
PART 1 – GENERAL PROCEDURES

CHAPTER 1

Introduction

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

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

- a. Provide guidance for NATO and national commanders and staff in order to promote the effective employment of AAR in NATO air operations.
- b. Lead to a better understanding of national AAR capabilities amongst NATO forces.
- c. Promote mutual AAR support amongst suitably equipped NATO forces.
- d. Promote the development of mutual AAR tactics and procedures.

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

104 Applicability of Limitations. Where limitations are specified in Part 1 to 4 of this document, these are to be considered the baseline for operations between tanker and receiver aircraft from different nations.

a. Tanker Restrictions. In all cases the appropriate National Annex for the participating nation's tanker is to be consulted to identify if more restrictive limitations apply for the tanker/receiver combination.

b. Receiver National Limitations. Receiver and/or tanker national limitations take precedence over less restrictive limitations published in Parts 1, 2, 3 or 4 of ATP-56 or the participating tanker's national annex. Additionally, when working with other nations, the most restrictive of the participant's national limits or those published in ATP-56 will apply. It is the responsibility of participants to bring such restrictions to the attention of the other party, either through pre-mission contact or verbally prior to commencing AAR.

c. Tanker/Receiver AAR from Same Nation. Nations may publish less restrictive criteria for their own aircraft when operating together.

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

106 Definitions, Terms and Phraseology. Definitions, terms and phraseology are listed in the ATP-56 Lexicon at Part 1 Annex 1A. Additional national terms and definitions are contained in the corresponding National Annex.

a. Warnings, Cautions and Notes. The following definitions and symbols apply to warnings, cautions and notes found throughout ATP-56.

WARNING

An operating procedure, practice or condition that may result in injury or death if not carefully observed or followed.

CAUTION

An operating procedure, practice or condition that may result in damage to equipment if not carefully observed or followed.

NOTE

An operating procedure, practice or condition that is essential to emphasise.

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

- a.** ATP-34 - Tactical Air Support of Maritime Operations (TASMO) or Joint Maritime Operations.
- b.** AIRN Manual 80-6.

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

- a. Equipment Compatibility.** It is essential that aircraft requiring AAR are fitted with probes/receptacles and fuel systems compatible with the characteristics of the tanker aircraft employed, eg drogue/boom system, fuel surge pressures, fuel type etc.
- b. Performance Compatibility.** It is essential for tanker and receiver aircraft performance to be compatible in terms of AAR speeds and altitudes.
- c. Procedural Compatibility.** It is essential for tankers and receivers to employ pre-planned and compatible procedures for rendezvous, making contact, fuel transfer and departure.

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

PART 1 ANNEX 1A

Lexicon Part 1 – Acronyms and Abbreviations

The Lexicon contains abbreviations relevant to ATP-56 and is not meant to be exhaustive. The definitive and more comprehensive list is in AAP-15.

AAR	Air-to-Air Refuelling
AARA	AAR Area
AARC	AAR Controller
AREP	AAR Entry Point
ATO	Air Tasking Order
ATC	Air Traffic Control
ALTRV	Altitude Reservation
AOB	Angle of Bank
AVANA	Approval Void if Aircraft Not Airborne
BDA	Boom Drogue Adapter
EMCON	Emission Control
EUCARF	European Centralised Airspace Reservation Facility
HAAR	Helicopter Air-to-Air Refuelling
IDS	Independent Disconnect System
LOA	Letters of Agreement
MBL/EBL/OBL	Manual / Emergency / Override Boom Latching
MARSA	Military Assumes Responsibility for Separation of Aircraft
MPRS	Multi-Point Refuelling System
NAAR	Night AAR
QF	Quick Flow AAR
RV	Rendezvous
RVIP	RV Initial Point
RVCP	RV Control Point
RVCT	RV Control Time
SKE	Station Keeping Equipment
SPINS	Special Instructions
TMO	Tanker Manual Override
UARRSI	Universal AAR Receptacle Slipway Installation
WARP	Wing AAR Pods

Lexicon Part 2 – Terms and Definitions

AAR Abort Point

A planned point along the receiver track at which the receiver must divert, if he is not in contact receiving fuel.

AAR Airspeed

An airspeed or Mach number at which AAR will be conducted.

AAR Area (AARA)

A defined area encompassing both a racetrack shape AAR track and its protected airspace.

AAR Bracket

Designated segment of a route where AAR is planned. The bracket is defined by a refuelling start point and stop point.

AAR Control Point (ARCP)(HAAR ONLY)

Helicopter Receivers. Normally the earliest point the tanker can pass abeam the receiver during join-up.

AAR Control Time (ARCT)(HAAR ONLY)

Helicopter Receivers. The planned time that the receiver and tanker will arrive over the ARCP.

AAR Element

One tanker and one or more receivers.

AAR Entry Point (AREP)

A designated point at which the receiver enters the anchor area.

AAR Envelope

The area limits behind a boom equipped tanker within which a receiver must fly to remain in contact.

AAR Exit Point (A/R EXIT PT)

The designated geographic point at which the refuelling track terminates.

AAR Formation (Tanker/Receiver Formation)

Two or more tankers and/or receivers operating together with a designated formation leader (See Formation below.).

