SEMITRAILER, CARGO, CONTAINER SIDE LOADER

TECHNICAL DESCRIPTION

This instruction is authorised for use by command of the Chief of Army. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with EMEI General A 001.

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INTRODUCTION

1. This EMEI provides a technical description of the Semitrailer, Cargo, Container Side Loader. The container side loader (CSL) is designated as material handling equipment (MHE) and will subsequently be referred to as MHE-CSL.

Associated Publications

2. Reference may be necessary to the latest issue of the following documents:
   a. EMEI Misc Equip O 008 – Lifting Tackle Components – Inspection for Useability;
   b. EMEI Vehicle H 520 – Semitrailer, Cargo, Container Side Loader – Data Summary;
   c. EMEI Vehicle H 523 – Semitrailer, Cargo, Container Side Loader – Light Grade Repair;
   d. EMEI Vehicle H 523-1 – Semitrailer, Cargo, Container Side Loader – AQIS Decontamination;
   e. EMEI Vehicle H 524-1 – Semitrailer, Cargo, Container Side Loader – Medium Grade Repair;
   f. EMEI Vehicle H 526 – Semitrailer, Cargo, Container Side Loader – Authority for Use;
   g. EMEI Vehicle H 526-1 – Semitrailer, Cargo, Container Side Loader – Suspension Bushing Replacement;
   h. EMEI Vehicle H 526-2 – Semitrailer, Cargo, Container Side Loader – Suspension Installation;
   i. EMEI Vehicle H 526-3 – Semitrailer, Cargo, Container Side Loader – Suspension System Maintenance;
   j. EMEI Vehicle H 526-4 – Semitrailer, Cargo, Container Side Loader – Suspension Alignment Procedure;
   k. EMEI Vehicle H 526-5 – Semitrailer, Cargo, Container Side Loader – Suspension Torque Specifications;
   l. EMEI Vehicle H 526-6 – Semitrailer, Cargo, Container Side Loader – York Axle Service Manual;
   m. EMEI Vehicle H 526-7 – Semitrailer, Cargo, Container Side Loader – Meritor Axle and Brake Service Manual;
   n. EMEI Vehicle H 526-8 – Semitrailer, Cargo, Container Side Loader – Kubota Workshop Manual;
   o. EMEI Vehicle H 526-9 – Semitrailer, Cargo, Container Side Loader – Hetronic Operating Instructions;
   p. EMEI Vehicle H 526-10 – Semitrailer, Cargo, Container Side Loader – Hydraulic Parts Storage;
   q. EMEI Vehicle H 526-11 – Semitrailer, Cargo, Container Side Loader – Crane Module Grease Points;
   r. EMEI Vehicle H 526-12 – Semitrailer, Cargo, Container Side Loader – Leg Tilt Housing Removal and Bearing Replacement;
   s. EMEI Vehicle H 526-13 – Semitrailer, Cargo, Container Side Loader – Leg Extension Cylinder Removal and Replacement;
   t. EMEI Vehicle H 526-14 – Semitrailer, Cargo, Container Side Loader – Danfoss Control Valve Coil Settings;
   u. EMEI Vehicle H 526-15 – Semitrailer, Cargo, Container Side Loader – Hydraulic Pump Replacement;
   v. EMEI Vehicle H 526-16 – Semitrailer, Cargo, Container Side Loader – Hydraulic Oil Replacement;
   w. EMEI Vehicle H 526-17 – Semitrailer, Cargo, Container Side Loader – Arm Bearings and Pins Replacement;
   x. EMEI Vehicle H 526-18 – Semitrailer, Cargo, Container Side Loader – Lifting Lug Wear Limits;
   y. EMEI Vehicle H 526-19 – Semitrailer, Cargo, Container Side Loader – Crane Pin Names;
   z. EMEI Vehicle H 526-20 – Semitrailer, Cargo, Container Side Loader – Top Arm Removal;
   aa. EMEI Vehicle H 526-21 – Semitrailer, Cargo, Container Side Loader – Remove and Replace G Pin;
bb. EMEI Vehicle H 526-22 – Semitrailer, Cargo, Container Side Loader – Remove Top Arm Cylinder;
cc. EMEI Vehicle H 526-23 – Semitrailer, Cargo, Container Side Loader – Remove Bottom Arm;
dd. EMEI Vehicle H 526-24 – Semitrailer, Cargo, Container Side Loader – Remove and Replace Stabiliser Extension Cylinder;
ee. EMEI Vehicle H 526-25 – Semitrailer, Cargo, Container Side Loader – Remove Stabiliser Housing;
ff. EMEI Vehicle H 526-26 – Semitrailer, Cargo, Container Side Loader – Replacing Bearings;
gg. EMEI Vehicle H 526-27 – Semitrailer, Cargo, Container Side Loader – Wear Pad Replacement;
hh. EMEI Vehicle H 526-28 – Semitrailer, Cargo, Container Side Loader – Top Arm Installation;
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pp. EMEI Vehicle H 526-36 – Semitrailer, Cargo, Container Side Loader – Updating Front and Rear ECU Programs;
qq. EMEI Vehicle H 526-37 – Semitrailer, Cargo, Container Side Loader – Calibrating SMARTlift™ Angle Sensors;
rr. EMEI Vehicle H 526-38 – Semitrailer, Cargo, Container Side Loader – Hetronic Frequency Setup;
ss. EMEI Vehicle H 526-39 – Semitrailer, Cargo, Container Side Loader – Software Updating Procedure;
tt. EMEI Vehicle H 526-40 – Semitrailer, Cargo, Container Side Loader – SMARTlift™ Troubleshooting;
uu. EMEI Vehicle H 526-41 – Semitrailer, Cargo, Container Side Loader – SMARTlift™ Crane Synchronisation Procedure;
vv. EMEI Vehicle H 526-42 – Semitrailer, Cargo, Container Side Loader – Starting SMARTlift™ with a Discharged ECU Battery;
ww. EMEI Vehicle H 526-43 – Semitrailer, Cargo, Container Side Loader – Cold Weather Operation of SMARTlift™ Display;
xx. EMEI Vehicle H 526-44 – Semitrailer, Cargo, Container Side Loader – SMARTlift™ Load Test Procedure;
yy. EMEI Vehicle H 529 – Semitrailer, Cargo, Container Side Loader – Servicing Instruction;
zz. EMEI Workshop D 701 – Painting of Army Equipment – Repair Policy for Equipment Painted in Polyurethane Paint;
bbb. DEF(AUST)206F – Petroleum, Oils and Lubricants Handbook;
ccc. Material Safety Data Sheets (MSDS) – Product Information Sheets;
ddd. Technical Regulation of Army Materiel Manual (TRAMM); and
Safety

