

Level 4 Aviation Exam Review

Subjects Covered

- PO 431 – Explain Principles of Flight
- PO 432 – Describe Aero Engine Systems
- PO 436 – Explain Aspects of Meteorology
- PO 437 – Explain Aspects of Air Navigation

PO 431 - Explain Principles of Flight

- 01 – Explain Features of Wing Design
- 02 – Describe Flight Instruments

PO 431.01 - Explain Features of Wing Design

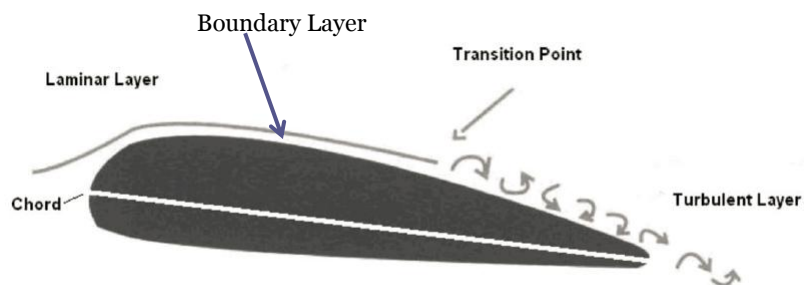
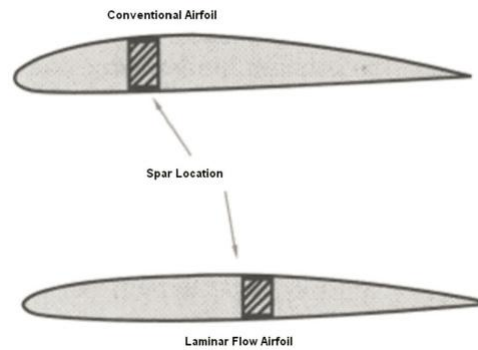
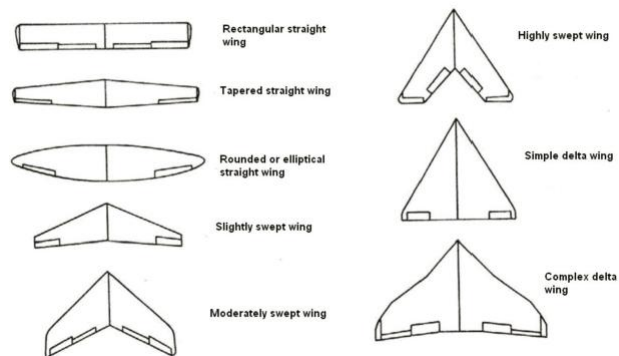


Figure A-1 Laminar and Turbulent Layers

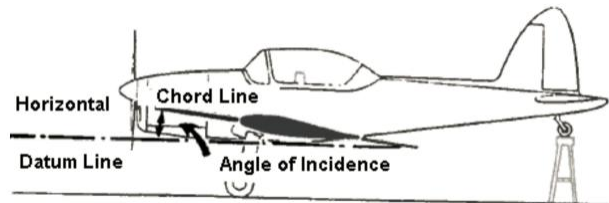
PO 431.01 Con't - Airfoils



PO 431.01 Con't - Planforms

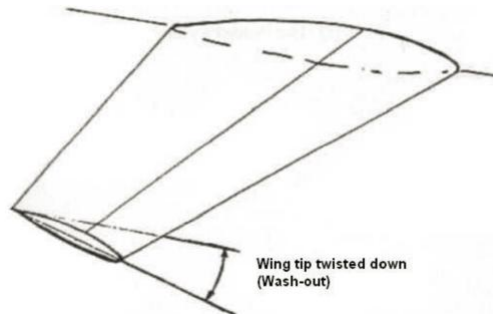


PO 431.01 Con't - Angle of Incidence



Affects flight visibility, takeoff and landing characteristics, and amount of drag in level flight

PO 431.01 Con't - Wash Out/In



Reduces tendency of wings to stall suddenly. Wash-Out when twisted down, Wash-In when twisted up

PO 431.01 Con't

- Aspect Ratio
 - Span of the wing divided by the average chord
 - High aspect ratios → more lift, less induced drag
- Spoilers
 - Used to decrease lift and increase drag
- Speed Brakes
 - Create drag with minimal effect on lift

