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Suggested amendments to be forwarded to:
National Fleet Manager, Medium Heavy B Vehicles, LVSP0,
DMO, Victoria Barracks, St Kilda Road, Southbank, Vic. 3006.
LEGAL STATUS STATEMENT

This Technical Manual User Handbook is authorised for issue by the authority of the Chief of Army. It provides direction and mandatory control and procedures for the transportation, operation and servicing of the equipment. Personnel are to obey the instructions and follow the procedures contained in this publication.
SYNOPSIS

The Truck, Wrecker, Heavy, MC3, 8 Tonne (Mack), Army (AUST) 6778 (HRV) is a 6 × 6 Wheeled Army version of the Mack R Series commercial chassis. The Army cab and chassis is designated RM6866RS. The recovery system incorporates two 13 tonne hydraulic winches, a Palfinger PK9501 crane and towing hitch.

The primary role of the wrecker is for the recovery of all medium and heavy ‘B’ vehicles. In a secondary role the HRV may be used in the recovery of Engineer plant and light ‘A’ vehicles.

The wrecker has a range of approximately 1000 km on first class roads at a maximum road speed of 100 km/h. It is rated to tow the Trailer, Recovery, Heavy, MC3, Haulmark, Model MC-4DT to the design capacity of the Truck and Trailer combination.

For normal operations the regulatory weight, speeds and dimensions should never be exceeded without the approval of local authorities.
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ASSOCIATED PUBLICATIONS

1. Defence Road Transport Instructions (DRTI)
2. Australian Army Books:
   Record Book for Service Equipment GM 120
3. Complete Equipment Schedules:
   (a) CCES 19726  Truck, Wrecker, Heavy, MC3
   (b) CCES 19727  Raven Radio Installation Kit
   (c) SCES 012323  Recovery Equipment HRV
   (d) SCES 012318  Vehicle Accessory Maintenance Kit
   (e) SCES 13820  Radio Set UHF 16 Channel 336-400 MHz Handheld Kit for HRV
4. EMEI Vehicle A 029 - Servicing of B Vehicles
5. EMEI Vehicle A 119-21 - Repair of Vehicles under Warranty Agreement
6. EMEI Vehicle D 320 - Data Summary
7. EMEI Vehicle D322 – Technical Description
8. EMEI Vehicle D323 – Light Repair Manual
10. EMEI Vehicle D324-2 - Heavy Repair Manual
11. EMEI Vehicle D329 – Servicing Instruction
12. EMEI Vehicle D329-1 – Servicing/Inspection of CES
13. Repair Parts Scale 02252
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Figure 1–1  Truck, Wrecker, Heavy, MC3, 8 Tonne (Mack), Army (AUST) 6778, front view

Figure 1–2  Truck, Wrecker, Heavy, MC3, 8 Tonne (Mack), Army (AUST) 6778, rear view
## ROTABLE ITEM IDENTIFICATION

Table 1-1 – Location of Identification Numbers on Rotable Items

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<td>Left hand door inside cab</td>
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<tr>
<td>Engine No.</td>
<td>Right hand top of timing gear housing</td>
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<td>Front axle No.</td>
<td>Left rear of axle housing</td>
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<td>Transmission No.</td>
<td>Left hand side</td>
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<td>Transfer Case</td>
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<td>Intermediate axle No.</td>
<td>Right hand front of carrier housing</td>
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<td>Rear axle No</td>
<td>Right hand front of carrier housing</td>
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<td>Injection pump identification</td>
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SECTION 1
GENERAL DESCRIPTION

CHAPTER 1  DATA SUMMARY

CHAPTER 2  EQUIPMENT DESCRIPTION
CHAPTER 1
DATA SUMMARY

NOTE
Throughout this manual all references to left-hand and right-hand are to be taken as viewed from the rear of the vehicle looking forward.

DATA SUMMARY

1.1. Vehicle
Manufacturer: Mack
Model: RM6866RS

1.2. Chassis
Type: Single rail, heat treated
Wheelbase: 5465 mm
Front Axle to Intermediate Axle: 4765 mm
Bogie Axle Spacing: 1400 mm

1.3. Engine
Manufacturer: Mack
Type: E6-320 Maxidyne series intercooled, six cylinder in line, four cycle turbo charged, compression ignition
Displacement: 11 L
Bore: 123.8 mm
Stroke: 152.4 mm
Compression Ratio: 15.0:1
Firing Order: 1-5-3-6-2-4
Power: 238 kW @ 2100 rpm  
231 kW @ 1800 rpm  
149 kW @ 1200 rpm

Maximum Torque: 1360 N.m at 1500 rpm

Engine Operating Range: 1300 rpm to 2100 rpm

No Load Maximum: 2280 rpm

Engine Idle Speed: 525 rpm to 575 rpm

Engine Speed for PTO Operation: 1500 rpm

Max Engine Speed (high idle): 2280 rpm

Max. Engine Speed (hand throttle setting): 1500 rpm

Oil Capacity (including filters): 55.3 L

Oil Filters: Full pressure, wet sump extended service interval (ESI) plus system, triple, disposable, full flow, spin-on, filters

Pressure: Normal (hot) at idle (600 rpm) 175 kPa  
Governed speed (hot) 275 to 660 kPa

Oil Cooler: Shell type with removable tube bundle

Engine Weight (dry): 982.2 kg including flywheel and clutch  
(excludes alternator and starter motor)

1.4. Cooling System

Type: Centrifugal, engine belt driven water pump and fan

Capacity: 54 L (50% Ethylene Glycol)

Specific Gravity of Coolant: 1.043 at 15°C

Thermostat: 81° to 83°C opening

Radiator: 6450 cm² with heavy duty core
Engine Coolant
Operating Range: 80 to 85°C
Coolant Conditioner: Spin on, disposable type
Horton Fan Hub Engage – 90°C ± 2°C
Operating Temp Range: Disengage – 90°C ± 2°C

1.5. Engine Accessory Drive
Type: Twin ‘V’ belts
Tension: Approx. 12 mm deflection midway along the longest span using moderate thumb pressure

1.6. Fuel Injection Pump
Manufacturer: American Bosch
Type: APE 6-BB injection pump, multiple plunger with hand primer facility, flange mounted, and puff limiter

1.7. Fuel Injectors
Manufacturer: American Bosch
Type: Five hole, spray type nozzle

1.8. Fuel Filters
Manufacturer: Mack
Type: Primary and secondary, spin on, disposable type, non-interchangeable

1.9. Engine Starter
Manufacturer: Ingersoll-Rand
Type: A five bladed vane motor with gear reduction, Bendix drive and silencer fitted

1.10. Turbocharger
Manufacturer: Schwitzer
Type: 631GC5134X, exhaust gas driven, radial flow with pressurised engine oil lubrication
1.11. **Intercooler**  
**Manufacturer:** Mack  
**Type:** Two stage, series, water-to-air heat exchanger combined with an air-to-air heat exchanger which is cooled by air from a charge air driven tip turbine fan

1.12. **Clutch**  
**Manufacturer:** Eaton Fuller  
**Type:** Solo heavy duty 1552 2800 lbs  
**Diameter:** 393.7 mm  
**Driven Plate Facing:** Ceramic metallic trapezoidal rigid buttons  
**Actuation:** Mechanical, by cable  
**Free Travel (pedal):** 38 to 50 mm

1.13. **Air Compressor**  
**Manufacturer:** Bendix-Westinghouse  
**Type:** Reciprocating TU-FLO 501  
**Capacity:** 0.34 m$^3$ minute at 1250 rpm governed to 830 kPa  
**Air Source:** Air supplied from engine intake manifold  
**Lubrication:** Engine oil  
**Drive:** Engine driven gear/shaft

1.14. **Electrical System**  
**Voltage:** 24 V negative earth  
**Batteries:** Two, 12 V 61 Ampere-hour. Located in battery compartment, underneath drivers top step  
**Isolator:** Rotary switch. Located on top of battery compartment behind drivers top step.

1.15. **Alternator**  
**Make:** LEA  
**Drive:** Indirect, twin 'V' belts
Voltage: 28 V
Maximum Output (cold): 140 amps
Maximum Output (hot): 100 amps

1.16. Transmission

Manufacturer: Eaton Fuller
Type: RTXF-14710B

Ratios:

<table>
<thead>
<tr>
<th>Gear</th>
<th>Shift Lever Position</th>
<th>Range</th>
<th>Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>1/6</td>
<td>Lo</td>
<td>10.99</td>
</tr>
<tr>
<td>2nd</td>
<td>2/7</td>
<td>Lo</td>
<td>8.18</td>
</tr>
<tr>
<td>3rd</td>
<td>3/8</td>
<td>Lo</td>
<td>6.07</td>
</tr>
<tr>
<td>4th</td>
<td>4/9</td>
<td>Lo</td>
<td>4.46</td>
</tr>
<tr>
<td>5th</td>
<td>5/10</td>
<td>Lo</td>
<td>3.32</td>
</tr>
<tr>
<td>6th</td>
<td>1/6</td>
<td>Hi</td>
<td>2.46</td>
</tr>
<tr>
<td>7th</td>
<td>2/7</td>
<td>Hi</td>
<td>1.83</td>
</tr>
<tr>
<td>8th</td>
<td>3/8</td>
<td>Hi</td>
<td>1.36</td>
</tr>
<tr>
<td>9th</td>
<td>4/9</td>
<td>Hi</td>
<td>1</td>
</tr>
<tr>
<td>10th</td>
<td>5/10</td>
<td>Hi</td>
<td>0.74</td>
</tr>
<tr>
<td>Lo Reverse</td>
<td>R</td>
<td>Lo</td>
<td>11.23</td>
</tr>
<tr>
<td>Hi Reverse</td>
<td>R</td>
<td>Hi</td>
<td>2.52</td>
</tr>
</tbody>
</table>

Oil Cooler: Oil/air heat exchanger mounted in front of engine radiator. Oil flow created by internal gear type pump in transmission.

1.17. Transfer Case

Manufacturer: Mack
Type: TC150 incorporating permanent front wheel drive, torque proportioning differential and differential lock out which is automatically engaged when low range is selected.
Ratios:  
High 0.768:1  
Low 1.992:1  
Front 0.966:1  

Oil Cooler: Located in front of the engine radiator. Oil flow is created by a pumping unit mounted on the RH side of the transfer case. The warning light may remain illuminated up to 1200 RPM.

1.18. Driveshafts and Universals

Manufacturer: Spicer

Transmission to Transfer Case: 1810 H.D. Series with two universal joints
Transfer Case to Front Axle: 1610 series, two pieces with three universal joints and centre support bearing
Transfer Case to Intermediate Axle: 1810 H.D. series with two universal joints
Intermediate to Rear Axle (rear): 1810 H.D. series, one piece with two universal joints

1.19. Front Drive Axle

Manufacturer: Fabco
Type: SDA-18B rated at 8.18 tonnes
Track: 1990 mm

1.20. Front Axle Centre

Manufacturer: Eaton
Ratio: 6.5:1

1.21. Rear Tandem Axle

Manufacturer: Mack
Type: SS441W bogie rated at 20 tonne
Track: 1830 mm
1.22. Rear Axle Centres
Intermediate: Mack CRDPC921 with double reduction and inter-axle power divider and inter-wheel power divider
Rear: Mack CRD931 with double reduction and inter-wheel power divider
Ratio: 6.34:1

1.23. Front Suspension
Front Springs: 2 × 7 leaf, semi elliptical rated at 5.4 tonne plus 10%
Shock Absorbers: Telescopic, hydraulic

1.24. Rear Suspension
Manufacturer: Neway
Type: ADST244-6 air bag suspension

1.25. Steering
Manufacturer: Sheppard
Type: Model 592 integrated power assist steering (Mack SGP49)
Steering Gear Ratio: 20:1
Steering Wheel Dia: 56 cm

1.26. Turning Circles
Between Kerbs: Average 24.1 m
Between Walls: Average 25.1 m

1.27. Wheels and Tyres
Rim, Type and Size: 8.00 × 20, 3 piece, 10 stud disc (olive drab)
Rim Manufacturer: Sankey Benson
Tyre Size and Type: 12.00 × 20 × 18 ply rating radial
Tyre Pressure (cold): Highway: Front 700 kPa
Intermediate 700 kPa
Rear 700 kPa
Cross-country:  
Front  550 kPa  
Intermediate  700 kPa  
Rear  700 kPa  
Sand:  
Front  400 kPa  
Intermediate  400 kPa  
Rear  400 kPa  

Wheel Stud Size and Thread:  
Front:  1 1/8 inch – 16 threads per inch, UNF (Unified National Fine thread)  
Rear Outer:  1 1/8 inch – 16 threads per inch (UNF)  
Inner:  3/ inch (UNF)  

Wheel Nut Torque Setting:  610 – 678 N.m. (400 – 500 lbf.ft)  

Provision for Tyre Inflation:  Air take off, and hose located on the LH side above the top step  

1.28. Brakes – Vehicle

Type:  Dual circuit, air over mechanical, wedge type, twin shoe, self adjusting, drum brakes  
Actuation:  Foot pedal  
Parking Brake:  Spring brakes on rear axles  
Maximum Gradient for Parking Brake Holding:  20 per cent uphill or downhill (highway laden)  
Emergency/ Parking Brakes:  Spring actuated, mechanical  
Warning Devices:  Low air buzzer and warning light  

1.29. Brakes – Work

Type:  Service brakes on all wheels  
Actuation:  Hand operated control valve, located right hand underside of dash
1.30. **Trailer Facilities**

- **Socket Type:** 12 Pin NATO
- **Pintle Hook:** Fully rotating, lockable
- **Pintle Hook Height:** 870 mm

1.31. **Brakes – Trailer**

- **Actuation:** Foot pedal or hand control valve
- **Couplings:** Gladhand couplings fitted at the rear of vehicle

1.32. **Crane Power Take-Off (PTO)**

- **Manufacturer:** Chelsea
- **Type:** 442XFAHX.A3XX
- **Ratio:** 0.520:1
- **Placement:** Mounted on the RH side of the transmission
- **Actuation:** Engaged using the rearward air shift control mounted on the floor to the RH side of the driver’s seat

1.33. **Recovery System Power Take-Off (PTO)**

- **Manufacturer:** Chelsea
- **Type:** 489XFAHX.A3XX
- **Ratio:** 0.520:1
- **Placement:** Mounted on the LH side of the transmission
- **Actuation:** Engaged using the forward air shift control mounted on the floor to the RH side of the driver’s seat

1.34. **Hydraulic System**

- **Capacity:** 150 L
- **Reservoir:** 60 L

1.35. **Crane Hydraulic Pump**

- **Manufacturer:** Commercial Hydraulics
1.36. **Recovery System Hydraulic Pumps**

**Manufacturer:** Commercial Hydraulics  
**Type:** Model P330B 242LEAB1025 0HAB1001 tandem gear type  
**Placement:** LH PTO

1.37. **Recovery System**

**Manufacturer:** Miller Industries, Ooltewah, Tn 37363, USA  
**Type/Model:** HRV-1856

1.38. **Winches**

**Manufacturer:** Sepson  
**Models:** H 200P  
**Type:** Hydraulic driven, drum type, 2 speed, constant force.  
**Capacity Auto Mode:** 13 tonne, constant force on all layers  
**Capacity Manual Model:** 13 tonne on bottom layer reducing to 9 tonne on top layer  
**Control System:** PLC controlled constant force system  
**Max. Oil Pressure:** 175 bar  
**Max. Oil Flow Rate:** 60 L/min  
**No. of Rope Layers:** 4

1.39. **Winch Ropes**

**Manufacturer:** Casar  
**Type:** Superplast, 10 strand – IWRC  
**Grade:** G1960  
**Length:** 98.5 m  
**Rope Dia:** 17 mm
Min. Breaking Load: 260 kN (26.5 tonne)

1.40. Winch Motors
Manufacturer: Danfoss
Type/Model: Primary Drive – 1 × OMH 250
Secondary Drive – 1 × OMH 200 and 1 × OMT 200

1.41. Crane
Manufacturer: Palfinger
Type/Model: PK 9501 single link with single extension, hydraulically actuated
Control System: Paltronic 50 monitoring and overload protection system
Remote Control: Scanreco radio and cable remote control system.
Maximum Lift: 5700 kg @ 1.4 metres
2220 kg @ 4.1 metres
1600 kg @ 5.6 metres
Operating Radius: 5.6 m max.
Battery Charger: Located under LH seat in the vehicle cab, constant power supply
Slewing Angle: 210°
Slewing Torque: 11.8 kNm (8700 ft lbs)
Lifting Moment: 88 kNm (64 880 ft lbs)
Operating Pressure: 30.5 mPa (4422 psi)

1.42. Towing Hitch
Max. Suspended Lift (towed load): 5500 kg
Max. Suspended Tow (towed load): 71 000 kg
Flat Tow: 30 000 kg (Pintle Hook Load)
Pintle hook to be used for all flat towing operations using the towing ‘A’ frame.
Max. Suspended Lift (static load with spades deployed): 6325 kg (tow cylinders fully retracted using both chain adaptors evenly distributed across the ‘T’ bar)

1.43. Remote Winch Control Sockets
Location: Control cabinet on each side of the recovery system

1.44. Power Supplies
Radio Power Supply: Crew cab
Work Lights Sockets: Each corner of the recovery system on lockers (4)
12 V dc Outlet: Located in crew cab, RH side rear

1.45. Lighting, External
Location, Quantity and Wattage
Headlights, High/Low/Park: Front of vehicle, 2 off, 75/70 Watt, Quartz Halogen, 2 off, 2 Watt
Driving Lights: Front of vehicle, 2 off, 70 Watt
Stop and Tail Lights: Rear of vehicle, 2 off, 21/5 Watt Tow Hitch – 1 off LED module
Directional Indicator Lights: Each corner of vehicle, 4 off, 18 Watt
Clearance Lights: Each side of vehicle – mirrors, 2 off, 2 Watt
Body Side Lights: Side of wrecker body, 4 off, 3 Watt
Side Marker Lights: Front mudguards 2 off, 5 Watt
Back-up Lights: Rear of vehicle, 2 off, 18 Watt
Work Lamps: Fixed work lights on the rear of the vehicle, 2 off
Flood Lamps: Mounting points and sockets at each corner of the recovery system on lockers (4)
  Shared mounting with rotating lights (2)
  Two of each kind of flood lamp are provided in the vehicle CES
Revolving Lights: Mounted on rear of crew cabin, 2 off, 70 Watt
1.46. Lighting, Internal

Location, Quantity and Wattage

Dome Light: Rear roof of cabin, 1 off, 5 Watt
Crew Cab: Cab roof, 2 off, white and red light, 1 off 10 Watt, 1 off 18 Watt
Map Reading Light: Left hand side of instrument panel, 1 off, 5 Watt
Panel Gauges and Warning Lights: Instrument panel, 12 off, 2 Watt
Fibre Optic Light: Instrument panel, 1 off, 3 Watt
Directional Signal Light: Directional indicator switch, 1 off, 2 Watt

1.47. Military Lighting

Blackout Lights: Front and rear of vehicle, 6 off, 5 Watt
Convoy Light: Rear of vehicle, 1 off, 5 Watt
Reduced Headlight: Right hand front of vehicle, 1 off, 18 Watt
Gauges: Instrument panel, 5 off, 3 Watt
Pyrometer Gauge Light: Instrument panel, 1 off, 2 Watt

1.48. Circuit Breakers and In-line Fuses

Circuit Breakers

Located inside the cab, left hand side, behind protecting panel:

<table>
<thead>
<tr>
<th>a. Blackout</th>
<th>10 amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Reduced headlamp</td>
<td>10 amp</td>
</tr>
<tr>
<td>c. Constant power, horn windscreen washer, map light</td>
<td>10 amp</td>
</tr>
<tr>
<td>d. Stop lights and reversing lights</td>
<td>15 amp</td>
</tr>
<tr>
<td>e. Headlights</td>
<td>20 amp</td>
</tr>
<tr>
<td>f. Side marker</td>
<td>10 amp</td>
</tr>
<tr>
<td>g. Turn indicators, interior lights, HI/LO buzzer and light</td>
<td>15 amp</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td>h.</td>
<td>Constant key power and voltmeter</td>
</tr>
<tr>
<td>i.</td>
<td>Dynatard engine brake</td>
</tr>
<tr>
<td>j.</td>
<td>Heater and demister</td>
</tr>
<tr>
<td>k.</td>
<td>Spare key power</td>
</tr>
</tbody>
</table>

Located on Kysor board:

- Headlights: 20 amp

Recovery System – Located on LHS external firewall: 40 amp

**In-line Fuses** - Located behind glove-box lid:

- Revolving lamp: 10 amp

1.49. **Air Conditioner**

Manufacturer: Crisp-Air

Type: Refrigerated split system

1.50. **Air Conditioner Compressor**

Manufacturer: Sanden

Model: SD7H15 24 V 2GA VSTDO

Type: 7 cylinder, reciprocating wobble plate compressor

Displacement: 155 cubic centimetres

1.51. **Air Conditioner Evaporator**

Manufacturer: Crisp-Air

Type: 61-0032 – coil is 6 row, 3 circuit copper tube aluminium fin type, rated at 3.6 kW at 140 l/sec, dP 167 Pa at air in 27°C/41% RH (relative humidity), or, 5.0 kW at 140 l/sec, dP 180 Pa at air in 38°C/40% RH (relative humidity).

Controls: 4 position, 3 speed fan switch (3 speed resistor), variable thermostat and mechanical lever for fresh or re-circulated air selection.

Outlets: 2 off rectangular outlets in the vertical rear section for occupants face and 2 off round multi directional outlets in the under section for occupants lap area. Return air and fresh air for the evaporator is via removable filter panels. Media specification – 13 mm spun polyester.

Air Inlet Filter Box: AIMA 0601 – The filter media is Type K – 13 mm spun Polyester. AS1132 Test at 1.778 m/s with No 4 Dust (ASHRAE) – 35 Res Pa, 350g of dust held per m² and average efficiency of 65%.

1.52. Receiver Dryer
Manufacturer: Crisp-Air RD 2105
Type: Upright, desiccant equivalent to XH9, switch ports 3/8 inch × 24 UNF (2 off) C/W sight glass.

1.53. Thermostatic Expansion Valve
Manufacturer: Egelhof
Type/Size: TCD 1,5 – No: 320 308

1.54. Refrigerant
Type: R134a (teltrafluorethane)
Capacity: 1.2 kg ± 50g

1.55. Air Conditioner Electrical Components
Pressure Protection: Crisp-Air SW 0086 – binary switch with 190 mm harness, HP 2200 kPa, LP 200 kPa, 3/ inch × 24 UNF male thread.

Clutch Coil: Sanden 0525-6340 – 24 V
Blower/Fan Switch: Crisp-Air SW 0035, 4 position
Resistor – Fan Speed: Crisp-Air REUN 1224, 3 speed, 12/24 V, 5 terminal
Thermostat: Ranco 18 inch bulb length, OFF – -2° ± 1.5°C, Differential – 3.5° ~ 6°C

1.56. Performance

Gradeability (both directions): 1 in 2

Range of Operation (approx.):
- 1145 km (primary roads)
- 834 km (secondary roads)

Fuel Consumption:
- 42 L per 100 km (primary roads)
- 58 L per 100 km (secondary roads)

Maximum Towed Load: 90 tonne GCM

1.57. Capacities

<table>
<thead>
<tr>
<th>Equipment</th>
<th>DEF(AUST) 206</th>
<th>Litres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine System (including filters):</td>
<td>OMD-115 (1)</td>
<td>55.3</td>
</tr>
<tr>
<td>Cooling System (including conditioner):</td>
<td>50% mix water and Antifreeze, Inhibited Ethylene Glycol</td>
<td>54</td>
</tr>
<tr>
<td>Transmission:</td>
<td>OEP-220 (1)</td>
<td>13.3</td>
</tr>
<tr>
<td>Transfer Case:</td>
<td>OEP-220 (1)</td>
<td>11.8</td>
</tr>
<tr>
<td>Front Axle:</td>
<td>OEP-220 (1)</td>
<td>11.4</td>
</tr>
<tr>
<td>Front Wheel Bearings:</td>
<td>OEP-220 (1)</td>
<td>Fill to level plug with level plug at horizontal height of hub centre.</td>
</tr>
<tr>
<td>Rear Axle:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Intermediate:</td>
<td>OEP-220 (1)</td>
<td>12.0</td>
</tr>
<tr>
<td>- Rear:</td>
<td>OEP-220 (1)</td>
<td>11.2</td>
</tr>
<tr>
<td>Power Steering:</td>
<td>OMD-115 (1)</td>
<td>7.75</td>
</tr>
<tr>
<td>Hydraulic System:</td>
<td>OM-68</td>
<td>150</td>
</tr>
<tr>
<td>Fuel Tank:</td>
<td>Distillate</td>
<td>498</td>
</tr>
</tbody>
</table>

(1) Refer EMEI Vehicle D 320 for current list of approved lubricants.
SHIPPING AND TRANSPORTATION DATA

1.58. Dimensions
Overall Length ................................................................. 9500 mm
Wheelbase .......................................................................... 5465 mm
Front Axle to Intermediate Axle ........................................ 4765 mm
Bogie Axle Spacing .............................................................. 1400 mm
Overall Width ....................................................................... 2500 mm
Overall Height – Unladen ..................................................... 3265 mm
  – Reducible .................................................................... 3075 mm
Track – Front ...................................................................... 1911 mm
  – Intermediate ................................................................ 1810 mm
  – Rear ........................................................................... 1810 mm

1.59. Manufacturer’s Axle Loadings
HRV in operational fitout, including CES, less crew and personal equipment:
  – Front Axle ................................................................. 6560 kg
  – Intermediate Axle ....................................................... 6100 kg
  – Rear Axle .................................................................. 6200 kg
  – Total .......................................................................... 18 860 kg

1.60. Fording Depth
Unprepared Vehicle .............................................................. 800 mm at 5 kph
Limiting Features ................................................................. fan – 1354 mm
Prepared Vehicle ................................................................. no facility available, as for unprepared vehicle

1.61. Bridge Classification ..................................................... 19/90

1.62. Ground Clearance
Operational Weight ............................................................. 250 mm
Limiting Feature ................................................................. equalising beam
1.63. Transportability

Railway Loading Gauges (local authorities must be consulted):

Victoria ................................................................. 1600 mm
Commonwealth ....................................................... 1435 mm
New South Wales .................................................... 1435 mm
South Australia ....................................................... 1435 mm
Western Australia ................................................... 1435 mm
Commonwealth ....................................................... 1067 mm
Queensland ............................................................. 1067 mm
South Australia ....................................................... 1067 mm
Tasmania ................................................................. 1067 mm
Western Australia ................................................... 1067 mm

1.64. Approach and Departure Angles

Approach Angle ......................................................... 32.5°
Limiting Feature ....................................................... muffler and brackets
Departure Angle ........................................................ 57°
Limiting Feature ....................................................... earth spades

1.65. Transport

Slinging and Tie-Down Points (refer to Figure 1-3).
Front towing / recovery points (2 off) fitted to front bumper bar.

May also be used as slinging and tie-down points.
Load capacity 13 tonne on each point.

Bail shackles (2) fitted to the recovery system tailgate either side of the towing hitch.

May also be used as slinging and tie-down points.
Load rating – 13 tonne each.

Earth spades in recovery system either side of the vehicle. There are two anchor points in each spade, however only one point per spade may be used at any one time.

For use as recovery return line points only.
Load rating – 13 tonne each.

Figure 1-3  Slinging, tie-down and recovery points
1.66. **Sea Transportability**. Refer to Table 1-2.

<table>
<thead>
<tr>
<th>Ship Type</th>
<th>Transportable</th>
<th>Numbers</th>
<th>Method of Loading/Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landing Craft Medium LCM8</td>
<td>YES</td>
<td>1</td>
<td>RO-RO</td>
</tr>
<tr>
<td>Naval Lighterage Equip.</td>
<td>YES</td>
<td>4 unladen/3 laden</td>
<td>as above</td>
</tr>
<tr>
<td>Landing Craft Heavy LCH</td>
<td>YES</td>
<td>6</td>
<td>as above</td>
</tr>
<tr>
<td>Landing Ship Heavy LSH</td>
<td>YES</td>
<td>approx. 40</td>
<td>as above</td>
</tr>
<tr>
<td>Ships</td>
<td>YES</td>
<td></td>
<td>In the unladen condition, the vehicle is transportable in the RO-RO or LO-LO Condition</td>
</tr>
</tbody>
</table>

RO-RO = Roll on – Roll off  
LO-LO = Crane load/unload

**Airportability:** The HRV is not air transportable

**Shipping Volume:** At reducible width and height $73 \text{ m}^3$

**Mass Unladen:** $18,860 \text{ kg (operational weight)}$
CHAPTER 2
EQUIPMENT DESCRIPTION

Introduction

1.67. The Truck, Wrecker, Heavy, MC3, 8 Tonne (Mack), Army (Aust) 6778, known as the Heavy Recovery Vehicle (HRV), is based on the Mack RM 6866 RS truck chassis. The vehicle incorporates a main transmission and transfer case with gearing designed to enable the vehicle to negotiate any terrain or gradient that will allow wheel traction, in practice this is limited to 50 per cent on concrete (approximately).

Operational and Logistic Concepts

1.68. The HRV provides the main means of logistic wheeled recovery support for second line transport and contributes significantly to third line transport recovery of field forces. The HRV is designed for the recovery of medium and heavy equipments. The vehicle has the capabilities of winching, lifting, rigid towing and suspended towing of casualties. The maximum loading for highway and cross-country is for a front lift tow of a laden Heavy B vehicle and a rear lift tow of an unladen heavy vehicle. The vehicle also has the capacity for towing a trailer for recovery.

Engine

1.69. The HRV is fitted with a Mack ‘Maxidyne’ E6-320 six cylinder diesel engine. The engine is of the constant horsepower principle and incorporates a turbocharger with a series intercooler to cool the incoming air and increase volumetric efficiency of the engine. The engine produces 238 kW at 2100 rpm and 1360 N.m torque at 1500 rpm. The engine is illustrated in Figure 1-4.

1.70. The engine is fitted with a Horton pneumatic fan drive hub. This hub allows the fan to free-wheel at times when the fan is not required for cooling but provides positive drive to the fan when the engine temperature reaches a preset value. An inline air filter and solenoid is fitted to the LH side of the fan shroud to filter and control the flow of compressed air to the fan hub. Refer to Figure 1-5.
Figure 1-4  Mack ‘Maxidyne’ E6-320 engine

Figure 1-5  Fan hub air filter and solenoid
Main Transmission

1.71. The transmission fitted to this vehicle is an Eaton RTXF 14710B non-synchromesh transmission providing ten forward speeds and two reverse speeds. The gear shift lever mechanically engages and disengages five forward gears and one reverse gear in the transmission front section. The range selector on the gear shift allows the operator to control an air actuated auxiliary section shifter to provide a LO and HI range. The five forward gears selected in LO range are used again in HI range to provide the ten progressive forward gear ratios. Similarly, the two reverse speeds are obtained by using HI and LO range.

1.72. Once the highest shift lever position (5th gear) is obtained in LO range, the operator pre-selects the range shift lever for HI range. The range shift occurs automatically as the shift lever is moved from 5th gear position to the 6th gear position.

1.73. When downshifting, the operator pre-selects the range lever for LO range and the range shift occurs automatically during the shift lever movement to the next gear position.

Transmission Oil Cooler

1.74. A transmission oil cooler is fitted to the front of the vehicle. Transmission oil is pumped from the transmission through the cooler and returned to the transmission. The oil pump is incorporated into the transmission. Refer to Figure 1-6 for the location of the oil cooler.

Power Take-Off (PTO)

1.75. There are two PTOs fitted to the vehicle, one to each side of the vehicle transmission. The RH PTO drives the pump supplying hydraulic power to the crane. The PTO fitted to the LH side of the transmission drives a tandem pump to provide hydraulic power to the recovery system. Refer to Figure 1-7.

1.76. The PTOs are pneumatically actuated. The control valves are located at the base of, and to the RH side of, the driver's seat. Red indicator lights located on the respective control valve facia panel and the vehicle dash panel are illuminated whenever a PTO is engaged.

1.77. Details of the PTOs are contained in Sect 1, Chap 1 – Data Summary.
Figure 1-6 Heat exchanger mountings

Figure 1-7 Transmission PTOs and hydraulic pumps
Hydraulic Pumps

1.78. The HRV carries three hydraulic pumps, two for the recovery system driven from the LH PTO and one for the crane driven from the RH PTO. The pump details are contained in Sect 1, Chap 1 – Data Summary. The rear pump of the tandem set drives the LH winch and LH spade whilst the forward pump drives the remainder of the recovery system.

Clutch

1.79. The vehicle is fitted with an Eaton Solo 1552 2800 lbs angle spring two plate clutch. The angle spring clutch uses six angle springs and is of the dry disc internally adjustable, pull-type design. The centrally located pressure springs are entirely insulated from the heat of the pressure plate. The pressure plate is driven by drive lugs which mate with drive slots in the clutch flywheel ring. Adjustments for lining wear MUST be made internally on the threaded adjusting ring. If clutch adjustments are attempted on the external adjusting lever early clutch failure will result.

Transfer Case

1.80. The vehicle is fitted with a two speed, manual change transfer case which incorporates an unequal torque proportioning gear type power divider to drive the front and rear axles. The power divider is automatic in operation but should it be necessary, it may be eliminated by the use of an air operated power divider lock out (PDLO) operated from the instrument panel. The PDLO also operates the inter-axle power divider fitted to the intermediate axle by a paralleling air circuit. When selecting low range the PDLO is automatically engaged.

Transfer Case Oil Cooler

1.81. The transfer case is fitted with an oil cooler to control the temperature of the oil within the transfer case. The oil from the transfer case is pumped from the transfer case, through an oil cooler located in front of the engine cooling radiator and then returned to the transfer case. The transfer case oil cooler pump is driven by a hydraulic motor which is in turn driven by power steering system oil diverted from the power steering pump. Refer to Figure 1-6 for the heat exchanger mounting location.
Rear Tandem Axles (bogie)

1.82. The bogie comprises an intermediate and rear axle assembly. Each assembly consists of a double reduction gear type differential (carrier) incorporating a power divider (cam and plunger differential) which exerts bias toward the axle offering the most resistance, a primary feature is that it prevents cross shaft ‘wind-up’. An additional inter-axle power divider is carried in front of the intermediate axle to prevent ‘wind-up’ between the intermediate and rear axle assemblies.

