



G1000[®] Integrated Flight Deck



Pilot's Training Guide

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INTRODUCTION

G1000 Integrated Flight Deck

The G1000® is a completely integrated avionics system, designed to fit a broad range of aircraft models. It is an all-glass flight deck that presents flight instrumentation, location, navigation, communication, and identification data on large-format, high-resolution displays. The digital data presentation on the G1000 puts all flight-critical information literally at the pilot's fingertips.

Purpose

This Pilot's Training Guide is provided to help the pilot transition to Garmin G1000-equipped aircraft. Use this study guide in combination with the G1000 Simulator and/or the G1000 Pilot's Guide as well as the flight instructor's guidance and feedback to maximize G1000 training before taking delivery of a new G1000-equipped aircraft.



NOTE: *Ground lessons should be completed before starting flight training.*



NOTE: *In this training guide, each lesson contains exercises as well as a list of resources that are recommended before completing these exercises.*

Flight and Ground Instruction

It is important to coordinate ground lessons with a properly trained flight instructor. Work with an instructor to make sure that the system is fully understood. This training guide works best if an instructor is involved from the very beginning. Work with an instructor to ensure that the flight lessons cover all appropriate material. Note that the instructor may determine that additional training is required to review aircraft systems, procedures, airspace, or other knowledge areas. Practice under an instructor until confidently proficient with the G1000 system.

Level of Knowledge Attained

The material contained in this guide is designed to help pilots progress from basic to advanced levels of knowledge. The basic skills of interpreting the Primary Flight Display (PFD), tuning the radios, and operating the Audio Panel are covered early on in the training material. Later sections cover navigation, terrain, and other more complex material. The Pilot's Training Guide is designed so that pilot and instructor can begin basic training quickly.



NOTE: *It is not necessary to complete the Navigation portion of the material before taking off on a local training flight.*

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Ground Lesson 1

INTRODUCTION AND G1000 SYSTEM OVERVIEW

Objectives

Upon completion of this lesson, the pilot should be able to do the following:

- Describe the basic components of the G1000 Integrated Flight Deck
- Describe the communication between G1000 components

Resources

- G1000 Pilot's Guide
- Aircraft Flight Manual (AFM) and supplements
- Pilot's Operating Handbook (POH) and supplements
- Aeronautical Information Manual (AIM)
- Federal Aviation Regulations (FAR)

Exercise 1.1:

Terminology and Review of Pertinent Federal Aviation Regulations

1. Define and describe the following navigation abbreviations and acronyms:

- WAAS

- LNAV

- LNAV/VNAV

- LPV

- VNAV (or VNV)

- APV

- SBAS

2. Describe how WAAS provides improved accuracy.

3. Explain the capabilities of TSO-C146a GPS equipment during instrument approaches, per the AIM.

4. Equipped with TSO-C146a GPS equipment, what other navigational instruments must your aircraft have on board to navigate in National Airspace?

Exercise 1.2: Component Review

1. Define the following equipment abbreviations and acronyms:

- AHRS

- ADC

- TIS

- TAWS

- AFCS

2. Describe the function of the following components of the G1000 Integrated Flight Deck:

- GRS 77

- GMU 74

- GIA 63

- GDU 10XX

- GTX 33

- GMA 1347

- GDL 69/69A

- GWX 68

- GFC 700

3. What is the primary interface used between the G1000 components?

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Ground Lesson 2

TRANSITION TO THE PRIMARY FLIGHT DISPLAY (PFD)

Objectives

Upon completion of this lesson, the pilot should be able to read, understand, and interpret the six primary flight instruments displayed on the PFD that indicate airspeed, attitude, altitude, vertical speed, turn rate/coordination, and heading.

Resources

- G1000 Pilot's Guide
- G1000 Cockpit Poster

Exercise 2.1: Instrumentation Layout

In the space provided below, sketch the six primary flight instruments as displayed. Also, include additionally displayed instruments, such as the Vertical Deviation/Glideslope Indicator, Marker Beacon Annunciation, Traffic Annunciation, and TAWS Annunciation on the PFD.

Exercise 2.2: Instrumentation Depiction

Assume that the aircraft is flying with the following indications and fill in the appropriate fields on the sketch with this data. Note that some data is not displayed for certain G1000 installations.

