NATIONAL NEONATAL TRANSPORT PROGRAMME

The National Neonatal Transport Programme

GUIDELINES FOR AIR TRANSPORT

Utilising the Aircraft of The Irish Air Corps

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INTRODUCTION

The National Neonatal Transport Programme (NNTP) established in March 2001, is a 24/7 retrieval service for the stabilisation and transportation of premature and sick neonates up to the age of six weeks corrected gestational age, who require transfer for specialist care within Ireland and abroad. The goals of the programme are:

1. To provide safe, efficient and timely retrieval and transfer of neonates for critical and other specialist care in tertiary hospitals across Ireland and abroad.
2. To enhance clinical outcomes for critically ill neonates by providing early appropriate transfer decision making, pre-transport stabilisation and specialised care en route.

The NNTP is funded by the Health Service Executive (HSE) and transport teams are drawn from the Coombe Women and Infants' University Hospital, the National Maternity Hospital and the Rotunda Hospital together with the National Ambulance Service. Each of these three hospitals is on call for NNTP transports for one week at a time (on a rotational basis). Under the supervision of a dedicated NNTP Consultant, who is available 24/7 to accompany the team if needed, there is a designated NNTP nurse, registrar and ambulance operative together with a dedicated NNTP ambulance available for transport daily.

For practical purposes, most neonatal transports in Ireland are best undertaken as road transfers. However, in circumstances, where factors such as distance, adverse road conditions or urgency of transport are paramount, the optimum mode is (rotary wing) air transport. As the demand for the NNTP service continues to grow, so too does the NNTP need for air transport.

A Service Level Agreement (SLA) between the Department of Defence and the Department of Health in consultation with the Health Service Executive, the Defence Forces and the Irish Air Corps in respect of provision of Air Ambulance Service exists since 2006.

The Irish Air Corps Air Ambulance Service is an emergency inter-hospital transfer service for the essential rapid transfer of patients between hospitals. The scope of the service as it applies to neonates includes:

1. **Air Transport of neonates requiring immediate medical intervention in Ireland**
2. **Air transport of patients requiring specialised emergency treatment in the UK.**

The Irish Air Corps provides rotary or fixed wing aircraft and flying crews for NNTP transports dependent upon the following:

- Availability of suitable aircraft
- Availability of flying crews
- Suitability of weather conditions

The NNTP has developed an air rig (consisting of incubator module and elevating trolley) specifically for air transport that integrates into the Irish Air Corps' EC135 and AW139 Rotary Wing Aircraft and Fixed Wing CASA CN 235 Aircraft. This lighter weight system can be loaded safely and accommodated securely in all these aircraft. The air rig can also be accommodated into the NNTP's dedicated critical care ambulances, other national front-line ambulances (including ICVs built after 2014), and in frontline ambulances in the UK.

PROTOCOL NO. 1

Algorithms for NNTP Air Transports in IAC Aircraft

1.1 When Referring Hospital is OUTSIDE Dublin

Transport is accepted by NNTP through the standardised (NEOC) call handling process.

↓

The decision to transport by air is made by the NNTP consultant (Protocol 2).

↓

When the decision to travel by air has been made, the NNTP consultant requests an air transport via NEOC/NACC (Protocol 3).

↓

He/She specifies aircraft preference and states whether the call is Priority or Routine.

↓

NEOC/NACC activate the NNTP ambulance operative and ambulance when appropriate.

↓

NEOC/NACC confirm Irish Air Corps acceptance to conduct the transport with NNTP within 15 mins.

↓

NEOC/NACC arrange air transport details with Irish Air Corps Operations Section and where required, organise suitable ambulance to meet aircraft at destination.

↓

NNTP ambulance collects team and ancillary air transport equipment as per 'Before Air Transport' Checklist from base hospital and travels to Baldonnel airbase (Protocol 4).

↓

While NNTP team is en route, Irish Air Corps staff load the NNTP air transport incubator module and folded elevating trolley, kept in No 3 Operations Wing (" Heli Ops") hangar into the aircraft.

↓

On arrival at Baldonnel, using the 'Before NNTP Air Transport' Checklist, NNTP team transfers ancillary air transport equipment to the aircraft & checks functionality.

↓

NNTP team boards aircraft and when leaving, calls the referring hospital to give ETA.

↓

On arrival at destination, the incubator module is unloaded onto the elevating trolley. This trolley loads and secures into any NAS/UK frontline ambulance/ ICVs built before 2014.

↓

NNTP team arrives (by ambulance if required) to the referring hospital, stabilises the infant.

↓

NNTP team travels with infant in an air rig back to the aircraft (in a frontline ambulance if required).

↓

Incubator module with infant and elevating trolley are loaded into aircraft by Irish Air Corps staff.

↓

NNTP team phone receiving hospital with ETA.

↓

NEOC/NACC in coordination with IAC arrange for NNTP ambulance to meet the NNTP team on arrival.

↓

NNTP team travels back to Baldonnel/other destination airport/helipad.

↓

Arrive and Irish Air Corps staff unload incubator module from aircraft onto the elevating trolley.

↓

Air rig is loaded into NNTP ambulance and travel with NNTP team to the receiving hospital/ infant handover.

↓

NNTP team return to base, 'After NNTP Air Transport' Checklist is completed and a clean air rig is subsequently returned to Baldonnel in an NNTP ambulance.

1.2. When Referring Hospital is WITHIN Dublin

Transport is accepted by NNTP through the usual NEOC call handling process.

↓

The decision to transport by air is made by the NNTP consultant (Protocol 2).

↓

When the decision to travel by air is made, the NNTP consultant requests an air transport via NEOC/NACC (Protocol 3).

↓

He/She specifies aircraft preference and states whether the call is Priority or Routine.

↓

NEOC/NACC confirm Irish Air Corps acceptance to conduct the transport with NNTP within 15 mins.

↓

NEOC/NACC activate the NNTP ambulance operative and ambulance to travel to Baldonnel at an agreed time to pick up the NNTP air rig, stored in No 3 Operations Wing ('Heli Ops') hangar and bring it to NNTP base.

↓

Using the 'Before NNTP Air Transport' Checklist, NNTP team transfers ancillary air transport equipment to the air rig & checks functionality.

↓

NEOC/NACC arrange air transport details with Irish Air Corps Operations Section and where required, organise suitable ambulance to meet aircraft at destination.

↓

NNTP ambulance collects team and fully equipped air rig (Protocol 4) from base hospital and travels to the referring hospital.

↓

NNTP team arrives at referring hospital, stabilises and transfers the infant to air rig.

↓

NNTP travel with infant to Baldonnel (or other airport/helipad) for flight in an NNTP ambulance (or other ambulance if required).

↓

On arrival at airport/helipad, incubator module with infant and folded elevating trolley are loaded into aircraft by Irish Air Corps staff.

↓

NNTP team boards aircraft and calls the receiving hospital with ETA.

↓

On arrival at destination, incubator module is unloaded onto elevating trolley by Irish Air Corps.

↓

This trolley then secures into NAS/UK frontline ambulances and in ICVs (built post 2014).

↓

NNTP team travels with the infant to the receiving hospital in frontline ambulance /infant handover.

↓

NNTP team plus air rig return to airport/helipad via frontline ambulance.

↓

Air rig is loaded into aircraft by Irish Air Corps staff and the team fly back to Baldonnel.

↓

Arrive and Irish Air Corps staff unload incubator module from the aircraft onto elevating trolley.

↓

NNTP team completes the 'After NNTP Air Transport' Checklist, leaving the air rig clean & restocked in Baldonnel.

↓

NNTP team travels back to the base hospital in an NNTP ambulance.

PROTOCOL NO. 2

Requesting the Irish Air Corps Air Ambulance Service

- All NNTP requests for the Irish Air Corps Air Ambulance Service are made by the NNTP consultant or a designate through **NEOC/NACC**.

- When requesting air transport, the NNTP should state:
    1. is the request:
        a. **A Priority Call**: NNTP requires information re IAC availability for mission within **15-20 minutes** and that an aircraft is available to **fly within the hour**.

        b. **A Routine Call**: NNTP require information re IAC availability for mission within **15-20 minutes** and that aircraft is available to **fly on the day requested**.

    2. is the preferred mode of flight requested by the NNTP:
        a. **Rotary Wing** EC135 or AW139

        b. **Fixed Wing** CASA CN 235

- **NB. It is important to note that helicopters are the only suitable aircraft for NNTP air transports within Ireland.** (This is because the additional ambulance journey times to and from airports necessitated by fixed wing travel, negate the time advantages gained over road transfer when flying to any destination within Ireland.)

- NACC will make contact with the Irish Air Corps Operations Section.

- NACC completes the details as per the Air Ambulance Request form and passes these details to Irish Air Corps Operations Section.

- The Irish Air Corps Operations Section then confirms all details with NACC, who in turn pass on confirmation and timings to NEOC and the NNTP requestor.

PROTOCOL NO. 3

The Decision to Travel By Air

The National Neonatal Transport Programme is primarily a ground transfer service and the decision to transport by air within Ireland is made on the basis of the urgency of the transport in relation to the infant's clinical condition in addition to the distance to be travelled.

3.1 Factors to be considered, Ground versus Air Transport

- Distance and duration of transport to the receiving hospital
- Level of medical care that the infant is currently receiving
- Urgency of providing a higher level of clinical care
- Geographic and logistical characteristics that affect expedient transport
- Diagnosis and medical stability of the neonate, including analysis of possible complications in his or her condition during transport
- Methods of transport available

3.2 Choosing Fixed or Rotary Wing Aircraft

A. Fixed Wing Air Transport is primarily only suitable for overseas NNTP transports.

- This is because all fixed wing flights involve additional ambulance journeys to and from airports and these journey times, when added to the fixed wing flight time, negate the time advantages gained by air transport over ground transfer.

B. Rotary Wing Air Transport is the only suitable air transport mode for NNTP transports within Ireland.

Helicopter transfer is the preferred option over road transfer when:

- there is an urgency of transport in relation to distances >180 kms (i.e. Letterkenny, Tralee, Castlebar, Sligo, Cork, Galway).
- there is an urgency to provide a higher level of medical care than is available at the referral centre.
- adverse road conditions impede ground transport.

3.3 Suitability of IAC Fixed Wing Aircraft for NNTP Use

A. CASA CN 235
The only current IAC fixed wing aircraft, in which the NNTP air transport incubator module and elevating trolley can be accommodated, is the **CASA CN 235** aircraft.

- CASA CN 235 has a Lifeport, which provides power and O2 and onto which the incubator module can be loaded and secured for flight.
- The folded NNTP elevating trolley can be stowed on board for travel.
- There is enough space to provide for easy access to the patient for interventions.
- There is enough space for parents to also travel, when deemed suitable.
- The cabin is pressurised to equate to an atmosphere pressure of 8000 feet above sea level.

B. The Learjet
In exceptional circumstances, the NNTP can be facilitated with a transport in the Learjet aircraft when traveling abroad, if the infant is suited to travelling using a Babypod instead of an incubator.

3.4. Suitability of IAC Rotary Wing Aircraft for NNTP Use

A. The AW139
The **most suitable** aircraft for NNTP air transport **within Ireland** is the **AW139**. It may also be suitable for transports to the UK when there is opportunity to **land directly** on the receiving **hospital grounds**.

- This AW139 has a Lifeport System, which provides power and O2 and onto which the NNTP incubator module can be loaded and secured for flight.
- The folded elevating trolley can be stowed on board for travel.
- There is relatively good access to the patient and space for interventions.

B. The EC135
The **EC135** aircraft is the secondary option for NNTP air transport **within Ireland**. It is not suitable for transports at night or to the UK.

- This EC135 provides power and O2 and the NNTP incubator module can be loaded and fixed directly to the floor of the aircraft for flight.
- The folded elevating trolley can be stowed on board for travel.
- There is limited access to the patient and space for interventions in flight.
- A maximum of 2 NNTP members can travel with the patient.

3.5 Factors that affect transport in IAC aircraft

- The infant may not be suitable for air transport as he/she can be adversely affected by the increased risks associated with air transport which include:
  hypothermia, hypoxia, expansion of gases trapped in a body cavity, noise and vibration.

- The infant may be adversely affected by a decrease in oxygen saturation levels at altitude (particularly in the CASA aircraft) resulting in increased FiO2 requirements.

- Unstable infants who are likely to require interventions en route are unsuitable for air transport in the EC135 as access to the infant is restricted. Access to the infant is much less restricted in the AW139 aircraft.

- Air transport may be affected by:
  - weather conditions (eg: high wind or fog)
  - availability of suitable landing site
  - unavailability of aircraft
  - unavailability of an ambulance that can accommodate the NNTP incubator to transfer between landing site and referring hospital (Health Canada, 2007)

3.6 Special Considerations

Although air transfer is often considered just another way of transporting a patient, there are great differences between this kind of transport and ground transport. An infant may be exposed to some specific risks during flight. Therefore, the accompanying clinical team must have a good understanding of the basics of aerospace medicine and the specific interactions that might occur for a particular illness or injury.
(*Please refer to section* The Basics of Aerospace Medicine)

The following neonates require special consideration in flight:

- neonates who have or who may develop airway compromise
- infants with high FiO2 requirements
- infants with gas trapped within any body cavity (e.g. pneumothorax)
- extremely premature infants
- infants with congestive heart failure
- infants with severe anaemia
- infants who have had thoracotomy or laparotomy (Health Canada, 2007)

The NNTP's recommendations in determining the most appropriate mode of transport should be documented on the infant's chart.