AAR RV

The procedures employed to enable the receiver(s) to reach the astern position behind the assigned tanker(s) (boom) or the observation position (drogue) by electronic, radio, and/or visual means.

AAR Stores

The refuelling pod, hose and drogue that connects onto the aircraft when configured in the tanker role.

AAR System Normal Operation

Both tanker and receiver using normal signal system.

AAR Time

Planned elapsed time from RVCP to completion point.

AAR Track

A track designated for AAR.

Air Tasking Order (ATO)

Formatted order detailing all information for the mission. Used to task and disseminate to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions.

Air Traffic Control (ATC)

A control system that ensures the safe operation of commercial and private aircraft, as well as military aircraft using the same airspace, by co-ordinating the movement of air traffic to ensure they remain a safe distance apart.

Alternate AAR Track

The track designated for AAR in the event that the primary track cannot be used.

Alternate RV

A RV achieved when primary means are not available. Alternate means may be radar beacon, common TACAN, Timing, DF Steer, ATC/GCI assistance etc, or any combination of these.

Altitude Differential

The difference between the receiver altitude and the tanker altitude.

Altitude Reservation (ALTRV)

An area of airspace reserved for AAR with the appropriate ATC authority. There are 2 types of ALTRV: moving and static. A moving ALTRV encompasses en route activities and advances coincident with the mission progress. A static ALTRV consists of a defined geographic area, specific altitude(s) and time period(s).

Amplifier Override

Procedure for using receiver override boom latching when receiver air refuelling system malfunctions. Also see Manual Boom Latching.

Anchor Point

A defined reference point upon which an anchor refuelling track is orientated.

Anchor Refuelling

AAR performed as the tanker(s) maintain a prescribed pattern which is anchored to a geographical point or fix (See RVs Alpha and Echo).

Anchor RV (RV Alpha)

The procedures normally employed by radar (CRC/GCI/AWACS) to vector the tanker(s) and receiver(s) for a visual join-up for refuelling.

Angels

A brevity code meaning aircraft altitude (in thousands of feet).

Approval Void if Aircraft Not Airborne (AVANA) by (time UTC)

ALTRV Approval Void for Aircraft Not Airborne by (time). In most cases the AVANA is one hour after the last planned take-off, after which time the ALTRV is automatically cancelled.

Astern Position

- a. Probe and Drogue.** The stabilized formation position behind the AAR equipment (approximately 5 ft directly aft of the drogue) with zero rate of closure.
- b. Boom.** The position approximately 50 ft behind and slightly below the tanker boom nozzle where the receiver stabilizes with zero rate of closure before being cleared to the contact position.

Awaiting AAR Position (non-SKE)

- a. Probe and Drogue.** The Awaiting AAR Position and the Observation Position are the same for fighter aircraft on a Probe and Drogue tanker, ie echelon on the left wing of the tanker.
- b. Fighter Formations - Boom.** The Awaiting AAR Position for fighter aircraft/elements on a boom tanker is a position 1 to 3 nm in trail and a minimum of 1000 ft below their tanker's altitude

Awaiting AAR Position (SKE and USAF Heavy Aircraft)

A 60° right echelon off the last tanker, 1 nm nose to nose spacing, stacked 500 ft above that tanker.

Base AAR Altitude

A reference altitude at which the lowest aircraft of a tanker formation (or a single aircraft for individual AAR) will fly. Ideally, this should be at least 2000 ft below receiver optimum altitude for refuelling.

Beacon RV

Use of an airborne radar or RV beacon to provide range and offset.

Bingo Fuel

A pre-determined quantity of fuel which requires the receiver or tanker to immediately return to home station or divert to an alternate.

Boom Cycling

A retraction and extension of the boom to relieve fuel pressure in the boom drogue adapter.

Boom Drogue Adapter (BDA) (KC-135)

Equipment used to convert the boom for use with probe equipped receivers.

Breakaway

An emergency in either the tanker or receiver may require an urgent cessation of refuelling; in such an event a radio call and/or appropriate visual signals will be given:

- a.** By the tanker when the receiver is judged to be flying erratically.
- b.** If the tanker has a malfunction.
- c.** By the boom operator or receiver if the receiver underruns the tanker.

The receiver(s) (and where appropriate, tanker) will immediately disconnect and take action as detailed in Part 2 Chapter 4. (HAAR detailed in Part 3 Chapter 4)

Brute Force Disconnect (Boom Only)

A disconnect which is the result of a receiver aircraft moving aft to full boom extension and overriding hydraulic pressure or a mechanical malfunction holding the receivers' toggles in the engaged position. A brute force disconnect may occur inadvertently or as part of a controlled tension disconnect procedure, coordinated between the boom operator and the receiver pilot.

Buddy Cruise

When tanker(s) and receiver(s) cruise as an AAR element/formation.

Buddy Join up Procedure (RV Foxtrot)

These procedures are utilized when the tanker(s) and receiver(s) approach the RVIP on a common track by taking off from the same base and joining up.

Buddy Takeoff/Departure

When tanker and receiver take off and climb as an element/formation.

Clear Astern

Radio call by the tanker clearing a receiver behind the left/centre/right assigned AAR equipment. The receiver moves to the astern position.

