UNITED STATES

ATP 3.3.4.2. (C)

STANDARDS RELATED DOCUMENT (SRD)

5 March 2019
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## CHAPTER 9 – AAR Formation Procedures – US Heavy Aircraft

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Preliminaries

1. Purpose. The primary function of this manual is to provide aircrew with internationally standardized definitions, abbreviations and procedures to enable successful and safe AAR operations. For DoD aircraft with an in-flight refueling capability, the relevant T.O.-1 series (USAF) or appropriate single service documents provide supplemental MDS-specific information on AAR orbit and rendezvous techniques used by crewmembers, and procedures and tactics concerning tanker/receiver formations. This manual offers information pertinent to refueling from flying boom and drogue equipped tankers. Importantly, where appropriate, the USA SRD offers placeholders for the KC-46 tanker. Additionally, the appropriate tanker SRD provides information crucial to successful AAR from foreign and commercial tankers.

2. Regulatory Nature of this Document. USA aircrews are to consider the instructions in this document as regulatory.

3. Waiver Authority and Deviations.

   **USAF Waiver Authority.**
   1. The USAF waiver authority to procedures and restrictions published in United States Standards Related Documents is as follows:
      a. **Operational Missions.** The COMMAFOR/NAF CC with OPCON for operational missions.
      b. **Training Missions.** The appropriate MAJCOM/A3 for training missions.
   2. For an operational mission or training mission involving US only aircraft, before a waiver is granted the Lead Command A3V for the tanker (where appropriate) and/or (where appropriate) receiver must be consulted.
   3. In the event that an engineering disposition is required, the Lead Command A3V for each platform will consult with the appropriate Systems Group (SG) engineers, or equivalent for activity involving USN/USMC or US Army.
   4. For missions involving foreign platforms requiring an engineering disposition, the US SG must work with the engineering support authority of the foreign platform before offering a recommendation on waiver action.

   **Deviations.**
   Do not deviate from the restrictions published ATP 3.3.4.2. and United States Standards Related Documents except when the situation demands immediate action to ensure safety. The Pilot in Command is vested with ultimate mission authority and is responsible for each course-of-action they choose to take. Report all deviations through the responsible MAJCOM Standardization/Evaluation (Stan/Eval) function.

   **USN/USMC Waiver Authority.** Requests for waivers to ATP 3.3.4.2. chapter 1-4 inclusive and US SRD Chapter 3 should be submitted in accordance with the requirements of OPNAVINST 3710.7.

4. NATO and USA Equivalent Terms. Where the NATO standard terms listed below are used in the ATP 3.3.4.2. and US SRD documents, USA users shall interpret them to mean the following:
i5. Carriage of ATP-3.3.4.2. USAF MAJCOMs, or appropriate equivalents in sister services, will direct which elements of ATP-3.3.4.2. should be carried by (or be accessible to) AAR qualified crews. As a minimum, all USA aircrew participating in AAR operations are to have access to ATP 3.3.4.2 Chapter 1 and US SRD. In addition, they must have access to the appropriate ATP 3.3.4.2. fixed wing (Chapter 2), rotary (Chapter 3) or tilt rotor (Chapter 4) sections of the document together with the relevant elements of the US SRD. Importantly, USA receiver aircraft planning to conduct AAR with commercial tankers and tankers of another nation are to have access to a copy of the commercial or foreign tanker’s National SRD.

i6. Platform-Based Tranches. The following platform-based table offers a suggested list of tranches from ATP-3.3.4.2. and US Standards Related Document (SRD), that should be made available to aircrew. (http://www.japcc.org/aar).

i7. Additional USA Tanker and Receiver Information. Refer to US Standards Related Documents for additional information about USA tankers and receivers.
i8. Amendment Process. The US Standards Related Document is reviewed and updated every 6 months, and the ATP-3.3.4.2 is updated every 3 years. To ensure that the document remains relevant, it is incumbent upon all operating personnel and those working with flight test and accident reports to ensure inclusion of the latest data in the manual. Importantly, an error in the main body cannot be rectified unless NATO is made aware of its existence. Similarly, errors in the US SRD can be rectified only if AMC or the USN/USMC (as appropriate) are informed about the problem. Therefore, it is essential that users play their part to provide comments, corrections, and queries regarding this manual. These should be submitted on an AF Form 847, or single Service equivalent, through channels established by higher headquarters, to HQ AMC/A3VK at A3.A3VK.ATP3342USSRDPOC@us.af.mil.

i8.1. Critical Timelines. Endorsed proposals for amendments to either the ATP-3.3.4.2 or USA SRD must be submitted to AMC/A3VK for consideration, implementation or onward transmission to NATO. Whilst submissions can be made at any time, the table below identifies the last submission date for each amendment cycle.

**i8.1.1. AMC Units.** For AMC units, only AF 847s endorsed and submitted by the unit OGV will be reviewed by AMC/A3VK.

**i8.1.2. Other USAF MAJCOMs.** Units must submit AF 847s to their MAJCOM A3 for consideration. Only proposals endorsed by a MAJCOM A3 and subsequently forwarded to AMC/A3VK will be considered for implementation.

**i8.1.3. Sister Services.** Units within the sister services must comply with appropriate service directives when submitting proposals for change. Only proposals endorsed at HQ level and subsequently forwarded to AMC/A3VK will be considered for implementation.

i8.2. Staffing Timelines – USA SRD. The following schematic illustrates the staffing process associated with the two six-monthly revision cycles for the US SRD.
8.3. Staffing Timelines – ATP-3.3.4.2. Proposals for changes to the ATP-3.3.4.2. may be submitted at any time in accordance with the procedures published in para 8.1. The schematic below illustrates the staffing process associated revisions to ATP 3.3.4.2.; proposed changes normally fall into one of two categories, namely:

8.3.1. Editorial Corrections. Proposals identifying grammatical, typographical and spelling errors only require “editorial” correction rather than coordination with all end users be that USA or other NATO nations. Such proposals will be forwarded by AMC/A3VK to the NATO Custodian for consideration/action.

8.3.2. Changes to Procedures. Proposals emanating from USA end users that would significantly change internationally agreed AAR procedures published in ATP 3.3.4.2. need to be staffed nationally before being forwarded to NATO. The DoD Head of Delegation (HOD) to the NATO AAR Working Group (see paras i10 and i11 below) will solicit agreement from MAJCOMs and other Services to ensure interagency consensus before seeking agreement to a change from other NATO nations.
i9. **Flight Safety.** Every effort has been made to provide flight crews with the safest possible procedures and techniques for all phases of AAR activities. These procedures and techniques will be followed by all flight crews involved in AAR activity. If occasions or unusual situations arise that are not specifically covered in this manual, flight safety will be the prime consideration in determining a course of action.

i10. **International Military Agreements for Rationalization, Standardization, and Interoperability.** On 8 February 2008 the Chairman of the Joint Chiefs of Staff issued an instruction entitled “International Military Agreements for Rationalization, Standardization, and Interoperability between the United States, its Allies, and other Friendly Nations (CJCSI 2700.01C)” available at [http://www.dtic.mil/cjcs_directives/cdata/unlimit/2700_01.pdf](http://www.dtic.mil/cjcs_directives/cdata/unlimit/2700_01.pdf). The instruction establishes policy, procedures, and responsibilities for achieving international military rationalization, standardization and interoperability (RSI) agreements with allies and other friendly nations in the areas of operations, doctrine, material, training, logistics and in-service equipment. Importantly, the instruction appoints the USAF as the national Lead Agent (LA) for AAR. Additionally, it details the staffing procedures that must be followed in order that the USA’s position in AAR related matters can be established and correctly articulated to NATO.

i10.1. **USA - Air Force Lead Command Responsibility for AAR.** Through AFPD 10-21 (Air Mobility Lead Command roles and responsibilities), the USAF has designated AMC as the lead command for the air mobility mission area, including AAR. Using this delegated authority, AMC is charged with managing and taking the lead in coordinating the processes that develop and maintain concepts, processes, and force structure to enable interoperability of forces, regardless of command.

i10.1.1. **DoD HOD to the NATO AAR Working Group.** Each NATO nation nominates a national representative who is an action officer to NATO’s AAR Working Group (AARWG). Using its Lead Command authority, AMC appoints the principal USA representative, commonly called the DoD “head of delegation (HOD)”. His individual serves as the chief national spokesperson and decision maker at AARP meetings (see para i11.5. for additional information).

i11. **AAR Staffing and Ratification Process – USA.** Updates to NATO Standardization Agreements (STANAGS) must be supported by a quorum of NATO user nations. The staffing process to determine the USA position on STANAG 3971 (the overarching directive for ATP-3.3.4.2.) and other AAR related STANAGs, as well as the offices through which it is eventually communicated back to NATO, is illustrated in the diagram below. The key offices associated with the staffing process, together with their responsibilities, are identified as follows:

i11.1. **NATO Custodian.** The ATP-3.3.4.2. Custodian is located within NATO’s Joint Air Power Competence Centre (JAPCC). The Centre provides innovative and timely advice and subject matter expertise, both proactively and responsively, for the transformation of Joint Air and Space Power to the Alliance and Nations. As a Centre of Excellence, with a strategic and operational level focus, it offers independent thought, analysis and solutions. The purpose is to enable NATO’s effective and efficient use of Joint Air and Space Power.

i11.2. **NATO Standardization Office.** The NATO Standardization Office (NSO) is a single part of the integrated structure of the Alliance and is, inter alia, responsible for coordination and support of all operational (doctrinal and procedural) standardization efforts on behalf of the Military Committee (MC). The NSO coordinates military standardization among all NATO bodies involved in standardization and it administers all NATO-Terminology activities as well as standardization efforts in the area of civil standards, which includes cooperation with civilian standard organizations.

i11.3. **USA Representative to NATO.** The USA representative to the NATO Military Committee Air Standardization Board (MCASB) is responsible for directing standardization issues, including requests for ratification, to the appropriate offices within HQ Air Force. The MCASB reports directly to the NSO.

i11.4. **AF International Standardization Office.** Upon receipt of requests for staffing action from the USA representative to the MCASB, the Air Force International Standardization Office (currently AF/A5XX) undertakes coordinating activities for the following:

i11.4.1. **NATO STANAGs in the 3000 and 7000 series.**

i11.4.2. **NATO terminology series and Air Standardization Coordinating Committee (ASCC) Air Standards.**
i11.4.3. NATO Allied Publications under purview of the NATO NSA.

i11.4.4. STANAGs in the 1000, 2000, 4000 series for the USAF.

i11.4.5. Army QSTAGs.

NOTE

FOR ATP-3.3.4.2. (STANAG 3971), USAF STAFFING ACTION IS DELEGATED TO THE DOD HOD TO THE NATO AARWG.

i11.5. DoD HOD. The DoD HOD will:

i11.5.1. Maintain contact with international POCs and USA POCs as determined by their official statements of interest, ie USAF MAJCOMs and the USN/USMC.

i11.5.2. Draft, coordinate, and issues USA decisions.

i11.5.3. Serve as the main USA link with other nations or organizations, eg NATO strategic commands, which participate in the activity.

i11.5.4. Have overriding authority over other USA delegates; the latter will be subordinate to the HOD. If a matter arises for which there is no USA position, the HOD will seek the consensus of the USA delegation. Short of consensus, the HOD may break the impasse to decide for the USA. However, such HOD decisions will be consistent with established USA policy, doctrine, and procedures. Alternately, the HOD may request deferral of the matter to the USA or abstain.

i11.5.5. Ensure that essential documents, decisions etc, are conveyed to fellow delegates and others as appropriate. Normally the chairman of the meeting will publish a record of decisions (ROD). If necessary, the HOD will coordinate with fellow USA delegates and submit USA comments, eg corrections, concerning the ROD. Internal USA reports of the meeting and necessary follow up action will be carried out as appropriate under the leadership of the HOD in coordination with fellow delegates (CJCSI 2700.01C dated 8 February 2008, Enclosure B provides amplifying information on this matter).

i11.5.6. Determine USA positions prior to international meetings. When developing the USA position, the HOD will consider all relevant information. Input from participating organizations will be solicited in the course of staffing positions. The HOD will collate all input and normally conduct working group meetings to review input and develop consensus for the USA position. The HOD should seek interagency consensus for the USA position. If consensus is not obtained, resolution will be decided per DOD 4120.24-M, March 2000, “Defense Standardization Program (DSP) Policies and Procedures” and Joint Staff Instruction 5711.01 series, “Action Processing”.

“Preliminaries (USA)
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### Summary of Change 3

Changed format, incorporated ATP 3.3.4.2, and US Standards Related Documents (SRD).

### Summary of Change 4


### Summary of Change 5

Updated tables 2-4, 2-5, and 2-6. Removed the following countries from tables due to lack of Quinquennial review: Egypt, Jordan, Kuwait, Singapore, Spain, and Turkey, UAE. Added F-35B/C receiver information to Appendix 8E. Updated Navy Flight Clearance Matrix Figure 3I-1. Miscellaneous minor corrections.

### Summary of Change 6

Added CV/MV-22 AR w/ KC-10 Centerline to Figure 3I-1. Corrected KC-10 mission planning and inflight data table to show 1 AR pump w/ CV/MV-22. Added information regarding CV/MV-22 and KC-10 formation procedures. Added RJAF F-16A/B and updated Chile F-16C/D Compatibility in Figure 2-6. Miscellaneous minor corrections.

### Summary of Change 7


### Summary of Change 8

Added KC-135 Block 45 Tanker Gross Weight and Center of Gravity Limitations. Expanded verbiage relating to authority to conduct AAR (para 2.6.5). Decreased receiver currency requirements for USAF tankers (para 2.3.3.1.1). Multiple updates to Figure 2-6 (AAR Compatible Commercial and Foreign Military Receivers).

### Summary of Change 9

Entirety of Chapter 3 (USN/USMC) has been updated. Added QF-16, F-15SA, French Air Force Mirage 2000, and Italian Air Force AM-X receiver aircraft information to Chapter 8.
Summary of Change 10
Expanded AAR Clearance information in para 2.1. Added Australian KC-30 and US F-16 Compatibility in Table 2-4, Updated NATO EF-2000 SS Altitude/Airspeed Table, Miscellaneous Minor Edits.

Summary of Change 11
Added KC-135 Block 45 operating information. Clarified notes regarding two AR pumps per WARP for various receivers. Added UAE F-16E/F and Mirage 2000-9 to figure 2-6. Updated CV/MV-22 receiver information regarding closure rates with KC-10. Updated Figure 2.1.

Summary of Change 12
Added GAF EF-2000 Typhoon, RSAF F-15S, and RSAF F-15SA TCA to Figure 2-6. Added dry contact information for EF-2000 Typhoon.

Summary of Change 13
Removed Figure 2-5 (Commercial/Foreign Military Tankers Technically Compatible w/USAF Receivers – Drogue). Renumbered Figure 2-6 to Figure 2-5. Added F-16 to Dutch KDC-10 in Figure 2-4. Added Saudi F-15C/D to Figure 2-5. Updated RSAF F-15SA information in Appendix 8E. Added AC-130J information to KC-10 and KC-135 Mission Planning and Inflight Data (Boom) tables.

Summary of Change 14
Added U.S. P-8A to KC-135 compatibility table (P-8A BUNO 167954 only)

Summary of Change 15
Corrected Figure 4A-1 and Figure 4C-3. The entirety of Chapter 3 has been updated. Updated Czech Republic Gripen information, removing simultaneous AR w/KC-10 and fuel top off limits. Added multiple receivers to RAAF KC-30 and RNLAF KDC-10 tankers. Added Romanian Air Force F-16 to USAF KC-10 and KC-135.

Summary of Change 16
Added F-16 to KDC-10 receiver compatibility table. Added USAF E-3G to KC-135 and KC-10 tables.

Summary of Change 17
Added Swiss F/A-18C/D to KC-10 and KC-135 receiver compatibility table. Removed P-8A BUNO restriction.

Summary of Change 18

Summary of Change 19
Added Australia KC-30/US B-1B to table 2-4.

Summary of Change 20
Added Norway F-35A and Japan F-35A to table 2-5. Note: These receivers may only be refueled while operated by USG (United States Government) personnel. See Appendix 8E.

Summary of Change 21
Entirety of Chapter 3 (USN/USMC Operations) updated. Added Chile KC-135E compatibility with US F-35A and Israel B-707 with US F-16 to Figure 2-4. Corrected F-35A Boom Interphone restriction in Chapter 8 to tails 2AF:0030 and prior only.

Summary of Change 22
Administrative updates. Removed Norway F-35A restriction for USG pilots only.

PAGE i-10
Summary of Change 23
Added Israel B-707 with US F-15 to Figure 2-4. Updated AR envelope information and removed outdated restrictions for F-35A.

Summary of Change 24
Added US B-1B with Dutch KDC-10 to Figure 2-4. Updated AR envelope information for F-22 to allow for increased AR speed during CORONET missions.

Summary of Change 25
Added USAF A-10 and B-1B as receivers to the RAAF KC-30 and USAF F-16 and B-1B as receivers to the UAE KC-30 in Figure 2-4. Added F-35B/C as a receiver to the F/A-18E/F in Figure 3I-1. Chapter 3 has been updated.

Summary of Change 26
Added Iraq F-16C/D to Figure 2-5. Chapter 3 has been updated to include the following changes: Addition of the (-6) AAR Store as authorized on Fleet FA-18 E/F tankers. FMS Customer (Finland) FA-18 C/D aircraft are recommended to conduct AAR operations with the same tankers as USN FA-18 A-D aircraft and are marked R3 in the Matrix. UK Voyager tankers are authorized to conduct AAR with FA-18A-F and EA-18G receivers, and the matrix is updated to C3 along with update to Note 18.

Summary of Change 27
Added US F-16 compatibility with Netherlands KDC-10 in table 2-4.

Summary of Change 28
Added KC-46A tanker information to Chapter 6. Added KC-46A tanker AAR information to C-17 and F-16 receiver sections and KC-46A as receiver information to Appendix 8E.

Summary of Change 29
Updated Chapter KC-46A information, updated KC-46A tanker section for C-17 receiver in Appendix 8E.

Summary of Change 30
Added warning regarding NVG rendezvous to Chapter 6 (KC-46). Added US Navy E-2D to KC-135, KC-10 receiver tables and Appendix 8E.
CHAPTER 1

GENERAL INFORMATION

1.1. Introduction. The USA has 6 main tanker types in service with the USAF, USMC, USN and the Coast Guard. Within some of these types there are different AAR equipment fits for Pod Status Lights; details of these variations are provided in the appropriate tanker chapter or appendix.

1.2. Tanker Aircraft Types.

1.2.1. KC-135 Stratotanker. See Chapter 4 for full details of the KC-135 Stratotanker.

1.2.2. KC-10 Extender. See Chapter 5 for full details of the KC-10 Extender.

1.2.3. KC-46 Pegasus. See Chapter 6 for full details of the KC-46 Pegasus.

1.2.4. HC/MC-130 Tanker (USA). See Chapter 7 for full details of the HC/MC-130 Tankers.

1.2.5. KC-130/130J Tanker (USMC). See Chapter 3, Appendix 3B, for full details of the KC-130/130J Tankers.

1.2.6. F/A-18E/F Tanker. See Chapter 3, Appendix 3F, for full details of the F/A-18E/F Tanker.

1.3. Receiver Qualification and Currency – Non-USA Receivers. See Chapter 2 for details.

1.4. Source Documents. See appropriate tanker chapters for details on source documents.

1.5. POCs for US SRD.

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<td>HQ AMC/A3V3K 402 Scott Drive Unit 3A1 Scott AFB, IL 62225-5302 <a href="mailto:A3.A3VK.ATP3342USSRDPOC@us.af.mil">A3.A3VK.ATP3342USSRDPOC@us.af.mil</a></td>
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<tr>
<td>USN/USMC</td>
<td>Commanding Officer Attn: KC-130 Division MAWTS-1 Yuma AZ 85369-9200 <a href="mailto:USMC_USN_AAR@usmc.mil">USMC_USN_AAR@usmc.mil</a></td>
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<td>Commanding Officer Airworthiness Directorate (4.0P) BLDG 460 22244 Cedar Point Rd Patuxent River, MD 20670-1163 Airworthiness <a href="mailto:gm.fct@navy.mil">gm.fct@navy.mil</a></td>
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1.6 POCs for STAN/EVAL.

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<td>HQ ACC/A3TV 205 Dodd Blvd, Suite 101 Langley AFB, Virginia 23665 <a href="mailto:ACC.dotvstb@us.af.mil">ACC.dotvstb@us.af.mil</a></td>
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1.7. National Reservations.

1.7.1. USA. USA forces do not participate in the European Air Transport Command (EATC).

1.7.1.1. USAF. None.

1.7.1.2. USN. None.

1.7.1.3. USMC. None.

1.7.1.4. US Army. TBD
CHAPTER 2

AIR REFUELING CLEARANCES

2.1. Introduction. A clearance to conduct AAR is comprised of five distinct elements, or pillars. These pillars are standardized AAR procedures and terminology (operational compatibility), minimum aircrew currency and training, technical compatibility, maintenance standards, and legal and financial agreements that permit the multinational AAR activity. Each of these elements must be satisfied before AAR is conducted. Clearances may be issued in the form of a Memorandum of Agreement, Air Tasking Order (ATO), Operational Order (OPORD), Exercise Order (EXORD), approved flying schedule, or other document. AAR Clearances are normally issued by Air Operations Centers, Combatant Commands, or other Higher Headquarters. Additional information regarding AAR Clearances and required pillars can be found in ATP3.3.4.2 SRD-1. USN/USMC crews should reference chapter 3 of this publication for additional service-specific requirements.

2.1.1. AAR Clearance Categories. There are three categories of AAR Clearance depending on the type of operational requirement, the urgency of the AAR operation, or the amount of risk assumed by the clearance. Previous Clearances can be built upon to raise the Clearance Category, or if the target category is not met, a lower category should be considered. Ultimately, clearances of any category are bilateral agreements between tanker and receiver organizations and their aspects are as defined and agreed upon by the Nations or organizations involved.

2.1.1.1. Category 1. Category 1 is used when there is an urgent requirement for an AAR clearance due to war, conflict, contingency operation or other urgent operational need and no AAR clearance pillars are successfully satisfied or are inadequate. This clearance will have a limited duration of validity.

2.1.1.2. Category 2. Category 2 is issued when an AAR clearance is required due to war, conflict, contingency operation or other operational need and/or when not all AAR clearance pillars are successfully satisfied. Restrictions in the AAR clearance envelope and/or operational limitations are imposed.

2.1.1.3. Category 3. Category 3 is issued when an AAR clearance is required in support of a routine or non-operational AAR requirement as defined by the requester. This type of clearance should satisfy all AAR clearance pillars. This clearance can have an open-ended duration of validity but is subject to review if there are changes impacting key elements of the AAR Clearance.

2.2. Operational Compatibility. Compliance with ATP 3.3.4.2 and the appropriate National SRD is expected from AAR participants. Any non-standardized procedure or term to be used during AAR operations should be contained within the bi-lateral agreement or other document coordinated between participants.

2.3 Aircrew Training and Currency.

2.3.1. U.S. Receiver with a Commercial of Foreign Military Tanker. Prior to undertaking AAR with a commercial or foreign military tanker, USA crews must be qualified and current in accordance with the most restrictive of either the USA requirements or the requirements of the tanker operator. Normally, tanker operators publish their receiver currency requirements in the appropriate National SRD to ATP-3.3.4.2. When this information is not published, tanker crews are responsible to liaising with the receiver crews to inform the tanker operator’s requirements.

2.3.2. U.S. Tanker with a Foreign Military Receiver. Normally, before attempting to undertake AAR with a USA tanker, non-USA national aircrew must be receiver qualified and current within their own military. Additionally, the receiver aircrew must have been briefed by a USA tanker qualified instructor on Boom/BDA/Drogue operations as applicable. As a minimum, this briefing will include: closure limitations, lighting schemes, procedures, possible difficulties and emergency actions. For AAR activity with USAF platforms, exceptions to this requirement will be addressed by Air Force A3O-AT at afa3oat.workflow@pentagon.af.mil.
2.3.2.1. Obtaining Initial AAR Receiver Qualification using USA Tankers – Non-USA National Aircrew. Initial qualification training (i.e. training for a first ever AAR qualification) for AAR receiver qualifications using USA tankers can only be undertaken following the completion of a Foreign Military Sales (FMS) case.

2.3.3. Maintaining AAR Currency using USA Tankers – Non-USA National Aircrew. For non-USA national aircrew wishing to maintain AAR receiver currency using USA tankers, the following requirements apply:

2.3.3.1. USAF Tankers.

2.3.3.1.1. After initial qualification, a pilot will be considered current for AAR activity if the most restrictive of the following two conditions are met:

2.3.3.1.1.1. Receiver Pilot is qualified and current within their own military.

2.3.3.1.1.2. Completes a minimum of 1 contact in the last 180 days.

2.3.3.1.1.3. As prescribed in the appropriate bilateral implementing arrangement between participating nations or published in theater SPINS.

2.3.3.1.2. Currency may be updated on any similar tanker with similar AAR systems (i.e. Hose-Drogue and/or Boom). Applicable aircraft/country specific guidance may set additional currency requirements.

2.3.3.2. USN/USMC Tankers.

2.3.3.2.1. Fixed Wing. After initial qualification, a pilot will be considered current for AAR activity if they have completed a minimum of 2 day and 2 night contacts in the last 90 days. Contacts may be against a drogue equipped tanker from any nation. Night currency is not required for day-only operations. Applicable aircraft/country flight manuals may set additional currency requirements.

2.3.3.2.2. Helicopters. After initial qualification, a pilot will be considered current for AAR activity if they have completed a minimum of 2 day and 2 night contacts in the last 180 days. Night currency is not required for day-only operations. Applicable helicopter flight manuals may set additional currency requirements.

2.3.4. Re-Qualifying if AAR Currency has Lapsed. A qualified instructor (who may be in another aircraft) must monitor at least one re-qualifying flight to regain currency if AAR receiver currency of non-USA national aircrew has lapsed. The re-qualifying flight must be flown in a dual control aircraft (where the aircraft type has such a capability) with a qualified instructor on board if the receiver pilot has not had a contact in the previous 6 months.

2.4. Minimum Maintenance Standards and Requirements. Aircraft maintenance standards and airworthiness for AAR will be IAW one or all of the following conditions. Applicable aircraft/country specific guidance may set additional maintenance requirements.

2.4.1. Original equipment manufacturer specifications.

2.4.2. Military service maintenance specifications.

2.4.3. Host nation civil regulatory guidance.

2.5. Legal and Financial Agreements. The authority to undertake AAR with commercial or non-USA military aircraft (tanker or receiver) is provided through formal agreements between the participants such as FMS case, theatre Air Tasking Order and/or Special Instructions, an Exercise/Operations Order, Acquisition and Cross-Servicing
Agreement (ACSA), or an Implementing Arrangement. The process to establish a bi-lateral agreement should mirror the technical compatibility request process in para 2.6.10.


2.6.1. What is an AAR Technical Compatibility Assessment? A technical compatibility assessment is an engineering analysis of a tanker/receiver combination conducted to determine the ability of two fuel transfer systems to safely mate, transfer fuel and subsequently decouple. Importantly, both participants (i.e., the tanker and receiver operators) should undertake independent technical compatibility assessments to ensure that they are aware of and accept any restrictions required to ensure safe AAR activity. The review examines factors that have the potential to impair AAR (aerials, fuselage obstructions, flight control system responses, camouflage (boom only) etc). Where the technical assessment establishes that there is a possibility that two platforms may adversely interfere with each other during AAR, especially if there are potential safety implications, it may be necessary to conduct flight trials; the cost of these will fall to the nation or commercial company requesting the AAR activity. An AAR Clearance is not obtained through the Compatibility Assessment process alone, but is the result of a process that includes the five clearance pillars listed in paragraph 2.1.

2.6.2. Requirement for an AAR Compatibility Review. Before participating in AAR activity with a commercial or foreign military tanker or receiver, both the tanker and receiver platforms must be reviewed by a competent technical authority to ensure that they are technically compatible with the other participant. Importantly, commercial and foreign military tankers and receivers that are derivatives of in-use US tankers and receivers still require a technical compatibility review by the USAF technical authority and the subsequent publication by the latter of a certifying letter. The absence of such a letter indicates that an AAR technical compatibility review has not been conducted and therefore AAR between the USAF and the commercial or foreign military tanker or receiver should not be undertaken.

2.6.3. Compatibility Criteria. Compatibility reviews include, but are not limited to: an assessment of the impact that each platform has on the fuel system of the other (fuel flow rates, backpressures, safety features etc) as well as other features that impact AAR (e.g. aircraft lighting/markings and the addition or removal of aircraft antennas).

2.6.4. Publication of Information Resulting from an AAR Compatibility Review. Confirmation that a technical compatibility assessment has been conducted and found to be satisfactory by the appropriate USAF receiver technical authority is published in Figures 2-1 (USAF boom receivers) and Figure 2-2 (USAF and US Army probe and drogue receivers) for USAF receivers on commercial or foreign tankers or Figures 2-3 and 2-4 for foreign receivers on USAF tankers. USN/USMC clearance information is located in Chapter 3, Figure 3I-1. Through this, the technical authority confirms that the combination of commercial or foreign military tanker and USAF receiver has been reviewed and deemed compatible, this includes any tanker modification significant to AAR. Where necessary, recommended procedural or technique changes necessary to ensure safe AAR are included in the tables. Additionally, information is provided on the date of the review and the technical authority that conducted the review.

2.6.5. Authority to Conduct AAR Activity. A published AAR technical compatibility for a specific tanker/receiver combination only verifies that the subject tanker and receiver are technically capable of safely conducting AAR. Importantly, it does not constitute an authority or clearance to conduct AAR activity. Any US asset must be tasked by the appropriate command, control, and/or execution authority to conduct AAR with commercial or Non-USA aircraft. The process to request authority (clearance) to conduct AAR with a US asset should mirror that to request a Non-USA receiver/tanker technical compatibility assessment. See Figures 2.2 and 2.3.

2.6.6. Platform Engineering Authority. Communications between the USA AAR engineering specialists and the non-USA platform engineering authority for the purposes of conducting a technical compatibility assessment will fall into one of the following:

2.6.6.1. Commercial Operator/Nation Retains Responsibility for AAR Engineering Communications. When a commercial operator or nation’s military is the point of contact for communications on all engineering issues associated with AAR, they must comply with the instructions in para 2.6.10.2.
2.6.6.2. Delegated Engineering Authority. Nations and commercial operators that appoint either the original manufacturer or another company as the platform engineering authority and give them permission to communicate with external agencies on all AAR engineering issues must comply with the following courses of action.

2.6.6.2.1. Action by Platform Owners. For the USA to be able to work directly with the delegated authority, the platform owners must confirm to the USA that responsibility for AAR engineering related communication has transferred to a third party. This can be achieved by providing the USA with a letter based on Leaflet 6.

2.6.6.2.2. Action by Third Party. Concurrent with the action described in para 2.6.6.2.1., the third party must comply with the requirements of para 2.6.10.2. In this case they conduct their activity as if they are the platform’s owners.

2.6.6.2.2.1. Action when Third Party is the Original Manufacturer. When the platform operator appoints the original manufacturer as the engineering authority, the original manufacturer’s request associated with ferry flights (see para 2.6.9.2.) may be expanded with a statement to this effect (see Leaflet 1 and Leaflet 2). This will permit extension of the platform’s ferry flight technical compatibility approval until the next planned quennial review (see para 2.6.9.6.).

2.6.7. Exchange of Technical Information. In order for the USA AAR engineering specialists to conduct a technical compatibility assessment, it is essential that the non-USA platform’s engineering authority (see para 2.6.6) provides the USA with all appropriate data. The minimum information necessary to inform the review is provided when the non-USA engineering authority submits a completed Standardized Technical Data Survey.

2.6.7.1. Standardized Technical Data Survey. Technical compatibility requests and tanker data supplied in response to information requests from receiver operators must be accompanied by a completed Standardized Technical Data Survey for the fuel transfer system under consideration. Survey templates are available in ATP-3.3.4.2., http://www.japcc.org/aar.

2.6.8. Operator-Specific AAR Technical Compatibility. A technical compatibility assessment and the subsequent approval of a tanker/receiver combination is specific to the platform owning nation or commercial operator. Significantly, whilst one company’s or nation’s platforms may have been reviewed and assessed to be technically compatible with USA platforms for AAR, it does not automatically follow that another company’s or nation’s similar platform is also technically compatible with USA platforms. Amongst other influencing factors, the subject aeroplanes may have different modifications to those on the previously approved variant operated by another company or nation. A technical compatibility assessment reviews national or commercial operator endorsed modifications incorporated into the subject platform that impact AAR (see para 2.6.12.1. for details of such modifications).

2.6.9. REQUIREMENT FOR A TECHNICAL COMPATIBILITY ASSESSMENT. A technical compatibility assessment is required for each of the following 6 events:

2.6.9.1. Prior to Being Declared Fully Operational – USA Military Platforms. The USAF and the USN/USMC conduct AAR technical compatibility assessments and (where necessary) flight trials for all USA receiver-capable platforms against some or all of the tanker aircraft in the USA inventory. A platform technical compatibility assessment, together with details of any identified operating restrictions and procedures, must be published before operators from outside of the flight test community can conduct AAR activity with the receiver. Details of technically compatible USA receivers for each USAF jet tanker are published in chapter 2 and in chapter 8 in this manual for USN/USMC tankers.

2.6.9.2. Ferry Flights Conducted by a Commercial Manufacturer. Airplane manufacturers from the USA build and frequently ferry their products to the new owners. This movement is usually achieved using company or military pilots flying the receivers in concert with AAR services provided by USA tankers; the receiver airplanes normally remain under the ownership of the manufacturer until they reach the final destination. As part of the process of ensuring safe ferry operations, 6 months prior to executing the ferry
flights, the manufacturer must comply with para 2.6.10.2. The ensuing technical compatibility assessment of newly produced receivers is intended to confirm that such platforms either:

2.6.9.2.1. Retain the same AAR characteristics as the equivalent platform in service with the USA military

Or

2.6.9.2.2. Any AAR relevant modifications are identified, their impact on AAR assessed and appropriate restrictions are developed to mitigate any risk to the tanker and/or receiver.

2.6.9.3. Change of Platform Ownership. The technical compatibility approval given to one owning nation or commercial operator does not normally transfer with the platform (see para 2.6.8.). Typically, a nation or commercial operator assumes engineering responsibility for the platforms upon taking ownership. Thereafter, if the new owning nation wishes to conduct AAR with USA assets (either tankers or receivers), the platform’s new owners must comply with para 2.6.10.2.

**EXCEPTION:** Engineering Authority for the Tanker Retained. When the new owning nation retains the platform manufacturer as the engineering authority, and AAR supported delivery flights have been conducted by the manufacturer in compliance with para 2.6.9.2., the compatibility assessment may transfer to the new platform owners upon platform delivery. For this to be put into effect, the manufacturer must identify this situation when applying for the technical compatibility assessment required for the ferry flights.

2.6.9.4. Non-USA Operated Platforms Planned to Conduct AAR with USA Platforms. Where a nation or commercial operator whose platforms have not been the subject of a USA technical compatibility assessment plans to conduct AAR with USA platforms, the following options apply:

2.6.9.4.1. Platform Owner Assumes Engineering Authority. When the new owner is also the engineering authority for the platform, the instructions in para 2.6.6. apply

2.6.9.4.2. Platform Owner Delegates Engineering Authority. When the platform operator delegates engineering authority to another organization or commercial company the instruction in para 2.6.6.2.1. apply.

2.6.9.5. Incorporation of Modifications that Impact AAR. Modifications made to a platform that have the potential to impact the AAR technical compatibility assessment must be re-validated. See para 2.6.15.3 for more information.

2.6.9.6. Quinquennial Review. Every 5 years the appropriate USA tanker or receiver platform engineering authority will review the technical compatibility of a receiver/tanker combination (see para 2.6.15.4).

2.6.10. AAR TECHNICAL COMPATIBILITY REVIEW – SUBMITTING A REQUESTING

2.6.10.1. USA Technical Compatibility POC. Contact details of a nation’s Technical Compatibility Point of Contact (POC) are listed in the appropriate tanker’s national Standards Related Documents (see Chapter 1 of this manual). This office is responsible for processing requests from non-USA receiver operators, both military and commercial, and for internal USA receivers planning to conduct AAR with commercial or non-USA military tankers.

2.6.10.2. Requests for AAR Technical Compatibility Review - Action by Receiver Nation or Receiver Commercial Operator. It is the receiver operator’s responsibility to request a technical compatibility assessment for its aircraft to receive fuel from a commercial tanker or a tanker from another nation. Requests for a technical compatibility assessment to work with a USA platform must be submitted in accordance with para 2.6.10.1. The request will fall under one of two categories:

2.6.10.2.1. Commercial and Non-USA Military Receivers – USA Tankers. The engineering authority (see para 2.6.6.) for commercial and non-USA military receivers must refer to para 2.6.11.1. for guidance on the process for requesting technical compatibility assessments against USA tankers.
2.6.10.2.2. USA Receivers - Commercial and Non-USA Military Tankers. USA military operators wishing to use commercial or non-USA military tankers for AAR must refer to para 2.6.11.2. for guidance on the process for requesting technical compatibility assessments against such platforms.

2.6.10.2.3. Figure 2.1 provides a precise diagram of the actions associated with each of the AAR events listed above.

**Figure 2.1. – Schematic of the Technical Compatibility Assessment Application Process**

### 2.6.11. AAR TECHNICAL COMPATIBILITY REVIEW – CONTENT OF A REQUEST

#### 2.6.11.1. Commercial and Non-USA Military Receivers with USA Tankers.

Commercial and non-USA military receiver aircraft requiring AAR technical compatibility assessments with USA tankers fall under one of the following two categories:

**2.6.11.1.1. USA Manufactured Receivers - Commercial or Non-USA Military Operated.** Commercial companies or non-USA military seeking technical compatibility assessments of USA manufactured receivers against USA tankers are subdivided into the following:

- **Aircraft Maintaining USA Configuration.** The commercial operator or non-USA military must verify in writing that the receiver airframe is similar to that operated by USA military forces and that they are modified and maintained in accordance with USA configuration control. In this instance, there is no requirement to submit a Standardized Technical Data Survey. A suggested letter template is offered at the end of this chapter in **Leaflet 1**.

- **Aircraft Not Maintaining USA Configuration.** Modifications to an airframe may adversely impact the AAR envelope of the platform or the platform’s AAR procedures. Some of the items that fall into this category are listed in para 2.6.12.1. Consequently, the commercial or non-USA military operator must provide the USA with full details of such modifications. Thorough analysis of the information by the appropriate USA engineering specialists will determine the impact these modifications have on the platform’s technical compatibility with USA military tankers. Letters requesting a technical compatibility survey must include a Standardized Technical Data Survey (see para 2.6.7.1.). A letter template is offered at the end of this Appendix in **Leaflet 2**.
2.6.11.2. Non-USA Manufactured Receiver Aircraft – Commercial or Non-USA Military Operated. Receiver aircraft that are not in the USA military inventory, whether operated commercially or by non-USA military, normally require full flight trials to ensure that they are technically compatible with USA military tankers. For non-USA military receivers, such trials are normally the subject of a FMS case. Requests for an FMS case must be submitted through the appropriate country desk of the Secretary of the Air Force/International Affairs (SAF/IA) when this activity involves USAF participation. When this activity involves USN/USMC participation, it should be submitted through the appropriate country desk of the Navy International Programs Office (NIPO). For commercially operated aircraft, this activity will be addressed during contract negotiations.

2.6.11.2.1. EXCEPTION: Non-USA Manufactured Receiver Aircraft – Technically Compatibility with a Non-USA Tanker that is a Derivative of a USA Tanker. A read-across technical compatibility assessment may be granted to non-USA manufactured receiver aircraft that are not in the USA military inventory if the platform meets specific criteria. In order to achieve this, the receiver must have been previously assessed and approved for AAR against a commercial or non-USA operated tanker that is similar to one operated by the USA military. Often, this will negate the need to conduct flight trials. The commercial operator or receiver nation must provide the USA with a copy of the receiver’s technical compatibility report with the non-USA tanker. This report, together with the appropriate Standardized Technical Data Survey (see para 2.6.7.1.) should be submitted under cover of a letter based on Leaflet 3 at the end of this chapter.

2.6.11.2. USA Receivers with Commercial and Non-USA Military Tankers. Before a USA receiver conducts AAR against a commercial or non-USA operated tanker, a technical compatibility assessment of the tanker / receiver combination is required. As the USA POC (see para 2.6.10.1.), US TRANSCOM J3-WR will facilitate contact between the appropriate offices of the USA and non-USA/commercial operators; normally, engagement will be via the SAF/IA country desk of the tanker nation or the equivalent in NIPO.

2.6.11.2.1. Obtaining a Technical Compatibility Review – USA Receivers against Commercial or Non-USA Military Tankers. The USA receiver platform’s Systems Group (SG) (or single service equivalent) must undertake a technical compatibility review of the tanker / receiver combination. The appropriate SG will work with the commercial or non-USA tanker’s engineering authority (see para 2.6.6.) to determine the AAR technical compatibility of the two platforms. The request from the USA to the operators of a commercial or non-USA tanker must be accompanied by a completed Standardized Technical Data Survey (see para 2.6.7.1.) for the USA platform. Non-USA tankers fall into one of two categories as follows:

2.6.11.2.1.1. Commercial and Non-USA Military Operated Tankers - Derivative of USA Military Tankers. A tanker operator with Engineering Authority over a USA derivative platform may incorporate modifications to meet commercial or national requirements without complying with USA configuration control. Therefore, to inform the technical compatibility assessment, it is imperative that the tanker operator provides the USA with details of all AAR-significant modifications (see para 2.6.12.1). One of the following actions must be followed:

2.6.11.2.1.1.1. Commercial Tanker Aircraft. The technical compatibility assessment of commercially operated tanker aircraft intended to conduct AAR with USA platforms will be addressed during contract negotiations.

2.6.11.2.1.1.2. Non-USA Military Tanker Aircraft Maintaining USA Configuration. When the tanker has not been modified since acquisition, or modifications have been in accordance with USA configuration control, the operator must confirm this status through a letter based on the template in Leaflet 1 at the end of this SRD.

2.6.11.2.1.1.3. Non-USA Military Tanker Aircraft Not Maintaining USA Configuration. Operators of tankers that have been modified, but not in accordance with USA configuration control, must identify AAR-significant modifications to the appropriate USA receiver SGs. This information can be provided through a letter based on the Leaflet 2 template at the end of this SRD accompanied by a completed Standardized Technical Data Survey (see para 2.2.2.1.).
2.6.11.2.1.2. Commercial and Non-USA Operated Tankers – Non-USA Manufactured Tankers. Normally, full receiver/tanker flight trials are required when USA receivers plan to conduct AAR against non-USA manufactured tankers that are not in the USA inventory. Such activity would normally attract costs for the flight trials and therefore the planned AAR activity must, in the first instance, be in the interests of the USA.

2.6.11.2.1.2.1. Commercial Non-USA Manufactured Tanker Aircraft. Technical compatibility assessment of a commercially operated non-USA manufactured tanker will be addressed during contract negotiations.

2.6.11.2.1.2.2. Non-USA Manufactured Military Tanker. Normally, a technical compatibility assessment of non-USA manufactured tankers will require flight trial. The process for requesting these is similar to that for non-USA manufactured receivers described in para 2.6.11.1.2.

**EXCEPTION:** Non-USA Manufactured Tanker – Technically Compatibility with a USA Manufactured Receiver. The USA may grant a read-across technical assessment for a USA operated receiver against a non-USA manufactured tanker not in the USA military inventory if certain conditions are fulfilled. Specifically, these are when the non-USA tanker operator has assessed and approved a derivative of the subject USA manufactured receiver against the subject non-USA manufactured tanker. For the USA to perform a read-across, the tanker nation must provide the USA with a copy of the tanker/receiver technical compatibility report and/or flight trials report.

2.6.12. TECHNICAL COMPATIBILITY ASSESSMENT – USAF PROCESS

2.6.12.1. USAF Technical Compatibility Assessment. For the USAF, Air Force Instruction 10-204 directs that a technical compatibility assessment is performed when USAF platforms operate with non-USA platforms that have not been previously assessed. The following sub-paras amplify upon the procedure.

2.6.12.1.1. Requests for Engineering Technical Compatibility Assessments. Upon receipt of a request for a technical compatibility assessment, US TRANSCOM J3-WR will engage the following offices:

2.6.12.1.1.1. AFLCMC. The Air Force Life Cycle Management Center (AFLCMC) Flight Systems Engineering Division, Aircraft Subsystems Branch (AFLCMC/EZFA) will be requested to conduct a technical compatibility assessment. Any supporting documentation from the non-USA nation or commercial operator will be forwarded with the request.

2.6.12.1.1.2. AMC/A3VK. An information copy of the request will be sent to HQ AMC StanEval tanker branch (AMC/A3VK) at A3_A3VK.ATP3342USSRDPDOC@us.af.mil. This will ensure that provision is made to include the platform in the next update of the USA SRD.

2.6.12.1.1.3. SAF/IA. For activity involving non-USA nations, the appropriate country desk of SAF/IA will be appraised of the interoperability request so that all political aspects are addressed.

2.6.12.1.1.4. Geographic COCOM. The Geographic COCOM will be informed of all requests for interoperability activity within the COCOM’s area of responsibility.

2.6.12.1.1.5. HAF Contracts Office. When activity is planned involving commercial tankers or receivers, the appropriate Headquarters Air Force (HAF) contracts office will be informed. This will ensure that all contractual issues are addressed.

2.6.12.1.2. Engineering Technical Compatibility Assessments and Recommendations. Following flight trials and/or technical analysis, the AFLCMC/EZFA engineering recommendation will be sent to US TRANSCOM J3-WR with information copies provided to AMC/A3VK and affected MAJCOMs.

2.6.12.1.3. Operator Review of AFLCMC/EZFA’s Recommendations. US TRANSCOM J3-WR will review the recommendations from AFLCMC/EZFA. When a commercial or non-USA platform is deemed suitable for AAR with a USA platform, the US SRD will be updated as appropriate. For platforms reviewed between revision cycles of the US SRD, see para 2.6.16.2.
NOTE: See para 2.6.5 for information about the difference between technical compatibility and the authority to conduct AAR.

2.6.12.1.4. Action when a Platform is Deemed Technically Incompatible. When either AFLCMC/EZFA or US TRANSCOM J3-WR determines that the configuration of the commercial or non-USA military platform presents too high a risk of damage to either the tanker or receiver, US TRANSCOM J3-WR will pass this information to the appropriate country desk at SAF/IA. From there the decision will be passed to the geographic COCOM and subsequently to the non-USA operator of the platform. Any recommended modifications to the platform made by AFLCMC/EZFA or US TRANSCOM J3-WR to reduce the risk of damage will be included in the correspondence.

Figure 2.2. – Non-USA Receiver Technical Compatibility Assessment– USAF Tankers
2.6.13. TECHNICAL COMPATIBILITY ASSESSMENT – USN/USMC PROCESS

2.6.13.1. USN/USMC Technical Compatibility Assessment. For the USN/USMC, per OPNAVINST 3710.7 and NAVAIRINST 13034.1 series instructions, a technical compatibility assessment in the form of a Naval Flight Clearance is required when USN/USMC platforms operate with platforms that are not cleared via current interim or permanent flight clearance processes.

2.6.14. TECHNICAL COMPATIBILITY ASSESSMENT – RECOMMENDATION

2.6.14.1. Types of AAR Technical Compatibility – Commercial and Non-USA Receivers. Following satisfactory flight trials and/or technical analysis by the USA technical authority one of three types of technical compatibility approvals will be recommended.

2.6.14.1.1. Category 1 (Operational Emergency) Technical Compatibility. Where mission requirements dictate that it is imperative to conduct AAR but flight trials have not been possible and technical analysis indicates that AAR between the USA tanker and the non-USA national receiver poses a significant potential risk of damage to the receiver or its AAR equipment, an Operational Emergency Compatibility (OEC) may be issued. Normally, OECs will specify the theatre or operation for which it applies, together with tanker and/or receiver restrictions that must be adhered to in order to minimize the risk of damage. Importantly, by operating a receiver under an OEC, the receiver operator accepts responsibility for any risks to the receiver associated with the AAR activity.

2.6.14.1.2. Category 2 (Interim) Technical Compatibility. Normally, an interim technical compatibility is offered where there are caveats/restrictions intended to mitigate potential risks that cannot be verified until flight trials have been performed and the results reviewed. This recommendation will be based on the

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1 OPNAVINST 3710.7 NATOPS General Flight and Operating Instructions, NAVAIRINST 13034.1 Flight Clearance Policy for Air Vehicles and Aircraft Systems
technical information supplied by the receiver nation or commercial operator, specifically reviewing the receiver’s AAR equipment and its ability to mate successfully with the tanker’s equipment. On occasions, this analysis will be performed using information derived from another nation’s full technical compatibility assessment for the same or similar tanker/receiver combination (this is a read across compatibility).

2.6.14.1.3. Category 3 (Full) AAR Technical Compatibility. When flight trials have been conducted between US military tankers and the receiver, a full AAR technical compatibility may be approved. Based upon the results of the trials, such approvals may contain restrictions to the operating envelope together with modified AAR procedures for either the tanker or receiver, or both, to ensure safe and effective AAR between the two platforms. The CAT 3 TCA can have an open-ended duration of validity and is reviewed every 5 years for changes impacting key elements of the AAR assessment.

2.6.15. TECHNICAL COMPATIBILITY ASSESSMENT – REVIEW PROCESS

2.6.15.1. AAR Technical Compatibility – Validity. A technical compatibility assessment for a receiver/tanker combination remains valid only when AAR related items on either platform are not modified. Items that affect AAR compatibility include, but are not limited to:

2.6.15.1.1. Physical changes to the area around the fuel on-take system.

2.6.15.1.2. Modifications to the fuel system (eg new fuel pumps, modified external fuel tanks etc).

2.6.15.1.3. Upgrades to a platform’s flight control system or (for fly by wire airplanes) control laws.

2.6.15.1.4. Camouflage is modified (boom only).

2.6.15.1.5. Any modification that amends the data that was previously submitted in the Standardized Technical Data Survey (see para 2.2.2.1.) that informed the original review.

2.6.15.1.6. For tankers, the AAR associated markings and lighting.

2.6.15.2. AAR Technical Compatibility – Platform Modifications. The validity of a platform’s technical compatibility approval discussed in para 2.6.12.1. is predicated on one of the following:

2.6.15.2.1. Platform Unmodified. The platform’s AAR system and other AAR characteristics remain unchanged from those at the time the assessment was conducted.

2.6.15.2.2. Platform Maintained in Accordance with US Configuration Control. For USA manufactured platforms the AAR systems and other AAR characteristics are maintained in accordance with USA modification configuration control. In this instance, the modifications will be reviewed as part of the upgrade program and any factors that influence AAR will be published for the entire family of similar airplanes.

*NOTE:* Whenever AAR significant modifications are incorporated (see para 2.6.12.1.), the platform’s non-USA military or commercial operator must comply with the instructions in para 2.6.5.

2.6.15.3. AAR Technical Compatibility – Review Following Platform Modification. Whenever a platform (tanker or receiver) is modified such that it may impact AAR (see para 2.6.12.1.) the technical compatibility of the tanker/receiver combination must be reviewed. It is incumbent upon the nation or commercial company operating the modified platform to:

2.6.15.3.1. Inform the other participants when such modifications are planned or incorporated

2.6.15.3.2. Request an updated technical compatibility assessment.
NOTE: The request should be submitted in writing employing an appropriately modified version of the letters in Leaflet 2 or Leaflet 3 included at the end of this SRD accompanied by a completed Standardized Technical Data Survey (see para 2.6.7.1.).

2.6.15.4. AAR Technical Compatibility – Quinquennial Periodic Review. For quality control purposes, it is necessary to conduct a periodic review of the validity of a technical compatibility assessment. Therefore, to maintain continuity of approval for AAR with USA platforms, non-USA and commercial operators must comply with the instructions below. Importantly, unless these instructions are followed, the technical compatibility assessment for non-USA receiver and tanker platforms with USA tankers and receivers will automatically lapse on the Quinquennial Review Expiry Date published in para 2.6.15. To revalidate a technical compatibility assessment, no later than 6 months prior to the published Quinquennial Review Expiry Date (see para 2.6.15.5., Requests for Quinquennial Review – Submission Date) the platform operator must comply with one of the following courses of action:

2.6.15.4.1. Platform not Modified or Remains Modified in Accordance with USA Configuration Control. An operator must confirm to the USA that, since the last technical compatibility review, the modification status of its platforms meet one of the following criteria:

2.6.15.4.1.1. Not had AAR significant modification incorporated (para 2.6.12.1. discusses items that have the potential to affect AAR compatibility). Or

2.6.15.4.1.2. Has been maintained in accordance with USA modification configuration control

NOTE: The confirmation must be submitted in the form of a letter to US TRANSCOM at transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil (copied to Air Mobility Command at A3.A3VK.ATP3342USSRDPOC@us.af.mil) based on the template in Leaflet 4.

2.6.15.4.2. Platform Modified. An operator whose platforms have been modified in the period since the last technical compatibility review such that the AAR capability may have been impacted (see para 2.6.12.1.) must update the USA on the platform’s status. The information must be submitted in the form of a letter to US TRANSCOM at transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil (copied to Air Mobility Command at A3.A3VK.ATP3342USSRDPOC@us.af.mil) based on the template in Leaflet 5 accompanied by a completed Standardized Technical Data Survey (see para 2.6.7.1.).

EXCEPTION: Recent Platform Assessment. When the technical compatibility of a platform has been reviewed and updated because of the requirements stipulated in para 2.6.15.3. within 12 months of the next published Quinquennial Review Expiry Date, the technical compatibility assessment will be extended automatically to the following Quinquennial Review Expiry Date.

2.6.15.5. Quinquennial Review Dates. The Quinquennial Review Submission Dates and Quinquennial Review Expiry Dates are as follows:

<table>
<thead>
<tr>
<th>Requests for Quinquennial Review – Submission Date</th>
<th>Quinquennial Review – Expiry Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 January 15</td>
<td>Summer Release of US SRD (approx 1 July 2015)</td>
</tr>
<tr>
<td>23 January 20</td>
<td>Summer Release of US SRD (approx 1 July 2020)</td>
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<td>24 January 25</td>
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</tr>
<tr>
<td>24 January 30</td>
<td>Summer Release of US SRD (approx 1 July 2030)</td>
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2.6.16. PUBLICATION OF APPROVED TANKER/RECEIVER COMBINATIONS
2.6.16.1. Publication of Commercial Operator and Nation-Specific AAR Technical Compatibility Assessment. Details of commercially or non-USA operated platforms assessed to be technically compatible with USA military platforms are published as follows:

2.6.16.1.1. USAF Tankers with Non-USA Receivers. Chapter 8, Appendix F, publishes details of commercial and non-USA AAR receivers technically compatible with USAF heavy jet tankers.

2.6.16.1.2. USN/USMC Platforms with Non-USA Platforms. Chapter 3, Appendix F publishes details of commercial and non-USA AAR platforms technically compatible with USN/USMC AAR platforms.

2.6.16.1.3. USAF Receivers with Non-USA and Commercial Tankers. Chapter 3 publishes details of commercial and non-USA tankers technically compatible with USAF receivers.

2.6.16.2. Publication of Technical Compatibility Assessments Conducted Out of Phase with the Release of US SRD. AAR compatibility assessments of commercial and non-USA platforms conducted between the publishing cycles of the US SRD will be released to USAF crews by the lead MAJCOM through Flight Crew Information Files. For USN/USMC crews, the appropriate single service equivalent will be invoked. The US HOD will be notified of all Out of Phase compatibility assessments by the respective branch POCs and will inform the ATP 3.3.4.2 custodian for inclusion in the official AAR Matrix.

2.6.16.3. Receiver Restrictions. For USAF receiver platforms, AAR restrictions with commercial or non-USA tankers are published in the Major Design Series Technical Orders or Flight Manual. For USN/USMC receiver platforms, AAR restrictions are published in the appropriate aircraft NATOPS Flight Manual. For USA platform AAR activity with commercial or non-USA receivers and tankers, the USA platform engineering authority releases AAR technical compatibility letters. The latter are used to populate the appropriate information in Chapters 3 and 8 in this document. USA crews are to ensure that they are familiar with the pertinent information and restrictions published in the appropriate documents discussed in this para before conducting AAR operations with a specific commercial or non-USA platform.

2.6.16.4. List of Leaflets

<table>
<thead>
<tr>
<th>Leaflet Number</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaflet 1</td>
<td>Letter Requesting Compatibility Assessment – USA Manufactured Platforms Modified in Accordance with USA Configuration Control</td>
</tr>
<tr>
<td>Leaflet 2</td>
<td>Letter Requesting Compatibility Assessment – Nationally Modified, USA Manufactured, Platform</td>
</tr>
<tr>
<td>Leaflet 3</td>
<td>Letter Requesting Compatibility Assessment – Non-USA Manufactured Platform</td>
</tr>
<tr>
<td>Leaflet 4</td>
<td>Quinquennial Review Letter Confirming that a Platform has been Modified in Accordance with USA Configuration Control or that the Modification State Remains Unchanged since the Previous Technical Compatibility Review</td>
</tr>
<tr>
<td>Leaflet 5</td>
<td>Quinquennial Review Letter Confirming that a Platform has been Modified since the Previous Technical Compatibility Review</td>
</tr>
<tr>
<td>Leaflet 6</td>
<td>Letter Informing USA that a Third Party has been Appointed to be a Platform’s Engineering Authority</td>
</tr>
</tbody>
</table>
Template for Letter Requesting Compatibility Assessment – USA Manufactured Platforms Modified in Accordance with USA Configuration Control

(HEADED PAPER WITH OFFICE/SERVICE/NATIONAL LOGO AS APPROPRIATE)

MEMORANDUM FOR: US TRANSCOM J3-WR  
508 Scott Drive,  
Scott AFB,  
IL 62225-5357  
USA

FROM: (Nation/Organization/Commercial Company)

SUBJECT: Request for Air to Air Refueling (AAR) Technical Compatibility Assessment of the (enter platform owning nation or commercial operator) (enter receiver or tanker type and mark/block as appropriate) with the USA (enter tanker or receiver type(s)).

REFERENCES:
A. ATP-3.3.4.2, US SRD, Chapter 2  
B. ATP-3.3.4.2.  
(http://www.japcc.org/aar).

1. In accordance with Reference A, (enter requesting country/commercial company) requests that the USA conducts an AAR Technical Compatibility Assessment of the (enter platform owning nation/commercial company) (enter receiver or tanker type and mark/block as appropriate) against the USA (enter tanker/receiver type(s)).

2. The (enter receiver or tanker type) is being sold* /was acquired* under Foreign Military Sales Case Number (enter details)* /Direct Commercial Sales* and all platforms are now modified to block (enter block number)*/have not been modified since delivery*.

3. Having reviewed Reference B and its appropriate appendices, we confirm that the subject airplanes have been modified only in accordance with USA configuration control and that no national changes have been incorporated in areas that would impact AAR compatibility with USA tankers*/receivers*.