PO 431.01 Con't

- High Lift Devices
 - Wing Tip Design
 - Wing tip fuel tanks, plates, winglets, drooping
 - Wing Fences
 - Control airflow direction over wing
 - Slats
 - Auxiliary airfoils that move in front of the leading edge of the wing at high angles of attack
 - Slots
 - Air passageways built into the wing
 - Flaps
 - Located at the trailing edge of the wing, increase lift by changing the wing's camber (curvature)

PO 431.02 Describe Flight Instruments

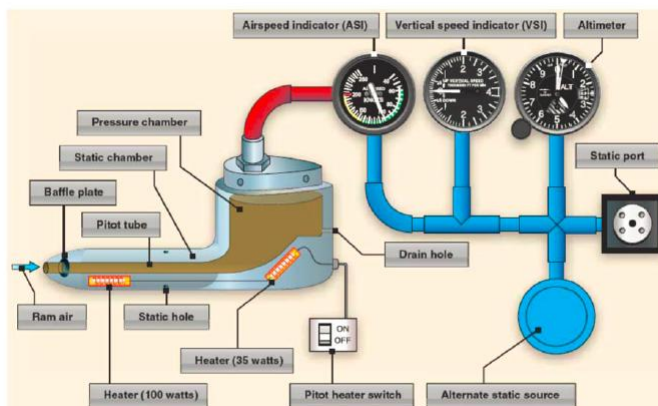


Figure A-1 Pitot Static System

PO 431.02 Con't

- Airspeed Indicator Errors
 - Density Error
 - Lower air density as altitude increases gives less than true airspeeds
 - Position Error
 - Eddies moving over the pitot intake cause errors
 - Lag Error
 - Mechanical error due to the moving parts of the instrument
 - Icing Error
 - Complete or partial blockage of the pitot tube by ice
 - Water Error
 - Water in the pitot system can cause lower readings, or block the system entirely

PO 431.02 Con't

- **Airspeed Definitions**
 - **Indicated Airspeed (IAS)**
 - Uncorrected measurement from the dial
 - **Calibrated Airspeed (CAS)**
 - IAS corrected for lag error and position error
 - **Equivalent Airspeed (EAS)**
 - CAS corrected for the compressibility factor
 - **True Airspeed (TAS)**
 - CAS corrected for density error

PO 431.02 Con't

- **Altimeter Errors**
 - **Pressure Error**
 - Variation in the barometric pressure at locations:
 - Lower pressure → reading higher than actual altitude
 - Higher pressure → reading lower than actual altitude
 - **Abnormally High Pressure**
 - **Abnormally Cold Temperature**
 - **Mountain Effect Error**
 - Increased wind speed in mountain passes cause localized low pressure areas

PO 431.02 Con't

- Altimeter Definitions
 - Indicated Altitude
 - Altitude displayed when set to current barometric pressure
 - Pressure Altitude
 - Altitude displayed when set to standard barometric pressure (29.92 inches of Hg)
 - Density Altitude
 - Pressure altitude corrected for temperature
 - Absolute Altitude
 - Actual height above earth's surface (set to field level pressure)

PO 431.02 Con't

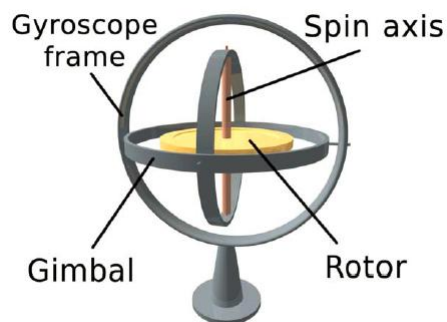


Figure A-5 Gyroscope

PO 431.02 Con't

- Gyroscope Definitions
 - Gyroscopic Inertia (rigidity in space)
 - Tendency of a rotating object to remain in its plane of rotation
 - Precision
 - Tendency of a rotating body, when a force is applied perpendicular to its plane of rotation, to turn in the direction of its rotation 90 degrees to its axis and take up a new plane of rotation parallel to the force applied

PO 431.02 Con't

- Gyroscopic Instruments
 - Heading Indicator
 - Attitude Indicator
 - Turn and Slip Indicator
 - Turn Coordinator
- Angle of Attack Indicator
 - Displays the relationship between the chord line of the wing and the relative airflow
- Mach Indicator
 - Displays the ratio of airspeed to the local speed of sound

