

Duncan Aviation Locations



■ Complete Service Facilities

LNK — Lincoln, NE 800.228.4277

BTL — Battle Creek, MI 800.525.2376

■ Avionics Install/Line Facilities

DAL — Dallas, TX

APA — Denver, CO

LAS — Las Vegas, NV

TEB — Teterboro, NJ

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■ Turboprop Support Facilities

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ISP — Long Island, NY

FTW — Ft. Worth, TX

MMU — Morristown, NJ

SDL — Scottsdale, AZ

HPN — White Plains, NY

BFI — Seattle, WA

BRD — Bridgeport, CT

ADS — Addison, Texas

STRAIGHT TALK ABOUT

TAWS

Straight Talk is a Duncan Aviation Publication

Editor's Notes

The class A TAWS/EGPWS unit is a remarkable little black box. An unparalleled safeguard against CFIT, it blends inputs from radio altimeter, barometric air data computer, discreet aircraft systems, GPS and FMS to deliver safety. The class A TAWS unit uses the radio altimeter and barometric information to perform classic GPWS functions (modes 1 through 6). In addition, the class A TAWS applies information from the FMS and its own internal database to perform the important additional terrain avoidance functions. The internal database is used with the selected flight plan and aircraft position to set up forward looking terrain avoidance.

All this sounds simple enough, but you must remember the aircraft is a very dynamic machine. The class A TAWS is more than an electronic module. It is a very powerful computer and software setup that is based on algorithms to constantly adapt to the dynamic state of the aircraft. By this constant awareness of the state of the aircraft, the software allows the TAWS unit to alert the flight crew to imminent danger, at the same time filtering and processing information to avoid false warnings.

As you can see, the class A TAWS unit is a sophisticated system. The class B TAWS system will be much simpler. It will not include a radio altimeter or an air data computer. Instead it will rely almost entirely on the external GPS position information. The TAWS rule acknowledges possible weaknesses in the class B TAWS system and questions linger about its ability to provide the level of protection the TAWS rule intended. The most apparent weakness could be the database accuracy. Because TAWS constantly compares its internal data base to the FMS database, an error in either database could give erroneous solutions. If the databases in the class A TAWS contain an error while the aircraft is too close to terrain, the radar altimeter will add its voice and the TAWS unit will issue a warning. As this first edition is being written, no class B units have been certified. We will watch as these products are being developed and communicate them to you.

STRAIGHT TALK ABOUT

TAWS

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Faxable worksheet _____

If this book does not contain a worksheet, download one at:
www.DuncanAviation.com/StraightTalkaboutTAWS
or e-mail us at: TAWS@DuncanAviation.com.

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What do the FARs say?

TAWS mandate as it applies to FAR Part 91 operations

FAR Part 91 Sec. 91.223 effective as of 03/29/2001 Page 1 of 1

Federal Aviation Regulation

▼ **Sec. 91.223**

| |
|---|
| Part 91 GENERAL OPERATING AND FLIGHT RULES |
| Subpart C—Equipment, Instrument, and Certificate Requirements |

Sec. 91.223

Terrain awareness and warning system.

(a) Airplanes manufactured after March 29, 2007. Except as provided in paragraph (d) of this section, no person may operate a turbine-powered U.S.-registered airplane configured with six or more passenger seats, excluding any pilot seat, unless that airplane is equipped with an approved terrain awareness and warning system that as a minimum meets the requirements for Class B equipment in Technical Standard Order (TSO)-C151.

(b) Airplanes manufactured on or before March 29, 2007. Except as provided in paragraph (d) of this section, no person may operate a turbine-powered U.S.-registered airplane configured with six or more passenger seats, excluding any pilot seat, after March 29, 2005, unless that airplane is equipped with an approved terrain awareness and warning system that as a minimum meets the requirements for Class B equipment in Technical Standard Order (TSO)-C151.

[Approved by the Office of Management and Budget under control number 2120-0631]

(c) Airplane Flight Manual. The Airplane Flight Manual shall contain appropriate procedures for—

- (1) The use of the terrain awareness and warning system; and
- (2) Proper flight crew reaction in response to the terrain awareness and warning system audio and visual warnings.

(d) Exceptions. Paragraphs (a) and (b) of this section do not apply to—

- (1) Parachuting operations when conducted entirely within a 50 nautical mile radius of the airport from which such local flight operations began;
- (2) Firefighting operations;
- (3) Flight operations when incident to the aerial application of chemicals and other substances.

