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# Study and Reference Guide

Flight Engineer Licence

## Aeroplane

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## **GENERAL**

### **KNOWLEDGE REQUIREMENTS**

An applicant for a Flight Engineer Licence is expected to have mastered the various subjects included in this guide. The Flight Engineer should have a thorough technical knowledge of the theory or principles involved, and a practical knowledge of the applications of such principles to the operation of the aeroplane.

### **EXAMINATION RULES**

#### **CAR 400.02**

- (1) Except as authorized by an invigilator, no person shall, or shall attempt to, in respect of a written examination,
  - a) copy or remove from any place all or any portion of the text of the examination;
  - b) give to or accept from any person a copy of all or any portion of the text of the examination;
  - c) give help to or accept help from any person during the examination;
  - d) complete all or any portion of the examination on behalf of any other person; or
  - e) use any aid or written material during the examination.
- (2) A person who commits an act prohibited under subsection (1) fails the examination and may not take any other examination for a period of one year.

### **TIME LIMIT**

Examinations, including all sections of a sectionalized examination, that are required for the issuance of a permit or licence or for the endorsement of a permit or licence with a rating shall be completed during the 24-month period immediately preceding the date of the application for the permit, licence or rating.

### **REWRITING OF EXAMINATIONS**

#### **CAR 400.04**

- (1) A person who fails an examination or a section of a sectionalized examination required for the issuance of a flight crew permit, licence, rating or foreign licence validation certificate is ineligible to rewrite the examination or the failed section for a period of
  - a) in the case of a first failure, 14 days;
  - b) in the case of a second failure, 30 days; and
  - c) in the case of a third or subsequent failure, 30 days plus an additional 30 days for each failure in excess of two failures, up to a maximum of 180 days.

### **EXAMINATION FEEDBACK**

Feedback statement on the results letter will inform the candidate where questions were answered incorrectly.

#### **Example of Feedback Statement**

Identify the atmospheric conditions favourable to thunderstorm formation.

## EXAMINATIONS

The candidate is allowed 3½ hours to complete the examination and is required to obtain a pass mark of 60 percent.

<b>Examination</b>	<b>Questions</b>	<b>Time Limit</b>	<b>Pass Mark</b>
Flight Engineer Licence – FLENG	80	3½ hours	60%

## **SECTION 1: AIR LAW AND PROCEDURES**

### **CANADIAN AVIATION REGULATIONS (CARs)**

Some Canadian Aviation Regulations (CARs) refer to their associated standards. Questions from the CARs may test knowledge from the regulation or the standard.

### **PART I – GENERAL PROVISIONS**

#### 101 – INTERPRETATION

101.01 Interpretation

#### 103 - ADMINISTRATION AND COMPLIANCE

103.02 Inspection of Aircraft, Requests for Production of Documents and Prohibition

103.03 Return of Canadian Aviation Document

103.04 Record Keeping

103.06 Notices of Refusal to Issue, Amend or Renew and Notices of Suspension or Cancellation

103.07 Administrative Grounds for Suspension, Cancellation or Refusal to Renew

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300.01 Interpretation

#### 301 – AERODROME

301.01 Application

301.04 Markers and Markings

301.06 Wind Direction Indicator

301.07 Lighting

301.08 Prohibitions

301.09 Fire Prevention

#### 302 – AIRPORTS

302.10 Prohibitions

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400.01 Interpretation

### **401 – FLIGHT CREW PERMITS LICENCES AND RATINGS**

401.03 Requirements to Hold a Flight Crew Permit, Licence or Rating

401.04 Flight Crew Members of Aircraft Registered in Contracting States other than Canada

401.05 Recency Requirements

401.08 Personal Logs

401.13 Examination Prerequisites

401.37 Privileges

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403.02 Requirements to hold AME Licence

403.05 Recency Requirements

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404.04 Issuance, Renewal and Validity Period of Medical Certificate

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404.10 Medical Certificate Requirements for Personnel Licences

404.18 Permission to Continue to Exercise the Privileges of a Permit, Licence or Rating

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507.02 Certificate of Airworthiness

