



Rail Operating Code

Code Supplement CS 4.20

Operating Instructions for Electric Shunt Vehicles

Issue Number	Prepared (P) Reviewed (R) Amended (A)	Approved by	Authorised for release by	Review date
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PICTURES OF ELECTRIC SHUNT VEHICLES (E-Maxi M and E-Maxi L)



Fig.1 E-Maxi M



Fig.2 E-Maxi L

Fig.15A : Configuration of the E-MAXI M remote control

1.0 TRAINING AND CERTIFICATION

To operate an ESV the user is required to hold a current license to operate and has completed a conversion training course. Refer RORP Section 10.3

2.0 COMMONLY USED ABBREVIATIONS

ESV	Electric Service Vehicle
E Maxi-M	110 ton ESV
E Maxi-L	300 ton ESV
WBS	Wagon Brake System (Air Brake System)
SIFA	Vigilance System
DeadMan Device	Throttle Safety Interlock
PLC	Programmable Logic Controllers

3.0 GENERAL

The ZAGRO E-MAXI M and E-MAXI-L are battery-driven road / rail vehicles used to perform the shunting operation of rail vehicles within Mechanical Depots / Workshops. Refer to local operating procedures (LOP) / joint operating procedures (JOP) for limitations.

The vehicle consists of a base frame, which also serves as a ballast weight. The all-wheel drive system of the road wheels ensures high manoeuvrability in diagonal and circular drive.

The ESV is propelled by means of four wheels made of Vulkollan rubber, driven by electric motors. Four electric motors equipped with steering motors serve as power units.

The rail guidance system consists of four rail guide wheels, which are hydraulically lifted and lowered.

The noise level of the vehicle in operation is below 80 dBA (except if warning alarms are actuated)

3.1 Electrical Cabinet

The electrical cabinet is located underneath the number 2 end cover. Important control elements such as programmable logic controllers (PLC), data recorder and battery monitoring systems are installed in this control cabinet.



Fig.3 Electrical Cabinet

3.2 Data Recorder

The data recorder is located in the control cabinet



Fig.4 Data Recorder

3.3 Radio Remote Control (Receiver)

The receiver is located under the No. 2 end cover of the vehicle.
The receiver includes an antenna cable, a connection cable and connection to the control panel.



Fig.5 Radio Remote Control Receiver

3.4 Technical Data

	E-Maxi-M	E-Maxi-L
Wheel base	1049 mm	1757 mm
Vehicle dimensions (base frame only)	2433 mm (length) 2055 mm (width)	3127 mm (length) 2055 mm (width)
Tyres	Vulkollan rubber	Vulkollan rubber
Permissible wheel load	1300 kg	1960 kg
Machine Mass	5200 kg	7840 kg
Permissible environment temperature	-25°C to +45°C	
Driving speed	Turtle: 0 – 3 km/h Hare: 0 – 5 km/h	
Push / Pull capacity	110 tonne	300 tonne
Drive motors (4)	80V / 5KW each	
Batteries (2 Nos per Vehicle)	Lead – Acid battery 40V / 375Ah each	Lead – Acid battery 40V / 625Ah each
Operation	Remote control	
Radio range	~700 metres	

Track Guiding Equipment:

	E-Maxi-M	E-Maxi-L
Guide wheels	4	
Wheel diameter	160 mm	
Minimum track radius	≥ 30 m	
Track gauge	1067 mm	
Wheel back to back dimensions	995 mm	
Rail wheel hydraulic pressure	~60 bar	

Brake system:

	E-Maxi-M	E-Maxi-L
Compressed air generator	Piston compressor	
Drive	Electric drive (via electric motor)	
Max. capacity	~ 380 l/min	
Reservoir operating pressure	800 -1000KPa	
Volume of reservoir	2 x 85 litre (=170 litres)	
Max operating train volume	1700 litre	
Brake release pressure	550 kPa	
Brake full application pressure	390 kPa	

4.0 EQUIPMENT

4.1 Track Guiding Equipment

The vehicle is guided on the rails by means of four rail guidance wheels. These are hydraulically lifted and lowered.

4.2 Earth Device

The vehicle is earthed to the rail head by a series of earthing straps and brushes at the rail which ensures the safety of the operators when working under overhead lines by bridging electrical resistance in order to impede the flow of dangerous body currents.

4.3 Lighting System

The lighting system consist of :

- A rotating beacon that indicates operational mode and connection with the remote pack.
- Directional lights – White and Red lights on both ends of the ESV. White indicates direction of travel and Red indicates the rear end of the ESV. Directional lights are automatically activated during rail / road movement.
- Working Lights (Coupler light) – Working lights on both end of the ESV on top of the coupler.

NOTE: The rotating beacon flash light is activated automatically.

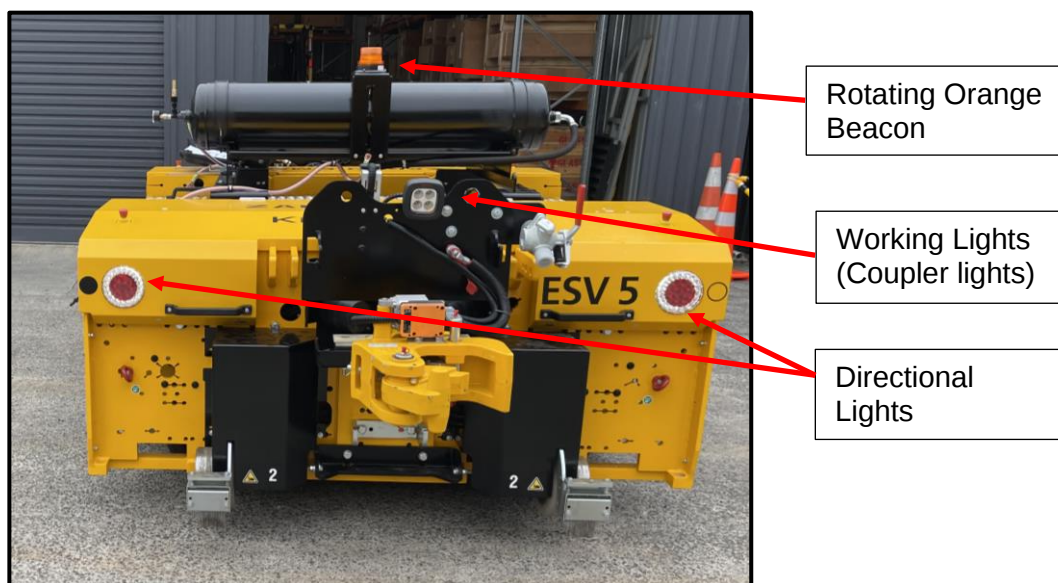


Fig.6 Location of Lights / Beacons

4.5 Signal Horn

The signal horn sounds when the button on the radio remote control is activated during rail / road operation.