**WARNING**

PUP contains poly-functional isocyanates that are toxic in low concentrations and are respiratory system and skin irritants. Personnel, handling, mixing, spraying or repairing PUP must wear suitable protective equipment, use suitable facilities, and adopt appropriate safety procedures.

PUP is most hazardous as a liquid, dry PUP is less hazardous but must be treated as industrial waste. Fine, dry PUP particles generated by sanding or grinding are eye and lung irritants.

3. The MHE-CSL is painted with polyurethane paint (PUP). Should the MHE-CSL require repairs that necessitate the removal of painted surfaces, refer to EMEI Workshop D 701.

**WARNING**

The MHE-CSL operating under load produces noise levels approaching 85 dB(A), all personnel must wear appropriate hearing protection.

4. The MHE-CSL operates at approximately 85 dB(A) when under load. Operators and maintenance staff must be aware of this hazard and shall wear approved hearing protection when operating the equipment.

**WARNING**

Operation of the MHE-CSL requires hydraulic oil under extreme pressures. Oil escaping from the system under pressure is dangerous and can cause serious injury.

5. The MHE-CSL systems require hydraulic oil under pressure for operation. The system oil pressure may reach 280 bar and all hydraulic pressure is to be relieved from the system prior to conducting any maintenance or repairs.

**WARNING**

The MHE-CSL is a crane system capable of lifting 36 000 kg. Operators and maintenance staff are to be aware of the dangers of operating this equipment, and be fully conversant with the safe operating zones.

6. The MHE-CSL crane modules are capable of lifting 36 000 kg. Operators and maintenance staff are to be aware of the safe operating zones (Figures 1 and 2) when operating the load handling system. The safe operating zones are identified on a placard fixed to the rear of the trailer on the right-hand side.
GENERAL DESCRIPTION

7. The MHE-CSL is capable of being towed and transported by existing military transport equipment. The trailer has been equipped with restraint points that are suitable for use during transport by air, rail and sea. Refer to UHB 7610-66-157-4388 for transportation details.

8. The MHE-CSL is fitted with a bolt-on 90 mm kingpin as the primary tow coupling. An additional 50 mm kingpin is provided in the CES should it be necessary to tow the trailer using a civilian prime mover.

9. The MHE-CSL is a fully self contained system for the lifting and transportation of ISO containerised cargo. The containers are lifted by two hydraulically operated crane arms capable of a combined lift of 36 000 kg. The two crane arms are an integral part of the two crane module that also incorporates hydraulically operated stabiliser legs that are deployed during the lifting operation. The crane modules can be moved longitudinally by hydraulic power along the chassis with stops provided at locations that suit the various container lengths. The containers are secured on the trailer using standard ISO container twist locks.

10. The MHE-CSL is fitted with a power pack that provides the hydraulic pressure necessary to operate the crane arms and the stabiliser legs. Pressurised air for the pneumatic system and electrical power for the lighting system are provided by the prime mover.

11. The load handling system is controlled by a digital control system via the SMARTlift™ interface. Two remote controls are supplied, one is connected to the system via an umbilical cable and the other is wireless. For safety reasons the two remote controls have inbuilt isolation measures to prevent them interfering with each other.
12. Each remote control is fitted with:
   a. two joysticks that operate all traverse, crane arm and stabiliser leg functions;
   b. a two-position switch for high and low speed operation;
   c. a three-position switch to select module traverse, stabiliser leg or crane arm operation; and
   d. a red emergency stop button.

13. The trailer (Figure 3) supports the two crane modules and all the sub-systems necessary for safe operation and control of the load handling system.

![Figure 3 General Layout]
14. The MHE-CSL should be operated within the manufacturer’s parameters (Figure 4) at all times to prevent the possibility of exceeding the safe operating load limits. Any attempt by the operator to overload the system will result in electronic warning and subsequent automatic shutdown.