Clear Contact (Probe and Drogue and BDA Only)

The receiver is cleared to move forward from the astern position to engage the probe in the drogue.

Clear Contact Position (Boom Only)

The receiver is cleared to advance to the contact position.

Clear Join

Radio call by the tanker clearing the receiver to join in close formation in the observation position or astern position for boom operations.

Clear Leave

Radio call given by the tanker clearing the receiver to leave the tanker formation. This call is given only after the receiver has completed the move to the Post AAR Position.

Communications Out

Radio silent AAR RV operations. All other RV aids may be used.

Contact

- a. **Probe and Drogue, and BDA.** A contact is made when the probe engages the drogue.
- b. **Boom.** Called by the boom operator and the receiver when the boom is locked in the receptacle.

Contact Point

The geographical point along the planned AAR track where fuel transfer should commence.

Contact Position (Boom Only)

The stabilized position of the receiver within the AAR envelope where it is possible to make contact.

CONVEX

Flying conversion exercises performed to familiarise and qualify aircrew in a new skill set.

Crossover (HAAR Only)

A specific manoeuvre to reposition a receiver from one side of the tanker to the opposite side.

Dead Hose

See Hard Hose

Descent Range

The distance from the tanker at which the receiver desires to initiate letdown to the tanker.

Deployment

The relocation of forces and materiel to desired operational areas.

Disconnect

- a. Action taken by receiver pilot or boom operator to disengage tanker and receiver refuelling systems.
- b. Command given by the tanker to receiver, either verbally or by signal, instructing receiver to disengage from tanker refuelling equipment.

(1) Probe and Drogue, and BDA. The receiver moves smoothly back toward the astern position until the probe disconnects from the drogue.

(2) Boom. When the boom is seen to be clear of the receptacle, the receiver moves smoothly back to the astern position.

Dry Contact

AAR engagement for aircrew proficiency during which fuel is not transferred.

Electronic Contact (HAAR Only)

Electronic data on aircraft/formation location. Operational equipment that provides, at a minimum, range information.

Emergency/Override Boom Latching

Procedure for using receiver override boom latching when receiver air refuelling system malfunctions. Also see Manual Boom Latching.

Emission Control (EMCON) Procedures

The management of electromagnetic radiation to counter an enemy's capability to detect, identify, or locate friendly emitters for exploitation by hostile action. For ease of tasking, the restrictions for both equipment emissions and radio transmissions are standardized into 4 Options. These options are detailed in the Communications Chapter.

Emitter

A piece of equipment that emits electromagnetic radiation (radios, radar, TACAN, IFF, Doppler, radio altimeter, etc).

End AAR

A planned point or the actual position within the confines of the AAR track at which all AAR operations/requirements are complete.

En route Formation (KC-135/KC-10A)

Two or more tankers in trail, 1 nm separation, and stacked up at 500 ft intervals.

En route RV (RV Golf)

Procedure used when join up is to be achieved en route to the AAR area at the RV position by making good a scheduled time. Timing may be accomplished by utilising an orbit delay or timing triangle.

En route RV HAAR (RV Golf)

An AAR RV conducted along the receivers' planned routing.

Force Extension

Tankers escorting fighters are force extended when they are refuelled en-route to their destination by other tankers which may or may not be part of the formation package.

Formation

Two or more aircraft with the same intended route or flight, maintaining station-keeping operations by either or both visual and electronic means. The formation will normally be flown with successive tankers in line astern, and stepped up or down behind the leader.

Go Reform Right/Left

Radio call given by the tanker which instructs a receiver to move from the astern position to the reform position after refuelling is complete. Omission of "right/left" means that the receivers are to reform on the right side of the tanker.

Ground Controlled Intercept (GCI)

A ground based radar system through which aircraft are controlled in order to achieve an airborne RV with other aircraft.

Hard Hose (Dead Hose)

A hose condition in which hose slack is not properly taken up on contact. Any resulting hose whip is likely to damage the receiver's probe.

Hot Armament

Forward firing ordnance that can be selected and fired by the receiver pilot or crew.

Inadvertent Disconnect (HAAR Only)

Unplanned disconnect. Receiver moves to astern position (or as briefed) to await further instructions from tanker.

Independent Disconnect System (IDS)(KC-10)

The Independent Disconnect System is an electrically controlled, pneumatically actuated system located in the nozzle assembly. It causes the sides of the KC-10 boom nozzle to collapse, allowing the boom to be retracted from the receiver aircraft while its toggles are in the latched extended position.

Join Up (HAAR Only)

Procedures used to transition the tanker from the RV phase of flight to a position abeam the receiver, ready to assume formation lead and the helicopter(s) ready to move to the observation position.

Join Up Altitude (HAAR Only)

A helicopter altitude that ensures tanker/receiver altitude separation during the join up.

Judy

Radio call made by the receiver when radar contact with the tanker and taking over responsibility for closing to within visual range.

Manual / Emergency / Override Boom Latching (MBL/EBL/OBL)

Procedure for using receiver boom latching when receiver AAR system malfunctions. Both tanker and receiver AAR systems in manual operation. Also known as Emergency/Override Boom Latching and Amplifier Override.

