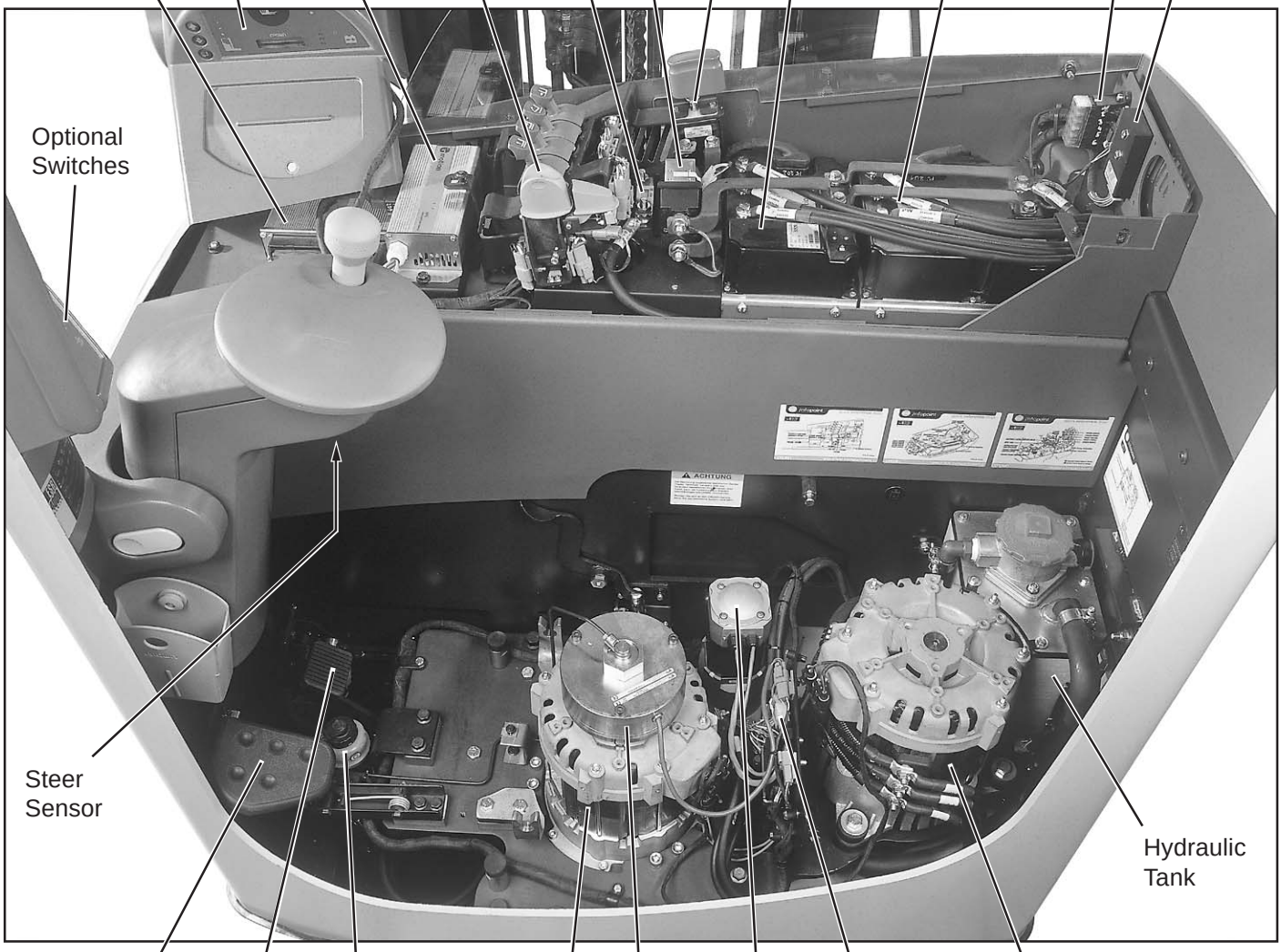
Maintenance Manual

ESR4500 Series

Printed in Germany • Status 2, Revision Level A
Order Number: 812549-006

INTRODUCTION

Printed in Germany


Display
Emergency Disconnect Switch
Main Fuse FU7
Fuses
Vehicle Control Module VCM
Steer Drive Module SDM
Travel Direction Switch
Main Contactor
Traction Drive Module TDM
Hydraulic Drive Module HDM
Start Up Module
Optional Switches
Steer Sensor
Hydraulic Tank
MS-2140-017
Brake Pedal
Steer Motor
Pump Motor
Safety Pedal
Brake Fluid Reservoir + Main Brake Cylinder
Brake
Connector panel
Drive Motor

Inspection and Maintenance Schedule (X = Standard, C = Cold Store)						
I = Inspection, L = Lubricate / A, M, ... = Lubricant			Years / Service Hours			
Item		**Action**	**1/4 500**	**1/2 1000**	**1 2000**	**2.5 5000**
I-46		Check the controllers are fixed.		X / C		
I-47		Make sure line connections to traction and lift drive modules, EMERGENCY DISCONNECT switch and main fuse FU7 are secure		X / C		
I-48		Make sure potentiometer connections are secure		X / C		
I-49		Make sure plugs on the connector panel are secure		X / C		
I-50		Test fan operation (drive module operating temperature must exceed 35°C)		X / C		
I-51		Check contactor, replace worn parts as necessary		X / C		
I-52		Make sure all line connections from drive and lift motors are secure		X / C		
I-53		Check power cables from drive and lift motors for damage		X / C		
I-54		Check drive and lift motor attachments		X / C		
L-14	M	Check and grease motor shaft toothing				X / C
I-55		Check rubber buffer on hydraulic motor		X / C		
I-56		Check sensor and temperature gauge connections		X / C		
I-57		Check battery cables and connectors for damage	C	X		
I-58		Check battery terminals	C	X		
I-59		Check battery condition	C	X		
I-60		Check acid density and acid level	C	X		
I-61		Check mast attachment		X / C		
L-15	G	Check, adjust and lubricate lift chains and chain anchors		X / C		
I-62		Check mast cables and tension jacks for damage and position		X / C		
I-63		Check diverter rollers		X / C		
L-16	B	Check mast sections for wear and apply grease		X / C		
I-64		Check mast rollers and stops		X / C		
I-65		Check height sensor and height sensor cable		X / C		
I-66		Check height reset switch or mast switch for lift speed reduction		X / C		
I-67		Check fork carriage for damage		X / C		
I-68		Check forks for damage and wear		X / C		
L-17	B	Sideshift: check rollers and slide blocks for wear, clean, grease and test operation	C	X		
L-18	B/BB	Lubricate the fork carriage slide rail via grease nipple	C	X		
I-69		Check if load backrest is secure, check for damage		X / C		

C **1** = every 1000 h or **annually** X **2** = every 2000 h or t**wice**

L06-gb

Lifting

"Lifting" is requested by pulling the raise/lower control lever. This changes the voltage on the loop of the raise potentiometer POT2. As a result, the main control module VCM switches on the pump and the magnet of the SVH raise pilot valve.

The SVH valve drives the DCVH raise/lower spool. The spool opens.

The lift speed is controlled by the pump motor speed in proportion to the movement of the control lever.

The oil flows from input P of the valve block through the DCVH spool via output A to the hydraulic cylinders. The hydraulic cylinders extend.

During raising, the "lower" control pressure side of the DCVH spool is connected to the tank return line via the lowering valve PVL. This is necessary to prevent any counter-pressure from building up (which would affect the movement of the spool).

If the raise/lower control lever is released, the main control module VCM switches off the pump and the current to the SVH solenoid. SVH changes through bias spring force so that the "raise" control pressure side of the spool is connected to the tank return line. The drop in pressure causes the spool to return to its home position and breaks the connection to the cylinders. The cylinders remain in their current position.

Note: If the MVL manual lowering valve is open, i.e. turned in, raising is inhibited.

Lowering

"Lowering" is requested by pushing the raise/lower control lever forward. This changes the voltage on the loop of the raise potentiometer POT2. As a result, the main control module VCM switches on the magnet of the lowering proportional valve PVL.

The PVL valve drives the DCVH raise/lower spool. The spool opens.

The oil then flows from the hydraulic cylinders, via port A of the valve block through the flow control valve PCL and the spool to output T, and from there via the return line back to the tank. The hydraulic cylinders retract.

