



STANDARDS RELATED DOCUMENT – SINGAPORE (Formerly National Annex G)

UNCLASSIFIED

ATP 3.3.4.2 (C)

July 2019



CONTENT PAGE

Preliminary	3
Chapter 1 - Receiver Aircrew Qualification and Currency.....	4
Chapter 2 - AAR Points of Contact.....	6
Chapter 3 – National Reservations.....	7
Annex A to National SRD – Singapore A330 MRTT	A-1
Appendix A1 – Singapore A330 MRTT Wing Mounted PODS	A1-1
Appendix A2 – Singapore A330 MRTT Boom	A2-1
Appendix A3 – Singapore A330 MRTT Exterior Lighting.....	A3-1
Appendix A4 – Singapore A330 MRTT Refuelling Visual References.....	A4-1
Annex B to National SRD – Singapore Receiver Data Clearances	B1
Appendix B1 – Singapore: Singaporean Tanker with Singaporean and Foreign Military Receivers: Clearance and Compatability	B1-1
Appendix B2 – Singapore: Singaporean Receivers to Foreign Military and Non- Military Tankers: Clearance and Compatability	B2-1
Appendix B3 – Singapore A330 MRTT – AAR Receiver Information	B3-1
Appendix B4 – Singapore: Common Warnings, Cautions and Notes.....	B4-1
Appendix B5 – Singapore: Boom Receiver Specific AAR Information	B5-1
Appendix B6 – Singapore Pod Receiver Specific AAR Information.....	B6-1

PRELIMINARY**INTRODUCTION**

1. Singapore has two tanker types, namely (1) A330 MRTT and (2) KC-130B, in operational service with the Republic of Singapore Air Force (RSAF). The RSAF complies with all ATP 3.3.4.2 (ATP-56) procedures unless stated otherwise in this national SRD.

PURPOSE

2. The primary function of this document is to provide operating aircrew with definitions, abbreviations, procedures and pertinent information to enable safe and efficient AAR operations with Singapore A330 MRTT (Multi-Role Tanker Transport). The appropriate OIP for RSAF aircraft with an in-flight refuelling capability provide specific information on techniques and procedures for performing AAR operations.

TANKER AIRCRAFT TYPE

3. A330 MRTT. See Annex A for full details.

NATIONAL AAR CLEARANCE PROCESS

4. Requests for AAR clearances with Singapore tankers should be made IAW ATP 3.3.4.2 SRD-1 Guide to Obtaining Air-To-Air Refuelling Clearances and Compatibility Certification. The format, content and addresses for a clearance request are at Annex B of this document, along with additional information on Singapore A330 MRTT and RSAF receiver AAR clearances.

AAR ARRANGEMENTS

5. Relevant bi-lateral or multi-lateral AAR Implementing Arrangements are to be in place between Singapore and the nation requiring AAR support. These arrangements will include conduct of operations, training and currency of aircrew, certification and testing of the tanker-receiver pair, logistics/fiscal issues and relevant legal/liability issues. Singapore currently has AAR Arrangements with the United States, United Kingdom, France, Australia, Thailand, Italy and Netherlands.

CHAPTER 1 - RECEIVER AIRCREW QUALIFICATION AND CURRENCY

INTRODUCTION

1. The RSAF complies with NATO SRD-2—Recommended Air-to-Air Refuelling (AAR) Aircrew Certification and Currency. Unless specifically agreed otherwise, before attempting to refuel from Singapore tankers, foreign national aircrew must be receiver qualified within their own Air Force. Additionally, the receiver aircrew must have been briefed by one of the following:

- a. A qualified and current Singapore A330 MRTT pilot
- b. Receiver AAR instructor, qualified and current, to refuel from the Singapore A330 MRTT
- c. An authorised officer delegated by the Commanding Officer (CO) of the RSAF tanker Squadron

2. As a minimum, the briefing will include:

- a. Closure limitations
- b. Lighting schemes
- c. Boom/Pod procedures as applicable
- d. Possible difficulties
- e. Emergency actions
- f. The briefing is to be given with the aid of the relevant Singapore Annexes of the ATP 3.3.4.2

MAINTAINING AAR CURRENCY ON SINGAPORE A330 MRTT – FOREIGN NATIONAL AIRCREW

3. After initial qualification, receiver currency requirements for foreign national aircrew receiving from Singapore A330 MRTT include both of the following:

- a. AAR currency and qualifications IAW receiver national

regulations

b. AAR mission in the preceding six months, including a minimum of one contact as a receiver (wet or dry)

4. Re-Qualifying if AAR Currency Has Lapsed. To regain currency in the event that foreign national AAR currency lapsed, a current and qualified instructor (who may be in another aircraft) must brief and monitor at least one re-qualifying flight, which must include a minimum of one contact (wet or dry).

CHAPTER 2 - AAR POINTS OF CONTACT1. POC for National SRD.

AIR - HQ RSAF - Air Operations Department
Transport Operations Branch
303 Gombak Drive #03-15
MINDEF Building
Singapore 663645

Tel: +65 6768 2646 / 6768 2594

Email: rsaf_tob@defence.gov.sg

2. POC for 112 Squadron.

Air Combat Command
Transport Group
112 Squadron
7629 Cranwell Road
Singapore 509863

Tel: +65 6586 4205 / 6586 4207

Email: 112sqn@defence.gov.sg

LAST UPDATE

3. Singapore SRD was last updated – July 2019.

4. Please check the date of this SRD and check it against the National SRD posted at the following website to ensure this is the most current national SRD:
<http://www.japcc.org/aar>

