

**MOZAMBIQUE CIVIL AVIATION
TECHNICAL STANDARDS**



**PART 63
MOZ-CATS-FCL 63
FLIGHT ENGINEER LICENSING**

MOZAMBIQUE CIVIL AVIATION TECHNICAL STANDARDS: CATS
Each Chapter is re-printed from the amended page onwards.

Parts	Parts Title	Control Date
21	MOZ-CATS-AR Airworthiness Requirements	October, 15, 2006
43	MOZ-CATS-GMR General Maintenance Rules	October, 15, 2006
47	MOZ-CATS-ARM Registration and Marking	October, 15, 2006
61	MOZ-CATS-FCL61 Pilot Licensing	October, 15, 2006
63	MOZ-CATS-FCL63 Flight Engineer Licensing	October, 15, 2006
65	MOZ-CATS-GSPL Ground Service Personnel Licensing	October, 15, 2006
66	MOZ-CATS- AMEL Aircraft Maintenance Engineer Licensing	October, 15, 2006
67	MOZ-CATS-MR Medical Requirements	October, 15, 2006
71	MOZ-CATS-AS Designation of Airspace	October, 15, 2006
91	MOZ-CATS-OPS-91 General Operating and Flight Rules	October, 15, 2006
103	MOZ-CATS-OPS 103 Microlight Aircraft Operations	October, 15, 2006
121	MOZ-CATS-OPS-121 Air Transport Operations – Large Aeroplanes	October, 15, 2006
127	MOZ-CATS-OPS-127 Air Transport Operations – Helicopters	October, 15, 2006
135	MOZ-CATS-OPS-135 Air Transport Operations – Small Aeroplanes	October, 15, 2006
139	MOZ-CATS-AH Licensing and Operation of Aerodromes and Heliports	October, 15, 2006
141	MOZ-CATS-ATO Aviation Training Organizations	October, 15, 2006
145	MOZ-CATS-AMO Aircraft Maintenance Organizations	October, 15, 2006
171	MOZ-CATS-TMS Aeronautical Telecommunication Service	October, 15, 2006
172	MOZ-CATS-ATS Air Traffic Service Organizations	October, 15, 2006
175	MOZ-CATS-AIS Aeronautical Information Service Organizations	October, 15, 2006

MOZAMBIQUE CIVIL AVIATION TECHNICAL STANDARDS: CATS

RECORD OF REVISIONS

Revision	Revision of Parts	No of pages	New Date
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			

MOZAMBIQUE CIVIL AVIATION TECHNICAL STANDARDS: CATS RELATING TO FLIGHT ENGINEER LICENSING

1. GENERAL

Decree 41 of 2001 empowers the Director General for Civil Aviation to issue technical standards for civil aviation on the matters which are prescribed by regulation.

2. PURPOSE

Document SA-CATS-FCL 63 contains the standards, rules, requirements, methods, specifications, characteristics and procedures which are applicable in respect of flight engineer licensing.

Each reference to a technical standard in this document, is a reference to the corresponding regulation in the Mozambique Civil Aviation Regulations, 1999, for example, technical standard 63.01.3 refers to regulation 3 of Subpart 01 of Part 63 of the Regulations.

The abbreviation “CAR” is used throughout this document when referring to any 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

63.01.3	VALIDATION OF LICENSE ISSUED BY APPROPRIATE AUTHORITY	8
1.	Application for validation of license issued by an appropriate authority	8
2.	Requirements and conditions for the issue of a validation	8
3.	Form of the validation.....	8
4.	Renewal of a validation issued by the Director.....	8
5.	Compliance	8
63.01.6	LOGBOOKS	9
1.	Form of logbooks	9
2.	Information to be contained in logbooks	9
3.	Manner in which logbooks are to be maintained	9
63.01.13	RETESTING AFTER FAILURE	10
1.	Retesting after failure	10
63.01.14	DESIGNATION OF EXAMINER	11
1.	Requirements.....	11
2.	Procedures.....	11
3.	Document used for Designation.....	11
4.	Submission of reports and forms	11
5.	Responsibility	11
6.	Monitoring of the system	11
63.02.3	TRAINING (FLIGHT ENGINEER LICENSE)	12
1.	Aim of training course	12
2.	Contents and duration of training course	12
3.	Training course syllabus	12
3.1	Air law and ATC procedures.....	12
3.2	Aircraft general knowledge	17
3.3	Flight performance and planning	28
3.4	Human performance and limitations.....	30
3.5	Meteorology	33
3.6	Navigation.....	33
3.7	Operational procedures	34
3.8	Principles of flight.....	36
3.9	Communications	37
4.	Practical training course.....	38
4.1	Contents.....	38
4.2	General	39
63.02.4	THEORETICAL KNOWLEDGE EXAMINATION	40
1.	Contents.....	40
2.	General.....	40
3.	Theoretical examination on type of aeroplane to which application relates	40
4.	Conducting of theoretical knowledge examination	41
5.	Duties of the Director	41
6.	Entry requirements and procedures for theoretical knowledge examinations	42
6.1	General	42
6.2	Procedures for examinations.....	42
6.3	Special Examinations	43
7.	Marking of examinations scripts	43
63.02.5	SKILL TEST.....	44
1.	Procedures and manoeuvres.....	44
2.	Conducting the skill test	44
3.	Skill test report	44
63.02.6	APPLICATION FOR FLIGHT ENGINEER LICENSE	45
1.	Application form for flight engineer license	45
2.	Skill test report	45
63.02.7	ISSUING OF FLIGHT ENGINEER LICENSE.....	46

1. Form	46
63.03.2 TRAINING	47
1. Training course	47
63.03.3 THEORETICAL KNOWLEDGE EXAMINATION	48
1. Theoretical examination on type	48
2. Conducting of theoretical knowledge examination	49
3. Duties of the Aviation Training Organization (ATO)/Operator/Manufacturer	49
4. Entry requirements and procedures for theoretical knowledge examinations	49
5. Remarking of examination papers	49
63.03.4 SKILL TEST	50
1. Procedures and manoeuvres	50
2. Conducting the skill test	50
3. Skill test report	50
63.03.5 APPLICATION FOR TYPE RATING	51
1. Application form for type rating	51
2. Skill test report	51
63.03.6 ISSUING OF TYPE RATING	52
1. Form	52
63.03.9 RENEWAL	53
1. Proficiency check	53
2. Certificate of competency	53
3. Form of application	53
4. Form of temporary type rating certificate	53
5. Form of renewal	53
63.03.10 REISSUE	54
1. Skill test report	54
2. Form of application	54
3. Form of temporary type rating certificate	54
4. Form of reissue	54
63.04.3 TRAINING	55
1. Training course	55
63.04.4 THEORETICAL KNOWLEDGE EXAMINATION	56
1. Examination	56
63.04.5 SKILL TEST	57
1. Procedures	57
63.04.6 APPLICATION FOR GRADE I FLIGHT ENGINEER INSTRUCTOR RATING	58
1. Application form for flight engineer instructor's rating	58
2. Skill test report	58
63.04.7 ISSUING OF GRADE I FLIGHT ENGINEER INSTRUCTOR RATING	59
1. Form	59
63.04.10 RENEWAL	60
1. Flight engineer instructor refresher seminar	60
2. Conducting the skill test	60
3. Skill test report	60
4. Form of application	60
5. Form of renewal	60
63.04.11 REISSUE	61
1. Skill test report	61
2. Form of application	61
3. Form of reissue	61

63.05.3	TRAINING.....	62
1.	Aim of training course	62
2.	Teaching and learning.....	62
3.	Suggested approximate breakdown of hours for the ground training part of the training course.....	65
4.	Flight training.....	66
4.1	Contents.....	66
4.2	General	67
63.05.4	THEORETICAL KNOWLEDGE EXAMINATION	68
1.	Examination	68
2.	Conducting of theoretical knowledge examination	68
3.	Duties of the Director	68
4.	Entry requirements and procedures for theoretical knowledge examinations.....	68
5.	Marking of examination papers	68
63.05.5	SKILL TEST.....	69
1.	Procedures.....	69
63.05.6	APPLICATION FOR GRADE II FLIGHT ENGINEER INSTRUCTOR RATING	70
1.	Application form for Grade II flight engineer instructor rating	70
2.	Skill test report	70
63.05.7	ISSUING OF GRADE II FLIGHT ENGINEER INSTRUCTOR RATING.....	71
1.	Form.....	71
63.05.10	RENEWAL.....	72
1.	Flight engineer instructor refresher seminar	72
2.	Conducting the skill test	72
3.	Skill test report	72
4.	Form of application.....	72
5.	Form of renewal	72
63.05.11	REISSUE	73
1.	Flight engineer instructor refresher seminar	73
2.	Skill test report	73
3.	Form of application.....	73
4.	Form of reissue	73
Annexure A:	FLIGHT ENGINEER LOGBOOK	74

63.01.3 VALIDATION OF LICENSE ISSUED BY APPROPRIATE AUTHORITY

1. Application for validation of license issued by an appropriate authority

The application form for the validation of a foreign flight engineer license referred to in MCAR 63.01.3 (1) is Form MZ 63-02, which is available from DIRECTOR.

2. Requirements and conditions for the issue of a validation

Any valid foreign flight engineer license and rating may be validated by the Director subject to the following conditions and requirements:

- (1) The applicant must pass an examination in Mozambique air law;
- (2) the applicant must pass a practical skill test conducted by a Grade I flight engineer instructor;
- (3) the applicant must have flown a minimum of 500 hours as a flight engineer in the country of issue of the foreign flight engineer license or in an environment at least equal or similar to that of Mozambique; and
- (4) no additions can be made to a flight engineer license regarding the types of aircraft which may be flown.
- (5) A validation shall only be considered after the license requirements and the standards of the foreign country have been reviewed and the country of issue has confirmed the validity of the applicant's license and ratings.
- (6) In cases where the requirements of a foreign country are lower than that of Mozambique, the applicant would be required to meet the higher requirement before the validation would be issued.
- (7) On receipt of the validation, the holder shall at all times meet the regulatory requirements for the validation issued and the holder shall at all times adhere to the privileges and limitations for the specific validation as it relates to regulations 63.02.9, 63.03.9, 63.04.9, and 63.05.9 for the applicable ratings.

3. Form of the validation

The form of the validation referred to in CAR 63.01.6(3) is determined by the Director and meets the requirements of Annex 1.

4. Renewal of a validation issued by the Director

The Director may renew the validation of a flight engineer license provided that the holder of such validation has, for the duration of the validation -

- (1) exercised the privileges of the flight engineer license to which the validation refers, in accordance with the provisions of the Act, the Regulations and this Technical Standard; and
- (2) operated safely and professionally, with a degree of competency appropriate to the privileges granted to the holder of a similar license.

5. Compliance

The appropriate standards, rules, requirements, methods, specifications, characteristics and procedures contained in the Act, the Regulations and this Technical Standard must be complied with at all times.

63.01.6 LOGBOOKS

1. Form of logbooks

Logbooks must be maintained in the form contained in Annexure A.

2. Information to be contained in logbooks

The following information must be recorded in logbooks:

- (1) Full name and address of owner;
- (2) summary of previous flying experience, if any; and
- (3) particulars of flights -
 - (a) date;
 - (b) type and registration of the aircraft in which the flight occurs;
 - (c) operating capacity of holder;
 - (d) flight time; and
 - (e) nature of flight.

