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DETAIL SPECIFICATION
FLIGHT MANUALS, AIR REFUELING PROCEDURES, AND ABBREVIATED CHECKLISTS

This specification is approved for use by the Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE.

1.1 Scope. This detail specification covers the requirements for the preparation of four (4) types of flight manuals and three (3) types of abbreviated flight manual checklists for all types of aircraft. This specification also includes air refueling procedures that are to be incorporated in the flight manuals and checklists. These procedures will provide flight crews with standard procedures and the data to engage in air refueling operations as dictated by mission requirements. This specification contains appendices which will allow for the tagging of flight manual information for digital delivery to the government. These will allow the flight manual to be prepared in either a paper or electronic presentation. In addition to "paper" delivery, this specification provides for standard generalized markup language (SGML) document type definition (DTD) usage (see appendixes A through C). All appendixes are intended for compliance when required; however, requirements that are not applicable to a specific aircraft will not be included. Further, any features applicable to a specific aircraft, but not specified herein, will be included in the manual unless waived by the acquiring activity (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: MSG/MMF, 4375 Chidlaw Road, Suite 008, Wright-Patterson AFB, OH 45433-5006 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC F7030 **AREA TMSS**

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1.2 Types of manuals. The four types of manuals covered by this specification are:

Flight Manual (eight sections) (see 3.3, 3.3.10, and 6.2)

Performance Data Manual (see 3.4)

Mission Crew Manual (see 3.5)

Supplemental Manual (see 3.6)

2. APPLICABLE DOCUMENTS.

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

SPECIFICATIONS

Military

MIL-PRF-5096	Military Specification, Manuals Technical: Inspection and Maintenance Requirements; Acceptance and Functional Check Flight Procedures and Checklists; Inspection Work Cards; and Checklists; Preparation of

STANDARDS

Military

MIL-STD-38784	Manuals, Technical - General Style and Format Requirements

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Joint Service Specification Guides

JSSG-2001	Air Vehicle
JSSG-2006	Aircraft Structures
JSSG-2010	Crew Systems

HANDBOOKS

Military

MIL-HDBK-1221	Manuals, Commercial Off-The-Shelf (COTS)
MIL-HDBK-1793	Flight Performance, Air Vehicle
MIL-HDBK-1797	Flying Qualities of Piloted Aircraft

(Copies of the above specifications, standards and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or www.dsp.dla.mil.)

2.2.2 Other government documents, drawings, and publications. The following other government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation (see 6.2).

PUBLICATIONS

Air Force Technical Manuals

TO 1-1B-50	Weight and Balance

Air Force Policy

AFH 11-203	Weather for Aircrews
AFMAN 11-217	Instrument Flying
AFI 11-215	Flight Manual Procedures
AFI 13-203	Air Traffic Control

(Copies of documents required by contractors in connection with specific procurement functions should be obtained from the acquiring activity or as directed by the contracting officer.)

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Government Printing Office (GPO)	Publication 310.1	Quality Assurance Through Attributes Program

(Copies of these documents are available from the Superintendent of Documents, U.S. Government Printing Office, North Capitol and "H" Streets, NW, Washington, D.C., 20402 or www.access.gpo.gov.)

2.3 Non-government publications. The following document(s) forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

U.S. Standard Atmosphere, 1976

(Application for copies should be addressed to the Superintendent of Documents, US Government Printing Office, Washington, D.C. 20402.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS.

3.1 Function of the manuals. The primary function of the manuals is to describe the aircraft, its equipment, and their operation, characteristics, and restrictions. Sufficient information shall be included so that a flight crew can operate the aircraft safely and efficiently. Some systems may require individual normal and emergency procedures, malfunction analysis, and alternate operations to provide maximum utilization of malfunctioning equipment. Duties that can be performed by either the pilot or another crew member shall be assigned to the other crew member to minimize the pilot's duties. These manuals are not designed to teach basic duties, but how to apply knowledge of basic duties to the operation of the system. Emphasis shall be placed on any variations to basic duties that are created by unique characteristics of the system.

3.2 General requirements. Unless otherwise specified, the manner of preparation and format for all manuals shall be in accordance with the requirements of MIL-STD-38784, except as follows:

a. The flight manual (including supplemental and mission crew manual) shall be arranged by sections and subsections (rather than chapters) and performance data shall be arranged by parts. All new sections and new parts shall begin on a right-hand page.

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b. Critical emergency and minimum reaction items shall be prepared in 10 point, extra bold, uppercase letters.

c. Performance data shall be published as a separate manual, or when specified by the acquiring activity, as an appendix within the flight manual (see 6.2).

d. Tables, charts, and graphs shall be considered illustrations and shall be identified and numbered as figures. Figure numbers in the performance data shall include the performance data letter and part number. For example, the first figure in performance data A, part 2 will be numbered Figure A2-1.

e. Paragraph numbering shall be in accordance with MIL-STD-38784, except that they only go to three indentures.

f. Section and part headings shall be 18-point boldface uppercase.

g. Sideheads shall conform to the following:

(1) Primary sideheads: 14-point, boldface, uppercase letters, with no text run-in.

(2) First subordinate sideheads: 10-point, boldface, uppercase letters, with no text run-in.

(3) Second subordinate sideheads: 10-point, boldface, uppercase and lowercase letters, with no text run-in.

(4) Third subordinate sideheads: 10-point, lightface, uppercase letters, with no text run-in.

(5) Fourth and all subsequent sideheads: 10-point, lightface uppercase letters, with the text run-in.

h. Subsection headings shall be 16-point, boldface, uppercase letters. A subsection is a major subdivision of a section. Subsection titles shall be centered at the beginning of each subsection. Subsections shall not be numbered. When subsections are used, there shall be at least two in a section. Subsections shall be divided into primary and subordinate sideheads, as required.

i. Page numbers for flight, supplemental, and mission crew manuals

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shall be as specified in MIL-STD-38784. Page numbers of the performance data shall include the performance data letter and the part number. For example: performance data A, part 1, page 1 shall be numbered A1-1, and performance data B, part 3, page 2 shall be numbered B3-2.

3.2.1 Warnings, cautions, and notes. The use Warnings, cautions, and notes, shall be in accordance with MIL-STD-38784, except that warnings and cautions shall follow the paragraph/procedure. Warnings and cautions used in flight manual checklists shall be held to an absolute minimum. Unless otherwise specified, only the most critical warnings and cautions will be included in the checklists. These warnings and cautions shall be approved by the acquiring activity (see 6.2). Unless otherwise specified, if warnings or cautions contained in the flight manual are not included in the checklist, the checklist line item shall be followed by a "W" or a "C" (see 6.2).

3.2.2 Consistency. All material in the flight manual and associated checklists shall be reviewed for consistency throughout the manual and with any other applicable manuals; for example, the takeoff technique specified in Section II of the manual shall be based on takeoff data presented in the performance data. All apparent or actual inconsistencies shall be corrected or explained.

3.2.2.1 Part nouns. Part nouns shall be specified by the acquiring activity, standardized, and not necessarily as reflected on the engineering drawings (see 6.2).

3.2.3 Duplication of procedures or techniques. The requirements of MIL-STD-38784 apply, except as specified herein, for specific emergency and alert requirements.

3.2.4 Use of color. Limited use of color is authorized in the flight manual. It's use shall be restricted to illustrations where standard black and white print will not effectively convey or highlight the required information. For illustrations depicting danger zones; the color red shall be used to identify hazardous areas; the color yellow shall be used to identify areas of potential hazard and the color green shall be used to identify safe areas. Unless otherwise specified by the acquiring activity (see 6.2), color shall be used to distinguish flow patterns on complex hydraulic, fuel, bleed, airflow, and electrical diagrams. Color illustrations portraying multi-function (glass cockpit) components and other displays such as color weather radar, shall be representative of the actual display.

3.2.5 References within the manual. The requirements of MIL-STD-38784 apply. References to figures shall not be used in procedures.

3.2.5.1 References. General temperature references, in air refueling procedures, shall be given in degrees Celsius in lieu of degrees Fahrenheit. In lieu of requiring the text to refer to speed and distance readings as calibrated by the equipment, the speed and distance readings shall designate if the reading is indicated, calibrated, true, etc. Further, the

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readings shall indicate the units, e.g., nautical miles, feet, seconds, etc.

3.2.6 References to other publications. The requirements of MIL-STD-38784 apply. As a general rule, reference may be made only to other flight manual publications.

3.2.7 Safety and operational supplements. Formal Safety and Operational Supplements shall be prepared to the requirements of MIL-STD-38784, except as specified by this paragraph.

3.2.7.1 Aircrew notices. The following notes shall be included (as specified below) in all flight manual safety and operational supplements. These notes shall be placed immediately after the title block and date of the supplement and before the purpose (see Figure 1).

3.2.7.1.1 Instruction notice. The following notice shall be included on all flight manual safety and operational supplements.

NOTICE TO AIRCREWS

- Write the number of this supplement alongside the changed portion of the Flight Manual in pencil.

3.2.7.1.2 Checklist notice. The following notice shall appear on all flight manual safety and operational supplements affecting checklists.

- This supplement affects your Flight Crew Checklist. Remove the checklist page(s) from the supplement and insert them in the checklist. Retain original checklist page(s).

3.2.7.2 Supplement title page changes. In the title block of either the safety or operational supplement, replace the words "Technical Manual" with the words "Flight Manual".

3.2.7.3 Status page for flight crew manual supplements. The last page of each formal flight manual safety/operational supplement shall consist of a supplement status page formatted similar to Figure 2.

3.2.7.4 Abbreviated checklist pages for flight manual supplements. Flight manual supplements containing information that affects related abbreviated flight crew checklists shall include temporary checklist pages which reflect the supplemental information. The checklist pages shall be marked on the affected side, opposite of and in line with the page number with the identifier **OPERATIONAL SUPPLEMENT** or **SAFETY SUPPLEMENT**, as applicable. The flight manual supplement number shall be placed in parenthesis at the top of the page, opposite of and in line with the technical order (TO) number. In addition, each affected area or step shall be preceded with the identifying code

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"**(S)**". The supplement identifier, supplement number, and identifying codes shall be presented in uppercase, 10-point, bold type. Refer to Figure 3 for an example abbreviated checklist supplement page.

3.2.7.4.1 Class 1 supplement pages. Class 1 supplement pages shall be provided as single-sided, pre-cut or ready-to-cut pages which can easily be inserted into the vinyl sleeve and over the top of the existing page.

3.2.7.4.2 Class 2 supplement pages. Class 2 supplement pages shall be provided as double-sided, pre-cut, prepunched ready-to-insert replacement pages. The supplement pages shall be printed on material of the same color which meets or exceeds the durability standards of the existing checklist pages.

3.2.8 Changes to the flight manuals. Changes to the flight manuals shall be prepared to the requirements of MIL-STD-38784, except as specified by this paragraph.

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T.O. 1F-13A-1S-15

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

F-13A AIRCRAFT

THIS PUBLICATION SUPPLEMENTS T.O. 1F-13A-1 DATED 31 AUGUST 1984, CHANGED 1 MAY 1985. Reference to this supplement will be made on the title page of the basic manual by personnel responsible for maintaining the publication in current status.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AF PERSONNEL

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Published under authority of the Secretary of the Air Force

17 JULY 1987

NOTICE TO AIRCREWS

- Write the number of this supplement alongside the changed portion of the Flight Manual.
- This supplement affects your Flight Crew Checklist. Remove the checklist pages from the supplement and insert them in the checklist. Retain original checklist page(s).

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OPERATIONAL SUPPLEMENT

FIGURE 1. Example of supplement title page.

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T.O. 1E-3A-43-1-1S-66

STATUS PAGE

This page is published with each formal Safety and Operational Supplement for Flight Manual Program publications. It contains a listing of the affected Flight Manual and its related Supplements and Checklists current on the date of this publication. Changes or revisions in production are shown in parentheses.

AIRCREW FLIGHT MANUAL	BASIC DATE	CHANGE NO./ DATE
T.O. 1E-3A-43-1-1	1 JUL 82	24 30 NOV 91

FLIGHT CREW CHECKLISTS	BASIC DATE	CHANGE NO./ DATE
T.O. 1E-3A-43-1-1CL-4	1 JUL 82	22 21 OCT 91
T.O. 1E-3A-43-1-1CL-5	1 JUL 82	21 21 OCT 91
T.O. 1E-3A-43-1-1CL-6	1 JUL 82	20 30 NOV 91
T.O. 1E-3A-43-1-1CL-7	1 JUL 82	22 30 NOV 91

SAFETY AND OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE
1S-63	12 DEC 91	SRCP 1C/2C DELIVERY
1S-64	4 FEB 92	TCTO 547 SUP DATA
1S-65	18 FEB 92	HF 1 RESTRICTION
1S-66	10 APR 92	COMM PROCEDURES

INCORPORATED, RESCINDED, OR DELETED SUPPLEMENTS

1S-38	15 DEC 90	INCORPORATED IN CHG 13
1S-59	1 JAN 91	RESCINDED

FIGURE 2. Example Supplement Status page.

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(TO 1F-4(R)C-1S-275) **TO 1F-4(R)C-1CL-1**

TAXIING

1. Wheel Brakes - TEST
2. Nose gear steering - ENGAGE & CHECK
3. (P-WSO) Flight instruments - CHECK OPERATION
4. (P-WSO) Oxygen diluter lever - AS REQUIRED
5. (P) Electronic altimeter - ON, SET CLEARANCE PLANE
6. (WSO) Electronic altimeter - CHECK

(S) 7. (P-WSO) FLR - CHECK

(S) 8. (WSO) FLR mode selector - STBY

9. (P-WSO) RWR/ECM - AS REQUIRED
10. (WSO) Sensor checks - AS REQUIRED
11. (WSO) Window defog - ON

BEFORE TAKEOFF

1. (P-WSO) Harness & leads - FASTENED
2. Internal wing transfer switch - NORMAL
3. Tanks 5&6 lockout - AS REQUIRED
4. Stab aug switches - ENGAGE
5. Flight controls - UNRESTRICTED (WSO visually check control surfaces)
6. Anti-ice switch - AS REQUIRED
7. Stabilizer trim - CHK 1 TO 3 UNITS NOSE DN
8. Fuel quantity - CHECK
9. (P-WSO) Canopies - CLOSE, CHECK
10. Defog-footheat & temp control - AS REQUIRED
11. (WSO) Command selector valve
12. (P-WSO) Lower ejection handle safety guard - CLEAR
13. Warning lights/voice warning system - CHECK

After runway lineup -

14. External transfer switch - AS DESIRED
15. Flaps - DOWN
16. Anti-skid - ON, LIGHT OUT

OPERATIONAL SUPPLEMENT **Change 3 2-17**

FIGURE 3. Example abbreviated checklist supplement page.

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3.2.8.1 Status page for change packages. When specified (see 6.2), a status page shall be provided as part of the change package. This status page shall be similar to the status page for flight manual supplements (see Figure 2), with the following exceptions.

a. The lead-in statement shall read:

> This page is published with each change package for Flight Manual Program publications. It contains a listing of the affected Flight Manual and its related Supplements and Checklists current on the date of this publication. However, formal Safety and Operational Supplements that are issued after the publication of this change, will contain a more current version of the status page. Changes or revisions that are in production are shown in parentheses.

b. The status page for changes shall be located immediately following the final page of the List of Effective Pages. It shall be numbered with an alphanumeric number which follows sequentially the last page of the List of Effective Pages. The page number and change designator shall be located as specified in MIL-STD-38784.

3.2.9 Extent of coverage. The extent of coverage shall be governed by the criteria specified in 3.2.9.1 and 3.2.9.2.

3.2.9.1 Complexity. Systems complicated by many controls or several modes of operation may require more coverage than a system that is simple. This should not be construed to require extensive coverage of systems that are complex in their configuration but simple in their operation. If complex equipment or operation concerns only part of the flight crew or concerns only special personnel, then a mission crew manual shall be prepared, unless otherwise specified by the acquiring activity (see 6.2).

3.2.9.2 Experience level of intended operating personnel. Coverage shall be governed by the fact that the manual shall be suitable for use by personnel expected to operate the equipment. The acquiring activity, in coordination with the using command(s), will determine the content and the complexity of the coverage of the manuals.

3.2.10 Abbreviations and symbols. Symbols used in this specification are contained in JSSG 2010.

3.2.11 Paragraph headings.

3.2.11.1 Use of "system" and "general." The word "system" shall be used in paragraph headings where possible; for example, the required primary heading shall be, "ELECTRICAL SYSTEM," not "ELECTRICAL CONTROLS," and "FUEL SYSTEM," not "FUEL SYSTEM CONTROL." (General headings of this type permit the inclusion of

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information concerning the system in general, its controls, and its indicators under a single primary paragraph heading.) The subordinate paragraphs shall have headings, such as,"FUEL SYSTEM CONTROL" and "FUEL SYSTEM INDICATORS." The heading, "GENERAL", shall not be used unless no suitable substitute can be determined.

3.2.11.2 Selection of headings. Paragraph headings shall be selected to facilitate reference to the text. The paragraph headings appearing in this specification need not be used in the manual; for example, the heating, the ventilating, and the pressurization systems will sometimes be covered under separate headings. In other installations, because of the complete interdependence of the systems, the heading, "air conditioning system" may be used more advantageously. Paragraph headings shall not be included simply to show that the concerned subject matter is not applicable, unless a commonly expected item is omitted from the aircraft and failure to make reference to that item would be interpreted by the reader as a publication error. Paragraph headings and explanations shall be included to indicate that certain portions of the manual will be added as soon as tests have been completed or that the applicable material may be found in another manual. Each paragraph shall have a heading or shall be immediately preceded by a paragraph heading.

3.2.12 Procedures. Procedures to accomplish any normal or emergency action that the flight crew may reasonably be expected to encounter shall be included. Procedures are those actions by a crew member involving the positioning of controls or the technique of operating the aircraft and its systems.

3.2.12.1 Presentation of procedures. Procedures shall be presented in checklist form, in text, or in tabular format, as appropriate. Numbering of primary and subordinate steps shall be in accordance with MIL-STD-38784.

3.2.12.1.1 Flight manual procedural requirements. Unless otherwise specified by the acquiring activity (see 6.2), the pilot and copilot procedures shall be combined in a single column. Where multiple columns are specified, each column shall have a heading in bold type identifying the crew member. Each item should be stated as briefly as possible with the subject being first and then the required action; e.g., "Start levers - CUTOFF." If it is intended that a system be placed in a particular configuration rather than only the control, reference to the control is omitted; e.g., "landing gear - DOWN", not "landing gear lever - DOWN". In cases where controls must be positioned but the system is not necessarily placed in operation, the control name (lever, switch, etc.) shall be included. If a procedure is affected by conditions existing when the action is performed, the words "AS REQUIRED" shall be substituted for the usual action; e.g. landing lights - AS REQUIRED. An explanation covering the different positions in which the controls must be placed in accordance with existing conditions shall follow this entry unless such information is obvious. If necessary to designate action by specific crew members, the designations shall be accomplished by means of capital letters such as:

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P	Pilot	DSO	Defense System Officer
N	Navigator	G	Gunner
E/FE	Engineer/Flight Engineer	O	Observer
LM	Loadmaster	RN	Radar Navigator
BO	Boom Operator	CSO	Communications Systems Operator
GC	Ground Crew	S	Scanner
OSO	Offensive Systems Officer	WSO	Weapons Systems Officer

3.2.12.1.1.1 The crew designator may follow (preferred method) the action item; or the crew designator may be placed in front of the procedure. In either case, the location of the crew designator shall be consistent throughout the manual and shall be approved by the acquiring activity (see 6.2). If more than one crew designator is listed, the sequence of listing shall indicate the order of reporting. Procedures that are provided to define aircraft and system operation techniques are generally presented in paragraph form.

3.2.12.1.1.2 Additional crew designator letters may be used if required and identified by the acquiring activity (see 6.2).

3.2.12.1.2 Abbreviated checklist requirements. Procedures included in the abbreviated flight manual checklists shall be obtained directly from the flight manual. Checklist procedures may include amplifications, but shall be kept to a minimum. The inclusion of warnings and cautions shall be as specified in paragraph 3.2.1.

3.2.12.2 Procedure amplifications. Amplifications of actions shall be accomplished by either an explanatory sentence following the item or by substeps (1), (2), (3), etc. Examples are:

a. Gear - UP

   Check that the landing gear position indicators display the word UP, and that the landing gear handle warning light is out.

b. Flight recorder - Check, then OFF

   (1) Flight recorder switch ON, observe OFF light goes out.

   (2) Insert headset plug at monitor panel to check time remaining.

   (3) Flight recorder switch OFF, observe OFF light illuminates.

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3.2.12.3 Coordinated action. If a procedure requires simultaneous or coordinated actions, the actions shall be arranged in parallel columns, chronologically, and numbered in the proper sequence. No attempt need be made to have like numbers opposite one another in the columns. If it is necessary to show that the action in one column must be delayed until a series of actions in another column have been completed, the former column shall be left blank until the required point opposite the latter column is reached. Coordinated procedures or techniques for which a checklist is not applicable (such as starting engines or takeoff) shall be provided in a tabular figure. This table shall have two or more columns (one for each crew member) and the actions shall be arranged in chronological order as in a coordinated checklist. Actions in the tabular format shall be written in sentence form without numbered steps. In a checklist, if coordination is required between the pilot and some other crew member, a circle shall be placed around the step number to identify the required coordination. If the action taken is to be reported to the person reading the checklist, the action shall begin quotation marks. Action that is not in quotation marks indicates that the crew member completes the action and remains silent.

3.2.12.4 Lengthy procedures. Where a phase of operation or a lengthy procedure spans several pages, consideration shall be given to a breakdown into subsections. Titles of continued procedures shall be duplicated on succeeding pages (e.g., INTERIOR INSPECTION - Continued).

3.2.12.5 Codes for types of operation. Codes identifying a type of operation, where procedures differ from the normal, shall precede the numbered item. If only one such operation is being covered, it may be desirable to use an asterisk (*) or other symbol. Such a symbol shall not be used elsewhere in the procedures to indicate another meaning. The use of **(S)** is reserved exclusively to identify areas within abbreviated checklists which were affected by current flight manual supplements (see 3.2.7.4).

3.2.12.6 Procedures for checklist. Procedures contained in sections, other than the Normal Procedures, Emergency Procedures, Mission Crew Duties and Procedures Sections, shall be incorporated into checklists, when applicable. When this is required, the procedural item shall refer to the procedure location within the flight manual, for example, "3. Oxygen - checked (refer to oxygen system Section I)."

3.2.12.7 High risk areas. All high risk situations, maneuvers, and procedures shall be emphasized throughout the manual. The appropriate response(s) in high risk conditions shall be stated.

3.2.13 Systems, controls, and indicators. Each major system installed on the aircraft shall be covered under a major heading. The name of the system shall be used as the primary paragraph heading and the name of each component, control, or indicator as the subordinate heading. Sufficient views to illustrate all instruments and controls in all operating crew member compartments shall be included. The requirements of this paragraph apply whenever there is a need to present system operation information. The

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description of the systems shall be covered as follows:

a. An introductory paragraph shall cover the basic concept, function, and integration of the system. Specific controls may be mentioned. However, a detailed discussion of the system shall be avoided in order to maintain the general nature of the introductory paragraph. Information such as automatic features and sources of power may be included in the introductory paragraph. This information shall be fully described in the detailed description. A reference shall be made to the servicing diagram for fluid specifications (see 3.3.3.42).

b. A detailed description on the operation of each system installed on the aircraft shall be provided. Normal and alternate procedures shall be provided. Information on the peculiarities and automatic features of the system shall be included. Information shall be given regarding items such as source of power to operate the system (mechanically, electrically, or hydraulically operated) and means by which the system accomplishes its functions. The internal mechanics of the system shall be described only insofar as necessary to make comprehension of the system complete. The integration of the system with other aircraft systems shall be fully described, including the effects that each system could have on the other.

c. Each control, contributing to the operation of the system, shall be described, and its location established. The description shall include the function of the control and the operation of each control setting. A detailed description on how activation of the control accomplishes the end result shall be stated (mechanically, electrically, or hydraulically). An example is, "The landing gear lever mechanically releases the uplocks and electrically positions the hydraulic selector valve." (not, "The landing gear lever operates the landing gear."). Descriptions of controls used in the normal operation of a system shall be listed first, followed by descriptions of those controls used as backups to the normal controls. The description of the controls and the indicators for a complex system may be included in chart or tabular form for purposes of clarity.

d. All indicators, instruments, and warning devices which are part of the system shall be fully described as outlined below:

(1) The location of the indicator, instrument, or warning device.

(2) If not included in the detailed system description, include the function.

(3) Power and input data sources for the instrument/instrument displays. Effects of sensor limitations on the displays.

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(4) Erroneous indications leading to unsafe operations.

(5) Alternate input data sources for instruments, including degradation of indications that may result from use of alternate data.

(6) If an indicator is very closely related to a single control, the indicator may be described in the paragraph covering the control.

3.2.14 Illustrations. A general arrangement diagram (see 3.2.14.5), and an adequate number of illustrations to show the controls operable by the flight crew shall be included. Cockpit and compartment views shall be included, to fully illustrate the areas that are used by flight personnel. Illustrations shall be added to the manual as necessary to simplify the comprehension of equipment and procedures. Illustrations shall be located with their related text.

3.2.14.1 Types of illustrations. The use of illustrations shall be based on clarity and economy of presentation, performance of function, and factual representation.

3.2.14.2 Callouts. Callouts on illustrations shall begin with the number 1 at the top left-hand corner and shall be arranged numerically in clockwise order. If a clockwise arrangement is not practical, the callouts shall be arranged in lines reading from left to right or top to bottom. Keys and callouts are not required for illustrations on which the names of the controls are legible on the printed page. Where the illustration will not suffer from overcrowding, nomenclature callouts may be used in place of numerical callouts and figure keys.

3.2.14.3 Panels and consoles. Repetitive views of panels and consoles to illustrate differences between groups of aircraft shall be avoided. Panels that are not identical in all the aircraft of a given series shall be labeled "typical" and no attempt shall be made to show minor variations in arrangement. Variations in the addition and deletion of controls and instruments shall be indicated by inserts and by notations in the figure key. The panels or consoles may be illustrated more than once if major changes in configuration are involved.

3.2.14.4 Schematic (flow) diagrams. Schematic diagrams, prepared in accordance with MIL-STD-38784, shall be used as necessary to show the "flow" of systems such as the hydraulic, fuel, electrical, and bleed systems. A drawing shall be included to provide the reader with a mental picture of the equipment and it's location, while the schematic diagram is studied in detail. The drawing shall be presented on a separate page preceding the schematic diagram unless space permits location on the same page. The schematic diagram shall illustrate the operation of the system in a manner as straightforward as possible. To accomplish this, the components of the schematic diagrams shall be presented in the following order of importance:

a. The flow of the system shall receive primary importance by having a

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minimum of turns in the lines. It shall be presented so that it can be read from left to right and top to bottom. The flow shall include such items as generators, tanks, and reservoirs, which are considered to be the starting point of most schematic diagrams. The diagram shall be arranged so that the flow of the system can be traced with minimum of effort. Crossovers shall be avoided or eliminated where possible. Return lines need not be shown in their entirety unless required to enhance the understanding of the system. To avoid any suggestion of electrical wiring diagrams, all electrical flow lines on electrical schematic diagrams shall be represented by wide bands as opposed to thin lines. This requirement shall not be construed to include electrical actuation lines which shall be represented by thin black lines.

b. A separate pattern shall be used for each individual system on any one illustration that will distinguish between the supply, pressure, and return systems. The same coding for each individual system shall be used throughout the manual.

c. Controls and indicators used by flight crews shall be second in importance only to the flow of the system. They shall be made to stand out by being presented in their actual shape as well as being emphasized by means of shading. Controls and indicators shall be set off slightly to the side. Controls on electrical diagrams may be placed directly on the flow lines.

d. All flow control devices within the system, such as check valves, fuel pumps, accumulators, and relays shall be identified. Solenoid valves shall be indicated as such and shall include a notation indicating whether the valve is spring loaded to the open or closed position. Once a symbol or device is established for a valve or control, it shall be used for this type valve throughout the manual. Where diagrams are complex by virtue of the equipment's automatic features or interrelated controls, such characteristics shall be covered by means of explanatory text in the diagram instead of by schematic representation. On schematic diagrams such as electrical, where a large number of items are listed, the items shall be presented in alphabetical order.

3.2.14.5 General arrangement diagrams. Each manual shall contain a diagram entitled "general arrangement diagram." This diagram shall illustrate the arrangement of the aircraft, including items such as external power receptacles, batteries, water containers, auxiliary power unit (APU), entrance doors, hatches, engine cover and tool kits, and other loose equipment. These diagrams shall not include individual controls, aircraft systems, or emergency equipment. The general arrangement diagram shall consist of one or more diagrams as necessary to accomplish their function. The remaining information that must be covered may either be included in this diagram or segregated into one or more separate illustrations as indicated herein for the crew movement diagram and compartment

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diagram. If desirable, two or more of these illustrations may be combined into one diagram "Crew Movement and Compartment." The following requirements shall be applicable to these diagrams.

a. The crew movement diagram shall illustrate the various routes available to the crew to move about the aircraft.

b. The compartment diagram shall illustrate and identify each compartment that can carry cargo or that can be entered by flight personnel. It shall identify each crew member, normal location, and depict dimensions of usable space of each compartment. The length shall be depicted by the portrayal of fuselage station numbers by compartment.

3.2.14.6 Exterior of aircraft. Views of the exterior of the aircraft shall not contain squadron or any other identifying insignia.

3.2.14.7 Foldouts. Foldout pages shall not be required in the air refueling section.

3.2.15 Nomenclature. The name used for an item of equipment shall be consistent throughout the manual. The name may be shortened provided the identity of the equipment is not confused.

3.2.15.1 Nomenclature for equipment, controls, and indicators. All equipment, controls, and indicators shall be identified by titles that are descriptive of their configuration and function, and shall be compatible with their placarded or decaled nomenclature, if possible. Titles shall be kept as short as possible, but provide adequate differentiation between similar items. Examples are:

a. Use "fuel selector handle," not "fuel selector control," and "flap lever," not "flap control."

b. If there is a switch with a decaled nomenclature of "EMER GEN," use "emergency generator switch." No attempt should be made to refer to this control as the "EMER GEN switch" simply to duplicate its exact decaled nomenclature.

c. If two systems (e.g., hydraulic and fuel) each have an isolation valve switch, then each shall be further identified as "hydraulic isolation valve switch" and "fuel isolation valve switch."

3.2.15.2 Nomenclature for control positions. Reference to a labeled control position shall be shown in uppercase letters; quotation marks shall not be used for this purpose. Where applicable, duplicate the exact labeled position (e.g., "Armament selector knob - STBY"). Reference to an implied position shall be indicated by capitalizing the first letter, with

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remaining letters in lower-case (e.g., "Flaps circuit breaker - pull").

3.2.15.3 Standard terminology. The requirements of MIL-STD-38784 apply. Terminology shall be consistent with the intended operator's standard usage. Where applicable, the following standard terminology shall apply:

a. References to a crew member shall be made by position occupied and not by qualification.

b. Cockpits in tandem seat aircraft shall be labeled "front" and "rear."

3.2.16 Quoting of numerical values. To the extent possible, a single appropriate location shall be used for quoting any numerical value or values so that if the value is changed, only one place in the manual will require changing. For example, system capacities should be discussed under the system description but limiting values such as maximum or minimum pressures would be covered in Section V. References shall be made to the place containing the information. In the case of operating procedures in Section II, for example, "...advance the throttle to max power" rather than to repeat the value shown in Section V for maximum power.

3.2.17 Operating limitations and restrictions. All operating limitations and restrictions shall be thoroughly covered (see 3.3.7). An explanation for the limitation or restriction shall be included when further clarification is needed. Limitations of a numerical value shall be rounded to the nearest readable figure consistent with the component or system concerned, not to exceed maximum system limits.

3.2.18 Instrument accuracy. Acceptable tolerances and fluctuations of instruments shall be stated if they are significant to the operation of the aircraft. Limitations which cannot be detected by the crew member shall not be imposed.

3.2.19 Multipurpose controls. Controls that are used to operate more than one system, such as a fuel and oil shutoff switch or a bomb-rocket-drop tank release button, shall be mentioned in connection with each system concerned. Detailed coverage regarding the control shall be included under the primary system. Reference shall be made to the other system description as necessary.

3.2.20 Equipment location. Familiar objects shall be utilized in locating equipment. Stations or bulkhead numbers are acceptable only when they are identifiable to the flight crew. If two or more compartments exist, each shall be identified.

3.2.21 Aircraft designation. Reference to the aircraft by model or series designation shall be avoided throughout the manual; for example, the reference shall be "The aircraft is equipped with ..." not "The F-22A is equipped with ..." Reference to a specific model or series, as necessary, is permissible in a manual containing several models or series.

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3.2.22 Airspeeds. All airspeeds for takeoff, climbout (obstacle clearance), approach, landing, stall speed, and associated charts shall be presented in the airspeed format needed by the primary crew member using the information. The flight crew shall not be required to convert airspeeds while utilizing procedural data or the associated charts.

3.2.23 Identification of various groups of aircraft. Effectivities or distinctions between groups of aircraft shall be made only when such information is of definite value to the flight crew in the operation of the aircraft. The two methods normally used to quote effectivities or distinctions between various groups of aircraft are: (1) noting the applicable serial/block number range, or (2) by means of a coding system. Wherever practical, visual cues should be used for differentiation; e.g., if some aircraft are equipped with a tail hook system and the detailed effectivity has been previously defined, then a procedural line item may be "Tail hook - DOWN (SOME AIRCRAFT)" or "Tail hook - DOWN (If Installed)." If a coding system is utilized, the following shall apply:

a. Paragraphs that do not cover all the aircraft listed on the title page shall be identified by a selected code. The code shall appear at the top left-hand corner and prior to each paragraph heading or procedural step to which the code applies. This requirement means that every paragraph requiring an identification code shall have one properly placed, even if there are several paragraphs applicable to the same version presented in succession.

b. Paragraphs that are applicable to all series of the aircraft shall not carry a notation.

c. Notes, cautions, and warnings shall be treated as individual paragraphs for coding purposes.