4. **(enter commercial company) further confirms that it has been appointed to continue to act as the engineering authority for the (enter receiver or tanker type and mark/block as appropriate) following transfer of ownership to (enter country).

5. In the event that nationally sanctioned modifications are incorporated that do not comply with USA configuration but have the potential to impact AAR we will submit a further technical compatibility request to the USA together with the appropriate survey from Reference B.

6. The (enter requesting country/company) point of contact for any queries is (enter rank/title, name, postal address, telephone number and e-mail address). Direct liaison is authorized.

// SIGNATURE//
NAME
RANK/TITLE
ORGANISATION NAME
COUNTRY

* Delete as appropriate
** For a manufacturer that retains engineering authority - include in request only if appropriate

Note: Submit completed document to US TRANSCOM J3-FR at transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil with an information copy to A3.A3VK.ATP3342USSRDPOC@us.af.mil
Template for Letter Requesting Compatibility Assessment – Nationally Modified, USA Manufactured, Platform

(HEADED PAPER WITH OFFICE/SERVICE/NATIONAL LOGO AS APPROPRIATE)

<table>
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<tr>
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<th>(DAY MONTH YEAR)</th>
</tr>
</thead>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td></td>
<td>IL 62225-5357</td>
<td>USA</td>
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<tr>
<td>FROM:</td>
<td>(Nation/Organization/Commercial Company)</td>
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</tr>
<tr>
<td>SUBJECT:</td>
<td>Request for Air to Air Refueling (AAR) Technical Compatibility Assessment of the (enter platform owning nation or commercial operator) (enter receiver or tanker type and mark/block as appropriate) with the USA (enter tanker or receiver type(s)).</td>
<td></td>
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</table>

REFERENCES:

A. ATP-3.3.4.2, US SRD, Chapter 2
B. ATP-3.3.4.2, [http://www.japcc.org/aar](http://www.japcc.org/aar).

1. In accordance with Reference A, (enter requesting country/commercial company) requests that the USA conducts an AAR Technical Compatibility Assessment of the (enter platform owning nation/commercial company) (enter receiver or tanker type and mark/block as appropriate) against the USA (enter tanker/receiver type(s)).

2. The (enter receiver or tanker type) was acquired under Foreign Military Sales Case Number (enter details)/Direct Commercial Sales* and all platforms are now modified to block (enter block number). In addition, we have incorporated nationally sanctioned modifications that have the potential to impact AAR.

3. We have reviewed and completed the appropriate appendix/appendices from Reference B and this is*/these are* attached for your examination.

4. (enter requesting country/commercial company) further confirms that, in the event that additional nationally*/company* sanctioned modifications are incorporated that do not comply with USA configuration but have the potential to impact AAR we will submit a further technical compatibility request to the USA together with the appropriate survey from Reference B.

5. In the event that nationally sanctioned modifications are incorporated that do not comply with USA configuration but have the potential to impact AAR we will submit a further technical compatibility request to the USA together with the appropriate survey from Reference B.

6. The (enter requesting country/company) point of contact for any queries is (enter rank/title, name, postal address, telephone number and e-mail address). Direct liaison is authorized.

// SIGNATURE//
NAME
RANK/TITLE
ORGANISATION NAME
COUNTRY

Note: Submit completed document to US TRANSCOM J3-FR at transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil with an information copy to A3.A3VK.ATP3342USSRDPOC@us.af.mil

5 March 2019
Template for Letter Requesting Compatibility Assessment – Non-USA Manufactured Platform

(HEADED PAPER WITH OFFICE/SERVICE/NATIONAL LOGO AS APPROPRIATE)

MEMORANDUM FOR: US TRANSCOM J3-WR 508 Scott Drive, Scott AFB, IL 62225-5357 USA

FROM: (Nation/Organization/Commercial Company)

SUBJECT: Request for Air to Air Refueling (AAR) Technical Compatibility Assessment of the (enter platform owning nation) (enter receiver or tanker type and mark/block as appropriate) with the USA (enter tanker or receiver type(s)).

REFERENCES:
A. ATP-3.3.4.2, US SRD, Chapter 2
B. ATP-3.3.4.2 (http://www.japcc.org/aar).

1. In accordance with Reference A, (enter requesting country/commercial company) requests that the USA conducts an AAR Technical Compatibility Assessment of the (enter platform owning nation) (enter receiver or tanker type and mark/block as appropriate) against the USA (enter tanker/receiver type(s)).

2. The aircraft are not on the US military inventory. However, they have been subject to a favorable technical compatibility assessment against the (enter tanker nation) (enter tanker type) which is similar to the (enter tanker) in the USA inventory*. (Delete last sentence if not applicable.)

3. We have reviewed and completed the appropriate appendices from Reference B and this is*/these are* attached for your examination. In addition, we include a copy of the technical compatibility assessment report for the (enter receiver type) against the (enter tanker nation) (enter tanker type)*.

4. (enter requesting country/commercial company) further confirms that, in the event that additional nationally*/company* sanctioned modifications are incorporated that have the potential to impact AAR we will submit a further technical compatibility request to the USA together with the appropriate survey from Reference B.

5. The (enter requesting country/company) point of contact for any queries is (enter rank/title, name, postal address, telephone number and e-mail address). Direct liaison is authorized.

// SIGNATURE//
NAME
RANK/TITLE
ORGANISATION NAME
COUNTRY

* Delete as appropriate

Note: Submit completed document to US TRANSCOM J3-FR at transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil with an information copy to A3.A3VK.ATP3342USSRDPOC@us.af.mil.
LEAFLET 4
Template for Quinquennial Review - Letter Confirming that a Platform has been Modified in Accordance with USA Configuration Control or that the Modification State Remains Unchanged since the Previous Technical Compatibility Review

(HEADED PAPER WITH OFFICE/SERVICE/NATIONAL LOGO AS APPROPRIATE)

MEMORANDUM FOR: US TRANSCOM J3-WR (DAY MONTH YEAR)
508 Scott Drive,
Scott AFB,
IL 62225-5357
USA

FROM: (Nation/Organization/Commercial Company)

SUBJECT: Quinquennial Review of Air to Air Refueling (AAR) Technical Compatibility of the (enter platform owning nation or commercial operator) (enter receiver or tanker type and mark/block as appropriate) with the USA (enter tanker or receiver type(s)).

REFERENCES:
A. ATP-3.3.4.2, US SRD, Chapter 2
B. ATP-3.3.4.2. (http://www.japcc.org/aar).

1. In accordance with Reference A, (enter requesting country/commercial company) requests that the USA conducts a Quinquennial Review of the AAR Technical Compatibility of the (enter platform owning nation/commercial company) (enter receiver or tanker type and mark/block as appropriate) against the USA (enter tanker/receiver type(s)).

2. The (enter receiver or tanker type) was previously reviewed and approved as compatible for AAR with USA platforms. The appropriate technical compatibility letter reference is: (see Note 1)

3. Having reviewed Reference B and its appropriate appendices, we confirm that, in the period since the approval referred to in paragraph 2, the subject aircraft have been modified in accordance with USA configuration control*/have not been modified such that the AAR capability has been impacted* and that no nationally approved changes have been incorporated in areas that would impact AAR compatibility with USA tankers or receivers.

4. The (enter requesting country/company) point of contact for any queries is (enter rank/title, name, postal address, telephone number and e-mail address). Direct liaison is authorized.

// SIGNATURE//
NAME
RANK/TITLE
ORGANISATION NAME
COUNTRY

* Delete as appropriate

Notes:
1. Enter reference letters and date extracted from US SRD, as follows:
   a. For non-USA receivers with USAF tankers, US SRD Figure 2-5
   b. For USAF receivers against non-USA tankers, US SRD Figure 2-4.
   c. For USN/USMC platforms against commercial and non-USA platforms, the reference is US SRD Appendix 3I
2. Submit completed document to US TRANSCOM J3-FR transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil with an information copy to A3.A3VK.ATP3342USSRDPOC@us.af.mil.
LEAFLET 5
Template for Quinquennial Review - Letter Confirming that a Platform has been Modified since the Previous Technical Compatibility Review

(HEADED PAPER WITH OFFICE/SERVICE/NATIONAL LOGO AS APPROPRIATE)

MEMORANDUM FOR: US TRANSCOM J3-WR  (DAY MONTH YEAR)
508 Scott Drive,
Scott AFB,
IL 62225-5357
USA

FROM: (Nation/Organization/Commercial Company)

SUBJECT: Quinquennial Review of Air to Air Refueling (AAR) Technical Compatibility of the (enter platform owning nation or commercial operator) (enter receiver or tanker type and mark/block as appropriate) with the USA (enter tanker or receiver type(s)).

REFERENCES:
A. ATP-3.3.4.2, US SRD, Chapter 2
B. ATP-3.3.4.2
(http://www.japcc.org/aar).

1. In accordance with Reference A, (enter requesting country/commercial company) requests that the USA conducts a Quinquennial Review of the AAR Technical Compatibility of the (enter platform owning nation/commercial company) (enter receiver or tanker type and mark/block as appropriate) against the USA (enter tanker/receiver type(s)).

2. The (enter receiver or tanker type) was previously reviewed and approved as compatible for AAR with USA platforms. The appropriate technical compatibility letter reference is: (see Note 1)

3. Having reviewed Reference B and its appropriate appendices, we confirm that, in the period since the approval referred to in paragraph 2, the subject aircraft have been modified. These modifications are in accordance national*/company*/manufacturer* requirements. We have reviewed and completed the appropriate appendix/ appendices from Reference B and this is*/these are* attached for your examination.

4. The (enter requesting country/company) point of contact for any queries is (enter rank/title, name, postal address, telephone number and e-mail address). Direct liaison is authorized.

// SIGNATURE//
NAME
RANK/TITLE
ORGANISATION NAME
COUNTRY

* Delete as appropriate

Notes:
1. Enter reference letters and date extracted from US SRD, as follows:
   a. For non-USA receivers with USAF tankers, US SRD Figure 2-5
   b. For USAF receivers against non-USA tankers, US SRD Figure 2-4.
   c. For USN/USMC platforms against commercial and non-USA platforms, the reference is US SRD Appendix 3I
2. Submit completed document to US TRANSCOM J3-FR at transcom.scott.tcj3.mbx.fr-air-refueling-branch@mail.mil with an information copy to A3.A3VK.ATP3342USSRDPOC@us.af.mil
LEAFLET 6
Template for Letter Informing USA that a Third Party has been Appointed to be a Platform’s Engineering Authority

(HEADED PAPER WITH OFFICE/SERVICE/NATIONAL LOGO AS APPROPRIATE)

MEMORANDUM FOR: US TRANSCOM J3-WR (DAY MONTH YEAR)
508 Scott Drive,
Scott AFB,
IL 62225-5357
USA

FROM: (Nation/Service)

SUBJECT: Appointment by (enter nation or armed service) of (enter company name) as the Engineering Authority for the (enter receiver or tanker type and mark/block as appropriate) for all Air to Air Refueling (AAR) engineering issues.

REFERENCES:
A. ATP-3.3.4.2, US SRD, Chapter 2
B. ATP-3.3.4.2
(http://www.japcc.org/aar).

1. In accordance with Reference A, (enter country) wishes to inform you that (enter company name) has been appointed as the Engineering Authority for all AAR related matters associated with the (enter receiver or tanker type and mark/block as appropriate).

2. The company will provide engineering information as deemed necessary to ensure that the USA is able to conduct AAR Technical Compatibility Assessments for this platform when working with USA refueling assets. This includes compiling and submitting a Technical Data Survey as required by Reference B where this is deemed necessary.

3. Additionally, (enter commercial company) will inform the USA when nationally sanctioned modifications are incorporated that do not comply with USA configuration but have the potential to impact AAR.

4. The (enter company name) point of contact for any queries is (enter title, name, postal address, telephone number and e-mail address). Direct liaison is authorized.

// SIGNATURE//
NAME
RANK/TITLE
ORGANISATION NAME
COUNTRY

Note: Submit completed document to US TRANSCOM J3-FR at transcom.scott.tecj3.mbx.fr-air-refueling-branch@mail.mil with an information copy to A3.A3VK.ATP3342USSRDPOC@us.af.mil
### Figure 2-4. Commercial/Foreign Military Tankers Technically Compatible w/USAF Receivers - Boom

**AAR COMPATIBLE COMMERCIAL AND FOREIGN MILITARY BOOM TANKERS**

**NOTE:** AAR compatibility for a non-US tanker listed in this table **ONLY** confirms that the tanker and receiver are **TECHNICALLY** capable of pairing up and transferring fuel. See Chapter 2, para 2.6.5 for information about the **AUTHORITY** to conduct AAR.

**KEY:**
- **GREEN (X) = TCA Current / Quinquennial Review Completed**
- **BLANK = NO TCA/ NOT COMPATIBLE AND/OR REVIEW NOT COMPLETED**
- Reference 2.6.14

| COUNTRY | AUSTRALIA | CHILE | FRANCE | FRANCE | ISRAEL | ITALY | JAPAN | NETHERLANDS | SAUDI ARABIA | SINGAPORE | TURKEY | UAE |
|---------|-----------|-------|--------|--------|--------|-------|-------|-------------|-------------|------------|--------|------|-----|
| C-5 | | | | | | | | | | | | |
| C-17 | CAT II | | | | | | | | | | | |
| C-32B | | | | | | | | | | | | |
| KC-10 | X | X | | X | X | X | | | | | | |
| KC-46 | | | | | | | | | | | | |
| KC-135 | X | X | | X | X | X | | | | | | |
| VC-25 | | | | | | | | | | | | |
| A-10 | X | X | | X | X | X | | | | | | |
| B-1B | CAT II | X | X | | X | X | X | | | | | |
| B-2A | | | | | | | | | | | | |
| B-52 | | | | | | | | | | | | |
| E-3/E-8 | | | | | | | | | | | | |
| F-15 | X | X | CAT II | X | X | X | | | | | | |
| F-16 | CAT II | X | X | CAT II | X | X | X | | | | | |
| F-22 | | | | | | | | | | | | |
| F-35 | X | X | | | | | | | | | | |
| HC-130 | | | | | | | | | | | | |
| RC-135 | | | | | | | | | | | | |
| AFSOC | | | | | | | | | | | | |
| AC-130H/U | | | | | | | | | | | | |
| MC-130 | | | | | | | | | | | | |
Figure 2-5. AAR Compatible Commercial and Foreign Military Receivers

TO UPDATE A RECEIVER’S TECHNICAL COMPATIBILITY, RECEIVER NATIONS MUST COMPLY WITH THE INSTRUCTIONS DETAILED IN CHAPTER 2, PARAS 2.6.1 THRU 2.9.5. NATIONS THAT DID NOT COMPLY WITH QUINQUENNIAL REVIEW PROCEDURES HAVE BEEN REMOVED.

**AAR COMPATIBLE COMMERCIAL AND FOREIGN MILITARY RECEIVERS KC-10, KC-135, AND KC-46 TANKERS:**

AAR compatibility for a non-US receiver listed in this table ONLY confirms that the tanker and receiver are TECHNICALLY capable of pairing up and transferring fuel. See chapter 2, para 2.6.5. for information about the AUTHORITY to conduct AAR.

**KEY:**

GREEN (X) = Quinquennial Review/TCA Current  
BLANK = NOT COMPATIBLE AND/OR REVIEW NOT COMPLETED  
ALL FULL TCAs WILL EXPIRE NEXT QUINQUENNIAL REVIEW: 31 DEC 2020  
see 2.6.14

**CORRECT AS OF: 12 OCT 2018**

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<th>WARP</th>
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<th>WARP</th>
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CORRECT AS OF: 12 OCT 2018  
ALL FULL TCAs WILL EXPIRE NEXT QUINQUENNIAL REVIEW: 31 DEC 2020  
see 2.6.14
AAR COMPATIBLE COMMERCIAL AND FOREIGN MILITARY RECEIVERS KC-10, KC-135, AND KC-46 TANKERS:

AAR compatibility for a non-US receiver listed in this table ONLY confirms that the tanker and receiver are TECHNOICALLY capable of pairing up and transferring fuel. See chapter 2, para 2.6.5. for information about the AUTHORITY to conduct AAR.

**KEY:**

- **GREEN (X) =** Quinquennial Review/TCA Current
- **BLANK = NOT COMPATIBLE AND/OR REVIEW NOT COMPLETED**
- **ALL FULL TCAs WILL EXPIRE NEXT QUINQUENNIAL REVIEW: 31 DEC 2020**

**CORRECT AS OF: 12 OCT 2018**

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AAR COMPATIBLE COMMERCIAL AND FOREIGN MILITARY RECEIVERS KC-10, KC-135, AND KC-46 TANKERS:
AAR compatibility for a non-US receiver listed in this table ONLY confirms that that the tanker and receiver are TECHNICALLY capable of pairing up and transferring fuel. See chapter 2, para 2.6.5. for information about the AUTHORITY to conduct AAR.

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CHAPTER 3

US NAVY/US MARINE CORPS AAR OPERATIONS

3.1 Purpose. This chapter supplements ATP-3.3.4.2 and the Standards Related Document (SRD) by providing receiver aircrews, tanker aircrews, and planning staffs with additional information necessary to plan, prepare for, and safely carry out AAR operations with USN and USMC assets. Detailed information for AAR operations with USAF assets is located in other chapters of the US SRD.

3.2 Scope. ATP-3.3.4.2 has replaced the NATOPS Air-to-Air Refueling Manual (NAVAIR 00-80T-110) as the source document that contains the standard operating procedures and information for U.S. Navy and USMC air-to-air refueling operations. Chapter 3 imparts the same Technical Flight Clearance authority to operate as does any other NATOPS manual (NAVAIRINST 13034.1 Series applies). This chapter and its appendixes contain USN/USMC-specific information that supplements the information contained in ATP-3.3.4.2 and US SRD Chapter 1. The contents and requirements contained in this chapter apply to all USN, USMC, and other multi-national military services personnel and equipment involved in air-to-air refueling operations with USN/USMC aircraft. Aircraft Refueling NATOPS (NAVAIR 00-80T-109), sections 6.2.9 - 6.2.11 provide special procedures/guidance for shipboard defueling, determination, and disposition of fuel other than JP-5.

3.3 Contents. Appendix 3A to this chapter contains general policies, AAR training and qualification requirements, and pre-flight briefing requirements for USN/USMC/other-service aircrew participation in AAR operations.

3.3.1 Appendixes 3B through 3G contain detailed descriptions of USN and USMC KC-130T/J and F/A-18E/F tanker aircraft and equipment. Description of OMEGA Aircraft Tankers, which are certified for AR via Navy Flight Clearances, have been added to appendix 3D.

3.3.2 Appendix 3H contains special information applicable to specific tanker and receiver AAR combinations.

3.3.3 Appendix 3I contains the USN AAR flight clearance matrix for USN, USMC, and other-service tanker and receiver aircraft and the date-time groups (for historical references) of previously issued COMNAVAIRSYSCOM AAR Interim Flight Clearance messages.

3.4 Reporting Conflicts and Recommended Changes. Conflicts between the contents of this document and other publications should be reported and resolved expeditiously. USN and USMC users should report all conflicts and unsafe procedures contained in this document and submit recommended changes to the contents of ATP-3.3.4.2 and the US SRD through the Airworthiness Information Resolution System (AIRS) database on the airworthiness website at https://airworthiness.navair.navy.mil. USN and USMC AAR technical and operational authorities will be notified immediately via email when an issue or recommendation is submitted via AIRS.
3.5 USN/USMC Internal Review of ATP-3.3.4.2 and US Standards Related Document. The information contained within ATP-3.3.4.2 and the US Standards Related Document requires review and approval by the responsible USN/USMC technical and operational authorities. Although neither ATP-3.3.4.2 nor SRD are NATOPS publications, the U.S. Navy NATOPS (Naval Aviation Training and Operating Procedures Standardization) program is an established program that is structured to provide a similar level of fidelity for the contents of such documents. USN/USMC personnel are to utilize the NATOPS review and approval structure established in the NATOPS General Flight and Operating Instructions (OPNAVINST 3710.7) during USN/USMC internal reviews of ATP-3.3.4.2 and the National Standards Document. The ATP 3.3.4.2 and US Standards Related Document is considered a Permanent Flight Clearance Product, like any other NATOPS manual.

3.5.1. USN/USMC Review Relationships. For the purposes of ATP-3.3.4.2 and US Standards Related Documents Chapter 3 reviews, Commanding General Fleet Marine Force Pacific is to assume the responsibilities of and perform the duties assigned in OPNAVINST 3710.7 for the NATOPS AAR Cognizant Command, and the Commanding Officer, Marine Aviation Weapons and Tactics Squadron One (CO MAWTS-1) are to assume the responsibilities of and perform duties assigned for the NATOPS AAR Model Manager. The commands listed below are designated as members of the NATOPS AAR Advisory Group for review of ATP 3.3.4.2 and its SRDs and are to have the responsibilities of and perform the duties assigned in OPNAVINST 3710.7 for NATOPS Advisory Group members. The NATOPS Model Manager is to assign a NATOPS Program Manager in writing and forward copies of the designation to both COMNAVAIRSYSCOM (AIR-4.0P) and COMMARFORPAC (SAFETY). MAWTS-1 (NATOPS AAR Model Manager and NATOPS AAR Program Manager) contact information is the same as for the USN/USMC SRD POC, which may be found in US SRD and the COMNAVAIRSYSCOM (AIR-4.0P) airworthiness website at https://airworthiness.navair.navy.mil.

3.5.2. USN/USMC NATOPS AAR Advisory Group. The advisory group for USN/USMC internal review of ATP-3.3.4.2 and the US Standards Related Document (SRD) (Chapter 3) to consist of the following:

<table>
<thead>
<tr>
<th>Advisory Group Member</th>
<th>Advisory Group Representative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commander, Naval Air Forces</td>
<td>COMNAVAIRFOR (N455)(COG)</td>
</tr>
<tr>
<td>Marine Aviation Weapons and Tactics</td>
<td>MAWTS-1 (MMU/PM)</td>
</tr>
<tr>
<td>Commander, Naval Air Forces Pacific</td>
<td>COMNAVAIRFORPAC (N40) (FA-18EF/EA-18G)</td>
</tr>
<tr>
<td>Commander, Naval Air Systems</td>
<td>COMNAVAIRSYSCOM (AIR-4.0P/PMA-201)</td>
</tr>
<tr>
<td>Commander, Naval Safety Center</td>
<td>COMNAVSAFECEN (Code11)</td>
</tr>
</tbody>
</table>

Note
NATOPS AAR Advisory group representatives are to be designated in writing and copies of their assignment letters are to be forwarded to COMNAVAIRSYSCOM (AIR-4.0P) and COMNAVAIRFOR (N455).
3.5.3. USN/USMC Review Responsibilities and Procedures.
COMNAVAIRSYSCOM (AIR-4.0P) is to forward AIRS recommendations and comments to CO MAWTS-1, who is to conduct a review IAW OPNAVINST 3710.7 review procedures. AIR-4.0P will assist MAWTS-1 to schedule and conduct the review. (This Review was known formerly as the NATOPS Conference).
COMNAVAIRSYSCOM (AIR-4.0P) is to prepare any amendment to or revision of US SRD Chapter 3 post review. When completed, the amendment or revised US SRD Chapter 3 is to be forwarded by COMNAVAIRSYSCOM (AIR-4.0P) to the AAR U.S. SRD POC. Similarly, USN/USMC endorsed changes to ATP-3.3.4.2 and its amendments are to be forwarded by COMNAVAIRSYSCOM (AIR-4.0P) to the AAR U.S. SRD POC or the AAR Working Group for further review and NATO approvals, and for issuing in accordance with established ATP publication review procedures.

3.5.4. Update History. This section contains a brief description for updates to Chapter 3 content starting with the baseline of September 2015, when the latest revision of former ‘Annex ZG’ was released.

**Change 4; Issued July 2018:** Update includes addition of the (-6) AAR Store as authorized on Fleet FA-18 E/F tankers. FMS Customer (Finland) FA-18 C/D aircraft are Recommended to conduct AAR operations with the same tankers as USN FA-18 A-D aircraft and are marked R3 in the Matrix. UK Voyager tankers are authorized to conduct AAR with FA-18A-F and EA-18G receivers, and the matrix is updated to C3 along with update to Note 18. All pages with New or Deleted content will be annotated with “Change 4” and the new (added) content will be marked in RED Bold Italic font. Deleted text or images may not be marked.

**Change 3; Issued May 2018:** Update includes addition of F-35B and F-35C as now authorized to receive fuel from F/A-18E/F tankers (configured with Advanced Drogue, AAR Store P/N 31-301-48310-6 or -7 only). Also, addition of definition/description for “R3” types of matrix entries applicable to USN Foreign Military Sales customers. All pages with New or Deleted content will be annotated with “Change 3” and the new (added) content will be marked in RED Bold Italic font. Deleted text or images may not be marked.

**Change 2; Issued JAN 2018:** Update includes extension of the CAT II expiration date for F/A-18 and EA-18G tanking on UK Voyager Tankers. Inclusion of P-8A in to the Receiver and Matrix sections as a placeholder for completed content in the next update (3H and 3I).

**Change 1; Issued AUG 2017:** Updated to include OMEGA Tanker descriptions and to include the 4th (Newest Omega Tanker, KC-707C). Other changes include addition of MV-22B receiving from Omega tanker. Receivers authorized to tank with ITAF KC-767A (EA-6B, AV-8B and F/EA-18A-G). Expanded UK Voyager tanker clearance to include ‘exercises’ and ‘training’ vice ‘combat only’ allowable receivers for F/A-18 (all models) Updated and re-organized the chapter 3 Matrix. Added AV-8B for full Fleet KC-30A. Other Misc/Admin changes.

**November 2016 update:** Numerous updates for clarity, reduction of duplicate data, addition of MV-22B AAR pilot qualifications information and a major revision of

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1 Change 4
the matrix notations in appendix 3I. These changes resulted from the May 2016 working group for chapter 3 held at MAWTS-1, MCAS Yuma and subsequent engineering review.


As of the September 2015 release, all current Fleet Level Interim Flight Clearance data to include data for AV-8B, F/A-18A-F, EA-18G, EA-6B, and C-130 have been incorporated into this chapter. Any changes after September 2015 will be summarized for each subsequent release of Chapter 3.

3.6 USN/USMC/USCG Distribution of ATP-3.3.4.2 and Standards Related Documents. In order to ensure that only the most current information is used, US Standard Related Document (SRD) will be posted on the NAVAIR Airworthiness Website, https://airworthiness.navair.navy.mil, and also distributed via link through the Joint Air Power Competence Center (JAPCC) website, at https://www.japcc.org/.
APPENDIX 3A

AAR POLICY AND REQUIREMENTS

3A.1 Introduction. This appendix contains AAR policy and training, qualification and currency, and briefing requirements for AAR operations. Developing the precise timing and airmanship skills of both tanker and receiver aircrews during training is the key to later mission accomplishment and operational success. Commanders responsible for the planning and execution of AAR operations should know the capabilities and limitations of the aircraft and aircrews involved and maximize opportunities for improvement during training.

3A.2 Policy. Tanker-receiver training should be conducted so as to ensure that refueling operations can be carried out at altitudes consistent with operational requirements and aircraft and aircrew limitations.

3A.2.1 The minimum altitude for all tanker evolutions (assigned stations, formations, rendezvous, engagements/disengagements, and departures) shall be 500 feet AGL day or night with or without NVG in accordance with service directives.

Note
Air-to-air refueling over densely populated areas should be avoided whenever possible because of the possibility of fuel and/or other material falling from the aircraft during refueling operations.

3A.3 Training. Air-to-air refueling training is to be conducted in accordance with this manual and the provisions of the applicable flight manuals. Before refueling training flights are scheduled, receiver pilots are to be thoroughly briefed on procedures, techniques, communications, and emergency provisions.

Close coordination between tanker and receiver units is necessary to ensure that proper fuel loads are aboard tanker aircraft. Both wet and dry sorties may be scheduled during any refueling period. An adequate number of receivers will be scheduled so as to achieve maximum utilization of the tanker on station. Receiver pilots are to be considered qualified in air-to-air refueling for transoceanic flights when the move from echelon or observation position to astern position is consistently accomplished in 5 minutes or less, and the move from the astern position to contact with fuel flowing is completed in 5 minutes or less. These criteria are in addition to specific numbers of wet or dry engagements that may be required by this or other publications.

Transoceanic flights by mass receiver formations are closely timed. Accordingly, receiver units are to schedule their best qualified pilots for these flights and are not to utilize a transoceanic flight as a means of increasing levels of pilot skill in refueling or to attain other training goals.
3A.4 Qualification and Currency for receiver pilots.

3A.4.1. Fixed Wing (Tactical) The following minimum initial qualification criteria shall be met by all fixed-wing pilots:

3A.4.1.1. Day. A total of six plugs with a minimum of two initial approaches to the basket. An initial approach is defined as commencing from the echelon position on the tanker and making a successful contact and withdrawal from the basket.

3A.4.1.2. Night. Same requirements as day. Day initial qualifications are to be completed before night qualifications are attempted.

3A.4.1.3. After initial qualification, a pilot will be considered current for deployment involving refueling operations if he has completed a minimum of 2 day and 2 night plugs in the last 365 days. Night currency is not required for day-only operations. Applicable aircraft flight manuals may contain additional currency requirements.

3A.4.2 Fixed Wing (Large Aircraft – P-8A) This section is under development for P-8A

3A.4.2.1. Day…. TBD for P-8A.

3A.4.2.2. Night. …TBD for P-8A.

3A.4.2.3. After initial qualification, a pilot will be considered current for deployment involving refueling operations …TBD for P-8A

3A.4.3. Tiltrotor. The following minimum initial qualification criteria shall be met by all tiltrotor pilots:

3A.4.3.1. Day. A total of five plugs with a minimum of two initial approaches to the basket. An initial approach is defined as commencing from the echelon position on the tanker and making a successful contact and withdrawal from the basket.

3A.4.3.2. Night. Same requirements as day. Day initial qualifications are to be completed before night qualifications are attempted.

3A.4.3.3. After initial qualification, a pilot will be considered current for deployment involving refueling operations if he has completed a minimum of 2 night plugs in the last 365 days. Night currency is not required for day-only operations. Applicable tiltrotor flight manuals may contain additional currency requirements.

3A.4.4. Helicopter. The following minimum initial qualification criteria are to be met by all helicopter pilots:

3A.4.4.1 Day. At least one rendezvous and join up with a total of three day plugs.
**3A.4.4.2. Night.** Same requirements as day. Day initial qualifications are to be completed before night qualifications are attempted.

**3A.4.4.3. After initial qualification.** A pilot will be considered current for deployment involving refueling operations if he has completed a minimum of 2 day and 2 night plugs in the last 180 days. Night currency is not required for day-only operations. Applicable helicopter flight manuals may contain additional currency requirements.

**3A.4.4. USAF KC-135/KC-10 Tanker Qualification for Fixed Wing.** The U.S. Navy/U.S. Air Force Interservice Support Agreement (ISA), dated 24 October 1983, prescribes currency requirements for use of USAF tanker assets by Navy/Marine Corps receiver aircraft as follows:

**3A.4.4.1. Case One.** To refuel from a USAF tanker, naval aviators are to be NATOPS, instrument, and AAR qualified for type aircraft.

**3A.4.4.2. Case Two.** To refuel from a USAF tanker during transoceanic missions, a pilot must meet the requirements of Case 1 and have at least 1 plug on a KC-10, a KC-130, or a KC-135 tanker within 90 days. If a transoceanic mission is to be conducted with a KC-135, a KC-135 must be used for qualification. If the mission is to be conducted with a KC-10, qualification on a KC-10, a KC-135, or a KC-130 is required within 90 days and qualification is required on a KC-10 within the last 12 months. If a transoceanic mission includes night refueling, a minimum of one night plug within 90 days on a KC-10, a KC-135, or a KC-130 is required. If a transoceanic mission includes night refueling from a KC-135, a KC-135 must be used for qualification. If the mission includes night refueling from a KC-10, qualification on a KC-135 or a KC-130 is required within 90 days, and qualification on a KC-10 is required within the last 12 months.

**3A.4.4.3. Case Three.** To refuel from a USAF tanker for contingency operations, a pilot must meet the requirements of Case 1 and have at least 2 plugs with a USAF tanker within the last 12 months.

Note
Revisions to the interservice support agreement may alter USAF tanker qualification requirements

**3A.4.4.4. Tiltrotor Currency Requirements.** The U.S. Navy/U.S. Air Force Interservice Support Agreement (ISA), dated 24 October 1983 does not apply to tiltrotor air-to-air refueling operations. All qualification and proficiency requirements for training, transoceanic, and contingency operations shall be conducted IAW Aviation Training and Readiness (T&R) Program Manuel (NAVMC 3500.14) and MV-22B T&R (NAVMC 3500.11.).

**3A.4.4.5. KC-10 Wing Aerial Refueling Pod System (WARPS).** The United States Air Force has developed a WARPS for KC-10 aircraft. In consideration of successful qualification testing with Navy receiver aircraft, all Navy and Marine Corps aircraft currently authorized to refuel from the KC-10 centerline hose reel system are authorized to refuel from the KC-10 WARPS within the AAR limits and restrictions contained in this manual and the applicable NATOPS flight manuals.

3-7 July 2018
3A.5. Briefing Information.

3A.5.1. Fixed Wing. See NATO ATP-3.3.4.2 Air-to-Air Refueling Chapter 2.

3A.5.2. Rotary Wing. See NATO ATP-3.3.4.2 Air-to-Air Refueling Chapter 3.

3A.5.3. Tiltrotor. See NATO ATP-3.3.4.2 Air-to-Air Refueling Chapter 4.
APPENDIX 3B
USN/USMC AAR OPERATIONS – KC-130 TANKER

3B.1. **Introduction.** The KC-130 is a multi-role, multi-mission tactical tanker/transport that provides the support required by Marine Air Ground Task Forces. This versatile asset provides air-to-air refueling to fixed wing, tiltrotor, and helicopter receivers, as well as aviation-delivered ground refueling when required. Additional tasks performed are air delivery of troops and cargo, combat assault transport, battlefield illumination, and offensive air support.

3B.2. **Receiver Types Certified.** Receiver clearance details are listed in Appendix 3I, Flight Clearance Matrix.

3B.3. **AAR Equipment.**

3B.3.1. **AR Pods.** The KC-130 has two drogue-equipped aerial refueling stations, one mounted on each wing outboard of the engine.

3B.3.1.1. **Description.** Each refueling station consists of a Sargent Fletcher 48-000 refueling pod, 93 ft (28.5 m) of hose, either a MA-3, or MA-3-1 reception coupling and a 30 in (0.76 m) diameter high-speed fixed wing or 47 in (1.19 m) diameter low-speed helicopter paradrogue. Helicopters may not refuel from a high-speed drogue. The KC-130J has fuel pumps in the AR pods to increase AR fuel flow to compatible receivers.

3B.3.1.2. **Basic Operation.** Fuel begins to flow after the receiver aircraft has pushed the refueling hose in approximately 5 ft (1.5 m) to the refueling range, and continues, provided the hose is maintained in the refueling range, between 20 and 80 ft (6-24 m) of hose extension. Hydraulic pressure provides 90 percent of the force required to rewind the hose, reduce hose slack during refueling, and reduce the potential development of a sine wave/hose whip. The engagement force required to latch the nozzle into the reception coupling varies depending on coupling type:

3B.3.1.2.1. **The MA-3** coupling requires a maximum 155 lb engagement force. The MA-3 coupling is flown on the KC-130, F/A-18E/F, and the KC-135 BDA.

3B.3.1.2.2. **The MA-3-1** coupling requires a maximum 90 lb engagement force. The MA-3-1 coupling is only flown on the USN and USMC KC-130.
WARNING

The area of extreme turbulence directly behind and slightly to the right of the tanker should be avoided. Blade stall and uncontrolled settling may be encountered if this area is entered.

Note

During the refueling, the receiver should maintain a position on the hose so that the 50-foot marker is just at the pod tunnel entrance.

3B.3.1.3. Incomplete Coupling Engagement. If the drogue is engaged with insufficient force to cause the probe nozzle to completely latch into the reception coupling and the hose/drogue is pushed forward into the refueling range, then excessive fuel spray from the coupling/nozzle interface may occur.

3B.3.1.3.1. Auto Acceleration. It is possible that receiver aircraft whose configuration is such that engine air intakes are directly behind the probe may encounter auto-acceleration in cases where coupling is improperly completed. If fuel escapes between the reception coupling and the probe and enters the receiver engine air intakes, a dangerous condition may result.

3B.3.1.4. Hose Reel Response. The tanker hose response should be reset in scenarios where a change in tanker/receiver airspeed occurs, after long periods of hose trail (e.g. in between receiver packages) or where the hose has crept just past the white preset trail mark. When these conditions occur as observed by the tanker observer or as reported by the receiver pilots, the receiver will be instructed to disconnect and to remain clear of the hose in question. The hose shall be cycled, the response set, the TANKER READY symbol/light will illuminate, and when cleared, the receiver may move to the contact position (reengage the hose). If hose response is subsequently improper, the receiver should be directed to the other wing, and the hose reel in question shall be secured until proper maintenance can be performed (except in an emergency).

WARNING

In-flight troubleshooting may not resolve the problem and shall not be used as an assurance that the hose reel is functioning properly. Engaging this hose reel could cause a sine wave (hose whip) response resulting in structural failure of the refueling probe, the hose, or both.
3.B.3.1.4.1 *It is prohibited* for receiver aircraft to conduct air-to-air refueling when the red and white hose extreme trail marking is visible (except in an emergency).

**WARNING**

Conducting air-to-air refueling operations with refueling hose at or near extreme trail can cause a sine wave (hose whip) response resulting in structural failure of the refueling probe, the hose, or both.

3.B.3.1.5. Emergency Refueling - Dead or Degraded Hose Response. Refueling may be conducted on a hose reel that has degraded or lost hose reel response (dead hose) only in an emergency. Proper technique must be employed and extreme care exercised. Under these conditions, minimum possible closure rate is necessary to avoid bending or breaking the receiver probe. Refueling from a dead or degraded hose reel is only an emergency procedure and the potential exists to cause a sine wave (hose whip) response resulting in structural failure of the refueling probe, the hose, or both. After contact with a dead hose, receiver position must be precisely maintained to minimize hose slack and resultant whip. Dead hose refueling may be encountered if a tanker experiences partial electrical or utility hydraulic system failure and may or may not result in a RED tanker status symbol light. Complete utility hydraulic system failure will always be indicated by illumination of the HYDRAULIC PRESSURE OFF symbol.

3.B.3.1.5.1 Breakaway. Drogue engagement with tanker’s bottom strobe illuminated is prohibited. This is the breakaway signal.

**WARNING**

- Closure rates above 2 kts on a known dead or poorly responding hose can lead to large sine wave formation. Keeping closure rate at contact to the minimum 1 to 2 kt will minimize but not necessarily eliminate adverse hose reel response. Receiver aircraft must be aware of potential for sine wave formation and be prepared to react by immediately disengaging.

- Improper disengagement position or aircraft misalignment at disengagement may produce a binding force between the probe and reception coupling, greatly increasing required disengagement force, and possibly resulting in structural failure of the probe or refueling hose.
3B.3.1.6. Disengagement Force The disengagement force for all KC-130 reception couplings is set at 420 +/- 30 lb when coupling is unpressurized. The disengagement force will increase to 640 +/- 55 lb for a wet coupling at 55 psig.

3B.3.1.7. Hose. The KC-130 aerial refueling hose is 93 ft (28.4 m) in length, of which 85 ft (26 m) of hose trails from the hose reel tunnel. The beginning and end of the HAAR refueling range (20 ft total) is indicated by 5 ft (1.52 m) white bands (2). The remainder of the hose is marked by 1 ft (0.30 m) white bands every 10 ft (3.05 m). The extreme trail (Emergency) band is at the forward end of the hose, and is 15 inches in length composed of 3 inch red (3) and white (2) stripes. The figure below indicates hose band locations. The hose contains a removable end fitting which allows for shortening by field maintainers.

3B.3.1.7. Drogues.

3B.3.1.7.1. Low Speed – KC-130.
3B.3.1.7.2. High Speed – KC-130.

3B.3.1.8. Lighting - AR Pods. Refueling pod illumination lights are located on the outboard leading edge of the horizontal stabilizer. The KC-130 has two modes of AR pod status lights, overt and covert.

3B.3.1.8.1. Description. Red, green, and amber lights are located on the trailing edge of each AR pod for use in the overt lighting scheme. For covert lighting, a symbolic lighting scheme consisting of small LED’s surround these red, green, and amber lights.

3B.3.1.8.2. Pod Status Lights. The AR pod status lights mean:

<table>
<thead>
<tr>
<th>Receiver Position</th>
<th>Overt Lights</th>
<th>Covert Lights</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Contact</td>
<td>Steady Red</td>
<td>Steady Circle with a Y</td>
<td>Pod not ready, do not make contact (if refueling is absolutely required, contact using emergency procedures shall be coordinated)</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Steady Y (see Picture below)</td>
<td>Pod system ready for contact</td>
</tr>
<tr>
<td>In Contact</td>
<td>Steady Green</td>
<td>Steady Circle</td>
<td>Fuel flow greater than 50 gpm.</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Steady Y</td>
<td>Past the inner refueling limit.</td>
</tr>
<tr>
<td>In Contact Anytime</td>
<td>Steady Red</td>
<td>Steady Circle with Y</td>
<td>Low hydraulic pressure, no hose response. Disconnect, pod malfunction.</td>
</tr>
</tbody>
</table>
3B.3.1.8.3. **Normal Operations.** Before a receiver is cleared for contact, the bottom strobe is turned off to indicate readiness of the tanker’s equipment and crew to conduct AAR.

3B.3.1.8.4. **Breakaway.** Aside from verbal communication, the tanker’s bottom strobe being switched on is the signal for a receiver to execute a breakaway. On a KC-130J, in addition to the bottom strobe, the pod will display a flashing red light (overt) or a flashing circle combined with a flashing Y (covert).

3B.3.1.8.5. **EMCON.** AAR during EMCON constraint requires additional light signals from the tanker; these are provided by hand held ALDIS lamps from observers in the paratroop door windows located at the rear of the fuselage on both sides of the aircraft.

![Figure 3B-1: KC130 Pod Status Lights](image)
Figure 3B-2 – KC130 T Exterior Light Locations

NOTE: KC-130 F/R aircraft do not have ventral/dorsal navigation lights.
Figure 3B-3. – KC-130J Exterior Light Locations

1. NAVIGATION LIGHTS
2. FORMATION LIGHTS
3. ANTICOLLISION (STROBE) LIGHTS
4. TAXI LIGHTS
5. LANDING LIGHTS
6. REFUELING POD ILLUMINATION LIGHT
7. POD STATUS LIGHTS
3B.4. Refueling Heights and Speeds.

3B.4.1. AAR Altitude Range. The minimum altitude for all tanker evolutions (assigned stations, formations, rendezvous, engagements/disengagements, and departures) shall be 500 feet AGL.

1) Maximum Hose Extension/Retraction Speed. The maximum hose extension/extraction speed for the high-speed drogue is 250 KIAS and the low-speed drogue is 120 KIAS.

2) Speed Range – High-Speed Drogue. The speed range for the high-speed drogue is 185 to 250 KIAS.

3) Speed Range – Low-Speed Drogue. The speed range for the low-speed drogue is 105 to 120 KIAS (acceleration to 130 KIAS is allowed after engagement).

3B.5. Maximum Transferable Fuel. Total fuel loads are normally up to 58,000 lb (26,350 kg), if configured with a fuselage tank, fuel load may be up to 84,000 lb (38,050 kg). Transferable fuel is dependent on sortie duration; around 28,000 lb (12,680 kg) is available for transfer during a 4 hr flight, assuming a fuel burn rate of 6,000 lb/hr (2,720 kg/hr).

3B.6. Fuel Transfer Rate. The rate of fuel transfer during AAR is governed by several factors including transfer rate capability of the receiver aircraft, tanker fuel system configuration and mode of tanker refueling system operations.

3B.6.1. With Removable Fuselage Tank. When the tanker has the 3,600 gallon fuselage tank installed, and if both of the AR pumps are used, fuel can be transferred at an approximate rate of 2,040 lb/min or 300 gpm (925 kg/min) per hose. One AR pump will supply a single hose approximately 2,040 lb/min or 300 gpm (925 kg/min).

3B.6.2. Without Removable Fuselage Tanks. With no fuselage tank installed, the maximum transfer capability is 1020 lb/min or 150 gpm (462 kg/min) for a single receiver engaged. With no fuselage tank and two receivers engaged, the transfer rate will be split between the receivers for 510 lb/min or 75 gpm (231 kg/min).

3B.6.3. Lower Fuel Pressure. A lower pressure can be selected on request. Pressures in the range of 28-40 psi up to maximum tanker capability may be planned for or requested based on receiver limitations.

3B.6.4. KC-130J. The KC-130J has fuel pumps fitted in the AR pods to improve performance when the fuselage tank is not installed. These pumps are selectable dependent upon receiver capabilities. Fuel transfer rates with these pod pumps are 2,040 lb/min or 300 gpm (925 kg/min) for either single or dual hose operations. When conducting AAR with international aircraft, KC-130Js are limited to transfer pumps only (AR pumps and pod pumps prohibited).
3B.7. Regulated Fuel Pressure. Fuel is delivered to the receiver at the regulated pressure of 50 ±5 psi (3.5 bars) at the drogue.

3B.8. Fuel Types Approved for AAR. JP-5 (F44), JP-8 (F34), F-24 (F24), Jet A1 (F35) and Jet A (no NATO Code). Only JP-5/F-44 shall be used to refuel an aircraft scheduled to immediately return to a USN ship.

Note
Fuel types should be pre-coordinated prior to conducting AAR.

3B.9 Specific KC-130T/J AAR with F-35B/C. Tanker aircrew shall be briefed by receiver aircrew on applicable altitude and airspeed limitations prior to conducting AAR.

3B.10 Specific KC-130 AAR with International Receiver aircraft T/M/S Configuration, Limits/Procedures/W/C/N:

3B.10.1 Fixed Wing
1) AAR operations are limited to transfer pumps only (AR pumps and pod pumps prohibited).
2) AAR operations are only valid for aircraft configurations and dimensions IAW STANAG 3447 dtd 13 May 2008 and that are compatible with USN and USMC MA-3 and MA-3-1 couplings. Aircraft that are modified and/or do not meet these international standards are prohibited.
3) Receiver aircraft with Quinson IFR nozzles are not authorized. Listed receiver aircraft with p/n 60318-2B Eaton or J.C. Carter manufactured MA-2 nozzles are authorized.
4) Authorized to provide up to a maximum fuel load (top offs authorized) to the following aircraft:

- Germany: Tornado IDS/ECR
- United Kingdom: Tornado GR4
- Italy: Tornado IDS/ECR
- Greece: Mirage 2000
- Morocco: F-5E/F
- France: Mirage 2000, C-160
- Spain: Eurofighter Typhoon 2000, EF-18A/B
- Kuwait F/A-18C/D

CAUTION
AAR operations with IFR nozzles other than Eaton or J.C. Carter manufactured MA-2 nozzles, P/N 60318-2B may result in damage to receiver and/or tanker aircraft.
3.10.2 Rotary Wing, UH-60J as follows:

1) Transfer pumps only.
2) Pod pumps prohibited.
3) Fuselage tank AR pumps prohibited.
4) Maximum of eight (8) fuel transfer pumps, delivering a maximum pressure of approximately 35 psig.
5) Receiver aircraft shall be compatible with USN and USMC MA-3 or MA-3-1 couplings.

WARNING

AAR with USMC KC-130J tankers using the AR pod pumps may result in excessive surge pressures which may cause failure of receiver aircraft refueling system components, endangering the aircraft and/or crew.

3B.11. Rendezvous Aids. The KC-130 has the following radar, navigation, and RV aids:

1) FM, VHF, UHF, HF, and SATCOM.
2) VOR, TACAN, ADF, GPS, and INS.
3) UHF-DF, A/A TACAN (DME and bearing), radar and TCAS. The ability of the A/A TACAN to provide azimuth is dependent on tanker and receiver equipment compatibility.

3B.12. Echelon Fixed Wing (FW) AAR Formation.

3B.12.1. General. USMC KC-130s typically employ multiple tankers in the tanker trail formation, as outlined in ATP 3.3.4.2 (main volume) Chapter 2 for fixed wing, Chapter 3, Section III for helicopters, and Chapter 4, Section III for tilt rotor receivers. However, the Echelon AAR formation can also be used for fixed wing, tilt-rotor or helicopter AAR. Most often it is used for force extension tanking in which the tanker formation is not required to orbit with receivers engaged. The formation itself is a comfortable right echelon, stepped down, with separation of 250 feet vertically, 500 feet laterally wing-to-wing, and 500 feet nose-to-tail (see Figure 3.2.). This formation allows room for receivers to maneuver in and out of the echelon, astern, and contact while keeping the tanker force in the smallest piece of airspace. The Echelon AAR formation is not as flexible a formation for static refueling because of the wingmen’s limited ability to maintain position in the turn and required power (and airspeed) to regain proper formation position out of the turn. Use of the Echelon AAR formation allows the RAC to more closely observe the receivers and tankers as the AAR evolution progresses. For a 4-ship tanker formation, the RAC is 2,250 feet away (750 feet per tanker) in the echelon formation as opposed to 9,120 feet away (3,040 feet per tanker) in the step-down formation. The Echelon AAR refueling formation also allows right-hand tanker observers to monitor the tanker formation, thus adding to the situational awareness of each tanker crew.
3B.12.2. Rendezvous. The Echelon AAR Formation facilitates a more expeditious join-up with multiple receivers and affords the RAC (in the trail tanker) an optimum position within the formation from which to view and control the evolution. The receiver flow will be High-Right to Low-Left joining in the right echelon position of the trail tanker. When receivers are approaching the right echelon, they should be directed forward without delay to the astern position of their assigned tanker. The intent of the Echelon AAR formation is to allow the RAC to maneuver the receivers to their assigned hoses in an expeditious manner and avoid holding in the echelon position of the trail tanker. For fixed wing receivers, it should be expected that they will arrive from a higher altitude than the tanker force and depart high as well in order to maximize their fuel economy. Tiltrotor and helicopters will most likely depart lower than the tankers.

3B.12.3. Join-up. The Echelon AAR formation minimizes the distance required for a receiver to move from echelon on the trail tanker to astern on their assigned tanker. It also minimizes distances required to move should a receiver be required to reposition to another tanker other than their pre-assigned tanker. Ensure receivers are briefed to move from right echelon up the left (inside) of the tanker formation to their assigned hose. This will avoid receivers crossing in front of the tanker formation, potentially creating wake turbulence through which the tankers (and their receivers) must fly.

3B.12.4. Formation Integrity. In the event that large turns are required by the tanker formation, wingmen may be required to drop into trail formation in order to maintain nose to tail separation. Moving to trail will prevent tankers from having to make excessive speed increases after the hoses have been trailed. Hose response is set at a specific speed and large increases or decreases can cause unacceptable response performance. While in the Echelon AAR formation in a turn with receivers in tow, it is possible that if the receiver disconnects, they may drop low enough to have their wake turbulence disrupt the following tanker’s airspace. When this occurs, large control inputs are required by the tanker in order to maintain its formation position and a steady platform. When monitoring TACAN of the lead tanker, the following are the approximate DME readings for proper Echelon AAR formation position: Dash-2 (.2 nm), Dash-3 (.3 nm), Dash-4 (.4 nm), and Dash-5 (.5 nm). Inadvertent Weather Penetration procedures shall be thoroughly briefed (see Figure 3B-5.).


- Hose Reel Maintenance Manual NAVAIR 03-100C-6.
- KC-130J NATOPS Flight Manual NAVAIR 01-75GAJ-1.
- KC-130T NATOPS Flight Manual NAVAIR 01-75GAH-1.
Figure 3B–4. Echelon FWAAR Formation
Figure 3B-5. Echelon FWAAR Formation Inadvertent Entry into Weather
3C.1 KC130T Tanker Dimensions. The KC-130T is 97 ft (29 m) long, with a wingspan of 132 ft (40 m); the aircraft height is 38 ft (12 m) and the stabilizer span is 52 ft (16 m).

**Figure 3C-1. KC130T Configuration**
3C.2. **KC-130J Tanker Dimensions.** The KC-130J is 97 ft (29 m) long, with a wingspan of 132 ft (40 m); the aircraft height is 38 ft (12 m) and the stabilizer span is 52 ft (16 m).

*Figure 3C-2. KC-130J Configuration*
APPENDIX 3D
USN/USMC AAR OPERATIONS

OMEGA TANKER

APPENDIX 3 E– RESERVED FOR FUTURE USE

The US NAVY is the AAR Operations Certification Agency for OMEGA owned Tankers. Documentation of Airworthy Certification for OMEGA Tankers to conduct AAR is found in NAVY issued Interim Flight Clearances.

Tanker Aircraft Type.

3D.1 *Omega KC-707A* (formerly KC-707/TT) (B707-368)
Formerly referred to as KC-707/TT.

Applicable FAA Registration Numbers: N707MQ.

Four wing-mounted Pratt & Whitney JT3D-3B engines power the aircraft. Maximum takeoff weight is 333,600 lb. with a maximum fuel load of 159,829 lb. Maximum landing weight is 247,000 lb. Communications equipment includes UHF, HF, VHF radios and satellite phone. The aircraft is also equipped with a Traffic Collision Avoidance System (TCAS) to assist with aircraft separation during air to air refueling (AAR) operations. The tanker is equipped with two AAR hose reel systems located in the lower aft fuselage. This redundant hose-drogue AAR system is internally mounted on the aircraft centerline within a pressurized compartment.

AAR Equipment.

The AAR system is comprised of two independent Sargent Fletcher FR300T refueling systems. Each system includes a 93-ft long hose. In full trail position, the hose extends about 80 ft. from the point at which it exits the aircraft to the drogue tip. The white refueling hoses have black markings that designate the refueling range and provide hose movement cues. The two hose reels are installed side-by-side and cannot be used simultaneously. The reels are hydraulically powered and operate independently, allowing for a truly redundant capability. Two J.C. Carter fuel transfer pumps per hose reel system provide fuel flow of up to 400 gallons per minute. Two in-line regulators provide fuel pressure regulation and surge suppression within the MA-4 couplings (50 ± 5 psi) from 0 to maximum fuel flow. The reels are controlled by a reel operator through a cockpit-mounted control panel that provides video coverage of the AAR area aft of the Omega 707 tanker.

FOR Authorized Receivers: SEE THE MATRIX APPENDIX (3I)
3D.2 Omega KC-707B (B707-338C)
Applicable FAA Registration Numbers: N624RH.

Four wing-mounted Pratt & Whitney JT3D-3B engines power the aircraft. Maximum takeoff weight is 333,600 lb. with a maximum fuel load of 159,829 lb. Maximum landing weight is 247,000 lb. Communications equipment includes UHF, HF, VHF radios and satellite phone and TCAS. The tankers are equipped with two under wing mounted refueling pods.

AAR Equipment.
The Omega KC-707B tanker has 2 wing mounted Flight Refueling MK32B-501 AAR pods installed approximately 10 ft. from each wing tip. Each AAR pod has a 49.5 ft. hose and an MA-3 coupling. To achieve fuel flow after making contact, the hose must be pushed in 5 ft. and maintained within the refueling range.

FOR AUTHORIZED RECEIVERS: SEE THE MATRIX APPENDIX (3I)

3D.3 Omega KC-707C. (B707-338C)
Applicable FAA Registration Numbers: N629RH

Four wing-mounted Pratt & Whitney JT3D-3B engines power the aircraft. Maximum takeoff weight is 333,600 lb. with a maximum fuel load of 159,829 lb. Maximum landing weight is 247,000 lb. Communications equipment includes UHF, HF, VHF radios and satellite phone. The aircraft is also equipped with a Traffic Collision Avoidance System (TCAS) to assist with aircraft separation during air to air refueling (AAR) operations. The tanker is equipped with two independent AAR hose reel systems located in the lower aft fuselage. The redundant centerline hose-drogue AAR system is internally mounted on the centerline of the aircraft within a pressurized compartment.

AAR Equipment.
The centerline AAR system is comprised of two independent Sargent Fletcher FR300(T) refueling systems. Each system includes a 93-ft long hose. In full trail position, the hose extends approximately 80 ft. from the point at which it exits the aircraft to the drogue tip. The white refueling hoses have black markings that designate the refueling range and provide hose movement cues. The two hose reels are installed side-by-side and cannot be used simultaneously. The reels are hydraulically powered and operate independently, allowing for a truly redundant capability. Two J.C. Carter fuel transfer pumps per hose reel system provide fuel flow of up to 400 gallons per minute. Two in-line regulators provide fuel pressure regulation and surge suppression within the MA-4 couplings (50 ± 5 psi) from 0 to maximum fuel flow. The reels are controlled by a reel operator through a cockpit-mounted control panel that provides video coverage of the AAR area aft of the Omega 707 tanker. The long hoses of the dual centerline system are capable of being extended one at a time for refueling a single receiver. The second centerline hose reel is installed to provide maximum redundancy.

FOR AUTHORIZED RECEIVERS: SEE THE MATRIX APPENDIX (3I)
3D.4 Omega KDC-10/MPTT.

Tanker Information
Applicable FAA Registration Numbers: N974VV

Three Pratt & Whitney JT9D-59A engines power the Omega KDC-10 aircraft. Maximum takeoff weight is 556,000 lb. with a maximum fuel load of 243,000 lb. Maximum landing weight is 403,000 lb. Communications equipment includes UHF, HF, VHF radios and satellite phone. The aircraft is also equipped with a Traffic Collision Avoidance System (TCAS) for collision avoidance during rendezvous (RV) procedures. The tanker is equipped with a two-point air to air refueling system, one located under each wing. This aircraft is fully RVSM compliant.

AAR Equipment.

The AAR system is comprised of two independent Cobham 909 wing refueling systems. Each system includes a 79-ft long hose.

FOR AUTHORIZED RECEIVERS: SEE THE MATRIX APPENDIX (3I)

3D.5 For complete descriptions, hose markings and dimensional/ lighting data of the OMEGA Tankers, refer to the OMEGA SRD.
3F.1. Introduction. The F/A-18E/F Super Hornet can be converted to the tanker role by fitting an externally carried AAR Store to its centerline station.

3F.2. Receiver Types Certified. Details of receiver clearances are listed in Appendix 3I, Flight Clearance Matrix.

3F.3. AAR Equipment.

3F.3.1. AAR Store.

3F.3.1.1. Description. The A/A42R-1 refueling store, P/N 31-301-48310-5/6, is fitted on the centerline station only. The hose is 50 ft (15 m) long, terminating in a MA-3 coupling and 27 in (0.67 m) diameter drogue.

3F.3.1.2. Basic Operation. Fuel flows when the hose is pushed in 5-6 ft (2 m); flow continues provided the hose is maintained in the refueling range, between 23-38 ft (7-11.5 m) of hose extension. Hydraulic pressure provides 90 percent of the force required to rewind the hose, reduce hose slack during refueling, and reduce the potential development of a sine wave/hose whip. The black hoses are marked with a 1 ft (0.3 m) white band each 10 ft (3 m) and a 3 in (0.08 m) white marking every 2 ft (0.6 m). The engagement force required to latch the nozzle into the reception coupling is a maximum 155 lb force. The disengagement force for all F/A-18E/F reception couplings is set at 320 lb. All above force levels are based on 0 to 10 lb per sq inch gauge (psig) static fuel pressure in the coupling.