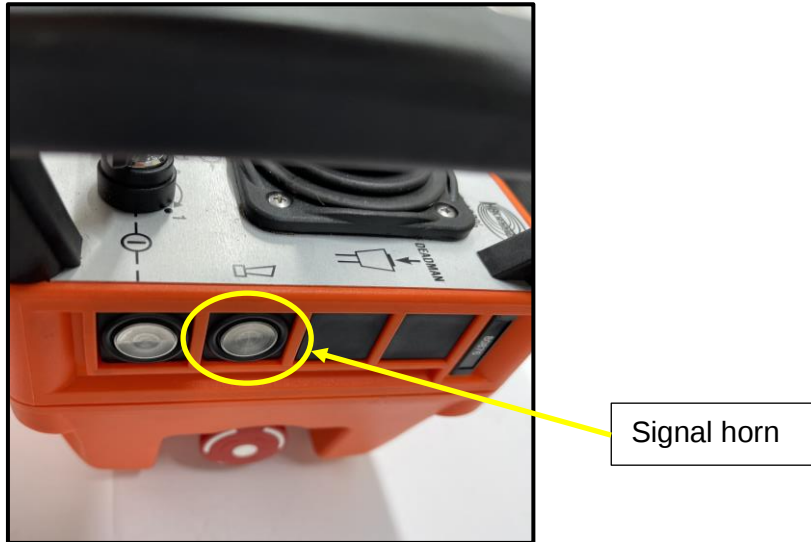


Fig.7 Signal Horn on Remote

4.6 Coupling System

AAR Coupler with auto-uncouple feature is used for both the E-Maxi L and E-Maxi M ESV.

NOTE:

E-Maxi L, 300t has AAR style Coupler at both front and rear of the vehicle.
E-Maxi M, 110t has AAR style coupler only on No. 2 end.

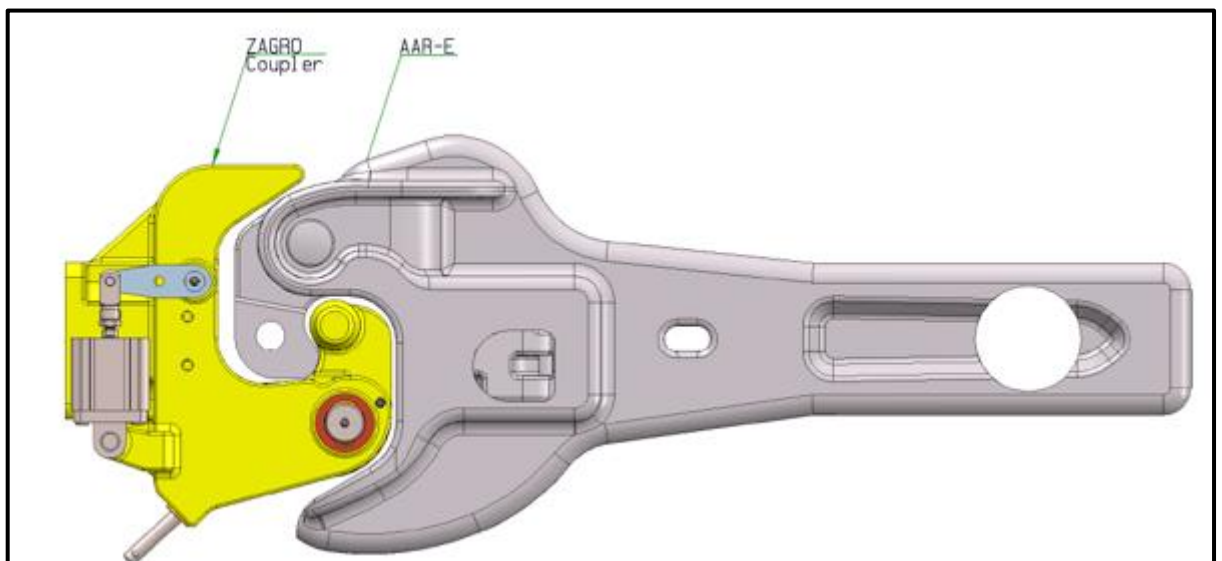


Fig.8 AAR Coupler

Automatic uncoupling of the coupler is performed from the remote control pack. The remote pack is provided with a dedicated switch to unlock the coupler from attached rail vehicle. This switch only works when the ESV is in rail mode operation. The auto-coupler feature does not work when the ESV is in road mode. To open the coupler in road mode, use the AAR Bypass switch or manually uncouple. Manual uncoupling is available in event of system failure.

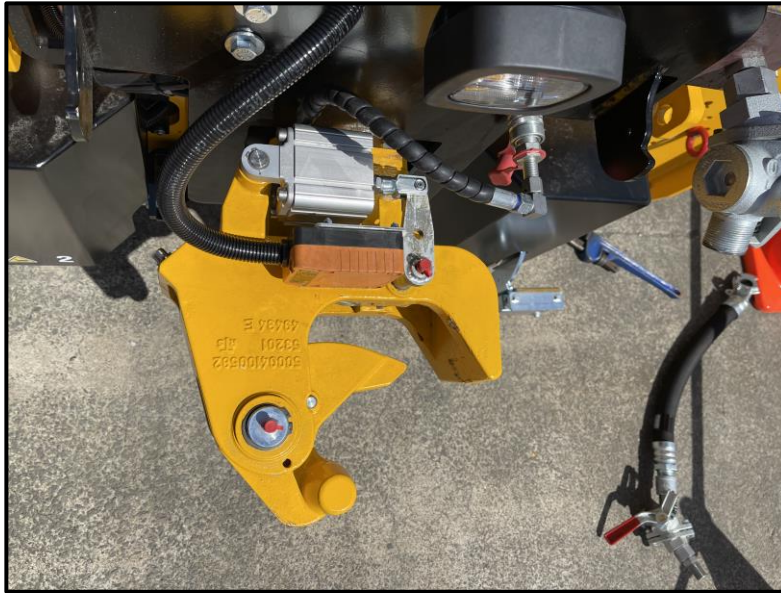


Fig.9 ZARGO couper on ESV

WARNING: When coupling, personnel must stand clear of the danger zone. Refer Rail Operating Code, Section 5.1 Instruction 4.2.17

4.7 Hydraulic Hand Pump

The hydraulic hand pump is used to lift the track guiding wheels manually in case of system failure.