3. Manner in which logbooks are to be maintained

In order to facilitate the issue of licenses, a flight engineer must -

- (1) clearly indicate night and instructional flight times; and
- (2) summarise his or her logbook.

63.01.13 RETESTING AFTER FAILURE

1. Retesting after failure

- (1) The pass mark for any written examination referred to in CAR 63.01.3, 63.02.4, 63.03.3, 63.04.4 or 63.05.4 is 70%.
- (2) A candidate who fails with a mark of between 66% and 69%, may apply in writing for a re-mark within 30 days from the date of receiving the examination results, on payment of the appropriate fee.
- (3) If the re-mark is successful, the fee will be refunded.
- (4) A candidate who fails may apply in writing for re-testing after 30 days from the date of receiving the examination results on payment of the appropriate fee.
- (5) A candidate may apply 4 times for re-testing, after which the candidate must undergo the appropriate training at an approved aviation training organization.
- (6) Any further application for re-testing must be accompanied by a training certificate issued by the aviation training organization for successful completion of an approved course.

63.01.14 DESIGNATION OF EXAMINER**1. Requirements**

The Director may designate the holder of a Grade I flight engineer instructor rating as an examiner.

2. Procedures.

- (1) Any person who desires to be designated as an examiner, must apply in writing to the Commissioner.
- (2) An application for the designation as an examiner must be accompanied by proof that the applicant complies with the conditions, requirements and standards prescribed in this technical standard.
- (3) The Director may, after due consideration of the application, designate the applicant as an examiner.
- (4) The Director may designate the applicant as an examiner for the period determined by the Director, which period may not exceed one year, calculated from the date of designation.
- (5) The Director may withdraw a designation if -
 - (a) it becomes evident that the designated examiner does not comply with the provisions of this technical standard; or
 - (b) the withdrawal is necessary in the interests of aviation safety.
- (6) The designated examiner must, upon the withdrawal of the designation by the Director, forthwith surrender the document referred to in CAR 63.01.14(3) to the Director.

3. Document used for Designation

- (1) The document referred to in CAR 63.01.14(3) must be carried by the Examiner and the Examiner's license number must be reflected on all the relevant documents signed by him/her.

4. Submission of reports and forms

- (1) An examiner must submit a report to the Director quarterly, on all practical skill tests conducted by the examiner. These reports must be submitted regardless of the results of the skill tests and even if no skill tests were conducted by the examiner.
- (2) Skill test forms and competency forms where the test resulted in failure must be forwarded by the examiner to the Director for record keeping.
- (3) In the event of a failure, the test form must indicate notes on the debriefing done and the candidate must initial at such notes.
- (4) Any skill test or competency form not duly completed by an examiner may be rejected by the Director.

5. Responsibility

- (1) it is the responsibility of the examiner to ensure that the candidate has passed the relevant theoretical knowledge examinations with the DIRECTOR before commencing the skill or competency test.
- (2) It is also the responsibility of the examiner to ensure that the candidate is in possession of a valid flight engineer license and that his or her flying hours comply with the requirements for that particular license as required.

6. Monitoring of the system

- (1) The Director may at any time require an examiner to subject himself or herself for a ground or skill test, should it become evident that such examiner is not maintaining the required standard of testing.
- (2) An inspector of the DIRECTOR may at any time request the examiner to observe the conduct of a practical skill test and the examiner may not refuse the inspector access.

63.02.3 TRAINING (FLIGHT ENGINEER LICENSE)**1. Aim of training course**

The aim of the training course is to train the candidate to the level necessary for the issuing of a flight engineer license and to operate aeroplanes in commercial air transportation.

The candidate must complete the approved training course with the holder of an aviation training organization approval issued in terms of Part 141. The training course must be completed within the 18 months immediately preceding the theoretical knowledge examination. The skill test must be conducted within 6 months of passing the theoretical examination.

The course comprises a theoretical knowledge and practical training course to flight engineer knowledge level.

2. Contents and duration of training course

The theoretical knowledge course must comprise of at least 350 hours (200 hours instruction and 150 hours of monitored self study) of instruction including formal classroom work, computer-based training, slide/tape presentation, interactive video and learning carrels where appropriate.

The 350 hours of instruction should preferably be divided as follows:

Subject	Hours
Air Law and ATC procedures	30
Aircraft general knowledge	40
Flight performance planning	55
Human performance and limitations	10
Meteorology	50
Navigation	50
Operational procedures	10
Principles of flight	25
Communications	20

3. Training course syllabus**3.1 Air law and ATC procedures****3.1.1 Civil Aviation Regulations,**

- (1) Structure of Civil Aviation Regulations,
- (2) Contents of the following Parts:
 - (a) Part 21 - Certification procedures for products and parts
 - (b) Part 47 - Registration and marking
 - (c) Part 63 - Flight engineer licensing
 - (d) Part 67 - Medical requirements
 - (e) Part 91 - General operating and flight rules
 - (f) Part 121 - Air transport operations: large aeroplanes.
 - (g) Part 172 - Airspace and air traffic services.

3.1.2 International Aviation Law

- (1) The Chicago Convention
 - (a) General principles and application:
 - sovereignty; and

- territory.
- (b) Flight over territory of Contracting States
- right of non-scheduled flight;
 - scheduled air services;
 - cabotage;
 - landing at customs airports;
 - applicability of air regulations;
 - rules of the air; and
 - search of aircraft.
- (c) Measures to facilitate air navigation:
- customs duty;
 - conditions to be fulfilled with respect to aircraft, such as certificates of airworthiness, licenses of personnel, recognition of certificates and licenses;
 - cargo restrictions;
 - photographic apparatus; and
 - documents to be carried in aircraft.
- (d) International standards and recommended practices:
- adoption of international standards and procedures;
 - endorsement of certificates and licenses;
 - validity of endorsed certificates and licenses; and
 - departure from international standards and procedures (notification of differences).
- (2) The Air Services Transit Agreement
- (a) The five freedoms.
- (3) The Convention of Tokyo
- (a) Jurisdiction; and
- (b) authority of the pilot-in-command of the aircraft.
- (4) The International Civil Aviation Organization
- (a) Annex 8 - Airworthiness of aircraft
- Applicability.
- (b) Annex 7 - Aircraft nationality and registration marks
- Applicability.
- (c) Annex 1 - Personnel Licensing
- Applicability.
- (d) Annex 2 - Rules of the Air
- Essential definitions;
 - Applicability of the rules of the air general rules (except water operations);
 - Visual flight rules;
 - Instruments flight rules;
 - Signals;
 - Interception of civil aircraft; and
 - Table of cruising levels.
- (e) Procedures for air navigation - Aircraft Operations Doc. 8168-OPS/611, Volume 1
- Altimeter setting procedures (ICAO Doc. 7030 – regional supplementary procedures):

- Basic requirements (except tables), procedures applicable to operators and pilots (except tables).

Secondary surveillance radar transponder operating procedures (ICAO Doc. 7030 - regional supplementary procedures):

- Operation of transponders; and
- phraseology.

(f) Annex 11 - Air traffic services

(i) Air traffic services

- Definitions (see general statements).

(ii) General

- Objectives of ATS, division of ATS, designation of the portions of the airspace and controlled aerodromes where ATS will be provided, establishment and designation of the units providing ATS, specifications (for flight information regions, control areas and control zones), minimum flight altitudes, priority in the event of an aircraft in emergency, in-flight contingencies time in ATS.

(iii) Air traffic control

- Application; and
- Provision of air traffic control service, operation of air traffic control service, separation minima, contents of clearances, co-ordination of clearances, control of persons and vehicles at aerodromes.

(iv) Flight information service

- For VFR flights: application and scope of flight information service; and

- Operational flight information service broadcasts.

(v) Alerting service

- Application, notification of rescue co-ordination centres (only INCERFA, ALERFA, DETRESFA), information to aircraft operating in the vicinity of an aircraft in a state of emergency.

(vi) Principles governing the identification of ATS routes other than standard departure and arrival routes.

(vii) Rules of the air and air traffic services (ICAO Doc. 4444 - RAC/501/ 11 and ICAO Doc. 7030 - Regional supplementary procedures)

- Definitions (see general statements).

(viii) General provisions

- General air traffic services operating practices:

- Submission of a flight plan;
- change from IFR to VFR flight;
- clearances and information;
- control of air traffic flow;
- altimeter setting procedures;
- indication of heavy wake turbulence category; and
- position reporting Appendix.

- AIREP form of air report AIREP form (Model AR), recording and reporting instructions (first 7 items).

(ix) Area control service

- Vertical separation:

- Vertical separation application;
 - vertical separation minimum;
 - minimum cruising level;
 - assignment of cruising level; and
 - vertical separations during ascent or descent.
 - Horizontal separation:
 - Lateral separation application;
 - geographical separation;
 - track separation between aircraft using the same VOR.
 - longitudinal separation application (except between supersonic aircraft).
 - Reduction separation minimum;
 - Air traffic control clearances:
 - Contents;
 - description of air traffic control clearances;
 - clearance to fly maintaining own separations while in VMC;
 - essential traffic information;
 - clearance of a requested change in flight plan; and
 - Emergency and communication failure:
 - Emergency procedures (only general priority)
 - emergency descent;
 - action by pilot-in-command;
 - air-ground communication failure (only concerning the actions by pilot-in-command);
 - interception of civil aircraft.
 - (x) Approach control service
 - Departing aircraft:
 - General procedures for departing aircraft;
 - clearances to climb maintaining own separation whilst in VMC;
 - information for departing aircraft; and
 - arriving aircraft:
 - General procedures for arriving aircraft;
 - clearance to descent maintaining own separation in VMC;
 - visual approach;
 - instrument approach; holding;
 - approach sequence;
 - expected approach time;
 - information for arriving aircraft.
 - (xi) Aerodrome control service
 - Functions of aerodrome control towers:
 - General;
 - alerting service provided by aerodrome control towers;
 - suspension of VFR operations by aerodrome control towers;
 - traffic and taxi circuits:
 - Selection of runway-in-use;
 - information to aircraft by aerodrome control towers:
 - Information related to the operation of the aircraft;
- Information on aerodrome conditions control of aerodrome traffic:

- Order of priority for arriving and departing aircraft;
 - control of departing and arriving aircraft.
- (xii) Flight information services and alerting service
- Air traffic advisory service;
 - alerting service; and
 - AFIS.
- (g) Annex 15 - Aeronautical information service
- Definitions (see general statements); and
 - Applicability.
- (h) Annex 14 - Aerodromes
- (i) Aerodrome data:
- Conditions of the movement area and related facilities.
- (ii) Visual aids for navigation:
- Indicators and signaling devices;
 - markings;
 - lights;
 - signs; and
 - markers.
- (iii) Visual aids for denoting obstacles:
- Marking of objects; and
 - lighting of objects.
- (iv) Visual aids for denoting restricted use of areas
- (v) Emergency and other services:
- Fire and rescue service;
 - apron management service; and
 - ground servicing of aircraft.
- (i) Annex 9 - Facilitation
- (i) Entry and departure of aircraft:
- Description, purpose and use of aircraft documents - general declaration.
- (ii) Entry and departure of persons and their baggage:
- Entry requirement and procedures for flight crew and other operator's personnel.

