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CESAB

REPAIR MANUAL

ECO P

60-70-85



Code 036-0432-00

04/2010

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Document changes history:

Edition	Changes
036-0432-00	New version

This manual covers the following truck models:

Model	Starting serial number	Ending serial number

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VEHICLE EXTERIOR VIEW

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VEHICLE MODELS

Vehicle Model	Load Capacity	Control Method	Voltage (V)
ECO P 60	6,0 ton	AC Microcomputer controller	80
ECO P 70	7,0 ton	↑	↑
ECO P 85	8,5 ton	↑	↑

FRAME SERIAL NUMBER

Frame serial number location
The frame serial number is stamped on the front cross plate. Please refer to the frame serial number when making inquiries about your vehicle.

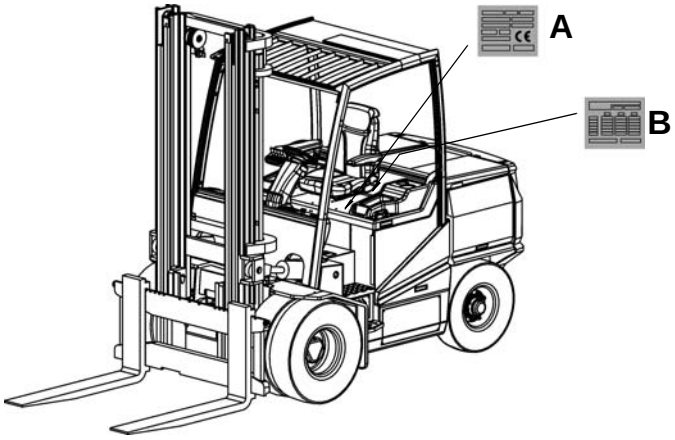
Vehicle model	Punching format	Punching position
ECO P 60	CE000000	
ECO P 70	CE000000	
ECO P 85	CE000000	

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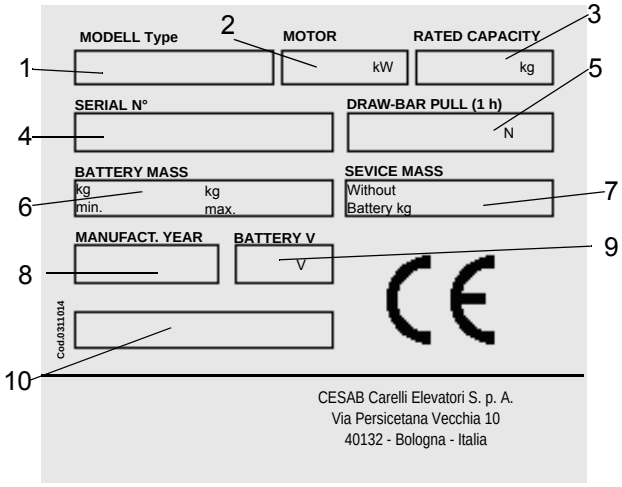
TRUCK CAPACITY AND IDENTIFICATION PLATES

A) IDENTIFICATION PLATE
B) LOAD CAPACITY PLATE

The position of the plates, like shown in the image, is referred to the standard truck: this position could vary in special trucks case.

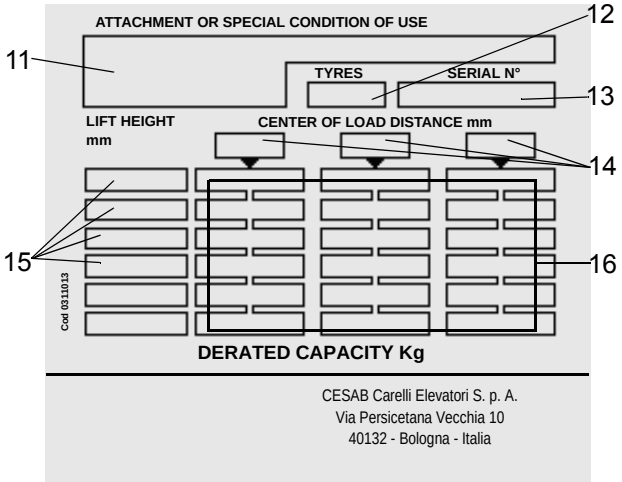


How to Read the Plates



A: Identification plate
It identifies the lift truck technical data

1. Vehicle model
2. Motor power
3. Nominal rated capacity
4. Truck serial number
5. Draw-bar pull
6. Battery weight (min/max)
7. Truck weight (without battery)
8. Year of manufacture
9. Battery voltage
10. Notes



B: Load capacity plate
It identifies the load capacity with a load center of 600 mm (except for different indications):

11. Special model, Attachment model
12. Truck tyres
13. Attachment serial number
14. Load center
15. Lift height Rated capacity