CHAPTER 3 – NATIONAL RESERVATIONS

1. Singapore AAR Airspace Arrangements. Published in the Aeronautical Information Publication (AIP), available from: <http://www.caas.gov.sg/rlegislation-regulations/guidelines-advisory/air-navigation-services/aeronautical-information-publication-amendments>
2. A330 MRTT AAR Precautions. HF radio, including data link transmissions shall not be made within ½ NM of Singapore A330 MRTT. Additionally, hot armament safe checks and forward radar/emitters to OFF/STDBY checks shall be made prior to closing with Singapore A330 MRTT.
3. EMCON. Singapore A330 MRTT adopts EMCON 2 procedures as the standard of refuelling for day to day operations; however other EMCON procedures may be briefed and used. Visual signals will be as published in ATP 3.3.4.2 Annex 2Q.
4. Practice Emergency Separations. Practice emergency separations are conducted IAW published ATP 3.3.4.2 (ATP-56) breakaway procedures:
 - a. Prior to the accomplishment of a practice emergency separation, coordination between the tanker pilot, Air Refuelling Operator (ARO) and the receiver pilot is mandatory. Coordination must include a briefing from the ARO on when the separation will occur and who will give the command of execution. Positive response from the receiver pilot is required. Response from the tanker pilot to the ARO may be given over interphone.
 - b. In some cases the receiver may move down and forward out of view of the AROs camera system during a separation. In this situation the ARO shall request the receiver to confirm well clear before advising the tanker captain that the receiver is well clear. If there is uncertainty of the receiver's position or a lack of response, the tanker will maintain the separation manoeuvre and consider climbing until safe separation is confirmed.
5. ATP 3.3.4.2 Rendezvous Procedures. RV Bravo and RV Charlie will not normally be executed by Singapore A330 MRTT Tankers but may be accomplished if briefed.
6. RV Delta. The A330 MRTT default procedure for RV Delta is Option 2 (USAF). Where the receiver RV speed is not known, Option 1 will be used.

ANNEX A TO NATIONAL SRD – SINGAPORE A330 MRTT**TANKER INFORMATION**

1. Introduction. Singapore A330 MRTT is equipped with an Advanced Refuelling Boom System (ARBS), wing-mounted AAR pods and a Boom Enhanced Visual System (BEVS). The aircraft also has a Universal Aerial Refueling Receptacle Slipway Installation (UARRSI) for receiving fuel from boom-equipped tankers.

2. Receiver Types Certified. Details of receiver technical clearances together with AAR speeds and altitudes are published in Annex B—Receiver/Data Clearances. In addition, Annex B provides Air Refuelling Operators (AROs) with receiver information essential to achieving safe AAR operations. For non-SIN receiver aircraft, the publishing of information in Annex B does not constitute an automatic authority to undertake refuelling.

AAR EQUIPMENT

3. There is one centreline Advanced Refuelling Boom System (ARBS) and two wing-mounted AAR pods operated by an ARO. The aircraft also has an UARRSI.

UNDER-WING REFUELING PODS

4. Description. Singapore A330 MRTT aircraft are fitted with two Cobham 905E under-wing refuelling pods. The hose length that trails from the pod is 93.5 ft (28.5 m). The hose is black and is marked by a series of bands as shown in Figure A1-5. The free end of the hose terminates in a MA-4 refuelling coupling and a conical shaped drogue. The aircraft is fitted with multiple cameras capable of monitoring both wing pods simultaneously during day or night.

5. Basic Operation. The hose must be pushed in at least 5 ft (1.52 m), indicated by a solid green light in overt mode or bottom IR light in covert mode, to start the fuel flowing. Specifics include:

a. Receiver Actions. The refuelling position inner limit is 63 ft and the outer limit is 83 ft hose of extension, thus providing a fore and aft range of movement of 20 ft.

b. Receiver Too Close. If the inner AAR limit is exceeded, the amber light flashes in overt mode or centre and bottom IR lights in

covert mode. Refer to Appendix A1, Figure A1-4 Singapore A330 MRTT Wing Pods Status Lights for appropriate receiver actions during AAR.

c. Simultaneous Contacts. The A330 MRTT is approved for simultaneous Pod AAR contacts.

6. Pod Lighting:

a. Day AAR. Red, amber, and green signal lights are located on the sides of the aft pod tail cone fairing. They are set up in pairs for redundancy and are clearly visible to the receiver pilot. The red (WARNING) signal lights are illuminated whenever the pods are not ready for receiver contact. The red lights also flash to signal a breakaway command along with a flashing lower Rendezvous light (beacon). Both left and right pods are controlled from a common breakaway switch on the ARO console.

b. Night AAR. The intensity of the coloured overt lights can be adjusted. The red lights will illuminate at 100% intensity in the case of a pod fault. The drogue has NVG compatible LED lighting powered by a small air driven generator in the coupling.

c. Covert Lights. The Pods are each fitted with two sets of covert infrared signal lights for covert operations and for night vision equipment compatibility. The overt and covert lights are mutually exclusive.

7. Pod Markings. Black and white reference lines are provided on each wing pod and on the underside of the tanker wing to aid the receiver pilot with alignment prior to contact with the drogue. One line is painted on each side of each wing pod on the underside of the wings and a third line is located on the bottom of each wing pod and is used as a centre for receiver aircraft alignment.

ADVANCED REFUELLING BOOM SYSTEM (ARBS)

8. Description. The A330 MRTT ARBS comprises a refuelling boom, boom lighting system, Boom Enhanced Vision System (BEVS) and Air Refuelling Operator (ARO) station. The ARBS is equipped with fly-by-wire flight control system. It provides an Automatic Load Alleviation System (ALAS) and has an auto-disconnect envelope for each receiver. The boom is located underneath the rear fuselage of the tanker aircraft and is 60 ft (18.2 m) long when fully extended. The system can transfer up to 3,300 kg/min (7,340 lb/min, 1,150 USGpm) of fuel at a pressure of 50 +/- 5 PSI, as per MCOM. Six

AAR fuel pumps are automatically controlled by an Air Refuelling Computer to control delivery fuel pressure and flow rates for individual receiver types. Fuel delivery pressure reduces prior to scheduled offload completion.

9. Basic Operation. The boom is remotely controlled from the ARO station in the cockpit. The ARO uses a 3D BEVS to monitor the AAR process. A 2D vision and reduced capability independent 3D backup option is available if the primary 3D vision system is degraded. Night refuelling is performed using BEVS IR 3D vision with IR illuminators, also with backup vision options. IR illuminators are not compatible with NVG equipment.

10. Basic Operational Procedures:

a. When ready to refuel, the boom is lowered from its stowed position and 12 ft (3.7 m) of the telescopic boom is extended by the ARO.

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

c. Closure to contact will be slow and stable (approximately one foot per second) with the receiver stabilising in the contact position.

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

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

11. Automatic Disconnect. Provided the receiver remains within the envelope, contact is maintained; however, if the receiver approaches the envelope limits, a disconnect will automatically occur. To ensure that physical disconnect occurs prior to the envelope limit, the system will anticipate the rate at which the receiver is approaching the envelope limits and automatically disconnect.

12. Boom Control Envelope. The Singapore A330 MRTT has three categories of Flight Control Laws (FCL); namely (1) SMALL, (2) F15 and (3) HEAVY.