- (j) Annex 12 - Search and rescue
 - (i) Organization:
 - Establishment and provision of SAR service;
 - establishment of SAR regions; and
 - establishment and designation of SAR services units.
 - (ii) Cooperation:
 - Cooperation between States; and
 - cooperation with other services.
 - (iii) Operating procedures:
 - Procedures for pilots-in-command intercepting a distress transmission; and
 - search and rescue signals.
 - (iv) Search and rescue signals:
 - Signals with surface craft;
 - ground/air visual signal code; and
 - air/ground signals.
- (k) Annex 17 - Security
 - (i) General:
 - Aims and objectives.
 - (ii) Organization:
 - Cooperation and coordination.
 - (iii) Operators:
 - Operators security programme.
- (l) Annex 13 - Aircraft accident investigation
 - Applicability.

3.2 Aircraft general knowledge

- (1) Airframe and system, electrics, powerplant, emergency equipment - Aeroplanes
 - (a) Airframe and systems
 - (i) Fuselage:
 - Types of construction; and
 - Structural components and materials.
 - (ii) Cockpit and cabin windows:
 - Construction (laminated glass); and
 - structural limitations.
 - (iii) Aerofoil:
 - Types of construction; and
 - structural components and materials.

(iv) Control surfaces:

- Vertical, horizontal and V-tail surfaces; and
- construction materials.

(v) Landing gear:

- Types;
- construction.
- locking devices and emergency extension systems;
- accidental retraction prevention devices;
- position, movement lights and indicators;
- nose wheel steering;
- wheels and tyres (construction, limitations); and
- braking systems:
 - Construction;
 - parking brake;
 - mode of operation of anti-skid system;
 - mode of operations of auto brake system; and
 - operation, indications and warning systems.

(vi) Flight controls (construction and operation)

- Primary controls:
 - Elevator, aileron and rudder;
 - trim;
 - mode of actuation; and
 - operation, indicators, warning devices and controls.
- secondary controls lift augmentation and wing flaps:
 - Lift dumping and speed brakes;
 - variable elevator;
 - mode of actuation (mechanical, hydraulic, fly-by-wire);
 - operation, indicators, warning devices; and
 - danger situations and potential failures.

(vii) Hydraulics

- Basic principles of hydromechanics:
 - Hydraulic fluids; and
 - schematic construction and functioning of hydraulic systems.

(viii) Hydraulic systems

- Main, standby and emergency systems;
- operation, indicators, warning systems; and
- ancillary systems.

(ix) Air driven systems (piston engines only)

(x) Pneumatic systems

- Power sources; and
- schematic construction and functioning of pneumatic systems.

(xi) Air conditioning system

- Heating and cooling; and
- construction, functioning and controls.

(xii) Pressurisation

- Cabin altitude, maximum cabin altitude, differential pressure;
- pressurized zones in the aircraft;
- operations and indicators;
- safety devices and warning systems;
- rapid decompression, cabin altitude warning; and
- emergency procedures.

(xiii) De-ice systems

- Pneumatic leading edge de-icing of wings and control surfaces;
- schematic construction;
- operational limitations; and
- initiation/timing of de-icing system usage.

(xiv) Air driven systems

- Pneumatic system:
 - Power sources;
 - schematic construction;
 - potential failures, warning devices;
 - operation, indicators, warning systems; and
 - pneumatic operated systems.
- Air conditioning system:
 - Construction, functioning, operation, indicators and warning devices;
 - heating and cooling;
 - temperature regulation;
 - automatic and manual; and
 - ram air ventilation.
- Anti-ice systems:
 - Aerofoil and control surfaces, power giant, air intakes, windshield;
 - schematic construction, operating limitations and initiation, timing of de-icing system usage; and
 - ice warning system.
- Non-pneumatic operated de-ice and anti-ice systems.

(xv) Schematic construction functioning and operation of:

- Air intake;
- propeller;
- pitot, static pressure sensor and stall warning devices;
- windshield;
- weeping wing system; and
- rain repellent system.

(xvi) Fuel system

- Fuel tanks:
 - Structural components and types;
 - location of tanks on single and multi-engine aircraft;
 - sequence and types of refueling; and
 - unusable fuel.
- Fuel feed:
 - Gravity and pressure feed;
 - crossfeed; and
 - schematic construction.

- Fuel dumping system.
- Fuel system monitoring:
 - Operation, indicators and warning systems;
 - fuel management (sequencing of fuel tank switching); and
 - dip stick.
- (b) Electrics
 - (i) Direct current (DC)
 - General:
 - Electric circuits;
 - voltage, current, resistance;
 - Ohm's law;
 - resistive circuits;
 - resistance as a function of temperature;
 - electrical power, electrical work;
 - fuses (function, type and operation);
 - the electrical field; and
 - the capacitor (function).
 - Batteries:
 - Types and characteristics;
 - capacity;
 - uses; and
 - hazards.
 - Magnetism:
 - Permanent magnetism;
 - electromagnetism - relay, circuit breaker, solenoid valve (principle, function and applications);
 - electromagnetic power; and
 - electromagnetic induction.
 - Generators:
 - Alternator - principle, function and applications, monitoring devices, regulation, control and protection and modes of excitation;
 - starter generator.
 - Distribution:
 - Current distribution (buses);
 - monitoring of the ammeter, voltmeter and annunciator;
 - electrical consumers;
 - DC power distribution:
 - * construction, operation and system monitoring; and
 - * elementary switching circuits.
 - Inverter (applications).
 - The aircraft structure as an electrical conductor.
 - (ii) Alternating current (AC)
 - General:
 - Single and multi-phase AC;
 - frequency;
 - phase shift; and
 - AC components.
 - Generators:

- 3-phase generator;
- brushless generator (construction and operation);
- generator drive -
 - * constant speed drive; and
 - * integrated drive.
- AC power distribution:
 - Construction, operation and monitoring; and
 - protection circuits, paralleling of AC-generators.
- Transformers:
 - Function; and
 - types and applications.
- Synchronous and asynchronous motors:
 - Operations; and
 - application.
 - Transformer/rectifier units.
- Semiconductors:
 - Principles of semi-conductors;
 - semiconductor resistors (properties and application);
 - rectifier (function and application);
 - transistor (function and applications); and
 - diode (function and applications).
 - Basic knowledge of computers.
 - Logic circuits.
 - Logical symbols.
 - Switching circuits and logical symbols.
- Basic radio propagation theory; basic principles:
 - Electromagnetic waves;
 - wave length, amplitude, phase angle, frequency;
 - frequency bands, side-band, single sideband;
 - pulse characteristics;
 - carrier, modulation, de-modulation;
 - kinds of modulation (amplitude, frequency, pulse, multiplex); and
 - oscillation circuits.
- Antennas:
 - Characteristics;
 - polarisation; and
 - types of antennas.
- Wave propagation:
 - Ground waves;
 - space waves;
 - propagation with the frequency bands;
 - frequency prognosis (MUF);
 - fading; and
 - factors affecting propagation (reflection, absorption, interference, twilight, shoreline, mountain, static).

(c) Powerplant

- (i) Piston engine
 - General:
 - Design types;
 - principles of the 4-stroke internal combustion engine; and
 - mechanical components.
 - Lubrication system:
 - Function;
 - schematic construction;
 - monitoring instruments and indicators; and
 - lubricants.
 - Air cooling:
 - System monitoring;
 - cylinder head temperature; and
 - cowl flaps.
 - Ignition:
 - Schematic construction and function;
 - types of ignition; and
 - magneto check.
 - Engine fuel supply:
 - Carburetor (construction and mode of operation, carburetor icing);
 - fuel injection (construction and mode of operation); and
 - alternate air.
 - Engine performance:
 - Pressure/density altitude; and
 - performance as a function of pressure and temperature.
 - Power augmentation devices:
 - Turbocharger, supercharger construction and effect on engine performance).
 - Fuel:
 - Types, grades;
 - detonation characteristics, octane rating;
 - colour coding;
 - additives;
 - water content, ice formation;
 - fuel density; and
 - alternate fuels, differences in specifications, limitations.
 - Mixture:
 - Rich and lean mixture; and
 - maximum power and fuel economy mixture setting.
 - Rotor:
 - Principles and operation of rotors;
 - rotor check; and
 - rotor efficiency as a function of airspeed.

- Engine handling and manipulation:
 - Power setting, power range;
 - mixture setting; and
 - operational limitations.
- Operational criteria:
 - Maximum and minimum RPM;
 - (induced) engine vibration and critical RPM; and
 - remedial action by abnormal engine start, run-up and in-flight.

Turbine engine.

Principles of operation.

- Types of construction:
 - Centrifugal; and
 - axial flow.
 - Engine construction.
- Air inlet:
 - Function.
- Compressor:
 - Function;
 - construction and mode of operation;
 - effects of damage;
 - compressor stall and surge (cause and avoidance); and
 - compressor characteristics.
- Diffusor:
 - Function.
- Combustion chamber:
 - Function, types and working principles;
 - mixing ratios;
 - fuel injectors; and
 - thermal load.
- Turbine:
 - Underspeed and over-speed governors;
 - function, construction and working principles;
 - thermal and mechanical stress;
 - effects of damage; and
 - monitoring of exhaust gas temperature.
- Jet pipe:
 - Function;
 - different types; and
 - noise silencing devices.
 - Pressure, temperature and airflow in a turbine engine
- Reverse thrust:
 - Function, types and principles of operation;
 - degree of efficiency; and
 - use and monitoring.

- Performance and thrust augmentation:
 - Water injection, principles of operation; and
 - use and system of monitoring.
- Bleed air:
 - Effect of use of bleed air on thrust, exhaust temperature, RPM and pressure ratio.
- Auxiliary gearbox:
 - Function.
- Engine systems
- Ignition:
 - Function, types, components, operation and safety aspects.
- Starter:
 - Function, type, construction and mode of operation;
 - control and monitoring; and
 - self sustaining and idle speeds.
- Engine start malfunctions:
 - Cause and avoidance.
- Fuel system:
 - Construction, components;
 - operation and monitoring; and
 - malfunctions.
- Lubrication:
 - Construction, components;
 - operation and monitoring; and
 - malfunctions.
- Fuel:
 - Effects of temperature;
 - impurities; and
 - additives.
- Thrust:
 - Thrust formula;
 - flat rated engine; and
 - thrust as a function of airspeed, air density, pressure, temperature and RPM.
 - Powerplant operation and monitoring.
- (ii) Auxiliary power unit (APU)
- General:
 - Function and types;
 - location; and
 - operation and monitoring.
- Ram air turbine:
 - Function.

- (d) Emergency equipment
- (i) Doors and emergency exits:
 - Accessibility;
 - normal and emergency operation;
 - markings;
 - floor exit markings;
 - crew emergency exits;
 - passenger emergency exits; and
 - evacuation slides, general usage or as life rafts or flotation.
 - (ii) Smoke detection:
 - Location, indicators, function test;
 - fire detection; and
 - location, warning mode, function test.
 - (iii) Fire fighting equipment:
 - Location, operation, contents, gauge, function test.
 - (iv) Aircraft oxygen equipment:
 - Principles of operation;
 - protection and surveillance devices;
 - drill, use of equipment in case of rapid decompression;
 - comparison of constant flow and demand outlet masks;
 - oxygen generators; and
 - dangers of oxygen use, safety measures.
 - (v) Emergency equipment:
 - Portable, hand-held fire extinguisher;
 - smoke mask, smoke protection hood;
 - portable oxygen system;
 - emergency locator beacon, transmitter;
 - life jacket, life raft;
 - pocket lamp, emergency lighting;
 - megaphone;
 - crash axe; and
 - fireproof gloves.