1) Hose. The F/A-18E/F hose is 50 ft (15 m) in length, of which 43 ft (13 m) of hose trails from the hose reel tunnel. The hose contains swaged end-fittings.
2) Drogue

3) Basic Operation. The hose must be pushed in about 5-6 ft (2 m) for fuel to flow.

3F.4. Lighting.

3F.4.1. AAR Pod.

3F.4.1.1. Description. The AAR pod has green, amber, and red status lights. Additionally, there are two white lights that illuminate the inside of the ARS tail cone.

Pod Status Lights. The AAR pod status lights mean:

<table>
<thead>
<tr>
<th>Receiver Position</th>
<th>Lights</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Contact</td>
<td>Steady Red</td>
<td>Pod not ready, do not make contact</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Ready for contact</td>
</tr>
</tbody>
</table>
3F.4.2. **Aircraft Lighting.** On the aircraft there are two red anti-collision strobe lights, one on each outboard vertical tail, which can be set to a specific strobe pattern to identify the F/A-18 as a tanker aircraft. Additionally, the aircraft has seven position lights (three green on the starboard side, three red on the port side, and one white on the tail), and ten formation strip lights (five on each side).

3F.5. **Refueling Heights and Speeds.** AAR height band is 500 to 35,000 ft; speed range is 180 to 300 KIAS/0.8 IMN max.

3F.6. **Maximum Transferable Fuel.** Maximum transferable fuel is 24,500 lb (11,113 kg). This is based on a 5-wet configuration, i.e. a/c is carrying four 480 gallon external fuel tanks and the ARS.

3F.7. **Fuel Transfer Rate.** The nominal fuel transfer rate is 1,500 lb/min (680 kg/min) or 220 gpm.

3F.8. **Regulated Fuel Pressure.** Fuel is delivered to the receiver at a regulated fuel pressure between 35-60 psi (2.5-3.8 bars).

3F.9. **Fuel Types Approved for AAR.** JP-5 (F44), JP-8 (F-34), F-24 (F24), Jet A1 (F35) and Jet A (no NATO Code). Only JP-5/F-44 shall be used to refuel an aircraft scheduled to immediately return to a USN ship.

**Note**

Fuel types should be pre-coordinated prior to conducting AAR.

3F.10. **Rendezvous Aids.** The F/A-18E/F has the following radio, navigation, and RV aids.

1) UHF/VHF, LINK 16, and HF radios.

2) TACAN, radar, and INS.

3) A/A TACAN (DME only).
3F.11. Source Documents.

- A/A42R-1 Buddy Store Maintenance Manual NAVAIR 01-10JA-34.

3G.1. **Tanker Dimensions.** The F/A-18E/F is approximately 60 ft (18.3 m) long, has a wingspan (with missiles) of 44 ft 11 in (13.7 m), and a height (top of fins) of 16 ft (4.9 m).

**Figure 3G-1. F/A-18E/ F Configuration**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Span (Wing Spread) Without Missiles</strong></td>
<td>42 Feet 10 Inches</td>
</tr>
<tr>
<td><strong>Span (Wing Spread) With Missiles</strong></td>
<td>44 Feet 11 Inches</td>
</tr>
<tr>
<td><strong>Span (Wings Folded)</strong></td>
<td>32 Feet 8 Inches</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td>60 Feet 2 Inches</td>
</tr>
<tr>
<td><strong>Height (Top of Fins)</strong></td>
<td>16 Feet 0 Inches</td>
</tr>
<tr>
<td><strong>Height (Top of Closed Canopy)</strong></td>
<td>10 Feet 8 Inches</td>
</tr>
</tbody>
</table>
APPENDIX 3H

USN/USMC AAR OPERATIONS RECIIVER SPECIAL INFORMATION

3H.1. Purpose. This appendix contains important information pertinent to specific tanker-receiver combinations.

3H.2. EA-6B Receiver Aircraft with:

3H.2.2. KC-135 Tankers.

3H.2.2.1. Lateral trim authority with MPRS. At all airspeeds and altitudes tested, the EA-6B lateral trim authority was insufficient to allow lateral stick forces to be completely trimmed out. Maintaining lateral position within 2 feet of the drogue trail position was moderately difficult and required up to approximately 10 lb of constant lateral stick force in the direction away from the tanker fuselage.

3H.2.2.2. Refueling speeds and altitudes. Optimum refueling speeds for MPRS is 250 to 270 KIAS at 25,000 feet MSL.

3H.2.3. KC-135 BDA Refueling (Including KC-135R Turkey)

a) Airspeed of 230 to 275 KIAS.

b) Altitude of 5,000 ft AGL to 30,000 ft MSL.

c) AAR engagement during moderate or greater turbulence is prohibited.

d) Night aided AAR operations are prohibited.

Warnings, Cautions and Notes: Specific to BDA

WARNING

Off-center disconnects can result in damage to the refueling probe or nozzle because of the excessive side loads generated by the KC-135 boom to drogue adapter.

CAUTION

Excessive closure rates (greater than 2 knots) may result in damage to the aircraft or the refueling drogue.
Note

- The KC-135 hose has a fixed length of 9 feet attached by a swiveling coupling to the end of a telescoping boom. The hose terminates in a hard, non-collapsible drogue and has no reel retraction capability.

- Air-to-air refueling from the KC-135 BDA is fundamentally different from the standard navy hose-drogue systems. After assuming a standard ready position, add power to create a closure rate of 2 knots or less. Due to the short length of hose and the weight of the drogue, the aircraft-to-drogue air stream interaction is minimized.

- For BDA tanking, once contact has been made, the drogue must be pushed in approximately 4 feet and held in that position within 2 feet fore and aft for fuel to flow (the hose forms a u-shape when in the correct position). If the EA-6B is positioned too far aft with the hose near the trail position, slight aft or radial movement results in disconnect. The potentially more hazardous situation occurs when the drogue is pushed too far forward, such that the hose could be looped around the drogue on the probe. When disengaging, align the drogue with the boom and back straight away with reference to the boom.

3H.2.4 KC-135R and C-135FR Tankers (French) with BDA or MPRS pods. This section describes AAR with French tankers using BDA or MPRS Pods installed. The following limits, Warnings, Cautions and Notes apply when refueling:

Note
External lights are not NVIS friendly. No covert lighting mode is available. This applies to both tanker variants.

3H.2.4.1 French KC-135R and C-135FR w/BDA.

a) Airspeed of 230 to 275 KIAS.

b) Altitude of 5,000 ft AGL to 30,000 ft MSL.

c) AAR engagement during moderate or greater turbulence is prohibited.

d) Night aided AAR operations are prohibited.
Warnings, Cautions and Notes: Specific to BDA

**WARNING**

Off-center disconnects can result in damage to the refueling probe or nozzle because of the excessive sideloads generated by the KC-135R and C-135FR boom to drogue adapter.

**CAUTION**

Excessive closure rates (greater than 2 knots) may result in damage to the aircraft or the refueling drogue.

**Note**

- The KC-135R and C-135FR hose has a fixed length of 9 feet attached by a swiveling coupling to the end of a telescoping boom. The hose terminates in a hard, non-collapsible drogue and has no reel retraction capability.

- Air-to-air refueling from the KC-135R and C-135FR BDA is fundamentally different from the standard Navy hose-drogue systems. After assuming a standard ready position, add power to create a closure rate of 2 knots or less. Due to the short length of hose and the weight of the drogue, the aircraft-to-drogue air stream interaction is minimized.

- For BDA tanking, once contact has been made, the drogue must be pushed in approximately 4 feet and held in that position within 2 feet fore and aft for fuel to flow (the hose forms a u-shape when in the correct position). If the EA-6B is positioned too far aft with the hose near the trail position, slight aft or radial movement results in disconnect. The potentially more hazardous situation occurs when the drogue is pushed too far forward, such that the hose could be looped around the drogue on the probe. When disengaging, align the drogue with the boom and back straight away with reference to the boom.
3H.2.4.2 French C-135FR w/MPRS Pods.

a) Airspeed of 230 to 270 KIAS.

b) Altitude of 5,000 ft AGL to 30,000 ft MSL.

c) AAR engagement during moderate or greater turbulence is prohibited.

d) Night aided AAR operations are prohibited.

Cautions and Notes: specific to MPRS:

While attempting to tank from the MPRS pods on the C-135FR, flying within the boundaries defined by the formation strip lights located on the underwing just inboard of the MPRS pods may result in control difficulties.

Note

- Optimum refueling conditions for MPRS are 250 to 270 KIAS at 25,000 ft MSL.

- During testing on USAF KC-135 tanker aircraft using wing pods, lateral trim authority was insufficient to allow the lateral stick forces to be completely trimmed out. Maintaining lateral position within 2 feet of the drogue trail position was moderately difficult requiring up to 10 lbs of constant lateral stick force in direction away from the tanker fuselage.

3H.2.5 OMEGA KC-707B (B707-338C) (with MK32B-501 series wing mounted aerial refueling pods) The B707-338C tanker is equipped with two wing AR pods. The following limits apply when refueling from the Omega B707-338C:

a) Airspeed of 250 to 270 KIAS.

b) Altitude of 5,000 ft AGL to 35,000 ft MSL.

c) AAR engagement during moderate or greater turbulence is prohibited.
d) Do not ascend above the chord line of the refueling pod at any time.

**Cautions and Notes** Operators should be thoroughly familiar with the following Cautions and Notes:

- Extreme aerodynamic forces exist behind the Boeing 707 tanker aircraft while conducting AAR operations. Full lateral trim away from the tanker may be required while refueling and may not zero out lateral stick forces required to maintain position.

- At night or without a visible horizon, the Boeing 707 wing dihedral can present the visual illusion of constantly turning.

**Note**

- From the echelon position, maneuver to stabilized position, one hose length aft and 10 to 15 ft below the basket, before moving to the astern position (full trail hose length is 49.5 ft vice 74 ft for the KC-135 / KC-10).

- Use minimum closure/contact rate. Final corrections may be difficult due to tanker-receiver aerodynamic interaction.

- The Omega KC-707B (B707-338C) tanker was formerly a RAAF B707-338C tanker. The AAR equipment has been overhauled, but not modified.

**3H.2.6 ITAF KC-767A** Aerial Refueling (AR) operations with Italian Air Force KC-767A Tanker configured with GE model S779-907001-1 (WARP) and GE model S770-808001-1 (HDU) are authorized for full fleet use. These operations have been certified by NAVAIR as a result of Flight testing

**3H.2.6.1 Limitations.**

- a) Altitude Envelope: 15,000 ft to 30,000 ft MSL.

- b) Airspeed: 225 - 300 KIAS

- c) Utilize an optimum closure/contact rate (1 to 3 knots)

- d) AR engagement during tanker bank angle changes is prohibited.

- e) "Topping-off" is prohibited to prevent damage to the fuel system (1,000 lbs less than maximum fuel).
f). AR is limited to VMC. IMC tanking is prohibited.

g) Night unaided and aided Aerial Refueling operations authorized.

h) Simultaneous refueling from centerline AR system and either Left or Right WARPS is prohibited.

i) Transmission on HF (including data link) within 1/2 NM of the tanker is prohibited. All equipment must be switched to: STANDBY/MONITOR.

3H.2.6.2 Special Procedures, Warnings Cautions and Notes:

**CAUTION**

Tanking in turbulence is not recommended due to hose and drogue vertical and lateral oscillations which can significantly increase pilot workload. Missed drogue engagements are likely and can result in damage to pitot-static and AOA probes, radome, windscreen, etc. Turbulence effects are most pronounced on the WARPs, with lesser effects from the centerline system.

**NOTES**

- Tanker wing dihedral may induce disorientation, as the wing can be inadvertently used as the horizon reference. This effect is stronger during turns and at night or in reduced visibility. Frequent cross-check of the attitude reference will help in identifying and alleviating this situation.

- With the receiver positioned 10 ft above the drogue at the pre-contact position for all three refueling stations, aerodynamic effects on the receiver pitot-static system produced erroneous air data fluctuations, including swings in HUD calibrated airspeed of up to +/- 30 kts, accompanied by canopy rumbling. Despite the erroneous air data fluctuations, position maintenance 10 ft above the drogue was not difficult.

- For the Centerline Hose: White hose markings denoting the fuel transfer zone (2 ft. in length) are difficult to distinguish from white markings denoting general hose trail position (1 ft. in length) due to their similarity in length combined with a poor sightline up the hose.

- Consult ATP 3.3.4.2-C, ITAF National SRD for useful information in regards to the tanker general description, dimensions, and light schemes.

**3H.3. S-3B Receiver Aircraft. Content deleted.** All S-3B aircraft have been divested from Naval inventory.

3H.4.1. General AAR Operations:

Note

Recommendations for US NAVY F/A-18 Foreign Military Sales Customers (not otherwise listed specifically) are as follows:

- **Finnish Air Force F/A-18 C/D HORNET** aircraft may conduct AR operations with the same tankers (US and Foreign) as the USMC F/A-18 A-D Hornets are currently authorized to tank from.

3H.4.1.1. Turbulence. Avoid operations in turbulence when practical.

⚠️ WARNING

- AAR operations in turbulence may result in unacceptable handling qualities and unsuccessful AAR operations. Turbulence may result in hose/drogue pitch and yaw oscillations significantly increased pilot workload and time required to safely refuel.

- For heavy tankers, when joining a flight of receiver aircraft, do not close astern of the tanker within 1 to 3 miles from a co-altitude to 500 feet below. Loss of aircraft control can occur if wake turbulence is encountered.

3H.4.1.2. Closure rate. Closure rate not to exceed 5 knots.

⚠️ CAUTION

Excessive closure rates may exceed the capabilities of the take-up reel. If this should happen, a sine wave develops in the hose. Immediate disengagement is required to prevent damage to the aircraft.

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³ Change 4
3H.4.1.3. Transfer rate. AAR transfer rate for the EA-18G and F/A-18A/F will vary from 1,000-2,000 ppm based on internal fuel state.

Note
With a fuel state above 10,500 lb (wings and externals receiving fuel) the refuel rate is approximately 1,000 lb. For fuel states up to the 10,500 lb level the refuel rate can rise to approximately 2,000 lb.

3H.4.2. KC-10 Refueling Operations. The KC-10 tanker is equipped with a centerline hose reel system and may be outfitted with two Wing Aerial Refueling Pods (WARP). At airspeeds above 250 KCAS, tanker induced light turbulence causes random drogue movement of 2 to 3 feet while 1 foot of movement will be encountered at airspeeds less than 250 KCAS. The recommended closure rate is 2 to 3 knots.

   a) Maximum airspeed for WARP AAR: 270 KCAS (optimum airspeed 220 KCAS).
   
   b) Maximum airspeed for Centerline AAR: 300 KCAS.
   
   c) Maximum altitude 33,000 feet MSL, E/F/G only.

3H.4.3. KC-135 Tankers. The KC-135 may be configured with two under wing refueling pods termed Multi-Point Refueling Systems (MPRS) and/or a Boom to Drogue Adapter (BDA) kit.

3H.4.3.1. KC-135 BDA Refueling (Including KC-135R Turkey). The KC-135 hose has a fixed length of 9 feet attached by a swiveling coupling to the end of a telescoping boom. The hose terminates in a hard, non-collapsible drogue and has no reel retraction capability.

3H.4.3.1.1. Limits.

   a) Airspeed of 200 to 275 KCAS or Mach 0.8 (whichever is less).
   
   b) Closure rate of 2 knots or less.
   
   c) Engagement during moderate or greater turbulence is prohibited.

3H.4.3.1.2. AAR from the KC-135 is fundamentally different from the standard Navy hose-drogue systems. After assuming a standard ready position, add power to create a closure rate of 2 knots or less. Due to the short length of hose and the weight of the drogue, the aircraft-to-drogue air stream interaction is minimized.
Excessive closure rates (greater than 2 knots) may result in damage to the aircraft or the refueling drogue

3H.4.3.1.3. Once contact has been made, the drogue must be pushed in approximately 4 feet and held in that position within +/-2 feet fore and aft for fuel to flow (the hose forms a U-shape when in the correct position). If the receiver aircraft is positioned too far aft with the hose near the trail position, slight aft or radial movement results in disconnect. The potentially more hazardous situation occurs when the drogue is pushed too far forward, such that the hose could be looped around the drogue on the probe.

3H.4.3.1.4. When disengaging, align the drogue with the boom and back straight away with reference to the boom.

Off-center disconnects can result in damage to the refueling probe or nozzle because of excessive side loads generated by the KC-135 boom-drogue adapter.

3H.4.3.2. KC-135 MPRS Refueling (Including KC-135R (Singapore)). The KC-135 MPRS incorporates the use of wing tip mounted aerial refueling pods to support receivers designed for hose/drogue refueling operations. The refueling hose is slightly shorter than the KC-130 (74 ft vs. 93 ft) and located near the wing tips. The extreme outboard wing location subjects the hose and drogue to wing tip flow disturbances at higher refueling speeds.

a) Maximum refueling speed 270 KCAS

b) Optimum refueling airs speeds 260 to 270 KCAS

c) Maintaining a slow controlled constant closure rate (less than 5 knots) will result in the best engagement results.

d) While flying at the approach position (20 ft aft of the drogue), small lateral trim inputs may be required to counter a tendency to roll toward the tanker. Deviations inboard and outboard may require additional lateral stick inputs. Deviations of more than 10 feet high can result in a strong sideslip (on right tanker wing, full left ball). Light buffet is a good indication to reposition down with respect to the tanker.
3H.4.4. CC-130T (RCAF) Refueling Operations. The Canadian CC-130T utilizes a 10 ft shorter hose than the USMC KC-130. This reduction in length may cause an increase in the drogue oscillation already characteristic of the USMC KC-130. The probe loads will also increase when coupled. Aircrew should be aware that excessive relative movement may cause structural damage that would not normally occur with the KC-130.

3H.4.4.1 Limits:

a) Airspeed of 200 to 250 KCAS

b) Altitude of 1,000 to 20,000 ft MSL.

Note
Engagements near 250 KCAS may be more difficult due to drogue oscillations induced by the bow wave of the receiver aircraft. Minimizing the airspeed or employing a moderate to high closure rate (no greater than 5 knots) will reduce the bow wave effect on the drogue. Due to this effect with F/A-18A-D receivers, the optimum engagement airspeed is 200 to 220 KCAS for F/A-18A-D.

3H.4.5. KDC-10 Omega Refueling Operations. The KDC-10 tanker is equipped with two wing pods. Characteristics will be similar to a KC-10 with wing pods. Following engagement, the hose develops a static droop which may result in intermittent or continuous fuel spray around the receiver IFR probe nozzle, predominantly at/above 20,000 ft. If fuel leaks from the probe nozzle after engagement, reengage or reduce altitude to attempt to provide a better seal. Fuel leakage will impinge the canopy, obscuring visibility, and has the potential for ingestion into ECS inlets, engine, or engine bay cooling inlets. This characteristic does not produce any adverse effects and may not be attributed to defective hardware. The following limits apply when refueling from the Omega KDC-10:

a) Airspeed of 200 to 300 KCAS

b) Altitude of 5,000 to 33,000 ft MSL

c) AAR operations with the KDC-10 flashing white wingtip lights on is prohibited at night (see warning)

d) AAR engagements during tanker bank angle changes are prohibited (see caution).

e) For F/A-18A-D, for single engine operations above 20,000 ft MSL, AAR operations are authorized for straight and level flight only (see warning).

f) For F/A-18A-D, at altitudes greater than 30,000 ft MSL

1) Undesirable pitch oscillations will make drogue engagement difficult. Reducing pilot input gain improves longitudinal handling qualities.
2) Engine response to throttle movements is slow, requiring slow deliberate power changes to capture closure rate. Rapid or large throttle movements may lead to engine stalls.

![WARNING]

- For F/A-18A-D, at airspeeds above 275, longitudinal pitch corrections can easily induce undesirable pitch oscillations and possible PIO. Undesirable pitch oscillations may require numerous attempts at engaging the drogue.

- Engaging at night with the KDC-10 flashing white wingtip lights on may blind the receiver pilot while in the echelon position.

- For single engine operations above 20,000 ft MSL, there is insufficient excess power and lateral control power in the trim system to maintain position during turns.

![CAUTION]

During tanker bank angle changes, hose and drogue oscillations will prevent receiver engagements or cause damage to the receiver aircraft or probe. Avoid engagement attempts until the tanker has established a stabilized roll attitude.

Note
For the F/A-18G and EA-18G, AAR operations above 270 KCAS and 25,000 ft have not been flight tested with the Omega KDC-10 or USAF KC-10. If drogue engagement is difficult due to aircraft controllability, reduce altitude and airspeed below 25,000 ft and 270 KCAS, then re-attempt.

3H.4.6. KC-707B (B707-338C) Omega Refueling Operations
(With MK32B-501 series wing mounted aerial refueling pods). The B707-338C tanker is equipped with two wing pods. The following limits apply when refueling from the Omega B707-338C

a) Airspeed of 250 to 325 KCAS.

b) Altitude of 5,000 to 33,000 ft MSL.

c) Maximum Closure/Contact rate is 5 knots.
Tanking position high and inboard relative to the tanker's outboard engine may result in the receiver inboard engine rolling back or flaming out. The receiver aircraft may also depart controlled flight if flown directly in the tanker engine wash.

Strong vortices in a position high relative to the tanker wing can result in departure from controlled flight and midair with the tanker. Avoid high positions where the receiver can look down on the tanker wing.

Due to degraded handling qualities in wake turbulence, avoid any tendency to go high and outboard during engagement or a missed approach to the basket. Receiver aircraft have received AOA vane and refueling probe damage during AAR when venturing into the wingtip aerodynamic environment.

The dihedral of the tanker wing presents the optical illusion that the receiver is constantly in a turn and caution is advised at night or no horizon flying. The wings of the 707 should not be used as a reference for the horizon.

Note
- From the echelon position maneuver to stabilized position one hose length aft and 10 to 15 ft below the basket before moving to the astern position (full trail hose length is 49.5 ft vice 74 ft for KC-135/KC-10).
- The astern position is 6 to 10 ft aft of basket. Trim laterally to remove stick forces
- Final corrections when closing on the drogue may be difficult due to tanker-receiver aerodynamic interaction.
- Tanker outboard engine jet wash may create buffet on the receiver inboard wing. The effect is stronger at 300 KCAS than at 250 KCAS.

- When refueling from tanker wing pods lateral stick and trim inputs are required to counter the receiver aircraft tendency to roll toward the tanker.
3H.4.7. HC/MC-130J (USAF) Refueling Operations. USAF HC/MC-130J configured with Sargent Fletcher Incorporated (SFI) Model 48-000-6 aerial refueling pods and high-speed drogues is considered acceptable to perform routine AAR operations with all F/A-18A-F and EA-18G receiver aircraft. There are no special Warnings, Cautions or Notes, and AAR procedures/limits are the same as for USMC KC-130J tankers. For a complete description of the USAF HC/MC-130J Tanker configuration, refer to Chapter 7 of the ATP- 3.3.4.2, US SRD.

a) Tanking with the variable speed drogue is prohibited.

3H.4.8. KC-130J (Italian Air Force) Refueling Operations. Italian Air Force KC-130J configured with Cobham Model 48-000 aerial refueling pods with FR300 hose reels is considered acceptable to perform routine AAR operations with all F/A-18A-F and EA-18G Receiver aircraft. There are no special Warnings, Cautions or Notes, and procedures/limits are the same as for US KC-130J tankers.

3H.4.9. KC-30A (RAAF) Tanker Refueling Operations. Refueling from the RAAF KC-30A Tanker is authorized when the tanker is equipped with Cobham MK32B-905E pods and operating with software version 39. This configuration should be verified during preflight planning. The following limits apply when refueling from the RAAF KC-30A:

a). When refueling, utilize a minimum closure/contact rate (not to exceed 5 knots).

b) AAR Envelope:

1) Airspeed: 250 to 300 KCAS/0.8 IMN

2) Altitude: 15,000 to 35,000 ft MSL.

c) AAR is limited to VMC. IMC tanking is prohibited.

d) NVG formation or refueling with the boom enhanced vision system (BEVS) illuminators energized is prohibited. The BEVS illuminators are incompatible with NVGs.

CAUTION

Tanking in turbulence is not recommended due to hose and drogue vertical and lateral oscillations which can significantly increase pilot workload. Missed drogue engagements are likely and can result in damage to pitot static and AOA probes, radome, windscreens, etc. F/A-18A-D test results indicate that drogue oscillations up to three drogue diameters vertically and up to one
drogue diameter laterally can develop even in very light turbulence.

NOTES

- Wake surveys of F/A-18A-D behind a RAAF KC-30A revealed a tendency for the receiver aircraft to roll towards the tanker while 5 ft high and/or inboard of the natural trail position of the hose; a sharp increase in outboard lateral stick force may be required to maintain wings level.

- Tanker wing dihedral can create a false horizon. A slow rate of lateral closure towards the tanker may develop due to alignment with the tanker wing. Lateral control inputs and subsequent pilot workload may increase.

- Flight testing has demonstrated that AAR with an F/A-18A-D single engine can be accomplished at 260KCAS within the altitude envelope. Optimum refueling altitude and airspeed may differ depending on configuration and conditions. Single engine engagements may require cycling of the operating engine throttle between MIL and AB, especially at higher altitudes. F/A-18E/F and EA-18G single engine flight testing has not been completed; optimum refueling altitude and airspeed may differ from F/A-18A-D.

- Several different KC-30A external lighting configurations for both aided and unaided refueling operations were evaluated by the RAAF. No single external lighting configuration was recommended for both aided and unaided operations. If possible, prior coordination of appropriate tanker external lighting configurations with RAAF KC-30A crew is advised. If prior coordination is not possible, receiver aircrew are advised to rendezvous with the KC-30A cautiously and request any objectionable lights be turned off by the KC-30A crew.
3H.4.10. CC-150T POLARIS (RCAF) Refueling Operations.  
AAR operations with Canadian Forces CC-150T Polaris strategic air-to-air (SAAR) tanker aircraft configured with Cobham MK32B-907E AAR pods.

3H.4.10.1. Special Procedures. Flight testing has demonstrated that the wake effects of the CC-150T on the F/A-18A-D flying qualities are easily compensated for. However, for F/A-18E/F and EA-18G, flight testing has not been completed to verify flying qualities with the CC-150T allow for safe refueling. The following applies for F/A-18E/F and EA-18G:

a) Approach cautiously and evaluate position maintenance while 10 to 15 feet aft of the drogue prior to approach.

b) If drogue motion or wake turbulence causes difficulty maintaining position, a higher or lower altitude or airspeed may improve flying qualities.

3H.4.10.2. Limitations.

a) F/A-18A-D AAR Envelope:
   1) Airspeed/Mach: 200 KCAS to 300 KCAS/0.8 IMN
   2) Altitude: 5,000 ft AGL to 35,000 ft MSL.

b) F/A-18E/F & EA-18G AAR Envelope
   1) Airspeed: 230 KCAS to 270 KCAS.
   2) Altitude: 10,000 ft MSL to 25,000 ft MSL.

c) Night close formation flying and AAR are prohibited with the CC-150T wingtip position lights and wing lights illuminated. This is due to excessive brightness of the CC-150T wingtip position lights and wing lights (lights mounted on outboard side of refueling pods and aimed outward and up).

d) Use of the CC-150T upper and lower beacon strobe lights are prohibited during AAR.

e) NVG formation and AAR operations are prohibited.

f) AAR with the receiver in half or full flaps is prohibited.

WARNING

Unsuitably high CC-150T roll rates caused by the tanker's autopilot increase the risk of mid-air collision during formation.
flying, especially at night. Tanker and receiver aircrew should communicate prior to the tanker initiating an autopilot turn.

**CAUTION**

- In moderate turbulence the hose and drogue will oscillate vertically up to three drogue diameters. This oscillatory motion will preclude successful air-to-air refueling operations. Tanking in turbulence is not recommended.

- During flight test, it was observed that the wing dihedral of the CC-150T may induce disorientation, as the wing can be inadvertently used as the horizon reference. This effect is stronger during turns and at night or in reduced visibility. Frequent cross-check of the HUD attitude reference will help in identifying and alleviating this situation.

**Note**

- The refueling drogue "BETA" lights (mounted to the periphery of the refueling drogue) are not sufficiently bright to perform the refueling task without externally illuminating the drogue (i.e. with the probe light).

- It was observed during flight testing that the bow wave of the F/A-18A-D causes the drogue to move slightly upward and to the right during the final phase of the approach. This effect is more pronounced at higher airspeeds. Bow wave effects of the F/A-18E/F and EA-18G are unknown.

- Flight testing has demonstrated that AAR with an F/A-18A-D single engine can be accomplished at 230 KCAS/15,000 ft MSL. Optimum refueling altitude and airspeed may differ depending on configuration and conditions. F/A-18E/F and EA-18G single engine flight testing has not been completed; optimum refueling altitude and airspeed may differ from F/A-18A-D.

- The CC-150T A/A TACAN system may provide erroneous bearing information when the tanker is banked.
3H.4.11 UK VOYAGER MK2/MK3 Tankers Refueling Operations. F/A-18A-F and EA-18G aircraft are authorized to perform AAR operations with UK Voyager MK2/MK3 tankers. The following limits, Procedures, Warnings, Cautions and notes apply refueling from the UK Voyager MK2/MK3:

Note

For the remainder of this section (3H.4.11) the UK Voyager MK2/MK3 tankers are referred to as "UK Voyager" with no distinction between the variants, and no differences called out for Limitations/Procedures or any Warnings, Cautions or Notes.

3H.4.11.1 Limitations:

a) Utilize an optimum closure/contact rate (1 - 3 knots).

b) AAR engagement during tanker bank angle changes is prohibited.

c) Airspeed: 275 to 300 KCAS.

d) Altitude: 15,000 to 30,000 MSL.

e) AAR limited to wing pods only.

f) Tanking from the centerline hose reel is prohibited.

g) AAR is limited to VMC.

h) IMC tanking is prohibited.

i) NVG formation or refueling is prohibited.

3H.4.11.2 Special Procedure for Receivers: If unable to verify that the LAIRCM system is OFF or in STAND BY, ensure helmet visors (clear, neutral density, or OD6 laser visor) are down for visual protection, when receiving fuel.

WARNING

UK Voyager is equipped with the LAIRCM system which may be hazardous to the receiving aircraft aircrew if not disabled.
CAUTION

Tanking in turbulence is not recommended due to hose and drogue vertical and lateral oscillations which can significantly increase pilot workload. Missed drogue engagements are likely and can result in damage to pitot static and AOA probes, radome, windscreen, etc. F/A-18A-D test results indicate that drogue oscillations up to three drogue diameters vertically and up to one drogue diameter laterally can develop even in very light turbulence.

Note

- Tanker wing dihedral can create a false horizon. A slow rate of lateral closure towards the tanker may develop due to alignment with the tanker wing. Lateral control inputs and subsequent pilot workload may increase.

- External lighting configurations for the UK Voyager tankers have not been evaluated by USN. If possible, prior coordination of appropriate tanker external lighting configurations with UK Voyager crew is advised. If prior coordination is not possible, receiver aircrew are advised to rendezvous with the UK Voyager cautiously and request any objectionable lights be turned off by the voyager crew.

- Flight testing has demonstrated that AAR with an F/A-18A-D single engine can be accomplished at 260KCAS within the altitude envelope. Optimum refueling altitude and airspeed may differ depending on configuration and conditions. Single engine engagements may require cycling of the operating engine throttle between MIL and AB, especially at higher altitudes. F/A-18E/F and EA-18G single engine flight testing has not been completed; optimum refueling altitude and airspeed may differ from F/A-18A-D.

- It is requested that receivers provide information relating to tanking events to include airspeed and altitude for tanking events as well as a characterization of the event itself (e.g. excess trim required, difficulty in discerning status lights, odd or unexpected hose response, "typical" or "fast" closure rates, night event, turbulence level, left or right side (pod) and any comments on difficulties or lack thereof before, during, and after the tanking events. Request these comments be emailed to requisite CLASS DESK and CC TO Thomas Cavallaro. EMAIL: THOMAS.CAVALLARO@NAVY.MIL.
3H.4.12 (ITAF) KC-767A: F/A-18A-F and EA-18G Aerial Refueling (AR) operations with Italian Air Force KC-767A Tanker configured with GE model S779-907001-1 (WARP) and GE model S770-808001-1 (HDU) are authorized for full fleet use. These operations have been certified by NAVAIR as a result of Flight testing.

   a) Altitude Envelope: 15,000 ft to 35,000 ft MSL.
   b) WARP and HDU Airspeed Envelope:
      (1) MIN Airspeed: 225 KCAS
      (2) MAX Airspeed: 300 KCAS
   c) Utilize an optimum closure/contact rate (1 to 3 knots)

3H.4.12.2 Special procedures, Warnings Cautions and Notes:

   NOTE
   • Consult ATP 3.3.4.2 (Italian SRD) for KC-767A tanker dimensions and lighting schemes.
   • With the receiver positioned 10 ft above the drogue at the pre-contact position for all three refueling stations, aerodynamic effects on the receiver pitot-static system produced erroneous air data fluctuations, including swings in HUD calibrated airspeed of up to +/- 30 KTS, accompanied by canopy rumbling. Despite the erroneous air data fluctuations, maintaining a position of 10 ft above the drogue was not difficult.
   • For the centerline hose: white hose markings denoting the fuel transfer zone (2 ft in length) are difficult to distinguish from white markings denoting general hose trail position (1 ft in length) due to their similarity in length combined with a poor sightline up the hose.

3H.5. AV-8B Receiver Aircraft. General Notes

   Note
   • While approaching the basket maintaining a slow controlled constant closure rate (less than 5 knots) will result in the best engagement results.
   • All AV-8B (USMC) technical clearances apply to Spain AV-8B and Italy AV-8B aircraft.

3H.5.1. HC/MC-130J (USAF) Refueling Operations. All AV-8B receiver aircraft are authorized to perform routine AAR operations with USAF HC/MC-
130J configured with Sargent Fletcher Incorporated (SFI) Model 48-000-6 aerial refueling pods. Use of high-speed drogues is considered acceptable. There are no special Warnings, Cautions or Notes, and AAR operating procedures/limits are the same as for USMC KC-130J tankers. For a complete description of the USAF HC/MC-130J tanker configuration, refer to Chapter 7 of the ATP-3.3.4.2, US SRD.

1) Tanking with variable speed drogue is prohibited.

3H.5.2. KC-130J (Italian Air Force) Refueling Operations. All AV-8B receiver aircraft are authorized to perform routine air-to-air refueling operations with Italian Air Force KC-130J tankers configured with SFI 48-000 aerial refueling pods. There are no special Warnings, Cautions or Notes, and procedures/limits are the same as for US KC-130J tankers and are in accordance with the AV-8B NATOPS.

3H.5.3. KC-135 Tankers

3H.5.3.1. Lateral trim requirements.

![CAUTION]

While flying in the approach position (20 ft aft of the drogue), small lateral trim inputs may be required to counter a tendency to roll toward the tanker. Deviations inboard and outboard may require additional lateral stick inputs. Deviations of more than 10 feet high can result in a strong sideslip (e.g., full left ball on the tanker’s right wing). Light buffet is a good indication for the receiver to reposition downward relative to the tanker.

3H.5.4 CC-150T POLARIS (RCAF) Refueling Operations. AV-8B AAR operations with Canadian Forces CC-150T Polaris strategic air-to-air (SAAR) tanker aircraft configured with Cobham MK32B-907E AAR pods is authorized.

3H.5.4.1. Special Procedures. Flight testing has not been completed to verify AV-8B flying qualities with the CC-150T allow for safe refueling. Tanker wake characteristics are unknown. The following applies:

a) Approach cautiously and evaluate position maintenance while 10 to 15 feet aft of the drogue, prior to approach.

b) If drogue motion or wake impingements make position maintenance difficult, a higher or lower altitude or airspeed may improve flying qualities.
3H.5.4.2. Limitations.

a) Airspeed/Mach: 230 to 270 KCAS

b) Altitude: 10,000 ft to 25,000 ft MSL.

c) Utilize a minimum closure/contact rate (not to exceed 3 knots)

d) Night close formation flying and AAR are prohibited with the CC-150T wingtip position lights and wing lights illuminated. This is due to excessive brightness of the CC-150T wingtip position lights and wing lights (lights mounted on outboard side of refueling pods and aimed outward and up).

e) Use of the CC-150T upper and lower beacon strobe lights are prohibited during AAR.

f) NVG formation and AAR operations are prohibited.

g) The maximum fuel on-load is limited to 500 lbs less than maximum capacity of internal and installed external tanks.

WARNING

Unsuitably high CC-150T roll rates caused by the tanker's autopilot increase the risk of mid-air collision during formation flying, especially at night. Tanker and receiver aircrew should communicate prior to the tanker initiating an autopilot turn.

CAUTION

- Tanking in turbulence will cause hose and drogue vertical and lateral oscillations which may result in drogue impact with receiver aircraft.

- During flight test, it was observed that the wing dihedral of the CC-150T may induce disorientation, as the wing can be inadvertently used as the horizon reference. This effect is stronger during turns and at night or in reduced visibility. Frequent cross-check of the HUD attitude reference will help in identifying and alleviating this situation.
Notes

- The refueling drogue "BETA" lights (mounted to the periphery of the refueling drogue) are not sufficiently bright to perform the refueling task without externally illuminating the drogue (i.e. with the probe light).

- The CC-150T A/A TACAN system may provide erroneous bearing information when the tanker is banked.

3H.5.5 KC-767A (ITAF): AV-8B Aerial Refueling (AR) operations with Italian Air Force KC-767A Tanker configured with GE model S779-907001-1 (WARP) and GE model S770-808001-1 (HDU) are authorized for full fleet use. These operations have been certified by NAVAIR as a result of Flight testing.

3H.5.5.1. Limitations.
   a) Altitude Envelope: 10,000 ft to 30,000 ft MSL.

   b) WARP and HDU Airspeed Envelope:
      (1) MIN Airspeed: 225 KCAS
      (2) MAX Airspeed: 300 KCAS FROM 15,000 FT MSL TO 25,000 MSL

      From 25,000 Ft to 30,000 FT, MSL, MAX Airspeed reduces in a linear fashion as follows:
      at 25,000 Ft MSL, 300 KCAS MAX
      at 26,000 Ft MSL, 295 KCAS MAX
      at 27,000 Ft MSL, 290 KCAS MAX
      at 28,000 Ft MSL, 285 KCAS MAX
      at 29,000 Ft MSL, 280 KCAS MAX
      at 30,000 Ft MSL, 275 KCAS MAX

   c) Utilize an optimum closure/contact rate (1 to 3 knots)

   d) The maximum fuel on-load is limited to 800 lbs less than total capacity of internal and installed external tanks.

3H.5.5.2 Special procedures, Warning s Cautions and Notes: There are no specific Procedures. Warnings Cautions or Notes associated with AV-8B tanking from ITAF KC-767A.

3H.5.6 KC-30A (RAAF): AV-8B Aerial Refueling (AR) operations with RAAF KC-30A tanker configured with Cobham MK32B 905E pods operating with software version 39 are authorized for full fleet use.

3H.5.6.1. Limitations.
   a) Altitude Envelope: 15,000 ft to 30,000 ft MSL.
b) Airspeed Envelope: 250-300 KCAS/0.8 IMN

c) Utilize a minimum closure/contact rate (not to exceed 5 knots).

d) The maximum fuel on-load is limited to 800 lbs less than maximum fuel load (filling to full capacity is not permitted).

e) AR is limited to VMC. IMC tanking is prohibited.

f) AR engagement during tanker bank angle changes is prohibited.

g) The tanker boom enhanced vision system (BEVS) illuminators are incompatible with night vision devices (NVD). Night aided (NVD), formation or refueling, with BEVS illuminators energized is prohibited.

3H.5.6.2. Special procedures, Warnings Cautions and Notes:

![WARNING]

Tanking in turbulence is not recommended due to hose and drogue vertical and lateral oscillations which can significantly increase pilot workload. Missed drogue engagements are likely and can result in damage to pitot static and AOA probes, radome, windscreen, etc. F/A-18A-D test results indicate that drogue oscillations up to three drogue diameters vertically and up to ONE drogue diameter laterally can develop even in very light turbulence.

Notes

- Wake surveys of F/A-18A-D behind a RAAF KC-30A revealed a tendency for the receiver aircraft to roll towards the tanker while 5 ft high and/or inboard of the natural trail position of the hose. A sharp increase in outboard lateral stick force may be required to maintain wings level.

- Tanker wing dihedral can create a false horizon. A slow rate of lateral closure towards the tanker may develop due to alignment with the tanker wing. Lateral control inputs and subsequent pilot workload may increase.

- The under-wing AR pod control software utilizes a built-in time delay between hose extend and rewind directions. Once receiver is stabilized in the refueling range and then closes on the tanker, a hose droop may be observed for approximately 2 seconds prior to the hose reel rewinding the slack hose.
• Tanker wake characteristics are unknown. Approach cautiously and evaluate position maintenance while 10-15 feet aft of the drogue, prior to approach. If drogue motion or wake impingement makes position maintenance difficult, a higher or lower altitude or airspeed may improve flying qualities.

• There is a lack of AV-8B specific visual cues in pilots peripheral vision when tanking on the port KC-30A AR station. This puts the pilots’ eyes on the drogue and the probe with a large aircraft in the pilots’ starboard peripheral, which increases pilot workload.

• Several different RAAF KC-30A external lighting configurations for both aided and unaided refueling operations were evaluated by the RAAF. No single external lighting configuration was recommended for both aided and unaided operations. If possible, prior coordination of appropriate tanker external lighting configurations is advised. If prior coordination is not possible, receiver aircrew are advised to rendezvous with the tanker cautiously and request any objectionable lights be turned off by the tanker crew.

3H. 6. MV-22B Receiver Aircraft.

3H.6.1. MC-130H Tankers.

a) Refueling speeds. Refueling speeds for the MC-130H are 160 to 180 KCAS.

b) Fuel delivery pressure. The maximum MC-130H fuel delivery pressure is 20 psi. MV-22B Refuel High Level Shut-Off Valves may not operate correctly below 35 psig. MV-22B crew should monitor fuel quantity gauges and isolate fuel tanks, as required to prevent overfill and fuel venting.

c) Maximum altitude is 10,000 ft MSL.

d) Flying qualities.

Note
The MC-130H tanker is required to maintain 0-degree flap deflection during refueling with the variable drag drogue (VDD).

e) Fuel transfer restrictions. MV-22B aircraft are to refuel using an Aerial Retractable Refueling Probe (ARRP) only with the MC-130H aircraft.

3H.6.2. KC-10 Tankers. Refer to US SRD Chapter 8, Appendix 8E.8.
3H.6.3 KC-130J/T, MC-130E/J/P, HC-130P/J Tankers

a) Flying qualities: The KC-130J/T, MC-130E/J/P, HC-130P/J Tankers are required to maintain 0 degree flap deflection during refueling with the variable speed drogue (VSD).

b) Fuel transfer restrictions. MV-22B aircraft are to refuel using an Aerial Retractable Refueling Probe (ARRP) only with the variable speed drogue (VSD).

3H.6.4 Omega KC-707A (formerly KC-707/TT): MV-22B Ground and Aerial Refueling (AR) operations with OMEGA KC-707A Tanker configured with SFI-FR300T-114 AR System, MA-4 coupling, and centerline high speed drogue assemblies is authorize for full fleet use. These operations have been certified by NAVAIR as a result of Flight testing.

3H.6.4.1 Envelope Limitations: IAW the following chart and additional limitation limitations listed below
MV-22B Limits
a) Airspeed: 200 KCAS
b) 84 percent NR only
c) Auto Flaps Only
d) Night Unaided operations prohibited

OMEGA KC-707A LIMITS (Provided for MV-22B Operator reference)
a) Tanker Flap Setting 14° degrees
b) MAX Tanker angle of bank while MV-22B is plugged: 15° degrees
c) Maximum of one refueling pump
d) Tanker lighting IAW table below

General Limitations:
Toboggan maneuvers prohibited, except in emergency

NOTE
For Tanker and general limitations (‘Tanker Flap Setting’, ‘Tanker Bank Angle’, ‘Toboggan Maneuver’, ‘Tanker lighting table for NVG’ and ‘Refueling pump’ limitations) communications and pre-flight briefings between the tanker and receiver aircrews are crucial to ensure awareness of these limitations on the part of both Aircrews.

Omega KC-707A Preferred Lighting Configuration (NVG Aided)

<table>
<thead>
<tr>
<th>Exterior Light</th>
<th>Description</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Tail Navigation Light</td>
<td>Single light</td>
<td>OFF</td>
</tr>
<tr>
<td>Strobe</td>
<td>Top of fuselage</td>
<td>OFF</td>
</tr>
<tr>
<td>Logo</td>
<td>Spotlights illuminating the tail logo</td>
<td>ON</td>
</tr>
<tr>
<td>Wingtip Navigation Light</td>
<td>Two standard (red/green)</td>
<td>ON</td>
</tr>
<tr>
<td>Wing Illumination</td>
<td>White engine/LE</td>
<td>ON</td>
</tr>
<tr>
<td>Nacelle Illumination</td>
<td>Spotlight</td>
<td>OFF</td>
</tr>
<tr>
<td>Beacon</td>
<td>Standard - red (lower/upper)</td>
<td>OFF</td>
</tr>
<tr>
<td>AR Beacon</td>
<td>Lower - green</td>
<td>OFF</td>
</tr>
<tr>
<td>Hose Exit Tube</td>
<td>Hose exit</td>
<td>(rheostat) OFF</td>
</tr>
<tr>
<td>AR Status Lights</td>
<td>Standard green, amber, red</td>
<td>(rheostat) Low</td>
</tr>
<tr>
<td>Drogue Illumination</td>
<td>Wind driven generator with four perimeter lights on drogue, reflective netting</td>
<td>(not adjustable in flight) ON</td>
</tr>
</tbody>
</table>
3H.6.4.2 Special Procedures, Warnings Cautions and Notes:

NOTE

- Refueling operations outside of the envelope depicted in ref c could result in the inability to maintain contact while the tanker is in a turn and result in high thrust command lever (TCL) workload in the refueling position.

- The power required to maintain an observation position is less than the power required to maintain pre-contact. This will result in the MV-22B accelerating towards the tanker when repositioning from pre-contact to observation without a power reduction.

- Moderate turbulence may be experienced when moving between the pre-contact and observation positions at an altitude in level with the tanker's deployed drogue.

3H.7 P-8A Receiver Aircraft: TBD pending incorporation of Fleet clearance data.

3H.8 F-35B and F-35C Receiver Aircraft: F-35B and F-35C aircraft are authorized to receive fuel from F/A-18E/F tankers equipped with AAR Store P/N 31-301-48310-6 or -7 and with the following Limitations, Procedures and Warnings / Cautions / Notes:

3H.8.1 Limitations:

a) F-35B/C (GEAR UP)
   1. Altitude: Sea Level to 35,000 ft MSL
   2. Minimum airspeed: 200 KCAS from Sea Level to 15,000 ft MSL
      220 KCAS from 15,000 to 35,000 ft MSL.
   3. Maximum airspeed: 300 KCAS/0.8 M

b) F-35B/C (GEAR DOWN)
   1. Altitude: Sea Level to 20,000 ft MSL
   2. Minimum airspeed: 200 KCAS from Sea Level to 15,000 ft MSL
      220 KCAS from 15,000 to 20,000 ft MSL
   3. Maximum airspeed: 300 KCAS.

3H.8.2 Special Procedure for Receivers: There are no special procedures for F-35B/C receivers at this time.
CAUTION

During in-flight refueling with and F/A-18 E/F tankers, very slow closures increase the potential for an incomplete latch. An incomplete latch may result in fuel spray which could damage the aircraft if ingested by the engine.

3H.9 (French) Super Entendard and Rafale M Receiver Aircraft. French Air Force Super Entendard and Rafale M receivers are authorized to receive fuel from F/A-18E/F tankers with the following Limitations, Procedures and Warnings / Cautions / Notes:

a) When refueling, receivers are to utilize a minimum closure/contact rate (not to exceed 5 knots).

b) Authorized to provide up to 700 lbs less than maximum fuel load (top offs prohibited).

c) Refueling of receiver aircraft only authorized with receiver IFR nozzle P/N 60318-2B.

d) Refueling of receiver aircraft with other IFR nozzles, including the Quinson nozzle P/N PRV 70-1 is prohibited.

CAUTION

- AAR operations with IFR nozzles other than 60318-2B may result in damage to receiver and/or refueling aircraft.

- The hose/drogue/coupling of the ARS when used with the F/A-18E/F tanker platform exhibits a strong tendency to recenter in its natural trail position which may introduce a hazard for extreme off center disconnects. During flight test where disconnect was slightly off center the drogue/coupling displayed a tendency to separate abruptly. Abrupt disconnects are not an issue as long as the receiver maintains constant separation rate until clear.

Note

- Prior to each refueling operation, tanker and receiver aircraft shall brief AAR procedures, capabilities, and limitations including IFR nozzle P/N.
- The Super Entendard IFR probe fails to completely meet the geometry requirements of STANAG 3447. It is possible that there could be minor contact between the Super Entendard IFR probe mast and the F/A-18E/F drogue struts.
APPENDIX 3I

USN/USMC AAR OPERATIONS
AAR FLIGHT CLEARANCES MATRIX

3I.1. General. This Matrix constitutes a guide to current permanent USN/USMC AAR aircraft flight clearances issued by COMNAVAIRSYSCOM 4.0P. Applicable aircraft NATOPS flight manual restrictions apply. Receivers (both U.S. and International) must meet ATP-3.3.4.6 requirements and use MA-2 or equivalent probe nozzles (IAW MS-24356). Foreign nations that wish to conduct AAR operations with USN/USMC aircraft must obtain an AAR operational flight release through TRANSCOM (see chapter 1, paragraph 1.6 for POC details). If an Aircraft/Receiver combination is not shown in either the Matrix or text of chapter 3 (this chapter), then there must be a current and specific COMNAVAIRSYSCOM issued Interim Flight Clearance (IFC) message (IFCs are a design/configuration authorization) that otherwise authorizes AAR in that combination.

Note
- Specific Flight Limitations, Procedures, Warnings, Cautions, and Notes for receiver aircraft are identified in the relevant receiver NATOPS and this document.

AAR Clearance Categories: The use of categories (C1, C2, C3) in the matrix (Figure 3I-1 below) are defined for United States operators in chapter 2 of the United States SRD, section 2.2.1. A paraphrased description is provided below.

The most common designation in the matrix (C3) is used to denote a Permanent Clearance category which has no operational restrictions and are intended as full Fleet usage clearances without expiration, (equivalent to a NATOPS).

C1 and C2 clearances are not intended as Full Fleet Clearances and have expiration dates and may contain certain limited envelope or Capability or Operation restrictions

R3/2/1 Designations are used for aircraft purchased from the United States Navy via a Foreign Military Sales Case. The US Navy, in these cases DOES NOT hold “Airworthiness Authority” for these aircraft and therefore can only “Recommend” AR Operations. It is up to the Airworthiness Authority for the Country owning the specific aircraft in question to Authorize those operations.
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<tr>
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<th>KC-130J USMC</th>
<th>KC-130T USN</th>
<th>KC-130 T-30 USN</th>
<th>F/A-18E/F USN</th>
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### AAR COMPATIBLE US MILITARY DROGUE TANKERS - USAF

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**Figure 31-1. Flight Clearance Matrix (Sheet 5 of 8)**
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EURO FIGHTER TYPHOON 2000 (SAF)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>INTERNATIONAL TANKERS</td>
<td>KC-130H SPAIN</td>
<td>CC-130T CANADA</td>
<td>CC-150T POLARIS COBHAM MK 32B-907E AAR PODS CANADA</td>
<td>KC-30A COBHAM MK32B PODS RAAF</td>
<td>UK VOYAGER KC MK2/MK3 TANKERS</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------</td>
<td>---------------</td>
<td>---------------------------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>AAR COMPATIBLE COMMERCIAL AND FOREIGN MILITARY DROGUE TANKERS</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

| RECEIVER |
|------------------|------------------|------------------|------------------|------------------|------------------|
| AV-8B (USMC)     | C3               | C3               | C3\(^{16}\)     | C3               |                  |
| AV-8B (ITALY)    | C3               | C3               | C3\(^{16}\)     | C3               |                  |
| AV-8B (SAF)      | C3               | C3               | C3\(^{16}\)     | C3               |                  |
| EA-6B (USN/USMC) | C3\(^{1,6,10}\) | C3\(^{10}\)     |                  |                  |                  |
| F/35B/C (USN/USMC)|                  |                  |                  |                  |                  |
| F/A-18A-D (USN/USMC)| C3\(^{8}\)    | C3\(^{8,10,16}\) | C3\(^{8}\)     | C3\(^{16}\)     |                  |
| F/A-18E/F (USN/USMC)| C3\(^{8}\)    | C3\(^{8,10,16}\) | C3\(^{8}\)     | C3\(^{16}\)     |                  |
| EA-18G           | C3\(^{8}\)     | C3\(^{8,10,16}\) | C3\(^{8}\)     | C3\(^{16}\)     |                  |
| MV-22B/CV-22 (USMC/USAF) |        |                  |                  |                  |                  |
| P-8A - Pending   |                  |                  |                  |                  |                  |
| CH-53E           |                  |                  |                  |                  |                  |
| MH-53E           |                  |                  |                  |                  |                  |
| MH-47E           |                  |                  |                  |                  |                  |
| MH-47G           |                  |                  |                  |                  |                  |
| MH-60K           |                  |                  |                  |                  |                  |
| MH-60L           |                  |                  |                  |                  |                  |
| UH-60J (JASDF)   |                  |                  |                  |                  |                  |
| F/A-18C/D (FINAF) | R3\(^{8}\)     | R3\(^{8,10,16}\) | R3\(^{5}\)     | R3\(^{16}\)     |                  |
| F/A-18CD (KAF)   |                  |                  |                  |                  |                  |
| C/F-18A/B Modernized (CAF) |        |                  |                  |                  |                  |
| F-5E/F (MOROCCO) |                  |                  |                  |                  |                  |
| SEA HARRIER AV-8 (INDIA) |        |                  |                  |                  |                  |
| HAWK (CAF/RAF/RAAF) |                  |                  |                  |                  |                  |
| BAE HAWK (MALAYSIAN) |                  |                  |                  |                  |                  |
| MIG-29N (MALAYSIAN) |                  |                  |                  |                  |                  |
| MIRAGE 2000 (FAF/GREECE) |        |                  |                  |                  |                  |
| TORNADO GR4 (RAF) |                  |                  |                  |                  |                  |
| TORNADO IDS (GAF/RAF/ITALY) |        |                  |                  |                  |                  |
| TORNADO ECR (GAF/ITALY) |                  |                  |                  |                  |                  |
| SUPER ENTENDARD (FAF) |                  |                  |                  |                  |                  |
| RAFALE M         |                  |                  |                  |                  |                  |
| EF-18A/B (SAF)   |                  |                  |                  |                  |                  |
| C160 (FAF)       |                  |                  |                  |                  |                  |
| EURO FIGHTER TYPHOON 2000 (SAF) |        |                  |                  |                  |                  |

\(^6\) Change 4

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July 2018

Figure 3I-1. Flight Clearance Matrix (Sheet 7 of 8)
<table>
<thead>
<tr>
<th>COUNTRY CODES</th>
<th>COUNTRY NAME</th>
<th>COUNTRY CODES</th>
<th>COUNTRY NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCAF</td>
<td>ROYAL CANADIAN AIR FORCE</td>
<td>RAF</td>
<td>ROYAL AIR FORCE</td>
</tr>
<tr>
<td>FAF</td>
<td>FRENCH AIR FORCE</td>
<td>RAFO</td>
<td>ROYAL AIR FORCE OF OMAN</td>
</tr>
<tr>
<td>FN</td>
<td>FRENCH NAVY</td>
<td>RNZAF</td>
<td>ROYAL NEW ZEALAND AIR FORCE</td>
</tr>
<tr>
<td>GAF</td>
<td>GERMAN AIR FORCE</td>
<td>RSAF</td>
<td>SINGAPORE AIR FORCE</td>
</tr>
<tr>
<td>FN</td>
<td>FRENCH NAVY</td>
<td>SAF/SAN</td>
<td>SPANISH AIR FORCE/NAVY</td>
</tr>
<tr>
<td>IAF</td>
<td>ISRAELI AIR FORCE</td>
<td>TuAF</td>
<td>TURKISH AIR FORCE</td>
</tr>
<tr>
<td>JASDF</td>
<td>JAPAN AIR SELF-DEFENSE FORCE</td>
<td>USAF</td>
<td>UNITED STATES AIR FORCE</td>
</tr>
<tr>
<td>KAF</td>
<td>KUWAIT AIR FORCE</td>
<td>USMC</td>
<td>UNITED STATES MARINE CORPS</td>
</tr>
<tr>
<td>RAAF</td>
<td>ROYAL AUSTRALIAN AIR FORCE</td>
<td>USN</td>
<td>UNITED STATES NAVY</td>
</tr>
<tr>
<td>FINAF</td>
<td>FINLAND AIR FORCE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Transfer pumps only
2. Restricted to one AR pump only
3. AR pumps PROHIBITED
4. Tanker maximum pressure 20 psig (140 kPa)
5. Closure/Disconnect airspeed limited to 2 KIAS or less
6. Closure/Contact rate limit 2-3 Knots
7. Maximum closure rate 3 Knots
8. Maximum closure rate 5 Knots
9. Top offs prohibited to 700 lbs (320 Kg) less than maximum fuel
10. Top offs prohibited to 1,000 lbs (455 Kg) less than maximum fuel
11. Maximum airspeed Mach 0.8 for BDA refueling
12. Tanker bank angle changes PROHIBITED during engagement
13. Drogue contact in a turn PROHIBITED
14. Variable Drag Drogue (VDD), day only, tanker flaps 0 deg deflection only, Aerial Retractable Refueling Probe (ARRP) only
15. If equipped with Variable Speed Drogue (VSD), tanker flaps 0 deg deflection only, ARRP only.
16. Night Aided formation and AAR operations PROHIBITED.
17. Maximum air refueling airspeed is 270 KCAS.
18. F/A-18 / EA-18 AAR operations prohibited with the Voyager MK3 centerline hosereel.
<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>CLEARANCE MESSAGE</th>
<th>PLATFORM</th>
<th>CLEARANCE MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV•8B (US/Italy/Spain)</td>
<td>KC•130F/R/T/J • AV•8B NATOPS KC•130T-30 • S•3B • 110031Z MAR 93 S•3 • AV•8B NATOPS KC•135 (MPRS) • 012002Z APR 98 KC•135 (MPRS) • AV•8B NATOPS KC•10 Centerline • AV•8B NATOPS KC•10 WARPS • 022002Z APR 92 KC•10 WARPS • AV•8B NATOPS France KC•135R • AV•8B NATOPS Italy B707 • AV•8B NATOPS Italy KC•130J • 072021Z OCT 09 Spain • 101520Z JUN 88 Spain B707 • AV•8B NATOPS CC•130 • 052114Z JUN 97 CC•130T • AV•8B NATOPS Omega 707 • 211407Z DEC 00 Omega 707 • AV•8B NATOPS Omega KC•10 • 022003Z APR 08 Omega KC•10 • AV•8B NATOPS</td>
<td>SEA HARRIER AV•8A (India)</td>
<td>F/A•18E/F • 312010Z AUG 07</td>
</tr>
<tr>
<td>EA•6B (USN/USMC)</td>
<td>KC•130F/R/T • EA•6B NATOPS KC•130J • 042002Z SEP 03 KC•130T-30 • 152002Z MAR 93 S•3B • 092100Z NOV 89 F/A•18E/F • 201350Z JUN 98 KC•135 (MPRS) • 022004Z NOV 01 KC•135 BDA • EA•6B NATOPS KC•10 WARPS • 25001Z SEP 92 KC•10 Centerline • 080529Z DEC 82 Spain B707 • 122017Z JUL 07 Spain KC•130H • 122017Z JUL 07 CC•130 • 102002Z APR 98 Omega 707 • 092006Z JAN 09 Omega KC•10 • 042003Z APR 09 Omega KC•10 • 042003Z APR 09</td>
<td>HAWK NATO</td>
<td>S•3KC•130/KC•130T-30 • 232009Z MAR 98</td>
</tr>
<tr>
<td>F/A•18A•D (USN/USMC)</td>
<td>KC•130U • 032014Z SEP 03 KC•130T-30 • 152002Z MAR 93 S•3B • 092100Z NOV 89 KC•135 (MPRS) • 022004Z NOV 01 CC•130 • 282011Z MAY 08 Omega 707 • 282007Z FEB 09 Omega KC•10 • 072005Z APR 08 UK VC•10 Wing • 261719Z OCT 90 KC•135 RSAF MPRS 042002Z JAN 11 Omega B707-338 MK32B 242000Z MAY 12 KC•130U (Italy) Cobham 292010Z JUL 13 KC•30A-RAAF • 222006Z JAN 15 CC•150T Polaris 292024Z JAN 15</td>
<td>BAE HAWK (Malaysian)</td>
<td>KC•130J • 022005Z JUL 08 KC•130R/T • 022005Z JUL 08</td>
</tr>
</tbody>
</table>
### Figure 31-2. Flight Clearance Messages (For Historical Record Only) (Sheet 2 of 2)

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>CLEARANCE MESSAGE</th>
<th>PLATFORM</th>
<th>CLEARANCE MESSAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/A-18E/F (USN/USMC)</td>
<td>KC-130J • 21200Z JUN 04&lt;br&gt;KC-135 (MPRS) • 022004Z NOV 01&lt;br&gt;CC-130 • 152004Z JUN 08&lt;br&gt;Omega 707 • 23200BZ FEB 09&lt;br&gt;Omega KDC-10 • 222011Z FEB 10&lt;br&gt;KC-135-MPRS-RSAF 042002Z JAN 11&lt;br&gt;KC-135R BDA TuAF-262009Z SEP 11&lt;br&gt;Omega B707-332B MK32B 242000Z MAY 12&lt;br&gt;KAF F/A-18CD w E/F 21212011Z May 2013&lt;br&gt;KC-130J (Italy) Cobham 292010Z JUL 13&lt;br&gt;KC-30A-RAAF-222006Z JAN 15&lt;br&gt;CC-150T Polaris 292024Z JAN 15</td>
<td>MIG-29N (Malaysian)</td>
<td>KC-130J • 022005Z JUL 08&lt;br&gt;KC-130R/T • 022005Z JUL 08</td>
</tr>
<tr>
<td>EA-18G</td>
<td>RSAF (MPRS) • 042002Z JAN 11&lt;br&gt;Omega 707 • 222021Z JAN 08&lt;br&gt;Omega KDC-10 • 222011Z FEB 10&lt;br&gt;KC-135R BDA TuAF-262009Z SEP 11&lt;br&gt;Omega B707-332B MK32B 242000Z MAY 12&lt;br&gt;CC-130T 052010Z APR 13&lt;br&gt;KC-130J (Italy) Cobham 292010Z JUL 13&lt;br&gt;KC-30A-RAAF-222006Z JAN 15&lt;br&gt;CC-150T Polaris 292024Z JAN 15</td>
<td>MIRAGE F1 (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
</tr>
<tr>
<td>MV-22/CV-22</td>
<td>KC-130 J • 272013Z MAR 08&lt;br&gt;KC-130 F/R/T • 272013Z MAR 08&lt;br&gt;KC-130 F/R/T/J • 022000Z OCT 09&lt;br&gt;KC-130 F/R/T/J • MV-22 NATOPS&lt;br&gt;MC-130 E/P • MV-22 NATOPS&lt;br&gt;MC-130 W/H • 272000Z JUN 08&lt;br&gt;MC-130 W/H • MV-22 NATOPS</td>
<td>MIRAGE 2000 (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
</tr>
<tr>
<td>CH-53E</td>
<td>KC-130J • 252000Z AUG 03&lt;br&gt;KC-130F/R/T • CH-53E NATOPS&lt;br&gt;KC-130T-30 • 152002Z MAR 93&lt;br&gt;MC-130W/H/E/P • CH-53E NATOPS</td>
<td>TORNADO F3 (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
</tr>
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<td>MH-53E</td>
<td>KC-130J • 252000Z AUG 03&lt;br&gt;KC-130F/R/T • CH-53E NATOPS&lt;br&gt;KC-130T-30 • 152002Z MAR 93&lt;br&gt;MC-130W/H/E/P • CH-53E NATOPS</td>
<td>TORNADO IDS (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
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<td>MH-47G</td>
<td>KC-130J • TM 1+1520+272+10+1&lt;br&gt;KC-130F/R/T • TM 1+1520+272+10+1</td>
<td>TORNADO PA-200 (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
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<tr>
<td>MH-60K</td>
<td>KC-130J • AWRT0081R10/TN 59599&lt;br&gt;KC-130F/R/T • AWRT0081R10/TN 59599</td>
<td>ENTENDARD (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
</tr>
<tr>
<td>F/A-18A/D (RAAF)</td>
<td>KC-130J • 302000Z MAY 08&lt;br&gt;KC-130R/T • 302000Z MAY 08&lt;br&gt;S-3B • S-3B NATOPS</td>
<td>HARRIER GR7 (NATO)</td>
<td>S-3/KC-130/KC-130T • 232009Z MAR 98</td>
</tr>
<tr>
<td>F/A-18A/D (CAF)</td>
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<td></td>
</tr>
<tr>
<td>F-5E/F (Morocco)</td>
<td>KC-130T • 142004Z JUN 07</td>
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CHAPTER 4

KC-135 STRATOTANKER

4.1. Introduction. The USAF has a large fleet of KC-135 Stratotankers with several variants in service. A small number of KC-135s are fitted with a receptacle to receive fuel from boom equipped tankers.

