafting tables and equipment.

B. A stock room set up to insure the proper segregation of materials.

C. Suitable separate space, temporary or permanent structure, for doping, including proper ventilation and temperature control.

D. Suitable separate space equipped with wash tank and air pressure cleaning equipment.

E. Suitable separate space provided with test stands for running in engines.

F. Suitable separate space provided with the necessary tables and benches, instruments and equipment to disassemble, repair, assemble, test, service and inspect the following:

1. Ignition, electrical equipment and appliances.

2. Carburetors and fuel systems.

3. Hydraulic and vacuum systems as applying to the actuation of aircraft and engines and their appliances.

G. Suitable space including tables, benches, horses, tail stands, etc., for the disassembly, inspection, assembly, and rigging of an aircraft.

H. Various types of fuselages, wings, control surfaces, landing gear, engines, propellers and their appliances, including instruments, communication aids and electrical equipment and appliances. This equipment shall include various types of modern American made aircraft, engines and propellers. The propellers shall be of fixed type, wood and metal, and adjustable and controllable metal. The engines shall include at least one opposed type, one in-line type, one radial type, one super charged type, and shall include at least one radial engine of not less than 350 horsepower. Also there shall be provided at least one modern type aircraft complete with engine, propeller, instruments, radio (two-way), landing lights, flares, and other items of equipment on which a mechanic might be required to work and with which he should be familiar.

The other various items of equipment, components, parts and appliances shall be of various types and makes, sufficiently diversified, to indicate the different manners of construction, assembly and operation when installed on an aircraft for use.

(Note: The foregoing equipment is not required to be in an airworthy condition and may have been damaged, provided it has been repaired sufficiently for complete assembly.)

I. An adequate supply of power plant and flight instruments and two-way radio communication equipment and facilities to provide a means of giving proper instruction in the installation and checking of these items in actual use.

J. An adequate supply of raw materials which are used in the construction, maintenance, repair and overhaul of aircraft, such as steel tubing, sheet metals, wood, rivets, bolts, pins, fabric, dope, glue, etc.

K. The following tools and miscellaneous items, the quantity to be governed by the number of students enrolled, shall be sufficient to assure each and every student of proper instruction in their purpose, use, and care:

1. Bench and shop, hand tools.
2. Micrometers, inside and outside.
3. Protractor and level.
4. Surface plates.
5. Trammel and plumb bob.
6. Mandrels, sufficient in number and size to provide for adequate instruction in their use.
7. V-blocks and truing stand.
8. Buffers, one of which shall be portable.
9. Emery wheels.
10. Spray gun.
11. Sewing machine, suitable for sewing aircraft covering.
12. Press and portable drills.
13. Band and rip saws.
14. Lathe
15. Planer or joiner for woodworking.
16. Welding equipment with proper assortment of torch tips and supplies.
17. Cutting and forming tools.
18. Benches, vises, saw horses, and step ladders.
19. Soldering equipment.

20. Brazing equipment.

21. Sanding machine.

22. Sand blasting equipment.

23. Bending and forming tools and equipment.

24. Air rivet hammer with controls and indicator.

25. Heat treating equipment for rivets and small structural parts.

26. Equipment for applying, and material to be used, for protective purposes and finish, on metal, wood, and fabric.

27. Cable splicing equipment.

28. Magnifying glasses of at least 4-6 power.

29. Suitable equipment for annealing and bending fuel and oil lines.

30. Steel tape at least 50 feet long.

31. Suitable equipment for localized etching of propellers.

32. Suitable equipment for measuring pitch angles.

33. No-go gauge, one for use on propeller splines and one for measurement of tolerances, as for valve guides, etc.

34. Suitable equipment for steaming and bending of aircraft wood.

35. Suitable equipment for making glued, wood joints.

36. Suitable equipment for testing glued joints.

37. Air Compressor, with pertinent attachments and supplies.

38. Suitable space, tables, engine stands and special tools required for disassembly, inspection, assembly, and timing of engines, including reamers, taps, valve grinding tools, valve seat cutters, and the like.

39. Block and tackle equipment, or portable crane, satisfactory to the Authority.

40. Propeller hub puller.

41. Equipment for checking alignment of crankshaft, master rods, and connecting rods which is satisfactory to the Authority.

42. High pressure spark plug testing machine.

43. Spline adapter and stand.

44. Adequate glue presses or clamps.

45. Wood propeller tipping material.

46. Scrapers, wood and riffle files, and tin snips or metal shears.

47. Blow torch and heating torch.

48. Batteries and sufficient equipment to give instruction in testing and charging of batteries.

The tools and shop equipment described herein shall be in a satisfactory working condition and shall be of a type and design proper for the purpose for which each is to be used. All instruments, testing equipment, and special equipment required for testing, servicing and overhauling aircraft, engines, propellers, electrical equipment and their appliances as specified herein shall be in a satisfactory working condition and shall be of a type and design proper for the purpose for which each is to be used, and satisfactory to the Authority.

Units of equipment on which instruction is to be given and on which practical experience is to be obtained in shop practice, such as aircraft, engines, propellers, appliances, electrical units, and the like, shall be provided in sufficient number to assure that all students shall receive such experience and instruction thereon as is indicated in the school curriculum, with not more than eight students working on any single unit at any one time.

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