The hydraulic hand pump (1) is integrated into the hydraulic circuit. For easy access, it is located on the vehicle frame at the No. 2 end. The lever for the pump actuation is stored under the No. 2 end cover.



Fig.10 Hydraulic Hand Pump

4.8 Speed Limit via Key Switch

There are two speed adjustments:

- slow speed  (symbol Turtle) and
- fast speed  (symbol Hare).

The maximum driving speed can be pre-set via the key switch. Under normal conditions, the low speed is 0 – 3 kph, the fast speed is 0 – 5 kph.



Fig.11 Speed Limit Key

4.9 Vigilance (SIFA) Button

The SIFA Vigilance is an automatic safety device which monitors the continuous attention of the operator.

If the SIFA button is not pressed during the monitoring time, the operator will be warned acoustically before automatic emergency braking is activated. See instruction 15.1



Fig.12 Vigilance (SIFA) Button

4.10 Emergency Stop

Activated Emergency Stop System

Emergency stop buttons serve as safety devices in an emergency situation to stop the ESV immediately. Four E-Stop buttons are located at each of the four corners on the ESV and a separate E-Stop button is located on the remote control pack. When one of the emergency stop buttons is actuated, the ESV Brakes are applied and also the air brake is put into emergency brake application.



Fig.13 Emergency Stop

Default Emergency Stop System

The emergency stop system is fail-safe.

- If there is an electrical system failure or break in power supply, the brakes are applied by default
- Outside of the radio range, or if the radio operation is disrupted, or in the event of radio power failure, the emergency stop is activated.
- The emergency stop is also activated and the brakes are applied, if no function has been operated on the vehicle for a certain period of time (vigilance SIFA).
- Emergency stop is also activated in the event of the remote controller being tilted more than 45° (tilt protection).

4.11 Air Brake System

As a principle, the air brake system works independently from ESV electrical / parking brakes. A vehicle compressor driven by the electric drive supplies compressed air to the reservoirs. A brake hose with shut-off valve and coupling head are mounted on the E-MAXI L front and rear headstocks and E-Maxi M on No. 2 end headstock only. Main reservoir pressure can be read on the air pressure gauge fitted to the main reservoir.



Figure.14 Air pressure gauge

If the maximum pressure is exceeded, the safety valve opens and releases the overpressure air into the atmosphere. During rail mode operation and coupled up to other rail vehicles, the train brake must be applied to secure the consist and prevent SIFA (Vigilance) activation.

When shunting operate in accordance with ROC Section 5.1

5.0 OPERATION

5.1 Configuration of the Remote Control

The ESV is operated by means of the radio remote control.