4.2. Receiver Types Certified. Details of receiver technical clearances together with AAR speeds and altitudes are published in Chapter 8, Receiver Data – Jet Tankers. In addition, Chapter 8, provides boom operators with receiver information essential to achieving safe AAR operations. For non-US receiver aircraft, the publishing of information in Chapter 8, Receiver Data – Jet Tankers does not constitute an automatic authority to undertake refueling. However, see Chapter 3, paragraph 2.6.5. for details about authority to conduct AAR.

4.3. AAR Equipment. There is one refueling mounted flyable boom for boom-type refueling. The boom can be modified to refuel probe-equipped aircraft by fitting a Boom Drogue Adapter (BDA); the BDA can only be fitted/removed on the ground. Approximately twenty aircraft have the capability to be fitted with two FRL Mk32B-753 wingtip mounted Multi-Point Refueling System (MPRS) AAR pods.

4.4. AAR Boom System. The boom is approximately 8.5m (28 ft) long with an additional 5.6 m (18.5 ft) of inner fuel tube which can be extended or retracted by the boom operator. The boom is equipped with a Boom Interphone System which permits direct communication with suitably equipped receivers.

4.4.1. Basic Operation

4.4.1.1. When ready to refuel, the boom is lowered from its stowed position and about 3 m (10 ft) of the retractable portion is extended by the boom operator.

4.4.1.2. When cleared, the receiver moves from a stabilized (zero rate of closure) astern position to a steady boom contact position.

4.4.1.3. Closure to contact will be slow and stable (approximately 1 foot per second) with the receiver stabilizing in the contact position.

4.4.1.4. When this is achieved, the boom operator flies the boom to the receiver aircraft’s receptacle and extends the boom to make contact. Locking toggles in the receptacle operate to hold the boom nozzle in contact.

4.4.1.5. The receiver then maintains its position within the boom operating envelope.

4.4.1.6. The following AP modes are approved for use when refueling in a Block 45 modified aircraft.

4.4.1.6.1. Air Refueling shall be accomplished in A/R mode.

4.4.1.6.2. For level flight, use ALT hold or ALTS (captured).

4.4.1.6.3. Tobogganing may be accomplished with VS or manual pitch control.

4.4.1.6.4. Lateral modes will be limited to basic ROLL or HDG modes. HDG correction while in HDG mode shall be limited to minor adjustments (less than 5 degrees). HDG mode shall not be used in anchor areas or heading reversals.
• THE RECEIVER WILL STABILIZE IN THE ASTERN POSITION AND ATTAIN A ZERO RATE OF CLOSURE. IF THE RECEIVER FAILS TO ATTAIN A STABILIZED POSITION, OR IT BECOMES APPARENT THAT A CLOSURE OVERRUN WILL OCCUR, BREAKAWAY PROCEDURES WILL BE INITIATED. FAILURE TO DO SO COULD RESULT IN A MID-AIR COLLISION.

• EXCESSIVE CLOSURE RATE OF LARGE RECEIVERS COULD CAUSE THE TANKER TO DESCEND INTO THE PATH OF THE RECEIVER. THE TANKER PILOT MUST BE PREPARED TO DISCONNECT THE AUTOPILOT TO PREVENT ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST INDICATION OF A CLOSURE OVERRUN.

• BLOCK 45 KC-135s HAVE THE POTENTIAL FOR PITCH OSCILLATIONS WHILE IN CONTACT WITH THE AUTOPILOT ENGAGED. IF AT ANY TIME THE OSCILLATION BECOMES OBJECTIONABLE FOR THE RECEIVER, AR DISCONNECT SHALL BE ACHIEVED. IF OPERATIONAL NEEDS REQUIRE CONTINUANCE OF AIR REFueling, THE TANKER CENTER OF GRAVITY SHALL BE MOVED FORWARD OR THE TANKER AUTOPILOT SHALL BE DISENGAGED FOR THE DURATION OF AIR REFueling OPERATIONS.

• BLOCK 45 MODIFIED KC-135s REFueling WITH AUTOPILOT ON REQUIRE OPERATIONAL CONSIDERATIONS AND LIMITATIONS TO REDUCE TANKER PITCH OSCILLATIONS WHEN OPERATING AT LIGHT WEIGHT WITH AN AFT CENTER OF GRAVITY. THE FOLLOWING OPERATIONAL CONSIDERATIONS AND LIMITATIONS ARE IMPOSED:

<table>
<thead>
<tr>
<th>Receiver Grouping</th>
<th>Tanker Gross Weight</th>
<th>Tanker CG Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC-10, E-4, VC-25</td>
<td>Below 200,000 lbs.</td>
<td>Forward of 32%</td>
</tr>
<tr>
<td></td>
<td>Above 200,000 lbs.</td>
<td>Forward of 34%</td>
</tr>
<tr>
<td>C-17, C-5</td>
<td>Below 240,000 lbs.</td>
<td>Forward of 30%</td>
</tr>
<tr>
<td></td>
<td>Above 240,000 lbs.</td>
<td>Forward of 34%</td>
</tr>
<tr>
<td>KC/NC/OC/RC/TC/WC-135, B-52, E-3, E-6, E-8, C-32B, B-737 AEW&amp;C, P-8A</td>
<td>Below 220,000 lbs.</td>
<td>Forward of 29%</td>
</tr>
<tr>
<td></td>
<td>Above 220,000 lbs.</td>
<td>No limitation</td>
</tr>
<tr>
<td>B-1</td>
<td>Below 170,000 lbs.</td>
<td>Forward of 33%</td>
</tr>
<tr>
<td></td>
<td>Above 170,000 lbs.</td>
<td>No limitation</td>
</tr>
<tr>
<td>B-2</td>
<td>Below 170,000 lbs.</td>
<td>Forward of 32%</td>
</tr>
<tr>
<td></td>
<td>Above 170,000 lbs.</td>
<td>No limitation</td>
</tr>
<tr>
<td>F-15, F-16, F-22, F-35A, AC/EC/MC/HC/C-130, A-10</td>
<td>All gross weights</td>
<td>No limitation</td>
</tr>
</tbody>
</table>

4.4.2. Automatic Disconnect.  Provided the receiver remains within the envelope, contact is maintained; however, if the receiver moves beyond the limits, a disconnect will automatically occur provided the tankers system is operating in normal.
APPROACHING BOOM LIMITS AT RELATIVELY HIGH VELOCITY CAN CAUSE STRUCTURAL DAMAGE AS A RESULT OF AN INABILITY TO DISCONNECT DUE TO BINDING ACTION OF THE BOOM NOZZLE.

NOTE

WHEN THE TANKERS AIR REFUELING SYSTEM IS IN OVERRIDE, BOOM LIMIT SWITCHES ARE INACTIVE, THE BOOM OPERATOR MUST INITIATE DISCONNECTS BEFORE THE RECEIVER EXCEEDS LIMITS.

4.4.3. Boom Envelope. The envelope is defined by automatic limit switches connected to the boom; the envelope permits a limited amount of fore and aft movement and some freedom of maneuver in the pitching, rolling and yawing planes. The envelope limits are set well within the mechanical limitations of the boom; therefore, provided the envelope limits are not exceeded too rapidly, disconnect will occur before the boom is damaged. The full boom envelope is illustrated in Figures 4A-1 and 4A-2 in Appendix 4A at the end of this chapter; however, the freedom of maneuver in boom elevation is reduced for some receiver aircraft because of their receptacle characteristics.

4.4.4. Normal Disconnect. To make a normal disconnect, the receiver releases the receptacle toggles (this may also be effected remotely by the boom operator) and remains stabilized in the contact position until the boom operator confirms a disconnect has been achieved; the receiver then moves to the astern position.

4.4.5. Brute Force Disconnect. There are two types of brute force disconnect, inadvertent, and controlled tension (coordinated).

4.4.5.1. Inadvertent Brute Force Disconnect. An inadvertent brute force disconnect is defined as any unplanned disconnect which is the result of one of the following:

- 4.4.5.1.1. The receiver aircraft moves rapidly to the aft limit, causing mechanical tanker/receiver separation.

- 4.4.5.1.2. Boom pullout occurs at 38 degrees elevation or below.

FOLLOWING AN INADVERTENT BRUTE FORCE DISCONNECT, AAR WILL BE TERMINATED EXCEPT DURING FUEL EMERGENCIES OR WHEN CONTINUATION OF AAR IS DictATED BY OPERATIONAL NECESSITY.

4.4.5.2. Controlled Tension Brute Force Disconnect. A controlled tension brute force disconnect is defined as an intentional coordinated disconnect occurring above 38 degrees elevation, accomplished by gradual aft movement of the receiver aircraft (approximately 1 foot per second) until the boom is fully extended, and ending with a controlled tension boom pullout. Coordination between the receiver pilot and boom operator is required to ensure as smooth a disconnect as possible. Following a controlled tension disconnect, AAR may be continued with other receivers, provided the results of the following checks are satisfactory:
4.4.5.2.1. Operational check of the boom for binding or uncontrollability.

4.4.5.2.2. Test of the tanker signal coil.

---

- A CONTROLLED TENSION BRUTE FORCE DISCONNECT WILL BE ACCOMPLISHED ONLY AS A LAST RESORT, AFTER ALL OTHER NORMAL AND EMERGENCY METHODS OF DISCONNECT HAVE FAILED.

- AAR FOR THE RECEIVER THAT REQUIRED A CONTROLLED TENSION DISCONNECT WILL BE TERMINATED EXCEPT DURING FUEL EMERGENCIES OR WHEN CONTINUATION OF AAR IS DICTATED BY OPERATIONAL NECESSITY. IF THE RECEIVER REQUIRES FURTHER AAR, THE FOLLOWING ACTIONS MUST BE ACCOMPLISHED BEFORE ATTEMPTING ANOTHER CONTACT:

4.4.5.2.3. Visual inspection of the receiver receptacle area and AAR boom.

4.4.5.2.4. Operational check of the boom for binding or uncontrollability.

4.4.5.2.5. Test of the tanker signal coil.

---

4.5. **AAR Boom Lighting.** Pilot Director Lights (PDL) provide positioning information to receiver pilots during boom type refueling. The PDLs are located on the bottom of the fuselage, aft of the nose landing gear; they consist of 2 panels of lights. The left panel gives boom elevation information and the right panel gives boom telescoping information. See Appendix 4A, Figure 4A-1.

4.5.1. **Basic Operation.** The lights are controlled by movement of the boom in elevation and by the in and out movement of the telescoping portion. These lights indicate the position of the boom in relation to the boom operating envelope and command the direction of receiver movement required to bring the boom to the ideal refueling position.

4.5.1.1. **Receiver Actions**

4.5.1.1.1. **Elevation.** At one end of the elevation panel is the illuminated letter U (for up); at the other end is the illuminated letter D (for down); see Appendix 4A to this Chapter. Adjacent to the letters are red arrowheads. If a receiver is in contact with the boom near the upward elevation limit, the red arrowhead next to the D will be illuminated; this indicates a downward movement is required. As the receiver moves down, the red light extinguishes and a green arrowhead illuminates, indicating the boom is approaching the ideal elevation. When the ideal elevation is reached, the green light extinguishes and 2 parallel green bars illuminate.

4.5.1.1.2. **Longitudinal Position.** Longitudinal position is verified using similar indications to those described above for the vertical position. The right-hand telescoping panel is similar in function, although the display is slightly different. The ends of the panel have the illuminated letters F and A (forward and aft); see Appendix 4A to this Chapter. The position information and movement commands are given by illuminated horizontal bars with red leading into green, with the ideal position shown by 2 parallel green bars illuminating. The command indications are separated by illuminated vertical white bars to give contrast. The telescoping part of the boom is in colored segments, which duplicate PDL indications; at night these segments are illuminated by boom marker lights. Lights are not provided for azimuth positioning; however, a fluorescent yellow stripe on the undersurface of the tanker fuselage is provided for centerline reference. .See Appendix 4A.
4.5.1.1.3. **Visual References - Heavy Receivers.** Heavy receivers should refer to Appendix 4E for illustrations and descriptions of tanker visual references.

4.5.1.2. **Radio Silent Procedures.** During radio silence, the PDLs can be used to give positioning commands to direct a receiver into the boom contact position. A steady red PDLs commands a large movement in the direction indicated, and a flashing red light commands a small correction. The PDLs can also be extinguished to signal a request for disconnect.

4.5.1.3. **Failure of PDLs to Illuminate**

4.5.1.3.1. **PDLs Fail to Illuminate When Making Contact.** If the PDLs do not illuminate when a receiver makes contact, the receiver pilot will inform the boom operator if refueling will continue. If refueling is continued, verbal corrections from the boom operator may be requested.

4.5.1.3.2. **PDLs Fail During Contact.** If the PDLs go out during contact, the receiver will initiate a disconnect and return to the astern position. Subsequently, if refueling is continued, verbal corrections from the boom operator may be requested.

4.5.1.4. **Flashing PDLs.** Flashing PDLs and the tanker lower strobe light on command a breakaway. Receivers will follow procedures in ATP 3.3.4.2 para 2.32.

4.5.1.5. **Other Illumination.** During night AAR, the AAR floodlight, and boom nozzle light will also be used to illuminate the boom and receiver receptacle.

4.6. **AAR Boom Drogue Adapter (BDA)** The BDA is 2.74 m (9 ft) of hose attached to the end of the telescoping part of the boom by a swiveling coupling; the hose terminates in a hard, non-collapsible drogue. The telescoping part of the boom is kept fully extended whilst the BDA is in use. The boom will be trailed at the pre-determined boom elevation and azimuth settings for that particular receiver type.

4.6.1. **Basic Operation.** The boom operator will hold the boom as motionless as possible, at the proper trail position, from the time the receiver reaches astern until completion of refueling. The ideal astern position for the receiver is to be stabilized 1.52 m (5 ft) behind the drogue. When cleared, the receiver moves forward to make contact; slight oscillations of the drogue are normal, and can be expected in even ideal weather conditions. The boom operator will not move the boom except to avoid striking the receiver airplane (the drogue is never “Locked down”).

**WARNING**

SIMULTANEOUS REFUELING FROM THE CENTERLINE BDA AND WINGTIP MOUNTED MPRS AAR POD(S) IS PROHIBITED DUE TO INADEQUATE REFUELLING ENVELOPE CLEARANCE BETWEEN RECEIVER AIRCRAFT.

4.6.2. **Receiver Actions** Extreme caution is required when operating on the BDA because, unlike hose drum systems, hose slack is not wound in. Contacts made with closure rates greater than about 2 kts will cause the hose to whip, with a consequently high probability of probe damage. Care must be taken to prevent the hose from looping around the probe, or touching the receiver’s fuselage; this can be avoided by the receiver approaching no closer than one half hose length. See Appendix 4B.

4.6.3. **Fuel Transfer** When the receiver has made contact, the tanker will transfer a small quantity of fuel to check the integrity of the system; if there are no fuel leaks, normal fuel transfer will continue. If possible, the tanker air refueling pumps will be switched off 5 seconds before the scheduled disconnect; this is to minimize fuel spray on disconnect.
4.6.4. Fuel Transfer Failure  If fuel does not transfer, the receiver will be instructed to disconnect; the receiver should drop back to the astern position and check that the correct fuel system selections have been made. The boom operator will cycle the boom system by retracting the boom to approximately 6.5 m (15 ft) extension and then fully re-extend it. The receiver will then be re-cleared for a further contact.

4.6.5. Normal Disconnect  When cleared, the receiver should disconnect by backing, remaining aligned with the boom and aim to separate leaving the drogue aligned to its free trail position. The boom operator does not retract the boom for a normal disconnect. To avoid the drogue striking the aircraft, the receiver pilot must not stray away from the correct lateral alignment.

NOTE

AS SOON AS THE RECEIVER IS IN A SAFE POSITION, THE BOOM OPERATOR WILL CYCLE THE BOOM BY RETRACTING TO APPROXIMATELY 15 FT (6.5M), THEN FULLY EXTENDING TO SIGNAL "READY FOR CONTACT". FAILURE TO CYCLE THE BOOM COULD PREVENT SUBSEQUENT CONTACTS.

4.6.6. Emergency Disconnect  In an emergency the boom operator may retract the boom, in which event the drogue will whip violently as contact is broken.

4.7. AAR Boom Drogue Adapter (BDA) Lighting  The elevation background lights and letters (PDLs described above in Para 4.5.) will be on during BDA AAR, but will not be used to direct receiver positioning; the PDLs do not provide correct positioning information during BDA operations. During night AAR, the AAR floodlight, boom nozzle light, and boom marker lights will also be used to illuminate the boom and BDA.

4.7.1. Radio Silent Procedures and Breakaway.  The elevation background lights and letters are used during radio silence to signal a routine disconnect (lights going out), or command a breakaway (flashing lights and tanker lower strobe light on).

4.8. AAR Multi-Point Refueling System (MPRS).  When installed, the pods trail a 22.5 m (74 ft) retractable hose with MA-4 coupling and collapsible paradrogue. The black hose is marked with a series of 0.3 m (1 ft) long white markings and two 0.6 m (2 ft) wide orange bands. The range between the orange bands corresponds with the green pod status lights indicating the fuel transfer position. Appendix 4C provides a visual description of the pod status lights and relates this to hose position.

4.8.1. Basic Operation.  To start fuel flowing, the hose must be pushed in at least 1.5 m (5 ft), indicated by the first orange band, whereupon a green pod status lights coming on.

4.8.2. Receiver Actions.  Receiver pilots should remain within the ideal refueling position; this is with the hose extended between the two orange bands. The inner limit is 16.4 m (54 ft) and the outer limit 21 m (69 ft). This provides a fore and aft range of movement of 4.6 m (15 ft). See Appendix 4C, Figure 4C-2 and Figure 4C-3.

4.8.3. Receiver Too Close.  If the hose is pushed in too far, the amber pod status lights flash, fuel ceases after the hose is pushed in to less than 15.2 m (50 ft). Fuel flow will start again as the hose is pulled back out past 15.8 m (52 ft). Thus the receiver has a fore and aft range of movement of 5.8 m (19 ft) during which fuel will flow. See Appendix 4C.

WARNING

- THE SYSTEM CAN BE USED TO REFUEL TWO RECEIVERS SIMULTANEOUSLY IF THE RECEIVER WINGSPAN IS LESS THAN 68 FT.
HOWEVER, THE BOOM OPERATOR WILL ONLY CLEAR ONE RECEIVER AT A TIME TO MOVE FROM ASTERN TO THE CONTACT POSITION.

- SIMULTANEOUS REFUELLING FROM THE CENTRELINE BDA AND WINGTIP MOUNTED MPRS AAR POD(S) IS PROHIBITED DUE TO INADEQUATE REFUELLING ENVELOPE CLEARANCE BETWEEN RECEIVER AIRCRAFT.

4.9. AAR Multi-Point Refueling System (MPRS) Lighting. Drogue lighting is provided by lights attached to four drogue ribs. Reflective tape is also affixed to both sides of each drogue rib and the outer ring. In addition to the drogue lighting, the following lights will be set by the boom operator; the receiver pilot can request intensity adjustments to lights as desired.

4.9.1. Day AAR. For day AAR, the pod status lights and pod floodlights should be turned on full bright.

4.9.2. Night AAR. In addition to the day AAR lights, the underbody, underwing, nacelle illumination lights, pod illumination, horizontal stabilizer, and outboard nacelle illumination lights will be set to on/full bright for night AAR; they may be adjusted as requested by the receiver pilot. The AAR floodlight may also be used as desired. (Also see details of aircraft lighting Appendix 4D)

4.9.3. Pod Status Lights. Three pairs of the lights (red, amber, and green) are located on opposite sides of the rear fairing of each pod. These lights inform the receiver pilot of the current mode/status of the pod. The lighting sequence is listed in, Appendix 4C Figure 4C-3.

4.9.4. Aircraft Lighting. Aircraft undersurfaces are illuminated by a comprehensive array of lights, many of which are adjustable for brilliance upon request (see Appendix 4D, Figure 4D-1). The initial setting for underbody and underwing lights will be on/full bright during all types of refueling day or night. The nacelle lights will be on during all types of refueling, but during night AAR, will be dimmed prior to receivers reaching the observation position.

4.10. Refueling Heights and Speeds

4.10.1. AAR RV Speed. The standard KC-135 tanker orbit speed is 275 KIAS or 0.78M, whichever is lower.

4.10.1.1. The tanker will normally adjust to AAR speed when rolled out towards the RVCP.

4.10.1.2. In the case of the A-10, fly orbit at 220 KIAS or the tanker’s charted holding speed, whichever is the higher, and plan to roll out ½ NM in front of the receiver.

4.10.2. Boom and BDA AAR. Boom and BDA AAR height band is sea level to heights in excess of 30,000 ft; speed range is 200 to 350 KIAS.

4.10.3. MPRS AAR. Wingtip mounted MPRS AAR pods height band for AAR is 5,000 to 35,000 ft; speed range is 220 to 300 KIAS.

4.11. Maximum Transferable Fuel. Total fuel load is 92,060 kg (203,000 lb). Maximum fuel available for offload on a four hour sortie is approximately 61,280 kg (135,000 lb).

4.12. Fuel Transfer Rate. The tanker can transfer fuel at the following rates:

4.12.1. Boom. Exceeding 6000 lb/min (2722 kg/min) through the boom.

4.12.2. BDA. Exceeding 2800 lb/min (1270 kg/min) through the BDA.

4.12.3. MPRS. Exceeding 2680 lb/min (1216 kg/min) through the wingtip mounted MPRS AAR pods.

4.13. Regulated Fuel Pressure. Fuel is delivered to the receiver at the regulated pressure of 3.5 ± 0.35 bars (50 ± 5
4.14. Fuel Types Available for AAR

Table 4-1 Fuel Grade Properties and Limits

<table>
<thead>
<tr>
<th>USE</th>
<th>GRADE</th>
<th>TYPE</th>
<th>FLIP CODE</th>
<th>NATO CODE</th>
<th>SPECIFIC GRAVITY (MAX/MIN AT 60°F)</th>
<th>FUEL FREEZE POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECOMMENDED FUELS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JP-8 +100</td>
<td>J8+100</td>
<td>KEROSENE</td>
<td>F-37</td>
<td>MIL-DTL-83133</td>
<td>0.840-0.775</td>
<td>-47/-53</td>
</tr>
<tr>
<td>JET A</td>
<td>A+</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>0.840-0.775</td>
<td>-40/-40</td>
</tr>
<tr>
<td>JET A-1</td>
<td>A1+</td>
<td>F-35</td>
<td>F-34</td>
<td>DEF STAN 91-91</td>
<td>0.802-0.751</td>
<td>-47/-53</td>
</tr>
<tr>
<td>JP-8</td>
<td>J8</td>
<td>F-34</td>
<td>MIL-DTL-83133</td>
<td>DEF STAN 91-87</td>
<td>0.802-0.751</td>
<td>-58/-72</td>
</tr>
<tr>
<td>JP-4</td>
<td>J4</td>
<td>WIDE CUT (GASOUNE TYPE)</td>
<td>F-40</td>
<td>MIL-DTL-5624</td>
<td>DEF STAN 91-88</td>
<td>0.845-0.788</td>
</tr>
<tr>
<td>ALTERNATE FUELS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JP-5</td>
<td>J5</td>
<td>KEROSENE (HIGH FLASH)</td>
<td>F-44</td>
<td>MIL-DTL-5624</td>
<td>0.802-0.751</td>
<td>-50/-58</td>
</tr>
<tr>
<td>JET B</td>
<td>B</td>
<td>NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>0.775 MIN</td>
<td></td>
</tr>
<tr>
<td>Additized TS-1/RT</td>
<td>KEROSENE</td>
<td>NONE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JP-7</td>
<td>J-7</td>
<td>MIL-DTL-38216</td>
<td>0.806-0.779</td>
<td>-43/-46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.15. Mark Facilities. In response to a receiver request to “Mark” the tanker can dump fuel from the boom. “Mark” should only be used if a receiver low fuel state or other similar circumstance requires the rendezvous be expedited. If required, the tanker will dump fuel in 500 to 1000 pound increments until positive visual contact can be maintained.

4.16. Tanker Dimensions. The KC-135 is 39 m (128 ft) long with a wingspan of 40 m (130 ft).

4.17. RV Aids. The KC-135 has the following radio, navigation and RV aids:

4.17.1. UHF, VHF, HF, and SATCOM radios.

4.17.2. VOR, TACAN, INS, GPS, and search/weather radar.

4.17.3. A/A TACAN (DME only), TCAS, IFF.

4.18. List of Source Documents

4.18.1. T.O. 1C-135(K)-1

4.18.2. T.O. 1C-135(K)R(I)-1

4.18.3. T.O. 1C-135(K)(I)-1

4.18.4. T.O. 1C-135(K)R(II)-1
APPENDIX 4A
KC-135 STRATOTANKER BOOM

Figure 4A-1 - KC-135R Pilot Director Lights Illumination Profile and Boom Limits.
Figure 4A-2 - KC-135R Boom Limits.
APPENDIX 4B
KC-135 STRATOTANKER BDA
APPENDIX 4C
KC-135 STRATOTANKER MPRS

Figure 4C-1 – KC-135 MPRS Pod Status Lights

<table>
<thead>
<tr>
<th>LIGHTS</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED (2)</td>
<td>Light is on steady when power is on and hose is stowed and when the hose is deploying or being rewound using the REW/IND/TRAIL switch on the pod control panel. Steady red light indicates to receiver the pod system is not ready to transfer fuel. Flashing indicates the need to immediate disconnect and separation. Comes on flashing when emergency breakaway switch on boom telescope lever is pressed; goes off after approximately 10 seconds or if emergency breakaway switch is pressed while lights are flashing.</td>
</tr>
<tr>
<td>AMBER (2)</td>
<td>When light is on steady, indicates to receiver that hose is fully extended and refueling system is ready for contact. Light flashes when hose is pushed in so deployed hose length is less than 51 feet and goes off when deployed hose length is more than 54 feet, when hose is pulled-out. Light is also on flashing when supplemental hose response is active.</td>
</tr>
<tr>
<td>GREEN (2)</td>
<td>Indicates to receiver that fuel transfer (greater than 50 gpm) is occurring. Lights are on when hose is deployed greater than 52 ft (but less than 69 ft), when the hose is pulled out. Lights are off when hose is pushed-in and less than 50 ft of hose is deployed or while supplemental hose response is active.</td>
</tr>
</tbody>
</table>
Figure 4C-2 – KC-135 MPRS Hose Markings/Pod Status Lights

- **Hose at Full Trail (Steady Amber)**: Pod marking
- **Hose Pushed in To Start Of Refueling Zone (No Lights Or Green Lights On If Fuel Flow >50 GPM)**: Pod marking
- **Hose Pushed In To Beginning Of Standoff Zone (Blinking Amber; Green On If Fuel Flow >50 GPM)**: Pod marking
- **Hose Pushed In To Fuel Cutoff Point In Standoff Mode (Green Off; Flashing Amber)**: Pod marking
- **Breakaway (Flashing Red; Immediately Disconnect And Move To A Safe Position Clear Of The Tanker And Refueling Equipment)**: Pod marking
Figure 4C-3 – KC-135 MPRS Pod Status Lights

<table>
<thead>
<tr>
<th>BEFORE CONTACT</th>
<th>STEADY RED</th>
<th>STEADY AMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pod NOT ready. Do NOT make contact.</td>
<td>Ready for contact</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IN CONTACT</th>
<th>STEADY GREEN</th>
<th>ALL LIGHTS OUT (Receiver in Fuel Transfer Position)</th>
<th>FLASHING AMBER</th>
<th>STEADY AMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel flows</td>
<td>Offload complete/dry contact</td>
<td>Forward limit, drawback</td>
<td>Aft limit</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANYTIME</th>
<th>ALL 3 LIGHTS OUT</th>
<th>FLASHING RED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disconnect</td>
<td>BREAKAWAY</td>
</tr>
</tbody>
</table>
Figure 4C-4 – KC-135 Hose and Drogue – In-Flight Positioning

WARNING
Flight outside designated envelope areas could result in receiver control difficulties and impingement on the refueling envelope of the other wing-tip pod or of the tanker envelope.

NOTE
Depicted hose extensions are based on nominal values and do not account for hysteresis in the fuel-draws or the effects of receiver closure rate and activation of supplemental hose response mode.
APPENDIX 4D
KC-135 STRATOTANKER
EXTERIOR LIGHTING

Figure 4D-1 – KC-135R Exterior Lighting

1  NOSE LANDING AND TAXI LIGHT (WHITE)
2 * NACELLE ILLUMINATION LIGHT (TYPICAL) (WHITE)
3  TAXI LIGHT (WHITE)
4  LANDING LIGHT (FIXED) (WHITE)
5 * [MPRS] POD ILLUMINATION LIGHTS (2) (WHITE)
6 * NAVIGATION LIGHT (LEFT-RED, RIGHT-GREEN, REAR-RED AND WHITE)
7 * [MPRS] OUTBOARD NACELLE ILLUMINATION LIGHTS (2) (WHITE)
8 * FIN TIP AERIAL REFUELING FLOODLIGHT (WHITE)
9 * [MPRS] HORIZONTAL STABILIZER ILLUMINATION LIGHTS (2) (WHITE)
10 * UNDERWING ILLUMINATION LIGHT (TYPICAL) (WHITE)
11  STROBE LIGHTS (2) (RED OR WHITE)
12 * UNDERBODY ILLUMINATION LIGHT (TYPICAL) (WHITE)
13  TERRAIN LIGHT (RETRACTABLE) (WHITE)
14 * RECEIVER PILOT DIRECTOR LIGHTS (WHITE, RED, GREEN)
15  BOOM MARKER LIGHTS (FLUORESCENT)
16 * BOOM NOZZLE LIGHT(S) (WHITE)

* Designates Adjustable Lighting
4E.1 Refueling Position - Visual References. When moving forward from the astern position to the contact position, the visual references used by heavy aircraft receiver pilots permit them to position their aircraft so that they remain within the tanker’s AAR envelop. The following paragraphs provide guidance to help pilots achieve the correct position.

4E.2 Position - Elevation. Determination of correct elevation is best achieved by comparing the alignment of the lower UHF antenna with the white line painted on the lower fuselage of the tanker. This antenna may be hidden by the VHF Data Link (VDL) antenna installed between the UHF antenna and the white line.


4E.2.1.1. Lower UHF Antenna. When receiving fuel, receiver pilots must exercise caution to ensure that they do not mistakenly attempt to create an inverted “T” using the VDL antenna instead of the UHF antenna. Moving two degrees left or right will allow the receiver pilot to distinguish the lower UHF antenna, and use normal references.

4E.2.1.2. Alternative Reference – VDL Antenna. When AAR position is determined by reference to the VDL antenna, the correct vertical position is achieved when the receiver pilot aligns the tip of the VDL antenna with an imaginary line drawn between the top of “D” and the top of the “F” of the Pilot Director Lights.

Figure 4E-1. Upper and Lower Limits - Lower UHF Reference
CHAPTER 5

KC-10 EXTENDER

5.1. Introduction. The USAF has 59 KC-10 Extenders in service. All KC-10s are equipped with an AAR boom and centerline drogue; many are fitted for Wing Air Refueling Pods (WARP). The aircraft has a receptacle for receiving fuel from boom-equipped tankers, and has a reverse fuel pumping capability.

5.2. Receiver Types Certified. Details of receiver technical clearances together with AAR speeds and altitudes are published in Chapter 8, Receiver Data – Jet Tankers. In addition, Chapter 8, provides boom operators with receiver information essential to achieving safe AAR operations. For non-US receiver aircraft, the publishing of information in Chapter 8, Receiver Data – Jet Tankers does not constitute an automatic authority to undertake refueling. However, see Chapter 3, paragraph 2.6.5. for details about authority to conduct AAR.

5.3. AAR Equipment. There is one centerline flyable boom for boom-type refueling. Additionally, a Sargeant Fletcher fuselage mounted hose drum unit is fitted for probe and drogue operation. Approximately twenty aircraft have the capability to be fitted with two Flight Refueling Ltd Mk32B wing mounted AAR pods; these are known as Wing Aerial Refueling Pods (WARPs).

5.4. AAR Boom System

5.4.1. Description. The boom is approximately 11 m (36 ft 9 in) long with an additional 7 m (22 ft) of telescoping inner fuel tube. When the boom is fully extended it has a total length of 58 ft 3 in. All KC-10 booms are equipped with a Boom Interphone System which permits direct communication with suitably equipped receivers.

5.4.2. Basic Operation. Procedures for refueling from the boom are identical to those used with the KC-135 boom; however, the boom has a more sophisticated control system which provides a number of additional operating facilities.

5.4.1.2.1. When ready to refuel, the boom is lowered from its stowed position and about 3.6 m (12 ft) of the retractable portion is extended by the boom operator.

5.4.1.2.2. When cleared, the receiver moves from a stabilized (zero rate of closure) astern position to a steady boom contact position.

5.4.1.2.3. Closure to contact will be slow and stable (approximately 1 foot per second) with the receiver stabilizing in the contact position.

5.4.1.2.4. When this is achieved, the boom operator flies the boom to the receiver aircraft’s receptacle and extends the boom to make contact. Locking toggles in the receptacle operate to hold the boom nozzle in contact.

5.4.1.2.5. The receiver then maintains its position within the boom operating envelope.

5.4.1.2.6. The digital fly-by-wire control system has an Automatic Load Alleviation System (ALAS). The ALAS reduces and maintains constant radial forces on the nozzle and receptacle; this permits a larger AAR envelope without nozzle binding.

WARNING

- THE RECEIVER WILL STABILISE IN THE ASTERN POSITION AND
ATTAIN A ZERO RATE OF CLOSURE. IF THE RECEIVER FAILS TO ATTAIN STABILISED POSITION, OR IT BECOMES APPARENT THAT A CLOSURE OVERRUN WILL OCCUR, BREAKAWAY PROCEDURES WILL BE INITIATED. FAILURE TO DO SO COULD RESULT IN A MID-AIR COLLISION.

- EXCESSIVE CLOSURE RATE COULD CAUSE THE TANKER TO DESCEND INTO THE PATH OF THE RECEIVER. THE TANKER PILOT MUST BE PREPARED TO DISCONNECT THE AUTOPILOT TO PREVENT ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST INDICATION OF A CLOSURE OVERRUN.

CAUTION

BINDING OF THE BOOM NOZZLE IN THE RECEIVER’S RECEPTACLE IS POSSIBLE, EVEN WITH A DISCONNECT SIGNAL. WHILE NOZZLE BINDING CAN OCCUR IN MOST DISCONNECT POSITIONS, IT IS MOST LIKELY AT HIGH RECEIVER ROLL AND LOW BOOM ELEVATION. IF NOZZLE BINDING OCCURS OR IS SUSPECTED, NEUTRALISE BOOM FLIGHT CONTROL INPUTS. AVOID ABRUPT BOOM FLIGHT CONTROL INPUTS.

5.4.3. Independent Disconnect System. The boom has an Independent Disconnect System (IDS). In the event of the receptacle toggles failing to unlatch from the boom using the normal electrical signaling system, the IDS can be used. The IDS employs compressed air to retract the toggle latches on either side of the boom nozzle; this obviates the requirement for brute force disconnects.

5.4.4. Boom Envelope. The envelope is defined by automatic limit switches connected to the boom; the envelope permits a limited amount of fore and aft movement and some freedom of maneuver in the pitching, rolling and yawing planes. The envelope limits are set well within the mechanical limitations of the boom; therefore, provided the envelope limits are not approached too rapidly, the automatic disconnect will occur before the boom is damaged. The full boom envelope is illustrated in Appendix 5A; however, the freedom of maneuver in the upper boom elevation is reduced for some receiver aircraft because of their receptacle characteristics.

5.4.5. Failure of the Boom Flight Control System. Should the boom fly-by-wire control system suffer certain failures, the boom operator may not be able to control the boom in one or more axis of movement; coordinated action between the boom operator and the receiver pilot will then be required to prevent the boom from striking the receiver. The receiver pilot must remain in contact and follow the boom operator’s instructions explicitly; the boom operator will direct the receiver to a safe disconnect position. This may be preceded by a period when the receiver pilot is required to maintain a stabilized in-contact position to allow the boom control surfaces to free stream to a neutral position. The safe position is defined as the position during a partial or complete boom control system failure that it is safe for the boom operator or receiver to initiate a disconnect. During one of these system failures, the boom operator will direct the receiver to this safe position, which is achieved when the receiver is approximately zero degrees roll and moving down and back.

5.5. AAR Boom Lighting

5.5.1. Description. Pilot Director Lights (PDL) provide positioning information to receiver pilots during boom type AAR. The PDLs are located on the bottom of the fuselage, aft of the nose landing gear; they consist of 2 panels of lights. The left panel gives boom elevation information and the right panel gives boom telescoping information. Appendix 5A, Figure 5A-1.

5.5.2. Basic Operation. The lights are controlled by movement of the boom in elevation and by the in and out movement of the telescoping portion. These lights provide positional trending information about the boom in relation to the boom operating envelope and command the direction of receiver movement required to bring the boom to the ideal refueling position.
5.5.3. Receiver Actions

5.5.3.1. Elevation. At one end of the elevation panel is the illuminated letter U (for up); at the other end is the illuminated letter D (for down). Adjacent to the letters are red arrowheads. If a receiver is in contact with the boom near the upward elevation limit, the red arrowhead next to the D will be illuminated; this indicates a downward movement is required. As the receiver moves down, the red light extinguishes and a yellow arrowhead illuminates, indicating the boom is approaching the ideal elevation. When the ideal elevation is reached, the green light extinguishes and two parallel green bars illuminate.

5.5.3.2. Forward/Aft. Forward/Aft position is verified using similar indications to those described above for the vertical position. The right-hand telescoping panel is similar in function, although the display is slightly different. The ends of the panel have the illuminated letters F and A (forward and aft). The position information and movement commands are given by illuminated horizontal bars with red leading into yellow, with the ideal position shown by two parallel green bars illuminating. The command indications are separated by illuminated vertical white bars to give contrast. The telescoping part of the boom is in colored segments, which duplicate PDL indications; at night these segments are illuminated by boom marker lights. Lateral position lights are not provided for roll positioning; however, a fluorescent yellow stripe on the undersurface of the tanker fuselage is provided for centerline reference.

5.5.4. Radio Silent Procedures. During radio silence, the PDLs can be used to give positioning commands to direct a receiver into the boom contact position. A steady red PDL light commands a large movement in the direction indicated, and a flashing red light commands a small correction.

5.5.5. Failure of PDLs to Illuminate

5.5.5.1. PDLs Fail to Illuminate When Making Contact. If the PDLs do not illuminate when a receiver makes contact, the receiver pilot will inform the boom operator if AAR will continue. Subsequently, if refueling is continued, verbal corrections from the boom operator may be requested.

5.5.5.2. PDLs Fail During Contact. If the PDLs go out during contact, the receiver is to initiate a disconnect and return to the astern position. If AAR is continued, verbal corrections from the boom operator may be requested.

5.5.5.3. Flashing PDLs. Flashing PDLs and tanker lower strobe light on command a breakaway; the receiver will disconnect immediately and move back and down to clear the tanker.

5.5.5.4. Other Illumination. During night AAR, the tail mounted floodlight (TMF), and the boom nozzle lights will also be used to illuminate the boom.

5.6. AAR Centerline Hose. A single fuselage mounted hose drum unit fitted within the lower rear fuselage offers a hose which exits from a tunnel offset by about 1.2 m (4 ft) to the right of the aircraft centerline. The hose is 24 m (80 ft) long, of which 21 m (70 ft) trails from the tunnel; the hose is marked by a series of 0.3 m (1 ft) and 0.6 m (2 ft) wide white bands, see Appendix 5B, Figure 5B-2. The hose terminates in a US MA-3/4 coupling and 0.7 m (26 in) diameter collapsible drogue.

5.6.1. Basic Operation

5.6.1.1. Before the centerline hose can be used for AAR, a series of checks need to be conducted by the tanker; these involve trailing the hose and performing a system test. Receivers are therefore to remain in the observation position until cleared astern the tanker; do not assume that the hose is primed and ready just because it is trailed.

5.6.1.2. When cleared to contact, the receiver should move forward to make contact at the designed closure speed of 2 – 3 kts; overtake speeds approaching 5 kts will almost certainly produce a sine wave whipping action, possibly leading to probe or drogue separation.

5.6.1.3. The hose must be pushed in at least 1.5 m (5 ft), indicated by the first of the 0.6 m (2 ft) white bands, to start fuel flowing.
5 March 2019

- SIMULTANEOUS AAR FROM THE CENTRELINE DROGUE AND WINGTIP MOUNTED WARP POD(S) IS PROHIBITED DUE TO INADEQUATE REFUELLING ENVELOPE CLEARANCE BETWEEN RECEIVER AIRCRAFT.

- EXCEPT IN AN EMERGENCY, CENTRELINE DROGUE AAR WILL NOT BE CONDUCTED WHILE TOBOGGANING.

**CAUTION**

THE CENTERLINE DROGUE REEL RESPONSE SYSTEM WILL BERESET AFTER ESTABLISHING/CHANGING ALTITUDE, ATTITUDE, OR AIRSPEED.

5.6.2. **Receiver Actions**

5.6.2.1. The ideal AAR position is reached when a further 6 m (20 ft) of hose is pushed in; this is indicated by the second of the 0.6 m (2 ft) white bands. The receiver can push in a further 4.6 m (15 ft) of hose and remain within the refueling range of the hose; the inner limit is marked by the third 0.6 m (2 ft) white band.

5.6.2.2. When in contact, the receiver should maintain the hose aligned with the hose tunnel; this may impose some lateral control loads because of the offset tunnel.

5.6.2.3. Wake turbulence from the tanker may be felt on rear control empennages and may cause some control surface loading.

5.6.2.4. Above 275 KIAS, good contacts are more likely if the probe contacts the center of the drogue; off-center contacts may be ‘soft’.

5.6.2.5. Fuel spray may enter the engine intake and result in engine malfunctions/compressor stalls.

5.6.2.6. The hose drum unit has a winding in torque (response system) applied to counter drogue air drag and thus provide a balanced hose; if tanker airspeed, altitude or attitude is changed, the hose response system will have to be reset.

5.6.2.7. Receivers will be directed clear of the hose whilst hose reset is accomplished.

5.6.3. **Receiver Too Close.** If the inner limit is exceeded, fuel flow ceases and the amber signal light flashes. The receiver has a fore and aft range of movement of 11 m (35 ft) during which fuel will flow.

5.7. **AAR Centerline Hose Lighting** Hose signal lights are mounted on the fuselage in a horizontal row to the left of the fuselage hose tunnel and beneath the pod mouth for the wing stations. The lights are colored red, green and amber.

5.7.1. **Centerline Hose Status Lights** See Appendix 5B, Figure 5B-4 for details about the Centerline Hose Status Lights.

5.8. **AAR Wing Air Refueling Pods (WARPs)** When installed, the hose length is 24 m (79 ft) of which 22.5 m (74 ft) trails from the pod. The hose is black and is marked by a series of 0.3 m (1 ft) wide white bands and two 0.6 m (2
5.8.1. **Basic Operation.** The hose must be pushed in at least 1.5 m (5 ft), indicated by the first 0.6 m (2 ft) wide orange band, to start the fuel flowing.

- SIMULTANEOUS AAR FROM THE CENTRELINE DROGUE AND WINGTIP MOUNTED WARP POD(S) IS PROHIBITED DUE TO INADEQUATE AAR ENVELOPE CLEARANCE BETWEEN RECEIVER AIRCRAFT.
- EXCEPT IN AN EMERGENCY, WARP DROGUE AAR WILL NOT BE CONDUCTED WHILE TOBOGGANING.
- HOSE REEL RESPONSE IS ONLY EFFECTIVE FROM APPROXIMATELY 14 m (46 ft) TO FULL TRAIL. IF THE RECEIVER PUSHES THE HOSE INSIDE THIS INNER RESPONSE LIMIT, A ‘DEAD HOSE’ WILL RESULT. A LOOP WILL FORM THAT COULD CAUSE DAMAGE TO THE RECEIVER AIRCRAFT.

5.8.2. **Receiver Actions.** The ideal refueling position is between the two 0.6 m (2 ft) wide orange bands which mark the inner limit of 17.4 m (57 ft) and the outer limit of 21 m (69 ft) of the AAR range, thus providing a fore and aft range of movement of 3.7 m (12 ft).

5.8.3. **Receiver Too Close.** If the inner AAR limit is exceeded, the amber light flashes (see Appendix 5C for a description of signal lights) indicating the inner response limit is being approached, fuel flow ceases after the hose is pushed in to 14.6 m (47 ft). Fuel flow will start again as the hose is pulled back out past 14.9 m (48 ft). Thus the receiver has a fore and aft range of movement of 6.4 m (20 ft) during which fuel will flow.

5.9. **AAR Wing Air Refueling Pods (WARPs) Lighting**

5.9.1. **Description**

- **5.9.1.1. Day AAR.** Red, amber, and green signal lights are located on the underside of the aft pod tail cone fairing. See Appendix 5C, Figure 5C-1. They are set up in pairs for redundancy and are clearly visible to the receiver pilot. The red (WARNING) signal lights are illuminated whenever the WARP power switch is on and the pods are not ready for receiver contact. The red lights also flash if the hose is at full trail or in AAR range to signal breakaway. Both left and right pods and the centerline hose/drogue signal red signal lights are controlled from a common breakaway switch on the centerline hose/drogue control panel, and alternately by the breakaway switch on the boom controller. The pods will enter a passive mode when either breakaway switch is activated.

- **5.9.1.2. Night AAR.** The intensity of the green and amber lights can be adjusted from BRIGHT for day operations to DIM for night operations. The red lights are always bright.

5.9.2. **Pod Status Lights.** See Appendix 5C for details about the WARP Status Lights.

5.9.3. **Pod Markings.** Three red guide lines are provided at each wing pod location to aid the receiver pilot with alignment prior to contact with the drogue. One line is painted on each side of each wing pod on the underside of the wings several feet away from the pods. A third line is located on the bottom of each wing pod and is used as a center for receiver aircraft alignment.

5.9.4. **Aircraft Lighting.** The aircraft has an extensive array of floodlights, which are adjustable for brilliance; formation keeping lights are also provided. See Appendix 5D, Figure 5D-1.
5.10. AAR Altitudes and Speeds

5.10.1. AAR RV Speed

5.10.1.1. The standard tanker orbit pattern airspeed is 275 KIAS or Mach 0.78, whichever is lower, but not below AAR orbit speed.

5.10.1.2. The standard tanker orbit pattern airspeed for A-10 AAR is 255 KIAS to facilitate the rendezvous slowdown to the A-10 AAR speed.

5.10.2. Boom. Boom AAR height band is sea level to 37,000 ft; speed range is 180 to 350 KIAS.

5.10.3. Centerline Hose. Centerline hose AAR height band is sea level to 35,000 ft; speed range is 200 to 280 KIAS.

5.10.4. WARP AAR. Wing pod AAR height band is sea level to 35,000 ft; speed range is 230 to 300 KIAS.

5.11. Maximum Transferable Fuel. Total fuel load is 154,240 kg (340,000 lb). Transferable fuel is dependent on sortie duration; about 113,330 kg (250,000 lb) is available for transfer during a 4 hour flight, assuming a fuel burn rate of 8170 kg/hr (18,000 lb/hr).

5.12. Fuel Transfer Rate

5.12.1. Boom. 8000 lb/min (3630 kg/min) through the boom.

5.12.2. Centerline Hose. 4000 lb/min (1820 kg/min) through the centerline hose.

5.12.3. WARP. 2400 lb/min (11 kg/min) through the wing hoses.

5.13. Regulated Fuel Pressure. Fuel is delivered to the receiver at the regulated pressure of 3.5 ± 0.35 bar (50 ± 5 psi).

5.14. Fuel Types Available for AAR

Table 5-1 Fuel Grade and Limits

<table>
<thead>
<tr>
<th>USE</th>
<th>GRADE</th>
<th>TYPE</th>
<th>NATO CODE</th>
<th>FLIP CODE</th>
<th>U.S. MILITARY SPEC</th>
<th>U.K. SPEC</th>
<th>SPECIFIC GRAVITY (MAX-MIN AT 60°F)</th>
<th>FREEZE POINT °C (°F)</th>
<th>FUEL DENSITY P/LB</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECOMMENDED FUEL</td>
<td>JP-8</td>
<td>KEROSENE</td>
<td>F-34</td>
<td>J8</td>
<td>MIL-T-83133</td>
<td>DERD 2453</td>
<td>0.840 - 0.775</td>
<td>-47 (-53)</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>JP-4</td>
<td>(WIDE CUT) GASOLINE TYPE</td>
<td>F-40</td>
<td>J4</td>
<td>MIL-T-5624</td>
<td>DERD 2454</td>
<td>0.802 - 0.751</td>
<td>-58 (-72)</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td>JP-5</td>
<td>(HIGH FLASH) KEROSENE</td>
<td>F-44</td>
<td>J5</td>
<td>MIL-T-5624</td>
<td>DERD 2498</td>
<td>0.845 - 0.788</td>
<td>-46 (-51)</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>JP-5B</td>
<td></td>
<td>F-42</td>
<td></td>
<td>MIL-T-5624</td>
<td>DERD 2488</td>
<td>0.845 - 0.788</td>
<td>-40 (-40)</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>JET A COMMERCIAL</td>
<td></td>
<td>F-30</td>
<td>A</td>
<td>NONE</td>
<td>DERD 2482 ASTM D1655-59T</td>
<td>0.840 - 0.775</td>
<td>-40 (-40)</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>JET A-1 COMMERCIAL</td>
<td></td>
<td>F-34</td>
<td>A1</td>
<td>NONE</td>
<td>DERD 2494 ASTM D1655-59T</td>
<td>0.840 - 0.775</td>
<td>-50 (-58)</td>
<td>6.7</td>
</tr>
</tbody>
</table>
5.15. **Mark Facilities.** In response to a receiver request to “Mark” the tanker can dump fuel and/or switch on High Intensity Lighting. “Mark” should only be used if a receiver low fuel state or other similar circumstance requires the rendezvous be expedited. If required, the tanker will dump fuel in 500 to 1000 pound increments until positive visual contact can be maintained.

5.16. **Tanker Dimensions.** The KC-10 is 55 m (180 ft) long and has a wingspan of 50 m (165 ft).