DATA SHEET FOR MATERIAL HANDLING EQUIPMENT									
CHARACTERISTICS									
1.1	Manufacturer		CESAB			CESAB		CESAB	
1.2	Model designation		ECO P 60			ECO P 70		ECO P 85	
1.3	Power unit		electric			electric		electric	
1.4	Operation		driver seated			driver seated		driver seated	
1.5	Load capacity	Q [kg]	6000			7000		8500	
1.6	Load centre distance	c [mm]	600			600		600	
1.8	Axle centre to fork face	x [mm]	595 (661 with sideshift/pos.)		a	615 (695 with sideshift. pos.)		635 (705 with sideshift/pos.)	
1.9	Wheelbase	y [mm]	2000			2000		2000	
WEIGHTS									
2.1	Service weight	kg	10280			11040		12577	
2.2	Axle loading, with load front/rear	kg	14745 / 1535			16342 / 1698		19116 / 1961	
2.3	Axle loading, without load front/rear	kg	5055 / 5225			5037 / 6003		5389 / 7188	
WHEELS AND TYRES									
3.1	Tyres : C=Cushion, PN=Pneumatic, SE=Superelastic, G=Twin ty		C / SE / PN	CG / SEG / PNG		CG / SEG / PNG		CG / SEG / PNG	
3.2	Tyre size front		713x360-560 / 355/65-15 / 355/65-15	713x254-560 / 8,25-15 / 8,25-15		713x254-560 / 8,25-15 / 8,25-15		713x254-560 / 8,25-15 / 8,25-15	
3.3	Tyre size rear		559x254-406 / 250-15	559x254-406 / 250-15		559x254-406 / 250-15		660x254-508 / 250-15	
3.5	Wheels: number front/rear (x = driven wheels)		2 x / 2	4 x / 2		4 x / 2		4 x / 2	
3.6	Track width front	b10 [mm]	1375 - 1450 - 1450	1450 / 1472 / 1472		1450 / 1472 / 1472		1450 / 1472 / 1472	
3.7	Track width rear	b11 [mm]	1230	1230		1230		1230	
DIMENSIONS									
4.1	Mast/fork carriage tilt forward/backward	α / β [°]	5° / 10°			5° / 10°		5° / 10°	
4.2	Height of mast, lowered	h1 [mm]	2525		b	2575	b	2575	b
4.3	Free lift	h2 [mm]	100			100		100	
4.4	Lift	h3 [mm]	3150			3150		3150	
4.5	Height, mast extended	h4 [mm]	4050		b	4105	b	4105	b
4.7	Height of overhead guard	h6 [mm]	2570			2570		2570	
4.8	Seat height	h7 [mm]	1379			1379		1379	
4.12	Towing coupling height	h10 [mm]	630			630		630	
4.19	Overall lenght	l1 [mm]	4425 (4491)		a	4445 (4525)	a	4538 (4608)	a
4.20	Lenght to face of forks	l2 [mm]	3225 (3291)		a	3245 (3325)	a	3338 (3408)	a
4.21	Overall width	b1\b2 [mm]	1750 / 1750 / 1804	1972 / 1972 / 2013		1972 / 1972 / 2013		1972 / 1972 / 2013	
4.22	Fork dimensions	s/e/l [mm]	60x200x1200			60x200x1200		70x200x1200	
4.23	Fork carriage ISO 2328, class/type A,B		4 A			4 A		5 A	
4.24	Fork carriage width	b3 [mm]	1600			1600		1600	
4.31	Ground clearance, with load below mast	m1 [mm]	205		b	205	b	205	b
4.32	Ground clearance, centre of wheelbase	m2 [mm]	180		b	180	b	180	b
4.33	Aisle width for pallets 1000x1200 wide	Ast [mm]	4899			4919		5090	
4.34	Aisle width for pallets 800x1200 long	Ast [mm]	5099			5119		5290	
4.35	Turning radius	Wa [mm]	3104			3104		3255	
4.36	Internal turning radius	b13 [mm]	1252			1252		1252	
PERFORMANCE									
5.1	Travel speed with/without load	km/h	14 / 16			14 / 16		13,5 / 16	
5.2	Lift speed with/without load	m/s	0,32 / 0,42			0,27 / 0,40		0,24 / 0,32	
5.3	Lowering speed with/without load	m/s	0,49 / 0,38			0,5 / 0,4		0,44 / 0,3	
5.5	Drawbar pull with/without load	N	13000			13000		13000	
5.6	Max drawbar pull with/without load (S2 5')	N	35000			35000		35000	
5.7	Gradeability with/without load (S2 30')	%	13 / 16			12 / 15		11 / 13	
5.8	Max gradeability with/without load (S2 5')	%	16 / 18			15 / 17		14 / 16	
5.9	Acceleration time with/without load	s	---			---		---	
5.10	Service brake		hydraulic			hydraulic		hydraulic	
DRIVE									
6.1	Drive motor, power (S2 60')	kW	27,1			27,1		27,1	
6.2	Lift motor, power (S3 22%)	kW	2x20			2x20		2x20	
6.3	Battery according to DIN 43531/35/36 A, B, C, NO		NO			NO		NO	
6.4	Voltage / battery capacity (K5)	V/Ah	80 / 640			80 / 720		80 / 1050	
6.5	Battery weight	kg	1150x2			1150x2		1350x2	
6.6	Energy consumption according to VDI	kWh/h	---			---		---	
OTHER									
8.1	Type of drive control		Inverter			Inverter		Inverter	
8.2	Operating pressure for attachments	bar	190			190		190	
8.3	Oil quantity for attachments	l/min	70			70		70	
8.4	Sound level at the driver's ear (EN 12053)	dB (A)	---			---		---	
8.5	Towing coupling, type DIN		---			---		---	

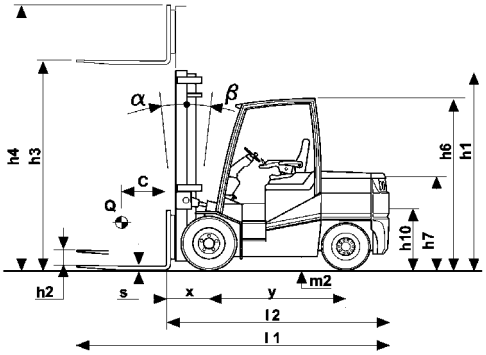
a) ( ) With sideshift/positioner.

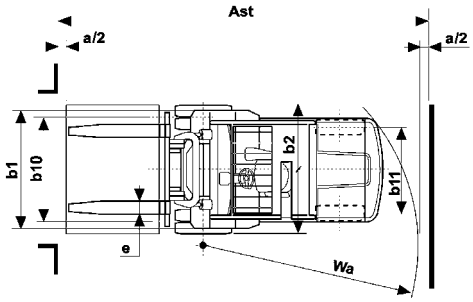
b) With superelastic tyres

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ECO P 60
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ECO P 85

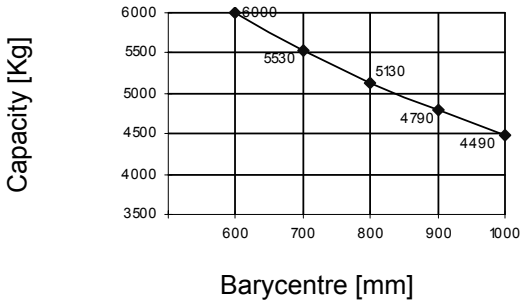




CAPACITY DIAGRAMS (with SE tyres)

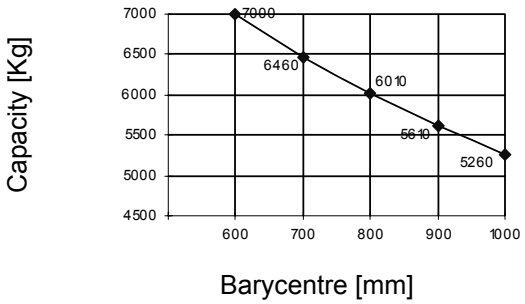
Barycentre [mm]	Capacity [Kg]
600	6000
700	5530
800	5130
900	4790
1000	4490

ECO P 60



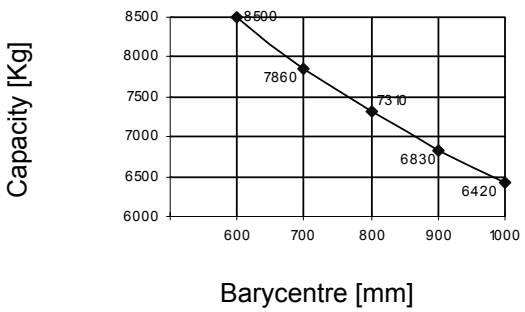
Barycentre [mm]	Capacity [Kg]
600	7000
700	6460
800	6010
900	5610
1000	5260