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- 571.02 Maintenance and Elementary Work Performance Rules
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- 571.11 Persons Who May Sign a Maintenance Release

## 591 – SERVICE DIFFICULTY REPORTING

- 591.01 Reporting Requirements

## STANDARDS

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Subchapter D - Design And Construction

- 525.855 - Cargo and Baggage Compartments
- 525.857 - Cargo Compartment Classification

## **PART VI – GENERAL OPERATING AND FLIGHT RULES**

### 600 – INTERPRETATION

- 600.01 Interpretation

### 602 – OPERATING AND FLIGHT RULES

- 602.01 Reckless or Negligent Operation of Aircraft
- 602.02 Fitness of Flight Crew Members
- 602.03 Alcohol or Drugs – Crew Members
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- 602.06 Smoking
- 602.07 Aircraft Operating Limitations
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- 602.10 Starting and Ground Running of Aircraft Engines
- 602.11 Aircraft Icing
- 602.30 Fuel Dumping
- 602.58 Prohibition
- 602.59 Equipment Standards
- 602.60 Requirements for Power-driven Aircraft
- 602.61 Survival Equipment – Flights over Land
- 602.62 Life Preservers and Personal Flotation Devices
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- 602.87 Crew Member Instructions
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- 604.26 Designation of Pilot-in command and Second-in-command
- 604.28 Instrument Approaches - Landing

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- 705.78 - Floor Proximity Emergency Escape Path Markings
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- 705.97 - Flashlights

## PERSONNEL REQUIREMENTS

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## TRAINING

705.124 - Training Program

705.125 - Conditional Approval of Training Program

705.127 - Training and Qualification Records

## **TC AIM CANADA**

### **OTHER LEGISLATION**

- 1 Canada Transportation Act Part II  
Air Transportation Licences,  
Prohibitions (section 57); Air  
Transportation Regulations  
(sections 3 and 7)
- 2 Canada Labour Code Part II –  
Occupational Safety & Health,  
Employee Rights & Duties (sections  
126, 127 and 128)
- 3 Transportation of Dangerous Goods  
by Air (TC AIM - RAC Annex 3.0)

### **TRANSPORTATION SAFETY BOARD OF CANADA (TSB) – A.I.M. GEN 3.0**

## SECTION 2: METEOROLOGY

### **THE EARTH'S ATMOSPHERE**

- 1 Properties
- 2 Vertical Structure
- 3 ICAO Standard Atmosphere

### **ATMOSPHERIC PRESSURE**

- 1 Pressure Measurements
- 2 Station Pressure
- 3 Mean Sea Level Pressure
- 4 Effects of Temperature

### **METEOROLOGICAL ASPECTS OF ALTIMETRY**

- 1 Pressure Altitude
- 2 Density Altitude
- 3 True Altitude
- 4 Altimeter Setting
- 5 Effects of both Pressure and Temperature

### **MOISTURE**

- 1 Relative Humidity
- 2 Dewpoint

### **AIRCRAFT ICING**

- 1 Formation
- 2 Types of ice
- 3 Reporting Criteria

### **AVIATION WEATHER REPORTS**

- 1 Aviation Routine Weather Report (METAR)
- 2 SPECI
- 3 Decoding
- 4 AWOS
- 5 Pilot Reports (PIREP/AIREP)

### **AVIATION FORECASTS**

- 1 Times Issued/Validity Periods
- 2 Decoding
- 3 Graphical Area Forecasts (GFA)/AIRMET
- 4 Terminal Area Forecasts (TAF)
- 5 Upper Level Winds and Temperature Forecasts (FD)
- 6 Significant In-flight Weather Warning Message (SIGMET)

## **SECTION 3: AERODYNAMICS AND THEORY OF FLIGHT**

### **AEROFOILS**

- 1 Shape
- 2 Camber
- 3 Chord
- 4 Span
- 5 Aspect Ratio
- 6 Streamlining
- 7 Angle of Attack
- 8 Vortex Generators

### **FORCES ACTING ON THE WING**

- 1 Airflow
- 2 Pressure Distribution
- 3 Downwash
- 4 Lift / Drag
- 5 Stalling Angle
- 6 Centre of Pressure
- 7 Profile Drag
- 8 Induced Drag
- 9 Parasite Drag