Mark

A request for the tanker to assist the receiver in achieving visual contact. Depending on type, the tanker may dump a small quantity of fuel, or fire a flare, or switch on/vary the high intensity lighting. Refer to National Annexes.

MARSA (FAA Only)

Military Assumes Responsibility for Separation of Aircraft - applies only to participating aircraft and FAA controlled formations.

Marshall Stack

A predetermined distance from an aircraft carrier in which aircraft hold to await an individual instrument approach to the deck. Marshall radials extend 20 to 45 nm from the carrier.

Minimum Safe Altitude (MSA)(HAAR Only)

A pre-briefed altitude that provides a vertical clearance from all obstacles within a defined range along a refuelling track. National restrictions determine the mission minimum.

Mixed AAR Formation

Any formation involving one or more tankers refuelling two or more dissimilar types of aircraft simultaneously.

Modified Point Parallel RV (RV Delta)

An RV procedure optionally employed when the receiver aircraft is established on-station in a command and control orbit or airspace patrol. The tanker enters the area, effects the RV, and completes the refuelling within the confines of the receiver's assigned airspace.

Multi-Point Refuelling System (MPRS) (KC 135)

Self-contained pods mounted on wing-tips of selected KC-135R aircraft that allow a single tanker to support both probe and drogue and boom AAR missions.

Night AAR (NAAR)

AAR operations that take place between official sunset and sunrise.

Normal Communications

Normal procedures as established in current AAR orders. All RV aids may be utilised as necessary.

Nose Cold

Radar selected to standby.

Observation Position (HAAR Only)

Helicopter – A position to the left or right of the tanker, outboard of the wingtip and slightly above and behind the tanker horizontal stabilizer. *Note: Helicopter receivers should initially RV on the left side of the tanker unless previously briefed or mission dictates otherwise.*

Observation Position (Fixed Wing Only)

The initial formation position for a receiver joining a tanker. This is normally echelon left for all receivers.

a. Drogue Equipped Tanker

(1). Availability of Observers. Refer to the tanker's National Annex to determine if an observer is located in the rear of the aircraft.

(2). Without Refuelling Observers. Receivers should initially be co-altitude with the tanker, at least one receiver wingspan outboard of the tanker wingtip and well forward, to be observed and identified by the tanker pilots.

(3). With Refuelling Observers. The observation position for fixed wing aircraft is stepped down, aft of the tanker wingline and one receiver wingspan outboard of the tanker wing.

b. Boom Equipped Tanker. A position to the left and slightly behind the tanker wing with a minimum of one receiver wingspan clearance between tanker and receiver (weather permitting). This contrasts with the Awaiting AAR position (see above).

Off-load/On-load

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

Offset (Track)

The lateral distance the tanker is displaced from the RVIP to RVCP track to compensate for turn radius and drift.

On-Call (Unplanned AAR)

An AAR that has not been planned before the mission, but becomes a requirement due to changing tactical situations.

On-Deck Position. (Quick Flow Procedure Only)

Left hand echelon formation on the receiver in the contact position.

Oral Communications (Boom Only)

The following terminology will be used by the boom operator when verbal instructions to the receiver are necessary:

Back	Move receiver backward
Down	Descend receiver.
Forward	Move receiver forward.
Left	Move receiver left.
Right	Move receiver right.
Stabilize	Hold receiver steady in present position
Up	Ascend receiver.
Slow Closure	Called when boom operator perceives an excessive closure rate. Receiver will reduce aircraft closure rate.
Return to astern	Receiver will manoeuvre aircraft to the astern position and stabilise

Orbit Departure Time

That time at which the tanker will depart the orbit point to effect the planned RV.

Orbit Pattern

The pattern flown by the tanker at the orbit point.

Orbit Point

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

Overrun

An overrun occurs when the receiver passes the tanker prior to or during the tanker RV turn.

Overtaking Point Parallel RV (RV Delta)

Same as Point Parallel RV except tanker plans to turn to refuelling track so as to roll out behind the receiver. The tanker then overtakes the receiver and begins a slowdown so as to position the tanker one mile in front of the receiver at AAR Airspeed.

Point Parallel RV Procedure (RV Delta)

The procedure normally used when the tanker arrives in the AAR area ahead of the receiver (A tanker orbit is normally planned).

Post AAR Position

The position to be maintained by receiver aircraft upon the completion of AAR.

- a. **Fighters and Heavy Probe Receivers.** See Reform Area/Position.
- b. **Heavy Boom Receivers.** Heavy boom receivers will maintain at least 1000 ft below and no less than 1/2 nm in trail behind the lead tanker (if unable to maintain visual contact, in trail distance is increased to 1 nm). This position will be maintained until clearance is received from Air Traffic Control.
- c. **Heavy Aircraft Formation (SKE).** See Post AAR Position (SKE).

Note: *In EMCON other than 3 or 4, tanker lead and receiver will verbally coordinate their respective separation manoeuvres prior to either aircraft departing formation.*

Post AAR Position (SKE)

A 60° left echelon, 2 nm nose to nose separation, stacked down 1000 ft off the lead tanker.