ECO P 70



Barycentre [mm]	Capacity [Kg]
600	8500
700	7860
800	7310
900	6830
1000	6420

ECO P 85



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HOW TO USE THIS MANUAL

EXPLANATION METHOD

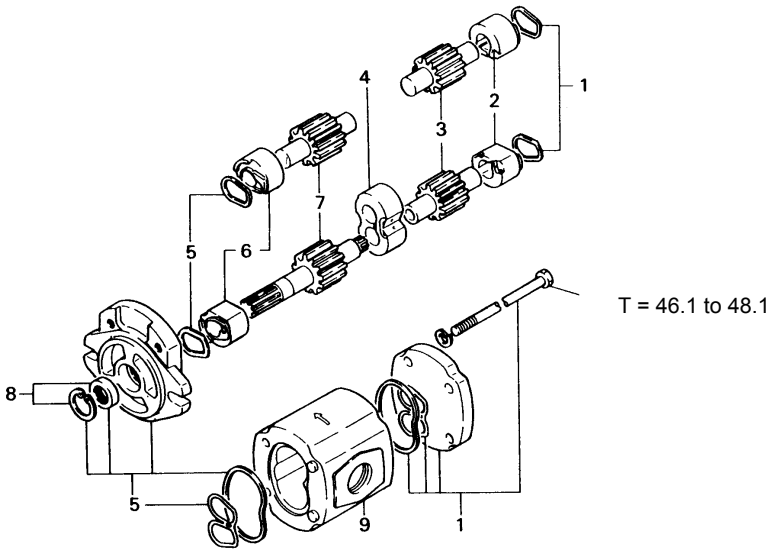
1. Operation procedure
   The operation procedure is described in either pattern A or pattern B below.
   1) Pattern A: Explanation of each operation step with illustration.
   2) Pattern B: Explanation of operation procedure by indicating step numbers in one illustration, followed by explanation of cautions and notes summarized as point operations.

Example of description in pattern B

DISASSEMBLY·INSPECTION·REASSEMBLY

Tightening torque unit T = N·m

- Sometimes step Nos. are partially omitted in illustrations.
- When a part requiring tightening torque instruction is not indicated in the illustration, the part name is described in the illustration frame.



Disassembly Procedure

1. Remove the cover. **[Point 1]]**
2. Remove the bushing. **[Point 2]** ←Operation explained later
3. Remove the gear

Points of intervention

Explanation of key point for operation with an illustration

[Point 1]
Disassembly: ↙
Put a match mark when removing the pump cover

[Point 2]
Inspection:
Measure the bush inside diameter
Limit 19.12 mm

Matters omitted from this manual
This manual omits descriptions of the following jobs, but perform them in actual operation:
(a) Cleaning and washing of removed parts as required
(b) Visual inspection (partially described)

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TERMINOLOGY

Caution:
Important matters, negligence of which may cause accidents. Be sure to observe them.

Note:
Important items, negligence of which may cause accidents, or matters in operating procedure which require special attention.

Standard:
Value showing the allowable range in inspection or adjustment

Limit:
The maximum or minimum value allowed in inspection or adjustment.

ABBREVIATIONS

Abbreviation	Meaning	Abbreviation	Meaning
ASSY	Assembly	SAE	Society of Automotive Engineers (USA)
ATT	Attachment	SAS	System of active stability
LH	Left hand	RH	Right hand
O/S	Oversize	U/S	Undersize
PS	Power steering	SST	Special service tool
EHPS	Power steering with total electronic control	STD	Standard
FHPSx	Power steering with hydraulic control	T=	Tightening torque
L/	Less (-)	°°T	Number of teeth (°°T)
OPT	Option	W/	With

ILLUSTRATIONS

The illustrations are supposed to point out the correct procedures to execute the truck and on his components, therefore they could not represent exactly the elements of this truck but similar mechanical components.

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SI UNITS

Meaning of SI

This manual uses SI units. SI represents the International System of Units established to unify the various systems of units used in the past for smoother international technical communication.

New Units Adopted in SI

Item	New unit	Conventional unit	Conversion rate* (1 [conventional unit] = X* [SI unit])
Force (**)	N (newton)	kgf	1 kgf = 9.80665 N
Torque(**) (Moment)	N·m	kgf·cm	1 kgf·cm = 9.80665 N·m
Pressure (**)	Bar	kgf/cm^2	1 Bar = 1 kgf / cm^2
Pressure (**)	Pa (Pascal)	kgf/cm^2	1 kgf/cm^2 = 98.0665 kPa = 0.0980665 MPa
Pressure (**)	Pa (Pascal)	mmHg	1 mmHg = 0.133322 kPa
Revolving speed	rpm	rpm	1 rpm = 1 r/min (giri al minuto)
Spring constant (**)	N/mm	kgf/mm	1 kgf/mm = 9.80665 N/mm
Volume	l	cc	1 cc = 10^{-3} x1l
Power	W	PS system	1 PS = 0.735499 kW
Heat quantity	W·h	cal	1 kcal = 1.16279 W·h
Specific fuel consumption	g/W·h	g/PS·h	1 g/PS·h = 1.3596 g/kW·h

<Reference>
(*) : X represents the value in SI units as converted from 1 [in conventional units], which can be used as the rate for conversion between conventional and SI units.
(**): In the past, kilogram [kg] representing mass was often used in place of weight kilogram [kgf], which should be used as the unit of force.

Conversion between Conventional and SI Units

Equation for conversion

Value in SI unit = Conversion rate × Value in conventional unit	Conversion rate: Figure corresponding to X in the conversion rate column in the table above
Value in conventional unit = Value in SI unit ÷ Conversion rate	

When converting, change the unit of the value in conventional or SI units to the one in the conversion rate column in the table above before calculation. For example, when converting 100 W to the value in conventional unit PS, first change it to 0.1 kW and divide by the conversion rate 0.735499.

