SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2008B

1 General information and technical data

Edition 2008B

1 General information and technical data

Scope, service manual

General

This manual describes the service procedures for ATLET stand-on stackers in the A-Ergo series. Use the manual for quick and correct service of respective truck models.

The manual describes models manufactured from and including the introduction of A-Ergo at the end of 2002.

You may find contradictions in the manual compared with the models supplied due to optional designs, upgrades and the like.

⚠ ***Warning!***

If the truck is rebuilt after delivery or supplemented in such a manner that safety may be affected, ATLET AB or its authorised representative should be contacted.

The electrical system must never be rewired in any form after delivery without written authorisation from Atlet AB, since this may change the measured and applicable EMC.

 The material has undergone careful examination with regard to correctness. Subject to alteration. In the event of inconsistent information in the Swedish and translated editions, it is the Swedish edition that applies.

Modifications and updates will be distributed via ATLET AB Service Manual Change.

Scope of the A-Ergo model

The stand-on stacker trucks in the A-Ergo series are available in a number of different variants with mast system, straddle lift, extendable stabilisors and telescopic forks (ATF).

How to use the manual

Structure

The manual is built up according to the same principle as ATLET spare parts catalogues, with the truck divided into one subsystem per section.

Sections 1 - 3 in this manual contain comprehensive information regarding technical data, service instructions and tools.

Sections 4-12 in the manual contain information limited to a specific area in the truck concerning a description of the mechanical handling of different components. For example, Masts (section 6) and Hydraulic System (section 8).

With regard to software this is described under section 10.

The main principle for extra accessories is to place them under the respective sections. Otherwise they are placed under section 12 “Miscellaneous”. For this reason section 12 is not always included in the Service Manual.

For specific problems or information about procedures, look in the main index for the correct section in the manual.

History

The following modifications affect the service procedure.

Table 1.1 Upgrades of the truck that affect the service procedure

Date	Chassis no.	Event

Symbol key

Warning!

Used if there is a risk of personal injury.

Important!

Used if there is a risk of damage to machine.

Note!

Used for general observation.

Safety instructions

General

Extreme importance must be placed on precautionary measures to avoid accidents during all work on the vehicle.

A general rule is to always implement preventive measures that are adapted to the type of vehicle to be worked on. The general rules below must always be observed:

- Smoking or naked flames are strictly forbidden as there is a risk of explosion in the vicinity of batteries and while working on gas equipped vehicles.
- The battery should always be protected during grinding work.
- Local fire regulations must be followed.
- The drive wheel should always be lifted up free from the floor during service work to prevent the vehicle from moving.
- Before working on the electrical system the battery plug should be pulled out.
- To prevent injuries caused by crushing the battery plug should always be removed when working on or around the mast and hydraulic unit. The mast or hydraulic unit can be actuated due to an electrical fault or a mistake while working. The battery plug may only be connected while trouble shooting, and when the greatest of care is exercised, (with the truck raised).

Warning!

Having the power connected to the truck when working on or around the mast can result in fatal injury!

- When working on or around the mast and the hydraulic unit, they must be locked by using the mast lock, wooden blocks or some other appropriate means.
- No other persons should be in the vicinity of the truck when it is test run in conjunction with repair work, in view of the risk of accidents or near-accidents from the truck making an unexpected manoeuvre.
- The system should not be pressurised, e.g. the pump motor shutoff and the forks down, when dismantling parts of the hydraulic system.
- All metal objects such as watches and rings should be removed when working on the electrical system, or in its immediate vicinity. A short-circuit from such objects can result in serious burn injuries.

Lifting the truck

Checks/Preparations

- When the truck is lifted by using a jack, make sure you secure it with blocks. The truck must not rest on the jack, while work is carried out.
- Ensure that straps, wires or chains have a sufficient lifting capacity before lifting the truck.
- Ensure that the drive wheel runs free of the floor before trouble shooting.

Permitted lifting points

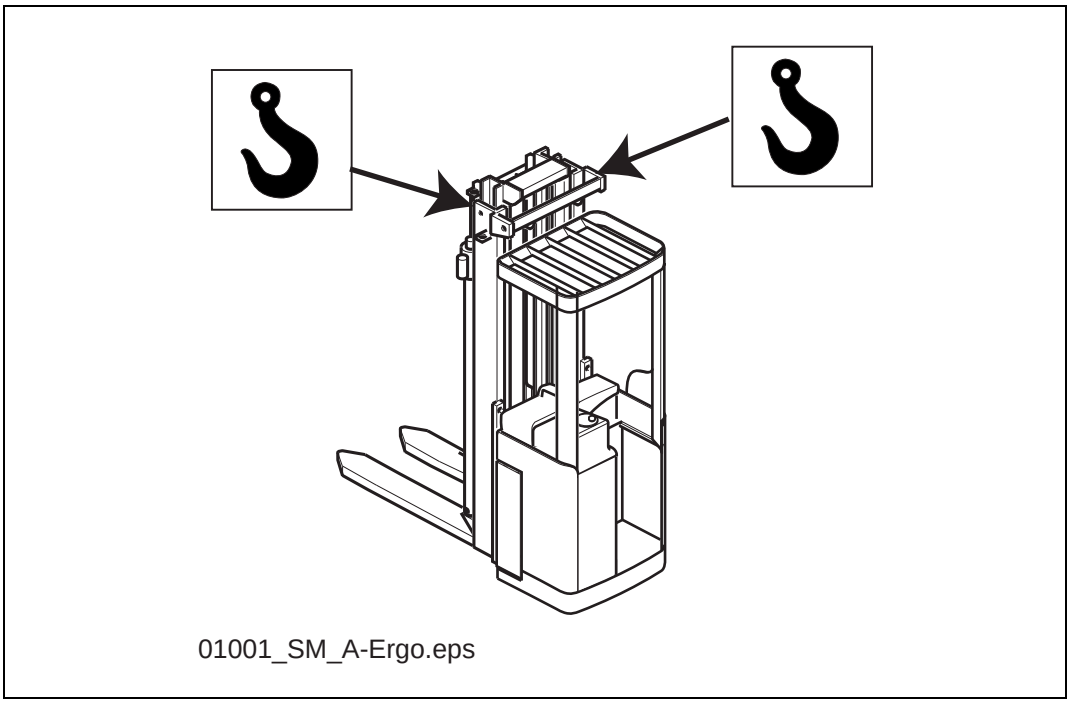


Figure 1.1 Permitted lifting points, A-Ergo

Figure1.1 shows where the permitted lifting points are placed on the truck. The lifting points are marked with a decal representing a lifting hook; the lifting holes in the outer mast should be used.

⚠ ***Warning!***

The machine must never be lifted from the overhead guard.

Welding on the truck

- During welding work the battery plug should always be disconnected and all connections to the control units and regulators (concerns all electronic units) should be disconnected. On completion of welding work the connectors should first be connected to the electronic units, after which the battery plug is connected to the battery.
- The welding earth should always be connected as close to the welding area as possible to eliminate damage to surrounding components.

Taking the environment into consideration

Atlet AB takes care of the environment. Waste material in conjunction with repairs, maintenance, cleaning, or scrapping, should be collected and disposed of in an environment-friendly way and in accordance with the directives of respective countries. Such work must only be carried out in areas intended for this purpose.

Environmentally hazardous waste, such as oil filters, batteries, hydraulic hoses and electronics, can have a negative effect on the environment, or health, if handled incorrectly. Recyclable material should be taken care of by specialised authorities.

Preparations

Service

- Go through all the safety instructions.
- Make sure that you have all the essential tools close at hand before starting work.
- Before cabling or other electrical components are disconnected, check the colour codes and check for damage to cables or connections.
- When complex components are repaired and dismantled, make sure that you have good control of the different component parts to avoid the risk of confusion.
- When repairing or maintaining sensitive components, make sure that you use clean tools and work on a clean work surface.
- Dismantle, inspect and adjust components according to the prescribed routines. See respective sections for detailed information.

Trouble shooting

When you suspect a faulty component, do not replace it immediately. First check the surrounding equipment and carry out complete trouble shooting routines. Make sure you know the reason for the fault before replacing a component.

Data A-Ergo

Designations

Truck designation

Table 1.2 Truck designations

Truck type	A-Ergo	Stand-on stacker, Standard
	A-Ergo TF	Stand-on stacker with telescopic forks
Load capacity	A-Ergo	1600 or 2000 kg
	A-Ergo TF	1000 kg

Type designation

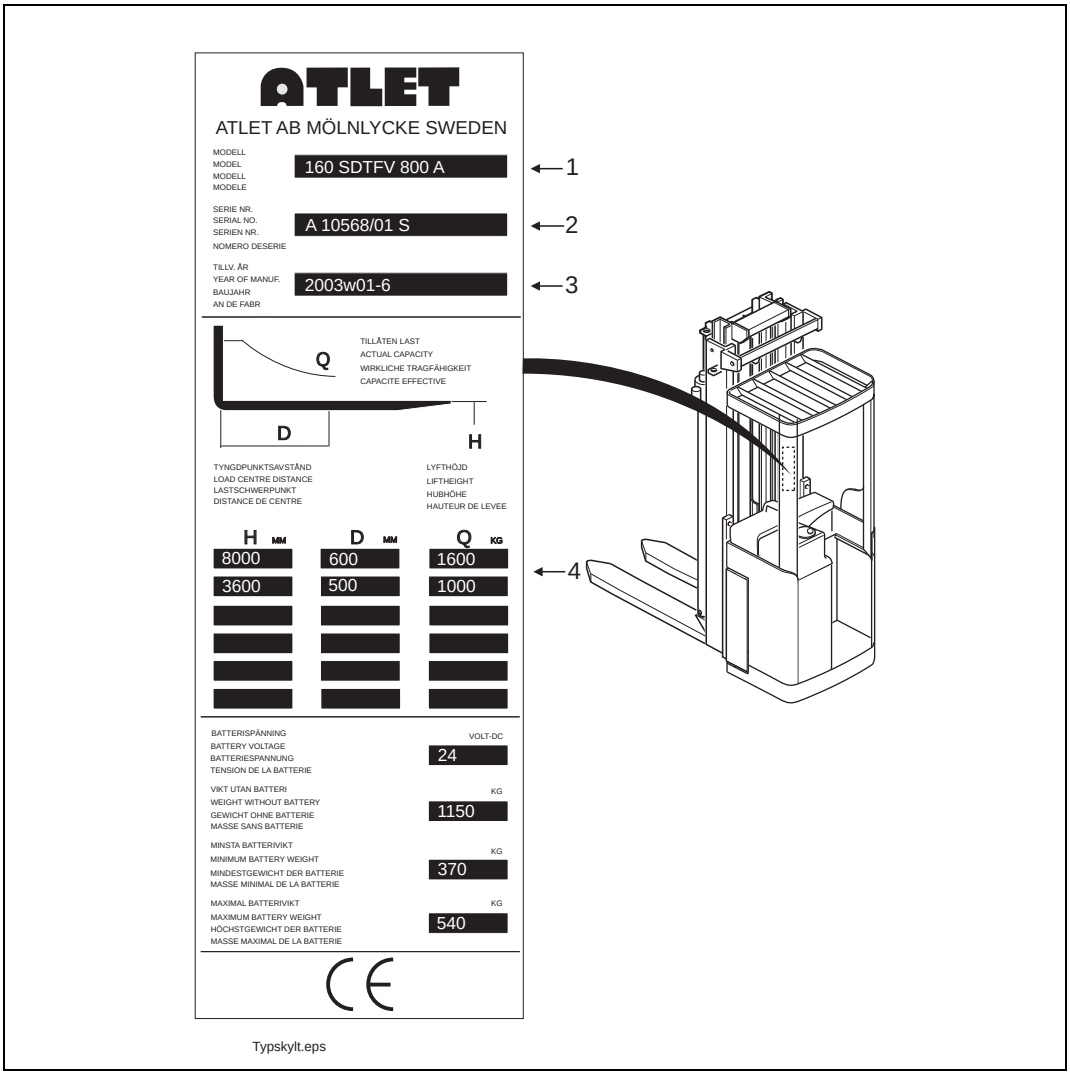


Figure 1.2 Example of type plate (–2006w36)

1. Model designation.
2. Type Series no./Version (S=Special version.).
3. Year of manufacture, week, and warranty period in months (only Sweden). (On the assumption that the service instructions in the warranty regulations are followed.)
4. Any load restrictions, depending on the position of the load on the forks (D) and/or lifting height (Q).

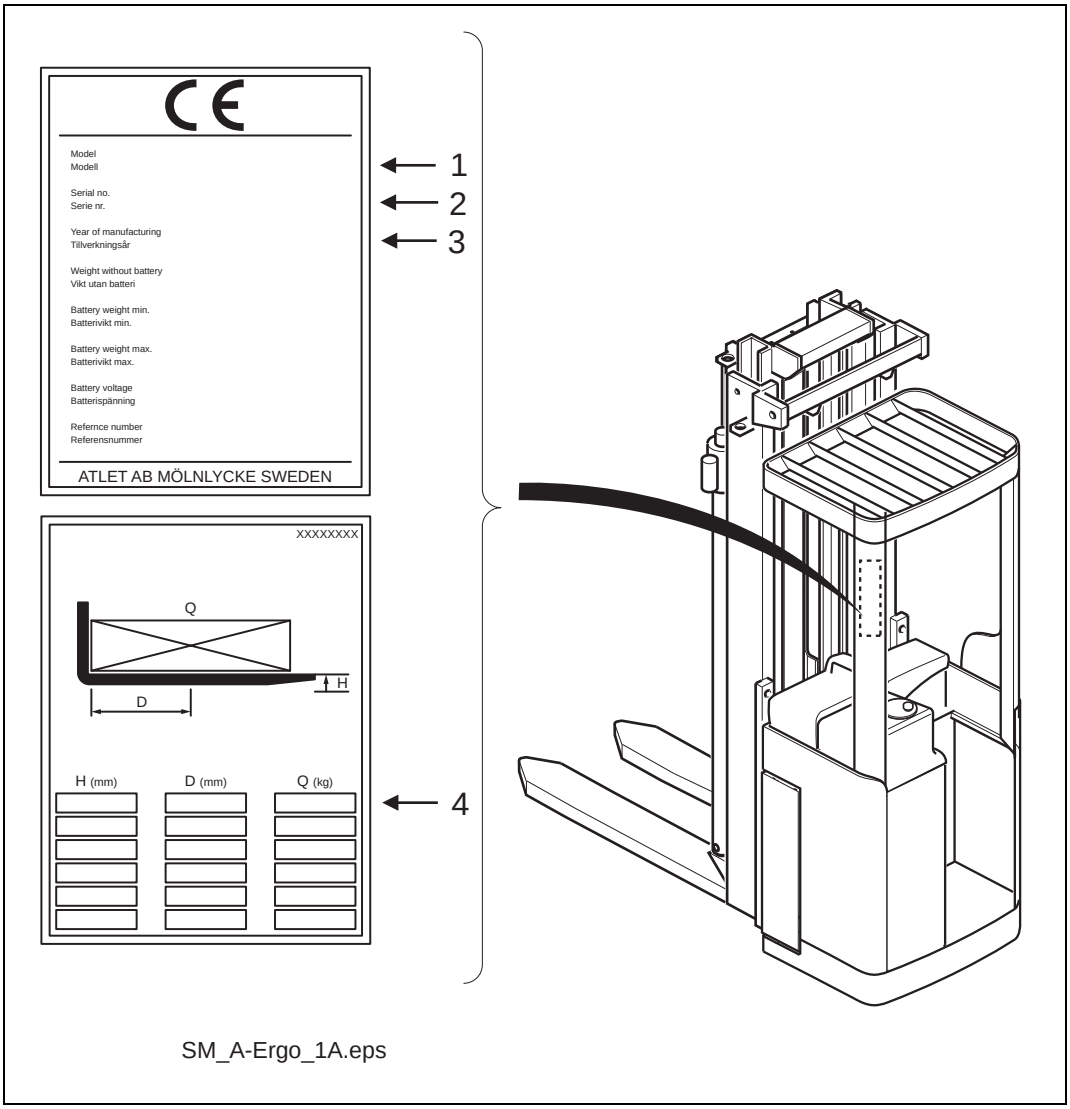


Figure 1.3 Example of type plate (2006w37–)

1. Model designation.
2. Type Series no./Version (S=Special version.).
3. Year of manufacture, week, and warranty period in months (only Sweden). (On the assumption that the service instructions in the warranty regulations are followed.)
4. Any load restrictions, depending on the position of the load on the forks (D) and/or lifting height (Q).

Note!

In cases where the machine plate has been lost or become illegible, it must be renewed immediately. In order to identify the machine's serial number, there is a plate located on each main component such as drive motor, gearbox, hydraulic unit, TMC etc. For some machines there is even a plate attached inside the battery compartment, or serial number punched on the side of the mast.

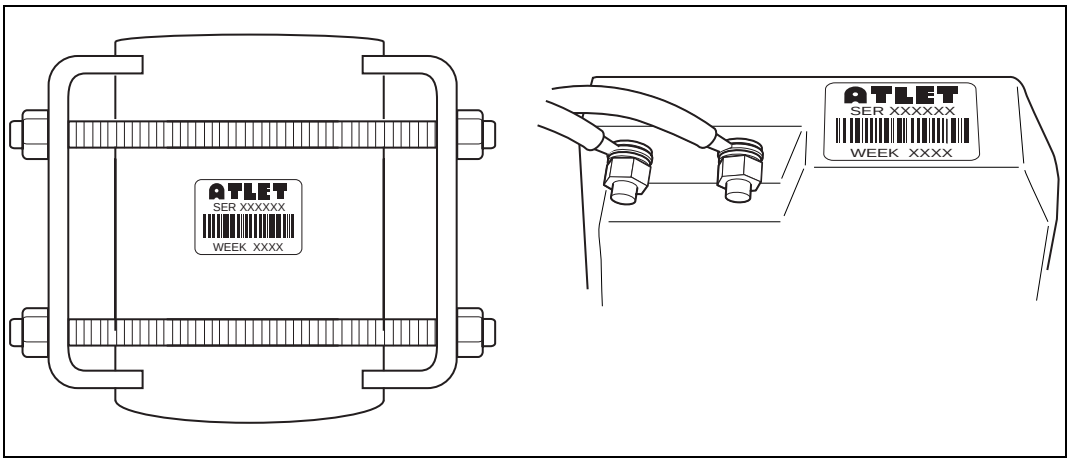


Figure 1.4 Example of plate with serial number.

Explanation of Model designation

Example: **A 160 S DTF V S 360 225 40**

Truck type	
Load capacity/10	
Narrow gauge	S
Broad gauge	B
Telescopic mast	T
Telescopic mast, Free-lift	TF
Double telescopic mast	DT
Double telescopic mast, Free-lift	DTF
Free-view mast	V
Stabilisers	S
Straddle lift	H
Lifting height in cm	
Battery Ah/5	
Charger Ampere	

Dimensions and weights

Dimensions A-Ergo

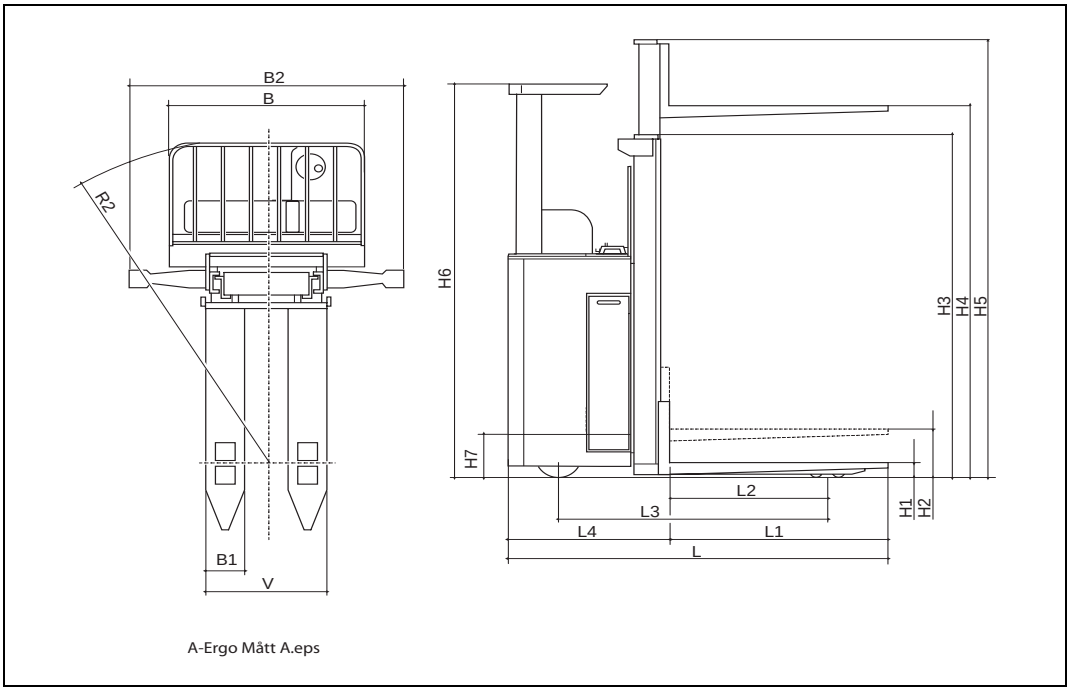


Figure 1.5 Positions for dimensions A-Ergo

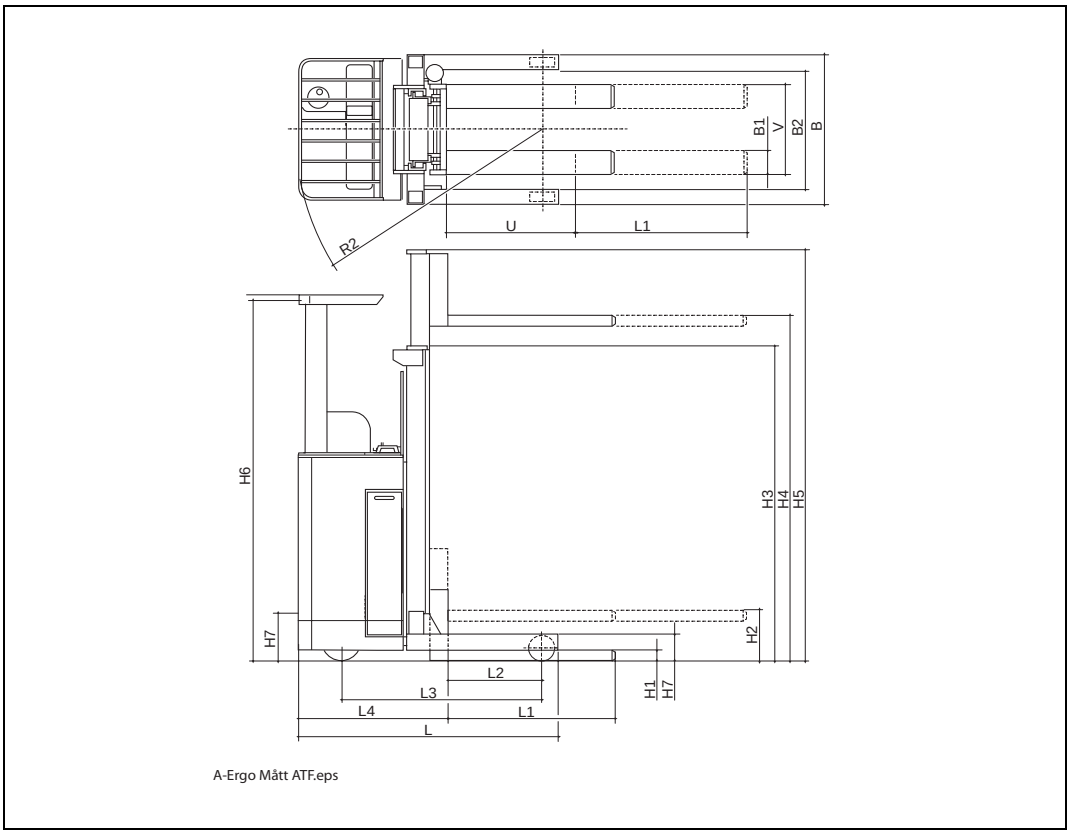


Figure 1.6 Positions for dimensions A-Ergo TF

Component specification

Table 1.3 Component specification

Component		Specification	
Drive motor		Drive voltage	16V
		Output standard	2.2 / 2.4 kW S2 60 min
		Insulation resistance	>24 kΩ
Gearbox		Gear ratio (standard)	16,95:1
		Oil volume	1.5 litres
Hydraulic system		Max pressure	17.5 MPa (=175 kp/cm²)
		Oil volume	max 19 litres
Hydraulic unit (motor and pump)	Type 1	Output	3.5 kW
	Type 2	Output	4.5 kW
	Type 3	Output	7.6 kW
Control system for drive motor		Type Zapi AC1	AC Transistor
		Voltage	24 V
		Max current	250A (RMS) in 2 min
Control system for steering wheel		Type Zapi AC1	AC Transistor
		Voltage	24V
		Max current	70A
Fuses		Control fuses 2 pcs.	7.5A 30.0A
		Pump motor fuse 1 pcs.	250A
		Drive motor fuse 1 pcs.	160A

Recommended consumable material

Oil and grease

Table 1.4 Table of recommended types of oil and grease

Brand	Gearbox oil As per API value GL-5		Hydraulic oil As per ISO VG 32, VG 15		Bearing grease NLGI 2 Lithium base	Worm gear oil (Only ATF)
	Normal	Cold store	Normal (32)	Cold store (15)		
BP	BP Energear Hypo 80W/140 EP	BP Energear SHX-S 75W/140	BP Bartran HV-32	BP Bartran SHF-S	BP Energrease LC 2	BP Energol SGXP 150
Castrol	Hypol C 80 W/90	-	Hyspin SHS 32	Hydraulic oil OM 15 Alt:Hyspin AWH 15	LMx	Alpha syn T 220
Mobil	Mobilube HD 85 W/ 90	-	DTE 13 M SHS 32	Flowrex 1	Mobilplex 48	GLY goyle 30
Shell	Spirax HD 85 W/90	-	Tellus oil TX 32	Tellus oil T 15	Retinax EP2	Tivela WB
Statoil / Exxon	Gearway G5 80 W/90	-	SHS 32	J 26	Uniway LIX 625	Snäckväxel-olja 375 S
Texaco	Geartex EP-C 80 W/90	-	Rando oil HDZ 32	Rando oil HDZ 15	Hytex EP2	Synlube CLP 220

☞ ***Important!***

Do not mix different lubricants – definitely not synthetic oil with mineral oil!

Standards and abbreviations

Screws

Tightening torque, screws and nuts

Table 1.5 Tightening torque, screws and nuts

DIM	Tensile grade			
	4,6	8,8	10,9	12,9
	Nm	Nm	Nm	Nm
M4	1,1	2,9	4,0	4,9
M5	2,2	5,7	8,1	9,7
M6	3,7	9,8	14	17
M8	8,9	24	33	40
M10	17	47	65	79
M12	30	81	114	136
M14	48	128	181	217
M16	74	197	277	333
M18	103	275	386	463
M20	144	385	541	649

The tightening torque in the table above are standard values. In some cases a specific tightening torque is specified in respective sections. If no tightening torque is specified in the service instructions, the values shown in the table above apply.

Tightening torque, hydraulic couplings

Table 1.6 Tightening torque, hydraulic couplings

Tightening torque: Pipe thread / metric thread:			
Metric fine thread	**Whitworth pipe thread**	**MA (Nm) with ring**	**MA (Nm) with elastic**
M10 x 1	G 1/8"	25	10
M12 x 1.5		30	20
M14 x 1.5	G 1/4"	50	30
M16 x 1.5	G 3/8"	80	35
M18 x 1.5		90	40
M20 x 1.5	G 1/2"	130	50
M22 x 1.5		150	60
M26 x 1.5		250	70
M27 x 1.5	G 3/4"	250	80
M27 x 2		250	90
	G 1"	350	140
M33 x 2		400	140
M42 x 2	G 11/4"	600	240
M48 x 2	G 11/2"	800	300

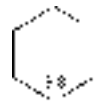
Conversion table

Table 1.7 Conversion table, torque units

Newton metre (Nm)	Kilopond metre (kpm)	Poundforce inch (lbg x in)	Poundforce foot (lbf x ft)
1	0,10	8,85	0,74
9,81	1	86,80	7,23
0,11	0,01	1	0,08
1,36	0,14	12,00	1

Screw types and tensile grades

Table 1.8

Figure	Screw type	Designation	Tensile grade
	M6S	Hexagon screw	8,8 10,9
	MC6S	Hexagon hole screw	8,8 10,9 12,9
	MF6S	Hexagon hole screw, countersunk	10,9
	MCS	Slotted screw	4,6
	MVBF	Oval head countersunk screw	4,6

Marking with the manufacturer trademark, including the tensile grade, is compulsory for screws with a thread diameter from and including 5 mm and in tensile grades according to the table above. Marking only takes place when the shape of the product permits this.

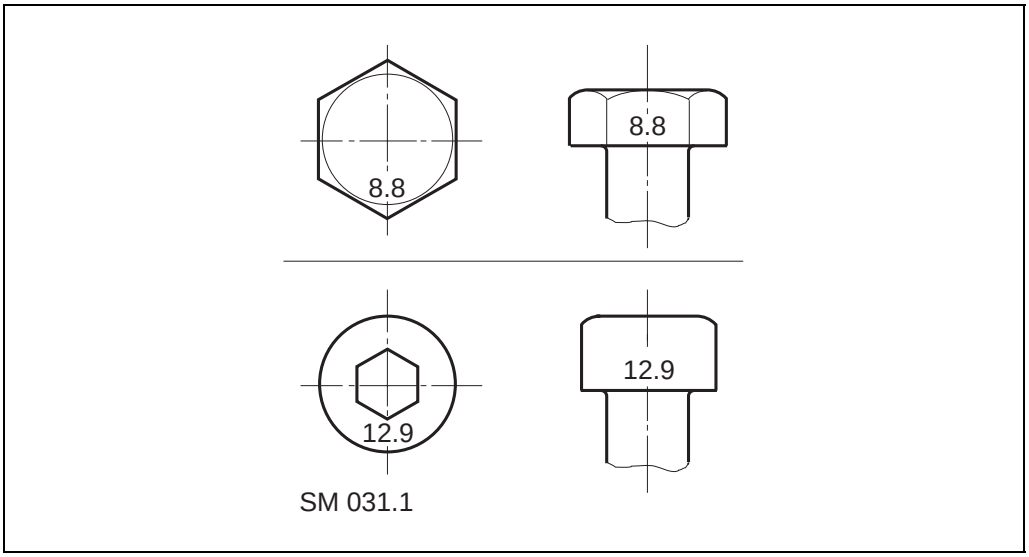


Figure 1.7 Example of marking

Colour of the truck

The truck is painted with the following NCS colour codes:

Table 1.9 NCS colour codes

Machine colour	Designation
Yellow	NCS 0070-Y20R
Medium grey	NCS 7000
Dark grey	NCS 8000

Colour codes, cabling

The colour codes of all the cables in the truck can be read off from the Atlet wiring diagram. The abbreviations have the following implication:

Table 1.10 Colour codes, Atlet wiring diagram

Code	Cable colour
BE	Beige
BL	Blue
BN	Brown
GN	Green
GR	Grey
OR	Orange
P	Pink
R	Red
SB	Black
VO	Violet
W	White
Y	Yellow

Note!

Two-colour cables are shown with both colour codes separated by a slash. E.g. blue/yellow cable is shown with colour code BL/Y.

Designations, electrical components

Electrical components normally have a designation of two letters:

Table 1.11 First letter

Code	Designation
A	Component or function without its own letter below
D	Diode
E	Electrical component
F	Fuse
I	Indicator
K	Connector
L	Lamp
M	Motor
P	Plug
R	Relay
S	Switch
T	Terminal
V	Valve
W	Audible warning

Table 1.12 Second letter

Code	Designation
B	Brake
C	Control system
E	Emergency function
F	Forward
H	Hour
K	Key
L	Lowering
M	Manoeuvre
P	Pump
R	Reverse
S	Speed

Example SL = Switch for Lowering function

Standard abbreviations

Table 1.13 Standard abbreviations

Magnitude	Unit	Designation
Current	Ampere	A
Voltage	Volt	V
Resistance	Ohm	Ω
Output	Watt	W
Torque	Newton metre	Nm
Pressure	Pascal	Pa

SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2004A

2 Special tools

Edition 2004A

2 Special tools

Special tools A-Ergo

Introduction

All special tools can be ordered from Atlet AB.

List of tools

Hand terminal

Table 2.1 Hand terminal, programming tool

Designation	Part number	Applications
Hand terminal Zapi steering regulators	104 400	Programming tool for the control units for the drive motor and steering

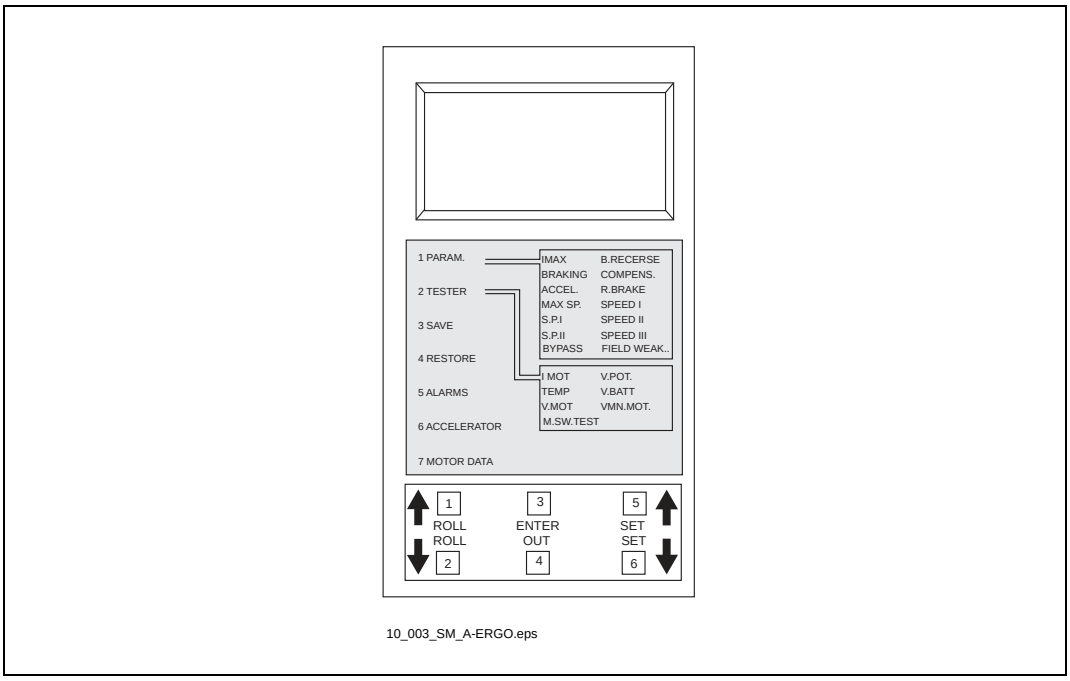


Figure 2.1 Hand terminal Zapi steering regulators, see section 10 for how they are used

Cleaning fluid

Table 2.2 Cleaning fluid, electronics

Designation	Part number	Applications
Cleaning fluid	P/N 112268	Cleaning of electric motors to counteract gearbox oil and other dirt

Dismantling tool, buttons and lamps

Table 2.3 Dismantling tool, buttons and lamps

Designation	Part number	Applications
Check nut extractor	P/N 103 885	Tool for releasing check nuts on lamps and buttons

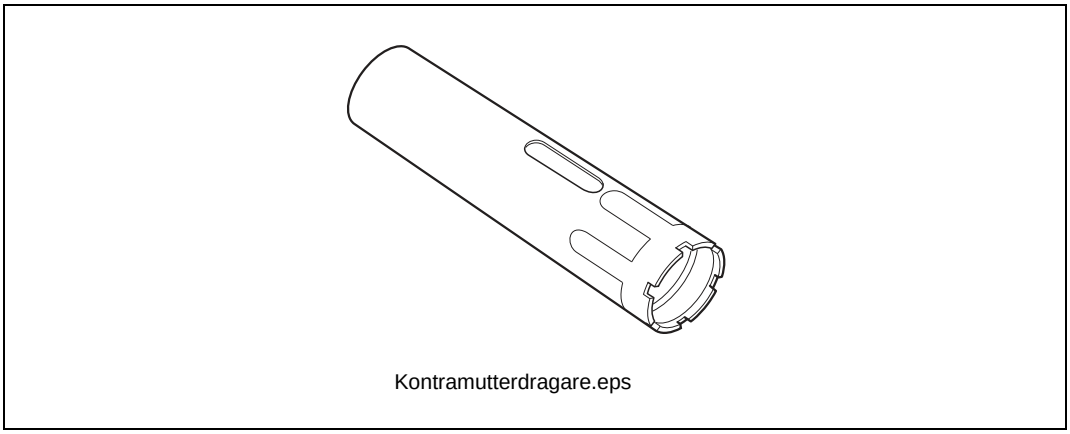


Figure 2.2 Check nut extractor

Crimping tool

Table 2.4 Crimping tool

Designation	Part number	Applications
Crimping tool Molex	P/N 006454	Cable connections
Pin extractor	P/N 006456	Cable connector

Lifting eye

Table 2.5 Lifting eye

Designation	Part number	Applications
Lifting eye	P/N 104737	Lifting eye for drive unit.

For detailed information on the above products, please contact Atlet.

SERVICE MANUAL

Machine: A-Ergo

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3 Service

Edition 2002B

3 Service

Regular maintenance

Introduction

Service should be carried out regularly two times a year with normal truck usage, i.e. 1000 operating hours per year. The planned service includes procedures such as driving tests, function tests, replacing filters and changing oils etc. Servicing is carried out at different intervals depending on the running time of the truck. When the truck is working in extreme conditions or in demanding environments, servicing can be planned at tighter intervals.

Safety

Important!

Check under every separate section which safety instructions are applicable for work on the truck.

The external functions in the steering servo system should be checked after every service and after all work carried out in the electrical system. All function tests of the safety system should be carried out with the truck speed controller in neutral, see section 10.

Recommendation

This section provides information on what the truck owner should take into consideration.

Regular service should be carried out by specially appointed and trained personnel with a good knowledge of the function and servicing of the truck.
To achieve the best results from your investment in the truck we advise you to contact Atlet Service and to subscribe to a service subscription for regular service.

Daily service

This section provides information on what the truck owner should take into consideration.

The truck driver is obliged to do the following (before each shift)

☞ ***Important!***

NOTE! Naked flames or smoking are prohibited when checking the specific acid weight and the acid level.

NOTE! Ergonomic loading procedures should be taken into consideration when replacing the battery or checking the battery to avoid injuries.

1. The battery acid level should be checked every day. See separate service instruction. Note that the acid level rises slightly during charging.
2. Check that the battery cables, connections and plugs are correctly connected and undamaged.
3. Check that the battery is properly locked in its compartment.
4. Check whether the truck has leaked oil.
5. Check the transport and safety signal.
6. Check the braking capacity of the main brake and parking brake.
7. Check that the wheels have no external damage.
8. On trucks equipped with a truck computer, check that the test routine is followed and that no error messages are shown on the display.
9. Check the battery indicator.

☞ ***Important!***

NOTE! Faults detected during daily maintenance are reported to the foreman. See driver instructions.

The truck driver is obliged to do the following (after each shift)

Battery charging.

Battery service must only be carried out by specially trained personnel. This training is provided during the truck driver course. The battery may, however, be charged by other personnel on the assumption that the battery plug is used to connect the battery to the charging unit. The battery is charged according to the recommendations of the battery manufacturer. Only fully automatic charging units should be used. The battery charging should be checked by measuring the acid weight in the cells if an unregulated charger is used.

Important!

NOTE! The acid weight should also be checked when an automatic charger is used. For other details concerning the battery and fully automatic chargers, see the separate service instructions for the battery and charger.

Weekly service (30 operating hours)

Responsibility: Truck driver

1. The battery is cleaned externally with warm water and rags.
2. Check the oil level in the hydraulic system by pushing out all the hydraulic cylinders to their end positions. After this check that the fork carriage goes all the way up to maximum lifting height without the pump sucking air.
3. Check that the wheels have not separated – tread/hub and tread/cord.
4. Check the acid weight. When the acid weight is checked the value for a fully charged battery should be 1.25–1.28 (25°C). The acid weight must not be less than 1.16 (25°C), i.e. have at least 20% capacity left if the battery is to maintain its service life.
5. The truck should be cleaned externally. Vacuum clean and wipe with a damp cloth in the driver compartment. Observe caution when using water jets. Electric panels and circuit cards should always be protected from splashing water when washing.

Service, 500 hours service interval

Responsibility: Foreman

See EN 1726 or ISO 3691

A service is carried out by ATLET service or specially trained personnel. Servicing is normally carried out after 500 hours or six months, but the working environment and application should be taken into consideration when deciding the service intervals. The service includes checking the complete truck, with the emphasis on both personal safety and operational reliability. A service interval of 250 hours is recommended for cold store trucks.

- Overall function test, control lever.
- Check of the horn.
- Test drive forwards, backwards and turning.
- Check of the drive unit.
- Check of the wheels.
- Test of the brake function.
- Check of oil levels and oil leakage.
- Check of the hydraulic unit, pipes and hoses.
- Check of the cylinders.
- Function test, lifting and lowering.
- Lubrication according to the lubrication chart.
- Measuring and check of the battery and charging function.
- Changing of oils and filters according to instructions.
- Check of damage on the chassis.
- Check of the attachments.
- Check of damage in welds.
- Check of the lifting forks.

(See “Check list, service inspektion” on page 3.7)

First service

The first service should be carried out after 200 hours of operation. See “Specific instructions” on page 3.19 for instructions.

Check list, service inspektion

For further information about procedures for inspections, repairs and replacement, refer to respective sections. Planned service inspections are implemented in accordance with the following points:

Chassis			
Inspection points	**Symptom**	**Inspection**	**Service code**
Signs/Decals	None, illegible	Visual	1024, 1101
Doors, panels	Attachment, damage	Visual, tools	1005, 1102, 1032
Overhead guard	Attachment	Visual, tools	1035
	Deformation, cracks, other damage	Visual, tools	
Load wheel	Damage, wear	Visual	1051, 1108
	Noise	Listen, tool	
	Attachment	Visual, tools	
Battery stop, Battery rollers, Battery lock	Damage, mounting, lubrication *	Visual, tools	1014, 1013 *
Rubber mats, compartment	Damage	Visual	1105, 1058
	Attachment	Visual, tools	
Chassis, general	Appearance	Visual	1033, 1112
	Damage	Visual	
	Loose screws	Tools	

* See “Lubrication chart” on page 3.16.

Frame			
Inspection points	**Symptom**	**Inspection**	**Service code**
Lift chains.**	Chain tensioning	By hand	2008
	Lubrication *	Visual, tools	
	Damage, chain	Visual	
	Damage, chain bolt and chain bolt mounting	Visual	

Frame			
Inspection points	**Symptom**	**Inspection**	**Service code**
Forks.**	Cracks	Visual	2026, 2107
	Wear	Visual	
	Angle	Visual	
Mast	Cracks/Weld damage	Visual, tools	2101, 2103
	Mast dampening	Operating test	
	Lubrication *	Visual, tools	
	Play, damage, wear on rollers	Visual, tools, operating test	
	Angle, parallel deformation	Visual	
	Attachment rollers	Visual, tools	
Fork carriage	Cracks/Weld damage	Visual, tools	2007, 2004 2033
	Wear, damage	Visual	
Link system, bar	Locking, damage	Visual, tools	
TF chains	Chain tensioning	Visual	
TF forks	Locking, damage	visual	
Angle gear	Oil level	Visual, tools	
	Leakage	Visual, tools	
	Function	Visual, tools	
Stabilisers	Function	Visual	
Stabiliser cylinders	Function	Visual	
Spring unit, stabiliser cylinders	Lubrication	Visual	

* See “Lubrication chart” on page 3.16.

** Fork tests and chain tests must be carried out at least every 1000 operating hours, see section 6.

Drive unit			
Inspection points	**Symptom**	**Inspection**	**Service code**
Gearbox * Drive shaft Gear	Oil level	Visual, filling	3101, 3006, 3104, 3106
	Noise	Listen, tool	
	Oil leakage	Visual, tools	
Drive motor	Function, noise	Listen, tool	7027, 7112, 7104
	Cable connections	Visual, tools	
Drive wheel	Noise	Listen	3005, 3102, 3002
	Damage, wear	Visual	
	Attachment	Visual, tools	
Sliding bearing	Noise, lubrication *	Listen, lubricate	3103

* See “Lubrication chart” on page 3.16.

Steering			
Inspection points	**Symptom**	**Inspection**	**Service code**
Gear	Noise	Listen, lubricate	4009
Servo motor	Attachment	Visual, tools	4014
Steering servo unit	Attachment	Visual, tools	4014
Steering wheel/step motor sensor	Attachment	Visual, tools	4013
	Damage, wear	Visual, function test, tools	

Brake			
Inspection points	**Symptom**	**Inspection**	**Service code**
Braking force.*	Malfunction	Function test, tools	5012
Braking capacity	Braking distance	Measure, tool	
Parking brake	Malfunction	Function test, tools	5014
Brake discs	Wear	Visual, tools	5104

* See also section 11.

Hydraulic system			
Inspection points	**Symptom**	**Inspection**	**Service code**
Hydraulic tank	Oil level	Visual, filling	6012, 6102
	Damage, leakage, contamination	Visual, cleaning	
	Air, oil filter blocked *	Visual, replace	
Cylinders	Function	Function test, stop watch	6017, 6001
	Damage	Visual, replace	
	Leakage	Visual, tools, replace	
	Cracks/Weld damage	Visual, tools, replace	
	Damage, chain attachments	Visual, tools	
Hoses	Leakage, damage	Visual, tools	6106
	Attachment	Visual, tools	
Nipples	Leakage	Visual, tools	6019
Pump motor	Function, noise	Listen, tool	
	Cable connections	Visual, tools	
Hydraulic pump	Leakage	Visual, tools	6109
	Damage	Visual, tools	
	Noise	Listen	
Proportional valve, on/off valve	Malfunction	Test of lever function	6009
	Malfunction	Calibration of levers	
	Leakage	Visual, tools	

* Replace filter every 1000 operating hours or when necessary (when it is dirty).

For further information concerning the hydraulic system, see also section 8 and lift cylinders section 9.

Electrical system			
Inspection points	**Symptom**	**Inspection**	**Service code**
Cabling, switches	Damage, malfunction	Visual, tools, replace	
Contactors	Malfunction	Visual, tools, replace	7107
	Cable break	Visual, tools	
	Contactor plate	Visual, tools	
Battery	Charging fault	Tools	7032
	Low acid level	Tools,	
	Low acid weight	Tools,	
	Damage	Visual	
	Low capacity after charging	Tools, DC voltmeter	
	Battery plug, malfunction	Function test, tools	
AC regulator	Cable break	Visual, tools	7025
Cabling	Damage, break	Visual, tools	7104
Horn	Malfunction	Function test	7014
Speed controller and brake pedal	Attachment	Visual, tools	7106
	Malfunction	Function test	
	Malfunction	Calibration	
Level selector	Malfunction	Function test	7034
Speed switch	Malfunction	Function test	7035
Fuses	Blown	Visual, measure, replace	7103
Battery plug	Malfunction	Visual, contact surfaces	7008
Video camera	Attachment	Visual, tools	7037
	Damage	Visual	
	Malfunction	Function test, tools	

Code explanation

Chassis			
Code	**Designation**	**Check**	**Reference to section**
1005	Doors	Screws should be tightened.	1
1013	Battery locking	Attachment and locking function	4
1024	Machine plate/ Warning decals	Attachment: text should correspond with machine type, and symbols and warning decals should be legible.	1
1032	Panels	Mounted using screws and clips as well as bonded parts.	4
1033	Paint	Scraping of paint and attachment/ lack of decals	1
1035	Overhead guard	Cracks in weld joints, collision damage, tightening of screws.	1 and 4
1051	Load wheel	Wear on wheel, dirt	4
1058	Rubber strips	Attached with glue or screws	
1107	Seat	Setting, tilt function , load and angle adjustment, attachment in chassis	4
1108	Load wheel bearing	Friction free movement, remove string, plastic bands, etc that have fastened.	4
1112	Accessories	Driver Instructions Manual, hydrometer and battery water bottle.	

Mast			
Code	**Designation**	**Check**	**Reference to section**
2004	Mast/chassis attachment	Screws between chassis and mast	6
2007	Rollers in fork carriage	Washers, lubrication of roller surfaces	6
2008	Lift chains	Equally tensioned, bolts locked, rust, wear, chain pulleys locked	6
2026	Forks	Locking device, cracks, damage, parallelism	6
2033	Side Shift	Mounting in fork carriage	
2101	Mast play	Check the max play. Lubricate sliding surfaces.	6
2103	Mast rollers	Washers, lubrication of roller surfaces	6

Drive unit			
Code	**Designation**	**Check**	**Reference to section**
3002	Drive wheel	Wear, damage Clean.	5
3005	Drive wheel bolt	Attachment, tightening torque	1
3006	Oil leakage	Leakage from shafts, joints, plugs or material	5
3101	Oil level	Oil level, oil change	1 and 5
3102	Noise	Gears, nut tightening	1
3103	Sliding bearing	Noise, requisite lubrication	1
3104	Drive shaft	Tightening of nuts.	1 and 5
3106	Gears	Gear ratio	1

Steering			
Code	**Designation**	**Check**	**Reference to section**
4004	Gear drive	Play, lubrication	1
4009	Gear wheel	Shaft locking, lubrication	1
4013	Mini-wheel	Attachment, rotation	7
4014	Servo motor	Attachment	7

Brake unit			
Code	**Designation**	**Check**	**Reference to section**
5012	Braking force	Braking distance	11
5014	Parking brake	Function, cable connections	11
5104	Brake discs	Friction surface > min level all round	11

Hydraulic system			
Code	**Designation**	**Check**	**Reference to section**
6001	Lift cylinders	Leakage at attachments, weld joints, wiper, piston rod	9
6009	Hydraulic valve	Leakage between sections, connections	8
6012	Oil level in tank	Oil level between min and max	3
6017	Lowering	Check lowering speed	1
6019	Nipples	Leakage	
6102	Filter	Replace if necessary	8
6106	Hoses	Cracks, wear, damage	1
6109	Hydraulic pump	Leakage between pump and motor	
6111	Accessories	Leakage from connections	8

Electrical system			
Code	**Designation**	**Check**	**Reference to section**
7008	Battery connections	That cable connections are not overheating	
7012	Hour meter	Read off the display	
7014	Horn	Function	
7017	Micro switch	Function	
7025	Transistor system	Dirt, moisture. Cable connections	
7027	Drive motor, bearings	Noise	
7030	Pump motor	Attachment, cleaning requirement	
7032	Battery	Acid level, charging. Note reading from hydrometer. Clean if necessary	
7034	Level selector	The mounting, position and function of the switch	
7035	Speed switch	Switches in mast, fork carriage, and forks regarding creep speed	10
7037	Video equipment	Function, mounting of camera and monitor, damage and stretching of cable in mast.	
7101	Contactors	Contact surfaces, cable connections, dust guard. Replace the contactor tips if they are burned.	
7103	Fuses	That they are not brittle	
7104	Cabling	Cable connections, attachment, run free from sharp edges	
7106	Speed controller	Attachment and function.	
7112	Drive motor cables	Attachment, wear, cleaning requirement	
7202	Keyboard	Attachment, damage, readability	
7203	Display	Attachment, damage	

Lubrication chart

A-Ergo

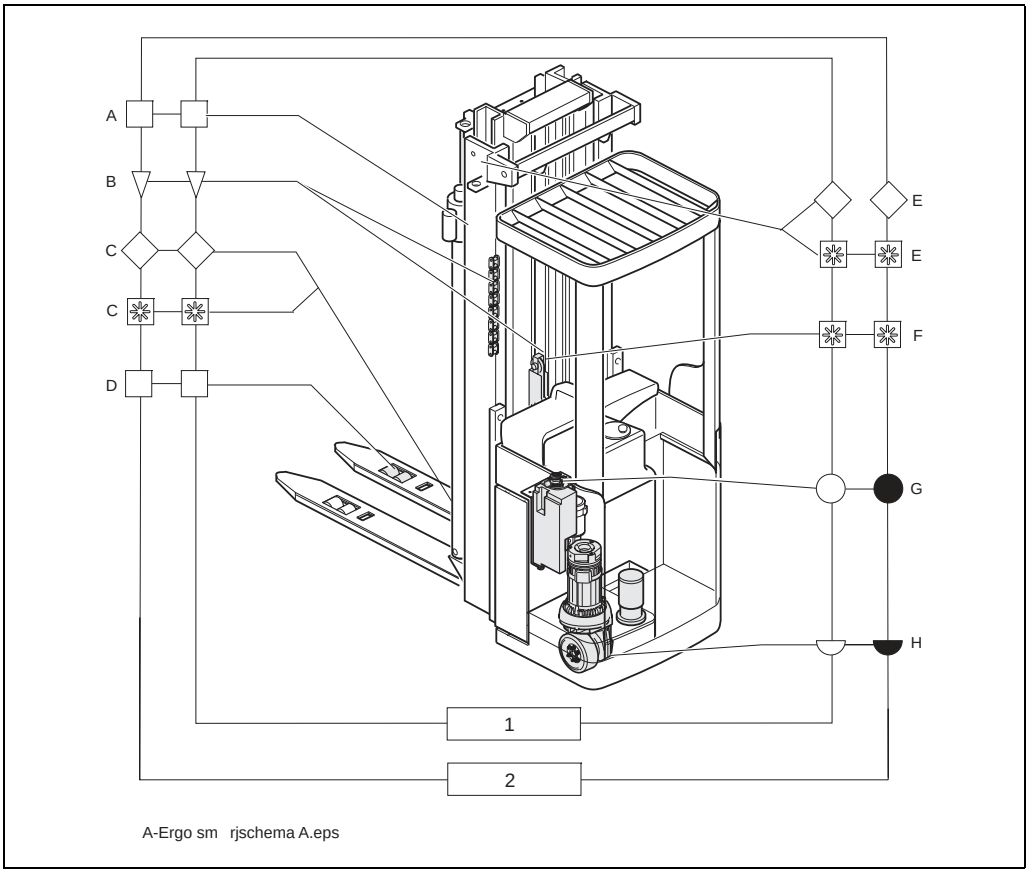


Figure 3.1 Lubrication chart A-Ergo. For explanation of symbols, see table 3.3

The service of an Atlet-truck can be divided into service that should be carried out in relation to how hard the truck has been loaded and used (see “Check list, service inspektion” on page 3.7) and regular annual service:

1. 500 hours service
2. Annual service

Table 3.1 Component to lubricate A-Ergo

Location	Explanation	Location	Explanation
A	Mast profile – roller surfaces and slide surfaces	E	Thrust rollers – all
B	Lift chains, all	F	Chain pulley, Shaft
C	Fork carriage – thrust rollers	G	Hydraulic oil, filter
D	Bogie – axle (unloaded)	H	Gearbox oil

Important!

All torsion springs in the machine should be lubricated during each service.

Supplementary lubrication chart, telescopic forks, (TF)

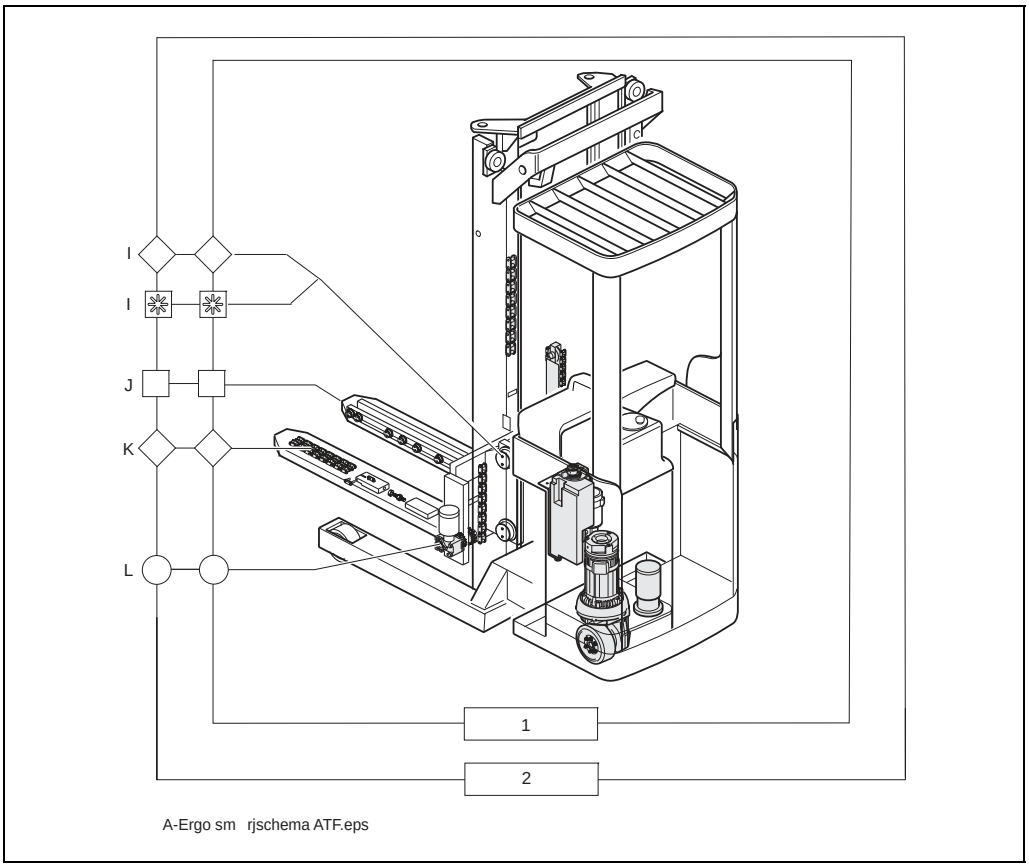


Figure 3.2 Supplementary lubrication chart TF. For explanation of symbols, see 3.3

Table 3.2 Supplementary components to lubricate TF

Location	Explanation	Location	Explanation
I	Fork carriage – thrust rollers	K	Chains Fork driving
J	Forks, rollers, slide surfaces	L	Angle gear

Explanation of symbols, lubrication chart

Table 3.3 Explanation of symbols for lubrication chart

Symbol	Explanation	Symbol	Explanation
	Hydraulic oil		Hydraulic oil, change
	Gearbox oil		Gearbox oil, change
	Grease		Chain spray
	Chain spray / oil		Only cold store version

Applicable in general for the symbols:

- Unfilled symbol – Check / lubrication
- Filled symbol – Change

Specific instructions

Storage of machines and motors

Machines in storage that will not to be used within a month, must be given special attention so that problems do not occur when they are to be used again. Dust, dirt, condensation and moisture that occurs during large variations in temperature, as well as problems with rust and oxidisation, must be prevented. Motors should therefore be protected with waxed paper or the equivalent, and also with a moisture absorbing material.

