U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: AIRPLANE FLIGHT MANUAL

Date: 7/14/97
Initiated By: ANM-110

AC No: 25.1581-1
Change:

1. PURPOSE. The primary purpose of the Federal Aviation Administration (FAA) approved transport category Airplane Flight Manual (AFM) is to provide an authoritative source of information considered necessary for safely operating the airplane. This Advisory Circular (AC) identifies the information that must be provided in the AFM under the airworthiness regulations and provides guidance as to the form and content of the approved portion of an AFM. Although mandatory terms such as "shall" or "must" are used in this AC, because the AC method of compliance is not mandatory, these terms apply only to applicants who seek to demonstrate compliance by following the specific procedures described in this AC.

2. RELATED FEDERAL AVIATION REGULATIONS (FAR). Sections 21.5, 25.1581, 25.1583, 25.1585, 25.1587, and 36.1581 of CFR parts 21, 25, and 36 (parts 21, 25, and 36) identify the information that must be provided in the AFM. Section 25.1581 also requires "other information that is necessary for safe operation because of design, operating, or handling characteristics." Additionally, 14 CFR parts 91, 121, 125, and 135 (parts 91, 121, and 135) provide operational requirements that affect AFM contents.

3. DEFINITIONS.

a. Airplane Flight Manual (AFM). An FAA-approved document that contains information (operating limitations, operating procedures, performance information, etc.) necessary to operate the airplane at the level of safety established by the airplane's certification basis.

b. Flightcrew Operating Manual (FCOM). A document developed by a manufacturer that describes, in detail, the characteristics and operation of the airplane or its systems.

c. Safe Operation. For the purposes of this AC, safe operation means operation of the airplane in a manner that is mandatory, or is recommended, for compliance with the airworthiness requirements.

d. Limitation. For the purposes of this AC, an AFM limitation establishes the approved bounds of operation of the airplane or its systems.

e. Airplane Flight Manual Warnings, Cautions, and Notes. The AFM contains operating procedures and techniques that may be categorized as warnings, cautions, and notes as defined in the following paragraphs. The following definitions should not be confused with the color

requirements prescribed in § 25.1322 for warning, caution, and advisory lights installed in the cockpit.

(1) Warning. An operating procedure or technique that may result in personal injury or loss of life if not followed.

(2) Caution. An operating procedure or technique that may result in damage to equipment if not followed.

(3) Note. An operating procedure or technique needing special emphasis.

f. Procedure. A procedure is a step-by-step method used to accomplish a specific task.

(1) Emergency. A procedure requiring immediate flightcrew action to protect the airplane and occupants from serious harm.

(2) Abnormal or Non-normal. A procedure requiring flightcrew action, due to failure of a system or component, to maintain an acceptable level of airworthiness for continued safe flight and landing.

(3) Normal. A procedure associated with systems that are functioning in their usual manner.

g. Revision. A change to the content of the AFM through the addition, deletion, or modification of material.

h. Appendices and Supplements. Additions to the AFM that may or may not supersede existing AFM material.

(1) Appendix. An addition to the AFM to cover the installation of optional equipment or specific operations (engine inoperative ferry, reduced thrust or power takeoff, configuration deviation list (CDL), etc.).

(2) Supplement. Information that supersedes or is in addition to the basic AFM resulting from the issuance of a supplemental type certificate (STC), or from approved changes to AFM limitations, procedures, or performance information without an STC.

i. FAA-Approval. The application of FAA certification procedures and the approval by a representative of the Administrator.

4. DISCUSSION. The AFM provides information to safely operate the airplane under normal, abnormal, and emergency conditions. The AFM contains the operating limitations, operating procedures, and performance information for the airplane.

a. Historically, the AFM was often the only source of information available to the flightcrew for safely operating a transport category airplane. Consequently, the form and contents of these earlier AFMs were designed to meet the needs of the flightcrew. For example, very detailed operating procedures were presented in a form easily used in the cockpit (e.g., checklist format).

b. As more complex equipment was incorporated into transport category airplanes, many airplane and equipment manufacturers developed separate operating manuals for onboard use by the flightcrew. These operating manuals are generically referred to within this AC as Flightcrew Operating Manuals (FCOM). By locating information such as cockpit checklists, systems descriptions, and detailed procedures in the FCOM, the bulk and complexity of the AFM can be kept manageable. As a result, the AFM for many transport category airplanes used primarily in air carrier operations has evolved into more of a reference document than a document used frequently by the flightcrew. In recognition of the usefulness and convenience provided by these FCOMs, the normal operating procedures information in the AFMs for these transport category airplanes should be limited to those procedures considered "peculiar" to the operation of that airplane type or are otherwise necessary for safe operation.

c. The AFM content should be limited to the smallest practicable amount of material that is appropriate for the intended operation of the airplane. In general, the systems descriptions and procedures provided in the AFM for most large transport airplanes (i.e., those used in air carrier operations for which separate operating manuals are provided) should be limited to that which is uniquely related to airplane safety or airworthiness. Since the AFM still serves as the sole operating manual for transport category airplanes not used primarily in air carrier operations, the AFMs for these airplanes should contain detailed operating information.

d. Widespread use of computers has led to the capability of replacing or supplementing parts of the conventional paper AFM with a computerized version. Guidance for FAA approval of computerized AFM information is presented in Appendix 1 of this AC.

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1. GENERAL GUIDELINES. Previously approved AFMs are unaffected by this AC. When such manuals are amended, the concepts of this AC should be applied, if practicable.

a. Segregation of Approved and Unapproved Material. Section 25.1581 requires that FAA-approved information be segregated, identified, and clearly distinguished from each unapproved part of the AFM. Unapproved material should be labeled that it is for guidance information only and must be located in a different section than the approved material. Information that may not be required for operation under the FAR, but is approved by the FAA (e.g., stopping performance with autobrakes), should be placed in the same section as other approved material. Information that is neither required by the FAR nor approved by the FAA (e.g., takeoff or landing performance on runways contaminated by standing water, slush, or snow) should be labeled as guidance information and placed in a different section than any approved material.

b. Provisions for approval of and revisions to the AFM are as follows:

(1) Each page of the approved portion should bear the notation, "FAA Approved," a unique date of approval or revision number for that page, the airplane type or model designation, and an appropriate document identification number. For AFM pages produced by an STC applicant, both the STC applicant's name and the airplane type or model designation should appear.

(2) All AFMs, revisions, appendices, and supplements requiring FAA approval must be submitted using approval procedures acceptable to the FAA. A log of currently approved pages in the AFM should be furnished by the applicant in each copy of the manual. A location should be provided on the log for the approval signature and the approval date. Alternatively, a specific approval page can be furnished for the approval signature, the approval date, and the current revision status.

(3) When revisions are incorporated, a means of indicating those parts of the information that have been changed should be provided. For example, vertical bars placed in the margin of the revised page may be used for this purpose. Each revised page should be identified in the same manner as the original, with the exception of the new date and revision notation, as applicable.

(4) Appendices and supplements should be incorporated in the AFM in a separate section appropriately identified at the end of the basic manual. Supplements should normally follow appendices. Format, page identification, organization, and other details should be the same as that of the basic manual.

(5) Appendices and supplements may be developed by the TC holder, STC applicant, or the operator, and should be submitted to the FAA for approval. Usually, the TC holder writes

appendices to the AFM, and an STC applicant or operator supplements the AFM. However, an STC applicant may elect to produce a completely new AFM.