(2) Instrumentation - Aeroplanes

- (a) Flight Instruments
- (i) Air data instruments
 - (ii) Pilot and static system:
 - Pitot tube, construction and principles of operation;
 - static source;
 - malfunction;
 - heating; and
 - alternate static source
 - (iii) Altimeter:
 - Construction and principles of operation;
 - display and setting;
 - errors;
 - correction tables; and
 - tolerances.

- (iv) Airspeed indicator:
 - Construction and principles of operation;
 - speed indications (IAS);
 - meaning of coloured arcs;
 - maximum speed indicator, barber pole; and
 - errors.
- (v) Mach meter
- (vi) Vertical Speed Indicator (VSI):
 - Aneroid and instantaneous VSI (IVSI);
 - construction and principles of operation; and
 - display.
- (vii) Gyroscopic instruments.
- (iii) Gyro fundamentals:
 - Theory of gyroscopic forces (stability, precession);
 - types, construction and principles of operation:
 - Vertical gyro;
 - directional gyro;
 - rate gyro;
 - rate integrating gyro;
 - single degree-of-freedom gyro; and
 - ring laser gyro.
 - Apparent drift;
 - random drift;
 - mountings; and
 - drive types, monitoring.
- (ix) Directional gyro:
 - Construction and principles of operation.
- (x) Slaved gyro compass:
 - Construction and principles of operation
 - components;
 - mounting and modes of operation;
 - turn and acceleration errors; and
 - application, uses of output data.
- (xi) Attitude indicator (vertical gyro):
 - Construction and principles of operation;
 - display types;
 - turn and acceleration errors;
 - application, uses of output data;
 - turn and bank indicator (rate gyro);
 - construction and principles of operation;
 - display types;
 - application errors;
 - application, uses of output data; and
 - turn coordinator.
- (xii) Magnetic compass:
 - Construction and principles of operation; and
 - Errors (deviation, effect of inclination).

- (xiii) Radio Altimeter:
 - Components;
 - frequency band;
 - principle of operation;
 - display; and
 - errors.
- (xiv) Electronic Flight Instrument System (EFIS);
 - Information display types;
 - data input;
 - control panel, display unit; and
 - example of a typical aircraft installation.
- (b) Flight control system
 - (i) Flight Director:
 - Function and application;
 - block diagram, components;
 - mode of operation;
 - operation set-up for various flight phases;
 - command modes (bars);
 - mode indicator;
 - system monitoring; and
 - limitations, operational restrictions.
 - (ii) Autopilot:
 - Function and application;
 - types (different axes);
 - block diagram, components;
 - lateral modes
 - longitudinal modes;
 - common modes;
 - autoland, sequence of operation;
 - system concepts for autoland, go around, take-off fail passive, fail operational (redundant) control modes;
 - signal interfacing to control surfaces;
 - operation and programming for various flight phases;
 - system monitoring; and
 - limitations, operational restrictions.
 - (iii) Yaw damper:
 - Function;
 - block diagram, components; and
 - signal interfacing to vertical stabilizer.
- (c) Warning and recording equipment
 - (i) Warning general:
 - Classification of warning; and
 - display, indicator system.
 - (ii) Stall warning:
 - Function;
 - constituent components of a simplified system;
 - block diagram, components of a system with angle-of-attack indicator; and
 - operation.

- (d) Power plant and system monitoring instruments
- (i) Pressure gauge:
 - Sensors;
 - Pressure indicators; and
 - Meaning of coloured arcs.
 - (ii) Temperature gauge:
 - Sensors;
 - ram rise, recovery factor;
 - temperature indicators; and
 - meaning of coloured arcs.
 - (iii) RPM indicator:
 - Interfacing of signal pick-up to RPM gauge;
 - RPM indicators, piston and turbine engines; and
 - meaning of coloured arcs.
 - (iv) Consumption gauge:
 - Fuel flowmeter (function, indicators); and
 - high pressure line fuel flowmeter (function, indications, failure warnings).
 - (v) Fuel gauge:
 - Measurement of volume/mass, units;
 - measuring sensors;
 - content, quantity indicators; and
 - reasons for in-correct indications.
 - (vi) Torque meter:
 - Indicators, units; and
 - meaning of coloured arcs.
 - (vii) Flight hour meter:
 - Drive source; and
 - indicators.
 - (viii) Vibration monitoring:
 - Indicators units;
 - interfacing to by-pass turbofan engines; and
 - warning system.
 - (ix) Remote (signal) trans-mission system:
 - Mechanical; and
 - Electrical.

3.3 Flight performance and planning

- (1) Performance of multi-engine aeroplanes not certified under Part 21 (JAR/FAR 25 (light twin))
- Definitions of terms and speeds.
 - Any new terms used for multi-engine aeroplane performance.
 - Importance of performance calculations.
 - Determination of performance under normal conditions i.e. all engines operating.
 - Consideration of effects of density altitude, wind, aeroplane mass, runway slope and runway conditions.
 - Elements of performance.
 - Take-off and landing distances.

- Rate of climb and descent.
 - Effects of selected power settings, speeds and aircraft configuration.
 - Cruise altitudes and altitude ceiling.
 - Payload/range trade-offs.
 - Speed/economy trade-offs.
 - Use of performance graphs and tabulated data.
 - Performance section of flight manual.
- (2) Flight planning and flight monitoring
- (a) Flight plans for cross-country flights
- (i) Fuel plan:
- Computation of planned fuel usage for each leg and total fuel usage for the flight:
 - Flight manual figures for fuel flow during climb, *en-route* and during des-cent; and
 - navigation plan for times *en-route*.
 - Fuel for holding or diversion to alternate airfield
 - Reserves.
 - Total fuel requirements for flight.
 - Completion of pre-flight portion of fuel log.
 - Flight monitoring and in-flight replanning.
 - In-flight fuel computations:
 - Recording of fuel quantities remaining at navigational checkpoints.
 - Calculation of actual consumption rate:
 - Comparison of actual and planned fuel consumption and fuel state.
 - Revision of fuel reserve estimates.
 - In-flight replanning in case of problems:
 - Selection of cruise altitude and power settings for new destination;
 - time to new destination; and
 - fuel state, fuel requirements, fuel reserves.
 - Radio communication and navigation aids.
 - Communication frequencies and call signs for appropriate control agencies and in-flight service facilities such as weather stations.
 - Radio navigation and approach aids, if appropriate:
 - Type;
 - frequencies; and
 - identification.
- (b) Air traffic service flight plan
- (i) Types of flight plan:
- ICAO flight plan;
 - Format;
 - information included in completed plan; and
 - repetitive flight plan.
 - Completing the flight plan.
 - Information for flight plan obtained from -
 - navigation flight plan;
 - fuel plan;
 - operator's records for basic aircraft information; and
 - mass and balance records.
 - Filing the flight plan.
 - Procedures for filing.
 - Agency responsible for processing the flight plan.
 - Requirements of the State concerning when a flight plan must be filed.
 - Closing the flight plan.
 - Responsibilities and procedures.
 - Processing agency.
 - Checking slot time.
 - Adherence to flight plan.

- (ii) Tolerances allowed by the State for various types of flight plans
 - In-flight amendment of flight plan:
 - Conditions under which a flight plan must be amended;
 - pilot's responsibilities and procedures for filing an amendment; and
 - agency to which amendments are submitted.
- (c) Practical flight planning
 - (i) Simple fuel plans.
 - (ii) Preparation of fuel logs showing planned values for:
 - fuel used on each leg;
 - fuel remaining at end of each leg; and
 - endurance, based on fuel remaining and planned consumption rate, at end of each leg.
 - (iii) Completion of fuel plan:
 - Time and fuel to top-of-climb;
 - cruise sector times and fuel used;
 - total time and fuel required to destination;
 - fuel required for missed approach, climb, en-route altitude and cruise alternate; and
 - reserve fuel.
 - (iv) Practical completion of an air traffic service flight plan.

3.4 Human performance and limitations

- (1) Human factors: basic concepts
 - (a) Human factors in aviation
 - (i) Competence and limitations.
 - (ii) Becoming a competent flight engineer:
 - The traditional approach towards “professionalism”.
 - (iii) Accident statistics
 - (iv) Flight safety concepts.
 - (b) Basic aviation physiology and health maintenance
 - (i) Basics of flight physiology:
 - The atmosphere:
 - Composition;
 - gas laws; and
 - oxygen requirement of tissues.
 - Respiratory and circulatory systems:
 - Functional anatomy;
 - hypobaric environment;
 - pressurisation, decompression;
 - rapid decompression -
 - Entrapped gases, barotraumas;
 - counter measures,
 - hypoxia;
 - symptoms; and
 - time of useful consciousness;
 - hyperventilation; and
 - accelerations.

- (ii) Man and environment: the sensory system:
 - Central and peripheral nervous system:
 - Sensory threshold, sensitivity, adaptation;
 - habituation; and
 - reflexes and biological control systems.
 - Vision:
 - Functional anatomy;
 - visual field, foveal and peripheral vision;
 - binocular and monocular vision;
 - monocular vision cues; and
 - night vision.
 - Hearing:
 - Functional anatomy; and
 - flight related hazards to hearing.
 - Equilibrium:
 - Functional anatomy;
 - motion, acceleration, verticality; and
 - motion sickness.
 - Integration of sensory inputs:
 - Spatial disorientation;
 - illusions -
 - * Physical origin;
 - * physiological origin; and
 - approach and landing problems.
- (iii) Health and hygiene:
 - Personal hygiene.
 - Common minor ailments -
 - Cold;
 - influenza; and
 - gastro-intestinal upset.
 - Problem areas for flight engineers:
 - Hearing loss;
 - defective vision;
 - hypotension, hypertension, coronaric disease;
 - obesity;
 - nutrition hygiene;
 - tropical climates; and
 - epidemic diseases.
 - Intoxication:
 - Tobacco;
 - alcohol;
 - drugs and self-medication; and
 - various toxic materials.

(2) Basic aviation psychology

(a) Human information processing

- (i) Attention and vigilance:
 - Selectivity of attention; and
 - divided attention.
- (ii) Perception:
 - Perceptual illusions;
 - Subjectivity of perception; and
 - “bottom-up”/“top-down” processing.
- (iii) Memory:
 - Sensory memory;
 - working memory;
 - long term memory; and

- motor memory (skills).
- (iv) Response selection:
- Learning principles and techniques;
 - drives; and
 - motivation and performance.
- (b) Human error and reliability
- (i) Reliability of human behaviour.
- (ii) Hypotheses on reality:
- Similarity, frequency; and
 - completion casuality.
- (iii) Theory and model of human error
- (iv) Error generation:
- Internal factors (cognitive styles);
 - external factors -
 - ergonomics;
 - economics; and
 - social environment (group, organization).
- (v) Decision making:
- Decision making concepts -
 - structure (phases);
 - limits;
 - risk assessment; and
 - practical application.
 - Avoiding and managing errors: cockpit management.
 - Safety awareness:
 - Risk area awareness;
 - identification of error proneness (oneself);
 - identification of error sources (others); and
 - situational awareness.
- (vi) Personality:
- Personality and attitudes:
 - Development; and
 - environmental influences.
 - Individual differences in personality:
 - Self concepts (e.g. action vs. state orientation).
 - Identification of hazardous attitudes (error proneness).
 - Human overload and underload.
 - Arousal.
 - Stress:
 - Definition(s), concept(s), mode(s);
 - anxiety and stress; and
 - effects of stress.
 - Fatigue:
 - Types, causes, symptoms; and
 - effects of fatigue.
 - Body rhythm and sleep:
 - Rhythm disturbances; and
 - symptoms, effects, management.
 - Fatigue and stress management:
 - Coping strategies;
 - management techniques;
 - health and fit-ness programmes;
 - relaxation techniques;
 - religious practices; and

- counselling techniques.
- Advanced cockpit automation.
- Advantages and disadvantages (criticalities).
- Automation complacency.
- Working concepts.