13. Normal Disconnect. To initiate a disconnect, the A330 MRTT ARO or receiver pilot will command the disconnect whilst the receiver remains stabilised

in the contact position. Once the ARO and/or receiver confirms a disconnect has been achieved, the receiver then moves to the astern position.

14. Independent Disconnect System (IDS). The Singapore A330 MRTT boom is equipped with an electrical IDS that operates whenever a disconnect is commanded by the tanker or detected from the receiver. This ensures a disconnect even if a fault occurs in the receiver's UARRSI latches. An alternate IDS signal path is available in the case that the normal disconnect process is ineffective. A Control Tension Disconnect procedure is available for Singapore A330 MRTT.

15. AAR Boom Lighting:

a. Description. Pilot Director Lights (PDL) provide positioning information to receiver pilots during boom type refuelling. The PDLs are located on the bottom of the fuselage, aft of the nose landing gear; they consist of two panels of lights. The left panel gives boom elevation information and the right panel gives boom telescoping information. See Appendix A2.

b. Basic Operation. The lights are controlled by movement of the boom in elevation and by the in and out movement of the telescoping portion. These lights indicate the position of the boom in relation to the boom operating envelope and command the direction of receiver movement required to bring the boom to the ideal refuelling position, they are not predictive.

c. Receiver Actions:

(1) Elevation. At one end of the elevation panel is the illuminated letter U (for up); at the other end is the illuminated letter D (for down); see Appendix A2. Adjacent to the letters are red arrowheads. If a receiver is in contact with the boom near the upward elevation limit, the red arrowhead next to the D will be illuminated; this indicates a downward movement is required. As the receiver moves down, the red light extinguishes and an amber arrowhead illuminates, indicating the boom is approaching the ideal elevation. When the ideal elevation is reached, the amber light extinguishes and a green bar illuminates.

(2) Longitudinal Position. Longitudinal position is verified using similar indications to those described above for the vertical position. The right-hand telescoping panel is similar in function,

although the display is slightly different. The ends of the panel have the illuminated letters F and A (forward and aft); see Appendix A2. The position information and movement commands are given by illuminated horizontal bars with red leading into amber, with the ideal position shown by a green bar illuminating. The command indications are separated by illuminated vertical white bars to give contrast. The PDL indications represent real envelope position. The telescoping part of the boom is in coloured segments which represent real beam extension. Lights are not provided for azimuth positioning; however, a fluorescent yellow stripe on the under surface of the tanker fuselage is provided for centreline reference. See Appendix A2.

(3) Disconnect. Receiver or Tanker disconnect actuation extinguishes all PDLs momentarily and then displays a red fly down and aft command until the system is reset.

d. Visual References. Receivers should refer to Appendix A4 for illustrations and description of tanker visual references.

e. EMCON Procedures. Based on the EMCON procedures agreed upon between the Receiver and Tanker, the PDLs are used to give positioning commands to direct a receiver into the boom contact position. A steady red PDL commands a large movement in the direction indicated, and a flashing red light commands a small correction. The PDLs are extinguished to signal a request for disconnect.

f. Failure of PDLs to Illuminate:

(1) PDLs Failure. If the PDLs have failed or do not illuminate when a receiver makes contact, the receiver pilot will inform the boom operator if refuelling will continue. If refuelling is continued, verbal corrections from the boom operator may be requested.

(2) PDLs Fail during Contact. If the PDLs go out during contact, the receiver shall initiate a disconnect and return to the astern position. Subsequently, if refuelling is continued, verbal corrections from the boom operator may be requested.

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

h. Other Illumination. During night AAR, the AAR (Infrared illuminators), and boom nozzle light (four small red LEDs) will be used to illuminate the receiver and provide boom nozzle tip indication to receiver pilots, respectively. At night, the coloured telescoping segments of the boom are illuminated by boom marker lights.

16. Refuelling Altitude/Level and Speeds:

a. AAR RV Speed. The A330 MRTT default procedure for RV D is option two (USAF). Where the receiver RV speed is not known, option one will be used.

b. Pod AAR. Speed range for Sargent Fledged drogue (SFI) is 260 to 325 KCAS / M0.86.

(1) Pod AAR – receiver emergency. The Singapore A330 MRTT may refuel probe equipped receivers below the minimum altitude specified in the applicable clearance/SRD during non-normal situations such as receiver emergencies. Unless an approved clearance states lower, the lowest level the Singapore A330 MRTT will refuel will be 5000ft AGL. Additionally, the A330 MRTT will not to operate below LSALT/MSA unless able to maintain Visual Meteorological Conditions (VMC) and visual clearance from terrain/obstacles. All other restrictions and limitations relevant to the receiver type will apply.

c. Boom. Boom AAR height band is:

(1) SMALL Boom Flight Control Law 1,500 ft AGL to 35,000 ft; speed range is 180 to 325 KCAS / M0.86

(2) F-15 Boom Flight Control Law 1,500 ft AGL to 35,000 ft; speed range is 250 to 315 KCAS / M0.80

(3) HEAVY Boom Flight Control Law 1,500 ft AGL to 30,000 ft; speed range is 225 to 300 KCAS / M0.80

17. Maximum Transferable Fuel. Total fuel load is 244,000 lb.

a. Maximum transferable fuel is normally indicated for a standard 4-hours mission. I.e French AF SRD for the Phoenix (A330 MRTT).

b. Total fuel load is 111 metric tons (244,000 lbs) Transferable fuel

is dependent on sortie duration; about 85 metric tons (187,000 lbs) is available for transfer during a four hour tanker mission, assuming a fuel burn rate of six metric tons/hr (13,200 lbs/hr).

18. AAR Fuel Transfer Rate. The tanker can transfer fuel at the following rates:
 - a. Pod. 420 US gal/min (2,750 lb/min - 1,250 kg/min) through the wing hoses.
 - b. Boom. 1,150 US gal/min (7,340 lb/min – 3,300 kg/min) through the boom.
19. Regulated Fuel Pressure. Fuel is delivered to the receiver at the regulated pressure of 50 +/- 5 psi (3.5 +/- 0.35 bar).
20. Tanker-to-Tanker Refuelling Ops. The Singapore A330 MRTT is capable of conducting tanker-to-tanker AAR operations.
21. Fuel Types Available for AAR:
 - a. Primary Fuel. The primary fuel is JP-8.
 - b. Alternate Fuels. The alternative fuels are Jet A, Jet A1, Jet B, JP4, JP-5, N°3 Jet, TS-1 and RT.
22. Lighting. The aircraft has an extensive array of lights which are adjustable for brilliance; formation keeping lights and I/R illuminators are also provided. For conducting night AAR, IR cameras and lighting sources are used. External light systems allow the aircraft to operate in Overt mode (using visible lights) and in Covert mode (the tanker uses IR lights and the receiver pilot uses night vision goggles). Appendix A3 - Table A3-1 & 2 show the standard pre-flight AAR lighting settings:
 - a. Overt mode. An operational mode in which the AAR process is performed with the help of the visible lights (rendezvous lights, self-illumination lights and formation lights). This operational mode can be used for both boom and pod AR operations.
 - b. Covert mode. An operational mode in which the AAR process is performed without the help of the visible lights (using only rendezvous and formation IR lights). In this mode only pod AAR operations can take place.

