

GOVERNMENT GAZETTE

OF THE

REPUBLIC OF NAMIBIA

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Government Notice

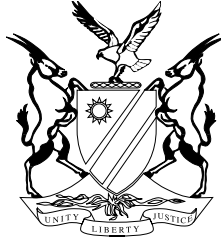
MINISTRY OF WORKS, TRANSPORT AND COMMUNICATION

No. 54

2004

NAMIBIAN CIVIL AVIATION TECHNICAL STANDARDS NAM-CATS-AMEL "AIRCRAFT MAINTENANCE ENGINEER LICENSING"

The Director: Civil Aviation has under regulation 11.035 of the Namibian Civil Aviation Regulations, 2001 and in consultation with the Civil Aviation Regulations Committee issued the technical standards in the schedule. These technical standards shall come into operation on 1 April 2004.



REPUBLIC OF NAMIBIA

CIVIL AVIATION

**DOCUMENT NAM-CATS-AMEL
(AIRCRAFT MAINTENANCE ENGINEER LICENSING)**

NAMIBIAN CIVIL AVIATION TECHNICAL STANDARDS RELATING TO AIRCRAFT MAINTENANCE ENGINEER LICENSING

1. GENERAL

Section 22A of the Aviation Act, 1962 (as amended by section 5 of the Aviation Amendment Act, 1998) empowers the Director: Civil Aviation to issue technical standards for civil aviation on the matters which are prescribed by regulation.

The Director: Civil Aviation has pursuant to the empowerment mentioned above, on 1 April 2004 issued technical standards relating to aircraft maintenance engineer licensing to be known as Document NAM-CATS-AMEL.

2. PURPOSE

Document NAM-CATS-AMEL contains the standards, rules, requirements, methods, specifications, characteristics and procedures which are applicable in respect of aircraft maintenance engineer licensing.

Each reference to a technical standard in this document, is a reference to the corresponding regulation in the Civil Aviation Regulations, 2001, for example, technical standard 66.02.2 refers to regulation 2 of Subpart 2 of Part 66 of the Regulations.

The abbreviation "CAR" is used throughout this document when referring to a regulation. The abbreviation "TS" refers to any technical standard.

3. SCHEDULES AND NOTES

Guidelines and recommendations in support of any particular technical standard, are contained in schedules to, and/or notes inserted throughout the technical standards.

LIST OF TECHNICAL STANDARDS

66.01.9 VALIDATION OF LICENCE ISSUED BY APPROPRIATE AUTHORITY

1. Form of application
2. Requirements and conditions
3. Form of validation
4. Renewal of validation
5. Requirements and conditions

66.01.11 DESIGNATION OF EXAMINERS

1. Conditions, rules, requirements, procedures or standards for designation of examiners

66.02.2 TRAINING

1. Core syllabus for the trade : AIRCRAFT ENGINE AND AIRFRAME TECHNICIAN
2. Core syllabus for the trade : AIRCRAFT STRUCTURES WORKER
3. Core syllabus for the trade : AIRCRAFT INSTRUMENT TECHNICIAN
4. Core syllabus for the trade : AIRCRAFT AVIONICS
5. Core syllabus for the trade : AIRCRAFT ELECTRICIAN

66.02.3 THEORETICAL KNOWLEDGE EXAMINATION

1. Entry requirements and procedures for theoretical knowledge examinations
2. Knowledge requirements
3. Retesting after failure

66.02.4 EXPERIENCE

1. Category A (aeroplanes) : Issue or addition of Category A
2. Category A (aeroplanes) : Extension of Category A
3. Category B : Issue or addition of Category B
4. Category B : Extension of Category B
5. Category C (engines) : Issue or addition of Category C
6. Category C (engines) : Extension of Category C
7. Category D (engines) : Issue or addition of Category D
8. Category D (engines) : Extension of Category D
9. Categories A and C (rotorcraft, including engines) : Issue or addition of Categories A and C
10. Categories A and C (rotorcraft, including engines) : Extension of Categories A and C
11. Category X (automatic pilots) : Issue or addition of Category X (automatic pilots)
12. Category X (automatic pilots) : Extension of Category X (automatic pilots)
13. Category X (compasses) : Issue or addition of Category X (compasses)
14. Category X (compasses) : Extension of Category X (compasses)
15. Category X (electrical equipment) : Issue or addition of Category X (electrical equipment)
16. Category X (ignition equipment) : Issue or addition of Category X (ignition equipment)
17. Category X (instruments) : Issue, addition or extension of Category X (instruments)
18. Category X (variable-pitch propellers) : Issue or addition of Category X (variable-pitch propellers)
19. Category X (avionic equipment) : Issue or addition of Category X (avionic equipment)
20. Category X (avionic equipment) : Extension of Category X (avionic equipment)
21. Category X (aircraft welding) : Issue or addition of Category X (aircraft welding)
22. Category X (aircraft welding) : Extension of Category X (aircraft welding)
23. Category W : Issue or addition of Category W
24. Category W : Extension of Category W

66.02.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF

1. Form of application

66.02.6 ISSUING OF LICENCE

1. Form of licence

66.02.9 RENEWAL OF LICENCE

1. Form of application
2. Form of renewal

66.02.10 REISSUE

1. Form of application

66.03.2 TRAINING (CATEGORY C)

1. Training standards

66.03.3 THEORETICAL KNOWLEDGE EXAMINATION

1. Written examination requirements
2. Retesting after failure

66.03.4 EXPERIENCE

1. Requirements

- 66.03.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**
1. Form of application
- 66.03.6 ISSUING OF LICENCE**
1. Form of licence
- 66.03.9 RENEWAL OF LICENCE**
1. Form of application
2. Form of renewal
- 66.03.10 REISSUE**
1. Form of application
- 66.04.2 TRAINING (CATEGORY W)**
1. Training standards
- 66.04.3 THEORETICAL KNOWLEDGE EXAMINATION**
1. Written examination requirements
2. Retesting after failure
- 66.04.4 EXPERIENCE**
1. Requirements
- 66.04.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**
1. Form of application
- 66.04.6 ISSUING OF LICENCE**
1. Form of licence
- 66.04.9 RENEWAL OF LICENCE**
1. Form of application
2. Form of renewal
- 66.04.10 REISSUE**
1. Form of application
- 66.05.2 TRAINING (CATEGORY B)**
1. Training standards
- 66.05.3 THEORETICAL KNOWLEDGE EXAMINATION**
1. Written examination requirements
2. Retesting after failure
- 66.05.4 EXPERIENCE**
1. Requirements
- 66.05.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**
1. Form of application
- 66.05.6 ISSUING OF LICENCE**
1. Form of licence
- 66.05.9 RENEWAL OF LICENCE**
1. Form of application
2. Form of renewal
- 66.05.10 REISSUE**
1. Form of application
- 66.06.2 TRAINING (CATEGORY D)**
1. Training standards

- 66.06.3 THEORETICAL KNOWLEDGE EXAMINATION**
1. Written examination requirements
2. Retesting after failure
- 66.06.4 EXPERIENCE**
1. Requirements
- 66.06.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**
1. Form of application
- 66.06.6 ISSUING OF LICENCE**
1. Form of licence
- 66.06.9 RENEWAL OF LICENCE**
1. Form of application
2. Form of renewal
- 66.06.10 REISSUE**
1. Form of application
- 66.07.2 TRAINING (CATEGORY X)**
1. Training standards
- 66.07.3 THEORETICAL KNOWLEDGE EXAMINATION**
1. Written examination requirements
2. Retesting after failure
- 66.07.4 EXPERIENCE**
1. Requirements
- 66.07.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**
1. Form of application
- 66.07.6 ISSUING OF LICENCE**
1. Form of licence
- 66.07.9 RENEWAL OF LICENCE**
1. Form of application
2. Form of renewal
- 66.07.10 REISSUE**
1. Form of application
- 66.08.2 TRAINING (AME INSTRUCTOR GRADE ONE)**
1. Training standards
- 66.08.3 THEORETICAL KNOWLEDGE EXAMINATION**
1. Written examination requirements
2. Retesting after failure
- 66.08.4 EXPERIENCE**
1. Requirements
- 66.08.5 APPLICATION FOR GRADE ONE AIRCRAFT MAINTENANCE INSTRUCTOR RATING**
1. Form of application
- 66.08.6 ISSUING OF GRADE ONE AIRCRAFT MAINTENANCE INSTRUCTOR RATING**
1. Form of rating

- 66.08.9 RENEWAL OF GRADE ONE AIRCRAFT MAINTENANCE INSTRUCTOR RATING**
1. Form of application
 2. Form of renewal
- 66.09.2 TRAINING (AME INSTRUCTOR GRADE TWO)**
1. Training standards
- 66.09.3 THEORETICAL KNOWLEDGE EXAMINATION**
1. Written examination requirements
 2. Retesting after failure
- 66.09.4 EXPERIENCE**
1. Requirements
- 66.09.5 APPLICATION FOR GRADE TWO AIRCRAFT MAINTENANCE INSTRUCTOR RATING**
1. Form of application
- 66.09.6 ISSUING OF GRADE TWO AIRCRAFT MAINTENANCE INSTRUCTOR RATING**
1. Form of rating
- 66.09.9 RENEWAL OF GRADE TWO AIRCRAFT MAINTENANCE INSTRUCTOR RATING**
1. Form of application
 2. Form of renewal

SCHEDULE 1: WELDING REQUIREMENTS

ANNEXURE A: APPLICATION FOR THE VALIDATION OF A FOREIGN AIRCRAFT MAINTENANCE ENGINEER LICENCE

ANNEXURE B: VALIDATION OF A FOREIGN AIRCRAFT MAINTENANCE ENGINEER LICENCE

ANNEXURE C: APPLICATION FOR AN AIRCRAFT MAINTENANCE ENGINEER LICENCE

APPLICATION FOR THE AMENDMENT OF AN AIRCRAFT MAINTENANCE ENGINEER LICENCE

APPLICATION FOR THE RENEWAL OF AN AIRCRAFT MAINTENANCE ENGINEER LICENCE

APPLICATION FOR THE REISSUING OF AN AIRCRAFT MAINTENANCE ENGINEER LICENCE

ANNEXURE D: AIRCRAFT MAINTENANCE ENGINEER LICENCE

RENEWAL OF AIRCRAFT MAINTENANCE ENGINEER LICENCE

ANNEXURE E: APPLICATION FOR AN AIRCRAFT MAINTENANCE INSTRUCTOR RATING

APPLICATION FOR THE RENEWAL OF AN AIRCRAFT MAINTENANCE INSTRUCTOR RATING

ANNEXURE F: AIRCRAFT MAINTENANCE INSTRUCTOR RATING

RENEWAL OF AIRCRAFT MAINTENANCE INSTRUCTOR RATING

66.01.9 VALIDATION OF LICENCE ISSUED BY APPROPRIATE AUTHORITY**1. Form of application**

The form referred to in CAR 66.01.9(1), on which application is made for the validation of a licence issued by an appropriate authority, is contained in Annexure A.

2. Requirements and conditions

The requirements and conditions referred to in CAR 66.01.9(3), are the following:
(Reserved.)

3. Form of validation

The form referred to in CAR 66.01.9 (4) (a), in which a licence is validated, is contained in Annexure B.

4. Renewal of validation

The circumstances and conditions referred to in CAR 66.01.9(5), for the renewal of a validation, are the following:
(Reserved.)

5. Requirement and conditions

The requirements and conditions referred to in CAR 66.01.9(6), are the following:
(Reserved.)

66.01.11 DESIGNATION OF EXAMINERS

- 1. Conditions, rules, requirements, procedures or standards for designation of examiners**
(Reserved.)

66.02.2 TRAINING**1. Core syllabus for the trade : AIRCRAFT ENGINE AND AIRFRAME TECHNICIAN****1.1 Introduction**

- (1) Organisational administration and policy
- (2) Aviation Act, 1962
- (3) NAMCARS and NAMCATS
- (4) Conditions of apprenticeship

1.2 Safety

- (1) Occupational Health and Safety
- (2) Approved first aid course
- (3) Fire fighting - approved
- (4) Incident reporting

1.3 Engineering practices

- (1) Identify, care and use of handtools
- (2) Use of torque wrenches and deadweight testing (Acro Torque)
- (3) Standard torques and charts
- (4) Ferrous and non-ferrous metals
- (5) Heat treatment of materials (hardening, case hardening, tempering, normalising, hardness test)
- (6) Identification and control of corrosion
- (7) Read engineering drawings and perform layout
- (8) Read and use measuring instruments (verniers, micrometers, vernier height gauges, dial test indicators and combination sets)
- (9) Use of callipers and dividers

- (10) Use of precision gauges (cylinder bore-, radius- hole-, telescopic-, drill point, snap-, ring-, slip-, sine- and weighting scale)
- (11) Read and use of steel rule and tape
- (12) Care and use of hand files
- (13) Care and use of hacksaws
- (14) Care and use of bandsaws
- (15) Identification and safe use of a pedestal drill
- (16) Identification and safe use of a bench grinder
- (17) Replace and dress a grinding wheel
- (18) Grinding of drill bits, punches and chisels
- (19) Drilling, tapping and reaming of holes
- (20) External and internal threading
- (21) Identification of screw threads
- (22) Repair of heli-coils
- (23) Stud removal
- (24) Manufacturing of projects

1.4 **Standard practices**

- (1) Selection of use of information-, procedures-, overhaul-, maintenance-, Illustrated Parts Catalogue manuals and Civil Aviation Regulations, 2001
- (2) Aircraft hardware and locking procedures
- (3) Jacking and levelling of aircraft
- (4) Determine the mass of an aircraft
- (5) Marshalling signals
- (6) Aircraft towing
- (7) Aircraft refuelling
- (8) Aircraft labels
- (9) Aircraft fluids (contamination, fuels, hydraulic fluids, oils, greases and inhibiting)
- (10) Cleaning solvents and compounds
- (11) Perform liquid penetrant and fluorescent dye inspection
- (12) Identify solid and flexible tubing
- (13) Flaring, bending and cutting of solid tubing
- (14) Solid and flexible end fittings
- (15) Testing of tubings
- (16) Maintenance of plain-, shell-, ball-, roller- and taper bearings
- (17) Common bearing faults

1.4.1 **Piston engines**

- (1) Identify different types of engines
- (2) Principles of operation
- (3) Identify major sections
- (4) Disassemble and assemble engines
- (5) Change components
- (6) Cleaning methods
- (7) Perform visual and dimensional inspections (cylinder, piston accessories, nips, crankshaft, reduction gear assembly, alignment checks and final inspections)
- (8) Magneto timing
- (9) Grinding of valves and valve seats
- (10) Sparkplug cleaning
- (11) Blowby check
- (12) Engine overhaul
- (13) Engine inhibiting
- (14) Engine testing

1.4.2 **Propellers**

- (1) Construction, description and operation
- (2) Replacement
- (3) Propeller overhaul

1.4.3 **Gas turbines**

- (1) Identify different types and major sections
- (2) Construction, description and operation

- (3) Lubrication system
- (4) Overhaul procedures (visual, dimensional and cleaning)
- (5) Change components
- (6) Remove, inspect and replace compressor and turbine blades
- (7) Measure creep
- (8) Strip and assemble accessory gearbox
- (9) Engine testing and inhibiting

1.4.4 **Hydraulics**

- (1) Identify components
- (2) Hydraulic operation principles
- (3) Construct a basic system
- (4) Service a system
- (5) Overhaul components
- (6) Change components
- (7) Operate systems

1.4.5 **Flight controls**

- (1) Mechanics of flight (low and high speed)
- (2) Terms and definitions
- (3) Axis of an aircraft
- (4) Flight controls (low and high speed)
- (5) Basic components
- (6) Terms and definitions
- (7) Major stresses
- (8) Major components
- (9) Wing forms and components
- (10) Fuselage types and components
- (11) Control rigging
- (12) Primary and secondary systems
- (13) Types of tensionmeters
- (14) Temperature and tension charts
- (15) Set cable tension
- (16) Identify inclinometers
- (17) Set surface travel
- (18) Carry-out rigging checks

1.4.6 **Safety equipment**

- (1) Not core. As required by organisation.

