

# KC-33A: Closing the Aerial Refuelling and Strategic Air Mobility Gaps

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This document is derived from the unsolicited proposal presented to the Department of Defence under the title 'Closing the Strategic Mobility Gap: The KC-33A Alternative', dated 3rd December, 2003. Some proprietary material has been removed, and additional new material incorporated.



# Introduction

- Since 911 the strategic environment the ADF must face has changed considerably.
- On the global stage, the ADF remains engaged in the War on Terror, and deployments are likely to continue over coming decades.
- In the Asia-Pacific region, China's planned acquisition of strategic bombers, aerial refuelling tankers and manufacture of long range cruise missiles significantly changes future demands for RAAF air defence and long range strike capabilities.
- Current planning for ADF capabilities in aerial refuelling and strategic air mobility remains at levels defined prior to these changes in the strategic environment.
- The KC-33A is an affordable solution for these critical problems.



# The Aerial Refuelling Gap

- Conventional metrics for aerial refuelling fleet sizing indicate that the RAAF should be operating at least 18 to 25 KC-135R equivalent tankers, given the size of its current and planned fighter fleet.
- Persistent strike operations required to support Network Centric Warfare impose similar or greater requirements in tanker fleet offload capability.
- Air defence operations, especially cruise missile defence operations, impose similar demands to support persistent fighter patrols at 500 NMI class ranges.
- The need to provide a deterrent long range strike capability to 3,000 NMI ranges post-dates AIR 5402 planning.
- The five AIR 5402 tankers will provide  $\approx 25\%$  of required offload.



# KC-33A as an AIR 5042 Supplement

- The KC-33A, an aerial refuelling conversion of the 747-400SF, represents a lower acquisition cost and higher performance supplement to the twin engine A330-200 now being acquired under AIR 5402.
- As an *Air Air Refuelling Tanker*:
  1. Double the fuel offload performance of twin engine alternatives.
  2. Four engine mission critical operational reliability.
  3. Faster cruise speed for strike packaging and survivability.
- As a *Strategic Air Lifter*:
  1. C-5B class payloads with much better range performance.
  2. Faster cruise speed for increased airlift productivity.
  3. Carries most C-130 sized payloads via Nose or Side Cargo Doors.





# ADF Air Refuelling Capability

# AIR 5402 Objectives

- Provide the RAAF with 4 to 5 medium sized twin engine tanker aircraft as replacements for the existing Boeing 707-338C tankers. The 707-338C were acquired to provide a “training and limited operational capability”.
- The new tanker aircraft are to provide both boom and dual redundant hose drogue capabilities to provide refuelling for F/A-18A, F-111 and coalition aircraft types.
- A supplementary airlift role is envisaged for these aircraft, constrained primarily to personnel and palletised freight airlift due to the payload size and floor strength limitations of this class of tanker aircraft.
- Outcome - Airbus/EADS A330 MRTT selected over Boeing KC-767.



# Boeing KC-767-200ER - Unsuccessful

- Based on late build 767-200ER airframe with -300 wing design.
- Boom is remote controlled 6,000 lb/min system using a fly-by-wire derivative of the KC-135R second generation boom design.
- Options for hose/drogue include a 4,000 lb/min centreline drum unit and 2,700 lb/min wing pods.
- Airlift provisions based on the 767-200SF/300SF freighter conversion kit - 19 pallet capacity.
- Design payload is  $\approx 40$  tonnes. Total fuel 201 klb - fuel offload performance  $\approx 10\%$  better than KC-135R.
- Critical runway length cited at 9,200 ft at MTOW.
- Orders: Italy; Japan





# Airbus A330-200MRTT - Successful

- Based on current A330 airframe with second generation Airbus fly-by-wire controls.
- Boom is remote controlled 8,000 lb/min system using a new EADS / CASA fly-by-wire design.
- Options for hose/drogue include a 4250 lb/min centreline drum unit and 2,800 lb/min wing pods.
- Airlift provisions optional for 26 pallet capacity.
- Design payload is  $\approx$ 50 tonnes - total fuel 246 klb.
- Critical runway length not cited.
- Orders: UK being negotiated.

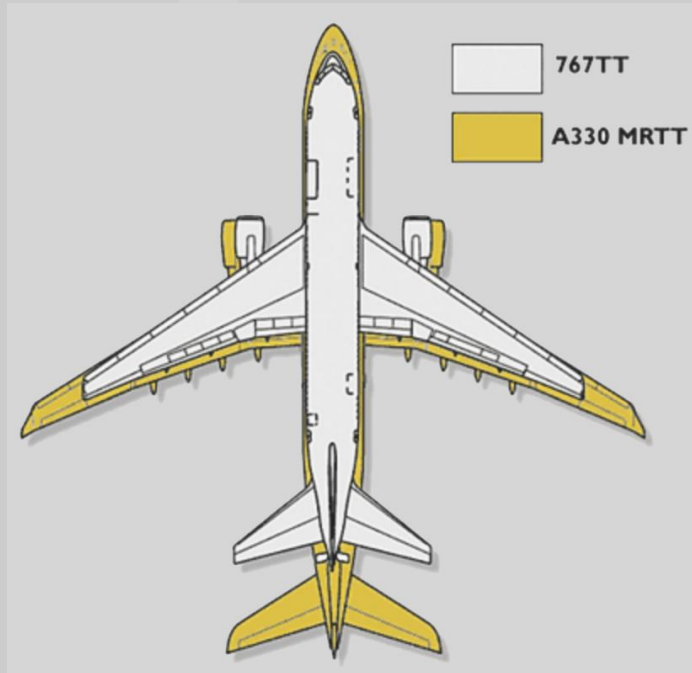


## Key Issues - A330-200MRTT

- Cost of new build aircraft/system US\$100M+ cf US\$58M for 747-400SF less AAR conversion.
- Airlift capacity is limited cf 747-400 series - design payloads at best 50% of 747-400SF. Fuel offload capacity is 40 to 50% of the 747-400SF series - doubles crew demands per available fuel offload.
- Service life - both 767 and A330 will be superceded in production between 2010 and 2020 by newer types; support base will contract post 2030.
- The A330-200 will not match 747-400SF at fast M 0.855 cruise or dash.
- The A330-200 is limited in size of main deck payload items vs 747-400SF.



# Size - 767 and A330



Boeing Illustration





ACTA to KC-33A Strategic Tanker/Transport



# Advanced Cargo Tanker Aircraft

- Late 1970s US Air Force program to provide a tanker transport to support CONUS fighter wing deployments to Europe and Pacrim.
- ACTA contenders MDC DC-10-30 and Boeing 747-100/200 with KC-135A common boom system and aft boom operator station.
- Industrial base issues and ground handling footprint favoured DC-10 over higher performance and better handling 747.
- Boeing produced complete production documentation packages for 747 tanker design anticipating further orders.
- Shah of Iran purchased the prototypes and additional aircraft conversions to support Iran's fleet of F-4Es. Aircraft U/S since 1979.
- Boeing abandoned marketing of 747 tanker conversions in 2000 to avoid competition against new build medium size 767 tanker.



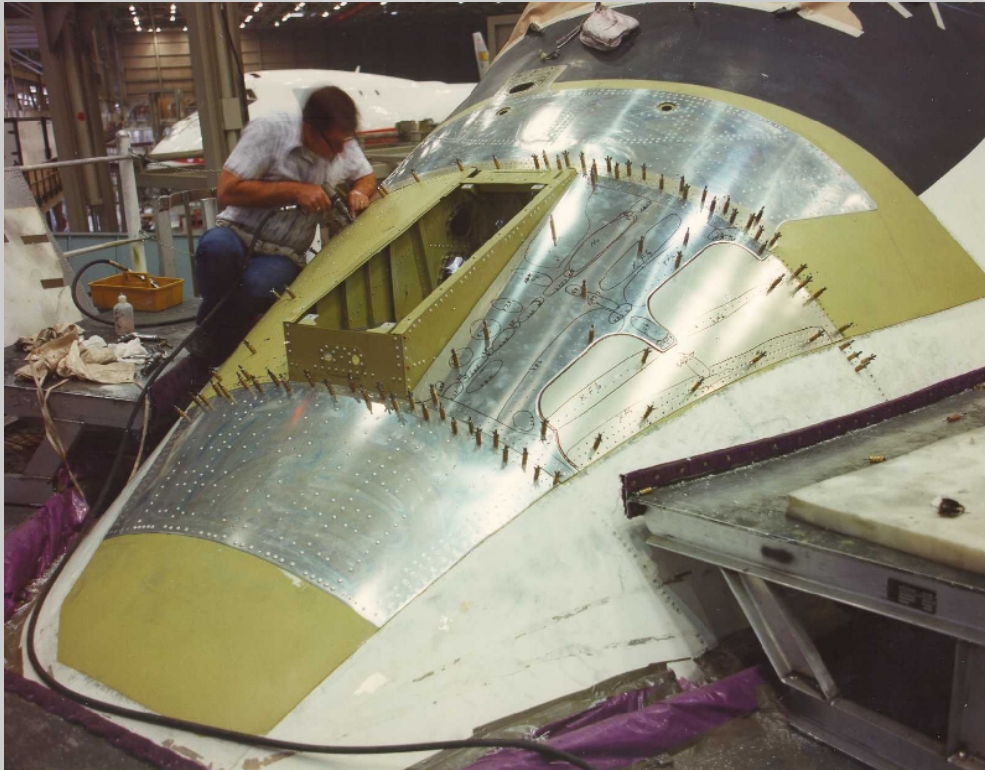
# ACTA Boom Installation



- Boom operator station is recessed in aft fuselage bulkhead.
- Aft lower fuselage reskinned and stiffeners added.