- Airspeed = 140 KIAS
- True Airspeed = 154 KTAS
- Altitude = 6760 ft
- Vertical Speed = 0 fpm
- Heading = 95°
- Barometric Altimeter Setting = 30.02 in Hg
- Outside Air Temperature = 4°C

Ground Lesson 3

POWER-UP, SELF-TEST, CHECKLIST

Objectives

Upon completion of this lesson, the pilot should be able to correctly identify proper alignment of the AHRS/ADC, complete a system self-test, and verify the database data.

Resources

- G1000 Pilot's Guide
- G1000 PC-based Simulator

Exercise 3.1: System Initialization

1. How does one verify the aircraft software upon power-up?

2. Is the aircraft required to remain stationary while the AHRS and ADC align?

3. Is any warm-up time required for the engine instrumentation to be accurate?

4. What pilot action should be taken if the MFD system self-test does not pass?

5. Where can one verify the effective dates of the Jeppesen database during the initial system start-up?

6. If the Jeppesen database is not current in the G1000, can the system still be used for IFR flight?

7. How does one verify if the autopilot has passed its preflight system test?

8. How does one verify if TAWS passed its preflight system test?

9. A pilot is planning a flight to KAPA (Centennial Airport, Denver, CO) from KCOU (Columbia, MO). When arriving at the aircraft, the pilot notices that the Jeppesen database is out of date by 3 cycles (84 days).
- Can the pilot make the flight under Instrument Flight Rules (IFR)?
 - What enroute flight planning considerations must be made?
 - What destination flight planning considerations must be made?

Ground Lesson 4

TRANSPONDER OPERATION

Objectives

Upon completion of this lesson, the pilot should be familiar and comfortable with the operation of the integrated transponder controls located on the PFD of the G1000 System. This includes the selection of the transponder operating mode, squawk code entry, and IDENT activation.

Resources

- G1000 Pilot's Guide
- G1000 PC-based Simulator

Exercise 4.1: Operating Modes and Code Entry

1. To which transponder operating mode does the G1000 System default when it is first powered up, if equipped with the Garmin Mode S Transponder (GTX 33)?

2. Describe the process for entering a newly assigned transponder code.

3. Which Garmin LRU failure will cause the G1000 to lose Mode C/S capability?

4. Equipped with a GTX 33 Transponder, how is the G1000 able to receive traffic information?

5. What is acquisition squitter?

Exercise 4.2: Practice (Optional)

Using the G1000 PC-based Simulator, review the start-up process and verify the Jeppesen database effective dates. Also, practice entering various transponder codes and changing the operating mode using the PFD softkeys.

Ground Lesson 5

COM RADIO AND AUDIO PANEL OPERATION

Objectives

Upon completion of this lesson, the pilot should be comfortable manually and automatically tuning and selecting communication frequencies, while properly configuring the selections on the GMA 1347 Audio Panel.

Resources

- G1000 Pilot's Guide
- G1000 Cockpit Poster
- G1000 PC-based Simulator

Exercise 5.1: COM Operation and Methods of Frequency Tuning

1. Are active frequencies displayed toward the inside or outside of the PFD and MFD in the NAV/COM Frequency boxes?

2. In what color are active frequencies displayed?

3. Which key should be pressed to change between the standby and active frequencies? Draw the label on this key.

4. If the **COM Frequency Transfer** Key is held for two seconds, what occurs?

5. When manually tuning a frequency, what is the large **COM** Knob used for? What is the small **COM** Knob used for?

6. When the **NRST** Softkey is pressed on the PFD, a list of the nearest airports appears, with runway length and tower/CTAF frequencies listed. How can one directly tune one of these frequencies without having to manually tune it into the COM radio?

Exercise 5.2: Practice (Optional)

Using the G1000 PC-based Simulator, power up the system.

- 1.** Verify the Jeppesen database effective dates and note those dates in the space provided below.

- 2.** Enter the transponder code “3470” and set the transponder to ‘ALT’ mode.
- 3.** In COM1, enter 124.30 MHz as the active frequency and 133.00 MHz as the standby frequency.
- 4.** In COM2, enter 135.325 MHz as the active frequency and 118.90 MHz as the standby frequency.