3.5 Meteorology

(1) Elementary meteorology covering generically:-

- a. The atmosphere;
- b. Pressure;
- c. Temperature;
- d. Density;
- e. Humidity;
- f. Wind;
- g. Air masses;
- h. Clouds;
- i. Fog and mist;
- j. Visibility;
- k. Precipitation;
- l. Fronts;
- m. Thunderstorms;
- n. Turbulence;
- o. Ice accretion; and
- p. Aircraft meteorology observations.

3.6 Navigation

(1) The earth

- a. Latitude & difference of latitude;
- b. Longitude and difference of longitude;
- c. Use of co-ordinates to locate position;
- d. Great circle, small circle, rhumbline, convergency and bearings calculations
- e. Direction:
 - i. true north,
 - ii. magnetic north,
 - iii. compass north,
 - iv. isogonals,
 - v. variation, and
 - vi. compass deviation;
- f. Distance:
 - i. units of distance and height,
 - ii. conversion form one unit to another,
- g. Radio bearings
- h. Navigational computer, electronic navigation computers and units used.

(2) Charts

- a. Charts projection theory:
 - i. orthomorphism, scale,
 - ii. chart length,
 - iii. earth distance,
 - iv. scale factor,
 - v. representative fraction,
 - vi. scale problems;
- b. Mecator chart:
 - i. construction and properties,
 - ii. plotting radio bearings,
 - iii. scale variation and calculations,
 - iv. measurement or calculation of tracks and distance
- c. Lambert Conformal Conic:
 - i. construction and properties,
 - ii. representation of great circles, rhumbines, meridians, and parallels of latitude;
 - iii. plotting radio bearings,
 - iv. scale variation and calculations
 - v. measurement or calculation of tracks and distance.

(3) Solar system & time

- a. UTC, GMT, LMT, Standard time

- b. Time conversions
 - c. International Date Line
- (4) Dead reckoning (DR) navigation
- a. Basics of DR
 - i. Track
 - ii. Heading (True, magnetic, compass)
 - iii. Wind velocity
 - iv. Airspeed (IAS, RAS, TAS, Machnumber)
 - v. Groundspeed
 - vi. ETA
 - vii. Drift, wind correction angle
 - viii. DR position, fix
 - b. Use of navigational computer
 - i. Speed. Distance, time
 - ii. Fuel consumption
 - iii. Conversions
 - iv. Heading, track, groundspeed
 - v. RAS, TAS, compressibility correction
 - vi. Wind velocity
- (5) Navigation plotting
- a. Navigation on the climb and decent
 - i. Mean climb TAS
 - ii. Mean climb wind velocity
 - iii. Groundspeed
 - iv. Distance flown
 - b. En-route navigation

3.7 Operational procedures

3.7.1 ICAO DOC 8168 Vol I)

- (1) Approach procedures
- a. General Criteria
 - i. Instrument approach procedure
 - ii. Categories of aircraft
 - iii. Obstacle clearance
 - iv. Obstacle clearance altitude/height
 - v. Factor affecting operational minima
 - b. Approach procedure design
 - i. Instrument approach areas
 - c. Approach segments
 - i. General
 - ii. Standard instrument arrivals
 - iii. Intermediate approach segment
 - iv. Finals approach segment
 - v. Missed approach
- (2) Holding procedures
- a. Shape and terminology associated with holding pattern
 - b. Speeds, rate of turn, timing, distance and limiting radial
 - c. Entry
 - d. Holding
 - e. Holding area
 - f. Buffer area
 - g. Minimum holding level
- (3) Altimeter setting procedures
- a. Basic requirements
 - b. Procedures applicable to operators and pilots
 - c. Pre-flight operational test

3.7.2 Aeronautical Information Publication (AIP)

- (1) Arrival and departure procedures
- a. Traffic flow management
 - i. Slot time sectors

- ii. Slot times
- b. Approach procedures
 - i. General
 - ii. Arriving flights
 - iii. General procedures for arriving flights
 - iv. VCM approach
 - v. Visual approach
 - vi. Communications failure procedure
 - vii. Interpretation of information provided on Standard Terminal Arrival Routes (STAR) and Standard Instrument Departures (SID) as published.

- (2) Aerodrome charts
 - a. Interpretation of information provided on aerodrome charts as published

3.7.3 Navigation charts

- (1) World aeronautical charts
- (2) Aerad route facility
- (3) Area charts

3.7.4 Aeronautical information circulars (AICs)

- (1) Flying at unmanned aerodromes
- (2) Airspace designation
- (3) Filing of flight plans and wake turbulence categories

3.7.5 ICAO Annex 14 - Aerodromes

- (1) Definitions
- (2) Runway and taxiway markings
 - a. Runway designation markings
 - b. Runway centre line marking
 - c. Threshold marking
 - d. Displaced threshold markings
 - e. Touchdown zone marking
 - f. Runway side stripe marking
 - g. Taxiway-holding position markings
- (3) Angle of approach and runway lighting system
 - a. PAPI and APAPI
 - b. Runway threshold identification lights
 - c. Runway edge lights
 - d. Runway threshold and wing lights
 - e. Runway end lights and stopway lights
 - f. Runway centre line lights
 - g. Runway touchdown lights
 - h. Taxiway centre line lights
- (4) Declared distances
 - a. Runway length
 - b. Landing distance available
 - c. Clearways and stopways
 - d. Accelerate-stop distance available
 - e. Take-off run available
 - f. Take-off distance available

3.7.6 Aerodrome operating minima

- (1) Part 91 of MCAR
 - a. Minimum heights
 - b. Minimum flight altitudes
 - c. Aerodrome operating minima
 - d. Pre-flight selection of aerodromes

- e. Planning minima for IFR flights
 - f. Meteorological conditions
 - g. Approach and landing conditions
 - h. Commencement and continuation of approach
- (2) Part 135 operations
- a. Aerodrome operating minima
- (3) Technical standards
- a. Part 91: planning minima for destination and alternate aerodromes
 - b. Part 135: take-off minima and non precision approach
- (4) Precision approach category operations
- a. GPS signal integrity
 - b. GPS satellite constellation
 - c. Airworthiness requirements
 - d. Pilot training
 - e. Operational requirements
 - f. Operations without RAIM
 - g. GPS distance information to ATS unit
 - h. Data integrity
 - i. Flight plan notification

3.8 Principles of flight

- (1) Elements of physics relating to aerodynamics
- a. Review of units of measurement
 - b. Mass, weight, force, resolution and composition of forces
 - c. Speed, acceleration inertia, momentum, motion on a curved track
 - d. Work, power, energy, pressure, air density, moments and couples, velocity, temperature.
- (2) Derivation of lift
- a. Equation of continuity
 - b. Bernoulli's theorem
 - c. Streamline flow
 - d. Angle of attack
 - e. Pressure distribution about a wing (Transverse and longitudinal)
 - f. Centre of pressure
 - g. Wing shape (Plan and section) and its effect on lift
 - h. Lift formula
 - i. Lift/Drag ratio
- (3) Drag
- a. Profile drag
 - i. Causes,
 - ii. Variation with speed
 - iii. Methods of minimizing
 - b. Induced drag
 - i. Causes
 - ii. Vortices
 - iii. Variation with speed
 - iv. Design factors affecting
 - c. Total effect of the combination of profile and induced drag
- (4) Distribution of forces – balance of couples
- a. Lift/mass and thrust/drag couples
 - b. Necessity of achieving balance
 - c. Methods of achieving balance
- (5) Stability
- a. Axes and planes of rotation
 - b. Static stability
 - c. Dynamic stability
 - d. Effects of design features on stability
 - e. Interaction between stability in different planes
 - f. Effect of altitude/speed on stability
 - g. Roll and yaw dampers

- (6) Stalling
 - a. Angle of attack
 - b. Boundary layer and causes of stalling
 - c. Variation of lift and drag in the stall
 - d. Movement of the centre of pressure
 - e. Tip stalling, its dangers and methods of minimizing
 - f. The spin (autorotation)
 - g. Symptoms of the stall
 - h. Stall warning devices
 - i. Stall recovery
 - j. Effect of turbulent flow over tail surfaces on stall
 - k. Recovery
 - l. Stick pushers
 - m. Enhanced stalling speed in manoeuvre
- (7) Lift augmentation
 - a. Flaps
 - i. Leading and trailing edge
 - ii. Effects of ...
 - iii. Advantages and disadvantages
 - b. Slots and slats
 - i. Effects of ...
 - ii. Advantages and disadvantages
 - c. Effects of lift augmentation devices on lift/drag ratio
- (8) Flying controls
 - a. Ailerons, elevators, rudders, spoilers
 - i. Primary effects of
 - ii. Secondary effects
 - b. Balancing of controls
 - i. Aerodynamic balance
 - c. Mass balance
 - d. Powered controls
 - i. Method of transmitting demands to control surfaces
 - ii. Feedback of control surface displacement (feel)
 - e. Trim (including variable incidence tailplane)

3.9 Communications

- (1) Basic radio theory
 - a. Electromagnetic waves
 - i. Frequency, wave length, cycle, phase, amplitude
 - ii. Frequency bands
 - iii. Sidebands, double sideband, single sideband, band width
 - iv. Carrier wave, modulation, demodulation
 - v. Amplitude modulation
 - vi. Frequency modulation
 - vii. Pulse modulation
 - viii. Multiplex
 - ix. Designation of emission
 - x. Signal/noise ratio
 - b. Antennas
 - i. Characteristics
 - ii. Polarization
 - iii. Polar diagram
 - iv. Types of antennas
 - c. Wave propagation
 - i. Ground waves
 - ii. Direct waves
 - iii. Sky waves
 - iv. Ionosphere, critical angle skip distance, dead space, refraction
 - v. Frequency prognosis (MUF)
 - vi. Fading
 - vii. Factors affecting propagation (reflection, absorption, attenuation, coastline, mountain, static)
- (2) Communication
 - a. VHF communications

- b. HF communications
- c. Selcal

- (3) Ground Direction finding (VDF)
 - a. Principle
 - b. Range
 - c. Errors and accuracy
 - d. Classification of bearings

- (4) ADF (Automatic direction finding)
 - a. NDB (Non-directional beacon)
 - i. A1A, A2A emissions, frequencies
 - b. Range and coverage
 - i. Errors
 - ii. Accuracy
 - iii. Factors affecting range and accuracy
 - iv. RBI (relative bearing indicator)
 - v. RMI (relative magnetic indicator)
 - vi. Calculations

- (5) VOR
 - a. Principles
 - b. Presentation and interpretation
 - c. Range and coverage
 - d. Errors and accuracy
 - e. Factors affecting range and coverage
 - f. Doppler VOR
 - g. TVOR (terminal VOR)
 - h. CDI (Course deviation indicator)
 - i. Calculations
 - j. Frequencies

- (6) ILS (instrument landing system)
 - a. Principles
 - b. Presentation and interpretation
 - c. Back beam
 - d. Range and coverage
 - e. Errors and accuracy
 - f. Factors affecting range and coverage
 - g. Categories
 - h. Frequencies
 - i. Calculations

- (7) DME (Distance measurement equipment)
 - a. Principles
 - b. Presentation and interpretation
 - c. Range and coverage
 - d. Errors and accuracy
 - e. Frequencies
 - f. DME/P (Precision DME)

- (8) Airborne weather radar
 - a. Principles
 - b. Presentation and interpretation
 - c. Range and coverage
 - d. Errors and accuracy
 - e. Factors affecting range and coverage

- (9) SSR (Secondary Surveillance radar)
 - a. Principles
 - b. Modes and codes

4. Practical training course

4.1 Contents

- (1) Briefing before and after exercises.

