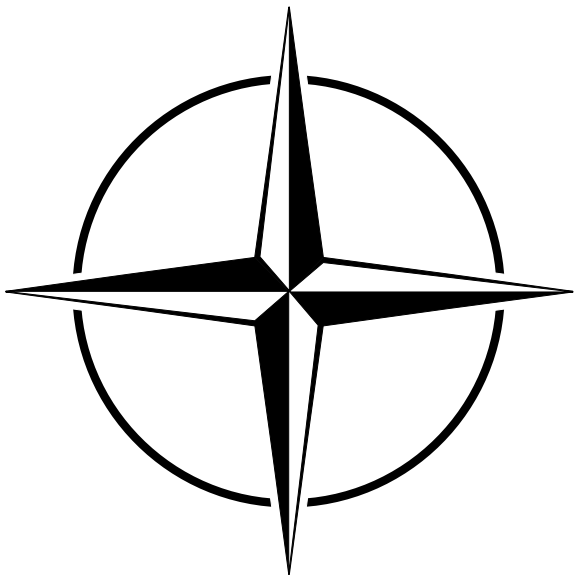

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AIR TO AIR REFUELLING

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November 2000

NORTH ATLANTIC TREATY ORGANISATION

MILITARY AGENCY FOR STANDARDIZATION (MAS)

NATO LETTER OF PROMULGATION

February 1999

1. ATP-56(A) - AIR TO AIR REFUELLING is a NATO UNCLASSIFIED publication. The agreement of nations to use this publication is recorded in STANAG 3971.

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3. Chapter 10, National Annexes contain only factual information. Changes to these are not subject to the ratification procedures; they will be promulgated on receipt from the nations concerned.

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Chairman MAS

ATP-56(A)

AIR TO AIR REFUELLING

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By Command
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RECORD OF RESERVATIONS BY NATIONS

CHAPTER	RECORD OF RESERVATIONS BY NATIONS
1	None
2	None
3	GR
4	None
5	None
6	None
7	None
8	None
9	None

SPECIFIC RESERVATIONS

NATION	RESERVATION
GR	1. In peacetime, AAR is not permitted over Hellenic territory. 2. In times of tension and war, AAR may be conducted within Hellenic Airspace after prior permission from Hellenic authorities. 3. During exercises, AAR over high seas within Athinai FIR should be co-ordinated with Hellenic ATS authorities for mutual agreement.
CZ	Will be implemented only in new supersonic tactical aeroplane or modernized aeroplane L-159

RECORD OF CHANGES

CHANGE	CHANGE DATE	DATE ENTERED	EFFECTIVE DATE	BY WHOM ENTERED

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PART 1 - GENERAL PROCEDURES

CHAPTER 1

INTRODUCTION

101. **Origin**. Many NATO air and maritime air forces have the capability to conduct air to air refuelling (AAR) operations. Although detailed procedures are dependent on aircraft type, mode of employment and national requirements, there is sufficient commonality for NATO Standard Procedures to be developed to enhance operational interoperability.

102. **Aim**. The aim of this publication is to provide a reference document covering procedures, national AAR equipment and AAR capable aircraft. This will:

a. Provide guidance for NATO and national commanders and staff in order to promote the effective employment of AAR in NATO air operations.

b. Lead to a better understanding of national AAR capabilities amongst NATO forces.

c. Promote mutual AAR support amongst suitably equipped NATO forces.

d. Promote the development of mutual AAR tactics and procedures.

103. **Scope**. This document will address the modes of employment of AAR, the commonality of equipment and identify areas where NATO standardisation is practicable. Annexes covering specific national procedures have been incorporated where necessary.

104. **Application**. The planning for and employment of AAR should be based on the principles and procedures contained in this document.

105. **Definitions, Terms and Phraseology**. Definitions, terms and phraseology are listed in Annex 1A. Additional national terms and definitions are contained in the corresponding National Annex.

106. **Additional Information**. Additional information on the detailed employment of AAR is contained in:

a. ATP-34 - Tactical Air Support of Maritime Operations (TASMO or Joint Maritime Ops).

b. AIRCENT Manual 80-6.

107. **AAR Objectives**. The objective of AAR operations is to enhance combat effectiveness by extending the range, payload or endurance of receiver aircraft. Successful AAR depends on 3 major factors:

a. Equipment Compatibility. It is essential that aircraft requiring AAR are fitted with probes/receptacles and fuel systems compatible with the characteristics of the tanker

aircraft employed, eg drogue/boom system, fuel surge pressures, fuel type etc.

b. Performance Compatibility. It is essential for tanker and receiver aircraft performance to be compatible in terms of AAR speeds and altitudes.

c. Procedural Compatibility. It is essential for tankers and receivers to employ pre-planned and compatible procedures for rendezvous, making contact, fuel transfer and departure.

108. **Combined AAR Operations**. Within the constraints of national procedures and equipment characteristics, it is highly desirable that all NATO receivers are able to conduct AAR operations with all NATO tankers on both a pre-planned and/or opportunity basis.

ANNEX 1A

DEFINITIONS, TERMS AND PHRASEOLOGY

This Annex is a glossary of definitions, terms and phraseology used during AAR.

AAR Area (AARA)	A defined area encompassing both a racetrack shape AAR track and its protected airspace.
AAR Bracket	Designated segment of a route where AAR is planned. The bracket is defined by a refuelling start point and stop point.
AARC	Air to air refuelling controller.
AAR Envelope	The area limits behind a boom equipped tanker within which a receiver must fly to remain in contact
AAR Exit Point	The designated geographic point at which the refuelling track terminates.
AAR Stores	The refuelling pod, hose and drogue that connects onto the aircraft when configured in the tanker role.
AAR Time	Planned elapsed time from ARCP to completion point.
AAR Track	A track designated for AAR.
Abort Point	A planned point along the receiver track at which the receiver must divert, if he is not in contact receiving fuel.
Air Refuelling Control Point (ARCP)	The planned geographic point over which the receiver(s) arrive in the observation/pre-contact position with respect to the assigned tanker
Air Refuelling Control Time (ARCT)	The planned time that the receiver and tanker will arrive over the ARCP.
Air Refuelling Initial Point (ARIP)	The geographical point at which the receiver enters the refuelling track (anchor), initiates radio contact with the tanker and begins manoeuvre to RV.
Air Tasking Order (ATO)	Formatted order detailing all information for the mission.
Altitude Differential	The difference between the receiver altitude and the tanker altitude.
Altitude Reservation (ALTRV)	An area of airspace reserved for AAR with the appropriate ATC authority. There are 2 types of ALTRV: moving and static. A

	moving ALTRV encompasses enroute activities and advances coincident with the mission progress. A static ALTRV consists of a defined geographic area, specific altitude(s) and time period(s).
Anchor Point	A defined reference point upon which an anchor refuelling track is orientated.
Anchor Refuelling	AAR performed as the tanker(s) maintain a prescribed pattern which is anchored to a geographical point or fix.
Approval Void Aircraft if Not Airborne (AVANA)	The time period for which an ALTRV is valid. In most cases the AVANA is one hour after the last planned take-off, after which time the ALTRV is automatically cancelled.
Base Altitude	A reference altitude at which the lead aircraft of a tanker formation (or a single aircraft for individual AAR) will fly.
Boom Drogue Adapter (BDA)	Equipment used to convert the boom for use with probe equipped receivers.
Bingo Fuel	A pre-determined quantity of receiver fuel which is insufficient for the receiver to complete the mission as planned.
Boom Cycling	A retraction and extension of the boom to relieve fuel pressure in the drogue adapter.
Breakaway	The command requiring an emergency separation between tanker and receiver: a. Given by the tanker when the receiver is judged to be flying erratically. b. Given if the tanker has a malfunction. c. Given by the boom operator or receiver if the receiver overruns the tanker. In all cases the receiver immediately disconnects, moves back and then goes to a safe position clear of the tanker and the refuelling equipment. Receivers waiting in echelon, as well as those executing a breakaway manoeuvre, are to exercise good lookout to prevent a receiver/receiver collision. The tanker is to maintain heading and assigned FL/altitude and, for boom/BDA operations, the tanker is to increase power and accelerate.

	Additionally, if losing visual contact after breakaway: Single receiver is to: Simultaneously call "loss of visual contact", slow down 10kts, descend 500 ft and hold tanker heading or maintain the turn. After 30 seconds, resume normal airspeed. Two receivers (on wing pods) are to: Simultaneously call "loss of visual contact", slow down 10kts, descend 300 ft/600 ft (left/right receiver) and: If straight and level: Turn 15º away from the tanker's heading using 15º AOB (left receiver to the left, right receiver to the right). Hold new heading for 15 seconds, then resume tanker's heading to parallel the track. After 30 seconds, resume normal airspeed. If in a turn: Outside receiver: Roll wings level. Hold new heading for 15 seconds, resume turn, and then resume normal airspeed. Inside receiver: Increase AOB by 15º, resume normal AOB after 30 seconds, and then resume normal airspeed.
Brute Force Disconnect (boom only)	A disconnect obtained by the receiver moving aft to full boom extension and over-riding hydraulic pressure or a mechanical interface holding the receiver's toggles in the engaged position.
Cell Formation	Two or more aircraft with the same intended route or flight, maintaining station-keeping operations by either or both visual and electronic means. Tanker cell formations are non-standard formations which may be accompanied by receivers. The formation will be flown with successive tankers in line astern and stepped up behind the leader.
Clear Astern (Pre-contact)	Radio call by the tanker clearing a receiver astern the left/centre/right assigned AAR equipment. The receiver moves to stabilize in the pre-contact position.
Clear Contact (probe and drogue only)	The receiver is cleared to move forward from the pre-contact position to engage the probe in the drogue.
Clear Contact Position (boom only)	The receiver is cleared to advance to the steady boom contact position.
Clear Join	Radio call by the tanker clearing the receiver to join in close formation in the observation position or pre-contact position for boom operations.

Clear to Leave	Radio call given by the tanker clearing the receiver to leave the tanker formation. This call is given only after the receiver has completed moving to an echelon position.
Contact	a. Probe and Drogue. A contact is made when the probe engages the drogue. b. Boom. Called by the boom operator and the receiver when the boom is locked in the receptacle.
Disconnect	a. Probe and Drogue. Command given by the tanker. The receiver moves smoothly back to the pre-contact position. b. Boom. Command given by the tanker or receiver. When the boom is seen to be clear of the receptacle, the receiver moves smoothly back to the pre-contact position.
Dry Contact	AAR engagement for aircrew proficiency during which fuel is not transferred.
Emission Control (EMCON) Procedures	The management of electromagnetic radiation to counter an enemy's capability to detect, identify, or locate friendly emitters for exploitation by hostile action. For ease of tasking, the restriction of electronic emissions are standardized into 4 Options:
Emission Option 1	Any and all emitters are authorized, ie full RT for training purposes adding any timing that would affect the RV.
Emission Option 2 (Restricted Communications)	Radio silent formation except for RV and AAR which is conducted with limited radio exchange. All other emitters are authorized. Essential radio transmissions for flight safety may be made. At initial contact, receivers and tankers will exchange callsigns, altitude and timing. Altimeter setting and hot armament check will also be co-ordinated, if applicable. If not at the planned RV altitude, an additional call is required when reaching that altitude. For boom operations, an abbreviated pre-contact radio check is required when the receiver reaches the pre-contact position. The boom operator will transmit numerical callsigns only, eg '25,57', and the receiver will respond '25'. If this check cannot be completed, refuelling will not commence unless a mission priority or receiver fuel emergency has been declared. Receivers will not depart the pre-contact position until either this radio check or visual signals direct approach to contact. Emission Option 2 is the desired standard for day to day AAR.

Emission Option 3 (Communications Out)	Radio silent operations including formation, RV and AAR. The use of other emitters is authorized unless specifically prohibited.
Emission Option 4 (Emission Out)	No emitters will be used unless specifically authorized by the plan which the AAR is supporting (ATO, Rules of Engagement ROE), Operations plan, Safe Passage procedures, or other mission directive).
Emitter	A piece of equipment that emits electromagnetic radiation (radios, radar, TACAN, IFF, doppler, radio altimeter, etc).
End AAR	A planned point or the actual position within the confines of the AAR track at which all AAR operations/requirements are complete.
Go Echelon Left/Right	Radio call given by the tanker which instructs a receiver to move from the pre-contact position to echelon after refuelling is complete.
Hard Hose	A hose condition in which hose slack is not properly taken up on contact. Any resulting hose whip is likely to damage the receiver's probe.
Judy	Radio call made by the receiver when radar contact with the tanker and taking over responsibility for closing to within visual range.
Manual Boom Latching (boom only)	Both receiver and tanker AAR systems in manual operation. The receiver pilot must initiate all disconnects.
Manual/Emergency/ Overrun Boom Latching (MBL/EBL/OBL)	Both receiver and tanker AAR systems in manual operation.
Mark	A request for the tanker to assist the receiver in achieving visual contact. Depending on type, the tanker may dump a small quantity of fuel, or fire a flare, or switch on/vary the high intensity lighting. Refer to National Annexes.
MARSA	Military Assumes Responsibility for Separation of Aircraft - applies only to participating aircraft.
Observation Position	The initial formation position for a receiver joining a tanker. This is normally echelon right for all receivers. There is a slight difference in the Observation Position between Drogue only equipped tankers and Boom (even when refuelling from pods) equipped tankers:

a. Drogue Equipped Tanker. The receivers should initially pull well forward, to be observed and identified by the tanker pilots.

b. Boom Equipped Tanker. A position slightly behind the tanker wing with a minimum of one receiver wingspan clearance between tanker and receiver (weather permitting).

Off-load/On-load — The tanker fuel, normally established at the planning stage, assigned for off-load/on-load to receiver(s) during an AAR mission.

On-Deck Position. — Right or left hand echelon formation on the receiver in the contact position. Applies to Quick Flow Procedure only.

Oral Communications (boom only) — The following terminology will be used by the boom operator when verbal instructions to the receiver are necessary:

Stabilize	Hold receiver steady in present position.
Forward	Move receiver forward.
Back	Move receiver backward.
Up	Ascend receiver.
Down	Descend receiver.
Right	Move receiver right.
Left	Move receiver left.

Orbit Departure Time — That time at which the tanker will depart the orbit point to effect the planned RV.

Orbit Pattern — The pattern flown by the tanker at the orbit point.

Orbit Point — A geographic point along the planned AAR track where the tanker will orbit.

Overrun — a. Rendezvous. An overrun when the receiver passes the tanker prior to or during the tanker RV turn.
b. Closure. An overrun when the receiver's closure rate prevents stabilizing in the pre-contact position, or when forward movement of the receiver is considered excessive during contact or approach to contact.

Pre-contact Position — a. Boom. The position approximately 50 ft behind and

	slightly below the tanker boom nozzle where the receiver stabilizes before being cleared to the contact position. b. Probe and Drogue. The stabilized formation position astern the AAR equipment (approximately 5 ft directly aft of the drogue).
Quick Flow AAR (QF)	Visual formation procedures used to expedite AAR operations by minimising required refuelling time.
Radio Silent	No radio transmissions between tanker and receiver except in an emergency. For further details see Chapter 7.
Rendezvous Procedure (RV)	A procedure to join the receiver with the tanker.
Rendezvous Initial Point (RVIP)	A planned geographic point prior to the ARCP to which tankers andreceivers time independently to effect an arrival at the RV control time. If the tanker/receiver is not already at its assigned RV FL/ altitude, it commences a climb/descent to that FL/altitude. This point may be a designated position established at the planning or briefing stage, or as directed by the tanker/GCI/AEW controlling the RV
Reverse Flow AAR (boom only)	The transfer of fuel from receiver to tanker.
Rim	The probe strikes the rim or periphery of the drogue but does no damage.
RV Control Time (RVCT)	A general term that applies to any control time to make good an RV between tanker/receiver at a specific point (ARCP, RVIP).
RV Flight Level (FL)/ Altitude	The FL or altitude of the tanker during a RV procedure. Receivers are separated from the tanker by FL/altitude during the procedure; unless otherwise stated, the receiver is to be 1000 ft below the tanker.
RV Initial Call	When the use of radio is authorized, the tanker is to confirm RV details before starting the RV procedure. The format of the call is in Annex 7A.
RV Point	A designated point where tanker and receiver are planned to be joined in formation (ARCP, RVIP, etc).
RV Rollout Heading	A heading reference taken by the tanker(s) on the final turn towards the RV Point.

RV Speed	The tanker speed (IAS) during the RV; this is usually the intended refuelling speed (normally optimised for best receiver AAR performance). Receiver speed during RV may be dependent on RV procedure; however it is usually 20 kts greater than the tanker. If communications are not possible for any reason, and pre-briefing is not possible, the tanker will fly at the optimum speed for the receiver type as listed in Annex 10R, TANKER AAR CAPABILITIES.
RV Track (Tanker Track)	The track flown by the tanker during the RV procedure. Receiver(s) track to the RV Point is dependent on planned route and RV procedure.
Safe Position (KC/KDC-10)	The position during a partial or complete boom control system failure that is safe for the boom operator to initiate a disconnect. This position is when the receiver is approximately 0° roll and moving down and back.
Single Hose Procedure	A change to the refuelling procedure which is effected when a tanker, which normally operates with 2 AAR stores, has one store unserviceable.
Soft Contact	The probe has not fully engaged in the drogue.
Special Instructions (SPINS)	Special Instructions which are attached to the ATO and detail operating procedures for all missions and tasks.
Spokes	The receiver has damaged the drogue.
Start Descent Point	A point where descent is initiated.
Start Point	A designated point on track where refuelling of the first receiver(s) is planned to start.
Stop Point	A designated point on track where refuelling of the last receiver(s) is planned to stop.
Tactical Stream	Two or more AAR cells proceeding at a pre-determined spacing along identical flight paths.
Tanker Manual Operation (TMO) (boom only)	Receiver AAR system in normal operation, tanker AAR system in manual operation.
TMO without Tanker Disconnect Capability (boom only)	Mode of operation used when tanker AAR signal system malfunctions. Receiver AAR system will remain in normal operation. AAR will not be accomplished except during fuel emergencies or when operationally essential.

Toboggan	Request from receiver for the tanker to start a slow descent, maintaining the refuelling airspeed. The standard rate of descent is 500 ft per minute and this should be used unless tanker or receiver requests otherwise.
Track Offset	Used in RV Delta (Point Parallel), it is the lateral distance which the tanker is offset from the receiver track. The distance compensates for tanker turn radius and drift during the turn towards the ARCP.
Transferable Fuel	Tanker fuel available for passing to a receiver. This is the total fuel in the tanker, minus the fuel the tanker requires to recover to an airfield including any landing/diversion/weather reserves.
Transmit for DF	A 10 second carrier wave transmission, unmodulated by speech, which allows relative positions of tanker and receiver to be determined using UHF/DF.
Turn Range	In some RV procedures, the distance measured between the tanker and receiver at which point the tanker initiates the turn for the RV.
Visual	Radio call from the receiver pilot confirming visual contact with the tanker.
Universal AAR Receptacle Slipway Installation (UARRSI)	A modular AAR unit incorporating an AAR receptacle and slipway to guide the tanker boom nozzle into the receptacle. The UAARSI has a boom interphone capability.

CHAPTER 2

EMPLOYMENT CONSIDERATIONS AND PRINCIPLES

PEACETIME

201. **Fundamental Principles**. Normally AAR operations require extensive pre-planning to ensure optimum effectiveness whilst maintaining safety and efficiency. This requires the identification of the best tanker type or types for the receiver, the selection of the optimum route for the operation, and suitable diversions for the aircraft types. If not tasked through a Combined Air Operation Centre (CAOC), it is essential that an efficient communications interface exists between tanker and receiver tasking organizations, to ensure the correct positioning and timing of the tanker to meet receiver demands.

202. **Flight Safety**. Formations undertaking AAR operations, or in transit, occupy a large volume of air space and cannot manoeuvre easily. Thus, not only must aircrew be well aware of the increased collision risk during AAR but all control agencies must recognise the special requirements of formations undertaking AAR operations.

203. **Airspace Reservations**. Because of the large volume of airspace required, it is important to consult the relevant documents so that National and International Air Traffic procedures are strictly adhered to. In particular, some nations require AAR operations to be conducted in specific geographical areas. For flight safety considerations, it is normal to conduct AAR operations in reserved airspace. Such airspace can be divided into 2 broad categories:

a. AARAs/Anchor Areas and AAR Tracks.

(1) Peacetime AARAs/anchors areas and AAR tracks are areas of airspace established by the national authority for the conduct of routine AAR training and are normally activated by NOTAM. Bookings for this airspace are usually made through the designated national scheduling unit, who are also responsible for liaison with the appropriate ATC authority for activation of the airspace and issue of NOTAMs. If suitably positioned, AARAs/anchors areas or AAR tracks may be used for AAR deployments.

(2) Exercise/operational AARAs/anchors areas and AAR tracks are temporary areas established by NOTAM for the duration of the exercise or operation and may be either permanent or time restricted as dictated by the nature of the task.

(3) Typical dimensions of AARAs/anchors areas and AAR tracks are at Annex 4A.

b. ALTRVs and Military Corridors. ALTRVs and military corridors are normally arranged with the appropriate national ATC authorities. For AAR purposes, moving ALTRVs are normally used to guarantee the required route and altitude(s) for an AAR supported deployment. Military corridors are activated by NOTAM and are essentially static ALTRVs. To ease the scheduling difficulties of the civilian ATC authorities, the USAF operate 3 scheduling facilities which may be used by other nations by prior

agreement. The facilities are responsible for prioritising military tasks and arranging the required ALTRV/corridor times with the appropriate ATC authority. The areas of responsibility for the 3 USA and 2 Canadian facilities are:

(1) Central Airspace Reservation Function (CARF): Continental USA, New York Oceanic FIR.

(2) European Central Airspace Reservation Facility (EUCARF): Europe, Santa Maria and Shanwick Oceanic FIRs.

(3) Pacific Military Airspace Reservation Facility (PACMARF): Pacific and Indian Ocean.

(4) Altitude Reservations East (ARE): Toronto, Montreal, Moncton and Gander FIRs and Gander Oceanic.

(5) Altitude Reservations West (ARW): Vancouver, Edmonton and Winnipeg FIRs.

COMBAT OPERATIONS

204. **Combat Operations**. The employment of AAR in war or other hostile environments will depend on the capabilities of the aircraft types employed, local threat assessments and proximity to unsecured airspace. It is not appropriate in this document to detail AAR operations under combat conditions; however, tankers are vulnerable and high value assets and therefore, in general, they should be placed well clear of the combat zone or protected using fighter support. The procedures and principles of AAR described in this document should be applied whenever possible.

TASKING

205. **AAR Requests**. Units operating tanker aircraft respond to requests for AAR support from receiver units. Receiver aircraft units, or their command/tasking authority, are to identify those tasks that require AAR and raise the necessary request for AAR support.

206. **Command and Control**. The command and control structure must be clearly identified within the operation order or national instructions. Commanders must decide on the priorities to accord to individual requests and allocate forces accordingly.

207. **AAR Tasking**. AAR tasking is normally issued by an ATO or an AAR Combined Task Message (AARCTM):

a. There are currently 2 ATO formats: the European AIRCENT 80-7 and the USAF Contingency Theatre Automatic Planning System (CTAPS).

b. The format and structure of the AARCTM is contained in APP-8 - Allied Tactical Air Messages (Formatted and Structured).

CHAPTER 3

REFUELLING EQUIPMENT

301. **Introduction**. This Chapter gives a general description of current AAR equipment. There are 2 different AAR systems in use: Probe and Drogue and the Flyable Boom. The 2 systems are not compatible. However, some booms can be adapted (on the ground) using a Boom Drogue Adapter (BDA) kit; this makes the boom compatible with probe equipped receivers. Some tankers (eg KC-10) are equipped with both boom and hose/drogue systems and either may be used on the same flight.

302. **Probe and Drogue**. The tanker trails a hose; the free end of the hose terminates in a reception coupling and a conical shaped drogue. Receiver aircraft are fitted with an AAR probe which terminates in a fuel nozzle; the receiver aircraft is flown to engage the probe into the drogue:

a. System Description. The tanker hose is carried on a power driven hose drum (or reel). To trail the hose, the hose drum brake is released and air drag on the drogue pulls the hose, at a controlled rate, into the airstream. When the hose is at full trail, a winding-in torque (response system) is applied to the drum; this counters the air drag of the drogue. The controlled balance between winding-in torque (response system) and air drag absorbs the impact of the receiver making contact; it also damps any tendency for the hose to whip as contact is made, provided excessive receiver closure rates are avoided. When contact is made the probe engages coupling latches, which grip the probe to make a fuel tight joint; fuel valves in the coupling and probe then open. The receiver continues to move forward, pushing the hose back onto the drum. When sufficient hose has rewound onto the drum, the main fuel valve in the AAR equipment opens and fuel can be pumped to the receiver. After making contact the forward movement required of the receiver to open the fuel valve is typically about 2 m (6 ft); however, the distance varies according to AAR equipment type, details are provided in National Annexes. Most systems afford a considerable range of fore and aft hose movement within which fuel will flow to an in-contact receiver. A range of movement from the valve open position to 7 m (20 ft) forward of this, is typical. On some equipment, the fuel valve closes if the hose is pushed in too far. Refer to National Annexes for specific recommended or permitted ranges of hose movement. When AAR is complete, the receiver pilot makes a small power reduction and drops back slowly to stabilize in the pre-contact position. As the hose nears the full trail position, the AAR equipment fuel valve closes. When the hose reaches full trail, the probe begins to pull out of the reception coupling; the coupling and probe fuel valves close, then the coupling latches release the probe. If the tanker pilot commands a Breakaway, the receiver drops back quickly. A sensor in the AAR equipment detects the high rate of hose movement and the hose drum brake is automatically applied; this achieves a swift, positive disconnect and occurs well before the hose reaches full trail. The Mk 17 hose remains in the braked position until it is manually reset but most hoses retrail automatically.

b. Tanker Installations. There are 2 general types of tanker AAR equipment: the podded store and the integral system. AAR pods are self-contained units requiring only fuel and low voltage electricity from the parent aircraft; the power source for fuel pumping and hose drum drive is usually a pod ram air turbine. AAR pods are widely used to give fast jet aircraft an alternate tanker capability; one pod is mounted on an under-wing or

under-fuselage pylon; refer to National Annexes for specific installations. Pods are also carried by some large tankers; usually a pylon mounted pod is carried under each wing. Integral AAR systems may be carried on large tankers; normally these are installed within the main fuselage and the hose is trailed from a centreline fairing or tunnel. However, there are variations on this general principle; for example the FAF Transall AAR equipment is mounted within the left-hand fuselage undercarriage bay. Integral AAR systems use a variety of high powered aircraft supplies (pneumatic, hydraulic and electric) for fuel pumping and hose drum drive.

c. Hose Dimensions and Markings. Generally pod hoses are shorter, lighter and have a narrower bore than integral system hoses. The lengths of pod hoses vary between 15 m (50 ft) and 27 m (90 ft) depending on the system and use; 24 m (80 ft) is typical of an integral system hose. National Annexes provide specific information. Most hoses are marked with coloured bands; there is a wide variety of colours and marking patterns, refer to National Annexes. However, most hoses have a series of bands or a block of colour to indicate the optimum receiver refuelling position; this is achieved when the hose is pushed in so that the markings enter the hose fairing or tunnel. On some hoses, the refuelling position marks are bounded by additional markings indicating the start and stop positions for fuel flow. Usually, there is a series of closely spaced bands at the tanker end of the hose; these provide cues for the receiver pilot to assess rates of fore and aft movement after making contact, or during disconnect.

d. Compatibility. Probe and drogue couplings are built to dimensions established by STANAG 3447; the aim of the STANAG is to ensure probe and drogue compatibility irrespective of the country of manufacture. However, the initial STANAG proved to be insufficiently precise in certain areas with the result that some British Flight Refuelling Limited (FRL) probes were incompatible with some US MA-3 and MA-4 couplings; there was a risk of the FRL probe becoming locked into the US couplings. STANAG 3447 has since been revised to eliminate this problem and all affected MA-3 and MA-4 couplings used within NATO have been modified to restore compatibility. Note that some MA-3 and MA-4 couplings supplied to other air forces outside NATO may still be unmodified. National Annexes list the type of couplings fitted to tankers.

e. Signal Lights. Associated with each tanker AAR installation is a set of rearward facing signal lights, using the colours red, amber and green; although some equipment may have only amber and green lights. On some systems, the signal lights are duplicated for redundancy. The lights provide indications of the operating status of the AAR equipment; on most installations, the lights can be controlled by the equipment operator to give radio silent commands. The NATO standard light signals are: red light means do not make contact or Breakaway, amber means clear contact and green signifies fuel is flowing. Variations on these principles are noted in National Annexes.

f. Drogue Lighting. Most drogues are illuminated to assist night AAR. Some drogues are lit internally by lights at the coupling; alternatively, the drogue periphery may be highlighted by a series of luminescent tritium light sources. On some tankers, reflective paint is applied to the inside of the drogue.

g. Probe Lights. Many receivers have a light which illuminates the probe. These

lights should be used with caution, because they can dazzle the refuelling operator in the tanker; furthermore, their use may accentuate a tendency for receiver pilots to chase the drogue and therefore possibly overcontrol.

h. Drogue Tunnel/Serving Carriage Lights. The drogue tunnel or the serving carriage of most tanker AAR installations are lit from within. This is particularly useful for gauging the amount of hose pushed back onto the hose drum.

303. **Boom**. The tanker is fitted with a flyable, telescopic boom; the free end of the boom terminates in a probe-like fuel nozzle. Receiver aircraft are fitted with a reception coupling, or receptacle. The receiver flies a steady formation position whilst the boom operator manoeuvres and extends the boom to make contact with the receptacle. Some booms are equipped with a Boom Interphone system which permits direct communication with suitably equipped receivers. Full description of the types of boom in service, and their operation, is provided in the appropriate National Annex.

a. Pilot Director Lights. To aid receiver positioning, the tanker aircraft is fitted with Pilot Director Lights (PDL); these consist of 2 parallel light arrays, set longitudinally on the undersurface of the fuselage between the nosewheel bay and the main landing gear. The PDLs give an in-contact receiver directions to move to attain and maintain the ideal refuelling position. One light array gives up and down commands and the other gives fore and aft commands. Coloured positioning bands on the telescoping portion of the boom correspond to the coloured segments of the fore and aft PDL. There are no lights for azimuth positioning. The PDL system should not be used when the BDA is fitted. A full description of PDLs and boom markings is given in the appropriate National Annex.

b. AAR Equipment Lighting. Boom tankers are fitted with a rear-mounted floodlight, which illuminates the receiver, to assist the boom operator. The boom is fitted with a boom nozzle light to assist the operator in positioning the nozzle into the receptacle. Some receivers' receptacles are also internally lit; the UARRSI is usually lit, or highlighted by marker lights.

304. **Boom Drogue Adapter**. The KC-135 and the C135FR boom can be modified to refuel some types of probe equipped aircraft by fitting a Boom Drogue Adapter (BDA); this consists of 3 m (9 ft) of hose attached to the end of the telescoping part of the boom. The hose terminates in a hard non-collapsible drogue. The BDA can only be fitted/removed on the ground. The PDLs should not be used with this system. The BDA does not have a hose response system; therefore receiver pilots should exercise caution during approach to contact. Excessive closure rates could result in a broken probe or hose. Attempts to disconnect which are not made down the correct withdrawal path could result in the probe binding in the reception coupling. For this reason, the USAF recommend the use of 'Flexitip' probes with the BDA. Flexitip probes have some internal bracings removed; this allows the probe mushroom valve tip some lateral movement within the probe structure and makes an off-centre disconnect easier. A full description of the BDA is given in the appropriate National Annex.

305. **Fuel Flow Rates and Pressures**. Fuel flow rates vary widely according to AAR installation. In general terms, the boom system offers the highest rate of fuel flow up to 3650 kg/min (8000 lb/min), podded hose systems offer flow rates between 870 kg/min to 1000 kg/min

(2800 lb/min to 3200 lb/min) and integral hose systems offer flow rates around 2300 kg/min (5000 lb/min). Fuel pressure is regulated in most systems not to exceed about 3.5 bars (50 psi) at the reception coupling. Fuel transfer rates will be affected by the SG of the fuel and the limitations of the receiver fuel system. See National Annexes for details.

Note. Many European aircraft have relatively poor on-load rates and consequently require lengthy AAR time; this may make their use incompatible with single-point tankers.

306. **Tanker Reference Markings**. Most tankers have some form of reference markings, providing enhanced cues for formation and/or AAR station keeping. These markings may be painted lines, fluorescent stripes, or electroluminescent panels. Boom tankers have a fluorescent yellow stripe on the bottom centreline of the fuselage to provide an azimuth reference. Some probe and drogue tankers have reference markings providing alignment cues for the approach to contact.

307. **Tanker Lighting**. Most tankers have floodlighting which make them readily visible to receivers. The lighting is designed to highlight parts of the tanker which may be used as formation visual references, to illuminate the AAR equipment and to light any reference markings provided for AAR. This lighting is usually dimmable. Some small combat aircraft with an alternate tanker role do not have floodlighting for AAR.

CHAPTER 4

RENDEZVOUS PROCEDURES

401. **Introduction**. The purpose of a rendezvous (RV) procedure is to achieve close visual contact between the tanker and a receiver section or element. For the purpose of this Chapter, each RV procedure is written for one tanker. However, all procedures can be adopted when tankers are flying in Multi-Tanker - Echelon formation (usually in line astern) and in Cell formation. The RV is usually at the ARCP and at the ARCT. This Chapter outlines 7 standard types of RV. The type of RV utilised will be dictated by mission requirements, available equipment, weather conditions and the EMCON option in force.

402. **Criteria for Procedures in General**.

a. Altimeter Settings. Unless otherwise directed, an altimeter setting of 1013.2 mb (29.92 inches) is to be used for AAR operations at or above transition altitude, or when over water and operating in accordance with ICAO procedures. When not operating on standard pressure settings, tanker crews are to include the altimeter setting in the RV Initial Call.

b. Height Separation. Receivers are normally to join from below and are to maintain a minimum of 1000 ft height separation, unless otherwise stated at the planning or briefing stage, until visual contact and positive identification have been made. If the planned flight levels are found to be unsuitable, the tanker commander may select other flight levels which will give the best possible chance of a successful RV. A change of flight levels is to be made only when all aircraft and radar units taking part in the procedure are aware of the proposed change and ATC has approved the airspace.

c. Speeds. The tanker speed during a RV procedure is usually the intended refuelling speed; this is normally optimised for best receiver AAR performance. If the speed differs from that pre-briefed, the tanker should advise the receiver in the RV Initial Call. If communications are not possible for any reason, and pre-briefing is not possible, the tanker will fly at the optimum speed for the receiver type, as listed in Annex 10R, TANKER AAR CAPABILITIES. The receiver should normally fly the procedure at the tanker's speed (KIAS) plus 20 kts.

d. Turning Angles of Bank and Range. A planning assumption of 25^{o} angle of bank is used by tankers for most RV procedural turns mentioned in this Chapter. This angle of bank should be flown whenever possible; most of the tanker Turn Ranges in RV procedures are based on this planning assumption. Additional sets of Turn Range tables are provided for some RV procedures; these tables are based on the planning assumption of the tanker using the angle of bank specified in the table.

Note. These tables assume that the tanker is actually turning at the prescribed turning range and do not take into account the inertia of large heavily laden tankers. The turn ranges published in the tables assume that the receiver will roll out 1 nm astern the tanker; the USAF use a different set of tables so the receiver rolls out 3 nm astern.

e. Racetracks and Orbits. Whenever possible, the tanker should set up a racetrack in a suitable position ahead of the RV. The main purpose of this is to allow the tanker timing to be adjusted to meet the needs of the receiver. In the Annexes to this Chapter, racetracks are described in positions ahead of the RV, which are considered to be ideal; however, these are not inflexible and they may be planned elsewhere if necessary. An orbit by the tanker may be used as a tactical holding device during the course of a RV to allow a receiver to catch up, or to hold if visual contact is not made when expected. Unless otherwise briefed, or for ATC reasons, all racetracks and orbits are to be to the left to give the tanker pilot the best lookout.

f. Heading Reference. All headings are magnetic unless otherwise stated.

403. **Types of RV**.

a. RV Alpha (Anchor RV). This is a procedure directed by a radar control station, whether ground based, seaborne, or airborne (AEW); details are at Annex 4A.

b. RV Bravo. This is a heading based procedure which utilises air to air equipment of both tanker and receiver. The tanker controls the procedure; details are at Annex 4B.

c. RV Charlie. This is a heading based procedure similar to the RV Bravo which allows receivers with an Airborne Intercept (AI) radar to control the procedure once positive AI radar contact is established; details are at Annex 4C.

d. RV Delta (Point Parallel). This procedure requires the receiver to maintain an agreed track and the tanker to maintain the reciprocal track, offset a pre-determined distance; details are at Annex 4D.

e. RV Echo. This procedure is intended for use in support of a combat air patrol (CAP). It is particularly useful during periods of EMCON constraints; details are at Annex 4E.

f. RV Foxtrot. This procedure is normally used when the tanker and receiver operate from the same base; details of the accompanied/buddy climb and tailchase departure are at Annex 4F.

g. RV Golf (Enroute). This procedure facilitates join up on a common track to make good a scheduled time. The receivers may have departed either from the same or different bases. There are a number of enroute RVs; details are at Annex 4G.

404. **Equipment Unserviceabilities**. In the event of equipment unserviceabilities which prevent the implementation of a RV procedure according to plan, the tanker is to make good the pre-arranged time at the control point and orbit left until a join-up is achieved, or, at the tanker commander's discretion, the attempt to RV is abandoned.

ANNEX 4A

RV ALPHA (ANCHOR RV)

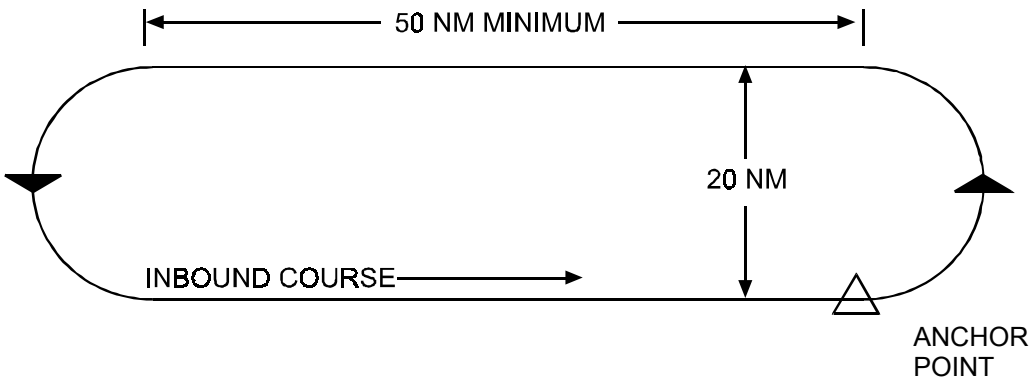
1. **Introduction**. This procedure is a RV carried out under the control of a radar station on the ground, in the air or on-board ship. The RV Alpha is normally used to vector receivers to tankers operating on an AARA/anchor area but may be used as required in any situation. However, with the agreement of the tanker, the controller may give the tanker alterations of heading to effect a quicker join-up.

2. **Procedure**. The essential requirement for a RV Alpha is positive control by the radar station to bring the receiver to 1 nm astern and 1000 ft below the tanker. When visual with the tanker, the receiver calls 'visual' and is then cleared by the tanker to join (on the right unless directed otherwise by the tanker).

3. **Control**. Where a radar station provides advisory information, as distinct from control, one of the other 6 types of RV should be planned. In this case, the information passed by the radar station may be used to supplement the use of airborne aids.

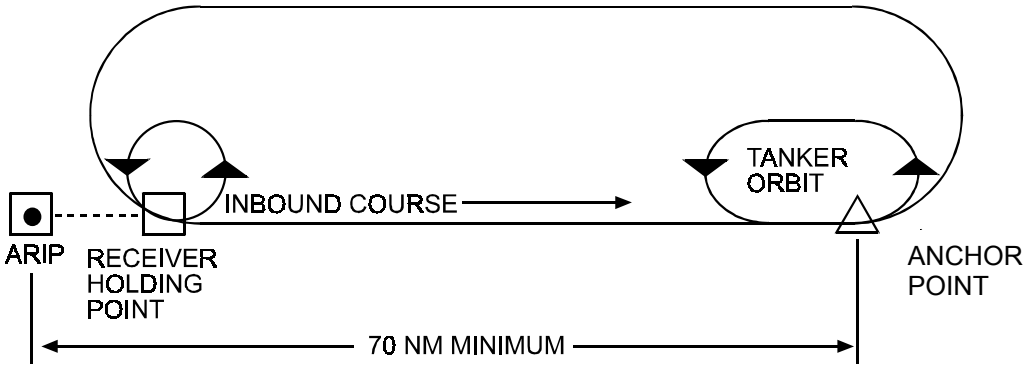
4. **Anchor Pattern**. The refuelling anchor pattern is a left-hand racetrack with legs separated by 20 nm and a minimum leg of 50 nm, as shown in Figure 4A-1. The location of the pattern is determined by the anchor point and the orientation of the inbound course. Single tankers or tanker formations/cells may be used in the anchor. Single tankers will be separated by 4000 ft; tanker formations will be separated by 4000 ft between the highest aircraft in the lower cell and the lead aircraft of the next higher cell. Anchor AAR tracks requiring frequent turns should be flown in trail or offset trail (approximately 20° echelon, as described in Chapter 5 paras 506 and 507).

FIGURE 4A-1. ANCHOR PATTERN



5. **Alternate Anchor Pattern**. In the event that a radar control unit is not available to control an anchor RV, an alternative anchor pattern is to be flown. This pattern is shown at Figure 4A-2 and the RV procedure is described in Annex 4D.

FIGURE 4A-2. ALTERNATE ANCHOR PATTERN



ANNEX 4B

RV BRAVO

1. **Introduction**. The RV Bravo is a heading based procedure and is thus ideally suited for situations where accuracy of the navigation equipment of the tanker or receiver is in doubt or degraded. It has a further advantage in that it does not require a pre-briefed AAR track. However, for pre-briefed tasks a RVIP, the receiver's inbound track and a RV control time are normally designated. This procedure caters for non-AI radar equipped receivers; it is also very suitable for large or battle-damaged receivers, because the tanker performs all turns during the procedure. As this procedure is heading rather than track based, it may not be suited to a busy ATC environment.

2. **Procedure**.

a. A reciprocal head-on approach without lateral displacement is set up. To give sufficient time to correct any heading error, a minimum initial head-on separation of 100 nm is desirable; see Figure 4B-1.

b. For maximum flexibility, the tanker should plan to have time in hand and a timing racetrack should be set up to the left at a convenient position up-track from the ARCP. Both aircraft navigate to make good the RVIP at the RV control time.

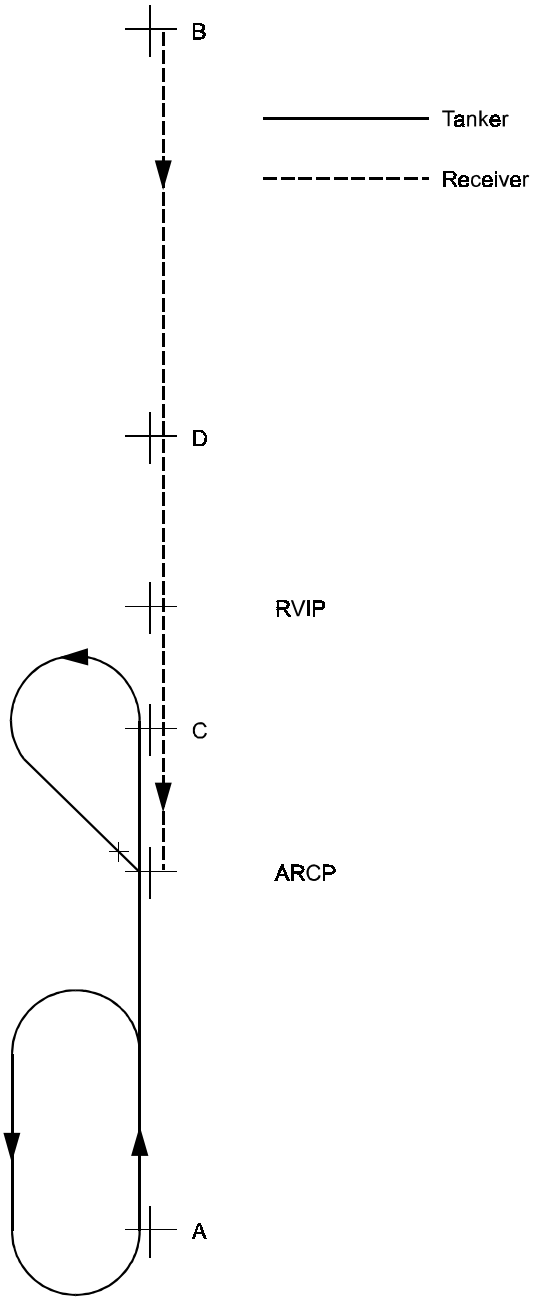
c. After the RV Initial Call has been made, the tanker crew is to call 'Transmit for DF' or use any other suitable equipment to ascertain relative positions. The tanker is to control the heading of the receiver to establish it on a reciprocal heading. As the RV progresses, further 10 second carrier wave transmissions are to be requested to refine the head-on approach.

d. When the turn range is reached, see Figure 4B-2, the tanker is to turn left 225°.

e. On roll-out, the tanker is to take a bearing on the receiver using UDF or other suitable equipment, obtain a range using A/A TACAN and start a stop-watch. These figures are plotted on the chart at Figure 4B-3 to obtain a time to run to the final turn onto the receiver's heading. Ideally, the receiver's relative bearing from the tanker should be 285^{o} and adjustments to the tanker/receiver speeds are not required. However, if the bearing is other than 285^{o}, using Figure 4B-3 the tanker must adjust speed to re-establish the ideal RV geometry.

3. **Control**. The RV Bravo is to be controlled throughout by the tanker unless, because of equipment unserviceabilities, the tanker makes a positive handover of control to the receiver. Should its equipment be unserviceable, the tanker, without relinquishing control, is to request the receiver to use its own equipment to establish the head-on approach. The receiver is to advise the tanker of all alterations of heading. Range information may be obtained from a ground radar unit.

FIGURE 4B-1. DIAGRAM OF RV BRAVO



Notes:

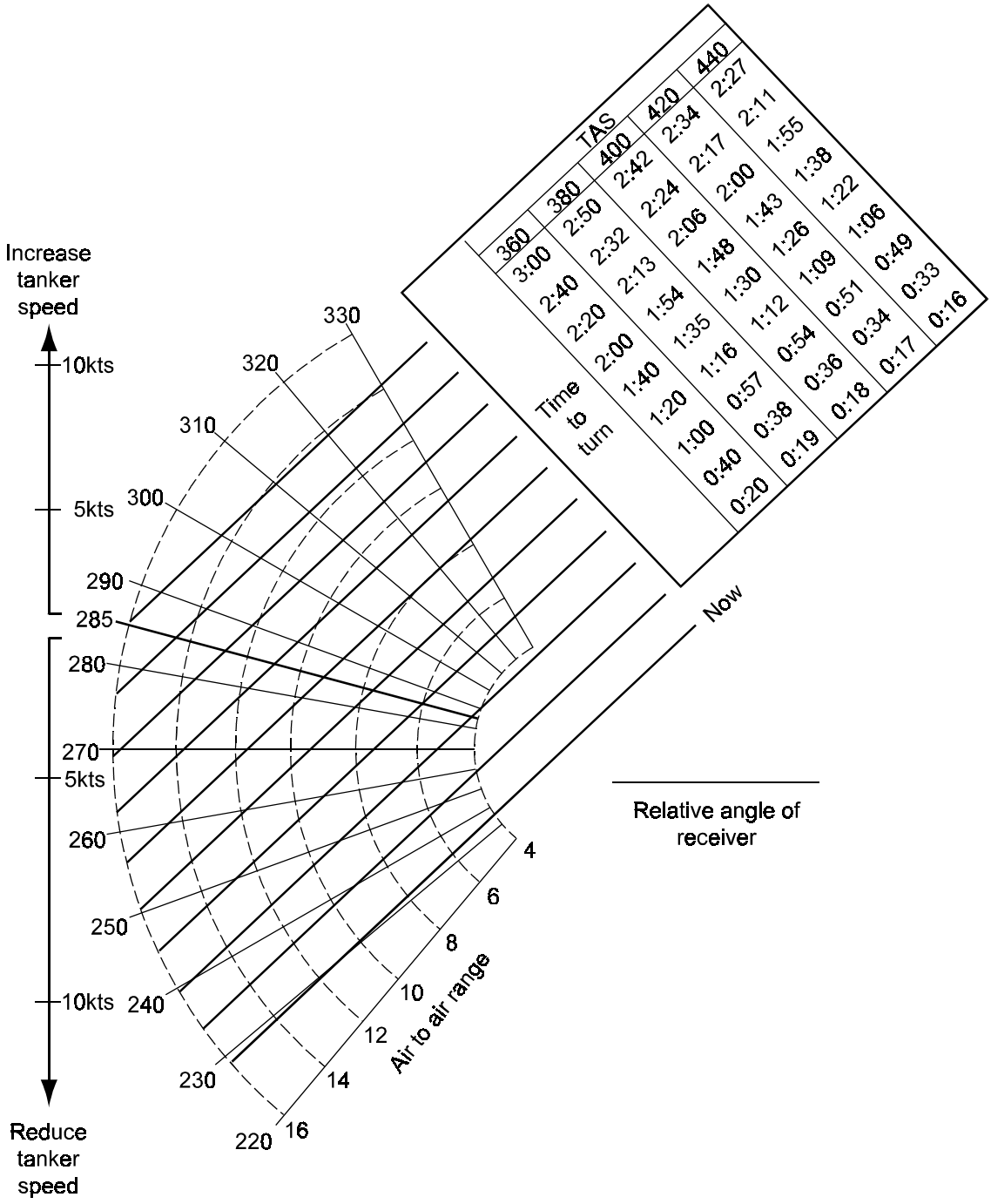
1. A minimum initial head-on separation of 100 nm (A-B) should be planned.
2. C-D = turn range.
3. The tanker racetrack is shown in an ideal position but it may be planned elsewhere as required.

FIGURE 4B-2. RV BRAVO TURN RANGE

TANKER 25° ANGLE OF BANK	
TANKER SPEED (TAS)	TURN RANGE (NM)
230	8.4
240	9.0
250	9.6
260	10.3
270	11.0
280	11.7
290	12.4
300	13.2
310	14.0
320	14.8
330	15.6
340	16.5
350	17.3
360	18.2
370	19.2
380	20.1
390	21.1
400	22.1
410	23.1
420	24.2
430	25.2
440	26.3
450	27.5
460	28.6
470	29.8
480	31.0
490	32.2
500	33.4

TANKER 15° ANGLE OF BANK	
TANKER SPEED (TAS)	TURN RANGE (NM)
180	9.2
190	10.0
200	10.9
210	11.8
220	12.8
230	13.9
240	14.9
250	16.0
260	17.2
270	18.4
280	19.6
290	20.9
300	22.2

FIGURE 4B-3. RV BRAVO CORRECTION CHART



Notes:

1. When tanker is on a heading of 45° less than the receivers, obtain relative bearing and A/A TACAN range and start stop-watch.
2. Plot receiver's position on chart and determine tanker's distance/time to the final turn.
3. Adjust tanker speed, if relative bearing other than 285°.

4. Tanker turns onto receiver’s heading at appropriate distance/time.

ANNEX 4C

RV CHARLIE

1. **Introduction**. The RV Charlie is a heading based procedure and is thus ideally suited when accuracy of navigation equipment is in doubt or degraded. It does not require a pre-briefed AAR track. However, for pre-briefed tasks a RVIP, the receiver's inbound track and a RV control time are designated. It requires the receiver to use an AI radar to complete the RV. As this procedure is heading rather than track based, it may not be suited to a busy ATC environment.

2. **Procedure**.

a. A reciprocal head-on approach with no lateral displacement is set up. To give sufficient time to correct any heading error, a minimum initial head-on separation of 100 nm is desirable; see Figure 4C-1.

b. For maximum flexibility, the tanker should plan to have time in hand; a left hand timing racetrack may be set up at a convenient position up-track from the RVIP, if required. Both aircraft navigate to make good the RVIP at the RV control time.

c. After the RV Initial Call has been made, the pilot in control is to call 'Transmit for DF' or use any other suitable equipment to ascertain relative positions. The controlling aircraft is to establish the other aircraft on a reciprocal heading. As the RV progresses, further 10 second carrier wave transmissions are to be requested to refine the head-on approach. Separation between aircraft is to be measured using A/A TACAN or AI equipment. The turn range must be passed to and acknowledged by the receiver.

d. When the turn range is reached, see Figure 4C-2, the tanker is to turn left through 180^{o} and the receiver(s) is to turn right 45^{o} using 45^{o} angle of bank and roll out wings level. When required, the receiver(s) is to commence a left turn to roll-out onto the tanker's heading. If visual at anytime during the RV, the receiver(s) is to adjust flight path as necessary to expedite the RV.

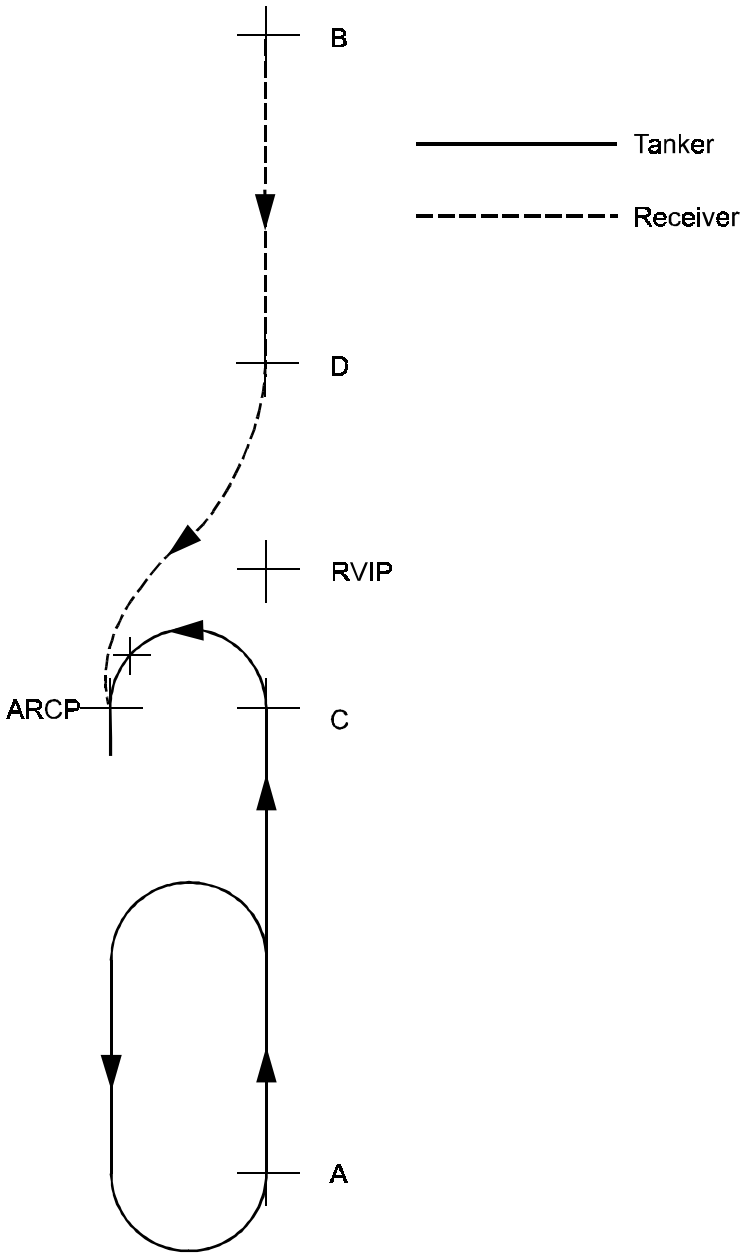
3. **Control**.

a. The initial control of RV Charlie (achieving and maintaining the head-on approach) is usually accomplished by the tanker. When the receiver has closed to effective AI range and is able to complete the procedure unassisted, the receiver is to call 'Judy' and then take control. On occasions it may be more appropriate for suitably equipped receivers to control the procedure throughout; however, it is important to establish clearly which aircraft is in control. Therefore, as a standard procedure, the tanker controls the RV, unless management for the whole RV is positively handed to the receiver.

b. Each aircraft is to turn onto the ARCP at the turn range.

c. In the event of the receiver not gaining AI contact, this procedure can revert to an RV Bravo as long as there is adequate split range.

FIGURE 4C-1. DIAGRAM OF RV CHARLIE



Notes:

1. A minimum initial head-on separation of 100 nm (A-B) should be planned.
2. C-D = turn range.
3. The tanker racetrack is shown in an ideal position but it may be planned elsewhere as required.

FIGURE 4C-2. RV CHARLIE TURN RANGE

TANKER 25° ANGLE OF BANK RECEIVER 45° ANGLE OF BANK	
TANKER SPEED (TAS)	TURN RANGE (NM)
230	5.4
240	5.8
250	6.2
260	6.6
270	7.0
280	7.4
290	7.9
300	8.3
310	8.8
320	9.3
330	9.8
340	10.3
350	10.9
360	11.4
370	12.0
380	12.5
390	13.1
400	13.7
410	14.4
420	15.0
430	15.6
440	16.2
450	16.9
460	17.6
470	18.3
480	19.0
490	19.7
500	20.5

TANKER 15° ANGLE OF BANK RECEIVER 45° ANGLE OF BANK	
TANKER SPEED (TAS)	TURN RANGE (NM)
180	6.0
190	6.5
200	7.0
210	7.6
220	8.2
230	8.8
240	9.5
250	10.2
260	10.9
270	11.6
280	12.4
290	13.2
300	14.0

ANNEX 4D

RV DELTA (POINT PARALLEL)

1. **Introduction**. The RV Delta (Point Parallel) is an offset RV based on a common track; see Figure 4D-1.

2. **Procedure**.

a. A common track of at least 70 nm is usually the minimum requirement for the RV and consists of a straight line between the ARIP and the ARCP. The tanker may enter the refuelling track from any direction and should arrive at least 15 minutes before the ARCT and establish a left-hand holding pattern using the ARCP as an anchor point. The receiver(s) is to enter the track via the ARIP and should aim to be at the ARCP at the ARCT. 15 minutes prior to the ARCT the tanker and the receiver(s) are to confirm their altitude and timing. The receiver(s) should fly down track towards the ARCP with A/A TACAN and radar beacon on (if appropriate) at 1000 ft below the base altitude. If either the tanker or receiver(s) is not at its briefed altitude an additional radio call is to be made when established at its nominated altitude. The tanker should not initiate the turn in front of the receiver(s) until confirmation of receiver(s) FL/altitude is received. During EMCON 2, radio calls will not be made unless they are necessary to ensure safe altitude separation.

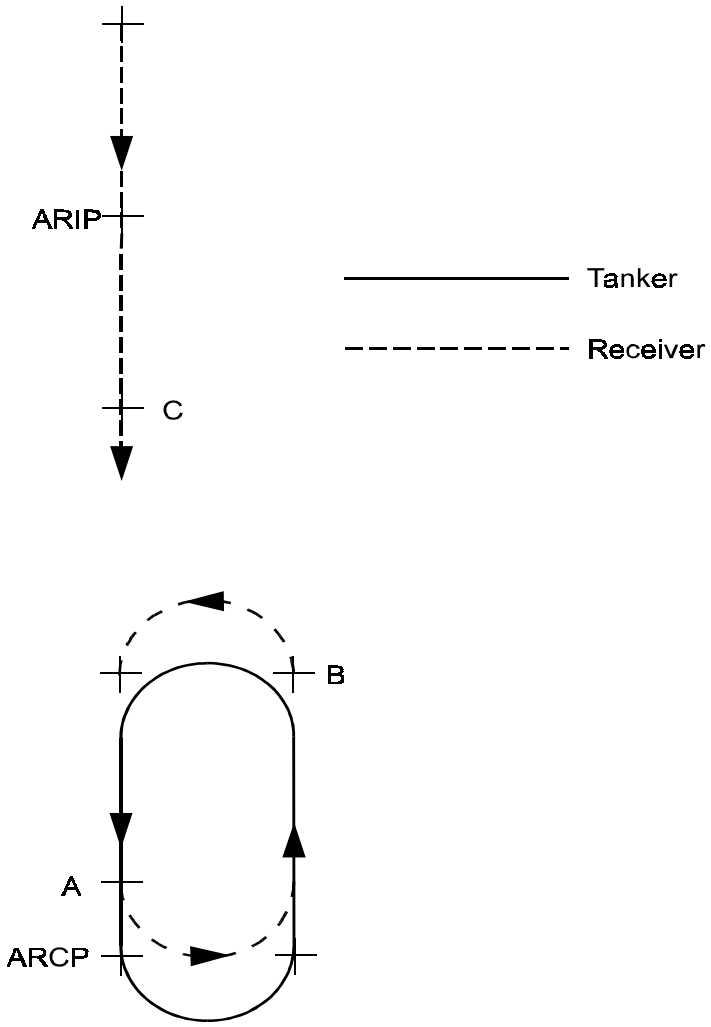
b. The tanker will fly the outbound leg at the appropriate offset from the common track in a holding pattern, see Figures 4D-2, 4D-3, 4D-4 and 4D-5 as appropriate, until it is determined by A/A TACAN, AI equipment, radar beacon (if equipped) or radio call that the receiver(s) are at the ARIP. The tanker is then to proceed towards the ARIP maintaining the offset. At the turn range, a left-hand turn is initiated to return to the ARIP - ARCP track, inbound to the ARCP. If applicable, in EMCON 1, after turning through 90° the tanker is to call ‘halfway round the turn’.

c. The RV altitude separation is to be maintained until visual contact is established. The receiver(s) will then commence a gradual climb to the pre-contact (boom) or observation position (drogue).

d. In the event that the receiver(s) is delayed, the tanker is to maintain a left-hand holding pattern over the ARCP until the receiver(s) arrives, is cancelled or the tanker is directed to proceed on its mission.

3. Overtake RV Delta (Point Parallel). This procedure assumes that the tanker’s normal cruising height and speed are higher than that of the receiver. It is similar to the RV Delta (Point Parallel) except the tanker plans to roll out 1 nm behind the receiver(s), see Figure 4D-4. The receiver(s) plans to arrive at the ARCP on time, at the base altitude - 1000 ft. The tanker arrives one minute later at the base altitude. The tanker then overtakes above the receiver(s) at the base altitude and slows down to position 1 nm in front of the receiver(s) at the refuelling speed. Once visual with the tanker, the receiver(s) climbs to the tanker’s base altitude. The tanker maintains control of the overtake RV Delta (Point Parallel) throughout. The receiver(s) must ensure that correct track, FL and speed are flown and during EMCON 1 the tanker is to call ‘turn’ at the turn range. It is possible to fly this procedure in EMCON 3 but aircraft must be at the correct FL.

FIGURE 4D-1. DIAGRAM OF RV DELTA (POINT PARALLEL)



Notes:

1. The minimum distance between the ARIP and the ARCP should be 70 nm.
2. The tanker is to hold at the appropriate AAR speed.
3. At the ARIP the receiver(s) call 'ARIP' and establish 1000 ft below the base altitude. At the same time the tanker (A) turns on to the reciprocal of the receiver(s) inbound track and maintains the computed offset.
4. At the turn range (B-C), the tanker turns onto the receiver(s) inbound track.