5.17. **RV Aids.** The KC-10 has the following radio, navigation and RV aids:

5.17.1. VHF, UHF and HF radios.

5.17.2. VOR, TACAN, INS, GPS, and search/weather radar.

5.17.3. UDF, A/A TACAN (bearing and DME), TCAS, radar transponder and radar beacon mode.

5.18. **Source Documents**

5.18.1. T.O. 1C-10(K)-A-1
APPENDIX 5A
KC-10 EXTENDER - BOOM

Figure 5A-1 - KC-10 Pilot Director Lights Illumination Profile
Figure 5A-2 – KC-10 Pilot Director Lights
APPENDIX 5B

KC-10 EXTENDER – CENTERLINE HOSE

Figure 5B-1 – KC-10 Centerline Hose/Drogue Signal Lights
Figure 5B-2 – KC-10 Centreline Hose
Figure 5B-3 – KC-10 Centreline Hose Markings/Pod Status Lights
### BEFORE CONTACT

<table>
<thead>
<tr>
<th>STEADY RED</th>
<th>STEADY AMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT ready. Do <strong>NOT</strong> make contact.</td>
<td>Ready for contact</td>
</tr>
</tbody>
</table>

### IN CONTACT

<table>
<thead>
<tr>
<th>STEADY GREEN</th>
<th>GREEN EXTINGUISHES</th>
<th>FLASHING AMBER</th>
<th>STEADY AMBER</th>
<th>STEADY RED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel flows</td>
<td>Offload complete</td>
<td>Hose is pushed back too far, drawback</td>
<td>Aft Limit</td>
<td>Disconnect, drogue malfunction</td>
</tr>
</tbody>
</table>

### ANYTIME

<table>
<thead>
<tr>
<th>ALL 3 LIGHTS ON (Green-Steady, Amber/Red-Flashing)</th>
<th>ALL 3 LIGHTS OUT</th>
<th>FLASHING RED (Tanker lower strobe on)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect Return to Astern</td>
<td>Disconnect</td>
<td><strong>BREAKAWAY</strong></td>
</tr>
</tbody>
</table>
Figure 5C-1 – KC-10 WARP Status Lights

2xAMBER  2xRED  2xGREEN  LIGHTS
Figure 5C-2 – KC-10 Wing Hose
Figure 5C-3 – KC-10 WARP Hose Markings/Status Lights

HOSE AT FULL TRAIL (STEADY AMBER)

REFUELING ZONE

AMBER/RED/GREEN

POD STATUS LIGHTS

HOSE PUSHED IN TO START OF
REFUELING ZONE (NO LIGHTS OR
GREEN LIGHTS ON IF FUEL FLOW
>50 GPM)

AMBER/RED/GREEN

POD STATUS LIGHTS

HOSE PUSHED TO WITHIN 10 FT OF
INNER REFUELLING LIMIT (FLASHING
AMBER/STEADY GREEN)

AMBER/RED/GREEN

POD STATUS LIGHTS

FLASHING AMBER

STEADY GREEN

HOSE PUSHED IN TO/THROUGH INNER
LIMIT; FUEL FLOW CUT OFF (GREEN
OFF/FLASHING AMBER)

AMBER/RED/GREEN

POD STATUS LIGHTS

FLASHING AMBER

BREAKAWAY (FLASHING RED); IMMEDIATELY DISCONNECT
AND MOVE TO A SAFE POSITION
CLEAR OF THE TANKER AND
REFUELING EQUIPMENT. LOWER
ROTATING BEACON FLASHING

AMBER/RED/GREEN

POD STATUS LIGHTS

FLASHING RED
### BEFORE CONTACT

<table>
<thead>
<tr>
<th>STEADY RED</th>
<th>STEADY AMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pod NOT ready. Do <strong>NOT</strong> make contact.</td>
<td>Ready for contact</td>
</tr>
</tbody>
</table>

### IN CONTACT

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<thead>
<tr>
<th>STEADY GREEN</th>
<th>GREEN EXTINGUISHES</th>
<th>FLASHING AMBER</th>
<th>STEADY RED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel flows</td>
<td>Offload complete/ Fuel flow ceased</td>
<td>Hose is pushed back too far, drawback</td>
<td>Disconnect</td>
</tr>
</tbody>
</table>

### ANYTIME

<table>
<thead>
<tr>
<th>ALL 3 LIGHTS OUT</th>
<th>FLASHING RED (Tanker lower strobe on)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect</td>
<td><strong>BREAKAWAY</strong></td>
</tr>
</tbody>
</table>
Figure 5C-5 – WARP Hose

WING POD HOSE POSITION AT FULL TRAIL

- START OF FUEL RANGE
- FORWARD LIMIT
- 22 FT FUEL RANGE
- APPROX 5 FT
APPENDIX 5D
KC-10 EXTENDER – EXTERIOR LIGHTING

Figure 5D-1 – KC-10 Exterior Lighting
Nose landing gear lights
Lower anti-collision/rendezvous light
Aft fuselage under body light (typical) (inboard side of outboard flap hinge fairing)
Forward fuselage underbody lights
Forward position light, green
Formation light (typical)
Fuselage landing light (typical)
Wing and engine scan light (typical)
Taxi and runway turnoff light - ground flood (typical)
Formation light (typical)
Aft position light white (typical)
Formation lights (typical)
Upper anti-collision/rendezvous light
Upper fuselage floodlights
Director lights
High intensity supplemental lights (typical)
Horizontal stabilizer illumination light (typical)
Receiver airplane floodlights
Logo lights
Forward position light, red
5E.1. AAR Position - Visual References. When moving forward from the astern position to the contact position, the visual references used by receiver aircraft pilots permit them to position their aircraft so that they remain within the tanker’s AAR envelope. The following paragraphs provide guidance to assist pilots achieve the correct position.

5E.2. Boom – Elevation

5E.2.1. Vertical Visual References – Heavy Aircraft Receivers

5E.2.1.1. Upper Limit

5E.2.1.1.1. Boom window and pivot in view
5E.2.1.1.2. Flap hinge below wing leading edge
5E.2.1.1.3. 1/2 UHF/VHF antenna below fuselage

5E.2.1.2. Lower Limit

5E.2.1.2.1. Boom window out of view
5E.2.1.2.2. Flap hinge inside slat inner edge
5E.2.1.2.3. 1/2 length of UHF/VHF antenna above fuselage
Figure 5E-1

- Closing to Astern Position
- Astern Position
- Contact Position
Figure 5E-2. Upper and Lower Limits

Figure 5E-3. Inner and Aft Limits
Figure 5E-4. Left and Right Limits

Left Limit

Right Limit
5E.3. **Centerline Hose Visual References.** The picture below shows the first white band just about to enter the hose drum unit tunnel; this is the beginning of the AAR zone. The lateral position is achieved through reference to the broad yellow line painted along the fuselage centerline.

**Figure 5E-5. Receiver Position on Centerline Hose**

Receiver with probe on right side correctly aligned along tanker centerline
5E.4. WARP Visual References. Three red guide lines are provided at each wing pod location to aid the receiver pilot with alignment prior to contact with the drogue. One line is painted on each side of each wing pod on the underside of the wings several feet away from the pods. A third line is located on the bottom of each wing pod and is used as a center for receiver aircraft alignment.

Figure 5E-6. WARP Visual References.
CHAPTER 6

KC-46A PEGASUS

6.1. Introduction. All KC-46s are equipped with an AAR boom and centerline drogue system; many are fitted for Wing Air Refueling Pods (WARP). The aircraft has a receptacle for receiving fuel from boom-equipped tankers. The KC-46A does not have a reverse fuel pumping capability.

6.2. Receiver Types Certified. Details of receiver technical clearances together with AAR speeds and altitudes are published at Chapter 8, Receiver Data – Jet Tankers. In addition, Chapter 8 provides boom operators with receiver information essential to achieving safe AAR operations. For non-US receiver aircraft, the publishing of information in Chapter 8, Receiver Data – Jet Tankers does not constitute an automatic authority to undertake refueling. See Chapter 2, paragraph 2.6.5. for details about authority to conduct AAR.

6.3. AAR Equipment. There is one centerline flyable boom for boom-type refueling. Additionally, a Centerline Drogue System (CDS) is mounted in the aft fuselage of the aircraft for probe and drogue operation. All aircraft have the capability to be fitted with two wing mounted AAR pods; these pods are known as Wing Aerial Refueling Pods (WARPs).

6.4. AAR Boom System

6.4.1. Description. The boom is approximately 36 ft 6 in long with an additional 21 ft of telescoping inner fuel tube. When the boom is fully extended it has a total length of 57 ft 6 in. All KC-46 booms are technically equipped with a Boom Interphone System for direct communication with suitably equipped receivers. However, boom interphone performance for KC-46 has been very poor and intermittent and currently should not be used to communicate with receiver aircraft. A Remote Vision System (RVS) is used to facilitate boom refueling operations. The RVS consists of six panoramic displays, two primary displays, three Long Wave Infrared (LWIR) panoramic cameras, four boom cameras (two visible and two LWIR), two video graphics processors and a scene selection controller. The Aerial Refueling Operator Station (AROS) consists of two identical seat positions with a primary display and left, center and right panoramic displays.

6.4.2. RVS-RELATED LIMITATIONS

• IF ANY RECEIVER AIRCRAFT IS GRANTED A WAIVER TO ANY PART OF SECTION 4.18.1 FUEL REQUIREMENTS IN AFI 11-202 VOLUME 3 AND COULD FLY OUT OF RANGE OF A DIVERT BASE, A LEGACY TANKER AIRBORNE SPARE IS REQUIRED FOR TANKER REFUELING OPERATIONS.

• RVS OPERATION IN LWIR IS PROHIBITED.

• BOOM AERIAL REFUELING CONTACTS WITHOUT STEREO VISION (I.E. MONO) IS PROHIBITED.

• BOOM OPERATORS WITHOUT PREVIOUS LEGACY TANKER QUALIFICATION MUST BE MONITORED BY A BOOM OPERATOR WHO IS PREVIOUSLY QUALIFIED ON A LEGACY TANKER SEATED IN THE INSTRUCTOR POSITION.

• USE OF SHARPENING SETTING CAN DEGRADE DEPTH PERCEPTION AND LEAD TO AN INCREASED RATE OF CONTACTS OUTSIDE THE RECEPTACLE. SHARPENING SHALL NOT BE USED TO FACILITATE CONTACTS BUT MAY BE USED AFTER DISCONNECT TO EVALUATE IF DAMAGE HAS RESULTED FROM CONTACTS OUTSIDE THE RECEPTACLE.
6.4.3. Basic Operation

6.4.3.1. When ready to refuel, the boom is lowered from its stowed position and 12 ft of the retractable portion is extended by the Boom Operator.

6.4.3.2. Receiver stabilizes in pre-contact position and the Boom Operator selects appropriate scene for lighting and background condition. RVS ops card may help with selection of appropriate scene.

6.4.3.3. When cleared, the receiver moves from the stabilized (zero rate of closure) pre-contact position to a steady boom contact position.

6.4.3.4. Closure to contact will be slow and stable (approximately 1 foot per second) with the receiver stabilizing in the contact position.

6.4.3.5. The Boom Operator will verify selected RVS scene remains stable. If scene degrades or visual cues are not discernable, return receiver to pre-contact position and re-evaluate scene selection before clearing receiver to proceed to contact position.

6.4.3.6. When contact position is achieved, the Boom Operator flies the boom to the receiver aircraft’s receptacle and extends the boom to make contact. Locking toggles in the receptacle operate to hold the boom nozzle in contact.

6.4.3.7. The receiver then maintains its position within the boom’s operating envelope.

6.4.3.8. The digital fly-by-wire control system has an Automatic Load Alleviation System (ALAS). The ALAS reduces radial forces on the nozzle and receptacle; this permits a larger AAR envelope without nozzle binding.

**WARNING**

- THE RECEIVER WILL STABILIZE IN THE ASTERN POSITION AND ATTAIN A ZERO RATE OF CLOSURE. IF THE RECEIVER FAILS TO ATTAIN STABILISED POSITION, OR IT BECOMES APPARENT THAT A CLOSURE OVERRUN WILL OCCUR, BREAKAWAY PROCEDURES WILL BE INITIATED. FAILURE TO DO SO COULD RESULT IN A MID-AIR COLLISION.

- EXCESSIVE CLOSURE RATE COULD CAUSE THE TANKER TO DESCEND INTO THE PATH OF THE RECEIVER. THE TANKER PILOT MUST BE PREPARED TO DISCONNECT THE AUTOPILOT TO PREVENT ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST INDICATION OF A CLOSURE OVERRUN.

- DUE TO KC-46 BOOM STIFFNESS, UPON DISCONNECT THE RECEIVER MAY ACCELERATE TOWARD OR AWAY FROM THE TANKER. THE BOOM OPERATOR SHOULD BE PREPARED TO IMMEDIATELY FLY THE BOOM AWAY FROM THE RECEIVER UPON DISCONNECT.

- DUE TO INADVERTENT AND UNDETECTED KC-46 BOOM LOADING, THE BOOM MAY RAPIDLY MOVE TOWARDS THE RECEIVER UPON DISCONNECT. THE BOOM OPERATOR SHOULD BE PREPARED TO IMMEDIATELY FLY THE BOOM AWAY FROM THE RECEIVER UPON DISCONNECT.
• IF THE LOSS OF STEREO VISION IS ENCOUNTERED DUE TO A FAILURE (I.E., MONO) WHILE THE RECEIVER IS IN CONTACT, A DISCONNECT OR BREAKAWAY SHALL BE PERFORMED WHEN APPROPRIATE, AND FURTHER BOOM REFUELING OPERATIONS SHALL BE TERMINATED DUE TO THE LOSS OF DEPTH PERCEPTION.

⚠️ CAUTION ⚠️

• BINDING OF THE BOOM NOZZLE IN THE RECEIVER’S RECEPTACLE IS POSSIBLE, EVEN WITH A DISCONNECT SIGNAL. WHILE NOZZLE BINDING CAN OCCUR IN MOST DISCONNECT POSITIONS, IT IS MOST LIKELY AT HIGH RECEIVER ROLL AND LOW BOOM ELEVATION. IF NOZZLE BINDING OCCURS OR IS SUSPECTED, NEUTRALISE BOOM FLIGHT CONTROL INPUTS. AVOID ABRUPT BOOM FLIGHT CONTROL INPUTS.

• AIRCRAFT SURFACES AND CONTOURS MAY APPEAR TO BE FLAT WHILE IN REALITY THEY ARE RAISED. THE ILLUSION MAY CAUSE DEPTH PERCEPTION ERRORS PRIOR TO MAKING CONTACT AND AFTER DISCONNECT.

• DUE TO LIMITATIONS OF THE RVS EXERCISE CAUTION TO AVOID STRIKING ANY ANTENNA IN THE VICINITY OF THE AERIAL REFUELING RECEPTACLE.

• ATTEMPTS TO AFFECT A CONTACT WITH LESS THAN OPTIMAL RVS IMAGERY IS AT THE DISCRETION OF THE BOOM OPERATOR.

• DAY, DAWN, OR DUSK CONTACTS SHALL NOT BE ATTEMPTED IF EITHER SUNLIGHT GLARE OR REFLECTIONS CAUSE THE BOOM REFUELING PICTURE TO WASH OUT OR, IF SHADOWS CAUSED BY THE TANKER OR RECEIVER FUSELAGE PREVENT THE BOOM OPERATOR FROM CLEARLY DISTINGUISHING THE RECEPTACLE CONTOURS, NOZZLE/RECEPTACLE SEPARATION DISTANCE, OR CUES AND BORDERS. THE TANKER SHALL CHANGE THE SCENE SELECTION OR ADJUST HEADING TO ACHIEVE ACCEPTABLE IMAGERY.

• IF RVS IMAGERY DEGRADATES WHILE IN CONTACT, ESPECIALLY IN A TURN, CONSIDER WAITING TO DISCONNECT UNTIL THE IMAGERY IMPROVES. IF THE IMAGERY DOES NOT IMPROVE OR THE RECEIVER IS LOST IN SHADOW OR WASHOUT, DIRECT THE RECEIVER TO A SAFE POSITION MOVING TO CENTER, BACK AND DOWN BEFORE DISCONNECTING.

• UNDER SOME SITUATIONS, RECEIVER MOTION MAY CREATE WASHOUT AND SHADOW CONDITIONS. THE BOOM OPERATOR SHALL INITIATE A DISCONNECT OR BREAKAWAY AS APPROPRIATE IF IMAGERY IS NOT SATISFACTORY.

• EMERGENCY SEPARATIONS MAY CAUSE THE RECEIVER TO DROP LOW AND OUT OF THE RVS FIELD OF VIEW. THIS COULD RESULT IN THE BOOM OPERATOR BEING UNABLE TO MAINTAIN VISUAL CONTACT. THE BOOM OPERATOR SHALL REQUEST A “WELL CLEAR”
CALL FROM THE RECEIVER PRIOR TO TERMINATING THE SEPARATION.

- IT MAY BE DIFFICULT TO SEE WHETHER THE BOOM NOZZLE IS SEATED IN THE RECEPTACLE – THE BOOM OPERATOR SHALL BE VIGILANT FOR NOZZLE FLOAT OUT. ENSURE THE NOZZLE IS CLEAR OF THE RECEPTACLE PRIOR TO FULLY RETRACTING THE BOOM. IF THE NOZZLE REMAINS CAPTURED IN THE RECEPTACLE AFTER A NORMAL DISCONNECT IS INITIATED, INITIATE INDEPENDENT DISCONNECT SYSTEM PROCEDURES.

**NOTE**

- OPTIMAL IMAGERY INCLUDES ADEQUATE DEPTH PERCEPTION AND ALL REQUIRED VISUAL CUES.

- DUE TO LIMITATIONS OF THE RVS, DEPTH PERCEPTION IS DYNAMIC AND MAY DEGRADE. THE BOOM OPERATOR SHOULD MONITOR QUALITY OF DEPTH PERCEPTION.

- TURNS AND TRANSITION OF BACKGROUNDS MAY RESULT IN RVS IMAGE DEGRADATION.

- USE OF THE BOOM FLOODLIGHT MAY IMPROVE IMAGERY DURING DUSK AND DAWN CONDITIONS. CONSIDER TURNING ON THE FLOODLIGHT PRIOR TO NIGHT CONDITIONS.

- THE BOOM OPERATOR SHOULD PROVIDE VERBAL CORRECTIONS TO RECEIVERS IN THE AIR REFUELING ENVELOPE IF PORTIONS OF THE ENVELOPE PRESENT LESS THAN OPTIMAL RVS IMAGERY DUE TO SHADOWS OR WASHOUTS. CORRECTIONS SHOULD BE USED TO POSITION RECEIVER WITHIN AREAS OF ACCEPTABLE IMAGERY

- DURING DAY CONDITIONS, THE RECEPTACLE DOORS MIGHT CREATE A SHADOW OVER THE RECEPTACLE AREA. THE SEVERITY OF THE ANOMALY IS DEPENDENT ON THE SUN ANGLE AND CAN VARY IN A TURN.

- UP TO 5 MINUTES PER RECEIVER SHOULD BE CONSIDERED IN PLANNING FOR KC-46 RVS SCENE OPTIMIZATION

- IF OPTIMAL SCENE SELECTION PROVES TO BE DIFFICULT FOR THE CURRENT AMBIENT CONDITIONS, REFER TO THE RVS SCENE SELECTION GUIDE FOR ADDITIONAL INSTRUCTIONS (LOCATED IN APPENDIX 8F).

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**6.4.4. Independent Disconnect System.** The boom has an Independent Disconnect System (IDS). In the event of the receptacle toggle latches failing to unlatch from the boom using the normal electrical signaling system, the IDS can be used. The IDS employs an electrical solenoid to retract striker plates inward on each side of the boom nozzle removing the latching surface for the receiver receptacle latches; this reduces the likelihood that a brute force disconnect is required by opening the latch channel and allowing the receiver receptacle latches to slide off the boom nozzle striker plates. The KC-46 IDS differs from legacy tanker systems in that it can be used repeatedly without needing recharging.

**6.4.5. Boom Envelope.** The KC-46A automatically defines receiver envelope limits based on Boom Operator-inputted receiver type. Each receiver has a specifically defined refueling envelope. The Boom Actuator Control Unit (ACU) monitors the boom position and rates of motion to remain within each receiver’s defined envelope.
Should the receiver approach the envelope limits, the boom control system initiates a disconnect prior to the boom exceeding an envelope limit. The full boom envelope is illustrated in Appendix 8A, Figure 8A-3; however, the envelope is reduced for some receiver aircraft because of individual receptacle characteristics.

6.4.6. **Failure of the Boom Flight Control System.** Should the boom fly-by-wire control system suffer certain failures, the Boom Operator may not be able to control the boom in one or more axis of movement. During one of these system failures, a RAIS message will be displayed and the Boom Operator will initiate a disconnect or breakaway based on the severity of the malfunction.

![CAUTION](image)

- AVOID RAPID OR ABRUPT LARGE BOOM CONTROL INPUTS OR REVERSALS, ESPECIALLY IN COMBINATION WITH LARGE CHANGES IN BOOM ELEVATION OR ROLL AS THEY MAY RESULT IN STRUCTURAL DAMAGE OR A BOOM INOP MESSAGE AT ANY SPEED.

6.4.7. **Receiver Actions**

6.4.7.1. **KC-46 RVS Timing.** An impactful effect of the KC-46 RVS from a receiver perspective is the amount of time that may be required for the KC-46 Boom Operator to safely and effectively complete the AR task. Receiver pilots should bear in mind that due to the multiple Warnings, Cautions and Notes listed above and multiple possible setting changes for the KC-46 RVS, AROs will likely need more time to setup and complete AAR than would be required for legacy tankers.

6.4.7.2. **KC-46 RVS Impact.** KC-46 AROs may need to call for breakaway, call for a disconnect, or call for the receiver to return to precontact at any point in the refueling process due to inconsistent and possibly degraded RVS conditions.

6.4.7.3. **Boom Forces.** Relatively large forces are required for the receiver to telescope the KC-46 boom in or out while in contact. This drives the following warning for the receiver pilot:

![WARNING](image)

- DUE TO THE BOOM STIFFNESS, THE RECEIVER MAY BE CARRYING AN UNKNOWN AMOUNT OF EXCESS THRUST. THE RECEIVER PILOT SHOULD BE VIGILANTLY MONITORING THRUST UPON DISCONNECT TO REACT AS QUICKLY AS POSSIBLE IF EXCESS THRUST DOES CAUSE THE RECEIVER TO ACCELERATE TOWARD THE TANKER.

Small thrust changes while in contact on the KC-46 boom may cause the bottoming out of a “recoil spring” on the KC-46 boom. This makes a “clunking” sound to the receiver pilot that may sound like the boom has disconnected even though it has not.

6.5. **AAR Boom Lighting**

6.5.1. **Description.** Pilot Director Lights (PDLs) include two illuminated light strips that are mounted on the belly of the aircraft just forward of the aircraft main landing gears. One strip indicates forward and aft movement requests and the other illuminated strip indicates up or down movement is required. Both PDL strips work together to keep the receiver aircraft in the center of the refueling envelope. (Appendix 8A, Figure 8A-1)
6.5.2. Basic Operation. The lights are controlled by movement of the boom in elevation and by the in and out movement of the telescoping portion. These lights provide positional trending information about the boom in relation to the boom operating envelope and command the direction of receiver movement required to bring the boom to the ideal refueling position. Lateral position lights are not provided for the roll (side-to-side) positioning of the receiver. Lateral positioning is defined by two illuminated centerline reference lights on the lower surface of the tanker fuselage (one aft and one forward).

- MANUALLY EDITING AUTOMATIC RECEIVER BOOM ENVELOPE DISCONNECT LIMITS IS NOT RECOMMENDED, DUE TO MANUAL LIMITS PROVIDING MISLEADING PDL TREND INFORMATION TO THE RECEIVER. EDIT LIMITS ONLY BECAUSE OF AN IDENTIFIED SAFETY NEED FOR A SMALLER DISCONNECT ENVELOPE, OR BECAUSE OF AN INCORRECT AUTOMATIC LIMIT.

- DO NOT EDIT RECEIVERS WHILE IN CONTACT. CHANGES MADE TO ANY BOOM, CDS OR WARP RECEIVER WHILE A BOOM RECEIVER IS SELECTED IN THE ACTIVE RECEIVER WINDOW ON THE BOOM AR FLIGHT PAGF MAY RESULT IN A ROLL LIMIT OF ZERO FOR THE ACTIVE RECEIVER.

6.5.3. Covert AR.

- COVERT BOOM AR BOTH FROM THE TANKER SIDE AND FROM THE RECEIVER SIDE IS CURRENTLY PROHIBITED WITH THE KC-46.

6.5.4. Radio Silent Procedures.

- EMCON 3 AND 4 (RADIO SILENT PROCEDURES) ARE CURRENTLY PROHIBITED FOR THE KC-46.

6.5.5. Receiver Actions

6.5.5.1. Elevation. The left PDL strip defines the vertical movement required to stay within the aerial refueling envelope. At the forward-most end of the elevation panel is the illuminated letter U (for up); at the other end is the illuminated letter D (for down). Adjacent to and between the two letters are red arrows. If a receiver is in contact with the boom near the upward elevation limit of the aerial refueling envelope, the red arrow next to the D is illuminated; this indicates a downward movement is required. As the receiver moves down, the red light extinguishes and an amber arrow illuminates, indicating the boom is approaching the ideal elevation. When the ideal elevation is reached, the amber light extinguishes and a green bar illuminates to indicate that the receiver is in the center of the refueling envelope.

6.5.5.2. Forward/Aft. The right PDL strip defines the forward/aft movement required to stay within the
aerial refueling envelope. At the forward-most end of the forward/aft panel is the illuminated letter A (for aft); at the other end is the illuminated letter F (for Forward). Forward/Aft position is similar to the Elevation PDL but the display is slightly different. The ends of the panel have the illuminated letters F and A (forward and aft). The required actions of the receiver pilot are provided by illuminated horizontal bars with red leading into amber. As with the left display, the ideal position is shown by illuminating a green bar in the center of the panel. The command indications are separated by illuminated vertical white bars to give contrast. Both the Elevation and Forward/Aft PDLs are capable of covert operations.

6.5.5.3. **PDLs Fail to Illuminate When Making Contact.** If the PDLs do not illuminate when a receiver makes contact, the receiver pilot will inform the Boom Operator if AR will continue. Subsequently, if refueling is continued, verbal corrections from the Boom Operator may be requested.

6.5.5.4. **PDLs Fail During Contact.** If the PDLs go out during contact, the receiver is to initiate a disconnect and return to the pre-contact position. If AR is continued, verbal corrections from the Boom Operator may be requested.

6.5.5.5. **Flashing PDLs.** Flashing PDLs and tanker lower strobe light command a breakaway; the receiver will disconnect immediately and move back and down to clear the tanker.

6.5.5.6. **Other Illumination.** During Night AAR, the boom floodlight, and boom marker light will be used to illuminate the boom. The receiver pilot will inform the Boom Operator if any KC-46 light is too bright or blinding, including the boom floodlight.

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6.6. **AAR Centerline Drogue System (CDS).** The CDS consists of a single fuselage mounted hose drum unit fitted within the lower rear fuselage. The system features electronic control of a hydraulically powered hose reel, variable fuel flowrate, dual regulator coupling and a high speed variable drag drogue.

6.6.1. **Basic Operation**

6.6.1.1. Before the CDS can be used for AAR, a friction calibration test must be performed. During the test the hose and drogue rewinds from full trail position (78 ft) approximately 1 ft and then extends back to full trail. Receivers are therefore to remain in a modified pre-contact position, 10-15 ft aft of the drogue, until the signal light turns from red to steady amber at which point the receiver should proceed to the normal precontact position. From there, the receiver should stabilize and proceed to contact as normal. Do not assume that the hose is ready for contact just because it is trailed.

6.6.1.2. When cleared to contact, the receiver should move forward to make contact at a minimal closure rate.

6.6.1.3. The hose must be pushed in at least 5 ft, indicated by the first of the 4 ft white bands, to start fuel flowing.
• **CDS REFUELING IS PROHIBITED FOR SOFTWARE VERSIONS PRIOR TO CDS RCU 5.0.**

• **SIMULTANEOUS AAR FROM THE CDS AND WINGTIP MOUNTED WARP POD(S) IS PROHIBITED DUE TO INADEQUATE REFUELING ENVELOPE CLEARANCE BETWEEN RECEIVER AIRCRAFT.**

• **TO MINIMIZE THE RISK OF INADVERTENT DISCONNECTS, CDS OPERATION WILL BE IN “WET” CONTACT MODE ONLY. PLANNED “DRY” CONTACTS ARE PROHIBITED.**

### 6.6.2. Receiver Actions

**6.6.2.1.** The ideal normal pre-contact position is reached when the receiver attains zero rate of closure 2-3 ft from the refueling drogue basket. After receiving clearance from the Boom Operator and a steady amber light, the receiver should move forward into the contact position.

**6.6.2.2.** When in contact, the receiver should maintain the hose aligned with the hose tunnel;

**6.6.2.3.** Wake turbulence from the tanker may be felt on rear control empennages and may cause some control surface loading.

**6.6.2.4.** Good contacts are more likely if the probe contacts the center of the drogue; off-center contacts may be ‘soft’.

**6.6.2.5.** Fuel spray may enter the engine intake and result in engine malfunctions/compressor stalls.

### 6.6.3. Receiver Too Close.

If the inner limit is exceeded, fuel flow ceases and the amber signal light flashes. The receiver has a fore and aft range of movement of 20 ft during which fuel will flow.

### 6.7. AAR Centerline Hose Lighting.

A pair of CDS tunnel flood lights mounted along the inner surface of the CDS tunnel provide illumination of the hose and its markings within and immediately beyond the CDS tunnel exit. A CDS hose flood light is mounted in the boom pivot fairing which provides illumination of the CDS hose and its markings along the forward segment of hose beyond the tunnel exit. A pair of lights mounted on the undersides of the horizontal stabilizer provides illumination of the contact envelope, the aft end of the hose, and the CDS drogue basket. Six LED coupling lights illuminate the coupling and drogue.

**6.7.1. Centerline Hose Status Lights.** Hose signal lights provide two redundant set of lights, one on each side of the CDS exit tunnel. The signal lights incorporate both visible and covert illumination sources. Each set of signal lights consist of one red/IR, one amber/IR, and one green/IR light.

**WARNING**

• **HOSE MARKING VISIBILITY IS DEGRADED AT AIRSPEEDS ABOVE 250 KIAS. NIGHT REFUELING OPERATIONS ARE PROHIBITED ABOVE 250 KIAS DUE TO INADEQUATE VISUAL CUES TO MAINTAIN RECEIVER POSITION IN THE REFUEL RANGE.**
**WARNING**

- ENSURE THE CDS HOSE FLOOD LIGHT IS SET TO 100% INTENSITY DURING NIGHT AND TWILIGHT OPERATION. AT TWILIGHT AND NIGHT, RECEIVERS CANNOT CLEARLY SEE THE HOSE OR DROGUE AS THEY MOVE FROM THE FORMATION POSITION TO THE PRE-CONTACT POSITION, UNLESS THE CDS HOSE FLOOD LIGHT IS SET TO 100%.

6.8. AAR Wing Air Refueling Pods (WARPs). The KC-46A WARPs system has not been qualified or tested with individual receivers, and therefore is currently prohibited for operational use. Information will be added to this section as it becomes available.

6.9. AAR Wing Air Refueling Pods (WARPs) Lighting. The KC-46A WARPs system has not been qualified or tested with individual receivers, and therefore is currently prohibited for operational use. Information will be added to this section as it becomes available.

6.10. AAR Altitudes and Speeds

6.10.1. AAR RV Speed

6.10.1.1. The standard tanker orbit pattern airspeed is 275 KIAS or Mach 0.78, whichever is lower, but not below AAR orbit speed.

6.10.2. Boom. Boom AAR height band is sea level to 35,000 ft; speed range is 180 to 325 KCAS.

6.10.3. Centerline Hose. Centerline hose AAR height band is sea level to 35,000 ft; speed range is 180 to 325 KCAS

6.11. Maximum Transferable Fuel. Total fuel load is 211,000 lb. Transferable fuel is dependent on sortie duration; about 155,000 lb is available for transfer during a 4 hour flight, assuming a fuel burn rate of 11,000 lb/hr.

6.12. Fuel Transfer Rate

6.12.1. Boom. 8,040 lb/min (1200 gal/min) through the boom.

6.12.2. CDS. 2,680 lb/min (400 gal/min) through the centerline hose.

6.13. Regulated Fuel Pressure. Fuel is delivered to the receiver at the regulated pressure of 3.5 ± 0.35 bar (50 ± 5 psi).

6.14. Fuel Types Available for AAR

The following fuels and mixtures thereof are approved for use:

5. Jet A and Jet A-1 as specified in ASTM D 1655
6. JP-5 as specified in MIL-DTL-5624
7. JP-8 as specified in MIL-DTL-83133
Fuels produced to other specifications and having properties meeting the requirements of the above specification are acceptable for use.

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Minimum Inflight Fuel Temp *</th>
<th>Maximum Fuel Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet A</td>
<td>-37°C</td>
<td>49°C (120°F)</td>
</tr>
<tr>
<td>Jet A-1</td>
<td>-44°C</td>
<td></td>
</tr>
<tr>
<td>JP-8</td>
<td>-44°C</td>
<td></td>
</tr>
<tr>
<td>JP-5</td>
<td>-43°C</td>
<td>49°C (120°F)</td>
</tr>
</tbody>
</table>

* 3°C above the freezing point for the fuel type

6.15. **Mark Facilities.** In response to a receiver request to “Mark” the tanker can dump fuel and/or switch on High Intensity Lighting. “Mark” should only be used if a receiver low fuel state or other similar circumstance requires the rendezvous be expedited. If required, the tanker will dump fuel in 500 to 1000 pound increments until positive visual contact can be maintained.

6.16. **Tanker Dimensions.** The KC-46 is 165 ft long and has a wingspan of 156 ft.

6.17. **RV Aides.** The KC-46 has the following radio, navigation and RV aids:

   6.17.1. VHF, UHF and HF radios.

   6.17.2. VOR, TACAN, INS, GPS, and weather radar.

   6.17.3. A/A TACAN (bearing and DME), TCAS, and radar transponder.

   6.17.4. Link-16 Tactical Data Link
APPENDIX 6A

KC-46 PEGASUS - BOOM

Figure 6A-1 - KC-46 Pilot Director Lights Illumination Profile
KC-46 Covert Pilot Director Lights

- COVERT BOOM AR BOTH FROM THE TANKER SIDE AND FROM THE RECEIVER SIDE IS NOT CURRENTLY AUTHORIZED WITH THE KC-46.

- NVG USAGE FOR RECEIVERS IS PROHIBITED ON JOIN-UP AND WHILE FLYING IN FORMATION WITH THE KC-46 TANKER DUE TO REQUIRED KC-46 LIGHTING CAUSING UNACCEPTABLE BLOOM/BLINDING TO RECEIVER PILOTS ON NVGS.
APPENDIX 6B
KC-46 PEGASUS – CENTERLINE DROGUE SYSTEM

Figure 6B-1 – KC-46 Centerline Hose/Drogue Signal Lights

Centerline Drogue System Signal Lights
Figure 6B-2 – KC-46 Centerline Hose

Figure 6B-3 – KC-46 Centerline Hose Markings/Pod Status Lights
Figure 6B-4 – KC-46 Centerline Hose Status Lights

### BEFORE CONTACT

<table>
<thead>
<tr>
<th>STEADY RED</th>
<th>STEADY AMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT ready. Do NOT make contact.</td>
<td>Ready for contact.</td>
</tr>
</tbody>
</table>

### IN CONTACT

<table>
<thead>
<tr>
<th>STEADY GREEN</th>
<th>FLASHING GREEN</th>
<th>ALL LIGHTS OUT</th>
<th>FLASHING AMBER</th>
<th>STEADY RED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Flows</td>
<td>Fuel Flow &lt; 50 GPM</td>
<td>Offload Complete</td>
<td>Inner/AFT Refueling Range Exceeded</td>
<td>CDS Malfunction</td>
</tr>
<tr>
<td>Pumps on 50-400 GPM Fuel Delivery</td>
<td>Pumps on &lt; 50 GPM Fuel Delivery</td>
<td>Upload Complete Disconnect</td>
<td>Inner/AFT Refueling Range Exceeded</td>
<td>Not Ready Contact Denied</td>
</tr>
</tbody>
</table>

### ANYTIME

<table>
<thead>
<tr>
<th>FLASHING RED</th>
</tr>
</thead>
<tbody>
<tr>
<td>BREAKAWAY</td>
</tr>
</tbody>
</table>
APPENDIX 6C

KC-46 PEGASUS – WARP

The KC-46A WARP system has not been qualified or tested with individual receivers, and therefore is currently prohibited for operational use. Information will be added to this section as it becomes available.
APPENDIX 6D
KC-46 PEGASUS – EXTERIOR LIGHTING

Figure 6D-1 - KC-46 EXTERIOR LIGHTING
AR Centerline Drogue Floodlight Illumination Areas

WARP Flood Light Illumination Areas (Aft View)
6E.1. AAR Position - Visual References. When moving forward from the astern position to the contact position, the visual references used by receiver aircraft pilots permit them to position their aircraft so that they remain within the tanker’s AAR envelope. The following paragraphs provide guidance to assist pilots achieve the correct position.

6E.2 Boom

Figure 8E-1 - KC-46 REFUELING VISUAL REFERENCES
30 Degree Line Astern

Flap Line

30° Reference

“Knob”

Lower Limit

30°

Upper Limit

Right drain
Contact Position – 30 Degree Line Reference

Contact Position
6E.3. Centerline Hose Visual References. TBD

6E.4. WARP Visual References. Three red guide lines are provided at each wing pod location to aid the receiver pilot with alignment prior to contact with the drogue. One line is painted on each side of each wing pod on the underside of the wings several feet away from the pods. A third line is located on the bottom of each wing pod and is used as a center for receiver aircraft alignment.
CHAPTER 7

HC/MC-130 TANKER

7.1. Introduction. The HC/MC-130 is a specially modified C-130 series airframe designed to support personnel recovery (PR) and Special Operations Forces (SOF) missions. The primary mission of HC/MC-130 is to conduct long-range, low-altitude, night and/or adverse weather delivery of personnel and cargo, employing both airdrop and airland methods conducting infiltration, exfiltration, resupply, helicopter aerial refueling and Forward Area Refueling Point (FARP) operations in hostile or enemy-controlled territory.

7.2. Receiver Types Certified. Receiver clearances details are published in Appendix 7A.

7.3. AAR Equipment. The HC/MC-130 has 2 drogue equipped refueling stations, one mounted on each wing outboard of the engines. There are five Mission Design Series (MDS) aircraft in this category: HC-130N/P, HC-130J, MC-130H, MC-130P, and MC-130J. Three MDS (HC-130N/P and MC-130P) have the Sargent Fletcher 48-000-4 refueling pod. MC-130H aircraft have the Integrated Air Refueling System (IARS) refueling pod. Two MDS (HC/MC-130J) have the Sargent Fletcher 48-000-6 refueling pod. Each type of refueling pod has different characteristics and pod status lights. Receivers should confirm which of the MDS tankers they will be refueling from.

7.4. POD Description.

7.4.1. HC/MC-130P/N Sargent Fletcher Refueling System - HC-130P/N and MC-130P. Each refueling station consists of a Sargent Fletcher 48-000-4 refueling pod, 24.7 m (81 ft) of hose, either an MA-2 or MA-3-1 reception coupling, and a 0.67 m (27 in) diameter high-speed or 1.3 m (54 in) diameter low-speed paradrogue. Helicopters may not refuel from the high-speed drogue.

7.4.2. MC-130H/W Integrated Air Refueling System. Each refueling station consists of an Integrate Air Refueling System (IARS) refueling pod, 26.5 m (87 ft) of hose, an MA-4A reception coupling, and a variable drag drogue (VDD) with an inside diameter of 0.68 m (24 inch).

7.4.3. HC/MC-130J Sargent Fletcher Refueling System- HC-130J and MC-130J. Each refueling station consists of a Sargent Fletcher 48-000-6 refueling pod, 28.5 m (93 ft) of hose, either an MA-3, or MA-3-1 reception coupling and a 0.67 m (27 in) diameter high-speed fixed wing or 54 in (1.3 m) diameter low-speed helicopter paradrogue. Helicopters may not refuel from a high-speed drogue. The HC/MC-130J has fuel boost pumps fitted in the AAR pods to improve performance.

7.5. Basic Operation.

7.5.1. HC/MC-130P/N Sargent Fletcher Refueling System - HC-130P/N and MC-130P. Fuel flows when the hose is pushed in 1.5 m (5 ft); flow continues provided the hose is maintained in the refueling range, between 17.1 – 23.2 m (56 – 76 ft) of hose extension. Hydraulic pressure provides 90% of the force required to rewind the hose during refueling to reduce hose slack and the potential development of a sine wave/hose whip. The MA-2 coupling requires 140 ft-lb of force to latch the nozzle into the reception coupling and 420 ft-lb of force to disconnect the nozzle from the coupling. The force levels are based on 0 to 10 lbs per sq inch gauge (psig) static fuel pressure in the coupling.

7.5.2. MC-130H Integrated Air Refueling System. Fuel flows when the hose is pushed in 1.5 m (5 ft); flow continues provided the hose is maintained in the refueling range, between 18.9 – 24.9 m (62 – 82 ft) of hose extension. The hose drum system is capable of retracting the hose up to 5.5 m (18 ft) per second to prevent hose whip (caused by excessive slack) when a receiver makes contact at speeds up to 3.1 m (10 ft) per second throughout the airspeed envelope. The drum response system allows contacts at engagement speeds as low as 0.6 m (2 ft) per second and disconnect speeds of up to 1.2 m (4 ft) per second. The MA-4A coupling requires 140 ft-lb of force to latch the nozzle into the reception coupling and 420 ft-lb of force to disconnect the nozzle from the coupling. The force levels are based on 0 to 10 lbs per sq inch gauge (psig) static fuel pressure in the coupling.
The VDD is capable of withstanding impact produced by the probe contact at an angular position of 15° off-center and for closing speeds up to 3 m (10 ft) per second.

7.5.3. **HC/MC-130J Sargent Fletcher Refueling System.** Fuel flows when the hose is pushed in 5 ft (1.5 m); flow continues provided the hose is maintained in the refueling range, between 20 – 80 ft (6 - 24 m) of hose extension. Hydraulic pressure provides 90 percent of the force required to rewind the hose during refueling to reduce hose slack and the potential development of a sine wave/hose whip. The MA-2 coupling requires 140 ft-lb of force to latch the nozzle into the reception coupling and 420 ft-lb of force to disconnect the nozzle from the coupling. The force levels are based on 0 to 10 lbs per sq inch gauge (psig) static fuel pressure in the coupling.

7.6. **HOSE.** The tanker will normally have two hoses extended (the tanker may elect to extend only one hose on missions that do not require the use of both hoses).

7.6.1. **HC/MC-130P/N.** The black hoses are marked with a 0.3 m (1 ft) white band each 3 m (10 ft) and a 1.5 m (5 ft) white banding marking the 6.1 m (20 ft) long refueling range. The hose contains a removable endfitting. When hose slack and whip occur and are observed by the tanker scanner or reported by the receiver pilot, the receiver will be instructed to return to the observation position. During refueling, the receiver should maintain a position on the hose midway between the two 1.5 m (5 ft) bands indicating the refueling range.

7.6.2. **MC-130H.** The black hoses are marked with a 0.3 m (1 ft) white band each 3 m (10 ft) and a 1.5 m (5 ft) white band marking the 6.1 m (20 ft) long refueling range. When hose slack and whip occur and are observed by the tanker scanner or reported by the receiver pilot, the receiver will be instructed to return to the observation position. During refueling, the receiver should maintain a position on the hose midway between the two 1.5 m (5 ft) bands indicating the refueling range.
7.6.3. HC/MC-130J. The black hoses are marked with a 0.3 m (1 ft) white band each 3 m (10 ft). The hose is 25.3 -28.4 m (83 - 93 ft ) in length, of which 23-26 m (75-85 ft) of hose trails from the hose reel tunnel. The hose contains a removable end fitting. The total hose length may be shortened from 28.4 m (93 ft) to 25.3 m (83 ft), or 23-26 m (75-85 ft) trailing from the hose reel. Helicopters and the V-22 shall maintain a refueling range between 80 - 60 ft utilizing the two 5 ft white bands on the refueling hose as the inner and outer limits.

![WARNING]

THE AREA OF EXTREME TURBULENCE DIRECTLY BEHIND AND SLIGHTLY TO THE RIGHT OF THE TANKER SHOULD BE AVOIDED. BLADE STALL AND UNCONTROLLED SETTLING MAY BE ENCOUNTERED IF THIS AREA IS ENTERED.

7.7. COUPLING. A self-sealing reception coupling in the drogue prevents the flow of fuel from the hose until it is engaged with the receiver probe. In order to ensure proper locking of the probe to drogue coupling, a positive closure rate should be maintained until after initial contact. Incomplete locking action could result in fuel spraying from the coupling. Fuel can be transferred with incomplete coupling only while the receiver pushes inward on the drogue.
• EXCESSIVELY HARD CONTACT BETWEEN PROBE AND DROGUE CAN DAMAGE THE REFUELING NOZZLE. SHOULD THE DROGUE BECOME UNSTABLE FROM PROBE CONTACT CAUSING SECTIONS OF THE CLOTH MATERIAL TO FAIL, IT IS POSSIBLE FOR THE DROGUE TO COLLAPSE AND FOR THE HOSE TO RETRACT FULLY INTO THE POD.

• ROTOR BLADE CONTACT WITH THE HEAVY RECEPTION COUPLING OR REFUELING HOSE CAN RESULT IN SIGNIFICANT DAMAGE TO THE ROTOR SYSTEM RESULTING IN SEVERE VIBRATIONS OR FAILURE OF THE ROTOR BLADES AND LOSS OF HELICOPTER CONTROL.

• WING/PROP TURBULENCE CAN CAUSE UNCONTROLLED SETTLING. IF SETTLING OCCURS WHILE CONNECTED TO THE DROGUE, DISCONNECT IMMEDIATELY. FAILURE TO DISCONNECT MAY RESULT IN DAMAGE TO THE PROBE AND POSSIBLE ROTOR BLADE-TO-PROBE CONTACT.

• CONTACT WITH A MALFUNCTIONING DROGUE THAT IS ROTATING AT GREATER THAN ONE REVOLUTION PER SECOND MAY DAMAGE THE PROBE NOZZLE LOCK RING; A COUNTERCLOCKWISE ROTATING DROGUE COULD RESULT IN PARTIAL OR COMPLETE UN-THREADING OF THE PROBE NOZZLE. THEREFORE, CONTACTS WITH THIS TYPE OF DROGUE MALFUNCTION SHOULD BE RESTRICTED TO OPERATIONAL NECESSITY.

• OFF-CENTRE DISCONNECTS CAN DAMAGE THE REFUELING NOZZLE.

7.7.1. MA-2 COUPLING. The MA-2 coupling is flown on the HC-130P/N and MC-130P.
7.7.1.1. Low Speed

NOTE

THE DROGUE MAY BECOME SLIGHTLY LESS STABLE AT REFUELING AIRSPEEDS BELOW 105 KNOTS; HOWEVER, SATISFACTORY REFUELING OPERATIONS CAN BE CONDUCTED AT AIRSPEEDS BETWEEN MINIMUM OPERATIONAL SPEED AND 130 KIAS.

7.7.1.2. High Speed

7.7.2. MA-3 COUPLING. The MA-3 coupling is flown on the HC/MC-130J. The MA-3 coupling requires 155 lb force (drogue dimensions are identical to MA-2 drogues depicted above).

7.7.3. MA-3-1 COUPLING. The MA-3-1 coupling is flown on the HC-130J/N/P and MC-130J/P. The MA-3-1 coupling requires 90 lb force (drogue dimensions are identical to MA-2 drogues depicted above).

7.7.4. MA-4A COUPLING. The MA-4A coupling is flown on the MC-130H.
7.8. AAR LIGHTING.

7.8.1. HC/MC-130 Exterior Lighting. HC/MC-130 aircraft have overt and covert anti-collision lights/strobes. Drogue illumination is provided by overt and infrared (IR) pod and hose illumination lights located on the outboard leading edge of the horizontal stabilizer. These illumination lights have variable intensity controls. The HC-130 and MC-130P have a three color, NVG compatible, pod status light display. The display can operate in two intensity modes: dim and bright. The MC-130H has two modes of AAR pod status lights, IR (covert) and normal.
### 7.8.2. AAR Pods.

#### 7.8.2.1. Sargent Fletcher Description. At the aft end of the refueling pod (HC-130P/N and MC-130P) are three lights; NVIS red, NVIS yellow, and NVIS green.

<table>
<thead>
<tr>
<th>Lights</th>
<th>Unaided (non-NVG) Refuelling</th>
<th>Aided (NVG) Refuelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anticollision/Strobe</td>
<td>OFF</td>
</tr>
<tr>
<td>a</td>
<td>Upper</td>
<td>OFF</td>
</tr>
<tr>
<td>b</td>
<td>Lower</td>
<td>OFF</td>
</tr>
<tr>
<td>2</td>
<td>Leading Edge</td>
<td>OFF</td>
</tr>
<tr>
<td>3</td>
<td>Navigation</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Flash/Off/Steady</td>
<td>STEADY</td>
</tr>
<tr>
<td>b</td>
<td>Wing</td>
<td>DIM</td>
</tr>
<tr>
<td>c</td>
<td>Tail</td>
<td>OFF</td>
</tr>
<tr>
<td>d</td>
<td>Fuselage</td>
<td>OFF</td>
</tr>
<tr>
<td>4</td>
<td>Formation</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Coloured Wing, Fuselage/Both</td>
<td>BOTH</td>
</tr>
<tr>
<td>b</td>
<td>Rheostat</td>
<td>BRIGHT</td>
</tr>
<tr>
<td>5</td>
<td>Pod &amp; Hose Illumination</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>On (White/OFF/IR)</td>
<td>OFF or OVERT</td>
</tr>
<tr>
<td>b</td>
<td>Rheostat</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>Pod Status Lights</td>
<td>DIM</td>
</tr>
</tbody>
</table>

**Tanker Ready NVIS Yellow Light**

**Fuel Flowing NVIS Green Light**

**Hydraulic Failure NVIS Red Light**

**Left HAR Pod**

**Right HAR Pod**
CAUTION

- **ENGAGING THE HOSE WITH THE RED (HYDRAULIC PRESSURE OFF) LIGHT ILLUMINATED IS CONSIDERED AN EMERGENCY PROCEDURE.**

7.8.2.2. **IARS Description.** At the aft end of the refueling pod (MC-130H) are three overt and three IR status lights; both sets are red, amber, and green.
7.8.2.3. **HC/MC-130J Sargent Fletcher Description.** Drogue illumination is provided by refueling lights located on the outboard leading edge of the horizontal stabilizer. There are equally spaced luminescent paint spots on the drogue to assist during night operations. The HC/MC-130J has two modes of AAR pod status lights, overt and covert.

7.8.2.3.1. **Description.** Red, green, and amber lights are located on the trailing edge of each AAR pod for use in the overt lighting scheme. For covert lighting, a symbolic lighting scheme consisting of small LED’s surround these red green and amber lights.

7.8.2.3.2. **Pod Status Lights.** The AAR pod status lights mean:

<table>
<thead>
<tr>
<th>Receiver Position</th>
<th>Overt Lights</th>
<th>Covert Lights</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before Contact</strong></td>
<td>Steady Red</td>
<td>Steady Circle with a Y</td>
<td>Pod not ready, do not make contact</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Steady Y (see picture below)</td>
<td>(if refuelling is absolutely required, contact using emergency procedures shall be coordinated)</td>
</tr>
<tr>
<td><strong>In Contact</strong></td>
<td>Steady Green</td>
<td>Steady Circle</td>
<td>Fuel flow greater than 50 gpm</td>
</tr>
<tr>
<td></td>
<td>Steady Amber</td>
<td>Steady Y</td>
<td>Past the inner refuelling limit</td>
</tr>
<tr>
<td><strong>Anytime</strong></td>
<td>Steady Red</td>
<td>Steady Circle with Y</td>
<td>Low hydraulic pressure, no hose response, Disconnect, pod malfunction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IARS Mode/Condition</th>
<th>Left Red</th>
<th>Centre Amber</th>
<th>Right Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakaway/Any Condition</td>
<td>Flash</td>
<td>Flash</td>
<td>Flash</td>
</tr>
<tr>
<td>Stowed/Trail/Response Test/Rewind/Passive</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Standby, Regulator outlet pressure within limits</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>Standby, Regulator outlet pressure out of limits (Normal/Overt)</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Standby, Regulator outlet pressure out of limits (Covert)</td>
<td>On</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Standby, Regulator outlet pressure within limits and motor overload present</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Tension Control, Hose length outside outer refuelling range</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Tension Control, Hose length in refuelling range, fuel flow ≤ 50 gpm</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Tension Control, Hose length in refuelling range, fuel flow ≥ 50 gpm</td>
<td>Off</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>Tension Control, Fuel Flow ≥ 50 gpm, Hose length within 1.5 m (5 ft) of inner refuelling range: Receiver is too close to the tanker, must back out</td>
<td>Off</td>
<td>Flash</td>
<td>On</td>
</tr>
<tr>
<td>Tension Control, Fuel Flow &lt; 50 gpm, Hose length within 1.5 m (5 ft) of inner refuelling range: Receiver is too close to the tanker, must back out</td>
<td>Off</td>
<td>Flash</td>
<td>Off</td>
</tr>
<tr>
<td>Tension Control, Hose length inside inner refuelling range: Receiver is too close to the tanker, must back out</td>
<td>Off</td>
<td>Flash</td>
<td>Off</td>
</tr>
</tbody>
</table>
7.9. **EMCON.** HC/MC-130 tankers use EMCON 2 procedures as the standard for refueling, however other EMCON procedures may be briefed and used. AAR is normally accomplished through the use of light signals from the tanker. All HC/MC-130 tankers use multi-color light signals (white, green, amber, and red) IAW ATP 3.3.4.2 Annex 2O, Emission Control. **EXCEPTION:** Unless briefed otherwise, one steady green light will be used to clear the receiver to contact from the observation position. Receivers are not required to wait in precontact for an additional signal for clearance to contact. Similarly, receivers are not required to wait for clearance from the tanker to disconnect.

7.9.1. **HC/MC-130J/P/N Aircraft.** For these aircraft, light signals are provided by hand held ALDIS lamps or flashlights with colored filters and will be seen in the paratroop door windows (located at the rear of the fuselage on both sides of the aircraft) or from the open ramp and door.

7.9.2. **MC-130H.** For these aircraft, light signals are provided by the External Signal Light (ESL) Panel mounted on the lower, forward area of the paratroop doors at the rear of the fuselage on both sides of the aircraft. ESL lights have adjustable intensity for all light conditions.

7.10. **AAR Altitudes and Speeds.**

7.10.1. **Altitude Band.** AAR altitude band is no lower than 300 ft above receiver minimum altitude to maximum service ceiling or AR pod altitude limitation, whichever is lower. HC/MC-130 aircraft normally ingress and conduct RV procedures at AAR altitude.
TANKERS SHOULD LIMIT BANK ANGLE TO 30° IN THE AIR REFUELLING CONFIGURATION TO PREVENT TANKER STALL. HOWEVER, IF TERRAIN OR WEATHER IS NOT A FACTOR, BANK ANGLE SHOULD BE LIMITED TO 15°. AT HIGH DENSITY ALTITUDES AND/OR HIGH GROSS WEIGHTS, THE RECEIVER MAY EXPERIENCE ROTOR BLADE STALL AT BANK ANGLES LESS THAN 30°. CAREFUL CONSIDERATION OF HELICOPTER LIMITATIONS SHOULD BE MADE WITH RESPECT TO BANK ANGLE AT HIGH DENSITY ALTITUDES.

NOTE

AT THE RECEIVER'S REQUEST, THE TANKER MAY USE ASYMMETRICAL POWER TO REDUCE TURBULENCE WHEN THE RIGHT REFueling POSITION IS USED.

7.10.2. Maximum Hose Extension/Retraction Speed. The maximum hose extension/retraction speed is: 120 KIAS/KCAS with the low speed drogue, 250 KIAS/KCAS with the high speed drogue and 180 KIAS/KCAS with the variable drag drogue (VDD).

7.10.3. Speed Range – High Speed Drogue. The refueling airspeed range for the high speed drogue is 185 to 215 KIAS (acceleration to 230 KIAS is allowed after engagement). The HC/MC- 130J refueling airspeed range for the high speed drogue is 185 to 250 KIAS.

7.10.4. Speed Range – Low Speed Drogue. The recommended refueling airspeed range for the low speed helicopter drogue is 105 to 120 KIAS (acceleration to 130 KIAS is allowed after engagement).

7.10.5. Speed Range – Variable Drag Drogue. The refueling airspeed range for the variable drag drogue is 110 to 180 KIAS/KCAS.

7.11. Maximum Transferrable Fuel. Maximum transferable fuel loads vary with mission type and length. HC/MC-130N/P aircraft are capable of installing internal fuel tanks to increase transferable fuel. Burn rates provided below are based on a low-level flight profile to and from the AAR track.
ATP-3.3.4.2.(C)
US STANDARDS RELATED DOCUMENT(SRD)

<table>
<thead>
<tr>
<th>TANKER TYPE</th>
<th>NORMAL FUEL LOAD</th>
<th>FUEL LOAD WITH INTERNAL TANKS</th>
<th>FUEL AVAILABLE AFTER 4 HR FLIGHT</th>
<th>TANKER BURN RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC-130E</td>
<td>22,680 kg (50,000 lb) 8000 US gal</td>
<td>N/A</td>
<td>8709 kg (19,200 lb) 3072 US gal</td>
<td>2812 kg/hr (6200 lb/hr) 992 US gal</td>
</tr>
<tr>
<td>MC-130H</td>
<td>25,401 kg (56,000 lb) 8960 US gal</td>
<td>N/A</td>
<td>9979 kg (22,000 lb) 3520 US gal</td>
<td>3175 kg/hr (7600 lb/hr) 1120 US gal</td>
</tr>
<tr>
<td>MC-130P</td>
<td>26,308 kg (58,000 lb) 9280 US gal</td>
<td>36.795 kg (81,120 lb) 12,979 US gal</td>
<td>12,700 kg (28,000 lb) 4480 US gal</td>
<td>2720 kg/hr (6000 lb/hr) 960 US gal</td>
</tr>
<tr>
<td>MC-130W</td>
<td>28,576 kg (63,000 lb) 10,080 US gal</td>
<td>N/A</td>
<td>14,968 kg (33,000 lb) 5280 US gal</td>
<td>2720 kg/hr (6000 lb/hr) 960 US gal</td>
</tr>
<tr>
<td>HC-130P/N</td>
<td>26,308 kg (58,000 lb) 9280 US gal</td>
<td>36.795 kg (81,120 lb) 12,979 US gal</td>
<td>12,700 kg (28,000 lb) 4480 US gal</td>
<td>2720 kg/hr (6000 lb/hr) 960 US gal</td>
</tr>
<tr>
<td>HC/MC-130J</td>
<td>27.727 kg (61,000 lb) 9760 US gal</td>
<td>N/A</td>
<td>17.727 kg (39,000 lb) 6240 US gal</td>
<td>2500 kg/hr (5700 lb/hr) 880 US gal</td>
</tr>
</tbody>
</table>

**NOTE:** Fuel loads are based on JP-8 at 2.83 kg (6.25 lbs) per gallon.

7.12. **Fuel Transfer Rate.** The rate of fuel transfer during AAR is governed by several factors. One is the transfer rate capability of the receiver aircraft. Another is a function of the tanker fuel system configuration and mode of tanker refueling system operations.

7.12.1. **HC/MC-130P/N/E Sargent Fletcher System.** If only the wing store fuel is available, the maximum transfer capability is 750 – 1000 lb/min (340 – 454 kg/min) or 120 – 160 gal/min for a single receiver engaged. With no fuselage tanks and two receivers engaged, the transfer rate will be split between the receivers: 375 – 500 lbs/min (170 – 227 kg/min) or 60 – 80 gal/min.

7.12.2. **MC-130H Integrated Air Refueling System.** The IARS pump is designed to provide fuel at varying flow rates up to 1937 lb/min (879 kg/min) or 310 gal/min.

7.12.3. **HC/MC-130J Sargent Fletcher System.** The maximum transfer capability is approximately 1020 lb/min (462kg/min) or 150 gpm for a single receiver engaged. With two receivers engaged, the transfer rate will be approximately 680 lb/min (308 kg/min) or 100 gpm for each receiver dependent upon the number of transfer pumps utilized. The HC/MC-130J has fuel boost pumps fitted in the AAR pods. These pumps are selectable dependent upon receiver capabilities. Fuel transfer rates with these pod boost pumps are up to 2,040 lb/min (925 kg/min) or 300 gpm for receivers capable of accepting this flow rate for either single or dual hose operations. A lower fuel transfer rate can be selected on request. Transfer rates in the range of 28-40 psi up to maximum tanker capability may be planned for or requested based on receiver limitations.