# ACTA Nose Mounted AAR Receptacle



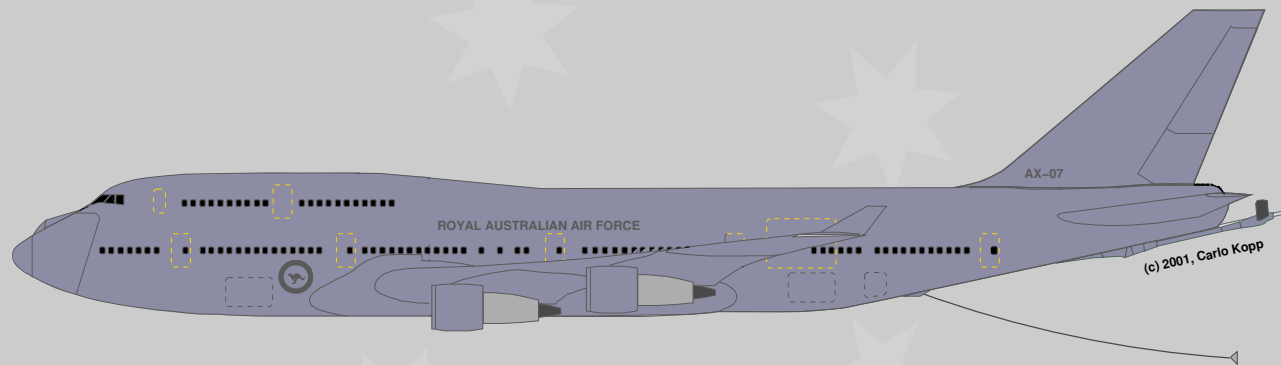
## 747-400SF to KC-33A Retrofit

- Merge elements of established Boeing KC-19A/747-100F ACTA tanker conversion design with existing KC-767-200ER RARO boom package and hose drum design, with 747-400ER auxiliary tanks.
- Both ACTA design and KC-767-200ER RARO boom based on KC-135A boom therefore low risk / low NRE design adaptation. Aft fuselage structural recertification required due to fuselage design changes post 747-300.
- Dual KC-767-200ER HDUs fitted to aft bulk cargo compartment.
- Utilise 747-400ER format aux tanks for additional auxiliary fuel.
- Use KC-767-200ER lighting, pumps, control systems - 747 unique plumbing and wiring only. Have Quick II, UHF vox, JTIDS, TACAN / beacon, IFF. The ROBE 'smart tanker' package is an option.





# Minimal NRE KC-33A Configuration



- Dual fuselage HDUs avoid expense of wing mounted pod design and certification effort - retain redundancy without cost/drag penalty.
- Leverage existing ACTA boom adaptation, E-4B airstairs and new KC-767 RARO boom, HDU and other systems.
- Commonality with new production KC-767 systems minimises design, production, and recurring support / training costs.

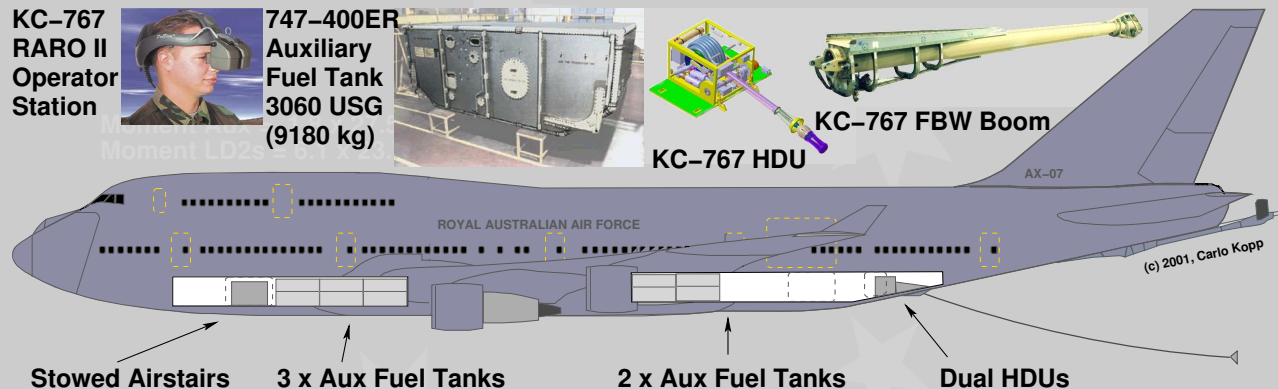
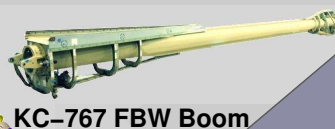


# Minimal NRE KC-33A Configuration

KC-767  
RARO II  
Operator  
Station



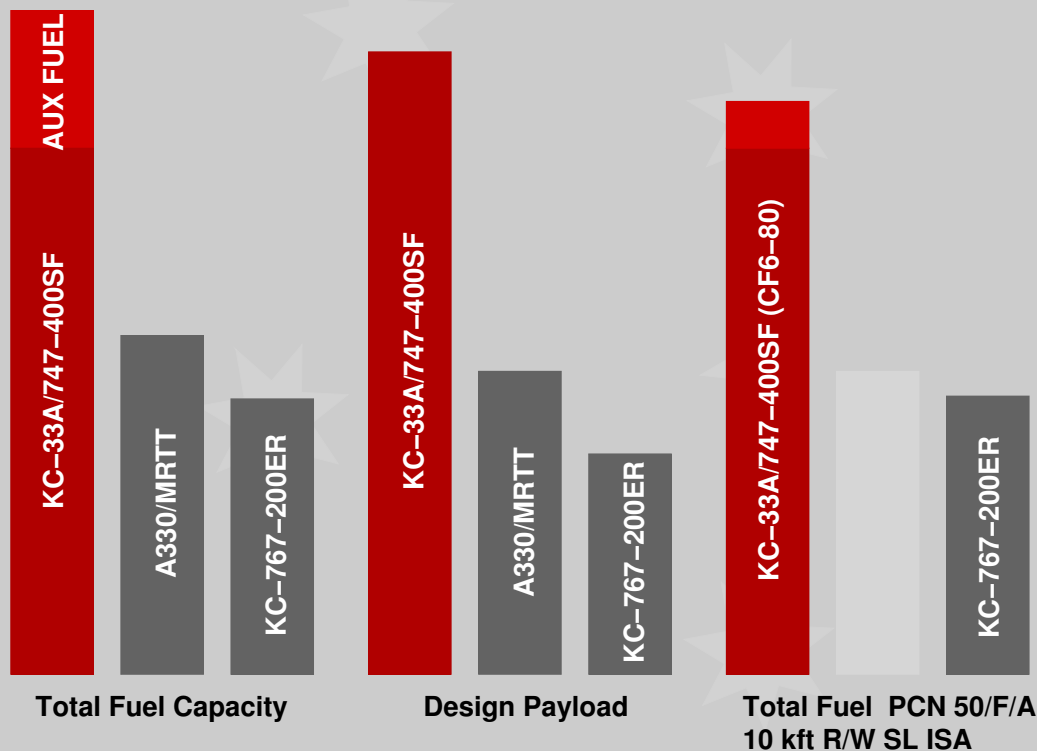
747-400ER  
Auxiliary  
Fuel Tank  
3060 USG  
(9180 kg)



- Dual fuselage HDUs are installed in the lower deck bulk cargo compartment. The folding airstairs displace cargo.
- The example depicted has 3 x auxiliary fuel tanks forward, and 2 x auxiliary fuel tanks aft. The lower deck has a payload capacity of up to 50.8 tonnes, some portion of which can be used for auxiliary fuel tanks and some for 463L pallets or LD2 containers.



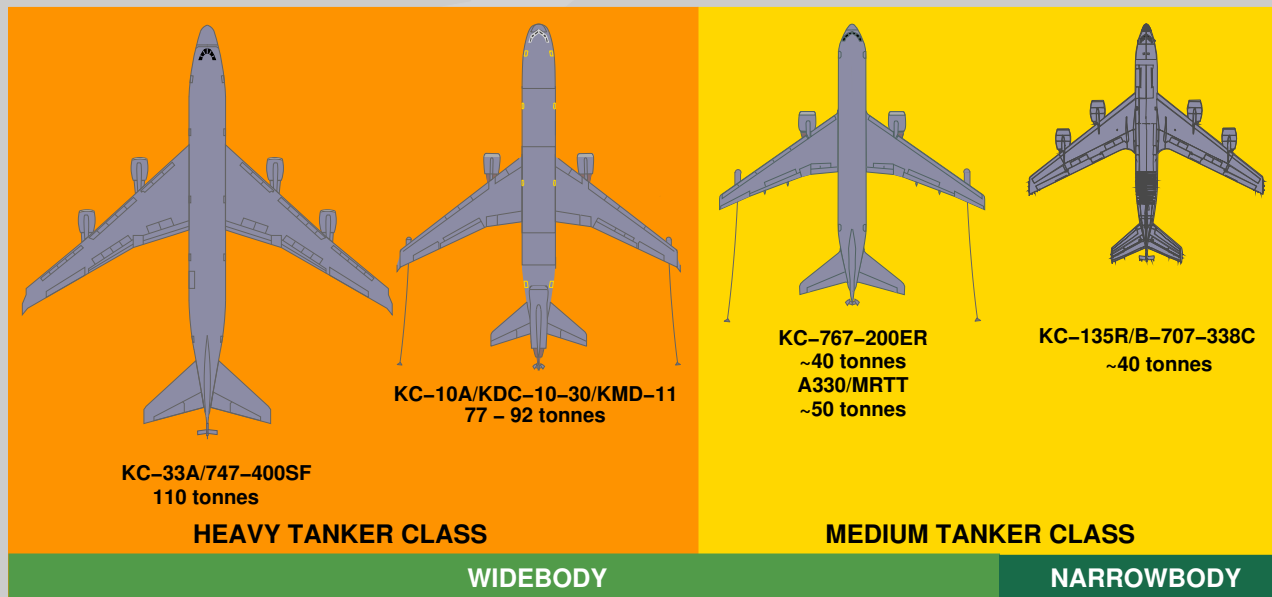
# Tanker Parametric Comparison



Sources: Boeing, Airbus Technical Literature



# Tanker Parametric Comparison



Heavy tankers typically produce the strategic effect of two or more medium tankers, offering important economies in aircrew numbers.