1.83. Drive between the intermediate and rear axle is by a short propeller shaft fitted with universal joints. Drive to the bogie wheels is achieved through ‘full floating’ axles fitted with air/spring operated wedge actuated, twin shoe drum brakes.

Power Dividers

1.84. The power dividers are automatic in operation and designed such that should either the front or rear bogie axle lose traction on one wheel 75 per cent traction is directed to the bogie axle which still has traction. The power divider lock-out facility (PDLO) is operated by a switch on the instrument panel and should be actuated only when extremely slippery off road conditions are encountered. When low range is selected the PDLO is automatically engaged.

Front Drive Steer Axle

1.85. The vehicle is fitted with a front drive steer axle, comprising a differential carrier assembly and axles, driving through universal joints to steerable drive ends fitted with air operated, wedge actuated, twin shoe drum brakes.

Power Steering

1.86. The vehicle is fitted with integrated power assist steering, wherein the booster cylinder, control valve and mechanical steering are incorporated into a single unit. Other major components of the steering include a reservoir, engine driven pump and hydraulic piping. It should be noted that should the power assistance fail, the mechanical section will function as a normal, non power assisted steering gear, but with a considerable increase in steering effort required. The power steering pump is fitted with a priority head to enable power steering oil to be diverted to the transfer case oil cooler circulation unit.
Front Suspension

1.87. The front suspension consists of semi-elliptic leaf springing dampened by telescopic shock absorbers. Bump stops are provided to limit vertical suspension travel.

Rear Suspension

1.88. The rear suspension is a Neway SA441W air bag system. The air bags provide control over side to side and axle to axle loading helping to equalise and control braking under all conditions.

1.89. The ride characteristics of the system are controlled by height and levelling control valves utilising the vehicle’s air system to maintain the required ride height. Air is automatically added to, or exhausted from, the suspension to maintain a constant ride height.

![Suspension control valve]

The air suspension must be inflated while the vehicle is in motion unless running under emergency conditions.

1.90. The suspension may be deflated during recovery operations and use of the crane if required by using the suspension control switch. This switch is located under the RH side of the dash panel, immediately behind the work brake valve. Refer to Figure 1-8.
Service Brakes

1.91. The vehicle is fitted with a dual circuit air brake system, consisting of two completely separate air circuits and a reserve emergency supply. The primary circuit supplies the rear brakes and the secondary circuit supplies the front brakes, each circuit, although separate, operates as a single system through a dual delivery treadle valve. Check valves protect each circuit in case of air loss in either primary or secondary system.

1.92. The reserve air supply is used to release the spring brakes when there is a loss of air in both primary and secondary systems, this allows the vehicle to be moved to a safe working area. This circuit is operated by a control on the instrument panel. Automatic adjusting wedge actuated drum brakes are fitted to the vehicle and operate when air pressure acting on a plunger diaphragm forces a wedge head between rollers and plungers attached to the brake shoes, the plungers and rollers then spread apart causing the brake linings to bear against the drum surface.

Emergency/Parking Brake

1.93. Spring brakes are used as emergency and parking brakes on both bogie axles.

1.94. The spring and service brake assembly are an integral unit comprising a diaphragm type service chamber, which applies the service brake when air pressure from a brake application is delivered, and a second chamber containing a strong spring under compression. The spring applies the service brakes when there is a loss of air pressure in both the primary and secondary air systems. The emergency/parking brake can be controlled from the cab by use of a hand operated valve. In order to apply or release the emergency/parking brake, the control valve in the cab is moved by the driver as directed on the knob and decal.

Work Brake

1.95. The six wheel brakes can be applied for use during recovery and winching operations by activating the control valve mounted beneath the right hand side of the dash panel. The work brake is not to be used for parking.
Air Dryer

1.96. An air dryer has been incorporated into the air system to remove moisture from the compressed air. The air dryer is located on the LH side of the chassis under the cab access steps.

1.97. The air dryer is electronically controlled by a control unit located in the engine bay. The control unit discharges the air dryer and wet tank dump valves initially on start up, then every six minutes afterwards. The actuation of the dump valve can be heard as a short discharge of air from the dump valve.

Engine Brake

1.98. The service brakes are assisted by an engine brake device (Dynatard), which converts the engine into an air compressor. This is accomplished by opening the exhaust valve near the completion of the compression stroke.

1.99. The engine, when acting as an air compressor, increases friction horsepower or retarding force providing increased vehicle safety from better braking control which also provides extended brake drum and lining life as well as increased tyre life.

1.100. The Dynatard can be activated by two methods, either by depressing the brake treadle valve or by operating a control switch on the instrument panel. With either method the accelerator pedal must be released to allow the injector pump rack to move to the zero fuel position. This action closes the injector pump switch allowing the electrical current to energise the solenoid control valve to bring the Dynatard into action. However, should the engine reach idle, the governor will automatically advance the rack from the no-fuel to a fuel delivery position, opening the injector pump and disengaging the Dynatard system.

Exercise caution when using the engine brake in wet or slippery conditions, especially if the vehicle is in a low gear and unladen.
The engine should be allowed to reach operating temperature before the engine brake is operated to avoid possible engine damage.

**Speed Limiter**

1.101. The vehicle is fitted with a speed limiter that limits the road speed of the vehicle to 102 kph on a flat, level primary road without influence of wind. When actuated, the speed limiter controls the air pressure applied to the throttle control system, hence controlling the fuel supply to the engine.

**Air Starting System**

1.102. Cranking is performed by a five-vane air motor with gear reduction which drives the engine flywheel through a conventional Bendix-type drive. A 0.27 cu. metre air start reservoir provides air pressure for the engine cranking motor only at a maximum pressure of 830 kPa. The connection to the cranking motor is through a flexible hose with a quick-acting relay valve to permit operation of the motor. This relay valve is operated through the instrument panel mounted ignition switch.

**Instruments, Electrical Accessories and Controls**

1.103. **Battery Isolator.** The main electrical supply circuit from the vehicle batteries includes a battery isolator mounted above and to the rear of the vehicle battery compartment. The isolator operates by rotating the switch to ON (green) to allow electrical flow or OFF (red) to interrupt electrical flow. No electrical component or accessory will work with the isolator turned OFF. Refer to Figure 1-9.
1.104. **Map Reading Lamp (Figure 1-48 Item 1).** Located left hand side of the dash panel.

1.105. **CD Player and AM/FM Tuner (Figure 1-48 Item 2).** The vehicle is fitted with a CD Player and FM Tuner, mounted in the LH Instrument panel. Refer to Figure 1-48. The unit has a removable front panel as a security device which should be secured in its storage case when not in use. There are 2 speakers for the Tuner CD player, mounted in the upper rear corners of the vehicle cab.

1.106. **Air Pressure Gauge (Figure 1-48 Item 3).** This indicates both the pressures of the primary and the secondary air systems. The primary system has a green indicator needle and the secondary system has a red indicator needle. The engine air starting system air pressure is not indicated.

1.107. **LH Winch Control Switch (Figure 1-48 Item 4).** This switch allows the vehicle operator to control the operation of the LH winch from inside the cab when performing forward recovery operations, including self-recovery.
1.108. Revolving Light Switch (Figure 1-48 Item 5). This is the master ON-OFF switch for the revolving amber warning lights, mounted at the rear of the crew cab.

1.109. Fuel Gauge (Figure 1-48 Item 6). This gauge registers the fuel level in the supply tank.

1.110. Work Light Switch (Figure 1-48 Item 7). This switch controls the supply of electrical power to the four work light sockets located on the recovery system.

1.111. Work Light ON Indicator Lamp (Figure 1-48 Item 8). This indicator lamp is illuminated when ever power is available to the recovery system work lights.

1.112. Exhaust Pyrometer (Figure 1-48 Item 9). Indicates temperature of exhaust gases at the exhaust manifold, aiding the operator to avoid excessive exhaust temperature by correct selection of gear ratio for load and grade conditions. Maximum operating temperature is shown on the pyrometer facia nameplate. An indication of readings are:

   a. 350° to 450°C light load,
   b. 450° to 550°C heavy load, and
   c. 550° to 650°C overload.

1.113. Driving Lamp Switch (Figure 1-48 Item 10). This switch controls the operation of the driving lamps. Power is available when high beam is selected only.

1.114. Headlights/Park Lights Switch (Figure 1-48 Item 11). Switch down for park lights (including body side lights) and up for headlights.

1.115. Remote Speaker (Figure 1-48 Item 12). The remote speaker enables the operator to use the RH hand held radio in hands free mode whilst driving the HRV.

1.116. Tachometer (Figure 1-48 Item 13). Engine speed is indicated in revolutions per minute. The tachometer readings should be used as a guide for shifting and selecting the various transmission speeds. The number of hours running is also recorded.

1.117. Emergency/Parking Brake Warning Light (Figure 1-48 Item 14). The vehicle must not be moved when this light is on as the emergency/ parking brakes are applied.
1.118. Speedometer and Odometer (Figure 1-48 Item 15). Indicates road speed in kilometres per hour and total distance vehicle has travelled. High beam indicator is shown by light symbol.

1.119. Oil Pressure Gauge (Figure 1-48 Item 16). Under normal operating conditions, the engine oil pressure will be between 275 kPa and 660 kPa, depending on engine speed and oil viscosity. Oil pressure may drop below 275 kPa at engine idling speed. Should pressure at operating speeds drop suddenly from normal reading, stop engine immediately and determine cause.

1.120. Coolant Temperature Gauge (Figure 1-48 Item 17). The proper operating temperature of the engine coolant is between 80 and 85°C. Extremely high ambient temperatures, slow operating conditions with heavy loads or steep grades at high altitudes, effect temperatures. As long as loss of coolant does not occur, higher than normal operating temperatures are not harmful.

1.121. Engine Warning Light (Figure 1-48 Item 18). When coolant level in radiator drops below required level, when oil pressure drops to 70 kPa or when coolant temperature exceeds 93°C an engine warning light will illuminate on the instrument panel and a bell will sound. Stop engine and determine cause.

1.122. Air Suspension Control Valve (Figure 1-48 Item 19). The air suspension control valve is located below and behind the work brake control valve and enables the air suspension to be inflated and deflated from within the cab.

1.123. Work Brake (Figure 1-48 Item 20). Pull lever down to apply and up to release the work brake.

1.124. Voltmeter (Figure 1-48 Item 21). The voltmeter is graduated from 18 volts to 32 volts and indicates system voltage as follows:

   a. With the battery isolator ON, starting switch ON or OFF, engine stopped, the voltmeter will show state of charge of the batteries. This reading should be approximately 24 volts for fully charged batteries.

   b. With the engine running at operating speeds, the voltmeter will show the voltage of the charging system. This reading should be between 24 volts and 28 volts. Low voltage will indicate high current draw from the alternator whilst a high voltage reading will indicate low current draw with fully charged batteries.
c. Any prolonged reading below or above these figures indicates that the batteries and/or the charging system requires a complete check.

1.125. **Air Horn (Figure 1-48 Item 22).** Operated by a push button on the right hand side of the dash panel.

1.126. **Electric Horn Button (Figure 1-48 Item 23).** Depression of the centre button of the steering column operates the horn.

1.127. **Electrical System Ignition/Start Switch (Figure 1-48 Item 24).** When switch is straight up and down, switch is off. Turn clockwise to activate vehicle electrical system and further movement to operate air starter.

1.128. **Engine Stop Control (Figure 1-48 Item 25).** Pull out to stop engine. Leave in OUT position whenever engine is not running. Return to IN position prior to starting. To release, turn clockwise to disengage ratchet and push IN.

1.129. **Instrument Lights (panel) (Figure 1-48 Item 26).** Turn knob right to ON position and keep turning until desired intensity is obtained. Ensure the instrument lights are turned off during day time operation as they are controlled independently of the headlights.

1.130. **Parking Brake (emergency stop) (Figure 1-48 Item 27).** Push lever down, hold down and push lock slide to the right. To release, push lever down slightly, push lock slide to the left, then release lever to OFF position.

1.131. **Clearance Lights Switch (Figure 1-48 Item 28).** This switch controls the clearance lights on the vehicle mirrors.

1.132. **Normal, Blackout and Reduced Lighting Switch (Figure 1-48 Item 29).** The three position headlights, blackout and reduced lighting switch provide the following functions:

   a. Normal lighting allows the use of head, tail, stop, parking, clearance, number plate, direction turn indicator, instrument, map reading and cab courtesy lights.

   b. Reduced lighting allows the use of only the reduced headlight, blackout marker, blackout stop, convoy, instrument lights and the map reading light. Provision for dimming and switching off the instrument lights is provided.

   c. Blackout lighting allows only the use of blackout marker, blackout stop, convoy, instrument and map reading lights.
1.133. **Dynatard Engine Brake Switch (Figure 1-48 Item 30).** Switch to OFF position when not in use. When in OFF position, light application of the brake pedal will operate the dynatard brake. When in ON position, as the foot lifts off the throttle the dynatard is automatically engaged.

1.134. **Reserve Air Supply Valve (Figure 1-48 Item 31).** Pull out for normal operation and push in for reserve air supply. This only supplies air for the emergency release of the spring brakes.

1.135. **Engine Operating Instruction Plate (Figure 1-48 Item 32).** Observe correct operating procedure. Refer to Figure 1-16.

1.136. **Power Divider Lock Out (Figure 1-48 Item 33).** Supplies increased traction when necessary. Switch to the left, PDLO activated. Switch to the right, normal driving position PDLO disconnected. When PDLO is activated, a warning buzzer will sound and a light will illuminate on the instrument panel. Switch is located on the top of the dash.

1.137. The vehicle operating air pressure is between 655 kPa and 830 kPa. Should the air pressure drop below 480 kPa the low pressure warning buzzer will operate as well as illuminating a warning light on the dash, indicating an unsafe vehicle condition. The vehicle is to be stopped immediately and the cause of the low air pressure determined and rectified before proceeding. The vehicle is not to be moved until the air pressure has reached at least 480 kPa and the low warning buzzer and light have cut out.

1.138. **Transfer Case Oil Cooler Warning Lamp (Figure 1-48 Item 34).**

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CAUTION

Continued, high speed, or high load operation of the vehicle without transfer oil cooler circulation may cause damage to the transfer case.
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1.139. The T-Case warning light indicates a loss of oil pressure in the Cooling System through either system leaks or T-Case seal failure. If the warning light remains illuminated above 1200 RPM, the operator must stop and check the T-Case and its cooling system for leaks and confirm the oil level within the T-Case. If no leaks are detected and T-Case oil level is ok, the vehicle can be driven safely and the operator is to report the failure at completion of their task. If an oil leak is detected and can not be repaired through tightening of unions, the vehicle must not be driven.
1.140. Drive Line Warning Lamps (Figure 1-48 Item 35). These lamps are illuminated to indicate the status of the drive line as indicated on their respective labels.

1.141. Hand Throttle (Figure 1-48 Item 36).

**WARNING**

The hand throttle is not to be used to set the engine speed at any time whilst the vehicle is mobile otherwise death or injury may occur to the vehicle occupants or other road users.

1.142. The hand throttle is provided to enable the engine rpm to be set at a required speed. Press the button and pull knob out for a quick response. Minor adjustment may be carried out by turning the knob. To release the hand throttle, press button and return the knob fully inwards. The hand throttle shall not be set above engine RPM of 1500 rpm.

1.143. Tractor Protection Valve (Figure 1-48 Item 37). Push to release the brakes. Pull to apply. DO NOT USE FOR PARKING.

1.144. Windscreen Washers (Figure 1-48 Item 38). Push the button in and hold as long as water is required. The windscreen washers are incorporated in the blade. The water supply is in the driver's door (refer to Figure 1-10 Item 2).

1.145. Windscreen Wipers (Figure 1-48 Item 39). Pull the knob out to operate the wipers. Turn the knob for speed control. To cancel, push the knob in and hold in until wipers have parked, then release.

1.146. Closed Circuit TV Screen (Figure 1-48 Item 40). The TV screen displays images generated from either of the two video cameras mounted on the rear of the recovery system. Images from only one camera can be displayed at any one time.

1.147. Trailer Brake Lever. The trailer brake lever is mounted on the RH side of the steering column. Pull trailer brake lever back to apply brakes. Push away to release.

1.148. Reversing Lights. The reversing lights illuminate automatically when the shift lever is moved to the reverse gear position. Do NOT leave gear lever in reverse when parking.
1.149. **Directional Signal Switch.** The directional control switch is mounted on the LH side of the steering column. Push the lever forward for right turn signals, and pull rearwards for left turn signals. Return to mid position manually after turn is made. An audible sound from a dash mounted indicator, mounted between tachometer and speedometer is activated whenever the indicators are operating.

1.150. **Hazard Switch.** The hazard switch is incorporated into the directional indicator switch. Pull the plunger out to actuate the hazard warning lights. To deactivate the hazard warning lights move the indicator switch lever forward or rearward then return it to the central position.

1.151. **Accelerator Pedal (Figure 1-10 Item 3).** The accelerator pedal actuates an air valve to provide air pressure to the throttle control to set the engine speed. Press to increase speed/engine rpm as required.

1.152. **Brake Pedal (Figure 1-10 Item 4).** Press the pedal progressively to apply increased braking pressure. The brake pedal is interconnected to the Dynatard engine brake to provide integrated braking effort.

1.153. **High-Low Beam Dipper Switch (Figure 1-10 Item 5).** Press down to switch between high and low beam.

1.154. **Clutch Pedal (Figure 1-10 Item 6).** Press the pedal in to disengage the clutch. The last 25 mm of pedal travel applies the clutch brake.

1.155. **Main Transmission Shift Lever.** Manually changes gear ratios in the main transmission.

1.156. **Main Transmission Shift Diagram Plate (Figure 1-14).** Illustrates main transmission shift pattern.

1.157. **Transfer Case Shift Lever.** Manually changes gear ratios in the transfer case.

1.158. **Transfer Case Shift Pattern (Figure 1-15).** Illustrates transfer case shift pattern and operating instructions.

1.159. **PTO Engagement Light.** This will light up when the PTO is engaged.
1.160. **Cabin.** The cabin consists of the standard Mack RM6866RS cabin plus a custom built crew cab fitted to the rear wall of the main cab. The crew cab provides additional seating for recovery crew and passengers plus storage facilities for the onboard radio communications system.

1.161. **Sound Proofing.** Sound proofing panels fitted to both the main and crew cabs reduce the noise levels experienced in the cabin.

1.162. **Cabin Suspension.** The main and crew cabs are mounted on a sub-frame which is in turn mounted onto the vehicle chassis by pivot points at the front and an airbag suspension at the rear. The airbag suspension and mountings allow the cabin to move independently of the vehicle chassis, therefore providing the crew with smoother ride characteristics.

1.163. **Cabin Heating and Ventilation System.** This heater is designed with sufficient capacity to supply uniform defrosting for both left and right hand windshields and at the same time maintain comfortable cab temperatures.

1.164. **Steering Column Adjuster (Figure 1-10 Item 1).** This allows steering column to be moved fore and aft approximately 76 mm. Press down to release, up to lock.

![Figure 1-10 Controls – forward cabin area](image)

1. Steering wheel adjustment control  
2. Windscreen washer reservoir  
3. Accelerator pedal  
4. Brake pedal  
5. High/Low beam switch  
6. Clutch pedal
1.165. Left Hand Heat Outlet Door (Figure 1-11 Item 2). When opened will provide warm air to the passenger area.

1.166. Fan Control (Figure 1-11 Item 3). Turn clockwise from off position to desired fan speed, low, medium or high. Turn anti-clockwise to shut-off.

1.167. Temperature Control (Figure 1-11 Item 4). Operates the water flow supplying the heater core. Push right to obtain desired temperature. Full right position is high, full left is off. There is a control flow tap mounted on the left rear of the engine. This allows water flow to be turned off during summer.

1.168. Defroster Control (Figure 1-11 Item 5). Provides entire flow of air to either the defroster or cab interior with any intermediate combination required. Pull left to increase defrosting action. Pull right diverts air flow to cab. Adjust for desired combination. The heater may be operated in conjunction with the air conditioner to provide warm, dehumidified air in the vehicle and crew cabs to assist with defrosting.

1.169. Right Hand Heat Outlet Door (Figure 1-11 Item 6). Provides additional warm air to driver.

Figure 1-11 Cabin heating system layout
1.170. Servicing Data and Tyre Pressure Plate (Figure 1-12). Observe correct servicing data and tyre pressures. This plate is located on the inside lower section of the left hand door.

**NOTE**

Refer EMEI Vehicle D 329 for current and approved lubricants.

![Servicing Data](image)

Figure 1-12 Servicing data and tyre pressure plate

1.171. Nomenclature Plate (Figure 1-13). This plate is located on the inside lower section of the left hand door.

![Nomenclature Plate](image)

Figure 1-13 Nomenclature plate
1.172. Gear Shift Pattern. The gear shift pattern instruction plate is fixed to the RH internal sun visor. Refer to Figure 1-14.

![Main transmission shift pattern](image1)

Figure 1-14  Main transmission shift pattern

1.173. Transfer Case Shift Pattern. The transfer case shift pattern and instruction plate is fixed to the RH internal sun visor. Refer to Figure 1-15.

![Transfer case shift pattern plate](image2)

Figure 1-15  Transfer case shift pattern plate
The transfer case is only to be shifted with the vehicle stationary.

1.174. Engine Instruction Plates. Engine operating instruction plates are fixed to the LH instrument panel and to the top of the centre instrument panel. Refer to Figure 1-16.

**STARTING INSTRUCTIONS**

PARKING BRAKE MUST BE APPLIED FOR STARTING. TO ASSURE ADEQUATE TURBOCHARGER LUBRICATION, ENGINE SPEED SHOULD NOT EXCEED 1400 R.P.M. UNTIL OIL PRESSURE EXCEEDS 140 kPa (20 P.S.I.)

Figure 1-16    Engine operating instruction plates

1.175. Cabin Seating. The vehicle is fitted with suspension seats with adjustments for seat cushion height and tilt, seat back angle, seat fore and aft movement and suspension unit loadings as detailed below.
WARNING

Adjusting the seat position whilst driving may cause loss of control of the vehicle with subsequent death or injury to the vehicle occupants and other road users.

1.176. Adjustments are as follows:

a. **Seat Cushion Height and Tilt (Figure 1-17 Item 1).**
   - Height Range: 65 mm in six steps
   - Tilt Range: 11 degrees forward
     13 degrees rearward

b. **Seat Back Angle (Figure 1-17 Item 2).**
   - Forward Tilt: 4 degrees
   - Rearward Tilt: 60 degrees
   - Adjustment: 32 steps at 2 degrees increments

c. **Suspension Unit (Figure 1-17 Item 3).**
   - Load Range: 60 kg to 130 kg
   - Load Adjustment: Infinitely variable with visual indicator
   - Stroke: 80 mm. Hydraulic shock absorber and progressive bump stops.

d. **Seat Slides (Figure 1-17 Item 4).**
   - Total Movement: 175 mm
   - Adjustment: 11 steps at 17.3 mm increments
1.177. **Crew Cab.** The crew cab is an extension to the vehicle cabin and is prefabricated from aluminium. The crew cab contains seating for crew members and mountings for the radio communications equipment.

1.178. **Air Conditioning System.** The vehicle is fitted with a Crisp-Air air conditioning system. This system cools, dehumidifies and circulates the air within the operator and crew cabs. Fresh air is available through the roof mounted fresh air vent.

**Stowage**

1.179. **Recovery Equipment and CES.** Stowage for recovery equipment and vehicle CES is provided in the lockers mounted on each side of the recovery system. The lockers are fitted with suitable brackets and mounting points for mounting and storing the various items of recovery equipment and vehicle CES. The storage lockers have a wear resistant lining to prevent damage and wear to the base material.

1.180. **POL Stowage.** Tray type containers are provided on the LH and RH side of the vehicle frame for the stowage of fuel and water jerry cans.
1.181. **Rifle Clips and Butt Boxes.** A rifle mounting position is provided for both driver and passenger; these are located between the respective seat and door. Rifle and MINIMI mounting positions are also provided in the crew cab.

1.182. **Fire Extinguisher.** Fire extinguishers are mounted:
   
   a. in the LHF cab foot well, and
   
   b. on the front of the lockers on each side of the recovery system.

1.183. All crew members should be fully conversant with the operating instructions for each type of fire extinguisher and use the extinguisher accordingly in the event of a fire.

1.184. **Spare Wheel Stowage.** The spare wheel is stowed on the tailgate of the recovery system. A lifting adaptor is provided to allow removal and replacement of the spare wheel with the truck mounted crane. Refer to Figure 1-18.

![Figure 1-18 Spare wheel stowage](image)
Flood Lamps

1.185. Four flood lamps are supplied with the HRV CES. Two of these have longer extension legs and are designed to fit into the mountings positioned at each of the four corners of the recovery system lockers and connect to the two pin sockets provided at each mounting point (refer to Figure 1-19). The other two are configured to enable fitment into the rotating light mountings. Refer to Figure 1-20.

Figure 1-19  Flood lamp fitted to recovery system locker mountings

Figure 1-20  Flood lamps fitted to rotating light mountings
**Miller Recovery System**

1.186. The recovery system is a Miller twin line recovery system incorporating two winches, a Palfinger vehicle mounted crane and a three point linkage with ‘T’ bar built into a purpose built frame.

1.187. **Winches.** The winches are a horizontal drum type winch, hydraulically powered from individual PTO mounted pumps on the vehicle transmission. Each winch has three drive motors providing drive to the winch drum through a drive gear, drive shaft and a planetary gear train. The winch ropes are fed from the winches through individual reversing sheaves and out through the fairleads located on the recovery system tailgate. Refer to Figure 1-21 for the location of the recovery system components.

1.188. **Earth Spades.** Earth spades fitted to the tailgate of the recovery system provide additional anchoring facilities for the vehicle when carrying out recovery tasks with loads to the rear of the vehicle. Internal hydraulic cylinders are fitted to raise and lower the earth spades. These are controlled from the main hydraulic control valve using control valve levers in the LH cabinet and switches both in the RH control cabinet and on the remote control pendant.

1.189. **Reversing Sheave.** Two reversing sheaves are mounted in the forward section of the recovery system, one either side of the hydraulic tank. The reversing sheave allows the direction of the winch cable to be reversed.

1.190. **Forward Recovery Sheave.** A forward recovery sheave is fitted to the rear of the tailgate to allow the rope from the LH winch to be fed through the guide channel to the front of the vehicle allowing forward recovery operations.

1.191. **Return Line Anchors.** Recovery return line anchors are provided as follows:
   
   a. Two bail shackles mounted on the tailgate of the recovery system for return lines from the rear and sides of the vehicle.

   b. Four holes located in the earth spades. The inner holes are for return lines from the rear of the vehicle whilst the outer two holes are for return lines from the sides of the vehicle.
1.192. **Rear Towing Eyes.**

![Plan view of recovery system](image)

**WARNING**

Equipment failure and personal injury may occur if excessive loads are placed on the rear towing eyes.
1.193. Rear towing eyes (refer to Figure 1-22) are fitted to the recovery system tailgate to allow the connection of the medium/heavy ‘B’ vehicle ‘A’ frame and are not to be used for debogging or winching operations. These points are only to be used when it is necessary to tow light and medium plant only under the following conditions:

a. the casualty is to be on a hard surface;

b. the road wheels, tracks and track gear are to be in operating condition;

c. recovery is to be for short distance only to facilitate loading to a transporter;

d. maximum speed of combination when connected to points 20 km or less if directed by OEM of plant equipment;

e. gradual turning of combination only when connected to the points; and

f. tow bar, when reversed on HRV, is not to be utilised to push equipment casualties, when connected, up ramps onto trailers.

Figure 1-22 Rear towing eyes
Winch Rope Fairleads and Rope Tensioners

1.194. Winch rope fairleads and rope tensioners are fitted to the rear of the HRV, one per winch rope. The fairleads allow the winch ropes to depart from the recovery system at angles up to 90° from the centreline of the HRV. Pneumatic rope tensioners allow the winch rope to be wound onto the winch drum whenever the rope is not under load. The pressure applied to the rope tensioners is controlled by air pressure regulators incorporated into the rope tensioner air line circuit. The pressure regulators are located on the recovery system, forward of the LH winch. Refer to Figure 1-23. The standard pressure setting for the pressure regulators is 6.8 to 7.5 bar (100 to 110 psi).

Figure 1-23 Rope tensioner air pressure regulators

Control System

1.195. The recovery system can be operated from any one of the following locations:

a. The control cabinet located inside the rear compartment of the LH storage bin using the switches and control levers provided.
b. The control cabinet located inside the rear compartment of the RH storage bin using the remote switches provided.

c. The remote control which connects to the recovery system by cable, therefore allowing the operator to move away from the vehicle freely whilst still being able to control the operation of the recovery system.

LH Control Cabinet

1.196. The LH control cabinet (refer to Figure 1-24) contains:

a. **Hydraulic Control Valve Levers.** A set of hydraulic control levers connected to the hydraulic control valve by cable. The function of each control lever is shown on the plate fixed in the cabinet immediately behind the levers.

b. **LH and RH Winch Hydraulic Pressure Gauges.** These gauges indicate the hydraulic pressure applied to the respective winch at any time.

c. **LH and RH Winch PLC Display Panels.** These panels display pertinent operating data from the PLC controlling the respective winch such as the load on the rope; the number of rope layers on the drum and distance from rope layer flag to sensor.

d. **LH and RH Winch PLC Isolation Switches.** These switches cut power to the respective winch PLC to enable the overload protection systems to be reset.

e. **LH and RH Winch Engage/Disengage Switches.** These switches actuate the air solenoids to provide air to the winch despooling devices and hence causing the winches to free wheel.

f. **Oil Cooler Fan Switch.** This switch allows the hydraulic oil cooler fan thermostat to be overridden, causing the oil cooler fan to run continuously.

g. **Work Light Switch.** This switch supplies power to the two work lights located on the rear of the vehicle.

h. **Flood Light Switch.** This switch supplies power to the flood light electrical sockets mounted on each of the four corners of the recovery system.
Figure 1-24  LH control cabinet

i. **Blue Light Switch.** This switch provides power to the cabinet’s internal blue light for operation under reduced lighting situations.

j. **Locker Light Switch.** This switch provides power to the cabinet’s internal white light.

k. **Engine Throttle Switch.** This switch provides power to and activates the engine throttle control to run the engine at the required rpm for operation of the recovery system.

l. **Connection Point for the Remote Control Pendant.** This socket allows connection of the recovery system remote control pendant.

m. **Remote Control Switch.** This switch supplies power to the remote control pendant to enable remote operation of the recovery system.

n. **Sheave Tensioner Switches (LH and RH).** These switches provide power to actuate the air solenoids that operate the rope tensioner systems fitted to the rope fairleads.
The function of each switch and control lever is clearly defined by labels displayed in the control panel.

The function of the hydraulic control levers fitted to the LH control cabinet from the left as viewed are:

- LH winch (red knob),
- LH earth spade,
- RH earth spade,
- RH winch (red knob),
- LH tow cylinder,
- Lift cylinder, and
- RH tow cylinder.

RH Control Cabinet

The controls and instruments located in the RH control cabinet perform the same functions as those described for the LH control cabinet. All switches and controls are labelled for their intended use. The RH control cabinet (refer to Figure 1-25) contains:

- **Hydraulic Control Valve Switches.** These are a series of electrical switches which activate the remote solenoids on the hydraulic control valve to perform the same functions as the control levers in the LH cabinet.

- **Connection Point for the Remote Control Pendant.** This socket allows connection of the recovery system remote control pendant.

- **LH and RH Winch Hydraulic Pressure Gauges.** These gauges indicate the hydraulic pressure applied to the respective winch at any time.

- **LH and RH Winch Engage/Disengage Switches.** These switches actuate the air solenoids to provide air to the winch despooling devices and hence causing the winches to free wheel.

- **Oil Cooler Fan Switch.** This switch allows the hydraulic oil cooler fan thermostat to be overridden, causing the oil cooler fan to run continuously.
f. **Work Light Switch.** This switch supplies power to the two work lights located on the tailgate of the vehicle.

g. **Flood Light Switch.** This switch supplies power to the flood light electrical sockets mounted on each of the four corners of the recovery system.

h. **Blue Light Switch.** This switch provides power to the cabinet’s internal blue light for operation under reduced lighting situations.

i. **Locker Light Switch.** This switch provides power to the cabinet’s internal white light.

j. **Engine Throttle Switch.** This switch provides power to and activates the engine throttle control to run the engine at the required rpm for operation of the recovery system.

k. **Remote Control Switch.** This switch supplies power to the remote control pendant to enable remote operation of the recovery system.
Remote Control

1.200. Remote control of the recovery system is enabled through the use of a control pendant connected to the recovery system by cable. The cable can be connected to the recovery system at points located in both the LH and RH rear control cabinets. Refer to Figure 1-26. The remote control system allows the operator to control all operating functions of the recovery system whilst standing away from the vehicle.

Figure 1-26  Recovery system remote control

1.201. The pendant has two operating modes, being Tow and Recover. The operating modes are selected by a two position mode selector switch located on the pendant. The action of the mode selector switch is to change the function of some switches located on the pendant. These switches are indicated by dual labelling on the switch buttons.

1.202. *In-Cab Controls.* A switch is located in the HRV’s LH instrument panel for operation of the LH winch during forward recovery operations. Refer to Figure 1-48.

Forward Recovery

1.203. Forward recovery operations are possible by redirecting the rope from the LH winch through the self recovery sheave mounted on the LH side of the tailgate allowing the rope to be redirected to the front of the vehicle.
Towing Hitch

1.204. The towing hitch is a three point linkage unit incorporating (refer to Figure 1-27):
   a. a lift cylinder,
   b. two towing cylinders,
   c. a pivot head,
   d. a crossbar, and
   e. towing adaptors.

1.205. All components of the towing hitch are controlled using the hydraulic control valve, actuated from either of the control cabinets or the remote control pendant.

Figure 1-27 Recovery system towing hitch
Towing Adaptors

1.206. Two universal towing adaptors and two universal chain adaptors are provided in the HRV CES for coupling various vehicle types to the cross-bar, however specific towing adaptors are provided for the following vehicle types (refer to Table 1-3 and Table 1-4):

   a. ASLAV.

   NOTE

   Until further notice, lift towing of ASLAVs is not authorised. Refer SIC-HAH 130233ZSEP05 - ASLAV Recovery.

   b. Landrover.

   c. Unimog (rear).