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OPERATING TIPS

1. Safe operation
   (1) After jacking up the vehicle, always support it with wooden blocks or sturdy rigid stands
   (2) When hoisting the vehicle or a heavy component, use wire rope(s), chains or slings with a sufficient reserve in load capacity to the load to lift
   (3) Always disconnect the battery plug before electrical parts inspection or servicing

2. Technical operation to perform
   (1) Before starting any kind of operation, prepare the tools, necessary measuring instruments (multimeter, megohmmeter, oil pressure gauge, etc.) and SST (Special Service Tools).
   (2) Before disconnecting wiring, always check the cable color and wiring state.
   (3) When overhauling functional parts, complicated portions or related mechanisms, arrange the parts neatly to prevent confusion.
   (4) When disassembling and inspecting parts such as the control valve, use clean tools and operate in a clean location
   (5) When disassembling, inspecting and reassembling, follow the specified procedures
   (6) Always replace gaskets, packing, O-rings, self-locking nuts and cotter pins with new ones each time they are disassembled
   (7) Always use genuine parts for replacement.
   (8) Reassembling, use specified bolts and nuts as shown in the specifications. Observe the specified tightening torque at the time of reassembly (tighten to the average value of the specified tightening torque range.). If no tightening torque is specified, tighten the bolt or the nut according to the value at the “standard tightening torque table”

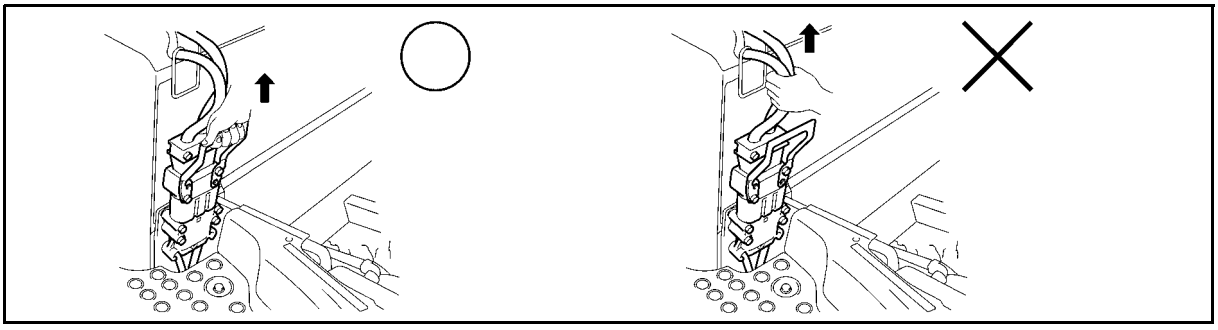
3. Determining the trouble status
   When a trouble occurs, do not attempt an immediate disassembling and/or replacing of any components but first determine if disassembly and/or replacement are actually required in order to resolve the defect.

4. Waste fluids and solid refuses disposal
   Always use a proper container when draining waste fluids from the vehicle. Careless discharge of oil, fuel, coolant, oil filter, battery, solid refuses or other harmful substance may adversely affect human health and destroy the environment. Always collect and sort well this kind of materials, and treat them properly by requesting disposal by specialized companies and however according to the current laws

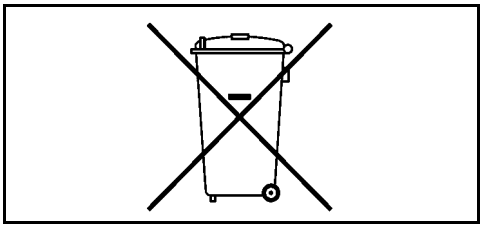
5. Greasing up each part
   In addition to periodic grease-up according to the lubrication chart, apply MP grease (or molybdenum disulfide grease) to each sliding contact face when repairing a portion (like pedal link) involving sliding contact.

6. Functional parts protection (battery operated vehicles)
   (1) After vehicle inspection or maintenance, before connecting the battery plug , check thoroughly each connector for connection failure or imperfect connection. Connectors failure or imperfect connection, especially related to the logic units, may damage elements inside them

7. Disconnect the battery plug
   When unplugging the battery plug, use the grip. Do not pull up the cable..



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BATTERY RECYCLING/DISCARDING

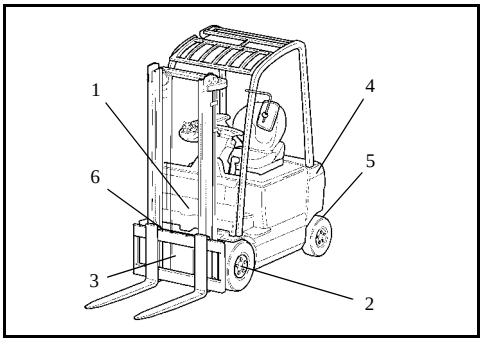
The forklift truck uses a lead accumulator and, in the case of some battery-powered trucks, a lithium battery.

Materials contained in batteries (also accumulators) are hazardous to the environment and humans and therefore discarded batteries should be returned to the manufacturer for recycling.

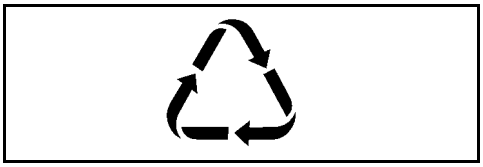
DISCARDING THE BATTERY

When the working life of the battery in the truck is at an end (change for a new battery) or if the entire truck is to be scrapped, special attention to environmental risks must be paid when disposing/recycling batteries. Contact the manufacturer about changing or discarding batteries.

RECYCLING

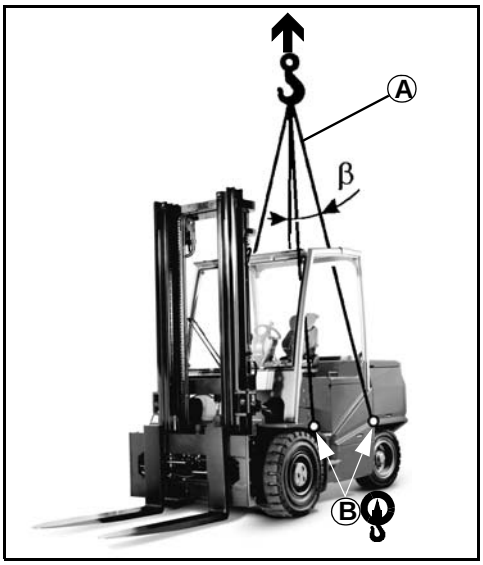


1	BODYWORK	steel, brass, bronze, ABS, plastic-reinforced fibre-glass, polymers
2	DRIVE UNIT	steel, copper, nylon, graphite, polymers
3	BRAKING UNIT	steel, polymers, nylon
4	ELECTRIC UNIT	steel, copper, silicon, brass, aluminium, lead, zinc, graphite, nylon, polymers
5	STEERING UNIT	steel, bronze, polymers
6	HYDRAULIC UNIT	steel, copper, bronze, brass, aluminium, graphite, polymers
	VARIOUS COMPONENTS	steel, copper, brass, aluminium, cast-iron, ABS, nylon, polymers
	DISPOSAL OF MINERAL OILS, GREASE AND BATTERY	In compliance with local directives. Please dispose of in an environmentally friendly way!



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LIFTING THE TRUCK



HOOKING POINTS FOR THE TRUCK LIFTING

Lifting the vehicle, always observe the specified hooking points and hoisting methods. Never hoist by any other attachment section and/or procedure as it is very dangerous.
The hooking points are shown on the truck with the symbol shown on the side (see figure)

If the truck is equipped with mudguard extensions, chains can only be hooked by previously disassembling the extensions themselves.