(6) It may be necessary to provide a greater amount of descriptive and procedural information in appendices and supplements than that appearing in the basic AFM, if the appendix or supplement is the only source for this information.

(7) For airplanes manufactured in the U.S. for foreign operators, appendices and supplements containing the information required by the Foreign Civil Airworthiness Authority (FCAA) may be incorporated into an FAA-approved AFM. Approval of these appendices and supplements should be in accordance with paragraph 5b of this AC.

c. The AFM may address either a single airplane model (i.e., hardware build) or several models of the same airplane type. If information is provided for more than one model, the AFM should clearly identify which operating limitations, operating procedures, and performance information apply to each model (e.g., by model designation, serial number, etc.). If the AFM format is such that different pages apply to different airplanes, the log of pages should clearly identify the specific pages of the AFM that apply to each airplane.

d. Any required weight and balance information that is not a physical part of the AFM must be incorporated by reference in the Limitations Section of the AFM per § 25.1583(c). The separate weight and balance document and revisions must be FAA-approved using appropriate approval procedures acceptable to the FAA.

e. Airplane Flight Manual Units. The AFM units should be consistent with the flight deck instrumentation, placards, and other measuring devices for a particular airplane. Multiple scales may be used on AFM charts to show different units, e.g., pounds and kilograms. However, the charts should be constructed to minimize any misunderstanding or interpolation problems by, for example, using a transfer scale so that principal values of each of the units are on major grid lines or index marks.

2. AIRPLANE FLIGHT MANUAL CONTENTS. The AFM should be divided into the following sections, as appropriate for the specific airplane type or model. For purposes of standardization, it is recommended that the sequence of sections and of items within sections follow this outline.

a. Introductory Section. The intent of the introductory material is to identify the revision status and control the applicability and content of the AFM. The normal content of this section is as follows:

(1) Title Page. The title page should include the manufacturer's name, the airplane model designation, the commercial designation or name, if any, assigned to the airplane, and an appropriate document identification number. Provision should be made for including the approval date of the basic document and the signature, name, and title of the FAA approving official.

(2) Log of Revisions.

(3) Revision highlights, if appropriate.

(4) Log of Pages (including all information necessary to determine which pages apply to a given airplane model (i.e., hardware build)).

(5) Compatibility listing of appendices and supplements produced by the airplane manufacturer.

(6) Table of Contents (alternatively, a Table of Contents for each section may be placed at the beginning of that section).

(7) List of Abbreviations.

b. Limitations Section. The purpose of the Limitations Section is to present those operating limitations appropriate to the airplane model as established in the course of the type certification process in determining compliance with the applicable provisions of parts 25, 34, and 36. The operating limitations must be expressed in mandatory, not permissive, language. The terminology used in the AFM must be consistent with the relevant regulatory language. Limitations prescribed by operating rules may be incorporated as appropriate.

(1) Weight Limitations. A statement of the maximum certified takeoff and landing weights must be provided. The maximum taxi/ramp weight, maximum zero fuel weight, and any other fixed limit on weight should also be included. Any limitations on airplane loading associated with the stated weight limitations must be included in the AFM or addressed in a separate weight and balance document. Separate takeoff and landing weight limits may be listed corresponding to each applicable constraint (e.g., structural or noise requirements, customer option, etc.), if the instructions in the Limitations Section clearly state that the most restrictive of these takeoff and landing weight limitations represent the maximum certified weights.

(i) For those performance weight limits that vary with runway length, altitude, temperature, or other variables, the variation in weight limitations may be presented as graphs in the Performance Section of the AFM and included as limitations by specific reference in the Limitations Section.

(ii) Only one set of takeoff and landing gross weight limits may be established under part 36 for a specific airplane model (i.e., hardware build).

(2) Noise Limitations. Section 36.1(g) states that an airplane model (i.e., hardware build) may not be identified as complying with the requirements of more than one noise stage level at a time. The operating limitations contained in the Limitations Section of the AFM should comply with the noise certification criteria for that stage. If the noise certification status of an airplane model is upgraded to a more stringent stage level, the AFM must either be revised or supplemented, whichever is appropriate, to include only information appropriate to the new stage level.

(i) Landing Flap Restriction. An operating limitation preventing the use of an approved landing flap setting to comply with noise requirements can only be established under the airworthiness requirements or as a voluntary design change. A statement must be added to the Limitations Section to preclude using that landing flap setting for normal operations. Emergency procedures may, however, continue to use the restricted flap setting. A placard must be placed in the airplane, and appropriate other means must be installed (e.g., crushable guard on the restricted portion of the flap selection quadrant), to prevent using the restricted flap setting for normal operations.

(ii) Reduced and Derated Takeoff Thrust or Power. In showing compliance with part 36, noise certification limitations are determined at the maximum all-engines-operating takeoff thrust or power. Reduced and derated thrust or power are not changes that would invalidate the noise certification status of the airplane, provided the full rated takeoff thrust or power remains approved for that airplane.

(3) Operating Limitations. The extremes of the operational variables, including any appropriate descriptions for which compliance with parts 25 and 36 has been shown and for which the AFM data have been approved, should be listed with respect to the following:

(i) Operations.

(A) Maximum takeoff, landing, and zero fuel weight limits.

(B) Minimum in-flight gross weight.

(C) Minimum and maximum pressure altitude for which operation is limited for each flight phase (takeoff, en route, and landing). Further altitude limitations caused by changes to structure, powerplant, equipment characteristics, or flight characteristics (e.g., due to failures) should be provided.

(D) Ambient atmospheric temperature (maximum and minimum).

(E) Minimum control speed. (This information may be located in the Performance Section of the AFM with a reference in the Limitations Section as to its location.)

(F) Maximum tailwind. The maximum allowable tailwind component for takeoff and landing should normally be limited to 10 knots. If airworthiness approval has been granted for takeoff and landing in tailwinds greater than 10 knots, the AFM should provide the limiting tailwind value, accompanied by a statement such as the following:

> The capability of this airplane has been satisfactorily demonstrated for takeoff and manual landing with tailwinds up to ___knots. This finding does not constitute operational approval to conduct takeoffs or landings with tailwind components greater than 10 knots.

(G) Maximum demonstrated crosswind.

(1) If the maximum demonstrated crosswind is considered to be limiting for either takeoff or landing, the crosswind limitation must be stated in the Limitations Section. If the crosswind value is considered to be limiting for one type of operation (e.g., autoland) but not for another, the crosswind limitation may also state the specific operations to which it applies.

(2) If the maximum crosswind value demonstrated under § 25.237 is considered to be not limiting for both takeoff and landing operations, the demonstrated crosswind value may be presented in a section other than the Limitations Section.

(H) Runway slope. Limitations and performance information should normally be restricted to runway gradients up to ±2 percent. Limitations for runway slopes greater than ±2 percent may be approved if the effects of the larger slopes are validated in a manner acceptable to the FAA.

(I) Runway surface type (smooth and hard-surfaced, or any other type approved).

(ii) En Route Flight Paths.

(A) Maximum altitude.

(B) Ambient atmospheric temperature (maximum and minimum).

(C) In accordance with § 25.123(a), en route flight path data must be presented in the AFM for all altitudes and temperatures within the operating envelope limits of the airplane.

