SESSION 75: EMERGENCIES — VACUUM AND GYROSCOPIC INSTRUMENT FAILURES

1. In a typical light aircraft, the vacuum (suction) system drives which gyroscopic instruments?

A. The turn coordinator and altimeter

B. The airspeed indicator and VSI

C. The attitude indicator and heading indicator

D. The magnetic compass and VSI

2. The turn coordinator in most light aircraft is driven by:

A. The vacuum system

B. Electrical power (a separate source from the vacuum-driven instruments)

C. The pitot-static system

D. The static port

3. A vacuum system failure is especially dangerous because:

A. It fails only on the ground

B. It can be insidious — the attitude and heading indicators degrade slowly and may give subtly wrong indications before fully failing

C. It causes an immediate fire

D. It disables the engine

4. The primary cockpit indication of vacuum/suction status is the:

A. Ammeter

B. Oil pressure gauge

C. Manifold pressure gauge

D. Suction (vacuum) gauge

5. A vacuum gauge reading below the normal range (e.g., below ~4.5–5.5 in. Hg) indicates:

A. Excess suction

B. A normal condition

C. An electrical failure

D. Insufficient suction — the vacuum-driven gyros may be unreliable

6. Many modern attitude/heading indicators include a warning flag that:

A. Appears when the gyro loses adequate power/suction

B. Indicates the autopilot is on

C. Shows the transponder code

D. Displays the airspeed

7. If the vacuum pump fails, the attitude indicator will typically:

A. Read correctly

B. Fail instantly with no warning

C. Spin down slowly, giving increasingly erroneous pitch and bank indications

D. Become more accurate

8. A subtle, slowly failing attitude indicator is hazardous because the pilot may:

A. Notice immediately

B. Lose the heading indicator only

C. Have a backup AI

D. Follow the erroneous indication into an unusual attitude before recognizing the failure

9. The key defense against an undetected gyro failure is:

A. The autopilot

B. A disciplined instrument cross-check that catches one instrument disagreeing with the others

C. The transponder

D. The DME

10. If the attitude indicator and heading indicator fail (vacuum loss), the pilot flies "partial panel" using the remaining instruments, which include the:

A. Turn coordinator, airspeed indicator, altimeter, VSI, and magnetic compass

B. Attitude indicator only

C. Heading indicator only

D. DME and transponder

11. On partial panel, bank information is obtained primarily from the:

A. Turn coordinator (and the magnetic compass for heading trend)

B. Failed attitude indicator

C. Altimeter

D. Airspeed indicator

12. On partial panel, pitch information is obtained from the:

A. Turn coordinator

B. Heading indicator

C. Altimeter, VSI, and airspeed indicator together

D. Magnetic compass

13. To maintain a constant heading on partial panel, the pilot uses the:

A. Failed heading indicator

B. Attitude indicator

C. Turn coordinator to hold wings level and the magnetic compass for heading

D. VSI

14. A standard-rate turn on partial panel is flown by referencing the:

A. Altimeter

B. Airspeed indicator

C. Magnetic compass alone

D. Turn coordinator (or turn-and-slip) to the standard-rate index, timed for the heading change

15. When the suspected failure is recognized, the pilot should:

A. Continue trusting the attitude indicator

B. Disregard all instruments

C. Cover or disregard the failed instrument(s) to avoid being misled, and transition to partial-panel flying

D. Pull the airspeed breaker

16. An electrically driven backup attitude indicator (if installed) provides:

A. An independent attitude reference if the vacuum system fails

B. Heading only

C. Airspeed

D. Vacuum

17. In an aircraft with an electric AI and vacuum-driven instruments, a vacuum failure leaves the pilot with:

A. The electric attitude indicator plus the electric turn coordinator and pitot-static instruments

B. No usable instruments

C. Only the magnetic compass

D. Only the heading indicator

18. A pilot who detects a vacuum failure in IMC should, in addition to flying partial panel:

A. Climb above the clouds

B. Advise ATC, request assistance/vectors, and plan to land at the nearest suitable airport, ideally in VMC if available

C. Squawk 7500

D. Disregard ATC

19. Recovery from an unusual attitude on partial panel uses the:

A. Failed attitude indicator

B. Magnetic compass

C. Airspeed, altimeter, VSI, and turn coordinator to identify and correct the nose-high or nose-low condition

D. DME

20. A nose-low unusual attitude (increasing airspeed, decreasing altitude) is corrected on partial panel by:

A. Increasing pitch only

B. Reducing power, leveling the wings (turn coordinator), then raising the nose to level flight

C. Adding power

D. Banking sharply

21. A nose-high unusual attitude (decreasing airspeed, increasing altitude) is corrected on partial panel by:

A. Reducing power

B. Adding power, lowering the nose, and leveling the wings (turn coordinator)

C. Banking

D. Pulling back

22. The magnetic compass on partial panel is subject to errors during turns and acceleration, so the pilot should:

A. Disregard it entirely

B. Use it only on the ground

C. Trust it during turns

D. Allow for lead/lag and acceleration/deceleration errors, using timed turns to roll out on heading

23. A pilot should periodically verify the vacuum gauge and cross-check the gyros against the other instruments in order to:

A. Set the transponder

B. Tune the navaid

C. Check the fuel

D. Detect a developing vacuum/gyro failure early

24. Practicing partial-panel flying is important because:

A. It is required for VFR

B. It builds the skill to maintain control and navigate when the primary gyros fail in IMC

C. It replaces the attitude indicator

D. It charges the vacuum pump

25. The fundamental principle of handling a vacuum/gyroscopic failure is that the pilot must:

A. Trust the attitude indicator regardless

B. Detect the failure through cross-check and the suction gauge, disregard the failed instruments, fly partial panel using the turn coordinator, pitot-static instruments, and compass, and land at a suitable airport

C. Descend immediately in all cases

D. Disregard the turn coordinator

ANSWER KEY & EXPLANATIONS — SESSION 75

1. C. AI and HI — The vacuum system typically drives the attitude indicator and heading indicator.

2. B. Electrical — The turn coordinator in most light aircraft is driven by electrical power, a separate source from the vacuum-driven instruments.

3. B. Insidious slow failure — A vacuum failure is dangerous because it can be insidious — the AI and HI degrade slowly and may give subtly wrong indications before fully failing.

4. D. Suction gauge — The primary cockpit indication of vacuum status is the suction (vacuum) gauge.

5. D. Insufficient suction — A low vacuum reading indicates insufficient suction — the vacuum-driven gyros may be unreliable.

6. A. Warning flag on power loss — Many modern AI/HI include a warning flag that appears when the gyro loses adequate power/suction.

7. C. Spins down slowly — A failed vacuum pump causes the AI to spin down slowly, giving increasingly erroneous pitch and bank indications.

8. D. Follow into unusual attitude — A slowly failing AI is hazardous because the pilot may follow the erroneous indication into an unusual attitude before recognizing the failure.

9. B. Cross-check — The key defense is a disciplined instrument cross-check that catches one instrument disagreeing with the others.

10. A. TC/ASI/alt/VSI/compass — On partial panel, the remaining instruments include the turn coordinator, airspeed indicator, altimeter, VSI, and magnetic compass.

11. A. Turn coordinator/compass — Bank information on partial panel comes primarily from the turn coordinator (and the compass for heading trend).

12. C. Alt/VSI/ASI — Pitch information on partial panel comes from the altimeter, VSI, and airspeed indicator together.

13. C. TC + compass — Constant heading on partial panel uses the turn coordinator to hold wings level and the magnetic compass for heading.

14. D. Turn coordinator/timed — A standard-rate turn on partial panel is flown referencing the turn coordinator to the standard-rate index, timed for the heading change.

15. C. Disregard failed/transition — On recognizing the failure, the pilot covers or disregards the failed instruments to avoid being misled and transitions to partial-panel flying.

16. A. Independent attitude — An electric backup AI provides an independent attitude reference if the vacuum system fails.

17. A. Electric AI + others — With an electric AI, a vacuum failure leaves the pilot with the electric attitude indicator plus the electric turn coordinator and pitot-static instruments.

18. B. Advise ATC/land — On detecting a vacuum failure in IMC, the pilot flies partial panel, advises ATC, requests assistance/vectors, and plans to land at the nearest suitable airport, ideally in VMC.

19. C. Pitot-static + TC — Unusual-attitude recovery on partial panel uses the airspeed, altimeter, VSI, and turn coordinator to identify and correct the condition.

20. B. Reduce power/level/raise nose — A nose-low unusual attitude is corrected by reducing power, leveling the wings (turn coordinator), then raising the nose to level flight.

21. B. Add power/lower nose/level — A nose-high unusual attitude is corrected by adding power, lowering the nose, and leveling the wings (turn coordinator).

22. D. Allow for compass errors — The magnetic compass on partial panel requires allowing for lead/lag and acceleration/deceleration errors, using timed turns to roll out on heading.

23. D. Detect failure early — Periodically verifying the vacuum gauge and cross-checking the gyros detects a developing vacuum/gyro failure early.

24. B. Builds control skill — Practicing partial panel builds the skill to maintain control and navigate when the primary gyros fail in IMC.

25. B. Detect/disregard/partial panel/land — The fundamental principle is to detect the failure through cross-check and the suction gauge, disregard the failed instruments, fly partial panel, and land at a suitable airport.