LIFTING THE TRUCK WITH OVERHEAD GUARD

The following equipment must be used to lift the truck without cabin:

A - CHAINS: ø 18 mm - Degree T (8) - UNI EN 818-2

B - HOOKS: for 10 t - UNI/ISO 7597

LIFTING THE TRUCK WITH CABIN

The following equipment must be used to lift the truck with cabin:

E - N° 2 slings: secondo normativa DIN B2N-UNI9531 9 m min. lenght, 2800 kg capacity

F - N° 4 liwer brackets to hold the slings

G - N° 2 upper brackets to hold the slings

Notes:
It is important to remember that the chain (slings) length must be sufficient to lift the truck in a horizontal position, with the lifting angles (ß) ≤ 45° with respect to the vertical lifting line.

Make sure that there are no personnel in the vicinity of the truck, before carrying out the lifting operation.

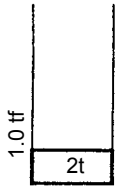
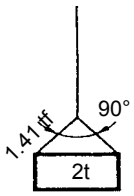
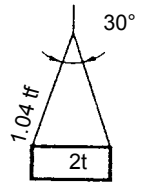
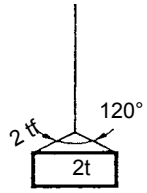
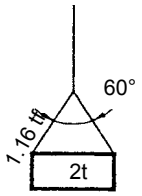
If any maintenance operations need to be performed on the truck in a raised position, the vehicle must be rested on appropriate supports, sufficient to bear the overall weight of the vehicle, keeping the chain (slings) taut.

TRUCK WEIGHTS		ON THE AXLE WEIGHT WITHUT LOAD (FRONT / REAR)
60	~ 10280 kg	~ 5055 / 5225 kg
70	~ 11040 kg	~ 5037 / 6003 kg
85	~ 12577 kg	~ 5389 / 7188 kg

Note:
The weights are refered to trucks with SE tyres, TV dupex mast (h3= 3160) and sideshift fork carriage

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WIRE ROPE SUSPENSION ANGLE LIST

Lifting angle	Tension	Compression	Suspension method	Lifting angle	Tension	Compression	Suspension method
0°	1.00 time	0 time		90°	1.41 time	1.00 time	
30°	1.04 time	0.27 time		120°	2.00 time	1.73 time	
60°	1.16 time	0.58 time					

SAFE LOAD FOR EACH WIRE ROPE SUSPENSION ANGLE

Rope diameter	Cutting load	Single-rope suspension	Two-rope suspension				Four-rope suspension			
		0°	0°	30°	60°	90°	0°	30°	60°	90°
6 mm	21380	3040	6080	5880	5200	4310	12160	11770	10400	8630
8 mm	31480	4410	8830	8530	7650	6280	17650	17060	15300	12550
10 mm	49230	6960	14020	13440	11770	9810	27460	26480	23540	19610
12.5 mm	76880	10980	21570	21280	18630	14710	43150	41190	37270	29420
14 mm	96400	13730	27460	26480	23540	18630	54920	52960	47070	37270

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COMPONENT WEIGHT

Component	Vehicle model	Weight (Kg)
Battery	60	~ 1150x2
	70	~ 1150x2
	85	~ 1382x2
Traction motor	all	~225
Lifting motor group (pump + electric motor)	all	2 x ~65
Rear axle (without wheels and dry)	all	~323
Counterweight	60	~1900
	70	~1900
	85	~2650
Mast group with fork carriage (with lift cylinder, without forks, lifting height 3160 mm, 2M TV mast)	all	~ 550
Vehicle weight (with battery)	60	~10280
	70	~11040
	85	~12577

LIFTING ANTERIOR TRUCK WHEELS

Before perform certain interventions it is necessary to lift the truck anterior wheels. Support the mast on two blocks, to avoid the risk of accidents

1 Block the steering wheels
2 Tilt back the mast and insert blocks under the mast base
3 Tilt ahead the mast: the anterior wheels must be lifted and free of rotate

To carry out correctly all the truck lifting operation it is necessary to have the following tools:
- a hydraulic jack with up to 5 ton capacity
- metal or hard wood blocks

Before putting the blocks under the must, check the inclination of the floor, the truck must be parked on a flat, horizontal surface.

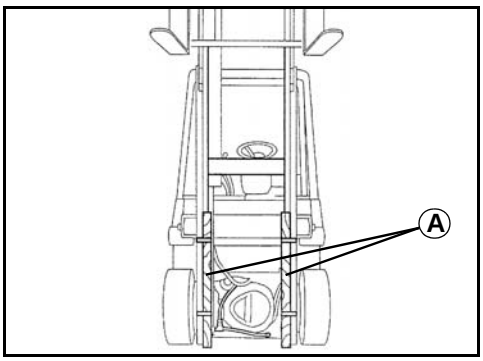
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OPERATIONS ON THE MAST

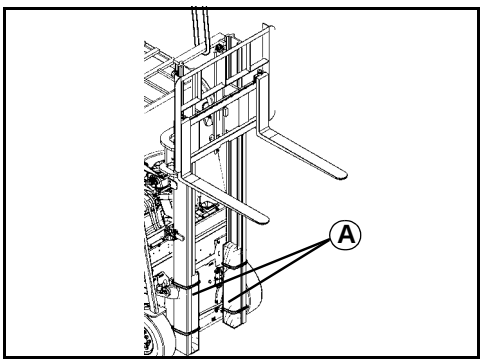
Always make sure that the mast mobile parts are secured/blocked before performing any maintenance/ repair work or any operations requiring the mast opening.
The mobile parts of the mast can be secured/blocked in two ways:

- Blocking with “bars/blocks“
- Blocking with chains

BLOCKING WITH “BARS/BLOCKS“



It is possible to use two **(A)** wooden bars/blocks (no chipboard) tieing inside the mast internal profiles to block it mechanically and avoid any kind of movement



In the case of F. F.L. mast, adopt the same procedure to secure also the fork carriage.
No load must be present on the mast.

BLOCKING WITH CHAINS



In alternative to the method previously described a chain can be used, as shown in picture. Do not twist the chain round his own axle, but roll up it on the mast and the fork carriage beams

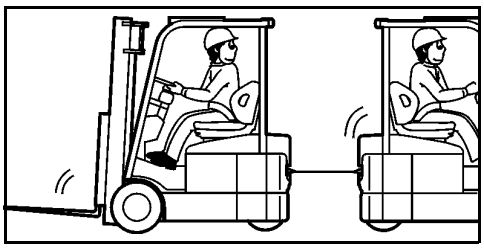


Secure/fix both ends of the chain with bolt, nut and washers of appropriate size for the chain used.
No load must be present on the mast.