FIGURE 4D-2. RV DELTA (POINT PARALLEL) TURN RANGE AND OFFSET TANKER 25° ANGLE OF BANK

OFFSET (NM)							25° AOB	TURN RANGE (NM)						
DRIFT ON OFFSET LEG (°)							TANKER TAS	DRIFT ON OFFSET LEG (°)						
15L	10L	5L	0	5R	10R	15R		15L	10L	5L	0	5R	10R	15R
4.8	4.3	3.8	3.3	2.9	2.5	2.0	230	9.0	8.5	8.0	7.5	7.0	6.5	6.1
5.3	4.7	4.1	3.6	3.1	2.7	2.2	240	9.7	9.1	8.6	8.0	7.5	7.0	6.5
5.7	**5.1**	**4.5**	**3.9**	**3.4**	**2.9**	**2.4**	**250**	**10.5**	**9.8**	**9.2**	**8.6**	**8.1**	**7.5**	**7.0**
6.2	5.5	4.9	4.3	3.7	3.1	2.6	260	11.2	10.5	9.9	9.2	8.6	8.0	7.5
6.7	5.9	5.2	4.6	4.0	3.4	2.8	270	12.0	11.3	10.6	9.9	9.2	8.6	8.0
7.2	6.4	5.6	4.9	4.3	3.6	3.0	280	12.9	12.0	11.3	10.5	9.8	9.1	8.5
7.7	6.8	6.0	5.3	4.6	3.9	3.3	290	13.7	12.8	12.0	11.2	10.4	9.7	9.0
8.2	**7.3**	**6.5**	**5.7**	**4.9**	**4.2**	**3.5**	**300**	**14.6**	**13.7**	**12.8**	**11.9**	**11.1**	**10.3**	**9.6**
8.8	7.8	6.9	6.0	5.2	4.5	3.7	310	15.5	14.5	13.6	12.6	11.8	10.9	10.1
9.4	8.3	7.3	6.4	5.6	4.8	4.0	320	16.5	15.4	14.4	13.4	12.5	11.6	10.7
10.0	8.9	7.8	6.7	5.9	5.1	4.2	330	17.4	16.3	15.2	14.2	13.2	12.2	11.3
10.6	9.4	8.3	7.3	6.3	5.4	4.5	340	18.4	17.2	16.1	15.0	13.9	12.9	11.9
11.2	**10.0**	**8.8**	**7.7**	**6.7**	**5.7**	**4.7**	**350**	**19.5**	**18.2**	**17.0**	**15.8**	**14.7**	**13.6**	**12.6**
11.9	10.5	9.3	8.1	7.1	6.0	5.0	360	20.5	19.2	17.9	16.6	15.5	14.3	13.2
12.5	11.1	9.8	8.6	7.5	6.4	5.3	370	21.6	20.2	18.8	17.5	16.3	15.1	13.9
13.2	11.7	10.4	9.1	7.9	6.7	5.6	380	22.8	21.2	19.8	18.4	17.1	15.8	14.6
13.9	12.4	10.9	9.6	8.3	7.1	5.9	390	23.9	22.3	20.8	19.3	17.9	16.6	15.3
14.7	**13.0**	**11.5**	**10.1**	**8.7**	**7.4**	**6.2**	**400**	**25.1**	**23.4**	**21.8**	**20.3**	**18.8**	**17.4**	**16.1**
15.4	13.7	12.1	10.6	9.2	7.8	6.5	410	26.3	24.5	22.8	21.2	19.7	18.2	16.8
16.2	14.3	12.7	11.1	9.6	8.2	6.8	420	27.5	25.7	23.9	22.2	20.6	19.1	17.6
16.9	15.0	13.3	11.6	10.1	8.6	7.2	430	28.8	26.8	25.0	23.2	21.5	19.9	18.4
17.7	15.7	13.9	12.2	10.5	9.0	7.5	440	30.1	28.0	26.1	24.3	22.5	20.8	19.2
18.6	**16.5**	**14.5**	**12.7**	**11.0**	**9.4**	**7.8**	**450**	**31.4**	**29.3**	**27.2**	**25.3**	**23.5**	**21.7**	**20.0**
19.4	17.2	15.2	13.3	11.5	9.8	8.2	460	32.8	30.5	28.4	26.4	24.5	22.6	20.8
20.2	18.0	15.9	13.9	12.0	10.3	8.5	470	34.2	31.8	29.6	27.5	25.5	23.6	21.7
21.1	18.7	16.5	14.5	12.6	10.7	8.9	480	35.6	33.1	30.8	28.6	26.5	24.5	22.6
22.0	19.5	17.2	15.1	13.1	11.2	9.3	490	37.0	34.5	32.1	29.8	27.6	25.5	23.5
22.9	**20.3**	**17.9**	**15.7**	**13.6**	**11.6**	**9.7**	**500**	**38.5**	**35.8**	**33.3**	**31.0**	**28.7**	**26.5**	**24.4**

FIGURE 4D-3. RV DELTA (POINT PARALLEL) TURN RANGE AND OFFSET TANKER 15° ANGLE OF BANK

OFFSET (NM)							15° AOB	TURN RANGE (NM)						
DRIFT ON OFFSET LEG (°)							TANKER TAS	DRIFT ON OFFSET LEG (°)						
15L	10L	5L	0	5R	10R	15R		15L	10L	5L	0	5R	10R	15R
8.4	7.5	6.6	5.8	5.0	4.3	3.6	230	15.1	14.1	13.2	12.3	11.5	10.7	9.9
9.2	8.1	7.2	6.3	5.5	4.7	3.9	240	16.3	15.3	14.3	13.3	12.4	11.5	10.7
10.0	**8.8**	**7.8**	**6.8**	**5.9**	**5.1**	**4.2**	**250**	**17.6**	**16.5**	**15.4**	**14.3**	**13.3**	**12.4**	**11.5**
10.8	9.6	8.4	7.4	6.4	5.5	4.6	260	19.0	17.7	16.5	15.4	14.3	13.3	12.3
11.6	10.3	9.1	8.0	9.9	5.9	4.9	270	20.3	19.0	17.7	16.5	15.4	14.2	13.2
12.5	11.1	9.8	8.6	7.4	6.3	5.3	280	21.8	20.3	19.0	17.7	16.4	15.2	14.1
13.4	11.9	10.5	9.2	8.0	6.8	5.7	290	23.3	21.7	20.2	18.9	17.5	16.2	15.0
14.3	**12.7**	**11.2**	**9.8**	**8.5**	**7.3**	**6.1**	**300**	**24.8**	**23.1**	**21.6**	**20.1**	**18.7**	**17.3**	**15.9**
15.3	13.6	12.0	10.5	9.1	7.8	6.5	310	26.4	24.6	22.9	21.4	19.8	18.4	16.9
16.3	14.5	12.8	11.2	9.7	8.3	6.9	320	28.1	26.2	24.4	22.7	21.0	19.5	18.0
17.4	15.4	13.6	11.9	10.3	8.8	7.3	330	29.8	27.7	25.8	24.0	22.3	20.6	19.0
18.4	16.4	14.4	12.6	11.0	9.3	7.8	340	31.5	29.4	27.3	25.4	23.6	21.8	20.1
19.5	**17.3**	**15.3**	**13.4**	**11.6**	**9.9**	**8.2**	**350**	**33.3**	**31.0**	**28.9**	**26.8**	**24.9**	**23.0**	**21.2**
20.7	18.3	16.2	14.2	12.3	10.5	8.7	360	35.1	32.7	30.5	28.3	26.3	24.3	22.4
21.8	19.4	17.1	15.0	13.0	11.1	9.2	370	37.0	34.5	32.1	29.8	27.7	25.6	23.5
23.0	20.4	18.0	15.8	13.7	11.7	9.7	380	39.0	36.3	33.8	31.4	29.1	26.9	24.8
24.2	21.5	19.0	16.6	14.4	12.3	10.2	390	41.0	38.2	35.5	33.0	30.6	28.2	26.0
25.5	**22.6**	**20.0**	**17.5**	**15.2**	**12.9**	**10.8**	**400**	**43.1**	**40.1**	**37.3**	**34.6**	**32.1**	**29.6**	**27.3**
26.8	23.8	21.0	18.4	15.9	13.6	11.3	410	45.2	42.0	39.1	36.3	33.6	31.1	28.6
28.1	25.0	22.0	19.3	16.7	14.3	11.9	420	47.3	44.0	41.0	38.0	35.2	32.5	29.9
29.5	26.2	23.1	20.2	17.5	14.9	12.4	430	49.5	46.1	42.9	39.8	36.8	34.0	31.3
30.9	27.4	24.2	21.2	18.4	15.6	13.0	440	51.8	48.2	44.8	41.6	38.5	35.6	32.7
32.3	**28.6**	**25.3**	**22.2**	**19.2**	**16.4**	**13.2**	**450**	**54.1**	**50.3**	**46.8**	**43.4**	**40.2**	**37.1**	**34.1**
33.7	29.9	26.4	23.2	20.1	17.1	14.2	460	56.5	52.5	48.8	45.3	42.0	38.7	35.6
35.2	31.2	27.6	24.2	20.9	17.9	14.9	470	58.9	54.8	50.9	47.2	43.7	40.4	37.1
36.7	32.6	28.8	25.2	21.8	18.6	15.5	480	61.3	57.1	53.0	49.2	45.5	42.0	38.6
38.8	34.0	30.0	26.3	22.8	19.4	16.2	490	63.9	59.4	55.2	21.2	47.4	43.7	40.2
39.9	**35.4**	**31.2**	**27.4**	**23.7**	**20.2**	**16.8**	**500**	**66.4**	**61.8**	**57.4**	**53.3**	**49.3**	**45.5**	**41.8**

FIGURE 4D-4. RV DELTA (POINT PARALLEL) TURN RANGE AND OFFSET KC-10

TURN RANGE - KC-10A									
TAS RCVR - TNKR		ARIP TO ARCP DRIFT							NOTES
		15L	10L	5L	0	5R	10R	15R	
CLOSURE RATE	1000	26	28	30	32	34	36	39	
	975	25	27	28	30	32	34	36	
	950	24	26	27	29	31	33	35	
	925	23	24	29	28	29	31	33	3 NM ROLLOUT RANGE
	900	22	23	25	27	28	30	32	
	875	21	23	24	26	27	29	31	
	850	20	21	23	24	26	27	29	
	825	19	20	21	23	24	26	27	
	800	18	19	21	22	23	25	26	
	775	17	18	19	21	22	23	25	
	750	16	17	18	20	21	22	24	
	725	15	16	17	18	20	21	22	
	700	15	15	16	17	18	19	20	
	675	12	13	14	15	15	16	17	
	650	11	12	13	14	15	15	17	1/2 NM ROLLOUT RANGE (A-10)
	625	10	11	12	13	14	15	16	
	600	9	10	11	12	13	14	15	
	575	9	10	10	11	12	13	14	
	550	8	9	9	10	11	12	12	
	525	7	8	8	9	10	11	11	
	500	7	7	8	8	9	10	11	
	475	6	7	7	8	8	9	10	
	575	8	9	10	11	11	12	13	
	550	7	8	9	10	11	12	13	1 NM ROLLOUT BEHIND C-130
	525	6	7	8	9	10	11	12	
	500	6	6	7	8	9	10	11	
	475	5	6	6	7	7	8	9	

OFFSET - KC-10A									
		ARIP TO ARCP DRIFT							NOTES
		15L	10L	5L	0	5R	10R	15R	
TANKER TAS	520	11	13	15	17	20	22	26	
	500	10	12	14	16	18	21	23	
	480	9	11	13	15	17	19	21	
	460	9	10	12	13	15	18	20	
	440	8	9	11	12	14	16	18	
	420	7	8	10	11	13	15	17	
	400	6	7	9	10	12	13	15	
	380	6	7	8	9	11	12	14	25° BANK
	360	5	6	7	8	9	11	12	
	340	5	5	6	7	8	10	11	
	320	4	5	6	6	7	9	10	
	300	4	4	5	6	7	8	9	
	280	3	4	4	5	6	7	8	
	260	3	3	4	4	5	6	7	
	240	2	3	3	4	5	5	6	

FIGURE 4D-5. RV DELTA (POINT PARALLEL) TURN RANGE AND OFFSET KC-135

TURN RANGE - KC-135									
TAS RCVR - TNKR		ARIP TO ARCP DRIFT							NOTES
		15L	10L	5L	0	5R	10R	15R	
CLOSURE RATE	1000	22	23	25	26	28	30	32	3 NM ROLLOUT RANGE
	975	21	22	24	25	27	28	30	
	950	20	22	23	24	25	27	29	
	925	19	21	22	23	24	26	28	
	900	19	20	21	22	24	25	27	
	875	18	19	20	21	23	24	26	
	850	17	18	19	20	22	23	24	
	825	16	17	18	19	20	21	23	
	800	15	16	17	18	19	21	22	
	775	15	16	16	17	18	20	21	
	750	14	15	16	17	18	19	20	
	725	13	14	15	16	16	17	18	
	700	12	13	14	15	16	16	17	

OFFSET - KC-135									
		ARIP TO ARCP DRIFT							NOTES
		15L	10L	5L	0	5R	10R	15R	
TANKER TAS	460	7	8	9	11	12	14	16	30° BANK
	440	6	7	8	10	11	13	15	
	420	6	7	8	9	10	12	14	
	400	5	6	7	8	9	11	12	
	380	5	6	6	7	9	10	11	
	360	4	5	6	7	8	9	10	
	340	4	4	5	6	7	8	9	
	320	3	4	4	5	6	7	8	
	300	3	4	4	5	5	6	7	
	280	3	3	4	4	5	6	6	
	260	2	3	3	4	4	5	5	
	240	2	2	3	3	3	4	4	

ANNEX 4E

RV ECHO

1. **Introduction**. The RV Echo should be used in tactical situations where it is necessary to have available a tanker with which receivers can RV in a known area on an opportunity basis. The RV Echo is normally used to support CAPs and is particularly appropriate when EMCON procedures are in force; see Figure 4E-1.

2. **Procedure**.

a. The position of the Anchor Point can be identified in 2 ways:

(1) A range and true bearing from a reference point with the inbound track to the Anchor Point orientated at right angles and to the left of the radial from the reference point.

(2) A geographic point and a true track which is to be flown towards the Anchor Point.

b. Although the normal RV Echo duration is 15 minutes, to allow for limitations in airspace reservations or operational requirements, it may be defined as an RV Echo 10, 15, 20 etc. It is vital that the anchor duration is pre-briefed, as the receiver will use the information to predict the approximate position of the tanker. In general, the pattern consists of 2½ minute turns and leg timing as dictated by the RV Echo duration. Each receiver homes independently onto the tanker using all available aids. Receivers without AI radar should aim to fly the inbound track to the Anchor Point and adjust their timing to arrive 30 seconds after the tanker.

c. The tanker should aim to fly through the Anchor Point at the RV FL/altitude on the hour and then at intervals as dictated by the RV Echo duration.

d. The receiver is to join the pattern 1000 ft below the RV FL/altitude.

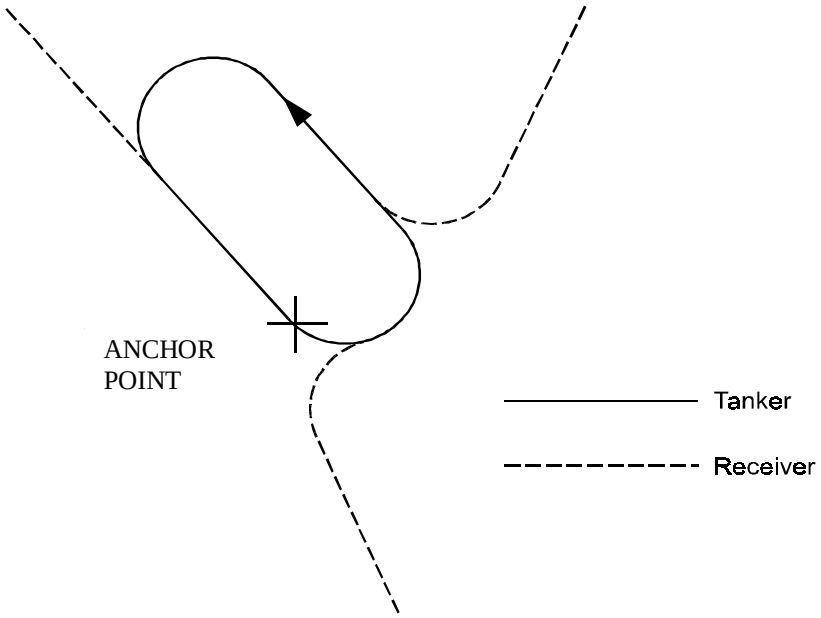
e. EMCON procedures may be used in conjunction with the RV Echo. However, in such circumstances, the receivers should be aware that several of them may be approaching the tanker from different directions, therefore good lookout and strict adherence to AAR procedures are essential. Within the limitations of the tactical situation, the tanker pilot is to adjust the height/position of the racetrack to maintain good VMC.

3. **Aids Used to RV**. Subject to the EMCON policy in force, all available aids should be used to achieve the RV. A/A TACAN, if available, should be used as follows:

a. The tanker should select the appropriate A/A TACAN channel throughout.

b. The tanker may select air to ground mode as necessary to obtain a position for a navigation fix.

FIGURE 4E-1. DIAGRAM OF RV ECHO



Notes:

1. Dotted lines show example tracks only, receivers may approach the tanker from any direction.
2. The RV FL/altitude, orientation (if necessary) and A/A TACAN channel should be specified in the tasking order.
3. Some French refuelling areas require receivers to join at a mid-point along the inbound track to the Anchor point. See French National Annex for details.

ANNEX 4F

RV FOXTROT

1. **Introduction**. The RV Foxtrot is normally used in VMC conditions when the tanker and receiver(s) are operating from the same airfield. Tanker and receiver take-offs occur within a few minutes of each other, which eliminates the fuel and time consuming racetracks of the other RV procedures. The collocated procedures have the added advantage that it is usually possible for the tanker to delay its take-off until assured of the receiver's serviceability on start up. However, adverse climb out weather or ATC considerations may make these procedures impracticable. There are two methods of effecting a RV Foxtrot: the Accompanied Departure / Buddy Climb and the Tailchase.

2. **Accompanied Departure / Buddy Climb**. In this procedure, see Figure 4F-1, the receiver(s) takes off before the tanker and completes a visual circuit of the airfield whilst the tanker takes off; the receiver(s) then joins formation with the tanker in the climb. This method has several advantages: the receiver(s) is not exposed to wake turbulence caused by the heavy tanker; furthermore, receiver(s) unserviceability immediately after take-off will be known before the tanker is airborne. However, this method has 2 disadvantages compared with the Tailchase RV: the receiver(s) consumes extra fuel completing the visual circuit; furthermore, weather conditions at the airfield need to be good enough for a visual circuit and join. The method of implementing the Accompanied Departure / Buddy Climb is:

a. Because airspace reservations are usually based on the tanker flight plan, the tanker take-off time remains the critical planning factor. Therefore, the receiver(s) must take-off ahead of the tanker with sufficient time in hand to fly a part visual circuit and still permit the tanker to achieve its ETD.

b. The receiver(s) flies a visual circuit and when the receiver is downwind the tanker then commences a take-off.

c. The tanker carries out a standard departure, the receiver(s) continues the visual circuit adjusting speed and track to join the tanker in the climb.

3. **Tailchase Departure**. In this procedure, see Figure 4F-2, the tanker takes off before the receiver(s). The standard method of planning this departure is to establish a RVIP after tanker top of climb; tanker and receiver take-offs are adjusted to make good the RVIP at the RV control time. The advantage of this method is that it is suitable when weather conditions are relatively poor at the airfield or during the initial stages of the climb. However, if weather conditions are good, the take-offs can be planned so that the receiver(s) join with the tanker in the climb. The method of implementing the Tailchase Departure is:

a. The tanker crew calculates their top of climb position and establishes the RVIP at one minute along track from the top of climb position. A direct climb-out from base is preferable but not essential.

b. Knowing the time to height, the RV control time is calculated from the tanker take-off time. The receiver calculates its own time for take-off to make good the RVIP and

compares that time with the tankers take-off time to ensure adequate separation to avoid the tanker's wake turbulence.

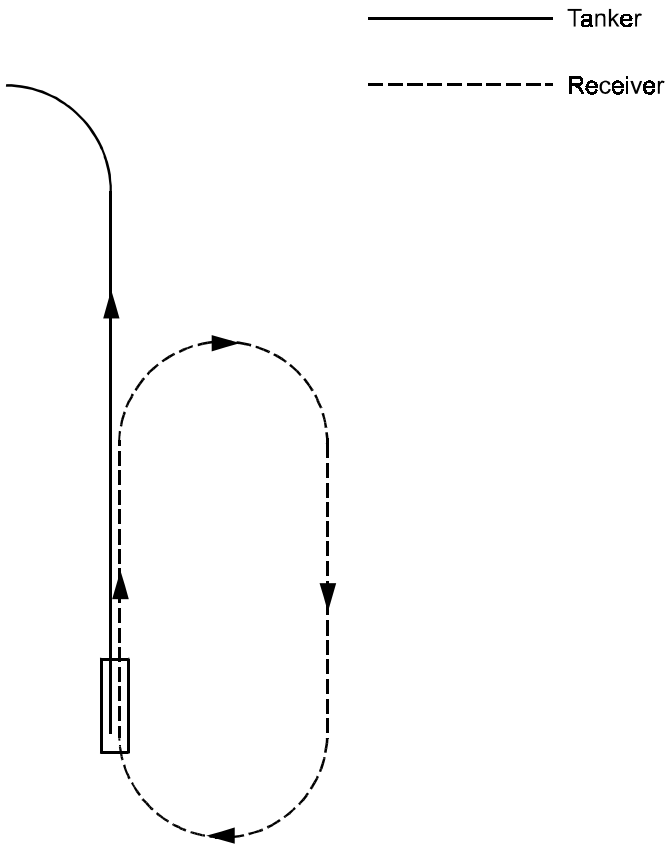
c. As soon as possible after take-off, the receiver is to establish RT contact with the tanker. The receiver is to ensure that its climbing flight level is at least 1000 ft below that of the tanker until positive visual identification is made. An agreed common rate of climb is to be pre-briefed as laid out in Chapter 5 Annex A. Following the initial RT contact, the tanker is to call the flight level every 5000 ft until the receiver is in visual contact; this also assists the receiver in maintaining vertical separation. If IMC is encountered by either aircraft prior to the join-up, more frequent height comparisons are to be made to ensure the necessary vertical separation is maintained.

d. Usually tanker and receiver(s) fly identical INS tracks and A/A TACAN is selected to give split ranges. If the departure procedures require the use of a ground base TACAN, then range comparison to this facility is to be made at every height check. If required, UDF may be used to ascertain relative positions.

e. If the receiver has not confirmed visual contact during the climb, the tanker is to make good the RVIP and hold in a left orbit until join up is complete.

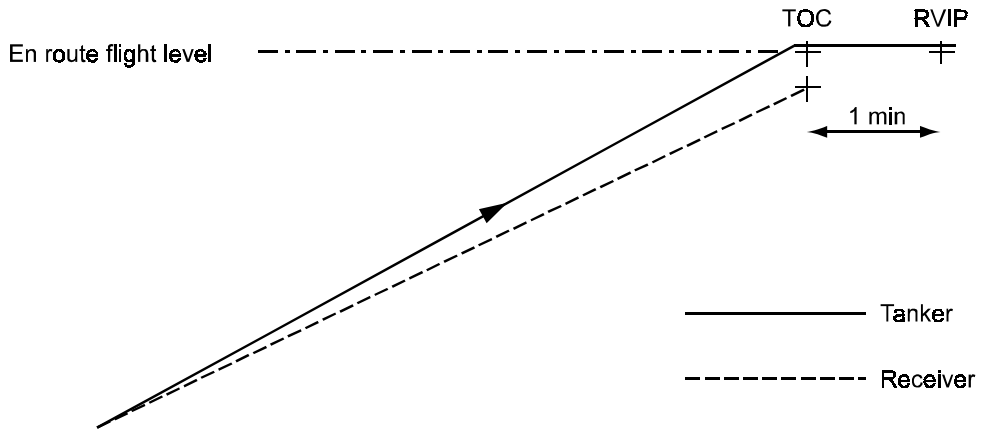
f. Careful pre-flight briefing between tanker and receiver crews is essential.

FIGURE 4F-1. DIAGRAM OF RV FOXTROT – ACCOMPANIED DEPARTURE / BUDDY CLIMB



Note: When receiver(s) is downwind, the tanker starts the take-off.

FIGURE 4F-2. DIAGRAM OF RV FOXTROT - TAILCHASE



Notes:

1. The receiver takes off after the tanker to make good the RV control time.
2. The receiver is to remain at least 1000 ft below the tanker's climbing flight level until visual.

ANNEX 4G

RV GOLF (EN ROUTE)

1. **Introduction**. The RV Golf (En route) procedure is used when a join up is to be accomplished en route to an AAR track to join an ALTRV or an established military corridor. The tankers and receiver(s) navigate independently to arrive at the RVIP at a designated RV control time. It is advisable for the tanker to plan a 10 minute holding pattern prior to the RVIP to counter departure delays or receiver(s) arriving early. A common track length equivalent to 15 minutes flying time should be planned to allow for tanker descent to RV FL/altitude, visual acquisition and timing corrections. 15 minutes prior to the RV control time the tanker and receiver(s) are to confirm their altitude and timing. When established on the common track, the tanker crew is to use all available locating aids (EMCON state permitting) to gain visual contact between the tanker and the receiver. If EMCON 4 procedures are in force, the tasking instructions should include control times for both the RVIP and the ARCP. There are 2 basic options for this procedure:

a. Procedure 1 (Receiver(s) with a similar transit speed and cruise height to the tanker). The tanker plans to arrive at the RVIP at the planned RV FL/altitude and RV control time. The receiver(s) arrives at the RVIP 1000 ft below the tanker at the RV control time plus 30 seconds and then adjusts KIAS to a 20 kt overtake on the tanker. Once visual with the tanker and cleared by the tanker captain, the receiver(s) climbs to the observation position (drogue) / pre-contact position (boom). A/A TACAN is used throughout to determine relative positions.

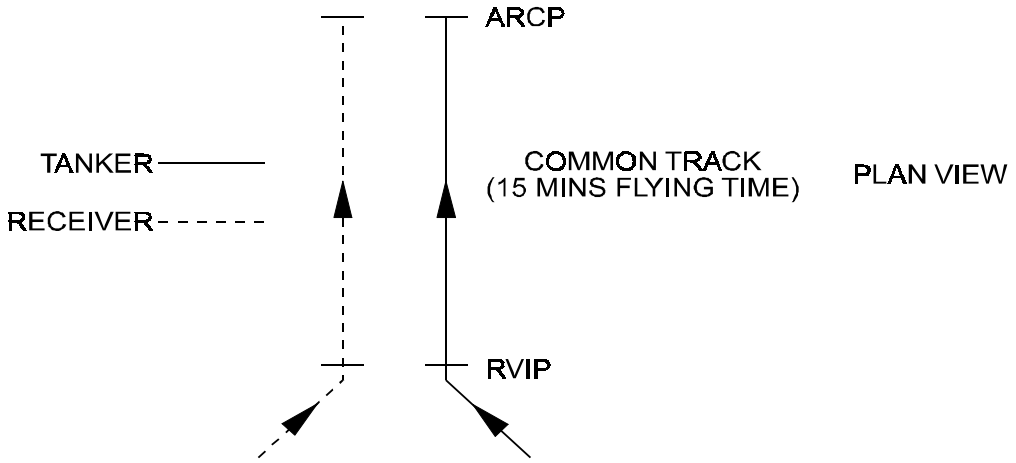
b. Procedure 2 (Turboprop receiver(s), or jet receiver(s) where there is considerable difference in cruising height and speed between the tanker and receiver).

(1) Turboprop Receiver. The receiver arrives at the RVIP at the RV control time and the RV FL/Altitude - 1000 ft. The tanker arrives at the RVIP at the RV control time plus 1 minute and commences a descent to arrive 1000 ft above and echelon right of the receiver. A/A TACAN/range to the ARCP is used throughout the descent to monitor relative positions. Once visual with the receiver, the tanker descends to the RV FL/altitude - 1000 ft. On the final approach to overtake, tanker speed is to be reduced to receiver speed + 5 kts and the tanker is to pass on the receiver's right-hand side with a displacement of at least 2 wingspans.

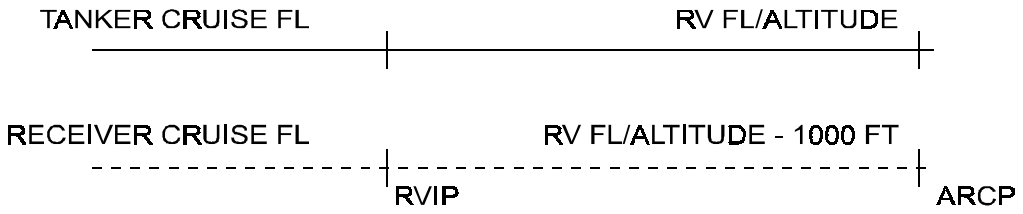
(2) Jet Receiver. The receiver plans to arrive at the RVIP and RV FL/altitude - 1000 ft at RV control time. The tanker arrives at the RVIP at a higher FL at the RV control time plus 30 seconds and then commences a descent to level off at the RV FL/altitude. During the descent, the tanker establishes a 20 kt overtake on the receiver and uses the A/A TACAN/range to the ARCP to monitor relative positions. When visual with the receiver, the tanker speed is reduced to the receiver's speed + 5 kts and the receiver climbs to the RV FL/altitude and establishes in the observation position on the tanker's echelon right.

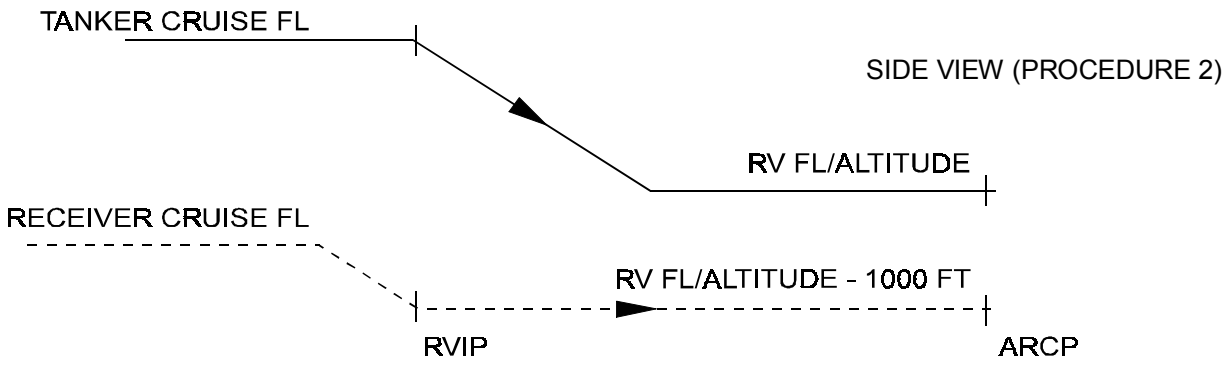
Note. This procedure may be used with the positions of the tanker and receiver reversed. In this case the procedure remains identical, except that the tanker, once joined with the receiver, overtakes the receiver as described in para 1b(1) above.

FIGURE 4G-1. DIAGRAM OF RV GOLF (EN ROUTE)



SIDE VIEW (PROCEDURE 1)





Notes:

1. The RVIP should be 15 minutes uptrack from the ARCP.
2. Tanker and receiver(s) compare ranges/time to go inbound to the RVIP from any direction to ensure that aircraft arrive in the correct order.

CHAPTER 5

FORMATION PROCEDURES

501. **Introduction**. Following the rendezvous, the receiver is to comply with these standard formation procedures to join, refuel and leave safely from the tanker.

502. **Flight Safety**. For flight safety reasons, it is important that these procedures are uncomplicated and unambiguous; furthermore, it is essential that there should be a high degree of commonality between tactical and strategic formation procedures. To minimise complications, these procedures are uniformly applicable by day and by night. These are essential prerequisites to making AAR practicable under EMCON.

503. **Formation Control**. The commander of the tanker (or lead tanker in multiple tanker formations) is responsible for the control and safe navigation of AAR formations.

504. **Single Tanker Formations**. Usually, tactical AAR involves receivers joining individually or in groups to refuel from one tanker and then departing. However, for training purposes, time with the tanker may be prolonged.

a. Joining. All receiver aircraft are to join on the right side of the tanker; multiple receiver formations are to be in echelon right formation. When joined, the receivers are to move forward to the observation position where they can be seen and identified by the tanker pilots.

b. Refuelling. Receiver aircraft are to move sequentially from echelon to the refuelling position on command from the tanker commander; this command may be given by radio or by using the standard procedural signals in EMCON conditions. When the tanker has 2 wing refuelling stations and both are available, the receiver moves to the left-hand refuelling position. If there is more than one receiver and both refuelling stations are vacant, the first receiver moves to the left-hand refuelling position and the second receiver moves in turn to the right-hand position.

c. Leaving. When refuelling is complete, the receiver moves to the left-hand side of the tanker. If there is more than one receiver, they move sequentially to take up an echelon left formation on the left-hand side of the tanker. On leaving from the left-hand side of the tanker, receivers are to leave either level with the tanker or to climb but are not to descend, as other receivers may be joining the tanker from below.

d. Visual Meteorological Conditions. For VMC, the tanker captain can brief for a formation most suited to the AAR sequence and the formation preferences of the receiver leader. However, receivers in loose formation are not to stray too far away from the tanker, otherwise they may conflict with other airspace users. Generally, the formation frontage should not exceed 1 nm and receivers must stay within 200 ft of the tanker's height; however, more stringent limits may be required of formations in certain controlled airspace.

e. Instrument Meteorological Conditions. Tanker captains should, whenever ATC and fuel considerations permit, avoid IMC by implementing track or height adjustments.

However, receiver height capabilities (particularly for AAR at high weights) may be a limiting factor; nevertheless, tanker captains should consider climbing to achieve VMC for cruise and initial AAR contact and then toboggan as receiver weight increases. If IMC cannot be avoided, the receivers are to be ordered into the close formation which will give them the best opportunity to retain visual contact with the tanker. Receivers should be arranged so that movement around the tanker is minimised during AAR sequences. Extended echelon formations can be difficult and tiring to fly, particularly under prolonged IMC. Thus receivers should be apportioned equally (as far as possible) to the left and right echelon positions on the tanker. The tanker captain is to exercise strict control of receiver movement around the tanker during formation changes for AAR brackets. If the receivers lose visual contact with the tanker, they are to immediately implement the procedures laid out in para 505 and maintain the prescribed separation until visual contact is regained.

505. **Loss of Visual Contact - Single Tanker Formation**. Any aircraft in close formation which loses visual contact with the tanker is to take immediate action to achieve safe separation from the tanker. The receiver is to call 'loss of visual contact' and proceed as follows:

a. Straight and Level. The receiver turns 15^{o} away from the tanker's heading using 15^{o} angle of bank, holds this new heading for 15 seconds, then resumes the tanker's heading to parallel track (15:15:15).

b. Turning. If the receiver is on the outside of a turn, the receiver rolls wings level, holds this new heading for 15 seconds and then resumes the turn. The tanker maintains the turn and confirms the roll-out heading. If the receiver is on the inside of a turn, the tanker rolls wings level and confirms the heading. The receiver maintains the turn until heading 15^{o} away from the tanker's heading, holds this new heading for 15 seconds, then resumes the tanker's heading to parallel track. In either turning case, if the tanker does not acknowledge the loss of visual contact call, the receiver is also to achieve an immediate height separation.

c. Climb/Descent. In addition to paras a and b above, in a climb/descent the receiver should level off whilst the tanker continues the climb/descent.

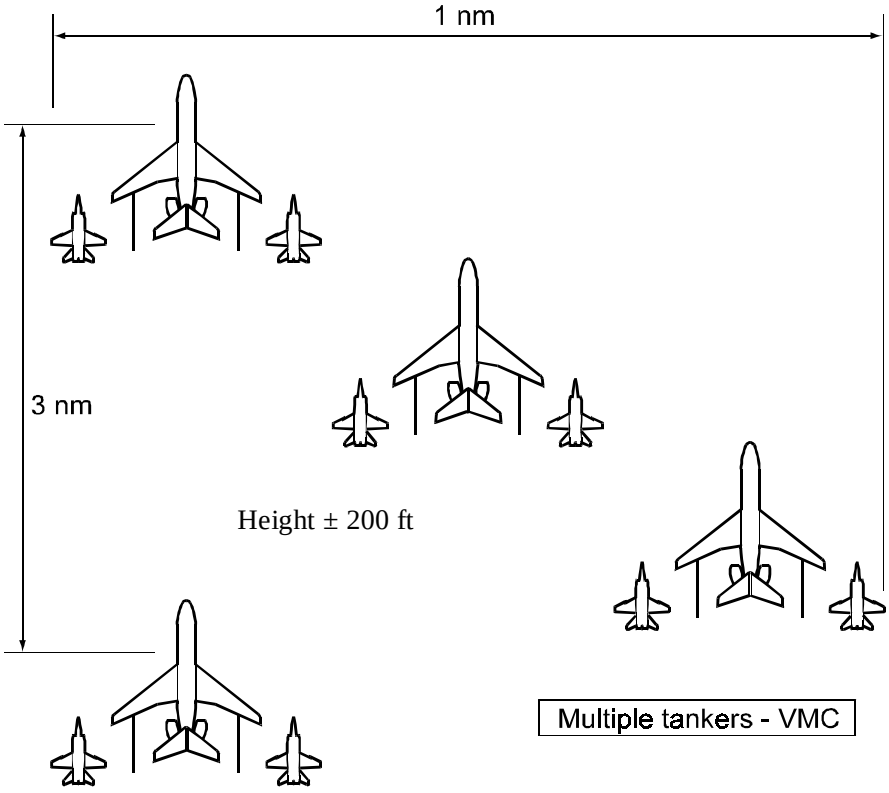
On hearing 'loss of visual contact', the tanker calls its heading (stating °T or °M), height, speed and the receiver A/A TACAN channel, and selects the tanker A/A TACAN channel. When initial separation is achieved, the receiver is to achieve a height separation and use radar/A/A TACAN to position 1 nm astern and ½ nm displaced from the tanker and await further instructions.

Notes:
1. National Annexes may stipulate different criteria from the above procedure (eg 20:20:20).
2. If encountering heavy IMC, the maximum number of receivers on each wing of a tanker should be 4. All other receivers should be trailing by at least one nautical mile."

506. **Multi-Tanker Formation - Echelon Procedures**. On occasions, tasking may require several tankers in formation during the RV and for refuelling. Tankers may fly in echelon right formation on the lead tanker. At the lead tanker commander's discretion, the other tankers may go to line astern formation for turns prior to and during a RV procedure; however, they must resume echelon right prior to the receivers joining formation. Receivers joining a multi-tanker formation

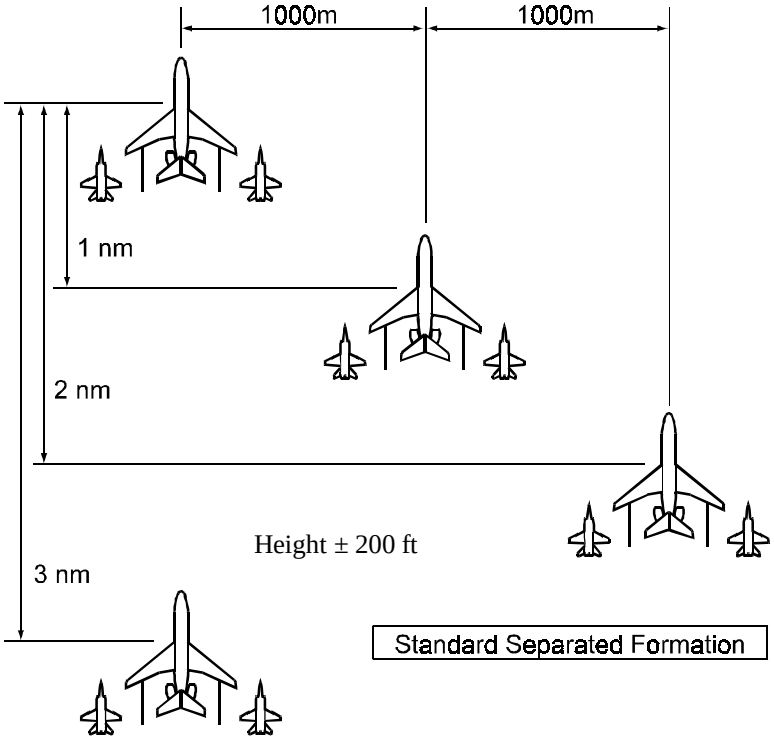
are to join on the right of the tanker formation. At the appropriate time, receivers will be cleared to join their assigned tanker; however, receivers are not to penetrate through the tanker formation to reach their tanker. Receivers are to drop back on the right of the tanker formation, then move across behind the formation, before moving forward to join their tanker.

a. Visual Meteorological Conditions. After joining, the standard cruise formation is with the tankers in echelon formation on the right side of the lead tanker. If the lead and the formation tanker(s) have concurrent AAR commitments, then the formation tanker(s) should establish a loose echelon position where the autopilot can be engaged to provide a steady AAR platform for the receivers. If, exceptionally, more than 3 tankers are allocated to a wave, then the fourth and subsequent tankers should be formed into a separate section 3 nm in trail from the leading section, using an A/A TACAN range from the lead tanker; this eases the tankers' station keeping task and keeps the formation frontage within reasonable bounds.



Note. Ideally, the formation should remain clear of cloud; however, provided sufficient visual cues remain, the formation may penetrate thin cloud. The No 2 tanker should be brought to close right echelon on the lead tanker and the receivers put into close left echelon on the lead tanker. If there is a third tanker, this should be placed in line astern behind the second tanker to ease the station keeping task; if there is a second section, then this should remain 3 nm astern of the lead tanker. The lead tanker will be able to refuel its receivers if these conditions prevail during the brackets. At the conclusion of the lead tanker's AAR duties, the receivers will be able to take formation on the station keeping tankers, freeing the lead tanker to hand over the lead and leave the formation by a level turn to the left. However, if the AAR plan requires concurrent AAR from the other tanker(s), then it is not practicable for the tanker(s) to hold close formation and provide a steady AAR platform. In this event, tankers are to take up a Standard Separated Formation, with the receivers in a discrete formation around their allocated tanker.

b. IMC - Standard Separated Formation. Tankers within each section are to be in right echelon, approximately 1000 m and 30° displaced from and 1 nm astern of the preceding tanker; radar and A/A TACAN ranges are to be used to maintain the prescribed displacement. If there is a second section of tankers, then tanker 4 is to maintain a range of 3 nm astern the lead tanker, and so on. The lead tanker captain is to make frequent broadcasts of its heading and speed whilst IMC prevail. If an aircraft cannot maintain the prescribed separation because of radar/TACAN unserviceabilities, a safe height separation from the rest of the formation is to be achieved; the tanker leader is to be informed.



c. Tanker Lead Change. There are several ways in which 2 tankers may change the lead when flying in visual contact. Provided good airmanship is applied, the lead change may be carried out in a manner suited to the particular circumstances. A maximum overtake speed of 10 kts is recommended. If a higher speed is used in poor visibility, it is possible that the new No 2 will lose sight of the leader before he can join formation. For the same reason, lateral separation should not be more than about 200 m. A recommended procedure suitable for most circumstances is as follows:

(1) The leader passes its datum heading and speed to the No 2 and orders him to overtake on the appropriate side.

(2) No 2 accelerates to overtake the leader on a 5^{o} divergent heading, climbing 200 ft above the leader's level. No 2 should aim to put himself slightly high in the leader's 3/9 o'clock moving forward to the 2/10 o'clock position.

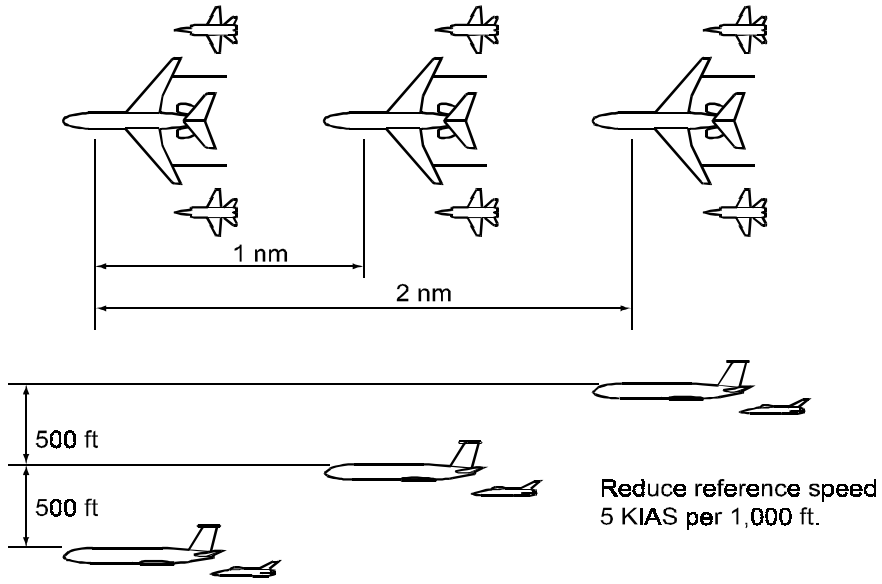
(3) As soon as the leader has visual contact with the No 2, the leader formally

hands over control and maintains echelon on the new leader until otherwise ordered.

(4) If at any stage during the overtake the No 2 loses sight of the leader before the leader calls 'visual', the No 2 must immediately take collision avoidance and report its actions to the leader.

Note. The US and RNLAF do not fly multi-tanker echelon procedures as described in para 506. US and RNLAF echelon formation is accomplished by cell aircraft at a predetermined angle off the lead tanker's right wing, at a specified distance (1 nm or greater) stacked up at 500 ft intervals, see para 507e(8). Echelon spacing and angle should be maintained using both visual and radar cues. Assumption of echelon formation in straight and level flight should be accomplished by succeeding aircraft turning from formation heading by increments of 5° to 10°. Aircraft will return to lead tanker's heading as echelon position is reached. If IMC conditions are encountered and operational considerations prevent altering course to avoid IMC conditions, the tanker formation will use electronic means to ensure standard separation. For US and RNLAF echelon formation, all tankers hold echelon formation off the lead tanker.

507. **Multi-Tanker Formation - Cell Procedures**. Cell formation is an alternative to echelon formation and may be adopted at any stage in the cruise at the discretion of the lead tanker. Before cell is flown, a full and formal brief is to be given by the cell leader. The main briefing points to be covered for a snake/cell climb are outlined in Annex 5A. The following is a guide to cell procedures and cannot cover all situations. Captains are to use their judgement when circumstances dictate, eg in conditions of reduced visibility. Cell leaders are responsible for their entire formation. Differing performance capabilities of other aircraft require additional considerations, particularly when dissimilar aircraft are mixed in a single cell. Cell members are to make every effort to maintain correct positioning and are to be prepared to provide assistance to the cell leader or to assume the cell lead if required. The standard cell formation is flown with successive tankers in line astern and stepped up behind the leader. For non-AI equipped receivers or non-SKE equipped tankers, weather limits for cell are 1000 ft clear of cloud, one nm visibility plus one nm of visibility per tanker in the cell. For AI equipped aircraft the weather limits are as prescribed for each nation. The cell is to comprise a maximum of 3 tankers and in VMC the normal separation between tankers is to be 500 ft and 1 nm but this may be reduced at the discretion of the cell leader in VMC to a minimum of 500 ft and ½ nm. In IMC the minimum separation is to be 1000 ft and 1 nm.



An altitude block is to be used whenever possible. If an altitude block is not available, each tanker is to have a separate IFR altitude assigned.

a. Take-off. If receivers are part of the formation from take-off, they should normally take-off first. Take-off intervals or sequence may be varied as necessary depending on aircraft acceleration and performance, training requirements, weather, airfield conditions and mission requirements. All aircraft are to use the runway centreline for alignment. The effects of turbulence and vortex generation increase as the take-off roll progresses, reaching a maximum at unstick. The effects of turbulence may be decreased after take-off by turning slightly left or right as soon as possible after airborne to place the aircraft upwind (if possible) and out of the vortex of the preceding aircraft.

b. Tanker Snake/Cell Climb Procedures. Usually, tankers will take-off from the same base in order to establish cell. Annex 5A outlines the snake/cell climb procedures for all types of tankers. Dissimilar tanker types are to fly a pre-briefed speed and rate of climb until joined up. A full brief is to be given by the cell leader.

c. Establishing Cell. Cell formation is normally to be established after cruising altitude is reached. Cell may be established directly or from echelon. Each tanker is to call when ‘in position’. To establish cell from echelon:

(1) VMC. For 2 tankers, No 2 drops back and climbs into position maintaining visual contact with the lead. For 3 tankers, No 3 maintains formation on No 2 until No 2 is in position then drops back further and climbs into its own position.

(2) IMC. For 2 tankers, No 2 first attains a ½ nm lateral spacing using the loss of visual contact procedure, then climbs to the appropriate altitude before dropping back into position directly astern the lead. For 3 tankers, No 3 is to move into its cell position first. When No 3 is in position, No 2 is then to establish its own cell position in turn.

d. Rendezvous. Turns in cell should be minimised to ease the station keeping task and tankers are not to exceed 20° AOB. Aircraft joining the formation should join in the normal manner 1 nm and 1000 ft below the lead tanker. Tankers joining a cell formation are to be passed the cell position to be adopted and an individual cell callsign numbered sequentially with No 1 as the lead. Receivers joining a cell formation are to state 'visual with xx number of tankers' before the lead tanker instructs the receiver(s) to join a specific tanker (using the tanker's formation position, not callsign). Aircraft joining a cell formation are not to enter the formation until all aircraft in the formation have been visually identified.

e. Maintaining Cell. Maintaining correct cell positioning requires constant attention and effort. The lead tanker is to fly as stable a platform as possible and is to call all changes of heading, height or airspeed. Any deviation from the stated parameters will be magnified with each succeeding aircraft. Subsequent tankers should maintain position by reference to the lead tanker using A/A TACAN, radar and visual references. If there is significant drift, aircraft will not fly 'nose to tail' but will fly crabbed relative to each other.

(1) Speeds. At medium cruising levels, due to differences in TAS, it will be necessary for following aircraft to fly about 5 KIAS slower for every 1000 ft they are above the lead. The lead tanker will fly the planned formation speed which will be dependent on tanker/receiver limitations and separately briefed. In some cases this may have to be increased so that the last tanker is not below the minimum speed for the receiver type.

(2) Turns. To maintain position, all aircraft must start the turn over the same geographical point. Succeeding tankers will therefore start the turn after an appropriate delay, which will depend on TAS and separation. The lead tanker should use 10^{o} AOB for turns up to and including 20^{o} and 20^{o} AOB for turns of more than 20^{o} (for the TriStar tanker with receiver(s) in contact, the AOB is restricted to 20°). Any necessary track adjustment due to wind on the AAR area is to be made on the straight legs; the bank angle is not to be increased during the turn.

(3) Climbs/Descents.

(a) VMC. In VMC, the lead tanker may elect to climb or descend the cell as a formation.

(b) IMC. In IMC, climbs or descents as a formation are not permitted and are to be accomplished by tanker elements moving individually. All movements are to be controlled by the lead tanker. For a descent, the lead descends first. When established, the lead calls its new level and instructs No 2 to descend to its new level. When No 2 has called at its new level, the lead instructs No 3 to descend and so on. For a climb the reverse procedure is to be used with the rear tanker moving first and the lead tanker last.

(4) Autopilot Operation. The autopilot is to be used to reduce fatigue and aid in altitude separation. Consideration is to be given to placing an aircraft with an inoperative or malfunctioning autopilot in the last position in the formation for

extended periods of cell.

(5) A/A TACAN. A/A TACAN should be used in the normal manner. If each tanker has 2 TACANs, a channel pairing should be specified between No 1 and No 2, and a separate pairing should be specified between No 2 and No 3 (the aircraft in front selects the higher channel). The lead should use its second TACAN for range (and bearing) for the receivers as normal.

(6) Cell Position Changes. Cell position changes must be carried out in a prompt but formal manner. To change the lead, the lead tanker calls the datum heading, height and speed and instructs No 2 to overtake (normally on the right).

(a) VMC. No 2 descends towards the echelon position on the lead and carries out a standard lead change.

(b) IMC. No 2 establishes ½ nm lateral separation from the lead tanker using loss of visual contact procedure, then increases speed by 10-15 KIAS and overtakes maintaining level. When No 1 is able to maintain separation on No 2 (using A/A TACAN and radar), No 1 hands over the lead. No 2 takes the lead, reduces to formation speed, renumbers the formation if applicable, instructs the new No 2 to climb into position and descends into the lead position. A similar procedure is to be used for other position changes within the cell.

Radar or visual contact must be maintained throughout the position change. If radar and visual contact is lost during a position change, maintain altitude and advise the cell leader that contact has been lost. Ensure positive separation by any means available and do not attempt to rejoin the formation until positive radar or visual contact is established. Aircraft changing position are to assume the callsign of their new position. When all aircraft are level at their new altitude and established in their new position, they are to acknowledge with their new cell formation callsign.

(7) Refuelling. During refuelling, the cell lead must fly precise airspeeds, altitudes and heading in order to maintain a stable platform for aircraft in the formation. Any deviation from these parameters requires corrections which increase in magnitude with each succeeding aircraft. Therefore, formation aircraft are to maintain their position relative to the lead aircraft. This prevents the ‘accordion’ effect during refuelling and possible conflict with other aircraft in the formation. Receivers with large onloads at high gross weight may require airspeeds to build as onload increases. Maintaining cell formation in this scenario may be extremely difficult and the cell leader should plan for this eventuality and brief/co-ordinate actions accordingly.

(8) En Route / Straight Track. If necessary, the receivers can be towed to a drop off point, as specified in the ATO. When the cell is flying a long straight track (IMC or VMC) each tanker can establish a 60° echelon offset from the tanker ahead:

(a) When the tanker to large receiver ratio is one to one or greater (ie 3 tankers and 2 receivers), 2 nm spacing stacked up 500 ft will normally be used.

(b) When the tanker to large receiver ratio is less than one to one (ie 2 tankers and 4 receivers), 2 nm spacing stacked up 1000 ft will normally be used.

(c) For all fighter type receivers, 1 nm spacing stacked up 500 ft will normally be used.

(9) Use of Radio. The management of cell formation usually requires the use of full RT. This situation demands strict radio and intercom discipline from all aircraft in the formation. Cockpit intercom and RT are to be brief and, if possible, not made when the receiver is closing to or in the contact position. Boom operator RT is to be brief but adequate and include the entire callsign identification. If RT silence is operationally essential, all aspects of cell formation, particularly the RV and join, are to be specifically pre-briefed. In the normal case when full RT is available, refuelling should normally be conducted using Radio Silence to reduce RT and avoid possible confusion between receivers. However, if full RT is used for refuelling, callsigns should not be abbreviated.

(10) EMCON. EMCON is to be the minimum required for flight safety and will depend on prevailing weather conditions.

(11) Receivers. Receivers are to join the cell at 1 nm and 1000 ft below the lead (lowest) tanker on the right and when cleared move up to their assigned tanker. Preferably, there are not to be more than 4 receivers per tanker. Flow through the tanker is to be right to left and if receivers require topping up they are to resume right echelon after initial refuelling. Once refuelling is complete, all receivers are to establish left echelon and, if possible, climb 1000 ft above the cell before departing. Any receiver that loses visual contact with its tanker is to carry out the loss of visual contact procedure specified in para 505. The lead tanker is to co-ordinate the rejoin, as applicable.

(12) Breakaway. It is essential that a Breakaway transmission is prefaced by the appropriate receiver callsign. On calling ‘Red 2 Breakaway, Breakaway, Breakaway’, the receiver is to disconnect and move back and go to a safe position clear of the tanker and the refuelling equipment. The tanker is to maintain its assigned FL/altitude and, for boom operations, the tanker is to increase power and accelerate.

(13) Weather Radar. The lead tanker is to maintain weather watch for the whole cell.

508. **Loss of Contact - Multi-Tanker Formation**. Tankers will normally fly in close formation or in a separated formation (eg cell/refuelling/trail) either visually or using radar. Loss of Visual Contact procedure is to be carried out if visual contact is lost when in close formation, or if both visual and radar contact are lost **and** altitude separation cannot be assured when in a separated

formation. No 2 tanker carries out the procedure at para 505. However, if No 3 loses contact with No 2, different circumstances apply for No 3 tanker. As it is not possible to ascertain immediately that No 2 is able to maintain formation, No 3 must assume that No 2 is carrying out the Loss of Visual Contact procedure. Therefore, No 3 carries out a modified procedure as follows:

a. Straight and Level. No 3 tanker turns 30^{o} away from the lead tanker's heading using 30^{o} angle of bank, holds this new heading for 30 seconds, then resumes the lead tanker's heading to parallel track.

b. Turning. If on the outside of a turn, No 3 tanker rolls wings level then reverses the turn through 30^{o} using 30^{o} angle of bank, holds this new heading for 30 seconds, then resumes the turn. If on the inside of a turn, No 3 tanker increases to 30^{o} angle of bank, maintains the turn until heading at least 30^{o} away from the lead tanker's heading, holds this new heading for 30 seconds, then resumes the lead tanker's heading to parallel track. In either turning case a height separation is to be achieved.

c. Climb/Descent. In addition to paras a and b above, in a climb/descent No 3 tanker should level off whilst the lead tanker continues the climb/descent.

When initial separation is achieved, tankers should re-adjust to cell/trail formation or obtain separate clearances if required. Any aircraft which can maintain visual or radar contact with a tanker executing Loss of Visual Contact procedure should remain in formation with that tanker.

Note. It is not possible to cover every situation, therefore, procedures for the more complex formations should be pre-briefed and based on the principles outlined above.

509. **AAR Deployments**. AAR deployments utilise tankers to deploy receivers along a pre-prepared route which may be promulgated in an ATO or a route brief and which may include an ALTRV. Often, a considerable portion of the route is flown with the receiver and tanker in company. On occasions, at least a part of the route may include the presence of several tankers. The general procedures established for single or multi-tanker formations should apply, where possible. Specific deployment formation procedures are laid out in national instructions; however, as a general principle, the type of formation to be adopted should be decided and briefed before take-off.

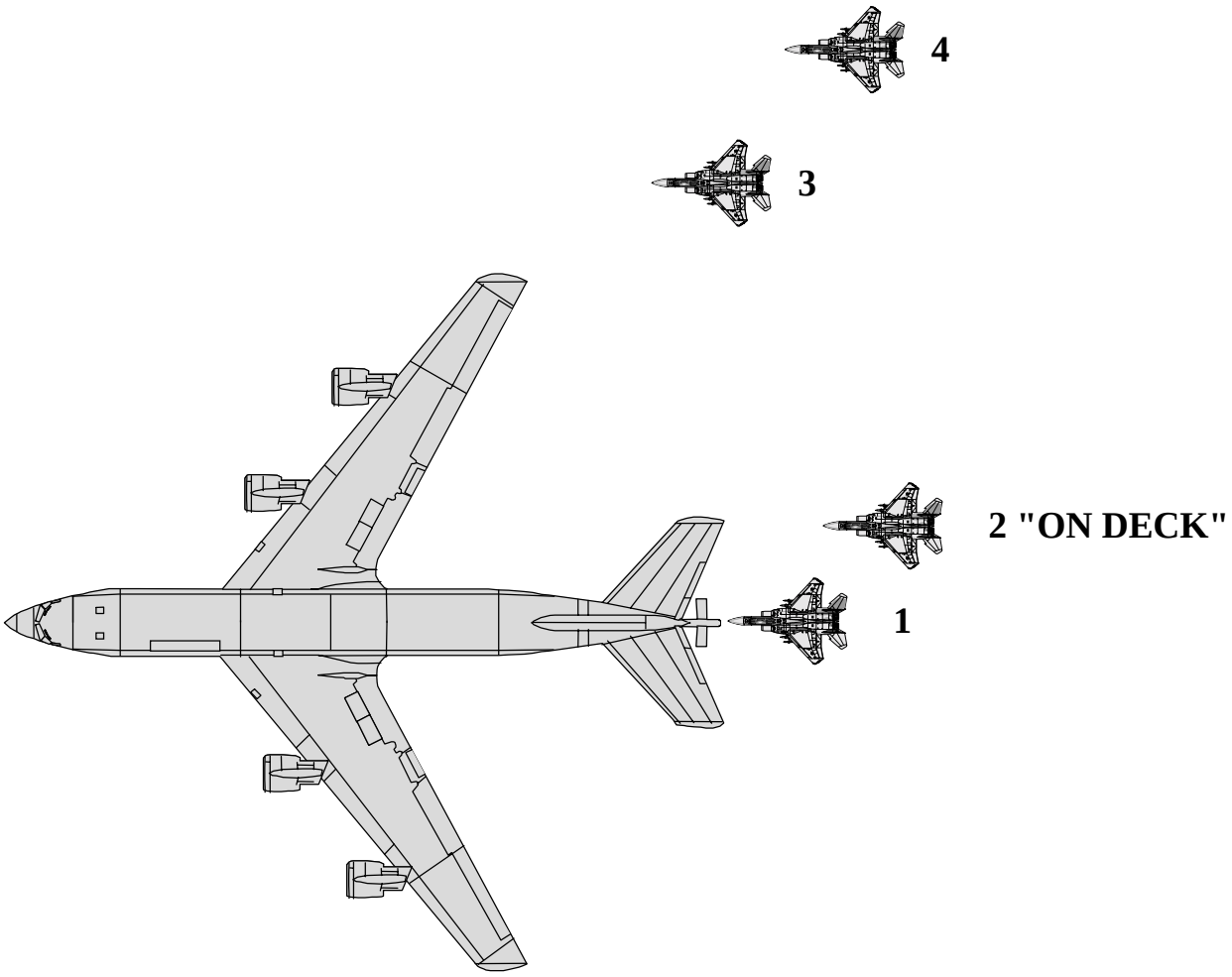
510. **Quick Flow Procedure (QF)**.

a. General. Fighter type receivers may use QF procedures to expedite AAR operations. QF allows receivers to minimize refuelling time with maximum fuel, but may only employed during DAY or NIGHT under VMC conditions. If it appears that flight may result in penetration of adverse weather conditions, standard IMC procedures will be used. Co-ordination between tanker(s) and receivers is required prior to initiating QF procedures. Air tasking guidance, direct communication with the tanker unit or adding the term “Quick Flow” to the initial radio call will satisfy those co-ordination requirements. The Tanker lead is the final authority prior to initiating and during QF operations. Right echelon formation is normally used for QF; however, variations are authorized with prior tanker lead approval and flight lead co-ordination.

b. QF Procedures. Normally, the receiver flight will join on the tanker with the flight lead moving to the pre-contact position. Remaining aircraft will proceed to the right observation, visual position. Once the flight lead commences refuelling, the second aircraft in the air refuelling sequence will move to the “On-Deck Position” (Figure 1). The "On-Deck Position" is echelon formation on the receiver in the contact position. When the flight lead completes refuelling, that aircraft moves to an observation position on the tanker’s left wing. The second receiver moves from the “On-Deck Position” to the pre-contact and contact position. If three or more receivers are part of the fighter formation, the third receiver moves to the “On Deck” position. The right to left flow continues until all fighters have refuelled. When AAR is complete, the aircraft will depart the tanker or remain in echelon formation on the tanker’s left wing for additional AAR. If further refuelling is required, reverse the above procedures with a left to right flow. The second receiver can assume a left "On Deck Position" and Quick Flow will continue in order. If additional receivers arrive prior to the first flights completion, they will remain in trail position until cleared by the tanker or observe the first flight departing the tanker.

c. Breakaway Procedures. In the event of a breakaway, the “On-Deck” receiver follows the receiver on the boom. Any receivers on the wing will remain with the tanker. In the event a breakaway is initiated while a receiver is transitioning from the observation position to the “On-Deck” position, that receiver will follow the receiver on the boom.

QUICKFLOW AIR REFUELING



ANNEX 5A

TANKER SNAKE/CELL CLIMB PROCEDURES

ITEM (a)	LEAD AIRCRAFT (b)	SUBSEQUENT AIRCRAFT (c)
Pre-flight Briefing	Brief should include, but is not restricted to, the following points: 1. Weather for T/O, en route, AAR, destinations and alternates. 2. ATC callsigns, individual cell callsigns, T/O time and R/T check in times (1). 3. Aircraft, parking locations, POB, fuel for each aircraft. 4. 1.35g buffet (VC10), buffet boundary (TriStar), 1.5 Vmm (KC-10) for each aircraft. 5. Differences in aircraft performance/dissimilar types (2). 6. COMMS/EMCON plan and allowable emitters, A/A TACAN channels and R/T channels/frequencies and inter-aircraft frequencies. 7. Taxy plan/sequence. 8. T/O and departure routeing, covering abort and emergencies plan and wake turbulence. 9. Flap retraction height/point (VC10), flap retract schedule (TriStar), Acceleration Height (KC-10/KC-135). Standard flap retract height for all aircraft in a cell climb with dissimilar tankers is 1500 ft (unless noise abatement procedures dictate otherwise). 10. Power settings. 11. Climb/cruise speeds and rate of climb/vertical speeds (below and above 10,000 ft). Intermediate level offs, turns and bank angles. 12. VMC/IMC procedures. 13. Cell join up, altitude block, airspeed (indicated/true/mach) and minimum manoeuvre airspeed. RV join procedure, ARCT and position in cell. 14. Any cell position changes. 15. AAR plan, receiver callsigns and assigned tanker, off/on loads, sequence, base altitude, track, type of RV. 16. Safety - Loss of Visual Contact procedures. 17. Cell break up and base recovery. 18. Tanker lighting (KC-10/KC-135).	
T/O-40	Call for ‘RT CHECK’. A/A TACAN ON, CHECKED, as reqd.	RT check with leader. A/A TACAN ON, CHECKED, as reqd.
T/O-20	Call for ‘START CLEARANCE’ for all aircraft. Start engines.	Start engines. Call ‘READY’ when ready to taxy.
T/O-10	Call ‘TAXY’ for all aircraft.	Taxy in turn.
CLNC	Obtain ATC clearance for all aircraft.	Acknowledge ATC clearance.
Holding Point	-	Call ‘READY’.

ITEM (a)	LEAD AIRCRAFT (b)	SUBSEQUENT AIRCRAFT (c)
Holding Point	Brief on A/A frequency: 'VMC/IMC SNAKE CLIMB AS BRIEFED. CLEARED TO FL__ (-1000 ft for each ac)'. Brief any changes.	Acknowledge: 'CLEARED TO FL ___'.
T/O	Call 'READY FOR DEPARTURE' for all aircraft. A/A TACAN ON. One aircraft on runway at a time. FTOT/FULL PWR (VC10), DERATE (TriStar, KC-10, KC-135) as reqd. Call all turns (3). Use 20° AOB.	Stream T/O: 30 sec VMC (VC10), 45 sec VMC (KC-135) and IMC (VC10, KC-135), 60 sec (TriStar, KC-10). A/A TACAN ON. FTOT/FULL PWR (VC10), DERATE (TriStar, KC-10, KC-135) as reqd. Start turns at appropriate interval after lead's call.
CLIMB IMC	Climb at 250 kts and briefed rate of climb, Vmm (KC-10) (4). Call passing every 5000 ft VMC or 2000 ft IMC (5). At FL100/10,000 ft increase to 290 kts and briefed rate of climb, 93% (VC10) or speed for weight (TriStar, KC-10) (4)(6). Call levelling at cruise FL.	Climb at lead's speed and rate of climb. In the climb minimum separation from aircraft ahead 2 nm/1000 ft until visual. Acknowledge height calls by calling passing level. At FL100/10,000 ft increase to lead's speed and rate of climb. Call when level.
TOC/ CRUISE IMC	Speed 290 kts (if subsequent aircraft is VC10) or 300 kts (if subsequent aircraft is TriStar, KC-10, KC-135). Maintain until following aircraft are in trail formation then as reqd (6).	Speed 20 kts above lead until in trail formation then as lead. When level minimum separation from aircraft ahead 1 nm/1000 ft until visual.
VMC	Visual join procedures may be adopted at any stage when sustained VMC is achieved.	
	Reduce speed (within buffet limits) and power to assist join as reqd (6). Max 20° AOB with large receivers joining or in echelon.	Call 'VISUAL'. Complete visual join. Max overtake 30 kts within 2 nm of aircraft ahead. When joined call 'ECHELON LEFT/ RIGHT'.

Notes:

1. Timings for RT checks, start and taxy should be stated by the lead tanker. Standard timings are: RT check at T/O-40, start at T/O-20, taxy at T/O-10 (or when all ac 'READY'). These timings may be varied to take account of local conditions.

2. If a VC10 and TriStar/KC-10 carry out a snake/cell climb, even if the TriStar/KC-10 is subsequently to lead the formation, the VC10 should lead the snake/cell climb. This will reduce problems of wake turbulence during the take-off and allow the TriStar/KC-10 to use its climb performance to best advantage. A KC-135 can be either lead or a subsequent aircraft. Any lead change should be carried out after join up. The following must be considered at the briefing stage:

a. Differences in rates of climb if there are large AUW or performance differences between aircraft.

b. IAS discrepancies caused by PEC differences.

3. Call all turns using the format ‘C/S TURNING LEFT/RIGHT XXX (hdg) NOW’ and commence the turn on executive word ‘NOW’, except for turns on a published SID which need not be called.

4. Details of the different climb parameters for each tanker are as follows:

a. The VC10 and KC-135 snake/cell climb speeds are 250 kts to FL100, then 290/0.82M (VC10K) or 290/0.84M (VC10C) or 280/0.78M (KC-135). However, a heavy VC10 may require a higher speed up to FL100 (1.35g buffet speed at FL100 at max AUW with aileron upset applied is 279 kts for a K2 and 268 kts for a K3/K4). If 250 kts is to be exceeded below FL100, ATC should be informed.

b. The recommended climb schedule for a TriStar is 250/300/0.80 if below 185,000 kg AUW and 250/320/0.82 if at or above 185,000 kg AUW. TriStars should have CLIMB 1 selected on the FMS when leading or following with TM engaged and CLIMB 3 displayed if following and using manual throttles.

c. Climb speeds for the KC-10 are normally 250/330/0.82M for aircraft less than 430,000 lbs Gross Wt. Above 430,000 lbs, the KC-10 climbs at Vmm to 10,000 ft then 330 KIAS/0.82M. For mixed KC-10/KC-135 formations, climb speeds are 285 KIAS with KC-10s less than 500,000 lbs and 310 KIAS for KC-10s equal to or greater than 500,000 lbs, unless a slower speed is required for an aircraft with more limiting performance.

5. In VMC, call height passing at least every 5000 ft until subsequent aircraft are visual. More frequent height calls should be given if there are large AUW or performance differences between aircraft, or if there are more than 2 aircraft in the snake climb. In IMC, call height passing every 2000 ft.

6. Call all speed changes.

CHAPTER 6

SAFETY PROCEDURES

601. **Introduction**. The foundation for the safe conduct of AAR by national or multi-national forces is standard, simple and unambiguous procedures. With these criteria established, multi-national AAR is practicable by day and night, and during periods of EMCON constraint.

602. **Rendezvous**. Regardless of the method used to achieve a RV it is vital to minimize collision risks by establishing a vertical separation between tanker and receiver; this vertical separation should be maintained until the receiver commences a visual join with the tanker. In some scenarios, prior to the start of the RV procedure, the receiver may be cruising above the level of the tanker. Nevertheless, where possible and to achieve a commonality of practice, the receiver should descend to be below the tanker before commencing the RV procedure. The cockpit view for receivers is usually better looking forward and upwards; moreover a join from below allows the receiver greater freedom for manoeuvre with less risk of losing visual contact with the tanker. Unless otherwise directed, a vertical separation of 1000 ft is to be established prior to RV, with the receiver below the level of the tanker. In some circumstances (eg ultra low-level AAR), a join from below may not be possible, in which case the tanker is to specify the exact nature of the join. If a RV is planned with a non-standard vertical separation, this should be specified in the tasking message or at the briefing stage.

603. **Joining**.

a. Probe and Drogue Refuelling. To complete a safe join, the receiver should achieve a stable formation position on the tanker before manoeuvring to the pre-contact position. Stable formation must be achieved in a position where an error of judgement in the join does not lead to a collision risk with the tanker. Longitudinal distance from the tanker and rate of closure from behind are the most difficult features to assess, particularly at night; therefore, a direct join to a position astern the tanker should not be attempted. Accordingly, all joins should be made to a loose echelon position; thus errors in line and overtake speed can be corrected clear of the tanker. It is also necessary to standardize the tanker side allocated for receiver join; this will eliminate a potentially hazardous source of confusion and make procedural joins in radio silence by day and night both feasible and safe. Moreover, the join procedure must be applicable to single and multi-tanker formations. The right-hand side of the tanker is allocated for joining aircraft; multi-tanker formations are to be in echelon right formation or cell formation during receiver joins. Therefore, unless the lead tanker pilot directs otherwise, receivers are normally to join on the right of a single tanker and join on the right of a multi-tanker formation or to the right of their assigned tanker once visual with the complete cell.

b. Boom Refuelling. The warnings described in para 603a apply but the first receiver can join the tanker directly to the pre-contact position, when the receiver has visually confirmed that no refuelling is in progress and the boom is lowered. The differences here are that the boom operator has a perfect rear view of the receiver and is able to give detailed commentary and advice to both the receiver and the tanker captain. Additionally the boom operator can call '(Receiver callsign), Breakaway, Breakaway, Breakaway' at any time depending on the circumstances. The standard signal given by the boom operator to clear

the receiver to the pre-contact position is lowering the boom, see Chapter 7 Annex 7C.