3.2.24 Aircraft affected by modification. Coverage for aircraft affected, either in production or by modification, shall be identified. Areas identified should be arranged so that, when all aircraft are modified, nonapplicable material can be removed without an entire rewrite of the area.

3.2.25 Security classification. Unless otherwise specified, the flight manual and associated checklists shall be unclassified (see 6.2). If classified data is required, the data shall be placed in a separate supplemental manual (see 3.6). Classified data shall be marked to the requirements of MIL-STD-38784.

3.3 Flight manual. Unless otherwise specified, the flight manual shall consist of eight sections. When specified, the associated performance data shall be provided as an appendix within the flight manual (see 3.4). The acquiring activity shall specify the types of manuals and abbreviated checklists to be procured (see 6.2). All sections shall begin on a right-hand page starting with an introduction paragraph. The arrangement of each section shall be as specified herein and shall be changed only with the approval of the acquiring activity (see

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6.2). If sections are added, the additional sections shall follow Section VIII and shall be numbered consecutively starting with IX. Titles for the additional sections must be approved by the acquiring activity (see 6.2). If a given section is not required, a stand-alone section title page shall be provided (on a right-hand page) along with a notation stating the section does not apply. If the section has been replaced by a supplemental manual (i.e. a mission crew manual), the section title page shall provide a reference to the related manual by TO number and title. The following section shall begin on the next right-hand page. The arrangement of the flight manual shall be as follows:

a. Front matter - (see 3.3.2)

b. Section I - Description and Operation (see 3.3.3).

c. Section II - Normal Procedures (see 3.3.4).

d. Section III - Emergency Procedures (see 3.3.5).

e. Section IV - Mission Crew Duties and Procedures (see 3.3.6).

f. Section V - Operating Limitations (see 3.3.7).

g. Section VI - Flight Characteristics (see 3.3.8).

h. Section VII - Adverse Weather Operation (see 3.3.9).

i. Section VIII - Air Refueling Procedures (see 3.3.10 and 6.2)

j. Additional Sections as approved by acquiring activity.

k. Performance Data (when specified) (see 6.2).

l. Glossary.

m. Alphabetical Index.

3.3.1 Trainer version aircraft. When applicable, a discussion shall be included to describe the essential differences between the basic aircraft and its trainer version. The discussion shall be limited to those differences affecting flight crew operation of the aircraft and performance variations. This data may be included in the main differences table (see 3.3.3.1.4). Unless otherwise specified by the acquiring activity this data may be included in accordance with j or within Sections I through VIII and the performance data (see 6.2).

3.3.2 Front matter. The general manner of preparation of front matter for the flight manual, performance data manual, supplemental manual, and the abbreviated flight

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manual checklist shall be in accordance with MIL-STD-38784 except as specified below.

a. Title page (see 3.3.2.1).

b. List of Effective Pages (see 3.3..2.2).

c. Verification Status Page (see 3.3.2.3).

d. Table of Contents (see 3.3.2.4).

e. List of Illustrations (see 3.3.2.5).

f. Foreword/Preface/Introduction (see 3.3.2.6).

3.3.2.1 Title pages. Title pages for flight manuals, performance data manuals, and supplemental flight manuals shall be in accordance with the requirements of MIL-STD-38784, with the exception of the following special requirements.

a. For flight manuals: The words "TECHNICAL MANUAL" shall be replaced by FLIGHT MANUAL.

b. For performance data manuals: The words "TECHNICAL MANUAL" shall be replaced by:

FLIGHT MANUAL
APPENDIX 1
PERFORMANCE DATA

c. For supplemental manuals: The words "TECHNICAL MANUAL" shall be replaced by:

SUPPLEMENTAL
FLIGHT MANUAL

3.3.2.1.1 Supersedure notice. The supersedure notice for a change or revision shall be placed on the title page in accordance with MIL-STD-38784. It shall include a list of all currently incorporated operational and safety supplements as well as a reference to the appropriate technical order index for the current status of flight crew flight manuals, operational and safety supplements, and checklists. When no operational or safety supplements are replaced, the notice shall read: "REFER TO TECHNICAL ORDER INDEX TO (applicable TO number) FOR CURRENT STATUS OF FLIGHT MANUALS, SUPPLEMENTS AND CHECKLISTS."

3.3.2.1.2 Supplemental manual reference. When a separate supplemental manual (performance data, classified, etc.) has been developed (see 3.6), a reference that the flight manual is incomplete without the supplemental manual shall be included on the title page.

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A similar reference to the flight manual shall be included on the title page of the supplemental manual. These references shall remain on the title pages as long as the supplemental manual exists.

3.3.2.1.3 Emergency procedure notice. One or both of the following statements shall appear on the title page of classified flight manuals, including changes, revisions, and applicable supplements. The acquiring activity will select the appropriate statement(s) (see 6.2).

> "When Section III, Emergency Procedures, is withdrawn from this manual for use in control towers, and if there is no classified information in Section III, the security classification of Section III shall be cancelled."
>
> "Radio transmission in the clear of pertinent emergency operating instructions contained herein is authorized under emergency conditions in accordance with AFI 13-203."

3.3.2.2 List of effective pages. A list of effective pages shall be prepared in accordance with MIL-STD-38784. A list of the current abbreviated flight crew checklists shall be provided at the end of the List of Effective Pages. This list shall include the basic or revision date, change number and date, and checklist title. This list shall be entitled "CURRENT FLIGHT CREW CHECKLISTS." When the option for Status Page for Changes (see 3.2.8.1) has been exercised, the list of Current Flight Crew Checklists shall be omitted from the List of Effective Pages on other than the basic issue or revision edition of the manual.

3.3.2.3 Verification status page. All flight manuals and associated checklists containing unverified procedures shall have a verification status page prepared in accordance with MIL-STD-38784.

3.3.2.4 Tables of contents. Each manual shall have a table of contents as specified in 3.3.2.4.1. A table of contents shall be included at the beginning of each section, at the beginning of the performance data, and at the beginning of each part of the performance data. Closely related primary paragraphs grouped on one or two pages shall not be listed individually in the tables of contents but shall be listed as a single entry designating the general subject matter. When a classified supplement is involved, the same principles established for the main table of contents shall be followed (see MIL-STD-38784).

3.3.2.4.1 Main table of contents. The main table of contents shall consist of the section headings, section numbers, and the number of the first page of each section. If a classified supplement is involved, the following principles shall apply to the basic flight manual: the complete table of contents shall be included; if any (unclassified) portion of an affected section appears in the basic manual, the table of contents entry shall be included; if no portion of an affected section appears in the basic manual, the table of contents shall refer only to the publication number of the classified supplement. The table of contents shall not

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refer to the fact that only a portion of a given section is included.

3.3.2.5 List of illustrations. A list of illustrations shall be prepared in accordance with MIL-STD-38784.

3.3.2.6 Foreword/Preface/Introduction. The introduction shall contain the scope of the manual and any other pertinent data. The page shall be identified by one of the following terms "FOREWORD," "PREFACE," or "INTRODUCTION." The introduction shall include the definitions of notes, cautions, and warnings and the usage of the words "shall," "will," "should," and "may," as defined in MIL-STD-38784. The information contained in the checklist or supplemental manual introduction shall not duplicate information in the flight manual introduction. The introduction shall also include the following information altered to fit the specific flight manual:

SCOPE.

This manual contains information which will provide you with a general knowledge of the aircraft, and its characteristics and specific normal and emergency operating procedures. Your flying experience is recognized; therefore, basic flight principles are avoided. This manual provides you with operating instructions useable under most conditions. This does not alleviate the need for sound judgement in your operation of the aircraft. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedure(s) presented in this manual.

PERMISSIBLE OPERATIONS.

The flight manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance from higher headquarters must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA.

Refer to the AF TO Catalog web page https://www.toindex-s.wpafb.af.mil for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also, check the flight manual title page, the title block of each safety and operational supplement, and the latest status page contained in the manual, or the latest safety or operational supplement. Clear up all discrepancies before flight.

ARRANGEMENT.

The manual is divided into eight independent sections to simplify reading it straight

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through or for using it as a reference manual. The aircraft performance data is located (the contractor shall insert either the appendix or TO number).

SAFETY SUPPLEMENTS.

Information involving safety will be promptly forwarded to you in a safety supplement. Urgent information is published in interim safety supplements and transmitted electronically. Formal supplements are mailed. The supplement title block and status page should be checked to determine the supplement's effect on the manual and other outstanding supplements.

OPERATIONAL SUPPLEMENTS.

Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

CHECKLISTS.

The flight manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures. Amplifications may be included, but shall be kept to a minimum. Primary line items in the flight manual and checklist are identical. If a formal safety or operational supplement affects your checklist, the affected checklist page will be attached to the supplement.

HOW TO GET INDIVIDUALLY ASSIGNED COPIES.

Each flight crew member is entitled to receive individually assigned copies of the flight manual, safety supplements, operational supplements, and checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer - it is their job to fulfill your TO requests. TO 00-5-1 and 00-5-2 give detailed information for properly ordering these publications.

FLIGHT MANUAL BINDERS.

Loose leaf binders and sectionalized tabs are available for use with your manual and checklists. They are obtained through local purchase procedures and are listed in the General Services Administration (GSA) Supply Catalog (FSN 7510, Office Products). Check with your supply personnel for assistance in acquiring these items.

WARNINGS, CAUTIONS, AND NOTES.

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The following definitions apply in "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING

Operating procedures, techniques, etc., which could result in personal injury and/or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc., which is considered essential to emphasize.

YOUR RESPONSIBILITY - TO LET US KNOW.

Every effort is made to keep the flight manual current. Review conferences with operating personnel, and a constant review of accident and flight test reports, assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual, or any phase of the flight manual program, are welcome. These should be forwarded on AF Form 847 as directed by AFI 11-215 through your command headquarters.

3.3.2.6.1 List of time compliance technical orders (TCTOs). A list of TCTOs (aircraft modifications) shall be included as a part of the Foreword/Preface/Introduction. The list shall be prepared in accordance with MIL-STD-38784 but shall be limited to those aircraft changes that are meaningful to the flight crew (see 6.13). The acquiring activity and the contractor should agree to use a common information service to determine when the entire fleet has been modified or the TCTO has been rescinded (see 6.2).

3.3.3 Section I - Description and operation. This section of the manual shall describe the aircraft, its controls, and installed equipment. It may be desirable to combine some subjects or to arrange them so that systems of a particular type are together; e.g., all hydraulically powered systems. In some manuals it may be desirable to arrange the subjects alphabetically. Section I shall include normal operation of systems and equipment and, if applicable, malfunction analysis information and alternate operation. These data may be presented in itemized procedural form and may be included in the flight crew checklist. Theory of operation may be included to adequately cover complex systems. Any

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features that are applicable to a specific aircraft, but are not specified herein, shall be included, unless waived by the acquiring activity. The order of subjects and content will be determined by the acquiring activity (see 6.2). Where appropriate, references shall be made to Section V for system/subsystem operating limitations and capabilities.

3.3.3.1 Aircraft general. This paragraph shall provide the aircrew with general aircraft information including general weight class, design, primary and alternate missions, and general operational characteristics. For aircraft with multiple crew members, this portion of the manual shall also define various crew requirements for the aircraft. These requirements shall be based on the following criteria:

a. A normal crew complement consists of the crew members required to accomplish the assigned mission.

b. A mission crew is the complement required to accomplish the aircraft's designed mission.

c. A minimum flight crew consists of the absolute minimum number of crew members required to takeoff, fly, and land the aircraft safely.

d. An emergency crew is the absolute minimum crew required to takeoff, fly, and land the aircraft where risk is involved and loss of the aircraft is likely.

3.3.3.1.1 Aircraft dimensions. The overall dimensions of the aircraft shall be discussed and illustrated. The reader shall be referred to Section II for turning radius and ground clearances.

3.3.3.1.2 Aircraft gross weight. The approximate gross weight of the aircraft in various configurations shall be listed. It shall be clearly stated that these weights shall not be used for operation or computing aircraft performance. Reference shall be made to the -5 series technical order for detailed weight and balance information.

3.3.3.1.3 Interior arrangement. A general description of the interior arrangement of the aircraft, including typical diagrams of the general arrangement, crew movement, and compartments shall be provided (see 3.2.14.5).

3.3.3.1.4 Main differences table. The main differences table shall indicate the main differences in design and operation between each aircraft series covered in the manual and other closely related series of the same model. Special emphasis shall be placed on new features which will affect recognition and operation. This table shall be brief, and located as near the beginning of the section as possible.

3.3.3.2 Engine. A general description of the engine and all its related controls, including special features of the engine, shall be provided. For the purpose of the manual, the

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description of engine feeder systems, such as fuel and oil supply systems, shall end where the systems deliver their product to an engine driven device (i.e., the oil pump). The description shall include the model designations of all engines used on the aircraft.

3.3.3.2.1 Engine thrust. A general description of the development of thrust or horsepower shall be provided. Where applicable, the description shall include the range of climatic conditions where maximum power can be obtained. Reference shall be made to the performance data (see 3.4.10.2).

3.3.3.2.2 Engine oil system. Data on all controls affecting the oil system shall be included. Engine oil pressure and temperature gauges shall be covered under engine instruments (see 3.3.3.2.6). A schematic of the engine oil system shall be provided.

3.3.3.2.4 Engine fuel control system. This system applies to all engines equipped with a fuel controlling device (a jet engine uses a fuel control; a reciprocating engine uses a carburetor or fuel injection device). When applicable, special emphasis shall be placed on the emergency systems. Any systems affected by throttle operation such as afterburner or water injection, system components such as fuel pumps and heaters shall be described. Coverage of carburetors or injection devices shall include items such as mixture, carburetor heat, and air filter. Schematics of the engine fuel control shall be provided.

3.3.3.2.4 Starting and priming system. These systems and associated controls shall be described. The point at which priming fuel is injected shall be stated.

3.3.3.2.5 Associated engine systems. Descriptions shall be provided for the following associated engine systems as applicable.

a. Compressor surge bleed system.

b. Afterburner.

c. Supercharger.

d. Water injection system including quantity, duration of supply, use, and controls.

e. Intake and exhaust area including the controls and indicators used in varying the intake and exhaust area, and any unusual features or characteristics of the system.

f. All equipment and controls provided for cooling of the engines.

g. The ignition system and its controls.

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h. Engine thrust reverser system operation.

i. Throttle system and all systems affected by throttle operation, such as water injection and propeller reversing.

j. Transmission system (the system utilized to transmit power from the engine to the propeller or rotor). A system schematic shall be provided.

k. Propeller or rotor and the system for controlling, feathering, or disengaging.

l. Type of assist takeoff units that are to be employed, where and how they are installed, and any special precautions regarding their use.

3.3.3.2.6 Engine instruments. All instruments that indicate engine condition or operation shall be described (see 3.2.13d and 3.3.3.2).

3.3.3.2.7 Engine operation. Each phase of engine operation from engine start to engine shutdown shall be described.

3.3.3.3 Engine overheat and fire detection system. These systems shall be described.

3.3.3.4 Engine fire extinguisher system. This system shall be described. Descriptions of equipment with dangerous agents shall include a warning spelling out the dangers, and precautions to follow when using the equipment.

3.3.3.5 Auxiliary power unit(s) (APU). The APU system, compressor assembly, power turbine assembly, accessory assembly, oil system, fuel system, starting system, special control, fire detection and warning system, and fire extinguisher system shall be described.

3.3.3.6 Air turbine motor/ram air turbine. The air turbine motor/ram air turbine operation and cooling shall be described. Descriptions of all components shall be included.

3.3.3.7 Oil supply system. Components of this system, such as tanks, pump, and cooler shall be described. Unless otherwise specified, a schematic diagram of the oil supply system shall be included. A reference shall be made to the servicing diagram (see 3.3.3.42) on oil grade and specification requirements.

3.3.3.8 Fuel supply system. The fuel supply system shall be fully described. Descriptions shall be provided for the following as applicable:

a. Fuel tanks.

b. Tank venting.

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c. Drop tank release controls.

d. Boost pumps.

e. Gravity pumps.

f. Jettisoning.

g. Single-point ground refueling system.

h. Any requirements for special fuels, what the fuel is used for, and what tanks are to be used in servicing.

i. Air refueling system (with appropriate references to Section VIII and air refueling operating procedures).

NOTE: A statement shall be made that approved fuel grades and applicable specifications are covered in the servicing diagram (see 3.3.3.42).

3.3.3.8.1 Fuel quantity data table. Fuel quantity data shall be given in tabular form. The names of the tanks appearing in the first column shall be identical to the name appearing on the tank selector; a more explanatory title may be carried in parentheses, if desired. The table shall include data on each tank (including dropable and ferry) that is designed for use with the aircraft. Care shall be exercised not to inadvertently quote tank volume as "usable fuel" or "fully serviced". Typical fuel configurations showing the total usable fuel in each case shall be included as a part of this table. For aircraft equipped with fuel quantity gauges reading in pounds, figures denoting pounds shall be followed by the conversion to gallons. A note shall be included indicating that gallon weights are based on a given density in pounds-per-gallon at standard-day temperature.

3.3.3.9 Electrical power supply system. Alternating current (ac), direct current (dc), and emergency or hot bus supply on complex aircraft, including components such as generators, alternators, and batteries shall be described. The relation of APU and external power source to the electrical system shall be covered. Schematics shall be included according to 3.3.3.9.1.

3.3.3.9.1 Electrical system schematic diagram. A schematic diagram shall be provided showing items such as sources of power, controls, bus arrangement, and circuits connected to each bus. Unless otherwise specified, separate schematics shall be provided for ac and dc systems (see 3.3.3.9, 3.2.14.4, and 6.2).

3.3.3.9.2 Circuit breakers and fuses. The location and function of all circuit breakers and fuses under the control of the crew member shall be described. Primary emphasis shall be placed on describing the function and general location in conjunction with the system with

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which it is associated. All major circuit breaker and/or fuse panels shall be displayed with the label of each clearly visible and its location in the aircraft identified (see 3.3.3.9.2.1).

3.3.3.9.2.1 Circuit breaker and junction box diagram. The location of each circuit breaker accessible to and used by the flight crew shall be shown. Each circuit breaker in the panels shall be identified. The location of each junction box containing circuit breakers or fuses shall be included. A circuit breaker index shall be provided for aircraft that have a large number of circuit breakers. The circuit breaker index shall list the aircraft systems alphabetically and list the components alphabetically under each system. The circuit breaker decal name and its location shall be listed next to each component (see 3.3.3.9.2).

3.3.3.10 Hydraulic power supply system. The primary and emergency systems and their related controls shall be described. Data on hydraulic pumps, suction boost pumps, reservoirs, and power transfer units shall be included. A schematic of each hydraulic power supply system shall be provided. A list of systems operated by each hydraulic power supply system shall be included.

3.3.3.11 Pneumatic power supply system. This system shall be described in the same manner specified for the hydraulic power supply system.

3.3.3.12 Bleed air supply system. The engine and APU bleed air supply systems shall be described. A schematic diagram of the system and a list of systems supplied with the bleed air shall be included. The bleed air duct overheat detection system shall also be described.

3.3.3.13 Landing gear system. This system, including information covering gear extension and retraction, position of gear doors when gear is extended, extension and retraction times, shall be described. A schematic of the landing gear system shall be provided. Complex and unique gear systems (i.e., ski systems) shall be discussed separately. Emergency gear operations shall be discussed.

3.3.3.14 Ground steering system. Items such as nose gear steering system, main gear steering, emergency steering, and crosswind positioning shall be described.

3.3.3.15 Brake system. The brake system, including the anti-skid system, shall be described.

3.3.3.16 Drag chutes and arresting equipment. Applicable types of aerodynamic drag devices and arresting hooks shall be described.

3.3.3.17 Wing flaps, slat system, and boundary layer control. All flaps, slats, boundary layer control, or other lift devices shall be described. Extension and retraction times shall be included.

3.3.3.18 Wing sweep system. This system shall be described. Precautions to be observed

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during operation and flight shall be included. The sweep settings which lead to optimum flight for various conditions such as takeoff, landing, and supersonic flight shall be listed.

3.3.3.19 Wing fold systems. This system shall be described. Precautions to be observed to ensure that wings are locked in the spread condition shall be included.

3.3.3.20 Speed brake system and spoiler system. All systems used for aerodynamic braking shall be described.

3.3.3.21 Stall limiter system. This system and associated equipment such as computers, angle Of attack (AOA) indicators, and warning devices shall be described.

3.3.3.22 Flight control systems. Primary and secondary flight controls, trim devices, locking devices, and control column shall be described. A schematic of the flight control systems shall be included.

3.3.3.23 Automatic flight control system. Automatic flight control and augmentation systems, including operational checkout procedures and normal operating procedures, shall be described.

3.3.3.24 Pitot static system. This system, including pitot-static heat, shall be described and all components receiving inputs from it shall be listed.

3.3.3.25 Flight instruments. The aircraft flight instruments/instrument displays and their associated systems shall be described. Detailed description and operation of individual instruments is not required if the same information is provided in other documents (such as AFMAN 11-217) that are readily available to the flight crew. The requirements of paragraph 3.2.13d apply to the description of the instruments.

3.3.3.25.1 Integrated flight displays. Integrated flight displays, including head up displays (HUD) and glass cockpit displays (GCD) shall be illustrated and described in detail. Dynamics, scale, and sign convention of analog displays shall be described. Unique color representations (color meaning) for integrated displays shall be defined. Limitations/restrictions on the use of integrated displays in night or instrument meteorological conditions (IMC) shall be described. Where flight instrument displays are interchangeable with other displays (i.e., on multi-function displays), the required display format for IMC or night flight shall be specified.

3.3.3.25.2 Flight instrument terminology. The terminology used for flight instruments shall be consistent with those in AFMAN 11-217.

3.3.3.25.3 Auxiliary flight reference system. This system shall be described.

3.3.3.26 Doors, hatches and ladders. Operation of doors, hatches, and ladders shall be

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described. Instruction for entry into the aircraft, if the entry is not obvious, shall be included. A diagram(s) of all doors, hatches, and ladders shall be shown to clearly indicate their location, operating handles or levers, and safety indicators.

3.3.3.27 Canopies. All controls, both external and internal, shall be described. Canopy defrost, including the settings required for high altitude and the prevention of frost or fog accumulation during rapid descent, shall be described. A diagram(s) of all canopies and their controls, indicating the opening, closing, and safety positions, shall be included.

3.3.3.28 Seats, ejection seats, and modules. Crew member seats shall be described. Ejection seat (module) and controls emphasizing how they are affected by other systems shall be described in detail. Applicable hardware, including survival equipment, automatic safety belt controls, triggering device for the automatic parachute, and its correct attachment shall be described. Appropriate illustrations of the equipment components shall be included.

3.3.3.29 Air conditioning system. Air source, air conditioning units or heaters, distribution, temperature regulation, air flow regulation, controls, indicators, and system operation shall be described. The air conditioning system may be covered as one system, or as several systems as noted in 3.3.3.29.1 through 3.3.3.29.5. A schematic of the air conditioning system, indicating the location of key system components of both the air conditioning and the pressurization systems, shall be included.

3.3.3.29.1 Compartment heat systems. Separate heating system(s) for compartments shall be described.

3.3.3.29.2 Pressurization system. The source and effects of pressurized air for both normal and emergency operation shall be described. A pressurization chart depicting the cabin altitudes that can be maintained at any given aircraft altitude and the maximum cabin-to-ambient pressure differential shall be included.

3.3.3.29.3 Windshield rain removal system. Rain removal systems such as bleed air, windshield wipers, repellent systems, controls, and system operation shall be described.

3.3.3.29.4 Anti-icing and de-icing systems. Information for de-icing of the wings, tail, propellers, pitot heads, temperature probes, angle of attack (AOA) vanes, and engine intakes shall be included. Windshield ice, anti-ice, ice detection, fog protection, and system operation shall be included.

3.3.3.29.5 Avionics equipment cooling system. The system(s) or method(s) provided for cooling avionics or electronic equipment shall be described.

3.3.3.30 Communications and avionics systems. A detailed description, including operation, of all communications and avionics equipment installed on the aircraft shall be

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provided. The characteristics, interrelationship of equipment, power source, and power requirements of these systems shall be described.

3.3.3.30.1 Communications and avionics equipment table. A table of communications and avionics equipment shall be included. The information shall be as follows:

a. Type - Type of equipment such as interphone, command radio, radio compass, identification friend or foe (IFF), long range navigation, and radar altimeter.

b. Designation - Placard nomenclature or applicable Air Force designation.

c. Function - Use of equipment such as intercommunication, short range, two-way voice communication, and instrument landing system (ILS).

d. Operator (for multiple crew member applications only) - Member(s) of the crew responsible for the operation of the equipment.

e. Location - Location of equipment and controls used to operate equipment.

f. Remarks - Any notes, cautions, or warnings, which are important to the operation or concerning its effect on other systems in the aircraft. A specific note stating that no transmissions except for emergency (distress) purposes shall be made on emergency channels.

3.3.3.31 Lighting system. Exterior and interior lighting systems shall be described. When specified by the acquiring activity, a diagram showing areas illuminated by exterior lighting shall be provided (see 6.2).

3.3.3.32 Oxygen systems. Crew and passenger oxygen systems shall be described with the crew system identified prior to the passenger system. An oxygen duration chart shall be prepared for each independent oxygen system in the aircraft. The chart shall show hours of oxygen available for crew and passengers (normal and 100 percent use) for various combinations of oxygen pressure versus altitude (see Figure 4). The locations of all portable oxygen bottles, recharger points, types of regulators, and masks shall be identified.

3.3.3.33 Air data computer. The functions of the air data computer and its controls and indicators shall be described. Systems receiving inputs from the air data computer shall be listed.

3.3.3.34 Armament/weapons system. Reference shall be made to the nonnuclear and nuclear munitions delivery manuals for comprehensive coverage of the armament/weapons system.

3.3.3.35 Stores coverage. Stores coverage shall make reference to Section V of the manual

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or the load configuration manual for limits and configurations.

3.3.3.36 Personnel accommodations. All personnel accommodations such as seats, bunks, comfort facilities, galley equipment, litters, coat racks, and equipment provided for the safety and comfort of personnel shall be described.

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Oxygen Duration (Typical)

OXYGEN DURATION (HOURS)

	COCKPIT PRESSURE ALTITUDE (FEET)	DILUTER LEVER (POSITION)	GAGE QUANTITY (LITERS)				
			5	4	3	2	1
1 CREWMEMBER	35,000 AND UP	100%	30.94	24.75	18.56	12.37	6.19
		NORMAL	30.94	24.75	18.56	12.37	6.19
	30,000	100%	22.63	18.11	13.58	9.05	4.53
		NORMAL	23.00	18.40	13.80	9.20	4.60
	25,000	100%	17.48	13.98	10.49	6.99	3.50
		NORMAL	21.72	17.37	13.03	8.69	4.34
	20,000	100%	13.19	10.55	7.91	5.28	2.64
		NORMAL	24.43	19.55	14.66	9.77	4.89
	15,000	100%	10.62	8.49	6.37	4.25	2.12
		NORMAL	29.86	23.89	17.92	11.94	5.97
	10,000	100%	8.53	6.83	5.12	3.41	1.71
		NORMAL	29.86	23.89	17.92	11.94	5.97
2 CREWMEMBERS	35,000 AND UP	100%	15.47	12.37	9.28	6.18	3.09
		NORMAL	15.47	12.37	9.28	6.18	3.09
	30,000	100%	11.31	9.05	6.79	4.52	2.26
		NORMAL	11.50	9.20	6.90	4.60	2.30
	25,000	100%	8.74	6.99	5.24	3.49	1.75
		NORMAL	10.86	8.68	6.51	4.39	2.17
	20,000	100%	6.59	5.27	3.95	2.64	1.32
		NORMAL	12.21	9.77	7.33	4.88	2.44
	15,000	100%	5.31	4.24	3.18	2.12	1.06
		NORMAL	14.93	11.94	8.96	5.97	2.98
	10,000	100%	4.26	3.41	2.56	1.70	0.85
		NORMAL	14.93	11.94	8.96	5.97	2.98

NOTES

1. Oxygen duration increases as cockpit pressure altitude increases because there is less ambient pressure acting upon the lungs. Therefore, a smaller quantity of oxygen at altitude will expand the lungs to the same size that they were at sea level.

2. Oxygen pressure changes with changes in temperature. As oxygen cylinders become chilled, the pressure is reduced, sometimes quite rapidly. A temperature drop of 100° F will reduce pressure by 20 percent.

FIGURE 4. Example of an oxygen duration chart.

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3.3.3.37 Emergency equipment. All emergency equipment shall be described except equipment which forms a part of a complete system: i.e., emergency landing gear control shall be treated under landing gear system. Emergency equipment to be covered shall include items such as fire extinguishers, emergency alarms, pyrotechnic equipment, axes, signal lamps, and first-aid kits. An illustration showing the location of all the emergency equipment shall be provided.

3.3.3.38 Cargo accommodations and aerial delivery. Accesses and space provided for cargo loading, tiedown provisions, and aerial delivery equipment shall be described. Precautions to be observed, and references to publications providing information for safe transport and delivery of cargo shall be included. Reference to the aircraft -9 cargo loading manual shall be made, as appropriate.

3.3.3.39 Navigation system. This system, its controls and indicators, interrelationship of equipment functions, and power sources and requirements shall be described.

3.3.3.39.1 Navigational aids. Navigational aids not covered under navigation-weapon systems such as terrain following radar, tactical air navigation (TACAN), instrument landing system (ILS), and identification friend or foe/selective identification feature (IFF/SIF) shall be described. Unless otherwise specified, a note advising the pilot to cross check all TACAN bearings with whatever means on-hand, such as airborne radar and ground radar, shall be included.

3.3.3.40 Mission equipment. Special equipment installed on the aircraft to support an assigned mission shall be described. If a mission crew manual (see 3.5) is developed, mission equipment information required to support the mission crew manual shall be located there. A reference to the applicable manual shall be made in Section I of the flight manual.

3.3.3.41 Miscellaneous equipment. A description and location of all equipment not covered elsewhere in the manual shall be included. Miscellaneous equipment shall include items such as protective covers, curtains, signal-light stowage, loose equipment storage, war readiness material kit stowage, chart holders, scroll checklist holders, and personnel warning signs.

3.3.3.42 Servicing diagram. This diagram (see Figure 5) shall provide primary and alternate servicing information and cover items such as tanks, holders, containers, and the service points of all items that could be serviced, utilized, or controlled by the flight crew. Emergency fuels shall not be addressed in the servicing diagram. International symbols and specifications for alternate servicing fluids such as fuel, water, alcohol, hydraulic fluid, anti-icing fluid, fire extinguisher agent, APU, fuel, oil, and other consumables shall be included. Reference shall be made to Section V for restrictions resulting from the use of alternate fluids (see 3.3.7.5.1). The drag chute and the external power cart shall be included as servicing items. Items such as grease and shock strut fluids shall not be

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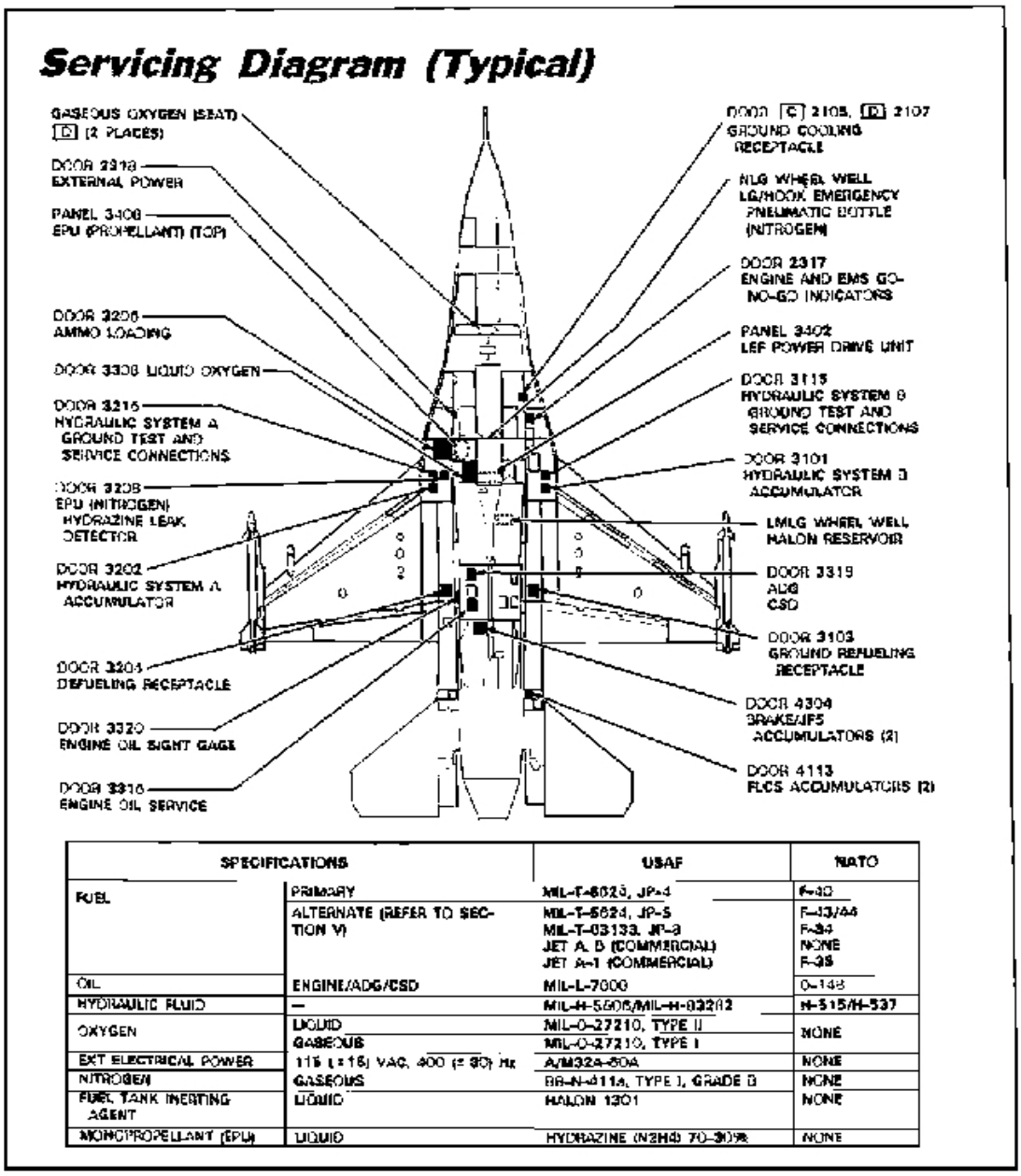

SPECIFICATIONS		USAF	NATO
FUEL	PRIMARY	MIL-T-5624, JP-4	F-40
	ALTERNATE (REFER TO SECTION V)	MIL-T-5624, JP-5 MIL-T-83133, JP-8 JET A, B (COMMERCIAL) JET A-1 (COMMERCIAL)	F-44/44 F-34 NONE F-35
OIL	ENGINE/ADG/CSD	MIL-L-7808	O-148
HYDRAULIC FLUID	—	MIL-H-5606/MIL-H-83282	H-515/H-537
OXYGEN	LIQUID	MIL-O-27210, TYPE II	NONE
	GASEOUS	MIL-O-27210, TYPE I	
EXT ELECTRICAL POWER	115 (±15) VAC, 400 (± 20) Hz	A/M32A-60A	NONE
NITROGEN	GASEOUS	BB-N-411a, TYPE I, GRADE B	NONE
FUEL TANK INERTING AGENT	LIQUID	HALON 1301	NONE
MONOPROPELLANT (EPU)	LIQUID	HYDRAZINE (N_2H_4) 70–30%	NONE

FIGURE 5. Example of servicing diagram.