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TOWING THE TRUCK

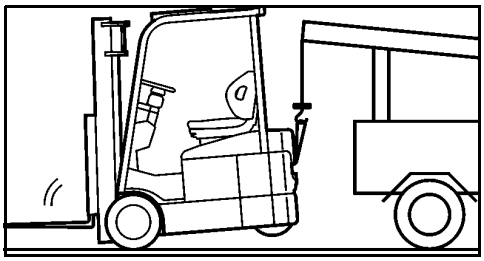
Please follow the instructions of chapter 08, paragraph “NEGATIVE BRAKES MANUAL UNBLOCKING“



The standard fork lift trucks are not suited for towing.

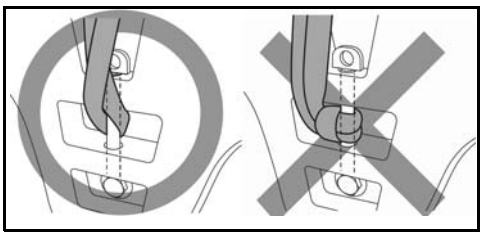
In special case, the rear draw bar can be used to tow a faulty lift truck.
In this case it is obligatory to use a stiff towing bar, fastened between the rear draw bar of the truck and the towing vehicle. You must proceed carefully and slowly, if possible on a level surface.

- while towing, do not carry any other loads on the forks;
- as far as possible, avoid driving on gradients. In any case, do not go over the figure for driving on gradients with a load.



Note the cautions below when towing the vehicle with back wheels lifted.

- Lift the rear wheels for towing
- The traveling speed when towing must not exceed the maximum traveling speed of the forklift.
- Before starting towing, always set the key switch to OFF, the direction switch to the neutral position and parking brake of released.
- Before towing, either remove the fork or take action to prevent the fork from coming into contact with the ground due to bouncing.

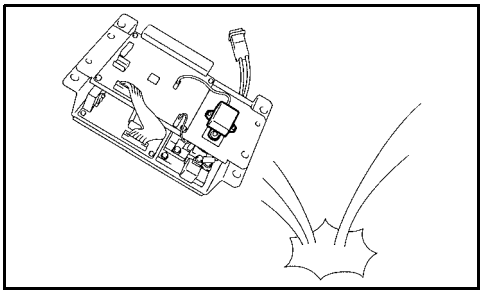


When making a curve, towed loads tend to reduce the curving radius; therefore it is important to widen the entrance radius in order to avoid striking against any obstacle.

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ELECTRICAL PARTS INSPECTION

1. Always disconnect the battery plug before inspecting or servicing electrical parts.
2. Pay sufficient attention when handling electronic parts.



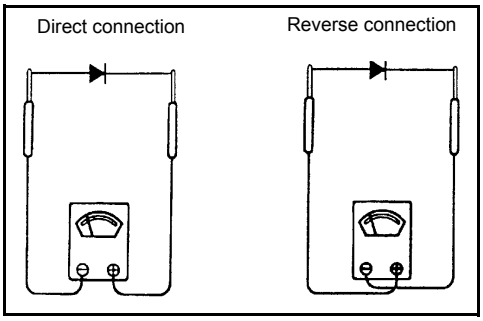
(1) Never subject electronic parts, such as computers and relays, to impact.
(2) Never expose electronic parts to high temperature or moisture.
(3) Do not touch connector terminals, as they may be deformed or damaged due to static electricity.

3. Connect a multimeter to the circuits to match the object and purpose of measurement
   Analog multimeter: this type is convenient to detect transitory conditions during measurements and the operating condition. Measured values are only just as an indication.

   Digital multimeter: a fairly accurate reading is possible. However, it is difficult to observe operating condition or transitory conditions

(1) Difference between measurement results with analog and digital multimeters
   ∗ The measurement results with analog and digital types can be different.
   Differences between the polarities of the analog type and the digital type are described below.

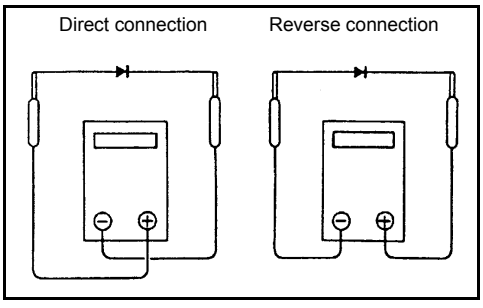
1) Analog multimeter



Example of measurement result
Multimeter range: kΩ

	Analog type
Direct connection	Continuity
	11 kΩ
Reverse connection	No continuity
	∞

2) Digital multimeter



Example of measurement result
Multimeter range: 2MΩ

	Digital type
Direct connection	No continuity
	1
Reverse connection	Continuity
	2 MΩ

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STANDARD TIGHTENING TORQUE TABLE

The tables here below are valid for screws and bolts without superficial covering, preventively lubricated with oil.

SCREWS WITH “ISO” COARSE THREAD

	Preloading V STD tightening torque (N)				TORQUE Max (Nm)			
Class nut/bolt	5S/6,6	6S/8,8	8G/10,9	10K/12,9	5S/6,6	6S/8,8	8G/10,9	10K/12,9
M 4 x 0,7	21781	3865	5435	6524	1,7	3	4,2	5,1
M 5 x 0,8	3502	6229	8780	10497	3,2	5,8	8,2	9,9
M 6 x 1	4974	8849	12459	14911	5,7	10	14,3	17,1
M 7 x 1	7142	12753	17854	21386	9,2	16,6	23	27,8
M 8 x 1,25	9025	16088	22661	27174	13,6	24,3	34	41,1
M 9 x 1,25	11870	21190	29921	35610	20,1	36	50,8	60,5
M 10 x 1,5	14519	25506	35905	42968	27,8	49	69	82
M 12 x1,75	20797	37082	52189	62588	46,5	83	117	140
M 14 x 2	28351	50620	71123	85347	74	132	186	223
M 16 x 2	38750	68866	97119	116739	113	200	283	339
M 18 x 2,5	47480	84366	118701	142245	157	279	392	471
M 20 x 2,5	60430	107910	151565	181485	218	388	545	653
M 22 x 2,5	74850	133416	187371	224649	294	520	731	883
M 24 x 3	87309	155979	218763	261927	383	687	961	1148
M 27 x 3	112815	202086	283509	340407	549	991	1393	1668
M 30 x 3	138321	247212	347274	415944	755	1354	1893	2276