Drive motor

Preventive maintenance

Preventive maintenance is implemented in accordance with the intervals set out in the service chart.

However, in some cases exceptions must be made and the intervals shortened, depending on local conditions in customer premises, e.g. a rugged environment with dust, high humidity levels, and salt, etc.

- Listen for abnormal noise from the bearings when the motor is run. Check that it does not vibrate abnormally.
- Blow clean the motor with dry compressed air or clean with a vacuum cleaner. A special cleaning fluid should be used to drive out oil and dirt, if oil has leaked from the gearbox into the motor, see section 2. Finally, blow dry with compressed air.
- Check the insulation resistance for the motor, see specification in section 1 for correct value.

Gearbox

First service

First oil change after 200 hours

- The first oil change should be done after 200 hours.
- Fill up with a recommended type of oil, see section 1.

Preventive maintenance

The oil level is checked during each service

- The oil level is checked during each service.
- The steering bearing must be greased at least once a year. If steam cleaning or high pressure washing has been carried out then new greasing is essential.

Note!

Remember to fill up the gearbox with oil after changing the oil or replacing the gearbox. See section 5 for procedure.

Note!

Spent oil should be taken care of and recycled according to the applicable legislation in respective countries.

Lift chains and forks

Check

Forks and lift chains should be checked during each service

For safety reasons the forks and all lift chains should checked during each service.

If a lift chain fails to be approved in any respect, the complete chain must be replaced; and it is not permitted to replace parts of a lift chain.

Important!

If the lift chain fails to be approved in any respect the complete chain must be replaced.

See under section 6 for instructions concerning checking chains and forks.

Regular maintenance

The chain should be kept clean.

Lubricant (see “Check list, service inspektion” on page 3.7) must be regularly applied on the chain so that all working surfaces are continuously lubricated.

The chain should be kept in motion when lubricating to ensure that the lubricant penetrates the working surfaces between the link plates and pins. All excess lubricant should wiped off, but solvent must not be used.

If the chain runs dry it should be lubricated more often; this also applies if the truck is working in special environments such as cold stores, etc.

Overhead guard

First service

Retightening after 200 hours

1. The attachment between the overhead guard and chassis should be retightened during the first service.

Tightening torque:

81 Nm

2. The tightening torque between the overhead guard and chassis should be **81 Nm.**

Mast

First service

Retightening after 200 hours

1. The attachment between the mast and chassis should be retightened during the first service, 200 hours.

Tightening torque:

277 Nm

2. The tightening torque between the frame and machine housing should be 277 Nm.

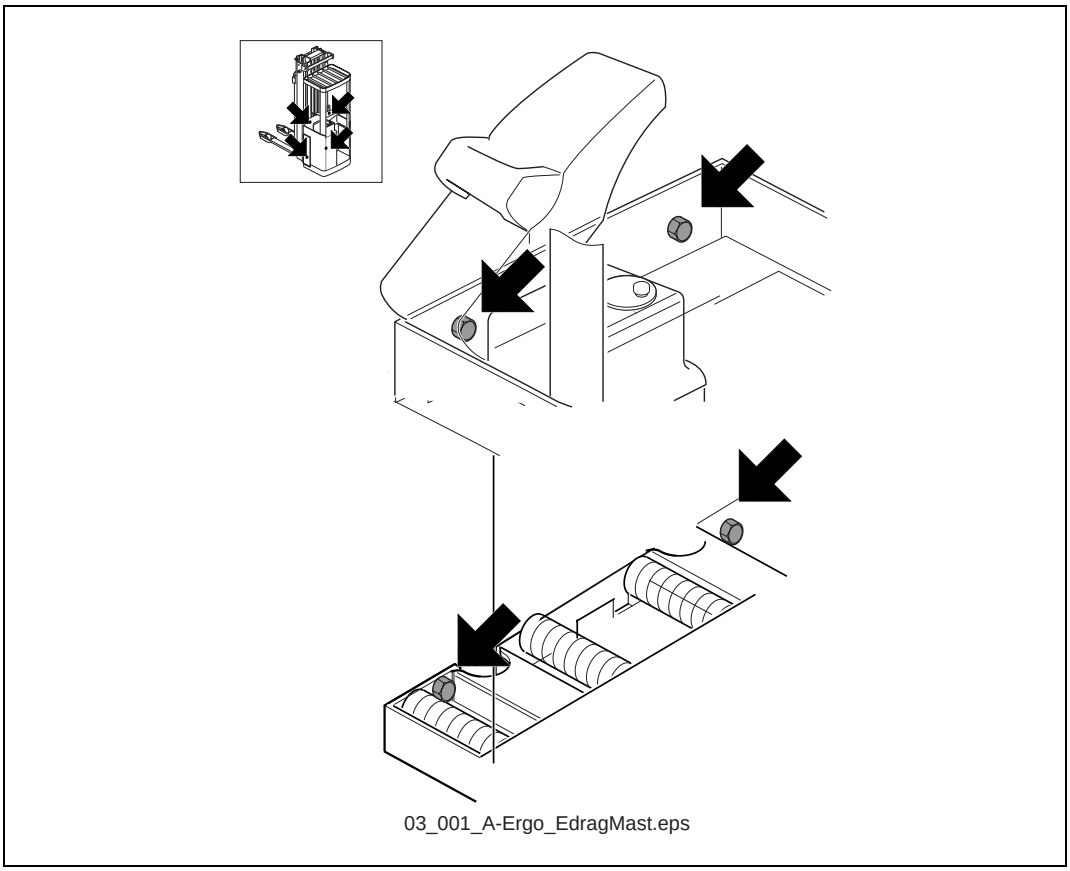


Figure 3.3 Position of screws that hold the mast to the chassis.

Hydraulic oil

Hydraulic oil change and replacement of filter after 200 hours

First service

- The oil filter should be replaced after 200 hours.

Replacement intervals

After 500 hours of operation: The hydraulic oil filter and air filter to the hydraulic oil tank should be replaced after no more than 500 hours of operation. Replacing the hydraulic oil filter refers to those types of trucks that have replaceable filters. Clean the suction filter.

After every 1000 hours of operation: Changing of the hydraulic oil and replacing the oil filter and air filter after 1000 hours of operations, or once every year (whatever is first).

If the hydraulic oil has been heated over 60 degrees Celsius the oil and the filter should be immediately replaced since their properties will have been changed.

If the hydraulic oil has become contaminated with water (e.g. during work in cold store) this can be detected in that the oil will look milky, or smell bad.

It can also be checked with the following simple test:

1. Use protective glasses, gloves and clothes, and observe the fire instructions for the premises.

⚠ ***Warning!***

Risk for burn injuries on the skin.

2. Put a little hydraulic oil in a teaspoon and heat the spoon with a cigarette lighter; if there is a crackling sound this proves that it contains water and should be changed.

The hydraulic oil should be filtered when filling, by pouring the oil through the filter.

Recommended replacement

Hydraulic hoses should be replaced after 5 years, since the rubber in the hose is perishable.

SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2005A

4 Chassis

Edition 2005A

4 Chassis

Design and function

Scope

A chassis normally includes the supporting parts of a construction and in the case of a truck the chassis consists of the machine housing, panels, arm rest, overhead guard and castor wheel.

With regard to the straddle legs and load wheels on the truck it could be said that they are a part of the chassis, but since they are also a part of the mast the instructions concerning straddle legs and load wheels are described in chapter 6, Mast, instead.

Machine housing

The chassis on A-Ergo trucks consists of a machine housing, which is available in different versions depending on the size of the battery.

All the truck components such as the mast, drive unit, and hydraulic system are mounted on the machine housing and this is therefore the most basic component on the truck.

The machine housing structure is prepared for different sizes of batteries. Spacers are fitted between the machine housing and mast in those cases where a larger battery is used, see figure 4.1.

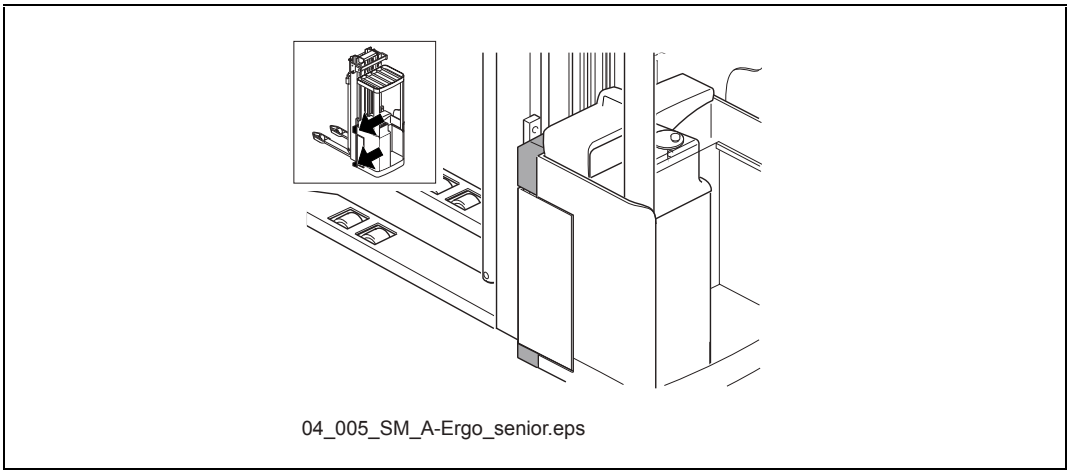


Figure 4.1 Machine housing prepared for large battery

Overhead guard

The overhead guard consists of a grille roof mounted on two pillars. The grille is designed to ensure good overhead visibility.

The construction has a design basis to withstand loads in accordance with current standards.

Arm rest and steering wheel panel

The purpose of the arm rests is to create an ergonomically correct working position for the driver. Together with the steering wheel panel it is possible to vertically adjust the arm rest to best suit different drivers.

Covers and panels

The purpose of the panels is to protect the driver from moving parts, electrical components, oils and fluids, and to protect components from external damage and fouling.

Foot plate

The foot plate consists of soft mat and a brake pedal (see section 11). The foot plate covers the attachment of the castor wheel.

Castor wheel

The castor wheel functions as a support wheel for the drive wheel, since the drive wheel is asymmetrically mounted on one side of the truck.

The castor wheel is a completely separate and free-turning wheel placed under the driver. It consists of a double-wheel mounted in a wheel fork. Between and at the sides of the wheel there are spacer washers, which have the purpose of guiding the wheel to the correct position in the wheel fork.

Shims are mounted between the castor wheel attachment plate and the machine housing to compensate for differences in the diameter of the drive wheel and the castor wheel.

Note!

Shims should be removed between the castor wheel and machine housing as the drive wheel becomes worn. This is done to counteract the truck inclining to the side, or to prevent the drive wheel from spinning. Check the number of shims when replacing the drive wheel.

Repair instructions

Overhead guard

Dismantling the overhead guard

1. Remove the panel in the driver compartment (5 screws).

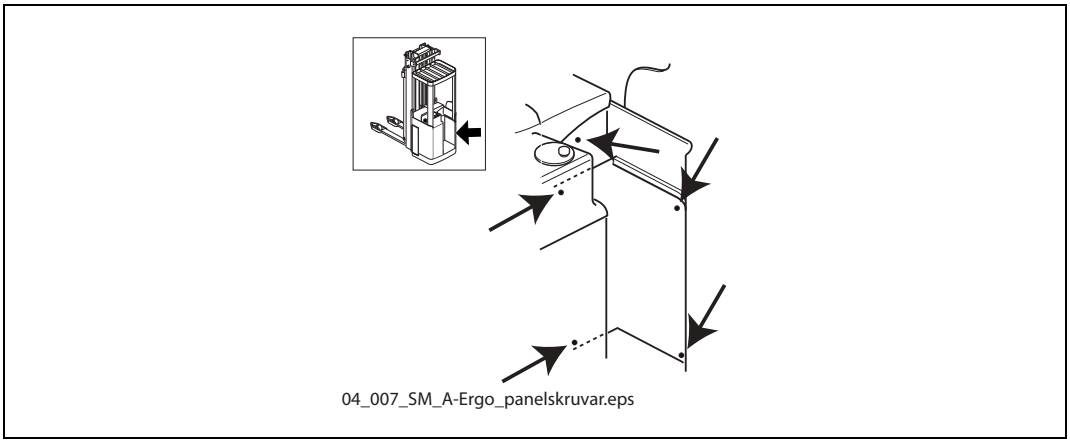


Figure 4.2 Attachment of panel in driver compartment

2. Attach a lifting strap to the roof grille, and make sure that weight of the grille is relieved from the truck.
3. Unscrew the screws between the machine housing and roof grille pillars.
4. Lift off the grille.

Mounting the overhead guard

1. Screw the overhead guard together with the pillars. **81 Nm.**

Tightening torque:

81 Nm

2. Attach a lifting strap to the roof grille and lift the grille into position.
3. Screw tight the screws between the machine housing and roof grille pillars. **81 Nm.**

Arm rest

Dismantling the arm rest

1. Unscrew the wing nut for adjusting the height.
2. Remove the height adjusting knob under the writing surface.
3. Pull up the arm rest so that the lock screw at the right attachment can be released..

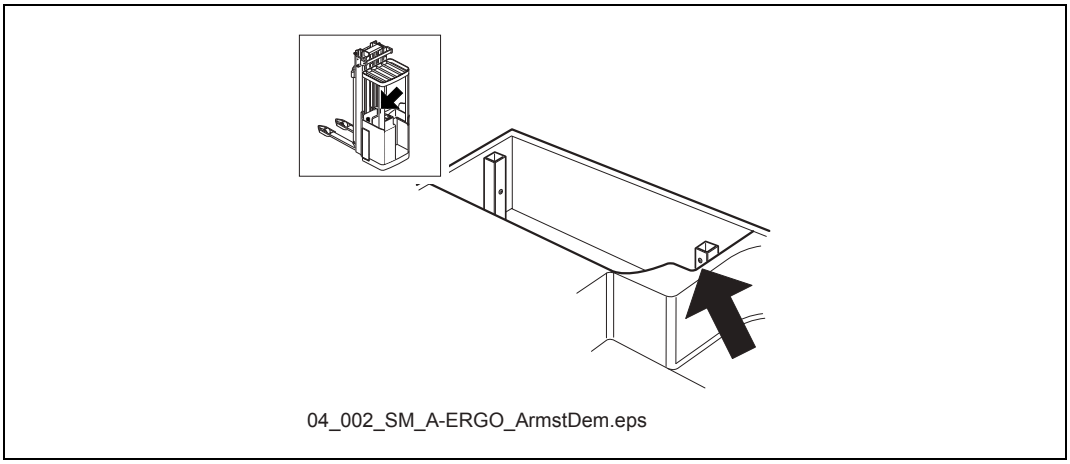


Figure 4.3 Front retaining screw, arm rest

4. Lift up the arm rest and disconnect all the cabling at the connectors.
5. Continue to lift the arm rest so that the lock screw on the left attachment can be released..

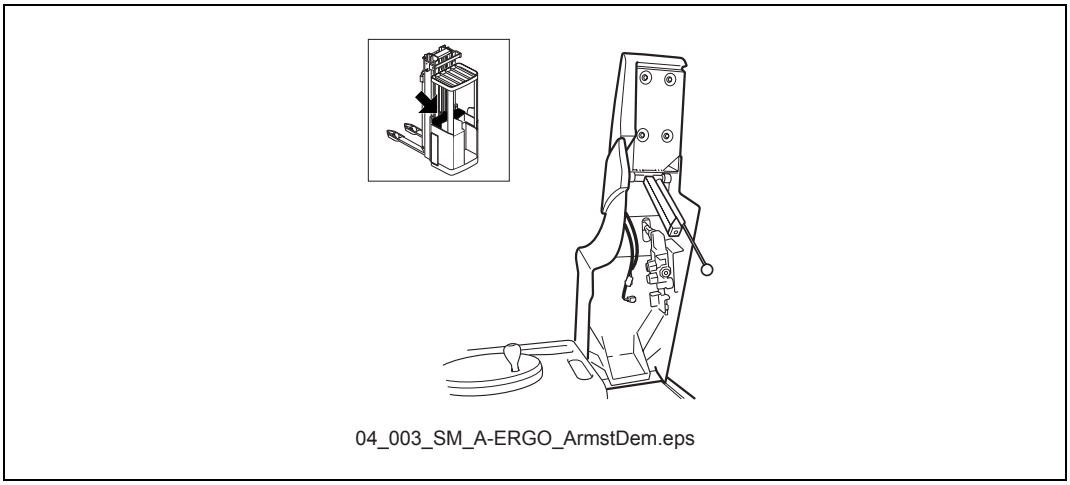


Figure 4.4 Arm rest raised

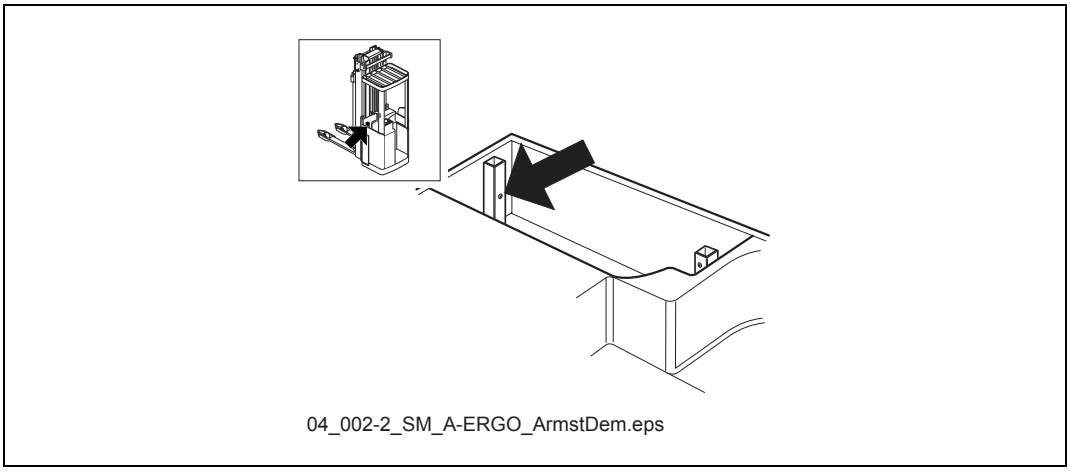


Figure 4.5 Rear retaining screw, arm rest

6. Lift off the panel.

Mounting the arm rest

1. Fit the left guide rail in its groove.
2. Screw tight the lock screw.
3. Connect the connectors.
4. Fit the left guide rail and gas spring in their grooves.
5. Press down the panel so that the right lock screw can but put in position.
6. Press down the panel, and lock the panel in the required position.

Steering wheel panel

Dismantling the steering wheel panel

1. Unscrew the wing nut for adjusting the height.
2. Lift up the steering wheel panel as far as it goes, and lock with the wing nut.
3. Open the machine cover.
4. Release all the cabling to the components on the steering wheel panel.
5. Release the lock knob on the inner guide rail..

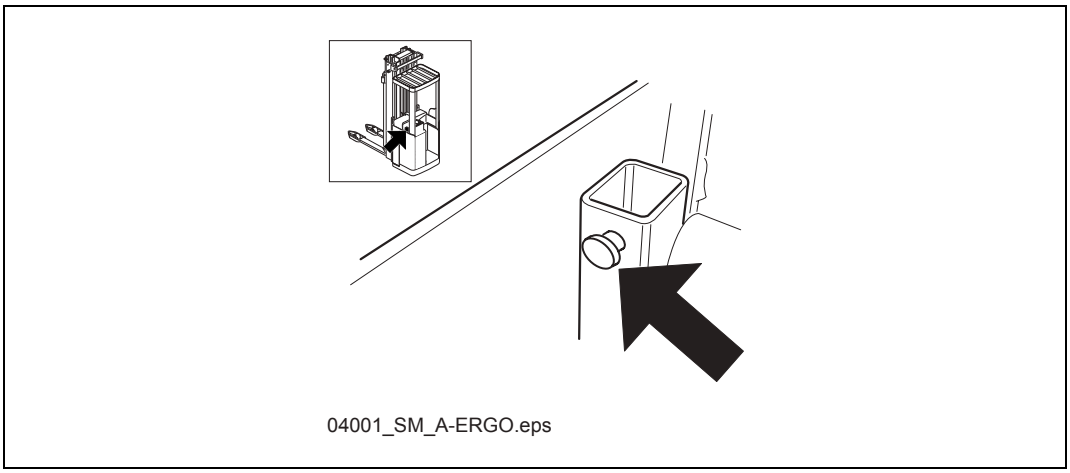


Figure 4.6 Lock knob, steering wheel panel

6. Release the wing nut for adjusting the height and lift off the steering wheel panel.

Mounting the steering wheel panel

1. Hold the machine cover open during the complete mounting procedure.
2. Fit the guide rails in their grooves.
3. Screw tight the lock screw when the panel is in it upper position.
4. Connect the connectors.
5. Close the machine cover.
6. Press down the panel, and lock the panel in the required position.

Covers and panels

Dismantling the machine housing cover

1. Remove the panel in the driver compartment.
2. Unscrew the wing nut for adjusting the height on the steering wheel panel.
3. Lift up the steering wheel panel as far as it goes, and lock with the wing nut.
4. Open the machine cover.
5. Secure the cap screw in the hinge with an Allen key and release the lock nut.
6. Release the screw in the hinge and lift down the cover.

Foot plate

Dismantling the foot plate

1. Pry out the cover pieces, 4 pcs, in the mat that cover the retaining screws so that they can be reached..

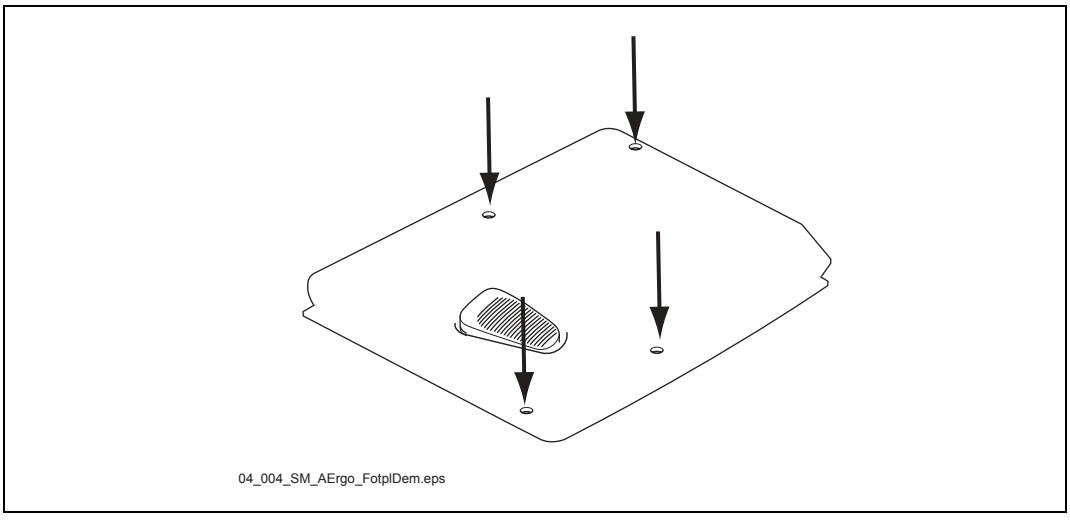


Figure 4.7

2. Unscrew the screws and lift up the foot plate.
3. Disconnect the connector to the brake pedal.

Castor wheel

Dismantling the castor wheel

1. Check that the battery is pushed in and locked.
2. Remove the foot plate, see “Dismantling the foot plate”, page 4.9.
3. Block up the truck (check the balance).
4. Loosen the bolts to the castor wheel, and remove them.

⚠ ***Warning!***

Pinch risk!

5. Pull out the castor wheel.

Mounting the castor wheel

1. Insert the castor wheel under the truck (the truck is assumed to be blocked up).
2. Lift up the wheel and place the shims in position.

Tightening torque:
81 Nm

3. Insert the bolts and tighten. **81 Nm.**
4. Lower down the truck.
5. Check the angle of the truck, see “Adjusting the angle of the truck”, page 4.11.

Dismantling castor wheel

1. Remove the castor wheel from the truck, see “Dismantling the castor wheel”, page 4.10.
2. Support the complete castor wheel in a vice by gripping the opposite side of the wheel fork where the locking pin is fitted.
3. Tap out the locking pin and drive out the axle.
4. Lift out the castor wheel from the wheel fork; and take care of the spacers.
5. Dismantle the bearings from the castor wheel by means of a bearing extractor.

Assembling castor wheel

1. Press the bearings in the wheel with a drift.
2. The axle is lubricated with oil before fitting.
3. Insert the wheel with the shims in the wheel fork.
4. Check that the hole for the locking pin in the axle comes opposite the hole on the wheel fork.

5. Carefully press in the axle by using a hammer and a suitable drift.
6. Fit the locking pin.
7. Turn the wheel and check that it rotates freely.
8. Fit the castor wheel in the machine, see “Mounting the castor wheel”, page 4.10.

Adjusting the angle of the truck

The angle of the truck can be adjusted by shimming the castor wheel.

1. Place the truck on a level surface.
2. Check if the truck stands at an angle:
    - Or: 1: place a spirit level against the sides of the mast and check whether the mast is at an angle.
    - Or: 2: check with a measuring scale on both sides of the truck between the floor and the machine housing.
3. If alignment is necessary, remove the castor wheel as per “Dismantling the castor wheel (page 4.10)”.
4. Add or remove shims. Shims are available in several different dimensions.
5. Fit the castor wheel, see “Mounting the castor wheel (page 4.10)”, and check measure.

Battery

Changing the battery

1. Disconnect the battery plug.
2. Lift up the battery lock..

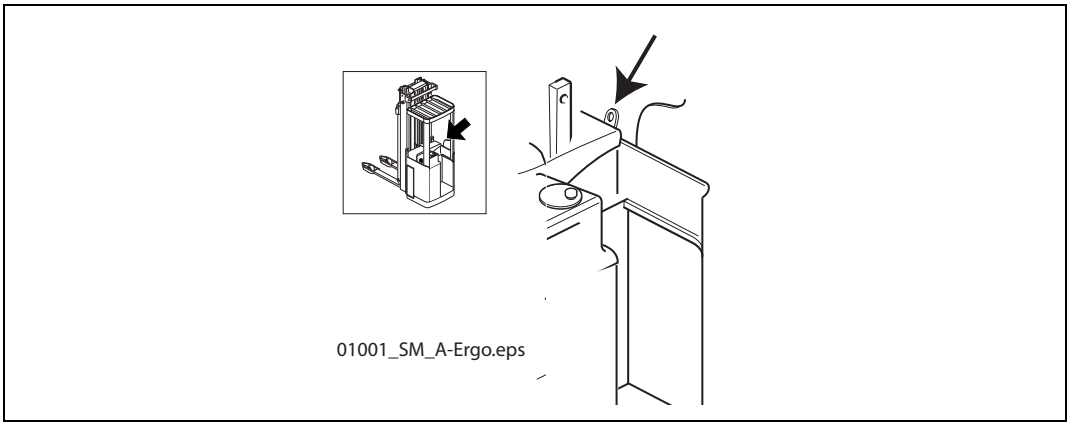


Figure 4.8 Battery lock

3. Roll out the battery on the charging/storage structure.
4. Roll in the new battery.
5. Secure the battery by means of the battery stop and replace the battery plug.

Replacing the battery rollers

1. Remove the battery.

⚠ ***Warning!***

Observe care to avoid “splashing” waste acid or oxide from the battery.

2. The battery rollers sit loosely in their attachments. Lift up the rollers in the back edge and pull backwards/upwards.

SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2004A

5 Drive unit

Edition 2004A

5 Drive unit

Design and function

Introduction

The drive unit is mounted in an assembly containing the brake, drive motor, gearbox and drive wheel. The steering servo motor is mounted on the same motor bed.

For technical data regarding component parts, see section 1.

Drive motor

The drive motor on A-ERGO is a brushless three-phase induction motor. A pulse sensor is enclosed in the bearing on the non-driving end of the motor, which provides speed feedback to the drive regulator, see section 10.

The motor is mounted directly on the gearbox and the power transmission takes place via a gear wheel individually adapted to each gearbox.

Gearbox

The gearbox is adapted to provide the best gear ratio over the speed range of the drive motor.

The drive motor and drive wheel are mounted on the gearbox.

The gearbox is mounted on the truck chassis. A gear ring bearing is mounted on the gearbox. The steering servo motor drives the gear ring bearing and in this way turns the gearbox and drive wheel in the required direction when the truck is steered.

Repair instructions

Preparations

1. Switch off all the power.
2. Release the panel for the control units and move it out of the way, see section 10.

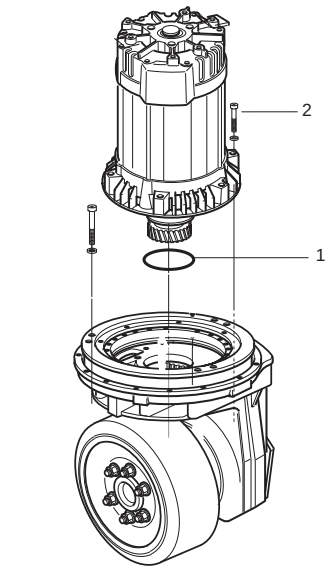
Drive motor

Dismantling the drive motor

⚠ ***Warning!***

The battery plug must be removed and the machine lifted so that the drive wheel runs free of the ground when working on the motor.

3. Disconnect the cables to the drive motor and electric brake.
4. Loosen the 8 socket head cap screws holding the motor together with the gearbox, see pos. 2.
5. Carefully lift out the motor from the gearbox, so that the gears are not damaged.
6. If the motor is to be replaced, the gear wheel must be released and put on the new motor. The gear wheel is paired together with the gearbox.



A-Ergo ByteMotor.eps

☞ ***Important!***

It is very important that the gear wheel corresponds with the gearbox it is rated for.

7. If the motor is to be repaired or reconditioned, see section “Dismantling drive motor”, page 5.5.
8. Check/replace the sealing ring, pos. 1

Assembling the drive motor

Tightening torque:

50 Nm

1. Tighten the gear wheel on the motor shaft. Tightening torque 50 Nm.
2. Apply oil on the sealing ring.
3. Carefully lower the motor down in the gearbox, the gear wheel can be damaged! To simplify assembly 3 screws without heads can be fitted in three of the 8 screw holes and used as guide pins.
4. Screw tight the motor on the gearbox (remove any guide screws).
5. Connect all the cabling.
6. Refit the control unit panel and tighten it.

Dismantling drive motor

1. Remove the motor from the machine housing, see “Dismantling the drive motor”, page 5.4.
2. Release the bearing plates and rotor. Since the tachometer is built into the bearing on the non-driving side of the motor, great care must be exercised to avoid damaging it.
3. Replace the motor bearing. Press on the inner ring. Slowly heat the bearing to max 50°.

Important!

The motor bearings should always be replaced when reconditioning the motor to ensure continued reliable operation.

4. The housing is sprayed with cleaning fluid, see section 3, and then blown dry; after the housing has dried carry out an insulation test.
5. Check that the insulation is satisfactory. Measure the resistance between coil and stator housing, see specification in section 1 for correct value. If the resistance is lower the motor must be blown clean and tested again.

Assembly drive motor

Tightening torque:

50 Nm

1. Assemble in the reverse order to dismantling. Note that the “knob” on the bearing should be fitted in the bevel on the plate.
2. The nut for the pinion on the motor shaft are tightened to **50 Nm**.

Storage of the drive motor

Machines in storage that will not to be used within a month, must be given special attention so that problems do not occur when they are to be used again. Dust, dirt, condensation and moisture that occurs during large variations in temperature, as well as problems with rust and oxidisation, must be prevented. Motors should therefore be protected with waxed pa-

per or the equivalent, and also with a moisture absorbing material, and stored indoors at room temperature, preferably in a cardboard box.

Gearbox

Oil change, gearbox

1. If oil needs to be drained off this is done through the plug in the bottom of the gearbox, pos. 1 figure 5.1
2. Oil is filled either through the plug, pos. 2 figure 5.1, or by dismantling the motor.
3. The oil should lie at the same level as the hole by the screw, pos. 2 figure 5.1. Fill with oil until the oil starts to run out from the hole.
   A suction spray is recommend to simplify filling via pos. 2.

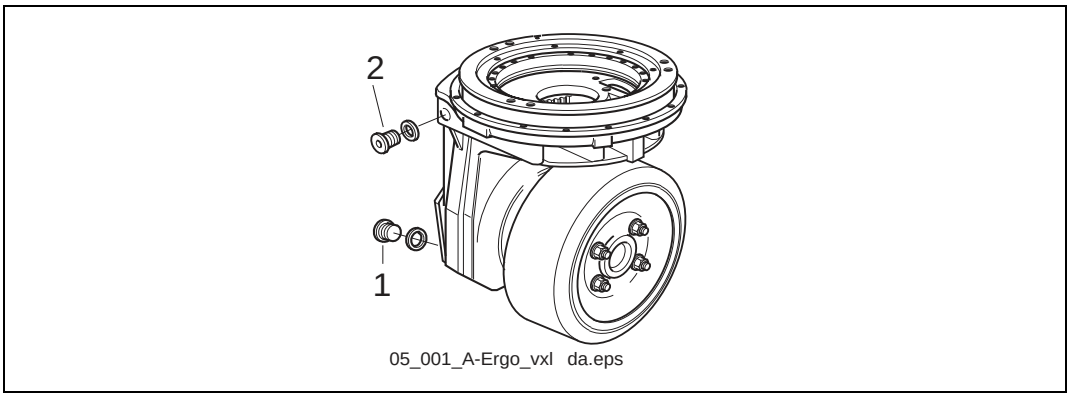


Figure 5.1 Gearbox

Dismantling and assembling the gearbox

1. Block up the truck. The drive wheel should run free, approx. 30 cm above the floor.
2. Loosen the cable connections to the drive motor, servo motor, electric brake and wheel indicators. Label the cables that are not labelled to ensure correct reassembly.
3. Dismantle the motor, see “Drive motor”, page 5.4
4. Loosen the 6 socket head cap screws on the bolted joint between the motor bed and chassis.
5. Lower down the gearbox from the machine with great care.

Note!

All the bolts and screws are tightened to the tightening torque specified in the table in section 1.

6. Drain the oil from the gearbox, see “Oil change, gearbox page 5.6”.

7. If appropriate: Take off the guide ring and guide ring bearing from the old gearbox and mount on the new gearbox.
8. Fit the new gearbox. Check that the mechanical limit positions come in the correct position.

Important!

Check that the mechanical limit positions come in the correct position.

Tightening torque:
47 Nm

9. When refitting in the machine housing the specified tightening torque must be applied, **47 Nm**
10. Fill up with new oil, see table of recommended oils in section 1.

Note!

Do not forget to fill the gearbox with oil before starting up. The oil can be filled before the drive motor is assembled on the gearbox. To ensure the oil level is correct: open the level plug, pos. 2 figure 5.1, and drain off any excess oil.

Note!

Spent oil should be taken care of and recycled according to the applicable legislation in respective countries.

Reconditioning of the gearbox

Replacing the drive shaft seal

1. Remove the gearbox, see “Dismantling and assembling the gearbox page 5.6”.
2. Remove the drive wheel.
3. Remove the cover.
4. Loosen the screws holding the crown wheel halfway, and drive out the shaft towards the drive wheel side.
5. The screws can be fully unscrewed when the crown wheel and bearing have come free from the shaft. The shaft is pulled out from the drive wheel side. Arrange the parts in the order they were dismantled to avoid confusion.
6. Remove the roller bearing closest to the seal by tapping the shaft end against a block of hard wood. Sometimes it is easier to remove the bearing if a sharp object is inserted down between the inner ring of the bearing and the flank of the shaft. Any burrs on the shaft must be removed before reassembly.
7. Carefully clean the seat for seal box in the gear housing.
8. When assembling, the first bearing is placed on the drive wheel side.
9. Fit the safety ring and seal in position. Make that it sits correctly.
10. Fit the guard and then carefully press in the drive shaft.
11. Now assemble the crown wheel and bearing. Start with the spacer.
12. Apply Loctite 207 on the shaft threads and screw together the complete drive shaft assembly with the washer and screws. The screws should be tightened to the tightening torque specified in the table in section 1.
13. Fit the cover. Remember that the drain hole should be the lowest point. Use a new seal. Screw in the oil drain plug with a new copper washer.
14. Fill with hypoid oil. See the table of recommended oils, section 1.

Assembly of gearbox

1. Preparation of the gearbox housing (see figure 5.2)

    1. Carefully clean the gearbox housing.
    2. Fit bearings, pos. 1, 2 and 3 in their positions.
    3. Fit the safety ring, pos. 4, in its position.

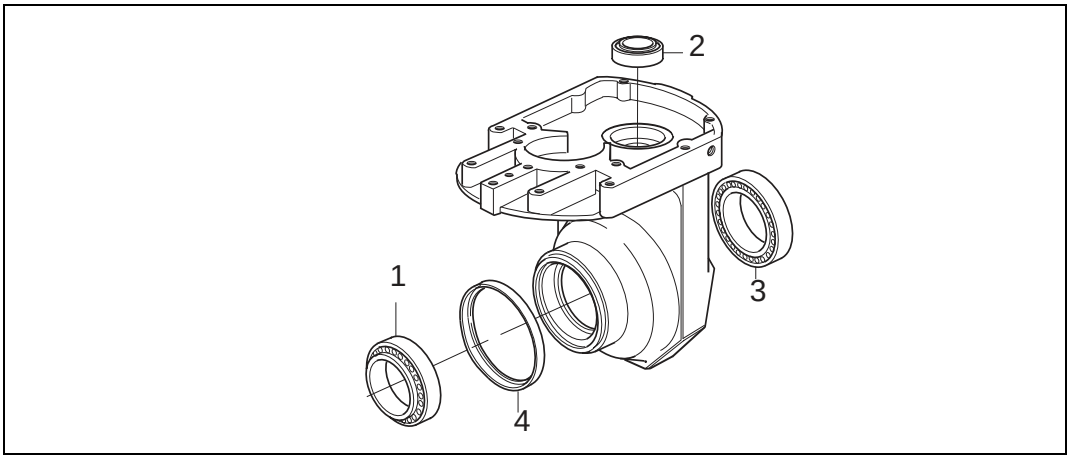


Figure 5.2 Preparations for gearbox housing

2. Fit the pinion shaft, pos. 5, in its position (see figure 5.3).

    1. Press bearing, pos. 6, on the pinion shaft.
    2. Set out required number of shims, pos. 7.
    3. Place the spacer pipe, pos. 8, in position on the pinion shaft.
    4. Place the gear, pos. 9, in its position.
    5. Place the pinion shaft in its position and tighten with the nut, pos. 10. The nut must be locked with “Delo 5249” or “Loctite 243”.

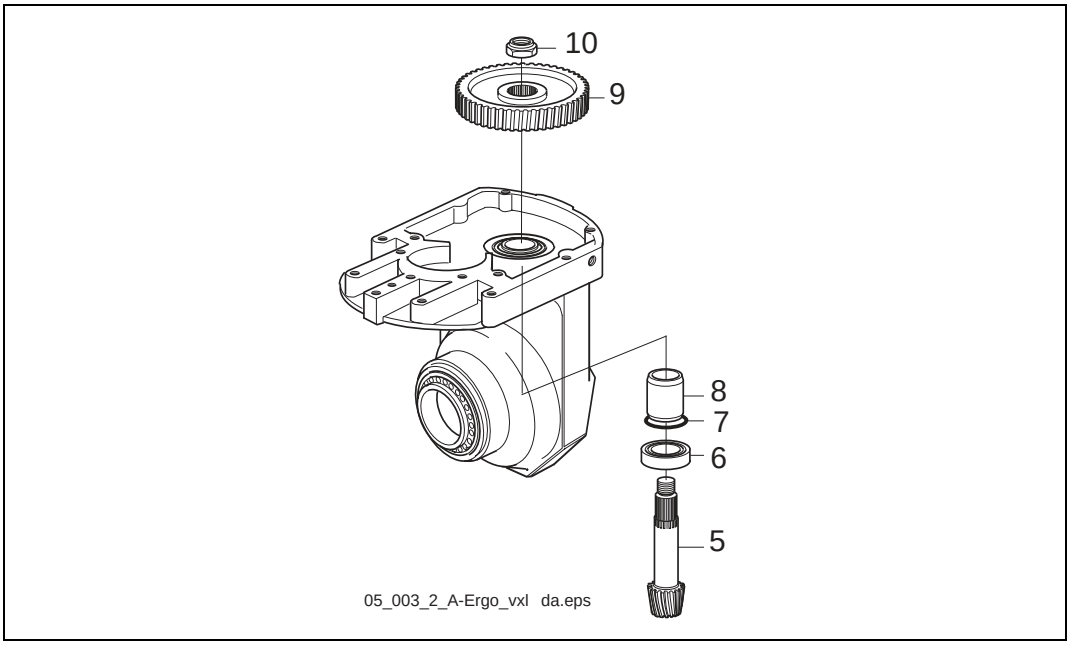


Figure 5.3 Fit the pinion shaft.

Note!

Always use the correct torque when tightening the nut, pos. 10.
The nut must be locked with “Delo 5249” or “Loctite 243”.

3. Fit the wheel hub, pos. 11, and crown wheel, pos. 15 (see figure 5.4).

    1. Press tight the seal, pos. 12.
    2. Set out required number of shims, pos. 13.
    3. Place the spacer ring, pos. 14, in its position and then the gear, pos. 15, in its position in the gearbox.
    4. Push in the hub, pos. 11, from the outside.
    5. The hub is locked with a washer, pos. 16, and screw, pos. 17.
       The screw should be locked with “Delo 5249” or “Loctite 243”.

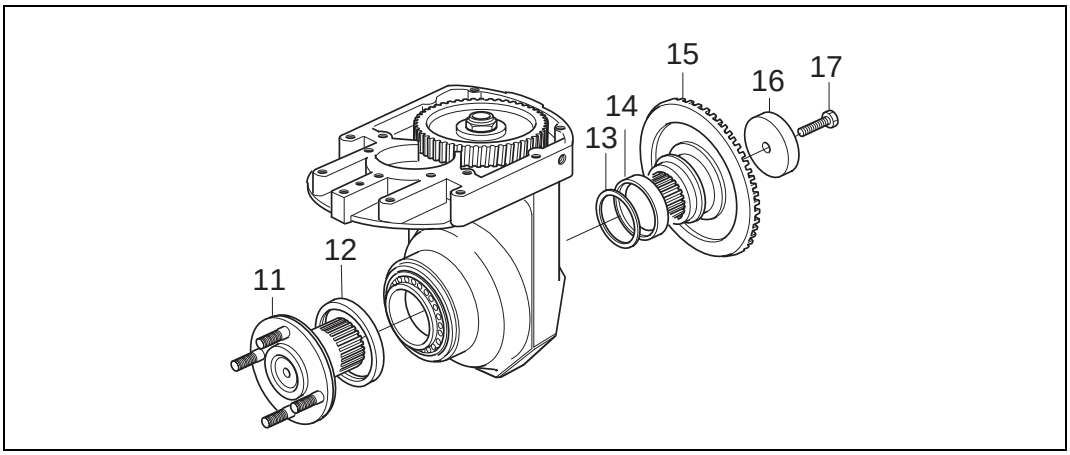


Figure 5.4 Fit the wheel hub and crown wheel.

Note!

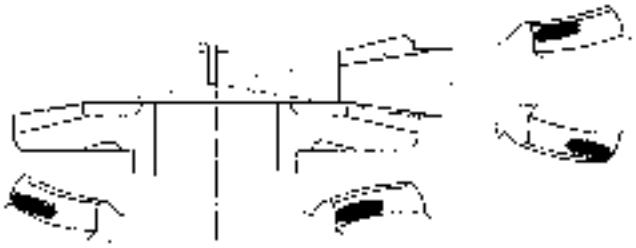
Always use the correct torque when tightening the screw, pos. 17.
The screw should be locked with “Delo 5249” or “Loctite 243”.

4. Adjusting the engagement of the gear wheel, pos. 5 and pos. 15

    1. Paint the gear teeth with a suitable colour for the purpose.
    2. Rotate the gear.
    3. Check the markings on the gear teeth.
    4. The figure below shows the correct engagement.

    5. If the engagement is shown as in the figure, the number of shims, pos. 7, on the pinion shaft, pos. 5, must be reduced (see figure 5.3).

    6. If the engagement is shown as in the figure below, the number of shims, pos. 7, on the pinion shaft, pos. 5, must be increased (see figure 5.3).



5. Fit the guide wheel (see figure 5.5)

    1. Apply a floating gasket on the top of the gearbox.
    2. Place the guide wheel in its position and tighten with the screws, pos. 18.
    3. Place the guide wheel bearing in its position and tighten.

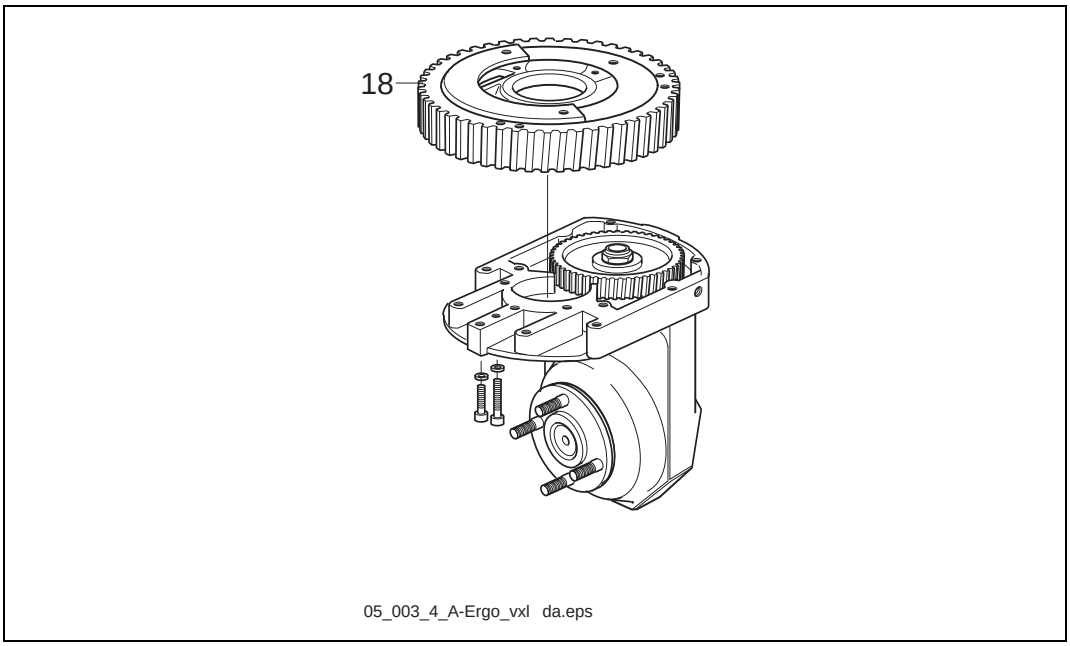


Figure 5.5 Fit the guide wheel.

6. Fit the cover, pos. 21 (see figure 5.6).

    1. Remember that the drain hole should be the lowest point. Use a new gasket, pos. 20. Screw in the oil drain plug, with a new copper washer, pos 22.

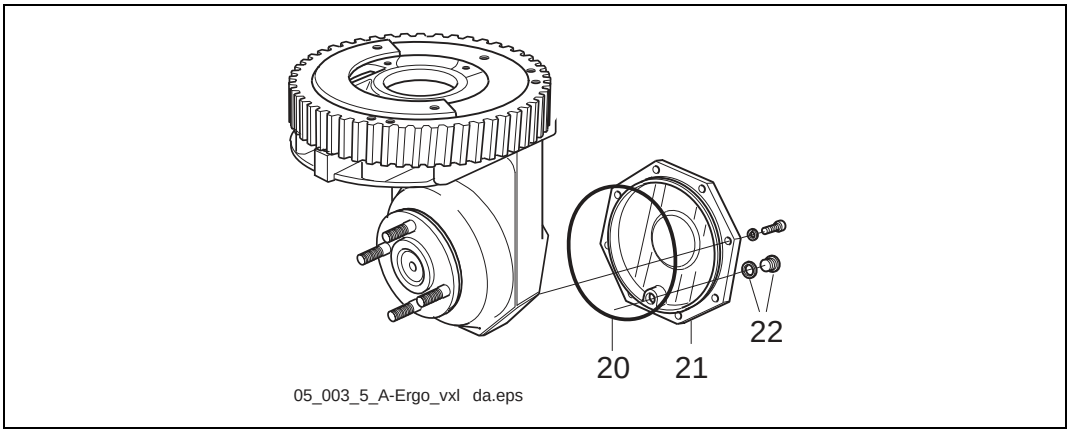


Figure 5.6 Fit the cover.

Drive wheel, replacement

1. Loosen the drive wheel nuts, without removing them.

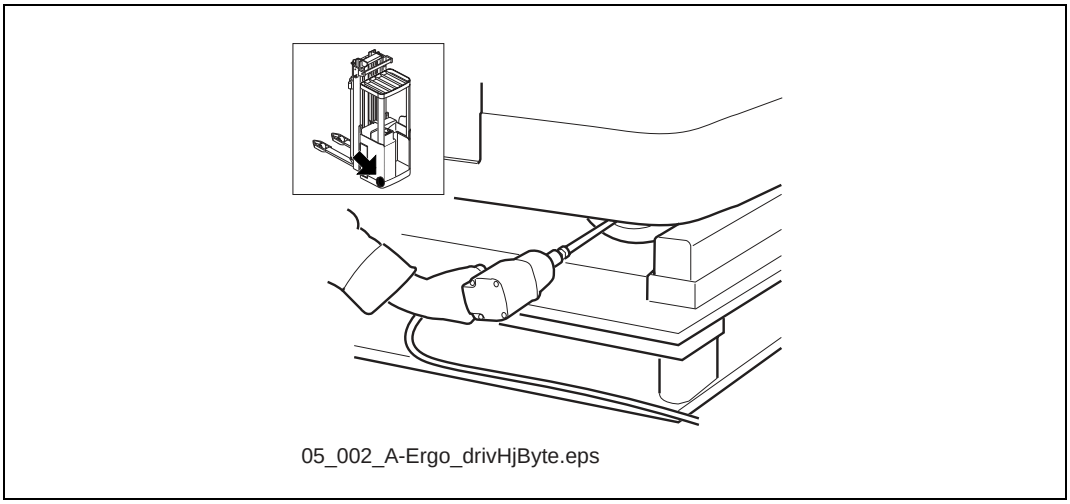


Figure 5.7 Loosen the nuts, drive wheel.

2. Block up the machine.
3. Remove the wheel nuts and lift the wheel forward.
4. Fit the new wheel, tighten the nuts by hand.
5. Lower down the machine to the floor.

Tightening torque:

135 Nm

6. Tighten the nuts, tightening torque 135 Nm

Diagnosis and trouble shooting

Trouble shooting chart

Symptom	Cause	Action
The wheel has a flapping sound when driving.	The tyre has separated as a result of impact.	1. Change the wheel. 2. Examine the floor for irregularities.
The wheel squeaks continuously when driving.	Bearing is damaged.	1. Replace bearing. 2. Inform the driver that cords and plastic etc. should be removed daily and the floor kept clean.
The wheel goes flat after long breaks, but becomes round again after driving for a while.	The wheel mass has become warm while driving and deforms when parked.	Try another type of wheel.
The wheel has a deformity that does not disappear when driving.	A "blow out" has occurred due to overheating and changed the molecular structure of the wheel mass.	Change the wheel.
The truck seems to jerk when driving.	Hard foreign object has fastened in the drive wheel.	1. Remove the object or replace the wheel. 2. See also the above items.
The truck jumps at regular intervals, proportional to the speed, when driving.	The wheel is oval.	1. Change the wheel. 2. Check/Adjust the brakes. 3. See also the above items.
The wheel has transverse cracks and small pieces have fallen out of the tyre.	The wheel has been heated. Small cracks appear with hard acceleration and reversing.	1. Lower the acceleration and reversing rate. 2. Change wheel if necessary.
The wheel has one or more small deformations.	Locking of the brakes so that the wheel slides, or loose objects on the floor that prevent the wheel from rotating.	1. Remove the objects on the floor. 2. Tell the driver to brake more smoothly.
Oil on the floor.	Leaking seal around the drive shaft.	• Replace seal. Or: • if there are parallel cracks in the casting then the gearbox must be replaced.

Symptom	Cause	Action
Grating noise when accelerating or when using the reversing brake.	1. Defective gear wheel in the drive unit.	Check the cogs by removing the cover.
	2. Too little oil in the gearbox..	If there are parallel cracks in the casting then the gearbox must be replaced.
Grating noise when the truck is lifted up, the drive wheel can rotate freely and the motor rotates.	Faulty bearing in the drive motor.	Dismantle and recondition the drive motor.
The truck rolls “sluggishly”.	1. The brakes are applied.	• Replace brake disc. If this does not help: • replace the complete brake unit.
	2. The drive unit has seized.	If there are parallel cracks in the casting then the gearbox must be replaced.
Clicking sound when driving.	Faulty wheel bearing.	Change the wheel.
Clicking sound when driving.	Loose wheel.	• Tighten the wheel. If this does not help: • Change the wheel.

SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2009A

6 Mast system

Edition 2009A

6 Mast system

Design and function

Mast system

There are four mast systems as standard versions, depending on the application or roof height, etc.

Table 6.1 Mast types

Designation	Description
T	Telescopic mast
TV	Telescopic Free-view mast
TFV	Telescopic Free-lift Free-view mast
DTFV	Double Telescopic Free-lift Free-view mast

A telescopic mast consists of an outer and inner mast, fork carriage and lift cylinder. The fork carriage is lifted up and down in the inner mast, which in turn moves up and down in the outer mast. The lift cylinder first lifts the fork carriage approx. 15 cm, and then the mast system follows the lifting movement.

A mast of the double telescopic type also has, in addition to an inner and outer mast, an intermediate mast. The lifting movement is the same as for a telescopic mast, and all the masts begin to move up (or down) simultaneously.

A mast type with free-lift function works in a similar way, but with the difference that the fork carriage moves to its top position in the inner mast before the next mast section starts to lift. Free-lift frames can be used to advantage in rooms with low ceilings or low door openings.

A mast of the free-view type implies that the distance between the mast profiles is longer, which gives better visibility.

Fork carriage

Different fork arrangements are mounted on the back of the fork carriage. From simple fixed forks to complex units with telescopic forks.

Fixed forks

Forks with a fixed width and length.

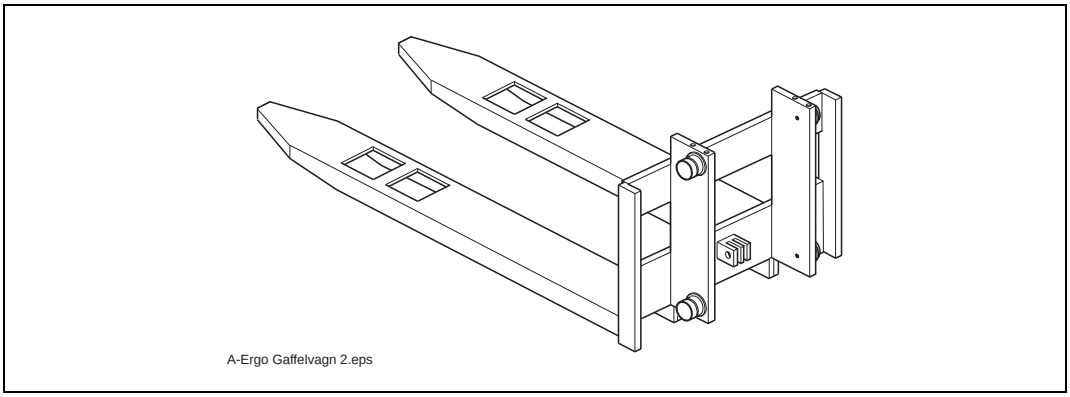


Figure 6.1 Fork carriage with fixed forks

Laterally adjustable forks

The forks can be adjusted to different widths.