1.4.7 **Engine servicing**

- (1) Not core. As required by organisation.
- (2) Landing gear
- (3) Landing gear systems
- (4) Service a wheel assembly
- (5) Service an oleo leg
- (6) Service a brake assembly
- (7) Service a brake system
- (8) Do an operational check
- (9) Set wheel alignment
- (10) Principles of operation of an aircraft's secondary systems
- (11) Pneumatic system
- (12) Identify components
- (13) Maintain components

1.4.8 **Inspections**

- (1) Inspection techniques
- (2) Pre-flight inspections
- (3) Between flight inspections
- (4) After flight inspections
- (5) Weekly inspections
- (6) Flight control system inspection

- 1.4.9 **Rotorcraft**
- (1) Rotorcraft theory
 - (2) Major transmission components
 - (3) Replace components
 - (4) Strip and assemble main rotor head
 - (5) Strip and assemble tail rotor head
 - (6) Strip and assemble tail and main rotor gear box
 - (7) Strip and assemble incline shaft, brake, clutch unit, free wheel unit
 - (8) Rotorcraft mass and balance
 - (9) Notar theory
 - (10) Notar blade inspection
 - (11) Rotor blade maintenance
- 1.4.10 **Structures and plastics**
- (1) Install aircraft rivets
 - (2) Mark-off projects
 - (3) Cut out projects
 - (4) Drill materials
 - (5) Bend materials
 - (6) Assemble materials
 - (7) Inspection of fabric covered materials
 - (8) Repair of fabric covered materials
- 1.4.11 **Batteries**
- (1) Service a battery
- 1.4.12 **Avionic mechanical**
- (1) Electron theory
 - (2) Properties of conductors and insulators
 - (3) Theory of electric charges
 - (4) Current flow and potential difference
 - (5) Methods of generating electricity
 - (6) Fundamentals of magnetism
 - (7) Operation of an electromagnet
 - (8) Measure volts, amperes and resistance
 - (9) Ampmeter and voltmeter range conversions
 - (10) Ampmeters and voltmeters connected in circuits
 - (11) Factors controlling resistance
 - (12) Resistance value and power rating
 - (13) Identify components in a simple circuit
 - (14) Calculate resistance of a series resistive network
 - (15) Calculate resistance of a parallel resistive network
 - (16) Kirchhoff's voltage and current laws
 - (17) Construct series and parallel circuits
 - (18) Theory of alternating current
 - (19) Various alternating current meters
 - (20) Ohm's law to determine amps, volts, resistance and power consumed in a pure resistive alternating current circuit
 - (21) Characteristics of inductance in alternating and direct current circuits
 - (22) Calculate inductances in series and parallel, inductive time constant and inductive circuits
 - (23) Apparent power and true power in an alternating current circuit
 - (24) Theory of capacitance
 - (25) Construction of different capacitors
 - (26) Characteristics of capacitance in direct and alternating currents
 - (27) Calculate capacitive time constant and reactance
 - (28) Theory and operation of a step up, step down and auto transformers
 - (29) Design and construct a step up and step down transformer
 - (30) Identify and select aircraft instrumentation
 - (31) Navigation radio communication principles
 - (32) Techniques of soldering practices
- 1.4.13 **Experience**
- (1) 80% of core and 20% of organisation requirements

1.4.14 Revision

- (1) Trade syllabus review.

2. Core syllabus for the trade : AIRCRAFT STRUCTURES WORKER**2.1 Introduction**

- (1) Organisational administration and policy
- (2) Aviation Act, 1962
- (3) NAMCARS and NAMCATS
- (4) Conditions of apprenticeship

2.2 Safety

- (1) Occupational Health and Safety
- (2) Approved first aid course
- (3) Fire fighting - approved
- (4) Incident reporting

2.3 Engineering practices

- (1) Apply sealants
- (2) Bend and roll material (bending allowances)
- (3) Correct use of pneumatic hand drills
- (4) Countersinking of holes
- (5) Deburr of holes
- (6) Identification, care and use of handtools
- (7) Identification, safe use of bench grinders, pedestal drill (replace and dress of grinding wheels)
- (8) Identify sealants and joints
- (9) Identify corrosion and treatments
- (10) Install temporary fasteners
- (11) Identification of rivets and defects (countersink and universal)
- (12) Installation of various types of fasteners
- (13) Identify profiles, abbreviations, extrusions, joints and radii
- (14) Identify various aircraft materials
- (15) Interpretation of manufacturers manuals
- (16) Installation of universal and countersink rivets and obtaining the correct bucktails
- (17) Manufacturing of various projects
- (18) Manufacturing and repairing of various aircraft components (stress skin repairs etc)
- (19) Manufacturing and repairing aircraft flex and solid tubing
- (20) Oxygen acetylene gas welding - heat treatment
- (21) Polishing of aircraft materials
- (22) Protective coatings
- (23) Read and use of measuring instruments (verniers, micrometers, rulers (metric and imperial) height gauges)
- (24) Removing of rivets and fasteners
- (25) Reaming of holes for various fasteners
- (26) Read and identify more complexed aircraft drawings
- (27) Stretch, crimp and form aircraft materials
- (28) Safety precautions and use of guillotine
- (29) Workout of bending allowances

2.3.1 Experience

- (1) 80% of core and 20% of organisation requirements.

2.3.2 Revision

- (1) Trade syllabus review.

3. Core syllabus for the trade : AIRCRAFT INSTRUMENT TECHNICIAN**3.1 Introduction**

- (1) Organisational administration and policy
- (2) Aviation Act, 1962
- (3) NAMCARS and NAMCATS
- (4) Conditions of apprenticeship

3.2 Safety

- (1) Occupational Health and Safety Act
- (2) Approved first aid course
- (3) Fire fighting - approved
- (4) Incident reporting

3.3 Engineering practices**3.3.1 Soldering**

- (1) Soldering and soldering process
- (2) Soldering to turret terminals
- (3) Soldering to cup terminals
- (4) Soldering to bifurcated terminals
- (5) Soldering hook, pierced and lug terminals
- (6) Axial lead components
- (7) Soldering IC
- (8) TO-5 type IC package and other multi lead devices

3.3.2 Electricity

- (1) AC/DC voltage with AVO meter
- (2) AC/DC current with AVO meter
- (3) Resistance with AVO meter
- (4) AC/DC voltages with digital multimeter
- (5) AC/DC current with digital multimeter
- (6) Resistance with digital multimeter
- (7) Values and tolerances of resistors
- (8) Values and tolerances of potentiometers
- (9) Resistance of series/parallel combination of resistors
- (10) Kirchhoff's voltage and current laws
- (11) OHM's law determine current, voltage and resistance in basic circuit
- (12) Power in DC load and maximum power transfer
- (13) Trouble shoot series and/or parallel circuits
- (14) Block diagram of power supply
- (15) Power supply with voltage and current specifications
- (16) AC voltages, current and measuring peak RMS values
- (17) AC/DC voltages with oscilloscope
- (18) Block diagram of function generator
- (19) Generates sine waves with function generator
- (20) Generate square waves with function generator
- (21) Time duration with oscilloscope
- (22) Frequency and phase difference with oscilloscope
- (23) Testing of inductors
- (24) Measure inductance, reactance and resistance of coil
- (25) Frequency and phase relationships of coil
- (26) Effect on DC on inductance of iron core choke
- (27) Impedance of RL circuit
- (28) Relationship that exists in RL CCT
- (29) Identify values of capacitors
- (30) Capacitance of capacitors in series and parallel
- (31) Capacitive reactance of capacitor
- (32) Voltage across capacitors and capacitor voltage dividers
- (33) Charging and discharging of capacitor
- (34) Phase angle between voltage, current in capacitive circuit.

3.3.3 Electronics

- (1) Atomic and semiconductor theory
- (2) Diode applications
- (3) Construct a transformer fed full and half wave rectifier
- (4) Testing of zener diodes
- (5) Valves of OPTO electronic devices
- (6) Operation of active filters
- (7) Testing of bridge rectifiers

- (8) Test a transistor
- (9) Construct a common base amplifier
- (10) Construct a common emitter amplifier
- (11) Construct a common collector amplifier
- (12) Field effect transistors
- (13) Metal oxide field effect transistors
- (14) Test a unijunction transistor
- (15) Test a thyristor
- (16) Construction and operation of switches
- (17) Test a thyristor
- (18) Voltage multipliers
- (19) Voltage regulation
- (20) Construct monostable
- (21) Construct a astable CCT
- (22) Construct bistable
- (23) Introduction to Operational amplifiers
- (24) Operational Amplifiers in DC CCT
- (25) Operational Amplifiers in AC CCT
- (26) Typical applications
- (27) Block diagram and operation of an oscilloscope

3.3.4 Digitals

- (1) Digital techniques in electronics
- (2) Binary no system
- (3) Binary coded octal system
- (4) Binary coded hexa-decimal system
- (5) Decimal to binary, vice versa
- (6) Binary to octal, vice versa
- (7) Binary to hexa-decimal, vice versa
- (8) Basic logic functions
- (9) Truth tables for: AND, OR, NOR, NAND
- (10) Re-design CCT by using NAND or OR gates
- (11) Boolean equations for logic functions
- (12) Simplificate by boolean algebra and karnaugh maps
- (13) Propagation delay
- (14) Power dissipation
- (15) Noise shielding
- (16) Fan out/in
- (17) Logic levels
- (18) TTL logic
- (19) MOS logic
- (20) Scottky TTL
- (21) Three state devices
- (22) Data busses
- (23) Identify different packages
- (24) Flip-flops
- (25) Counters
- (26) Arithmetic CCT
- (27) Combine logic CCT
- (28) Processor language
- (29) Introduction to microprocessors
- (30) Internal organisation of microprocessors
- (31) Computer memory

3.3.5 Theory of flight

- (1) Terms and definitions
- (2) Aircraft controls
- (3) Facts of aircraft stability
- (4) Identification and operation of gas turbine engines
- (5) Operation of engine and flight instruments

3.3.6 Hand tools and hand skills

- (1) Hand tools
- (2) Linear measuring tools
- (3) Use steel rule and tape
- (4) Set calliper and divider using rule
- (5) Vernier inside, outside and depth
- (6) Vernier height gauge
- (7) Use of micrometers
- (8) Use of a hacksaw
- (9) Manufacture a workpiece
- (10) Layout using scriber, vernier height gauge, steel ruler or tape
- (11) Bench grinder
- (12) Grinding wheels
- (13) Grind drill bit
- (14) Drill press
- (15) File to layout
- (16) Drill and ream holes
- (17) Internal thread by using hand taps
- (18) External thread by using hand dies
- (19) Locking devices
- (20) Use of screwdrivers and spanners

3.3.7 Pitot and static units

- (1) Basic principles of pitot static
- (2) Vacuum chamber
- (3) Barometer
- (4) Altimeters
- (5) Mach indicator
- (6) Outflow valve and pressure switches
- (7) VSI
- (8) Airspeed

3.3.8 Mechanical watches

- (1) Watches

3.3.9 Pressure switches

- (1) Altitude switch
- (2) Principles of pressure switch
- (3) Oils pressure switch

3.3.10 Basic compass

- (1) Aircraft magnetism
- (2) Magnetic properties
- (3) Identify components
- (4) Direction of magnetic field
- (5) Standby compass

3.3.11 Oxygen

- (1) Properties of oxygen
- (2) General life support
- (3) Testing
- (4) Precautions

3.3.12 Moving coil meters

- (1) Moving coils
- (2) JPT

3.3.13 Fuel quantity and flow systems

- (1) Resistive type fuel system
- (2) Capacitive type fuel system
- (3) Indicator and TX

3.3.14 Methods of temperature measurement

- (1) Temperature measurement
- (2) Thermocouples
- (3) Resistive probes

3.3.15 Engine instruments

- (1) RPM test bench
- (2) RPM indicators
- (3) Tacho generators
- (4) Oil pressure theory
- (5) Oil pressure TX
- (6) Oil pressure indicators
- (7) RPM system
- (8) Vibration system
- (9) Fuel pressure

3.3.16 Display equipment

- (1) Construction of CRT
- (2) CRT deflection
- (3) Colour CRT

3.3.17 Synchro system

- (1) Synchro theory
- (2) Control synchro theory
- (3) Differential synchro theory
- (4) Dessyn system
- (5) Synchro TX theory
- (6) Synchro indicator theory

3.3.18 Gyroscopic instruments

- (1) Principles of operation
- (2) Artificial horizon
- (3) Turn and bank indicator
- (4) Directional indicator

3.3.19 Navigation systems

- (1) Operation of instrument landing system
- (2) RTII (Radio Magnetic Indicator)

3.3.20 Autopilots

- (1) Theory
- (2) Flight recorders
- (3) Recorders

3.3.21 Experience

- (1) 80% of core and 20% of organisation requirements.