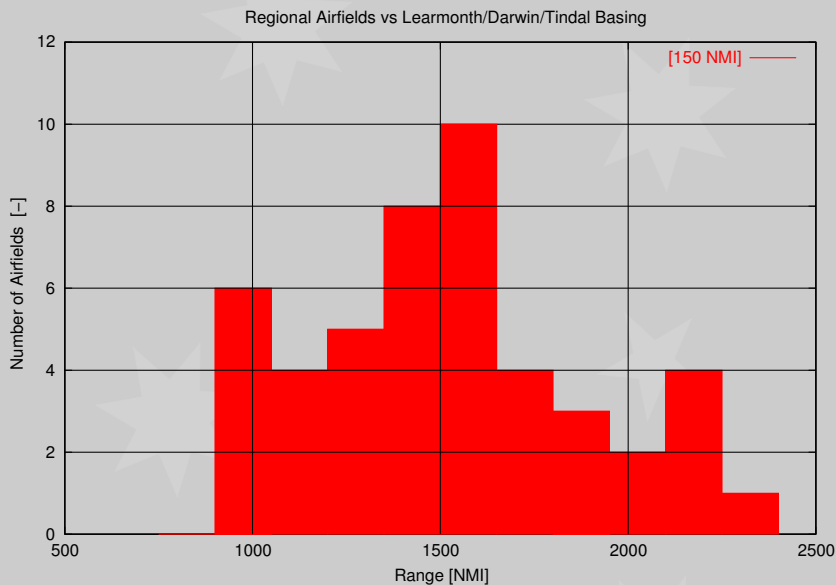


# Constraints - Northern Basing

- Strategic geography dictates Learmonth, Tindal and Darwin are most important runways for basing tankers to support DCA, OCA and land/maritime strike operations.
- Fuel resupply infrastructure is an issue for all northern RAAF bases. Learmonth allows for offshore POL jetty replenishment, Tindal for railway replenishment via Katherine, Darwin for railway or sea port replenishment. The remainder present access difficulties for high rate replenishment. Learmonth, Tindal and Darwin have 747 rated main runway surfaces (PCN 50 - 66) of practically viable length (8.9 - 10.9 kft).
- Curtin and Scherger are not viable for tanker basing and should not be used to impose restrictive performance and size constraints on tanker aircraft.



# Impact of Basing on AAR Demand



Histogram of striking distances from RAAF bases to dual use airfields in the northern archipelago. Circa 50% of potential targets fall between 1,500 and 2,500 NMI requiring very robust AAR capability.



# Operational Considerations

- Strike operations at 1,000 NMI or greater favour heavy tankers over medium sized tankers.
- Strike operations using persistent 'killbox interdiction' favour heavy tankers over medium sized tankers.
- Only DCA CAP AAR support at 500 NMI or less favours medium sized tankers over heavy tankers.
- Fast 747 M0.855 CRZ does not impose speed restrictions on strike packages refuelled by KC-33A unlike twin engine tankers.
- Four engines provide mission critical reliability for long range / long endurance refuelling profiles unlike twin engine tankers.
- Additional satcom antenna radomes for communications relay will not incur significant drag penalty unlike twin engine tankers.



# Operational Considerations

- The large offload and freight capacity of the KC-33A permits its use in the same global deployment support role performed by the USAF KC-10A Extender fleet (AFDD 2-6.2).
- The main deck freight payload of the 747-400SF is equivalent to five C-130H aircraft, thus permitting a small number of KC-33A aircraft to support global deployments of RAAF F/A-18A and F-111 with a low number of sorties.
- Large offload capacity makes KC-33A a very attractive contribution to coalition air campaigns, especially to support carrier based US Navy and US Marine Corps assets. KC-33A is also well suited to supporting extended range coalition operations in the Pacrim from secure Australian basing - supplementing limited US Air Force KC-10A Extender numbers.







## The ADF's Strategic Mobility Gap



# Closing the Strategic Mobility Gap

- Australia's existing airlift force structure is optimised for intratheatre airlift rather than strategic airlift. The C-130H, C-130J and Caribou are tactical transports designed for intratheatre work.
- The prospect of ongoing global and regional operations over coming decades presents an ongoing demand for a strategic airlift capability.
- Since 911 the airline downturn has produced a surplus of often low time commercial transport aircraft including C-5 payload class 747-400 passenger transports.
- The current price of a 747-400 Special Freighter (aircraft and conversion) varies between US\$54M and US\$58M (Bedek).
- AIR 5402 presents an opportunity to address both aerial tanker and strategic airlift needs with a single low cost solution.

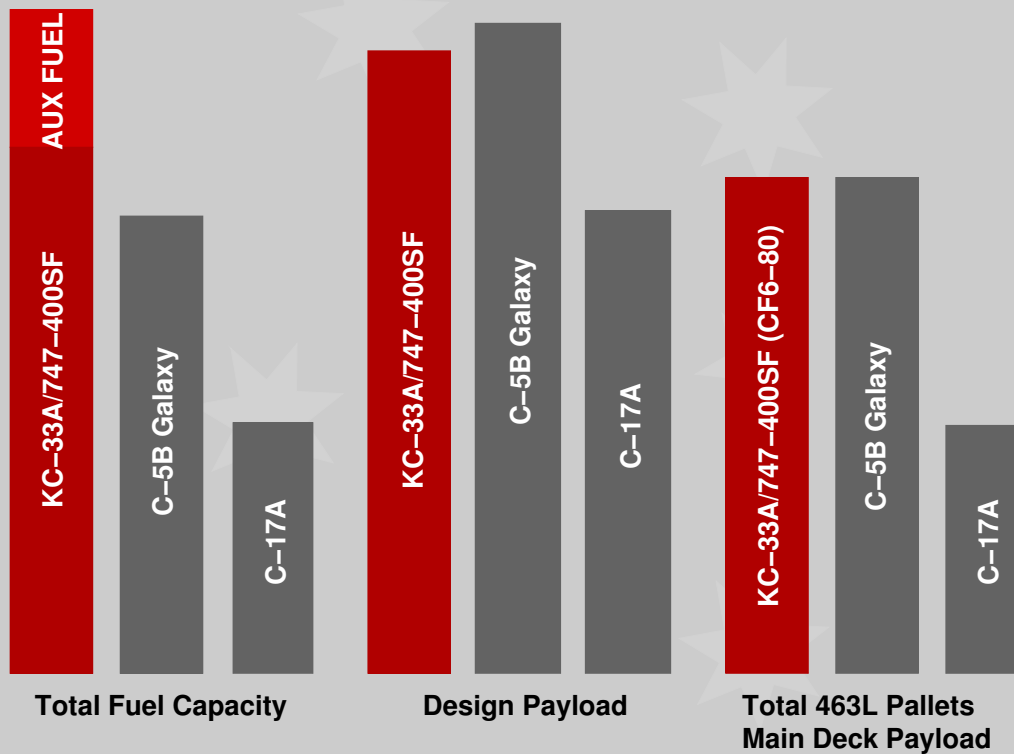


# The 747 as a Strategic Airlifter

- The 747 is the backbone of the US Civil Reserve Air Fleet which supplements the US Air Force fleet of C-5B, C-17A, C-141 in contingencies. The 747-100 is the C-19A, the 747-200 the C-25A and the 747-400 the C-33A. The E-4B airborne command post and VC-25A presidential transports are based on the 747-200, the YAL-1A AirBorne Laser is based on the 747-400F.
- The C-33A was evaluated as a supplement for the C-17A in US Air Mobility Command service. A split buy of C-17As and C-33As was repeatedly proposed during the 1990s as the 747-400 strongly outperforms the C-17A in payload / range capability.
- The 747-400 provides C-5B Galaxy class payload lift, yet is faster and longer ranging than the C-5B and C-17A. It lacks their intratheatre short field, outsize payload and RORO capabilities.



# Airlift Parametric Comparison



Sources: Boeing, Janes Technical Literature





CONOPS for ADF Strategic Air Mobility



# Strategic Air Mobility CONOPS

- Defence White Paper 2000 states the Primary Role of the ADF is the Defence of Australia.
- However while Defence of Australia [DA], Contributing to the Security of our Immediate Neighbourhood [CSIN], Supporting Wider Interests [SWI] and Contributing to Coalition Operations World Wide [CCOW] are the principal tasks of the ADF the Government has stated in the Defence Update 2003 that there will be an increased requirement to deploy expeditionary forces under the CCOW task.
- The Minister added that there was a need 'to enhance the lift requirement for deployment'.
- The further afield these deployments are, the greater the requirement for high range/payload strategic air transporters.

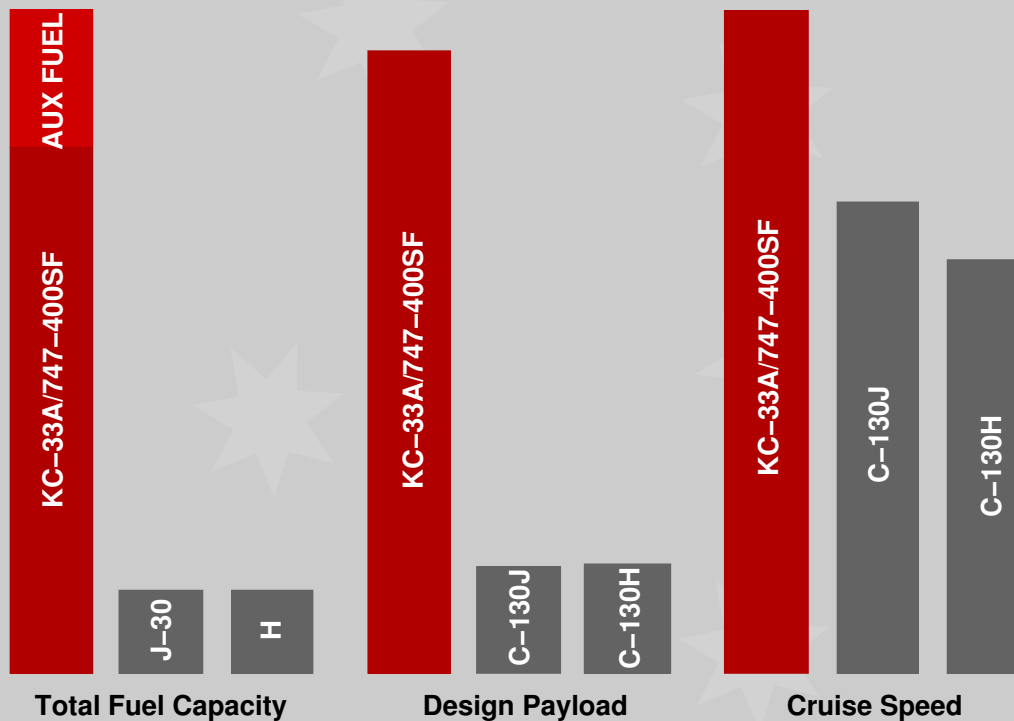


## C-130 vs Fast/Heavy Airlift

- The primary role of a strategic transport will be to deploy and support an Expeditionary Force - principally Army.
- Army states 'As part of the ADF, the [Army] Objective Force will be optimised to conduct Manoeuvre Operations in the Littoral Environment [MOLE] in either a DA or CSIN context but will retain the flexibility to be employed in SWI missions . and CCOW'.
- Australia has too few C-130H/J to use them as strategic transporters, particularly carrying only one M113, unless the requirement is operationally urgent, hazardous, or the airfield cannot be used by a large transport like the KC-33A/747-400.
- The C-130H/J cruises at only 60% the speed of and carries only about 20% of the payload of a KC-33A/747-400.