Exercise 5.3: Audio Panel Operation

1. Which key should be pressed on the Audio Panel (GMA 1347) to monitor a COM radio frequency without transmitting?
2. If available, describe how the split COM feature works and provide a sample scenario of its use.
3. What purpose does the red button located at the bottom of the Audio Panel (GMA 1347) serve?
4. Does **COM MIC** Key selection have any impact on the display of the COM frequencies on the PFD or MFD? Explain.
5. Two pilots on a long cross-country flight encounter bad weather. The pilot flying the plane wants a weather update, but is struggling to get on frequency and be heard because the ARTCC frequency is very busy handling multiple reroutes. What tools are available to get the necessary weather information to continue the flight?

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Ground Lesson 6

NAVIGATION

Objectives

Upon completion of this lesson, the pilot should be able to navigate using ground-based NAVAIDs and GPS while manually tuning VOR/LOC/ILS frequencies and creating GPS direct-tos and flight plans.

Resources

- G1000 Pilot's Guide
- G1000 Cockpit Poster
- G1000 PC-based Simulator

Exercise 6.1: Land-based Navigational Aids

1. Is the process to manually tune a NAV frequency the same as it is for a COM frequency?
2. When using the database to automatically tune a NAV frequency, is the process the same as it is for automatically loading a COM frequency?
3. What type of information is provided about a ground-based navigational aid when it is highlighted by panning on the map and the **ENT** Key is pressed?
4. How and where can the pilot select the Course Deviation Indicator (CDI) navigation source displayed on the HSI for the NAV1 or NAV2 frequency?
5. Does the G1000 System automatically attempt to identify the tuned NAV frequency? How is this visually presented?
6. How and where can the pilot select additional bearing pointer information displayed on the HSI for the NAV1 or NAV2 frequency?

7. With the NAV radio receiving the tuned VOR station, the corresponding Bearing Information Window displays the distance to bearing. What source provides the distance information?

8. How and where can the pilot select the DME information displayed on the PFD?

Exercise 6.2: Practice (Optional)

Using the G1000 PC-based Simulator, power up the system and configure the G1000 as needed for the following IFR clearance out of KAPA (Centennial Airport, Denver, CO):

“N12345 is cleared to the Goodland, KS, airport, via the Thurman VOR, Byers VOR, then direct. Climb and maintain eight thousand, expect one-two thousand in ten minutes. Departure frequency is 126.75, squawk 3470.”

Exercise 6.3: GPS Navigation

1. Can a direct-to/flight plan be created using GPS on both the PFD and the MFD or must one or the other be used (if so, which one)?
2. Describe the process for canceling a direct-to.
3. Describe the process for entering a flight plan.
4. When flight plan information has been entered, does the G1000 System auto-sequence the waypoints and does the autopilot continuously fly the programmed route?
5. Describe some of the advantages of flight planning as opposed to using continuous direct-to navigation.

Exercise 6.4: Practice (Optional)

Using the G1000 PC based Simulator, power up the system.

- 1.** Verify the Jeppesen database effective dates and note those dates in the space provided below.

- 2.** Enter the transponder code “1252” and set the transponder to ‘ALT’ mode.
- 3.** In COM1, enter the ATIS frequency for KAPA as the active frequency and the ground control frequency as the standby frequency.
- 4.** In COM2, enter the KAPA Tower frequency as the active frequency and the departure frequency for an eastbound departure as the standby frequency.
- 5.** Tune in and place Thurman, CO VOR (TXC) into the active NAV1 frequency; tune in and place Byers, CO VOR (BVR) into the active NAV2 frequency.
- 6.** Create a flight plan from KAPA to KIXD via Thurman, Goodland, Hill City, Salina, and Topeka VORs and the RUGBB intersection.

Exercise 6.5: Instrument Approaches

1. When first selecting an approach, what is the default option that appears when the **PROC** Key is pressed?
2. What is the difference in how the HSI presents data between selecting Vectors-to-Final or an Initial Approach Fix during an instrument approach?
3. Describe the CDI scaling that occurs when flying a GPS approach, according to the AIM.
4. When navigating using the GPS, if an ILS, LOC, or VOR approach is selected, where is the frequency for the primary approach navigational aid automatically placed?
5. When flying an ILS approach, where do the Glideslope Indicator and Marker Beacon Annunciation appear on the PFD?
6. Can GPS be used to fly a VOR approach?
7. Does GPS provide guidance data to the autopilot to allow it to fly a coupled holding pattern?
8. Can GPS be used in lieu of DME when flying a DME arc associated with a VOR, LOC, or ILS approach procedure?