(4) Center-of-Gravity Limits. Indicate, by using tables or graphs, the center-of-gravity (c.g.) limits for taxi, takeoff and landing, zero fuel weight, and for any other practicably separable flight condition. As appropriate, data should be provided for a range of weights between the maximum taxi weight and the minimum in-flight weight. The data should be shown with the appropriate gear position for the phase of flight, and gear effects on center-of-gravity should be built into the charts. Data may be presented for gear-extended position only if there is proper accounting for the moment change due to gear retraction. The c.g. limits should be presented in terms of either the distance-from-a specified datum or as a percentage of the length of the mean aerodynamic chord (MAC). Either the location of the datum or the length and location of the MAC should be stated, as applicable. If alternate forward c.g. limits have been approved, these limits should be presented and appropriately identified.

(5) Fuel Limitations. A statement in accordance with § 25.1585(d) must be included. Operating limitations due to fuel related considerations (e.g., lateral fuel imbalance, fuel management, fuel temperature, speed restrictions associated with minimum or ballast fuel requirements) and their effects on other limitations (e.g., boost pump(s) inoperative, fuel type) should also be provided.

(6) Powerplant Limitations.

(i) State all limitations necessary to ensure safe operation of engines, propellers, fuel systems, and powerplant accessories, including auxiliary powerplants (see §§ 25.1521, 25.1522, and 25.1583). If the use of reduced or derated takeoff thrust or power is requested, then any associated operating or performance limitations should be included in accordance with acceptable reduced and derated takeoff thrust or power procedures. Limitations related to the use of reverse thrust in flight or on the ground should be clearly identified. Any engine limitations associated with operations in adverse weather (heavy rain, hail, turbulence, lightning, etc.) should be specified.

(ii) Because engine ice protection is critical to safety in icing conditions, a statement should be included in the Limitations Section that the engine ice protection must be on during all ground and flight operations when icing conditions exist or are anticipated. The following definition of icing conditions should also be included in the Limitations Section:

> Icing Conditions - Icing conditions exist when outside air temperature (OAT) on the ground and for takeoff, or total air temperature (TAT) in flight, is 10 degrees C or below, and visible moisture in any form is present (such as

clouds, fog with visibility of one mile or less, rain, snow, sleet, or ice crystals). Icing conditions also exist when the OAT on the ground and for takeoff is 10 degrees C or below when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on engines, nacelles, or engine sensor probes.

(7) Airspeed and Mach Number Limitations. All airspeed limitations should be in terms of indicated airspeed and in units of knots or Mach number, where applicable, and should be consistent with cockpit indication. If airspeed or Mach number limitations vary with altitude or loading conditions, such variation must be shown. Limitations data must be included for at least the following:

(i) Maximum operating limit speed, V_{MO}/M_{MO}, together with a statement that this speed limit may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorized for flight test or pilot training. The last phrase ("unless a higher speed is authorized for flight test or pilot training") may be omitted at the option of the applicant.

(ii) Maneuvering speed, V_A, together with a statement that full application of longitudinal, directional, and lateral flight controls, as well as maneuvers that involve angles of attack near the stall, should be confined to speeds below this value.

(iii) Flap-extended speed, V_{FE}, for each approved flap and high lift device position.

(iv) Landing gear operating speed, V_{LO}, together with a statement that this is the maximum speed at which it is safe to extend or retract the landing gear. If different speeds are established for extension and retraction, each speed should be listed and defined.

(v) Landing gear extended speed, V_{LE}, together with a statement that this is the maximum speed at which the airplane can be safely flown with the landing gear extended and locked.

(vi) Any other limiting speeds for extendable devices other than the landing gear should be included as applicable (e.g., spoilers, thrust reversers, landing lights, ram air turbines (RAT), windows that may be opened in flight, etc.).

(8) Maneuvering Load Factor Limitations. The positive and negative flight maneuvering limit load factors (expressed in terms of "g's") for which the structure is approved should be provided, including any variation with the position of the high lift devices.

(9) Kinds of Operations. This subsection should contain a statement similar to the following:

This airplane is certificated in the transport category and is eligible for the following kinds of operations when the appropriate instruments and equipment required by the airworthiness and operating requirements are installed and approved and are in operable condition.

The approval status of the following should be stated:

(i) Operation in atmospheric icing conditions.

(ii) Extended over-water operation.

(iii) Extended range operation with two-engine airplanes (ETOPS).

(iv) Day and night operations under visual flight rules (VFR).

(v) Operations under instrument flight rules (IFR).

(vi) Backing the airplane with reverse thrust.

(vii) Category I, II, or III operations.

(10) Minimum Flightcrew. The minimum number of flightcrew approved to operate the airplane should be stated.

(11) Systems and Equipment Limitations. All limitations applicable to systems and equipment installations that are considered necessary for safe operation must be included. Examples of systems and equipment installations for which limitations may be appropriate include electrical, hydraulic, pneumatic, cabin pressurization, air conditioning, airframe fire protection, airframe ice protection, auto braking systems, autopilot, autothrottle, flight director, yaw damper, anti-skid devices, and performance or flight management systems (including software identifier if displayable).

(12) Miscellaneous Limitations. This item should include any information not specified under the preceding headings but necessary, as a limitation, to ensure safe operation of the airplane.

c. Operating Procedures Section. The Operating Procedures Section of the AFM should contain, as a minimum, the essential information, peculiar to the particular airplane type or model, that is needed for safe operation under normal and other than normal conditions. Procedures not directly related to airworthiness, or not under control of the flightcrew, should not

be included in the AFM. A notation similar to the following should be placed at the beginning of the Operating Procedures Section:

> The operating procedures contained in this manual have been developed and recommended by the manufacturer and approved by the FAA for use in operating this airplane. These procedures are provided as guidance and should not be construed as prohibiting the operator from developing equivalent procedures in accordance with the applicable operating rules.

(1) Procedures Categories. Information should be presented for normal and non-normal/emergency procedures and be distinctly separated. The non-normal/emergency procedures may either be placed in one section or in separate non-normal and emergency procedures sections of the AFM. In either case, procedural tasks that are considered recall or immediate action items that must be accomplished from memory should be clearly identified.

(2) Format. Procedures should be presented in either a narrative or a checklist format, depending upon the intended use of the AFM.

(i) Narrative. This format is acceptable if sources of procedures information other than the AFM are intended for flightcrew use (e.g., a Flightcrew Operating Manual (FCOM)). Procedures presented in this format should be drafted in a manner from which the needed sequence can be easily established.

(ii) Checklist. This format should be used if the AFM is intended to be used directly by the flightcrew for operating procedures.

(3) Procedures Development. Prior to initial type certification, it is essential to verify that the proposed procedures are technically valid and operationally practicable. It is recognized that such procedures may have had only limited operational exposure at the time of certification and may need to be revised based on service experience.

(4) Procedures Content. The content and level of detail for the normal and non-normal procedures provided in the AFM should be based on the intended use of the AFM. More information and detail should be provided in AFMs that are intended to be the flightcrew's primary source of operating procedures information than for AFMs that are not intended to be used directly by the flightcrew.

(i) General. Classifying an operating procedure as normal or non-normal should reflect whether the airplane's systems are operating normally. Procedures associated with failed or inoperative systems should be considered non-normal. Procedures associated with glideslope deviation, ground proximity warning, all-engines-operating go-around, turbulent air penetration, windshear alerts, traffic advisories or resolution alerts from the traffic alerting and collision

avoidance system, etc., which do not occur routinely, should be placed in the normal procedures subsection, provided the airplane's systems are operating normally.