# C-130 vs KC-33A Comparison

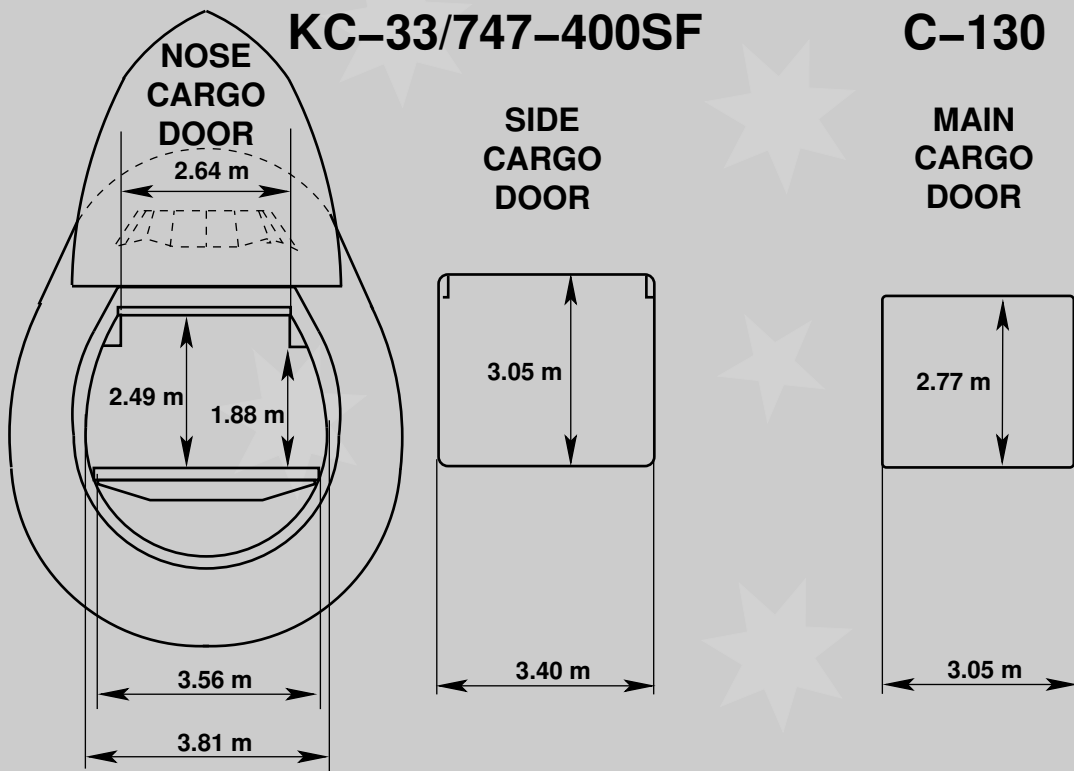


Sources: Boeing, Janes Technical Literature





# C-130 vs KC-33A Payload Doors



## Sealift vs Airlift

- Deployment by sealift is not always the best solution.
- As demonstrated in East Timor, sealift incurs increasing time delay to materiel delivery with increasing distance. The delays observed in 1999 multiply with distance from Australian ports.
- In a broader conflict many SLOCs may be closed or contested, further adding distance and time to sealift.
- Some heavy equipment by weight alone must travel by sealift. MBTs at 50 to 70 tonnes are a good example - the US always transports MBTs by sealift.
- Personnel and other material eg M113AS3/4, ASLAV, Perentie or engineering equipment such as water purification plant can be delivered quickly by airlift across the region or globally.

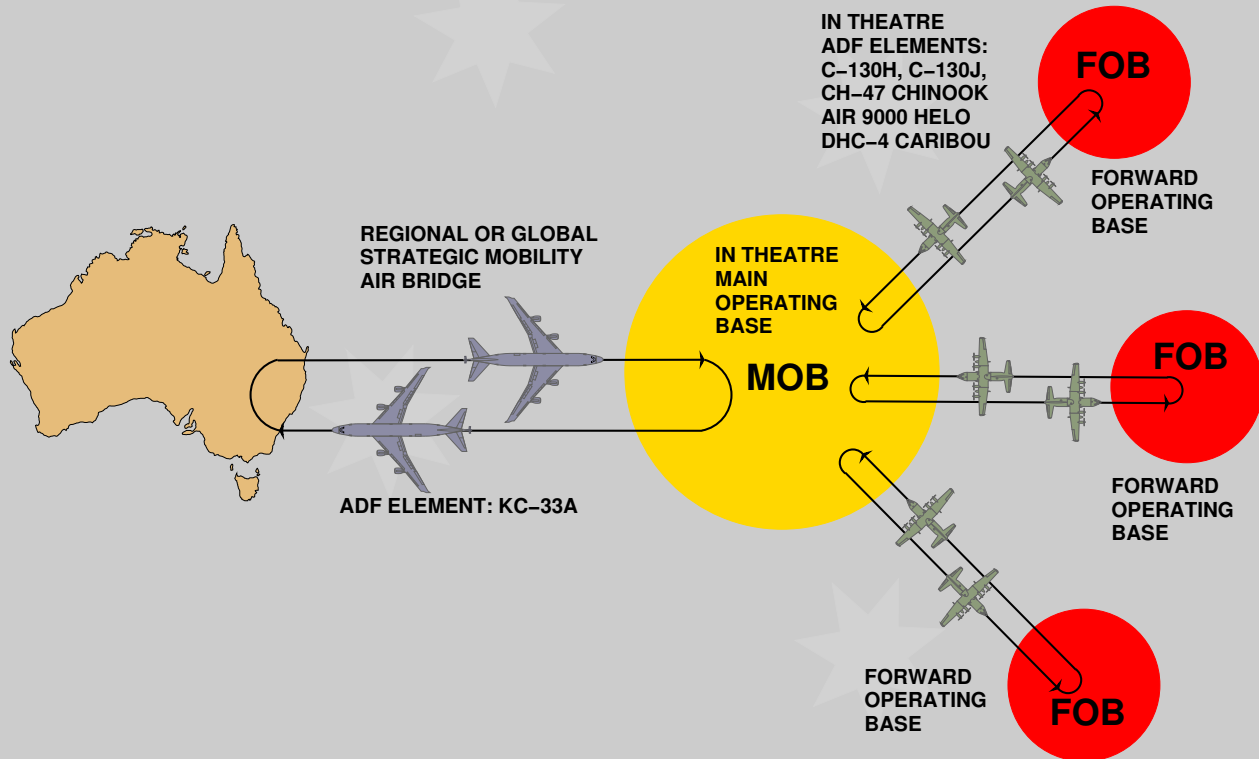


# MOB vs FOB

- The KC-33A is a strategic transport that can deliver large quantities of personnel, weapons, stores and equipment to the in theatre MOB.
- Onward delivery to FOB would be by C-130H/J, Caribou or Army Chinook depending on type and weight of load and distance involved.
- The RAAF would not risk high value aircraft - either KC-33A or C-17A into a hazardous FOB - assuming the FOB runway can survive repeated landings by heavily laden airlifters.
- Large airlifters are highly vulnerable to large calibre sniper, MAN-PADS, mortar, long range artillery, rocket or TBM fire.
- There is a high risk of the destruction of such a large aircraft closing the FOB down for many hours stopping the vital flow of materiel and reinforcements.



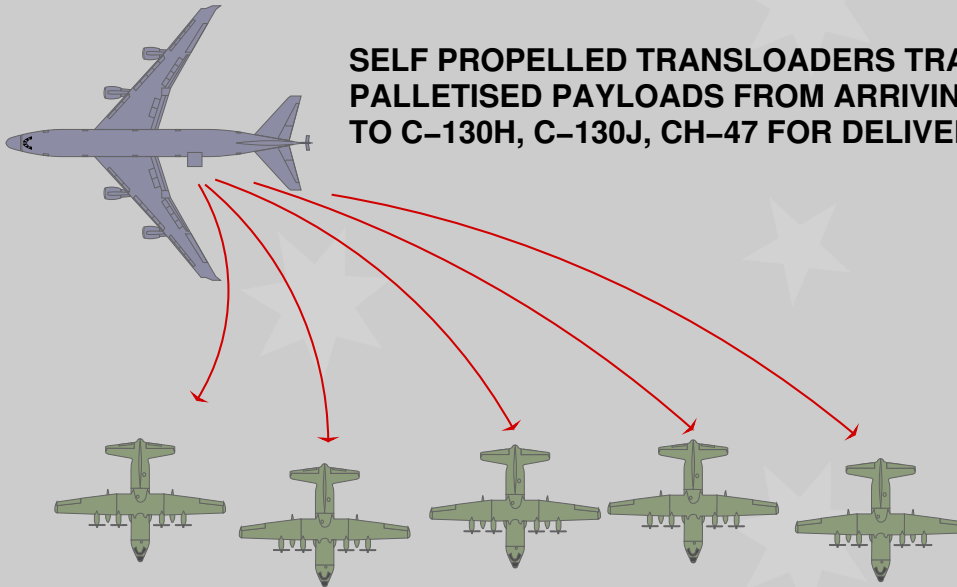
# MOB vs FOB Model



# MOB CONOPS

## MOB OPERATION

**SELF PROPELLED TRANSLOADERS TRANSFER  
PALLETISED PAYLOADS FROM ARRIVING KC-33A  
TO C-130H, C-130J, CH-47 FOR DELIVERY TO FOB**