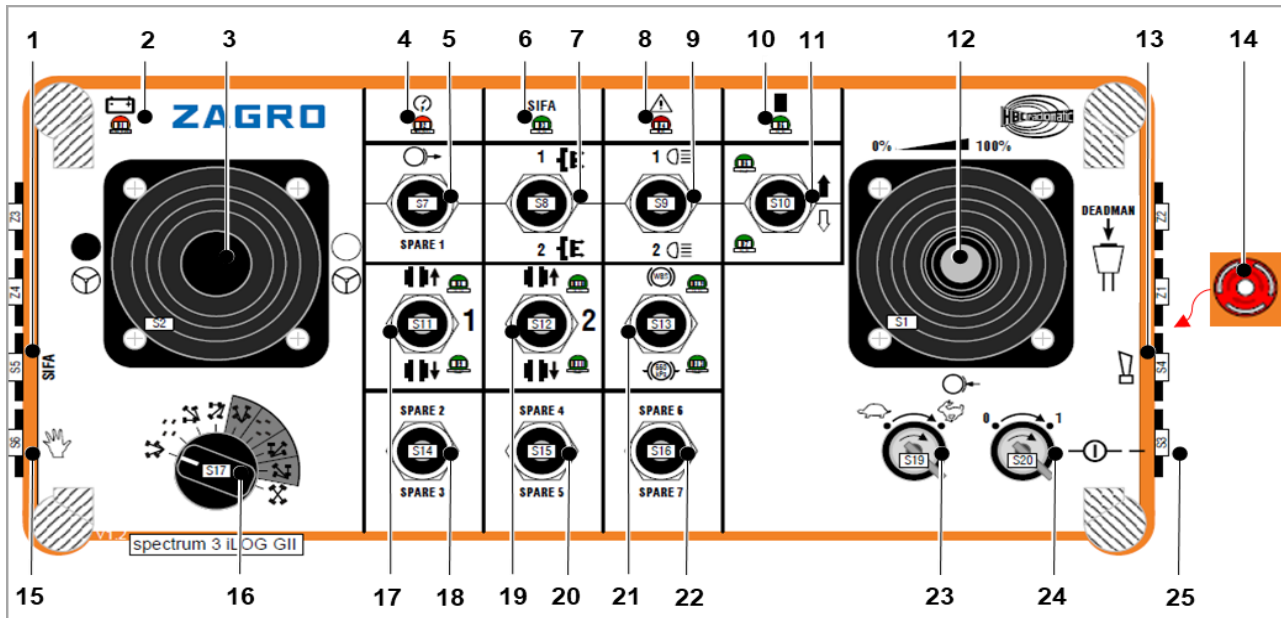


Fig.15A : Configuration of the E-MAXI M remote control

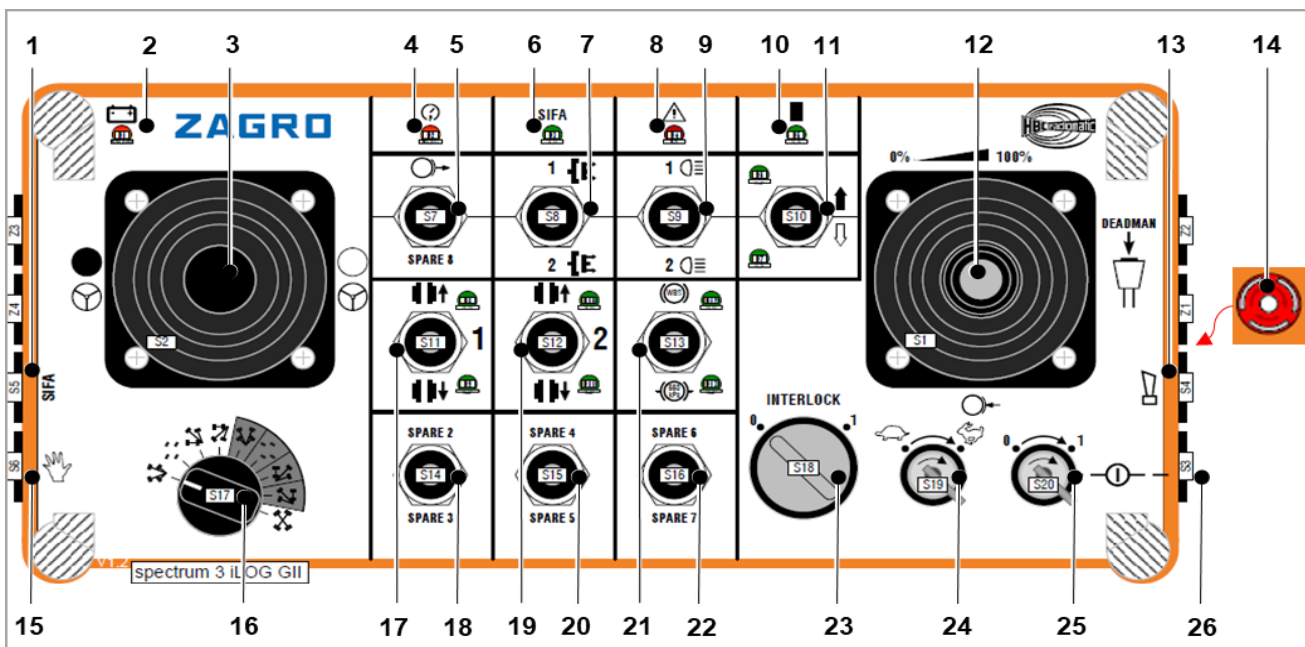


Fig.15B : Configuration of the E-MAXI L remote control

E-MAXI M		E-MAXI L	
1	SIFA Vigilance button		
2	Battery LED information (Red = Low Battery)		
3	Steering regulator		
4	Lamp for brake pressure 550kPa (green means ready for driving)		
5	Brake release / Spare		
6	SIFA (Vigilance) control lamp		
7	Open coupler No. 1 End (Push Forward to Open Coupler) / No. 2 End (Pull Backward to Open)		
8	Error lamp (This lamp lights red, if the vehicle shows any errors on the vehicle display unit)		
9	Working light (Coupler light) –No. 1end / No. 2 end ON / OFF		
10	Remote control is operative		
11	Choose driving direction		
12	Driving regulator with dead man’s safety system		
13	Signal horn		
14	Emergency stop		
15	Two-hand operation Ensures that the operator consciously continues the action. This button is to be used, when you want to un-couple, on-track, off-track or to activate the air brake system.		
16	Steering control (9 steering modes)		
17	Track Guiding wheels No1 end LOWER / LIFT		
18	Spare		
19	Track Guiding wheels No 2 end LOWER / LIFT		
20	Spare		
21	Brake system / 550 kPa (Forward – air brake system activate, Reverse - release the train brakes)		
22	Spare		
23	Driving speed (Turtle / Hare)	23	UWL Interlock
24	Remote Control Unit ON / OFF	24	Driving speed (Turtle / Hare)
25	Reset Tthis button needed to activate the remote control and reset error LED)	25	Remote Control ON / OFF
		26	Reset (this button needed to activate the remote control)

From the table, Item No's 1 to 22 are common for remote control pack for both E-Maxi M and E-Maxi L type ESVs.

Item No's 23,24 and 25 on left hand side are for E-Maxi M and similarly for right side are for E-Maxi L.

5.1.1 Descriptions of Steering Modes

The Control for the steering modes is integrated in the remote control panel.

IMPORTANT: Select one of the steering modes whilst stationary and brake applied

The following nine steering modes exist (Fig.16):

1. All-wheel steering (longitudinal direction)
2. Diagonal drive (longitudinal direction)
3. Axle steering - track No 1 end (longitudinal direction)
4. Axle steering - track No 2 end (longitudinal direction)
5. All-wheel steering: 90° drive with small wheel turning angle (transversal direction)
6. Diagonal drive (transversal direction)
7. Axle steering half-circle ○ (transversal direction)
8. Axle steering full-circle ● (transversal direction)
9. Circle drive on the spot, slow speed – steering by steering controller is not possible (Fig.15A & 15B Pos. 3).

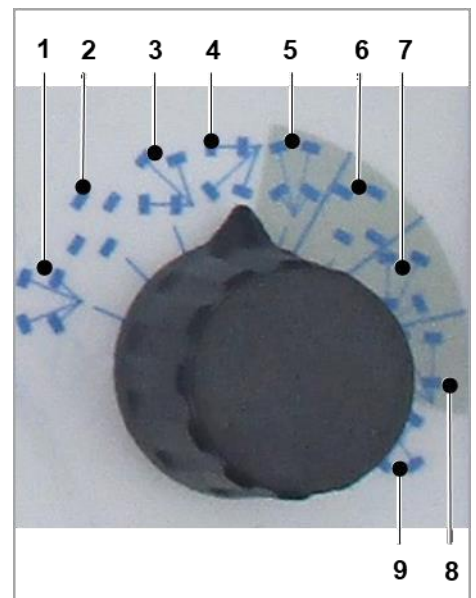


Fig.16 : Steering Control

Before switching the steering modes from the longitudinal directions (bright-coloured area) to the transversal directions (dark-coloured area) and circle drive, the button to select the driving direction ↑↓ must be returned to its “neutral” position. The green LED lamps near the button to select the driving direction will be off.

The vehicle executes the steering mode change only when stationary with brakes applied. During the movement, the mode cannot be changed but can be preselected.

5.1.2 Symbols on the Remote Control and Vehicle

NOTE: To aid in the operation, certain symbols are identified on the remote control pack and ESV. During operation of the vehicle, the operator is guided by these symbols.

The steering direction is determined by the steering regulator (Fig.15A & 15B Pos.3). The remote control panel shows two steering directions: solid-circle ● and hollow-circle ○.

The steering direction is identified on the ESV by decals: solid-circle ● (Fig.17 Pos.3) and hollow-circle ○ (Fig.17 Pos.2). The decals correspond to the symbols on the remote pack steering regulator.

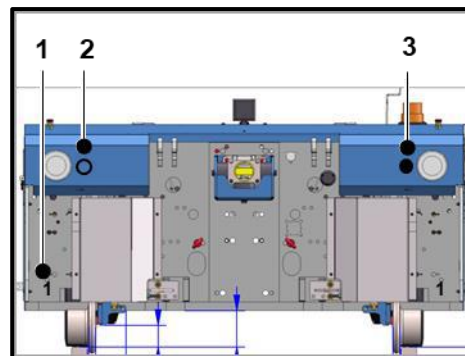


Fig.17 Decals on the ESV

The driving direction is determined by the position of the switch (Fig.15A & 15B Pos.11). The direction is identified on the ESV by decals: solid-arrow ● and hollow-arrow ○. The decals correspond to the symbols on the remote pack direction selector.