(ii) Other Sources of Procedures Information. The flightcrew of large transport category airplanes typically use sources of operating procedures information other than the AFM. Examples of other sources of operating procedures information include manufacturer- or operator-produced operating manuals, Quick Reference Handbooks (QRH's), System Pilot's Guides, and Emergency or Abnormal Checklists. For these airplanes, items such as cockpit checklists, systems descriptions, and the associated normal procedures should not be presented in the AFM if they are provided in other documents acceptable to the FAA. Normal procedures that are necessary for safe operation should be presented in the AFM, but the remaining normal procedures should be placed in the manufacturer-produced FCOM (or other acceptable source of operating procedures information). The non-normal procedures section of the AFM for these types of airplanes should include, as a minimum, procedures dictated by the airplane's systems and failure modes, and may also include those emergency procedures listed in paragraph 2c(5) of this AC.

(A) The system description and procedures provided in the AFM should be limited to that which is uniquely related to airplane safety or airworthiness. The AFM should include a brief general description of the system and its intended use. The limitations section of the AFM should reference the operating manual in which the detailed system description and procedures can be found. This reference should include the document title, the document or part number, and the date of issue, and may allow the use of later appropriate revisions. An example wording would be: "The [*Manufacturer Unit Model*] System Pilot's Guide, P/N XXXX, dated XXXX (or later appropriate revision) must be immediately available to the flightcrew whenever XXXX [e.g., navigation] is predicated on the use of the system. The software version [if applicable] stated in the Pilot's Guide must match that displayed on the equipment."

(B) Information that restricts or defines the operation of a particular system (e.g., authorizing or prohibiting specific types of approaches) should be located in the limitations section of the AFM. Emergency or abnormal procedures should be located in the appropriate procedures section(s) of the AFM.

(C) Detailed system descriptions and normal procedures that represent one means, but not the only means, of operation should be located in appropriate operating manuals with a reference placed in the procedures section of the AFM. This reference should include the document title, the document or part number, and the date of issue. The reference may also allow the use of later appropriate revisions of that document. An example wording would be: "Normal operating procedures are contained in the [*Manufacturer Unit Model*] System Pilot's Guide, P/N XXXX, dated XXXX (or later appropriate revision)."

(iii) AFM Used Directly. For those manufacturers and operators that do not produce other sources of procedures information (generally manufacturers and operators of small transports), the AFM is the only source of this information. In this circumstance, the AFM operating procedures information must be comprehensive and include information such as cockpit checklists, systems descriptions, and associated procedures.

(5) Emergency Procedures. The emergency procedures can be included either in a dedicated section of the AFM or in the non-normal procedures section. In either case, this section should include the procedures for handling any situation that is in a category similar to the following:

(i) Engine failure with severe damage or separation.

(ii) Multiple engine failure.

(iii) Fire in flight.

(iv) Smoke control. At least the following should be clearly stated in the AFM:

After conducting the fire or smoke procedures, land at the nearest suitable airport, unless it is visually verified that the fire has been extinguished.

(v) Rapid decompression.

(vi) Emergency descent.

(vii) Uncommanded reverser deployment in flight.

(viii) Crash landing or ditching.

(ix) Emergency evacuation.

d. Performance Section. This section of the AFM contains the performance limitations and other data required by parts 25 and 36, and any special conditions that may apply. Additional information may be provided to assist the operator in complying with the operating rules or for implementing unique operational needs. The performance information should cover the operating range of weights, altitudes, temperatures, airplane configurations, thrust ratings, and any other operational variables stated as operational performance limitations for the airplane. If additional performance information is presented for operation at a specific altitude, these performance data should cover a pressure altitude span of at least the specific altitude ±1,000 feet to allow an operator to adequately account for pressure altitude variations. It is recommended that such data be included as a separate section or appendix to the AFM.

(1) General. Include all descriptive information necessary to identify the configuration and conditions for which the performance data are applicable. Such information should include the type or model designations of the airplane and its engines, the approved flap settings, a brief description of airplane systems and equipment that affect performance (e.g., anti-skid, automatic spoilers, etc.), and a statement indicating whether such systems and equipment are operative or inoperative. This section should also include definitions of terms used in the Performance Section (e.g., IAS, CAS, ISA, configuration, net flight path, icing conditions, etc.), plus calibration data for airspeed (flight and ground), Mach number, altimeter, air temperature, and other pertinent information. The airspeed, altitude, and air temperature calibration data should be presented for the following ranges:

(i) Takeoff configurations:

(A) Ground run, 0.8 V_{1MIN} to V_{2MAX}

(B) Inflight, V_{2MIN} to V_{FE}

(ii) Approach and landing configurations:

(A) Approach, 1.2 V_S to V_{FE}

(B) Landing, 1.3 V_S to V_{FE}

(iii) En route configuration:

(A) Airspeed and Altimeter: For the takeoff/takeoff path altitude range, 1.25 V_S to V_{MO}/M_{MO}.

(B) Airspeed and Altimeter: For higher altitudes, from 1.25 V_S or the speed for 1.2g buffet onset margin, whichever is lower, to V_{MO}/M_{MO}.

(C) Mach Number: From the lowest useful Mach number (generally in the range of 0.4 to 0.5) to M_{MO}.

(D) Total or Static Air Temperature: For Mach numbers corresponding to the speed ranges noted in paragraphs 2d(1)(iii)(A) and (B) of this AC.

(2) Performance Procedures. The procedures, techniques, and other conditions associated with the AFM performance data should be included. Performance procedures may be presented as a performance subsection or in connection with a particular performance graph. In

the latter case, a comprehensive listing of the conditions associated with the particular performance data may serve as procedures if sufficiently complete. The AFM should also include adequate information to enable the operator to show compliance with § 25.1001 for each takeoff.

(3) Thrust or Power Setting. Thrust or power settings should be provided for at least takeoff, maximum continuous, and go-around thrust or power, along with the thrust or power setting procedures necessary to obtain the performance shown in the AFM. These data should be shown for each applicable thrust or power setting parameter. If backing the airplane by reverse thrust or power is proposed, thrust or power setting limits should be established considering contaminated runway, foreign object damage potential, environmental control system impact, airplane weight and c.g., cockpit visibility, effect of braking, etc.

(4) Minimum Control Speeds. Minimum control speed data may be located in the Performance Section with a reference in the Limitations Section as to its location.

(5) Stall Speeds. The stall speeds established in showing compliance with certification requirements should be presented, together with associated conditions. Data should be presented in terms of calibrated airspeed.

(6) Takeoff Speeds. The takeoff speeds, V_1, V_R, and V_2, must be presented in the AFM, together with the associated conditions. These speeds should be presented in units consistent with cockpit instrument indications. V_1 and V_R speeds should be based upon ground effect calibration data, while V_2 speeds should be based upon free air calibration data. The takeoff speeds associated with the minimum control speeds and the maximum energy absorption capability of the brakes should be included. At the option of the applicant, the AFM may also include the V_1 speeds associated with unbalanced field lengths. At all conditions and airplane configurations represented in the AFM (i.e., at all altitudes, temperatures, weights, winds, runway slopes, flap settings, etc.), the accuracy of the V_1 speed should either: 1) be within 1.5 knots of the V_1 speed used to calculate the takeoff and accelerate-stop distances, or 2) not cause an increase to these distances of more than the greater of 100 feet or the incremental increase resulting from a 1.5 knot variation in V_1 speed.