In proportion to the movement of the control lever, the lowering proportional valve PVL controls the oil pressure on the spool, and hence the amount of opening of the spool and ultimately the lowering speed.

The flow control valve PCL installed before the spool ensures that the lowering speed is kept constant for each control lever position.

During lowering, the "raise" control pressure side of the DCVH spool is connected to the tank return line via the raise valve PVL. This is necessary to prevent any counter-pressure from building up (which would affect the movement of the spool).

If the raise/lower control lever is released, the main control module VCM switches off the current to the PVL solenoid. PVL changes through bias spring force so that the "lower" control pressure side of the spool is connected to the tank return line. The drop in pressure causes the spool to return to its home position and breaks the connection to the cylinders. The cylinders remain in their current position.

Pressure switch PLS is fitted on the hydraulic line to the lift cylinders. If more than 400 kg is placed on the forks, the pressure switch converts the switch limit of PVL. This prevents the load from stopping abruptly when being lowered. This prevents the mast from swaying.

The valve block contains the AVL valve which is used to set the maximum lowering speed when PVL is fully opened. The maximum lowering speed for 1.4 t and 1.6 t trucks is 0.58 m/s, and for 2.0 t trucks 0.51 m/s. Replacement AVLs are preset to 0.58 m/s and must be set to 0.51 m/s for 2.0 t trucks (see description in the "Valve Block" section).

The MVL emergency lowering valve allows the mast to be lowered manually in the event of hydraulic failure. To lower, turn the emergency lowering valve clockwise.

Hydraulic Reservoir

The hydraulic reservoir has a capacity of approx. 36 litres.

Discharging the Hydraulic Reservoir

- Unscrew the filter lid (5).
- Suction off the hydraulic oil via the filler port.
- Fully discharge the reservoir into a suitable collection tray by opening the drain plug (4) (Fig. MS-2140-054).

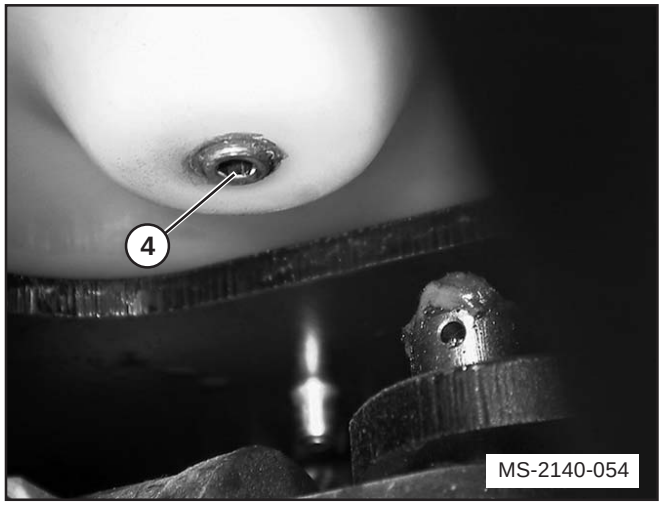
Filling the Hydraulic Tank

All hydraulic systems are extremely sensitive to contamination.

Therefore, the oil must be filtered through a 10 micron filter or strainer 100 before entering the system.

Note: The return filter filters the return flow, i.e. from outside to inside. It does not filter the oil you add to the reservoir via the filler port.

- Bleed the entire hydraulic system and then fill the reservoir.
- All cylinders must be fuly retracted (mast carriage on chassis, mast lowered, fork carriage tilted forward).
- Keep filling until the oil is at the “Max” level (Fig. MS-2140-026).



Gear unit

Preparation

Raise the truck approx. 500 mm to remove the gear unit.

See *Chapter 1*, Raising and Jacking up the Truck

Tools required:

- Forklift truck with sufficient capacity, lift height and fork length for the truck to be raised.
- Safety mechanism for the forks of the lifting truck, required to hold the raised truck.
- Sufficient number of wooden blocks (surface area of at least 250 x 250 mm) or suitable supports to secure the raised truck.
- Device to carry the gear unit onto a jack or pallet truck.

Removal

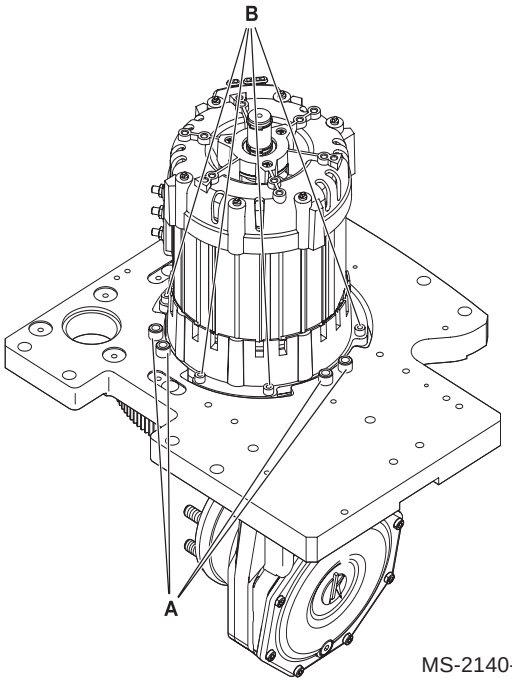
- Disconnect the battery and remove the key.
- Secure the truck to prevent it from being switched on again.
- Secure the truck with a second forklift and prevent it from sliding away.

DANGER

Never work underneath a suspended load.

Fatal injuries could result if the truck is suddenly lowered.

- Raise the truck until you can push a jack / pallet truck underneath the truck to support it.
- Raise the truck again by approx. 50 mm in order to be able to loosen the gear unit from the toothing at a later time.
- Lower the truck onto the wooden blocks/supports.
- Raise the device on the jack/pallet truck until it contacts the gear unit.
- Remove the electrical connections from the motor.



MS-2140-082

- Undo the six gear unit mounting screws (A) and the six motor mounting screws (B) in Fig. MS-2140-082.
- Lower the device together with the gear unit and pull it out from under the truck.

Servicing

WARNING

The gear unit must only be serviced by trained and authorised Crown personnel. Failure to comply will invalidate the warranty.

Correcting the flank tooth bearing and pre-tensioning the shaft support requires years of experience with gear units. Incorrect adjustments and settings will result in premature failure of the gear unit.

It is therefore generally preferable to replace the whole gear unit.

New gear units are always supplied without oil.

Before using the gear unit for the first time, fill oil in accordance with the "Lubricant Table".

The lift encoder is a sensor ball bearing in the top bearing plate of the pump motor. The lift encoder monitors the current motor speed and relays this to the HDM.

ECR3 (Steering feedback encoder)

The steering feedback encoder is installed in the steer motor. It feeds back a signal in proportion to the steering direction and the steering speed.

ECR4 (Steering encoder)

The steering encoder is located in the steering column below the steering wheel. When the steering wheel is turned it transmits a signal to the steer module which is based on the direction of turn and the speed of turn.

ECR5 (Height encoder)

The height encoder is located on the top cross member of the outer mast. It monitors the lift height when the free lift has been exceeded. It must be re-calibrated when replaced (see Calibration in the Service menu). Lifting is inhibited if the height encoder is faulty or if there are no height encoder signals to the VCM after 30 seconds.

THS1 (Temperature sensor 1)

THS 1 is located in the drive motor and monitors the current motor temperature. When the motor temperature reaches 145 °C, the maximum current is restricted to 250 A. If the motor temperature continues to rise, the current is reduced in proportion up to 0 A for a temperature of 165°C. At a motor temperature of 165°C and 0 A current, the motor cuts out.

THS2 (Temperature sensor 2)

THS2 is located in the hydraulic pump motor and monitors the current motor temperature. When the motor temperature reaches 145 °C, the maximum current is restricted to 250 A. If the motor temperature continues to rise, the current is reduced in proportion up to 0 A for a temperature of 165°C. At a motor temperature of 165°C and 0 A current, the motor cuts out.

Option THS3 (Temperature switch 3)

Switch THS3 is used only with cold store trucks. It is attached near to the accelerator pedal. The thresholds are:

ON: +2°C

OFF: +12°C

RES1 (Reach sensor 1)

SLOW Down range identified for forward/reverse reach,

”OFF“ = Reduced fwd./rev. reach

(OFF = in slow down range, ON in “normal” range)

RES1 generally activates reach speed reduction

RES2 (Reach sensor 2)

Slow Down range identified.