604. **Refuelling**.

a. Standardization. To achieve safe refuelling the standardized radio terms in Chapter 7 Annex 7A are to be used. A procedure for light signals to achieve safe radio silent AAR is at Chapter 7 Annex 7C. However, it is recognised that not all NATO aircraft carry the necessary lights to fully implement these procedures at this time; national variations to light signals are contained in National Annexes.

b. Probe and Drogue AAR Over Land. AAR involves a small risk of parts of the tanker/receiver's AAR equipment detaching in-flight; broken probe nozzles are the most common occurrence and not all nozzles are retained in the tanker's drogue coupling. Furthermore, on a few occasions a tanker hose has separated from the aircraft. The civil population (and their property) should not be exposed to avoidable hazards; therefore routine AAR (including hose trail and wind) is not normally to take place over populated areas.

c. Trailing and Winding Hoses. If a tanker hose is trailed or wound when the aircraft is not steady in straight and level flight, the hose may not feed correctly off or onto the hose drum; this could cause the hose to jam. The risk is small but can be easily avoided without significant operational penalties; therefore, hoses are not to be moved during aircraft attitude changes and should only be wound during turns in cases of operational necessity. Hoses may be trailed and wound in a steady climb or descent and may be trailed during a steady turn.

d. Probe and Drogue Contacts and Disconnects. The rear viewing system of most multi-point tankers can only monitor the approach path to one wing hose at a time; therefore, for simultaneous AAR one receiver is to be in contact (with fuel flowing if wet) before the second receiver may be cleared for contact. Receivers should be cleared to disconnect simultaneously but may be cleared to disconnect individually if disparate fuel transfers are in progress. An individual disconnect may disturb the hose for the remaining in contact receiver; therefore, during receiver CONVEX tanker captains may only order individual disconnects with the approval of the receiver leader or in the event of a spokes contact. There is considerable potential for receiver pilot disorientation during AAR, particularly at night or when horizons are ill defined; this can be exacerbated by the wing anhedral/dihedral of some tankers giving false horizontal cues. Ideally, all contacts and disconnects should occur in straight and level flight, although by day experienced pilots may make contacts/disconnects in steady turns, climbs and descents providing the formation is clear of cloud and the drogues are stable. Contacts/disconnects are not to be permitted during tanker attitude changes. During receiver CONVEX, tanker captains are to order all contacts/disconnects in straight and level flight unless the receiver supervisory pilot requests otherwise for training purposes. By night extra caution is needed to guard against disorientation. Therefore, at night contacts and disconnects are only to be made in turns, climbs and descents when it is operationally necessary.

e. Change Hose Procedure. It is important to move one receiver at a time when changing hoses. To swop over 2 receivers using wing hoses, the tanker captain is to order

one receiver to the echelon position; with this achieved, the second receiver maybe cleared astern the vacant hose. When this move is complete, the first receiver may be cleared astern its new hose.

f. Spokes Contact. A receiver pilot making a spokes contact, defined in Chapter 1 Annex 1A, is to call 'spokes'. If the probe has penetrated the drogue structure, the receiver pilot is to hold a stabilized in-contact position; the tanker captain is to order the receiver to 'maintain position'. This will allow a controlled sequence of actions to minimize further damage to the tanker and receiver(s). The captain of a multi-point tanker carrying out simultaneous AAR is then to order the unaffected receiver to disconnect and move to an echelon position. The affected receiver is then to be ordered to disconnect; the receiver is to disconnect in accordance with advice given in its own aircraft manual.

(1) Subsequent Actions. A spokes contact will impair the structural integrity of the drogue and it is not to be used for further AAR. The affected hose is to be wound in; this is to be accomplished before a multi-point tanker continues AAR with its serviceable hose. When the spokes contact occurs, the drogue may shed debris; there is a significant probability of the receiver's engine(s) ingesting the debris. When clear of the tanker, receiver pilots are to check engine instruments to assess possible damage, and if practical, have an airborne inspection to check for airframe damage. Receiver pilots are then to proceed as follows:

(a) Operational Sorties. Where operational considerations are paramount, the sortie may be continued if there are no signs of engine or airframe damage. The receiver pilot is to advise the tanker captain accordingly.

(b) AAR Deployments. Where there are no signs of damage, it may be preferable to continue with the deployment rather than embark on a long diversion to a foreign airfield where the aircraft may be grounded awaiting technical assistance. The receiver leader is to advise the tanker captain of the preferred course of action. The tanker captain is to assess the effect of the receivers' wishes upon the safety of the formation; in particular, the implications of single hose AAR upon the overall plan is to be considered. The final decision on whether to continue or divert the formation (or part of it) rests with the tanker captain.

(c) Training Sorties. Experience shows that even though there may be no indication to the receiver pilot of malfunction, engines sustain damage caused by ingestion of pieces of the drogue on 25% of all spokes contacts. Unless there are overriding reasons to continue the sortie, the safest course of action is to divert to the nearest suitable airfield.

(2) After Landing. In all cases, the engine(s) of a receiver aircraft that has had a spokes contact is to be inspected for possible damage after landing.

g. Locked Receiver Nozzle. Exceptionally, it is possible that the receiver probe nozzle may jam in the drogue reception coupling. If difficulty is experienced in disconnecting, the

receiver pilot is to maintain a stabilized in-contact position; the tanker captain is to be informed so he can disconnect the receiver using the other hose (if any). When ordered by the tanker captain to disconnect, the receiver is to withdraw down the natural line of the hose; throttles may have to be fully retarded to achieve separation. Upon disconnect, the receiver is to immediately go to an echelon position; parts of the probe and/or drogue may separate from the receiver and the tanker. The affected hose is not to be used for further AAR. The receiver pilot is to proceed in accordance with the instructions given in his aircraft manual.

h. Boom. The following warnings and cautions are specific to boom AAR:

(1) If radio communications between the boom operator and the receiver pilot is lost or unreliable, contacts are not permitted unless operationally necessary.

(2) A receiver approaching the 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.

(3) The receiver will stabilize in the pre-contact position. If the receiver fails to attain stabilized position or it becomes apparent that a closure overrun will occur, breakaway procedures will be initiated. Failure to do so can result in a mid-air collision.

(4) Disconnect or breakaway procedures will be initiated any time the receiver becomes erratic within the AAR envelope or damage to either aircraft appears imminent.

(5) Receiver pilots should not attempt to push the boom in during boom telescope failure.

605. **Leaving**. Once refuelling is complete, receivers should move echelon left of the tanker and leave either level with the tanker or climb. Receivers must not descend from a tanker formation in case other receivers are joining the tanker from below.

606. **Aircraft Malfunction**. A tanker or receiver emergency may require an urgent cessation of refuelling; in this event the radio call '(Receiver callsign), Breakaway, Breakaway, Breakaway' and/or signal light command is to be given, see Chapter 7 Annexes 7A and 7C. The receiver is required to disconnect immediately and move clear of the tanker, see Chapter 7 Annex 7A. The responsibility of achieving safe separation is placed on the receiver; the tanker is to maintain heading and FL/altitude and, for boom/BDA operations, the tanker is to increase power and accelerate.

607. **Wake Turbulence**. Wake turbulence caused by wide-bodied (heavy) jets can affect a considerable area and precautions are necessary to ensure that AAR formations are not subject to disturbance whilst refuelling is in progress. If a contact is reported by radar or sighted visually, whose track will coincide with or cross within 10 nm of the track of an AAR formation and whose height is within the 2000 ft band above the formation, the following action is to be taken

a. Attempt to identify if the contact is ‘heavy’

b. If ‘heavy’ or if identity cannot be established:

(1) Order any receivers in contact to disconnect.

(2) Do not bring receivers into contact until affected track area has been traversed.

Important Note. Multi-tanker formations that include TriStar/KC-10 should be particularly aware of wake turbulence, especially if the TriStar/KC-10 is leading or takes the lead.

608. **Fuel Dump**. On occasions, a tanker may have to dump fuel. The tanker pilot is to inform the national ATC agency that a ‘fuel dump’ is necessary and is to obtain permission from the ATC agency prior to dumping fuel. Many nations have designated fuel dump areas and, if possible, the tanker is to fly to this area before dumping fuel.

609. **Hose Jettison**. If at all possible, hoses are to be jettisoned over the open sea, at least 20 nm from the coast. Some nations have reserved ordnance jettison areas; therefore, the tanker pilot is to advise the ATC agency of the need to jettison a hose and is to operate in accordance with the national ATC agency directions. Additionally, the tanker crew is to use all available means to ensure the area below the tanker is clear. This is best achieved by carrying out a visual search of the area below, if weather conditions and fuel reserves permit. If weather conditions and/or fuel reserves do not permit a visual search, then the hose may be jettisoned, under the directions of the national ATC agency, from the normal cruising height. In this case, the tanker’s radar is to be used to check that the area is clear and the ATC agency is to confirm that the airspace beneath the tanker is clear of other aircraft. The position and time of release is to be logged and reported using an appropriate national Air Incident Report. Only in an emergency is the hose to be jettisoned over land. If the hose fails to jettison, the aircraft is to recover to land avoiding built up areas.

610. **Weapons**. It is the responsibility of the receiver aircraft commander to ensure weapons are safe prior to commencing a RV with a tanker. Radio calls between tanker and receiver to check on armament states are inappropriate and are impracticable during conditions of EMCON constraint.

CHAPTER 7

COMMUNICATIONS

701. **Security**. It can be assumed that all AAR frequencies will be subject to regular monitoring by potentially hostile agencies. Message originators are to ensure that classified information is not passed in an unclassified form. In particular, messages concerning airframe numbers, linkage of squadrons and locations, order of battle and associations of personnel with units are not to be transmitted. Tanker transmissions are liable to be intercepted, thus giving hostile forces knowledge of tanker positions and procedures; therefore, transmissions must be kept to a minimum. It will also be necessary on occasion to restrict the use of some or all aircraft electronic transmitting equipment.

702. **Communications in Multi-Tanker Cells/Formations**. The lead tanker crew is responsible for the cell/formation communications. If special circumstances require, specific tasks may be delegated to other tankers in the formation.

703. **HF Transmission Restrictions**. No HF transmissions are to be made from a tanker or receiver when a receiver is in contact or about to make contact and all HF equipment must be switched to STANDBY/MONITOR where possible.

Note. Some receiver aircraft have flight control systems which are susceptible to HF transmissions. Therefore, they may require a greater separation from the tanker before HF transmissions are made (eg Tornado aircraft require 1000 m / ½ nm separation before tanker HF is used).

704. **IFF/SIF**. IFF/SIF is to be operated on all exercises/operations in accordance with the tasking order. If it is necessary to switch IFF to standby, the controlling unit is to be informed.

705. **SAR Aircraft**. On some Oceanic AAR flights, maritime patrol aircraft may be tasked to provide airborne SAR cover for a deployment. SAR aircraft should listen out on the briefed AAR frequency and monitor normal Oceanic frequencies for regular position reports. Where applicable, individual Mode 1 IFF settings should be allocated to all tankers and receivers to aid the SAR aircraft to track the formation(s).

706. **AAR Radio Procedures**. Control of receivers during routine AAR is accomplished by radio commands given by the tanker. To assist interoperability these commands are standardized. Radio communications should be kept to a minimum consistent with safety; excessive radio traffic is distracting to the receiver pilot and is a potential source of confusion. Regardless of the type of AAR equipment in use, only a basic set of commands is required to accomplish refuelling. These basic commands are listed at Annex 7A. In general terms, the probe and drogue system places the responsibility of positioning for refuelling on the receiver, after the tanker has cleared the receiver astern/pre-contact the refuelling equipment. The boom system places more reliance on the tanker giving positioning commands to the receiver and the boom interphone should be used rather than RT whenever possible. During AAR, tanker crews should if possible maintain a listening watch on 243.00 MHz; this provides a guard frequency for receivers that need to join a tanker but do not know the AAR control frequency. Furthermore, 243.00 MHz provides a guard frequency in the event of loss of radio contact between tanker and receiver.

707. **Fuel Transferred**. At a convenient time between the receiver disconnecting and leaving the formation, the tanker should inform each receiver of the amount of fuel transferred. For boom equipped tankers, the offload report should be done through the boom interphone system. Whenever possible, the fuel quantity should be expressed in the units of measurement used by the receiver's fuel system.

708. **Loss of Radio Contact**. If radio contact is lost between tanker and receiver on the allocated AAR frequency, attempts are to be made to re-establish contact on the secondary AAR frequency. If contact is not established on the secondary frequency or one is not allocated, both tanker and receiver are to establish contact on 243.00 MHz (121.50 MHz for some receivers). Continued routine communication should not take place on the distress frequency; therefore tanker and receiver should attempt to continue AAR communication on another mutually acceptable frequency. Some receivers have only one main radio and a standby radio pre-tuned to the distress frequency. If the loss of radio contact was caused by the failure of the receiver's main radio, then AAR communication on the distress frequency will be necessary; nevertheless, this should be minimized and radio silent procedures should be adopted if possible.

709. **Emission Control Procedures**. There may be a need to conduct AAR exercises/operations in electronic silence. The controlling authority will promulgate the emission control (EMCON) procedure in force for the exercise/operation. The use of electronic emitters will vary according to the assessed threat. The definition of each EMCON option is given in Chapter 1 Annex 1A. EMCON options and acceptable communications for each option are shown in Annex 7B, which gives 4 levels of restriction on the use of electronic emissions and provides for further refined selection of transmitters.

710. **Radio Silent Procedures**. There will be occasions when AAR is conducted using agreed procedures and signalling facilities without the use of radio. Radio silent procedures and visual boom signals are detailed in Annex 7C. The occasions requiring silent procedures are:

a. When called for by the EMCON policy in force.

b. When deemed tactically necessary by the tanker captain or for training purposes agreed between tanker and receiver. In these cases, the tanker commander initiates the procedures by stating at the briefing stage or on radio at any time 'silent procedures'.

c. In the event of radio failure.

d. In the event that a receiver requires fuel but does not know the tanker's operating frequency.

ANNEX 7A

RADIO PROCEDURES

SERIAL (a)	SITUATION (b)	TANKER RT (c)	RECEIVER RT (d)
1	RV Initial Call	(Callsign) this is (callsign), for RV …., my FL …., when cleared, your FL …., select A/A TACAN Channel …. (Use altitudes and altimeter setting if appropriate and add AAR speed if different from pre-briefed)	(Callsign) this is (callsign), RV …., when cleared, my FL ….
2	Receiver has radar contact and takes responsibility for closing to visual range	-	Judy
3	Receiver has visual contact approaching tanker	-	Visual
4	Receiver cleared to join tanker	Clear join	Acknowledge (1) (2)
5	Receiver echelon left/right	-	Echelon left/right (3)
6	Tanker AAR equipment deployed (hose trailed, boom lowered)	Clear astern (pre-contact) left/centre/right (3)	Acknowledge (3) (4) (5)
7	Receiver astern (pre-contact) left/centre/right	-	Astern (pre-contact) left/centre/right (3) (5)
8	Tanker AAR equipment ready to pass fuel	Clear contact (specify left/ right if a multi-point tanker) (3) (6)	Acknowledge (7)
9	Closing to boom nozzle	Stabilize, Forward, Back, Up, Down, Right, Left, Return to pre-contact (3)	Acknowledge (3)
10	Receiver to disconnect	Disconnect (3)	Acknowledge (3) (8)
11	Receiver astern (pre-contact) left/centre/right	-	Astern (pre-contact) left/centre/right
12	Receiver to effect emergency disconnect	(Callsign), Breakaway, Breakaway, Breakaway (9)	Acknowledge (10)
13	Practice Emergency Separation (11)	(Callsign), Breakaway, Breakaway, Breakaway (9)	Acknowledge (3)
14	Receiver strikes drogue and suspects damage to ribs or canopy of drogue	-	Spokes (12)
15	Receiver to move from astern (pre-contact) to echelon	Go echelon left/right (13)	Acknowledge (3)
16	Receiver echelon left/right	-	Echelon left/right (13)
17	Receiver cleared to leave the tanker	Clear to leave	Acknowledge

Notes:

1. Receiver to complete join to the observation position.

2. For boom, receiver may join directly to pre-contact position.

3. Only required during EMCON Option 1.

4. Receiver moves astern assigned AAR equipment and stabilizes in the pre-contact position.

5. Boom operations need not designate centre.

6. During EMCON Option 2, the boom operator and lead receiver will accomplish an abbreviated radio check prior to boom contact, eg tanker: '36 Alpha, 42', receiver: '36 Alpha'. If more than one receiver formation is on the AAR frequency, tanker will use the full receiver callsign. After contact, use the boom interphone to maximum extent possible.

7. Receiver advances to engage probe with drogue or moves to the boom contact position.

8. Receiver makes a routine disconnect and drops back to the pre-contact position.

9. The specific receiver callsign must preface the breakaway call.

10. Receiver makes an immediate disconnect, moves back and then goes to a safe position clear of the tanker and the refuelling equipment, usually to echelon.

11. Prior to a practice breakaway, in-flight co-ordination between the tanker crew and receiver pilot is mandatory.

12. After a spokes, tanker and receiver consult to assess damage to AAR equipment and establish feasibility of continuing AAR.

13. Tanker passes to receiver the amount of fuel transferred (using the units of measurement of the receiver's fuel system).

ANNEX 7B

EMCON OPTIONS - COMMUNICATIONS

ITEM	ACTION	EMISSION OPTION (1) (2) (3)			
		1	2	3	4
1	Radio set 30 minutes prior to ARCT/RV (if dual radio capable).	X	X	(4)	(5)
2	15 minute call (if applicable).	X	X		
3	A/A TACAN set 15 minutes prior to ARCT/RV.	X	X	X (6)	
4	Beacon positive identification (if applicable).	X			
5	ARIP call (if applicable).	X			
6	ADF check (if applicable).	X			
7	Halfway through the turn call (tanker) - (if applicable).	X			
8	Boom - 1 nm closure call (receiver).	X			
9	Mandatory boom operator calls:				
	a. Pre-contact call.	X	X		
	b. Clear receiver to contact.	X			
	c. Acknowledge contact/disconnect.	X			
	d. Verbal corrections.	X			
	e. Advise receiver(s) to return to pre-contact for check list or equipment considerations.	X			
10	Mandatory receiver calls after 15 minute call:				
	a. Visual contact established/lost to include overrun.	X			
	b. Pre-contact call (acknowledgement).	X	X		
	c. When contact or disconnect is made.	X			
	d. Boom - verbally notify boom operator prior to Manual/emergency boom latching procedures.	X	X		

Notes:

1. When using EMCON Options 2 - 4, boom interphone should be used when compatible. Tanker and receiver planners will co-ordinate and crews are to be thoroughly briefed on: RV type, RV point and time, tanker and receiver FL/altitudes, cell procedures and break up arrangements, and missed RV procedures (including refuelling area departure time and back up communication procedures). If different EMCON options are to be used during different phases of the route, this must be included in the briefing.

2. Variations may be co-ordinated, eg: ‘EMCON 2, ITEM 9A COMMS N/A’ would mean normal EMCON Option 2 procedures except the pre-contact call would be deleted.

3. EMCON Options 1 and 2 only are used when the FAF C135-FR is conducting pod refuelling.

4. Radio silent procedures. Use of other emitters is authorized unless prohibited by supported operations plans.

5. No emissions (radios, doppler, navigation transmissions, radar, IFF, exterior lighting, etc) unless authorized by the ATO, ROE, operations plans, safe passage procedures or other mission directives.

6. RV Bravo, Charlie, Delta (Point Parallel) and Echo.

EMCON OPTIONS - EMITTERS

ITEM	EQUIPMENT	EMISSION OPTION			
		1	2	3	4
1	Radar	On	On	As required	Off
2	Doppler	On	On	As required	Off
3	Beacon	On	On	As required	Off
4	Radio Altimeter	On	On	As required	Off
5	TACAN/DME	On	On	As required	Off
6	IFF	On	On	As required	Off
7	UHF/VHF	On	On	Monitor	Monitor
8	HF	On	On	Monitor	Monitor
9	Lighting	On	On	As required	Off

Note. Variations may be co-ordinated, eg: ‘EMCON 2, ITEM 1 EMITTERS OFF’ would mean normal EMCON Option 2 procedures except the radar would be off.

ANNEX 7C

RADIO SILENT PROCEDURES

SERIAL (a)	SITUATION (b)	TANKER ACTIONS (c)	RECEIVER ACTIONS (d)
1	Receiver requires fuel	-	Receiver joins on tanker's right side well forward to attract tanker pilot's attention (1)
2	Tanker acknowledges receiver presence, has understood and has fuel available	Trails hose/extends boom	-
3	Tanker acknowledges but has no fuel available	Tanker's hose/boom remains stowed or retracted	Receiver diverts or attempts to find another tanker
4	Tanker AAR equipment ready, receiver clear astern	Switch off all red anti-collision beacons/strobes. All on again when receiver seen to move astern	Receiver goes astern AAR equipment (left hose as first choice on multi-point tankers, if available)
5	Fuel transfer	Light sequence as in National Annex (2). Visual boom signals are detailed overleaf	Receiver reacts to lights/visual signals
6	Receiver leaves formation	-	Receiver pulls forward on left side in visual contact then turns away
7	Receiver to breakaway	Tanker AAR equipment red signal light on. For tankers not fitted with AAR equipment red signal lights, any other specified red light on (eg anti-collision, hand held lamp), refer to National Annex	Receiver makes emergency disconnect, moves back and then goes to a safe position clear of the tanker and the refuelling equipment, usually to echelon

Notes:

1. For boom, receiver may join directly to pre-contact position.

2. It is not yet possible to propose standardized signals to indicate clearance for receivers to commence and disconnect refuelling because AAR light signalling equipment is not fitted on NATO aircraft to a common STANAG.

VISUAL BOOM SIGNALS

SERIAL (a)	MEANING (b)	BOOM AAR SIGNAL (c)
1	Tanker ready for contact (1)	Boom in trail: Extended 10 ft (KC-135) Extended 12 ft (KC-10)
2	Tanker manual operation without disconnect capability Or Tanker acknowledgement of receiver's manual boom latching signal	Boom in trail (fully extended)
3	Fuel offload complete	Boom in trail (fully retracted)
4	Tanker AAR system inoperative	Boom stowed (fully retracted)
5	System malfunction. Tanker and receiver check AAR systems	Extended 5 ft (KC-135) Boom 0° elevation, extended 5 ft (KC-10)
6	Breakaway	Flashing pilot director lights (push emergency break switch). Tanker lower rotating beacon on (Beacon light master switch to Both)
7	Tanker request for disconnect, receiver return to pre-contact position	Turn pilot's director lights off during contact. Push disc signal switch (2)
8	Receiver request manual boom latching Or Receiver acknowledgement of tanker's manual operation signal without tanker's disconnect capability signal	Receiver closing and opening receptacle door when in pre-contact position
9	Receiver emergency fuel shortage exists (3)	Receiver rocks wings or shows a steady light
10	Initiate toboggan manoeuvre	Flashing light from receiver cockpit area

Notes:

1. When more than one receiver is being refuelled, the boom operator will not give the ready for contact signal until the preceding receiver has cleared the tanker.

2. The receiver(s) will advise the tanker of any pilot director light malfunction.

3. If fuel shortage occurs at times other than scheduled AAR, the receiver should be positioned so the signal may be seen from the tanker cockpit.

CHAPTER 8

ACCOMPANIED LET DOWN PROCEDURES

801. **General**. It may occasionally be necessary for a tanker to accompany receiver aircraft from cruising level through a joint descent to a height of 500 ft AGL on the approach to a runway. The accompanied let down procedure provides a standard method of making a formation descent to a point from which a final approach and landing can be completed.

802. **Criteria**. When considering the use of an accompanied let down, the following criteria should be used:

a. The procedure must be fully pre-briefed with particular regard to formation procedures, speeds, angles of bank and weather minima.

b. Aircraft limiting speeds for gear and flaps must not be exceeded.

c. Single frequency approaches should be used whenever possible.

803. **Considerations**. In addition to the criteria at para 802 above, the following aspects should be considered:

a. The effect of wake turbulence, especially in strong crosswind conditions.

b. At night or in IMC, reduced visibility may make formation flying difficult.

c. Most receivers are sensitive to power changes, thus all tanker changes in speed or power must be called early to prevent an overtake.

d. Calls must be made when selecting services, on commencing descent or go-around and for heading changes.

e. Primary considerations for the tanker pilot must be smooth flying, accurate airspeeds and the avoidance of rapid applications of bank. Bank angle is a particular consideration bearing in mind the long moment of the wing tip from the centreline. If the tanker autopilot is in use, it is advisable to disconnect it (if possible) from automatic lateral steering and height control facilities, to avoid unexpected and rapid deviations from a steady formation lead condition.

804. **Standard Accompanied Let Down**. Procedures unique to specific combinations of tanker and receiver types are covered in national instructions. However, on occasion a receiver(s) may require a let down led by a tanker from another NATO nation and in circumstances where pre-briefing or in-flight briefing is not possible. The following NATO Standard Accompanied Let Down should be used in these circumstances:

a. The tanker assumes responsibility for radio communication with the ground on behalf of the whole formation. The tanker navigates to the destination airfield or responds to ground directions.

b. When appropriate, the formation descends to FL100/10,000 ft at the refuelling airspeed, avoiding high rates of descent.

c. During the descent from FL100/10,000 ft to the runway instrument pattern height, the formation progressively reduces speed to 200 KIAS.

d. The tanker should request a runway instrument approach with, if possible, a straight-in approach.

e. At 3 nm or 500 ft AGL the tanker adopts the go around/overshoot procedure, the receiver reduces to landing speed and lands.

CHAPTER 9

HELICOPTER AAR

GENERAL

901. **Introduction**. In general, the principles outlined in Chapters 1-7 are also applicable to helicopter AAR, although there are significant differences in procedure in the rendezvous and join phases. An important consideration is that the most effective performance and procedure may not be the optimum for either the tanker or the receiver, although each aircraft must remain within its own operating limitations. These procedures assume a single tanker; differences in procedure for multi-tanker formations are outlined at the end of this Chapter. Specific-to-helicopter AAR definitions are shown at Annex 9A.

902. **Equipment**. Helicopters should be refuelled only from tankers fitted with a low speed drogue. Low speed drogues are of a larger diameter to provide acceptable flying characteristics at the lower speeds.

903. **Performance**. The choice of airspeed and altitude for refuelling will depend upon the performance capabilities of the tanker and the helicopter. Typical refuelling airspeeds are in the range 105 to 120 KIAS, with 110 KIAS being the routine refuelling speed. Maximum hose extend/ retract airspeed is 120 KIAS and after full extension of the drogue with receivers in contact the maximum airspeed is 130 KIAS. At speeds lower than 105 KIAS the drogue may not inflate properly and may possibly droop, thereby reducing the clearance between the helicopter rotor blades, the hose and the tanker's tail. The Hercules tanker minimum refuelling speed is 3 - 5 KIAS above the power-off stall speed and the normal configuration for refuelling is 70% flaps, undercarriage up and level flight. The altitude range for helicopter refuelling is typically from 1000 ft to 3000 ft AGL, although higher/lower altitudes may be used when mission requirements dictate.

904. **Communications**. Control of routine helicopter AAR may be conducted by radio commands given by both tanker and receiver. The basic commands which are specific to helicopter AAR are detailed in Annex 9B. There will be occasions when helicopter AAR is conducted using agreed procedures and signalling facilities without the use of radio. Radio silent procedures are detailed in Annex 9C. Radio silent procedures at night will only be conducted with receivers using NVGs.

905. **Lighting**. Night helicopter AAR is normally conducted using NVGs. Details of NVG AAR EMCON procedures are given at Annex 9D. During the RV phase, the receiver formation will be identified to the tanker by the use of IR or red strobes (ie the lead and last receiver will display IR or red strobes). The tanker will illuminate its strobes until the receiver formation is abeam, thereafter the tanker will extinguish its strobes. After the join is complete, all receivers except the last receiver will then extinguish their strobe lighting which will reduce the potential for disorientation.

906. **General Procedure**. Prior to any planned AAR, a briefing between tanker and receiver crews must take place. Helicopter AAR is divided into 4 phases: rendezvous (RV), join, refuelling and post-refuelling. During the RV, the tanker performs all turns to avoid reduction in receiver

performance. In principle, the aim of the RV is to position the tanker ½ nm astern of the receivers, from which position the join is commenced. During the join, the tanker proceeds from ½ nm trail to the lead position and establishes the refuelling configuration.

RENDEZVOUS

907. **Criteria for RV**.

a. Initial Contact**.** Normally 10 minutes prior to the ARCT the tanker is to establish radio contact with the receivers, confirm refuelling details and state the altimeter setting being used for refuelling, the A/A TACAN in use and transmit IFF and DF as applicable.

b. Receiver Formation**.** Multi-receiver formations are to fly in echelon left prior to the join phase.

908. **Types of RV**.

a. Random RV. This procedure is used in VMC. The tanker manoeuvres to a position ½ nm astern the receivers. Details are at Annex 9E.

b. Overtake RV. In this procedure the tanker approaches the receivers from behind using range and bearing or bearing only information. Details are at Annex 9F.

c. Head-on RV. In this procedure the tanker approaches the receivers head-on and makes a procedure turn back onto the receivers' track. The type of procedure turn used depends on equipment availability. Details are at Annex 9G.

d. Head-on Offset RV. The tanker approaches the receivers on the reciprocal of the refuelling track, approximately 3 nm offset from the track. A standard rate turn to the left through 180° is commenced once the receivers pass abeam. The tanker plans to be 2 nm astern the receivers on completion of the turn. Details are at Annex 9H.

JOIN

909. **General**. The join procedure enables the tanker to proceed from ½ nm in trail to the lead position whilst establishing the refuelling configuration (hoses trailed, flaps down (70% for the Hercules), at refuelling speed) and with the receivers in echelon left. Receivers are to adjust altitude and confirm level at the join-up altitude (refuel altitude - 300 ft for receiver low procedure) before the tanker commences the join procedure.

Note. For emergency (single engine operation) the join-up altitude is the refuel altitude + 500 ft (receiver high procedure), which compensates for loss of power. However, if receiver high procedure is used under normal operations, the join-up altitude is the refuel altitude + 200 ft.

910. **Procedure**. Once the tanker has confirmed that the receiver is at the join-up altitude, the tanker commences a slow overtake at the refuelling altitude on the receiver formation's right-hand side. During the overtake, the tanker lowers flap and trails hoses as appropriate. When the tanker passes the lead receiver's 3 o'clock position the lead receiver is to call 'visual' and select IFF to

standby. The tanker will take the lead and establish the refuelling airspeed, the first receiver should manoeuvre to the observation position. Remaining receivers are to maintain echelon, at least 200 ft to the left and 200 ft behind the tanker.

911. **Crossover**. The procedure whereby a helicopter changes to the opposite echelon is termed a crossover. When cleared, the receiver moves to a position in echelon outside the tanker's wingtip at least 100 ft aft and 50 ft above the tanker's tail. The receiver then crosses to a similar position on the other side before descending to the observation position. This procedure ensures that the receiver avoids the area of extreme turbulence directly behind, and for the Hercules slightly right, of the tanker. It is imperative that receivers avoid this area of extreme turbulence, otherwise blade stall and uncontrolled settling may result. The tanker may use asymmetric power to reduce turbulence when the right refuelling position is used.

REFUELLING

912. **General**. The left hose is the primary hose for a Hercules tanker, although either wing hose may be used. For multiple receivers both hoses may be used, however, consideration must be given to carrying 2 loadmasters/observers to monitor this operation. Simultaneous contacts or disconnects are not to be made. However, refuelling of 2 helicopters simultaneously can be accomplished provided the procedure is fully briefed and agreed between the tanker and receivers. The second receiver shall be cleared for contact only after the first receiver is in the refuelling position. Ideally, contacts should be made in straight and level flight, although experienced receivers may make contact in the turn by day. During turns at night, the helicopter is either to be in contact or established in the observation or pre-contact position. Night contacts should not be made in the turn owing to the risk of receiver pilot disorientation. Once established in the refuelling position, turns are permitted by day or night.

913. **Contact**. When cleared by the tanker for contact, the receiver moves from the observation position to the pre-contact position where the receiver stabilizes before commencing the approach. A receiver should not be delayed in the pre-contact position, as it is a difficult position to maintain due to the tanker's turbulence. If delays in refuelling are expected, the receiver should be held in the observation position. For the Hercules tanker, the wing refuelling basket flies 22 ft below the wing at 110 KIAS. Once a contact is made the receiver will call 'contact'. At contact, the receiver movement should be precise and deliberate. Lateral (outboard) movement of about 6 - 10 ft out is essential in order to provide rotor to tanker clearance and at the same time an upward movement of approximately 15 ft up should be flown to establish the wing tip refuelling position. A good refuelling position is aligning the refuelling probe within the range of half the distance between the refuelling pod and the wing tip dump tube. The pilot may need to move left or right due to turbulence. When refuelling from the left hose, the probe should not be farther outboard than the dump tube nor farther inboard than the refuelling pod. When refuelling from the right hose, the probe should be no farther outboard than the dump tube and no farther inboard than half the distance between the refuelling pod and the dump tube. A good 'step up' is with the trailing edge of the Hercules wing at eye level.

914. **Disconnect**. When refuelling is complete, the receiver will call for disconnect. The receiver should normally disconnect approximately 5 ft high of the basket free flying position to allow the basket to go down. When clear of the drogue, the receiver should manoeuvre to the observation position or the outside echelon position if there are other receivers on that side.

POST-REFUELLING

915. **Leaving**. When all refuelling is complete and the receivers have called clear, the tanker will wind the hoses and accelerate smoothly away from the receiver formation. The tanker will ensure the receivers are clear and will climb or descend 1000 ft prior to initiating any turns. When receiver(s) have completed fuel transfer, the tanker will pass fuel offload, distance, heading and ETA to the receiver's next checkpoint/destination, if required.

SAFETY PRECAUTIONS

916. **General**. The tanker will be in a slow speed, high drag configuration with a small but adequate margin for safety above stalling speed. Reduction or loss of power at high AUW may result in a stall with no stall warning. Furthermore, at high altitudes and high ambient temperatures, the loss of an engine may require full power on the remaining engines to maintain speed and height. However, the tanker's 3-engine minimum control speed may be close to the helicopter refuelling speed. Power must therefore be increased with caution to avoid the possibility of loss of directional control. In the worst case, the tanker may have to lose height or reduce power on the asymmetric engine in order to maintain directional control. The maximum AOB during refuelling is 30°, however, 10° - 20° AOB is normally sufficient.

917. **Refuelling**. Extreme caution is required in turbulence, as the whipping action of the hose will increase the likelihood of the rotor blades striking the hose. Fast contacts and off-centre disconnects should be avoided otherwise damage to the refuelling equipment may result. If settling occurs whilst in contact, the receiver must disconnect immediately to avoid damage to the refuelling equipment or the possibility of the rotor blades striking the hose. If the hose starts to oscillate significantly whilst in contact, the receiver should disconnect at the normal rate; a fast disconnect is likely to aggravate any hose motion. If the hose is too unstable before contact, the hose should be primed again or the tanker should be asked to enter a turn. Both actions will result in stabilizing the hose and basket.

918. **Loss of Visual Contact**. If visual contact is lost, prompt action is required to ensure safe separation between aircraft. Once safe separation is assured, subsequent action will depend on the circumstances prevailing and will be at the discretion of the tanker commander.

a. Before the Tanker has the Lead. If the tanker is within 5 nm of the receivers and loses visual and electronic contact, the tanker is to call 'contact lost' and make an immediate right turn 45° away from the receivers' heading. After 30 seconds the tanker should initiate a climb/descent to the rendezvous altitude and manoeuvre for another RV or continue as pre-briefed. If visual contact is lost at 1 nm or less but electronic contact is maintained, the tanker is to call 'no visual contact', make an immediate right turn 45° away from the receivers' heading, configure for refuelling and reduce to refuelling speed. After 30 seconds the tanker should turn left and resume the receivers' heading and maintain electronic contact at a position 1 to 2 nm behind the receivers until visual contact is re-established.

b. After the Tanker has the Lead**.** If a receiver loses visual contact with the tanker, the receiver is to call 'lost visual contact'. The tanker is to disconnect the receivers (if in

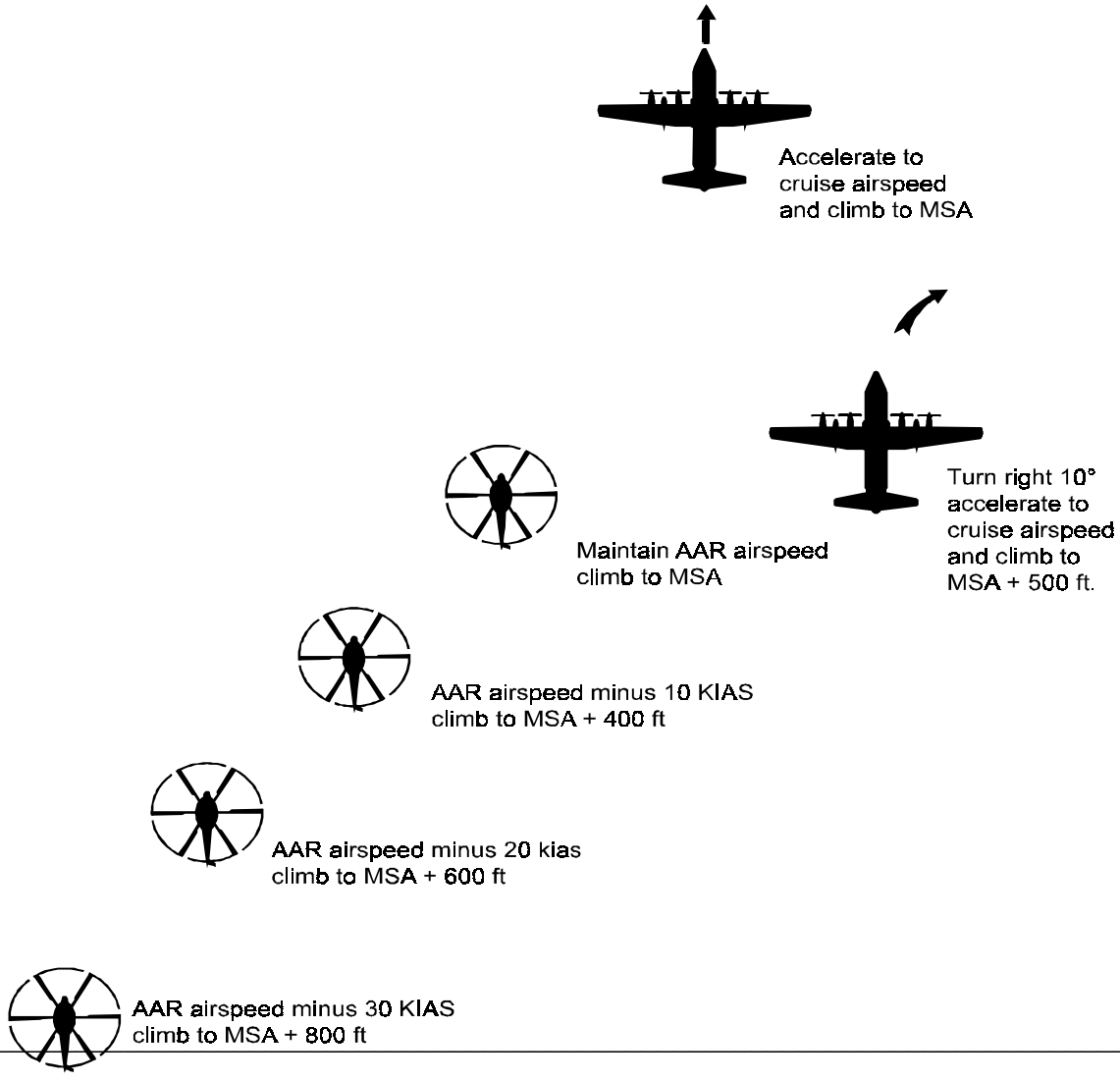
contact), wind the hoses, fly straight ahead, climb to safety altitude and increase speed to cruise airspeed. The tanker should aim to achieve a minimum of 1000 ft height separation from the receivers. Additional tankers should follow the procedures laid down in para 923(b).

(1) Refuelling in Mountainous Terrain.

No 1 receiver maintains refuel airspeed and climbs to safety altitude.
No 2 receiver decelerates to refuel airspeed minus 10 KIAS and climbs to safety altitude + 400 ft.
No 3 receiver decelerates to refuel airspeed minus 20 KIAS and climbs to safety altitude + 600 ft.
No 4 receiver decelerates to refuel airspeed minus 30 KIAS and climbs to safety altitude + 800 ft.

Note. All receivers are to maintain heading as relayed by the tanker and hold their adjusted airspeed for 3 minutes after reaching their altitude. After 3 minutes they are to accelerate to the base airspeed.

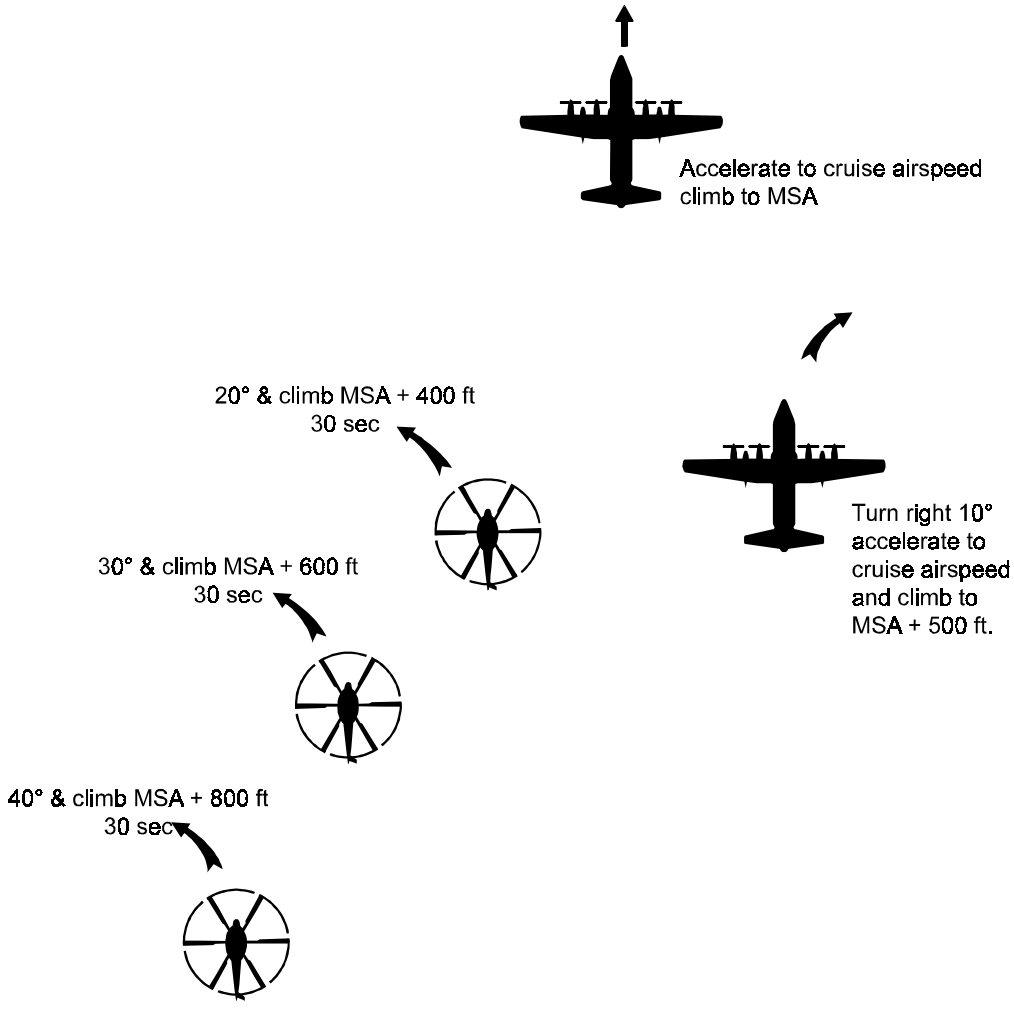
FIGURE 9-1. LOSS OF VISUAL CONTACT (MOUNTAINOUS TERRAIN)



(2) Refuelling in Non-Mountainous Terrain.

No 1 receiver maintains refuelling speed, turns 20° left/right away from the formation and climbs to safety altitude + 400 ft. After 30 seconds the receiver resumes the tanker's heading.
No 2 receiver maintains refuelling speed, turns 30° left/right away from the formation and climbs to safety altitude + 600 ft. After 30 seconds the receiver resumes the tanker's heading.
No 3 receiver maintains refuelling speed, turns 40° left/right away from the formation and climbs to safety altitude + 800 ft. After 30 seconds the receiver resumes the tanker's heading.

FIGURE 9-2. LOSS OF VISUAL CONTACT (NON-MOUNTAINOUS TERRAIN)



MULTI-TANKER PROCEDURES

919. **Introduction**. Multi-tanker AAR for helicopters is not permitted in IMC. Multi-tanker formations in VMC should use the procedures outlined above with the differences noted in the following paragraphs.

920. **Rendezvous**.

a. Head-on RV. The tankers fly in trail and approach the receivers on a reciprocal track offset by 5 nm. When visual and abeam the receivers, the tanker formation will turn left, adjust to refuelling altitude and proceed to 2 nm trail. Details are at Annex 9I.

b. Overtake RV. The tanker formation should be in trail and, if there is a spare, the spare tanker will go to echelon right prior to coming abeam the receivers.

921. **Join-Up**. Each receiver element is to establish a spacing between elements, normally 2 nm. The first and last receiver in each element is to have a strobe light on to define the element. The first primary tanker is to join the lead receiver element, the second primary tanker is to join the second receiver element. The spare tanker, if present, is to maintain echelon right on the second tanker.

922. **Refuelling**. When the join is complete, receivers will be cleared to join their assigned tanker. All receiver formation changes are to be accomplished using the crossover technique. When joined in the observation position on the appropriate tanker, single tanker procedures will be used for refuelling. On completion of refuelling, receivers are to re-establish in the observation position on their respective tanker. They will then be cleared to take up the pre-briefed enroute formation.

923. **Loss of Visual Contact**. Multi-tanker AAR for helicopters is not practical in IMC, therefore the RV, join and refuelling should be accomplished in VMC. If IMC is encountered, the refuelling must cease. Specific loss of visual contact procedures can be very complex and must be pre-briefed. Receivers will follow the basic format laid out in paras 918b(1) or (2) and the format for tankers is as follows:

a. Lead Tanker. Lead tanker orders '(callsign), lost visual contact', accelerates to cruise airspeed and climbs to safety altitude.

b. Additional Tankers. Tanker 2 will accelerate to cruise airspeed, turn right 10° for 10 seconds using 10° AOB and climb to safety altitude + 500 ft. Tanker 3 will accelerate to cruise airspeed, turn right 20° for 20 seconds using 20° AOB and climb to safety altitude + 1000 ft. On completion of this manoeuvre, the tankers will revert to the original track.

NVG REFUELLING PROCEDURES

924. **General**. Conducting NVG AAR assists the assault force in avoiding detection near the battle area while extending its range. NVG AAR also provides many more cues than unaided night

refuelling.

925. **Concept of Operations**. NVG AAR is accomplished in a low altitude environment, either along the route or in an orbit over a known point. Selection of the route and the NVG ARCP should preclude detection by enemy forces.

926. **Mission Planning**. The nature of the mission will dictate many of the parameters involved in a helicopter AAR mission. A thorough threat assessment and terrain analysis must be made in order to properly select the AAR area, altitudes and routes to and from the operating area. Additionally, the number of helicopters and their sequencing will dictate the size and length of the AAR track.

927. **General Procedure**. Prior to any planned NVG AAR mission, a briefing between tanker and receiver crews is essential and the following items must be covered and co-ordinated:

a. Visibility. The minimum visibility for NVG rendezvous for AAR is 5 nm. Flight through clouds after contact is not recommended; due to the ability of NVGs to see through light layers of clouds and precipitation, pilots may not be able to detect clouds until they are in them. Therefore, crews must remain alert to gradual reductions in visual acuity which could indicate impending IMC. In addition to weather, it is imperative that a thorough analysis of the illumination available at the NVG ARCP and along the AAR route is conducted for the duration of the planned refuelling activity. The moon angle and azimuth are important when considering formation requirements and pilot to drogue look angles. The light level planning calendar program is an excellent tool for application in this case.

b. Refuelling Altitude. The refuelling altitude should be the lowest usable altitude to avoid enemy detection while maintaining a margin of safety. Awareness of low altitude turbulence, low moon angle and terrain shadowing considerations may rule some altitudes unusable.

c. Pod Lighting. The Hercules pod lights should be at dim and/or taped with a hole that is large enough to allow the light colour to be seen. The pod lights should not be set too bright as receiver vision will be severely restricted.

d. Tanker External Lighting. Once the receiver(s) establishes in the observation position, the tanker external lighting should be configured as follows:

(1) Anti-Collision Lights Off.

(2) Navigation Lights Steady Dim (Tail Off).

(3) Formation Lights Off.

(4) Landing Lights Off.

(5) Taxi Lights Off.

(6) Leading Edge Lights Off.

(7) Pod & Hose Illumination Lights Off.

e. Receiver External Lighting. The receiver's probe light should be switched off or set no higher than 50%. If the receiver probe light is opened to 100%, it will restrict the Hercules loadmaster's ability to see the receiver and will limit the visibility of the hose range markings. The receiver's external lighting should be configured as the tactical situation dictates.

f. Tanker/Receiver EMCON Procedures. NVG AAR EMCON procedures are detailed in Annex 9D. The loadmasters/observers/crew chiefs should be briefed on the EMCON signals as they can assist the pilots.

928. **RV Procedures**. The recommended RV procedure for training is for the tanker to conduct the RV at the ARCP at the ARCT, hoses in and normal external lighting. The receivers should adjust to the refuelling altitude and manoeuvre to the observation position after the tanker has passed the receivers on the right-hand side and has taken the lead. Once the receivers are in the observation position, the tanker should assume a NVG compatible lighting configuration as described in paras 927c and d. The hoses should be extended with the receivers in the observation position.

Note 1. The tanker loadmaster should be equipped with NVGs and a flashlight with a blue/green or green filter lens for all NVG/EMCON signalling. An alternate method of signalling the receiver would be to use the ALDIS lamp with a NVG compatible filter kit installed or IR chemlights.

Note 2. The probe light brightness can be adjusted with the rheostat so that it can emit enough light to illuminate the drogue yet not be visible to the eye. 50% is the maximum recommended for the probe light since brighter positions tend to wash out the tanker loadmaster's NVGs. The brightness of the co-pilot's spot light (with or without an IR lens) may also be reduced to provide the additional cues required by the pilot but always consider the tanker loadmaster's NVGs. When the probe light is used, a shadow cast at 4:30 on the drogue will provide additional line up cues. Hose range markings should be visible to the non-operating pilot, who should advise the operating pilot changing trends, eg 'you are at minimum distance and closing'. The pilot not at the controls can assist with wing and flap cues for line up on the tanker. Pre-briefed crew coordination is an absolute requirement if effecting contact. The aircrewman should be used to monitor fuel onload and tank selection, while the pilot not on the controls acts as a safety monitor/back-up. If the pod refuelling signal lights have not been taped, the hose range markings will be harder to see until the hose is in the refuelling range.

EMERGENCY REFUELLING PROCEDURES

929. **Fuel Spillage**. Fuel spillage can occur from a soft contact or a poor connection between the hose and the drogue. At any time fuel spillage is noticed, fuel transfer is to be stopped and the tanker notified. A serious fire hazard exists as the entire outside of the helicopter is likely to be sprayed by fuel. Radio transmissions and electrical switching of systems must be kept to a minimum. If fuel spillage continues, the flight should be terminated as soon as practicable. A running landing should be made to preclude re-circulation of fuel spray due to rotor wash during hover operations. Upon landing, the helicopter should be shut down and immediately washed to eliminate any fire risk.

Note 1. A small amount of fuel spray from the probe coupling during fuel transfer does not require fuel transfer to cease. The tanker and receiver should be notified if this condition exists. Refuelling should be continued or ceased at the discretion of the receiver pilot.

Note 2. If a probe head leaks, increased fuel spillage may be expected during the probe retraction process. When retraction is complete, fuel spillage should diminish.

930. **Refuelling with a Non-Extended Probe**. AAR with a non-extended probe is possible for emergency fuel situations only. Extreme caution must be exercised and cyclic smoothness must be flown due to the close proximity of the rotor tips and the refuelling hose and drogue. The probe will sometimes extend when in the extend mode, if jarred loose by contact with part of the drogue or when a disconnect is accomplished.

931. **Helicopter Single Engine AAR**. Normal AAR procedures are applicable to single engine operations. Refuelling may have to be conducted at a lower altitude due to a reduction in helicopter performance. The following technique is recommended:

a. The helicopter will maintain the highest single engine airspeed possible consistent with the operating limitations. The receiver must notify the tanker of this speed.

(1) If the receiver airspeed is 105 KIAS or higher, the tanker will complete a standard join up.

(2) If the receiver airspeed is below 105 KIAS, the following procedures will apply:

(a) Refuelling altitude will be 500 ft below the receiver's cruise/join up altitude.

(b) The refuelling airspeed will be the tanker's minimum operational speed or the receiver's speed, which ever is the highest.

(c) The tanker will perform a standard RV but expect the receiver to establish receiver high procedures.

(d) When 2 nm in trail the tanker will slow down to below 130 KIAS. At 1 nm in trail the tanker reduces speed to 110 KIAS. On approaching the 3 o'clock position the tanker is to establish the refuelling speed, hose trailed. **Warning.** When operating at or near these minimum operating speeds, any bank angle could result in a stall, without warning.

b. As the nose of the tanker passes the helicopter's 3 o'clock position, the helicopter will initiate a shallow dive to accelerate and close on the tanker. The altitude differential should be sufficient to gain the additional airspeed required to manoeuvre into the pre-contact position.

c. Once established in the pre-contact position, the power required to stay with the

tanker will be less than that required to maintain the same airspeed outside the tanker's draught effect. Care should be taken not to lose airspeed as there will not be sufficient

power available to manoeuvre back into position.

d. During single engine refuelling operations, the receiver should closely monitor rotor speed.

e. If the right hose is the only operational hose and single engine AAR is required, the same basic procedures will apply except the tanker will manoeuvre to execute a join up on the left side of the helicopter.

932. **Tanker Hose Hydraulic System Failure**. When hydraulically operated AAR equipment is being used, AAR may be completed from a 'dead hose' in emergency, if the proper technique is employed and extreme care is exercised. The receiver pilot must be advised of the dead hose condition prior to contact. Under these conditions, minimum possible closure rate is necessary to preclude bending or breaking the receiver probe. Once engaged on a dead hose, receiver position must be precisely maintained to minimize hose slack and the resultant whip. From this point, the pilot should only focus his attention on the tanker pod and wing and fly a normal formation position until refuelling is complete.

933. **Emergency AAR Disconnect and Hose Jettison**. If the helicopter is unable to disconnect from the tanker after refuelling, the hose may be jettisoned as follows:

a. The helicopter should move to the high refuelling position with the probe above the tanker hose pod.

b. The receiver calls 'hose jettison'.

c. The tanker completes hose jettison actions.

d. The receiver should initiate a slow breakaway from the tanker and slow to an airspeed commensurate with stability and flight characteristics of the hose.

e. The receiver should perform an approach and vertical landing from a 100 ft hover.

Note 1. During situations where the drogue remains attached to the probe, fuel spillage is likely to occur.

Note 2. In a situation where the drogue remains attached to the probe and the probe is extended, any attempt to yaw the helicopter could result in damage to the probe assembly and possible damage to the helicopter, if the probe jettisons itself during the yawing movement.

Note 3. The helicopter is likely to experience a slight pitch down when the hose is jettisoned.

Note 4. Due to aerodynamic drag on the hose, there should be no delay between activating the hose power switch and the hose guillotine switch (Sargent Fletcher equipment only).

ANNEX 9A

HELICOPTER AAR DEFINITIONS

This Annex is a glossary of definitions and terms used during Helicopter AAR.

Air Refuelling Control Point (ARCP)	A pre-briefed point over which the receiver arrives in the observation position with the assigned tanker. This point may be defined by a terrain feature, a geographical or navigation fix, TACAN cut or waypoint.
Air Refuelling Control Time (ARCT)	The time that the tanker and receiver RV at the ARCP. The receiver should be at the ARCP at the ARCT or up to 2 minutes early. The tanker should be at the ARCP at the ARCT or up to 2 minutes late.
Air Refuelling Initial Point (ARIP)	A point located upstream from the ARCP at which the receiver aircraft initiates a rendezvous with the tanker.
Refuel Altitude	The altitude at which refuelling operations will be conducted (usually 300 ft above the join-up altitude for receiver low, 200 ft below the join-up altitude for normal receiver high or 500 ft below join-up altitude for single engine receiver high).
Join-Up Altitude	The altitude at which the receiver is to be established passing the ARCP (normally refuel altitude less 300 ft, however, + 500 ft if single engine or + 200 ft for normal receiver high).
Refuel Airspeed	The airspeed at which refuelling operations will be conducted (usually 110 KIAS).
Observation Position	The position the receiver assumes after join-up but prior to refuelling operations. Usually a left echelon position clear of the tanker's propeller wash.
Breakaway	Cease refuelling operations and break formation.
Primary Hose	For all helicopter refuelling operations, the primary hose will usually be the left-hand side.
Crossover	The helicopter positions outside the tanker's wingtip, 100 ft astern and 50 ft above the tanker's tail and when clear crosses behind the tanker to assume the opposite echelon position.
Minimum Visibility	Minimum visibility for a VMC RV is 5 nm. Minimum visibility for a radar RV is 1 nm.

ANNEX 9B

HELICOPTER AAR RADIO PROCEDURES

SERIAL (a)	SITUATION (b)	TANKER R/T (c)	RECEIVER R/T (d)
1	Tanker is positioned ½ nm in trail	Half mile trail	Acknowledge
2	Tanker is abeam the receiver and assumes the formation lead	Abeam	Visual
3	Before receiver goes astern. Guns stowed and safe	-	Hot armament checks complete
4	Refuelling operations may begin	Clear contact	Acknowledge
5	Receiver in contact with hose and refuelling	-	Contact
6	Receiver clear of hose and stopped refuelling	-	Disconnect
7	Receiver is clear to crossover as required	Clear to crossover	Acknowledge
8	An emergency exists, the formation is to split	Breakaway, Breakaway, Breakaway (1)	Acknowledge

Note 1. Either the tanker or the receiver calls Breakaway depending on who has the emergency.

ANNEX 9C

HELICOPTER AAR RADIO SILENT LIGHT PROCEDURES (NON-NVG)

SERIAL (a)	SITUATION (LIGHT SIGNAL) (b)	TANKER ACTIONS (c)	RECEIVER ACTIONS (d)
1	Tanker flashes one white light	-	Go to observation position
2	Tanker flashes 2 white lights	-	Crossover
3	Tanker flashes one amber light	-	Prepare for a turn. Go to observation position unless in refuelling position
4	Tanker flashes 2 amber lights	-	Tanker is unable to pass fuel. Go to spare tanker
5	Tanker flashes one green light (1)	-	Clear/wet/dry contacts and/or crossover
6	Tanker flashes red	-	Breakaway
7	Receiver flashes one white	Reset the real response	-
8	Receiver flashes multi-whites whilst in contact	More fuel is required	-
9	Receiver flashes red	Breakaway	-

Notes:

1. Once the receiver or element has crossed over, an additional green flash is required before contact on the new side. Each receiver must obtain its own green flash from the tanker prior to contact.

2. Receiver to Receiver. During simultaneous refuelling, place the position light to FLASH five seconds prior to disconnect, to preclude simultaneous disconnects.

ANNEX 9D

HELICOPTER NVG AAR EMCON PROCEDURES

SERIAL (a)	SITUATION (LIGHT SIGNAL) (b)	FROM (c)	TO (d)	MEANING (e)	RESPONSE (f)
1	Position lights FLASHING	Receiver	Tanker	You have the lead	-
2	Anti-Collision lights OFF	Tanker	Receiver	I have the lead	-
3	Hoses out	Tanker	Receiver	Cleared to pre-contact position	Move to pre-contact position
4	Steady light	Observer	Receiver	Cleared to engage drogue	Engage drogue
5	Steady light	Observer	Receiver engaged with drogue	Receiver has pre-briefed amount of fuel	Receiver disengages
6	Flashing light	Observer	Receiver engaged with drogue	Tanker experiences problems with the hose	Receiver disengages and remains outboard of the hose
7	Hose partially/fully retracted	Tanker	Receiver	Hose unsafe	Receiver does NOT engage the drogue
8	Receiver remains in contact after pre-briefed offload	Receiver	Tanker	Receiver requires more fuel than briefed	Tanker will top-up if fuel available
9	Receiver disengages drogue and remains in pre-contact position outboard of the hose	Receiver	Tanker	Receiver is NOT satisfied with the hose response or fuel flow rate	Hose retracted, troubleshoot and extend. Receiver cleared to engage
10	Lower Anti-Collision light ON	Tanker	Receiver	Emergency breakaway	Emergency breakaway

ANNEX 9E

RANDOM RV

1. **Introduction**. A Random RV is used in VMC only and allows the tanker to expedite the join.

2. **Procedures**. The tanker must maintain visual contact with the receivers throughout the RV. The receivers are to confirm level at the join-up altitude. When appropriate, the tanker instructs the receivers to climb/descend (receiver high/low) to the join-up altitude and positions ½ nm astern the receivers at the refuelling altitude. When the receivers have confirmed level at the join-up altitude, the tanker commences the join.

ANNEX 9F

OVERTAKE RV

1. **Introduction**. In this procedure the tanker approaches the receiver(s) from behind using range and bearing information or bearing only information.

2. **Procedure**. The receiver(s) confirms level at the join-up altitude. The procedure changes with availability of aids as follows:

a. Bearing and Range Available. The tanker requests confirmation that the receiver(s) is at the join-up altitude. On confirmation, the tanker descends or climbs to reach the refuelling altitude a minimum of ½ nm behind the receiver(s) and then commences the join-up.

b. Bearing Only Available. The tanker plans to reach the refuelling altitude a minimum of 5 nm behind the receiver(s). When visual with the receiver(s), the tanker requests that the receiver(s) climbs or descends to the join-up altitude and confirms that the receiver(s) has done so. The tanker then commences the join-up.

ANNEX 9G

HEAD-ON RV

1. **Introduction**. In this procedure the tanker approaches the receivers along the reciprocal of the refuelling track and makes a procedure turn back onto the receivers' track. The type of procedure turn used depends on the equipment available.

2. **Procedure**. The tanker uses all available aids to achieve and maintain the reciprocal head-on approach with a minimum height separation of 1000 ft from the receivers. The receivers are to confirm level at the join-up altitude.

a. Range and Bearing Available. The tanker flies the pattern shown in Figure 9G-1. When the turning point is reached, see Figure 9G-2, the tanker turns right through 45° using a half standard rate turn, holds the new heading for 1 minute 15 seconds, then turns left through 225° again using a half standard rate turn.

b. Bearing only Available. The tanker flies the pattern shown in Figure 9G-3. When 5 nm from the receivers, the tanker reduces speed to 180 KIAS. As the receivers pass the wing tip, the tanker turns left or right through 210° using a standard rate turn.

On completion of the procedure turn, the tanker climbs or descends to the refuelling altitude. When level at the refuelling altitude the tanker should fly at 180 KIAS, lower flap as required and close to ½ nm astern. When the receivers have confirmed level at the join altitude, the tanker commences the join.

FIGURE 9G-1. DIAGRAM OF HEAD-ON RV - RANGE AND BEARING AVAILABLE

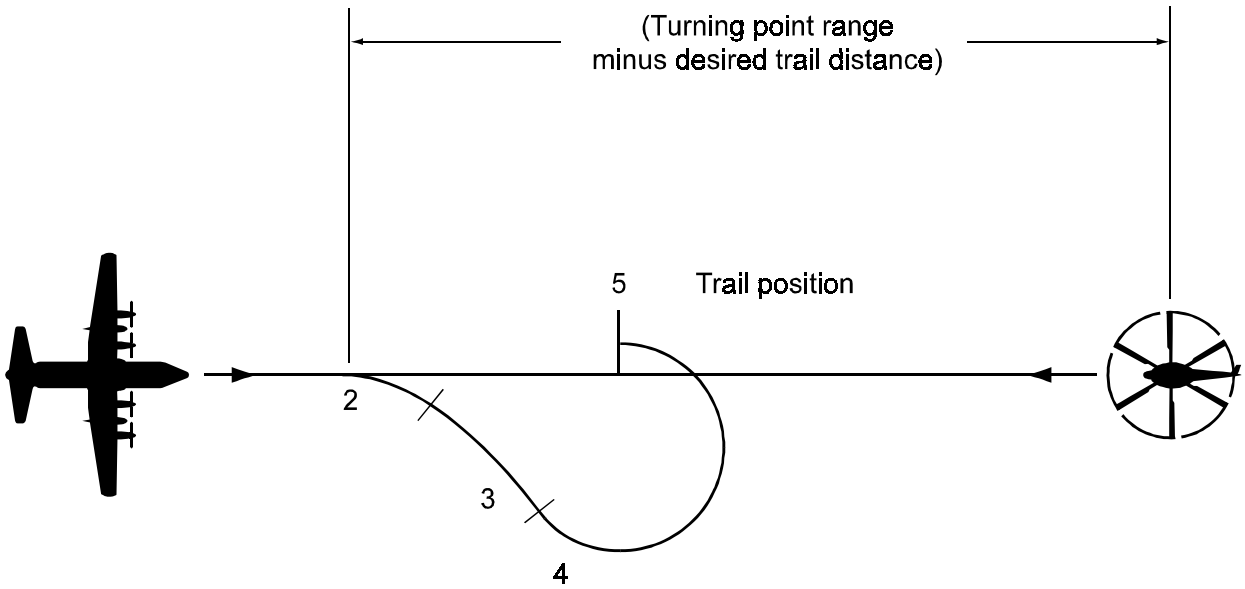
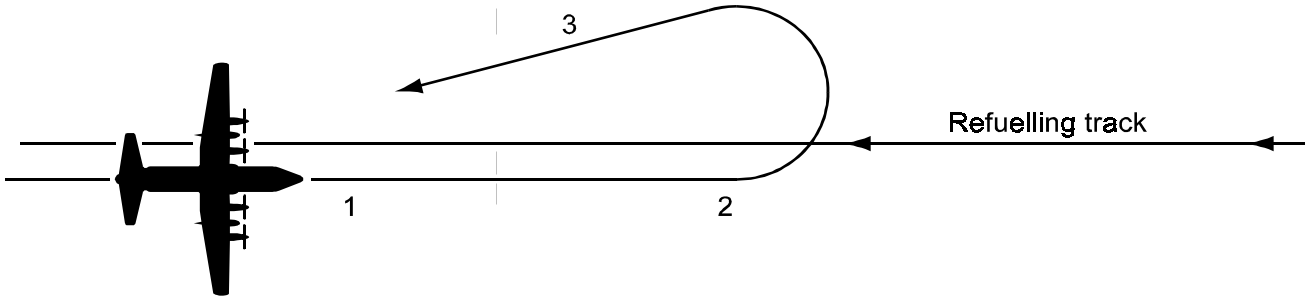


FIGURE 9G-2. HEAD-ON RV - RANGE AND BEARING AVAILABLE TURNING POINT RANGE

KC-130 TAS	Helicopter TAS							
	80	90	100	110	120	130	140	150
160	10.4	11.1	11.8	12.5	13.2	13.9	14.6	15.3
170	10.7	11.4	12.1	12.8	13.5	14.2	14.9	15.6
180	11.0	11.7	12.4	13.1	13.8	14.5	15.2	15.9
190	11.3	12.0	12.7	13.4	14.1	14.8	15.5	16.2
200	11.6	12.3	13.0	13.7	14.4	15.1	15.8	16.5
210	11.9	12.6	13.3	14.0	14.7	15.4	16.1	16.8
220	12.2	12.9	13.6	14.3	15.0	15.7	16.4	17.1
230	12.5	13.2	13.9	14.6	15.3	16.0	16.7	17.4
240	12.8	13.5	14.2	14.9	15.6	16.3	17.0	17.7
250	13.1	13.8	14.5	15.2	15.9	16.6	17.3	18.0
260	13.4	14.1	14.8	15.5	16.2	16.9	17.6	18.3
270	13.7	14.4	15.1	15.8	16.5	17.2	17.9	18.6
280	14.0	14.7	15.4	16.1	16.8	17.5	18.2	18.9

Turning point range in nm using half standard rate turn (1½° per second)

FIGURE 9G-3. DIAGRAM OF HEAD-ON RV - BEARING ONLY AVAILABLE



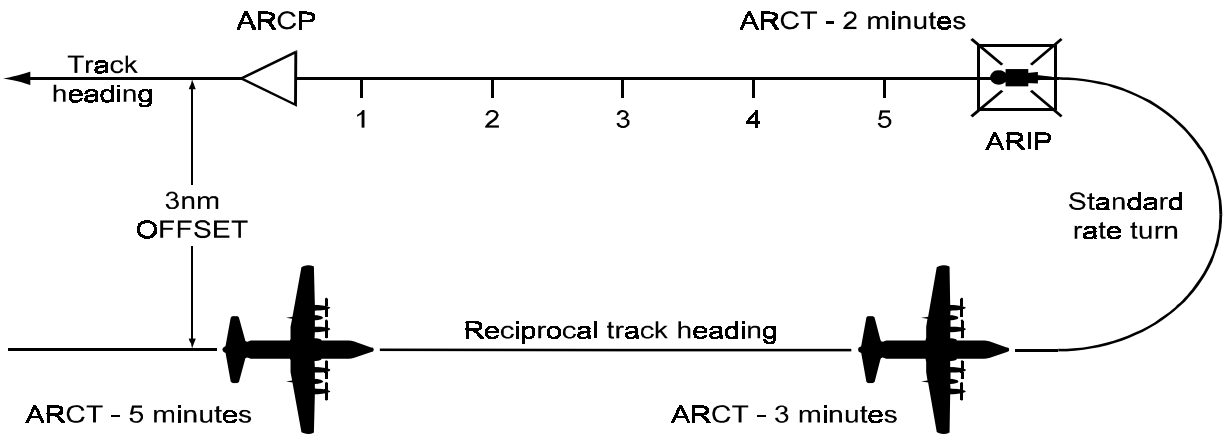
ANNEX 9H

HEAD-ON OFFSET RV

1. **Introduction**. In this procedure the tanker approaches the receiver(s) from head-on but offset and makes a standard rate turn onto the receivers' track.