(7) Takeoff and Accelerate-Stop Distances. Takeoff and accelerate-stop distances, complying with §§ 25.105, 25.109 and 25.113, must be provided. At the option of the applicant, and with concurrence by the FAA, additional data may be provided for operations on other than smooth hard-surfaced runways.

(8) Climb Limited Takeoff Weight. The climb limited takeoff weight, which is the most limiting weight showing compliance with §§ 25.121(a), (b), and (c), must be provided.

(9) Miscellaneous Takeoff Weight Limits. Takeoff weight limits should be shown for any equipment or characteristic of the airplane that imposes an additional takeoff weight restriction (e.g., maximum tire speed, maximum brake energy, fuel jettison considerations, inoperative system(s), etc.).

(10) Takeoff Climb Performance. For the prescribed takeoff climb airplane configurations, the climb gradients must be presented, together with associated conditions. The scheduled climb speed(s) should be included.

(11) Takeoff Flight Path Data. Takeoff flight paths, or performance information necessary to construct such paths, together with the associated conditions (e.g., procedures and speeds), should be presented for each approved takeoff configuration. The presentation should include all flight path segments existing between the end of the takeoff distance and the end of the takeoff path, as defined in § 25.111(a). Such data must be based upon net performance, as prescribed in §§ 25.115(b) and (c).

(12) En Route Flight Path Data. The net flight path gradient data prescribed in § 25.123 must be presented, together with the associated conditions (e.g., procedures and speeds). Data must be presented for both one- and two-engines-inoperative cases, as applicable, throughout the approved operating altitude and temperature envelope.

(13) Climb Limited Landing Weight. The climb limited landing weight, which is the most limiting weight showing compliance with §§ 25.119 and 25.121(d), should be provided.

(14) Miscellaneous Landing Weight Limits. Landing weight limits for any equipment or characteristic of the airplane configuration that imposes an additional landing weight restriction should be shown.

(15) Approach Climb Performance. For the approach climb configuration(s), the climb gradients (§ 25.121(d)) and weights up to maximum takeoff weight (§ 25.1587(b)(3)) should be presented, together with associated conditions (e.g., procedures and speeds). The affects of ice accretion on unprotected portions of the airframe, and the effects of engine and wing ice protection systems should be provided.

(16) Landing Climb Performance. Data for the landing climb configuration(s) should be presented in a manner similar to that described for the approach configuration above.

(17) Landing Approach Speeds. The scheduled speeds associated with the approved landing distances and operational landing runway lengths (see paragraph 2d(18) of this AC) should be presented, together with associated conditions.

(18) Landing Distance. The landing distance from a height of 50 feet must be presented either directly or with the factors required by the operating regulations, together with associated conditions and weights up to the maximum takeoff weight. For all landplanes, landing distance data must be presented for level, smooth, dry, hard-surfaced runways for standard day temperatures. At the option of the applicant, and with concurrence by the FAA, additional data may be presented for other temperatures and runway slopes within the operational limits of the airplane, or for operations on other than smooth hard-surfaced runways. For Category III operations, additional landing performance data may be required.

(19) Performance Limits and Information Variation with Center-of-Gravity. If performance information (e.g., buffet boundary) is not presented for the most critical c.g. condition, the AFM should present the effect of variation with c.g.

(20) Noise Data. The noise levels achieved during type certification in accordance with the provisions of part 36 should be presented, together with associated conditions and with the note prescribed in § 36.1581(c). The noise levels achieved during type certification should be included in the AFM and consist of only one takeoff, one sideline, and one approach noise level for each airplane model (i.e., hardware build). The noise certification stage level should accompany the noise level information to indicate the compliance status. Supplementary information (labeled as such) may be added to the AFM concerning noise levels for other configurations or conditions.

(21) Miscellaneous Performance Data. Any performance information or data not covered in the previous items that are required for safe operation because of unusual design features or operating or handling characteristics should be furnished. For example, the maximum quick turnaround weight should be provided.

e. Loading Instructions. Section 25.1583 requires instructions necessary to ensure loading of the airplane within the established limits of weight and center-of-gravity, and to maintain the loading within such limits in flight to be presented either in the AFM or included in a separate weight and balance document referenced in the AFM Limitations Section. If applicable, the loading instructions must refer to the flight procedures that consider the change to the airplane's center of gravity as fuel is consumed.

(1) Loading Instructions Presented in a Separate Document. If the loading instructions are presented in a separate document, the AFM Limitations Section should contain at least the following:

(i) Maximum taxi gross weight limits.

(ii) Maximum takeoff gross weight limits.

(iii) Maximum landing gross weight limits.

(iv) Maximum zero fuel weight limits.

(v) Minimum in-flight gross weight.

(vi) Center-of-gravity limits.

(vii) Information required to maintain the airplane within the above limits.

(2) Weight and Balance Data. Documentation of the weight and balance material outlined below is normally adequate for airplanes with conventional loading and fuel management techniques. For airplanes that require fuel to be redistributed (other than through normal consumption) to maintain loading within prescribed limits, the loading instructions should be expanded as necessary.

(i) Weight Limits. A list and identification of all weight limitations should be included.

(ii) Center-of-Gravity Limits. The approved center-of-gravity range, or ranges, should be presented with due accounting for airplane configuration (i.e., landing gear position, passenger loading, cargo distribution, etc.) such that loading limits can be maintained.

(iii) Dimensions, Datum, and MAC. The dimensions and relative location of airplane features associated with weighing and loading of the airplane and with weight and balance computations should be described or illustrated.

(iv) Configuration Checklist or Equipment List. The airplane should be defined or described sufficiently to identify the presence or absence of optional systems, features, or installations that are not readily apparent. In addition, all other items of fixed or removable equipment included in the empty weight should be listed.

(v) Fuel and Other Liquids. All fuel and other liquids, including passenger-service liquids, that are included in the empty weight should be identified and listed, together with the information necessary to enable ready duplication of the particular condition.

(vi) Weighing Computations. Computation of the empty weight and the empty weight c.g. location should be included.

(vii) Loading Schedule. The loading schedule should be included, if appropriate.

(viii) Loading Instructions. Complete instructions relative to the loading procedure or to the use of the loading schedule should be included.

(ix) Compartment and floor load limits should be included.

3. CONFIGURATION DEVIATION LIST (CDL). Operating the airplane without certain secondary airframe and engine parts is allowed through the use of an approved CDL. The CDL should be included in the AFM as a separate appendix. The CDL should be prepared in accordance with the guidance provided in Advisory Circular 25-7, "Flight Test Guide for Certification of Transport Category Airplanes."

4. SPECIFICATION AND SUBMITTAL OF AFMs, REVISIONS, APPENDICES, AND SUPPLEMENTS. The format and contents of the AFM, revision, appendix, or supplement should be proposed by the applicant and accepted by the FAA well before submittal of AFM material. The time required for FAA review and approval, and the manner in which AFM material and supporting documentation (e.g., flight test results) will be submitted, should also be established well in advance of the actual submittal. Large submittals may be broken down into smaller packages of related material and submitted to the FAA as it becomes available.