Solid-arrow 

Hollow-arrow 

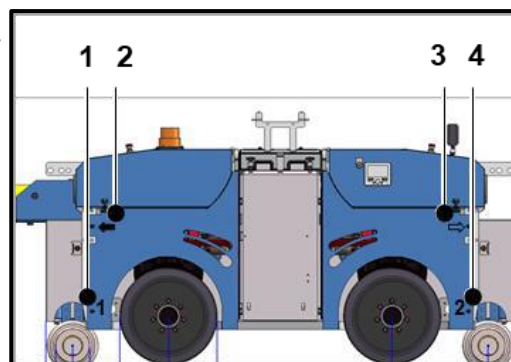


Fig.18 Decals on the ESV – lateral view

The rail guiding wheel is marked with numbers No. 1 end and No. 2 end. The wheels are raised and lowered by switches 17 and 19 on the remote control pack (Fig.15A & 15B Pos.17 and Pos.19). Please refer instruction 8.4



Fig.19 Direction Selector

5.1.3 Key switch for underfloor wheel lathe (UWL)

NOTE: Applies to E-MAXI L only

The E-Maxi L is equipped with a key switch (Fig.15B Pos.23) for underfloor wheel lathe interlocking.

In position '0', the UWL key cannot be removed.
All functions of the remote control are active in position '0'.
The UWL is switched-off.

In Position '1', the UWL key can be removed to be used at the UWL. The functions "Emergency stop" and "parking brake" are still operable. The remote control pack remains switched-on via the "switch control unit ON / OFF" (Fig. 15B Pos.25).



Fig.20 Key switch for UWL

6.0 PRESTART INSPECTION

Check the following items daily at a prestart inspection and sign off in the logbook.

1	Check Charging levels on ESV Battery and Remote Pack. Check battery acid levels on the ESV Battery
2	Hydraulic System : Visual Check for leakage
3	Road Tyres: Visual Check for damages, wear
4	Visual Check Machine for Damage
5	Power Up Machine, Remote Pack and witness self-test
6	Check Warning Horn Operation
7	Check operation of Work lights
8	Check Rotating Amber Beacon Active
9	Check operation of Directional lights
10	Apply / Release Brakes (Carry out half wheel test)
11	Check operation of Emergency Stop Buttons (4 Buttons on ESV and 1 Button on Remote Pack)
12	Check Wagon Brake System is operable
13	Check Operation of Remote Control Vigilance System (SIFA)

7.0 ROAD MODE OPERATION

In road mode, do not attempt to operate the ESV on a loose surface such as ballast or a metal surface. The ESV must only be operated in road mode on a sealed road.

1. STARTING THE ESV

Ensure the battery isolation switch is closed. Turn ON the main switch key adjacent to the display panel (Fig.21 Pos.1) to activate the ESV. Turn ON the remote control switch (Fig.15A Pos 24 & Fig.15B Pos.25) to position “1” to activate the remote pack.

To establish remote pack and ESV:

1. Briefly press the reset button ① (Fig.15A Pos 25 & Fig.15B Pos.26).
2. Press and hold the reset button, until the LED light at Position 10 on the remote control pack goes GREEN (Fig 15A & 15B Pos.10) and ERROR indicator light goes RED (Fig 15A & 15B Pos.8).
3. Press and hold the reset button again, until the error LED light goes OFF (Fig.15A & 15B Pos.8)
4. Radio connection between the remote pack and ESV is indicated by a slow pulsing GREEN light on LED at position 2 of remote pack and also by the flashing orange beacon on the ESV.

2. STEERING AND DRIVING MODE SELECTION

Choose the appropriate steering mode at the switch  “steering control” (Fig.15A & 15B Pos.16). See Section 5.1.1 for different steering modes.

The driving speed can be preset via the key switch “choose driving speed” either Turtle / Hare speed (Fig.15A Pos.23 & Fig.15B Pos.24). The key can be placed in the low turtle speed (recommended during shunting work). Then the drive speed is limited to 3 km/h.

3. DIRECTION CONTROL

Press the direction selector forward or reverse  (Fig.15A & 15B Pos.11) to select the direction of travel (forward or reverse). The green LED lighting next to the button indicates the selected direction.

4. SPEED REGULATION

To set the vehicle into motion, push down on the deadman button (Fig.15A & 15B Pos.12) then push the driving regulator forward. Note the speed will be proportional to the 0%  100% movement of driving regulator.

The deadman switch does not require to be held down continuously.
NOTE:- upon release of the driving regulator, the deadman switch will become inactive after a duration of 2 seconds.

5. BRAKING REGULATION

When the driving regulator is released, the park brake applies by default, the vehicle reduces its speed and stops.

Pull the driving regulator to braking position  to actively apply brakes. The power is cut and the brakes are actively applied. The required braking effort is proportional to the position of the driving regulator.

6. STEERING REGULATION

Use the steering regulator (Fig.15A & 15B Pos.3) to guide the ESV towards the appropriate direction. Use solid-circle ● decal and hollow-circle ○ decal to determine steering direction.

8.0 ON-TRACKING WITH THE ESV

Before progressing ensure it is safe to do and there are no conflicting movements.

At the operational site an approx. 4 m length of straight level track area is needed to on-track the ESV. Position the ESV, so that the wheel flanges at one end line-up with the rails.

As soon as one end of the rail guidance wheels are put in the correct position, the other end can be positioned over the rails in the same way using the steering regulator (Fig.15A & 15B Pos.3) if required.

Press the button “two-hand operation”  (Fig.15A & 15B Pos.15) and hold the button.

Press the button “track guiding 1”  (Fig.15A & 15B Pos.17) or “track guiding 2”  (Fig.15A & 15B Pos.19) for the corresponding track guiding in combination with the „two-hand operation“ button (Fig.15A & 15B Pos.15) to lower the rail wheels.

The flashing of the signal lamps next to the buttons “track guiding 1” (Fig.15A & 15B Pos.17) or “track guiding 2” (Fig.15A & 15B Pos.19) shows the actuation of the track guiding system. If the end position is reached, the indicator light turns to a steady green.

The road wheels automatically move to straight position (and are not steerable anymore) when the track guiding wheels are completely lowered. The steering is blocked.

After all rail guiding wheels are tracked on and the road wheels have positioned into the straight direction, the ESV is ready to drive on rails.

8.1 RAIL MODE OPERATION

The driving speed can be pre-adjusted by the key switch “choose driving speed” (Fig.15A Pos.23 & Fig.15B Pos.24) Turtle / Hare. Select either Hare (max speed up to 5kph) or Turtle (max speed up to 3 kph). Turtle speed is recommended during shunting work.