2. **Procedure**. The tanker approaches the receiver(s) on the reciprocal of the refuelling track and uses all available aids to achieve a 3 nm offset from the track and a minimum separation of 1000 ft. The procedure may be done visually by flying to a point 3 nm abeam the receiver(s). The tanker should plan to be abeam the ARCP on the reciprocal track heading, at the refuelling altitude and enroute airspeed approximately 5 minutes prior to the ARCP. The tanker should turn 180° left using a standard rate of turn 3 minutes prior to the ARCT or abeam the receivers. On completion of the turn, the tanker should be ½ nm astern and should then overtake echelon right reducing to the refuelling airspeed.

FIGURE 9H-1. DIAGRAM OF HEAD-ON OFFSET RV



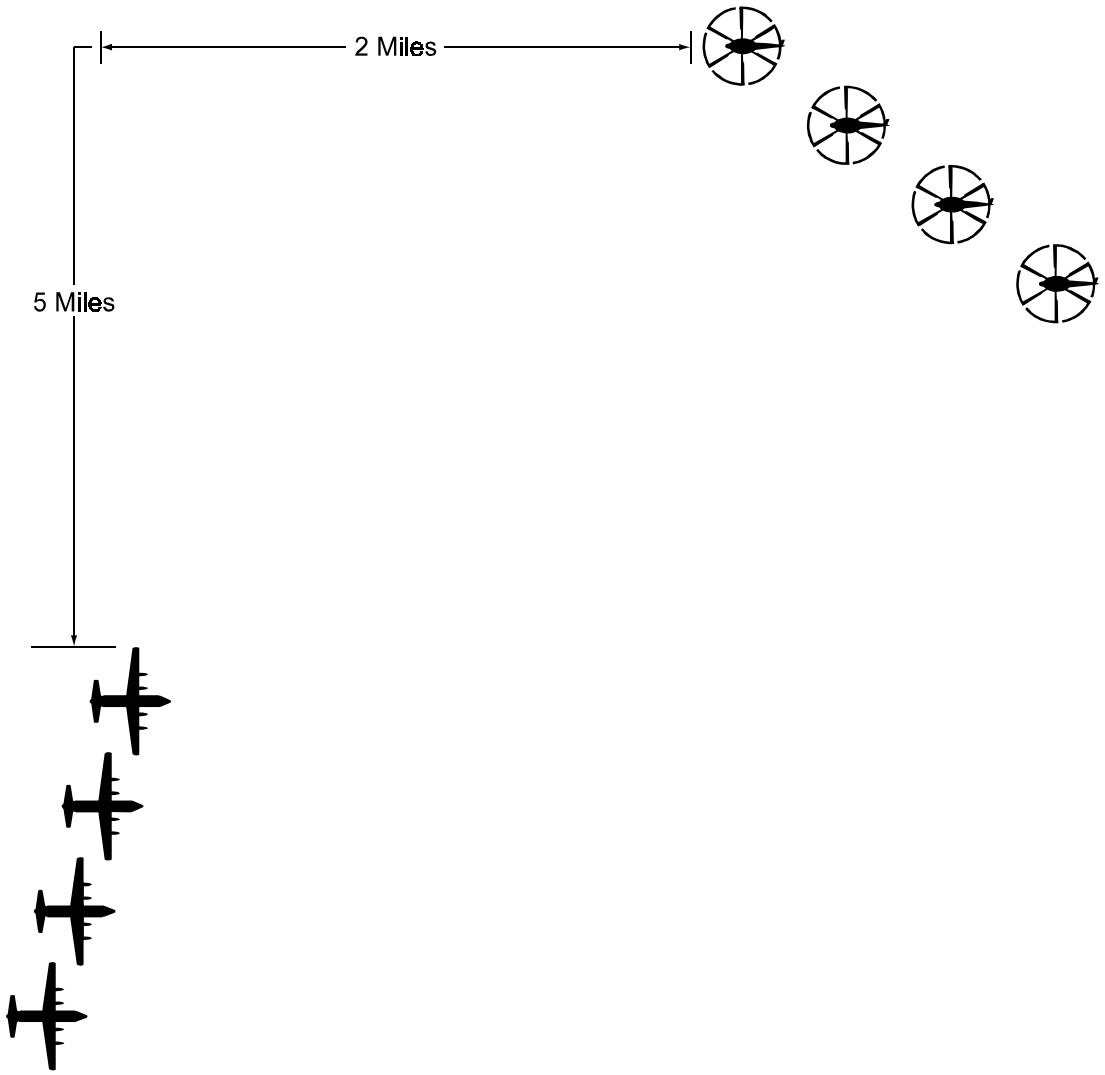
ANNEX 9I

MULTI-TANKER HEAD-ON RV

1. **Introduction**. In this procedure the tankers approach the receivers head-on but offset and make a procedure turn back onto the receivers' track.

2. **Procedure**. The tankers are to be in trail at 200 KIAS on a reciprocal track to the receivers but offset to the receivers' left by 5 nm. When abeam the receivers, the tankers carry out a left descending turn to the refuelling altitude maintaining 200 KIAS. At the completion of the turn, the tanker formation reduces speed to 180 KIAS. When the receivers have confirmed level at the join altitude, the tankers commence the join. The spare tanker, if present, establishes echelon right prior to the tanker formation coming abeam the receivers.

FIGURE 9I-1. DIAGRAM OF MULTI-TANKER HEAD-ON RV



LIST OF EFFECTIVE PAGES TO PART 1 (LEP)

PAGE NUMBERS	EFFECTIVE PAGES
I (Reverse blank)	Change 1
III (Reverse blank)	Original
V (Reverse blank)	Original
V11 to IX (Reverse blank)	Change 1
XI to XV (Reverse blank)	Change 1
1-1 to 1-2	Original
1A-1 to 1A-8	Change 1
2-1 to 2-2	Original
3-1 to 3-4	Original
4-1 to 4-2	Original
4A-1 to 4A-2	Original
4B-1 to 4B-4	Original
4C-1 to 4C-3 (Reverse blank)	Original
4D-1 to 4D-6	Original
4E-1 to 4E-2	Original
4F-1 to 4F-4	Original
4G-1 to 4G-2	Change 1
5-1 to 5-11	Original
5A-1 to 5A-3 (Reverse blank)	Original
6-1 to 6-5 (Reverse blank)	Change 1
7-1 to 7-2	Original
7A-1 to 7A-2	Change 1
7B-1 to 7B-2	Original
7C-1 to 7C-2	Original
8-1 to 8-2	Original
9-1 to 9-11 (Reverse blank)	Original
9A-1 to 9B-1	Original
9C-1 to 9D-1	Original
9E-1 to 9F-1	Original
9G-1 to 9G-2	Original
9H-1 to 9I-1	Original

PART 2 - NATIONAL PROCEDURES

CHAPTER 10

NATIONAL PROCEDURES

1001. **National Annexes**. The Annexes to this Chapter are provided for each nation or AAR organisation to furnish necessary information to assist AAR interoperability. The information provided gives tanker capabilities and characteristics relevant to AAR. Each nation or organisation has its own instructions relating to AAR planning, AAR deployments and peacetime training constraints; the National Annexes list the source document for that information. The Annexes also list any national or organisational reservations or amendment to the standard procedures of this ATP. Annex 10R summarizes the national tanker capabilities in tabular format. Annex 10S is a matrix of tanker/receiver clearances.

1002. **Format of Annexes**. The National Annexes are laid out in the following standard format:

1. Introduction.

2. Tanker Aircraft Type. All tanker types are listed and the following information is given for each type:

a. AAR Equipment. Type of AAR equipment (boom or drogue) and location of the equipment.

b. Refuelling Heights and Speeds. Refuelling height and speed envelope, of the tanker.

c. Maximum Transferable Fuel.

d. Fuel transfer rate.

e. Regulated Fuel Pressure.

f. Fuel Types Available for AAR:

(1) Primary/usual type of fuel.

(2) Alternate types of fuel that may be carried on occasion.

g. Receiver Clearances

(1) Receiver Aircraft Permanently Certified. These clearances are based on the mechanical compatibility between the tanker and receiver aircraft. The receivers in this sub para should not be subject to any mechanical restrictions. Those receivers with restrictions should be

listed under subsequent sub paras.

(2) Receiver Aircraft Certified for Approved Operations/Exercises. This section lists those receivers where the clearance is limited to contingency operations and certain approved exercises. In these cases, national approval from both tanker and receiver nation may be required

h. Lighting. This section should detail the AAR equipment signal lights, night floodlighting and electroluminescent markings.

i. Mark facilities.

j. Dimensions. This section should include a drawing with the physical dimension of the tanker aircraft, together with the location of the AAR store.

k. RV aids.

3. Receiver Qualification and Currency. This section should cover receiver qualification, currency requirements and the requalifying procedures if the currency has lapsed.

4. Source Documents.

5. National Points of Contact (POC). Information to include job title, full postal address, telephone number, Fax number, and Email address.

a. POC for National Annex. The office responsible for the content of the National Annex. Each nation or organisation is responsible for reviewing/updating their National Annex regularly and informing the Editor of any changes. Ideally, this review/ update should be conducted at least annually to maintain the currency and credibility of the National Annex.

b. POC for Tanker/Receiver Clearances. The initial point of contact for all matters concerning tanker and receiver clearances. If available, details of the normal clearance process, including any standard questionnaire.

c. POC for STANEVAL. The initial point of contact for all international AAR and STANEVAL matters.

6. National Annex Last Updated. Date of last change.

7. National Reservations. Any national reservations or amendments to the standard ATP-56(A) procedures are laid out sequentially, to accord with ATP-56(A) chapterization.

1003. **Changes to Annexes.**

a. The National Annexes contain only factual information and, therefore, are not

subject to the normal ratification process.

b. All formally ratified changes to Part 1 will continue to be distributed in hard-copy form; however, amendments to the national annexes will be made **on the web pages only** until a complete reprint of the document is made.

c. National annexes which have been amended from the last hard-copy will be annotated accordingly.

d. Users of national annexes are strongly advised to refer to the web copy to ensure that they have the latest amendment to the relevant annex.

e. Changes will be included as near as possible to the following dates: 1 Jan, 1 Apr, 1 Jul, 1 Oct. Inputs for change should be sent to the Editor as either hard-copy or by e-mail and will be included in the next scheduled change. However, any change of an urgent nature will be included immediately on request from national annex POC.

f. Nation and AAR Organisation annexes are listed below:

ANNEX	NATION
10A	Australia
10B	Belgium
10C	Canada
10D	Denmark
10E	France
10F	Germany
10G	Greece
10H	Italy
10I	Netherlands
10J	Blank
10K	Norway
10L	Portugal
10M	South Africa
10N	Spain
10O	Turkey
10P	United Kingdom
10Q	United States of America
10R	Tanker AAR Capabilities
10S	Tanker/Receiver Clearances
10T	AAR Clearances Procedure
10U	Omega Air

1004. **POC for Editor of ATP-56(A)**.

Chief AAR Northern Region
NATO AAR Coordination Cell
Reaction Force Air Staff
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D-47546 Kalkar
Germany

Tel: (+49) 2824 90 2294
Fax: (+49) 2824 90 2274

CRONOS: RFAS AAR Coordination Cell
Email: rfas.aar@rfas.de

ANNEX 10A

NATIONAL ANNEX - AUSTRALIA

1. **Introduction**. Australia has one tanker type, the Boeing 707-338C, operated by the Royal Australian Air Force (RAAF).

2. **Boeing 707-338C**.

a. AAR Equipment. The RAAF B707 tanker has 2 wing mounted Flight Refuelling Mk32B AAR stores installed approximately 10 ft from each wing tip. Each AAR store has a 49.5 ft hose and a MA3 coupling. To achieve fuel flow after making contact, the hose must be pushed in 5 ft and maintained within the refuelling range. Refuelling range limits and corresponding hose markings are illustrated at Appendix 1.

b. Refuelling Height and Speed. Refuelling operations may be carried out between 1000 and 35,000 ft at speeds between 250 and 325 KIAS. Operations below 10,000 ft require special authorization.

c. Maximum Transferable Fuel. Fuel transfer is carried out from the B707's normal fuel tanks. The maximum fuel load for the B707 is 158,000 lbs. The maximum fuel offload is dependent upon a number of factors including sortie length, holding requirements and availability of alternate airfields. A representative offload of 100,000 lbs is available assuming a 2½ hr sortie with a fuel burn rate of 15,000 lb/hr and minimum reserve requirements.

d. Fuel Transfer Rate. The fuel transfer rate is 400 US gallons/minute.

e. Regulated Fuel Pressure. The AAR pod's ram air turbine (RAT) is automatically adjusted to ensure that the fuel pressure at the coupling is regulated to 50 ± 5 psi irrespective of fuel flow.

f. Fuel Types Available for AAR. Dependent on fuel type loaded.

(1) Primary fuel types authorized are JP4 (F40), JP5 (F44) and JP8 (F34).

(2) Alternate fuel types authorized are F35 (AVTUR/JET A1) and F43 (AVCAT).

g. Receiver Types Permanently Certified. The following aircraft are cleared to refuel from the RAAF B707 tanker:

(1) F/A-18A, F/A-18B (RAAF).

(2) Tornado F3, GR4/4A (RAF).

(3) A-4S Skyhawk (RSAF).

h. Receiver Types Cleared for Approved Operations/Exercises. The following aircraft have been cleared to refuel from RAAF B707 tanker during contingency operations and approved exercises, upon written authorisation from Air Commander Australia :

(1) AV-8B (USMC).

(2) CF-18 (CF).

(3) EA-6B Prowler (USN).

(4) F/A-18C (USN).

(5) F/A-18D (USMC).

(6) F-14 Tomcat (USN).

(7) Harrier GR7 (RAF).

(8) Mirage 2000 (FR).

(9) Sea Harrier F/A 2 (RN).

i. Lighting. Tanker aircraft lighting is illustrated at Appendix 2. AAR signal lights are located at the base of the pod tunnel and consist of 2 each (one for redundancy) red, amber and green lights. Light signals are as follows:

Steady Red	Do not make contact or, if in contact, remain in contact and await further instructions.
Steady Amber	Tanker ready for contact
No Lights	Do not make contact or, if in contact and within the refuelling range, fuel either not flowing or flowing at less than 50 gal/min. (Note. Normal indication for dry contacts).
Steady Green	Fuel flowing $\geq$ 50 gal/min. (Note. Green light may flash on/off when topped off indicating fuel transfer = fuel burn).
Flashing Amber	Hose pushed in < 25 ft from the fully stowed position. (Note. Fuel transfer will cease if the hose is pushed in further than 23 ft from the fully stowed position).
Flashing Red	Disconnect and move to echelon left. (Note. If the red pod light is accompanied by the illumination of the tanker's lower beacon, breakaway and move to nearest echelon).

j. Mark Facilities. Nil.

k. Dimensions. Location of the AAR stores and physical dimensions of the B707 are illustrated at Appendix 3.

l. RV Aids. The B707 has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios (2 of each).

(2) VOR, ILS, TACAN, ADF, INS and weather radar.

(3) UDF, A/A TACAN (bearing facility available to suitably equipped receivers) and IFF interrogator.

3. **Source Documents**.

a. DI(AF) AAP 7211.019-1, Flight Manual Boeing 707-338C.

b. Air Lift Group/Tactical Fighter Group Air to Air Refuelling Standing Instructions (ALG/TFG AAR SI(OPS).

4. **POC for National Annex**.

Staff Officer Capability Management
HQ Air Lift Group
RAAF Base Richmond
New South Wales 2755
Australia
Tel: (+61) 2 4587 2020
Fax: (+61) 2 4587 2903

5. **POC for Tanker/Receiver Clearances**.

Plans Transport
HQ Air Command
RAAF Base Glenbrook
New South Wales
Australia
Tel: (+61) 2 4737 7004
Fax: (+61) 2 4737 7533

6. **POC for STANEVAL**.

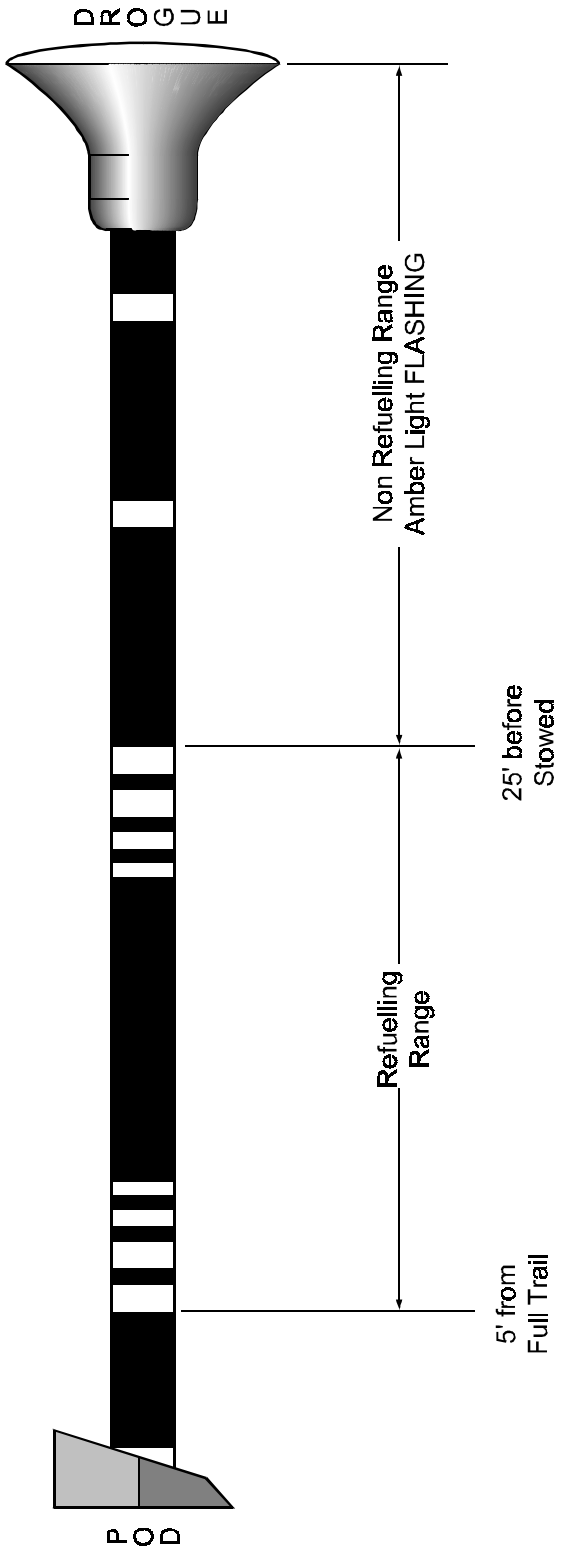
Commanding Officer 33 Squadron
RAAF Base Richmond
New South Wales 2755
Australia
Tel: (+61) 2 4587 3300
Fax: (+61) 2 4587 3394

7. **National Annex Last Updated**. Sep 02.

8. **National Reservations**. Nil.

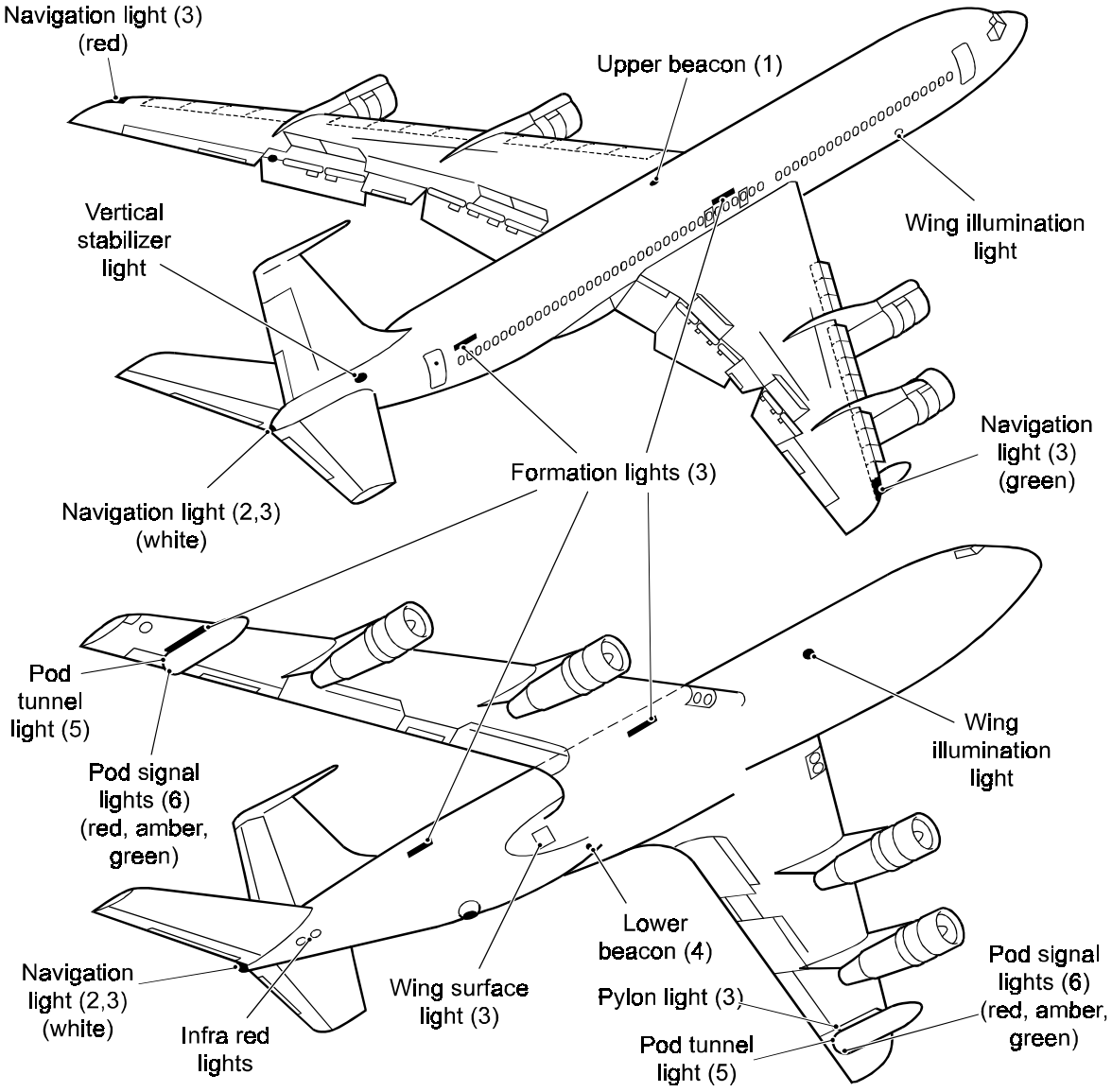
APPENDIX 1 TO ANNEX 10A

MK32B AAR POD REFUELLING RANGE AND HOSE MARKINGS



APPENDIX 2 TO ANNEX 10A

BOEING 707-338C LIGHTING

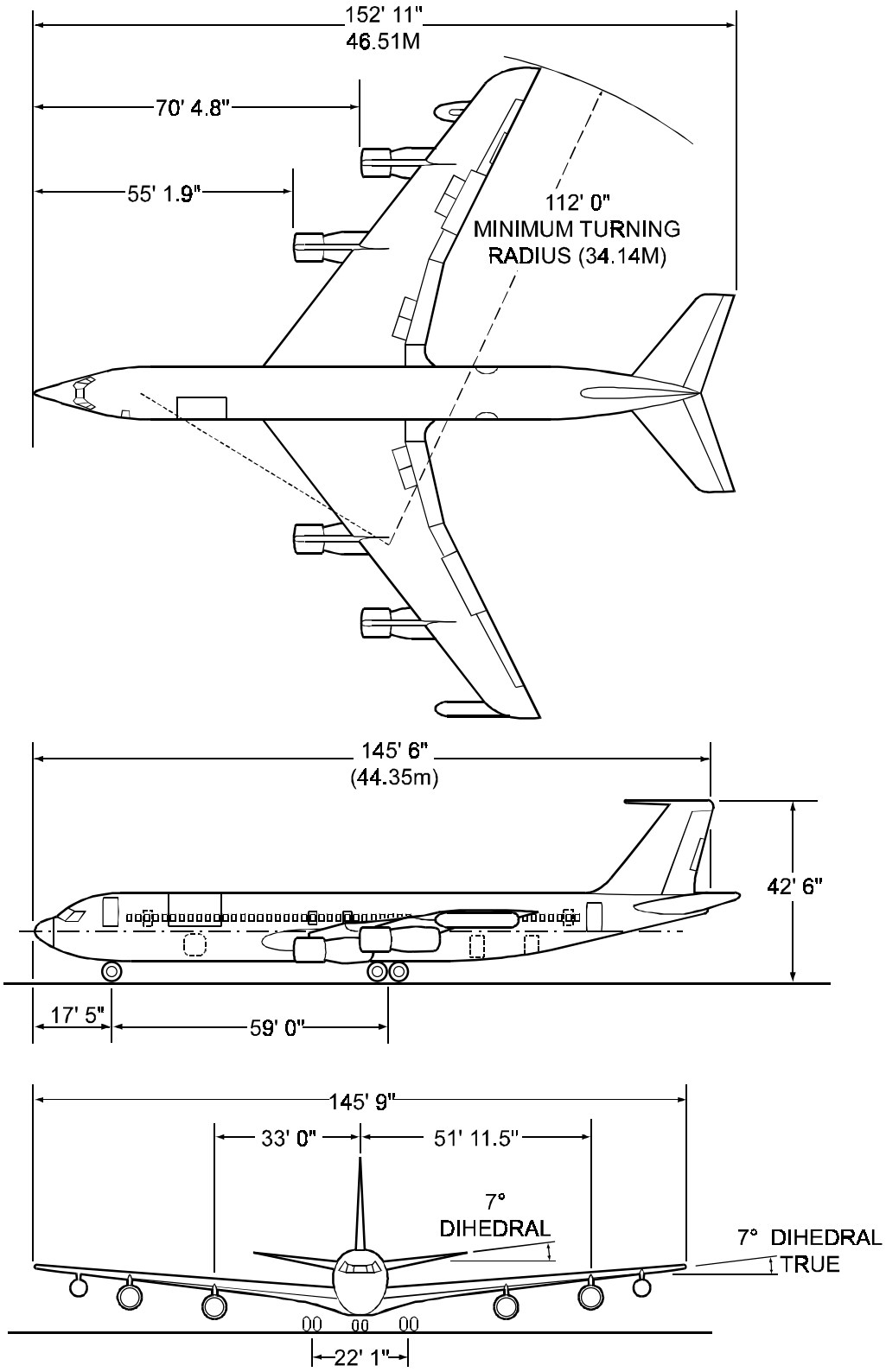


Notes:

1. Selectable to White/Red/Off. Normally selected to Red for AAR. Used during NOCOM Procedures to control formation.
2. May be selected OFF individually.
3. Rheostat controlled intensity.
4. Selectable to WHITE/RED/OFF. Normally selected OFF for AAR. Selected ON to initiate BREAKAWAY.
5. Selectable to BRIGHT/DIM.
6. AMBER & GREEN lights are selectable to BRIGHT/DIM.

APPENDIX 3 TO ANNEX 10A

BOEING 707-338C DIMENSIONS



ANNEX 10B

NATIONAL ANNEX - BELGIUM

1. **Introduction**. Belgium has no indigenous tanker assets and consequently no inputs for this Annex.

2. **POC for National Annex**.

BELGIAN DEFENCE
AIR COMPONENT
COMOPSAIR
Current Operations A3
Quartier Reine Elisabeth
Rue d' Evere 1
1140 BRUXELLES

Tel: + 32.2.701.4932
Fax: + 32.2.701.7404

3. **POC for Tanker/Receiver Clearances**.

(As for National Annex).

4. **POC for STANEVAL**.

(As for National Annex).

5. **National Annex Last Updated**. March 2003

6. **National Reservations**. Nil.

ANNEX 10C

NATIONAL ANNEX - CANADA

1. **Introduction**. Canada has one tanker type, the CC130T.

2. **CC130T**.

a. AAR Equipment. There are 2 removable underwing pods located halfway between each wing-tip and the outboard engine. The FRL Mk32B-751 incorporates an MA3 coupling and a soft drogue. The refuelling hose is 23.7 m (78 ft) in length. To attain fuel flow, the hose should be pushed in at least 1.4 m (5 ft) which is marked by the first orange band on the hose. Beyond this orange band are 3 white bands at 1.4 m (4.5 ft) intervals and a second orange band. Fuel will flow when the hose is positioned between these 2 orange bands (a distance of 20 ft). Beyond the second orange band are 4 white bands at 3 m (10 ft) intervals. See Appendix 1.

b. Refuelling Heights and Speeds. The AAR height band is 1000 ft to 25,000 ft and the speed range is 200 to 250 KIAS.

c. Maximum Transferable Fuel. Maximum fuel load is 30,390 kg (67,000 lb). Transferable fuel is dependent on sortie duration but an offload of 20,140 kg (45,000 lb) is available for a 2 hr flight, assuming a fuel burn rate of 2270 kg/hr (5000 lb/hr) including diversion reserves. In overweight conditions, maximum fuel load is 37,770 kg (83,100 lb).

d. Fuel Transfer Rate. Transfer rate is 450 - 900 kg/min (1000 - 2000 lb/min).

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated to 45 - 55 psi.

f. Fuel Types Available for AAR. All fuels used by the CC130T, which includes F40, F34, F35 and F44.

g. Receiver Types Certified. The following aircraft types are cleared to refuel from the CC130T:

(1) AV-8B (USN, USMC).

(2) CF-18 (CAF).

(3) E/F-18 A/B (SAF).

(4) EA-6B (USN, USMC).

(5) F-14 (USN).

(6) F/A-18 (USN, USMC).

(7) F/A-18 A to D (RAAF).

(8) Harrier GR7 (RAF).

(9) Mirage F1, 2000 (FAF).

(10) Sea Harrier F/A2 (RN).

(11) S-3 (USN).

(12) Tornado F3, GR4/4A (RAF).

(13) Tornado IDS/ECR (GAF).

(14) Tornado IDC, ECR, ADV (IAF).

(15) Tornado PA 200 (GN).

h. Lighting. Six AAR advisory lights are located below the pod aft fairing. They are arranged in a horizontal row and are coloured from left to right: amber, red and green. See Appendix 2. The lights signal the following:

Steady Red	Pod malfunction, do not make contact. (If already in contact, disconnect until malfunction cleared)
Steady Amber	Ready for contact
Steady Green	Fuel flowing
Flashing Red	Breakaway
Flashing Amber	Hose pushed in too far
Flashing Amber (with Steady Green)	Hose at forward end of refuelling range
Flashing Green	Receiver fuel tanks full

When conducting night AAR operations, the hose markings near the pod aft fairing will be illuminated by a white light located in the aft fairing, when the AAR advisory lights are dimmed. The drogue canopy is fitted with luminous reflecting beta lights. A variable intensity pod and hose illumination light is located on the leading edge tip of the horizontal stabilizer. To assist in night formation, 3 strip lights are located on each side of the aircraft as follows:

Wing-tip	Aft of the navigation light
Fuselage	Aft of the paratroop door
Horizontal Stabilizer	Underside of the stabilizer orientated from the stabilizer tip inward to the fuselage

The CC130T also has red anti-collision lights located on the top and bottom of the fuselage, wing leading edge illumination lights and blue formation lights located on the upper surface of the wings and fuselage.

i. Mark Facilities. Fuel dump from wing-tips.

j. Dimensions. See Appendices 1 and 3.

k. RV Aids. The aircraft has the following radio, navigation and RV aids:

(1) VHF, UHF, HF radios.

(2) VOR, DME, TACAN, ADF, INS, GPS.

(3) UHF/DF, A/A TACAN.

3. **Source Documents**.

a. SMM-2602 (1) Air-to-Air Refuelling Operations, Volume 1, Tactics and Procedures.

4. **POC for National Annex**.

A7 Strategic Plans and Doctrine
1 Canadian Air Division HQ
PO Box 17000 Stn Forces
Winnipeg
Manitoba R3J 3Y5
Canada
Tel: (+1) 204 833 2500 Ext 5180
Fax: (+1) 204 833 2560
DSN 257 5180

5. **POC for Tanker/Receiver Clearances**.

(As for National Annex).

6. **POC for STANEVAL**.

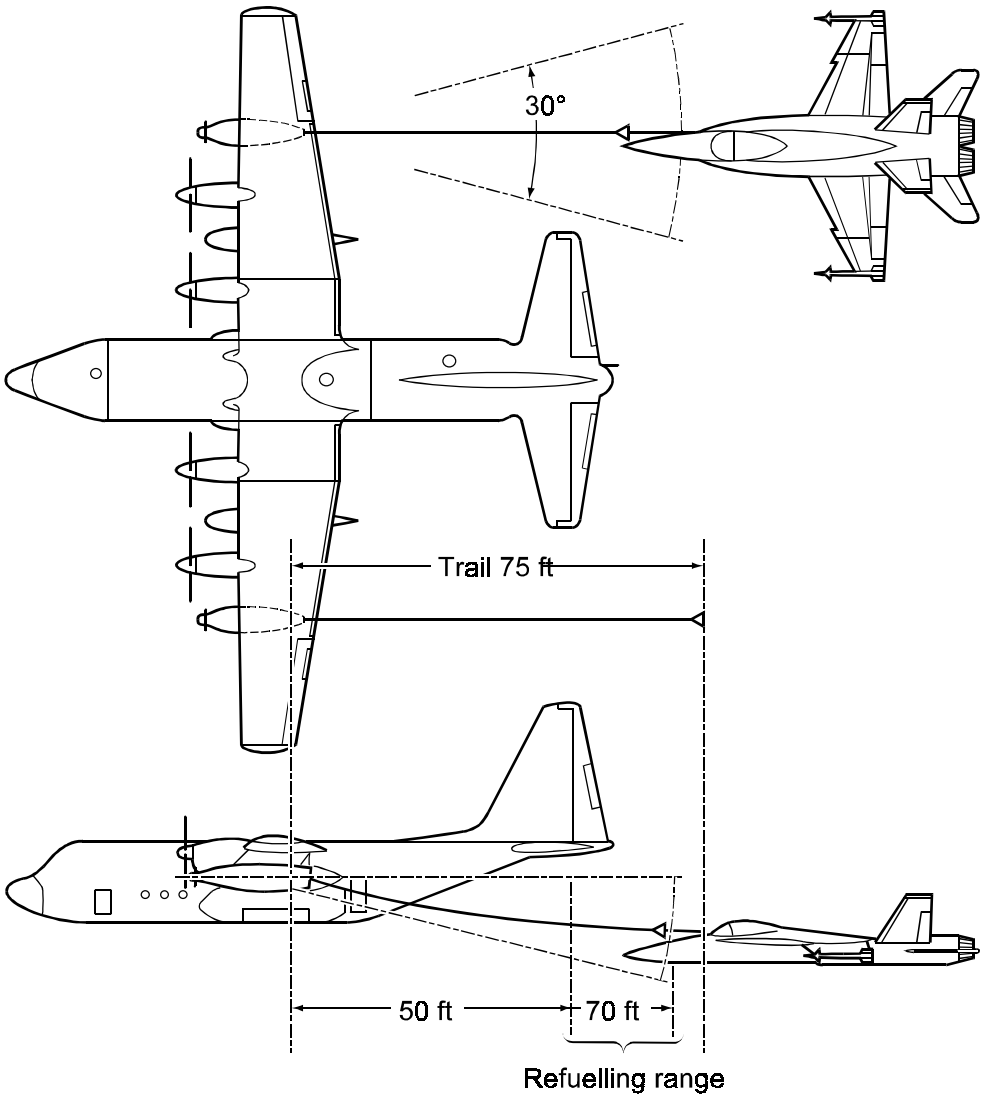
(As for National Annex).

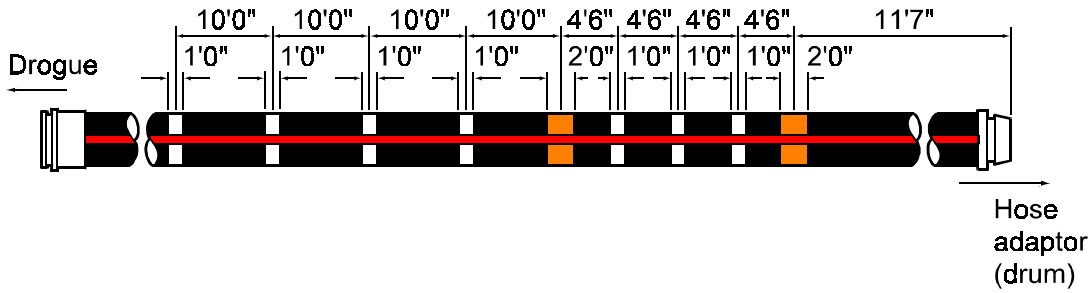
7. **National Annex Last Updated**. Dec 02.

8. **National Reservations**. Nil.

APPENDIX 1 TO ANNEX 10C

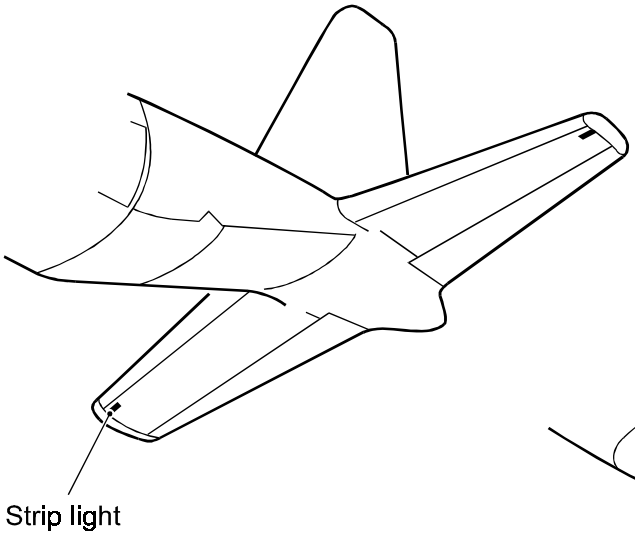
CC130T

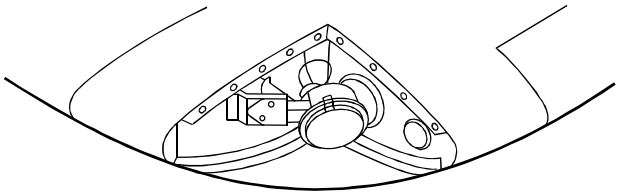




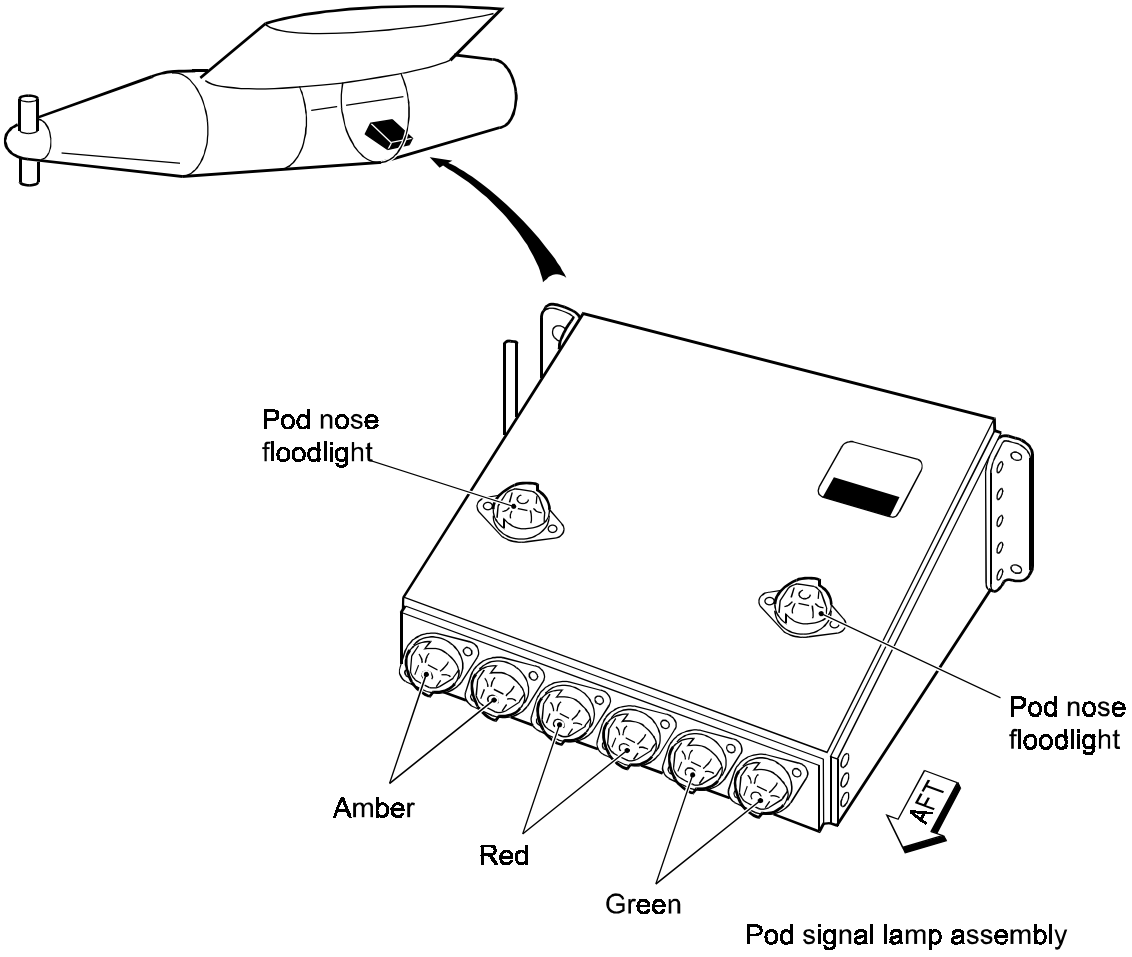
APPENDIX 2 TO ANNEX 10C

CC130T LIGHTING





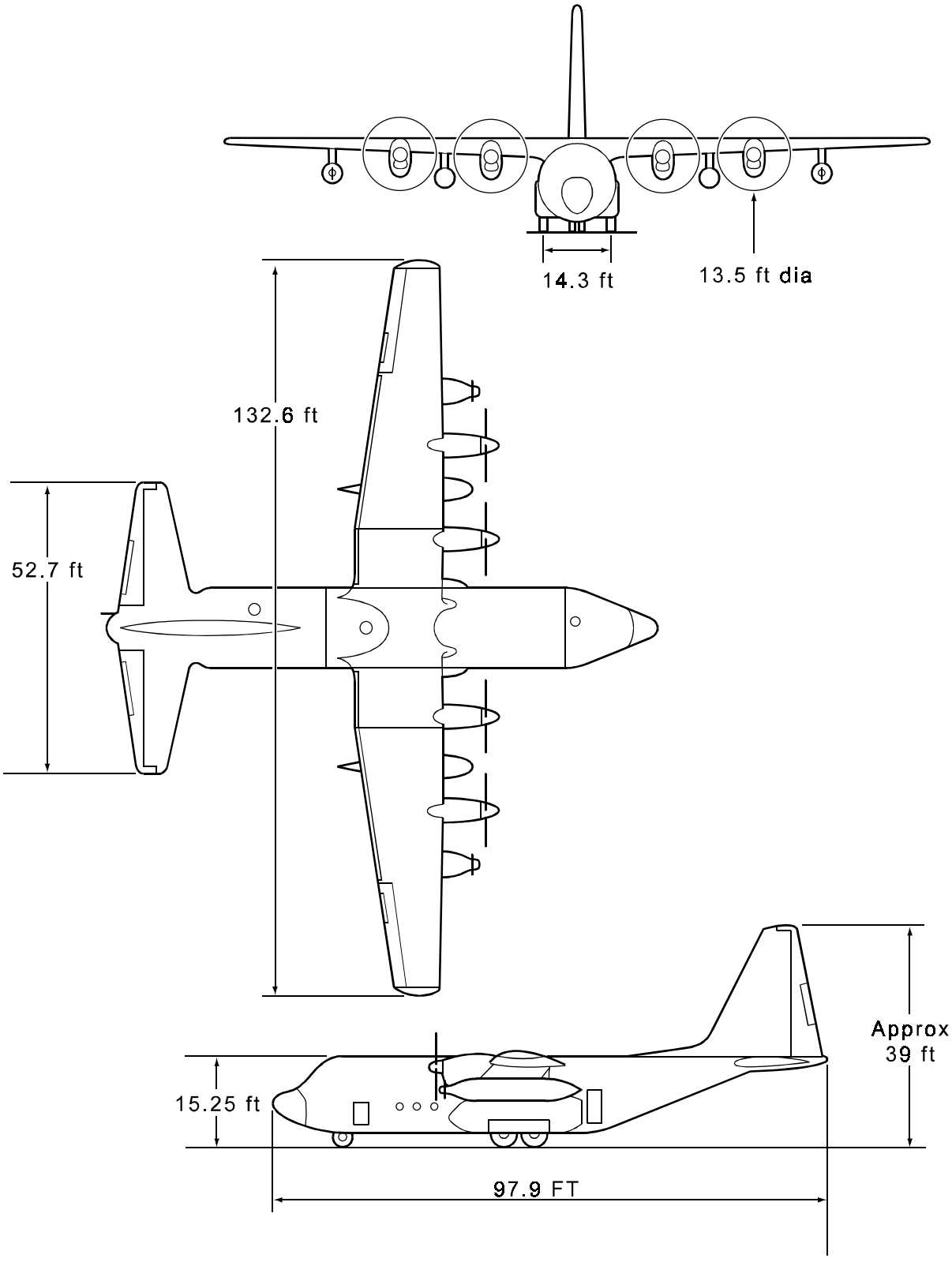
Horizontal stab tip light



Pod signal lamp assembly

APPENDIX 3 TO ANNEX 10C

CC130T DIMENSIONS



ANNEX 10D

NATIONAL ANNEX - DENMARK

1. **Introduction**. Denmark has no indigenous tanker assets and consequently no inputs for this Annex.

2. **POC for National Annex**.

3. **POC for Tanker/Receiver Clearances**.

4. **POC for STANEVAL**.

5. **National Annex Last Updated**. Nov 94.

6. **National Reservations**. Nil.

ANNEX 10E

NATIONAL ANNEX - FRANCE

1. **Introduction**. The French Air Force (FAF) has 2 main tanker types: the C135 FR and the C160 NG Transall. The French Navy (FN) operates Etendard IV M, Etendard IV P and Super Etendard converted to the tanker role by fitting an externally carried AAR pod. During operations, the FAF tanker squadrons usually use the RV Procedure ECHO as described in Chapter 4 Annex 4E. The tanker should aim to fly to the ARCP on the hour and every 15 minutes thereafter. The ARIP should be flown as close as possible in order to provide a straight flight to ease rendezvous for blind aircraft.

2. **Obtaining a Receiver Qualification on FAF Tankers**. Unless agreed otherwise, before attempting to qualify on FAF tankers, foreign national aircrew must be receiver qualified within their own air force. Additionally, in order to qualify to receive fuel from FAF tankers, foreign national aircrew are to have tanked during the preceding 90 days. The other specific training requirements are:

a. Receiver aircrew are to have seen the FAF training video "AAR on French Tankers" which can be obtained through National STANEVALs.

b. Receiver aircrew are to have been briefed by a qualified instructor on BDA operations, procedures, peculiarities, possible difficulties and emergency actions.

c. Two training flights are to be flown under the supervision of a qualified instructor (who may be in another aircraft). The flights are to include, as a minimum, a join and rejoin procedure and 2 contacts, one of which must involve the transfer of fuel.

3. **Maintaining AAR Currency**. The periodicity required to maintain an AAR qualification on FAF tankers is:

a. BDA. One AAR sortie every 2 months using the BDA system.

b. Probe and Drogue. One AAR sortie every 4 months using wing pods.

4. **Requalifying if AAR Currency has Lapsed**. If AAR currency has lapsed, receiver aircrew are to see the FAF training video "AAR on French Tankers" before undertaking AAR from a FAF tanker. In addition, a qualified instructor (who may be in another aircraft) must monitor the first requalifying flight. If the receiver pilot has not tanked in the previous 6 months, the requalifying flight must be flown in a dual control aircraft with the qualified instructor on board.

5. **C135 FR**. The FAF operates the C135 FR, most of which are fitted with wing mounted FRL Mk32B air refuelling pods.

a. AAR equipment. There is one centreline mounted flyable boom and 2 wing mounted air refuelling pods. Probe and drogue refuelling for 2 receivers simultaneously on right and left wing pods or one receiver on boom drogue adapter (BDA). Boom

refuelling is for AWACS aircraft only.

(1) Boom. See the KC-135 characteristics (Annex 10Q para 2a(2)). Boom refuelling is restricted to AWACS due to boom operator training.

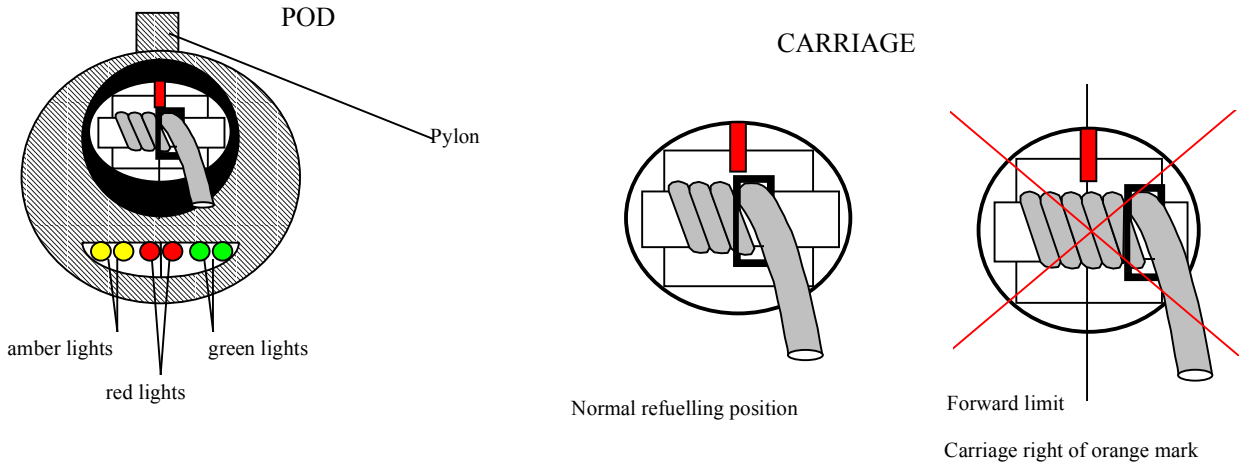
(2) BDA. The boom is usually modified to refuel probe equipped aircraft by fitting a BDA, which is 2.74 m (9 ft) of hose attached to the end of the telescoping part of the boom by a swivelling coupling MA2 type; the hose terminates in a hard, non-collapsible drogue. The telescoping part of the boom is kept fully extended whilst the BDA is in use. There are pre-determined boom elevation and azimuth settings for each receiver type; the boom operator endeavours to hold the boom steady at the settings throughout the pre-contact and refuelling phases. The ideal pre-contact position for the receiver is to be stabilized 1.5 m (5 ft) behind the drogue; when cleared, the receiver moves forward to make contact. Great caution is required with the BDA because, unlike hose drum systems, hose slack is not wound in. Contacts made with closure rates greater than about 2 KIAS will cause the hose to whip, with a consequent high probability of probe damage. Having made contact, the probe should be positioned slightly offset from the boom to make the hose adopt a U shape to one side; the ideal in-contact position is illustrated in Appendix 1. The ideal position permits about 1.5 m (5 ft) of forward and aft movement. 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. 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 fuel does not transfer, the receiver will be instructed to disconnect; the receiver should drop back to the pre-contact 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-extending it. The receiver will then be re-cleared for a further contact. If possible, the tanker air refuelling pumps will be switched off 5 seconds before the scheduled disconnect to minimize fuel spray on disconnect. When cleared, the receiver should disconnect by dropping back, 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 normal disconnect; however, in an emergency he may do so in which event the drogue will whip violently as contact is broken. To avoid the drogue striking the aircraft, the receiver pilot must not stray away from the correct lateral alignment.

(3) Wing-mounted AAR Pods. The C135 FR can be fitted with 2 wing-tip mounted AAR pods. Each refuelling station consists of a FRL Mk32B refuelling pod, a 22.5 m (74 ft) re-windable hose terminated in a MA4 coupling and 25 in (0.63 m) diameter paradrogue. The hose is marked by two 1.2 m (4 ft) wide white bands, marking the fuel transfer range limits and a 1.2 m (4 ft) wide red band marking the contact forward limit before reaching the hose rewinding stop. Two side mounted monitoring cameras allow the boom operator to monitor the pod air refuelling operation and to order 'move back', 'disconnect' or 'breakaway'. The hose must be pushed in at least 1.8 m (6 ft), indicated by the first white band, to

start fuel flowing. The ideal refuelling position is between the 2 white bands which show the inner limit 17 m (56 ft) and the outer limit 20.7 m (68 ft) of the refuelling range. If the inner limit is exceeded, fuel flow ceases and the amber signal flashes (see para 2h for the description of signal lights). Thus, the receiver has a fore and aft range of movement of 3.7 m (12 ft) during which fuel flows. See Appendices 2 and 3.

Caution.

1. Receivers must be very careful and follow the boom operator's orders and signal lights and draw back as soon as they are ordered. Otherwise, when reaching the forward limit of the refuelling range, the hose rewinding system stop can be reached very quickly and cause a sudden lash of the hose. A reliable reference for this forward limit is the position of the rewinding carriage inside the pod. The left edge of this carriage must not be right of the painted orange mark on the carrier as shown:



2. Refuelling receivers must remain clear of the outboard engine wake.

3. Refuelling receivers must remain below the pod to keep clear of the vortices of the wing trailing edge. See Appendix 2.

4. The system is very sensitive to turbulence. If turbulence is encountered, pod AAR can be hazardous and therefore the BDA system should be used, if the receiver is certified.

b. Refuelling Heights and Speeds. The AAR height band for boom and BDA is sea level to 45, 000 ft. For the pods the AAR height band is sea level to 35,000 ft. The speed range for the boom and BDA is 200 to 350 KIAS and for the pods 240 to 325 KIAS.

c. Maximum Transferable Fuel. Total fuel load for C135 FR without pods is 83,900 kg (185,000 lbs) and for C135 FR with pods is 87,100 kg (192,000 lbs). Transferable fuel is dependent on sortie duration; around 58,000 kg (130,000 lbs) is available for transfer during a 4 hr flight assuming a fuel burn rate of 5500 kg/hr (12,000 lbs/hr).

d. Fuel Transfer Rate. The tanker can transfer fuel at rates exceeding 2725 kg/min (6000 lb/min) from the boom and at 1275 kg/min (2800 lb/min) from the BDA and the pods. Tanker fuel transfer rate depends on the number of pump operating.

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated to be 3.5 bars (50 ± 5 psi).

f. Fuel Type available for AAR:

(1) Primary/usual fuel is F34.

(2) Alternate fuel is F35, F40 and F44.

g. Receiver Types Certified. The following aircraft types are cleared to refuel from the C135 FR (boom, BDA or pods as applicable).

(1)	AMX (IAF)	BDA and Pods
(2)	A-6/EA-6 (USN)	BDA and Pods
(3)	AWACS (FAF, RAF, NATO)	Boom
(4)	F8E (FN)	Pods
(5)	F-14 (USN)	BDA and Pods
(6)	F-18 (USN, SAF, CAF)	BDA and Pods
(7)	Harrier GR7 (RAF)	Pods
(8)	Jaguar (FAF, RAF)	BDA and Pods
(9)	Mirage F1 (FAF, SAF), IV P, 2000 (FAF)	BDA and Pods
(10)	Super Etendard (FN)	Pods
(11)	S3A Viking (USN)	BDA and Pods
(12)	Tornado (GAF, IAF, RAF)	BDA and Pods

Note 1. Additional clearances, subject to compatibility tests, can be obtained from French MOD.

Note 2. Receiver Allowed. The receiver must be technically certified by their national air force before refuelling on FAF C135 FR. For operations, to refuel on the C135 FR, the receiver must be listed in para 2g above. For exercises, if there is no permanent agreement, an official request must be sent to COAIR in Paris (TTY: AIR CENTOPS

PARIS). For training missions, to be cleared to practise AAR on the C135 FR, nations must sign a permanent agreement.

h. Lighting. AAR equipment signal lights are mounted in horizontal rows on the AAR pods. Lights are coloured red, green and amber, see Appendices 3 and 4 for further details. The lighting sequence is as follows:

Before contact:	Steady Amber	Ready for contact
	Steady Red	Pod inoperative
In contact:	All lights out	Offload complete / dry contact
	Steady Green	Fuel transfer
	Steady Amber	Aft limit
	Flashing Amber	Forward limit, drawback
	Flashing Red	Breakaway

Aircraft under surfaces are illuminated by adjustable flood lights and fluorescent boom marker lights allow BDA and boom air refuelling, see Appendix 5. Night pod air refuelling is not cleared due to restricted lighting and monitoring devices.

i. Mark Facilities. Fuel dump (from boom).

j. Dimensions. See aircraft drawings, Appendix 6.

k. RV Aids. The C135 FR has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, ADF, INS and search weather radar.

(3) UDF (AN/1 RA-25), A/A TACAN and radar beacon mode.

Note: The only EMCON procedures available on wing pod equipped C135 FR are Options 1 and 2 (see Chapter 7 Annex 7B). On the BDA system, all EMCON options are available.

6. **C160 NG Transall**. The new generation of C160 type aircraft has a probe for receiving fuel from drogue equipped tankers. Some have both tanker and receiver capabilities.

a. AAR Equipment. The C160 has one fuselage refuelling station; the hose drum unit is fitted internally in the extended left main landing gear pod. The hose is 27.5 m (90 ft) long and terminates in a MA-3 type coupling and drogue.

b. Refuelling Heights and Speeds. The AAR height band is sea level to 18,000 ft and the speed range is 160 to 220 KIAS. The operating speed to extend the hose is 180 KIAS.

c. Maximum Transferable Fuel. Transferable fuel is dependent on sortie duration; maximum transferable fuel is 14,000 kg (30,870 lb).

d. Fuel Transfer Rate. Maximum transfer rate is 1200 litres/min or 960 kg/min (2100 lb/min).

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated not to exceed 3.5 bars (50 ± 5 psi).

f. Fuel Type Available for AAR:

(1) Primary/usual fuel is F34.

(2) Alternate fuel - information not supplied.

g. Receiver Types Certified. The following aircraft types are certified to receive fuel from the C160 Transall:

(1) AMX (IAF).

(2) C160 NG (FAF).

(3) Etendard IV P (FN).

(4) F8E Crusader (FN).

(5) Jaguar A and E.

(6) Mirage F1 (FAF, SAF), 2000 (FAF).

(7) Super Etendard (FN).

(8) Tornado IDS (GAF, IAF, RAF).

h. Lighting.

(1) C160 Exterior Lighting. The C160 has the following exterior lighting: anti-collision lights (red) on the top of the fin and under the right main landing gear pod, engine nacelle and underwing floodlighting, receiver aircraft flood lights and electroluminescent lines on the left main landing gear pod. See Appendix 7.

(2) AAR Equipment Signal Lights. AAR equipment signal lights are mounted in vertical rows next to the left landing gear box hose tunnel. Lights are coloured amber, green and red, see Appendix 8. The lights signal the following:

Steady Red	Do not make contact
Steady Amber	AAR system ready for contact
Steady Green	Fuel flows
Red (whilst in contact)	Breakaway

i. Mark Facilities. Fuel dump through hose.

j. Dimensions. See aircraft drawing, Appendix 9.

k. RV Aids. The C160 NG has the following radio, navigation, and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, ADF and INS and search/weather radar.

(3) A/A TACAN (range available) and radar beacon mode.

7. **Etendard (ETD) and Super Etendard (SUE)**. The FN operates Etendard and Super Etendard aircraft fitted with an externally carried AAR Pod.

a. AAR Equipment. Both types of aircraft have one centreline refuelling station. The Douglas 827A pod is in service but is currently being replaced by the Inter-technique 827B pod.

b. Refuelling Heights and Speeds. The AAR height band is sea level to 25,000 ft but for training purposes fuel transfer is not permitted below 5000 ft. Speed range is 250 - 280 KIAS (optimum 270 KIAS). Maximum speed for hose trail is 280 KIAS.

c. Maximum Transferable Fuel. Transferable fuel depends on mission duration. Maximum transferable for the Etendard is 2400 kg (5290 lb) at 100 nm from a carrier and for the Super Etendard is 1800 kg (3970 lb) at 50 nm from a carrier or base.

d. Fuel Transfer Rate. The tanker can transfer fuel at a constant rate of 300 - 400 kg/min (660 - 800 lb/min).

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated not to exceed 3.8 bars (55 psi). Nominal fuel pressure is 2.15 bars (31 psi).

f. Fuel Type Available for AAR:

Primary/usual is F34 (if land based) or F42/F40 (if carrier based).

g. Receiver Types Certified. The following aircraft types are certified to receive fuel from the Etendard (ETD) or Super Etendard (SUE):

(1) A-6E.

(2) EA-6B.

(3) Etendard IV M, IV P, Super Etendard.

(4) F8E Crusader (FN).

(5) F-14.

(6) F-18.

(7) Mirage F1B/C, 2000B/C (FAF).

h. Lighting.

(1) Super Etendard Exterior Lighting. The Super Etendard has the following exterior lighting: an anti-collision light on the tail white or an experimental green for AAR, navigation lights and blue formation lights. See Appendix 10.

(2) Etendard Exterior Lighting. As para 4h(1) above with the exception of the anti-collision light, which is not fitted.

(3) AAR Equipment Signal Lights. AAR equipment signal lights are mounted at both sides of the hose drum on the rear of the pod. These lights can be dimmed on request. The lights signal the following:

Steady Amber	AAR system ready for contact
Steady Green	Fuel flows

(4) Correct Refuelling Position. There are 5 white bands marked on the hose, 3 of these bands must be pushed back into the pod housing to extinguish the amber light for fuel to flow. See Appendix 10.

i. Mark Facilities. Information not supplied.

j. Dimensions. See aircraft drawing, Appendix 11.

k. RV Aids. The Super Etendard has the following radio, navigation, and RV aids:

(1) VHF and UHF radios.

(2) VOR, TACAN, INS and search radar.

(3) A/A TACAN.

(Note. The Etendard is not fitted with INS, VOR or search radar).

8. **Source Documents**.

a. EMAA/CPE AIR H7 (C135 & C160 AAR Procedures).

b. EMM/ALae' Special Instructions (Super Etendard buddy-buddy AAR Procedures).

9. **POC for National Annex**.

EMAA/BSA
24 Boulevard Victor
00460 PARIS ARMÉES
Paris
Tel: (+33) 1 45 52 22 04
Fax: (+33) 1 45 52 22 12

10. **POC for Tanker/Receiver Clearances**.

(As for National Annex)

11. **POC for STANEVAL**.

CFAS/3B, Base Aerienne 921
95155 Taverny Cedex
France
Tel: (+33) 1 30 40 46 10
Fax: (+33) 1 30 40 64 11

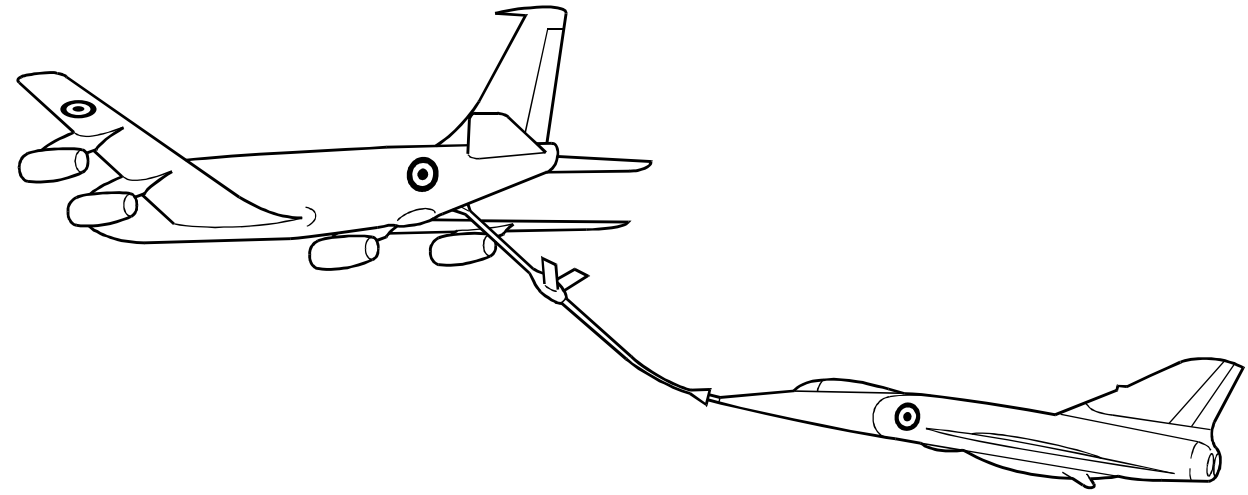
7. **National Annex Last Updated**. 1 Feb 99.

8. **National Reservations**. Nil.

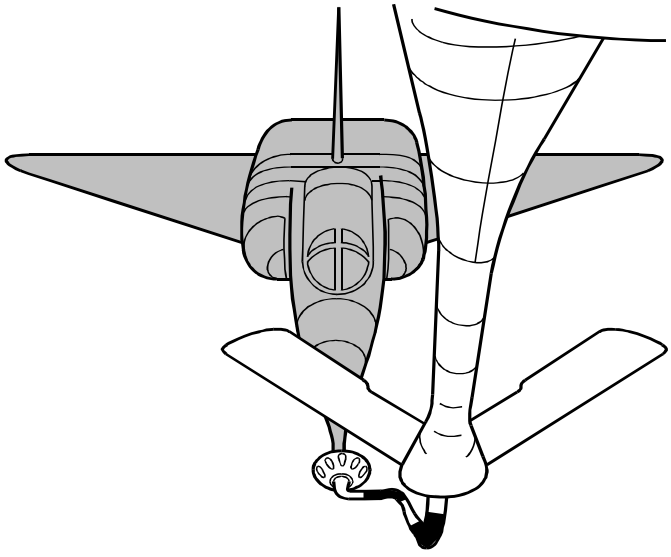
APPENDIX 1 TO ANNEX 10E

BDA IN CONTACT POSITION

PROBE AND DROGUE REFUELLING



REFUELLING THE MIRAGE IV

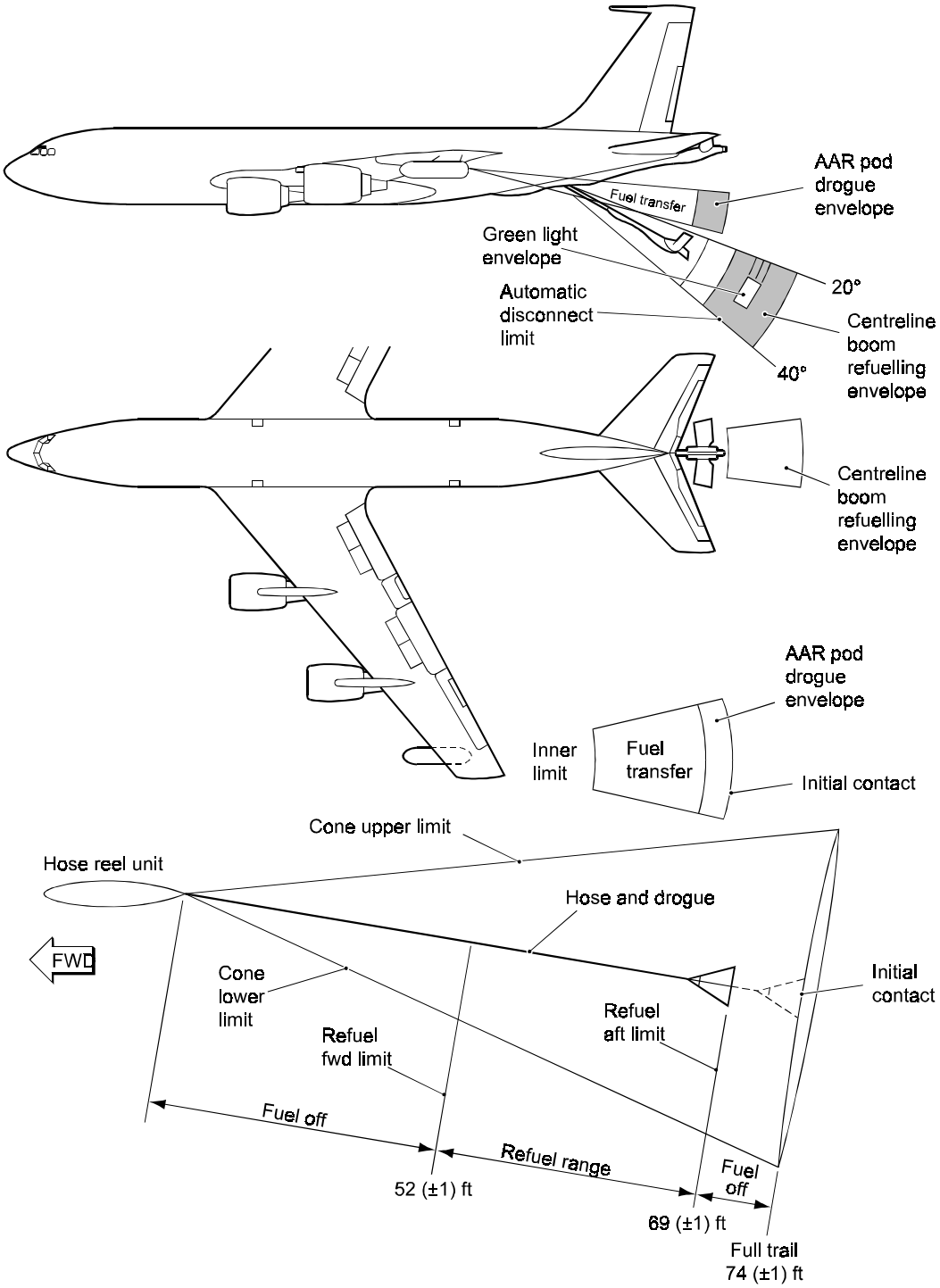


Description
The boom to drogue kit is used for field installation of a drogue adapter. The weight increase is approximately 121 lbs plus the weight of the additional trapped fuel. The adapter incorporates a fuel dump fitting (a poppet valve spring loaded to approx 5 lb) and internally stiffened hose, a trunnion and a conical rubber wing drogue. Brute force separation of the probe and drogue is set a maximum of 320 lb with no fuel pressure. This force increases at a rate of 4 lbs per pound of fuel pressure.

