PART 2 - FIXED WING PROCEDURES

CHAPTER 1

Rendezvous Procedures

101 Introduction. The purpose of a 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 adapted when tankers are flying in any formation. The RV is usually at the RVCP and at the RVCT. This Chapter outlines 7 standard types of RV. The type of RV utilised will be dictated by the mission requirements, available equipment, weather conditions and the EMCON option in force.

102 General Procedures

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. To minimise the chance of dissimilar pressure settings between receivers and tankers, the following terminology is to be used:

(1) Flight Level. When the tanker and receiver altimeters are set to the international pressure setting of 1013.2 mb (29.92 inches), vertical reference will be made using the term 'flight level'.

(2) Altitude. When the tanker and receiver altimeters are set to QNH or a regional pressure setting, vertical reference will be made using the term 'altitude'.

(3) Height. When the tanker and receiver altimeters are set to QFE, vertical reference will be made using the term 'height'.

b. Vertical Separation. Receivers are normally to join from below and are to maintain a minimum of 1000 ft vertical separation, unless otherwise stated at the planning or briefing stage, until visual contact and positive identification have been made. If the planned flight levels/altitudes/heights are found to be unsuitable, the tanker commander may select other flight levels/altitudes/heights that will give the best possible chance of a successful RV. A change of flight levels/altitudes/heights 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 use of the airspace.

c. Speeds

(1) Tanker. The tanker speed during a RV procedure is prescribed in the tanker's flight manual and repeated in the applicable National Annex; this speed is normally optimised for best tanker performance. This is the speed that the tanker will fly if communication is not established with the receiver. If the tanker's speed differs from that listed, the tanker should advise the receiver in the RV Initial Call.

(2) Receiver. The receiver should normally fly the speed prescribed in its flight manual and listed in appropriate tanker National Annex. For Option 1 of the RV Delta (Part 2 Chapter 1, Annex 1D, page 1D-1) where the tanker's speed is known to the receiver, the receiver flies the tanker speed plus 20 kts.

d. Visibility. Receivers will maintain altitude separation of at least 1000 ft until 1 nm from the tanker.

(1) Visual With Tanker. Once the receiver(s) is visual with the tanker, receivers are clear to join and should initiate a progressive climb towards the tanker.

(2) Not Visual With Tanker. If receivers are not visual with the tanker, the subsequent actions will be in accordance with the capability of the receiver.

(a) Receivers Without Radar or with Weather Radar. Aircraft without radar or with only Weather Radar shall not proceed inside 1 nm unless the tanker is in sight.

(b) Basic Airborne Intercept Radar. Where receiver national limitations permit, aircraft with a basic airborne intercept radar (ie, target search available but lock capability not available) may climb to 500 ft below base AAR altitude, maintain this level and close to ½ nm.

(i) Loss of Radar Contact. If radar contact is lost inside of 1 nm without visual contact with the tanker, the receiver is to descend to 1000 ft below tanker altitude.

(c) Airborne Intercept (AI) Radar. Where receiver national limitations permit, as long as radar lock is maintained, aircraft equipped with an AI radar may continue closure at no more than 10 kts of overtake inside of ½ nm maintaining 500ft vertical separation to a minimum range of 1500 ft.

(i) Visual Contact Established. When visual contact is established with the tanker, a progressive climb may be initiated in order to join the tanker.

(ii) No Visual Contact by 1500 ft Range. If visual contact is not established by a range of 1500 ft, closure is to cease.

(iii) Loss of Radar Lock Inside ½ nm Range. If radar lock is subsequently lost, the receiver shall re-establish at least ½ nm range and maintain a minimum of 500 ft vertical separation.

(3) Visual Contact Not Established. If visual contact is not achieved at the appropriate minimum closure range, the receiver(s) may:

(a) Stabilise at the appropriate minimum range and maintain it until the tanker manoeuvres into an area of improved visibility.

or

(b) Descend to 1000 ft below the tanker, drop back to 1 nm and either maintain this position until the tanker manoeuvres into an area of improved visibility or terminate the RV.

e. Termination of AAR Due to Visibility. AAR is to be discontinued when in-flight visibility is deemed insufficient for safe AAR operations.

f. Turning Angles of Bank (AOB) and Range. A planning assumption of 25^{o} AOB is used by tankers for most RV procedural turns mentioned in this Chapter and its Annexes. This AOB 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 AOB specified in the table.

Notes:

(1) *These tables assume that the tanker is actually established in the turn at the prescribed turning range.*

(2) *Figures 1B-2, 1B-3, 1C-2, 1D-3 and 1D-4 publish turn ranges that achieve a tanker roll out 1 nm ahead of the receiver.*

(3) *Figures 1D-6 and 1D-7 are used by the USAF to ensure that the tanker rolls out 3 nm ahead of the higher speed receiver(s), whilst, with slower receivers, the tanker will roll out either ½ nm behind or 1 nm in front of the receiver(s).*

g. 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.

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

i. Base AAR Altitude. See definition in Lexicon.

103 Visual Acquisition of Tanker. To enhance visual acquisition of the tanker(s), the receiver or air/ground agency controlling the rendezvous may request the tanker to switch on/vary the high intensity lighting using the RT call:

"(Receiver Callsign) Mark"

Some tankers are capable of dumping a small quantity of fuel, or firing a flare in response to this call. This procedure should only be used if a receiver has a low fuel state or other similar circumstances that necessitate the RV to be expedited.

104 Rendezvous Overrun. When either the tanker or receiver detects that an overrun condition exists, or if the receiver(s) passes the tanker prior to or during the tanker rendezvous turn the following procedures will be employed:

a. Receiver(s). The receiver(s) will ensure positive vertical separation such that they pass at least 1000 ft below the tanker(s). The receiver(s) will also call:

"(Tanker Callsign) Execute Overrun"

and decelerate, maintaining AAR heading and assigned flight level/altitude.

b. Tanker(s). The tanker(s) will maintain flight level/altitude/height, accelerate to overrun speed (but to no more than drogue limiting speed if drogue(s) are trailed) and maintain AAR heading.

c. Terminate. When either the tanker or receiver deems that the overrun condition is no longer a factor, they will call:

"(Receiver Callsign) Terminate Overrun"

d. Rejoin. Once the overrun condition has been corrected and the receiver is below and behind the tanker, (ie tanker has positive electronic or visual contact ahead of the receiver(s)) the tanker(s) will slow to AAR airspeed and complete normal RV procedures. Receivers will not begin a climb to the RV altitude until it is evident that the tanker(s) will remain in front of the receiver for the entire closure to the astern position.

105 Joining - Probe and Drogue Tankers

a. Observation Position. The left-hand side of the tanker is allocated for joining aircraft, unless the lead tanker directs otherwise. The exact location of the observation position is dependent upon the availability of rearward facing observers or boom operators that can monitor the receivers; see the Tanker's Nation Annex for tanker configuration.

(1) Tankers Without Refuelling Observers. Where the tanker has no rearward facing observers, the receivers must move forward ahead of the wingline to the observation position in order to be seen and identified by the tanker pilots. See Figure 1-1.

(2) Tankers With Refuelling Observers. Where the tanker has rearward facing observers or boom operators, the observation position is behind the wingline of the tanker. See Figure 1-2.

b. Joining Multi-Tanker Formations. Multi-tanker formations are to be in echelon right formation during receiver joins. Receivers are normally to join on the left of a multi-tanker formation, or to the left of their assigned tanker once visual with the complete formation.

Figure 1-1. Diagram of Key Areas Around a Probe and Drogue Tanker Without an Aft Observer

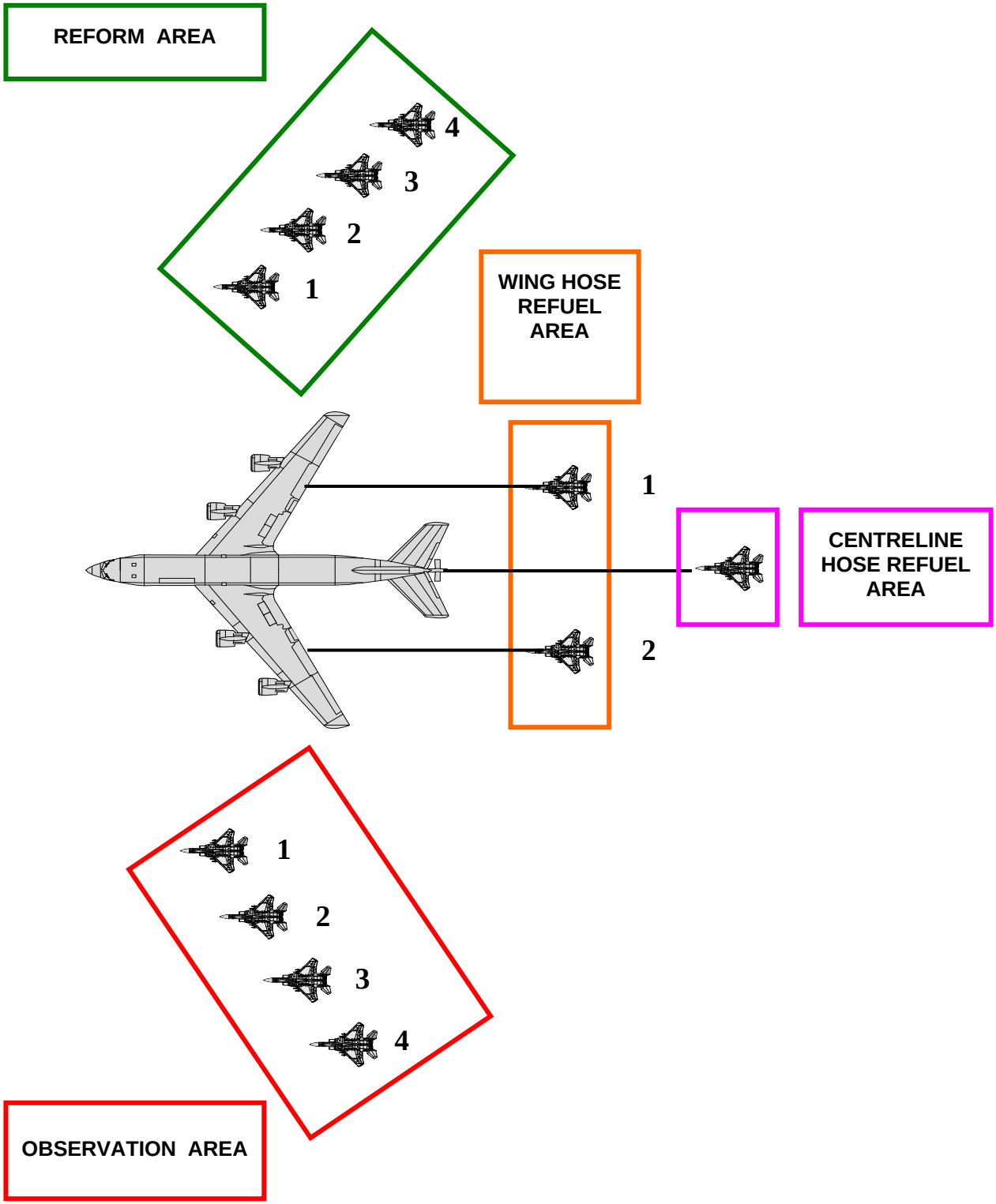
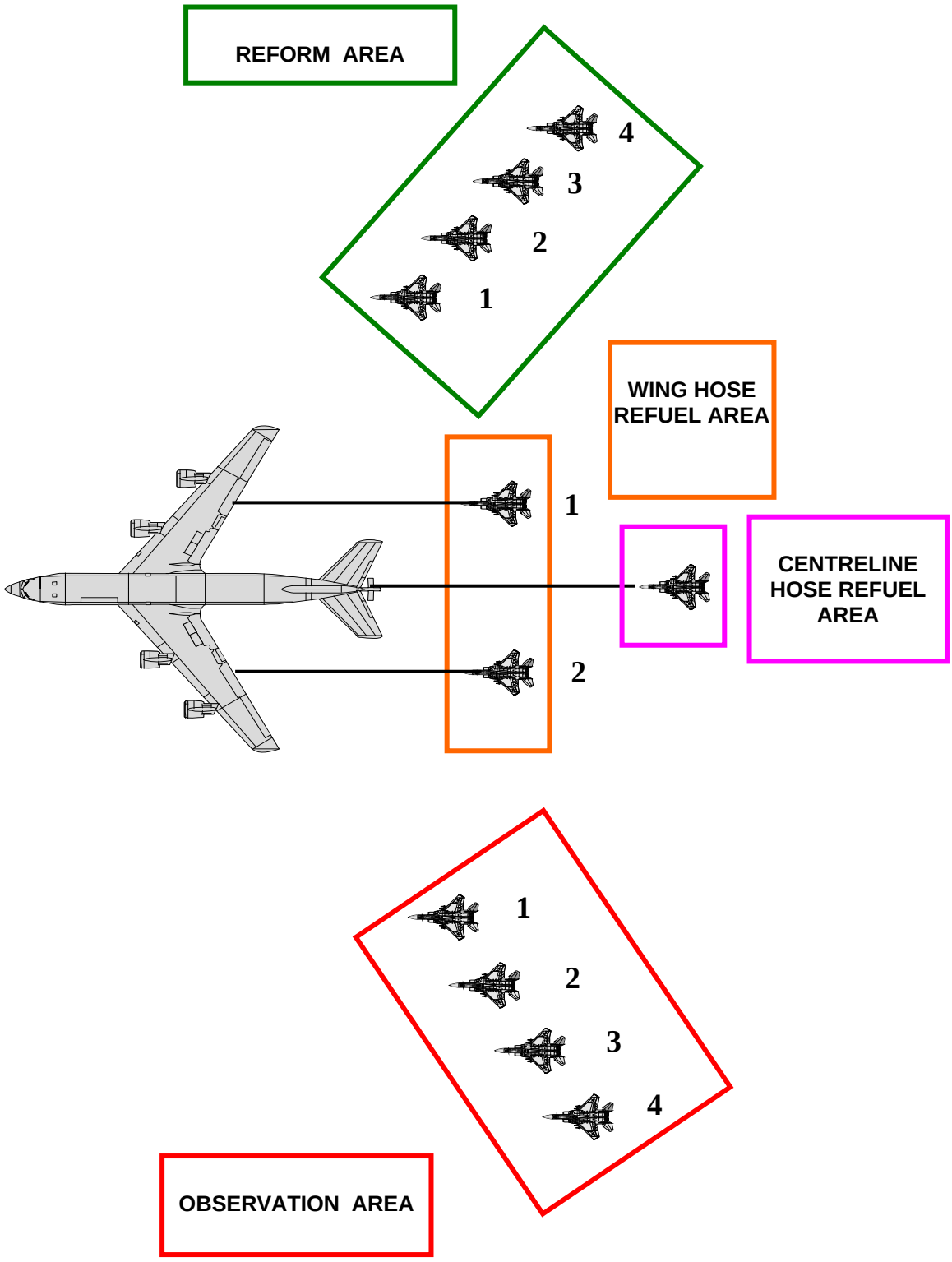


Figure 1-2. Diagram of Key Areas Around Tankers - Boom and Probe and Drogue with an Aft Observer



106 Refuelling – Probe and Drogue

a. Join – Observation Position. Receivers arrive from tanker's left side and form up in the observation position as described in para 105. See Figures 1-3A, 1-3B and Figure 1-2 as appropriate to the tanker.

b. Receiver Sequence. To ensure safe operations, the tanker will direct receivers to the formation position that they are to adopt. Furthermore, the tanker will direct when receiver aircraft are to reposition. Receiver aircraft are to move sequentially from echelon in the observation position to the astern position on command from the tanker; this command may be given by radio or by using the standard procedural signals in EMCON conditions. See Figure 1-3 for illustrations of controlled receiver flow around the tanker.

c. Simultaneous Movement of Receivers- Repositioning Receivers. Up to two receivers may be directed to move simultaneously from the observation position to behind the hoses. Similarly, both aircraft behind the hoses may be directed to move simultaneously from this position to the reform position. See Figure 1-3 for illustrations of controlled receiver flow around the tanker. Until directed by the tanker, all other aircraft should remain steady in their allocated formation position.

d. Collision Avoidance. Receivers are responsible for ensuring that the airspace they are moving into is clear of other aircraft. In addition, moving receivers are mutually responsible for ensuring that they do not collide with the other repositioning aircraft.

e. Receiver(s) on Tanker with 2 Wing Refuelling Stations

(1) One Receiver on Tanker with 2 Wing Refuelling Stations. When the tanker has 2 wing refuelling stations and both are available, the receiver moves to the right hand refuelling position

(2) Two Receivers on Tanker with 2 Wing Refuelling Stations. If there is more than one receiver and both refuelling stations are vacant, the first receiver moves behind the right hand hose into the astern position, and the second receiver moves in turn behind the left hand hose into the astern position. See Figures 1-3C and 1-3D.

(3) Receivers Waiting on the Tanker Wing. Until directed by the tanker, all other aircraft should remain steady in their allocated formation position.

f. Receiver(s) on Tanker with One Wing Refuelling Station or Centreline Station

(1) Movement of Receivers. When the tanker has one wing refuelling station or a single centreline hose, only one receiver will be directed to move in turn to cycle from the Observation Position to behind the available hose.

(2) Receivers Waiting on the Tanker Wing. Until directed by the tanker, all other aircraft should remain steady in their allocated formation position.

g. Clear for Contact and Remaining in Contact

(1) Individual Clearance to Contact. Normally, the tanker is only able to safely monitor one receiver at a time. Consequently, receivers will be cleared (verbally and/or by light signals) to make contact one at a time. Where the tanker is able to monitor both receivers, simultaneous contacts may be approved.

(2) Remaining in Contact. Because of the potential to cause the tanker to yaw slightly if one receiver disconnects from a wing hose, receivers should remain in contact until cleared to disconnect by the tanker. See Figure 1-3E.

h. Disconnect. Normally, when both wing hoses are occupied, the tanker will instruct receivers to disconnect simultaneously. However, the tanker may order individual disconnects either to maximise hose efficiency or because of disparate receiver fuel states.

(1) Other Considerations for Disconnecting. Refer to Part 2 Chapter 4 para 404e for other safety considerations associated with receiver disconnects.

i. Change Hose Procedure. It is important to move only one receiver at a time when cycling/changing the receivers behind hoses. To cycle 2 receivers between wing hoses, the tanker is to:

(1) Order one receiver to the observation or reform position.

(2) With this achieved, the second receiver may be cleared to the astern position behind the vacant hose.

(3) On completion of this manoeuvre, the first receiver may be cleared to the astern position behind its new hose.

j. Reforming. Once cleared from behind the hose, receivers will reform in echelon in the Reform Position. See Figure 1-3F.

k. Refuelling Subsequent Receiver(s). The next receiver waiting in the Observation Position will remain in that position until cleared by the tanker to move behind the hose. Before moving, the receiver(s) must also visually confirm that the previous receiver(s) have moved towards the Reform Position.

l. Other Receivers Joining. Receivers must exercise caution as other formations may be joining the tanker at the same time as they are reforming and departing. See Figure 1-3H.

m. Silent Procedures. During silent procedures, tankers will use visual signals to clear receivers to reposition. Receivers remain responsible for ensuring that the area into which they are moving has been vacated by the previous receiver.

107 Joining – Boom

a. Join - Single Tanker – Observation Position. Receivers arrive from tanker's left side, unless the lead tanker directs otherwise, and form up in the observation position. The observation position is behind the wingline of the tanker. See Figure 1-4 and Figure 1-5A.

(1) First Boom Receiver. The boom operator has a good rear view of the receiver and is able to give detailed commentary and advice to both the receiver and the tanker. If cleared by the tanker, the first receiver of a formation may join directly behind the boom. The receiver visually must confirm that no AAR is in progress and that the boom is lowered. See Figures 1-5B.

(2) Remainder of Formation. All other members of the formation should form up in the observation position. See Figures 1-5A and B.

b. Joining Multi Tanker Formations. Multi-tanker formations are to be in echelon right formation during receiver joins. Receivers are normally to join on the left of a multi-tanker formation, or to the left of their assigned tanker once visual with the complete formation. See Figures 1-5A and 1-5B.

Figure 1-3. Diagram of Receiver Flow Around a Probe and Drogue Tanker

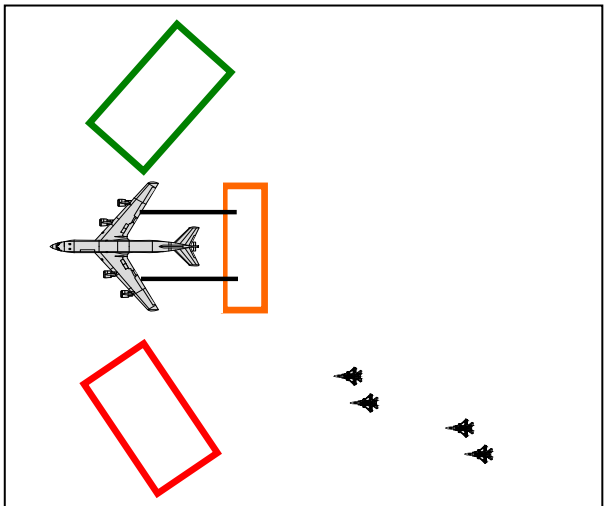


Fig 1-3A. Receivers Join on Left Wing

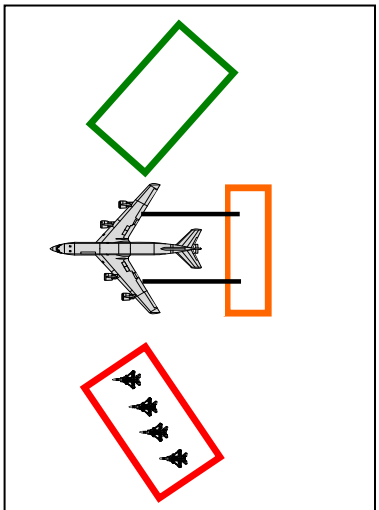


Fig 1-3B. Observation

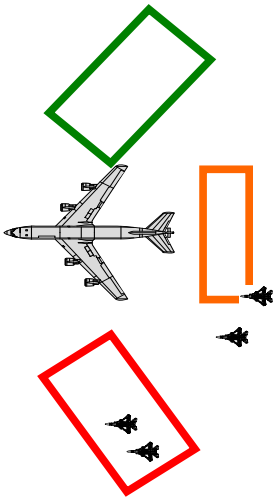


Fig 1-3C. Pair Move Aft

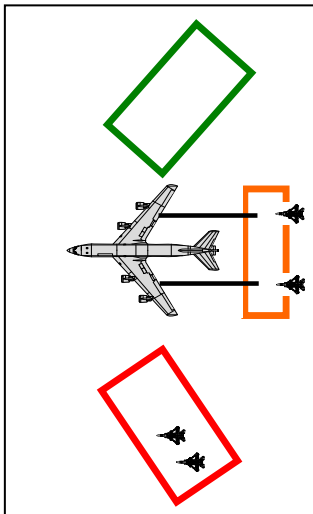


Fig 1-3D. Receivers in Astern Position

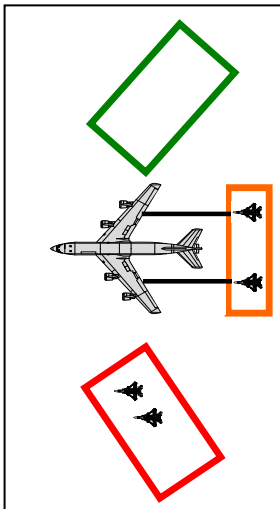


Fig 1-3E. Both in Contact

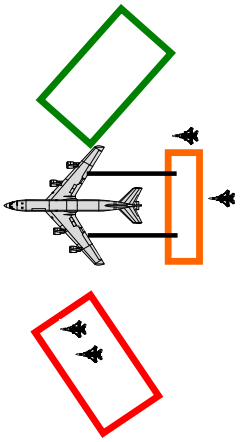


Fig 1-3F. Receivers Complete

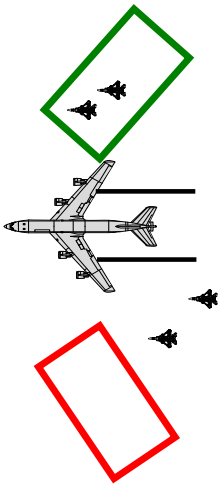


Fig 1-3G. 2nd Pair Aft

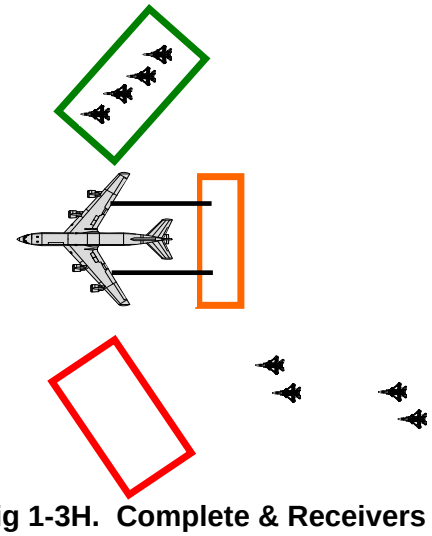


Fig 1-3H. Complete & Receivers Join

108 Joining – Boom Tankers

a. Join - Single Tanker – Observation Position. Receivers arrive from tanker's left side, unless the lead tanker directs otherwise, and form up in the observation position. The observation position is behind the wingline of the tanker. See Figure 1-4.

b. Receiver Sequence. To ensure safe operations, the tanker will direct receivers to the formation position that they are to adopt, ie the observation, refuelling or reform areas. Furthermore, the tanker will direct when receiver aircraft are to reposition, and then only one aircraft at a time is to be changing formation position; all other aircraft should remain steady in the formation position allocated by the tanker; this command may be given by radio or by using the standard procedural signals in EMCON conditions. See Figure 1-5 for illustrations of controlled receiver flow around the tanker.

c. Collision Avoidance. Receivers are responsible for ensuring that the airspace they are moving into is clear of other aircraft. In addition, moving receivers are mutually responsible for ensuring that they do not collide with other repositioning aircraft.

d. Boom Signals. The standard signal given by the boom operator to clear the receiver to the astern position is lowering the boom. Refer to Part 2 Chapter 5 Annex 5C Figure 5C-3.

e. Receiver Flow – Single Tanker

(1) One Tanker and One Receiver. The standard flow for boom AAR operations between one tanker and one receiver is for the receiver to join directly behind the boom, only if the receiver has visually confirmed that no AAR is in progress and that the boom is lowered.

(2) One Tanker and More Than One Receiver. With the exception of non-bomber heavy receivers that flow from right to left, for two or more receivers the standard flow is left to right. This standard may only be adjusted when airspace, ATO, or SPINS make flowing from left to right impossible.

f. Refuelling First Receiver. The first receiver is refuelled and, when complete moves to the reform position on the right wing. See Figures 1-5C and 1-5D.

(1) Receiver/Tanker Formation. Once in position, the receiver pilot flies close formation with the tanker, although this can be complicated by wake turbulence.

(2) Boom/Receiver Mating. The boom is unlatched from its stowed position and "flown" towards the receiver by the boom operator using the attached wings. The telescoping section is then hydraulically extended until the nozzle fits into the receiver's receptacle.

(3) Fuel Flow. Following connection of the boom nozzle with the receiver's receptacle, an electrical signal is passed between the boom and receiver, hydraulically opening valves. At this point, the tanker activates pumps to drive fuel through the boom, and into the receiver.

(4) Indicator Lights. Once the two aircraft are mated, additional lights (pilot director lights (PDLs)) on the tanker, activated by sensing switches in the boom, illuminate if the receiver flies too low or too high, or too near or too far away.

g. Refuelling Complete. When fuelling is complete, the valves are closed and the boom is automatically or manually retracted.

h. Reforming. Once cleared from behind the boom, receivers will reform in echelon in the Reform Position. See Figure 1-5D.

i. Refuelling Subsequent Receivers. The next receiver(s) waiting in the Observation Position will remain in that position until cleared by the tanker to move. Once the refuelled receiver is clear of the boom and moving towards the reform position, the next receiver in the sequence will be directed to the astern position and then complete the refuelling sequence discussed above. Before moving, the receiver must also visually confirm that the previous receiver has moved towards the Reform Position. See Figure 1-5E.

j. Other Receivers Joining. Receivers must exercise caution as other formations may be joining the tanker at the same time as they are reforming and departing. See Figures 1-5F and 1-5G.

k. Silent Procedures. During silent procedures, tankers will use visual signals to clear receivers to reposition. See Part 2, Annex 5C, Figure 5C-3. Receivers should comply with the controlled formation changes detailed above.

109 Refuelling – Boom Drogue Adaptor (BDA). Part 1 Chapter 3, para 304 describes how the boom is modified through the BDA to allow probe receiver aircraft to take on fuel. In order to achieve a successful transfer of fuel, the tanker and receiver must comply with the following:

a. The tanker flies straight and level, and the drogue is allowed to trail out behind and below it.

b. Probe equipped receivers should adopt formation positions appropriate to a tanker with an observer in the rear of the tanker (Figures 1-2 and 1-4).

c. The drogue can be flown by the boom operator but the receiver must fly the probe directly into the basket to make contact.

d. The boom operator holds the BDA as motionless as possible.

e. The receiver must make contact with the drogue and then move forward and offset to one side.

f. After the receiver states "contact" the boom operator triggers contact which allows the tanker pilot to start the AAR pumps and offload fuel.

g. The receiver maintains position during refuelling, keeping an eye on the hose to make sure he remains in a suitable position.

h. When fuelling is complete, the receiver decelerates firmly enough to extract the probe out of the basket. The line of rearward movement should straighten the hose and place the probe along the same longitudinal access as the boom and hose, thereby minimising lateral loads on the probe.

Figure 1-4. Diagram of Key Areas Around a Boom Tanker

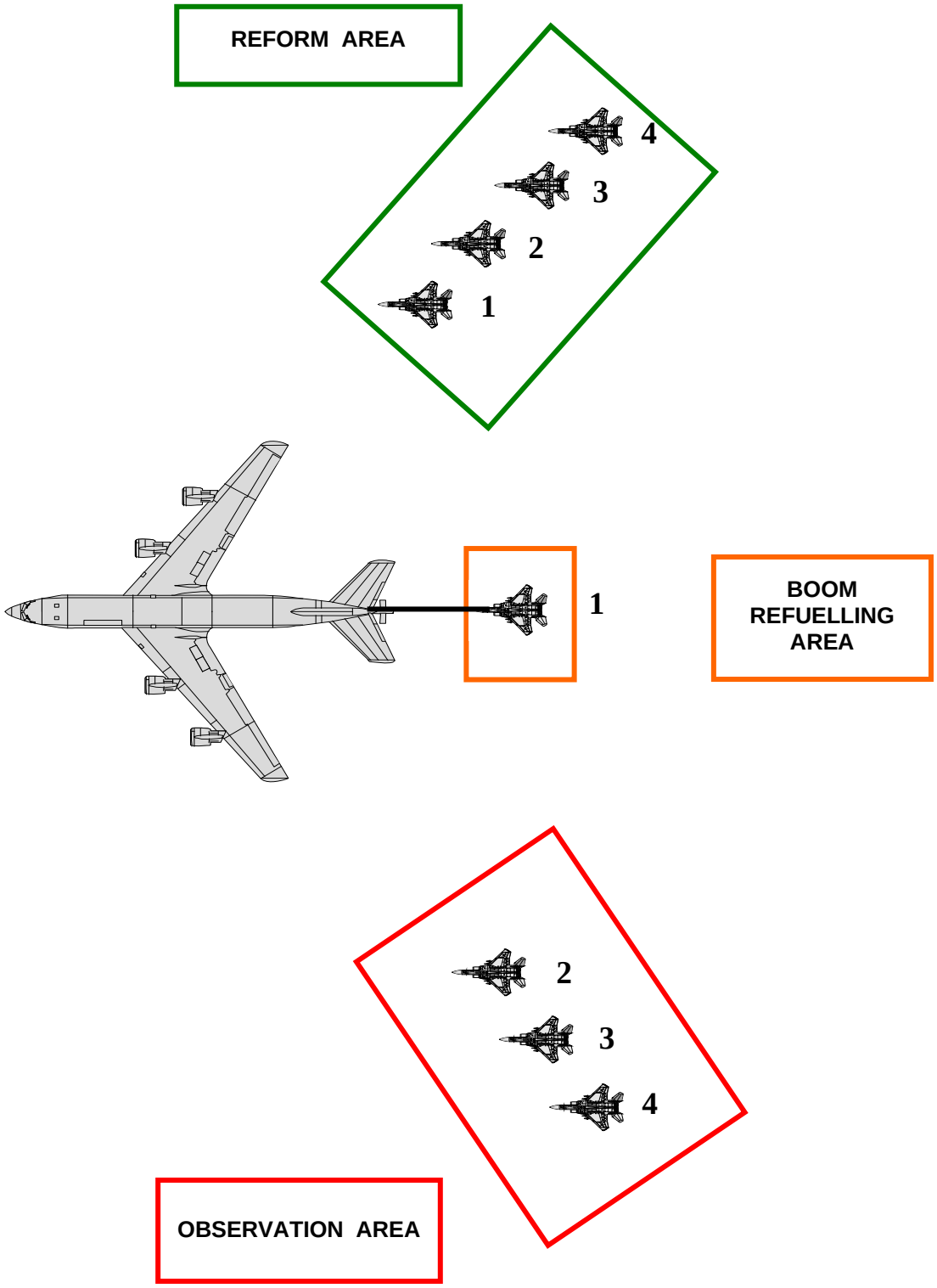


Figure 1-5. Diagram of Receiver Flow Around a Boom Tanker

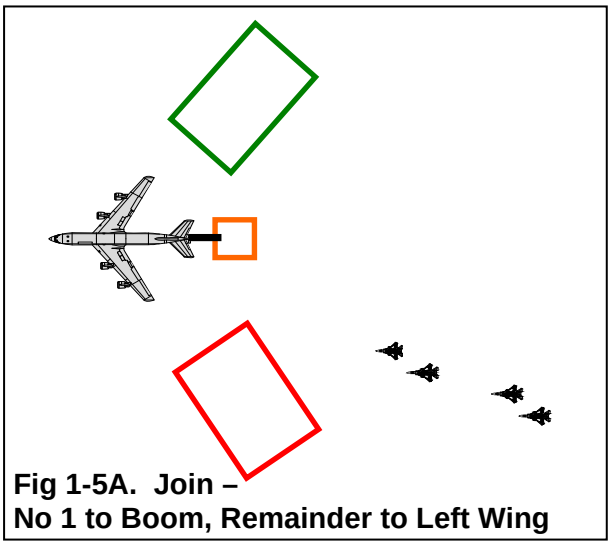


Fig 1-5A. Join –
No 1 to Boom, Remainder to Left Wing

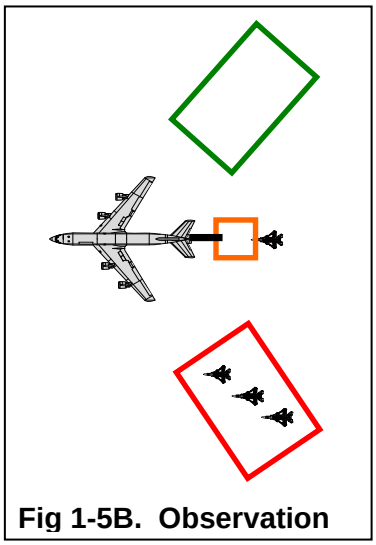


Fig 1-5B. Observation

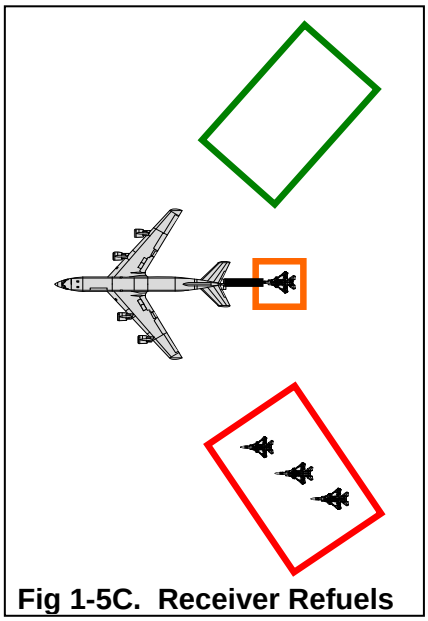


Fig 1-5C. Receiver Refuels

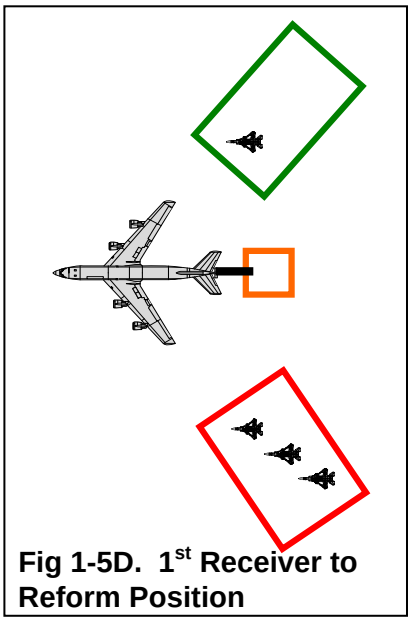


Fig 1-5D. 1st Receiver to Reform Position

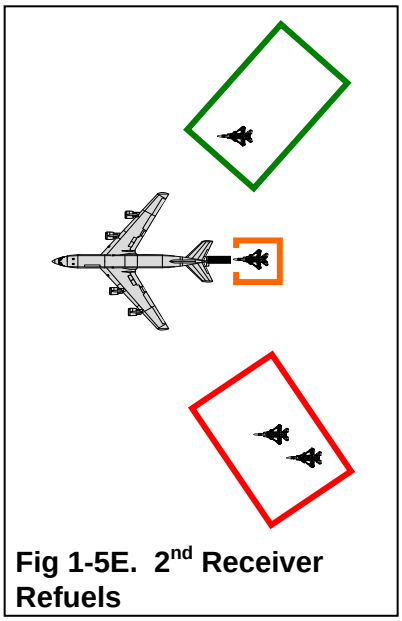


Fig 1-5E. 2nd Receiver Refuels

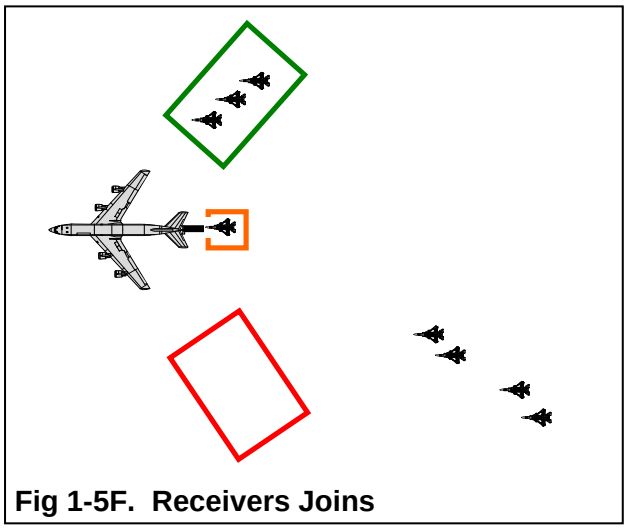


Fig 1-5F. Receivers Joins

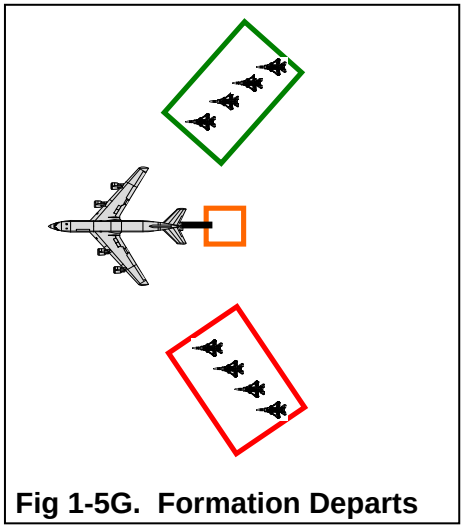


Fig 1-5G. Formation Departs

110 Leaving

a. Boom Fighters and Probe and Drogue Receivers (Fighter and Heavy Aircraft). Once refuelling is complete, receivers will be cleared to the reform position. If there are two or more receivers, they should reform using echelon right formation, moving sequentially outboard of the tanker with the first receiver remaining closest to the tanker's wing. From this position, they leave the tanker either level with the tanker or climbing.