SCREWS WITH “ISO” FINE THREAD

	Preloading V STD tightening torque (N)				TORQUE Max (Nm)			
Class nut/bolt	5S/6,6	6S/8,8	8G/10,9	10K/12,9	5S/6,6	6S/8,8	8G/10,9	10K/12,9
M 8 x 1	9761	17168	24231	29038	14,5	25,5	36,2	43
M 10 x1,25	15107	26879	37867	45420	28,4	51	72	85
M 12 x1,25	23740	40613	56898	68474	52	89	126	151
M 12 x1,5	21778	38848	54642	65531	49	87	123	147
M 14 x 1.5	30902	54936	77303	92705	78	140	196	235
M 16 x 1,5	41202	73575	103003	123606	118	211	294	353
M 18 x 1,5	53268	95157	133416	159903	171	304	422	510
M 20 x 1,5	67689	118701	168242	202086	239	422	598	716
M 22 x 1,5	82404	147150	206010	247212	314	564	790	952
M 24 x 2	94667	168732	237402	284490	402	721	1010	1216
M 27 x 2	122625	218763	307053	367875	589	1050	1472	1766
M 30 x 2	154017	272718	384552	461070	814	1442	2040	2453

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HIGH PRESSURE HOSE FITTING TIGHTENING TORQUE

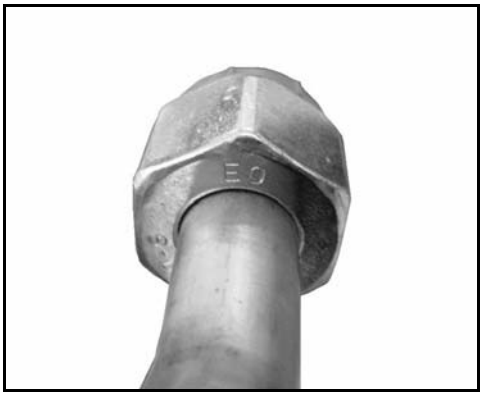
1. When connecting a high pressure hose, wipe the hose fitting and mating nipple contact surfaces with clean cloth to remove foreign matters and dirt. Also check no dent or other damage on the contact surfaces before installation.
2. When connecting a high pressure hose, hold the hose to align the fitting with the nipple and tighten the fitting.
3. The maximum tightening torque must not exceed twice the standard tightening torque.
4. For conical fittings only

Nominal diameter of screw	Standard tightening torque (N·m)		Hose inside diameter (mm)
	Standard	Tightening range	
7/16 — 20UNF	25	24 to 26	6
9/16 — 18UNF	34	32 to 36	9
3/4 — 16UNF	59	56 to 62	12
7/8 — 14UNF	59	56 to 62	12
7/8 — 14UNF	78	74 to 82	15
1·1/16 — 12UNF	118	112 to 123	19
1·5/16 — 12UNF	137	130 to 144	25
PF1/4	25	24 to 26	6
PF3/8	34	32 to 36	9
PF1/2	59	56 to 62	12
PF3/4	118	112 to 123	19
PF1	137	130 to 144	25

ASSEMBLAGE FOR NIPPLES TYPE PARKER ERMETO E0/ E0-2

To tighten all the nipples marked E0/ E0-2 on the truck, act as indicated in the procedure here below:





1. Tighten the nipple with the spanner up to the point of resistance (without any spanner extension)
2. Tighten the nipple firmly starting with min. 1/ 6 of a turn (a face of the hexagon), up to max. 1/ 4 of a turn (a face and half of the hexagon); it is recommended the use of a spanner extension

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PERIODIC MAINTENANCE

Periodic inspection and maintenance are necessary to keep your forklift truck running smoothly. The designated number of hours for each inspection cycle is as follows.
Daily (pre-operation check) Every 8 hours
Weekly Every 40 hours
6-week Every 250 hours
3-month Every 500 hours
6-month Every 1,000 hours
12-month Every 2,000 hours

If operating hours in 6 weeks exceed 250 hours, perform inspection according to the operating hours specified in the periodic inspection guide. Pre-operation checks and weekly inspections should preferably be performed by the user. 6-week, 3-month, 6-month and annual inspections should be performed at your dealer, as high skill and special tools are required.
Refer to the periodic maintenance table to determine inspection and maintenance items and inspection cycles.
Use only genuine original parts for replacement, and use the recommended types of lubricants.

PERIODIC REMPLACEMENT TABLE

REPLACEMENT CYCLE (Based on total operating months or hours, whichever comes first)	every	1 week	6 weeks	3	6	12	18	months
	every	40	250	500	1000	2000	3000	hours
Hydraulic oil						I	←	
Hydraulic filter		I *				I	←	
Drive unit oil					I	←	←	
Oil tank breather filter						I	←	
Hoses from power steering unit to steering cylinder	(every 30 months or 5000 hours)							
Service brake and parking brake hoses	(every 30 months or 5000 hours)							
Tilt cylinder hydraulic hoses	(every 30 months or 5000 hours)							
Steering system hoses	(every 60 months or 10000 hours)							
Lifting chains	(every 60 months or 10000 hours)							
Chain securing tie rods	(every 60 months or 10000 hours)							
High pressure hydraulic tubing	(every 60 months or 10000 hours)							

*: For new vehicles

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PERIODIC MAINTENANCE TABLE

INSPECTION METHOD

I: Inspect, correct and replace as required. **T**: Tighten. **C**: Clean. **L**: Lubricate. **M**: Measure and correct, and adjust as required.

REPLACEMENT CYCLE (Based on total operating hours or months, whichever comes first)	every	6 weeks	3	6	12	months
	every	250	500	1000	2000	hours
ELECTRICAL SYSTEM						
Motor						
Rotation sound		I*	I	←	←	
Terminal looseness			T	←	←	
Battery						
Charging level			I	←	←	
Electrolyte level			I	←	←	
Electrolyte specific gravity			M	←	←	
Terminal looseness			I	←	←	
Abnormality in the upper portion of the battery and/or the case			I	←	←	
Voltage measurement of each battery cell after charging					M	
Magnetic switch						
Contact looseness, damage, abrasion			I	←	←	
Auxiliary contact operating, condition, contamination, and abrasion			I	←	←	
Mounting condition of the arc shoote					I	
Operating condition and timings					I	
Looseness of the coil mounting locations					I	
Mounting condition and looseness of the main circuit lead wire					I	
Microswitch						
Operating condition and timings			I	←	←	
Installation damage and looseness			I	←	←	
Direction switch						
Operating condition, damage			I	←	←	
Controller						
Operating condition			I	←	←	
Interior contamination and damage			C	←	←	
Motor input voltage					M	
Fuse						
Looseness			I	←	←	