3.3.22 Revision

- (1) Trade syllabus review

4. Core syllabus for the trade : AIRCRAFT AVIONICS TECHNICIAN**4.1 Introduction**

- (1) Organisational administration and policy
- (2) Aviation Act, 1962
- (3) NAMCARS and NAMCATS
- (4) Conditions of apprenticeship

4.2 Safety

- (1) Occupational Health and Safety
- (2) Approved first aid course

- (3) Fire fighting - approved
- (4) Incident reporting

4.3 **Engineering practices**

4.3.1 **Soldering**

- (1) Soldering and soldering process
- (2) Soldering to turret terminals
- (3) Soldering to cup terminals
- (4) Soldering to bifurcated terminals
- (5) Soldering hook, pierced and lug terminals
- (6) Axial lead components
- (7) Soldering IC
- (8) TO-5 type IC package and other multi lead devices
- (9) The flat pack
- (10) Desoldering

4.3.2 **Electricity**

- (1) Principles of electrostatics
- (2) Principles of conductors and insulators
- (3) Which active components operates with magnetism
- (4) Relays
- (5) Magnetic field about wire carrying current
- (6) Voltage will be induced in coil when moving through magnetic field
- (7) Magnetic field about bar and horse shoe magnets
- (8) Block diagram and operation of a VOM
- (9) Use of ECG manual
- (10) Block diagram and operation of digital multimeter
- (11) AC/DC voltages with AVO meter
- (12) AC/DC current with AVO meter
- (13) Resistance with AVO meter
- (14) AC/DC voltages with digital multimeter
- (15) AC/DC current with digital multimeter
- (16) Resistance with digital multimeter
- (17) Values and tolerances of resistors
- (18) Values and tolerances of potentiometers
- (19) Resistance of series/parallel combination of resistors
- (20) Kirchoff's voltage and current laws
- (21) OHM's law determine current, voltage and resistance in basic circuit
- (22) Power in DC load and maximum power transfer
- (23) Trouble shoot series and/or parallel circuits
- (24) Block diagram of power supply
- (25) Power supply with voltage and current specifications
- (26) AC voltages, current and measuring peak RMS values
- (27) AC/DC voltages with oscilloscope
- (28) Block diagram of function generator
- (29) Generates sine waves with function generator
- (30) Generate square waves with function generator
- (31) Time duration with oscilloscope
- (32) Frequency and phase difference with oscilloscope
- (33) Testing of inductors
- (34) Measure inductance, reactance and resistance of coil
- (35) Frequency and phase relationships of coil
- (36) DC effect on inductance of iron core choke
- (37) Impedance of RL circuit
- (38) Relationship that exists in RL CCT
- (39) Identify values of capacitors
- (40) Capacitors in series and parallel
- (41) Capacitive reactance of capacitor
- (42) Voltage across capacitors and capacitor voltage dividers
- (43) Charging and discharging of capacitor
- (44) Phase angle between voltage and current in pure capacitive circuit

- (45) Frequency change and connection in RL and RC circuits
- (46) Impedance of RC CCT
- (47) Relationship that exists in RC CCT
- (48) Effect of frequency on impedance on RLC CCT
- (49) Apparent power, true power and power factor in AC CCT
- (50) Resonant frequency of series LC CCT
- (51) Impedance of parallel RC and RLC CCT
- (52) Impedance in RLC CCT
- (53) Turns ratio and primary load current of insulation transformers
- (54) Parallel resonance
- (55) Types of batteries
- (56) Battery maintenance and storage
- (57) Battery internal resistance
- (58) Identify, test, apply fuses
- (59) Bandwidth of series resonance
- (60) Battery voltages in series and parallel
- (61) Series RC phase shift

4.3.3 Electronics

- (1) Atomic theory for semiconductors
- (2) Diodes and test
- (3) Transistor and test
- (4) Zener diode and test
- (5) Transformer full and half wave rectifier
- (6) Function generator
- (7) Sine waves
- (8) Common base amplifier
- (9) Common emitter amplifier
- (10) Common collector
- (11) Class A amplifier
- (12) Class B amplifier
- (13) Cascading (transformer)
- (14) Cascading (RC)
- (15) Cascading (direct)
- (16) Amplifier principle
- (17) Fault Finding 2 stage amplifier
- (18) Active filters
- (19) Differential amplifier
- (20) Complementary symmetry amplifier
- (21) Clipping and clamping
- (22) Fault find push pull amplifier
- (23) Operational amplifier
- (24) Regulated PSU
- (25) Voltage doubling and tripling
- (26) Audio amplifier construction
- (27) Test, trace and repair amplifier
- (28) FET
- (29) UJT
- (30) Plugs and sockets
- (31) Class C amplifier
- (32) RF amplifier cascading
- (33) RF amplifier test, trace and repair
- (34) Astable multivibrator
- (35) Bistable multivibrator
- (36) Schmidt trigger
- (37) Diagnostic testing on TV
- (38) TRIACS
- (39) SCR's
- (40) Bandwidth of common emitter amplifier
- (41) Bridge rectification

- (42) OPTO electronics
- (43) DIACS
- (44) AM signals with function generator
- (45) FM signals with function generator
- (46) RF generator
- (47) RF generator and AM modulation
- (48) RF generator and FM modulation
- (49) Carrier signals
- (50) Hartley oscillator
- (51) Colpitts oscillator
- (52) Phase shift oscillator
- (53) Crystal oscillator
- (54) Phase lock loop

4.3.4 **Digitals**

- (1) Basic logic function
- (2) TTL and MOS voltage levels
- (3) IC packaging
- (4) Practical reasons and uses
- (5) Binary number system
- (6) Positive and negative logic
- (7) Series/parallel data
- (8) RTL logic characteristics
- (9) TTL logic characteristics
- (10) DTL logic characteristics
- (11) Identify and explain logic levels
- (12) Identify and explain TTL logic levels
- (13) Introduction to microprocessors
- (14) Internal organisation of microprocessors
- (15) Computer memory
- (16) Processor language

4.3.5 **Theory of flight**

- (1) Terms and definitions
- (2) Aircraft controls
- (3) Facts of aircraft stability
- (4) Identification and operation of gas turbine engines
- (5) Operation of engine and flight instruments

4.3.6 **Hand tools and hand skills**

- (1) Hand tools
- (2) Linear measuring tools
- (3) Set calliper and divider using rule
- (4) Use a vernier
- (5) Vernier height gauge
- (6) Use steel rule and tape
- (7) Use of micrometer
- (8) Hacksaw cut to layout
- (9) Manufacture a workpiece
- (10) Layout using scribe, vernier height gauge, steel ruler or tape
- (11) Bench grinder
- (12) Grinding wheel
- (13) Grind drill bit
- (14) Drill press
- (15) File to layout
- (16) Drill and ream holes
- (17) Internal thread by using hand taps
- (18) External thread by using hand dies
- (19) Locking devices
- (20) Use of screwdrivers and spanner

4.3.7 Synchro's and servo's

- (1) Synchro and servo

4.3.8 Basic communication and antennas

- (1) Telephony
- (2) Volume and radio signals
- (3) Propagation and paths
- (4) Transmission lines
- (5) Antenna principles
- (6) Dipoles and vertical antenna's
- (7) UHF and antenna arrays
- (8) Practical demonstrator
- (9) Practical construction and SWR
- (10) Magnetic recording
- (11) Practical applications
- (12) Introduction to radar
- (13) TX block diagram-AM
- (14) RX block diagram-AM
- (15) RX block diagram-SSB
- (16) TX block diagram-SSB
- (17) TX block diagram-FM
- (18) RX block diagram-FM

4.3.9 Basic TX

- (1) Operator power amplifier - AM output
- (2) Master oscillator - A
- (3) Phase lock loop - AM
- (4) Balanced modulator SSB
- (5) FM TX construction
- (6) Pre lines TX fault finding
- (7) TX fault finding (symptoms)
- (8) TX fault finding (visual inspection)
- (9) TX fault finding (main dc checks)
- (10) TX fault finding (signal tracing)
- (11) TX fault finding (stage identification)
- (12) TX fault finding (stage DC checks)
- (13) TX fault finding (component Identification)
- (14) TX fault finding resistance confirm
- (15) Practical TX fault finding
- (16) SSB TX fault diagnostics

4.3.10 Basic RX

- (1) Mixers, oscillators and detectors
- (2) RX auxiliary CCT
- (3) RX practical AM detector
- (4) RX fault finding preliminary check
- (5) RX fault finding symptoms checks
- (6) RX fault finding visual inspect
- (7) RX fault finding main DC checks
- (8) RF probe and oscillator
- (9) RX fault finding signal injection
- (10) RX fault finding stage Identification
- (11) RX fault finding stage DC checks
- (12) RX fault finding component Identification
- (13) RX fault finding resistance confirmation
- (14) Practical RX fault finding
- (15) SSB RX fault diagnostics

- 4.3.11 **Display equipment**
 - (1) Radar displays
 - (2) Levels on TV unit
 - (3) Diagnostic testing
 - (4) Display equipment
- 4.3.12 **Navigation systems**
 - (1) ADF
 - (2) VOR
 - (3) ILS
 - (4) DME
 - (5) Radio altimeters
 - (6) ATC transponder
 - (7) Omega, VLF and weather radar
 - (8) Aircraft controls, locations and safety
 - (9) GPS
- 4.3.13 **Aircraft communication**
 - (1) IFF and transponder
 - (2) Aircraft intercom system
- 4.3.14 **High frequency equipment**
 - (1) Principle of operation, HF, UHF, VHF
- 4.3.15 **Experience**
 - (1) 80% of core and 20% of organisation requirements.
- 4.3.16 **Revision**
 - (1) Trade syllabus review

5. Core syllabus for the trade : AIRCRAFT ELECTRICIAN

- 5.1 **Introduction**
 - (1) Organisational administration and policy
 - (2) Aviation Act, 1962
 - (3) NAMCARS and NAMCATS
 - (4) Conditions of apprenticeship
- 5.2 **Safety**
 - (1) Occupational Health and Safety
 - (2) Approved first aid course
 - (3) Fire fighting - approved
 - (4) Incident reporting
- 5.3 **Engineering practices**
 - 5.3.1 **Soldering**
 - (1) Soldering and soldering process
 - (2) Soldering to turret terminals
 - (3) Soldering to cup terminals
 - (4) Soldering bifurcated terminals
 - (5) Soldering hook, pierced and lug terminals
 - (6) Axial lead components
 - (7) Soldering Integrated Circuit
 - (8) TO-5 type Integrated Circuit package and other multi lead devices
 - (9) The flat pack
 - (10) Desoldering
 - 5.3.2 **Electricity**
 - (1) Principles of electrostatics
 - (2) Principles of conductors and insulators

- (3) Principles of magnetism
- (4) Which active components operates with magnetism
- (5) Magnetic field about wire carrying current
- (6) Voltage will be induced in coil when moving through magnetic field
- (7) Magnetic field about bar and horse shoe magnets
- (8) Block diagram and operation of a VOM
- (9) Use of ECG manual
- (10) Block diagram and operation of digital multimeter
- (11) AC/DC voltages with AVO meter
- (12) AC/DC current with AVO meter
- (13) Resistance with AVO meter
- (14) AC/DC voltages with digital multimeter
- (15) AC/DC current with digital multimeter
- (16) Resistance with digital multimeter
- (17) Values and tolerances of resistors
- (18) Values and tolerances of potentiometers
- (19) Resistance of series/parallel combination of resistors
- (20) Kirchoff's voltage and current laws
- (21) OHM's law determine current, voltage and resistance in basic circuit
- (22) Power in DC load and maximum power transfer
- (23) Measure inductance, reactance and resistance of coil
- (24) Frequency and phase relationships of coil
- (25) DC effect on inductance of iron core choke
- (26) Impedance of RL circuit
- (27) Relationship that exists in RL CCT
- (28) Identify values of capacitors
- (29) Capacitors in series and parallel
- (30) Capacitive reactance of capacitor
- (31) Voltage across capacitors and capacitor voltage dividers
- (32) Charging and discharging of capacitor
- (33) Phase angle between voltage and current in pure capacitive circuit

5.3.3 Electronics

- (1) Construction and operation of switches
- (2) Test a thyristor
- (3) Voltage multipliers
- (4) Voltage regulation
- (5) Construct monostable
- (6) Construct a astable CCT
- (7) Construct bistable
- (8) Introduction to operational amplifiers
- (9) Operational amplifiers in DC CCT
- (10) Operational amplifiers in AC CCT
- (11) Typical applications
- (12) Block diagram and operation of an oscilloscope

5.3.4 Digitals

- (1) Digital techniques in electronics
- (2) Binary of system
- (3) Binary coded octal system
- (4) Binary coded hexa-decimal system
- (5) Decimal to binary vice versa
- (6) Binary to octal vice versa
- (7) Binary to hexa-decimal vice versa
- (8) Basic logic functions
- (9) Truth tables for: AND, OR, NAND and NOR gates
- (10) Re-design CCT by using NAND or OR gates
- (11) Boolean equations for logic functions
- (12) Simplificate by boolean algebra and karnaugh maps
- (13) Propagation delay
- (14) Power dissipation

- (15) Noise shielding
- (16) Fan out/in
- (17) Logic levels
- (18) TTL logic
- (19) MOS logic
- (20) Scottky TTL
- (21) Three-stage devices
- (22) Data busses
- (23) Identify different packages
- (24) Flip-flops
- (25) Counters
- (26) Arithmetic CCT
- (27) Combine logic CCT
- (28) Processor language
- (29) Introduction to microprocessors
- (30) Internal organisation of microprocessors
- (31) Computer memory

5.3.5 Theory of flight

- (1) Terms and definitions
- (2) Aircraft controls
- (3) Facts of aircraft stability
- (4) Identification and operation of gas turbine engines
- (5) Operation of engine and flight instruments

5.3.6 Hand tools and hand skills

- (1) Hand tools
- (2) Linear measuring tools
- (3) Use steel rule and tape
- (4) Set calliper and divider using rule
- (5) Vernier, inside, outside and depth
- (6) Vernier height gauge layout for inspection
- (7) Use of micrometer
- (8) Hacksaw cut to layout
- (9) Manufacture a workpiece
- (10) Layout using scribe, vernier height gauge, steel ruler or tape
- (11) Bench grinder
- (12) Dress a grinding wheel
- (13) Grind drill bit
- (14) Drill press
- (15) File to layout
- (16) Drill and ream holes
- (17) Internal thread by using hand taps
- (18) External thread by using hand dies
- (19) Locking devices
- (20) Use of screwdrivers and spanners

5.3.7 Servicing of aircraft wiring

- (1) Wire marking
- (2) Cable loom
- (3) Fault find and test of cable loom
- (4) Wire stripper and crimping tool
- (5) Plugs and sockets
- (6) Crimping of various terminals
- (7) Continuity tester
- (8) Meggar
- (9) Crimping of various splices
- (10) Electronic symbols, CCT diagrams
- (11) Busbars
- (12) CCT diagrams of AC/DC electrical systems

5.3.8 Operation, maintenance and servicing of DC machines

- (1) DC machines
- (2) Armature and commutator servicing
- (3) Field coil and measure its resistance
- (4) Brushes used in DC machines
- (5) Install brushes
- (6) Lubricants
- (7) Types of bearings
- (8) Lubrication and installation of bearings
- (9) Gears, clutches, brakes and switches
- (10) Inspection of gears, clutches, brakes and switches
- (11) O-rings and seals
- (12) Inspection of O-rings and seals
- (13) Lapping of steel and carbon seals
- (14) Fault finding on DC machines
- (15) Repair, service, overhaul and testing of DC generators
- (16) Repair, service, overhaul and testing of DC motors
- (17) Synchro and servos

5.3.9 Operation of aircraft batteries

- (1) Batteries
- (2) Voltage of battery in series and parallel
- (3) Internal resistance of dry cell
- (4) Safety precautions secondary cells
- (5) Use of hydrometer
- (6) Gravity readings of cells
- (7) Inspection of aircraft batteries
- (8) Test of aircraft batteries
- (9) Maintenance of aircraft batteries
- (10) Applications of voltage regulator
- (11) Fuses
- (12) Circuit breakers
- (13) Testing of DC control equipment
- (14) Testing of relays
- (15) Testing of DC control equipment

5.3.10 Operation, servicing and maintenance of AC machines

- (1) Operation of AC machines
- (2) Repair and testing of AC machines
- (3) Operation of an AC induction motor
- (4) Overhaul and test induction motor
- (5) Operation of split phase induction motor
- (6) Overhaul and test capacitor start induction motor
- (7) Operation of a capacitor start induction motor
- (8) Operation of a capacitor start capacitor run motor
- (9) Shaded pole motor
- (10) Universal motor
- (11) Overhaul and test of universal motor
- (12) Synchronous motors
- (13) Contactors
- (14) Cut-out protection single-phase motors
- (15) Start and switch single-phase motors

5.3.11 Electromechanical devices

- (1) Rotary actuators
- (2) Linear actuators

5.3.12 Operation, servicing and maintenance of aircraft control equipment

- (1) Voltage regulation
- (2) Magnetic amplifiers

- (3) Brake control equipment
- (4) Environmental control

5.3.13 **Operation, servicing and maintenance of APU and TRU**

- (1) Auxiliary Power unit (AA)
- (2) Applications of transformer rectifier units
- (3) Applications of inverters
- (4) AC ignition exciter
- (5) DC ignition exciter
- (6) Ignitor plug
- (7) Magnetos

5.3.14 **Operation, servicing and maintenance of aircraft lighting**

- (1) Application of aircraft lighting equipment
- (2) Fault find of aircraft lighting equipment
- (3) Fault find of aircraft lighting panel
- (4) Explain aircraft lighting system

5.3.15 **Operation of a fire protection pneumatic and air conditioning system**

- (1) Fire protection
- (2) Pneumatics and air conditioning system

5.3.16 **Experience**

- (1) 80% of core and 20% of organisation requirements.

