# REVISION LOG

Update notices for this book will be available online at www.actechbooks.com/revisions.html
If you would like to be notified when changes occur, please join our mailing list at www.actechbooks.com

| VERSION | EFFECTIVE DATE | DESCRIPTION OF REVISION(S) |
|---|---|---|
| 001 | 2015.01 | Module creation and release. |
| 002 | 2016.01 | Minor Revisions |
| 003 | 2017.09 | Format Updates |
| 003.1 | 2019.02 | Added section on Pneumatic and Pressure Pumps in Submodule 16. |
| 003.2 | 2019.05 | Corrected incorrect answers in Submodule 20. |
| 004 | 2019.12 | Typographic format updated; Sequencing of content to Appendix 1 refined. |
| 004.1 | 2021.04 | Enhanced content of M11A Submodule 08(b). |
| 004.2 | 2023.01 | Added Measurement Standards. Improved Figures 13-51, 18-5, and 18-6. |
| 004.3 | 2023.04 | Enhanced content in Submodule 14 - Lights. |
| 005 | 2024.04 | Regulatory update for EASA 2023-989 Compliance. |
| 005.1 | 2024.05 | Replaced Figures 1-39 and 5-69, adjusted small text errors throughout Module. |

Module was reorganized based upon the EASA 2023-989 subject criteria. Enhancements included in this version 005.1 are:

- 11.1 *Drag Inducing Devices* - complete rewrite.
- 11.2 *Fuselage Components, Structural Assembly Techniques, Reinforcement* - added content.
- 11.3.1(B) *Airborne Towing Devices* - added content.
- 11.3.5 *Engine Mounts* - complete rewrite.
- 11.4(C) *Control and Indication Control Valves* - added content.
- 11.5.2 *Controller Pilot Datalink* - added content.
- 11.5.2 *Audio Systems* - added content.
- 11.5.2 *Cockpit Voice Recorders* - added content.
- 11.5.2 *Microwave Landing Systems* - added content.
- 11.5.2 *ARINC Communications* - added content.
- 11.5.2 *Avionics Test Equipment* - added content from Module 7.4.
- 11.6 *Battery Maintenance and Troubleshooting* - added content.
- 11.10 *Inert Gas Systems* - added content.
- 11.11 *Servicing Hydraulic Systems* - added content.
- 11.11 *Boeing 737NG Hydraulic System* - added content.
- 11.13 *Tail Protection and Tail Skids* - added content.
- 11.16 *Pneumatic System Components* - added content.
- 11.21 *Electronic Flight Bag Classifications* - added content.
- Question and Answer updates for all Submodules.

### STALL WEDGES

A stall wedge or stall strip is a fixed wedge shaped strip attached spanwise to the wing leading edge. [**Figure 1-38**] It is located on the inboard section of the wing at such a point that it causes the boundary airflow to become turbulent as the angle of attack increases to a certain point. This purposeful destruction of the boundary airflow as the angle of attack increases causes the root of the wing to stall first. Thus, airflow over the outboard wing section and over the ailerons is preserved during the stall making it easier to recover. A wedge can also serve as a stall warning device by invoking turbulence with vibrations warning the pilot.

Figure 1-38. A stall wedge causes the wing root to stall before the outboard wing. This preserves airflow over the ailerons for controlled recovery from the stall.

### WING TIP VORTICES

Wingtip vortices are caused by the air beneath the wing, which is at the higher pressure, flowing over the wingtip and up toward the top of the wing. The end result is a spiral or vortex that trails behind the wingtip anytime lift is being produced. This vortex is also referred to as wake turbulence, and is a significant factor in determining how closely one aeroplane can follow behind another on approach to land. The wake turbulence of a large aeroplane can cause a smaller aeroplane, if it is following too closely, to be thrown out of control. Vortices from the wingtip as well as the inboard edge of the ailerons and from the horizontal stabilizer are visible on the MD-11 shown in **Figure 1-39**.

Figure 1-39. Vortices on an MD-11.

Upwash and downwash refer to the effect an airfoil has on the free airstream. Upwash is the deflection of the oncoming airstream, causing it to flow up and over the wing. Downwash is the downward deflection of the airstream after it has passed over the wing and is leaving the trailing edge. This downward deflection is what creates the action and reaction described under lift and Newton's third law.

### WINGLETS

A winglet is an obvious vertical upturn of the wing's tip resembling a vertical stabilizer. [**Figure 1-40**] It is an aerodynamic device designed to reduce the drag created by wing tip vortices in flight. Usually made from aluminum or composite materials, winglets can be designed to optimize performance at a desired speed. They use the flow of air from under the wing to create thrust thereby reducing induced drag. Significant fuel savings are also achieved.

Figure 1-40. A winglet reduces aerodynamic drag caused by air spilling off of the wing tip.

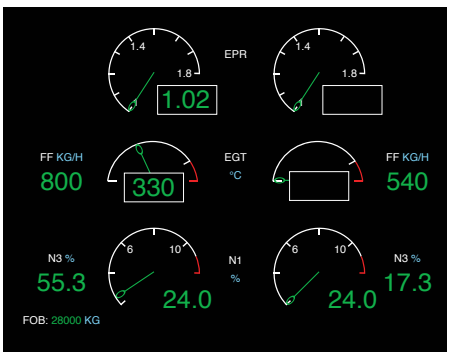
pressure is grouped with other engine parameter displays on the same page or portion of a page on the display. **Figure 5-68** shows this grouping on a Garmin G1000 digital instrument display system for general aviation aircraft.

## ENGINE PRESSURE RATIO (EPR)

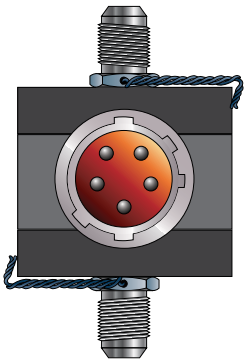
Turbine engines have their own pressure indication that relates the power being developed by the engine. It is called the engine pressure ratio (EPR) indicator (EPR gauge). This gauge compares the total exhaust pressure to the pressure of the ram air at the inlet of the engine. With adjustments for temperature, altitude, and other factors, the EPR gauge presents an indication of the thrust being developed by the engine. Since the EPR gauge compares two pressures, it is a differential pressure gauge. It is a remote sensing instrument that receives its input from an engine pressure ratio transmitter or, in digital instrument systems displays, from a computer. The pressure ratio transmitter contains the bellows arrangement that compares the two pressures and converts the ratio into an electric signal used by the gauge for indication. [**Figure 5-69**]


Figure 5-68. Oil pressure indication with other engine-related parameters shown in a column on the left side of this digital cockpit display panel.


A. An analog EPR gauge from a turbine engine.




B. A digital EPR indication and other turbine engine parameters on a cockpit digital display screen.



C. Engine pressure ratio transducer.

Figure 5-69. An Engine Pressure Ratio (EPR) gauge in analog and digital format and its transducer.