(ON = Slow Down rear, OFF = Slow Down front)

RES2 identifies the position of the mast in order to set off again at the appropriate speed.

(If the mast is in the Slow Down range, the speed must be reduced for Fwd. reach activation). For Rev. reach activation start again at normal reverse speed.

SVH (Lift valve)

SVR is incorporated with PVL in a single valve. SVR is a black and white valve and opens when lifting is selected. The lift speed is governed by the pump speed.

PVL (Proportional valve lower)

PVL is incorporated with SVR in a single valve. The lowering speed is governed proportionally by PVL.

Statuscode 180 - 181

Status Code 180

Fehler am Lenkmotor - Encoder ECR3
Error Steer Feedback Encoder ECR3

LOG BOOK display:

1	8	0		X	X	X	X	X	h			X	X	X	C
E	C	R	3		H	A	L	L		S	E	N	S	O	R

Explanation:

ECR3 is a 3-channel hall sensor. An error is generated if a channel is not correctly identified or if 2 channels are short-circuited.

Effect on truck:

- Parking brake applied
- Traction drive module deactivated
- Main contactor deactivated

Possible Causes:

- Check lines and connections
- Disconnect PC412 and check +5V between pins 4 and 6.
  Present: SDM OK.
  Not present: Replace SDM.
- Re-connect plug. Check +5V between PC436-4 and 6.
  Not present: Check line.
  Present: Replace motor

Status Code 181

Fehler am Lenkencoder ECR4
Error Steer Encoder ECR4

LOG BOOK display:

1	8	1		X	X	X	X	X	h			X	X	X	C
E	C	R	4		S	T	E	P	P	E	R		M	O	T

Explanation:

ECR4 is a stage motor which when applied sends an induced voltage signal to the steer drive module. An open line or short circuit are identified.

Effect on truck:

- Parking brake applied
- Traction drive module deactivated
- Main contactor deactivated

Possible Causes:

- Check lines and connections
- Disconnect PC414 and measure +5V between pin 5 or pin 2 (purple line) and BATT NEG.
  Present: Replace ESR4.
  Not present: Check connection to SDM, replace steer drive module

Statuscode 241

Status Code 241

Eingangsspannung von POT2 ist unter dem Grenzwert
Input Voltage from POT2 under Limit

LOG BOOK display:

2	4	1		X	X	X	X	X	h			X	X	X	C
P	O	T	2		U	N	D	E	R		L	I	M	I	T

Explanation:

The loop voltage from POT2 is continually monitored during start-up and operation. The lower limit of 0.6 volt is exceeded during this time.

Effect on truck:

Hydraulic function completely disabled.

Possible Causes:

- Select menu item A2.4 (POT2).
  Activate “Raise/Lower”.

- Take readings from display.

  Approx. 0 V: open circuit between potentiometer CA407-2 (red), CA407-1 (green) and VCM or short circuit between CA407-2 (red) and CA407-3 (yellow).
  Check connection PC407 and PC205.
  If the wiring is ok, replace the potentiometer.

  Approx. 5.0 – 6.0 V: correct reading when control lever is in neutral.

  0.7 – 1.5 V: correct reading when control lever is in max “Lower” position.

  9.5 – 10.5 V: correct reading when control lever is in max “Raise” position.

  If the readings are correct, there is probably an intermittent fault in the potentiometer circuit. Check wire connections and potentiometer.

Note: Recalibrate potentiometer after carrying out repairs

Statuscode 261

Status Code 261 **Kurzschluss PVL (Absenkventil)**
Short Circuit PVL (Lower Valve)

LOG BOOK display:

2	6	1		X	X	X	X	X	h			X	X	X	C
P	V	L		L	O	W	E	R		V	A	L	V	E	

Explanation:

On the VCM main controller an overcurrent is detected on the PVL output during lifting and the contactor output is cut out.

Effect on truck:

- Hydraulic valves are cut out
- Pump continues to operate.

Possible Causes:

Check coil resistance

Disconnect PC807 connector from solenoid valve. Connect measuring device between pins 1 and 2 to PVL and measure the coil resistance. Resistance = 27 Ohm.
If the coil resistance is excessive or 0 ohms, PVL must be replaced.

Missing Positive Test

- Power up the truck and record the voltage between PC422-8 and the battery negative. Battery voltage should be applied.

- Disconnect PC807 from the solenoid valve and record the voltage between PC422-8 and the battery negative.
  If battery positive is still applied, there is a short circuit between PC807-1 and PC205-42 against the battery positive.
  After recording, re-connect PC807.

- Power up the truck and connect the measuring device between PC422-9 and the battery negative.
  Without applying POT2 (raise/lower) battery positive should be applied.
  When activating POT2 (lower) the voltage should drop to approx. 33 volt. If not, replace the VCM.

Statuscode 285 - 300

Status Code 285

Temperatursensor Kurzschluss oder offener Stromkreis
Temp. Sensor Short or Open Circuit

LOG BOOK display:

2	8	5		X	X	X	X	X	h			X	X	X	C
T	E	M	P	.	S	E	N	S	O	R		H	M	O	T

Explanation: Short circuit or open circuit on hydraulic motor temperature sensor.

Effect on truck:
- Truck starts up.
- Main contactor activated
- Fwd./rev. reach and lowering possible.
- Creep mode possible.

Possible Causes: Faulty temperature sensor. Disconnect PC430 and measure the resistance between pins 1 and 2. Resistance at 25°C approx. 600 ohms. If the resistance level deviates significantly: Replace motor.

Status Code 300

Fahrsteuerung hat konstanten Überstrom
Continuous Over Current Traction Module

LOG BOOK display:

3	0	0		X	X	X	X	X	h			X	X	X	C
H	I	G	H		C	U	R	R	E	N	T			T	M

Explanation: Excessive current detected in power circuit (exceeds 525 A).

Effect on truck:
- Hydraulic and traction drive modules deactivated
- Main contactor ED1 deactivated
- Parking brake applied

Possible Causes:
module power circuit.
- Short circuit in motor feed line or motor coil, or error in traction drive
- Switch off the truck and measure the insulation resistance. If necessary replace the traction motor or the traction drive module.

Statuscode 382 - 383

Status Code 382

Kurzschluss an ECR1
ECR1 Short Circuit

LOG BOOK display:

3	8	2		X	X	X	X	X	h			X	X	X	C
E	C	R	1		S	H	O	R	T		C	I	R	C	.

Explanation:
encoder.

Short circuit between Channel A and Channel B on traction motor

Effect on truck:

- Truck starts up.
- Main contactor activated
- Creep mode travel possible.
- Fwd./rev. reach and lowering possible.

Possible Causes:

- Select menu A2.26. Activate travel and check following displays:
  SET SPEED = 685. If this value is present, VCM and TDM are OK.
  ACTUAL SPEED = 0. No feedback from encoder.
- Check line from CA201 to PC425, check encoder cable.
- Replace motor or rotor.

Status Code 383

Leitung unterbrochen an ECR1
ECR1 Open Circuit

LOG BOOK display:

3	8	3		X	X	X	X	X	h			X	X	X	C
E	C	R	1		O	P	E	N		C	I	R	C	.	

Explanation:

Open circuit or no power supply to traction motor encoder.

Effect on truck:

- Truck starts up.
- Main contactor activated.
- Creep mode travel possible.
- Fwd./rev. reach and lowering possible.

Possible Causes:

- Select menu A2.26. Activate travel and check following displays:
  SET SPEED = 685. If this value is present, VCM and TDM are OK.
  ACTUAL SPEED = 0. No feedback from encoder.
- Check line from CA201 to PC425, check encoder cable.
- Disconnect PC425 and check +12V between pins 1 and 4.
  Present: TDM OK.
  Not present: Check line, replace TDM.
- Replace motor or rotor.

Statuscode 885

Status Code 885

Fehler Höhenrücksetzschalter
Error Height Reset Switch

LOG BOOK display:

8	8	5		X	X	X	X	X	h					
E	R	R	O	R		H	G	T	R	S		S	W	

Explanation: Height reset switch operational fault

Effect on truck:
- Lift speed is reduced to half speed.
- Lift height display cut out and message displayed: Height encoder off.

Possible Causes:
- Select menu item A2.18 (HGTRS). Raise fork carriage over free lift and then lower it. Monitor the display in the process.
  ON = Mast not extended with 2nd stage (below the free lift)
- Check HGTRS setting
- If the 2nd mast stage HGTRS is permanently ON, disconnect PC802. If the signal does not change to OFF, line short circuit.
- Replace switch

Service Level

The service menu described in the following pages is divided into “sections”.