5.3.17 **Revision**

- (1) Trade syllabus review.

66.02.3 THEORETICAL KNOWLEDGE EXAMINATION

1. Entry requirements and procedures for theoretical knowledge examinations

1.1 General

- (1) Candidates who intend to sit for a theoretical knowledge examination must complete the application form timeously to be considered for the examination concerned.
- (2) Applications must be accompanied by certified true copies of the necessary supporting documents. It is of utmost importance that the experience claimed is verified by the approved person of the AMO where the candidate is employed. Particular attention should be paid to Part III of the application.
- (3) After evaluation of the application the successful candidates will be advised of the topics to be written as well as of the costs involved.
- (4) All applications must reach the examination section of the CAA or the aviation training organisation, as the case may be, before the first closing date as specified in an aeronautical information circular, to be published from time to time by the Director.
- (5) All fees must be paid on or before the second closing date as specified in an aeronautical information circular, to be published from time to time by the Director. Failure to pay such fees timeously will disqualify the candidate from being entered for the examination concerned.
- (6) Applications or fees which are received after the respective closing dates will not be accepted, regardless of the date on which such applications were completed.
- (7) A candidate accepted for a theoretical knowledge examination will be required to answer in a written examination, questions to demonstrate his or her knowledge of the appropriate topics which are prescribed in paragraph 2 below.

1.2 Procedures for examinations

- (1) Written examination instructions to candidates will be attached to the letter of acceptance from the CAA or aviation training organisation concerned. The letter of acceptance will serve as admittance to the examination room. Candidates unable to produce this letter of acceptance, will be denied access to the examination room.
- (2) Candidates must -
 - (a) report at the examination room at least 20 minutes before the scheduled time of commencement;
 - (b) provide an identity document in the form of either an identity book, AME licence with a photo or in the case of non-citizens, a passport;
 - (c) sign the attendance register;
 - (d) provide their own writing and ancillary equipment;
 - (e) check that their examination number and necessary information are correct on all the documents;
 - (f) remain silent during the course of the examination;
 - (g) stop writing at the instruction of the invigilator;
 - (h) hand in examination script when so instructed by the invigilator;
 - (i) hand in all question papers, scrap paper and related documents;
 - (j) if there is any lack of clarity regarding a question, write his/her complaints to the examiner on the scrap paper and hand this in with his/her answer paper; and
 - (k) comply with all examination instructions during the course of the examination.
- (3) Candidates may not -
 - (a) retain any notes of whatever nature during the examination;
 - (b) communicate with another candidate;
 - (c) pass any object to another candidate;
 - (d) look at the work of another candidate;
 - (e) enter the examination room if more than 30 minutes late;
 - (f) leave the examination room within the first hour of the examination;
 - (g) leave the examination room without the invigilators permission;
 - (h) write on the answer sheet of multiple choice examinations apart from the mark to indicate the answer selected;
 - (i) make any notes or marks on the manuals and question papers;
 - (j) direct any question regarding the questionnaire to the invigilator;

- (k) use or retain in their possession, while in the examination room, a programmable computer/calculator;
 - (l) smoke in the examination room;
 - (m) behave in an unsatisfactory manner; or
 - (n) disobey the instructions of the invigilator.
- (4) The following types of programmable computers have been identified as such and may not be taken into the examination room:
- (a) Any calculator with an alphanumerical keyboard;
 - (b) Position organiser/Navmaster;
 - (c) All Hewlett Packards.

If doubt exists whether a computer may be used or not, candidates may request the CAA or the aviation training organisation concerned, at least 30 days before the examination, to approve such computer.

1.3 Special examinations

Special examinations will only be considered if -

- (1) written application is submitted in accordance with paragraph 1.1;
- (2) motivation is acceptable; and
- (3) the fees concerned are paid.

2. Knowledge requirements

2.1 Category A (aeroplanes)

- (1) An applicant accepted for examination in Category A to cover aeroplanes will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects, according to the construction of the type for which accepted:
 - (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category A.
 - (b) Practical arithmetical calculations, involving vulgar and decimal fractions, percentages and mensuration.
 - (c) The various terms used in aeroplane construction and aerodynamics, the functioning of each component of an aeroplane, and the elementary principles of theory of flight.
 - (d) The preparation of a brief report, illustrated by sketches if necessary, describing the replacements required in the event of damage, defect or wear.
 - (e) The inspection and checks for alignment after assembly of aeroplane structural components.
 - (f) The inspection during and after adjustment of flying controls.
 - (g) The correction of faults experienced in flight, with particular reference to rigging and control settings.

- (h) General maintenance of the airframe (including equipment but excluding the engine) and minor repairs.
 - (i) Defects and deterioration of metallic materials, treatments and methods used against corrosion.
 - (j) Defects and deterioration of wooden structures, including treatments and methods used in this connection, where applicable.
 - (k) Defects and deterioration of materials - other than wood or metal - such as fabric, dopes, rubber, etc. Treatments and methods used in rectifying defects encountered, where applicable.
 - (l) The inspection of control mechanisms for defects and deterioration.
 - (m) The inspection and scope of investigation following heavy landings.
 - (n) The methods of checking flying instruments for correct functioning, the inspection of instruments and instrument installations in aeroplanes and methods of making check calibrations.
 - (o) The inspection of electrical installations in aeroplanes and testing for correct functioning and condition.
 - (p) The inspection of under-carriage shock-absorbing systems, brakes, wheels and tyres.
 - (q) The principles of operation of retracting undercarriage and flap operating systems and inspection of these systems installed in aeroplanes, where applicable.
 - (r) The method of determining the mass and the position of the centre of gravity of an aeroplane and the preparation of a mass and balance schedule.
 - (s) Where applicable, general principles of operation of the particular type of automatic pilot installed in the aeroplane.
 - (t) Where applicable, methods of coupling the automatic pilot system to the aircraft flying controls. Tests to ensure that the automatic pilot can be immediately disengaged and/or over-controlled in any emergency.
 - (u) Where applicable, the daily maintenance and periodical inspections necessary to ensure correct operation and functioning of automatic pilot installations. Such minor replacements and adjustments to the automatic pilot on the aeroplane as specified in the maintenance manual as being within the scope of an aircraft maintenance engineer licensed in Category A.
 - (v) The regulations in Part 66 so far as they affect an aircraft maintenance engineer licensed in Category A.
 - (w) Detailed knowledge of the construction of the airframe and the principles of operation of the components.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.2 Category B (aircraft)

- (1) An applicant accepted for examination in Category B for the certification of the repair and overhaul of aircraft, incorporating the use and replacement of approved parts and components only, will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects, according to the construction of the type for which accepted:
 - (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category B.
 - (b) Practical arithmetical calculations, involving vulgar and decimal fractions, percentages and mensuration.
 - (c) The various terms used in aeroplane construction and aerodynamics, the functioning of each component of an aircraft and the elementary principles of theory of flight.
 - (d) The preparation of an inspection report on the condition of an aircraft that is about to be overhauled.
 - (e) The method of systematically carrying out the required overhaul.
 - (f) The procedure for compiling an inspection report of work done in the overhaul of the components.
 - (g) The approved repair scheme applicable to the complete rectification and overhaul of the components, including fixed-pitch propellers or rotors.
 - (h) The inspection of the repair, overhaul and assembly of components and the workshop processes involved, such as gluing, doping, welding, brazing and soldering, so far as they affect the incorporation of previously approved replacement members and parts, including the appropriate protective and heat treatments, where applicable.
 - (i) The inspection and methods of checking for alignment and symmetry of components such as fuselages, hulls, floats, wings and fixed-pitch propellers and rotors, where applicable.
 - (j) The inspection of the repair, overhaul and functional testing of tanks, radiators and coolers.
 - (k) The inspection of the repair, overhaul and functional testing of shock-absorbing devices of landing gear.
 - (l) The inspection of the engine installations, including controls and fuel, oil and coolant systems.
 - (m) The inspection of the complete aircraft, including controls and trimming devices, for correct assembly and functioning.
 - (n) The general principles of electricity and magnetism and, as far as it is practicable on the ground, the inspection of the installation and functioning of instruments, automatic pilots and electrical equipment. Methods of making check calibrations.

- (o) The method of determining the mass and the position of the centre of gravity of an aircraft and the preparation of the mass and balance schedule.
 - (p) The preparation of a sketch from which a finished drawing can be made.
 - (q) The inspection of the assembly and functioning of retracting devices of landing gear, where applicable.
 - (r) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category B.
 - (s) Detailed knowledge of the construction of the airframe and its components.
 - (t) The composition, properties, uses, defects and protection against corrosion and deterioration of the principal materials used in the construction of the airframe and its components.
 - (u) The identification, selection, inspection and physical testing of the various timbers used in the construction of the aircraft, where applicable.
 - (v) The methods of examination and physical testing of all the non-metallic materials (other than timbers) used in the construction of the aircraft to ensure compliance with specification requirements.
 - (w) The inspection during manufacture of non-metallic materials into aircraft parts and components, of the workshop processes involved in gluing, stitching, doping and protective measures against corrosion and deterioration, where applicable.
 - (x) The methods of examination and physical testing of both ferrous and non-ferrous metallic materials used in the construction of the aircraft to ensure compliance with specification requirements.
 - (y) The inspection during manufacture of metallic materials into aircraft parts and components, and of the workshop processes involved. Heat treatment, including temperature control, welding, soldering, brazing, electro-plating and other protective treatments against corrosion and deterioration.
 - (z) The inspection during construction of components such as fuselages, wings, fixed-pitch propellers, rotors, tanks, radiators and coolers.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the 26 subjects, as applicable, prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and their interpretation of drawings.

2.3 Category C (engines)

- (1) An applicant accepted for examination in Category C to cover aeroplanes will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects, according to the construction of the type for which accepted:

- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category C.
- (b) Practical arithmetical calculations involving vulgar and decimal fractions, percentages and mensuration.
- (c) The principles of operation of the engine and its parts and accessories.
- (d) The preparation of a brief report, illustrated by sketches if necessary, describing the replacements required in the event of damage, defect or wear.
- (e) Methods of inspection for defects during rectification, clearances and allowances for wear and distortion.
- (f) Methods of rectification of defects, inspection during and after re-assembly.
- (g) Inspection and checks on complete installation and systems, as required during engine installation.
- (h) The methods of checking engine instruments for correct functioning, the inspection of engine instruments and instrument installations in aeroplanes, and methods of making check calibrations.
- (i) Testing and tuning during ground running in accordance with the manufacturer's recommended procedure, including diagnosis of all types of running faults.
- (j) Preparing engines for initial installation and inhibiting of engines.
- (k) General maintenance of the engine and its installation, including minor repairs.
- (l) Where applicable, the assembly of variable-pitch propellers dismantled for ease of transport, assembly of propeller to engine, inspection of damage to propellers, permissible limits and methods of rectification.
- (m) Where applicable, the principles of variable-pitch propellers and controlling devices, inspection of correct assembly and functioning, ground testing and rectification of defects.
- (n) Detailed knowledge of the construction of the type of engine for which accepted.
- (o) Constructional details of parts, the rectification of which may be certified by the holder of a licence in Category C.
- (p) Typical faults and defects calling for partial overhaul or other rectification which may be certified by the holder of a licence in Category C.
- (q) The inspection of the complete fuel, oil and, where applicable, coolant systems and tests for functioning and defects and methods of rectification.
- (r) Inspection of ignition systems for correct installation, condition, timing and functioning, and test for defects and methods of rectification.

- (s) The principles of operation of carburettors and/or injectors, inspection of carburettors and/or injectors and induction systems, test for functioning and defects.
 - (t) Where applicable, the inspection of fixed-pitch propellers and checks during assembly to engine.
 - (u) Where applicable, the principles of supercharging and the operation of boost controls, inspection for correct assembly adjustment and functioning.
 - (v) The composition, properties, uses, defects and protection against corrosion and deterioration of the principal materials used in the construction of the engine, its parts, accessories and installation.
 - (w) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category C.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.4 **Category D (piston engines)**

- (1) An applicant accepted for examination in Category D for the certification of the overhaul and repair of engines, incorporating the use and replacement of approved parts and components only, will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects, according to the construction of the type for which accepted:
- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category D.
 - (b) Practical arithmetical calculations, involving vulgar and decimal fractions, percentages and mensuration.
 - (c) The principles of operation of the engine and its components and accessories.
 - (d) The preparation of an inspection report on the condition of an engine stripped down for complete overhaul.
 - (e) The method of systematically carrying out the complete overhaul and repair of the engine, its parts and accessories, not incorporating electric principles but including the replacement of the mechanical parts of a magneto.
 - (f) The procedure for completing the inspection report on work done in the overhaul of the parts.
 - (g) The methods of inspection during overhaul of the parts of an engine for wear, misalignment, distortion and damage. The defects likely to be encountered and their rectification, the permissible allowances for wear and distortion and the balancing of parts.