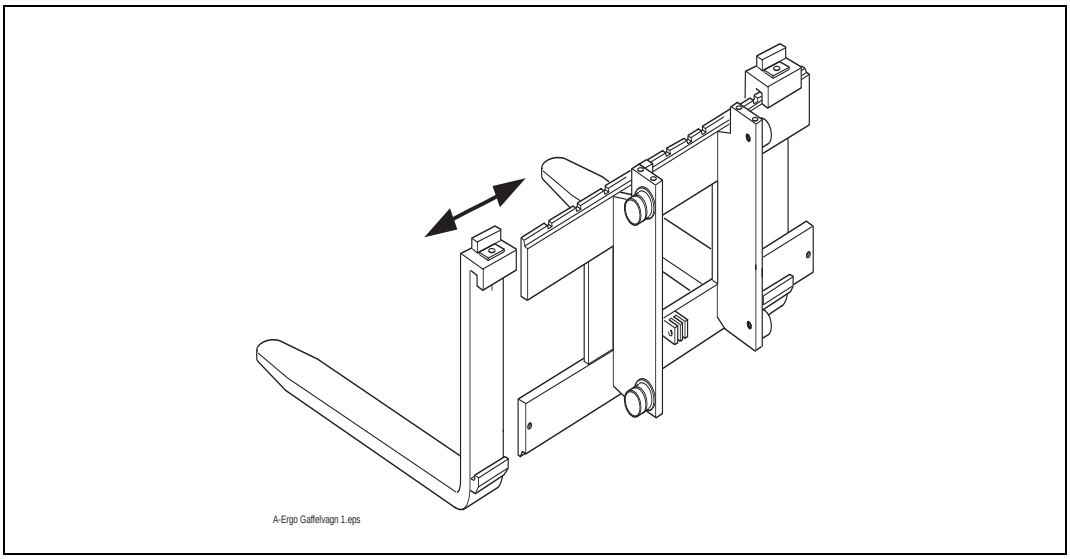


Figure 6.2 Fork carriage with laterally adjustable forks

Telescopic forks (TF)

The fork blades can be pushed out.

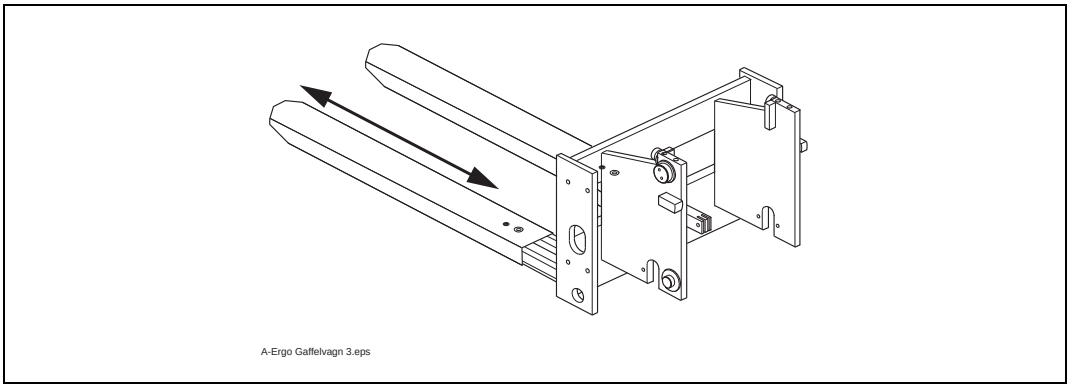


Figure 6.3 Fork carriage with extendable/telescopic forks

Overload clutch, telescopic forks (TF)

The ATF fork carriage has an overload clutch. The overload clutch is a unit that safeguards against overloading the components that drive the forks in and out.

The torque that the overload clutch can transfer is limited by the force the pressure springs, pos. 1, transfer to the pressure plate, pos. 2, and the brake linings, pos. 3, to the sprocket, pos. 4, (see figure 6.4). For adjusting instructions, see "Adjusting the overload clutch (TF)" on page 6.32.

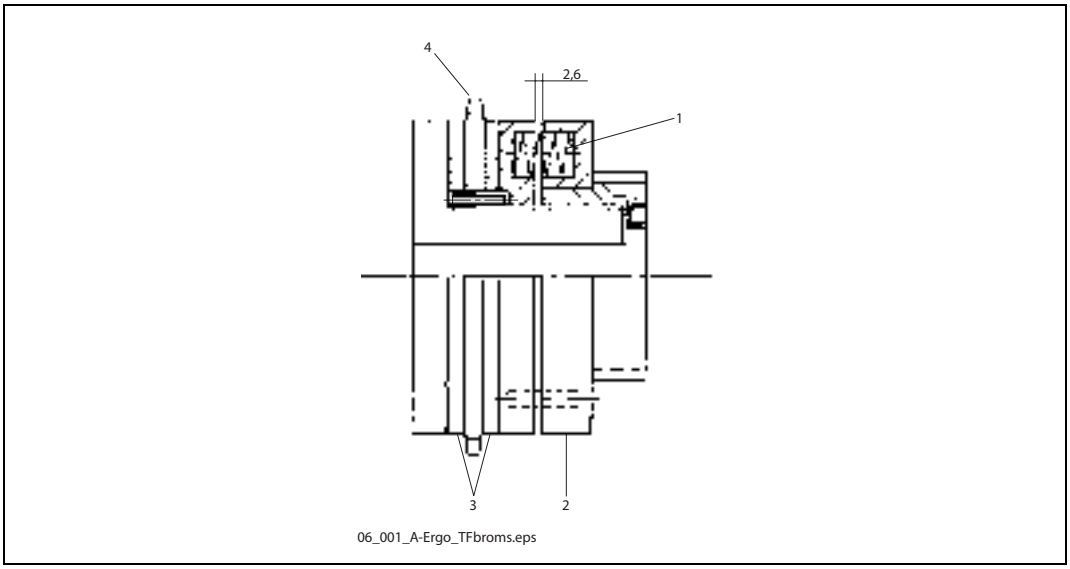


Figure 6.4 Overload clutch

Fork drive motor, telescopic forks (TF)

The fork drive motor is mounted on the back of the fork carriage and has the purpose of pushing the forks in and out so as to reach further forward. The transmission of power between the motor and forks takes place via an angle gear and chain. The motor is controlled via controls on the control panel.

For data on the motor, see the motor plate mounted on the motor.

Straddle lift

Straddle lift means that the straddle legs can be raised sufficiently high to lift a pallet from the floor. With masts with straddle lift it is possible to transport a pallet on the fork carriage, and if the fork carriage is raised high enough a pallet directly on the straddle legs. This enables two pallets to be transported at the same time.

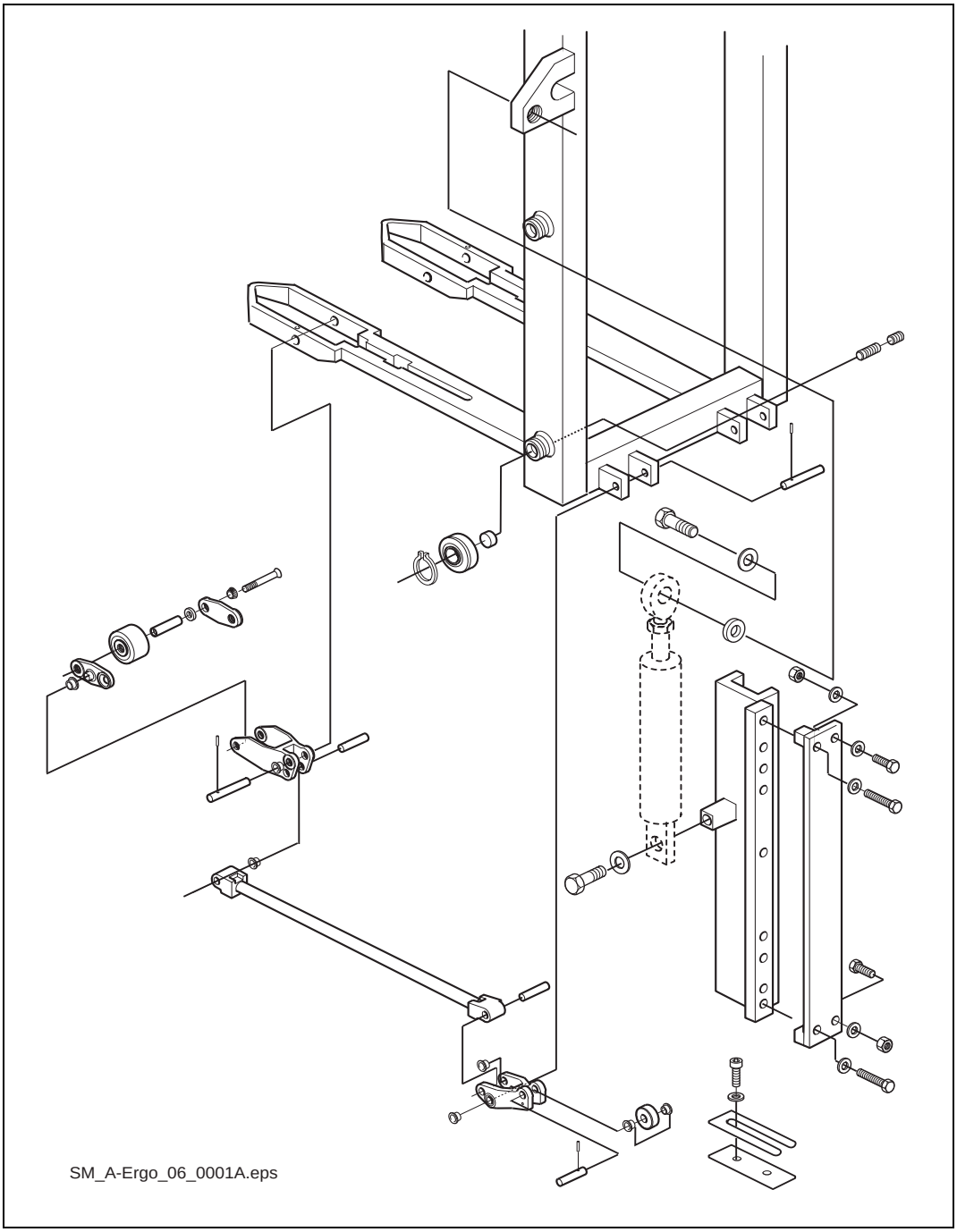


Figure 6.5 Straddle lift

Side stabilisers

The truck can be fitted with extendable side stabilisers to guarantee lateral stability and to eliminate the risk of tipping during high lifts. The system consists of extendable side stabilisers, which are extended by means of the standard hydraulic unit.

A limit switch, i.e. a height position switch, on the mast limits the lifting height when the stabilisers are withdrawn. When the stabilisers are extended a pressure switch gives a signal that the forks can be lifted to their maximum position.

☞ ***Important!***

Driving with the side stabilisors extended involves certain risks.

If the truck is equipped with side stabilisers, then this is a safety function that must be in operation and function correctly.

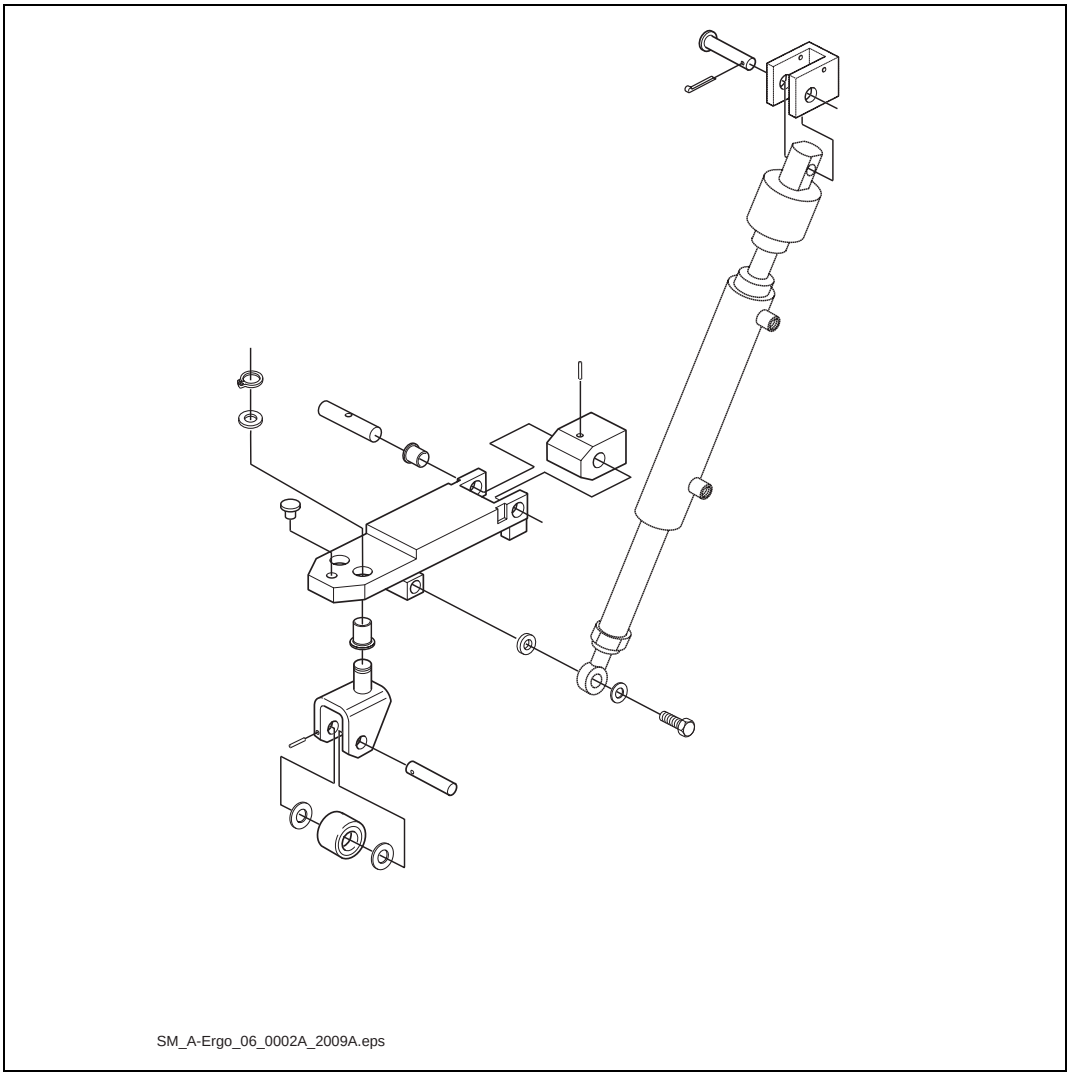


Figure 6.6 Side stabilisers

Repair instructions

Replacing the mast/straddle legs

Dismantle the mast/straddle legs from the chassis

1. Remove the battery.
2. Block up the chassis.

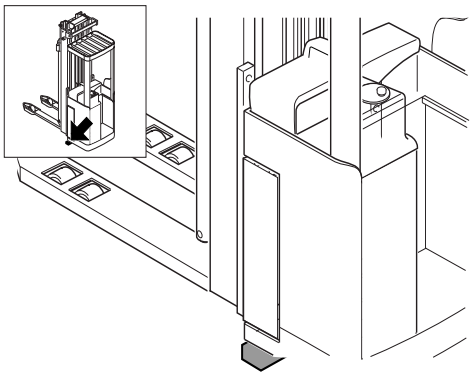


Figure 6.7 Blocking up the chassis

3. Support the mast to relieve the attachment.

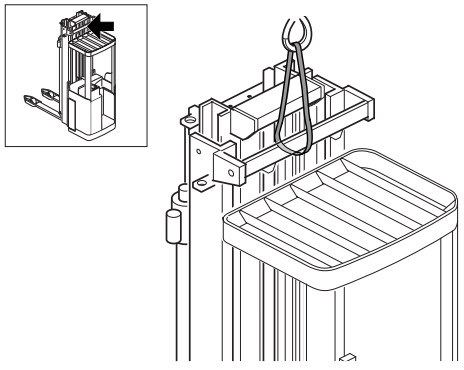


Figure 6.8 Supporting the mast

If the mast has straddle lift:

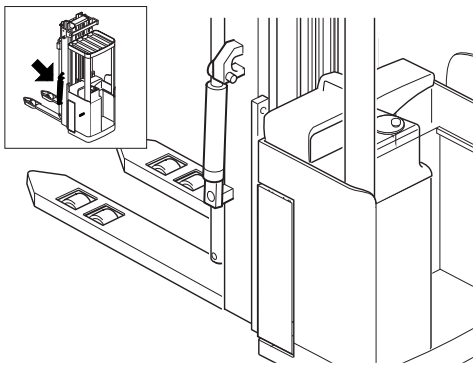


Figure 6.9 Straddle lift

4. Screw a screw into one of the screw holes on the spacer between the guide and chassis in order to hold up the spacer when dismantling.

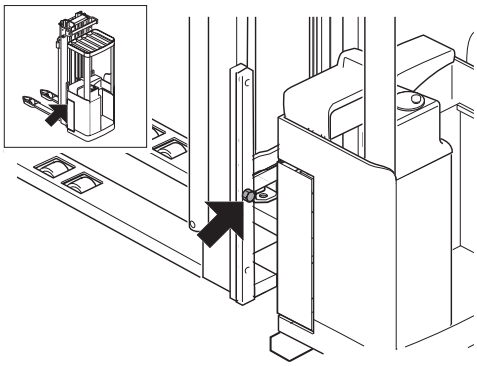


Figure 6.10 Screw, spacer/guides

5. Fix the guides with a strap to the mast.

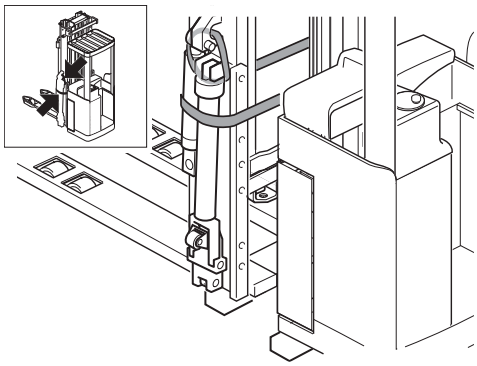


Figure 6.11 Fix the guides

6. Unscrew the screws for the attachment of the mast on the chassis.

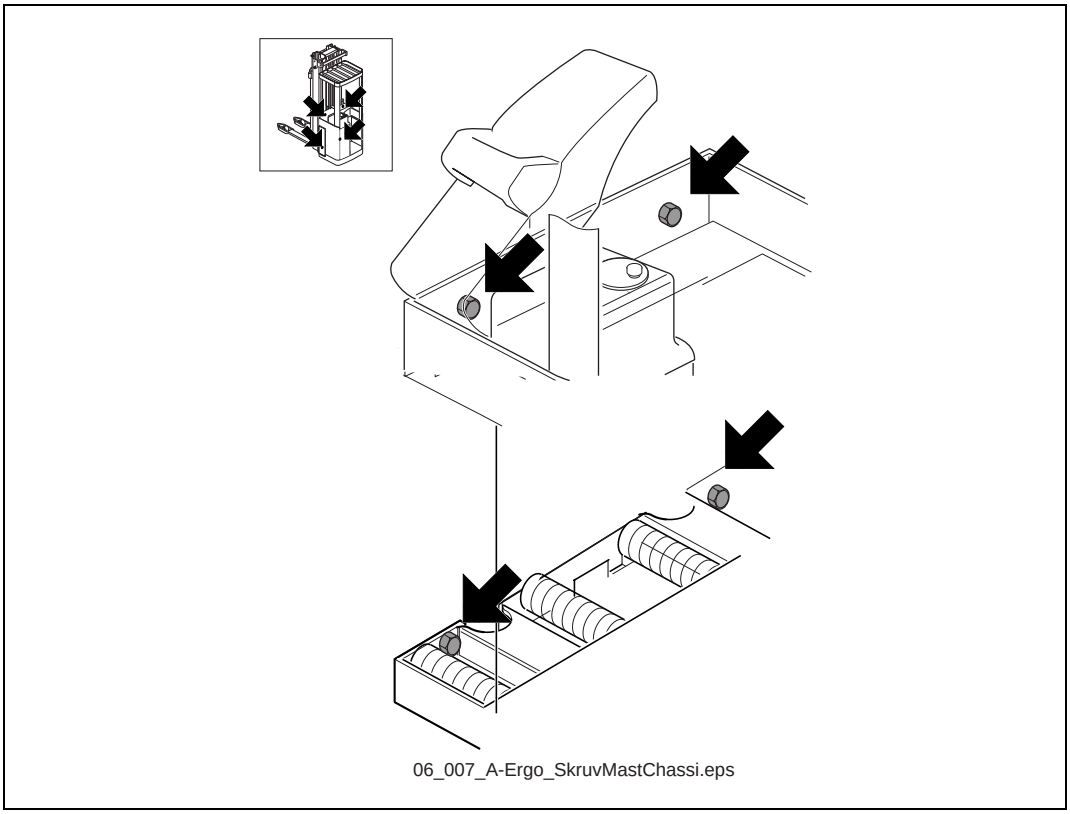


Figure 6.12 Upper screw attachment, mast

7. Release the hydraulic connections.

☞ ***Important!***

Contain surplus hydraulic oil in a suitable way.

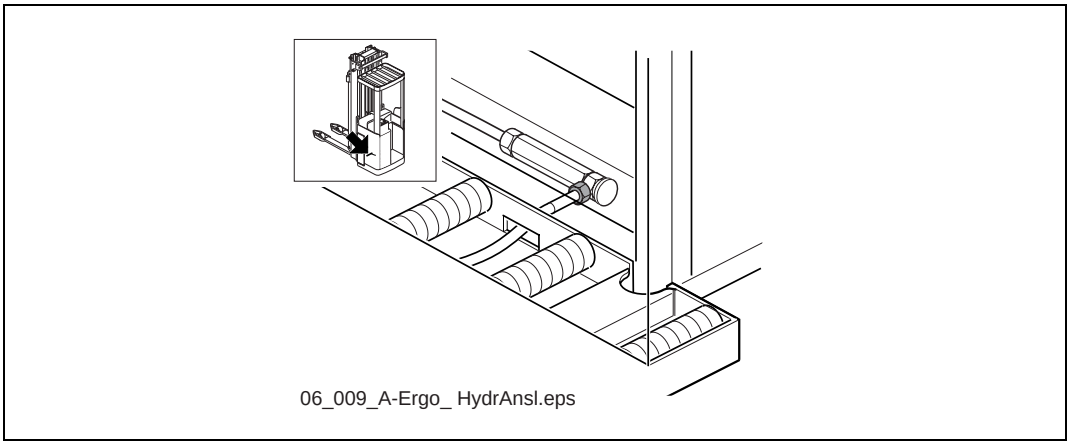


Figure 6.13 Hydraulic connection

Mount the mast/straddle legs on the chassis

1. Make sure that the mast is suitably supported so that it cannot move.

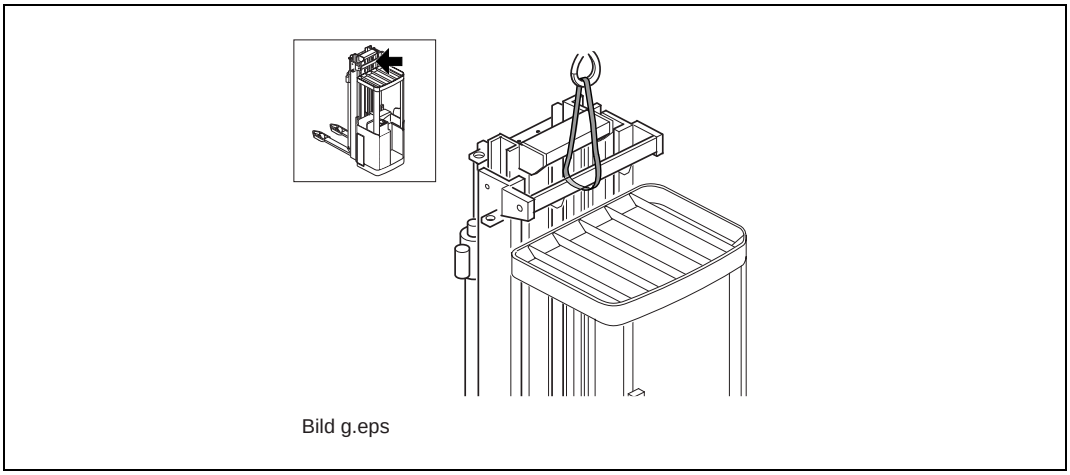


Figure 6.14 Example of supported mast

If the mast has straddle lift:

2. Check that the guides are at the same level and fix them to the mast.

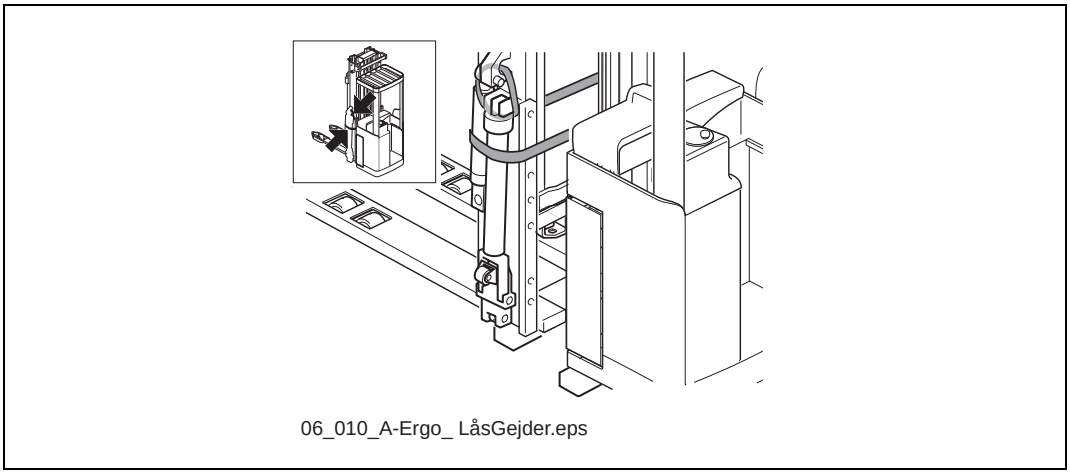


Figure 6.15 Fix the guides

3. Make sure to screw tight the spacer between the mast and chassis in the guide in one of the screw holes that are not used.

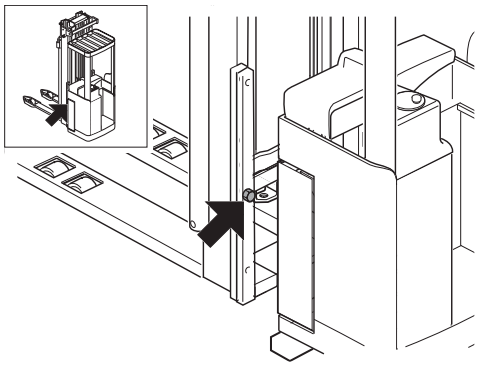


Figure 6.16 Screw, spacer/guides

4. Insert a suitable number of shims, 3 as standard.

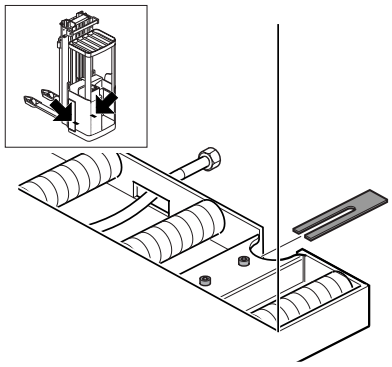


Figure 6.17 Shims

5. Lower the mast so that the link arms slide in under the chassis when the mast and chassis are brought together.

6. Connect the hydraulic couplings together.

7. Bring the mast and chassis together and screw tight.

Tightening torque: 277 Nm

8. The tightening torque between the frame and machine housing when refitting should be 277 Nm.

If the mast has straddle lift:

9. Remove the strap and screw holding the spacer to the guides.

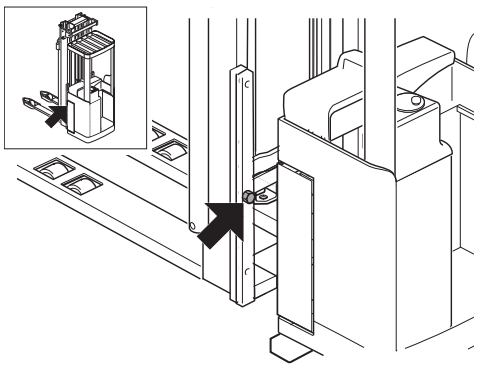


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Figure 6.18 Remove screw, spacer/guides

10. Check that the gap between the floor and forks is sufficient, see see "Adjusting the straddle lift" on page 6.35.

Dismantling the mast

General

The following is generally applicable for all types of masts when dismantling:

- Stand in an area with adequate ceiling height and with approved lifting devices.

The following is generally applicable for all types of masts when assembling:

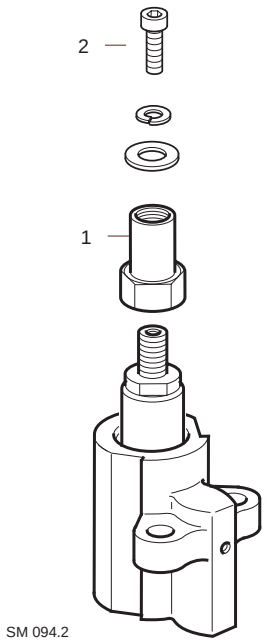
- The mast is assembled in the reverse order to dismantling.

Inspecting or repairing the mast system:

- Check that the thrust rollers lie flush with the roller surfaces on the mast. Check also that they roll easily.
- An operating test must be made after each measure/action on the mast system. The mast must not jam or run too slowly (the mast sections move in the wrong order) when lifting and lowering.

Adjusting the lateral inclination in top position.

1. Lower the mast and slacken the chains.
2. Adjust the attachment of the outer cylinders with the top nut, pos. 1. Adjust both cylinders equally so that the mast does not pull skew.
3. If there is sufficient movement in the cylinder attachment, the rollers will be in contact with the running surfaces of the mast at all lifting heights.
4. Test the operation of the lifting movement. Lift up to top position and check that the mast does not swing to the side when the end position is reached.
5. Lock the top nut with the lock screw, pos. 2.
6. Tighten the chain and check that the rollers still make contact with the runners.
7. The cylinder attachment should be flexible.
8. Adjust the mast,see "Adjusting the play in the mast" on page 6.15.



SM 094.2

Adjusting the play in the mast

The lateral play is adjusted with 0.5 or 1 millimetre shims behind the thrust rollers. If there is excessive play between thrust roller and roller surface on the mast profile, the thrust roller must be replaced with a new roller with a larger diameter.

Thrust rollers are available in three different diameters (the diameter is specified on each roller):

160 mast:

- 78.2 mm, 78.6 mm 79.0 and 79.4 mm.

200 mast and TF-mast:

- 107.0 mm, 107.5 mm 108.0 mm, and 108.5 mm.

Table 6.2 Permitted play between roller surfaces on the mast

Mast type	Permitted play between thrust rollers and roller surfaces between mast sections and fork carriage and mast
160	0.5 mm
200	0.6 mm
TF	0.6 mm

Replacement, DTFV mast

1. Lower the fork carriage onto a European pool pallet, or the like, so that the intermediate cylinder lift chain slackens.
2. Release the lift chain from the intermediate cylinder by releasing the chain bolt, and remove the pin between the bolt and chain.
3. Lift the mast until the fork carriage comes free from the inner mast.
4. Place a wooden block on the straddle legs between the outer profiles so that it comes under the intermediate cylinder. Lower the inner and intermediate mast so that the inner mast rests on the wooden block and the outer chains slacken.
5. Remove the two outer chains by removing the pins in the upper chain attachment.
6. Release the hoses that run in the mast from the block in the outer mast, and plug them.
7. Remove the pulley wheel for the hoses from the intermediate mast.
8. Remove the pulley wheel for the chains from the intermediate mast.
9. Unscrew the screw for the lifting stop..

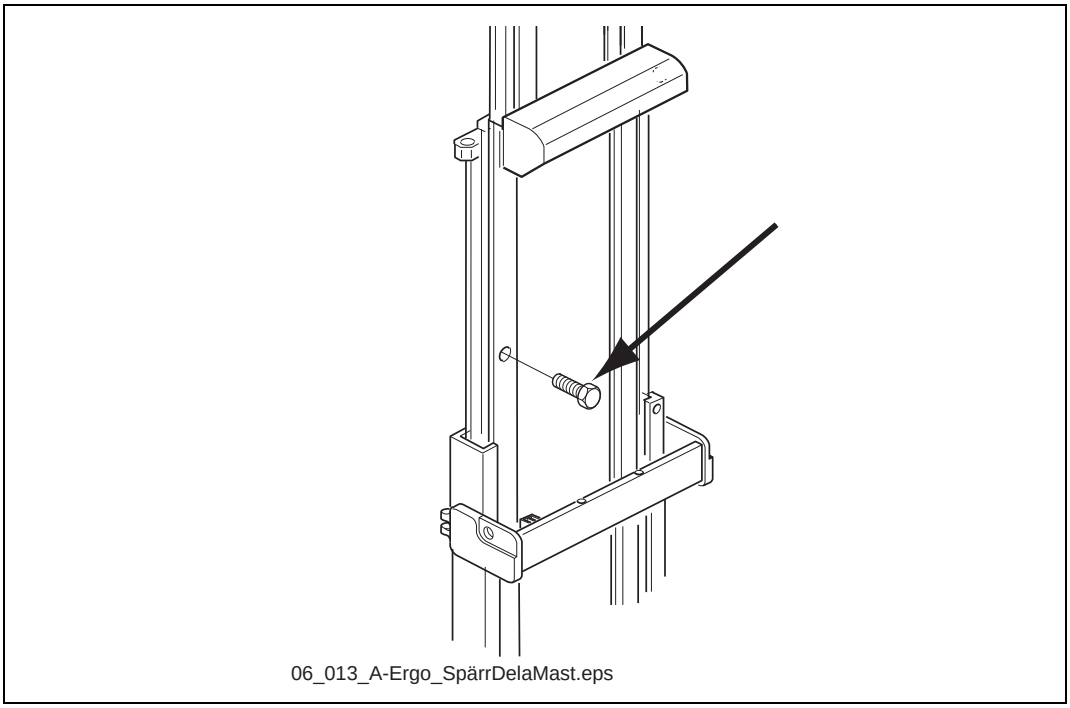


Figure 6.19 Screw, lifting stop

10. Lift the inner mast straight up until the lower thrust roller on the inner mast and the upper thrust roller on the intermediate mast meet, and then pull the inner mast forwards to release it from the intermediate mast. If the ceiling is too low dismantle the mast, see "Dismantle the mast/straddle legs from the chassis" on page 6.8, and set it down.

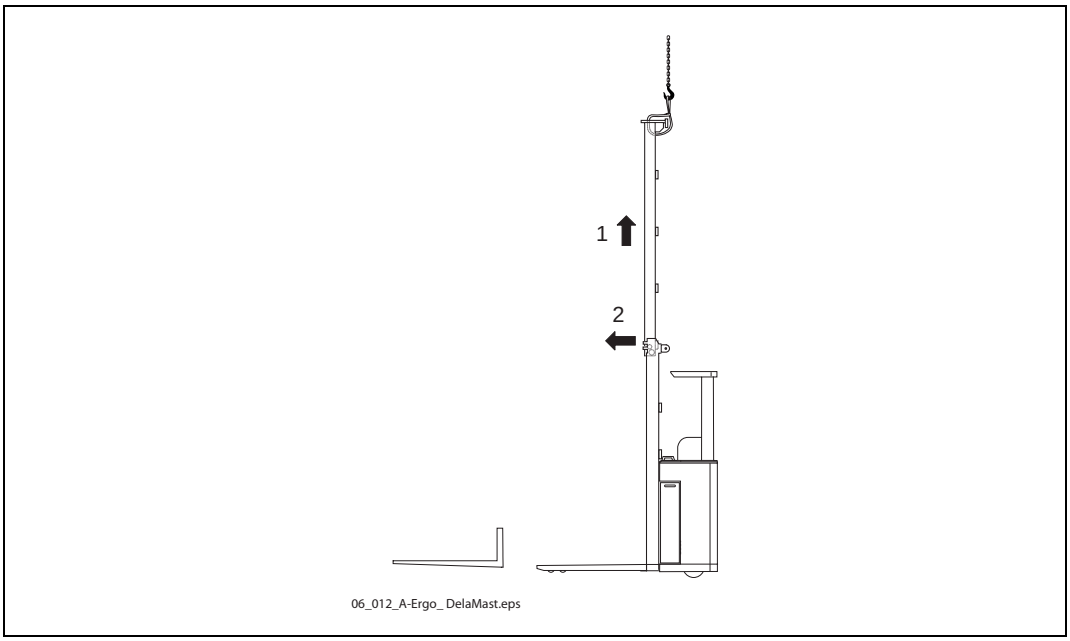


Figure 6.20 Position for dismantling intermediate masts

11. Remove the upper retaining screws for the side cylinders.
12. Lift out the intermediate mast in the same way as the inner mast.

Tightening torque: 277 Nm

13. The tightening torque between the frame and machine housing when refitting should be 277 Nm.

Replacement, TFV mast

1. Lower the fork carriage onto a European pool pallet, or the like, so that the intermediate cylinder lift chain slackens.
2. Release the lift chain from the intermediate cylinder by releasing the chain bolt, and remove the pin between the bolt and chain.
3. Lift the mast until the fork carriage comes free from the inner mast.
4. Lower down the mast to its bottom position.
5. Release the hose from the outer mast and plug it. Remember to remove the cable ties.
6. Remove the upper retaining screws for the side cylinders.
7. Lift the inner mast straight up until the lower thrust roller on the inner mast and the upper thrust roller on the outer mast meet, and then pull the inner mast forwards to release it from the outer mast. If the ceiling is too low dismantle the mast, see "Dismantle the mast/straddle legs from the chassis" on page 6.8, and set it down.

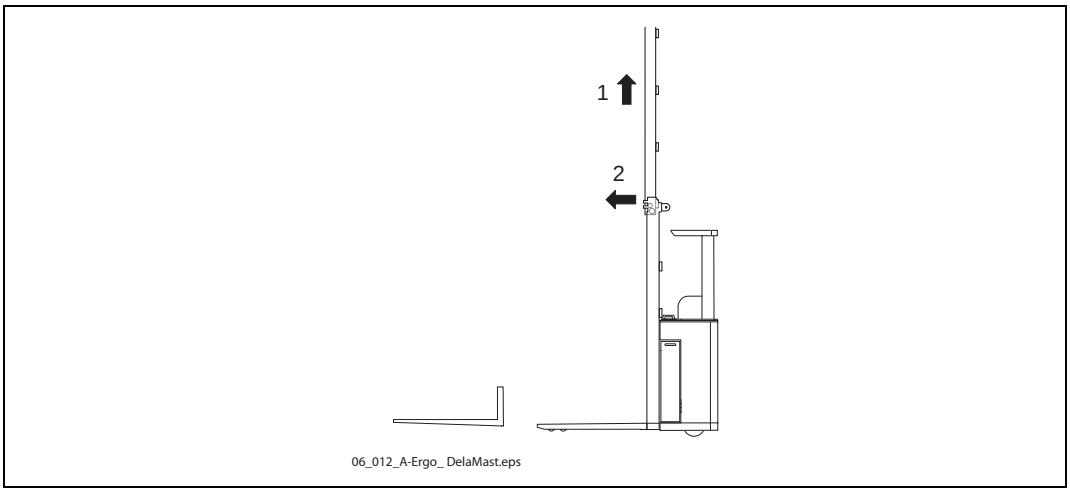


Figure 6.21 Position for dismantling intermediate masts

Tightening torque: 277 Nm

8. The tightening torque between the frame and machine housing when refitting should be 277 Nm.

Replacement, TV mast

1. Lower the fork carriage onto a European pool pallet, or the like, so that the lift chains slacken.
2. Release the lift chains from the outer mast by removing the upper pins.
3. Lift until the fork carriage comes free from the inner mast.
4. Lower down the mast to its bottom position.
5. Remove the upper retaining screws for the side cylinders.
6. Lift the inner mast straight up until the lower thrust roller on the inner mast and the upper thrust roller on the outer mast meet, and then pull the inner mast forwards to release it from the outer mast. If the ceiling is too low dismantle the mast, see "Dismantle the mast/straddle legs from the chassis" on page 6.8, and set it down.

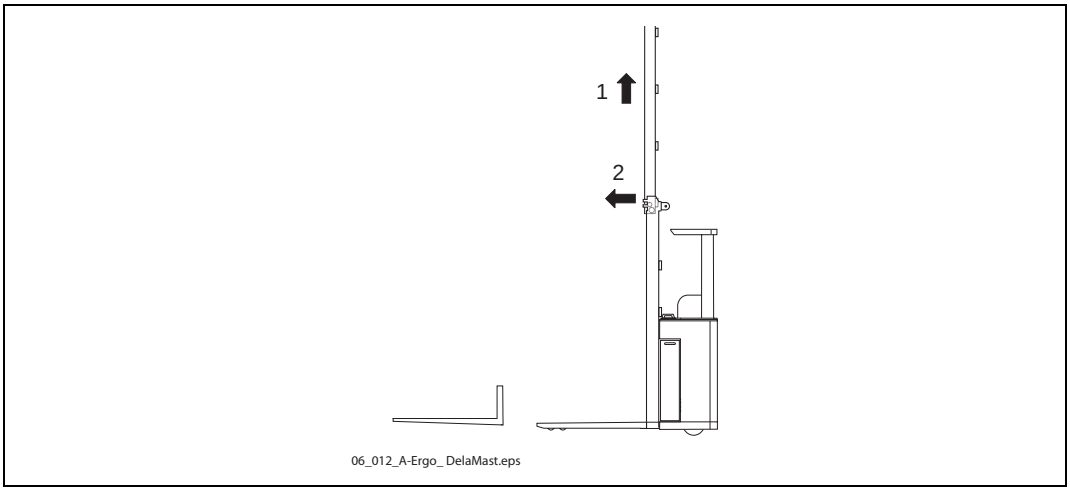


Figure 6.22 Position for dismantling intermediate masts

Tightening torque: 277 Nm

7. The tightening torque between the frame and machine housing when refitting should be 277 Nm.

Replacement, T mast

1. Lower the fork carriage onto a European pool pallet, or the like, so that the intermediate cylinder lift chain slackens.
2. Release the lift chain from the intermediate cylinder by releasing the chain bolt, and remove the pin between the bolt and chain.
3. Lift until the fork carriage comes free from the inner mast.
4. Lower down the mast to its bottom position.
5. Secure the lift cylinder so that it cannot move sideways.
6. Remove and plug the oil pipes.
7. Release the upper retaining bolts on the lift cylinder from the inner mast.
8. Remove the lower retaining screw.
9. Carefully lift up the inner mast until it can be lifted out from the cylinder.
10. Lift the inner mast straight up until the lower thrust roller on the inner mast and the upper thrust roller on the outer mast meet, and then pull the inner mast forwards to release it from the outer mast. If the ceiling is too low dismantle the mast, see "Dismantle the mast/straddle legs from the chassis" on page 6.8, and set it down.

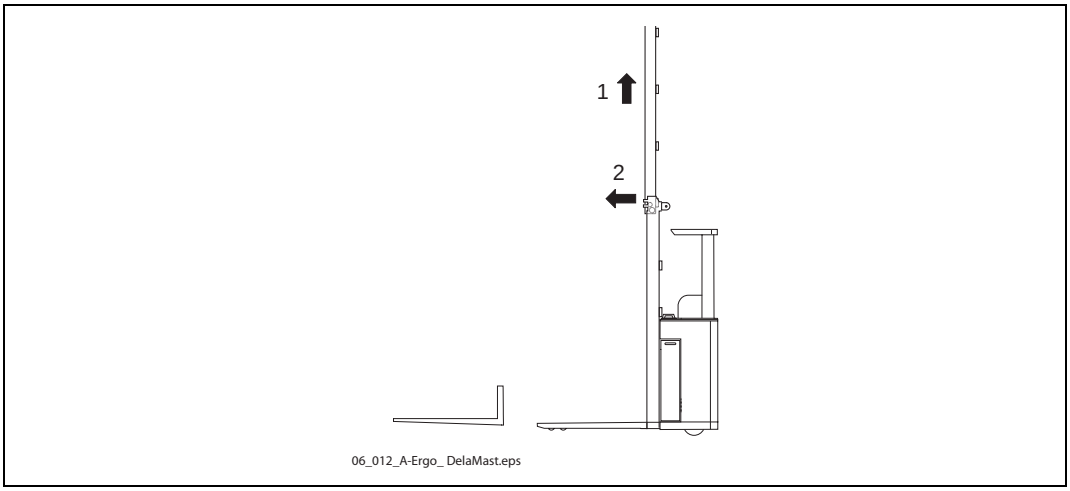


Figure 6.23 Position for dismantling intermediate masts

Tightening torque: 277 Nm

11. The tightening torque between the frame and machine housing when refitting should be 277 Nm.

Lift chains

Replacement

1. Remove the stop screw in the inner mast, where appropriate.

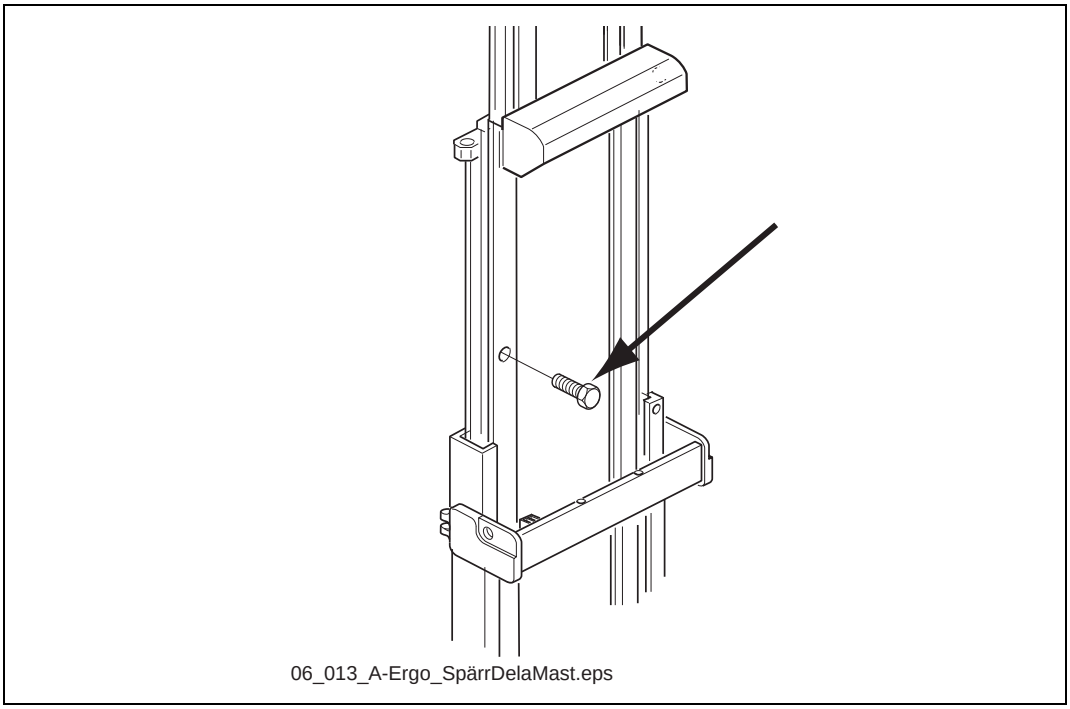


Figure 6.24 Screw, lifting stop

2. Lower down the fork carriage onto a European pool pallet, or the like, so that the chain slackens.
3. Remove the lift chain.

Re-fitting the chains

When chains are re-fitted it is important to align them correctly and to ensure there is no deterioration of the clearance.

Check

- Check that the chain is clean. Measure when the forks are unloaded.
- Measure the elongation of the chain; measure over the 25 links that go over the pulley wheel, since elongation is normally greatest here. Compare with the measurements below. If the elongation of the chain is more than 2 % it should be replaced.

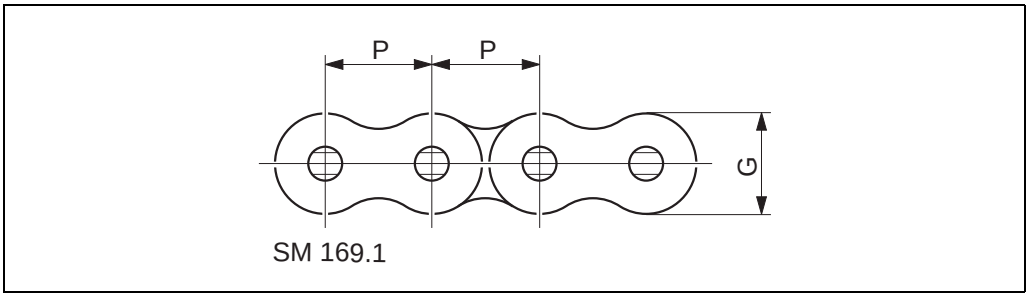


Figure 6.25 Measuring positions

Table 6.3 Chain dimension

Chain dimension (inches)	P (nominal) Pitch dimension (mm)	P (true) True pitch dimension (mm)	Measureed over 25 links New chain (mm)	Max over 25 links 2% elongation (mm)
1/2”-2*2	12.70	12.59	314.75	321.05
5/8”-4*4	15.88	15.875	396.88	404.81
3/4”-3*4	19.05	19.05	476.25	485.78
3/4”-4*4	19.05	18.91	472.75	482.21
1”-4*4	25.40	25.32	633.00	645.66
1 1/4”-4*4	31.75	31.54	788.50	804.27
1 1/2”-4*4	38.10	38.06	951.50	970.53

- Measure the height of the chain link plates, dimension G in figure 6.25. Max wear is 5%. Measure the original height where the chain is not worn as a comparison.

  Example: A chain has an original plate height of 23.2 mm, and therefore the plate height should be at least 23.2 - 5% = 23.2 x 0.95 = 22 mm.

- Make sure than none of the pins in the plates have twisted, see 6.26.

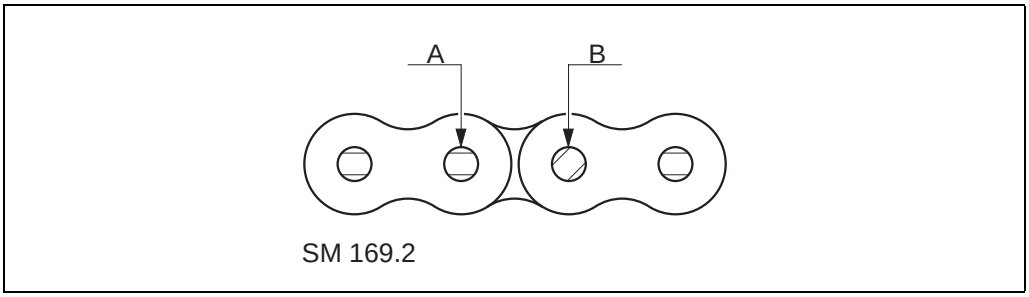


Figure 6.26 Twisted pin

- Make sure that there are no cracks in the plates.
- Look for traces of mechanical damage or rust.
- Check that the chain runs easily over the pulley wheel and does not jam.
- Lubricate the chain after cleaning and inspection.

Forks

Adjusting the lowest height on forged forks

1. The inner and outer masts should be lowered.
2. Adjust the two outer lift chains so that the mast hangs a little from the lift chains.
3. Adjust the middle chain so that the fork head is 5 ± 2 mm from the ground (see figure 6.27).

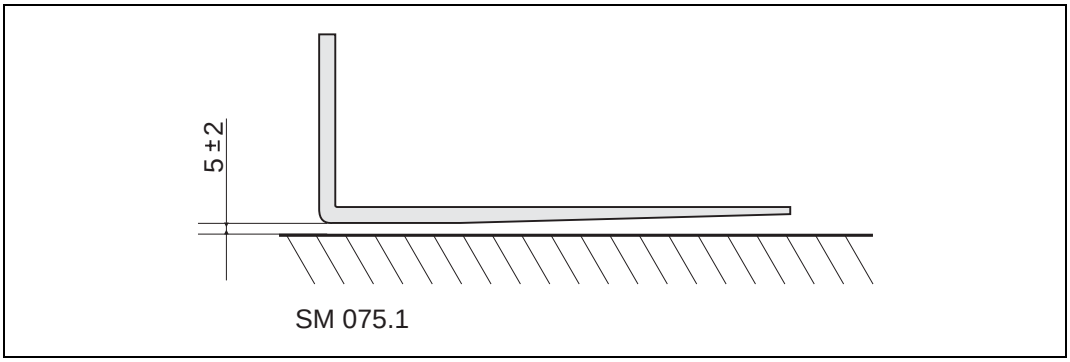


Figure 6.27 Distance from floor

Adjusting the lowest height on welded forks

1. The inner and outer masts should be lowered.
2. Adjust the two outer lift chains so that the mast hangs a little from the lift chains.
3. Adjust the chains so that the fork height is as shown in table 6.4.

Fork height in lowered position:

Table 6.4 Height of forks over floor in rest position

Mast type	Min	Max (mm)
A-Ergo 160	controlled by ground clearance	89
A-Ergo 200	controlled by ground clearance	91
A-Ergo Telescopic forks (TF)	controlled by ground clearance	73

Fork test

Seven inspection points are included in the fork test. If the forks fail to meet any of the points, the machine must be taken out of service. If the customer is not prepared to do this, it should be written in the report that “The forks do not comply with the requirements in SS-ISO/ 5057”. When the customer subsequently signs the service order, they bear the responsibility for the defective forks.

☞ ***Important!***

The truck must pass the fork test to comply with SS-ISO/5057.

1. **Straightness of the blades and shanks:**Deviations from the straightness of the carrier surface and the support surface must not exceed 0.5% of the length of the blade and shank. See figure6.28.

   L = 1150 mm, max deviation 5.75 mm.

   L = 950 mm, max deviation 4.75 mm.

   L = 800 mm, max deviation 4.00 mm.

   h = 492 mm, max deviation 2.46 mm.

   h = 464 mm, max deviation 2.32 mm.

2. **Crack formation:** Check whether the forks are cracked. Check carefully around the heel and hooks. See figure6.28.
3. **Wear:** Check the forks for wear, especially around the heel. The blade thickness must not be thinner than 90% of the original thickness.

   The original thickness is found by:

   - Reading the marking on old forks.
   - Measuring the blade thickness in the centre of the shank.
   - Contacting Atlet for information about blade thickness.

4. **Fork angle:** The angle,α, between the blade and the shank must be max 93 degrees. See figure6.28.
5. **Difference in height between the tips of the forks:**The difference in height, dH, between the tips must not exceed 3% of the blade length. See figure6.28.
6. **Locking device:** Check that the locking device works.
7. **Markings:** The fork markings should be explicit and include the lifting capacity in kg for one fork and the distance to the centre of gravity in mm. See pos. 8 in figure 6.28.

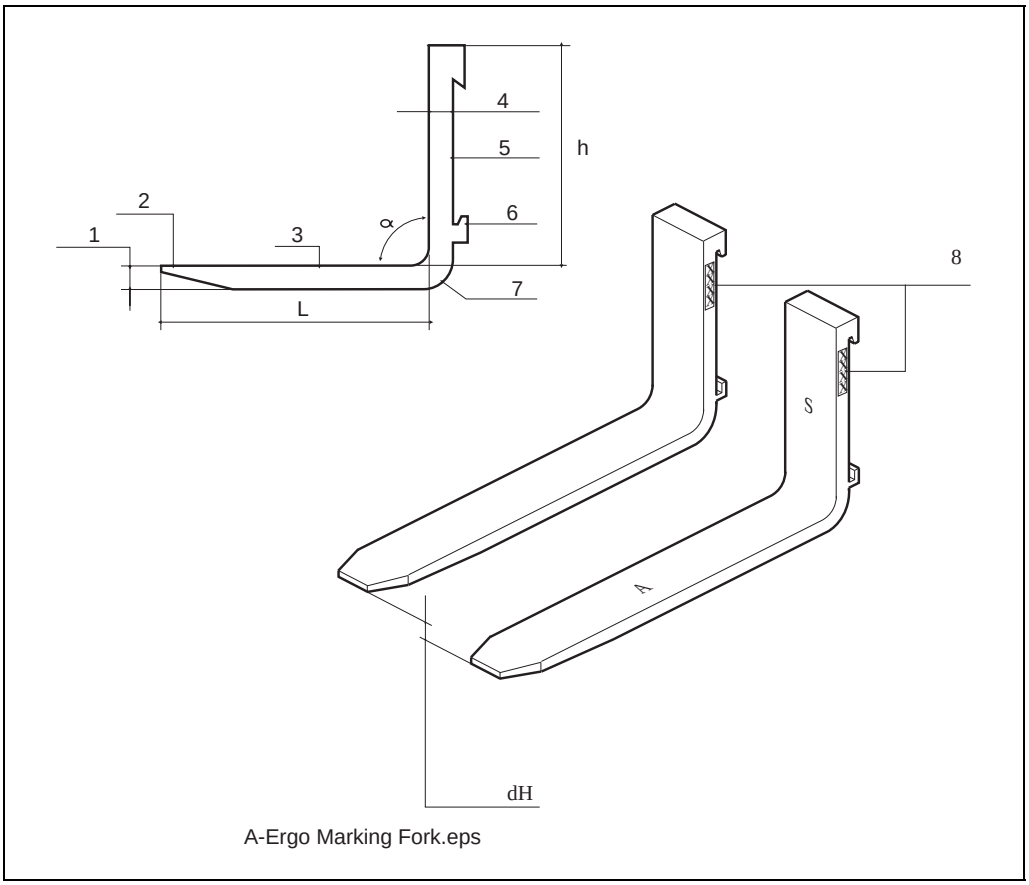


Figure 6.28 Fork designations

Explanation of figure

Position	Explanation	Position	Explanation	Position	Explanation
1	Thickness	5	Shank	A	Carrier surface
2	Tip	6	Hook	h	Height
3	Blade	7	Heel	dH	Difference in height
4	Thickness	8	Marking	L	Length
				S	Support surface

Fork carriage, general

Adjusting the fork carriage

1. The thrust rollers have a specific clearance to the roller surfaces.
2. The lateral play is adjusted by adjusting the number of shims behind the load rollers, and by replacing the rollers.