- c. Rendezvous Lights and Formation Lights. Able to operate in covert and overt modes. Rendezvous lights have different flash patterns. The number of flashes generally indicates the aircraft number in a multi-ship formation. All the external lights used for AAR operations are dimmable. See Appendix A3, Figures A3-1 & 2.

23. Mark Facilities. The A330 MRTT has the following mark facilities for receivers to positively identify the tanker:
 - a. Seven discrete rendezvous flash patterns.
 - b. The ability to vary the intensity of all covert and overt self-illumination lighting.
 - c. A fuel dump facility - the tanker needs to be configured for this, and is only practical as a last resort location aid.

24. RV Aids. The A330 MRTT has the following radio, navigation and RV aids:
 - a. VHF x 1, V/UHF x 3 and HF x 2 radios and SATCOM (1 x MIL, 1 x CIVIL)
 - b. VOR, TACAN, INS, GPS, and weather radar
 - c. A/A TACAN (1 x Standard, 1 x BEACON, ETCAS)

25. Average Fuel Burn Rate – 15,000 lbs/hr.

26. Dimensions. The A330 MRTT is 59.0 m (193 ft 7 in) long and has a wingspan of 60.3 m (197 ft 10 in).

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ANNEX A TO NATIONAL SRD - SINGAPORE

APPENDIX A1 – ANNEX A TO NATIONAL SRD – SINGAPORE A330
MRTT WING MOUNTED PODS

TO BE UPDATED AT A LATER DATE

**APPENDIX A2 – ANNEX A TO NATIONAL SRD – SINGAPORE A330
MRTT BOOM**

Figure A2-1: Singapore A330 MRTT Pilot Director Lights Diagram

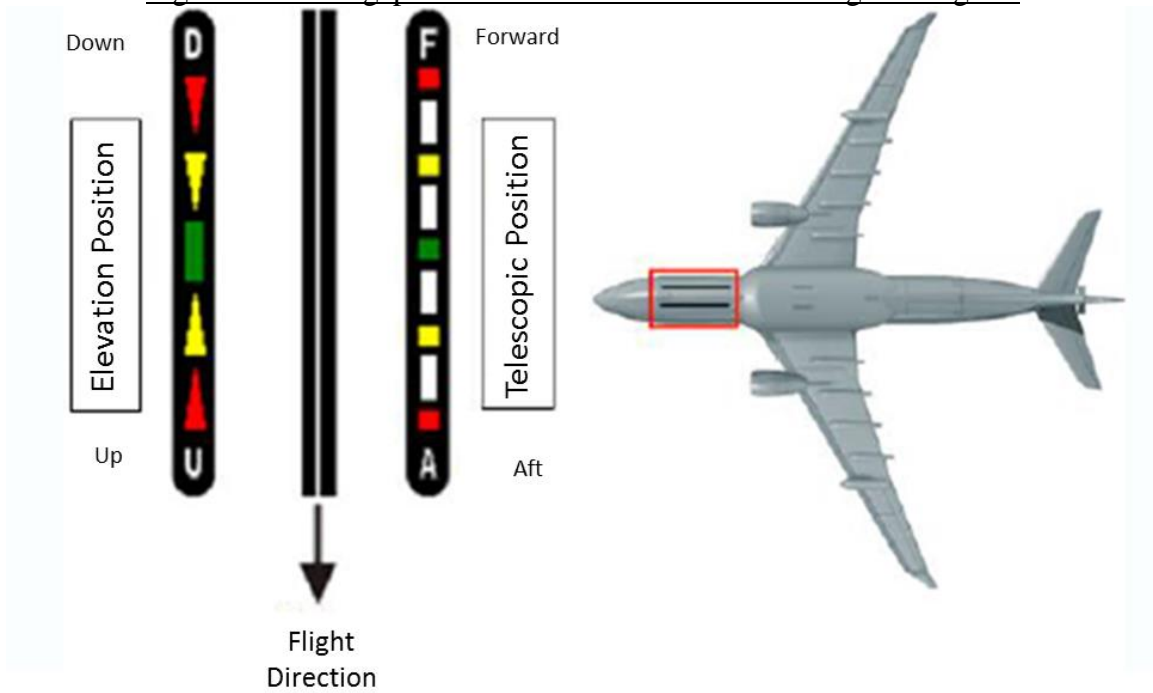
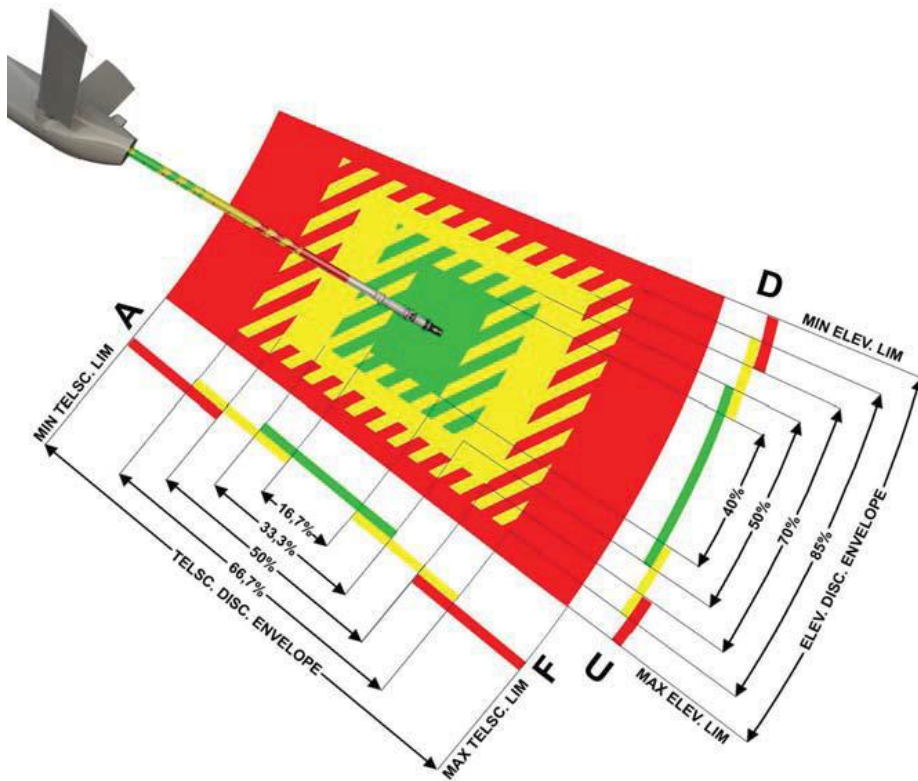