Table 1-3 HRV Towing Adaptors

<table>
<thead>
<tr>
<th>Universal adaptor</th>
<th>Universal adaptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landrover rear adaptor</td>
<td>Landrover rear adaptor</td>
</tr>
<tr>
<td>Landrover adaptor pin and collar</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td>Unimog rear adaptor</td>
<td></td>
</tr>
<tr>
<td>ASLAV adaptor</td>
<td></td>
</tr>
<tr>
<td>‘S’ Liner rear lift spacers</td>
<td></td>
</tr>
</tbody>
</table>
1.207. The chain adaptors may be used in conjunction with other adaptors to enable connection of safety chains to the towing bar as depicted in some examples shown in Table 1-4.

**Table 1-4  Lift/Towing Adaptors and Their Applications**

<table>
<thead>
<tr>
<th>Universal tow adaptor setup for Landrover 4 × 4 and 6 × 6 front lift with collared pins and reduction bushes fitted.</th>
<th>Chain adaptor</th>
<th>ASLAV adaptor block</th>
</tr>
</thead>
</table>

Table 1-3  HRV Towing Adaptors (Continued)
<table>
<thead>
<tr>
<th><img src="image1.png" alt="Image" /></th>
<th>Universal tow adaptor set up with Landrover 4 × 4 and 6 × 6 rear lift tow adaptor.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Universal adaptor setup for Unimog front lift tow. Note the small pin and spacer used for coupling. Refer to Figure 1-29.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Unimog Rear lift tow adaptor setup. Refer to Figure 1-31.</td>
</tr>
<tr>
<td></td>
<td><strong>WARNING</strong></td>
</tr>
<tr>
<td></td>
<td>When rearlift towing of loaded Unimog the centre of gravity must be kept as low as possible (rear suspension to be compressed).</td>
</tr>
<tr>
<td>Table 1-4 Lift/Towing Adaptors and Their Applications (Continued)</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Universal adaptor setup for Mack R series front lift tow. Refer to Figure 1-29.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Mack R Series rear lift tow. Unladen tow only permitted.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Universal chain adaptor – example connection.</td>
</tr>
<tr>
<td>Image</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Universal adaptors used for front lift tow of Mack Fleetliner. Unladen tow only permitted.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Chain adaptors used for rear lift tow of Mack Fleetliner. Unladen tow only permitted.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Universal adaptor used for rear lift tow of MB Actross. Unladen rear tow only permitted.</td>
</tr>
</tbody>
</table>

**NOTE**

Front lift tow of the MB Actross is not permitted as it will overload the tow hitch and HRV rear suspension.
### Table 1-4  Lift/Towing Adaptors and Their Applications (Continued)

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Universal adaptor used for front lift tow of the Scania. Unladen lift tow only permitted.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Chain adaptor used for rear lift tow of the Scania. Unladen lift tow only permitted.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Universal adaptor setup for Bushmaster front lift tow using small diameter pins for coupling. Refer to Figure 1-28. See comments regarding recovery of the ADI Bushmaster over public roads following this table.</td>
</tr>
</tbody>
</table>
Table 1-4  Lift/Towing Adaptors and Their Applications  
(Continued)

<table>
<thead>
<tr>
<th>Adaptor Setup</th>
</tr>
</thead>
</table>
| **Universal adaptor setup for Bushmaster rear lift tow using small diameter pins in the coupling. Refer to Figure 1-28.**  
See comments regarding recovery of the ADI Bushmaster over public roads following this table. |
| **ASLAV Adaptors set for front lift tow. Refer to Figure 1-30.**  
**NOTE**  
Until further notice, lift towing of ASLAVs is not authorized. Refer SIC-HAH 130233ZSEP05-ASLAV Recovery. |
| **Universal adaptor setup for ‘S’ Liner rear lift tow using ‘S’ Liner rear lift spacers in the coupling.** |
Table 1-4 Lift/Towing Adaptors and Their Applications (Continued)

Universal chain adaptor setup on tow hitch for generic lift tow application.
Connection to any casualty is to be in accordance with documented practice for the specific vehicle types or in accordance with good recovery practice. Refer to Figure 1-32.

ADI Bushmaster Recovery

1.208. When the ADI Bushmaster is towed with either a front or rear lift, the load on the HRV rear axles exceeds the limit allowed on public roads. The ADI Bushmaster must be loaded onto a Heavy Recovery Trailer when it is to be recovered over public roads.

Figure 1-28 Towing hitch fitted with Landrover towing adaptors
Figure 1-29  Towing hitch fitted with universal towing adaptors

Figure 1-30  Towing hitch fitted with ASLAV towing adaptors
Figure 1-31  Towing hitch fitted with Unimog rear lift towing adaptors

Figure 1-32  Towing hitch fitted with chain adaptors
Safety Chains

**WARNING**

Operators are not to move under suspended loads. Safety chains are to be attached to the casualty and the towing hitch prior lifting. Death or personal injury can occur from falling loads.

1.209. Two safety chains are fitted into, and stowed in, the recovery system tailgate. The safety chains are to be attached to all casualties during lift tow operations to retain the casualty to the towing hitch in the event of connection failure which may cause the casualty to become unhitched from the HRV. The safety chain keyholes located in the HRV tailgate are not to be used for securing the safety chains to a casualty. Wherever possible, the chain adaptor is to be used to connect the safety chains to the towing hitch. Refer to Figure 1-33.

Figure 1-33  Example connection using chain adaptor with safety chains
1.210. After lifting the casualty adjust the safety chains so that they have sufficient slack to allow free movement of the casualty on the towing adaptors, whilst being able to capture the casualty before the casualty strikes the ground in case of connection failure. Adjustment is to be made at the towing hitch with full consideration of personal safety in the event that the casualty should fall.

**Winches**

1.211. The winches are hydraulically driven, two speed, electronically controlled, single drum type winch. Electronic control is achieved through the use of a programmable logic controller (PLC). The winches are capable of operating in both manual and automatic modes. Selection of the operating mode is made by setting the position of the mode selection lever fitted to the hydraulic control block. Refer to Figure 1-34.

1.212. When operating in automatic mode, the PLC controls the hydraulic oil pressure applied to the winch to achieve a constant, maximum line pull of 13.0 tonnes, regardless of the number of layers of rope on the drum. When operating in manual mode, the maximum line pull is limited to 13.0 tonnes on the first layer of the drum, reducing to 9 tonnes on the fourth layer. The PLC detects the No of rope layers on the drum through the use of the rope layer sensor fitted to one end of the winch. The sensors are fitted to opposite ends of the LH and RH winches. Refer to Figure 1-34.

**WARNING**

Failure to use the correct in-service winch rope may cause damage to equipment and injury or death to the user.

1.213. All ropes used with the recovery system must have the relevant details stamped on the rope ferrule and must comply with the required rope specifications. The recovery Load Limit (RECLL) is to be stamped on the ferrule fitting of the winch rope and is not be less than 13 tonne. Ropes that do not have the RECLL identified on the rope are not to be used.
1.214. The winches have a free-spooling device that allows the winch drum to free-wheel for de-spooling of the winch rope. This device consists of a pneumatically operated plunger that engages in corresponding drillings in the external circumference of the planetary gear ring. Overrun of the winch drum, causing loosening of the rope coils on the drum, is prevented by a drag brake acting on the winch gear ring. The operator must develop a suitable technique for pulling the winch rope in order to minimise loosening of the rope coils on the drum. If excessive overrun is experienced, adjustment of the drag brake may be necessary. Refer to Figure 1-34.

![Free-spooling device](image)

**Figure 1-34** Winch rope layer sensor

1.215. **Speed Control.** The winch hydraulic system automatically controls the recovery speed according to the load on the rope. When recovering a load up to 3 tonnes, the winch operates in high speed, using one hydraulic motor only. When the load exceeds 3 tonnes, the winch will automatically shift to low speed and will then be driven by all three motors. When driving the winch in the reverse direction, all three motors are in operation.

1.216. **Electronic Control System.** Each winch has a dedicated control system, which has two major components the operator should be aware of. The first is the PLC, which is mounted on the inner surface of
the inner wall of the corresponding side locker. Refer to Figure 1-35. The second component is the display unit which is mounted in the control cabinet on the LH side of the vehicle. The display unit has an LCD panel that displays the following information:

a. operating mode,
b. load in tonnes,
c. rope layers on the drum, and
d. the distance from the mechanical flag and the distance sensor.

1.217. The PLC display panel will indicate tonnage loading at loads in excess of 6 tonnes only. On initial start up, the PLC display panel will display the following in order as listed:

a. PLC type and model details;
b. PLC software version details;
c. winch operating mode, either automatic or manual; and
d. winch operating parameters (refer to Figure 1-36).
Indicates the current load, in tonnes, on the respective winch rope.
Note: No display until load exceeds 6 tonnes

Load: 0.0 tonnes
Level: 4 52mm

Indicates the current No. of layers on the winch drum
Indicates the distance between the rope layer flag and the sensor

Figure 1-36  Winch operating parameter screen display

1.218. Rope Path. The ropes from the winches are fed forward from the winch, through reversing sheaves and back to the rear of the recovery system where they pass through individual self-aligning fairleads mounted in the tailgate. For forward recovery, the rope from the LH winch is passed from the fairlead, through a sheave mounted on the tailgate, through a guide channel to the front of the vehicle before passing through a set of guide rollers located on the front bumper bar. Refer to Figure 2-31, Figure 2-32 and Figure 2-33.

Winch / Recovery System Pneumatics

1.219. Compressed air for the operation of the recovery system pneumatics is supplied from the HRV air system via a distribution manifold located on the vehicle’s chassis crossmember. The air pressure is regulated to 5.5 to 6.2 bar (80-90 psi) for the recovery system. A mist lubricator mounted with the pressure regulator provides a light mist of oil in the air for lubrication of the mechanical components of the recovery system pneumatics.
Recovery Hydraulic System

1.220. Hydraulic oil for the winches and crane is supplied by a single oil reservoir located at the front of the recovery system, immediately rearward of the crane. An integrated oil cooler receives return oil from the LH winch and cools the oil before it returns to the oil tank. A diagram of the recovery system hydraulic circuit is shown in Figure 1-37. The application of hydraulic spool valve segments to each actuator directly corresponds to the order of the hydraulic control levers in the LH control cabinet.

Figure 1-37 Recovery system hydraulic circuit

<table>
<thead>
<tr>
<th>Spool Valve/Device</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>LH Winch</td>
</tr>
<tr>
<td>2.</td>
<td>LH Spade</td>
</tr>
<tr>
<td>3.</td>
<td>RH Spade</td>
</tr>
<tr>
<td>4.</td>
<td>RH Winch</td>
</tr>
<tr>
<td>5.</td>
<td>LH Tow</td>
</tr>
<tr>
<td>6.</td>
<td>Lift</td>
</tr>
<tr>
<td>7.</td>
<td>RH Tow</td>
</tr>
</tbody>
</table>

Hydraulic reservoir located in forward part of the recovery system. Supplies recovery system and crane

Hydraulic control valve located inside the recovery system tailgate

Tandem pump

To crane
1.221. The hydraulic system consists of the following:

a. **Hydraulic Pumps.** The winches are driven by a tandem, PTO driven pump mounted to the vehicle transmission. Each winch operates from one section of the pump.

b. **Hydraulic Reservoir.** Oil for the hydraulic system is supplied from the hydraulic reservoir located in the forward part of the recovery system sub-frame. The oil reservoir has a filler cap and strainer, dip stick, oil level indicator and supply line strainers. Refer to Figure 1-38.

   ![CAUTION]

   **The oil cooler heat exchanger and fan are not to be used as step or walkway. Walking on the oil cooler may cause damage to the cooling fins.**

c. **Oil Cooler.** A thermostatically controlled oil cooler is mounted on top of the hydraulic reservoir. The hydraulic oil cooler fan operates at 60°C. Oil returning from the LH winch and LH spade is passed through the cooler before returning to the reservoir. Refer to Figure 1-38.

d. **Return Line Oil Filters.** Three identical replaceable paper elements; return line oil filters are built into the top of the reservoir. Two are for the recovery system and the third is for the crane. Refer to Figure 1-38.

e. **Control Valve.** A seven segment control valve is mounted on the recovery system tailgate, immediately behind the winches. The control valve is both mechanically and electrically actuated either by actuating levers mounted in the LH control cabinet of the recovery system; actuating switches mounted in the RH control cabinet or by the cable remote control system. The control valve incorporates the pressure relief valves required to protect the system from excessive pressures.

f. **Hydraulic Actuators.** Hydraulic cylinders are used to operate the spades and towing hitch. Each winch has three hydraulic drive motors.
Cat Walks

1.222. The upper portion of the recovery system is enclosed by perforated aluminium cat walks. These catwalks are designed to allow the operator safe access to the various components of the recovery system and fuel tank and to also allow the carriage of light loads, e.g., camouflage netting. The weight carrying capacity of the catwalks is limited and any loading is to be limited to a maximum load of 300 kg across the entire area of the cat walks with a maximum loading of 50 kg per m².

Palfinger Crane

1.223. The crane fitted to the recovery system is a Palfinger model PK9501 single linkage, 9.5 metre crane, modified from the standard configuration with a shorter column to reduce the overall height of the vehicle. The crane is hydraulically operated by either the Scanreco combined cable and radio remote or manual control systems.

1.224. Hydraulic oil supply for the crane is provided from a PTO mounted pump on the vehicle transmission. Oil is provided from the hydraulic reservoir mounted on the recovery system. The PTO is controlled from inside the operators cab.
1.225. The crane incorporates the Palfinger Paltronic 50 crane monitoring and overload protection system to monitor the loading of the crane and prevent excessive overloading.

1.226. Maximum lift for the crane, at full extension, is 1600 kg. Refer to the load chart shown in Figure 1-39.

![Crane load diagrams](image)

**Figure 1-39  Crane load diagrams**

1.227. **Hydraulic System.** The hydraulic system shares a common oil reservoir with the recovery system which feeds a single stage gear type hydraulic pump fitted to the RH PTO. Oil supplied from the pump is directed to the hydraulic control valve through a high pressure oil filter located on the crane base. Refer to Figure 1-40. From the high pressure filter, the oil then flows to the control valves.

1.228. Return oil from the control valves returns to the hydraulic reservoir via a return line filter located in the top of the reservoir.

1.229. Cooling of the oil is achieved by circulation of the oil through the recovery system hydraulic circuit. To achieve oil cooling, the recovery system PTO needs to be engaged.

1.230. The crane has two stabiliser legs; each is hydraulically operated from a dual spool control valve located on the RH side of the vehicle with operating levers located on each side. Refer to Figure 1-41. The stabilisers have removable footings that are stowed in the storage cabinets of the recovery system. The footings must be fitted whenever the stabilisers are used. The stabiliser legs are designed for stabilising the vehicle only and not for lifting the vehicle.

1.231. The functions of each control valve lever are indicated by labels attached to the crane adjacent to the control valve levers.
Figure 1-40  High pressure oil filter

Figure 1-41  Stabiliser legs control valve
1.232. **Control Systems.** The crane may be operated by the following means:

a. Using the control levers located on the hydraulic control valve. Refer to Figure 1-42.

b. Using the remote control, either as a cable connection or as a radio remote. Refer to Figure 1-43. The operating distance of the radio remote is sufficient to allow the operator to stand well clear of the operating area whilst still retaining good visual contact.

![Figure 1-42 Crane control centre](image)
1.233. Control Valves. There are two banks of hydraulic control valves fitted to the crane. The main control valve is located on the LH side of the vehicle and is used to control the functions of the crane. The second bank is a two spool valve located on the crane base on the RH side of the vehicle which is used to control the operation of the stabiliser legs. Remote levers are provided to allow the stabiliser legs to be actuated from either side of the vehicle. Refer to Figure 1-41.

1.234. Main Control Valve. The hydraulic control valve is a four spool system with control spools for the functions listed below. Directions for movement of the levers to perform any particular function are indicated by labels fixed to the control valve cover. These labels conform to recognised standards for crane operation.

   a. Slewing left and right.
   b. Inner boom.
   c. Raising and lowering the outer boom.
   d. Extending and retracting the extension boom.

1.235. Remote Control. The remote control is a linear remote control system and may be utilised as either a cable or radio remote. Selection of cable remote is automatic once the cable is connected to the remote control console and the crane control panel. Refer to Figure 1-43. The remote control cable has a length of 15 metres.
1.236. Functions available from the remote control console are:
   
a. crane operation other than stabiliser control,
   
b. emergency stop,
   
c. remote control functionality checks,
   
d. setting the crane operation speed,
   
e. overriding the crane overload protection (OLP) system, and
   
f. radio frequency change.

1.237. **Crane Hourmeter.** The crane is fitted with an hourmeter to
collect the operating hours of the crane. Refer to Figure 1-44. The
functions of the hourmeter are as follows:

   a. Indication of the number of servicing intervals that have
      passed. This is shown on the LH side of the display as S1, S2,
      S3 ....

   b. The first 10 seconds after activation of the crane the hour-
      meter shows the absolute value of operating hours.

   c. After the expiration of the first 10 seconds, the display will
      change over to countdown which begins at 1000 hours and
      counts down to 0.

   d. When there are 100 hours operating time remaining, the
      display will start to flash to remind the crane operator of the
      emerging need to service the crane.

![Crane hourmeter display](image)

**Figure 1-44** Crane hourmeter display
e. When the display reaches 0 hours remaining, an additional red LED will begin to flash.

f. If the service is not carried out, the hourmeter will continue counting the hours as a minus value.

g. Once the crane is serviced, the hourmeter will be reset and the countdown will again start at 1000 hours.

NOTE

It is absolutely necessary to ensure that the hourmeter is reset at each annual service.

Radio Communications Equipment

1.238. HF/VHF Radios. Provision for a mounting HF a low powered station and a VHF medium powered station is made in the RHS of the crew cab. The stations are connected via shielded control cables to an extended front panel mounted on the cab heater box and cab floor. The extended front panel provides mountings for two LSF 300 speakers, two MF301 microphones, two CF307 remote channel selectors and a power supply socket. A HF tuner is mounted in the RHR body locker. Provision is also made for aerial mountings on the side tool bins. Refer to the User Handbook for Single Channel Radio System RAVEN B Vehicle and Ground Installations.

1.239. Operation of the recovery system hydraulic oil cooling fan generates electro magnetic interference (EMI) which may mask in and out bound radio signals for communication equipment within a 50 m radius. Operators are to:

a. ensure that the recovery system is turned off whenever operating the RAVEN communication system, and

b. avoid operating the recovery system within 50 m of command posts or areas using communication equipment.

1.240. Handheld Radios. The HRV is equipped with two Tait Orca 5010 handheld radios for use by the crew during recovery operations. Each of the radios has a cradle mounting available to enable battery charging from the HRV electrical system. One of the radio cradles is fitted with a separate microphone and remote speaker to allow hands free operation by the HRV driver. These radios are programmed to the Army UHF Band Plan and channel selection is to be in accordance with Unit Communications Instructions.
1.241. **Batteries.** The handheld radios must be fitted with NiCd batteries for use in the HRV. NiMH batteries will operate the radio, but are not suitable for recharging in the vehicle mount.

1.242. Battery charging status is indicated by the charger status LED on the cradle. When the radio is placed in the cradle, the LED will glow amber for three seconds then change to red to indicate charging is taking place. Refer to Figure 1-45. The LED will change to green when the battery is charged to a minimum of 70% of its capacity. If the battery is either too hot or too cold the LED will continue to glow amber until the battery temperature is within the safe range for charging. The safe temperature range is 0°C to 50°C. If the indicator remains amber for an extended period of time during periods of high temperatures, consider running the air conditioner to cool the vehicle cab. Optimum battery charging performance is obtained between 15°C and 25°C.

![Handheld radio cradle and charger](image-url)

**Figure 1-45**  Handheld radio cradle and charger
1.243. Charge times for the radio, with the radio turned off are:
   a. up to 1½ hours for 1100 mAh NiCd batteries, and
   b. up to 2 hours for 1500 mAh NiCd batteries.

1.244. The radios may be used whilst charging; however charge times will vary depending on how much the radio is used.

1.245. Explanations of the charging status LED displays are shown in Table 1-5.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steady red</td>
<td>Battery charging.</td>
</tr>
<tr>
<td>Steady green</td>
<td>Battery charged to a minimum of 70% of capacity.</td>
</tr>
<tr>
<td>Steady amber</td>
<td>Charge suspended until battery temperature is within correct range.</td>
</tr>
<tr>
<td>Flashing red</td>
<td>Battery not seated properly in the charger, contacts dirty, battery faulty or NiMH battery inserted.</td>
</tr>
</tbody>
</table>

1.246. Whilst the radio is seated in the cradle, operation remains the same except that:
   a. The radio’s microphone will be inoperative and the external microphone must be used.
   b. The radio’s speaker will be inoperative where the external speaker has been installed. Speaker volume can still be adjusted from the radio’s volume control.

1.247. **Electrical Trailer Connection Socket.** A 12-pin NATO trailer socket connection is fitted to the rear of the vehicle to the left of the pintle hook and is wired in accordance with DEF (AUST) 5101 excepting for the blackout stoplight circuit which is connected through terminal F.

1.248. **Rear Vision Mirrors.** Rear vision mirrors are fitted to each side of the cab. The mirrors are hinged to fold inwards and lessen damage during cross country operations.

1.249. **Corner Markers.** Corner markers are fitted to the extremities of the front mudguards to aid clearance judgement.
1.250. **Bridge Classification Sign.** A bridge classification sign with the number 19/90 is mounted on the front bumper (refer to Figure 1-46).

![Bridge Classification Sign](image)

1.251. **Unit/Formation Signs.** Four unit/formation sign holders are fitted to the vehicle.

1.252. **‘C of G’ Designation Plate.** A plate denoting the position of the longitudinal point of balance of the unladen vehicle is fitted on the left side of the body.

**Oxygen/Acetylene Cylinder Stowage**

1.253. Storage facilities for oxygen and acetylene bottle are provided between the recovery system body and the crane. Refer to Figure 1-47.

![Oxy/Acetylene Bottle Stowage](image)

Figure 1-47  Oxy/Acetylene bottle stowage
1. Map reading lamp
2. Radio/CD player
3. Air pressure gauge and low air pressure warning lamp
4. LH winch control switch
5. Revolving light switch
6. Fuel gauge
7. Work light switch
8. Work light ON indicator lamp
9. Exhaust pyrometer
10. Driving light switch
11. Headlights/park light switch
12. Remote speaker
13. Tachometer
14. Emergency parking brake warning light
15. Speedometer and odometer
16. Oil pressure gauge
17. Coolant temperature gauge
18. Engine warning light
19. Air suspension control switch (under RH dash panel behind work brake control)
20. Work brake control
21. Voltmeter
22. Air horn
23. Electric horn button
24. Electrical system ignition/start switch
25. Engine stop control
26. Instrument lights (Panel)
27. Parking brake (emergency stop)
28. Clearance lights switch
29. Normal, blackout and reduced lighting switch
30. Dynatard engine brake switch
31. Reserve air supply valve
32. Engine operating instruction plates
33. Power divider lock out
34. Transfer case oil warning lamp
35. Drive line warning lamps
36. Hand Throttle
37. Tractor protection valve
38. Windscreen washer switch
39. Windscreen wiper switch
40. Closed circuit TV monitor
CHAPTER 1
PRECAUTIONS BEFORE USE

Precautions

2.1. The following precautions apply to the operation of the HRV.

2.2. Before starting the vehicle it is necessary for operators to check and ensure that:
   a. the PTO is disengaged and transmission is in the neutral position prior to starting vehicle, and
   b. the recovery system switches in the R/H Control Locker are in the ‘OFF’ position and free from obstruction.

2.3. Before operating the crane it is necessary for operators to check and ensure that:
   a. the air system is at normal operating pressure prior to engaging PTO for crane operation otherwise damage to PTO will occur, and
   b. the overload and function test is conducted on radio control unit and crane prior to operation.

2.4. Before winching it is necessary for operators to check and ensure that:
   a. the air system is at normal operating pressure prior to engaging PTO for winch operation otherwise damage to PTO will occur, and
   b. the free spool device is fully engaged and winch rope is correctly laid (refer to Para 3.9) prior to operation.

2.5. Before lift tow operations it is necessary for operators to check and ensure that:
   a. the air system is at normal operating pressure prior to engaging PTO for lift tow operation otherwise damage to PTO will occur, and
   b. the tow cylinders are fully retracted and casualty is at height appropriate to road conditions prior to towing casualty.
2.6. Before leaving the vehicle it is necessary for operators to check and ensure that:

a. the PTO is disengaged, and

b. the recovery systems and equipment are correctly stowed prior to leaving vehicle.
CHAPTER 2
PREPARATION

Preparation for Transportation

2.7. When preparing the HRV for transportation by any means, the following actions must be carried out:
   a. The rear suspension is to be deflated.
   b. The cabin air bags are to be deflated and the level adjustment rod secured.
   c. The rear vision mirrors are to be folded in.
   d. The air cleaner intakes are to be sealed.
   e. The cabin windows are to be raised.
   f. The exhaust is to be covered and taped.
   g. The ladder extension handles are to be lowered.

2.8. If height reduction is a requirement then the following actions must also be carried out:
   a. The air cleaner air horns are to be removed and the air intakes covered and taped.
   b. The rotating/work lights are to be removed and the blanking plugs placed in the sockets.

Cabin Air Bag Deflation

2.9. The cabin air bags can be deflated by removing the two level adjustment rods from their lower connection points. Refer to Figure 2-1. Allowing the rods to hang will cause the suspension to deflate, causing the cabin sub-frame to settle onto the bump stops. There is one level adjusting rod on each side of the HRV cabin.

2.10. When reconnecting the control rod after transportation, be sure to press against the rubber insert to prevent it being forced out of the control rod end.
Figure 2-1  Cabin suspension level control rod (LH shown)
CHAPTER 3
SAFETY PRECAUTIONS

Vehicle Operation

HRV Access Points

2.11. Operator access points, other than normal cabin access doors, onto the HRV are limited to those shown in Figure 2-2. Operators are not to use any points other than those shown to access the HRV.

2.12. The shaded areas shown in Figure 2-2 are the limits of access on the upper surfaces of the HRV. Operators are not to climb onto or access any area of the cabin roof or any other area not shaded in Figure 2-2 except when necessary to clean the fresh air filter. When maintenance is required to the fresh air filter, operators are to access the cabin roof area using approved workstands, including safety harness.

2.13. A safety hazard exists between the cab step and the front mudguard. Operators are not to attempt use the cab entry steps to access the HRV bonnet.

Figure 2-2  HRV access points
Use of the Air Conditioner

2.14. Operators are to ensure that a reasonable amount of fresh air is supplied to the HRV cabin. The vehicle is not to be driven for extended periods with either the air conditioner or cabin heater running whilst the fresh air vent and windows closed. Operating for extended periods without fresh air will cause drowsiness and fatigue with a resultant risk of vehicle accident.

Head Strike Hazards

2.15. Head strike hazards exist around the towing hitch ‘T’ bar. Operators are to exercise caution when working around the ‘T’ bar to prevent possible injury when working in that area.

Spare Wheel Handling

2.16. Recognised manual handling techniques are to be applied when man handling the spare wheel. Where possible, the wheel should be handled by two people however if a second person is not available, extreme care is to be taken to prevent personnel injury.

Recovery System Operation

2.17. Always wear suitable leather gloves when handling recovery equipment, particularly steel wire rope to prevent injury to hands.

2.18. Recovery personnel must be safety conscious at all times, whether recovering or towing casualties, and ensure that only qualified and authorised personnel are permitted to operate the equipment controls.

2.19. All items of recovery equipment are to be inspected regularly and replaced if their serviceability is in doubt. Equipment that is not in good condition cannot be relied upon to withstand loads that may be placed on them. This includes lifting and towing gear that is an integral part of the HRV, i.e. cables, hooks, sheaves and pulleys.

2.20. On arrival at a casualty site, or at any extended halt, ensure that, suitable warning lights and signs are displayed or placed on the road and vehicles, in accordance with current road laws. Before moving off, the ‘ON TOW’ sign is to be attached to the casualty and lights checked for serviceability.

2.21. Recovery personnel are to be fully conversant with the system of hand signals detailed in EMEI MISC EQUIP O 011. Winch operators should have a clear, uninterrupted view of the crew commander at all times and where necessary, the casualty.
2.22. Handheld radios are to be utilised where visual contact is likely to be impeded.

2.23. Before commencing to pull a load ensure that:
   a. all slack in the winch tackle is taken up slowly until lightly tensioned;
   b. there are no loops or kinks in the winch rope(s) or chains;
   c. retaining pins must be uppermost, i.e. shackles, snatch blocks;
   d. wooden runners/rollers are to be placed under snatch blocks to eliminate ingress of dirt within the sheaves;
   e. all connections are secure and not liable to slip, causing ‘snatching’ or sudden strain;
   f. the rope is firmly wound on the winch drum(s) and that there are no loose coils of rope on the drum;
   g. when laying out tackle, there is not to be less than four coils of rope on the winch drum;
   h. the winch disengagement device plungers are fully engaged in the winch drive;
   i. the vehicle work brake is applied;
   j. that the earth spades are firmly engaged in the ground;
   k. all personnel are clear of the immediate area around the tackle to prevent injury in case of rope or tackle failure;
   l. a final visual inspection of all tackle and the HRV is carried out prior to conducting the winching operation; and
   m. ensure that the engine remote throttle control is set, engine speed should be 1500 rpm.

2.24. During winching operations on an incline do not allow personnel to stand or move into the area behind a casualty.

2.25. During winching operations do not allow personnel to stand within, or move into, the ‘V’ of the tackle.

2.26. Personnel are not to walk over ‘Live’ winch ropes or tackle.

2.27. Before operating the towing hitch, ensure that all personnel are clear of the towing hitch and/or the casualty to prevent potential crush injuries.
2.28. Do not work under any suspended load.

2.29. Before disconnecting a casualty, ensure that the vehicle park brake is applied and the casualty has its road wheels chocked.

2.30. When operating on the side of a road, warning signs are to be deployed, flashing lights operating and safety vests are to be worn unless operational requirements dictate otherwise.

2.31. When winching in or out with live ropes, the rope handling tools are to be used to guide or handle the winch rope(s). Operators are not to grasp live tackle by hand when winching.

**Lift Tow Casualty Considerations**

2.32. When lift towing vehicles, ensure that adequate preparation has been made for lift towing the specific vehicle type. Such preparation may include, but is not limited to any of the following actions:

a. drive shaft removal/disconnection;

b. chaining/security of suspension components;

c. referring to towing restrictions, i.e. forward/rearward, laden/unladen towing;

d. wheels and tyres checked for security and inflation;

e. checking brake connections;

f. checking security of ‘ON TOW’ sign and serviceability of lighting;

g. checking weight and loading on the towing hitch;

h. covering of the casualty air intake and exhaust openings;

i. casualty load checked for security;

j. casualty windows closed and mirrors turned in;

k. casualty steering lock disengaged for rear lift tow;

l. casualty steering properly secured for both front and rear lift tow;

m. inter vehicle air line connected where applicable;

n. consideration of use of trailer for transporting casualty; and

o. ensuring that safety chains are applied.
Crane Operation

2.33. **Before Operation.** To ensure that the crane is operated safely, observe the following instructions:

   a. Survey the surrounding area where the crane is to be operated to ensure safe working conditions.
   
   b. Set the HRV work brake to ON.
   
   c. The crane is to be operated by qualified and authorised personnel only.
   
   d. The access handrails fitted to the LH cabinet are to be fully lowered.
   
   e. The LH rotating/work light is to be removed.
   
   f. Safety devices are there for your protection and are not to be interfered with.
   
   g. The engine remote throttle control is set, engine speed should be 1500 rpm.
   
   h. Always operate the crane control systems with slow even pressures. Never jerk or suddenly release any control lever to stop a function. Always return the control to the neutral position in a smooth, even manner.
   
   i. The crane is not to be operated on a slope greater than 5°.
   
   j. Do not use the crane stabilisers to lift the vehicle.
   
   k. Always deploy the stabilisers before unfolding and using the crane.
   
   l. If support plates are used under the crane stabilisers ensure that they are suitable for the task.
   
   m. Ensure that all slings, shackles and the hook are correctly fitted.
   
   n. Exercise extreme caution when operating near any electrical power lines (minimum distance is six metres).
   
   o. Helmets and safety vests are to be worn when operating the crane.

2.34. **During Lifting Operations.** When carrying out lifting tasks, the following are to be observed:

   a. Exercise extreme caution when operating in confined spaces.
b. Never travel with a suspended load or with the crane boom protruding past the sides of the vehicle.

c. Never stand under a suspended load or between the load and the vehicle or some other immovable object.

d. Always use the shortest boom length possible for the task.

e. Always ensure that you observe the load while it is being moved. If you need to look in another direction, stop the operation immediately.

f. Use tag lines of natural fibre, 16 mm diameter when slewing loads.

g. Never slew a load if it has not been lifted clear of the ground or other surface.

h. Keep heavy loads as close as possible to the ground.

i. Ensure that the crane boom is kept at or greater than the minimum distances from any power lines. Unless otherwise stated, use six (6) metres as a minimum distance.

j. The crane operator is to have a clear view of the direction of travel of the slew and lift.

k. When changing position, mounting or dismounting the HRV and using the remote control, the remote control power is to be switched off.

l. The crane is not to be used to lift personnel.

m. The crane is not to be operated to perform any task considered ‘unsafe’ by the operator.

n. When working with a partner, hand signals must be used where verbal communications are not practicable. Refer to AS 2550 for commonly used hand signals.

2.35. **On Completion of Lifting Tasks.** On completion of lifting tasks and before moving the HRV, the following are to be observed and carried out:

a. the crane is to be correctly folded and stowed, including the stabilisers and stabiliser feet;

b. the PTO is to be disengaged;

c. refit the LH rotating/work light to the crew cab; and

d. the HRV work brake is to be released.
Handheld Radio Operation

2.36. When operating the handheld radios, the following safety precautions must be observed:

   a. when transmitting, hold the radio microphone 25 – 50 mm from your mouth;
   b. when transmitting, keep the antenna at least 25 mm from any part of your body, especially your face and eyes;
   c. turn off the radio where radio waves could interfere with electronic devices;
   d. turn off the radio whilst close to, or in, refuelling points;
   e. turn off the radio whilst in areas where detonator/explosives are being used;
   f. turn off the radio before boarding/leaving an aircraft and whilst on board an aircraft;
   g. do not use the radio whilst driving vehicles or operating machinery; and
   h. do not place the radio, battery or accessories in liquids as they will be damaged.