7.13. **Regulated Fuel Pressure.**

7.13.1. **HC/MC-130P/N Sargent Fletcher System.** Fuel is delivered to the receiver within the pressure range of 5 – 28 psi (0.35 – 1.93 bars) at the drogue. The tanker crew is unable to adjust delivery pressure.

7.13.2. **MC-130H Integrated Air Refueling System.** The IARS pump is designed to provide fuel at varying pressures up to 120 psi (8.3 bars) at the drogue. Fuel pressure is programmable to accommodate receiver aircraft limitations and needs. Receiver must coordinate required/maximum fuel pressure prior to refueling.

7.13.3. **HC/MC-130J Sargent Fletcher System.** Fuel is delivered to the receiver at a regulated pressure of 2.76 – 3.79 bars (45 psig, -5/+10 psig) @ 300 gpm.

**NOTE**
AT THE DELIVERY PRESSURES BELOW, THE HELICOPTER TANKS MAY BE FILLED TO TOP OFF WITH NO VALVE CLOSURE RESTRICTIONS.

<table>
<thead>
<tr>
<th>Helicopters</th>
<th>Pressure (psig)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-53J/M</td>
<td>35 psig</td>
</tr>
<tr>
<td>MH-60K/L</td>
<td>35 psig</td>
</tr>
<tr>
<td>HH-60G</td>
<td>35 psig</td>
</tr>
<tr>
<td>MH-47D</td>
<td>20 psig</td>
</tr>
<tr>
<td>MH-47E</td>
<td>35 psig</td>
</tr>
</tbody>
</table>

7.14. Fuel Types Available for AAR.

7.14.1. Primary Fuel. The primary fuels are F34 (JP-8), F24 (Jet A + Static Dissipator Additive (SDA) + Corrosion Inhibitor / Lubricity Improver (CI/LI) + Fuel System Icing Inhibitor (FSII)), and F27 (F24 + the +100 Thermal Stability Additive (TSA)).

7.14.2. Alternate Fuels. The alternative fuels are F-40 (JP-4), F-44 (JP-5), Jet A and Jet A-1. For HC/MC-130J, ASTM D 1655 (w/Gov additives) and TS-1 (w/Gov additives) can also be used.


7.15. Mark Facilities. Overt or IR strobes and fuel dump.

7.16. Tanker Dimensions. Aircraft diagrams are at Appendix 7B to this Chapter. The HC/MC-130 is 29.8 m (97.8 ft) long, with a wingspan of 40.4 m (132.6 ft); the aircraft height is 11.7 m (38.5 ft) and the stabilizer span is 16.1 m (52.7 ft).

7.17. RV Aids. The HC/MC-130 has the following radar, navigation and RV aids:

7.17.1. FM, VHF, UHF, HF, and SATCOM.

7.17.2. VOR, TACAN, ADF, GPS and INS.

7.17.3. UHF-DF, A/A TACAN (DME only), weather and ground mapping radar, and TCAS.

7.18. Source Documents.

7.18.1. T.O. 1C-130(H)N-1 Flight Manual USAF Series HC-130 Aircraft

7.18.2. T.O. 1C-130(M)H-1 Flight Manual USAF Series MC-130H Aircraft

7.18.3. T.O. 1C-130(M)P-1 Flight Manual USAF Series MC-130P Aircraft

7.18.4. T.O. 1C-130(M)J-1 Flight Manual USAF Series MC-130J Aircraft

7.18.5. T.O. 1C-130(H)J-1 Flight Manual USAF Series HC-130J Aircraft

7.18.6. T.C.T.O. 1C-130-1831 Replacement of NVG Compatible Lenses for Formation and Refueling Lighting on MC-130E/P Aircraft
7A.1. Receiver Types Certified. All H-47, H-53, and H-60 series probe equipped helicopters as well as V-22 series tilt-rotor aircraft are certified to receive fuel from HC/MC-130 aircraft. All other receivers must meet provisions of MIL-HDBK-516, paragraph 8.7, before seeking receiver certification.

7A.2. Receiver Crew Certification. Pilots meeting minimum initial qualification and currency requirements outlined below are certified to receive fuel from HC/MC-130 aircraft.

7A.2.1. Initial Qualification.

7A.2.1.1. Day. At least one (1) rendezvous and join-up with a total of three (3) contacts. Applicable receiver flight/training manuals may set additional qualification requirements.

7A.2.1.2. Night. At least one (1) rendezvous and join-up with a total of three (3) contacts. Day initial qualification must be achieved prior to night qualification. Applicable receiver flight/training manuals may set additional qualification requirements.

7A.2.2. Currency Requirements.

7A.2.2.1. Day. Accomplish a minimum of one (1) rendezvous, join-up, and contact IAW AFI 11-2MDS series (or service equivalent) publications, or at a minimum every 180 calendar days. Applicable receiver flight/training manuals may set additional currency requirements.

7A.2.2.2. Night. Accomplish a minimum of one (1) rendezvous, join-up, and contact IAW AFI 11-2MDS series (or service equivalent) publications, or at a minimum every 180 calendar days. Applicable receiver flight/training manuals may set additional currency requirements. Night currency is not required for day only operations.
APPENDIX 7B
HC/MC-130 TANKER CONFIGURATIONS

Figure 7B-1 – HC/MC-130H/P Configuration
Figure 7B-2 – HC/MC-130J Configuration
Figure 7C-1 – HC/MC-130H/P Exterior Lighting

\[ I = \text{Infrared (IR)} \\
N = \text{Night Vision Imaging System (NVIS)} \\
G = \text{Overt Green} \\
R = \text{Overt Red} \\
W = \text{Overt White} \]
Figure 7C-2 – HC/MC-130J Exterior Lighting
CHAPTER 8

RECEIVER DATA – JET TANKERS
(BOOM/BDA/DROGUE)

8.1. Introduction. This Chapter provides data essential for safe boom and drogue AAR operations between USAF heavy jet tanker and appropriately equipped receiver aircraft. Importantly, for boom AAR, as well as offering information about the location of the boom receptacle, it lists receiver aircraft equipment in close proximity to the receiver receptacle that must be avoided to prevent damage during AAR operations.

8.2. USAF Heavy Jet Tanker/AAR Receiver Data. Tanker-specific receiver data is published in the following Appendices:

8.2.1. KC-135 Stratotanker – AAR Receiver Information. Appendix 8A to this chapter contains data necessary to effect KC-135 AAR operations.

8.2.2. KC-10 Extender – AAR Receiver Information. Appendix 8B to this chapter contains data necessary to effect KC-10 AAR operations.

8.2.3. KC-46 – AAR Receiver Information. Appendix 8C to this chapter contains data necessary to effect KC-46 AAR operations.

8.3. Common Warnings, Cautions and Notes. Warnings, Cautions and Notes that are common to all USAF tankers are published in Appendix 8D to this chapter. The definitions for each of these labels is published in ATP 3.3.4.2.

8.4. Receiver-Specific AAR Information. Where receiver-specific information is necessary to enhance the safety of AAR activity, it is promulgated in Appendix 8E to this chapter. Importantly, users of this chapter must also consult Appendix 8E to ensure that they garner a full understanding of areas that must be considered before conducting AAR.

8.5. Commercial and Foreign Military AAR Receivers Technically Compatible with USAF Heavy Jet Tankers. All AAR participants, whether a tanker or receiver, must be reviewed to ensure that they are technically compatible with the other participant. Confirmation that a technical compatibility assessment has been conducted and found to satisfactory is published by the appropriate tanker technical authority and incorporated into Figure 2-5 of this instruction. If a conflict exists between this document and another nation’s SRD or any information maintained by an office other than a US Government Agency, this document shall take precedence.

8.6. KC-135 AAR Mission Planning and Inflight Data. This Appendix publishes AAR planning data for all receiver aircraft with an AAR technical compatibility assessment has been conducted and a letter issued permitting operations with the KC-135 Stratotanker. Dependent upon the fuel transfer mechanism in use, the appropriate tanker/receiver data for Boom, BDA, and MPRS are contained in the following figures:
APPENDIX 8A
KC-135 STRATOTANKER AAR
RECEIVER INFORMATION
## KC-135 AAR MISSION PLANNING AND INFIGHT DATA (BOOM)

**NOTE:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

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<tr>
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</tr>
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<td>300 KIAS</td>
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<td>310 / 0.88</td>
<td>6000 / 4</td>
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<td>4 7-9</td>
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<td>10-40</td>
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</table>

### NOTES:

1. B-2 FWD limit is 10, AFT limit is 18. Extend boom to 12 feet for astern.
2. < 5 units of trim the elevation limits are 20 UP and 35 LOWER.
3. < 5 units of trim the elevation limits are 25 UP and 35 LOWER.
4. < 4 units of trim the elevation limits are 20 UP and 35 LOWER.
5. AC-130U/EC-130U/MC-130J AAR airspeed envelope is 190 - 230 KIAS from 0 to 20,000 feet MSIL. Adjust A/R airspeed as requested by receiver.
6. RCVWC-135, E-8 and USAF E-3 receivers are equipped with boom interphone system.
7. At the first indication of reduced fuel flow during AAR, reduce to one A/R pump.
8. E-3DF - Use a maximum of two A/R pumps.
9. (CT-49A Only) Do not activate the A/R pumps while in contact. After five dry contacts, have the receiver move to the astern position, and wet down the boom.
10. Use one A/R pump with receivers configured with external tanks.
11. The receiver may request to decrease to one A/R pump during fuel transfer or after a pressure disconnect.
12. To minimize pressure disconnects, reduce the number of A/R pumps to two at the first indication of reduced fuel transfer rate.
13. Reverse flow AAR is only accomplished in an actual fuel emergency.
14. F-15SA 200/300/- See Notes in Appendix 8E.
15. Boom interphone not permitted with tail numbers 2AF-0001 through 2AF-0030 or 2AN-0001 through 2AN-0002.
16. Boom Trim Setting of at least 3 is recommended. If less than 3 units of boom trim are used, restrict lower elevation limit to 35 degrees and notify receiver of envelope restriction.
17. Category II Clearance. AR is not authorized without receiver MAJCOM/CA3 approval. See paragraphs 2.1.1, 2.6.5, and 8E.20 for restrictions and limitations.
# KC-135 AAR Mission Planning and Inflight Data (BDA)

**NOTE:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

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<th>OPTIMUM AAR ALT/IAS/MACH</th>
<th>CRUISE IAS</th>
<th>PROBE LIMIT MACH</th>
<th>PPM / # PUMPS</th>
<th>RENDEVOUS X</th>
<th>BOOM TRAIL POSITION</th>
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<tr>
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<td>150/250/-</td>
<td>310</td>
<td>1-2 FPS</td>
<td>- / 1</td>
<td>X</td>
<td>X</td>
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<td>250/275/0.68</td>
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<td>280/275/0.80</td>
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<td>X</td>
<td>X</td>
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<td>- / 250-280 / -</td>
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<td>4R</td>
<td>30</td>
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<td>200-310/275 +5 KIAS</td>
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<td>- / 1</td>
<td>4R</td>
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**Notes:**

1. Due to probe weakness, attempt contact at lower airspeed/closure rate. If required, increase airspeed in 5-knot increments, closure rate as necessary, up to indicated limits.
2. UK F-3 ADV and UK GR-1 Tornado Aircraft - Daylight AAR under VFR conditions only.
3. Probe limit MACH is based upon the aerodynamic loads on the receiver’s probe while in contact.
4. No AAR operations shall be conducted with the F-3’s Stability Augmentation System inoperative unless an emergency fuel quantity condition exists in the receiver.
5. Boom trail position for Tornado F-3 ADV is 4L.
### KC-135 AAR MSN Planning and Inflight Data (MPRS)

**NOTE:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

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<td><strong>OPTIMUM AAR ALT/IAS/MACH</strong></td>
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**NOTES:**

1. Daylight AAR only.
2. Due to probe weakness, attempt contact at lower airspeeds/closure rate; if required, increase airspeed in 5 knot increments, closure rate as necessary, up to indicated limits.
3. Use only one pod and one AR pump. Simultaneous AAR is prohibited. Inform the receiver of any observed fuel venting; continuation of AAR will be at the discretion of the receiver pilot.
## APPENDIX 8B

### KC-10 EXTENDER AAR RECEIVER INFORMATION

#### 8B.1. KC-10 AAR Mission Planning and Inflight Data.

This Appendix publishes AAR planning data for all receiver aircraft with an AAR technical compatibility assessment has been conducted and a letter issued permitting operations with the KC-10 Extender tanker. Dependent upon the fuel transfer mechanism in use, the appropriate tanker/receiver data for Boom and Drogue are contained in the following figures:

### KC-10 AAR MISSION PLANNING AND INFIGHT DATA (BOOM)

**NOTE:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

| TYPE | RCVR | BUDDY CRUISE | optimum AAR ALT/CAS/MACH | OVERRUN CAS/MACH | PPM/PUMP | RENDEZVOUS | A/A TAG | SINGLE / MULTIPLE | VHF | INTERPHONE | VOICE | A/R ALTITUDE | REVERSE AR | FLOOR LIGHT | DIRECTORY | LIMITS |
|------|------|--------------|---------------------------|------------------|-----------|------------|--------|------------------|------|-------------|-------|-------------|---------|-------------|----------|--------|---------|--------|-------|
| A-10AC | 210 | 190/210/- | 240 | 250 | 3000/2 | X X X X X | 1NN | X | 5-7 | .75 | 19 - 19 | 20 - 40 |
| B-18 | 320/70 | 210/320/70 | 350 | 350/80 | 7000/6 | X X X X X | RDR LOCK | X | X | 5-9 | .50 | 25 - 25 | 20 - 40 |
| B-2A | - / 76 | 250/275/75 | 450 | 5200/4 | X X X X X | X/NN | 1NN | X | 6-10 | .75 | 17 - 17 | 20 - 40 |
| B-52H | 275/80 | 300/275/80 | 310 | 310/88 | 7300/6 | X X X X | 1NN / 2NM | X | 6-9 | .25 | 19 - 19 | 20 - 40 |
| C-5A/C/M | 300/77 | 250/275/66 | 300 | 310 | 7300/6 | X X X X | X | 1NN / 2NM | X | 6-9 | .50 | 21 - 21 | 20 - 40 |
| C-17A | 310/77 | 120 – 310/285 | 310 | 310 | 8400/6 | X X X X | X | 1NN / 2NM | X | 7-9 | .75 | 19 - 19 | 25 - 40 |
| C-32B | 310/77 | 250/275/66 | 310 | 310/77 | 6000/4 | X X X X | X | 1NN | X | 7-9 | .75 | 25 - 25 | 20 - 40 |
| C-130/J/PU 320/70/130I/AC-130J | - | 080000 | 215 | 240 | 3000/2 | X X X X | 1NN | X | 6-9 | .50 | 15 - 15 | 20 - 40 |
| E-4B | - / .82 | 250/275/82 | 310 | 310 | 7800/6 | X X X X | 1NN / 2NM | X | X | 5-7 | .75 | 21 - 21 | 20 - 40 |
| F-15A/E-110K | 310/82 | 300/310/82 | 345 | 350/88 | 3200/2 | X X | RDR LOCK | X | 5-7 | 1.0 | 23 - 23 | 20 - 40 |
| K/N/R/5560-F3 | 310/82 | 300/310/82 | 345 | 350/88 | 4000/2 | X X | RDR LOCK | X | 6-10 | 1.0 | 15 - 21 | 25 - 40 |
| F-22A | 310 | 250/310/- | 335/88 | 3000/2 | X X | RDR LOCK | X | 5-7 | .75 | 15 - 15 | 25 - 40 |
| F-35A | 300 | 200/300/- | 335 | 335 | 1800/2 | X X | RDR LOCK | X | 7 | .25 | 19 - 19 | 25 - 40 |
| KC-135A | - / .82 | 250/290/82 | 325 | 335/88 | 7800/6 | X X X X | 1NN / 2NM | X | X | 5-9 | .75 | 25 - 25 | 20 - 40 |
| T17 (737 AWACS) | 2700/74 | 200-250 / 270 / | 310 | 310 | 4000 / 2 | X X X X | 1NN | X | 5-9 | .50 | 25 - 25 | 20 - 40 |

### NOTES:

1. A-10 with 2 external tanks and 2 ECM PODS use A/R altitude of 15,000 FT.
2. When topping off C-5, use only 4 pumps.
3. RC/WE-135, E-8 and USAF E-3 aircraft equipped with boom interphone.
4. E-3, F-15, F-16 can interphone IFF/SIF.
5. F-4/E/F with 3 external tanks use A/R altitude of 25,000 FT. Only RF-4 has HF.
6. AC-130H optimum AAR speed CAS is 190 KTS.
7. EC-130/IM-130/J/AC-130J aircraft AAR envelope is 190 to 230 KIAS at 0 – 20,000 FT MSL. Optimum is 210 KIAS/10,000 FT MSL. Upper limit for the AC-130/J is 25 degrees.
8. The C-32B can refuel at altitudes between FL200 and FL310. Speeds can vary between 250 – 300 KIAS.
9. F-15SA 200/300/- See Notes in Appendix 8E
10. Boom interphone not permitted with tail numbers 2AF:0001 through 2AF:0030 or 2AN:0001 through 2AN:0002.
## KC-10 AAR MISSION PLANNING AND INFLIGHT DATA (DROGUE)

**Note:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

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<tr>
<td>TORNADO F-3 ADV</td>
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**Notes:**

1. Applicable to Centerline Drogue only.
2. For WARP AAR a minimum of two AR pumps will be used for each WARP Pod in use. When using both pods at the same time, a minimum of four AR Pumps will be used.
3. For Centerline Drogue use 275 KIAS or .80 MACH, whichever is less. For WARP the maximum AAR speed is 300 KIAS or .86 MACH, whichever is less.
4. Night AAR with the HAWK shall not be conducted.
5. Due to unknown structural strength of the HAWK probe mast, closure rate is restricted to 1-2 FPS.
6. Due to design weakness of the JAGUAR-S probe, contact should first be attempted at the lower airspeeds and closure rates. If necessary, increase speeds (5 knot increments) and slowly increase closure rate (up to 4 FPS authorized).
7. (ALL) Concurrent AAR with the WARP and Centerline Drogue will not be conducted.
8. No AAR operations shall be conducted with the Stability Augmentation System inoperative unless an emergency fuel quantity condition exists in the receiver.
9. CV-22/MV-22 are authorized only to refuel from the Centerline Drogue only. Authorized AAR envelope is 200-210 KIAS and 5,000 to 16,000 ft MSL.
10. With external stores, limit altitude/airspeed to 10,000-25,000 ft MSL and 240-275 KCAS. Mission Planning: 20,000 ft MSL, 250 KCAS.

**PAGE 8-6**
8C.1. **KC-46 AAR Mission Planning and Inflight Data.** This Appendix publishes AAR planning data for all receiver aircraft with an AAR technical compatibility assessment has been conducted and a letter issued permitting operations with the KC-46 tanker. Dependent upon the fuel transfer mechanism in use, the appropriate tanker/receiver data for Boom and Drogue are contained in the following figures:

### KC-46 AAR Mission Planning and Inflight Data (Boom)

**NOTE:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

<table>
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<tr>
<th>TYPE</th>
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<th>RCVR RV SPD/CAS</th>
<th>OVERRUN CAS/MACH</th>
<th>PPM</th>
<th>RENDEZVOUS AAR</th>
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<td>FL250-FL300/310</td>
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<td>350/.88</td>
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<td>X</td>
<td>1NM/2NM</td>
<td>10</td>
<td>23 - 23</td>
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**NOTES:**
1. Boom Interphone use is prohibited.
2. Category II Clearance. AR is not authorized without tanker and receiver MAJCOM/A3 risk acceptance and approval. See paragraphs 2.1.1, 2.6.5, and applicable receiver data in Appendix 8E for additional restrictions and limitations.
# KC-46 AAR MISSION PLANNING AND INFLIGHT DATA (DROGUE)

**NOTE:** For foreign national receivers, before planning/conducting AAR activity, see Chapter 2, para 2.6.5 and Figure 2-5.

## CURRENT AS OF: 12 Feb 19

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<th>OPTIMUM AAR ALT/TAS/MACH</th>
<th>RCVR RV SPEED</th>
<th>OVERRUN CAS/MACH</th>
<th>PPM/ # PUMPS</th>
<th>RENDEZVOUS</th>
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**PLACEL HOLDER PENDING DATA RELEASE**

**NOTES:**
8D.1. COMMON WARNINGS, CAUTIONS, and NOTES. The following WARNINGS, CAUTIONS and NOTES are common to all receiver aircraft and must be read in conjunction with the receiver-specific information published in the appropriate paragraph below.

**WARNING**

- (ALL) FOR ALL FOREIGN AIRCRAFT AAR, DO NOT TRANSMIT ON THE HF RADIO WHEN THE RECEIVER IS WITHIN 1/2 NM; THIS INCLUDES DATALINK.

- (ALL) FOR ALL U.S. BOOM RECEIVER AARS, DO NOT TRANSMIT ON HF RADIO WHEN RECEIVER IS IN CLOSE PROXIMITY OR IN CONTACT WITH THE AAR BOOM, UNLESS OTHERWISE SPECIFIED.

- (ALL) TANKER AIRSPEED AND ALTITUDE CHANGES MUST BE MADE SMOOTHLY AND CAUTIOUSLY WHILE THE RECEIVER IS IN OR NEAR THE CONTACT POSITION. ANY AIRSPEED OR ALTITUDE ADJUSTMENTS REQUIRED BY THE TANKER DUE TO AERODYNAMIC EFFECT OF RECEIVER CLOSURE SHOULD BE ACCOMPLISHED AFTER THE RECEIVER IS STABILISED IN THE CONTACT POSITION.

- (ALL) THE BOOM OPERATOR MUST BE CONSTANTLY AWARE OF THE RECEIVER’S POSITION AND RATE OF MOVEMENT. THE RECEIVER’S RATE OF MOVEMENT TOWARD AN ENVELOPE LIMIT WILL DICTATE THE NEED TO INITIATE A DISCONNECT. IF THE MOVEMENT IS TOWARD THE INNER LIMIT, BOOM OPERATORS WILL EXERCISE SOUND JUDGMENT IN INITIATING A DISCONNECT OR BREAKAWAY PRIOR TO THE RECEIVER EXCEEDING THE LIMIT OR OVERRUNNING THE TANKER.

**CAUTION**

- (ALL) FOR ALL FIGHTER AND C-130 AIRCRAFT, THE TELESCOPE-AT-DISCONNECT SWITCH WILL BE IN MANUAL DURING AAR OPERATIONS.

- (ALL) FOR ALL FIGHTER AIRCRAFT, AVOID EXCESSIVE RETRACTION RATES TO PREVENT PULLING THE RECEIVER FORWARD IF A BOOM RELEASE IS NOT OBTAINED.
• (ALL) CONTACT WILL NOT BE ATTEMPTED UNTIL THE FIGHTER TYPE RECEIVER HAS STABILIZED 2 TO 3 FEET FROM THE CONTACT POSITION.

• (ALL) FOR UARRSI AND ALL FIGHTER RECEPTACLES, TO MINIMIZE NOZZLE COCKING WHEN MAKING CONTACT WITH THE RECEIVER, THE BOOM NOZZLE SHOULD BE INSERTED STRAIGHT INTO THE RECEPTACLE WITHOUT AID OF THE SLIPWAY; USING THE SLIPWAY MAY CAUSE THE NOZZLE TO COCK, PREVENTING CONTACT.

• (ALL) DURING AAR OPERATIONS, EXERCISE CAUTION TO AVOID STRIKING ANY ANTENNA IN THE VICINITY OF THE AAR RECEPTACLE.

• (ALL) ATTEMPTS TO AFFECT A CONTACT DURING LOSS OF ANY AAR LIGHTING THAT RESULTS IN LESS THAN DESIRED ILLUMINATION WILL BE AT THE DISCRETION OF THE BOOM OPERATOR.

• (ALL) ALL FOREIGN RECEIVER PILOTS SHALL BE AAR QUALIFIED AND CURRENT IN ACCORDANCE WITH USAF PROCEDURES FOR ALL AAR OPERATIONS.

NOTE

• (ALL) RECEIVER PHOTOGRAPHY IS PROHIBITED WHILE CONDUCTING FLIGHT OPERATIONS IN THE EDWARDS FLIGHT TEST CENTER COMPLEX.


• (ALL) EXCEPT WHEN SECURITY WOULD BE COMPROMISED, A VERBAL HOT ARMAMENT CHECK WILL BE ACCOMPLISHED BETWEEN THE TANKER AND RECEIVERS CARRYING FORWARD FIRING ORDNANCE DURING THE 15 MINUTES PRIOR TO ARCT CALL. THE VERBAL HOT ARMAMENT CHECK ACCOMPLISHED BETWEEN THE TACTICAL AIR CONTROLLER AND THE RECEIVER DURING ANCHOR RENDEZVOUS WILL SATISFY THIS REQUIREMENT.

• (ALL) NIGHT IS DEFINED AS THE PERIOD OF TIME WHEN THE BOOM NOZZLE IS NOT CLEARLY VISIBLE WITHOUT THE AID OF TANKER EXTERIOR AAR LIGHTING.

• (ALL) WHEN CONDUCTING AAR WITH USAF RECEIVERS, THE TERM "PRE-CONTACT" MAY BE USED IN LIEU OF "ASTERN". PRE-CONTACT IS DEFINED AS A POSITION APPROXIMATELY 50 FT. BEHIND AND SLIGHTLY BELOW THE TANKER BOOM NOZZLE WHERE THE RECEIVER STABILIZES WITH ZERO RATE OF CLOSURE BEFORE BEING CLEARED TO THE CONTACT POSITION.

• (ALL) THIS NOTE REFERENCES ATP 3.3.4.2. ANNEX 2L PARAGRAPH 2L.10. FOR US HEAVY RECEIVERS REFUELING IN SKE FORMATIONS, IT IS IMPORTANT FOR TANKERS TO BOTH MAINTAIN PRECISE FORMATION POSITION AND PROVIDE A SMOOTH REFUELING
PLATFORM. HOWEVER, DO NOT JEOPARDIZE FORMATION SAFETY OR AIRCRAFT SEPARATION REQUIREMENTS FOR THE SAKE OF PLATFORM CONTROL.
## APPENDIX 8E
### RECEIVER-SPECIFIC AAR INFORMATION

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8E.1. AAR Data A-10A/C

8E.1.1. General Information

8E.1.1.1 The A-10 has a UARRSI receptacle located 26 inches AFT of the nose on centerline, and is 32 inches in front of the pilot's windscreen. Receptacle slipway lights are rheostat controlled.

8E.1.2. AAR of Deployment Configured A-10s

8E.1.2.1 For AAR of deployment configured A-10’s (two external tanks and two ECM pods) use the following guidelines.

8E.1.2.1.1. AAR altitude: 15,000 MSL (Max).
8E.1.2.1.2. Buddy cruise altitude: 20,000 MSL (Max).
8E.1.2.1.3. AAR airspeed: 210 KCAS (Min).
8E.1.3.1.4. Buddy cruise airspeed: 230 KCAS (Max).

8E.1.3. (KC-135) Rendezvous Procedures
**8E.1.3.1. Modified Overtaking RV Delta (Point Parallel Rendezvous).** When used, the KC-135 will follow procedures for RV Delta (point parallel rendezvous), fly orbit at 220 KIAS or charted holding speed, whichever is higher, and plan to roll out ½ NM in front of the receiver.

- **8E.1.3.1.1. Tanker Speed Reduction.** The tanker then slows to AAR airspeed.
- **8E.1.3.1.2. Overrun.** If an overrun occurs, maintain overrun airspeed until reaching ½ NM in front of the receiver or until directed by the receiver pilot, whichever occurs first.

**8E.1.3.2. RV Golf (Enroute Overtaking) Rendezvous**

- **8E.1.3.2.1.** An RV Golf (enroute overtaking) rendezvous is used when tanker(s) and receiver(s) arrive from the same general direction.
- **8E.1.3.2.2.** Each airplane will fly individual flight plans to a common ARIP/RV and join-up enroute to the ARCP.
- **8E.1.3.2.3.** The receiver(s) will plan to arrive at the ARIP/RV one minute prior to the ARCT.
- **8E.1.3.2.4.** This procedure makes use of the tanker’s increased overtake ability to compensate for the A-10’s lower airspeed.
- **8E.1.3.2.5.** To be effective, tanker(s) and receiver(s) must arrive at the ARIP/RV at their respective times.
- **8E.1.3.2.6.** Tanker(s) and receiver(s) will adjust enroute airspeed/flight path to make the rendezvous control time.
- **8E.1.3.2.7.** Tanker(s) and receiver(s) should communicate as soon as possible (in no case later than 15 minutes prior to the rendezvous control time) to update ETAs.
- **8E.1.3.2.8.** Receiver(s) and tanker(s) must be at their assigned altitude prior to reaching the ARIP/RV.
- **8E.1.3.2.9.** These altitudes will provide at least 1000 feet separation between the highest receiver and the lowest tanker with the receiver always at the lower altitude.
- **8E.1.3.2.10.** The receivers will not depart their designated altitude until the tanker has passed abeam the receivers.
- **8E.1.3.2.11.** The receiver will proceed down track from the ARIP/RV at 220 KIAS, and the tanker will overtake the receiver at 275 KIAS.
- **8E.1.3.2.12.** Once visual/radar contact is established with the receiver, the tanker will maneuver to pass overhead the receiver.
- **8E.1.3.2.13.** The pilot not flying will call when the tanker passes overhead the receiver.
- **8E.1.3.2.14.** After the receiver passes under the tanker glare shield (1/2 NM on TCAS), the tanker will maintain 275 KIAS for another 30 seconds, decelerate to stabilize on AAR airspeed with the receiver(s) approximately 1/2 NM in trail.

**8E.1.4. (KC-10) Rendezvous Procedures**

- **8E.1.4.1.** KC-10 orbit speed for rendezvous with A-10 receivers is 255 KIAS, but not below A-10 AAR orbit speed.
- **8E.1.4.2.** During the rendezvous maneuver, consideration should be given to adjusting to minimum maneuver speed halfway through the rendezvous turn.
- **8E.1.4.3.** Maintain at least minimum maneuver speed until less than 15 degrees of bank.
- **8E.1.4.4.** Slow to AAR speed when rolling out on AAR heading.

**8E.1.5. KC-10/KC-135 Restrictions**
8E.1.5.1. **Tanker Gross Weight.** The tanker’s gross weight at the beginning of AAR operations will not be greater than:

8E.1.5.1.1 **KC-10.** 540,000 pounds (deployment configured A-10 with two external tanks and two ECM pods).

8E.1.5.1.2. **KC-135.** 250,000 pounds.

8E.1.5.2. **Bank Angle.** The tanker’s angle of bank during AAR will be limited to 15 degrees.

8E.1.5.3. **Tanker Aircraft Response - Low Airspeed.** Airspeed must be monitored closely, as aircraft response to power adjustment for lost airspeed is slower than normal.

8E.1.5.4. **Power Control.** Judicious power control is critical at the relatively low airspeeds required during AAR.

8E.1.5.5. **Fuel Spray.** The boom operator is to immediately notify the receiver pilot of any fuel spray from the boom nozzle or receiver receptacle during contact.

8E.1.5.6. **(KC-135) Fuel Configuration.** Consider establishing the fuel configuration prior to slowing to AAR airspeed.

8E.1.5.7. **(KC-135) Fuel Drain.** Draining fuel from the center wing tank to the forward body tank with certain fuel loads may be slower than normal.

---

**CAUTION**

- **(ALL) DURING BOOM RETRACTION, THE RECEIVER SLIPWAY DOOR FORWARD AREA MAY BE DAMAGED BY THE BOOM NOZZLE CATCHING ON A GAP IN THE FORWARD END OF THE SLIPWAY. RETRACT THE BOOM SLOWLY AND RAISE IT TO CLEAR THE DOOR AREA.**

- **(KC-135) DURING AAR, DO NOT ALLOW THE AIRSPEED TO DECREASE BELOW 190 KIAS OR .6 AOA, WHICHEVER IS HIGHER, DUE TO DECREASED BOOM CONTROL AT LOWER AIRSPEEDS.**

- **(KC-135) DURING ANY AAR WHICH REQUIRES THE INDICATED AIRSPEED TO BE LESS THAN 220 KIAS, KEEP THE A/R LINE VALVE CLOSED FOR DRY CONTACTS TO PRECLUDE FUEL SIPHONING FROM THE FORWARD BODY TANK AND CAUSING UNEXPECTED CG CHANGES.**

- **(KC-135) TURN THE LINE VALVE TO THE CLOSED POSITION APPROXIMATELY 15 SECONDS PRIOR TO PLANNED DISCONNECT; THIS IS TO PREVENT FUEL SPRAY FROM IMPAIRING THE VISION OF THE RECEIVER PILOT.**

---

**CAUTION**

- **(KC-135) AT THE DISCRETION OF THE BOOM OPERATOR, NIGHT AAR MAY BE ACCOMPLISHED IF EITHER THE BOOM NOZZLE LIGHT OR TMF IS INOPERATIVE, SO LONG AS THE RECEIVER RECEPTACLE...**
LIGHTS ARE OPERATIVE. IF THE RECEIVER RECEPTACLE LIGHTS ARE INOPERATIVE, BOTH THE BOOM NOZZLE LIGHT AND TMF MUST BE OPERATIVE.

NOTE

- (ALL) WITH CERTAIN GROSS WEIGHTS AND AIRCRAFT CONFIGURATION, THE TANKER RATE OF ACCELERATION ON A BREAK-AWAY MAY EXCEED THE RATE OF ACCELERATION FOR THE RECEIVER AIRCRAFT IN THE OBSERVATION POSITION.

- (KC-10) THE KC-10 WILL REQUIRE SLATS EXTENDED UNTIL THE GROSS WEIGHT REACHES APPROXIMATELY 420,000 POUNDS, STANDARD DAY CONDITIONS. THIS GROSS WEIGHT AND BELOW WILL ALLOW THE KC-10 TO MAINTAIN CLEAN THE 210 KCAS AAR SPEED AT 15,000 MSL AND 230 KCAS AT 20,000 MSL DURING CRUISE.

- (KC-10) THE 540,000 POUND KC-10 MAXIMUM GROSS WEIGHT IS LIMITING ONLY SO FAR AS THE A-10 IS POWER-LIMITED AND UNABLE TO BREAK THROUGH THE KC-10 BOW WAVE UNDER THESE CONDITIONS. THE ONLY WAY POSSIBLE FOR THE A-10 TO EFFECT A HOOKUP ABOVE 540,000 POUNDS KC-10 GROSS WEIGHT MAY BE FOR THE KC-10 TO TOBOGGAN FOR EACH RECEIVER. THIS SHOULD BE DONE ONLY AS A LAST RESORT.

8E.1.6. Enroute Formation Join-Up. When join-up involves one tanker with one or more receivers, the tanker will level off at the highest altitude in the formation with receivers stacked down at 500 feet intervals with 1 NM in trail separation. Airspeeds at level-off will be adjusted as necessary to close the formation.

8E.1.7. RV Procedures. The AAR formation will be 30 degrees right echelon, 2 NM separation, stacked up at 500 foot intervals. Adjust to AAR speed when rolled out toward the ARCP.
B-1B

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.2. AAR Data B-1B

8E.2.1. General Information

8E.2.1.1 The B-1 has a UARRSI receptacle located 8 feet from the nose of the aircraft and 18 inches in front of the crew compartment windshield.

**NOTE**

ALL THE NOZZLE TIP MAY HANG-UP ON THE LEADING EDGE OF THE DROP-DOWN RECEPTACLE DOOR. TO ASSURE SUCCESSFUL CONTACT, PRECISE POSITIONING OF THE BOOM STRAIGHT INTO THE RECEPTACLE IS REQUIRED.

8E.2.2. Rendezvous Procedures

8E.2.2.1 The AAR formation will be 30 degrees right echelon, 2 NM separation, stacked up at 500 foot intervals.

8E.2.2.2. Adjust to AAR speed when rolled out toward the ARCP.

8E.2.3. KC-10/KC-135 Restrictions

PAGE 8-17
8E.2.3.1. (KC-135) **Bank Angle.** Limit the bank angle to 15 degrees for turns while in contact unless the receiver requests otherwise.

8E.2.3.2. (KC-135) **A/R Pumps.** Four A/R pumps may be used for offload; however, if a pressure disconnect occurs, two pumps should be used.

8E.2.3.3 **Boom Handling.** Exercise extreme caution while flying and extending the boom into the receptacle prior to contact and at disconnect.

![CAUTION](image)

- **(ALL)** The B-1 centerline split windshield is located 18 inches directly aft of the air refueling receptacle. Exercise utmost caution while flying and extending the boom into the receptacle prior to contact and at disconnect.

- **(KC-135)** Night AAR is permitted if either the boom nozzle lights or tail-mounted floodlight are inoperative, so long as the receiver’s receptacle lights are operative; if the receiver’s receptacle lights are inoperative, both the nozzle lights and floodlight must be operative.

- **(KC-135)** Close the line valve approximately 15 seconds prior to planned disconnects; this reduces fuel spray which impairs the receiver pilot’s vision.
B-2A

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.3. Data B-2A

8E.3.1. General Information

8E.3.1.1(1) The B-2 AAR receptacle is located 24 ½ feet aft of the nose, 16 feet aft of the crew compartment windshield.

8E.3.1.2. The receptacle rotates along the aircraft centerline

8E.3.1.3. Slipway lights are inside the receptacle.

8E.3.1.4. AAR lead-in lights are in front of the receptacle at 12, 9, and 6 feet.

8E.3.1.5. The area aft of the AAR receptacle is lit by three floodlights.

8E.3.1.6. Slipway lights and flood lights are rheostat controlled.

8E.3.1.7. B-2 performance data is estimated.
• (ALL) BOOM OPERATORS MUST AGGRESSIVELY ADVISE THE RECEIVER TO SLOW THE CLOSURE RATE TO 1 FOOT PER SECOND. AN EXCESSIVE CLOSURE RATE COULD CAUSE THE TANKER TO DESCEND INTO THE RECEIVER. THE PILOT MUST BE PREPARED TO DISCONNECT THE AUTOPILOT AND PREVENT ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST INDICATION OF A CLOSURE OVERRUN.

• (ALL) TANKER AIRSPEED AND ALTITUDE ADJUSTMENTS SHALL BE MADE SMOOTHLY AND SLOWLY WHEN THE B-2 IS IN OR NEAR THE CONTACT POSITION. ADJUSTMENTS REQUIRED BY THE TANKER TO COMPENSATE FOR RECEIVER CLOSURE SHOULD BE ACCOMPLISHED AFTER THE RECEIVER IS IN THE CONTACT POSITION.

CAUTION

• (ALL) AT TRUE AIR TEMPERATURES COLDER THAN APPROXIMATELY -45 DEGREES C, THE BOOM LATCHING TOGGLES MAY TAKE UP TO 1 SECOND TO ENGAGE AND 2 SECONDS TO RELEASE.

• (ALL) FOR NIGHT AAR, THE TMF (S) AND BOOM NOZZLE LIGHT (S) SHALL BE OPERATIONAL.

• (ALL) CONTACT WITH THE SURFACE OUTSIDE OF THE RECEPTACLE MUST BE AVOIDED. THE RECEIVER PILOT WILL BE INFORMED OF BOOM CONTACTS OUTSIDE THE RECEPTACLE.

NOTE

• (ALL) THE ABSENCE OF DIRECT LIGHTING FROM THE AFT AAR LEAD-IN LIGHT TO THE AAR RECEPTACLE (6 FEET) MAY CAUSE ERRORS IN DEPTH PERCEPTION DURING NIGHT AAR.

8E.3.2. Rendezvous Procedures

8E.3.2.1. The type of rendezvous will be a Modified Overtaking RV Delta or RV Golf.

8E.3.2.2. Receiver closure shall not continue inside 1/2-NM range (1 NM for multiple tanker formations and 2 NM for multiple receiver formations) unless visual contact is established with the tanker.

8E.3.3. AAR Procedures

8E.3.3.1. Closure Procedures

8E.3.3.1.1. The receiver initiates descent to 1000 feet below assigned AAR base altitude at the ARIP.

8E.3.3.1.2. The receiver descends at approximately 2000 to 3000 FPM at 0.76 Mach.

8E.3.3.1.3. The receiver maintains 450 KTAS (0.80 Mach maximum) after level off until rendezvous is complete.

8E.3.3.1.3. If the receiver is more than 3 NM in trail from the tanker after completion of descent and closure, the receiver airspeed may be increased up to 0.80 Mach to expedite join-up.
8E.3.3.2. Receiver Visual Closure

8E.3.3.2.1. The receiver maintains 1000 feet below AAR base altitude until 1 NM in trail and visual contact is established.

8E.3.3.2.2. The receiver does not exceed 30 KCAS above AAR airspeed inside of 1 NM from the tanker.

8E.3.3.2.3. After safe closure is ensured, receiver airspeed is reduced as necessary to AAR airspeed.

8E.3.3.2.4. If a closure overrun occurs and visual contact is lost, the receiver establishes a positive rate of descent to 1000 feet below AAR base altitude.

8E.3.3.3. Receiver Radar Closure

8E.3.3.3.1. If visual contact is not established by 1 NM, the receiver slows to AAR airspeed and maintains 1 NM.

8E.3.3.3.2. Once established on AAR airspeed, the receiver climbs to 500 feet below the AAR base altitude, closing to 1/2 NM while maintaining radar contact with the tanker.

8E.3.3.3.3. The receiver does not exceed 20 KCAS above AAR airspeed when closing from 1 NM to 1/2 NM without visual contact.

8E.3.3.3.4. If radar contact is lost without visual contact inside of 1 NM, the receiver descends to 1000 feet below AAR base altitude.

8E.3.3.3.5. The receiver does not close inside of 1/2 NM without tanker visual contact.

8E.3.3.4. Overrun

8E.3.3.4.1. If a rendezvous overrun occurs, the receiver reduces airspeed to no less than 230 KCAS, as required, and maintains track and altitude.

8E.3.3.4.2. The tanker increases airspeed to 300 KCAS, maintains AAR base altitude, adjusts track as required, and overtakes the receiver.

8E.3.3.4.3. After passing the receiver, the tanker reduces AAR airspeed.

8E.3.3.4.4. If positive position of the receiver is established, the tanker may direct the receiver to maneuver to decrease closure time.

8E.3.3.5. Buddy Join-up

8E.3.3.5.1. Lead holds 325 KCAS until reaching 0.75 Mach and maintains 0.75 Mach until level at assigned altitude.

8E.3.3.5.2. Lead should limit bank angle to 25 degrees during departure to allow wingmen to use cutoff as required.

8E.3.3.5.3. At final altitude, formation lead slows to 0.71 Mach to expedite closure. Following aircraft close at 0.75 Mach to join up.

8E.3.3.5.4. After join up, the formation accelerates to 0.76 Mach or maintains briefed airspeeds and altitudes until reaching the ARIP or a point 100 NM from the ARCP.

8E.3.3.5.5. Lead shall level off at the lowest altitude in the formation with the trailing aircraft stacked up at 500-foot intervals with 1-NM separation.

8E.3.3.6. (KC-10) Abnormal Procedures

8E.3.3.6.1. There is a slight bow-wave effect from the B-2 on the tanker during closure to the contact
8E.3.3.6.2. The effect could cause the tanker to experience trim changes depending on the rate of receiver movement.

8E.3.3.6.3. The B-2 should use a slow closure rate of approximately 1 foot per second.

8E.3.3.6.4. Rapid closure adversely affects the pitch trim of both aircraft.

8E.3.3.6.5. The slow closure rate permits smaller adjustments to stabilize in the proper AAR position.

8E.3.3.6.6. The bow-wave effect increases as receiver gross weight increases, tanker gross weight decreases, and during approach to the upper limit of the boom envelope.

8E.3.3.6.7. If inadvertent disconnects occur due to a tanker malfunctioning signal amplifier or receiver system malfunction, AAR can be completed by receiver override operation.

8E.3.3.6.8. Boom operators shall vigorously advise the receiver to slow the closure rate to 1 foot per second, if required.

8E.3.3.6.9. Tanker airspeed and altitude adjustments shall be made smoothly and slowly when the B-2 is in or near the contact position.

8E.3.3.6.10. Adjustments required by the tanker to compensate for receiver closure should be accomplished after the receiver is in the contact position.

8E.3.3.7. (KC-135) Abnormal Procedures

8E.3.3.7.1. Because of the restrictive inner boom envelope limit, the boom will be extended to 12 feet for the astern position.

8E.3.3.7.2. There is considerable bow-wave effect from the receiver during closure to the contact position.

8E.3.3.7.3. The effect has a steeper gradient and is similar in magnitude to a C-5 receiver.

8E.3.3.7.4. Up to 3 units of boom trim may be used.

8E.3.3.7.5. The bow-wave effect increases as receiver gross weight increases; as tanker gross weight decreases, and during approach to the upper limit of the boom envelope. The effect causes the tanker to experience large trim changes, depending on the rate of receiver movement.

8E.3.3.7.6. Rapid closure adversely affects the pitch trim of both aircraft; a slow closure rate permits smaller adjustments to stabilize in the proper AAR position.

8E.3.3.7.7. The receiver should use a slow closure rate of approximately 1 foot per second.

8E.3.3.7.8. When the tanker CG is 30% MAC or greater, the autopilot pitch control may become unstable, causing slow oscillations and resulting in altitude deviations of approximately 100 to 200 feet.

8E.3.3.7.9. B-2 receivers have manual boom latching capability.
8E.4. AAR Data B-52H

8E.4.1. General Information

8E.4.1.1. The receptacle doors on the B-52 rotate up, forming a large slipway 2.5 feet long and located 14.5 feet AFT of the nose and 7.5 feet behind the center windows on fuselage centerline.

8E.4.1.2. Lead-in stripes are located in front of the receptacle at 5, 4 and 3 foot intervals.

8E.4.1.3. Receptacle lights are located on the inside of each door illuminating the slipway and receptacle and are rheostat controlled.

8E.4.1.4. During night AAR, the floodlight may cause a momentary reflection from the receiver's center windscreen as the receiver moves from astern to the contact position.
C-5A-C/M

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.5. AAR Data C-5A-C/M

C-5 on KC-135

C-5 on KC-10

C-5 close-up on KC-10

8E.5.1. General Information
8E.5.1.1. The receptacle on a C-5 has a drop-down door which forms a small slipway 2.5 feet long.

8E.5.1.2. The receptacle is located 36.5 feet AFT of the nose slightly to the right of centerline. The distance from cockpit windows is approximately 12 feet.

8E.5.1.3. Lead-in stripes are located in front of the receptacle at 5, 4 and 3 foot intervals.

8E.5.1.4. Receptacle lights are located inside the slipway on both sides of the receptacle and are rheostat controlled by the pilot.

8E.5.1.5. There is also an override if the lights fail to come on normally.

8E.5.2. AAR Procedures

8E.5.2.1. (ALL) AAR Procedures. Receiver closure rate from astern position must be made smoothly and slowly (approximately 1 foot per second).

WARNING

- (ALL) TANKER AIRSPEED AND ALTITUDE CHANGES MUST BE MADE SMOOTHLY AND CAUTIOUSLY WHILE THE RECEIVER IS IN OR NEAR THE CONTACT POSITION. ANY AIRSPEED OR ALTITUDE ADJUSTMENTS REQUIRED BY THE TANKER DUE TO AERODYNAMIC EFFECT OF RECEIVER CLOSURE SHOULD BE ACCOMPLISHED AFTER THE RECEIVER IS STABILIZED IN THE CONTACT POSITION.

- (ALL) THE BOOM OPERATOR MUST BE CONSTANTLY AWARE OF THE RECEIVER’S POSITION AND RATE OF MOVEMENT. THE RECEIVER’S RATE OF MOVEMENT TOWARD AN ENVELOPE LIMIT WILL Dictate THE POINT TO INITIATE A DISCONNECT. IF THE MOVEMENT IS TOWARD THE INNER LIMIT, BOOM OPERATORS WILL EXERCISE SOUND JUDGMENT IN INITIATING A DISCONNECT OR BREAKAWAY PRIOR TO THE RECEIVER EXCEEDING THE LIMIT OR OVERRUNNING THE TANKER.

- (ALL) THE BOOM OPERATOR MUST AGGRESSIVELY ADVISE THE RECEIVER TO SLOW THE RATE OF CLOSURE TO APPROXIMATELY 1 FOOT PER SECOND.

8E.5.2.2. (KC-10) AAR Procedures

8E.5.2.2.1. There is a slight bow wave affect on the boom elevators when the C-5 reaches approximately 10 to 20 feet, depending on receiver closure rate.

8E.5.2.2.2. The faster the closure rate, the greater the affect of the bow wave.

8E.5.2.2.3. Too rapid a closure rate could adversely affect the pitch trim of both aircraft.

8E.5.2.2.4. The boom operator will advise the receiver to slow its rate of closure if required.
(KC-10) FUEL FLOW SHALL BE MONITORED CLOSELY WHEN REFUELING A C-5 TO FULL TANKS. THE C-5 MANIFOLD DOES NOT CONTAIN A FUEL PRESSURE DISCONNECT SWITCH AND OVER-PRESSURIZATION COULD OCCUR. WHEN FUEL FLOW STARTS TO DECREASE, REDUCE THE NUMBER OF AR PUMPS IN USE TO A MAXIMUM OF FOUR, TURN AR PUMPS OFF WHEN FUEL STOPS OR BRIEFED OFFLOAD IS COMPLETED.

NOTE

- (KC-10) THE C-5 MINIMUM AAR SPEED WILL BE 252 KCAS/0.62, AND 300 KCAS/0.77 WILL BE THE MAXIMUM AAR SPEED.
- (KC-10) THE KC-10 TANKER MINIMUM AAR SPEED AND MAXIMUM ALTITUDE WILL BE DETERMINED FROM THE CRUISE BUFFET-ONSET BOUNDARY (SLATS RETRACTED) CHART.
- (KC-10) SLATS WILL NOT BE EXTENDED TO LOWER MINIMUM AAR SPEED TO 252 KCAS.
- (KC-10) DURING AAR WITH A C-5, THE RECEIVER'S NOZZLE POSITION SWITCH WILL NOT BE ACTIVATED WHEN THE NOZZLE IS INSERTED INTO THE RECEPTACLE, AND THE RECEIVER'S DISCONNECT LIGHT WILL REMAIN ILLUMINATED THROUGHOUT AAR.

8E.5.2.3. (KC-135) AAR Procedures

8E.5.2.3.1. There is considerable bow-wave effect on the ruddervators when the C-5 reaches approximately 10 to 20 feet depending on receiver closure rate.

8E.5.2.3.2. The faster the closure rate, the greater the effect of the bow-wave.

8E.5.2.3.3. Too rapid a closure rate adversely affects the pitch trim of both airplanes and can cause pitch trim forces in excess of autopilot capability.

8E.5.2.3.4. If boom instability is experienced while attempting contact, the boom should be moved out of the bow wave and allowed to stabilize prior to re-attempting contact.

8E.5.2.3.5. The Boom Operator will hold sufficient down pressure on the ruddervator control stick during contact to ensure the nozzle will clear the receptacle when a disconnect occurs.

8E.5.2.3.6. When accomplishing the astern call during EMCON 1 or EMCON 2, advise the receiver of the boom trim setting and subsequent lower elevation limitation; also notify the receiver when changing the trim setting if it affects the elevation limits.

8E.5.2.3.7. During EMCON 3 and above, use 5 units of trim to maximize the AAR envelope.

8E.5.2.3.8. Five units of boom trim is the preferred setting for the C-5 because it expands the lower envelope limit to 40 degrees and affords the boom operator or receiver a greater chance of effecting a disconnect before boom nozzle binding or the boom envelope limit is reached.

8E.5.2.3.9. As the receiver approaches the contact position, a slight amount of upward control stick force is required to maintain the boom at 30 degrees elevation.

8E.5.2.3.10. When the boom nozzle reaches approximately 20 feet from the receptacle, the bow wave begins to neutralize the stick force; complete neutralization occurs as the nozzle reaches approximately 10 feet from the receptacle.
**SE.5.2.3.11.** As ruddervator trim increments are increased, upper elevation boom travel will be reduced proportionally.

**SE.5.2.3.12.** Upper elevation control improves as the receiver’s bow-wave effect increases.

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**WARNING**

- **(KC-135)** EXCESSIVE CLOSURE RATE COULD CAUSE THE TANKER TO DESCEND INTO THE PATH OF THE RECEIVER. THE PILOT MUST BE PREPARED TO DISCONNECT THE AUTOPILOT TO PREVENT ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST INDICATION OF A CLOSURE OVERRUN.

- **(KC-135)** PILOTS MUST BE AWARE THAT SITUATIONS THAT INDUCE SUDDEN LARGE OUT-OF TRIM CONDITIONS (LARGE THRUST OR AIRSPEED CHANGES, RAPID MOVEMENT OF LARGE RECEIVER AIRCRAFT ETC) MAY EXCEED AIRCRAFT TRIM CAPABILITY. IN THESE SITUATIONS, THE “FAIL PASSIVE” DESIGN OF THE DIGITAL AUTOPILOT MAY RESULT IN LARGE VARIATION IN AIRCRAFT ATTITUDE/ALTITUDES PRIOR TO AUTOMATIC DISENGAGEMENT OF THE AUTOPILOT. PILOTS MUST BE PREPARED TO ASSUME AIRCRAFT CONTROL IMMEDIATELY AND SHOULD EXPECT SIGNIFICANT OUT OF TRIM CONTROL FORCES TO EXIST FOLLOWING MANUAL/AUTOMATIC AUTOPILOT DISENGAGEMENT.
• (KC-135) THE TANKER MUST CLOSELY MONITOR THE FUEL FLOW WHEN REFUELING TO FULL TANKS, AS THE C-5 DOES NOT CONTAIN A PRESSURE DISCONNECT SWITCH. WHEN FUEL FLOW STOPS OR WHEN THE BRIEFED OFFLOAD HAS BEEN TRANSFERRED, TURN THE A/R PUMPS OFF.

• (KC-135) DUE TO ADVERSE TRIM CHANGES ON BOTH THE TANKER AND RECEIVER, MACH/AIRSPEED DURING CONTACT SHALL IN NO CASE BE MORE THAN 0.64M OR 265 KCAS, WHICHEVER IS LOWER.

• (KC-135) NIGHT AAR IS PERMITTED IF EITHER THE BOOM NOZZLE LIGHT OR TMF ARE INOPERATIVE, SO LONG AS THE RECEIVER’S RECEPTACLE LIGHTS ARE OPERATIVE; IF THE RECEIVER’S RECEPTACLE LIGHTS ARE INOPERATIVE, BOTH THE NOZZLE LIGHT AND TMF MUST BE OPERATIVE.
8E.6. AAR Data C-17A

8E.6.1. General Information

8E.6.1.1. The C-17 has a UARRSI receptacle, located 15 feet AFT of the nose, and 10 feet AFT of the center windows, on the fuselage centerline.

8E.6.1.2. Lead-in stripes are located in front of the receptacle at 1 foot intervals.

8E.6.1.3. The receptacle is illuminated by lead-in perimeter lights and slipway lighting.

8E.6.1.4. There is a 6 inch tall blade type antenna located approximately 6 feet aft of the UARRSI on the aircraft centerline.

8E.6.1.5. Except when mission requirements dictate, do not attempt contacts at night with the receiver lead-in perimeter lights and the tanker TMF failed, or with the receiver slipway light and tanker boom nozzle light failed.

8E.6.1.6. A formation of C-17’s will use SKE procedures during AAR.

8E.6.2. AAR Procedures

8E6.2.1. (ALL) AAR Procedures
• (ALL) EXCESSIVE CLOSURE RATE MAY CAUSE THE TANKER TO DESCEND INTO THE PATH OF THE RECEIVER. THE PILOT MUST BE PREPARED TO DISCONNECT THE AUTOPILOT TO PREVENT ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST INDICATION OF A CLOSURE OVERRUN.

• (ALL) TANKER AIRSPEED AND ALTITUDE CHANGES MUST BE MADE SMOOTHLY AND CAUTIOUSLY WHILE THE RECEIVER IS IN OR NEAR THE CONTACT POSITION. ANY AIRSPEED OR ALTITUDE ADJUSTMENT REQUIRED BY THE TANKER DUE TO AERODYNAMIC EFFECTS OF THE RECEIVER SHOULD BE ACCOMPLISHED AFTER THE RECEIVER IS STABILIZED IN THE CONTACT POSITION.

• (ALL) BOOM OPERATORS MUST BE ALERT TO THE RECEIVER’S CAPABILITY OF RAPID MOVEMENT IN BOTH PITCH AND ROLL AXES WITHIN THE AAR ENVELOPE. MONITOR THE RECEIVER’S RATE OF MOVEMENT AND USE SOUND JUDGMENT IN DETERMINING WHEN TO INITIATE A DISCONNECT, TO ENSURE THAT THE NOZZLE DISCONNECTS FROM THE RECEPTACLE PRIOR TO GETTING INTO A POSITION WHERE NOZZLE BINDING CAN OCCUR. IF RECEIVER MOVEMENT IS TOWARD THE INNER LIMIT, BOOM OPERATORS WILL EXERCISE SOUND JUDGMENT IN INITIATING A DISCONNECT OR BREAKAWAY PRIOR TO THE RECEIVER EXCEEDING THE LIMIT OR OVERRUNNING THE TANKER.

• (ALL) THE BOOM OPERATOR MUST AGGRESSIVELY ADVISE THE RECEIVER TO SLOW THE RATE OF CLOSURE TO APPROXIMATELY 1 FOOT PER SECOND.

**8E.6.2.2. (KC-10) AAR Procedures**

8E.6.2.2.1. When initiating fuel transfer to the C-17, arm at least one A/R pump prior to contact.

8E.6.2.2.2. If positive fuel pressure does not occur within 15 seconds after a boom contact made signal, initiate a disconnect.

8E.6.2.2.3. Select an alternate pump prior to re-accomplishing contact.

8E.6.2.2.4. All six A/R pumps may be used.

**NOTE**

(KC-10) IT IS NORMAL FOR FUEL TRANSFER TO INDICATE ZERO FLOW FOR UP TO 15 SECONDS AFTER THE FIRST PUMP IS SELECTED.

8E.6.2.2.5. Reverse AAR with the C-17 is prohibited.

8E.6.2.2.6. Unless mission requirements dictate, do not attempt contacts at night with the loss of the following lighting: C-17 lead-in perimeter lights and both TMFs failed, or with the C-17A slipway lights and both boom nozzle lights failed.

8E.6.2.2.7. Boom operators must be alert to the C-17’s capability of rapid movement in both pitch and roll axes within the AAR envelope.
8E.6.2.3. (KC-135) AAR Procedures

8E.6.2.3.1. The receiver bow wave effect is more pronounced than the C-5 due to the rapid movements that the receiver is capable of performing.

8E.6.2.3.2. Bow wave effects are accentuated when the receiver is above 25 degrees elevation.

8E.6.2.3.3. During receiver closure from, or backing out to, approximately 40 feet, pilots must anticipate elevator trim changes of approximately ±2 units.

8E.6.2.3.4. Pilots should monitor the elevator trim wheel for excessive trim cycling.

8E.6.2.3.5. Autopilot elevator trim authority may be exceeded.