(1) Vertical Separation. Normally, receivers must not descend from a tanker formation unless co-ordinated with an ATC or other controlling unit as other receivers are likely to be joining the tanker from below.

b. Heavy Receivers - Boom. Normally, on completion of AAR, the tanker(s) will climb to the top of the AAR block and the receiver will descend to the bottom of the AAR block. While obtaining the tanker post AAR report, the receiver is to manoeuvre to a position that ensures safe separation from the tanker(s). Thereafter, the tanker is to return to the designated ATC or control frequency.

(1) Receivers Required to Climb. Where receiver(s) are required to accelerate and climb on the refuelling heading, the receiver(s) will manoeuvre either left or right (with minimum of 1 nm separation) of the tanker(s) prior to accelerating and climbing. This will preclude the departing receiver's jet wash from causing injury to personnel on or damage to the remaining tanker(s).

111 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 Part 2 Annex 1A.

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 Part 2 Annex 1B.

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 Part 2 Annex 1C.

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 Part 2 Annex 1D.

e. RV Echo (Timing). This procedure is intended for use in support of a combat air patrol (CAP); particularly during periods of EMCON constraints; details are at Part 2 Annex 1E

f. RV Foxtrot (Sequenced). 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 Part 2 Annex 1F.

g. RV Golf (En-route). 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 Part 2 Annex 1G.

112 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.

PART 2 - ANNEX 1A

RV Alpha (Anchor RV)

101A Introduction. The RV Alpha (Anchor) 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.

102A Procedure. The essential requirement for a RV Alpha is positive control by the radar controller to bring the receiver to an ideal position of 1 nm behind and 1000 ft below the tanker.

a. Track Requirements. The radar controller will either anchor the tanker or provide headings for it to fly.

b. Tanker Responsibilities. The tanker(s) is(are) to:

(1) Fly an anchor orbit unless directed otherwise by the radar controller.

(2) Be at the base AAR altitude.

(3) Normally, fly the turns at either 15 or 25 AOB.

c. Receiver Responsibilities. Receiver(s) are to:

(1) FL/Altitude/Height. When directed by the controlling agency, be established at 1,000 ft below the assigned base air refuelling altitude.

(2) Heading. Fly headings as directed by the controlling agency.

(3) Receiver Takes Control of RV. Complete the RV using organic AI radar once radar contact with the tanker is established and call:

"(Callsign) Judy"

(4) Receiver Visual with Tanker. When visual with the tanker and EMCON procedures permit the use of radios, the receiver calls:

"(Callsign) visual"

and is then cleared by the tanker to join (on the left unless directed otherwise by the tanker).

d. Communication Procedures. Whilst on station, the tanker will monitor the published AAR frequency. When the controlling agency initiates the receiver RV, it will ensure that the receiver(s) confirm their FL/altitude/height, A/A TACAN (channel), Mode 3 and armament state to the tanker.

(1) In EMCON 1, the receiver(s) should not close inside 1 nm until radio contact is established with the tanker.

(2) If either the tanker or receiver(s) is not at its briefed FL/altitude/height an additional radio call is to be made when established at its nominated FL/altitude/height.

(3) During EMCON 2, radio calls will not be made unless they are necessary to ensure safe vertical separation.

e. Vertical Separation. The RV vertical separation is to be maintained until 1nm from the tanker(s) and visual contact is established. The receiver(s) will then commence a gradual climb to the astern (boom) or observation position (drogue). If the tanker(s) is not acquired visually by 1 nm, use the procedures described in Part 2 Chapter 1, para 102d.

f. Navigation Responsibilities During AAR. Unless the controlling agency is vectoring the tanker, navigation is the tanker's responsibility from the astern position (boom) or observation position (drogue) until the receiver(s) depart the tanker. Nevertheless, receivers should monitor their navigation systems to ensure situational awareness.

103A Control. Where a radar station provides advisory information, as distinct from control, one of the other 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.

104A Anchor Pattern

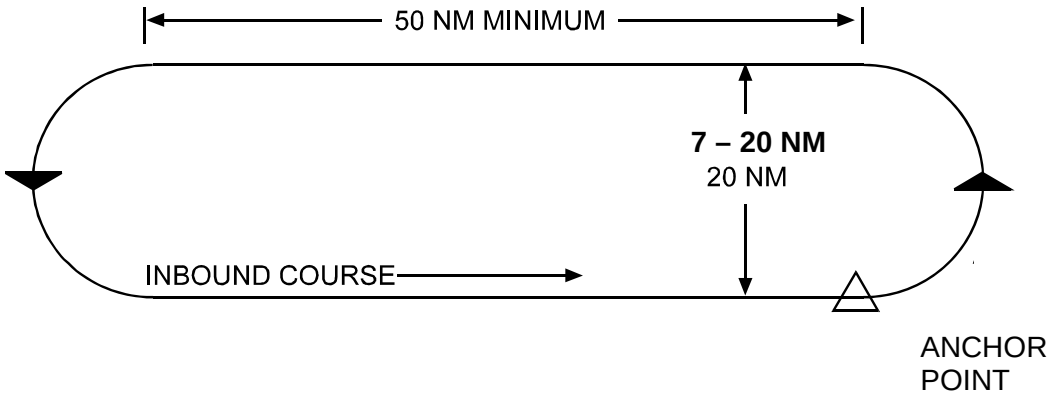
a. The refuelling anchor pattern is a left-hand racetrack with legs separated by as little as 7 nm for smaller, slower tankers such as the KC-130 and as much as 20 nm for larger, faster tankers. The standard leg length for this pattern is 50 nm, as shown in Figure 1A-1.

b. The location of the pattern is determined by the anchor point and the orientation of the inbound course.

c. Single tankers or tanker formations may be used in the anchor. Routinely, single tankers will be separated by 4000 ft; tanker formations will be separated by 4000 ft between the highest aircraft in the lower formation and the lead aircraft of the next higher formation. (The actual vertical separation between tanker formations will be briefed in the SPINS or pre-flight formation brief. Normally, 3000 ft should be considered the minimum for safe vertical separation between multiple tanker formations).

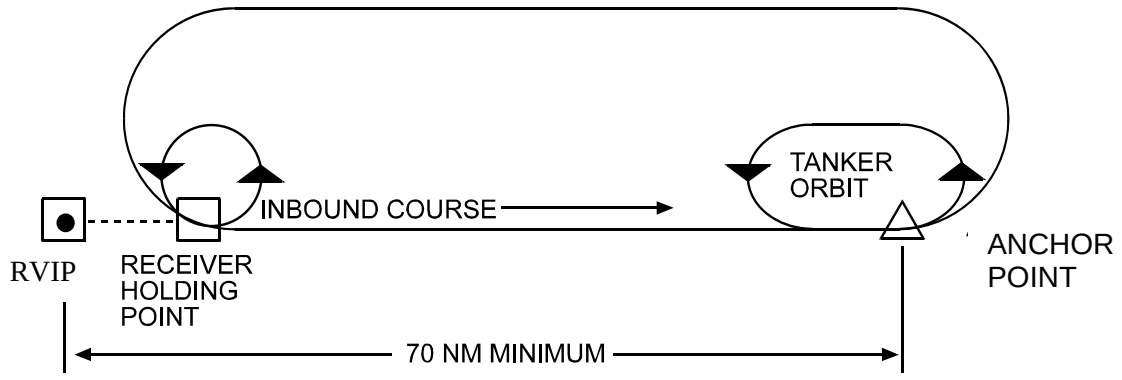
d. Anchor AAR tracks requiring frequent turns should be flown in trail or offset trail (approximately 20° echelon, as described in Part 2 Annex 2A).

Figure 1A-1. Anchor Pattern



105A Alternative 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 1A-2 and the RV procedure is described in Part 2 Annex 1D.

Figure 1A-2. Alternate Anchor Pattern



PART 2 - ANNEX 1B

RV Bravo

101B Introduction. The RV Bravo is a heading based procedure that utilises air to air equipment of both tanker and receiver; it is 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 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 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.

102B Procedure

a. Track Requirements. 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 1B-1.

b. Navigation to the RVIP. 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 RVCT.

c. Receiver and Tanker Airspeeds

(1) The tanker flies at the indicated refuel speed for the receiver. This speed is available in the appropriate National Annex, through the SPINS or arranged between the tanker and receiver on the ground or in the air prior to AAR.

(2) The tanker translates the indicated refuel speed into TAS for the RV altitude (Part 2 Chapter 1, Annex D, Figures 1D-2 and 1D-3), applies it to the appropriate AOB table (Figure 1B-2) and calculates the turn range.

(3) The receiver should normally fly the procedure at the tanker's speed (KIAS) plus 20 kts.

d. Transmission for Direction Finding (DF)

(1) 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.

(2) The tanker is to control the heading of the receiver to establish it on a reciprocal heading.

Example:

(a) *Tanker and receiver established on heading 090º and 270º respectively.*

(b) *The tanker pilot calls "Transmit for DF' and then establishes that the relative bearing of the receiver is 20º right of the tanker's nose.*

(c) *He then calls for the receiver aircraft to turn 10º right onto 280º and changes his own heading to 100º.*

(3) As the RV progresses, further 10 second carrier wave transmissions are to be requested to refine the head-on approach using the technique described in paras 102B.d (1) and (2).

e. Tanker Turn Range. When the appropriate turn range is reached, see para 102B.c, the tanker is to turn to the left through 225°.

f. Tanker Reversal onto Receiver's Track

(1) On roll-out, the tanker is to take a bearing on the receiver using DF or other suitable equipment, obtain a range using A/A TACAN and start a stop-watch.

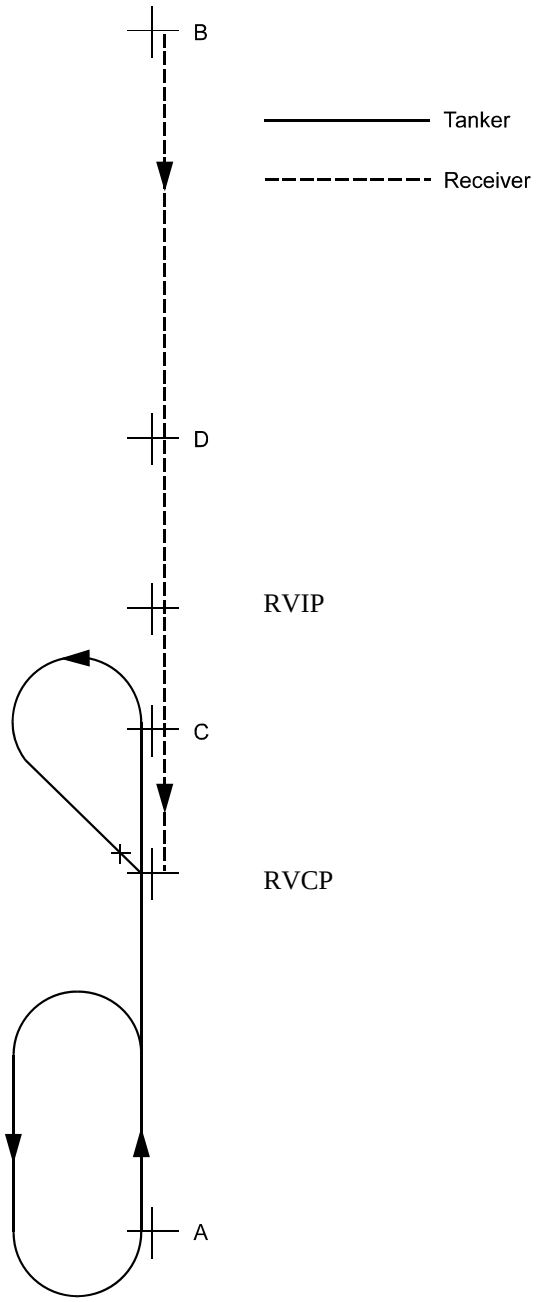
(2) These figures are plotted on the chart at Figure 1B-3 to obtain a time to run to the final turn onto the receiver's heading.

(a) Ideally, the receiver's relative bearing from the tanker should be 285^{o} and adjustments to the tanker/receiver speeds are not required.

(b) However, if the bearing is other than 285^{o}, using Figure 1B-3 the tanker must adjust speed to re-establish the ideal RV geometry.

103B 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 1B-1. Diagram of RV Bravo



NOTES:

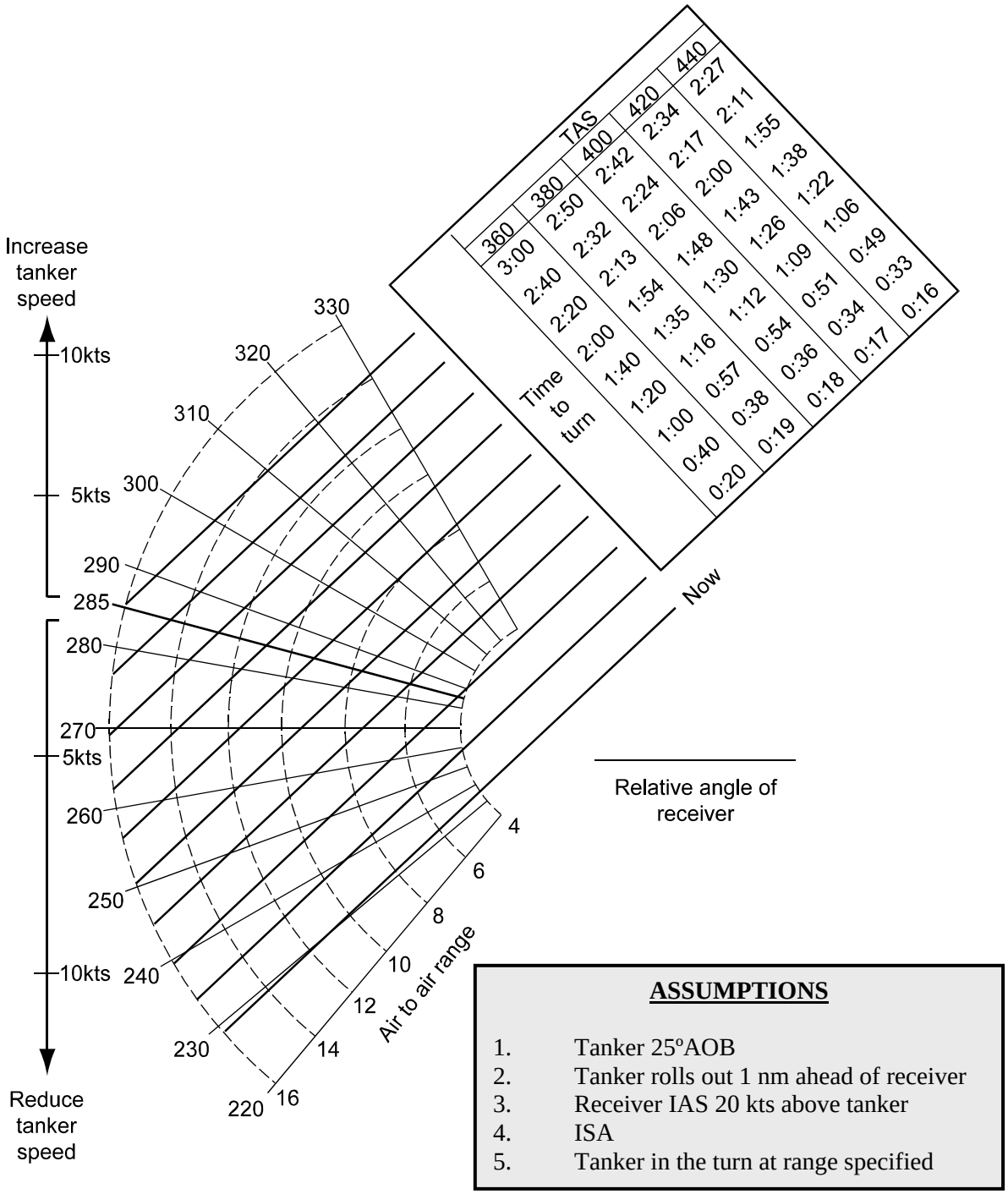
1. A minimum initial head-on separation of 100 nm (A-B) should be planned.
2. C-D = turn range.
3. The tanker racetrack is shown in an ideal position but it may be planned elsewhere as required.

Figure 1B-2. RV Bravo Turn Range

Tanker 25° AOB	
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° AOB	
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 1B-3. RV Bravo Correction Chart



ASSUMPTIONS

1. Tanker 25ºAOB
2. Tanker rolls out 1 nm ahead of receiver
3. Receiver IAS 20 kts above tanker
4. ISA
5. Tanker in the turn at range specified

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. Adjust tanker speed, based on left hand speed scale, if relative bearing is other than 285°.
3. Plot receiver's position on chart and determine tanker's distance/time to the final turn.
4. Tanker turns onto receiver's heading at appropriate distance/time.
5. If A/A Tacan range decreases and then starts to increase again, ignore timing and turn immediately on to receiver's heading then carry out DF to resolve relative position.

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PART 2 - ANNEX 1C

RV Charlie

101C Introduction. The RV Charlie is a heading based procedure (similar to the RV Bravo) that allows receivers with an AI radar to control the RV once positive AI radar contact is established. It is thus ideally suited when accuracy of tanker navigation equipment is in doubt or degraded. It does not require a pre-briefed AAR track. However, for briefed tasks a RVIP, the receiver's inbound track and a RVCT 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.

102C Procedure

a. Track Requirements. 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 1C-1.

b. Navigation to the RVIP. 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 RVCT.

c. Receiver and Tanker Airspeeds

(1) The tanker flies at the indicated refuel speed for the receiver. This speed is available in the appropriate National Annex, through the SPINS or arranged between the tanker and receiver on the ground or in the air prior to AAR.

(2) The tanker translates the indicated refuel speed into TAS for the RV altitude (Part 2 Chapter 1, Annex D, Figures 1D-2 and 1D-3), applies it to the appropriate AOB table (Figure 1C-2) and calculates the turn range dependent on drift.

(3) The receiver should normally fly the procedure at the tanker's speed (KIAS) plus 20 kts.

d. Transmission for Direction Finding (DF)

(1) 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.

(2) The controlling aircraft is to establish the other aircraft on a reciprocal heading.

Example:

(a) *Tanker and receiver established on heading 360º and 180º respectively.*

(b) *The pilot in control calls "Transmit for DF' and then establishes that the relative bearing of the tanker is 20º left of the receiver's nose.*

(c) *He then calls for the tanker to turn 10º left onto 350º and changes his own heading to 170º.*

(3) As the RV progresses, further 10 second carrier wave transmissions are to be requested to refine the head-on approach using the technique described in paras 102C.d(1) and (2).

(4) Separation between aircraft is to be measured using A/A TACAN or AI equipment.

(5) The turn range must be passed to and acknowledged by the receiver.

e. Tanker and Receiver Turn Range

(1) When the turn range is reached, see Figure 1C-2, the tanker is to turn left through 180^{o} and the receiver(s) is to turn right 45^{o} using 45^{o} AOB and roll out wings level.

(2) When required, the receiver(s) is to commence a left turn to roll-out onto the tanker's heading.

(3) If visual at anytime during the RV, the receiver(s) is to adjust flight path as necessary to expedite the RV.

103C Control

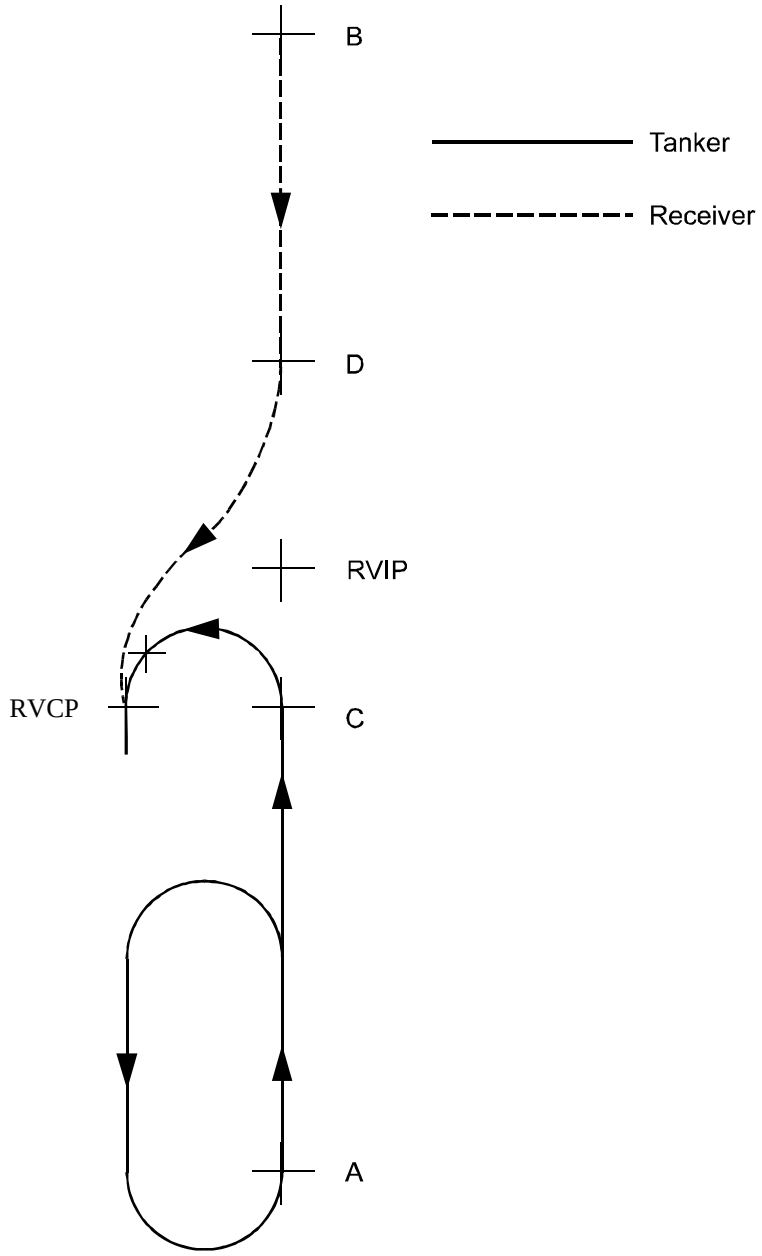
a. Initial Control. The initial control of RV Charlie (achieving and maintaining the head-on approach) is usually accomplished by the tanker.

b. Receiver Control. 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.

c. Turn to ARCP. Each aircraft is to turn towards the RVCP at the turn range.

d. Failure to Achieve AI Contact. In the event of the receiver not gaining AI contact, this procedure can revert to an RV Bravo (Part 2 Chapter 1, Annex B) as long as there is adequate split range.

Figure 1C-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 1C-2. RV Charlie Turn Range

TANKER 25° AOB RECEIVER 45° AOB	
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° AOB RECEIVER 45° AOB	
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

PART 2 - ANNEX 1D

RV Delta (Point Parallel)

101D Introduction. The RV Delta (Point Parallel) procedure requires the receiver to maintain an agreed track and the tanker to maintain the reciprocal track, offset a pre-determined distance; see Figure 1D-1.

102D Procedure

a. Track Requirements. A common track of at least 70 nm is usually the minimum requirement for the RV and consists of a straight line between the RVIP and the RVCP.

b. Receiver and Tanker Airspeeds. Two methods exist to determine when the tanker initiates its final turn onto the receiver's heading.

(1) Option 1 - Tanker Airspeed Known to Receiver

(a) RV Speed - Tanker. The tanker flies at the indicated refuel speed for the receiver. This speed is available in the appropriate National Annex, through SPINS or pre-arranged between the tanker and receiver on the ground or in the air prior to AAR.

(b) Turn Range. The tanker translates the indicated refuel speed into TAS (Figure 1D-2 or Figure 1D-3), applies it to the appropriate AOB table (Figure 1D-4 or Figure 1D-5) and calculates the turn range dependent on drift.

(c) RV Speed – Receiver. The receiver should normally fly the procedure at the tanker's speed (KIAS) plus 20 kts.

(d) Turn Range and Offset Calculation. The worksheet at Figure 1D-6 provides a step by step approach to calculating the tanker turn range and offset.

(e) Receiver Roll Out Range. The data in Figure 1D-4 or Figure 1D-5 should result in the tanker rolling out with the receiver 1 nm behind the tanker.

(2) Option 2 - Receiver Airspeed Known to Tanker (Normal USAF Procedure)

(a) RV Speed – Receiver. The tanker extracts the receiver indicated RV speed from the appropriate National Annex, SPINS or as pre-arranged between the tanker and receiver on the ground or in the air prior to AAR.

(b) RV Closure Speed. The tanker translates the receiver's indicated refuel speed into TAS using the table at Figure 1D-2 or Figure 1D-3 and adds it to the tanker's TAS to calculate the RV closure speed.

(c) Turn Range. Entering the appropriate table in Figures 1D-7 or Figure 1D-9 with the RV closure speed will provide the tanker's turn range, dependent on AOB.

(d) Anchor Offset. The anchor offset, corrected for drift and tanker TAS is derived from Figure 1D-8 or Figure 1D-10, dependent on AOB.

(e) Back-Up Turn Time. Figure 1D-12 provides a backup time to turn based on a known hack range and closure speed.

(f) Turn Range and Offset Calculation. The worksheet at Figure 1D-13 provides a step by step approach to calculating the tanker turn range and offset.

(g) Receiver Roll Out Range. The data in Figure 1D-7 or Figure 1D-8 will result in the tanker rolling out with the receiver behind the tanker at 3 nm, ½ nm or 1 nm in front of the tanker, depending on the receiver AAR speed.

(h) Turn Range/Offset Correction - 3 NM Rollout. During an RV Delta execution, if the actual offset differs from that derived using the instructions in para 102D (2) (f), use Figure 1D-11 to calculate the corrected turn/offset parameters. Using the calculated turn range and offset pairing, enter the chart at column A. Move horizontally through columns B to G to find the actual offset. At the intersection of these variables, identify the revised turn range that will result in a 3 nm RV Delta tanker/receiver rollout.

***Example 1*:** *VC10 tanker at FL 230, Tornado F3 receiver at FL220, OAT at tanker altitude minus 35ºC with 15º right drift on the RVIP to RVCP leg.*

Tanker RV Speed. From UK National Annex VC10 tanker speed = 280 KIAS

Receiver RV Speed. Receiver flies tanker KIAS + 20 kts.

Using the above data and referencing the Figures identified in Column C of Figure 1D-6, the appropriate interpolated values extracted from the tables will provide both the anchor offset and tanker turn range.

A	B	C	D	E
	PARAMETER	**REFERENCE**	**TANKER**	**RECEIVER**
1	ALTITUDE		FL230	FL220
2	TANKER RV IAS	TANKER NATIONAL ANNEX	280	
3	RECEIVER RV IAS (=TANKER IAS +20 KTS)			300
4	TANKER RV TAS	FIG 1D-2 or 3	386	
5	ACTUAL TEMP		-35	
6	STD TEMP	FIG 1D-2	-31	
7	**ACTUAL – STD (Row 4 – Row 5)** (<**STD** = REDUCE BY 1 kt / ºC) (>**STD** = INCREASE BY 1 kt / ºC)		**- 4** +	
8	**CORRECTED TAS (Row 3±Row 6)**		382	
9	RVIP TO RVCP DRIFT		**15 ~~L~~/R**	
10	TURN RANGE	FIG 1D-4 ~~or 5~~	23.0	
11	OFFSET	FIG 1D-4 ~~or 5~~	13.4	

Example 2: *KC-10 Tanker at FL 230, F-16A receiver at FL220, OAT at tanker altitude minus 28ºC with 10º left drift on the RVIP to RVCP leg.*

Tanker RV Speed. KC-10 tanker speed (varies with aircraft weight) = 275 KIAS.

Receiver RV Speed. Figure ZE-4 to Annex ZE provides receiver RV speed of 345 KIAS.

Using the above data and referencing the Figures identified in Column C of Figure 1D-13, the appropriate interpolated values extracted from the tables will provide both the anchor offset and tanker turn range.

Using a few fixed range points and the closure TAS, a backup time to turn can be calculated. These times are extracted from Figure1D-12.

A	B	C	D	E	F
	PARAMETER	**REFERENCE**	**TANKER**		**RECEIVER**
1	ALTITUDE		FL230		FL220
2	RV IAS	TANKER NATIONAL ANNEX	275		345
3	RV TAS	FIG 1D-2 or 3	380		467
4	ACTUAL TEMP			-28	
5	STD TEMP	FIG 1D-2		-31	
6	**ACTUAL – STD (Row 4 – Row 5)** (<**STD** = REDUCE BY 1 kt / ºC) (>**STD** = INCREASE BY 1 kt / ºC)			- + **3**	
7	**CORRECTED TAS (Row 3±Row 6)**		383		470
8	**CLOSURE TAS (RCVR + TNKR)**			853	
9	RVIP TO RVCP DRIFT	DERIVED FROM TANKER NAV SYSTEM		10 **L/~~R~~**	
10	TURN RANGE	FIG 1D-7 ~~or 9~~		21.2	
11	OFFSET	FIG 1D-8 ~~or 10~~		7	
12	50 MN TIMING BACKUP	FIG 1D-12		1:47	
13	30 NM TIMING BACKUP	FIG 1D-12		0:23	

c. Tanker Responsibilities. The tanker(s) is(are):

(1) Responsible for directing the rendezvous.

(2) To be at the base AAR altitude.

(3) May enter the refuelling holding orbit from any direction.

(4) To attempt to arrive at least 15 min before the RVCT and, normally, establish a left-hand holding pattern using the RVCP as an anchor point.

(5) Normally, to fly the straight legs for 2 min duration and fly the turns at either 15º or 25ºAOB.

d. Receiver Responsibilities. Receiver(s) will:

(1) Be established at 1000 ft below the assigned base AAR altitude when departing the RVIP.

(2) Enter the track via the RVIP and should aim to be at the RVCP at the RVCT (see Figure 1D-1).

(3) Depart from the RVIP and not deviate from the RVIP/RVCP centreline unless directed to do so by the tanker.