PO 432 - Describe Aero Engine Systems

- 01 – Describe Fuel Systems
- 02 – Describe Propeller Systems
- 03 – Describe Engine Instruments

PO 432.01 Describe Fuel Systems

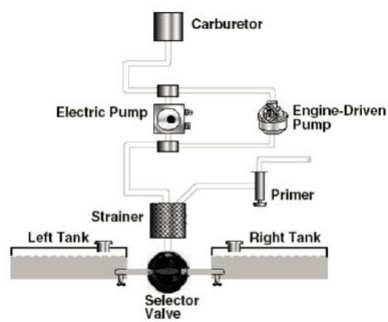


Figure A-1 Pressure-Feed System

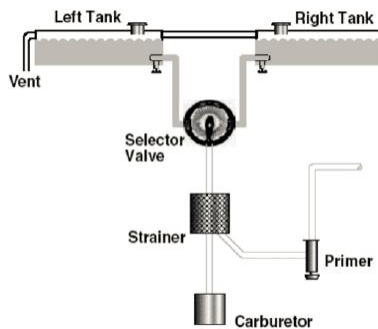


Figure A-2 Gravity-Feed System

PO 432.02 Describe Propeller Systems

- Propeller
 - Provides necessary thrust to move aircraft forward
 - Pushes air backward as the plane moves forward
- Pitch
 - Distance a propeller travels forward in one revolution

PO 432.02 Con't

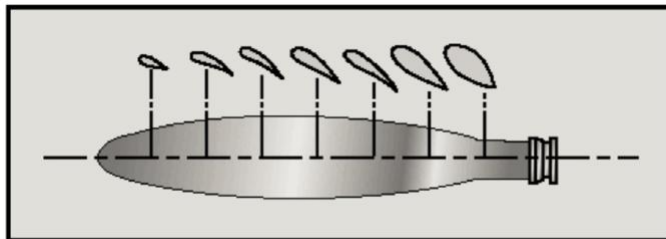


Figure A-1 Propeller Blade Shape

PO 432.02 Con't

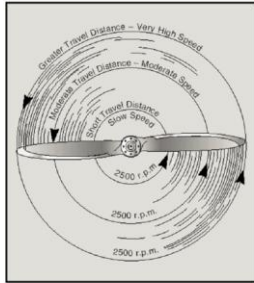


Figure A-2 Relationship of Travel Distance and Speed of Various Portions of Propeller Blade

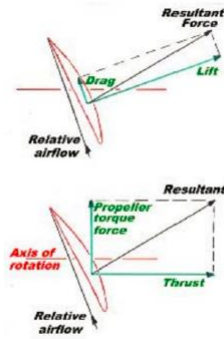


Figure A-3 Forces Acting on a Propeller Blade

PO 432.02 Con't

- Types of Propellers
 - Fixed Pitch – Blade angle can't be adjusted
 - Adjustable Pitch – Blade angle can be adjusted on ground
 - Controllable Pitch – Blade angle can be adjusted in flight
 - Constant Speed – Blade angles adjust automatically to maintain a constant RPM

PO 432.03 Describe Engine Instruments



Oil Pressure Gauge



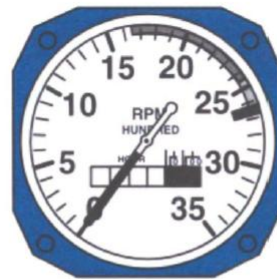
Oil Temperature Gauge

Figure A-1 Oil Pressure and Temperature Gauges

PO 432.03 Con't



Figure A-2 Cylinder Head Temperature Gauge



- GREEN (Normal Operating Range)
- YELLOW (Caution Range)
- RED (Maximum Allowable)

Figure A-3 Tachometer

PO 432.03 Con't



Figure A-4 Manifold Pressure Gauge

PO 436 - Explain Aspects of Meteorology

- 01 – Explain Winds
- 02 – Describe Air Masses and Fronts

PO 436.01 Explain Winds

- Surface Winds
 - Surface friction on the ground slows air, causing a lower wind speed than expected from the pressure gradient
 - Hills and valleys substantially distort airflow:
 - Katabatic Winds
 - Anabatic Winds
 - Mountain Waves
- Gusts
 - Rapid and irregular change in wind speed