![Figure 4 Safe Operating Parameters](image)

**Detailed Description**

**Crane Lifting Module**

15. The crane lifting module (Figure 5) comprises the stabiliser leg assembly and the crane arm assembly. The module is moved longitudinally along the chassis by hydraulic power provided by the power pack assembly. The module can be locked in fixed locations along the chassis to suit the size of container being handled and transported.

16. The modules and lifting arms are constructed from high tensile steel and are made up of continuously welded box sections. The pins that locate all the moving parts of the module are located in lubricated glacier bearings, these bearings can be replaced as and when required.

17. Pilot operated, over-centre, manual valve controls are fitted to the crane arms. These controls are preset by the manufacturer to cope with shock loads and counter attempts to exceed the safe working load. The over-centre valves:
a. prevent the crane arms from moving unless there is a pressure signal from the main hydraulic valve;
b. ensure that the movement and control of the load remains constant whilst being lowered, regardless of the pressure in the cylinders; and
c. ensure that the load is held in position should the hydraulic system lose pressure, or in the event of a hydraulic hose failure.

Figure 5  Crane Lifting Module

Stabiliser Leg Assembly
18. The stabiliser leg assembly (Figure 6) provides the stability required for the crane arms to lift a load. Once deployed the stabiliser legs support the load during the lifting operation, and prevent tilting and twisting of the trailer chassis. The stabiliser legs are able to be deployed at various distances from the chassis dependant on the operating space available and the surface. The further from the chassis the legs are deployed, the greater the mass that can be lifted. The stabiliser leg assemblies are able to be operated individually or in unison as each module is controlled by a separate joystick on the controller.

19. Using a combination of different leg extensions and tilt angles the operator has many options for positioning the stabiliser feet. The feet can be placed on the ground:
   a. at maximum reach, thereby ensuring maximum lifting capacity;
   b. at minimum reach, resulting in minimum lifting capacity;
   c. underneath the deck of a companion vehicle; or
d. on the deck of a companion vehicle or rail car.

20. A stabiliser leg interlock system is fitted that prevents a load from being lifted without the legs being deployed. When the load handling system is activated an audible warning sounds and a warning light on the crane lifting module illuminates until both stabiliser legs are deployed.

21. A plunger switch is fitted to each stabiliser leg housing. The switch is activated when the foot has a positive downward pressure and until that occurs the crane lifting arms automatically remain disabled. The functions that are disabled are the top arm raise and bottom arm lower.

22. Proximity switches are mounted on the stabiliser leg housings. These switches activate warning lights both on the remote control and main control panel to indicate that the leg is tilted beyond the point of optimum stability. This warns the operator that stability has been reduced and therefore lifting should not take place. If a stabiliser foot loses contact with the ground during lifting operations the audible and visual warnings are activated and the appropriate hydraulic functions are disabled until the situation is rectified.

Figure 6  Stabiliser Leg Assembly
Crane Arm Assembly
23. The crane arm assembly (Figure 7) is used to lift and handle a load after the stabiliser legs have been correctly deployed. The crane arm assemblies can be operated individually or in unison as each arm is controlled by a separate joystick on the controller.

Lifting Chain Assembly
24. A lifting chain assembly (Figure 8) is fitted to each crane arm assembly. A chain assembly consists of two legs of chain with 16 mm diameter links. Each chain leg is fitted with a chain shortener and a container lifting lug. The chain legs are attached to the clevis with pins, the clevis is attached to a pivot pin on the top arm of the crane arm assembly.

25. The container lifting lugs are specifically configured for right-hand and left-hand operation. This is determined by the positioning of the roll pin fitted to the lifting lug. The roll pin prevents the lifting lug from accidentally falling out of the container corner lifting block. When facing the end of the container, the lifting lugs should be fitted to the left and right lower corner lifting blocks with the roll pin facing outwards. Failure to ensure that the lifting lugs are fitted correctly may result in the container coming loose during lifting operations. The chain shorteners are fitted to provide the ability to shorten the chain legs when lifting and stacking containers on top of one another. Annual testing of the chain assembly is required in accordance with EMEI Misc Equip O 008.
TRAILER SYSTEMS

Power Pack

26. The MHE-CSL is fitted with a power pack (Figure 9) that provides the electrical and hydraulic power necessary for the operation of all functions.

27. The power pack is mounted in the chassis forward of the front axle and it is housed in a sub-frame. The power pack is able to be removed as an assembly for ease of maintenance and repair. The power pack assembly comprises:
   a. a Kubota V2403-M-T turbocharged, four-cylinder diesel engine;
   b. engine starting and battery charging circuits;
   c. a cooling system;
   d. an exhaust system;
   e. a direct coupled tandem hydraulic pump; and
   f. a combined fuel tank and hydraulic oil reservoir assembly.
28. The power pack control panel (Figure 10) is positioned adjacent to the power pack and comprises:
   a. an electric start/stop key switch;
   b. a green emergency stop circuit lamp;
   c. a yellow glow plug lamp;
   d. a blackout switch; and
   e. an emergency stop button.
Pneumatic System

29. The pneumatic system provides pressurised air for the operation of the trailer braking system and the engine throttle control. The trailer brakes are to be applied at all times whilst operating the MHE-CSL. A hold back protection valve is fitted which protects the trailer brake system and isolates the auxiliary pneumatic system if the trailer air system drops below a predetermined level.