Exercise 6.6: Practice (Optional)

Using the G1000 PC-based Simulator, power up the system.

1. Verify the Jeppesen database effective dates and note those dates in the space provided below.
2. Enter the transponder code “5455” and set the transponder to ‘ALT’ mode.
3. In COM1, enter the ATIS frequency for KAPA as the active frequency and the ground control frequency as the standby frequency.
4. In COM2, enter the KAPA Tower frequency as the active frequency and the departure frequency for an eastbound departure as the standby frequency.
5. Assume that a pilot is departing KAPA and selects and loads the Plains Two Departure, Goodland Transition (PLAIN2.GLD). The rest of the flight plan goes from KAPA to KMKC via Hill City and Salina VORs with the Jayhawk Five Arrival via the Emporia Transition (EMP.JHAWK5). Expect the ILS 3 Approach into Kansas City Charles B. Wheeler Downtown Airport.

Load VOR frequencies as appropriate to monitor the progress of the flight along with the GPS navigation.

6. Initiate the flight on the Simulator. Enroute just east of Goodland, the pilot receives the following amended clearance from ARTCC:

“N12345, I am showing level-4 radar returns on my radar over the Hill City VOR, in a line that runs from 40 miles to the southwest of Hill City to 150 miles to the northeast. The entire storm appears to be moving east at 30 knots.”

The pilot was planning on stopping for fuel in Salina, but realizes that the storm will be on top of the airport by the time of arrival. Note that the aircraft is not equipped with a Stormscope or datalink weather.

What are the pilot’s options? Rank these options from best to worst.

Exercise 6.7: Vertical Navigation (VNAV)

1. Where does one go to program a VNAV flight plan on the G1000?

2. Are any VNAV messages provided to the pilot?

3. Are visual references for VNAV operations shown on the moving map?

4. How do you verify the GFC 700 autopilot is correctly moded to capture the current VNAV profile?

5. How do you cancel a VNAV profile?

Exercise 6.8: Charts

1. How does one view the Safe-Taxi diagram on the MFD as well as on the PFD?

2. On which MFD pages can JeppView charts be viewed?

3. How does one verify the currency of the charts?

4. Can one legally replace paper charts with electronic charts?

Ground Lesson 7

MULTI FUNCTION DISPLAY (MFD) OPERATION

Objectives

Upon completion of this lesson, the pilot should be able to locate, use, and configure data on the MFD during flight operations.

Resources

- G1000 Pilot's Guide
- G1000 Cockpit Poster
- G1000 PC-based Simulator

Exercise 7.1: MFD Configuration and Controls

1. Which main type of data is presented on the default MFD page display?

2. What data types can be overlaid on the MFD map? Where are the controls for this data overlay located?

3. Which MFD page within which page group must be accessed to verify the status of the G1000's GPS receivers?

4. How are the Nearest (NRST) pages accessed?

5. What types of information can be accessed via the Waypoint (WPT) pages?

6. How can map display orientation be changed between north-up and track-up presentations?

7. When panning on the Navigation Map Page, where does information appear about the terrain shown at the Map Pointer cursor location?

8. Which page should be accessed in order to change the navigation data field options at the top of the MFD display?

9. Which key can be pressed and held for two seconds to quickly return to the Navigation Map Page?

10. A pilot is on a flight from KAPA (Centennial Airport, Denver, CO) to KGJT (Grand Junction Airport, Grand Junction, CO) over the mountains. Weather is predicted to be MVFR with scattered rain over the entire route of flight. How would one configure the MFD to give the best presentation of data for this flight? Assume that a GDL69 Datalink Receiver is installed in the aircraft.

Ground Lesson 8

PRIMARY FLIGHT DISPLAY (PFD) OPERATION

Objectives

Upon completion of this lesson, the pilot should be able to configure and interpret data presented on the PFD during all phases of flight operations.