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included. The servicing diagram shall normally be the last illustration in Section I.

3.3.4 Section II - Normal procedures. This section shall cover the normal duties/procedures of the flight crew. Duties of the mission crew are located in Section IV or the applicable mission crew manual (see3.5).

3.3.4.1 Flight crew normal duties/procedures. This section shall be concerned primarily with the duties of the crew members who directly contribute to the aircraft operation. It shall contain all normal procedures that are required once the crew member arrives at the aircraft, as well as all normal procedures required to accomplish a flight. The procedures shall include all steps required to ensure flight under conditions such as visual flight rules, night, and instrument conditions. Each crew member's duties that contribute to the physical act of flying the aircraft shall be included in this section. (NOTE: Whenever practical, duties shall be assigned to other crew members in order to minimize pilot duties.) All other duties relating to the operation of the installed equipment required to accomplish the assigned mission shall be covered in Section IV. Checking and proper positioning of installed equipment controls shall be included, if neglect of these operations would affect the safety or the efficiency of the flight. Function, operation, or effect of controls shall be repeated here only as required for emphasis. The use of notes, cautions, and warnings shall be held to a minimum so that their importance is not de-emphasized. Complete coverage shall be required regarding unique "feel", characteristics, and reaction of the aircraft during specific phases of operation covered in this section. (Note: Complete flight characteristics shall be described in Section VI.) Detailed coverage of operations such as taxiing, takeoff, climb, and instrument flight shall be included. All precautions to be observed during the various operations shall be covered. All information on emergency procedures shall be located in Section III.

3.3.4.1.1 Flight crew duties. A discussion outlining the primary duties of each crew member shall be covered under a single primary paragraph which shall be subdivided into a introductory paragraph and subordinate paragraphs. The introductory paragraph shall contain a comprehensive description of the primary and alternate functions of the crew member. It shall also include a description of the general duties of the crew member, such as operating the heating system or ascertaining that all hatches in the rear of the aircraft are securely locked. Subordinate paragraphs shall be included as required to present each pertinent phase of flight operation, such as "Before Starting Engine" and "Before Takeoff."

3.3.4.1.2 Introductory material. Introductory material shall be included to apprise the crew of the special problems involved in operating the aircraft and in crew coordination. Matters such as general mission planning and crew and passenger briefing shall be covered.

3.3.4.1.3 Danger areas. For jet and turboprop aircraft, an illustration showing danger areas both forward and aft of engines shall be included (see 3.3.4.1.12). The exhaust temperatures and velocities at various distances aft of the engines shall be included. The

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figures for these exhaust temperatures and velocities shall be provided for maximum power, both with and without afterburner, and for idle power. Danger areas for the auxiliary power unit exhaust, turbine areas, and assist takeoff bottles as well as turbine disintegration area, all radiation and any other danger areas, as applicable, shall be included. Approach and departure areas for helicopters, while rotors are turning, shall be included. The acceptable noise level areas for personnel equipped with muff type protectors, aircraft headsets, and ear plugs, as well as personnel with no protection, shall be reflected. These areas shall be depicted for idle power and maximum power (with and without afterburner). Noise levels shall be presented in graphical form.

3.3.4.1.4 Checklist program. A description of the checklist program shall be provided.

3.3.4.1.5 Sequence of phases, actions, inspections, and checks. Phases, actions, inspections, and checks shall be arranged chronologically and designed to avoid requiring crew members to retrace any steps. All checks shall be made from left to right or top to bottom. Checks shall be grouped to minimize control manipulation and ground operating time.

3.3.4.1.6 Special inspections. Procedures for aircraft flown under special conditions, such as scramble or missions requiring intermediate stops, shall be included. Under these conditions only certain items of the preflight, engine run-up, and other applicable procedures need be accomplished to assure a safe operation. A note shall be included stating, "When takeoff is delayed for extended periods of time during intermediate stops because of conditions such as weather or crew rest, completion of all normal procedures shall be required." For the aircraft in which special operations frequently occur, a code shall be developed to identify each item of a normal procedure that must be performed during the special operation, for example: External power-connected items not coded may be checked at the discretion of the flight crew except when an aircraft has been cocked for scramble. In this case it is imperative that only the coded (see 3.2.12.5) items be accomplished.

3.3.4.1.6.1 Passenger briefing. For aircraft capable of carrying passengers, a line item titled "Passengers Briefed" is required under both the "Before Starting Engines" and the "Descent" checklists. Also, a statement shall be included stating that the pilot is responsible for this briefing. However, it may be delegated to another crew member. A sample passenger briefing card shall be included. The passenger briefing shall be presented as follows:

a. Predeparture - Names of flight crew, destination, altitude of flight, time of flight, use of equipment, location of emergency exits, introduction to alarm bell and other items (such as smoking on military flights).

b. Over-water - Emergency equipment, location of safety jackets, and other items.

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c. Arrival - Advice during descent pertaining to seat belts, local time, no smoking, and like items.

3.3.4.1.7 Flight planning. A requirement, that items such as fuel, airspeed, and power settings be determined as necessary to complete the proposed mission, using the data contained in the performance data (see 3.4.10.9), shall be included.

3.3.4.1.8 Takeoff and landing data card. The reader shall be referred to the appropriate portion of the manual for an illustration of the takeoff and landing data (TOLD) card and the proper means of filling it out. When appropriate, a statement specifying when the card need not be filled out shall be included. The TOLD card shall be included in the flight crew checklist (see 3.7.5 and 3.4.10.9.1.3.1).

3.3.4.1.9 Weight and balance. A statement instructing the pilot to obtain weight and balance data for takeoff and landing shall be included. Reference shall be made to the applicable weight and balance forms within TO 1-1B-50.

3.3.4.1.10 Preflight check. The preflight check shall include all required checks after arrival at the aircraft and prior to starting engines. On larger aircraft, the interior inspection may precede the exterior inspection so that controls may be positioned to facilitate the exterior inspection. The requirements in 3.3.4.1.10.1 through 3.3.4.1.10.4 are typical and should be followed as listed. The flight crew inspection shall be based upon the premise that all required maintenance inspections have been completed.

3.3.4.1.10.1 Before inspection . A requirement directing that appropriate maintenance forms be reviewed for status of the aircraft and that the required maintenance inspections have been completed and signed off shall be included.

a. Before exterior inspection, the proper position of all controls affecting safety shall be covered. All other actions essential to perform a satisfactory exterior inspection, such as unlocking of the flight controls and noting the position indicated by the trim tab indicators, shall be included.

b. The alarm bell checkout procedures shall precede the application of external and battery power.

c. All matters which must be considered before the interior inspection is initiated shall be covered. This would include matters such as connection and position of external power unit and stationing of personnel outside of the aircraft to assist in the interior inspection.

3.3.4.1.10.2 Exterior inspection. All exterior points to be checked shall be included, emphasizing the major components which have an effect on safety of flight. The inspection shall proceed around the aircraft, presenting the inspection items in a logical sequence. For

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aircraft equipped with external fuel tanks and no direct reading quantity gauge, the following shall be included: "Visually check each tank for fuel level. If quantity is questionable, use dip stick to determine the amount. Assure the caps are replaced and properly secured." Diagrams covering the paths to be followed and the various checks to be made during the exterior inspections shall be included.

3.3.4.1.10.3 Interior inspection. The complete interior inspection shall be described and shall include the following, as required:

a. A check to ascertain that all miscellaneous equipment (see 3.3.3.41) is stowed as required.

b. Positioning of all applicable controls and the checking of all applicable indicators.

c. Insofar as practical, all controls shall be positioned as required for engine starting.

d. Functional checks for all the systems, which can be performed before the engines are started.

e. For aircraft in which engine power is not necessary, flight controls shall be checked for free and correct movement.

f. Check headrest area of the ejection seat to determine if the face curtain handles are properly stowed, the catapult pin is installed and connected to the removal mechanism, and the catapult firing yoke is properly positioned and connected.

g. Instructions that the controls be positioned as necessary to facilitate exterior inspection. Instructions to reposition any controls set to facilitate the exterior inspection shall be included. (Applicable only for the aircraft where the interior inspection is performed before the exterior.)

h. Instructions on the use of external power or on-board auxiliary power units, and any necessary switching involved in its use.

i. Interior inspection diagram for large aircraft.

3.3.4.1.10.4 Before starting engines. Precautions to be observed and checks to be accomplished "Before Starting Engines" shall be included. These are checks that could not be properly accomplished during the interior inspection, such as routing of anti-g suit hose, oxygen system, seats and pedals, safety belt and shoulder harness, and parking brake. If applicable, a passenger briefing as described in 3.3.4.1.6.1 shall be included.

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3.3.4.1.11 Starting engines. Complete procedures for starting engines, including the starting order for multi-engined aircraft, shall be provided. For jet and turboprop aircraft, procedures to avoid hot starts and precautions to be observed when a hot start is experienced shall be included. Instructions outlining the restrictions related to the possible effects of adverse weather during engine start (see 3.3.9.2) shall be included.

3.3.4.1.12 Engine ground operation. Engine speed for warm-up and ground operation shall be specified in revolutions per minute (RPM). Any special precautions or requirements (i.e., operation in supercooled fog etc.) shall be included. Reference shall be made to danger area illustrations for hazardous operation (see 3.3.4.1.3).

3.3.4.1.13 Before taxiing. All checks to be accomplished before taxiing, such as check of flight controls for free and correct movement, checkout of the automatic flight control system, hatches and doors, IFF/SIF, standby control locks, hydraulic pressure, chocks, obtain clearance to taxi, advising crew, and check safety belt fastener shall be included. Checks of the safety lock pins may be performed prior to taxiing.

3.3.4.1.14 Taxiing. All information which is useful to the pilot while taxiing, such as the melting and freezing of ice on painted stripes, precautions to help avoid ground accidents during the day and night, engine operation, engine power settings, checking of flight instruments, and crosswinds, shall be included.

3.3.4.1.14.1 Turning radius and ground clearance diagram. A diagram illustrating minimum turning radius and ground clearances for items such as wings, gear, propellers, and rotors shall be included. A caution denoting the outward sweep of swept-wing aircraft during turns shall be included.

3.3.4.1.15 Engine run-up. Complete instructions for checking items such as engine and propeller operation including power and ignition shall be included. Means of assuring that the propeller is not in reverse pitch shall be covered. The proper use of brakes during run-up shall be described.

3.3.4.1.16 Before takeoff. All checks that must be accomplished prior to takeoff, such as trim tabs, altitude indicator setting, wing sweep position, and flap/slat position, hydraulic pressure, shall be listed. If applicable to the aircraft and not accomplished prior to taxi (see 3.3.4.1.13), the safety lock pins shall be checked and removed prior to takeoff.

3.3.4.1.17 Line up. Items required to be accomplished between "Before Takeoff" and "Takeoff" phases shall be included. The procedures shall be as brief as possible.

3.3.4.1.18 Takeoff. Takeoff shall be the period when the aircraft is lined up on the runway and power is applied for the takeoff run until the aircraft is airborne and cleaned up for the after takeoff climb. The transition to forward flight for helicopters shall be considered a part of the takeoff. The takeoff discussion shall include information covering an engine

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failure during takeoff and a reference to Section III for the appropriate emergency procedures. A description of the takeoff, covering procedures necessary to complete a normal takeoff shall be included. The normal takeoff shall be the one upon which the takeoff data, in the performance data, is predicated (see 3.4.10.3.1.3.1). A statement of this fact shall be included. As a minimum, the following shall be included in the takeoff procedures:

a. Use of controls to overcome engine torque, if applicable.

b. Force required to lift nose wheel or tail wheel, if applicable.

c. Conditions that may affect takeoff such as runway surface covering (RSC), runway condition reading (RCR), crosswind, runway length, runway slope, ambient conditions, and obstacle clearance (see 3.4.10.3.1.5.8).

d. Takeoff configuration such as external stores, center of gravity (CG) location, gross weight, and flap position (see 3.4.10.3).

e. Effect of trim changes that may be required after breaking ground.

f. Recommended procedures such as the use of brakes, anti-skid, flaps, and trim; and the effects of deviating from the recommended procedures.

g. Peculiarities of the particular type of aircraft (for example: Vertical/short takeoff and landing aircraft, conventional aircraft, and helicopters).

h. Peculiarities of the particular model (for example: Some aircraft reach flying speed before they reach rotation speed with forward CG).

i. High altitude takeoffs and runway requirements.

j. Means of determining when a takeoff should be aborted.

k. Effects of wake turbulence (wing tip vortices) on the specific aircraft being covered. Include time interval before taking off behind helicopters, large aircraft, etc. Include procedures to be used such as attempt to remain above and upwind of the preceding aircraft's flight path.

l. Instrument takeoff procedures where they differ from normal procedures or a statement that they are the same.

m. Any other item requiring consideration.

3.3.4.1.19 Takeoff, landing, instrument approach, and missed approach diagrams.

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Diagrams covering each phase of takeoff, landing, instrument approach, and missed approach shall be included. The landing and the missed approach diagrams may be presented separately or as a single illustration. These diagrams are not intended to show paths to be flown but are intended to establish steps of procedure chronologically; therefore, care shall be taken not to imply that the illustrated path must be followed literally. The titles of these illustrations shall include the word "typical" to prevent this misinterpretation. The diagrams shall indicate the specific actions required to accomplish the indicated phase of operation, such as: "release brakes" and "retract flaps in 10 degree increments." Each of these diagrams shall be based on a normal takeoff or landing gross weight. The weight and configuration on which the diagram is based shall be prominently displayed. Emphasis shall be placed on the fact that airspeeds are based on this single weight. To avoid confusion with the checklists the actions in these diagrams shall not be numbered. Depending on the complexity of the aircraft, the variation in airspeeds shall be covered by references to the performance data, percentage of stall, or incremental increases in airspeed with weight of fuel remaining. Tabular presentations showing variation of airspeeds with weight shall not be included.

3.3.4.1.20 Special type takeoffs. Other types of takeoff such as instrument, catapult launched, assisted, short field, and rotor bleed (helicopters), shall be covered, including appropriate "Warnings" and "Cautions". Unusual takeoffs shall be included only with the approval of the acquiring activity and the flight manual manager (see 6.2). For helicopters and conventional aircraft that can be operated from or in proximity of terrains having adverse winds or drafts, coverage with necessary illustrations explaining how to cope with these conditions shall be included.

3.3.4.1.21 After takeoff climb. All actions to be accomplished immediately after takeoff such as braking wheels, retracting landing gear, or retracting flaps shall be included. Applicable provisions for an oxygen system check shall be made. If flap retraction procedure differs under various conditions such as heavy weight or weather, this information shall be included. Minimum airspeed and altitude for retracting flaps shall be covered. For aircraft of highly variable gross weight, the climb shall be covered, and the airspeed at which climb should be started shall be stated (see 3.4.10.3.1.5.19). Maximum angle of bank versus minimum flap retract speed shall be covered. Control of the aircraft under instrument flight conditions from takeoff through acceleration to climb speed shall be included.

3.3.4.1.22 Climb. Normal climb procedures that are required to produce the results stated in the performance data climb charts (see 3.4.10.4) shall be included. Proper positioning of engine cooling flaps and the relation of airspeed to cooling shall be emphasized.

3.3.4.1.23 Cruise. Actions that must be taken when the transition from climb to cruise is made shall be covered. Any particular actions that must be considered during cruise flight shall be covered. Actual procedures shall not be included in this paragraph beyond those required to transition from climb to cruise.

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3.3.4.1.24 Flight characteristics. Reference shall be made to Section VI for information regarding flight characteristics.

3.3.4.1.25 Descent. The procedural steps for the descent phase of operation shall be included. The checklist shall include all checks which must be made immediately before and during descent to land. Normal descent procedures required to produce the results stated in the performance data charts shall be covered in detail. Special instructions regarding various types of descent such as enroute, tear drop, rapid (with spoiler), and rapid (clean) penetration shall be included.

3.3.4.1.26 Holding. Airspeeds and other pertinent information for various holding configurations shall be included.

3.3.4.1.27 Instrument approaches. Procedures for all instrument approaches shall be included. Applicable precautions and restrictions shall be covered. Diagrams to illustrate approach patterns with consideration of aircraft configuration and capability (see 3.3.4.1.19) shall be provided.

3.3.4.1.28 Automatic approach. Preparations, procedures, and precautions to be followed during the automatic approach shall be covered. Unsatisfactory approach indications, and procedures for discontinuing such an approach shall be described.

3.3.4.1.29 Circling Approaches. Aircraft configuration, airspeed, maximum bank angles, and angle of attack shall be described. If the airspeed used during the circling maneuver exceeds the maximum speed allowed for that aircraft's instrument category, the appropriate higher category shall be specified.

3.3.4.1.30 Before landing. All applicable procedures and steps that must be accomplished prior to landing shall be covered (see 3.4.10.8). A fuel check shall be provided. Reference shall be made to the weight and CG limitations covered in Section V.

3.3.4.1.31 Landing. The problems that may be encountered during the landing phase shall be discussed. Normal landing procedures that are required to produce the results stated in the landing charts of the performance data shall be covered (see 3.4.10.8). Procedures such as use of brakes, nose wheel on or off the runway, and drag chute deployment shall be included. The procedures for each type of landing that can be made shall be included. For vertical takeoff and landing aircraft, the transition from conventional flight shall be discussed. The effects of wake turbulence on the landing phase of the specific aircraft shall be covered. Include time interval before landing behind large aircraft, helicopter, etc. Include hazards of penetrating the center of the vortex core. Reference shall be made to Section VII for description of hydroplaning. Unless otherwise specified by the acquiring activity, the information included in this paragraph need not be in checklist form (see 6.2).

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3.3.4.1.32 Go around/missed approach. All instructions such as trim changes and flap settings for executing a go around/missed approach shall be included. Proper throttle use shall be emphasized. A diagram as described in 3.3.4.1.19 shall be provided.

3.3.4.1.33 Touch and go landings. Touch and go landing procedures, including any differences caused by use of the crosswind landing gear, shall be provided. Traffic pattern procedures shall be included, or may be combined with the "Before Landing" or "Touch and Go" procedures provided all essential items are covered. The procedures shall note that touch and go landings introduce an element of danger because of the many rapid actions that must be executed while rolling on the runway at high speed.

3.3.4.1.34 After landing. All checks and operations to be accomplished after turnoff from runway and before the parking area is reached shall be included.

3.3.4.1.35 Hot refueling. If applicable, coverage shall include all procedures required (and necessary precautions to be taken) before entering the refueling area, during refueling, and when departing the area.

3.3.4.1.36 Engine shutdown. The proper procedures for engine shutdown, including all precautions to be observed shall be provided.

3.3.4.1.37 Postflight. Procedures necessary to accomplish the postflight check shall be included.

3.3.4.1.38 Before leaving aircraft. Actions necessary to position all controls and control locks and to secure the aircraft shall be covered. Procedures, as applicable, shall be provided to ensure that classified codes have been removed from any system installed (i.e., IFF/SIF). A requirement for the flight crew to make entries into the AFTO Form 781 recording any flight limits that have been exceeded, shall be included.

3.3.4.1.39 Alert procedures. Since a crew on alert status will use the alert procedures checklist as their master checklist, the alert procedures checklist shall include all the procedures required to operate the aircraft under the alert concept. Once the crew member is in the midst of the alert checklist, there shall not be any reference to the normal procedures checklist. Normal operating procedures contained in the normal flight crew checklist shall be included in the alert checklist. This allows the duplication of those procedures only in the alert checklist. The alert section of the flight manual may contain the normal procedural step without amplification. This will allow for continuity in learning the procedures without having to reference throughout the flight manual. Appropriate references shall be made to the normal operating procedures section in the aircraft flight manual for amplification. Amplification of the alert procedural entries shall be avoided if such amplification is already provided in the normal procedures. The addition of alert procedures shall have no effect on the normal procedures. The following detail requirements applicable to alert procedures shall be included.

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3.3.4.1.39.1 Explanatory material. A complete explanation of the alert concept, the interrelationship of crew members including the ground crew, and the proper use of the checklist shall be included as an introduction to the alert procedures. Each phase of operation shall include an explanation of the purpose of the phase and when it is employed.

3.3.4.1.39.2 Arrangement of the alert procedures. The alert procedures shall be divided into two parts. One part shall be a chronological sequence of events when the aircraft is put on alert, is cocked, scramble is performed, and normal flight is continued. The other part shall be the phases of operation that do not follow any particular chronological pattern. The following example could be the phases of operation for a typical manual:

PREFLIGHT

1. Accomplish "Before Interior Inspection," "Interior Inspection," and "Exterior Inspection" as set forth in the normal conditions.

COCKING

SCRAMBLE

AFTER TAKEOFF-CLIMB
1. After takeoff, return to the normal conditions beginning with "After Takeoff-Climb."

NOTE: The following phases of operation have no particular chronological identification but will have to be used while the aircraft is on alert status as circumstances dictate.

DAILY PREFLIGHT

UNCOCKING

TAXI BACK

1. .....
ETC.

3.3.5. Section III - Emergency procedures. Section III of the flight manual shall describe the procedures to be followed to meet any emergency that could reasonably be expected to occur. The requirements specified in the following paragraphs are not all-inclusive. The emergency section shall be developed based on the best available data for the particular aircraft. Emergency operation of auxiliary equipment shall be covered only insofar as it affects safety of flight. Emergency systems and equipment shall be described in Section I of the manual. Section III shall administer only procedural information. All pages containing

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emergency information shall be bordered by emergency page markings as specified in MIL-STD-38784. Complete coverage regarding the "feel" characteristics, and reaction of the aircraft during various emergencies affecting flight such as flight with one or more engines inoperative and trim failure, shall be provided. All precautions to be observed while coping with an emergency shall be discussed. Combinations of emergencies are normally not covered because of the numerous possible combinations. (see 6.9). Emergency procedures requiring expediency in landing shall be written with full consideration of the expected time-to-failure after initial malfunction of the critical system(s) (see 6.6). The terms "Land as Soon as Possible" and "Land as Soon as Practical" are defined in the introduction to Section III (see 3.3.5.4), and shall be used throughout the section as general guidance (where appropriate) to relate to the aircrew the degree of urgency in landing.

3.3.5.1 Arrangement. The emergency procedures in Section III shall be presented either by phase of operation or by system as specified by the acquiring agency (see 6.2).

3.3.5.1.1 Phase of operation arrangement. If an emergency can occur in more than one phase of operation, it shall be presented in the phase where it is most likely to occur first. When phase of operation arrangement has been specified, the sequence shall be as presented below:

a. Introduction (see 3.3.5.4)

b. General Emergency Procedures (see 3.3.5.5)

c. Ground Operation Emergency Procedures (see 3.3.5.6)

d. Takeoff Emergency Procedures (see 3.3.5.7)

e. In-flight Emergency Procedures (see 3.3.5.8)

f. Landing Emergency Procedures (see 3.3.5.9)

g. Miscellaneous Emergencies (see 3.3.5.11)

3.3.5.1.2 System arrangement. Under the system arrangement philosophy, the General Emergency Procedures portion shall contain such "flight oriented" procedures as; out of control and spin recovery; ejection and bailout; emergency descent; forced landing; ditching and so on. The coverage and content requirements for non-system oriented procedures are the same as for the phase of operation arrangement. When system arrangement has been specified, the sequence shall be as presented below:

a. Introduction (see 3.3.5.4)

b. General Emergency Procedures (see 3.3.5.5)

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c. System Emergency Procedures (see 3.3.5.10)

d. Miscellaneous Emergencies (see 3.3.5.11)

3.3.5.2 Narrative versus numerical presentation. Normally, if the crew member must analyze the emergency to determine subsequent actions, available information needed to help determine the correct action shall be presented in narrative form. All definite procedures shall be presented in numerical steps.

3.3.5.3 Critical emergency procedures. The critical emergency steps (boldface type) in a critical emergency procedure shall be the steps that must be performed immediately without reference to a written checklist. Any other steps, when there is time to consult a checklist, shall be considered noncritical and shall be in standard type. A statement requiring crew members to be able to demonstrate correctly, the accomplishment of bold faced procedures in the published sequence without directly referring to the checklist, shall be included.

3.3.5.3.1 Criteria for determining critical emergency procedures. Critical emergency procedures, if required, shall be selected from the basic emergency procedures by the contractor. These procedures shall be approved by the procuring activity. The criteria for determining a critical emergency procedure shall be as follows:

a. It must be a serious emergency.

b. It must be acted upon immediately with no time to refer to the printed checklist.

c. It must have a reasonable frequency rate.

3.3.5.3.2 Criteria for critical emergency steps. If an emergency procedure is determined to be critical, it shall be as follows:

a. It shall be easy to understand and learn.

b. It shall contain only the items that must be performed immediately to alleviate the emergency sufficiently to permit time for the flight crew to refer to the printed checklist.

c. It shall be as brief as possible.

d. It shall consist of consecutive primary line items. Critical and noncritical emergency steps shall not be intermingled. For example, if steps 1 and 5 are critical, steps 2, 3, and 4 shall also be critical, or the procedure shall be rearranged so that steps 1 and 5 are consecutive line items and not

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intermingled. Further, the sequence shall begin with the first critical procedural step.

e. Line items directing standard action such as alerting the crew and maintaining directional control, or items involving a crew member's analysis and judgment of the particular situation, such as "land as soon as practical", shall not be included as critical emergency steps. This information is addressed in the introduction to Section III.

f. The terms contained in the glossary of terms shall be used to the maximum extent possible without deviating from the requirement to utilize crew station placarded terms.

g. Insofar as possible, the nomenclature used, regarding the action to be performed, shall be the same between aircraft containing like items or procedures.

3.3.5.4 Introduction. The introduction shall include information on the layout and use of the section and a statement outlining the three basic rules to emergency actions. This statement should be similar to: "In all emergencies, the overriding considerations must be to: 1. Maintain aircraft control. 2. Analyze the situation. 3. Take proper action." The introduction shall explain the general information that will not be found in, but will apply to, all critical emergency procedures (see 3.3.5.3.2). An illustration shall be provided to show locations of the miscellaneous emergency equipment (see 3.3.5.12.1). In addition, the introduction shall contain the following definitions for; Land as Soon as Possible; and Land as Soon as Practical.

Land as Soon as Possible - An emergency will be declared. A landing should be accomplished at the nearest suitable airfield considering the severity of the emergency, weather conditions, field facilities, ambient lighting, aircraft gross weight, and command guidance.

Land as Soon as Practical - Emergency conditions are less urgent, and although the mission is to be terminated, the degree of the emergency is such that an immediate landing at the nearest adequate airfield may not be necessary.

3.3.5.5 General emergency procedures. The general emergency procedures shall include all reasonably expected emergencies that could occur in two or more phases of operation or affect two or more systems or subsystems. This grouping is intended to separate the procedures which are treated as an entity and are not associated with a particular phase of operation or system. Care shall be taken to restrict the procedures of this grouping to prevent destroying the phase or system grouping of Section III of the manual and to eliminate confusing cross-referencing during an emergency.

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3.3.5.5.1 Minimum control speeds (air and ground). Minimum control speeds (air and ground) shall be presented either by a single paragraph or by separate paragraphs under the general emergency procedures or in the appropriate phase of operation. The minimum control speed for the aircraft including information such as "with and without" boost and, if applicable, pertinent information in sequence such as gross weight, power available, application, aircraft configuration, crew duties, and recovery techniques shall be discussed. Reference shall be made to the performance data for definitions of minimum control speeds.

3.3.5.5.2 Engine failure under various conditions. Actions to be taken in the event of engine failure under various conditions shall be included. Complete procedures to be followed in shutting down the malfunctioning engine and establishing continued flight shall be included. A diagram covering takeoff, landing and missed approach with one or more engines inoperative (see 3.3.5.12.3), shall be provided. Insofar as possible, the shutdown procedures shall be identical to the procedures required in the event of engine fire. These procedures shall be subdivided under three individual paragraph headings as follows:

a. Maintain necessary control and power - Items such as regaining lost power by advancing throttles and adjusting mixtures on good engines and regaining flight control shall be described in narrative form.

b. Shutdown - The critical steps necessary to stop the engine and prepare to fight a possible engine fire shall be included.

c. Clean-up - The noncritical steps required to completely shutdown the engine, trim the aircraft, and establish necessary power settings for continued flight shall be included. If practical, a common shutdown procedure which is applicable to the various engine emergencies requiring shutdown shall be given.

3.3.5.5.3 Abort and barrier engagement. As applicable, a combined procedure for both abort and barrier engagement (applicable to takeoff or landing) shall be provided. Where applicable, it shall include use of the tail hook. The considerations for making the decision whether to abort and whether to engage the barrier shall be discussed. Engaging the barrier on the approach end of the runway and the type of emergencies which might warrant this engagement, shall be mentioned. Mention shall be made of stores that may be jettisoned on the runway to reduce aircraft weight to barrier and tail hook limitations or to improve configuration and increase probability of engagement and that this jettisoning is done at the pilot's discretion. A narrative comparison of the danger of jettisoning stores on the runway with the improved capability of barrier engagement shall be included.

3.3.5.5.4 Canopy or hatch retention or jettisoning. Where applicable, an explanation of the advantages of retaining the canopy or hatch for crash landing, aborted takeoffs, and barrier engagements shall be included. Instructions to disconnect all leads and restraints, that could delay evacuation before opening the canopy, to minimize the crew members' exposure

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time to dangers such as fires, outside explosions, and debris, shall be included. Instructions to use normal canopy opening procedures and each alternate method to open the canopy shall be included. The safest alternate method and the hazards involved shall be listed first; the second safest alternate shall be listed second and so on, until all methods are included. The canopy breaker tool shall be discussed. (Note: An exception to retaining the canopy is in the case of ditching. In the case of ditching, the canopy should be jettisoned.) It shall also be mentioned that the helmet visor should be in the down position for crash landings, aborted takeoffs, and barrier engagements.

3.3.5.5.5 Landing gear retraction while on the ground. The possibility of retracting the landing gear while the aircraft is on the ground as a last resort to stop the aircraft shall be discussed. Procedures shall be included as necessary.

3.3.5.5.6 Jettisoning external stores. The advantages and disadvantages of jettisoning external stores on the ground and in flight, the types of stores that may be jettisoned and the possibility of jettisoned stores colliding with the aircraft or other aircraft in close proximity shall be discussed.

3.3.5.5.7 Emergency ground egress. Procedures for evacuating the aircraft shall be included. Appropriate warnings such as the inadvertent deployment of a survival kit shall be included. Items such as primary and alternate escape routes and location of doors and escape hatches to be used shall be specified.

3.3.5.6 Ground operation emergency procedures. Ground operation emergencies shall be all emergencies that occur when the aircraft is on the ground except during takeoff and landing. The various types of emergencies which may occur on the ground and the procedures which should be followed to meet each emergency shall be described. An emergency egress illustration shall be provided (see 3.3.5.12.2). The ground operation emergencies shall not include takeoff and landing.

3.3.5.6.1 Engine fire or overheat during start or shutdown. Complete instructions regarding the recommended procedures for addressing an engine fire or overheat condition shall be included. One or more procedures may be necessary depending on the aircraft. Insofar as possible, a common engine shutdown procedure following various engine emergencies shall be used; ideally, it will be the same as the normal engine shutdown procedure.

3.3.5.6.2 Emergency brake system operation during taxi. A discussion of brake failures, most likely to occur, which would warrant use of emergency or alternate brake operation shall be included. Caution against using the emergency brake system if applicable, shall be included. Limitations of the emergency brake system or alternate brake operation shall be mentioned. Pertinent operating information shall be included. Secondary emergencies that may arise from continued operation of an aircraft with a brake system failure, such as loss of hydraulic fluid, shall be mentioned. If applicable, how to prevent such secondary

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emergencies shall be mentioned.