3.7. Transport Mode Advantages

Road Ambulance
- Available
- Can be used in most weather conditions
- Infant transferred only twice (into and out of ambulance)
- Adequate cabin space
- Twin transfer possible
- Minimal weight restrictions for numbers of passengers
- Easily diverted
- Relatively lower cost

Helicopter
- Rapid transport time
- Can reach otherwise inaccessible areas

3.8 Transport Mode Disadvantages

Road Ambulance
- Longer transit times
- Mobility limited by road and traffic conditions

Helicopter
- Requires unobstructed landing sites
- Weight limits
- May require multiple patient transfers
- Twin transfer not possible
- Limited fuel capacity which limits range
- Restricted by weather
- Noise and vibration interference
- No cabin pressurisation
- Increased costs

Fixed Wing
- Requires runway/airport for take off and landing
- Requires multiple patient transfers

3.9 Hazards of Air Transport
- Adverse weather conditions
- Dimmed lighting (at night)
- Lack of cabin space to perform emergency procedures (in EC135) / inability to stop
- Infant can be adversely affected by hypoxia, hypothermia, air leaks, noise and vibration (Jaimovich, 2002)

PROTOCOL NO 4

The NNTP Air Transport Module Equipment Item List

4.1 Equipment Item List

Equipment Item	Model/Make	Storage
Elevating Trolley	Transporter (Paraid)	These items belong to the NNTP and are stored with the Air Rig in No 3 Operations Wing, for the NNTP's exclusive use
Incubator plus AC & (Amb) DC cables	TI 500 (Draeger)	
Suction Unit & Canister plus AC cable	LCSU 4 (Laerdal)	
Humidifier Device	Neo-Pod (Westmed)	
02 Hose and Flowmeter	Oxygen care	
02 Regulator with Double Outlet	Oxygen care	
Humidifier AC and DC Cables		These items belong to the NNTP and are kept in Pouches on the Air Rig in No 3 Operations Wing
AC Cables for T1 Vent and Braun Pumps plus Combi Leads		
Neonatal ECG, Sa02, IBP, NIBP cables		
02 Hose for T1 Ventilator and NO Hose		
Ventilator	T1 (Hamilton)	These items are kept with the NNTP teams and must be transferred to the Air Rig for <u>**all**</u> air transports
Patient Monitor	Tempus Pro (RDT)	
Syringe Pumps x 5	Perfuser Space (B.Braun)	
Handheld Pulse Oximeter	Rad 5 (Massimo)	
No Cylinder and Regulator	Medivent	Brought by the NNTP only when Required
No and No2 Environmental Monitors	Medivent	
Interface plate for AW139	Lifeport	Provided by IAC and stored in No 3 Operations Wing
E Size 02 Cylinders x 2	BOC	
DC Cables for Incubator, Suction and pumps	AAT	
Interface plate for CASA CN 235	Lifeport	Provided by IAC and stored in No 1 Operations Wing
E Size 02 Cylinders x 2	BOC	
DC Cable for Ti500 Incubator	CASA CN235	

<u>N.B This equipment only is certified for use in the IAC's EC135, AW 139 and Casa CN235</u>

4.2 Equipment Checklists

All other consumable equipment items for air transports, kept with the NNTP team, are checked pre and post each air transport as per 'Before and After NNTP Air Transport' Checklists (Appendix 3). These checklists are available in hard copy on the NNTP air rig, in the transport folders and on http://nntp.ie/library/pdf/NNTP-AirTransportChecklists.pdf

PROTOCOL NO.5

Use of the Paraid Transporter Elevating Trolley

Function

1. The elevating trolley is intended to:
    a. Facilitate the carriage of the NNTP's air transport incubator module on ground transport.
    b. Facilitate loading onto the IAC's Rotary and Fixed wing aircraft.
    c. Be stowed on board these aircraft while in flight for subsequent use on ground transport at our destination.

2. Instructions for the use of this trolley are contained in the manufacturer's user manual. (Appendix 6)

Storage

3. The air rig (elevating trolley together with the incubator module) is to be kept routinely in IAC No 3 Operations Wing (" Heli Ops") hangar for use with the AW139 and EC135 aircraft.

4. When required for fixed wing operations (CASA CN 235), the air rig (elevating trolley together with the incubator module) will be required to be brought to IAC No 1 Operations Wing ahead of the mission and returned to No 3 Operations Wing on completion.

Loading and Stowage

5. **EC135**
The elevating trolley facilitates direct loading of the incubator module onto the floor of the EC135. The trolley (and locks in their fully folded position) can be carried in the hull of the aircraft. To facilitate space for the folded elevating trolley, the Tempus Pro monitor should be removed (using the clamp) from the incubator module (while patient leads stay attached) and then passed through the hull of the aircraft to the front cabin where it is mounted on the standard rail.

6. **AW139**
The elevating trolley in its fully elevated position facilitates the loading directly onto the Lifeport (with the interface plate already in situ) in the AW139. The folded trolley can then be carried tied down in the hull of the aircraft.

7. **CASA CN 235**
a. When loading onto the CASA CN 235 Lifeport (different to the AW139 Lifeport), the interface plate for the Lifeport (kept in No 1 Operations Wing hangar) is required to be placed between the trolley and the incubator module prior to loading onto the Lifeport. The logistics involved in organising this will require communication between NNTP, IAC and NAS on a case by case basis.

b. The folded elevating trolley can then be secured on the locks on the back entrance to this aircraft.

PROTOCOL NO. 6

Power Capabilities and Available Power Sources for NNTP Equipment

Incubator Isolette TI500

- The incubator TI500 has two batteries that should last for at least 150 minutes once fully charged
- When not in active operation, the incubator is charged via AC cable.
- During the flight, the incubator can be plugged into the:
    - AC source on the Lifeport in AW139 and CASA CN 235
    - DC source - in EC135
      - on the AAT tower ("medical rack") in AW139
      - in CASA CN 235 - wall mounted DC socket (left side of the aircraft)
- The incubator can be plugged into any AC source (eg. ambulance, hospital) during air transport if necessary

Hamilton T1 Ventilator

- This has a battery life of 8 hours
- The ventilator can also be plugged into the AC source on the AW139 and CASA Lifeport
- It can be plugged into an AC source (eg. ambulance, hospital) during air transport if necessary

Neo-Pod Humidifier System

- The Neo-Pod has no battery power
- It must be connected to either the **AC** or **DC** power source in AW139
- It can also operate via the **DC** power source in the EC135
- The Neo-Pod requires the **AC** power source on CASA aircraft

Tempus Pro Monitor

- The Tempus Pro monitor has a battery life of at least 13 hours once fully charged

B. Braun Perfusor® Space syringe infusion pumps

- B.Braun syringe pumps have a battery life of at least 8 hours (at 25 mls. per hour) once fully charged
- They can be plugged into the aircraft's **AC** source by 3 way 'combi' leads
- Alternatively, **DC** source can be utilized during the flight if necessary
- The pumps can be plugged into any **AC** source (eg. ambulance, hospital) during air transport if necessary

Laerdal Compact Suction Unit (LCSU) 4

- The LSU suction unit should operate for approx 45 mins on battery power when fully charged
- It should be fully charged and checked before flight

NOxBOXlite

- No external power required
- It has internal lithium battery which is replaced every 2 years
- Digital display should be active if battery adequate

Handheld Pulse Oximeter Masimo Rad-5

- Battery powered (3 AA batteries - please bring extra)

NB:

1. **The sources of DC and AC power on all IAC aircraft are only activated once the aircraft engines are turned on, so be aware that NNTP equipment is otherwise running on its own battery sources.**

2. **When travelling to your destination on board the aircraft, run the incubator on the AC power in the aircraft to keep it warm. Alternatively, DC source can be utilised but remember, the batteries are not being charged simultaneously.** This is different from the usual situation when the equipment is being powered by AC and the batteries are being charged simultaneously.

PROTOCOL NO. 7

Gas Requirements and Supply for Air Transport

- The Hamilton T1 ventilator requires varying litres of gas/min to operate depending on the O2 requirements and ventilator settings (see manual). The most flow demanding mode is the "High Flow" mode with its maximum setting of 12l/min
- **In any mode: O2 consumption (Hamilton) = [(ExpMinVol x 2) + 4 l/min] x (FiO2 -20.9) / 79.1 [consumption in in liters/min]**
- During positive pressure ventilation of an intubated patient the maximum O2 usage when 100% O2 is required, is approx. **9 l/min**.
- During "High Flow" mode on the maximum setting (flow of 12 l/min) the consumption is **12 l/min**.
- During "nCPAP" the consumption is between **5-7l/min**.
- During Bilevel CPAP ("nCPAP-PC") the consumption can be up to **15 l/min**.

The incubator module has the capacity to hold **2 E size O2 cylinders (2 x 680 l)** with **EACH** lasting approx. **75-80 minutes** on maximum **positive pressure ventilation mode** (9 l/min and requiring 100% O2). In **"High Flow"** mode at 15 l/min **EACH** cylinder will last approx. **40 minutes** and during **hand ventilation** using a self-inflating bag with 100% O2 at 10 l/min **EACH** cylinder will last approx. **55-60 min**.

- **NB: Hamilton T1 ventilator entrains air from the environment in all ventilatory modes and so no medical air is required for its functionality.**

EC135 and AW139 Capacity:

- The primary source of O2 during the air transport is the aircraft systems.
- The EC135, AW139 and CASA CN 235 all MUST have the capacity to supply O2 for a complete neonatal transfer to the furthest hospital destinations within Ireland and when travelling abroad. This includes pre-start, taxi, in flight, arrival and possible wait for an ambulance at either end. It must also take into account sufficient gases for a diversion en route.

The EC135 Helicopter

- 2 E size O2 cylinders have a capacity **680 l EACH**. Together they should last **approx. 2.5 hours at maximum positive pressure ventilation** (9 l/min and requiring 100% O2). **It will be less while "hand ventilating".**
  - **NB:**
    Hamilton T1 ventilator entrains air from the environment in all ventilatory modes and so no medical air is required for its functionality.
    Hamilton T1 ventilator will signal **"Oxygen supply failed"** in case of oxygen supply failure.

The AW139 Helicopter

- O2 is supplied by a ZX cylinder in the Lifeport which equates to **3040 l**. This should last **approx. 5 hours at maximum positive pressure ventilation** (9 l/min and requiring 100% O2). **It will be less while "hand ventilating"**.
  - **NB:**
    Hamilton T1 ventilator entrains air from the environment in all ventilatory modes and so no medical air is required for its functionality.
    Hamilton T1 ventilator will signal **"Oxygen supply failed"** in case of oxygen supply failure.

The CASA CN 235

- O2 is supplied by 2 ZX cylinders in CASA Lifeport which equates to **6080 l**. This should last **approx. 11 hours at maximum usage** (9 l/min and requiring 100% O2).

Gas Usage:

- It is important to remember when ventilating on less than 100% oxygen, the O2 will last longer.
- It is estimated that the longest flying times are:
    - 1hour and 10 minutes. within Ireland (Dublin-Tralee)
    - approx. 3 hours in the CASA CN 235 when travelling abroad.
- However, every effort to conserve gases should be made in case of unforeseen delays.

PROTOCOL NO. 8

Procedure for Loading/Unloading Incubator Module

(NB: please see Protocol No.5 Use of the Paraid Transporter Elevating Trolley)

Responsibilities

The loading and unloading of the incubator module is the responsibility of the Irish Air Corps but the NNTP medical team continue to be responsible for the patient throughout the procedure.

EC135 Helicopter

- Paraid Transporter Elevating Trolley has a pedal pump operated raising and lowering mechanism. This needs to be at a midway height to load into the E135 aircraft and folded to load into the NNTP ambulance

- The incubator module separates from the elevating trolley and glides into the helicopter on a wheel based system, which securely locks into the aircraft.

- When loading the incubator module with the patient into the helicopter, one of the NNTP medical team should stay on the ground while the other is in the helicopter to ensure constant visualisation of the patient.

- Check the ventilator tubing connections are secure prior to and after loading of the incubator into the helicopter.

- The incubator module should be secured into position on the aircraft before connecting the oxygen hose from the incubator module to the helicopter oxygen supply/cylinder for travelling. The NNTP team member observing the infant indicates to the Irish Air Corps staff when it is OK to do so.

- The DC cables from the incubator and the Neo-Pod are then attached to the helicopter DC power source.

- To facilitate space for the folded elevating trolley, the Tempus Pro monitor is now removed (using the clamp) from the incubator module (while patient leads stay attached) and then passed through the hull of the aircraft to the front cabin where it is mounted on the standard rail.

- The elevating trolley, with its yellow ambulance locks folded inwards (please see Appendix 6 for Paraid Transporter Elevating Trolley operations), is then loaded in the aft of the aircraft.

- The reverse of this procedure applies to unloading the incubator when the infant is on board.

AW139 Helicopter

- Lifeport power connection is connected to the aircraft system by the technicians/crew man and Lifeport is then switched ON.

- Lifeport O2 cylinder is connected to the Lifeport system. Lifeport oxygen cylinder is open.

- Paraid Transporter Elevating Trolley has a pedal pump operated raising and lowering mechanism. The elevating trolley needs to be at the maximum height with wheels locked to load into the AW 139 aircraft and folded when loaded into the NNTP ambulance.

- The incubator module separates from the elevating trolley and glides into the helicopter (from the side) on a wheel based system, which securely locks onto the Lifeport in the aircraft.

- When loading the incubator module with the patient into the helicopter, one of the NNTP medical team should stay on the ground while the other is in the helicopter to ensure constant visualisation of the patient.

- Check the ventilator tubing connections are secure prior to and after loading of the incubator into the helicopter.

- The incubator module should be secured into position in the aircraft before connecting the oxygen to the Lifeport for travelling.

- The elevating trolley in a folded position is then loaded in the hull of the helicopter.

- **Oxygen hose can be changed from incubator module cylinder to Lifeport any time irrespective of engine running and it is recommended to do so as soon as the patient stabilises after loading .**

- **NB:** Hamilton T1 ventilator will signal **"Oxygen supply failed"** in case of oxygen supply failure.

- The AC cables from the NNTP's equipment are then connected to the Lifeport for power.

- Alternatively, some NNTP equipment (incubator module, Neo-Pod and pumps) can be connected by DC cables to AAT tower ("medical rack"). However, **AC power is the preferred mode** as equipment is also charging on this mode.

- **NB: Although connected to the Lifeport, no external power is available to the incubator module until the EMS electrical power is switched ON by the crew after the aircraft engines are running.**

- The Power Mode indicator will continue to display "battery" until the EMS electrical power is switched on by the crew. Then the Power Mode indicator on the incubator panel displays "AC (DC) Power Mode".

- The reverse of this procedure applies to unloading the incubator module when the infant is on board.

<u>CASA CN 235</u>

- Paraid Transporter Elevating Trolley has a pedal pump raising and lowering mechanism. The elevating trolley needs to be at the minimum height to load via ramp at the back of the CASA CN 235 .

- When loading onto the CASA Lifeport (different to the AW139 Lifeport), the interface plate for the Lifeport (kept in IAC No 1 Operations Wing hangar) has to be placed between the elevating trolley and the incubator module prior to loading the whole system onto the CASA CN 235.

- The Irish Air Corps staff wheel the NNTP air rig onto the CASA CN 235.

- The incubator module is then loaded onto the Lifeport by sliding it onto the angled loading sled kept in No 1 Operations Wing hangar for loading onto the CASA Lifeport.