Resources

- G1000 Pilot's Guide
- G1000 Cockpit Poster
- G1000 PC-based Simulator

Exercise 8.1: PFD Configuration and Controls

1. Which control is used for cycling between GPS, VOR1, VOR2, LOC1, and LOC2 CDI navigation sources?

2. Name the two display formats available for the HSI (note that some aircraft have only one available display format).

3. What type of data can be overlaid on the PFD Inset Map?

4. Are the navigation data fields at the top of the PFD configurable by the pilot?

5. From the PFD, can the pilot enter, view, and edit a flight plan?

6. Where is the knob for course selection or OBS (omni-bearing selector) located?

7. What happens when the **HDG** Knob is pressed?

8. What happens when the **CRS** Knob is pressed?

9. Where is the control for the Altimeter barometric pressure setting located?

10. What are the ranges of viewable tape in the Altimeter and Airspeed Indicator?

11. A pilot is flying through the Rocky Mountains and decides to land at KASE in Aspen, CO. The RNAV (GPS) 15 approach via radar vectors is assigned. It is daytime, although visibility is limited to a few miles with cloud tops at 10,000 feet MSL. What options should be selected for display on the PFD Inset Map?

Ground Lesson 9

EMERGENCY PROCEDURES

Objectives

Upon completion of this lesson, the pilot should be able to determine the types of emergencies with associated component failures and take appropriate action during emergencies or failures.

Resources

- G1000 Pilot's Guide
- G1000 Cockpit Poster
- G1000 PC-based Simulator

Exercise 9.1: Emergencies and Failure Modes

1. If one display fails, what happens to the remaining displays?

2. How is an AHRS failure indicated on the G1000?

3. When the AHRS and/or ADC fail, what remedial action should be taken by the pilot?

4. What information is presented to the pilot when a display is operating in Reversionary Mode?

5. Describe the aircraft on-board power sources that remain in case of alternator failure and also provide an explanation as to their operation, including a basic description of each power bus.

6. During which phase of flight is PDA active?

7. The NCR is only active during the departure phase of the flight. What condition(s) must exist to activate this alert?

8. Does the “Five-Hundred” alert have any pop-up text?

9. What aircraft altitude source does TAWS use to determine alerts?

10. Is TAWS in the G1000 System certified to allow deviations from ATC assigned altitudes?

Ground Lesson 11

TRAFFIC OPERATION

Objectives

Upon completion of this lesson, the pilot should be able to accurately interpret traffic data while both incorporating this information into the aeronautical decision making (ADM) process and understanding the limitations of these systems.

Resources

- G1000 Pilot's Guide
- Aeronautical Information Manual (AIM)

Exercise 11.1: Traffic Information Service

1. To be visible on the TIS display, does the intruder aircraft need to be equipped with transponder?
2. What are the requirements for using TIS?
3. With TIS, up to how many intruder aircraft can be displayed on the PFD/MFD.
4. Describe the service volume for the Traffic Information Service.
5. How often is TIS information uplinked to the G1000's receiver?
6. Describe difference between Traffic Advisories (TA) and Proximity Advisories (PA).

7. When a Traffic Advisory is issued, is one allowed to deviate from the ATC assigned instructions?

3. List all XM Weather Products and their corresponding update rates.

4. Reported/forecast products use a date/time stamp. On what are the date and time based?

5. When and how is weather data information received?

6. What type of lightning strike information does XM Weather provide?

7. What is NEXRAD?

8. What are the coverage areas of the XM Satellite signal? At what altitude must the aircraft be to receive the XM signal?

9. A pilot is planning a cross-county flight. Does weather data provided by WxWorx satisfy FAR 91.103 preflight action?

- 10.** A pilot is on a VFR flight from KXYZ to KABC. Currently, the altitude is 9,500 feet, 50 miles from KABC. Weather is predicted to be MVFR at the destination airport. Using the MFD, describe the steps that must be taken to receive a METAR and/or TAF at the destination airport.

Exercise 12.2: Lightning Detection

1. When flying an aircraft with a WX-500 Stormscope installed, where can the lightning data be displayed?
2. How is WX-500 data presented by the G1000 System?
3. When a lightning bolt is changed to a “+” (plus) symbol, what does this change denote?

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Ground Lesson 13

GFC 700 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

Objectives

Upon completion of this lesson, the pilot should be able to understand the operation of the Garmin Automatic Flight Control System (AFCS) and use the autopilot throughout various phases of flight.

Resources

- G1000 Pilot's Guide

Exercise 13.1: Flight Director and Autopilot Operation

1. List all parts (LRUs) associated with the GFC 700 in the aircraft being flown.
2. Where are the AFCS controls located in the cockpit?
3. Where are flight director mode annunciations displayed? Describe the annunciation colors.
4. List any flight director pitch and roll limitations.
5. Describe Flight Level Change Mode (FLC).
6. Describe the function of the Control Wheel Steering (**CWS**) Button.