3.3.5.6.3 Loss of nose landing gear steering. A discussion of the steering failures most likely to occur, especially hardcover signals which would warrant use of emergency or alternate steering, shall be included. Pertinent operating information shall be included. Secondary emergencies that may arise from continued operation of an aircraft with a steering failure, such as overheated brakes, shall be discussed.

3.3.5.7 Takeoff emergencies. Takeoff emergencies shall be all the emergencies that could occur after the pilot performs the first takeoff action listed in the takeoff procedures in Section II of the manual and ends when the climb configuration or the emergency landing configuration is established.

3.3.5.7.1 Engine failure during takeoff. The possibilities of both forced landing and continued flight shall be included. Information concerning jettisoning external stores, landing gear retraction, pilot techniques, and best airspeed for power available (partial loss of power) shall be included. Reference shall be made to the paragraph concerning runway barrier engagement in Section III of the manual.

3.3.5.7.2 Takeoff with one or more engines inoperative. For multi-engine aircraft, in which takeoff with less than all engines operating is feasible, instructions for such takeoff shall be included. Warnings and precautions shall be discussed. Procedures required to produce the results stated in the appropriate takeoff chart in the performance data of the manual shall be employed. If necessary, a diagram similar to the one required for normal takeoff shall be included.

3.3.5.7.3 Tire failure during takeoff roll. A discussion of the procedures required to be observed in the event of tire failure during takeoff roll shall be included.

3.3.5.7.4 Fire or overheat light during takeoff. Complete precautions and instructions for fire or overheat light during takeoff shall be included.

3.3.5.8 In-flight emergencies. In-flight emergencies shall include all emergencies that could occur from the time the climb configuration is established until the final landing configuration is established. If an emergency (including the loss of controlled flight) will lead to a loss of altitude, the minimum altitude that will be required to recover the aircraft and the point at which ejection or bailout should occur shall be stated. An illustration shall be provided depicting maximum glide (see 3.3.5.12.7). If a multi-crew aircraft will require the ejection of the crew members who are nonessential for flying, sooner than the ejection of the crew members who are essential for flying, the procedures shall specify when the crew members who are nonessential for flying shall either eject or bailout.

3.3.5.8.1 Out of control procedures. Out of control flight and how it is different from a spin shall be defined. The specific procedures that are needed to return to controlled flight and

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the sequence in which the procedures are to be accomplished shall be stated. If the sequence of the procedures is not important, this fact shall be included. What the pilot will see (the instruments and the dynamic relationship to the earth), how the aircraft will respond to flight control inputs, and how the pilot will recognize when the aircraft is or is not responding shall be described.

3.3.5.8.2 Spin recovery. Spin recovery procedures shall be included. The accompanying text shall refer to Section VI of the manual for an explanation of the spin characteristics of the aircraft.

3.3.5.8.3 Engine restart. Complete instructions on the proper means of restarting an engine in flight and resuming normal flight shall be included. Specific details such as airspeed, altitudes, and RPM shall be included. If considered advantageous, engine restart instructions may be presented in chart form. When applicable, a warning shall be included to address safe ejection altitude versus the time it takes to develop usable thrust from minimum airstart RPM.

3.3.5.8.4 Propeller malfunction. Complete procedures to be performed in the event of runaway propeller and any other type of propeller failure shall be given. Instructions regarding action to be taken if propeller does not feather properly shall be included.

3.3.5.8.5 Ejection or bailout. The technique, precaution, and warning signals for leaving the aircraft in flight shall be described. These instructions shall contain information pertaining to all ejection/bailout options under varying conditions such as (but not limited to) airspeed, aircraft attitude, controlled and uncontrolled flight (including spins and dives), and the minimum safe altitudes for ejection/bailout under each of these conditions. Complete coverage for bailout from aircraft not equipped with ejection systems shall be included. Bailout in the event of ejection seat failure shall be covered in narrative form only. The proper procedure for preparing the aircraft for bailout and the method of jettisoning cockpit enclosures and exterior doors shall be indicated. For aircraft equipped with an escape capsule, the instructions, techniques and precautions involved in use of the escape capsule shall be included. A pictorial sequence of operation for ejection or bailout shall be provided.

3.3.5.8.5.1 Operation of seat-type survival kit. For aircraft that utilize some form of a seat-type survival kit, a statement which explains whether activation of the survival kit does (or does not) cut off emergency oxygen supply shall be included. If it does, it shall state that the survival kit should be deployed below 14,000 feet above sea level. In any event, the procedures shall be written to require the survival kit deployment prior to contact with ground or water.

3.3.5.8.6 Fire, smoke, and fumes. Complete emergency procedures regarding fire, smoke, and fumes aboard the aircraft shall be provided. Information concerning fire warning indicators, fire suppressant discharge, alternate procedures, fire out confirmation, and the

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procedures for adjusting for the possible after effects of fire shall be provided. When applicable, information shall be provided concerning the disabling of systems that may be feeding the fire. Procedures for the rapid evacuation of smoke and fumes from the aircraft interior, and the use of aircrew oxygen and smoke equipment, shall be provided.

3.3.5.8.6.1 Engine fire during flight. Complete instructions regarding the recommended method of detecting and extinguishing an engine fire during flight shall be included. Procedures for afterburner overheat shall be included for jet aircraft so equipped.

3.3.5.8.6.2 Fuselage and wing fire. Complete instructions regarding the recommended method of combating a fire within the aircraft fuselage and wings shall be provided.

3.3.5.8.6.3 Electrical fire and overheat. Complete instructions regarding the recommended method for extinguishing electrical fires shall be provided. If some fire extinguishers provided are not to be used for electrical fires, that fact shall be stated. Procedures to address electronic overheat conditions that may occur during flight shall be provided.

3.3.5.8.7 System failures. Procedures to address the in-flight failure of systems which would result in an emergency situation shall be provided. Instructions, as applicable, to permit the system to be operated in a degraded condition shall be provided. Information, as applicable, to cover alternate or backup systems that may be engaged to accommodate for the loss or severe degradation of a primary system shall be provided. Examples of systems to be covered are, but not limited to; fuel, oil, electrical, hydraulic, and flight control.

3.3.5.8.8 Shock effects to engine or aircraft. If supersonic speeds are possible and give rise to emergencies, procedures to cope with the emergencies such as duct instability and variable inlet ramps shall be covered.

3.3.5.8.9 Flight without canopy. The hazards of flight without a canopy or without a hatch, including wind blast effects, shall be discussed.

3.3.5.8.10 Crew environment emergencies. Procedures for emergencies such as failure of anti-g suit to deflate, loss of pressurization, excessive temperature (air conditioning), and hypoxia shall be included.

3.3.5.8.11 Emergency descent. If the difference between a rapid descent and an emergency descent is sufficient to affect the safety of the personnel aboard the aircraft, techniques and procedures for an emergency descent shall be included.

3.3.5.8.12 Structural failure. A structural failure procedure shall be included. This procedure should include necessary pilot and crew procedures in the event of suspected or actual structural failure.

3.3.5.9 Landing emergencies. Landing emergencies shall include all emergencies that

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could occur from the time the final landing configuration is established until the aircraft is stopped or departs from the runway. Statements that the canopies should be retained for all landings and that combustion type heaters should be off for emergency landings shall be included. For both hard and soft ground, the following shall be included: Preparation, warning signals to crew, approach, crew positions, harness locks, landing procedures, and crew/passenger exit. The procedures to be followed to ascertain the degree of aircraft control available when control system malfunction occurs shall be included.

3.3.5.9.1 Forced landing or landing with one or more engines inoperative. The changes in configuration and procedures, and the recommended precautions required for a forced or engine(s)-out landing shall be included. In the event of complete loss of power, it shall be emphasized that ejection or abandonment of the aircraft may be preferable to forced landing, as applicable. Procedures for landing single-engine and twin-engine jet aircraft without thrust shall be included. A missed approach with one or more engines inoperative shall be discussed. A note that the pilot, prior to ejection or abandonment, should attempt to turn the aircraft toward an area where injury or damage to property on the ground or water is least likely to occur shall be included.

3.3.5.9.2 Simulated forced landing or flame-out landing. Procedures for performing a simulated forced landing or flame-out landing shall be included. The danger of falling behind the required airspeed and the best procedures for recovery shall be discussed. Other areas to be considered are areas such as altitude at high key and low key, aircraft configuration, pattern airspeeds, and engine speed. Warnings and cautions as applicable shall be included. A note that the aircraft should always be in a position from which a landing can be completed shall be added.

3.3.5.9.3 Landing gear malfunction. Procedures for emergency extension of the landing gear shall be included. Procedures for combinations such as main gear down, nose gear up, one main gear up, nose wheel cocked, and all gear up shall be included. Procedures for a wheels-up landing shall be included.

3.3.5.9.4 Ditching (applicable aircraft). Complete instructions regarding the method and the best configuration for ditching the aircraft shall be included. Capabilities of the aircraft after ditching and the advantage of ditching versus bailout or vice versa shall be discussed. The discussion shall include night ditching, partial-power ditching, power-off ditching, preparation for ditching, and after ditching. The discussion shall also include blocked escape routes and alternate duties in case some crew members are injured. An illustration, as applicable, showing ditching and crash-landing stations for crew members and passengers, shall be provided (see 3.3.5.12.5). In addition, a ditching chart and sea state table shall be included (see 3.3.5.12.6).

3.3.5.9.5 Landing without brakes. Procedures for accomplishing a landing when brakes are inoperative and system failures that could lead to this emergency shall be discussed. If failure of these systems affects any other areas, the area affected shall be mentioned. It

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shall be noted that emergency brakes (if applicable) are limited to a certain number of applications.

3.3.5.9.6 Other landing emergencies. As applicable, emergencies such as flap failure, speed brake failure, asymmetric loads, leading edge slat failure, tire failure upon landing, and scraping of tail shall be covered.

3.3.5.10 System emergencies. When system arrangement has been specified, the emergency procedures shall be grouped for each major system of the aircraft. The use of high level system groupings (i.e., flight controls rather than flaps) is preferred. The high level systems may be broken down to aircraft specific subsystems to ease location of specific emergencies.

3.3.5.11 Miscellaneous emergencies. Critical emergency items shall not appear in the miscellaneous group.

3.3.5.11.1 Emergency entrance. If required by the acquiring activity, instructions regarding means of effecting emergency entrance into the aircraft shall be included (see 6.2).

3.3.5.11.2 Hung ordnance. Procedures to be taken when ordnance has failed to leave aircraft after triggering shall be included.

3.3.5.12 Illustrations (Section III).

3.3.5.12.1 Miscellaneous emergency equipment. A phantom illustration shall show aircraft emergency equipment such as stowed parachutes, fire axes, flares, pyrotechnic pistols, life rafts, hand-held fire extinguishers, and first-aid kits. This illustration shall not include system emergency equipment such as emergency hydraulic controls, engine fire extinguishing systems, and emergency landing gear controls.

3.3.5.12.2 Emergency egress. If the aircraft is a manned aircraft, and is large enough to permit circulation of personnel, the emergency stations and the routes of egress to be followed for ground emergencies, in-flight, and after crash-landing on land or water shall be indicated for all personnel. Coding shall be used to differentiate between routes and exits to be used in flight and routes and exits to be used after a crash-landing. This illustration may be combined with the miscellaneous emergency equipment diagram, unless the resulting illustration would be confusing. Additional illustrations showing the operation of all emergency exits from inside the aircraft shall be included. The location of each exit shall be indicated on a caption drawing(s) of the aircraft.

3.3.5.12.3 Takeoff, landing and missed approach - one or more engines inoperative diagram. A diagram emphasizing the difference between normal procedures and procedures with one or more engines inoperative shall be included. Items such as

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minimum airspeeds and effects on systems or inoperative systems because of certain engines out shall be emphasized. If there is little or no difference in the full-power available and partial-power available landing, they may be combined with the normal diagram in Section II of the manual, with proper notations. If the diagram for this emergency is identical to the normal procedures, the requirement for this illustration may be deleted; however, a reference should be made to this effect in the text.

3.3.5.12.4 Smoke identification diagram. A diagram indicating the means of identifying the source of reciprocating engine fires, by the type of smoke and flames emitted from the engine compartment, shall be included.

3.3.5.12.5 Ditching and crash landing stations. As applicable, a diagram showing the position of each crew member and passenger during ditching and crash landing shall be included.

3.3.5.12.6 Ditching chart and sea state table. A ditching chart and a sea state table shall be included. The ditching chart shall include first actions of the crew members, necessary duties at planned times, equipment items that the crew member is responsible for having in his possession after ditching, position of the crew member during ditching, and most probable egress route for the individual crew member positions. A statement that the sequence of events may be varied depending on existing conditions shall be included on the ditching chart.

3.3.5.12.7 Maximum glide. An illustration for maximum glide, providing all parameters that affect gliding distance with partial-power or power-off, for maximum glide distances and minimum rate of descent, shall be included. The airspeeds shown shall be integer numbers divisible by five and in knots indicated airspeed (KIAS), and the altitudes shall be for all altitudes below absolute ceiling. The data basis for all helicopters, single-engine aircraft, and twin-engine aircraft shall be given.

3.3.5.12.8 Warning/caution advisory (WCA) display analysis illustration. A warning/caution advisory display analysis illustration shall be included and shall be the last illustration preceding the emergency entrance illustration. It shall list each warning and caution annunciator, the malfunction causing the annunciator to be displayed, and how to cope with and clear the condition.

3.3.5.12.9 Emergency entrance diagram. A diagram illustrating points at which emergency entrance can be effected into the aircraft after it has crash-landed shall be included. It shall be the last page of Section III of the manual, and the text for emergency entrance shall immediately precede it.

3.3.6 Section IV - Mission crew duties/procedures. This section shall cover the responsibilities of each crew member not covered in Section II and shall include a description of the primary and alternate functions of each. The development of procedures

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in this section shall follow the requirements of Section II unless development of such procedures falls under a separate detail specification. When specified by the acquiring activity, a separate mission crew manual shall be prepared (see 3.5). The acquiring activity shall determine if all or portions of this section shall be included in Mission Crew Manual(s) (see 6.2). Depending on the content remaining in Section IV, the following shall apply:

a. If all of Section IV is included in a separate manual(s), then a statement that Section IV material is located in the other manual(s) shall be placed under the section title.

b If only portions of Section IV are included in a mission crew manual, then the system title shall be included in Section IV followed by a reference to the applicable manual. The remainder of the section shall be as specified below.

3.3.6.1 Coverage. Duties of each crew member shall be covered under a single primary paragraph which shall be subdivided into an introductory paragraph and subordinate paragraphs. The introductory paragraph shall contain a comprehensive description of the primary and alternate functions of the crew member. It shall also include a description of the general duties of the crew member, such as operating the heating system or ascertaining that all hatches in the rear of the aircraft are securely locked. Subordinate paragraphs shall be included as required to present each pertinent phase of flight operation, such as "Before Starting Engine" and "Before Takeoff."

3.3.6.2 Extent of coverage. Emphasis shall be placed on the duties that are driven by the characteristics of the aircraft. A minimum of space shall be devoted to the specialized duties that are the responsibilities of a crew member by virtue of that function; for example, the navigator is fully aware of the responsibilities of a navigator, but may have additional responsibilities assigned.

3.3.6.3 Crew coordination. A summary of the responsibilities of each crew member shall be included. It shall also relate the coordinated actions between each crew member.

3.3.6.4 Sequence of phases and actions. Sequence of phases and actions shall be arranged chronologically.

3.3.6.5 Checks. All checks shall be made from left to right or top to bottom except where chronology must take precedence.

3.3.6.6 Alignment. This section shall be aligned, according to the physical location of the crew members covered, starting from the front and proceeding to the rear, with the left position taking precedence over the right position.

3.3.7 Section V - Operating limitations. This section shall cover all important limitations

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that must be observed. Limitations that are characteristic only of a specialized phase of operation shall be covered in the discussion of the operation and need not be repeated in this section. Special emphasis shall be placed on any unusual restrictions that are particularly characteristic of the aircraft.

3.3.7.1 Extent of coverage. The following paragraphs describe the types of limitations to be covered; however, only the criteria that actually limit operation need be included. For example, if the design of the aircraft precludes overloading, a weight limitation discussion is unnecessary. To avoid duplication of limitations, the information appearing on the instrument marking pages shall not be repeated in the text. If the instrument marking limitations cannot be adequately explained in the space provided by the captions, additional explanations shall be covered under the appropriate paragraph headings. Mach numbers and airspeeds shall be given in the same units as indicated by installed instruments. Tables of servicing fluids, and when specified, aircraft capacities shall be included with a listing of fuels (see 6.2). Fluids shall not be listed by brand name; however a reference to TO 42B-1-14 for fuels and TO 42C-1-16 for alcohols shall be included.

3.3.7.2 Emergency crew. A statement shall be included that specifies the Emergency Crew requirements as applicable (see 3.3.3.1).

3.3.7.3 Instrument markings. Each instrument that indicates an operating limit shall be illustrated. Each illustration that contains an engine power instrument shall include a notation of the fuel grade on which the limits are based. The notation shall be conspicuously located and shall be printed in 12 point boldface type. This illustration shall always begin on the first full page following the table of contents in Section V.

3.3.7.4 Summary table of limitations. When specified (see 6.2), a Summary Table of Limitations shall be provided. The table shall include a summary of the aircraft and system operating limitations as provided in Section V. This table shall immediately follow the Instrument Markings.

3.3.7.5 Engine limitations. Engine limitations covering points such as overspeed, turbo limitations, idle limitations, overboost, overtemperature, and inverted flight shall be included. Limitations that must be observed when alternate fuel grade is used shall be provided. A definition of power referenced in the text and in the performance data (see 3.4.10.2) such as maximum thrust, maximum power, and maximum except for takeoff (METO) power, shall be included. For helicopters, the various conditions that limit power such as gas producer speed on a cold day and transmission limits shall be included (see 3.4.10.10.3.3).

3.3.7.5.1 Alternate fluid limitations. If applicable, this paragraph shall identify alternate fluids that may be used with possible loss of efficiency and increased maintenance/overhaul. These alternate fluids shall be listed in the aircraft servicing diagram (see 3.3.3.42).

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3.3.7.5.2 Emergency fuel limitations. This paragraph shall identify emergency fuel, if applicable, that may cause sufficient damage to the engines so that its use shall be limited to a single flight. Include a notation that after an aircraft has been flown with emergency fuel, identify this condition in AFTO Form 781 and ensure that required inspections have been made before releasing for flight. These fuels shall not be listed in the aircraft servicing diagram (see 3.3.3.42). A statement that operations or maintenance personnel shall not grant waivers on the use of emergency fuel beyond one time flights shall be included.

3.3.7.5.3 Single-engine/engine-out flight limitations. Performance limitations due to primary or secondary flight controls, trimming requirements, optimum climb/cruise profiles, maneuvering limitations, and landing phase considerations shall be included. Flight characteristics limitations with engine(s) operating in the secondary or backup control mode shall be included.

3.3.7.6 Starter limitations. The limitations applicable to the starter system shall be included.

3.3.7.7 Propeller limitations. Propeller limitations covering points such as reverse pitch and restricted RPM shall be included when applicable.

3.3.7.8 Rotor limitations. Rotor limitations during flight, power-on and power-off, and during ground operation shall be included for helicopters. Limitations directly related to time shall be clearly stated. The maximum recommended wind velocity for starting and stopping rotors shall be included.

3.3.7.9 Airspeed and mach limitations. Maximum mach or airspeed limits shall be provided for level flight and for various conditions of weight and configuration. Additional airspeed and mach limitations such as the following shall also be included (see 3.2.22):

a. Maximum dive airspeed.

b. Airspeed limitations for jettisoning external stores.

c. A chart showing limiting airspeed versus altitude for various configurations or minimum and maximum rotor speeds.

3.3.7.10 Flight maneuvering limitations. Flight maneuvering limitations such as the following shall be included:

a. Acrobatic flight.

b. Restrictions on control movements and bank angle limits.

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c. Limits for slipping or skidding during asymmetric power condition or landing approaches.

d. Roll coupling phenomena such as roll entry G, angle of attack (AOA) overshoots, and rolling limits.

e. If the manual is for a high speed, highly maneuverable aircraft, a diagram showing acceleration limits for the combinations of airspeeds and altitudes shall be included. Direct reading mach meters shall reflect the reading utilized in the cockpit. Charts for calibrated airspeed (CAS), or indicated airspeed (IAS) and indicated mach number (IMN) shall be included. All prohibited regions of operation shall be clearly marked.

3.3.7.11 Acceleration limitations. Acceleration limitations such as the following shall be included:

a. Maximum acceleration with tip tanks.

b. Maximum bank at high weights.

c. Maximum permissible accelerations under various flight conditions at specific gross weights and fuel versus load distribution.

d. Purpose of the operating flight strength diagram (see 3.3.7.10e).

3.3.7.12 Hovering limitations. Hovering limitations such as maximum crosswind and downwind (including gusts) and their relation to maximum sideways and rearward flight, limitations caused by recirculation effects, and gross weight limitations shall be included.

3.3.7.13 Center of gravity limitations. Center of gravity (CG) limitations such as the following shall be included:

a. Effects such as forward, aft and lateral CG position on towing, taxiing, hover, stall, takeoff, in-flight, approach, and landing.

b. Limitations due to the use of external or internal hoists or winches.

c. Cargo loading limitations due to CG restrictions.

d. A CG envelope chart shall be included when necessary. Reference to the Weight and Balance Handbook and the -5 series technical order shall be included.

3.3.7.14 Weight limitations. Weight limitations that are not covered or are not emphasized

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sufficiently in the weight limitations chart (see 3.3.7.14.1) shall be included. Limitations for aircraft in which weight distribution is a problem (such as minimum fuel to be carried in the wings at various gross weights) shall be included. Reference shall be made to fuel supply management in Section I (see 3.3.3.8). Text shall contain a tabulation of normal, emergency, and overload takeoff gross weights and design zero fuel weight for the aircraft. Sample problems illustrating the affect of aircraft loading shall be presented. Problems concerning an aircraft that has an operating weight greater than the operating weight on which the chart is based, shall be included.

3.3.7.14.1 Weight limitation chart. This chart shall be provided for aircraft that have weight limitations of such a complex nature that it would be impractical to cover by means of text only (see 3.3.7.14). Each component of the chart shall be clearly identified. The purpose of this weight information is to provide operating personnel with the detailed criteria upon which the importance of the mission can be weighed against the degree of risk that is being assumed; not to establish maximums (see 3.4.10.1.1.4.11). A single chart shall be used to portray the weight capabilities of the aircraft; however, additional charts may be used, when necessary, to portray the various configurations of the aircraft. Various criteria that affect gross weight shall be represented as indicated in 3.3.7.14.1.1 through 3.3.7.14.1.7 except that criteria which are beyond the weight capabilities of the aircraft need not be shown.

3.3.7.14.1.1 Operating weight chart. The chart shall be based on the standard operating weight of the aircraft. The operating weight shall be quoted in boldface type in a conspicuous part of the chart, or a correction grid shall be included for aircraft that have variable operating weights.

3.3.7.14.1.2 Alternate load. The alternate load which consists of cargo, bombs, and nonstandard equipment shall be shown along the vertical axis of the chart. It shall be noted that an alternate load shall not include any weight carried by the wings. Any load in or under the wings, except fuel or disposable tanks, shall be shown by the use of additional charts.

3.3.7.14.1.3 Fuel versus alternate load capacity envelope. The various combinations of fuel and alternate load that can be carried by the available capacity of the aircraft shall be illustrated by an envelope. The envelope shall begin at the maximum alternate load and shall show the addition of fuel (with removal of alternate load as necessary) until maximum fuel capacity is reached. Each phase of addition of fuel and removal of alternate load shall be identified.

3.3.7.14.1.4 Weight limiting factors. Lines representing the various weight limiting factors affecting taxi, takeoff, flight, and landing gross weights shall be included. The basis for the limiting factors shall be as defined in JSSG-2006 (formerly AFGS-87221) for structural limitations. Lines representing other factors that will be detrimentally affected by increasing weight shall also be included.

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3.3.7.14.1.5 Gross weight. The gross weight of the loaded aircraft shall be shown by lines sloping to the axis of the chart. It shall be noted that the origin of the chart represents the standard operating weight of the aircraft (see 3.3.3.1.2).

3.3.7.14.1.6 Stores chart. A chart showing certified stores, weapon loading capability, and restrictions to be observed shall be included. Only stores that are compatible with the aircraft shall be listed. Stores that are not compatible but are to be carried, shall be listed on separate illustrations with sufficient instructions for permissible operation and ample warning on restrictions. If the aircraft is equipped to carry a variety of external stores, information concerning the maximum weight to be carried at each station and the maximum lateral unbalanced load that can be carried shall be included. If a separate loading configuration manual is procured, this information shall be included in the load configuration manual. A reference to the appropriate publication shall be made in this Section of the flight manual.

3.3.7.14.1.7 Brake energy limits chart. A chart showing brake energy limits for various weights, speeds and configurations shall be included.

3.3.7.14.2 Weight limitations chart requirements. Light and dark shading shall be used to emphasize areas of varying degrees of risk. The unshaded area shall include loadings which present no particular problem in regard to strength or performance of the aircraft. The light shaded area shall cover loadings of progressively increasing risk as the dark shaded area is approached. A statement, that caution must be exercised in this area because certain operations may become marginal and aircraft life may be decreased, shall be included. The dark shaded area shall represent loadings that are not recommended. Operation in the dark shaded area should be attempted only when the importance of the mission is such that safety of flight is of secondary consideration.

3.3.7.14.3 Disposal of cargo and stores. All limitations imposed by the disposal of cargo or stores during flight shall be included.

3.3.7.14.3.1 Fuel and external disposal tanks. The weight of fuel and external disposable tanks shall be shown along the horizontal axis of the chart.

3.3.7.15 Barrier limitations. Barrier limitations, with an illustration showing the maximum barrier engaging speeds versus weight for airplane and various arresting systems in use shall be included. Maximum engaging speeds versus weight combinations shall be based on the maximum permissible arresting hook load or the arresting system (barrier) strength, whichever is the lesser.

3.3.7.16 Drag chute limits. Speed limits for drag chute deployment and any other applicable limits shall be included (see 3.4.10.8.1.3.2).

3.3.7.17 Landing limitations. All landing limitations such as the rate of descent, glide

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slope, landing, and maximum sink rate shall be included (see 3.3.4.1.25).

3.3.7.18 Other limitations. Other types of limitations that affect operation of the aircraft shall be included.

3.3.8 Section VI - Flight characteristics. This section shall fully describe the flight characteristics of the aircraft. Unless otherwise specified, this section shall contain as a minimum, the following areas: (see 6.2)

a. Flight control system.

b. Normal flight characteristics.

c. Dive recovery characteristics

d. Flight with asymmetric loads.

e. Abnormal flight characteristics.

f. Stalls.

g. Departures.

h. Spins.

i. Engine operation.

3.3.8.1 Extent of coverage. Coverage in Section VI will vary depending on the type of aircraft covered. The subjects listed in the following paragraphs shall be addressed in describing aircraft flight characteristics. Applicable subjects shall be covered in detail. Any aircraft unique flight characteristics not outlined below shall also be included. All flight limitations should be addressed in Section V and limitations, warnings, or cautions which are not in Sections I, II, or V, shall not be mentioned in Section VI. This section should also address the flight characteristics relative to automatic or integrated systems, such as terrain following, flutter/load alleviation, flight/propulsion control systems, etc., that may be unusual but normally expected.

3.3.8.2 Flight control system.

3.3.8.2.1 Control effectiveness. The effectiveness and reactions that may be encountered in the use of the flight controls throughout the entire flight envelope shall be included (see 3.3.7.10). When and how the controls are used to achieve maximum performance and any precautions that must be observed shall be stated. Primary and secondary flight controls (e.g. aileron, elevators, rudders, trim tab, speed brakes, slats, cyclic stick, cyclic pitch, etc.),

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control augmentation systems, and other aerodynamic considerations shall be included.

3.3.8.2.2 Control forces. Characteristics such as roll, yaw, and stick forces per gravity (G), in relation to different airspeeds and altitudes shall be included. Susceptibility to G overshoot and pilot induced oscillation (PIO) shall be described. Charts depicting incidents such as sideslip maneuvering envelopes (depicts relationships between AOA and angle of sideslip) shall be included.

3.3.8.3 Normal flight characteristics. Normal flight characteristics shall include the following flight regimes as a minimum:

a. Heavy takeoff and landing.

b. Lightweight takeoff and landing.

c. Normal cruise.

d. Maneuvering (to include maximum performance, wing sweep, and AOA considerations) with respect to varying altitude and external stores loading.

e. Rolling G flight.

f. Negative G flight.

g. As a minimum, charts with the following details shall be provided:

(1) Maneuverability (altitude versus airspeed depicting G available at varying gross weights and drag configurations).

(2) CG travel (with respect to fuel consumption).

(3) Pitch rate (show aircraft capabilities to achieve pitch rates which could result in G or AOA overshoot).

3.3.8.4 Dive recovery characteristics. High and low speed diving characteristics of the aircraft shall be described. Dive recovery procedures and precautions shall be covered. A chart showing dive recovery techniques (various G pullouts for combinations of altitude, airspeed, dive angles, and various aircraft configurations) shall be included.

3.3.8.5 Flight with asymmetric loads. Flight characteristics resulting from asymmetric loads shall be described for takeoff, maneuvering, and landing (see 3.4.10.1.1.4.2). This description shall amplify roll response, trim consideration, AOA limitations, and weapons delivery precautions. All mission phases which are applicable for the particular weapon system shall be addressed.

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3.3.8.6 Abnormal flight characteristics. Aircraft flight characteristics with malfunctions in the primary and secondary flight controls (e.g., aileron, elevators, speed brakes, slats, collective pitch, etc.) shall be described. In addition, flight characteristics with control or stability augmentation system malfunction or the effects of emergency positions selected shall be described.

3.3.8.6.1 Roll coupling. Roll coupling characteristics of the aircraft shall be included (see 3.3.7.10).

3.3.8.6.2 Aircraft unique characteristics. If an aircraft exhibits unique flight characteristics or unique flight control configuration, it shall be described in this section. Examples of this would include auto rolls, manual reversion, or inverted pitch hang-up.

3.3.8.6.3 Single-engine/engine-out flight characteristics. A description of flight characteristics and handling qualities with a single engine remaining or multiple engines out shall be included. Performance limitations due to primary or secondary flight controls, trimming requirements/techniques, optimum climb/cruise profiles, maneuvering limitations, and landing phase considerations shall be included. Include flight characteristics for multi-engine aircraft operating between air minimum control speed (VMCA) and 1G stall speed. Any other characteristics that adversely affect flight shall be included. A chart showing engine-out thrust required (for thrust limited aircraft in certain configurations) shall be provided.

3.3.8.6.4 Unusual attitudes. If the unusual attitude recovery methods for an aircraft differ from those prescribed in applicable service directives, they shall be described in detail.

3.3.8.7 Stalls. The following stall characteristics shall be described as appropriate:

a. 1G, accelerated, and negative G stalls.

b. Aircraft motions following vertical tail slides.

c. Stall characteristics in the takeoff, power approach, and landing configuration.

d. Power and landing configuration.

e. Power effects on stall characteristics.

f. Stall warning systems and relation to high AOA characteristics.

g. Effects of changes in weight, altitude, and external stores configuration (to include typical combat loads).

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h. Recovery characteristics and procedures.

i. A chart showing stall speeds (gross weight versus CAS/IAS/AOA at varying bank angles).

j. A complete discussion of helicopter stall characteristics and the appropriated corrective actions.

3.3.8.8 Departures. Transition from stall to departure shall be described and shall include effectiveness of the flight controls to prevent or recover from departures. The following shall be included:

a. The effect of changes to both the longitudinal and lateral CG location.

b. The effects of changes in weight, altitude, and external stores configuration (to include typical combat loads).

c. Post stall gyration characteristics.

d. Departure recovery procedures and characteristics shall be emphasized, with an estimate of altitude loss to recover.

e. Known pilot control actions such as excessive magnitudes, abruptness, delay, or wrong phasing which must specifically be avoided to prevent inadvertently transitioning the aircraft from a departure into a spin while attempting recovery.

3.3.8.9 Spins. A complete discussion of the characteristics of spins that are unique to the aircraft shall be provided. Specific recovery procedures shall be provided in Section III.

3.3.8.10 Engine operation. Engine operation during uncontrolled flight shall be described. Precautions to prevent loss of engine(s), additional recovery problems resulting from loss of engine(s), and restart capabilities shall be included.

3.3.9 Section VII - Adverse weather operation. This section shall provide information pertaining to the operation of aircraft under adverse weather and climatic conditions such as snow, ice, rain, fog, extreme temperatures, turbulent air, and desert operations. This section shall be primarily narrative in nature since Section II provides procedures under normal instrument flight conditions. Procedural items shall be used only to cover specific procedures that are characteristic of adverse weather operations such as oil dilution or preparation for turbulent air flight. Procedures included in this section shall comply with the requirements for procedures in Section II and shall have numbered steps for inclusion of separate procedures in the abbreviated checklist.

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3.3.9.1 Turbulence and thunderstorms. Handling characteristics of the aircraft in turbulence and thunderstorms shall be included. Unique procedures, including all preparations to be made before entering turbulence or thunderstorms, shall be described. If a single airspeed is used to penetrate turbulence it shall be presented in large boldface numerals. If more than one penetration airspeed is provided they shall be presented in a chart. Information pertaining to the effects of lightning on the aircraft, flight crew, and aircraft systems (as well as warnings and cautions) shall be included in the text where necessary.

3.3.9.1.1 Wind shear. A detailed description concerning the detection of wind shear and its effects on the aircraft shall be provided. Information concerning the special handling techniques and any preparations that must be made before engaging wind shear shall be provided.