Post AAR Procedures

The procedures employed by tankers and receivers after final disconnect and prior to establishing cruise.

Practice Emergency Separation

The term to be used by tanker and receiver aircrews when referring to a Practice Breakaway, prior to accomplishing the manoeuvre.

Quick Flow AAR (QF)

Visual formation procedures used to expedite AAR operations by minimising required refuelling time.

Radio Silent

No radio transmissions between tanker and receiver except in an emergency. For further details see Part 2 Chapter 5.

Receiver Holding Point

A point along the upstream end of the inbound course to the Anchor Point where the receiver(s) will hold until cleared for RV by the tanker. This point is used during Anchor Refuelling Alternate Procedures.

Reform Area/Position

An area to the right and level or slightly above the tanker formation, where receivers other than those moving to the Post AAR Position reform upon completion of AAR. This is normally echelon right for all participating receivers.

a. Drogue Equipped Tanker

(1) Availability of Observers. Refer to the tanker's National Annex to determine if an observer is located in the rear of the aircraft.

(2) No Refuelling Observers. Receivers should initially be co-altitude with the tanker, at least one receiver wingspan outboard of the right tanker wingtip and well forward, to be observed by the tanker pilots.

(3) With Refuelling Observers. The reform position for fixed wing aircraft is level or slightly above the tanker, aft of the tanker wingline and one receiver wingspan outboard of the right tanker wingtip.

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

Receiver/Tanker Route Formation (Fighter)

Receivers positioned on the tanker with two or four receivers' wingspan clearance.

Refuelling Altitude

The briefed AAR altitude that meets the performance and operational requirements of both the tanker and receiver aircraft.

Refuelling Heading

A true / magnetic / grid heading taken by the tanker(s) and receivers to maintain AAR track.

RV Control Point (RVCP)

The planned geographic point over which the receiver(s) arrive in the observation/astern position with respect to the assigned tanker.

RV Control Time (RVCT)

The planned time that the receiver and tanker will arrive over the RVCP.

RV Equipment

Electronic/radio equipment installed in tanker and receivers for use in achieving an RV.

RV FL/ Altitude/Height

The FL, altitude or height of the tanker during an RV procedure.

RV Initial Call

When the use of radio is authorized, the tanker is to confirm RV details before starting the RV procedure. The format of the call is in Part 2 Annex 5B.

RV Initial Point (RVIP)

A planned geographic point prior to the RVCP to which tankers and receivers time independently to effect an arrival at the RV control time. If the tanker/receiver is not already at its assigned RV FL/altitude, it commences a climb/descent to that FL/altitude. This point may be a designated position established at the planning or briefing stage, or as directed by the tanker/GCI/AEW controlling the RV.

RV Point

A designated point where tanker and receiver are planned to be joined in formation (RVCP, RVIP, etc).

RV Procedure

A procedure to join the receiver with the tanker.

RV Rollout Heading

A heading reference taken by the tanker(s) on the final turn towards the RV Point.

RV Speed

a. For RVs where the receiver flies the tanker speed plus 20 kts, the tanker speed (IAS) is known as the RV speed; this is usually the intended refuelling speed (normally optimised for best receiver AAR performance).

Note: If communications are not possible for any reason, and pre-briefing is not possible, the tanker will fly at the optimum speed for the receiver type as listed in Part 5 Annex BB, TANKER AAR CAPABILITIES.

b. For RVs where the receiver's speed is known to the tanker, RV Speed is the speed flown by the receiver when flying towards the tanker for the RV.

RV Track (Tanker Track)

The track flown by the tanker during the RV procedure. Receiver(s) track to the RV Point is dependent on planned route and RV procedure.

Reverse Flow AAR (boom only)

The transfer of fuel from receiver to tanker.

Rim

The probe strikes the rim or periphery of the drogue but does no damage.

Safe Position (KC/KDC-10)

The position during a partial or complete boom control system failure that is safe for the boom operator to initiate a disconnect. This position is when the receiver is approximately 0° roll and moving down and back.

Station Keeping Equipment (SKE)

An avionics based formation management system that allows a large number of aircraft operating on different frequency channels to fly fully instrumented formation in zero visibility. The system can also communicate navigation data and proximity warnings when a threat of collision exists. Participating aircraft can operate within a limited radius of a selected master system on the same frequency.

Single Hose Procedure

A change to the refuelling procedure which is effected when a tanker, which normally operates with 2 AAR stores, has one store unserviceable.

Soft Contact

The probe has not fully engaged in the drogue.

Special Instructions (SPINS)

Special Instructions which are attached to the ATO and detail operating procedures for all missions and tasks.

Spokes

The receiver has damaged the drogue.

Start Descent Point

A point where descent is initiated.

Start Point

A designated point on track where refuelling of the first receiver(s) is planned to start.

Stop Point

A designated point on track where refuelling of the last receiver(s) is planned to stop.

Switches Safe

All Weapons Switches selected to Safe/Off.

Tactical Air Control System

Any CRC, GCI, or AWACS command and control system.

Tactical Stream

Two or more AAR formations proceeding at a pre-determined spacing along identical flight paths.

Tanker Abeam (HAAR)

When receiver is aft of the tanker's 9 o'clock position during join-up.