Select driving direction  (Fig.15A & 15B Pos.11) forward or reverse to move the ESV in the corresponding direction (forward or reverse). The green LED lighting next to the button indicates the selected direction.

To set the vehicle into motion, push down on the deadman button (Fig.15A & 15B Pos.12) then push the driving regulator forward. Note the speed will be proportional to the movement of driving  regulator.

Move the ESV approximately one meter then release the throttle to ensure the brake applies. This application of the brake needs to be confirmed before progressing. Once braking application has been confirmed, proceed with the rail movement.

When the driving regulator is released, the ESV will coast for 3 – 4 seconds and then stop.

During rail mode with attached rail vehicles, the air brake system should be piped through.

With the rail consist attached to the ESV, braking must be actively executed. This will require the operator to pull back the driving regulator into the braking position. Braking effort is proportional to the position of the driving regulator in the braking range. Brake pipe pressure in full service application is 390kPa.

The air brakes are released by holding “WBS switch” on remote pack into release position. Brake pipe pressure in release is 550kPa.

The ESV park brake is automatically activated when the machine stops.

8.2.1 Park Brake Release

ESV park brake can be released by pushing the button  “open brake” (Fig.15A Pos.5).

The park brake release is commonly used to release tension on the couplers when uncoupling.

It should be noted that when the park brake has been released, the ESV will have no braking until the driving regulator has been reset.

8.3 Audible warning System

8.3.1 Audible Warning Signal when driving ESV

When starting or driving the vehicle, an audible warning signal (beep) sounds. The function is active in road and rail operation.

NOTE: The audible warning signal when driving the ESV varies in accordance with the ambient noise levels. 82 to 110 dB.

8.3.2 Error Alarm signal

The Error alarm signal sounds if the system detects an error. Such errors could be caused by:

- Incorrect rail guidance wheel position
- Coupler open warning

8.3.3 Vigilance (SIFA) Alarm

The remote pack includes an audible alarm in the event vigilance cycle requires a response from operator.

8.3.4 Tilt Alarm

The remote pack includes an audible alarm in the event the remote pack is tilted more than 45 degrees.

8.3.5 Signal Horn

During road and rail operation the signal horn is activated by pressing the button  (Fig.15A & 15B Pos.13) on the remote control panel.

8.4 Lighting System

8.4.1 Indication of driving direction

The ESV is equipped with four lamps (red/white switchable). The driving direction is shown with 2 x white (forward) and 2 x red (reverse) lamps. When the driving direction is changed the lamps switch automatically.

8.4.2 Working light (Coupler Light)

The ESV is equipped with working coupler lights. It can be switched on and off during the road drive with a radio remote control for No. 1 end  No. 2 end  (Fig.15A & 15B Pos.9).

8.4.3 Flashing Orange Beacon

ESV is equipped with flashing orange beacon which confirms connectivity between remote pack and the ESV.

8.5 Off-Tracking of the ESV

Before progressing ensure it is safe to do and there are not any conflicting movements.

When off-tracking, do not attempt to operate the ESV on a loose surface such as ballast or a metal surface. The ESV must only be operated in road mode on a sealed road.

Stop the machine on a straight level plane and secured track area. Ensure that the rail vehicles are uncoupled correctly and secured.

Press and hold the button  “two-hand operation” (Fig.15A & 15B Pos.15).

Simultaneously, press the button 'track guiding wheel'  (Fig.15A Pos.17 & Fig.15B Pos.19) to lift the rail guide wheels. Continue holding the button until the rail guidance wheels are fully retracted and the hydraulic motor has stopped.

If the rail guidance wheels do not fully retract then the green LED next to the button will flash and the alarm will sound. In this case repeat the operation above.

The road wheels will now be steerable again, after all rail wheels are lifted up completely. The ESV can be driven in road mode off the track.

IMPORTANT: Do not attempt to off-track the ESV while rail vehicles are coupled.

9.0 ELECTRICAL

The electric cabinet is located behind the cover of the vehicle on No. 2 end. The operating elements of the vehicle, such as the key switch and the display, are installed to the left on the cover of the control cabinet.

9.1 Control Elements on the Vehicle

9.1.1 Main Switch

Use the key (Fig.21 Pos. 1) to activate the ESV. After activation the ESV performs a system check.



Fig.21 Configuration on vehicle

9.1.2 Display Panel

The display (Fig.21 Pos. 2) visualises the data including:

- Steering mode
- Speed
- Operating hours meter
- Battery charge indicator (symbol or figure in %)
- Hydraulic pressure of rail wheels
- Service intervals
- Reservoir Pressure and Brake Pipe pressure
- Error codes

9.1.3 Coupling Sensor

ESVs are equipped with coupling sensors mounted on each coupler that detects coupling with other rail vehicles. When a coupling is detected, inadvertent lifting of the rail guidance wheels are prevented and driving in road mode is not possible.



Fig.22 Sensor

9.1.4 AAR Bypass key

This key can only be activated in Road mode. The use of the key is restricted to opening the coupler and driving away from a coupled rail vehicle in creep mode (1 km/h).

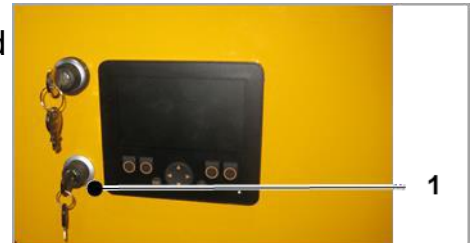


Fig.23 AAR bypass key

This key switch has no functionality in rail mode.

A sensor (Fig.22 Pos. 1) is mounted at the AAR coupling head.

10.0 BATTERY

The battery isolation switch (Fig.24 Pos.1) interrupts the bonding between batteries and electric circuits.



interrupts the bonding

The battery isolation switch is located underneath the cover on No. 2 end of the ESV, on the outside right hand edge of the electric cabinet.

Prior to operation insert and turn the battery isolation switch to establish the power supply to the ESV.

Turn the lever (Fig.24 Pos.1) down once, to interrupt the voltage on the vehicle.

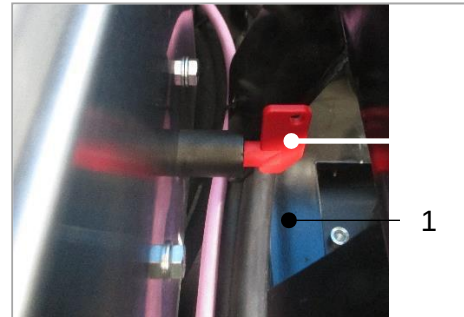


Fig.24 Battery isolation switch

10.1 Battery Charge Status

The battery status (Fig.25 Pos. 1) is shown in the display as a symbol and in percent.