Amdt. 91-263, EFF. 3/29/2001

► **Comments**

TAWS mandate as it applies to FAR Part 135 operations

FAR Part 135 Sec. 135.154 effective as of 03/29/2000 Page 1 of 1

Federal Aviation Regulation

▼ **Sec. 135.154**

| |
|---|
| Part 135 OPERATING REQUIREMENTS: COMMUTER AND ON-DEMAND OPERATIONS AND RULES GOVERNING PERSONS ON BOARD SUCH AIRCRAFT |
| Subpart C—Aircraft and Equipment |

Sec. 135.154

Terrain awareness and warning system.

(a) Airplanes manufactured after March 29, 2007.

- (1) No person may operate a turbine-powered airplane configured with 10 or more passenger seats, excluding any pilot seat, unless that airplane is equipped with an approved terrain awareness and warning system that meets the requirements for Class A equipment in Technical Standard Order (TSO)-C151. The airplane must also include an approved terrain situational awareness display.
- (2) No person may operate a turbine-powered airplane configured with 6 to 9 passenger seats, excluding any pilot seat, unless that airplane is equipped with an approved terrain awareness and warning system that meets as a minimum the requirements for Class B equipment in Technical Standard Order (TSO)-C151.

(b) Airplanes manufactured on or before March 29, 2007.

- (1) No person may operate a turbine-powered airplane configured with 10 or more passenger seats, excluding any pilot seat, after March 29, 2005, unless that airplane is equipped with an approved terrain awareness and warning system that meets the requirements for Class A equipment in Technical Standard Order (TSO)-C151. The airplane must also include an approved terrain situational awareness display.
- (2) No person may operate a turbine-powered airplane configured with 6 to 9 passenger seats, excluding any pilot seat, after March 29, 2005, unless that airplane is equipped with an approved terrain awareness and warning system that meets as a minimum the requirements for Class B equipment in Technical Standard Order (TSO)-C151.

[Approved by the Office of Management and Budget under control number 2120-0631]

(c) Airplane Flight Manual. The Airplane Flight Manual shall contain appropriate procedures for—

- (1) The use of the terrain awareness and warning system; and
- (2) Proper flight crew reaction in response to the terrain awareness and warning system audio and visual warnings.

[Doc. No. 00-7595, Amdt. 135-73, 65 FR 16736, March 29, 2000]

Amdt. 135-73, EFF. 3/29/2000

► **Comments**



**What do the FARs and
the Advisory Circulars
mean to me?**

Highlights of AC25-23

(A complete copy of AC25-23 is available on request or on-line at www.airweb.faa.gov).

Note: The FARs only state the TAWS requirement. Advisory Circular 25-23 is the guidance document for installation and certification in Part 25 aircraft.

TSO C151a: The basis for approval of the TAWS unit by the manufacturer. It does not include installation and certification guidance in the aircraft.

AC 25-23: Issued for TAWS certification guidance as the rule requiring TAWS is not explained in adequate detail to complete and certify the installation. This 30-page document is used by certification facilities such as Duncan Aviation when applying for certification of the TAWS in your aircraft. AC 25-23 also specifies that TAWS certification on Part 25 aircraft is to be done through TC or STC processes.

TSO-C151a: Prescribes minimum design standards for building a TAWS unit. The TAWS TSO incorporates Forward Looking Terrain Avoidance (FLTA) features and the standard GPWS TSO-C92c.

System Safety Assessment:

- Perform system safety assessment to establish hazards associated with the proposed installation IAW AC 25.1309-1A.
- Assure the TAWS meets TSO-C151a for failures or false warnings.

Software Evidence: Verification of TSO-C151a software level.

Position Source:

- Horizontal position source.
 - Previously approved navigation source.
 - RNAV (class A only, TSO-115 or AC 90-45A).
 - GPS (required for class B, TSO-C129a or AC20-130A and/or AC20-138).
- Internal GPS position source. (Alarm per DO-208, TSO-C129a).
- Vertical position source.
 - Barometric altitude (TSO-C10b).
 - Radio altimeter (class A requirement only).
 - Air data computers (TSO C-106 or later rev.).
 - GPS (if GPS is only means, must meet TSO-C145).