The terms are not translated from English because the module service menu display is in English. For a description of the terms and their significance in terms of programming the control module, refer to the following pages, under “Service Menu”.

Chapter structure :

ANALYZER

A1 STATUS

A1.1	VCM	Vehicle Control Module
A1.2	TDM	Traction Drive Module
A1.3	HDM	Hydraulic Drive Module
A1.4	SDM	Steer Drive Module
A1.5	Main C;	Main Contactor closed
A1.6	Battery Charge %	
A1.7	TEMP	Traction Drive Module (TDM)
A1.8	TEMP	Traction Motor
A1.9	TEMP	Hydr. Drive Module (HDM)
A1.10	TEMP	Hydraulic Motor
A1.11	TEMP	Steer Drive Module
A1.12	Escape	

A2 INPUTS

A2.1	FS	Forward Switch
A2.2	RS	Reverse Switch
A2.3	Pot1	Accelerator Pedal
A2.4	Pot2	Lift / Lower Potentiometer
A2.5	Pot3	Reach Potentiometer
A2.6	Pot4	Tilt Potentiometer
A2.7	Pot5	Sideshift Potentiometer
A2.8	Pot6	5th Function Potentiometer
A2.9	ACS	Accelerator Switch
A2.10	SES	Seat Switch
A2.11	SPS	Safety Pedal Switch
A2.12	BLS	Battery Latch Switch
A2.13	BRS	Brake Switch
A2.14	BPS	Brake Pressure Switch
A2.15	BFS	Brake Fluid Switch
A2.16	FLS	Free Lift Switch
A2.17	HGTS	Height Switch
A2.18	HGTRS	Height Reset Switch
A2.19	ECR5	Height Encoder
A2.20	LS	Load Sensor
A2.21	ORS	Override Switch
A2.22	PLS	Pressure Load Switch
A2.23	RES1	Slow down in
A2.24	RES2	Slow down out
A2.25	I BAT	Battery current
A2.26	TXN RPM	Tract Motor set & actual speed
A2.27	I TXN	Traction Motor current
A2.28	V	Travel speed
A2.29	Pump RPM	Pump Motor set & actual speed
A2.30	I PUMP	Pump Motor current
A2.31	N Steer	Motor Speed
A2.32	I STE	Steer Motor current
A2.33	SFS1SA	Steer sensor
A2.34	SFS2	Steer sensor
A2.35		Steer wheel angle
A2.36	UBAT	Battery Voltage
A2.37	Escape	

A3 OUTPUTS

A3.1	STS	Set TXN speed
A3.2	SPS	Set pump speed
A3.3	SSS	Set steer speed
A3.4	SVB	Brake output
A3.5	Main C	Main Cont. output
A3.6	SVH	Lift Valve output
A3.7	PVL	Lower Valve output
A3.8	PVRT	Retract Valve output
A3.9	PVRE	Reach Valve output
A3.10	PVMR	Mast Right Valve output
A3.11	PVML	Mast Left Valve output
A3.12	SVT	Tilt Valve output
A3.13	SVS	Sideshift Valve
A3.14	SV5	5th Function output
A3.15	ALM2	Alarm 2 output, direction
A3.16	BEAC	Beacon output
A3.17	FAN	Fan output
A3.18	Escape	

CALIBRATION

C1 Accelerator Pedal

C1.1	Released
C1.2	Depressed

C2 Raise Lower Handle

C2.1	Raise
C2.2	Lower
C2.3	Center

C3 Reach Handle

C3.1	Retract
C3.2	Reach
C3.3	Center

C4 Tilt Handle

C4.1	Tilt up
C4.2	Tilt down
C4.3	Center

A2.14 - A2.20 Inputs

A 2 . 1 4	B P S =	O F F
B R A K E	P E S S U R E	S W

The pressure switch is located on the brake cylinder and is closed during braking. In addition to the mechanical brake force this activates regenerative electrical braking.
(ON : activated; OFF: deactivated)

A 2 . 1 5	B F S =	O F F
B R A K E	F L U I D	S W .

Brake fluid level monitoring switch
(ON : activated; LED active in display; OFF: deaktiviert)

A 2 . 1 6	F L S =	O F F
F R E E L I F T	S W I T C H	

Free lift switch, (ON = fork carriage within mast structure)
simultaneous control by LCS switch

A 2 . 1 7	H G T S =	O F F
H E I G H T	S W I T C H	

Lift speed reduction mast switch
(ON = lift speed reduced)

A 2 . 1 8	H G T R S =	O F F
H E I G H T	R E S E T	S W .

Height reset switch, Height Encoder measurement start
(ON = Mast with 2nd stage not extended)

A 2 . 1 9	E C R 5 = X X X X X
H E I G H T	E N C O D E R

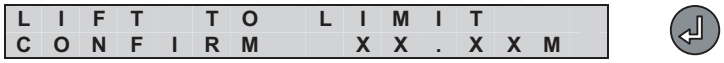
Height Encoder, encoder impulses are displayed

A 2 . 2 0	L S =	X X X X
L O A D	S E N S O R	

Load Sensor,
FKS open (forks tilted fully fwd/back; reading approx. 10-20)
FKS closed (for O kg the value is approx. 300 – 400)

C7.1.3 Calibration

If this function is selected, the display changes to the next display text.

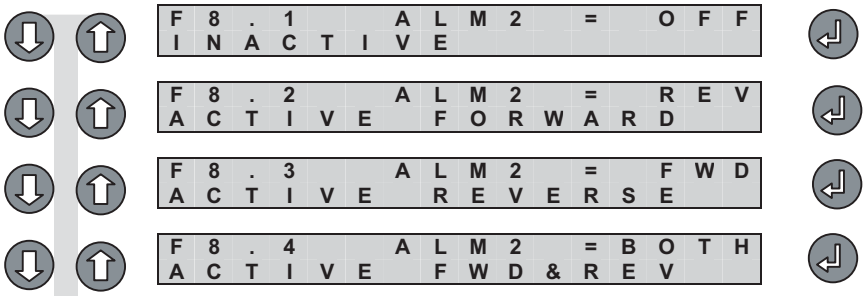


Now raise to the appropriate height and confirm this height.
The current height is displayed at the same time.

F8 Features

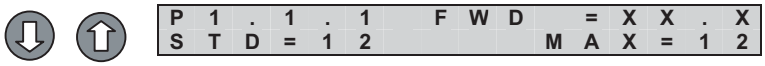
The travel alarm can be selected via the display with the following functions:

OFF: Off
REV: Active only for reverse travel
FWD : Active only for forward travel
BOTH: Active for both forward and reverse travel

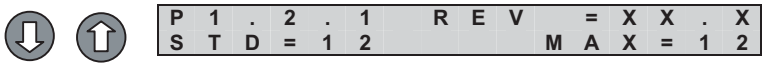


Performance

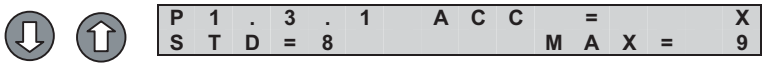
P1 - P1.5.1 Performance



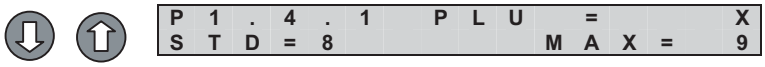
FORWARD travel speed can be set in increments of 0.1 km/h. The display shows the set value, the default value and the max. permissible speed.



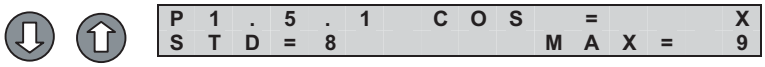
REVERSE travel speed can be set in increments of 0.1 km/h.



Truck acceleration setting.



Plugging setting.
Plugging: Reversing the travel direction with the pedal depressed.



Coasting setting.
Coasting: Pedal reverts to the neutral position.