- Once loaded, the incubator module securely locks onto the Lifeport in the aircraft.

- When loading the air rig with the patient into the CASA CN 235, one of the NNTP team should maintain constant visualisation of the patient.

- Check the ventilator tubing connections are secure prior to/after loading.

- The incubator should be secured into position in the aircraft before connecting the oxygen supply to the Lifeport for travelling.

- The elevating trolley is then folded and carried on the aircraft for use at the destination.

- **Oxygen hose can be changed from incubator module cylinder to Lifeport any time irrespective of engine running and it is recommended to do so as soon as the patient stabilises after loading.**

- **NB:** Hamilton T1 ventilator will signal **"Oxygen supply failed"** in case of oxygen supply failure.

- The AC cables from the NNTP's equipment are then connected to the Lifeport for power.

- Alternatively, some NNTP's equipment (incubator, Neo-Pod) can be connected to the 28 V wall mounted socket on the left side of the aircraft (facing forward). However, **AC power is the preferred mode** as equipment is also charging on this mode.

- **NB: Although connected to the Lifeport, no external power is available to the incubator module until the EMS electrical power is switched ON by the pilots after the aircraft engines are running.**

- The Power Mode indicator will continue to display "battery" until the EMS electrical power is switched on by the crew. Then the Power Mode indicator on the incubator panel displays "AC (DC) Power Mode".

- The reverse of this procedure applies to unloading the incubator when the infant is on board.

PROTOCOL NO. 9

Flight Safety & Emergency

Helicopter safety involves common sense and adherence to the safety procedures and protocols as explained by the Irish Air Corps staff.

- Do not enter the runway area or embark/ disembark from the aircraft until instructed to do so by the Irish Air Corps staff.
- When approaching the aircraft, make eye contact with the crew man or pilot.
- Never approach or leave the aircraft from the rear when the blades are in motion.
- High visibility vests should be worn on the runway of the Casement Aerodrome in Baldonnel.
- Do not place any items under the seat in the helicopters - these are designed as collapsible seats for the unlikely event of hard landing.
- Make sure YOU know how to communicate using the headset. If it is not working, ask for help or replacement.
- If something doesn't feel right - ask the other people if they hear/see/smell anything unusual.
- If your pilot/crew man/team mate denies your findings - ask yourself whether you want to ignore it as well or whether you want to abort the mission - you have the right to say "No".
- Your own safety is the top priority.
- In case of an emergency landing:
  - minutes to impact: secure loose objects and turn off the oxygen cylinders - if time allows
  - seconds to impact: assume brace position. If you are sitting in a rear-facing seat - stay upright and erect.
- Do not exit the helicopter until the rotor blades stop turning - people have survived a crash but died due to a rotor blade strike on exit.

PROTOCOL NO. 10

Communication in Flight

Adequate inter-team and air to ground communications are essential at all times.

- Communication headset must be worn at all times by the transport team. The headset has a built-in microphone for intra-helicopter communications.
- Refrain from general informal talking during take off and landing.
- **YOU CANNOT HEAR THE EQUIPMENT ALARMS DURING TRAVEL. IT IS IMPORTANT TO HAVE THE LIMITS SET SO THAT YOU CAN SEE THE ALARM LIGHTS AT ALL TIMES. KEEP ONE SET OF EYES ON THE PATIENT/MONITOR AT ALL TIMES.**
- Alert the crew man immediately of any changes in the infant's condition which may necessitate intervention.
- Exchange phone numbers with the crew man/pilots to allow for easy communications while you are with the patient in the referring unit.
- The pilots/crew man has a radio communication with the NEOC/NACC and will facilitate any request you may have for NEOC/NACC.

PROTOCOL NO. 11

Procedures for the Use of inhaled Nitric Oxide (iNO) in Flight

1. NO cylinders must be clearly marked with necessary hazard labels.

2. Both NO and NO 2 environmental monitors must be carried on every flight with iNO.

3. The monitors must be fully functional and tested before departure.

4. In the event of an alarm, the medical crew must alert the flight crew of a gas leak. In such an event, the flight crew will ventilate the cabin immediately.

5. Continuation of the flight is at the discretion of the pilot in command, air crew and the NNTP Team.

PROTOCOL NO.12

NNTP Team Responsibilities

12.1 Prior to Air Transport

1. Daily checks of NNTP Equipment:
    1. Hamilton T1 ventilator functions and alarms
    2. B.Braun Space syringe infusion pumps ensuring that the batteries are charged
    3. Tempus Pro monitor ensuring that the batteries are charged
    4. Handheld Pulse Oximeter Masimo Rad-5 ensuring that the batteries are charged
    5. NO and NO2 Environmental Monitors ensuring they are functional
    6. NO cylinder and regulator

2. Bring **all other equipment** required for NNTP Air Transports to Baldonnel and complete the **'BEFORE NNTP Air Transports Checklist'** as follows:

1. Take the following equipment with you from the NNTP Base:
    1. The NNTP Transport Bags (plus softies!)
    2. Hamilton T1 ventilator
    3. B.Braun Space syringe infusion pumps x 5
    4. Tempus Pro Monitor
    5. NO cylinder and regulator (when required)
    6. NO and NO2 environmental monitors (when required)

2. Check the following are clean and functioning on the NNTP Air Rig (kept in Baldonnel)
    1. LCSU4 suction unit (charged) + canister + tubing
    2. Neo-Pod humidifier device
    3. 02 flowmeter (turned off)
    4. NOxBOXlite (when required)

3. Ensure you have the following (kept in pouches on the NNTP Air Rig in Baldonnel)
    1. Spare monitor leads: ECG/RESP, SaO2, NIBP, IBP
    2. AC & DC cables for Neo-Pod
    3. AC Cable for Hamilton ventilator
    4. AC cable and connectors for pumps x 5
    5. O2 hose for Hamilton ventilator
    6. NO hose (when required)

4. Ensure you take the following from the Main bag with you:
    1. Ventilator tubing for air transport (Armstrong Medical) + scavenger (if required)
    2. Hamilton expiratory valve
    3. Hamilton flow sensor
    4. nCPAP pressure line (F&Prt266) (from ground vent circuit pack)
    5. Transwarmer mattress

5. Ensure the Grab Bag is available to you in flight

12.2 During Air Transport

The NNTP is responsible for the infant and medical equipment at all times throughout the transport process.

12.3 Following Air Transport

The NNTP ensures all equipment is cleaned appropriately and restocked as per the following:

'AFTER NNTP Air Transport Checklist'.

1. The following equipment to be cleaned and replaced onto the NNTP ground rig:
    1. Hamilton T1 ventilator
    2. B.Braun Space syringe infusion pumps x 5
    3. Tempus Pro monitor
    4. NO cylinder and regulator
    5. NO and NO2 environmental monitors

2. The NNTP Air Rig and following equipment to be deep cleaned in the base hospital prior to returning it to Baldonnel.
    1. TI500 Incubator
    2. NNTP elevating trolley
    3. LCSU4 suction unit
    4. Neo-Pod humidifier device
    5. E Size O2 cylinders x 2
    6. 02 flowmeter (turned Off)
    7. NOxBOXlite

3. The following are to be cleaned and returned to their pouches on the NNTP Air Rig
    1. Spare monitor leads: ECG/RESP, SaO2, NIBP, IBP
    2. AC & DC Cables for Neo-Pod
    3. AC cable for Hamilton ventilator
    4. AC cable and connectors for pumps x 5
    5. O2 hose for Hamilton
    6. NO hose

4. The following is placed in/on the incubator, ready for the next transport:
    1. Self inflating bag
    2. Neo-Tee
    3. Air transport tubing (Armstrong)+ scavenger
    4. LCSU4 suction unit + canister + tubing
    5. Transwarmer mattress
    6. Hamilton expiratory valve
    7. Hamilton flow sensor
    8. Incubator bedding, hat, booties nappies and other softies

- The NNTP ambulance operative is responsible for returning the NNTP Air Rig to Baldonnel.

PROTOCOL NO.13

Irish Air Corps Responsibilities

13.1 No 3 Operations Wing Responsibilities

No 3 Operations Wing is responsible for:

1. The storage of the following equipment in a secure, clean environment:
    - a) TI500 incubator with AC cable
    - b) The Paraid Transporter Elevating Trolley
    - c) LCSU 4 suction unit with AC cable
    - d) The Interface Plate for AW139 Lifeport
    - e) E size O2 cylinders x2 (provided by Irish Air Corps) and regulator x2 with double outlet
    - f) O2 flowmeter

2. Reporting any faults or problems as soon as they are detected to the NNTP team via NEOC or the NNTP coordinator.

3. Keeping the incubator plugged into the AC source in order to keep the battery fully charged.

4. Keeping the LCSU4 suction unit plugged into the AC source in order to keep the battery fully charged.

5. Performing daily checks of the incubator ensuring :
    - Power mode "AC" is illuminated
    - Battery condition status is indicating battery charge condition (25-100%)
    - Heater power indicator is illuminated (25-100%) https://www.draeger.com/Products/Content/isolette-ti500-pi-9069068-en-master-1408-1.pdf
    - Incubator temperature is set at 34°C and the incubator air temperature is reading close to 34°C and feels warm
    - Interior light is working

6. Performing daily checks of the functionality of the LCSU suction unit ensuring:
    - a) The battery is kept fully charged.
    - b) The canister is present and intact.

7. Performing daily checks of the Paraid Transport Elevating Trolley ensuring:
    - a) It functions correctly (see Appendix 6).

8. Supplying 2 E size O2 cylinders for the incubator ensuring:
    - a) They are full at the beginning of each transport.
    - b) The regulators, O2 hose and O2 flowmeter are attached and functioning.

9. NOxBOXlite display is functional and displays "0".

10. Providing DC cables for incubator and B.Braun Space syringe infusion pumps.

No 3 Operations Wing responsibility **BEFORE FLIGHT:**
AW139

1. LifePort installation
2. If used, AAT tower("medical rack") is connected to the aircraft power system.
3. Lifeport with Interface Plate is in situ in the helicopter, Lifeport is connected to the aircraft power system and is then switched ON.
4. Lifeport O2 cylinder is connected to the Lifeport system. Lifeport oxygen cylinder is open.

13.3 No 1 Operations Wing Responsibilities

No 1 Operations Wing is responsible for - Long Term:
1. The storage of CASA CN 235 specific interface plate that is used for securing the incubator module on to the Lifeport

2. Provision of Aerosled stretcher (in case of BabyPod transfers or any other Aerosled based transports)

3. Supplying O2 for Lifeport and any additional O2 cylinders deemed necessary

4. Provision of incubator **DC** cable specific for CASA CN 235 operations

BEFORE FLIGHT - SHORT TERM:

CASA CN 235/PILATUS PC12/LEARJET
Note: The long term storage of the NNTP air rig is in No 3 Operations Wing - the air rig should be brought from there to No 1 Operations Wing prior to scheduled fixed wing transports/retrievals.

1. No 1 staff is then responsible for the storage of the following equipment in a secure, clean environment until the actual flight:
    - TI500 incubator with AC cable
    - The Paraid Transporter Elevating Trolley
    - LCSU 4 suction unit with AC cable
    - The Interface Plate for CASA CN 235 Lifeport
    - E size O2 cylinders x2 (provided by Irish Air Corps) and regulator x2 with double outlet
    - O2 flowmeter - already mounted on the incubator module

2. Reporting any faults or problems as soon as they are detected to the NNTP team via NEOC or the NNTP coordinator.

3. Keeping the incubator plugged into the AC source in order to keep the battery fully charged.

4. Keeping the LCSU4 suction unit plugged into the AC source in order to keep the battery fully charged.

5. Performing daily checks of the incubator ensuring :

6. Power mode "AC" is illuminated
    - Battery condition status is indicating battery charge condition (25-100%)
    - Heater power indicator is illuminated (25-100%) https://www.draeger.com/Products/Content/isolette-ti500-pi-9069068-en-master-1408-1.pdf
    - Incubator temperature is set at 34°C and the incubator air temperature is reading close to 34°C and feels warm
    - Interior light is working

7. Performing daily checks of the functionality of the LCSU suction unit ensuring:
    a) The battery is kept fully charged.
    b) The canister is present and intact.

8. Supplying 2 E size O2 cylinders for the incubator ensuring:
    a) They are full at the beginning of each transport.
    b) The regulators, O2 hose and O2 flowmeter are attached and functioning.

PROTOCOL NO. 14

Equipment Service Maintenance

The <u>NNTP</u> is responsible for:

1. The preventative maintenance service of theTI500 Incubator and battery
2. The preventative maintenance service of the LCSU 4 suction unit
3. The preventative maintenance of the Paraid Transporter Elevating Trolley
4. Informing the Irish Air Corps if there are any additional or new equipment to be carried in EC135 or AW139 helicopters or CASA CN 235 aircraft that are not listed in these protocols
5. Informing the Irish Air Corps if scheduled maintenance on aeromedical equipment owned by NNTP and carried on transfers has not been completed for whatever reason
6. Ensuring that after an air transport, all equipment is cleaned appropriately and restocked as necessary (eg. temperature probe, suction liner & tubing , restraint straps, linen etc.)
7. Ensuring that NNTP ambulance operative returns the air rig to Baldonnel

The <u>Irish Air Corps</u> is responsible for:

1. The maintenance of all IAC equipment carried on neonatal transfers as per the manufacturer's instructions
2. Informing the NNTP team via NEOC and NNTP coordinator of any significant issues in relation to EC135, AW139 or CASA CN 235 interior (including Lifeports) and air transport equipment items
3. Informing the NNTP team via NEOC and NNTP coordinator of any significant periods of helicopter unavailability

3. ADDITIONAL INFORMATION WHEN ORGANISING OVERSEAS TRANSPORTS

These issues should be discussed with the NNTP Consultant / Coordinator and NEOC/NACC when planning an overseas transport.

LOGISTICAL FACTORS TO BE CONSIDERED

1. Consider the timing of the journey

Is it an urgent forward journey or planned return journey?