30. The trailer pneumatic system has three storage reservoirs placed under the chassis which are charged by the air compressor on the prime mover. The engine speed control on the power pack is air activated and controlled by a solenoid actuated air cylinder. When no air is applied to the engine speed control cylinder the engine operates at an idle speed of 1 400 rpm. When any of the hydraulic functions of the loader system are activated, the air cylinder raises the engine speed to 2 800 rpm.

31. A pneumatic engine run/stop control solenoid, activated by the key switch and the emergency stop button, supplies system air pressure to activate the engine speed control cylinder. This cylinder requires air pressure for the engine to run and it is spring-loaded to the stop position. Turning the key switch off or pressing the emergency stop button exhausts the air from the speed control cylinder which moves the throttle to a no fuel position to stop the engine.

Hydraulic System

32. The hydraulic system supplies hydraulic oil under pressure to operate the hydraulic cylinders fitted to the crane lifting modules. The hydraulic system comprises the following components:

a. **Hydraulic Oil Reservoir.** The hydraulic oil reservoir is attached to the power pack sub-frame. The reservoir is fitted with a return oil filter, breather assembly, and taps to isolate the reservoir from the hydraulic system.

b. **Hydraulic Pump.** Hydraulic pressure is supplied by a tandem, geared, hydraulic pump that is directly coupled to the engine.

c. **Unloader Valve.** The unloader valve assembly is high speed and load sensed.

d. **Filtration.** A high pressure filter is fitted in-line after the hydraulic pump and a return oil filter is fitted in the line at the hydraulic oil reservoir.

e. **Proportional Control Valves.** A Danfoss proportional control valve is fitted to each of the two crane lifting modules. The valves are operated by electrical signals received from the control modules. Manual override handles are provided as CES items and these can be fitted to provide the operator with a means to control the hydraulics in the event of a loss of electrical power.

f. **Traverse Cylinders.** The crane lifting modules are connected to the trailer chassis via two hydraulic cylinders. Operation of these cylinders allows the modules to be moved longitudinally along the chassis to positions that match the size of the container being handled and transported.

g. **Stabiliser Leg Cylinders.** Each crane lifting module is fitted with two hydraulic cylinders that operate the stabiliser legs. One cylinder provides the lifting action for the stabiliser leg and the other cylinder extends and retracts the stabiliser leg. Each cylinder is fitted with a double check valve to provide load system safety in the event of a hose failure or similar incident.

h. **Lifting Cylinders.** Each crane lift module is fitted with two hydraulic cylinders that operate the crane arms. The top lifting arm cylinder is fitted with a single over-centre valve, and the bottom lifting arm cylinder is fitted with a double over-centre valve.

i. **Over-centre Valves.** The pilot operated over-centre valves are fitted on the crane arm cylinders. The over-centre valves are preset at the factory and are designed to cushion shock loads and prevent attempts to exceed the safe working load of 36 000 kg. The over-centre valves:

1. prevent the arms from moving unless there is a pressure signal from the main hydraulic control valve;

2. keep the movement of the load under control at a constant rate when being lowered, regardless of the pressure that may be in the cylinders; and

3. ensure that the cylinders are held in position should the hydraulic system suddenly lose pressure, which also prevents the load from being dropped in the event of a hose failure.
j. **Solenoid Operated Dump Valve.** The solenoid operated dump valve is activated by the joystick controllers and the emergency stop buttons. When the valve is in the de-energised condition, load sense pressure is dumped to the reservoir. When the valve is energised, the load sense line is prevented from being dumped to the reservoir thereby allowing the hydraulic system to operate.

k. **Pressure Gauge.** System pressure is displayed on the pressure gauge which is located on the rear face of the rear crane lifting module.

### Hydraulic System Operation

33. The tandem pump delivers oil to the high speed, load sensed unloader valve where the output flows can be combined to provide high speed operation (Table 1). The flow can also be divided, with the output from one pump providing low speed operation, whilst the output from the second pump is returned to the reservoir. The solenoid operated dump valve is fitted to the unloader valve.

34. The pump output from the high speed load sensed unloader valve passes through the high pressure filter, the flow is then divided and supplied to the front and rear crane lifting module control valves. The control valves are interconnected with a load sense line that maintains synchronisation of the crane lifting arms when unequal loads are handled.

<table>
<thead>
<tr>
<th>Serial</th>
<th>Speed Mode</th>
<th>High Speed</th>
<th>Low Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Operating oil flow</td>
<td>120 L/min</td>
<td>60 L/min</td>
</tr>
<tr>
<td>2</td>
<td>Operating pressure</td>
<td>140 bar @ HS-LS-U valve</td>
<td>280 bar @ Danfoss PVG32</td>
</tr>
<tr>
<td>3</td>
<td>Pumps operating</td>
<td>Two</td>
<td>One (second pump output to tank)</td>
</tr>
<tr>
<td>4</td>
<td>High speed solenoid</td>
<td>Energised</td>
<td>De-energised</td>
</tr>
<tr>
<td>5</td>
<td>High speed relief</td>
<td>140 bar (2 000 psi)</td>
<td>Not active</td>
</tr>
<tr>
<td>6</td>
<td>Load sense solenoid</td>
<td>Energised</td>
<td>De-energised</td>
</tr>
<tr>
<td>7</td>
<td>Load sense relief</td>
<td>140 bar (2 000 psi)</td>
<td>Not active</td>
</tr>
</tbody>
</table>

35. The Danfoss PVG 32 crane control valves are proportionally controlled. Electrical inputs from the joysticks are received by the proportional control valves that regulate oil flow thereby providing directional control of the hydraulic cylinders. High or low speed operation can be selected using the remote control, the low speed function only applies to the crane lifting arms. Stabiliser leg operation is always provided at high speed regardless of the position of the high/low speed selector switch.