- Close the seat switch (sit on the seat), apply the safety pedal and depress the accelerator as far as it will go.
- The system should respond immediately as follows:
  - The main contactor drops (opens).
  - The service display is illuminated.
  - In LOG EVENTS, error no. 301 “SHORT CIRCUIT TM” is stored.
- Disconnect the battery again.
- Press the horn for approx. 3 seconds. This will fully discharge the drive module capacitors.
- Disconnect the test wiring from the V terminal of the traction motor and connect it to the W terminal with the additional M8 nut. Do not loosen the motor cables in the process.
- Guide the cables out of the truck so that the folded down seat panel does not damage the cables when they are on the seat. Fold the seat back.
- Connect the battery.
- Switch the truck on.
- Close the sea switch (sit on the seat), apply the safety pedal and depress the accelerator as far as it will go.
- The system should respond immediately as follows:
  - The main contactor drops (opens).
  - The service display is illuminated.
  - In LOG EVENTS, error no. 301 “SHORT CIRCUIT TM” is stored.

If the test fails, replace the drive module.

Final procedure

- Switch the truck off.
- Disconnect the battery again.
- Press the horn for approx. 3 seconds. This will fully discharge the drive module capacitors.
- Remove the test wiring.
- Connect the battery.
- Switch the truck on.
- Test the operation. Close the seat switch (sit on the seat), apply the safety pedal and gently depress the accelerator (not all the way). The drive wheel turns slowly without error message.
- Switch the truck off.
- Jack down the truck.

STEERING

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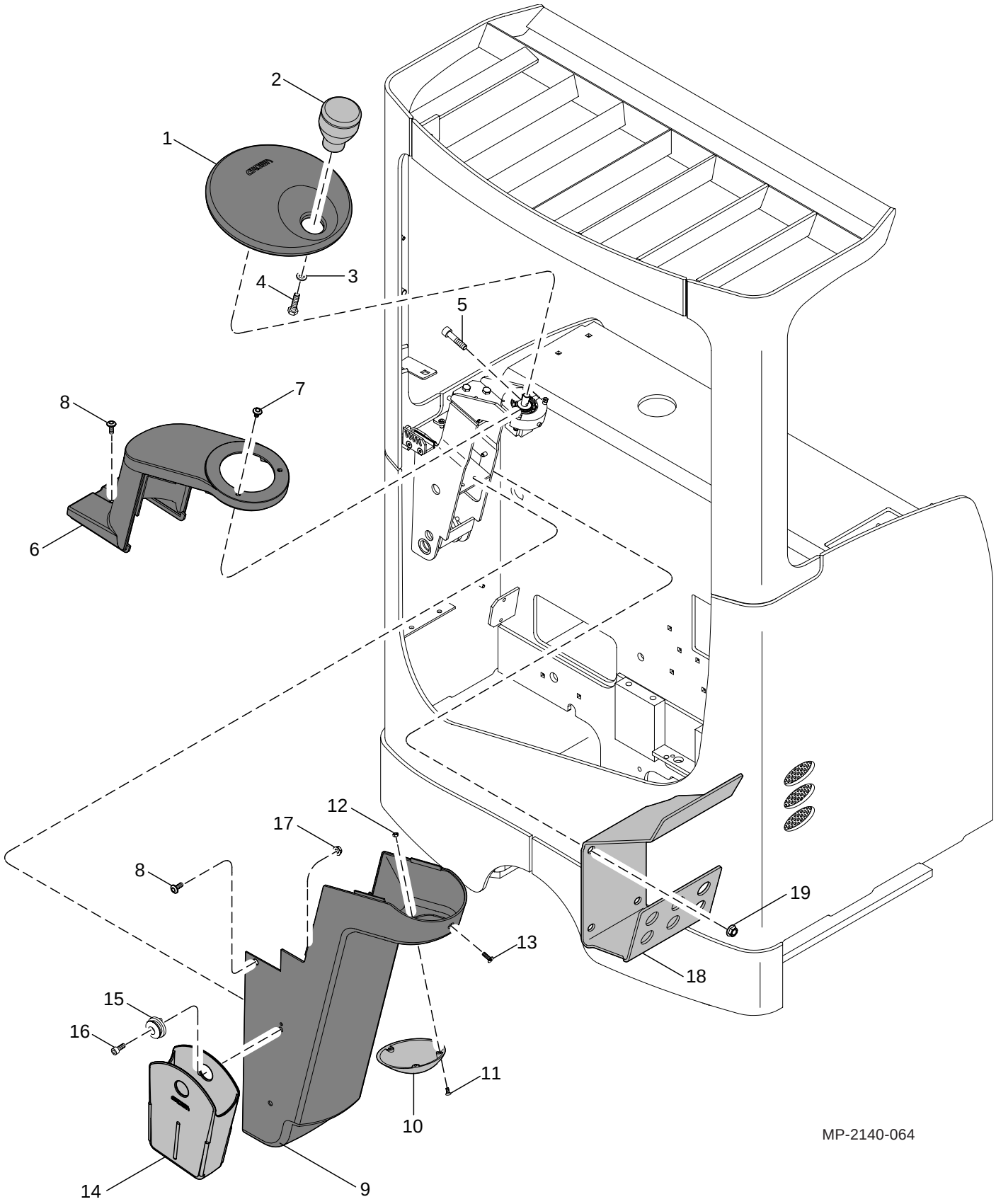
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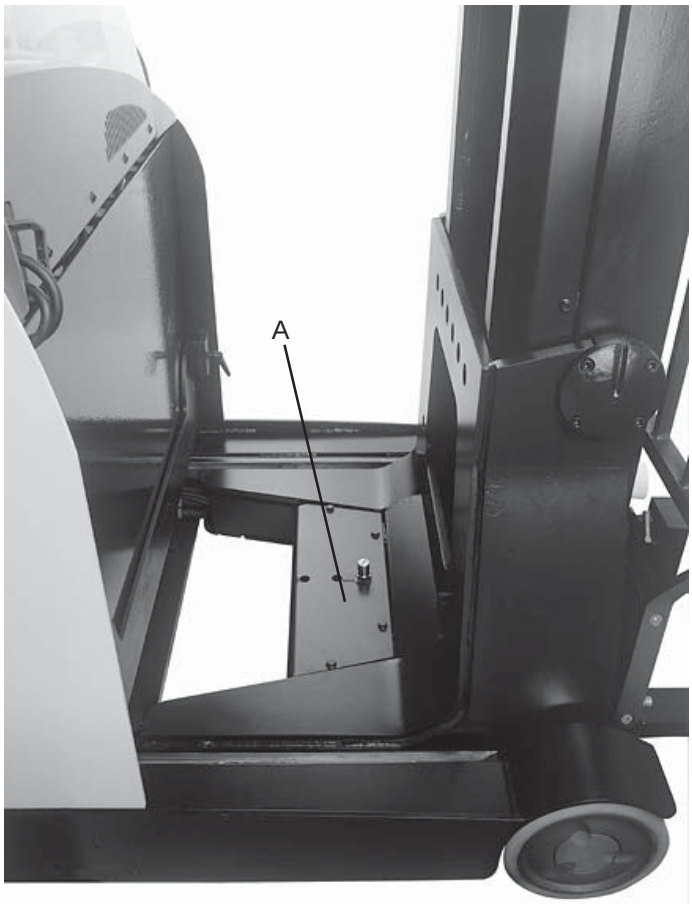
MP-2140-064

- Now remove the 8 mast mounting screws from the reach carriage and the screws (27) at the bottom of the mast.



MS-2140-001

- Remove the cover (A, Fig. MS-2140-001).
- Remove the covers (6, 8 and for 2.0 tonne mast also 31) of the lift cylinders on the left and right hand sides of the outer mast.
- Mark the hydraulic hose connections (Fig. MS-2140-010) for the auxiliary function on the left channel of the 1st mast stage for later re-assembly.
- There is a danger of mixing up the screws.
- Disconnect the hydraulic hose connection for the auxiliary function. Apply filler plugs to all open ports.
- Remove the connector and where necessary the wire attachments of all the electrical connections from the reach carriage to the mast. Pull out and upwards all the wires from the reach carriage to the mast. Temporarily attach the loose wires to the mast.

MS-2140-010

- Secure the fork carriage with a load sling to prevent it from moving in the mast.
- Raise the mast up out of the reach carriage.
- Place the mast with its back (the side facing the driver) onto a suitable surface with sufficient capacity (pallets, steel benches).

Assembly

Assembly is the reverse of disassembly.