Terrain Database:

- Updates (must be updateable, must have procedure in place and must have information for logical safety decisions to upgrade).
- Valid regional data (ICA should identify method for determining the status of the data base, including the area of intended use).

Display Presentation:

- Terrain display (class A must have terrain and alert displays capabilities).
- Terrain display presentation requirements.
 - Intuitive.
 - Viewable, clear.
 - Easily determine threats.
 - Terrain should be visually distinct.
- Pop-up mode switching functionality.
 - Automatic.
 - Consistent with weather and traffic alerts.
 - Manual reversion.
 - Prioritized.
- Auto range switching mode must be self-evident.

Alerts: Must be clear, concise, unambiguous and consistent with human factors plan.

Alert Prioritization:

- Only one alert at a time.
- Meets alert table criteria in AC25-23.

System Inhibits Required:

- FLTA.
- PDA.
- Basic GPWS (alerts flight into terrain when not in landing configuration).
- Basic GPWS (alerts excessive downward deviation from the glideslope).

Flight Data Recorder: Interconnected where required.

Ground Test Considerations: Thorough test and evaluation before flight.



Key Terms:

Flight Test Considerations:

- Determinations.
- FLTA flight test considerations.
- PDA flight test considerations.
- Basic GPWS flight test considerations.
- Terrain display flight test considerations.
- Added feature flight test considerations (windshear, bank angle, altitude and minimums callouts, and features not required by TSO C151a).
- Pressure altitude variations in cold weather.

Aircraft Flight Manual Supplement:

- Limitations.
- Restricted areas of operations.
- Operational considerations for normal/abnormal procedures.

CFIT: Controlled Flight into Terrain. An incident in which an aircraft, while controlled by the flight crew, is inadvertently flown into terrain, obstacles or water without flight crew awareness.

FLTA: Forward Looking Terrain Avoidance: The TAWS requirement to provide look-ahead terrain and obstacle protection forward and below the aircraft flight path.

Obstacle: Man-made structure in the intended flight path.

PDA: Premature Descent Alert: The ability of the TAWS to detect and issue an alert when the aircraft is hazardously below the normal approach path for the nearest runway.

TAD: Terrain Awareness Display.

TAWS: Terrain Awareness and Warning System. A generic term used to describe an alerting system which detects potentially hazardous terrain situations and provides the flight crew with information in time to avoid CFIT. (Note: EGPWS is a trademark name owned by Honeywell/AlliedSignal. The Honeywell EGPWS units form the basis of information that is used in the TAWS rules.)

TCF: Terrain Clearance Floor. (see page 28).

Time-Shared Display: A display that shows terrain information in addition to displaying other information such as radar and FMS maps. Multi-Function Displays and radar Indicators are normally time-shared displays.



**What are the
differences between
“Class A” and “Class B”
TAWS?**



CLASS A TAWS

Class A TAWS offers these functions:

- a) FLTA (Forward Looking Terrain Avoidance).
 - Reduce required terrain clearance.
 - Imminent terrain impact.
- b) PDA (Premature Descent Alert Function).
- c) Basic GPWS Functions.
 - Mode 1 (excessive rate of descent alert/warning).
 - Mode 2 (excessive closure rate to terrain).
 - Mode 3 (negative climb rate or altitude loss after take-off).
 - Mode 4 (flight into terrain when not in landing configuration).
 - Mode 5 (excessive downward deviation from an ILS glideslope).
 - Airplane descent to 500 feet above terrain or the nearest runway elevation (“Five Hundred” voice callout).

Class A TAWS notes:

- Class A TAWS requires a display which shows the aircraft in relation to the terrain on a radar indicator, MFD, EFIS or other compatible indicator.
- Class A allows use of GPS, RNAV, INS and other sources.
- Class A requires a 2500 ft radio altimeter to function as a backup to GPS and barometric altitude.
- A class A TAWS unit can be installed to meet or exceed class B requirements — adding a significant level of safety.

CLASS B TAWS

Class B TAWS offers these functions:

- a) FLTA (Forward Looking Terrain Avoidance).
 - Reduce required terrain clearance.
 - Imminent terrain impact.
- b) PDA (Premature Descent Alert Function).
- c) Limited basic GPWS functions.
 - Mode 1 (excessive rate of descent).
 - Mode 2 **NOT AVAILABLE** (requires radio altimeter).
 - Mode 3 (negative climb rate or altitude loss after take-off).
 - Mode 4 **NOT AVAILABLE** (requires radio altimeter, barometric altimeter, and gear/flap inputs).
 - Mode 5 **NOT AVAILABLE** (class A TAWS only).
 - Airplane descent to 500 feet above terrain or the nearest runway elevation (“Five Hundred” voice callout).