### Electrical System

36. The 12 V electrical system comprises the following :

a. **Supply.** The system’s electrical supply is provided by two batteries which are charged by the alternator fitted to the power pack engine. The batteries provide power for the power pack, work lights, SMARTlift™ electronic control units, and remote control units. The batteries are housed in a battery box and the lid houses two battery isolation switches. Electrical power for the trailer running lights is supplied from the prime mover lighting circuit.

b. **Main Junction Box.** A main junction box is mounted in a cabinet located at the rear of the trailer chassis.

c. **Crane Junction Boxes.** Electrical junction boxes are mounted to each of the crane lift modules.

d. **Power Pack Control Panel.** The power pack control panel is mounted to the chassis adjacent to the power pack and houses the controls necessary for operation.

e. **Remote Controls.** Two remote control units are stored in the CES cabinets on the trailer chassis. One remote is a wireless unit, while the other is a replica of the wireless version but is fitted with a 10 metre umbilical control cable for use when wireless operation is considered unsafe, or not desired.

f. **SMARTlift™.** A chassis mounted SMARTlift™ control system junction box is fitted to the rear of the trailer.
DIGITAL CONTROL

General

37. The batteries initially supply power to the main junction box and the remote control umbilical cable is plugged into this junction box. If the wireless remote control is being used the receiver unit is plugged into the junction box.

38. The main junction box is connected to the chassis mounted junction box and the two crane mounted junction boxes. The SMARTlift™ control unit is located on the chassis between the main junction box and the crane mounted junction boxes.

WARNING

The SMARTlift™ load monitoring system is not a fail-safe safety system. Its purpose is to monitor load handling and to alert the operator when a potential overload of the system occurs. SMARTlift™ warns the operator when a load has moved to the limit of the safe working envelope, and it also prevents the operator from moving the load further into an area where stability may be compromised.

Operators are to be trained and competent in the use of the complete system and adhere to all safety procedures. The system must be correctly maintained at all times and must not be operated if any faults are present.

39. The SMARTlift™ load monitoring system is integrated into the load handling system and it comprises various components and sensors. The interface (Figure 11) for the system is located at the right-hand rear of the trailer. The load monitoring system monitors all lifting and electrical systems utilising an electronic control unit mounted on each crane lifting arm. Signals from the electronic control units are relayed to the SMARTlift™ controller which constantly calculates the load, reach, and crane arm angle. The system warns the operator if the load approaches an unsafe condition and will restrict operation of the crane arms, allowing only movements required to correct the unsafe condition.

Digital Control and SMARTlift™ System

40. The control system comprises:
   a. an electronic control unit fitted to the base of each crane lifting module;
   b. electro-hydraulic proportional control actuators;
   c. a liquid crystal display located at the rear of the chassis;
   d. a wireless remote control unit radio receiver;
   e. a wireless operated remote control unit;
f. a cable operated remote control unit;
g. various mechatronic sensors;
h. an engine run/stop and engine speed control; and
i. high/low hydraulic speed valve solenoids.

Remote Controls

41. The Hetronic radio remote control unit (Figure 12) allows the operator to control load handling whilst being able to view the operation from a safe distance. The receiver is fitted with a controller area network (CANbus) wiring system which eliminates the need for complex wiring looms.

42. The remote control unit is a transmitter and features proportional joysticks for precise control of the hydraulic functions. All crane functions and starting of the powerpack are controlled by the remote control unit. Both the transmitter and receiver are housed in enclosures that have an ingress protection rating of IP65.

43. The wireless remote control is shielded against interference from electromagnetic fields and radio transmissions. The remote controls use frequency synthesizer technology to eliminate problems typically associated with radio remote control systems.

44. The wireless remote control system includes a transmitter and a receiver that operate over the 400-470 MHz radio band range that are approved by the federal communications commission (FCC).

45. The transmitter generates electronic signals that are transmitted to the receiver, the transmitter and receiver have identical address codes and frequency channels. This feature prevents any interference with any other MHE-CSL system that may be operating in the immediate vicinity.

46. As a safety feature, the hydraulic valves and load sense dump solenoid are only energised when the joysticks are moved off-centre. A manual override feature is activated by entering a personal identification number (PIN).

47. The remote control is equipped with:
   a. a function selector switch which allows the selection of the various modes being:
      (1) off;
      (2) traverse;
      (3) stabiliser legs; and
      (4) crane arms;
   b. two joysticks that operate the hydraulic functions;
   c. a two-position switch for high and low speed operation; and
   d. an emergency stop button.