After assembling, check or adjust as follows:

- Bleed the lift cylinders and free-lift cylinder
- Test the hydraulic system
- Check / adjust the chain tension
- Check / calibrate the height encoder
- Check / calibrate the load sensor

- Undo the bottom stud at the base of the free lift cylinder.
- Using the crane lower the fork carriage down onto a pallet positioned underneath it.
- Place a load sling around the highest cross member of the second mast stage.
- With the crane slowly raise the 2nd mast stage until the fork carriage rests freely on the pallet.
- Using a forklift, remove the fork carriage from the work area.
- Place the second mast stage onto wooden blocks placed underneath it.
- Remove the pressure line below the free lift cylinder. Fully remove the two steel hydraulic lines attached to the free lift cylinder. Seal the ports with filler plugs.
- Place a load sling below the middle attachment plate around the free lift cylinder. Gently tension the load sling with the crane. This will prevent the cylinder from falling out when you undo the final two mounting studs.
- Undo the two mounting studs (24) from the free lift cylinder.
- Using the crane, lift the cylinder out and put down on one side.

Assembly

Assembly is the reverse of disassembly.

Before bleeding, replenish with hydraulic oil up to the max. marking. After assembling, bleed the hydraulic system and check the operation of the FLS free lift switch.

Do not remove this layer! After commissioning the chain supplement the factory lubrication through a regular lubrication schedule.

Rust film on lift chains can be removed and neutralised by cleaning with chain oil. **Always replace heavily corroded and rusting chains. The risk of cracking as a result of rust is too great.**

Chain Lateral Wear

Wear traces along a stretch of the chain on the pin heads and the outer plates indicate misalignment. This can have one of two causes: uneven chain tension or misalignment between the pulleys and the chain anchors.

Uneven Chain Tension

When fitting or adjusting the chains make sure that they are evenly charged. If for example the fork heel height or the platform height are changed, the chain anchors must be loosened until both forks touch the ground. Both chains must have equal amounts of air or tension at this point. The lower chain anchor nuts must be tightened by the same number of turns. When the required height has been reached, fix the setting with the top (chain side) lock nut and its respective lock washer.

Misalignment of Lift Components

Misalignment of the chain pinion and the chain due to the wrong number of washers on the mast or a damaged mast or cylinder components can also contribute to wearing of the chain sides.

To test whether this is the case, proceed as follows: Place the truck on a horizontal surface in the service station. Support the fork carriage and detach both ends of the lift chain from the chain anchor and visually inspect the alignment with the anchor slots.

Integrated Sideshifter

Disassembly

(See Figure M1500)

- Lower the fork carriage onto a pallet.
- **Depressurise the hydraulic system** (see *Chapter 2* or *Chapter 7*).
- Switch off the truck and disconnect the battery.
- Place a flat tray underneath to collect any spilled hydraulic oil.
- Remove the load backrest.
- Unscrew the stopper (25) and remove the forks.
- Undo all the hydraulic connections to the sideshifter (seal all ports with filler plugs).
- Unscrew the lug (18).
- Tilt the frame (20) up and slide it from the frame on the side. Make sure you do not push the slide pieces (12) out of their seats in the process.
- Dismantle the cylinder if necessary.

Assembly

- Clean all contact surfaces and lubricate them again.
- Use new seals and deflector rings if have dismantled the cylinder.
- Assemble all components in the reverse order of disassembly.
- Bleed the sideshifter cylinder by moving it from the left to right ends approximately 20 times. The cylinder has an internal valve and is self-bleeding. Bleed the tilt cylinder as usual via the ports (see *Chapter 2*, **note the safety instructions!**)

Lift cylinder

General

Make sure the components and the working area are clean. Thoroughly clean the cylinder before dismantling it. Hydraulic systems are sensitive to contamination.

When carrying out repairs, always replace all the seals and bearing rings. Apply a thin layer of hydraulic oil to all the seals and internal metal surfaces prior to assembly. Use hydraulic oil according to the temperature range of the area of application (see Lubricant table in Chapter 1).

Removal and Assembly

Inspect the piston rod for damage over the full lift height before removing it. Damaged piston rods damage the seals very rapidly. Replace the damaged piston rod whenever you fit new seals.

- Refer to the *Mast chapter* for the removal and assembly of the lift cylinders.

Dismantling

CAUTION

Possible damage!

The cylinder tube can become damaged when you clamp the cylinder. Do not overtighten the devices for holding the cylinder.

Rod Seal Removal

- Clamp the removed cylinder to prevent it from twisting.
- Unscrew the cylinder cap (8) from the cylinder tube.
- Remove the deflector ring (10), the rod seal (9), the bearing ring (7), the guide ring (5) and the O ring (6) from the cylinder cap.
- Thoroughly clean all metallic components with a suitable light solvent. In particular, the seats of the seals and the bearing rings must be absolutely clean and free of foreign bodies. Apply weak, dry compressed air to the components until they are dry. Immediately protect shiny metal surfaces with a thin film of hydraulic oil (for the oil type refer to the lubricant table in Chapter 1).

Piston Rod Removal

- To replace the guide ring (2), first remove the piston rod. Pull the piston rod from off the cylinder tube.
- Remove the guide ring (2). Take the half shelves (3) off the piston rod.

Assembly

CAUTION

Possible damage!

Incorrect handling during assembly can result in leaks.
Take care not to damage the piston rod and the new seals during assembly. Use guide bushing and burr-free tools without sharp edges.

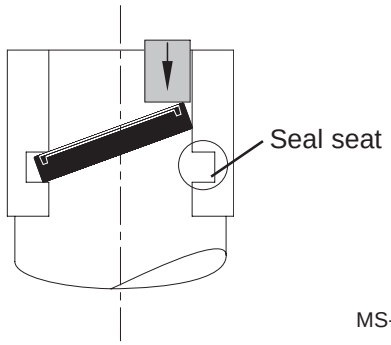
Apply a thin coating of hydraulic oil to all seals and components prior to assembly. Observe the general instructions on assembling seal rods in this chapter.

Piston Rod Assembly

- Insert the half shelves (3) into the groove of the piston rod.
- Pull up a new, lubricated bearing ring (2).
- Push the piston rod into the cylinder tube.

Installing the Rod Seal

- Insert a new deflector ring (10), a new rod seal (9), a new bearing ring (7), a new O ring (6) and a new guide ring (5) into the cylinder cap. Cover threads and sharp edges with suitable means to avoid damage during assembly.