7. When the go-around control is pressed, what flight director and autopilot functions can be expected?

8. List several ways the autopilot can be disengaged.

9. An aircraft has just departed from an airport and is performing a runway heading climb-out. Following the departure procedure, the plane climbs to 4000 feet, then turns to a heading of 270°. The final cruising altitude is 9000 feet. How would the pilot configure the autopilot to follow all of the departure procedure up to the final cruising altitude?

10. Using the scenario above, configure the autopilot to intercept an airway. Currently, the autopilot is set to Heading Select and Altitude Hold modes.

Appendix

CONSIDERATIONS ON USING THE G1000 INTEGRATED FLIGHT DECK TO ENHANCE THE AERONAUTICAL DECISION MAKING (ADM) PROCESS AND SINGLE-PILOT RESOURCE MANAGEMENT (SRM)

The Garmin G1000 Integrated Flight Deck has brought a number of improvements in cockpit technology to General Aviation (GA) aircraft. These improvements range from longer life and greater reliability of the primary instruments to a simplified pilot interface. With the addition of new technologies, the G1000 System is capable of providing the pilot with a wider variety of information about the flight environment, thereby leading to greater situational awareness and reduced pilot workload. The G1000 System allows the pilot to focus on aeronautical decision making (ADM) and single-pilot resource management (SRM).

The majority of GA flight operations are single-pilot operations. The single-pilot, IFR, cross-country flight is often regarded as one of the most challenging flight operations. The need to communicate and navigate while relying solely on aircraft instruments makes the single-pilot cockpit a busy and stressful environment. Since the inability to manage these demands effectively can prove life threatening, understanding and using all the tools available in the cockpit is key to overcoming the challenges presented by single-pilot IFR flights.

AUTOMATIC FLIGHT CONTROL

The autopilot is a fundamental tool that is often overlooked in the current aviation training environment. As an SRM tool, no other piece of avionics is as valuable in reducing pilot workload as the autopilot. Pilots should routinely practice using the autopilot and gain a full understanding of their particular system. Using the autopilot allows the pilot to focus on other flight management tasks such as route deviation planning and general aircraft system monitoring without reaching a point of sensory overload.

In the case of system failures or emergencies, the autopilot relieves the pilot of the workload of manually flying the aircraft and thus allows the problem to be addressed. It is important to note that many GA aircraft are equipped with a rate-based autopilot that receives roll inputs from an electric turn-coordinator. In aircraft equipped with a vacuum-driven attitude indicator, failure of the vacuum pump should prompt the pilot to immediately change to a partial panel scan and to engage the autopilot in at least a roll and pitch mode. In aircraft equipped with a GPS coupled to the autopilot, the pilot should activate GPS direct-to navigation to the nearest suitable airport, then place the autopilot in navigation mode to fly straight to the airport. In either case, the autopilot reduces pilot workload by helping to ensure that the wings remain level and that standard-rate turns are used.

The G1000 System will interface with third-party, rate-based autopilots as well as with the Garmin GFC 700 Automatic Flight Control System (AFCS). Third-party manufactured autopilots are linked to a remote-mounted rate-based gyro independent of the G1000 System; therefore, the above-mentioned methodology still applies if attitude information is lost. Indeed, using the autopilot in roll-control or navigation mode at the point of attitude failure allows the pilot to maintain control of the aircraft while taking appropriate emergency actions. Again, the use of the autopilot reduces pilot workload and should allow the pilot to better manage the

emergency. Nonetheless, it is imperative that the pilot double-check all autopilot inputs in order to avoid mode confusion and monitor them to ensure that the intended operation is taking place.

If equipped with a GFC 700 AFCS, it is also important for pilots to understand the capabilities and limitations of the system. For example, losing number two Integrated Avionics Unit (GIA #2) causes the autopilot to be disabled; however, the flight director function will still be available. This allows pilots to program the flight direct as an additional tool for assistance during flight.

COMMUNICATION AND NAVIGATION

While the autopilot is the single most valuable tool for SRM, it is also important that the pilot develop a consistent approach to using the communication (COM) and navigation (NAV) tools present in the G1000 System. The two COM and NAV receivers combined with the ability to tune COM and NAV frequencies from the Jeppesen database give the pilot a streamlined process for frequency selection and management.