Figure 12    Remote Control Unit
48. The role of the function selector switch is to select the operating mode of the remote control:
   
   a. **Off Mode.** This mode turns off all power to the hydraulic control valves. If the trailer is moved while the SMARTlift™ system is operating, the switch must be set to OFF. The emergency stop button should also be depressed during movement of the trailer.
   
   b. **Traverse Mode.** This mode is used when moving the crane lifting modules along the chassis rails to the positions required for various container sizes. Whenever a stabiliser leg is in contact with the ground the traverse mode is automatically disabled. If a stabiliser is extended for any distance the traverse mode is disabled, an audible warning sounds and a screen message is displayed on the SMARTlift™ panel. High speed operation is automatically selected when using the traverse mode.
   
   c. **Stabiliser Mode.** This mode is for extending and retracting the stabiliser legs. High speed operation is automatically selected when using the stabiliser mode. If there is any load on the lifting cylinder, an audible warning sounds and a screen message is displayed on the SMARTlift™ panel.
   
   d. **Crane Arm Mode.** This mode is for extension and retraction of the crane arms. When this mode is selected sensors automatically check that the stabilisers are firmly in contact with the ground or a companion trailer. If no contact is sensed the crane arm mode is automatically disabled, an audible warning sounds and a screen message is displayed on the SMARTlift™ panel. If a stabiliser foot lifts from the ground during a loading operation the lifting is allowed to continue. When the crane arm mode is first selected during an operation, the sensors automatically check the trailer camber and elevation. If the camber and/or elevation are outside safe working parameters the crane arm mode is automatically disabled. Whenever this situation occurs it may be possible to correct the problem using the stabiliser legs.

49. **Joysticks.** The joysticks control all the hydraulic functions of the crane lifting modules. Control of each function is dependent on the position of the function selector switch. Output signals from the joysticks are transmitted via relays in the main junction box to the hydraulic control valves, and to the function diverter valves via the crane mounted junction boxes. The joysticks also incorporate micro switches that independently signal the dump solenoid valve relay and a power relay that energises the proportional valve coils in the hydraulic control valve.

50. **High/Low Speed Switch.** A two-position switch controls high and low speed settings. When high speed is selected, two relays in the main junction box are activated. One relay directs joystick signals to the hydraulic control valve coils, the other relay activates the high speed load sensed unloader valve solenoid coils. When low speed is selected these relays are de-energised and the joystick signals are now directed via the electronic hydraulic flow controllers to the hydraulic control valves.

51. **Emergency Stop.** An emergency stop button is fitted to the remote control to shut down all systems in an emergency. Any dangerous or unsafe conditions should then be rectified. To re-enable the system after the emergency stop button has been activated, the button should be re-set and then the start button is pressed.

52. **Manual Operation.** In the event of an electrical system failure the operating cycle can be completed manually by using manual control levers. These levers are stored in a toolbox and are then fitted to the crane lifting arm control valves. Prior to being able to manually operate the system the load sense dump solenoid must be energised. The operator must press a rubber covered button on the left-hand side of the powerpack control panel to override the emergency stop circuit and energise the load sense dump solenoid.
54. **Safe Mode.** When the remote control unit battery operating voltage drops below 3.4 volts the system automatically switches to a safe mode. An audible alarm will sound to indicate a low battery voltage situation, after a further 30 seconds the remote control transmits an emergency stop signal and all functions cease to operate. To allow the system to restart, a fully charged battery must be inserted into the remote control unit.

55. **Battery Charging.** A battery charger (Figure 13) that recharges remote control unit batteries is permanently connected to the powerpack batteries and charging system. The charger is able to be used when the powerpack control panel start key is either in the ON or OFF position.

56. When a battery is inserted into the charger the CHARGE light emitting diode (LED) flashes to indicate that the battery is charging. When the charger detects peak battery voltage, or after 5 hours on charge the battery charging process will stop automatically and the READY LED will illuminate. If the battery is left in the charger after the charging process is completed, the ready LED remains illuminated and the charger continues to trickle charge the battery. The battery will not be damaged by leaving it in the charger.

57. The fast charging facility is achieved by pressing the fast charge button on the charger, this causes the FAST CHARGE LED to illuminate and the charging will be completed in 2 hours.

58. If a battery fails to accept a charge or has an open circuit cell then no LEDs will illuminate when the battery is placed in the charger. If a battery has a short circuited cell, the CHARGE LED will blink continuously, in either case do not use the battery and dispose of it correctly.

![Battery Charger Diagram](image-url)
ELECTRICAL SYSTEM

Junction Boxes

59. There are four electrical junction boxes (Figure 14) mounted on the MHE-CSL.

Junction Box E

60. Junction box E (Figure 15) is the main junction box and houses various fuses and relays as part of the electrical system, it controls the engine functions. The relays (Item A) are fitted with an LED that illuminates green when the relay is energised. The printed circuit board (Item B) is marked with a table showing the layout and function of the fuses. The various circuit fuses (Item C) are fitted with an LED that illuminates red when the fuse is blown.
Junction Box B

61. Junction box B (Figure 16) controls the display screen and remote control unit radio receiver.

![Figure 16 Junction Box B](image16)

Junction Boxes F and R

62. Junction boxes F and R (Figure 17) are mounted on the crane lifting modules. They receive sensor inputs and control hydraulic valves on the crane lifting modules. The components and circuits of both junction boxes are identical.

63. The green LEDs (Item A) indicate the presence of junction box supply voltage. The green LED marked UE illuminates when the SMARTlift™ system is operational. The green LED marked D+ illuminates when the horn button on the remote control unit is pressed.

64. The red LEDs (Item B) are fitted to circuit fuses. The red LED marked LED1 illuminates when the angle sensor ground fuse has blown. The red LED marked LED2 ECU illuminates when the fuse has blown.