3.3.9.2 Snow, ice, rain, fog, and slush. The problems caused by snow, ice, rain, fog and slush shall be described in a separate paragraph for each phase of operation, e.g., "starting engines", "taxi", and "takeoff" including the effects of water and slush spray on engines, gear wells, and flaps. Appropriate warnings that prohibit takeoff with snow, ice, or frost on lifting surfaces, engine cowlings, or any other surface that may adversely affect performance, shall be included. Effects of engine power and airspeed on the performance of ice and rain removal systems shall be included. Indications that can forewarn of engine icing such as manifold pressure, tachometer, exhaust gas temperature, engine pressure ratio (EPR), and rough engine shall be included. If the aircraft is not equipped with carburetor air temperature or mixture temperature gauges, outside air temperature (OAT) at which icing can occur during climb, cruise, and descent shall be provided. The problem of jet engine damage caused by the ingestion of ice and the preventive measures such as nacelle heat and engine screens shall be described. Effects of ice accumulation during flight shall be emphasized. The consequences that may result from engine icing shall be included. Appropriate warnings or cautions, on engine or auxiliary power unit (APU) operation in conditions where there is the potential for ice to develop, shall be provided.

3.3.9.2.1 Effects of ice and snow on runways, taxiways, and ramps. This paragraph shall contain information applicable to runway conditions when ice and snow are present and shall include the following:

a. Painted areas on runways, taxiways, and ramps are significantly more slippery that unpainted areas. In addition, painted areas may serve as condensation surfaces and it is possible to have wet, frosty, or icy conditions on these areas when the overall weather condition is dry. Refer to AFH 11-203, Weather for Aircrews.

b. When conditions of snow or ice exist, the approach ends of the runway are usually more slippery than any other areas due to the melting and freezing of ice and snow at this location.

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3.3.9.2.2 Hydroplaning. Conditions that could contribute to hydroplaning and the problems caused by hydroplaning shall be discussed in detail.

3.3.9.3 Cold weather, hot weather, and desert/tropical operation. Any special precautions/procedures necessary when operating the aircraft in cold weather (such as allowing sufficient warm-up of instruments), hot weather, deserts, or tropical environments shall be included. Appropriate warnings covering the effects of extreme cold on the aircraft's emergency escape systems such as emergency slides, escape hatches, doors and windows, pneumatic actuators, etc., shall be provided

3.3.10 Section VIII - Air refueling procedures. If developed as a separate section, the air refueling section shall contain four major parts. Additional data and information may be required by the procuring activity and if required will be included in the appropriate part (see 6.2).

a. General

b. Flying safety

c. Terminology

d. Air refueling procedures

3.3.10.1 General. The general part shall provide the scope of the air refueling section and any other pertinent data required by the acquiring activity (see 6.2). This part shall also provide the scope of the air refueling procedures covered. Proper control and utilization of this section will ensure concurrent inter-command distribution of standard and up-to-date air refueling data to tanker and receiver crew members.

3.3.10.1.1 Deviations. Deviations from the procedures contained in the air refueling section must be authorized in detail by a specific operations order or a command directive.

3.3.10.1.2 Part 1 - General. This part shall contain the following general information and operational procedures which encompass air refueling operations by all types of aircraft:

a. Command and control of tanker/receiver forces.

b. General tanker/receiver responsibilities. Information to specific aircraft types/models shall also be included.

c. Refueling airspace requirements.

d. Weather restrictions.

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e. Communications requirements.

f. Visual signals.

3.3.10.2 Part 2 - Flying safety. This part shall address flying safety issues which are particular to air refueling operations in general, e.g., flying large numbers of dissimilar aircraft in close proximity, conducting rendezvous in controlled airspace, etc. This part shall also contain those specific guidelines and lessons learned as specified by the acquiring activity (see 6.2).

3.3.10.3 Part 3 - Terminology. This part shall include a comprehensive glossary of terms and abbreviations used in air refueling operations. Terms which refer only to a particular class of aircraft or refueling technique, e.g., fighter, bomber, probe/drogue, boom/receptacle, etc., shall be clearly identified.

3.3.10.4 Part 4 - Air refueling procedures. This part shall contain the following major paragraph divisions:

a. Departure/en route procedures.

b. Rendezvous procedures.

c. Specific Air refueling procedures.

3.4 Performance data. Performance data shall be delivered either as a separate manual appendix or as an appendix within the flight manual (see 6.2). Regardless of location of the performance data, all data shall be prepared as specified herein. The requirements of 3.4.10 through 3.4.10.8.1.5 apply to development of performance data for fixed-wing aircraft. The performance data requirements for helicopters are contained in 3.4.10.10. Unless otherwise specified herein, the general requirements on chart preparation and content contained in 3.4.2 through 3.4.9 shall apply to all performance data charts.

3.4.1 Performance manual requirements. For development of a separate performance data manual, the preparation of front matter shall be as specified in paragraph 3.3.2.

3.4.2 Extent of coverage. Any charts, or other required information, that are applicable to the performance of the aircraft shall be included, to define the total operational envelope of the aircraft even if it exceeds the users planned operational envelope. Unless otherwise specified by the acquiring activity (see 6.2), all performance data charts presented in the flight manual shall be in Drag Index Format (see 3.4.3.3). Charts for multi-engine aircraft shall include curves covering operation after failure of one or more engines. Two or more requirements for any part of the performance data may be combined into single charts if it does not degrade or complicate use of the chart. Except as specified in 3.4.10.10 the requirements of the following sections shall apply to helicopters.

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3.4.3 Format for data presentation. Graphical or tabular presentation of performance data is essential to provide coverage of the complete operational envelope. Specific user requirements for graphs and the additional tables shall be coordinated among the acquiring activity, the contractor, and the user as early as possible in the acquisition process.

3.4.3.1 Graphical. All performance data presented in the flight manual shall be prepared in graphical format. For aircraft with multiple drag indices, charts shall be prepared using the drag index format (see 3.4.3.3). If the aircraft does not have multiple drag indices, then all charts shall be prepared without a drag index grid.

3.4.3.2 Tabular. Tabular presentations will normally be limited to data presented in the flight crew checklist and those tables specifically authorized for the flight manual. Any additional use of tabular presentation of performance data in the flight manual shall be authorized by the acquiring activity (see 6.2). Tabular presentations in the flight manual shall be limited to informal presentations. Tabular data shall be supplemental to, and derived from, the graphical data.

3.4.3.3 Drag Index. This format allows for the presentation of performance data for a large number of external stores/drag configurations on one chart, thereby reducing the number of charts required. It also allows for future modifications and changes.

3.4.3.4 Specific configuration. In some circumstances, it may be more advantageous to prepare separate performance data charts for certain configurations. In cases of alternate configurations involving a change in performance of 5 percent or less, the configurations may be grouped. If the configurations differ more than 5 percent, separate charts shall be included (see 3.2.23).

3.4.3.5 Nomographs. Nomographs shall not be used unless specified by the acquiring activity (see 6.2).

3.4.4 Chart data basis. Basic aerodynamic data used in preparing the charts shall be derived from flight tests if available; otherwise, estimates shall be used until verified by flight tests. Engine power and fuel flow data used in preparing the chart shall be derived from the engine manufacturer's specification unless flight tests indicate an adjustment is required to reduce specification power/thrust or to increase specification fuel flow. Charts using estimated data will be replaced by charts using flight test data when it becomes available.

3.4.4.1 Standard atmosphere. The US Standard Atmosphere, 1976.

3.4.4.2 Fuel flow conservation. When performance data is estimated, fuel flows shall be increased by 5 percent. When performance data has been flight tested, the following shall apply to fuel flows:

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a. For helicopters, add an operational factor of 5 percent.

b. For fixed-wing aircraft, do not add an operational factor unless approved by the acquiring activity (see 6.2). If it is included, it shall not exceed 5 percent.

3.4.4.3 Performance ground rules. The ground rules described for calculating performance are intended to furnish the most simple and accurate data available to the operating crews. In cases where those rules result in data which is not consistent with flight test or accepted operational techniques, it is expected that the more realistic data will be utilized after proper technical substantiation.

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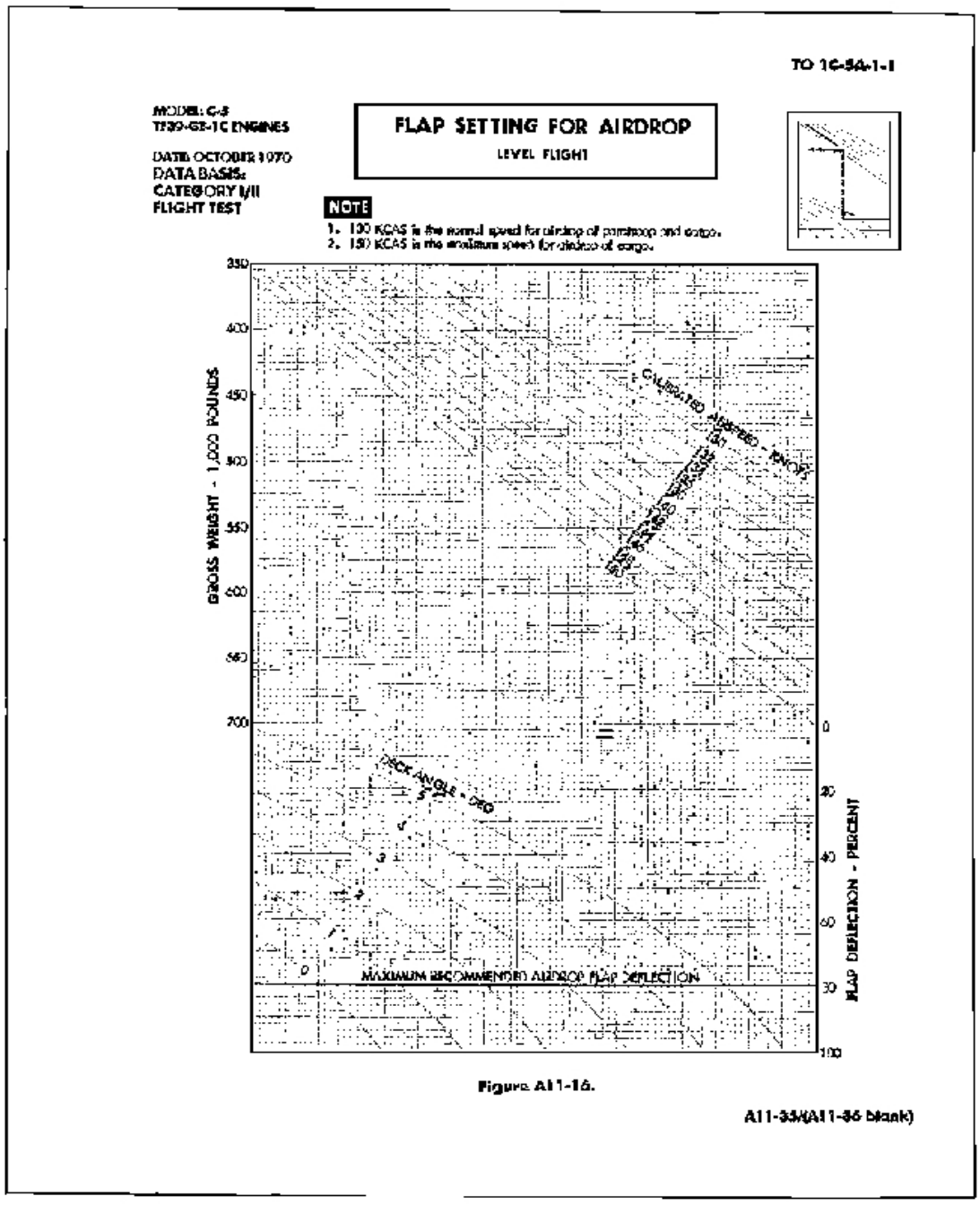

Figure A11-16.

A11-33/(A11-34 blank)

FIGURE 6. Example performance data chart (typical).

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3.4.4.4 Identification of marginal operations chart. Performance charts provided for aircraft operation under conditions that are marginal and could lead to aircraft damage or accident shall be marked in accordance with the requirements of MIL-STD-38784 for emergency page marking.

3.4.5 Specific chart requirements (also applies to helicopters).

3.4.5.1 Chart layout. Charts shall be prepared so they can be read while holding the manual in the same upright position required to read the text (see Figure 6). Charts shall be laid out using the following guidelines:

a. Provide maximum size and space for data.

b. Notes and borders shall be minimized.

c. Simple presentations are preferred over excessive background art work.

d. Single line presentation in lieu of multiline presentations are preferred.

e. Data lines shall be at least ⅛-inch apart.

f. The two outside lines in a series of converging lines should be continued to a point, cross, or to the end of the chart. The other lines in the series should be discontinued when they converge to ⅛-inch separation.

g. Cross-hatching over grid patterns should be avoided. Shading should be used in lieu of cross-hatching over grid patterns, or the grid patterns should be omitted in the area containing the cross-hatching.

3.4.5.2 Chart construction. Scales, baselines, parameters, lettering, and numbering shall be in bolder print. Scales and parameters for altitude shall increase vertically on the page. Other units shall increase from left to right or vertically upwards on the page, except that the gross weight scale on a range or time integration chart shall decrease from left to right.

3.4.5.2.1 Gridlines. Gridlines may be either screened lines or solid lines. In either case, the desired effect shall be a tone difference between gridlines and plotted curves. Basic grid structure should be composed of major (heavy) lines for each major unit, intermediate (accented) lines halfway between major lines, and minor lines for each sub-unit. Sub-units shall be 0.05, 0.1, 0.2, or 0.5 of the major unit as most suitable for presentation.

3.4.5.2.2 Grid spacing. Grid spacing on the printed page shall be limited to a maximum of 20 gridlines per inch and a minimum of 4 gridlines per inch.

3.4.5.2.3 Chart entry. Single chart entries should be used wherever possible. Double

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entries shall be used only when single entries cannot be utilized.

3.4.5.2.4 Baseline. A baseline is the zero correction line when entering a correction chart such as temperature, wind, RCR, etc. Baselines shall normally be placed at the entry point to the chart. When required, a baseline may be placed within a chart, provided the line is clearly marked with a descriptive title.

3.4.5.2.5 Interception of lines. Interception of lines at angles of less than 30° shall be avoided.

3.4.5.2.6 Transfer scales. Charts may extend beyond one page; however, the entrance scale on the succeeding page shall match the exit scale of the preceding page. If no exit scale exists, a transfer scale that permits accurate transfer from the exit point to the entrance point of the continued chart shall be utilized.

3.4.5.2.7 Scales. Scales, curves, and guidelines for each parameter shall bracket the lowest value to the limit value for that parameter specified in Section V and shall also extend to the next major unit for that parameter.

3.4.5.2.7.1 Limitations and restrictions. Limit lines shall be included and labeled to represent any safety limitation(s) or restrictions deemed necessary by the acquiring activity (see 6.2).

3.4.5.2.7.2 Temperature scales. Temperature scales in Centigrade (Celsius) shall be used. Unless otherwise specified by the acquiring activity, subscales in Fahrenheit shall be included (see 6.2).

3.4.5.2.7.3 Air temperature scales. Ambient air temperature scales shall be labeled, "air temperature". The temperature obtained from the aircraft temperature gauges shall be labeled, "indicated outside air temperature" (IOAT).

3.4.5.2.7.4 Air temperature range scales. The air temperature range on the charts shall be from -60°C to +60°C.

3.4.5.2.7.5 Standard-day temperature correction scales. Temperature correction scales showing corrections from standard-day temperature values shall range from -20°C below standard to +20°C above standard.

3.4.5.2.7.6 Altitude scales. Altitude lines and scales for sea level shall be labeled "sea level" in lieu of "zero" as the altimeter may indicate.

3.4.5.2.7.7 Drag index scales. The chart is intended to be general, therefore, the major index lines shall be identified by whole numbers for ease of interpolation.

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3.4.5.2.7.8 Airspeed scales. Airspeed scales shall meet the requirements specified in 3.2.22. Charts connected with in-flight operation may incorporate a secondary true airspeed (TAS) scale.

3.4.5.2.7.9 Weight scales. The gross weight scale shall bracket data from minimum operating weight to the maximum overload takeoff weight.

3.4.5.2.8 Correction grids. All charts associated with takeoff and landing shall have correction plots attached for runway slope, wind velocity, RCR, RSC, CG, flap correction, and rotation speed increase using the baseline, guideline, or reflector line format. All corrections shall be made after the basic values have been determined. When approved by the acquiring activity, the correction grids described in 3.4.5.2.8.1 through 3.4.5.2.8.7 shall be grouped on a separate page opposite the basic chase around graph to improve accuracy of the data (see 6.2).

3.4.5.2.8.1 Slope correction. Runway slope correction shall be 0 to 3 percent uphill and downhill.

3.4.5.2.8.2 Wind velocity correction. Wind correction plots shall be for 0 to 40 knots headwind and 0 to 20 knots tailwind. Tailwind lines shall be dashed lines superimposed on solid headwind lines. All wind correction plots shall be for 100 percent accountability.

3.4.5.2.8.3 Basis for wind correction. An aircraft operating with an existing headwind or tailwind will experience a variation in performance on the runway in acceleration/deceleration characteristics. Since basic acceleration distance, speed and time curves, and refusal speeds are computed for still air (zero wind) performance, a correction curve shall be added to the charts to permit determination of performance characteristics as a function of the wind.

3.4.5.2.8.4 RCR correction. These grids shall show the increases in stopping distance required when braking coefficients of friction on dry hard surface runways deteriorate because the surface is partially or completely covered with water, snow, or ice. RCR correction shall be plotted from a baseline of 23 to 2. Rules for computation; estimated data shall be based on an RCR of 23 having a maximum effective braking coefficient of friction of 0.3 with a straight line relationship to an RCR of zero being equal to an effective breaking coefficient friction of zero. Data based on flight tests shall also show correction from a baseline of 23 to 2.

3.4.5.2.8.5 RSC correction. Data based on the latest technique for measuring effects of RSC shall be included. Precautions such as surface covering impingement on aircraft during takeoff, its effect on takeoff roll and stopping effect including hydroplaning shall be included.

3.4.5.2.8.6 Flap setting correction. Individual charts shall be used for each flap setting.

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However, if a correction grid can be constructed it shall, with the approval of the acquiring agency, be substituted for individual charts (see 6.2). Separate charts shall be presented for each flap setting used for takeoff.

3.4.5.2.8.7 CG correction. The CG correction shall be plotted to include foreword and aft limits with the baseline at the CG for the clean aircraft with maximum internal fuel and zero payload (see 3.4.10.1.1.4.11).

3.4.5.2.9 Labels for curve(s) within a chart. Each curve set shall be given a descriptive title such as 99 percent max range, pressure altitude, gross weight, etc. Titles shall not interfere with the readability of the chart.

3.4.5.2.10 Title block. The title block shall be placed at the top of the page. The maximum size of the title block shall not exceed the top quarter of the image area.

3.4.5.2.10.1 Bordered title. A descriptive title that is bordered on all four sides shall be included in the upper portion of the title block. It shall be located horizontally in either the center or outer (unbound) portion of the title block as determined by the acquiring activity (see 6.2).

3.4.5.2.10.2 Title block information. The title block shall contain all the information required to utilize the chart. The following information is to be furnished, as applicable, in the title block of each chart provided. The title block shall be located at the top of the figure and shall not interfere with the information presented in the chart. The following charts shall be included:

a. Descriptive title (Bordered title see 3.4.5.2.10.1).

b. Aircraft model(s).

c. Engine types and model, and propeller designation.

d. Fuel grade (unless it has been included in the performance data introduction).

e. Drag index if applicable (see 3.4.10.1.1.4.1).

f. Atmospheric conditions such as pressure altitude, density altitude, temperature, standard-day condition, variations from standard-day conditions, and wind.

g. Operational conditions such as external tanks and armament, number of operating engines, power plant settings, mixture settings, flap positions, and speed brake positions.

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h. Examples on charts as described in 3.4.5.2.11a.

i. Chart data basis as described in 3.4.4.

j. Date of the flight manual in which the data first appeared.

3.4.5.2.11 Examples on charts. In graphical charts where reading is not obvious, the chart shall contain examples in either of the following acceptable methods:

a. A miniature simplified reproduction of the chart shall be included and located in the upper part of the title block, at the top of the page, and shall be placed so that it does not interfere with the bordered title. Baselines, parameters, guidelines, dash lines, and arrowheads shall be used sparingly to provide the example desired without including grid patterns and numerals (see Figure 6).

b. An example shall be included on the first of each of the various types of charts using a dashed line and following the values used in the sample problems included in the text. The problem shall be selected so that the dashed lines of the example will remain clear of the chart area normally used.

3.4.6 General information charts. Charts presenting general information, not specifically based on aircraft or engine data for the applicable aircraft (such as density altitude or temperature conversion), shall not include any reference to a specific aircraft, engine, date, or data base.

3.4.7 Description of charts. A description of all charts, including their functions, all methods of use, definitions and limitations, shall be provided. This description shall be given from the aircraft performance viewpoint and shall avoid duplication of information contained in any other section of the manual.

3.4.8 Sample problems for charts. The text in each section preceding the performance data charts shall contain sample problems describing the use of each different chart with a complete discussion of each problem.

3.4.9 Sample charts. Where doubt exists as to the exact format desired for a particular chart the acquiring activity shall be requested to supply examples. These examples may be in the form of a flight manual or specially prepared sketches.

3.4.10 Performance data charts and text. The performance data charts and text shall be arranged as shown below. Data for additional aircraft or engine configurations not accounted for by a drag index format shall be included. Additional parts may be added to present data on special performance modes, for example, air refueling or combat performance. The criteria for calculating performance data shall be derived using MIL-

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HDBK-1793 as a guide. The following charts shall be provided:

Part 1 - Introduction

Part 2 - Engine data

Part 3 - Takeoff

Part 4 - Climb

Part 5 - Cruise

Part 6 - Endurance

Part 7 - Descent

Part 8 - Approach and landing

Part 9 - Mission planning

3.4.10.1 Part 1 - Introduction.

3.4.10.1.1 Content and arrangement.

3.4.10.1.1.1 Table of contents. A table of contents shall be prepared in accordance with 3.3.2.4.1 and 3.3.2.

3.4.10.1.1.2 List of charts. A list of the charts identifying page number, figure number, and title shall be included.

3.4.10.1.1.3 Introductory text. This paragraph shall present a brief summary of data basis used to prepare charts. Applicable conditions plus any other information relative to the use of the charts shall be provided. Explanations and example problems shall be included in the introductory text for the charts and tables specified in the contract. If the performance data is published as a separate manual/appendix, this paragraph shall include a statement that all charts contained in the performance data are for specific aircraft model, engine type/model, carburetor, and propeller designation, as applicable. A reference to Section V, engine limitations for restrictions on alternate fuels shall be provided (see 3.3.7.5).

3.4.10.1.1.4 Chart explanation. Charts as prescribed below shall be prepared. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be included:

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a. Drag number table.

b. Drag due to asymmetric loading.

c. Pitot static installation correction.

d. Compressibility correction to CAS.

e. Temperature correction for compressibility.

f. Mach number correction.

g. True mach number (TMN) - CAS/IAS conversion.

h. True mach number - true airspeed (TAS) conversion.

i. Temperature conversion.

j. Angle of attack.

k. Aircraft gross weight and CG position.

l. Standard charts and tables.

m. Additional charts.

3.4.10.1.1.4.1 Drag number table. The table for drag numbers shall present drag numbers and weight data for all external items (stores, tanks, racks, and pylons) approved for loading on a particular station. The initial entry shall be a drag number for the clean aircraft and shall present a typical operating weight, weight of internal usable fuel, and (if applicable) weight of internally carried ammunition as mission planning data. Each authorized external item shall have a drag number assigned dependent upon its aerodynamic characteristics and location on the aircraft. Correction factors in the form of drag numbers shall be presented to account for interference between stores on any given station and between stores mounted on different stations. Unless otherwise specified by the acquiring activity, the method of accounting for interference shall be as shown in the following examples (see 6.2):

a. Drag numbers for stores shall be totaled in one table and include interference effects.

b. For aircraft that can accept multiple or triple ejector racks, a drag number per store shall be assigned equal to the total drag number including interference for a full rack divided by the total number of stores per rack, i.e.,

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six for a multiple ejection rack.

c. Drag number for all developing systems shall be presented in non-dimensional numbers such as C_D X 10^4. For revisions to existing systems, if the drag number basis is different from that described above, it shall be defined prior to the drag number table.

d. The drag index number is a summation of the store drag numbers. Scaling of drag numbers should result in a total drag number equal to or less than 100 units.

3.4.10.1.1.4.2 Drag due to asymmetric loading chart. This chart shall plot incremental drag numbers versus net asymmetric load for various mach numbers and pressure altitudes.

3.4.10.1.1.4.3 Pitot static installation correction. If correction is more than ±2 knots airspeed or ±100 feet pressure altitude, the following charts for the installation correction shall be furnished. (Corrections up to a magnitude of ±2 knots airspeed or ±100 feet pressure altitude may be shown in tabulations.)

a. The chart for airspeed installation correction shall plot equivalent airspeed (EAS) versus CAS [IAS corrected for instrument error] or IAS versus correction to EAS. For high speed flights, the airspeed correction may be a plot of mach position correction versus indicated mach. Parameters shall be included for normal operating weights and for all normal configurations such as full flaps and gear down, and flaps and gear up, for both in ground effect (IGE) and out of ground effect (OGE). Text shall include an explanation of the conversion from IAS to TAS and the statement: "Where the symbol IAS is used on performance charts, mechanical error is assumed to be zero."

b. The chart for altimeter correction shall be a plot of altimeter position error correction to be added to pressure altitude versus CAS/IAS with pressure altitude parameters, from sea level to service ceiling and gross weight parameters, for all normal configurations such as full flaps and gear down. For aircraft whose airspeed correction data is in terms of mach number, the altitude position correction shall be a chart showing altitude or altitude correction versus mach number. The data shall include ground effects and the curves shall be similar to those for airspeed corrections.

3.4.10.1.1.4.4 Compressibility correction to CAS chart. This chart shall be a plot of CAS versus CAS or CAS versus compressibility correction with parameters of altitude.

3.4.10.1.1.4.5 Temperature correction for compressibility chart. This chart shall be a plot of CAS/IAS versus air temperature with parameters of pressure altitude and IOAT. An

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additional grid may be added to determine temperature variation from standard. For aircraft with mach indicators, the chart shall be a plot of IOAT versus air temperature with the parameters of mach number. The recovery factor used shall be noted on each chart.

3.4.10.1.1.4.6 Mach number correction chart. This chart shall be a plot of indicated mach versus true mach with parameters of pressure altitude.

3.4.10.1.1.4.7 True mach number - CAS/IAS conversion chart. This chart shall be a plot of true mach number versus CAS/IAS with parameters of pressure altitude.

3.4.10.1.1.4.8 True mach number - TAS conversion chart. The requirement for TMN - TAS conversion will entail the development of two charts. For mission planning, the chart shall be a plot of TAS versus TMN with parameters of pressure altitude. For in-flight use, this chart shall be a plot of TAS versus TMN with parameters of air temperature.

3.4.10.1.1.4.9 Temperature conversion chart. This chart shall be a plot of degrees Fahrenheit (°F) versus degrees Centigrade (°C).

3.4.10.1.1.4.10 Angle of attack chart. This chart shall plot CAS/IAS versus indicated AOA (units)and fuselage AOA (degrees) with parameters of gross weight. Separate charts shall be provided for various flap settings as required.

3.4.10.1.1.4.11 Aircraft gross weight and CG position chart. This chart shall plot the change in aircraft gross weight and CG from a basic configuration for various store weights on the store positions (see 3.4.5.2.7.9). A note shall be added to refer to the aircraft weight and balance handbook (see TO 1-1B-50). This chart is required for aircraft having charts with CG corrections and may be used by flight crews when the weight and balance manual is not available. Contractor format, approved by the acquiring activity, is acceptable (see 6.2).

3.4.10.1.1.4.12 Standard charts and tables. When standard charts and tables are utilized, only the portion that is applicable to the specific aircraft shall be presented. Standard charts and tables shall consist of the following and will be provided by the acquiring activity:

a. U.S. Standard Atmosphere Table (see 3.4.4.1).

b. Density altitude chart.

c. Density altitude tables, density altitude versus ($1/\sqrt{\sigma}$) each 100 feet (ft).

d. Altitude pressure table, inches Mercury (Hg) versus feet.

e. Airspeed conversion.

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f. Standard units conversion charts.

g. Fuel density/weight versus temperature.

3.4.10.1.1.5 Additional charts. Any charts peculiar to certain aircraft shall be included.

3.4.10.2 Part 2 - Engine data.

3.4.10.2.1 Content and arrangement.

3.4.10.2.1.1 Table of contents (see 3.4.10.1.1.1).

3.4.10.2.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.2.1.3 Introductory text (see 3.4.10.1.1.3).

3.4.10.2.1.4 Chart explanation. Explanations and sample problems shall be given for the charts shown below. Two or more requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be provided:

a. Maximum power available for takeoff for all types of engines.

b. EPR, core speed, or fan speed (turbo engines).

c. Engine operating limits (reciprocating engines).

d. Power available in-flight.

e. Fuel flow.

f. Torque and fuel flow correction for air bleed on.

g. Additional charts.

3.4.10.2.1.4.1 Maximum power available for takeoff for all types of engines.

a. Maximum power prediction reciprocating engines. This chart shall be applicable to reciprocating engines that have a takeoff manifold pressure limit and torque/brake mean effective pressure (BMEP) limit. It shall be plotted by brake horsepower (BHP) and torque available, wet and dry, low and high blower, military or maximum continuous power, or standard and alternate grade fuel (see 3.3.7.5). It is a plot of maximum BHP and torque available for takeoff versus pressure altitude with parameters of carburetor

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air temperature. Correction plots for manifold pressure in inches Hg, not to exceed maximum BHP and dew point in °F shall be attached (see 6.10). Subscales for predicted torque and minimum torque (normally 95 percent of predicted torque) shall be shown on the BHP grid.

b. Maximum power (torque or thrust) available turbofan/turboprop engines. This chart shall be a plot of torque pressure or thrust available for takeoff at the static condition with normal air conditioning and pressurization bleed versus air temperature with parameters of pressure altitude. A standard-day temperature line shall be superimposed on the chart. Tabulated corrections or correction charts for ram effects and effects of air bleed, on and off, shall be furnished. Subscales for predicted torque and minimum acceptable torque shall be shown on the BHP grid.

3.4.10.2.1.4.2 EPR, core speed or fan speed (turbofan engines) chart. This chart shall be used to present the maximum setting for takeoff with and without bleed extraction and missed approach setting. It is a plot of power available for takeoff and missed approach versus air temperatures with parameters for pressure altitude.

3.4.10.2.1.4.3 Engine operating limits (reciprocating engines) chart. This chart shall be a plot of engine BHP versus altitude for constant RPM with dashed lines of constant manifold pressure superimposed and shall not include ram. Regions of blower operation shall be noted.

3.4.10.2.1.4.4 Power schedule (reciprocating engines) chart. This chart shall consist of plots of BHP versus manifold pressure and engine RPM, BMEP, or torque pounds per square inch for low and high blower. Limit lines shall be used to indicate regions such as turbo surge, closed waste gate, propeller vibration, and BMEP. A correction for variations in carburetor air temperature shall be included.

3.4.10.2.1.4.5 Power (torque or thrust) available in-flight (turboprop engines) chart. This chart shall be constructed to show torque versus pressure altitude with parameters of knots calibrated airspeed (KCAS), air temperature, and turbine inlet temperature.

3.4.10.2.1.4.6 Fuel flow chart. The chart shall be prepared as follows:

a. For reciprocating engines, the chart shall be a plot of fuel flow per engine versus BHP per engine for operation in accordance with the recommended power schedule. Parameters of altitude and RPM shall be included if these factors appreciably alter the fuel flow.

b. For jet engines, the chart shall be a plot of fuel flow per engine versus EPR core speed or fan speed with parameters of TMN, air temperature, and pressure altitude. The TMN and altitude shall cover the operational range of

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the aircraft. Structural, power, or aerodynamic limits shall be shown.

3.4.10.2.1.4.7 Torque and fuel flow correction for air bleed on chart. The charts for in flight correction for air bleed on shall be prepared as follows (see 3.4.10.2.1.4.1b):

a. The chart for torque shall be a plot of torque with normal air conditioning and pressurization bleed versus torque or thrust with air bleed systems on with parameters of pressure altitude.

b. The chart for fuel flow shall be a plot of fuel flow with normal air conditioning and pressurization bleed versus fuel flow with air bleed systems on with parameters of pressure altitude.

3.4.10.2.1.5 Additional charts. Any charts peculiar to certain aircraft such as reverse thrust limiter and low speed compressor RPM shall be furnished.

3.4.10.3 Part 3 - Takeoff.

3.4.10.3.1 Content and arrangement.

3.4.10.3.1.1 Table of contents (see 3.4.10.1.1.1).

3.4.10.3.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.3.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3 the following shall be included:

3.4.10.3.1.3.1 Monitoring aircraft performance during takeoff. (see 6.11). The presentation requirements outlined for this section shall be followed to the extent practical based on the aircraft and currently established procedures (see 3.3.4.1.18).

3.4.10.3.1.3.2 Takeoff performance data. The following takeoff performance data explanations shall be included:

a. Takeoff speed shall be the speed at which the main gear leaves the ground (i.e., liftoff).

b. Climbout speed shall be the minimum speed for obstacle clearance.

c. Takeoff ground run shall be the distance in feet to takeoff speed.

d. Rotation speed shall be the speed at which rotation from the three point attitude to the takeoff attitude is initiated by applying back pressure to the control stick or column.