For permitted play, see "Adjusting the play in the mast" on page 6.15.

Dismantling the fork carriage

1. Lower down the fork carriage on a European pallet, or the like.
2. Remove the lift chain.
3. Lift up the inner mast with standard hydraulic system until the fork carriage is released.

☞ ***Important!***

Observe great caution!

4. Reverse the truck away.

Fork carriage, telescopic forks, TF

Dismantling the fork carriage TF

The fork carriage only needs to be lifted out of the frame when replacing fork carriage rollers. To lift out, see the instructions for dismantling the type of frame the truck is equipped with.

1. Lift the fork carriage to a suitable height to dismantle the over-cogging protection on the back of the fork carriage, see figure6.29.

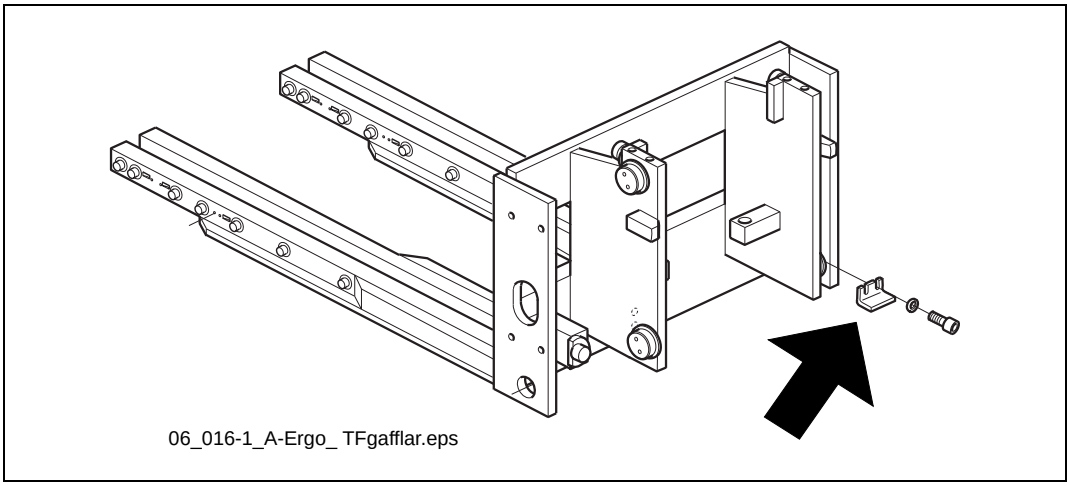


Figure 6.29 Over-cogging protection

2. Lower the fork carriage to a suitable height to achieve a comfortable working position, and make sure that the forks are fully withdrawn.
3. Pull the battery plug out from the electrical panel plug to disconnect the power to the electrical system.
4. Release the flexible cable to the fork drive motor by loosening the two nuts that hold the motor end head, and then remove the cables connections to the motor.

5. Release the bolts, pos. 1, just enough to be able to adjust the chain tensioning bolt, pos. 2. Screw the bolt to the left so that the chain slackens and the chain lock, pos. 3 and 4, can be removed, see figure6.30.

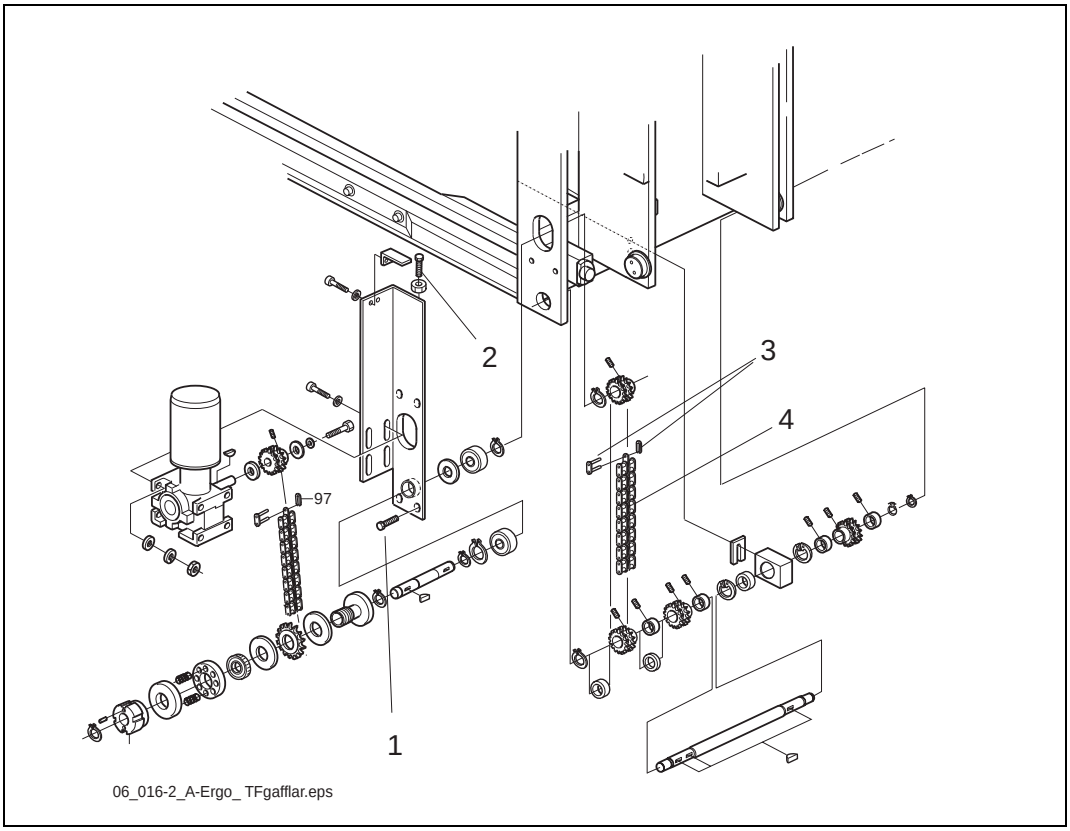


Figure 6.30 Chain tensioning bolt

6. Loosen the bolts completely and lift off the drive assembly.
7. Unscrew the screws on the forks and pull off the forks, see figure 6.31.

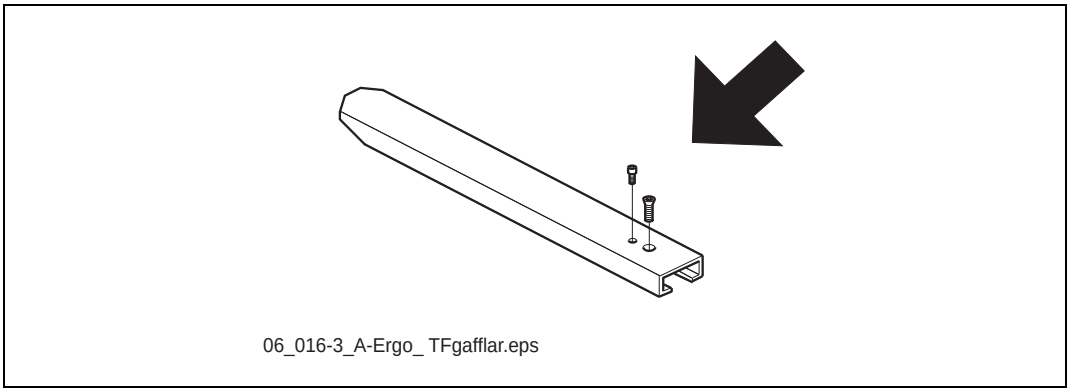


Figure 6.31 Fork attachment

8. Release the chain adjuster, pos. 1 figure6.32.

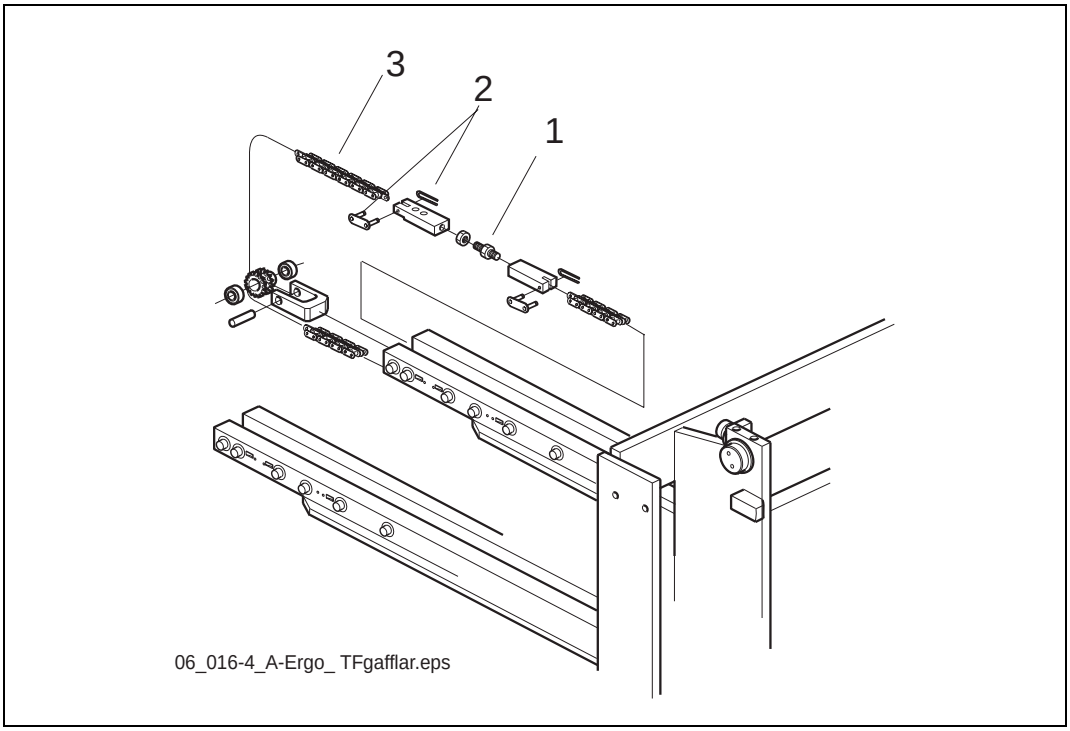


Figure 6.32 Chain adjuster

9. Remove the chain lock, pos. 2, and remove the chains, pos. 3 figure6.32.
10. Remove the sprockets in the tips of the inner forks.
11. Remove the side thrust rollers, figure 6.33.

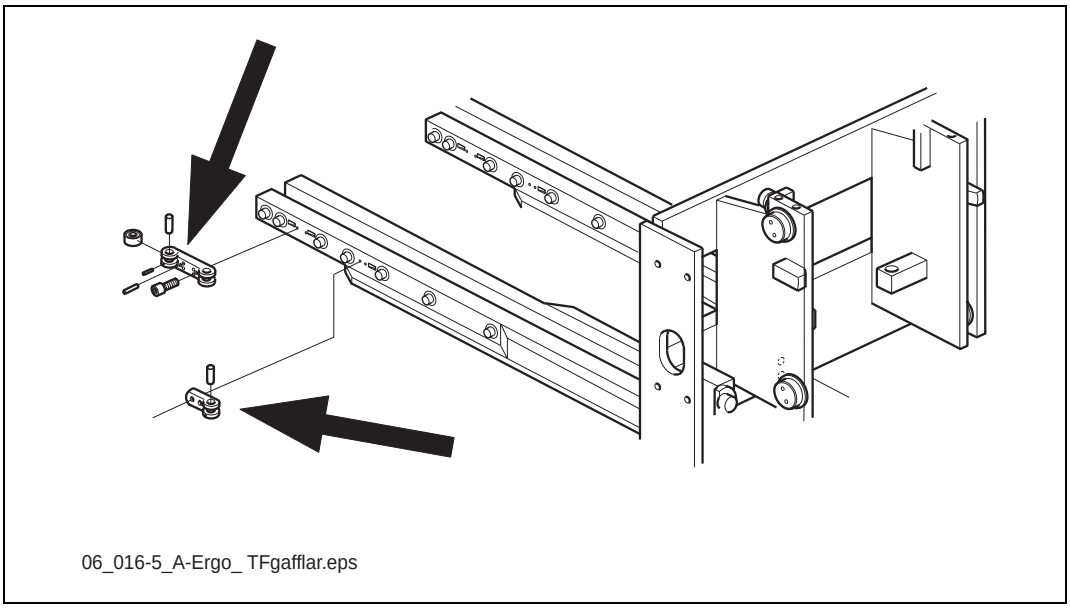


Figure 6.33 Side thrust rollers

12. Remove the outer circlips holding the side bearing for the shaft, pos. 16.34.

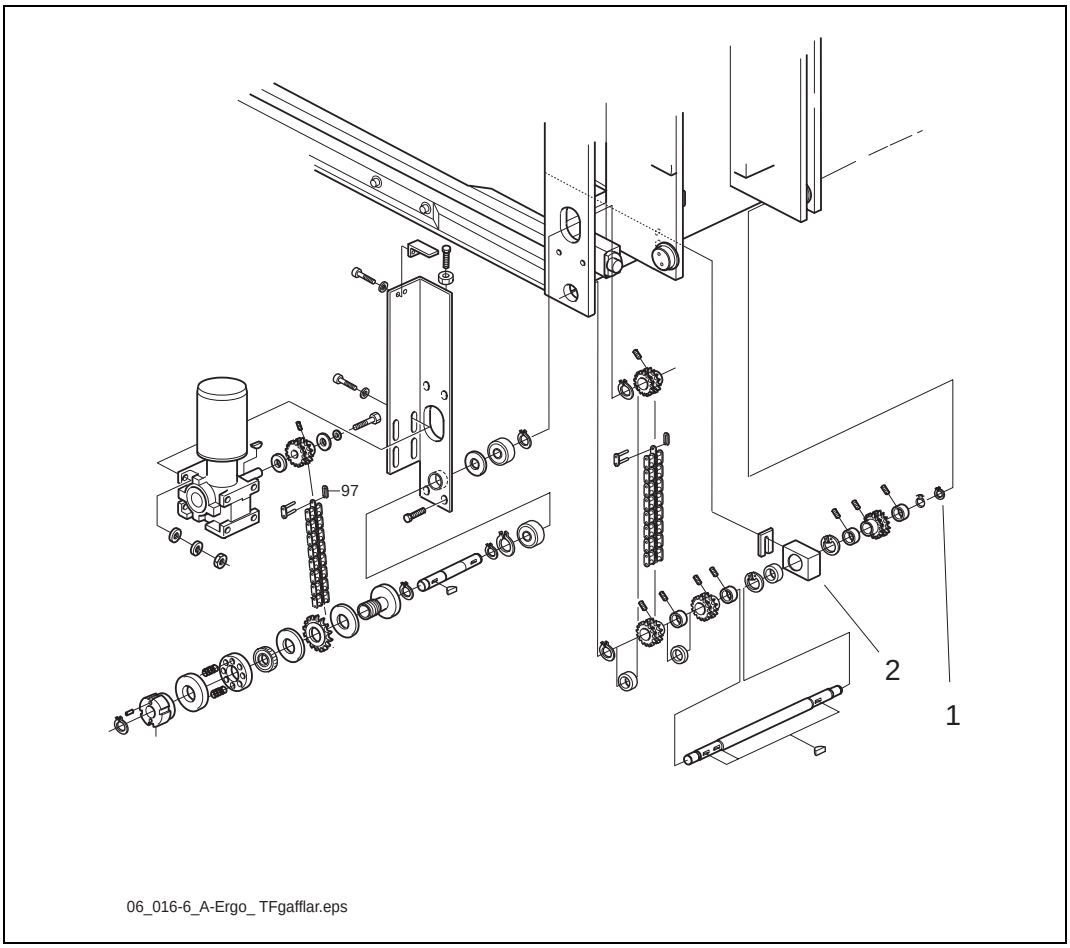


Figure 6.34 Outer circlips for side bearing and intermediate bearing

13. Loosen the intermediate bearing, pos. 2 figure6.34. Drive the shaft to one side so that the side bearing can be pressed out of the fork carriage. Remove the bearing and lift the shaft out from the fork carriage.

14. Note the order in which the gear, circlips and spacers are fitted, and then work them off.

Assembling the fork carriage TF

1. Fit the sprockets in the tips of the inner forks. Lightly grease the bearing inside and outside before fitting.

2. Fit the rear shaft with sprocket, stop rings and bearing housing. Check that the shaft is not tensioned skew by rotating it by hand at least one turn in each direction.

3. Fit and adjust the fork chains so that they run parallel with the sprockets, and so that they give 2-4 mm in the middle. Lock the sprockets, stop rings and chain tensioners. Lightly grease the chains along their entire length.

4. Fit the over-cogging guard.

5. Fit and adjust the roller attachments by using a fork, so that the play is less than 0.3 mm. Make sure that the forks are centred on the inner forks. Remember to lock with the screws.
6. Lightly grease all the roller surfaces along their entire length, and fit the forks.
7. Fit the complete motor. Fit and adjust the lower motor chain so that it runs parallel between the sprockets, and so that it gives 2-4 mm in the middle. Lock the motor attachment and the sprocket. Lightly grease the chain along its entire length.
8. Remove the plug in the gearbox and check the oil level, which should reach to the centre of the output shaft. Top up if necessary.

Inspection after assembling the fork carriage TF

Test run the fork carriage and check that:

- the forks do not jam.
- the forks go fully in and out.
- the chains run parallel between the sprockets.
- there is no abnormal noise.
- the overload clutch slips in the end positions

Adjusting the overload clutch (TF)

The spring tension is not adjustable since the tensioning nut, pos. 1, should be fully screwed in and locked with stop screws. The bearing, pos. 2, and sprocket, pos. 3, should be lightly lubricated with cold-resistant grease (-35°C), see figure6.35.

⚠ ***Warning!***

There must not be any grease on the friction linings.
If the overload clutch is damaged, it must be completely replaced.

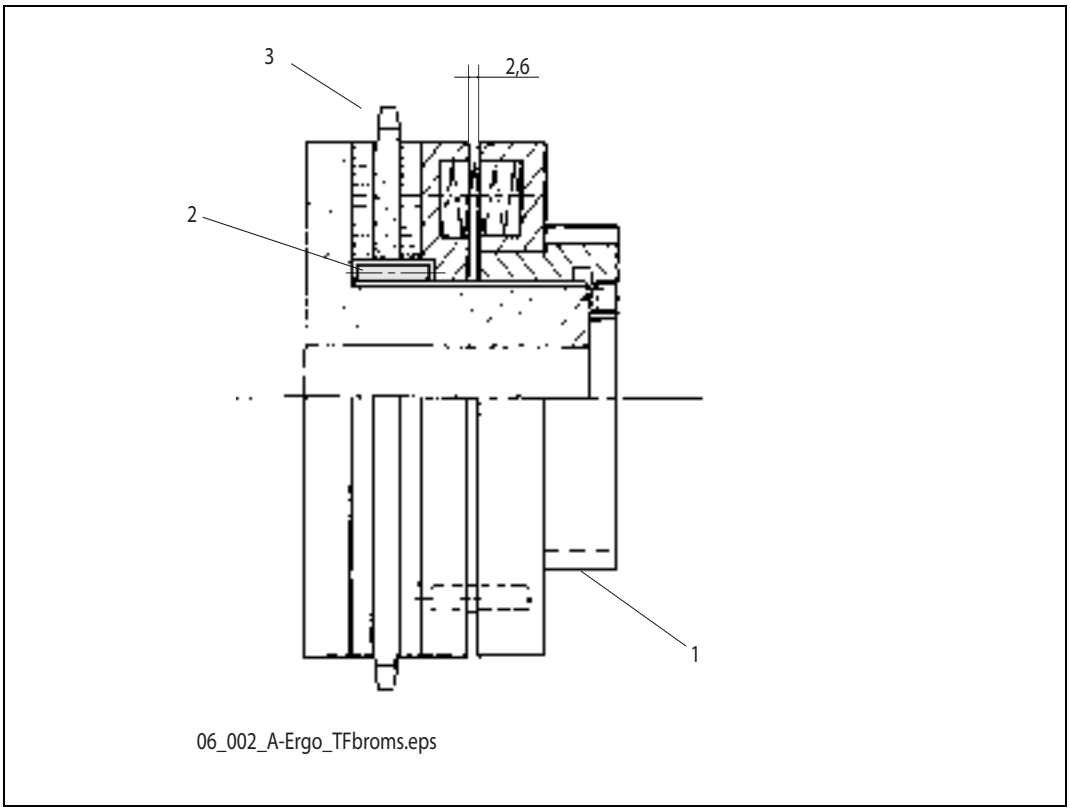


Figure 6.35 Overload clutch

Replacing the fork drive motor (TF)

1. Release the cable bracket and the cover over the motor, and lift them off.
2. Note the connection of the electric cables, and release them.
3. Loosen the bolts.
4. Lift the motor straight up.

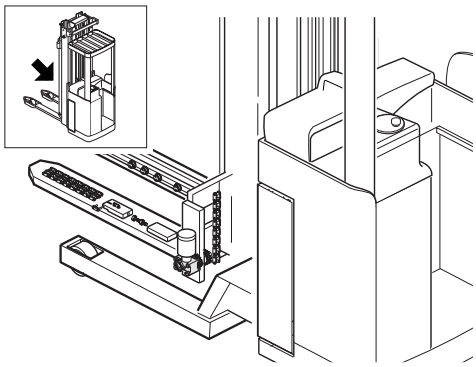


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Figure 6.36 Fork drive motor and gearbox

Replacing the coupling between fork drive motor and gearbox (TF)

1. Dismantle the motor, see see "Replacing the fork drive motor (TF)" on page 6.33.
2. Release the coupling by unscrewing the stop screw, and pull off the coupling.
3. Push on a new one and tighten it with the stop screw.
4. Loosen and pull off the coupling half located in the gear, and fit a new one.
5. Fit the motor, connect the cables, and test drive.

Replacing the cabling, fork drive motor (TF)

1. Lift the forks approx. one metre above the floor.
2. Release the bracket holding the electric cable at the motor.
3. Remove the cover over the drive motor end, where the electric cable goes in.
4. Remove the panel over the component box, including all the clips holding the cable.
5. Check the markings and positioning of the electric cables.
6. Release the cable and pull it out.
7. Move the springs over to the new cable, put it in place, and connect it.
8. Fit the cover and bracket over the drive motor.
9. Clamp the cable secure, lift the forks a number of times, and check that it is not clenched, catches, or rubs against something.
10. Fit the panels.

Straddle lift

Adjusting the straddle lift

1. Place the truck on a level floor and lower the forks and the adjustable straddle lift.
2. Check that the distance between the floor and top of the forks corresponds with table 6.5 below. Measure at four points:
   - at each fork tip
   - at the back of the fork on each side
3. Check that the distance is the same between mast and guides. If necessary adjust to the same distance with the adjusting screws, both at the top and bottom.
4. The lateral play in the mast should be max 0-0.5 mm. Because of the inexactitude in the linearity of the mast section a play of max 1.5 mm is permitted at the “worst point”, raised or lowered.
   This means that if for example the play is 0.5 mm with the straddle lift raised, the play with the straddle lift it its lower position should be max 1.5 mm, and the reverse.
5. Check the play between the roller surfaces on the mast and guides. For permitted play see "Adjusting the play in the mast" on page 6.15, 160 mast.
6. Check that the forks are horizontal.
7. If the fork tips point upwards the shims over the pressure plate should be removed (on the assumption that the forks are straight).
8. If the fork tips point downwards shims should be added over the pressure plate (on the assumption that the forks are straight).

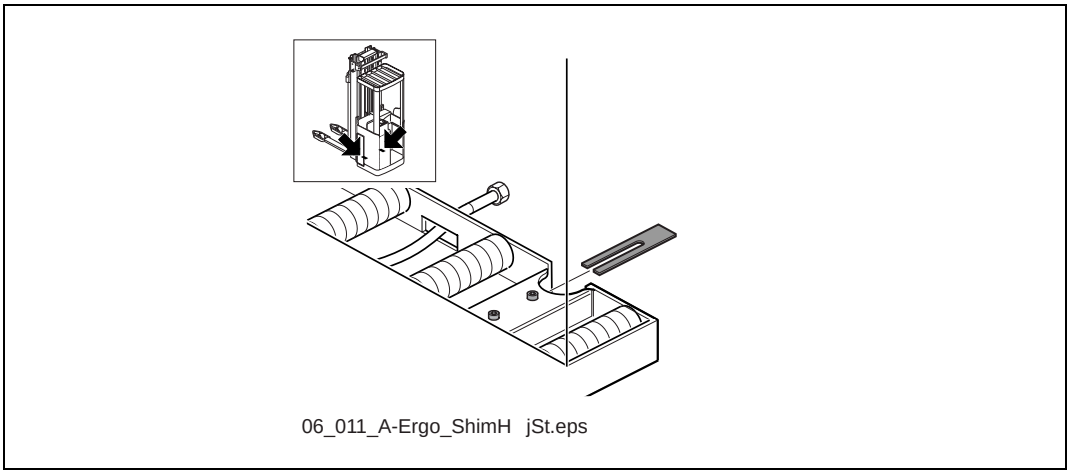


Figure 6.37 Positioning of shims

9. When the forks are parallel, check the height. The cylinders can be extended if it is not high enough.
10. Test lift, and check that the straddle lift does not lift skew. If so, adjust the length of the cylinders until the best lifting movement is obtained.
11. Check measure, and if necessary make further adjustments.

Table 6.5 Height measurements for adjustable straddle lift/forks

Truck with straddle lift	
Distance to top of fork	Max 95 mm
Distance to top of straddle leg	Max 90 mm Min 85 mm

Dismantling and assembling of straddle lift

1. Lift up the straddle lift with the truck. Place a block under the tips of the straddle lift and lower down the straddle lift, whereby the load wheel lifts from the floor.
2. Tap out the retaining pin through the shaft and drive out the shaft holding the wheel fork.
3. Tap out the retaining pin at the pressure link arm and pull out the load wheel, pull rods and pressure link arm complete.
4. Tap out the shafts from the ends of the pull rods.
5. Check for wear and replace damaged parts if necessary.
6. Assemble in the reverse order.
7. Check the lifting movement. If the straddle lift pulls at an angle it must be adjusted, see section "Adjusting the straddle lift" page 6.35.

Side stabilisers

Checking the side stabiliser

1. Place the truck on a level surface.
2. Fix a tape measure with the zero at the top edge of one fork. Lift until the stabiliser switch in the mast breaks, i.e. until the mast stops, and measure the height. Lift height should be at 3000 mm +/- 25 mm.
3. Extend the stabilisers until the motor stops. Check that the wheels are pressed against the floor and check the residual suspension. See table 6.6.

Table 6.6 Reference values for side stabilisers

Reference values for side stabilisers	
When the stabilisers are extended at full speed the spring should compress 4-9 mm, when the pump motor has stopped. Irregularities in the floor are absorbed by the spring in the top of the cylinder, see figure 6.38 below.	
Residual suspension with fully extended stabilisers and a level floor.	5-10 mm

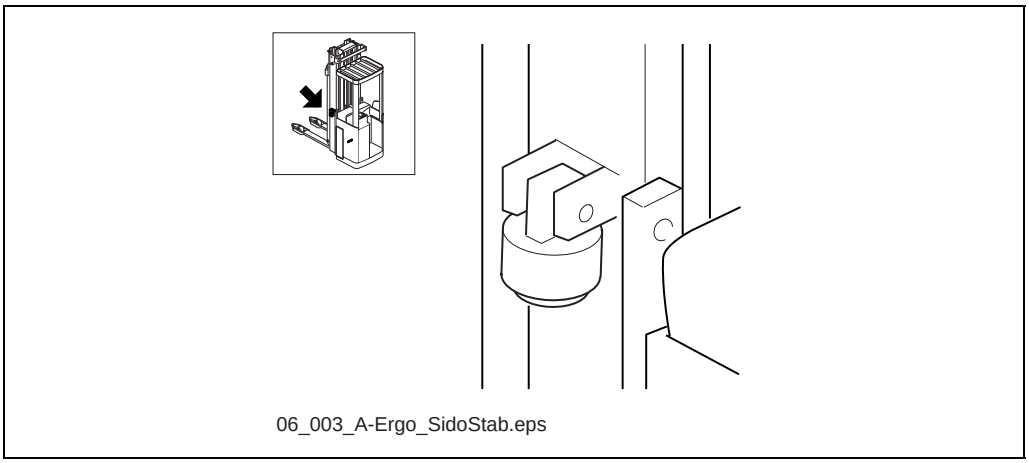


Figure 6.38 Check points for side stabilisers

Adjusting the length of side stabilisers

- Mechanical adjustment is made by adjusting the lower end of the piston.

Diagnosis and trouble shooting

Trouble shooting chart

Table 6.7 Symptom/Action table

Symptom	Possible reason	Action
Play in mast.	Too few shims on mast rollers.	Re-shim.
The mast lowers unevenly, jumps.	Too many shims on mast rollers.	Re-shim.
	No grease on the mast roller surfaces.	Grease roller surfaces.
The mast squeaks.	No grease on the mast roller surfaces.	Grease roller surfaces.

SERVICEMANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2002B

7 Steering

Edition 2002B

7 Steering

Design and function

General

The steering movement is transferred completely electronically, without mechanical connection between the steering wheel and wheel. The system consists of steering wheel, regulator, steering servo unit and servo motor. A monitoring system is built into the steering servo unit, which stops the truck if an electrical fault occurs in the regulator.

Steering

The steering wheel is mounted in a vertically adjustable panel to allow the best possible adjustment. The steering wheel has no mechancial contact with the wheel. All the steering takes place by means of a sensor in the form of a step motor under the steering wheel. The sensor gives a signal to the servo steering regulator, which converts the signal to a drive voltage for the steering servo motor to turn to the right or left, depending on the direction of rotation of the steering wheel, see section 10.

The steering servo motor is of the 3-phase induction motor type. The turning movement is limited by means of two limit switches, S4 and S5. These are placed in the motor bed and stop the turning movement before the mechanical end stop is reached.

To maintain control of the acceleration during hard turns there is also a 45° sensor, S8, on some trucks, placed in the motor bed..

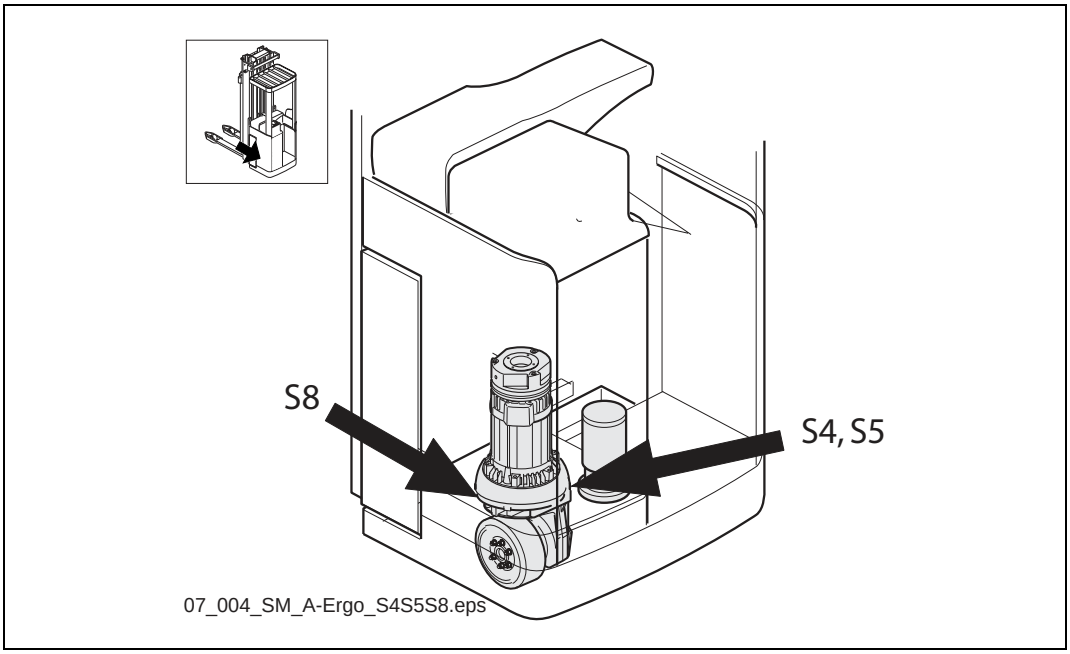


Figure 7.1 Limit switch S4 and S5.

Regulator, steering servo motor

For information concerning regulators, see section 10.

Repair instructions

Steering wheel, step motor sensor

Replacement

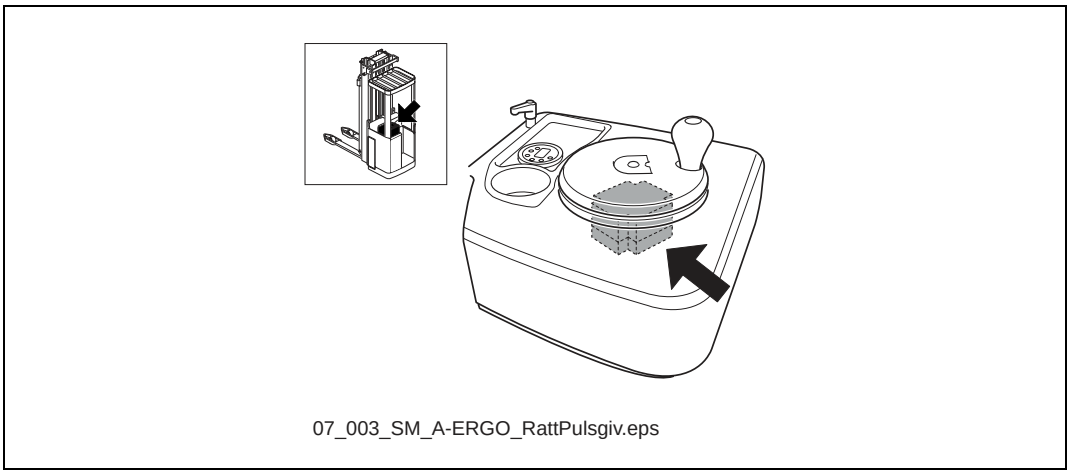


Figure 7.2 Position of step motor sensor

1. Remove the steering wheel panel and turn it upside down, see section 4 for instructions.
2. Remove the cables to the steering wheel sensor.
3. Unscrew the steering wheel sensor.
4. Lift over the fixed components to the new steering wheel sensor.
5. Connect the steering wheel sensor and refit the panel.

Steering servo motor with gearbox

Dismantling

1. Move away the power panel, see section 10.
2. Remove the cables to the steering servo motor.

3. Unscrew the steering servo motor from the motor bed..

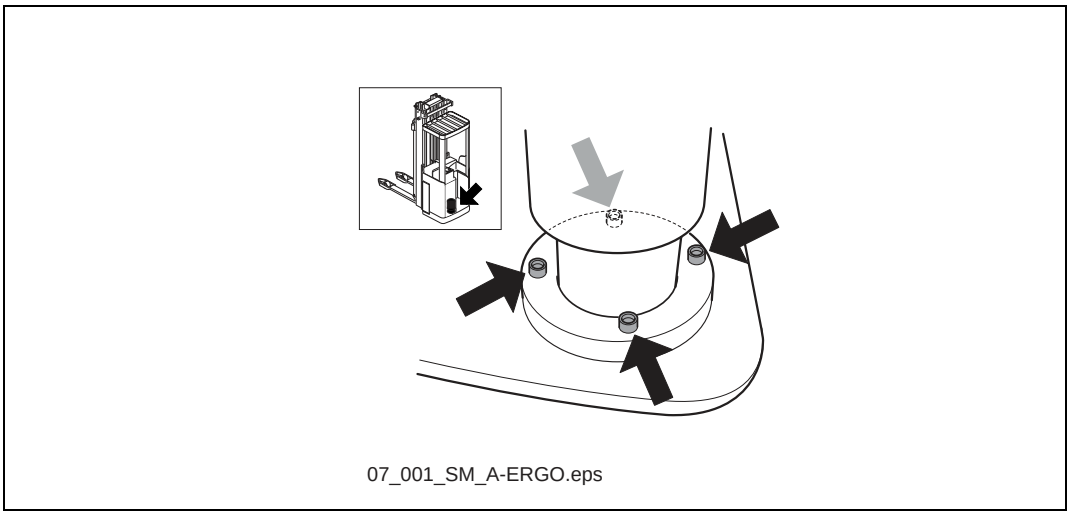


Figure 7.3

4. Unscrew the steering servo motor gearbox and carefully release it; the component gears are loose.

Important!

Carefully release the gearbox, the component gears are loose.

Replacing the steering servo sensor

See section 10.

Diagnosis and trouble shooting

See section 10 for trouble shooting of the steering servo system.

SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2009A

8 Hydraulic system

Edition 2009A

8 Hydraulic system

Design and function

General

Lift

The driver operates a lift lever or alternatively a proportional electric lever that actuates a microswitch, which in turn actuates the lift motor by means of a contactor. The motor drives the built-in hydraulic pump, which pumps hydraulic oil to the lift cylinders. The lift lever/electric lever also controls a control value, which controls the oil flow to the cylinder performing the work.

In the control valve there is a pressure limiting valve, which limits the maximum hydraulic oil pressure. The pressure of the hydraulic oil is built up when the cylinder goes towards its end position. A pressure limiting valve opens when the maximum system pressure has been reached , which leads the oil from the pump back to the tank. The opening pressure of the pressure limiting valve is set at the factory so that the machine will be able to do the work it is designed for.

⚠ ***Warning!***

The pressure limiting valve must only be adjusted by authorised and trained personnel, since it is essential for the safety of the truck. All work with the hydraulic system should be carried out in a pressureless state, and in a clean environment.

Lower

When the lowering movement is controlled manually by means of a lever there is a lowering brake valve placed between the control valve and the cylinder, which regulates the lowering speed by restricting the return of the hydraulic oil.

In those cases where the lifting and lowering movement is regulated by means of an electric control valve the lowering brake valve is integrated in the control valve. When the lowering movement is actuated the oil from the cylinder is led through the control valve back to the tank when the cylinder is retracted by the weight of the fork carriage.

On certain cylinders there is also a hose rupture valve, which provides protection from accidents during the uncontrolled discharge of oil.

Hose rupture valve

Hose rupture valves, the purpose of which is to prevent the forks dropping down out of control if for example a hydraulic hose ruptures, are fitted in most of the lift and stabiliser cylinders. They are placed in front of the nipple connected for the supply of hydraulic oil. In the free-lift cylinder a lowering brake valve is normally fitted instead.

Lowering brake valve

The lowering brake valve regulates the lowering speed and is mounted in a valve housing, placed in the lower section of the mast. It controls the lowering speed of the cylinders (TV, TFV, DTFV cylinders). For free-lift there is a lowering brake valve in the bottom of the free-lift cylinder (T cylinder).

The valve is set at the factory, but may subsequently be adjusted. Check the lowering speed in relation to table 8.2 before repairing or adjusting.

There are no external lowering brake valves on trucks equipped with electric control valves and they are integrated as a function in the control valve instead, see "Electric control valve" on page 8.2. On these trucks there should be a hose rupture valve.

Mechanical control valve

General

The control valve controls the lifting and lowering movements of the truck. The lifting and lowering speed is proportional to the operation of the control lever.

Lifting function

The pump provides pressure to the lift cylinders through the open control valve. If the lift cylinders are obstructed, have an excessive load, or if there is a fault on the control valve so that it does not open, the oil will return to the tank through the pressure limiting valve.

Lowering function

The control valve opens to release the oil from the lift cylinders. When the fork carriage presses down the lift cylinder the oil flow goes through the lowering brake valve, which regulates the lowering speed, see table "Adjusting the lowering brake valve" on page 8.22.

Electric control valve

General

The control valve controls the lifting and lowering movements of the truck. The lifting and lowering speed is proportional to the operation of the control lever.

Lifting function

The pump supplies pressure to the control valve, which in turn closes the pressure chamber completely. This pressure also opens the non-return valve and then continues through the open proportional valve to the lift cylinders If the lift cylinders are obstructed, have an excessive load, or if there is a fault on the proportional valve so that it does not open, the oil will return to the tank through the pressure limiting valve.

Lowering function

The control valve opens to release the oil from the lift cylinders. Since the non-return valve is closed, the only way out for the oil is through the pressure chamber. The flow through the pressure chamber is in turn controlled by the pressure difference over the feed restriction in the proportional valve, since the control valve does not receive pressure from the pump.

Lowering brake function

The pressure chamber is the heart of the electrical control valve.

☞ ***Important!***

It is set at the factory and should NEVER be altered.

The feed restriction in the proportional valve has a stroke length limit, which can be set from outside. The stroke length limit governs the maximum lowering speed.

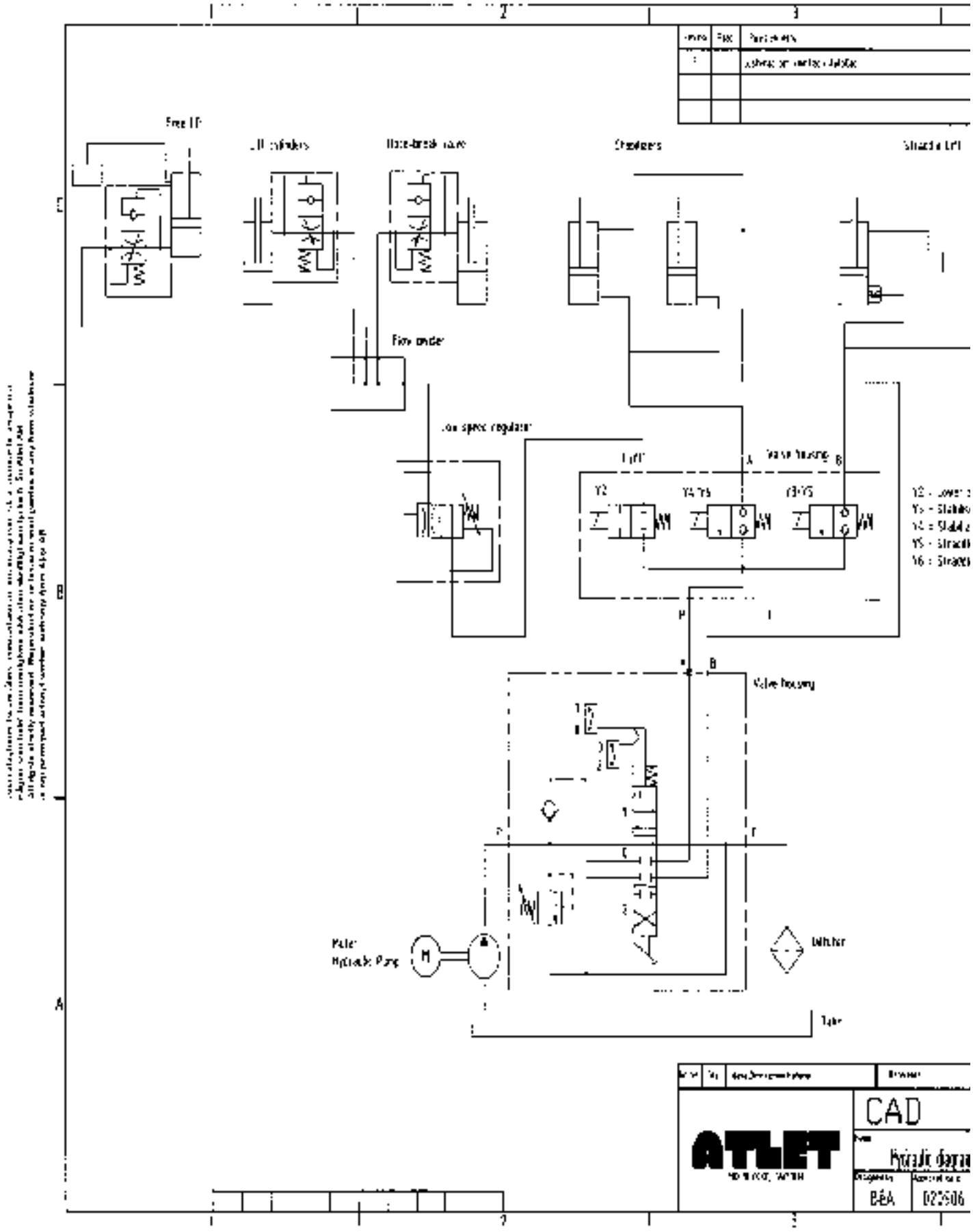
The pressure chamber maintains a constant pressure drop over the feed restriction in the proportional valve during lowering. This enables the lowering speed to remain constant regardless of the load, and therefore no external lowering brake valves are required.

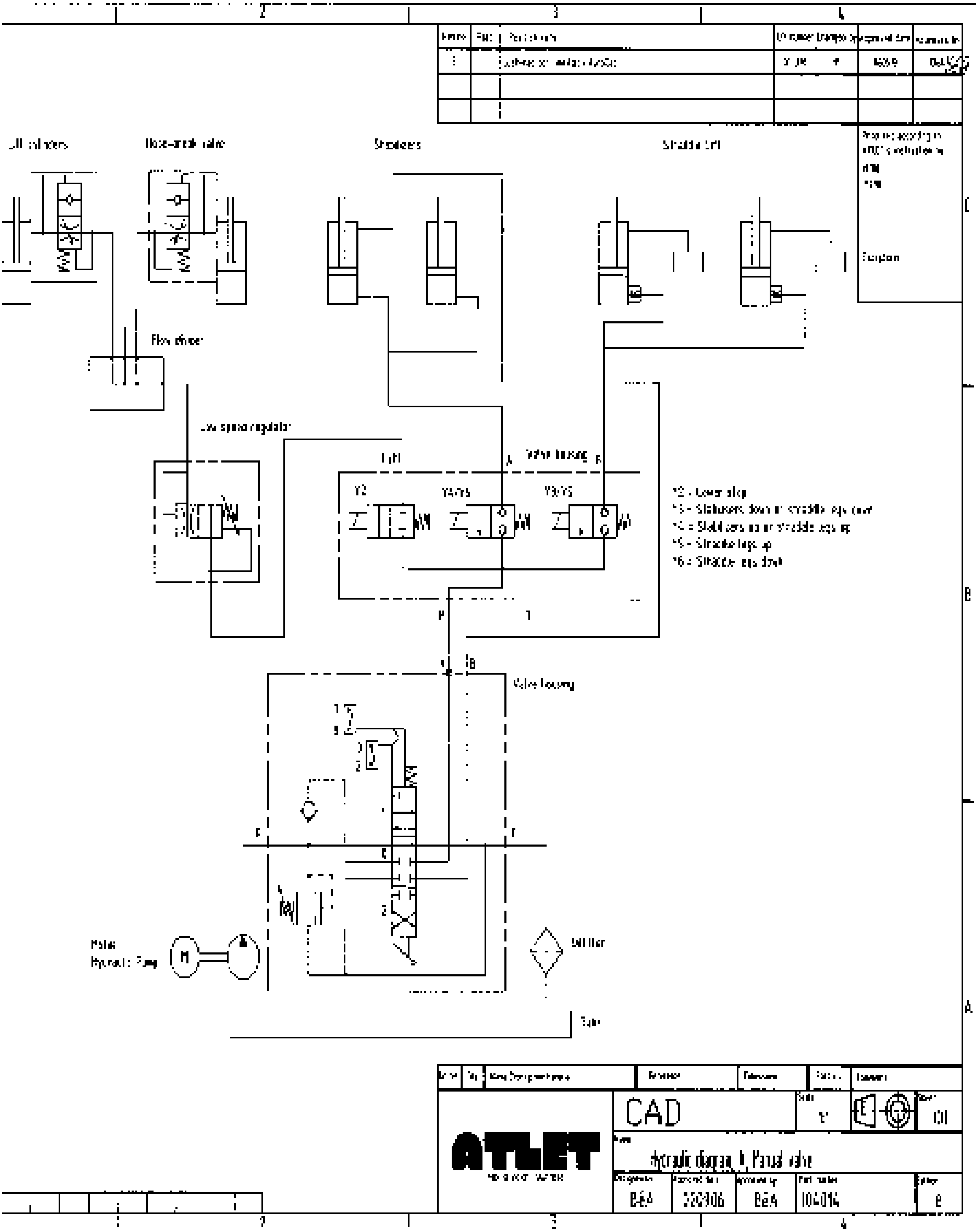
Hydraulic diagram

Table 8.1 List of hydraulic diagrams for A-Ergo

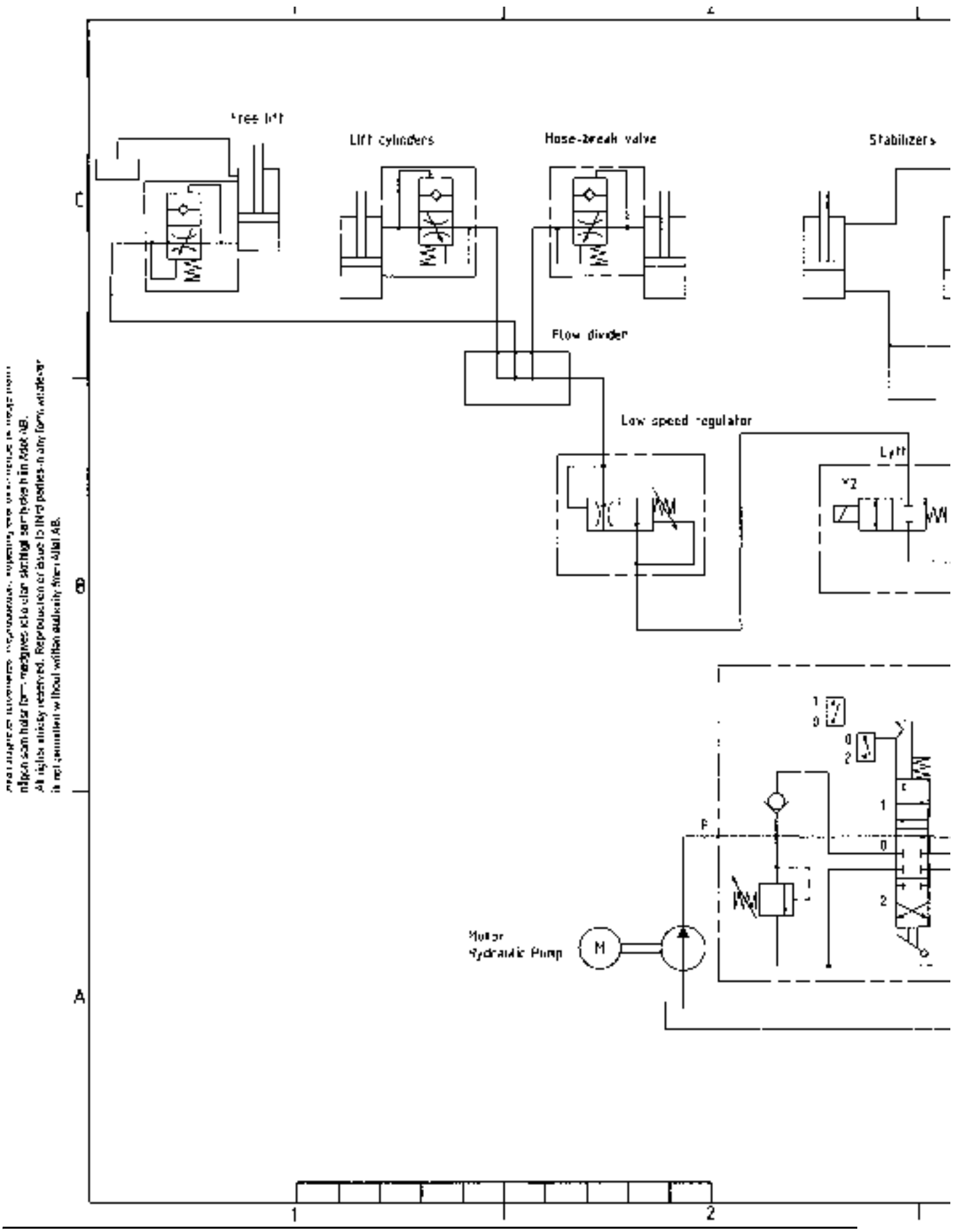
Description	Page
Hydraulic diagram, Manual valve 104014 (–2008w45)	8.4
Hydraulic diagram, Manual valve 104014 (2008w46–)	8.6
Hydraulic diagram, Proportional valve 104005 (–2008w45)	8.8
Hydraulic diagram, Proportional valve 104005 (2008w46–)	8.10
Hydraulic diagram, ALL 104913	8.12

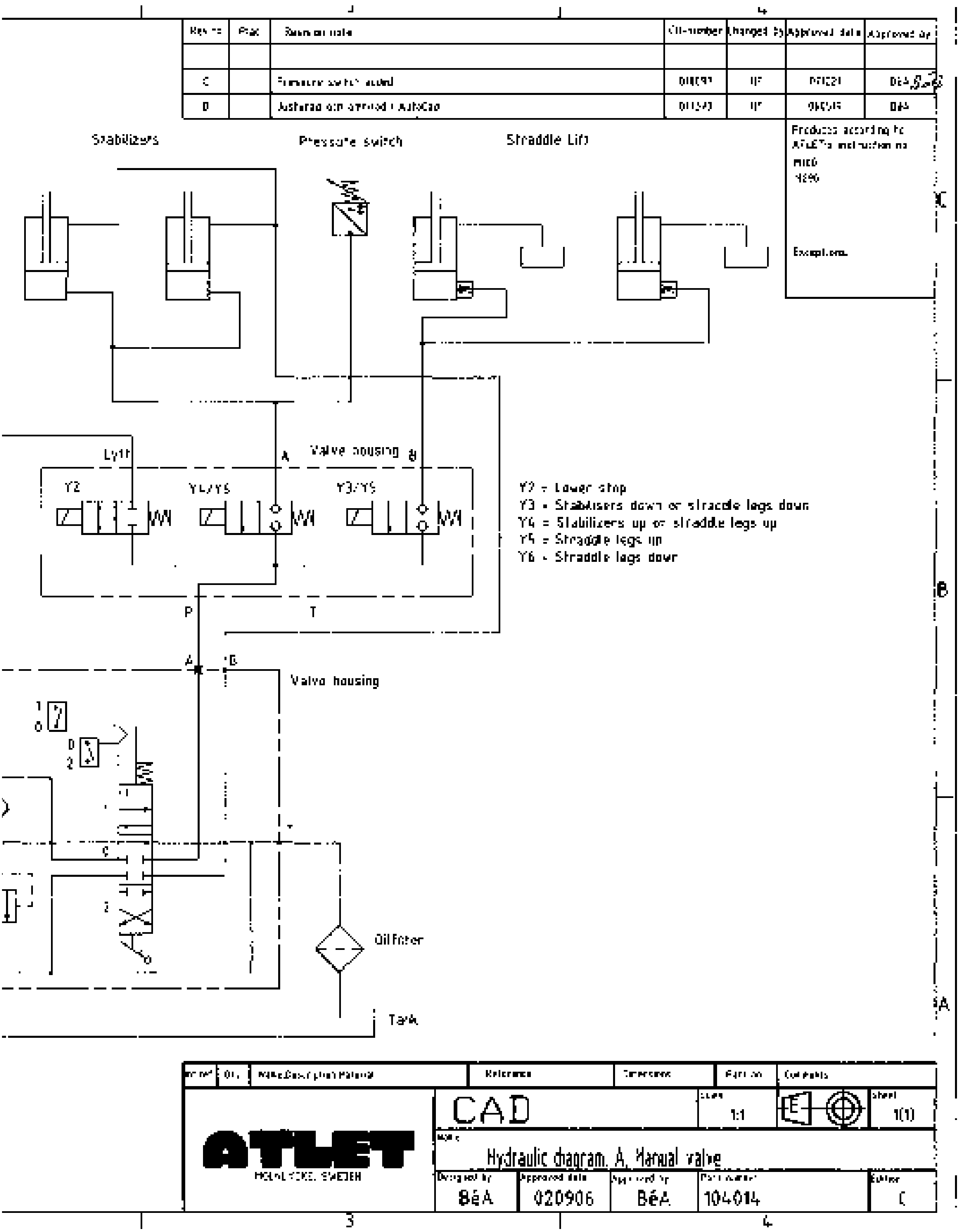
Hydraulic diagram, Manual valve 104014 (–2008w45)