- (h) The inspection during rectification of parts and the re-assembly of the engine and of the workshop processes involved, so far as they affect the incorporation and fitting of previously approved replacement parts, including the appropriate protective treatments applicable.
 - (i) The methods of inspection and checking the correct functioning of the ignition, carburation or injection, bonding and, where applicable, coolant systems.
 - (j) The inspection of the complete engine, including controls for correct assembly and functioning.
 - (k) The principles, functioning, operation, adjustment and control of the equipment used for testing engines.
 - (l) The inspection, adjustment and testing of an engine and all its accessories after overhaul, including the measurement of the power developed and of the fuel and oil consumption.
 - (m) The preparation of a sketch from which a finished drawing can be made.
 - (n) The methods of inspecting and checking of the correct functioning of propeller control systems, where applicable.
 - (o) The principles of supercharging and the operation and testing of superchargers and boost control systems, where applicable.
 - (p) Detailed knowledge of the construction of the engine, its parts and accessories.
 - (q) The composition, properties, uses, defects and protection against corrosion and deterioration of the principal materials used in the construction of the engine, its parts, accessories and installation.
 - (r) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category D.
 - (s) The methods of examination and physical testing of both ferrous and non-ferrous metallic materials used in the construction of the engine to ensure compliance with specification requirements.
 - (t) The methods of examination and physical testing of metal forgings, castings and pressings used in the construction of the engine, for the detection of characteristic defects which may render them unsuitable and to ensure compliance with both specification and drawing requirements.
 - (u) The inspection of metallic materials during the manufacture of metal forgings, castings and pressings into engine parts, the repair of parts and of the workshop processes involved, heat treatments, including temperature control of hardening, tempering, case hardening and normalising procedures, and of welding, white-metalling, soldering, brazing, electroplating and other protective treatments against corrosion and deterioration.
 - (v) The inspection and methods of checking the finished parts prior to and during assembly into the complete engine for correct alignment, mass and balance.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions

in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.5 Categories A and C (rotorcraft, including engines)

- (1) An applicant accepted for examination in Categories A and C for the certification before flight of rotorcraft, including engines, will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects, according to the construction of the type for which accepted:
 - (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Categories A and C.
 - (b) Practical arithmetical calculations, involving vulgar and decimal fractions, percentages and mensuration.
 - (c) The maintenance, including minor repairs, of the rotorcraft, including its engine or engines, and its equipment.
 - (d) The various terms used in rotorcraft construction and aerodynamics and the functioning of each component of a rotorcraft.
 - (e) The assembly of rotorcraft structures, with particular reference to the assembly and functioning of the rotors, including transmission.
 - (f) The adjustment of the rotors for the purpose of rectifying faults experienced in flight as a result of a defect or maladjustment,
 - (g) The inspection of electrical installations in rotorcraft and testing for correct functioning and condition.
 - (h) Defects and deterioration in covered surfaces, in timber and metal structures, as applicable and methods of rectification.
 - (i) The principles and functioning of shock-absorbing devices and retracting devices of landing gear, where applicable.
 - (j) The methods of effecting minor repairs and replacements.
 - (k) The methods of checking flying and engine instruments for correct functioning, methods of making check-calibrations, and inspection of instruments and installations in rotorcraft.
 - (l) The preparation of a brief report, illustrated by sketches if necessary, describing the replacements of repairs required in the case of damage.
 - (m) The principles of operation of the engine, its parts and accessories.
 - (n) Detailed knowledge of the construction of the rotorcraft and its engine or engines.
 - (o) Methods of inspecting engines during replacement of approved parts; the defects likely to be encountered and their rectification and the permissible allowances for wear and distortion.
 - (p) The inspection, adjustment and testing of an engine and its accessories after the replacement of approved parts, to ensure correct functioning and power output.

- (q) The inspection, before flight, of an engine and its installation, engine ignition apparatus, carburettors, pumps, filters and starting mechanism.
 - (r) The use of equipment required to test engines after the replacement of approved parts.
 - (s) The principles of supercharging and the operation of superchargers, where applicable.
 - (t) The principles of operation of the transmission and the inspection and rectification of faults in the system.
 - (u) The composition, properties, uses, defects and protection against corrosion and deterioration of the principal materials used in the construction of the rotorcraft, including its engine or engines.
 - (v) The method of determining the mass and the centre of gravity of a rotorcraft and the preparation of a mass and balance schedule.
 - (w) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Categories A and C.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.6 **Category X (automatic pilots)**

- (1) An applicant accepted for examination in Category X for the certification of the repair and overhaul of automatic pilots will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (a) to (d) and, in addition, according to the class of automatic pilot for which accepted, questions to demonstrate his or her knowledge of the subjects prescribed in items (e) to (l), (m) to (t) or (u) to (bb):
- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) Elementary physics and the elementary practical mathematical calculations involved.
 - (c) The fundamental principles employed in the construction and operation and their application to the particular automatic pilot for which the application is accepted.
 - (d) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (automatic pilots).
Automatic pilots employing hydraulic operation
 - (e) General principles of construction and operation of the control units, sub-assemblies, hydraulic and air systems.
 - (f) The necessary inspection prior to installation in the aircraft of the automatic pilot and its sub-assemblies, including oil pumps, regulators and accessories.

- (g) The inspection, during and after installation in the aircraft, including procedure for bleeding the hydraulic system. Tests to be carried out to ensure that the automatic pilot can be disengaged quickly and/or manually over-controlled in emergency in flight and that it is correctly installed.
- (h) The types of faults which may develop in operation and methods adopted to trace the causes. The adjustment and rectification of minor defects and measures taken to prevent their recurrence.
- (i) The inspection of parts of the control units and sub-assemblies during overhaul, repair or modification and the correction of physical and mechanical faults peculiar to such parts. The effect of variation and adjustment.
- (j) The methods and procedure for lapping, polishing, testing and inspecting ball-races, cones and pivots to the gyro systems, gimbal systems and attachments.
- (k) The conventional method of tuning, balancing, calibrating, adjusting and testing during and after overhaul, repair or modification of the sub-assemblies and the complete automatic pilot in the workshop so far as is permitted by the manufacturer's approved overhaul and repair manual.
- (l) The principles employed and methods adopted in construction, operation, calibration and testing of the substandard test apparatus normally used in automatic pilot repair workshops. The use for this purpose of reference standards.
Automatic pilots employing pneumatic operation
- (m) The general principles of operation and construction of the control unit or units and sub-assemblies, including the monitoring system and air system.
- (n) The necessary inspection prior to installation in the aircraft of the automatic pilot and its sub-assemblies including the compressors, separators and driers.
- (o) The inspection during and after installation in the aircraft. Tests to be carried out to ensure that the automatic pilot can be disengaged quickly and/or manually over-controlled in emergency in flight and that it is correctly installed.
- (p) The type of faults which may develop in operation, methods adopted to trace the causes. The adjustment and rectification of minor defects and measures to be taken to prevent their recurrence.
- (q) The inspection of parts of the control units and sub-assemblies during overhaul, repair or modification and the correction of physical and mechanical faults peculiar to such parts. The effect of variation and adjustment.
- (r) The methods and procedures for lapping, polishing, testing and inspecting ball-races, cups, cones and pivots of the gyro systems, gimbal systems and attachments.
- (s) The conventional method of tuning, balancing, calibrating, adjusting and testing during and after overhaul, repair or modification of the sub-assemblies and the complete automatic pilot in the workshop so far as is permitted by the manufacturer's approved overhaul and repair manual.

- (t) The principles employed and the methods adopted in the construction, operation, calibration and testing of the substandard test apparatus normally used in automatic pilot repair workshops. The use for this purpose of reference standards.
Automatic pilots employing electrical operation (including those with electronic amplifiers)
 - (u) Electricity and magnetism, definitions of terms used and their application and the elementary practical mathematical calculations involved. Basic electronic principles, the operation of electronic components, electronic circuit analysis and basic calculations involved with such circuits.
 - (v) General principles of operation and construction of the control unit or units and sub-assemblies, including the electrical, hydraulic and/or air systems and monitoring systems, where applicable.
 - (w) The necessary inspection prior to installation in the aircraft of the automatic pilot and its sub-assemblies.
 - (x) The inspection during and after installation in the aircraft of the automatic pilot and its sub-assemblies.
 - (y) The types of electrical and mechanical faults which may develop in operation and the methods adopted to trace the causes. The adjustments and rectification of minor defects and measures taken to prevent their recurrence.
 - (z) The inspection of components of the control units and sub-assemblies during overhaul, repair or modification and the correction of physical, electrical and mechanical faults peculiar to such components. The effect of variation and adjustment.
 - (aa) The conventional method of calibrating, adjusting and testing during and after overhaul, repair or modification of the sub-assemblies and the complete automatic pilot in the workshop so far as is permitted by the manufacturer's approved overhaul and repair manual.
 - (bb) The principles employed and methods adopted in the construction, operation, calibration and testing of the substandard test apparatus normally used in automatic pilot repair workshops. The use for this purpose of reference standards.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1) according to the class of automatic pilot for which application is accepted. An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.7 Category X (compasses)

- (1) An applicant accepted for examination in Category X for the certification of the installation and compensation of direct-reading compasses will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (a) to (j). An applicant for examination in remote-reading compasses will be required in addition to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (k) to (m) according to the form of construction applicable to the type of remote-reading compass for which the application is accepted:

- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) The general principles of magnetism, magnetic materials and permanent magnets, polarity and strength of bar magnets, the earth as a magnet, the magnetic meridian and its relationship to the geographic meridian.
 - (c) The general principles of construction of typical aircraft compasses, including magnet systems, damping liquid, verge ring and markings, rubber line, grid wires, shock-absorbing suspension and corrector box, the inspection necessary for the detection of common defects that may arise in use.
 - (d) Minor external repairs to the compass and de-aerating the compass liquid.
 - (e) The installation of compasses in aircraft, points to be observed and the procedure adopted before adjustments are made.
 - (f) The precautions to be observed in the choice of a site for and the preparation of a "swinging base" and checking the base by means of a landing compass.
 - (g) The compensation of compasses in aircraft, including the observation of deviations, the calculations and adjustments necessary for corrections of coefficients A, B and C, the procedure to be followed after the corrections are made and the preparation of deviation cards and graphs.
 - (h) The use of a landing compass for the checking of compasses in aircraft.
 - (i) The compensation of the compass in a marine aircraft afloat by means of a bearing plate, on the aircraft, or by the use of a landing compass ashore.
 - (j) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (compasses).
 - (k) The general principles of construction of remote-reading aircraft compasses, the principles of operation and functioning of the particular type for which the application is made and inspection of the parts necessary, prior to installation in the aircraft.
 - (l) The installation and correct positioning of the remote-reading compass in the aircraft, including the components and accessories, points to be observed and the procedure adopted before adjustments are made.
 - (m) The methods and procedure adopted for the compensation of remote-reading compass in the aircraft, the adjustments to be made to the master compass, the master indicator and the repeater units in order to ensure correct functioning.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her knowledge, in a practical form, of the subjects prescribed above.

2.8 Category X (electrical equipment)

- (1) An applicant accepted for examination in Category X for the certification of the overhaul, repair and modification of aircraft electrical equipment, including installations in aircraft with main power supply systems, the nominal tension of which does not exceed 30 volts, will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects:
 - (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) Elementary electricity and magnetism, definitions of the terms used and their application, and the elementary practical mathematical calculations involved.
 - (c) The construction and functioning of all types of electro-magnetic induction machines used on aircraft.
 - (d) The method of carrying out overhauls and repairs to electro-magnetic induction machines used on aircraft, the inspection necessary to detect defects, mechanical, electrical and magnetic, as a result of wear and deterioration, and the permissible allowances in each case.
 - (e) The inspection of parts of aircraft electrical generators, motors, automatic control and switch gear.
 - (f) The schedule of tests, the equipment required for such tests, and the methods employed in carrying out functional tests to prove the satisfactory condition of electrical generators and motors after overhaul and repair.
 - (g) The general principles of construction and functioning of all types of automatic control and switch gear, the method of carrying out overhauls, repairs and tests.
 - (h) The installation, functioning and testing of all types of electrical batteries.
 - (i) The selection and inspection of materials used in the construction, repair and overhaul of aircraft electrical equipment.
 - (j) The types, sizes and capacities of cables, fuses and switch gear used in aircraft electrical installation.
 - (k) The specified light-angles of navigation lamps, the installation, inspection, overhaul and testing of navigation, signalling and landing-light equipment.
 - (l) Methods of inspecting and testing the whole of the electrical system installed in aircraft, including the bonding and earthing system.
 - (m) The preparation of a circuit diagram illustrating the symbols used to denote the various items of equipment.
 - (n) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (electrical equipment).

- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.9 Category X (ignition equipment)

- (1) An applicant accepted for examination in Category X for the certification of the repair and overhaul of aircraft engine ignition equipment will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the following subjects:
- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) Elementary electricity and magnetism, definitions of the terms used and their application and the elementary practical mathematical calculations involved.
 - (c) The construction and functioning of all types of engine ignition apparatus, including screened types fitted to aircraft engines.
 - (d) The method of carrying out overhauls and repairs, the inspection necessary to detect defects, mechanical, electrical and magnetic, as a result of wear and deterioration and the permissible allowances in each case.
 - (e) The inspection and testing of parts and assemblies, and the equipment required for such tests.
 - (f) The schedule of tests, the equipment for such tests, and the methods employed in carrying out functional tests to prove the satisfactory condition of apparatus after overhaul and repair.
 - (g) The construction and functioning of impulse starters, the method of carrying out overhauls, repairs and tests.
 - (h) The construction and functioning of automatic timing devices, the methods of carrying out overhauls, repairs and tests.
 - (i) The construction, inspection and testing of ignition cables, screened harness and fittings, the defects and deterioration likely to be encountered, and the effect on engine ignition apparatus and spark plugs, of metal braiding on cables.
 - (j) The overhaul and testing of spark plugs.
 - (k) The preparation of a wiring diagram from which a finished drawing could be made of the internal and external connections of a typical ignition system.
 - (l) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (engine ignition equipment).
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.10 Category X (instruments)

- (1) An applicant accepted for examination in Category X for the certification of the overhaul, repair and modification of aircraft and engine instruments, excluding electrically operated instruments, will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (a) to (j). An applicant accepted for examination in Category X for the certification of the overhaul, repair or modification of aircraft and engine instruments, including electrically operated instruments, will be required in addition to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (k) and (l).
 - (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1, so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) Elementary physics and the elementary practical mathematical calculations involved.
 - (c) The general principles of construction, operation, overhaul and repair of all types of mechanically operated aircraft and engine instruments.
 - (d) The types of fault which may develop in operation, methods adopted to trace the causes and measures taken to prevent their recurrence, the effect of variation and adjustment on instrument mechanisms.
 - (e) The inspection of parts of the various instruments during overhaul and repair, the correction of mechanical faults peculiar to such instruments.
 - (f) The conventional methods of calibration, adjusting and testing aircraft and engine instruments, high and low pressure tests, temperature and vibration tests, and luminosity tests on luminous fluorescent dial markings.
 - (g) The principles employed, and method adopted, in the construction and operation of the substandard test apparatus normally used in instrument repair shops for calibration purposes.
 - (h) Methods of testing and checking the accuracy of the substandard test apparatus, and the use for this purpose of reference standards.
 - (i) The preparation of a sketch from which a finished drawing could be made of a part of a typical instrument mechanism.
 - (j) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (instruments).
 - (k) Elementary electricity and magnetism, definitions of the terms used and their application, and the elementary practical mathematical calculations involved.
 - (l) The general principles of construction, operation, overhaul and repair of all electrically-operated instruments used in aircraft, methods of adjustment, detection and rectification of faults peculiar to specific instruments and equipment, and the tests necessary to prove correct functioning.

- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.11 Category X (variable-pitch propellers)

- (1) An applicant accepted for examination in Category X for the certification of the overhaul, repair or modification of variable-pitch propellers, will be required to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (a) to (o), according to the form of construction applicable to the type of propeller for which application is accepted. An applicant accepted for examination in Category X for the certification of the overhaul, repair or modification of electrically operated variable-pitch propellers will be required in addition to answer, in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in item (p):
- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1 so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) Practical arithmetical calculations, involving vulgar and decimal fractions, percentages and mensuration.
 - (c) The principles and functioning of the operating systems of current types of variable-pitch propellers.
 - (d) The preparation of an inspection report on the condition of the propeller dismantled for complete overhaul.
 - (e) The method of systematically carrying out the required overhaul.
 - (f) The procedure for completing the inspection record on work done in the overhaul of the parts.
 - (g) The approved repair scheme applicable to the rectification and overhaul of the parts.
 - (h) The methods of inspection during the overhaul of the parts of a propeller for wear, malalignment, distortion and damage. The defects likely to be encountered and their rectification, the permissible clearances and allowances for wear and distortion, and the balancing of parts.
 - (i) The inspection during rectification of parts and components and the re-assembly of the propeller, the workshop processes involved, so far as they affect the incorporation and fitness of previously approved replacement parts, including the appropriate protective treatments applicable.
 - (j) The inspection during rectification of spinners, fans and all parts normally attached to, and rotating with, propellers.
 - (k) The construction and functioning of auxiliary oil pumps, motors, constant-speed governors, controlling means and de-icing equipment and the methods of carrying out overhauls, repairs and tests.

- (l) The inspection of a complete propeller for correct assembly, adjustment, mass and balance, methods employed for correcting balance and checking torque loading of blades.
 - (m) Assembly of a propeller to an engine, check testing and adjustment for performance and correction of faults.
 - (n) The preparation of a sketch from which a finished drawing could be made of a part of the operating mechanism of a variable-pitch propeller.
 - (o) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (variable-pitch propellers).
 - (p) Elementary electricity and magnetism, definitions of the terms used and their application and the elementary practical mathematical calculations involved.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects, as applicable, prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.12 Category X (avionic equipment)

- (1) An applicant accepted for examination in Category X for the certification of the overhaul, repair, modification and installation of avionic equipment in aircraft will be required to answer in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (a) to (f), and in addition, according to the rating for which he has been accepted, questions to demonstrate his or her knowledge of the subjects prescribed in items (g) to (j) or (k) to (o):
- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1 so far as they affect an aircraft maintenance engineer licensed in Category X.
 - (b) Elementary electricity and magnetism, definitions of terms used and their application and the elementary mathematical calculations involved.
 - (c) Basic theory pertaining to radio and electronic principles.
 - (d) Basic semi-conductor and digital devices theory and its application.
 - (e) Operation and use of electronic test equipment and the limitations on the use of such equipment.
 - (f) The regulations in Part 66, so far as they affect an aircraft maintenance engineer licensed in Category X (avionic equipment).
Avionic equipment excluding equipment employing pulse techniques
 - (g) Methods of inspecting and testing the whole of the avionic system, excluding equipment employing pulse techniques, installed in aircraft, including the bonding and earthing system.
 - (h) Theory of operation, maintenance procedures, alignment and testing of all types of avionic equipment excluding equipment employing pulse techniques.

- (i) The installation of all such equipment in aircraft, the procedures to be followed and the precautions to be observed.
 - (j) Theory of operation, installation, inspection and testing of appropriate avionic equipment antenna and transmission lines.
Avionic equipment employing pulse techniques
 - (k) Basic theory and principles of pulse techniques.
 - (l) Methods of inspecting and testing the whole of the avionic system employing pulse techniques installed in aircraft, including the bonding and earthing system.
 - (m) Theory of operation, maintenance procedures, alignment and testing of all types of avionic equipment employing pulse techniques.
 - (n) The installation of all such equipment in aircraft, the procedures to be followed and the precautions to be observed.
 - (o) Theory of operation, installation, inspection and testing of appropriate avionic equipment antenna and transmission lines.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects, as applicable, prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.13 Category X (aircraft welding)

- (1) An applicant accepted for the examination in Category X (aircraft welding) will be required to answer in a written examination, questions to demonstrate his or her knowledge of the subjects prescribed in items (a) to (f) and, in addition, shall pass practical tests to demonstrate his or her knowledge of the subjects prescribed in item (g):
- (a) British Civil Airworthiness Requirements, British Civil Aircraft Inspection Procedures and the FAA Advisory Circular 43.13-1A, in so far as these affect an aircraft maintenance engineer licensed in Category X (aircraft welding).
 - (b) Elementary welding procedures and their application, definitions and terms used, and the elementary mathematical calculations involved in aircraft welding.
 - (c) Basic theory pertaining to welding principles.
 - (d) Basic strength of material and heat treatment theory and its application.
 - (e) Operating and use of test equipment and the limitations on the use of such equipment.
 - (f) The regulations in Part 66 in so far as they affect an aircraft maintenance engineer licensed in Category X (aircraft welding).
 - (g) The welding requirements as prescribed in Schedule 1.
- (2) Where, subsequent to the written examination, a supplementary examination is required by the Director, an applicant may be required to answer further questions in respect of the subjects prescribed in subparagraph (1). An applicant may also be required to demonstrate his or her practical knowledge of inspection, the use of measuring instruments and the interpretation of drawings.

2.14 Category W

(Reserved.)

3. Retesting after failure

- (1) The pass mark for any written examination referred to in paragraph 1 is 75%.
- (2) A candidate who fails with a mark of between 71% and 74%, may apply in writing for a remark within 30 days from the date of receiving the examination results, on payment of the appropriate fee.

If the remark is successful, the fee will be refunded.

- (3) A candidate who fails with a mark of above 68%, may apply to be entered for the following examination sitting.
- (4) A candidate who fails with a mark of between 60% and 68%, has to wait for six months before applying to enter again.
- (5) A candidate who fails with a mark of less than 60%, will have to wait for 12 months before applying to enter again.

66.02.4 EXPERIENCE

1. Category A (aeroplanes): Issue or addition of Category A

An applicant for the issuing of a licence in Category A, or for the addition of Category A to an existing licence, must have had the experience, appropriate to the type for which application is made, shown in the following table:

1 Applications relating to airframes will be accepted for the following	2 Total aeronautical engineering experience		3 Experience in column 2 must include periods of general practical maintenance and inspection solely of airframes prior to flight, totalling		4 Experience in column 3 must include periods of practical maintenance and inspection prior to flight on the type for which application is made (or a type of similar charac- teristics with satisfactory experience on the type), totalling
	training	With training	Without training	Without training	
All or any one of the types classified under group 1	3 years	2 years	12 months	6 months	Without With training 6 months
All or any one of the types classified under group 2	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 3	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 4	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 5	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 6	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 7	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 8	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 9	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 10	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 11	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 12	3 years	2 years	12 months	6 months	6 months

2. Category A (aeroplanes): Extension of Category A

- (1) An applicant for the extension of Category A of his or her licence must have had six months' experience of practical maintenance and inspection of airframes spent solely on the type (or types in the group in the case of an application in respect of a group) for which the extension is desired, unless the licence is
- (2) Where the application is for an extension to cover an airframe of appreciably simpler design and classified in a different group to that or those for which the licence is already valid, then the Director may reduce the six-month qualifying period required above to suit the circumstances of the case.

3. Category B: Issue or addition of Category B

An applicant for the issuing of a licence in Category B, or the addition of Category B to an existing licence for the certification of the repair and overhaul of airframes, must have had the experience, appropriate to the type for which application is made, shown in the following table:

1 Applications relating to airframes will be accepted for the following	2 Total aeronautical engineering experience		3 Experience in column 2 must include periods of general practical maintenance and inspection solely of airframes prior to flight, totalling		4 Experience in column 3 must include periods of practical maintenance and inspection prior to flight on the type for which application is made (or a type of similar characteristics with satisfactory experience on the type), totalling
	Without training	With training	Without training	With training	
All or any one of the types classified under group 1	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 2	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 3	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 4	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 5	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 6	3 years	2 years	12 months	6 months	6 months

4. Category B: Extension of Category B

An applicant for the extension of Category B of his or her licence must have had six months' experience of the practical repair and overhaul of airframes spent solely on the type (or types in the group in the case of an application in respect of a group) for which the extension is desired, unless the licence is already valid in Category B for a type classified in the same group as that in which the type applied for is classified.

5. Category C (engines): Issue or addition of Category C

- (1) An applicant for the issuing of a licence in Category C, or the addition of Category C to an existing licence, must have had the experience, appropriate to the type for which application is made, shown in the following table:

1 Applications relating to airframes will be accepted for the following	2 Total aeronautical engineering experience		3 Experience in column 2 must include periods of general practical maintenance and inspection solely of airframes prior to flight, totalling		4 Experience in column 3 must include periods of practical maintenance and inspection prior to flight on the type for which application is made (or a type of similar charac- teristics with satisfactory experience on the type), totalling
	Without training	With training	Without training	With training	With or without training
All or any one of the types classified under group 1	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 2	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 3	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 4	3 years	2 years	12 months	6 months	6 months

- (2) Where a licence is already valid under Category D for an engine classified under groups 01, 02, 03 and 04, then the experience requirements for the addition of Category C to include the same engine will be half of those stated above.

6. Category C (engines): Extension of Category C

- (1) An applicant for the extension of Category C of his or her licence must have had six months' experience on the practical maintenance and inspection of engines prior to flight spent solely on the type (or types in the group in the case of an application in respect of a group) for which the extension is desired, unless the licence is already valid in Category C for a type classified in the same group as that in which the type applied for is classified, in which case evidence of recent satisfactory experience or the passing of a recent satisfactory course on the type (or types in the group in the case of an application in respect of a group) for which application is made, may be accepted, except that for types of engines of 1 500 kW or more, the applicant's experience must have been on types of approximately comparable power.
- (2) Where an application is made for the extension to cover an engine of appreciably simpler design and classified in a different group to that or those for which the licence is already valid, the Director may reduce the six-month qualifying period required above to suit the circumstances of the case.

7. Category D (engines): Issue or addition of Category D

- (1) An applicant for the issuing of a licence in Category D or for the addition of Category D to an existing licence, for the certification of the repair and overhaul of engines must have had the experience, appropriate to the type for which application is made, shown in the following table:

1 Applications relating to airframes will be accepted for the following	2 Total aeronautical engineering experience		3 Experience in column 2 must include periods of general practical maintenance and inspection solely of airframes prior to flight, totalling		4 Experience in column 3 must include periods of practical maintenance and inspection prior to flight on the type for which application is made (or a type of similar charac- teristics with satisfactory experience on the type), totalling
	Without training	With training	Without training	With training	With or without training
All or any one of the types classified under group 1	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 2	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 3	3 years	2 years	12 months	6 months	6 months
All or any one of the types classified under group 4	3 years	2 years	12 months	6 months	6 months

- (2) Where a licence is already valid in Category D for an engine classified under group 03, then the experience requirements for the addition of Category D to include the same engine will be half of those stated above.

8. Category D (engines): Extension of Category D

An applicant for the extension of Category D of his or her licence must have had six months' experience in the practical repair and overhaul of engines spent solely on the type (or types in the group in the case of an application in respect of a group) for which the extension is desired, unless the licence is already valid in Category D for a type classified in the same group as that in which the type applied for is classified, in which case evidence of recent satisfactory experience or the passing of a recent satisfactory course on the type (or types in the group in the case of an application in respect of a group) for which application is made, may be accepted.

9. Categories A and C (rotorcraft, including engines): Issue or addition of Categories A and C

An applicant for the issuing of a licence in Categories A and C, or for the addition of Categories A and C to an existing licence, for the certification of rotorcraft with a maximum certificated mass of 5 700 kg or less, must have had three years' aeronautical engineering experience, including a minimum of one year of general practical experience of the maintenance and inspection solely of rotorcraft (including their engines) of which six months must have been on the practical maintenance and inspection of the type or group for which application is made, or one of similar characteristics, followed by the passing of a satisfactory course on the type.

10. Categories A and C (rotorcraft, including engines): Extension of Categories A and C

An applicant for the extension of Categories A and C of a licence already valid for the certification before flight of rotorcraft, to include a further type or types of rotorcraft, must have had recent satisfactory experience or undergone a recent satisfactory course on the type or types for which application is made.

11. Category X (automatic pilots): Issue or addition of Category X (automatic pilots)

- (1) An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul,

repair, modification, calibration and installation in aircraft of automatic pilots which do not operate on electronic principles, must have had at least three years' instrument engineering experience, including a minimum of nine months on gyroscopic instruments, and three months general practical experience of the repair, modification, calibration, installation and testing of aircraft automatic pilots, of which at least half must have been recent experience concentrated on the particular type of automatic pilot to which the application relates.

- (2) An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the installation and in flight adjustment of electronic automatic pilots, must have had at least three years' electronic experience, and one and a half years' general practical experience of the repair, modification, calibration, installation and testing of electronic automatic pilots, of which at least half must have been recent experience concentrated on the particular type of automatic pilot to which the application relates.

12. Category X (automatic pilots): Extension of Category X (automatic pilots)

An applicant for the extension of Category X of a licence already valid for the certification of the repair and overhaul of automatic pilots, to include one further type of automatic pilot similar to that for which the licence is already endorsed, must have had at least four months' recent practical experience of the particular type and, in addition, a satisfactory course, except that where the type of automatic pilot to which the application relates includes electronic principles, the applicant must have had at least nine months' practical experience of the particular types.

13. Category X (compasses): Issue or addition of Category X (compasses)

- (1) An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the installation and compensation of direct-reading magnetic compasses in aircraft, must have had the appropriate experience referred to in CAR 43.02.18, in the installation and compensation of direct-reading magnetic compasses in aircraft.
- (2) An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the installation and compensation of remote-reading compasses in aircraft, must have had the appropriate experience referred to in CAR 43.02.18, in the installation and compensation in aircraft of the type of remote-reading compass for which the application is made.

14. Category X (compasses): Extension of Category X (compasses)

An applicant for an extension to Category X of a licence already valid for the certification of the installation and compensation of compasses to include direct-reading magnetic compasses or one further type of remote-reading compass, must have had the appropriate experience referred to in CAR 43.02.18, of the type for which the extension is required.

15. Category X (electrical equipment): Issue or addition of Category X (electrical equipment)

An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul, repair or modification of aircraft electrical equipment, including installations in aircraft with main power supply systems, the nominal tension of which does not exceed 30 volts, must have had at least three years' electrical engineering experience, including a minimum of one and a half years of recent general practical experience

in the overhaul, repair and testing of aircraft electrical equipment, including recent experience of the inspection and testing of electrical installations in aircraft: Provided that three months' recent general practical experience in the overhaul, repair or modification of aircraft electrical equipment for engines classified in groups 01, 02 and 03 will be acceptable for the issuing of a licence in Category X, or the addition of Category X to an existing licence -

- (a) If the applicant is the holder of an existing Class I licence in Category X (ignition equipment); or
- (b) If the applicant is the holder of an existing Class I licence in Category D for any or all of the engines classified in groups 01, 02 and 03: Provided that the privileges of any Category X licence issued or added to an existing licence in accordance herewith shall be restricted to the certification of the overhaul, repair or modification of electrical equipment fitted to the engine type ratings entered under Category D of the existing licence.