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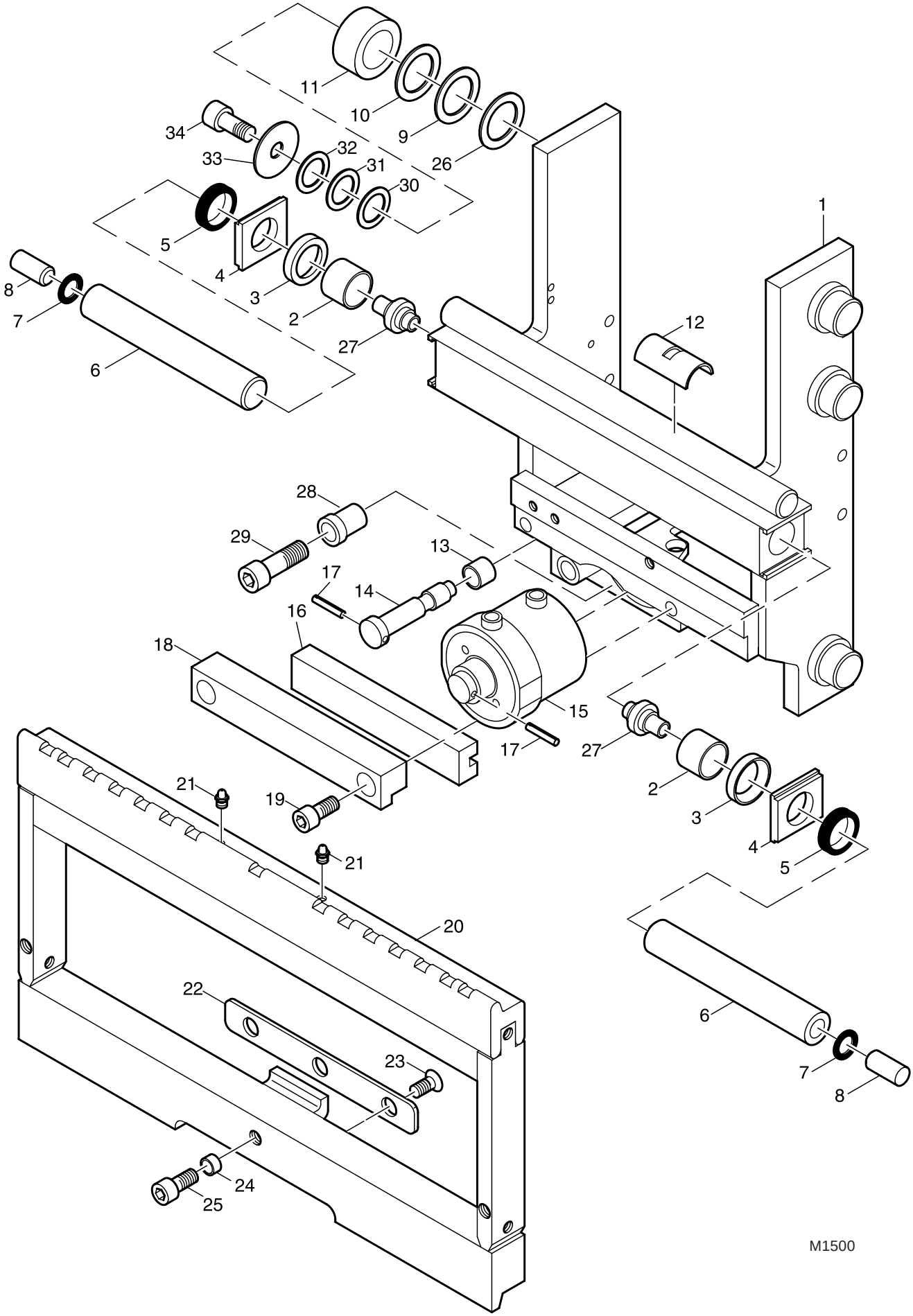
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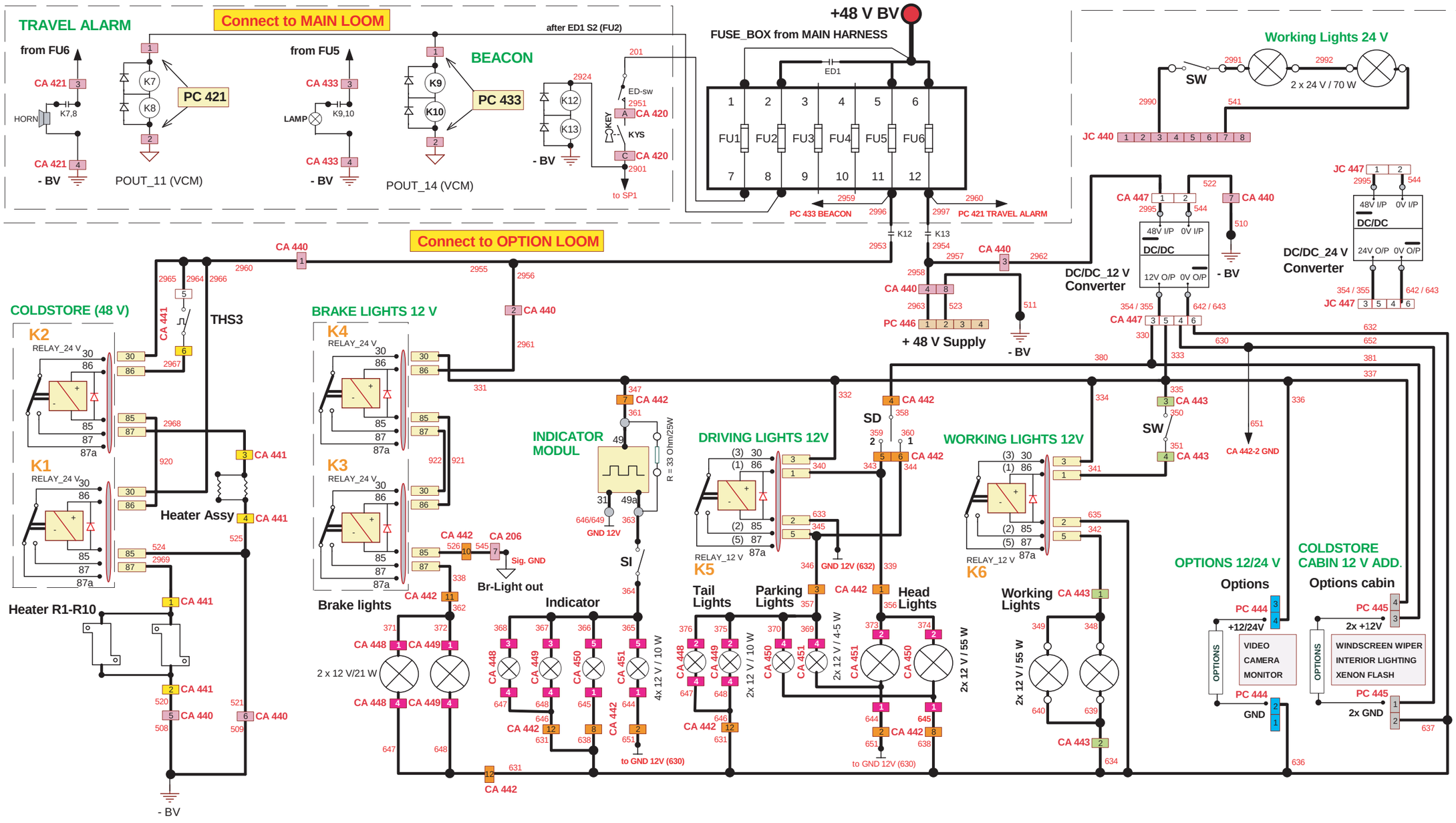
M1500


TRAVEL ALARM
Connect to MAIN LOOM
from FU6
CA 421
HORN
K7,8
CA 421
- BV
PC 421
POUT_11 (VCM)
from FU5
CA 433
LAMP
K9,10
CA 433
- BV
BEACON
PC 433
POUT_14 (VCM)
after ED1 S2 (FU2)
201
2924
K12
K13
- BV
ED-sw
2951
CA 420
KEY
KYS
CA 420
2901
to SP1
+48 V BV
FUSE_BOX from MAIN HARNESS
ED1
FU1 FU2 FU3 FU4 FU5 FU6
PC 433 BEACON
2959
2996
2997
PC 421 TRAVEL ALARM
2960
Working Lights 24 V
SW
2991
2992
2 x 24 V / 70 W
2990
541
JC 440
Connect to OPTION LOOM
CA 440
2960
2955
2956
2953
K12
K13
2954
2957
CA 440
2962
2958
CA 440
2963
523
511
PC 446
+ 48 V Supply
- BV
DC/DC_12 V Converter
CA 447
2995
544
522
7 CA 440
510
48V I/P 0V I/P
DC/DC
12V O/P 0V O/P
- BV
354 / 355
642 / 643
CA 447
330
333
380
DC/DC_24 V Converter
JC 447
2995
544
48V I/P 0V I/P
DC/DC
24V O/P 0V O/P
354 / 355
642 / 643
JC 447
632
652
381
337
COLDSTORE (48 V)
K2
RELAY_24 V
CA 441
2965
2964
2966
THS3
5
6
2967
30 86 85 87 87a
2968
920
3 CA 441
K1
RELAY_24 V
Heater Assy
4 CA 441
525
524
2969
85 87 87a
1 CA 441
Heater R1-R10
2 CA 441
520
5 CA 440
508
6 CA 440
509
- BV
BRAKE LIGHTS 12 V
K4
RELAY_24 V
2 CA 440
2961
331
K3
RELAY_24 V
922
921
CA 442
526
10
545
7
CA 206
Sig. GND
Br-Light out
338
CA 442
11
362
Brake lights
371
372
CA 448
CA 449
2 x 12 V/21 W
CA 448
CA 449
647
648
INDICATOR MODUL
347
7 CA 442
361
49
R = 33 Ohm/25W
31
49a
646/649
363
GND 12V
SI
364
Indicator
368
367
366
365
CA 448
CA 449
CA 450
CA 451
4x 12 V / 10 W
647
648
646
CA 442
12
631
638
CA 442
651
to GND 12V (630)
631
12
CA 442
332
DRIVING LIGHTS 12V
(3) 30
(1) 86
(2) 85
(5) 87
87a
RELAY_12 V
K5
3
1
340
2
5
345
346
GND 12V (632)
339
Tail Lights
Parking Lights
Head Lights
CA 442
1
357
356
376
375
370
369
373
374
CA 448
CA 449
CA 450
CA 451
2x 12 V / 10 W
2x 12 V / 4-5 W
2x 12 V / 55 W
647
648
646
CA 442
12
631
644
645
CA 442
8
638
651
to GND 12V (630)
4 CA 442
SD
358
359
360
2
1
5
6
CA 442
343
344
WORKING LIGHTS 12V
(3) 30
(1) 86
(2) 85
(5) 87
87a
RELAY_12 V
K6
3
1
341
2
5
635
342
Working Lights
CA 443
1
349
348
2x 12 V / 55 W
640
639
CA 443
2
634
334
3 CA 443
335
SW
350
4 CA 443
351
651
CA 442-2 GND
336
OPTIONS 12/24 V
Options
PC 444
3
4
+12/24V
OPTIONS
VIDEO
CAMERA
MONITOR
PC 444
2
1
GND
636
COLDSTORE CABIN 12 V ADD.
Options cabin
PC 445
4
3
2x +12V
OPTIONS
WINDSCREEN WIPER
INTERIOR LIGHTING
XENON FLASH
PC 445
1
2
2x GND
637