### **THRUST**

- 1 Turbo-Prop
- 2 Turbo-Jet
- 3 Propeller Thrust and Torque
- 4 Blade Angle
- 5 Angle of Attack
- 6 Geometric Pitch
- 7 Variable Pitch
- 8 Propeller Efficiency
- 9 Slipstream, Gyroscopic and Asymmetric Effects

### **WEIGHT**

- 1 Centre of Gravity
- 2 Wing Loading
- 3 Forces Acting on the Aircraft in Manoeuvres
- 4 Load Factor
- 5 Gust Loads
- 6 Relationship of Weight and Load Factor on Stalling Speeds

### **EQUILIBRIUM**

- 1 Forces Acting on an Aircraft in Flight
- 2 Balancing of Forces
- 3 Slipstream
- 4 Downwash

### **CONTROL**

- 1 Control Surfaces
- 2 Pitch, Roll and Yaw
- 3 Relationship Between Yaw and Roll
- 4 Static and Dynamic Balancing of Controls
- 5 Trim and Trimming Devices

### **STABILITY AND INSTABILITY**

- 1 Aircraft Axes and Planes of Movement
- 2 Longitudinal Stability
- 3 Lateral Stability
- 4 Directional Stability
- 5 Inherent Stability
- 6 Sweepback
- 7 Dihedral
- 8 Horizontal Stabilizers
- 9 Vertical Stabilizers

## **SECTION 4: FLIGHT OPERATIONS**

### **METEOROLOGICAL CONDITIONS AFFECTING PERFORMANCE**

- 1 Pressure and Density Altitude
- 2 Airspeed Versus Mach Number
- 3 Altimeter Setting and Associated Errors
- 4 Temperatures
  - Static
  - Ram
  - Ambient
- 5 Relative Humidity and Dewpoint
- 6 Engine Icing
- 7 Structural Icing

### **AEROPLANE PERFORMANCE**

- 1 Required Thrust and Power
- 2 Take-off Performance
- 3 Climb Performance
- 4 Cruise Flight
- 5 Maximum Range
- 6 Maximum Endurance
- 7 Landing Performance
- 8 Effect of Airframe Surface Contamination
- 9 Effect of Runway Surface Contamination
- 10 “V” Speeds
- 11 Hydroplaning

### **COMPUTING CENTRE OF GRAVITY**

- 1 Use of Weights and Moments
- 2 Centre of Gravity Relative to Datum
- 3 Centre of Gravity Relative to Percentage of Mean Aerodynamic Cord
- 4 Use of Reduction Factor and Index Units

### **CALCULATING CHANGES TO CENTRE OF GRAVITY**

- 1 Zero Fuel Weight
- 2 Effect of Fuel Consumption
- 3 Effect of Fuel Dumping

### **CENTRE OF GRAVITY LIMITS**

- 1 Take-off Limits
- 2 Landing Limits
- 3 Zero Fuel Limits
- 4 Fore and Aft Limits
- 5 Use of Loading Charts / Graphs
- 6 Compartment Load Limits
- 7 Weight, Altitude, Temperature (WAT), Takeoff and Landing Performance Charts

### **CRITICAL SURFACE CONTAMINATION**

- 1 Clean Aircraft Concept – Practices and Techniques
- 2 Frozen Contaminants Including Cold-Soaking Phenomenon
- 3 De-Icing and Anti-Icing Fluids
- 4 De-Icing and Anti-Icing Procedures
- 5 Variables that can influence Holdover Time
- 6 Critical Surface Inspections
- 7 Pre-take-off Inspection
- 8 Health Affects
- 9 Use of Application Guideline Tables