Tanker Manual Override (TMO) (Boom Only)

Receiver AAR system in normal operation, tanker AAR system in manual operation.

Tanker Manual Override (TMO) without Tanker Disconnect Capability (Boom Only)

Mode of operation used when tanker AAR signal system malfunctions. Receiver AAR system will remain in normal operation. AAR will not be accomplished except during fuel emergencies or when operationally essential.

Terminate (Emergency Separation)

Call by tanker to cease breakaway manoeuvre.

Texaco (HAAR)

Brevity term to request a Helicopter Refuelling that can be accomplished on-call.

Toboggan

Request from receiver for the tanker to start a slow descent, maintaining the refuelling airspeed. The rate of descent is between 300 and 500 ft per min and this should be used unless tanker or receiver requests otherwise.

Track Offset

Used in RV Delta (Point Parallel), it is the lateral distance which the tanker is offset from the receiver track. The distance compensates for tanker turn radius and drift during the turn towards the ARCP.

Transferable Fuel

Tanker fuel available for passing to a receiver. This is the total fuel in the tanker, minus the fuel the tanker requires to recover to an airfield including any landing/diversion/weather reserves.

Transmit for DF

A 10 sec carrier wave transmission, unmodulated by speech, which allows relative positions of tanker and receiver to be determined using UHF/DF.

Turn Range

In some RV procedures, the distance measured between the tanker and receiver at which point the tanker initiates the turn for the RV.

Underrun

An underrun occurs when the receiver's closure rate prevents stabilising in the astern position, or when forward movement of the receiver is considered excessive during contact or approach to contact.

Universal AAR Receptacle Slipway Installation (UARRSI)

A modular AAR unit incorporating an AAR receptacle and slipway to guide the tanker boom nozzle into the receptacle. The UAARRSI has a boom interphone capability.

Visual

Radio call from the receiver or tanker confirming visual contact with the other aircraft.

Visual Formation

Receiver(s) flying off tanker's wing.

Wave (of aircraft)

A series of aircraft formations departing from or arriving at an airfield or target, or passing a precise geographic location, with a specified interval between each formation.

Wet Contact

AAR engagement during which fuel is transferred.

Wing AAR Pods (WARP) (KC-10)

A set of 2 self-contained Flight Refuelling Ltd Mk32 refuelling pods mounted on selected KC-10 aircraft that allows simultaneous refuelling of 2 probe-equipped receivers.

PART 1 – GENERAL PROCEDURES

CHAPTER 2

Employment Considerations and Principles

201 Peacetime

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

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

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

(1) AAR Areas (AARAs)/Anchor Areas and AAR Tracks

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

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

(c) Typical dimensions of AARAs/anchor areas and AAR tracks are in Part 2 Annex 1A.

(2) Altitude Reservations (ALTRVs) and Military Corridors. ALTRVs and military corridors are normally arranged with the appropriate national ATC authorities. For AAR purposes, moving ALTRVs are normally used to guarantee the required route and altitude(s) for an AAR supported deployment. Military corridors are activated by NOTAM and are essentially static ALTRVs.

(a) ALTRV Scheduling Facilities. To ease the scheduling difficulties of the civilian ATC authorities, the USAF operate 3 scheduling facilities which may be used by other nations by prior agreement. The facilities are responsible for prioritising military tasks and arranging the required ALTRV/corridor times with the appropriate ATC authority.

The areas of responsibility for the 3 USA and 2 Canadian facilities are:

(i) Central Airspace Reservation Function (CARF): Continental USA, New York and Oakland Oceanic FIRs (DSN 904-4426, Commercial: USA 703-904-4426).

(ii) European Central Airspace Reservation Facility (EUCARF): Europe, Santa Maria and Shanwick Oceanic FIRs (DSN 314-480-7346, Commercial: Germany 6371-47-7346).

(iii) Pacific Military Airspace Reservation Facility (PACMARF): Pacific and Indian Ocean (DSN 315-449-7286, Commercial: USA 808-449-7286).

(iv) Altitude Reservations East (ARE): Toronto, Montreal, Moncton and Gander FIRs and Gander Oceanic (Commercial: Canada 709-651-5243).

(v) Altitude Reservations West (ARW): Vancouver, Edmonton and Winnipeg FIRs (Commercial: Canada 780-890-4739).

(b) Additional Information. Amplifying information on the use of reserved FAA airspace can be found in FAA Order 7610.4K – Special Military Operations. This is an access controlled document but copies may be released to legitimate applicants (see http://www.faa.gov/airports_airtraffic/air_traffic/publications/spec_ops/ for access details).

(3) ALTRV Utilisation. There are significant differences between FAA and ICAO procedures when using ALTRVs. Fundamentally, ICAO acknowledges that ALTRVs can be established, but it does not recognise them in official publications.

(a) Pre-Flight Planning. Prior to flying a mission employing an ALTRV, aircrew must review their own nation's relevant National Instructions and/or regulations, together with appropriate airspace planning documents, to ensure compliance with all governing regulations for the airspace in which the ALTRV is established.