APPENDIX 2 TO ANNEX 10E

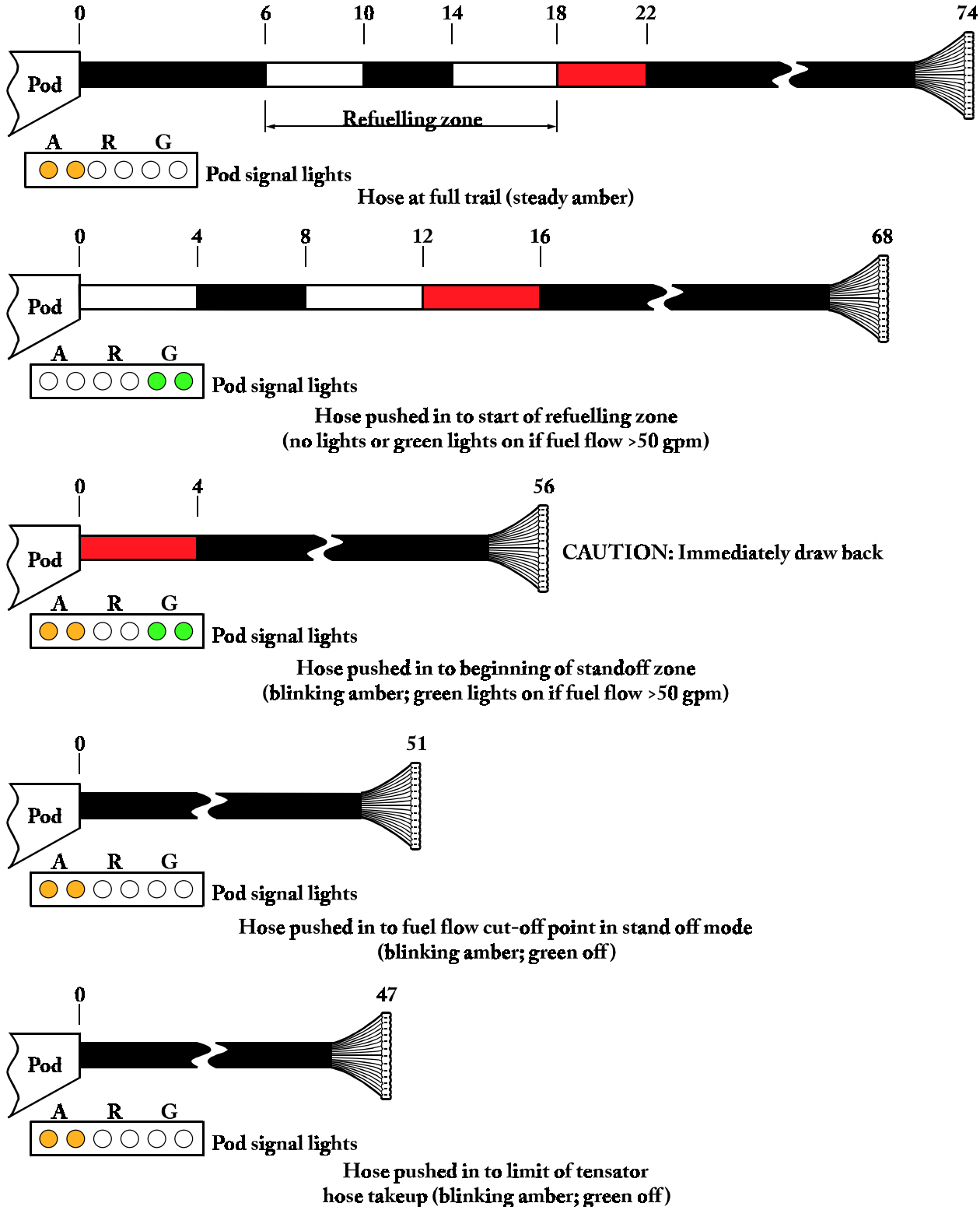
HOSE AND DROGUE POSITION IN FLIGHT

(Not to scale)



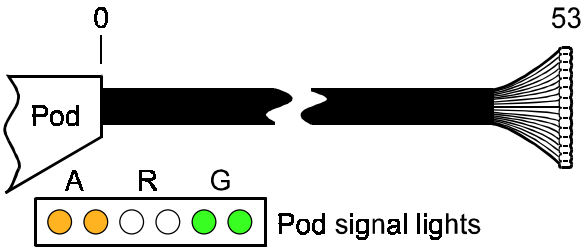
APPENDIX 3 TO ANNEX 10E

HOSE MARKINGS VERSUS POD SIGNAL LIGHTS – HOSE PUSHED IN

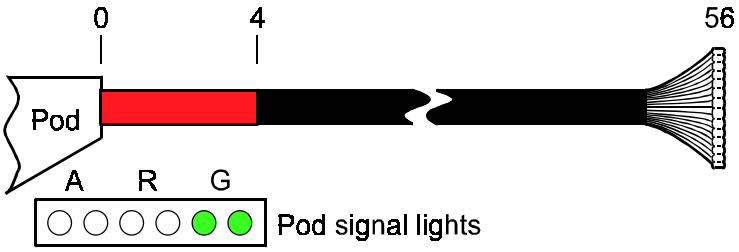


Deployed hose lengths shown above are minimum values at which the depicted condition is expected to occur.

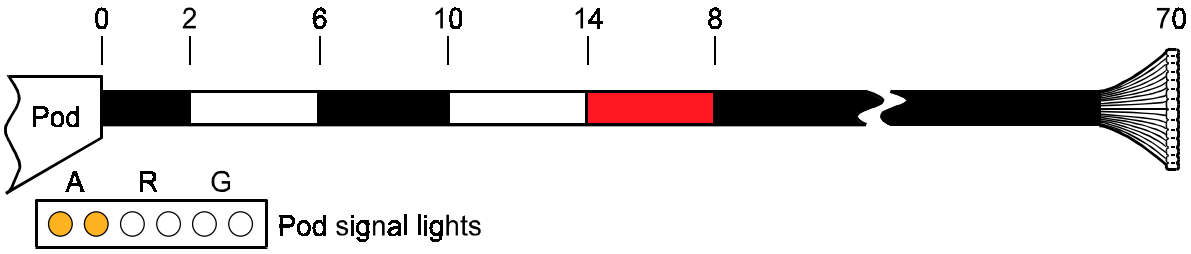
HOSE MARKINGS VERSUS POD SIGNAL LIGHTS – HOSE PULLED OUT



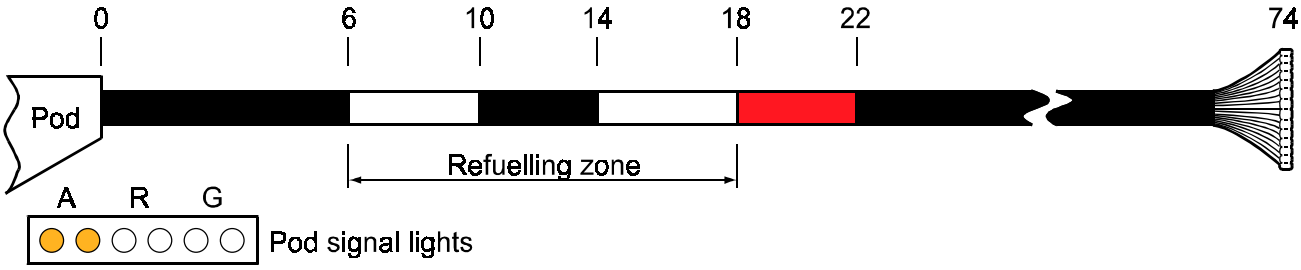
Hose pulled out to fuel start point in standoff mode
(blinking amber; green on if fuel flow > 50 gpm)



Hose pulled out to beginning of refuelling zone
(amber off; green on if fuel flow > 50 gpm)



Hose pulled out to fuel flow cutoff
point of refuelling zone (amber on; green off)

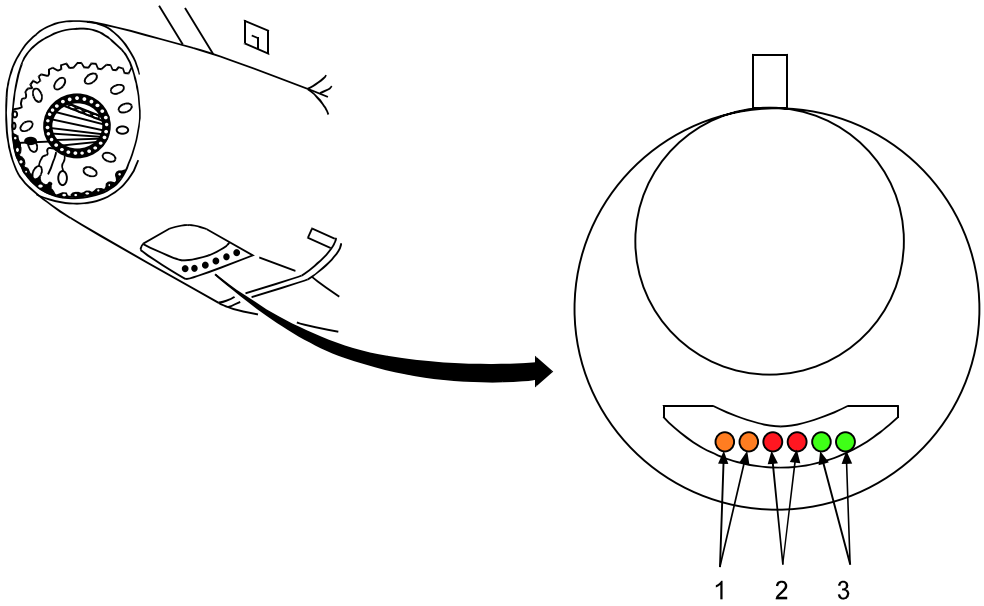


Hose at full trail (steady amber)

Deployed hose lengths shown above are maximum values at which the depicted condition is expected to occur.
Red signal lights on steady - pod not ready. Hose extending/retracting.
Red signal lights on blinking - breakaway.

APPENDIX 4 TO ANNEX 10E

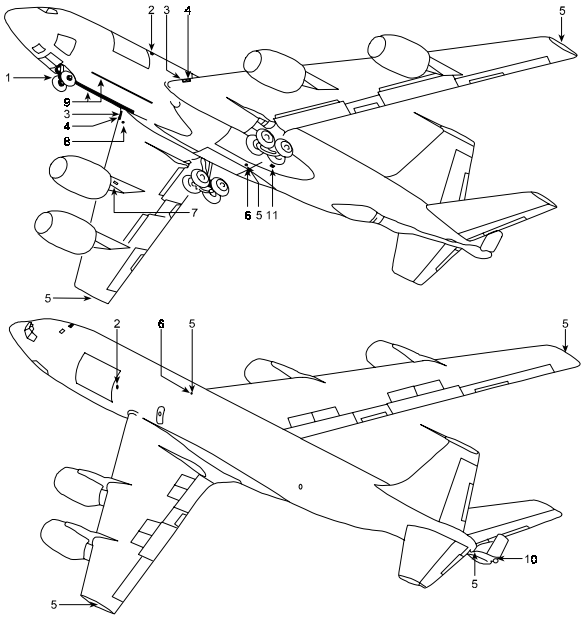
POD REFUELLING LIGHTS



NO	CONTROL /INDICATOR	FUNCTION
1	Amber Light (2)	An amber light indicates to the receiver that the system is ready for contact. The light comes on steady when the hose is fully extended and the refuelling system is ready for an offload. The lights flash when the hose is pushed in and less than 56 ft of the hose is deployed, and the light extinguishes when the hose is deployed greater than 56 ft, when the hose is pulled out.
2	Red Light (2)	A steady red light indicates to a receiver that the pod system is not ready to transfer fuel. The lights come on steady when the hose is deploying or being rewound using the REWIND/TRAIL switch on the control panel. A flashing Red light indicates the need for an immediate disconnect and separation. The light comes on flashing when the switch on the control panel is pressed; goes off when the switch is pressed again,.
3	Green Light (2)	Green lights indicate to the receiver that fuel is flowing (greater than 50 gpm). The lights go out when the hose is pushed in and less than 51 ft is deployed. The lights are on when the hose is deployed greater than 53 ft (but less than 68 ft), when the hose is pulled out.

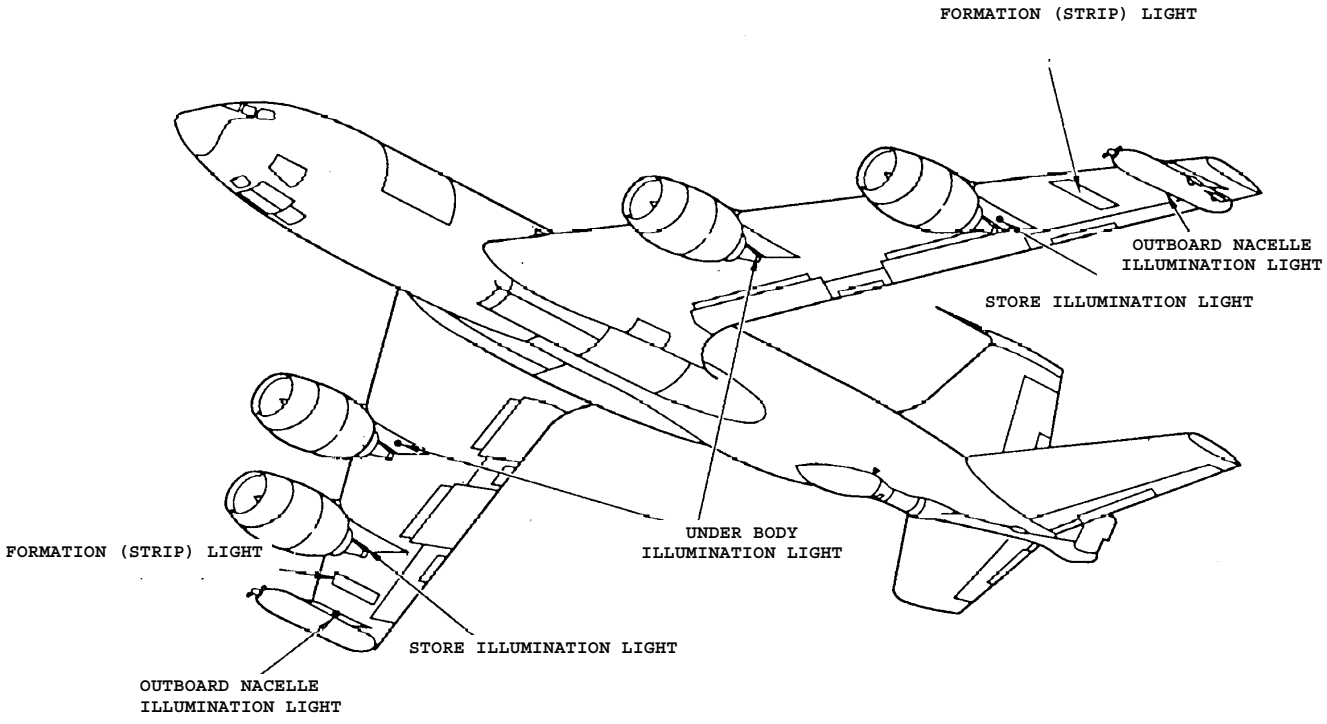
APPENDIX 5 TO ANNEX 10E

C135 FR BDA EXTERIOR LIGHTING



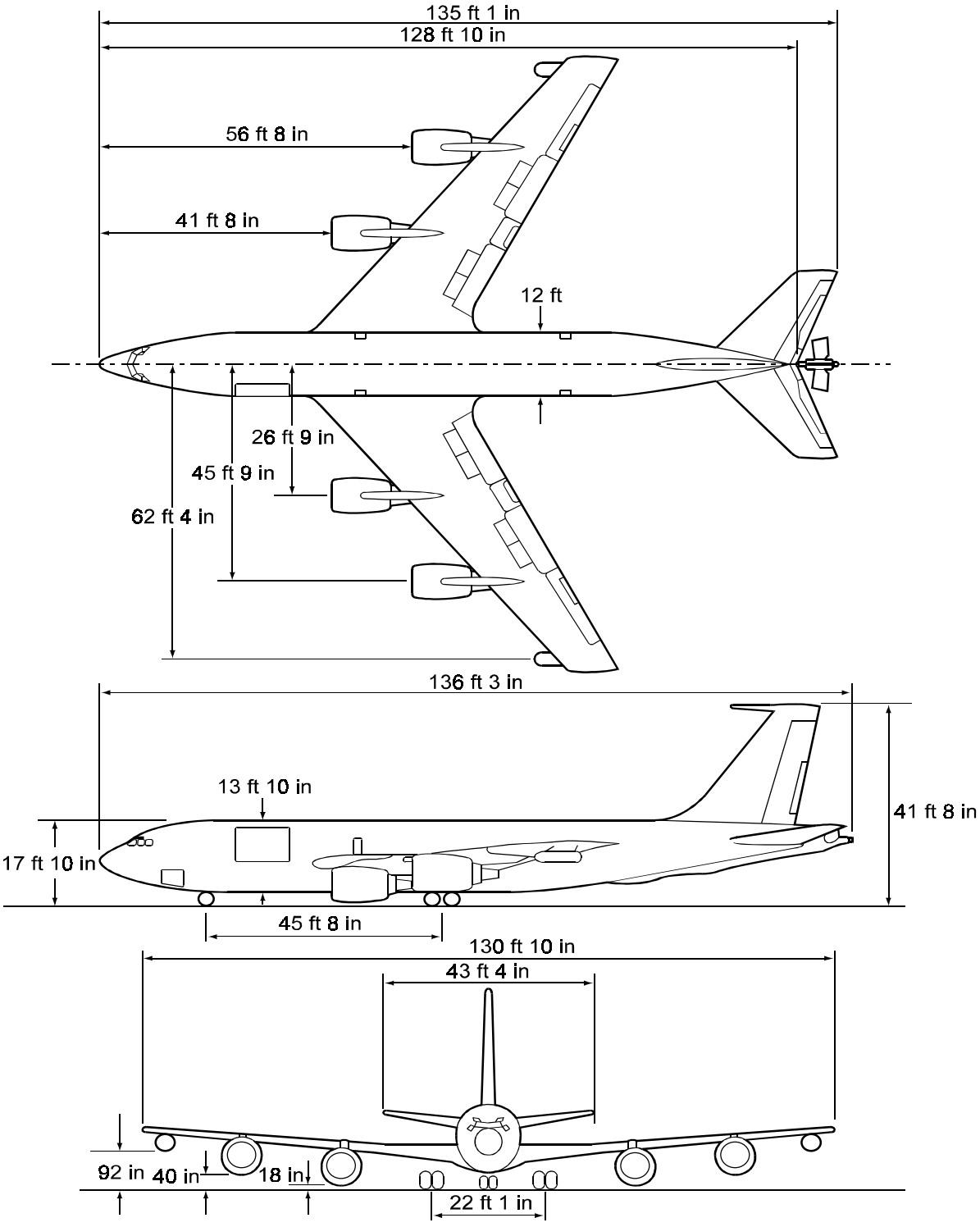
1. NOSE LANDING AND TAXI LIGHT
2. NACELLE ILLUMINATION LIGHT (2 PLACES)
3. TAXI LIGHT (2 PLACES)
4. LANDING LIGHT (FIXED) (2 PLACES)
5. NAVIGATION LIGHT (7 PLACES)
6. ROTATING BEACON LIGHTS (2 PLACES)
7. UNDERBODY ILLUMINATION LIGHT (2 PLACES)
8. TERRAIN LIGHT (RETRACTABLE)
9. RECEIVER PILOT DIRECTOR LIGHTS
10. BOOM MARKER LIGHTS (FLUORESCENT)
11. UNDERWING ILLUMINATION LIGHT (2 PLACES)

C135FR WING POD EXTERIOR LIGHTING



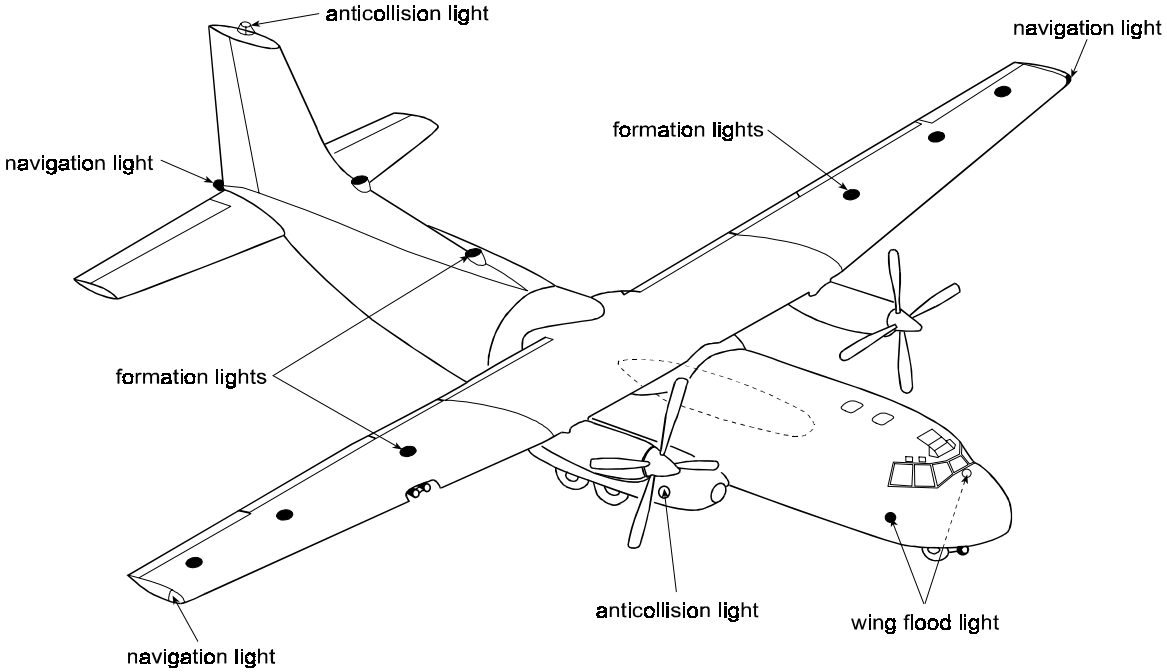
APPENDIX 6 TO ANNEX10E

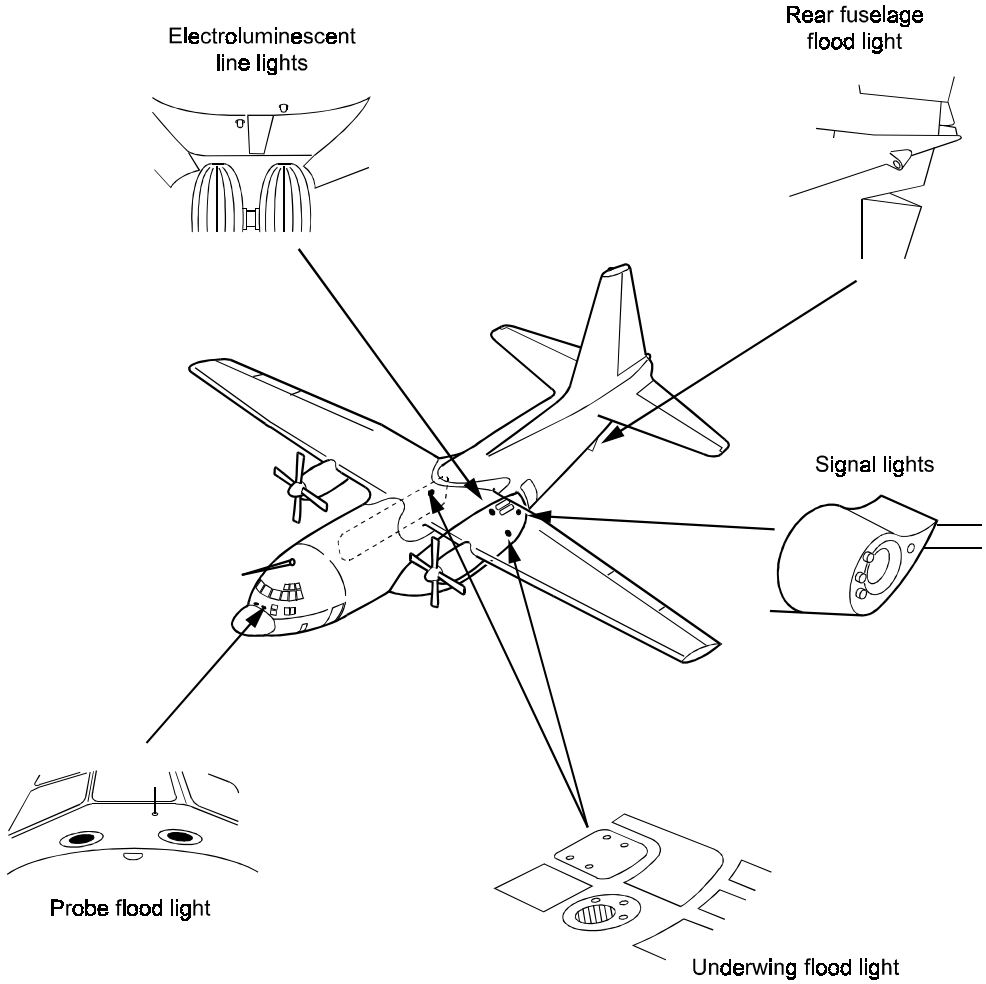
C135 FR PODS



APPENDIX 7 TO ANNEX 10E

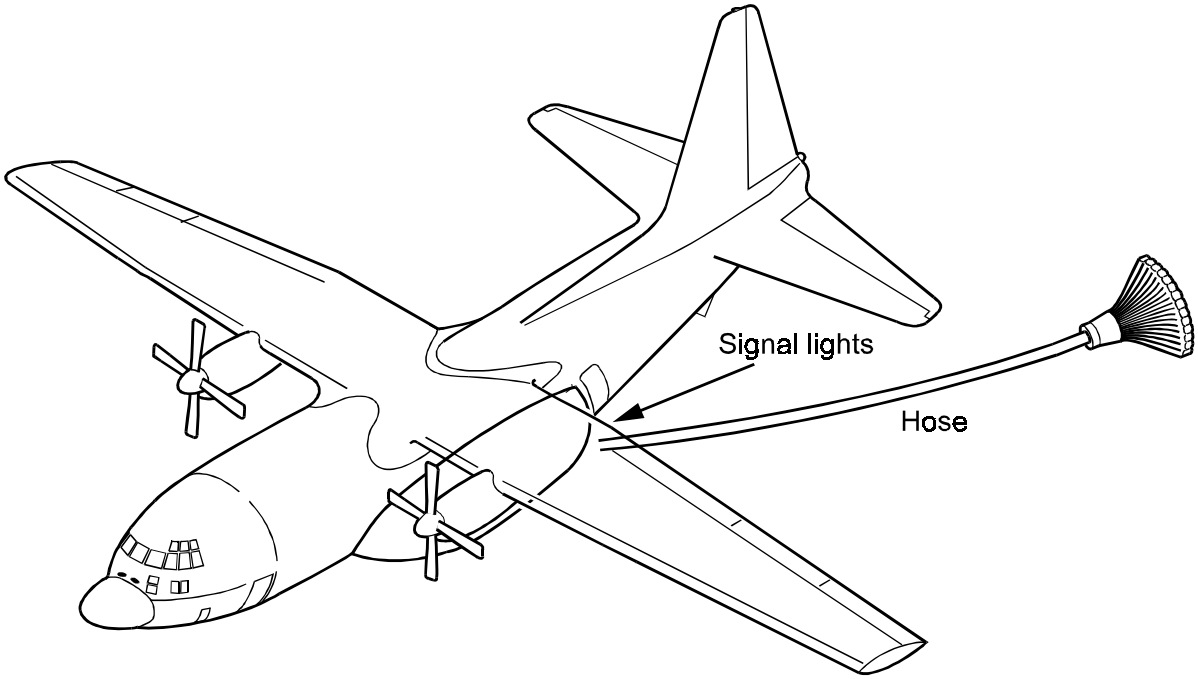
C160 EXTERIOR LIGHTING

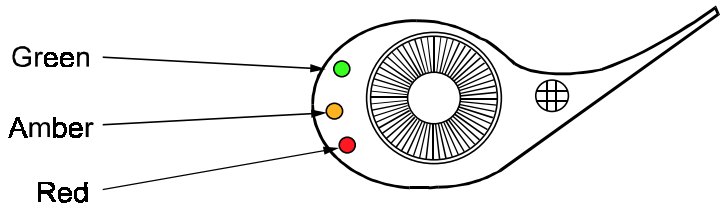




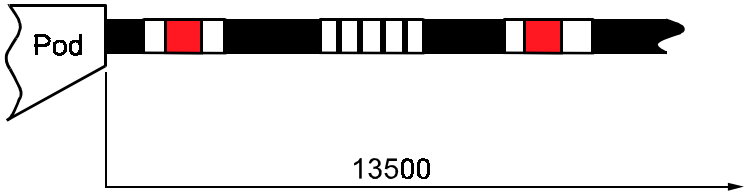
APPENDIX 8 TO ANNEX 10E

C160 AAR EQUIPMENT SIGNAL LIGHTS AND HOSE MARKINGS



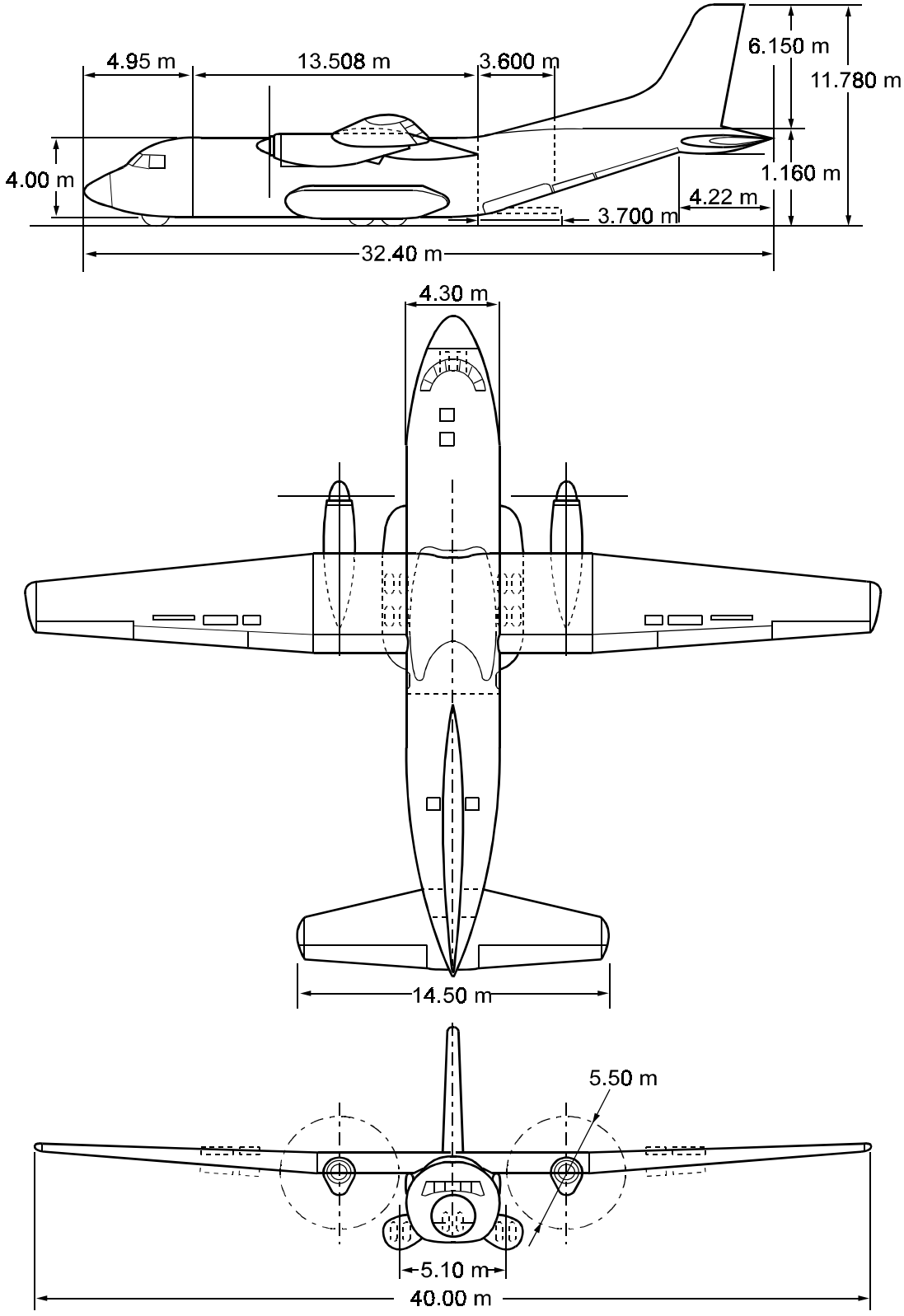


Hose markings



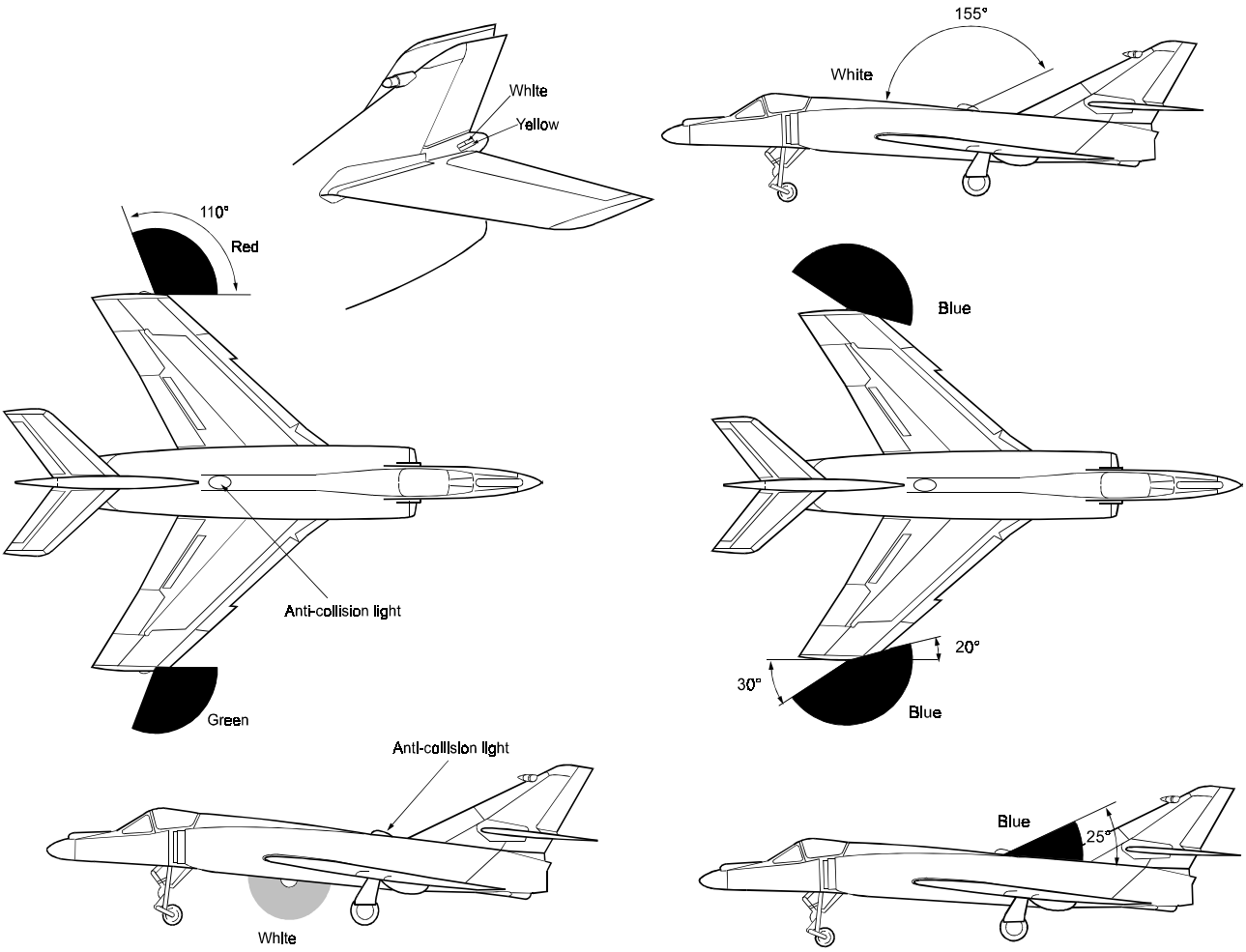
APPENDIX 9 TO ANNEX 10E

C160 TRANSALL

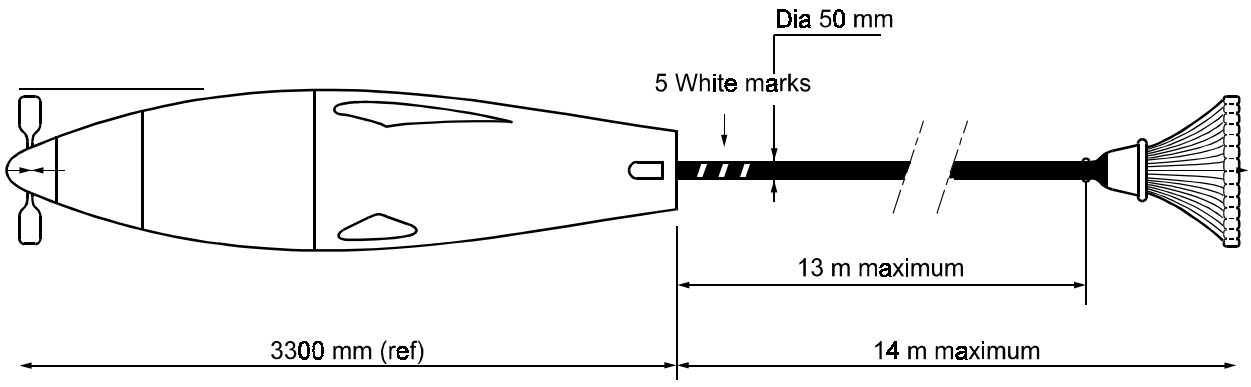


APPENDIX 10 TO ANNEX 10E

SUPER ETENDARD - EXTERIOR LIGHTING

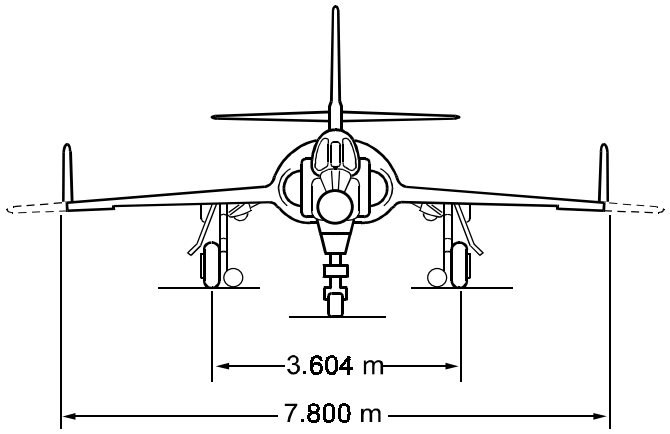


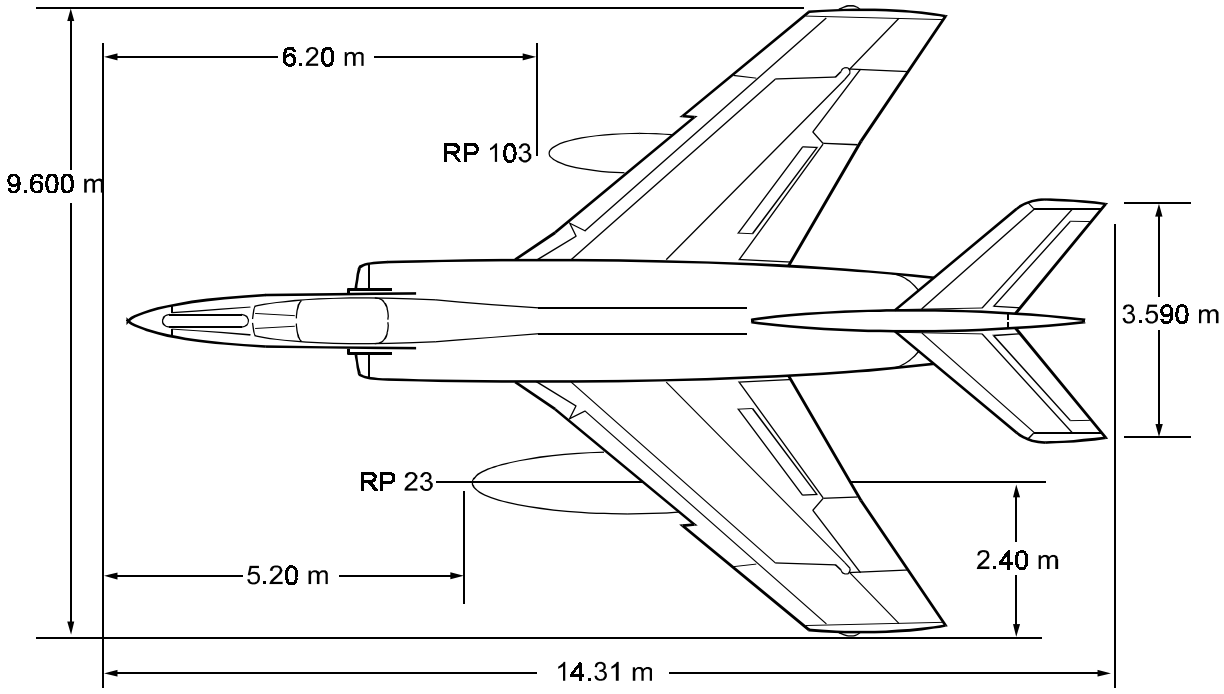
827 SERIES POD - HOSE MARKINGS

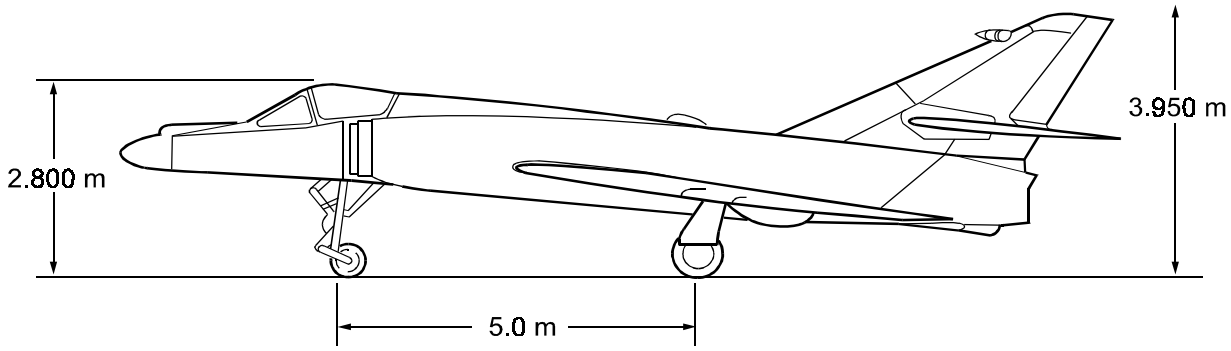


APPENDIX 11 TO ANNEX 10E

SUPER ETENDARD







ANNEX 10F

NATIONAL ANNEX – GERMANY

1. **Introduction.** The German Tornado is capable of performing air to air refuelling as a tanker.

2. **Capabilities and Characteristics.** The details below apply to the German Tornado only:

a. AAR Equipment. The Tornado, when operating as a tanker, is fitted with a Sargent Fletcher buddy-buddy refuelling pod fitted at the centreline fuselage station. The extended hose, FRL coupling and drogue are 15m (49ft) long. To open the refuelling valve, the hose has to be pushed back in approximately 1.5m (6ft); however, the forward limit is with 2 of the hose marker rings remaining visible. The diameter of the drogue is 710mmr. Recommended closing speed for contact is 3-4 KIAS, but is not to exceed 7 KIAS. If contact speed is in excess of 7 KIAS the possible resulting hose-whip may break off the receiver's probe tip or, in an extreme case, damage the tanker's refuelling equipment or airframe.

b. Refuelling Heights and Speeds. Any height between sea-level and 28,000ft. Optimum altitude band for refuelling is 5,000ft-20,000ft. Speed range is 200-300 KIAS/0.75 Mach with an optimum speed of 270 KIAS.

c. Maximum Transferable Fuel. 5,500kg (12,000lb) under optimum conditions, but not more than 3,400kg (7,500lb) per contact.

d. Fuel Transfer Rate. Transfer rate is 300kg/min (650lt/min) to 600kg/min (1,300lb/min), depending on the configuration and the fuel level in the receiver aircraft's tanks.

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated to 240-380 KPA (35-55 psi).

f. Fuel Types Available for AAR.

(1) F-34 is the primary fuel when the Tornado tanker is operating from GAF airfields.

(2) F-35 and F-40 are also cleared as alternatives.

g. Receiver Types Certified. The following aircraft are cleared to refuel from the Tornado:

(1) Tornado IDS/ECR

(2) AM-X

h. Lighting. A set of three coloured lights each side of the pod's tail-cone act as indicators to the receiver for the following:

Amber -	The hose is extended and the pod is ready for receiver contact and fuel transfer.
Green -	Fuel is flowing from the pod to the receiver aircraft.
Steady Red -	Do not make contact. The hose may be winding or trailing.
Flashing Red -	Breakaway.

The drogue canopy is fitted with four equally spaced reflector lights to provide illumination for night refuelling. A floodlight (located on the pod's tail) illuminates the underside of the tanker aircraft fuselage.

i. Mark Facilities. The aircraft is fitted with strobe lighting and is capable of fuel dump.

j. Dimensions. See aircraft drawing, Appendix 1.

k. RV Aids. The aircraft has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) Tacan, Doppler and INS.

(3) Air to Air Tacan (DME only).

l. Limitations. The B/B refuelling pods is not designed to be used for continuous training contacts. A high number of contacts, with partial hose trail and wind AAR training missions may lead to failure of the pod components. Therefore, the following additional limitations must be observed:

(1) Maximum operating time with the hose extended is 45 minutes. If an interval of 15 minutes or more is expected between a series of training contacts, the hose is to be rewound and the pod shut down.

(2) Tanker airspeed changes, with hose extended, must be kept within 10 KIAS of the briefed speed and altitude must be constant. For speed changes greater than 10 KIAS, the hose must be wound in and then retrailed at the new speed. Receiver aircraft must stay clear of the hose during this operation.

(3) During dry training contacts, the pod must be kept full of fuel to provide cooling for it's hydraulic system. If wet training contacts are performed, the pod must be refuelled when reaching 650kg.

(4) Only 3 complete hose extension/retraction cycles per hour are permitted.

(5) HF transmissions by the tanker are not permitted during refuelling, or if receiver aircraft are within 150ft (50m) radius.

(6) Due to outstanding trials, the Tacan of the receiver must be operated in REC mode only.

3. **Source Document.**

a. GAF TO 1F-PA-200 (IDS)-1.

b. GAF TO 1F-PA-200 (ECR)-1.

4. **POC for National Annex.**

German Air Force Command
TFT b
Bw:61
Fliegerhorst Wahn 504/ 03d
PO Box 90 61 10
51127 Koln
GERMANY
Phone (49) 22 03 602 58 62
Fax (49) 22 03 602 45 69
IVSN 90414 3451 5862

5. **POC for Tanker/Receiver Clearances.**

(As for National Annex)

6. **POC for STANEVAL.**

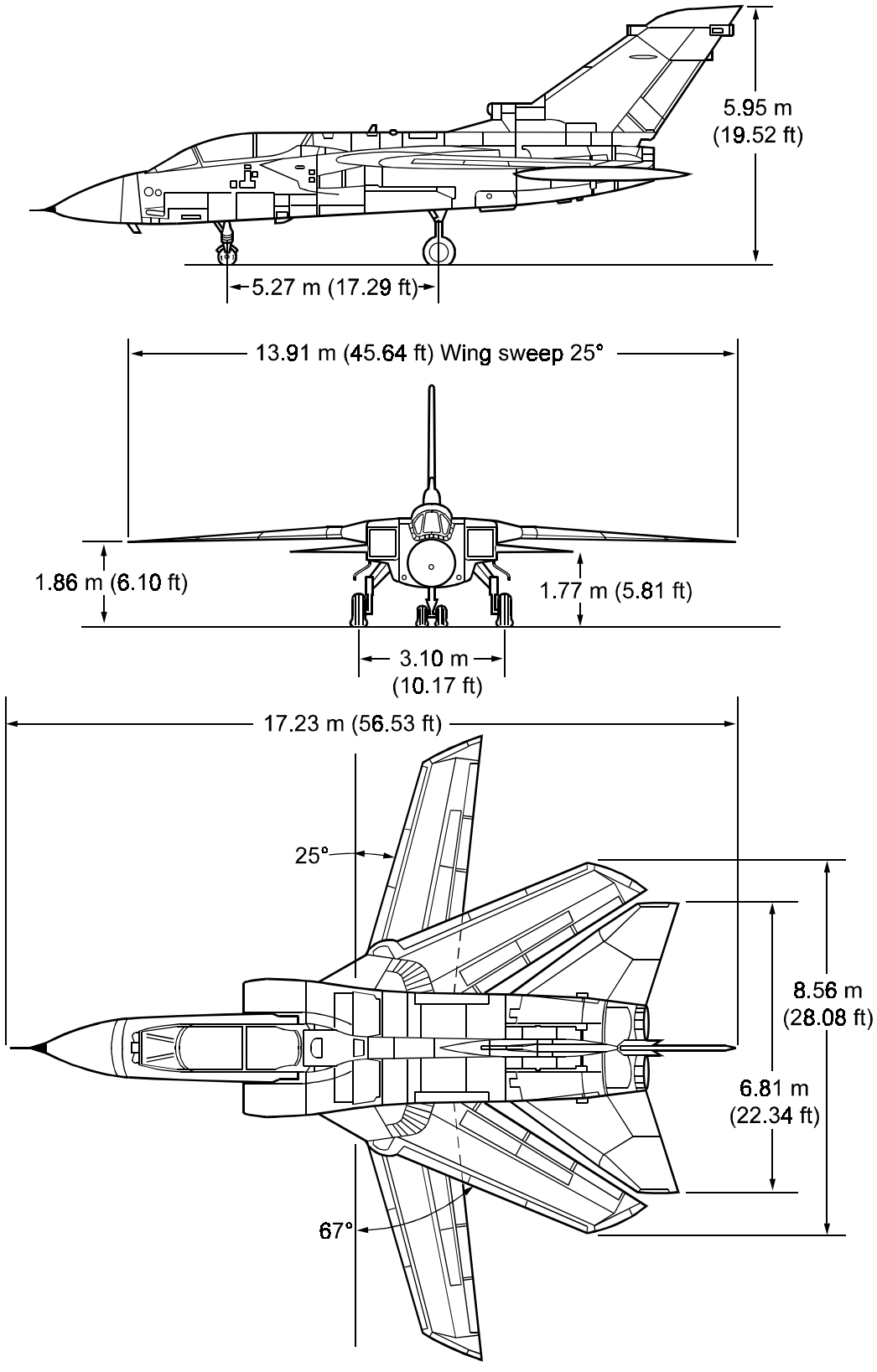
(As for National Annex)

7. **National Annex Last Updated.** Dec 02.

8. **National Reservation.** Nil.

APPENDIX 1 TO ANNEX 10F

TORNADO IDS/ECR



ANNEX 10G

NATIONAL ANNEX - GREECE

1. **Introduction**. Greece has no indigenous tanker assets and consequently no inputs for this Annex.

2. **POC for National Annex**.

3. **POC for Tanker/Receiver Clearances**.

4. **POC for STANEVAL**.

5. **National Annex Last Updated**. 15 Jun 96.

6. **National Reservations**.

   a. In peacetime AAR is not permitted over Hellenic territory.

   b. In times of tension and war AAR may be conducted over Hellenic Airspace after permission from Hellenic authorities.

   c. During exercises AAR over high seas within Athinai FIR should be co-ordinated with Hellenic ATS authorities for mutual agreement.

ANNEX 10H

NATIONAL ANNEX - ITALY

1. **Introduction**. Italy has 2 tanker types: the PA 200 Tornado and the Boeing 707/320.

2. **PA 200 Tornado**. The Tornado can be converted to the AAR role by fitting a refuelling pod on the centreline pylon:

a. AAR Equipment. The Tornado as a tanker aircraft has a Sargent Fletcher buddy-buddy refuelling pod fitted at the centreline fuselage station. The hose is 16 m (51 ft) long and terminates in a Flight Refuelling Ltd coupling and a 0.7 m (28 in) drogue. The hose must be pushed in 1.5 m (5 - 7 ft) for fuel to flow.

b. Refuelling Heights and Speeds. Any height between sea level and 20,000 ft. Speed range is 200 to 320 KIAS or .75 Mach, with an optimum of 270 KIAS.

c. Maximum Transferable Fuel. Total fuel load is 7600 kg (16,750 lb). Transferable fuel is dependent on sortie duration; assuming a fuel burn of 30 kg/min (66 lb/min) around 2200 kg (4900 lb) is available for transfer during a 2 hr hour flight.

d. Fuel Transfer Rate. Maximum transfer rate is 600 kg/min (1300 lb/min).

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated to be between 240 to 380 KPA (35 to 55 psi).

f. Fuel Types Available for AAR.

g. Receiver Types Certified. The following aircraft is cleared to refuel from the PA 200 Tornado:

(1) AMX (IAF).

(2) Tornado IDS (IAF).

h. Lighting. The refuelling pod has two sets of red, green and amber equipment status lights mounted on the hose tunnel, see Appendix 1. The lights indicate the following:

Amber Light	The pod system is ready for receiver contact.
Green Light	Fuel is flowing from the pod to the receiver aircraft.
Steady Red	Do not make contact.
Flashing Red	The receiver is to breakaway.

The drogue canopy is fitted with 4 equally spaced white lights for night refuelling. A floodlight illuminates the lower fuselage.

i. Mark Facilities. The aircraft is fitted with strobe lighting.

j. Dimensions. See aircraft drawing, Appendix 2.

k. RV Aids. The aircraft has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) TACAN, Doppler and INS.

(3) A/A TACAN.

3. **Boeing 707/320 T/T**.

a. AAR Equipment. The aircraft has one fuselage mounted hose drum unit and 2 wing-tip mounted Sargent Fletcher Aviation AAR pods. All hoses are 15 m (50 ft) long, each terminates in a MA-3 coupling and drogue. Wing pods might be fitted with Flight Refuelling Ltd Baskets. See Appendix 3 for flight envelopes during AAR.

b. Refuelling Heights and Speeds. The AAR height band is sea level to 35,000 ft; speed range is 200 to 325 KIAS.

c. Maximum Transferable Fuel. Maximum fuel load is 71,000 kg (156,200 lb). Transferable fuel is dependent on sortie duration; around 25,000 kg (55,000 lb) of fuel is available for transfer during a 4 hr flight, assuming an average fuel consumption of 7400 kg/min (16,300 lb/min) and including diversion reserves.

d. Fuel Transfer Rate. Transfer rate is about 1200 - 1300 kg/min (2600 - 2800 lb/min).

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated not to exceed 3.5 bars (50 psi).

f. Fuel Types Available for AAR.

(1) Primary/usual fuel is F34.

(2) Alternative fuels depend upon airfield of loading.

g. Receiver Types Certified. The following aircraft types are cleared to refuel from the Boeing 707/320 T/T:

(1) AMX (IAF).

(2) AV-8B (SAF, USMC, IT).

(3) CF-18 (CAF).

(4) EF- 18 (SAF).

(5) Harrier GR7 (RAF).

(6) Jaguar (FAF).

(7) MB 339 CD (IAF).

(8) Mirage F1 (FAF, SAF), IV P, 2000 (FAF).

(9) Tornado IDS, ECR, GR4/4A, F3, ADV, PA 200 (IAF, GAF, RAF).

Note. Each clearance is on the basis of mechanical compatibility between the B707 T/T Sargent Fletcher Aviation Mk34 pods and centre unit refuelling drogue/receptacle and the receiver aircraft nozzle/mast. Reference NATO STANAG 3447 for further details. National authorities are responsible for ensuring that the fuel systems of their receiver aircraft are compatible with the B707 T/T AAR system output pressures and fuel flow rates.

The following aircraft types are cleared to refuel from Italian Boeing 707/320 T/T when equipped with Flight Refuelling Ltd baskets:

(1) AMX (IAF).

(2) Tornado ADV (IAF).

h. Lighting. AAR equipment signal lights are mounted in 2 diagonal rows next to the hose tunnel of the centre refuelling station and in vertical rows on both sides of the AAR wing-tip pods. Lights are coloured red, amber and green. Light colours have the following meaning:

Flashing Red/Steady Red	Do not make contact.
Steady Amber	Tanker ready for contact.
Steady Green	Fuel flows.
Flashing amber	Hose pushed in beyond minimum refuelling range, receiver too close.
No Light Indications (after successful fuel transfer)	Planned offload complete. No more fuel available, receiver to disconnect.
No light indications soft (within one minute of contact)	If no indication of fuel increase, suspect contact, receiver to disconnect.
Green, changing Dim/Bright	Planned offload complete. More fuel available, receiver may remain in contact or disconnect.
Flashing Red/Steady Red (whilst in contact)	Breakaway.

The aircraft underwing, outboard engine nacelles and wing-tip AAR stores are illuminated (see Appendices 4 and 5) and the drogue canopy is fitted with light sources. The hose is marked with 4 light reflecting white bands spaced at 3 m (10 ft) intervals.

i. Mark Facilities. Nil.

j. Dimensions. See aircraft drawing, Appendix 6.

k. RV Aids. The aircraft has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, ADF and INS.

(3) UDF and A/A TACAN.

4. **Source Documents**.

a. Boeing 707/320 Aeroplane Flight Manual.

b. Italian Tanker Operations Manual.

c. AER IF-PA 200-1.

d. SMA 41-ItAF AAR National Instructions.

5. **POC for National Annex**.

Stato Maggiore dell'Aeronautica
3° Reparto
Viale dell'Università, 4
00100 Rome
Italy
Tel: (+39) 06 4986 4008
Fax: (+39) 06 4986 6268

6. **POC for Tanker/Receiver Clearances**.

Stato Maggiore Aeronautica
4° Reparto
Viale dell'Università, 4
00185 Rome
Italy
Tel: (+39) 06 4986 4238
Fax: (+39) 06 4986 4333

7. **POC for STANEVAL**.

Italian Air Staff (Ops Branch)
Viale dell'Università, 4
00185 ROME
Italy
Tel: (+39) 06 4986 5412 (IVSN 436 0111 Ext 5412)
Fax: (+39) 06 4986 6268

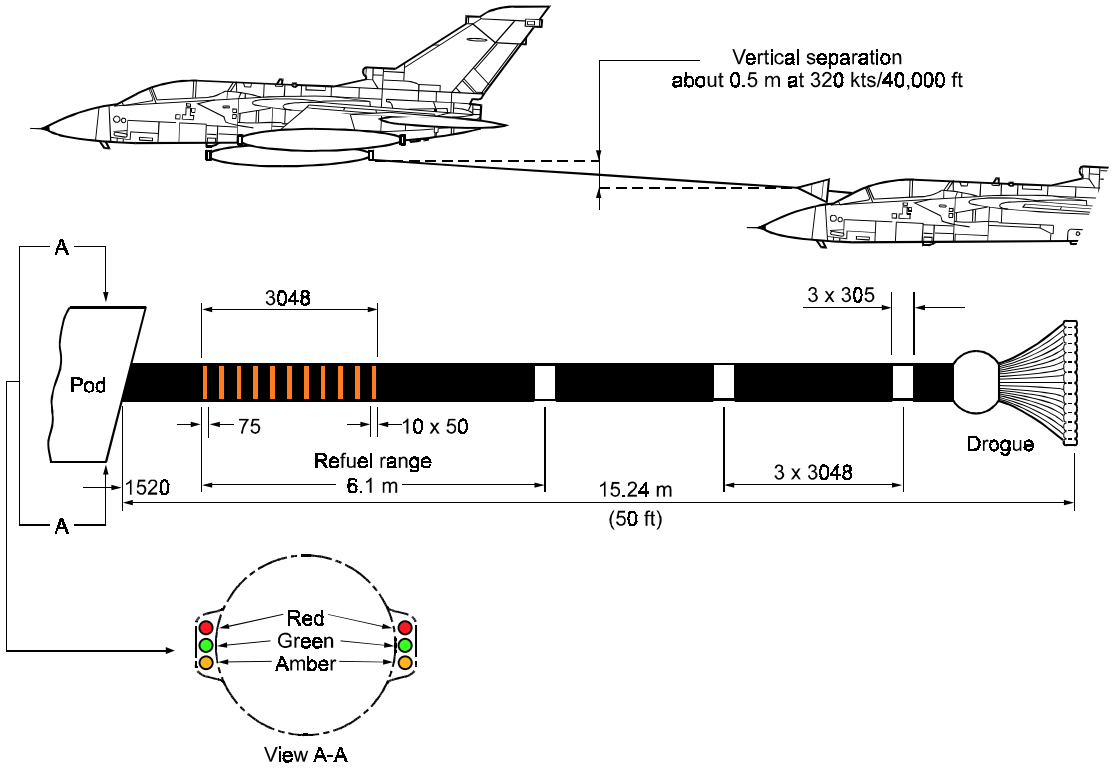
14th Stormo
Pratica di Mare
00040 Pomezia
Italy
Tel: (+39) 06 9129 2175
Fax: (+39) 06 9129 2386

8. **National Annex Last Updated**. Mar 03.

9. **National Reservations**. Nil.