2.37. **Hazardous Atmospheres.** A hazardous atmosphere has the potential for fire and explosion from dusts, gases, liquids and solids. The radios are not to be used in hazardous atmospheres.

2.38. **Electromagnetic Interference.** Radio waves can interfere with electronic devices used by facilities such as hospitals, medical centres, aircraft and industrial facilities. The radios should not be used in such areas where electromagnetic interference could occur.

2.39. **Battery Replacement.** Do not attempt to install or remove batteries in hazardous atmospheres.
CHAPTER 4
OPERATING INSTRUCTIONS

NOTE
The information contained in this Chapter details the use and operation of the HRV equipment. Where applicable, warnings, precautions, cautions and limitations on the use of the equipment, where known, are included. This Chapter does not provide information on the application of general recovery or crane operating techniques.

For information on general recovery techniques, including warnings, precautions, cautions and limitations on equipment, refer to the Army Recovery Manual, EMEI’s and Recovery Training Précis.

For information on general crane operating techniques, including warnings, precautions, cautions and limitations on lifting equipment, refer to local instructions and technical documentation for the equipment to be lifted.

General

2.40. Proper operation determines the service life and operating economy of the vehicle. This includes, careful driving, normal road speeds, reasonable rates of acceleration and braking; also shifting in a manner to avoid shock loading and labouring.

2.41. Before attempting to operate the HRV or perform any function with it, all operators are to be familiar with the safety precautions included in Chapter 3.

Starting

2.42. Before Starting. Carry out first parade service as detailed in Sect 3, Chap 1.

2.43. Before Starting Engine. Ensure the parking brake is applied. Depress clutch pedal fully to disengage the clutch. Move gear shift lever to neutral.
2.44. **Starting Engine.** Start the engine as follows:

a. Turn the battery isolator ON to provide power to the vehicle electrical circuit.

b. Turn ignition switch ON so instruments will operate.

c. Check the PTO controls and disengage the PTOs if they are engaged.

d. With engine stop control pushed IN to running position, clutch pedal fully depressed and accelerator pedal approximately half way, engage air starter.

e. When starting vehicle with no air registering on gauges, the hand throttle is to be pulled part way out approximately 15 mm or 4 to 5 turns counter clockwise.

f. Allow the air pressure to build to the correct operating pressure.

g. Ensure the hand throttle is pushed fully in before moving vehicle.

**NOTE**

Before shutting down and parking ensure air pressure is at maximum 830 kPa.

The turbocharger operates at high speeds, therefore lubrication at start up and shutdown is of primary importance. Any excessive engine speed immediately after starting up, can damage the turbocharger. Likewise, when preparing to shutdown after a long haul, idle engine for three minutes to ensure that the turbocharger is rotating slowly. This idling period also dissipates excess heat build up, preventing early turbocharger failure.

If necessary to idle for extended periods, set at fast idle, about 800 rpm with hand throttle. Unnecessary idling for long periods of time wastes fuel, fouls injector nozzles and unburned fuel causes carbon formation, glazing of cylinder bores and oil dilution.
NOTE

Never race an engine during warm-up period. Never operate engine beyond governed speed (as in downhill overrun operation). Engine bearings, pistons and valves will be damaged if these precautions are not taken.

To aid starting in sub-zero temperatures, use the hand throttle as described Para 1.141, allowing the engine to fast idle (max. 1300 rpm) for several minutes before returning the hand throttle to normal idle position.

Moving Off

2.45. Prior to moving off, ensure that:
   a. the front bumper bar steps are raised and secured;
   b. the rear air bag suspension is inflated;
   c. rear vision mirrors are correctly adjusted;
   d. seat belts are on and securely buckled;
   e. all external equipment is secured;
   f. all lockers are correctly closed, including crew cab door;
   g. crane and crane stabiliser legs are correctly stowed;
   h. winch ropes are secured to the rear towing eyes; and
   i. when travelling unladen the lift ram is fully raised and the LED tail lamp is in place and operating.

2.46. Place the vehicle in motion as details below:

   NOTE

   Allow the engine to reach operating temperature before moving off.

   a. With the engine running, apply the service brakes then release the parking brakes.
   b. Ensure that the range selector is down in the LO range position.
   c. Depress the clutch pedal fully to the floor to engage the clutch and the clutch brake.
d. Move the gear shift lever into the first or second shift position depending on load and terrain conditions.

**CAUTION**

If the spring brake warning light is on indicating rear brakes are not released, do not attempt to move the vehicle as drive line damage will result.

e. Engage clutch smoothly by releasing clutch pedal. At the same time, push accelerator down as necessary for the engine to move the vehicle.

f. If towing a casualty with inter-vehicle air line connections in place, actuate the trailer brake control to test the casualty brakes. If possible, rectify any braking defects before proceeding.

**CAUTION**

Never allow the foot to ride the clutch pedal with clutch engaged – this causes premature release bearing failure and short clutch facing life.

g. As the vehicle gains speed, continue shifting until cruising speed is reached and the transmission is in the highest gear possible with engine in the normal operating range, remembering that ‘double-clutching’ is required at all times. The transmission shift pattern is shown in Figure 2-3.

![Transmission shift lever positions](image-url)

Figure 2-3 Transmission shift lever positions
 Range Selection. Range selection is made by using the range selector incorporated into the gear shift lever. HI and LO ranges are selected as shown in Figure 2-4.

Pre-select all range shifts when upshifting or downshifting. Pre-selection requires that the range selector is moved to the needed position before starting the lever shift. Pre-selected range shifts are completed automatically as the lever is moved through neutral and into the next gear. Pre-selecting all range shifts prevents damage to the transmission and provides for smoother shifts.

When driving the vehicle, the following operating tips should be noted:

1. Always select an initial starting gear that provides sufficient reduction for the load and terrain.
2. Always use normal double-clutching procedures when making lever shifts.
3. Never slam or jerk the shift lever to complete gear engagements.
4. Never coast with the shift lever in the neutral position.
5. Never move the range selector with the shift lever in neutral while the vehicle is moving.
6. Never make a range shift while moving in reverse.
7. Never downshift at too high of a road speed.
k. **Upshifting.** Move the shift lever, double-clutching, to the next desired gear position in LO range.

l. **Range Shift.** When in last gear position for LO range and ready for the next up shift, pull up the range selector and move the shift lever, double-clutching, to the next higher speed position according to your shift pattern. As the shift lever passes through neutral, the transmission will automatically shift from LO to HI range.

**NOTE**

If after attempting a range shift to HI the transmission remains in neutral with the shift lever in gear, the range synchronizer protection device may be activated. Move the shift lever into neutral to allow the range shift to complete and then, move the shift lever back into gear.

m. **Downshifting.** Move the shift lever, double-clutching, to the next desired gear position in HI range. To carry out a range shift from HI Range to LO Range (6th to 5th):

1. While in 6th and ready for the next downshift, pre-select LO range by pushing the range selector down.

2. Move the shift lever, double-clutching, to the next desired gear position in LO range. As the shift lever passes through neutral, the transmission automatically shifts from HI range to LO range.

3. Continue downshifting, double-clutching to the next desired gear position in LO range.

n. **Clutch Brake.** A clutch brake is mounted on the primary shaft of the transmission and is connected to the clutch discs. The action of the clutch brake overcomes the tendency of the clutch discs to continue to rotate at high speed when the clutch is disengaged. The clutch brake operates on the last 25 mm of pedal travel, and is to be used for gear engagement only while the vehicle is stationary. ‘Double-clutching’ should be used on all shifts (refer to Figure 2-5).
The E6-320 engine operating range is 1300 to 2100 rpm. It is not possible to make a clean downshift before the engine rpm drops to 1200 to 1400 rpm. Downshifting above this engine speed may result in engine over speed and possible engine damage. On an up shift, the engine rpm should be allowed to drop to 1400 to 1500 rpm before engaging the higher gear.

Good Driving Habits

2.47. Engine Temperature. Before entering high speed traffic conditions, allow the engine to reach operating temperature. Normal temperature is between 80 to 85°C. Do not remove the radiator pressure cap or add coolant when the engine is overheated.

2.48. Instruments. Glance at the instruments frequently. When trouble is indicated, take prompt action to correct the problem.

2.49. Clutch. To avoid damage, engage the clutch without ‘shock loading’ the drive line, especially on grades when loaded. Do not ride the clutch pedal.

2.50. Shifting. Avoid gear clashing by synchronising the engine and vehicle speeds. Do not permit the load to drive the engine above the governed speed. Use the correct gear to suit vehicle speed and loads. Use same the gear to travel downhill as you would uphill.
2.51. **Braking.** Avoid sudden stops. When stopping on slippery surfaces, alternately and smoothly apply and release the brakes to prevent skidding. When slowing for a stop, leave the clutch engaged as long as possible to utilize the braking effect of the engine. Disengage the clutch when the engine rpm has dropped to a little above idling speed.

2.52. **Braking with Dynatard (engine brake).** When travelling downhill, select a gear to allow the weight of the vehicle to be held by the engine brake without excessive use of the service brakes. (DO NOT EXCEED 2100 rpm).

2.53. **Stopping the Engine.** After a hard run, allow the engine to idle for three minutes before shut-down in order to stabilise the temperature of all engine parts, particularly the turbocharger.

2.54. **Parking.** When parking the vehicle:
   a. apply the parking (emergency) brake,
   b. leave the transmission in neutral, and
   c. leave the engine stop control in the OUT (engine stopped) position.

2.55. Check the parking brake frequently to ensure it is adjusted to lock and hold the vehicle when parked. Do not use it for braking the vehicle when in motion except in an emergency.

**Emergency Procedures**

2.56. **Starting (no air).** Before attempting emergency starting set the parking brake and rectify the cause of the fault. If the air start reservoir is empty and another vehicle is not available, the vehicle may be started by utilising the air charging hose to supply air to the air start reservoir from the tyres fitted to the vehicle, using the air hose provided and the air start tank air coupling located above the driver’s steps. Refer to Figure 2-6.
   a. The air start reservoir should be charged with air from at least four tyres.
   b. Ensure the tyres are inflated as soon as the vehicle is re-started.
   c. When this operation is necessary, it is suggested that the four inner tyres of the rear duals be used.
d. Air supply is also available from the tyre inflation point connected to the brake system. Providing the brake system is charged to operating pressure, sufficient air should be available to charge the air start reservoir. The tyre inflation coupling is located on the leading side of the passenger access steps. Refer to Figure 2-7.
2.57. **Starting (flat batteries).** If the vehicle has flat batteries, it is possible to start the engine by manually actuating the air start solenoid. Refer to Figure 2-8.

a. Set parking brake and place the gear lever in the neutral position.

b. Set the engine stop control to the RUN position.

c. Turn the ignition switch to the ON position.

d. Set the hand throttle (4 to 5 turns counter clockwise) minimum.

e. Insert a suitable implement in the air solenoid in the position marked by the arrow in Figure 2-8 and push in. This solenoid is located under the passenger floor above chassis rail. It can be accessed by pulling back the rubber flap inside the LHF mudguard.

f. The engine should now start.

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Figure 2-8  Air start solenoid
2.58. **Service and Trailer Brakes.** In the event of brake system failure, the actions required are detailed below.

a. **Loss of Primary Air Supply.** Loss of the primary air system (to the rear brakes) leaves the vehicle with the secondary front brake system operational. This condition will produce a ‘low pressure’ indication by buzzer and warning light. A brake application makes the spring brake control valve responsive to the secondary signal system. The valve will respond by automatically modulating the rear spring brakes.

   ACTION REQUIRED. Confirm by visual observation of the dual pressure gauge that the primary air supply has failed (green needle). Move the vehicle with extreme care to the nearest safe parking area and affect repair or recovery.

b. **Loss of Secondary Air Supply.** Loss of the secondary air supply will be observed on the dash mounted dual pressure gauge (red needle) and indicates that the front brakes are not serviceable.

   ACTION REQUIRED. Proceed to the nearest safe parking area with extreme caution, and affect repair or recovery.

c. **Loss of Both Primary and Secondary Air Supply.** Loss of both primary and secondary air supply will result in automatic application of the spring brakes and trailer/casualty brakes.

   The reserve air supply should now be activated.

   (1) Push the reserve air button in.

   (2) Release park brake (if already engaged).

   (3) If a trailer is attached, push the tractor protection switch in and hold until the trailer brakes are released, thus allowing the button to stay in and releasing the trailer brakes.

   (4) Vehicle braking is now controlled by the park brake control (emergency brake) or the hand control if a trailer is attached.

   ACTION REQUIRED. The vehicle should not be moved, except when it is an obstruction to traffic and then only moved sufficiently so as not to cause an obstruction. Seek repair or recovery action.
d. Complete Air Brake System Failure (i.e. a total loss of air from the primary, secondary and reserve air systems). A total air brake system failure will result in the immediate application of the spring brakes on the vehicle and trailer/casualty (if fitted or towed). The spring brakes cannot be released in the manner described in Para 2.58c.

ACTION REQUIRED. The spring brakes must be released by the following method.

**WARNING**

The following procedure will result in the vehicle having NO brakes and if not followed correctly the vehicle may move out of control causing death or injury. The vehicle should be recovered to a safe working area.

1. If the vehicle is to be towed, ensure that it is securely connected to the towing vehicle.
2. Chock all wheels to prevent the vehicle moving using any suitable means available.
3. Remove the rubber cap from the compression spring chambers.
4. Remove the release stud from the brake chamber side pocket and insert it into the pressure plate receptacle within the compression spring chamber.
5. Turn the release stud a quarter of a turn to seat the cross pin into the pressure plate receptacle.
6. Refit the nut to the stud and turn it with a spanner until the compression spring is caged.
7. Repeat this operation at the other wheels, releasing all spring brakes. Refer to Figure 2-9.
Changing a Wheel

**WARNING**

Wheel nuts may loosen after initial tightening, therefore it is mandatory to retighten the wheel nuts after travelling approximately 50 km to reduce the risk of death or injury.

2.59. To replace a flat tyre with the spare wheel proceed as follows:

**NOTE**

Before proceeding with changing the wheel, ensure that the vehicle is on flat, level ground and not obstructing traffic.
a. Remove the spare wheel from its stowage position on the tailgate. The spare wheel has a lift adaptor plate that allows the wheel to be easily lifted with the vehicle mounted crane. Refer to Figure 2-10. The crane is to be operated as stated under Crane Operation.

![Figure 2-10 Using the crane to lift the spare wheel](image)

b. Remove the hydraulic jack and handle, the base plate, wheel brace and lever, and the two blocks of wood from the tool box.

**NOTE**

Wheel nuts on the passenger side of the vehicle have left-hand threads and those on the driver's side have right-hand threads.

c. Place a block of wood in front of the wheel, then start vehicle and drive the wheel on to the block of wood.

d. Apply the parking brake and install chocks to a wheel not being removed.

e. Place the jack base plate on the ground beneath the axle from which the flat tyre is being removed. Place the second block of wood on the baseplate and install the jack on top of the wood (refer to Figure 2-11) and install directly under the axle.
f. Install the jack handle and pump the jack up to raise the axle until the wheel is clear of the block of wood.

g. Loosen the wheel nuts on the wheel with the flat tyre using the wheel brace and lever.

**NOTE**

Ensure the jack is secure before attempting to remove the wheel from the axle.

h. Remove the block of wood.

**WARNING**

Correct manual handling techniques must be employed when handling the HRV wheels to prevent personal injury.

i. Remove the wheel nuts and remove the wheel from the hub (refer to Figure 2-12).
j. Position the replacement wheel on the hub and fit the wheel nuts.

k. Tighten the wheel nuts in the correct sequence (diagonally opposite) to ensure that the wheel is centred on the axle. Wheel nuts are to be torqued to 645 N.m (474 lbs ft) as per EMEI Vehicle G 799-26.

l. Check that everything is clear from under the vehicle, then lower the axle by opening the pressure relief valve located in the base of the jack, until the wheel rests on the ground.

m. Remove the jack, block of wood and baseplate from under the vehicle.

n. Remove the wheel chocks.

o. Lift the wheel with the flat tyre onto the wheel carrier using the crane and wheel lift adaptor. Secure it in place. (Refer to Figure 1-18.)

p. Stow the crane in the travel position.

q. Stow all tools and equipment in the tool box.
NOTE
The use of the blocks of wood applies mainly to the front wheels. However, if an outer wheel on the rear bogie needs replacing, an acceptable time saving method is to run the inner wheel of that axle onto a block of wood. In so doing the outer wheel is lifted clear of the ground facilitating the removal of the wheel. If an inner wheel needs to be replaced, the axle will have to be lifted by means of the hydraulic jack. After replacing the wheel, recheck the tightness of the wheel nuts after travelling the next 40 km. Before checking inner rear wheel nuts on dual wheels, it is essential to loosen the outer wheel nuts. After tightening the inner wheel nuts, retighten the outer nuts which must be rechecked after a further 40 km.

Air Suspension

2.60. The HRV rear suspension can be deflated to aid in stability of the vehicle during recovery operations and use of the crane. Deflate the rear suspension by actuating the suspension control switch located under the RH side of the HRV dash panel. Refer to Figure 1-48. The rear suspension must be inflated before moving the HRV.

Air Conditioning

General

2.61. Proper operation and care will determine the service life and operating economy of this equipment. This includes correct and timely operator servicing, inspections and reporting of defects.

WARNING
This air conditioning system contains R134a refrigerant under pressure. Do not tamper with it. If problems do develop, consult an authorised service agent.
Operation

Fresh Air Intake

**WARNING**

The air conditioner recirculation mode should not be used for prolonged periods of time. Using fresh air mode will reduce the build up of carbon dioxide in the cabin and prevent bacteria build up in the evaporator coil fins.

**2.62.** Ignition power and engine rotation are essential ingredients for the operation of the air conditioning system. To operate the system, proceed as follows (refer to Figure 2-13):

a. Turn the FAN switch to the desired blower speed (1, 2 or 3).

Figure 2-13  Air conditioning system control panel
b. Adjust the TEMP switch to the desired temperature. It will take a few minutes, depending on the outside ambient temperature, for the cabin temperature to stabilise.

c. Select the appropriate fresh air mode by selecting the OPEN (fresh) or CLOSED (recirculation) setting using the fresh air intake control. The OPEN setting will allow the intake of fresh air through the roof mounted flap. Further adjustment of the TEMP control may be necessary.

d. Adjust the overhead directional air vents to direct the air through the cab as required.

**Performance Tips**

2.63. The following tips will assist in gaining optimum efficiency from the air conditioning system:

a. If the vehicle is parked in the sunlight on a hot day for a long period, the cabin temperature may be extremely high. To cool the interior quickly, carry out the following procedure:

   (1) Open the windows to exhaust the hot air.

   (2) Operate the air conditioning system with maximum fan speed and cooling.

   (3) When the temperature has cooled sufficiently, close the windows and operate the system in recirculation mode until the desired temperature is reached.

   (4) Adjust the fan speed and temperature controls as desired.

b. To maintain maximum cooling, all windows should be closed.

c. Operate the system in FRESH mode as much as possible. This will help prevent odours by minimising bacteria forming residue from accumulating on the evaporator coil fins.

d. The air conditioning system, when used conjointly with the vehicle's heating system, will provide dehumidified warm air for demisting the windows.
Tropical/High Humidity Conditions

2.64. If the air conditioning system is operated in tropical or high humidity conditions, some excess water may be retained in the drain tray and may need to be 'released' periodically to ensure correct operation and drainage. If this does occur, reduce the blower fan speed (fan speed 1) or turn the fan off for approximately 30 seconds to allow excess water condensation to drain from the evaporator drain tray.

CD Player and AM/FM Tuner

2.65. Head Unit. The functions of the controls located on the head unit are described in Table 2-1 and shown in Figure 2-14.

![Radio / CD player control panel](image)

Figure 2-14 Radio / CD player control panel

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CLOCK Button</td>
</tr>
<tr>
<td></td>
<td>Press to change the clock display.</td>
</tr>
<tr>
<td>2.</td>
<td>EJECT Button</td>
</tr>
<tr>
<td></td>
<td>Press to eject a CD.</td>
</tr>
<tr>
<td>3.</td>
<td>AUDIO Button</td>
</tr>
<tr>
<td></td>
<td>Press to select the various sound quality controls.</td>
</tr>
</tbody>
</table>
### Table 2-1  Radio / CD Player Control Panel (Continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>▲/▼/◄/► Buttons Press the required button for manual tuning, fast forward, reverse and track search controls. These buttons are also used for controlling functions.</td>
</tr>
<tr>
<td>5.</td>
<td>BAND Button Press this button to select any one of the three FM bands or one AM band and to cancel the control mode of functions.</td>
</tr>
<tr>
<td>6.</td>
<td>DETACH Button Press this button to release the front panel.</td>
</tr>
<tr>
<td>7.</td>
<td>LOUDNESS Button Press this button to switch loudness ON or OFF.</td>
</tr>
<tr>
<td>8.</td>
<td>LOCAL/BSM Button Press this button to switch local function ON or OFF.</td>
</tr>
<tr>
<td>9.</td>
<td>1-6 Buttons Press the desired button to select pre-programs/tuning.</td>
</tr>
<tr>
<td>10.</td>
<td>SOURCE Button Press this button to switch the unit ON and to cycle through all available sources.</td>
</tr>
<tr>
<td>11.</td>
<td>VOLUME Press this button to increase or decrease the volume.</td>
</tr>
<tr>
<td>12.</td>
<td>EQ Button Press this button to select the various equalizer curves.</td>
</tr>
</tbody>
</table>

### Switching On/Off

**WARNING**

Do not adjust radio/CD player settings whilst driving otherwise accidents causing personal injury or death may result.

2.66. Press the SOURCE button to switch the unit on.
2.67. Press and hold the SOURCE button down until the unit switches off.

**Adjusting Initial Settings**

2.68. Initial settings allows you to perform initial settings for the unit as follows:

   a. setting the clock,
   b. setting the FM tuning step, and
   c. setting the AM tuning step.

2.69. To make initial settings, select the setting required for changing as follows:

   a. Press the AUDIO button and hold it until ‘CLOCK’ appears in the display.

   b. Press the AUDIO button repeatedly to switch between the following settings:

      (1) Clock,

      (2) FM 100 (FM tuning step), and

      (3) AM 9 (AM tuning step).

2.70. To cancel the settings, press the BAND button or by holding the AUDIO button down until the unit switches off.

2.71. **Setting the Clock.** Set the clock as follows:

   a. Press the AUDIO button repeatedly until ‘CLOCK’ appears in the display.

   b. Press ◀ or ► to select on segment of the clock display, either Hour or Minute. As segments of the clock display are selected, they will begin to blink.

   c. Press ▲ or ▼ to set the clock. Pressing ▲ will increase the value and pressing ▼ will decrease the value.

2.72. To turn the clock display on or off, press the CLOCK button. Each press of the CLOCK button will switch the clock display ON or OFF.
2.73. **FM Tuning Step.** The FM tuning step can be switched between 100 mHz (preset) and 50 mHz. Set the FM tuning step as follows:

**NOTE**

If seek tuning is performed in 50 kHz steps, stations may be tuned in imprecisely. Tune in the stations with manual tuning or use seek tuning again.

a. Press the AUDIO button repeatedly to until ‘FM 100’ appears in the display.
b. Press ◀ or ▶ to select the FM tuning step. The selected tuning step will appear in the display.

2.74. **AM Tuning Step.** The AM tuning step can be switched between 9 kHz (preset) and 10 kHz. Set the FM tuning step as follows:

a. Press the AUDIO button repeatedly to until ‘AM 9’ appears in the display.
b. Press ◀ or ▶ to select the AM tuning step. The selected tuning step will appear in the display.

**Selecting a Source**

**NOTE**

If there is no CD in the unit, the source will not switch to the CD player.

2.75. Inserting a CD into the CD player will automatically set the source to the built-in CD player.

2.76. To switch between the CD player and the tuner, press the SOURCE button.

**Audio Adjustments**

2.77. The Tuner/CD Player has facilities to control the audio output of the unit. When making audio adjustments, the display panel will appear similar to that shown in Figure 2-15.

2.78. To set the audio functions press AUDIO repeatedly to switch between the following audio functions:

a. FAD – balance adjustment;
b. EQ – equaliser;
c. LOUD – loudness;
d. FIE – front image enhancer; and
e. SLA – source level adjustment.

2.79. **FAD/BAL – Balance Adjustment.** FAD should be set to ‘0’ as the vehicle does not have rear speakers installed. Press ◀ or ▶ to adjust the balance between the LH and RH speakers. When setting the balance between left and right, the display will change to ‘BAL’. BAL L9 – BAL R9 is displayed as the balance moves from left to right.

2.80. **EQ – Equaliser.** There are six stored equaliser curves that can be recalled at any time. These are listed in Table 2-2. Press EQ to select the equaliser. Pressing EQ repeatedly will switch between the six listed equaliser curves.

### Table 2-2 Equaliser Curves

<table>
<thead>
<tr>
<th>Display</th>
<th>Equaliser Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPR-BASS</td>
<td>Super bass</td>
</tr>
<tr>
<td>POWERFUL</td>
<td>Powerful</td>
</tr>
<tr>
<td>NATURAL</td>
<td>Natural</td>
</tr>
<tr>
<td>VOCAL</td>
<td>Vocal</td>
</tr>
</tbody>
</table>
Table 2-2  Equaliser Curves (Continued)

<table>
<thead>
<tr>
<th>CUSTOM</th>
<th>Custom. An equaliser curve you can create</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ FLAT</td>
<td>Flat. When selected, no supplement or correction is made to the sound. Can be used to check the effect of equaliser curves by switching alternatively between EQ FLAT and a set equaliser curve.</td>
</tr>
</tbody>
</table>

2.81. You can adjust the currently selected equaliser curve setting as desired. Adjusted equaliser curves are memorised in CUSTOM. To adjust an equaliser curve:

a. Press AUDIO to select EQ. Press AUDIO until ‘EQ’ appears in the display.

b. Press ▼ or ► to select the audio band to adjust. Each press of < or > selects equaliser bands in order of EQ-L (low) – EQ-M (mid) – EQ-H (high).

c. Press ▲ or ▼ to adjust the level of the equaliser band. Each press of the button(s) increases or decreases the level of the equalisation band. +6 to -6 is displayed as the level is increased or decreased.

d. Select another band and adjust as desired.

NOTE

If you make adjustments when a curve other than CUSTOM is selected, the newly adjusted curve will replace the previous curve. Then a new curve with ‘CUSTOM’ appears on the display while selecting the equaliser curve.

2.82. You can make fine adjustments to the centre frequency and the Q factor curve (curve characteristics) of each currently selected curve band (EQ-L/EQ-M/EQ-H). Refer to Figure 2-16. Adjust the curve as follows:

a. Press AUDIO and hold until frequency and the Q factor (eg, ‘F-80 Q 1W’) appears in the display.

b. Press AUDIO to select the desired band for adjustment. (Low – Mid – High).
c. Press ▲ or ► to select the desired frequency as shown in Table 2-3.

Table 2-3  Fine Adjusting Frequency Curve

<table>
<thead>
<tr>
<th>Level</th>
<th>40 – 80 – 100 – 160 (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid</td>
<td>200 – 500 – 1k – 2k (Hz)</td>
</tr>
<tr>
<td>High</td>
<td>3k – 8k – 10k – 12k (Hz)</td>
</tr>
</tbody>
</table>

d. Press ▲ or ▼ to select the desired Q factor. Continue pressing the button until Q factor appears in the display – 2N – 1N – 1W – 2W.

**NOTE**

If you make adjustments when a curve other than CUSTOM is selected, the newly adjusted curve will replace the previous curve. Then a new curve with custom appears on the display while selecting the equalizer curve.

2.83. **Loudness.** Loudness compensates for the deficiencies in the low and high sound ranges at low volume. To switch loudness on:

a. Press the AUDIO button until ‘LOUD’ appears in the display panel.

b. Press ▲ to turn loudness on.

c. Press ◄ or ► to select the desired level. Each press of ◄ or ► selects the level in the order of LOW – MID – HIGH.
2.84. Front Image Enhancer (FIE). The FIE function is a simple method of enhancing front imaging by cutting mid and high range frequency output from the rear speakers, limiting their output to low-range frequencies. The FIE function is not useable in this application as the vehicle does not have rear speakers fitted.

2.85. Adjusting Source Levels. Source level adjustment allows you to adjust the volume of each source to prevent radical changes in volume when switching between sources. Settings are based on the FM tuner volume level which remains unchanged. To compare the FM tuner volume level of the source you wish to adjust:

a. Press AUDIO until ‘SLA’ appears in the display.
b. Press ▲ or ▼ to adjust the source volume. ‘SLA +4’ to ‘SLA -4’ is displayed as the source volume is increased or decreased.

2.86. The AM tuner volume may also be adjusted with source level adjustments.

Using the Tuner

2.87. When using the tuner, the display panel will appear similar to that shown in Figure 2-18.

2.88. Tuning. Tune the Radio as follows:

a. Press SOURCE to select the radio.
b. Use the VOLUME control to set the sound level.
c. Press the BAND button to select the required band, either F1, F2, F3 or AM.
d. To manually tune the radio, press either ◄ or ► with quick releases to adjust the frequency up or down by steps.
e. To perform seek tuning, press and hold down the ◄ or ► buttons for about one second and release. The tuner will scan the frequencies until a signal strong enough to provide good reception is found. Seek tuning may be cancelled at any time by quickly pressing and releasing ◄ or ►.

2.89. Preset Frequencies. You can store up to six broadcast frequencies for each band in the tuner. To store a frequency in memory press a preset tuning button until the preset number stops flashing. The number selected will flash in the preset number indicator and then
remain lit. The next time that button is pressed, the frequency will be recalled from memory.

2.90. **Tuning Strong Signals.** Local seek tuning allows you to tune in only those radio stations with sufficiently strong signals for good reception. To select local tuning, press the LOCAL/BSM to switch local tuning on. ‘LOCAL’ will appear in the display panel. Pressing LOCAL/BSM again will switch local seek tuning off.

2.91. **Storing Strongest Frequencies.** (Best Stations Memory) BSM allows you to store the six strongest broadcast frequencies under the preset tuning buttons 1-6. Pressing any one of the preset buttons will then select the frequency stored under that button. Store the best local stations as follows:

**NOTE**

Storing broadcast frequencies with BSM may replace broadcast frequencies you have saved using the 1-6 buttons.

a. Press LOCAL/BSM and hold until BSM turns ON. BSM will begin to flash. Whilst BSM is flashing the six strongest broadcast stations will be stored under the preset tuning buttons in order of signal strength. BSM will cease to flash when the process is finished.

b. To cancel BSM, press LOCAL/BSM.

**Using the CD Player**

2.92. Operate the CD player as follows:

**NOTE**

The CD player will play one standard 12 cm or 8 cm (single) CD at a time. Do not use any adaptors when using 8 cm CDs.

If you cannot insert a CD completely, or if after insertion, the CD does not play, check that the label side of the CD is up.

If the CD player does not operate properly, an error message may be displayed. Refer to Table 2-4.
Do not insert anything other than a CD into the CD loading slot.

a. Insert a CD into the CD loading slot and apply light pressure until the player accepts the CD. Refer to Figure 2-17. When using the CD player, the display will appear similar to that shown in Figure 2-18.

b. After a CD has been inserted, press the SOURCE button to select the CD player.

c. Adjust the VOLUME control to adjust the sound level.

Figure 2-17  CD loading slot

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Track Number Indicator  Shows which track the CD player is currently playing.</td>
</tr>
<tr>
<td>2.</td>
<td>Play Time Indicator     Shows the elapsed playing time of the current track.</td>
</tr>
</tbody>
</table>

Figure 2-18  CD player display panel
d. Press and hold ◀ or ► to perform fast forward or reverse.

e. Press ◀ or ► to back or forward to another track. Pressing ► skips to the start of the next track, pressing ◀ skips to the start of the current track. Pressing ◀ once again will skip to the start of the previous track.

f. To play tracks in random order, press the 4 button. ‘RDM’ will appear in the display. Pressing 4 again will turn random play off.

g. To repeat a track, press the 5 button. The selected track will play repeatedly until REPEAT is turned off. Press 5 again to switch repeat off.

**NOTE**

Performing a track search or fast forward/reverse will automatically cancel repeat play.

h. To pause the CD playback, press the 6 button. ‘PAUSE’ will appear in the display panel. Press 6 once again to resume playing.

### Table 2-4 CD Player Error Messages

<table>
<thead>
<tr>
<th>Message</th>
<th>Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERROR-11, 12, 17,30</td>
<td>Dirty disc</td>
<td>Clean disc.</td>
</tr>
<tr>
<td>ERROR-11, 12, 17,30</td>
<td>Scratched disc</td>
<td>Replace disc.</td>
</tr>
<tr>
<td>ERROR-11, 12, 17,30, A0</td>
<td>Electrical or mechanical fault</td>
<td>Turn the ignition ON and OFF, or switch to a different source, then back to the CD player.</td>
</tr>
<tr>
<td>ERROR-44</td>
<td>All tracks are skip tracks</td>
<td>Replace disc.</td>
</tr>
</tbody>
</table>
Closed Circuit TV

2.93. The closed circuit TV (CCTV) system consists of a single 150 mm screen located in the LH dash panel and two cameras located on the rear of the recovery system. Refer to Figure 2-19 and Figure 2-20.

Figure 2-19  Closed circuit TV monitor

Figure 2-20  Closed circuit TV camera
Operation

2.94. The CCTV system control switches provide the functionality as shown in Figure 2-21 and Table 2-5.

![CCTV operating controls](image)

**Figure 2-21  CCTV operating controls**

**Table 2-5  CCTV Screen Control Functionality**

<table>
<thead>
<tr>
<th>Item</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Brightness Control.</strong> The brightness is automatically adjusted when set to AUTO (button out). When the button is in, the screen stays at a fixed brightness level.</td>
</tr>
</tbody>
</table>
| 2.   | **Exposure Switch.** Pressing this switch will improve the screen image under the following conditions:  
  a. When glare makes the image hard to see in daylight.  
  b. When darkness makes the image hard to see at night.  