5. APPROVAL OF AFMs, REVISIONS, APPENDICES, AND SUPPLEMENTS.

a. FAA Approval of an AFM Developed by a U.S. Manufacturer. AFMs, revisions, appendices, and supplements are to be approved by the manager of the appropriate Aircraft Certification Office (ACO) or his designated representative. As necessary, or at the request of the applicant, the ACO manager will convene a Flight Manual Review Board (FMRB) to determine whether the limitations, procedures, and performance information contained in the AFM provide for safe operation and are compatible with the airplane type design and certification basis. The Flight Test Branch (or equivalent) of the appropriate ACO is responsible for FAA coordination of AFM material, including coordination with the designated operations specialist or Aircraft Evaluation Group (AEG) personnel. Although the AEG participates in the review process, FAA approval of the AFM does not constitute approval for use in operations under parts 121, 125, or 135.

b. Foreign Civil Airworthiness Authority (FCAA) Approval of an AFM Developed by a U.S. Manufacturer.

(1) AFMs developed by a U.S. manufacturer for FCAA certification may be approved by the FAA in one of three ways, depending upon the formal agreements made between the FAA and the FCAA.

(i) Type I Approvals. In this case, the regulatory standard of the FCAA is the FAR, with possibly some unique FCAA requirements of minor significance, and the FCAA has

delegated approval authority to the FAA. The AFM is coordinated as described in paragraph 5a of this AC. The FAA assumes technical responsibility and approval is granted without consulting the FCAA, except in cases outside of formal agreements. Approval statements contained in the AFM should indicate that the AFM is "FAA Approved." No reference to the FCAA is necessary.

(ii) Type II Approvals. In this case, the regulatory standard of the FCAA is mostly the FAR with a limited number of FCAA requirements of major significance. An example of such a regulatory standard is the Joint Aviation Requirements (JAR). The AFM approval process is coordinated as described in paragraph 5a of this AC. Depending on the agreement with the FCAA, the FAA may assume technical responsibility for the AFM. The AFM should contain a preamble or introduction listing the unique, non-FAA requirements, and stating that the AFM satisfies the regulatory requirements of the FCAA, and that the AFM is approved by the FAA on behalf of the FCAA. For the first issue of the AFM, written concurrence is required from the FCAA that FAA approval may be granted. Depending upon the written agreement made between the FAA and FCAA, subsequent revisions may not require written authorization from the FCAA for the FAA to grant approval.

(iii) Type III Approvals. In this case, the regulatory standard of the FCAA is extensively different from the FAR. The FAA assumes limited technical responsibility for approving the AFM, in accordance with the written agreement between the FAA and FCAA. The AFM is not subject to the approval coordination process described in paragraph 5a of this AC. The AFM should contain a preamble or introduction stating that the AFM satisfies the regulatory requirements of the FCAA, and that the AFM is signed by the FAA on behalf of the FCAA. Written authorization must be obtained from the FCAA prior to FAA signature for the first issue and all subsequent revisions. The FCAA may choose to retain signature authority, whereupon the FAA will not be involved in any phase of the approval process. However, if the FCAA approved material is an appendix or supplement to an FAA approved basic AFM, the FCAA approved material may still be acknowledged on the basic AFM log of pages.

(iv) Additionally, for Type II and III approvals, the FCAA may specify changes or inclusion of certain amendments. The FAA would then ensure that these changes were made, and would assume the responsibility only for assuring that they meet the specified FCAA requirements. If the FAA has knowledge of an unsafe condition resulting from the proposed limitations, procedures, or performance, the FAA will neither approve nor sign the AFM, and will notify the FCAA of the condition requiring further attention.

(2) When there is no formal agreement between authorities, the FCAA should assume AFM approval duties. In this case, the FAA could, if requested by the FCAA, oversee the administrative approval of the AFM, similar to a Type III approval, when notified by the FCAA that the AFM meets their requirements. Technical review of the AFM contents would be the

responsibility of the FCAA, and a special preface page should explain the nature of the aforementioned approval and signature action.

c. FAA Approval of an AFM Developed by a Foreign Manufacturer.

(1) When an application is made for FAA certification of an airplane manufactured by a foreign country, the AFM that has been prepared will be assessed by the FAA certification team in accordance with the certification procedures for import, and notification will be made of any changes required to comply with the requirements of the FAA.

(2) The approval process will be consistent with the methods described in paragraph 5b of this AC.

d. Approval of Minor AFM Revisions by Designated Engineering Representatives (DERs). The approval of certain minor AFM revisions may be delegated to authorized Flight Analyst DERs. It is the responsibility of the ACO Flight Test Branch manager (or equivalent) to evaluate the capability, delegate the authority, and monitor the approval activities of the airplane manufacturer and authorized designees. The following guidelines specify the additional DER qualifications, the review process for the DER and the airplane manufacturer to follow, and the types of revisions that are eligible for DER approval:

(1) Additional DER Qualifications. In addition to being a Flight Analyst DER, the nominee should possess the following characteristics:

(i) Be an employee of a transport airplane manufacturer.

(ii) Have sound general knowledge of the type certification process.

(iii) Be familiar with the historical background of the airplane manufacturer's AFMs.

(iv) Have administrative ability.

(v) Have the authority to coordinate the DER review process.

(2) DER/Airplane Manufacturer Review Process. The airplane manufacturer should institute a structured review process to ensure the integrity of DER-approved AFM revisions. The manufacturer's coordination records must be made available to the FAA to audit the process. The following procedures are recommended:

(i) Identify whether the AFM revision is eligible for DER approval (see paragraph 5d(3) of this AC).

(ii) Research and draft the revised material.

(iii) Select the appropriate engineering disciplines/organizations within the company (e.g., aerodynamics, propulsion, etc.) for review.

(iv) Conduct an initial review and make appropriate changes to the proposed AFM revision.

(v) Coordinate the final engineering and airworthiness approval.

(vi) Have the authorized DER sign the AFM above the signature block. Clearly identify the signer as a DER rather than the ACO manager or Flight Test Branch manager.

(vii) Send an advance copy of the approved AFM revision to the ACO, along with appropriate documentation identifying the coordination elements.

(viii) Have the authorized DER sign the 8110-3 form and submit it to the ACO.

(ix) Send final copies of the AFM revision to the ACO.

(3) Material Eligible for DER Approval. The following types of AFM revisions are eligible for approval by authorized Flight Analyst DERs:

(i) The addition of airplane serial numbers to an existing AFM for which the airplane configuration, relative to the AFM, is identical to airplanes already covered by that AFM.

(ii) Changes to weight limitations that are within all previously FAA-approved limitations (e.g., structural, noise, etc.).

(iii) The addition of compatible and previously FAA-approved AFM appendices.

(iv) Conversions of previously FAA-approved combinations of units of measure added to an AFM in a previously FAA-approved manner.

(v) Minor editorial changes and corrections.

(vi) The addition of previously FAA-approved optional equipment for the same airplane model with similar operability and compatibility characteristics, provided no additional compatibility testing is required.

(vii) Revisions for which an FCAA has granted FAA/DER approval authority through specific FAA/FCAA agreements and procedural practices.

(viii) The incorporation of information from an Airworthiness Directive into subsequent AFMs after the first such revision is approved by the ACO.

(4) Material Ineligible for DER Approval. New information of any kind, or any information not previously approved by the FAA, including limitations, operating procedures, and performance, are ineligible for DER approval. Other types of AFM revisions ineligible for DER approval include:

(i) Any information that requires certification flight tests.

(ii) Any revision for which approval or signature authority is contrary to existing FAA/FCAA agreements or procedural practices.

(iii) Revisions associated with concurrent type certification activity.

(iv) Changing units of measure to be incompatible with airplane indication systems (e.g., fuel quantity/flow gauges).

(v) Any revision not clearly identified in paragraph 5d(3) of this AC as eligible for DER approval.