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e. Maximum braking speed shall be the highest speed from which the aircraft can be brought to a stop without exceeding the maximum design capability of the brakes.

f. Minimum afterburner blowout speed shall be the minimum speed from which a safe takeoff can be continued in the remaining runway length, should failure occur.

g. Critical engine failure speed shall be the speed at which the most critical engine can fail and the same distance is required to either continue the takeoff or stop the aircraft.

h. Critical field length shall be the total length of the runway required to accelerate with all engines to critical engine failure speed, experience a critical failure, and then continue to takeoff or stop (see 3.4.10.3.1.5.9).

i. Refusal speed shall be the maximum speed with normal acceleration where a stop can be completed while on the runway.

j. Refusal distance shall be the distance required to accelerate to the refusal speed with normal acceleration.

k. Minimum go speed shall be the higher of ground minimum control speed and the minimum speed at which an aircraft can experience a failure of the most critical engine and still takeoff under existing conditions of temperature, pressure altitude, gross weight and runway remaining. The data are based on an engine failure occurring at the minimum go speed and allows for a 3 second decision period with the remaining engines operating at the initial thrust setting.

l. Maximum abort speed shall be the maximum speed at which an abort can be started and the aircraft stopped within the remaining runway length. Maximum abort speed shall be the lowest of the maximum braking speed, refusal speed, and rotation speed. Allowances included in this data are based on a 3 second decision period (with engines operating at initial thrust setting) and a 3 second period to accomplish abort procedures.

m. Air minimum control speed shall be the minimum airborne speed at which the engine most critical to directional control can fail, with the remaining engine(s) operating at takeoff thrust and a straight flight path at that speed can be maintained with full rudder deflection and no more than 75 percent of the available aileron control, or 5° of bank into the operating engine(s).

n. Ground minimum control speed shall be the minimum speed during takeoff

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run at which the engine most critical to directional control can fail with the remaining engine(s) operating at takeoff thrust and a straight path on the runway can be achieved and maintained using the elevator, aileron, rudder controls and nose wheel steering as required.

o. Acceleration checks are made to determine if the acceleration of the aircraft is adequate to assure a safe takeoff. (Unless otherwise specified by the acquiring activity, the speed/distance, speed/time and charted power setting (EPR or N_1)/speed are three acceptable methods covered in this specification (see 6.2)).

p. Acceleration speed check shall be made at some point prior to refusal speed and shall be the minimum speed allowable at the acceleration speed check time or distance. A charted EPR or power check up to computed decision speed (S1) may be used. This procedure requires an abort if any engine falls below charted EPR or power prior to S1. On unmarked runways the acceleration check speed is an even 10 knot increment not less than 5 knots and not more than 15 knots below refusal or maximum abort speed. On marked runways the acceleration check shall always be made at some point prior to refusal speed. (For cargo/transport type aircraft the acceleration check shall be made at the first 1,000 foot marker at least 500 feet but no more than 1,500 feet, prior to refusal distance. For any other type aircraft the acceleration check shall be made at preselected distances consistent with aircraft performance and command requirements).

q. Acceleration check speed tolerance for single-engine aircraft shall be a reduction in speed below normal acceleration speed and is dependent on the amount of excess runway available beyond normal takeoff distance. (For multi-engine aircraft it is dependent on the amount of excess runway available beyond critical field length. The tolerance shall be limited to a maximum (to be defined by the acquiring activity) when the acceleration check is made at a marker (see 6.2)).

r. Commitment speed shall be the speed at which the pilot becomes committed to continue the takeoff. The takeoff run should be aborted if an emergency occurs before commitment speed.

s. Climb gradient is a ratio expressed in percent and defined as:

$$\text{Climb Gradient} = \frac{\text{Vertical Height (climb) X 100}}{\text{Horizontal Distance (climb)}}$$

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3.4.10.3.1.3.3 Terminology applicable to winds. The terms applicable to winds are shown in paragraphs 3.4.10.3.1.3.3.1 and 3.4.10.3.1.3.3.2 and shall be included in the manual. Unless otherwise specified by the acquiring activity, the "Wind Summary Sample Table" (see Table 1) shall be included (see 6.2) based on the following explanations:

a. Steady wind value shall be reported steady wind.

b. Gust increment shall be reported wind in excess of steady wind value.

c. Headwind component is the effective wind parallel to the runway, determined from the steady wind value plus the gust increment and blowing in the direction opposite of takeoff.

d. Tailwind component is the effective wind parallel to the runway, determined from the steady wind value plus the gust increment and blowing in the direction of takeoff.

e. Crosswind component is the effective wind 90° across the runway, determined from the steady wind value plus the gust increment.

3.4.10.3.1.3.3.1 Wind direction and velocity. Winds are measured at some fixed point. However, if the airfield is located in an area of variable terrain, the possibility exists that wind velocity and direction will vary over portions of the airfield. Likewise, wind shear can result with varying winds.

3.4.10.3.1.3.3.2 Accounting for wind. The entire runway (100 percent) will be used in computing all maximum braking and time limit data. Accept the benefits of headwinds as an increased safety margin, i.e., consider the use of headwind only when necessary for mission accomplishment. When it is necessary to use the wind, it may be decided to take only

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TABLE I. Wind summary sample table.

Type of Wind	How to Obtain Component	Use of Wind Component
Headwind	Enter wind component chart with steady wind value to obtain runway component.	Apply 100% of runway component to acceleration check and ground run distances.
		Apply 50% of runway component to all takeoff and landing distances except for acceleration check.
		Do not apply headwinds for terrain clearance.
Tailwind	Enter wind component chart with steady wind value plus the gust increment to obtain runway component.	Apply 100% of runway component to acceleration check and ground run distances.
		Apply 150% of runway component to all takeoff and landing distances except for acceleration check.
		Apply 150% of runway component for terrain clearance.
Crosswind	Enter wind component chart with steady wind value plus the gust increment to obtain crosswind.	Adjust ground minimum control speed for 100% of crosswind component. 1/
		Check necessity of increased takeoff and landing speeds.
Gusts	Reported wind in excess of steady value equals gust increment.	Increase takeoff speed, threshold speed, and landing speed by the full gust increment not to exceed _____ knots. 2/

1/ This statement shall be included only when the manual contains a ground minimum control speed chart with speeds that require correction for crosswinds.
2/ This value will be provided by the acquiring activity (see 6.2).

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partial benefit. In such a case it is recommended that 50 percent of the headwind component and 150 percent of the tailwind component be applied (except acceleration check). The following conditions shall be considered in accounting for wind:

a. No corrections for headwind should be made to any distance or speed except when computing acceleration checks.

b. Apply tailwinds.

c. Apply the crosswind and headwind gust increment to the takeoff speed, final approach speed, threshold speed and landing speed. All distances and speeds except takeoff speed and ground minimum control speed shall be corrected for steady state headwinds or tailwinds during takeoff planning and the crosswind component and headwind gust increment shall be applied to takeoff speed, threshold speed and landing speed.

3.4.10.3.1.4 Takeoff chart presentation. There are two acceptable chart presentations for takeoff data. Preferred is the takeoff factor which includes a separate chart or charts to combine the air temperature, pressure altitude, and engine thrust variables into a takeoff factor which is then used to enter each of the various takeoff data charts. Also acceptable is the basic presentation which includes all variables on each of the various takeoff data charts (see 3.3.4.1.18).

3.4.10.3.1.4.1 Takeoff chart parameters. Takeoff data such as ground run and critical field length shall be presented for altitudes from -2,000 to +16,000 feet pressure altitude (not to exceed the performance capability of less than +16,000 feet) and for air temperature. Any one particular parameter, such as takeoff ground run, shall be presented. Up to three separate charts may be used to cover segments of altitude.

3.4.10.3.1.4.2 Takeoff graphic illustrations. Graphic illustrations with explanatory text shall be provided for the following runway critical field relationship. These illustrations are plots of distance versus runway available with parameters of acceleration, stopping distance, V_{MCG}, V_{CEF}, V_R, V_{TO}, and applicable terms.

a. Runway available equal to critical field length.

b. Runway less than critical field length.

c. Runway longer than critical field length.

3.4.10.3.1.5 Chart explanation. Explanations and example problems shall be given for the charts shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be included:

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a. Takeoff factor/thrust factor.

b. Takeoff gross weight limit.

c. Minimum safe single-engine takeoff speed.

d. Takeoff and landing crosswind.

e. Takeoff ground run.

f. Reduced power/thrust takeoff.

g. Assist takeoff ignition time.

h. Total obstacle clearance distance.

i. Critical field length.

j. Refusal speed/critical engine failure speed.

k. Minimum afterburner blowout speed.

l. Minimum go speed.

m. Maximum abort speed.

n. Takeoff speed.

o. Acceleration check.

p. Ground minimum control speed.

q. Air minimum control speed.

r. Climbout factor.

s. Climbout flight path.

t. Maximum braking speed.

u. Basic takeoff charts.

v. Time, distance, and fuel to climb initiation.

w. Additional charts.

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3.4.10.3.1.5.1 Takeoff factors/thrust factors. Takeoff and thrust factors reference numbers shall be utilized on takeoff data charts and are determined from air temperature, pressure altitude, and engine thrust variables.

3.4.10.3.1.5.1.1 Takeoff factors for reciprocating engine aircraft. The takeoff factor shall be determined from the parameters of BMEP or torque pressure and density altitude. It is recommended that the minimum BMEP or torque pressure be used to determine the takeoff factor.

3.4.10.3.1.5.1.2 Takeoff factors for turbine powered aircraft. The takeoff factor shall be determined from the parameters of air temperature and pressure altitude with normal bleed (air condition and pressurization) on. A standard-day temperature line may be superimposed on the pressure altitude lines. Corrections to the takeoff factor for the effects of air bleed on, air bleed off, partial afterburner, military thrust, screens retracted, and anti-ice on shall be provided.

3.4.10.3.1.5.1.3 Takeoff factors for turboprop aircraft. Determining the takeoff factor is the same as 3.4.10.3.1.5.1.2 except that a correction chart for air bleed on and air bleed off shall be furnished.

3.4.10.3.1.5.1.4 Takeoff factors/thrust factors for turbine powered aircraft with flat rated engines. The thrust factor shall be determined from the parameters of EPR and pressure altitude. Performance losses due to bleed system operation are accounted for by the reduced EPR used to enter the chart. The takeoff factor is determined from the thrust factor and the parameters of air temperature and pressure altitude. Both a thrust factor and a takeoff factor are normally used for flat rated turbine engines.

3.4.10.3.1.5.2 Takeoff gross weight limit chart. There are two acceptable chart presentations. One plots gross weight versus takeoff/thrust factor with parameters of rate of climb for 100 through 500 feet per minute with a correction grid for air temperature variation from standard-day. The other presentation provides two charts. The first chart plots gross weight versus takeoff/thrust factor with parameters of percent gradient. The second chart plots rate of climb versus gross weight with parameters of percent gradient and altitude. Rules for computation: The rate of climb slope shall be based on maximum power with the most critical engine inoperative, OGE, gear up/flaps set for takeoff, propeller feathered (when applicable), at climbout speed (constant CAS/IAS). Rate of climb based on flight tests shall be obtainable at speeds recommended for climbout but not less than b. and c. below. The climbout speed for estimated data shall not be less than the following:

a. One hundred twenty percent of 1G power-off stall speed.

b. Air minimum control speed.

c. Five knots above the speed for zero rate of climb.

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3.4.10.3.1.5.3 Minimum safe single-engine takeoff speed chart. This chart shall depict the single-engine speed required to attain a rate of climb of 100 feet per minute with maximum thrust OGE in the takeoff configuration. This is a plot of single-engine takeoff speed versus takeoff factor with parameters of gross weight, CG, temperature, and any other variables required. This chart shall be required for two-engine aircraft whenever the manual does not contain a takeoff gross weight limit chart (see 3.4.10.3.1.5.2) or a critical field length chart (see 3.4.10.3.1.5.9). Takeoff speeds based on flight tests shall meet the criteria specified in b. and c. below. The takeoff speed for estimated data shall be not less than those determined by the following criteria:

a. Lift coefficient not exceeding 110 percent of 1G power-off stall speed.

b. Air minimum control speed.

c. Five knots above the speed for zero rate of climb.

3.4.10.3.1.5.4 Takeoff and landing crosswind chart. This chart shall present wind direction of 0° to 90° in 5° increments and wind velocity of 0 to 60 knots in 5 knot increments. Minimum touchdown or rotation speed shall be included on the chart and shall present the minimum speed for various crosswinds at maximum slope angle (with maximum or near maximum rudder deflection). The crosswind chart is based on the following formula:

$$TAS = V\frac{\sin\theta}{\sin\beta_{max}}$$

Where TAS is true airspeed, V is velocity of wind, θ is the angle between the wind and the flight path of the aircraft, and β_{max} is the maximum angle of sideslip an aircraft is authorized at the TAS in question. Influencing factors that shall be considered peculiar to a particular aircraft and may appreciably influence sideslip angle are as shown below:

a. Runway altitudes and temperatures.

b. Aircraft CG position.

c. External store configuration.

d. Directional ground control for various runway conditions and ground roll limitations.

e. Safety factor in directional control power to allow some control for turbulence and maneuvering (Assume maximum authorized rudder for crosswind is 80 percent of β_{max}). The above factors should be considered with the intent to provide the maximum safe crosswind capability for each existing condition

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rather than considering the worst case. Considering all items may require several charts to provide correction factors before finally reading the crosswind chart.

3.4.10.3.1.5.4.1 Crosswind landing gear position chart. This chart shall present crosswind gear setting versus crosswind with parameters of gross weight.

3.4.10.3.1.5.5 Takeoff ground run charts. These charts shall be a plot of the takeoff factor versus ground run with parameters of gross weight (see 3.4.10.3.1.3.2c.). Graphical data shall be presented for each recommended takeoff flap setting. Lines of constant increase in takeoff speed from the normal schedule following an engine failure to meet the 100 feet per minute minimum rate of climb shall be included if applicable. If assist devices are a part of the standard equipment, separate charts shall be prepared to indicate takeoff ground run with assist device (see 3.3.3.2.5). A chart for one engine inoperative from brake release shall be required for all aircraft that have three or more engines. When requested by the acquiring activity, charts shall be furnished for zero flap settings and alternate fuel grades (see 6.2). Rules for computation are shown below:

a. Distance for estimated data shall be based on takeoff speeds for the takeoff configuration IGE not less than those determined by the following criteria:

   (1) Lift coefficient not exceeding 110 percent of 1G power-off stall speed.

   (2) Lift coefficient based on maximum AOA attainable with the main landing gear oleo struts positioned for the static condition.

   (3) Minimum speed at which the aircraft has a rate of climb of 100 feet per minute OGE with all engines operating, including the effect of increased drag due to gear retraction.

   (4) Air minimum control speed.

b. Distances shall be for hard surfaces using a roll resistance of 0.025. When requested by the acquiring activity, coefficients for other types of surfaces shall be furnished (see 6.2).

c. Distances based on flight tests shall be obtainable at speeds recommended for normal operation but not less than the preceding criteria specified in a.(2), (3), & (4).

d. When requested by the acquiring activity, data for other than normal operation such as maximum effort shall be based on flight tests (see 6.2).

3.4.10.3.1.5.5.1 Water takeoff run for amphibian aircraft charts. Charts of takeoff for water and ground runs shall be provided for amphibian aircraft.

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3.4.10.3.1.5.6 Reduced power/thrust takeoff charts. When requested by the acquiring activity, charts for takeoff runs for reduced power/thrust shall be provided (see 6.2).

3.4.10.3.1.5.7 Assist takeoff ignition time chart. When specified, this chart shall be a plot of takeoff factor versus ignition time with parameters of gross weight. A wind correction grid shall be included (see 6.2).

3.4.10.3.1.5.8 Total obstacle clearance distance charts. This chart shall be a plot of obstacle height from zero to two hundred feet versus total obstacle clearance distance with parameters of ground run distance. This chart shall be required for single-engine aircraft.

3.4.10.3.1.5.9 Critical field length chart. This chart shall be similar to the chart for takeoff ground run (see 3.4.10.3.1.1.5). For multi-engine aircraft, lines of constant increase in takeoff speed from the normal schedule with all engines operating to meet the 100 feet per minute minimum rate of climb potential with one engine inoperative shall be included. Aircraft equipped with drag chutes shall have charts with and without drag chute deployed. Aircraft equipped with reverse thrust devices shall have charts with and without reverse thrust. The critical field length shall be based on the following rules (see 3.4.10.3.1.3.2h.):

a. At engine failure speed the aircraft continues to accelerate for 3 seconds with remaining engines at takeoff thrust and zero thrust on the inoperative engine.

b. At the end of the three second acceleration time, thrust on all engines is reduced to idle, brakes applied, and deceleration devices deployed.

c. Sufficient time allowed for deployment of the deceleration device or for reverse thrust to build up before including its effect on deceleration.

NOTE

On multi-engine aircraft, reverse thrust shall not be applied in a manner that will induce yawing moments.

d. Effective tire to runway braking coefficient of friction for dry runway shall not exceed 0.3 for estimated data.

e. Critical engine failure speed shall not be less than the ground minimum control speed.

3.4.10.3.1.5.10 Refusal speed/critical engine failure speed chart. This chart shall be a plot of takeoff factor versus refusal/critical engine failure speed with parameters of runway length available and gross weight (see 3.4.10.3.1.3.2g. and i.). A takeoff speed line shall be superimposed on the gross weight lines, to plot gross weight versus speed. Aircraft equipped with reverse thrust devices shall have refusal speed charts both with and without

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reverse thrust. Refusal speeds and critical engine failure speeds shall be based on the same rules specified for the chart for critical field length chart (see 3.4.10.3.1.5.9).

3.4.10.3.1.5.11 Minimum afterburner blowout speed chart. This chart shall plot minimum afterburner blowout speed (see 3.4.10.3.1.3.2f) versus takeoff factor for runway length and gross weight parameters.

3.4.10.3.1.5.12 Minimum go speed chart. This chart shall plot thrust factor versus minimum go speed (see 3.4.10.3.1.3.2k) with parameters of runway length and gross weight.

3.4.10.3.1.5.13 Maximum abort speed chart. This chart shall plot thrust factor versus maximum abort speed (see 3.4.10.3.1.3.2l) with parameters of runway length and gross weight corrected for RCR. Aircraft equipped with drag chutes shall have maximum abort speed both with and without drag chutes (see 3.4.10.3.1.5.9).

3.4.10.3.1.5.14 Takeoff speeds chart. This chart shall be a plot of gross weight versus speed (see 3.4.10.3.1.3.2a.). All speeds such as takeoff, rotation, flaps up, or climbout may be plotted on the same chart. Aircraft using speed schedules for various CG positions shall have separate charts for each of the speeds with parameters of CG in percent mean aerodynamic chord (MAC).

3.4.10.3.1.5.15 Acceleration check chart. At least one of the following charts shall be provided for acceleration check planning. The charts shall provide the information necessary to perform an acceleration check by at least one of the three allowable methods; speed/distance, speed/time, or power setting (EPR or N_1)/speed. A method to correct takeoff distance and acceleration check distance or time shall be provided for rolling takeoffs or "rolling EPR" takeoffs. If speed/distance information is provided, at least one other method shall be included for use on unmarked runways.

3.4.10.3.1.5.15.1 Acceleration check speed chart. This chart shall be a plot of acceleration check speed versus takeoff factor with gross weight and acceleration check time and/or distance parameters. Wind and slope corrections shall be provided.

3.4.10.3.1.5.15.2 Acceleration check time chart. This chart shall be a plot of acceleration check time versus takeoff factor with gross weight and acceleration check speed parameters.

3.4.10.3.1.5.15.3 Power setting check chart. Takeoff power setting (EPR or N_1) charts in Part 2 - Engine Data, may be used for the power setting/speed method.

3.4.10.3.1.5.16 Ground minimum control speed chart. This chart shall be a plot of thrust factor versus CAS/IAS with parameters of RCR and crosswind (see 3.4.10.3.1.3.2n). The following information shall be included in the text: V_{MCG} must be equal to or less than V_R. The charts for control of the aircraft during takeoff run following sudden loss of thrust from

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the most critical engine shall allow the pilot to maintain a straight path on the runway with no more than a deviation of 30 feet from the path originally intended with rudder forces not to exceed 180 pounds. The following criteria shall also apply:

a. Takeoff thrust can be maintained on the operative engine(s).

b. For a dry runway, control can be maintained by elevator, aileron, rudder controls, and nose wheel steering.

c. For wet and icy runways, control can be maintained by elevator, aileron, and rudder controls. No credit will be given for nose wheel steering, unless such control is demonstrated by flight test.

d. The aircraft is trimmed for takeoff.

e. CG is in the most unfavorable position.

f. Automatic devices which operate in the event of a thrust failure may be used.

g. The aircraft motion, following sudden asymmetrical loss of thrust, shall be such that dangerous conditions can be avoided. A realistic time delay of 1 second can be considered.

h. Some runways may have runway crowns up to 1.5 percent transverse gradient and can significantly effect the ground minimum control speed of the aircraft. (The chart format is based on a yawing moment balance criteria. At low RCR, the aircraft may be side force limited and will require a different chart format that includes RCR, crosswind and gross weight variables. The acquiring activity shall determine the need for this additional chart (see 6.2)).

3.4.10.3.1.5.17 Air minimum control speed chart. The chart for air minimum control speed IGE and OGE, gear down, and takeoff flap setting for one and two engines inoperative, shall be a plot of air temperature, °C versus CAS/IAS in knots with parameters of pressure altitude (see 3.4.10.3.1.3.2m.). A standard-day temperature line may be superimposed across the altitude lines. For aircraft equipped with jet engines, the chart shall be a plot of gross weight versus airspeed with parameters of thrust factor. The chart shall also be based on the ability to achieve straight flight throughout the climbout following sudden asymmetric loss of thrust from the most critical engine. In addition to the criteria in 3.4.10.3.1.5.16 a, d, e, f, and g, the following shall also be included:

a. The rudder pedal force required to maintain straight flight with asymmetric thrust shall not exceed 180 pounds.

b. Aileron control shall not exceed either the force limit recommended in MIL-HDBK-1797, or 75 percent of the available aileron control.

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c. Bank. Angle shall not exceed 5° from the inoperative engine or as limited by step b. above.

3.4.10.3.1.5.18 Climbout factor chart. This chart shall be a plot of takeoff/thrust factor versus climbout factor with the parameters of takeoff gross weight (see 3.4.10.3.1.3.2b.). The climbout factor shall be a reference number utilized on the climbout flight path charts to simplify determination of climbout performance. Climbout factor numbers shall be scaled to avoid using them for takeoff or thrust factors. Data for all engines operating and one engine inoperative shall be included.

3.4.10.3.1.5.19 Climbout flight path chart. These charts shall be plots of vertical height above takeoff point versus horizontal distance from brake release with the parameter of climbout factor. All engines operating charts shall be constructed to a minimum of either 8,000 feet vertical height or 24 nautical miles horizontal distance. One engine inoperative charts shall be a minimum of either 2,200 feet vertical height or 10 nautical miles horizontal distance. The horizontal distance shall be in feet with a subscale in nautical miles. Enlarged sections of these charts for close-in obstacles shall also be presented. Correction grids (see 3.4.5.2.8) for tailwinds shall be included in the text for one engine inoperative. The critical field length (see 3.4.10.3.1.5.9) portion of the total distance shown is for a dry level runway; however, the critical field length is extended for other runway conditions (see 3.4.10.3.1.5.16) or with an uphill slope (see 3.4.5.2.8.1). In determining the corrected critical field length, a correction shall not be applied for headwind, but shall be applied for tailwind. The charts for all engines operating, shall be based on all engines accelerating from brake release to takeoff. Charts for one engine inoperative, shall be based on all engines accelerating from brake release to critical engine failure speed and one engine failing at critical engine failure speed to takeoff. Gear retraction shall be initiated as soon as the aircraft is airborne and a positive rate of climb established. Climbout speeds shall not be less than those shown on the takeoff gross weight limit chart (see 3.4.10.3.1.5.2).

3.4.10.3.1.5.20 Maximum braking speed chart. This chart shall plot maximum braking speed versus gross weight for various parameters of pressure altitude and air temperature (see 3.4.10.3.1.3.2e.). The chart shall be based on the maximum torque available with proven efficiency level attainable from the skid control system. If no skid control system is installed, 0.9 maximum torque as demonstrated for the maximum energy conditions of MIL-W-5013 shall be used.

3.4.10.3.1.5.21 Basic takeoff chart. This chart shall include all variables necessary to obtain takeoff data and shall be used when the takeoff factor is not used.

3.4.10.3.1.5.22 Time, distance, and fuel to climb initiation chart. This chart shall contain plots of time, distance, and fuel from brake release to climb initiation versus takeoff factor with parameters of gross weight and, if applicable, drag index. Tabulated values for ground taxi and static military and maximum thrust fuel flows in pounds per minute shall be included. Data shall normally be shown for maximum and military thrust with all engines

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operating and maximum thrust with one engine inoperative.

3.4.10.3.1.5.23 Additional charts. Any charts peculiar to the takeoff operation of certain aircraft, such as runway slope correction greater than 3 percent and takeoff stabilizer setting, shall be included.

3.4.10.4 Part 4 - Climb.

3.4.10.4.1 Content and arrangement.

3.4.10.4.1.1 Table of contents (see 3.4.10.1.1.1).

3.4.10.4.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.4.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3 the following shall be included.

3.4.10.4.1.3.1 Ceiling terminology. The terms applicable to ceilings are similar to those used in MIL-HDBK-1793. All ceiling data shall be based on recommended climb speeds. Any other ceiling terms shall be identified.

3.4.10.4.1.3.2 Climb terminology. All terms pertinent to climb shall be included along with terms such as climb speeds, schedules, cruise ceilings, and performance ceilings.

3.4.10.4.1.3.3 Factors affecting climb performance. A discussion of the factors affecting climb performance shall be presented (see 3.3.4.1.21). Various climb procedures, effect of climb speed and drag index on rate of climb, engine cooling, use of cowl flaps, and effect of temperature and corrections shall be discussed. The effect of an inoperative engine on climb performance for multi-engine aircraft shall also be included (see 3.4.10.3.1.5.19).

3.4.10.4.1.4 Chart explanation. Explanations and example problems shall be given for the charts shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be required:

a. Time, distance, and fuel

b. Speed

c. Ceiling

d. Additional charts

3.4.10.4.1.5 Chart format. Climb charts shall be presented as specified in 3.4.3. Charts shall be presented for all engines operating and, if applicable, one and two engines

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inoperative. Charts shall be based on maximum continuous power, military power, and/or maximum power as required.

3.4.10.4.1.5.1 Time, distance, and fuel to climb chart. These charts shall be plots of gross weight versus time, distance, or fuel with parameters of pressure altitude and drag index if required. Influence lines showing the effect of decreasing weight during the climb shall be included. A standard-day temperature correction grid shall be attached. The range of altitudes shall be from sea level to the aircraft standard-day service ceiling. When requested by the acquiring activity, additional ceiling lines shall be included. Charts shall be based on the speed and power required in normal service. If climb is to be performed at a constant calibrated airspeed and/or mach number, it shall be noted on the charts.

3.4.10.4.1.5.2 Climb speed chart. When climb charts are based on varying speed, climb speed charts shall be provided. If climb speeds are different for all engines operating and one and two engines inoperative, separate charts shall be furnished. These charts shall plot KCAS/KIAS or TMN versus pressure altitude with parameters of gross weight and drag index if required. Applicable ceiling lines shall be superimposed on the gross weight curves. A standard-day temperature correction grid shall be attached (see 3.4.5.2.7.5).

3.4.10.4.1.5.3 Ceilings chart. This chart shall be a plot of gross weight versus altitude with parameters of either rates of climb from zero to five hundred feet per minute in increments of one hundred feet per minute or drag index. Rates of climb shall be based on the climb speed schedule at the given weight and power setting. Separate charts shall be provided for service ceiling, cruise ceiling, combat ceiling, and optimum cruise climb altitude. A standard -day temperature correction grid shall be provided (see 3.4.5.2.7.5).

3.4.10.4.1.6 Additional charts. (see 3.4.10.1.1.5).

3.4.10.5 Part 5 - Cruise.

3.4.10.5.1 Content and arrangement.

3.4.10.5.1.1 Table of contents (see 3.4.10.1.1.1).

3.4.10.5.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.5.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3, the following shall be included.

3.4.10.5.1.3.1 Cruise terminology. The following terms applicable to cruise shall be used.

a. The airspeed for maximum range shall be the speed at which 100 percent of the nautical miles per pound of fuel are attainable at a given weight and altitude.

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b. The airspeed for long range operation shall be the greater of the two speeds at which 99 percent of the maximum nautical miles per pound of fuel are attainable at a given weight and altitude.

c. The constant power cruise is a technique that consists of setting a power and allowing airspeed to increase with weight reduction.

d. Constant speed/mach cruise shall be a technique that consists of maintaining a preselected airspeed/mach at constant altitude by periodic reduction of power.

e. Cruise climb is a technique that consists of maintaining a constant Weight to Pressure Ratio (W/δ) at recommended long range cruise mach/airspeed. This is done by establishing the thrust for the desired speed and allowing the aircraft to gain altitude as weight is decreased by fuel consumption. The altitude flown, which shall not exceed cruise ceiling, is the optimum cruise climb altitude and is the altitude at which maximum value of nautical miles is obtained for each pound of fuel consumed.

f. The step climb cruise is a technique that is a compromise between constant altitude cruise and cruise climb. It consists of flying at either long range speed, maximum continuous power, or constant TAS/mach at a starting altitude that approximates the optimum cruise climb altitude or cruise ceiling. This altitude is then maintained until weight has decreased enough to allow a 2,000 foot or 4,000 foot climb back to the optimum cruise altitude or cruise ceiling.

3.4.10.5.1.3.2 Range terminology. Terms and factors affecting range data shall be presented. The effects of airspeed, power settings, altitude, temperature, wind, gross weight, external configuration, inoperative engine, fuel boil-off, and anti-icing bleed, are all factors that could affect range performance.

3.4.10.5.1.4 Chart explanation. Explanations and example problems shall be given for the charts below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be included:

a. Cruise climb

b. Optimum step climb

c. Specific range

d. Fuel flow

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e. Range summary

f. Diversion range summary

g. Additional charts

3.4.10.5.1.5 Chart format. Cruise charts shall be presented as specified in 3.4.3. Charts shall be presented for all engines operating and, if applicable, one and two engines inoperative.

3.4.10.5.1.5.1 Cruise climb chart. This chart shall contain plots of altitude, specific range (nautical air miles per pound of fuel burned), and mach number versus gross weight for parameters of air temperature or drag index, as applicable. The plotted mach numbers and altitudes shall provide the conditions to be flown to maximize the range of the aircraft. The mach numbers shall be the long range cruise mach numbers. A standard-day temperature correction grid (see 3.4.5.2.7.5) shall be provided for drag index format charts.

3.4.10.5.1.5.2 Optimum step climb chart. This chart shall contain plots of optimum step climb range and flight time versus gross weight for parameters of drag index, if drag index is required. A standard-day correction grid shall be supplied except as follows. If temperature change has minimal effect on either parameter, a note stating this shall be included and the temperature correction grid shall not be included. Climbs shall be conducted at maximum continuous power (normal rated thrust). The applicable mach/mach schedule shall be placed on the chart. If charts are separated for clarity, they shall be placed on facing pages.

3.4.10.5.1.5.3 Specific range chart. These charts shall be prepared as stated below and shall be provided as applicable.

a. Specific range charts in non-drag index format shall be a series of plots of nautical air miles per pound of fuel burned (specific range) versus true airspeed in knots true airspeed (KTAS) or true mach for parameters of gross weight. A subscale of KCAS/KIAS shall be included under the KTAS scale with influence lines defining the change in KCAS/KIAS for air temperature variations from a standard-day temperature grid. Long range cruise speed and maximum endurance airspeed curves shall be superimposed on the gross weight curves. Where applicable, engine operating lines such as BHP, torque, or fuel flow shall be included. Unless otherwise specified, separate charts shall be prepared for altitudes from sea level to the cruise ceiling of the aircraft in increments of 5,000 feet altitude and for all applicable configurations (see 6.2). A note defining the percent change in specific range with air temperature shall be included on the chart. A note defining the wind correction method shall be included on the chart.

b. Specific range charts in drag index format shall consist of a series of charts.

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Each chart shall consist of three pages of generalized fuel flow data for obtaining specific range for variations in gross weight, pressure altitude, and mach number/true airspeed. Each chart in the series shall contain data for a different drag index. Page 1 of each chart shall be a plot of gross weight versus a reference number which is some function of gross weight divided by the pressure ratio (W/δ) for parameters of pressure altitude. The second page shall be a plot of mach number/true airspeed versus reference number for a baseline of long range cruise speed. Influence curves shall be added to obtain reference numbers at speeds other than long range cruise speed. A subscale of KCAS/KIAS shall be included under the mach number/true airspeed scale with influence lines defining the change in KCAS/KIAS for variations in air temperature from standard-day. A note defining the percent change in specific range with air temperature shall be included on this page. A note defining wind correction method shall be included on this page. A maximum endurance line shall be superimposed on the influence curves. The third page shall be a plot of reference number versus specific range for parameters of pressure altitude.

3.4.10.5.1.5.4 Fuel flow chart. This chart shall be a plot of fuel flow versus true mach number for parameters of air temperature and specific range. Specific range data shall cover the full spectrum of values available for the aircraft. No additional data is required on this chart.

3.4.10.5.1.5.5 Range summary chart. This chart shall contain plots of constant altitude/constant mach number range and flight time versus gross weight for parameters of pressure altitude. A standard-day temperature correction grid shall be included unless temperature has minimal effect on either parameter. If the temperature grid is not included, a note so stating shall be included. The applicable mach number shall be placed on the chart. If charts are separated for clarity, they shall be placed on facing pages.