A typical methodology for COM/NAV frequency management is to designate COM1 and NAV1 as the primary airborne and enroute frequencies. COM2 can then be reserved for both weather (ATIS, ASOS, AWOS) and ground frequencies. Meanwhile, NAV2 is set as the backup to NAV1. If established as part of a standard operating procedure, these selections help to minimize confusion over which COM and/or NAV is selected and active. When a consistent approach to frequency management is not used, the pilot is more likely to run into mode confusion concerning the use of the Audio Panel (GMA 1347); this can in turn lead to missed radio calls and/or transmissions on the incorrect frequency.

FLIGHT PLANNING

While managing frequencies for ground-based NAVAIDs is important, proper use of the GPS flight planning function can also prove beneficial. Rather than performing continuous direct-to navigation with the GPS, taking the time on the ground to enter a full flight plan allows the G1000 to enhance the navigation experience. First, the pilot will be able to visually inspect the route of flight on the map, once at altitude, to verify both terrain clearance (using the Terrain Awareness overlay) and active airspaces (if active, MOAs and Restricted areas call for a re-routing from ARTCC). Secondly, using the flight planning function allows for seamless autopilot turn anticipation. Finally, taking a moment to program the flight plan on the ground makes it easier to react quickly to in-flight routing changes. Pilots should program the flight plan prior to takeoff on even short cross-country flights.

Likewise, the maps on both the Multi Function Display (MFD) and Primary Flight Display (PFD) help the pilot to manage the navigation functions of the system. By using the maps to verify GPS navigation inputs, the pilot is able to visually cross-check data entry by looking at the course lines drawn on the map. This visual representation of the active navigation is the quickest way to determine whether all of the correct waypoints were entered for the intended route of flight.

WEATHER AWARENESS

In this discussion so far, the focus has been on SRM. Now, attention will be turned to leveraging the various data inputs from the on-board weather sensors, datalinks, traffic awareness, and terrain awareness functions. Proper understanding of both the operation of these various tools and their integration with the pilot's aeronautical decision making (ADM) process can bring significant safety gains to the GA fleet.

Weather datalink and airborne lightning detection equipment have brought unprecedented weather avoidance capabilities to the GA aircraft. Datalink weather receivers can bring a wide variety of information into the cockpit besides the well-known NEXRAD radar images. While these weather tools provide valuable information, they do have limitations that must be considered to be used appropriately by the pilot in the ADM process. Neither datalink weather nor airborne lightning detection equipment is to be used for storm penetration. Instead, these planning tools should be used to help the pilot make a timely and well-informed decision on how to proceed with the flight.

While avoiding strong thunderstorms and other areas of heavy precipitation is desirable, the ability to also review textual weather information for the destination while enroute allows the pilot to maintain better situational awareness for airport selection in case of an emergency. This capability also allows the pilot to evaluate all approach options based on ceilings at the destination airport or whether to divert to an alternate airport much earlier in the flight. This, coupled with the ability to review weather information well outside of the transmission range of ATIS/AWOS/ASOS systems, enables the pilot to better prepare for arrival and reduces last-minute workload.

Thunderstorms are typically used as a main selling point for datalink weather receivers due to their visual NEXRAD presentation, whereas ice—the other main weather concern for flight—is often not emphasized enough. However, it should be stressed that the potential for icing is also provided textually and, in some cases, graphically via datalink weather. This becomes a very powerful tool in the winter months. The ability to display information about icing potential in either format (textual or graphical) is a significant improvement for the overall safety of flight.¹

Overlaying both the NEXRAD and lightning images on either the G1000 MFD or PFD map serves to corroborate information on the location of the strongest storms. When lightning detection equipment is installed in the aircraft, the unique strike-aging capability of the G1000 provides additional visual cues as to the current state/stage of the storm. Continuously growing strike rate counts, as well as, an increase in the number of lightning bolts (bold or normal) often denotes a developing severe thunderstorm. On the other hand, decreasing strike rates combined with a growing number of “plus” (+) symbols indicates a decrease in the strength of the storm and its possible dissipation.²

While this type of information is very powerful and convincing, it is important to use it to plan the flight path and not to attempt penetration of an area of severe weather. The data should be used to plan a deviation well clear of areas indicating storm activity to ensure the remainder of the flight can be safely executed. One should always remember that discretion is often the better part of valor and that no technology can depict actual meteorological conditions with 100% accuracy.