Figure A2-2: Singapore A330 MRTT Boom Pilot Director Light Profile



APPENDIX A3 – ANNEX A TO NATIONAL SRD – SINGAPORE A330
MRTT EXTERIOR LIGHTING

Figure A3-1: Singapore A330 MRTT Exterior Lighting

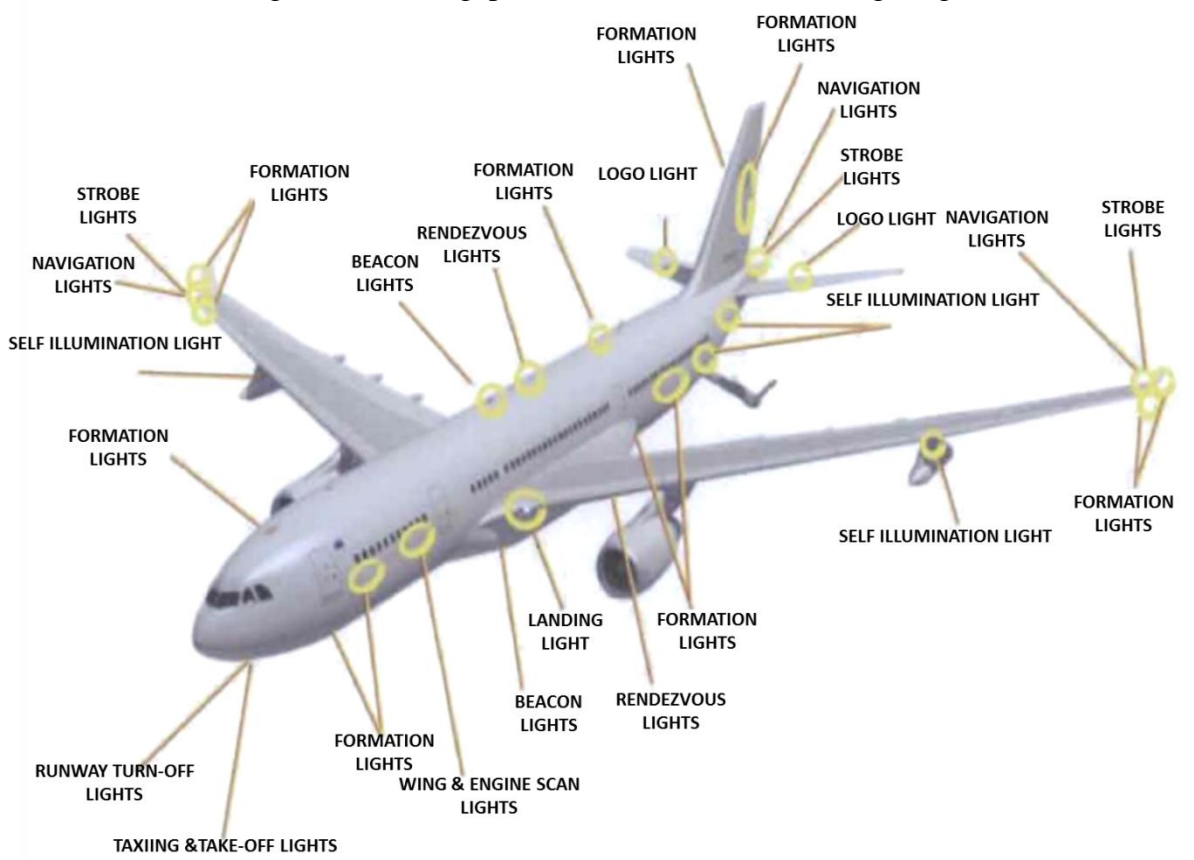


Figure A3-2: Singapore A330 MRTT Pod Light Settings

RECEIVER POSITION		OVERT OPERATION			COVERT OPERATION		
NOT IN CONTACT	IN CONTACT	RED	AMBER	GREEN	3 LIGHTS	2 LIGHTS	1 LIGHT
Not applicable	<p><u>Too close-Move aft</u></p> <p>Mandatory instruction: move aft immediately. Receiver is forward of the refuelling range and is too close to the tanker. Fuel flow stops.</p>	OFF	FLASH	OFF	OFF	FLASH	FLASH
<p><u>Clear contact</u></p> <p>Tanker ready for receiver to make contact. Receiver should make contact with hose.</p>	<p><u>Move forward into refuelling range</u></p> <p>Hose is aft of refuelling range. Receiver should continue to push hose in to enter refuelling range. Fuel flow stops.</p>	OFF	ON	OFF	OFF	ON	ON
<p><u>Breakaway</u></p> <p>Mandatory instruction: carry out procedure described in ATP3.3.4.2 (ATP-56) for Breakaway. Flashing red or 3-light signal has been displayed for 10 seconds. After that the signal should revert to red or 3-light ON until the tanker crew resumes normal operations.</p>	<p><u>Breakaway</u></p> <p>Mandatory instruction: carry out procedure described in ATP3.3.4.2 (ATP-56) for Breakaway. Flashing red or 3-light signal has been displayed for 10 seconds. After that the signal should revert to red or 3-light ON until the tanker crew resumes normal operations.</p>	FLASH	OFF	OFF	FLASH	FLASH	FLASH
<p><u>Maintain astern</u></p> <p>Tanker not yet ready to refuel receiver. Receiver should remain in Astern or pre-contact position. May also indicate a pod fault.</p>	<p><u>Disconnect</u></p> <p>Mandatory instruction: non-emergency disconnect. Receiver is to carry out a normal disconnect and either: Radio procedure: follow ARO instructions. Radio silent: move to reform position. May also indicate a pod fault.</p>	ON	OFF	OFF	ON	ON	ON
Not applicable	<p><u>Clear to disconnect as required</u></p> <p>Receiver is in refuel range but fuel flow is less than 50 US gal per min. Radio procedures: Await instruction from tanker crew. Radio silent: Maintain position or disconnect when ready. Receiver pilot should determine reason for fuel flow as either: a. Tanks are full b. Receivers switch selections incorrect c. Soft contact d. Dry contact</p>	OFF	OFF	FLASH	OFF	OFF	FLASH
Not applicable	<p>Receiver is in refuel range and fuel flow is more than 50 US gal per min. Receiver should: Radio procedure: Await instruction to disconnect. Radio silent: Maintain position or disconnect.</p>	OFF	OFF	ON	OFF	OFF	ON

*Steady Red light should also be included for scenario in which receiver remains a long time between Standby and Outer limit.