3.4.10.5.1.5.6 Diversion range summary chart. The chart for diversion range summary shall be a plot of fuel versus distance with parameters of altitude and shall show fuel required to cruise short distances in the clean configuration of clean plus empty pylon configuration, as applicable. Data shall be included for level flight at several typical initial altitudes plus data for climb to and cruise at optimum altitude from the initial altitudes selected. Data shall include a maximum range descent. The fuel required shall not include a landing reserve. The time data shall not be included.

3.4.10.5.1.6 Additional charts. (See 3.4.10.1.1.5).

3.4.10.6 Part 6 - Endurance.

3.4.10.6.1 Content and arrangement.

3.4.10.6.1.1 Table of contents (see 3.4.10.1.1.1).

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3.4.10.6.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.6.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3 the following shall be included:

3.4.10.6.1.3.1 Factors affecting endurance. The factors affecting endurance performance, the effect of airspeed, power, altitude, temperature, inoperative engine, and methods to obtain maximum endurance should be included.

3.4.10.6.1.4 Chart explanation. Explanations and example problems shall be given for the charts shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be provided:

a. Effect of bank angle on maximum endurance.

b. Maximum endurance.

c. Additional charts.

3.4.10.6.1.4.1 Chart data basis. The basis for the endurance charts shall be the higher of the following speeds:

a. Minimum fuel flow.

b. One hundred twenty percent of minimum buffet onset speed.

3.4.10.6.1.4.2 Effect of bank angle on maximum endurance chart. This chart shall be a plot of bank angle versus percent of maximum endurance.

3.4.10.6.1.4.3 Maximum endurance chart. This chart shall plot fuel required for loiter times versus gross weight with parameters of pressure altitude, drag index (see 3.4.3.3), air temperature, and bank angles. A speed schedule for true mach number, data for all engines operating, and one engine and two engines inoperative shall be included, as applicable. When this chart is developed for reciprocating engines CAS/IAS rather than mach number shall be used.

3.4.10.6.1.5 Additional charts. Any charts peculiar to certain aircraft such as power/EPR or time for maximum endurance, shall be included.

3.4.10.7 Part 7 - Descent.

3.4.10.7.1 Content and arrangement.

3.4.10.7.1.1 Table of contents (see 3.4.10.1.1.1).

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3.4.10.7.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.7.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3, the following shall be included:

3.4.10.7.1.3.1 Factors affecting descent. Factors affecting descent such as the types of descent, the effects of airspeed, drag devices, inoperative engine, time, distance, and fuel consumption during descent shall be included (see 3.3.4.1.25).

3.4.10.7.1.4 Chart explanation. Explanations and example problems shall be given for the charts shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be provided:

a. Maximum range descent.

b. Enroute descent.

c. Penetration descent.

d. Rapid descent.

e. Additional charts.

3.4.10.7.1.4.1 Descent chart data basis. This shall plot time, distance, and fuel for descent versus pressure altitude with parameters of drag index (see 3.4.10.1.1.4.1). Data shall be included for the charts identified in 3.4.10.7.1.4. Similar data shall be presented for selected configurations if drag index is not used.

3.4.10.7.5 Additional charts. Any charts required for descent information peculiar to certain aircraft shall be included.

3.4.10.8 Part 8 - Approach and landing.

3.4.10.8.1 Content and arrangement.

3.4.10.8.1.1 Table of contents (see 3.4.10.1.1.1).

3.4.10.8.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.8.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3, the following shall be included:

3.4.10.8.1.3.1 Terminology applicable to approach and landing. The following terms shall be included:

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a. Approach speed is the speed for the final approach to landing.

b. Threshold speed is the minimum speed for obstacle clearance.

c. High key or low key position is the altitude in feet over the touchdown point on the runway.

d. Touchdown speed is the speed at which the main gear touches the ground.

3.4.10.8.1.3.2 Factors affecting approach and landing. The effects of gross weight, temperature, altitude, RCR, hydroplaning, braking devices such as reverse thrust, speed brakes, spoilers, and drag chutes shall be discussed. Approach paths, missed approach characteristics, initial stall warning speeds, approach threshold, and touchdown speeds shall be included. The method used to obtain the distances shown and the use of crosswind landing gear to specific aircraft shall be explained.

3.4.10.8.1.4 Chart explanation. Explanations and example problems shall be given for the charts and tables shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be provided:

a. Landing crosswind

b. Air minimum control speed

c. Landing speeds

d. Flare distance

e. Landing distance

f. Additional charts

3.4.10.8.1.4.1 Landing crosswind chart. This chart shall be in the same format as specified in Part 3 (see 3.4.10.3.1.5.4). If the crosswind landing chart is identical to the crosswind chart referenced above, the chart shall be relabeled and included in the landing section.

3.4.10.8.1.4.2 Air minimum control speed chart. This chart shall be in the same format as specified in Part 3 (see 3.4.10.3.1.5.17).

3.4.10.8.1.4.3 Landing speeds chart. This chart shall be a plot of gross weight versus CAS/IAS (knots), with parameters of approach speed, threshold speed, and touchdown speed at various flap settings, including zero flaps (see 3.3.4.1.25). For estimated data, the landing lift coefficient utilizing ground effect shall be based on the maximum AOA attainable with the main landing gear oleo strut positioned for the static condition provided

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the landing lift coefficient OGE shall not exceed 110 percent of the 1G power-off stall airspeed for landing configuration. Distances to clear a 50 foot height shall be based on airspeeds that are at least 120 percent of the 1G power-off stall airspeed for the landing configuration. Baseline distances shall be for a hard surface dry runway using a maximum braking coefficient of friction of 0.3. Sufficient time shall be allowed after touchdown for deployment of drag chutes, activation of reverse thrust devices, plus time for their effect on deceleration.

3.4.10.8.1.4.4 Flare distance chart. This chart shall be a plot of air temperature in °C (see 3.4.5.2.7.2) versus flare distance from 50 foot height with parameters of pressure altitude and gross weight (see 3.4.10.1.1.4.11). Correction grids (see A) for various flap setting, increased threshold speed and wind shall be attached.

3.4.10.8.1.4.5 Landing distance chart. These charts shall be plots of air temperature versus landing ground roll with parameters of pressure altitude and gross weight (see 3.4.10.1.1.4.11). The charts shall be for landing ground roll and landing distance from 50 feet for selected flap positions with and without decelerating devices. Correction grids (see 3.4.5.2.8) shall be added for increased threshold speed, slope, RCR, reverse thrust, and wind. Landing data shall be presented for pressure altitudes from -2,000 to +16,000 feet and for temperatures from -60°C to +60°C. Landing distances based on flight tests shall not be less than the landing distances required in normal service (see 3.3.4.1.31).

3.4.10.8.1.5 Additional charts (see 3.4.10.1.1.5).

3.4.10.9 Part 9 - Mission planning.

3.4.10.9.1 Content and arrangement.

3.4.10.9.1.1 Table of contents (see 3.4.10.1.1.1).

3.4.10.9.1.2 List of charts (see 3.4.10.1.1.2).

3.4.10.9.1.3 Introductory text. In addition to the requirements of 3.4.10.1.1.3 the following shall be included.

3.4.10.9.1.3.1 Takeoff and landing data (TOLD) card. Complete instructions for filling out the TOLD card shall be provided and the chart(s) from which the data is extracted shall be referenced. A sample TOLD card shall be provided like the actual TOLD card located in the flight crew checklist. Figure 7 shows the typical information required for a TOLD card.

3.4.10.9.1.3.2 In-flight data card. Complete instructions for filling out the in-flight data card shall be provided. A sample card shall be provided.

3.4.10.9.1.3.3 Mission planning. Sample problems that are typical of the normal missions accomplished shall be provided. The sample problems shall outline each step in mission

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planning from start engines to stop engines. Actual performance data chart values shall be used throughout the problems.

3.4.10.9.1.4 Chart explanation. Explanations and example problems shall be given for the charts shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be included:

a. Fuel consumption/jettison

b. Formatting speeds and altitudes

c. Combat speeds, fuel allowances, level flight acceleration, steady state turn performance, and temperature effect on maximum speed

d. Forward support area operations

e. Additional charts

3.4.10.9.1.4.1 Fuel consumption/jettison chart. Charts for fuel jettison time, fuel consumption during ground operation, and fuel consumption from brake release to flaps up, shall be provided.

3.4.10.9.1.4.1.1 Fuel consumption during ground operation. A paragraph discussing fuel consumption for ground operation shall be provided. A fuel flow value in pounds, for various power settings, shall be included.

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TAKEOFF AND LANDING DATA CARD

CONDITIONS

	TAKEOFF	LANDING
Runway length	_____ ft	_____ ft
Runway height	_____ ft	_____ ft
Runway gradient	_____ ft	_____ ft
Gross weight	_____ lb	_____ lb
Center of gravity	_____	_____
Cross wind component	_____	_____
Head wind component	_____	_____
Outside air temperature	_____	_____
Pressure altitude	_____ ft	_____ ft
Dew point	_____	_____
Runway condition reading	_____	_____
Crosswind gear setting	_____	_____

TAKEOFF

Flap setting in degrees		_____
Engine pressure ratio (or torque)		_____
Carb air temperature (as required)		_____
Refusal speed/distance	_____ kt /	_____ ft
Rotation speed		_____ kt
Engine out climb speed (multi-engine)		_____ kt

LANDING

	IMMEDIATELY AFTER TAKEOFF	FINAL LANDING
Approach speed	_____ kt	_____ kt
Flare speed	_____ kt	_____ kt
Touchdown speed	_____ kt	_____ kt
Ground run (max and min)	_____	_____

NOTES:

FIGURE 7. TOLD Card Information (typical).

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3.4.10.9.1.4.1.2 Fuel consumption from brake release to flaps-up. A paragraph discussing fuel consumption required for takeoff (brake release to flaps-up speed) shall be provided. An average fuel consumption value(s) in pounds shall be provided.

3.4.10.9.1.4.2 Formatting speeds and altitudes chart. This chart shall plot airspeed-altitude compatibility for tanker and receiver aircraft with parameters of drag index, gross weight, and temperature deviation from standard-day. The receiver aircraft performance shall be corrected for downwash of the tanker thrust. Unless otherwise specified by the acquiring activity, separate charts, limited by 200 feet per minute climb potential, with military or normal power, shall be prepared for each receiver/tanker combination (see 6.2).

3.4.10.9.1.4.3 Combat speeds, fuel allowances, level flight acceleration, steady state turn performance, and temperature effect on maximum speed. Unless otherwise specified by the acquiring activity, these charts shall be included in this section (see 6.2).

3.4.10.9.1.4.4 Forward support area operations. Planning criteria, procedures, performance charts and necessary explanatory text covering operations from forward support areas shall be included. This data is not required if the aircraft is not capable of operations from a forward support area. The acquiring activity shall determine the need for this data (see 6.2).

3.4.10.9.1.5 Additional charts (see 3.4.10.1.1.5 and 6.2).

3.4.10.10 Helicopters. The following paragraphs contain the requirements for development of helicopter performance data. The requirements above may be used to provide additional guidance in developing helicopter performance data. Where the requirements differ, those in the following paragraphs shall take precedence for helicopters.

3.4.10.10.1 Chart requirements. All charts shall be graphical. The charts for maximum gross weight for hovering and the chart for power required to hover shall be placed on opposite pages. For multi-engine helicopters, operation after failure of one or more engines shall be included in the charts for maximum gross weight for hovering, minimum height for safe landing after engine failure, takeoff distance, climb, service ceiling, and cruise (range and endurance). Standard-day lines shall be omitted on all charts except the density altitude chart. Airspeeds shall be shown as "CAS/IAS" except in charts where the use of CAS/IAS instead of TAS would result in significant errors in the performance information.

3.4.10.10.2 Range of chart parameters. Unless otherwise specified, the range of parameters shall be OAT in increments of 10°C, density altitude from -8,000 feet to +30,000 feet, pressure altitude from -2,000 feet to +20,000 feet, headwind from 0 to 30 knots, rotor RPM from the minimum power-on to the maximum power-on RPM, and wheel/skid height from 0 feet to OGE. The altitude scale range may increase or decrease depending on the performance capabilities of the individual aircraft.

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3.4.10.10.3 Chart explanation. Explanations and example problems shall be given for the charts shown below. Two or more of these requirements may be combined into a single chart if this would enhance or simplify the presentation without degrading the output data. The following charts shall be provided:

a. Airspeed installation correction.

b. Density altitude.

c. Power available.

d. Fuel flow (turboshaft engines).

e. Maximum gross weight for hovering.

f. Power required to hover.

g. Headwind influence on maximum gross weight for hovering.

h. Headwind influence on power required to hover.

i. Power deterioration check (turboshaft engine).

j. Minimum height for safe landing after engine failure.

k. Takeoff distance.

l. Climb.

m. Service ceiling.

n. Cruise (range and endurance).

o. One engine inoperative capability.

p. Maximum airspeed for blade stall.

q. Power-on landing distances.

r. Additional charts (see 3.4.10.1.1.5).

3.4.10.10.3.1 Airspeed installation correction chart. This chart shall be a graph of KCAS versus KIAS and KIAS versus KTAS. Flight conditions that shall be included are level flight, climb, autorotation, and powered descent (R/D= 500 FPM).

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3.4.10.10.3.2 Density altitude chart. This chart shall be a plot of density attitude versus OAT for parameters of pressure altitude and reciprocal of the square root of density ratio (smoh). A scale for smoh ($1/\sqrt{\sigma}$) shall be added to the right side.

3.4.10.10.3.3 Power available.

3.4.10.10.3.3.1 Turboshaft engines chart. This chart for power available in hover and takeoff shall be a plot of air temperature versus torque with parameters of pressure altitude in increments of 2,000 feet and units of torque from zero to the limitation. Separate charts shall be required for maximum power, military power, and maximum continuous power. The transmission limit shown on the chart shall be based on the time duration of the power setting.

3.4.10.10.3.3.2 Reciprocating engines. This curve shall be a plot of engine BHP versus altitude for constant RPM with dotted lines of constant manifold pressure superimposed. Regions of blower operation shall be noted. This curve shall not include ram air.

3.4.10.10.3.4 Fuel flow (turboshaft engines) chart. This chart shall be a plot of fuel flow per engine versus torque per engine with parameters of pressure altitude. The pressure altitude shall range from sea level to 20,000 feet in increments of 2,000 feet. Transmission limit lines shall be superimposed. The chart shall be based on a constant zero °C air temperature and the engine specification fuel flow corrected for engine installation losses and increased +5 percent. The change in fuel flow for ambient temperatures above and below zero °C shall be noted on the chart. If the engine installation losses vary significantly throughout the flight envelope, the fuel flow data shall be based on these losses at the long range cruise speed.

3.4.10.10.3.5 Maximum gross weight for hovering. This curve shall be a plot of hover gross weight versus pressure altitude with parameters of OAT and correction plots for the power-on rotor RPM range and wheel height (zero feet to OGE height). Unless otherwise specified by the acquiring activity, charts shall be for the highest power setting, with a torque correction factor to be used when the actual engine performance differs significantly from the engine specification (see 6.2). The rotor RPM correction applies only to helicopters that have an operational band of rotor RPM.

3.4.10.10.3.6 Power required to hover chart. This chart shall be a plot of gross weight versus torque pressure with parameters of pressure altitude and correction plots of rotor RPM, OAT, and wheel height. The rotor RPM correction is applicable only if the helicopter has an operational band of rotor RPM. This chart shall be placed in the manual on the right-hand page opposite the chart for maximum gross weight to hover.

3.4.10.10.3.7 Headwind influence on maximum gross weight for hovering chart. This chart shall contain several plots of headwind versus gross weight for various wheel heights. The plots shall consist of a baseline at zero knots headwind and guidelines for other wind speeds. The data shall be based on the baseline rotor speed and the engine power setting

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used to construct the chart for maximum gross weight for hovering. Headwind influence curves shall be presented for the lowest operational wheel height, 5 feet, 15 feet, 30 feet, and OGE.

3.4.10.10.3.8 Headwind influence on power required to hover chart. This chart shall contain several plots of headwind versus torque pressure for various wheel heights. The plots shall consist of a baseline at zero knots headwind and guidelines for other wind speeds. Torque pressure shall range from flight idle to maximum torque. The data shall be based on the baseline rotor speed used to construct the chart for power required to hover. Headwind influence curves shall be presented for the lowest operational wheel height, 5 feet, 15 feet, 30 feet, and OGE. This chart shall be placed on the right-hand page opposite the chart for headwind influence on maximum gross weight for hovering.

3.4.10.10.3.9 Power deterioration check (turboshaft engine) chart. This chart shall provide the pilot with a means to determine the degree of engine deterioration from initial installation. A statement shall be included that the chart provides the initial power characteristics and that periodic checks shall be made to observe trends. The parameters shall be torque, pressure altitude, air temperature, and turbine inlet temperature. Various turboshaft engines may require a different power indicator such as gas producer speed or exhaust gas (tailpipe) temperature. The percent reduction in torque to allow freedom from engine stall shall be as established by the engine manufacturer. The range of parameters shall be pressure altitude from sea level to 20,000 feet in increments of 2,000 feet. Torque pressure and turbine inlet temperature shall be from flight idle to maximum power.

3.4.10.10.3.10 Minimum height for safe landing after engine failure chart. This chart shall be a plot of the minimum height required for safe landing after engine failure versus level flight airspeed in KCAS/KIAS. Regions of avoidance, caution, and safe operation shall be shown. The avoidance area shall be labeled "avoid continuous operation". Because the chart is a safety of flight item, it shall be shaded to show the regions of safe operation, caution, and avoidance. Separate charts shall be furnished for several gross weights and power levels. The page containing this chart shall have an emergency border in accordance with the requirements of MIL-STD-38784. For single-engine helicopters, the density altitude shall extend from sea level to at least 12,000 feet. For multi-engine helicopters, the format of this chart shall be the same as for single-engine helicopters, except the chart shall be based on a condition of total power failure. For a single-engine failure in a multi-engine helicopter, the chart shall be in terms of pressure altitude with ambient temperature corrections. The definition of power failure and time delay for corrective action for all helicopters shall be as contained in MIL-H-8501.

3.4.10.10.3.11 Takeoff distance chart. This chart shall be a plot of gross weight versus total distance required to clear a 50-foot obstacle for parameters of pressure altitude, air temperature and correction plots of climbout airspeed and headwind. Ranges of parameters shall be pressure altitude in increments of 2,000 feet and climbout airspeed of 10 to 60 KCAS/KIAS. A correction plot relating maximum hover wheel/skid height to takeoff distance shall be superimposed on the air temperature correction plot. The text

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shall contain information on the optimum takeoff technique to the maximum hover/skid height. Charts shall be required for the following takeoff techniques: rolling (wheeled helicopters), level acceleration, simultaneous climb and acceleration, rotor bleed, sling load, and sideslip (tandem rotor helicopters). Unless otherwise specified by the acquiring activity, data for wheeled helicopters shall be presented showing takeoff ground distance required versus KCAS/KIAS at takeoff (see 6.2). The rotor bleed takeoff shall be considered an emergency procedure, and the page shall have an emergency border in accordance with the requirements of MIL-STD-38784. Distances based on flight tests shall be not less than the takeoff distances required in normal service when the aircraft is operated in accordance with the instructions contained in Section II of the flight manual. Calculated minimum distances based on estimates shall be increased at least 15 percent until verified by flight tests. For land-based helicopters, distances shall be presented for dry sod having a rolling coefficient of friction of 0.05 for takeoff.

3.4.10.10.3.12 Climb chart. This chart shall present information for pressure altitudes from sea level to service ceiling in increments of 2,000 feet for parameters of OAT. Climb information shall be time to climb (minutes), distance traveled (nautical miles), fuel used (pounds), and rate of climb (feet per minute). Configurations and gross weight shall correspond to those used in presenting takeoff data. Warmup and takeoff fuel allowances shall not be included in the curves; however, the text shall identify the fuel allowances. The warmup and takeoff fuel allowances are 5 minutes (MET0) power at sea level for reciprocating engines and 2 minutes (maximum continuous power) at sea level for turboshaft engines. A note shall be entered on the chart to indicate the quantity of fuel allowance. Time to climb and fuel used shall be based on the integrated rate of climb from sea level. No allowance shall be made for weight reduction. Best climb CAS/IAS, manifold pressure and supercharger ratio shall be shown. Separate charts shall be required for each power setting. The charts shall be based on a constant climb speed which must be an integer number divisible by five and in units of CAS/IAS such as 60, 65, 70, etc.

3.4.10.10.3.13 Service ceiling chart. This chart shall be a plot of service ceiling (altitude at which rate of climb is 100 feet per minute at a given weight) versus gross weight with parameters of air temperature. The pressure altitude shall range from sea level to at least 25,000 feet. Curves shall be based on military and maximum continuous power. The service ceiling data shall be based on the same climb speed schedule and configuration as specified in 3.4.10.10.3.12. For multi-engine helicopters, an additional chart shall be prepared showing service ceiling with one engine inoperative.

3.4.10.10.3.14 Cruise (range and endurance) chart. These charts shall present range and endurance data versus TAS for parameters of pressure altitude in increments of 2,000 feet from sea level to 20,000 feet or service ceiling, whichever is less. The airspeed conversion plot (KTAS to KIAS) shall be located below the specific range plot. The baseline, superimposed on the W/δ guidelines shall be located on the long range speed for the configuration shown (see 3.4.10.5.1.3.1b). The gross weight increments for the specific range plot should be between 10 percent and 20 percent of the maximum useful load. These charts shall be located on opposing pages in the manual.

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3.4.10.10.3.14.1 Cruise (range and endurance without compressibility effects). For helicopters that do not experience power required increases due to rotor blade compressibility effects (not more than 5 percent increase in power required), the altitudes in the range and endurance charts shall be density altitudes. The notation specifying the range of OAT in °C shall not be included.

3.4.10.10.3.14.2 Cruise (range and endurance with compressibility effects). For helicopters that experience power required increases due to rotor blade compressibility effects, the altitudes in the range and endurance charts shall be pressure altitudes. Range data at the long range airspeed shall be determined for various altitudes at a constant +30°C air temperature. Additional charts shall be required when air temperature below +30°C causes a decrease in unit range of 5 percent or greater. The air temperature range for this chart shall be entered in the note.

3.4.10.10.3.15 Single-engine capability chart. This chart shall present absolute ceiling information. The chart shall consist of gross weight, fuel flow, and indicated torque versus OAT, for pressure altitudes from sea level to absolute ceiling in 2,000 foot increments. The chart shall be based on the single-engine best climb speed at military power. A correction plot for rates of descent from 0 feet per minute to 600 feet per minute shall also be included on the chart. The chart shall have an emergency border in accordance with the requirements of MIL-STD-38784.

3.4.10.10.3.16 Maximum airspeed for blade stall chart. This chart shall be a plot of pressure altitude versus blade stall airspeed in units of CAS/IAS with parameters of OAT and correction plots for rotor RPM, gross weight, and angle of bank. The angle of bank shall range from 0 to 50°.

3.4.10.10.3.17 Power-on landing distance chart. This chart shall be a plot of density altitude versus power-on horizontal landing distance and landing ground roll with parameters of gross weight and correction plots for headwinds. Distances based on flight test data shall not be less than the landing distances required in normal service when the aircraft is operated in accordance with the instructions for a normal power-on landing contained in Section II of the flight manual. Estimated data shall be increased by 15 percent. The distance for land-based helicopters, shall be presented for firm day sod having a braking coefficient of 0.25.

3.4.10.10.4 Additional charts. Special charts that are peculiar to certain aircraft and necessary to completely define the operation or restrictions of the aircraft may be included and are shown below:

a. Airspeed fuselage mach number curve.

b. KIAS versus KTAS (if used, this chart shall be located after the airspeed calibration chart. Data shall be provided for level flight and climb).

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c. Minimum flying speed.

d. Airspeed rotor tip mach number curve.

e. OEG hovering endurance.

f. Gross weight limitation.

3.5 Mission crew manual. This manual shall be prepared to furnish additional information required for a function, or to provide additional information for a given crew station. The information contained in this manual shall be sufficient to allow the crew member to perform assigned functions, interface with the remainder of the flight crew, and provide a stand-alone document for all information required (including emergency procedures) by the crew member. The mission crew manual shall be prepared to the requirements of this paragraph and the content shall meet the requirements of this specification where applicable.

3.5.1 Function. This manual shall cover pertinent information that is applicable to a system or piece of equipment, specific functions or procedures, and will normally be utilized for special functions or by particular crew members. Items requiring coordination with the pilot or other crew members shall also appear in the standard flight manual and/or other mission crew manuals where appropriate. Items such as oxygen checks, ditching position, emergency stations, and aircraft emergencies shall be contained in the mission crew manual.

3.5.2 References. The mission crew manual and the flight manual shall completely reference each other, where necessary. The title pages and tables of contents shall reference each other.

3.5.3 Front matter (mission crew manual). Front matter requirements for this manual shall be the same as for the flight manual except that the title page need not have the same issue date as the flight manual (see 3.3.2). The title shall also depict the function(s) covered therein.

3.5.4 Sections (mission crew manual). This manual shall have five Sections. When specified, additional sections shall be included (see 3.5.4.6) in addition to the following:

a. Section I - Description and theory of operation.

b. Section II - Normal procedures.

c. Section III - Emergency procedures.

d. Section IV - Malfunction analysis and alternate procedures.

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e. Section V - In-flight repairs.

3.5.4.1 Section I Description and theory of operation. This section shall contain the description of the system and theory of operation.

3.5.4.2 Section II Normal procedures. This section shall contain numbered procedures beginning with the entry of the applicable crew member into the aircraft and progressing in phases until the crew member leaves the aircraft. Any inspections or interface required of the crew member with other members of the crew shall be provided.

3.5.4.3 Section III Emergency procedures. This section shall provide emergency procedures for any systems under the control of the crew member(s) covered by the manual. Common crew member responsibilities for aircraft emergencies shall also be provided.

3.5.4.4 Section IV Malfunction analysis and alternate procedures. This section shall contain malfunction analysis and the alternate procedures to follow for maximum use of the equipment in accomplishing the assigned mission.

3.5.4.5 Section V In-flight repairs. This section shall include instructions on making repairs that can be accomplished during flight. This section may be combined with Section IV if it is determined to be more advantageous to the involved crew member, and is approved by the acquiring activity (see 6.2).

3.5.4.6 Additional sections. When specified, additional sections shall be added to the manual (see 6.2). Numbering of added sections shall be consecutive beginning with Section VI. In the event that additional sections are required and Section V has been combined with Section IV, the added section(s) shall begin with Section VI and a statement shall be included explaining that Section V has been included as part of Section IV.

3.6 Supplemental manual. This manual shall provide supplemental operating instructions for aircraft which have been modified with special equipment. Since a complete standard flight manual is available for the standard aircraft, only the additional data which is necessary to cover the differences created by the modification shall be covered. A drag index will be used where possible in lieu of developing complete performance data. The supplemental manual shall also be utilized to present classified information when necessary. If there is a need to present both classified and unclassified information, the development of two supplemental manuals may be authorized by the acquiring activity (see 6.2). This paragraph shall not be used to develop performance data or load configuration supplements. In the event that a supplemental manual impacts the flight crew checklist, the acquiring activity shall determine the extent of the requirement and when specified, the appropriate checklist shall be prepared in accordance with paragraph 3.7.

3.6.1 Content and format. The content and format shall be the same as specified for the standard flight manual.

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3.6.2 References. The supplemental manual shall be completely referenced to the flight manual. If specified by the acquiring activity, the flight manual shall reference an unclassified supplemental manual (see 6.2). References to classified supplements shall not be included in the flight manual except as specified in 3.3.2.1.2 and 3.3.2.4.1.

3.6.3 Title page. The title page to the supplemental manual shall be prepared as specified in 3.3.2.1.

3.6.4 Main table of contents. A complete table of contents shall be included. The table of contents shall be prepared using the same format as specified in 3.3.2.4.1 for classified supplements.

3.6.5 Foreword/Preface/Introduction. The foreword shall cover the scope and concept of the manual.

3.6.6 Section titles. If an entire section is omitted, the section title and a note to refer to the flight manual for the required information shall be included. If two or more sections in sequence are omitted from the partial manual, a notation similar to the following shall be included:

"Sections I through III (See TO .....)"

3.6.7 Tables of contents. A table of contents shall be included for each section of the supplemental manual unless the section consists of only a few pages wherein a table of contents would not serve a useful function. If a table of contents is included, it shall be complete. If any portion of the material is covered in the supplemental manual, reference shall be made to the page on which that item begins.

3.6.8 Coverage within sections. Each section shall clearly identify the portion of information contained therein, and the portion which is contained in the flight manual. However, when only a few subjects or pages of the supplemental manual are involved, it shall be permissible to include an introduction stating the following: "Except for the following, all other limitations are covered in TO ...." The same convention shall be employed when only a portion of a major paragraph is included in the supplemental manual. The supplemental manual shall also identify any information in the flight manual that is not applicable to the modified aircraft.

NOTE: If the normal or the emergency procedures are changed from the standard flight manual, it shall be necessary to present the entire procedure (as changed in the supplemental manual).

3.6.9 Index. Unless otherwise specified, an alphabetical index shall be included in the supplemental manual.

3.7 Abbreviated flight crew checklist requirements. The requirements contained herein

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are for the development of abbreviated flight crew checklists based on information contained in the flight manual. See paragraph 6.5 for definition of the types of checklists. Specialized checklists for items such as weapons delivery and cargo loading shall not be prepared using the requirements of this specification. Refer to the DODISS to determine the appropriate specifications to be used to develop these specialized checklists. When specified by the acquiring activity, an integrated flight crew checklist shall be prepared (see 6.2). An integrated flight crew checklist shall contain all applicable checklists (i.e., flight manual, air refueling, weapons delivery, etc.).

3.7.1 Source and sequence of checklist data. The information for checklists shall be drawn from the flight manual procedures (see 3.2.12.2.1.2). Unless otherwise specified (see 6.2), the information shall be arranged in the same sequence as the parent manual (with exception of the emergency procedures for the Class 2 checklist). The emergency procedures section in the Class 2 checklist shall be located as specified by the acquiring activity (see 6.2).

3.7.2 Content. The content of the flight crew checklist shall be as specified herein. The general requirements of 3.3.2 apply to checklists except as specified below in the development of front matter.

3.7.2.1 Checklist title page. The title page shall include the crew position of the crew member for whom the checklist is applicable.

3.7.2.2 Table of contents. A table of contents is not required for the front matter. A table of contents as specified in 3.3.2.4 shall be prepared for each section or part of the checklist.

3.7.2.3 List of effective pages. A list of current abbreviated flight crew checklists (as prescribed in paragraph 3.3.2.2 for the flight manual) shall not be included on the List of Effective Pages for checklists.

3.7.2.4 Introduction for Class 1 and 2 checklists. The introduction shall contain a brief explanation of the purpose and scope of the checklist as well as a brief discussion covering it's use. The information provided shall not duplicate the information contained in the introduction of the parent manual.

3.7.3 Performance data for Class 1 and 2 checklists. Performance data shall be presented in the most readable form and shall be easily accessible. Tabular data is generally preferred to graphical data due to the size limitations involved.

3.7.4 Illustrations. Illustrations shall not be included in the flight crew checklists unless approved by the acquiring activity (see 6.2). If illustrations are authorized, the following criteria shall apply. The illustration shall be derived from the flight manual. Figure numbers shall not be used. Illustration titles shall correspond to the title used in the flight manual.

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3.7.5 Takeoff and landing data (TOLD) card. A TOLD card shall be provided in the flight crew checklist. This card shall contain information similar to that provided in Figure 7 (tailored to meet the requirements of the particular aircraft). Instructions for using the TOLD card shall not be provided in the checklist. Unless otherwise specified, the TOLD card shall be located on the last page(s) in the normal procedures section of the checklist (see 6.2). Adequate space shall be provided for each information category to allow for the entry of values by the crew member.

3.7.6 Page numbering for Class 1 and 2 checklists. Each page of the Class 1 and 2 checklists shall be numbered. The page numbers of the introduction shall be lower-case numerals (i, ii, etc). Unless otherwise specified (see 6.2), the page numbering format for Class 1 and 2 checklists shall conform to the numbering format of the parent manual with the exception of the emergency procedures section of the Class 2 checklist. The first page of the emergency procedures section of the Class 2 checklist shall be numbered E-1. If more than one version of a section or part is included in the flight manual (i.e., coverage of various configurations of aircraft/systems), the page numbering format in the checklist shall correspond to the numbering format of the parent manual. Except for the emergency procedures in the Class 2 checklist, each section of the checklist shall begin at the top of a right-hand page.

3.7.7 Abbreviated checklist content requirements. Class 1 or 2 checklists developed from data derived from a flight manual prepared in accordance with this specification, shall contain all the information required by the crew member in order to function as part of the crew complement. Figure 8 provides an example of a Class 1 or Class 2 checklist page.

3.7.8 Class 3 (scroll) checklist. The Class 3 (scroll) checklist shall be developed from data taken from the normal procedures section of the flight manual. Each Class 3 checklist shall provide only the procedures for the crew position for which it is designated (i.e., pilot or navigator). Line items may be further abbreviated to fit the procedure on one line. Class 3 (scroll) checklists shall duplicate the information contained in the applicable portion of the Class 1 or 2 checklist and shall contain only the normal procedures that can be accomplished while occupying the applicable crew station. The procedural paragraph heading from the flight manual shall be included. If there is a reference in the flight manual procedure, it may be included in the Class 3 (scroll) checklist. Figure 9 provides an example of a Class 3 checklist.

3.7.9 Checklist format and arrangement. The flight crew checklists shall be prepared using the checklist requirements contained in MIL-PRF-5096, MIL-STD-38784, and as specified herein.

3.7.9.1 Class 1 and 2 checklists.

3.7.9.1.1 Class 1 checklist. Class 1 checklists shall be prepared in 4½ by 7-inch size and the maximum printing area shall be 3 ⅝ by 6 ½- inches.