2. Consider then the optimum time to travel based on the following

Flight duration
Landing site
Limitations on landing site availability
- airport opening hours
- daylight vs darkness
- security restrictions
- weather restrictions

3. Consider the journey time from landing site to Destination Hospital

Traffic congestion
Road conditions
Weather conditions

4. Availability of ambulance transport at another end

IAC staff shift durations /changeovers
NNTP staff shift durations /changeovers

QUESTIONS TO ASK NEOC/NACC

1. What incubator/equipment securing mechanisms are available to you

- in aircraft
- in ambulance at destination

2. What electrical power and connectivity is available to you

- in aircraft
- in ambulance at destination
- in destination hospital

3. What oxygen supply and connectivity is available to you

- in aircraft
- in ambulance at destination
- in destination hospital

4. How long will the oxygen cylinders available to you last?

- cylinder contents
- gas consumption

ADDITIONAL EQUIPMENT THAT MAY BE NEEDED

- straps for securing equipment abroad
- country specific electrical adapter
- country specific oxygen connectors
- extra medical gases for ambulance journey abroad
- extra medical gases for in house management abroad

PERSONAL ITEMS

- money for taxi /food/ B&B if necessary
- food /water
- warm jacket

DETAILS REQUIRED BY IAC AHEAD OF FLIGHT

Ensure you have a written record of these:

NEOC/NACC phone number
IAC Operations Section phone number
IAC Pilot name
NNTP Coordinator number
NNTP Duty Consultant name and number
Referring Unit number
Referring Doctor name and number
Receiving Unit number
Receiving Doctor name and number
Parent 1 name and number
Parent 2 name and number
Additional details required by IAC ahead of flight
Patient Details
Name (as on passport)
Date of Birth
Place of Birth
Nationality
Passport No.
Passport Expiry Date
Passport Place of Issue

- **Passengers (NNTP Team, Parents) Details**
  same as above
- **Luggage - how many bags**
  (limited to one per passenger)

4. THE BASICS OF AEROSPACE MEDICINE

THE ATMOSPHERE

The atmosphere surrounding the Earth is divided into four stratified layers: the troposphere, the stratosphere, the ionosphere and the exosphere. The layer closest to the earth, the troposphere extends up to 60000 ft (18290 m) at the equator and up to 30000 ft (9145 m) at the poles. (Canada Health,2007)

Both the un-pressurised rotary-wing aircraft and the pressurised fixed-wing aircraft used by the Irish Air Corps' for neonatal air ambulance fly in the troposphere. The EC135 helicopters generally fly at levels of 1000-1500 feet (300-450m) above the ground as they are usually operated as single pilot helicopters and generally do not fly at higher altitudes (under IFR – instrument flight rules). The AW139 helicopters operate at levels up to 5000 ft (1200- 1500m) as it is a larger two-pilot helicopter with the ability to carry sufficient fuel reserves for IFR flight. The Learjet, Casa CN 235 and Pilatus PC 12 airplanes (pressurised) usually fly within 20000-30000 ft (6096-9145 m) above the ground.

As an aircraft ascends in the troposphere, the following factors come into play:

- **the temperature drops (by 2°C for every 1000 ft [300 m] ascended)**
- **atmospheric pressure falls**
- **water vapour is reduced (Jaimovich,2004)**

Composition

The atmosphere is composed primarily of oxygen and nitrogen.

Approximate Gaseous Content of the Atmosphere

Gas	% of Total
Oxygen	21
Nitrogen	78
Trace gases	1
Total	100

BAROMETRIC (ATMOSPHERIC) PRESSURE

Barometric (atmospheric) pressure is the pressure exerted against an object or a person by the atmosphere. The pressure is usually measured in millimetres of mercury (mm Hg) or Kilopascals (kPa) for medical purposes. As an aircraft ascends, barometric pressure falls.

Barometric Pressure at Various Altitudes

Altitude (ft)*	**Barometric Pressure (mmHg)**	**Barometric Pressure (kPa)**
Sea level	760	101.3
1 000	733	97.7
1 500	707	94.2
3 000	681	90.8
5 000	632	84.2
10 000	523	69.7
20 000	350	46.6
25 000	282	37.6
30 000	226	30.1
*1000 ft = 304.8 m		

GAS LAWS

Changes in atmospheric pressure affect the human body according to the following laws governing atmospheric gases.

Dalton's Law

The total pressure of a mixture of gases is equal to the sum of the partial pressures of the individual gases present.

Physiological significance: Oxygen transfer from the air to the vital organs of a human being is a direct result of atmospheric pressure. Increasing altitude results in a drop in atmospheric pressure. As this occurs, the pressure of the individual gaseous components in the atmosphere also decreases. Therefore, the availability of oxygen declines as altitude increases, which results in oxygen deficiency (hypoxia). Even healthy people will suffer hypoxia during unpressurised flight above 10,000ft, and the impact on a seriously ill or injured person is greater than that on a healthy person.

Boyle's Law

The volume of a gas is inversely proportional to its pressure when temperature remains constant.

Physiological significance: As altitude increases, atmospheric pressure drops, and gases (including gases trapped in any body cavity) expand. The expansion of gases causes an increase in the pressure on surrounding tissues and may result in tissue damage. This expansion of gases explains the effects of changes in atmospheric pressure on ears, sinuses, teeth and the gastrointestinal tract. Gas in the middle ear or the sinuses that expands under these conditions may not be vented adequately, which can result in pain, inflammation and, in the case of the middle ear, the possibility of rupture of the eardrum. (Canada Health, 2007)

TYPES OF AIRCRAFT

Pressurised Aircraft

In medical terms, use of a pressurised aircraft allows control of the atmospheric pressure within the aircraft ("cabin altitude") to meet the patient's needs. Pilots and air medical escorts can work together to provide the optimal cabin altitude for the patient, according to clinical needs and aviation safety.

Types of pressurised Irish Air Corps aircraft

- CASA CN 235
- Learjet
- Pilatus PC-12 NG

Unpressurised Aircraft

The role of unpressurised aircraft in the transport of acutely ill clients is limited by the altitude restrictions indicated for various medical conditions These restrictions force the unpressurised aircraft to fly at altitudes much lower than usual. This factor has several important implications for the transport of acutely ill patients:

- Lower-altitude trips may take longer because of inclement weather, which delays the arrival and subsequent treatment of the client at the receiving hospital
- Greater turbulence at lower altitudes may result in:
    - more hemorrhage in a infant with injuries to an organ (e.g. liver or spleen)
    - more pain, especially in patients with musculoskeletal trauma
    - greater anxiety leading to higher oxygen demands and resultant cardiovascular or pulmonary deterioration
    - greater risk of vomiting and possible pulmonary aspiration
- Greater turbulence at lower altitudes will also directly affect medical care by:
    - making invasive procedures such as initiating an IV line more difficult
    - adversely affecting the performance of medical personnel because of air sickness (i.e., nausea, vomiting, faintness, anxiety)

Aviation considerations may prevent flight at the altitude that offers the best cabin altitude for the infant. In such situations, overall safety must be the major consideration. Nevertheless, it is important that the clinicians keep the pilot fully informed of the infant’s clinical status so that appropriate decisions can be made. (Canada Health,2007)

Types of unpressurised Irish Air Corps aircraft

- EC 135 (Eurocopter)
- AW 139 (AugustaWestland)

PHYSIOLOGICAL EFFECTS OF FLIGHT

ALTITUDE AND OXYGEN DELIVERY

The availability of oxygen declines with increasing altitude because of a drop in barometric pressure (according to Dalton's law; see above). The higher the cabin altitude, the lower the atmospheric pressure inside the aircraft and the more significant the effect on tissue oxygenation. These changes are most pronounced in unpressurised aircraft, where cabin altitude is essentially the same as true altitude.

- Although this is not a significant problem with helicopter transfers, it is worth remembering in respect of respiratory compromised infants that -
  As altitude increases and barometric pressure decreases, the partial pressure of gases also decreases, thus reducing arterial PaO2.
- This can lead to hypoxaemia and O2 requirements may increase.
- Problems may occur if the infant already requires 100% O2 or if significant ascent is necessary. (Canada Health, 2007)

Factors relating to patients that influence the development of hypoxia in flight

- Altitude: Tolerance decreases as altitude increases
- Rate of ascent: Tolerance decreases as rate increases
- Time at altitude: Tolerance decreases as time at altitude is prolonged
- Individual tolerance: Individual variation in tolerance may be due to individual metabolic rate, diet and other factors
- Physical fitness: Tolerance increases with physical fitness
- Physical activity at altitude: Oxygen consumption is greater than normal in infants who are distressed
- Environmental temperatures: Tolerance decreases with extreme cold or heat
- Medications, toxic substances: Oxygen utilization is inhibited by some drugs and toxins (e.g. carbon monoxide) (Canada Health,2007)

General Management

- Identify infants at risk before transport
- Use pulse oximeter to monitor oxygen saturation
- Bring adequate amounts of oxygen
- Supply oxygen and titrate it to maintain appropriate saturations for the individual infant
- Because the aircraft environment is very dry, humidify the oxygen whenever possible
- Treat underlying causes of hypoxia (e.g. administer blood for severe anemia or acute and significant blood loss)
- Reduce cabin altitude to minimize the hypoxia associated with flight (Canada Health, 2007, Cornette, 2004)

ALTITUDE AND EXPANSION OF TRAPPED GASES

With increasing altitude, gases within body cavities expand (according to Boyle's law; see above - therefore as an aircraft ascends, the barometric pressure decreases and the volume of gas within a closed space expands. Such expansion does not result in any difficulty if the concomitant pressure can be relieved. However, if the gases are "trapped" in an organ with inelastic walls and the gases continue to expand within the walls of the organ, some degree of pain and other clinical symptoms and signs may be experienced.

Volume Expansion of Gases

Altitude (ft)	Altitude (m)	Relative Gas Volume
0	0	1.0
5 000	1500	1.2
10 000	3000	1.5
15 000	4500	1.9
18 000	5400	2.0
20 000	6000	2.4

Pressure and Gas Expansion

- Gas expansion is small (10-15%) at the altitude of helicopters (1000- 5000ft).
    - However, this can affect any cavity containing air including the stomach, intestines, middle ear, sinuses and existing air leaks (e.g. PNO).
    - Ensure all ETTs are patent and if the chest drain in situ, leave open not clamped.
    - Insert and drain orogastric or nasogastric tube to prevent gas expansion.
    - Give infants a soother during ascent and descent (when appropriate).
    - Use analgesics in accordance with the severity of the infant's condition.
    - Restriction of cabin altitude or a more gradual descent (or both) will help.
      (Canada Health, 2007)

Respiratory System

Aviation factors affecting lower respiratory tract conditions:

- Reduced atmospheric pressure (leading to gas expansion)
- Decreased presence of water vapour (leading to dehydration)
- Reduction in partial pressure of oxygen leading to hypoxia

Over-pressurisation syndrome (relating to Boyle's law; see above) may develop when alveoli spontaneously rupture in association with gas expansion during ascent. This is most common in patients with air-trapping type of disease. Sudden decompression in the aircraft results in rapid expansion of gases, which could result in pneumothorax, pneumomediastinum or air embolism.

- Pre-existing pneumothorax could become a tension pneumothorax if not treated appropriately (Canada Health, 2007) (Barry and Leslie, 2003)

THERMAL ISSUES

Thermal environment

- The importance of maintaining an appropriate thermal environment for the neonate and the avoidance of cold stress has been well documented.
- Environmental factors include cold hangars, unsheltered areas, chill generated by rotating wing in vicinity of helicopter, effects of altitude.

As aircraft ascends, the frame cools, resulting in a drop in temperature of up to 2 °C for each 1000 feet altitude and in unheated military helicopters, this may put high demands on the incubator system (Jaimovich,2004).

To reduce heat loss and to conserve battery power of the incubator system:
cover incubator/turn up cabin heat/use hats/bubble wrap/chemical mattresses.

Incubator used for air transports should always have fully charged batteries at the beginning of a transfer. AC/ DC power cables suitable for both the aircraft and the ambulance should be taken.

NOISE

Noise is a heath pollutant and a recognised stressor in all modes of neonatal transport. From research and evidence, the recommended noise exposure level is limited to 45 decibel (dB) in the NICU, in order to promote physiological stability. The need for interhospital patient transfers will inevitably expose neonates to higher levels of noise. The current international standards of the recommend the limit of noise exposure during transport is up to 60 dB. However, it has been an overall challenge to ensure this exposure limit is adhered to as the universal practise is variable and still developing. The level of noise exposure is highest during air transport. In this environment, the average background noise is 80-90dB; and can potentially reach peak levels of more than 100dB. These levels are perceived as harmful and detrimental to the human ear. The fluctuations of peak noise during takeoff and landing can increase the neonatal startle response and cause discomfort. The increase in vibration can also amplify noise levels through resonance transmission. (See next section on vibration). There is evidence from previous studies of the effects of noise to changes in the neonatal heart rate, oxygen saturation and behaviour. Therefore, it is important to recognise that high noise levels can aggravate the physiologically compromised neonate (e.g. hypoxia);particularly when travelling at high altitudes.

It is crucial to alleviate noise exposure towards the neonate during air transport by:

- The application of neonatal noise attenuators (Natus MiniMuffs ™) or the equivalent, if available.
- The avoidance of opening the incubator door/ access ports, particularly during take-off and landing, unless absolutely necessary i.e. clinically indicated
- Cover the incubator with absorptive material to dampen noise transmission
- The anticipatory increase of the patient's oxygen requirement during take-off and landing as clinically indicated.
- The use of dynamic absorptive materials e.g. mattress and restraints to reduce movement through vibration and reduce the amplification of noise.

VIBRATION

- Vibration is not usually detrimental to the infant, but will dislodge medical devices (lines and tubes) and adversely affect monitoring equipment.
- During transport, all lines should be secure and visible, particularly arterial lines, to allow observation without the need to open the incubator. Insertion sites of the UVC and UAC should always be visible - do not cover the infant with non-see-through materials.
- Fluidized mattresses and restrainers for the infant can help reduce the effects of vibration on both the baby and equipment.

EFFECTS OF TAKEOFF/LANDING

- Rapid acceleration during takeoff, with the infant secured head forward, theoretically results in reduced cerebral perfusion.
- Conversely, on landing, rapid deceleration may cause a sudden rise in venous cerebral perfusion.
- Take off and landing is always accompanied by an increase in overall vibrations which often lead to spontaneous disconnections of the ventilator circuit. Medical devices have a tendency to vibrate out (or in) of the patient.
- Sensitive patients often have an increased number of desaturations, apnoeas, bradycardias during takeoff/landing.
- There is evidence that premature infants undergoing any type of transport may have a higher incidence of intraventricular bleeding.