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ANNEX A TO NATIONAL SRD - SINGAPORE

APPENDIX A4 – ANNEX A TO NATIONAL SRD – SINGAPORE A330
MRTT REFUELLING VISUAL REFERENCES

TO BE UPDATED AT A LATER DATE

ANNEX B TO NATIONAL SRD – SINGAPORE RECEIVER DATA
CLEARANCES

INTRODUCTION

1. This annex provides technical compatibility, clearances and important data essential for safe Boom/Receptacle and Probe/drogue operations with RSAF tankers.

NOTE

It is the responsibility of nations performing AAR with Singapore to inform the RSAF of any evolution of their receiver aircraft which may change the AAR capability (addition of antenna, modification of fuel systems and/or probe, particularities of new tanks, modification of flight controls law etc).

AAR Requests

2. Please send through Military Attaché to:

a. Air Force Headquarters: Transport Operations Branch

3. A formal request for an AAR Clearance could be tanker or receiver initiated. The following information is the minimum required to be sent by the requesting agency. The requesting nation/organization should make its request to the agency identified in the other nation/organization's SRD to ATP 3.3.4.2. The below information is an example of, but not limited to, what should be included in the formal request:

a. AAR Clearance Category sought. (CAT1, CAT2, CAT3).

b. Details of AAR MoU or AAR Implementing Arrangements between Nations.

c. Operational Mission Requirements, including preferred AAR envelope.

d. Type of refuelling system involved. (Hose/drogue, boom/receptacle, Boom Drogue Adaptor (BDA) or all three).

e. Type and make of all aircraft requiring AAR. (Can be model IE F-16D, receiver flagged nation).

f. Availability of Standardised Technical Data Sheet (STDS) and

POC for technical compatibility assessments.

- g. Data on all receiver aircraft emitters (ie. peak power, average power, gain and frequency band data for all receiver RF emitters). These are required for inadvertent HIRF and HERP effects on tanker systems and personnel.
- h. Flight test results/reports and POC.
- i. POC and authority for operational evaluation concerning training, currency and AAR operations.
- j. Authority for direct contact with receiver and tanker aircraft manufacturers, AR system manufacturers, OEM or others (including limitations on data exchange).
- k. POC of receiver and tanker aircraft and AAR system manufacturers, OEM or others.
- l. Previous AAR clearances between the designated receiver and other tankers.
- m. Fuel type required.

**APPENDIX B1 – ANNEX B TO NATIONAL SRD –SINGAPORE:
SINGAPOREAN TANKER WITH SINGAPOREAN AND FOREIGN
MILITARY RECEIVERS: CLEARANCE AND COMPATABILITY**

Table B1-1: RSAF A330 MRTT to Singapore and Foreign Military Receivers Clearance and
Technical Compatibility Matrix

COUNTRY	FORCE	AIRCRAFT	BOOM	PODS	REMARKS
SGP	RSAF	F-15SG	C3		
SGP	RSAF	F-16C	C3		
SGP	RSAF	F-16D	C3		
SGP	RSAF	F-16D+	C3		
SGP	RSAF	A330 MRTT	C3		
AUS	RAAF	KC-30A	C3		Expiry: 25/04/2024
<p>Note:</p> <p>C1 – Receiver has Category 1 Clearance C2 – Receiver has Category 2 Clearance C3 – Receiver has Category 3 Clearance</p>					

APPENDIX B2 – ANNEX B TO NATIONAL SRD – SINGAPORE:
SINGAPOREAN RECEIVERS TO FOREIGN MILITARY AND NON-
MILITARY TANKERS: CLEARANCE AND COMPATABILITY

Table B2-1: RSAF Receiver with Foreign Military and Non-Military Tankers Clearance and
Technical Compatibility Matrix

COUNTRY	FORCE	TANKER	F-15SG	F-16C	F-16D	F-16D+	A330 MRTT
AUS	RAAF	KC-30A		C3	C3	C3	C3
Note:							
C1 – Receiver has Category 1 Clearance							
C2 – Receiver has Category 2 Clearance							
C3 – Receiver has Category 3 Clearance							

**Appendix B3 – Annex B to National SRD – Singapore A330 MRTT – AAR
Receiver Information**

Table B3-1: AAR Mission Planning Data (Boom)

RECEIVER	AAR ENVELOPE FL / KCAS / MACH	kg/min /PUMPS	DISCONNECT LIMITS	
			L U F	R D A
SGP F-15SG	100-300 / 265-300 ¹ / 0.78	1400 / 2	10 – 15 25 – 40 10 – 21	
SGP F-16C	080-300 / 265-315 / 0.76	1400 / 2	15 – 15 28 – 40 6 – 21	
SGP F-16D	080-300 / 265-315 / 0.76	1400 / 2	15 – 15 28 – 40 6 – 21	
SGP F-16D+	080-300 / 265-315 / 0.76	1400 / 2	15 – 15 28 – 40 10 – 21	
SGP A330 MRTT	100-300 / 225-300 / 0.80	3600	15 – 15 23 – 37 6 – 21	
AUS KC-30A	150-300 / 250-290 / 0.80	3600	15 – 15 23 – 37 6 – 21	

¹ Refer to Figure B5-1 for the AAR envelope.