Releasing the button causes it to return to the NORMAL position. |
Table 2-5  CCTV Screen Control Functionality (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td><strong>Light Sensor.</strong> This sensor detects the surrounding light level. Do not block or tamper with this sensor and hole. Poking tools or other objects into this sensor hole may damage the equipment.</td>
</tr>
<tr>
<td>4.</td>
<td><strong>Camera Selection Switch.</strong> This switch selects the desired camera.</td>
</tr>
<tr>
<td>5.</td>
<td><strong>CAM/EXT Switch.</strong> Not used in this application. Allows selection of an external video image when utilised.</td>
</tr>
<tr>
<td>6.</td>
<td><strong>Brightness Control.</strong> Provided to adjust the brightness of the screen display if required.</td>
</tr>
<tr>
<td>7.</td>
<td><strong>Contrast Control.</strong> Provided to allow adjustment of the screen contrast is required.</td>
</tr>
<tr>
<td>8.</td>
<td><strong>ON-SB Switch.</strong> Switches the CCTV system on. Pressing the switch a second time will switch the system off.</td>
</tr>
</tbody>
</table>

**RECOVERY SYSTEM OPERATION**

**CAUTION**

Clean and lubricate the reversing sheave and shaft prior to winching in to prevent damage occurring to the chrome surface of the shaft otherwise rapid shaft and bush wear may be the result.

**CAUTION**

The snatch blocks used in the tackle are to be greased prior to operation (rotate sheave when greasing).
Preparation for Recovery

2.95. On arrival at the scene of the casualty, a reconnaissance of the terrain should be made to determine the placement of the HRV, method of rigging, anchor points available and allowances to be made when calculating the total pull required. The HRV should be positioned to avoid twisting stresses being placed on the HRV chassis and recovery system sub-frame. During static winching the HRV is to be positioned on level ground.

2.96. Operators are to conduct continual, visual inspections of all tackle used prior, during and after the recovery operation.

2.97. Spade legs are to be deployed during static winching with the exception of forward recovery and self recovery operations.

2.98. The work brake is to be applied at all times during recovery operations other than during self-recovery.

Engaging/Disengaging the Power Take-Offs (PTOs)

**CAUTION**

Do not drive the vehicle with the PTOs engaged otherwise damage may occur to the PTOs, hydraulic pumps and/or the hydraulic systems.

**CAUTION**

Ensure that the air system pressure is at normal operating pressure prior to engaging either PTO otherwise PTO drive gear damage may occur.

2.99. The two PTO's are engaged/disengaged by fully depressing the clutch pedal and by operating the respective control valves located at the base of, and to the RH side of, the drivers seat. The engaged/disengaged positions are illustrated in Figure 2-22.
Tackle Layouts

**WARNING**

The Sepson winches do not have excess load cut out on paying out. When paying out under load utilising multiple winches, compensation tackle must be utilised.

2.100. It is only by the intelligent use of tackle layout that heavy loads can be handled safely and efficiently. A thorough knowledge of the mechanics of rigging is essential to the recovery personnel.

2.101. All static winching operations are to be carried out with the HRV positioned on level ground.

2.102. Figure 2-23 and Figure 2-24 below illustrate examples of simple direct layouts using one winch as a service line and the other as a compensating line. The same layout is used on both sides of the HRV to stabilise the vehicle and ensure that loads and forces exerted are equal on each side.
Figure 2-23  Side winching – 1:1 tackle layout

Figure 2-24  Side winching – 2:1 tackle layout

2.103. Figure 2-25 and Figure 2-26 illustrate examples of a 2:1 and 3:1 direct layout with both winch ropes connected at the rear of the HRV.

Figure 2-25  Side winching – 2:1 tackle layout
2.104. Figure 2-27 and Figure 2-28 illustrate example layouts for a 2:1 layout to the rear of the HRV where either one or both ropes can be used as service lines.
2.105. Figure 2-29 illustrates an example 3:1 layout for forward, self-recovery where the LH winch rope is used as the service line.

2.106. On completion of self-recovery tasks the tackle is to be disconnected at the anchor point.

2.107. All rigging and tackle layouts used should be in accordance with recognised recovery principles and training. Information on the use of pulley or snatch blocks is contained in the Recovery Manual. The method of rigging for a particular task will depend upon terrain, weather conditions, availability of natural anchors, soil conditions, HRV stability and the type, size and mechanical condition of the casualty.

2.108. **Rope Departure Angles.** When winching a casualty from the rear or front, the HRV should be positioned so that the casualty can be recovered with a direct pull. If the HRV is positioned that a side pull is necessary, then a compensating tackle layout must be used. When using compensating tackle for side winching, the service and compensating lines are to be at even angles from the centreline of the HRV.
Exceeding a rope angle of 30° during forward self recovery will allow the rope to foul on the roller mounting brackets, resulting in possible equipment failure and serious injury to personnel.

2.109. When self recovering to the front, the maximum rope angle from centre shall be 30°.

Winching Out

Paying out the rope from the winch drum under power without applying tension to the winch rope may cause loose coils of rope on winch drum and subsequent rope damage.

2.110. Winching out under power will loosen the rope coils on the winch drum, risking damage to the rope, therefore this method of feeding out winch rope is not to be used where there is no load on the winch rope. The winch ropes should be pulled out by hand, or other means, with the winch drum free-wheeling. If over-running of the winch drum is experienced when despooling the rope, adjust the winch drag brake to prevent overrun.

2.111. In the event that there is a need to payout the rope under power, eg when there is a load on the rope, care is required as the load is removed from the rope to ensure that excessive loosening of the rope coils on the winch drum does not occur.

NOTE

The instructions as written below apply to the operation of each winch individually. If both winches are operated at the one time, then the instructions apply equally to each winch.

2.112. Paying Rope Out by Hand (free-spooling). To payout the rope by hand, use the following procedure:

a. Ensure that the rope tensioner is OFF.
b. Disengage the winch free-spooling device to allow the winch drum to free wheel.

c. Disconnect the rope end from its stowage position on the tailgate of the vehicle.

d. Draw the rope from the winch as required at walking pace only, ensuring that the rope is laid straight and will be free of twists and kinks.

2.113. Paying Rope Out Under Power. Paying out the winch rope under power should be carried out as follows:

a. Ensure that there is sufficient load on the winch rope to draw the rope from the winch as it is de-spooled.

b. Ensure that the rope tensioner is OFF.

c. Ensure that the free-spooling device is engaged.

d. Use winch handling tools to maintain tension on the rope (close to HRV, less effort required) whilst the rope is ‘live’.

e. The winch may be operated by using the control levers in either the LH or RH control cabinets or by using the remote control pendant.

Winching In

**WARNING**

Prior to any recovery tasks from rope layers 3 or 4 of the winch drum, the operator must ensure that the remaining layers have been laid under a minimum load of 1000 kg. Failure to comply may result in damage to the winch rope.

**WARNING**

Failure to visually ensure that the winch free-spooling device plunger is properly engaged may result in sudden free-spooling of the winch, causing equipment damage, death or injury.
Engaging the free-spooling device by pulling the winch rope by hand or operating above engine idle speed will cause damage to the despooling device engaging hole.

2.114. **Engaging the Free-spooling Device.** The free-spooling device is to be engaged as follows:

   a. Set the engine speed to idle.
   b. Set the free-spooling switch for the respective winch to engaged.
   c. Apply the rope tensioner for the respective winch.
   d. Engage the recovery system PTO if not already engaged.
   e. Slowly winch in until the free-spooling device is heard to engage in the winch gear ring or the rope is seen to move.
   f. Visually check the free-spooling device plunger to ensure that it is fully engaged. If not fully engaged, rectify the problem before carrying out winching operations.

2.115. **Winching in Under Load.** Before winching in under load, the following conditions for the winch are to be set:

   a. The rope tensioner is to be released.
   b. The free-spooling device is to be fully engaged.
   c. Set the winch operating mode. Select the required operating mode, i.e. Man. or Auto, using the selector lever on the respective winch hydraulic control blocks. The operating mode(s) are shown on the respective winch display panels.
   d. The winch may be operated by using the control levers in either the LH or RH control cabinets or by using the remote control pendant.
   e. The work brake is to be applied.
2.116. **Winching In – No Load.** When winching in, without load on the winch rope, it is necessary to ensure that the rope is placed under tension to ensure the correct lay of the rope on the winch drum. To winch in under no load conditions, the following conditions for the winch must be set.

   a. The rope tensioner is to be applied.
   b. The free-spooling device is to be fully engaged.
   c. The winch may be operated by using the control levers in either the LH or RH control cabinets or by using the remote control pendant.

2.117. Ropes are to be re-laid under a load of 1000 kg to ensure correct lay and prevent rope damage prior to conducting further recovery tasks.

**Winch Overload**

2.118. In the event that the winches are placed in an overload situation, the PLC will prevent further operation of the winch and the message ‘SYSTEM BLOCKED, SAFETY RELAY ON’ will appear on the respective winch display panel. When this occurs it will be necessary to reset the PLC as follows:

   a. Switch off power to the winch(s) at the respective PLC isolation switch. Refer to Figure 2-30.
   b. Switch power back on.
   c. Ascertain the cause of the overload and rectify.
   d. Check the condition of the winch cable and take appropriate action.
   e. Continue the recovery task.
Self Recovery

2.119. In the event that the vehicle becomes bogged, or for some other reason requires recovery in a forward direction, self recovery is possible using the LH winch.

Under no circumstances is the vehicle to be driven whilst the PTO is engaged. All winching operations are to be carried out with the vehicle transmission in neutral otherwise transmission, PTO and/or hydraulic pump failure may occur.
2.120. Prepare the vehicle for and carry out forward recovery as follows:

**CAUTION**

**Tension must be maintained on the winch rope when paying out.**

a. Pay out sufficient rope from the LH winch to allow the rope to reach through to the front of the vehicle.

b. Remove the retaining pin from the self recovery sheave housing on the tailgate.

c. Position the rope in the self-recovery sheave and replace the retaining pin.

d. Draw the rope through the guide chute to the front of the vehicle using a suitable pull cord.

e. Remove the upper guide roller from the roller set on the front bumper of the vehicle.

f. Feed the rope through the front roller assembly and replace the guide roller.

g. Pay out sufficient rope to reach an adequate anchor point for recovery.

h. Operate the LH winch as normal to affect recovery. Winching in can be affected using the winch switch located on the LH instrument panel. Refer to Figure 1-48.

2.121. The path of the winch rope is shown in Figure 2-31, Figure 2-32 and Figure 2-33.

2.122. After forward recovery, recondition the vehicle as necessary. The rope may be retained in the forward self recovery configuration if required.
Figure 2-31  Rope path through forward recovery sheave for forward recovery tasks

Figure 2-32  Rope path past side roller for forward recovery tasks
After Recovery

2.123. On immediate completion of the recovery task ensure that:
   a. the winch ropes are correctly stowed and secured to the tailgate,
   b. the free-spooling plungers are properly engaged,
   c. the earth spades are fully raised,
   d. all CES items and other items of equipment are properly stowed in the storage bins,
   e. damaged items are identified and taken out of service,
   f. the PTOs are disengaged,
   g. any casualty for towing is securely attached to the towing hitch,
   h. the work brake is to be released,
   i. the air bag suspension is to be inflated,
j. the rope tensioners are to be released,
k. PLCs are switched off,
l. remote control power switches are switched off, and
m. all workstation and crane lighting is switched off.

2.124. Following the completion of recovery tasks all recovery equipment used must be:
   a. cleaned and visually inspected for damage and serviceability;
   b. stowed correctly in the stowage facilities provided. Incorrect stowage may cause damage to the equipment and/or the stowage bins; and
   c. inspected and removed from the HRV on return to the Unit if damaged, tagged appropriately and reported to the workshop supervisor.

2.125. Before disconnecting a casualty ensure that the HRV park brake is applied, air bags deflated and the casualty has its road wheels chocked and brakes applied where possible.

Lift Tow Operations

**WARNING**

The left and right Tow Cylinders are to be fully retracted when lift towing an equipment casualty. The travel position for the Tow Rams at all times is to be in the fully retracted position. Failure to comply may result in injury to personnel or damage to equipment.

**WARNING**

Before operating the towing hitch ensure that all personnel are clear of the towing hitch. Personnel are not to stand between the towing hitch, the crossbar and the casualty.
WARNING

Before operating the towing hitch ensure the rear air bags are deflated before connecting/ disconnecting 'T' bar to casualty.

CAUTION

When lowering the towing hitch to full extent, it is possible for the lift cylinder to contact the towing pintle hook. Operators are to ensure that contact between the lift cylinder and pintle hook is prevented to prevent damage to the lift cylinder.

CAUTION

Prior to negotiating an obstacle the equipment casualty must be raised to a suitable height to ensure that the wheels/components which are suspended of the equipment casualty do not impact with the ground surface. Failure to comply may cause damage to the tow hitch and equipment casualty.

CAUTION

Raising the lift cylinder with the tow cylinders set to different lengths may cause the lift cylinder to contact the mounting point in the HRV tailgate causing damage to the lift cylinder.

CAUTION

The Rear airbags must be inflated prior to moving off with/without casualty.
2.126. When the tow hitch is first connected to an equipment casualty conduct the following procedures:
   a. ensure safety chains are connected to the casualty prior to lifting;
   b. retract the left and right tow cylinders evenly whilst retracting (raising) the lift ram, to ensure the equipment casualty suspension is not compressed during operation;
   c. once tow cylinders are fully retracted lift the casualty to a height in accordance with Para 2.128; and
   d. adjust safety chains in accordance with Para 1.209.

Operation of the Tow Hitch when Lowering an Equipment Casualty

2.127. When lowering an equipment casualty for disconnection with the tow hitch conduct the following procedures:
   a. ensure HRV rear suspension air bags are deflated;
   b. extend left and right tow cylinders 30 mm;
   c. ensure there is enough slack in safety chain adjustment prior to lowering for disconnection; and
   d. extend lift cylinder, lower casualty fully to the ground.

Height Position of Equipment Casualties when Raised for Suspended Rigid Tow Operations

2.128. When lifting an equipment casualty for suspended rigid tow operations, position of the C of G of the casualty and components that may lower during the lifting application (suspension stations, battle field damage etc) must be considered by the operator. The operator should concentrate on keeping the equipment casualty as low as possible; however, must provide suitable clearance between the ground and lowest point of suspended casualty components. This may require the removal of some components, such as wheels, or by chaining suspension prior to lifting (coil suspension, intermediate axle rear lift etc). The conduct of chaining the suspension of the equipment casualty and removal of wheels will lower the C of G of the casualty providing a better stable configuration when towing. These techniques will also lower the tow hitch and assist the T-Bar to rotate on a level plane.
2.129. Operators on completion of lifting the equipment casualty are to visually check the changes of the clearances of the casualty at the rear of the towed combination. This is to ensure that no components of the equipment casualty can impact on the ground surface. Adjust height if required. The ground clearance from the lowest point of the equipment casualty suspended to the ground surface is to be between 200 to 300 mm.

2.130. Operators are to be vigilant when operating/towing equipment casualties cross-country or when negotiating rough terrain. Prior to negotiating an obstacle the equipment casualty is to be raised to a suitable height to ensure that the wheels/components which are suspended can not impact on the ground. Whilst negotiating the obstacle the speed of the vehicle combination is to be keep to a minimum. Once the obstacle has been negotiated the equipment casualty is to be lowered to the correct height in accordance with Para 2.128.

**Vehicle Towing Adaptor Configurations**

2.131. Fitment and configuration of the towing hitch adaptors are shown in Table 1-4.

2.132. The recovery operator must be conversant with all restrictions and limitations applicable to the different types of vehicle casualties, including the ability to perform front or rear lift tow, whether laden or unladen lift tow is permissible etc.

**Bushmaster Vehicles**

2.133. When lift towing an ADI Bushmaster vehicle with the HRV, the HRV’s rear axle group mass exceeds the road law limit of 20 tonnes. When the ADI Bushmaster vehicle is either front or rear lift towed, the load exceeds the limit allowed on public roads, therefore the ADI Bushmaster must be loaded onto a Heavy Recovery Trailer when it is to be recovered over public roads.
CRANE OPERATION

Slewing the crane causes the crane column to pass very close to the upper portion of the crew cab. When operating the crane there should not be any personnel in the cabin of the HRV. During crane operation the operator should observe the clearance between the cabin and the crane column. Partially or fully deflated cabin suspension air bags may cause the crane to contact the cabin.

2.134. The crane operator is the vital link in the safe, accident-free performance of the crane and conduct of lifting operations. Written rules can not cover all situations that may arise when operating a crane. Most hazards can be avoided by exercising intelligent thinking, care and due consideration of the operating environment. Before operating the HRV mounted crane, be sure to read the safety precautions listed in Chapter 3.

2.135. An inspection of the work area is to be made by the crane operator to identify all safety hazards prior to operating the crane.

A vehicle mounted crane is dangerous if operated incorrectly. The operator must exercise extreme caution to avoid mistakes which may result in personal injury and/or property damage. The crane must only be operated by trained personnel. The crane should not be used to lift personnel.

NOTE

References to the operation of the hydraulic control valves should also be taken as using the remote control levers as the operating function is the same however the stabilizers cannot be operated from the remote control.
2.136. **After Operation.** After performing lifting operations with the crane, observe the following instructions:

- Ensure that the crane and stabilisers are stowed correctly before resuming driving operations. Stabiliser feet are to be removed and placed in the lockers.
- Ensure that the PTO is disengaged before moving the vehicle.
- Refit the LH rotating work light to the crew cab.

2.137. The crane is designed for lifting loads only. Mechanical interventions, such as pushing or driving against obstacles, fastening of loads at points other then those provided for this purpose, i.e. the hook, pulling of loads are prohibited.

**Crane Preparation**

**WARNING**

The crane must not be operated if wind speed exceeds 50 kmh or if thunderstorms are approaching.

**CAUTION**

The crane is designed to operate in a temperature range of -30°C to +50°C. If the temperature exceeds these limits the crane should not be operated otherwise damage to the hydraulic system may occur.

2.138. Prepare the vehicle and crane for operation as follows:

- Position the vehicle so that the crane is in reach of the load. Check that the ground below each stabiliser leg is firm. The maximum ground inclination is 5°.
- Apply the vehicle park brake and work brake.
- Place the transmission in neutral.
- Remove the LH rotating/work light from its mounting.
- Lower the recovery system access handrails to their lowest position.
f. Engage the crane PTO and set the engine speed to 1500 rpm.

g. Connect the remote control cable if using the cable remote control.

h. Fit the stabiliser feet to the stabilisers and lower the stabilisers.

Lowering the Stabilisers

**WARNING**

The stabiliser legs are for stabilising the vehicle only and are not to be used to lift the vehicle.

**NOTE**

If the ground under the stabilisers is soft or of doubtful stability, lower the stabiliser on the side of the softer ground first. This action saves time should it become necessary to re-position the vehicle to gain stability for crane operation. If required, reinforce the standing by laying steel mesh or sand bags under the stabiliser feet.

2.139. Lower the stabilisers as follows:

**WARNING**

When lowering the stabilisers, ensure that your feet are clear of the area below the stabiliser footing otherwise crush injuries may occur.

a. Set the crane mode to stabilisers by turning the mode switch fully anti-clockwise to the stabiliser position (refer to Figure 2-34).

b. Select the right hand or left hand stabiliser leg as required.

c. Position the stabiliser feet under each the stabiliser legs.

**NOTE**

The first stabiliser leg operated will raise the vehicle chassis about 50 to 100 mm. The second stabiliser is used to level the vehicle.
Figure 2-34  Crane mode selection

d. Lower the first stabiliser leg into the socket of the stabiliser footing.

e. Lower the opposite stabiliser into its footing with sufficient pressure to stabilise the vehicle only.

Unfolding the Crane

2.140. Unfold the crane and prepare it for use as follows and by following the steps shown on the decals illustrated in Figure 2-35.

**WARNING**

If the crane overload protection system fails to pass the initial test, stow the crane and do not use it until the fault is rectified by a repair agency.

For operational requirements the crane may still be operated in accordance with emergency operation procedures as per Para 2.152.
The crane will not operate in MANUAL and REMOTE operation at the same time. Selection of which control system (mode) to operate in, is made by setting the mode selector switch to the desired position.

a. Set the crane switch to the desired setting, either REMOTE, or MANUAL as required.

b. Move the crane main boom lever to the RAISE position and raise the boom to its full height, release the lever to the NEUTRAL position. The overload protection system should respond when the cylinder reaches its full extent and place the crane in an overload condition. From this point, the crane should not react to any further control functions. The red LED marked ‘CRANE’ on the Paltronic control panel should be illuminated.
NOTE
The crane will not react to any control function that has the potential to increase the load placed on the crane.

c. Check the display in the Paltronic display panel. The display should show the error ‘03.’ followed by a secondary code of ‘02’. Refer to Figure 2-36.

NOTE
If the main boom does not lower when the OLP button is pressed and the main boom lever actuated, it may be necessary to extend the outer boom to add weight to the main boom to facilitate lowering of the main boom.

WARNING
Lowering the main boom to an angle less than 45° may result in personnel injury when opening the outer boom.

d. Press the overload bypass (OLP) button and lower the main boom slightly. When in an overload condition, the crane will only allow the crane to operate for a maximum of 1.5 seconds. If the overload condition is not overcome within this time, the crane will again cease operation and will not accept further actuation of the OLP button for a period of 30 seconds.

e. Move the outer boom control lever to the LOWER position to fully fold the outer boom.

f. Move the crane extension boom control lever to the EXTEND position to allow it to clear the stowage boss.

g. Move the crane’s outer boom control lever to the RAISE position to finish unfolding the crane.
Lifting a Load

2.141. The crane's safe working loads and radii are shown in Figure 2-37.

2.142. Before lifting any loads, ensure that the hook is correctly fitted and that the safety locking clip is firmly in place.

**WARNING**

Use the remote control console to set the crane speed to micro operation whenever personnel are working in close proximity to the hook.
2.143. Carry out the following procedures to lift a load with the crane:

**NOTE**

Set the main boom angle to 20° above horizontal for maximum lift.

a. Slew the crane so that the hook is positioned directly over the load to be lifted.

b. Adjust the boom height to allow the hook to engage the load, including any slings used to lift the load.

c. Attach the hook to the load and ensure that the safety latch is closed and secure.

**CAUTION**

Ensure that the load is clear of any obstructions before slewing the crane. Slew the crane slowly to prevent load swing.

d. Lift the load gently by raising the appropriate boom.

**Emergency Stop Buttons**

2.144. Emergency stop buttons are located:

a. on the main control console fitted to the crane, and

b. on the remote control console.
Overload Protection System

NOTE
The Palfinger Paltronic 50 is used on this crane.

2.145. The overload protection system is activated by excessive hydraulic pressure in the inner boom lift cylinder. When the overload protection system is actuated, no further action may be taken that will place additional load on the crane, however actions that will reduce the loading may be carried out. When the crane is placed in an overload condition, the LED shown in Figure 2-38 will be illuminated.

Figure 2-38  Overload protection actuated indicator

2.146. When the crane reaches 90% of its overload capacity, an intermittent, audible signal will be heard. All functions of the crane will still continue to operate. Once the crane reaches 100% of its overload capacity, a constant audible alarm will sound and load moment reducing functions only will operate.

2.147. To rectify a crane overload situation, you may perform any function that reduces the load on the crane such as:

a. retracting the extension boom, and

b. folding the outer boom, providing that doing so will not exceed the operating radius of the crane.
Releasing a Load

**CAUTION**

Ensure that the load is completely stable and on firm standing before releasing the hook.

2.148. Use the following procedure to release a load from the crane:

a. Using the appropriate boom and slewing controls, position the crane, and lower the load gently and accurately into place. If using the remote control, set the crane operating to one of the micro speed settings.

b. Open the safety catch on the hook and release the hook from the load.

**NOTE**

Raise the appropriate boom until the boom is clear of the load and any obstructions before slewing the crane.

c. Move the crane away from the load for the next lift or stowage as required.

Stowing the Crane

2.149. Carry out the following procedure to stow the crane, following the steps illustrated on the decals illustrated in Figure 2-39.

a. Extend the extension boom to approximately 50 cm.

b. Fold the second jib completely.

c. Retract the extension boom until it locks into its rest.

d. Slew the crane to ensure that the alignment marks on the crane column and base are properly aligned. These alignment marks are visible on the column when standing at the hydraulic control valve.

e. Fold the inner boom until the boom is located in, and resting on, the boom rest as shown in Figure 2-40.
Figure 2-39   Folding the crane for stowage

Figure 2-40   Crane boom rest
Stowing the Stabilisers

2.150. Carry out the following procedure to stow the stabilisers:
   a. Set the mode selector switch to Stabilisers.
   b. Actuate the control valve for the stabiliser to be raised.
   c. Remove the stabiliser footing from the stabiliser leg and stow it in the proper storage cabinet.
   d. Repeat steps b. and c. above for the stabiliser on the opposite side.

Prior to Moving Off

Ensure that the crane is folded and stowed, that stabilisers are fully raised and that the stabiliser footings and remote control components are properly stowed before resuming driving operations.

2.151. Prior to moving the vehicle after using the crane:
   a. return the engine to idle speed,
   b. disengage the PTO,
   c. replace the work/rotating light, and
   d. disengage the vehicle work brake.

Emergency Operation

2.152. In the event that it is necessary to operate the crane when all electric power has been lost, the crane may be operated by manually opening the dump valve using the bridging bolt. Refer to Figure 2-41. The bridging bolt has a plastic locking cap to lock the valve in its normal operating position. Turning this cap will break the locking tab from the cap, which should be replaced at the earliest convenience.
The crane should be operated in this manner only for the purposes of removing any load on the crane and stowing the crane to the transport position for repair. Do not continue operating the crane otherwise.

2.153. Set the crane for emergency manual operation as follows:

a. Open the dump valve by rotating the bridging bolt clockwise, breaking off the yellow tab engaged in the valve housing. Continue turning the knob, until it strikes its stop.

b. Try to retract the extension boom, if this is not possible, screw the bridging bolt out one complete turn and try retracting the extension boom again. Once crane movements are possible, the load must be removed immediately and the crane stowed for transport. Do not operate the crane again until the fault has been rectified.
2.154. When operating in an emergency manual mode the following factors apply:

a. With the bridging bolt wound fully in, the crane will operate at reduced speed and capacity. The stabilisers may also be actuated.

b. Screwing the bridging bolt out two turns will cause the crane to operate at full speed and full capacity however the stabilisers will not operate.

Remote Control

**WARNING**

When operating the crane with the remote control, always be aware of your surroundings to prevent possible death or injury from falls, trip hazards and other potentially dangerous situations encountered do to a failure to maintain an awareness of the operating environment.

**WARNING**

In order to make smooth and precise crane movements during radio remote control operation, either the carry belt or shoulder strap for the remote control must be used.

**CAUTION**

The remote control console is weatherproof when it is the correct way up. It is not waterproof, and should not be placed upside down in inclement weather, placed in water or neither wholly or partially submerged. Water will enter the remote control casing through a hole in the base of the casing within the battery compartment. In the event that the remote control has, or is thought to have, suffered water ingress, do not attempt to use it, but have it returned to a service agency for drying and repair.
2.155. The crane may be operated using the remote control console, either as a radio remote or cable remote. Selection of cable remote is determined by connecting the remote console to the crane by the cable. To use the remote control with the crane, you need to set the crane mode switch to the REMOTE position. Refer to Figure 2-42.

![Mode switch](image)

Figure 2-42 Mode switch set to remote control

2.156. The following functions may be carried out using the remote control. Refer to Figure 2-43 for the location of the remote control devices.

a. crane operation other than the stabilisers,
b. emergency stop,
c. remote control functional tests,
d. setting the crane operating speed,
e. overriding the overload protection (OLP) system, and
f. changing the radio remote control frequency.
2.157. **Switching the Remote On/Off.** To switch the remote control unit on, rotate the emergency stop button clockwise as indicated by the arrows formed in the button then press the ON button. To switch the remote off, press the emergency stop button in. The remote control will automatically switch off after five minutes of inactivity.

2.158. **Emergency Stop.** In the event of an emergency situation occurring, further crane operation may be prevented by pressing the emergency stop button.

2.159. **Crane Operation.** The raise, lower, extend and retract functions of the crane are executed by operating the four levers on the remote control unit. The function of each lever is identified by the labels attached to the remote control unit.

2.160. **Remote Control Function Tests.** The functions of the remote control may be tested as follows:

   a. Set the emergency stop button to ON.

   b. Press the ON button 10 times in succession.
c. Actuate each of the control levers and switches in turn. As each control is actuated, a beeping sound will be heard and the green LED will illuminate concurrently with the audible sound. As each lever is moved further, the beeping sound will occur more frequently and the LED will flash faster until continuous sound and illumination of the green LED occurs.

d. Press the emergency stop button to switch the unit off and cancel the functional tests.

2.161. **Setting the Crane Operating Micro Speed.** You may set the operating speed of the crane whilst using the remote control to any one of five operating speeds. To adjust the speed of the crane, press the micro switch to the left and release. Each press of the micro switch reduces the speed of the crane by one increment. Whilst a reduced operating speed is set, the green LED will flash a corresponding number of times for the time that the remote control is switched on, i.e. if the micro switch is pressed three times, the green LED will flash three times, pause, then repeat the three flashes again.

2.162. Once the operating speed of the crane has been set, this becomes the default setting and the crane will always return to this operating speed when the remote control is switched on.

2.163. **Setting Normal Speed.** To set the crane speed back to normal, press the micro switch to the OFF position. This will cancel the current speed setting and the crane will return to normal operating speed.

2.164. **Setting for Cable Remote Operation.** To set the crane for operation as a cable remote control, simply attach the cable remote cord between the remote control unit and the socket located on the main control panel for the crane. Refer to Figure 2-44.

2.165. **Overriding the Overload Protection System.** The overload protection may be overridden for a short period in order to bring the crane back into a safe load situation. This can be achieved by pressing the ON button once. This will have the same effect as pressing the OLP button on the main control station of the crane and operates in the same manner.

2.166. **Changing the Crane Radio Frequency.** If the crane is not operating correctly when on radio remote control, there may be a problem with radio interference. An alternative radio frequency may be selected by pressing the ON button twice. Continue selecting frequencies if required. The crane operates on a total of 12 different
frequencies. If a frequency without interference cannot be found, then revert to cable remote operation. The remote control will always fail to safe where radio frequency interference exists.

2.167. **Changing the Remote Control Battery.** To change the battery in the remote control, invert the remote to access the battery. Remove the battery as shown in Figure 2-45 and Figure 2-46. Do not remove a battery from the remote control until it has been totally discharged.
2.168. Replace the battery in the reverse manner.

2.169. **Battery Charging.** Once a flat battery has been removed, ensure that it is placed in the charger immediately for recharging. Placing a partially discharged battery in the battery charger will extend the recharging time as the battery must be totally discharged before being recharged. Whilst the battery charger has this functionality, it does take an extended time to fully discharge a battery. Normal charging time for a battery from being totally discharged to fully charged is approximately 1.5 hours. The battery charger operates independently of the HRV’s switched electrics and is therefore operational at all times.

2.170. **Operating in Darkness.** If the operational situation prevents the use of light, use an assistant to call boom and slewing instructions. If there are no lighting restrictions, use the recovery system work lights.

2.171. **CES Slinging.** From time to time it will be necessary to lift items of CES off the HRV. Refer to Figure 2-47 and Figure 2-48 for illustration of the means of lifting the SWR pannier and the cam nets utilising HRV CES.
Figure 2-47  Means of lifting the SWR pannier

Figure 2-48  Means of lifting cam nets using the cam net lifter
Recovery of HRV on Breakdown

2.172. In the event that the HRV itself becomes disabled, or the recovery system becomes inoperable during a recovery task, it will be necessary to ensure that the various components of the HRV and recovery system are retracted and/or stowed to enable recovery. Components that may require attention are:

   a. the earth spades,
   b. winch ropes,
   c. towing hitch,
   d. crane,
   e. crane stabiliser legs, and
   f. PTOs.

2.173. If the recovery system is operable, use the various controls to retract and stow the recovery system components as necessary.

2.174. If the recovery system is inoperable, then the various components may be retracted and stowed as described in Paras 2.175 to 2.179.

2.175. Earth Spades. The earth spades may be retracted manually by using the following procedure:

   a. Remove the top cover plate from the earth spade slide in the tailgate.
   b. Remove the plug from the test port marked ‘TE’ or loosen the hydraulic hose fittings at the earth spade cylinder.
   c. Position a suitable means to collect hydraulic fluid that will be expelled from the open ‘TE’ port.
   d. Hold the respective spade cylinder control valve lever in the RAISE position.
   e. Lift the earth spade using a crane or other suitable lifting device.
   f. Release the control valve and secure the earth spade in the raised position.
   g. Replace the plug in the ‘TE’ port or tighten the cylinder hose fittings as required.
2.176. **Winch Ropes.** The winch ropes cannot be rewound onto the winches effectively and hence they are to be coiled and securely stowed.

2.177. **Towing Hitch.** The towing hitch may be raised and or retracted by moving the lift cylinder control valve lever to RAISE and manually raising the towing hitch using a crane or other means.

2.178. **Crane Stabilisers.** The crane stabilisers may be raised as detailed below. Refer to Figure 2-49.

   a. Loosen the fitting located in the block on top of the stabiliser to be raised.
   
   b. Use a suitable lifting device to raise the stabiliser leg to the fully raised position. Hydraulic oil will be expelled from the loose fitting.
   
   c. Tighten the fitting in the hydraulic block.
   
   d. Use a suitable restraining device, chain or tie the stabiliser leg in the raised position.
   
   e. Remove and stow the stabiliser footing.
   
   f. Clean up all spilt oil from the stabiliser.

![Figure 2-49](image)

*Fitting to be loosened*

**Figure 2-49**  Manually raising the stabiliser legs
2.179. **Crane Boom.** In the event that the crane boom is loaded, or otherwise in a position effecting the safe recovery of the vehicle, use the following method to place the crane boom into a suitable position.

![CAUTION](image.png)

All forced movement of the crane should be carried out slowly to prevent damage to the hydraulic system.

a. Use any safe means available remove any load suspended or otherwise attached to the crane.

b. Screw the dump valve bridging bolt fully in to allow passage of hydraulic oil through the hydraulic control valve. Refer to Figure 2-50.

c. If the outer boom is not fully raised, move the outer boom control lever to the RAISE position and using a suitable means, lift the boom into the fully raised position.

d. If the inner boom is not at a height where it will clear the vehicle body when slewed, move the inner boom control lever to the RAISE position and using a suitable means, lift the boom into a position where it will clear the vehicle body.