- (2) Airworthiness certificate limitation and manufacturers recommend limitation for all exercises to be adhered to.
- (3) Operation restriction and procedures as called for in the minimum equipment and configuration deviation lists for all exercises to be adhered to.
- (4) Pre-flight:
 - (a) Sign On
 - (b) Appearance, Punctuality
 - (c) Briefing Notices. Ops. Notices
 - (d) Cockpit safety inspection;
 - (e) external safety inspection;
 - (f) cockpit preparation;
 - (g) external inspection; and
 - (h) before start checklist.
- (5) Normal procedure and checklists for -
 - (a) engine start;
 - (b) taxi out;
 - (c) take-off;
 - (d) rejected take-off;
 - (e) engine failure after V1;
 - (f) climb;
 - (g) cruise;
 - (h) descent;
 - (i) approach;
 - (j) go-around;
 - (k) landing;
 - (l) landing roll;
 - (m) taxi in;
 - (n) parking;
 - (o) shut down;
 - (p) cold weather operation;
 - (q) hot weather operation;
 - (r) wet or slippery runways;
 - (s) severe turbulence; and
 - (t) wind shear.
- (6) Alternate operational procedure and check lists.
- (7) Abnormal procedure and checklists.
- (8) Emergency procedures and checklists.

4.2 General

All exercises to have an assessment rating or grade scale 1 - 9 for the following aspects -

- (1) Technical knowledge;
- (2) standard and normal procedures;
- (3) general flying;
- (4) monitoring and crew coordination;
- (5) crew coordination; and
- (6) abnormal and emergency procedures.

63.02.4 THEORETICAL KNOWLEDGE EXAMINATION**1. Contents**

An applicant for a flight engineer license must pass a written theoretical knowledge examination on -

- (1) (a) flight-time limitations;
- (b) the following as set out in the AIP, NOTAMs and AICs currently in force:
 - (i) the organization and operation of the various air traffic service units;
 - (ii) holding, approach and departure procedures;
 - (iii) entry and departure requirements;
 - (iv) search and rescue;
 - (v) incident reporting procedures;
- (2) navigation;
- (3) elementary meteorology;
- (4) the technical subjects prescribed in paragraphs 2 and 3.

2. General

- (1) Elementary principles of theory of flight, definition of terms, e.g. airflow, forces on an aircraft, straight and level flight, relation between speed and angle of attack, angle of incidence, lift/drag ratio, stability, centre of pressure, flaps and slots.
- (2) Properties of air, density, pressure, relationship between pressure, density and temperature, and their effect on aircraft and engine performance, isothermal atmosphere, international standard atmosphere.
- (3) The action is to be taken in the event of a serious defect or a heavy landing.
- (4) The principles of operation of engines and their component parts and accessories.
- (5) Definition of the terms associated with propellers, function of constant speed, fully feathering and braking propellers.
- (6) Direction of movement of controls, principles of operation and function of trimming, servo or balance tabs and alternative devices.
- (7) Elementary knowledge of electricity and magnetism: definition of terms, e.g. volts, amperes, ohms, watts, alternating and direct current, aircraft batteries, charging and functioning.

3. Theoretical examination on type of aeroplane to which application relates

The examination in the following subjects must be confined to the type of aircraft in respect of which application is made:

- (1) Operational limitations of the aircraft, including its engines;
- (2) definitions of the datum point and position of centre of gravity limits;
- (3) aircraft loading and centre of gravity computation prior to and for duration of flight;
- (4) information contained in a certificate of airworthiness and associated documents;
- (5) aircraft performance with respect to speed limitations;
- (6) the procedure to be followed in the case of an emergency, particularly in the even of power plant failure and fire whilst airborne;

- (7) knowledge of the operations manual or flight manual and maintenance inspection cycles;
- (8) operation of flying controls, trimming, servo or balance tabs and alternative devices;
- (9) normal and emergency systems for operating the landing gear and flaps, including a working knowledge of the systems;
- (10) the pneumatic pressure and vacuum system, location and functioning of the pumps and important units. Ground tests for correct functioning;
- (11) the pressurization, heating and ventilating system, including a working knowledge of the principle components, the regulation of pressure, temperature and humidity;
- (12) the operation and functioning of the de-icing system, including the main units and duration of the supply;
- (13) the wheel brake system, pressures and defects liable to reduce the operating efficiency. Knowledge of the landing gear shock-absorbing system;
- (14) a knowledge of the fuel system, including the location and function of all important units incorporated in the system;
- (15) the location and capacity of the fuel tanks, including supplementary schemes, where applicable, the means of ascertaining fuel consumption *en route*;
- (16) a knowledge of the oil system, including capacity of the tanks, the location and function of all important units incorporated in the system;
- (17) the coolant system, where applicable, and the recommended range of temperature to be maintained under various circumstances.
- (18) a general knowledge of the electrical system, voltage and amperage in particular circuits, position and current-carrying capacity of fuses, circuit breakers and main units in the installation; importance of using and method of replacing correct fuses and resetting of circuit breakers;
- (19) the functioning of electrical engine starters and generators; location and checking of security and condition of batteries, action to be taken in the case of failure of any unit in the electrical system;
- (20) flight planning based on loading and performance charts, fuel consumption and engine power curves. Control of power outputs and the computations involved;
- (21) the operation and elementary principles of the automatic pilot, including the method of engagement and disengagement, emergency release and power source, as applicable;
- (22) a working knowledge of the principles of operation of the engine instruments;
- (23) characteristics of particular engines and their component parts and accessories and methods of control used therefore;
- (24) types of fuel and oil used and refueling procedures;
- (25) operation and control of propellers fitted to the particular power plants;
- (26) operation and control of jet engines; and
- (27) all normal procedures, alternate procedures as contained in the aeroplane flight manual.

4. Conducting of theoretical knowledge examination

- (1) The written theoretical knowledge examination for Number 1 and 2 above is conducted by the DIRECTOR. The written theoretical examination for Number 3 above is conducted by a flight engineer instructor at the ATO, the operator or the manufacturer.
- (2) The flight engineer instructor referred to above, may not be the flight engineer instructor from whom the applicant received his/her theoretical training.

5. Duties of the Director

- (1) The Director must publish in an AIC –
 - a. The dates on which examinations are to be written;
 - b. The latest date by which applications for each examinations are to reach the Director;
 - c. The format and duration of each examination; and
 - d. The fees payable for such examination.
- (2) The entry fee paid for any examination may, upon request by the candidate be refunded or transferred to a subsequent examination: Provided that an acceptable reason for such request is furnished.

6. Entry requirements and procedures for theoretical knowledge examinations.

6.1 General

- (1) Candidates who intend to sit for a theoretical knowledge examination must complete the application form.
- (3) Applications must be accompanied by copies of the necessary supporting documents and the fee prescribed in Part 187 of the MCAR.
- (4) Applications must reach the Director before the closing date as published.
- (5) A candidate accepted for a theoretical examination will be required to demonstrate his or her knowledge of the appropriate topics prescribed in Numbers 1 and 2.

6.2 Procedures for examinations

- (1) Written examination instructions to candidates will be attached to the letter of acceptance from the Director. 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 his/her relevant valid license or identity document or passport as proof of identity;
 - c. sign the attendance register;
 - d. provide their own writing and ancillary equipment;
 - e. remain silent during the course of the examination;
 - f. stop writing at the instruction of the invigilator;
 - g. hand in examination script, scrap paper and related documents where applicable when so required;
 - h. if there is any lack of clarity regarding the question, write his/her complaints to the examiner on the scrap paper and mark this well and hand it in;
 - i. check that their examination number and necessary information are correct on all documents; and
 - j. comply with all examination instructions during the course of the examination.
- (3) Candidates may not –
 - k. Retain any notes of whatsoever nature during the examination;
 - l. Communicate with other candidates;
 - m. Pass any object to another candidate;
 - n. Look at the work of another candidate;
 - o. Enter the examination room if more than 30 minutes late;
 - p. Leave the examination room within the first hour of the examination;
 - q. Leave the examination room without the invigilator's permission;
 - r. Write on the answer sheet of multiple choice examinations, apart from the mark to indicate the correct answer;
 - s. Make any notes on the manuals and question papers;
 - t. Direct any question regarding the questionnaire to the invigilator;
 - u. use or retain in their possession while in the examination room, any programmable computer or calculator;
 - v. smoke in the examination room;
 - w. behave in an unsatisfactory manner; or;
 - x. 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:
 - y. Any calculator with an alpha-numerical keyboard;
 - z. Position organizer / Navmaster;
 - aa. All Hewlett-Packards.

If any doubt exist, candidates may request the ATO or DIRECTOR, at least 30 days before the examination, to approve the use of such computer or calculator.

6.3 Special Examinations

- (1) Special examinations will only be considered if –
 - a. Written application is submitted;
 - b. The motivation for the special examinations is acceptable; and
 - c. The fees concerned are paid.

7. Remarking of examinations scripts

- (1) A candidate who has failed one or more examination papers with a mark between 66% and 69% may on payment of the fee prescribed in Part 187 of the MCAR apply for the remarking of the script or scripts concerned.
- (2) Application for the remarking of an examination script or scripts must be made in writing to the Director, and such application, accompanied by the fee, must reach the Director not later than one months after the examination results were published.
- (3) The decision of the Director on any remarked examination script, is final.

63.02.5 SKILL TEST

1. Procedures and manoeuvres

The procedures and manoeuvres referred to in CAR 63.02.5 to be performed in the practical skill test are the same as the exercises of the practical training course referred to in TS 63.02.3, including -

- (1) the ability to perform normal, alternate and emergency manoeuvres, appropriate to the category and class of aeroplane type for which a license is applied, with a degree of competency appropriate to that of a flight engineer;
- (2) tracking from or to VOR and NDB stations and utilizing navigation aids as applicable; and
- (3) flight planning and mass and balance problems appropriate to the type of aeroplane license applied for.

2. Conducting the skill test

The skill test must be conducted by designated examiner.

3. Skill test report

- (1) Completion: the designated examiner conducting the skill test must complete the skill test report on Form MZ 63-30, available from Director.
- (2) Assessment: All duties and procedures must be assessed as satisfactory or unsatisfactory.

63.02.6 APPLICATION FOR FLIGHT ENGINEER LICENSE

1. Application form for flight engineer license

The application form for the issuing of a flight engineer license is MZ 63-01, which is available from the Director.

2. Skill test report

The skill test report mentioned in 63.02.5 that must accompany an application for the issuing of a flight engineer license is form MZ 63-30, which is available from the Director.

63.02.7 ISSUING OF FLIGHT ENGINEER LICENSE

1. Form

A flight engineer license will be issued in the form determined by the Director, which meets the requirements of Annex 1.