(4) Aid the RV, when so equipped, by remaining in electronic contact on radar, A/A TACAN, TCAS or other means as soon as possible, but no later than 50 nm range or the RVIP, whichever occurs first, until reaching the observation position (drogue) or astern position (boom).

e. Communication Procedures. Fifteen minutes prior to the RVCT the tanker and the receiver(s) are to confirm their FL/altitude/height, A/A TACAN (channel), Mode 3, armament state and timing. The receiver(s) should fly down track towards the RVCP with A/A TACAN and radar beacon on (if appropriate) at 1000 ft below the base AAR altitude.

(1) If radio contact between the tanker and receiver has not been established prior to the RVCT, the tanker will maintain orbit over the RVCP until 10 min after the RVCT, unless otherwise briefed.

(2) If either the tanker or receiver(s) is not at its briefed FL/altitude/height an additional radio call is to be made when established at its nominated FL/altitude/height.

(3) The tanker must not initiate the turn in front of the receiver(s) until the receivers confirm that they are level at their assigned FL/altitude/height.

(4) During EMCON 2, radio calls will not be made during the RV unless they are necessary to ensure safe vertical separation. However, an astern RT call is required to ensure two way contact between the tanker and receiver(s).

f. Initiation of RV by Tanker. The tanker will fly the outbound leg at the appropriate offset from the common track in a holding pattern, see Figures 1D-4, 1D-5, 1D-7 and 1D-8 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 RVIP. At that point, the tanker will either extend the outbound leg or, if inbound to the RVCP, turn to the reciprocal of the receiver's in-bound track to close with the receiver.

g. Initiation of Tanker's Final Turn. At the appropriate turn range (slant range), the tanker initiates a turn to return to the RVIP - RVCP track, inbound to the RVCP. If applicable, in EMCON 1, after turning through 90° the tanker is to call 'halfway round the turn'. This is the

best time to determine if an overrun condition exists and the best time for visual acquisition. If an overrun condition exists, carry out the appropriate actions as described in Part 2 Chapter1, para 104.

h. Vertical Separation. The RV vertical separation is to be maintained until 1 nm of the tanker and visual contact is established. The receiver(s) will then commence a gradual climb to the astern (boom) or observation position (drogue).

i. Tanker/Receiver Rollout Range. At completion of the turn, receivers are normally 3 nm (US procedures) or 1 nm (other nations) in trail of the tanker(s).

j. Tanker Speed Adjustment. Tankers adjust to refuelling air speed when rolled out toward the RVCP.

k. Navigation Responsibilities During AAR. Navigation responsibility from the astern position (boom) or observation position (drogue) until the receiver(s) depart the tanker is primarily with the tanker, with receivers monitoring their navigation system to ensure situational awareness.

NOTE

Radio silence must be broken if the tanker or receiver determines that either the tanker or receiver will exceed ATC protected airspace while manoeuvring to attain the offset.

l. Late Arrival of Receivers. In the event that the receiver(s) is(are) delayed, the tanker is to normally maintains a left-hand holding orbit over the RVCP until 10 min after the RVCT, unless otherwise briefed.

m. RV with Correct Receiver. Tankers must ensure that they do not attempt to RV with the wrong receiver. Comparing the A/A TACAN DME and the TCAS target distance is an effective method of establishing positive identification. Additionally, to aid the receiver in identifying the tanker, if the tanker does not receive a communication from the receiver by RVCT minus 10 min, the tanker will transmit in the blind giving the information normally given during the RV. The tanker will cross the RVCP at the RVCT and at subsequent intervals of 8 min thereafter until the receiver has cancelled or the tanker must depart or is directed to proceed on its mission.

n. Missed RV Procedures. If contact is not established between the tanker and receiver, the tanker will arrive at the RVCP at the RVCT. When either aircraft arrives at the RVCP and does not have visual contact with the other, the aircraft will cross the RVCP at the appropriate altitude at the RVCT and at subsequent intervals of 8 min thereafter. While in the orbit, every attempt should be made to establish visual contact with the other aircraft. The length of the delay and the decision as to when to terminate radio silence should be determined during mission planning prior to flight.

103D 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 1D-7.

a. RVCP – Receiver. The receiver(s) plans to arrive at the RVCP on time, at the base altitude minus 1000 ft.

b. RVCP-Tanker. The tanker arrives at the RVCP one minute after the receiver at the base altitude.

c. Overtake - Tanker. 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.

d. Climb - Receiver. Once visual with the tanker, the receiver(s) climb(s) to the tanker's base altitude.

e. RV Control. The tanker maintains control of the overtake RV Delta (Point Parallel) throughout.

f. RT Call – Receiver. The receiver(s) must ensure that correct track, FL/altitude/height and speed are flown and, during EMCON 1, the tanker is to call 'turn' at the turn range.

g. EMCON 3. It is possible to fly this procedure in EMCON 3 but aircraft must be at the correct FL/altitude/height.

104D Modified RV Delta (Point Parallel) (EC-135, E-3, E-4, C-130). A modified point parallel RV is a procedure used to accomplish an RV with an EC-135/E-4 aircraft in a Post-Attack Command and Control System (PACCS) orbit, an E-3 on AWACS patrol, or a C-130 in a special on-station orbit; see Figure 1D-6. The following procedures will be used:

a. RVIP. The RVIP will be located at one of the turn points.

b. RVCP. The RVCP will be located at the turn point on the opposite direction track.

c. Descent – Receiver. If receiver requirements prevent early descent to RV altitude, the receiver may descend after passing the RVIP; however, the receiver must not descend until radio contact is established with the tanker and safe lateral separation is confirmed.

d. Orbit – Receiver. The receiver will establish a right-hand orbit 1000 ft below AAR altitude prior to the tanker's entry into the orbit area.

e. Orbit – Tanker. The tanker will be at refuelling altitude upon entering the orbit area and will establish a standard RV Delta (point parallel) orbit at the RVCP.

f. Departing RVIP – Receiver. The receiver will call departing the RVIP. The receiver will increase airspeed to closure airspeed during the last half of the turn toward the tanker. After the receiver rolls out from the turn toward the tanker, normal RV Delta (point parallel) procedures will be used.

g. Departing RVIP – Tanker. The tanker in the RVCP orbit will turn toward (if flying away from) or continue toward the RVCP when the receiver calls departing the RVIP.

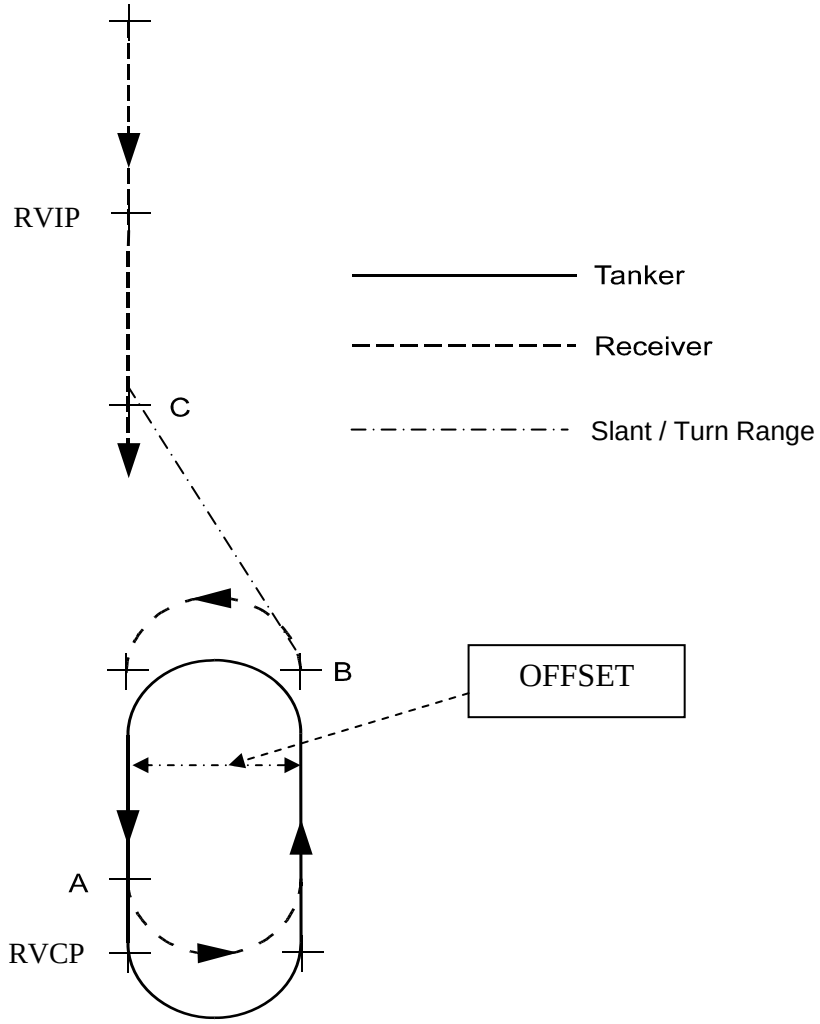
h. Turn Towards Receiver – Tanker. Two minutes after the receiver's RVIP call, the tanker will turn toward the receiver.

i. Final Turn – Tanker. At the appropriate turn range (Figures 1D-3, 1D-6 and 1D-7) the tanker will turn inbound to the RVCP and adjust to appropriate air refuelling speed (Refer to tanker's National Annex) when rolled out toward the RVCP.

j. Post RV Actions. Closure and contact will be normal after the RV. The refuelling track will follow the PACCS/ AWACS/Special Orbit Pattern, remaining within published/briefed orbit boundaries, using no more than 15° AOB during turns.

k. Departure – Tanker. Upon completion of refuelling, or when cleared by the receiver, the tanker will depart the area and the receiver will climb to assume normal on-station orbit.

Figure 1D-1. Diagram of RV Delta (Point Parallel)



NOTES:

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

Figure 1D-2. KCAS to TAS Conversion

TRUE AIRSPEED TABLE

PRESSURE ALTITUDE 1000 FT	STD DAY TEMP	KCAS										
		200	**220**	**240**	**250**	**255**	**265**	**275**	**280**	**285**	**290**	**295**
6	+3	215	238	259	272	277	288	299	304	309	314	319
8	-1	222	245	266	279	285	296	307	312	318	323	329
10	-3	230	253	274	287	293	304	315	321	327	332	338
12	-7	237	261	282	296	302	313	324	330	336	341	347
13	-11	240	264	286	300	306	318	329	335	341	346	352
14	-13	244	269	291	305	312	324	335	341	347	352	358
15	-15	248	273	295	310	317	329	340	347	353	358	364
16	-17	254	279	301	315	322	334	345	352	358	363	369
17	-19	258	283	305	319	327	339	350	357	363	368	374
18	-21	262	287	310	324	332	344	355	362	368	373	379
19	-23	266	293	316	330	336	349	361	367	373	378	384
20	-25	269	296	320	334	340	353	366	373	379	384	390
21	-27	273	300	324	338	345	359	372	378	385	391	398
22	-29	276	304	328	342	349	363	376	383	390	396	403
23	-31	280	310	335	349	354	367	380	386	393	400	406
24	-33	284	314	340	354	360	374	388	394	401	407	413
25	-35	289	319	346	361	368	382	396	402	409	415	422
26	-37	294	324	352	366	374	387	402	408	415	422	429
27	-38	301	332	360	374	381	395	410	417	424	431	438
28	-40	307	338	365	380	388	401	415	423	431	438	445
29	-42	313	344	373	388	396	408	423	431	439	446	452
30	-44	318	350	378	395	402	416	430	437	444	451	459
32	-48	330	362	392	407	415	429	443	452	460	469	476
34	-52	342	374	405	419	426	442	456	464	472	481	488
36	-56	352	384	418	432	442	458	472	478	485	494	502

PRESSURE ALTITUDE 1000 FT	STD DAY TEMP	KCAS										
		300	**305**	**310**	**315**	**320**	**325**	**330**	**335**	**340**	**350**	
6	+3	325	331	336	342	348	354	360	366	372	381	
8	-1	335	340	346	352	358	364	370	376	382	391	
10	-3	344	349	355	361	367	373	379	385	391	400	
12	-7	353	358	364	370	376	382	388	394	400	409	
13	-11	358	363	369	375	381	387	393	399	404	414	
14	-13	364	369	375	381	387	393	399	405	410	420	
15	-15	370	375	381	387	393	399	405	411	416	426	
16	-17	375	381	387	393	399	405	411	417	422	432	
17	-19	380	386	392	398	404	410	416	422	428	438	
18	-21	385	391	397	403	409	415	421	427	434	444	
19	-23	390	397	403	409	416	422	428	434	440	451	
20	-25	396	403	409	415	422	428	434	440	446	458	
21	-27	405	411	417	423	429	435	442	449	455	466	
22	-29	410	417	423	430	437	442	449	456	462	473	
23	-31	412	419	426	432	439	445	452	459	466	480	
24	-33	419	426	433	439	446	453	461	469	476	489	
25	-35	428	435	442	449	455	461	468	473	480	493	
26	-37	435	442	449	456	462	468	475	482	488	502	
27	-38	444	451	458	464	470	477	484	490	496	510	
28	-40	452	459	466	473	479	486	493	499	505	518	
29	-42	459	466	473	481	487	494	501	508	515	528	
30	-44	466	473	480	487	494	501	508	515	523	536	
32	-48	484	490	497	504	510	517	525	533	541	554	
34	-52	496	503	510	517	523	530	537	545	553	567	
36	-56	509	517	524	532	539	547	555	563	570	584	

NOTES:

1. For each °C below std day temp subtract 1 knot from std day TAS

2. For each °C above std day temp add 1 knot to std day TAS

Figure 1D-3. KIAS to TAS Conversion

TRUE AIRSPEED TABLE

PRESSURE ALTITUDE 1000 FT	KIAS												
	200	**210**	**225**	**235**	**245**	**250**	**255**	**260**	**270**	**275**	**280**	**285**	**290**
3	212	222	238	249	259	265	269	275	286	291	297	302	307
6	214	224	240	251	261	268	272	278	289	294	298	305	310
9	223	235	251	263	274	279	285	290	302	307	313	318	324
10	227	238	255	267	278	283	289	295	307	312	317	322	328
12	234	245	263	275	286	292	298	303	315	321	327	332	338
14	241	253	271	283	295	301	307	313	325	330	336	342	348
16	249	261	280	292	304	310	316	322	335	341	347	352	359
18	257	269	288	301	314	320	326	332	346	351	357	363	370
20	265	278	298	311	324	330	336	343	356	362	367	374	381
21	270	283	303	316	329	335	342	348	361	367	374	379	387
22	274	288	308	321	334	341	347	355	367	374	380	386	393
23	279	292	313	326	339	347	354	360	372	379	385	392	399
24	283	297	318	332	345	353	359	365	379	384	391	397	404
25	288	302	324	338	351	358	364	371	385	390	397	404	411
26	293	307	329	343	357	363	371	377	390	397	404	410	417
27	298	312	334	348	363	370	376	384	397	404	410	417	424
28	303	318	340	354	369	376	382	390	404	410	417	424	431
29	308	323	345	360	375	385	389	396	411	416	424	431	437
30	313	329	351	366	381	388	395	403	416	424	431	437	445
31	319	335	357	372	387	395	402	410	424	431	437	444	453
32	325	340	364	379	394	401	409	416	431	437	445	452	459
33	331	346	370	385	401	408	416	424	438	445	452	460	466
34	336	352	376	392	407	415	423	431	445	452	460	466	474
35	342	358	382	398	414	422	430	438	454	460	467	474	481

PRESSURE ALTITUDE 1000 FT	KIAS												
	300	**305**	**310**	**315**	**320**	**325**	**330**	**335**	**340**	**345**	**350**	**355**	**360**
3	318	323	328	334	339	344	350	355	360	366	371	376	381
6	321	326	331	337	342	347	352	358	364	369	374	379	385
9	335	340	346	351	357	362	368	373	379	385	390	395	401
10	340	345	351	356	362	367	373	378	384	390	395	401	406
12	349	355	361	367	372	378	384	390	395	400	406	412	418
14	360	366	372	377	383	389	395	401	407	412	418	424	430
16	371	372	383	389	395	401	407	412	418	424	430	436	442
18	382	388	394	400	407	413	419	425	431	437	443	449	455
20	394	400	406	412	419	425	431	437	444	450	456	462	469
21	400	406	413	418	425	431	438	444	450	456	463	469	475
22	406	413	419	425	432	438	445	452	457	463	470	476	483
23	411	417	425	431	437	444	451	457	464	470	477	483	490
24	417	424	431	437	444	451	458	464	471	477	484	490	497
25	424	431	437	444	450	458	465	472	478	485	491	497	504
26	431	437	444	450	458	465	472	479	486	492	499	505	512
27	437	445	451	459	466	472	479	486	493	500	506	513	520
28	445	452	459	466	474	480	487	494	501	507	514	521	528
29	452	459	466	474	482	488	494	501	508	515	522	529	536
30	459	466	474	482	490	496	502	509	516	523	530	537	544
31	466	474	481	489	497	503	510	517	524	531	538	545	552
32	474	481	489	496	504	511	518	525	532	539	546	553	560
33	481	489	496	504	512	519	526	533	540	547	554	561	568
34	489	497	504	512	520	527	534	541	549	556	563	570	577
35	497	504	512	521	529	535	542	550	558	564	571	578	585

Figure 1D-4. RV Delta (Point Parallel) Turn Range and Offset

Tanker 25° AOB

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

Figure 1D-5. RV Delta (Point Parallel) Turn Range and Offset

Tanker 15° AOB

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

Figure 1D-6. Work Sheet - RV Delta (Point Parallel)

Turn Range and Offset – Receiver Flying Tanker Speed +20kts

A	B	C	D	E
	PARAMETER	**REFERENCE**	**TANKER**	**RECEIVER**
1	ALTITUDE		FL230	FL220
2	TANKER RV IAS	TANKER NATIONAL ANNEX		
3	RECEIVER RV IAS (=TANKER IAS +20 KTS)			
4	TANKER RV TAS	FIG 1D-2 or 3		
5	ACTUAL TEMP			
6	STD TEMP	FIG 1D-2		
7	**ACTUAL – STD (Row 4 – Row 5)** (<**STD** = REDUCE BY 1 kt / ºC) (>**STD** = INCREASE BY 1 kt / ºC)		**-** **+**	
8	**CORRECTED TAS (Row 3±Row 6)**			
9	RVIP TO RVCP DRIFT		**L/R**	
10	TURN RANGE	FIG 1D-4 or 5		
11	OFFSET	FIG 1D-4 or 5		

Figure 1D-7. RV Delta (Point Parallel) Turn Range and Offset

Tanker 25º AOB

TURN RANGE - 25º AOB									
TAS RCVR - TNKR		RVIP TO RVCP DRIFT							NOTES
ORBIT LEFT		15L	10L	5L	0	5R	10R	15R	
		15R	*10R*	*5R*	*0*	*5L*	*10L*	*15L*	*ORBIT RIGHT*
CLOSURE RATE	1000	26	28	30	32	34	36	39	3 NM ROLLOUT RANGE
	975	25	27	28	30	32	34	36	
	950	24	26	27	29	31	33	35	
	925	23	24	29	28	29	31	33	
	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	1 NM ROLLOUT BEHIND C-130
	550	7	8	9	10	11	12	13	
	525	6	7	8	9	10	11	12	
	500	6	6	7	8	9	10	11	
	475	5	6	6	7	7	8	9	

NOTE: The turn range presented by some Flight Management Systems (FMS) may not agree with the values in the table. The FMS calculation accounts for additional variables and should be considered more accurate.

Figure 1D-8. RV Delta (Point Parallel) Offset

Tanker 25º AOB

OFFSET - 25º AOB									
		RVIP TO RVCP DRIFT							NOTES
ORBIT LEFT		15L	10L	5L	0	5R	10R	15R	
		15R	*10R*	*5R*	*0*	*5L*	*10L*	*15L*	*ORBIT RIGHT*
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	
	430	7.5	8.5	10.5	11.5	13.5	15.5	17.5	
	420	7	8	10	11	13	15	17	
	410	6.5	7.5	9.5	10.5	12.5	14	16	
	400	6	7	9	10	12	13	15	
	390	6	7	8.5	9.5	11.5	12.5	14.5	
	380	6	7	8	9	11	12	14	25° BANK
	370	5.5	6.5	7.5	8.5	10	11.5	13	
	360	5	6	7	8	9	11	12	
	350	5	5.5	6.5	7.5	8.5	10.5	11.5	
	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	
	220	2	3	3	4	4	5	5	

NOTE: Offsets in the top right shaded area may place the aircraft outside of the FAA protected airspace.

Figure 1D-9. RV Delta (Point Parallel) Turn Range

Tanker 30º AOB

TURN RANGE - 30º AOB									
TAS RCVR - TNKR		RVIP TO RVCP DRIFT							NOTES
ORBIT LEFT		15L	10L	5L	0	5R	10R	15R	
		15R	*10R*	*5R*	*0*	*5L*	*10L*	*15L*	*ORBIT RIGHT*
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	

Figure 1D-10. RV Delta (Point Parallel) Offset

Tanker 30º AOB

OFFSET - 30º AOB									
		RVIP TO RVCP DRIFT							NOTES
ORBIT LEFT		15L	10L	5L	0	5R	10R	15R	
		15R	*10R*	*5R*	*0*	*5L*	*10L*	*15L*	*ORBIT RIGHT*
TANKER TAS	460	7	8	9	11	12	14	16	30º 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	

Figure 1D-11. RV Delta (Point Parallel) Turn Range/Offset Correction – 3 NM Rollout

TURN RANGE ADJUSTMENT CHART 3 NM ROLLOUT RANGE							
A		B	C	B	E	F	G
PLANNED TURN		ACTUAL OFFSET (NM)					
RANGE	OFFSET	0	5	10	15	20	25
13	2	13	14	16	20	24	28
14	3	14	15	17	20	24	29
	4	13	14	17	20	24	28
15	4	15	15	18	21	25	29
16	4	16	16	18	22	25	29
	5	15	16	18	21	25	29
17	4	17	17	19	22	26	30
	5	16	17	19	22	26	30
	6	16	17	19	22	25	30
	7	16	16	18	22	25	29
18	5	17	18	20	23	26	30
	6	17	18	20	23	26	30
	7	17	17	19	22	26	30
	8	16	17	19	22	26	30
19	5	18	19	21	24	27	31
	6	18	19	21	23	27	31
	7	18	18	20	23	27	31
	8	17	18	20	23	26	30
	9	17	17	20	22	26	30
20	6	19	20	22	24	28	32
	7	19	19	21	24	27	31
	8	18	19	21	24	27	31
	9	18	19	21	23	27	31
	10	17	18	20	23	26	30
21	7	20	20	22	25	28	32
	8	19	20	22	25	28	32
	9	19	20	22	24	28	31
	10	18	19	21	24	27	31
	11	18	19	21	23	27	31
22	8	21	21	23	25	29	32
	9	20	21	23	25	28	32
	10	20	20	22	25	28	32
	11	19	20	22	24	28	32
	12	18	19	21	24	27	31
23	9	21	22	23	26	29	33
	10	21	21	23	26	29	33
	11	20	21	23	25	28	32
	12	20	20	22	25	28	32
24	10	22	22	24	27	30	33
	11	21	22	24	26	29	33
	12	21	21	23	26	29	33
	13	20	21	23	25	28	32
25	12	22	23	24	27	30	33
	13	21	22	24	26	29	33
26	13	23	23	25	27	30	34
	14	22	23	24	27	30	33
27	13	24	24	26	28	31	34
	14	23	24	25	28	31	34
28	15	24	24	28	28	31	34

This chart includes all the turn range/offset possibilities in the 400-480 TAS range.

1. Enter chart from left with the planned turn range/offset.
2. Enter from the top with the observed offset as it occurs during the RV.
3. The intersection of these entries is the new turn range at which to command the tanker's turn.

EXAMPLE:
With a planned 20/8 and actual 20 nm offset, the tanker's turn should occur at 27 nm.

NOTE
New turn ranges are rounded to the nearest nm.

Figure 1D-12. Timing Chart (Nil Wind)

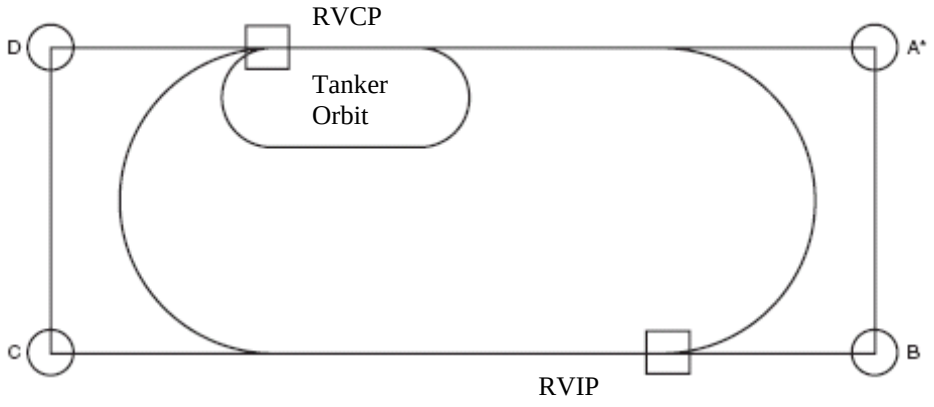
	DISTANCE	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	TURN RANGE
CLOSURE SPEED	460	3:05	3:44	4:22	5:02	5:41	6:20	6:59	7:38	8:17	8:56	9:36	10:15	10:54	11:33	12:12	6.4
	480	2:51	3:28	4:06	4:43	5:21	5:58	6:36	7:13	7:51	8:28	9:06	9:43	10:21	10:58	11:36	7.2
	500	2:38	3:14	3:50	4:26	5:02	5:38	6:14	6:50	7:26	8:02	8:38	9:14	9:50	10:26	11:02	8
	520	2:27	3:01	3:36	4:10	4:45	5:19	5:54	6:29	7:03	7:38	8:12	8:47	9:22	9:56	10:31	8.8
	540	2:16	2:49	3:22	3:56	4:29	5:02	5:36	6:09	6:42	7:16	7:49	8:22	8:56	9:29	10:02	9.6
	560	2:06	2:38	3:10	3:42	4:14	4:46	5:18	5:51	6:23	6:55	7:27	7:59	8:31	9:03	9:36	10.4
	580	1:57	2:27	2:58	3:30	4:00	4:31	5:02	5:33	6:04	6:36	7:07	7:38	8:09	8:40	9:11	11.2
	600	1:48	2:18	2:48	3:18	3:48	4:18	4:48	5:18	5:48	6:18	6:48	7:18	7:48	8:18	8:48	12
	620	1:39	2:09	2:37	3:06	3:36	4:05	4:34	5:03	5:32	6:01	6:30	6:59	7:28	7:57	8:26	12.8
	640	1:32	2:00	2:28	2:56	3:24	3:52	4:21	4:49	5:17	5:45	6:13	6:41	7:09	7:37	8:06	13.6
	660	1:25	1:52	2:19	2:46	3:14	3:41	4:08	4:36	5:03	5:30	5:57	6:25	6:52	7:19	7:46	14.4
	680	1:18	1:44	2:11	2:37	3:04	3:30	3:57	4:23	4:50	5:16	5:43	6:09	6:36	7:02	7:28	15.2
	700	1:07	1:33	1:58	2:24	2:50	3:15	3:41	4:06	4:32	4:58	5:24	5:49	6:15	6:41	7:06	17
	720	1:00	1:25	1:50	2:15	2:40	3:05	3:30	3:55	4:20	4:45	5:10	5:35	6:00	6:25	6:50	18
	740	:54	1:18	1:42	2:06	2:30	2:55	3:19	3:43	4:08	4:32	4:56	5:21	5:45	6:09	6:34	19
	760	:47	1:11	1:35	1:58	2:21	2:45	3:09	3:33	3:56	4:20	4:44	5:07	5:31	5:55	6:18	20
	780	:42	1:05	1:28	1:50	2:13	2:36	3:00	3:23	3:46	4:09	4:32	4:55	5:18	5:42	6:04	21
	800	:36	:59	1:21	1:43	2:05	2:28	2:51	3:13	3:36	3:59	4:21	4:44	5:06	5:29	5:51	22
	820	:31	:53	1:15	1:37	1:58	2:20	2:42	3:04	3:26	3:48	4:10	4:32	4:54	5:16	5:38	23
	840	:26	:47	1:09	1:30	1:51	2:12	2:34	2:55	3:17	3:38	4:00	4:21	4:43	5:04	5:25	24
	860	:21	:42	1:03	1:24	1:44	2:05	2:26	2:47	3:08	3:29	3:50	4:11	4:32	4:53	5:13	25
	880	:16	:37	:57	1:18	1:38	1:58	2:19	2:39	3:00	3:20	3:40	4:01	4:21	4:42	5:02	26
	900	:12	:32	:52	1:12	1:32	1:52	2:12	2:31	2:52	3:12	3:31	3:52	4:11	4:32	4:52	27
	920	:08	:27	:47	1:07	1:26	1:46	2:05	2:24	2:44	3:04	3:23	3:43	4:02	4:22	4:41	28
	940	:04	:23	:42	1:01	1:20	1:40	1:58	2:18	2:37	2:56	3:15	3:34	3:53	4:12	4:31	29
	960	:00	:19	:38	:56	1:15	1:34	1:52	2:11	2:30	2:48	3:08	3:26	3:45	4:03	4:22	30
	980	-	:15	:33	:51	1:10	1:28	1:46	2:04	2:23	2:41	3:00	3:18	3:36	3:55	4:13	31
	1000	-	:11	:29	:47	1:05	1:23	1:41	1:59	2:17	2:35	2:53	3:11	3:29	3:47	4:05	32

Note: The table provides a tanker time to turn to achieve a 3 nm roll out in front of the receiver.

Figure 1D-13. Work Sheet - RV Delta (Point Parallel)
Turn Range and Offset– Tanker and Receiver Flying AAR RV Speeds

A	B	C	D	E	F
	PARAMETER	**REFERENCE**	**TANKER**		**RECEIVER**
1	ALTITUDE				
2	RV IAS	TANKER NATIONAL ANNEX			
3	RV TAS	FIG 1D-2 or 3			
4	ACTUAL TEMP				
5	STD TEMP	FIG 1D-2			
6	**ACTUAL – STD (Row 4 – Row 5)** (<**STD** = REDUCE BY 1 kt / ºC) (>**STD** = INCREASE BY 1 kt / ºC)			- +	
7	**CORRECTED TAS (Row 3±Row 6)**				
8	**CLOSURE TAS (RCVR- TNKR)**				
9	RVIP TO RVCP DRIFT	DERIVED FROM TANKER NAV SYSTEM		**L/R**	
10	TURN RANGE	FIG 1D-7 or 9			
11	OFFSET	FIG 1D-8 or 10			
12	50 MN TIMING BACKUP	FIG 1D-12			
13	30 NM TIMING BACKUP	FIG 1D-12			

Figure 1D-14. Diagram of a Modified RV Delta (Point Parallel)



PART 2 - ANNEX 1E

RV Echo (Timing)

101E Introduction. The RV Echo is a timing based anchor orbit and should be used in tactical situations where it is necessary to have a tanker available with which receivers can RV in a known area on an opportunity basis. The RV Echo is normally used to support Combat Air Patrols (CAPs) and is particularly appropriate when EMCON procedures are in force; see Figure 1E-1.

102E Procedure

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

(1) Range and True Bearing. 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) Geographic Point and True Track. A geographic point and a true track which is to be flown towards the Anchor Point.

b. Anchor Duration

(1) Although the normal RV Echo duration is 15 min, to allow for limitations in airspace reservations or operational requirements, it may be defined as an RV Echo 10, 15, 20 etc.

(2) It is vital that the anchor duration is briefed prior to the mission, as the receiver will use the information to predict the approximate position of the tanker.

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

d. Receiver Join on Tanker

(1) Each receiver homes independently onto the tanker using all available aids.

(2) The receiver is to join the pattern 1000 ft below the RV FL/altitude/height.

(3) Receivers with AI radar or visual contact may join at any suitable point along the anchor.

(4) Receivers without AI radar should aim to fly the inbound track to the Anchor Point and adjust their timing to arrive 30 sec after the tanker.

e. Impact of EMCON Procedures. EMCON procedures may be used in conjunction with the RV Echo. However, in such circumstances, the receivers should be aware that several other receivers/formations may be approaching the tanker from different directions. Therefore, it is essential that all receivers maintain a good lookout and strict adherence to AAR procedures.

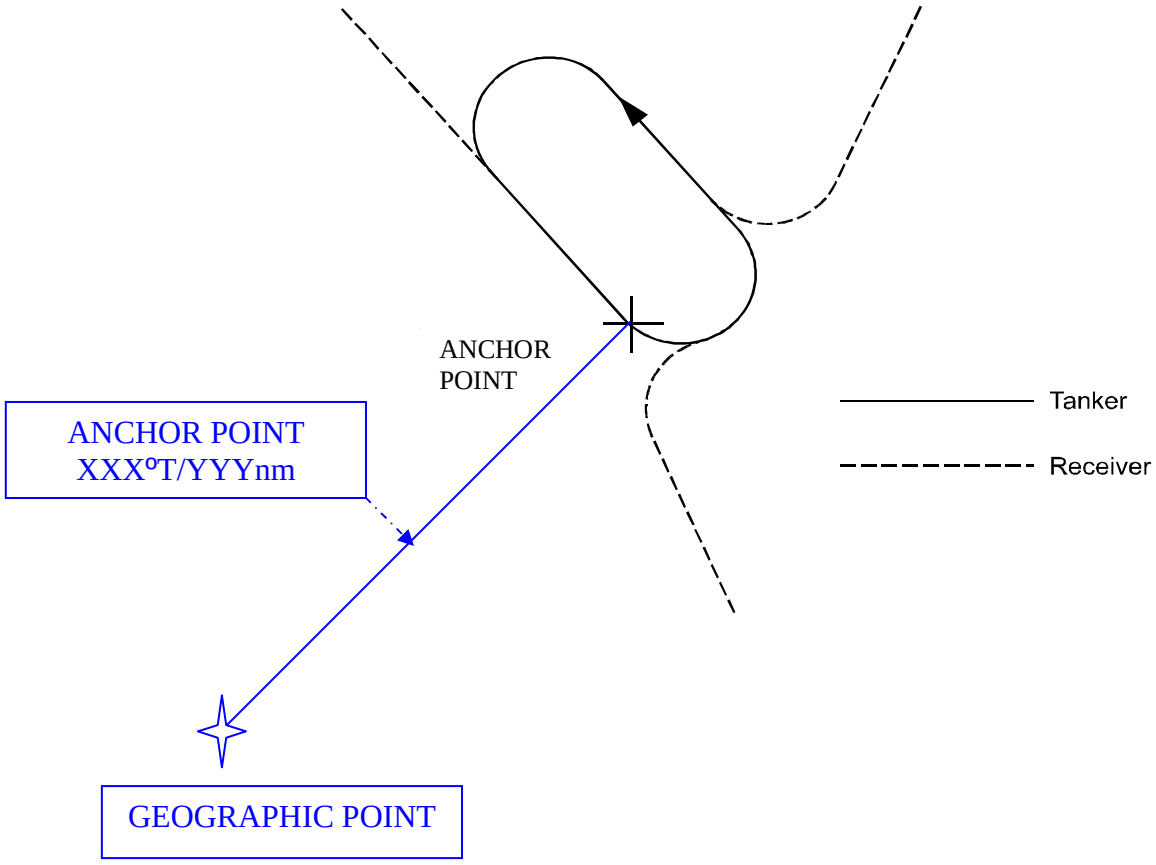
f. Tanker Actions to Ensure VMC. Within the limitations of the tactical situation, the tanker pilot is to adjust the FL/altitude/height and or position of the racetrack to maintain good VMC.