![Figure 2-50 Dump valve](image.png)
e. If the crane boom is not directly over the vehicle body, manually slew the crane as follows:

(1) Secure the crane boom to prevent uncontrolled slewing due to loss of hydraulic fluid.

(2) Loosen the hydraulic unions on the slew cylinder load holding valve as indicated in Figure 2-51.

(3) Slew the crane into position over the vehicle body, preferable so that the hook is midway across the vehicle.

(4) Tighten the slew cylinder pipe fittings on the load holding valve.

f. Support the crane boom to prevent the boom falling due to loss of hydraulic fluid.

g. Loosen the pipe fittings on the inner boom lift cylinder load holding valve as indicated in Figure 2-52.

h. Place suitable dunnage on the vehicle body catwalks to support the crane boom once lowered.

i. Slowly lower the boom onto the dunnage.

j. Secure the boom into position using suitable chains or rope.

Figure 2-51  Slew cylinder unions loosened for manual slewing
2.180. **Brake Operation.** The HRV braking system may be charged with air from the towing vehicle if required, to release the HRV spring brakes. This may be achieved by connecting the Service and Emergency air supply lines of the towing vehicle to the HRV as follows:

a. Supply Coupling (Yellow) connected to the air line coupling located at the front of the HRV (refer to Figure 2-53), and

b. Emergency Coupling (Red) connected to the tyre inflation coupling located on the left of the vehicle under the cab steps.

2.181. The Tractor Protection Control Switch located on the dashboard must be pressed in to supply air and enable operation of the brakes on the towed HRV.

Figure 2-52  Inner boom lift cylinder unions loosened for manual raising or lowering

k. Tighten the hydraulic pipe fittings on the inner boom lift cylinder load holding valve.

l. Screw the dump valve bridging bolt out to close the dump valve.
Cleaning

2.182. The HRV is fitted with sensitive electrical, mechanical, hydraulic and pneumatic components that are prone to damage if care is not taken when cleaning, particularly when using high pressure cleaners.

NOTE

The ingress of water into the hydraulic oil tank, the directional control valves, including crane controls, and the winches will lead to equipment failure.

2.183. When washing the vehicle, using high pressure water blast cleaning, the following must be observed:

NOTE

Cabinet seals and latches will not seal against a direct water jet blast.
a. High pressure water jets must not be directed at the top of the hydraulic oil tank, the hydraulic directional control valves, the winch drums, the cabinet seals and latches, within cabinets, PLC’s, cameras, internals of the crew cab and vehicle cabin.

**CAUTION**

The ingress of water will cause rust and lubricant contamination and may result in the premature failure of equipment.

b. Use pH neutral, biodegradable cleaning agents to avoid damage to chrome parts.

c. When cleaning the crane and recovery equipment with a high pressure cleaning device the temperature of the cleaning agent must not exceed 60°C.

d. After high pressure water cleaning, all lubrication points on the recovery system, crane and vehicle are to be serviced to expel water from the bushes, bearings and seals.

e. Winch ropes are to be lubricated.

**WARNING**

PPE, including goggles, rubber gloves and rubber aprons are to be worn when cleaning and oiling the CES.

2.184. **Cleaning CES.** All shackles, chains, snatch blocks and SWR slings are to be lightly oiled after cleaning with a light oil or diesel fuel. Excess oil is to be drained off the CES prior to placement in the stowage bins. Care is to be taken not to mix shackle pins and bodies when cleaning.

2.185. **Snatch Blocks.** Snatch blocks are to be greased (rotate sheave when greasing) after cleaning.
High pressure cleaners and steam cleaners are not to be used when cleaning SWR.

2.186. Winch Ropes. High pressure cleaners and steam cleaners are not to be used when cleaning winch ropes or auxiliary SWR. Use of a garden hose and nozzle at normal tap pressure is acceptable for cleaning excess mud, grit etc from the SWR. Once ropes have been washed, the SWR are to be lubricated with a light SWR lubricant spray oil such as ROCOL.

2.187. Winches. When cleaning around winches, operators are to check for any obstructions around the rope layer sensor. Refer to Figure 1-34.

Communications Equipment

2.188. The communications equipment fitted to the vehicle should be installed, connected and operated in accordance with the operation instructions provided with the communications equipment.

Handheld Radios

Radio Operation

2.189. Handheld Operation. Operate the Tait radios as follows (refer to Figure 2-54):

a. Switch the radio on using the ON/OFF and VOLUME switch.

b. Select the required/allocated channel using the 16-way channel selector.

c. Hold the radio in either way as shown in Figure 2-55.

d. Press the PUSH TO TALK (PTT) button to transmit.

e. Release the PTT switch when finished transmitting to listen.
Figure 2-54  Tait handheld radio operation

Figure 2-55  Holding the Tait handheld radio
2.190. **Hands Free Operation.** When the radio is mounted in the vehicle cradle, operation of the radio remains the same except that:

a. the radio’s microphone will be inoperative and the external microphone will need to be used, and

b. the radio’s speaker will be inoperative and the external speaker mounted on the vehicle dashboard will operative.

2.191. **Fitting the Radio to the Cradle.** Fit the handheld radio to the cradle as follows:

a. Ensure that the release button on the cradle is down.

b. Insert the radio into the cradle cavity.

c. Push the radio firmly into place against the locating pegs. You will hear the radio snap into place and the release button will pop up when the radio is fully into place.

2.192. **Releasing the Radio from the Cradle.** Release the radio from the cradle as follows:

a. Push the release button down.

b. Remove the radio from the cradle.

**Radio Troubleshooting**

2.194. In the event that you are unable to communicate with the handheld radio, you should check that:

a. the radio is switched on,

b. the correct channel is selected,

c. the battery is charged and correctly fitted,

d. the antenna is not damaged, and

e. the battery charger is working.

2.195. The indicators from the radio listed in Table 2-6 will assist to identify faults with the radios.
### Table 2-6  Handheld Radio Troubleshooting

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Problem/Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED red/green</td>
<td>Fast flash</td>
</tr>
<tr>
<td></td>
<td>Radio is incorrectly configured. Contact an authorised tait dealer or repair agency.</td>
</tr>
<tr>
<td>LED red</td>
<td>Slow flash</td>
</tr>
<tr>
<td>Low pitch beep</td>
<td>Battery is low. Charge the battery.</td>
</tr>
<tr>
<td>every five seconds.</td>
<td></td>
</tr>
<tr>
<td>high pitch beep</td>
<td>The temperature is too high. You should stop transmitting and allow the radio to cool down.</td>
</tr>
<tr>
<td>twice, short</td>
<td></td>
</tr>
<tr>
<td>duration.</td>
<td></td>
</tr>
<tr>
<td>Low pitch beep,</td>
<td>Battery is too low to operate the radio. Turn off the radio. Charge the battery.</td>
</tr>
<tr>
<td>long duration.</td>
<td></td>
</tr>
<tr>
<td>LED red</td>
<td>Fast flash, high pitch beeps</td>
</tr>
<tr>
<td></td>
<td>Radio is stunned. Contact the dispatcher.</td>
</tr>
</tbody>
</table>

**Battery Maintenance**

**2.196. Battery Storage.** If the radio is not to be used for extended periods, the following actions will prolong the life of the battery:

- a. if possible, discharge the battery;
- b. remove the battery from the radio; and
- c. store it in a cool, dry location, away from sunlight.

**2.197.** The only method available for charging the battery is the trickle charge system in the radio cradle.

**Power Saving**

**2.198.** The following power saving activities should be carried out if the vehicle is to be parked and not used for a period longer than 2 days to protect the vehicle batteries from excessive discharge:

- a. Remove the Tait handheld radios from their respective cradles.
b. Remove the Palfinger battery from the battery charger.

c. Switch off all electrics, including winch PLC’s.

CES Stowage

2.199. CES shall be stored in accordance with Table 2-7 and Figure 2-56 to ensure compliance with essential weight distribution throughout the vehicle.

2.200. Miller towing adaptors are identified in Table 1-3.

Table 2-7 Layout of CES

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>13mm grade ‘T’ locking shortening claw hook - plunger type</td>
<td>Safety Chain Holders</td>
<td>2</td>
</tr>
<tr>
<td>20 inch Cotton webbing strap</td>
<td>Bow Shackles</td>
<td>2</td>
</tr>
<tr>
<td>Chain assembly, single leg, alloy steel grade t, 4 m lg by 13 mm dia, latchlok hook w/removable joining link 1 end, oblong link w/removable joining link other end</td>
<td>Safety Chain Holders</td>
<td>2</td>
</tr>
<tr>
<td>Light, revolving, warning, vehicular, amber</td>
<td>Crew Cab Roof</td>
<td>2</td>
</tr>
<tr>
<td>T-bar retaining bracket &amp; stop light with lead Nato plug</td>
<td>T-Bar</td>
<td>1</td>
</tr>
<tr>
<td>Towbar, motor vehicle (consisting of the following 9 items) (SCES 011952)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Extinguisher, fire dry chemical, 1.5 kg capacity, stored pressure regulated charge type</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Can, water military, plastic 22 L</td>
<td>3 &amp; 25</td>
<td>3</td>
</tr>
<tr>
<td>1/2 inch drive torque wrench (left and right hand drive) 40-200 N.m</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Bag, canvas, stowage, radio antenna.</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Battery for remote control for knuckle boom crane</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Belt, waist</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Cable, remote control, 15 m lg. For attaching the remote control console to the crane.</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Charger unit for remote control unit for knuckle boom crane</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>First aid kit, motor vehicle, mechanised units, AFV (SCES 011010)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Description</td>
<td>Location</td>
<td>Qty</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Flood light, portable for mounting on crew cab</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Flood light, portable with extension and lead for mounting on CES binning</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Gloves, men's, size medium, grey, industrial, leather</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Head lamp, lightweight, dry cell, battery powered, zoom lens</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Helmet, safety, Eproc cap safety V-guard elite green</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Protective cover for Engel fridge, 15 litre, for northern units</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Refrigerator-freezer, portable chest, 15 L capacity, 548 mm lg by 306 mm W by 348 mm H, 12V (3.7a)/24V (1.4a), ice cube capacity</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Remote control unit with carry strap for knuckle boom crane</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Strap shoulder</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Vest, high visibility, universal size, orange and silver, w/reflective tape, safety</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Extinguisher, fire, dry chemical, 4.5 kg capacity, stored pressure regulated discharge type</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Shovel, hand, post hole, 54 inch handle lg, 11 inch lg by 7-1/4 inch W blade dim</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Oxygen cylinder, size D</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Axe, single bit, 2 kg, 130 mm cutting edge, 820 mm lg handle</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Bar, pinch, 900 by 25mm, 3 ft by 1 inch</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Bar, wrecking, metric, bent wedge, curved claw, 20 mm by 750 mm lg</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Bead breaker, pneumatic tyre heavy duty, slide hammer type</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Block, tackle, single-snatch, 250 mm dia single sheave, classification for reeving with 20 mm and 22 mm dia grade 1770 steel wire rope, WLL 12400 kg, recovery</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Block, tackle, snatch, RECLL 52 tonne</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Cutter bolt, clipper cut type, 16 mm dia, 1050 mm lg</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Hammer, hand, sledge and blacksmith's, double faced, 4.5 kg</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Handle, mattock-pick, wood, 2.3 kg pick, lg - 900 mm lg</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Description</td>
<td>Location</td>
<td>Qty</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Handling tool, winch rope</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Head fitting, block tackle snatch steel, 320 mm o/a lg, 143 mm o/a dia. 1/2-13 UNC by 39 mm thd lg, 12.4 tonne working load limit (WLL), 30 tonne recovery load limit (RLL)</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Head fitting, block tackle snatch, 52 tonne RECLL</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Mattock, cutter type, 4-1/2 lbs</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Outrigger feet for knuckle boom crane</td>
<td>7 &amp; 22</td>
<td>2</td>
</tr>
<tr>
<td>Rack, snatch block. Used to stow recovery snatch blocks in the LH front tool bin</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Runner wood, 6 inch W, 3 inch thk, 3 ft lg, c/w reinforcing bolts, nuts and washers, mfr in workshops from seasoned hardwood in accordance with DWG TSU 48</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Shovel, hand GS, rd point blade, plastic D-type handle, black or dark green, 35-1/2 inch lg</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Adaptor towing, Unimog rear lift</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Adaptor, lift and towing Aslav</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Adaptor, rear lift and towing, Landrover</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>CES cabinet lifting eye bolts</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Chain adaptors for towing</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Elevating block, jack, base plate, steel, 380 mm sq, 12 mm thk, w/carry handle</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Spacer, towing adaptor. Used to locate the towing adaptors on the crossbar to prevent movement against the locating pins.</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Adaptor, fork, LH, used with Aslav adaptor</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Adaptor, fork, RH, used with Aslav adaptor</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Bracket, mounting, engineers vice</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Covers CH Fleetliner, axle cap</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Lifting and pulling machine, non man riding, 3.2 tonnes WLL (lift) and 5.0 tonnes RLL (pull) (SCES 010655)</td>
<td>9 &amp; 14</td>
<td>1</td>
</tr>
<tr>
<td>Roller, material handling, wood, Wandoo, 2 ft lg by 3-1/2 inch dia</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Description</td>
<td>Location</td>
<td>Qty</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Tarpaulin extendable, lightweight, 20 ft by 16 ft</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Vice machinist and with swivel base 75 mm</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Chain assy, Rudd, grade 8S, 20 mm, 32 tonne RECLL, 3 metres lg, with COV20B master link and Covvsu 20b connecting link each end (note colour black)</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Grade T, lifting sling, 10 mm dia, four leg 3 metres lg with LMOL and shortening claws at top, with eye type latchlok hooks at bottom</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Hook assembly, includes locking latch and pin. For use with Palfinger crane</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Recovery system remote control unit</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Inner tube, pneumatic tyre, vehicular, 12.00-20, valve TR179A/86 single bend, on centre, truck and bus</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Pin, lynch</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Pin, lynch</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Rim, wheel, pneumatic tyre, 20 by 8 inch, 10 stud, 11.25 inch PCD, consists of; rim and centre qty 1, 20 by 8 V side ring qty 1 and 20 by 8 V lock ring qty 1</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Spare wheel cover</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Spare wheel lifter</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Tyre, pneumatic, vehicular, 12.00-20, 18 ply, truck and bus, militaire all weather, radial ply, steel belted, tubed tyre</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Camouflage net</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Camouflage net, support set</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Cover, canvas. Used to cover Swr stowage pannier</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Lifting and pulling machine, non man riding, 3.2 tonnes WLL (lift) and 5.0 tonnes RLL (pull) (SCES 010655)</td>
<td>9 and 14</td>
<td>1</td>
</tr>
<tr>
<td>Pin lynch</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Steel wire reel</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Wire rope assembly, single leg, steel 1770 grade, 6 by 25 type, 4.5 m lg by 22 mm dia, 305 kN min breaking strength, w/loop and thimble both ends</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Description</td>
<td>Location</td>
<td>Qty</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Wire rope assy 24mm dia Eurolift 15 metres lg, REC II 26.75 tonne, G1960 grade, MBL 53.5 tonne with Aust Standard heavy duty galvanised thimbles each end, recovery load limit</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Wire rope assy 24 mm dia Eurolift 5 metres lg, REC II 26.75 tonne, G1960 grade, MBL 53.5 tonne with Aust Standard heavy duty galvanised thimbles each end, recovery load limit</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Oxyacetylene cylinder, size D</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Pin, cable, rear (self recovery)</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Pin, lynch</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Sign assembly on tow, vehicular; marine plywood, 48 inch lg by 12 inch W by 3/4 inch thk board, letters/strips use reflective red, colour of board is white</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Adaptor, lift and towing universal. Used for Unimog front, Landrover front, Mack, Bushranger and Landrover rear with 18569043</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Bush, reducing, adaptor pin (light) used to reduce hole size in universal adaptor 18568026 for Landrover front lift</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Cotter pin, 1-1/4 inch hair pin</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Pin (light), headed, shouldered, includes security cable and locking pin. Used with 18568026 for Landrover front</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Pin, retaining ‘T’. Steel with cross pin. Fitted into the ends of the towing hitch crossbar for security of adaptors. (7-1/4 inch lg by 5/8 inch dia)</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Pin, retaining, ‘T’, steel with cross pin. Used to position lift/tow adaptors on cross bar (10-3/4 inch lg by 3/4 inch dia)</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Shackle bow, alloy steel grade S, 35 mm dia, M38 thd collared eye pin, 13 tonne WLL, zinc</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Shackle bow, alloy steel grade S, 38 mm dia m41 thd collared eye pin, 17 tonne WLL, zinc</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Shackle bow, alloy steel, quality grade S, 22 mm nom dia, 37 mm opening w, c/w metric thd collared eye pin, 6.5 tonne WLL</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Shackle bow, alloy steel, quality grade S, 25 mm nom dia, c/w metric thread, collared eye pin, 8.5 tonne WLL, zinc coated</td>
<td>19</td>
<td>6</td>
</tr>
</tbody>
</table>
Table 2-7  Layout of CES (Continued)

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shackle, bow, alloy steel, quality grade S, 51 mm nom dia, 83 mm opening w, c/w metric thd collared eye pin, 35 tonne WLL</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Spacer, towing adaptor. Used to pack the rear lift towing eyes on the international 'S' line vehicles.</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Brake hose Aslav (emergency) male end fitting, 1.6 metres lg</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Brake hose Aslav (service) female end fitting, 1.6 metres lg</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Brush, wire, scratch 190 mm lg by 57 mm W, 45 mm lg of fibres, 5 rows wide 14 rows lg</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Can, dispensing, funnel top, tinplate, 500 ml capacity, w/o handle</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Can, screw cap, tin, oil container, rectangular, 5 litres capacity</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Chuck, air, inflating, 1/4 inch NPT internal thd</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>CH Fleetliner service line connector</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Elevating block, jack, base plate, wood, 12 inch W by 18 inch lg by 3 inch thk</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Hose assembly, nonmetallic, 3/8 inch ID hose J1402, 8 m o/a lg., straight adaptors 1/2 inch NPT</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Hose assembly, nonmetallic, rubber synthetic, 3/8 inch ID, 5/8 inch OD, 20m lg, w/quick disconnect fittings both ends</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Hose assy brake inter vehicle, Susi coil, emergency, red glad hand one end, including adaptor bayonet and QD gladhand</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Hose assy brake inter vehicle, Susi coil, service, blue glad hand one end, adaptor bayonet and QD gladhand</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Inflator-gauge, pneumatic tyre, dual reading 10 to 150 psi and 70 to 1000 kPa</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Jack, hydraulic, hand, 20 tonnes, 260 mm closed, 425 mm ext H</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Jack, hydraulic, hand, metric, single lift, 280 mm closed H, 450 mm extended H, 30 tonne (comes with handle)</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Lubricating gun, hand, lever operated, hydraulic type, 16 oz capacity, c/w flexible hose 10 inch lg</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Multiplier kit, torque wrench, 1800 ft lb capacity, cased (SCES 010062-02)</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Description</td>
<td>Location</td>
<td>Qty</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Scania emergency line adaptor for towing Scania 4×4</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Scania service line adaptor for towing Scania 4×4</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Sign warning, motor vehicle, steel, triangular, 13 inch square, red and white, w/carry case that acts as a base during use (box of 3)</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Tyre inflation hose 20 metres, non-metallic rubber, w/quick disconnect fittings both ends</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Cam net lifting</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Cook set, three piece, aluminium; consist of cover assy 8-1/16 inch OD by 1-3/32 inch H; pot, inner 7-1/2 OD by 4-5/32 inch H; pot, outer, 8-1/16 inch OD by 4-3/32 inch H</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Gloves, welder's, brown, gauntlet, leather</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Jumper cable, battery 400 amp, heavy duty, 4 m lg, c/w alligator clips</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Lock steering wheel</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Rope, fibrous, manila, hawser laid, 3 strand, 12 mm dia, 9.30 kN breaking strength, 250 m nom lg</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Stove, LP gas, portable, 2 burners; c/w driptray, hotplate, toaster and gas cylinder, 4 kg capacity, 3/8 inch LH threaded</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Strap, web, with ratchet</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Torch outfit, cutting and welding, recovery mechanic, medium recovery vehicle ‘MRV’ (SCES 010699-03)</td>
<td>21</td>
<td>1</td>
</tr>
<tr>
<td>Chain assy Rudd VIP grade 8S 16 mm, recovery load limit (RECLL)20 tonne, 6 metres lg, with Covvsu coupling link and COV16B master link each end (note colour black)</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Chain assy Rudd VIP grade 8S 16 mm, recovery load limit (RECLL)20 tonne, 4 metres lg, with Covvsu coupling link and COV16B master link each end (note colour black)</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Chain single leg grade T, 10mm dia, 5 metres lg, with side acting plunger type locking shortening claw hook each end</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Handle, wheel nut wrench, 3/4 inch dia, 30 inch lg</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Tyre iron, 24-1/2 inch</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>Wrench adjustable, metric, 600 mm chrome plated, 68 mm jaw opening</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Description</td>
<td>Location</td>
<td>Qty</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>----------</td>
<td>-----</td>
</tr>
<tr>
<td>Wrench, socket, sq, double ended, 13/16 inch and 1-1/2 inch, 16 inch o/a lg</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Broom, push, fibre, bass, w/o handle</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Extinguisher, fire stored pressure, foam, 10 litre, hand</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Handle, circular, bass, 1.520 m lg by 25 mm dia</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>16mm VIP identification tag and test gauge</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>20mm VIP identification tag and test gauge</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Adaptor, straight, pipe to hose, 3/8 inch NPT to 3/8 inch ID hose (Mack)</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Adaptor, Truck, Medium, MC2, copper alloy, 32.0 mm lg, 25.0 mm A/F, 3/8 inch 18 NPT 2A internal thread (old series Mog)</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Adaptor, Truck, Medium, MC2, brass, 45 mm lg, 25 mm A/F; 3/8 inch, NPS, 2A, internal thd one end and M22 by 1.5, internal thd other end (new series Mog)</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Bracket, locking, working gear group, high/low select arm, Unimog MRV, towing</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Extension, socket wrench, male and female, 3/4 inch sq drive, 220 mm lg</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Hook locking transmission, high/low select arm Unimog MRV towing</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Knife, hunting, 5 inch lg blade, 9.5 inch o/a lg, leather handle, grooved back, w/sheath</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Nylok nut for axle pin, for block, tackle, snatch, RECLL 30 tonne</td>
<td>24</td>
<td>6</td>
</tr>
<tr>
<td>Nylok nut for axle pin, for block, tackle, snatch, RECLL 52 tonne</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>Sleeve locking transmission, high/low select arm Unimog MRV towing</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Toolkit, recovery mechanic, medium/heavy recovery vehicle – (SCES 010699-03)</td>
<td>24</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 2-56  Layout of stowage
SECTION 3
OPERATOR SERVICING

CHAPTER 1  SERVICING
CHAPTER 2  LUBRICATION
CHAPTER 3  FAULT FINDING
CHAPTER 4  CONSUMABLES
CHAPTER 1
SERVICING

General

3.1. This chapter details the operator servicing and lubrication requirements for the equipment. The instructions contained in EMEI Vehicle D 329 – Servicing Instruction, take precedence over the instructions detailed in this handbook.

3.2. Parade and periodic servicing must be carried out in accordance with EMEI Vehicle D 329 and this Section. If servicing, as per EMEI Vehicle D 329 cannot be performed when it is due, or within the allowable limits, the situation is to be reported immediately to the Workshop Supervisor.

Operator’s Daily Servicing

First Parade Servicing

3.3. Before starting the vehicle or moving off with a loaded or unloaded vehicle, carry out the inspections, checks and tests identified as daily tasks in Table 3-1, Table 3-2 and Table 3-3. Inspect the vehicle for security, serviceability and any evidence of damage and fluid loss.

3.4. Make a final check of the security of equipment and loads, including loads on casualties.

Start Vehicle

3.5. Start vehicle as detailed in Sect 2, Chap 4 and check the following:

a. Air Gauge: 480 kPa minimum (buzzer shut-off) before moving. Operating pressure – 620 kPa to 830 kPa.

b. Oil Pressure: Check for minimum of 175 kPa at idle and 275 kPa to 660 kPa at maximum rpm.

c. Voltmeter: With switch on and engine off, or engine running, any irregular readings indicates that either the batteries or charging system require checking.

d. Parking Brake: Check release, holding ability and application.
e. Work Brake: Check release, holding ability and application.

f. Seat Adjustment: Ensure seat is correctly adjusted.

g. Transfer Case Oil Cooler: Check that the light is initially illuminated and then extinguished, indicating oil circulation.

h. Rear Vision Mirrors: Adjust both rear vision mirrors to enable clear vision to the rear of the vehicle.

i. Air System Dump Valves: Check operation of air system wet tank and air system filter for dump valve operation. These valves expel air approximately every six minutes after the ignition is turned on. An audible sound is apparent on release of air.

j. Records: Complete documentation and report defects as necessary.

Moving Off and Running

3.6. On initial movement of the vehicle:

a. Moving Off. When the vehicle has built up sufficient air pressure, carry out the following tasks:

(1) Release parking brake.

(2) Check correct operation of steering and brakes.

b. Running Periods. At short, regular intervals, keep a running check on all instruments. i.e. fuel, temperature and oil pressure gauges, charging rate and speedometer.

Halts on the March

3.7. At halts on the march check that:

a. all tyres are inflated and serviceable;

b. wheel hubs or brake drums are not overheated (check with back of hand or fingers);

c. there are no oil, fuel or coolant leaks;

d. loads and/or casualty are secure;

e. check all lights; and

f. clean the windscreen, door glass, light lenses as necessary.
3.8. At alternate halts or after approximately four hours running:
   a. Check tyre pressures. If low, inflate. (If high, check later when tyres are cold, before deflating).
   b. Ensure that all wheel nuts are secure.
   c. Carry out a visual check for loose bolts or fittings. Tighten as necessary.
   d. Ensure security of stowed items.
   e. Check security and correct operation any parts of the vehicle on which recent repairs or adjustments have been carried out.
   f. Check inter-vehicle brake hoses to the casualty or trailer for security and leaks.
   g. Check the ‘ON TOW’ sign for security and operation of lights.
   h. Check signage and/or flags for security if applicable.

**Last Parade Servicing**

3.9. On completion of each day’s usage, perform the following tasks:
   a. Clean the vehicle.
   b. Re-lay the winch ropes under a load of 1000 kg to ensure correct lay and prevent rope damage during recovery tasks.
   c. Carry out reservoir de-watering routine (refer to Para 3.18).
   d. Carry out Halts on the March servicing.
   e. Draw fuel and lubricants, as required and top up fuel tank and, engine oil.
   f. If vehicle has been subjected to deep water crossings, the oils in the front hubs, front and rear axles, transmission and transfer case, should be checked immediately afterwards for signs of water contamination. If any traces of water are found, the oil should be drained and replenished with correct type as soon as possible.
   g. Check radiator core, oil coolers and air conditioner condenser for damage or air flow restriction. Clean as required with compressed air or water, working from the engine side of the radiator.
   h. Switch off all electrical devices.
i. Complete documentation and report defects.

j. Close cab doors and windows.

**Reporting of Defects**

**3.10.** Defects found when conducting parade and operator periodic servicing must be reported to a supervisor for workshop action.

**Periodical Maintenance**

**3.11.** To ensure that the vehicle is correctly maintained and fit for operational tasks, it is necessary to carry out regular periodical maintenance. Periodical maintenance details are as follows:

a. Daily, weekly and monthly servicing in accordance with Table 3-1, Table 3-2 and Table 3-3 is to be carried out by operators and is the responsibility of owner units.

b. Initial, minor and major servicing is to be carried out in accordance with EMEI Vehicle D 329 by RAEME tradespersons with assistance from operators working under RAEME tradesperson supervision. The unit is responsible for ensuring that the vehicle is serviced at the following intervals:

   (1) **Initial Service.** This is to be carried out on a new or rebuilt vehicle at the completion of the first three months or 5000 km of operation, whichever occurs first.

   (2) **Minor Service.** This is to be carried out every twelve months or 20 000 km of operation whichever occurs first.

   (3) **Major Service.** This is to be carried out every 24 months or 40 000 km of operation, whichever occurs first.

   (4) **Alternate Major Service.** This is to be carried out every 48 months or 80 000 km of operation, whichever occurs first.

**3.12.** Carry out operator servicing tasks in accordance with the following:

a. Table 3-1 lists the tasks to be performed by the operator on a daily/weekly/monthly basis for the cab/chassis. Refer to Figure 3-16 and Figure 3-17.

b. Table 3-2 lists the tasks to be performed by the operator on a daily/weekly/monthly basis for the recovery system. Refer to Figure 3-18, Figure 3-19 and Figure 3-20.
c. Table 3-3 lists the tasks to be performed by the operator on a daily/weekly/monthly basis for the crane. Refer to Figure 3-21.

Servicing Frequency

3.13. The operator servicing frequencies listed in Table 3-1, Table 3-2 and Table 3-3 are for normal operating conditions, based on continual daily usage. Discretion is to be applied for vehicles that have low usage levels. If the vehicle is being subjected to abnormal operating conditions such as high dust levels or moisture then the frequency of servicing/maintenance checks will need to be increased.

Cab/Chassis

3.14. The cab/chassis is to be maintained on a regular basis as indicated in Table 3-1, Figure 3-16 and Figure 3-17.

Table 3-1 Daily/Weekly/Monthly Maintenance Tasks – Cab/Chassis

<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lubricate steering drag link</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
</tr>
<tr>
<td>2. Lubricate steering shaft (2 fittings in cab)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
</tr>
<tr>
<td>3. Lubricate constant velocity joints</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
</tr>
<tr>
<td>4. Front wheel hub oil level</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>OEP 220</td>
</tr>
<tr>
<td>5. Lubricate upper and lower drive hub pivots</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
</tr>
<tr>
<td>6. Lubricate tie rod ends</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
</tr>
<tr>
<td>7. Drain air cleaner at rubber drain valves</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
<td>Lubricant</td>
<td>No of Points</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------</td>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>8. Lubricate propeller shafts</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>13</td>
</tr>
<tr>
<td>9. Lubricate transfer case selector</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>10. Lubricate transfer case linkage support</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>11. Lubricate all winch rope guide rollers (Forward recovery system. Rotate sheaves and rollers during greasing)</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>6</td>
</tr>
<tr>
<td>12. Lubricate front spring shackle pins</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>13. Lubricate mudguard pivots</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>14. Power steering, check fluid level, top-up as required</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Check front axle oil level (differential)</td>
<td></td>
<td>X</td>
<td></td>
<td>OEP-220</td>
<td>1</td>
</tr>
<tr>
<td>16. Check engine oil level (top-up if necessary)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>OM 115</td>
<td>1</td>
</tr>
<tr>
<td>17. Lubricate clutch cross shaft</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>18. Check transmission oil level</td>
<td></td>
<td></td>
<td>X</td>
<td>OEP-220</td>
<td>1</td>
</tr>
<tr>
<td>Operation</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
<td>Lubricant</td>
<td>No of Points</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>19.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check condition and tension of fan belts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain the fan hub air filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>50% Ethylene Glycol (pre-mix prior to filling)</td>
<td>1</td>
</tr>
<tr>
<td>Check coolant level (top-up if necessary)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check coolant temperature gauge reading normal reading 80 to 85°C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check radiator cooling fins for restriction, clean if required</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td></td>
<td>X</td>
<td></td>
<td>OEP-220</td>
<td>1</td>
</tr>
<tr>
<td>Check transfer case oil level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td></td>
<td>X</td>
<td></td>
<td>OEP-220</td>
<td>1</td>
</tr>
<tr>
<td>Check Intermediate axle oil level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td></td>
<td>X</td>
<td></td>
<td>OEP-220</td>
<td>1</td>
</tr>
<tr>
<td>Check the rear axle oil level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>Check the pintle hook and towing eye wear surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check the operation of the air conditioning system. Run for 10 minutes</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Air conditioner fresh air filter</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
Table 3-1 Daily/Weekly/Monthly Maintenance Tasks – Cab/Chassis (Continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Air conditioner return air filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Check for air, fuel, oil and coolant leaks</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check air buzzer and low air pressure light</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of air system dump valves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>- Check operation of the TruckMaster air filter and DumpMaster (EXT 50) dump valve</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Check all vehicle lights for correct operation including recovery system and crane</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check equipment stowage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check all instruments and gauges for operation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check battery terminals for cleanliness and security</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
<td>Lubricant</td>
<td>No of Points</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------</td>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>- Check battery, electrolyte levels. Top-up if necessary</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check clutch pedal for adequate free travel</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check driving mirrors, door windows, catches and latches</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check for the presence of the vehicle first aid kit</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>- Check fuel supply (at tank)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Drain water from fuel tank</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Check operation of CCTV cameras</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of electric and air horns</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of hand throttle control</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of power divider and transfer case lockout lights</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of transfer case controls</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
<td>Lubricant</td>
<td>No of Points</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>- Drain moisture from brake air reservoirs</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>- Check parking brake for application, release and holding ability</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check seats and seat belts for operation, condition and security</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check serviceability of ‘ON-TOW’ sign (lights, retaining straps)</td>
<td></td>
<td>X</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>- Check the operation of air suspension system</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>- Check operation of vehicle jacks</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>- Check tyres and wheels for security and serviceability. Inflate tyres if necessary</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>- Inspect wheel nuts for evidence of looseness</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check security and inflation pressure of spare wheel</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
Table 3-1    Daily/Weekly/Monthly Maintenance Tasks – Cab/Chassis (Continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Clean windscreen, door glass, mirrors, lights reflectors and cameras lens</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of windscreen wipers and washers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Top-up windscreen washer reservoir if required</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Check operation of handheld radios</td>
<td></td>
<td></td>
<td>X</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>- Wipe the handheld radio contacts and accessory interface with a dry lint free cloth to remove any dirt, oil or grease</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Recovery System

3.15. The recovery system is to be maintained on a regular basis as indicated in Table 3-2, Figure 3-18, Figure 3-19 and Figure 3-20.
<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the hydraulic reservoir oil level</td>
<td>X</td>
<td>X</td>
<td>OM-68</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2. Check the directional control valve pressure regulator 5.5 to 6.2 bar (80 to 90 psi)</td>
<td></td>
<td>X</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3. Check/top-up mist lubricator level</td>
<td>X</td>
<td></td>
<td>Tellus 22 or equivalent</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4. Drain moisture from the air filter (turn drain screw clockwise to drain)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5. Inspect the winch ropes, drum and rope wedge</td>
<td>X</td>
<td></td>
<td>Rocol or equivalent SWR lubricant</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>6. Clean winch free spool cylinder engaging holes</td>
<td>X</td>
<td></td>
<td></td>
<td>2 per winch</td>
<td></td>
</tr>
<tr>
<td>7. Lubricate the spade cylinder upper pins (under cover plate)</td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8. Lubricate the fairlead sheaves (rotate sheaves when greasing)</td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9. Lubricate the rope tensioners</td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>10. Lubricate the forward recovery sheave (rotate sheave when greasing)</td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Operation</td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
<td>Lubricant</td>
<td>No of Points</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>11. Lubricate the control lever bushes</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>7</td>
</tr>
<tr>
<td>12. Lubricate the cat walk hold open latch</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>13. Clean and lubricate the reversing sheave bushes (rotate sheaves after greasing)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>14. Lubricate the lift cylinder pin (at tailgate)</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>15. Lubricate the fairlead pivot. (rotate fairleads when greasing)</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>16. Lubricate the tow cylinder pins (at tailgate)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>17. Lubricate the towing pivot head</td>
<td></td>
<td>X</td>
<td></td>
<td>XG-291</td>
<td>8</td>
</tr>
<tr>
<td>18. Check and adjust Winch drag brake</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1 per winch</td>
</tr>
<tr>
<td>- Lubricate the spade cylinder lower pins. (extend spade)</td>
<td>X</td>
<td></td>
<td></td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>- Check sheave tensioner pressure settings 6.8 to 7.5 bar (100 to 110 psi)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Table 3-2  Daily/Weekly/Monthly Maintenance Tasks – Recovery System (Continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Conduct recovery system function test listed on page 3-29</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Crane Servicing

3.16. The crane is to be serviced by the operator on a regular basis as indicated in Table 3-3 and Figure 3-21.

Table 3-3  Daily/Weekly/Monthly Maintenance Tasks – Crane

<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lubricate the crane linkage system</td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
<td>4</td>
</tr>
<tr>
<td>2. Lubricate the boom lift cylinder centre pivot</td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
<td>2</td>
</tr>
<tr>
<td>3. Lubricate the elevating arm cylinder pivot</td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>4. Lubricate the boom bushes</td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>5. Lubricate the boom extension</td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
<td>1</td>
</tr>
<tr>
<td>6. Lubricate the crane pillar bearing and slew gear</td>
<td></td>
<td></td>
<td>X</td>
<td>XG-291</td>
<td>3</td>
</tr>
<tr>
<td>7. Lubricate the stabiliser control levers and shift rods</td>
<td></td>
<td></td>
<td>X</td>
<td>OMD-115</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 3-3  Daily/Weekly/Monthly Maintenance Tasks – Crane  (Continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Lubricant</th>
<th>No of Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the hour meter for servicing due</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td></td>
<td>X</td>
<td>OMD-115</td>
<td></td>
</tr>
<tr>
<td>Lubricate the main control levers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the tamper evident seals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the crane base mounting shackle bolts security</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td></td>
<td></td>
<td></td>
<td>OMD-115</td>
<td></td>
</tr>
<tr>
<td>Lubricate and visually inspect the hook</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check condition of instructional decals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check operation of control panel lights</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct function test as per Para 3.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HRV Specific Recovery CES**

3.17. HRV unique recovery CES items are to be inspected and serviced in accordance with EMEI Vehicle D 329-1.

**Vehicle Cab Chassis**

**Brake System Reservoirs**

3.18. Slightly open the drain valves on the upper and lower primary tanks, the secondary tank and the reserve tank to expel accumulated moisture due to condensation. Refer to Figure 3-1.
Clutch Cross Shaft Bearings

3.19. The clutch cross shaft, located in the bell housing, forward of the transmission is lubricated by a grease nipple at each end of the shaft and is to be lubricated every minor and major. DO NOT over grease. The clutch release cross shaft lubrication points are shown in Figure 3-2.