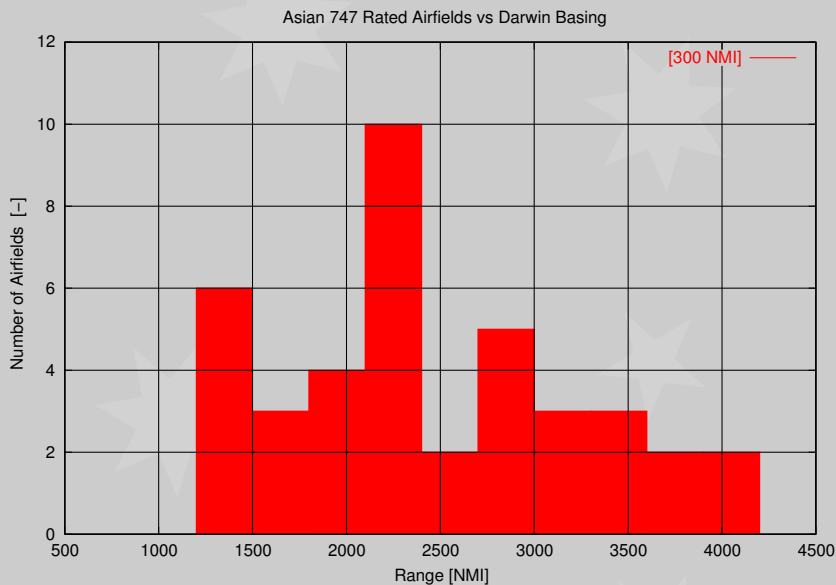


# Regional/Global Runway Access

- Political access considerations aside, there are no less than 55 runways rated as suitable for the 747 within the arc from India through China to South Korea, excluding US and Japanese military airfields.
- Thailand has 3 such runways, Malaysia 6, Brunei 1, Singapore 2 and Indonesia no less than 9. Within the nearer region this is a total of 21 runways rated for 747, excluding military installations.
- At this time the US is planning to create a global network of 'bare bones bases' following the model created by the RAAF for operations across the north of Australia. As these US bases will be designed from the outset to support heavy tankers and airlifters, they become prospective MOB's for CCOW related ADF strategic airlift operations.



# Distances to Regional Runways



Histogram of great circle distances from RAAF Darwin to 747 compatible airfields in Asia. KC-33A aircraft can refuel each other thus permitting unlimited global reach for strategic airlift operations.



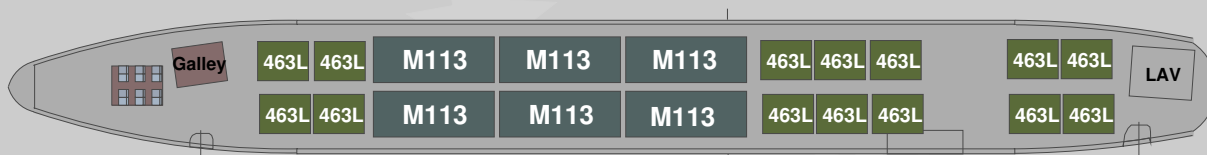
# Independent Strategic Lift

- With the KC-33A the ADF does not need to rely on the US Air Mobility Command or leased Antonov/Ilyushin operators for most of their air transport requirements. *We have discretion - we can decide where and how we lift which assets.*
- US experience since 1990 indicates that a large fraction of total airlift demand is personnel movement. Most materiel carried by airlift is palletised freight, rather than outsized/oversized items requiring a specialised RORO airlifter.
- With the KC-33A performing personnel and palletised materiel lift, RORO airlifters are needed only for the remaining fraction of outsized/oversized payloads, and short field operations if/when required.

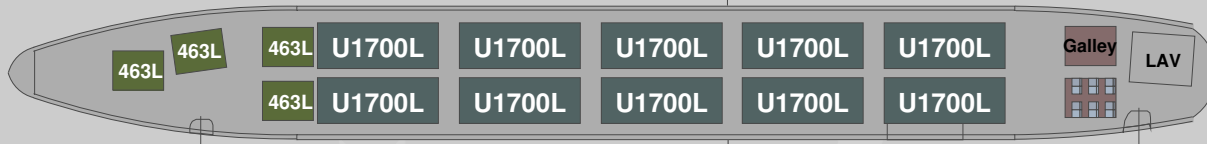




# Example Deployment Payloads (1)



6 x M113A1/AS3/AS4; 12 x Personnel (70.4 tonnes); 0 – 14 x 463L (0 – 40 tonnes); SCD



10 x U1700L; 12 x Personnel (72 tonnes); 4 x 463L (0 – 23 tonnes); NCD



10 x Land Rover; 36 x Personnel (43 tonnes); 4 x 463L (24 tonnes); SCD



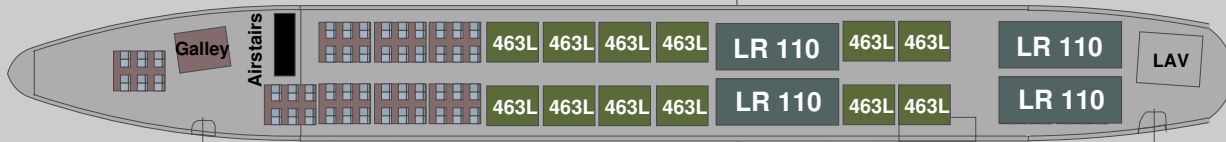
360 x Personnel (68 tonnes); Lower Deck 463L Pallets Subject to Configuration; Airstairs, PAX Doors



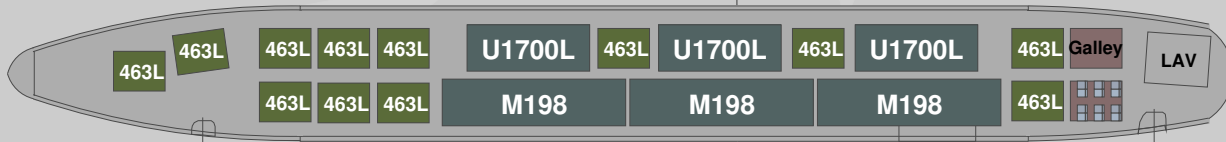
# Example Deployment Payloads (2)



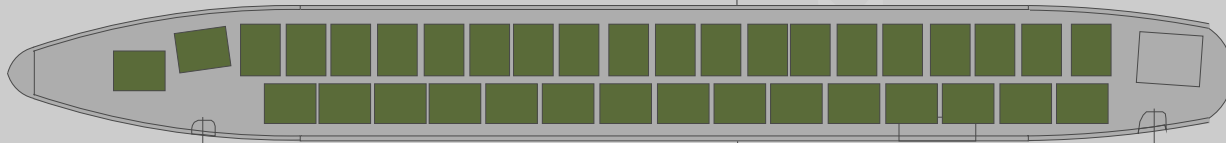
6 x U1700L; 6x L119; 12 x Personnel (55 tonnes); 2 x 463L (12 tonnes); NCD



96 x Personnel; 4 x LR 110 (30 tonnes); 12 x 463L Pallets (40 – 70 tonnes); SCD, Airstairs



3 x U1700L; 3 x M198; 12 x Personnel (44 tonnes); 12 x 463L (26 – 66 tonnes); NCD



36 x 463L Main Deck; 3–5 x 463L Lower Deck (up to 110 tonnes); SCD, NCD, AFT CCD



# Example Deployment Scenarios

- 1 Bde - one half mechanised infantry battalion with 348 troops in six sorties, including personal weapons, 30 x M113 APC and up to 40 tonnes of stores on 463L pallets.
- 1 Bde - one 6 gun 155 mm M198 Battery in three sorties with 92 to 202 tonnes of stores on 463L pallets.
- 3 Bde - one half light infantry battalion with 348 troops in three sorties, including personal weapons, 10 x Unimog, 10 x Land Rovers and up to 50 tonnes of stores on 463L pallets.
- 3 Bde - one 6 gun 105 mm L119 Hamel Battery in two sorties with 42 to 82 tonnes of stores on 463L pallets.
- Palletised stores payloads of up to 110 tonnes.



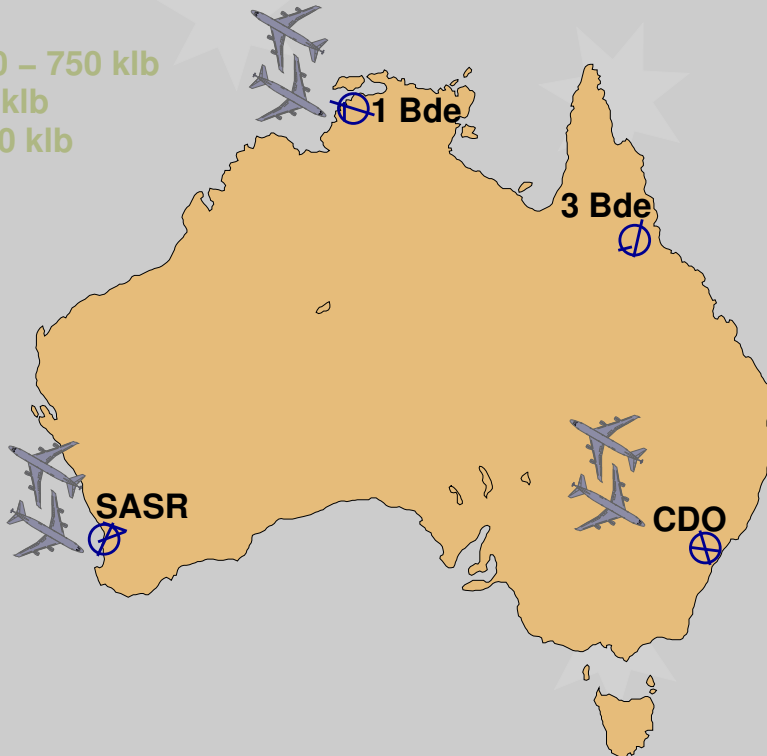
# Example Deployment Ranges

- Achievable deployment range varies with runway parameters, aircraft configuration and engine fit, elevation, temperature, payload and fuel load - cited examples are best estimates based on published performance figures for 747-400F series.
- Townsville is limited to payloads of around 70 tonnes to achieve useful unrefuelled ranges. Darwin permits full payloads of around 110 tonnes for unrefuelled operations in the nearer region.
- 1 Bde (Darwin) to  $\approx 4,500$  NMI with 70 tonne payload,  $\approx 2,300$  NMI with 110 tonne payload, subject to aircraft configuration, unlimited with aerial refuelling.
- 3 Bde (Townsville) to  $\approx 2,500$  NMI with 70 tonne payload, subject to aircraft configuration, unlimited with aerial refuelling.