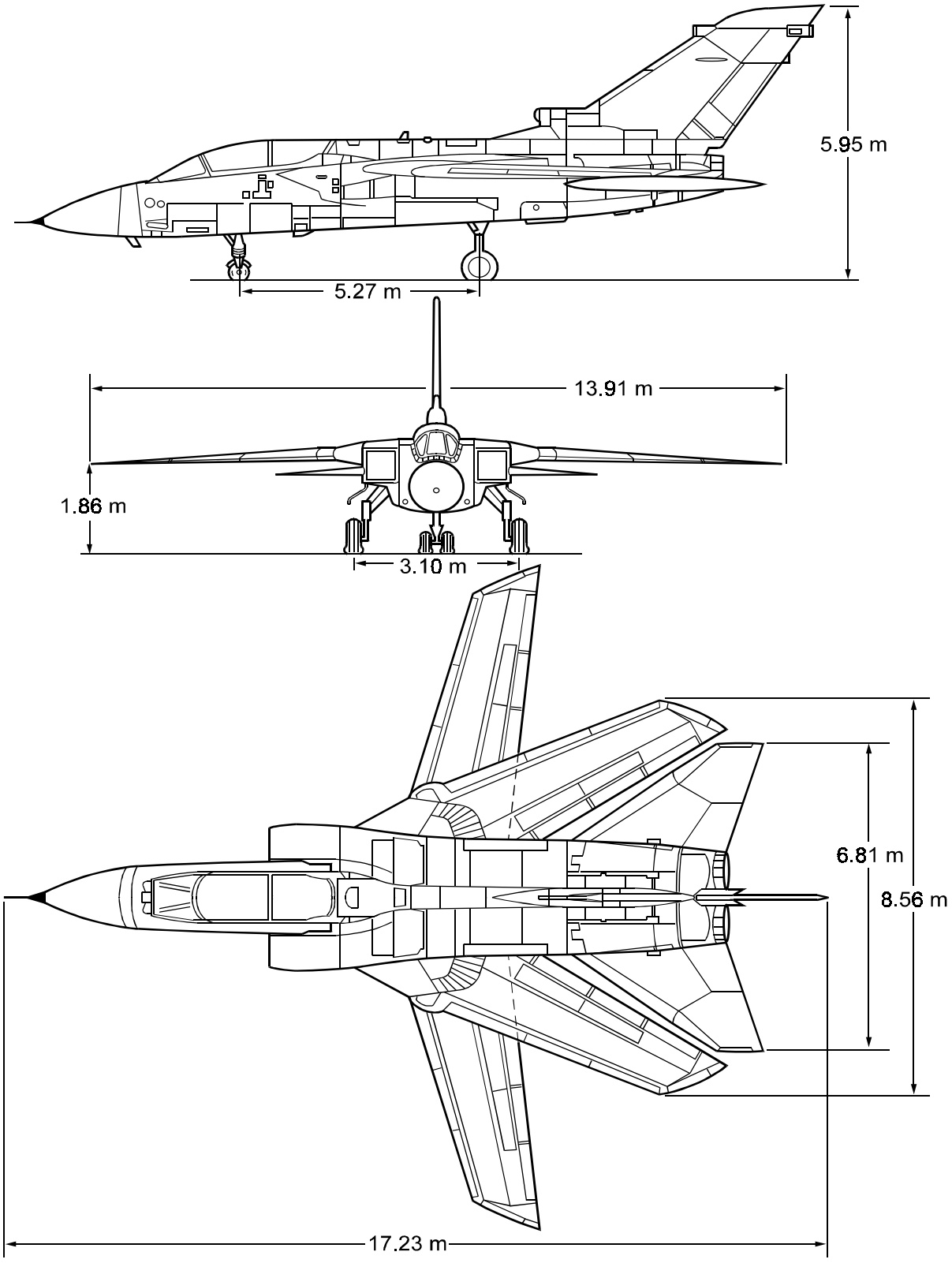
APPENDIX 1 TO ANNEX 10H

SIGNAL LIGHTS AND HOSE MARKINGS



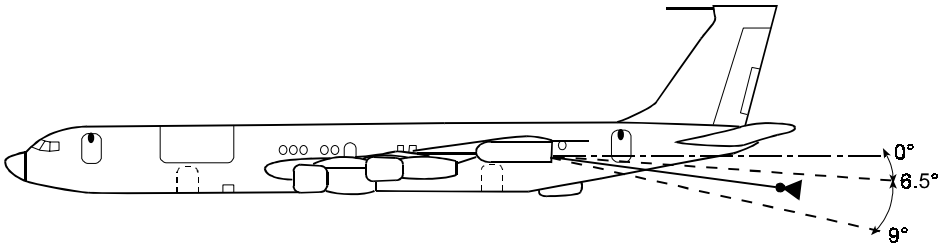
APPENDIX 2 TO ANNEX 10H

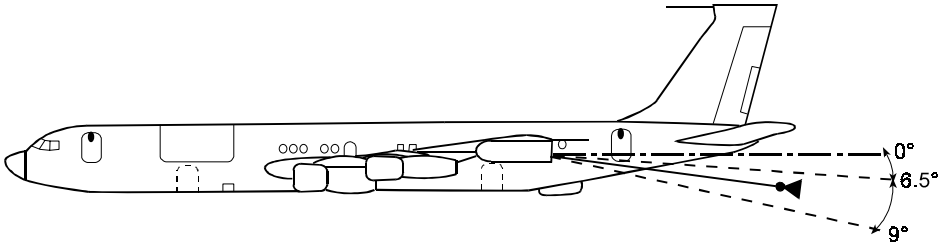
TORNADO

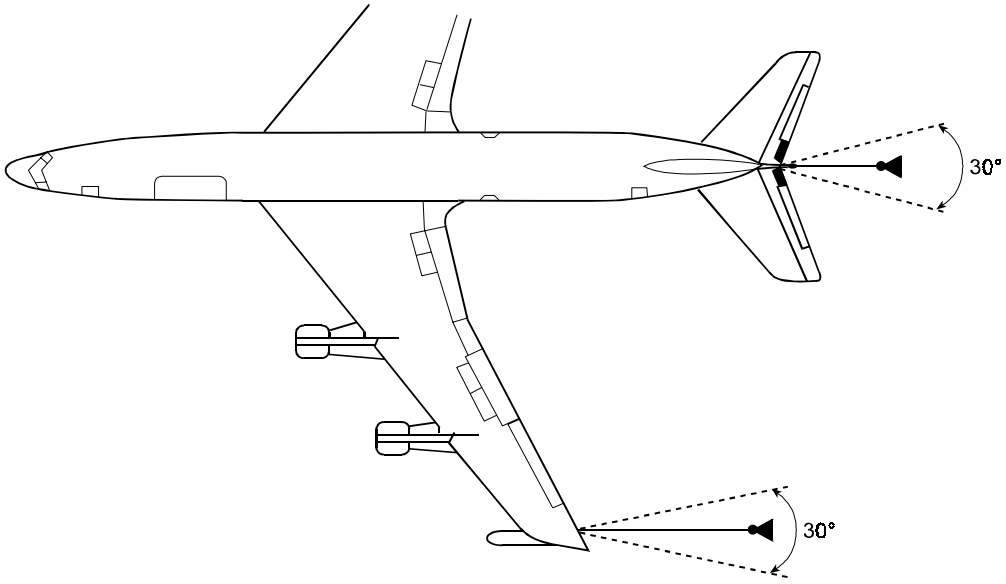


APPENDIX 3 TO ANNEX 10H

BOEING 707 TANKER - HOSE AND DROGUE ENVELOPE (1)

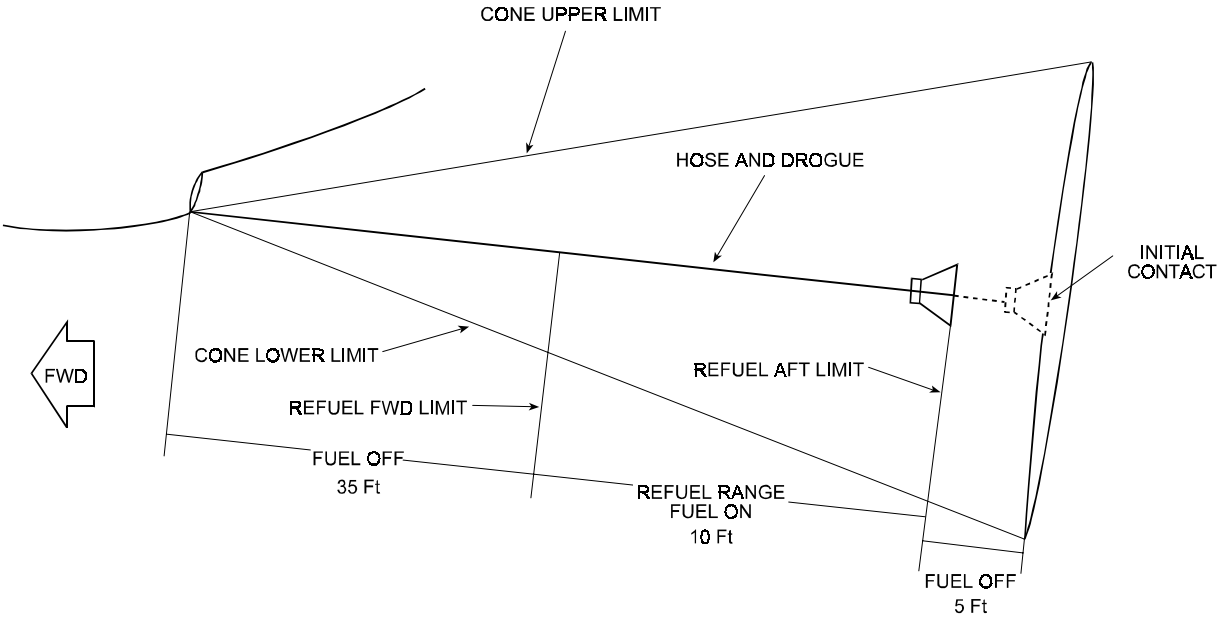


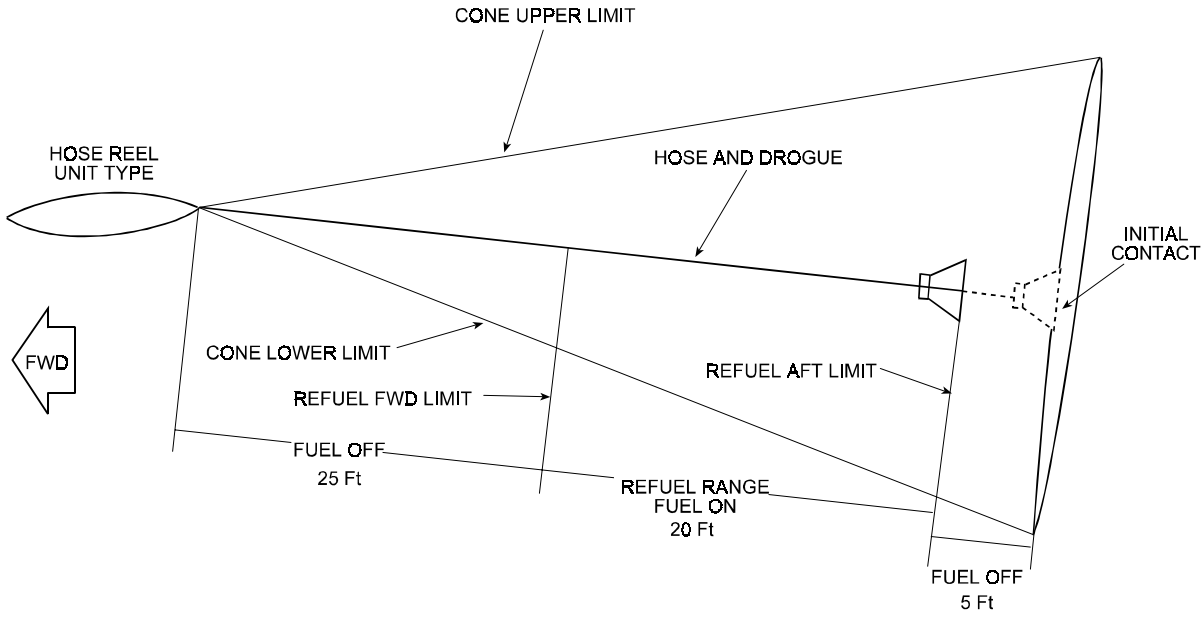




BOEING 707 TANKER – HOSE AND DROGUE ENVELOPE (2)

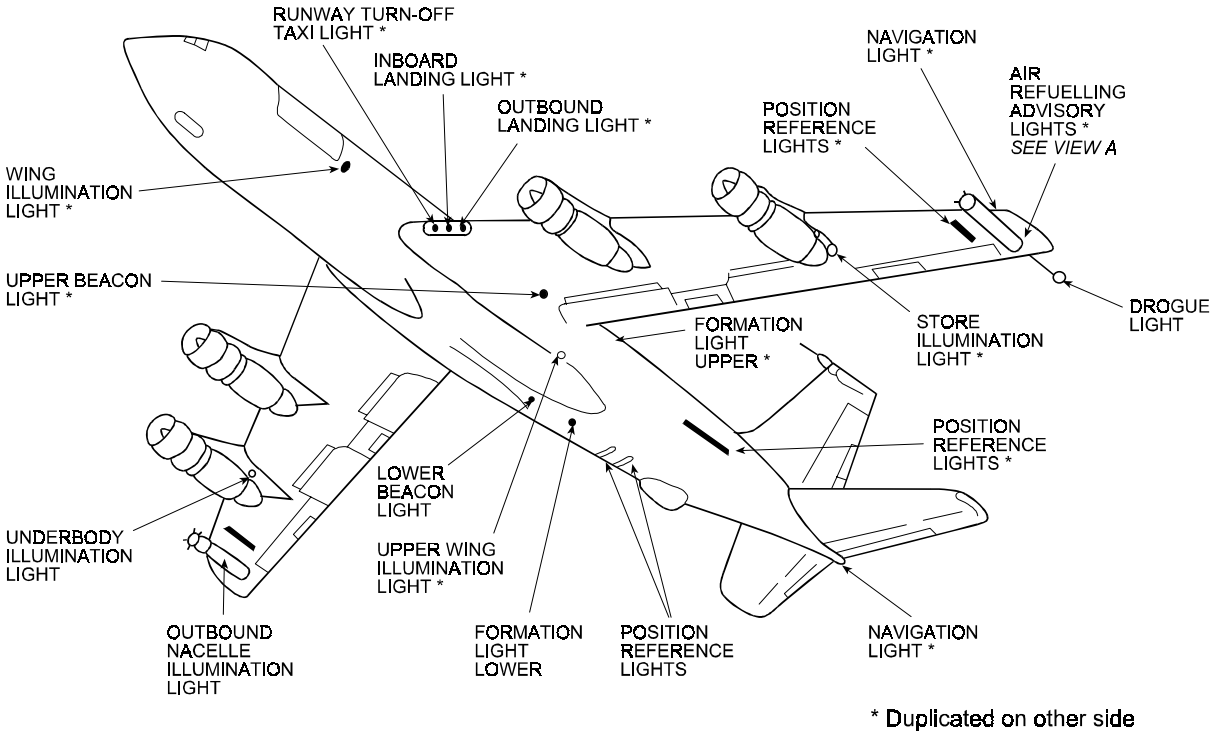
(Not to scale)

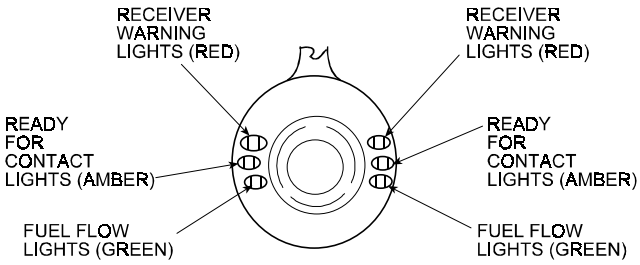


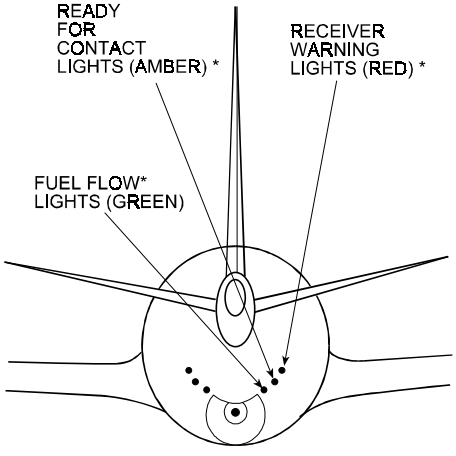


APPENDIX 4 TO ANNEX 10H

BOEING 707 TANKER – TANKER EXTERNAL LIGHTING

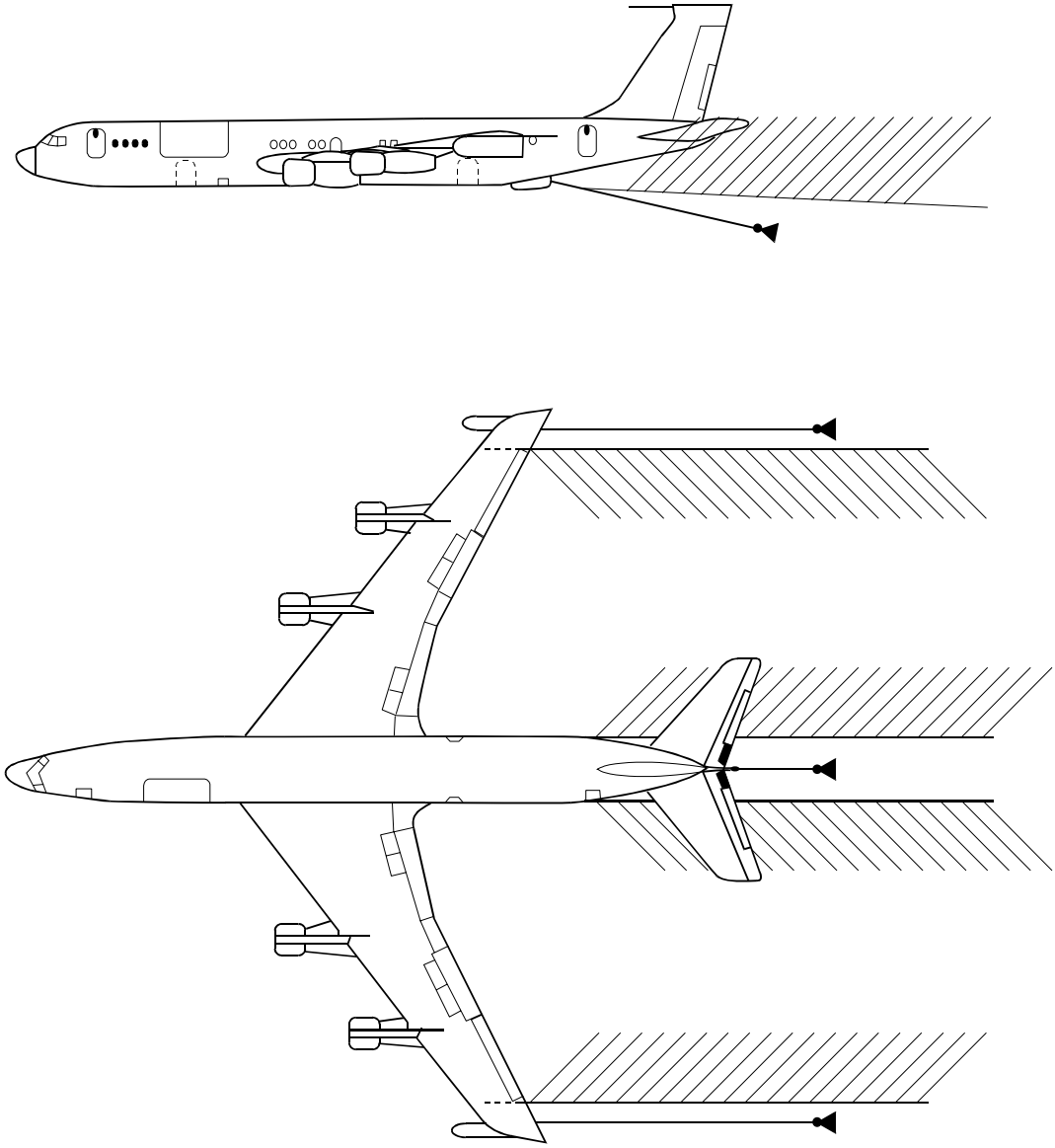






APPENDIX 5 TO ANNEX 10H

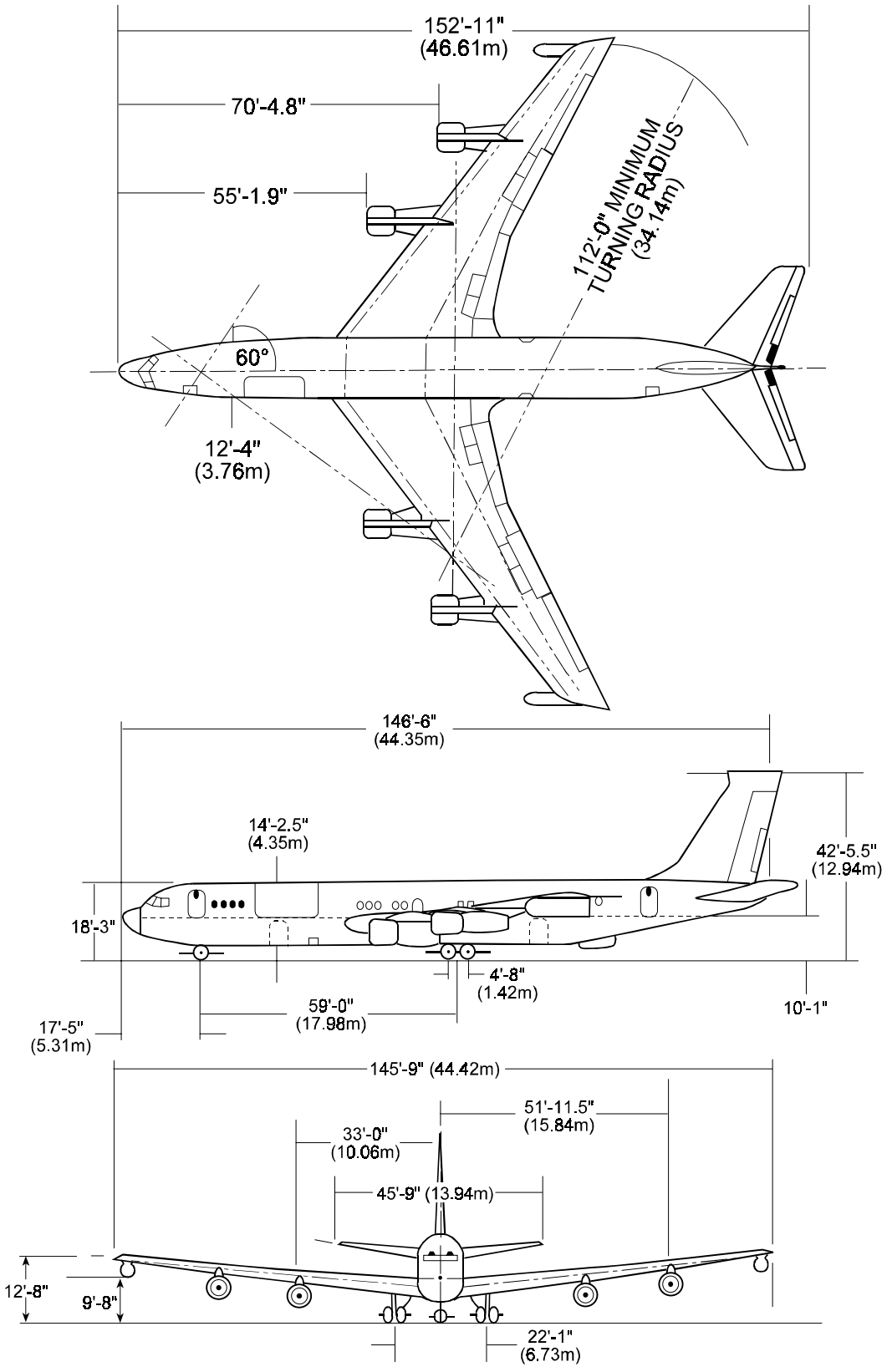
BOEING 707 TANKER – POSITION REFERENCE LIGHT ZONES



Note. Receivers will not fly within the boundaries defined by the position reference lights located on the sides and bottom of the fuselage and on the underwing. Flight in these areas could result in aircraft control difficulties and impingement on other receivers' envelopes or on the tanker envelope.

APPENDIX 6 TO ANNEX 10H

BOEING 707 TANKER



ANNEX 10I

NATIONAL ANNEX - NETHERLANDS

1. **Introduction**. The Netherlands have one tanker type, the KDC-10, which is functionally equivalent to USAF KC-10A series aircraft except that the aircraft has no receptacle for receiving fuel from boom equipped tankers. However, the KDC-10 has a reverse fuel pumping capability via the boom.

2. **KDC-10**.

a. AAR Equipment. One centreline flyable boom, which is identical to the boom system of the USAF series KC-10 aircraft. Procedures for refuelling from the boom are identical to those used with the USAF KC-10 boom. The KDC-10 boom is controlled from a remote aerial refuelling operator (RARO) station using a closed circuit 5 camera 3- dimensional video system, rather than from a visible station as in the USAF KC-10. The cameras are located in a fairing just in front of the boom attachment. Prior to and during refuelling, a heading change may be required if sun or shadow adversely affect camera operation.

b. Refuelling Heights and Speeds. The boom AAR height band is sea level to 37,000 ft; speed range is 180 to 350 KIAS.

c. Maximum Transferable Fuel. Total fuel load is 110,993 kg (244,700 lb). Transferable fuel is dependent on sortie duration; about 71,810 kg (158,000 lb) is available for transfer during a 4 hr flight, assuming a fuel burn rate of 8170 kg/hr (18,000 lb/hr).

d. Fuel Transfer Rate. 2270 kg/min (5000 lb/min) through the boom.

e. Regulated Fuel Pressure. 3.5 bars ± 0.35 bar (50 ± 5 psi).

f. Fuel Type Available for AAR.

(1) Primary/usual type of fuel is F34 (JP8) when operating from NL airfields.

(2) Alternative fuels depend upon airfield of loading; tanker can accept F35 (JET A1), F44 (JP5).

g. Receiver Types Certified. See Appendix 3.

The same boom envelope limits apply as for USAF KC-10A with the exception of a temporary right roll limitation of 21° rather than 23° right roll for F-16 aircraft.

h. Lighting. Aircraft lighting is identical to the USAF KC-10A with the

exception of logo and floodlights. The aft edge of the wing-tips are provided with logo lights illuminating the vertical fin if required, see Appendix 1.

(1) Pilot Director Lights. The PDLs have the same function and meaning as those fitted to the KC-10, see Appendix 2.

(2) Receiver Aircraft Floodlights. The receiver aircraft floodlights in the KDC-10 are used to illuminate the receiver aircraft during night refuelling. To achieve near day performance on the KDC-10 video camera's Remote Vision System, the floodlights are infra-red and can hardly be seen by the human eye.

i. Mark Facilities. Fuel dump and high intensity lighting. The aircraft is painted white on top, grey on bottom and has a blue stripe each side of the fuselage.

j. Dimensions. The KDC-10 is 55 m (180 ft) long and has a wingspan of 50 m (165 ft).

k. RV Aids. The KDC-10 has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, INS and search/weather radar.

(3) UDF, A/A TACAN (bearing and DME).

3. **Source Documents**.

a. CSTO NE 1-1C-1-33 (KDC-10 Air Refuelling Procedures).

b. CSTO NE 1C-10 (K)A-1 (KDC-10 Flight Manual).

4. **POC for National Annex**.

ROYAL NETHERLANDS AIR FORCE
Tactical Air Force
Chief Air Transport Operations Branch
PO Box 20703
2500 ES The Hague
The Netherlands

Tel: (+31) 70 339 62 01
Fax: (+31) 70 339 62 02

5. **POC for Tanker/Receiver Clearances**.

ROYAL NETHERLANDS AIR FORCE
Airbase Eindhoven
PO Box 90102
5600 RA Eindhoven
The Netherlands

Tel: (+31) 40 289 68 36
Fax: (+31) 40 289 68 15

6. **POC for STANEVAL**.

(As for National Annex).

7. **National Annex Last Updated**. Jul 03.

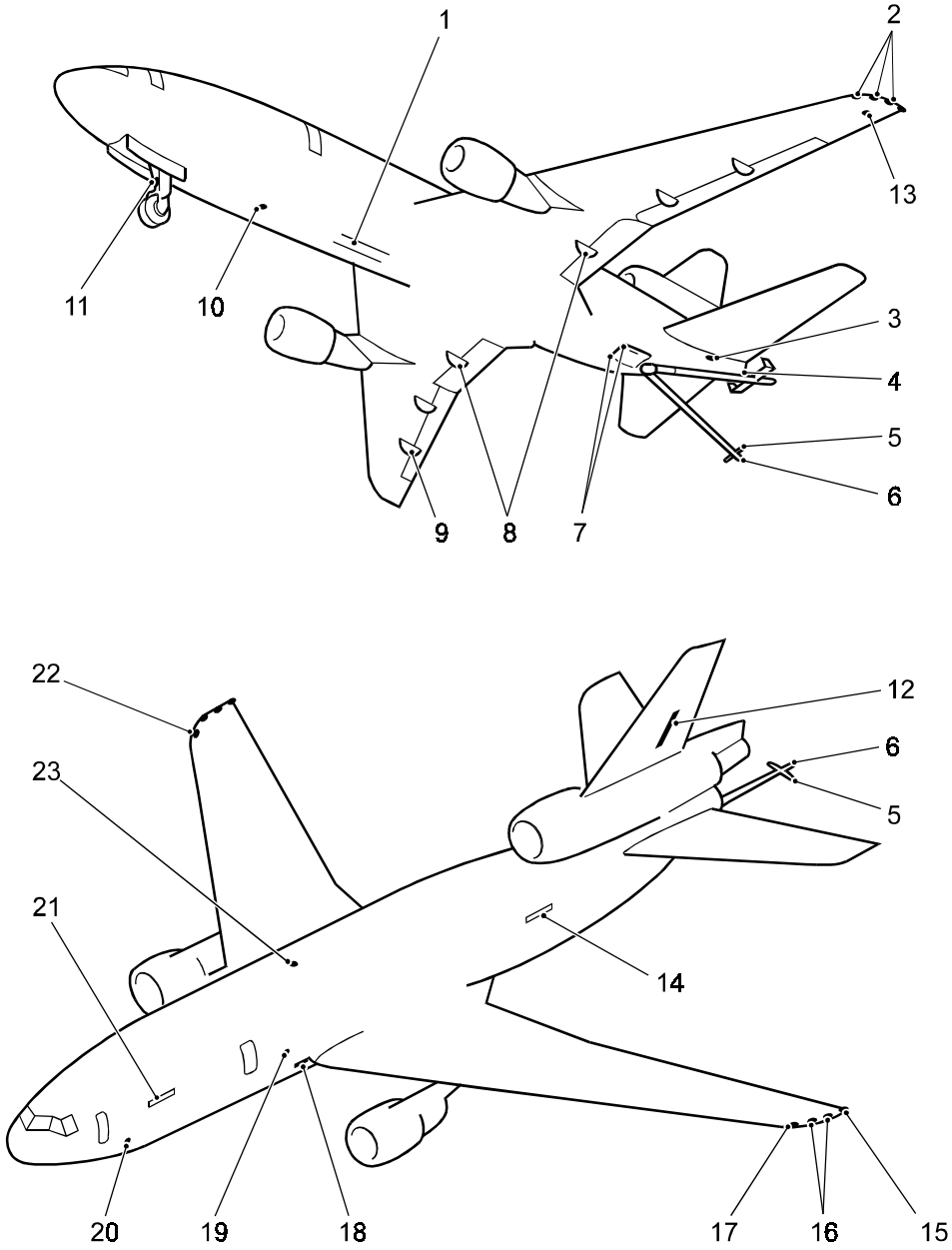
8. **National Reservations**. Nil.

Appendices:

1. KDC-10 Exterior Lighting.
2. KDC-10 Pilot Director Lights Illumination Profile.
3. KDC-10 Tanker Receiver Matrix.

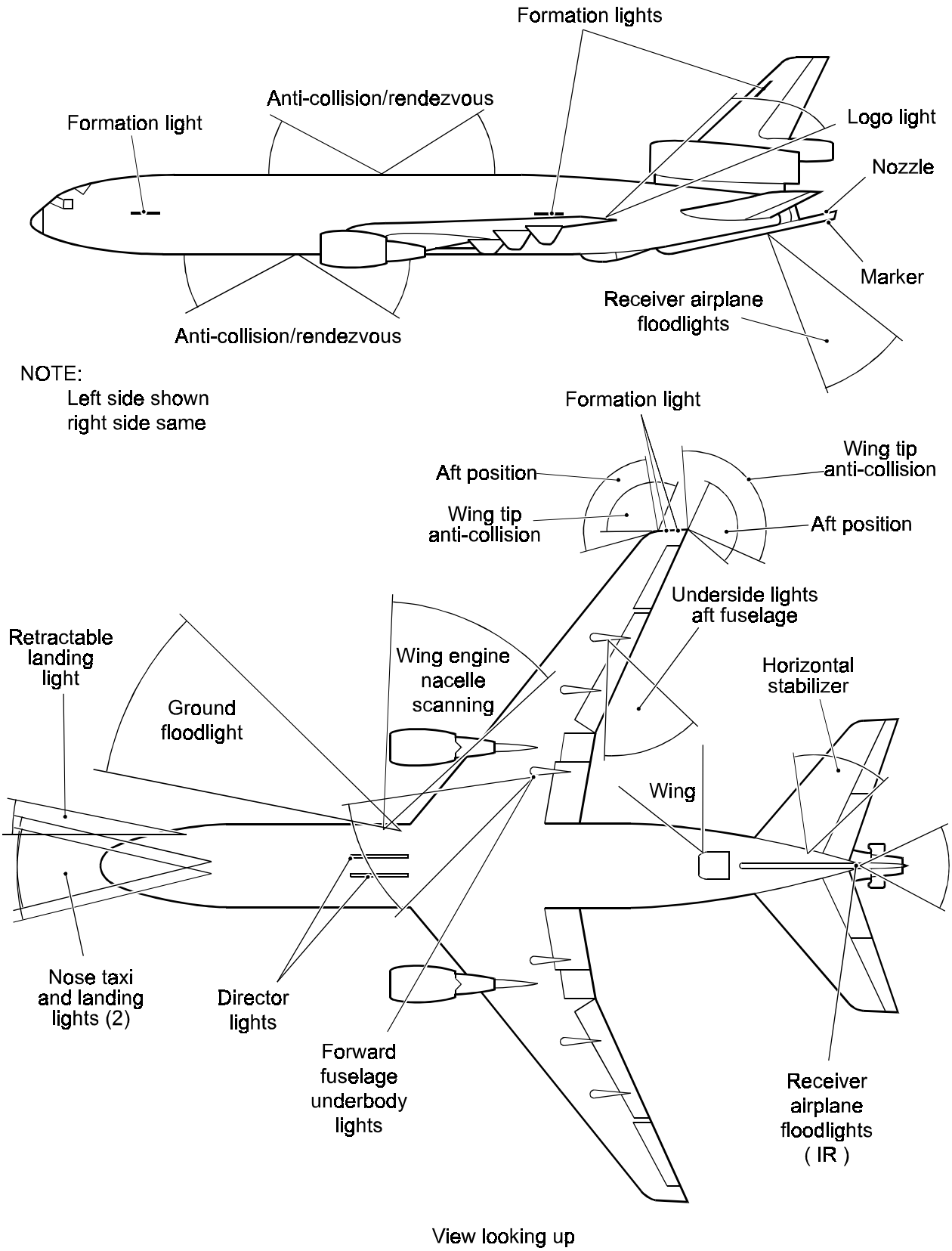
APPENDIX 1 TO ANNEX 10I

KDC-10 EXTERIOR LIGHTING (1)



1. Pilot Director Lights
2. High Intensity Supplemental Lights (typical)
3. Horizontal Stabilizer Illumination Light (typical)
4. Receiver Aircraft IR Floodlights
5. Boom Marker Lights (florescent)
6. Boom Nozzle Lights
7. Wing Illumination Lights
8. Forward Fuselage Underbody Lights
9. Aft Fuselage Underbody Light (typical)-inboard side of outboard flap hinge fairing
10. Lower Anti-collision/ Rendezvous Light
11. Nose Landing Gear Lights
12. Formation Light (typical)
13. Logo Lights
14. Formation Light (typical)
15. Aft Position Light, White (typical)
16. Formation Light (typical)
17. Forward Position Light, Red
18. Taxi and Runway Turnoff Light-Ground Flood (typical)
19. Wing and Engine Scan Light(typical)
20. Fuselage Landing Light (typical)
21. Formation Light (typical)
22. Forward Position Light, Green
23. Upper Anti-collision/ Rendezvous Light

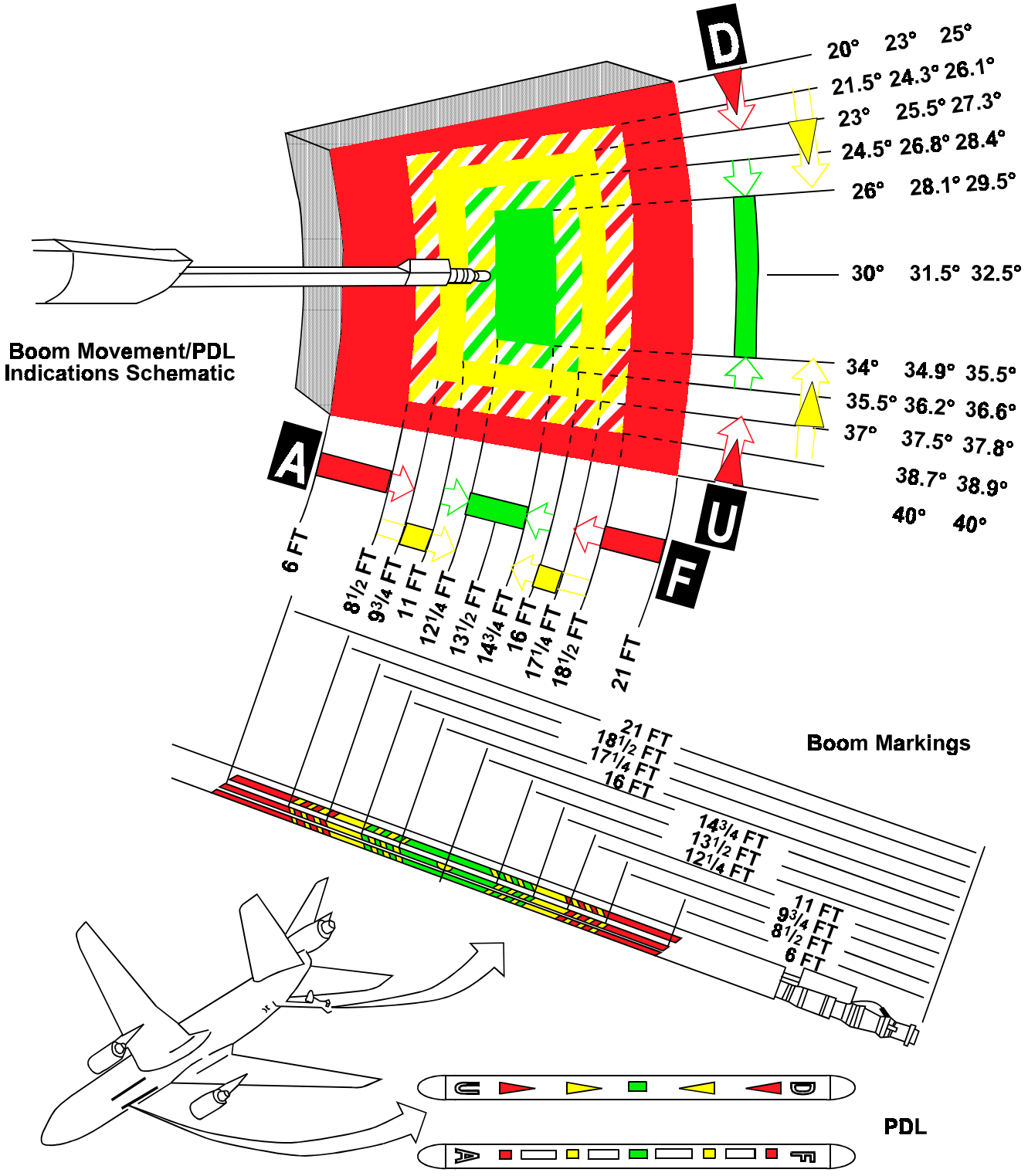
KDC-10 EXTERIOR LIGHTING (2)



View looking up

APPENDIX 2 TO ANNEX 10I

KDC-10 PILOT DIRECTOR LIGHTS ILLUMINATION PROFILE



APPENDIX 3 TO ANNEX 10I

KDC-10 TANKER RECEIVER MATRIX

RECEIVER / TANKER	KDC-10
A-10	✓
E-3A (NATO)	✓
E-3D (RAF)	✓
E8A JSTARS	✓
F-15 (USAF)	✓
F-16 (BAF)	✓
F-16 (Greek AF)	✓
F-16 (RDAF)	✓
F-16 (RNoAF)	✓
F-16 (RNLAF)	✓
F-16 (Turkish AF)	✓
F-16 (USAF)	✓
KC/RC 135	✓
KC-10	✓
MC-130 (USAF)	✓

Note: The same boom envelope limits apply as for USAF KC-10A with the exception of a temporary right roll limitation of 21° rather than 23° right roll for F-16 aircraft.

ANNEX 10K

NATIONAL ANNEX - NORWAY

1. **Introduction**. Norway has no indigenous tanker assets and consequently no inputs for this Annex.

2. **POC for National Annex**.

3. **POC for Tanker/Receiver Clearances**.

4. **POC for STANEVAL**.

5. **National Annex Last Updated**. Nov 90.

6. **National Reservations**. Nil.

ANNEX 10L

NATIONAL ANNEX - PORTUGAL

1. **Introduction**. Portugal has no indigenous tanker assets and consequently no inputs for this Annex.

2. **POC for National Annex**.

3. **POC for Tanker/Receiver Clearances**.

4. **POC for STANEVAL**.

Estado-Maior Da Força Aérea
No 3 Divsao (Operacoes)
Av Da Força Aérea
Alfragide
2720 Amadora
Portugal
Messages: DIVTRESFAP
Tel: (+351) 1 471 3549 Ext 3207
Fax: (+351) 1 471 9403

5. **National Annex Last Updated**. 15 Jul 96.

6. **National Reservations**. Nil.

ANNEX 10M

NATIONAL ANNEX - SOUTH AFRICA

1. **Introduction**. South Africa has one tanker type, the Boeing 707/320C.

2. **Boeing 707/320C**.

a. AAR equipment. The South African Boeing 707/320C has 2 wing-tip mounted AAR pods and one fuselage mounted hose drum unit. The wing-tip pod hoses are 16 m (55 ft) and the fuselage mounted hose is 22 m (74 ft) long, each terminating in MA-3/MA-4 coupling and drogue.

b. Refuelling Heights and Speeds. The AAR height band is 500 ft AGL/AMSL to 35,000 ft. The speed range is 220 to 325 KIAS.

c. Maximum Transferable Fuel. Transferable fuel is dependent on sortie duration. Approximately 25,000 kg (55,000 lb) of fuel is available for AAR transfer during a 4 hr flight, assuming an average fuel consumption rate of 7000 kg/hr (16,300 lb/hr), including diversion reserves

d. Fuel Transfer Rate. Transfer rates of wing mounted pods is 1500 kg/min (3300 lb/min) and the fuselage mounted reel system is 900 kg/min (1980 lb/min).

e. Regulated Fuel Pressure. The fuel pressure at the drogue is regulated not to exceed 3.5 bars (50 ± 5 psi).

f. Fuel Type available for AAR:

(1) Primary/usual fuel is JET A1.

g. Receiver Types Certified. The following aircraft are cleared to refuel from the Boeing 707/320C tanker:

(1) Mirage F1.

(2) Any aircraft fitted with a standard make AAR probe compatible with a MA-3/MA-4 coupling can be cleared.

h. Lighting. AAR equipment signal lights are mounted on 2 diagonal rows next to the hose tunnel of the fuselage mounted hose reel and on vertical rows on either side of the AAR wing pods. Light colours have the following meaning:

Flashing Red	Do not make contact
Steady Amber	Tanker ready for AAR

Steady Green	Fuel flows
Flashing Amber	Hose pushed in beyond the minimum refuelling range, ie receiver too close. No fuel flow.
Flashing Red (whilst in contact)	Tanker emergency, breakaway.

The aircraft underwing surface and outboard engine nacelles are illuminated and the drogue canopy is fitted with a fluorescent light source. The hose is marked with 4 light reflecting white bands spaced at 3 m (10 ft) intervals.

i. Mark Facilities. Nil.

j. Dimensions. Standard Boeing 707/320 dimensions.

k. RV Aids. The Boeing 707/320C tanker is equipped with the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, INS and ADF navigation aids.

(3) UDF and A/A TACAN.

3. **Source Documents**.

a. Boeing 707/320C Aircraft Flight Manual.

b. 60 Squadron South Africa Air Force AAR SOPs.

4. **POC for National Annex**.

5. **POC for Tanker/Receiver Clearances**.

6. **POC for STANEVAL**.

OC 60 Sqn
Private Bag X1001
Air Force Base Waterkloof
Verwoerdburg
0140 Pretoria
South Africa
Tel: (+27) 012 672 3658
Fax: (+27) 012 672 3651

7. **National Annex Last Updated**. 15 Jun 96

8. **National Reservations**. Nil.

ANNEX 10N

NATIONAL ANNEX - SPAIN

1. **Introduction**. Spain has 2 tanker types: the KC130H Hercules, operated by the Spanish Air Force (SAF) as the TK-10, and the Boeing 707 T/T, operated by the SAF as the TK-17.

2. **KC130H**. The KC130H is cleared as a tanker by day and night:

a. AAR Equipment. The KC130H has 2 drogue equipped refuelling stations, one mounted on each wing outboard of the engines. Each refuelling station consists of a refuelling pod, 26 m (85 ft) of hose, MA-2 coupling and 1 m (27 in) diameter paradrogue. Fuel flows when the hose is pushed in 1.5 m (5 ft); flow continues provided the hose is maintained in the refuelling position, between 6 - 24 m (20 - 80 ft) of hose extension. Hydraulic pressure provides 90% of the force required to rewind the hose during refuelling to reduce hose slack and whip. The hoses are marked each 3 m (10 ft). The MA-2 coupling requires 140 ft lb of pressure to make contact (2 - 5 knot closure) and 420 ft lb to disconnect.

b. Refuelling Heights and Speeds. AAR height band is from 1500 ft to 23,000 ft; speed range is 195 to 250 KIAS. Refuelling at tanker heavy weights and high speeds will require detailed planning and may require the use of the toboggan manoeuvre.

c. Maximum Transferable Fuel. With an internal auxiliary tank, total fuel loads are normally up to 32,662 kg (72,000 lb), with an overload weight of 38,500 kg (84,900 lb). Without the auxiliary tank, total fuel is 27,954 kg (61,500 lb). Transferable fuel is dependent on sortie duration; around 18,182 kg (40,000 lb) is available for transfer during a 4 hr flight with the auxiliary tank and 24,045 kg (52,900 lb) if overload. Without the auxiliary tank, 13,409 kg (29,500 lb) of fuel is transferable. Fuel figures assume a fuel burn rate of 2727 kg/hr (6000 lb/hr).

d. Fuel Transfer Rate. With fuselage fuel tank fitted, the transfer rate is about 885 kg/min (1950 lb/min) per drogue. Without the fuselage tank, the transfer rate is about 442 kg/min (975 lb/min) per drogue.

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated to be 45 ± 5 psi.

f. Fuel Types Available for AAR. Information not available.

g. Receiver Types Certified. The following aircraft types are cleared to refuel from the SAF KC130H:

(1) AMX (daylight only) (IAF).
(2) CASA 295 (T-21) (SAF).
(3) C-160NG Transall (day only, limited to 50 ft of drogue visible) (FAF).
(4) CF-18 (CAF).
(5) EA-6B (USN).
(6) EF-18 A/B (SAF).

(7) EF-2000.
(8) F-14 Tomcat (USN).
(9) F-18 (A/B/C/D) (USN, USMC).
(10) Harrier AV-A/B, GR-7, Sea Harrier F/A2 (SAF, RAF, USN, USMC).
(11) Jaguar (FAF, RAF).
(12) Mirage 2000 (FAF).
(13) Mirage F1EE (SAF, low transfer rate), F1CR (FAF).
(14) S-3 Viking (USN).
(15) Tornado IDS, ECR, F3, GR4/4A, PA 200 (IAF, GAF, RAF).
(16) Super Etendard (FAF). Authorized to provide up to 700lb less than maximum fuel load (top offs prohibited).

h. Lighting. Red, green and amber lights are located on the trailing edge of each pod. These are AAR pod status lights and mean:

Steady Red (before contact)	Do not make contact
Steady Amber	Pod system ready for contact
Steady Green	Fuel flows
Flashing Green	Receiver full or pod fuel malfunction
Steady Red (whilst in contact)	Disconnect, pod malfunction

The light signal commanding a breakaway is the tanker's lower rotating beacon being switched on. Before a receiver is cleared for contact, the beacon is turned off to indicate the tanker's AAR checklist has been completed. AAR during EMCON constraint requires additional light signals from the tanker; these are provided by hand held ALDIS lamps. These lights will be seen in the paratroop door windows located at the rear of the fuselage on both sides of the aircraft. Drogue illumination is provided by refuelling lights located on the outboard leading edge of the horizontal stabilizer.

i. Mark Facilities. Nil.

j. Dimensions. See aircraft drawing, Appendix 1.

k. RV Aids. The KC130H has the following radio, navigation and RV aids:

(1) VHF, and HF radios.

(2) VOR, ADF, TACAN and INS.

(3) UDF and A/A TACAN (ranges).

3. **Boeing 707 T/T**. The B707 T/T is cleared as a tanker by day and night.

a. AAR Equipment. The B707 T/T has 2 drogue equipped refuelling stations, one mounted on each wing outboard of the engines. Each refuelling station consists of a refuelling pod, 15 m (50 ft) of hose and a MA-4 coupling. Fuel flows when the hose is pushed in 1.5 m (5 ft); flow continues provided the hose is maintained in the refuelling position, between 9.1 - 13.7 m (30 - 45 ft) of hose extension. The hoses are marked each 3 m (10 ft). The MA-4 coupling requires 140 ft lb of pressure to make

contact (2 - 5 knot closure) and 420 ft lb to disconnect.

b. Refuelling Heights and Speeds. AAR height band is from 1500 ft to 35,000 ft; speed range is 200 to 350 KIAS (standard 250 to 310 KIAS). Standard altitude is 20,000 ft. Optimum speed is 275 KIAS or 0.78 IMN, whichever is the lower.

c. Maximum Transferable Fuel. Maximum fuel load is 71,000 kg (156,200 lb). Transferable fuel is dependant on sortie duration; around 33,000 kg (73,000 lb) of fuel is available for transfer during a 4 hr flight, assuming an average fuel consumption of 7400 kg/hr (16,300 lb/hr) including diversion reserves.

d. Fuel Transfer Rate. Transfer rate is about 1500 kg/min (3330 lb/min) per drogue.

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated to maintain a maximum pressure of 55 psi.

f. Fuel Types Available for AAR. Information not available.

g. Receiver Types Certified. The following aircraft types are cleared to refuel from the SAF B707 T/T:

(1) AMX (daylight only) (IAF).
(2) CASA 295 (T-21) (SAF).
(3) CF-18 (CAF).
(4) EA-6B (USN).
(5) EF-18 A/B (SAF).
(6) EF-2000.
(7) F-18 (A/B/C/D) (USN, USMC).
(8) Harrier AV-A/B, GR-7, Sea Harrier F/A2 (SAF, RAF, USN, USMC).
(9) Jaguar (FAF, RAF).
(10) Mirage 2000 (FAF).
(11) Mirage F1EE (SAF, low transfer rate), F1CR (FAF).
(12) S-3 Viking (USN).
(13) Tornado IDS, ECR, F3, GR4/4A, PA 200 (IAF, GAF, RAF).

h. Lighting. Red, amber and green lights are located on the trailing edge of each pod. These are AAR pod status lights and mean:

Steady Red (before contact)	Do not make contact
Steady Amber	Pod system ready for contact
Flashing Amber	Hose pushed in beyond minimum refuelling range. No fuel flow
Steady Green	Fuel flows
Steady Red (whilst in contact)	Disconnect, pod malfunction
Flashing Red (whilst in contact)	Breakaway

i. Mark Facilities. Nil.

j. Dimensions. See aircraft drawing, Appendix 2.

k. RV Aids. The B707 T/T has the following radio, navigation and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, ADF, TACAN and INS/GPS.

(3) UDF and A/A TACAN (ranges).

4. **Source Documents**.

a. Spanish Air Force AAR Manual (Manual de Reabastecimiento en Vuelo).

5. **POC for National Annex**.

Seccion Defensa & Ataque
Division Operaciones / Estado Mayor Aire
Cuartel General Ejercito Aire
C/ Romero Robledo n-8
28008 Madrid
Spain
Tel: (+34) 91 549 0700 Ext 2491
Fax: (+34) 91 544 7509

6. **POC for Tanker/Receiver Clearances**.

7. **POC for STANEVAL**.

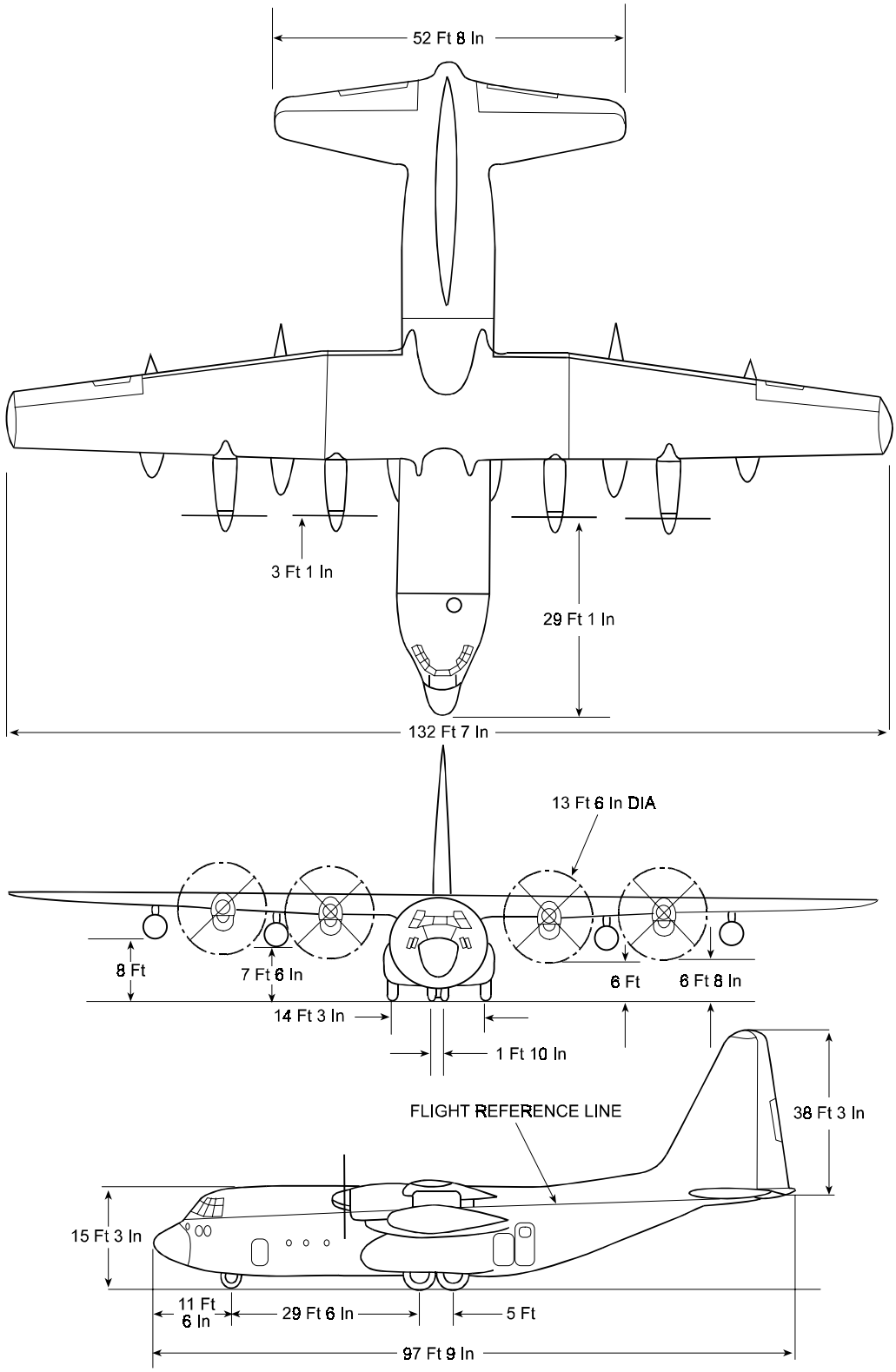
(As for National Annex).

8. **National Annex Last Updated**. Dec 02

9. **National Reservations**. Nil.

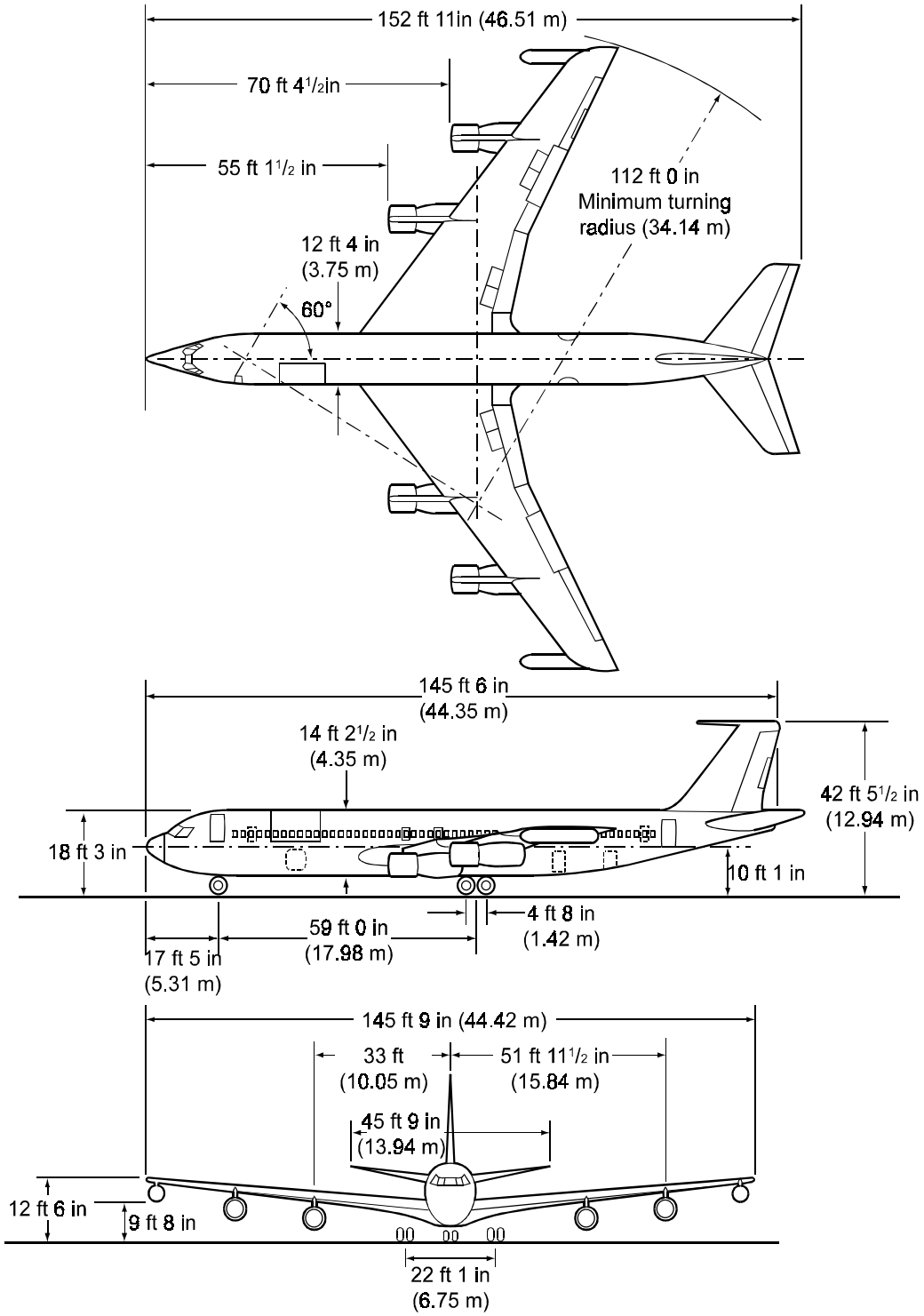
APPENDIX 1 TO ANNEX 10N

KC130H DIMENSIONS



APPENDIX 2 TO ANNEX 10N

BOEING 707 T/T DIMENSIONS



ANNEX 10O

NATIONAL ANNEX - TURKEY

1. **Introduction**. Turkey has one tanker type: the KC-135R, which is operated by the Turkish Air Force (TuAF). The TuAF normally use RV Delta (Point Parallel) in preference to RV Bravo and Charlie. If RV Bravo or Charlie is specified for a NATO exercise/operation, the TuAF would require pre-mission briefing between tanker and receiver.

2. **KC-135R**. The TuAF operate the KC-135R in the boom configuration, plus one boom drogue adapter (BDA) kit.

a. AAR Equipment. One centreline mounted flyable boom. The boom can be modified to refuel probe equipped aircraft by fitting a BDA; the BDA can only be fitted/removed on the ground.

(1) Boom. The boom is approximately 6.1 m (20 ft) long with an additional 5.5 m (18.5 ft) of inner fuel tube which can be extended or retracted by the boom operator. Some booms are equipped with a Boom Interphone System which permits direct communication with suitably equipped receivers. 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. When cleared, the receiver moves from the pre-contact position to a steady boom contact position. 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. The receiver pilot then maintains his aircraft within the boom operating 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 manoeuvre in the pitching, rolling and yawing planes. Provided the receiver remains within the envelope, contact is maintained; however, if the receiver moves beyond the limits, a disconnect will automatically occur. The envelope limits are set well within the mechanical limitations of the boom; therefore, provided the envelope limits are not exceeded too rapidly, the disconnect will occur before the boom is damaged. The full boom envelope is illustrated in Appendix 1; however, the freedom of manoeuvre in boom elevation is reduced for some receiver aircraft because of their receptacle characteristics. 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 pre-contact position. If the receptacle toggles fail to release, they can be over-ridden by the receiver carrying out a Brute Force Disconnect.

(2) BDA. The BDA is 2.74 m (9 ft) of hose attached to the end of the telescoping part of the boom by a swivelling 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. There are pre-determined boom elevation

and azimuth settings for each receiver type; the boom operator endeavours to hold the boom steady at these settings throughout the pre-contact and refuelling phases. The ideal pre-contact 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. Great caution is required with the BDA because, unlike hose drum systems, hose slack is not wound in. Contacts made with closure rates greater than about 2 knots will cause the hose to whip with a consequent high probability of probe damage. Having made contact, the probe should be positioned slightly offset from the boom to make the hose adopt a U shape to one side; the ideal in-contact position is illustrated in Appendix 2. The ideal position permits about 1.52 m (5 ft) of forward and aft movement. 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. 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 fuel does not transfer, the receiver will be instructed to disconnect; the receiver should drop back to the pre-contact 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. If possible, the tanker air refuelling pumps will be switched off 5 seconds before the scheduled disconnect to minimize fuel spray on disconnect. When cleared, the receiver should disconnect by dropping back, 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. However, in an emergency he may do so, in which event the drogue will whip violently as contact is broken. To avoid the drogue striking the aircraft, the receiver pilot must not stray away from the correct lateral alignment.

b. Refuelling Heights and Speeds. The AAR height band is sea level to heights in excess of 30,000 ft; speed range is 200 to 320 KIAS.

c. Maximum Transferable Fuel. The maximum transferable fuel for KC-135R (CFM 56 engines) is 92,060 kg (203,000 lb) and maximum fuel available for offload on a 4 hr sortie is approximately 61,280 kg (135,000 lb).

d. Fuel Transfer Rate. The tanker can transfer fuel at rates exceeding 2722 kg/min (6000 lb/min) through the boom and at 1270 kg/min (2800 lb/min) through the BDA.

e. Regulated Fuel Pressure. 3.5 ± 0.35 bars (50 ± 5 psi).

f. Fuel Types Available for AAR.

(1) Primary fuel is F34.

(2) Alternate fuels are F35, F40 and F44.

g. Receiver Types Certified. To aid identification, the common NATO reporting name (if applicable) is given in addition to the US nomenclature. Boom or BDA compatibility is listed. This document is not a clearance for all NATO receivers to refuel with TuAF tankers. Although certified, some receiver types may not be qualified on the KC-135.

(1)	A-10	Thunderbolt	Boom
(2)	B-l	Lancer	Boom
(3)	B-2	Spirit	Boom
(4)	B-52	Stratofortress	Boom
(5)	C-5	Galaxy	Boom
(6)	C-17	Globemaster III	Boom
(7)	C-130	Hercules	Boom (USAF models only)
(8)	C/EC/KC/RC/WC-135		Boom
(9)	C-l41	Starlifter	Boom
(10)	EA-6B	Prowler	BDA
(11)	E-3	Sentry	Boom
(12)	E-4	Elint model of B 747	Boom
(13)	F/RF-4	Phantom	Boom (USAF)
(14)	F-14	Tomcat	BDA
(15)	F/TF-l5	Eagle	Boom
(16)	F-l6	Falcon	Boom
(17)	F/A-l8, CF-l8	Hornet	BDA
(18)	F-117	Nighthawk	Boom
(19)	KC-l0	Extender	Boom
(20)	S-3	Viking	BDA
(21)	Tornado F3, GR1, IDS, PA 200		BDA

h. Lighting. Aircraft undersurfaces are illuminated by floodlights, which are adjustable for brilliance, see Appendix 3. Also provided are Pilot Director Lights (PDL), which give positioning information to receiver pilots in contact and during disconnect. 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 refuelling position. 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 4. 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 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. Similar indications are provided for upward commands. 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; red leads into green, with the ideal position shown by 2 green dots. The command indications are separated by illuminated vertical white bars to give contrast. The telescoping part of the boom is in coloured segments which duplicates PDL indications. Lights are not provided for azimuth positioning; however, a fluorescent yellow stripe on the under-surface of the tanker fuselage is provided for centreline reference. During radio silence, the PDLs can be used to give some 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. When a receiver is in contact, flashing PDLs command a breakaway; if the PDLs go out, a routine disconnect is required. If the PDLs do not illuminate when a receiver makes contact, the receiver should disconnect and await instructions.

i. Mark Facilities. Fuel dump (from boom).

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

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

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, INS, Doppler Nav system and search/weather radar.

(3) UDF, A/A TACAN (DME only), ETCAS, radar transponder and radar beacon mode.

3. **Source Documents**.

a. TO 1-1C-1-3 (KC-135 Air Refuelling Procedures).
b. TO lC-135 (K) R-l (KC-135 Flight Manual).

4. **POC for National Annex**.

TuAF Ops Plan Division
06100. BAKANLIKLAR
Ankara
Turkey
Tel: (+90) 312 414 3553
Fax: (+90) 312 425 6181

5. **POC for Tanker/Receiver Clearances**.

6. **POC for STANEVAL**.

Commanding Officer 101 Sqn

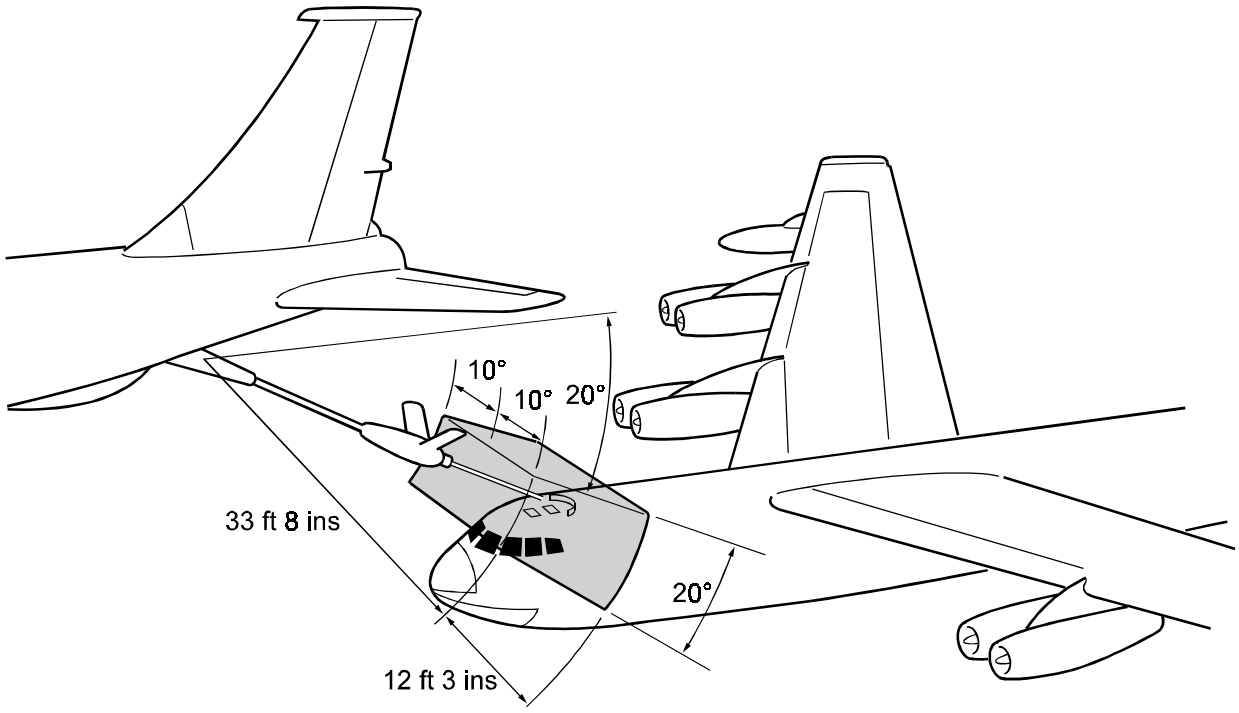
Tel: DSN 676 2566
Fax:

7. **National Annex Last Updated**. Dec 02.

8. **National Reservations**. Nil.