103E Aids Employed to RV. Subject to the EMCON policy in force, all available aids should be employed to achieve the RV. If available, A/A TACAN should be used as follows:

a. The tanker should select the A/A TACAN channel appropriate to the towline or as directed in the SPINS or tasking order throughout its time on station.

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

Figure 1E-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/height, orientation (if necessary) and A/A TACAN channel should be specified in the SPINS or tasking order.

PART 2 ANNEX 1F

RV Foxtrot

101F Introduction. The RV Foxtrot is a sequenced departure normally used in VMC conditions when the tanker(s) 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.

102F Accompanied Departure / Buddy Climb. In this procedure, see Figure 1F-1, the receiver(s) takes off before the tanker and complete(s) 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:

a. Wake Turbulence. The receiver(s) is not exposed to wake turbulence caused by the heavy tanker.

b. Receiver Unserviceabilities. Receiver(s) unserviceability immediately after take-off will be known before the tanker is airborne.

103F Accompanied Departure / Buddy Climb - Planning Considerations. This method has 2 significant factors that need to taken into consideration deciding whether or not to employ this RV rather than the Tailchase Departure described below.

a. Fuel Consumption. The receiver(s) consumes extra fuel completing the visual circuit.

b. Ability to Join Up. Weather conditions at the airfield need to be good enough for a visual circuit and join.

Therefore, during the planning phase, careful consideration of factors such as weather conditions and route of flight are required to ascertain the optimal procedure.

104F Accompanied Departure / Buddy Climb - Implementation. The method of implementing the Accompanied Departure / Buddy Climb is:

a. Receiver/Tanker Departure. 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 visual circuit and still permit the tanker to achieve its Estimated Time of Departure (ETD).

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

c. Tanker Departure. 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.

105F Tailchase Departure. In this procedure, see Figure 1F-2, the tanker takes off before the receiver(s).

106F Tailchase Departure - Planning Considerations. As the tanker launches first, planning factors must take into consideration that, should one or more receivers fail to get airborne, the tanker will normally continue as planned accompanied by the reduced number of receivers.

107F Tailchase Departure – Establishing RVIP. The standard method for arranging 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.

108F Tailchase Departure - Implementation. Careful pre-flight briefing between tanker and receiver crews is essential.

a. RVIP. 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. RVCT. Knowing the time to height, the RVCT is calculated from the tanker take-off time.

c. Take-Off Time - Receiver. 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.

d. Vertical Separation - Receiver. As soon as practical after take-off, the receiver is to establish RT contact with the tanker. The receiver is to ensure that its passing FL/altitude/height is at least 1000 ft below that of the tanker until positive visual identification is made.

e. Rate of Climb. An agreed common rate of climb is to be pre-briefed as laid out in Part 2 Chapter 2 Annex 2C.

f. Height Calls - Tanker. Following the initial RT contact, the tanker is to call the FL/altitude/height 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.

g. Navigation Aids. Usually, tanker and receiver(s) fly identical INS tracks and A/A TACAN is selected to give split ranges.

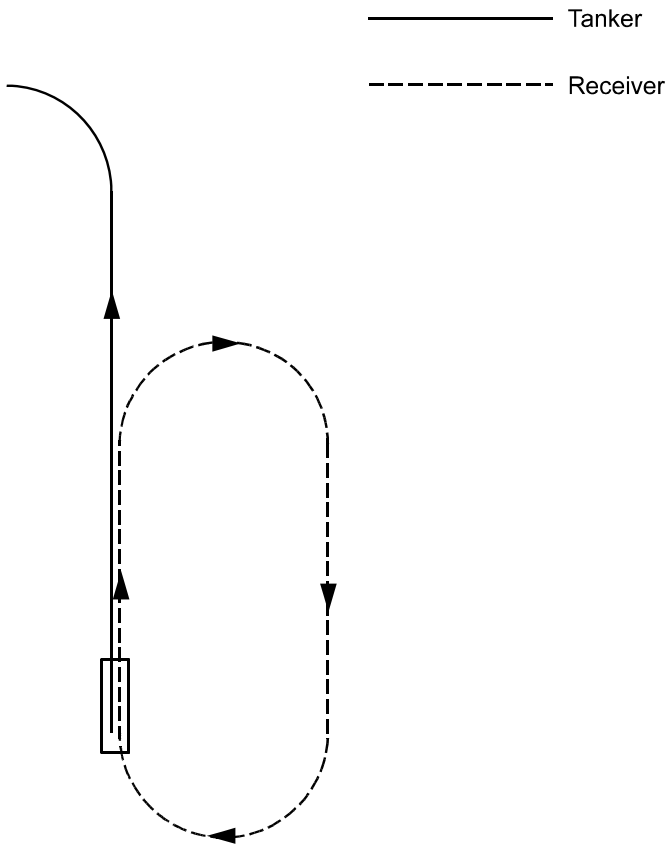
(1) If the departure procedures require the use of a ground base TACAN, then range and bearing comparison to this facility is to be made at every height check.

(2) If required, UHF Direction Finder (UDF) may be used to ascertain relative positions.

h. Orbiting – Tanker. If the receiver has not confirmed visual contact during the climb, the tanker is to make good the RVIP and, with ATC agreement, establish a left hand orbit until join up is complete.

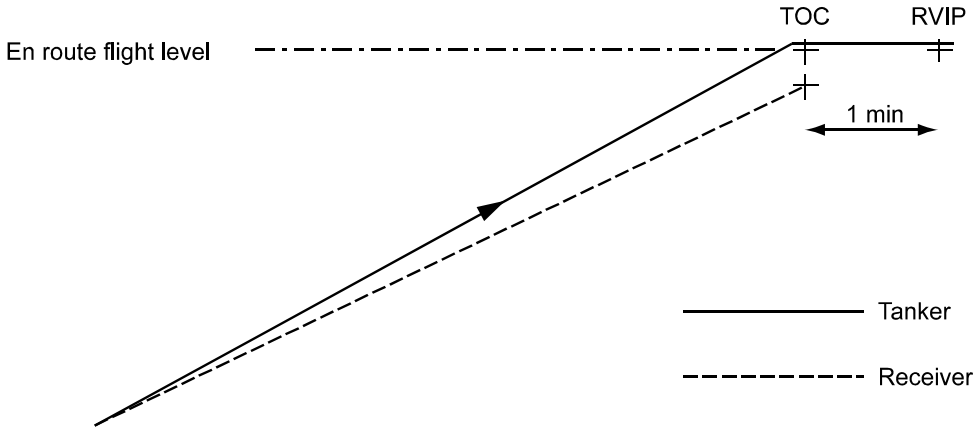
109F Receivers Depart Before Tanker. Sometimes, the receiver(s) may depart ahead of the tanker(s). In such cases, the procedures listed above remain valid, although the lead formation assumes responsibility for height calls. Once VMC, the formation will co-ordinate with ATC a 1000 ft separation between the receivers and tankers. Additionally, if the tanker is unable to accelerate and overtake the receivers, the formation should arrange with ATC for the receivers to orbit left in order to acquire the tanker.

Figure 1F-1. Diagram of RV Foxtrot –Accompanied Departure / Buddy Climb



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

Figure 1F-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 height/altitude/flight level until visual.

PART 2 - ANNEX 1G

RV Golf (En Route)

101G Introduction. The RV Golf facilitates a join up en-route on a common track to make good a scheduled time to join an ALTRV or other established military corridor; the tanker(s) and receiver(s) may have departed either from the same or different bases. See Figure 1G-1.

102G Basic Procedure

a. Arrival at RVIP. The tankers and receiver(s) navigate independently to arrive at the RVIP at a designated RVCT. To counter departure delays or receiver(s) arriving early, it may be necessary for the tanker to arrive approximately 10 min before the receiver(s) and establish an orbit prior to the RVIP.

b. Track Requirements. A common track length equivalent to 15 min flying time should be planned to allow for tanker descent to RV FL/altitude/height, visual acquisition and timing corrections.

c. Communication Procedures. Fifteen minutes prior to the RVCT the tanker and receiver(s) are to confirm their FL/altitude/height, A/A TACAN (channel), Mode 3, armament state and timing. The receiver(s) should fly towards the RVCP with A/A TACAN and radar beacon on (if appropriate) at 1000 ft below the base AAR altitude.

d. Visual Acquisition of Tanker(s)/Receiver(s). When established on the common track, tanker(s) and receiver(s) are to use all available locating aids (EMCON state permitting) to gain visual contact between the tanker(s) and the receiver(s).

103G Variations in EMCON 2 to Basic Procedure

a. During EMCON 2, if radio contact between the aircraft has not been established prior to the RV control time, or the adjusted RV control time, tanker(s) and receiver(s) are to maintain their assigned FL/altitude/height and depart the RV to cross the RVCP/RVIP at the RVCT.

b. Aircraft delaying at the RVCP will employ normal orbit procedures unless otherwise directed. If there is minimal separation between following aircraft or formations using the same track, orbits at the RVCP will require close coordination and thorough crew briefings to ensure vertical separation.

104G Specific Procedures in EMCON 4. If EMCON 4 procedures are in force, the tasking instructions should include control times for both the RVIP and the RVCP. There are 3 basic options for this procedure:

a. Procedure 1. This procedure should be used when the receiver(s) and tanker(s) have a similar transit speed and cruise height.

(1) Tanker. The tanker plans to arrive at the RVIP at the planned RV FL/altitude/height and RV control time at the AAR speed.

(2) Receiver. The receiver(s) arrive(s) at the RVIP 1000 ft below the tanker at the RV control time plus 30 sec and then adjusts KIAS to a 20 kts overtake on the tanker.

(3) Receiver Visual with Tanker. Once visual with the tanker and cleared by the tanker,

the receiver(s) climbs to the observation position (drogue) / astern position (boom). A/A TACAN is used throughout to determine relative positions.

b. Procedure 2. This procedure is used when turboprop or jet receiver(s) have a considerable difference in cruising FL/altitude/height and speed to that of the tanker.

(1) Navigation Aids. A/A TACAN/range to the RVCP is used throughout the descent to monitor relative positions.

(2) Receiver. The receiver arrives at the RVIP at the RV control time and the RV FL/altitude/height minus 1000 ft.

(3) Tanker. The tanker arrives at the RVIP at the RV altitude and the RV control time plus 1 minute and commences to overtake the receiver, maintaining 1000 ft vertical separation, aiming to pass to overhead a boom receiver or at least 2 wingspans to the right of a probe and drogue receiver.

(4) Join

(a) Boom. On passing the receiver, the tanker is to reduce to AAR speed. Once visual with the tanker and cleared to join, the receiver is to commence a climb to the astern position.

(b) Probe and Drogue. Once the tanker and receiver are visual, the tanker descends to the RV FL/altitude/height minus 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.

c. Procedure 3. This is a modification of the Procedure 2 and is normally used by Probe and Drogue tankers for jet receivers that have a considerable difference in cruising FL/altitude/height and speed to that of the tanker.

(1) Receiver. The receiver plans to arrive at the RVIP and RV FL/altitude/height minus 1000 ft at the RV control time.

(2) Tanker. The tanker arrives at the RVIP at a higher FL/altitude/height at the RV control time plus 30 seconds and then commences a descent to level off at the RV FL/altitude/height.

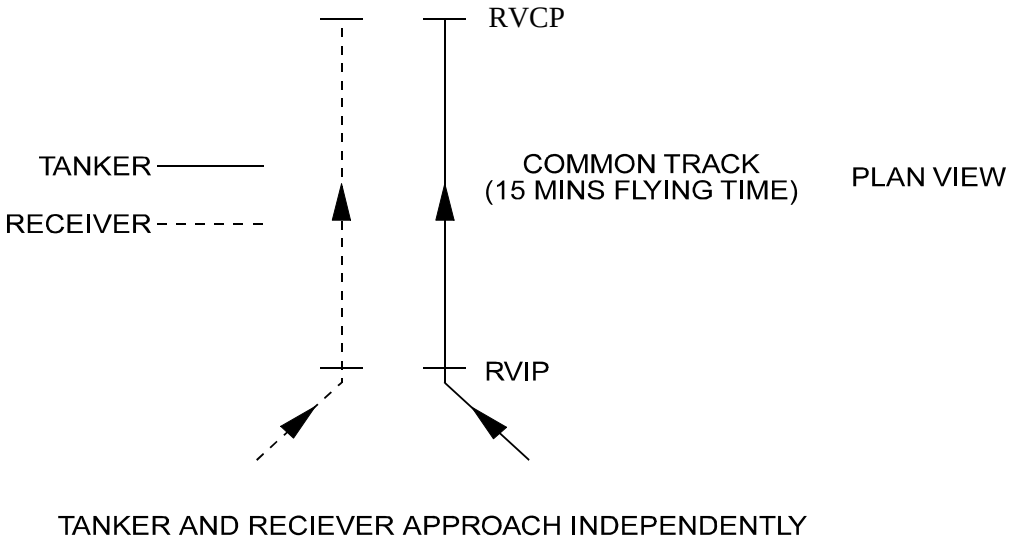
(3) Tanker Descent. During the descent, the tanker establishes a 20 kts overtake on the receiver and uses the A/A TACAN/range to the RVCP to monitor relative positions.

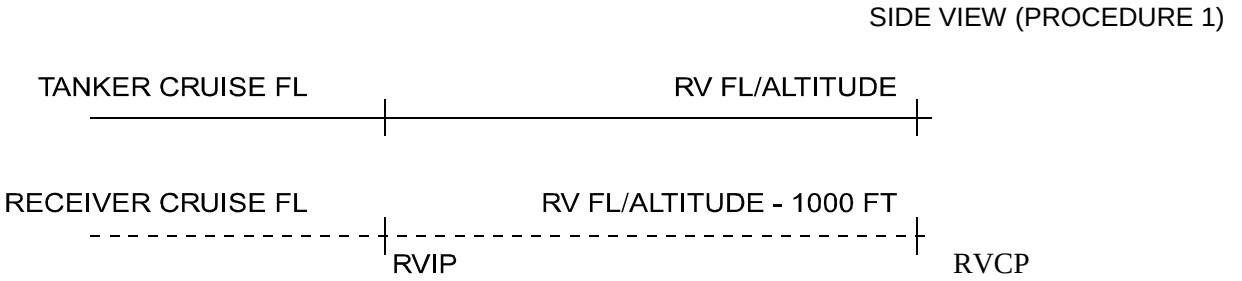
(4) Tanker Visual with Receiver. When visual with the receiver, the tanker speed is reduced to the receiver's speed + 5 kts and the receiver climbs to the RV FL/altitude/height and establishes in the observation position on the tanker's echelon left.

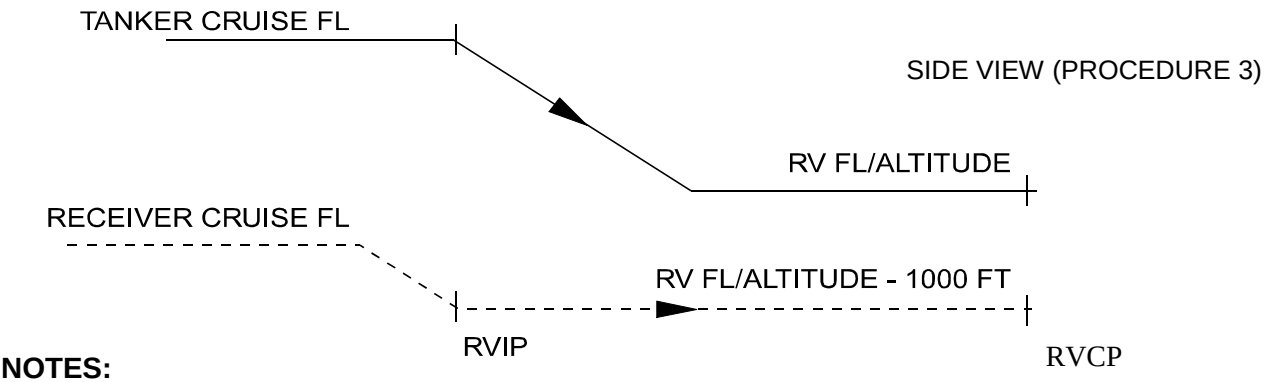
NOTE

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 104G.b above.

Figure 1G-1. Diagram of RV Golf (En Route)







NOTES:

1. The RVIP should be 15 minutes up track from the RVCP.
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.

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PART 2 – FIXED WING PROCEDURES

CHAPTER 2

Formation Procedures

201 Introduction. The procedures for safe rendezvous, joining, refuelling and leaving the tanker are detailed in Part 2 Chapter1 and Part 2 Chapters 4. This chapter describes factors that must be taken into account when a formation of receivers and/or tankers operates together.

202 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.

203 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.

204 Wingman/Receiver Responsibilities. To ensure safe operations and integrity of the formation, wingman are to:

a. Keep the leader in visual or electronic contact at all times.

b. Maintain briefed position at all times.

c. Anticipate corrections/changes and plan accordingly.

d. Monitor all aspects of formation operations and advise the receiver formation leader if an unsafe condition is identified.

205 Airspeeds and Altitudes. The optimum altitude and airspeed for AAR varies with the tanker/receiver combination. See tanker National Annex for appropriate details.

206 Weather/Visibility. Refer to Part 2 Chapter 1, para 102d.

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

a. Visual Meteorological Conditions (VMC). For VMC, the tanker should brief a formation most suited to the AAR sequence, taking into consideration the formation preferences of the receiver leader. In most cases, aircraft that are not refuelling will be directed to remain in either the Observation or Reform position/area. Should the tanker clear receivers to maintain a loose formation, they are not to stray too far away from the tanker, otherwise they may conflict with other airspace users. Local ATC restrictions may stipulate more stringent requirements, but, generally, the formation frontage should not exceed 1 nm and receivers must stay within ±200 ft of the tanker's height.

b. Instrument Meteorological Conditions (IMC). Whenever ATC and fuel considerations permit, tankers should avoid IMC by implementing track or height adjustments.

(1) Climb to VMC. Receiver performance capabilities (particularly for AAR at high weights) may be a limiting factor; nevertheless, tankers should consider climbing to achieve VMC for cruise and initial AAR contact and then toboggan as receiver weight increases.

(2) Unable to Avoid IMC. 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.

(a) Receivers should be arranged so that movement around the tanker is minimised during AAR sequences.

(b) 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.

(c) The tanker is to exercise strict control of receiver movement around the tanker during formation changes for AAR brackets.

(d) Receiver Loss of Visual Contact. If the receivers lose visual contact with the tanker, they are to immediately implement the 'Lost Wingman" procedures laid out in Part 1, Chapter 4 and maintain the prescribed separation until visual contact is regained.

208 Detailed Formation Procedures

a. Multi-Tanker Formation Procedures. Part 2 Annex 2A provides information about multi-tanker formation procedures.

b. Force Extension Procedures. Part 2 Annex 2B provides information about force extension procedures.

c. Tanker Snake/Formation Climb. Part 2 Annex 2C provides a guide to tanker snake/formation climb procedures.

d. Alternative AAR Formation Procedures – Heavy Aircraft. Part 2 Annex 2D discusses alternative AAR formation procedures for heavy aircraft.

e. Receiver Station Keeping Equipment (SKE) - AAR Procedures. Part 2 Annex 2E provides guidance on the use of SKE when flying heavy aircraft in formation with tankers.

f. Quick Flow Procedures. Part 2 Annex 2F describes receiver actions when employing Quick Flow procedures.

PART 2 - ANNEX 2A

Multi-Tanker Formation Procedures

NOTE

The US and RNLAF do not fly multi-tanker echelon procedures as described in this Annex. US procedures are published in appropriate national documents and summarised in Part 2, Annex 2D.

201A Multi-Tanker Formation - Echelon Procedures. On occasions, tasking may require several tankers to be in formation during the RV and for refuelling. Tankers may fly in echelon right formation on the lead tanker.

a. Formation Turns. At the lead tanker'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.

b. Receivers Joining a Tanker Formation

(1) Fighter and Heavy Probe and Drogue Receivers. All fighter and heavy probe and drogue receivers joining a multi-tanker formation are to join on the left of the tanker formation.

(2) Heavy Boom Receivers. All heavy boom receivers will join either directly behind the boom or, if there is more than one heavy receiver, the second and subsequent receivers will join on the right of the tanker formation.

(3) Receivers and Assigned Tankers. At the appropriate time, receivers will be cleared to join their assigned tanker.

(a) Receivers are not to penetrate through the tanker formation to reach their tanker.

(b) Receivers are to drop back on the left of the tanker formation, then move across behind the formation, before moving forward to join their tanker.

202A Formation in Visual Meteorological Conditions (VMC)

a. After joining, the standard cruise formation is with the tankers in echelon formation on the right side of the lead tanker.

b. 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.

c. Ideally, when more than 3 tankers are allocated to a wave, 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 or TCAS range from the lead tanker; this eases the tankers' station keeping task and keeps the formation frontage within reasonable bounds.

(1) Where possible, the formation should remain clear of cloud.

(2) Provided sufficient visual cues remain, the formation may penetrate thin cloud.

(a) 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.

(b) If there is a third tanker, this should be placed in line astern behind the second tanker to ease the station keeping task.

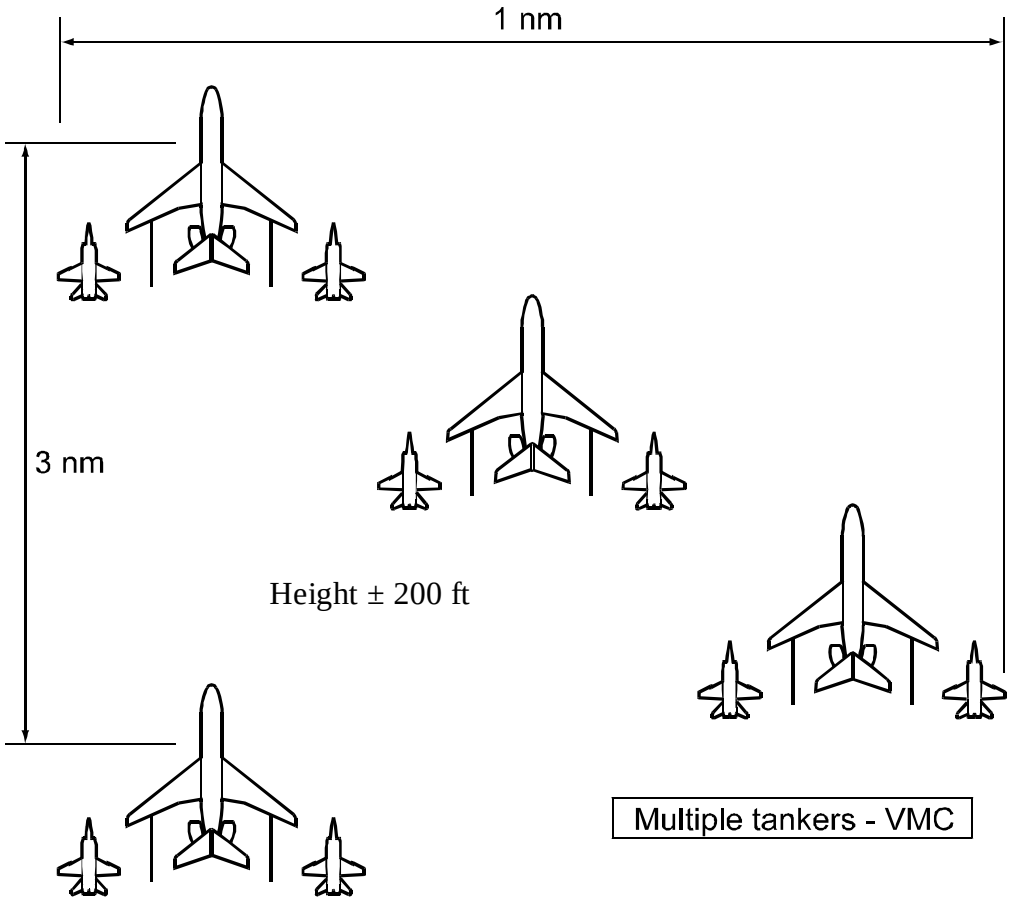
(c) If there is a second section, then this should remain 3 nm behind of the lead tanker.

(3) The lead tanker will be able to refuel its receivers if these conditions prevail during the brackets.

(4) 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.

(5) 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.

Figure 2A-1. Diagram of VMC Multi-Tanker Formation



203A Formation in Instrument Meteorological Conditions (IMC) - Standard Separated Formation

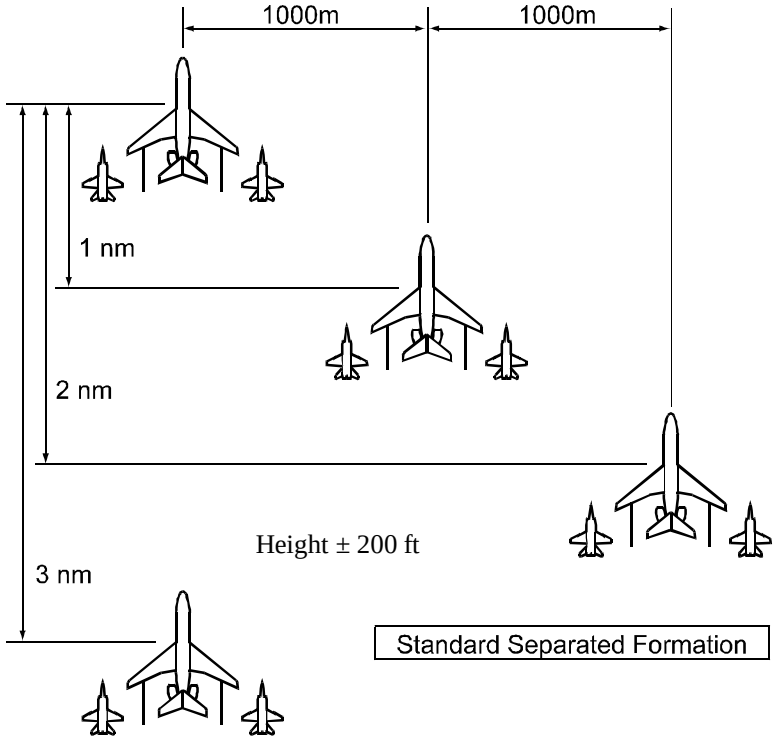
a. Tankers within each section are to be in right echelon, approximately 1000 m and 30° displaced from and 1 nm behind of the preceding tanker; radar, TCAS and A/A TACAN ranges are to be used to maintain the prescribed displacement.

b. If there is a second section of tankers, then tanker 4 is to maintain a range of 3 nm behind the lead tanker, and so on.

c. The lead tanker is to make frequent broadcasts of its heading and speed whilst IMC prevail.

d. If an aircraft cannot maintain the prescribed separation because of radar/TCAS/TACAN unserviceabilities, a safe height separation from the rest of the formation is to be achieved; the tanker leader is to be informed.

Figure 2A-2. Diagram of IMC Multi-Tanker Formation



204A 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 joining 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:

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

b. 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.

c. 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.

d. 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.

205A Multi-Tanker Formation Procedures. The formations described in this Annex are an alternative to close echelon formation and may be adopted at any stage in the cruise at the discretion of the lead tanker.

a. Pre-Flight Brief. Before a tanker formation is flown, a full and formal brief is to be given by the formation leader. The main briefing points to be covered for a snake/formation climb are outlined in Annex 2C.

b. Formation Considerations. The following is merely a guide to formation procedures and cannot cover all situations. Crews are to use their judgement when circumstances dictate, eg in conditions of reduced visibility.

(1) Formation Leaders. Formation 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 formation.

(2) Formation Members. Formation members are to make every effort to maintain correct positioning and are to be prepared to provide assistance to the formation leader or to assume the formation lead if required.

(3) Standard Formation. The standard formation is flown with successive tankers in line astern and stepped up behind the leader.

(4) Formation Weather Limits – Non-AI Radar Aircraft. For non-AI equipped receivers or non-SKE equipped tankers, weather limits for formation are 1000 ft clear of cloud, one nm visibility plus one nm of visibility per tanker in the formation.

(5) Formation Weather Limits – AI Radar Aircraft. For AI equipped aircraft the weather limits are as prescribed for each nation.

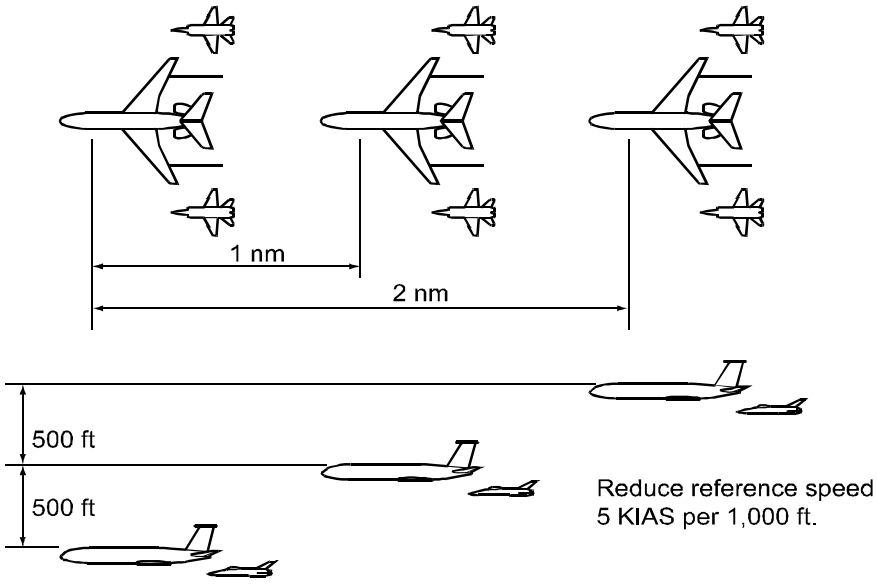
(6) Formation Size. Normally, the formation is to comprise a maximum of 3 tankers.

(a) 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 formation leader in VMC to a minimum of 500 ft and ½ nm.

(b) In IMC the minimum separation is to be 1000 ft and 1 nm.

(7) Altitude Block. 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.

Figure 2A-3. Diagram Of Multi-Tanker Formation



c. 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 getting airborne to place the aircraft upwind (if possible) and out of the vortex of the preceding aircraft.

(1) Tanker Snake/Formation Climb Procedures. Usually, tankers will take-off from the same base in order to establish formation. Part 2 Annex 2C outlines the snake/formation 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 formation leader.

d. Establishing Formation. Normally, the briefed formation disposition is to be established after cruising altitude is reached; formation disposition may be established directly or from echelon. Each tanker is to call when 'in position'. To establish formation disposition from echelon:

(1) VMC

(a) For 2 tankers, No 2 drops back and climbs into position maintaining visual contact with the lead.

(b) 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

(a) 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 behind the lead.

(b) For 3 tankers, No 3 is to move into its formation position first. When No 3 is in

position, No 2 is then to establish its own formation position in turn.

e. Rendezvous. Turns in formation should be minimised to ease the station keeping task and tankers are not to exceed 25° AOB (if tanker national restrictions direct the use of AOB less than 25º, ATC should be informed). Aircraft joining the formation should join in the normal manner 1 nm and 1000 ft below the lead tanker.

(1) Tankers joining a formation are to be passed the formation position to be adopted and an individual formation callsign numbered sequentially with No 1 as the lead.

(2) Receivers joining a 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).

(3) Safety. Aircraft joining a formation are not to enter the formation until all aircraft in the formation have been visually identified.

f. Maintaining Formation. Maintaining correct formation 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, TCAS 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 25^{o} AOB for turns of more than 20^{o} (if tanker national restrictions direct the use of AOB less than 25º, ATC should be informed). Any necessary track adjustment due to wind in the AAR area is to be made on the straight legs; the bank angle is not to be increased during the turn.

NOTE

Some tankers with receiver(s) in contact, are restricted to 20° AOB. See National Annexes for details

(3) Climbs/Descents

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

(i) For a descent, the lead descends first.

(ii) When established, the lead calls its new level and instructs No 2 to descend to its

new level.

(iii) When No 2 has called at its new level, the lead instructs No 3 to descend and so on.

(iv) 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 formation.

(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 tanker and No 2 tanker, and a separate pairing should be specified between No 2 tanker and No 3 tankers (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) Formation Position Changes. Formation 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

(i) 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.

(ii) When No 1 is able to maintain separation on No 2 (using A/A TACAN, TCAS and radar), No 1 hands over the lead.

(iii) 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.

(iv) A similar procedure is to be used for other position changes within the formation.

(c) Radar and/or Visual Contact. Radar or visual contact must be maintained throughout the position change.

(i) If radar and visual contact is lost during a position change, maintain altitude and advise the formation leader that contact has been lost.

(ii) The formation member losing contact is to ensure positive separation by any means available and must not attempt to rejoin the formation until positive radar or visual contact is established.

(d) Renumbering of Formation Members. 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 formation callsign.

(7) Refuelling. During refuelling, the formation 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 rise as onload increases. Maintaining formation in this scenario may be extremely difficult and the formation 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 formation is flying a long straight track (IMC or VMC), tankers can establish a 60° echelon on 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. Formation management usually requires the use of full RT. This situation demands strict radio and intercom discipline from all aircraft in the formation.

(a) Cockpit intercom and RT are to be brief and, if possible, not made when the receiver is closing to or in the contact position.

(b) Boom operator RT is to be brief but adequate and include the entire Callsign identification.

(c) If RT silence is operationally essential, all aspects of formation disposition, particularly the RV and join, are to be specifically pre-briefed.

(d) 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

(a) Receivers are to join the formation at 1 nm and 1000 ft below the lead (lowest) tanker on the left and, when cleared by the tanker formation leader, move up to their assigned tanker.

(b) Preferably, there are not to be more than 4 receivers per tanker.

(c) Flow through the tanker is to be left to right.

(i) If receivers require topping up they are to resume left echelon after initial refuelling.

(d) Once refuelling is complete, all receivers are to establish right echelon and, if

possible, climb 1000 ft above the formation before departing.

(e) Any receiver that loses visual contact with its tanker is to carry out the loss of visual contact procedure specified in Part 2 Chapter 4, para 406 or 407 as appropriate.

(i) 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 tanker Callsign. Refer to Part 2 Chapter 4, para 408 for subsequent actions.

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

(14) Loss of Contact - Multi-Tanker Formation. See Part 2 Chapter 4 para 407 for Loss of Visual Contact procedures.

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PART 2 - ANNEX 2B

Force Extension Procedures

201B AAR Deployments (Force Extension). AAR deployments, also known as Force Extension missions, 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. Options for deployment formation procedures are presented below and specific instructions are laid out in national instructions; as a general principle, the type of formation to be adopted should be decided and briefed before take-off.

202B Use of AAR for Force Extension. Where force extension procedures are employed, force extension tankers (also known as 'whirlers') provide AAR for tankers escorting fighters during deployment operations. Force Extension missions are often complex and demanding to all aircrew, especially in IMC. All facets of the mission, to include the RV, formation, air refuelling, VMC/IMC rejoin procedures, and formation break-up are to be briefed during mission planning and clearly understood by all participants.