APPENDIX B4 – ANNEX B TO NATIONAL SRD – SINGAPORE:
COMMON WARNINGS, CAUTIONS AND NOTES

WARNINGS

1. HF radio, including data link transmissions shall not be made within ½ NM of RSAF A330 MRTT tanker aircraft.
2. For all boom receiver AARs, do not transmit on HF radio when receiver is in close proximity or in contact with the AAR boom, unless otherwise specified.
3. All IFF interrogator, electronic stores, radar and electronic counter measures must be turned OFF or STBY prior to aerial refueling.
4. One Engine Inoperative (OEI) AAR is only permitted for mission or safety critical requirements.
5. Tanker airspeed and altitude adjustments must be made smoothly and cautiously while the receiver is in or near the contact position. Any airspeed or altitude adjustments required by the tanker should be accomplished after the receiver is stabilized in the contact position.
6. In the case of a large receiver, excessive closure rate may cause the tanker to descend into the path of the receiver. The tanker pilot must be prepared to disconnect the autopilot to prevent altitude deviations.
7. The ARO must be constantly aware of the receiver's position and rate of movement. The receiver's rate of movement toward an envelope limit will determine the need to initiate a disconnect. If the movement is toward the inner limit, AROs will exercise sound judgement in initiating a disconnect or breakaway prior to the receiver exceeding the limit or underrunning the tanker.

CAUTIONS

8. Emergency separations may cause the receiver to drop low and out of view of the Boom Enhanced Vision System (BEVS) image. This could result in the ARO being unable to maintain visual contact. The ARO should request a "well clear" call from the receiver prior to terminating the separation.
9. Anytime a receiver is forward of the astern position, bright and sustained reflections off the receiver may degrade BEVS fidelity and cause loss

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ANNEX B TO NATIONAL SRD - SINGAPORE

of visibility of the receiver and receptacle area. If visibility precludes making contact, the ARO should return the receiver to astern. If visibility is insufficient to ensure safe separation, the ARO should call a breakaway.

10. For all fighter aircraft, avoid excessive retraction rates to prevent pulling the receiver forward if a disconnect is not obtained.

11. Contact will not be attempted until the fighter type receiver has stabilized 2 to 3 feet from the contact position.

12. For UARRSI and all fighter receptacles, to minimize nozzle cocking when making contact with the receiver, the boom nozzle should be inserted directly into the receptacle without the aid of the slipway. Using the slipway may cause the nozzle to cock, preventing contact.

13. Due to limitations of the visual system. Exercise caution to avoid striking any antenna in the vicinity of the AAR receptacle.

14. Any attempt to affect a contact during loss of any AAR lighting that results in less than desired illumination will be at the discretion of the ARO.

NOTES

15. When EMCON permits, a verbal armament check will be accomplished between the tanker and receiver/s carrying forward firing ordnance during the RV initial call. The verbal hot armament check accomplished between the tactical air controller and the receiver will satisfy this requirement.

16. Night is defined as the period from sunset to sunrise in each twenty-four hours, when the Sun is below the horizon.

**APPENDIX B5 – ANNEX B TO NATIONAL SRD – SINGAPORE: BOOM
RECEIVER SPECIFIC AAR INFORMATION**

1. Read this Appendix in conjunction with Appendix B1 and B4.

Table B5-1: AAR Data for RSAF A330 MRTT Tanker

Receiver Aircraft	Page
SGP F-15SG	B5-2
SGP F-16	B5-5
SGP A330 MRTT	B5-7
AUS KC-30A	B5-8

SGP F-15SG



AAR Envelope

1. Altitude: FL100 – FL300
2. Airspeed: Refer to **Figure B5-1**
265 – 300 KCAS for FL150 and above
265 – 290 KCAS at FL100
Mach \leq 0.78M
3. Boom envelope shall be IAW **Table B5-2**

Table B5-2: MRTT ARBS Envelope for F-15SG

RSAF F-15SG	DISCONNECT
Boom Elevation	25° (upper) – 40° (lower)
Boom Roll	10° left – 15° right
Boom Telescopic	10 – 21 ft