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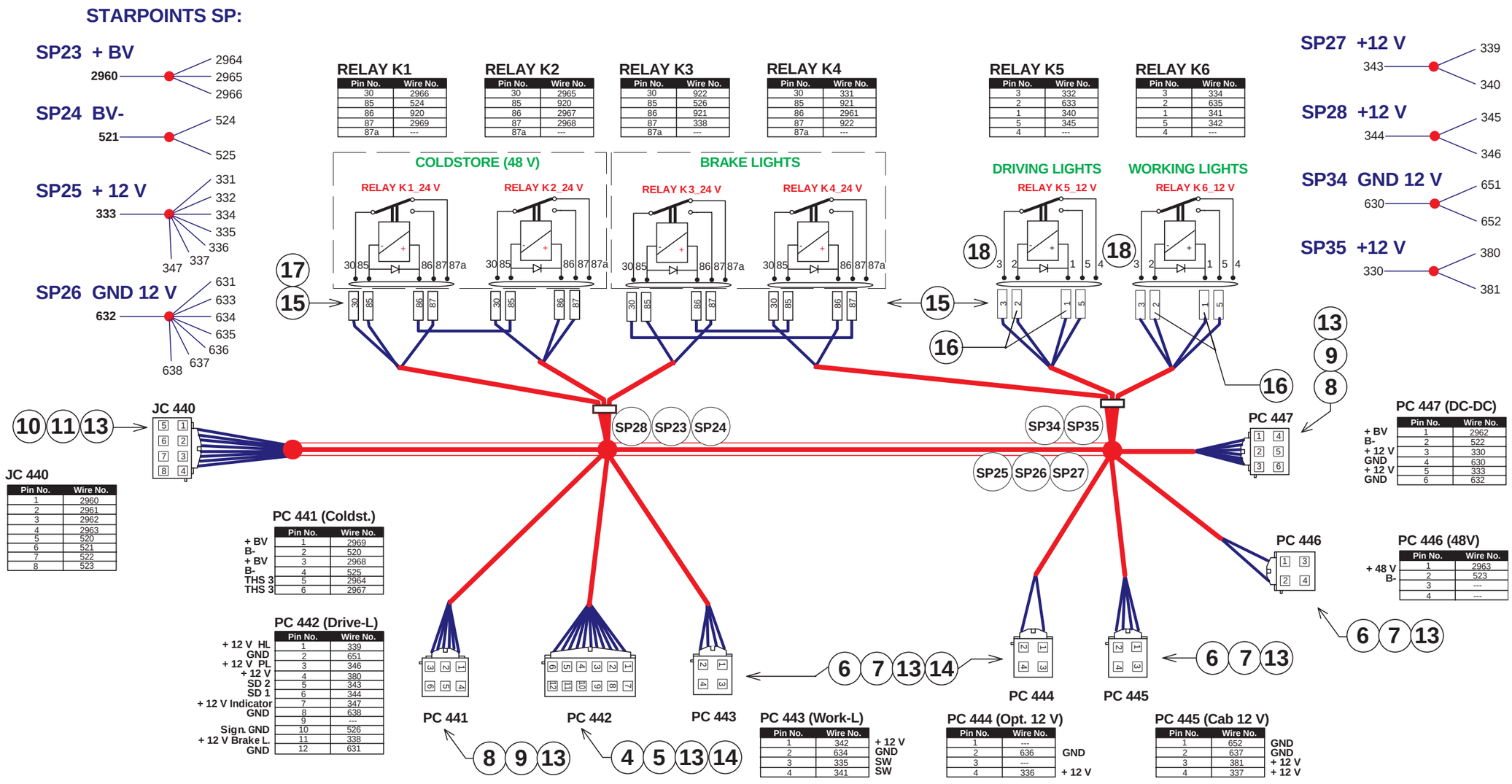


813445_2E_Option_wiring - Loom_sh1

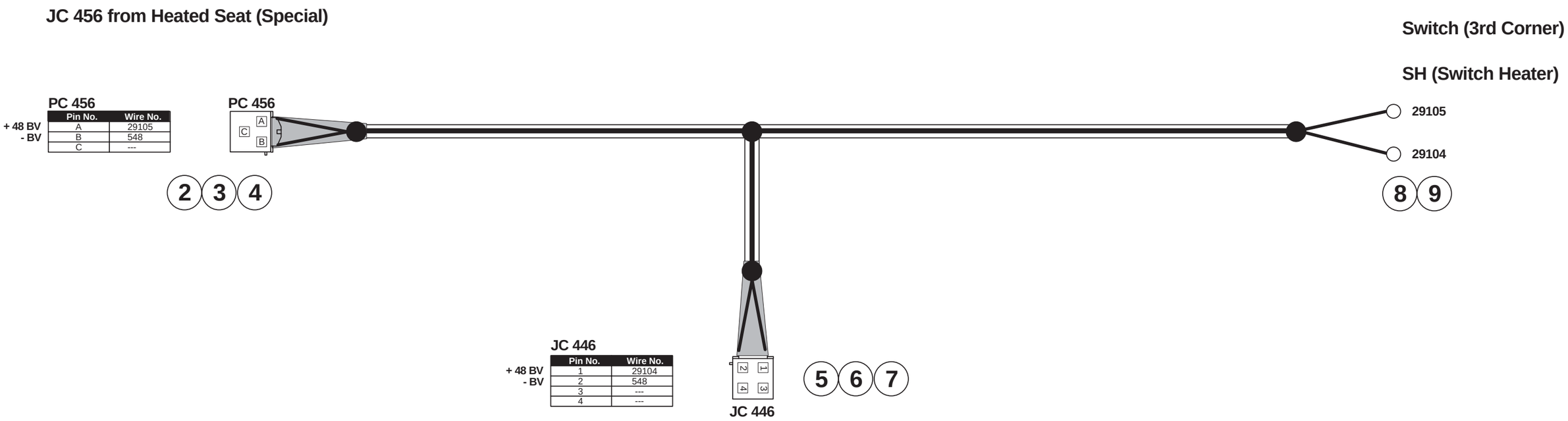
4	792880-006	PIN HOUSING	1
5	793090-006	ANTI BACKOUT	1
6	792880-003	PIN HOUSING	4
7	793090-003	ANTI BACKOUT	4
8	792880-004	PIN HOUSING	2
9	793090-004	ANTI BACKOUT	2
10	792880-005	PIN HOUSING	1
11	793090-005	ANTI BACKOUT	1

813445-1_GB-T

13	792882	PIN CRIMP	43
14	793222	BLANKING PIN	5
15	813444-001	FLAT SOCKET	20
16	813444-002	FLAT SOCKET	4
17	811996-001	RELAY SOCKET	4
18	811996-002	SOCKET	2
19	051051-004	CABLE TIE (BLK)	2

813445-2_GB-T

Harness Heated Seat



PC 446 from Harness Option 813445

ITEM NO.	PART NO.	DESCRIPTION	QUANTITY
2	792882	PIN CRIMP	2
3	808123-002	PIN HOUSING	1
4	793090-002	ANTI BACKOUT	1
5	792883	SOCKET CRIMP	2
6	808124-003	SOCKET HOUSING	1
7	793091-003	ANTI BACKOUT	1
8	793217-022	FASTON RECEPTACLE	2
9	793217-027	INSULATION SLEEVE	2

814430_GB-T