Class B TAWS notes:

- Class B **does not** require a display. If a display is installed, it should meet the guidelines of Class A TAWS.
- Class B TAWS must have an approved GPS for horizontal position. TSO C129a.
- Class B TAWS **does not** require a radio altimeter.

Important notes.

- Modes 2, 4 and 5 are not available with class B TAWS.
- In addition to Modes 1-6, class A TAWS offers FLTA and TCF.
- Some class A systems also offer obstacle and windshear alerts.
- Choosing to graphically display TAWS terrain data is the most important situational awareness enhancement you can make.



Questions and Answers



I understand we must install TAWS in our aircraft. Why?

At the urging of the NTSB to reduce CFIT incidents, the FAA issued the rules that are shown on pages 4 and 5 of this book. One rule pertains to Part 91 operators, the other to Part 135 operators. A rule is in place for Part 121 operators which is available at www.airweb.faa.gov.

When is the compliance date for TAWS?

For aircraft manufactured prior to March 29, 2002, the compliance date is March 29, 2005. This rule affects over 11,000 U.S. registered corporate aircraft. **We suggest you schedule this installation during your next major maintenance event.** The simple math of TAWS compliance dictates that approximately 2,500 systems per year now need to be installed. These installations will be done by an estimated 40 major installation centers such as Duncan Aviation and the OEM shops. They will be supplemented by about 50 smaller installation shops.

When should I plan my TAWS installation?

Duncan Aviation strongly encourages you to have the TAWS installation completed at your next major event, which could include inspection, interior refurbishment or modifications.

What is all this confusion with EGPWS and TAWS?

EGPWS is a trade name that is registered to the company that developed GPWS and subsequently EGPWS (Sundstrand/AlliedSignal/ Honeywell/GE). In requiring TAWS for business aircraft, the FAA chose not to use the EGPWS trade name for legal reasons. The Honeywell EGPWS products are TAWS rule compliant since the TSO and AC writers are familiar with the EGPWS products.

Then what is the deal with manufacturers using the name TAWS?

Universal Avionics and other manufacturers cannot use the trade name EGPWS since it belongs to Honeywell. Universal Avionics made the decision to develop Terrain Warning products when the NTSB was considering asking the FAA to mandate TAWS for turbine aircraft. Universal Avionics selected the FAA generic TAWS when they named their new product. For clarity, we will use the name “UNS TAWS” when we mention the Universal product in this booklet. “TAWS” used otherwise notates the FAA definition found in the definition section of this booklet.

How do I determine what I am required to install?

The TAWS regulations separate the installations by Part 91 or Part 135 rules. Part 135 is further broken down by the number of passenger seats (page 5). The installations will normally be accomplished IAW Advisory Circulars.

- AC 25-23 dated pertains to Part 25 aircraft.
- AC 23-18 dated pertains to Part 23 aircraft.

How do I determine which unit best fits my needs?

Use the *TAWS Aircraft Equipment Survey* in this booklet (visit www.DuncanAviation.com/StraightTalkaboutTAWS to download or e-mail us at TAWS@DuncanAviation.com if yours is missing). Duncan Aviation’s EGPWS team will use the information you provide to determine which systems will fit with the existing equipment in your aircraft. They will then make recommendations based on this assessment.



Can I do the minimum to just get by?

Certainly, but please remember the intent of the NTSB and FAA is sincere. They want to bring a higher level of safety to the aircraft fleet. Also, keep in mind they sift through every accident site and generate post accident investigation reports. They would like to work themselves out of this grizzly aspect of their job. In addition, the human lives and dollar loss to the fleet will be reduced significantly by proper use of TAWS.

What is the significance of the TAWS timing?

Several advancements have allowed for reliable TAWS production:

1. Affordable computer processing power has become available.
2. An accurate terrain database has become available.
3. GPS accuracy has become available.
4. Capability to store the terrain database has become available.

What led the NTSB and the FAA to require the TAWS installations?

Several very visible and unfortunate incidents occurred.

1. An airline incident in Cali, costing hundreds of lives.
2. A USAF incident in Bosnia costing the life of the Secretary of State and others.
3. An airline incident in Guam costing hundreds of lives.
4. Other incidents, including airline, corporate jet and corporate turboprop aircraft.