TRAFFIC AWARENESS

Traffic Collision and Avoidance Systems (TCAS) represent another technological advance that has been made in the area of traffic avoidance. Originally developed for large commercial aircraft, TCAS technology is now starting to trickle down features and capabilities to the GA fleet. For example, the GTX 33 Mode-S Transponder can be used as an optional component in G1000-equipped aircraft and brings Traffic Information Service (TIS) data directly to the cockpit.

TIS data is provided and transmitted by the FAA over Mode-S terminal radar sites and is derived from the actual transponder returns of aircraft as seen on the air traffic controller's scope. A key difference between TIS and a TCAS system is that TIS should only be used as an additional tool to see and avoid traffic. Therefore, the pilot should not become reliant on TIS and try to avoid traffic solely by reference to the traffic display in the cockpit. Mode-S radar coverage and TIS service are only available in areas equipped with Mode-S terminal radar. Since TIS service may not always be available in the enroute environment, the pilot should not entirely depend on this tool to acquire traffic visually and should always scan for traffic. Deviations should not be performed until the pilot has visually acquired the threat traffic.

TERRAIN AWARENESS

The last tool to be discussed given its benefit to the ADM process is the new generation of GA terrain awareness systems. Terrain awareness systems are split into two generic classes, that is, certified systems and non-certified systems. Certified devices are classified as Terrain Awareness and Warning Systems, classes A and B (TAWS-A and TAWS-B). These systems provide a number of terrain avoidance features that are not available in the non-certified terrain awareness systems. The G1000 includes a non-certified terrain awareness feature that can be displayed on both the MFD and the PFD Inset Map. TAWS-B is an option available on certain G1000-equipped aircraft.

A map terrain overlay is available to depict dangerous terrain elevations relative to aircraft altitude. Red terrain indicates that terrain elevation is within 100 feet of or higher than the aircraft altitude. Yellow terrain indicates that terrain is within 1,000 feet of the aircraft altitude. These two colors allow the pilot to look at the planned route and then decide on an optimal altitude for completion of the flight. This color scheme also provides additional situational awareness during the critical approach phases of the flight in both VFR and IFR conditions. With the interest in preventing Controlled Flight into Terrain (CFIT) accidents, even simple situation awareness tools such as the built-in G1000 terrain awareness feature can provide yet another helpful input to the ADM process.

FINAL THOUGHTS

In conclusion, as GA aircraft and pilots transition to 21st-century technology, the G1000 Integrated Flight Deck provides a number of safety-enhancing benefits. Although automation in the cockpit should be embraced, both its positive and negative impacts on the safety of flight should be recognized and understood. Proper autopilot use is key to enhancing safety by reducing pilot workload; this is particularly true in certain emergency situations. In addition, the ability to develop a methodical approach to other cockpit tasks, even as simple as COM/NAV frequency selection and GPS management, can help the pilot to maintain better situational awareness while minimizing the overall cockpit workload.

The ability to view weather, traffic, and terrain information to improve the ADM process represents another significant benefit brought to the cockpit by the G1000 Integrated Flight Deck. From satellite downlink weather with both NEXRAD radar images and textual weather to real-time lightning detection data, the pilot now has access to a wealth of information directly in the cockpit. Although the combination of weather, TIS, and terrain awareness information can increase the safety of flight, it is also critical that the pilot use this information properly and consistently. Too often, human beings rely on technology alone to provide the solution to hazardous situations. However, in the dynamic, three-dimensional flight environment, it is the pilot who represents the most significant component of the avionics system. It is from the cockpit that the most important calculations are made using the information and inputs provided by the avionics to ensure a safe flight. These calculations are enhanced both by regular recurrent training and by the full understanding of the strengths and limitations of the various data inputs. Good ADM and SRM practices are of critical importance to the long-term improvement of the GA safety record.

1 G1000 GDL 69/69A use XM Satellite Radio with WxWorx data. Refer to www.wxworx.com for more information on available weather data products.

2 Refer to appropriate manufacturer documentation concerning the complete operation of lightning detection equipment.

3 For more information on the TIS system, refer to www.tc.faa.gov/act310/projects/modes/tis.htm.



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