203B Force Extension Procedures. When deploying packages of aircraft, particularly fighters, force extension (or trail) procedures may be employed. The procedures detailed below are the standard for force extension tankers providing AAR to escort tankers. Any deviations to these procedures are to be co-ordinated between all tankers (escorting and force extension), receivers, and the mission commander. If a pre-departure briefing is not conducted due to geographically separated departure locations, the escorting tanker will coordinate changes in flight to the force extension tanker upon initial contact, prior to the AAR RV.

a. Basic Join Principles. The RV Delta (Basic Point Parallel) or RV Golf (En route Rendezvous) usually offer the most convenient process to gather the tanker and receiver aircraft.

b. Transit Formation. Once together, multi-ship tanker formation should plan to fly 60º echelon, 2 nm spacing unless otherwise directed.

c. Formation in IMC. Missions that encounter IMC conditions during air refuelling may increase air refuelling echelon formation spacing from 2 nm to 3 nm.

d. Join with Force Extension Tanker(s). If a mid transit tanker (or 'whirler') RV is planned, the escorting tanker will attempt to contact the force extension (or 'whirler') tanker and exchange information that will assist the AAR join. In-flight visibility will be the determining factor in utilising VMC versus IMC procedures to conduct air refuelling.

NOTE

For the purpose of these procedures, the USAF defines VMC as visibility equal to or greater than 2 nm. Similarly, they define IMC as visibility less than 2 nm.)

e. Join Force Extension Tanker - VMC. When cleared by the escorting tanker pilot, receivers will join on the force extension tanker in the observation position or as directed by the force extension tanker. Once all receivers have joined the force extension tanker, the escorting tanker will be cleared for refuelling. Receivers should fly a loose wing formation and, with the exception of receivers behind the boom or drogues executing the manoeuvre, remain with their

force extension tanker in the event that a breakaway is called.

f. AAR Speeds. The tanker will inform receivers the speed to be used as the refuelling airspeed for the formation (normally, for large aircraft tankers, this will be in the range 290-310 KIAS). The lead force extending tanker will determine air refuelling airspeed based on receiver/tanker aircraft types, altitude, weight, weapons load, etc.

g. Join Force Extension Tanker - IMC or Night. Air-to-air radar equipped fighters, when cleared by the escorting tanker pilot, should adopt one of the following formation positions:

(1) Close Formation with Force Extension Tanker. With the agreement of the Force Extension tanker, position in close formation on both wings of the Force Extension Tanker.

(2) Trail. If close formation is not practical, the receiver formation should position 1.5 to 2 nm in trail (6 o'clock position) of the escorting tanker, 2000 ft (or as briefed) below their assigned tanker whilst it is being refuelled by the force extension tanker.

(a) AI radar or other electronic means should be used to confirm longitudinal separation.

h. Post Refuelling Procedures

(1) Once all AAR is complete, the escorting tanker(s) will descend 1000 ft below the force extension tanker, offset slightly to the right, and then move to a position 1 nm in front of the force extension tanker(s).

(2) Once the escorting tanker(s) is stabilized in this position, it will assume lead for the formation after a positive verbal lead change.

(3) The escorting tanker will then clear the fighters forward to rejoin.

(4) Non-air-to-air radar equipped fighters and other aircraft will rejoin visually with their respective escorting tanker.

(5) If required, air-to-air radar equipped fighters will rejoin using radar guidance.

i. Rejoin in IMC. If IMC prevails and poor visibility precludes visual rejoins, some nations may permit the force extension tanker(s) to momentarily reduce separation to 1/2 nm and 500 ft vertical separation to facilitate the rejoin. See Part 2 Chapter 1, para 102d.

j. Inability to Rejoin by End of Track. If the formation reaches the end of the AAR track and visual rejoins are not possible, fuel permitting, force extension tankers will continue along the receiver’s route of flight until visual rejoins are possible. If the force extension tanker(s) reaches BINGO FUEL at, or after the end of the AAR track and the fighters/receivers have not rejoined with the escorting tanker(s), the entire formation will abort to a suitable alternate airfield.

k. Formation Deconfliction Prior to Separation. The tanker radar should be used for position monitoring throughout the manoeuvre. It is the force extension tanker’s responsibility to inform the entire formation of current heading and airspeed until relieved of that responsibility by a lead change.

(1) The force extension tanker/formation will reform at the top of the air refuelling block.

(2) Once the fighters have rejoined on their respective escorting tankers, the escorting tanker/ formation will reform at the bottom of the block.

(3) Formation separation will be accomplished by the force extension or escorting tanker formation increasing/decreasing airspeed as determined by mission requirements and/or the permission brief.

(4) Force extension or escorting tankers will not make any climbing or descending turns to depart the stream until the tankers are identified visually or by radar, are well clear, and verbal co-ordination is made between tanker formation leaders. All aircrews must clear aggressively and be cognizant of potential converging headings or conflicts.

(5) When simultaneous refuelling of fighters and escorting tankers is required. The lead force extending tanker will determine air refuelling airspeed based on aircraft type, altitude, weight, weapons load, etc.

NOTE

For KC-10 receivers, use 310 KCAS and for KC-135 receivers use 295 KIAS.

l. Departure – Force Extension Tanker. Once all fighters/receivers have rejoined on their respective escorting tanker, the force extension tanker(s) will depart the stream from the rear of the formation.

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PART 2 - ANNEX 2C

Tanker Snake/Formation Climb Guide

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 formation 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 V_{mm} (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. Taxi 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 formation 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. Transition altitude. 13. VMC/IMC procedures. 14. Formation join up, altitude block, airspeed (indicated/true/mach) and minimum manoeuvre airspeed. RV join procedure, RVCT and position in formation. 15. Any formation position changes. 16. AAR plan, receiver callsigns and assigned tanker, off/on loads, sequence, base altitude, track, type of RV. 17. Safety - Loss of Visual Contact procedures. 18. Formation break up and base recovery. 19. 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 taxi.
T/O-10	Call 'TAXI' for all aircraft.	Taxi in turn.
CLNC	Obtain ATC clearance for all aircraft.	Acknowledge ATC clearance.

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)'. Or, if block levels allocated 'MY FL ___, YOUR FL___' Brief any changes.	Call 'READY'. Acknowledge: 'VMC/IMC SNAKE CLIMB AS BRIEFED TO FL ___' Or, if applicable, 'MY 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 20º/25º AOB as reqd.	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, V_{mm} (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 20º/25º AOB as reqd 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 taxi should be stated by the lead tanker. Standard timings are: RT check at T/O-40, start at T/O-20, taxi 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/formation climb, even if the TriStar/KC-10 is subsequently to lead the formation, the VC10 should lead the snake/formation 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/formation 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. TriStar 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.

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PART 2 - ANNEX 2D

AAR Formation Procedures – Heavy Aircraft

201D AAR Formation Procedures – Heavy Aircraft

a. Departure. For formation departure and join-up prior to air refuelling, comply with applicable national formation directives.

NOTE

Normally, tankers will maintain en-route formation while in the orbit pattern (see figure 2D-1).

b. En-Route Formation. During the final turn to AAR track, tankers will adjust from en-route formation to 60° right echelon with 2 nm nose-to-nose separation (1 nm for fighters) and stack up at 500-ft intervals (see figures 2D-2). Unless otherwise briefed, this formation will be used during the air refuelling operation. Pilots will use their radar scopes, A/A TACAN and TCAS to maintain the formation position.

Figure 2D-1. Diagram of En-Route Formation

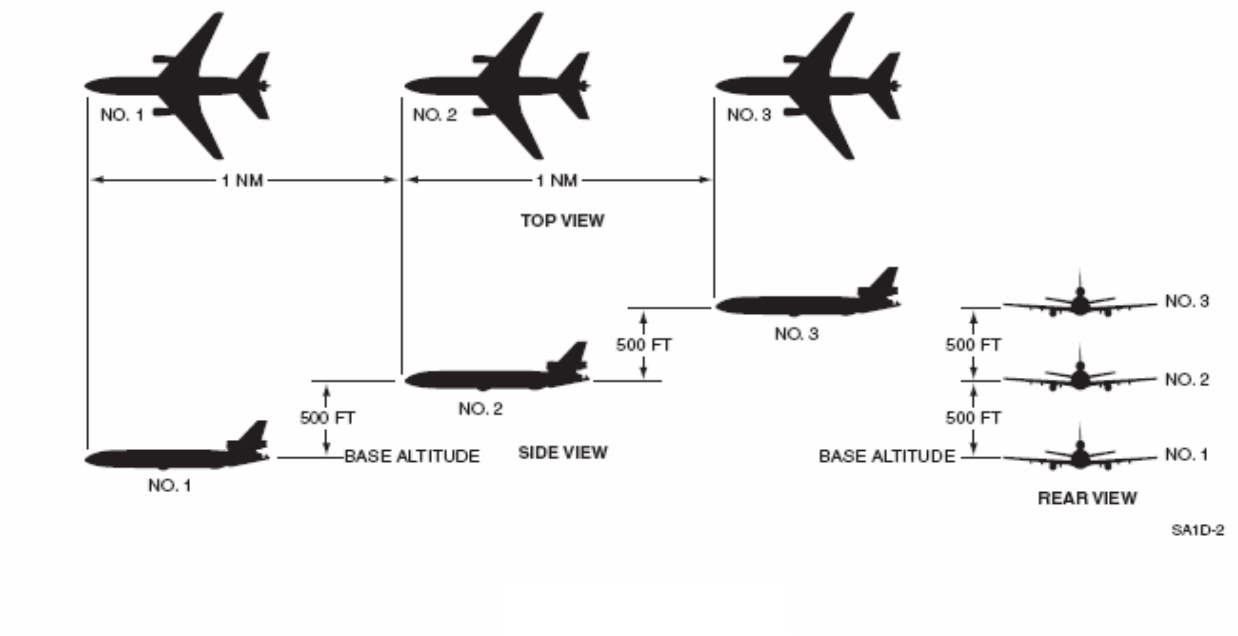
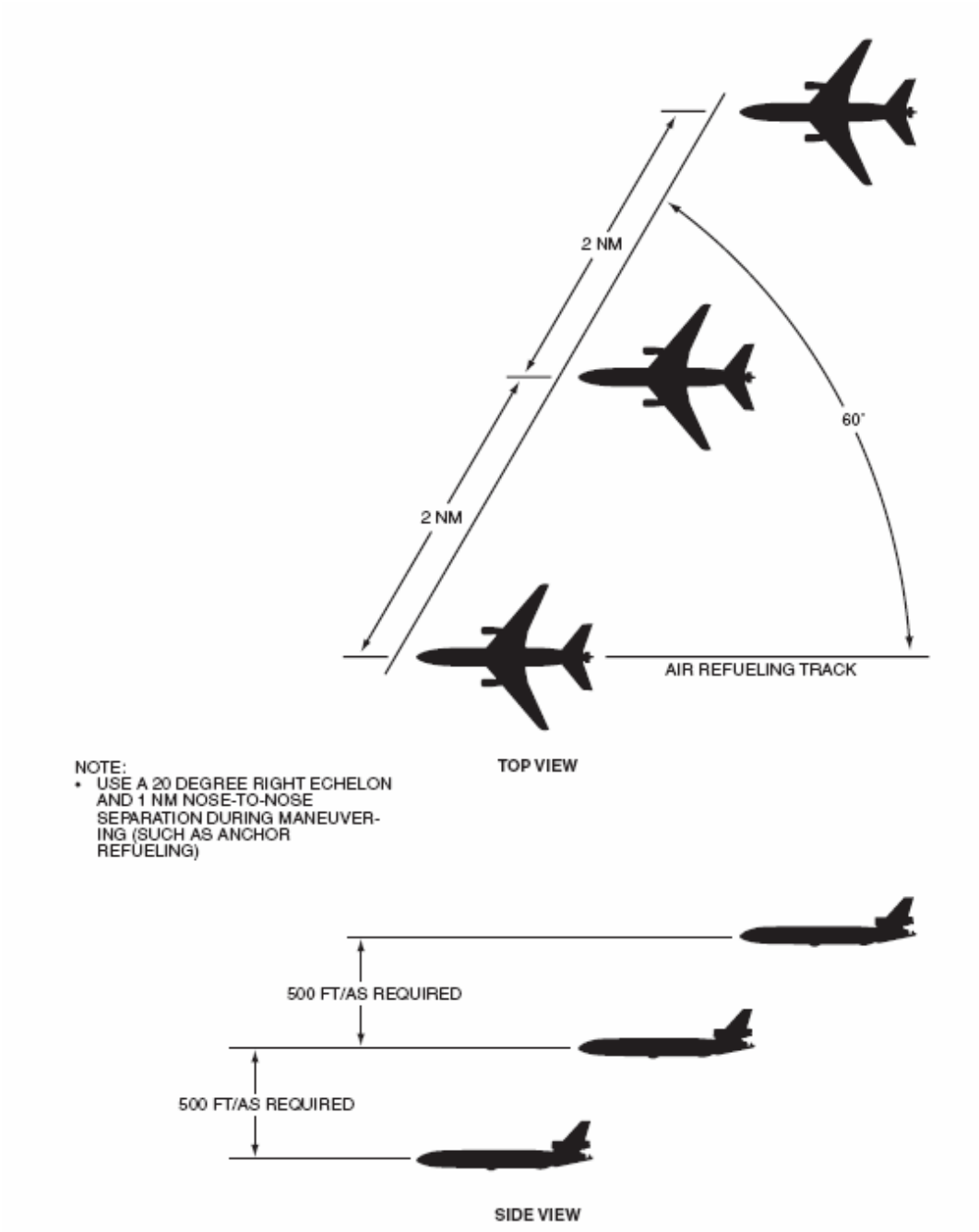


Figure 2D-2. AAR Formation



NOTES

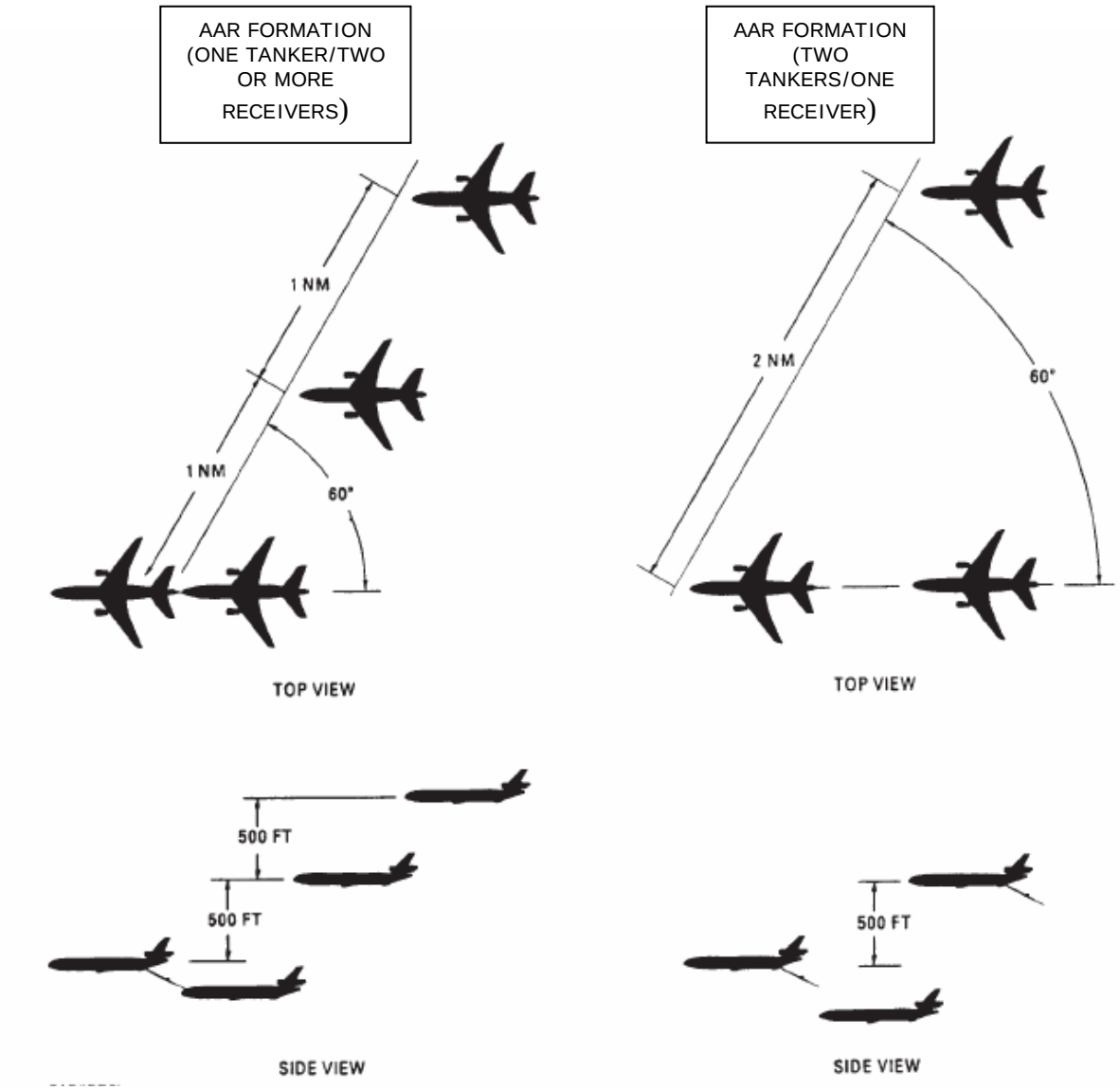
- **For an AAR formation of two tankers / four multi-engine receivers or three tankers / six multi-engine receivers, the tankers will stack up at 1000 ft intervals instead of 500 ft intervals.**

- **Echelon should be maintained throughout the refuelling except where conditions require turns into echelon formation greater than 30°, in which case the formation will be directed by the leader to assume 1 nm in trail formation until the turn is complete.**

202D AAR Formation Procedures To Be Used By USAF Heavy Receivers

a. General. The receiver formation will move into AAR formation upon completion of the RV or as prebriefed. AAR formation is defined as 60° right echelon stacked up at 500 ft intervals with 1 nm nose-to-nose separation (see figure 2D-3). Nose to nose separation may be increased to match tanker air refuelling formations.

Figure 2D-3. AAR Formations – Heavy Receivers



a. One Tanker/One Receiver

(1) Upon completion of AAR, the receiver will move aft and descend to a position at least 1000 ft below the tanker, and at least 1/2 nm in-trail.

(2) If unable to maintain visual contact with the tanker, increase spacing to 1 nm. This position will be maintained until air refuelling is terminated and clearance is received from ARTCC.

(3) Prior to either aircraft departing the AAR formation, clearance from ARTCC (US airspace) or ATC must be received and the tanker and receiver must coordinate their respective separation manoeuvres (verbal coordination not applicable during EMCON 3 and EMCON 4).

b. One Tanker/Two Receivers

(1) Receiver number 2 will maintain the AAR formation position (60^o right echelon stacked up 500 ft from the tanker) until refuelling is complete for the lead receiver.

(2) At that time, the lead receiver will descend 1500 ft, move aft and left to assume a 60^o left echelon, 2 nm nose-to-nose separation from the refuelling element, stacked down at 1500 ft.

(3) Once receiver lead is established in this post AAR position and calls "established in post AAR", receiver number 2 will establish radio contact with the tanker and close by descending, then moving left (10^o or less of heading change), until established in a position 500 ft below and 1/2 nm in trail of the tanker.

(4) After receiver number 2 has completed refuelling, it will manoeuvre directly aft while descending 1000 ft below the tanker (500 ft above receiver lead) call level at their altitude, decelerate, and rejoin on receiver lead (verbal coordination not applicable during EMCON 3 and EMCON 4).

(5) If needed, the tanker will then climb (or the receiver element may descend) to an altitude which provides a minimum of 1000 ft between the tanker and the highest receiver.

(6) Prior to any aircraft departing the AAR formation, 1000 ft of altitude separation between the tanker and highest receiver should be established (500 minimum required), clearance from ARTCC (US only) or ATC must be received, and the tanker and receivers must coordinate their respective separation manoeuvres (verbal coordination not applicable during EMCON 3 and EMCON 4).

c. Two or More Tankers/One Receiver

(1) During final turn to the AAR track, the tanker formation will move into echelon formation on the right of the tanker leader, stacked up at 500 ft intervals with 2 nm nose-to-nose separation measured along the 60^o echelon (see figure 2D-3).

(2) The receiver will rendezvous with the lead tanker. When reaching 2 nm from the last tanker, and visual contact is established, the receiver will manoeuvre to refuel from the last tanker.

(3) After completion of this refuelling, the receiver will descend, then manoeuvre left (10^o or less of heading change), until established in a position 500 ft below and 1/2 nm

in trail of the next tanker (as necessary).

(4) Upon completion of this air refuelling, the receiver will move aft and descend to a position at least 1000 ft below the lead tanker, and at least 1/2 nm in-trail.

(5) If unable to maintain visual contact with the lead tanker, increase spacing to 1 nm.

(6) This position will be maintained until air refuelling is terminated and clearance is received from ARTCC (US only) or ATC.

(7) Prior to any aircraft departing the air refuelling formation, 1000 ft of altitude separation between the lowest tanker and the receiver should be established (500 ft minimum required), clearance from ARTCC must be received, and all tankers and receivers must coordinate their respective separation manoeuvres (verbal coordination not applicable during EMCON 3 and EMCON 4).

d. Three Tankers/Two Receivers

(1) A minimum of 4 successive altitudes (3000 ft) is required for this procedure.

(2) Planned fuel onload figures may vary depending on the mission.

(3) For three tankers/two receivers, the receiver leader will refuel from tanker number 2 first, receiving 1/3 of the scheduled onload.

(4) The receiver leader will then descend and then move left to refuel off the lead tanker, receiving the other 2/3 onload.

(5) Receiver number 2 will refuel from tanker number 3 first, receiving 2/3 of the scheduled onload.

(6) Receiver number 2 will then descend and then move left to refuel off tanker number 2, receiving the 1/3 of the scheduled onload (after the lead receiver has cleared tanker number 2).

(7) When the lead receiver has completed refuelling, it will clear the lead tanker by descending, moving aft and left to assume a 60^{o} left echelon, 2 nm nose-to-nose separation from the refuelling element, stacked down 1500 ft.

(8) Once the lead receiver is established in this post AAR position, the crew will call "Established in Post A/R."

(9) After receiver number 2 has completed refuelling, it will descend, move directly aft while descending 1500 ft below tanker number 2 (500 ft above receiver lead), call level at their altitude, decelerate, and rejoin on receiver lead (verbal coordination not applicable during EMCON 3 and EMCON 4).

(10) If needed, the tankers will then climb (or the receiver element may descend) to an altitude which provides a minimum of 1000 ft between the lowest tanker and the highest receiver.

(11) Prior to any aircraft departing the air refuelling formation, 1000 ft of altitude separation between the lowest tanker and highest receiver should be established (500 ft minimum required), clearance from ARTCC (US only) or ATC must be received, and all tankers and receivers must coordinate their respective separation manoeuvres

(verbal coordination not applicable during EMCON 3 and EMCON 4).

e. Two Tankers/Three Receivers

(1) A minimum of 4 successive altitudes (3000 ft) is required for this procedure.

(2) Planned fuel onload figures may vary depending on the mission.

(3) The receiver leader will receive the total scheduled onload from the lead tanker.

(4) Receiver number 2 will receive 1/2 the scheduled onload from tanker number 2 and 1/2 the scheduled onload from the lead tanker.

(5) Receiver number 3 will receive the total scheduled offload from tanker number 2. Receiver number 3 will maintain the air refuelling formation (60^o right echelon stacked up 500 ft from the number 2 tanker) until receiver number 2 has completed refuelling with tanker number 2.

(6) After completing the onload, receiver lead will descend, move aft and left, and assume a 60^o left echelon, 2 nm nose-to-nose separation from the lead tanker, stacked down 2000 ft.

(7) Once the lead receiver is established in this post AAR position, they will call "Established in Post A/R."

(8) Receiver number 2 will refuel from tanker number 2 first, receiving 1/2 of the scheduled onload.

(9) Receiver number 2 will then descend and move left to refuel off the lead tanker, receiving 1/2 of the onload (after the lead receiver has cleared the lead tanker).

(10) After receiver number 2 has completed refuelling with the lead tanker receiver number 2 will descend 1500 ft below the lead tanker (500 ft above the receiver lead), call level at their altitude, decelerate, and rejoin on the lead receiver (verbal coordination not required during EMCON 3 and EMCON 4).

(11) Once receiver number 3 has completed refuelling with tanker number 2, they will descend 1000 ft below the lead tanker (500 ft above the number 2 receiver), call level at their altitude, decelerate, and rejoin on the receiver element (verbal coordination not required during EMCON 3 and EMCON 4).

(12) If needed, the tankers will then climb (or the receiver element may descend) to an altitude which provides a minimum of 1000 ft between the lowest tanker and the highest receiver.

(13) Prior to any aircraft departing the air refuelling formation, 1000 ft of altitude separation between the lowest tanker and highest receiver should be established (500 ft minimum required), clearance from ARTCC (US only) or ATC must be received, and all tankers and receivers must coordinate their respective separation manoeuvres (verbal coordination not applicable during EMCON 3 and EMCON 4).

f. Post AAR Position. The post AAR position is defined as the 60^o left echelon position, 2 nm nose-to-nose separation from the lead tanker, stacked down with a minimum of 1000 ft separation between the lowest tanker and the highest receiver.

PART 2 - ANNEX 2E

Receiver Station Keeping Equipment (SKE) – AAR Procedures

201E Introduction. This annex provides amplified guidance for aircraft employing Station Keeping Equipment (SKE) to maintain separation.

202E Pre-Flight Briefing. Tanker aircrews will contact their respective SKE formation receiver aircrews prior to flight to ensure full understanding of the formation air refuelling procedures to be used.

203E Formation Size and Dimensions

a. Normal Formation. The normal SKE formation consists of elements of three aircraft which fly co-altitude, 4000 ft in-trail from each other, 500 ft right for the number two aircraft, 500 ft left for the number three aircraft (Figure 2E-1).

b. Maximum Formation Size. Formations may consist of up to ten elements of three aircraft. Each element will stack-up 100 ft above the preceding element. Tanker formations conducting refuelling operations with SKE formations will fly 60^{o} right echelon, 1 nm spacing, stacked up 500 ft (Figure 2E-1).

204E Rendezvous. Plan normal rendezvous procedures (en-route or point parallel). The following detailed tactics will be used when refuelling large formations of receiver aircraft utilising SKE:

a. Receiver formations utilising SKE procedures will use normal AAR Formation Procedures with minor modifications.

b. At the completion of the rendezvous, receiver formations will transition to a right 60^{o} echelon refuelling formation.

c. Receivers awaiting an open tanker will maintain the Awaiting AAR Position. (Exception: The number three receiver when operating with a single tanker will remain inline with the number two receiver until the number two receiver transitions to the precontact position).

d. Awaiting AAR Position. The Awaiting AAR Position is defined as right 60^{o} echelon off the last tanker, 1 nm nose to nose spacing, stacked 500 ft above that tanker. Receivers in the Awaiting AAR Position will be cleared to their tanker after the preceding receiver calls "RECEIVER (NUMBER) ESTABLISHED IN POST AAR."

e. Change in Formation Constitution. Procedures, including spacing to be used, will be briefed to tanker and receiver crews prior to flight. If the formation ratio changes (loss of a tanker or receiver through unserviceability, add-on tanker or receiver, etc.), in-flight coordination is required prior to the rendezvous.

205E Positive Separation. It is the responsibility of all formation members (both tanker and receiver) to ensure positive separation throughout refuelling operations. Formation members shall know and understand where all formation members are at all times. Question any manoeuvre or position which you do not understand.

206E Unplanned Turns. If an unplanned turn must be accomplished (i.e. weather), tankers must coordinate with receivers well in advance of the turn. Lead tanker will announce turn direction and approximate roll out heading on AAR primary. All receivers must acknowledge before the turn may

commence. Receiver acknowledgement indicates there is proper separation (see definition below) between all receivers and tankers and proper separation will be maintained throughout the turn. If a receiver cannot maintain proper separation, he will call:

"RECEIVER (NUMBER), STANDBY TURN"

Tankers will maintain current heading until Receiver (number) can maintain proper separation and calls:

"RECEIVER (NUMBER), READY FOR TURN"

207E Separation Criteria. Proper separation is defined as one of the following:

a. Established in post-AAR.

b. Established in awaiting-AAR.

c. Established or approaching (within 0.5 nm) the astern or contact position.

d. 500 ft altitude separation and 0.5 nm lateral separation being attained and maintained from each tanker and receiver.

208E Turns Greater than 90 Degrees. Before executing turns greater than 90^{o}, tankers must be in trail formation and receivers must be in a SKE in-line formation at least 1000 ft below the lowest tanker. Awaiting AAR receivers will not depart the Awaiting AAR Position toward the contact position until the:

"RECEIVER (NUMBER) ESTABLISHED IN POST AAR"

call is received. Before moving from the Awaiting AAR Position, that receiver will verify the previous receiver is clear of the intended flight path to the previous receiver calls:

"RECEIVER (NUMBER) CLEAR"

the receiver in the Awaiting AAR Position will establish radio contact with his respective tanker, and be cleared to precontact position using normal closure procedures.

209E Formation Irregularities. Any crewmember noting a formation position irregularity which may involve conflicting flight paths will immediately notify the pilot flying who will take action to prevent such conflict (roll out of closure heading, cease climb or descent, etc.) and establish radio contact with the other aircraft to de-conflict the situation.

210E Tanker Echelon. Tankers will maintain a precise 60^{o} right echelon formation position when refuelling with SKE formations. Precise formation position is more important than maintaining a smooth platform.

NOTE

When refuelling SKE formations, crewmembers should shorten individual tactical call signs. Tanker lead is "TANKER 1", Receiver lead is "RECEIVER 1" and so on.

211E Conditions for 180 Degree Turns On Track. Tanker/SKE Receiver formations may execute 180^{o} turns on tracks if all the following conditions are met (no later than 2 min prior to the turn):

a. Tankers are in-line formation.

b. Receivers have rejoined in an in-line SKE formation and are maintaining a position 2 nm in trail of the lead tanker around the turn.

c. The highest receiver is at least 1000 ft below the lowest tanker.

212E Formation Post Roll-Out. Upon roll-out on new base course, if further formation refuelling is desired, the receiver formation will transition to normal AAR formation refuelling position. Receivers may elect to use a SKE Box Pattern. If this option is used, tanker(s) will proceed to the RVCP and prepare for a second rendezvous (point parallel). Prior coordination is essential.

NOTES

- **SKE Box Pattern is a series of turns, 90^{o} or less, initiated at the air refuelling exit point designed to position the SKE formation for a point parallel rendezvous in the opposite direction.**

- **EXCEPTION: For 2 or 3 receivers on 1 tanker only; the receiver in the contact/astern position may remain in the contact/astern position during the turn. The other receiver(s) will move to the in-trail position for the duration of the 180^{o} turn. In-trail aircraft will return to awaiting A/R or post A/R, whichever is appropriate, after the refuelling formation is re-established on track (after the turn). The receiver in the contact/astern position will remain in the contact/astern position until the other receiver(s) is re-established in the awaiting A/R or post A/R position.**

213E Post SKE AAR. At the completion of AAR, receiver aircraft will move to the Post AAR position to accomplish their rejoin. The Post AAR position is defined as 60^{o} left echelon, 2 nm nose to nose separation, stacked down 1000 ft off the lead tanker. For large formations, this may require several receivers to cross behind the tanker formation prior to the tankers' transition to en-route formation (see Figure 2E-3 and 2E-5).

NOTE

For post AAR, to transition back to SKE formation, consideration must be given to the amount of time required to accomplish this transition. THIS MAY TAKE UP TO 15 MINUTES. Once the receiver formation is confirmed in their respective SKE positions, the SKE formation leader will confirm position with tanker leader. Upon confirmation, the tanker formation can move to the in-trail formation, stacked up 500 ft.

214E Breakaway. In the event of a breakaway, SKE receiver aircraft are limited to an altitude 500 ft below their respective tanker.

215E Typical SKE Formations. Figures 2E-1 through 2E-8 depict typical receiver AAR formations when using SKE equipment.