PO 436.01 Con't

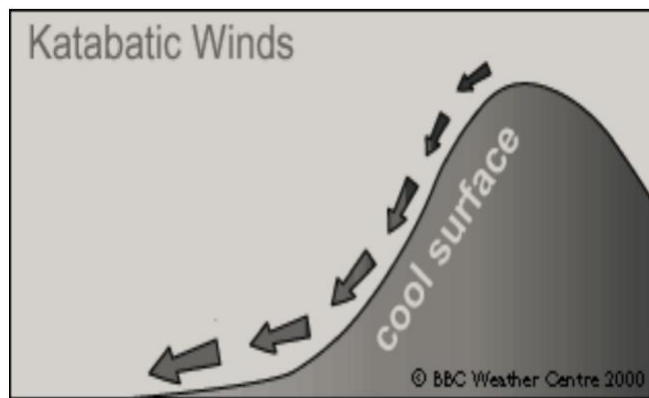


Figure A-1 Katabatic Wind

PO 436.01 Con't

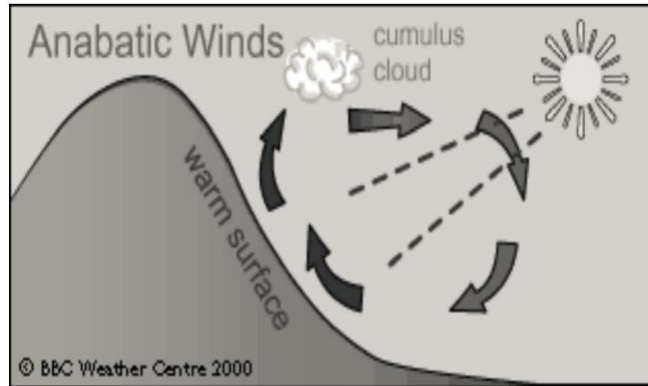


Figure A-2 Anabatic Wind

PO 436.01 Con't

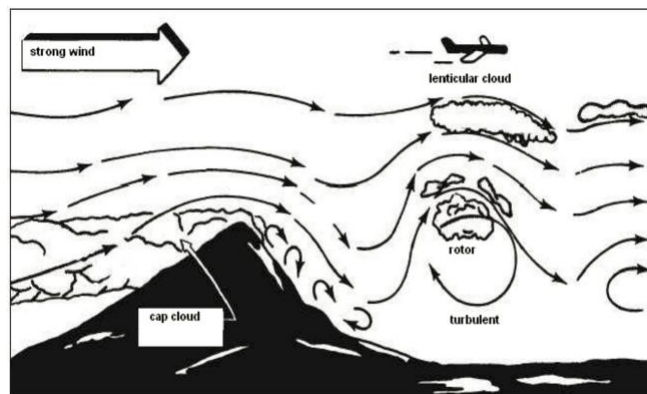


Figure A-3 Mountain Wave

PO 436.01 Con't

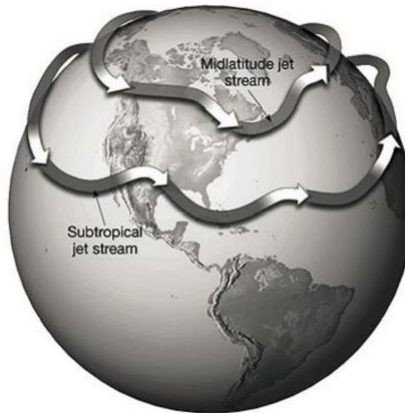


Figure A-4 The Jet Stream

PO 436.01 Con't



Figure A-5 Seasonal Mid-Latitude Jet Stream

PO 436.02 - Describe Air Masses and Fronts

- Air Masses
 - Large sections of the troposphere with uniform properties of temperature and moisture in the horizontal direction
- Weather in Air Masses
 - Determined by moisture content, cooling process, and stability of the air
- Stability of Air
 - Stable air → stratus clouds and poor visibility
 - Unstable air → cumulus clouds and good visibility

PO 436.02 - Con't

Warm Air Mass Characteristics

- Stability
- Smooth Air
- Poor Visibility
- Stratiform Clouds and Fog
- Precipitation in the form of:
 - Drizzle