16. Category X (ignition equipment): Issue or addition of Category X (ignition equipment)

An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul, repair or modification of aircraft engine ignition equipment, must have had at least three years' electrical engineering experience, including a minimum of one and a half years of recent general practical experience in the overhaul, repair and testing of all types of aircraft engine ignition equipment: Provided that three months' recent general practical experience in the overhaul, repair and modification and testing of ignition equipment for engines classified in groups 01, 02 and 03 will be acceptable for the issuing of a licence in Category X, or the addition of Category X to an existing licence -

- (a) if the applicant is the holder of an existing Class I licence in Category X (electrical equipment); or
- (b) if the applicant is the holder of an existing Class I licence in Category D for any or all of the engines classified in groups 01, 02 and 03: Provided that the privileges of any Category X licence issued or added to an existing licence in accordance herewith with be restricted to the certification of the overhaul, repair, modification and testing of ignition equipment fitted to the engine type ratings entered under Category D of the existing licence.

17. Category X (instruments): Issue, addition or extension of Category X (instruments)

- (1) An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul, repair or modification of aircraft and engine instruments, excluding electrically operated instruments, must have had at least three years' instrument engineering experience, including a minimum of one and a half years of recent general practical experience in the overhaul, repair, calibration and installation in aircraft of all types of physically and mechanically operated aircraft and engine instruments.
- (2) An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul, repair or modification of aircraft and engine instruments, including electrically operated instruments, or the extension of Category X (instruments) to include the certification of the overhaul and repair of electrically operated instruments must, in addition to the experience detailed in subparagraph (1) above, either be a holder of a licence in Category X (electrical equipment), together with at least six months' recent practical experience in the overhaul, repair or modification of electrically operated aircraft and engine instruments, or have had at least one year of recent general

practical experience in the overhaul, repair or modification of electrically operated aircraft and engine instruments.

18. Category X (variable-pitch propellers): Issue or addition of Category X (variable-pitch propellers)

An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul, repair or modification of variable-pitch propellers, must have had a minimum of one and a half years of recent general practical experience in the overhaul and repair of variable-pitch propellers, of which at least six months must have been spent on the overhaul or repair of the type of propeller to which the application relates: Provided that the Commissioner may agree to lesser periods of experience on specified types of propellers of comparatively simple construction: Provided further that six months' experience in the overhaul and repair of the type of propeller to which the application relates will be acceptable if the applicant, being the holder of an existing aircraft maintenance engineers' licence in Category B or D, applies for the addition of Category X to such licence.

19. Category X (avionic equipment): Issue or addition of Category X (avionic equipment)

An applicant for the issuing of a licence in Category X, or for the addition of Category X to an existing licence, for the certification of the overhaul, repair, modification and installation of avionic equipment or of avionic equipment employing pulse techniques, must have had at least three years' electronic engineering experience, including a minimum of one and a half years of recent general practical experience in the overhaul, repair, calibration and installation in aircraft of all types of avionic equipment to which the application relates.

20. Category X (avionic equipment): Extension of Category X (avionic equipment)

An applicant for the extension of Category X of a licence already valid for the certification of the overhaul, repair, modification and installation of avionic equipment or of avionic equipment employing pulse techniques to include the type of avionics equipment to which the application relates, must, in addition to the experience detailed in paragraph 19 above, have had at least one year of recent general practical experience in the overhaul, repair or modification of avionic equipment of the type concerned.

21. Category X (aircraft welding): Issue or addition of Category X (aircraft welding)

(Reserved.)

22. Category X (aircraft welding): Extension of Category X (aircraft welding)

(Reserved.)

23. Category W: Issue or addition of Category W

(Reserved.)

24. Category W: Extension of Category W

(Reserved.)

66.02.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**1. Form of application**

- (1) The form referred to in CAR 66.02.5(1)(a), in which application must be made for the issuing of a Class II licence with a Category A rating, is contained in Annexure C.
- (2) The form referred to in CAR 66.02.5(2)(a), in which application must be made for the amendment of a Class II licence with a Category A rating, is contained in Annexure C.

66.02.6 ISSUING OF A LICENCE**1. Form of licence**

The form referred to in CAR 66.02.6(2), on which a Class II licence with a Category A rating is issued, is contained in Annexure D.

66.02.9 RENEWAL OF LICENCE**1. Form of application**

The form referred to in CAR 66.02.9(2)(a), in which application must be made for the renewal of a Class II licence with a Category A rating, is contained in Annexure C.

2. Form of application

The form referred to in CAR 66.02.9(4), in which a Class II licence with a Category A rating is renewed, is contained in Annexure D.

66.02.10 REISSUE**1. Form of application**

The form referred to in CAR 66.02.10(3), in which application must be made for the reissuing of a Class II licence with a Category A rating, is contained in Annexure C.

66.03.2 TRAINING**1. Training standards**

The form referred to in CAR 66.03.2, is the appropriate training set out in TS 66.02.2.

66.03.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Written examination requirements**

The requirements for the written examination referred to in CAR 66.03.3(1), are the appropriate requirements set out in TS 66.02.3.

2. Retesting after failure

The periods for retesting after failure referred to in CAR 66.03.3(2), are the periods specified in paragraph 3 of TS 66.02.3.

66.03.4 EXPERIENCE**1. Requirements**

The experience requirements referred to in CAR 66.03.4, are the appropriate experience requirements set out in TS 66.02.4.

66.03.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**1. Form of application**

- (1) The form referred to in CAR 66.03.5(1)(a), in which application must be made for the issuing of a Class II licence with a Category C rating, is contained in Annexure C.
- (2) The form referred to in CAR 66.04.5(2)(a), in which application must be made for the amendment of a Class II licence with a Category W rating, is contained in Annexure C.

66.03.6 ISSUING OF LICENCE**1. Form of licence**

The form referred to in CAR 66.03.6(2), on which a Class II licence with a Category C rating is issued, is contained in Annexure D.

66.03.9 RENEWAL OF LICENCE**1. Form of application**

The form referred to in CAR 66.03.6(2), on which a Class II licence with a Category C rating is issued, is contained in Annexure D.

2. Form of renewal

The form referred to in CAR 66.03.9(4), in which a Class II licence with a Category C rating is renewed, is contained in Annexure D.

66.03.10 REISSUE**1. Form of application**

The form referred to in CAR 66.03.10(3), in which application must be made for the reissuing of a Class II licence with a Category C rating, is contained in Annexure C.

66.04.2 TRAINING**1. Training standards**

The form referred to in CAR 66.04.2, is the appropriate training set out in TS 66.02.2.

66.04.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Written examination requirements**

The requirements for the written examination referred to in CAR 66.04.3(1), are the appropriate requirements set out in TS 66.02.3.

2. Retesting after failure

The periods for retesting after failure referred to in CAR 66.04.3(2), are the periods specified in paragraph 3 of TS 66.02.3.

66.04.4 EXPERIENCE**1. Requirements**

The experience requirements referred to in CAR 66.04.4, are the appropriate requirements set out in TS 66.02.4.

66.04.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**1. Form of application**

(1) The form referred to in CAR 66.04.5(1)(a), in which application must be made for the issuing of a Class II licence with a Category W rating, is contained in Annexure C.

(2) The form referred to in CAR 66.04.5(2)(a), in which application must be made for the amendment of a Class II licence with a Category W rating, is contained in Annexure C.

66.04.6 ISSUING OF LICENCE**1. Form of licence**

The form referred to in CAR 66.04.6(2), on which a Class II licence with a Category W rating is issued, is contained in Annexure D.

66.04.9 RENEWAL OF LICENCE**1. Form of application**

The form referred to in CAR 66.04.9(2)(a), in which application must be made for the renewal of a Class II licence with a Category W rating, is contained in Annexure C.

2. Form of renewal

The form referred to in CAR 66.04.9(4), in which a Class II licence with a Category W rating is renewed, is contained in Annexure D.

66.04.10 REISSUE**1. Form of application**

The form referred to in CAR 66.04.10(3), in which application must be made for the reissuing of a Class II licence with a Category W rating, is contained in Annexure C.

66.05.2 TRAINING**1. Training standards**

The training referred to in CAR 66.05.2, is the appropriate training set out in TS 66.02.2.

66.05.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Written examination requirements**

The requirements for the written examination referred to in CAR 66.05.3(1), are the appropriate requirements set out in TS 66.02.3.

2. Retesting after failure

The periods for retesting after failure referred to in CAR 66.05.3(2), are the periods specified in paragraph 3 of TS 66.02.3.

66.05.4 EXPERIENCE**1. Requirements**

The experience requirements referred to in CAR 66.05.4, are the appropriate experience requirements set out in TS 66.02.4.

66.05.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**1. Form of application**

(1) The form referred to in CAR 66.05.5(1)(a), in which application must be made for the issuing of a Class I licence with a Category B rating, is contained in Annexure C.

(2) The form referred to in CAR 66.05.5(2)(a), in which application must be made for the amendment of a Class I licence with a Category B rating, is contained in Annexure C.

66.05.6 ISSUING OF LICENCE**1. Form of licence**

The form referred to in CAR 66.05.6(2), on which a Class I licence with a Category B rating is issued, is contained in Annexure D.

66.05.9 RENEWAL OF LICENCE**1. Form of application**

The form referred to in CAR 66.05.9(2)(a), in which application must be made for the renewal of a Class I licence with a Category B rating, is contained in Annexure C.

2. Form of renewal

The form referred to in CAR 66.05.9(4), in which a Class I licence with a Category B rating is renewed, is contained in Annexure D.

66.05.10 REISSUE**1. Form of application**

The form referred to in CAR 66.05.10(3), in which application must be made for the reissuing of a Class I licence with a Category B rating, is contained in Annexure C.

66.06.2 TRAINING**1. Training standards**

The training referred to in CAR 66.06.2, is the appropriate training set out in TS 66.02.2.

66.06.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Written examination requirements**

The requirements for the written examination referred to in CAR 66.06.3(1), are the appropriate requirements set out in TS 66.02.3.

2. Retesting after failure

The periods for retesting after failure referred to in CAR 66.06.3(2), are the periods specified in paragraph 3 of TS 66.02.3.

66.06.4 EXPERIENCE**1. Requirements**

The experience requirements referred to in CAR 66.06.4, are the appropriate requirements set out in TS 66.02.4.

66.06.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**1. Form of application**

(1) The form referred to in CAR 66.06.5(1)(a), in which application must be made for the issuing of a Class I licence with a Category D rating, is contained in Annexure C.

(2) The form referred to in CAR 66.06.5(2)(a), in which application must be made for the amendment of a Class I licence with a Category D rating, is contained in Annexure C.

66.06.6 ISSUING OF LICENCE**1. Form of licence**

The form referred to in CAR 66.06.6(2), on which a Class I licence with a Category D rating is issued, is contained in Annexure D.

66.06.9 RENEWAL OF LICENCE**1. Form of application**

The form referred to in CAR 66.06.9(2)(a), in which application must be made for the renewal of a Class I licence with a Category D rating, is contained in Annexure C.

2. Form of renewal

The form referred to in CAR 66.06.9(4), in which a Class I licence with a Category D rating is renewed, is contained in Annexure D.

66.06.10 REISSUE**1. Form of application**

The form referred to in CAR 66.06.10(3), in which application must be made for the reissuing of a Class I licence with a Category D rating, is contained in Annexure C.

66.07.2 TRAINING**1. Training standards**

The training referred to in CAR 66.07.2, is the appropriate training set out in TS 66.02.2.

66.07.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Form of licence**

The form referred to in CAR 66.06.6(2), on which a Class I licence with a Category D rating is issued, is contained in Annexure D.

2. Retesting after failure

The periods for retesting after failure referred to in CAR 66.07.3(2), are the periods specified in paragraph 3 of TS 66.02.3.

66.07.4 EXPERIENCE**1. Requirements**

The experience requirements referred to in CAR 66.07.4, are the appropriate experience requirements set out in TS 66.02.4.

66.07.5 APPLICATION FOR LICENCE OR AMENDMENT THEREOF**1. Form of licence**

(1) The form referred to in CAR 66.07.5(1)(a), in which application must be made for the issuing of a Class I licence with a Category X rating, is contained in Annexure C.

(2) The form referred to in CAR 66.07.5(2)(a), in which application must be made for the amendment of a Class I licence with a Category X rating, is contained in Annexure C.

66.07.6 ISSUING OF LICENCE**1. Form of licence**

The form referred to in CAR 66.07.6(2), on which a Class I licence with a Category X rating is issued, is contained in Annexure D.

66.07.9 RENEWAL OF LICENCE**1. Form of licence**

The form referred to in CAR 66.07.9(2)(a), in which application must be made for the renewal of a Class I licence with a Category X rating, is contained in Annexure C.

2. Form of renewal

The form referred to in CAR 66.07.9(4), in which a Class I licence with a Category X rating is renewed, is contained in Annexure D.

66.07.10 REISSUE**1. Form of application**

The form referred to in CAR 66.07.10(3), in which application must be made for the reissuing of a Class licence with a Category X rating, is contained in Annexure C.

66.08.2 TRAINING**1. Training standards**

(Reserved).

66.08.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Written examination requirements**

(Reserved).

2. Retesting after failure

(Reserved).

66.08.4 EXPERIENCE**1. Requirements**

(Reserved).

66.08.5 APPLICATION FOR GRADE ONE AIRCRAFT MAINTENANCE INSTRUCTOR RATING**1. Form of application**

The form referred to in CAR 66.08.5(a), in which application must be made for the issuing of a Grade One aircraft maintenance instructor rating, is contained in Annexure E.

66.08.6 ISSUING OF GRADE ONE AIRCRAFT MAINTENANCE INSTRUCTOR RATING**1. Form of rating**

The form referred to in CAR 66.08.6(2), on which a Grade One aircraft maintenance instructor rating is issued, is contained in Annexure F.

66.08.9 RENEWAL OF GRADE ONE AIRCRAFT MAINTENANCE INSTRUCTOR RATING**1. Form of application**

The form referred to in CAR 66.08.9(2), in which application must be made for the renewal of a Grade One Aircraft maintenance instructor rating, is contained in Annexure E.

2. Form of renewal

The form referred to in CAR 66.08.9(4), in which a Grade One aircraft maintenance instructor rating is renewed, is contained in Annexure F.

66.09.2 TRAINING**1. Training standards**

(Reserved.)

66.09.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Written examination requirements**

(Reserved.)

2. Retesting after failure

(Reserved.)

66.09.4 EXPERIENCE**1. Requirements**

(Reserved.)

66.09.5 APPLICATION FOR GRADE TWO AIRCRAFT MAINTENANCE INSTRUCTOR RATING**1. Form of application**

The form referred to in CAR 66.09.5(a), in which application must be made for the issuing of a Grade Two aircraft maintenance instructor rating, is contained in Annexure E.

66.09.6 ISSUING OF GRADE TWO AIRCRAFT MAINTENANCE INSTRUCTOR RATING**1. Form of rating**

The form referred to in CAR 66.09.6(2), on which a Grade Two aircraft maintenance instructor rating is issued, is contained in Annexure F.

66.09.9 RENEWAL OF GRADE TWO AIRCRAFT MAINTENANCE INSTRUCTOR RATING**1. Form of application**

The form referred to in CAR 66.09.9(2), in which application must be made for the renewal of a Grade Two aircraft maintenance instructor rating, is contained in Annexure E.