Figure 3-1 Location of wet and primary air tanks

Figure 3-2 Location of clutch cross shaft lubrication points
Coolant Top Up – Mixing

3.20. Engine radiator coolant is to be pre-mixed before adding to the engine coolant system. Coolant is to be mixed in accordance with the individual manufacturer’s instructions and ratios.

Horton Fan Hub

3.21. The Horton fan hub air filter is drained by opening the drain screw located on the base of the filter housing. Turn screw clockwise to drain. Refer to Figure 3-3.

![Figure 3-3 Draining the Horton fan hub filter](image)

Transfer Case Lever and Linkage Lubrication

3.22. The transfer case shift lever and linkage support lubrication points are shown in Figure 3-4 and Figure 3-5.
The transfer case oil level is checked by using the dipstick fitted to the oil cooler suction unit on the RH side of the transfer case. Refer to Figure 3-6. The dipstick is accessed by removing the knurled knob fitted to the suction unit and withdrawing the dipstick. Refer to Figure 3-7. Oil should be visible on the flattened portion of the dipstick. Refer to Figure 3-8.
NOTE

Vehicles that have been in recent use should be allowed to stand for 10 minutes prior to checking the oil level. This will let the oil settle and give an accurate measurement on the dipstick.

Figure 3-6  Transfer case oil cooler suction unit

Figure 3-7  Transfer case oil level dipstick
3.24. **Transfer Case Oil Filling (Operator).** For minor top ups of the transfer case proceed as follows:

   a. Remove the filler plug on the top face of the oil cooler suction unit. See Figure 3-6.

   b. Insert the oil filler nozzle and slowly add the required amount of oil (OEP 220).

   c. Reinstall the filler plug and allow the oil to settle before checking the oil level with the dipstick.

3.25. **Transfer Case Oil Filling (Maintainer).** For initial filling or filling after draining the transfer case proceed as follows:

   a. Remove the rear bearing cover retaining bolt that is located at the 3 o’clock position, see Figure 3-9, when oil starts to flow from this opening the correct level has been reached.

   b. Remove the rear bearing cover retaining bolt that is located at the 9 o’clock position, see Figure 3-9, insert the oil filler nozzle and slowly add the required amount of oil (OEP 220).

   c. When oil starts to flow from the rear bearing cover bolt hole the correct level has been reached.

   d. Remove the filling nozzle, wait until the oil ceases to flow and then reinstall the two bearing cover bolts. Tension required is 45 to 65 lbf.ft (61 to 88 N.m).
Air Conditioning – Air Filter Cleaning

**WARNING**

Exercise care when accessing the return air filter to remove the risk of falling from the vehicle cabin. Personal injury may result from falling.

3.26. **Fresh Air Intake Filter.** This filter is located on the rear exterior of the cabin roof rack. Refer to Figure 3-10.
3.27. To clean the air filter elements, proceed as follows:

a. Remove the three screws securing the filter cover and lift off the cover.

b. Remove the grille and filter pad carefully and separate the filter from the retainer and filter grilles.

c. Wash the filter pad in water. The use of a mild detergent is preferred. Do not use solvent or petroleum based cleaners.

d. Dry the pad and refit to the filter housing in the reverse order to removal. Refer to Figure 3-11.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Filter cover</td>
<td>3.</td>
<td>Filter element</td>
</tr>
<tr>
<td>2.</td>
<td>Filter retainer</td>
<td>4.</td>
<td>Rubber gasket</td>
</tr>
</tbody>
</table>

Figure 3-11  Cabin fresh air filter – order of assembly
3.28. **Return Air Intake Filter.** This filter is located on the front of the evaporator assembly, adjacent to the windscreen. Refer to Figure 3-12. To clean or replace the return air intake filter, proceed as follows:

![Return Air Filter and 'Oddie' Clip](image)

**Figure 3-12** Air conditioner return air filter

a. Twist the 'Oddie' clips located at each end of the filter grille using a flat tipped screw driver.

b. Remove the grille and filter pad.

c. Wash the filter pad in water. The use of a mild detergent is preferred. Do not use solvent or petroleum based cleaners.

d. Dry the pad and refit to the filter housing in the reverse order to removal. Position the 'Oddie' clips as shown in Figure 3-13 and press into place.

![Orientation of 'Oddie' Clip](image)

**Figure 3-13** Orientation of 'Oddie' clip for refitting

3-25
Recovery System

Recovery System Mist Lubricator Refill

3.29. The mist lubricator can be topped with oil by unscrewing the lubricator bowl from the body and refilling with light machine oil. Once refilled, refit the bowl back to the lubricator body.

Winch Ropes

3.30. The winch rope should be pulled out, checked, cleaned and regreased every service. When rewinding the rope onto the winch, the rope tensioner must be applied. Ropes are to be inspected in accordance with EMEI Vehicle D 108.

3.31. When winch ropes require replacement, fit new winch ropes as follows:

**WARNING**

*Always wear suitable leather gloves when handling winch ropes, otherwise personal injury may occur.*

a. Park the vehicle in a position where the full length of the rope may be laid out behind the vehicle. The rope is 98.5 metres long. This area should preferably be hard standing to keep the rope clean.

b. Disengage the winch free-wheeling plunger and pull the old rope from the winch drum until all rope is wound off the drum. Do not attempt to drive the rope out under power.

c. Remove the rope wedge securing the rope into the winch drum.

d. Pull the remaining rope from the winch, roll it up and secure it properly for disposal.

e. Clean the winch drum, sheaves and fairleads to remove any remaining dirt, old grease and foreign matter.

f. Lay out the new rope behind the vehicle. Ensure that it does not twist or kink. New ropes are to be removed from the rope spool in order to prevent kinking and twisting of the rope.
g. Feed the new rope through the fairlead, reversing sheave and through the rope hole in the winch drum. Ensure that the rope path is correct and that no fouling of other recovery system components will occur.

h. Secure the rope into the winch drum using the rope wedge as shown in Figure 3-14. Ensure that the wedge is securely engaged with the drum.

![Figure 3-14 Fitting the rope wedge into the winch drum](image)

i. Engage the winch free-spooling plunger. Ensure that it is fully engaged into the winch drive.

j. Wind the rope in until there are four rope turns on the drum. Check the rope on the drum and the security of the rope wedge.

k. Apply a load to the rope. The rope must be wound on the drum with a loading of 1000 kg to prevent damage to the rope during actual recovery operations.
l. Operate the winch to wind the remaining rope onto the drum. Maintain a watch on the winch to ensure that the rope is being wound correctly onto the drum.

m. Carry out a minimum of two full length pulls of the rope under load as per Para 3.31 k. to ensure that the rope is correctly laid onto the winch drum.

n. Secure the loose end of the ropes together to prevent uncontrolled movement of the loose rope ends.

**Winch Drag Brake Adjustment**

3.32. The winch drum brake is to be adjusted so that the winch rope can be pulled out by one operator at walking pace, with the winch drum in freespool mode, and that the drum stops when the operator stops. A second person should be used to observe the winch whilst the rope is being pulled from the drum and prevent overspooling as necessary. If required, adjust the winch brake as follows. Refer to Figure 3-15.

a. Loosen the lock nut.

b. Turn the adjusting screw ¼ turn clockwise to increase the braking effort or anti-clockwise to decrease the braking effort.

c. Tighten the lock nut.

![Winch Drag Brake Adjuster](image-url)
d. With the winch in freespool mode check the brake adjustment by pulling the winch rope by one operator at walking speed from the rear of the HRV and with a second operator viewing the winch drum.

e. The correct adjustment is when the operator pulling the winch rope can walk with the winch rope without undue effort and when given the command to stop from the operator viewing the winch drum the winch drum stops without overspooling of the winch rope on the drum.

f. If the drum continues to turn/overspool, conduct Para 3.32 a. to d. to rectify.

Winch Tensioner Adjustment

3.33. To adjust the rope tensioner pressure regulators conduct the following:

a. with the HRV operating and at the normal operating air pressure engage the winch PTO;

b. utilising the function switches in the LH work station engage the LH and RH rope tensioners;

c. visually check the LH and RH rope tensioner pressure gauges for the correct settings (6.2 bar – 90 psi);

d. to adjust turn the valves contained to the gauges clockwise to increase pressure, anti clockwise to decrease pressure; and

e. on completion of adjustment disengage then re engage both rope tensioners to confirm correct pressure settings.

Functional Tests

3.34. The following functional tests are to be carried out on the HRV on a monthly basis to ensure the continued operational reliability of the recovery system and crane. These tests are to be carried out in a suitable area with due consideration for safety and adequacy for the conduct of these tests.

Recovery System

3.35. Each of these tests must be carried out from each of the following workstations to confirm the serviceability of each control system:

a. LH Control Cabinet,
b. RH Control cabinet, and
c. remote control pendant.

3.36. Carry out the functional tests for the recovery system as follows:
   a. Check the hydraulic oil reservoir level and top up if necessary.
   b. Engage the recovery system PTO.
   c. Extend and retract the tow hitch lift cylinder.
   d. Extend and retract each tow cylinder.
   e. Extend and retract each earth spade cylinder. Ensure that the spades are fully retracted.
   f. Disengage the free spooling device on one winch and withdraw approximately 10 metres of rope.
   g. Set the winch to AUTOMATIC operation.
   h. Engage the free-spooling device and check for correct engagement.
   i. Apply the rope tensioner for the respective winch.
   j. Actuate the winch to winch the rope in.
   k. Release the rope tensioner and winch out under power. Ensure that the rope is manually drawn from the winch drum whilst winching out to prevent loosening of rope coils on the winch drum.
   l. Apply the rope tensioner and winch the rope in under tension.
   m. Set the winch to MANUAL operation and perform winch in and out functions ensuring that the rope tensioner is disengaged/engaged when required.
   n. Repeat the winch tests on the other winch.
   o. Set the winch back to AUTOMATIC mode, stow winch ropes in travel mode.
   p. Test all lighting, including control cabinets, work lights, flood lights and rotating lights. This includes testing all power sockets and the crew cab mounted flood lights.
q. Test the manual override switches for the hydraulic oil cooler from each of the LH and RH control cabinets. Visually check that the oil cooler fan is operating.

r. Actuate the throttle control switch from each of the LH and RH control cabinets and check the engine rpm on the tachometer. Engine speed should be 1500 rpm.

s. Switch off PLC’s, work station lights, disengage rope tensioners and recovery system PTO.

t. Carry out a visual inspection of the recovery system components for any evidence of wear, insecurity of components etc.

u. Check the oil cooler for cleanliness. If any blockages or restrictions are evident in the cooling fins, the cooler is to be cleaned and restrictions to air flow removed.

Crane

3.37. The crane functional tests are to be carried out using each of the following means:

   a. Local operation using the control valve levers.
   b. Remote control using the radio remote system.
   c. Remote control using the remote control cable.

3.38. Carry out functional tests on the crane as follows. All safety requirements are to be observed.

   a. Carry out pre-operation checks as per Sect 2, Chap 4.
   b. Inspect the hook and attachments for serviceability.
   c. Engage the crane PTO.
   d. Fit the stabiliser footings and lower both stabilisers to the ground.
   e. Conduct the crane overload test as per Para 2.140.
   f. Fully extend and retract the outer boom.
   g. Fully extend and retract the boom extension.
   h. Slew the crane through the full extent of rotation.
   i. Carry out a visual inspection of the crane and components for wear, insecurity of components etc.
   j. Fold and stow the crane.
k. Retract the stabilisers.
l. Remove and stow the stabiliser footings.
m. Stow all equipment.
n. Check the remote battery charger operation. Illuminated lamps indicate power is available.
o. Disengage the crane PTO.
Figure 3-16 Servicing points for front power train and drive line
Figure 3-17 Servicing points for driveline (rear)
Figure 3-18 Servicing points for recovery equipment
Figure 3-19  Servicing points for recovery system – rear
Figure 3-20  Servicing points for winches
Figure 3-21 Servicing points for crane
CHAPTER 2
LUBRICATION

Introduction

Transfer Case Fault Finding

2.40. The T-Case warning light (Figure 1-48 Item 34) indicates a loss of oil pressure in the Cooling System through either system leaks or T-Case seal failure. If the warning light remains illuminated above 1200 RPM, the operator must stop and check the T-Case and its cooling system for leaks and confirm the oil level within the T-Case. If no leaks are detected and T-Case oil level is OK, the vehicle can be driven safely and the operator is to report the failure at completion of their task. If an oil leak is detected and can not be repaired through tightening of unions, the vehicle must not be driven.

Winch Fault Finding

3.41. Table 3-4 and Table 3-5 provide fault finding procedures for the recovery system winches when in either automatic or manual modes.

Table 3-4 Winch System Fault Finding (Automatic Mode)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Winch will not operate</td>
<td>a. PTO has not been engaged</td>
<td>Engage PTO.</td>
</tr>
<tr>
<td></td>
<td>b. PLC isolation switch turned off</td>
<td>Set PLC isolation switch to ON position.</td>
</tr>
<tr>
<td></td>
<td>c. No oil flow to winch</td>
<td>Check hydraulic oil level.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check all hydraulic lines, fittings and components for leaks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ensure the hydraulic isolation valves under the tank are all open.</td>
</tr>
</tbody>
</table>
### Table 3-4  Winch System Fault Finding (Automatic Mode)  
(Continued)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. Automatic / Manual selector valve incorrectly set</td>
<td>Ensure the lever on the hydraulic valve block is in either the Automatic or Manual position. Move the lever in the required direction until it stops. Ensure that the sensor on the block 'sees' the control handle and the display shows the selected mode.</td>
<td></td>
</tr>
<tr>
<td>e. Defective hydraulic motors</td>
<td>Report to Technical Maintenance Organisation.</td>
<td></td>
</tr>
<tr>
<td>f. Emergency stop button is pressed</td>
<td>Reset emergency stop on the recovery system remote control.</td>
<td></td>
</tr>
<tr>
<td>g. Electric defect</td>
<td>Use manual operation and report to Technical Maintenance Organisation.</td>
<td></td>
</tr>
</tbody>
</table>

2. Winch drum does not turn  

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The pin of the disengaging (free spooling) device is disengaged from the ring gear</td>
<td>Ensure that ALL winch Engage/Disengage switches are in the engaged position and check that the pin locks into the ring gear. Correct pin engagement is checked by measuring the distance the pin protrudes from the top of the cylinder cap. This distance should be between 4 and 7 mm and must not exceed 7 mm.</td>
<td></td>
</tr>
<tr>
<td>Symptom</td>
<td>Probable Cause</td>
<td>Action</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>2. Winch drum does not turn (Continued)</td>
<td>a. The pin of the disengaging (free spooling) device is disengaged from the ring gear (Continued)</td>
<td>If adjustment is required, report to Technical Maintenance Organisation (refer to EMEI Vehicle D 323). Check the electrical circuit and solenoid bank for correct operation.</td>
</tr>
<tr>
<td>3. Winch drum does not disengage</td>
<td>a. The pin of the disengaging (free spooling) cylinder will not disengage from the ring gear</td>
<td>Check the air supply to lower port of the disengaging cylinder. Check the electrical circuit and solenoid bank for correct operation. Pay out rope to unload winch. Report to Technical Maintenance Organisation for repair.</td>
</tr>
<tr>
<td>b. Winch is under load</td>
<td></td>
<td>Report to Technical Maintenance Organisation for repair.</td>
</tr>
<tr>
<td>c. Disengaging (free spooling) cylinder piston return spring broken or collapsed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Disengaging (free spooling) cylinder piston jammed in cylinder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Winch display will not operate</td>
<td>a. No power to PLC</td>
<td>Ensure that the PTO is engaged and the PLC isolation switch is in the ON. Check the power supply and main recovery circuit breaker. Check the fuses in the PLC (refer to EMEI Vehicle D 323).</td>
</tr>
<tr>
<td>Symptom</td>
<td>Probable Cause</td>
<td>Action</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>b. Broken connection between PLC and display box</td>
<td>Check all wiring and connections between the PLC and Display. Report defects to Technical Maintenance Organisation.</td>
<td></td>
</tr>
</tbody>
</table>

5. Winch will not achieve required force

<table>
<thead>
<tr>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Selector valve in manual position</td>
<td>Place the lever on the hydraulic valve block in the Automatic position. Check that the sensor is in place, is in good condition and that the wiring between the sensor and the PLC is in good condition. Report defects to Technical Maintenance Organisation.</td>
</tr>
<tr>
<td>b. Fault with inductive sensor on the hydraulic valve block (not sensing that the lever is in the Automatic position)</td>
<td></td>
</tr>
<tr>
<td>c. Low hydraulic pressure</td>
<td>Check the hydraulic pressure at the gauge on the control panel. A minimum of 100 bar is required to overcome the sequence valve and engage secondary motors. If required pressure is not achieved, report to Technical Maintenance Organisation.</td>
</tr>
<tr>
<td>d. Electrically controlled pressure reducing valve malfunction</td>
<td>Check the electrical connection between the valve and PLC box. Report defects to Technical Maintenance Organisation for inspection and repair.</td>
</tr>
<tr>
<td>Symptom</td>
<td>Probable Cause</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>f. Problem with mechanical flag adjustment seized, damaged or worn pressure plate or linkages</td>
<td>Report to Technical Maintenance Organisation for repair.</td>
</tr>
<tr>
<td></td>
<td>b. Hydraulic brake clutch pack worn and/or reduced spring tension</td>
</tr>
<tr>
<td>7. Display showing Menu 15 (Alarm, Sensor Fault)</td>
<td>a. Poor electrical connection between distance sensor and PLC</td>
</tr>
<tr>
<td><strong>Symptom</strong></td>
<td><strong>Probable Cause</strong></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>9. Display showing Menu 16-17 (Alarm, Pressure guard 1 or 2)</td>
<td>a. Poor electrical connection between pressure guard and PLC</td>
</tr>
<tr>
<td></td>
<td>d. Hydraulic oil filters are dirty</td>
</tr>
<tr>
<td></td>
<td>e. The brake doesn't work properly</td>
</tr>
</tbody>
</table>
Table 3-4  Winch System Fault Finding (Automatic Mode)  
(Continued)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d. Hydraulic oil too hot</td>
<td>Refer to serial 12.</td>
</tr>
<tr>
<td></td>
<td>e. Hydraulic oil filters are dirty</td>
<td>Replace.</td>
</tr>
<tr>
<td>13. The display shows level 3 even though the winch has 4 rope layers spooled on the drum</td>
<td>a. Problem with mechanical flag adjustment seized, damaged or worn pressure plate or linkages</td>
<td>Report to Technical Maintenance Organisation for repair.</td>
</tr>
<tr>
<td>Symptom</td>
<td>Probable Cause</td>
<td>Action</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Winch will not operate</td>
<td>a. PTO has not been engaged</td>
<td>Engage PTO.</td>
</tr>
<tr>
<td></td>
<td>b. No oil to winch</td>
<td>Check hydraulic oil level.</td>
</tr>
<tr>
<td></td>
<td>c. Automatic / Manual selector valve incorrectly set</td>
<td>Check all hydraulic lines, fittings and components for leaks.</td>
</tr>
<tr>
<td></td>
<td>d. Defective hydraulic motors</td>
<td>Ensure the hydraulic isolation valves under the tank are all open.</td>
</tr>
<tr>
<td></td>
<td>e. Emergency stop button is pressed</td>
<td>Ensure the lever on the hydraulic valve block is in the Manual position. Move the lever in the required direction until it stops.</td>
</tr>
<tr>
<td>Winch drum does not turn</td>
<td>a. The pin of the disengaging (free spooling) device is disengaged from the ring gear.</td>
<td>Ensure that ALL winch Engage/Disengage switches are in the engaged position and check that the pin locks into the ring gear. Correct pin engagement is checked by measuring the distance the pin protrudes from the top of the cylinder cap. This distance should be between 4 and 7 mm and must not exceed 7 mm.</td>
</tr>
<tr>
<td>Symptom</td>
<td>Probable Cause</td>
<td>Action</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2. Winch drum does not turn (Continued)</td>
<td>a. The pin of the disengaging (free spooling) device is disengaged from the ring gear (Continued)</td>
<td>If adjustment is required, report to Technical Maintenance Organisation (refer to EMEI Vehicle D 323). Check the electrical circuit and solenoid bank for correct operation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Winch drum does not disengage</td>
<td>a. The pin of the disengaging (free spooling) cylinder will not disengage from the ring gear</td>
<td>Check the air supply to lower port of the disengaging cylinder. Check the electrical circuit and solenoid bank for correct operation. Pay out rope to unload winch. Report to Technical Maintenance Organisation for repair.</td>
</tr>
<tr>
<td></td>
<td>b. Winch is under load</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Disengaging (free spooling) cylinder piston return spring broken or collapsed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Disengaging (free spooling) cylinder piston jammed in cylinder.</td>
<td></td>
</tr>
<tr>
<td>4. Winch will not achieve required force</td>
<td>a. Low hydraulic pressure</td>
<td>Check the hydraulic pressure at the gauge on the control panel. A minimum of 100 bar is required to overcome the sequence valve and engage secondary motors. If required pressure is not achieved, report to Technical Maintenance Organisation.</td>
</tr>
</tbody>
</table>
Table 3-5  Winch System Fault Finding (Manual Mode)  
(Continued)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Hydraulic brake clutch pack worn and/or reduced spring tension</td>
<td></td>
<td>Report to Technical Maintenance Organisation for repair.</td>
</tr>
<tr>
<td>d. Hydraulic oil filters are dirty</td>
<td></td>
<td>Replace.</td>
</tr>
</tbody>
</table>
### Table 3-5  Winch System Fault Finding (Manual Mode) (Continued)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. The brake doesn't work properly</td>
<td>Report to Technical Maintenance Organisation for valve adjustment or repair in accordance with EMEI Vehicle D 324-1.</td>
<td></td>
</tr>
</tbody>
</table>

8. Winch will not achieve required rope speed  
   a. Engine rpm too low  
   b. Hydraulic pump worn out  
   c. Hydraulic motor worn out  
   d. Hydraulic oil too hot  
   e. Hydraulic oil filters are dirty  
   f. Control valve defect  
   Report to Technical Maintenance Organisation for adjustment.  
   Refer to serial 9.  
   Replace.  

9. Hydraulic oil too hot (>70°C)  
   a. Control valve defect  

---

**Palfinger Crane Error Codes**

3.42. The Palfinger crane has two categories of codes displayed in the status display LED of the Paltronic unit box. These codes are:

a. **Standard Codes (non-flashing).** Standard codes are indicated by a steadily displayed two digit number eg 03. Refer to EMEI Vehicle D 323.

b. **Flashing Codes.** Flashing codes are displayed in conjunction with following additional information code (refer to Table 3-7). The main code is displayed with a dot after the number (eg 63.)
while the additional code is displayed without a dot (eg 07). Refer to Table 3-6.

3.43. The system further distinguishes between status codes and error codes as follows:

a. **Status Codes.** Status codes are information for the operator which appears during normal crane operation. By following correct operating procedures a displayed status code will automatically change back to the normal operating code (00). Eg; if the code 03 is displayed indicating an overload situation, it will revert back to 00 when the lifting moment is reduced.

b. **Error Codes.** Error codes indicate a system fault and are denoted by ** under the code numeral in EMEI Vehicle D 323. Error codes must be reset by pressing the OLP button or restarting the system upon the completion of repairs.

3.44. Operators are not to attempt any repair task to the crane protection system for which they have not been trained. Operators are to seek technical assistance where required.

**Testing the Crane Radio Remote**

3.45. To test the control levers and buttons on the remote control console, proceed as follows:

a. To enter the test mode press and release the emergency stop button on the remote console, then press the start button ten times in rapid succession.

b. Test the proportional levers by operating them one by one. The console will give acoustical signals according to the angle of the lever.

c. Test the digital functions (buttons and switches) by operating them one by one. A beep will be heard each time a function is operated.

d. If there is a fault with a particular function no beeping will be heard and the console should be replaced.

**NOTE**

The crane can be used in manual mode if the remote console is unserviceable.

e. To exit the test mode, press the emergency stop button.
<table>
<thead>
<tr>
<th>Code 1</th>
<th>Code 2</th>
<th>Description</th>
<th>Reason</th>
<th>Solution</th>
<th>LED</th>
<th>Locked Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>AA</td>
<td>Actual load limit on crane overridden. Load moment increasing movements blocked</td>
<td>Crane in overload</td>
<td>Reduce load on crane (refer to user handbook).</td>
<td>Crane</td>
<td>OVL crane</td>
</tr>
<tr>
<td>42</td>
<td>AA</td>
<td>CAN error interrupt, bus off</td>
<td>CAN – bus error</td>
<td>Check all CAN bus connections, restart system.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>BB</td>
<td>CAN – bus error</td>
<td>CAN – members have the same or similar addresses</td>
<td>Check and reset all address switches of CAN – bus members (refer to ‘addressing of the system’). Change CAN – bus member’s one by one, restarting system after each change.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>DD</td>
<td>CAN warning status</td>
<td>CAN – bus error, warning status</td>
<td>Check all bus connections, restart the system.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>BB</td>
<td>Initialisation error of CAN – bus members</td>
<td>CAN – member received a non programmed restart. This may occur due to bad connections, defective cables or plugs.</td>
<td>Check all bus connections and replace cable if necessary. Restart system. If error remains, change the CAN member indicated by the flashing address code.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>EE</td>
<td>Comparison of actual desired position of control valve spools not okay</td>
<td>Too fast change of operating direction on a single function (A to B), very cold oil or incorrectly programmed delay time</td>
<td>Restart system. Allow engine to idle with PTO engaged to warm up oil. If error continues, check RC signal and Danfoss module.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>BB</td>
<td>Error document from the main spool position box to the main unit</td>
<td>The spool position box found an error</td>
<td>Restart system. If error remains, change the spool position box. The additional information (BB) shows the address of the defective unit.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>BB</td>
<td>10 times no telegram (100 ms) from spool position</td>
<td>Spool position box gives no answer</td>
<td>Check wiring and restart system. If error remains, change the spool position box. The additional information (BB) shows the address of the defective unit.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>EE</td>
<td>Lever not in neutral position during start up</td>
<td>The spool of a certain function is acted while starting the system. The cable to the spool position switch is defective. Connection of the switch or in the spool position box is loose. Spool position sensor is damaged. The LED in the spool position box has to be on in the neutral position of the spool</td>
<td>Check the wiring and connections to the shown function. To find out if the switch or cable is damaged interchange two different spool position connections in the box. If the code remains the same after restarting the system, the cable is defective. If the code changes, the switch is defective.</td>
<td>Crane</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Code 2</td>
<td>Description</td>
<td>Reason</td>
<td>Solution</td>
<td>LED</td>
<td>Locked Functions</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-------------</td>
<td>--------</td>
<td>----------</td>
<td>-----</td>
<td>-----------------</td>
</tr>
</tbody>
</table>
| 64. ** | FF | Lever acted in both directions (no signal from a spool position sensor at all) | Cable from the spool position box to the switch is broken  
No power to the switch  
Check: in neutral position, the LEDs in the spool position box must be on | Check the wiring connections.  
To find out if the switch or cables are defective, interchange two different spool position connections in the box. If the code remains the same after restarting the system, the cable is defective. If the code changes, the switch is defective. If necessary, change wiring or switch (Danfoss module). | Crane flashing | All |
<p>| 65. ** | BB | Error initialisation of spool position box | It is impossible to initialise a spool position box. The box has probably been removed. | Check wiring and restart system. If the unit has been removed, the configuration in the software must be corrected (PALDIAG software). | Crane flashing | All |
| 66. ** | CC | Error message from the display unit to the main unit | A display unit found an internal error. | Restart the system. If error remains, change the defective display unit. The additional information (CC) shows the address of the defective unit. | Nil | Nothing |
| 67. ** | CC | 10 times no telegram (100 ms) from display unit | A display unit gives no answer | Check wiring and restart system. If error remains, change the defective display unit. The additional information (CC) shows the address of the defective unit. | Crane flashing | None |
| 68. ** | CC | Error initialisation of display unit | It is impossible to initialise a display unit. The unit has probably been removed. | Check wiring and restart system. If the unit has been removed, the configuration in the software must be corrected (PALDIAG software). | Nil | Nothing |
| 70. ** | CC | Error document from RRC-receiver unit | Radio remote control receiver found an internal error | Restart system, if error remains, change the receiver box. | Crane flashing | All |
| 71. ** | CC | Error document from RRC-receiver unit (digital function). 100 ms no telegram | No answer from RRC-receiver box | Check EX3 cable, restart the system. If error remains, change the receiver box. | Crane flashing | All |
| 72. ** | CC | Error document from RRC-receiver unit (proportional function) | No answer from RRC-receiver box | Check EX3 cable, restart the system. If error remains, change the receiver box. | Crane flashing | All |
| 73. ** | CC | Initialisation error of RRC-receiver box | System switches off due to overheating or receiver actually disconnected | Check EX3 cable, restart the system. If error remains, change the receiver box. Check CAN – bus configuration in the software to be sure to have correct setting, in case of code 77.99. | Crane flashing | All |</p>
<table>
<thead>
<tr>
<th>Code 2</th>
<th>Code 3</th>
<th>Description</th>
<th>Reason</th>
<th>Solution</th>
<th>LED</th>
<th>Locked Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>02</td>
<td>Overload crane nominal load</td>
<td>Crane overload</td>
<td>Reduce load on crane.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>51-5F</td>
<td>Address of defective CAN member</td>
<td>Also see codes 61. to 65. and 66. to 68</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td>61-6F</td>
<td>Address of defective CAN member</td>
<td>Code 51 is the crane spool position box, 52 is the fly jib spool position box</td>
<td>Check connections and addressing. Replace cables and connectors, reset the address using PALDIAG software.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>51, 52, 99</td>
<td>Address of defective CAN member.</td>
<td>Address with ‘O’ not allowed</td>
<td>Address switch to ‘1’ causes address 51. Address switch to ‘2’ causes address 52. and so on… Not known address gives code 99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td>61, 62, 63, 64, 99</td>
<td>Address of defective CAN member.</td>
<td>All addresses of this kind are display units, there is no defined rule how to order them</td>
<td>Check connections and addressing. Replace cables and connectors, reset the address using PALDIAG software.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DD</td>
<td>00</td>
<td>No specification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>01</td>
<td>Stuff error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02</td>
<td>Form error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>03</td>
<td>Acknowledge error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>04</td>
<td>Bit 1 error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>05</td>
<td>Bit 0 error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>06</td>
<td>CRC error</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>07</td>
<td>Unused</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE</td>
<td>01</td>
<td>Main boom lowering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02</td>
<td>Main boom lifting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>03</td>
<td>Outer boom lifting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>04</td>
<td>Outer boom lowering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Code 3</td>
<td>Description</td>
<td>Reason</td>
<td>Solution</td>
<td>LED</td>
<td>Locked Functions</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>------------------------------</td>
<td>----------------</td>
<td>----------</td>
<td>-----</td>
<td>------------------</td>
</tr>
<tr>
<td>05</td>
<td></td>
<td>Slewning left</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td></td>
<td>Slewning right</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td>Extending extension boom</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF</td>
<td>01</td>
<td>Main boom lifting and lowering</td>
<td>Normal function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td>Main boom lifting and lowering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td>Rotation left and right</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 4
CONSUMABLES