Stabilizers
Flow divider
Low speed regulator
Valve housing
Y2
Valve housing
Motor
Hydraulic Pump
Oil filter
Tank
CAD
ATLET
104014

Hydraulic diagram, Manual valve 104014 (2008w46–)




Rev no
Revision note
Changed by
Approved date
Approved by
C
Pressure switch added
D
Stabilizers
Pressure switch
Straddle Lift
Produced according to
Exceptions
Valve housing
A
B
Y2
Y4/Y6
Y3/Y5
Y2 = Lower stop
Y3 = Stabilisers down or straddle legs down
Y4 = Stabilizers up or straddle legs up
Y5 = Straddle legs up
Y6 = Straddle legs down
P
T
Valve housing
Oil filter
Tank
Reference
Dimensions
CAD
1:1
1(1)
ATLET
Hydraulic diagram, A, Manual valve
Designed by
BéA
Approved date
020906
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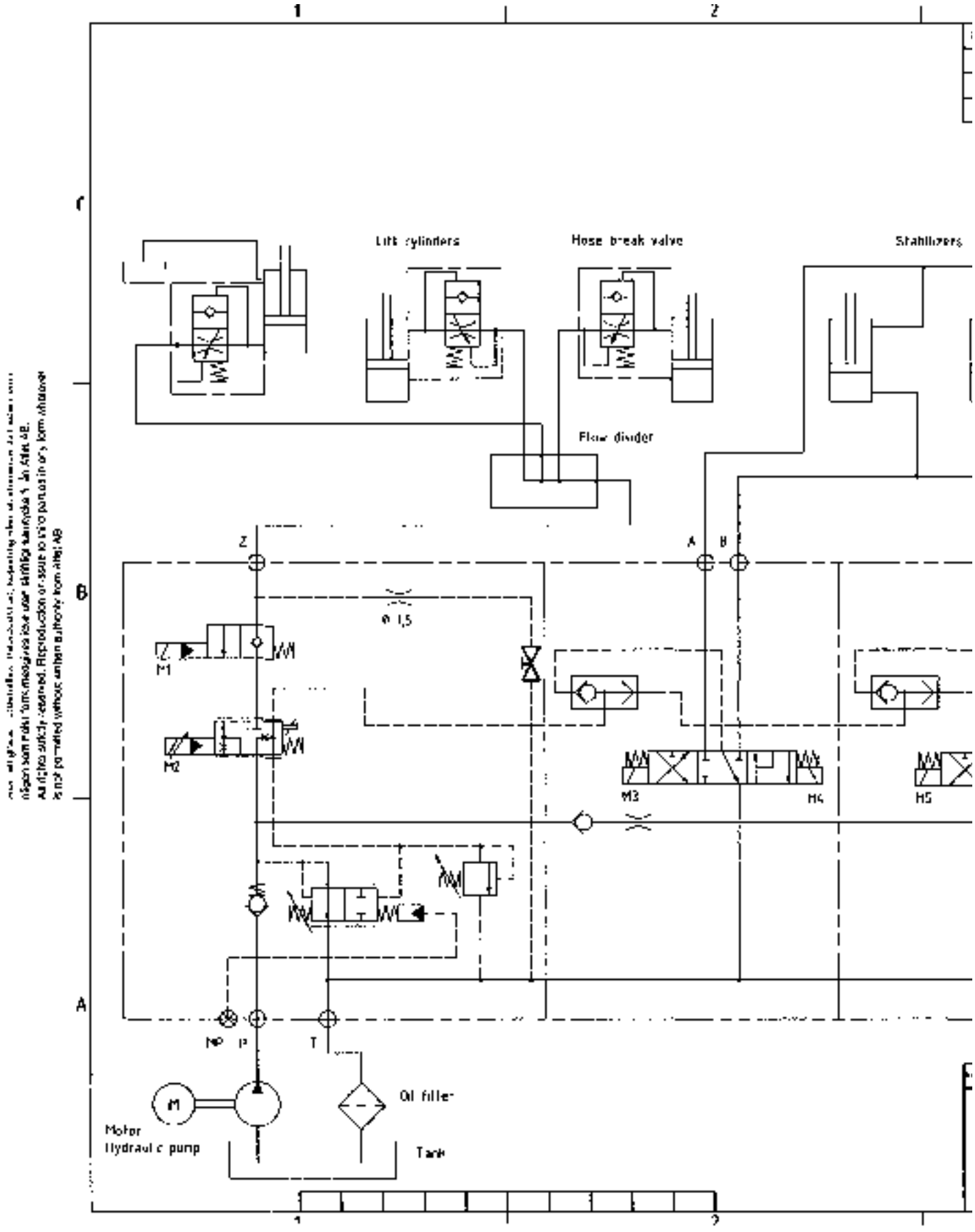
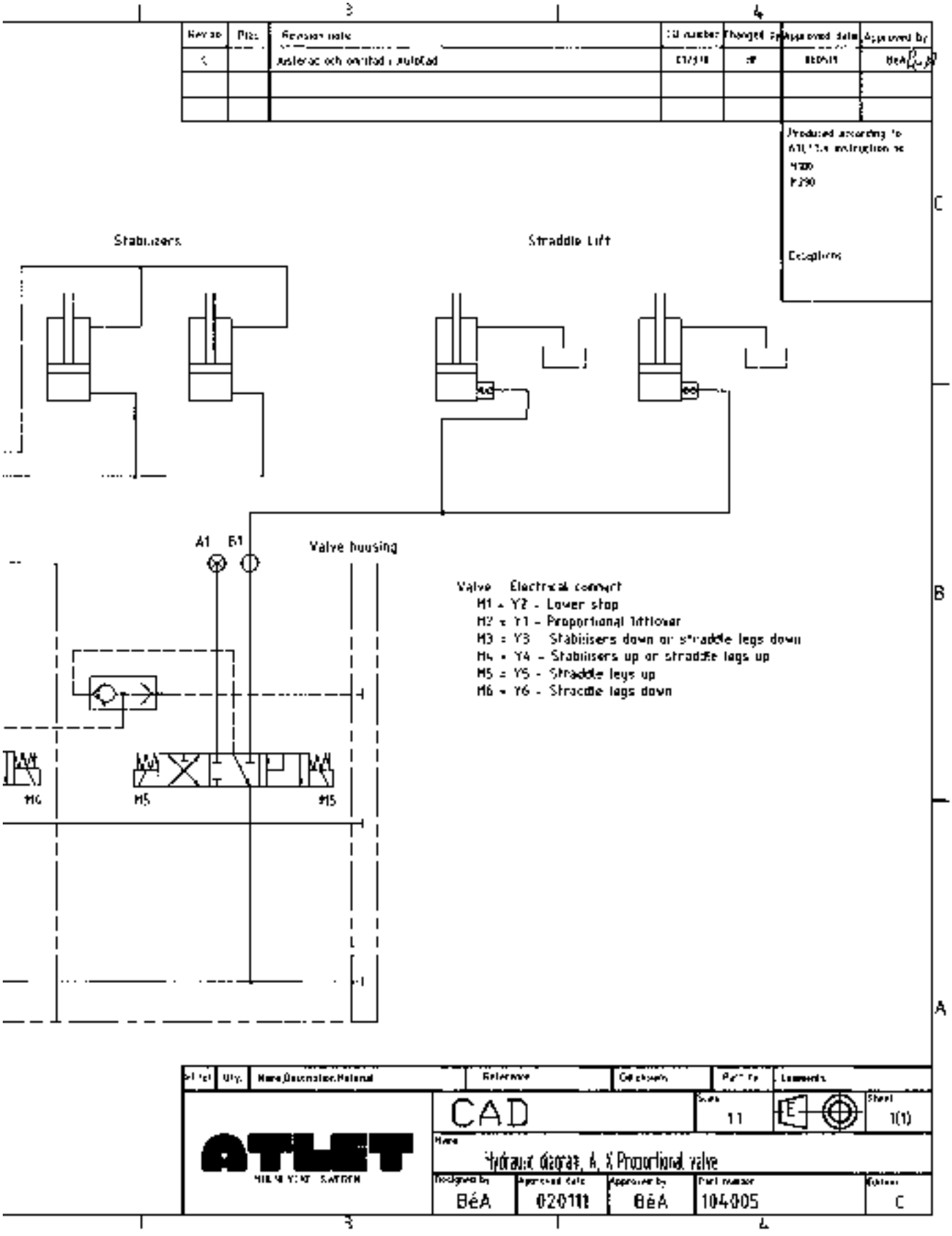
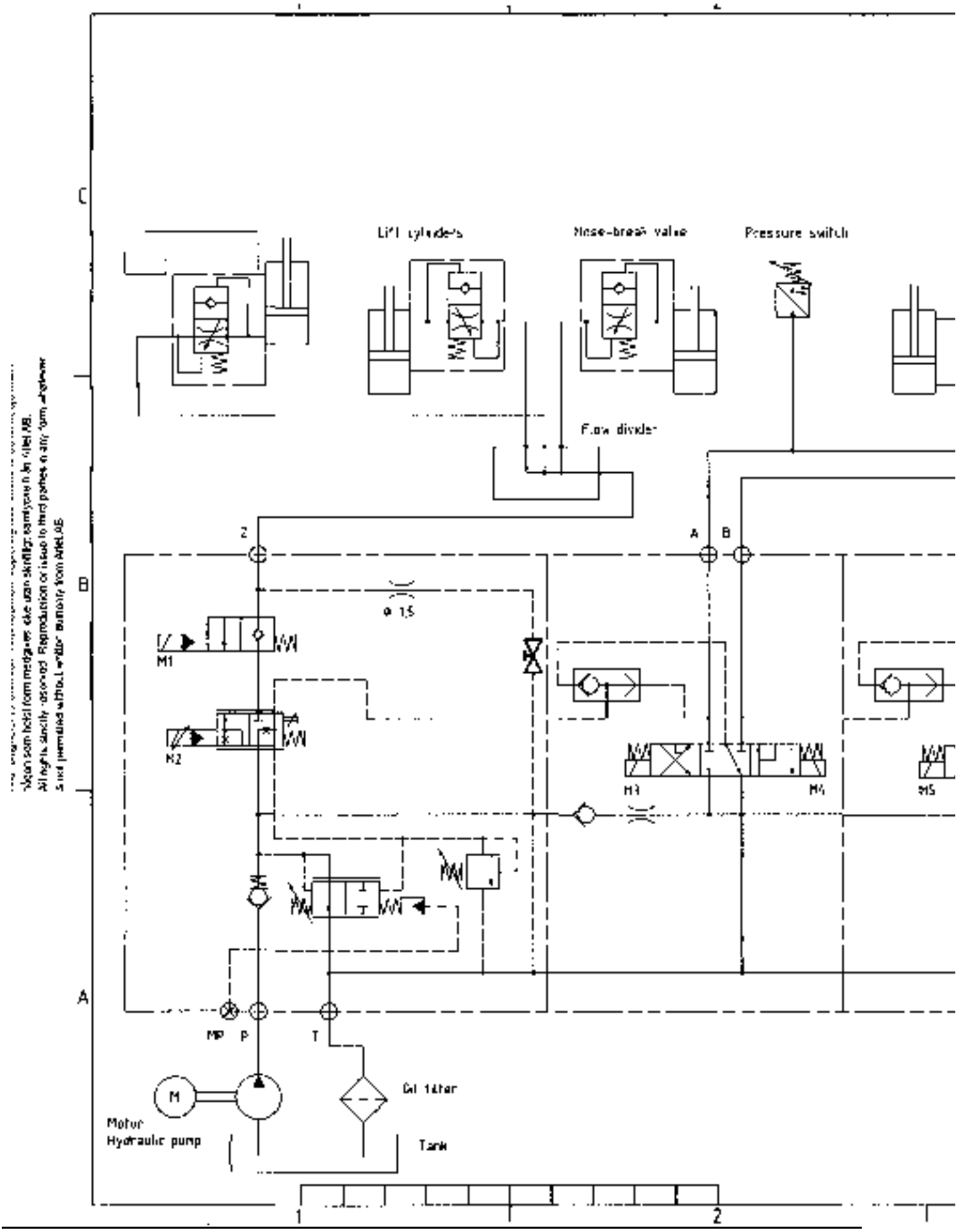
104014
C
3
4

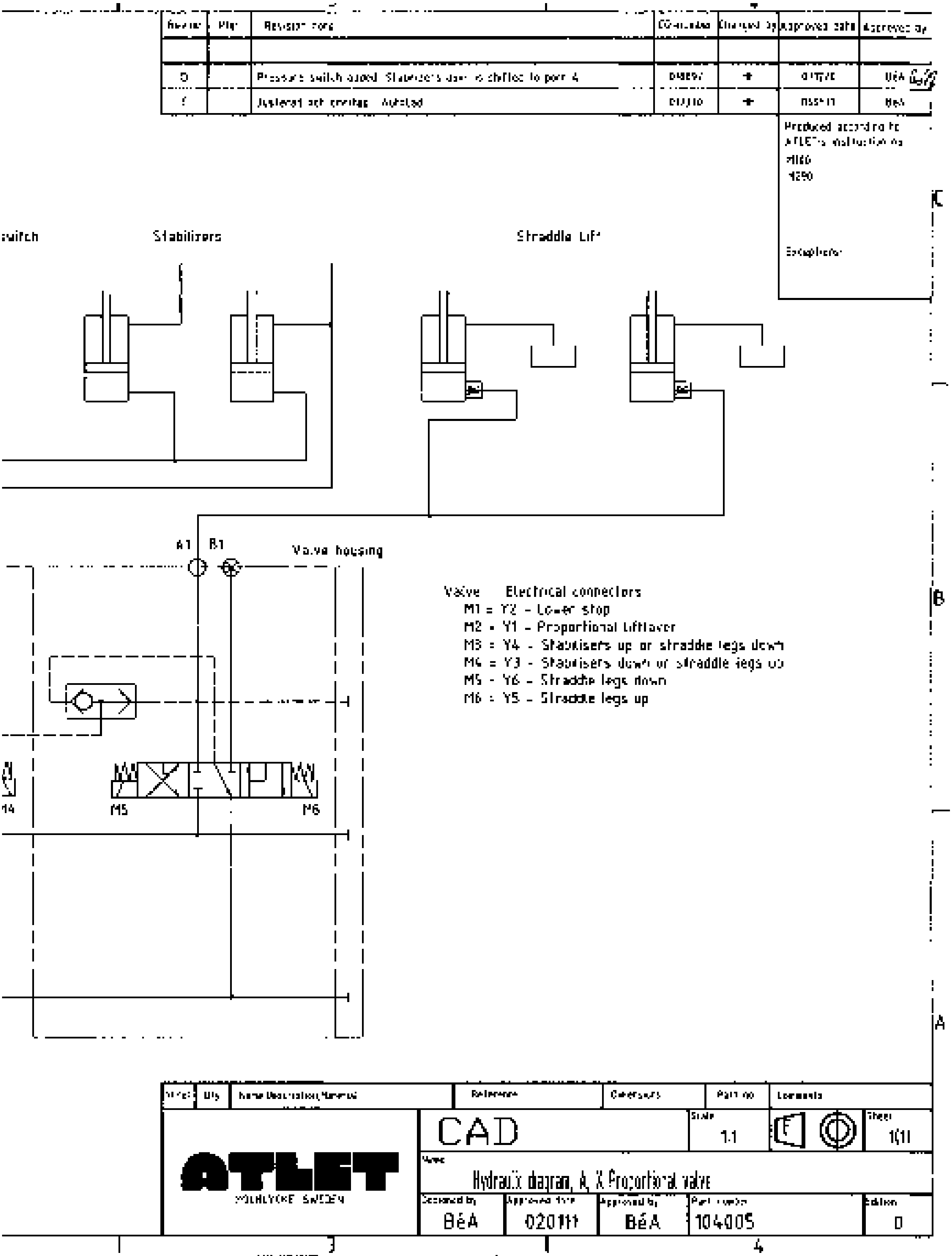
Hydraulic diagram, Proportional valve 104005 (–2008w45)



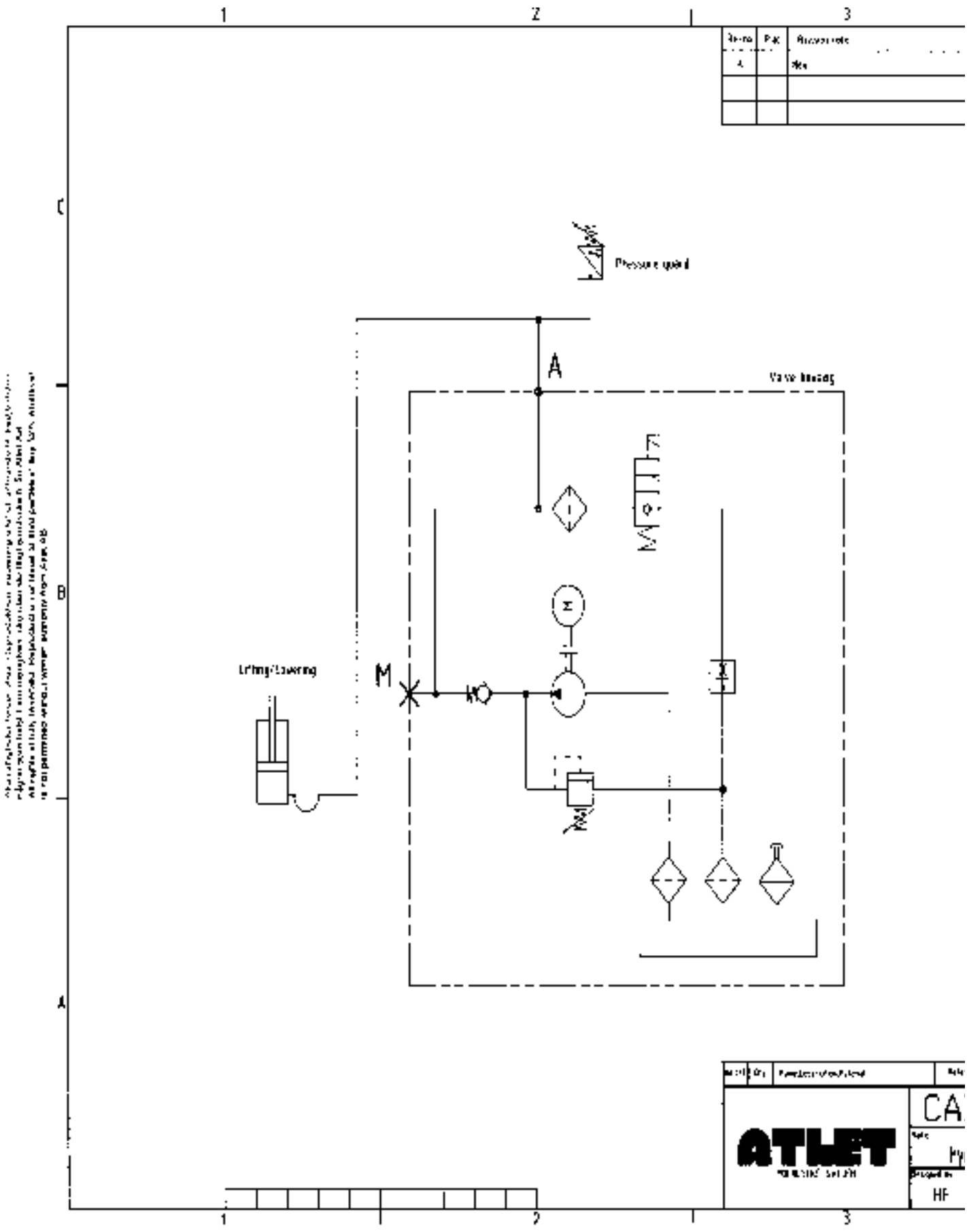

Stabilizers
Straddle Lift
A1
B1
Valve housing
M6
M5
M5
Valve Electrical connect
M1 = Y2 - Lower stop
M2 = Y1 - Proportional liftlower
M3 = Y3 Stabilisers down or straddle legs down
M4 = Y4 - Stabilisers up or straddle legs up
M5 = Y5 - Straddle legs up
M6 = Y6 - Straddle legs down
CAD
Hydraulic diagram, A, S Proportional valve
BéA
020111
BéA
104005
C

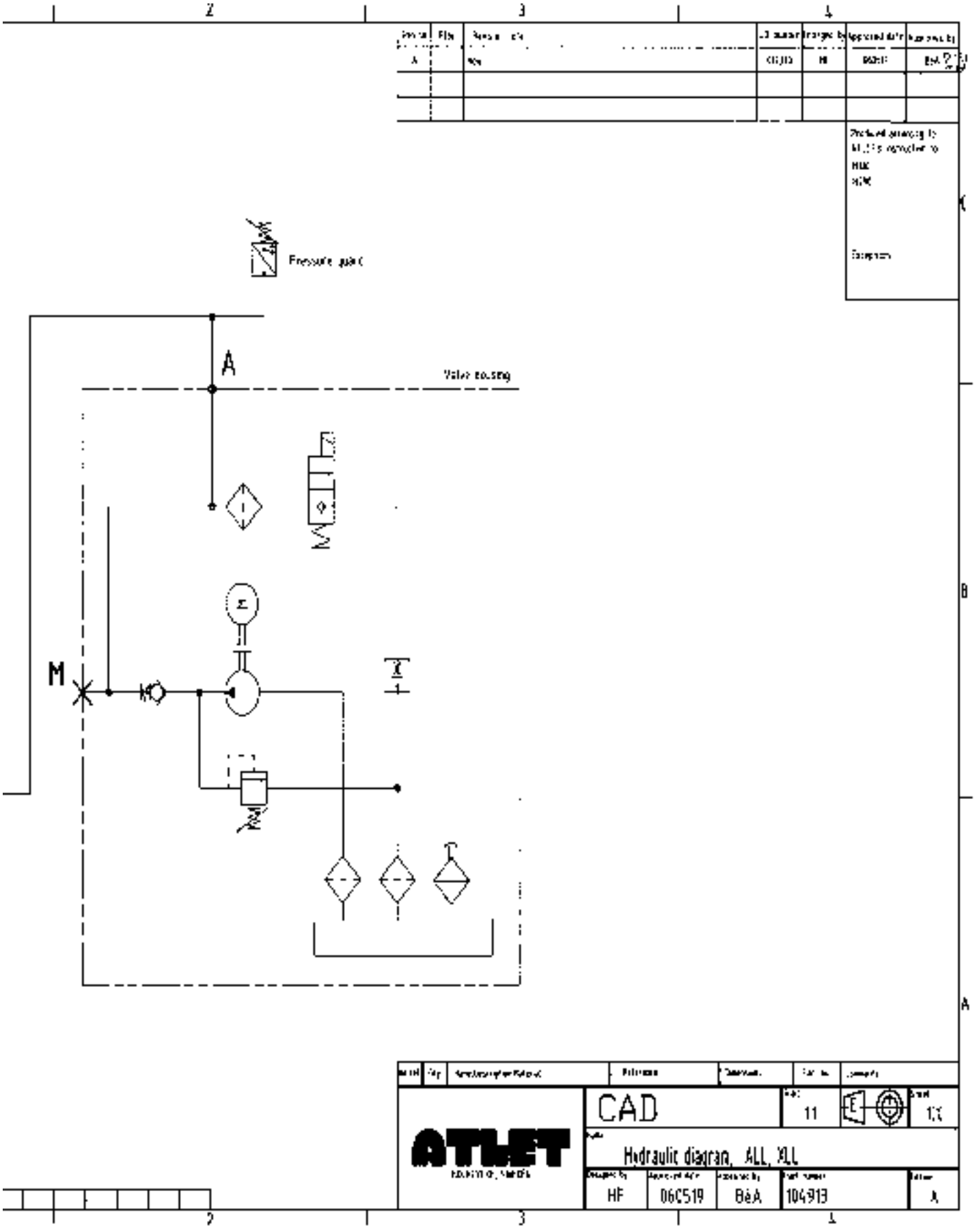
Hydraulic diagram, Proportional valve 104005 (2008w46–)




Stabilizers
Straddle Lift
Valve housing
A1
B1
M5
M6
Valve Electrical connectors
M1 = Y2 - Lower stop
M2 = Y1 - Proportional liftlever
M3 = Y4 - Stabilisers up or straddle legs down
M4 = Y3 - Stabilisers down or straddle legs up
M5 = Y6 - Straddle legs down
M6 = Y5 - Straddle legs up
CAD
1:1
ATLET
MÖLNLYCKE SWEDEN
Hydraulic diagram, A, X Proportional valve
BéA
020111
BéA
104005
D

Hydraulic diagram, ALL 104913

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Hydraulic diagram, ALL, XLL
ATLET
HF
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BèA
104913
A

Repair instructions

Hydraulic system

General rules

Important!

Cleanliness during all work with hydraulic components is of the greatest importance for the operating safety and service-life of the system. The following should be taken into consideration:

- Dirt particles must not get into the components.
- Do not use cloths that shred fibres or particles.
- Only use clean tools.
- Carefully clean tanks, pipes and hoses before installation.
- Welded or hot-bent pipes must be pickled (cleaning with acid bath) and washed before they are built in.
- The oil tank must be sealed and provided with an efficient air filter to prevent dirt contaminating the hydraulic system.
- Sealing compounds such as flax, cement or thread tape are not permitted.
- Take into consideration the specified operating data.
- Do not exceed permitted pressures and volume flows.
- Do not exceed or go below the specified temperature range.
- Pay attention to specified electrical voltages and power consumption.

Note!

All work with the hydraulic system should be carried out in a pressureless state and in a clean environment.

Installation

To prevent dirt and corrosion in the hydraulic system all hydraulic components should be provided with plastic plugs in the connections before they are delivered. Only remove these plugs just before the component is to be installed in the machine. Retaining screws and connections must correspond with those on the drawing. Retaining screws should not be tightened with a higher torque than what is specified on the drawing. If such information is lacking the torque should not exceed the tightening torque specified in section 1.

Connections

Couplings should be fitted according to the tightening torque specified in section 1. We recommend couplings with elastic seals. Such couplings are necessary for control valves. Ring couplings do not seal at the low torque generally applicable for proportional valves.

Connect pipes and hoses in accordance with the hydraulic diagram. Pay attention to the connection designations. Do not use force; and avoid building-in tensions in pipes, etc,

Start up

Check that everything is connected in accordance with the hydraulic diagram. Set the pressure limiting valves down to a very low pressure if they are not sealed. Start up with low pressure and volume flows.

Test the function and tightness of the system. Clean the system by allowing the oil to pass over the filter for a while, without loading the system (replace the filter insert at the recommended intervals). Check the oil level. Set the pressure and volume flows slowly to the values they should have. Check the connected measuring equipment regularly, where appropriate. Pay attention to the noise level; abnormal noise indicates defects. Test during variable loads that components are correctly fitted, and that the system is tight.

In the event of the return of equipment to the manufacturer, protect polished surfaces from damage and dirt by covering them with foil and protective paper. Fit plastic plugs in all connections. Send the complete component, not loose parts.

Hydraulic oil, changing/draining

Properties of the hydraulic oil

The hydraulic oil recommend in this manual, section 1, has properties that promote a long service-life and first-rate functionality, and should be the oil used in the truck. The hydraulic oil used in Atlet trucks should comply with Atlet quality requirements:

- Smooth and uninterrupted flow without abrasion.
- Long service-life.
- High viscosity index with wide range of temperature applications.
- First-rate low temperature properties.
- High filterability.
- First-rate capacity to separate air and water.
- First-rate wear protection.
- First-rate oxidation stability.
- Negligible foaming.
- Protection from rust and corrosion.
- First-rate adhesive capacity.

Requisite equipment

- New oil, or purifying equipment for the old oil.
- A tray to collect the oil in.
- A clamp or plug for the suction pipe.

Procedure

1. Lower down the forks and disconnect the battery electrically.
2. Lift up the steering wheel panel and pull out the machine housing cover.
3. Check how much oil needs to be filled by checking the oil level (the level differs between different truck variants).
4. Lower the forks to their lowest position and disconnect the battery electrically.
5. Place the tray on the floor behind the truck.
6. Clamp the suction pipe between the pump and tank, release the suction hose from the pump and lead it to the tray, and then release the clamp so that the oil runs out.

Important!

Make sure that the oil does not overflow in the tray. The oil should be taken care of in accordance with environmental legislation.

Filters are always replaced when changing the oil!

7. Replace the suction pipe, and fill up with new oil through the hydraulic oil filter to the same level as before. If there has been any leakage it will be necessary to fill to a higher level than before. To obtain the correct oil level all the cylinders should be run to their end positions, and check that the pump does not suck air.
8. Run in the cylinders and check that the oil tank does not overflow.

Note!

The hydraulic oil should be filtered when filling, by pouring the oil through the filter.

9. Wipe up any spilled oil, close the machine housing cover, and lower down the steering wheel panel.

Air filter, replacing

The air filter is placed on the side of hydraulic tank cap.

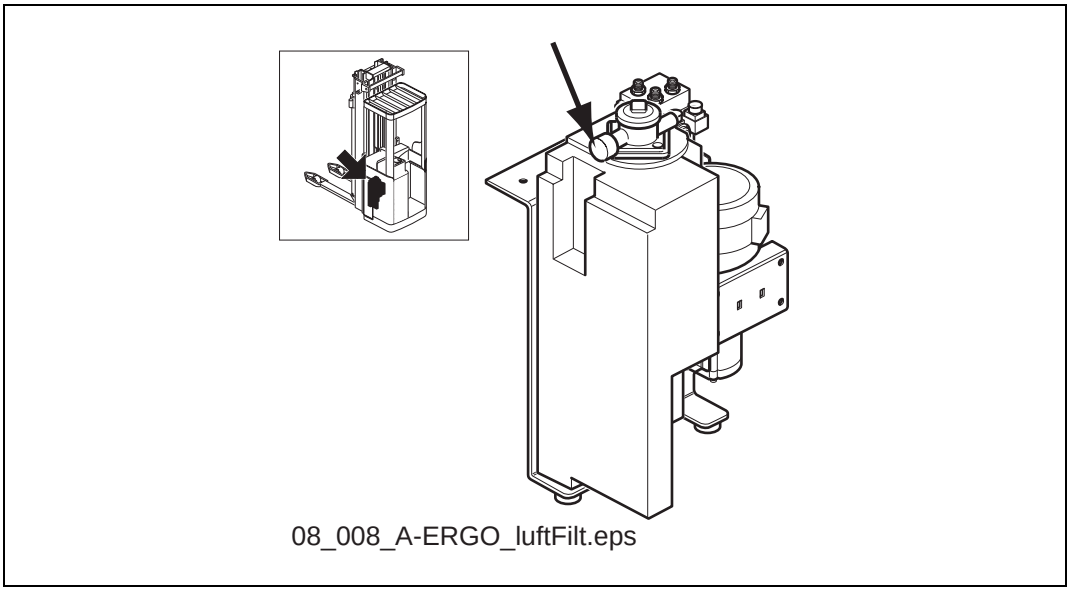


Figure 8.1 Air filter on hydraulic tank

1. Unscrew the cap on the filter housing.
2. Take out the filter.
3. Wipe clean the filter housing with a cloth that does not shred fibres.
4. Insert a new filter and screw on the cap.

Oil filter insert, replacement

1. Lower down the forks and disconnect the battery electrically.
2. Open the machine housing cover.
3. Remove the cap located on the top of the hydraulic oil tank.

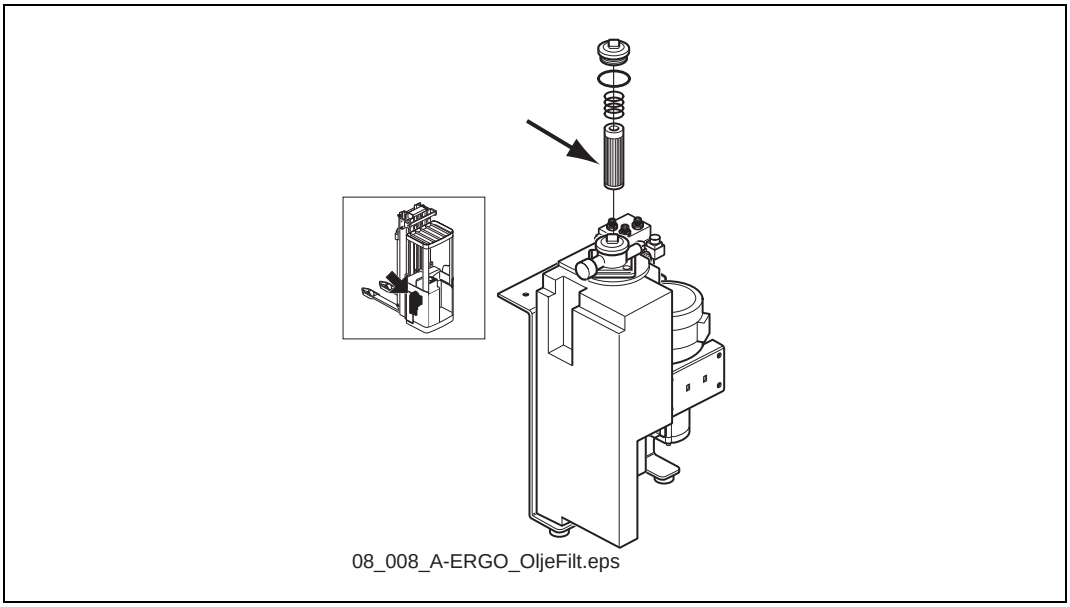


Figure 8.2 Oil filter

4. Lift up the filter insert, wait until the oil has managed to run off the filter, and then lift it out.
5. Pull the filter loose from the rod.
6. Clean the magnet on the rod, the purpose of which is to attract swarf.
7. Insert a new filter.
8. Replace the filter insert in the hydraulic oil tank, fit a new O-ring, and screw tight the cap.
9. Close the machine housing cover.

Checking the hydraulic oil level

1. Carefully lift the fork carriage to its top position.
2. Check that the hydraulic pump does not suck air. This can be recognised by the function in operation moving jerkily, or by an abnormal screeching noise.
3. If the hydraulic pump sucks air lower down all the hydraulic functions to their lower positions, open the machine housing cover, and check the oil level in the hydraulic tank.
4. Fill with hydraulic oil of the grade recommended in section "Properties of the hydraulic oil" on page 8.16 so that the level rises a few cm, and then perform the “test lift” and check as above.
5. Repeat this procedure until a normal function is obtained.

Lowering brake valve

Dismantling and assembling

1. Lift the forks so that the inner mast lifts approx. 30 cm. Place a block under the inner mast and carefully lower down so that the mast rests on the block. Continue lowering until the system is pressureless.
2. Disconnect and push the battery out to improve accessibility.
3. Place protective paper under the truck, release the hose from the valve housing, pos. 1, and plug it.
4. Unscrew the lowering speed valve, pos. 2, and plug the valve housing, pos. 1.
5. If a fault is suspected on the valve, it should be check measured. There are specific dimensions for the spring length, depending on which cylinder it is to protect. See adjustment values in table 8.2.
6. Adjust the valve, or replace with a new one, and fit it in the valve housing.
7. Fit the hose and push back the battery..

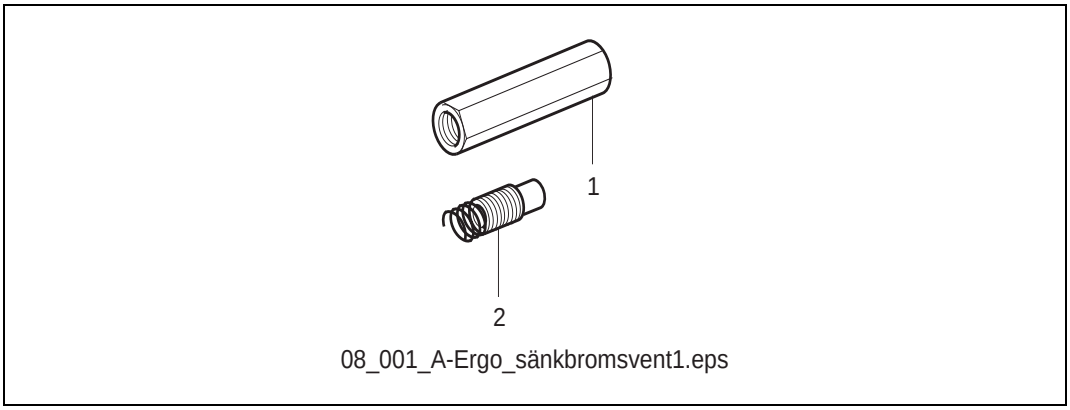


Figure 8.3 Lowering brake valve

8. Test run.

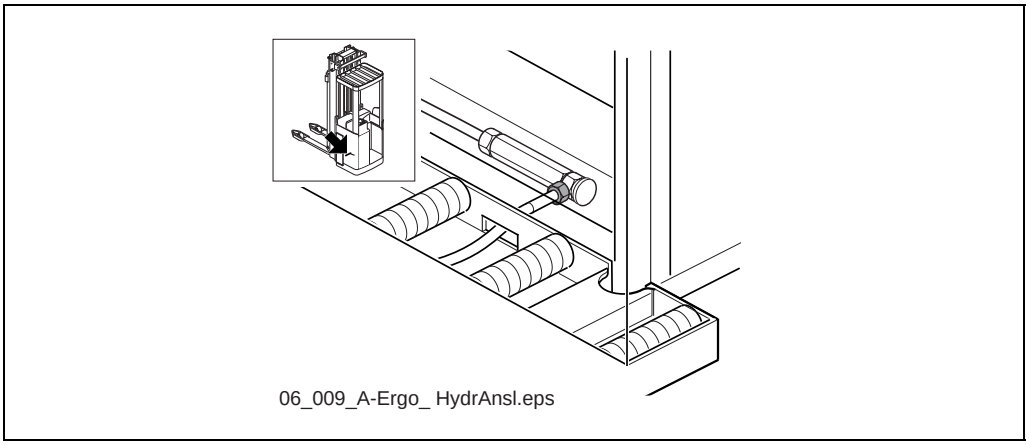


Figure 8.4 Position of lowering brake valve

Table 8.2 Adjusting the lowering brake valve

Machine type	Marking	s mm	v s/m	Q L/min
A Straddle lift	SB09C/3402	7,5	9,6	10
A 160 T	SB25C/3342	13,5	1,8	37
A 160 TV	SB25C/3342	13,5	1,8	37
A 160 TFV	SB27C3345	16	1,8	45
A 160 DTFV	SB25C3342	13,5	1,8	37
A TF/200 TFV	SB27C/3345	16	2,0	45
A TF/200 DTFV	SB27C/3345	16	2,0	45

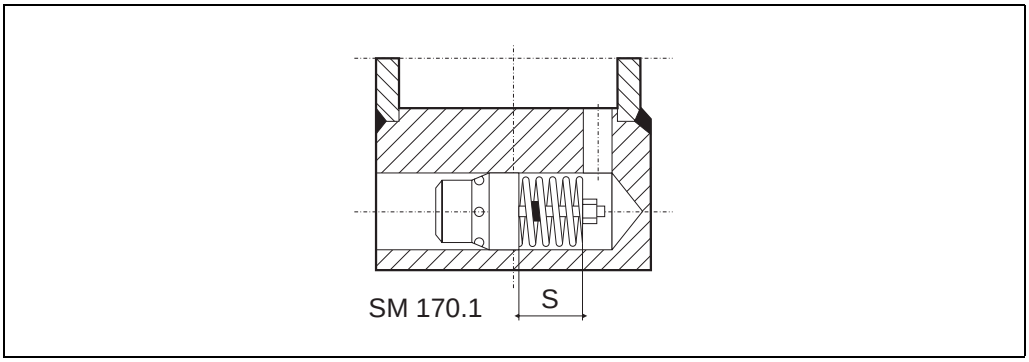


Figure 8.5 Cross-section, lowering brake valve

Hose rupture valve

Dismantling and assembling

1. Lower down the forks and relieve the pressure.
2. Place protective paper under the cylinder to be repaired.
3. Loosen the pipe or hose that goes to the cylinder, and plug it.
4. Remove the nipple placed in the cylinder.
5. Unscrew the hose rupture valve, pos. 1 figure 8.6, that is screwed into the cylinder.

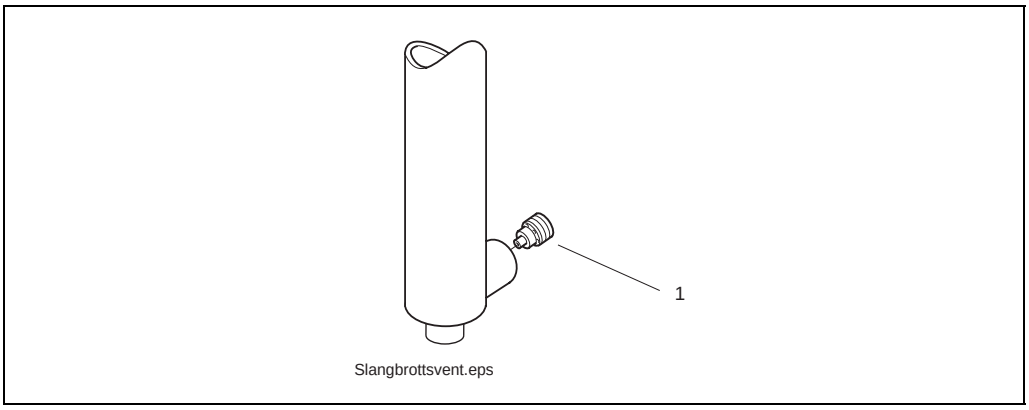


Figure 8.6 Hose rupture valve

6. If a fault is suspected, check the length of the spring in relation to the table or data sheet. Adjust, or fit a new valve.
7. Fit the nipple, connect the pipes, and wipe clean.
8. Test run, see adjustment values for hose rupture valve in table 8.3..

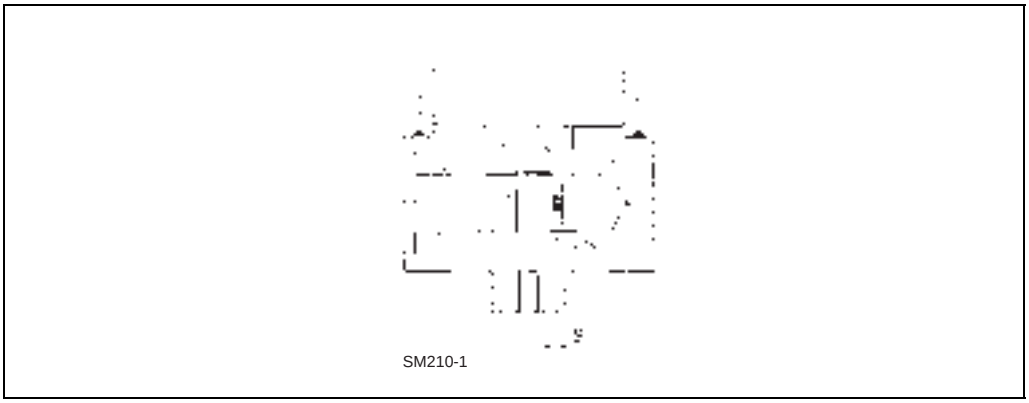


Figure 8.7 Hose rupture valve in cross-section

Table 8.3 Adjustment values for hose rupture valve

Machine type	Marking	s mm	Q L/min
A 160 T (Electric proportional valve)	LB3C/3791	2,4	80
A 160 TV	LB3C/9175	1,2	50
A 160/200/TF TFV Free-lift	LB3C/3791	2,4	80
A 160/200/TF TFV End stroke	LB3C/9185	1,2	50
A 160/200/TF DTFV Free-lift	LB4C/3694	2,0	125
A 160/200/TF DTFV End stroke	LB3C/3691	2,0	67

Control valve

General instructions when working with control valve

1. Cleanliness

    - Dirt particles must not get into the components.
    - Cloths must not shred fibres and particles.
    - Tools should be clean.
    - The tank, pipes and hoses should be carefully cleaned before installation.
    - Welded or hot-bent pipes should be pickled and washed before they are built in.
    - The oil tank must be sealed and provided with an efficient breathing filter that prevents the penetration of dirt.

2. Sealant

    - Hemp, cement or sealing tape are not permitted.

3. Operating data

    - Do not exceed permitted pressures and volume flows.
    - Do not exceed the specified temperature range.
    - Pay attention to specified electrical voltages and max power consumption.

Manually operated hydraulic valve, dismantling and assembling

1. Lower down the forks and relieve the pressure in the hydraulic system.
2. Lift up the hand rest so that the valve becomes accessible. See section 4 for dismantling of arm rest.

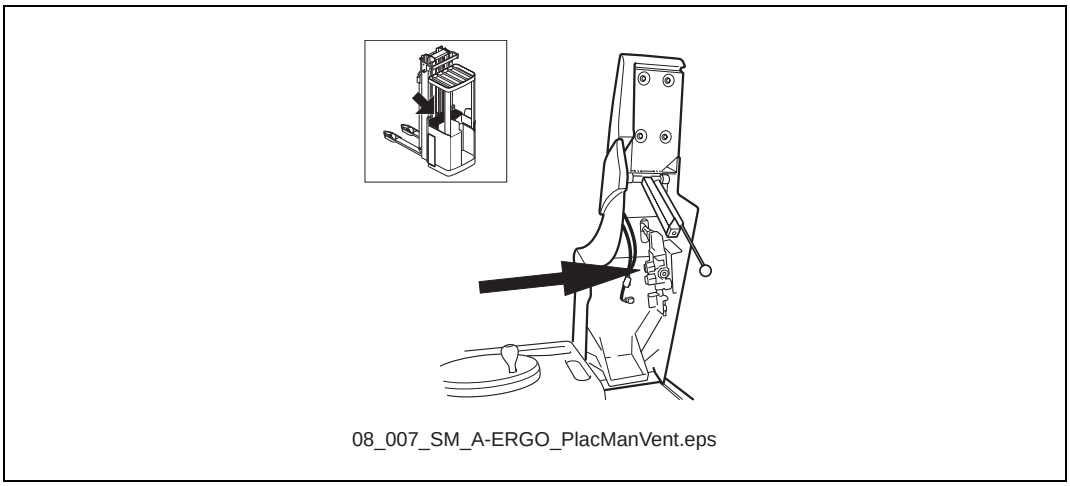


Figure 8.8 Position of manual proportional valve

3. Place protective paper under the valve and release the electric cables to the microswitch(s).
4. Loosen all the oil pipes connected to the valve, and plug them.
5. Loosen the valve from the truck, and lift it out.
6. When fitting, first place the valve in the truck but do not tighten until all the oil pipes are connected. Tighten the valve and then the oil pipes.
7. Adjust the pressure limiting valve to the rated weight in accordance with the machine plate.
8. Seal the setting.

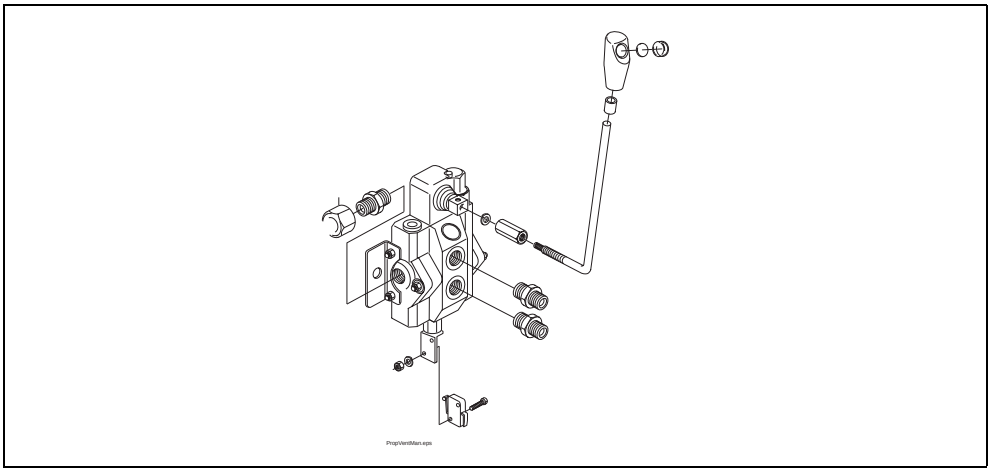


Figure 8.9 Lever regulated valve

Electrically operated control valve, dismantling and assembling

1. Lower down the forks and relieve the pressure in the hydraulic system.
2. Switch off the key switch.
3. Open the machine housing cover and lift up the hand rest so that the valve becomes accessible.

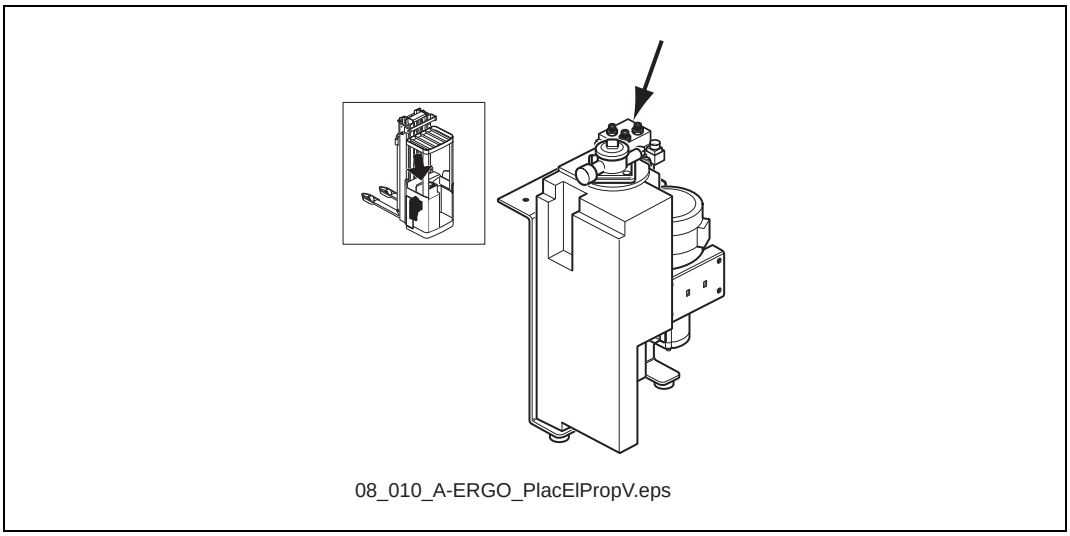


Figure 8.10 Position of electric proportional valve

4. Place protective paper under the valve and release the electric cables to the microswitch(s).
5. Loosen all the oil pipes connected to the valve, and plug them.
6. Loosen the valve from the truck, and lift it out.

Tightening torque:

60 Nm.

7. When fitting, first place the valve in the truck but do not tighten until all the oil pipes are connected. Tighten the valve and then the oil pipes, max 60 Nm.
8. Adjust the pressure limiting valve to the rated weight in accordance with the machine plate.
9. Seal the setting.

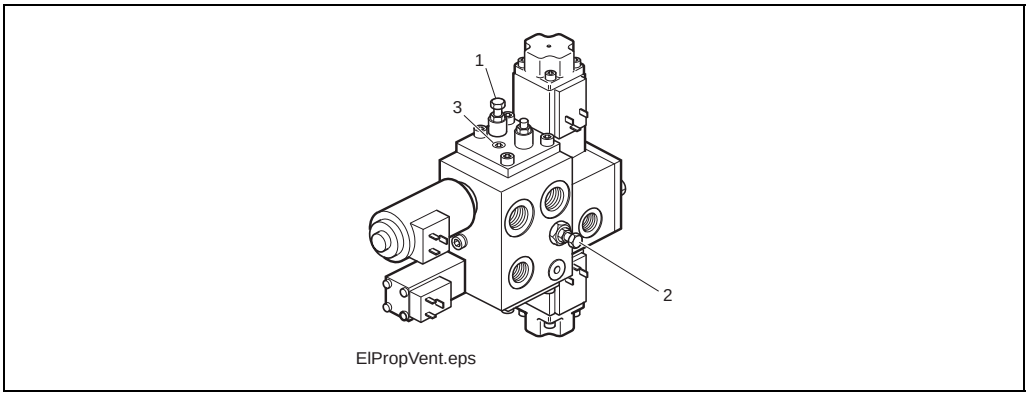


Figure 8.11 Electrically operated proportional valve

Checking the lowering speed

The lowering speed of the fork carriage is checked with the load on the forks specified on the truck machine plate.

Check the actual lowering speed with the table below.

☞ ***Important!***

In accordance with EN 1726 a load must not be lowered faster than 0.6 m/s.

Table 8.4

Mast type	Lowering speed m/s
A 160	max 0.6
A 200/TF	max 0.5

If the correct lowering speed cannot be achieved then the electrical signal from the control unit to the solenoid valves should be checked first, in accordance with "Adjusting the regulator, electric valve" on page 8.28.

The hydraulic valve is then adjusted in accordance with "Adjusting the lowering speed valve in the electric hydraulic valve" on page 8.28.

Adjusting the regulator, electric valve

See section 10.

Adjusting the lowering speed valve in the electric hydraulic valve

As a first step all the the control unit settings should always be checked before a hydraulic adjustment is made.

See section 10.

If the correct lowering speed has not been obtained (see "Checking the lowering speed" on page 8.28) adjust the lowering speed valve mounted on the hydraulic valve, see pos. 1 figure 8.12, until the correct lowering speed is obtained.

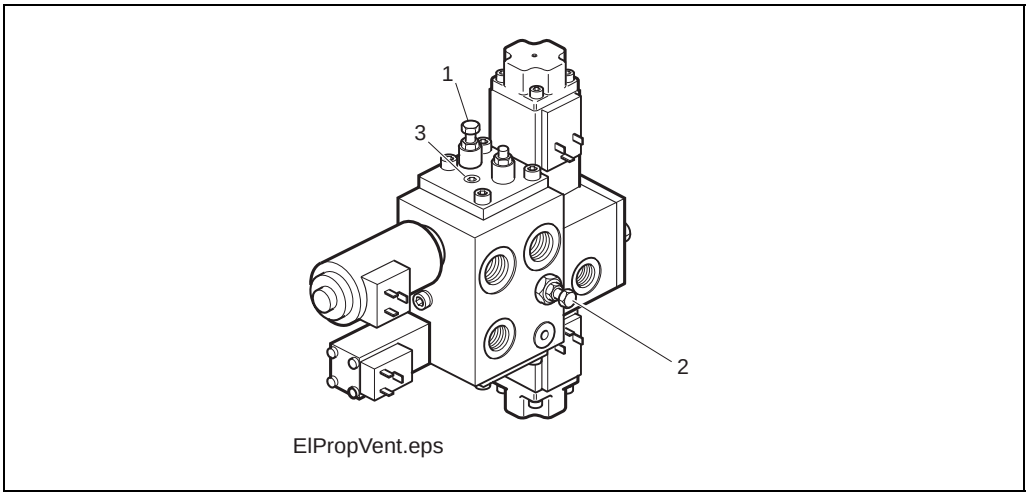


Figure 8.12 Electrically operated proportional valve

Adjusting the working pressure

1. Place the max truck load on the forks (specified on the truck machine plate).
2. Unscrew the adjusting screw, pos. 2 see figure8.12, two turns to the left.
3. At the same time as the lift function for the fork carriage is actuated, screw in the adjusting screw until the fork carriage begins to lift from the floor, and then screw in an additional ¼ of a turn and lock.
4. Finally, perform repeated lifting operations to ensure that the lifting capacity is sufficient.
5. Seal!

Emergency lowering valve

The emergency lowering valve is used to lower the forks during power failure.

⚠ ***Warning!***

Make sure the forks can be lowered safely before the emergency lowering valve is opened.

1. Open the emergency lowering valve (3) using a 2.5 mm hexagon wrench.
2. Tighten the emergency lowering valve (3) when the forks are lowered.

Hydraulic pump motor

Dismantling the hydraulic pump motor

1. Lift the forks to their highest position to lower the hydraulic oil level in the tank, thus reducing oil leakage at the pump shaft when the motor is removed.

⚠ ***Warning!***

Do not work under the forks.

2. Disconnect the battery electrically.
3. Open the machine housing cover and release the cables to the hydraulic motor.
4. Loosen the retaining bolts that hold the pump at the hydraulic motor.
5. Loosen and remove the bolts that hold the clamp round the hydraulic motor.
6. Remove the loosened retaining bolts and release the pump from the hydraulic motor. Lift off the hydraulic motor.

☞ ***Important!***

Check that the connector is turned in the right direction and that the motor and pump journals come at 90° in relation to each other.