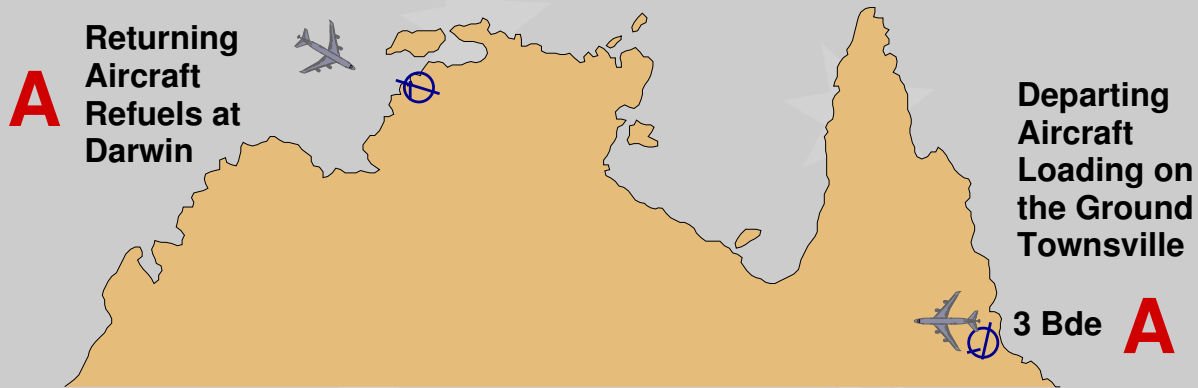


# Conventional Departures

Darwin – 700 – 750 klb  
Perth – 850 klb  
Sydney – 800 klb



# Townsville - Refuelled Departures





## KC-33A/747-400SF Payload Capabilities



# Airstairs for Embarking Troops



- E-4B NAOC and VC-25 carry folding internal lower deck airstairs.
- KC-33A definition includes this feature to permit troops to embark and disembark without ground support equipment.





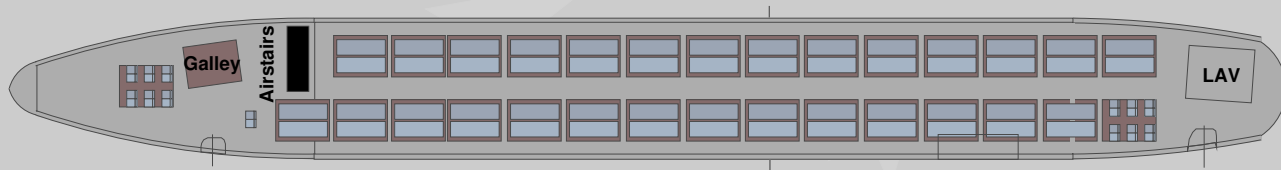
# Palletised Passenger Seats



- Utilise KC-767A palletised passenger seat design - 12 seats/pallet.
- Standard 108 x 88 inch 463L footprint permits main deck seating for  $30 \times 12 = 360$  passengers / attendants.
- Modification of 12 seat pallets to 15 seat configuration provides seating for 450 passengers / attendants.
- Main deck passenger doors and emergency slides retained during Special Freighter conversion to facilitate troop transport role.
- Palletised troop lavatory and galley modules are provided for rapid reconfiguration of aircraft between airlift and trooplift roles.



# Palletised Medevac Configuration



- KC-33A fast cruise and global range permits rapid medevac of large numbers of casualties arising from disasters or terrorist attacks.
- Utilise KC-767A palletised passenger seat design - 12 seats/pallet.
- Utilise KC-767A palletised medevac litter modules - 6 litters/pallet.
- Standard 108 x 88 inch 463L footprint permits main deck accommodation for  $28 \times 6 = 168$  casualties plus 24 medical personnel.
- Consideration should be given to a containerised operating theatre module and/or intensive care or burns treatment modules.



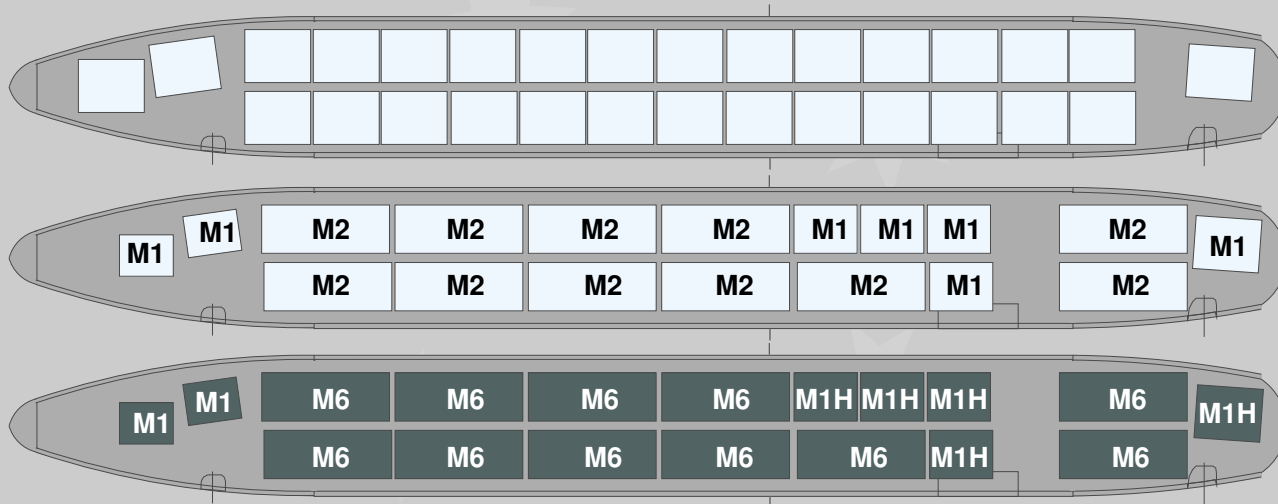
## 463L Format Seats and Litters



- 463L format KC-135R/CH-47 palletised seats Rated to 9G, 10 klb payload (AAR Corp).
- 463L format KC-767A palletised seats. Rated to 9G, 10 klb payload (AAR Corp).
- 463L format KC-767A palletised litters. Rated to 9G with optional 3 litters and seats, or 6 litters (AAR Corp).



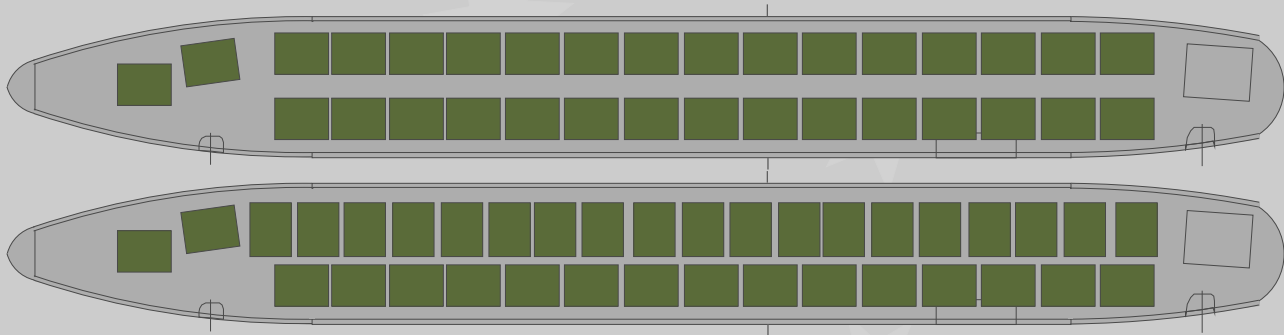
# Commercial Pallets and Containers



- 11 x M6 pallets or M2 containers (11.35 t), plus up to 7 x 747 pallets or M1 containers, or 26 x M1 pallets or containers (5.68 t).
- Loading via Side Cargo Door or Nose Cargo Door where fitted.



# Military 463L Pallets



- Main deck can carry 32 x 463L military 108 x 88 x 96 inch pallets, 36 x 463L military 108 x 88 x 96 inch pallets.
- Main deck pallet loading via Side Cargo Door or Nose Cargo Door where fitted.
- Lower deck can accommodate up to 10 x 463L pallets subject to aircraft configuration. Auxiliary fuel and airstairs installation in KC-33A configuration will reduce available 463L pallet capacity.



# 463L Military and ISO Pallets



- HCU-6/E 463L format Air Cargo Pallet. Rated to 4.5 tonnes (AAR Corp).
- ISO M6 format 6 metre Air Cargo Pallet. Compatible with NATO PLS (AAR Corp).
- A large number of Milspec and COTS standard pallets and containers are available in the current market.

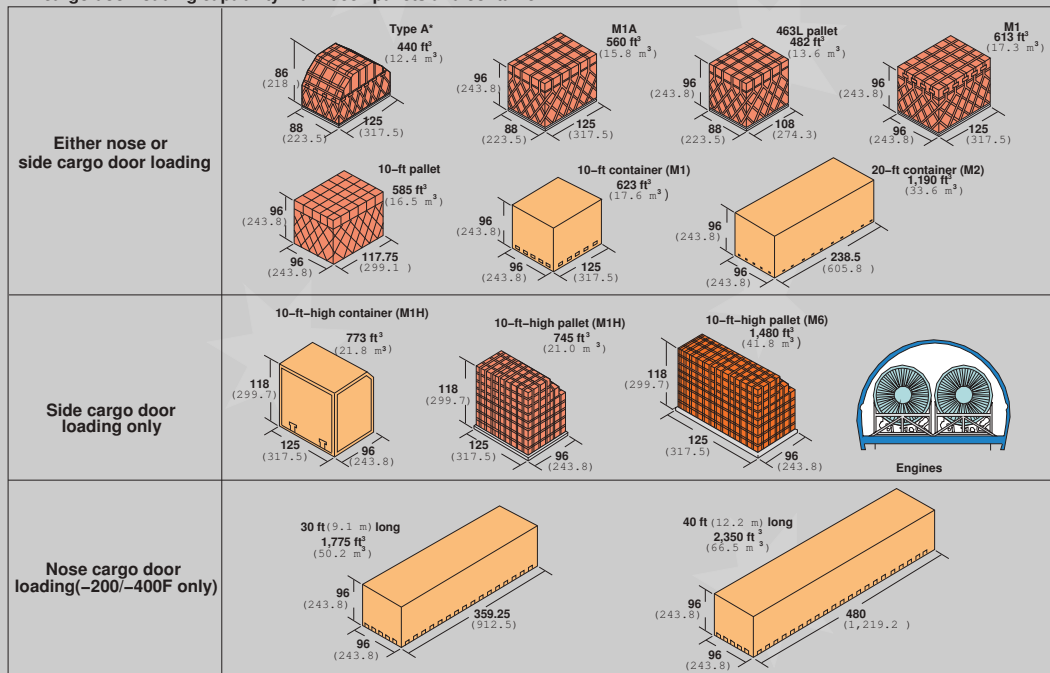


# Container/Pallet Compatibility

## 747-100SF/-200F/SF/-300SF/-400 Freighters

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747 cargo door loading capability main deck pallets and container



\* Volumes are based on SAE Aerospace Standard, AS 1825.