APPENDIX 1

COMPUTERIZED AIRPLANE FLIGHT MANUAL

1. PURPOSE. This appendix presents guidelines for obtaining approval of a computerized version of an AFM that would replace or supplement parts of the conventional paper AFM. These guidelines also apply to computerized AFM appendices and supplements. The criteria provided in the main body of this Advisory Circular (AC) remain applicable except where modified by this appendix. These guidelines do not cover:

a. Systems used on board the airplane during flight.

b. Systems that provide direct input to other airplane systems or equipment.

c. Supplementary software or software functions used to prepare documentation suitable for use in the operation of the airplane under the applicable operating rules (e.g., airport analysis software).

2. APPLICABILITY. This appendix applies to airplanes eligible to be certificated under part 25. The guidelines contained herein pertain to generating and presenting AFM performance information by means of computer software. This appendix may be amended to include relevant aspects for other FAA approved information that is stored and presented through computer software.

3. DEFINITIONS.

a. Computerized AFM. The computerized AFM software application used in conjunction with the hardware and software environment in which it is installed to generate computerized AFM information.

b. Computerized AFM Software Application. The computer programs and data, installation information, and operating guide that are used in generating computerized AFM information.

c. Computerized AFM Information. The information generated by the FAA-approved computerized AFM in lieu of or supplementing parts of the conventional paper AFM.

d. Software Environment. The additional computer programs (e.g., operating system) that provide services to the computerized AFM software application to input, process, and output the information to the user.

e. Hardware Environment. The equipment (e.g., terminal, printer, keyboard, math co-processor, central processing unit, etc.) that enables the operation of the software environment and the computerized AFM software application to input, process, and output the information to the user.

f. Commercial-Off-the-Shelf (COTS) Computer. A multi-purpose computer (e.g., a standard personal computer) that is available, or can be made available, to all potential users of the respective computerized AFM.

g. Calculation. Data generation by means of any combination of table-lookup or arithmetic operations.

h. First Principles Calculation. A calculation using basic parameters such as lift, drag, thrust, etc. with the equations of motion.

4. GENERAL GUIDELINES. The holder of the type certificate (TC) is responsible for obtaining approval of new and revised computerized AFMs. An applicant seeking a supplemental type certificate (STC) based on a computerized AFM should comply with the same guidelines as the TC holder. The criteria herein do not affect the status of computerized AFMs that have previously been FAA-approved. When such manuals are amended in the future, the concepts of this appendix should be applied, where practicable.

a. Official Reference.

(1) The conventional paper portion of the AFM should contain appropriate references about applicability of the FAA-approved computerized AFM software application. This reference should be revised each time the FAA-approved computerized AFM software application is changed (see paragraph 6d of this appendix).

(2) The Limitations Section of the conventional paper portion of the AFM should contain at least the following information:

(i) A statement similar to the following:

The computerized AFM replaces or supplements portions of the paper AFM, and is an FAA-approved source for that AFM information. Any modification to the FAA-approved computerized AFM software application, or subsequent alteration to the generated output, will cancel the airworthiness approval of the information, unless this change was approved by the appropriate airworthiness authority. This

statement applies regardless of any approval notation printed on a generated output.

(ii) The title, manufacturer, and version number of any unapproved software used in connection with the AFM software application per paragraph 6a(5) of this appendix. The version number reference may refer to future versions of the software (e.g., "Version XX and later") if the verification check performed under paragraph 6c(1) of this appendix is designed such that improper operation of later software versions would be detected.

(iii) The installation information referenced in paragraph 6c(2) or 6c(3) of this appendix, whichever is appropriate, and instructions for using the installation utility function or test set described in paragraph 6c(1) of this appendix.

(iv) Instructions for the use of information provided in the paper portion of the AFM that must be applied to or used in combination with the computerized AFM input or output (e.g., structural weight limitations, adjustments or correction factors to be applied in accordance with paragraph 5d(4) of this appendix, and airplane performance information not provided in computerized form).

(3) The information listed in paragraphs 4a(2)(ii) through 4a(2)(iv) above may appear in a user's guide rather than the Limitations Section of the conventional paper portion of the AFM if a reference to the user's guide is placed in the Limitations Section. The reference should make it clear what information is being referenced, and should include the title of the user's guide, the document number or other identification means, and the date of issue. Reference may be made to the use of later appropriate revisions of the user's guide.

b. Approved and Unapproved Information. Section 25.1581 requires that FAA-approved information be segregated, identified, and clearly distinguished from any unapproved information presented in the AFM. Therefore, the approval status of generated output should be clearly indicated on the screen and printed on each printout page of any calculated results by indication of:

(1) Approved program version.

(2) Approved data version, if applicable.

(3) Approval status of results with respect to requirement basis of the computation (e.g., FAA-approved vs. not approved).

(4) Applicable certification basis, if the program is capable of generating results for more than one certification basis (e.g., FAR/Joint Aviation Requirements (JAR)).

(5) Date of output data generation.

c. Software Usage Aspects. The applicant should substantiate that the computerized AFM is designed to:

(1) Provide a generated output containing all the information required to be in the conventional paper AFM by part 25 for the part that is replaced or supplemented by the computerized AFM. This includes all relevant information (e.g., variables used for a specific condition) to determine the operating condition and applicability of the generated output.

(2) Provide equivalent or conservative results to that obtained by direct use of a first principles calculation using certified baseline parameters (e.g., lift, drag, thrust).

(3) Preclude calculations that would generate results identified as FAA-approved by:

(i) Extrapolating data beyond computational bounds agreed to by the FAA and the applicant; or

(ii) Using unapproved flight test analysis or AFM expansion methods.

(4) Provide at least the standard of transparency (e.g., understanding of performance relations and limitations) that is available from a conventional paper AFM presentation, including the capability to make multiple point calculations and plot the results.

(5) Minimize mistakes or misunderstanding by a trained user during data input and interpretation of output.

5. COMPUTERIZED AIRPLANE FLIGHT MANUAL CONTENTS.

a. General.

(Reserved)

b. Limitations Section.

(Reserved)

c. Operating Procedures Section.

(Reserved)

d. Performance Section.

(1) The computerized AFM may be used to generate all of the FAA-approved performance information required to be in the AFM.

(2) The operating rules (§§ 91.9(b)(1), 121.141(b), and 125.75(b)) require operators to carry, in each transport category airplane, either the AFM or an operator-prepared manual that contains all of the information required to be in the AFM. The computerized AFM is not intended for use on board the airplane. Thus, any portions of the AFM that are provided only in computerized (i.e., electronic) form may not be used to satisfy these operating requirements. This does not preclude printing out information calculated by the FAA-approved computerized AFM and subsequently using the paper printout on board the airplane.

(3) Configuration Deviation List (CDL) and Master Minimum Equipment List (MMEL) effects on performance may be included if they are FAA-approved and applications are clearly identified on the generated output.

(4) Although the output from the computerized AFM should be usable without adjustment, applying corrective factors that are provided in the paper AFM may be acceptable in the following cases:

(i) CDL or MMEL information.

(ii) Urgent temporary FAA-approved revisions made mandatory for safety reasons.

(iii) Any case in which the appropriate data are unavailable from the computerized AFM and it is clear to the user that corrective factors must be applied.

(iv) Supplements produced by STC applicants.

(5) Supplementary performance information may be included in accordance with paragraph 4b of this appendix (e.g., for operation on runways contaminated with standing water, slush, snow, or ice).