## **SECTION 5: AEROPLANE SYSTEMS**

### **GENERAL**

- 1 Basic Airframe
- 2 Auto Pilot
- 3 Auto Throttles
- 4 Yaw Damper
- 5 Adjustable Stabilizer
- 6 Hydraulic
- 7 Slats
- 8 Slots
- 9 Flaps
- 10 Asymmetry Systems
- 11 Spoilers
- 12 Speed Brakes
- 13 Flight Controls
- 14 Trim Systems
- 15 De-icing Systems
- 16 Anti-icing Systems
- 17 Rain Dispersal Systems
- 18 Fuel System
- 19 Refuelling System
- 20 Defuelling System
- 21 Fuel Dumping
- 22 Antiskid System
- 23 Thrust Reversers

### **ELECTRICAL AND INSTRUMENT**

- 1 Basic AC Electrical Theory
- 2 Basic DC Electrical Theory
- 3 System Controls and Indicators
- 4 Interpretation of Electrical Schematics
- 5 Ground Power Systems
- 6 Constant Speed Drives
- 7 Generator
- 8 Alternator
- 9 Inverter
- 10 Bus Distribution Systems
- 11 Instrument Power Sources
- 12 Pitot Static Systems
- 13 Flight Instruments
- 14 Engine Instruments
- 15 EICAS and ECAM

### **PRESSURIZATION**

- 1 Air Sources
- 2 Cabin Supercharger
- 3 Bleed Air
- 4 Turbo-compressor
- 5 Pressurization Principles
- 6 Indicators
- 7 Controls

### **AIR-CONDITIONING**

- 1 Heating
- 2 Cooling
- 3 Temperature Control

### **PNEUMATICS**

- 1 Pneumatic System Operation
- 2 Overheat Protection
- 3 Malfunctions

### **EMERGENCY EQUIPMENT**

- 1 Fire Detection Systems
- 2 Smoke Detection Systems
- 3 Overheat Detection Systems
- 4 Fire Extinguishing Systems
- 5 Fire Extinguishing Controls and Indicators
- 6 Portable Fire Extinguishers
- 7 Crew Oxygen Systems
- 8 Passenger Oxygen Systems
- 9 Emergency Lighting
- 10 Evacuation and Ditching Equipment

## **SECTION 6: POWERPLANTS**

### **TURBO – JET AND TURBO PROP ENGINES**

- 1 Basic Engine components
- 2 Basic Operating Principles
- 3 Engine Limitations
- 4 Engine Computations
- 5 Bleed Air System
- 6 Anti-icing System
- 7 Starter
- 8 Lubricating System
- 9 Cooling and Exhaust Control System
- 10 Vibration Monitoring
- 11 Engine Instruments and Power Sources
- 12 Temperature Control and Regulation
- 13 Accessories and Drives
- 14 Fuel Control System
- 15 Reduction Gear Boxes
- 16 Torque Sensing Devices
- 17 Fuel and Propeller Co-ordinator
- 18 Engine Starting

### **CRUISE AND POWER COMPUTATIONS**

- 1 Fuel Consumption
- 2 Principles of Cruise Control
- 3 Use of Performance charts
- 4 Calculation of Fuel Burn-off
- 5 Calculation of Fuel Remaining
- 6 Calculation of Fuel Required
- 7 Calculation of Landing Weight

## **SECTION 7: PROPELLERS**

### **PROPELLER SYSTEMS**

- 1 Principles of Propeller Design
- 2 Feather System
- 3 Reversing System
- 4 Manual Feather and Unfeather
- 5 Auto-feather
- 6 RPM and Phase Synchronization
- 7 Overspeed Protection
- 8 Beta Range
- 9 Negative Thrust Sensing

## **SECTION 8: EMERGENCY OPERATIONS**

### **EMERGENCY OPERATION OF SYSTEMS**

- 1 Hydraulic System
- 2 Emergency Brake
- 3 Emergency Operation of Landing Gear
- 4 Emergency Flap Extension
- 5 Pressurization
- 6 Air-conditioning
- 7 Emergency Depressurization
- 8 Emergency Descent
- 9 Fuel Dumping
- 10 Smoke Evacuation
- 11 Fires
- 12 Electrical System Faults
- 13 Generator Malfunction
- 14 Constant Speed Drive Malfunction
- 15 Emergency Operation of Flight Controls
- 16 Operation With Asymmetric Flap
- 17 Emergency Checklist Operation
- 18 One Engine Inoperative Operations