\* Maximum height varies from 78 to 86 in (198 to 218 m), depending on airplane type (e.g., 707, 727, 757, DC-8).

TBC-MD-0075F1-30-3-PH/LM/KW



## Nose (NCD) vs Side Cargo Door (SCD)

- New production 747-400F/ERF can be equipped with the NCD and the SCD. Cited  $\approx$  US\$58M Special Freighter conversions of surplus passenger transports are only fitted with the SCD.
- There are compelling reasons why the NCD should be retrofitted to 747-400SF conversions to KC-33A:
  - Loading and unloading times are halved for most payloads, eg C-5B and An-124 heavy lifters.
  - Payload items longer than 6 metres can be handled.
  - Commercial freight terminals often have nose loading facilities.
- Retrofit of the NCD will incur some NRE as no conversion kit as yet exists for the 747-400SF. Components manufactured for production fit on new 747-400F/ERF would be used mostly.



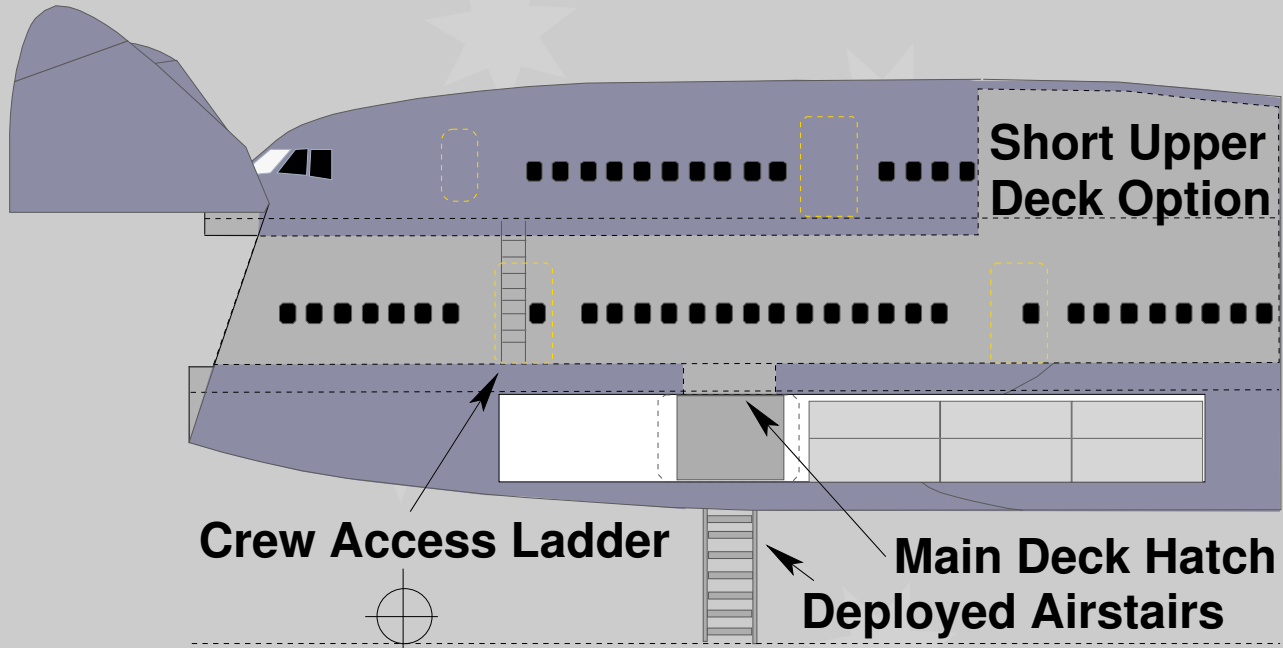


## Other Modifications

- Aerial refuelling receptacles are used on all US Air Force 747 variants. The flexibility afforded by aerial refuelling dictates that this modification should be incorporated in all KC-33A aircraft.
- US CRAF 747-100/200 transports had modifications to their powered floor mechanisms and rollers to accommodate both commercial and military pallets and containers. The KC-33A system will need to be specified for compatibility with 463L military pallets.
- The lower deck folding airstairs add the need for a main deck floor hatch for access. The hatch design must be capable of bearing full floor loads and fitted with the roller system.
- A flight deck access ladder to the main deck (cf C-5B) will be required to provide crew access in flight.



# Crew and Personnel Access



# Incompatible Payloads

- Some payloads will remain incompatible with the KC-33A for reasons of size, weight or both. These items must be moved by RORO airlifters such as the C-5B, C-17, An-124 or C-130, or by sealift.
- The height of S-70/UH-60 Blackhawk helicopters in stowed configuration is too large for NCD access to the KC-33A. Without significant upper fuselage teardown these cannot be carried.
- The Leopard 1 and M1 series tanks are too large and heavy. In practice tanks are not carried by airlift, even if the C-5B, C-17 and An-124 can carry one tank each.
- Cabin height is the principal limitation on loading trucks via the NCD. The retrofit of soft top cabin roofs and folding windshields to most truck types would permit access via the NCD.





# Loaders and Transloaders



# Loaders / Transloaders

- In theatre loading, unloading and transloading operations are performed using mobile loaders.
- The US Air Force employ the C-17/C-5 transportable 60 klb Tunner for high volume operations.
- The US Air Force employ the C-130 transportable 25 klb FMC Halvorsen (NGSL) for lower volume operations. It is a less capable licence built variant of the RAAF's C-130 transportable Static Engineering Pty Ltd TASLU 40 klb loader.
- The Boeing On Board Loader was manufactured during the 1980s. A derivative design could be employed should an internal loader be sought.



# RAAF 40 klb SE 'TASLU' Loader



# USAF 60 klb 'Tunner' Loader





# Boeing On Board Loader (1)





## Boeing On Board Loader (2)



# Boeing On Board Loader (3)



# Boeing On Board Loader (4)



# Boeing On Board Loader (5)





Strategic Lift for Army Vehicles - Concepts





# Airlifting Army Vehicles - LAV-25



- The LAV-25 and ASLAV have been deployed globally.



# Airlifting Army Vehicles - Unimog 4x4



- A range of Unimog 1700L/38 configurations are in use. The height of the Unimog hard top cabin is the only impediment to loading Unimogs via the Nose Cargo Door of the KC-33A.



# Unimog Airlift Adaptation



- The cheapest modification to the basic Unimog 1700L/38 and 2450L trucks would be the retrofit of a 'convertible' cab. A proven design exists in the U1300L soft top production variant.





# Airlifting Army Vehicles - Land Rover



- The Australian Army uses a range of 4x4 and 6x6 Land Rover derivatives. In general, 6x6 variants are compatible with the Nose Cargo Door, where cabin height is not an issue.

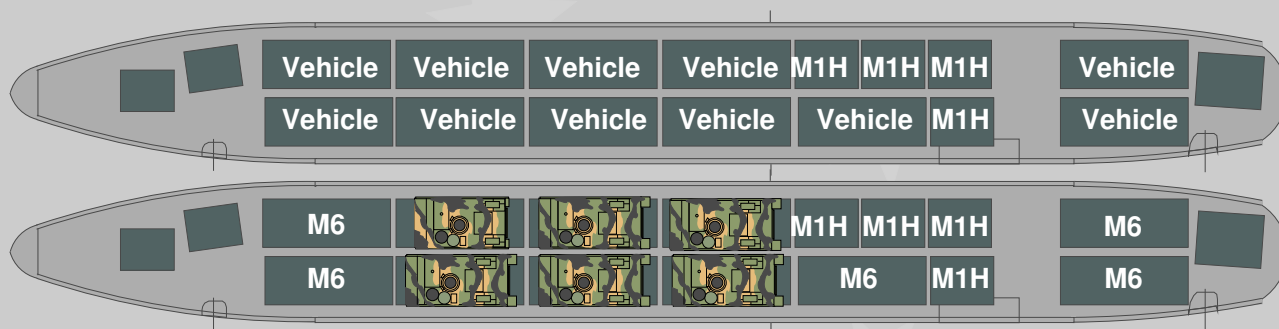


# Palletised Equipment Compatibility

- M113 variants, including the M113AS3 and stretched M113AS4 are suitable for palletised carriage. Nose Cargo Door access is limited to subtypes without turrets. Land Rover Perentie variants are suitable, but with height restricting Nose Cargo Door access for some models.
- Palletised L119 and M198 artillery pieces are suitable for Nose Cargo Door access, the L119 also for Side Cargo Door access.
- ASLAVs may prove suitable for Side Cargo Door loading, but a clearance check is required to prove this. The Unimog 1700L/38 4x4, 2450L 6x6, Mack MC3 and Bushmaster IMV are too large for either door, although minor modifications to the Unimogs would permit Nose Cargo Door access.