Lubricants

3.46. The list of lubricants contained in Table 3-8 are those lubricants that are used on the HRV.

Table 3-8  Fuel and Lubricants

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Type/Grade</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>Diesel</td>
<td>498 L</td>
</tr>
<tr>
<td>Engine</td>
<td>OMD-115</td>
<td>55.3 L (including filters)</td>
</tr>
<tr>
<td>Cooling system</td>
<td>Anti-Freeze</td>
<td>54 L</td>
</tr>
<tr>
<td></td>
<td>Anti-Boil</td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>OEP-220</td>
<td>12 L</td>
</tr>
<tr>
<td>Transfer case</td>
<td>OEP-220</td>
<td>9.5 L</td>
</tr>
<tr>
<td>Front axle (differential)</td>
<td>OEP-220</td>
<td>11.4 L</td>
</tr>
<tr>
<td>Front wheel bearings</td>
<td>OEP-220</td>
<td>fill to level plug</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(level plug horizontal with centre of hub)</td>
</tr>
<tr>
<td>Inter axle</td>
<td>OEP-220</td>
<td>12 L</td>
</tr>
<tr>
<td>Rear axle</td>
<td>OEP-220</td>
<td>11.2 L</td>
</tr>
<tr>
<td>Power divider</td>
<td>OEP-220</td>
<td>fill to level plug</td>
</tr>
<tr>
<td>Steering</td>
<td>OMD-115</td>
<td>7.75 L</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>OM-68</td>
<td>150 L</td>
</tr>
<tr>
<td>Air system lubricator</td>
<td>Tellus 22 or</td>
<td>20 ml</td>
</tr>
<tr>
<td></td>
<td>equivalent</td>
<td></td>
</tr>
<tr>
<td>Winch ropes</td>
<td>ROCOL or</td>
<td>4 x 500 ml aerosol cans</td>
</tr>
<tr>
<td></td>
<td>equivalent SWR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>lubricant</td>
<td></td>
</tr>
</tbody>
</table>

Minor Parts

3.47. The list of globes contained in Table 3-9 are those light globes that are used on the HRV. RPS 02252 is to be referred to for correct NSNs of items listed in Table 3-9 and Table 3-10.
<table>
<thead>
<tr>
<th>NSN/Mack Part No.</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5965-66-122-4444</td>
<td>Lamp, incandescent, 24 V</td>
<td>Cabin heater control</td>
</tr>
<tr>
<td>6240-00-019-0877</td>
<td>Lamp, incandescent, 24 to 28 V, 3cp, SCC, 'G' shape, clear</td>
<td>Front side marker lamp/rear blackout marker / front blackout marker and clearance and convey lamp</td>
</tr>
<tr>
<td>6240-00-019-3093</td>
<td>Lamp, incandescent, single contact bayonet base, 10 Watt, 28 V Nominal</td>
<td>Crew cab lamp</td>
</tr>
<tr>
<td>6240-00-295-2668</td>
<td>Lamp, incandescent 24 V, 18 Watt, BA15s base</td>
<td>Crew cab lamp</td>
</tr>
<tr>
<td>6240-12-328-2741</td>
<td>Lamp, incandescent, 24 V</td>
<td>Reversing lamp</td>
</tr>
<tr>
<td>6240-66-022-9412</td>
<td>Lamp, incandescent, 24 V</td>
<td>Map reading light</td>
</tr>
<tr>
<td>6240-66-023-2574</td>
<td>Lamp, incandescent 24 V, 3 Watt, brass ferrule base, cyl, shape, clear.</td>
<td>Side clearance lamp</td>
</tr>
<tr>
<td>6240-66-034-7725</td>
<td>Lamp, incandescent, 24 V, 2 Watt, single contact, (BA9s), 'T' shape, clear</td>
<td>Instrument panel</td>
</tr>
<tr>
<td>6240-66-095-0961</td>
<td>Lamp, incandescent, 24 V, 75/70 Watt, P43t base, quartz halogen</td>
<td>Headlamp</td>
</tr>
<tr>
<td>6240-66-098-3050</td>
<td>Lamp, incandescent, 24 V, 70 Watt, PK22s base, H3 YC2470</td>
<td>Driving Light</td>
</tr>
<tr>
<td>6240-66-110-8928</td>
<td>Lamp, incandescent, 24 V</td>
<td>Stop/ tail lamp</td>
</tr>
<tr>
<td>6240-66-134-9372</td>
<td>Lamp, incandescent, 24 V</td>
<td>Rear indicator lamp</td>
</tr>
<tr>
<td>6240-66-134-9372</td>
<td>Lamp, incandescent 24 V, 21 Watt, BA15s base</td>
<td>Rear, body mounted work lamps</td>
</tr>
<tr>
<td>6240-99-995-2162</td>
<td>Lamp, incandescent, 24 V, 5 Watt, wedge base, w2.1x9.5d</td>
<td>Lower left instrument panel</td>
</tr>
<tr>
<td>41MO29409M</td>
<td>Lamp, incandescent, 24 V</td>
<td>Removable work lamps</td>
</tr>
<tr>
<td>41MO29410M</td>
<td>Lamp, rotating lamp 24 V</td>
<td>Rotating lamps</td>
</tr>
<tr>
<td>X70MO227</td>
<td>Lamp, incandescent, 24 V, 2 Watt, single contact</td>
<td>Front indicator and mirror clearance</td>
</tr>
</tbody>
</table>
Air, Fuel and Oil Filters

3.48. The list of air, fuel and oil filters contained in Table 3-10 are those air, fuel and oil filters that are used on the HRV.

<table>
<thead>
<tr>
<th>NSN/Mack Part No.</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2940-66-152-4929</td>
<td>Filter element, intake air</td>
<td>Air cleaners</td>
</tr>
<tr>
<td>2940-00-029-0388</td>
<td>Filter element, fluid 10.5</td>
<td>Engine oil filter</td>
</tr>
<tr>
<td>2940-00-230-3681</td>
<td>Filter element, fluid paper</td>
<td>Power steering filter</td>
</tr>
<tr>
<td>2930-66-115-4967</td>
<td>Filter, water engine coolant</td>
<td>Water conditioner</td>
</tr>
<tr>
<td>2910-66-115-4970</td>
<td>Filter element, fluid</td>
<td>Primary fuel filter</td>
</tr>
<tr>
<td>2910-01-127-3685</td>
<td>Filter element, fluid 4-3/8</td>
<td>Secondary fuel filter</td>
</tr>
</tbody>
</table>
SECTION 4
WARRANTY
CHAPTER 1
WARRANTY AND REPAIR

Mack Trucks Australia Warranty

4.1. Mack Trucks Australia Pty Ltd (MTA) warrants that any Supplies provided under the Heavy Recovery Vehicle Contract (Contract No. V9-202793) shall be fit for the purpose or purposes detailed in the Contract, (a copy of which is held by the B-Vehicle National Fleet Manager). Furthermore, MTA warrants that the design, materials and workmanship in the Supplies conform with, and that the Supplies meet the requirements of the Contract.

4.2. Notwithstanding the above, the vehicle component parts as listed in Table 4-1 are warranted for the time specified after acceptance of the Supplies by the Commonwealth, as annotated on the respective SG1 (copies of which are held by the B-Vehicle National Fleet Manager).

4.3. Should any defect or fault develop within the term specified in Table 4-1, after acceptance of the Supplies by the Commonwealth, and upon examination by MTA or one of their authorised distributors or dealers, and such defect or fault is found to be due to defective material or workmanship, MTA undertakes to repair or exchange or to have repaired or exchanged such defective or faulty part or parts free of charge.

4.4. MTA, unless the B-Vehicle National Fleet Manager otherwise allows, shall meet all costs of, and incidental to, the performance of remedial work, including any packaging, freight (not exceeding the freight cost between the Contract delivery point and the MTA’s nominated repair facility and return), disassembly and re-assembly costs.

4.5. Where a further defect attributable to either:
   
a. the same cause as the initial failure, or
   
b. a failure to correctly repair that fault in an item of Supplies remedied in accordance with the foregoing warranty, is notified to MTA before the expiry of the warranty period, or during a period commencing on the date the remedied Supplies are returned to the Commonwealth and extending for half the Warranty Period, whichever is the greater, MTA shall remedy the further defect.
4.6. The Commonwealth may at its discretion require MTA to carry out tests as are relevant to the remedial work and provided for under the Heavy Recovery Vehicle Contract. If such tests show that the Supplies remedied by MTA do not comply with the Heavy Recovery Vehicle Contract, MTA shall rectify the defect, and the costs of the tests shall be borne by MTA. The Commonwealth shall bear the cost of any test where the Supplies which have been remedied fulfil the Heavy Recovery Vehicle Contract requirements.

4.7. The foregoing warranty does not cover normal wear and tear resulting from regular usage nor does it cover defects or faults arising out of misuse, or neglect; and shall not apply to vehicles that have been altered without approval from MTA. Furthermore, the foregoing warranty will not apply where failure arises from:

a. the vehicle not being maintained in accordance with the User Handbook or authorised EMEIs;

b. incorrect tuning, adjustments, or maintenance operations that are associated with periodic servicing operations;

c. the use of incorrect lubricants, oils or fuels;

d. EMEI storage procedures not being effectively applied;

e. a change to the vehicle specifications without the prior approval of MTA;

f. the specified gross vehicle weight or gross combined weight being exceeded;

g. the use of equipment not normally or reasonably associated with the operation of the Supplies;

h. supplies that have been altered in form or function without consultation with or an approval from MTA;

i. any part or parts from which the identification marks or numbers have been altered or removed by the Commonwealth;

j. repairs which involved or resulted from either direct or indirect use of non-genuine parts;

k. parts or equipment which have not been supplied by MTA or by a supplier approved by MTA and any problems which may arise, either directly or indirectly, from the fitment of such equipment; or
The consequences of the Supplies having been repaired by a non-approved repairer. For the purpose of this clause approved repairer shall include Defence vehicle maintenance personnel.

4.8. The obligation to remedy defects in Supplies shall not extend to the remedy of defects in Government Furnished Material (GFM) incorporated into the Supplies unless it was an item repaired/refurbished during the associated Emergent Work activity.

Effecting Warranty Repairs – Normal System

4.9. Supplies having defects or malfunctions considered warrantable are to be presented, together with the appropriate GM 120 to MTA or one of their authorised distributors or dealers via the normal Defence repair chain. Initiating units are to raise an EMEFIX (GM 153) for Warranty Repair through their unit supporting repair agency to their regional Joint Logistic Unit noting the following information:

a. the equipment fault will be warranty repair, ie “Warranty Repair - Water Pump leaking”;

b. identify the vehicle by Army registration number;

c. identify the vehicle by chassis number;

d. identify the engine number;

e. date vehicle entered service (if known);

f. current odometer and hour meter reading;

g. nature of failure (brief explanation); and

h. nature of repair necessary (highlighting that the repair is to undertaken under warranty by MTA).

4.10. Where a vehicle is presented to MTA or one of their authorised distributors or dealers for warranty repairs, the Unit is not to be further involved, as the dealer has adequate authority and the necessary procedures to obtain authority from the DMO Regional Fleet Services Manager in the case of additional repairs.

4.11. While any authorised distributor or dealer may carry out warranty repairs or replacements, the primary responsibility for performing warranty repairs and replacements rests with MTA. Where MTA fails within the period of 30 days after notification by the Commonwealth to rectify a defect pursuant to the aforementioned warranty, the Commonwealth may, without limiting MTA’s warranties and obligations,
perform or have performed the necessary remedial work at the expense of MTA and may recover such expenses as a debt.

**Effecting Warranty Repairs – Remote Locations**

4.12. In certain circumstances (where units/vehicles are located more than 40km from MTA or one of their authorised distributors or dealers) MTA may authorise warranty repairs to be carried out by RAEME tradesmen or by a nominated agent. In such circumstances, MTA will reimburse the Commonwealth for parts used at warranty cost and labour standard repair times and at the prevailing MTA dealer warranty hourly labour rate.

4.13. Requests for authorisation for RAEME tradesmen to carry out warranty repairs are to be made by telephone in the first instance and followed up by an e-mail and/or facsimile to MTA. The person making the contact should have the following information available:

   a. Army registration number (ARN);
   b. vehicle chassis number;
   c. engine number;
   d. date vehicle entered service (if known);
   e. current odometer and hour meter reading;
   f. nature of failure (brief explanation);
   g. nature of repair necessary; and
   h. parts delivery address (if required).

4.14. It is expected that such authorisation will be formally given within seven days of notification of the defect/malfunction. After making due allowance for exceptional circumstances, where authorisation is not received within seven days, the matter is to be treated as a disputed claim and processed in accordance with paragraph 4.19 of this chapter. Spare parts are to be provided on a one-for-one basis. In an emergency, where MTA cannot supply the necessary spare parts in a reasonable time, items from stock may be used. If repairs are carried out using stock items, the replacement items are to be returned to stock upon receipt from MTA. **Defective components are to be returned to MTA.**
4.15. When seeking a claim for reimbursement, the information required to be documented by the requesting unit in such circumstances is:

   a. identify the vehicle by Army registration number (ARN);
   b. identify the vehicle by chassis number;
   c. identify the engine number;
   d. date vehicle entered service (if known);
   e. current odometer and hour meter reading;
   f. nature of failure (brief explanation);
   g. nature of repair necessary;
   h. part replaced by designation and part number;
   i. time taken or Standard Repair Time (SRT) and EMEFIX number;
   j. if parts were procured through a MTA dealer, then documentation identifying purchase and price paid; and
   k. MTA authority number.

4.16. It should be noted that MTA reserve the right to inspect and test any parts considered defective, or inspect those items subject to environmental deterioration, prior to accepting a claim.

Recording of Repairs

4.17. Details of all repairs carried out under warranty are to be recorded in the applicable Record Book for Service Equipment (GM 120).

Reporting of Defects

4.18. All defects, which occur during the warranty period, are to be reported using the RODUM in accordance with TRAMM Vol 2, Sect 1, Chap 5.

Disputed Claims

4.19. Disputed warranty claims are to be referred to the B-Vehicle National Fleet Manager.

Warranty Periods

4.20. The data contained in Table 4-1 has been extracted from the terms specified in the Heavy Recovery Vehicle Production Contract.
<table>
<thead>
<tr>
<th>No</th>
<th>System</th>
<th>Candidate Item</th>
<th>Warranty Period</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Camera System</td>
<td>Monitor</td>
<td>1 Year</td>
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<tr>
<td>2</td>
<td></td>
<td>Selector Panel</td>
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<td>3</td>
<td></td>
<td>Camera</td>
<td>1 Year</td>
</tr>
<tr>
<td>4</td>
<td>Engine Upgrade</td>
<td>Turbo</td>
<td>1 Year</td>
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<td>5</td>
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<tr>
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<td>Air Cleaner Assembly</td>
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<td>8</td>
<td>Drive Train</td>
<td>Transmission</td>
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<td>9</td>
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<td>Power Take-off Unit</td>
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<td>10</td>
<td>Millers Recovery System</td>
<td>Palfinger Crane</td>
<td>3 Years</td>
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<tr>
<td>11</td>
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<td>Hydraulic Oil Cooling System</td>
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<td>14</td>
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<td>15</td>
<td>Winch Assembly</td>
<td>Drive Motor</td>
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<td>Free Wheel Brake</td>
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<td>Winch Cable</td>
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<td>Cable Layout Assembly</td>
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<td>Magnetic Torque Sensor</td>
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<td>21</td>
<td>Tow Lift Assembly</td>
<td>Upper Ram</td>
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<td>22</td>
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<td>Lower Ram</td>
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<td>General Hardware (Nuts, Bolts etc.)</td>
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</table>
### HRV Service Centres

**4.21.** MTA regional Offices and a directory of HRV service centres throughout Australia. This list is correct at time of printing.

#### List of Agents

**QUEENSLAND**

**HEAD OFFICE**
Mack Trucks Australia Pty Ltd
20 Westgate Street
Wacol Q 4076
Ph: 07 3718 3500

**BRISBANE**
Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd
20 Westgate Street
Wacol Qld 4076
Main Switch: 07 3718 3333
Workshop: 07 3718 3620
Workshop Fax: 07 3718 3414
Sales: 07 3718 3505
Sales Fax: 07 3718 3383
Service: 1800 200 700
Parts: 07 3718 3555
Parts Fax: 07 3718 3408
Parts AH: 07 3718 3525

**BUNDABERG**
Parts & Service
Ken Landt Diesel Repairs
104 Scotland Street
Bundaberg Q 4670
Ph: 07 4153 1849
Fax: 07 4153 2553
AH Parts & Service: 0409 531 849

**CABOOLTURE**
Parts & Service
Northside Diesel
Commercial Drive
Caboolture Q 4510
Ph: 07 5495 4133
Fax: 07 5495 7011
AH: 0407 765 131

**CAIRNS**
Parts & Service
North Star Truck and Marine
52 Comport Street
Portsmith Q 4870
Ph: 07 4035 2500
Fax: 07 4035 1484
AH Parts & Service: 07 4035 2500

**EMERALD**
Service
Rod Bianchi Motors
1 Cottonview Road
Emerald Q 4720
Ph: 07 4982 2733
Fax: 07 4982 4554
AH Parts & Service: 07 4982 2245
List of Agents (Continued)

GLADSTONE
Service
Diesel Maintenance Ph: 07 4972 6699
6 Blain Drive Fax: 07 4972 6705
Gladstone Q 4680 AH: 07 4978 2924

GOLD COAST
Parts & Service
Diesel Torque Ph: 07 5596 3972
89 Spencer Road Fax: 07 5596 4630
Nerang Qld 4211 AH Service: 0414 648 072

GOONDIWINDI
Parts & Service
Queensland Truck Centre Ph: 07 4671 5933
48 Russell Street Fax: 07 4671 5944
Goondiwindi. Qld 4390 AH Service: 0427 147 335

GYMPIE
Parts & Service
Brunjes’ Mechanical Repairs Ph: 07 5482 9992
391 Bruce Highway Fax: 07 5482 6400
Gympie Q 4570 AH Parts: 07 5482 5675
AH Service: 07 5482 7875

MTA MACKAY
Truck Sales & Parts
Mack Trucks Australia Pty Ltd Truck Sales & Parts 07 4955 7556
Cnr Presto Avenue & Harbour Rd Fax: 07 4955 7845
Mackay Q 4740 AH: 0407 893 303

Service
McAleese Workshop (Address as above) Ph: 07 4955 6500
Fax: 07 4955 6470
AH: 0407 639 326

MT ISA
Parts & Service
Queensland Truck Centre Ph: 07 4743 1100
3 Traders Way Fax: 07 4743 1019
Mt Isa Q 4825 AH: 0417 713 313

MTA ROCKHAMPTON
Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd Ph: 07 4927 4700
Cnr Farm & Alexandra Streets Fax: 07 4922 3492
North Rockhampton Q 4710 AH: 07 4927 4700
List of Agents (Continued)

TOOWOOMBA
Parts & Service
Queensland Truck Centre Ph: 07 4630 1977
334-338 Anzac Avenue Fax: 07 4630 1507
Toowoomba Q 4350 AH: 0419 670 450

MTA TOWNSVILLE (Mack & Volvo)
Truck Sales (Mack only)
Parts & Service for both brands
Volvo truck sales person located on site
Mack Trucks Australia Pty Ltd Ph: 07 4774 5452
780-786 Ingham Road Fax: 07 4774 5568
Bohle Q 4818 AH Parts: 0418 162 802
AH Service: 0418 162 801

NEW SOUTH WALES

MTA SYDNEY
Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd Ph: 02 9755 2344
49-51 Governor Macquarie Drive Fax: 02 9755 1864
Chipping Norton NSW 2170 Parts Ph: 02 9728 8288
service Ph: 02 9728 8299
AH Parts & Service: 02 9755 2166

ALBURY
Parts & Service
Mack - Volvo Ph: 02 6024 8000
254 Macauley Street Fax: 02 6021 8933
Albury NSW 2640 AH: 02 6059 8625
Or: 02 6024 4210

COFFS HARBOUR
Parts & Service
Bermack Truck Services Pty Ltd Ph: 02 6652 2453
28 England’s Road Fax: 02 6652 1665
Coffs Harbour NSW 2450 AH: 02 6653 2023

GOSFORD
Parts & Service
David Best Truck Centre Ph: 02 4323 7145
Pacific Highway & Cary St Fax: 02 4323 1515
North Gosford NSW 2250 AH: 02 4323 7145
List of Agents (Continued)

GRiffith

Parts
Hartwigs Trucks  Ph: 02 6964 6066
42 Jondaryn Way  Fax: 02 6962 9617
Griffith. NSW 2680  Mobile: 0427 244 969
Pager: 0427 627 088

LISMORE

Parts & Service
JA Leu & Son  Ph: 02 6621 3061
1 Union Street  Fax: 02 6622 0176
South Lismore NSW 2480  AH: 02 6624 3745

MTA NEWCASTLE

Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd  Ph: 02 4966 3679
1 Enterprise Drive  Fax: 02 4966 3780
Beresfield NSW 2322  AH: 02 4966 3985

ORANGE

Parts
Hartwigs Trucks Pty Ltd  Ph: 02 6360 0239
7 Hawthorne Place  Fax: 02 6360 0243
Orange NSW 2800  AH: 02 6360 0239

PENRITH

Parts & Service
Clancy’s Truck & Trailer Repairs Pty Ltd  Ph: 02 4731 5809
73-75 Batt Street  Fax: 02 4721 7246
Penrith NSW 2750  AH Parts & Service: 0418 446 985

MTA PORT KEMBLA (Mack & Volvo)

Truck Sales (Mack only)
Parts & Service for both brands
Volvo truck sales person located at VTA Chullora
Mack Trucks Australia Pty Ltd  Ph: 02 4272 9755
223-225 Berkeley Road  Fax: 02 4272 9977
Unanderra NSW 2526  AH: 0407 898 697
AH Parts: 0408 264 965

QUEANBEYAN

Truck Sales, Parts & Service
Southern Truck Centre  Ph: 02 6299 6433
12 Wycombe Street  Fax: 02 6299 1802
Queanbeyan NSW 2620  AH Service: 0413 873 984
AH Parts: 0413 873 985
List of Agents (Continued)

TAMWORTH
Service
MJ Hayes Transport Services Ph: 02 6761 8900
Lot 1, Manilla Road Fax: 02 6761 8666
Tamworth NSW 2340 AH: 02 6765 7924

TUGGERAH
Parts & Service
David Best Truck Centre Ph: 02 4353 2668
Lot 4 Mildon Road Fax: 02 4353 2669
Tuggerah NSW 2259 AH: 1300 767 535

AUSTRALIAN CAPITAL TERRITORY AREA
QUEANBEYAN
Truck Sales, Parts & Service
Southern Truck Centre Ph: 02 6299 6433
12 Wycombe Street Fax: 02 6299 1802
Queanbeyan NSW 2620 AH Service: 0413 873 984
AH Parts: 0413 873 985

VICTORIA
MTA LAVERTON
Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd Ph: 03 9931 6777
121-123 Boundary Road Fax: 03 9931 6780
Laverton North VIC 3026 24 hr Breakdown: 0408 309 704

MTA SOMERTON
Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd Ph: 03 9305 4711
40-46 Hume Highway Fax: 03 9305 4801
Somerton VIC 3062 Parts Ph: 03 9305 4700
Parts Fax: 03 9305 4803
Service Fax: 03 9305 1259
AH: 03 9305 4711

MTA DANDENONG
Truck Sales, Parts & Service
Mack Trucks Australia Pty Ltd 03 9793 1744
77-125 Princes Highway Fax: 03 9706 7308
Dandenong VIC 3175 Parts & Service 03 9793 2511
Fax:
Roadside Assistance: 0409 149 816
List of Agents (Continued)

HORSHAM
Parts
Emmett's Motors Ph: 03 5381 1555
6 Dimboola Road, Fax: 03 5382 2604
Horsham Vic 3400 Parts Mobile: 0429 811 555

BALLARAT
Parts & Service
P& D Diesel Service Ph: 03 5334 7680
Melbourne Road Fax: 03 5334 7887
Leigh Creek AH: 03 5331 5040
Ballarat VIC 3352

MILDURA
Parts & Service
Sunraysia Truck Centre Ph: 03 5023 5557
1192 Benetook Avenue Fax: 03 5023 0443
Mildura VIC 3500 AH: 03 5023 5557

SHEPPARTON
Parts & Service
HM Transport Maintenance Ph: 03 5831 6996
21 Lockwood Road Fax: 03 5821 1886
Shepparton VIC 3630 AH: 03 5831 6996

TRARALGON
Service
Somerset Motors Ph: 03 5176 1915
Lot 23 Stratton Drive Fax: 03 5176 0915
Traralgon VIC 3844 AH: 0417 347 713

TASMANIA

LAUNCESTON
Truck Sales, Parts & Service Ph: 03 6336 0600
Webster Machinery Pty Ltd Fax: 03 6326 3207
274 Georgetown Road Parts Fax: 03 6326 3597
Launceston TAS 7248 AH Parts: 0419 375 271
AH Service: 03 6391 1227
Mobile: 0418 137 519
Or: 0418 135 106
## List of Agents (Continued)

### BURNIE
Parts & Service  
Webster Machinery Pty Ltd  
61 Main Road  
61 Main Road  
Wivenhoe TAS 7320  
Ph: 03 6431 9855  
Fax: 03 6431 9848  
AH Service: 03 6425 6987  
AH Parts: 03 6431 3760  
Or: 03 6433 3632

### DEVONPORT
Parts & Service  
Webster Machinery Pty Ltd  
6 Steele Street  
6 Steele Street  
Devonport TAS 7310  
Ph: 03 6424 7155  
Fax: 03 6424 9122  
AH Parts: 03 6424 1333

### HOBART
Truck Sales, Parts & Service  
Webster Machinery Pty Ltd  
120 Campbell Street  
120 Campbell Street  
Hobart TAS 7000  
Ph: 03 6238 0200  
Fax: 03 6238 0205  
Service Ph: 03 6238 0233  
AH Service: 0409 012 481  
Parts Ph: 03 6238 0251  
AH Parts: 0419 202 194

### SOUTH AUSTRALIA
### MTA ADELAIDE
Truck Sales, Parts & Service  
Mack Trucks Australia Pty Ltd  
200 Cavan Road  
200 Cavan Road  
Gepps Cross SA 5094  
Ph: 08 8344 0500  
Fax: 08 8359 4291  
Parts: 08 8344 0513  
Parts Fax: 08 8359 4572  
AH Parts: 0418 891 918  
Service: 08 8344 0521  
Service Fax: 08 8359 4691  
AH Service: 0417 883 929

### MOUNT GAMBIER
Truck Sales, Parts & Service  
J & B Trucks  
203 Jubilee Highway  
203 Jubilee Highway  
Mt Gambier SA 5290  
Ph: 08 8725 7999  
Fax: 08 8724 9712  
AH Service: 08 8734 9390  
Or: 0408 849 519  
Breakdown Service: 0419 216 017  
AH Parts: 08 8725 2974
List of Agents (Continued)

PORT AUGUSTA
Parts & Service
Butler's Mechanical Service
2-5 Woodcock Street
Port Augusta SA 5700
Ph: 08 8642 2188
Fax: 08 8642 4498
AH Parts & Service: 08 8642 6389
Or: 0419 849 866

WESTERN AUSTRALIA

PERTH
Truck Sales, Parts & Service.
Truckworld
74 Great Eastern Highway
South Guildford WA 6055
Ph: 08 9277 1233
Fax: 08 9277 3029
Parts Fax: 08 9277 3012
Service Fax: 08 9479 5104
AH: 08 9277 1233

ALBANY (sub-dealer of Truckworld)
Parts & Service
Albany Truck Servicing & Repairs
17 Charles Street
Albany WA 6330
Ph: 08 9841 1249
Fax: 08 9842 1519
AH: 08 9841 2629
Or: 0429 411 249

BROOME
Parts & Service
Broome Diesel & Hydraulic Service
Lot 102 De Castilla Street
Broome WA 6725
Ph: 08 9192 1330
Fax: 08 9192 2403
AH: 08 9192 1330

BUNBURY (sub-dealer of Truckworld)
Parts & Service
Wesburn Pty Ltd
Lot 20 Halifax Drive
Bunbury WA 6230
Ph: 08 9725 4388
Fax: 08 9725 4514
AH: 0417 964 241

ESPERANCE (sub dealer of Truckworld)
Parts & Service
Farmers Centre (WA) Pty Ltd
495 Beckwith Road
Esperance WA 6450
Ph: 08 9071 3728
Fax: 08 9071 4160
AH: 0409 835 745

GERALDTON (sub dealer of Truckworld)
Parts & Service
Mid West Mack
35 Carr Street
Narngalu WA 6530
Ph: 08 9923 3686
Fax: 08 9923 3759
AH: 08 9923 3759
List of Agents (Continued)

KALGOORLIE (sub-dealer of Truckworld)
Parts & Service
Bradver
8 Percy Lane
West Kalgoorlie WA 6430
Ph: 08 9081 7755
Fax: 08 9091 7766
AH: 0417 174 639
Or: 0407 911 150

KARRATHA (sub-dealer of Truckworld)
Parts & Service
Godfrey Fitting Service
Lot 4600 Pyramid Road
Karratha Industrial Estate
Karratha WA 6714
Ph: 08 9144 2013
Fax: 08 9144 2414
AH: 0418 938 075

KUNUNURRA
Parts & Service
Kununurra Diesel Services
219 Bloodwood Drive
Kununurra WA 6743
Ph: 08 9169 1054
Fax: 08 9169 1918
AH: 0409 691 054

NORTHERN TERRITORY

MTA DARWIN ( Mack & Volvo )
Truck Sales, Parts & Service for both brands
Mack Trucks Australia Pty Ltd
1890 Berrimah Road
Berrimah NT 0828
Ph: 08 8984 3714
Fax: 08 8947 0182
Parts Fax: 08 8947 3482
Breakdown Service: 0408 147 848
Or: 0419 658 751
AH Parts: 0418 814 091

ALICE SPRINGS
Parts & Service
Steer Diesel Service
22 Cameron Street
Alice Springs NT 0870
Ph: 08 8952 8507
Fax: 08 8953 4929
AH: 0419 556 007

KATHERINE
Parts & Service
Highway Motors
1128 Victoria Highway
Katherine NT 0850
Ph: 08 8972 1715
Fax: 08 8972 1512
AH Service: 0417 655 303
Or: 0411 513 468
AH Parts: 0419 818 428
Crisp-Air Warranty

4.22. The Crisp-Air warranty covers the air conditioning system fitted to this vehicle. This warranty is separate from the vehicle warranty provided by Mack Trucks Australia for the vehicle.

Warranty

4.23. The Contractor warrants that the design, materials and workmanship in the supplies conform with, and that the Supplies meet the requirements of the Contract. The Contractor shall remedy by repair, replacement or modification, defects in design, materials and workmanship in the Supplies notified to the Contractor by the Project Authority (PA) during the period of 3 years or 100,000 km from installation of the Supplies, with the exception of the compressor and condenser coil, which are warranted for 12 months or 100,000 km (called the ‘warranty period’). The air-conditioner serial number, vehicle ARN and date of installation will be forwarded to Crisp-Air by the PA within 30 days of installation to activate the equipment warranty.

4.24. The warranty provided by the Contractor under Para 4.23 shall not apply to the extent that the defect arises from the Commonwealth’s negligent or wilful damage of the Supplies.

4.25. The Contractor, unless the Project Authority otherwise allows, shall meet all costs of, and incidental to, the performance of remedial work under Para 4.23, including any packing, freight (not exceeding the freight cost between the Contract delivery point and the Contractor’s nominated repair facility and return), disassembly and re-assembly costs.

4.26. Where the Contractor fails within the period of months after notification by the Project Authority, to rectify a defect pursuant to Para 4.23, the Commonwealth, without limiting the Contractor’s warranties and obligations under this warranty, may perform or have performed the necessary remedial work at the expense of the Contractor, and may recover such expense as a debt due to the Commonwealth in accordance with clause 11.3 of Contract V9 203038.

4.27. The rights and remedies provided in Para 4.23 are in addition to, and shall not limit, any other rights of the Commonwealth under the Contract or otherwise.
**Support Period**

4.28. The Contractor undertakes to support the Supplies for the period of 10 years (the ‘Support Period’) commencing immediately after delivery of the Supplies by providing facilities for the supply of sufficient quantities of spare parts and support equipment to maintain the Supplies in effective operation. Eight weeks lead time for procurement of major spares items will be required.

4.29. Where, during the Support Period, the Contractor becomes aware that its ability to provide spare parts or support equipment may be adversely affected; it shall provide the Commonwealth with advance notice being not less than 6 months of that event. Where there will be a final production run, the Contractor shall nominate in the notice the date by which the Commonwealth may place final orders.

**Application of Warranty**

4.30. The Army representative making the contact should have the following information available:

   a. The registered number of vehicle effected (ARN).
   b. Date the air conditioning system was fitted to the vehicle.
   c. Outline of the problem encountered.
   d. Rank, Name Unit and contact details.

**Contractor Contact Details**

4.31. The contact details for the Contractor are listed below:

   Crisp-Air Pty Ltd
   17 Colebard St East
   ACACIA RIDGE QLD 4110

   PO Box 308
   ARCHERFIELD, QLD 4108

   Telephone:  (07) 3277 3299
   Fax:        (07) 3275 1180

   **NOTE**

   The Contractor and the Project Authority are to be contacted for approval before any warranty work is commenced.

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<th>Page No.</th>
<th>A</th>
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<tbody>
<tr>
<td></td>
<td>ADI bushmaster recovery ................................................................</td>
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<td>Adjusting initial settings .......................................................</td>
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<td>After recovery ...............................................................................</td>
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<td>Bushmaster vehicles .......................................................................</td>
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