63.03.2 TRAINING

1. Training course

- (1) The training referred to in MCAR 63.03.2, consists of at least the following parts of the training course specified in CATS 63.02.3 –
- a. 3.1 Air Law and Procedures (as required)
 - b. 3.2 Aircraft general
 - c. 3.3.Flight performance and planning (as required)
 - d. 3.7 Operational procedures (as required)
 - e. 3.8 Principles of flight (as required)
 - f. 3.9 Communications (as required)

63.03.3 THEORETICAL KNOWLEDGE EXAMINATION**1. Theoretical examination on type**

The examination in the following subjects is confined to the type of aircraft in respect of which application is made:

- (1) Operational limitations of the aircraft, including its engines;
- (2) definitions of the datum point and position of centre of gravity limits;
- (3) aircraft loading and centre of gravity computation prior to and for duration of flight;
- (4) information contained in a certificate of airworthiness and associated documents;
- (5) aircraft performance with respect to speed limitations;
- (6) the procedure to be followed in the case of an emergency, particularly in the event of power plant failure and fire whilst airborne;
- (7) knowledge of the operations manual or flight manual and maintenance inspection cycles;
- (8) operation of flying controls, trimming, servo or balance tabs and alternative devices;
- (9) normal and emergency systems for operating the landing gear and flaps, including a working knowledge of the systems;
- (10) the pneumatic pressure and vacuum system, location and functioning of the pumps and important units. Ground tests for correct functioning;
- (11) the pressurization, heating and ventilating system, including a working knowledge of the principle components, the regulation of pressure, temperature and humidity;
- (12) the operation and functioning of the de-icing system, including the main units, and duration of the supply;
- (13) the wheel brake system, pressures and defects liable to reduce the operating efficiency. Knowledge of the landing gear shock-absorbing system;
- (14) a knowledge of the fuel system, including the location and function of all important units incorporated in the system;
- (15) the location and capacity of the fuel tanks, including supplementary schemes, where applicable, the means of ascertaining fuel consumption *en route*;
- (16) a knowledge of the oil system, including capacity of the tanks, the location and function of all important units incorporated in the system;
- (17) the coolant system, where applicable, and the recommended range of temperature to be maintained under various circumstances;
- (18) the functioning of electrical engine starters and generators; location and checking of security and condition of batteries, action to be taken in the case of failure of any unit in the electrical system;
- (19) the functioning of electrical engine starters and generators; location and checking of security and condition of batteries, action to be taken in the case of failure of any unit in the electrical system;
- (20) flight planning based on loading and performance charts, fuel consumption and engine power curves. Control of power output and the computations involved;
- (21) the operation and elementary principles of the automatic pilot, including the method of engagement and disengagement; emergency release and power source, as applicable;
- (22) a working knowledge of the principles of operation of the engine instruments;

- (23) characteristics of particular engines and their component parts and accessories and methods of control used thereof;
- (24) types of fuel and oil used and refueling procedures;
- (25) operation and control of propellers fitted to the particular power plants;
- (26) operation and control of jet engines; and
- (27) all normal procedures, alternate procedures and emergency procedures as contained in the aeroplane flight manual.

2. Conducting of theoretical knowledge examination

- (1) The written theoretical knowledge examination must be conducted by a flight engineer instructor of the ATO, the operator or the manufacturer.
- (2) The flight engineer instructor referred to above, may not be the flight engineer instructor from whom the applicant received his/her theoretical training.

3. Duties of the Aviation Training Organization (ATO)/Operator/Manufacturer

- (1) The ATO may publish –
 - a. The dates on which examinations are to be written;
 - b. The latest date by which applications for each examinations are to reach the Director;
 - c. The format and duration of each examination; and
 - d. The fees payable for such examination.
- (2) The entry fee paid for any examination may, upon request by the candidate be refunded or transferred to a subsequent examination: Provided that an acceptable reason is furnished.

4. Entry requirements and procedures for theoretical knowledge examinations

- (1) The entry requirements are the same as the entry requirements stipulated in TS 63.02.3.

5. Marking of examination papers

- (1) The marking requirements are the same as those stipulated in TS 63.02.3.

63.03.4 SKILL TEST

1. Procedures and manoeuvres

The procedures and manoeuvres referred to in CAR 63.03.4 are the exercises of the practical training course referred to in TS 63.03.2, including -

- (1) the ability to perform normal, alternate and emergency manoeuvres, appropriate to the category and class of aeroplane type for which a license is applied, with a degree of competency appropriate to that of a flight engineer;
- (2) tracking from o to VOR and NDB stations and utilizing navigation aids as applicable; and
- (3) flight planning and mass and balance problems appropriate to the type of aeroplane applied for.

2. Conducting the skill test

The skill test must be conducted by designated examiner.

3. Skill test report

- (3) Completion: the designated examiner conducting the skill test must complete the skill test report on Form MZ 63-30, available from Director.
- (4) Assessment: All duties and procedures must be assessed as satisfactory or unsatisfactory.

63.03.5 APPLICATION FOR TYPE RATING

1. Application form for type rating

The application form for the issuing of a type rating is form MZ 63-03, which is available from the Director.

2. Skill test report

The skill test report referred to in 63.03.4 that must accompany an application for the issuing of a type rating is form MZ 63-30, which is available from the Director.

63.03.6 ISSUING OF TYPE RATING

1. Form

A type rating will be issued in the form contained in Annexure G.

63.03.9 RENEWAL

1. Proficiency check

The proficiency check required for the renewal of a type rating is the skill test referred to in TS 63.03.4.

2. Certificate of competency

The certificate of competency required for the renewal of a type rating, is contained in form MZ 63-03, which is available from the Director.

3. Form of application

The form of application for the renewal of a type rating is form MZ 63-03, which is available from the Director.

4. Form of temporary type rating certificate

The form of a temporary type rating certificate is contained in form MZ 63-03, which is available from the Director.

5. Form of renewal

A type rating is renewed in the form determined by the Director and meets the requirements of Annex 1.

63.03.10 REISSUE

1. Skill test report

The skill test report to be provided to the Director for the reissuing of type rating is contained in form MZ 63-30, which is available from the Director.

2. Form of application

The form of application for the reissue of a type rating is form MZ 63-03, which is available from the Director.

3. Form of temporary type rating certificate

The form of a temporary type rating certificate is contained in form MZ 63-03, which is available from the Director.

4. Form of reissue

A type rating is reissued in the form determined by the Director and meets the requirements of Annex 1.

63.04.3 TRAINING

1. Training course

- (1) The training referred to in TS 63.05.3 constitutes the training requirements for this technical standard.
- (2) The training course must cover the whole syllabus in detail, but with specific attention to the assessment of student performance in the ground and flight training.

63.04.4 THEORETICAL KNOWLEDGE EXAMINATION

1. Examination

- (1) The examination referred to in TS 63.05.4 constitutes the examination for this technical standard.
- (2) The examination must cover all material, but specific attention must be given to the assessment of student performance in the ground and flight training.

63.04.5 SKILL TEST

1. Procedures

- (1) The procedures referred to in CAR 63.04.5 are the exercises contained in TS 63.02.5.
- (2) The training course must cover the whole syllabus in detail, but with specific attention to the assessment of student performance in the ground and flight training.

63.04.6 APPLICATION FOR GRADE I FLIGHT ENGINEER INSTRUCTOR RATING

1. Application form for flight engineer instructor's rating

The application form for the issuing of a Grade I flight engineer instructor rating is form MZ 63-04, which is available from the Director.

2. Skill test report

The skill test report that must accompany an application for the issuing of a Grade I flight engineer instructor rating is form MZ 63-30, which is available from the Director.

63.04.7 ISSUING OF GRADE I FLIGHT ENGINEER INSTRUCTOR RATING

1. Form

A Grade I flight engineer instructor rating will be issued in the form determined by the Director and meets the requirements of Annex 1.

63.04.10 RENEWAL

1. Flight engineer instructor refresher seminar

(1) A grade I flight engineer instructor shall be required to attend an acceptable refresher seminar presented by a reputable national or international aviation organization within the 12 months immediately preceding the date of renewal.

(2) The content of the seminar must cover topics, which is relevant to the instruction of flight engineers.

2. Conducting the skill test

The skill test must be conducted by a designated examiner.

3. Skill test report

The skill test report to be provided to the Director for the renewal of a Grade I flight engineer instructor rating, is form MZ 63-30, which is available from the Director.

4. Form of application

The form of application for the renewal of a Grade I instructor rating is form MZ 63-04, which is available from the Director.

5. Form of renewal

A Grade I instructor rating is renewed in the form determined by the Director and meets the requirements of Annex 1.

63.04.11 REISSUE

1. Skill test report

The skill test report to be provided to the Director for the reissuing of a Grade I flight engineer instructor rating, is form MZ 63-30, which is available from the Director.

2. Form of application

The form of application for the reissue of a Grade I instructor rating is form MZ 63-04, which is available from the Director.

3. Form of reissue

A Grade I instructor rating is reissued in the form determined by the Director and meets the requirements of Annex 1.

63.05.3 TRAINING**1. Aim of training course**

- (1) The training course should be designed for the applicant to be given adequate training in ground and flying instructional techniques based upon established teaching methods.
- (2) On successful completion of the training course and final test, the applicant will be issued with a Grade II flight engineer instructor rating permitting the holder to give ground and flight training appropriate to the issue of a flight engineer license or type rating.
- (3) The training course should stress the role of the individual in relation to the importance of human factors in the man-machine environment. Special attention should be paid to the applicant's maturity and judgement, including an understanding of adults, their behavioural attitudes and variable levels of education.
- (4) With the exception of paragraph 2, all the subject detail contained in the ground and flight training syllabus is complementary to the training course prescribed in TS 63.02.3. The purpose of the course is to -
 - (a) refresh and bring up to date the technical knowledge of the student instructor;
 - (b) train the student instructor to teach the ground subjects and air exercises;
 - (c) ensure that the student instructor's flying is of a sufficiently high standard; and
 - (d) teach the student instructor the principles of basic instruction and to apply them at the flight engineer level.
- (5) During the training course, the student instructor should be made aware of his or her attitude to the importance of flight safety. The flight engineer instructor is the critical link in the flight training process and his or her attitude to flight safety has a major impact upon student flight engineers. Improving safety awareness is therefore a fundamental objective throughout the training course. It will be of major importance for the training course to aim at giving the student instructor knowledge, skills and attitudes relevant to a flight engineer instructor's task and to achieve this the training course syllabus should comprise at least -
 - (a) teaching and learning; and
 - (b) flight training.