What are some common threads in these incidents?

- Weather with very poor visibility.
- Navigation errors or problems.
- Communications problems.
- And, of course, terrain.

Could TAWS have prevented these incidents?

The NTSB investigations led them to conclude that even if the weather, navigation, and communications problems existed, the aircraft could have been saved if a TAWS unit had been available to warn the crews that they were about to fly a perfectly good aircraft into terrain.

Our aircraft is not part of the above-mentioned fleets, why should the TAWS mandate affect me?

The FAA had to take all issues into account. To support the FAA position, most major airlines did the math and determined that installing TAWS in their aircraft is not only cheaper than another Cali-type incident, it helps ensure the safety of the flying public. This is an important factor in instilling passenger confidence and the survival of the aircraft fleet. It is self-serving to the passengers, crew and the aircraft owner.

Who should I consider for my installation?

There are a number of installation centers that can perform the TAWS installation for you. Duncan Aviation is the industry leader in TAWS/EGPWS installations with more than 20 STCs and experience with more than 200 EGPWS/TAWS installations and we are continuously updating earlier GPWS STCs and adding new STCs.



What unit should I consider for my TAWS installation?

As with any major purchase, you must consider the following items:

1. The integrity of the manufacturer.

- How long have they been serving the aviation industry and how well have they done?
- How many TAWS units have they produced and how are they working?
- Where will they be after the TAWS regulations are satisfied?
- Do they have a workable database upgrade program in place and what does it cost to maintain?

2. The integrity of the installation facility.

- Have they built their reputation by committing to long-term relationships in the industry?
- Will they help with future projects as well as offer maintenance help?
- Do they own the STC to ensure hassle-free upgrades?

3. The value of the TAWS unit.

- This could be called the benefit/cost ratio.
- What benefits do I seek and what do they cost?
- If I desire additional benefits, are the additional costs worthwhile in my aircraft. One example is the windshear option of some EGPWS units.

4. The interfaces that are available.

- Should I add significant safety by giving the crew visual clues on an MFD or radar indicator?
- Should I consider adding a display if the present units in my aircraft are not TAWS compatible?
- Should I consider a class A TAWS for the added safety?

5. Aircraft downtime.

- Aircraft are known as time machines and downtime is the enemy. You should plan your TAWS installation during your next major event to ensure you won't incur unnecessary downtime later. If you have a major event planned in the next two years, add TAWS to your workscope. If your next major event is in 2004 or later, plan your TAWS installation during crew vacations or other windows of opportunity.

Duncan Aviation is your TAWS connection. Our knowledgeable sales team is eager to discuss your specific TAWS requirements and help you find the system that best meets your needs. Call **Ron Hall** today at **800.228.4277** or **402.475.2611**, **Dennis DeCook** at **800.525.2376** or **616.969.8400** or e-mail us at **TAWS@DuncanAviation.com** to discuss or schedule your TAWS installation today.



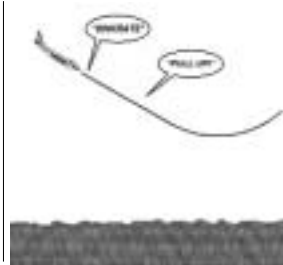
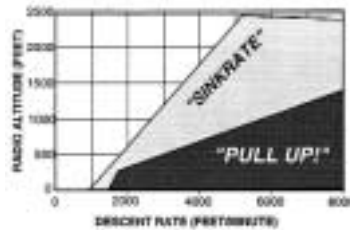
**What are these “Modes”
and what does each do?**



The Classic EGPWS modes.

MODE 1

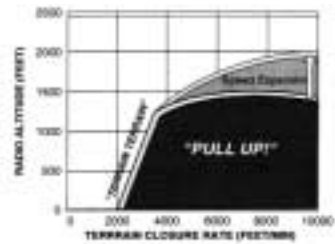
Excessive Descent Rate Alert/Warning



MODE 2

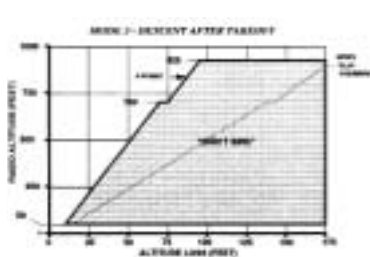
Excessive Closure Rate to Terrain Warning