Figure B5-1: AAR Envelope for MRTT – F-15SG Pairing

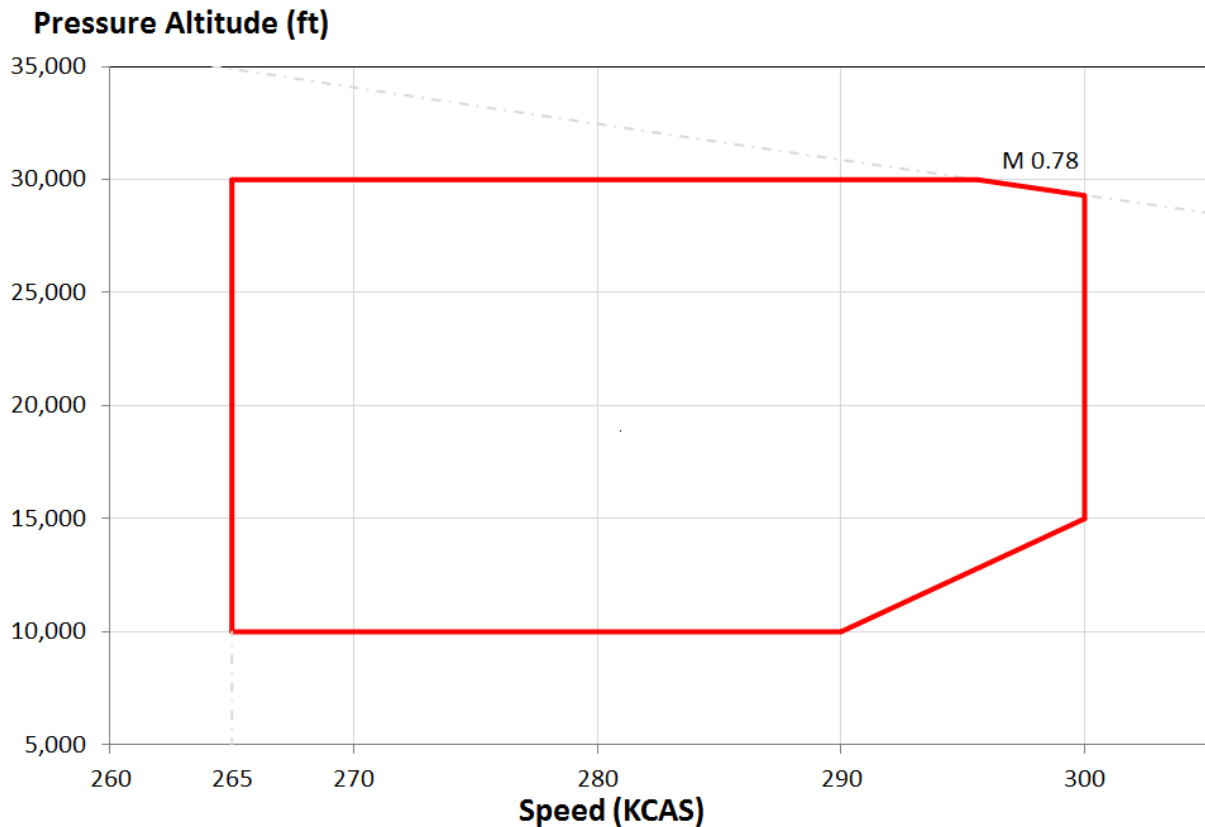


Table B5-3: Restrictions for MRTT – F-15SG AAR Operation

S/N	RESTRICTIONS
1	Tanker’s and receiver’s HF-1 and HF-2 radios shall be turned OFF or INHIBIT prior to the receiver advancing closer than the pre-contact position.
2	All IFF interrogator, electronic stores, radar and electronic counter measures must be turned OFF or STBY prior to aerial refuelling.
3	One Engine Inoperative (OEI) AAR is only permitted for mission or safety critical requirements.
4	F-15SG shall not carry stores on forward left CFT station (LC3 and LC6).

4. The MRTT ARBS version must be or later than Upgrade III Loop 6.1. MRTT AAR operation with F-15SG can only be conducted with the boom F-15 FCL (CL2F15 and CL2pF15).

5. Receiver asymmetry limits:

- a. For gross weight \leq 60,000 lbs, limited to 20,000 ft-lbs asymmetry
- b. For gross weight $>$ 60,000 lbs, limited to 5,000 ft-lbs asymmetry

NOTE

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ANNEX B TO NATIONAL SRD - SINGAPORE

During flight test, a left roll tendency was observed in the centre and right side of the boom envelope. These require a slight constant right aileron and/or rudder inputs to maintain in position. Aircrew qualitatively assessed that the workload was minimal to moderate and was manageable.

During Boom disconnect, aircraft may yaw left (up to approximately 2°) into the boom as the boom was flying up and away from the receptacle. The workload to ensure safe separation was minimal and manageable.

SGP F-16



AAR Envelope

1. Altitude: FL080 – FL300
2. Airspeed: 265 – 315 KCAS and $\leq 0.76M$
3. Boom envelope shall be IAW **Table B5-4**

Table B5-4: MRTT ARBS Boom Envelope for F-16

RSAF F-16		DISCONNECT
Boom Elevation		28° (upper) – 40° (lower)
Boom Roll		15° left – 15° right
Boom Telescopic	C/D	6 – 21 ft
	D+	10 – 21 ft

Table B5-5: Restrictions for MRTT – F-16 AAR Operation

S/N	RESTRICTIONS
1	Tanker's and receiver's HF-1 and HF-2 radios shall be turned OFF or INHIBIT prior to the receiver advancing closer than the pre-contact position.
2	All IFF interrogator, electronic stores, radar and electronic counter measures must be turned OFF or STBY prior to aerial refuelling.
3	One Engine Inoperative (OEI) AAR is only permitted for mission or safety critical requirements.

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ANNEX B TO NATIONAL SRD - SINGAPORE

4. F-16C/D is limited to gross weight $\leq 42,300$ lbs.
5. F-16D+ is limited to gross weight $\leq 45,000$ lbs.

NOTE

In the contact position with the MRTT, the F-16C/D/D+ may slowly oscillate in yaw (+/- 3 deg) as boom wake impinges the F-16's tail. This is more likely to occur when the F-16 is high and forward in the boom envelope. Without corrective action, the F-16 position may oscillate beyond +/- 10 deg boom roll. It is widely accepted to be a pure yaw oscillation that develops instead of roll/yaw. Applying either a small lateral input or utilizing coordinated rudder with opposing lateral input to stabilize the F16 in a steady heading sideslip can damp out the oscillations should they be experienced.

SGP A330 MRTT



AAR Envelope

1. Altitude: FL150 – FL300
2. Airspeed: 250 – 290 KCAS and $\leq 0.80M$
3. Boom envelope shall be IAW **Table B5-6**

Table B5-6: MRTT ARBS Boom Envelope for RSAF A330 MRTT

RSAF A330 MRTT	DISCONNECT
Boom Elevation	23° (upper) – 37° (lower)
Boom Roll	15° left – 15° right
Boom Telescopic	6 – 21 ft

Table B5-7: Restrictions for MRTT – MRTT AAR Operation

S/N	Restrictions
1	Tanker's and receiver's HF-1 and HF-2 radios shall be turned OFF or INHIBIT prior to the receiver advancing closer than the pre-contact position.
2	All IFF interrogator, electronic stores, radar and electronic counter measures must be turned OFF or STBY prior to aerial refuelling.
3	One Engine Inoperative (OEI) AAR is only permitted for mission or safety critical requirements.
4	In the receiver role, speed brake should be used by the receiver during breakaways and practice emergency separations.

AUS KC-30A**AAR Envelope**

1. Altitude: FL150 – FL300
2. Airspeed: 250 – 290 KCAS and $\leq 0.80M$
3. Boom envelope shall be IAW **Table B5-8**

Table B5-8: ARBS Boom Envelope for RAAF KC-30A

RSAF A330 MRTT	DISCONNECT
Boom Elevation	23° (upper) – 37° (lower)
Boom Roll	15° left – 15° right
Boom Telescopic	6 – 21 ft

Table B5-9: Restrictions for RSAF MRTT – RAAF KC-30A AAR Operation

S/N	Restrictions
1	Tanker's and receiver's HF-1 and HF-2 radios shall be turned OFF or INHIBIT prior to the receiver advancing closer than the pre-contact position.
2	All IFF interrogator, electronic stores, radar and electronic counter measures must be turned OFF or STBY prior to aerial refuelling.
3	One Engine Inoperative (OEI) AAR is only permitted for mission or safety critical requirements.

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ANNEX B TO NATIONAL SRD - SINGAPORE

S/N	Restrictions
4	In the receiver role, speed brake should be used by the receiver during breakaways and practice emergency separations.

APPENDIX B6 – ANNEX B TO NATIONAL SRD – SINGAPORE POD
RECEIVER SPECIFIC AAR INFORMATION

1. Read this Appendix in conjunction with Appendix B1 and B4.

Table B6-1: AAR Data for RSAF A330 MRTT Tanker

Receiver Aircraft	Page
NIL	-