# Main Deck Payloads

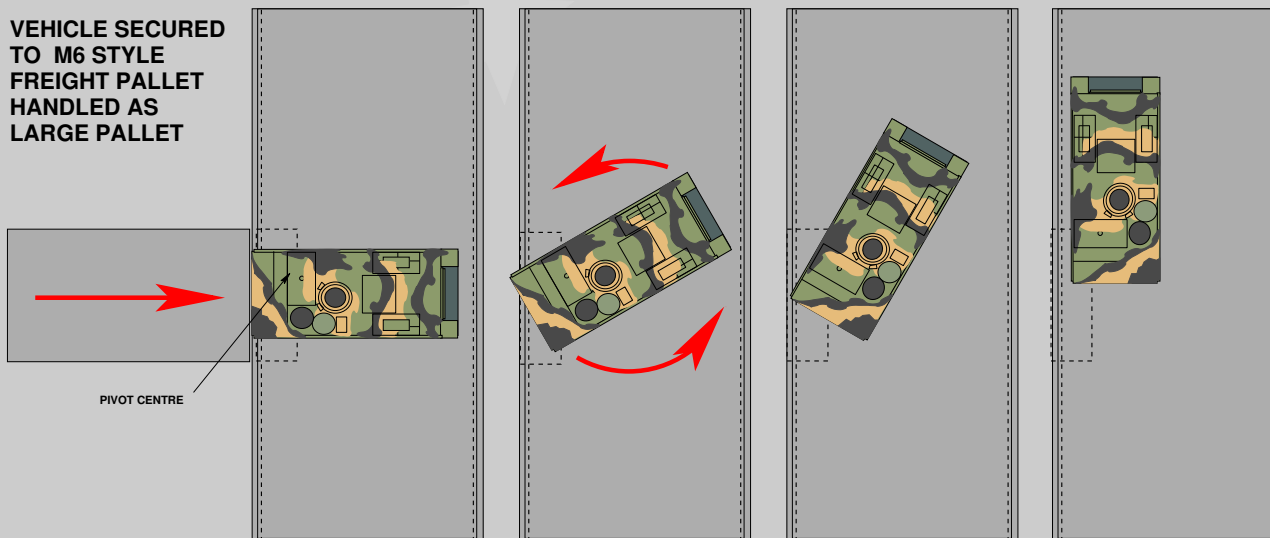


- Vehicles handled and carried on M6 style cargo pallets (M113AS3 / M113AS4 depicted). SCD loading concept - 90° pivot technique used for M6 pallet or M2 container.
- Increased floor strength may be required for heavier vehicle types.
- Number and placement of palletised vehicles subject to weight and balance of aircraft, fuselage loads and floor strength.



# AFV Side Cargo Door Loading Concept

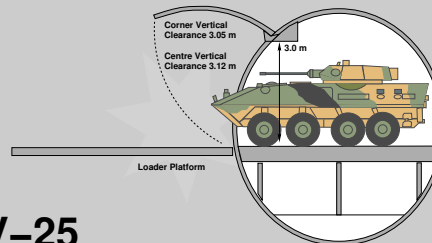
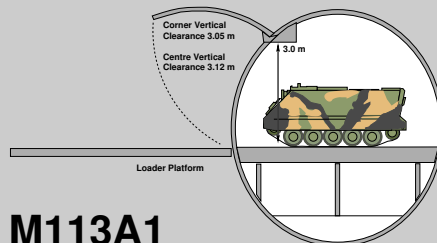
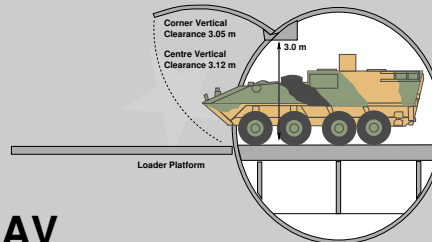
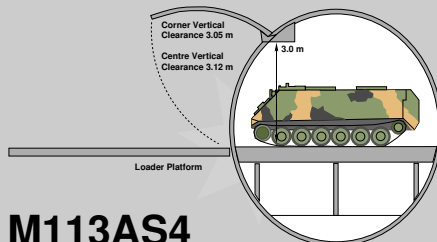
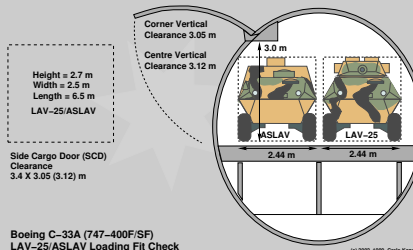
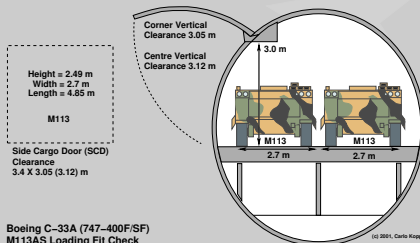
VEHICLE SECURED  
TO M6 STYLE  
FREIGHT PALLET  
HANDLED AS  
LARGE PALLET



- Pivot technique widely used for Special Freighter SCD loading of larger containers or palletised payloads.
- Inflatable airbag under AFV may be used to distribute weight.



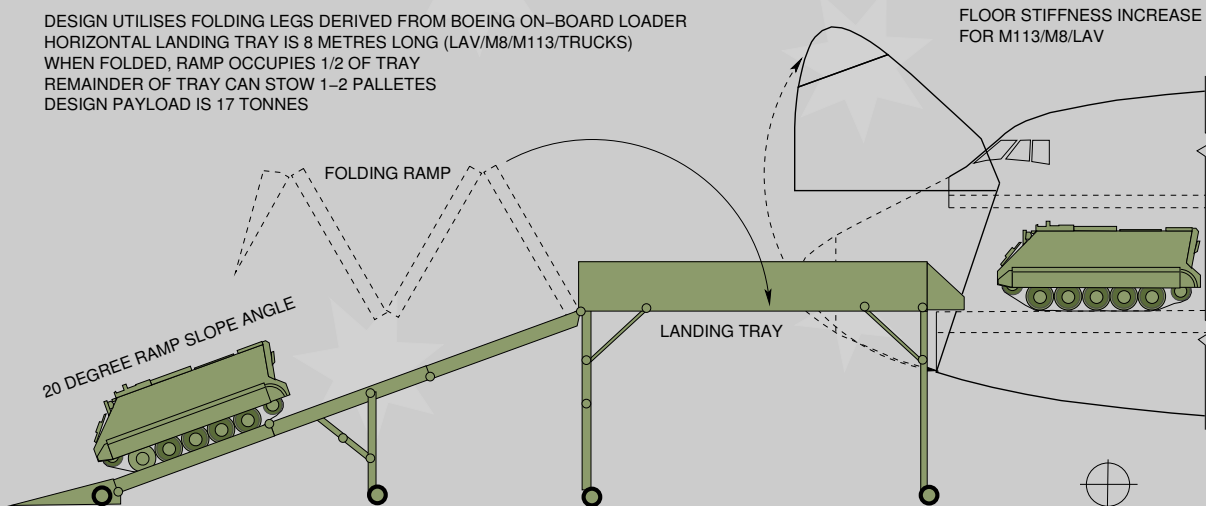
# AFV Side Cargo Door Loading Concept



# M113 Nose Cargo Door RORO Concept

DESIGN UTILISES FOLDING LEGS DERIVED FROM BOEING ON-BOARD LOADER  
 HORIZONTAL LANDING TRAY IS 8 METRES LONG (LAV/M8/M113/TRUCKS)  
 WHEN FOLDED, RAMP OCCUPIES 1/2 OF TRAY  
 REMAINDER OF TRAY CAN STOW 1-2 PALLETES  
 DESIGN PAYLOAD IS 17 TONNES

FLOOR STIFFNESS INCREASE  
 FOR M113/M8/LAV



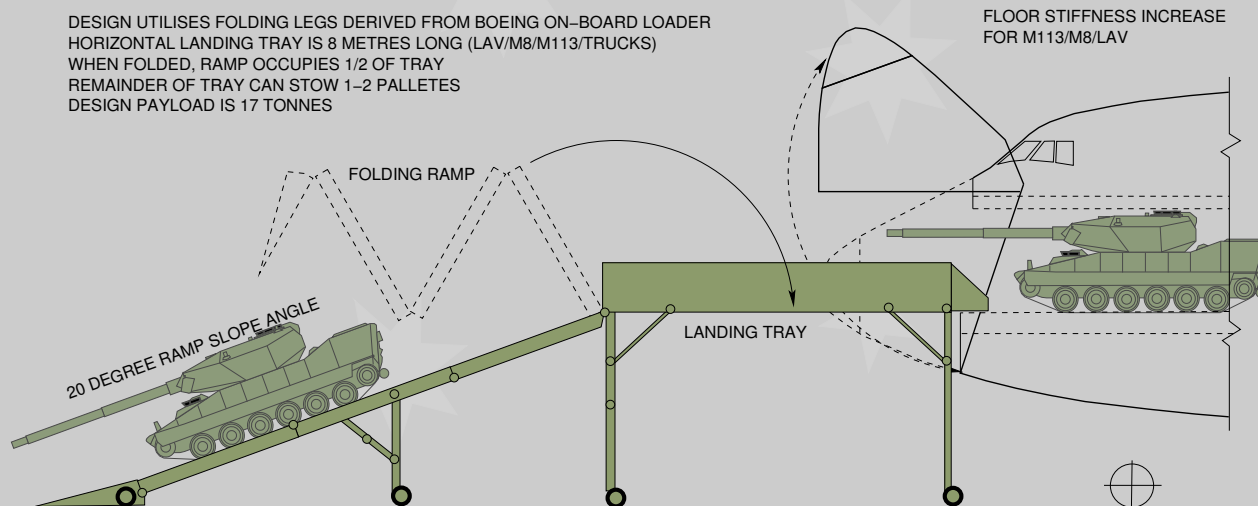
(c) 2001, Carlo Kopp

KC-33A (KC-747-400F) RO-RO Nose Door Ramp CONOPS Proposal



# M8 AGS NCD RORO Concept

DESIGN UTILISES FOLDING LEGS DERIVED FROM BOEING ON-BOARD LOADER  
 HORIZONTAL LANDING TRAY IS 8 METRES LONG (LAV/M8/M113/TRUCKS)  
 WHEN FOLDED, RAMP OCCUPIES 1/2 OF TRAY  
 REMAINDER OF TRAY CAN STOW 1-2 PALLETES  
 DESIGN PAYLOAD IS 17 TONNES



(c) 2001, Carlo Kopp

KC-33A (KC-747-400F) RO-RO Nose Door Ramp CONOPS Proposal





## End Analysis Document





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