Cold Air Mass Characteristics

- Instability
- Turbulence
- Good Visibility
- Cumuliform Clouds
- Precipitation in the form of:
 - Showers
 - Hail
 - Thunderstorms

PO 436.02 Con't

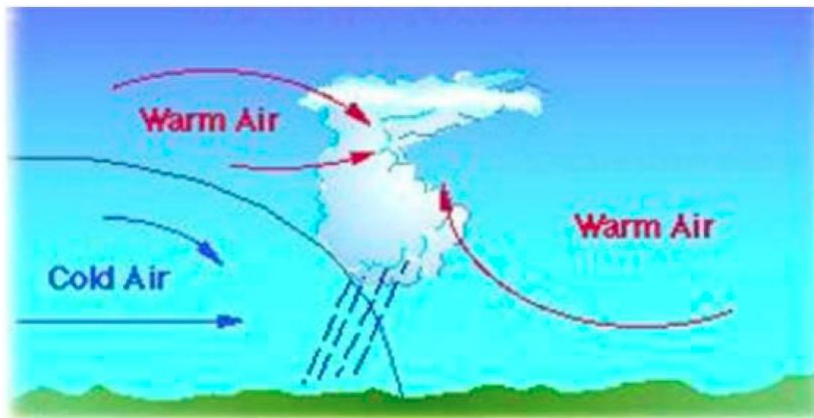


Figure 1 Cold Front

PO 436.02 Con't

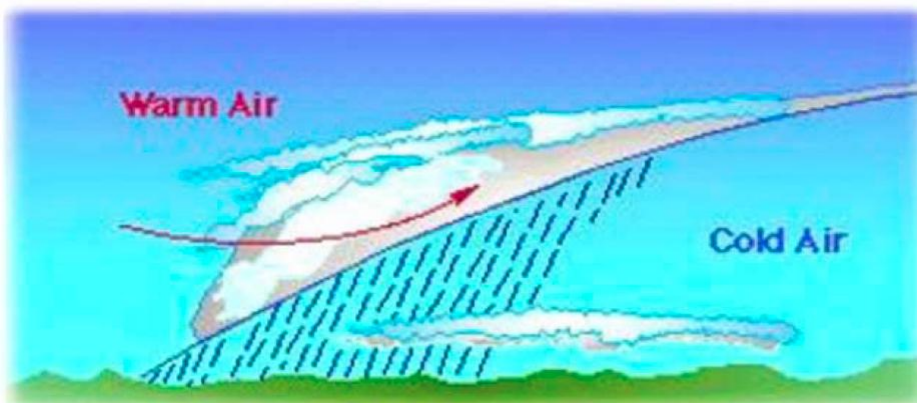


Figure 2 Warm Front

PO 437 - Explain Aspects of Air Navigation

- 01 – Define Air Navigation Terms
- 02 – Describe the Magnetic Compass

PO 437.01 Define Air Navigation Terms

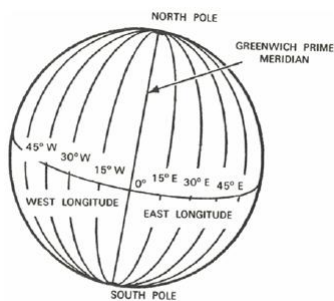


Figure 1 Meridians of Longitude

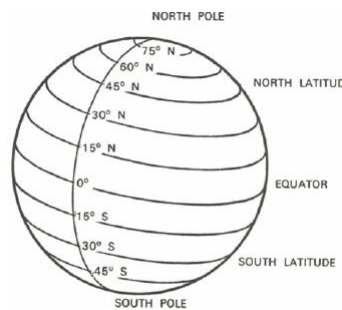


Figure 2 Parallels of Latitude

PO 437.01 Con't

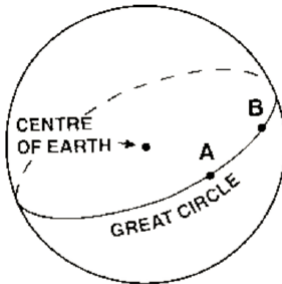


Figure 4 Great Circle

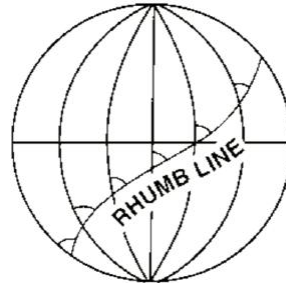
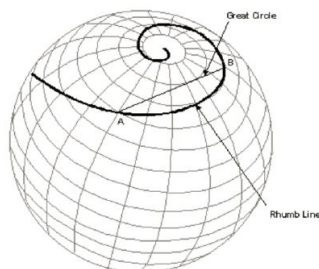


Figure 5 Rhumb Line

PO 437.01 Con't



The great circle is a straight line and the rhumb line is a spiral curve

Figure 6 Great Circle and Rhumb Line

Great Circles show the shortest path. Rhumb Lines show the path that requires a constant heading.