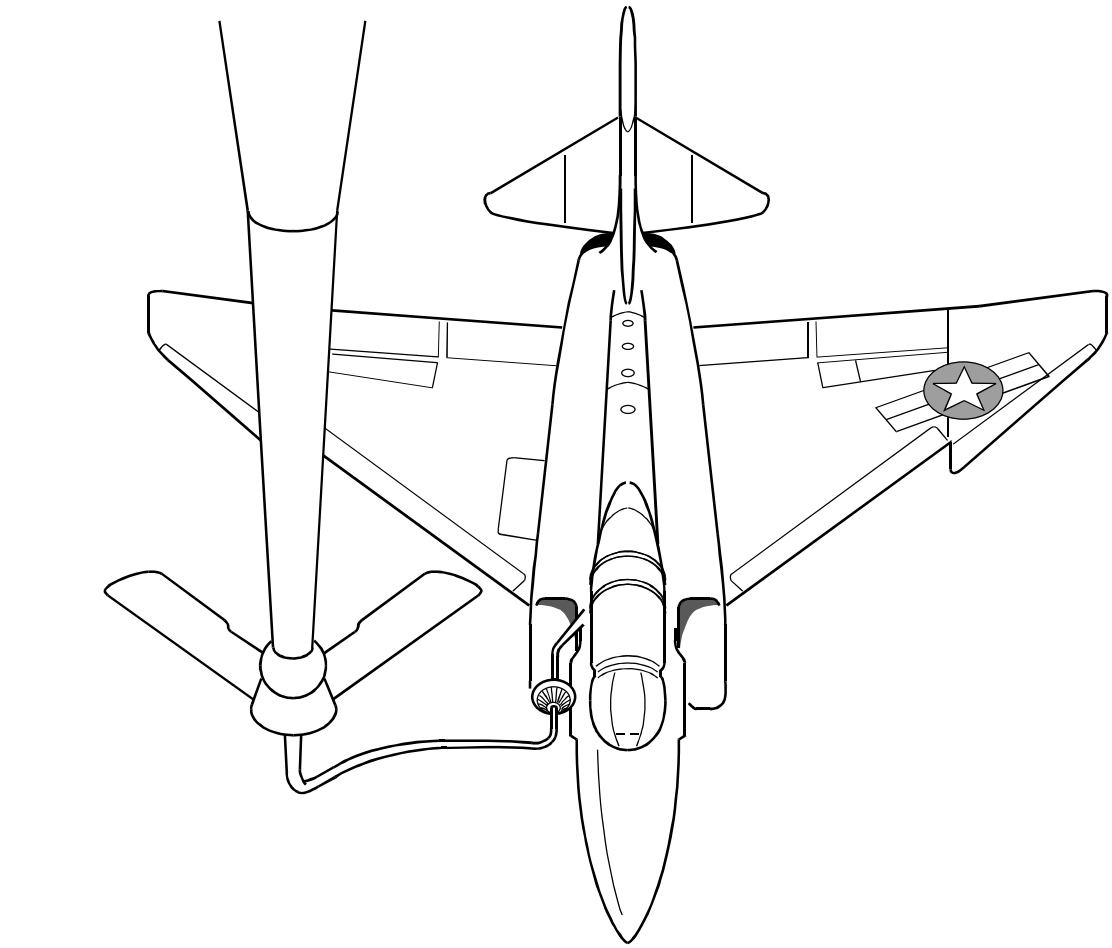
APPENDIX 1 TO ANNEX 10O

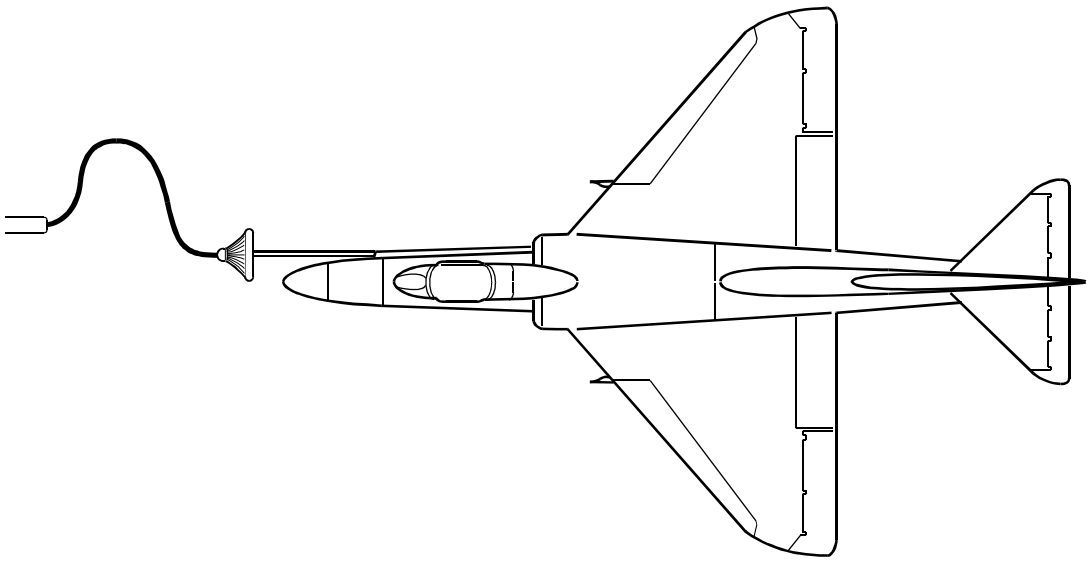
KC-135 BOOM ENVELOPE LIMITS



APPENDIX 2 TO ANNEX 10O

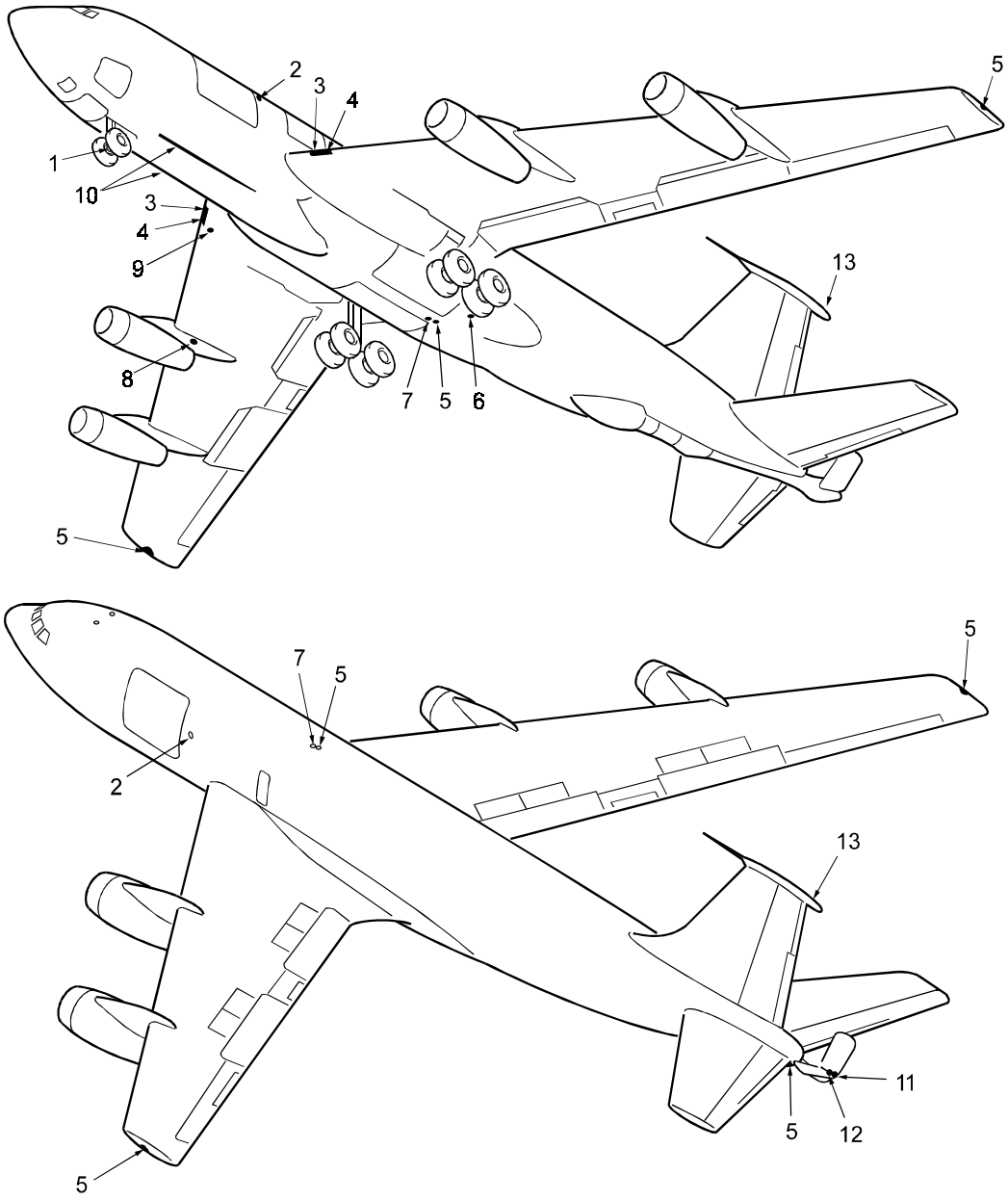
BOOM DROGUE ADAPTER REFUELLING





APPENDIX 3 TO ANNEX 10O

KC-135 EXTERIOR LIGHTING

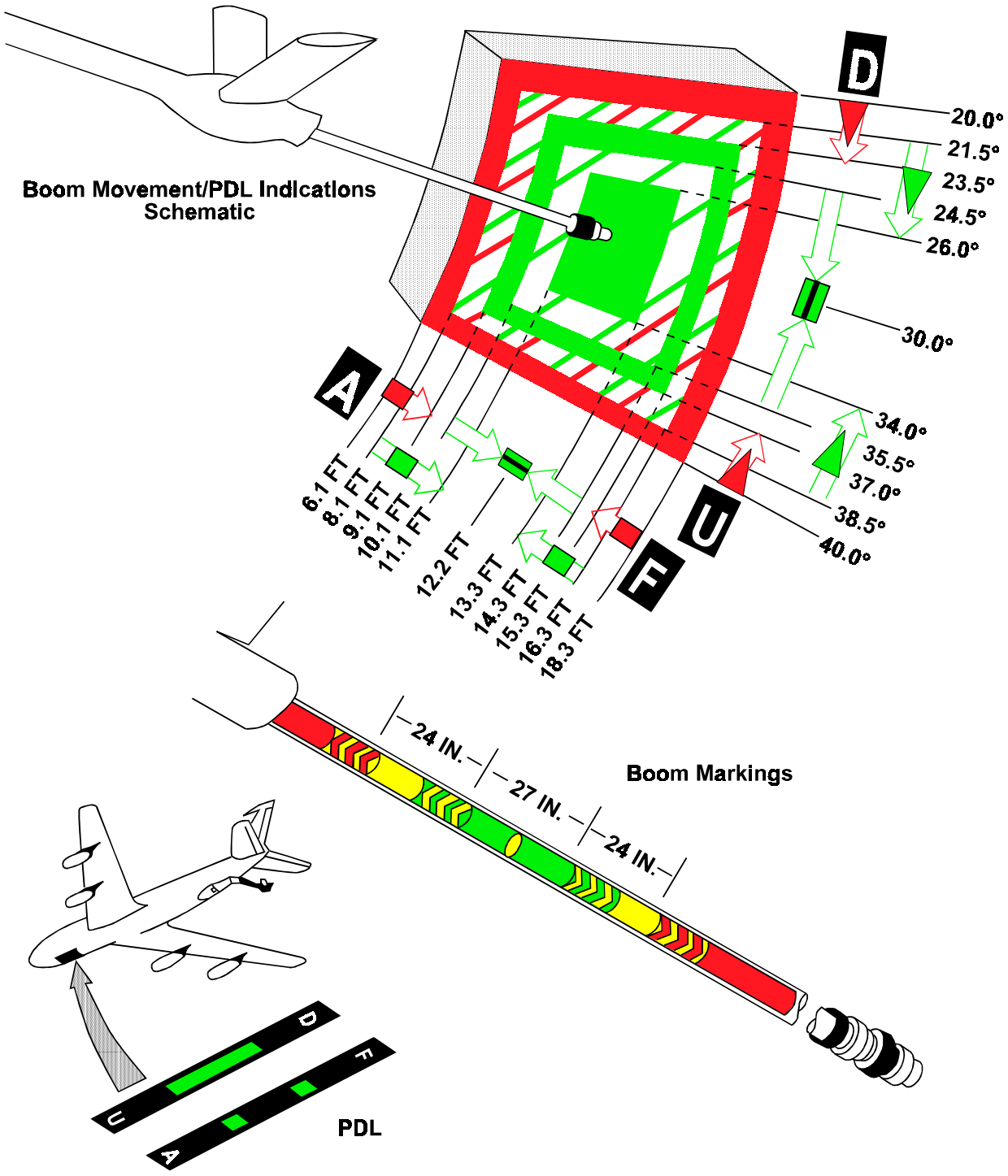


1	Nose landing and taxi light	*8	Underbody illumination light (typical)
*2	Nacelle illumination light (typical) (2 places)	9	Terrain light (retractable)
3	Taxi light (2 places)	*10	Receiver pilot director light
4	Landing light (fixed) (2 places)	11	Boom marker lights (fluorescent)
*5	Navigation light (7 places)	*12	Boom nozzle light
*6	Underwing illumination light (typical)	13	AAR flood lights
7	Rotating beacon lights (2 places)		

*Designates Adjustable Lighting

APPENDIX 4 TO ANNEX 10O

KC-135 PILOT DIRECTOR LIGHTS – ILLUMINATION PROFILE



ANNEX 10P

NATIONAL ANNEX - UNITED KINGDOM

1. **Introduction**. The UK has 2 tanker types, TriStar and VC10, both operated by the RAF.

2. **TriStar K1 and KC1**. There are 2 marks of TriStar tanker in service, details are applicable to both marks. TriStar tankers are capable of having a probe fitted to receive fuel.

a. AAR Equipment. There are 2 FRL Mk17T hose drum units (HDU) mounted side-by-side, recessed into the lower rear fuselage of the aircraft; only one hose is available for use at a time. The centreline hose is 24 m (81 ft) long and terminates in a FRL coupling and drogue. When the receiver pushes in 2 m (7 ft) of hose, fuel will flow. Hose markings are shown at Appendix 1.

b. Refuelling Heights and Speeds. AAR height band is sea level to 35,000 ft; speed range is 200 to 320 KIAS.

c. Maximum Transferable Fuel. Total fuel load is 128,000 kg (260,500 lb). Transferable fuel is dependent on sortie duration; a representative offload of 86,000 kg (190,000 lb) is available for a 4 hr flight, assuming a fuel burn rate of 8000 kg/hr (18,000 lb/hr).

d. Fuel Transfer Rate. Transfer rate is 2200 kg/min (4800 lb/min) at 40 psi (2.75 bars).

e. Regulated Fuel Pressure. Fuel pressure at the drogue is regulated not to exceed 3.5 bars (50 psi).

f. Fuel Types Available for AAR.

(1) Primary/usual type of fuel is F34 when operating from UK RAF airfields.

(2) Alternate fuels depend upon airfield of loading; tanker can accept F35, F40, F43 and F44.

g. Receiver Types Certified. See Appendix 4.

h. Lighting. AAR equipment signal lights are mounted in vertical rows next to the fuselage hose tunnels. Lights are coloured red, green and amber. The lights signal the following:

Steady Red	Do not make contact
Steady Amber	Tanker ready for contact
Steady Green	Fuel Flows

Flashing Amber	Planned offload complete, no more fuel available, receiver to disconnect.
Flashing Green	Planned offload complete, more fuel available, receiver may remain in contact or disconnect as required.
Flashing Green (within one minute of contact)	Soft contact. Receiver clear to disconnect.
Red (whilst in contact)	Breakaway
All lights out	Equipment malfunction. Disconnect/do not make contact.

Aircraft undersurfaces are illuminated by floodlights. Drogue canopy is fitted with luminous light sources.

i. Mark Facilities. Aircraft are fitted with strobe lighting.

j. Dimensions. See aircraft drawing, Appendix 2.

k. RV Aids. The TriStar has the following radio, navigation, and RV aids:

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, ADF and INS.

(3) UDF, A/A TACAN (bearing facility available with suitably equipped receivers).

3. **VC10C1K, K3 and K4**. There are 3 marks of VC10 tanker in service and all are fitted with a probe to receive fuel. The following information applies to all marks except where detailed.

a. AAR Equipment. The VC10 has one FRL Mk17B fuselage mounted hose drum unit and 2 wing mounted FRL Mk32-2800 AAR pods, with the exception of the C1K which has wing mounted pods only. The centre hose is 24 m (81 ft) long and the wing pod hoses are 18 m (55 ft) long; all hoses terminate in a FRL coupling and drogue. Hose markings are shown at Appendix 1.

b. Refuelling Heights and Speeds. AAR height band is sea level to 35,000 ft; speed range is 235 to 310 KIAS.

c. Maximum Transferable Fuel. Total fuel loads are: C1K and K4 70,300 kg (155,000 lb) and K3 80,000 kg (176,000 lb). Transferable fuel is dependent on sortie duration; around 32,000 kg (70,000lb) is available for transfer from a C1K or K4 and 45,000 kg (100,000 lb) is available from a K3 for transfer during a 4 hr flight, assuming a fuel burn rate of 7000 kg/hr (16,000 lb/hr).

d. Fuel Transfer Rate. Centreline maximum transfer rate is 2200 kg/min (4800 lb/min); wing pods transfer rate is 1300 kg/min (3000 lb/min).

e. Regulated Fuel Pressure. Fuel pressure at all drogues is regulated not to exceed 3.5 bars (50 psi).

f. Fuel Types Available for AAR. As for the TriStar.

g. Receiver Types Certified. See Appendix 4.

h. Lighting. AAR equipment signal lights are mounted in vertical rows at the fuselage AAR station and horizontally on the AAR pods. The colours and meanings are as for the TriStar. Aircraft undersurface floodlighting and drogue lights are as for the TriStar.

i. Mark Facilities. Aircraft are fitted with strobe lighting.

j. Dimensions. See aircraft drawing, Appendix 3.

k. RV Aids. The VC10 has the following radio, navigation, and RV aids:

(1) VHF, UHF and HF radios, plus AUTOCAT for C1K and K4 only.

(2) VOR, TACAN, ADF and INS.

(3) UDF and A/A TACAN (bearing available to suitably equipped receivers).

4. **Source Documents**.

a. TriStar and VC10 Technical Manuals.

b. United Kingdom AAR National Instructions (UKAARNIs).

5. **POC for National Annex**.

SO2 AAR Trg
HQ 2 Group
Royal Air Force High Wycombe
Buckinghamshire HP14 4UE
UK

Tel: (+44) 1494 496583
Fax: (+44) 1494 497981
E-mail: 2gp-aar&trg@hwstc.raf.mod.uk

6. **POC for Tanker/Receiver Clearances**.

(As for National Annex).

7. **POC for STANEVAL**.

(As for National Annex).

8. **National Annex Last Updated**. Jul 03.

9. **National Reservations**. Nil

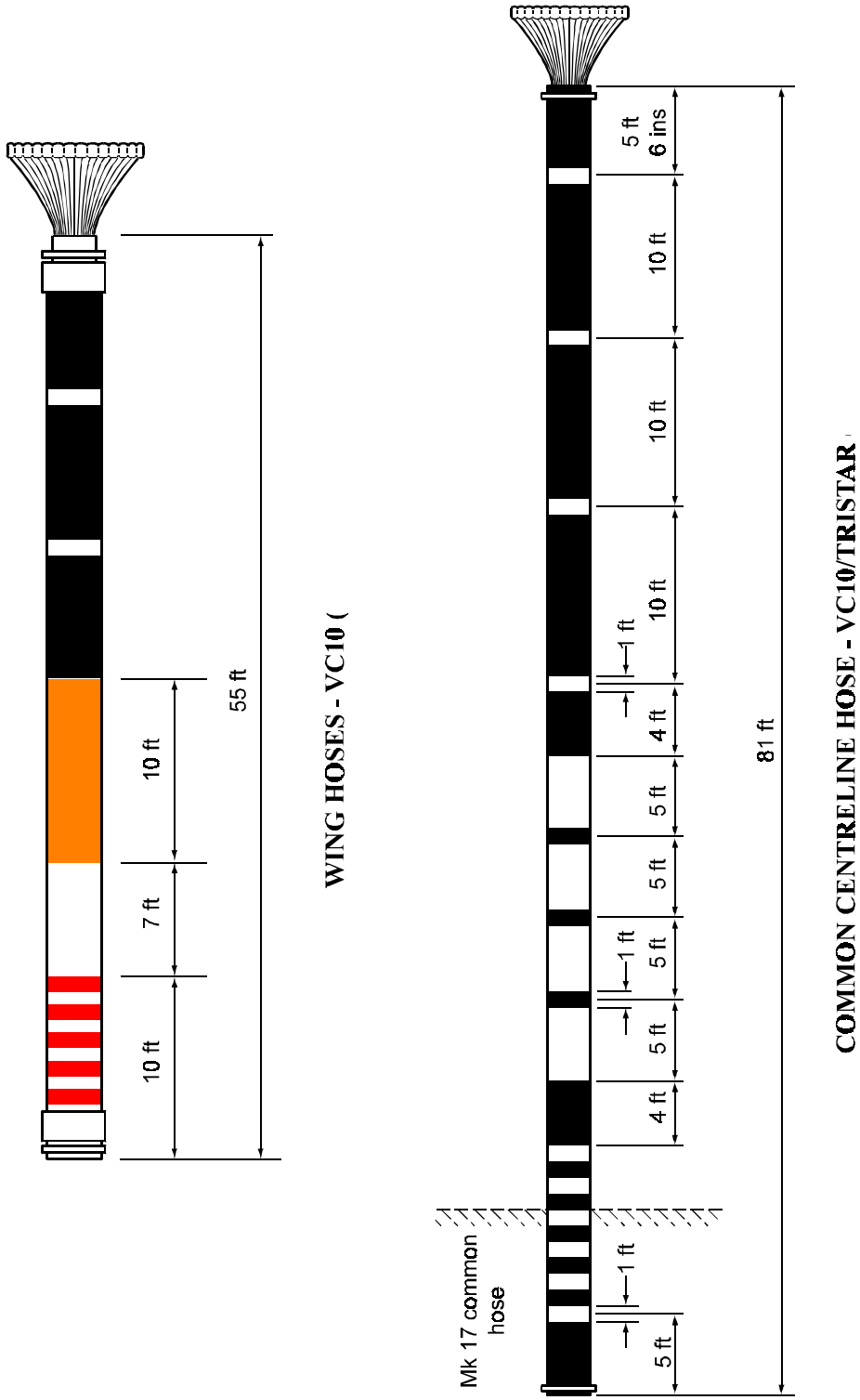
10. **Receiver Training With RAF Tankers**. Receiver training with RAF tankers for non-receiver qualified crews will normally require a full training package, to include ground briefings and airborne instruction. For receiver crews who are already qualified and current (within 6 months) on another probe and drogue system, the ground briefing may be replaced by viewing the RAF AAR Training video. Copies of the RAF AAR Training video are available from to the UK POC.

Appendices:

1. Hose Markings.
2. Tristar.
3. VC10 K3/4.
4. VC10 and Tristar Tanker Receiver Matrix.

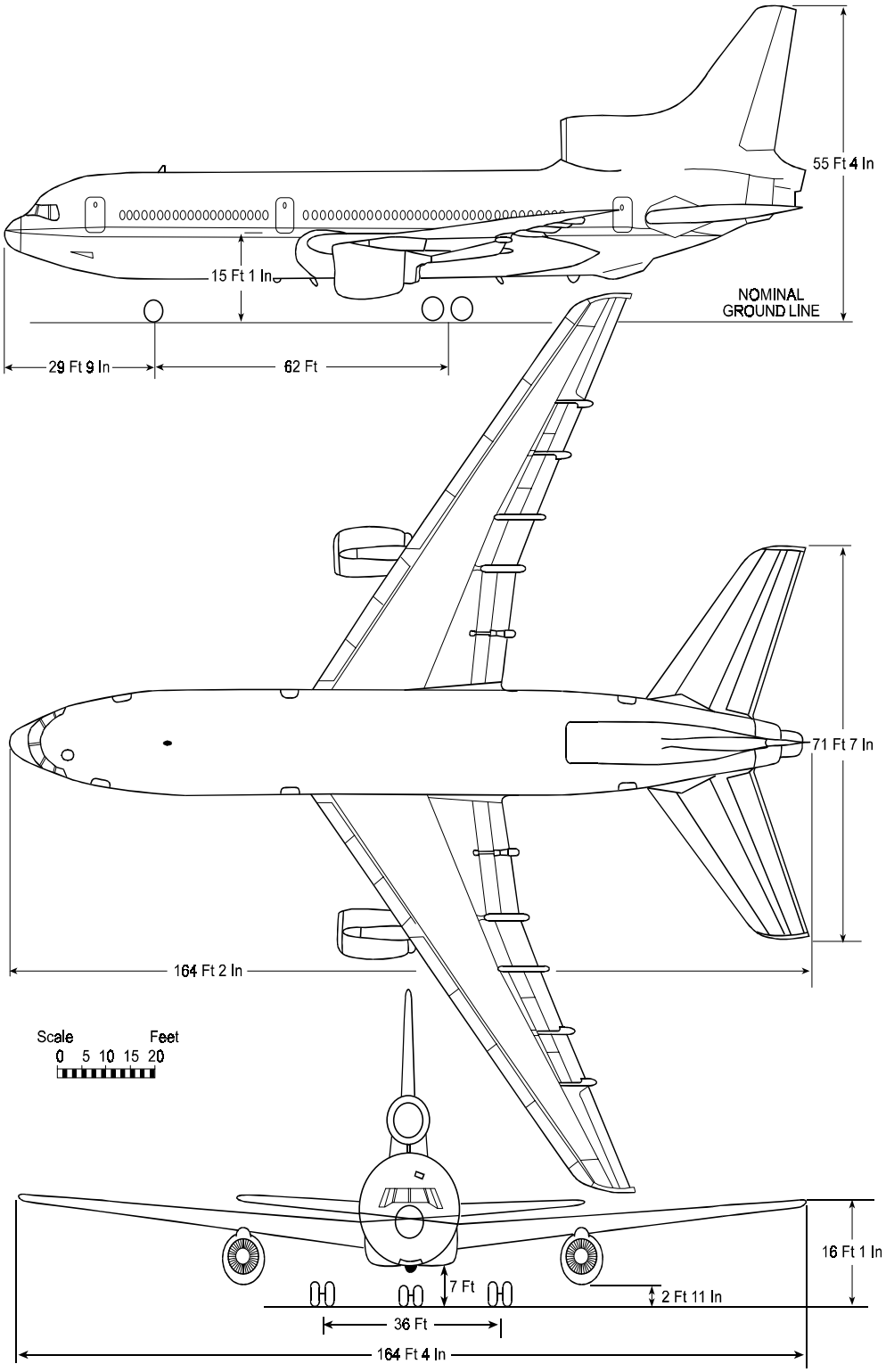
APPENDIX 1 TO ANNEX 10P

HOSE MARKINGS



APPENDIX 2 TO ANNEX 10P

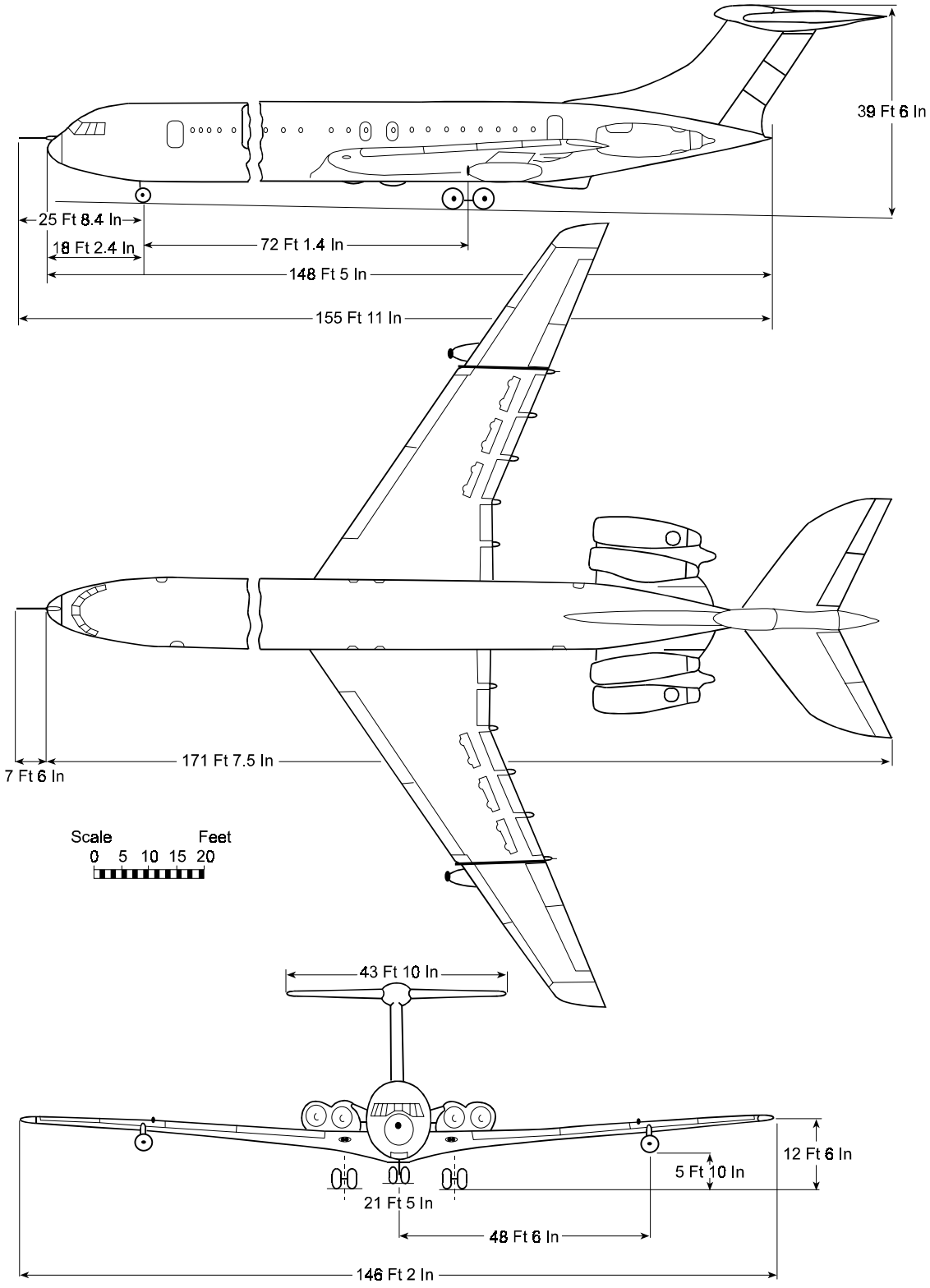
TRISTAR



APPENDIX 3 TO ANNEX 10P

VC10 K3/4

(The VC10 C1K and K2 have similar dimensions except that the fuselage is 13 ft shorter)



APPENDIX 4 TO ANNEX 10P

VC10 AND TRISTAR TANKER RECEIVER MATRIX

RECEIVER / TANKER	TRISTAR	VC10K3 & 4		VC10CMk1K
		HDU	Wing Hoses	
A-4 S (RSAF)	✓	✓	✓	✓
AMX (IAF)	✓	✓	✓	✓
AV-8B (Spanish Navy)	✓	✓	✓	✓
AV-8B (USMC)	✓	✓	✓	✓
AV-8B (USN)	✓	✓	✓	✓
AV-8S (Spanish Navy)	✓	✓	✓	✓
C-130 Hercules C1/3 (RAF)	✓	✓		
CF-18 (CAF)	✓	✓	✓	✓
Cheetah (SAAF)	✓	✓	✓	✓
E-3D (RAF)	✓	✓		
E-3F (French AF)	✓	✓		
EA-6B (USMC)	✓	✓	✓	✓
EA-6B (USN)	✓	✓	✓	✓
F-5E (RSAF)	✓	✓	✓	✓
F-14 (USN)	✓	✓	✓	✓
F/A-18 (Kuwait AF)	✓	✓	✓	✓
F/A-18 (RAAF)	✓	✓	✓	✓
F/A-18 (SAF)	✓	✓	✓	✓
F/A-18 (Swiss AF)	✓	✓	✓	✓
F/A-18 (USMC)	✓	✓	✓	✓
F/A-18 (USN)	✓	✓	✓	✓
F-18 (Finnish AF)	✓	✓	✓	✓
F-18 (USMC)	✓	✓	✓	✓
F-18 (USN)	✓	✓	✓	✓
Harrier GR7/7A (RAF)	✓	✓	✓	✓
Harrier T10 (RAF)	✓	✓	✓	✓
Hawk 203 (RAFO)	✓	✓	✓	✓
Hawk 208 (RMAF)	✓	✓	✓	✓

RECEIVER / TANKER	TRISTAR	VC10K3 & 4		VC10CMk1K
		HDU	Wing Hoses	
Jaguar A (French AF)	✓	✓	✓	✓
Jaguar GR3/3A (RAF)	✓	✓	✓	✓
Jaguar S (Ecuadorian AF)	✓	✓	✓	✓
Jaguar S (Indian AF)	✓	✓	✓	✓
Jaguar S (Nigeria AF)	✓	✓	✓	✓
Jaguar S (RAFO)	✓	✓	✓	✓
Mirage 2000 (Egyptian AF)	✓	✓	✓	✓
Mirage 2000 (French AF)	✓	✓	✓	✓
Mirage F1 (French AF)	✓	✓	✓	✓
Mirage F1 (SAF)	✓	✓	✓	✓
Mirage IV (French AF)	✓	✓	✓	✓
Nimrod MR2 (RAF)	✓	✓		
Nimrod R1 (RAF)	✓	✓		
S-3B (USMC)	✓	✓		
S-3B (USN)	✓	✓		
Sea Harrier F/A2 (RN)	✓	✓	✓	✓
Sea Harrier T8 (RN)	✓	✓	✓	✓
Super Etendard (French	✓	✓	✓	✓
Tornado ADV (Royal Saudi	✓	✓	✓	✓
Tornado ADV (IAF)	✓	✓	✓	✓
Tornado ECR (GAF)	✓	✓	✓	✓
Tornado F3 (RAF)	✓	✓	✓	✓
Tornado GR4/4A (RAF)	✓	✓	✓	✓
Tornado IDS (GAF)	✓	✓	✓	✓
Tornado IDS (German Navy)	✓	✓	✓	✓
Tornado IDS (IAF)	✓	✓	✓	✓
Tornado IDS (Royal Saudi AF)	✓	✓	✓	✓
Typhoon (Baseline	✓	✓	✓	✓
Typhoon (SG2 configuration)		✓	✓	✓
VC10C1K, K3, K4 (RAF)	✓	✓		

Note: The above clearances are issued on the basis of mechanical compatibility between the TriStar Mk17T HDU, the VC10 Mk17B HDU and Mk32-2800 pod refuelling drogue/receptacle, and the nozzle/mast of the receiver aircraft. Refer to NATO STANAG 3447 for further details. National authorities are responsible for ensuring that the fuel systems of their receiver aircraft are compatible with the VC10/TriStar AAR system output pressures and flow rates.

ANNEX 10Q

NATIONAL ANNEX - UNITED STATES OF AMERICA

1. **Introduction**. The USAF normally use RV Delta (Point Parallel) in preference to RV Bravo and Charlie. If RV Bravo or Charlie is specified for a NATO exercise/operation, the USAF would require pre-mission briefing between tanker and receiver. The US has 4 tanker types in service with the USAF, USMC and USN.

2. **KC-135**. The USAF has a large fleet of KC-135s with several variants in service; the main differences are in fuel capacity and engines. Some KC-135s are fitted with a receptacle to receive fuel from boom equipped tankers; all of these have the capability to reverse pump fuel from their receptacle into a tanker.

a. AAR Equipment. There is one centreline mounted flyable boom for boom-type refuelling. 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. Some aircraft are fitted with two FRL Mk32B-753 wing tip mounted Multi-Point Refuelling System (MPRS) AAR pods.

(1) Boom. The boom is approximately 6.1 m (20 ft) long with an additional 5.5 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. 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. When cleared, the receiver moves from the pre-contact position to a steady boom contact position. 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. The receiver pilot then maintains his aircraft within the boom operating 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 manoeuvre in the pitching, rolling and yawing planes. Provided the receiver remains within the envelope, contact is maintained; however, if the receiver moves beyond the limits, a disconnect will automatically occur. The envelope limits are set well within the mechanical limitations of the boom; therefore, provided the envelope limits are not exceeded too rapidly, the disconnect will occur before the boom is damaged. The full boom envelope is illustrated in Appendix 1; however, the freedom of manoeuvre in boom elevation is reduced for some receiver aircraft because of their receptacle characteristics. 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 pre-contact position. If the receptacle toggles fail to release, they can be over-ridden by the receivers gradual movement aft, and ending with a smooth tension boom pullout above 38 degrees elevation. Coordination between the receiver pilot and boom operator is required to ensure as smooth a disconnect

as possible.

(2) BDA. The BDA is 2.74 m (9 ft) of hose attached to the end of the telescoping part of the boom by a swivelling 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. The boom operator will hold the boom as motionless as possible, at the proper trail position, from the time the receiver reaches pre-contact until completion of refuelling. The ideal pre-contact 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"). Great caution is required with 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. Having made contact, the probe should be positioned slightly offset from the boom to make the hose adopt a U shape to one side; the ideal in-contact position is illustrated in Appendix 2. The ideal position permits about 1.52 m (5 ft) of forward and aft movement. 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. 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 fuel does not transfer, the receiver will be instructed to disconnect; the receiver should drop back to the pre-contact 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. If possible, the tanker air refuelling pumps will be switched off 5 seconds before the scheduled disconnect; this is to minimize fuel spray on disconnect. When cleared, the receiver should disconnect by dropping back, 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. However, in an emergency he may do so, in which event the drogue will whip violently as contact is broken. To avoid the drogue striking the aircraft, the receiver pilot must not stray away from the correct lateral alignment.

Note: Simultaneous refuelling from the centreline BDA and wing tip mounted MPRS AAR pod(s) is prohibited due to inadequate refuelling envelope clearance between receiver aircraft.

(3) Wingtip Mounted MRPS AAR Pods. Some KC-135 aircraft are fitted with two FRL Mk32B-753 wing tip mounted MPRS AAR pods. 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 (see Lighting paragraph for description of the pod status lights). To start fuel flowing, the hose must be pushed in at least 1.5 m (5 ft), indicated by the first orange band, and green pod status lights coming on. Receiver pilots should remain within the ideal refuelling position between the two orange bands; inner limit 16.4 m (54 ft), and outer limit 21 m (69 ft), thus providing a fore and aft range of movement of 4.6 m (15 ft). 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 Appendices 3, 6, and 7.

Notes:

1. 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 pre-contact to the contact position.

2. Simultaneous refuelling from the centreline BDA and wing tip mounted MPRS AAR pod(s) is prohibited due to inadequate refuelling envelope clearance between receiver aircraft.

b. Refuelling Heights and Speeds. Boom, and BDA AAR height band is sea level to heights in excess of 30,000 ft; speed range is 200 to 320 KIAS. Wingtip mounted MPRS AAR pods height band for AAR is 5,000 to 35,000 ft; speed range is 220 to 300 KIAS

c. Maximum Transferable Fuel. Total fuel load varies from 84,870 kg (187,000 lb) for the KC-135E to 92,060 kg (203,000 lb) for the KC-135R (CFM 56 engines). Maximum fuel available for offload on a 4 hr sortie is approximately 54,430 kg (120,000 lb) for a KC-135E or 61,280 kg (135,000 lb) for a KC-135R.

d. Fuel Transfer Rate. The tanker can transfer fuel at rates exceeding 2722 kg/min (6000 lb/min) through the boom, 1270 kg/min (2800 lb/min) through the BDA, and 1216 kg/min (2680 lb/min) through the wing tip mounted MPRS AAR pods.

e. Regulated Fuel Pressure. 3.5 ± 0.35 bars (50 ± 5 psi).

f. Fuel Types Available for AAR.

(1) Primary fuel is F34.

(2) Alternate fuels are F35, F40 and F44.

g. Receiver Types Certified. See Appendix 14.

h. Lighting. Aircraft undersurfaces are illuminated by a comprehensive array of lights, many of which are adjustable for brilliance upon request (see Appendix 4). The initial setting for underbody and underwing lights will be on/full bright during all types of refuelling day or night. The nacelle lights will be on during all types of refuelling, but during night AAR, will be dimmed prior to receivers reaching the observation position. In addition to these settings, specific lights used to aid the receiver pilot for various types of AAR are as follows:

(1) Boom. Pilot Director Lights (PDL) give positioning information to receiver pilots during boom type refuelling. 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 refuelling position. 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 5. 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 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. Similar indications are provided for upward commands. 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 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 coloured 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 centreline reference. 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. If the PDLs do not illuminate when a receiver makes contact, the receiver should disconnect and await instructions. If the PDLs go out during contact, the receiver is to initiate a disconnect and return to the precontact position. 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. During night AAR, the AAR floodlight, and boom nozzle light will also be used to illuminate the boom.

(2) BDA. The elevation background lights and letters (PDLs described

above) will be on during BDA AAR, but will not be used to direct receiver positioning. 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). During night AAR, the AAR floodlight, boom nozzle light, and boom marker lights will also be used to illuminate the boom and BDA.

(3) Wing Tip Mounted MPRS AAR Pod. 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. For day AAR, the pod status lights and pod floodlights should be turned on full bright. In addition to these 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. The AAR floodlight may also be used as desired. The receiver pilot can request intensity adjustments to lights as desired.

(a) 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 as follows (see Appendices 6, and 7 for further details):

Before contact:	Steady Red	Pod not ready, do not make contact
	Steady Amber	Ready for contact
In Contact:	Steady Green	Fuel transfer
	All lights out (receiver in fuel transfer position)	Offload complete/dry contact
	Flashing Amber	Forward limit, drawback
	Steady Amber	Aft limit
Anytime:	Flashing Red	Breakaway

i. Mark Facilities. Fuel dump (from boom).

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

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

(1) UHF, VHF, HF, and SATCOM (some aircraft) radios.

(2) VOR, TACAN, INS, GPS, and search/weather radar.

(3) UDF, A/A TACAN (DME only), TCAS, radar transponder and radar beacon mode.

3. **KC-10**. The USAF has a 59 KC-10s in service. The aircraft has a receptacle for receiving fuel from boom-equipped tankers, and has a reverse fuel pumping capability.

a. AAR Equipment. One centreline flyable boom and a Sergeant Fletcher fuselage mounted hose drum unit. Some aircraft are fitted with 2 Flight Refuelling Ltd Mk32B wing mounted AAR pods. The USAF calls them Wing Aerial Refuelling Pods (WARPs).

(1) Boom. The boom is approximately 11 m (35 ft) long with an additional 7 m (22 ft) of telescoping inner fuel tube. All KC-10 booms are equipped with a Boom Interphone System which permits direct communication with suitably equipped receivers. Procedures for refuelling 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. 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 refuelling envelope without nozzle binding. 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 signalling system, the IDS can be used. The IDS employs compressed air to retract the toggle latches on either side of the boom; this obviates the requirement for brute force disconnects. 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 may 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.

(2) Fuselage Hose. There is one fuselage mounted hose drum unit mounted within the lower rear fuselage; the hose exits from a tunnel, which is offset by about 1.2 m (4 ft) to the right of the aircraft centreline. 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 8. The hose terminates in a US MA-3/4 coupling and 0.7 m (26 in) diameter collapsible drogue. When cleared, 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. 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. The ideal refuelling 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 refuelling range of the hose; the inner limit is marked by the third 0.6 m (2 ft) white band. If the inner limit is exceeded, fuel flow ceases and the

amber signal light flashes. (See Lighting paragraph for a description of signal lights). Thus the receiver has a fore and aft range of movement of 11 m (35 ft) during which fuel will flow. 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. Wake turbulence from the tanker may be felt on rear control empennages and may cause some control surface loading. Above 275 KIAS, good contacts are more likely if the probe contacts the centre of the drogue; off-centre contacts may be 'soft'. Fuel spray may enter the engine intake and result in engine malfunctions/ compressor stalls. 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 is changed by more than 5 kts, the hose response system may have to be reset. Receivers will be directed clear of the hose whilst hose reset is accomplished.

(3) Wing Pods. Some KC-10 aircraft are fitted with 2 FRL Mk32B wing pods. 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 ft) wide orange bands. The hose terminates in a US MA-4 coupling and collapsible drogue. 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. The ideal refuelling 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 refuelling range, thus providing a fore and aft range of movement of 3.7 m (12 ft). If the inner refuelling limit is exceeded, the amber light flashes (see Lighting paragraph for 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 (48 ft). Fuel flow will start again as the hose is pulled back out past 14.9 m (49 ft). Thus the receiver has a fore and aft range of movement of 6.4 m (20 ft) during which fuel will flow. 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.

b. Refuelling Heights and Speeds. Boom AAR height band is sea level to 37,000 ft; speed range is 180 to 350 KIAS. Fuselage hose AAR height band is sea level to 35,000 ft; speed range is 200 to 280 KIAS. Wing pod AAR height band is sea level to 32,000 ft; speed range is 200 to 325 KIAS.

c. 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 hr flight, assuming a fuel burn rate of 8170 kg/hr (18,000 lb/hr).

d. Fuel Transfer Rates. 3630 kg/min (8000 lb/min) through the boom, 1820 kg/min (4000 lb/min) through the fuselage hose and 1110 kg/min (2400 lb/min) through the wing hoses.

e. Regulated Fuel Pressure. 3.5 ± 0.35 bar (50 ± 5 psi).

f. Fuel Types Available for AAR. As for the KC-135.

g. Receiver Types Certified. See Appendix 15.

h. Lighting. The aircraft has a comprehensive array of floodlights, which are adjustable for brilliance; formation keeping lights are also provided, see Appendices 9 and 10. There are Pilot Director Lights (PDL) for use with the boom and signal lights for use with the hose.

(1) PDL. The PDLs have the same function and meaning as those fitted to the KC-135, although the displays are slightly different, see Appendix 11.

(2) Signal Lights. 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 coloured red, green and amber. The lights signal the following:

Steady Red	Do not make contact (if in contact, breakaway)
Steady Amber	Tanker ready for contact
Steady Green	Fuel flows
Green extinguishes	Fuel transfer complete
Flashing Amber	Hose is pushed in too far
All 3 lights out	Disconnect
Flashing Red	Breakaway

i. Mark Facilities. Fuel dump. High intensity lighting.

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

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

(1) VHF, UHF and HF radios.

(2) VOR, TACAN, INS and search/weather radar.

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

(4) GPS and TCAS.

4. **KC-130**.

a. AAR Equipment. The KC-130 has 2 drogue equipped refuelling stations, one mounted on each wing outboard of the engines. Each refuelling station consists of a Sargent Fletcher 48-000 refuelling pod, 26 m (85 ft) of hose, MA-2 coupling and a 1.2 m (27 in) diameter high speed fixed-wing or 2.4 m (54 in) diameter low speed helicopter paradrogue. Helicopters may not refuel from a high speed drogue. Fuel flows when the hose is pushed in 1.5 m (5 ft); flow continues provided the hose is

maintained in the refuelling position, between 6 - 24 m (20 - 80 ft) of hose extension. Hydraulic pressure provides 90% of the force required to rewind the hose during refuelling to reduce hose slack and whip. The hoses are marked each 3 m (10 ft). The MA-2 coupling requires 140 ft lb of pressure to make contact (2 - 5 kt closure) and 420 ft lb to disconnect.

b. Refuelling Heights and Speeds. AAR height band is from 500 ft to 23,000 ft; speed range for the high speed fixed-wing drogue is 200 to 250 KIAS and for the low speed helicopter drogue is 105 to 130 KIAS. Maximum hose extension/extraction speed is 120 KIAS.

c. Maximum Transferable Fuel. Total fuel loads are normally up to 32,660 kg (72,000 lb), with an overload weight of 39,460 kg (87,000 lb). Transferable fuel is dependent on sortie duration; around 18,140 kg (40,000 lb) is available for transfer during a 4 hr flight, assuming a fuel burn rate of 2720 kg/hr (6000 lb/hr).

d. Fuel Transfer Rates. With the removable fuselage fuel tank fitted, transfer rate is about 1850 kg/min (4080 lb/min) with the 2 AAR pump configuration or 925 kg/min (2040 lb/min) with the single AAR pump configuration. Without the fuselage tank, the transfer rate is about 460 kg/min (1020 lb/min). The lower transfer rate can be selected on request.

e. Regulated Fuel Pressure. Regulated fuel pressure is 3.5 bars (50 psi) at the drogue.

f. Fuel Types Available for AAR.

(1) Primary/usual fuel is F44.

(2) Alternate fuels are F34 and F40.

g. Receiver Types Certified. See Appendix 16.

h. Lighting. Red, green and amber lights are located on the trailing edge of each AAR pod; these are AAR pod status lights and mean:

Steady Red	Do not make contact (if refuelling is absolutely required, contact using emergency procedures shall be co-ordinated)
Steady Amber	Pod system ready for contact
Steady Green	Fuel flows
Flashing Green	Receiver full or pod fuel malfunction
Steady Red (whilst in contact)	Disconnect, pod malfunction

The light signal commanding a breakaway is the tanker's lower rotating beacon being switched on. Before a receiver is cleared for contact, the beacon is turned off to indicate the tanker's AAR checklist has been completed. AAR during EMCON constraint requires additional light signals from the tanker; these are provided by hand

held ALDIS lamps. These lights will be seen in the paratroop door windows located at the rear of the fuselage on both sides of the aircraft. A steady light signals clear for contact; whilst in contact, a steady light signals disconnect. A flashing ALDIS means no more fuel available or the tanker is experiencing difficulties. Receivers should disengage and move to a position outboard of the hose. Drogue illumination is provided by refuelling lights located on the outboard leading edge of the horizontal stabilizer. There are 6 equally spaced luminescent paint spots are on the drogue to assist during night operations.

i. Mark Facilities. Fuel dump.

j. Dimensions. Aircraft diagram is at Appendix 12. The KC-130 is 29 m (97 ft) long, with a wingspan of 40 m (132 ft); the aircraft height is 12 m (38 ft) and the stabilizer span is 16 m (52 ft).

k. RV Aids. The KC-130 has the following radar, navigation and RV aids:

(1) VHF, UHF and HF.

(2) VOR, TACAN, ADF, GPS, INS and navigator/sextant.

(3) UDF, A/A TACAN (DME only) and IFF interrogator.

5. **S-3B**. The S-3B Viking can be converted to the tanker role by fitting an externally carried AAR pod.

a. AAR Equipment. The pod is fitted on the left wing pylon only. The hose is 15 m (50 ft) long, terminating in a MA-3 coupling and 0.6 m (24 in diameter) drogue. The hose must be pushed in about 2 m (5 - 6 ft) for fuel to flow.

b. Refuelling Heights and Speeds. AAR height band is 500 to 35,000 ft; speed range is 200 to 300 KIAS.

c. Maximum Transferable Fuel. Maximum transferable fuel is 6120 kg (13,500 lb).

d. Fuel Transfer Rate. Transfer rate is 620 kg/min (1370 lb/min).

e. Regulated Fuel Pressure. Regulated fuel pressure is between 2.5 - 3.8 bars (30 - 60 psi).

f. Fuel Types Available for AAR. F-34, F40 and F44.

g. Receiver Types Certified. Aircraft cleared to refuel from the S-3 are the same as for the KC-130.

h. Lighting. The AAR pod has a green and amber light; amber means the pod is ready for fuel transfer and green indicates fuel is flowing. There are 4 floodlights, 2 on each side. 2 are located on the leading edge of the wings near the wing access

panels between the engine and the fuselage. Their purpose is to illuminate the rounded forward section of the fuselage and radome. The other 2 are located on the aft inboard side of the pylon near the pylon access doors. Their purpose is to illuminate the engine nacelle and pod and the red V-pattern. All 4 lights are blue-green in colour. Additionally, the port wing red position light has a square cut-out, which is an aimed white light designed to illuminate the RAT so that the pilot can see if it is operating correctly.

i. Mark Facilities.

j. Dimensions. Aircraft diagram is at Appendix 13. The S-3B is 21 m (69 ft) long and has a wingspan of 16 m (53 ft).

k. RV Aids. The S-3B has the following radio, navigation and RV aids:

(1) UHF and HF radios.

(2) TACAN and INS.

(3) A/A TACAN (DME only).

6. **Source Documents**.

a. USAF. TO 1-1C-1-3 (KC-135 Air Refuelling Procedures).
TO 1C-135(K)-1 (KC-135 Reference Data).
TO 1C-135(K)R(I)-1 (KC-135 Inflight Data).
TO 1-1C-1-33 (KC-10 Air Refuelling Procedures).
TO 1C-10(K)A-1 (KC-10 Flight Manual).

b. USN/USMC. NATOPS Air Refuelling Manual NAVAIR 00-80T-110.

7. **POC for National Annex**.

USAF: HQ AMC/DOVK
402 Scott Drive. Unit 3A1
Scott AFB, IL 62225-5302
Tel: (+1) 618 229 2771 DSN 779 2771
Fax: (+1) 618 256 5692 DSN 576 5692

USN: Naval Air Systems Command
AIR 4.3.5.3
Bldg 2187 Suite 2380-A3
48110 Shaw Rd. Unit 5
Patuxent River, MD 20670
Tel: (+1) 301 342 9382 DSN 342 9382
Fax: (+1) 301 342 9414

US Army

8. **POC for Tanker/Receiver Clearances**.

USAF: (As for National Annex – USAF)
USN: (As for National Annex - USN)

9. **POC for STANEVAL**.

USAF: HQ AMC/DOVK
402 Scott Drive. Unit 3A1
Scott AFB, IL 62225-5302
Tel: (+1) 618 229 2771 DSN 779 2771
Fax: (+1) 618 256 5692 DSN 576 5692

US Army: 160th Special Operations Aviation Regiment (Airborne)
AOAV-5C (Flt Standards Office)
6950 38th St
Fort Campbell, KY 42223-5738
Tel: (+1) 502 798 1764/1647
Fax: (+1) 502 798 1471

US Navy: Navy Safety Centre
375 A St
Norfolk, VA 23511
Tel: (+1) 804 444 6525 DSN 564 6525
Fax: (+1) 804 444 7049

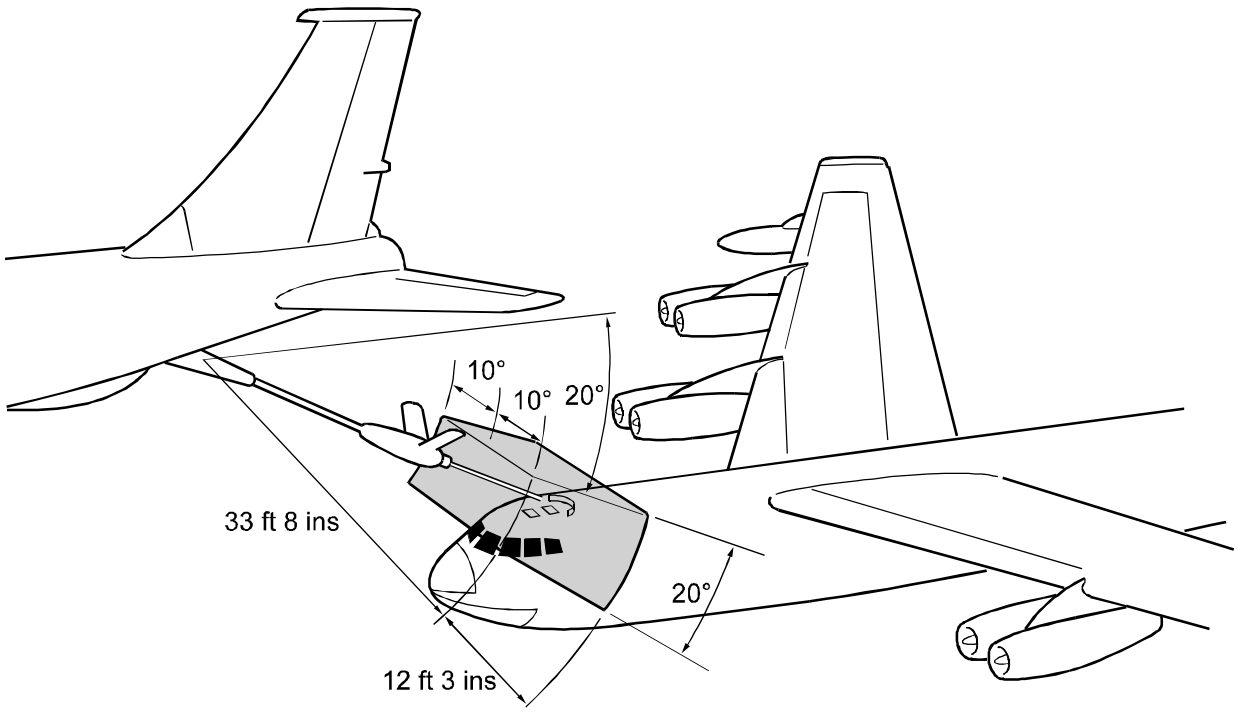
USMC: VMGR-352 Dept of Safety & Standardization
MCAS El Toro
Santa Ana, CA 92709
Tel: (+1) 714 726 6855
Fax: (+1) 714 726 4863

10. **National Annex Last Updated**. May 03.

11. **National Reservations**. Nil.

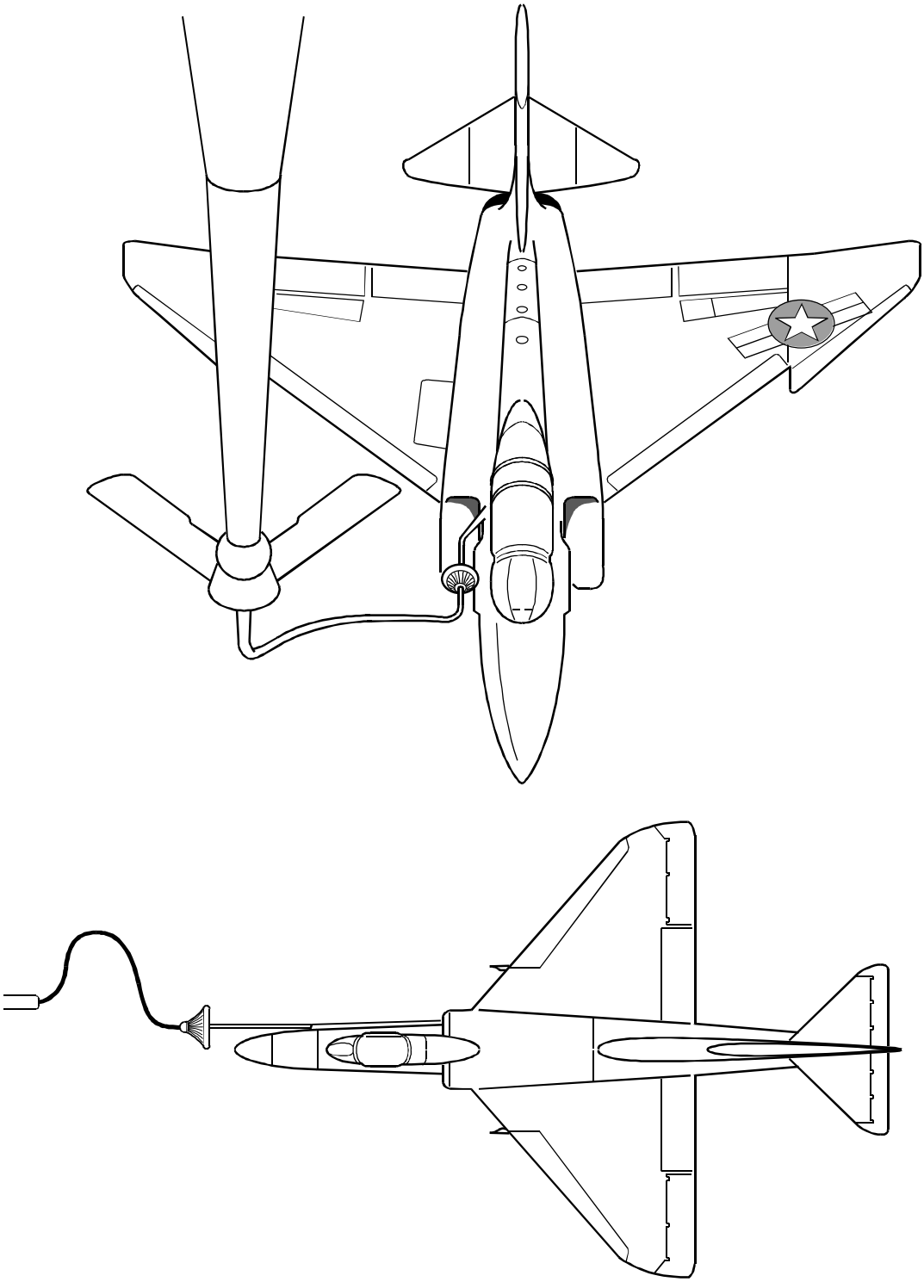
APPENDIX 1 TO ANNEX 10Q

KC-135 BOOM ENVELOPE LIMITS



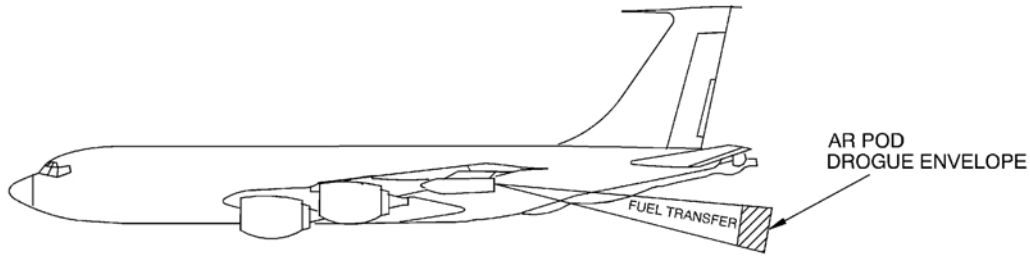
APPENDIX 2 TO ANNEX 10Q

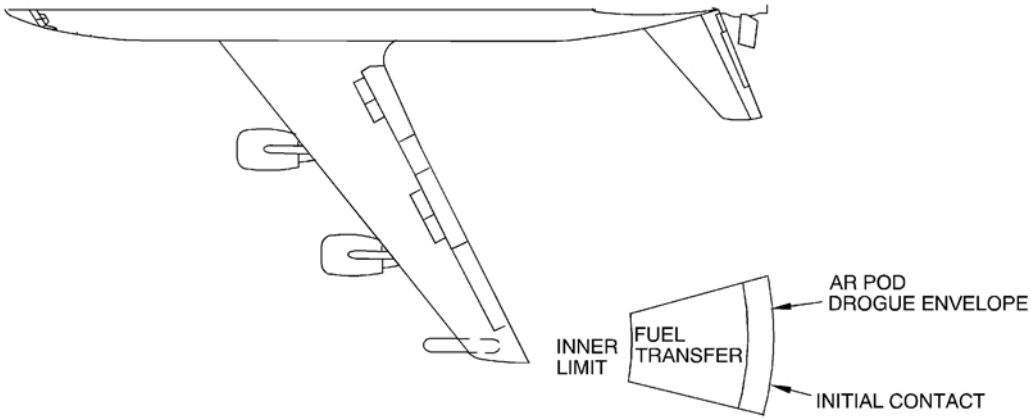
KC-135 BOOM DROGUE ADAPTER REFUELLING

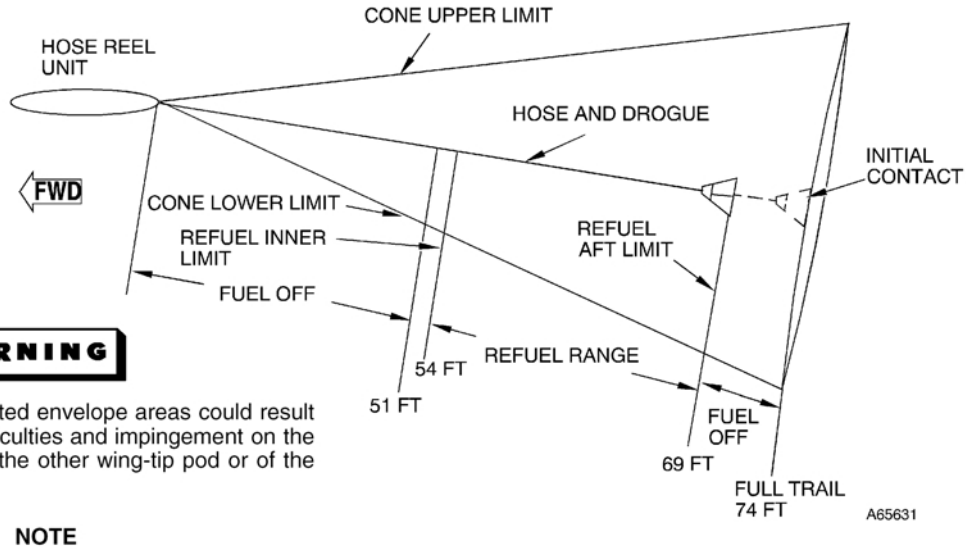


APPENDIX 3 TO ANNEX 10Q

KC-135 MPRS HOSE AND DROGUE POSITIONING IN-FLIGHT







WARNING

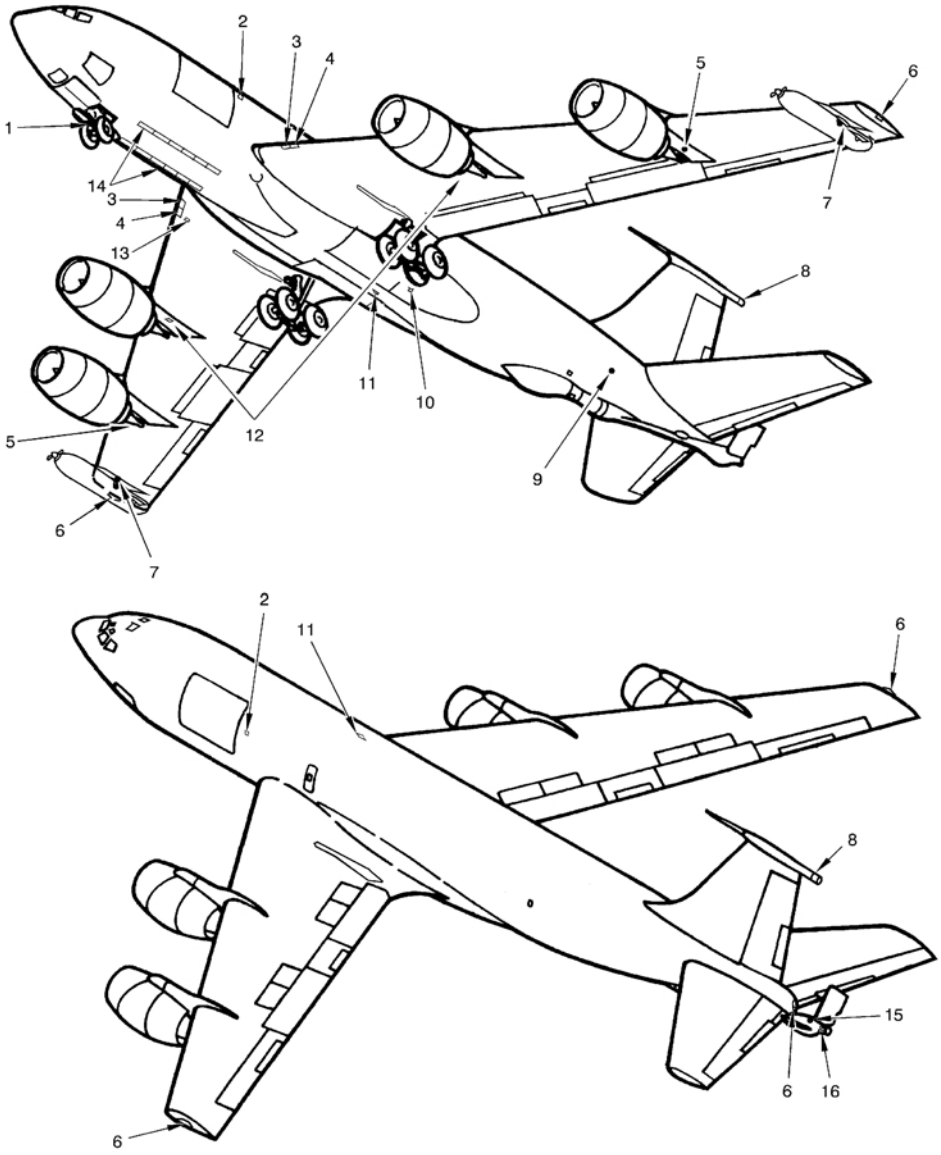
Flight outside designated envelope areas could result in receiver control difficulties and impingement on the refueling envelope of the other wing-tip pod or of the tanker envelope.

NOTE

Depicted hose extensions are based on nominal values and do not account for hysteresis in the fuel-draulics or the effects of receiver closure rate and activation of supplemental hose response mode.