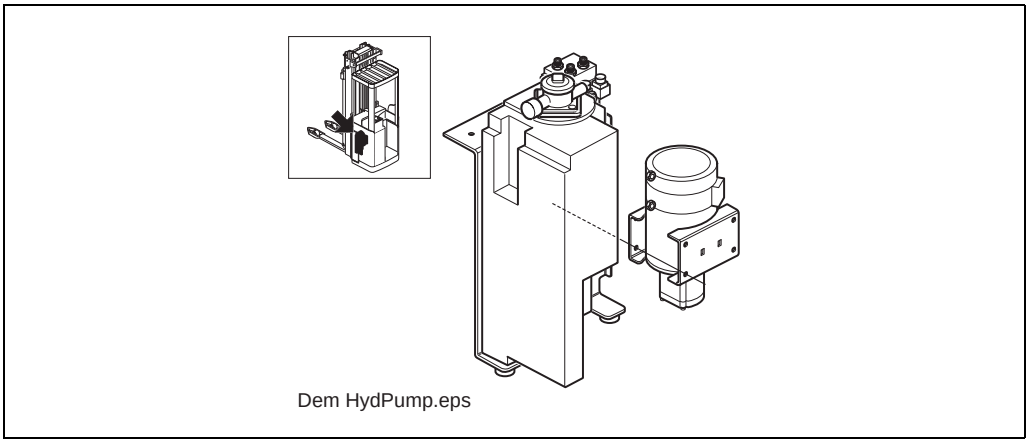


Figure 8.13 Hydraulic pump motor

Assemble in the reverse order.

☞ ***Important!***

Grease in the pump journal before fitting!

Hydraulic pump motor ALL

If there is a change in the performance of the motor it should be inspected inside. The brushes are one of the most common sources of a fault.

The brushes can become worn out, or stick in their holders. In both cases inadequate contact between the brushes and the commutator can lead to serious damage to the commutator surface.

When should the brushes be replaced?

- If a brush cannot move freely in the brush holder. To check this the brush holder must first be released from the brush rocker. The force from the brush spring should then press out the brush from the brush holder as far as permitted by the cable.
- If a brush is approaching the end of its useable life. The length of the brushes must never be less than 10 mm (a new brush has a length of 17 mm). Since this is difficult to measure, there is another alternative. Measure the difference between the cable and the slot in the brush holder. The difference should be at least 1 mm. Even if the difference should be slightly larger it is recommended to replace the brushes, since their residual service-life may be shorter than the time to the next inspection.

Replacing the brushes

The actual brushes cannot be replaced since they are included in a set consisting of brush, brush holder and spring. These can be installed as follows.

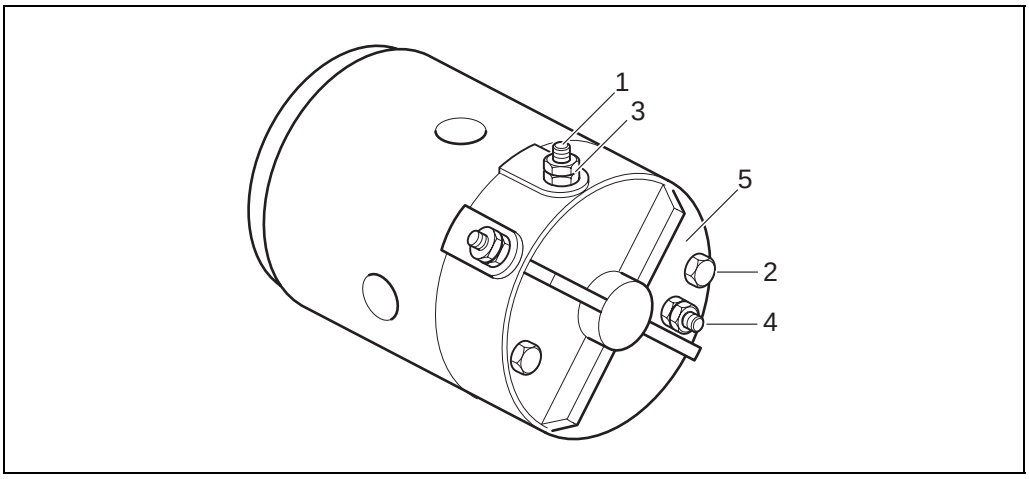


Figure 8.14

1. Release the cables from the terminals on the motor (pos. 1 figure 8.14).
2. Release the through bolts from the rear end head on the motor (pos. 2 figure 8.14).
3. Lift the motor out of the truck.
4. Place the motor on its drive end.

5. Release the nuts on the terminals (pos. 3 figure 8.14). If the motor has a return earth cable the earth connection on the rear end head of the motor should also be released (pos. 4 figure 8.14).

6. Release the rear end head (pos. 5 figure 8.14). Make sure that the terminals remain in their positions.

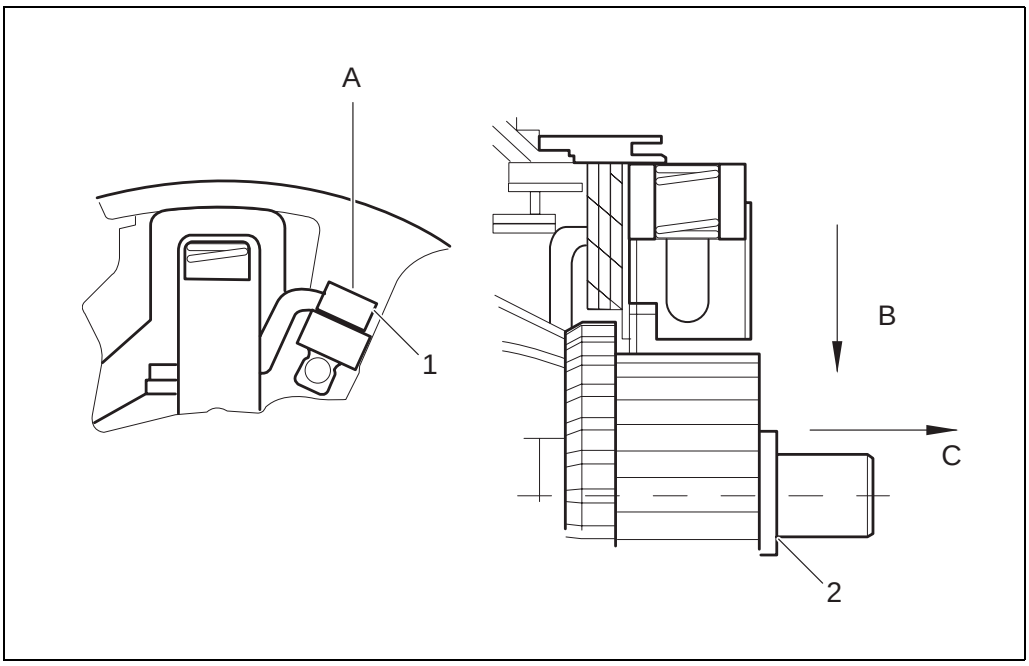


Figure 8.15

7. Disconnect all four brushes by loosening the screws, pos. 1 figure 8.15 - A. Now press each brush set to the commutator pos. 2 figure 8.15 - B. Remove the brush set from the brush rocker - C. The old brush set is replaced with a new set in the reverse order. It is recommended to replace each brush set separately to avoid confusion. Make sure that each brush set is replaced with the correct part, in other words one that has the cable on the correct side. (The service kit consists of two matching pairs of brush sets!)

8. Tighten the screw, pos. 1 figure 8.15, to approx. 1.3-1.8 Nm.

9. Replace the terminals in the slots in the rear end head, and replace it on the motor. Check that there is a washer between the rotor and end head (pos. 2 figure 8.15) and that the holder is held in place with a tooth and slot on the casing in the respective end.

10. Fit the through bolts and put the motor back in the truck. Tighten the bolts to approx. 4.8-6.8 Nm.

11. Tighten the terminals to 10-14 Nm (pos. 3 figure 8.14).

12. Replace the cables to the motor terminals.

Tips to prolong the service-life of the motor

- Rapid wear of brushes and commutator is often caused by oil. Oil or grease is burned by the sparks that develop at the brushes, which leaves a residue of abrasive ash. If oil or grease is found in the motor the cause of this must be eliminated immediately.
- Never overload the motor. Brushes that have been intensely overheated expand permanently and can fasten in the brush holders.
- The lifespan of the brushes not only depends on the load, but also on how worn the commutator is. The commutator should have a smooth, level, greyish-black surface. A worn commutator must be machined (never use abrasive paper, a whet stone or file!) to a surface fineness of Ra = 0.8-1.8 µm and a maximum offset of 0.03 mm (with the rotor resting in the bearing seats). For the service-life of the commutator it is better to machine it a little and more often, than seldom and a lot. The minimum diameter of the commutator is 40.8 mm.
- The motor must not be exposed to full loading immediately after changing the brushes.
- Look for signs of overheating on the windings, dark patches, brittle or burned insulation, and damage to the soldering on the commutator. If the motor is damaged in this way it is no longer serviceable.
- If possible, remove dust and dirt from the inside of the motor with compressed air.
- A dirty commutator should always be cleaned with a clean cloth moistened with petrol (do not use waste cotton since it sheds fibres), and carefully blown clean with compressed air.
- If the bearing brass looks as if it are out of oil (i.e. very little oil can be seen on the rotor washer or on the brush holder) lubricate it with a little bearing grease.

Stabiliser cylinders

The stabiliser cylinders have in their upper end a flexible attachment, the purpose of which is to compensate for minor irregularities in the floor

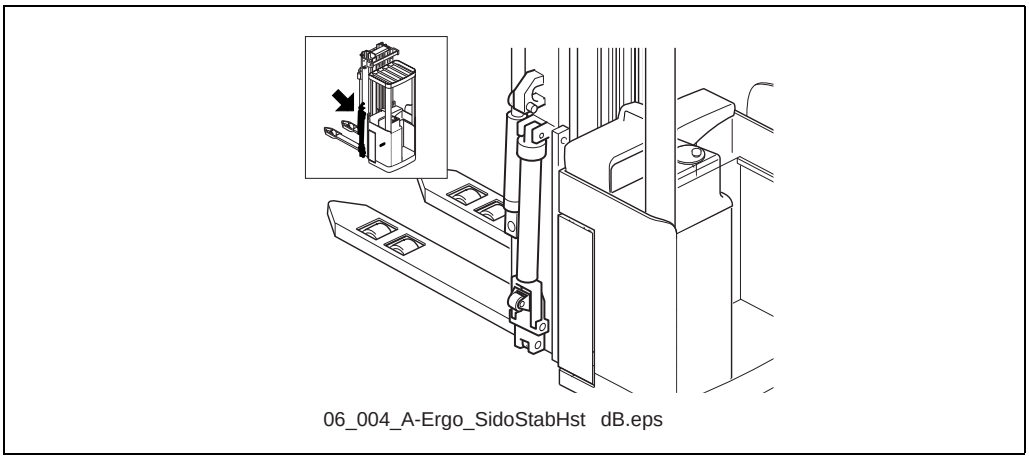


Figure 8.16 Stabiliser cylinder

Dismantling and assembling the stabiliser cylinders

1. Run out the stabiliser cylinders completely.
2. Remove the cotter in the upper attachment. First grip the cylinder with one hand, and then pull out the HCB bolt. This is because of the pretension in the spring unit.
3. Lift the stabilisers slightly to release the pretension in the spring unit.
4. Pull out the battery plug.
5. Release the hoses and plug them.
6. Remove the lower screw that goes through the piston rod end.

Dismantling and assembling, gaskets

1. Unscrew the piston rod guide and pull the piston rod out of the cylinder pipe.
2. Support the piston rod in a vice in the end that normally sits in the straddle lift. Use protective jaws on the vice.
3. Unscrew the nut and remove the gasket holder with the piston seals.

☞ ***Important!***

Before fitting, all seals should be lubricated with hydraulic oil.

4. Assemble in the reverse order.

Installation instruction for pipe couplings

To achieve a safe and tight connection when installing pipe couplings in the hydraulic system, the following points should be taken into consideration:

1. The pipe should be cut at right angles by means of a pipe cutter (see figure8.17 and8.18) after which it is deburred internally and externally, and carefully cleaned.

☞ ***Important!***

When using a pipe cutter the end of the pipe becomes skew, with the formation of substantial burrs internally and externally. It is therefore important to straighten the end of the pipe and remove the burrs, both internally and externally.

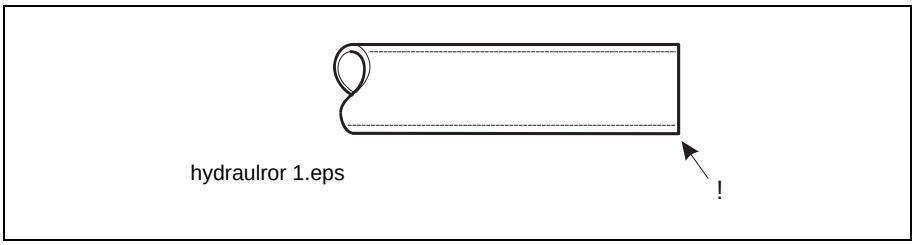


Figure 8.17 Cut at right angles!

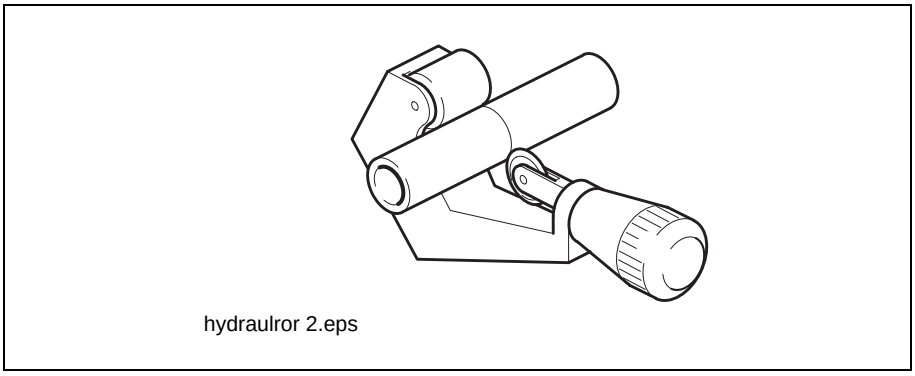


Figure 8.18 Pipe cutter

2. Oil the thread and ring (do not use not grease). Put the nut and ring over the pipe end as shown in the figure. If the ring cannot be worked over the pipe end it must absolutely not be enlarged. File down the pipe end instead.
3. Small pipe dimensions can be fitted directly in the coupling connected to the machine part. Screw the nut by hand until it lies flush with the ring, press the pipe towards the shoulder in the coupling cone, and then tighten the nut a ¾ turn.

☞ ***Important!***

The pipe must not follow round.

4. The ring will now have gripped the pipe, and no longer needs to be pressed against the shoulder. Complete the fitting with an additional ¾ turn of the nut. A mark on the nut simplifies following the specified torque, see figure 8.19.

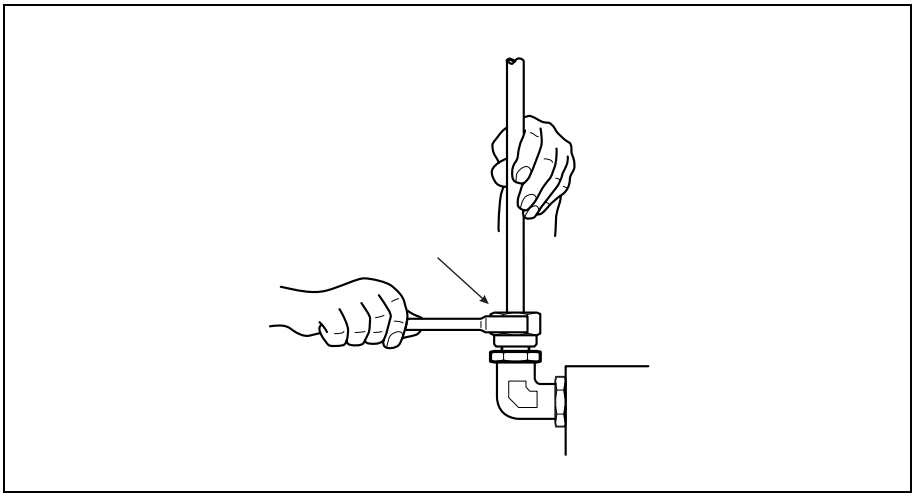


Figure 8.19 A mark on the nut simplifies the specified torque

5. Larger pipe dimensions and couplings in free pipes are preferably fitted by placing the coupling body in a vice. The length of the U-ring spanner should be 15 times the width of the nut (can be extended with a piece of pipe). Otherwise fit according to point 3.
   If several couplings of the same type are to be fitted, make sure that each pipe end goes in the same coupling cone it was previously fitted in.
   Fitting is simplified if the nut is loosened and oil is applied between the friction surfaces.

6. After fitting, release the cap nut and check that the ring has pressed up a visible swelling in the area in front of it, see figure 8.20. If not, give it another short turn. It is of no importance whether the ring can still be turned.

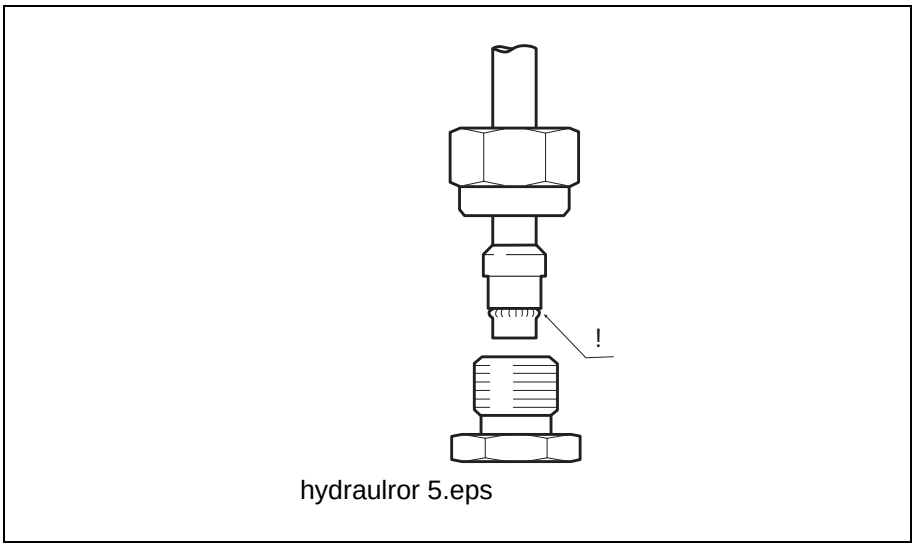


Figure 8.20 A visible swelling should have formed after tightening

After a visible swelling has formed the nut should be fitted without extension of the U-ring spanner, and without excessive force.

Important!

Refitting: After a visible swelling has formed the nut should be fitted without extension of the U-ring spanner, and without excessive force.

7. If the pipe is to be bent after a coupling, the straight pipe end should have a length of at least 2 nut heads, H.
   Long and heavily loaded pipes should be provided with pipe clips.

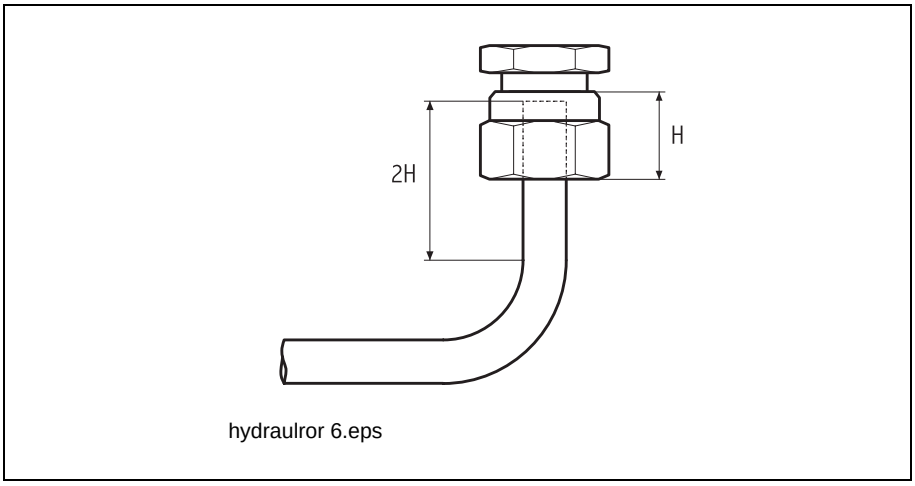


Figure 8.21 Straight pipe length between bend and coupling

8. Final assembly should be done with at least 1 turn of the nut from the point where it cannot be turned by hand.

Diagnosis and trouble shooting

Symptom and Action

A number of fault symtoms have been listing in the table below with a number of possible faults and repair procedures. It is therefore possible that other faults not listed can occur.

Table 8.5

Symptom	Possible fault	Action
The lift motor runs but the fork carriage does not lift.	The lowering valve has jammed and is open.	1. Close the valve. 2. Adjust, or remove any dirt in the valve.
The lift motor runs but the fork carriage lifts very slowly.	The machine is overloaded.	Lighten the load.
	The overflow valve is defective.	Adjust the valve to the rated weight.
	An object has partially blocked hoses, hydraulic pipes or valves.	Dismantle and clean.
	A hydraulic hose has been clenched.	Rearrange the hose and clamp it secure.
The lift motor emits a screeching noise just before the fork carriage reaches the top.	The oil level is too low in the hydraulic tank.	1. Fill up with hydraulic oil. When the tank is almost full, try with 0.1 litre at a time to avoid overfilling. 2. Find out the reason for the low level, and rectify the fault.
The fork carriage cannot be lowered.	Valve does not open on return because of object in the system.	Dismantle the valve and clean.
	The hose rupture valve is closed because the lowering speed is too high.	Limit the lowering speed.
	The hose rupture valve is closed because the spring in the valve is defective.	Replace the hose rupture valve.
The fork carriage lowers too slowly.	The lowering valve or lowering brake valve is dirty or defective.	1. Run the motor at full power for 1 minute to see if the dirt is released. 2. If not, dismantle the valve and clean it, or alternatively replace defective parts.
	The oil filter is blocked and dirty.	Replace filter.

Table 8.5

Symptom	Possible fault	Action
The fork carriage lowers too quickly.	The lowering brake valve is defective.	Replace the lowering brake valve.
	The lowering brake valve is incorrectly adjusted.	Adjust the lowering brake valve.
Hydraulic oil flows out through the air filter.	Oil level too high.	Reduce the oil level to the correct level.
	The oil foams.	Replace with oil with the correct properties.
	Condensation in the oil tank.	Drain the oil out of the tank and fill with new hydraulic oil to the correct level.
The fork carriage bounces when lifting.	Air in the hydraulic system.	Bleed the system through the lift cylinders.
The hydraulic oil smells of sulphur.	The oil separators in the hydraulic oil are destroyed.	1. Change the oil and filter. 2. Flush the complete system with new hydraulic oil.
	Motor oil has been used and caused the hydraulic oil to emulsify with water, which has then rotted.	

SERVICEMANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2002B

9 Lift cylinders

Edition 2002B

9 Lift cylinders

Design and function

Introduction

The lift cylinders consist of single-acting hydraulic cylinders, where hydraulic oil is pumped into the cylinder and presses out the piston rod.

When the driver activates the lowering function the cylinders are pressed together by means of a control valve releasing oil out from the cylinders. They are then pushed together by the weight of the forks, at the same time as the oil returns to the hydraulic tank.

As opposed to the lift cylinders, the side stabiliser cylinders are double-acting. This means that a hydraulic oil also acts in the opposite direction and pushes the cylinder together.

Repair instructions

General

Bleeding of cylinders with air screw

⚠ ***Warning!***

When bleeding, the air screw must be opened no more than approx. a half turn. If the air screw is opened completely the oil will spurt out and the forks crash uncontrollably to bottom position. The hose rupture valves do not function in this phase.

1. Open the air screw a maximum of approx.: one half turn.

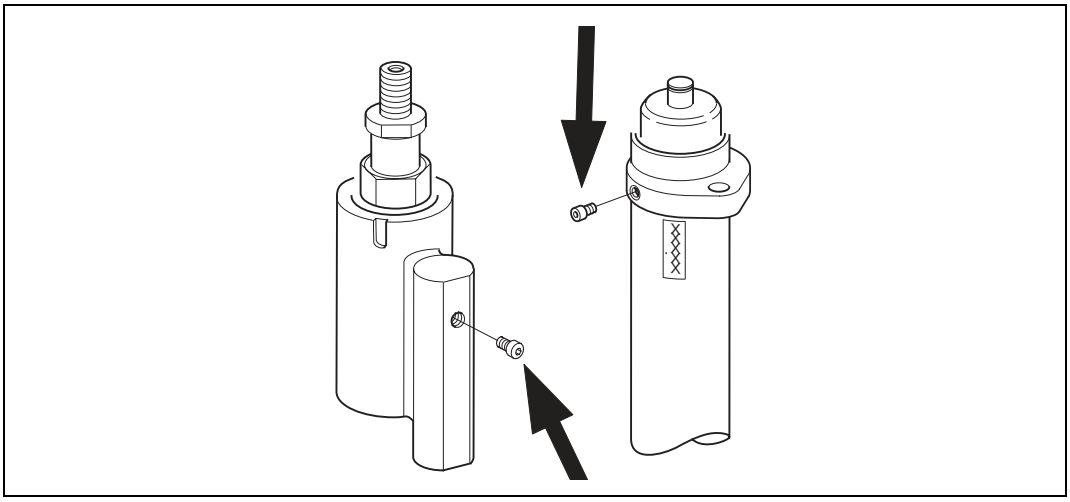


Figure 9.1 Example, air screw.

2. Check that there is sufficient oil in the hydraulic tank and that the pump does not suck air.
3. Carefully run the cylinder repeatedly between its end positions.
4. When oil without air bubbles comes in the tank the cylinders have been bled.
5. Adjust the oil level in the hydraulic tank.
6. Repeatedly lift from bottom to top position.
7. Check that the forks do not bounce, if so repeat the bleeding again.

Bleeding of cylinders without air screw

Cylinders without air screws are bled by running the cylinder repeatedly between its end positions.

☞ ***Important!***

Check the oil level regularly.

Free-lift cylinder TFV / DTFV

Dismantling and assembling

1. Remove the retaining screw that holds the lower end of the cylinder.
2. Lower down the forks, e.g. on a pallet, so that the chain slackens. Remove the chain pin that goes through the chain bolt on the cylinder, and place the chain over the back of the fork carriage.
3. Release the fork carriage from the mast by lifting up the inner mast with the hydraulic pump. Reverse the truck away.
4. Lower down so that all the cylinders are pushed together completely.
5. Loosen the bolts that hold the clamp at the top end of the cylinder, without removing it.
6. Loosen and disconnect the oil pipe.
7. Remove the clamp, and lift out the cylinder.
8. Plug the oil pipe.
9. Assemble in the reverse order.

Dismantling and assembling

1. Support the lower end of the cylinder in a vice.

Important!

Risk of deformation, use moderate force.

2. Remove the circlip, pos. 1 see Figure 9.2, and remove the yoke, pos. 2.
3. Place a container for oil spillage under the cylinder.
4. Remove the top nut, pos. 3, with a suitable tool and take it off the piston rod.
5. Take out the piston rod.
6. Remove the seal, pos. 4, and guide rings, pos. 5, on the piston. Use a thin tool that will not scratch.
7. Remove the seal, pos. 6, and scraper, pos. 7, from the top nut and O-ring, pos. 8.
8. Clean all parts and check for damage. Replace if necessary.

Note!

Always use original spare parts for maximum safety and service-life.

9. Assemble in the reverse order. Lubricate all parts with hydraulic oil before fitting.

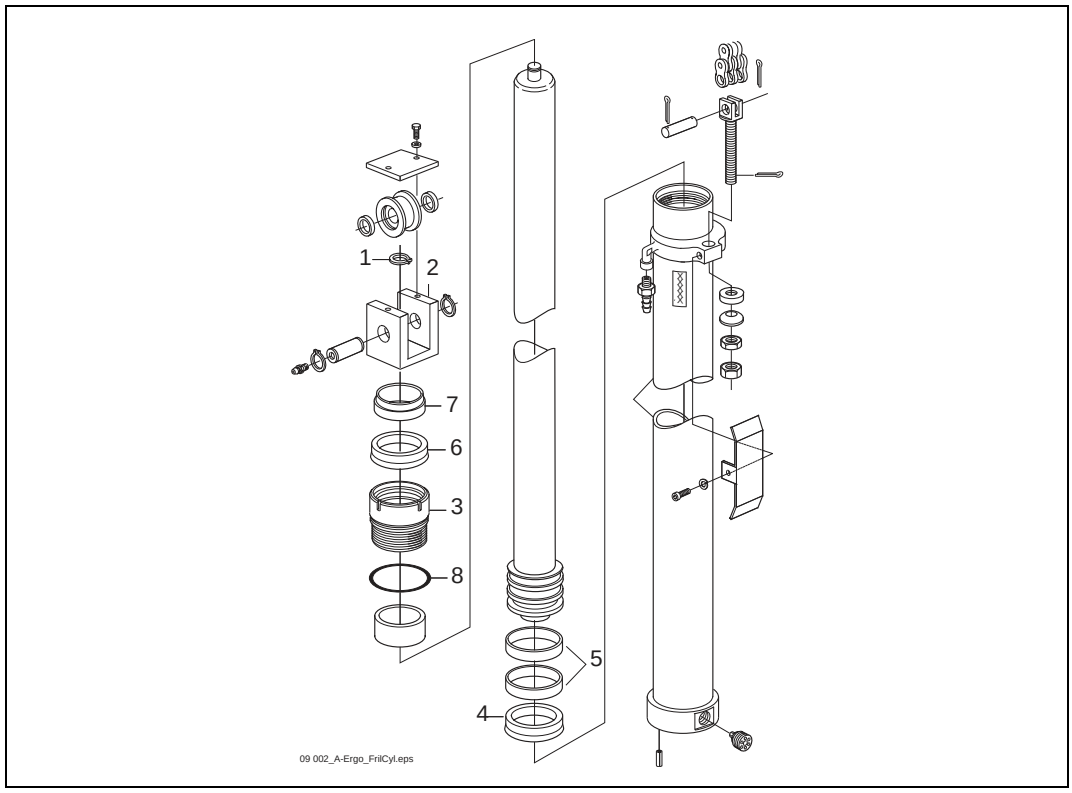


Figure 9.2 Free-lift cylinder TFV/DTFV

Lift cylinder TV/TFV/DTFV

Dismantling and assembling

1. Lift the forks until the inner mast is raised approx. 20 mm, place wooden blocks under the inner mast, and lower it down onto the blocks.
2. Loosen the upper retaining screws, pos. 1 see Figure 9.3.
3. Lower down the cylinder to compressed position.
4. Loosen, disconnect, and plug the oil pipe.
5. Remove the retaining screw, pos. 2 see Figure 9.3.
6. Lift out the cylinder.
7. Assemble in the reverse order.

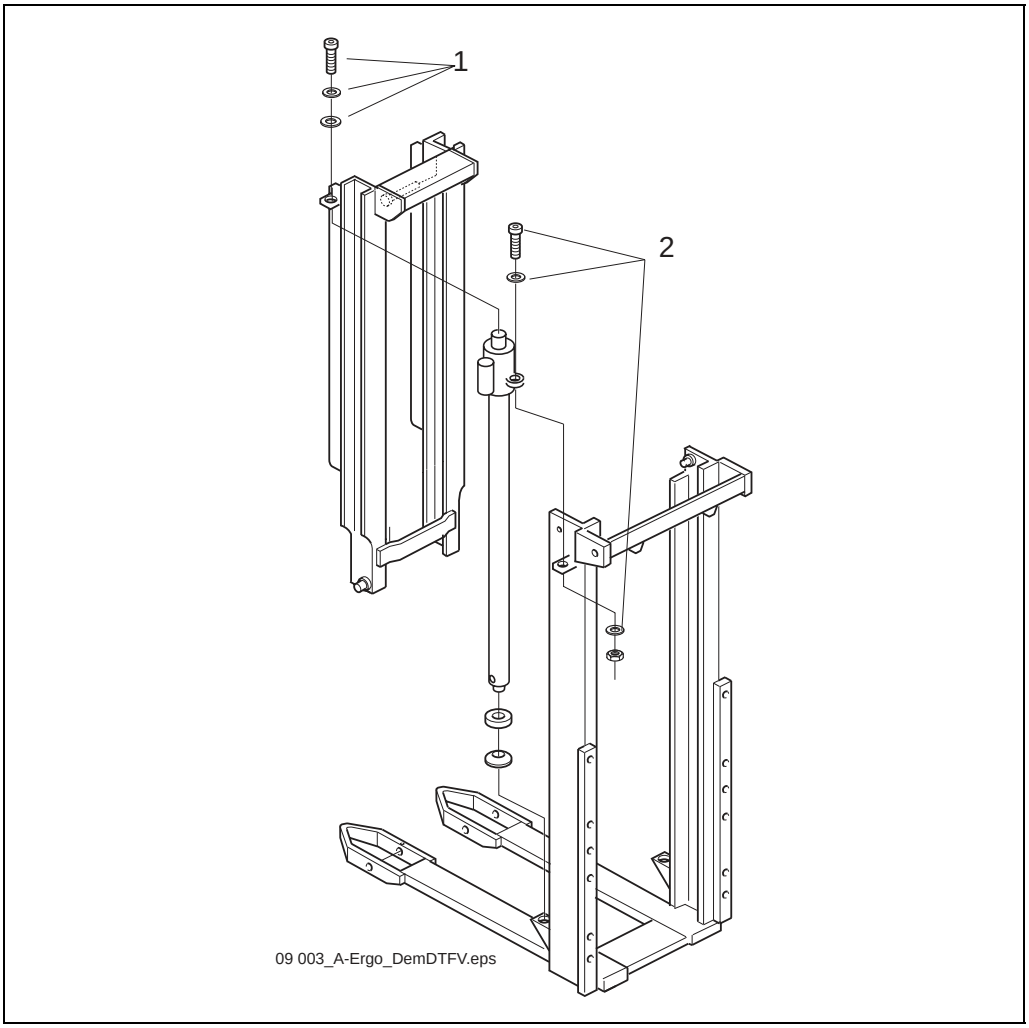


Figure 9.3 Lift cylinder TV/TFV/DTFV

Dismantling and assembling

1. Note how far the adjusting screw, pos. 1 see Figure 9.4, is screwed into the piston rod end (required when fitting).
2. Unscrew the adjusting screw, pos. 1.
3. Support the lower end of the cylinder in a vice.

☞ ***Important!***

Risk of deformation, use moderate force.

4. Place a container for oil spillage under the cylinder.
5. Loosen the top nut, pos. 2, and remove it, and take out the piston rod, pos. 3.
6. Remove the sealing rings and guides, pos. 4 and 9, from the top nut.
7. Remove the guide rings, pos. 5, from the piston rod.
8. Clean all parts and check for damage. Replace if necessary.

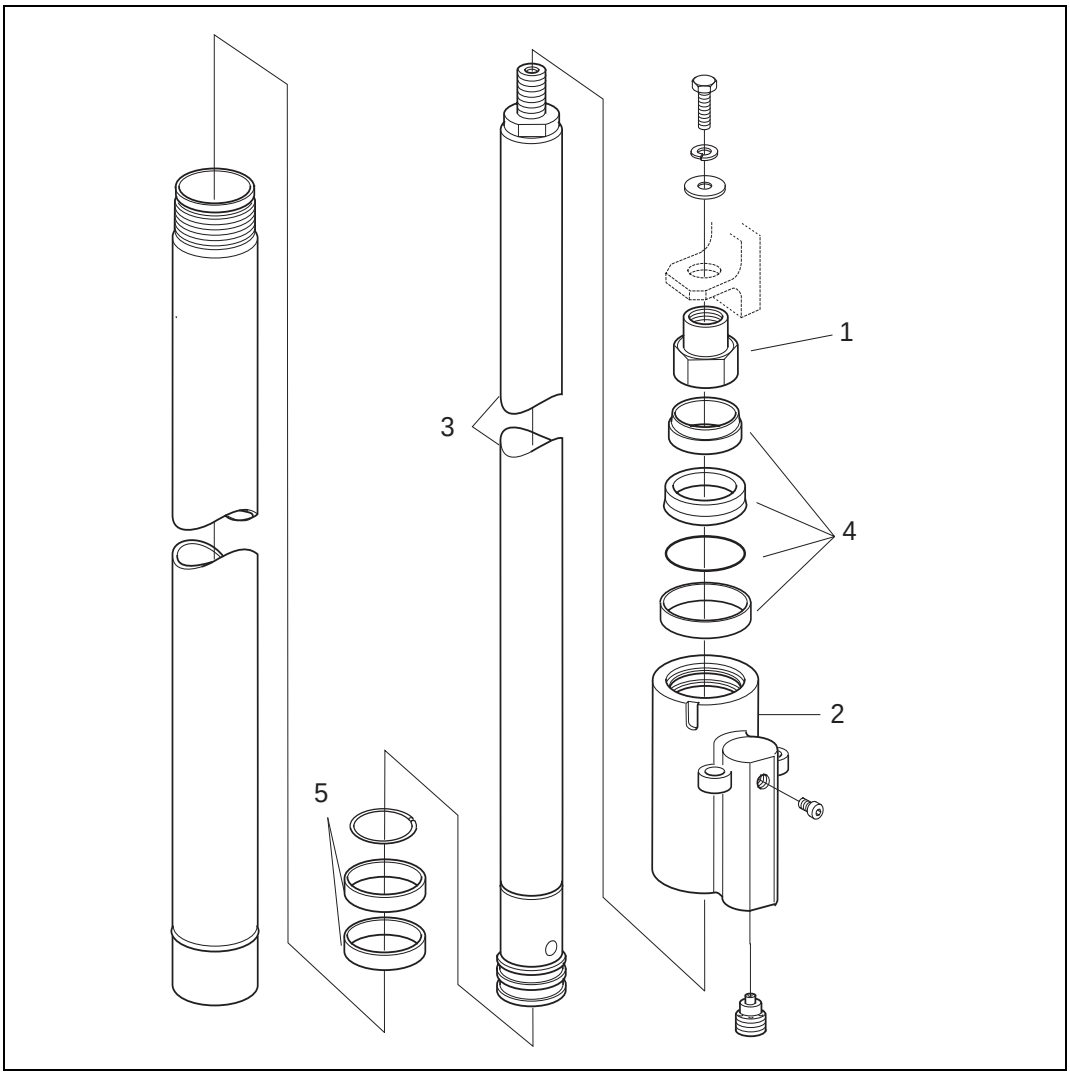


Figure 9.4 Lift cylinder TV/TFV/DTFV

Note!

Always use original spare parts for maximum safety and service-life.

9. Assemble in the reverse order. Lubricate all parts with hydraulic oil before fitting.

Lift cylinder T

Dismantling and assembling

1. Lower down the forks, e.g. on a pallet, so that the chain slackens. Remove the split pin bolt, pos. 1, see Figure 9.5, that sits in the top end of the cylinder.
2. Remove the chain and place it over the back of the fork carriage.
3. Release the fork carriage from the mast by lifting up the inner mast with the hydraulic pump. Reverse the truck away.
4. Place a wooden block under the inner mast, 10-15 cm thick, and carefully lower the inner mast until it rests on the block.
5. Secure the cylinder so that it cannot drop out of the mast! Remove the circlip, pos. 2, and remove the lower retaining screw, pos. 3.
6. Carefully lower so that the piston rod comes out of the yoke, pos. 4. When the piston rod is completely pushed in, remove the oil pipe and return pipe, and tilt forward the cylinder and lift it out.
7. Assemble in the reverse order.

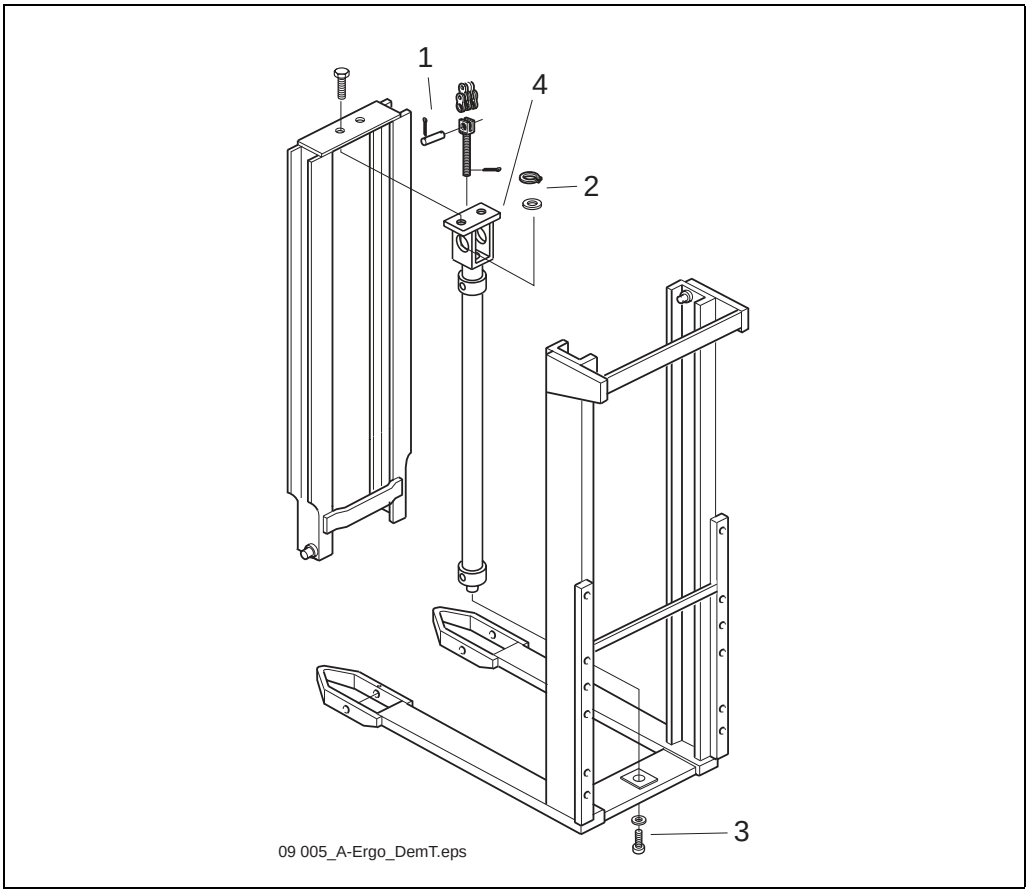


Figure 9.5 Lift cylinder T

Dismantling and assembling

1. Place the cylinder on a bench with the chain attachment facing down.
2. Loosen and remove the top nut, pos. 1 see Figure 9.6, with a hook spanner.
3. Pull out the piston rod, pos. 2, and place it carefully on the bench to avoid damaging it.
4. Remove the parts, pos. 3, 4, 5, 6, 7 and 8.
5. Clean all parts and check for damage. Replace if necessary.

Note!

Always use original spare parts for maximum safety and service-life.

6. Assemble in the reverse order. Lubricate all parts with hydraulic oil before fitting.

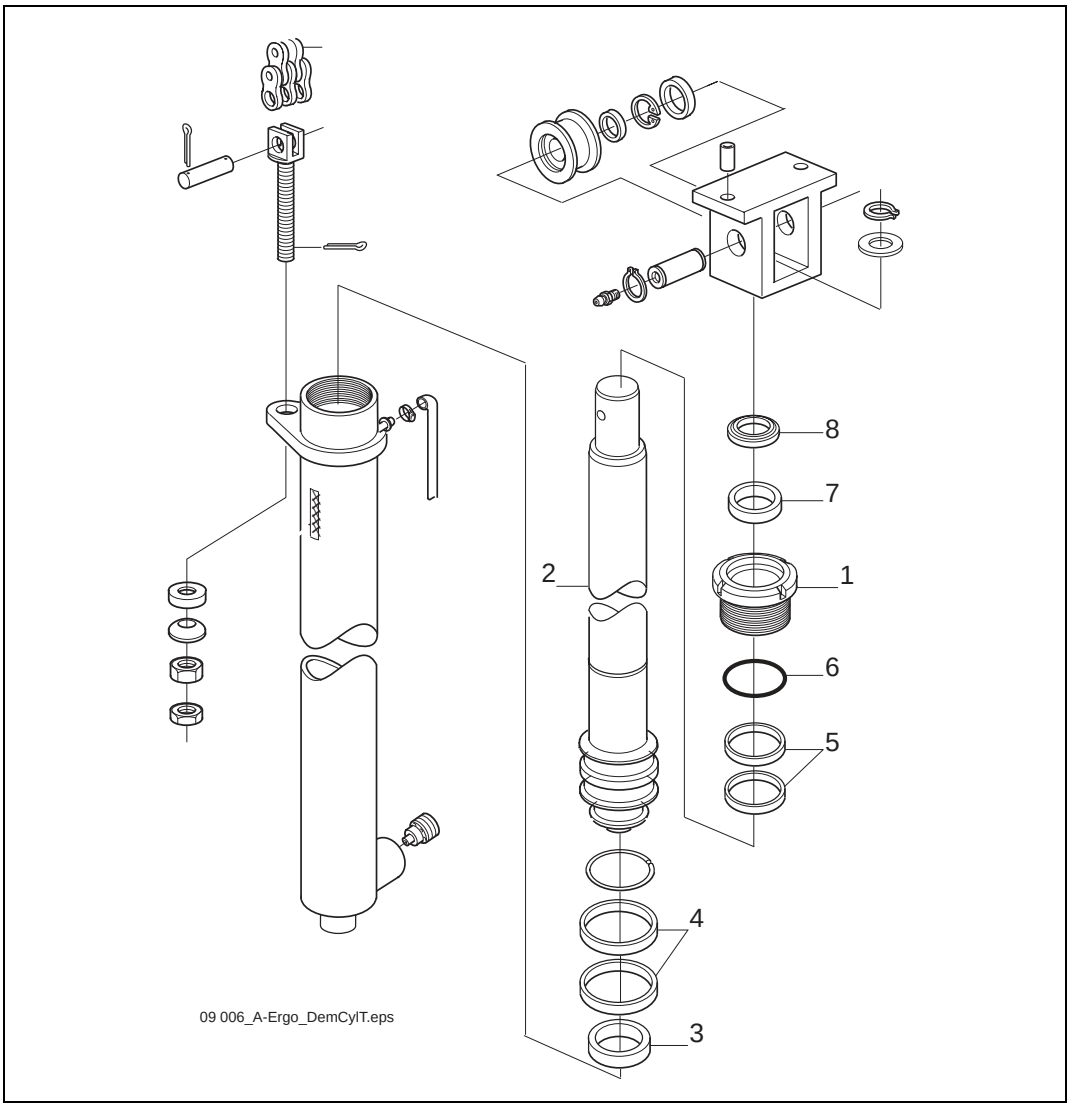


Figure 9.6 Lift cylinder T

SERVICE MANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2005B

10 Electrical system

Edition 2005B

10 Electrical system

General

Safety procedures

General

Warning!

Working with electrical vehicles can result in personal injury.

- During all work on the electrical system, or in its immediate vicinity, rings, watches and other metal objects must be removed since the battery has such a capacity that a short circuit over such an object can result in very serious burn injuries.
- Working with electrical vehicles can result in personal injury. All testing, trouble shooting and adjusting must be carried out by authorised personnel. The drive wheel should run free of the floor and be able to rotate freely during work.

Electronic regulators

- All electronic regulators in the truck have multiple safety systems.
- When replacing or repairing the electronic regulators, or removing cables, the battery should always be disconnected.

Important!

Incorrectly connected battery cables can destroy the electronic regulators.

Warning!

During all work on the truck the drive wheel must be lifted up from the floor to prevent accidents occurring.
Watches and other metal objects should be removed to avoid burn injuries.

After the power has been disconnected to the regulator and work or trouble shooting is to be carried out there may still be voltage remaining in the condensers for a few minutes, so for this reason observe care when working with current-carrying tools during these few minutes.

Safety check

Important!

The function of the external components in the steering servo system should be checked after every service and after all work carried out in the electrical system. All function tests of the safety system should be carried out with the truck speed controller in neutral.

The steering servo system

The steering servo system has a number of safety monitors, partly to check the regulator circuits but also to check external circuits and components such as the steering wheel sensor, steering motor and end position sensors.

A function test of the steering servo system safety functions should result in it not being possible to activate the control system and drive system, and also that it should not be possible to put the brake in unbraked position.

The monitoring system for the steering wheel sensor and its cabling are checked by separating the connector to the steering wheel sensor, which should result in an error code, see "Error codes, steering servo regulator, EPS" on page 10.61.

The steering motor monitor system is checked by disconnecting a cable connection to the motor, either on the motor or on the regulator. An error code should then be shown when turning the steering wheel, see "Error codes, steering servo regulator, EPS" on page 10.61.

One dangerous moment is if the end position switches for the steering function are activated when the wheel is not in the actual end position. This is monitored by the regulator sensing whether the sensor is actuated even if the wheel moves away from the sensor. Test this by strapping terminal 2 and 3 in the end position sensor contactors, see S4 and S5 in the wiring diagram, Wiring Diagram Handbook, steer from the respective sensor and check that an error code is shown, see "Error codes, steering servo regulator, EPS" on page 10.61.

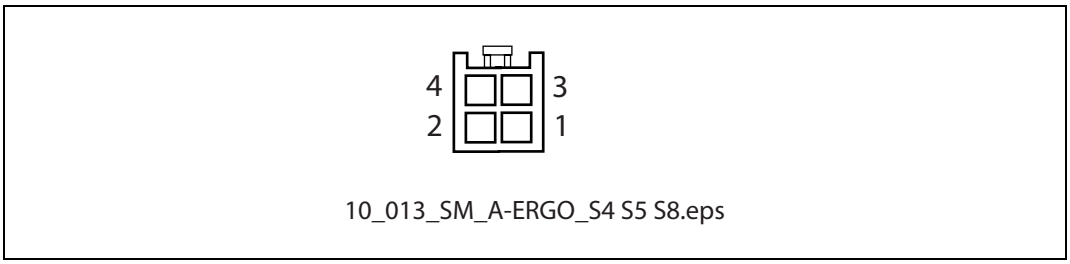


Figure 10.1 Connector S4 and S5 seen from cable side

Drive motor system

The monitoring system checks that starting is done in the correct order, i.e. that the speed controller does not give an output signal when the truck is started with the key switch.

This function is tested by switching off the key switch, holding the speed controller in actuated position, and switching the key switch on again. The truck should then not move before the speed controller has been in neutral.

Testing of the motor circuit is not possible since it is a three-phase motor, and neither is it necessary.

There are different systems that reduce the top speed of the truck and the lifting height and load of the forks. These systems are tested by lifting the forks over the switching height and loading them over the set weight. A tortoise should then be indicated on the MDI display, see "Multi Function Display Indicator (MDI)" on page 10.13.

Operation, Hand terminal

The Hand terminal is connected to the regulators via a 9-pole contactor, connector C. In the normal position this is covered by a rubber plug, which must be replaced after the Hand terminal has been disconnected.

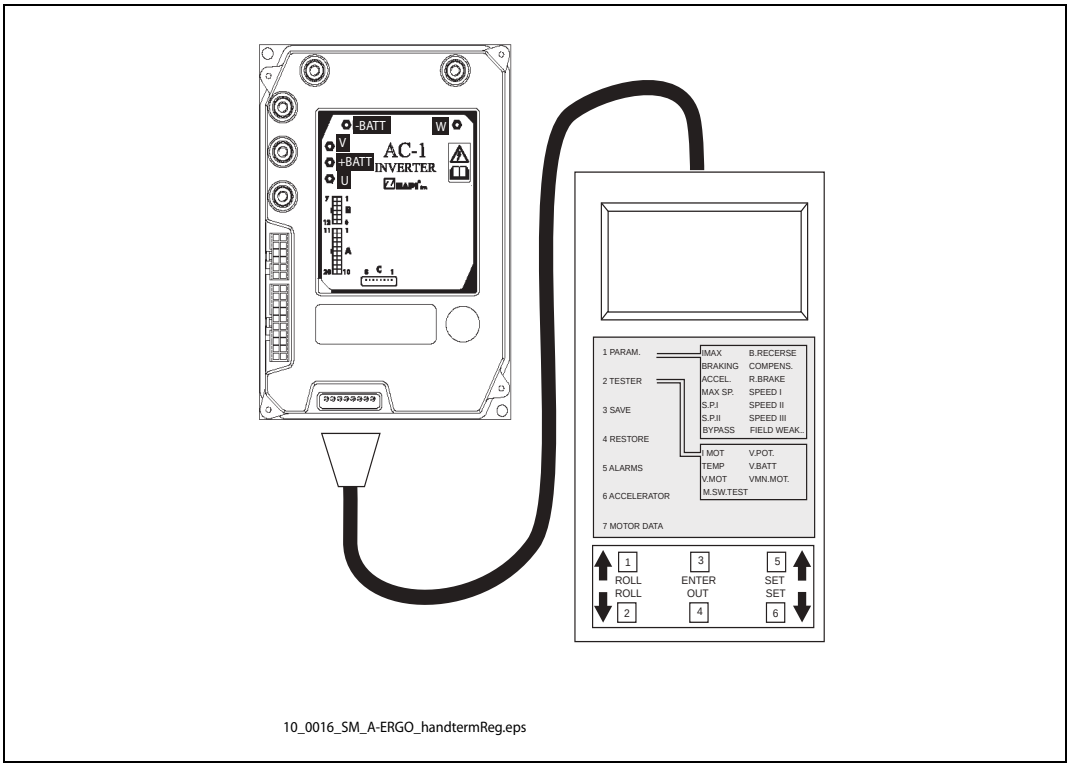


Figure 10.2 Hand terminal/programming tool for adjusting the settings on the regulators

All the adjustments of settings in the regulators are made with the Hand terminal.

The settings in the drive motor regulator and the steering servo regulator can be checked and adjusted by means of the six buttons on the Hand terminal.

See table 10.1 below for instructions how the terminal is used in the menus.

Table 10.1 Instructions for using the Hand terminal

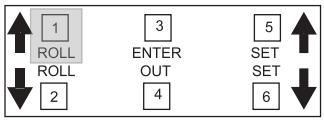
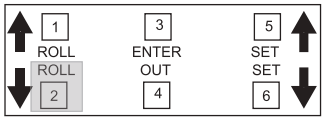
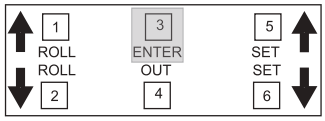
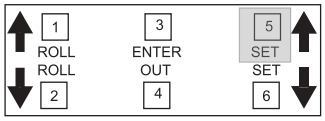
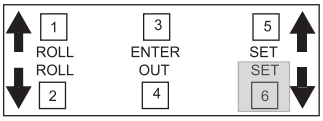
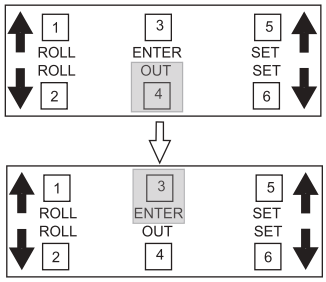
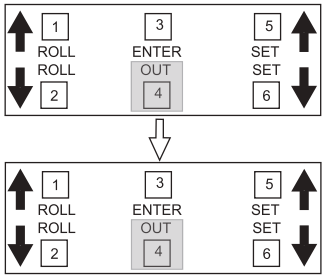
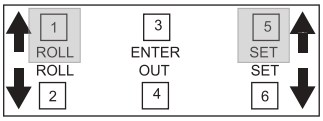
Required function		Buttons to use
To scroll down in the menus:	ROLL (1)	
To scroll up in the menus:	ROLL (2)	
To go into a menu selection:	ENTER (3)	
To increase the actual set value:	SET (5)	
To reduce the actual set value:	SET (6)	
To exit a menu selection and save the changed value: 	OUT (4) + ENTER (3)	
To exit a menu selection without saving: 	OUT (4) + OUT (4)	

Table 10.1 Instructions for using the Hand terminal

Required function		Buttons to use
To select CONFIG MENU:	ROLL (1) + SET (5)	

All error messages are also presented through the Hand terminal, see "Error codes" on page 10.56.