Figure 2E-1. SKE Formation

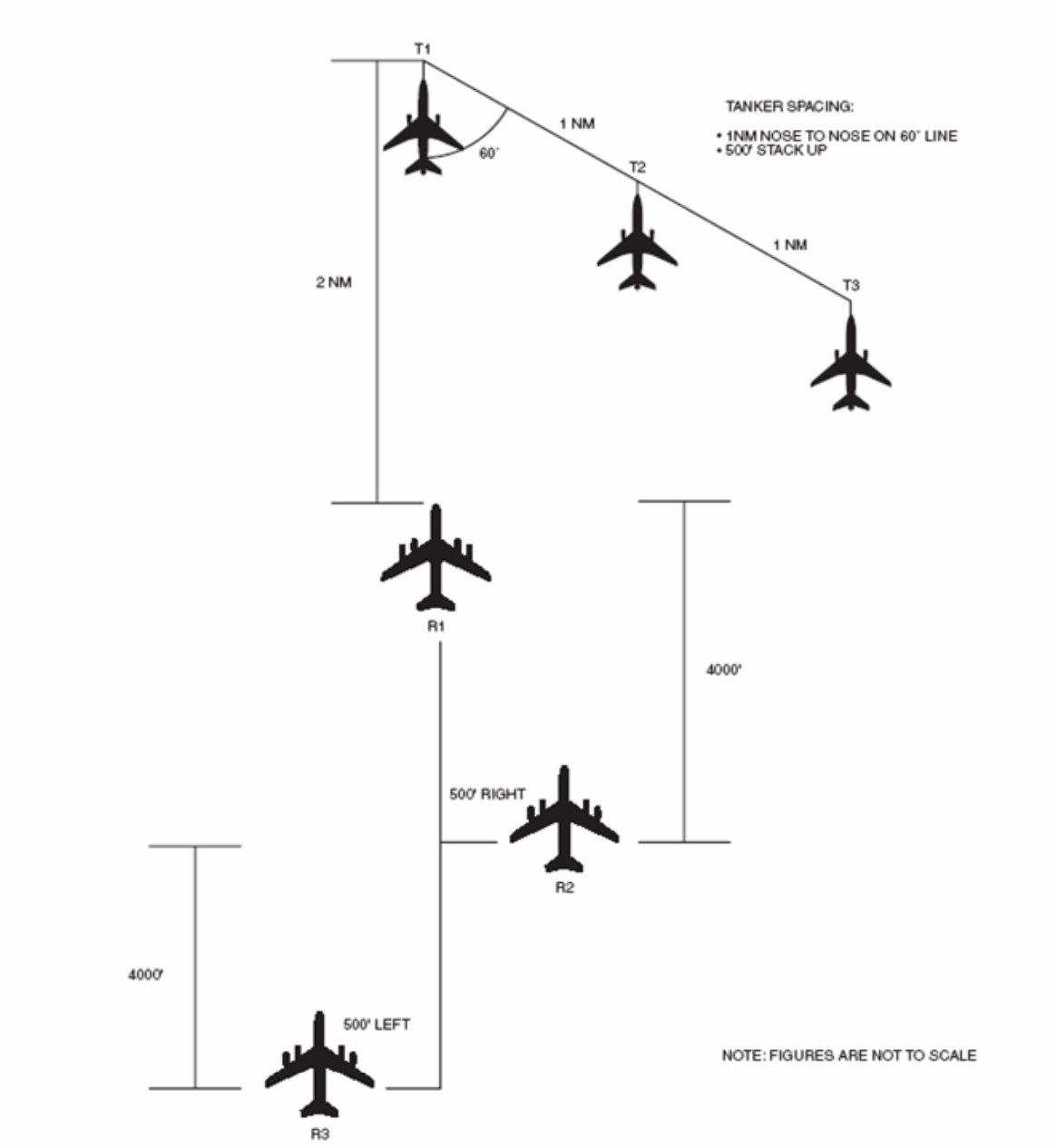


Figure 2E-2. AAR Procedures (3 Receivers (or 2) on 1 Tanker)

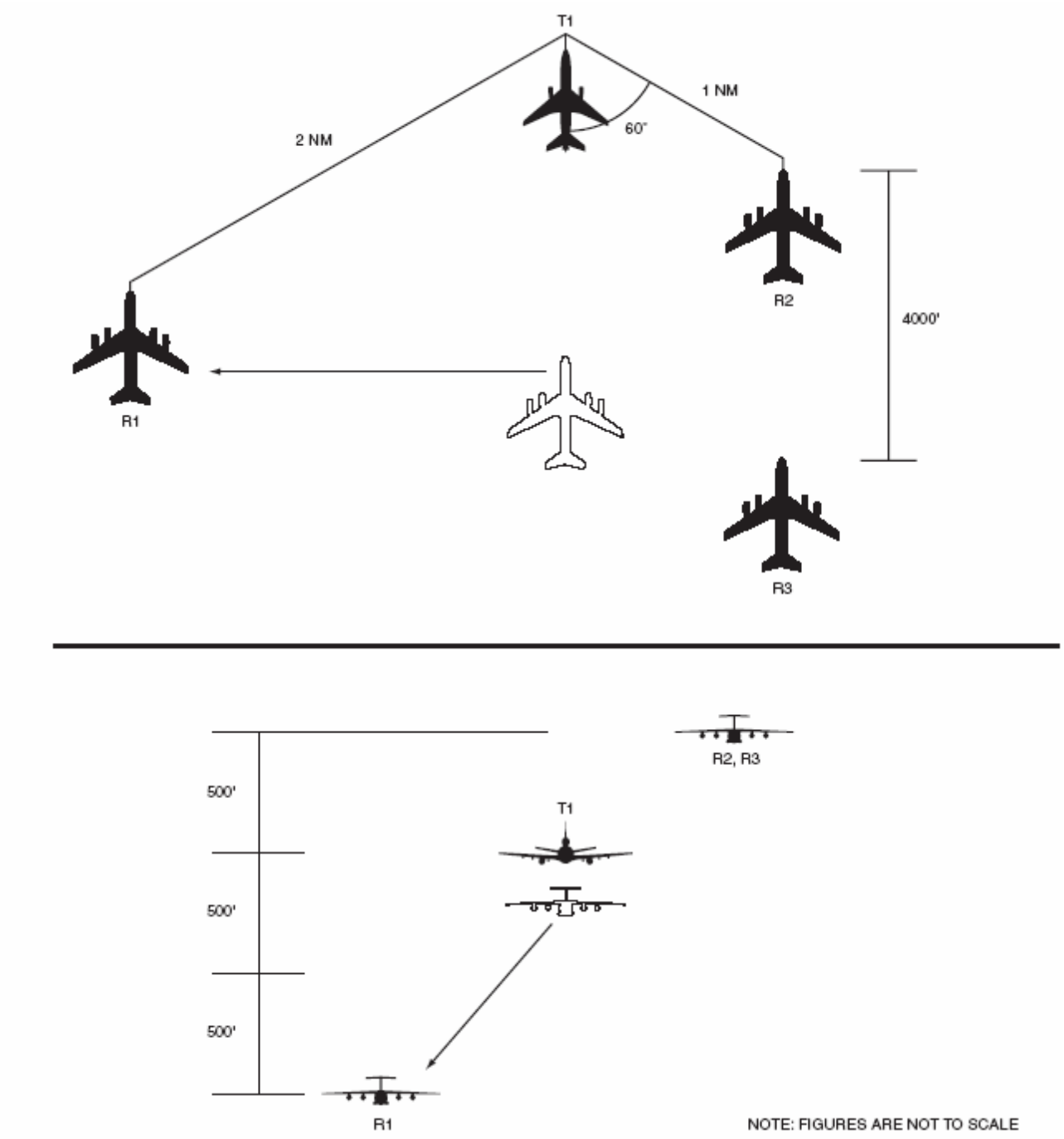


Figure 2E-3. Post AAR Procedures 3 Receivers (or 2) on 1 Tanker

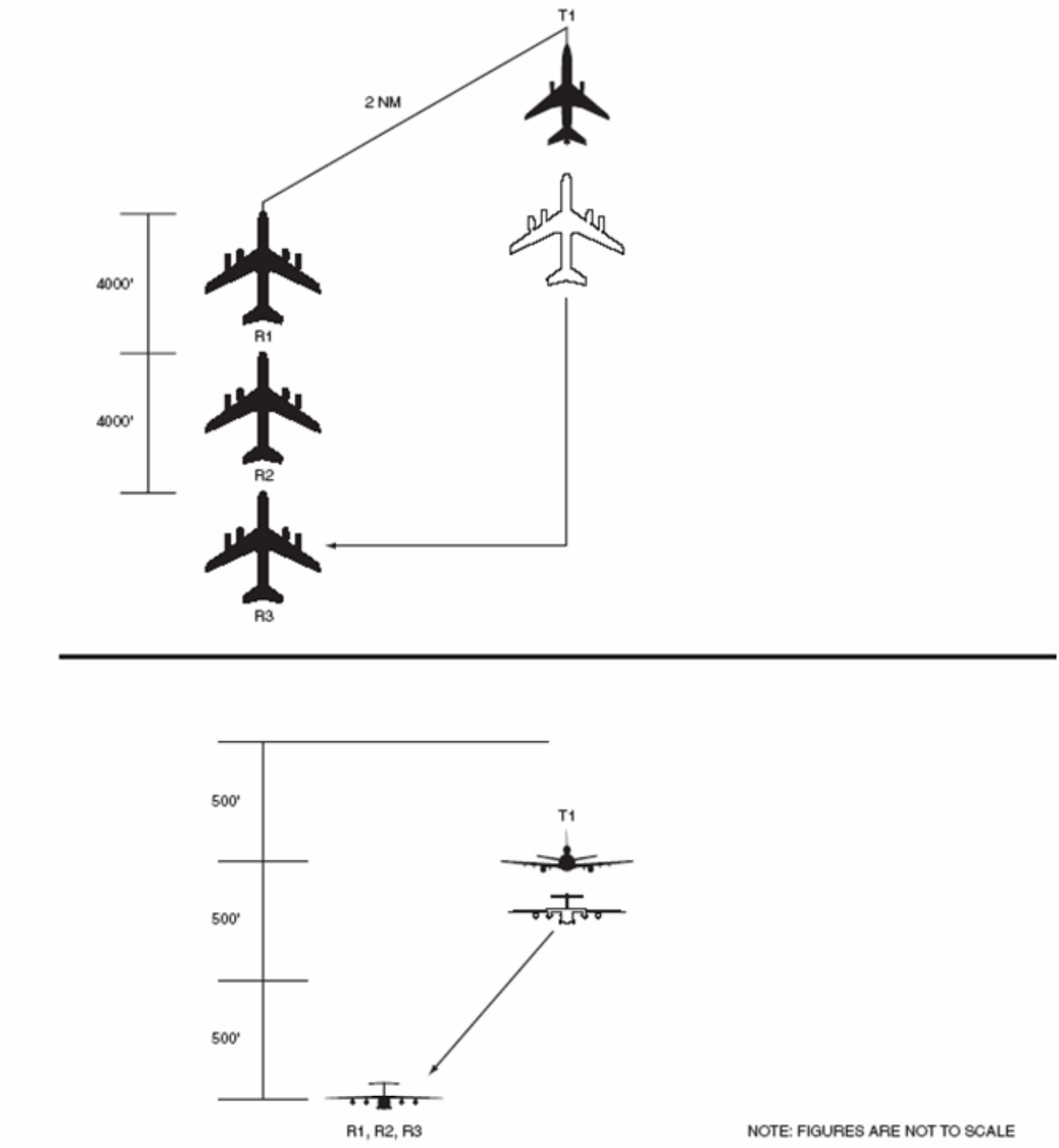


Figure 2E-4. AAR Procedures (3 Receivers on 2 Tanker)

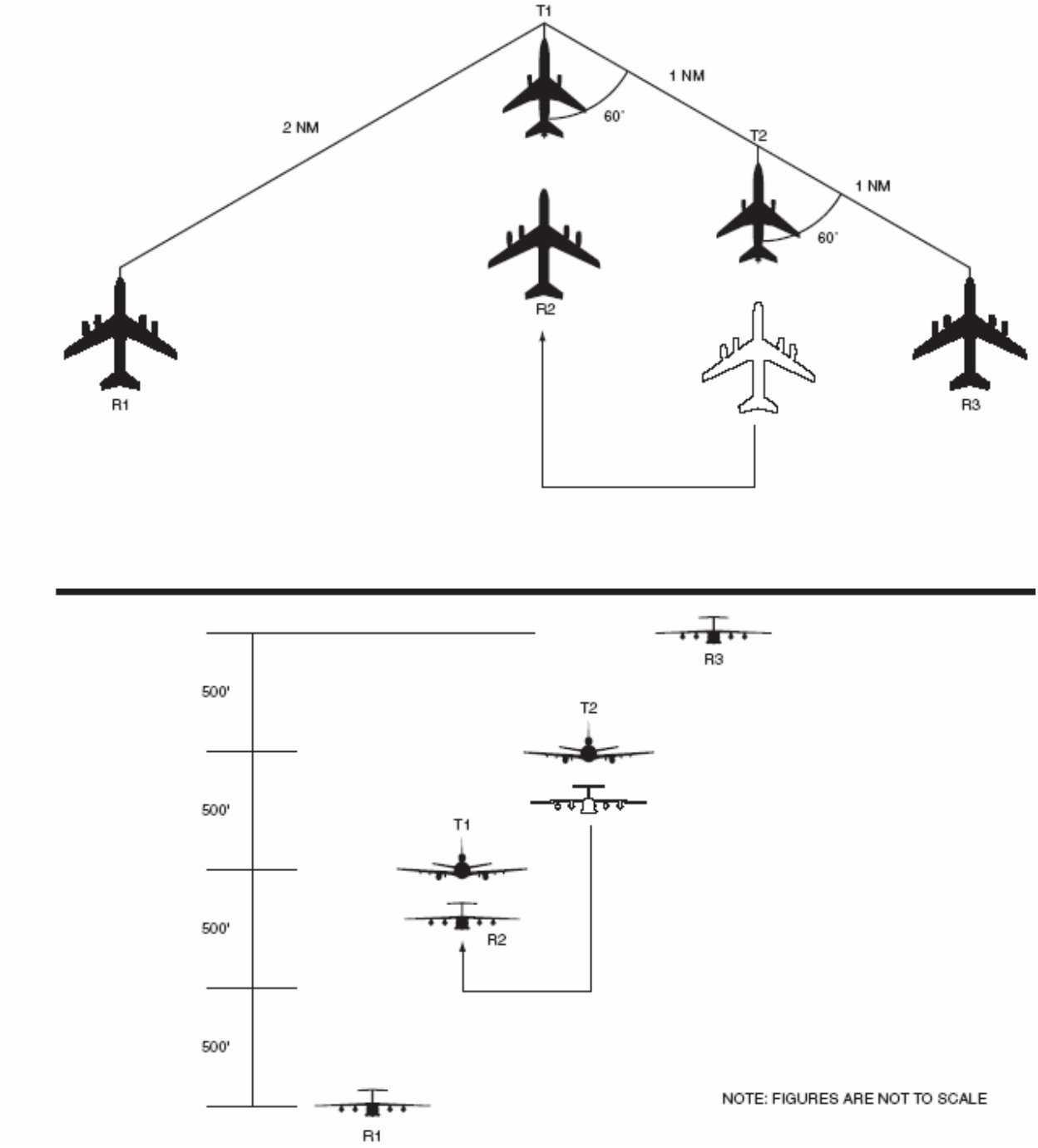


Figure 2E-5. Post AAR Procedures (3 Receivers on 2 Tankers)

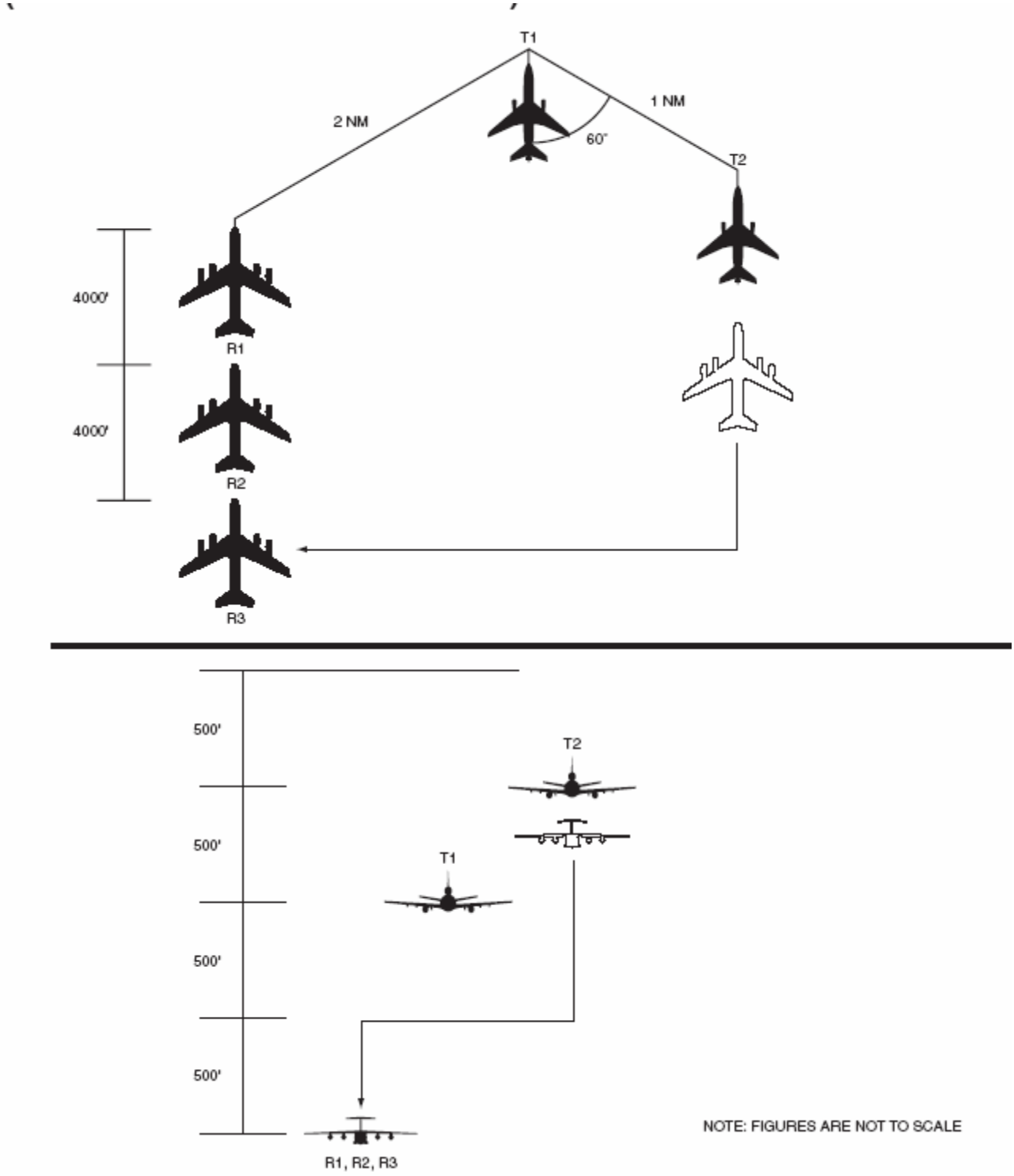


Figure 2E-6. AAR Procedures (X Receivers on X Tankers)

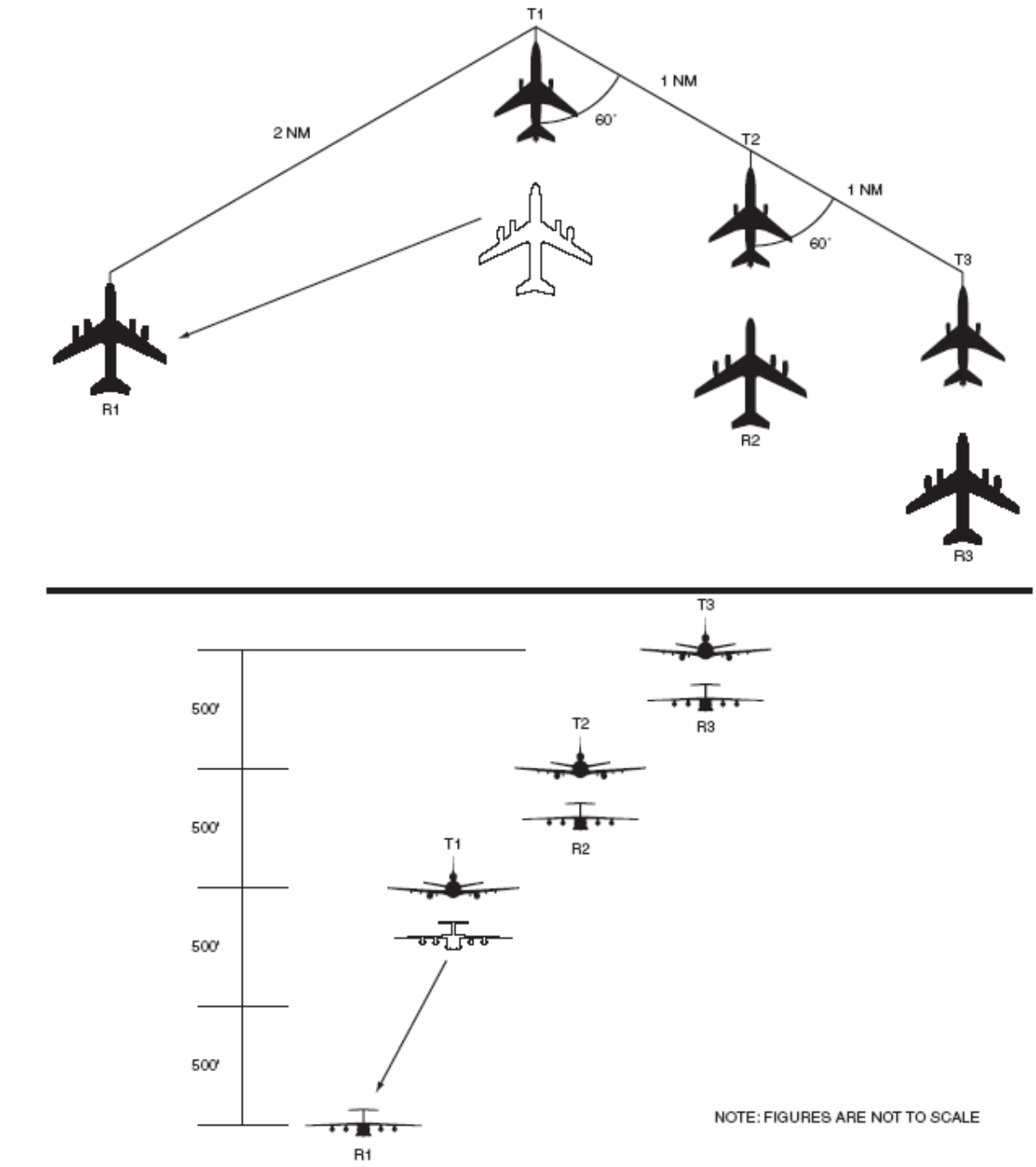


Figure 2E-7. Post AAR Procedures (X Receivers on X Tankers)

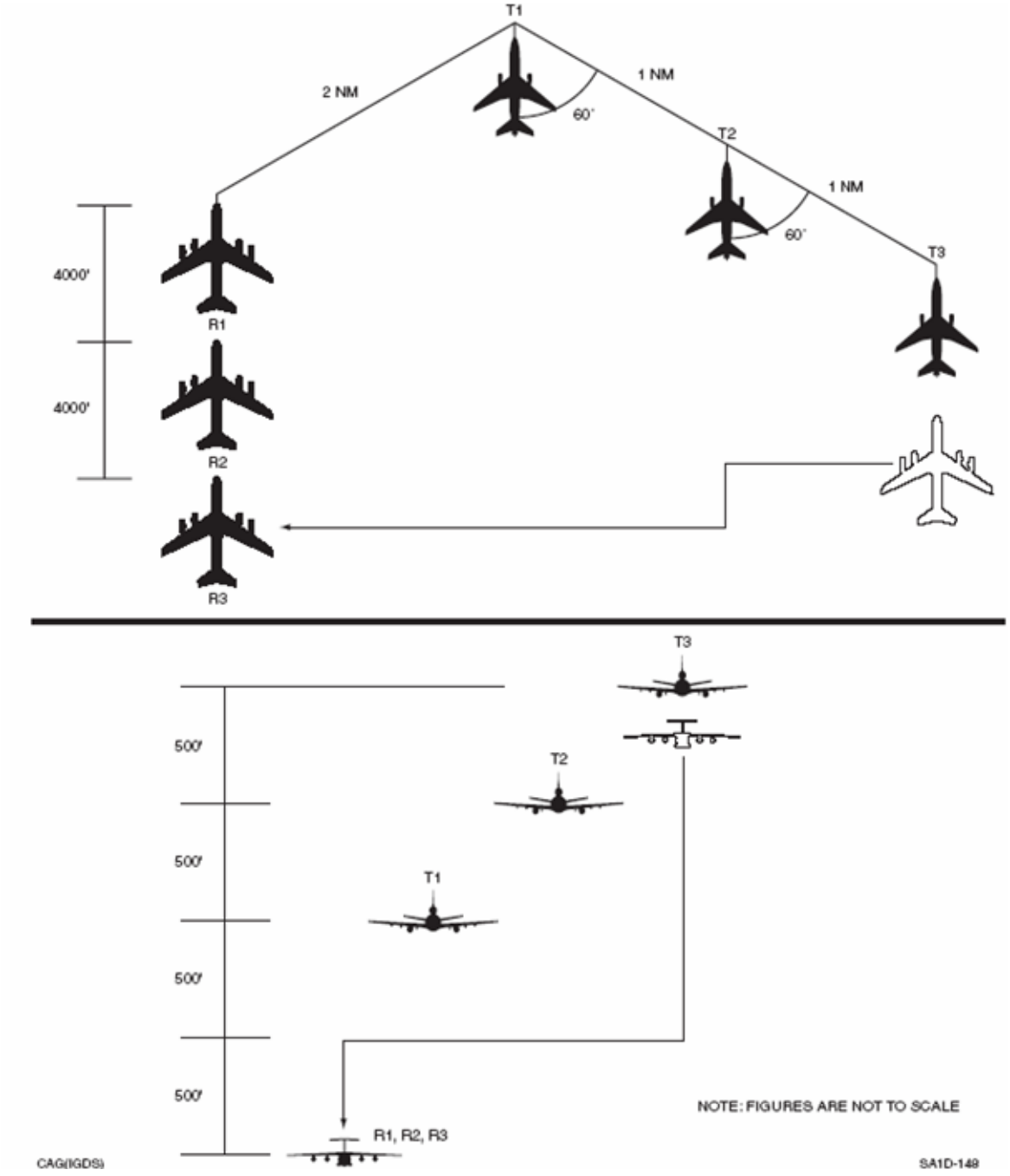
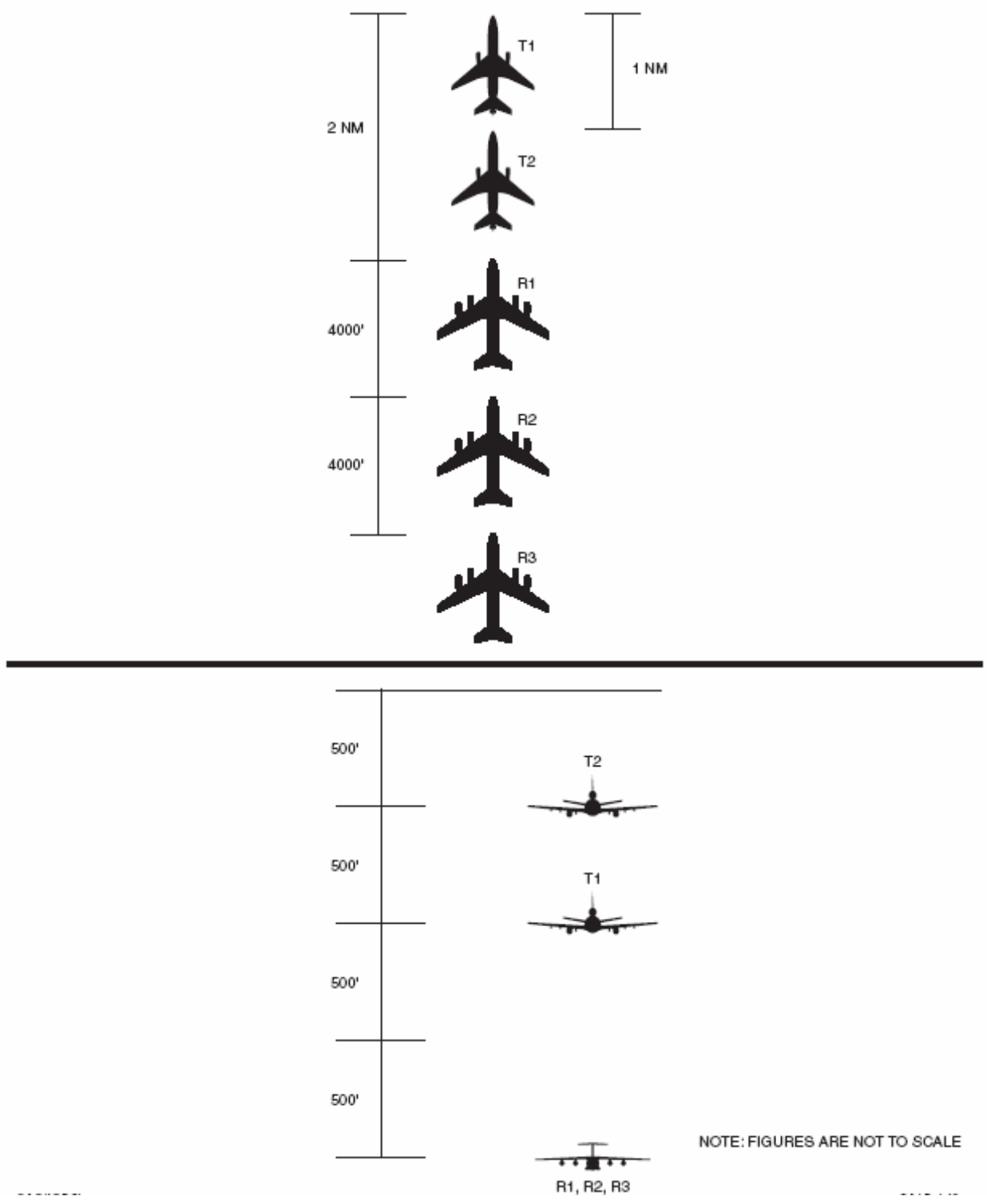


Figure 2E-8. Post AAR Turns at End of Track



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PART 2 - ANNEX 2F

Quick Flow Procedures

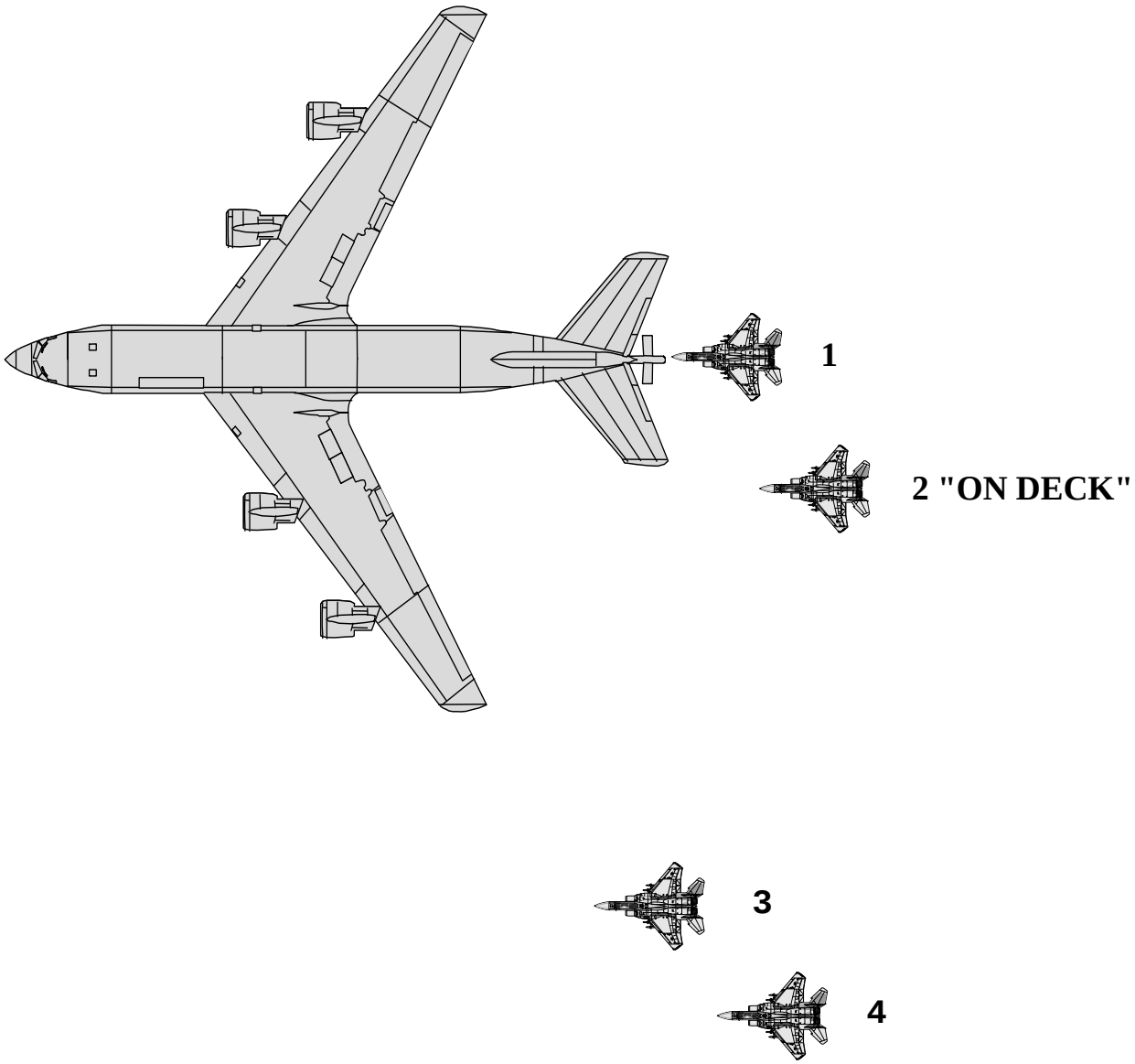
201F Quick Flow Procedure (QF) (Boom Only)

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 be employed only 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. Left 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 astern position. Remaining aircraft will proceed to the left 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 2F-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 right wing. The second receiver moves from the “On-Deck Position” to the astern and contact position. If three or more receivers are part of the fighter formation, the third receiver moves to the “On Deck” position. The left to right 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 right wing for additional AAR. If further refuelling is required, reverse the above procedures with a right to left flow. The second receiver can assume a right "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.

Figure 2F-1. Quickflow Air Refuelling



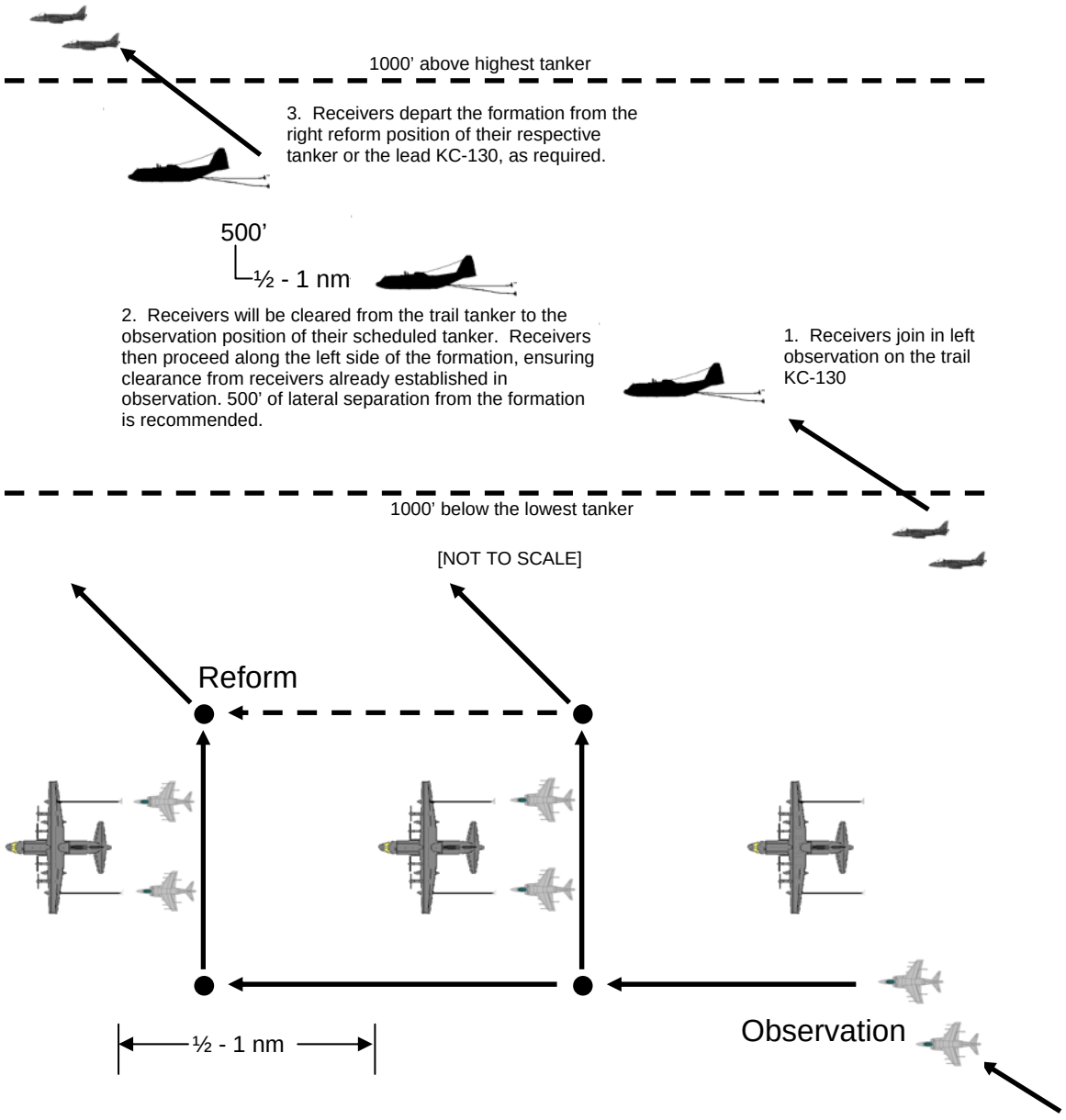
PART 2 - ANNEX 2G

KC-130 AAR Formation Procedures

201G Introduction. The USMC typically employs multiple tankers in a trail formation. This formation is similar to the cell formation commonly used by other tanker aircraft; however, tankers are stepped down vice stepped up and longitudinal separation between tankers may be as little as ½ nm. The stepped down formation and reduced separation together permit the Refuelling Area Commander (RAC), located in the last tanker, to monitor and control all refuelling operations. The RAC directs all receiver movement around the tanker formation. This formation is routinely used during multi-tanker operations on a static orbit and may also be used during force extension operations.