![Figure 17 Junction Boxes F and R](image17)
SMARTLIFT™ LOAD MONITORING SYSTEM

Sensors

65. The SMARTlift™ system uses its software and sensors (Figure 18) to monitor and control the lifting operation. The system warns the operator when the load has moved to the limit of the safe working envelope and prevents the operator from moving the load further into an area where the stability may be compromised.

Electronic Control Unit (ECU)

66. Each crane lifting module is equipped with an ECU that monitors the following parameters:
   a. stabiliser angle,
   b. stabiliser leg extension,
   c. stabiliser foot ground contact pressure,
   d. bottom lifting arm angle,
   e. top lifting arm angle,
   f. top lifting arm hydraulic cylinder pressure, and
   g. trailer camber and elevation.
**Operation in Arm Mode**

67. When the lifting arm mode is selected the sensors automatically check that the stabilisers are firmly in contact with the ground or a companion trailer. If there is no stabiliser contact the lifting arm mode is disabled, an audible warning sounds and a screen message is displayed on the SMARTlift™ control unit.

68. When the lifting arm mode is selected during an operation, the sensors automatically check the trailer camber and elevation. If the readings are outside the safe working parameters the crane arm mode is disabled. It may be possible to correct the trailer camber using the stabilisers; if so, the crane arm mode will be enabled. If a stabiliser lifts clear of the ground during a loading operation, the lift is allowed to continue.

**Offside Stability**

69. Whenever the crane lifting arm pin is within 250 mm from the trailer centre line on the stabiliser side of the trailer, and the base of the container is higher than the top of the strike plates, the offside stability alarm is activated. When this situation occurs, the bottom arm lower and the top arm raise hydraulic functions are disabled. The SMARTlift™ system also activates the offside stability alarm if the crane arm lifting pin crosses the centre line of the trailer whilst the trailer is loaded.

70. The pressure in the top arm cylinder is also monitored, this enables the system to estimate the mass on the crane arm lifting pin. This value is displayed on the SMARTlift™ control unit to the nearest tonne whenever the system is being operated in the lifting arm mode.

71. If the road elevation results in one end of the trailer being higher than the other, then the system will allow the highest end of the container to be raised above the offside strike plate height. This ensures that the container can be placed on the trailer and secured by the container twist-locks.

72. Each crane lifting arm ECU calculates the position of the stabiliser foot and the position of the crane lifting arm pin. Whenever the crane lifting arm pin is extended beyond the stabiliser foot pin, the system calculates the stability of the trailer on the offside. As the crane arm lifting pin is extended, the system warns the operator that an unstable situation is imminent. If the operator continues with the action the system automatically disables the hydraulic functions that are increasing the distance of the crane arm lifting pin from the trailer. If the stabiliser is very steeply angled and the container is also very heavy, then the system may even prevent the crane arm lifting pin from being extended beyond the stabiliser foot pin.

73. If a container has been unequally loaded, and the heavy side is closest to the offside of the trailer, then it may be necessary to lift the container higher than normal to clear the trailer deck, or, move the crane arm lifting pin farther offside than normal. Either of these situations can cause the offside stability protection to activate earlier than desired, there are three possible solutions:
   a. Move the trailer and pick up the container from the other side.
   b. Shorten the lifting chains so the container can be raised higher.
   c. If the operator decides it is safe to attempt the lift, then a manual override code can be keyed into the SMARTlift™ control unit. This action will allow the offside stability protection system to be overridden for one operation only. In a manual override condition the operation of the hydraulic functions is extra slow.

**Angle and Pressure Sensor Failures**

74. If any of the angle or pressure sensors fail, this will prevent operation of the crane lifting arms. If the operator decides it is safe to attempt a lift, then a manual override code can be keyed into the SMARTlift™ control unit. This action will allow the SMARTlift™ system to be overridden for one operation only. All subsequent actions will also require the entry of the manual override code until the fault has been rectified.

**SMARTlift™ Display Screen**

75. The SMARTlift™ control unit is equipped with an interactive LCD screen (Figure 19). The LCD shows system information, warnings, alarms and crane arm settings. The LCD is also used when carrying out crane arm synchronisation and entering manual override commands.

76. Navigation of the various screen displays and menus is achieved by rotating and by pressing the display dial. The dial can be rotated in both directions to obtain the desired setting or menu item, the setting or menu item is then confirmed by pressing the display dial.
77. To access the main menu (Figure 20) from the default screen, the display dial is turned until the menu icon becomes highlighted, the dial is then pressed. Each of the main menu items provides access to the next layer of the menu structure. The lower menus and screens have an option to return to the main menu or to the previous menu item, this allows the operator to back through previous selections.
Menu Functions for Crane Synchronisation

78. The crane synchronisation menu is protected by an access code which prevents unauthorised and/or untrained personnel from using the menu. Crane synchronisation is a process of matching the speeds of the front and rear crane lifting arms in low speed only. The synchronisation is set by the original equipment manufacturer however it may need to be reset once the system has been in operation beyond 50 hours.

