Flight Training Fundamentals – What is a Glass Cockpit?

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As a flight training student, you will hear the phrase "glass cockpit" throughout your flight training and commercial pilot career. But what exactly is it? Here is the definition and history of a glass cockpit.

A glass cockpit is an aircraft cockpit that features electronic instrument displays rather than mechanical gauges – it is as simple as that. A glass cockpit uses displays driven by flight management systems that can be adjusted to display flight information as needed. This simplifies aircraft operation and navigation and allows pilots to focus only on the most pertinent information. They are also popular with airline companies as they usually eliminate the need for a flight engineer.

Early glass cockpits in old McDonnell Douglas, Boeing 737, 757 and 767 and Airbus A300-600 and A310's used Electronic Flight Instrument Systems (EFIS) to display attitude and navigational information only, with traditional mechanical gauges retained for airspeed, altitude and vertical speed. Later glass cockpits, found in the Boeing 737NG, 747-400, 767-400, 777, A320 and newer Airbuses have completely replaced the mechanical gauges and warning lights that were in the previous generations of aircraft. Today, all commercial aircraft have glass cockpits as well as most private aircraft.

History

Before the 1970's, aircraft were not considered sufficiently demanding to require advanced equipment like electronic flight displays. Also, computer technology was not at a level where sufficiently light and powerful circuits were available. The increasing complexity of transport aircraft, the advent of digital systems and growing air traffic congestion around airports began to change that.

The average transport aircraft in the mid-1970s had more than one hundred cockpit instruments and controls, and the primary flight instruments were already crowded with indicators, crossbars, and symbols, and the growing number of cockpit elements were competing for cockpit space and pilot attention. As a result, NASA conducted research on displays that could process the raw aircraft system and flight data into an integrated, easily understood picture of the flight situation, culminating in a series of flights demonstrating a full glass cockpit system.
The success of the NASA-led glass cockpit work is reflected in the total acceptance of electronic flight displays beginning with the introduction of the MD-80 in 1979. Airlines and their passengers alike have benefited. The safety and efficiency of flights has been increased with improved pilot understanding of the aircraft's situation relative to its environment (or "situational awareness").

By the end of the 1990s, Liquid crystal display (LCD) panels were increasingly favored among aircraft manufacturers because of their efficiency, reliability and legibility. Earlier LCD panels suffered from poor legibility at some viewing

angles and poor response times, making them unsuitable for aviation. Modern aircraft such as the Boeing 737 Next Generation, 777, 717, 747-400ER, 767-400ER, 747-8, and 787, Airbus A320 family (later versions), A330 (later versions), A340-500/600, A340-300 (later versions), A380 and A350 are fitted with glass cockpits consisting of LCD units.
The glass cockpit has become standard equipment in airliners, business jets, and military aircraft. By the end of the century glass cockpits began appearing in general aviation aircraft as well. By 2005, even basic trainers like the Piper Cherokee and Cessna 172 were shipping with glass cockpits as options and many modern aircraft such as the Diamond Aircraft twin-engine travel and training aircraft DA42, and Cirrus Design SR20 and SR22 are available with glass cockpit only.

Future Developments

Unlike the previous era of glass cockpits—where designers merely copied the look and feel of conventional electromechanical instruments onto cathode ray tubes—the new displays represent a true departure. They look and behave a lot like other computers, with windows and data that can be manipulated with point-and-click devices. They also add terrain, approach charts, weather, vertical displays, and 3D navigation images.
The improved concepts enables aircraft makers to customize cockpits to a greater degree than previously. All of the manufacturers involved have chosen to do so in one way or another—such as using a trackball, thumb pad or joystick as a pilot-input device in a computer-style environment. Many of the modifications offered by the aircraft manufacturers improve situational awareness and customize the human-machine interface to enhance safety.
As aircraft displays have modernized, the sensors that feed them have modernized as well. Traditional gyroscopic flight instruments have been replaced by Attitude and Heading Reference Systems (AHRS) and Air Data Computers (ADC's), improving reliability and reducing cost and maintenance. GPS receivers are frequently integrated into glass cockpits.

Modern glass cockpits might include Synthetic Vision (SVS) or Enhanced Vision systems (EVS). Synthetic Vision systems display a realistic 3D depiction of the outside world (similar to a flight simulator), based on a database of terrain and geophysical features in conjunction with the attitude and position information gathered from the aircraft navigational systems. Enhanced Vision systems add realtime information from external sensors, such as an infrared camera.

All new airliners such as the Airbus A380, Boeing 787 and private jets such as Bombardier Global Express and Learjet use glass cockpits. Certain general aviation aircraft, such as the 4-seat Diamond Aircraft DA40, DA42 and DA50 and the 4-seat Cirrus Design SR20 and SR22, are available with glass cockpits. Systems such as the Garmin G1000 are now available on many new GA aircraft, including the classic Cessna 172.

Safety

As aircraft operation becomes more dependent on glass cockpit systems, flight crews must be trained to deal with possible failures. In one glass-cockpit aircraft, the Airbus A320, fifty incidents of glass cockpit blackout have occurred. In January 2008, United Airlines Flight 731 experienced a serious glass-cockpit blackout, losing half of the ECAM displays as well as all radios, transponders, TCAS, and attitude indicators. Partially due to good weather and daylight conditions, the pilots were able to land successfully at Newark Airport without radio contact.

Glass cockpit blackouts are the main reason flight training students need to know how to fly with and without electronic instrument displays – and why flight training students need to know what a glass cockpit is.