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6. APPENDICES

Appendix 1 - Glossary of Terms and Abbreviations

AC	alternating current
AW139	AgustaWestland 139 helicopter, rotary wing
CASA CN 235	fixed wing aircraft
DC	direct current
EAS	Emergency Aeromedical Service
EC135	Eurocopter 135 helicopter, rotary wing
EMS	emergency medical services
EMT	emergency medical technician
ETT	endotracheal tube
IAC	Irish Air Corps
IFR	instrument flight rules
(i)NO	(inhaled) nitric oxide
LCSU	Laerdal Compact Suction Unit
NACC	National Aeromedical Coordination Centre
NAS	National Ambulance Service
nCPAP	nasal continuous positive airway pressure
NEOC	National Emergency Operations Centre
NICU	neonatal intensive care unit
NNTP	National Neonatal Transport Programme
NO2	nitrogen dioxide
PNO	pneumothorax
VFR	visual flight rules

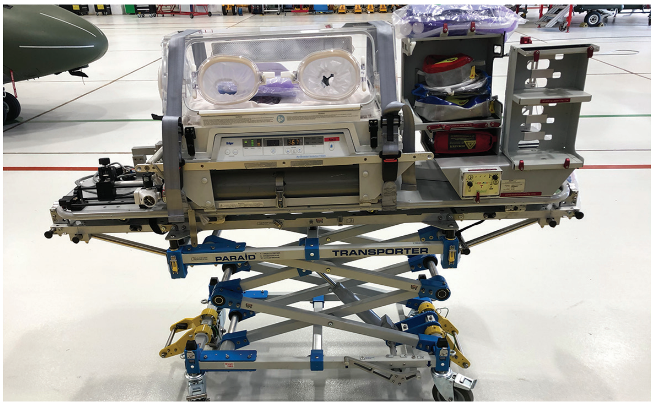
Appendix 2 - Equipment Photo Catalogue

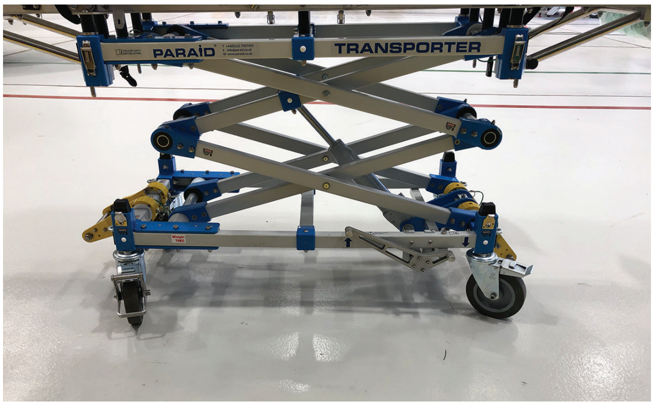
AW 139

EC 135

CASA CN 235

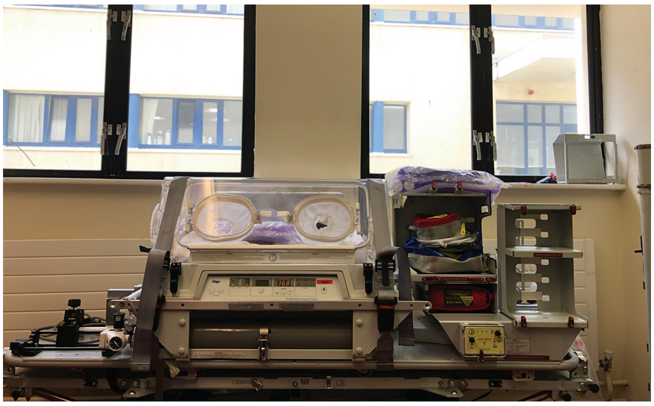
LEARJET





NNTP Air Rig "Air Rig"(= Incubator Module plus Elevating Trolley)

PARAID Transporter Elevating Trolley a.k.a. "Elevating Trolley"



"Incubator Module"

"Interface Plate" (black) for CASA CN 235 Lifeport operations (stored in No 1 Ops Wing storage)

Appendix 3 - NNTP Before & After Air Transport Checklist

BEFORE NNTP AIR TRANSPORTS CHECKLIST

NATIONAL NEONATAL TRANSPORT PROGRAMME

1. Take the following equipment with you from the NNTP Base:

1. The NNTP Transport Bags (plus softies!)
2. Hamilton Ventilator
3. BBraun Pumps x 5
4. Tempus Pro Monitor
5. NO Cylinder and Hose (when required)
6. NO and NO_2 Environmental Monitors (when required)

2. Check the following are clean and functioning on the NNTP Air Rig (kept in Baldonnel):

1. LCSU4 Suction Unit + Canister + Tubing
2. Neo-Pod Humidifier Device
3. O2 Flow-meter (Turned OFF)
4. NoxBox Lite (if required)

3. Ensure you have the following (kept in pouches on the Air Rig in Baldonnel):

1. Spare Monitor Leads: ECG/RESP, SaO_2, NIBP, IBP
2. AC & DC Cables for Neopod
3. AC Cable for Hamilton Ventilator
4. AC Cable and Connectors for Pumps x 5
5. O_2 Hose for Hamilton Ventilator

4. Ensure you take the following from the Main Bag with you:

1. Ventilator Tubing for Air transport (Armstrong Medical) + NO scavenger (if required)
2. Hamilton Expiratory Valve
3. Hamilton Flow Sensor
4. NCPAP Pressure Line (F&P RT266) (from Ground vent circuit pack)
5. Transwarmer Mattress

5. Ensure the Grab Bag is available to you in flight

AFTER NNTP AIR TRANSPORTS CHECKLIST

1. The following equipment to be cleaned and replaced onto the NNTP Ground Rig:

1. Hamilton Ventilator
2. BBraun Pumps x 5
3. Tempus Pro Monitor
4. NO Cylinder and Hose
5. NO and NO_2 Environmental Monitors

2. The NNTP Air Rig and following equipment to be deep cleaned in your base hospital prior to returning it to Baldonnel:

1. TI500 Incubator
2. NNTP Elevating Trolley
3. LCSU4 Suction Unit
4. Neo-Pod Humidifier Device
5. E Size O_2 and Air Cylinders
6. O2 Flow-meter (Turned OFF)
7. NoxBox Lite

3. The following are to be cleaned and returned to their pouches on the Air Rig:

1. Spare monitor leads: ECG/RESP, SaO_2 , NIBP, IBP
2. AC & DC Cables for Neo-Pod
3. AC Cable for Hamilton Ventilator
4. AC Cable and Connectors for Pumps x 5
5. O_2 Hose for Hamilton

4. The following are to be placed in/on the incubator, ready for the next transport:

1. Self Inflating Bag
2. Neo-Tee
3. Suction Canister + Tubing
4. Transwarmer Mattress
5. Air Transport Tubing (Armstrong x 1) + NO scavenger
6. Hamilton Expiratory Valve
7. Hamilton Flow Sensor
8. NCPAP Pressure Line (F&P RT266) (from Ground vent circuit pack)

Appendix 4 - Important Phone Numbers

The National Neonatal Transport Programme (NNTP)

Coordinator	Ann Bowden	087 6787190
Clinical Lead	Dr Jan Franta	087 3416951
Consultants	Dr Hana Fucikova	085 2084928
	Dr Jyothsna Purna	089 2342874
	Dr Eoin O'Currain	087 3420127
	Dr Nurul Aminudin	087 1262637

NNTP/NMH Clinical Engineer		01 6373141/2
		on call 086 2458002

NEOC		1800222378
NACC		1850211869
IAC Baldonnel	Main switch	01 4037689
	No 3 (Rotary) Wing	01 4037590
	No 1 (Fixed) Wing	01 4037558
	Group Duty Officer (out of hours)	01 4037900

Appendix 5 - Estimated Journey Times, Available Helipads and Night Landing Capabilities

When flying using:

VFR-Visual Flight Rules - In this mode the Pilots are clear of cloud and rely on visual information to fly.

VFR Times are worked out using the following:
Flight time home plus:-
Departure and climb time of 3 mins
Arrival time of 3 mins

VFR 120 Kts Still Wind (Normal Cruise Speed EC135)

Hospital	Offical Hospital Name	Distance (nm)	Time (mins)	Nearest (IF) Airport	Night Approved
Castlebar	Mayo University Hospital	107	60	EIKN 17.5 NM	Yes
Cork	Cork University Hospital	111	62	EICK 3 NM	Yes
Crumlin	Children Health Ireland at Crumlin	5	9	EIME 5 NM	No
Galway	Galway University Hospital	93	53	EINN 36 NM	Yes
Letterkenny	Letterkenny University Hospital	127	70	EIDL 25 NM	Yes
Sligo	Sligo University Hospital	92	52	EIKN 25 NM	Yes
Tallaght	Tallaght University Hospital	3	8	EIME 3 NM	Yes(Cranes!)
Tralee	Kerry University Hospital	133	73	EIKY 8 NM	Yes
Waterford	Waterford University Hospital	67	40	EIWF 5 NM	No
Wexford	Wexford General Hospital	57	35	EIWF 24 NM	No

VFR 140 Kts Still Wind (Normal Cruise Speed AW139)

Hospital	Offical Hospital Name	Distance (nm)	Time (mins)	Nearest (IF) Airport	Night Approved
Castlebar	Mayo University Hospital	107	52	EIKN 17.5 NM	Yes
Cork	Cork University Hospital	111	54	EICK 3 NM	Yes
Crumlin	Children Health Ireland at Crumlin	5	8	EIME 5 NM	No
Galway	Galway University Hospital	93	46	EINN 36 NM	Yes
Letterkenny	Letterkenny University Hospital	127	60	EIDL 25 NM	Yes
Sligo	Sligo University Hospital	92	45	EIKN 25 NM	Yes
Tallaght	Tallaght University Hospital	3	7	EIME 3 NM	Yes(Cranes!)
Tralee	Kerry University Hospital	133	63	EIKY 8 NM	Yes
Waterford	Waterford University Hospital	67	35	EIWF 5 NM	No
Wexford	Wexford General Hospital	57	30	EIWF 24 NM	No

IFR-Instrumental Flight Rules - In this mode the Pilots are relying on their instuments enroute to their destination prior to using visual information to land. This would usually be at night or in bad weather.

IFR Times to Baldonnel are worked out using the following:

Flight time home plus:-

Departure and climb time of 3 mins

Approach time at Baldonnel of 12 mins

IFR flight time from the Pads to Baldonnel Still Wind

Hospital	Offical Hospital Name	Distance (nm)	Time (mins)	Nearest (IF) Airport	Night Approved
Castlebar	Mayo University Hospital	107	61	EIKN 17.5 NM	Yes
Cork	Cork University Hospital	111	63	EICK 3 NM	Yes
Crumlin	Children Health Ireland at Crumlin	5	N/A	EIME 5 NM	No
Galway	Galway University Hospital	93	55	EINN 36 NM	Yes
Letterkenny	Letterkenny University Hospital	127	69	EIDL 25 NM	Yes
Sligo	Sligo University Hospital	92	54	EIKN 25 NM	Yes
Tallaght	Tallaght University Hospital	3	N/A	EIME 3 NM	Yes(Cranes!)
Tralee	Kerry University Hospital	133	72	EIKY 8 NM	Yes
Waterford	Waterford University Hospital	67	44	EIWF 5 NM	No
Wexford	Wexford General Hospital	57	39	EIWF 24 NM	No

IFR Times to Hospitals are worked out using the following:

Flight time overhead IFR Airport (IAF) plus:-

IF Departure and climb time to 400ft of 5 mins extra

Approach time at Airport of 12 mins

Flight time from DA/MAP to the hospital

3min Approach/Recce into Pad

IFR flight time from Baldonnel to the Hospital Pads

Hospital	Offical Hospital Name	Distance (nm)	Time (mins)	Nearest (IF) Airport	Night Approved
Castlebar	Mayo University Hospital	107	70	EIKN 17.5 NM	Yes
Cork	Cork University Hospital	111	68	EICK 3 NM	Yes
Crumlin	Children Health Ireland at Crumlin	5	N/A	EIME 5 NM	No
Galway	Galway University Hospital	93	N/A	EINN 36 NM	Yes
Letterkenny	Letterkenny University Hospital	127	78	EIDL 25 NM	Yes
Sligo	Sligo University Hospital	92	67	EIKN 25 NM	Yes
Tallaght	Tallaght University Hospital	3	N/A	EIME 3 NM	Yes(Cranes!)
Tralee	Kerry University Hospital	133	81	EIKY 8 NM	Yes
Waterford	Waterford University Hospital	67	54	EIWF 5 NM	No
Wexford	Wexford General Hospital	57	62	EIWF 24 NM	No

(IAC June 2020)

PARAiD®
Specialists in Patient Handling Transportation

User Manual

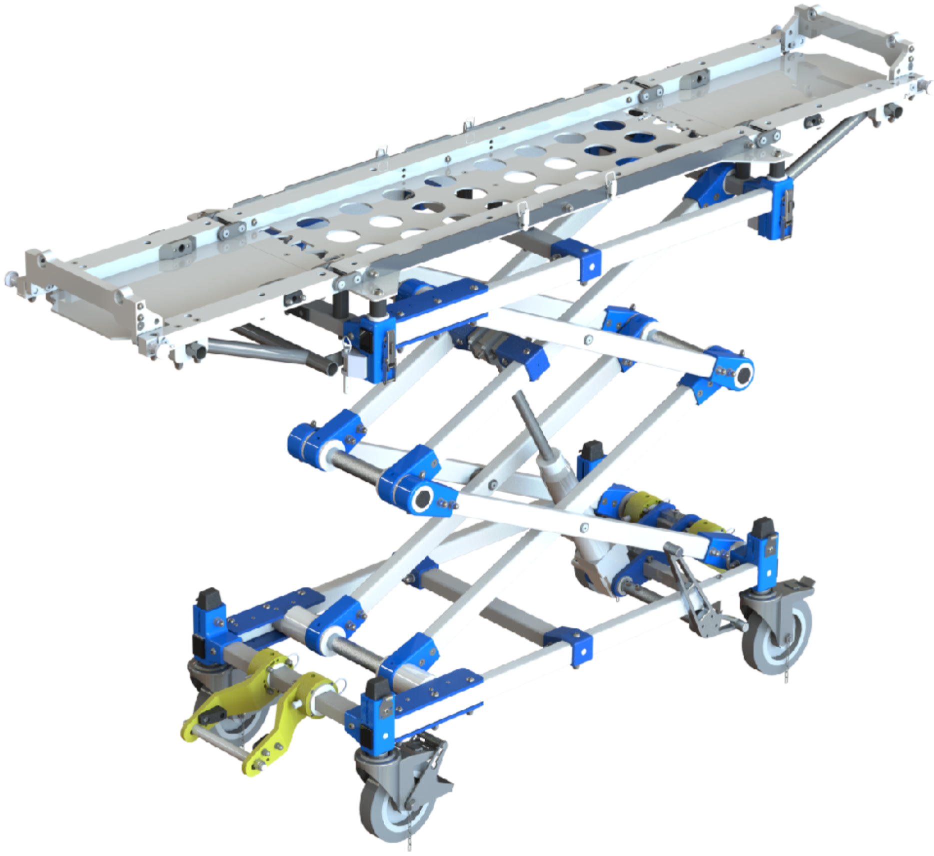
TRANSPORTER+
INTENSIVE CARE TROLLEY

Made in the UK

Introduction

The information within this document provides clear guidance for the operation, maintenance and the servicing of the custom-made Transporter Trolley.