202G Multi-Tanker Rendezvous Procedures. The RVs employed by USMC KC-130s are the same as those for other tanker formations. RVs Alpha or Echo are used during static-orbit operations whilst, during force extension operations, the RV-Delta (Point Parallel) is the most common RV.

Figure 2G-1. USMC KC-130 Formation



203G Multi-Tanker Formation Procedures

a. Receiver Join. Receivers joining a multi-tanker formation are to join in the left observation position on the last tanker in the formation. Upon completion of the join, the receiver cruise formation is echelon in the observation position. The tankers remain in the trail formation for all phases of refuelling.

(1) Receiver Tanker Assignment. When appropriate, receivers will be cleared by the RAC to join their assigned tanker in the observation position. Receivers should anticipate receiving this clearance prior to stabilizing on the trail tanker.

(2) Receiver Joining Assigned Tanker. Once cleared, receivers move along the left side of the tanker formation to the observation position of their assigned tanker. During this manoeuvre, receivers shall exercise caution and remain clear of other receivers already established in an observation position. A lateral separation of 500 ft from the tanker formation is recommended during this procedure.

b. Receiver Refuelling Flow

(1) Astern Position. Once receivers are established in the observation position, the RAC will clear them to the astern position on the appropriate hose. Receivers should anticipate being directed to the right hose first, if available.

(a) Normally, receivers will not be directed behind an aircraft already in contact with a refuelling hose.

(b) Aircraft that are complete with refuelling on the left hose will be directed to disconnect and remain in the contact position until the receiver in the right hose has disconnected.

(2) Clearance to Contact. Once established in the astern position, receivers will be cleared to contact.

(3) Reform Position. Once receivers are refuelling complete, they will be directed to disconnect and manoeuvre to the reform position to the right of their respective tanker. With clearance from the RAC, the receiver flight lead may reform his entire flight in the reform position on the lead tanker. Receiver aircraft are to exercise caution and remain clear of other receivers already established in a reform position when manoeuvring along the right side of the tanker formation.

(4) Leaving. When cleared to leave, receiver aircraft depart the tanker formation either level or climbing.

204G Communication Procedures. The terminology used during RT-controlled evolutions is standard. Receivers should be aware that the RAC, vice individual aircraft commanders, controls all receivers in the formation. During evolutions employing min-com or radio silent procedures, observers located in the paratroop doors of the KC-130 control receiver movement via aldis-lamp signals per Part 2 Chapter 5 Figure 5C-2.

205G Procedures During IMC. The stepped-down formation employed by the USMC poses a unique problem when receiver aircraft experience a “loss of visual contact”. In Part 1 Chapter 4, receivers in contact that lose sight of the tanker are instructed to initially descend 500 ft and reduce airspeed by 10 KIAS. Executing this procedure with a stepped-down formation creates a conflict between the receiver and the trailing tanker. To mitigate this hazard, the KC-130 formation should increase nose-to-tail separation to at least 1 nm. Additionally, receivers in contact that lose visual contact should climb 500 ft, vice descend 500 ft.

PART 2 – FIXED WING PROCEDURES

CHAPTER 3

Accompanied Let Down Procedures

301 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.

302 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.

303 Considerations. In addition to the criteria at para 302 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.

304 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.

NOTE

Consider progressive speed reduction to be at 250 KIAS by 10,000 ft (for FAA and Canadian Regs).

PART 2 – FIXED WING PROCEDURES

CHAPTER 4

Safety Procedures

401 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.

402 Rendezvous

a. Vertical Separation. 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.

b. Receiver Joining Tanker from Below. In some scenarios, prior to the start of the RV procedure, the receiver may be cruising above the level of the tanker. Nevertheless, unless otherwise directed, and to achieve a commonality of practice, the receiver should descend and establish itself at least 1000 ft 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.

c. Ultra Low Level AAR. 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 an RV is planned with a non-standard vertical separation, this should be specified in the tasking message, SPINS or at the briefing stage.

403 Joining - Safety Considerations

a. Probe and Drogue Refuelling

(1) To complete a safe join, the receiver should achieve a stable formation position (ie zero rate of closure) on the tanker before manoeuvring to the astern 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.

(2) 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 behind the tanker should not be attempted.

(3) Accordingly, all joins should be made to a loose echelon position in the observation position; thus errors in line and overtake speed can be corrected clear of the tanker.

b. Boom. Although receiver may join directly behind the boom, the considerations described in para 403a(1) applies equally to receivers joining a boom equipped tanker.

404 Refuelling

a. Standardization. To achieve safe refuelling the standardised radio terms in Part 2 Chapter 5 Annex 5B are to be used. A procedure for light signals to achieve safe radio silent AAR is at Part 2 Chapter 5 Annex 5C. 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 at Part 5.

b. Probe and Drogue AAR Over Land. AAR involves a small risk of parts of the tanker's/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 Hoses – Inadvertent Separation. If the tanker has not trailed refuelling hoses before receiver join, the tanker will direct receivers to remain clear of the below and aft position of the refuelling hoses whilst the hoses are trailed. The majority of inadvertent hose departures (separation from the aircraft) from tankers occur during trailing or rewinding of refuelling hoses.

d. 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:

(1) Are not to be moved during aircraft attitude changes.

(2) Should only be wound during turns in cases of operational necessity.

(3) May be trailed and wound in a steady climb or descent.

(4) May be trailed during a steady turn.

e. 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, unless the tanker approves simultaneous receiver contact, the following guidelines should be adopted:

(1) Simultaneous AAR. For simultaneous AAR, one receiver is to be in contact (with fuel flowing if wet) before the second receiver is cleared for contact.

(2) Simultaneous Disconnect. Normally, receivers will be cleared to disconnect simultaneously.

(3) Individual Receiver Disconnect. Receivers may be cleared to disconnect individually if disparate fuel transfers exist. An individual disconnect may disturb the hose for the receiver remaining in contact; therefore, during receiver CONVEX, tankers may only order individual disconnects with the approval of the receiver leader or in the event of a spokes contact.

(4) Contacts/Disconnects – Straight and Level. 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.

(5) Prohibited Contacts/Disconnects. Contacts/disconnects are not to be permitted during tanker attitude changes.

(6) Contacts/Disconnects – CONVEX. Some nations require that, during receiver CONVEX, tankers will order all contacts/disconnects in straight and level flight unless the receiver supervisory pilot requests otherwise for training purposes.

(7) Contacts/Disconnects – Night. By night, extra caution is needed to guard against

disorientation. Therefore, with due regard to prevailing visual conditions, the tanker may permit contacts and disconnects at night whilst in a steady turn/climb/descent. Where a receiver pilot subsequently elects to make contact or disconnect only in straight and level flight, they should, if possible, inform the tanker. Some nations will not permit night contacts or disconnects in a steady turn/climb/descent unless operationally necessary.

f. Damaged Spokes. A receiver pilot damaging the spokes 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 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). When conducting multi-point simultaneous AAR, the tanker 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 - Tanker. Damaged spokes will impair the structural integrity of the drogue so it is not to be used for further AAR. Before, a multi-point tanker continues AAR with its serviceable hose, tanker crews will follow tanker-specific procedures for the damaged hose.

(2) Subsequent Actions – Receiver. When spokes damage occurs, the drogue may shed debris; and 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 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 of the preferred course of action. The tanker 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 are to be considered. The final decision on whether to continue or divert the formation (or part of it) rests with the tanker.

(c) Training/CONVEX 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.

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

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

(1) If difficulty is experienced in disconnecting, the receiver pilot is to maintain a stabilized in-contact position; the tanker is to be informed so that the receiver on the other hose (if any) can be order to disconnect.

(2) When ordered by the tanker to disconnect, the receiver with the jammed nozzle is to withdraw down the natural line of the hose; throttles may have to be fully retarded to achieve separation.

(3) 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.

(4) The affected hose is not to be used for further AAR.

(5) The receiver pilot is to proceed in accordance with the instructions given in his aircraft manual.

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

WARNING

The receiver will stabilize with zero rate of closure in the astern position. If the receiver fails to attain stabilized position or it becomes apparent that a closure underrun will occur, breakaway procedures will be initiated. Failure to do so can result in a mid-air collision. Furthermore, the majority of damaged booms result from receivers closing too fast and exceeding the AAR envelope (inner limit). It is critical for receivers to stabilize with a zero rate of closure prior to the boom/AAR systems operator clearing the receiver to contact.

CAUTION

- **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.**
- **Disconnect or breakaway procedures will be initiated any time the receiver becomes erratic within the AAR envelope or damage to either aircraft appears imminent.**
- **Receiver pilots should not attempt to push the boom in during boom telescope failure**

NOTE

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

405 Options to Reduce the Likelihood of Employing Loss of Visual Contact (Lost Wingman) Procedures

a. Maximum Number of Receivers – VMC. In day VMC, the number of receivers assigned to a tanker will be limited only by boom or hose cycle time, receiver bingo fuel requirements, or the tanker's offload capability.

b. Avoidance of Weather. If a tanker or receiver identifies flight conditions ahead of the formation (visually, using radar, reports from aircraft ahead or from ATC) that could result in one

or more formation members losing visual contact with other formation members, the tanker should avoid the area using navigational turns and co-ordination with ATC.

c. Formation Entering Weather. In the event that the formation enters an area of reduced visibility, the tanker should endeavour to maintain straight and level flight. If turns are necessary, they should be made using 10º AOB and called over the radio. In addition, the tanker will state the approximate roll out heading.

Tanker call: "HAPPY 25, turning right, rollout heading 250."

Tanker executes turn.

d. Formation Management

(1) Actions to Mitigate Risk of Loss of Visual Contact (Lost Wingman). When in-flight conditions are likely to impede safe operations of large formations on the wing of the tanker, the tanker and/or receiver formation lead should consider re-distributing receivers around the tanker. Such actions as restricting the number of receivers on a wing or moving some or all receivers into radar trail (provided that the lead receiver in each element is suitably equipped with a serviceable radar) should be considered.

(2) Large Receiver Formations. Nations have different definitions of a "standard formation". For instance, within the UK, a formation:

> "is considered as a single unit for separation purposes provided that the formation elements are contained within one mile laterally and longitudinally and are at the same level."

This contrasts with FAA regulations where:

> "a "standard formation" is one in which a proximity of no more than 1 mile laterally or longitudinally and within 100 ft vertically from the flight leader is maintained by each wingman."

In all cases, the formation leader is responsible for separation between units comprising the formation. This is known as MARSA – Military Accepts Responsibility for Separation of Aircraft. Also, whenever a tanker/receiver formation transits a nation's airspace, the tanker (as the formation lead) must be aware of the formation regulations that govern that airspace and brief the receivers accordingly. Importantly, if the formation occupies or plans to occupy a volume of airspace (ie. vertically, horizontally or longitudinally) in excess of that defined by the Aeronautical Information Publications appropriate to the airspace, it is imperative that approval for using the additional airspace is obtained from the authority responsible for controlling the airspace.

(a) Formation Size – Night/IMC. During night and/or IMC, the tanker/receiver formation lead should limit the size of the formation operating on the tanker. In such situations, normally, no more than 12 receivers will be in formation with a single tanker, with no more than 3 receivers in close formation on each wing (see para 405d(2)(b)).

(b) Receivers on Tanker's Wing – Night/IMC. Normally, during night and/or IMC, the tanker should restrict the number of receivers in close formation with the tanker to a maximum of 6. These aircraft can be distributed with a maximum of 3 on each wing. Importantly, when a receiver is positioned astern of, or in contact with, a fuel transfer system, a wing position must be left vacant for each such receiver to accommodate the receiver(s) when refuelling is complete.

(c) Receivers in Trail. When the wing positions are full (to include those positions reserved for receivers astern of, or in contact with, the fuel delivery system), other aircraft/elements should be directed to assume a trail position. The first element should be 1 to 1½ nm behind the tanker and stepped down 1000 ft below their tanker's altitude. The second trail element should be 1 to 1½ nm behind the first element and stepped down 1000 ft below the first element's altitude, but see para 405d(2) for ATC considerations.

(d) Large Formation – Receiver Distribution. During pre-mission briefing for large formations, the tanker and formation lead should agree on a distribution plan for the receivers around the tanker in the event of night/IMC. Whilst numerous factors will help determine the most appropriate plan for a specific mission, Figure 1-1 illustrates one possible formation suitable for both boom and centreline hose receivers. Figure 1-2 offers a suggested formation for twin probe and drogue operations. In both cases, receivers are shown in the astern position; normally when not refuelling, these receivers will be positioned on the tanker's wing.

(e) Receivers – Tanker Formations. For formations of tankers, only the last tanker will have receivers in trail.

(3) Additional Receivers – Joining (Night/IMC). In night and/or /IMC conditions, additional receivers should not be cleared to join the tanker when 3 receivers are already in both the observation and reform positions. Where less than 3 receivers are on a wing, additional receivers may be cleared to join that wing so long as they:

(a) Remain visual with the tanker and all receivers during the join.

(b) Join on the outside of the formation already on the wing.

(c) The total number of receivers on a wing does not exceed 3.

(4) Tanker Management of Receivers. A large formation of up to 12 receivers against one tanker requires extensive coordination between the tanker and receiver formation lead. This is because there will be almost continuous receiver manoeuvring as receiver elements completing refuelling move aft and trailing elements move forward to the tanker's wing. To expedite this movement, the tanker should use the following procedures when directing the receiver aircraft.

(a) Tanker. The tanker should be in straight and level flight.

(b) Tanker Manoeuvring for Weather. For tanker actions when approaching weather see paras 405b and 405c.

(c) Manoeuvring of Receiver Elements

(i) Element Moving Aft. The receiver element moving to trail from the observation or reform position is to reposition first by moving aft and then down 500 ft.

(ii) Elements Moving Forward. The trailing elements are not to move forward until lateral and vertical separation with the tanker and other receiver elements is confirmed using visual, radar, TCAS, A/A TACAN or other means.

(iii) Elements Leaving In-Trail Altitude. Elements moving forward may only leave their in-trail altitude when:

(A) Visual with both the tanker and any receiver elements between them and the tanker and able to remain clear of such elements when manoeuvring.

OR

(B) Each in-trail element has confirmed and deconflicted its longitudinal and vertical position with respect to the tanker and other receiver elements using visual, radar, TCAS, A/A TACAN or other means.

(iv) Element Closest to Tanker. Once paras 405d(4)(c)(ii) and (iii) are satisfied, the element closest to the tanker may close to radar lock-on limits, or visual limits (as stipulated in Part 2, Chapter 1) if radar is not working/fitted. Once visual with the tanker, the tanker may clear the element to close to the wing and/or boom as appropriate.

(v) Subsequent Trailing Element. Once the element closest to the tanker has vacated its in-trail position, the next trailing element will move forward to 1nm to 1½ nm in trail of the tanker. Only when it has fulfilled the criteria paras 405d(4)(c)(ii) and (iii), will the element climb to 1000 ft below the tanker's altitude.

(vi) Descent of Element Moving Aft. The receiver element moving to the trail position will continue to move aft to the last in-trail position at 500 ft below the tanker. Once the first and second elements have moved forward and are confirmed to be ahead of the element moving aft using visual, radar, TCAS, A/A TACAN or other means, the latter may descend to the appropriate in-trail altitude (1000 ft below the tanker if there is only one trail element or 2000 ft below the tanker if there are two trail elements).

(d) Tanker to Tanker RVs. During tanker-to-tanker RVs, the tanker escorting the fighters should be at the lower altitude. If the escorting tanker is at the higher altitude, additional altitude separation between formations will be required.

Figure 1-1. Night/IMC Formation Suitable for Both Boom and Centreline Hose Receivers

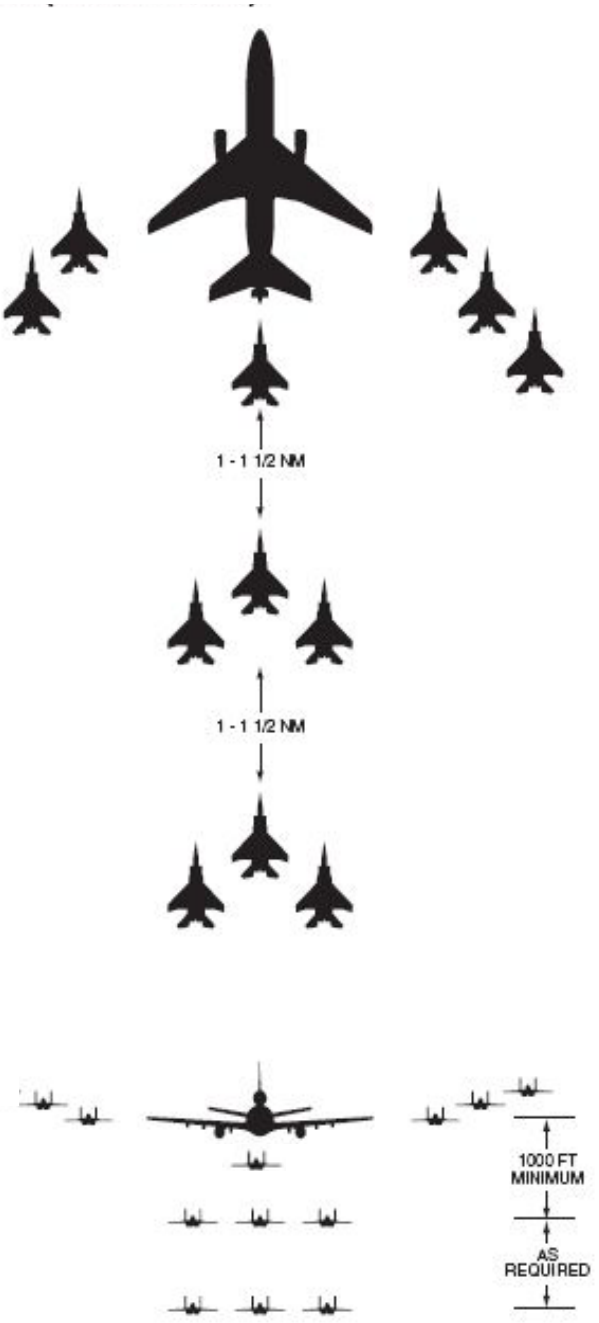
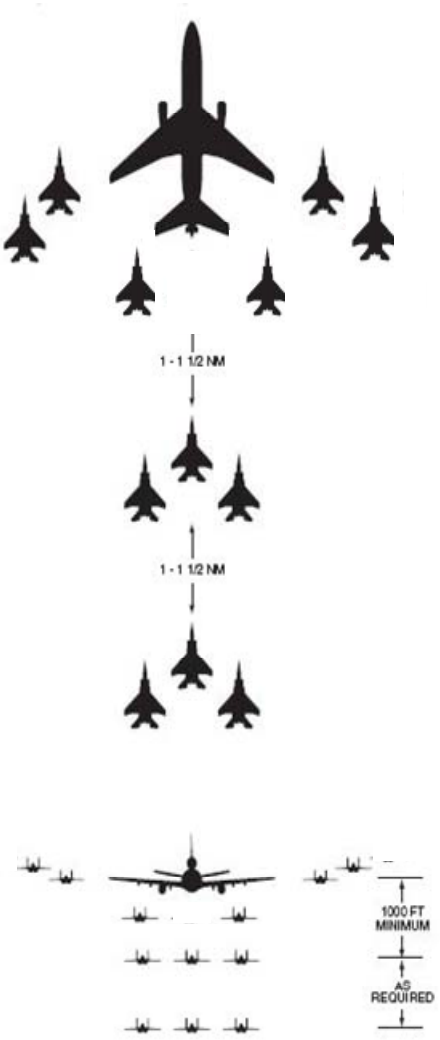
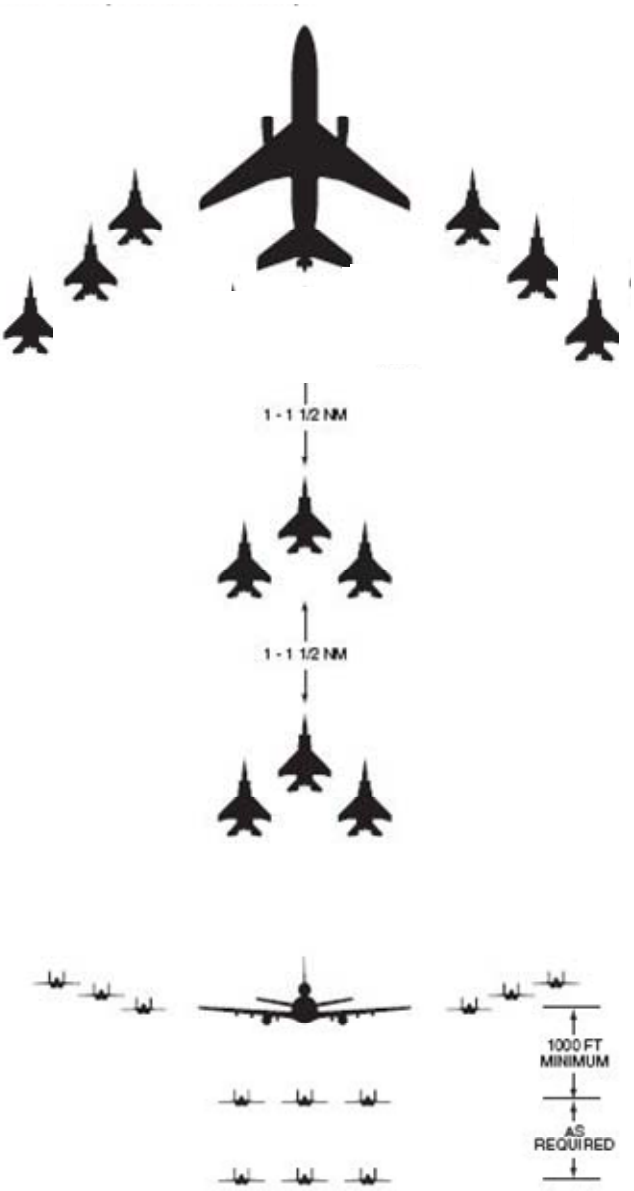


Figure 1-2. Night/IMC Formations Suitable for Dual Probe and Drogue Receivers



or



406 Loss of Visual Contact (Lost Wingman) – Receivers on Tanker Wing in Single Tanker Formation

a. Immediate Actions upon Loss of Visual Contact. Any aircraft in close formation that loses visual contact with the tanker or the receiver upon which it is formating is to take immediate action to achieve safe separation from the tanker, and if necessary, other receivers. This will be achieved by executing Loss of Visual Contact (Lost Wingman) Procedures whilst simultaneously transitioning to flight instruments. The receiver is to call:

- '(Callsign) loss of visual contact

or

- '(Callsign) lost wingman'.

b. Specific Tanker and Receiver Actions

TANKER ACTIONS		
(1) Assume Steady Heading	**(2) Subsequent R/T Calls**	**(3) Navigation Aids**
If turning, the tanker is to call: **a.** • '(Callsign) Rolling out heading XXX°' Thereafter, the tanker is to roll wings level.	The tanker is to transmit the following on the AAR frequency: • Its heading (stating °T or °M). (If rolling out of a turn, the tanker will give the heading it intends to maintain after rollout.) • Its FL/altitude/height. • Its speed. • The receiver A/A TACAN channel.	The tanker will: • Select the tanker A/A TACAN channel. • Attempt to establish receiver position(s) by all available means (Radar, TCAS, ATC, DATA LINK etc).

RECEIVER ACTIONS		
Receivers(s) Astern or Contact. Receiver(s) astern or in contact losing visual contact with the tanker will execute the procedures described in para 409.		
Receivers on Tanker's Wing. Upon losing sight of the element upon which it is formating, or if unable to maintain formation due to spatial disorientation (SD), the receiver will simultaneously execute the applicable loss of visual contact (lost wingman) procedures described below while transitioning to instruments.		
Tanker Straight and Level (Figure 1-3)		
Receiver Closest to Tanker Wing (No 1)	**Receiver on Wing of No 1 (No 2)**	**Receiver on Wing of No 2 (No 3)**
	• Attempt to remain in formation with the No 1.	• Attempt to remain in formation with the No 2.
	If visual contact cannot be maintained, the second in echelon will:	If visual contact cannot be maintained, the third in echelon will:
• Turn away from the tanker's heading using 15° AOB for 15 sec (15:15).	• Turn away from the tanker's heading using 30° AOB for 30 sec (30:30).	• Turn away from the tanker's heading using 45° AOB for 30 sec (45:30).
• Resume the tanker's heading to parallel track	• Resume the tanker's heading to parallel track.	• Resume the tanker's heading to parallel track.
Tanker Turning - Receiver on Outside of Turn (Figure 1-4)		
Receiver Closest to Tanker Wing (No 1)	**Receiver on Wing of No 1 (No 2)**	**Receiver on Wing of No 2 (No 3)**
	• Attempt to remain in formation with the No 1.	• Attempt to remain in formation with the No 2.
	If visual contact cannot be maintained, the second in echelon will:	If visual contact cannot be maintained, the third in echelon will:
• Turn away from the tanker by rolling through wings level to achieve 15° AOB in the opposite direction.	• Turn away from the tanker by rolling through wings level to achieve 30° AOB in the opposite direction.	• Turn away from the tanker by rolling through wings level to achieve 45° AOB in the opposite direction.
• Maintains this turn for 15 sec (15:15).	• Maintain this turn for 30 sec (30:30).	• Maintain this turn for 30 sec (45:30).
• Resume the tanker's heading to parallel track.		
Tanker Turning - Receiver on Inside of Turn (Figure 1-5)		
Receiver Closest to Tanker Wing (No 1)	**Receiver on Wing of No 1 (No 2)**	**Receiver on Wing of No 2 (No 3)**
	• Attempt to remain in formation with the No 1.	• Attempt to remain in formation with the No 2.
	If visual contact cannot be maintained, the second in echelon will:	If visual contact cannot be maintained, the third in echelon will:
• Momentarily reduce power to ensure nose-tail separation.		
• Roll into turn to achieve 15° AOB.	• Roll into turn to achieve 30° AOB.	• Roll into turn to achieve 45° AOB.
• Maintains this turn for 15 sec (15:15).	• Maintain this turn for 30 sec (30:30).	• Maintain this turn for 30 sec (45:30).
• Resume the tanker's heading to parallel track.		

Figure 1-3. Loss of Wingman – Tanker Straight and Level

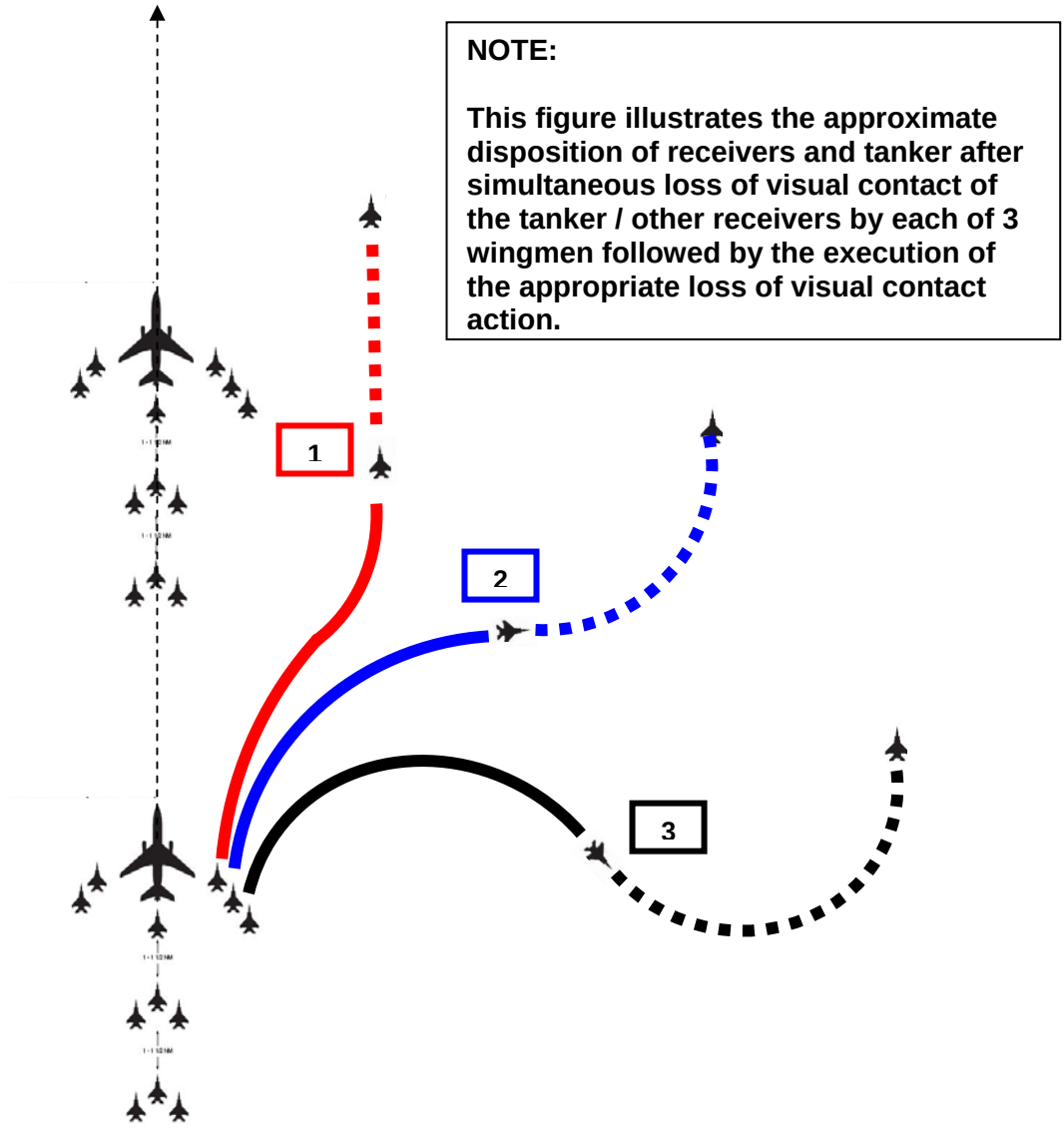
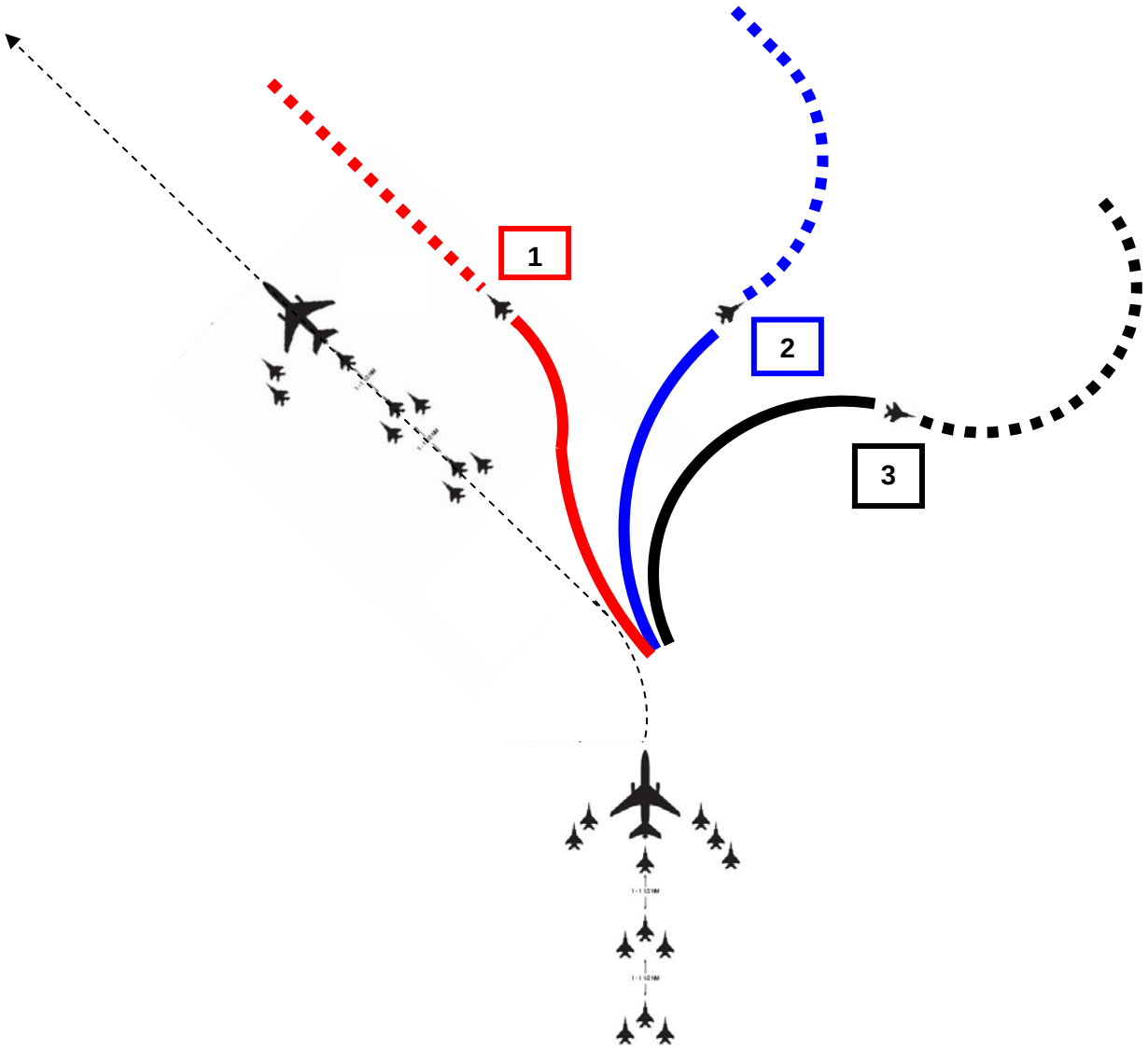


Figure 1-4. Loss of Wingman – Receivers on Outside of Turn



NOTE:

This figure illustrates the approximate disposition of receivers and tanker after simultaneous loss of visual contact of the tanker / other receivers by each of 3 wingmen followed by the execution of the appropriate loss of visual contact action. The tanker has rolled wings level on the first call of:

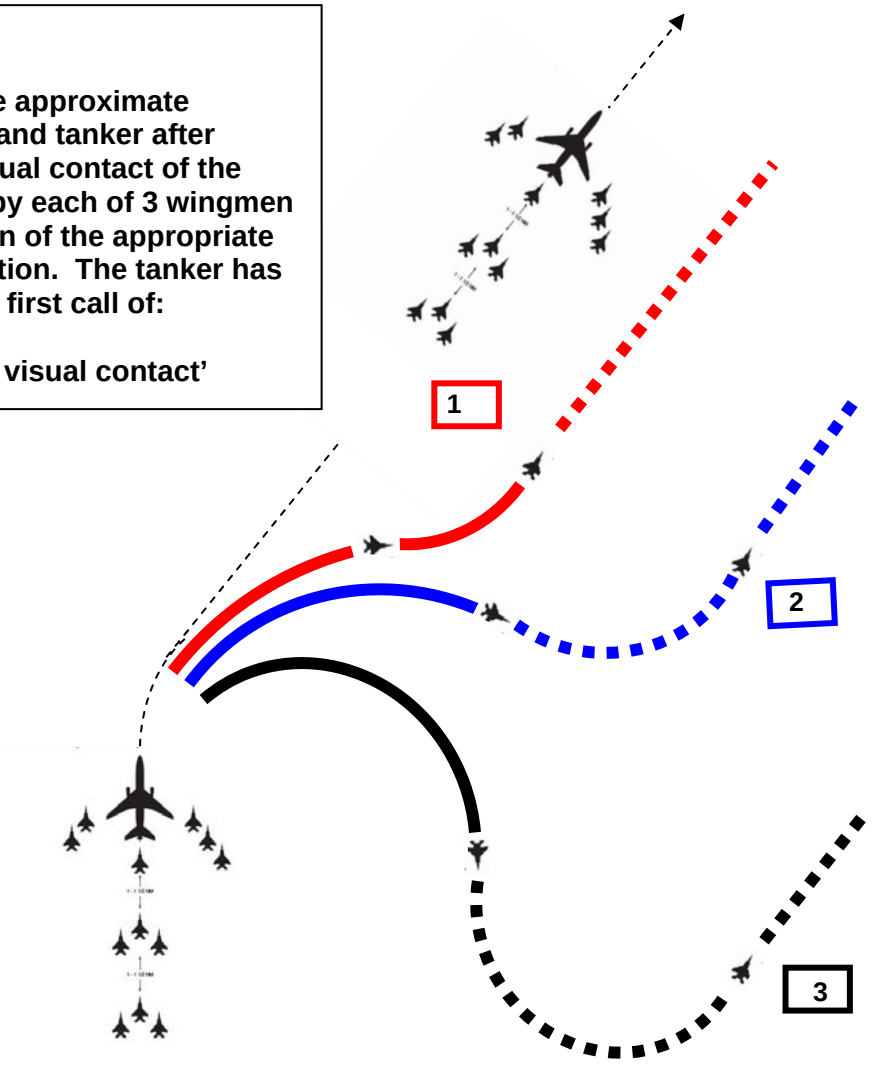
'(Callsign) loss of visual contact'.