APPENDIX 4 TO ANNEX 10Q

KC-135 EXTERIOR LIGHTING

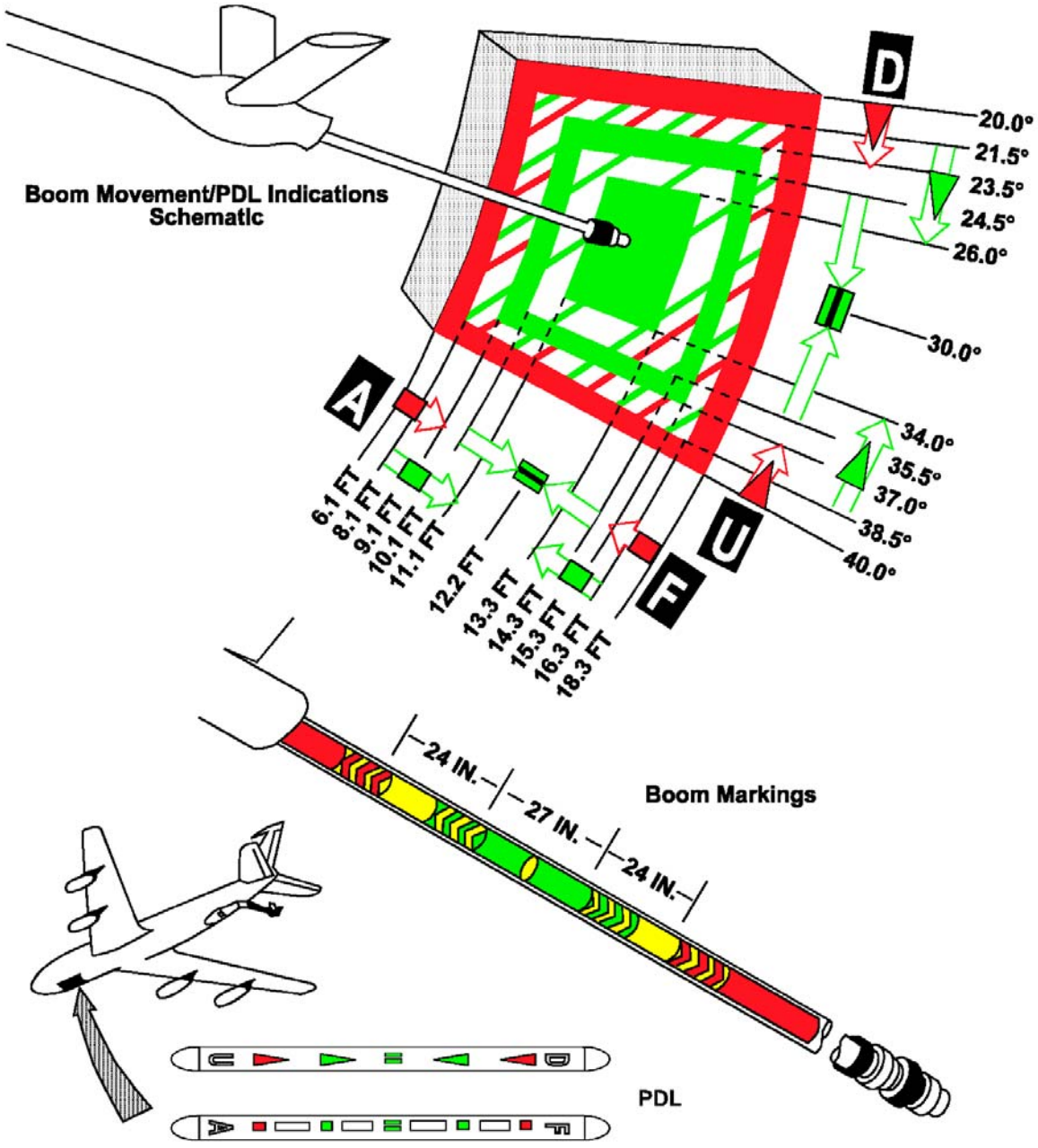


1	NOSE LANDING AND TAXI LIGHT (WHITE)	*9	***[MPRS]*** HORIZONTAL STABILIZER ILLUMINATION LIGHTS (2) (WHITE)
*2	NACELLE ILLUMINATION LIGHT (TYPICAL) (WHITE)	*10	UNDERWING ILLUMINATION LIGHT (TYPICAL) (WHITE)
3	TAXI LIGHT (WHITE)	11	STROBE LIGHTS (2) (RED OR WHITE)
4	LANDING LIGHT (FIXED) (WHITE)	*12	UNDERBODY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

* Designates Adjustable Lighting

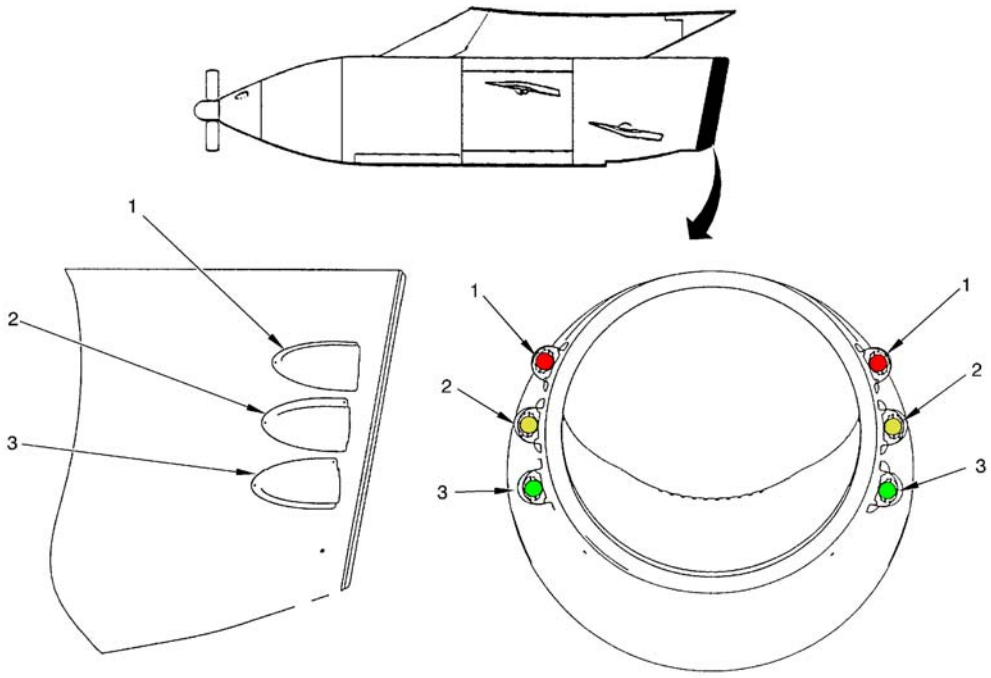
APPENDIX 5 TO ANNEX 10Q

KC-135 PILOT DIRECTOR LIGHTS ILLUMINATION PROFILE



APPENDIX 6 TO ANNEX 10Q

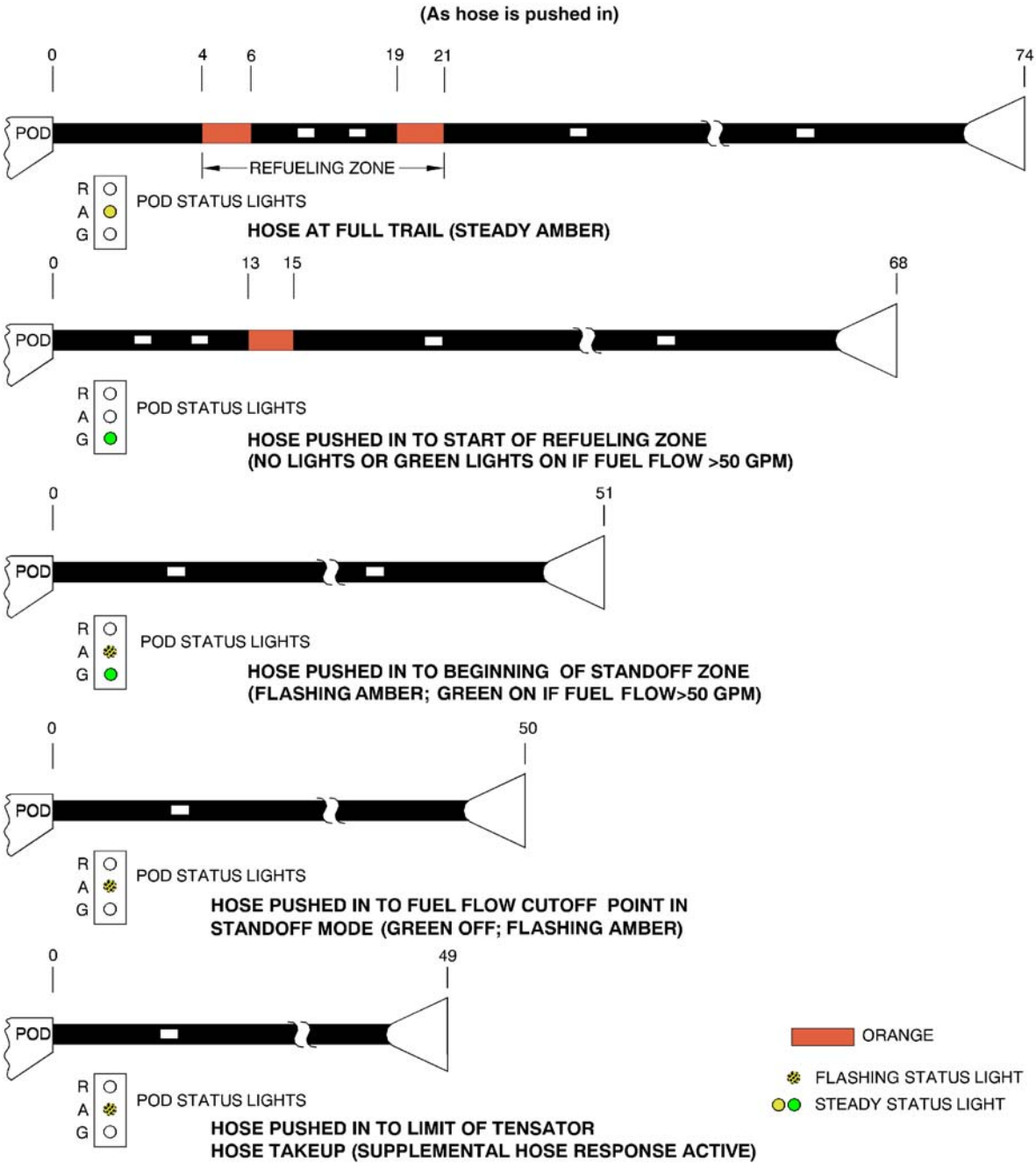
KC-135 MPRS POD STATUS LIGHTS



NO.	CONTROL/INDICATOR	FUNCTION
1	Red Light (2)	Light is on steady when power is on and hose is stowed and when the hose is deploying or being rewound using the REWIND/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 for 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.
2	Amber (Aviation Yellow) Light (2)	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.
3	Green Light (2)	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.

APPENDIX 7 TO ANNEX 10Q

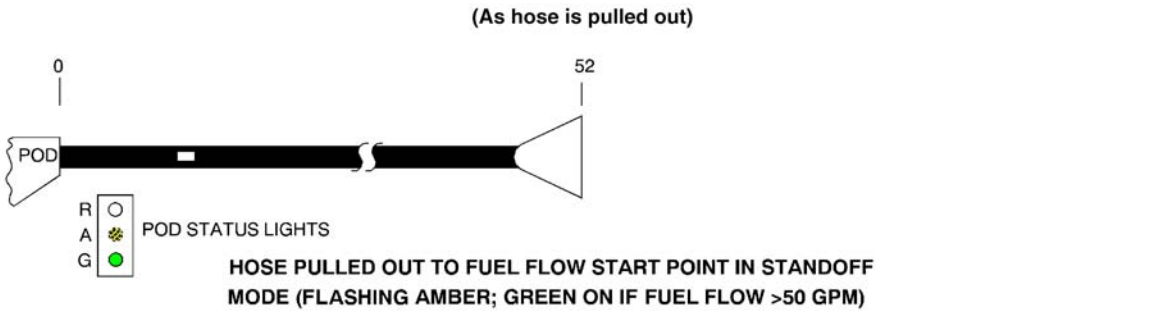
KC-135 MPRS HOSE MARKINGS VERSUS POD STATUS LIGHTS

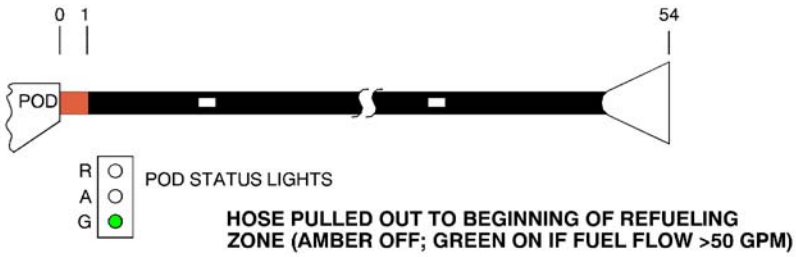


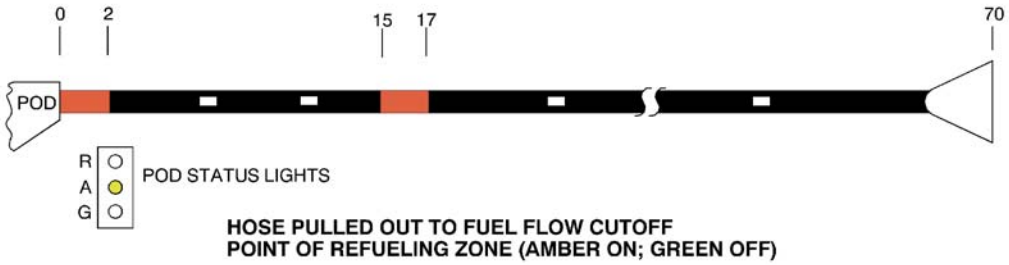
NOTE

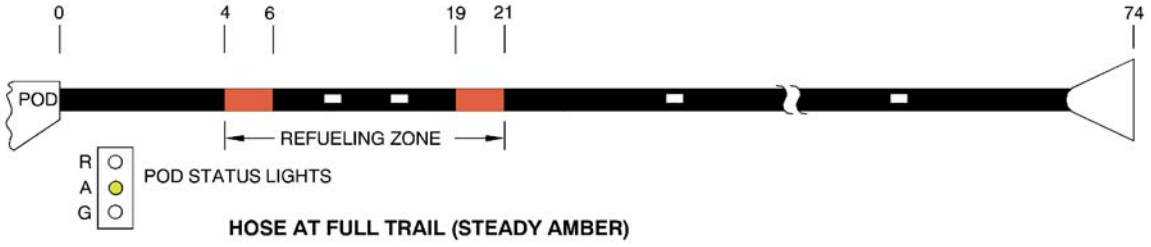
Deployed hose lengths shown on this page are minimum values at which the depicted condition is expected to occur.

KC-135 MPRS HOSE MARKINGS VERSUS POD STATUS LIGHTS









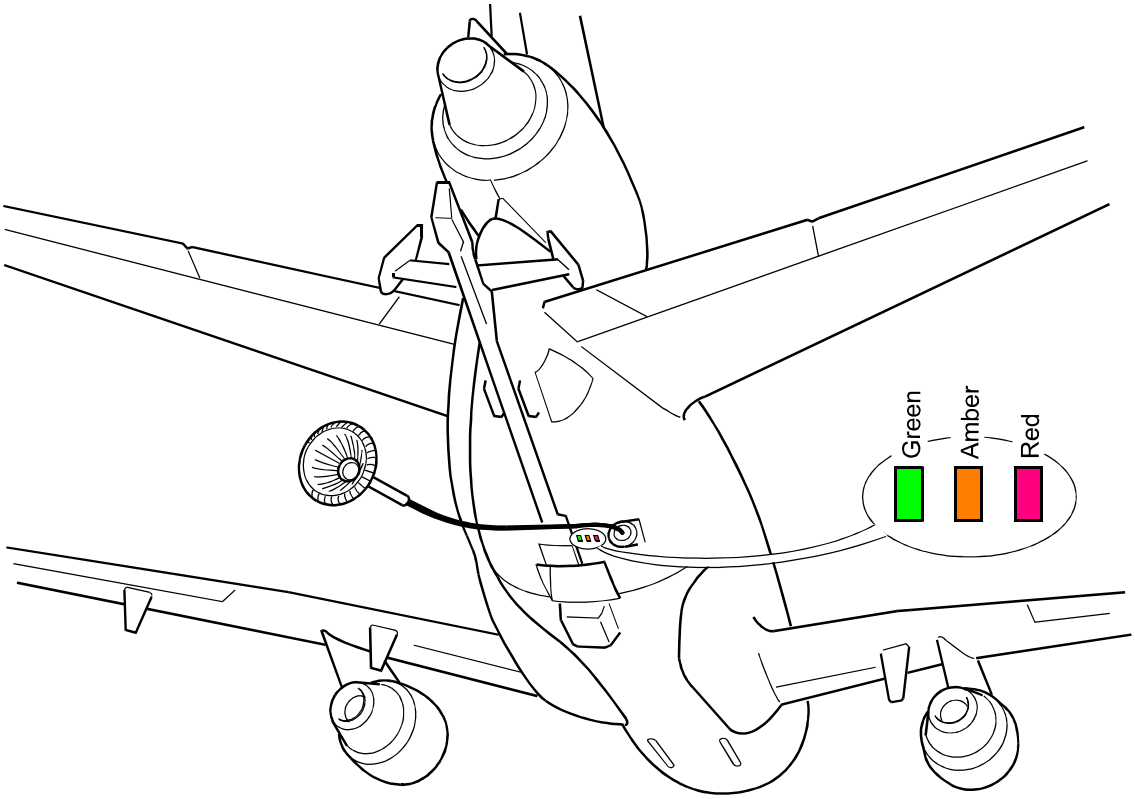
NOTE

Deployed hose lengths shown on this page are maximum values at which the depicted condition is expected to occur.

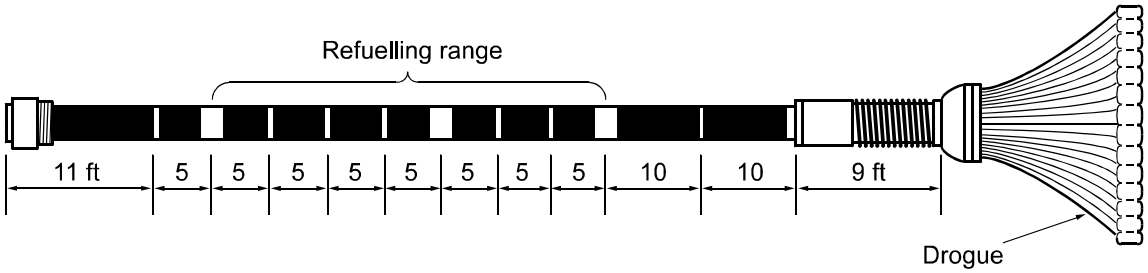
- Red status lights on steady – pod not ready; hose extending/retracting
- Red status lights on flashing – breakaway

APPENDIX 8 TO ANNEX 10Q

KC-10 HOSE REFUELLING

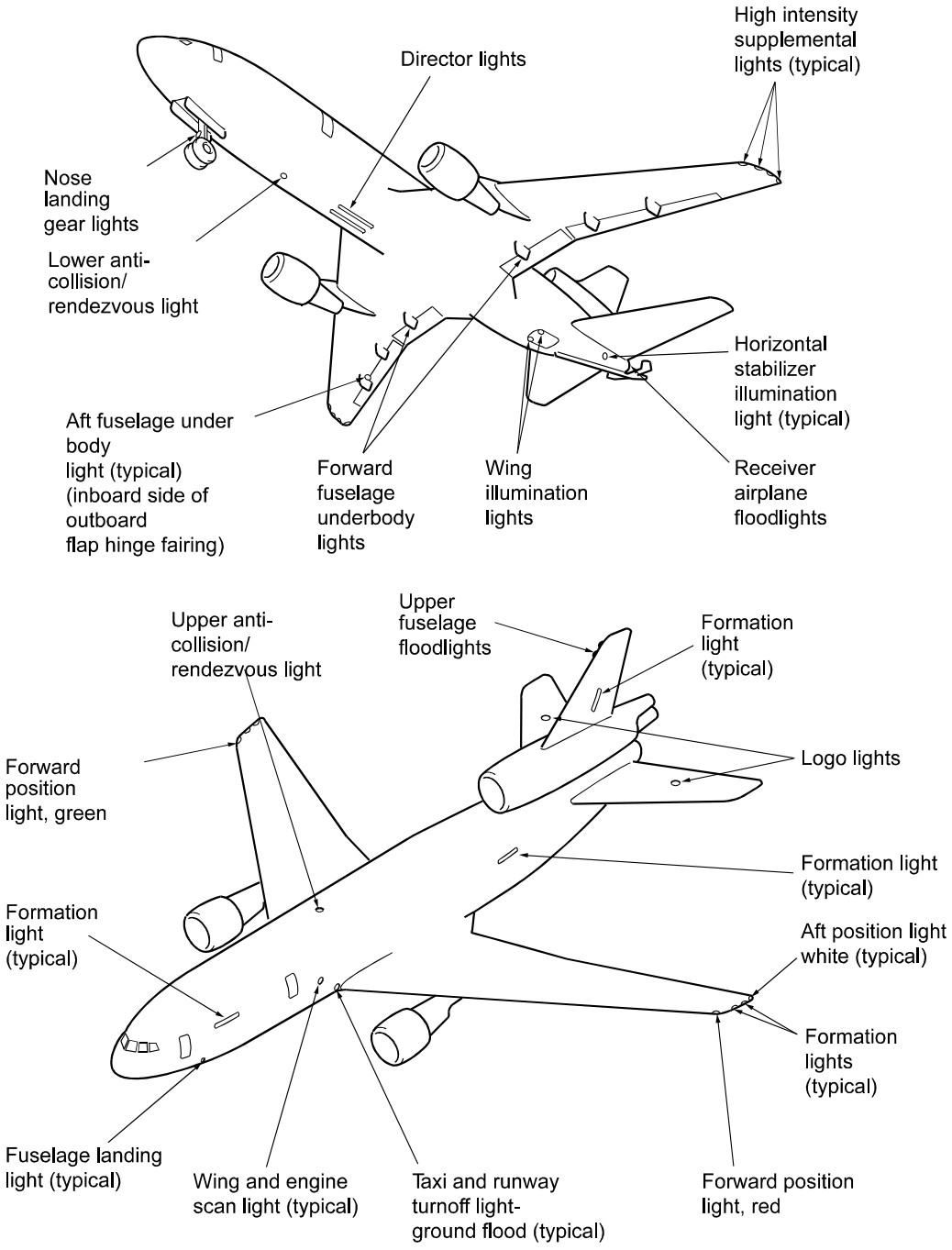


KC-10 Hose/drogue signal lights



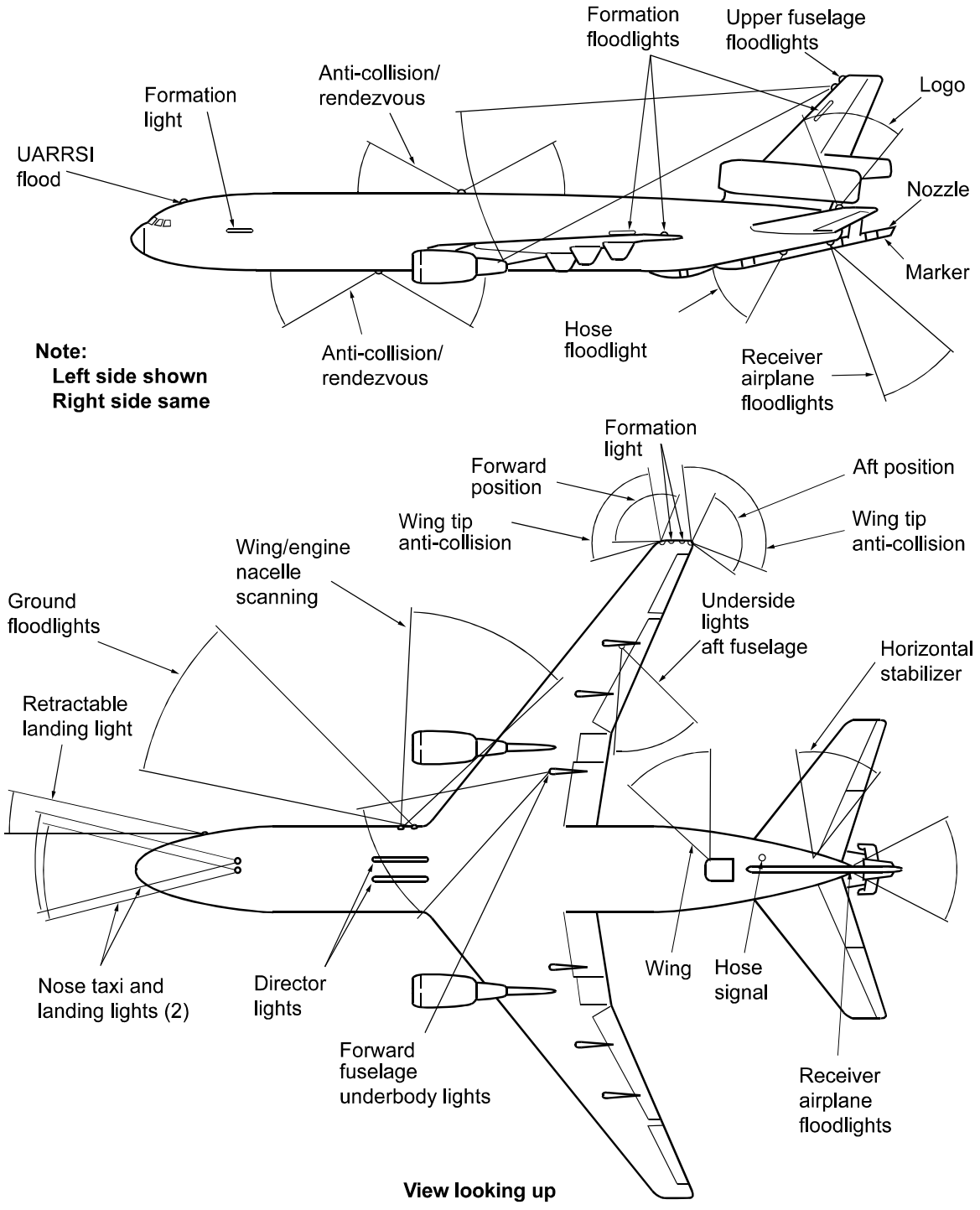
APPENDIX 9 TO ANNEX 10Q

KC-10 EXTERIOR LIGHTING (1)



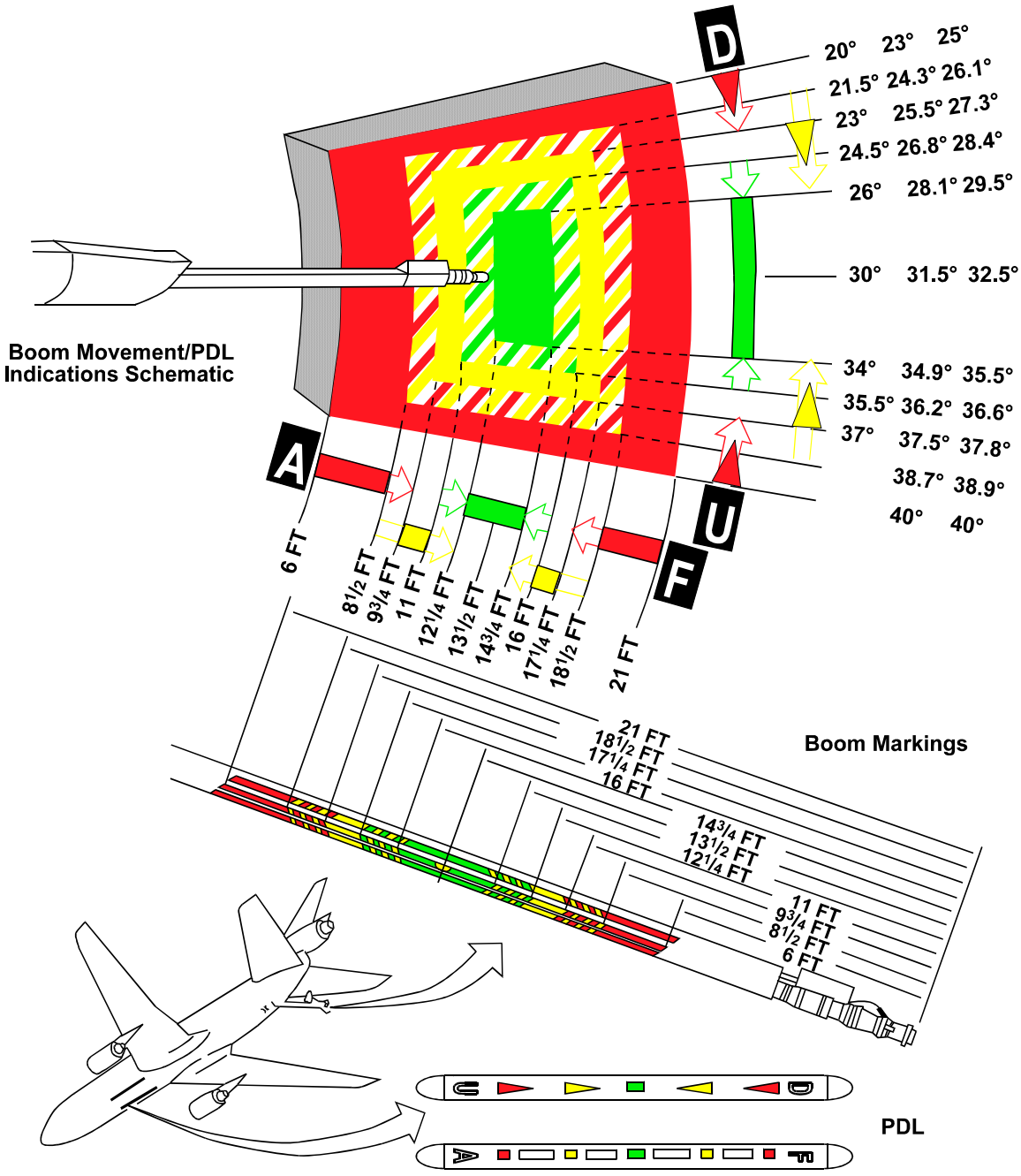
APPENDIX 10 TO ANNEX 10Q

KC-10 EXTERIOR LIGHTING (2)



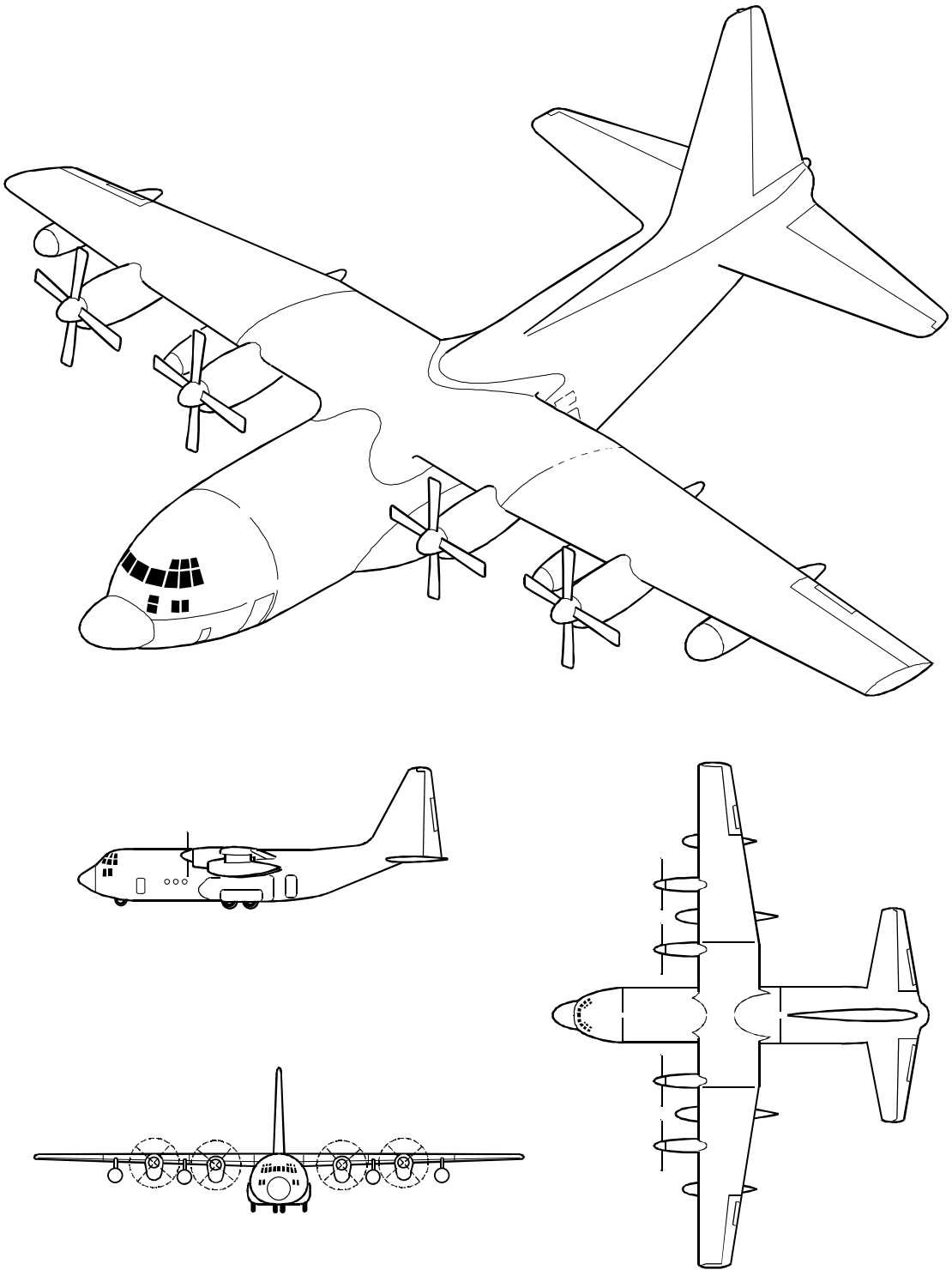
APPENDIX 11 TO ANNEX 10Q

KC-10 PILOT DIRECTOR LIGHTS ILLUMINATION PROFILE



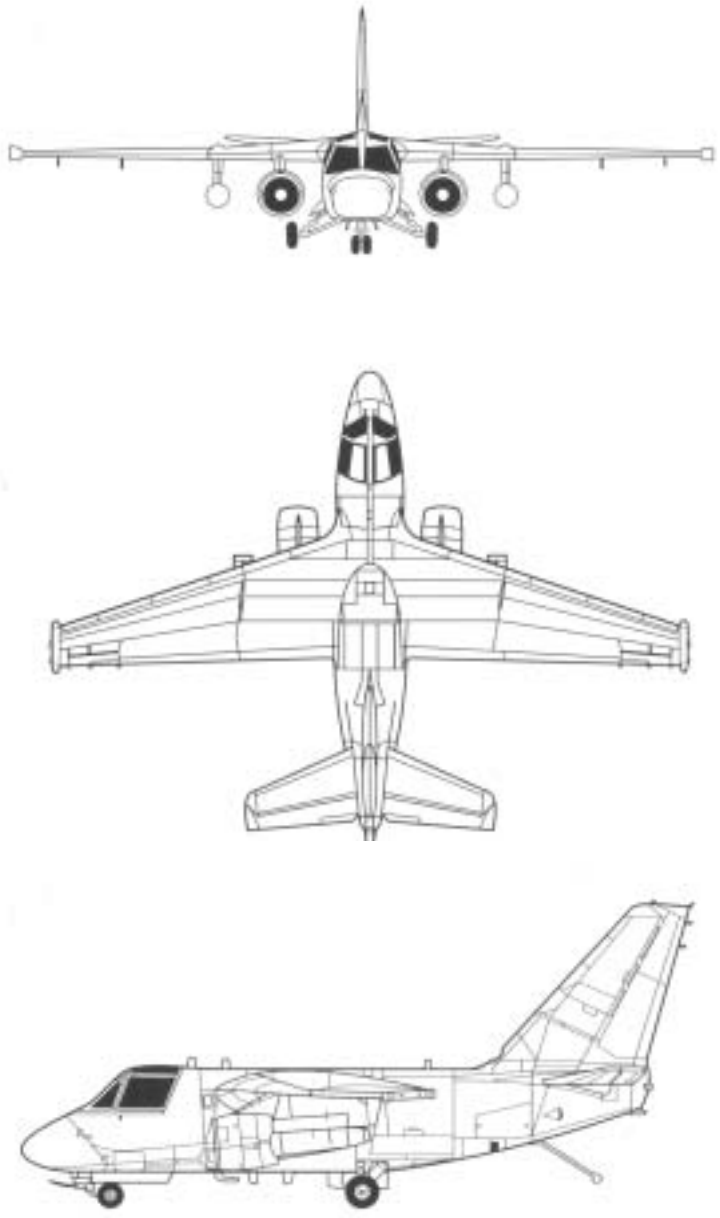
APPENDIX 12 TO ANNEX 10Q

KC-130 HERCULES



APPENDIX 13 TO ANNEX 10Q

S-3B VIKING



KC-135 Clearances

1. Receiver Types Certified against the KC-135. To aid identification, the common NATO reporting name (if applicable) is given in addition to the US nomenclature. Boom, BDA, or MPRS Pods compatibility is listed. This document is not a clearance for all NATO receivers to refuel with USAF tankers. Receiver pilots must be qualified and current in USAF AAR procedures before commencing AAR with USAF KC-135s.

(1)	A/EA-6	Intruder/Prowler	BDA/Pods
(2)	A-10	Thunderbolt	Boom
(3)	AMX		BDA/Pods
(4)	AV-8A/B		Pods
	AV-8PLUS (Spanish, Italian)		Pods
(5)	B-1	Lancer	Boom
(6)	B-2	Spirit	Boom
(7)	B-52	Stratofortress	Boom
(8)	C-5	Galaxy	Boom
(9	C-17	Globemaster III	Boom
(10)	C-130	Hercules	Boom (USAF models only)
(11)	C/EC/KC/RC/WC-135		Boom
(12)	C-141	Starlifter	Boom
(13)	E-3, E-3D, E-3F, B-707 IFT/NTCA,E-6, EC-18,		Boom
	EC137, TC-18, Sentry		Boom
(14)	E-4/VC-25A	Elint B 747/Air Force One	Boom
(15)	E-8	JSTARS	Boom
(16)	F/RF-4	Phantom	Boom
(17)	F-14	Tomcat	BDA/Pods
(18)	F/TF-15	Eagle	Boom
(19)	F-16 (USAF)	Falcon	Boom
	F-16 (Belguim and Turkish)		Boom
(20)	F/A-18, CF-18, EF-18 Hornet		BDA/ Pods
(21)	F/EF-111	Aardvark/Raven	Boom
(22)	F-117	Nighthawk	Boom
(23)	Harrier GR7, T10		MPRS Pods
(24)	Hawk		MPRS Pods
(25)	Jaguar S, B, GR MK 3/3A		BDA/Pods
(26)	KC-10	Extender	Boom
(27)	Mirage F1, F1CR, IV, IV-P, 2000		BDA/Pods
(28)	S-3	Viking	BDA/Pods
(29)	SR-71	Blackbird	Boom
(30)	Sea Harrier F/A2		Pods
(31)	Tornado F3, GR4/4A, ADV		BDA /Pods
	Tornado IDS/ECR, PA-200		BDA/Pods

KC-10 Clearances

1. Receiver Types Certified against the KC-10. To aid identification, the common NATO reporting name (if applicable) is given in addition to the US nomenclature. Boom, Centre Hose or Wing Pods compatibility is listed. This document is not a clearance for all NATO receivers to refuel with USAF tankers. Receiver pilots must be qualified and current in USAF AAR procedures before commencing AAR with USAF KC-10s.

(1)	A/EA-6	Intruder/Prowler	Pods/Centre
(2)	A-10	Thunderbolt	Boom
(3)	A-37B		Pods/Centre
(4)	AMX		Pods/Centre
(5)	AV-8A/B		Pods/Centre
	AV-8PLUS (Spanish, Italian)		Pods/Centre
(6)	B-1	Lancer	Boom
(7)	B-2	Spirit	Boom
(8)	B-52	Stratofortress	Boom
(9)	C-5	Galaxy	Boom
(10)	C-17	Globemaster III	Boom
(11)	C-130	Hercules	Boom (USAF models only)
(12)	C/EC/KC/RC/WC-135		Boom
(13)	C-141	Starlifter	Boom
(14)	E-3, E-3D, E-3F, B-707 IFT/NTCA,E-6, EC-18,		Boom
	EC137, TC-18, Sentry		Boom
(15)	E-4/VC-25A	Elint B 747/Air Force One	Boom
(16)	E-8	JSTARS	Boom
(17)	F/RF-4	Phantom	Boom
(18)	F-14	Tomcat	Pods/Centre
(19)	F/TF-15, F-15J/DJ (Japan)	Eagle	Boom
(20)	F-16 (USAF)	Falcon	Boom
	F-16 (Belgium, Denmark, Israel, Netherlands		Boom
	Singapore, Thailand and Turkish)		Boom
(21)	F/A-18, CF-18, EF-18	RAAF-18 Hornet	Pods/Centre
(22)	F/EF-111	Aardvark/Raven	Boom
(23)	F-117	Nighthawk	Boom
(24)	Harrier GR7, T10		Pods/Centre
(25)	Hawk		Pods/Centre
(26)	Jaguar S/B, GR Mk 3/3A		Pods/Centre
(27)	KC-10	Extender	Boom
(28)	Mirage F1, 2000		Pods/Centre
(29)	S-3	Viking	Centre
(30)	SR-71	Blackbird	Boom
(31)	Sea Harrier F/A2		Pods/Centre
(32)	Tornado F3, GR4/4A, ADV		Pods/Centre
	Tornado IDS/ECR, PA-200		Pods/Centre

KC-130 Clearances

g. Receiver Types Certified. All USN and USMC probe equipped aircraft, including helicopters, and the following:

(1) Authorized to provide up to maximum fuel load (top offs allowed):

(a) Harrier GR7

(b) Jaguar A/E/B/S

(c) Mirage F1, 2000

(d) Sea Harrier F/A2

(e) Tornado F3, IDS, ECR, PA 200, ADV

(2) Authorized to provide up to 700 lb less than maximum fuel load (top offs prohibited):

(a) F-8

(b) Etendard and Super Etendard

(c) Hawk 203

ANNEX 10R
TANKER AAR CAPABILITIES

TANKER TYPES	AAR EQUIP-MENT	AAR: FL KIAS	TYPICAL OFFLOAD	AAR TRANSFER RATE	AAR FUEL PRESSURE	FUEL TYPE PRIMARY (ALTERNATE)	LIGHTS: FORM-ATION AAR	MARK FACILITY	RV AIDS
AUSTRALIA 707-338C	Hose (2 x pods)	1000ft-F350 250-325	45,400 kg (100,000 lb)	> 50 galls/m	3.5 bars 50±5 psi	F34 40 F44 (F35 F43)	Floods Signal	Nil	VHF UHF HF VOR ILS ADF INS UDF A/A TACAN
CANADA HERCULES CC-130T	Hose (2 x pod)	1000ft-F250 200-250	20,410 kg (45,000 lb)	450-900 kg/m (1000-2000 lb/m)	3.5 bars (50±5 psi)	F34 F35 F40 F44	Floods Signal	Fuel dump	VHF UHF HF VOR DME ADF INS GPS UDF A/A TACAN
FRANCE C135FR	Boom/ BDA --- Hose (2 x pods)	SL-F450 200-350 --- SL-F350 240-325	58,000 kg (130,000 lb)	2725 kg/m (6000 lb/m) --- 1275 kg/m (2800 lb/m)	3.5 bars (50±5 psi)	F34 (F35 F40 F44)	Floods --- Signal	Fuel dump	VHF UHF HF VOR ADF INS UDF A/A TACAN
C160 NG TRANSALL	Hose (1 x C'line)	SL-F180 160-220	14,000 kg (30,870 lb)	960 kg/m (2100 lb/m)	3.5 bars (50±5 psi)	F34	Floods Signal	Fuel dump	VHF UHF HF VOR ADF INS A/A TACAN
ETENDARD/ SUPER ETENDARD	Hose (1 x pod)	SL-F250 250-280	2000 kg (4400 lb)	300-400 kg/m (660-800 lb/m)	2.15 bars (31 psi)	F34 land F40/42 afloat	Signal		VHF UHF A/A TACAN
GERMANY TORNADO	Hose (1 x pod)	SL-F280 200-320	5500 kg (12,000 lb)	600 kg/m (1300 lb/m)	3.0 bars (35-55 psi)	F34	Signal	Fuel dump HISL	VHF UHF HF INS A/A TACAN
ITALY TORNADO	Hose (1 x pod)	SL-F200 200-320	2200 kg (4900 lb)	600 kg/m (1300 lb/m)	3.0 bars (35-55 psi)		Floods Signal	HISL	VHF UHF HF INS A/A TACAN
BOEING 707/320 T/T	Hose (1 x C'line) (2 x pod)	SL-F350 200-325	25,000 kg (55,000 lb)	1200-1300 kg/m (2600-2800 lb/m)	3.5 bars (50 psi)	F34	Floods Signal	Nil	VHF UHF HF VOR ADF INS UDF A/A TACAN
NETHERLANDS KDC-10	Boom	SL-F370 180-350	71,810 kg (158,000lbs)	2270 kg/m (5000 lb/min)	3.5±0.35 bar (50±5 psi)	F34 (F35 F40 F44)	PDL Floods Signal	Fuel Dump HISL	VHF UHF HF VOR INS UDF Brg&DME A/A TACAN
NEW ZEALAND A-4K SKYHAWK	Hose (1 x pod)	SL-F300 200-300	2500 kg (5500 lb)	600 kg/m (1300 lb/m)	3.5 bars (50±5 psi)	F40 (F44)	Floods Signal	Fuel Dump	VHF UHF VOR INS UDF A/A TACAN
SOUTH AFRICA 707/320C	Hose (2 x pod) (1 x C'line)	500ft-F350 220-325	25,000 kg (55,000 lb)	C'line 900 kg/m (1980 lb/m) Pods 1500 kg/m (3300 lb/m)	3.5 bars (50±5 psi)	JET A1	Floods Signal	Nil	VHF UHF HF VOR ADF INS UDF A/A TACAN
SPAIN KC130H (TK-10)	Hose (2 x pod)	1500ft-F230 195-250	+ Aux Tank 18,180 kg (40,000 lb) No Aux Tank 13,410 kg (29,500 lb)	+ Aux Tank 880 kg/m (1950 lb/m) No Aux Tank 420 kg/m (970 lb/m)	(45±5 psi)		Floods Signal	Nil	VHF UHF HF VOR ADF INS UDF A/A TACAN
707 T/T (TK-17)	Hose (2 x pod)	1500ft-F350 200-350	25,000 kg (55,000 lb)	1500 kg/m (3300 lb/m)	< 3.5 bars (50 psi)		Floods Signal	Nil	VHF UHF HF VOR ADF INS UDF A/A TACAN
TURKEY KC-135	Boom --- BDA	SL-F300 200-320	61,2800 kg (135,000lb)	2720 kg/m (6000 lb/m) --- 1270 kg/m (2800 lb/m)	3.5 bars (50±5 psi)	F34 (F35 F40 F44)	PDL Floods --- Floods	Fuel dump	VHF UHF HF VOR INS UDF A/A TACAN Radar +
UK TRISTAR K	Hose (2 x C'line)	SL-F350 230-320	86,320 kg (190,000lb)	2200 kg/m (4800 lb/m)	3.5 bars (50 psi)	F34 (F35 F40 F43 F44)	Floods Signal	HISL	VHF UHF HF VOR ADF INS UDF A/A TACAN
VC10K	Hose (2 x pod) (1 x C'line)	SL-F350 230-320	45,400 kg (100,000lb)	C'line 2280 kg/m (4800 lb/m) Pods 1360 kg/m (3000 lb/m)	3.5 bars (50 psi)	F34 (F35 F40 F43 F44)	Floods Signal	HISL	VHF UHF HF VOR INS UDF A/A TACAN
VC10C1K	Hose (2 x pod)	as VC10K	as VC10K	1360 kg/m (3000 lb/m)	as VC10K	as VC10K	as VC10K	as VC10K	as VC10K
USA KC-135	Boom --- BDA	SL-F300 200-320	57,650 kg (127,000lb)	2720 kg/m (6000 lb/m) --- 1270 kg/m (2800 lb/m)	3.5 bars (50±5 psi)	F34 (F35 F40 F44)	PDL Floods --- Floods	Fuel dump	VHF UHF HF VOR INS UDF A/A TACAN Radar +
KC-10	Boom --- Hose (1 x C'line) --- Hose (2 x pod)	SL-F370 180-350 --- SL-F350 200-325 --- SL-F320 200-325	113,330 kg (250,000lb)	3630 kg/m (8000 lb/m) --- 1820 kg/m (4000 lb/m) --- 1110 kg/m (2400 lb/m)	3.5 bars (50±5 psi)	F34 (F35 F40 F44)	PDL Floods --- Floods Signal --- Floods Signal	Fuel dump HISL	VHF UHF HF VOR INS UDF brg&DME A/A TACAN Radar + transponder
KC-130	Hose (2 x pod)	500ft-F230 Fixed wing: 200-250 Helo: 105-130	18,140 kg (40,000 lb)	+ Aux Tank Dual Pump 1850 kg/m (4080 lb/m) Single Pump 925 kg/m (1040 lb/m) No Aux Tank 460 kg/m (1020 lb/m)	3.5 bars (50 psi)	F44 (F34 F40)	Signal	Fuel dump	VHF UHF HF VOR ADF GPS INS UDF A/A TACAN IFF interrogator
S-3B	Hose (1 x pod)	SL-F250 200-300	6120 kg (13,500 lb)	620 kg/m (1370 lb/m)	3.8 bars (55 psi)	F44 (F34 F40 ashore)	Floods Signal		UHF HF INS A/A TACAN

ANNEX 10S
TANKER/RECEIVER CLEARANCES

TANKER / RECEIVER	**AUSTRALIA** 707-338C	**CANADA** HERCULES CC-130T	**FRANCE** C135FR	**FRANCE** C160 NG TRANSALL	**FRANCE** ETENDARD	**GERMANY** TORNADO	**ITALY** B707/320 T/T	**NETHERLANDS** DC10	**SOUTH AFRICA** B707/320C	**SPAIN** KC130H (TK-10)	**SPAIN** B707 T/T (TK-17)	**TURKEY** KC-135	**UK** TRISTAR	**UK** VC10K3 & 4	**UK** VC10CMk1K	**USA** KC135	**USA** KC10	**USA** KC130	**USA** S3B
AMX (IAF)			X	X		X	X			X	X		X	X	X	X	X		
AV-8B (USN)		X								X	X		X	X	X	X	X	X	X
AV-8B (USMC)	X	X					X			X	X		X	X	X	X	X	X	X
AV-8B (IT Navy)											X					X	X		
AV-8B/ AV-8PLUS (SPANISH NAVY)			X				X			X	X		X	X	X	X	X		
A-4 (RSAF)	X												X	X	X				
EA-6 (USN, USMC))	X	[redacted]																	
EF-2000	[redacted]																		

[redacted]

[redacted]

[redacted]

ANNEX 10S
TANKER/RECEIVER CLEARANCES

RECEIVER \ TANKER	**AUSTRALIA** 707-338C	**CANADA** HERCULES CC-130T	**FRANCE** C135FR	**FRANCE** C160 NG TRANSALL	**FRANCE** ETENDARD	**GERMANY** TORNADO	**ITALY** B707/320 T/T	**NETHERLANDS** DC10	**SOUTH AFRICA** B707/320C	**SPAIN** KC130H (TK-10)	**SPAIN** B707 T/T (TK-17)	**TURKEY** KC-135	**UK** TRISTAR	**UK** VC10K3 & 4	**UK** VC10CMk1K	**USA** KC135	**USA** KC10	**USA** KC130	**USA** S3B
AMX (IAF)			X	X		X	X			X	X		X	X	X	X	X		
AV-8B (USN)		X								X	X		X	X	X	X	X	X	X
AV-8B (USMC)	X	X					X			X	X		X	X	X	X	X	X	X
AV-8B (IT Navy)											X					X	X		
AV-8B/ AV-8PLUS (SPANISH NAVY)			X				X			X	X		X	X	X	X	X		
A-4 (RSAF)	X												X	X	X				
A-10								X				X				X	X		
B-1 Lancer												X				X	X		
B-2 Spirit												X				X	X		
B-52 Stratofortress												X				X	X		
CASA 295 (T-21) (SAF)										X	X								
Cheetah (SAAF)									X				X	X	X				
C-5 Galaxy												X				X	X		
C-17 Globemaster III												X				X	X		
C-130								X				X				X	X		
C-130 Hercules C1/3 (RAF)													X	X					
C/EC//RC/WC-135												X				X	X		
C-141 Starlifter												X				X	X		
C160 NG (FAF)				X						X									
E3/E3A (USAF/NATO)			X					X				X				X	X		
E3D (RAF)			X					X				X	X	X		X	X		
E3F (FAF)			X									X	X	X		X	X		
E-4												X				X	X		
E-8 JSTARS																X	X		
EA-6 (USN, USMC))	X	X	X		X					X	X	X	X	X	X	X	X	X	X
EF-2000										X	X								
Etendard (FAF)				X	X													X	X
F-4												X				X	X		
F5E (Singapore)													X	X	X				
F-14 (USN)		X	X		X					X		X	X	X	X	X	X	X	X
F-15								X				X				X	X		
F-16								X				X				X	X		
F/AtoD-18 (USN, USMC)	X	X	X							X	X	X	X	X	X	X	X	X	X
FA-18 (RAAF)	X	X											X	X	X	X	X		
FA-18 (KuwaitAF)													X	X	X				
F/A-18 (Swiss)			X										X	X	X				
CF-18 (CAF)	X	X	X							X	X	X	X	X	X	X	X		
F-18 (FinnishAF)													X	X	X				
EF-18 (SAF)		X	X				X		X	X	X		X	X	X	X	X	X	X
F-117 Nighthawk												X				X	X		
Harrier GR7/7A (RAF)	X	X	X				X			X	X		X	X	X	X	X	X	X
Harrier T10 (RAF)										X	X		X	X		X	X		
Hawk 203 (RAFO)													X	X	X	X	X	X	X
Hawk 208 (RMAF)													X	X	X	X	X		
Jaguar A (French AF)			X	X			X			X	X		X	X	X	X	X	X	X
Jaguar GR3/3A (RAF)			X							X	X		X	X	X	X	X		
Jaguar S (Ecuador, India, Nigeria, RAFO)								X				X	X	X	X	X	X	X	X
KC-10 Extender								X				X				X	X		
KC-135								X				X				X	X		
MB339CD (IAF)							X												
Mirage F1 (French AF)		X	X	X	X		X			X	X		X	X	X	X	X	X	X
Mirage F1E (SAF)			X	X			X			X	X		X	X	X	X	X		
Mirage IVP (French AF)			X	X			X						X	X	X	X	X		
Mirage 2000 (Egypt)													X	X	X				
Mirage 2000 (French AF,)	X	X	X	X	X		X			X	X		X	X	X	X	X	X	X
Nimrod R1, MR2 (RAF)													X	X					
Sea Harrier F/A2 (RN)	X	X								X	X		X	X	X	X	X	X	X
Sea Harrier T8 (RN)													X	X	X				
Super Etendard (FN)			X	X						X			X	X	X			X	X
S-3B, ES-3A (USN, USMC)		X	X							X		X	X	X		X	X		
Tornado F3 (RAF)	X	X	X				X			X	X	X	X	X	X	X	X	X	
Tornado GR4/4A (RAF)	X	X	X			X	X			X	X		X	X	X	X	X		
Tornado IDS (IAF)		X	X	X		X	X			X	X	X	X	X	X	X	X	X	X
Tornado IDS (Saudi Arabia)												X	X	X	X	X	X	X	X
Tornado ADV (Saudi Arabia)													X	X	X				
Tornado ADV (IAF)		X	X				X			X	X		X	X	X				
Tornado ECR, IDS, PA 200 (GAF/GN))		X	X	X		X	X			X	X		X	X	X	X	X	X	X
VC10CMk1K, K3, K4 (RAF)													X	X					

Notes:

1. This matrix is not an authoritative document. It is intended to provide guidance to AAR Planners and Operators on the understanding that to complete AAR operations between different nations a valid authorization or agreement between the concerned nations is to be in place. Additionally, crew qualifications and currency is to be taken into account.

2. The information contained in this Annex is a summary of the National Annexes.

3. An "X" indicates that the two aircraft have been tested or are assessed as mechanically compatible for AAR. Limitation on this clearance may exist and National POCs/Operating Authorities are to be consulted.

4. The appropriate tanker National Annex must be consulted to confirm which of BDA, boom or hose is required for each tanker/receiver combination.

SUGGESTED PROCEDURE

FOR OBTAINING

AIR TO AIR REFUELLING CLEARANCE

Below are the **minimum** details required when making an initial request for AAR clearance.

a. Agency that the request is aimed at. To include :

Position & Mailing Address.
Name of Point of Contact, if available.
E-Mail Address.
Phone/Fax Numbers.

b. Agency requesting clearance, including all points of contact details as at "a" above.
c. Category of clearance request required. ie 1-urgent, 2-partial, 3-full.
d. Magnitude of support required (flight hours, amount of fuel etc)
e. Location and time of support required: area, country, day, night.
f. Type of refuelling system involved - boom/BDA/drogue or all 3.
g. Type and mark of all aircraft involved.
h. Type of Fuel
i. Is authority given for direct contact with aircraft and AAR system manufacturers.
j. POC of aircraft and AAR system manufacturers.
k. Accurate technical data (as available) and / or completed Performance Interface Questionnaire for the type of aircraft to be refuelled and, if necessary, the tanker: see attached questionnaire.
l. AAR training currency requirements of receiver pilot's nation/or as required by tanker nation.
m. Proposed aircraft accident/incident accountability and liability.

CATEGORIES OF REQUESTS FOR CLEARANCE

There are three categories of request for clearance, depending on the urgency of the AAR requirement.

CATEGORY 1 – URGENT REQUEST

a. Definition. An urgent requirement for AAR due to war, conflict or other operational need.

b. Period. This clearance will be withdrawn at the termination of the war, conflict or operational need.

c. Considerations. Due to the limited timescale, there will be no opportunity for testing which will restrict the, subsequently agreed, cleared refuelling envelope. It is **essential** that there is an

open and rapid exchange of information between all agencies. The successful outcome will be enabled by:

(1) Maximum use of technical information and full access to **accurate** data from all equipment manufacturers.
(2) A fully completed Performance Interface Survey (if available).
(3) Acceptance that no ground/flight testing or instrumentation will be required.
(4) Ground fit checks carried out only if marginal hardware clearance data indicates a requirement.
(5) An early decision as to whether clearance is required for day or night AAR, or both.

Leading to: Expedient Operations Supplement for AAR restrictions - No published Technical Orders (TOs).

CATEGORY 2 – PARTIAL CLEARANCE

a. Definition. A critical requirement for AAR as indicated in a Category 1 clearance, but with opportunity for supplemental testing to minimise the restrictions to the cleared refuelling envelope.

b. Period. This clearance will be withdrawn at the termination of the war, conflict or operational need.

c. Considerations. This clearance is similar to Cat 1 and is still expected to be achieved within a limited timescale. However, some ground and flight-testing will be achieved to limit the restrictions to the cleared AAR envelope.

(1) Maximum use of technical data and full access to **accurate** data from all equipment manufacturers.
(2) A fully completed Performance Interface Questionnaire (if available).
(3) Agreement of minimum, supplemental ground/flight testing or instrumentation required.
(4) An early decision as to whether clearance is required for day or night AAR, or both.

Leading to: Issue of TOs, if time factor is not critical.

CATEGORY 3 – FULL CLEARANCE

a. Definition. A routine requirement for AAR clearance as defined by the requester.

b. Period. This clearance is open ended, but is liable to review if there are changes to equipment or procedure.

c. Considerations. Only those restrictions to the envelope as required by the requester. To include all ground and flight testing at each stage.

(1) Use of technical data and full access to **accurate** data from all equipment manufacturers.

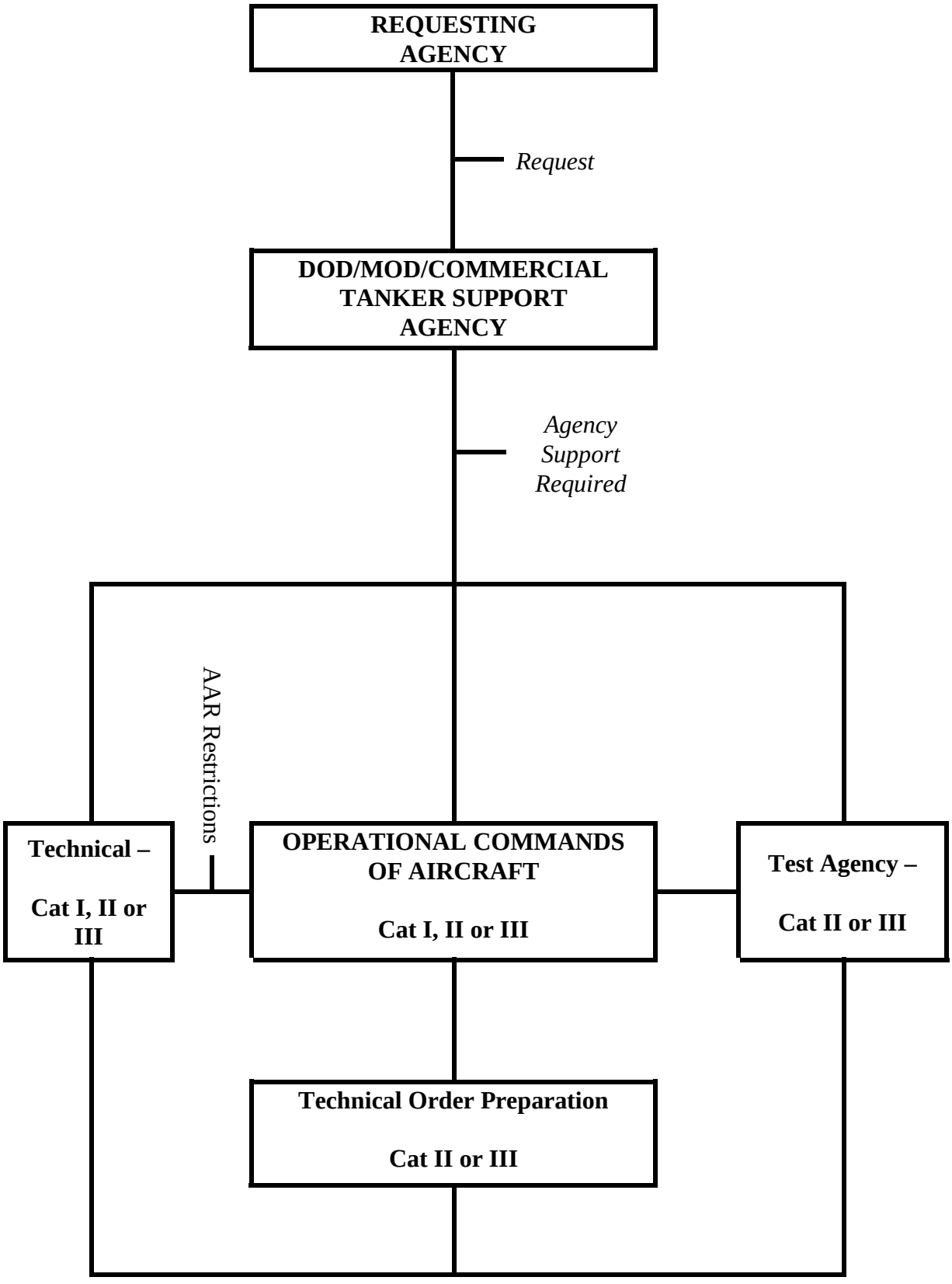
(2) Meetings to involve technical, operational and identified test agencies as well as aircraft hardware manufacturers.
(3) A fully completed Performance Interface Questionnaire (if available).
(4) Complete ground and flight-tests with instrumentation as necessary to minimize limitations to AAR envelope.
(5) Day and night AAR clearance or as required by the inquirer.

Leading to: TOs, including identification of any restrictions required by ground and flight-test results.

GENERAL CONSIDERATIONS FOR ALL AGENCIES

1. Technical and operational interface meetings as required.
2. Methods for implementing AAR restrictions.
3. Fuel accountability.
4. Aircraft liability.
5. Accident /incident - conduct of investigations.
6. Training requirements and considerations.
7. Maximum use and availability of technical data (all aircraft)
8. Availability of technical expertise.
9. Identity of test agency as required.
10. Preparation of TOs and or method for identifying critical AAR restrictions.
11. Handling of sensitive information and it’s associated protection, including military and industry concerns.
12. Foreign Military Sales.
13. Funding or Fund Sharing when military and commercial goals are mutual.
14. Use of ATP-56(A).
15. Specific AAR and operational procedures /navy/marine/air force/special ops forces etc.

CLEARANCE PROCESS – FLOW DIAGRAM



ANNEX 10U

NATIONAL RESOURCES – OMEGA AIR

1. Introduction. Omega Air, Inc. is a commercial company engaged in the sale and lease of services of KC-707 aerial refueling tanker aircraft.

2. OMEGA KC-707 Tanker Aircraft. Four wing-mounted JT3D-3C engines power the aircraft, S/N 20029. Maximum takeoff weight is 333,000 lb, and maximum landing weight is 247,000 lb with a fuel load of 160,000 lb. Communications equipment includes UHF, HF, and VHF radios. The aircraft is also equipped with a Traffic Collision Avoidance System for collision avoidance during rendezvous (RV) procedures. The tanker is equipped with an aerial refuelling system located in the lower aft fuselage. The duel hose drogue aerial refuelling (AR) system is internally mounted on the centerline of the aircraft within a pressurized compartment.

a. AAR Equipment. The aerial refuelling system is comprised of two independent Sargent Fletcher SF300 refuelling systems. These systems currently are used on the wings of KC-130F/R/T aircraft. Each system includes a 93-ft long hose. In full trail position, the hose extends 80 ft from the point at which it exits the aircraft to the drogue tip. The white refuelling hoses have black markings that designate the refuelling range and provide hose movement cues. The two reels are installed side-by-side and cannot be used simultaneously. The reels are hydraulically powered and operate independently, allowing for a redundant capability. The location of the AAR systems is shown in Figures 2 (to be issued). Two J.C. Carter fuel transfer pumps provide fuel flow of up to 1675 kgs with two pumps operating per reel system. Two in-line regulators provide fuel pressure regulation and surge suppression within the MA-4 couplings (55 ± 5 psig) from 0 to maximum fuel flow. The reels are controlled by a reel operator from a cockpit-mounted control panel that provides video coverage of the AR area aft of the Omega 707.

b. Refuelling Heights and Speeds. AAR height band is 5,000 ft to 38,000 ft; speed range is 200 kts to 320 kts.

c. Maximum Transferable Fuel. Total fuel load is 72,727 kg (160,000 lb). Transferable fuel is dependant on sortie duration; a representative offload of 35,455 kg (78,000 lb) is available for a 5 hr flight, assuming a fuel burn rate of 5,909 kg/hr (13,000 lb/hr).

d. Fuel Transfer Rate. Transfer rate is 1675 kg/min at 50 psi.

e. Regulated Fuel Pressure. 50 psi (± 5).

f. Fuel Types Available for AAR.

(1) Primary fuel is Jet A and Jet A-1 (F-35).

(2) Alternative fuels are F-34, F-40 and F-44.

g. The following receiver types are cleared to refuel from the KC-707 Omega SN 20029 tanker:

(1) F/A-18A-D.

(2) F-18E/F.

(3) F-14.

(4) S-3B.

(5) AV-8B.

(6) EA-6.

h. Lighting. AAR equipment signal lights are mounted 6 ft aft of the hose exit point on the aircraft centerline. The lights signal the following:

Prior to contact

Red	Receiver is not cleared for contact.
Amber	Tanker ready for contact.

Following contact

Red	Fuel does not flow.
Green	Fuel flows.
Amber	Hose is not within designated refuelling range. (No fuel flow.
Flashing Red	Breakaway.

Aircraft undersurfaces are illuminated by floodlights. Drogue canopy is fitted with luminous light sources.

i. Mark Facilities. Aircraft are fitted with strobe lighting. Red and green rotating beacons, navigation lights, wing tip formation lights, underbelly lights and logo lights.

j. Dimensions. Aircraft drawings (to be issued).

k. RV Aids. The KC-707 Omega tanker is equipped with:

(1) VHF, UHF and HF radios.

(2) GPS,VOR.DME ADF and TACAN.

(3) UDF, A/A TACAN.

3. Source Documents.

a. ARSAG Aerial Refuelling Performance and Interface Survey dated 20 Oct 81. See ARSAG web site at www.arsaginc.com.

b. STANAG 3447 (Edition 3) dated 25 Sep 90. Subject: ‘Aerial Refuelling Equipment Dimension and Functional Characteristics’ See ARSAG web site at www.arsaginc.com.

c. MIL-A-19736A (wep) 5 Aug 60 ‘Air Refuelling Systems, General Specifications for’.

d. Original Technical Exhibit dated 2 Feb 96 Revised 26 Apr 96 ‘Operational/Technical Requirements for Omega Air KC-707-320 Tanker Aerial Refuelling Equipped with Dual In-Fuselage Probe/Drogue Reel System’.

e. Marconi Statement of Work Redundant Centerline Aerial Refuelling System Omega Air Inc., B-707B Rev A dated 14 Aug 98 and Omega SOW Technical Exhibit dated 14 Aug 98.

f. F-4 Aerial Refuelling Flight Demonstration with Omega Air KC-707 Tanker dated 24

Feb 00 D H Kalt, Omega Consultant Trip Report.

g. Contractors Marconi: J. C. Carter, Sargent Fletcher, and design, ground and flight test documents

h. Navy Test Report No. NAWCADPAX/RTR-200206 dated 1 Mar 01. Subject: 'Omega Air 707/F/A-18-A-D Aerial Refueling Ground and Flight Test Evaluation'.

j. Naval Air System Command message 302008Z Oct 00 clearance F-18 E & F.

k. Naval Air System Command message 211407Z Dec 00 clearance F-14, S-3B, AV-8B and EA-6.

4. POC for Annex

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6. POC for STANEVAL.

(As for Annex)

7. Annex Last Updated. Initial version (Aug 01)

8. Reservations. Nil

LIST OF EFFECTIVE PAGES TO PART 2 (LEP)

PAGE NUMBERS	EFFECTIVE PAGES
10-1 to 10-4	Jul 02
10A-1 to 10A-4	Apr 02
10A-1-1 to 10A-2-1	Original
10A-3-1 (Reverse blank)	Original
10B-1 (Reverse blank)	Mar 03
10C-1 to 10C-3 (Reverse blank)	Dec 02
10C-1-1 to 10C-2-1	Original
10C-3-1 (Reverse blank)	Original
10D-1 (Reverse blank)	Original
10E-1 to 10E-9 (Reverse blank)	Original
10E-1-1 to 10E-2-1	Original
10E-3-1 to 10E-3-2	Original
10E-4-1 to 10E-5-1	Original
10E-6-1 to 10E-7-1	Original
10E-8-1 to 10E-9-1	Original
10E-10-1 to 10E-11-1	Original
10F-1 to 10F-3 (Reverse blank)	Dec 02
10F-1-1 (Reverse blank)	Original
10G-1 (Reverse blank)	Original
10H-1 to 10H-5 (Reverse blank)	Mar 03
10H-1-1 to 10H-2-1	Original
10H-3-1 to 10H-3-2	Original
10H-4-1 to 10H-5-1	Original
10H-6-1 (Reverse blank)	Original
10I-1 to 10I-3 (Reverse blank)	Jul 03
10I-1-1 to 10I-1-2	Original
10I-2-1 (Reverse blank)	Original
10I-3-1 (Reverse blank)	Jul 03
10K-1 (Reverse blank)	Original
10L-1 (Reverse blank)	Original
10M-1 to 10M-3 (Reverse blank)	Original
10N-1 to 10N-4	Dec 02
10N-1-1 to 10N-2-1	Original
10O-1 to 10O-5 (Reverse blank)	Dec 02
10O-1-1 to 10O-2-1	Original
10O-3-1 to 10O-4-1	Original
10P-1 to 10P-4	Jul 03
10P-1-1 to 10P-2-1	Original
10P-3-1 (Reverse blank)	Original
10P-4-1 (Reverse blank)	Jul 03

PAGE NUMBERS	EFFECTIVE PAGES
10Q-1 to 10Q-12	May 03
10Q-1-1 to 10Q-2-1	Sep 02
10Q-3-1 to 10Q-4-1	Sep 02
10Q-5-1 to 10Q-6-1	Sep 02
10Q-7-1 to 10Q-8-1	Sep 02
10Q-9-1 to 10Q-10-1	Sep 02
10Q-11-1 to 10Q-12-1	Sep 02
10Q-13-1 (Reverse blank)	Sep 02
10Q-14-1 to 10Q-15-1	May 03
10Q-16-1 (Reverse blank)	May 03
10R-1 (Reverse blank)	Sep 02
10S-1 (Reverse blank)	Jul 03
10T-1 to 10T-4	Sep 00
10T-1-1 (Reverse blank)	Sep 00
10U-1 to 10U-3 (Reverse blank)	Aug 01
Part 2 LEP-1 to Part 2 LEP-2	Jul 03