Not available with Class B TAWS



MODE 3

Alert to Descent After Take-off

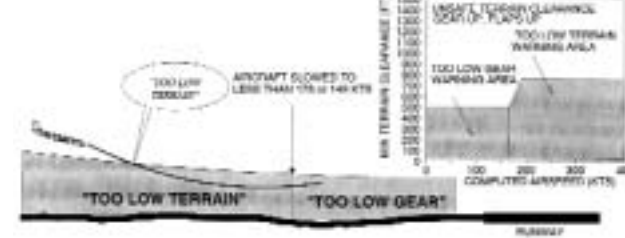


Important note:

- Modes 2, 4 and 5 are not available with class B TAWS.

Insufficient Terrain Clearance

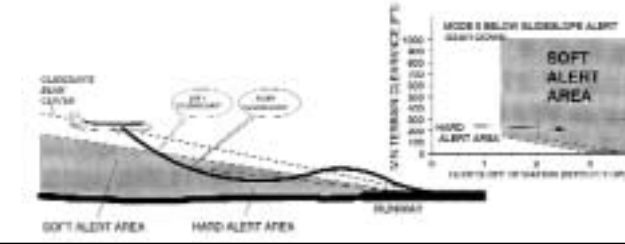
Not available with Class B TAWS



MODE 4

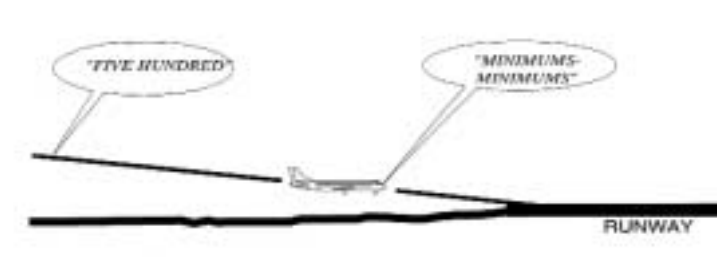
Alert to Inadvertent Descent below Glideslope

Not available with Class B TAWS



MODE 5

Altitude Callouts and Excessive Bank Angle Alert



MODE 6

Features available only with class A TAWS

- *In addition to Modes 1-6, class A TAWS offers FLTA and TCF.*

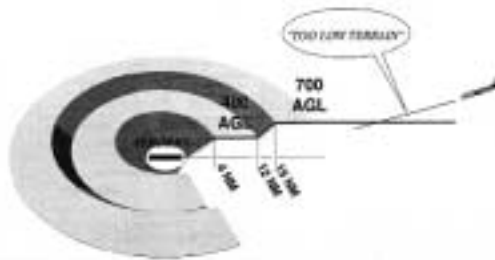
Forward Looking Terrain Avoidance

Obstacles in this region will display in red.

Obstacles in this region will display in yellow.

Obstacles in this region will display in green.

Terrain Clearance Floor



Some class A systems also offer windshear alerts.

Notes

[illegible]

TAWS Aircraft Equipment Survey

As a practical guide in determining the appropriate TAWS installation in your aircraft, a brief inventory of the aircraft equipment will help you and Duncan Aviation. Please complete the survey and return it to Duncan Aviation: **FAX: 402.479.1611.**

Your name _____

Company name _____

Address _____

Phone _____ Cell _____

Fax _____ Pager _____

E-mail _____

Aircraft make _____

Aircraft model _____

Aircraft serial number _____

Registration number _____

Radio altimeter model _____

VHF NAV model _____

Angle of attack transmitter _____

Angle of attack indicator _____

Radar indicator _____

Radar R/T unit _____

EFIS multi-function generator _____

IRS/INS model _____

AHRS model _____

Flight Management System #1 _____

Software level _____

Audio panels _____

Air data computer _____

or

SAT/TAS computer _____

or

Pilot's altimeter (if no air data computer) _____

Existing GPWS model _____

(Original installation facility)

Auto pilot computer _____

TCAS computer _____

Anticipated installation date _____

Other items to expedite proposals,
installation and certifications ☐

Panel photos (for annunciator layouts) ☐

Avionics bay photos (for equipment layouts) ☐

Avionics wiring diagrams (for interface determinations) ☐

Aircraft equipment list (for part number verification) ☐

Copies of Flight Management System supplements
(for software verification) ☐