!(KC-135) PILOTS MUST BE AWARE THAT SITUATIONS THAT INDUCE SUDDEN LARGE OUT-OF-TRIM CONDITIONS (LARGE POWER OR AIRSPEED CHANGES, RAPID MOVEMENT OF THE RECEIVER AIRCRAFT, ETC.) MAY EXCEED AIRCRAFT TRIM CAPABILITY. IN THESE SITUATIONS, THE FAIL-PASSIVE DESIGN OF THE AUTOPILOT MAY RESULT IN A LARGE VARIATION OF AIRCRAFT ATTITUDE/ALTITUDES PRIOR TO AUTOMATIC DISENGAGEMENT OF THE AUTOPILOT. PILOTS MUST BE PREPARED TO ASSUME AIRCRAFT CONTROL IMMEDIATELY, AND SHOULD EXPECT SIGNIFICANT OUT OF TRIM CONTROL FORCES TO EXIST FOLLOWING MANUAL/AUTOMATIC AUTOPILOT DISENGAGEMENT.

8E.6.2.3.6. Due to the ability of the C-17 to move rapidly within the AAR envelope, consider setting the telescope-at-disconnect switch to AUTO.

8E.6.2.3.7. The optimum boom trim setting is 5 units; this setting expands the lower envelope to 40 degrees, and affords the boom operator and receiver a greater chance of effecting a disconnect before boom nozzle binding occurs or the boom envelope limit is reached.

8E.6.2.3.8. As the amount of boom trim is decreased, boom control authority is significantly degraded to the point that 0 units of boom trim may not allow boom control authority below 35 degrees elevation, regardless of boom operator input.

8E.6.2.3.9. During EMCON 1 or EMCON 2 AAR operations, when accomplishing the astern call, advise the receiver of the boom trim setting and subsequent lower elevation limitation; also notify the receiver when changing the trim setting if it affects the elevation limits.

8E.6.2.3.10. During EMCON 3 and above, use 5 units of trim to maximize the AAR envelope.

8E.6.2.3.11. As the receiver approaches the contact position, a slight amount of upward control stick force may be required to maintain the boom at 30 degrees elevation.

8E.6.2.3.12. During approach to contact, a bow wave similar to, but more intense than that encountered with the C-5, becomes evident the last 10 to 20 feet prior to contact.

8E.6.2.3.13. The boom operator must ensure that the receiver has stabilized at the astern position (zero rate of closure) before clearing the receiver to the contact position.

8E.6.2.3.14. The C-17 rate of closure from the astern position must be made smoothly and slowly (approximately 1 foot per second).
8E.6.2.3.15. If the rate of forward movement is excessive or continues past the contact position, the boom operator will exercise sound judgment in initiating a breakaway prior to the receiver overrunning the tanker.

8E.6.2.3.16. Contact should not be attempted until the receiver has stabilized in the contact position.

8E.6.2.3.17. When initiating fuel transfer, the aft pump in the forward body tank or the forward pump in the aft body tank must be energized on and providing positive fuel pressure within five seconds following a boom contact made signal.

8E.6.2.3.18. If either of these pumps cannot be energized in that time frame, perform a disconnect and re-accomplish a contact.

8E.6.2.3.19. It is normal for fuel transfer to indicate zero flow for up to fifteen seconds after the first pump is energized.

8E.6.2.3.20. Additional A/R pumps may be energized following fifteen seconds of stabilized fuel flow to the receiver.

8E.6.2.3.21. A maximum of 4 A/R transfer pumps may be used.

NOTE

(KC-135) DO NOT ACCOMPLISH REVERSE FLOW AAR EXCEPT IN AN ACTUAL FUEL EMERGENCY.

8E.6.2.4. (KC-46) AAR Procedures

8E.6.2.4.1. Altitude/Airspeed

<table>
<thead>
<tr>
<th>C-17A with KC-46A Mission Planning Data</th>
</tr>
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<tbody>
<tr>
<td>Airspeed</td>
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<tr>
<td>250 – 295 KCAS</td>
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<tr>
<td>Planning: 275 KCAS</td>
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<tr>
<td>Buddy Cruise: 310 KCAS/.77 M</td>
</tr>
<tr>
<td>RCVR RV Speed: 310 KCAS</td>
</tr>
<tr>
<td>Overrun Speed: 310 KCAS</td>
</tr>
</tbody>
</table>
C-17A with KC-46A AR Flight Envelope

CAUTION

REFUELING BELOW 10,000 FEET MSL IS A HIGH WORKLOAD TASK THAT SHOULD BE RESERVED FOR EMERGENCY FUEL ONLOAD OR CONTINGENCY OPERATION.

8E.6.2.4.2. Lighting/Visual Cues

Refer to Chapter 6 of this publication for all general warnings/cautions/notes relating to poor visibility using the KC-46 RVS.

Recommended Light Settings for Night/Twilight AR:

**KC-46A:**

- ARO:
  - Floodlight: 7
  - Underwing: 5
  - PDL: 10
  - PDL Background: 10
  - CDS Tunnel: 7

- Receiver Reference: 15
- Underbody: Default
- Marker: 10
- Illumination: 20

**C-17A:**

- AR Lead-In: 12 O’Clock
- Slipway: 12 O’Clock
- AR Flood: 12 O’Clock

**Pilot:**

- Position: 1 O’Clock
- Wing Strobe: OFF
- Anti-Collision: Upper ON/Lower OFF

- Formation: As Desired
- Wing Illumination: As Desired
IF A KC-46A BOOM FLOODLIGHT IS INOPERATIVE, AR SHALL NOT BE CONDUCTED AT NIGHT OR TWILIGHT UNLESS A FUEL EMERGENCY DICTATES. VISIBILITY OF THE BOOM THROUGH THE KC-46 RV'S IS NON-EXISTENT IN THIS SCENARIO, AND C-17 RECEIVER LIGHTS DO NOT PROVIDE SUFFICIENT ILLUMINATION ALONE.

NOTE

IF THE KC-46A BOOM MARKER LIGHT IS INOPERATIVE, CONTACT SHOULD BE MADE AT THE DISCRETION OF THE RECEIVER PILOT

8E.6.2.4.3. Other

If positive offload rate does not occur within 15 seconds after positive boom pressure, initiate a disconnect.

REFUELING HEAVYWEIGHT C-17A (ABOVE 500,000 LBS) UP TO 15 DEGREES OF BANK CAN BE ACCOMPLISHED, BUT WILL REQUIRE AGGRESSIVE RECEIVER THROTTLE INPUTS AND CAREFUL MONITORING OF FORE/AFT MOVEMENT.

WARNING

REFUELING HEAVYWEIGHT C-17A (ABOVE 500,000 LBS) ABOVE 15 DEGREES OF BANK MAY LEAD TO DIVERGENT FORE/AFT AIRCRAFT MOTION POTENTIALLY RESULTING IN A COLLISION OR BREAKAWAY.

NOTE

IT IS NORMAL FOR FUEL TRANSFER TO INDICATE ZERO FLOW FOR UP TO 15 SECONDS AFTER THE PUMPS ARE TURNED ON.

BOOM INTERPHONE USE IS PROHIBITED.

NO TANKER OR RECEIVER HF RADIO TRANSMISSIONS ARE PERMITTED INSIDE ½ NM.
KC-46 AUTO-THROTTLE USE WHILE REFUELING THE C-17 IS PROHIBITED.

THE KC-46 BOOM TAKES RELATIVELY LARGE FORCE FOR THE RECEIVER TO TELESCOPE IT IN OR OUT WHILE IN CONTACT. THIS DRIVES THE FOLLOWING WARNINGS AND NOTE FOR BOTH THE ARO AND THE C-17 PILOT:

![WARNING]

UPON DISCONNECT THE RECEIVER MAY ACCELERATE TOWARD OR AWAY FROM THE TANKER. THE ARO SHOULD BE PREPARED TO IMMEDIATELY FLY THE BOOM AWAY FROM THE RECEIVER UPON DISCONNECT.

DUE TO THE BOOM STIFFNESS, THE RECEIVER MAY BE CARRYING AN UNKNOWN AMOUNT OF EXCESS THRUST. THE RECEIVER PILOT SHOULD BE VIGILANTLY MONITORING THRUST UPON DISCONNECT TO REACT AS QUICKLY AS POSSIBLE IF EXCESS THRUST DOES CAUSE THE C-17 TO ACCELERATE TOWARD THE TANKER.

NOTE

SMALL THRUST CHANGES WHILE IN CONTACT ON THE KC-46 BOOM MAY CAUSE THE BOTTOMING OUT OF A “RECOIL SPRING” ON THE KC-46 BOOM. THIS MAKES A “CLUNKING” SOUND TO THE C-17 PILOT THAT MAY SOUND LIKE THE BOOM HAS DISCONNECTED EVEN THOUGH IT HAS NOT.

FOR THE C-17 SPECIFICALLY, DUE TO THE STIFF BOOM, PILOT WORKLOAD WHILE IN CONTACT CAN BE INCREASED COMPARED TO LEGACY TANKERS, DUE TO INTERACTION BETWEEN THE STIFF BOOM, C-17 THROTTLE RESPONSE, AND BOOM ELEVATION.

UPON DISCONNECT THE BOOM MAY RAPIDLY MOVE TOWARDS THE RECEIVER DUE TO INADVERTENT UNDETECTABLE LOADING OF THE BOOM. THIS DRIVES THE FOLLOWING NOTE AND WARNING:

THE ARO SHOULD VIGILANTLY MONITOR INPUTS TO THE FLIGHT CONTROL STICK WHILE IN CONTACT. THE KC-46 BOOM FLIGHT CONTROL STICK IS VERY SENSITIVE, AND INADVERTENT INPUT IS VERY EASY TO MAKE.

![WARNING]

THE ARO SHOULD BE PREPARED TO IMMEDIATELY FLY THE BOOM AWAY FROM THE RECEIVER UPON DISCONNECT.
C-32B

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.7. AAR Data C-32B

8E.7.1. General Information

8E.7.1.1. The C-32 has a UARRSI receptacle located approximately 15 feet aft of the nose and 9 feet behind the cockpit windows on the aircraft’s centerline.

8E.7.1.2. There are no external floodlights to illuminate the receptacle area but the receptacle has adjustable integral lighting.

NOTE

• (ALL) THE C-32 DOES NOT HAVE LEAD-IN STRIPES OR RECEPTACLE MARKINGS ON TOP OF THE AIRCRAFT. DURING NIGHT AAR, THE NOSE SECTION OF THE AIRCRAFT APPEARS TO BE A FLAT SURFACE WHILE IN REALITY IT IS RAISED. THIS ILLUSION MAY CAUSE DEPTH PERCEPTION ERRORS PRIOR TO MAKING CONTACT.

• (ALL) PRIOR TO AAR WITH THE C-32 AT NIGHT, THE BOOM OPERATOR SHOULD REFUEL THE C-32 DURING DAYLIGHT TO BECOME FAMILIAR WITH THE C-32 UARRSI.

• (ALL) DURING NIGHT AAR MISSIONS, BOTH TANKER AND RECEIVER AIRCRAFT WILL USE ALL AVAILABLE EXTERNAL LIGHTING. AS A MINIMUM, ONE OF THE FOLLOWING EXTERNAL LIGHT CONDITIONS MUST BE MET:

<table>
<thead>
<tr>
<th>Boom Nozzle Lt (BNL) – INOP/Off</th>
<th>BNL - On</th>
<th>BNL – INOP/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tail Mounted Floodlight (TMF)- On</td>
<td>TMF – On</td>
<td>TMF – INOP/Off</td>
</tr>
</tbody>
</table>
NOTE

(ALL) EXCEPT FOR EMERGENCY CONDITIONS, AAR OPERATIONS SHOULD NOT BE CONDUCTED WHEN OTHER SINGLE AND DUAL FAILURE COMBINATIONS ASSOCIATED WITH THESE LIGHTS EXIST. DURING AAR WITH LESS THAN OPTIMAL LIGHTING, EXTREME CARE SHOULD BE TAKEN DUE TO REDUCED DEPTH PERCEPTION AND LACK OF VISUAL CUES ON THE C-32 AIRCRAFT.

8E.7.1.3. (KC-135) Four units of boom trim are preferred, as it expands the lower envelope. During EMCON 1 or 2, notify the receiver of the boom trim setting and lower elevation limit. Notify the receiver any time boom trim settings are changed. During EMCON 3 and above, use 4 units of boom trim
**8E.8. AAR Data CV/MV-22**

**8E.8.1. General Information**

**8E.8.1.1. (KC-10)** The MV-22 and CV-22 aircraft can only be air-to-air refueled using the KC-10A centerline drogue system.

**8E.8.1.2. (KC-10)** The KC-10A hose reel response, pressure regulation system, and the MA-4 coupling on the centerline drogue system shall be fully functional.

**8E.8.1.3. (KC-10)** The flight performance capability of the CV/MV-22 aircraft is unique when in the aerial refueling environment of a KC-10A. As such, the aerial refueling envelope is very dependent upon the gross weight of the CV-22/MV-22 and the KC-10A tanker for a given altitude and atmospheric condition. Paragraphs (f)1 and (f)2 depict this interdependency for each type of receiver platform. At higher KC-10A and/or CV/MV-22 gross weights, the CV/MV-22 may have difficulty making a contact, air-to-air refueling, and maintaining position in a turn. It is, therefore, highly critical that tanker and receiver mission planners account for these factors when aerial refueling operations are required between the CV/MV-22 and the KC-10A.

**8E.8.2. (KC-10) Rendezvous Procedures**

**8E.8.2.1. Overtaking RV Golf (En-Route Rendezvous)**

**8E.8.2.1.2.** An overtaking enroute rendezvous will be normally used for all CV/MV-22 operations.

**8E.8.2.1.3.** When executing an overtaking rendezvous with more than one tanker, delay adjusting airspeed, extending the slats, or maneuvering to AAR formation until all aircraft are established on the AAR heading.

**8E.8.2.1.4.** Tanker(s) and receiver(s) arrive from the same general direction; each aircraft will fly individual flight plans to a common ARIP/RV and join-up enroute to the ARCP.

**8E.8.2.1.5.** The receiver(s) will plan to arrive at the ARIP/RV 1 minute prior to RVCT.

**8E.8.2.1.6.** This procedure makes use of the tanker’s increased overtake ability to compensate for the receiver’s lower airspeed.
8E.8.2.1.7. To be effective, tanker(s) and receiver(s) must arrive at the ARIP/RV at their respective times.

8E.8.2.1.8. Tanker(s) and receiver(s) will adjust enroute airspeed/flight path to make the rendezvous control time.

8E.8.2.1.9. Tanker(s) and receiver(s) should communicate as soon as possible (in no case later than 15 minutes prior to the rendezvous control time) to update ETAs.

8E.8.2.1.10. Receiver(s) and tanker(s) will be at their assigned altitude prior to reaching the ARIP/RV.

8E.8.2.1.11. These altitudes will provide at least 1000 feet separation between the highest receiver and the lowest tanker with the receiver always at the lower altitude.

8E.8.2.1.12. The receiver will proceed down track from the ARIP/RV at 215 KIAS, and the tanker will overtake the receiver at 275 KIAS.

8E.8.2.1.13. Once visual/radar contact is established with the receiver, the tanker will maneuver to pass overhead the receiver.

8E.8.2.1.14. The pilot not flying/pilot monitoring will call when the tanker passes overhead the receiver.

8E.8.2.1.15. After the receiver passes under the tanker glare shield (1/2 NM on TCAS/ 1/3 NM on radar), the tanker will maintain 275 KIAS for another 15 seconds, then reduce power to idle and begin slowing to 205 KIAS.

8E.8.2.1.16. Failure to make R/T Contact If radio communications between airplanes have not been established by the rendezvous control time, airplanes will depart the ARIP/RV to make good the ARCT at the RVCP.

8E.8.2.1.17. Delaying at ARCP Use normal orbit procedures when delaying at the RVCP.

8E.8.2.1.18. Formation Procedures Once join-up has been accomplished, utilize formation procedures contained in ATP 3.3.4.2., Chapter 2. Receivers should maintain visual formation (e.g., Fixed wing Echelon Left/Right) no closer than two receivers’ wingspan spacing off the tanker. If visibility is insufficient for visual formation, CV/MV-22 aircraft will maintain a minimum 500 ft above or below tanker altitude and no less than 1/2 nm in trail of the tanker instead of the close formation.

8E.8.2.1.19. Overrun If the tanker has overrun the receiver during the final phase of the rendezvous, the following procedures are recommended:

8E.8.2.1.19.1. The tanker will reduce airspeed to 200 KIAS with slats set for AAR (if required) and maintain track at the assigned AAR altitude.

8E.8.2.1.19.2. The receiver will adjust airspeed, maintain an altitude 1000 feet below assigned base AAR altitude, adjust track as required, and close on the tanker.

8E.8.2.2. (KC-10) Overtaking RV Delta (Point Parallel Rendezvous)

8E.8.2.2.1. The overtaking point parallel rendezvous with CV/MV-22 receivers is standard with the exception that the tanker will utilize overtaking procedures.

8E.8.2.2.2. The overtaking RV Delta (point parallel rendezvous) uses normal RV Delta procedures except the tanker plans to roll out behind the receiver.

8E.8.2.2.3. The tanker then overtakes the receiver using the speed schedule and procedures outlined in the Enroute Overtaking Rendezvous.

8E.8.2.2.4. For formation operations, the tanker will adjust to AAR formation (stacked up 500 feet, 1 NM nose-to-nose, 60 degrees echelon) after completing the turn to the AAR heading.
8E.8.2.2.5. When executing tanker overtaking rendezvous with one or more tankers, delay adjusting airspeed, extending slats, or maneuvering to AAR cell formation until all aircraft are established on AAR heading.

8E.8.2.2.6. Overrun If the tanker has overrun the receiver during the final phase of the rendezvous, the following procedures are recommended:

8E.8.2.2.2.1. The tanker will reduce airspeed to 200 KIAS with slats set for AAR (if required) and maintain track at the assigned AAR altitude.

8E.8.2.2.2.2. The receiver will adjust airspeed, maintain an altitude 1000 feet below assigned base AAR altitude, adjust track as required, and close on the tanker.

8E.8.3. Closure Procedures

8E.8.2.1. The receiver will maintain 215 KIAS until 1/2 NM in trail, then slow during closure to reach the astern position at 205 KIAS.

8E.8.4. (KC-10) AAR Procedures

8E.8.4.1. AAR Procedures

- FLAPS SHALL NOT BE EXTENDED. THE TANKER CAN BE CONFIGURED WITH OR WITHOUT THE USE OF SLATS.

- DO NOT RAISE OR LOWER SLATS WHILE THE RECEIVER IS CLOSER THAN THE ASTERN POSITION BECAUSE OF THE RESULTANT PITCH CHANGE OF THE TANKER.

- EXCESSIVE CLOSURE RATE (>5 KCAS FOR KC-10) MAY CAUSE A VIOLENT HOSE WHIP FOLLOWING CONTACT AND RESULT IN, OR INCREASE THE DANGER OF, STRUCTURAL DAMAGE TO THE AIRCRAFT IN THE EVENT OF MISALIGNMENT OR DROGUE REEL RESPONSE MALFUNCTION. BOOM OPERATORS WILL MAINTAIN DUE CONSIDERATION OF RECEIVER CLOSURE RATE AND BE PREPARED TO EXECUTE BREAKAWAY PROCEDURES WHEN EXCESSIVE CLOSURE RATES ARE OBSERVED.

- MISALIGNMENT OF PROBE TIP TO THE DROGUE (ESPECIALLY AT HIGH CLOSURE RATES) MAY CAUSE A HOSE WHIP OR SPEARING OF THE BASKET DURING CONTACT.

- IF IN A TURN WHEN A BREAKAWAY IS INITIATED, MAINTAIN THE ESTABLISHED BANK ANGLE WHILE ADDING POWER. DO NOT ROLL WINGS LEVEL AND DO NOT RAISE OR LOWER SLATS UNTIL THE RECEIVER IS WELL CLEAR.

- THE MAXIMUM TANKER GROSS WEIGHT BEGINNING AAR OPERATION WITH CV/MV-22 RECEIVERS WILL NOT BE GREATER THAN 475,000 POUNDS.

- RECEIVER AIRCRAFT SHALL NOT ATTEMPT TO CONDUCT AERIAL REFueling ON A HOSE REEL THAT HAS EXHIBITED...
SIGNS OF DEGRADED PERFORMANCE OR THAT HAS HAD AN IN-FLIGHT FAILURE EXCEPT FOR FUEL EMERGENCIES. IN SUCH AN EMERGENCY SLOW CLOSURE RATE OF 1-2 KNOT WILL REDUCE THE LIKELIHOOD OF A SINE WAVE AND/OR STRUCTURAL DAMAGE

NOTE

KC-10S ARE RESTRICTED TO SINGLE TANKER OPERATIONS DURING AAR WITH CV/MV-22 FORMATIONS. THIS DOES NOT PRECLUDE ADDITIONAL TANKERS JOINING AND/OR DEPARTING THE FORMATION MID-MISSION, BUT AAR WILL NOT BEGIN UNTIL ADDITIONAL TANKERS HAVE DEPARTED THE FORMATION.

8E.8.4.1.1. CV/MV-22 aircraft AAR envelope is 200 to 210 KIAS at 5,000 to 16,000 feet MSL Optimum is 205 KIAS/10,000 feet MSL.

8E.8.4.1.2. Bank angle during AAR with CV/MV-22 receivers will be limited to 15 degrees.

8E.8.4.1.3. Fuel transfers shall be conducted with no more than one KC-10A aerial refueling pump.

8E.8.4.1.4. Receiver contacts shall be limited to straight and level flight conditions.

8E.8.4.1.5. The probe system on the CV/MV-22 shall be fully extended to permit aerial refueling operations. Attempts to aerial refuel with a probe that is not fully extended shall be strictly limited to emergency situations only.

8E.8.4.1.6. The CV/MV-22 AR probe light shall be operational to conduct night aerial refueling operations. Boom Operators should be aware CV/MV-22 AR probe light brilliance is not adjustable and can obscure probe when approaching contact.

8E.8.5. (KC-10) Restrictions

8E.8.5.1. Tanker Gross Weight The tanker’s gross weight at the beginning of AAR operations will not be greater than 475,000 pounds.

8E.8.5.2. Bank Angle The tanker’s angle of bank during AAR will be limited to 15 degrees.

8E.8.5.3. Tanker Aircraft Response - Low Airspeed Air speed must be monitored closely, as aircraft response to power adjustment for lost airspeed is slower than normal.

8E.8.5.4. Toboggan The use of toboggan maneuvers is prohibited except for fuel emergencies.

8E.8.5.5. The use of WARP equipment is not authorized.

8E.8.5.6. Power Control Judicious power control is critical at the relatively low airspeeds required during AAR.

NOTE

WITH CERTAIN GROSS WEIGHTS AND AIRCRAFT CONFIGURATION, THE TANKER RATE OF ACCELERATION ON A BREAK-AWAY MAY EXCEED THE RATE OF ACCELERATION FOR THE RECEIVER AIRCRAFT IN THE OBSERVATION POSITION.
The KC-10 will require slats extended until the gross weight reaches approximately 375,000 pounds, standard day conditions. This gross weight and below will allow the KC-10 to maintain clean the 205 KCAS AAR speed at 15,000 MSL (400,000 pounds at 10,000 MSL).

8E.8.6. (KC-10) Formatting Capability

8E.8.6.1. CV-22 Air Refueling Envelope with KC-10

8E.8.6.2. MV-22 Air Refueling Envelope with KC-10
8E.9. AAR Data AC/EC/MC/C-130E/H/J/P/U

8E.9.1. General Information

8E.9.1.1. The C-130 has a UARRSI receptacle located 12 feet AFT of the nose and 5.5 feet behind center window on fuselage centerline.

8E.9.1.2. Distance lead-in stripes are located in front of the receptacle at 1-foot intervals.

8E.9.1.3. Approximately 17 inches forward of the receptacle is a set of lights offset on both sides to illuminate the area around the receptacle.

8E.9.1.4. There is additional lighting in the slipway area.

8E.9.2. Rendezvous Procedures

8E.9.2.1. En-Route Overtaking Rendezvous

8E.9.2.1.1. An overtaking enroute rendezvous will be normally used for all C-130 operations.

8E.9.2.1.2. When executing an overtaking rendezvous with more than one tanker, delay adjusting airspeed, lowering the flaps, or maneuvering to AAR formation until all aircraft are established on the AAR heading.

8E.9.2.1.3. Tanker(s) and receiver(s) arrive from the same general direction; each aircraft will fly individual flight plans to a common ARIP/RV and join-up enroute to the ARCP.
8E.9.2.1.4. The receiver(s) will plan to arrive at the ARIP/RV 1 minute prior to ARCT.

8E.9.2.1.5. This procedure makes use of the tanker’s increased overtake ability to compensate for the receiver’s lower airspeed.

8E.9.2.1.6. To be effective, tanker(s) and receiver(s) must arrive at the ARIP/RV at their respective times.

8E.9.2.1.7. Tanker(s) and receiver(s) will adjust enroute airspeed/flight path to make the air refueling control time.

8E.9.2.1.8. Tanker(s) and receiver(s) should communicate as soon as possible (in no case later than 15 minutes prior to the rendezvous control time) to update ETAs.

8E.9.2.1.9. Receiver(s) and tanker(s) will be at their assigned altitude prior to reaching the ARIP/RV.

8E.9.2.1.10. These altitudes will provide at least 1000 feet separation between the highest receiver and the lowest tanker with the receiver always at the lower altitude.

8E.9.2.1.11. The receiver will proceed down track from the ARIP/RV at 215 KIAS, and the tanker will overtake the receiver at 275 KIAS.

8E.9.2.1.12. Once visual/radar contact is established with the receiver, the tanker will maneuver to pass overhead the receiver.

8E.9.2.1.13. The pilot not flying will call when the tanker passes overhead the receiver.

8E.9.2.1.14. After the receiver passes under the tanker glare shield (1/2 NM on TCAS/1/3 NM on radar for KC-10), the tanker will maintain 275 KIAS for another 30 seconds (15 seconds for KC-10), then reduce power to idle and begin slowing to 200 KIAS (190 KIAS for AC130H).

8E.9.2.1.15. (KC-135) Flaps

8E.9.2.1.15.1. Weight 210K lbs or Less. AAR may be accomplished with either flaps up or flaps 20 degrees at gross weights up to 210,000 lbs.

8E.9.2.1.15.2. Weight Greater than 210K lbs. At gross weights above 210,000 Lbs, AAR must be accomplished with flaps 20 degrees.

8E.9.2.1.15.3. Extending Flaps. If AAR is to be accomplished with flaps 20 degrees, then extend the flaps when passing through 220 KIAS.

8E.9.2.1.15.4. Pitch Change. Be prepared for a pitch change and continue to slow to 200 KIAS for AAR.

8E.9.2.1.15.5. Autopilot Axis Altitude Hold. With airspeed stabilized at 200 KIAS, the autopilot elevator axis altitude hold may be engaged if desired.
NOTE

(ALL) DUE TO ENGINE SPOOL-UP TIME AND RAPID AIRPLANE DECELERATION WHEN FLAPS ARE LOWERED TO 20 DEGREES, PILOTS MUST BE PREPARED TO ADVANCE THROTTLES SIMULTANEOUSLY WITH EXTENSION OF FLAPS.

8E.9.2.1.16. Failure to make R/T Contact. If radio communications between airplanes have not been established by the air refueling control time, airplanes will depart the ARIP to make good the ARCT at the ARCP.

8E.9.2.1.17. Delaying at ARCP. Use normal orbit procedures when delaying at the ARCP.

8E.9.2.1.18. Formation Procedures. Once join-up has been accomplished, normal formation procedures apply.

8E.9.2.1.19. Overrun. If the tanker has overrun the receiver during the final phase of the rendezvous, the following procedures are recommended:

8E.9.2.1.19.1. The tanker will reduce airspeed to 200 KIAS (0.6 AOA minimum) with flaps set for AAR and maintain track at the assigned AAR altitude.

8E.9.2.1.19.2. The receiver will adjust airspeed, maintain an altitude 1000 feet below assigned base AAR altitude, adjust track as required, and close on the tanker.

8E.9.2.2. Overtaking RV Delta (Point Parallel Rendezvous)

8E.9.2.2.1. The overtaking RV Delta (point parallel rendezvous) uses normal RV Delta procedures except the tanker plans to roll out behind the receiver.

8E.9.2.2.2. The tanker than overtakes the receiver using the speed schedule and procedures outlined in the Enroute Overtaking Rendezvous.

8E.9.2.2.3. For formation operations, the tanker will adjust to AAR formation (stacked up 500 feet, 1 NM nose-to-nose, 60 degrees echelon) after completing the turn to the AAR heading.

8E.9.2.3. Overtaking Modified Point Parallel Rendezvous

8E.9.2.3.1. The modified point parallel rendezvous with C-130 receivers is standard with the exception that the tanker will utilize overtaking procedures.

NOTE

- **(KC-10) WHEN EXECUTING TANKER OVERTAKING RENDEZVOUS WITH ONE OR MORE TANKERS, DELAY ADJUSTING AIRSPEED, EXTENDING SLATS, OR MANEUVERING TO AAR CELL FORMATION UNTIL ALL AIRCRAFT ARE ESTABLISHED ON AAR HEADING.

- **(KC-10) IF THE TANKER HAS OVERRUN THE RECEIVER DURING THE FINAL PHASE OF THE RENDEZVOUS, THE FOLLOWING PROCEDURES ARE RECOMMENDED. THE TANKER WILL REDUCE AIRSPEED TO 200 KCAS WITH SLATS EXTENDED AND MAINTAIN TRACK AT THE ASSIGNED AAR ALTITUDE. THE RECEIVER WILL INCREASE AIRSPEED, MAINTAIN AN ALTITUDE 1000 FEET BELOW ASSIGNED BASE AAR ALTITUDE, ADJUST TRACK AS REQUIRED, AND CLOSE ON THE TANKER.

8E.9.3. Closure Procedures

8E.9.3.1. The receiver will maintain 215 KIAS until 1/2 NM in trail, then slow during closure to reach the astern position at 200 KIAS.
8E.9.4. AAR Procedures

8E.9.4.1. (ALL) AAR Procedures

! CAUTION

(ALL) BOOM NOZZLE POSITION SHALL BE MONITORED CLOSELY PRIOR TO CONTACT AND FOLLOWING DISCONNECT AS RECEPACLE TO PROPELLER LINE DISTANCE IS ONLY 15.5 FEET.

NOTE

• (ALL) THE MC-130H COMBAT TALON II (CTII) HAS AN ELONGATED TEAR SHAPED ANTENNA LOCATED APPROXIMATELY 5 FEET IN FRONT OF THE RECEPACLE, PROTRUDING OUT FROM THE FRONT OF THE RECEPACLE AND AIRCRAFT.

• (ALL) AC/EC/HC/MC-130J AIRCRAFT AAR ENVELOPE IS 190 TO 230 KIAS AT 0 TO 20,000 FEET MSL. OPTIMUM IS 210 KIAS/10,000 FEET MSL.

• (ALL) THE AC-130J UTILIZES A TRIPLE-BAR LEAD-IN MARKING CONFIGURATION COMPARED TO THE STANDARD C-130 DOUBLE-BAR MARKING.

• (ALL) AC/HC/MC-130J AIRCRAFT HAVE AN ANTENNA LOCATED APPROXIMATELY 2.5 FEET BEHIND THE UARRSI. THE LIGHTING CONFIGURATION FORWARD OF THE RECEPACLE IS THE SAME AS LEGACY C-130 RECEIVER AIRCRAFT

• (ALL) ON EC-130J AIRCRAFT, FUEL MAY BE SEEN SWIRLING WITHIN THE UARRSI PRESSURE BOX DURING AAR.

• (ALL) BANK ANGLE DURING AAR WITH C-130 RECEIVERS WILL BE LIMITED TO 15 DEGREES

8E.9.4.2. (KC-10) AAR Procedures

! WARNING

(KC-10) DO NOT RAISE OR LOWER SLATS/FLAPS WHILE THE RECEIVER IS CLOSER THAN THE ASTERN POSITION BECAUSE OF THE RESULTANT PITCH CHANGE OF THE TANKER.

8E.9.4.3. (KC-135) AAR Procedures

8E.9.4.3.1. For formation operations, aircraft will be stacked up at 500 foot intervals from the leader with 1 NM nose-to-nose separation along the 60-degree echelon line.
8E.9.4.3.1. Consider establishing the fuel configuration prior to slowing to AAR airspeed; draining fuel from the center wing to the forward body tank with certain fuel loads may be slower than normal.

8E.9.4.3.1. Power control is critical at the relatively low airspeeds required by the receiver.

8E.9.4.3.1. Airspeed must be monitored closely as the airplane response to power adjustments for lost airspeed is slower than normal, especially at gross weights approaching 250,000 pounds.

8E.9.4.3.1. Boom operators must be aware of changes in boom flight characteristics during AAR with the C-130 at slower airspeed in combination with tanker flap setting of 20 degrees.

8E.9.4.3.1. Control of the boom becomes heavier and the boom tends to trail at 35 to 37 degrees when flaps are lowered to 20 degrees.

8E.9.4.3.1. When the receiver stabilizes in the astern position, the boom operator will hold required up pressure on the ruddervator control stick to maintain a 30-degrees trail position.

8E.9.4.3.1. Increased force is required to fly the boom to effect contact and to maintain boom-to-receptacle alignment.

8E.9.4.3.1. To minimize nozzle cocking when making contact below 33 degrees elevation, the boom must be inserted straight into the receptacle without aid of the slipway; using the slipway may cause nozzle to cock, preventing contact.

8E.9.4.3.1. For night AAR, if the receiver’s nose section cannot be seen or the boom operator is having depth perception problems, fly the boom around the receiver’s fuselage nose section as the receiver approaches the contact position.

8E.9.4.3.1. This procedure will also avoid directing the boom nozzle light into the eyes of the receiver pilot.

**WARNING**

- **(KC-135)** DO NOT RAISE OR LOWER FLAPS WHILE THE RECEIVER IS CLOSER THAN THE ASTERN POSITION BECAUSE OF THE RESULTANT PITCH CHANGE OF THE TANKER

- **(KC-135)** DURING AN ACTUAL/PRACTICE EMERGENCY SEPARATION, DO NOT RAISE OR LOWER THE FLAPS UNTIL THE RECEIVER IS WELL CLEAR.

- **(KC-135)** IF IN A TURN WHEN A BREAKAWAY IS INITIATED, MAINTAIN THE ESTABLISHED BANK ANGLE WHILE ADDING POWER. DO NOT ROLL WINGS LEVEL AND DO NOT RAISE OR LOWER FLAPS UNTIL THE RECEIVER IS WELL CLEAR.

- **(KC-135)** THE MAXIMUM TANKER GROSS WEIGHT BEGINNING AAR OPERATION WITH C-130 RECEIVERS WILL NOT BE GREATER THAN 250,000 POUNDS.

- **(KC-135)** DURING AAR, DO NOT TO ALLOW THE AIRSPEED TO DECREASE BELOW 190 KIAS OR 0.6 AOA, WHICHEVER IS HIGHER, BECAUSE OF DECREASED BOOM CONTROL AT LOWER AIRSPEEDS.
(KC-135) DURING AAR WITH THE FLAPS EXTENDED, EXERCISE EXTREME CAUTION TO ENSURE THAT THE FLAP PLACARD SPEED IS NOT EXCEEDED.

(KC-135) DURING ANY AAR WHICH REQUIRES THE INDICATED AIRSPEED TO BE LESS THAN 220 KIAS, KEEP THE A/R LINE VALVE CLOSED FOR DRY CONTACTS TO PRECLUDE FUEL SIPHONING FROM THE FORWARD BODY TANK AND CAUSING UNEXPECTED CG CHANGES.

8E.10.1. General Information

8E.10.1.1. The receptacle doors on all models of -135's rotate up forming a large slipway 2.5 feet long.

8E.10.1.1. Location distance from radome to receptacle will vary depending on aircraft model.

8E.10.1.1. From center windows to receptacle is approximately 7 feet.

8E.10.1.1. Receptacle lights are on the inside of each door illuminating the slipway and receptacle area and are rheostat controlled.

NOTE

(ALL) REVERSE FLOW AAR CAN ONLY BE ACCOMPLISHED WITH AIRCRAFT NOT RESTRICTED FOR REVERSE FLOW AAR.
E-3A-D/F/G/E-6B/CT-49A (NTCA) /E-8C

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.11. AAR DATA E-3A-D/F/G/E-6B/CT-49A (NTCA) /E-8C

![E-3 on KC-10](image)

![E-3D/F on KC-135](image)
8E.11.1. General Information

8E.11.1.1. The receptacle doors on the E-3 rotate up forming a large slipway 2.5 feet long and are located approximately 15 feet aft of the nose section and 7 feet behind the centre windows on aircraft centerline.

8E.11.1.2. Receptacle lights, located on the inside of each door illuminating the slipway and receptacle area are rheostat controlled.

NOTE

(ALL) PROVIDE E-3 RECEIVERS WITH TYPE OF FUEL TO BE OFFLOADED. IF JP-4 (NATO F-40) OR JET B (NATO F-45) FUEL IS BEING OFFLOADED INFORM E-3 RECEIVER OF FUEL TEMPERATURE. E-3 FUEL BOOST PUMPS ARE NOT CERTIFIED FOR FLIGHTS USING JP-4 OR JET B FUEL WITH FUEL TEMPERATURES EXCEEDING 85°C. ANY FUEL MIXTURE CONTAINING MORE THAN 0.1% JP-4/ JET B IS TO BE CONSIDERED JP-4.

8E.11.2. E-3D/F

8E.11.2.1. The United Kingdom’s E-3D and French E-3F are identical to the U.S. E-3B/C aircraft except for the installation of high bypass fan engines and a AAR probe located 30 inches forward and 3 feet to the left of the receptacle as seen from the boom operator’s position.

8E.11.2.1. The probe is approximately 10 feet in length and has electroluminescent outline lighting, except for the last 1.5 feet of the probe tip. E-3F may or may not be equipped with AAR probe.
• (ALL) THE BOOM MAY BLOCK THE FAF E-3D/F PROBE FROM VIEW DURING APPROACH TO CONTACT IF THE RECEIVER IS OFFSET APPROXIMATELY 5 DEGREES TO THE LEFT.

• (ALL) NIGHT AAR WITH FAF E-3D/F RECEIVERS WILL NOT BE ATTEMPTED IF THE PROBE ELECTRO-LUMINESCENT LIGHTING, BOOM NOZZLE LIGHT(S), AND TMF(S) ARE INOPERATIVE.

• (ALL) THE FAF E-3D/F AIRCRAFT IS CLEARED FOR BOOM AAR ONLY. PROBE/DROGUE AAR IS NOT PERMITTED

• (ALL) AERODYNAMIC EFFECTS FROM THE FAF E-3D/F PROBE DURING THE LAST FIVE FEET PRIOR TO CONTACT PUSH THE BOOM UP AND THE BOOM OPERATOR’S RIGHT. THE BOOM OPERATOR MUST ENSURE THE BOOM IS CLEAR OF THE PROBE AT ALL TIMES.

• (ALL) THE FAF E-3F FUEL SYSTEM SHALL NOT BE FILLED TO TOP-OFF. NO RECEIVER MAIN AR LINE VALVE CLOSURES SHALL OCCUR WHILE FUEL IS FLOWING.

• (ALL) KC-135 REFUELING IS LIMITED TO A MAXIMUM OF 2 AR PUMPS.

• (ALL) REVERSE FLOW AAR IS PROHIBITED

8E.11.3. E-6B Data

8E.11.3.1. The Navy E-6B is a B-707 airframe with CFM-56 engines and a standard -135 AAR receiver receptacle.

8E.11.3.1.2. The AAR functions are essentially the same as the E-3.

8E.11.3.1.3. All data remains the same except the E-6B does not have mission radar and IFF rendezvous equipment.

8E.11.4. CT-49A NATO Trainer/Cargo Aircraft (NTCA)

8E.11.4.1. The NATO Trainer/Cargo Aircraft (TCA) is equipped with a UARRSI receptacle that has boom interphone capability.

8E.11.4.2. The NTCA provides dry contacts only for NATO E-3 pilot training.

8E.11.4.3. It is approved for dry contacts only (day and night).

8E.11.4.4. (KC-135) To drain trapped fuel from the boom, ensure the A/R line valve is closed and accomplish the boom draining steps (except stowing the boom) contained in the FUEL DUMPING checklist of the applicable flight manual.

8E.11.4.5. (KC-135) When boom draining is complete, close the boom marker and nozzle lights circuit breakers.

NOTE

(ALL) ONLY DRY CONTACTS WILL BE ACCOMPLISHED. DO NOT PRESSURIZE THE AR MANIFOLD WITH BOOM VALVE.
8E.11.5. E-8C

8E.11.5.1. The E-8 is a B-707 airframe with a UARRSI receptacle located approximately 15 feet aft of the nose section and 7 feet behind the center windows on the aircraft centerline.

8E.11.5.1. A blade antenna is located 18 inches aft of the receptacle.

- (KC-135) NIGHT AAR WILL NOT BE ATTEMPTED IF THE RECEIVER'S RECEPTACLE LIGHTS ARE INOPERATIVE OR THE TANKER DOES NOT HAVE EITHER AN OPERABLE BOOM NOZZLE LIGHT OR TMF.

- (KC-10) NIGHT AAR CAN BE SAFELY ACCOMPLISHED WITH FAILED RECEIVER RECEPTACLE LIGHTS PROVIDED THAT AT LEAST ONE TMF IS OPERATIONAL.
E-4B/VC-25A

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.12. AAR Data E-4B/VC-25A

8E.12.1. General Information

8E.12.1.1. The E-4 has a UARRSI receptacle which is located on the nose section 8 feet aft of the radome.

8E.12.1.1. The aircraft is provided with a receptacle "spoiler", 1 foot high and 2 feet across, located just aft of the AAR receptacle. It is designed to reduce/normalize receiver pilot pitch control problems.

8E.12.1.1. With the spoiler retracted, receiver pilot workload is greatly increased to control E-4 pitch oscillations encountered when closing from 10 to 2 feet and when contact is made.
NOTE

(ALL) DURING NIGHT AAR, THE NOSE SECTION OF THE AIRCRAFT APPEARS TO BE A FLAT SURFACE WHILE IN REALITY, IT IS RAISED. THE ILLUSION MAY CAUSE DEPTH PERCEPTION ERRORS PRIOR TO MAKING CONTACT.

8E.12.2. Rendezvous

8E.12.2.1. Radar/beacon will be the primary rendezvous means.

8E.12.2.1. Differential DME from a common ground TACAN may be used during EMCON 1 or alternate rendezvous.

8E.12.3. VC-25 Data

8E.12.3.1. The VC-25A AAR installation is externally exactly like the E-4 except for the lack of reference markings in front of the receptacle/slipway and the nose, upper fuselage (including the AAR receptacle, slipway and spoilers being painted with a glossy blue paint.)

8E.12.3.1. All data remains the same.

8E.12.3.1. (KC-135) Normal autopilot trim changes occur when the receiver closes from the astern position.

CAUTION

• (KC-135) AAR WITH THE RECEIVER’S A/R SPOILER RETRACTED SHALL ONLY BE ACCOMPLISHED WITH A MINIMUM OF THE TANKER AUTOPILOT ELEVATOR AXIS AND ALTITUDE HOLD ENGAGED, AND THE YAW DAMPER ON.

• (KC-135) NIGHT AAR IS PERMITTED IF EITHER THE BOOM NOZZLE LIGHTS OR TAIL-MOUNTED FLOODLIGHT ARE INOPERATIVE, SO LONG AS THE RECEIVER’S RECEPTACLE LIGHTS ARE OPERATIVE: IF THE RECEIVER’S RECEPTACLE LIGHTS ARE INOPERATIVE, BOTH THE NOZZLE LIGHTS AND FLOODLIGHT MUST BE OPERATIVE.

• (KC-10) THE VC-25 CAN BE REFUELED BY THE KC-10 WITH ANY TWO LIGHTING FAILURES (SLIPWAY, SPOILER, FAIRING, WING) PROVIDED THAT THE AT LEAST ONE KC-10 TAIL MOUNTED FLOODLIGHT (TMF) AND ONE BOOM NOZZLE LIGHT ARE OPERATIONAL.
F-4E/F

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.13 AAR Data F-4E/F

8E.13.1. General Information

8E.13.1.1. All models of the F-4 have a small receptacle with no slipway that is located on the fuselage centerline 2.5 feet behind the AFT canopy.

8E.13.1.1. Depending on the model, the receptacle is approximately 25 feet from the nose of the aircraft.

8E.13.1.1. There is a 3 inch high antenna located 1.5 feet forward of the receptacle approximately on fuselage centerline.

8E.13.1.1. Depending on the model, additional antennas may be located AFT of the receptacle.

8E.13.1.1. For night AAR, lights are located in the receptacle.

8E.13.1.1. The receiver pilot has the capability to position the lights to bright or dim only.

8E.13.1.1. When using the TMF, a momentary reflection from the receiver's windscreen may occur as the receiver moves in from astern position.

8E.13.2. AAR Procedures

CAUTION

(KC-135) FOR NIGHT AAR, IF THE BOOM NOZZLE LIGHT FAILS BUT THE TMF IS OPERATIVE, ATTEMPTS TO EFFECT A CONTACT WILL BE AT THE DISCRETION OF THE BOOM OPERATOR. SHOULD THE RECEIVER'S RECEPTACLE LIGHT BECOME INOPERATIVE, THE BOOM OPERATOR MAY REQUEST THE RECEIVER PILOT TO TURN ON THE ANTICOLLISION LIGHT.

NOTE
(ALL) SOME MODELS OF THE F-4 DO NOT HAVE MANUAL BOOM LATCHING (MBL) CAPABILITY.

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers


8E.14.1. General Information

8E.14.1.1. The receptacle on the F-15 has a fold down door which forms a small slipway. It is located 30 feet from the nose and 3 feet left of centerline in the aircraft wing root area.

8E.14.1.2. Lights for the slipway are in the receptacle and on the aft portion of the canopy which illuminates the area around the receptacle.
<table>
<thead>
<tr>
<th>Receiver System</th>
<th>Tanker System</th>
<th>Altitude</th>
<th>Airspeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-15A-D</td>
<td>KC-135R/T</td>
<td>10,000-32,000 ft</td>
<td>300 – 330 KCAS or 0.82 Mach</td>
</tr>
<tr>
<td></td>
<td>KC-10</td>
<td>10,000-32,000 ft</td>
<td>295 – 325 KCAS or 0.82 Mach</td>
</tr>
<tr>
<td>F-15E/I</td>
<td>KC-135R/T</td>
<td>8,000 -30,000 ft</td>
<td>250 – 350 KCAS, or 0.88M</td>
</tr>
<tr>
<td></td>
<td>KC-10</td>
<td>8,000 -30,000 ft</td>
<td>250 – 350 KCAS, or 0.88M</td>
</tr>
</tbody>
</table>

8E.14.2. AAR Procedures

**CAUTION**

(ALL) DO NOT ATTEMPT CONTACT IF THE FORWARD AAR DOOR IS VIBRATING. CONTACT WITH THE BOOM MAY CAUSE LOSS OF THE AAR DOOR.

**NOTE**

(ALL) TO ASSURE SUCCESSFUL CONTACT, PRECISE POSITIONING OF THE BOOM STRAIGHT INTO THE RECEPTACLE IS REQUIRED. THE NOZZLE TIP MAY HANG-UP ON A GAP IN THE FORWARD END OF THE RECEPTACLE SLIPWAY. THE TIP MAY ALSO HANG-UP ON THE RECEPTACLE FORWARD ROLLERS IF ATTEMPTING CONTACT FROM EITHER SIDE OF THE SLIPWAY.

8E.14.3. F-15E Data

**8E.14.3.1.** To aid in determining the approximate deck angle and closure rate, a tail floodlight has been added.

**NOTE**

(ALL) DURING NIGHT AAR, EXERCISE EXTREME CARE DUE TO REDUCED DEPTH PERCEPTION AND LACK OF VISUAL CUES ON THE F-15E DARKER PAINT SCHEME.

8E.14.4. F-15SA Data

**8E.14.4.1.** Do not attempt contact if the forward AR door is vibrating. Contact with the boom may cause loss of the AR door.

**8E.14.4.2.** To ensure successful contact, precise positioning of the boom straight into the receptacle is required. The nozzle tip may hang-up on a gap in the forward end of the receptacle slipway. The tip may also hang-up on the receptacle forward rollers if attempting to contact from either side of the slipway.

**8E.14.4.3.** Additional standard procedures/restrictions used for AR with USAF F-15Es shall be followed.
K/NF/Q/F-16A-F/I/F-2A/B

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.15. AAR Data F-16A-F/I

F-16 on KC-10

Singapore AF F-16 W/ Raised Receptacle

F-16 With Conformal Tanks on KC-135
8E.15.1. General Information

8E.15.1.1. The F-16 has a ARRSI receptacle which is located 27 feet from the nose on aircraft centerline, 6.5 feet aft of the canopy.

8E.15.1.2. The F-16B/D/F/I model (two-seater) receptacle is slightly closer to the canopy.

8E.15.1.3. There is a 2-inch high antenna on the upper fuselage centerline, 3 feet forward of the receptacle.

8E.15.1.4. On F-16B/D/F/I models, the antenna is 8 inches higher due to being mounted on the aft portion of the raised panels that blend the canopy to the fuselage.

8E.15.1.5. F-16C/D/F/I (single-/two-seater) models are modified with a tapering fillet at the base of the vertical stabilizer approximately 9 inches aft of the ARRSI.
8E.15.1.6. A single antenna on the fillet is approximately 2 feet aft of the receptacle.

8E.15.1.7. On F-16B/D/F/I models, the area forward and aft of the receptacle is reduced.

8E.15.1.8. Lighting for the receptacle is of fixed intensity.

8E.15.1.9. The floodlight on the upper fuselage, which illuminates the AAR markings around the receptacle, can be varied in intensity.

8E.15.1.10. The receivers may be equipped with conformal fuel tanks (CFTs); receivers with CFTs will be refueled using standard F-16 procedures with the following exceptions:

8E.15.1.10.1. The AAR altitude is restricted to 15,000 to 30,000 feet MSL with optimum altitude being 20,000 feet MSL.

8E.15.1.10.2. Tanker A/R airspeed is 310 ± 10 KCAS (no slower than 300 KCAS)

8E.15.1.10.3. On airplanes with CFTs installed, the top of the CFT is above the level of the AAR receptacle; the tanks are especially high toward the forward end.

8E.15.1.10.4. Airplanes with CFTs may have a green receptacle light that is visible during night AAR.

8E.15.1.10.5. CFT configured aircraft are limited to gross weights of 48,000 lbs.

8E.15.1.11. NF-16D VISTA aircraft will be refueled using standard F-16 procedures with the following exceptions:

8E.15.1.11.1. AAR is restricted to day VMC only.

8E.15.1.11.2. VISTA aircraft have a unique paint scheme.

8E.15.1.12. QF-16 aircraft will be refueled using standard F-16 procedures with the following exceptions:

8E.15.1.12.1. All electronic stores, radar, and electronic countermeasures must be turned off or in standby mode prior to aerial refueling.

8E.15.1.12.2. AR operations shall be conducted only with manned QF-16 aircraft.

8E.15.1.12.3. AR operation shall be conducted in daylight conditions only.

8E.15.1.12.4. Any electrical equipment installed due to the FSAT conversion must be “OFF” or in ‘STANDBY’ mode during AR operations.

8E.15.1.12.5. The QF-16A/C is equipped with a cover plate (chromate yellow in color) just aft of the TACAN antenna on the upper fuselage of the aircraft.

**NOTE**

- (ALL) NO AR OPERATIONS SHALL BE CONDUCTED IF THE FLIGHT TERMINATION SYSTEM ANTENNA (WHITE IN COLOR) IS INSTALLED AT THIS LOCATION. SEE BELOW PHOTOS.
8E.15.1.13. Aerial refueling operations can be conducted at 5K-33K feet altitude and 275-325 KCAS.

8E.15.2. AAR Procedures

WARNING

(ALL) DURING AAR WITH AN AIRPLANE WITH CFTS, IMMEDIATELY INFORM THE RECEIVER OF ANY FUEL VENTING IN THE AREA OF THE ENGINE EXHAUST; THERE IS A POSSIBILITY THAT VENTED FUEL COULD BE IGNITED DURING AFTERBURNER OPERATION.

CAUTION

• (ALL) F-16B/D MODEL - AVOID STRIKING THE PANELS THAT BLEND THE AFT PORTION OF THE CANOPY WITH THE FUSELAGE DURING CONTACT AND AFTER DISCONNECT. THESE PANELS ARE APPROXIMATELY 18 INCHES FROM SLIPWAY DOORS.

• (ALL) DURING AAR WITH AN AIRPLANE WITH CFTS, DO NOT ALLOW THE BOOM TO CONTACT THE CFT; A BOOM STRIKE ON EITHER CFT COULD LEAD TO TANK FAILURE AND A CATASTROPHIC FUEL LEAK. IMMEDIATELY INFORM THE RECEIVER OF ANY STRIKE TO A CFT.
• (ALL) SOME NF/F-16B/D/F/I (TWO-SEATER) MODELS ARE MODIFIED WITH A RAISED AVIONIC HUMP ON THE SPINE OF THE AIRCRAFT WHICH RAISES THE RECEPTACLE APPROXIMATELY 1 FOOT.

NOTE

• (ALL) F-16 AND F-2 DOES NOT HAVE MBL CAPABILITY.
• (ALL) DURING F-16 AND F-2 AAR, BE AWARE THAT PRESSURE DISCONNECTS MAY OCCUR.

8E.15.3. F-2A/B

8E.15.3.1. On the F-2A, there is a 2-inch high TACAN antenna on the upper fuselage centerline, approximately 5 feet forward of the receptacle.

8E.15.3.2. On the F-2B model, the upper TACAN antenna is approximately 8 inches higher than on the A-model.

8E.15.3.3. There is a single UHF/VHF antenna on the fillet that blends with the vertical stabilizer to the fuselage that is approximately 4 feet aft of the receptacle.

8E.15.3.4. The intensity of the F-2 slipway light is variable.

8E.15.3.5. The intensity of the floodlight on the F-2 upper fuselage, which illuminates the AR markings around the receptacle, is fixed and remains ON anytime the slipway door is open.

NOTE

• If both the boom nozzle light and receiver slipway light are inoperative, AR will not be conducted unless a fuel emergency dictates. Exercise extreme caution to avoid contact outside the receptacle or slipway due to degraded depth perception.

• If the receiver’s AR flood light is inoperative, but all other tanker and receiver lights are operative, contact can be made at the discretion of the boom operator.

• Auto pressure disconnects will occur at top-off.

• Pressure disconnects may occur immediately when 2 AR pumps are engaged. One pump may be necessary depending on the individual tanker aircraft.

8E.15.4. (KC-46) AAR Procedures

8E.15.4.1. Altitude/Airspeed
### F-16C/D with KC-46A Mission Planning Data

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<td>250 – 325 KCAS</td>
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<td>31k lbs &lt; F-16 GW &lt; 36k lbs:</td>
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<tr>
<td>255 – 325 KCAS/84 M</td>
<td></td>
</tr>
<tr>
<td>Planning: 310 KCAS</td>
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<td>Buddy Cruise: 310 KCAS</td>
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<td>RCVR RV Speed: 345 KCAS</td>
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<tr>
<td>Overrun Speed: 350 KCAS/88 M</td>
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</tr>
</tbody>
</table>

---

**F-16C/D with KC-46A AR Flight Envelope, Light F-16**

![Diagram of KC-46A F-16C/D AR Envelope, Light F-16](image)

**F-16C/D with KC-46A AR Flight Envelope, Mid F-16**

![Diagram of KC-46A F-16C/D AR Envelope, Mid F-16](image)
8E.15.4.2. Lighting/Visual Cues

**Boom Operator:**

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<th>Setting</th>
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<td>Receiver Reference</td>
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**Pilot:**

<table>
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<tbody>
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<td>Position</td>
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<tr>
<td>Anti-Collision</td>
<td>Upper ON/Lower OFF</td>
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<tr>
<td>Wing Strobes</td>
<td>OFF</td>
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<tr>
<td>Wing Illumination</td>
<td>OFF</td>
</tr>
<tr>
<td>Formation</td>
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</tr>
</tbody>
</table>

**Recommended Light Settings**

AR of camouflage/aggressor/thunderbird paint scheme aircraft is prohibited

Covert AR is prohibited (this includes both the use of the LWIR camera system and the covert KC-46 exterior lighting scheme).

Refer to Chapter 6 of this publication for all general warnings/cautions/notes relating to poor visibility using the KC-46 RVS.

**WARNING**

- Air Refueling is prohibited if a KC-46A Boom Floodlight is inoperative at night or twilight. Visibility of the boom through the KC-46 RVS is non-existent in this scenario, and F-16 receiver lights do not provide sufficient illumination alone.
• The KC-46 has relatively low visibility of its boom structure, flight controls, and telescope at night, especially from the precontact position. Approach to contact with less than optimal visibility of the boom structure will be at the discretion of the receiver pilot.

NOTE

• If the KC-46A Boom Marker Light and the F-16 AR Floodlight are both inoperative but all other lights are operative, contact should be made at the discretion of the ARO.

• The positioning of the KC-46 boom floodlights can interfere with receiver pilot night vision goggles (NVGs) from the formation and pre-contact position. Consider removing NVGs before rendezvous with the KC-46 tanker.

8E.15.4.3. Other

Boom interphone use is prohibited.

AR during EMCON 3 and 4 is prohibited.

NOTE

• No tanker or receiver HF radio transmissions are permitted inside ½ nm.

• Relatively large forces for the receiver to telescope the KC-46 boom in or out while in contact. This drives the following warnings for both the ARO and the F-16 pilot:

WARNING

• Upon disconnect the receiver may accelerate toward or away from the tanker. The ARO should be prepared to immediately fly the boom away from the receiver upon disconnect.

• Due to the boom stiffness, the receiver may be carrying an unknown amount of excess thrust. The receiver pilot should be vigilantly monitoring thrust upon disconnect to react as quickly as possible if excess thrust does cause the F-16 to accelerate toward the tanker.
• Upon disconnect the boom may rapidly move towards the receiver due to inadvertent undetectable loading of the boom. This drives the following note and warning:

NOTE

• The ARO should vigilantly monitor inputs to the flight control stick while in contact. The KC-46 boom flight control stick is very sensitive, and inadvertent input is very easy to make.

WARNING

• The ARO should be prepared to immediately fly the boom away from the receiver upon disconnect.

NOTE

• Slipway-assisted contacts may result in nozzle cocking.
F-22A

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.16. AAR Data F-22A

8E.16.1. General Information

8E.16.1.1. The F-22 has a UARRSI receptacle located 33.5 feet from the nose of the aircraft, 14.8 feet aft of the canopy, on centerline.

8E.16.1.2. The receptacle is flanked by doors that articulate outward and lay flat against the top of the fuselage.

8E.16.1.3. The door hinges are protected by a metal shroud that presents a possibility of the boom nozzle catching and damaging the door assembly.