2. Form of renewal

The form referred to in CAR 66.09.9(4), in which a Grade Two aircraft maintenance instructor rating is renewed, is contained in Annexure F.

SCHEDULE 1: WELDING REQUIREMENTS**1. WELDING TESTS****1.1 General**

(1) Welding ratings will be required for -

- (a) oxy-acetylene;
 - (b) inert gas shielded arc;
 - (c) plasma arc;
 - (d) atomic hydrogen;
 - (e) metal arc; and
 - (f) carbon welding processes,
- for the following groups or metallic materials:

Group 1 - Aluminium alloys
Group 2 - Magnesium alloys
Group 3 - Carbon steels
Group 4 - Corrosion and heat-resisting steels
Group 5 - Nickel base and cobalt base alloys
Group 6 - Titanium alloys
Group 7 - Copper base alloys

(2) Welding ratings will be limited to those types of materials or material groups and welding processes on which the applicant has demonstrated his or her welding ability by means of the tests referred to hereunder.

(3) Where a welder is employed by an approved aircraft maintenance organisation, the responsibility of maintaining a satisfactory standard of

competency of the welder concerned will be entrusted to the organisation which must use the procedure for establishing such competency as set out in this Schedule.

1.2 **Welding test for initial ratings**

- (1) Each welder will be required to make test pieces and at his or her option, prepare test specimens appropriate to the ratings required. Such test pieces and test specimens must conform to the standards shown in Figures 1, 2 and 3 and 4. For test pieces shown in Figures 2 and 3, a 25% variation in tube diameter will be permitted and tubular material wall thicknesses must be within 20% of the range specified.
- (2) Applicants must use for their tests, piece materials of the same specifications or the nearest equivalent as those they will be welding on aircraft, but if this provides undue difficulty, similar materials will be acceptable if two control specimens of the parent material conforming to the tensile test specimen of Figure 1, are submitted.
- (3) The test pieces required for the various groups of materials are as follows:
 - (a) For group 1 and 2 materials, the test pieces shown in Figures 1 and 4.
 - (b) For group 3 and 4 materials, the test pieces shown in Figure 1, for plasma arc welding process, and Figures 2 and 3 for oxy-acetylene and inert gas shielded arc welding processes.
 - (c) For group 5, 6 and 7 materials, the test piece shown in Figure 1.
 - (d) Where the applicant desires a welding rating to be limited to certain types of work, e.g. tubular repairs only, such applicable test pieces as shown in Figures 1, 2, 3 or 4.
 - (e) Figure 3 does not apply in respect of the plasma arc welding process.
- (4) The welding of test pieces must be done by each welder in accordance with the requirements prescribed in paragraph 2 and under the supervision of a person approved for the purpose by the Director. If the welder elects to have the test specimens prepared before these are submitted to the test laboratory for examination, such preparation must also be under the control of the supervisor.
- (5) The welds of test pieces and test specimens may not be hammered, dressed or sand blasted.
- (6) The supply of welding equipment and test materials is the responsibility of the welder concerned.
- (7) Only one set of test pieces and test specimens is permitted at a time for each rating of each welder.
- (8) A welder may abandon any test at any stage if he or she is dissatisfied with the results. In such cases and in the case of failure to pass the initial test, he or she will only be permitted to do further tests after a period of 30 days during which period he or she must obtain additional welding experience. If a welder fails the second renewal test, all the prescribed tests for that group of metallic material will have to be satisfactorily completed after a further period of 30 days.
- (9) A welder only becomes qualified for a material or material group using the appropriate welding process on the date that the approved examiner indicates in writing that the test concerned was satisfactory.

1.3 **Welding tests for renewal**

- (1) Each welder will normally be required to do a test piece for each rating for which renewal is required and, at his or her option, prepare the necessary test specimens in accordance with Figure 1. For such tests the provisions of paragraphs 1.2(1) and 1.2(5) and (9) inclusive apply.
- (2) A welder may abandon any renewal test at any stage if he or she is dissatisfied with the results.
- (3) In cases where the privileges of a rating have lapsed for more than 6 months, the complete test must be satisfactorily completed before the privileges of the rating concerned are again exercised.

1.4 **Examination of test pieces and test specimens**

Examination of test pieces and test specimens must be done in accordance with the following requirements:

(1) **General**

All welds must be examined for contour, width, reinforcement, penetration, bonding, porosity, non-metallic inclusions and excessive carburisation cracks. Where excessive penetration occurs, the test piece or specimen will be rejected, but isolated excrescences on the underside of a weld are acceptable provided the weld is free from cavities, oxide films and other defects.

(2) **Tensile tests**

- (a) Tensile test specimens must be tested to destruction in direct tension. The ultimate tensile stress (calculated on the minimum area of cross section of the specimen) and the position of the break must be recorded.
- (b) A break through the weld of a sheet-to-sheet but welded test specimen will be considered satisfactory only if the ultimate tensile stress at which the break occurs, is to the acceptable value for the type of material concerned.
- (c) Tensile tests on tube to tube specimens must produce end loads without bending. Suitable pins passing through the top and bottom cross tubes and shackles should be used on the tensile test machine for this purpose. Where the specimen fails by the weld metal peeling away from the surface of one of the component parts, the weld will not be considered satisfactory even though the required ultimate tensile stress may have been reached.

(d) **Bend tests**

(3) **Bend tests**

- (a) Bend test specimens must be bent so that the weld is along the axis of the bend with the base of the weld "V" on the inner side of the bend. To facilitate close contact of the specimen to the bar about which it is bent, the side of the specimen remote from the weld face should be dressed by filing or grinding until any excrescences are level with the parent metal. The edges of the specimen in the vicinity of the weld should be given a reasonable radius. A backing ingot or slab of lead may be used if desired in accomplishing bends of test specimens. Specimens will be considered satisfactory if they withstand the bend tests without showing cracks visible to the naked eye.

- (b) The angles and radii of bends for the various materials involved must be as shown in the following table:

SCHEDULE 1: WELDING REQUIREMENTS

Material	Angle of bend	Radius of bend
Aluminium alloys	180°	5 times nominal thickness of test piece
Magnesium alloys	180°	10 times nominal thickness of test piece
Carbon and low alloy steels	180°	2 times nominal thickness of test piece
Austenitic steels *	90°	3 times nominal thickness of test piece
Boron containing steels	180°	3 times nominal thickness of test piece
Titanium	180°	5 times nominal thickness of test piece
All other materials	180°	2 times nominal thickness of test piece

* Austenitic steel bend specimens in the “as welded” condition must be given the “weld decay” pickling test, prescribed by the specification for the parent metal, prior to bending. The formula for the weld decay solution is: 222 grams of copper sulphate, 106.5 ml of sulphuric acid and add water to make a total of 2 liters.

(4) Microscopic examinations

- (a) Micro specimens must be examined microscopically in the unetched and etched conditions for satisfactory fusion and adequate penetration and for freedom from carburisation or decarburisation, cracks, excessive cavitation and harmful inclusions.
- (b) Examination for intergranular oxide films must be done with the specimen in the unetched condition as the presence of such films is difficult to detect in the etched condition. If the area of intergranular oxide is only very slight and satisfactory results are obtained from mechanical testing of the related test specimens, further sections of the weld should be micro examined before a decision is reached.
- (c) For fillet welds of 45° or greater, the maximum lack of fusion which will normally be accepted, is that revealed by a line of oxide extending from the root for a distance not greater than one third of the distance between the root and the toe of the weld provided that the amount of weld material used is adequate to give a throat thickness of not less than the thickness of the sheets or tubes used for test pieces.
- (d) For fillet welds at acute angles e.g. 30° in Figure 3, complete penetration in the root of the weld may be difficult to achieve without excessive melting of the parent metal. The presence of a fairly large cavity or corresponding lack of fusion will be acceptable at the apex of such welds provided there is a bridge of weld material of a reasonable throat depth showing satisfactory fusion to the parent metal.

(5) Assessment of welded pieces

Final assessment of the weld must be based on consideration of the sample weld as a whole, including the results obtained by visual inspection, microscopical examination, and where applicable, radiographic examination and mechanical testing. If any doubt exists regarding the quality of the weld, or any defect revealed is thought to be of a local character, further sections may be examined and final assessment must be based on all the specimens examined.

2. METHODS OF PREPARATION OF WELDED TEST PIECES AND TEST SPECIMENS

The preparation of welded test pieces for the groups of materials must be as follows:

2.1 Figure 1: Sheet to sheet butt weld

- (1) Edges of sheets to be welded must be chamfered when 16 I.S.W.G or thicker material is used except for aluminium and aluminium alloys, in which case edge preparation is not necessary for material thinner than 12 I.S.W.G.
- (2) Welds must be performed by forward welding from one side only using correct flux and filler rod.

2.2 Figure 2: Sheet to tube weld

- (1) The centre of each end plate must be drilled with a 12 mm diameter hole prior to welding. The ends of the tube need not be chamfered for material thinner than 16 I.S.W.G.
- (2) End plates may be positioned with tack welds and the first to be welded must be done with the end plate flat on the bench and the tube in the vertical position; this weld must be completed by working around the test piece. The second end plate must be welded to the tube with the tube in the horizontal position and not moved during the process of completing the weld; this weld must be completed by working under and over the test piece.
- (3) The specimen for microscopic examination must be cut from one end of the test piece as indicated in Figure 2. The remainder of the test pieces must be preserved and submitted for any further examination which may be considered necessary should the results of the macroscopic examination raise any doubt.

2.3 Figure 3: Tube to tube weld

- (1) After preparation of the tubes for welding these must be assembled in a jig and tack welded.
- (2) The assembly must then be removed from the jig and mounted in a vertical position with the longest tube (365 mm) at the lowest point. The assembly may not be moved from this position during the process of completing the welds.
- (3) The uppermost joint formed by the short horizontal, vertical and diagonal tubes must be welded by the "overhead" welding technique and the remaining joints completed by working around the test piece.

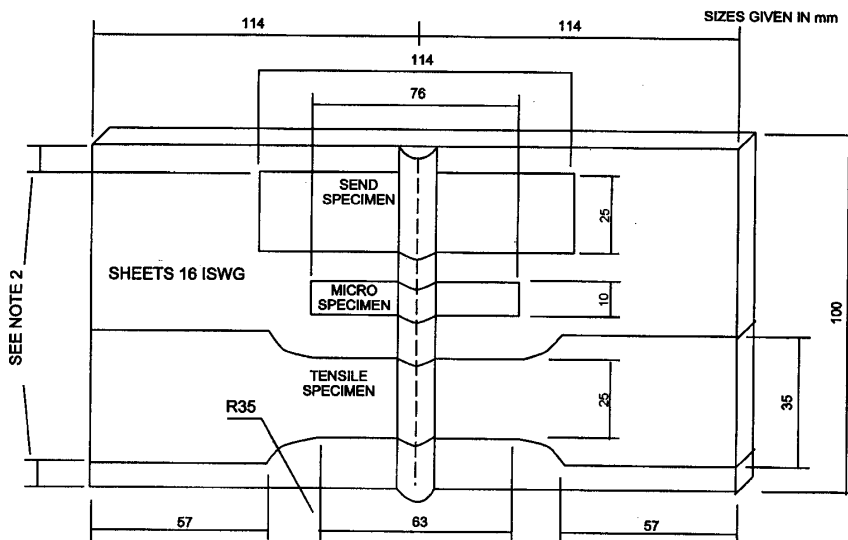
2.4 Figure 4: Block build-up

Do a build-up operation of the U cut-out on the machined block, by multiweld runs, to a level slightly above that of block surface.

SCHEDULE 1: WELDING REQUIREMENTS

FIGURE 1

SHEET TO SHEET BUTT WELD

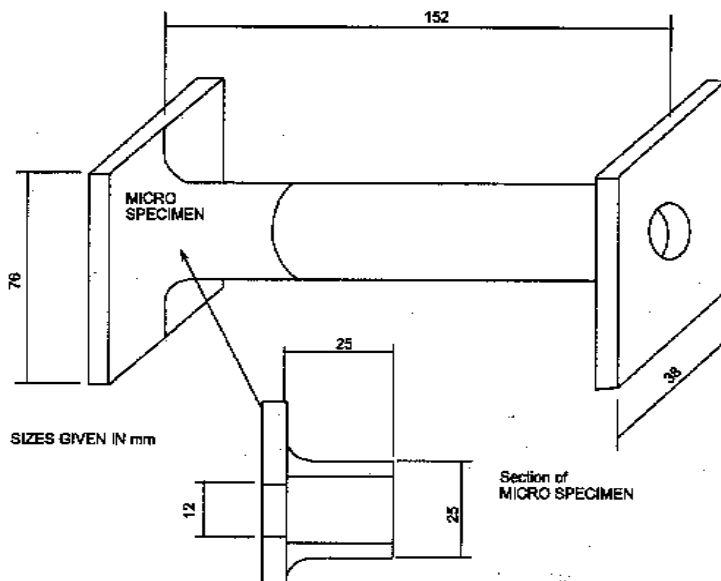


Notes:

- 1 ISWG = Imperial or British Standard wire gauge.
- 2 Enough discard so that the beginning and end of the run is not included in the test specimen.

FIGURE 2

SHEET TO TUBE WELD



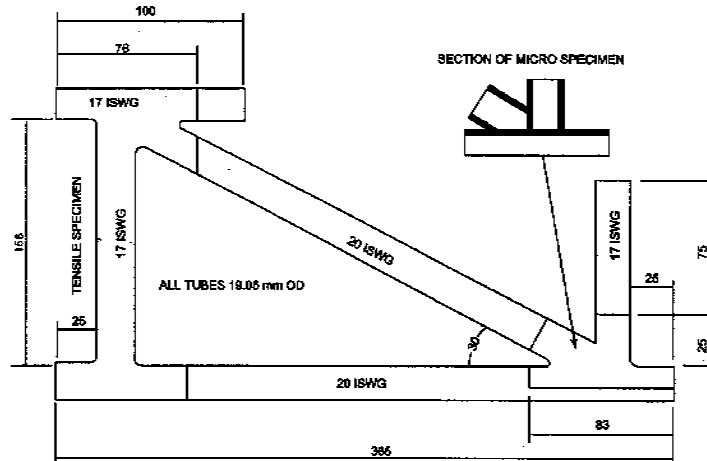
Notes:

1. A variation of up to 25% in tube diameter will be permitted for tubular material but wall thickness of tubes must be within the dimensions specified.

2. For Oxy-acetylene welding use tube 20 ISWG (0,889 - 1,016 mm) and end plates 16 ISWG (1,626 - 1,676 mm).
3. For ARC welding use tube 16 ISWG (1,626 - 1,676 mm) and end plates 16 ISWG (1,626 - 1,676 mm).

FIGURE 3

TUBE TO TUBE WELD



Notes:

1. A variation of up to 25% in tube diameter will be permitted for tubular material but wall thickness of tubes must be within the dimensions specified.
2. For ARC welding, substitute 14 ISWG (1,829 - 2,108 ,,) for 17 ISWG (1,422 - 1,473 mm) and 16 ISWG (1,626 - 1,676 mm) for 20 ISWG (9,899 - 1,016 mm).

FIGURE 4

BLOCK BUILD-UP