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3.7.9.1.2 Class 2 Checklist. Class 2 checklists shall be prepared in one of the following sizes:

TABLE II. Class 2 Checklist sizes.

Checklist size	Maximum printing area	Staggered pages
5 by 8-in	4⅛ by 7 ½- in	YES
5 by 9-in	4⅛ by 8 ½-in	YES
5¼ by 11-in	5⅛ by 10 ½-in	NO
5¾ by 11-in	5⅝ by 10½-in	NO

3.7.9.1.2.1 Checklist page length. When specified by the acquiring activity (see 6.2), the following additional requirements apply to Class 1 and 2 checklists: The length of the emergency pages for Class 2 checklists shall be staggered vertically in ¼-inch increments to permit the visual indexing of the procedures at the bottom of the page. The last page of the emergency procedures shall be 8-inches (9-inches for the 5 by 9-inches) in length and shall be the longest page in the emergency procedures. Page numbers for staggered pages shall be centered at the bottom of the page.

a. When specified by the acquiring agency, the Class 1 or Class 2 checklists shall be printed on JCP-040 (115 pounds per 500 sheets) white or yellow paper.

b. When specified by the acquiring agency, the checklist pages shall be laminated.

3.7.9.1.2.2 Checklist page tabs. Each page shall have a tab title on each side of the page number. The tab title at the right of the page number shall identify the data contained on the page. The tab title to the left of the page number shall identify the data on the preceding page. The change number identifier for staggered pages shall be located immediately under the TO number near the upper outer corner of the page.

3.7.9.2 Checklist page emergency borders. Emergency page markings shall be provided across the top of the page only. The acquiring agency shall provide specific guidance concerning the arrangement of the data within this format.

3.7.9.3 Class 1 and Class 2 checklist drilling dimensions. For drilling dimensions, see Figure 10. Unless otherwise specified, pages shall be printed on JCP-A60 (50 pounds per 500 sheets) white paper.

3.7.9.4 Class 3 (scroll) checklists. Scroll checklists shall be prepared on UV emulsion, black

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image, sensitized on one side, matte on reverse side, 0.0043-in thick mylar-polyester film (Technifax part number P3200M or equivalent). Film shall be trimmed to form a finished size of 2 ¾ by 96 (maximum) inch size. The print area shall be 2 ½by 91 (maximum) inch size. Scroll checklists shall be revised rather than changed when changes to the material are required.

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TAXIING

1. Wheel Brakes - TEST
2. Nose gear steering - ENGAGE & CHECK
3. (P-WSO) Flight instruments - CHECK OPERATION
4. (P-WSO) Oxygen diluter lever - AS REQUIRED
5. (P) Electronic altimeter - ON, SET CLEARANCE PLANE
6. (WSO) Electronic altimeter - CHECK
7. (P-WSO) FLR - CHECK
8. (WSO) FLR mode selector - STBY
9. (P-WSO) RWR/ECM - AS REQUIRED
10. (WSO) Sensor checks - AS REQUIRED
11. (WSO) Window defog - ON

BEFORE TAKEOFF

1. (P-WSO) Harness & leads - FASTENED
2. Internal wing transfer switch - NORMAL
3. Tanks 5&6 lockout - AS REQUIRED
4. Stab aug switches - ENGAGE
5. Flight controls - UNRESTRICTED (WSO visually check control surfaces)
6. Anti-ice switch - AS REQUIRED
7. Stabilizer trim - CHK 1 TO 3 UNITS NOSE DN
8. Fuel quantity - CHECK
9. (P-WSO) Canopies - CLOSE, CHECK
10. Defog-footheat & temp control - AS REQUIRED
11. (WSO) Command selector valve
12. (P-WSO) Lower ejection handle safety guard - CLEAR
13. Warning lights/voice warning system - CHECK

After runway lineup -

14. External transfer switch - AS DESIRED
15. Flaps - DOWN
16. Anti-skid - ON, LIGHT OUT

FIGURE 8. Example page of Class 1 or Class 2 Checklist.

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STOP TURNING

T.O. 1C-5A-1CL-1-1

24 MAY 1989

PILOT'S SCROLL

CHECKLIST

AIRPLANE

USAF SERIES

C-5A AND C-5B

AF33(657)-15053
F41608-88-D-A383

THIS PUBLICATION REPLACES
T.O. 1C-5A-1CL-1-1 DATED
2 AUGUST 1988
(DISTRIBUTION STATEMENT)
(EXPORT CONTROL NOTICE)
(HANDLING AND DESTRUCTION NOTICE)

Note
This scroll checklist reflects information contained in the Pilot's Abbreviated Flight Crew

BEFORE STARTING ENGINES
1. Forms 781 & 365-4 - "CHECKED AND SIGNED" (P)
2. Oxygen - "CHECKED AND ON" (CP,P)
3. Radios, Radar Altimeters, and IFF - "ON AND STBY" (CP,P)

4. INS Interface Check - "AS REQUIRED" (CP,P,N)

//

\\

12. Cargo Door System - AS REQUIRED
13. Inertial Positions - "CHECKED" (CP,P,N)
14. INS Mode Selector Switches - "AS REQUIRED" (CP,P,N)
15. FSAS Power Switch - OFF 16. Engineer's Report - "CHECK COMPLETED" (E)
17. Engine Shutdown Check - "COMPLETED" (CP)

BEFORE LEAVING

1. PACS Pitch and Roll Switches - "OFF" (P)
2. AFCS - OFF
3. Oxygen Regulators - "100%AND OFF" (CP,P)
4. Stallimiter System -"OFF" (CP,P)
5. IFF - OFF, CODES - **AS** REQUIRED
6. Parking Brake - "AS REQUIRED" (P)
7. Before Leaving Airplane Check - "COMPLETED" (CP)

END

T.O. 1C-5A-1CL-1-1

STOP TURNING

FIGURE 9. Example Class 3 Checklist.

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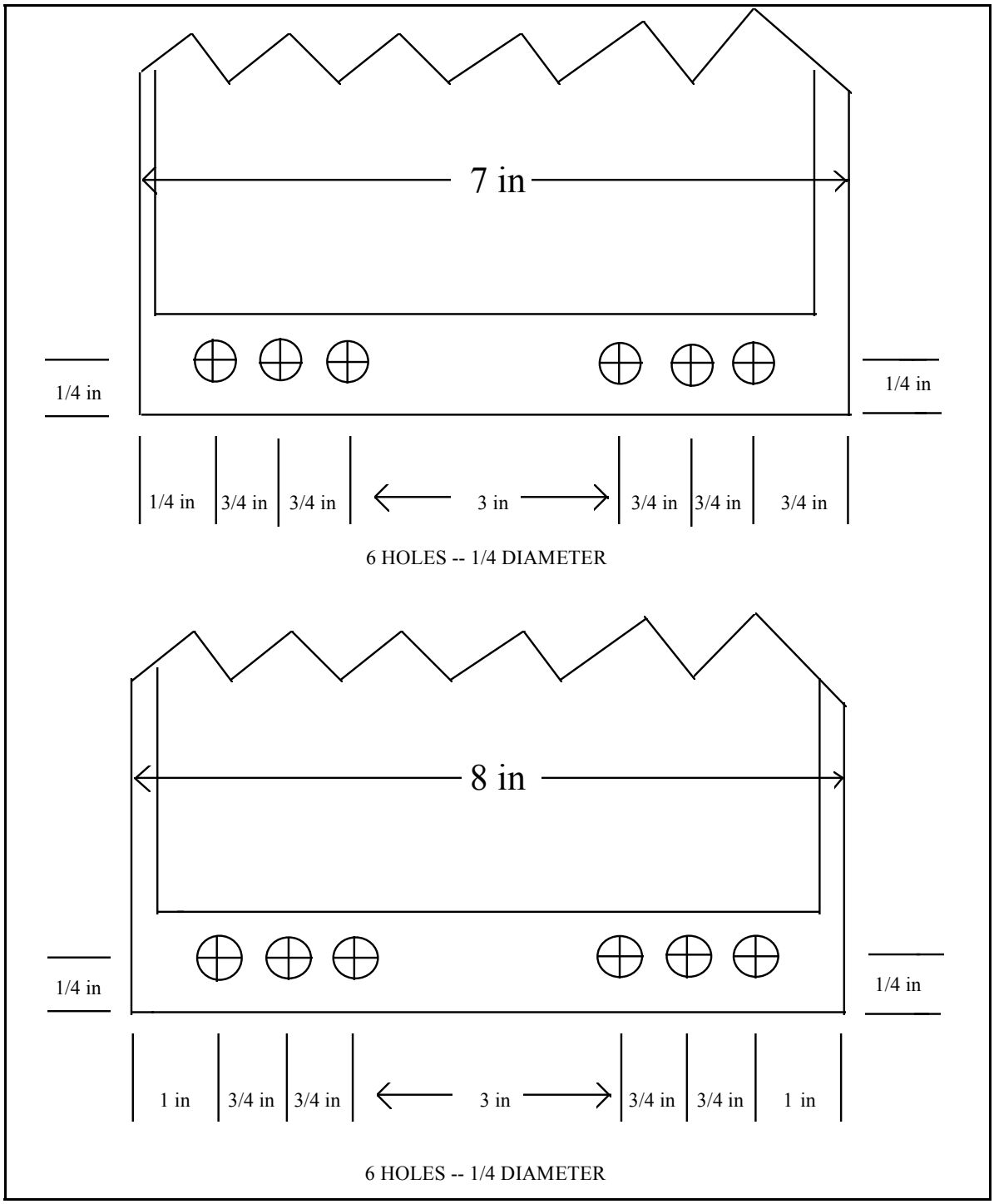

FIGURE 10. Drilling dimensions, 4 ½ by 7 and 5 by 8-inch checklists.

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4. VERIFICATION

4.1 Verification. Unless otherwise specified in the contract or purchase order:

a. Validity of the accuracy and scope of the flight manual technical content, and user interface functionality shall be the responsibility of the contractor (see 6.6.6).

b. The contractor shall provide suitable facilities to perform the validation functions specified herein.

c. The contractor's existing quality assurance procedures shall be used.

d. The government reserves the right to review any of the verifications.

4.1.1 Minimum verification requirements. As a minimum, verification shall ensure the following:

a. Suitability of the flight manuals for the intended environment.

b. Usability by the intended users.

c. Compatibility with other government systems.

4.1.2 Compliance. All flight manuals shall meet all requirements of Sections 3 and 5. The requirements set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any requirements in this specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the government for acceptance comply with all requirements of the contract. Use of sampling inspections shall be in accordance with commercially acceptable quality assurance procedures; however, government approval for use of sampling in QA procedures does not authorize submission of known defective material, either indicated or actual, nor does it commit the government to accept defective material.

5. PACKAGING.

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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5.2 Printing standard. All flight manual publications shall be prepared to quality level III as specified in GPO Publication 310.1.

6. NOTES.

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. This specification covers flight manuals that are intended to provide information for flight crews in the operation of aircraft and their on-board systems.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this document.

b. Whether features other than as specified herein are required (1.1).

c. Issue of the DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced herein (2.2.1, 2.2.2).

d. Whether Performance Data will default as a separate manual or be developed as an appendix within the Flight Manual itself (3.2c).

e. Approval of critical 'Warnings' and 'Cautions' as well as the use of the letters 'W' or 'C' in the flight crew checklists (3.2.1).

f. Whether the acquiring activity requires standardized part nouns and not necessarily as reflected on the engineering drawings (3.2.2.1).

g. Whether color shall be used to distinguish flow patterns on complex diagrams (3.2.4).

h. Whether a status page for changes shall be provided as part of the change packages (3.2.8.1).

i. Whether a mission crew manual should be developed to support a complex system (3.2.9.1).

j. Whether pilot and copilot procedures shall be combined in single column format or presented in separate (multiple) columns (3.2.12.1.1).

k. Whether the crew designator will be placed in front of, or after the procedural step (3.2.12.1.1).

l. Whether additional crew designator letters are required (3.2.12.1.1.2).

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m. Whether flight manual and associated checklists will be classified (3.2.25).

n. Types of manuals and checklists to be procured (3.3).

o. Approval of section arrangement other than specified herein (3.3).

p. Approval of added sections and added section titles in the flight manual. Specify who will develop and maintain the DTD's and FOSI's required to support these and other additions and deviations to flight manual/performance data/mission crew/supplemental manual/abbreviated checklist layout (3.3).

q. Approval for additional section titles (3.3).

r. Whether performance data is required (3.3).

s. Whether air refueling procedures will be created as stand-alone section or incorporated within the manual as a system (3.3 and 3.3.10).

t. Method of including trainer version of aircraft information (if applicable) in the flight manual (3.3.1).

u. Which emergency procedures notice to include on the title page of a classified flight manual (3.3.2.1.3).

v. Determine what common information service will be required (3.3.2.6.1).

w. How the material in Section I will be presented (3.3.3).

x. Whether separate or combined electrical system schematics will be provided (3.3.3.9.1).

y. Whether a diagram is required showing area of illumination for exterior lighting (3.3.3.31).

z. Whether unusual takeoff information will be provided (3.3.4.1.20).

aa. Development of landing procedures in checklist format (3.3.4.1.31).

ab. Whether emergency entrance information shall be included (3.3.5.11.1).

ac. The arrangement of emergency procedures by system or phase of operation (3.3.5.1).

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ad. Content requirements for Mission Crew Duties/Procedures section (3.3.6).

ae. Whether Table of Servicing Fluids will contain aircraft capacities (3.3.7.1).

af. Whether a Summary Table of Limitations will be provided (3.3.7.4).

ag. Any changes, additions, or deletions to flight characteristic data requirements in Section VI (3.3.8).

ah. Whether additional air refueling data information is required (3.3.10.1).

ai. Whether any additional air refueling flight safety lessons learned are to be provided (3.3.10.2).

aj. If all performance data charts presented in the flight manual shall be in a format other than Drag Index Format (see 3.4.2).

ak. Whether additional tables will be allowed in the performance data section (3.4.3.2).

al. Whether nomographs may be used in the performance data section (3.4.3.5).

am. Whether to add a fuel flow conservation factor for fixed-wing aircraft (3.4.4.2b).

an. Whether limit lines representing any safety limitations or restrictions shall be included (3.4.5.2.7.1).

ao. Whether to provide temperature subscales in Fahrenheit (3.4.5.2.7.2).

ap. Whether to place correction grids on performance data charts on the same chart or on separate page opposite the chart (3.4.5.2.8).

aq. Whether to use a correction grid or prepare a separate chart for all but takeoff flap settings (3.4.5.2.8.6).

ar. Whether acquiring activity must provide sample charts (3.4.9).

as. Provide the location of the bordered title on performance data charts (3.4.5.2.10.1).

at. Whether to use a different method to account for stores interference on drag number tables (3.4.10.1.1.4.1).

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au. Approval of contractor format for aircraft gross weight and center of gravity chart (3.4.10.1.1.4.11).

av. Other types of takeoff acceleration checks other than those specified (3.4.10.3.1.3.2o).

aw. Specify maximum tolerance for acceleration check speed (3.4.10.3.1.3.2q).

ax. Whether the "Wind Summary Sample Table" shall be included (3.4.10.3.1.3.3).

ay. Define Not-to-Exceed full gust increment value in knots (TABLE I).

az. If charts shall be furnished for zero flap settings and alternate fuel grades (3.4.10.3.1.5.5).

ba. If coefficients for other types of surfaces shall be furnished (3.4.10.3.1.5.5b).

bb. If data for other than normal operation such as maximum effort shall be based on flight tests (3.4.10.3.1.5.5d).

bc. If reduced power takeoff performance data charts shall be provided (3.4.10.3.1.5.6).

bd. Whether an assist takeoff ignition time chart is required (3.4.10.3.1.5.7).

be. Whether to provide a runway transverse gradient chart (3.4.10.3.1.5.16h).

bf. Whether to use smaller increments on range charts (3.4.10.5.1.5.3a).

bg. Whether specialized or additional charts are required for mission planning (3.4.10.9.1.4.2, 3.4.10.9.1.4.3, 3.4.10.9.1.4.4, and 3.4.10.9.1.5).

bh. Define chart format for Maximum Gross Weight for Hovering (3.4.10.10.3.5).

bi. Other methods of presenting wheeled helicopter takeoff data (3.4.10.10.3.11).

bj. Format and Sections to be included in a mission crew manual (3.5.4.5, and 3.5.4.6).

bk. Whether two supplemental manuals will need to be procured covering classified and unclassified data (3.6).

bl. Whether the Flight Manual will reference unclassified supplemental manuals (3.6.2).

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bm. Whether an alphabetical index is required for the supplemental manual (3.6.9).

bn. Whether an integrated flight crew checklist will be developed (3.7).

bo. Location and arrangement of checklist data (3.7.1).

bp. Whether to authorize use of illustrations in flight crew checklists (3.7.4).

bq. Location of the TOLD card within the checklist (3.7.5).

br. Page numbering format for Class 1 and 2 checklists (3.7.6).

bs. Specify Class 2 page size (3.7.9.1.2)

bt. Specify additional requirements for Class 1 and 2 checklists (3.7.9.1.2.1).

bu. Packaging requirements (5.1).

6.3 Acronyms.

a. AFMAN - Air Force Manual
b. AOA - Angle of attack
c. APU - Auxiliary power unit
d. ASSIST - Acquisition Streamlining and Standardization Information System
e. BHP - Brake horsepower
f. BMEP - Brake mean effective pressure
g. CALS - Continuous Acquisition and Life-cycle Support
h. CAS - Calibrated airspeed
i. CG - Center of gravity
j. COTS - Commercial Off-The-Shelf
k. DODISS- Department of Defense Index of Specifications and Standards
l. DTD - Document Type Definition
m. EAS - Equivalent airspeed
n. EPR - Engine pressure ratio
o. GPO - Government Printing Office
p. GSA - General Services Administration
q. HUD - Head up display
r. IAS - Indicated airspeed
s. IFF - Identification friend or foe
t. IGE - In ground effect
u. ILS - Instrument landing system
v. IMC - Instrument meteorological conditions
w. IMN - Indicated mach number
x. IOAT - Indicated outside air temperature
y. KCAS - Knots calibrated airspeed

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z. KIAS - Knots indicated airspeed
aa. KTAS - Knots true airspeed
ab. MAC - Mean aerodynamic chord
ac. METO - Maximum except for takeoff
ad. OAT - Outside air temperature
ae. OGE - Out of ground effect
af. PIO - Pilot induced oscillation
ag. RCR - Runway condition reading
ah. RPM - Revolutions per minute
ai. RSC - Runway surface covering
aj. SIF - Selective identification feature
ak. TACAN - Tactical air navigation
al. TAS - True airspeed
am. TCTO - Time compliance technical order
an. TO - Technical order
ao. TOLD - Takeoff and landing data
ap. TMN - True mach number
aq. VMCA - Air minimum control speed

6.4 Commercial flight manuals. The contents of MIL-HDBK-1221 will be used as a guide for the review and acceptance of commercial flight manuals. Acquiring activities will review the commercial flight manual against the intent of this handbook. Useability and content of the commercial manual will be the major consideration in reviewing commercial flight manuals.

6.5 Concurrence of checklists with flight manuals. Checklists shall be issued simultaneously with the initial issue or revision of the flight manual. Changes to checklists that are affected by a change or supplement to the flight manual shall be issued with the change or supplement. (Note: This requirement may allow different crew member checklists to have different numbers of changes/change dates than is shown on the flight manual title page.)

6.6 Critical system malfunctions. Some equipment malfunctions historically lead to rapid deterioration of a critical system which in turn requires the pilot to "Land as Soon as Possible." Other equipment malfunctions result in a less rapid deterioration of flying qualities and a less urgent requirement to land. For those malfunctions, the term "Land as Soon as Practical" has been designated (see 3.3.5).

6.7 Definitions. To clarify the terms used throughout this specification, the following definitions are given:

6.7.1 Intermediate stops: Stops such as refueling, crew change, or pickup and discharge of cargo or passengers.

6.7.2 Emergency descent: A descent in which technique and procedures, if exceeded, could result in superficial damage to the aircraft but does not result in permanent damage or

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major repairs to the aircraft.

6.7.3 Miscellaneous emergencies: All conditions that do not immediately affect the airworthiness of the aircraft but that could deteriorate into a dangerous situation.

6.7.4 Drag index number: A summation of the store drag numbers. Scaling of drag numbers should result in a total drag number equal to or less than 100 units.

6.7.5 Air refueling. The refueling of an aircraft in-flight by another aircraft.

6.7.6 Air refueling control time. The planned time that the receiver and tanker will arrive over the air refueling control point.

6.7.7 Air refueling initial point. A point located upstream from the air refueling control point at which the receiver aircraft initiates a rendezvous with the tanker.

6.7.8 Air refueling rendezvous. The procedures employed to enable the receiver(s) to reach the precontact position behind the assigned tanker(s) by electronic, radio, and/or visual means.

6.7.9 Alternate rendezvous. A rendezvous accomplished when primary means are not available.

6.7.10 Altitude blocks. A specified number of altitudes authorized by air traffic control for operation of aircraft.

6.7.11 Breakaway. The command used by either tanker or receiver crew members to indicate a need for emergency vertical and horizontal separation of tanker and receiver.

6.7.12 Buddy takeoff/departure. When tanker and receiver take off and climb as an element/cell.

6.7.13 Contact. That configuration in which the tankers and receivers are physically engaged and if applicable, their respective electrical systems indicate a contact made condition.

6.7.14 Contact position. The stabilized position of the receiver within the air refueling envelope where it is possible to make contact.

6.7.15 Controlled airspace. Airspace requiring communication with an Air Traffic Control facility.

6.7.16 Disconnect. When tanker and receiver separate from air refueling contact; also it is a command to separate, but not warranting a breakaway.

6.7.17 En route rendezvous. Procedure used when join-up is to be accomplished en route to

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the refueling area at the join-up initiation geographic point (RZ) by making good a scheduled time. Timing may be accomplished by utilizing an orbit delay or timing triangle.

6.7.18 Hot armament. Forward firing ordnance that can be selected and fired by the receiver pilot or crew.

6.7.19 Join-up. Those procedures employed to enable the tanker to assume formation lead and the receiver to assume observation position.

6.7.20 Observation position.

a. (Bomber) A position to the right and/or left and slightly behind the tanker where receiver fly while observing or awaiting air refueling.

b. (Helicopter) A position to the left or right of the tanker, outboard of the wingtip and slightly above and behind the tanker horizontal stabilizer where the receivers fly while observing or awaiting air refueling.

c. (Fighter) A position to the right and/or left and slightly behind the tanker wing with a minimum of one receiver wingspan clearance between tanker and receiver (weather permitting).

6.7.21 Offset (track). The lateral distance the tanker is displaced from the air refueling initial point to air refueling control time track to compensate for turn radius and drift.

6.7.22 Overrun.

a. Rendezvous - An overrun when the receiver passes the tanker prior to or during the tanker rendezvous turn.

b. Closure - An overrun when the receiver's closure rate prevents stabilizing in the precontact position, or when forward movement of the receiver is considered excessive during contact or approach to contact.

6.7.23 Point parallel rendezvous procedures. The procedures normally used when the tanker arrives in the refueling area ahead of the receiver (A tanker orbit is normally planned).

6.7.24 Post air refueling procedures. The procedures employed by tankers and receivers after final disconnect and prior to establishing cruise.

6.7.25 Precontact (ready) position.

a. Boom and receptacle - The position approximately 50 feet behind and slightly below the tanker boom nozzle where the receiver stabilizes before being cleared to the contact position.

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b. Probe and drogue - A position where the probe is approximately 5 feet directly aft of the drogue.

c. Helicopter - A position behind the paradrogue and slightly below the tanker wing where the receiver stabilizes before attempting contact.

6.7.26 Radio silence. Air refueling without the aid of verbal instructions.

6.7.27 Radar station keeping. Term used when radar is used as the primary method for maintaining an aircraft in a specified location.

6.7.28 Rendezvous equipment. Electronic/radio equipment installed in tanker and receivers for use in accomplishing a rendezvous.

6.7.29 Reverse flow air refueling. The transfer of fuel from receiver to tanker.

6.7.30 Toboggan. The maneuver called for by receiver pilot (verbal or C-130 visual signal) to the tanker pilot to commence approximately 300 feet per minute rate of descent.

6.7.31 Turn range. The distance used to determine the tanker start turn point and is measured directly from aircraft to aircraft.

6.7.32 Abbreviated checklists: There are three classes of abbreviated checklists as follows:

Class 1 - Pocket-sized checklists for insertion in standard plastic inserts.

Class 2 - Pocket-sized checklists for attachment to clipboard.

Class 3 - Scroll-type checklists.

6.7.33 Verification. Verification (section 4), in the context of this specification equates to the contractor's quality assurance program for validating the content of the Flight Manuals. Suggested validation methods include:

a. Actual performance. Using production configured equipment, hands-on performance of the procedure using the technical instructions as written.

b. Simulation. Using production configured equipment and the flight manual procedure, simulate the actions required by the task steps.

c. Table top analysis. Primarily for non-procedural data, compare the technical content to source data to ensure the technical accuracy and depth of coverage.

6.8 Documentation of deviations or additional requirements. Procurement documents will require documentation of each deviation by specification paragraph number and of all items

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that are not covered in this specification but that are applicable in the preparation of any flight manual. The documentation of the deviations will also include the reasons for the deviations and the reasons the specification requirement could not be followed. Copies of this documentation will be forwarded to the office responsible for this specification.

6.9 Emergencies. Many emergencies will require some urgency in landing the aircraft. If the pilot waits too long and over-flys "acceptable" recovery bases enroute to a base with a more favorable landing environment, system degradation may require abandonment of the aircraft. If however, the pilot overemphasizes the need for an expedited landing and chooses the nearest base with any degree of acceptability (however marginal), the aircraft and crew may be subjected to unnecessary risk (see 3.3.5).

6.10 Manifold pressure. To partially offset the loss of power due to humidity, the manifold pressure limits for maximum power may be increased by the existing water vapor pressure up to 1.5 inches Hg with the use of a correction scale (see 3.4.10.2.1.4.1a).

6.11 Monitoring aircraft performance. The reason for monitoring aircraft performance is to determine if a safe takeoff can be made and to give the pilot a basis to determine when to abort or continue takeoff during an emergency (see 3.4.10.3.1.3.1).

6.12 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, specifications and standards that have been cleared and listed in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.12.1 Technical manual acquisition. To acquire the technical manuals described herein, this specification must be selected in AF TMCR TM-86-01, which is then listed in the Contract Data Requirements List (DD Form 1423).

6.13 Time compliance technical orders. When modifications have been completed on the entire fleet, the "before" coverage shall be removed (see 3.3.2.6.1).

6.14 Subject term (key word) listing.

Abbreviated flight manual checklist
Air refueling
Air refueling procedures
Departure procedures
Emergency air refueling procedures
Flight manual
Mission crew manual
Performance data manual
Rendezvous procedures

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Supplemental flight manual

6.15 Supersession information. This specification supersedes the following document:

MIL-PRF-38413D dated 1 March 1996

6.15 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the change.

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APPENDIX A

FLIGHT MANUALS
DOCUMENT TYPE DEFINITION

A.1 SCOPE.

A.1.1 Scope. This appendix provides the special or unique criteria, in addition to the provisions of this specification, required for the development of a flight manual. The markup tags described herein are based on rules outlined in MIL-PRF-28001 and ISO 8879. This Appendix is a mandatory part of this specification. The information contained herein is intended for compliance. The document type definition (DTD) referenced herein may be obtained directly from the preparing activity (see A.5).

A.2 APPLICABLE DOCUMENTS.

A.2.1 Government documents.

A.2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the ASSIST database (http://www.dodssp.daps.mil/) and cited in the solicitation (see 6.2).

SPECIFICATIONS

Military

MIL-PRF-28001	Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or www.dsp.dla.mil.)

A.2.1.2 Non-government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those cited in the solicitation or contract.

NON-GOVERNMENT PUBLICATIONS

International Organization for Standardization (ISO)

ISO 8879	Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML) (DoD Adopted)

(Application for copies should be addressed to Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia PA 19111-5094, for issue to DoD activities. Others may purchase copies from the American National Standards Institute, 11 West 42nd Street, New York NY 10036.)

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A.3 DOCUMENT TYPE DEFINITION.

A.3.1 SGML document type definition. The DTD associated with this appendix provides the structure and content of documents prepared in accordance with this specification. The DTD is available in digital format. See A.5 for information on obtaining the file. Data to be delivered digitally in accordance with this specification shall be SGML tagged using the DTD found in this Appendix. The procedure for accomplishing this is found in MIL-PRF-28001 and ISO 8879.

A.4 DETAILED DESCRIPTION.

A.4.1 Document type definition. The DTD within this appendix provides the structure and content of documents prepared in accordance with this specification. The DTD is available in a digital format. See A.5, for information on obtaining the file.

A.4.2 Tag description table. The Tag Description Table (TDT) provides detailed descriptions of the tags and provides the element tagging structure, full element name, tag minimization requirements, element structure, referencing elements, source paragraph, and attribute descriptions unique to the element. See A.5, for information on obtaining this table.

A.5 OBTAINING FILES.

A.5.1 Obtaining files. The files contained in these appendixes are for convenience and informational purposes only. The current DTD, FOSI, screen FOSI, and TDT are available for download as ASCII files. These files may be obtained directly from the preparing activity's world wide web site at: http://www.ide.wpafb.af.mil/tmss/index.html.

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APPENDIX B

SUPPLEMENTAL FLIGHT MANUALS DOCUMENT TYPE DEFINITION SUBSET

B.1 SCOPE.

B.1.1 Scope. This appendix provides the special or unique criteria, in addition to the provisions of this specification, required for the development of supplemental flight manuals. The markup tags described herein are based on rules outlined in MIL-PRF-28001 and ISO 8879. This Appendix is a mandatory part of this specification. The information contained herein is intended for compliance. The document type definition (DTD) referenced herein may be obtained directly from the preparing activity (see A.5). This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

B.2 APPLICABLE DOCUMENTS.

B.2.1 Government documents.

B.2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) or www.dsp.dla.mil. and supplement thereto, cited in the solicitation (see 6.2)

B.2.1.2 Non-government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those cited in the solicitation or contract.

NON-GOVERNMENT PUBLICATIONS

International Organization for Standardization (ISO)

ISO 8879 Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML) (DoD Adopted)

(Application for copies should be addressed to Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia PA 19111-5094, for issue to DoD activities. Others may purchase copies from the American National Standards Institute, 11 West 42nd Street, New York NY 10036.).

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SPECIFICATIONS
Military

MIL-PRF-28001 Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or www.dsp.dla.mil.)

B.3 DOCUMENT TYPE DEFINITION SUBSET.

B.3.1 SGML document type definition subset. The DTD associated with this appendix provides the structure and content of documents prepared in accordance with this specification to create supplemental flight manuals. The DTD is available in digital format. See A.5 for information on obtaining the file. Data to be delivered digitally in accordance with this specification shall be SGML tagged using the DTD found in this Appendix. The procedure for accomplishing this is found in MIL-PRF-28001 and ISO 8879.

B.4 DETAILED DESCRIPTION.

B.4.1 Document type definition. The DTD within this appendix provides the structure and content of documents prepared in accordance with this specification. The DTD is available in a digital format. See A.5, for information on obtaining this file.

B.4.2 Tag description table. The Tag Description Table (TDT) provides detailed descriptions of the tags and provides the element tagging structure, full element name, tag minimization requirements, element structure, referencing elements, source paragraph, and attribute descriptions unique to the element. See A.5, for information on obtaining this table.

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APPENDIX C

ABBREVIATED FLIGHT CREW CHECKLISTS
DOCUMENT TYPE DEFINITION

C.1 SCOPE.

C.1.1 Scope. This appendix provides the special or unique criteria, in addition to the provisions of this specification, required for the development of a flight manual. The markup tags described herein are based on rules outlined in MIL-PRF-28001 and ISO 8879. This Appendix is a mandatory part of this specification. The information contained herein is intended for compliance. The document type definition (DTD) referenced herein may be obtained directly from the preparing activity (see A.5). This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

C.2 APPLICABLE DOCUMENTS.

C.2.1 Government documents.

C.2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) or www.dsp.dla.mil and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

Military

MIL-PRF-28001	Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or www.dsp.dla.mil..)

C.3 DOCUMENT TYPE DEFINITION.

C.3.1 Document type definition. The DTD associated with this appendix provides the structure and content of documents prepared in accordance with this specification. The DTD is available in digital format. See A.5 for information on obtaining the file. Data to be delivered digitally in accordance with this specification shall be SGML tagged using the DTD found in this Appendix. The procedure for accomplishing this is found in MIL-PRF-28001 and ISO 8879.

C.4 DETAILED DESCRIPTION.

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C.4.1 Document type definition. The DTD within this appendix provides the structure and content of an abbreviated flight crew checklists prepared in accordance with this specification. The DTD is available in a digital format. See A.5, for information on obtaining the file.

C.4.2 Tag description table. The Tag Description Table (TDT) provides detailed descriptions of the tags and provides the element tagging structure, full element name, tag minimization requirements, element structure, referencing elements, source paragraph, and attribute descriptions unique to the element. See A.5, for information on obtaining this table.

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2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-DTL-7700G (USAF)	2. DOCUMENT DATE *(YYYYMMDD)* 20020513

3. DOCUMENT TITLE

Detail Specification Flight Manuals, Air Refueling Procedures, and

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include ZIP Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) DSN *(If applicable)*	**7. DATE SUBMITTED** *(YYYYMMDD)*

8. PREPARING ACTIVITY

a. NAME MSG/MMF	b. TELEPHONE *(Include Area Code)* (1) Commercial (937)904-0786 (2) DSN 674-0786
c. ADDRESS *(Include ZIP Code)* 4375 Chidlaw Road, Suite 008 Wright-Patterson AFB 45433-5008	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888

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