2. Teaching and learning

- (1) The learning process
 - (a) Motivation;
 - (b) perception and understanding;
 - (c) memory and its application;
 - (d) habits and transfer;
 - (e) obstacles to learning;
 - (f) incentives to learning;
 - (g) learning methods; and
 - (h) rates of learning.
- (2) The teaching process
 - (a) Elements of effective teaching;
 - (b) planning of instructional activity;

- (c) teaching methods;
 - (d) teaching from the “known” to the “unknown”; and
 - (e) use of “lesson plans”.
- (3) Training philosophies
- (a) Value of a structured training course;
 - (b) importance of a planned syllabus; and
 - (c) integration of ground and flight training.
- (4) Techniques of applied instruction
- (a) Classroom instruction techniques:
 - (i) Use of training aids;
 - (ii) group lectures;
 - (iii) individual briefings; and
 - (iv) student participation/ discussion.
 - (b) Airborne instruction techniques:
 - (i) The fight/cockpit environment;
 - (ii) as the 2nd or 3rd crew member;
 - (iii) techniques of applied instruction; and
 - (iv) post flight and in-flight judgement and decision making.
- (5) Student evaluation and testing
- (a) Assessment of student performance:
 - (i) The function of progress tests;
 - (ii) recall of knowledge;
 - (iii) translation of knowledge into understanding;
 - (iv) development of under-standing into actions; and
 - (v) the need to evaluate rate of progress.
 - (b) Analysis of student errors:
 - (i) Establish the reason for errors;
 - (ii) tackle major faults first, minor faults second;
 - (iii) avoidance of over criticism; and
 - (iv) the need for clear concise communication.
- (6) Training programme development
- (a) Lesson planning;
 - (b) preparation;
 - (c) explanation and demonstration;

- (d) student participation and practice; and
 - (e) evaluation.
- (7) Human performance and limitations relevant to flight instruction
- (a) Physiological factors;
 - (b) psychological factors;
 - (c) human information procession;
 - (d) behavioural attitudes; and
 - (e) development of judgement and decision making
- (8) Hazards involved in simulating systems failures and malfunctions in the aeroplane during flight
- (a) Selection of a safe altitude;
 - (b) importance of “touch drills”;
 - (c) situational awareness; and
 - (d) adherence to correct procedures.
- (9) Training administration
- (a) Flight/ground training records;
 - (b) flight engineers personal flying log book;
 - (c) the flight/ground curriculum;
 - (d) study material;
 - (e) official forms;
 - (f) aircraft flight/owner’s manuals/ flight crew operating handbooks;
 - (g) flight authorization papers; aircraft documents; and
 - (i) the regulations applicable to a flight engineer license, type rating and a Grade I and Grade II flight engineer instructor rating.
- (10) Ground training
- The ground training consists of all instruction given on the ground for the purpose of the training course by a competent person, and includes classroom lectures, tutorials, long briefings and directed private study, but excludes pre-flight briefings and post flight discussions which form part of the flight training.
- (11) Flight training
- The student instructor must occupy the seat normally occupied by the flight engineer instructor, in both aeroplane and simulator, except when acting as a flight engineer on mutual flights.
- (12) Air exercises
- (a) The air exercises are similar to those used for the training of flight engineers but with additional items designed to cover the needs of a flight engineer instructor.
 - (b) The numbering of exercises should be used primarily as an exercise reference list and as a broad instructional sequence guide. The demonstrations and practices need not necessarily be given in the order listed. The actual order and content will depend upon the following interrelated factors:
 - (i) The applicant’s progress and ability;

- (ii) the weather conditions affecting the flight;
 - (iii) the flight time available;
 - (iv) instructional technique considerations;
 - (v) the local operating environment; and
 - (vi) the exercises being carried out by the other crew members under instruction.
- (c) A student instructor will eventually be faced with similar interrelated factors and they should be shown and taught how to construct flight lesson plans, taking these factors into account, so as to make the best use of each flight lesson, combining parts of the set exercises as necessary. There must be liaison with the pilot instructor as to the best use of available time and crew coordination for all the exercises.

(13) General

- (a) The briefing normally includes a statement of the aim and a brief allusion to principles of flight only if relevant. An explanation must be made of exactly what air exercises are to be taught by the student instructor and practiced by the student instructor during the flight. It should include how the flight will be conducted with regard to who is to fly the aeroplane and what airman-ship, weather and flight safety aspects currently apply. The nature of the lesson will govern the order in which the constituent parts are to be taught.
- (b) The four basic components of the briefing will be:
- (i) The aim;
 - (ii) principles of flight (briefest reference only);
 - (iii) the air exercise(s) (what, and how and by whom); and
 - (iv) airmanship (weather, flight safety, etc).

(14) Planning of flight lessons

The preparation of lesson plans is an essential prerequisite of good instruction and the student instructor must be given supervised practice in the planning and practical application of flight lesson plans.

(15) General considerations

- (a) The student instructor should complete flight training to practice the principles of basic instruction at the flight engineer level.
- (b) During this training, except when acting as a flight engineer for mutual flights, the student instructor must occupy the seat normally occupied by the flight engineer instructor. The flight engineer instructor giving or monitoring to the student instructor may occupy the flight engineer seat, although it is more desirable that the student instructor gives instruction to a line flight engineer and the flight engineer instructor occupies an extra seat in the cockpit or simulator.

3. Suggested approximate breakdown of hours for the ground training part of the training course.

(The item numbers shown below relate to the item numbers of paragraph 2 “Teaching and learning” above.)

Item No.	Tuition hours	Practice hours in class	Comment	Progress tests
1	2.00	-	Allow for questions and short discussion periods	0.30
2	4.00	-	The tuition time should allow for questions and short discussion periods	1.00
3	2.00	-	The training syllabus prescribed in TS 63.02.3 should get used as reference material	0.30
4(a)	5.00	34	The time spent in practice under this item will involve the student	

			instructor refreshing his or her technical knowledge, and developing his or her classroom instruction techniques. It will also include discussion between student instructors and advice on teaching from the supervising instructor should include all systems as contained in the operations manual of the aeroplane.	
4(b)	4.00	34	The time spent in practice will be mainly directed to the giving of pre-flight briefings. It will allow the student instructor to develop his or her ability to give a practical and short briefing (10 - 15 minutes) to another student instructor. The briefing will outline in a logical sequence the flight lesson to be undertaken	
5(a)	2.00	-	Emphasis should be placed on the validity of questions used in progress tests	1.00
5(b)	2.00	-	Emphasis should be placed on the need to give encouragement to the student	1.00
6	5.00	15	The time spent in practice will be directed towards the planning of classroom lesson periods and the development of the ability of the student instructor to construct lesson plans	
7	5.00	-	Scenarios relevant to good judgement and decision making should be set and analyzed.	1.00
8	2.00	-	Examples of hazards should cover a broad range of light aircraft and types of operation and not to be confined to the aeroplane used on the course	1.00
9	2.00	-	General revision of relevant documents	
TOTAL	35.00	83.00		7.00
COURSE TOTAL = 125 HOURS				

Note: Technical ground classroom could be longer for large aircraft

4. Flight training

4.1 Contents

- (1) Briefing before and after exercises.
- (2) Airworthiness certificate limitation and manufacturers recommend limitation for all exercises to be adhered to.
- (3) Operation restriction and procedures as called for in the minimum equipment and configuration deviation lists for all exercises to be adhered to.
- (4) Pre-flight:
 - (a) Cockpit safety inspection;
 - (b) external safety inspection;
 - (c) cockpit preparation;
 - (d) external inspection; and
 - (e) before start checklist.
- (5) Normal procedure and checklists for -
 - (u) engine start;
 - (v) taxi out;
 - (w) take-off;
 - (x) rejected take-off;
 - (y) engine failure after V1;
 - (z) climb;
 - (aa) cruise;
 - (bb) descent;
 - (cc) approach;
 - (dd) go-around;
 - (ee) landing;
 - (ff) landing roll;

- (gg) taxi in;
- (hh) parking;
- (ii) shut down;
- (jj) cold weather operation;
- (kk) hot weather operation;
- (ll) wet or slippery runways;
- (mm) severe turbulence; and
- (nn) wind shear.

- (9) Alternate operational procedure and check lists.
- (10) Abnormal procedure and checklists.
- (11) Emergency procedures and checklists.

4.2 General

All exercises to have an assessment rating or grade scale 1 - 9 for the following aspects -

- (1) Technical knowledge;
- (2) standard and normal procedures;
- (3) general flying;
- (4) monitoring and crew coordination;
- (5) crew coordination;
- (6) abnormal and emergency procedures; and
- (7) instructional skill.

63.05.4 THEORETICAL KNOWLEDGE EXAMINATION

1. Examination

An applicant for a Grade I flight engineer instructor rating must pass a written theoretical knowledge examination on -

- (1) theory of flight;
- (2) principles of flying instruction;
- (3) navigation and meteorology;
- (4) the regulations made under the Act relating to the licensing requirements applicable to flight engineers licenses and ratings;
- (5) theory of high-altitude flight;
- (6) the application of aero-medicine to high-altitude flying; and
- (7) human factor performance and limits relevant to instruction.

2. Conducting of theoretical knowledge examination

- (1) The written theoretical knowledge examination must be conducted by the Director or a designated examiner.
- (2) The designated examiner referred to above, may not be the flight engineer instructor from whom the applicant received his/her theoretical training.

3. Duties of the Director

- (1) The Director must publish –
 - a. The dates on which examinations are to be written;
 - b. The latest date by which applications for each examinations are to reach the Director;
 - c. The format and duration of each examination; and
 - d. The fees payable for such examination.
- (2) The entry fee paid for any examination may, upon request by the candidate be refunded or transferred to a subsequent examination: Provided that an acceptable reason is furnished.

4. Entry requirements and procedures for theoretical knowledge examinations

The entry requirements are the same as the entry requirements stipulated in TS 63.02.3.

5. Marking of examination papers

The marking requirements are the same as those stipulated in TS 63.02.3.

63.05.5 SKILL TEST

1. Procedures

The procedures referred to in MCAR 63.05.5 are the exercises contained in TS 63.02.5.

63.05.6 APPLICATION FOR GRADE II FLIGHT ENGINEER INSTRUCTOR RATING

1. Application form for Grade II flight engineer instructor rating

The application form for the issuing of a Grade II flight engineer instructor rating is form MZ 63-04, which is available from the Director.

2. Skill test report

The skill test report that must accompany an application for the issuing of a Grade II flight engineer instructor rating is form MZ 63-30, which is available from the Director.

63.05.7 ISSUING OF GRADE II FLIGHT ENGINEER INSTRUCTOR RATING

1. Form

A Grade II flight engineer instructor rating will be issued in the form determined by the Director that meets the requirements of Annex 1.

63.05.10 RENEWAL

1. Flight engineer instructor refresher seminar

(1) A grade I flight engineer instructor shall be required to attend an acceptable refresher seminar presented by a reputable national or international aviation organization within the 12 months immediately preceding the date of renewal.

(2) The content of the seminar must cover topics, which is relevant to the instruction of flight engineers.

2. Conducting the skill test

The skill test must be conducted by a designated examiner.

3. Skill test report

The skill test report to be provided to the Director for the renewal of a Grade II flight engineer instructor rating is form MZ 63-30, which is available from the Director.

4. Form of application

The form of application for the renewal of a Grade II instructor rating is form MZ 63-04, which is available from the Director.

5. Form of renewal

A Grade II instructor rating is renewed in the form determined by the Director and meets the requirements of Annex 1.

63.05.11 REISSUE

1. Flight engineer instructor refresher seminar

- (1) The holder of a lapsed grade II flight engineer instructor rating referred to in MCAR 63.05.11 shall be required to attend an acceptable refresher seminar presented by a reputable national or international aviation organization within the 12 months immediately preceding the date of renewal.
- (2) The content of the seminar must cover topics, which is relevant to the instruction of flight engineers.

2. Skill test report

The skill test report to be provided to the Director for the reissuing of a Grade II flight engineer instructor rating, is form MZ 63-30, which is available from the Director.

3. Form of application

The form of application for the reissue of a Grade II instructor rating is form MZ 63-04, which is available from the Director.

4. Form of reissue

A Grade II instructor rating is reissued in the form determined by the Director and meets the requirements of Annex 1.

Annexure A: FLIGHT ENGINEER LOGBOOK

Year		Aircraft		Pilot-in-command	Details of flight Route	Duration of flight		Remarks
Day	Month	Type	Registration marks			Hours	Minutes	
					Totals brought forward	
.....
.....
.....
.....
.....
Totals carried forward								