### **EMERGENCY OPERATION OF POWER PLANTS**

- 1 Analyzing Engine Faults
- 2 Fire Indications
- 3 Emergency Fire Procedures
- 4 Engine Failure Procedures
- 5 Propeller Failures
- 6 Air Start Procedures

## **SECTION 9: HUMAN FACTORS**

### **AVIATION PHYSIOLOGY**

- 1 Hypoxia/Hyperventilation
- 2 Gas Expansion Effects
- 3 Decompression (including SCUBA diving)
- 4 Vision/Visual Scanning Techniques
- 5 Hearing
- 6 Orientation/Disorientation (including visual and vestibular illusions)
- 7 Positive and Negative "G"
- 8 Circadian Rhythms/Jet Lag
- 9 Sleep/Fatigue

### **THE OPERATING ENVIRONMENT**

- 1 Personal Health/Exercise/Fitness
- 2 Obesity/Diet/Nutrition
- 3 Medications (prescribed and over-the-counter)
- 4 Substance Abuse (alcohol and drugs)
- 5 Pregnancy
- 6 Heat/Cold
- 7 Noise/Vibration
- 8 Effects of Smoking
- 9 Toxic Hazards (including carbon monoxide)

### **AVIATION PSYCHOLOGY**

- 1 The Decision-Making Process
- 2 Factors That Influence Decision-Making
- 3 Situational Awareness
- 4 Stress
- 5 Managing Risk
- 6 Attitudes
- 7 Workload (attention and information processing)

### **EQUIPMENT / MATERIALS RELATIONSHIP**

- 1 Controls and Displays
  - Errors in Interpretation and Control
  - Information Selection - "glass" cockpits
- 2 Alerting and Warning Systems
  - Appropriate Selection and Set Up
  - False Indications
  - Distractions and Responses
- 3 Standard Operating Procedures (SOPs)
- 4 Correct Use of Charts, Checklists and Manuals
- 5 Cockpit Visibility and Eye Reference Position / Seat Position / Design Eye Reference Point (DERP)

### **INTERPERSONAL RELATIONS**

- 1 Communications with
  - Flight and Cabin Crew
  - Passengers
  - Company Management
  - Flight Operations
  - Maintenance Personnel
  - Air Traffic Services
- 2 Crew Problem Solving and Decision Making
- 3 Crew Management / Small Group Dynamics
- 4 Operating Pressures
  - Family
  - Peer
  - Employer

## **RECOMMENDED STUDY MATERIAL**

- Air Command Weather Manual (TP 9352E).
- Air Command Weather Manual (Supplement) (TP 9353E).
- Human Factors for Aviation - Basic Handbook (TP 12863E), and Advanced Handbook (TP 12864E).
- When in Doubt ... Aircraft Critical Surface Contamination Training (TP 10643E)
- Transport Canada Aeronautical Information Manual (TC AIM) (TP 14371E)
- *Canadian Aviation Regulations* (CARs)

The Study Guide for the Radiotelephone Operator's Restricted Certificate (Aeronautical) is available free of charge from district offices of Industry Canada - Examinations and Radio Licensing (<http://www.strategis.gc.ca>).

Information on the Transportation of Dangerous Goods is available from Transport Canada.

Air Transportation Licence information is available from the Canadian Transportation Agency (internet address: <https://www.otc-cta.gc.ca/eng>).

Customs Requirements is available from the Canada Customs and Revenue Agency ([Canada Revenue Agency Web site / Site Web de l'Agence du revenu du Canada](#))

Canada Labour Code is available from Social Development Canada (<http://www.sdc.gc.ca/>).

Information on text books and other publications produced by commercial publishers can be obtained through local flying training organizations, bookstores and similar sources.

Publications used in pilot training in the United States are available through the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (<http://www.access.gpo.gov/index.html>).

## **ENQUIRIES**

Information concerning the location of pilot training organizations and matters pertaining to flight crew licensing may be obtained by contacting the appropriate Regional Offices. A complete listing may be found at:

<http://www.tc.gc.ca/eng/civilaviation/opssvs/general-exams-centres-2010.htm>