(b) ATC Clearance. In FAA Airspace, operations within an ALTRV permit the participating aircraft to manoeuvre freely within the vertical, lateral and longitudinal limits specified in the ALTRV message. In contrast, an ICAO ALTRV may or may not be an actual ATC clearance, depending on the region in which the formation is operating. For instance, Shanwick FIR (United Kingdom) requires aircraft to obtain ATC approval for all altitude changes. Importantly, aircraft transiting multiple airspace regions/countries need to be aware that ALTRV procedures may change when crossing FIR boundaries.

(i) US DoD European Operations. For US DoD aircraft operating in European airspace, letters of agreement (LOA) maintained at European Centralised Airspace Reservation Facility (EUCARF) explain ALTRV procedures and routings for individual countries. LOAs are coordinated on a one-to-one basis between EUCARF and each controlling agency/nation, not for the whole region. Crews must therefore consult paragraph "g" of the ALTRV message for country-specific information, pay close attention to comments therein and explicitly follow all instructions. If further clarification is required, contact the ALTRV planner first, followed by the appropriate altitude reservation facility.

(c) Formation - FAA. The FAA has specific definitions to describe a formation. These are:

(i) Standard Formation. A standard formation is one in which each wingman maintains a proximity of no more than 1 nm laterally or longitudinally and within 100 ft vertically from the flight leader.

(ii) Non-standard formation. Non-standard formations are those operating under any of the following conditions:

(A) When the flight leader has requested and ATC has approved other than standard formation dimensions.

(B) When operating within an authorized altitude reservation (ALTRV) or under the provisions of a letter of agreement.

(C) When the operations are conducted in airspace specifically designed for a special activity.

(d) Formation – ICAO. ICAO does not recognize the terms in para 201c(3)(c). However, Part 7 of NAT DOC 001, *Guidance and Information Material Concerning Air Navigation in the North Atlantic*, provides the following guidance:

(i) Definition of a Formation Flight. More than one aircraft, which, by prior arrangement between the pilots, operate as a single aircraft with regard to navigation and position reporting, are defined as a formation flight. Separation between aircraft within a formation flight remains the responsibility of the flight leader and the other pilots within it. This includes during transition periods when aircraft within the formation are manoeuvring to attain separation from each other in order to effect individual control, and during join-up and break-away.

(ii) Provisions

(A) Flight Plan. A formation shall file an appropriate ICAO flight plan for an operation although an ATC clearance will only be issued to the formation leader.

(B) Formation Dimensions – ICAO. All aircraft within a formation shall operate so that the wing aircraft maintain a distance of not more than one nm laterally or longitudinally and a vertical displacement of not greater than 30 m (100 ft), from the flight leader.

(C) Separation – Other Traffic. A formation flight will be considered as one aircraft by ATC for separation purposes. If at least one of the aircraft participating in the formation flight is MNPS approved, the entire formation flight is considered to be approved for operation in NAT MNPS Airspace. Formation flights will be considered as non-RVSM flights regardless of whether one or all aircraft in the formation are RVSM approved.

(D) Formation in RVSM Airspace. Formation flights operating within RVSM Airspace will only be approved by means of an airspace reservation.

(e) Formations – UK Airspace. In UK airspace, formations are considered as a single unit for separation purposes provided that:

(i) Formation Dimensions. The formation elements are contained within one nm both laterally and longitudinally, and are at the same level or altitude.

(ii) Controller Approved Formation. Exceptionally, at the controller's discretion, these limitations may be increased to 3 nm and/or 1000 ft vertically.

(iii) Co-ordinated Formation. The formation, although operating outside the parameters given above, has been the subject of a mission-specific airspace co-ordination and notification procedure.

(f) Formation – UK and European Airspace. Within congested UK and European airspace, unless otherwise approved, formation leaders must minimize formation spacing. Many controlling agencies (particularly civilian) only use secondary radar (IFF) to provide aircraft control. As such, unless agreed otherwise, they ‘see’ the formation as a one nautical mile ‘box’ based on the squawking aircraft and make separation allowances between other traffic based on that assumption. ATC is blind to aircraft in the formation outside the ‘box’. Therefore, rigid adherence to the approved formation dimensions is essential to ensure that the safety bubble between other traffic and the formation is not compromised.

(g) Large Formations. It is imperative that formation leads coordinate any additional dimensions with ATC if mission requirements dictate. If it is not possible to keep the formation within the limits previously mentioned, inform ATC and anticipate that aircraft greater than one mile from the lead aircraft may be considered as separate “speaking units” and receive separate controlling instructions.

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

203 Tasking

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

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

c. AAR Tasking. AAR tasking is normally issued by an ATO or an AAR Combined Task Message (AARCTM). The format and structure of the AARCTM is contained in APP-8 - Allied Tactical Air Messages.

PART 1 – GENERAL PROCEDURES

CHAPTER 3

Refuelling Equipment

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

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

a. System Description

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

(10) The Mk 17 hose remains in the braked position until it is manually reset but most hoses retrail automatically.

b. Tanker Installations. There are 2 general types of tanker AAR equipment: the podded store and the integral system.

(1) AAR pods are self-contained units requiring only fuel and low voltage electricity from the parent aircraft; the power source for fuel pumping and hose drum drive is usually a pod ram air turbine.