Correct handling and operation of the trolley is essential for the safety of the infant and user. To avoid errors when handling or operating the trolley this document should be accessible by the user at all times. Instructions and requirements should be adhered to at all times during the handling and operation of the trolley.
The trolley must ONLY be used for it's described and intended purposes.



Product No. REF: 2-PAR-AMET-08 Serial No. 128051

General description and features

The purpose of the Transport Trolley is to provide:

1. A transportation facility for a single infant when placed in the incubator.
2. A means to raise the transport incubator to a level where it can be safely transfered on and off an aircraft.

The trolley, and parts provided by Paraid are identified and listed on page 2. The trolley is also fitted with swivel/brake anti-static locking wheels to allow smooth and easy movement around a hospital environment or to a new location. The trolley is intended to be used mostly in a hospital environment, and has the ability to be loaded into and transported in a road ambulance vehicle, which features suitable and tested securing/locking devices.

NOTE: Any lifting actions must be fully risk-assessed by the operator in advance.

2-PAR-AMET-08 Product Guide Rev_1

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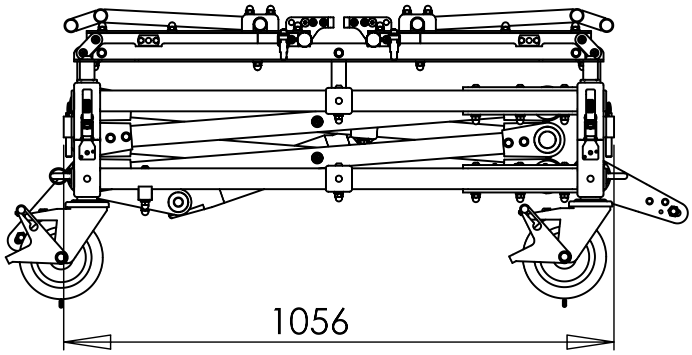
Technical Specifications

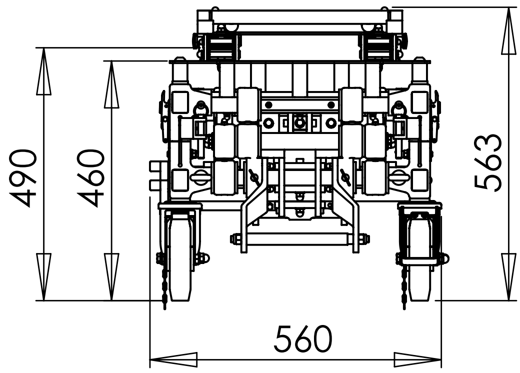
Dimensions

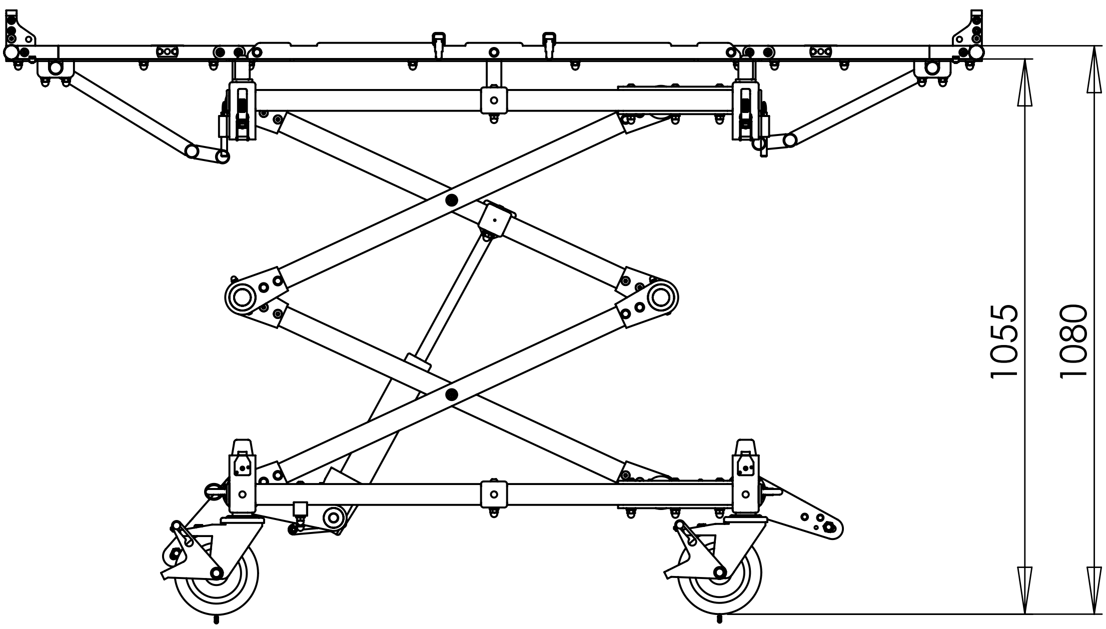
Height: 490mm (lowered) - 1055mm (raised)
Length: 1056mm (1100mm from eyelet bolts)
Width: 560mm

Weight 70Kg (unladen)

Maximum payload 145Kg (Tested using Finite Element Analysis with 145Kg payload in accordance with BS EN 1789)







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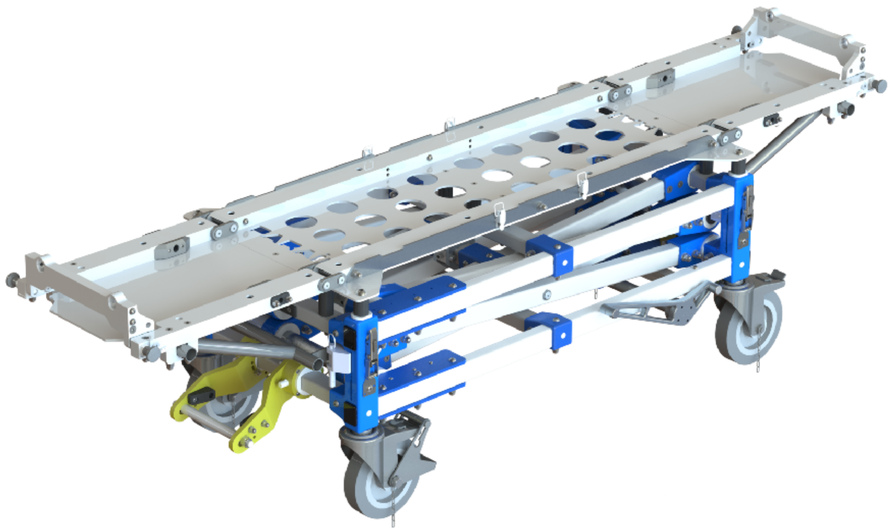
The operation, maintenance and servicing of the prescribed medical devices listed is the responsibility of:



Medical Devices

1 x AAT Aeromedical Incubator Sled with or without Lifeport Interface Plate

The trolley is designed to carry a load of 145Kg Max.

DO:

- Ensure maintenance is carried out [see "maintenance" page].
- Visually inspect trolley after use: any wear and tear or signs of damage must be rectified before use.
- Only use towing handle when pulling.
- Make sure all medical devices, connections and mountings are secure before operational use.
- Apply & release wheel brake using foot only, unless otherwise hand operated castor wheels are present.

DON'T:

- Lift The Trolley! These trolleys are designed to be loaded into a road ambulance with either a suitable ramp or tail-lift.
- Transfer the patient unless the trolley wheels are locked [using brake mechanism on wheel].
- Let the trolley:
  - drop off kerbs
  - get trapped in gulleys / drains
  - run into obstacles.
- Apply or release the wheel brake using hand.

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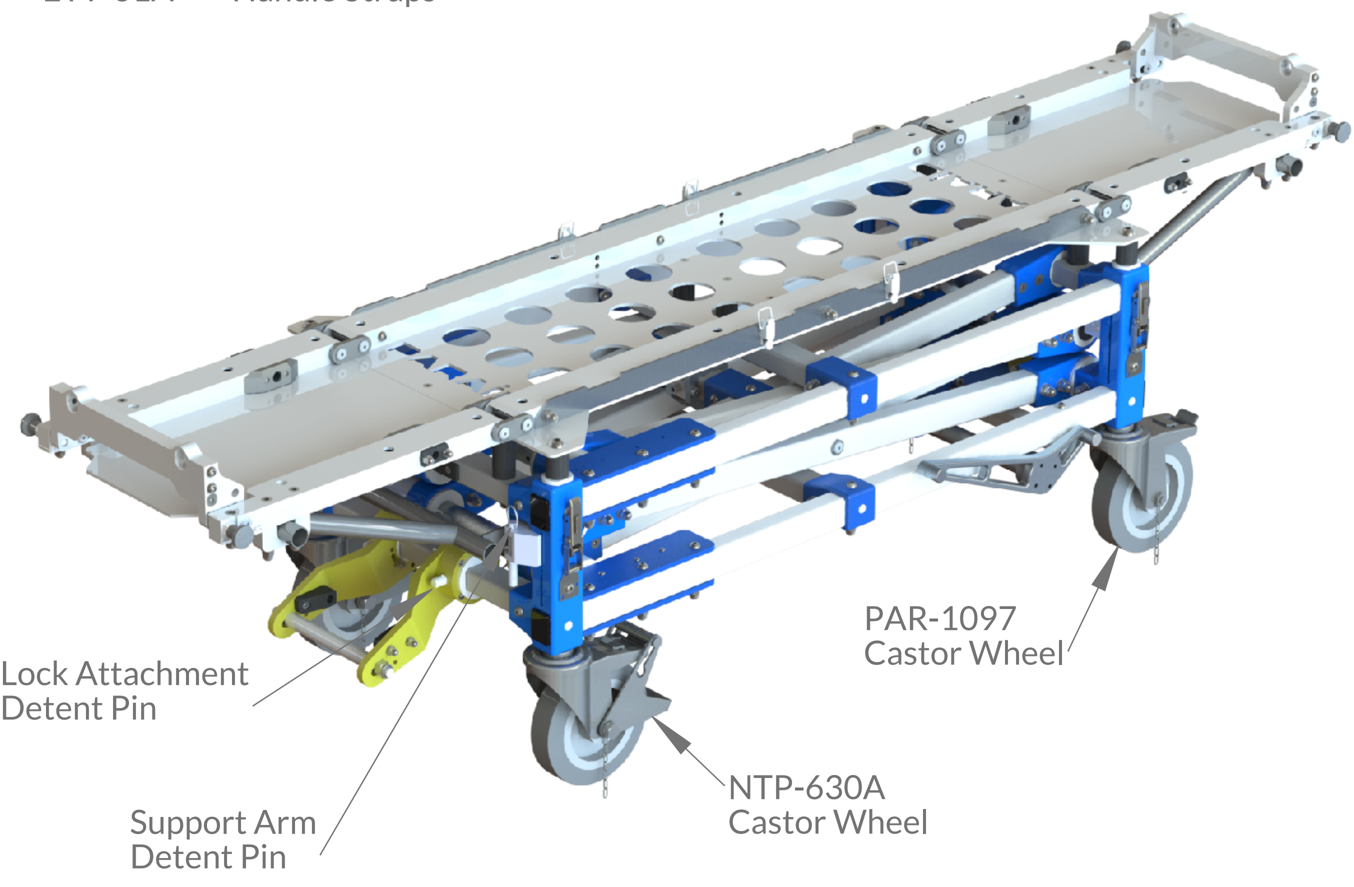
Trolley Spares

NTP-630A	Castor Wheel (with hand operated brake)
PAR-1097	Castor Wheel
PAR- 2171	Lock Attachment Detent Pin
PAR-2172	Support Arm Detent Pin
ETT-59	Green Lanyard
ETT-61A	Handle Straps



The medical device fixations have been specifically designed **ONLY** for the prescribed medical devices listed in this document and should not be used for any other equipment or purpose.

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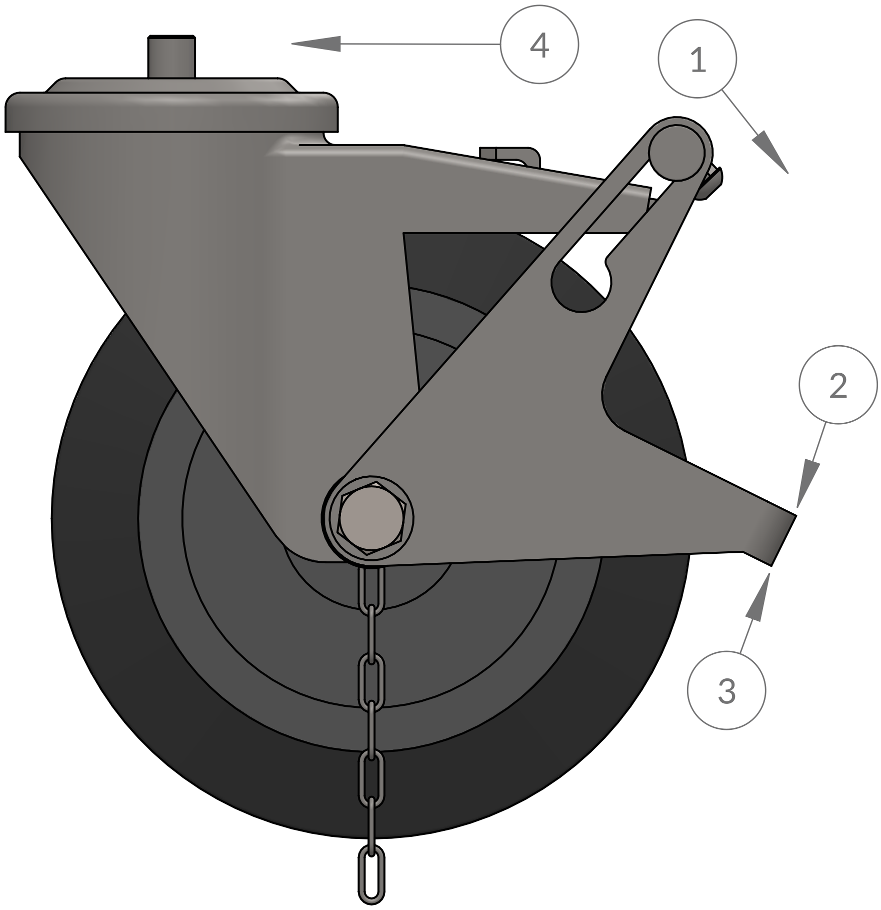

NTP-630A CASTOR WHEEL OPERATION

To Apply Brake

1. Using foot, press down firmly in areas 1 or 2.

To Release Brake

2. Using a hand, lift up in area 3 and press area 4. This will allow you to control the brake lever. Using foot only press brake pedal in area 4.

