

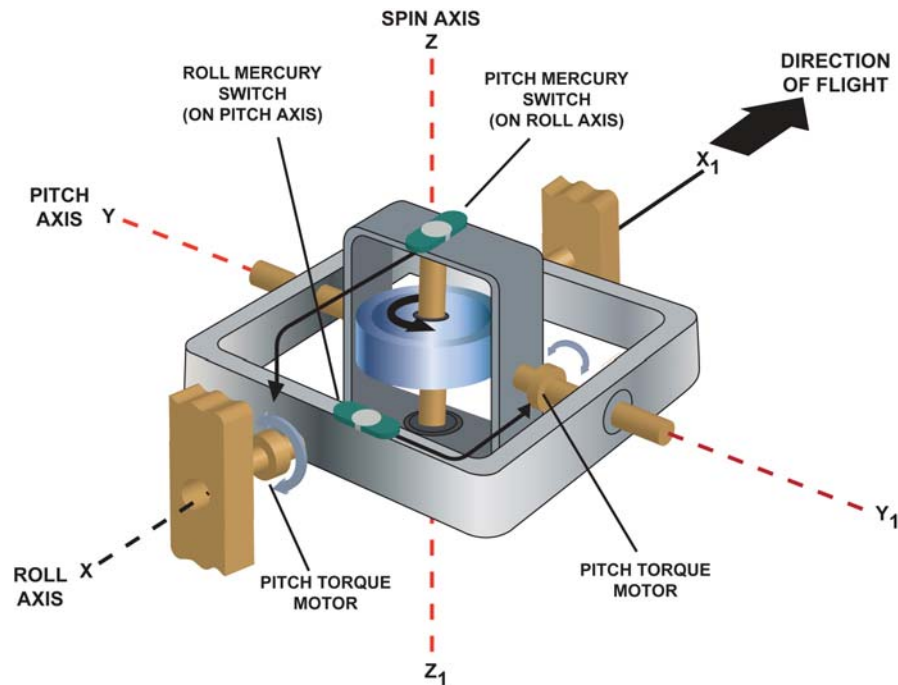
Additionally, the centrifugal force causes the pendulous unit to swing outward in the opposite direction to that of the turn, causing the inner gimbal to give a false indication of climb or descent, known as pendulosity Error. During a left turn, the classic artificial horizon indicates a false descent, and during a right turn indicates a false climb. These two forces act together, and during a 360° turn, the error reaches a maximum value at 180°, and returns to zero when the turn is complete. In modern gyroscopes, the axis of rotation is slightly offset from its true vertical to counter these errors, although this is only valid for one particular rate of turn and airspeed. The scales, similarly offset, do not affect the indications during straight and level flight.

These artificial horizon turning errors, for an uncorrected air driven gyro rotating anti-clockwise, are often questioned in the JAA exam. They are summarised below.

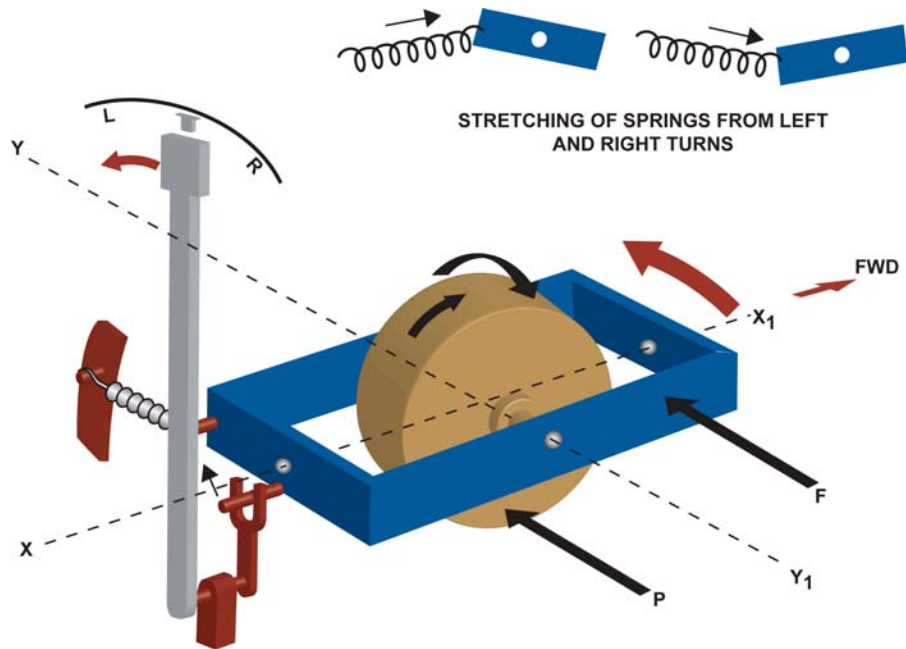
Turning through 90°	Under reads bank angle	Pitch error indicating a climb
Turning through 180°	Reads correct bank angle	Pitch error indicating a climb
Turning through 270°	Over reads bank angle	Pitch error indicating a climb
Turning through 360°	Reads correct bank angle	Pitch angle correct

ELECTRICALLY DRIVEN ARTIFICIAL HORIZON CONSTRUCTION

An example of an electrically driven artificial horizon is shown below.



It consists of the same basic components as the vacuum-driven type, except that the vertical spin axis gyroscope is a squirrel-cage induction motor. Unlike conventional induction motors, where the rotor normally revolves inside the stator, in order to make the motor small enough to fit within the space available in a modern miniaturised instrument, the rotor is designed to rotate in bearings outside the stator. This ensures that the mass of the rotor is concentrated as near to the periphery as possible, thus ensuring maximum inertia, and adequate rigidity.



It uses a rate gyro, and has freedom of movement in the rolling plane only. The rotor is either electrically driven, and includes a power failure warning flag, or is air driven. Both types of drive are structured to produce a low rotor speed of approximately 9000 rpm, because in level flight, the gyro axis is maintained in its horizontal position by an adjustable spiral spring.

The spring attaches between the gimbal and the instrument case. A pointer is also attached to the gimbal, and moves over a scale showing the aeroplane's rate of turn, which is positioned adjacent to the zero datum mark, when the gyro is in its horizontal position (i.e. when the aeroplane is in level flight). A damping device, usually a piston cushioned by air in a cylinder, is fitted to the gimbal to ensure that the instrument reacts smoothly to changes in the rate of turn, and at the same time reacts to a definite turn rate without pointer oscillation.

When the aeroplane turns, the gyro precesses, thus tilting the rotor and gimbal ring until the precessing force matches the tension of the spring. At this point, the precession ceases, and the gyro remains inclined for the duration of the turn, giving an indication of the actual rate of turn, shown by the pointer's position on the scale. When the aeroplane stops turning the gyro returns to its original horizontal position under the action of the spring.