8E.16.1.4. For visibility, the hinge covers are painted with red and white stripes.

8E.16.2. Rendezvous

8E.16.2.1. Expect a receiver turn on rendezvous. Normally the tanker will orbit at 275 KIAS and wait for a receiver directed "push it up" call.

8E.16.2.2. The F-22 may or may not have an A/A TACAN.

8E.16.2.3. Normally test crews will not coordinate an A/A TACAN for rendezvous, however in-flight coordination can be done.

8E.16.3. AAR Procedures
(ALL) RECEIVERS WITH SPECIAL INSTRUMENTATION ARE CLEARED FOR DAYLIGHT OPERATIONS ONLY, USING VFR CONDITIONS AND VFR CLOUD COVER. TEST AIRPLANES ARE NOT IFR CAPABLE AND HAVE NOT UNDERGONE ICING TESTS; THE SPECIAL INSTRUMENTATION COULD BE DAMAGED.

CAUTION

- (ALL) WHEN CLEARED TO CONTACT POSITION, ENSURE THE RECEIVER MAINTAINS CENTERLINE TO MINIMIZE POTENTIAL FOR DAMAGE TO RECEPTACLE AREA.
- (ALL) CONTACT WITH THE SURFACE OUTSIDE OF THE RECEPTACLE MUST BE AVOIDED. THE RECEIVER PILOT WILL BE INFORMED OF BOOM CONTACTS OUTSIDE THE RECEPTACLE OR DAMAGE TO THE RECEPTACLE DOOR HINGE COVERS.
- (ALL) AT NIGHT, THE FORWARD EDGE OF THE RECEIVER'S RECEPTACLE MAY NOT BE VISIBLE, INCREASING THE CHANCE OF BOOM STRIKES OUTSIDE THE RECEPTACLE; TO IMPROVE VISIBILITY, HAVE THE RECEIVER DECREASE THE INTENSITY OF THE RECEPTACLE LIGHT.
- (ALL) WHEN THE TANKER TMF (S) ARE INOPERATIVE, THE RECEIVER NOSE AND ENGINE INLETS MAY NOT BE VISIBLE. CLOSELY MONITOR THE RECEIVER'S ELEVATION DURING CLOSURE TO ENSURE ADEQUATE BOOM CLEARANCE. VISIBILITY OF THE BOOM AND BOOM NOZZLE WILL IMPROVE IN THE VICINITY OF THE RECEIVER'S EXTERNAL SPOTLIGHT LOCATED BEHIND THE CANOPY.
- (KC-10) IF BOTH NOZZLE LIGHTS FAIL, THE RECEIVER'S RECEPTACLE LIGHT, SPOTLIGHT AND THE KC-10 TMFS MUST BE OPERATIVE, UNLESS OPERATIONAL MISSION, OVER-WATER DEPLOYED OR FUEL EMERGENCY DICTATES. IF BOTH THE RECEIVER'S RECEPTACLE LIGHT AND SPOTLIGHT ARE INOPERATIVE, AAR WILL NOT BE CONDUCTED UNLESS OPERATIONAL MISSION, OVER-WATER DEPLOYMENT OR FUEL EMERGENCY DICTATES.

CAUTION

- (KC-10) THE MAXIMUM FLOODLIGHT SETTING IS 7 TO PREVENT DISTRACTING THE RECEIVER PILOT WHILE CLOSING TO THE CONTACT POSITION.
- (KC-135) IF ANY TANKER LIGHTING FAILS, BUT THE RECEIVER EXTERNAL SPOTLIGHT IS OPERATIVE, CONTACT WILL BE AT THE DISCRETION OF THE BOOM OPERATOR.

NOTE

- (ALL) F-22'S DO NOT HAVE MBL CAPABILITY.
- (ALL) WITH TWO PUMPS, THE F-22 MAY EXPERIENCE A PRESSURE DISCONNECT WHEN FUEL QUANTITY IS WITHIN 1,500 POUNDS OF FULL TANKS. THE RECEIVER MAY ASK TO
DECREASE TO ONE PUMP DURING FUEL TRANSFER OR AFTER AN INADVERTENT DISCONNECT.

- (KC-10) FOR NIGHT AAR, THE BOOM OPERATOR WILL NOTIFY THE RECEIVER IF THE BOOM NOZZLE LIGHTS ARE INOPERATIVE.
- (KC-135) FOR NIGHT AAR, THE BOOM OPERATOR WILL NOTIFY THE RECEIVER IF EITHER THE TMF OR BOOM NOZZLE LIGHT IS INOPERATIVE.

8E.16.4. Airspeed / Altitude/External Stores

8E.16.4.1. The Maximum Bank angle during AAR is 30 Degrees.

8E.16.4.2. F-22 aircraft configured with two external tanks in the inboard positions is the only external tank configuration certified for AAR. No other external tank configurations are permissible

CAUTION

(ALL) F-22 AIRCRAFT CONFIGURED WITH A MIX OF EXTERNAL TANKS AND EXTERNAL ARMAMENT ARE NOT CLEARED FOR AAR.

8E.16.5. (KC-135) Aerial refueling operations can be conducted at 5K-36K feet altitude and 215-350 KCAS (up to 0.9 Mach).

8E.16.6. (KC-10) Aerial refueling operations can be conducted at 5K-31K feet altitude and 215-350 KCAS (up to 0.88 Mach).

8E.16.7. To facilitate mission planning with multiple tanker types, it is recommended that 310 KCAS at 25K feet altitude be used as the optimum. Overrun airspeed for any tanker is 335 KCAS.
8E.17. AAR Data F-35A

**F-35A**

**IMPORTANT:** Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.17.1. General Information
8E.17.1.1. (KC-10) The AAR speed envelope shall be 230 – 350 KCAS, no greater than Mach 0.87. The AAR altitude envelope shall be 10,000 – 30,000 ft MSL. The optimum AAR condition is 300 KCAS at 20,000 ft MSL.

![F-35A KC-10A AR Envelope](image1)

8E.17.1.2. (KC-135) The AAR speed envelope shall be 230 – 350 KIAS, no greater than Mach 0.84. The AAR altitude envelope shall be 10,000 – 30,000 ft MSL. The optimum AAR condition is 305 KIAS at 20,000 ft MSL.

![F-35A KC-135R/T AR Envelope](image2)

**CAUTION**

- THE BOOM OPERATOR SHALL AVOID THE RECEPTACLE DOORS DURING THE APPROACH TO CONTACT AND IMMEDIATELY AFTER DISCONNECT. THE AAR RECEPTACLE DOORS, WHEN OPEN, ARE RAISED FROM THE AIRCRAFT MOLD LINE WITH SERRATED LEADING EDGES ON EITHER SIDE OF THE RECEPTACLE. THE RECEIVER PILOT SHALL BE NOTIFIED IF A BOOM STRIKE OCCURS OUTSIDE THE RECEPTACLE.
• AT THE DISCRETION OF THE BOOM OPERATOR, NIGHT AAR MAY BE ACCOMPLISHED WITH UP TO ONE LIGHT INOPERATIVE ON EACH THE TANKER AND F-35A. WITH THE EXCEPTION THAT IF THE F-35 SPOTLIGHT, WHICH ILLUMINATES THE SLIPWAY IS INOPERATIVE, BOTH THE TAIL MOUNTED FLOOD LIGHT AND BOOM NOZZLE LIGHT MUST BE OPERATIVE.

NOTE

• AAR SHALL BE PROHIBITED IF THE TANKER FUEL TEMPERATURE IS BELOW -50°F (-46°C).

• THE F-35A HAS THREE LIGHTS TO AID IN NIGHT REFUELING OPERATIONS. A SPOTLIHT TO ILLUMINATE THE SLIPWAY, A RECEPTACLE LIGHT TO ILLUMINATE THE RECEPTICAL, AND UNDER-DOOR LIGHTS TO ILLUMINATE THE RECEPTACLE DOORS.

• HF RADIO TRANSMISSIONS ARE NOT PERMITTED INSIDE ½ NM.

• BOOM INTERPHONE SHALL NOT BE UTILIZED ON TAIL NUMBERS 2AF:0001 THROUGH 2AF:0030 OR 2AN:0001 THROUGH 2AN:0002.

• THERE ARE 3 ANTENNAS (SHORT OR FLUSH MOUNT) NEAR AIRCRAFT CENTERLINE APPROXIMATELY 3 FEET FORWARD OF THE RECEPTACLE. A COMMUNICATION ANTENNA (TALLER OR FLUSH MOUNT) IS LOCATED APPROXIMATELY 5 FEET AFT OF THE RECEPTACLE.

<table>
<thead>
<tr>
<th>Tail Number</th>
<th>Telemetry Antennas (2 per A/C)</th>
<th>~3 ft Forward of Receptacle</th>
<th>~5 ft aft of receptacle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2AF:0001</td>
<td>Short</td>
<td>Short</td>
<td>Taller</td>
</tr>
<tr>
<td>2AF:0002</td>
<td>Short</td>
<td>Short</td>
<td>Taller</td>
</tr>
<tr>
<td>2AF:0003</td>
<td>Flush</td>
<td>Flush</td>
<td></td>
</tr>
<tr>
<td>2AF:0006</td>
<td>Note 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2AF:0004</td>
<td>Short</td>
<td>Flush</td>
<td>Flush</td>
</tr>
</tbody>
</table>

Notes:
1. All jets manufactured after 2AF:0006 have flush mounted antenna types.

NOTE

• JAPAN (JASDF)-OWNED F-35A MAY ONLY BE REFUELED WHILE OPERATED BY US GOVERNMENT PILOTS IS SUPPORT OF TESTING, FERRY, OR DELIVERY FLIGHTS.
F-35B/C

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.18. AAR Data F-35B/C

F-35B on KC-135 BDA

8E.18.1. General Information

<table>
<thead>
<tr>
<th>Tanker</th>
<th>Drogue Station</th>
<th>Airspeed</th>
<th>Altitude</th>
<th>Day</th>
<th>Night</th>
<th>External Stores</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC-135</td>
<td>BDA</td>
<td>200-300 KCAS</td>
<td>FL100-FL250</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Linear from 200 KCAS/FL250 to 250KCAS/FL300 and 250-300 KCAS (FL300)</td>
<td>FL250-FL300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KC-135</td>
<td>MPRS</td>
<td>220-300 KCAS or Mach 0.84, whichever is lower</td>
<td>9,000 ft – 35,000 ft MSL</td>
<td>YES</td>
<td>NO</td>
<td>YES*</td>
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<tr>
<td>KC-10</td>
<td>Centerline</td>
<td>200-325 KCAS</td>
<td>FL100-FL280</td>
<td>YES</td>
<td>YES</td>
<td>YES**</td>
</tr>
<tr>
<td></td>
<td>WARP</td>
<td>230-300 KCAS</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* (KC-135) Altitude and airspeed shall be restricted to 10,000-30,000 ft MSL, 250-270 KCAS with external stores.
** (KC-10) Altitude and airspeed shall be restricted to 10,000-25,000 ft MSL, 240-275 KCAS with external stores.
KC-135 Warnings, Cautions, and Notes:

- AAR WITH THE F-35 IN AFTERBURNER IS PROHIBITED ON THE BDA

- DUE TO THE LOCATION OF THE F-35B/C ENGINE INTAKE IN RELATION TO THE AR PROBE, DAMAGE TO THE PROBE OR DROGUE COULD RESULT IN FOD IN THE ENGINE

CAUTION

- DUE TO LIMITED CLEARANCE BETWEEN THE F-35B/C PROBE AND CANOPY/FUSELAGE, EXERCISE EXTREME CAUTION WHILE THE F-35B/C IS IN OR NEAR THE CONTACT POSITION AS ANY UNSTABLE CONDITION MAY RESULT IN DAMAGE TO THE RECEIVER AND/OR THE DROGUE/HOSE SYSTEM.

NOTE

- AR IS RESTRICTED TO DAY VMC CONDITIONS

- AAR IS PERMITTED WITH UP TO TWO AR PUMPS FOR THE BDA AND MPRS.

- AAR OPERATIONS WITH EXTERNAL STORES OR EXTERNAL FUEL TANKS ARE NOT AUTHORIZED

- AR OPERATIONS WITH AN INSTALLED SPIN RECOVERY PARACHUTE ARE NOT AUTHORIZED

- NO TANKER HF RADIO TRANSMISSIONS ARE PERMITTED INSIDE ½ NM OF RECEIVER.

- REFERENCE AND FOLLOW ALL APPLICABLE F-35B/C AOLs REGARDING AERIAL REFUELING PROBE WEAK-LINK TEMPERATURE LIMITS.

- DURING AAR AT HIGHER ALTITUDES AND SLOWER AIRSPEEDS, THE F-35B/C ENGINE RESPONSE TO THROTTLE MOVEMENT MAY BE DELAYED AND SHOULD BE ACCOUNTED FOR IN MAKING CONTACT AND MAINTAINING POSITION.

KC-10 Warnings, Cautions, and Notes:

CAUTION

- DUE TO LIMITED CLEARANCE BETWEEN THE F-35B/C PROBE AND CANOPY/FUSELAGE, EXERCISE EXTREME CAUTION WHILE THE F-35B/C IS IN OR
NEAR THE CONTACT POSITION AS ANY UNSTABLE CONDITION MAY RESULT IN DAMAGE TO THE RECEIVER AND/OR THE DROGUE/HOSE SYSTEM.

NOTE

• SIMULTANEOUS AAR IS PERMITTED ON WARPS ONLY

• AAR IS PERMITTED WITH UP TO TWO AR PUMPS FOR THE CENTERLINE. FOR WARP AAR A MINIMUM OF TWO AR PUMPS WILL BE USED FOR EACH WARP IN USE. WHEN USING BOTH PODS AT THE SAME TIME, A MINIMUM OF FOUR AR PUMPS WILL BE USED.

• AAR OPERATIONS WITH AN INSTALLED SPIN RECOVERY PARACHUTE ARE NOT AUTHORIZED

• NO TANKER HF RADIO TRANSMISSIONS ARE PERMITTED WITHIN ½ NM OF THE RECEIVER.

• REFERENCE AND FOLLOW ALL APPLICABLE F-35B/C AOLs REGARDING AERIAL REFUELING PROBE WEAK-LINK TEMPERATURE LIMITS
8E.19. General Information

8E.19.1. The KC-10 has a UARRSI receptacle located 12 feet aft of the nose and 6 feet behind cockpit windows on aircraft centerline.

8E.19.2. AAR receptacle floodlights are located on both sides and just forward of the leading edge of the receptacle. Black lead-in stripes in front of the receptacle are 4 inches wide and 1 foot apart.

8E.19.3. The AAR area is outlined with a 4 inch wide black stripe. The black stripe directly around the receiver door is 2 inches wide.

8E.19.4. Modified aircraft have electroluminescent (EL) light strips that replace the red lead-in stripes. Each light strip is 3 inches wide.

8E.19.5. The EL light strips form a forward perimeter, lead-in stripes, and aft left and right perimeters.
8E.19.1.6. During AAR with less than optimum lighting, extreme care should be exercised due to reduced depth perception and lack of visual cues on the camouflaged aircraft.

8E.19.1.7. (KC-135) The aerodynamic effects on the tanker aircraft during AAR are similar, but to a lesser degree, than those experienced with the C-5 receiver. The effects are particularly noticeable during rapid receiver separations.

**WARNING**

(KC-135) PILOTS MUST BE AWARE THAT SITUATIONS THAT INDUCE SUDDEN LARGE OUT-OF-TRIM CONDITIONS (LARGE THRUST OR AIRSPEED CHANGES, RAPID MOVEMENT OF LARGE RECEIVER AIRCRAFT, ETC) MAY EXCEED AIRCRAFT TRIM CAPABILITY. IN THESE SITUATIONS, THE “FAIL PASSIVE” DESIGN OF THE DIGITAL AUTOPILOT MAY RESULT IN LARGE VARIATION IN AIRCRAFT ATTITUDE/ALTITUDES PRIOR TO AUTOMATIC DISENGAGEMENT OF THE AUTOPILOT. PILOTS MUST BE PREPARED TO ASSUME AIRCRAFT CONTROL IMMEDIATELY AND SHOULD EXPECT SIGNIFICANT OUT OF TRIM CONTROL FORCES TO EXIST FOLLOWING MANUAL/AUTOMATIC AUTOPILOT DISENGAGEMENT.

**CAUTION**

(ALL) AAR RECEPTACLE FLOOD LIGHT DOORS ARE LOCATED ON BOTH SIDES AND JUST FORWARD OF THE LEADING EDGE OF THE RECEPTACLE. IF AAR RECEPTACLE FLOOD LIGHTS ARE TURNED ON, CAUTION MUST BE EXERCISED TO PREVENT STRIKING THE DOORS.

**NOTE**

- (ALL) DURING NIGHT AAR, THE NOSE SECTION OF THE AIRCRAFT APPEARS TO BE A FLAT SURFACE WHILE IN REALITY, IT IS RAISED. THE ILLUSION MAY CAUSE DEPTH PERCEPTION ERRORS PRIOR TO MAKING CONTACT.

- (KC-10) DURING NIGHT TRAINING MISSIONS, BOTH TANKER AND RECEIVER AIRCRAFT WILL USE ALL AVAILABLE EXTERNAL LIGHTING. AS A MINIMUM, EITHER ONE TMF, OR ONE NOZZLE LIGHT WITH OVERRIDE CAPABILITY WILL BE OPERABLE. DURING AAR WITH LESS THAN OPTIMUM LIGHTING, EXTREME CARE SHOULD BE EXERCISED DUE TO REDUCED DEPTH PERCEPTION AND LACK OF VISUAL CUES. AAR WILL BE AT THE DISCRETION OF THE BOOM OPERATOR.

**NOTE**

- (KC-135) FOR NIGHT AAR, IF THE BOOM NOZZLE LIGHT, TMF, OR RECEIVER’S RECEPTACLE LIGHTING FAILS, ATTEMPTS TO EFFECT CONTACT WILL BE AT THE DISCRETION OF THE BOOM OPERATOR.
**KC-46A**

**IMPORTANT:** Read in conjunction with Appendix 10D – Common Warnings, Cautions and Notes and Appendix 10F - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.20. AAR Data KC-46A

8E.20.1. Airworthiness

8E.20.1.1. The KC-46A airworthiness approval restricts each individual KC-46A to 500 hours in precontact range or closer as a receiver and 1,000 contacts as a receiver. The MAJCOM/A3 for which the KC-46A is operated under must approve air refueling prior to operations taking place.
8E.20.2. General Information

8E.20.2.1. The KC-46A has a Boeing-type receptacle, located 11 feet aft of the center window on the fuselage centerline. Lead in stripes start 3 inches forward of the AR door panels and extend forward at 1 foot intervals. The AR receptacle consists of electrically actuated doors and hydraulically actuated receptacle latches.

8E.20.2.2. AAR receptacle slipway lights are located on both sides and just forward of the leading edge of the receptacle. Black lead-in stripes in front of the receptacle are 4 inches wide and 1 foot apart.

8E.20.2.3. During AAR with less than optimum lighting, extreme care should be exercised due to reduced depth perception and lack of visual cues on the receiver aircraft.

8E.20.2.5. The aerodynamic effects on the tanker aircraft during AAR are similar, but to a lesser degree, than those experienced with the C-5 receiver. The effects are particularly noticeable during rapid receiver separations.

- PILOTS MUST BE AWARE THAT SITUATIONS THAT INDUCE SUDDEN LARGE OUT-OF-TRIM CONDITIONS (LARGE THRUST OR AIRSPEED CHANGES, RAPID MOVEMENT OF LARGE RECEIVER AIRCRAFT, ETC) MAY EXCEED AIRCRAFT TRIM CAPABILITY. IN THESE SITUATIONS, THE “FAIL PASSIVE” DESIGN OF THE DIGITAL AUTOPILOT MAY RESULT IN LARGE VARIATION IN AIRCRAFT ATTITUDE/ALTITUDES PRIOR TO AUTOMATIC DISENGAGEMENT OF THE AUTOPILOT. PILOTS MUST BE PREPARED TO ASSUME AIRCRAFT CONTROL IMMEDIATELY AND SHOULD EXPECT SIGNIFICANT OUT OF TRIM CONTROL FORCES TO EXIST FOLLOWING MANUAL/AUTOMATIC AUTOPILOT DISENGAGEMENT.
NOTE

- DURING NIGHT AAR, THE NOSE SECTION OF THE AIRCRAFT APPEARS TO BE A FLAT SURFACE WHILE IN REALITY, IT IS RAISED. THE ILLUSION MAY CAUSE DEPTH PERCEPTION ERRORS PRIOR TO MAKING CONTACT.

- DURING NIGHT TRAINING MISSIONS, BOTH TANKER AND RECEIVER AIRCRAFT WILL USE ALL AVAILABLE EXTERNAL LIGHTING. AS A MINIMUM, EITHER ONE TMF, OR ONE NOZZLE LIGHT WITH OVERRIDE CAPABILITY WILL BE OPERABLE. DURING AAR WITH LESS THAN OPTIMUM LIGHTING, EXTREME CARE SHOULD BE EXERCISED DUE TO REDUCED DEPTH PERCEPTION AND LACK OF VISUAL CUES. AAR WILL BE AT THE DISCRETION OF THE BOOM OPERATOR.

- FOR NIGHT AAR, IF THE BOOM NOZZLE LIGHT, TMF, OR RECEIVER'S RECEPTACLE LIGHTING FAILS, ATTEMPTS TO EFFECT CONTACT WILL BE AT THE DISCRETION OF THE BOOM OPERATOR.

- UNDESIREABLE BOOM OSCILLATIONS MAY OCCUR AT APPROXIMATELY 1 TO 3 FEET FROM THE RECEPTACLE. THE BOOM OPERATOR MAY USE THE SLIPWAY TO MAKE CONTACT AND MINIMIZE UNDESIREABLE BOOM OSCILLATIONS.

8E.20.3. KC-135 AAR Operations

<table>
<thead>
<tr>
<th>Airspeed</th>
<th>Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC-135 AP On*: 250 – 325 KCAS, Max .76 M</td>
<td>8,000 – FL330</td>
</tr>
<tr>
<td>KC-135 AP Off: 250 – 325, Max .8 M</td>
<td></td>
</tr>
<tr>
<td>Planning: 275 KIAS/0.74 M</td>
<td>Planning: FL200 - 250</td>
</tr>
<tr>
<td>Buddy Cruise: .77 M</td>
<td></td>
</tr>
<tr>
<td>RCVR RV Speed: 310 KIAS</td>
<td></td>
</tr>
</tbody>
</table>

* Not Authorized on Block 45

8E.20.3.2. The KC-46 receptacle is illuminated by slipway and bore lighting.

8E.20.3.3. The KC-46 has a receptacle, located 11 feet aft of the center window on the fuselage centerline.

8E.20.3.4. Lead in stripes start 3 inches forward of the AR door panels and extend forward at 1 foot intervals.

---

**WARNING**

- **TANKER AIRSPEED AND ALTITUDE CHANGES MUST BE MADE SMOOTHLY AND CAUTIOUSLY WHILE THE RECEIVER IS IN OR NEAR THE CONTACT POSITION. ANY AIRSPEED OR ALTITUDE ADJUSTMENT REQUIRED BY THE TANKER DUE TO AERODYNAMIC EFFECTS OF THE RECEIVER SHOULD BE ACCOMPLISHED AFTER THE RECEIVER IS STABILIZED IN THE CONTACT POSITION.**

- **PILOTS MUST BE AWARE THAT SITUATIONS THAT INDUCE SUDDEN LARGE OUT-OF-TRIM CONDITIONS (LARGE POWER OR AIRSPEED CHANGES, RAPID MOVEMENT OF THE RECEIVER AIRCRAFT, ETC.) MAY EXCEED AIRCRAFT TRIM CAPABILITY. IN THESE SITUATIONS, THE FAIL-PASSIVE DESIGN OF THE AUTOPILOT MAY RESULT IN A LARGE VARIATION OF AIRCRAFT ATTITUDE/ALTITUDES PRIOR TO AUTOMATIC DISENGAGEMENT OF THE AUTOPILOT. PILOTS MUST BE PREPARED TO ASSUME AIRCRAFT CONTROL IMMEDIATELY,**
AND SHOULD EXPECT SIGNIFICANT OUT OF TRIM CONTROL
FORCES TO EXIST FOLLOWING MANUAL/AUTOMATIC
AUTOPILOT DISENGAGEMENT.

- THE BOOM OPERATOR MUST AGGRESSIVELY ADVISE THE
  RECEIVER TO SLOW THE RATE OF CLOSURE TO
  APPROXIMATELY 1 FOOT PER SECOND.

- EXCESSIVE CLOSURE RATE MAY CAUSE THE TANKER TO
  DESCEND INTO THE PATH OF THE RECEIVER. THE PILOT MUST
  BE PREPARED TO DISCONNECT THE AUTOPILOT TO PREVENT
  ALTITUDE DEVIATIONS. INITIATE A BREAKAWAY AT THE FIRST
  INDICATION OF A CLOSURE OVERRUN.

  !

  CAUTION

- EXCEPT WHEN MISSION REQUIREMENTS DICTATE, DO NOT
  ATTEMPT CONTACTS AT NIGHT WITH THE RECEIVER
  RECEPTACLE LIGHTS AND TANKER TMF FAILED.

- IF THE RATE OF FORWARD MOVEMENT IS EXCESSIVE OR
  CONTINUES PAST THE CONTACT POSITION, THE BOOM
  OPERATOR WILL EXERCISE SOUND JUDGMENT IN INITIATING A
  BREAKAWAY PRIOR TO THE RECEIVER OVERRUNNING THE
  TANKER.

NOTE

- VISIBILITY OF THE BOOM NOZZLE AND RECEPTACLE IS
  LIMITED ABOVE 25 DEGREES ELEVATION.

- AS THE KC-46 NEARS 290,000 LBS GROSS WEIGHT, FUEL FLOW
  RATE MAY MOMENTARILY INDICATE ZERO BEFORE RESUMING
  ONLOAD DUE TO KC-46 VALVES OPENING AND CLOSING.

- BOOM TRIM SETTING OF AT LEAST 3 IS RECOMMENDED. IF
  LESS THAN 3 UNITS OF BOOM TRIM ARE USED, RESTRICT
  LOWER ELEVATION LIMIT TO 35 DEGREES AND NOTIFY
  RECEIVER OF ENVELOPE RESTRICTION.

- AS THE RECEIVER APPROACHES THE CONTACT POSITION, A
  SLIGHT AMOUNT OF UPWARD CONTROL STICK FORCE MAY BE
  REQUIRED TO MAINTAIN THE BOOM AT 30 DEGREES
  ELEVATION.

- BOOM INTERPHONE USE IS PROHIBITED.
- WHEN THE TANKER CG IS 30% MAC OR GREATER AND TANKER WEIGHT IS LESS THAN 200,000 LBS, THE AUTOPILOT PITCH CONTROL MAY BECOME LESS STABLE, CAUSING ABRUPT OSCILLATIONS AND RESULTING IN ALTITUDE DEVIATIONS OF APPROXIMATELY 100 TO 200 FT.

- KC-135 BLOCK 45 AUTOPILOT HAS NOT BEEN TESTED WITH THE KC-46. BLOCK 45 KC-135s WITH AUTOPILOT ON ARE PROHIBITED FROM REFUELING THE KC-46. BLOCK 45 KC-135s WITH AUTOPILOT OFF ARE PERMITTED TO REFUEL THE KC-46 USING THE AP OFF KC-135/KC-46 ENVELOPE.

- THE AERODYNAMIC EFFECTS ON THE TANKER AIRCRAFT DURING AR ARE SIMILAR TO, BUT MORE ABRUPT THAN THOSE EXPERIENCED WITH THE KC-10 RECEIVER. THE EFFECTS ARE PARTICULARLY NOTICEABLE DURING RAPID RECEIVER SEPARATIONS OR CLOSURES FASTER THAN 1 FOOT PER SECOND.

- DURING APPROACH TO CONTACT, A BOW WAVE SIMILAR TO, BUT MORE INTENSE THAN THAT ENCOUNTERED WITH THE KC-10 BECOMES EVIDENT IN THE 15 FEET PRIOR TO CONTACT.

- CONTACT SHOULD NOT BE ATTEMPTED UNTIL THE RECEIVER HAS STABILIZED IN THE CONTACT POSITION.

- AIRFLOW EFFECTS AROUND THE KC-46 RECEPTACLE MAY PUSH THE BOOM NOZZLE LEFT OR RIGHT.
**Wedgetail (737 AEW&C)**

**IMPORTANT:** Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.21. AAR Data Wedgetail (737 AEW&C)

8E.21.1. General Information

8E.21.1.1. The Wedgetail has a UARRSI receptacle which is located approximately 16 feet from the nose on aircraft centerline, 8 feet behind the cockpit.

8E.21.1.2. If the Wedgetail is refueled to top-off, it is likely that the receiver's pressure disconnect switch will be activated and initiate a disconnect once top-off is achieved.

8E.21.1.3. During AAR the Wedgetail mission radar must be in standby mode or off.

8E.21.1.4. AAR lighting and formation lighting have varied intensity.

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**CAUTION**

- (ALL) WHEN REFUELING THE WEDGETAIL AUTO TELESCOPE RETRACT IS PROHIBITED.

- (KC-10) NIGHT AAR IS PERMITTED IF EITHER THE BOOM NOZZLE LIGHT OR TMF ARE INOPERATIVE, SO LONG AS THE RECEIVER’S RECEPTACLE LIGHTS ARE OPERATIVE. IF THE RECEIVER’S RECEPTACLE LIGHTS ARE INOPERATIVE, AS A MINIMUM, EITHER ONE TMF, OR ONE NOZZLE LIGHT WITH OVERRIDE CAPABILITY WILL BE OPERABLE.
CAUTION

- (KC-135) NIGHT AAR IS PERMITTED IF EITHER THE BOOM NOZZLE LIGHT OR TMF ARE INOPERATIVE, SO LONG AS THE RECEIVER’S RECEPTACLE LIGHTS ARE OPERATIVE; IF THE RECEIVER’S RECEPTACLE LIGHTS ARE INOPERATIVE, BOTH THE NOZZLE LIGHT AND TMF MUST BE OPERATIVE

NOTE

- (ALL) THE WEDGETAIL CANNOT INDEPENDENTLY TURN OFF ITS TOP FUSELAGE ANTI-COLLISION (ROTATING BEACON) LIGHT WITHOUT TURNING OFF THE BOTTOM FUSELAGE AND TAIL CONE ANTI-COLLISION LIGHTS.
8E.22. AAR Data TA/A-4AR; AMX; JAGUAR B/S; MIRAGE 2000/F-1

8E.22.1. General Information

8E.22.1.1. The tanker pressure regulation system and MA-4 coupling pressure regulators will be fully functional. The Mirage F-1 should be equipped with a flex-tip probe nozzle. If the Mirage F-1 is not equipped with a flex-tip probe nozzle, then the F-1 pilot will be advised to avoid off center disconnects when conducting AAR from the BDA.

8E.22.1.2. During AAR with Jaguar B/S airplanes, a ground-fit check of the probe and drogue is required.

8E.22.1.2. Night AAR with the Mirage and Jaguar S is prohibited unless the receiver is equipped with a probe nozzle light. The tanker must have all AAR lights, including tail mounted floodlight when using the BDA, operable in addition to the AM-X and Mirage 2000 probe nozzle light.

8E.22.1.3. All electronic stores, radar, and electronic countermeasures must be turned off or in standby within ½ NM of the tanker.

8E.22.1.4. No tanker or receiver aircraft high frequency radio transmissions shall be permitted while the Mirage 2000 is in the pre-contact, contact, or formation position to preclude potential upset of vehicle systems, such as the flight control computer.

8E.22.2. AAR Operations

8E.22.2.1. AAR shall not occur in turbulence greater than light with the Mirage 2000/ F-1 and AM-X.

8E.22.2.2. The Mirage 2000 shall avoid off-center disconnects during BDA refueling operations. The FAF Mirage 2000 may be equipped with two refueling probe nozzles. The Quinson probe nozzle does not have a flexible tip designed to reduce binding during off-center disconnects.

8E.22.2.3. The receiver pilot shall be informed by the tanker of the type fuel being transferred.

8E.22.2.4. Simultaneous AR is prohibited for the Mirage 2000.

8E.22.2.5. The maximum capacity that the receiver shall be refueled to is 90 percent. The maximum capacity that the AM-X shall be refueled to is 80 percent. No receiver valve closures are permitted which would terminate fuel flow to the receiver.

8E.22.2.6. The AAR speed envelope shall be 225 to 275 KIAS. The AAR altitude envelope shall be 5,000 to 25,000 feet.
**8E.22.2.7. (KC-10)** The maximum capacity that the Mirage 2000 (French, Egyptian, United Arab Emirates (UAE)) and French Mirage F-1, shall be refueled to is 80 percent.

**8E.22.2.8.** The KC-10A Centerline systems and KC-135R/T tanker shall be restricted to the use of only one AR pump for fuel transfer. The KC-10A WARP system requires two AR pumps for fuel transfer.

**WARNING**

- **(ALL) DO NOT AAR WITH AM-X RECEIVERS HAVING A DEGRADED ELECTRONIC FLIGHT CONTROL SYSTEM (ECFS) UNLESS_DICTATED BY A FUEL EMERGENCY; IF A FUEL EMERGENCY EXISTS, WARP/MPRS IS THE PREFERRED METHOD OF AAR BECAUSE IT ENSURES MAXIMUM TANKER/RECEIVER SEPARATION. AR FROM THE KC-10A CENTERLINE HDU IS AUTHORIZED IF WARP REFUELING IS UNAVAILABLE. AR FROM THE KC-135R/T BDA KIT SHALL BE PROHIBITED WHEN AM-X RECEIVER HAS A DEGRADED EFCS (EVEN IN A FUEL EMERGENCY).**

- **(ALL) AR OPERATIONS SHALL BE PROHIBITED WHEN AN EFSC FAILURE AND ANY DAMPER OFF CONDITION EXISTS ON THE AM-X, AND TURBULENCE IS MODERATE TO HEAVY,**

- **(ALL) WHENEVER ASYMMETRIC WING LOADING CONFIGURATIONS EXIST ON THE AM-X, AR OPERATIONS SHALL BE PERFORMED FROM THE KC-135R/T MPRS AND KC-10A WARP ONLY (EVEN WITH EFSC FUNCTIONING PROPERLY).**

- **(KC-135 BDA) AFTER AN A-4 RECEIVER AIRCRAFT ENGAGES THE DROGUE, THE TANKER SHALL TRANSFER 300 POUNDS, AND THEN CEASE TRANSFER TO ENSURE THAT FUEL IS NOT LEAKING FROM THE DROGUE. IF NO LEAKAGE IS REPORTED, CONTINUE NORMAL TRANSFER. IF DURING SUBSEQUENT REFUELING THE A-4 PILOT OR BOOM OPERATOR OBSERVES FUEL ESCAPING AT THE COUPLING, A BREAKAWAY WILL BE CALLED.**

- **(KC-135) AAR FROM THE BDA IS PROHIBITED WHENEVER THE AM-X ECFS IS DEGRADED.**
AV-8B, GR-7 (Harrier)

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.23. AAR Data AV-8B, GR-7 (Harrier)

8E.23.1. General Information

8E.23.1.1. The tanker pressure regulation system and MA-3/4 coupling pressure regulators will be fully functional.

8E.23.2. AAR Operations

8E.23.2.1. The receiver pilot shall be informed by the tanker of the type fuel being transferred.
8E.24. AAR Data EF-2000SS/TS (Typhoon)

8E.24.1. General Information

8E.24.1.1 The NATO/GAF/SAF EF-2000 SS (Single Seat) variant shall be authorized with the KC-135 MPRS and KC-10A WARPS and centerline HDU. The NATO/GAF/SAF EF-2000 TS (Twin Seat) variant shall be authorized with the KC-135 MPRS and KC-10A centerline HDU.

<table>
<thead>
<tr>
<th>Tanker System</th>
<th>Altitude</th>
<th>Airspeed</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC-135 MPRS</td>
<td>6,000-35,000 ft</td>
<td>220 – 300 KIAS, not to exceed 0.85M</td>
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<tr>
<td></td>
<td>Planning: 20,000 ft</td>
<td>Planning: 255 KIAS</td>
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<tr>
<td>KC-10 WARPS</td>
<td>5,000 -33,000 ft</td>
<td>230 – 300 KIAS, not to exceed 0.85M</td>
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<tr>
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<td>33,000 – 35,000 ft</td>
<td>250 – 300 KIAS, not to exceed 0.85M</td>
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<tr>
<td>KC-10 HDU</td>
<td>5,000 – 21,500 ft</td>
<td>210 – 280 KIAS</td>
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<td>21,500 – 25,000 ft</td>
<td>235 – 280 KIAS</td>
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<tr>
<td></td>
<td>25,000 – 30,000 ft</td>
<td>265 – 280 KIAS</td>
</tr>
<tr>
<td></td>
<td>Planning: 20,000 ft</td>
<td>Planning: 255 KIAS</td>
</tr>
</tbody>
</table>

8E.24.2. AAR Operations

8E.24.2.1. The tanker pressure regulation system and both of the pressure regulators in the MA-4 coupling shall be fully operational

8E.24.2.2. Due to lack of a probe light on the EF-2000/Typhoon, all KC-135 and KC-10 AAR lighting should be fully functional.
8E.24.2.3. To prevent the potential of fuel tank overpressurization, fuel top-off is not permitted. For dry contacts, KC-135 boom line valve or KC-10 drogue valve will be closed.

8E.24.2.4. SAF EF-2000 TS variant rear cockpit pilot shall conduct AR during daylight conditions only.

8E.24.2.5. The receiver aircraft is to disconnect immediately when the tanker pod/HDU lights extinguish (indicating fuel flow less than 50 gallons per minute) to prevent overpressure of the receiver’s fuel system.

8E.24.2.6. KC-135R/T and KC-10A crews shall ensure that for dry contacts (training) the respective AR valve is DISARMED.

8E.24.2.7. Except in emergency, bracket/towlining (main group fuel tank top-ups) refueling is prohibited.

8E.24.3. Royal Saudi Air Force refueling criteria for Typhoon FGR MK4/TMK3

NOTE

- THE SAUDI AIR FORCE TYPHOON WILL ONLY BE REFUELED IN SUPPORT OF OPERATION INHERENT RESOLVE (OIR)

- NIGHT AR IS PROHIBITED.

- THE TANKER PRESSURE REGULATION SYSTEM AND THE PRESSURE REGULATORS IN THE MA-4 COUPLING SHALL BE FULLY FUNCTIONAL.

- RECEIVER CLOSURE RATE SHALL BE LIMITED TO 2 FEET PER SECOND

- NO TANKER AIRCRAFT HIGH FREQUENCY (HF) RADIO TRANSMISSION SHALL BE PERMITTED WHEN RECEIVER IS IN THE ASTERN, CONTACT, OR FORMATION POSITION.

- NO AR OPERATIONS ARE TO BE CONDUCTED WITH THE RECEIVER AIRCRAFT IN DEGRADED COMMAND AND STABILITY AUGMENTATION SYSTEM MODE.

8E.24.3.1 AR speeds shall be limited to 250-280-KIAS

8E.24.3.2. AR altitudes shall be limited to 15,000 to 25,000 feet.

8E.24.3.3. While performing planned dry contacts from wing pods the hose must be primed and:

8E.24.3.3.1. **(KC-135)** Ensure the pod valve is disarmed (ARMED and OPEN lights off) to prevent over-pressurization of the Typhoon and EF-2000.

8E.24.3.3.2. **(KC-10)** Ensure the wing drogue valve is ARMED and the pod valve is disarmed (pod valve ARMED light off) to prevent over-pressurization of the Typhoon and EF-2000.

8E.24.3.4. **(KC-10)** Typhoon TMK3 is prohibited from being refueled by the WARP system.

8E.24.3.5. **(KC-10)** Typhoon MK4 variants are authorized to be refueled by the WARP system
**8E.24.3.7. (KC-10)** Fuel transfer shall be limited to one AR pump during centerline HDU operations and 2 AR pumps per WARP during WARP operations.

**8E.24.3.8. (KC-135)** Fuel transfer shall be limited to one AR pump per pod used during MPRS operation on the KC-135.

**8E.24.3.9. (KC-135)** AR operations shall be prohibited with the KC-135 Boom Drogue Adapter (BDA) kit.
**GRIpen (JAS 39C/D)**

**IMPORTANT:** Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.25. AAR Data GRIPEN

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**8E.25.1. General Information**

8E.25.1.1. The tanker pressure regulation system and MA-4 coupling pressure regulators will be fully functional.

8E.25.1.2. Night AAR shall be prohibited.

**8E.25.2. AAR Operations**

8E.25.2.1. AAR shall not occur in turbulence greater than light.

8E.25.2.2. The receiver pilot shall be informed by the tanker of the type fuel being transferred.

8E.25.2.3. Maximum receiver closure rate shall be no greater than 3 ft/sec

8E.25.2.4. (KC-135) Fuel transfers shall be conducted with up to 2 AR pumps for single receiver refueling and up to 3 AR pumps for simultaneous refueling, including tank top-offs.

8E.25.2.5. All electronic stores, radar, and electronic counter measures must be turned off prior to AAR.

8E.25.2.6. The Gripen probe mast contains a pin which may be a “snag” point during coupling engagements and disengagements with the probe nozzle. This pin could damage the drogue canopy which could adversely affect the drag force of the drogue, resulting in instability during extension and rewind operations.

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**WARNING**

- (KC-135) AAR USING THE BOOM DROGUE ADAPTOR IS PROHIBITED.

**NOTE**

(ALL) AFTER AN AAR MISSION WITH THE GRIpen, MAINTENANCE WILL INSPECT THE DROGUE ASSEMBLY OF THE APPROPRIATE HOSE SYSTEM(S) FOR CANOPY TEARS AND OTHER DAMAGE. THIS IS DUE TO THE LOCATION OF THE GRIpen’S PROBE PIN. ANNOTATE “DROGUE ASSEMBLY INSPECTION REQUIRED” IN AIRCRAFT 781A.
**Tornado (F-3 ADV, GR-4/-4A, IDS/ECR/PA-200)**

**IMPORTANT:** Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.26. AAR Data Tornado (F-3 ADV, GR-4/4A, IDS/ECR/PA-200)

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**8E.26.1. General Information**

**8E.26.1.1.** Only Tornado IDS/ECR/PA-200 airplanes equipped with the J.C. Carter flexible-tipped nozzle or an Aeronautical Systems Division (ASD)-approved alternate nozzle will be refueled with the boom drogue adapter (BDA).

**8E.26.1.2.** The Tornado is equipped with a retractable probe mast located on the right side of the cockpit for GR-4, GR-4A, IDS, ECR, PA200 types, and on the left side for E-3 and ADV types.

**8E.26.1.3.** Per Tornado technical orders, no AAR operations are to be conducted with the receiver aircraft in degraded Command and Stability Augmentation System modes.

**8E.26.2. AAR Operations**

**8E.26.2.1.** Limit the bank angle to 15 degrees for turns while in contact unless the receiver pilot requests different angles.

**8E.26.2.2.** The receiver pilot shall be informed by the tanker of the type fuel being transferred.

**8E.26.2.3. (KC-135)** AAR using the Boom Drogue Adaptor is restricted to day only with all Tornado variants.

### ALTITUDE/AIRSPEED:

<table>
<thead>
<tr>
<th>Tanker System</th>
<th>Altitude</th>
<th>Airspeed</th>
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</thead>
<tbody>
<tr>
<td>KC-135R/T Multi Point Refueling System (MPRS)</td>
<td>10,000 – 26,000 ft</td>
<td>220 – 300 KIAS</td>
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<td>Planning: 15,000 ft</td>
<td>Planning: 270 KIAS</td>
</tr>
<tr>
<td>KC-135R/T Boom to Drogue Adaptor (BDA)</td>
<td>10,000 – 26,000 ft</td>
<td>220 – 300 KIAS</td>
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<tr>
<td></td>
<td>Planning: 15,000 ft</td>
<td>Planning: 270 KIAS</td>
</tr>
<tr>
<td>KC-10A Wing Aerial Refueling Pods (WARPS)</td>
<td>10,000 – 30,000 ft</td>
<td>250 – 290 KIAS</td>
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<tr>
<td></td>
<td>Planning: 20,000 ft</td>
<td>Planning: 270 KIAS</td>
</tr>
<tr>
<td>KC-10A Hose Drum Unit (HDU)</td>
<td>10,000 – 30,000 ft</td>
<td>250 – 290 KIAS</td>
</tr>
<tr>
<td></td>
<td>Planning: 20,000 ft</td>
<td>Planning: 270 KIAS</td>
</tr>
</tbody>
</table>
8E.26.3. Royal Saudi Air Force refueling criteria for Tornado TSP 2

NOTE

- THE SAUDI AIR FORCE TORNAADO WILL ONLY BE REFUELED IN SUPPORT OF OPERATION INHERENT RESOLVE (OIR)

- NIGHT AR IS PROHIBITED.

- THE TANKER PRESSURE REGULATION SYSTEM AND THE PRESSURE REGULATORS IN THE MA-4 COUPLING SHALL BE FULLY FUNCTIONAL.

- RECEIVER CLOSURE RATE SHALL BE LIMITED TO 2 FEET PER SECOND

- NO TANKER AIRCRAFT HIGH FREQUENCY (HF) RADIO TRANSMISSION SHALL BE PERMITTED WHEN RECEIVER IS WITHIN ½ NM OF THE TANKER.

- NO AR OPERATIONS ARE TO BE CONDUCTED WITH THE RECEIVER AIRCRAFT IN DEGRADED COMMAND AND STABILITY AUGMENTATION SYSTEM MODE.

- LIMIT BANK ANGLE TO 15 DEGREES.

8E.26.3.1 AR speeds shall be limited to 250-280-KIAS

8E.26.3.2. AR altitudes shall be limited to 15,000 to 25,000 feet.

8E.26.3.3. The maximum capacity that the Royal Saudi Air Force (RSAF) Tornado IDS TSP, shall be refueled to is 80 percent. No receiver valve closure shall be permitted which would terminate fuel flow to the receiver.

8E.26.3.4. (KC-10) Fuel transfer shall be limited to one AR pump during centerline HDU operations and 2 AR pumps per WARP during WARP operations.

8E.26.3.5. (KC-135) Fuel transfer shall be limited to one AR pump per pod used during MPRS operation on the KC-135.

8E.26.3.6. (KC-135) AR operations shall be prohibited with the KC-135 Boom Drogue Adapter (BDA) kit.
RAFALE

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.26. AAR Data Rafale

Rafale on Boom/Drogue Adapter

8E.27.1. General Information

8E.27.1.1. This information applies to USAF tankers only.

8E.27.1.2. Night AAR with the Rafale is prohibited unless the tanker has all AAR lights, including tail mounted floodlight when using the BDA, operable.

8E.27.1.13. The KC-10A tanker pressure regulation system and the MA-4 coupling pressure regulators shall be fully functional.

8E.27.2. AAR Operations

8E.27.2.1. AAR shall not occur in turbulence greater than light.

8E.27.2.2. The KC-10A aircraft shall be restricted to the use of only one AAR pump for HDU and two AAR pumps for WARP during fuel transfer to the receiver.

WARNING

(KC-10) NO AAR OPERATIONS SHALL BE CONDUCTED WITH THE RAFALE HAVING A DEGRADED ELECTRONIC FLIGHT CONTROL SYSTEM UNLESS THERE IS AN EMERGENCY FUEL CONDITION WITHIN THE RECEIVER. IF SUCH A CONDITION EXISTS, THE PREFERRED SYSTEM TO AAR WITH IS THE CENTERLINE DROGUE SYSTEM.

8E.27.2.3. The maximum capacity that the receiver shall be refueled to is 90 percent. The receiver pilot shall terminate fuel flow by disconnecting when the 90 percent capacity has been attained.

8E.27.2.4. All electronic stores, radar, and electronic counter measures must be turned off prior to AAR.

8E.27.2.5. The receiver pilot shall be informed by the tanker of the type fuel being transferred.
SUPER ETENDARD

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.28. AAR Data Super Etendard

Super Etendard on Centre line Drogue

8E.28.1. General Information

NOTE

- WILL ONLY BE REFUELED IN SUPPORT OF OPERATION INHERENT RESOLVE.
- NO TANKER OR RECEIVER AIRCRAFT HIGH FREQUENCY (HF) RADIO TRANSMISSIONS SHALL BE PERMITTED WHILE THE FRENCH SUPERÉTENDARD IS IN THE ASTERN, CONTACT OR FORMATION POSITION.
- AR OPERATIONS SHALL BE PROHIBITED WITH THE KC-135R BOOM-TO-DROGUE ADAPTER (BDA)
- NIGHT AAR SHALL BE PROHIBITED.

8E.28.1.1. Each Super Etendard receiver aircraft shall be equipped with a DoD Mil-N-25161 MA-2 probe nozzle.

8E.28.2. AAR Operations

8E.28.2.1. Due to the unknown structural strength of the receiver probe mast, the receiver aircraft overtake speed at contact to the drogue basket/coupling shall be restricted to 1-2 feet per second closure rate.

8E.28.2.2. Due to unknown proof pressure capability of the receiver lines and fuel surge pressures generated during fuel transfer, each receiver's fuel system shall not be filled to top-off. AAR shall be limited to not exceeding 80 percent of maximum fuel capacity. No receiver valve closures shall be permitted which would terminate fuel flow to the receiver.

8E.28.2.3. The tanker crew shall notify the receiver pilot the type of fuel being transferred. Receiver crew should be advised that a USAF tanker typically refuels with JP-8 (NATO F-34) fuel while overseas and Jet A fuel with military additives (NATO F-24) while in the United States.

8E.28.2.4. Fuel transfer from the KC-10 shall be limited to one AAR pump operation and the pump shall be turned off the tanker crew when the receiver crew indicates that they have reached 80 percent of maximum fuel capacity. For wing aerial refueling pod (WARP) operation, two AAR pumps shall be used per WARP.
8E.28.2.5. French Super Étendard receiver aircrews shall be familiarized with the AR procedures associated with the KC-135R multi-point refueling system (MPRS). Fuel transfers shall be limited to one AR pump per pod used, during MPRS operations on the KC-135R.

8E.28.2.6. A ground fit check of the KC-10’s centerline system’s drogue basket/coupling with the French probe should be successfully completed prior to AAR operations. This fit check will verify that the engagement of the receiver’s probe with the KC-10’s drogue basket/couplings can be accomplished and made cleanly whilst in flight.

8E.28.2.7. The receiver pilot shall be informed by the tanker of the type fuel being transferred.
8E.29. AAR Data P-8A

8E.29.1. General Information

8E.29.1.1. P-8A symmetric and asymmetric external store configurations with harpoons are permitted.

8E.29.1.2. Night AR is authorized. Night AR is not authorized with both the KC-135R/T and P-8A AAR lights inoperable/off.

8E.29.1.3. The USN P-8A cannot independently turn off its top fuselage anti-collision (rotating beacon) light without turning off the bottom fuselage and tail cone anti-collision lights.

8E.29.2. AAR Operations

8E.29.2.1. No tanker HF radio transmissions are permitted inside ½ NM.

8E.29.2.2. Emitters not used during AR shall be turned to STANDBY or OFF.

8E.29.2.3. Block 45-equipped KC-135 shall remain forward of 29% CG when refueling at gross weights below 220,000 lbs.

8E.29.2.4. When refueling at or above FL260, tanker crews should use minimum bank angle turns to assist the receiver in maintaining position.
E-2D

IMPORTANT: Read in conjunction with Appendix 8D – Common Warnings, Cautions and Notes and Figure 2-5 - Foreign AAR Receivers Technically Compatible with USAF Heavy Jet Tankers

8E.30. AAR Data E-2D

8E.30.1. General Information

8E.30.1.1. The E-2D probe is approximately 13 feet in length and extends just over a foot forward of the nose of the aircraft.

8E.30.1.2. Day, dusk, and night operations are authorized.

8E.30.2. AAR Operations

8E.30.2.1. No tanker HF radio transmissions are permitted inside ½ NM.

8E.30.2.2. The flight performance capability of the E-2D behind a tanker is similar to the CV/MV-22. At higher altitudes, airspeeds, or tanker/receiver gross weights the E-2D may have difficulty making a contact and maintaining position in a turn.

8E.30.2.3. E-2D engine temperature limitations may drive requests for adjustment of refueling altitude and/or speed.

WARNING

• DO NOT RAISE OR LOWER SLATS OR FLAPS WHILE THE RECEIVER IS CLOSER THAN THE ASTERN POSITION BECAUSE OF THE RESULTANT PITCH CHANGE OF THE TANKER.

• DURING AN EMERGENCY SEPARATION, DO NOT RAISE OR LOWER THE FLAPS OR SLATS UNTIL THE RECEIVER IS WELL CLEAR.

• DURING AR WITH SLATS OR FLAPS EXTENDED, EXERCISE EXTREME CAUTION TO ENSURE THAT THE PLACARD SPEED IS NOT EXCEEDED.
8E.30.3.1 Except when mission requirements dictate, do not attempt contacts at night with the tanker TMF failed.

8E.30.3.2 AR is not authorized using the KC-135 MPRS.

8E.30.3.3 The use of toboggan maneuvers with the BDA is permitted.

8E.30.3.4 An AOA up to 0.6 is permitted during AR.

- **WARNING**

  - **AR IS PROHIBITED IF THE E-2D AUXILIARY STABILITY AUGMENTATION SYSTEM (AUX SAS) IS DEGRADED.**

  - **WARNING: UNSTABLE CONTACTS OR DISCONNECTS ON THE KC-135 BDA MAY RESULT IN HOSE WHIP OR PROBE DAMAGE.**

  - **CAUTION: DURING ANY AR WHICH REQUIRES THE INDICATED AIRSPEED TO BE LESS THAN 220 KIAS, KEEP THE A/R LINE VALVE CLOSED FOR DRY CONTACTS TO PRECLUDE FUEL SIPHONING FROM THE FORWARD BODY TANK AND CAUSING UNEXPECTED CG CHANGES.
8E.30.4 KC-10 Operations

8E.30.4.1. AR is not authorized using the KC-10 WARPS.

- **WARNING**: EXCEPT IN AN EMERGENCY, AR IS PROHIBITED IF THE E-2D AUXILIARY STABILITY AUGMENTATION SYSTEM (AUX SAS) IS DEGRADED.
CHAPTER 9

AAR Formation Procedures – US Heavy Aircraft

NOTE

THE PROCEDURES CONTAINED WITHIN THIS SECTION ARE TO BE USED WITH US TANKER AND RECEIVER AIRCRAFT ONLY. PROCEDURES ARE RELEVANT TO ALL TANKER FORMATIONS, INCLUDING MIXED CELLS OF TANKER TYPES. VARIATIONS FROM THESE PROCEDURES ARE AUTHORIZED AS NECESSARY AND PROVIDED ALL CELL MEMBERS ARE BRIEFED AND UNDERSTAND VARIATIONS.

9.1. Large Formations with More Tankers than Receivers

9.1.1. A minimum of 5 successive altitudes (4000ft) is required for a 4 ship procedure.

9.1.1.1. Plan an extra 1000ft for additional 1-2 tanker aircraft.

9.1.1.2. As a guide for large formations, the altitude block needed can be calculated by adding the total number of tankers, dividing by 2 and rounding up. A 2000 foot buffer should be included to allow for room to climb/descend. (ex: 5/2.5 = 3 = 3,000ft + 2,000ft = 5,000ft total altitude block).

9.1.2. Following the rendezvous, the lead receiver refuels from the lead tanker. Subsequent receivers obtain fuel from their corresponding tanker; ie, receiver 2 goes to tanker 2, etc. The last, and highest, tanker in the formation is the “airspare.” The receiver will obtain its entire offload from its tanker. This procedure requires tanker and receiver pre-brief and/or mission commander understanding and concurrence.

9.1.3. If it is necessary for any receiver to utilize the air-spare, they will descend to the bottom of the block, 1000 feet below lead/lowest tanker and move aft with sufficient distance from other aircraft or until all aircraft in the formation are identified. Then move to the right until directly behind the airspare.

9.1.4. When the lead receiver has completed refueling, it will clear the lead tanker by descending, moving aft and left to assume a 60 degree left echelon, 2 nm nose-to-nose separation from the refueling element, stacked down 1000 ft. plus 500 feet for each aircraft in the receiver formation.

9.1.5. Once the lead receiver is established in this post AAR position, the crew will call "Established in Post A/R”, if using EMCON 1 or EMCON 2.

9.1.6. After receiver number 2 has completed refueling, it will descend, move directly aft while descending at least 1500 ft below tanker number 2 to maintain 500 ft above receiver lead, and if using EMCON 1 or EMCON 2, call level at their altitude, decelerate, and rejoin on receiver lead.

9.1.7. Additional receivers will follow the same procedures.

9.1.8. Although it should not be required, if needed, the tankers will then climb (or the receiver element may descend) to an altitude which provides a minimum of 1000 ft between the lowest tanker and the highest receiver.

9.1.9. Prior to any aircraft departing the air refueling formation, 1000 ft of altitude separation between the lowest tanker and highest receiver should be established (500 ft minimum required), clearance from ARTCC (US only) or ATC must be received, and all tankers and receivers must coordinate their respective separation maneuvers.

9.1.10. EMCON 3 or EMCON 4 utilization while performing this procedure requires careful consideration and thorough pre-brief.

9.1.11. If using EMCON 3 or EMCON 4, and required to implement airspare fallback procedures, the airspare must ensure receivers are supported before leaving the leading formation. Unless planned otherwise, the airspare should perform fallback procedures 10 minutes after all receivers have contacted their tankers.
9.2. Airspare Fallback Procedures

NOTE

This procedure is necessary to increase tanker reliability in the event of following formations (stream operations) of tankers and receivers. Trailing formations will typically be 20 to 30 minutes in trail.

9.2.1. In formations with less receivers than tankers, the farthest tanker on the starboard side (usually #4) will be considered the “airspare”.

9.2.2. When all receivers in the leading formation(s) have ensured they can receive their fuel, the airspare tanker can be cleared to fall back and join a follow-on formation.

9.2.3. Airspare aircraft will coordinate during mission planning with formation members from both formations, including coordinating rendezvous procedures (i.e. A/A frequency pairing).

9.2.4. The air-spare tanker will depart the lead formation high and to the right to rejoin on a trailing formation head-on from the right.

9.2.4.1. When cleared off from lead, climb 1000 feet or to the top of block.

9.2.4.2. Turn RIGHT 180 degrees. Given increased cross track distance from parallel A/R track, crews should consider requesting additional ATC maneuvering airspace (unless due regard).

9.2.4.3. Attain turn range and offset for a RIGHT turning re-join 2NM behind and 1000 feet above the highest tanker in the following formation.

9.2.4.4. Initiate rejoin turn on the trailing formation at the appropriate turn range and rejoin to the farthest starboard position.

9.2.4.5. Once turn is complete, all aircraft have been visually identified, move to a right 60 degree/2mile position and descend (if required) into formation position.

9.2.4.6. Stand-by for refueling requirements. Consideration should be given to spreading the off-load as necessary to allow each tanker to land without the need to dump fuel.
Air Refueling Formation

(NOT TO SCALE)