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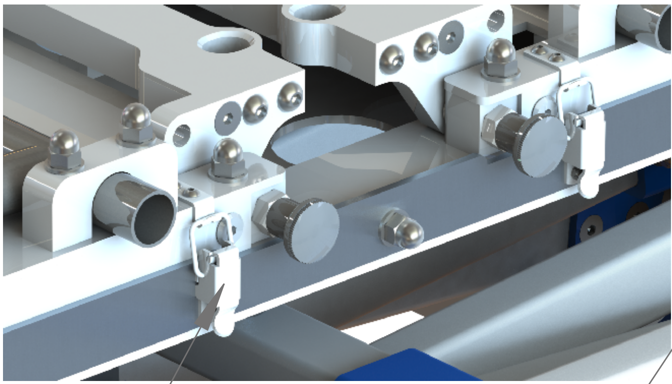
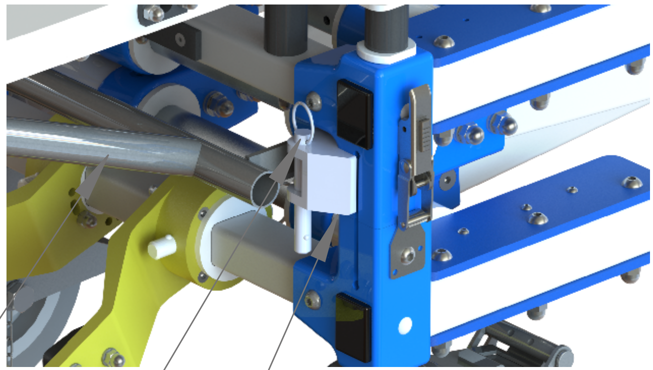


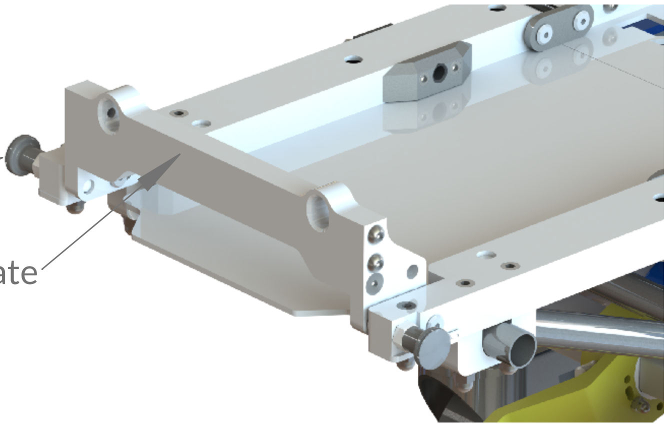


Latch

Support Arm

Support Arm Detent Pin

Support Arm Housing



Spring Pin

Gate

TO UNLOCK/UNFOLD RECEIVER BED

1. To unlock the receiver, disengage the four latches located in the centre of the receiver bed.
2. Fold the ends of the receiver bed over.
3. Remove the support arm detent pins.
4. Insert the support arms at each end in the support arm housings.
5. Re-insert the support arm detent pins fully.
6. At the end of the receiver bed, pull out the spring pin and rotate 90° (this will lock the pin in an out position).
7. Rotate the gate up and release the spring pin by rotating 90°.
8. Ensure the spring pin is fully engaged and the gate is firm before transporting.
9. Reverse process to fold away.

<PARA >NOTE: Ensure all detent pins and spring pins are fully engaged before transportation.

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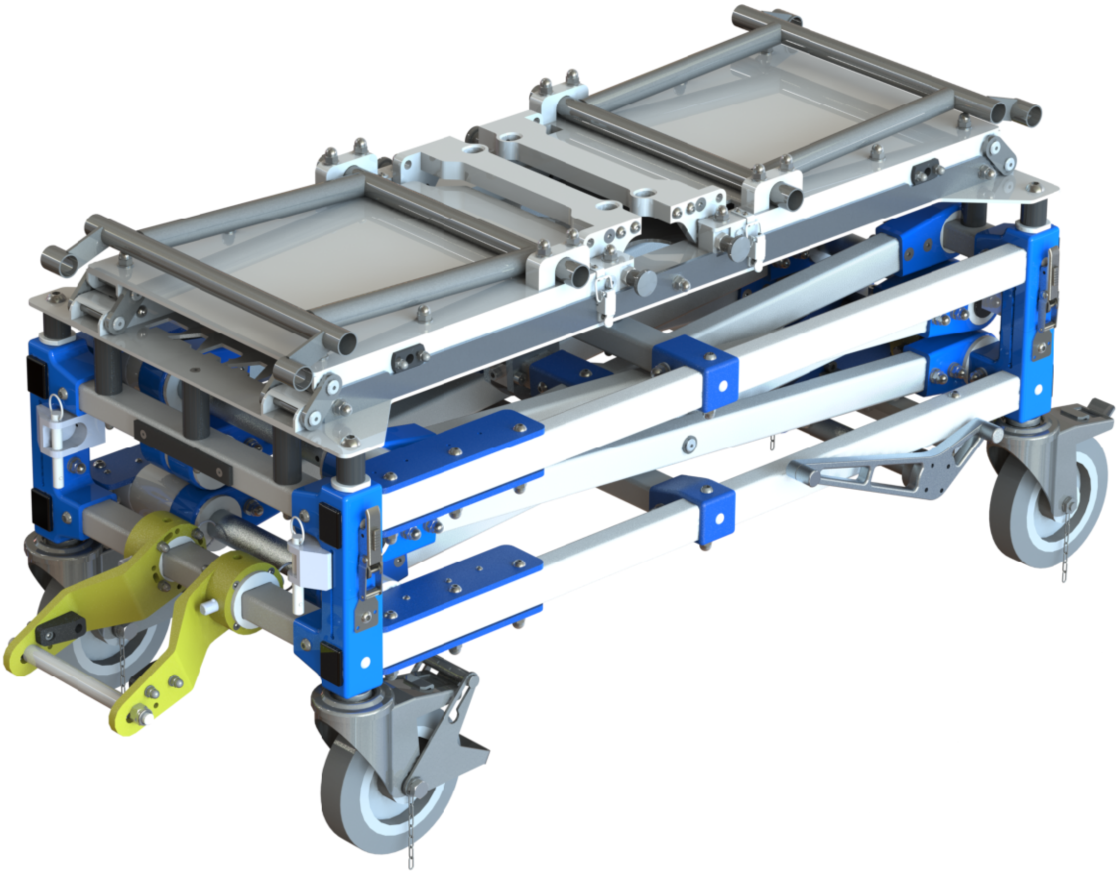

TO UNLOCK/UNFOLD RECEIVER BED

1. When the receiver bed is folded back, ensure the hinge is folded inwards, and the latch lines up with the catch plate.

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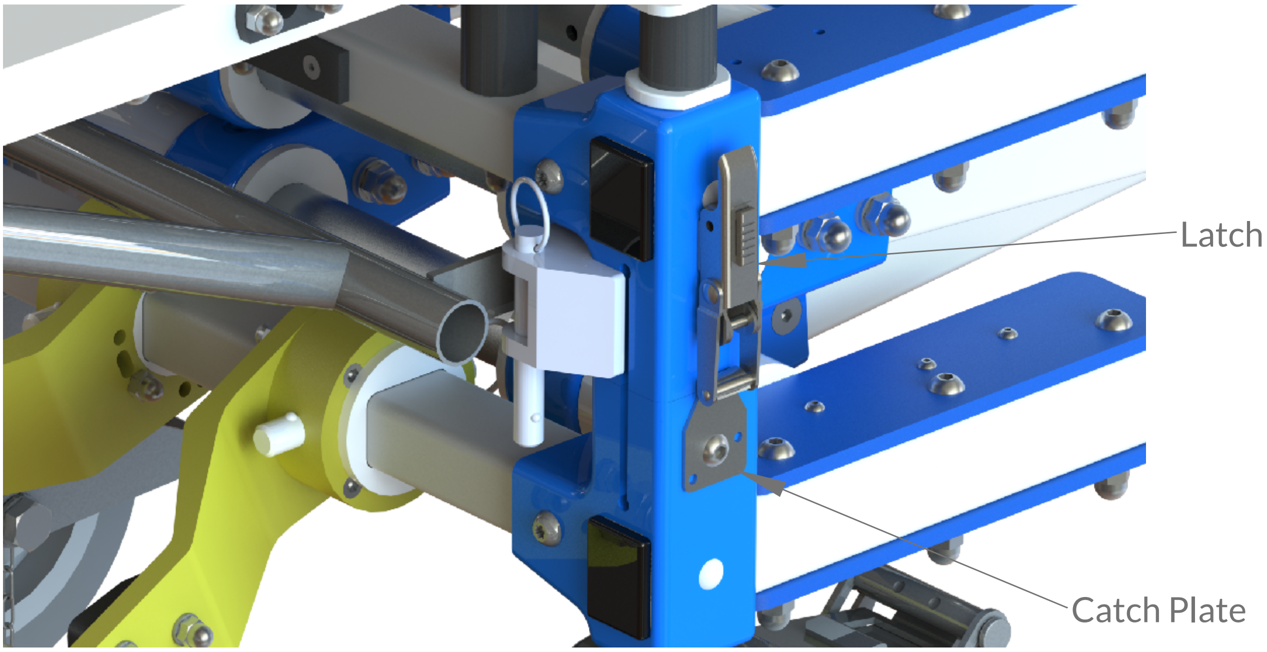

TO LOCK/UNLOCK LATCH

1. To unlock the latch, slide the middle button on the latch down, and pull down on the latch.
2. Unhook the latch and fold back up, ensuring the latch is free of the catch plate.
3. Reverse the process to lock.
4. Ensure all latches are free of the catch plate before operating lifting pedal.
5. Ensure ALL FOUR latches are engaged before transportation.

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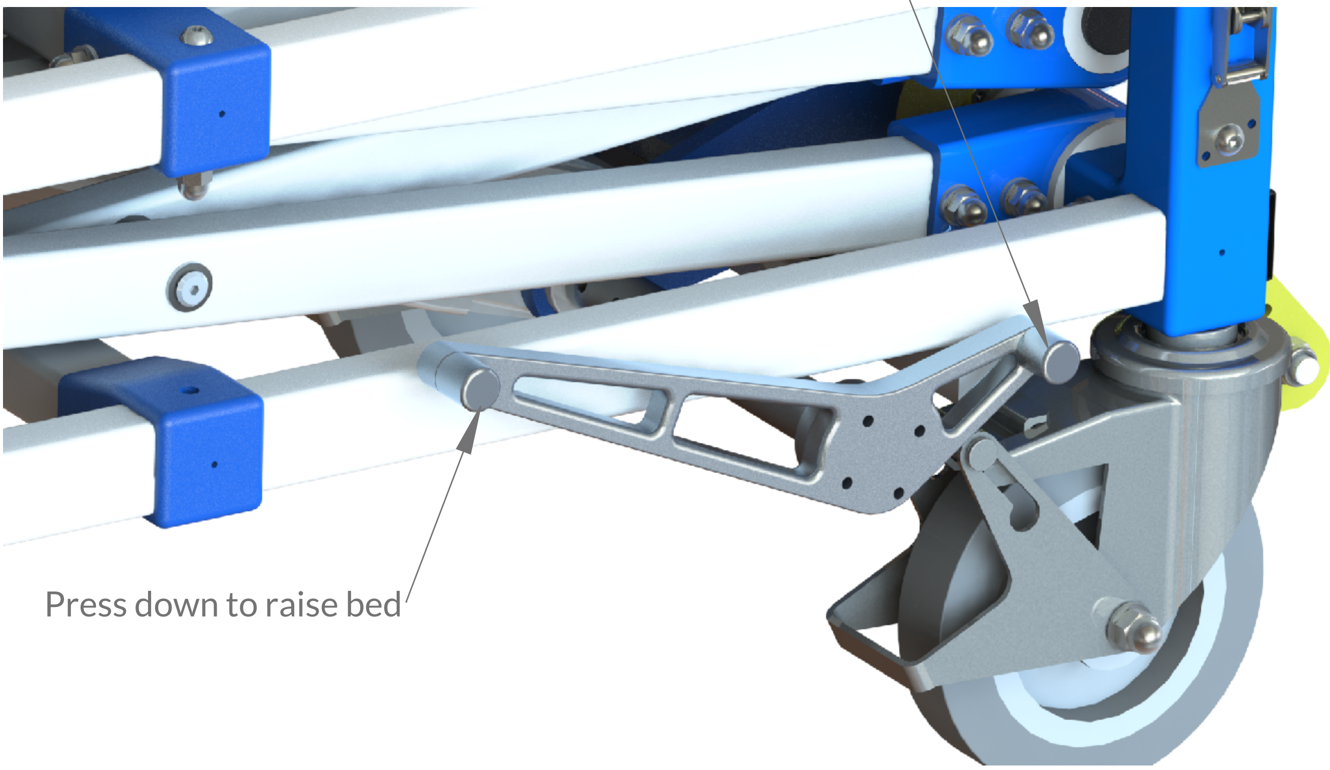

TO RAISE/LOWER THE TROLLEY

1. Unlock all latches in each corner of the trolley.
2. Press gently down on the longer end of the pedal until the pedal comes to a stop. Release the pedal and allow the pedal to return. Repeat process until the trolley has reached its full height.
3. Press down on the shorter end of the pedal and keep pressed down to lower.
4. Lock all latches before transportation.