PO 437.01 Con't

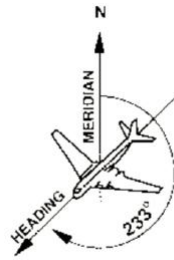


Figure 7 Heading

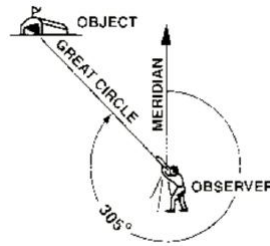


Figure 8 Bearing

PO 437.02 Describe the Magnetic Compass

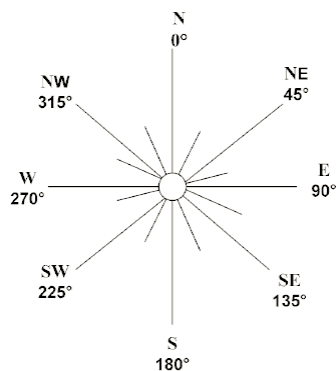


Figure A-1 Points on a Compass Rose

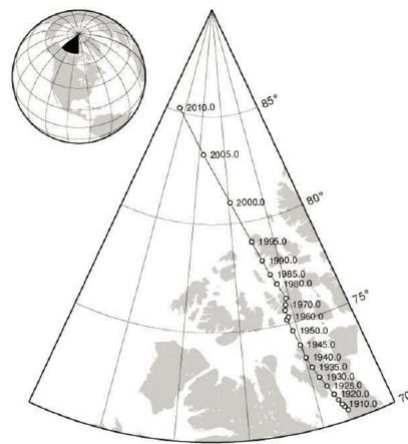


Figure A-3 Location of the Magnetic North Pole

PO 437.02 - Con't

- **Parts of a Magnetic Compass**
 - **Lubber Line**
 - Indicates the direction the airplane is heading
 - **Compass Card**
 - Attaches to the pivot and moves within the compass bowl; contains the numbers that indicate direction
 - **Pivot**
 - Allows the compass card to rotate freely
 - **Magnetic Needle**
 - Always points to magnetic north
 - **Liquid**
 - Contained in the compass bowl. Lubricant for the pivot.

PO 437.02 - Con't

- **Variation (magnetic declination)**
 - Angle between true north and magnetic north
- **Agonic Lines**
 - Join places of zero magnetic variation
- **Isogonic Lines**
 - Join places of equal magnetic variation
- **Compass North**
 - The north reading of a compass when affected by other surrounding magnetic fields (engines, metal, etc.)
- **Deviation**
 - The angle between magnetic north and compass north

PO 437.02 - Con't

- **Magnetic Dip**
 - The force of the earth's magnetic field is horizontal at the equator, but bend down at the poles
 - Causes the north-seeking end of the needle to dip downwards
- **Northerly Turning Error**
 - Aerodynamic forces during a turn influence the liquid in the compass bowl, and resultantly move the compass needle
 - On turns from north, the error causes the compass to lag
 - On turns from south, the error causes the compass to lead

PO 437.02 - Con't

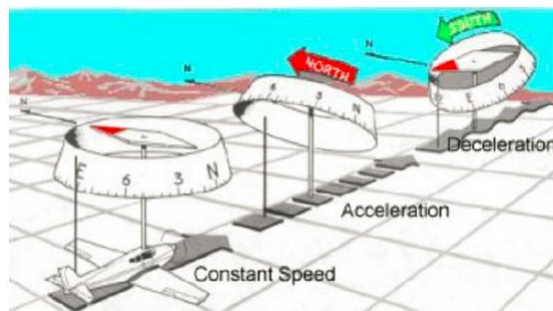


Figure A-5 Acceleration and Deceleration Errors