Design and function

General functional description, regulators

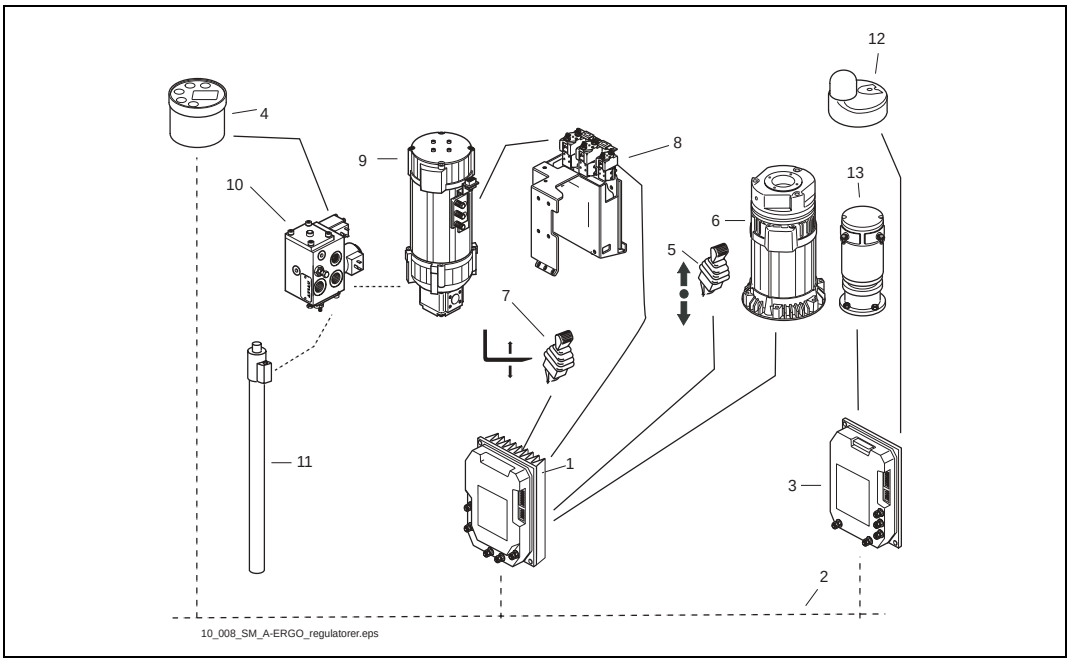


Figure 10.3 Overview of communication channels, electrical system

1. Drive motor regulator
2. CanBus link
3. Steering servo regulator
4. Multi Funktion Display (MDI)
5. Speed controller
6. Drive motor
7. Lift control
8. Electrical panel
9. Hydraulic pump
10. Hydraulic valve
11. Hydraulic cylinder, lift
12. Steering wheel
13. Steering servo motor

Communication between regulators

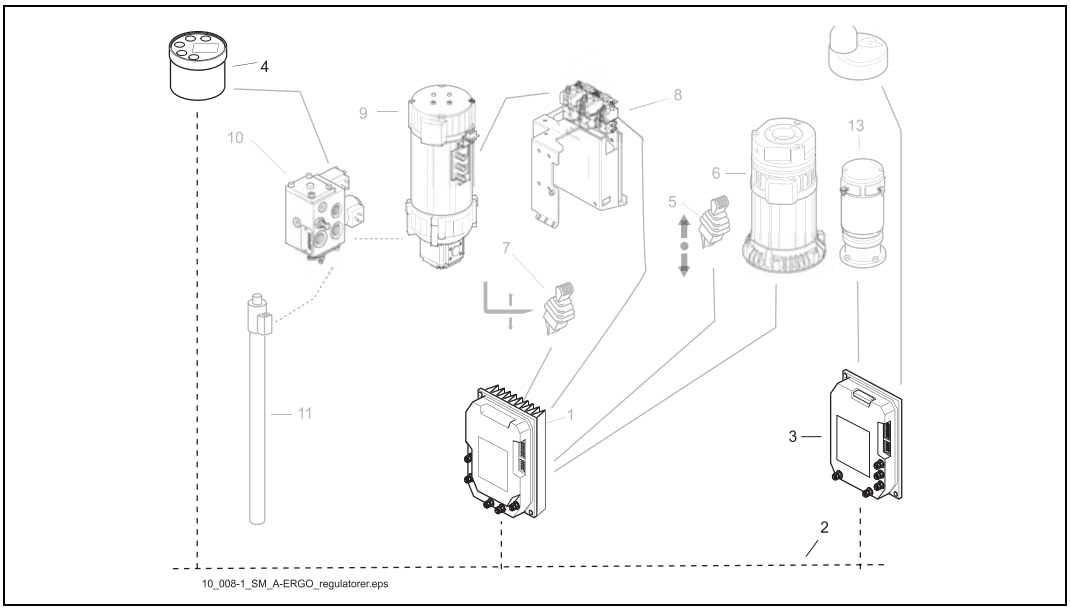


Figure 10.4 Communication between regulators

The brain in the system is the regulator for the drive motor (1), which via Canlink (2) communicates with the regulator for the steering servo motor (3) and the Multi Function Display (MDI) (4).

The controller units have a self-diagnosis part that can generate error codes. These error codes are presented on the MDI display (4) and in the Hand terminal (see section 2, Special tools). The MDI also presents the time the truck has been in operation and the battery status.

Drive motor regulator

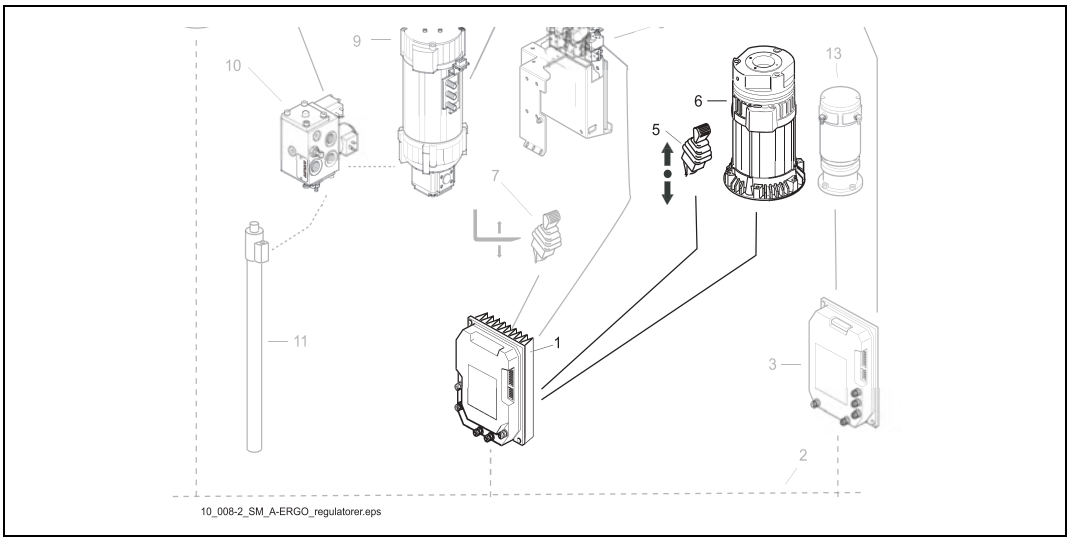


Figure 10.5 Overview of drive motor regulator, drive motor

When the lever for the speed controller (5) is actuated the drive motor regulator (1) sends a drive voltage to the drive motor (6). A pulse transducer in the upper bearing of the drive motor restores the motor speed to the regulator, which adjusts the drive voltage until its speed corresponds to the speed control.

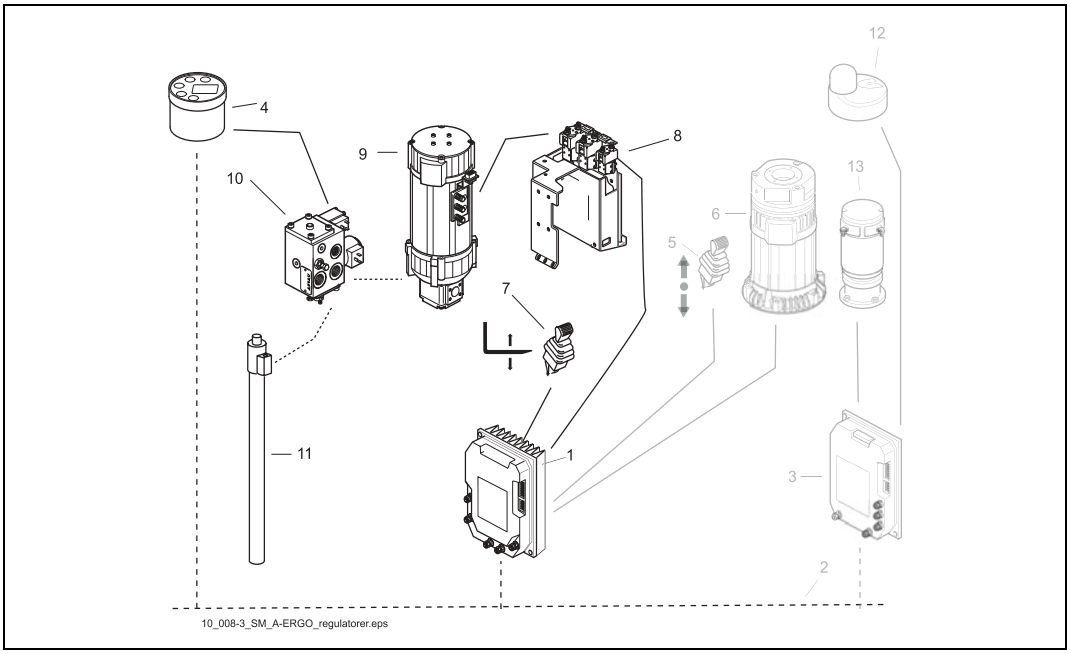


Figure 10.6 Overview of drive motor regulator, hydraulic pump motor, lift valve and lift cylinder

When the control lever for electrically controlled lifting (7) is actuated the regulator for the drive motor (1) sends a voltage to the lift motor contactor (8), which starts the lift motor (9). The drive motor regulator also forwards via the CAN link (2) the magnitude of the response on the control to the MDI (4) and the lift speed is then controlled by the MDI, which provides an equally high control voltage in proportion to the control level to the control valve (10), which in turn provides a proportionally equally high flow of hydraulic oil to the lift cylinder (11), which then provides the variable lifting and lowering speed.

On trucks with manual hydraulic valves the modulation of the valve is controlled directly by the position of the lift lever.

Steering servo regulator

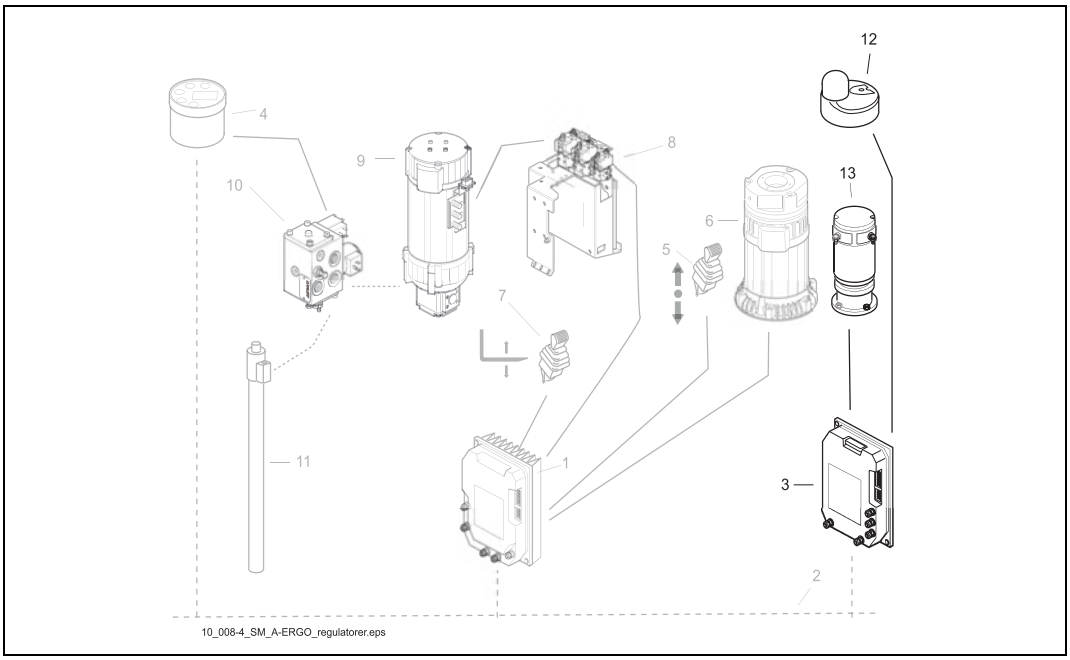


Figure 10.7 Overview of steering servo regulator, steering wheel, steering servo motor

When the steering wheel is turned a signal is sent via a step motor on the steering wheel (12) to the regulator for the steering servo motor (3), which in turn forwards a proportional drive voltage to the steering servo motor (13), which turns the drive wheel with the required speed and in the required direction.

Multi Function Display Indicator (MDI)

Display description

The battery charging is indicated by means of five LEDs, four green and one red. When the battery is fully charged all the green LEDs light up. The LEDs go off as the battery is discharged and when the battery charge has reached a level that requires the battery to be charged the red LED lights up (steady signal).

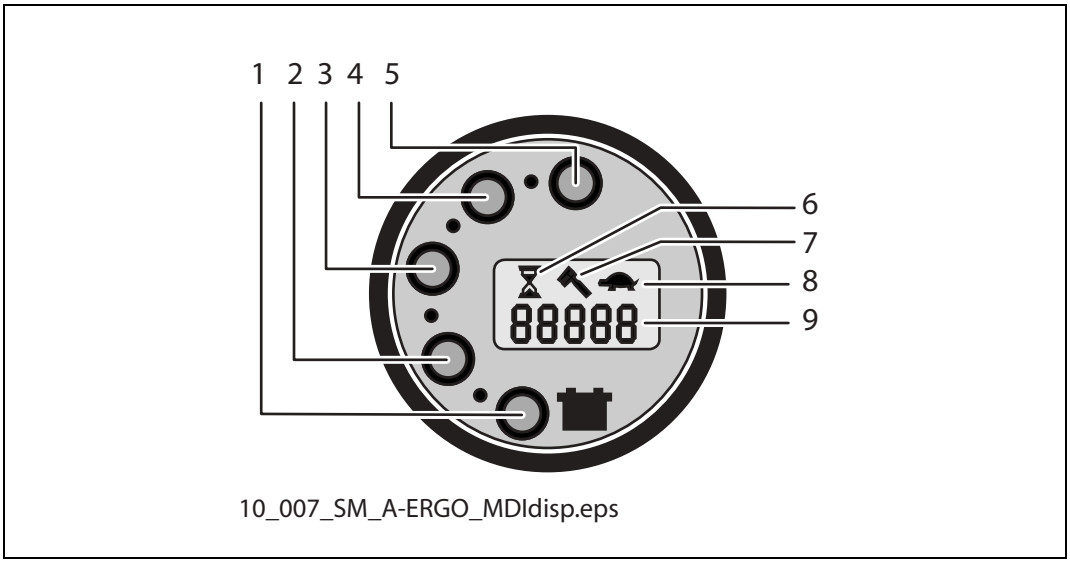


Figure 10.8 Multi Function Display (MDI)

1. Steady red signal:
   <10% battery capacity
   Flashing red signal: Error code indicating
2. 25% battery capacity
3. 50% battery capacity
4. 75% battery capacity
5. 100% battery capacity
6. A flashing hourglass indicates that the hour counter is active (Hourglass)
7. Error code displayed/Service necessary (Spanner)
8. Reduced top speed (Tortoise)
9. Alphanumeric display

Function

The display consists of a field with alphanumeric symbols and three different figurative symbols.

The truck operating time, error codes and the MDI software version are indicated on the alphanumeric display part:

- The operating time counter indicates the hours the truck has been in operation.
- Error codes are indicated by means of a pre-defined code and by the flashing of the red LED.

- The software version is shown briefly on start up, EPXXX where XXX represents the version.

Other symbols:

- A tortoise shows that the maximum speed is reduced.
- A spanner is shown in conjunction with the indication of an error code, or when pre-programmed service should be carried out.
- The hourglass flashes when the hour counter is active.

Drive motor regulator, AC1

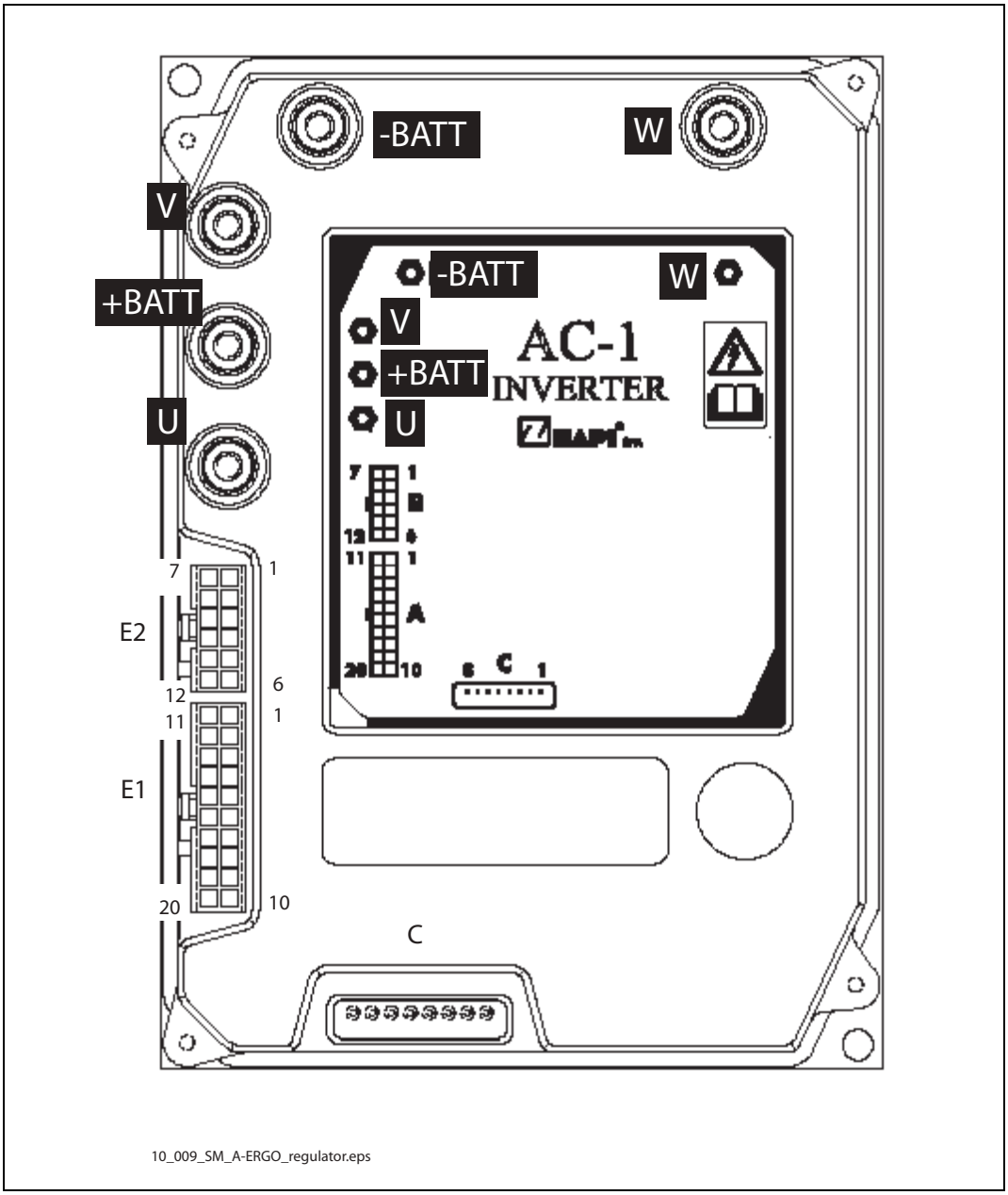


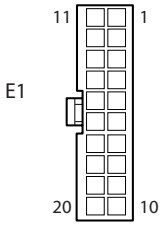
Figure 10.9 Regulator, drive motor and hydraulic motor

Function, drive motor regulator AC1

In an alternating current based control system it is important for the rotation of the motor to be synchronised with the drive regulator. A sensor, incremental encoder, placed in the motor with two phases displaced 90° is used for this. If these signals are subject to interference, or lost, then the synchronisation between the motor and drive regulator will not function. This will result in the motor running very slowly and consuming maximum power. Avoid running the motor in this state.

Connector, specification, drive motor regulator AC1

The drive motor regulator has three connectors with inputs and outputs for valves, sensors, changer-over switches and programming tools. etc. Each connector pin is specified below, with where appropriate the voltage level in connected position.



Connector E1 (the figure shows the connector from the cabling side).

Table 10.2 Connector E1 drive motor regulator AC1

Pin	Description	Comment
E1.1	Controlling of Drive contactor	Controlled to B-
E1.2	Supply to Drive contactor	+24V
E1.3	Controlling of electric brake	Controlled to B-
E1.4	Controlling of pump contactor	Controlled to B-
E1.5	Supply to pump contactor	
E1.6	Controlling of valve for straddle lift	Controlled to B-
E1.7	CAN communication	CAN Low
E1.8	Neg. supply to Lift/Lower control	B-
E1.9	Pos. supply to drive motor encoder	+4-5V
E1.10	Neg. supply to drive motor encoder	B-
E1.11	Pos. supply to instrument	+24V
E1.12	Neg. supply to instrument	B-
E1.13	Input from speed reduction switch	From pressure switch, see note below (*)
E1.14	Input for lifting of straddle lift	+24V on activation
E1.15	Input for lowering of straddle lift	+24V on activation
E1.16	+12V supply to instrument	+12V
E1.17	CAN communication	CAN High
E1.18	Signal from lift control	Neutral = approx. 2.5V Max lifting speed = approx. 4.5V Max lowering speed = approx. 1.0 V
E1.19	Input A from drive motor encoder	Synchronises motor drive with phase distorted pulses from the encoder
E1.20	Input B from drive motor encoder	
(*)	**The input from the pressure switch is filtered so that pressure surges will not trigger the reduction of speed. A modified input value is required for at least 1 second to be accepted. No modification of the input value is accepted during lifting and lowering movements.**	

Connector E2 (the figure shows the connector from the cabling side).

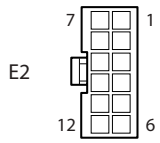


Table 10.3 Connector E2 drive motor regulator AC1

Pin	Description	Comment
E2.1	Supply from key lock	+24V
E2.2	Supply to external units	+24V
E2.3	Input from brake switch	+24V required for driving
E2.4	Not used in the A model	
E2.5	Not used in the A model	
E2.6	Not used in the A model	
E2.7	Prop. valve: Stabilisers up Man. valve: Stabilisers up and down	Accessories: Input from control switch
E2.8	Prop. valve: Stabilisers down Manual valve: Start of pump motor	Accessories: Input from control switch
E2.9	Acceleration reduction	Reduction with wheel modulation. B- gives reduction. Functional lamp L1 required for correct function
E2.10	Input signal from speed controller	Neutral = approx. 2.5V Maximum in direction of forks= approx 1.0V Maximum in opposite direction= approx 4.5V
E2.11	Neg. supply to speed controller	B-
E2.12	Pos. supply to speed controller and lift control	+5V

Connector C is used to connect the programming tool, Hand terminal.

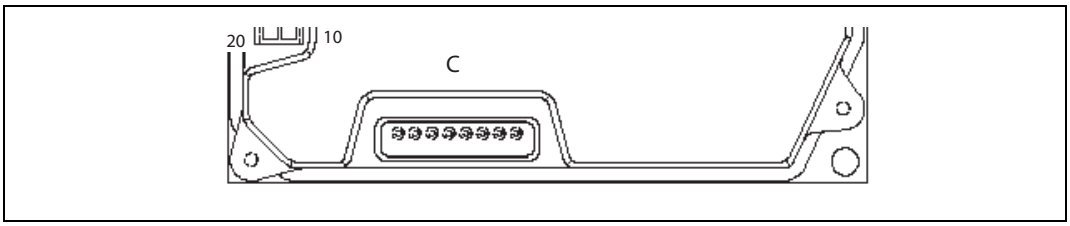


Figure 10.10 Connector C (figure shows connector on the regulator)

The battery and motor connections are separately located on the motor control unit.

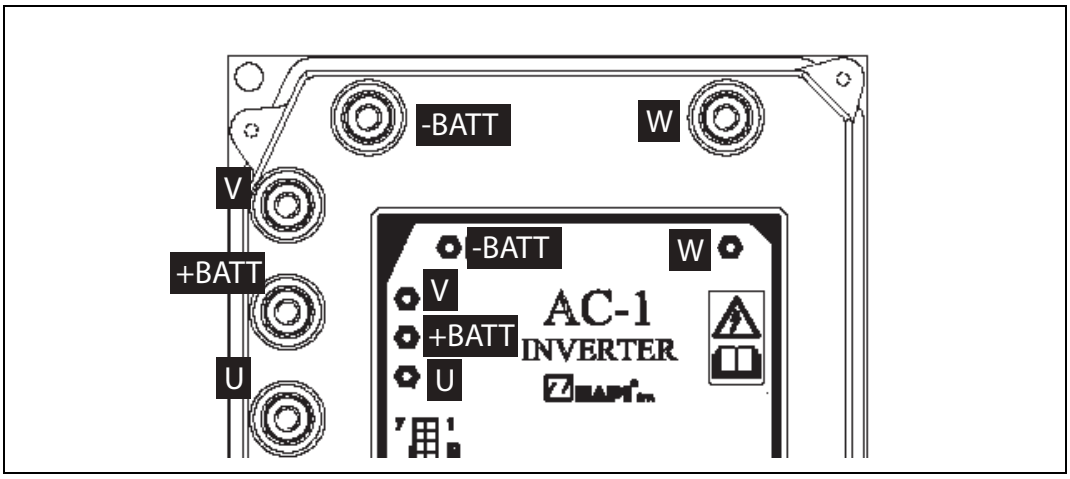


Figure 10.11 Connections, battery and motor

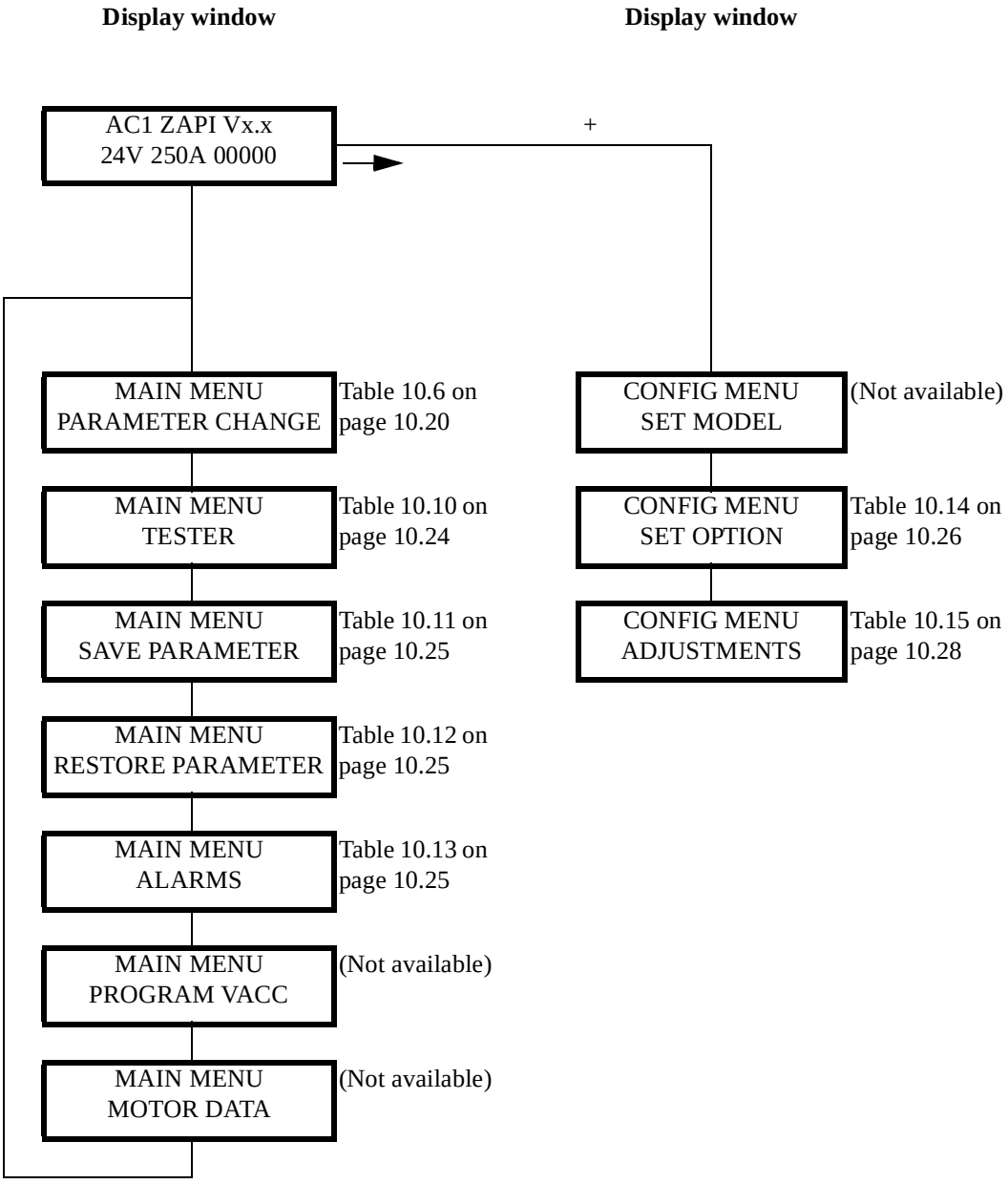
Table 10.4 Separate cable connections

Pin	Description
-BATT	Negative supply from the battery.
+BATT	Positive supply from the battery.
U; V; W	Motor connections, connected to corresponding marking on the drive motor

Menu tree, drive motor regulator AC1

The following main headings are found in the drive motor regulator menu tree. Use the Hand terminal to see the menus, see "Operation, Hand terminal" on page 10.6.

Table 10.5 Main flow in Hand terminal menus, Drive motor regulator



To see what is included in each menu selection, see the tables referred to after each display window.

Submenu specification PARAMETER CHANGE

Table 10.6 Delivery Settings in Drive Controller A with Zapi AC 1 in truck (Parameter Change Menu)

FUNCTION	A	A Std Incr. speed 10 km/h	ATF+ ALL	Speed Red. by Press.switch	Speed red. With stab out <2 m	NOTES
ACCELERATION DELAY	3	3	3	3	3	Acceleration ramp. Lower value gives faster acceleration.
EXTRA ACC DELAY	5	5	5	5	5	Increased acceleration ramp with 45 degr steering angle.
RELEASE BRAKING	6	6	6	6	6	Brake torque with throttle to neutral position. Option
INVERS BRAKING	8	8	8	8	8	Brake torque with throttle in reversed direction.
PEDAL BRAKING	7	7	7	7	7	Brake torque with foot switch released. May not be changed. EU regulation
SPEED LIMIT BRAKING	7	7	7	7	7	Brake torque when throttle demand is decreased
BRAKE CUTBACK	5	5	5	5	5	Brake torque when speed reduction switch is activated.
MAX SPEED FORW	94	**119**	94	94	94	May not be increased over this value
MAX SPEED BACK	94	94	94	94	94	May not be increased over this value
CUTBACK SPEED 1	100	100	100	***1**	**0**	Reduced speed. To be adjusted according to specification in the KO, Special Design
CUTBACK SPEED 2	70	70	**100**	70	70	To be adjusted to 5 km/h with forks over switching level.
H&S CUTBACK	10%	10%	10%	10%	10%	Not used in the A model.
FREQUENCY CREEP	0.30	0.30	0.30	0.30	0.30	Lowest speed when the truck is started.
MAXIMUM CURRENT	9	9	9	9	9	Maximum current to the drive motor.
INCHING SPEED	0	0	0	0	0	Not used in the A model.
INCHING TIME	0	0	0	0	0	Not used in the A model.
AUXILIARY TIME	10	10	10	10	10	May not be set to other value.
LIFT CUTBACK	75	75	75	75	75	Setting of valve voltage in lifting mode.
MIN VALVE 1	5	5	5	5	5	Lowest opening value of the proportional valve.

Table 10.6 Delivery Settings in Drive Controller A with Zapi AC 1 in truck (Parameter Change Menu)

MIN VALVE 2-4	0	0	0	0	0	Lowest opening value of the lift stop valve.
MAX VALVE 1	70	70	70	70	70	Max voltage to the proportional valve
MAX VALVE 2	255	255	255	255	255	Max voltage to the lift stop valve
MAX VALVE 3 och 4	100	100	100	100	100	Maximum voltage to other valves
VALVES VOLTAGE	24	24	24	24	24	System voltage to the valves
OPENING RAMP V1-V4	0.2	0.2	0.2	0.2	0.2	Opening ramp for the valves
CLOSING RAMP V1-V4	0	0	0	0	0	Closing ramp for the valves

Changes from standard are marked with bold text.

*1 = To be set to values specified in KO, Special Design

Adjustment menu

Tabell 10.7 Adjustment menu

Adjusted parameter	Set value
THROTTLE X POINT	54
THROTTLE Y POINT	25
ADJUSTMENT #1	5
ADJUSTMENT #2	9

Option menu

Tabell 10.8 Option menu

Adjusted parameter	Set value
HYDRAULIC	0 for manual valve
	1 for prop. valve and Stabs or Risible forks
	2 for Prop. valve and Stabs and Risible forks
PEDAL BRAKING	Digital

Each parameter can be set in ten steps, see table 10.9 below for available alternatives.

Table 10.9 Available parameter values, Drive motor regulator

PARAMETER	UNIT	PARAMETER LEVEL IN STEPS OF 10									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
ACCELERATION DELAY (*)	Sec.	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	5,5
EXTRA ACCEL. DELAY (**)	(**)	1,5	1,8	2,1	2,4	2,7	3,0	3,5	4,0	4,5	5,0
RELEASE BRAKING (***)	Sec.	5,5	5,0	4,5	4,0	3,5	3,0	2,5	2,0	1,5	1,0
INVERSE BRAKING (***)	Sec.	5,5	5,0	4,5	4,0	3,5	3,0	2,5	2,0	1,5	1,0
PEDAL BRAKING (***)	Sec.	5,5	5,0	4,5	4,0	3,5	3,0	2,5	2,0	1,5	1,0
SPEED LIMIT BRAKING (***)	Sec.	8,9	8,3	7,7	7,1	6,6	6,0	5,5	4,9	4,4	3,8
BRAKE CUTBACK (***)	Sec.	5,5	5,0	4,5	4,0	3,5	3,0	2,5	2,0	1,5	1,0
MAX SPEED FW	Hz	67	72	78	89	94	99	109	114	119	124
MAX SPEED BW	Hz	67	72	78	89	94	99	109	114	119	124
CUTBACK SPEED 1	% Max Sp	10	20	30	40	50	60	70	80	90	100
CUTBACK SPEED 2	% Max Sp	10	20	30	40	50	60	70	80	90	100
H&S CUTBACK	% Max Sp	10	15	20	25	37	50	62	75	87	100
FREQUENCY CREEP	Hz	0,3	0,6	0,9	1,2	1,5	1,8	2,1	2,4	2,7	3,0
MAXIMUM CURRENT	% IMax	47	53	58	64	70	76	82	88	94	100
INCHING SPEED	Hz	0	2	4	6	8	10	12	14	16	18
INCHING TIME	Sec.	0,3	1,0	2,0	2,8	3,63	4,5	5,4	6,2	7,1	8,0
AUXILIARY TIME	Sec.	0,0	0,4	0,8	1,4	2,0	3,0	4,0	6,0	8,0	10,0
LIFT CUTBACK	%	10	15	20	25	37	50	62	75	87	100
MIN VALVE 1	This parameter can be adjusted in steps of 1 between 1 to 255.										
MIN VALVE 2	This parameter can be adjusted in steps of 1 between 1 to 255.										
MIN VALVE 3	This parameter can be adjusted in steps of 1 between 1 to 255.										
MIN VALVE 4	This parameter can be adjusted in steps of 1 between 1 to 255.										
MAX VALVE 1	This parameter can be adjusted in steps of 1 between 1 to 255.										

Table 10.9 Available parameter values, Drive motor regulator

PARAMETER	UNIT	PARAMETER LEVEL IN STEPS OF 10									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
MAX VALVE 2	This parameter can be adjusted in steps of 1 between 1 to 255.										
VALVE 3 VOLTAGE	%V	12	20	25	40	50	60	70	80	90	100
VALVE 4 VOLTAGE	%V	12	20	25	40	50	60	70	80	90	100
VALVES VOLTAGE	V		12	24	36	48	60	72	80	96	120
V1 OPENING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V2 OPENING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V3 OPENING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V4 OPENING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V1 CLOSING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V2 CLOSING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V3 CLOSING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0
V4 CLOSING RAMP	Sec.	0,2	0,4	0,6	0,8	1,0	1,2	1,4	1,6	1,8	2,0

(*) The acceleration time is the time from 0 to 100 Hz. This is an average ramp which in reality can be affected by different settings and loads.

(**) EXTRA ACCEL. DELAY gives a multiple of the level set in ACCELERATION DELAY. Example:

- ACCELERATION DELAY=LEVEL 2
- EXTRA ACCEL. DELAY= LEVEL 5
- Gives a delay of 2.0s * 3.0 = 6.0s

(***) The braking capacity is based on the deceleration ramp and is the time between which the regulator pulses from 100 to 0 Hz, and is an average ramp that can be affected by different settings and loads.

Submenu specification for TESTER.

Table 10.10 Submenu TESTER, Drive motor regulator

TEST	UNIT/ STATUS	DESCRIPTION
BATT VOLTAGE	V	Voltage to the key lock.
MOTOR VOLTAGE	%	Voltage to the motor in % of the battery voltage.
VOLTAGE BOOSTER	%	Voltage to the motor in % of the battery voltage during loading.
FREQUENCY	Hz	The pulse frequency of voltage and current to the motor.
ENCODER	Hz	The motor speed, measured as a frequency from the encoder bearing in the motor.
SLIP VALUE	Hz	The slipping of the motor, the difference between modulated frequency and the motor frequency.
COS FI		Cos (φ) of the motor, the phase displacement between current and voltage.
CURRENT RMS	A	The RMS value of the motor current.
BATTERY CURRENT	A	Calculated current from the battery.
BATTERY CHARGE	%	Charging status of the battery in %.
TEMPERATURE	°C	The regulator temperature of the cooling body.
ACCELERATOR	V	The voltage from the speed controller shown as voltage to the left and % to the right.
LIFTING CONTROL	V	The voltage from the lift potentiometer shown as voltage to the left and % to the right.
LIFTING SWITCH	ON/OFF	Status of the lift control.
DECENT SWITCH	ON/OFF	Status of the lower control.
FORW. SWITCH	ON/OFF	Status of the forward direction of the speed controller.
BACK. SWITCH	ON/OFF	Status of the backward direction of the speed controller.
SEAT SWITCH	ON/OFF	Not used.
H&S CUTBACK	ON/OFF	Not used.
BRAKE SWITCH	ON/OFF	Status of the foot pedal. (If Input #4" option is set as Brake)
CUTBACK SWITCH	ON/OFF	Status for input Speed reduction 1.
DIGITAL INPUT #1	ON/OFF	Status for the lift switch.
DIGITAL INPUT #2	ON/OFF	Status for lowering switch during lowering (if Input #2 is set as Present #1).

Table 10.11 Submenu SAVE PARAMETER, Drive motor regulator

SAVE PARAMETER	All set parameters can be saved in the Hand terminal memory with this menu.

Table 10.12 Submenu RESTORE PARAMETERS, Drive motor regulator

RESTORE PARAMETERS	All parameters stored in the Hand terminal memory can be downloaded in the regulator memory with this menu.

Table 10.13 Submenu ALARMS, Drive motor regulator

ALARMS	The following is presented in this menu: CODE = Error code h = time (which operating hour) the error code occurred. N° = how many times the actual error code occurred. °C = temperature of the regulator when error code was set.

Submenu obtained by pressing button 1 and 5 at the same time on the Hand terminal, specified below:

- See table 10.14
- See table 10.15..

Table 10.14 Submenu SET OPTION, Drive motor regulator

FUNCTION	SELECTION	DESCRIPTION
HYDRAULIC	0	Manual valve.
	1	Proportional valve with or without side stabilisers **or** straddle lift.
	2	Proportional valve with the combination side stabilisers **and** straddle lift.
TILLER SWITCH	**HANDLE**	Pin E2.3 is used as input from foot brake switch.
	SEAT	Pin E2.3 is used as input from seat switch.
SET INPUT #1	**PRESENT**	Pin E1.13 is used as input for speed reduction.
	OPTION #1	Pin E1.13 is used as input for hand brake.
SET INPUT #2	**PRESENT**	
	OPTION #1	
SET INPUT #3	**PRESENT**	
	OPTION #1	
SET INPUT #4	BELLY	Pin E2.7 is used as input from belly switch.
	BRAKE	Pin E2.7 is used as input for brake.
	EXCLUSIVE HYDRO	Pin E2.7 is used as **EXCLUSIVE HYDRO,** hydraulic brake input.
HOUR COUNTER	**RUNNING**	The hour counter registers the number of hours driven.
	KEY ON	The hour counter registers the key hours.
BATTERY CHECK	**ON**	The battery indicator is active, and when the battery discharging exceeds 90% an alarm is activated and the power to the drive motor is maximised to half of max.
	OFF	The battery indicator is active, but no alarm or reduction during large discharge.
HYRDO KEY ON	ON/**OFF**	If this function is set to ON the drive regulator will control a hydraulic contactor when the key is switched on, if the function Aux output #1 is set as Hydrocontactor or Exclusive hydro.
STOP ON RAMP	ON/**OFF**	The ramp stop function is activated with the time set in the Auxiliary time parameter, and after this time the function of the parameter Aux output #1 will be activated **(see also "Set Aux Output in combination with Ramp On/Off, Drive motor regulator." on page 10.29)**.
	OFF	The ramp stop function is not activated **(see also "Set Aux Output in combination with Ramp On/Off, Drive motor regulator." on page 10.29)**.

Table 10.14 Submenu SET OPTION, Drive motor regulator

FUNCTION	SELECTION	DESCRIPTION
AUX OUTPUT #1	HYDRO CONTACTOR	Pin E1.3 controls a hydraulic function when a direction, brake pedal is active, or the truck is in motion **(see also "Set Aux Output in combination with Ramp On/Off, Drive motor regulator." on page 10.29)**.
	BRAKE	Pin E1.3 controls the electric brake**(see also "Set Aux Output in combination with Ramp On/Off, Drive motor regulator." on page 10.29).**
	EXCLUSIVE HYDRO	Pin E1.3 drives a hydraulic function when the Exclusive hydro input is active **(see also "Set Aux Output in combination with Ramp On/Off, Drive motor regulator." on page 10.29)**.
AUX FUNCTON #1	PRESENT, with delay.	The function controls the delay to the stabilizers where a double acting hydraulic function is used. Otherwise no delay is required.
	ABSENT, without delay.	
PEDAL BRAKING	ANALOG, Option, Set input #4" is set on Belly:	The mechanical brake has a potentiometer installed so that when the speed controller is released the regulator will modulate a braking force in relation to how much the brake pedal is pressed down. The minimum braking force is determined by the parameter Release braking (with slight brake pressure). The maximum braking force is determined by the parameter Pedal braking.
	ANALOG, Option, Set input #4 is set on Belly:	As for option BELLY above, but with the addition that the mechanical brake also has a switch installed as well as a potentiometer.
	DIGITAL	No analog foot brake function.
	NONE	The mechanical brake has neither a potentiometer nor a switch installed.
QUICK INVERSION	BELLY	The function is activated but not timed.
	TIMED	The function is timed.
	NONE	The function is switched off.
AUX OUTPUT #1	100%	Drive voltage to emergency contactor and electric brake in percent of the battery voltage.
PERFORMANCE	**OPTION #1**	Sets the power during Low Performance.
	OPTION #2	Sets the power during High Performance.
VALVE 1 TYPE	OPTION #1	Electric valve 1 is of the On/Off type.
	OPTION #2	Electric valve 1 is of the proportional type.
VALVE 2 TYPE	**OPTION #1**	Electric valve 2 is of the On/Off type.
	OPTION #2	Electric valve 2 is of the proportional type.
VALVE 3 TYPE	OPTION #1	Electric valve 3 is of the On/Off type.
VALVE 4 TYPE	OPTION #1	Electric valve 4 is of the On/Off type.

See table 10.15 below for specification of submenu ADJUSTMENTS. The submenu is obtained via buttons 1 and 5 on the Hand terminal..

Table 10.15 Submenu ADJUSTMENTS , Drive motor regulator

FUNCTION	VALUES		EXPLANATION	
	Option	Basic setting		
MIN LIFT	...V	-	Saves the **lowest** value from the lift potentiometer when the lift switch is activated.	See also "Calibration, Lifting/ Lowering control" on page 10.41.
MAX LIFT	...V	-	Saves the **highest** value from the lift potentiometer when the lift switch is activated.	
MIN LOWER	...V	-	Saves the minimum value from the lowering potentiometer when the lowering switch is activated	
MAX LOWER	...V	-	Saves the largest value from the lowering potentiometer when the lowering switch is activated.	
SET BATTERY TYPE	24V/ 36V/ 48V	24V	Selects battery voltage.	
BATTERY ADJUST	...V	23.8V	Final adjustment of measured battery voltage.	
THROTTLE 0 ZONE	...%	9%	Sets the zero point on the speed controller.	
THROTTLE X ZONE	...%	27%	Changes the characteristics from the speed controller.	
THROTTLE Y ZONE	...%	47%	The parameter changes the characteristics of the speed controller.	
ADJUSTMENT #02	1 - 9	3	Sets the lower level of battery discharging.	
ADJUSTMENT #01	1 - 9	3	Sets the upper level of battery discharging.	
CHECK UP DONE	ON/ OFF	-	Acknowledgement that Service has been carried out.	
CHECK UP TYPE				
NONE	0	-	Service reminder indicator switched off.	
OPTION #01	0	-	Alarm 99 at 300 hours of operation.	
OPTION #02	0	-	Alarm 99 + red LED lights up on MDI at 340 hours of operation.	
OPTION #03	0	-	Alarm 99 + red LED lights up on MDI at 380 hours of operation and the truck is stopped.	

When setting AUX OUTPUT and RAMP ON/OFF in the menu SET OPTION, different functions are obtained on output pin E1:3. The combinations are specified in table 10.16 below.

Table 10.16 Set Aux Output in combination with Ramp On/Off, Drive motor regulator.

Aux Output	Pin E1.3 Driver:	Stop on ramp	Behaviour of the truck when stopping on a sloping ramp
Brake	The magnetic brake.	On	The truck is held stationary by means of the drive motor until the time set in the parameter Auxiliary time has expired and then the electric brake is activated and the modulation to the drive motor is cancelled. Only use this combination if a negative brake is installed.
		Off	The truck is held by means of the drive motor but moves slowly down the ramp until the time set in the parameter Auxiliary time has expired and then the electric brake is activated and the modulation to the drive motor is cancelled. Only use this combination if a negative brake is installed.
Hydr. Cont	A hydraulic contactor.	On	The truck is held stationary by means of the drive motor until the time set in the parameter Auxiliary time has expired and then the truck moves slowly down the ramp until it reaches level ground.
		Off	The truck is not braked electrically, but only rolls slowly down a ramp until it comes to a level surface.
Excl. Hydro	A hydraulic contactor.	On	The truck is held stationary by means of the drive motor until the time set in the parameter Auxiliary time has expired, and only rolls slowly down a ramp until it comes to a level surface.
		Off	The truck is not braked electrically, but only rolls slowly down a ramp until it comes to a level surface.

Steering servoregulator, EPS-AC

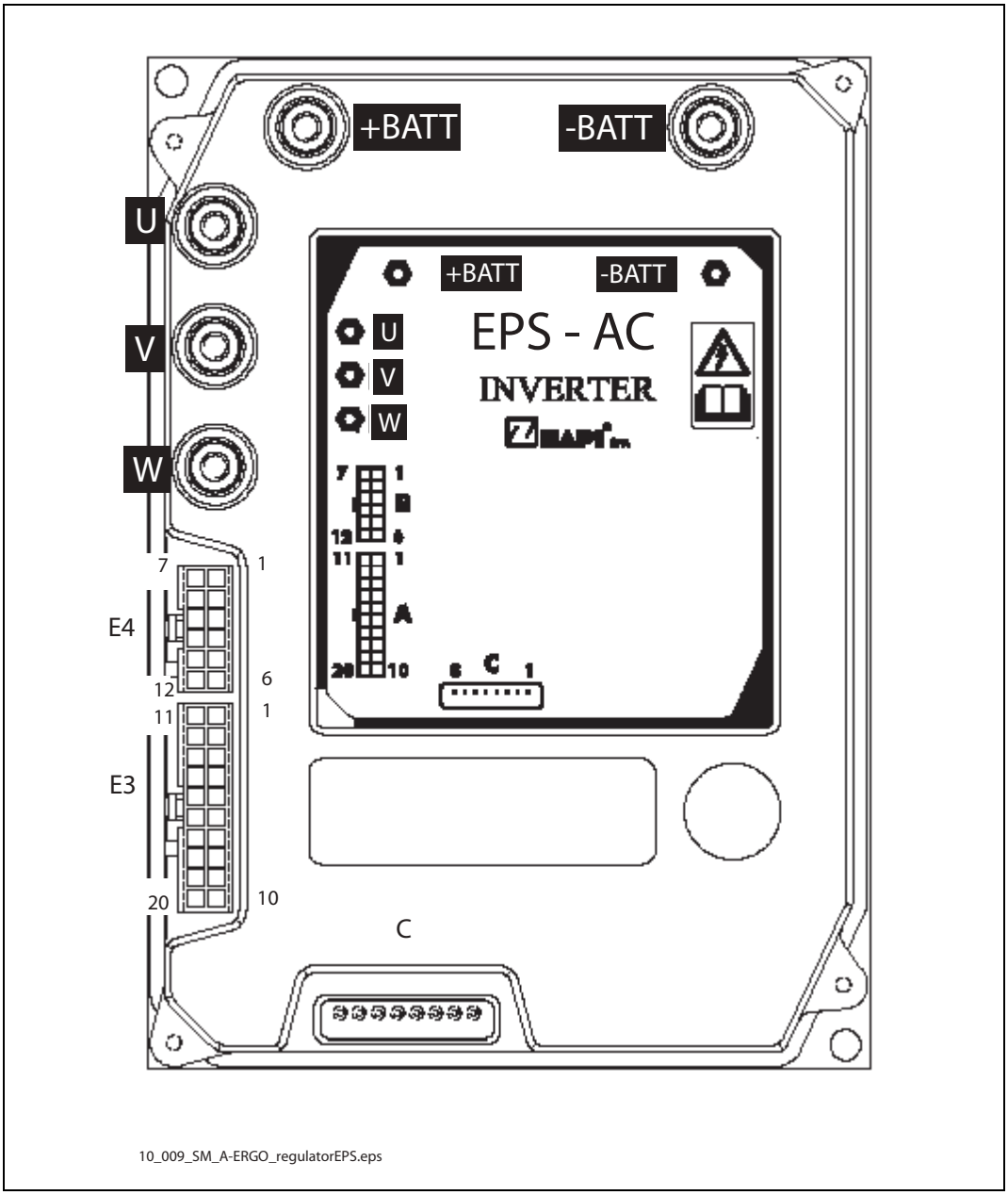


Figure 10.12 Steering servo regulator

Function, steering servo regulator EPS-AC

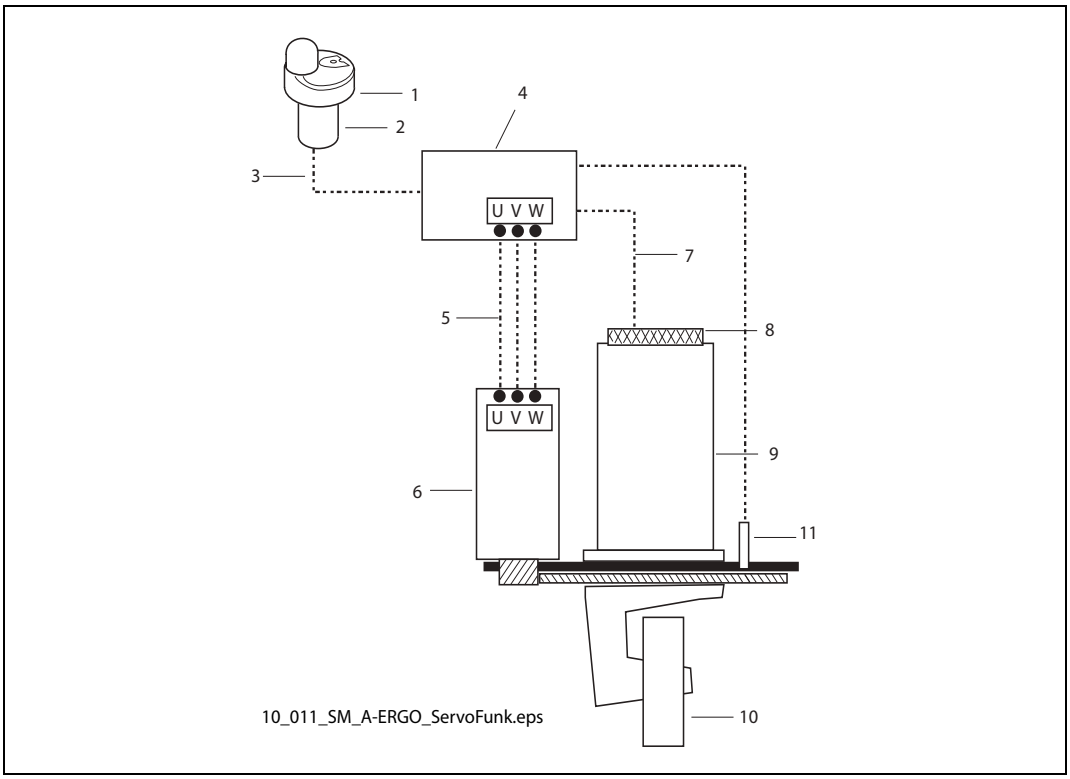


Figure 10.13 Functional overview of steering servo system

1. Steering wheel
2. Step motor sensor
3. Step motor sensor cabling, 6 cables
4. Steering servo regulator
5. Motor cabling
6. Steering servo motor
7. Cabling, safety steering drive motor brake
8. Drive motor brake
9. Drive motor
10. Drive wheel
11. End position sensor

A step motor sensor is connected to the steering wheel, which sends a signal to the steering servo regulator when the steering wheel is activated. The steering servo regulator provides drive voltage to the steering servo motor, which turns the drive wheel in the required direction and with the required speed. If a fault is indicated the regulator will disconnect the drive to the drive motor and allow the drive motor brake to pull, and in so doing stop the truck.

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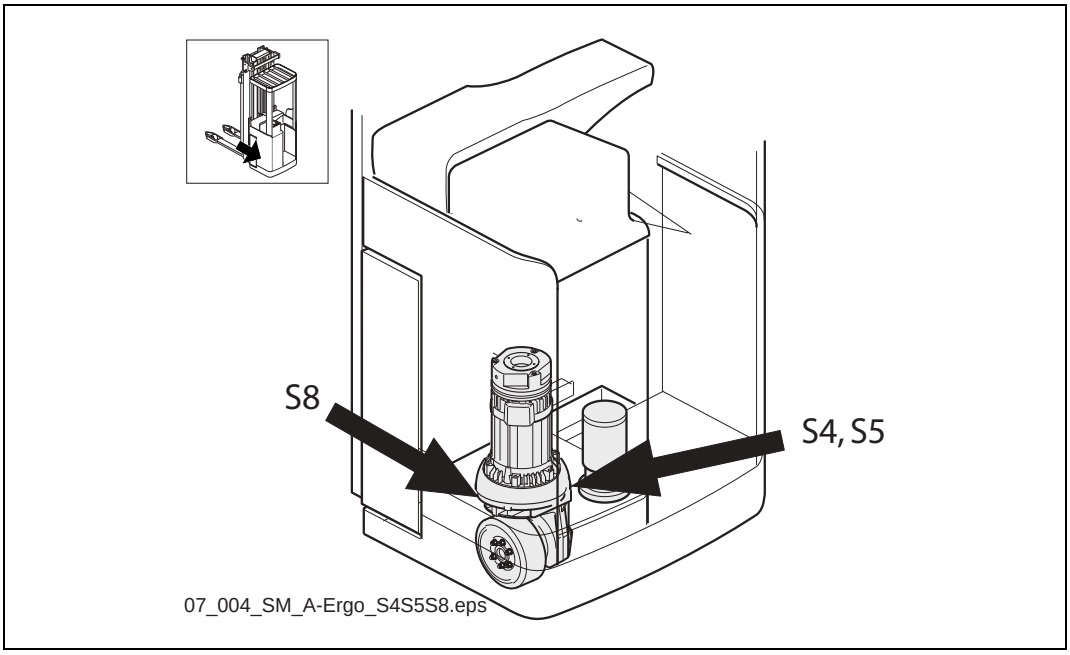


Figure 10.14 Limit position switch S4 and S5.

The end positions of the drive unit are indicated by inductive sensors, S4 and S5. When a sensor is actuated the turning motion is stopped in this direction. To monitor that the turning motion is not stopped by the sensor before the drive unit is in the end position, the steering sensor regulator senses whether the drive unit is moving from the sensor without the end position indicating releasing.

A third sensor, S8, senses whether the wheel is turned more than 45 degrees from the direction straight ahead. If this is the case the drive motor acceleration is reduced to reduce the tipping moment that occurs during acceleration sideways. The reduced acceleration is set with the parameter EXTRA ACCEL DELAY in the menu PARAMETER CHANGE with the help of the Hand terminal (see section 2, Special tools).