NOTE: The pedal is only for operating the raising mechanism, and should not be stood or jumped on. Only enough pressure to depress the pedal should be applied.

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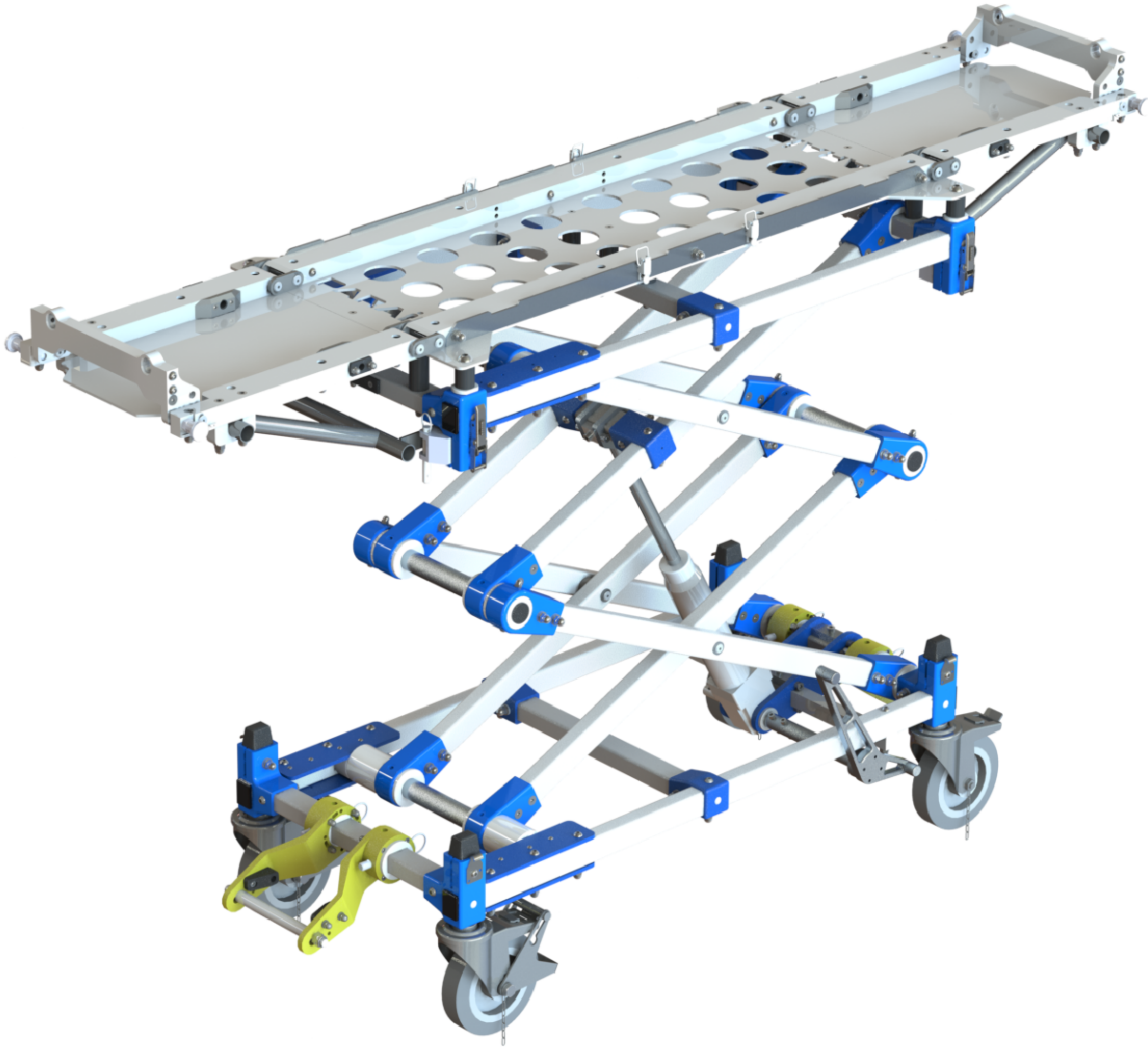

TO RAISE/LOWER THE TROLLEY

When raising and lowering the trolley with the Aerosled locked on board, it is recommended that a person be either side to steady the trolley.

Ensure the Aerosled is moved slowly across the receiver bed, ensuring the wheels do not come off the receiver bed.

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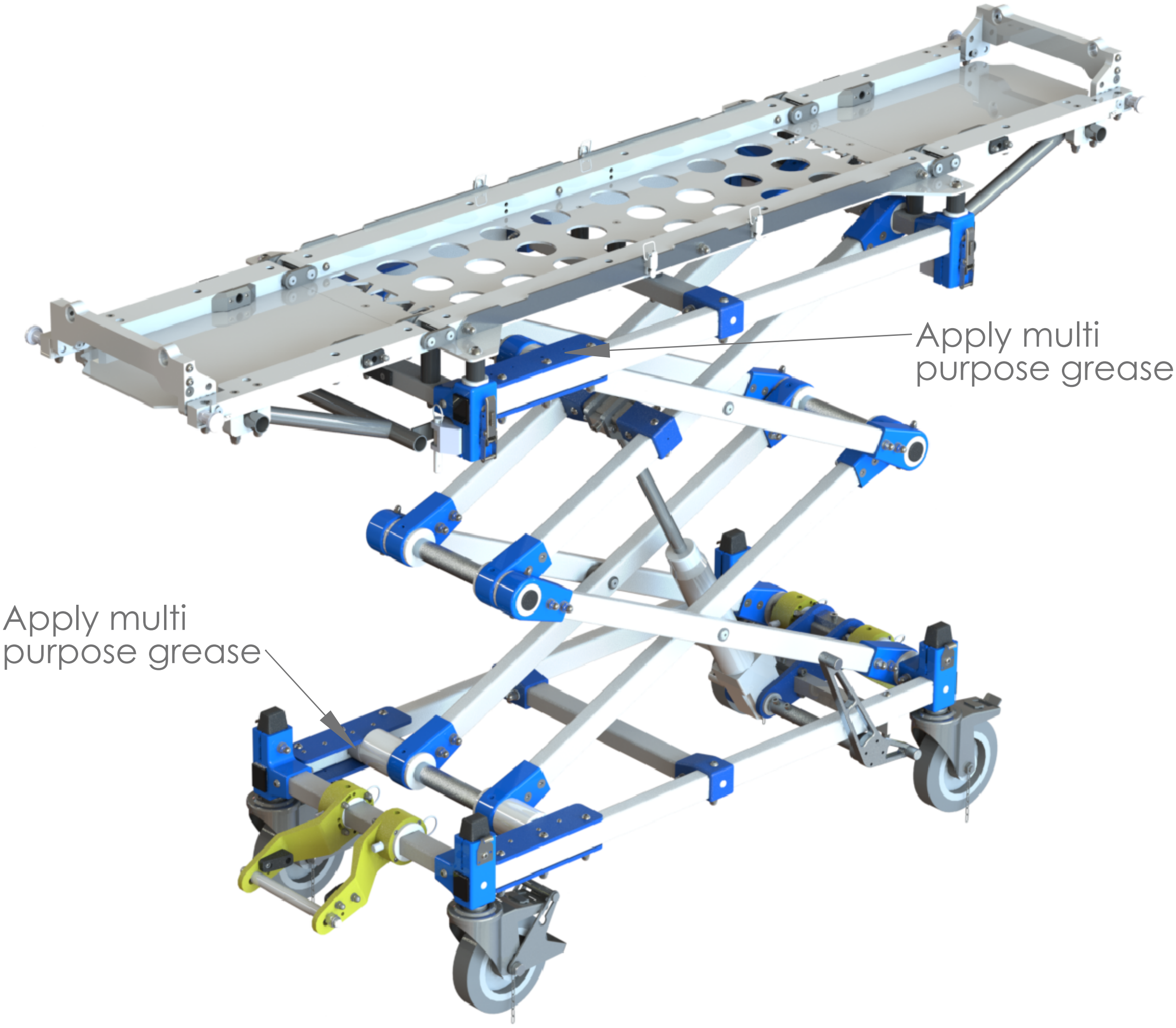

APPLICATION OF GREASE

Multi purpose grease should be applied in the areas shown on both sides every 6 months, or as required should the scissor action begin to judder.

The grease should be applied to the rack located under the blue plates. Simply work the trolley up and down until the grease has been worked into the moving parts.

Do not allow the trolley to seize up. It is recommended to raise and lower the trolley at least once a week.

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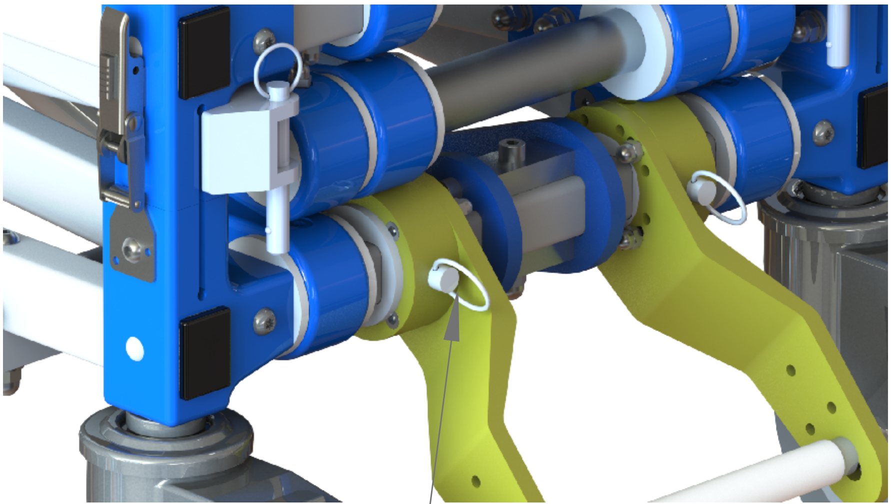
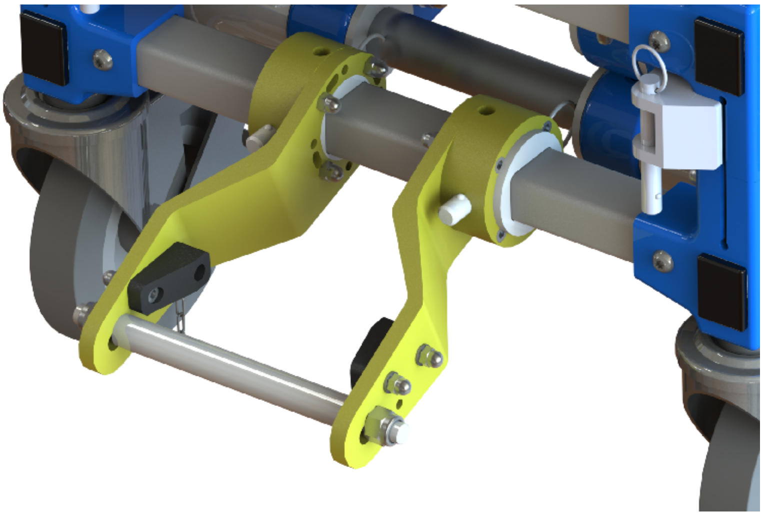


Lock Attachment Detent Pin



TO FOLD/ENGAGE THE LOCK ATTACHMENTS

NOTE: The trolley must be in a raised position to lock/unlock the head end lock attachment.

1. Remove the lock attachment detent pins from the locks.
2. Rotate the lock attachments around, out of the way (reducing the length of the trolley).
3. Lower trolley.
4. Reverse the process to engage the lock attachments, ensuring the detent pins are fully engaged at both ends of the trolley before transportation.

Maintenance

The maintenance schedule described below is essential to retaining warranty cover.

Cleaning

Hand-wash with warm water and a mild detergent using a soft cloth or sponge.

Wipe dry with a soft cloth

Monthly Inspection

A qualified maintenance person should carry out the inspection. If the trolley is damaged or does not function properly, take it out of service until the problem has been corrected.

Check all fixings on trolley frame and equipment superstructure. They should still be secure and any moving parts still smooth in operation.

For all medical devices refer to the relevant manuals.

Inspection records must be documented and maintained.

Repair & Service

Use only factory authorised repair parts to maintain the safety and performance of the trolley. Please contact original supplier for all parts and components.

To order service parts or to request service help contact ParAid Sales department.

Note

The bearing supplied/fitted to the wheels are sealed i.e. do NOT require lubrication.

The hydraulic system onboard the trolley is maintenance free.

CAUTION

Do **NOT** use a high-pressure washer to clean the trolley.

WARNING

Improper maintenance can cause injury and unpredictable operation. Maintain the trolley to ParAid instructions.

Maintenance Schedule

The following checks are recommended after the corresponding number of months of use.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Change Castor Wheels												X
Inspect Lifting Action			X			X			X			X
Apply Multi Purpose Grease to Scissor Action						X						X
Check Fasteners Are Tight						X						X
Check Detent Pins For Damage			X			X			X			X
Check For Damage To Lock Attachments						X						X

Note: An annual maintenance contract is available from Paraid. Please contact for details.

A general check of the trolley should be performed before every transfer to ensure wheels are tight, no fasteners are loose and all detent pins are present.

It is strongly recommended the castor wheels are changed every 12 months (depending on use), as wear to the wheels can affect the ability for the trolley to engage in ambulance floor locks.

Warranty

The trolley is covered by the Paraid Warranty. NOTE: This trolley should only ever be used by trained personnel. Any required modifications subsequent to the original design can be undertaken by Paraid. Please note any modifications NOT carried out by, or with the approval of, Paraid will invalidate the warranty.

Warranty Period

The ParAid Trolley is guaranteed for one year against defective material and workmanship.

Warranty Details

Damage caused by abuse and misuse , or any other damage which has occurred due to not adhering to these guidelines is excluded. No guarantee claim will be accepted for damage caused by operating errors, non-observation of the operating instructions, improper repairs or the use of spare parts considered to be non-original.

Issues and claims concerning product failure should be submitted in writing to Paraid. Neither the manufacturer nor their agents shall make recompense for repairs carried out by outside contractors or be liable for any other damage either incidental or consequential to property or persons.

Health & Safety

All applicable UK & European regulations should be observed when handling, operating and transporting the trolley.

Guarantee

We hereby guarantee that the product is free from defect, faulty materials and is suitable for the purpose for which it is intended.

THE TROLLEY MUST BE MAINTAINED in accordance to the schedule and records maintained. Should you encounter any problems please contact Paraid.

NOTE: Any unauthorised modification to the Paraid trolley negates all warranties

Manufacturer Details

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