- Warning Low Battery indication in the display as from 30 %, the radio device beeps for 5 seconds every 30 seconds;
- Warning Low Battery indication in the display as from 25 %, the radio device beeps, the low speed is activated
- Warning Low Battery indication in the display as from 20 %, the radio device beeps, the ESV is inoperable.



Fig.25 Battery index

It is recommended to return the ESV to the charging station when the last 25 % are reached.

Normal operation would be to return the ESV to the charging station and place on charge when not being used.

10.2 Battery Charging

To charge the batteries perform the following steps:

1. Open the battery covers at the left and right side of the ESV.
Before the battery charging can proceed, the battery covers must be removed for degassing purposes. If the covers are left in place, there is a limit switch that prevents charging.
2. Connect the ESV to the battery charger via the approved adaptor cable.

The charging process starts automatically after the battery charger is connected correctly and switched ON. The battery charging unit underneath the cover on No. 1 end on the ESV will show a RED charging light while charging.



Fig.26 Electricity plug

3. The Battery charge status can be seen on the battery charging unit via the LED lights.
 - RED indicates battery is still charging
 - GREEN indicates that the battery is fully charged.
4. At conclusion of charging, switch the power supply off and disconnect the electrical plugging cable.
5. Inspect the electrolyte level and if necessary top-up.
NOTE:- Electrolyte level should be checked after approximately 30 minutes after the charging is finished.
6. Stow the cables and close the covers.

NOTE: Let the battery rest for approx. 30 minutes after the charging process has finished to allow for de-gassing. After expiration of 30 minutes the machine can be put back into operation.

SAFETY: During battery maintenance and charging, personnel should observe the following:

- Full PPE should be worn
- The ESV should be well ventilated during charging
- During Charging and de-gassing, strictly avoid naked flames or sparks near the vicinity of the ESV.
- Be aware of the acidic nature of the electrolyte. Avoid skin and eye contact. Wear protective gloves, full face shield and apron as well as normal eye protection.

11.0 Pneumatic AAR Coupling Bar

11.1 Coupling of Rail Vehicles

1. After stopping short, Slowly (approx. 1 km/h) drive to the opposing coupler of the rail vehicle. Note: the coupler on the stationery rail vehicle prior to coupling should be in open position.
2. Pay attention that the coupling height is correct. The coupling mouth must not be lower or higher than the opposing coupler.
3. Pull out short to ensure that the coupling is successful.
4. Connect the rail Air brake system by connecting the brake pipes and opening the shut-off cocks.
5. Remove chocks and release handbrake on rail vehicle and release air brakes
6. Perform a brake function test. If the braking test was successful the shunting work can be started.

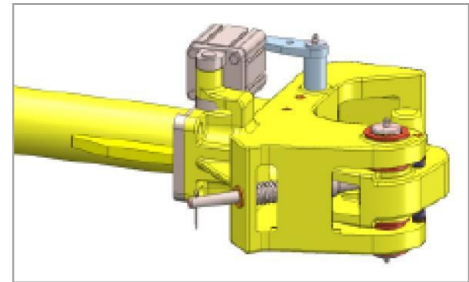


Fig.27 Pneumatic AAR coupler head

11.2 Uncoupling of Rail Vehicles

1. At the completion of the shunt, apply the air brakes.
2. Secure the rail vehicle in accordance with ROC procedure Section 5.1 sub paragraph 3.2.6.
3. Then press and hold the button “two-hand operation”  on the remote control pack (Fig.15A & 15B Pos.15) and simultaneously press the switch “open coupler” for the corresponding No.1  / No. 2  end (Fig.15A & 15B Pos.7). The automatic coupler will open and will remain open for an approximately 15 seconds. During this time, an audible warning will sound.
4. Release the brakes on the ESV.
5. Slowly drive away from the parked rail vehicle.

12.0 PARKING THE ESV

12.1 RAIL MODE

- Park the ESV on a suitable level plane track.
- Ensure the ESV is secured as per ROC Section 5.1 sub paragraph 3.2.6.

12.2 ROAD MODE

- Park the ESV at its designated charging area.
- Park brakes are deployed by default when the ESV is stopped.

Switch off the main switch (Fig.21 Pos.1) and the turn switch on the remote control pack to '0' position (Fig.15A Pos 24 and Fig.15B Pos.25). Remove keys and store them with the remote pack at designated remote pack charging area.

13.0 BRAKES

13.1 Charging Air Reservoir

1. Switch on the ESV and connect the remote pack.
 - To activate the Air brake system, press and hold the button for the two-hand operation  (Fig.15A & 15B Pos.15), simultaneously press the WBS switch  (Fig.15A & 15B Pos.21) . The Green light adjacent to the switch will illuminate green indicating the WBS system is active.
2. The compressed air reservoir will then fill up to 1000 kPa. The reservoir pressure and brake pipe pressure values are indicated on the display.

The compressed air reservoir can be filled in either rail or road mode. The brake pipe line can only be activated in rail mode and is ventilated in road mode.

Charging range for the reservoir is 800kPa to 1000kPa.

13.2 Activation and Release of Brakes

Braking is activated by use of the driving regulator. To operate the brakes, pull the driving regulator towards the position “Braking”  (Fig.15A & 15B Pos.12).

The braking effort is proportional to the position of the driving regulator in the braking position. Brake pipe pressure in full service braking is 390kPa. Release pressure is 550kPa. Braking effort can be modulated by placing the driving regulator between the neutral and full service positions.

When the drive regulator is put to its neutral position, the last brake command remains valid.

To release the train brakes, pull the switch for the air brake system  (Fig.15A & 15B Pos.21). Full release of brakes is indicated by a steady green light adjacent to the switch. The rail vehicle brake pipe is charged to 550 kPa. The ESV park brake remains applied until the driving regulator is placed in the driving position.

14.0 EMERGENCY EQUIPMENT / OPERATION

14.1 Emergency Operation

IMPORTANT: It is recommended to open the vehicle cover by two persons.

Open the cover of the ESV over the control cabinet on No. 2 end.

Activate emergency operation only in case of ESV failure.

Activate “emergency control” by turning the key (Fig.28 Pos.1) into position “I” to the right.