Figure 1-5. Loss of Wingman – Receivers on Inside of Turn

NOTE:

This figure illustrates the approximate disposition of receivers and tanker after simultaneous loss of visual contact of the tanker / other receivers by each of 3 wingmen followed by the execution of the appropriate loss of visual contact action. The tanker has rolled wings level on the first call of:

'(Callsign) loss of visual contact'



c. Tanker Failure to Acknowledge. In either turning case, if the tanker does not acknowledge the loss of visual contact call, the receiver is also to achieve an immediate vertical separation of 500 ft below tanker FL/altitude/height.

d. Tanker Climbing/Descending - Receivers. In addition to the actions described in paras 406b above, when the tanker is climbing or descending, and where proximity to terrain is not a factor, the receiver(s) should level off whilst the tanker continues the climb/descent to the ATC cleared FL/altitude/height. The receiver must inform ATC of its level off FL/altitude/height either directly or through the tanker (see para 406f).

e. Lost Wingman with Fuel Transfer Complete. When a receiver executes Loss of Visual Contact (Lost Wingman) procedures and fuel transfer is complete, it may decide to leave the tanker rather than execute a rejoin. In such circumstances the procedures outlined in Part 2, Chapter 1, para 110 should be modified as appropriate to the situation.

f. Informing ATC

(1) Receiver. If the receiver executing loss of visual contact (lost wingman) procedure is working the ATC frequency, they are to inform ATC about their actions and seek an ATC service to rejoin the tanker/other receivers or depart.

(2) Tanker. Where the receiver is not working the ATC frequency, the tanker is to relay the necessary safety information detailed in para 406 f (1) above.

g. Rejoin

(1) Vertical Separation. When initial lateral separation is achieved, the receiver(s) is/are to achieve a vertical separation.

(2) Longitudinal Separation. Separated receiver(s) is/are to use radar/A/A TACAN/TCAS or other means to position 1 nm behind the last in-trail receiver element, so long as this does not conflict with the position of the next tanker in trail.

(3) Parameters to Rejoin Formation. Receivers will only attempt to rejoin the formation when they can achieve the parameters described in Part 2 Chapter 1, para 102d.

NOTES

- **National Annexes may stipulate different criteria from the above procedure (e.g. 20:20).**
- **If mission requirements dictate, tanker and receiver crews must agree differences to above procedures prior to flight.**

407 Loss of Visual Contact (Lost Wingman) - Multi-Tanker Formation. Depending on national policy, tankers will fly in both close and separated formation (e.g. echelon or trail). In the latter, the tankers will use a combination of visual positioning, electronic aids, radio transmissions and vertical separation to maintain the relative position between formation members.

a. Loss of Visual Contact – Tankers in Close Formation. For those nations that permit tankers to fly in close formation (see Figure 1-6), when visual contact is lost the Loss of Visual Contact Procedures ("Lost Wingman Procedures") described in para 406 is to be actioned, substituting tanker where reference is made to receiver(s).

Figure 1-6 – Tanker Close Formation

b. Loss of both Visual Contact and Situational Awareness – Separated Formation. Normally, in addition to visual monitoring, tankers in separated formation, both swept or trail, have many ways of maintaining situational awareness between all participating tankers. This includes air-to-air TACAN, weather radar, TCAS, radios, and vertical separation. If both visual contact and situational awareness are lost, the following procedures should be employed:

(1) Immediate Action by Tanker Losing Situational Awareness. The tanker losing both visual and situational awareness will transmit:

(a) "Callsign, Lost Contact"

(2) Achieving Vertical Separation. The tanker losing both visual and situational awareness will coordinate with other tankers in the formation to ensure that vertical separation is achieved.

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.

408 Breakaway. Whenever a 'Breakaway' call is made, the receiver and tanker will perform the following actions:

TANKER ACTIONS		
Initial Actions. The tanker is to maintain heading or established AOB and assigned FL/altitude/height and		
Subsequent Actions.		
Drogue Tankers	**Boom/BDA**	**Post Breakaway – All Tankers**
• Some nation's tankers will accelerate up to the drogue limiting speed for probe and drogue AAR operations	• The tanker is to increase power and accelerate	• To regroup the formation, when the situation permits, consider rolling wings level • Calling the roll-out heading on R/T
	• If the Boom Operator calls "clear to climb", the tanker will begin a slow climb maintaining established AOB. It is imperative that the airspeed is not allowed to decrease below that indicated at the start of climb	

RECEIVER ACTIONS		
(1) Immediately disconnect. **(2)** Move back and go to a safe position clear of the tanker and the refuelling equipment.		
Probe and Drogue – Wing	**Probe and Drogue – Centreline**	**Boom**
For probe and drogue tankers, the safe position is clear of the area directly behind the tanker and outboard of the tanker's wing.		
• **Left Wing**. The receiver on the left hose moves to the left wing	• **Centreline**. A receiver on the centreline hose should move outboard to whichever wing has room to accommodate the aircraft.	• The receiver will commence an immediate descent to achieve vertical separation
• **Right Wing**. The receiver on the right hose moving to the right wing		• If possible, drop aft of the tanker until the entire tanker is in sight
		• In the event that the receiver loses visual contact with the tanker during the breakaway: • **Fighters:** Descend at least 500 ft below the tanker • **Heavy Receivers:** Descend at least 1000 ft below the tanker
Breakaway Terminated. Once the breakaway is terminated, the receiver may either arrange with the tanker for a further closure or to depart.		
SAFETY NOTES: **(1) Receivers waiting in echelon should remain in formation on the tanker.** **(2) Receivers waiting in echelon, as well as those executing a breakaway manoeuvre, are to exercise good lookout to prevent a receiver/receiver collision.**		

409 Loss of Visual Contact – Receiver(s) in Contact or Astern, or Astern Following a Breakaway

RECEIVER(S)
Immediate Receiver Actions upon Loss of Visual Contact Upon losing sight of the tanker, or if unable to maintain formation due to spatial disorientation (SD),a receiver(s) in contact or astern or following a breakaway will simultaneously: **(1) Immediately disconnect (if appropriate).** **(2) Execute the applicable loss of visual contact (lost wingman) procedures described below while transitioning to instruments.** **(3) Make a call of:** **• '(Callsign) loss of visual contact'** **(4) Slow down 10kts**

TANKER ACTIONS
Initial Actions. The tanker is to maintain heading or established AOB and assigned FL/altitude/height and

Subsequent Actions		
Drogue Tankers	**Boom/BDA**	**Post Breakaway – All Tankers**
• Some nation's tankers will accelerate up to the drogue limiting speed for probe and drogue AAR operations	• The tanker is to increase power and accelerate	• To regroup the formation, when the situation permits, consider rolling wings level and calling the roll-out heading on R/T
	• If the Boom Operator calls "clear to climb", the tanker will begin a slow climb maintaining established AOB. It is imperative that the airspeed is not allowed to decrease below that indicated at the start of climb	

SUBSEQUENT RECEIVER ACTIONS		
Tanker Straight and Level		
Wing Pod Receiver(s)	**Centreline Probe Receiver – Fighter and Heavy Receivers**	**Boom Receiver – Fighter & Heavy**
When one or two receivers on the wing pod(s) lose visual contact, they are to:	A centreline receiver is to:	A boom receiver is to:
• Perform Immediate Receiver Action as described above, plus • Hold tanker heading		
• Descend 500 ft/1000 ft (left/right receiver)	• Descend 500 ft or until visual with the tanker	• **Fighters:** Descend at least 500 ft below the tanker
		• **Heavy Receivers:** Descend at least 1000 ft below the tanker
• After 30 sec, resume normal airspeed		
• ***Wing Pod and Centreline Probe and Drogue****. Once visual with tanker, position to left or right of the tanker centreline either as directed by the tanker or where there is a space within the formation on the tanker's wings.* ***Do NOT remain directly behind the tanker as debris or the hose may fall from the tanker.***		

<table>
<tr><th colspan="5">SUBSEQUENT RECEIVER ACTIONS</th></tr>
<tr><th colspan="5">Tanker Turning</th></tr>
<tr><td colspan="5">• Perform Immediate Receiver Action as described above, plus</td></tr>
<tr><td>Wing Pod Receiver - Outside of Turn</td><td></td><td>Centreline Probe Receiver – Fighter and Heavy Receivers</td><td></td><td>Boom Receiver – Fighter & Heavy</td></tr>
<tr><td>When one or two receivers on the wing pod(s) lose visual contact, they are to:</td><td></td><td>A centreline receiver is to:</td><td></td><td>A boom receiver is to:</td></tr>
<tr><td>• Roll through wings level, to achieve 15° AOB in the opposite direction</td><td></td><td colspan="3">• Roll wings level</td></tr>
<tr><td>• Descend 500 ft/1000 ft (left/right receiver)</td><td></td><td>• Descend 500 ft or until visual with the tanker</td><td></td><td>• Fighters:
Descend at least 500 ft below the tanker</td></tr>
<tr><td></td><td></td><td></td><td></td><td>• Heavy Receivers:
Descend at least 1000 ft below the tanker</td></tr>
<tr><td>• Establish a heading 15° away from the tanker’s heading</td><td></td><td colspan="3" rowspan="2"></td></tr>
<tr><td>• Hold new heading for 15 sec</td><td></td></tr>
<tr><td>• Resume the tanker’s heading to parallel track (15:15:15)</td><td></td><td colspan="3">• When stable, turn on to tanker’s heading</td></tr>
<tr><td colspan="5">• After 30 sec, resume normal airspeed</td></tr>
<tr><td>Wing Pod Receiver - Inside of Turn</td><td></td><td colspan="3" rowspan="8"></td></tr>
<tr><td>• Call “loss of visual contact”</td><td></td></tr>
<tr><td>• Simultaneously slow down 10 kts and</td><td></td></tr>
<tr><td>Maintain the turn until heading 15° away from the tanker’s heading</td><td></td></tr>
<tr><td>• Descend 500 ft/1000 ft (left/right receiver)</td><td></td></tr>
<tr><td>• Hold new heading for 15 sec</td><td></td></tr>
<tr><td>• Resume the tanker’s heading to parallel track (15:15:15)</td><td></td></tr>
<tr><td>• After 30 sec, resume normal airspeed</td><td></td></tr>
<tr><td colspan="3">• Wing Pod and Centreline Probe and Drogue. Once visual with tanker, position to left or right of the tanker centreline either as directed by the tanker or where there is a space within the formation on the tanker’s wings. Do NOT remain directly behind the tanker as debris or the hose may fall from the tanker.</td><td></td><td></td></tr>
<tr><td colspan="5">Breakaway Terminated. Once the breakaway is terminated, the receiver may either arrange with the tanker for a further closure or to depart.</td></tr>
<tr><td colspan="5">SAFETY NOTES:

1. Receivers waiting in echelon should remain in formation on the tanker.
2. Receivers waiting in echelon, as well as those executing a breakaway manoeuvre, are to exercise good lookout to prevent a receiver/receiver collision.</td></tr>
</table>

410 Leaving. See Part 2 Chapter 1 para 110.

411 Aircraft Malfunction

a. A tanker or receiver emergency may require an urgent cessation of refuelling; in this event the radio call:

- "(Tanker Callsign), Breakaway, Breakaway, Breakaway"

and/or signal light command is to be given, see Part 2 Chapter 5 Annexes 5B and 5C.

b. The receiver is required to disconnect immediately and move clear of the tanker, see para 408 and 409. The responsibility of achieving safe separation is placed on the receiver.

c. The tanker is to maintain heading. Also, the tanker is to maintain FL/altitude/height or climb as required by national breakaway procedures. Additionally, some nation's tankers will accelerate up to the drogue limiting speed for drogue AAR operation.

d. For boom/BDA operations, the tanker is to increase power and accelerate.

412 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 vertical position 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.

c. Order any receivers in contact to disconnect.

d. Do not bring receivers into contact until affected track area has been traversed.

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.

413 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.

414 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 FL/altitude/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.

415 Radar and Weapons. It is the responsibility of the receiver aircraft commander to ensure that the aircraft radar is not radiating. Normally, the radar should be set to standby once the receiver is visual with the Tanker. Similarly, the receiver aircraft commander is to ensure that weapons are safe prior to commencing an RV with a tanker. During conditions of EMCON constraint (EMCONs 3 and 4), radio calls between tanker and receiver to check on radar and/or armament states are both inappropriate and impractical.

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PART 2 – GENERAL PROCEDURES

CHAPTER 5

Communications

501 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.

NOTE

Depending on the EMCON conditions, some tanker nations may permit or mandate the transmission of aircraft airframe numbers in order to track fuel transfer. Receiver national guidance must be followed before complying with such requests.

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

503 HF Transmission Restrictions

a. Facilitating Join-up. HF radio communications during AAR is limited to situations when either the tanker/receiver combination is beyond UHF range or to facilitate join up for AAR if unable to make UHF contact.

b. Use of HF During AAR. 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).

504 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.

505 Search and Rescue (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).

506 AAR Radio Procedures

a. General. Control of receivers during routine AAR is achieved by radio commands given by the tanker. To assist interoperability, these commands are standardized, although mission/operation-specific requirements may be detailed in the tasking order. Importantly, to avoid uncertainty, normally, all RT calls will be prefaced with the speaking unit's individual callsigns. Outside of the training arena, normal operations are conducted using EMCON 2 procedures. Therefore, radio communications should be kept to a minimum consistent with safety and the published EMCON option; 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 Part 2 Annex 5B.

b. Probe and Drogue. 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 the refuelling equipment.

c. Boom. 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.

d. Air-to-Air (A/A) TACAN

(1) To provide A/A TACAN ranging, the tanker and the receiver (one aircraft per receiver and tanker formation) should tune the assigned A/A TACAN channels 15 min before the RVCT. The two designated channels will be 63 channels apart with the receiver setting the lower channel and the tanker the higher channel. The majority of receivers use the Y- channel but some only have X-channel capability.

(2) A/A TACAN should be left in the A/A setting until the receiver reaches astern (boom) or the observation position (drogue).

e. Monitoring Guard. During AAR , where radio equipment permits, tanker crews must 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.

f. Loss of RT Communication. Loss of radio communication between tankers and receivers could prove hazardous, particularly during boom AAR. Receiver and tanker crews are to be aware of any national restrictions on the conduct of AAR when communications have been lost and are to operate in accordance with such instructions.

507 Verbal Communication – Boom AAR Only. Communication requirements should be established prior to the flight. Normally, boom visual signals will be used exclusively; however, if required or requested by the receiver, the boom operator will begin communications when the receiver reaches approximately 50 ft from the contact position. Direction, if required, will precede distance (in ft) for the receiver to move and will be given until the receiver reaches the contact position; example:

"Forward 50", "Up 4", "Back 2"

When contact is established the tanker will state:

"(Tanker Callsign) contact"

For Emission Options 1 and 2, the boom operator will make a astern radio check with the receiver(s) and the receiver(s) will acknowledge; example:

Tanker will say:

"25/57"

The receiver will reply:

"25"

508 Boom Envelope Demonstrations. During receiver pilot demonstration of AAR envelope limits, the boom operator will state the limit and give the boom position for the limit being demonstrated in increments of "2" for roll/azimuth and elevation, and "1" for telescoping (These are "degrees" and "feet" respectively but the dimensions are not normally included in R/T transmissions). When tankers are not equipped with an Independent Disconnect System, prior to receivers demonstrating envelope limits, the boom operator is required to confirm that a boom operator-initiated disconnect occurred. In this instance, receivers shall not request an envelope limits demonstration on the first contact.

509 Manual and Emergency Boom Latching. During tanker manual operation (without tanker disconnect capability) and emergency boom latching the following receiver briefings will be accomplished:

a. Tanker Manual Operation (TMO) Briefing (Without Tanker Disconnect Capability). During the briefing for tanker manual operation where there is no tanker disconnect capability, the boom operator will state:

"(Receiver Callsign), the following contacts will be made in tanker manual operation without tanker disconnect capability. Receiver air refuelling system will remain in normal and receiver pilot must initiate all disconnects."

"(Tanker Callsign), ready"

Receiver pilot acknowledges by stating:

"(Receiver Callsign) ready"

b. Emergency Boom Latching/Override Operation Briefing. During the briefing for emergency boom latching/override operation, the boom operator will state:

"(Tanker Callsign), ready"

Receiver pilot will acknowledge by stating:

"(Receiver Callsign), ready"

Tanker boom operator will state

"(Receiver Callsign), the following contacts will be made in manual boom latching. The receiver must initiate all disconnects"

The receiver will acknowledge by stating:

"(Receiver Callsign) astern ready"

Tanker boom operator acknowledges by stating:

"(Tanker Callsign), ready"

510 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 interphone equipped tankers, the offload report may be made prior to disconnect. Whenever possible, the fuel quantity should be expressed in the units of measurement used by the receiver's fuel system.

511 Loss of Radio Contact. If radio contact is lost between tanker and receiver on the allocated AAR frequency:

a. Attempts are to be made to re-establish contact on the secondary AAR frequency.

b. 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).

c. 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.

d. 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.

512 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 Part 2 Annex 5A. Also, EMCON options and acceptable communications for each option are shown in Part 2 Annex 5A. This describes 4 levels of restriction on the use of electronic emissions and provides for further refined selection of transmitters.

513 Radio Silent Procedures. There will be occasions when AAR is conducted using agreed procedures and signalling facilities without the use of radio. For pre-planned operational and training missions, the method, time and place of rendezvous, together with the amount of fuel to be transferred, must be covered in the pre-flight briefing of both the tanker and receiver crews. Radio silent procedures and visual boom signals are detailed in Part 2 Annex 5C. The occasions requiring silent procedures are:

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

b. When deemed tactically necessary by the tanker 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. Refuelling following total radio failure should only be undertaken when refuelling is essential due to the critical nature of the mission.

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

514 Breakaway During Silent Procedures. If the situation calls for a breakaway during radio silent AAR, verbal breakaway procedures will be used in conjunction with the visual signal detailed in Part 2 Annex 5C.

PART 2 - ANNEX 5A

Emission Control

Figure 5A-1. Emission Control (EMCON) Options – Communications Criteria

EMCON	Criteria
Emission Option 1	Any and all emitters are authorized, ie full RT for training purposes adding any timing that would affect the RV. *(Note: This option is normally used for all Qualification/Certification Training.)*
Emission Option 2 (Restricted R/T Communications)	Routine EMCON. a. Emission Option 2 is the desired standard for day to day AAR. General. b. Radio silent formation except for RV and AAR which is conducted with limited radio exchange. c. All other emitters are authorized. d. Essential radio transmissions for flight safety may be made. e. At initial contact, receivers and tankers will exchange callsigns, RV (type), FL/altitude/height, A/A TACAN, Mode 3, altimeter setting and any changes in tanker timing that would affect the RV (in minutes early or late). f. Altimeter setting and hot armament check will also be co-ordinated, if applicable. g. If not at the planned RV FL/altitude/height, an additional call is required when reaching that FL/altitude/height. Boom Operations. h. For boom operations, an abbreviated astern radio check is required when the receiver reaches the astern position. i. 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. j. Receivers will not depart the astern position until either this radio check is achieved or visual signals direct approach to contact. k. Tanker boom operators will give verbal corrections when required to ensure receiver aircraft maintains proper envelope position. Restrictions under EMCON 2. l. More restrictive procedures under emission Option 2 will be fully coordinated between tanker and receiver units. In an emergency or abnormal condition, the tanker/receiver may transmit over an AAR frequency.
Emission Option 3 (Silent R/T)	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 authorised by the plan that the AAR is supporting (ATO, SPINS, Rules of Engagement (ROE), Operations plan, Safe Passage procedures, or other mission directive).

Figure 5A-2. Emission Control (EMCON) Options - Communications

Item	Action	Emission Option (1) (2) (3)			
		1	**2**	**3**	**4**
1	Tanker radio set 30 min prior to RVCT/RV (if dual radio capable).	X	X	(4)	(5)
2	15 min call (if applicable).	X	X		
3	A/A TACAN set 15 min prior to RVCT/RV.	X	X	X (6)	
4	Beacon positive identification (if applicable).	X			
5	RVIP call (if applicable).	X	X(7)		
6	ADF check (if applicable).	X			
7	Halfway through the turn call (tanker) - (if applicable).	X			
8	Mandatory tanker/boom operator calls:				
	a. Astern 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 astern for check list or equipment considerations.	X			
9	Mandatory receiver calls after 15 min call:				
	a. Visual contact established/lost to include overrun.	X			
	b. Astern 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		
10	Post AAR	X	X		

NOTES:

1. **When using EMCON Options 2 - 4, boom interphone should be used when receiver 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/heights, 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 astern 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, Rules of Engagement (ROE), operations plans, safe passage procedures or other mission directives.**
6. **RV Bravo, Charlie, Delta (Point Parallel) and Echo.**
7. **Modified RV Delta (Point Parallel) procedure.**

Figure 5A-3. 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 appropriate / briefed	As appropriate / briefed
10	TCAS	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.					

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PART 2 - ANNEX 5B

Communication Procedures

Serial (a)	Situation (b)	Tanker RT (c)	Receiver RT (d)
1	15 min prior to RV	a. Set Radar/Rendezvous Beacon (where fitted) b. Set Air to Air TACAN to appropriate channel (ensure Y- or X- channel set appropriate to receiver capability)	a. Set Radar/Rendezvous Beacon (where fitted) b. Set Air to Air TACAN to appropriate channel (unless required for navigation) c. Transmit receiver IFF
2	RV Initial Call – made following ATC clearance to call (may be as much as 15 min prior to RVCT)	"(Receiver Callsign), (tanker callsign) for RV (type). My FL/altitude/height, when cleared, your FL/altitude/height, set A/A TACAN (channel), Mode 3, (timing if required), (and altimeter setting if not 1013.2mb (29.92 inches Hg))" **(1)**	"(Tanker Callsign), (receiver callsign), when cleared, my FL/altitude/height, TACAN (channel), Mode 3, (timing, if required), (and altimeter setting if not 1013.2mb (29.92 inches Hg)), (*if appropriate*, nose cold, switches safe)" **(1)**
3	Receiver has radar contact and takes responsibility for closing to visual range	-	"(Callsign) Judy"
4	Receiver has visual contact approaching tanker	-	"(Callsign) Visual"
5	Receiver cleared to join tanker	"(Callsign) Clear join"	Acknowledge **(2) (3)**
6	Receiver in the Observation Position	-	"(Callsign) Observation" **(4)**
7	Tanker AAR equipment deployed (hose trailed, boom lowered)	"(Callsign) Clear astern left/centre/right" **(4)**	Acknowledge **(4) (5) (6)**
8	Receiver astern left/centre/right	-	"(Callsign) Astern left/centre/right **(4) (6)**
9	Tanker AAR equipment ready to pass fuel	"(Callsign) Clear contact (specify left/ right if a multi-point tanker)" **(4) (7)**	Acknowledge **(8)**
10	Closing to boom contact	"Stabilize, Forward, Back, Up, Down, Right, Left, Return to astern" **(4)**	Acknowledge **(4)**
11	Receiver to disconnect	"(Callsign) Disconnect" **(4)**	Acknowledge **(4) (9)**
12	Receiver astern left/centre/right	-	"(Callsign) Astern left/centre/right"
13	Receiver to effect Emergency Separation	"(Callsign), Breakaway, Breakaway, Breakaway" **(10)**	Disconnect **(11)**
14	Practice Emergency Separation **(12)**	"(Callsign), Breakaway, Breakaway, Breakaway" **(10)**	Disconnect **(11)**
15	Terminate Emergency Separation	"(Callsign) Terminate Emergency Separation"	Acknowledge **(4)**

Serial (a)	Situation (b)	Tanker RT (c)	Receiver RT (d)
16	Receiver strikes drogue and suspects damage to ribs or canopy of drogue	-	"(Callsign) Spokes" **(13)**
17	Receiver to move from astern to Reform Position	"(Callsign) Go reform" **(14)**	Acknowledge **(4)**
18	Receiver echelon Observation/Reform	-	"(Callsign) Observation/Reform **(14)**
19	Receiver cleared to leave the tanker	"(Callsign) Clear to leave"	Acknowledge

Communication Procedures

NOTES:

1. In some national airspace, ATC controllers permit receiver(s) to contact the tanker to discuss the RV whilst the receiver(s) is(are) still under ATC control. The tanker's "when cleared" statement warns the receiver(s) that the RV information is not to be acted upon until ATC either releases the receiver(s) (eg MARSA) or approves changes in the receiver(s) flight parameters such as FL/altitude/height.

2. For Probe and Drogue/BDA operations, receivers form echelon in the observation position.

3. For boom operations, the first receiver may join directly to astern position, all others form echelon in the observation position.

4. Only required during EMCON Option 1.

5. Receiver moves behind the assigned AAR equipment and stabilizes in the astern position.

6. Boom operations need not designate centre.

7. 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.

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

9. Receiver makes a routine disconnect and drops back to the astern position.

10. To avoid confusion with multiple tankers on the same frequency, the specific tanker callsign must preface the breakaway call.

11. See Part 2 Chap 4, para 408.

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

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

14. Tanker passes to receiver the amount of fuel transferred (Note: When known, use the unit of measurement of the receiver's fuel system, otherwise use the tanker's unit of fuel measurement.)

PART 2 - ANNEX 5C

Radio Silent Procedures

Figure 5C-1. Radio Silent Procedures - Probe and Drogue

Serial (a)	Situation (b)	Tanker Actions (c)	Receiver Actions (d)
1	Receiver requires fuel	-	Receiver joins on tanker's left side at the observation position, and extends probe **(See notes 1 and 2)**
2	Tanker acknowledges receiver presence, has understood and has fuel available	Trails hose	-
3	Tanker acknowledges but has no fuel available	Tanker's hose remains stowed or retracted	Receiver diverts or attempts to find another tanker **(See note 4)**
4	Tanker AAR equipment ready, receiver clear astern	Switch off all red anti-collision beacons/strobes. All on again when receiver seen to move behind the tanker	Receiver goes to the astern position behind the AAR equipment (right hose as first choice on multi-point tankers, if available)
5	Fuel transfer	Light sequence as in National Annex **(See note 4)**	Receiver reacts to lights/visual signals
6	Receiver leaves formation	-	Receiver pulls forward on right side in visual contact then turns away
7	Receiver to breakaway	a. Tanker AAR equipment red signal light on or flash. b. Some tankers will turn strobes lights on and navigation lights to bright. c. For tankers not fitted with AAR equipment red signal lights (1) Any other specified red light on (eg anti-collision, hand held lamp). (2) Refer to Tanker National Annex for other variations.	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 tankers where the crew is only on the flight deck (see appropriate Tanker National Annex), receivers should pull well forward to attract the pilot's attention.**
2. **For tankers with observers stationed in the rear of the aircraft (see appropriate Tanker National Annex), receivers should not move forward of the tanker's wing leading edge.**
3. **Receivers should depart the tanker using the prescribed procedures for refuelling (e.g. – from the right side of the tanker, level or climbing).**
4. **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.**

Figure 5C-2. Radio Silent Procedures – Aldis-Equipped Probe and Drogue

Serial (a)	Situation (b)	Tanker Actions (c)	Receiver Actions (d)
1	Receiver requires fuel	-	Receiver joins on tanker's left side at the observation position **(See notes 1 and 2)**
2	Tanker acknowledges receiver presence, has understood and has fuel available	Trails hose	Proceed to astern position on respective hose(s). (Right hose as first choice on multi-point tankers, if available)
3	Tanker acknowledges but has no fuel available	Tanker's hose remains stowed or retracted	Receiver diverts or attempts to find another tanker **(See note 3)**
4	Receiver is cleared to contact hose.	One steady Aldis signal from respective side of aircraft.	Receiver engages drogue
5	Fuel transfer	Light sequence as in National Annex **(See note 5).**	Receiver reacts to lights/visual signals
6	Receiver has briefed amount of fuel, or tanker has no additional give remaining.	One steady Aldis signal to receiver engaged in drogue.	Receiver disconnects and proceeds to the right reform.
7	Receiver has briefed amount of fuel, but request additional offload.	Tanker provides additional fuel in briefed increments, unless there is no additional offload (refer to item 6)	Receiver remains engaged in drogue after receiving steady Aldis signal.
8	Receiver is not satisfied with hose response or fuel flow rate.	Tanker resets hose response once receiver is clear of the hose.	Receiver disconnects, moves aft and outboard of hose, and awaits further signal from tanker.
9	Hose is unsafe	Tanker retracts hose	Receiver proceeds to open hose or departs tanker/tanker cell.
10	Tanker has a malfunction that requires receiver to momentarily disconnect	Flashing Aldis signal from the observer	Receiver disconnects, moves aft and outboard of hose, and awaits further signal from tanker.
11	Emergency requiring a breakaway exists	Tanker turns on lower anti-collision light	Receiver expeditiously disconnects from hose, moves aft and outboard, and awaits further signal from tanker. **(See note 4)**

NOTES:

1. **For tankers where the crew is only on the flight deck (see appropriate Tanker National Annex), receivers should pull well forward to attract the pilot's attention.**
2. **For tankers with observers stationed in the rear of the aircraft (see appropriate Tanker National Annex), receivers should not move forward of the tanker's wing leading edge.**
3. **Receivers should depart the tanker using the prescribed procedures for refuelling (e.g. – from the right side of the tanker, level or climbing).**
4. **When a breakaway is signalled for an emergency situation, receivers should avoid exacerbating the situation with an excessively rapid disconnect from the hose.**
5. **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.**

Figure 5C-3. - Radio Silent Procedures - Boom

Serial (a)	Boom/Receiver AAR Signal (b)	BDA/Receiver AAR Signal (c)	Meaning (d)
1	Receiver may join directly to astern position		Receiver requires fuel/training
2	Boom extended in trail.		Tanker ready for contact **(See Note 1)**
3	Boom in trail (fully extended)		Tanker manual operation without disconnect capability or Tanker acknowledgement of receiver's manual boom latching signal
		Boom in trail (fully extended)	Tanker ready for contact
4	Boom in trail (fully retracted)	Boom in trail (fully retracted)	Fuel offload complete
5	Same receiver returns to astern with receptacle door open (DAY): Pilot signals closed fist, thumb to mouth plus hand signalling number equating to one finger for every 1000lb of fuel required. (NIGHT): Same receiver returns to astern with receptacle door open, ready for contact. **(See note 2)**		Additional fuel required – EMCON 2-4
6	Boom stowed (fully retracted)	Boom stowed (fully retracted)	Tanker AAR system inoperative
7	Boom 0° elevation, extended 5 ft		System malfunction. Tanker and receiver check AAR systems
8	Flashing pilot director lights (push emergency breakaway switch). Tanker lower rotating beacon on (Beacon light master switch to Both)	Flashing pilot director lights (push emergency breakaway switch). Tanker lower rotating beacon on (Beacon light master switch to Both)	Breakaway
9	Turn pilot's director lights off during contact. Push disconnect signal switch **(See note 3)**	Turn pilot's director lights off during contact. Push disconnect signal switch **(See note 3)**	Tanker request for disconnect, receiver return to astern position

10	Receiver closing and opening receptacle door when in astern position		Receiver request manual boom latching or Receiver acknowledgement of tanker's manual operation signal without tanker's disconnect capability signal
11	Receiver rocks wings or shows a steady light	Receiver rocks wings or shows a steady light	Receiver emergency fuel shortage exists **(See note 4)**
12	Flashing light from receiver cockpit area	Flashing light from receiver cockpit area	Initiate toboggan manoeuvre

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. Additional fuel offload for each subsequent contact will be 5000 lb for large receiver aircraft and 2000 lb for small receiver aircraft.

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

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

LIST OF EFFECTIVE PAGES TO PART 2 ATP-56(B)

PAGE NUMBERS	EFFECTIVE PAGES
1-1 to 1-14	Change 1
1A-1 to 1A-2	Change 1
1B-1 to 1B-6	Change 1
1C-1 to 1C-4	Change 1
1D-1 to 1D-18	Change 1
1E-1 to 1E-2	Change 1
1F-1 to 1F-4	Change 1
1G-1 to 1G-4	Change 1
2-1 to 2-2	Change 1
2A-1 to 2A-10	Change 1
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2F-1 to 2F-2	Change 1
2G-1 to 2G-2	Change 1
3-1 to 3-2	Change 1
4-1 to 4-22	Change 1
5-1 to 5-4	Change 1
5A-1 to 5A-4	Change 1
5B-1 to 5B-2	Change 1
5C-1 to 5C-4	Change 1
LEP-1 to LEP-2	Change 1

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