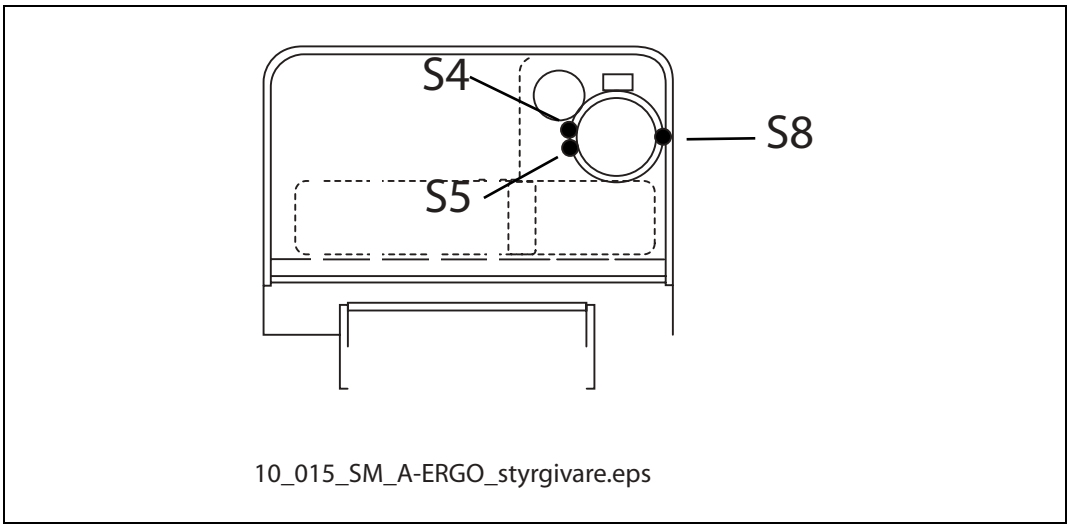
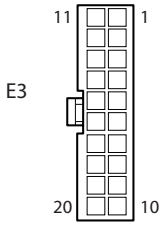


Figure 10.15 Sensor positioning, truck seen from above.

Connector, specification, steering servo regulator EPS-AC

The steering servo regulator has three connectors with inputs and outputs for sensors and programming tools. etc.
Each connector pin is specified below, with where appropriate the voltage level in connected position.



Connector E3 (the figure shows the connector from the cabling side).

Table 10.17 Connector E3 steering servo regulator

Pin	Description	Comment
E3.1	Not used in the A model	
E3.2	Not used in the A model	
E3.3	CAN communication	CAN High
E3.4	Not used in the A model	
E3.5	Speed reduction	
E3.6	Not used in the A model	
E3.7	From steering wheel sensor	Step motor
E3.8	Not used in the A model	
E3.9	Not used in the A model	
E3.10	From steering wheel sensor	Step motor
E3.11	Control signal from speed controller	Neutral = approx. 2.5V Maximum in direction of forks = approx 4.5V Maximum in opposite direction = approx 1.0
E3.12	Not used in the A model	
E3.13	CAN communication	CAN Low
E3.14	Not used in the A model	
E3.15	Not used in the A model	
E3.16	Not used in the A model	
E3.17	Not used in the A model	
E3.18	Not used in the A model	
E3.19	Not used in the A model	
E3.20	From steering wheel sensor	Step motor

Connector E4 (the figure shows the connector from the cabling side).

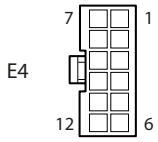


Table 10.18 Connector E4 steering servo regulator

Pin	Description	Comment
E4.1	Output from safety relay	+24V that is disconnected if there is a fault in the steering servo
E4.2	Not used in the A model	
E4.3	From steering wheel sensor	Step motor
E4.4	From steering wheel sensor	Step motor
E4.5	Not used in the A model	
E4.6	End position signal	Stops clockwise steering direction
E4.7	Input to safety relay	+24V
E4.8	Not used in the A model	
E4.9	From steering wheel sensor	Step motor
E4.10	Not used in the A model	
E4.11	Not used in the A model	
E4.12	End position signal	Stops anticlockwise steering direction

Connector C is used to connect the programming tool, Hand terminal..

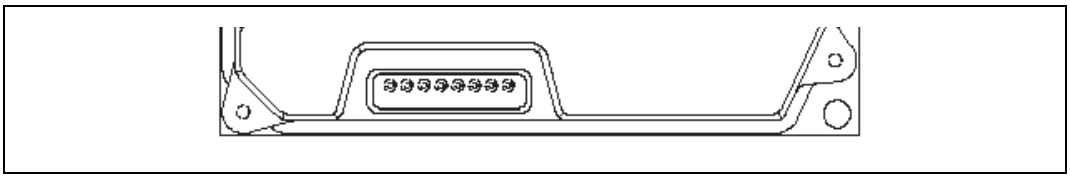


Figure 10.16 Connector C (the figure shows the connector from the cabling side)

The battery and motor connections are separately located on the steering servo motor regulator.

Table 10.19 Separate cable connections

Pin	Description
-BATT	Negative supply from the battery.
+BATT	Positive supply from the battery.
U; V; W	Motor connections.

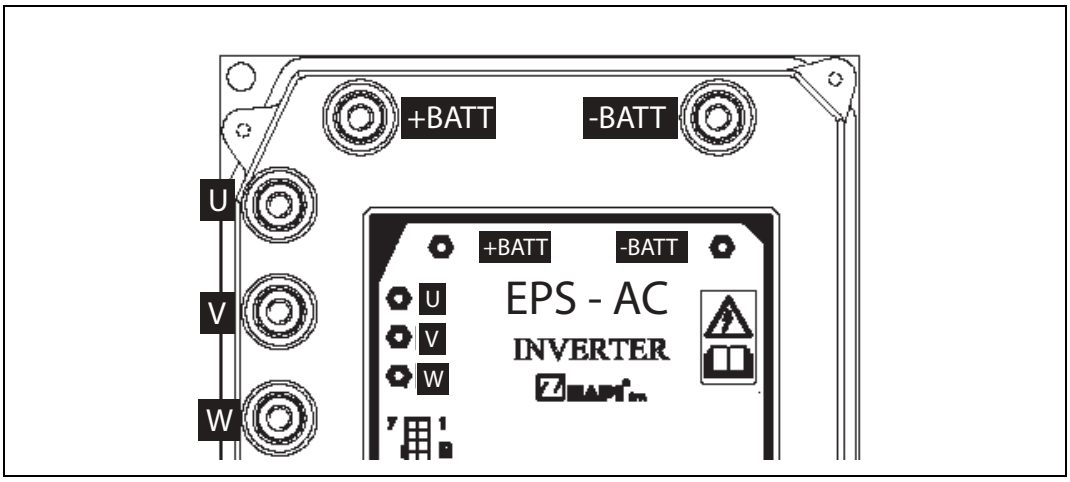
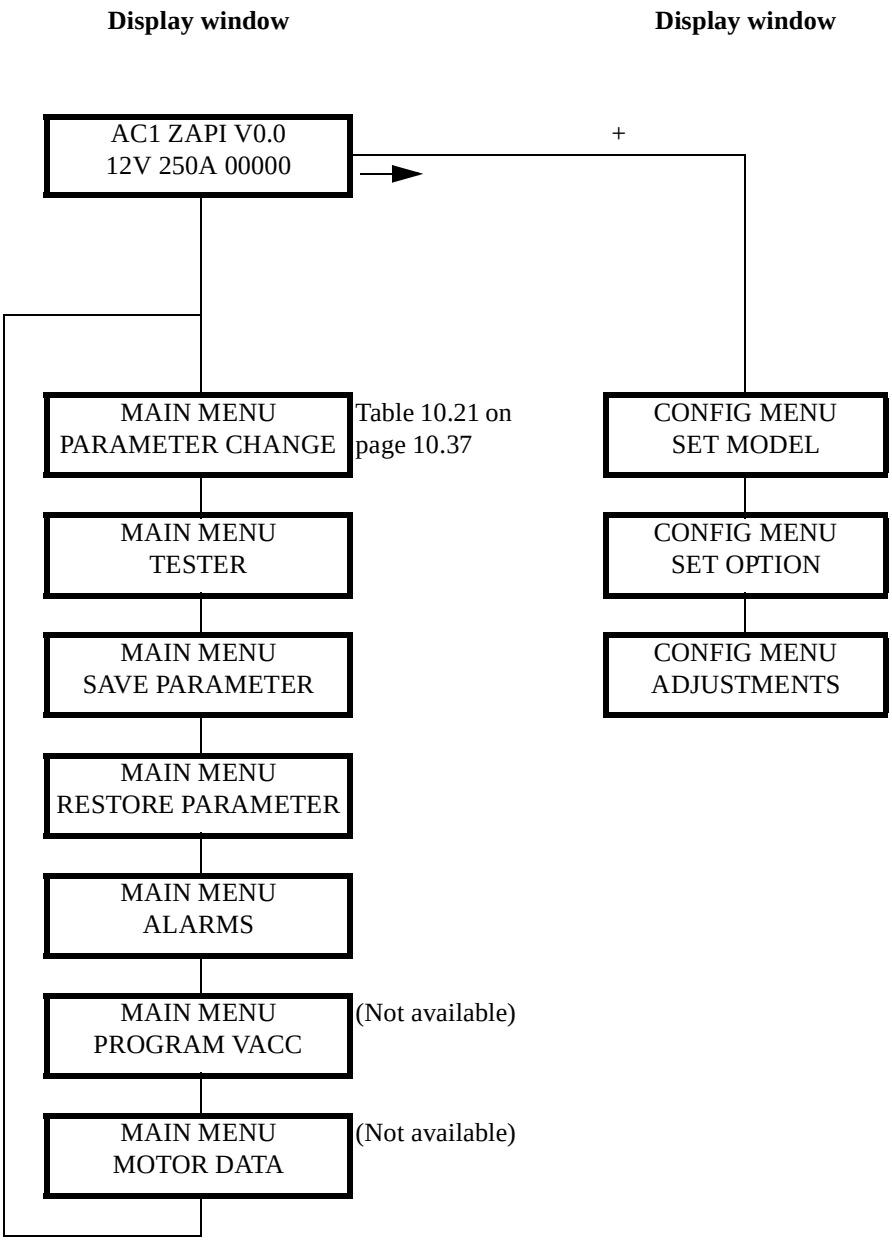


Figure 10.17 Connections, battery and motor

Menu tree, steering servo regulator EPS-AC

The following main headings are found in the steering servo motor regulator menu tree. Use the Hand terminal to view the menus, see "Operation, Hand terminal" on page 10.6.

Table 10.20 Main flow in the Hand terminal menus



Under menu selection PARAMETER CHANGE it is possible to set certain parameters for the turning motion, see table 10.21 below.

Table 10.21 Submenu PARAMETER CHANGE, steering servo regulator

PARAMETER/BASIC SETTING		EXPLANATION
SPEED LIMIT	7	Sets the maximum turning speed for the steering of the drive wheel
AUX FUNCTION 3	2	Sets the compensation of the sensitivity of the steering wheel modulation at high speed.
SENSIBILITY	3	Sets the sensitivity of the steering wheel modulation.
AUX FUNCTION 2		
CREEP SPEED	7	Reinforcement of power for small turns.
PERSUIT RAMP	-	Not used
COMPENSATION	2	Sets the compensation for voltage drop in cables and transistors.
DESENSIBILIZAT	-	Not used
POS ACCURACY	-	Not used
AUXILARY RAMP	-	Not used
AUXILIARY TIME	1	Sets the time the wheel is held in locked direction after the steering wheel is no longer activated.
ANTIROLLBACK	40%	Sets the force that holds the wheel in locked direction after the steering wheel is no longer activated.
HOUR COUNTER	RUNNING	The time is counted when the system is active and when controlling is possible.
MICRO CHECK	PRESENT	Connected monitoring system MUST NEVER BE DISCONNECTED
ENCODER CONTROL	OFF	There is no encoder in this system.
FEEDBACK DEVICE	OPTION 1	Not used
DIRECTION GAUGE	OPTION 1	Not used
AUTO INPUT ACTIVE	1	Not used
AUX FUNCTION 1	0	Not used

Wiring diagram

All the wiring diagrams are included in a separate Wiring Diagram Handbook, contact Atlet for further information.

The wiring diagrams relevant to A_Ergo are specified in the table below.

Table 10.22

Description	Machine	Reference	Document code
Connection diagram	A-ERGO		104100
Circuit diagram	A-ERGO		104101

Repair instructions

Calibration, Speed controller

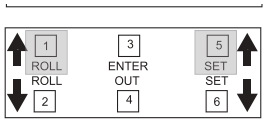
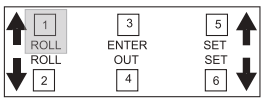
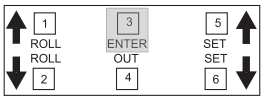
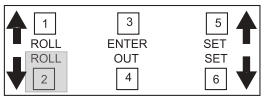
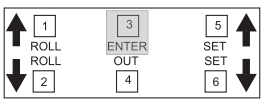
Supply: 5V

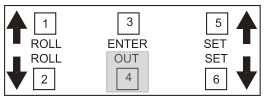
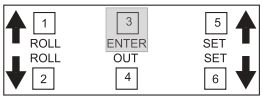
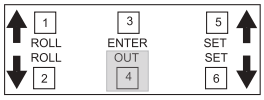
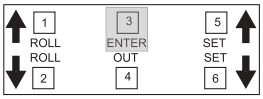
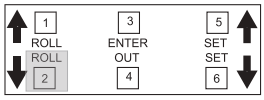
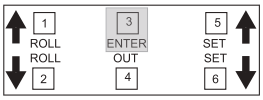
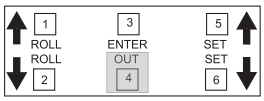
Neutral position: 2.5V

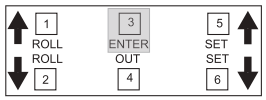
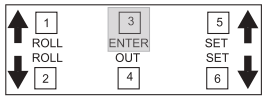
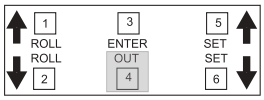
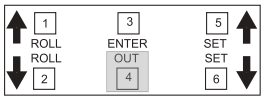
The drive is regulated with a linear lever, which is supplied with approx.: 5 V.

In neutral position the control should provide 2.5 V. When the lever is moved opposite to the direction of travel forwards the output signal from the sensor increases to 4.5 V, compared to 1.0 V when the lever is moved in the reverse direction.

The Hand terminal is used to calibrate the start position and max position, see "Operation, Hand terminal" on page 10.6 for user instructions.

Instructions	Display and keyboard
1. Connect the Hand terminal, the display shows:	AC1 ZAPI Vx.x 24V 250A 00000
2. After start up, press the two outer buttons.	 CONFIG MENU SET MODEL
3. Step to the Adjustment menu.	 CONFIG MENU ADJUSTMENT
4. Press ENTER to enter.	
5. Step to ACCELER MIN.	 ADJUSTMENT ACCELER MIN
6. Press ENTER.	
7. The display shows the actual value.	ACCELER MIN ...V

Instructions	Display and keyboard
8. Actuate the control to a position that is suitable to start the travel in the "direction of the drive wheel". If the control position is too far from neutral this will reduced controllability. An increase of the voltage by approx. 0.2 V from neutral can be appropriate.	
9. Press OUT.	
10. Press ENTER to save the value.	
Press OUT if the value is NOT to be saved.	
11. The display now shows:	CONFIG MENU ADJUSTMENT
12. Press ENTER to enter.	
13. Step to ACCELER MAX.	
	ADJUSTMENT ACCELER MAX
14. Press ENTER.	
15. The display shows the actual value.	ACCELER MAX ...V
16. Actuate the control to position maximum speed in the "direction of the drive wheel".	
17. Press OUT.	

Instructions	Display and keyboard
18. Press ENTER to save.	
19. Step to SET ACC REV MIN and repeat the procedure steps 8 to 12 in the direction of the forks. Step to SET ACC REV MAX and repeat the procedure steps 14 to 12 also in the direction of the forks.	
20. Press ENTER to save the value.	
Press OUT if the value is NOT to be saved.	
21. The display now shows:	CONFIG MENU ADJUSTMENT
22. To return to the main menu, press OUT.	

The speed controller is now calibrated in both directions. Test the sensitivity, and if any parameter does not feel right recalibrate that function.

Calibration, Lifting/Lowering control

This function stores the minimum and maximum values for the lifting and lowering controls.

The minimum value is the position on the lever when the respective movement is to start, and the maximum value is the value when the movement reaches maximum speed.

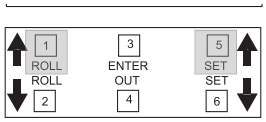
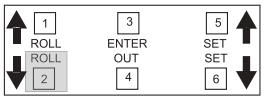
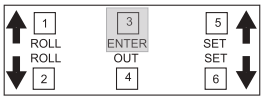
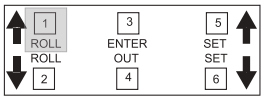
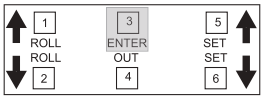
Supply: 5V

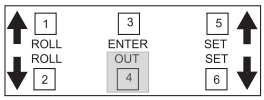
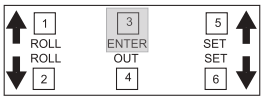
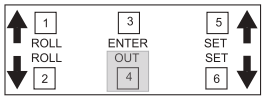
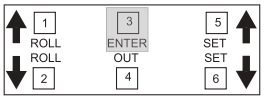
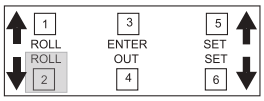
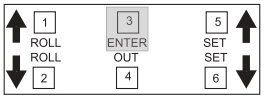
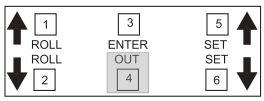
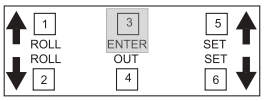
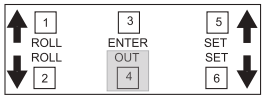
The lifting and lowering movements are regulated with a linear lever supplied with 5 V.

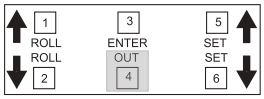
Neutral position: 2.5V

In neutral position the control should provide 2.5 V. When the lever is moved to lifting position the voltage increases to 4.5V, and decreases to 1.0 V when lowering.

The Hand terminal is used to calibrate the start position and max position.

	Instructions	Display and keyboard
1.	Connect the Hand terminal, the display shows:	AC1 ZAPI Vx.x 12V 250A 00000
2.	After start up, press the two outer buttons.	 CONFIG MENU SET MODEL
3.	Step to the Adjustment menu.	 CONFIG MENU ADJUSTMENT
4.	Press ENTER to enter this function.	
5.	Step to MIN LIFT.	 ADJUSTMENT MIN LIFT
6.	Press ENTER.	
7.	The display shows the actual value.	MIN LIFT ...V
8.	Actuate the control to a position that is suitable to start the lifting movement.	

Instructions	Display and keyboard
9. Press OUT.	
10. Press ENTER to save the value.	
Press OUT if the value is NOT to be saved.	
11. The display now shows:	CONFIG MENU ADJUSTMENT
12. Press ENTER to enter this function.	
13. Step to MAX LIFT.	
	ADJUSTMENT MAX LIFT
14. Press ENTER.	
15. The display shows the actual value.	MAX LIFT ...V
16. Actuate the control to position for maximum lift.	
17. Press OUT.	
18. Press ENTER to save the value.	
Press OUT if the value is NOT to be saved.	

Instructions	Display and keyboard
19. The display now shows:	CONFIG MENU ADJUSTMENT
20. Repeat the procedure for MIN LOWERING and MAX LOWERING.	
21. To return to the main menu, press OUT.	

The lifting/lowering control is now calibrated.

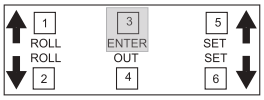
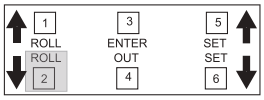
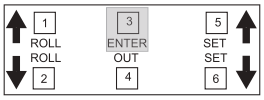
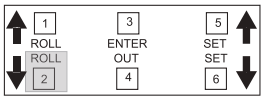
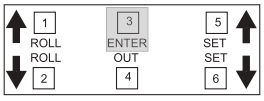
Save parameters in the Hand terminal memory

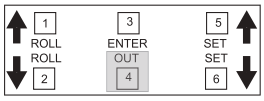
This function stores the set parameters in the Hand terminal memory.

These parameters can then be downloaded into another regulator by using the RESTORE function.

The following data can be saved by using SAVE PARAMETERS:

1. All parameters (PARAMETER CHANGE).
2. Options (SET OPTIONS).
3. Battery level (BATTERY LEVEL).

Instructions	Display and keyboard
1. Connect the Hand terminal, the display shows:	AC1 ZAPI Vx.x 24V 250A 00000
2. After start up, press button 3, ENTER to enter the MAIN MENU.	
	MAIN MENU PARAMETER CHANGE
3. Step to SAVE PARAM.	
	MAIN MENU SAVE PARAM.
4. Press ENTER to enter.	
5. If this function has been used previously, this is indicated with a two digit reference.	SELECT: Mod. 00 FREE
6. Step up, button 2, or down, button 1, until the window indicates FREE.	
	SELECT: Mod. 01 FREE
7. Press ENTER to save.	

Instructions	Display and keyboard
8. The display shows what is saved while it is carried out.	READING... ACCELER DELAY (ECC)
9. When everything is ready the window shows:	MAIN MENU SAVE PARAM.
10. Press OUT to return to the start window.	 AC1 ZAPI Vx.x 24V 250A 00000

Download parameters from the Hand terminal

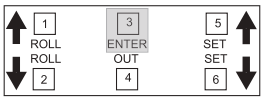
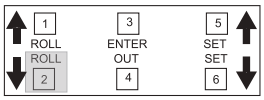
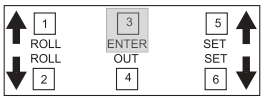
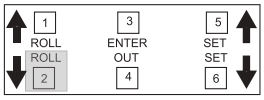
This function permits stored parameters in the Hand terminal memory to be downloaded to the regulator.

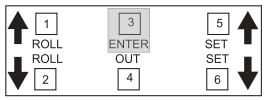
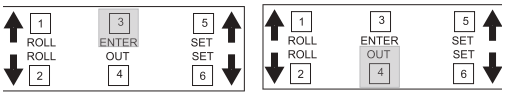
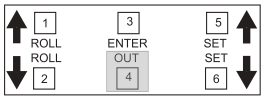
The following data can be downloaded by using RESTORE PARAMETERS:

1. All parameters (PARAMETER CHANGE).
2. Options (SET OPTIONS).
3. Battery level (BATTERY LEVEL).

☞ ***Important!***

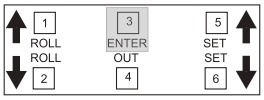
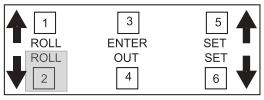
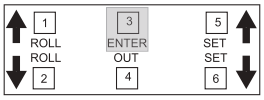
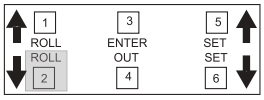
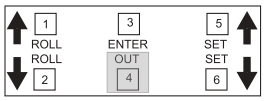
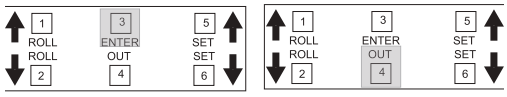
All the values in the regulator memory will be overwritten with the parameters in the Hand terminal..

Instructions	Display and keyboard
1. Connect the Hand terminal, the display shows:	AC1 ZAPI Vx.x 24V 250A 00000
2. After start up, press button 3, ENTER to enter the MAIN MENU.	
	MAIN MENU PARAMETER CHANGE
3. Step to RESTORE PARAM.	
	MAIN MENU RESTORE PARAM.
4. Press ENTER to enter.	
5. The display will show the models that are saved with a two digit code.	SELECT: Mod. 00 AC1 ZAPI V1
6. Step up, button 2, or down, button 1, until the required model pops up.	
	SELECT: Mod. 01 AC1 ZAPI V1

Instructions	Display and keyboard
7. Press ENTER to start downloading.	
8. The question Are you sure? comes up on the display.	ARE YOU SURE? YES = ENTER NO = OUT 
9. The display shows what is saved while it is carried out.	STORING... ACCELER DELAY
10. When everything is ready the window shows: 11. Press OUT to return to the start window.	MAIN MENU RESTORE PARAM.  AC1 ZAPI Vx.x 24V 250A 00000

Checking error codes

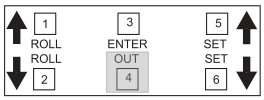
The regulator remembers the last five errors that have occurred. An error code is presented for every error that is saved, the number of times this error has occurred, what the hour counter showed, and the temperature of the regulator.

Instructions	Display and keyboard
1. Connect the Hand terminal, the display shows:	AC1 ZAPI Vx.x 24V 250A 00000
2. After start up, press button 3, ENTER to enter the MAIN MENU.	
	MAIN MENU PARAMETER CHANGE
3. Step to ALARMS.	
	MAIN MENU ALARMS
4. Press ENTER to enter.	
5. The display will show the error code, the number of times the error has occurred, and the temperature of the regulator at the time of the error.	CODE 00005 #02 20ºC
6. Step up, button 2, to see the next error, or down, button 1, to see previous errors.	
	CODE 00007 #03 18ºC
7. Press OUT to exit the ALARM window.	
8. The question Clear logbook? comes up.	CLEAR LOGBOOK? YES = ENTER NO = OUT
9. Press ENTER for yes and OUT for no.	

Instructions

10. Press OUT to exit the ALARM window.

Display and keyboard



AC1 ZAPI Vx.x
24V 250A 00000

Replacing drive regulator/steering servo regulator

1. If possible save current parameter settings, see “Save parameters in the Hand terminal memory” on page 44, before dismantling.
2. Switch off the power to the truck and pull out the battery plug.
3. Pull out the electrical panel so that the regulator becomes accessible.
4. Disconnect the motor cabling and supply cabling.
5. Pull out the control cabling, connector E1 and E2, and E3 and E4.
6. Unscrew the regulator.
7. **Steering servo regulator:** Scrape clean the contact surface between the regulator and attachment plate.
8. **Steering servo regulator:** Apply heat extraction paste between the regulator and attachment plate.
9. Refit the regulator.
10. Connect the control cabling, connector E1 and E2, and E3 and E4.
11. Connect the motor cabling and supply cabling.
12. Download the parameter settings the regulator had previously (assumes that point 1 above has been completed), see “Download parameters from the Hand terminal” on page 46.

Replacing MDI

1. Switch off the power to the truck and pull out the battery plug.
2. Lift up the control panel, see section 7 for access.
3. Loosen connector E5.
4. Loosen the clamp and pull out the MDI.
5. Assemble in the reverse order.

Replacing the steering servo sensor

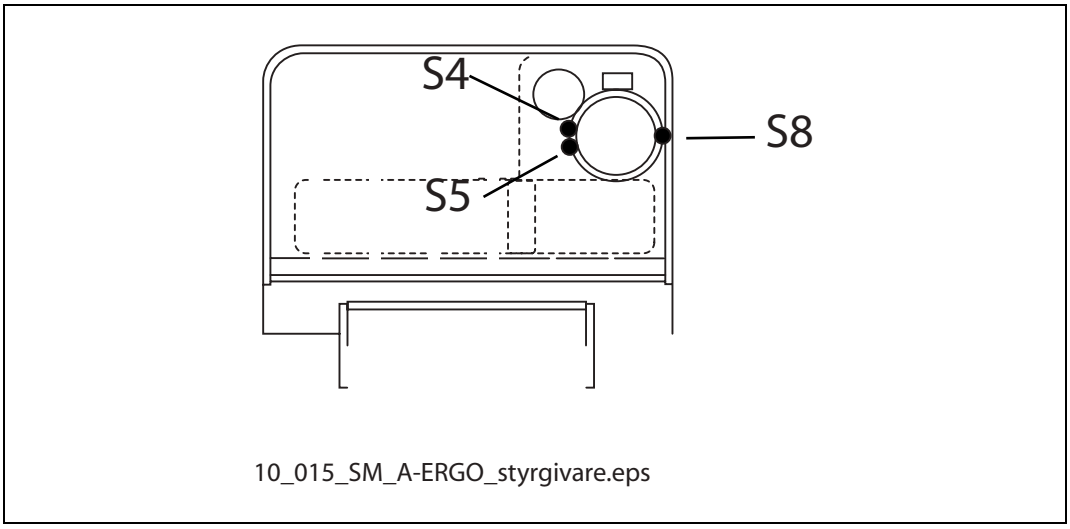


Figure 10.18 Positioning steering servo sensor, truck seen from above

Dismantling the steering servo sensor

1. Switch off the power and disconnect the battery.
2. Loosen the lock nut on the sensor.
3. Unscrew the sensor (and follow the cable so that it does not twist).

Assembling the steering servo sensor

1. Screw in the sensor (and follow the cable so that it does not twist) until it meets the cam.
2. Screw up the sensor 1 turn and tighten the sensor with the nut.
3. Lock the nut with liquid thread locking agent.

☞ ***Important!***

The nut should be locked with liquid thread locking agent. Make sure that the thread locking agent is applied in the threaded hole.

Diagnosis and trouble shooting

Safety

☞ ***Important!***

See "Safety procedures" on page 10.3 before starting work on the electrical system.

Tools for trouble shooting

Circuit diagram

The circuit diagram forms the basis for trouble shooting work and provides an overview of the function of the electric system, from where it is possible to localise faults.

Circuit diagrams are supplied with each truck, or can be found in a separate Wiring Diagram Handbook.

Wiring diagram

The wiring diagram should be used to translate the principle solutions of the circuit diagram to the practical connections in the truck.

Wiring diagrams are supplied with each truck, or can be found in a separate Wiring Diagram Handbook.

Error codes

Error codes are read-off on the MDI, see "Multi Function Display Indicator (MDI)" on page 10.13, and through the Hand terminal, see "Operation, Hand terminal" on page 10.6.

The implications of the error codes are specified in the following sections:

- Drive motor regulator, see:"Error codes, drive motor regulator" on page 10.57.
- Steering servo regulator see:"Error codes, steering servo regulator" on page 10.61.
- Error codes in the display, see:"Error codes MDI" on page 10.56.

Multimeter

When using the multimeter all measurements should be made with B- as reference.

The safest way of trouble shooting is with the negative test cable connected as close to the battery as possible, with the exception of if voltage levels from the speed controller are to be measured, in which case it is best to use B- on the respective regulator.

Input and output specification

Pin numbering in contactors, see

- "Connector E1 drive motor regulator AC1" on page 10.16.
- "Connector E2 drive motor regulator AC1" on page 10.17.
- "Connector E3 steering servo regulator" on page 10.33.
- "Connector E4 steering servo regulator" on page 10.34.

Practical trouble shooting

For all trouble shooting in the electrical system it is recommended to first connect the Hand terminal to the actual regulator and to check if it gives an error message, and to translate this in the tables, see "Error codes" on page 10.56.

Errors which in the first instance appear to refer to a regulator may in actual fact be an error in another unit, and therefore for this reason search for an error message in all units if it does not occur in the first.

Error in the drive function

1. Connect the Hand terminal to the drive regulator and read-off any error messages, they will come up automatically when the Hand terminal has logged into the drive regulator.
2. If there are no error messages actuate the brake switch and speed controller to see if any message comes up.
   If not, go over to the test menu and read-off the function of the brake switch (Brake switch "Submenu TESTER, Drive motor regulator" on page 10.24) and the output signal from the speed controller (ACCELERATOR), .

   - see "Calibration, Speed controller" on page 10.38.

     There are no separate direction switches, and the direction is determined by the throttle voltage from the speed controller. However, the direction selection can be studied in the test menu with FORW SWITCH and BACK SWITCH (indicate if the system interprets the travel direction),
   - see, "Submenu TESTER, Drive motor regulator" on page 10.24.
3. Check also the position of the switches for speed reduction by means of SPEED SWITCH 1 and 2 in the test menu,.

   - see "Submenu TESTER, Drive motor regulator" on page 10.24.
4. Also check the current to the motor CURRENT RMS.
   If current goes to the motor without it moving, or if it moves slowly, this may be because of an error in the encoder signal from the motor, which can be studied by using ENCODER in the test menu,.

   - see "Submenu TESTER, Drive motor regulator" on page 10.24.
   - If the encoder should be defective then the encoder bearing in the drive motor must be replaced, see section 5.
5. Over +75 °C in the drive regulator reduces the maximum motor current gradually with increasing temperature. At 100 °C it is reduced to zero.

This is presented as an error message HIGH TEMPERATURE in the Hand terminal and 16A61 in the instrument display (MDI).

6. If error message VACC NOT OK is received in the Hand terminal or 16A78 in the instrument display (MDI), the error may be because the speed controller is incorrectly calibrated.

    - To calibrate the speed controller, see"Calibration, Speed controller" on page 10.38.

Error in the steering servo system

1. Connect the Hand terminal to the regulator.
2. Read any error messages, and read the reason and solution in "Error codes" on page 10.56.

Error in the lifting/lowering system

1. Connect the Hand terminal to the drive regulator and read any error messages, see "Error codes" on page 10.56.
2. Check the system settings with "Delivery Settings in Drive Controller A with Zapi AC 1 in truck (Parameter Change Menu)" on page 10.20.
3. Use the Test menu, see "Submenu TESTER, Drive motor regulator" on page 10.24, to study the following:

    - Input voltage from the lifting/lowering control with: LIFTING CONTROL.
    - If the system interprets the lifting requirement with: LIFTING SWITCH.
    - If the system interprets the lowering requirement with: DESCENT SWITCH.

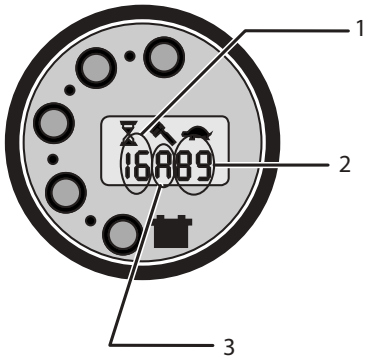
Error symptom, drive motor regulator

Table 10.23 Error symptoms

Symptom	Possible reason	Action
Low voltage to drive motor	Battery voltage lower than set limit value.	Charge the battery.
The system does not start	Incorrect start up sequence.	The key lock should switch on before the speed controller can be actuated.

Error codes

Error codes MDI



1. Indication of which regulator set alarm.
2. Alarm number
3. A=Alarm

By looking at the first two digits in the error code it is possible to identify the regulator that set the alarm, see table 10.24 below.

Table 10.24 Indication of which regulator set alarm.

Regulator code	Explanation	Error codes
02	Drive motor regulator	See "Error codes, drive motor regulator" on page 10.57.
06	Steering servo regulator	See "Error codes, steering servo regulator" on page 10.61.
16	Multi Function Display	See table 10.25 below.

Certain error codes are set unique by MDI, see 10.25 below.

Table 10.25 Error codes presented in Multi Function Display, MDI

Error code MDI	Error code, Hand terminal	Explanation	Check/Action
16A67	CAN BUS KO	Poor contact with CAN-BUS link.	1. Check the cabling and contactors. 2. If OK, replace regulator.
16A70	HW OVER CURR	Valves connected to E5.4 and/or E5.6 short circuited.	Check power consumption. Replace valve when overcurrent exceeds 2A.
16A74	DRIVER SHORTED	MDI PRC has detected short circuit at ON/OFF valves.	Check power consumption to ON/OFF valves. Replace valve when overcurrent exceeds 2A.
16A75	CONTACTOR DRIVER	Internal error MDI.	Replace MDI.
16A89	PEPV NOT OK	Positive voltage to valves lacking or too low.	Check voltage E5.1 = B+. If OK, replace MDI.
16A90	NEVP1 NOT OK	Problem with one of the proportional valve guides.	

Error codes, drive motor regulator

The following error codes are set by the drive motor regulator, table 10.26.

Table 10.26 Error codes, drive motor regulator, AC1

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
02A00	BATTERY LOW	If the function BATTERY CHECK is activated and the battery has less than 10% left the current will be reduced to half the set level, at the same time as an error code is shown.	Charge the battery.
02A08	WATCHDOG	This is an internal test carried out both during driving and when stationary, and it is the logic that is tested.	Replace regulator.
02A13	EEPROM KO	Error in the area that contains adjustable parameters.	Switch on and off from the key once: • If the error code has disappeared, note that all adjustable parameters have gone back to the default values and that a new setting must be made. • If the error persists, replace regulator.
02A16	AUX OUTPUT KO	When the key is switched on, check the µP Drive contactor driver for the electric brake. If the answer is not correct an error code will be given.	Replace regulator.
02A17	LOGIC FAILURE #3	Error in the hardware part that handles the overcurrent protection to the different phases to the motor.	Replace regulator.
02A18	LOGIC FAILURE #2	Error in the hardware part that handles the voltage supply in the different phases to the motor.	Replace regulator.
02A19	LOGIC FAILURE#1	Indicates that the over/undervoltage protection has been activated.	a) A real under/overvoltage has occurred. b) Replace regulator.
02A30 / 02A31	VMN LOW/ VMN HIGH	This test is carried out during start up and when stationary.	a) Problem with the cables to the motor, connections, windings in the motor, or contact to material. b) Replace regulator.
02A37	CONTACTOR CLOSED	Drive contactor closed during start	a) Check contactor and cables. b) Replace regulator.
02A38	CONTACTOR OPEN	The logic has sent a voltage to the main contactor coil and this is expected to be closed, but the contactors are not closed.	a) Break in cables to the coil. b) Defective contactor.

Table 10.26 Error codes, drive motor regulator, AC1

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
02A53	STBY i HIGH	Check that the current is 0 when stationary. If not the truck will be stopped.	a) Defective current sensor. b) Replace regulator.
02A55	PROG LIFT LEVER	This alarm indicates that there is an error in the program for the lifting/ lowering control.	Error in the program for lifting/ lowering control.
02A60	CAPACITOR CHARGE	Internal regulator error.	Replace regulator.
02A61	HIGH TEMPERATURE	Temperature of cooling flange over 75°C. The current is limited in relation to the excess temperature. The regulator stops completely at 100°C.	1. Check fan at the electrical panel 2. No action if no other symptoms are shown. 3. Improve cooling
02A67	CAN BUS KO	Monitoring of CAN bus.	a) Check cables. b) Replace regulator.
02A70	ENCODER ERROR	Incorrect signal from the drive motor speed feedback sensor (Encoder).	1. Check the encoder signal with the Hand terminal. 2. Check cabling between the drive motor encoder and drive regulator.
02A71	HAND-BRAKE	The truck does not start because the foot brake switch is not actuated.	a) Switch defective. b) The driver has used the wrong sequence during start up. c) Defective cables. d) If the error persists, replace regulator.
02A73	THERMIC SENSOR KO	Incorrect values from the sensor that controls the regulator temperature.	Replace regulator.
02A74	DRIVER SHORTED	Internal error, regulator.	Replace regulator.
02A75	CONTACTOR DRIVER	Internal error, regulator.	Replace regulator.
02A76	COIL SHORTED	When the key is switched on, check the µP Drive contactor driver for FF.SR. If the answer is not correct there will be an error code, in the event of this error replace regulator. FF SR carries out a hardware check of the current to the drive contactor coil, and if it is too high the drive contactor opens and an error code is shown.	1. Check for possible short circuiting in the cabling, and if the coil has the correct resistance. 2. Replace regulator.

Table 10.26 Error codes, drive motor regulator, AC1

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
02A78	VACC NOT OK	This test is carried out when stationary. The reason for the alarm is that the voltage from the speed controller is 1 volt higher that the minimum value programmed in the PROGRAM VACC function.	a) Speed controller not correctly calibrated. b) Speed controller defective.
02A79	INCORRECT START	This alarm indicates that an incorrect start has been made.	a) Speed controller defective. b) The driver has used the wrong sequence during start up. c) Defective cables. d) If the error persists, replace regulator.
02A80	FORW + BACK	This test is carried out all the time, and means that double travel directions have been requested at the same time.	a) The driver has used the wrong sequence during start up. b) Defective cables. c) If the error persists, replace regulator.
02A86	PEDAL WIRE KO	This error code indicates that there is a fault in the cables to the speed controller potentiometer.	Check the cabling to the speed controller.
02A89	PEV NOT OK	The voltage on PEV output is not correct.	Replace regulator.
02A93	INPUT ERROR #2	This alarm is detected only at power up. Meaning: The battery voltage differs more than 20% compared to nominal value.	Check with a multimeter if the battery voltage is really over or under the mentioned thresholds. If not, using the Zapi console, check the”BATTERY VOLTAGE” in the tester menu. If you find a mismatch between the real battery voltage and the Zapi console battery voltage, you should tune it: Go into the adjustment menu. Make sure that “SET BATTERY TYPE” is 24V and then tune the “ADJUST BATTERY” parameter to the correct value. Then switch the truck off and on.
02A94	CURR.SENS KO	Error in current meter system.	Replace regulator.

Table 10.26 Error codes, drive motor regulator, AC1

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
02A99	INPUT ERROR #1	The speed controller has two output signals, a primary one centred around 2.5 V, increasing when driving in the machine housing direction and decreasing in the forks direction, and a secondary one also centred around 2.5 V but going in the opposite direction when accelerating. This is used as a control signal and goes in on the steering servo contact E3.11. From there is goes via the CAN system to the drive regulator and is compared with the primary one. If these do not correspond the system will go into neutral position and the brake will be activated.	• Check the speed controller and cabling. • Measure the voltage levels.
		Poor contact with speed controller.	• Check connector E3 to see that the contact surfaces are OK. • Check measure E3.11.

Error codes, steering servo regulator

The following error codes are set by the steering servo regulator, table 10.26.

Table 10.27 Error codes, steering servo regulator, EPS

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
06A08	MICRO SLAVE	Internal error, steering servo regulator.	If the error persists, replace regulator.
06A13	EEPROM KO	Internal error, steering servo regulator.	Carry out a CLEAR EEPROM. • Use the Hand terminal, press both the SET buttons (5+6) at the same time to enter ALARM CONFIG MENU. • Step forward to CLEAR EEPROM. • Press ENTER twice (3+3.) If the error persists, replace regulator.
06A16	LOGIC FAILURE #4	Internal error, steering servo regulator. High rest potential between the U and W phase.	If the error persists, replace regulator.
06A17	LOGIC FAILURE #3	Internal error, steering servo regulator. High rest potential between the V and U phase.	If the error persists, replace regulator.
06A18	LOGIC FAILURE #2	Occurs when the required voltage between phase U and W differs from the measured value.	If the error persists, replace regulator.
06A19	LOGIC FAILURE #1	Occurs when the required voltage between phase U and V differs from the measured value.	If the error persists, replace regulator.
06A28	S.P OUT OF RANGE	Occurs when the potentiometer for the required steering angle has poor electrical contact.	• Check the connections and cabling of the steering angle potentiometer. • If a fault cannot be found, replace potentiometer.
06A29	F.B OUT OF RANGE	Occurs when the potentiometer for resetting the steering angle has poor electrical contact.	• Check the connections and cabling of the steering angle potentiometer. • If a fault cannot be found, replace potentiometer.
06A32	VMN NOT OK	Occurs when the initial rest potential between at least one phase and signal earth is high.	If the error persists, replace regulator.

Table 10.27 Error codes, steering servo regulator, EPS

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
06A37	KM CLOSED	Occurs when safety contact drops in advance.	• Check the electrical installation, pin E4.1 and E4.7. • Where appropriate, check the function of change-over-switches and relays in the circuit. • If none of the above errors are found, replace regulator.
06A38	KM OPEN	Occurs when safety contact opens too late.	• Where appropriate, check the function of change-over-switches and relays in the circuit. • If none of the above errors are found, replace regulator.
06A39	KS CLOSED	Occurs when safety contact drops in advance.	• Check the electrical installation, pin E4.1 and E4.7. • Where appropriate, check the function of change-over-switches and relays in the circuit. • If none of the above errors are found, replace regulator.
06A40	KS OPEN	Occurs when safety contact opens too late.	• Where appropriate, check the function of change-over-switches and relays in the circuit. • If none of the above errors are found, replace regulator.
06A48	MAIN CONT OPEN	Occurs during initiation of synchronisation of the CanBus system with the drive motor regulator AC1 if the main contactor does not close.	Probably an alarm from the drive motor regulator AC1.
06A53	STBY is HIGH	Rest potential too high.	Replace regulator.
06A61	HIGH TEMPERATURE	Regulator temperature over 76 °C.	Switch off the truck and allow the unit to cool.
06A67	KEYOFF	A warning that the Sicus module gives a Key-off command via Can Bus.	The error code disappears if the Sicus module switches off the command.
06A68		One steering end limit switch (S4 or S5) is closed when it should be open. Each time the steering is turned away from the end position the limit switch is checked to see that it opens. If it does not open, the error shows and the drive is stopped.	• Check function of both end limit sensors (S4 and S5). • Check sensor (S4 and S5) adjustment.

Table 10.27 Error codes, steering servo regulator, EPS

Error code indicating		Explanation	Check/Action
MDI	**Hand terminal**		
06A70	HIGH CURRENT	Occurs if the current amplifier output signal gives a higher value than the Imax level for more than one second.	If the error persists, replace regulator.
06A71	POWER FAILURE #3	Occurs with phase loss, steering servo motor U, V, W.	Check measure steering servo motor and cabling.
06A72	POWER FAILURE #2	Occurs with phase loss, steering servo motor U, V, W.	Check measure steering servo motor and cabling.
06A73	POWER FAILURE #1	Occurs with phase loss, steering servo motor U, V, W.	Check measure steering servo motor and cabling.
06A81	DATA ACQUISITIO N	Occurs when the operator changes ADJUSTMENT #1 to level 1.	Switching the key off and on resets the alarm.
06A94	MICRO SLAVE KO	Set point value for steering wheel modulation and actual value from drive wheel do not correspond.	Check connections. - Step motor sensor - Steering servo motor - Limit position sensor, steering If the error persists, replace regulator.
06A95	D LINE SENSOR KO	Occurs when the signal from the step motor sensor, pin E4.3 EPS, is open.	1. Check step motor cabling. 2. Measure the resistance between pin E4.3 and signal earth (should be close to 30Ω). 3. If the error persists, replace step motor sensor.
06A96	Q LINE SENSOR KO	Occurs when the signal from the step motor sensor, pin E4.9 EPS, is open.	1. Check step motor cabling. 2. Measure the resistance between pin E4.6 and signal earth (should be close to 30Ω). 3. If the error persists, replace step motor sensor.

SERVICEMANUAL

Machine: A-Ergo

Manual No: 005975

Edition 2007A

11 Brake and speed system

Edition 2007A

11 Brake and speed system

Design and function

Electric brake

A-Ergo is fitted with an electric brake. The electric brake is a safety brake with two friction surfaces. The brake torque that can be adjusted using an adjuster screw on the older model (–2006w46), is generated by spring pressure. The brake is activated when the voltage across the coil is cut, i.e. the truck brakes when it has no power supply.

When the brake is actuated the springs press on the plate, which is pressed axially to the rotor. When the brake is to be released the coil is supplied with battery voltage. The magnetic field created between the plate and the magnetic part allows the rotor to rotate freely.

The brake is actuated in four different ways (see also the wiring diagram):

1. Via the drive motor regulator when the regulator indicates a serious fault.
2. Via the steering servo regulatorn, which disconnects the brake coil supply to the plus terminal of the battery if a serious fault is indicated.
3. Via the foot pedal, which disconnects the brake coil supply to the plus terminal of the battery when the driver is not longer actuating it.

Repair instructions

Electric brake

Adjusting the electric brake (–2006w46)

Adjusting is carried out in the following order.

1. Adjusting of A dimension:

A dimension:
A = 0.2 mm

    1. Fit the electric brake and tighten the bolts.
    2. Check the gap, see figure11.1, between the magnetic part and the plate (the A dimension should be: A = 0.2 mm
    3. If the gap needs adjusting, release the bolts holding the brake and turn the adjusting sleeves.
    4. Tighten the brake and check that the gap is the same all round.

2. Test the brakes by driving and test braking.

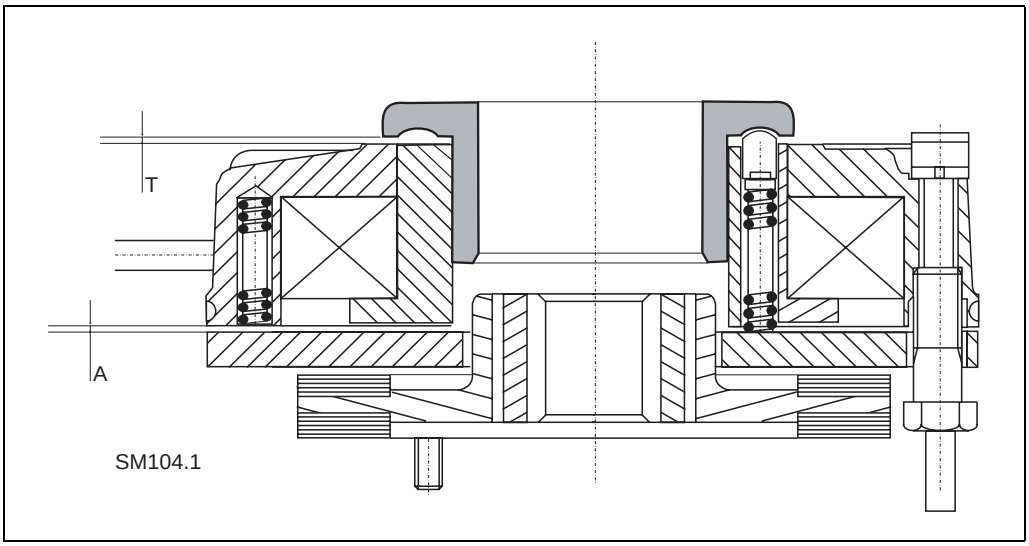


Figure 11.1 Electric brake

Adjusting the electric brake (2006w47–)

Electric brake in new design (from 2006 w47) is adjusted at the factory and cannot be adjusted later.

Replacing the magnetic part, electric brake (–2006w46)

1. The T dimension should be checked before replacing the magnetic part!

2. When refitting the magnetic part adjust the T dimension to the same dimension as before by means of a hook spanner, see figure 11.1.

Warning!

Remember to lock any adjustments!

Warning!

Check that you have a safe braking capacity.

Warning!

The friction lining must be at least 1 mm, otherwise it must be replaced.

Note!

When you install a new brake, remember to remove the transport lock.

Replacing the brake disc (2006w47–)

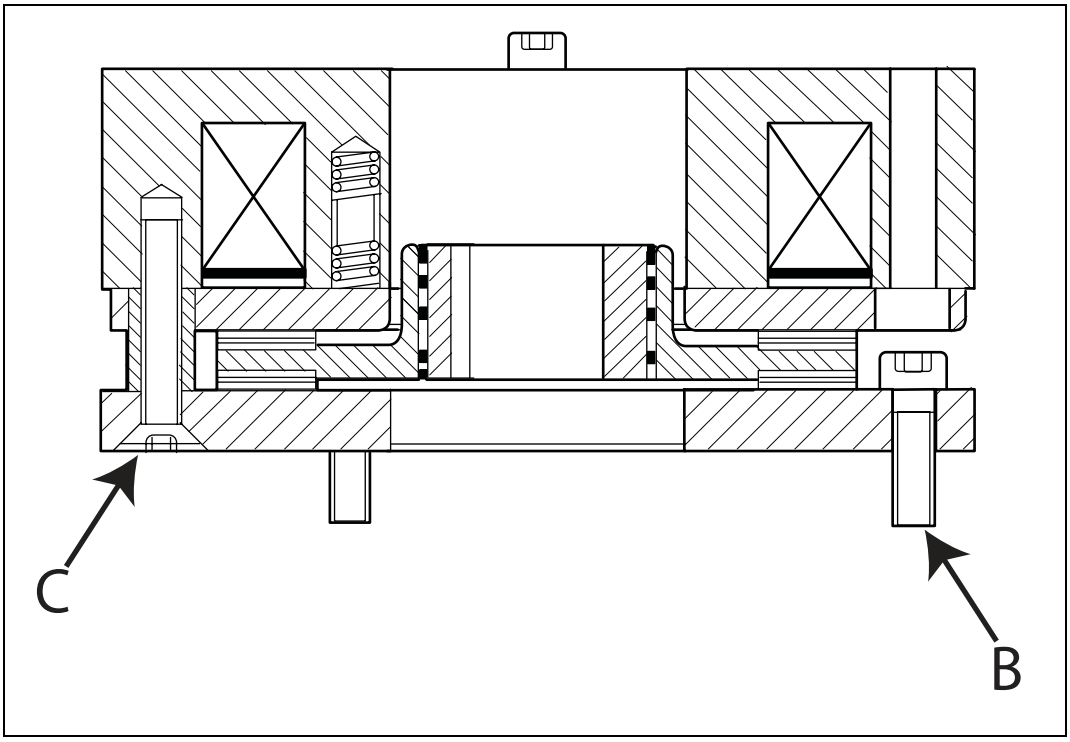


Figure 11.2 Electric brake (2006w47–)

1. Disconnect the electrical connections to the magnetic part.
2. Undo the three retaining screws, pos B in figure11.2.
3. Dismantle the brake by unscrewing 3 screws, pos C.
4. Lift out the brake disc and clean the magnetic part and brake plate.
5. Mount the new brake disc and refit the magnetic part. Tighten the three retaining screws at 9.5 Nm.

6. Reconnect the electrical connections to the magnetic part.

⚠ ***Warning!***

Check that you have a safe braking capacity.

Emergency release

The brake can be released manually where necessary.

Note!

If the brake is released manually, there is no working parking or emergency brake. Never leave a truck with a manually released brake!

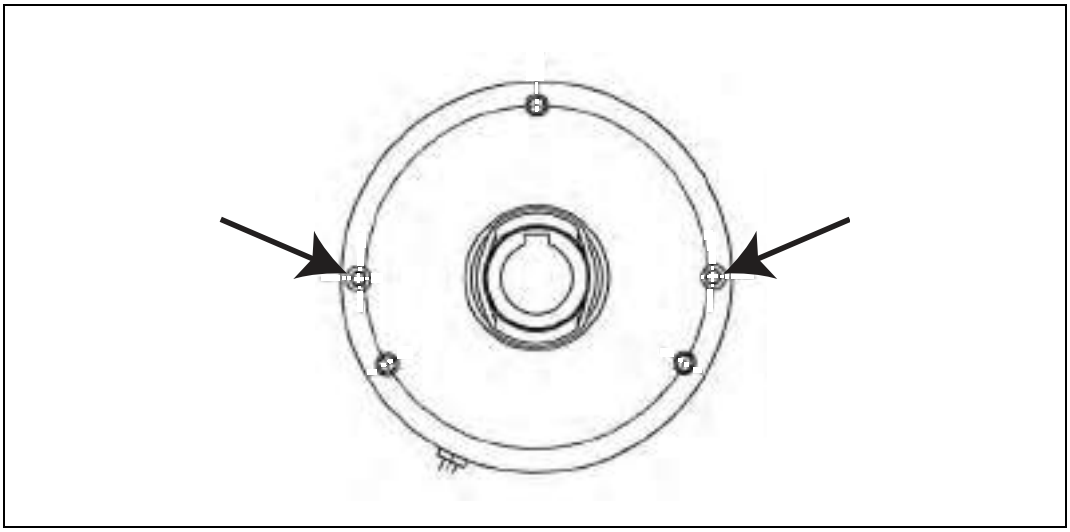


Figure 11.3

To manually release the brake, screw in two screws (M6x55) in the two marked holes. (Figure 11.3).

Speed controller

Replacing the speed controller

1. Lift up the arm rest, see section 4.

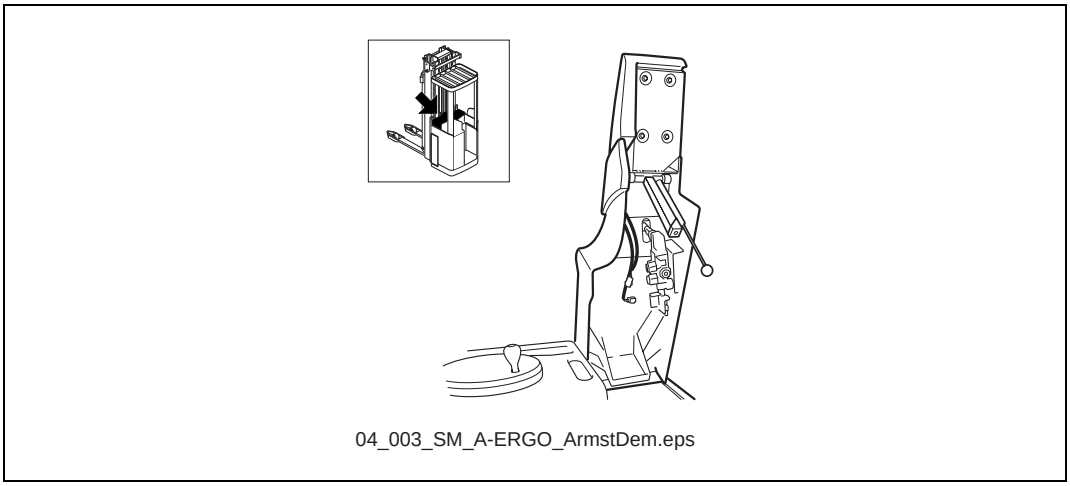


Figure 11.4 Lift up arm rest

2. Release the cabling to the speed controller.
3. Unscrew the two screws holding the controller in place, and take out the controller.

Adjusting the speed controller

See section 10.

Checking the foot pedal

The foot pedal can be checked in two different ways, either by measuring the resistance or by measuring it connected in the system and supplied with voltage.

We recommend measuring the switch connected in the system and supplied with voltage.

1. Lift up the drive wheel and secure the truck with blocks.
2. Connect a voltmeter over the foot switch connectors.
3. Press down the foot switch.
4. Read-off the value, it should be less than 0.1 Ohm.
5. Release up the foot switch and read-off the value, it should be approx. battery plus. The resistance of the switch should be measured if it is lower.