(2) AAR pods are widely used to give fast jet aircraft an alternate tanker capability; one pod is mounted on an under-wing or under-fuselage pylon; refer to National Annexes for specific installations.

(3) Pods are also carried by some large tankers; usually a pylon mounted pod is carried under each wing.

(4) Integral AAR systems may be carried on large tankers; normally these are installed within the main fuselage and the hose is trailed from a centreline fairing or tunnel. However, there are variations on this general principle; for example the FAF Transall AAR equipment is mounted within the left-hand fuselage undercarriage bay.

(5) Integral AAR systems use a variety of high powered aircraft supplies (pneumatic, hydraulic and electric) for fuel pumping and hose drum drive.

c. Hose Dimensions and Markings

(1) Generally pod hoses are shorter, lighter and have a narrower bore than integral system hoses. The lengths of pod hoses vary between 15 m (50 ft) and 27 m (90 ft) depending on the system and use; 24 m (80 ft) is typical of an integral system hose. National Annexes provide specific information.

(2) Most hoses are marked with coloured bands; there is a wide variety of colours and marking patterns, refer to National Annexes.

(3) However, most hoses have a series of bands or a block of colour to indicate the optimum receiver refuelling position; this is achieved when the hose is pushed in so that the markings enter the hose fairing or tunnel.

(4) On some hoses, the refuelling position marks are bounded by additional markings indicating the start and stop positions for fuel flow. Usually, there is a series of closely spaced bands at the tanker end of the hose; these provide cues for the receiver pilot to assess rates of fore and aft movement after making contact, or during disconnect.

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

e. Signal Lights. Associated with each tanker AAR installation is a set of rearward facing

signal lights, using the colours red, amber and green; although some equipment may have only amber and green lights. On some systems, the signal lights are duplicated for redundancy. The lights provide indications of the operating status of the AAR equipment; on most installations, the lights can be controlled by the equipment operator to give radio silent commands.

(1) NATO Standard Lighting. The NATO standard light signals are:

(a) Red Light. A red light means Breakaway, or do not make contact.

(b) Amber Light. An amber light means clear contact.

(c) Green Light. A green light signifies fuel is flowing.

(2) National Differences. Variations on these principles are noted in National Annexes.

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

g. Probe Lights. Many receivers have a light which illuminates the probe. These lights should be used with caution, because they can dazzle the refuelling operator in the tanker; furthermore, their use may accentuate a tendency for receiver pilots to chase the drogue and therefore possibly overcontrol.

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

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

a. Pilot Director Lights. To aid receiver positioning, the tanker aircraft is fitted with Pilot Director Lights (PDL); these consist of 2 parallel light arrays, set longitudinally on the undersurface of the fuselage between the nosewheel bay and the main landing gear. The PDLs give directions to a receiver informing it which way to attain and maintain the ideal refuelling position.

(1) One light array gives up and down commands and the other gives fore and aft commands.

(2) Coloured positioning bands on the telescoping portion of the boom correspond to the coloured segments of the fore and aft PDL.

(3) There are no lights for azimuth positioning.

(4) Only the PDL Elevation Background Lights will be used when the BDA is fitted.

(5) A full description of PDLs and boom markings is given in the appropriate National Annex.

b. AAR Equipment Lighting. Boom tankers are fitted with a rear-mounted floodlight, which illuminates the receiver, to assist the boom operator. The boom is fitted with a boom nozzle light

to assist the operator in positioning the nozzle into the receptacle. Some receivers' receptacles are also internally lit; the UARRSI is usually lit, or highlighted by marker lights.

304 Boom Drogue Adapter

a. System Description

(1) The KC-135 and the C135FR boom can be modified to refuel some types of probe equipped aircraft by fitting a Boom Drogue Adapter (BDA); this consists of 3 m (9 ft) of hose attached to the end of the telescoping part of the boom. The hose terminates in a hard non-collapsible drogue.

(2) The PDLs should not be used with this system.

(3) The BDA does not have a hose response system; therefore receiver pilots should exercise caution during approach to contact.

(a) Excessive closure rates could result in a broken probe or hose.

(b) Attempts to disconnect which are not made down the correct withdrawal path could result in the probe binding in the reception coupling.

(i) For this reason, the USAF recommends the use of 'Flexitip' probes with the BDA. Flexitip probes have some internal bracings removed; this allows the probe mushroom valve tip some lateral movement within the probe structure and makes an off-centre disconnect easier.

(4) A full description of the BDA is given in the appropriate National Annex.

b. Tanker Installation. The BDA can only be fitted/removed on the ground.

305 Fuel Flow Rates and Pressures. Fuel flow rates vary widely according to AAR installation. In general terms, the boom system offers the highest rate of fuel flow up to 3650 kg/min (8000 lb/min), podded hose systems offer flow rates between 870 kg/min to 1000 kg/min (2800 lb/min to 3200 lb/min) and integral hose systems offer flow rates around 2300 kg/min (5000 lb/min). Fuel pressure is regulated in most systems not to exceed about 3.5 bars (50 psi) at the reception coupling. Fuel transfer rates will be affected by the SG of the fuel and the limitations of the receiver fuel system. See National Annexes for details.

NOTE

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

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

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

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