79. Crane synchronisation is only effective when low speed is selected on the remote control unit. Reset as follows:
   a. Check that the maximum speed is 2 800 rpm.
   b. Select low speed and crane arm mode.
   c. Using the LCD, go to the main menu and select crane synchronisation.
   d. Enter the access code by turning the display dial and pressing it when the correct number appears, then turn the dial to go to the next field and press the dial, and repeat the procedure until the complete access code has been entered.
   e. After the access code has been entered the crane synchronisation menu appears.
   f. Select the top arm synchronisation and the top arm screen is displayed.
   g. On the remote control unit move both joysticks at full deflection to raise the cranes and time the arms over their full stroke. Carry out the same actions for the remaining functions. The top arm raise time is 52 seconds and the lower is 32 seconds. The bottom arm raise time is 90 seconds and the lower is 70 seconds.
   h. If any of the function times are incorrect, adjust the percentage values on the LCD until they are correct. Select the appropriate function by turning the display dial and then press it. Adjust the value up or down by turning the dial backwards or forwards. Save the new value by pressing the display dial.

80. Test the crane synchronisation settings by lifting a 15 000 to 20 000 kg container under normal loading and unloading conditions. Small adjustments of the percentage values may be required to achieve this and to correct variations under load. When carrying out adjustments always attempt to slow down a fast arm action rather than trying to speed up a slow arm action, this is to prevent exceeding the available oil flow.

Sensor Values

81. The view sensor values menu enables access to information that is useful for diagnostic purposes.

82. Front Angle Sensors. This option displays information on the extension of the front stabiliser leg in millimetres, the angle of the stabiliser leg, the angle of the top and bottom crane arms, and the pressure in the top arm lifting cylinder.

83. Front Stabiliser Extension Sensors. This option displays information on the magnetic counter, the magnetic reset sensors, and the stabiliser deployed microswitch.

84. Rear Angle Sensors. This option displays information on the extension of the rear stabiliser leg in millimetres, the angle of the stabiliser leg, the angle of the top and bottom crane arms, and the pressure in the top arm lifting cylinder.

85. Rear Stabiliser Extension Sensors. This option displays information on the magnetic counter, the magnetic reset sensors, and the stabiliser deployed microswitch.

86. View Special Options. This option displays information regarding engine management and any optional features installed. The system continuously monitors the engine oil pressure, water temperature and the alternator output. If any of these values are outside their normal operating range an audible alarm sounds and a message is displayed on the LCD. If low oil pressure or high water temperature is detected the engine will automatically be shut down after 20 seconds to protect the engine from damage.

87. The park brake sensor prevents operation of the system if the park brake is not applied, the brake status is displayed as ON or OFF.
View Joysticks Option

88. Selecting the view joysticks option displays information that is useful for diagnostic purposes. The values displayed help determine if there are communication errors between the remote control unit and the electronic control units located on each crane lifting module.

CHASSIS

Chassis Construction

89. The chassis consists of two rails that run the full length of the trailer. The rails are fitted with the appropriate brackets and cross-member sections to provide support to all the fittings and systems, they also provide a sliding surface for the crane lifting modules. The chassis provides anchor points for the hydraulic traverse cylinders that move the crane lifting modules to the correct locations for the size of container being handled.

90. The chassis members are constructed from high tensile steel and can be damaged or distorted by extreme heat. The chassis is not to be drilled, welded or heated without the appropriate engineering approvals by the design authority.

91. The chassis is fitted with a 10 mm rub-plate that is fitted with a bolt on king pin. The primary king pin is a 90 mm pin, this diameter is standard across the commonwealth fleet. An additional 50 mm king pin is provided as part of the complete equipment schedule (CES). The 50 mm pin is required when the trailer is being towed using civilian prime movers. The king pin retaining bolts are fitted with a thread locking sealant, they are only to be used once and must be discarded once removed. Users shall ensure that only approved bolts of the correct part number are used whenever the bolts are replaced.

Batteries and CES Stowage

92. The batteries and the CES stowage boxes (Figure 21) are constructed from PVC and they are bolted to the left-hand side of the chassis. The battery box lid is fitted with two battery isolator switches. The lids are double latched and fitted with locking hasps for security. Two additional stowage boxes are also fitted on the right-hand side of the chassis.

Figure 21 Batteries and CES Stowage Boxes

Trailer Lighting

93. Power for the trailer lighting is supplied from the lighting system of the prime mover via the NATO 12-pin trailer lighting plug fitted to the left-hand side of the trailer coupling. This system includes clearance lights, tail lights, brake lights, indicators, work lights and a blackout feature.
Suspension System

94. The trailer suspension is a Hendrickson HT 230 Series air bag system (Figure 22), and is fitted with ride dampening and height control adjustment.

Axles and Braking System

95. The trailer is fitted with three sets of York 2782/1/1850T axles, they are fitted with cast, 5-spoke spider hubs.

96. The brakes are cam operated Bendix 420 mm diameter drum brakes. The brake actuators are Bendix 24/30 air actuators operating on long S-cam shafts and are fitted with automatic slack adjusters. The brake shoes have a built in wear indicator that is easily checked to determine the condition of the brake linings.

Rear Trailer Coupling and Connections

97. To enable the trailer to be utilised in a road train configuration a rear Ringfeder 101 AUS trailer coupling (Figure 23), and air and electrical connections are fitted. The trailer coupling has a pin diameter of 50 mm and has a D rating of 286 kN.
98. Air connections are fitted for both emergency and supply air (Figure 24), both lines can be isolated by taps and the connections are of a standard glad hand configuration.

Figure 24  Air and Lighting Connections

Landing Legs

99. A pair of landing legs are mounted to the front of the trailer as support when the prime mover has been uncoupled. The landing legs are mechanically operated via a two-speed gearbox and handle that is fitted to the right-hand side of the trailer.