(6) The applicant may request FAA approval of supplementary computerized AFM applications (e.g., optimized runway performance). This supplementary software application will not be required by the FAA for type certification.

6. SOFTWARE INTEGRITY, DEVELOPMENT, AND DOCUMENTATION REQUIREMENTS. The computerized AFM consists of the AFM software application used in

conjunction with the hardware and software environment in which it is installed. This section provides guidelines that address the integrity, development process, and documentation requirements of the software.

a. Software Integrity.

(1) The computation of hazardously misleading primary information, such as takeoff speeds, landing approach speeds, engine thrust or power, engine limit data, or other related airplane performance data, should be improbable (as defined in § 25.1309). The AFM software application should, as far as practicable, be protected from inadvertent, deliberate, or unauthorized alterations. For example, self-check features could be used to provide software verification and protection against deliberate or inadvertent alteration.

(2) The level of integrity established for the computerized AFM is the basis for the software development process and should be addressed in the plan for software aspects of certification (see paragraph 6b of this appendix).

(3) Each part of the FAA-approved AFM software application (e.g., program, data) should bear a unique notation, a unique date, or a revision number.

(4) A means to check the programs and data to avoid undetected failures should be provided (e.g., a checksum routine, tabular data to verify a check case, or provisions for a line-by-line file comparison).

(5) Commercially available software, such as operating systems (e.g., MS-DOS), word processors, and spreadsheets, will not be approved by the FAA. However, this software can be used to run the computerized AFM software application or process (i.e., edit, format, manipulate, etc.) AFM data to produce approved AFM information if:

(i) The applicant demonstrates that the unapproved software does not interfere with the correct functioning of the FAA-approved computerized AFM software application;

(ii) The applicant demonstrates that the unapproved software produces reliable results when used with the specified hardware environment and the computerized AFM software application.

b. Software Development. The integrity of the software components of the computerized AFM is achieved through the software development processes used.

(1) The applicant should propose the software development process in the plan for software aspects of certification. Per AC 20-115B, RTCA/DO-178B provides an acceptable

means of compliance for the software components of the AFM. The applicant should document the methods, parameters, and allowable range of conditions contained in the computerized AFM. The results obtained from the computerized AFM should be shown to meet all applicable part 25 requirements. This compliance may be shown using substantiation documentation, demonstrations, or other means mutually agreed to by the FAA and the applicant.

(2) The applicant should submit a description of the computerized AFM and the plan for software aspects of certification to the FAA for review early in the certification process. This plan proposes the schedule and means by which compliance with the requirements will be achieved and the means by which certification data and supporting records will be made available to the FAA for review.

c. Hardware and Software Environment. The computerized AFM software application may be FAA-approved independent of the hardware and software environment in which it is installed. A common example of this would be the development of a computerized AFM software application to be run in a commercial-off-the-shelf (COTS) hardware and software environment. The applicant should provide for item (1) as follows, plus either item (2) or (3), as appropriate:

(1) A mechanism, such as an installation utility function or test set, that verifies the proper functioning of the computerized AFM software application in the target software and hardware environment. The verification check should include, but not be limited to, proper functioning with hardware specified in the AFM, including input and output devices, and with resident software, including terminate-and-stay-resident or other control programs such as Microsoft Windows, and with any operating system calls made by the AFM software.

(2) If the computerized AFM is intended for a COTS hardware and software environment, installation information that describes the minimum requirements, including limitations and constraints, for the software and hardware environment.

(3) If the computerized AFM is intended for a specific hardware/software system, installation information that describes the specific hardware and software environment in which the computerized AFM software application must be installed. Additionally, the applicant should provide a configuration management scheme that ensures the hardware and software environment that will be used in service is identical to the environment specified in the FAA-approved installation data.

d. Revisions to a Computerized AFM Software Application.

(1) Revisions to an FAA-approved computerized AFM should be submitted for evaluation and FAA-approval in accordance with software development methodology

established in paragraph 6b of this appendix. A log of FAA-approved AFM software application parts should be furnished by the applicant. For historical purposes, the applicant should maintain records from which the information from any approved revision level of the computerized AFM can be reproduced, unless none of the affected airplanes remain in operational service.

(2) The applicant should submit a description of the proposed changes and an updated plan for software aspects of certification. In addition, the applicant should:

(i) Re-assess the software integrity level (paragraph 6a of this appendix) of the revised computerized AFM;

(ii) Demonstrate that the revisions do not affect any of the unrevised portions of the computerized AFM; and

(iii) Demonstrate that the revisions are compatible with the hardware and software environment intended for the computerized AFM software application.

(3) The computerized AFM software application is not intended to be user-modifiable software (under the definition of user-modifiable software provided in DO-178B). Revisions to a computerized AFM can be made only by the TC or STC holder of that computerized AFM. STC applicants may supplement but not revise a TC holder's computerized AFM.

(4) When revisions are incorporated, a means (e.g., document) of indicating those parts of the software that have been changed should be provided.

(5) Each revised software element should be identified in the same manner as the original, with the exception of the new date or revision notation (see paragraph 6a(3) of this appendix).

e. Submittal and FAA-Approval of Software.

(1) The applicant will be considered the responsible party for all matters pertaining to the computerized AFM software application, including submittal to the FAA and obtaining FAA-approval.

(2) The applicant and the FAA shall discuss and agree on the data structures and calculation models.

(3) The applicant should provide any part of the hardware environment necessary for operating the computerized AFM that is not readily available to the FAA.

f. Documentation Requirements. Documentation containing the following information should be provided by the applicant to the FAA:

(1) Approval plan that describes the software aspects of certification, including time schedules, an outline of the desired applications, and design objectives for software and data integrity.

(2) Software development plan, including the methods used to accomplish the design objectives.

(3) Software descriptions, including justifications that program structures and calculation models are appropriate to their intended function.

(4) Data verification document, including a description of the scope and depth of the review, analysis, and tests used to determine that the developed software and generated output accurately reflect the airplane performance characteristics. This description should include the purpose of each test case and the set of inputs, expected results, test environment, and calculated results.

(5) Operating instructions, including all information for proper use of the computerized AFM, installation instructions, and identification of the suitable hardware and software environment.

(6) Software configuration reference, including a log of the approved software elements and a statement that design objectives of the approval plan and compliance with the guidelines of this appendix have been demonstrated.

7. PROVISIONS FOR FAA POST CERTIFICATION ACCESS TO COMPUTERIZED AFM. In the plan for software aspects of certification, the applicant should propose which components of the computerized AFM will be submitted to the FAA. In cases where the AFM software application can be installed on FAA equipment, the applicant need only provide the computerized AFM software application, which includes the installation data and operating guide. However, if the computerized AFM software application requires a hardware and software environment that is not available to the FAA, the applicant should also provide the appropriate FAA certification offices with the necessary components to access the AFM software application.

8. PROVISIONS FOR PUBLIC ACCESS TO COMPUTERIZED AFM. The AFM is necessary for the safe operation of an airplane and is considered public information. Public disclosure of AFM information is necessary. Recognizing that the computerized AFM software application may also contain data, analysis methods, and operating systems that are proprietary

to the applicant, the FAA will not provide direct public access to the software, unless the applicant states that public access is authorized. To satisfy the need for public disclosure when public access to the software application is not authorized, the FAA will use the computerized AFM to generate a limited number of discrete computer results or other AFM information requested by the public.

U.S. Department
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**Federal Aviation
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