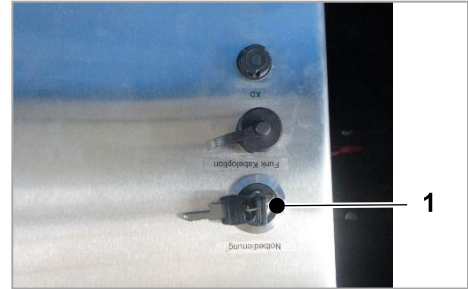


Fig.28 Emergency operation

NOTE: Activate the emergency operation in the event of a fault and use it to only off rail or similar. Do not perform shunting operation nor travel over long distances

14.1.1 Error Message

Any warning and error messages (Fig.29 Pos.1) are indicated on the display. To make the vehicle operational again, confirm by the button “OK” (Fig.29 Pos.2)



Fig.29 Error menu

15.0 PROTECTIVE DEVICES

15.1 Operation of the Vigilance (SIFA)

The safety system SIFA is active during rail mode only. The SIFA is activated automatically as soon as the ESV rolls or the driving direction ↑↓ is set.

15.1.1 Function

The vigilance cycle is set to 30 seconds.

The monitoring time is reset automatically when changing the steering regulator, driving regulator, driving direction, brake release button, coupler button and deadman switch.

There is also a SIFA button (Fig.15A & 15B Pos.1) which can be used to reset the vigilance cycle.

At 25 seconds, an audible warning signal (beep) sounds and the SIFA control lamp (Fig.15A & 15B Pos.6) flashes red.

If the vigilance cycle is not reset (Fig.15A & 15B Pos.1) within 5 seconds of the audible warning sounding, the audible warning will issue a continuous warning tone and the SIFA lamp will be a steady red. The air brake will then apply an emergency stop, brake pipe pressure will rapidly reduce to 0kPa and the ESV brake will apply.

The SIFA button cannot be held continuously to override the vigilance system.

The SIFA needs reactivation by pressing and holding the 'Reset' button (Fig.15A Pos.25 and Fig.15B Pos.26) on remote pack after each emergency stop.

16.0 TOWING

The ESV can be towed when a suitable coupling bar is connected with coupler.

The towing is only allowed in rail operation, because no steering is possible.

To open the brakes, please proceed as follows:

- The SIFA is active during the emergency operation. Use the SIFA button (Fig.15A & 15B Pos.1). Refer instruction 15.1
- When the button „open brake“  (Fig.15A & 15B Pos.5) is pushed and held, and if the key switch for emergency operation (Fig.28 Pos.1) is simultaneously activated, the park brake remains open. When the key switch is switched off, the brake closes.
- Should the ESV be towed when the parking brake is open, the driving direction where the vehicle shall run must be selected additionally. Choose the driving direction  (Fig.15A & 15B Pos.11) to move the ESV in the corresponding direction.
- The message "EMERGENCY OPERATION PARKING BRAKES OPEN" is indicated on the display and remains there as long as the brakes are open.

16.1 Electric Failure

To tow the ESV the park brakes have to be released mechanically first. To do this perform the following steps:

1. Open the covers of the ESV at No. 1 and No.2 end.
2. Release the 3 screws (Fig.30 Pos.1) at the top of the motors.

After all screws are released on all motors the machine can be towed with maximum attention over a short distance at a slow speed (max. 2 kph). Once towing is completed, then tighten the screws again.

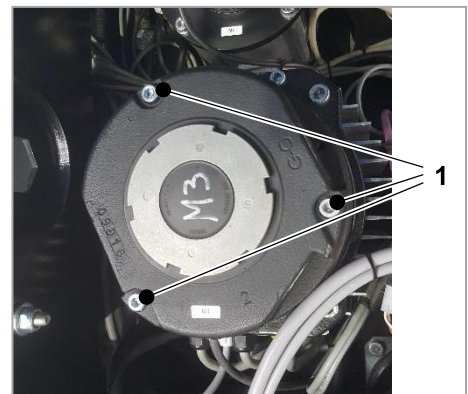


Fig.30 Parking brake at the motor

16.2 Hand Hydraulic Pump

IMPORTANT: Using the hydraulic hand pump to lift the track guiding equipment is only necessary and permissible in the case of a breakdown

The hand hydraulic pump (Fig.31 Pos.1) is located on No. 1 end.

In case of hydraulic failure proceed as follows:

1. Open the cover of the vehicle on No.1 end and take the lever out from under the cover.
2. Turn the way valve (Fig.32 Pos.1 and Pos 2) for the corresponding track guiding wheels (No.1 end and No. 2 end) until it latches in.
3. Fit the lever (Fig.33 Pos.1) to the pump (Fig.31 Pos.1)
4. Pump to lift the corresponding track guiding wheel
5. Repeat the process for the other track guiding wheels.
6. After the track guiding wheels are lifted completely, turn the way valve out until it latches
7. Stow away the lever under the cover
8. Remount the cover.
9. After the track guiding wheels are lifted completely, the machine can be moved from the track carefully.



Fig.31 Hand hydraulic pump

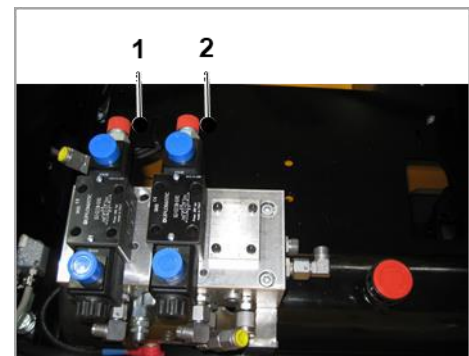


Fig.32 Way valve



Fig.33 Lever under the cover

16.3 Emergency Stop Switch

IMPORTANT: The radio remote control pack is provided with an emergency stop switch. Push this button **only in case of emergency**.

If the emergency stop switch (Fig.15A & 15B Pos.14) is pushed:

- the brake closes immediately,
- rail air brake pipe is immediately exhausted,
- power is cut out
- the vehicle comes to standstill
- remote pack turns off
- Error message is displayed on ESV

The emergency stop will be activated if the vehicle is out of the radio remote range or if the remote operation is disturbed. In this case the radio remote connection is interrupted.

To put the vehicle into service again pull out the activated emergency stop switch. In addition, take one of the two measures as follows:

1. Confirm the error message at the display with “OK” – see chapter 3.17.2, or
2. Press and hold the button “Reset” ① until the error light goes OFF (Fig.15A Pos.25 and Fig.15B Pos.26). The control lamp (Fig.15A & 15B Pos.10) on the remote control panel lights permanently green, so the connection to the vehicle is established.

The error message “Confirm emergency shut-off”/ “fix emergency and reset” is deleted on the display. The rotating beacon is reactivated.

Fill the air brake system again according. Refer instruction 13.0

16.4 45° Tilt Function

If the remote control pack is during operation inclined 45 degrees, an audible warning sounds and after 6 seconds, an emergency stop is initiated. In order to be able to put the ESV back into operation, confirm the error message on the display with OK. Refer instruction 14.1.1