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REPLACEMENT CYCLE (Based on total operating hours or months, whichever comes first)	every	6 weeks	3	6	12	months
	every	250	500	1000	2000	hours
Wiring (including charging cord)						
Harness deterioration, damage and looseness of clamp		I*	I	←	←	
Looseness of the connections, taping condition		I*	I	←	←	
Connecting condition and damage of the battery connector		I*	I	←	←	
POWER TRANSMISSION SYSTEM						
Drive unit						
Oil leakage			I	←	←	
Oil level		I	←	←	←	
Bolt or nut looseness					T	
DRIVE SYSTEM						
Wheels						
Tire pressure (OPT)			M	←	←	
Tire cuts, damage or uneven treads			I	←	←	
Hub nut looseness			T	←	←	
Tread depth		M*	M	←	←	
Metal chips, pebbles or other foreign matter trapped in tire treads		I*	I	←	←	
Rim side ring and disc wheel damage		I*	I	←	←	
Front wheel bearing abnormal noise and looseness		I*	I	←	←	
Rear wheel bearing abnormal noise and looseness		I*	I	←	←	
Front axle						
Deformation and damage					I	
Rear axle						
Deformation and damage					I	
Abnormal noise looseness of rear axle bearing					I	
Loosenes of axle beam in vehicle longitudinal direction		M*			M	
STEERING SYSTEM						
Steering wheel						
Play, looseness and loosening		I*	I	←	←	
Operating condition		I*	I	←	←	
Steering valve						
Oil leakage		I*	I	←	←	
Mounting looseness		T*	T	←	←	
Steering system						
Steering angle to right and left					I	
Power steering						
Oil leakage and oil level			I	←	←	
Looseness in mounting parts			I	←	←	
Power steering hose damage					I	

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REPLACEMENT CYCLE (Based on total operating hours or months, whichever comes first)	every	6 weeks	3	6	12	months
	every	250	500	1000	2000	hours
BRAKING SYSTEM						
Brake pedal						
Braking performance			I	←	←	
Parking brake						
Pull margin and operating force			I	←	←	
Braking performance			I	←	←	
Rods and cable						
Loosening, looseness or damage		I*	I	←	←	
Operating condition		I*	I	←	←	
System brake						
Oil leak		I*	I	←	←	
Disc wear and damage					I	
MATERIAL HANDLIG SYSTEM						
Fork						
Damage and wear of fork and stopper pin			I	←	←	
Misalignment between left and right fork fingers			I	←	←	
Cracks at forks root and welded portion					I*1	
Mast and lift bracket						
Deformation, damage and cracks in welded portion			I	←	←	
Wear, damage and rotating condition of roller			I	←	←	
Mast and lift bracket looseness			I	←	←	
Wear and damage of mast support bushing			I	←	←	
Wear and damage of roller pin			I	←	←	
Wear and damage of mast pads			I	←	←	
Chain and chain wheel						
Tension deformation, damage and slackness of chain		I*	I	←	←	
Chain lubrication			I	←	←	
Abnormality of chain anchor bolt and nut			I	←	←	
Wear, damage and revolution of chain wheel			I	←	←	
Attachment (OPT)						
Abnormalities and mounting condition			I	←	←	

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REPLACEMENT CYCLE (Based on total operating hours or months, whichever comes first)	every	6 weeks	3	6	12	months
	every	250	500	1000	2000	hours
HYDRAULIC SYSTEM						
Cylinder						
Cylinder mounting looseness, damage			T	←	←	
Looseness, deformation and damage of rod and rod end			I	←	←	
Cylinder operation			I	←	←	
Natural drop, natural forward tilt			M	←	←	
Oil leakage and damage			I	←	←	
Pin and cylinder shaft support wear and damage			I	←	←	
Uneven movement			I	←	←	
Hydraulic pump						
Oil leakage and abnormal noise			I	←	←	
Hydraulic oil tank						
Oil level, contamination			I	←	←	
Tank and oil strainer					C	
Oil leakage			I	←	←	
Control lever						
Operation			I	←	←	
Oil control valve						
Oil leakage			I	←	←	
Relief pressure measurement					M	
Safety valve function			I	←	←	
Hydraulic hose and piping						
Oil leakage			I	←	←	
Deformation and damage			I	←	←	
Linkage looseness			T	←	←	
SAFETY DEVICES, ETC.						
Head guard						
Welded portion cracks			I	←	←	
Deterioration, damage			I	←	←	

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REPLACEMENT CYCLE (Based on total operating hours or months, whichever comes first)	every	6 weeks	3	6	12	months
	every	250	500	1000	2000	hours
Backrest						
Looseness in mounting parts			T	←	←	
Deterioration, cracks and damage			I	←	←	
Lighting system (OPT)						
Operation, mounting condition			I	←	←	
Horn						
Operation, mounting condition			I	←	←	
Turn signals (OPT)						
Operation, mounting condition			I	←	←	
Instruments						
Operation			I	←	←	
Backup buzzer (OPT)						
Operation, mounting condition			I	←	←	
OPS						
Function		I*	I	←	←	
Seat						
Mounting looseness, damage			I	←	←	
Seat belt damage and operation			I	←	←	
Deadman seat operation			I	←	←	
Seat switch operating condition		I*	I	←	←	
Body						
Frame, cross member, etc. damage, cracking					I	
Bolt and nut looseness					T	
Rear-view mirror (OPT)						
Dirt, damage			I	←	←	
Rear reflection			I	←	←	
Other						
Lubrication status			L	←	←	

*: For new vehicles
*1: Fissure and crack detector

Note:
In case of hard operating conditions, the service interval of 170 hours or 1 month may be recommendable.

WARNING:
Complete the information concerning all maintenance operations with those mentioned in the relevant safety and operator manuals

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SERVICE DATA

Adjustment value table

Item		Vehicle model	Eco P 60	Eco P 70	Eco P 85
Steering wheel play	mm (in.)		20-50 (0.79-1.97)	←	←
Battery electrolyte specific gravity (20°C) (Reference)		Standard	1.280	←	←
		Limit	1.150	←	←
Oil control valve set pressure	Mpa (kg/cm^2)	Lift / Tilt	21 (214)	24 (245)	23 (234)
Brake pedal play	mm (in.)		0.5-1 (0.02-0.04)	←	←
Brake pedal floor clearance (floor mat)	mm (in.)		75 +/- 2.5 (2.9 +/- 0.1)	←	←
Hub nut tightening torque	N·m (kgf-m) [lbf-ft]	Front	480 (49) [354]	←	←
		Rear	380 (39) [280]	←	←
Sound pressure level (L_{PA}) in accordance with EN 12053 Uncertainty K=4 dB(A)	dB (A)		=<70	←	←
Whole body vibration in accordance with in EN 13059 Uncertainty K=0.3 x a m/s^2 (a:listed value)	m/s^2		0.40 +/- 0.05	←	←

***Note**

- The vibration values shown above are obtained from the measurements in accordance with EN 13059.
- The magnitude of hand arm vibration of lift trucks is 2.5m/s^2 or below as defined in EN 13059.
- The whole body vibration values shown above cannnot be used for calculating 8 hour vibration exposure in 2002/44/EC (Vibration Directive).
  If calculated according to the general forklift operation pattern, the result will be lower than 0.5 m/s^2.)
- The sound presure values shown above can be used as the sound level at operators' ears. (Values are in accordance with EN 12053 measurement methods.)

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LUBRICANT CAPACITY AND TYPE TABLE

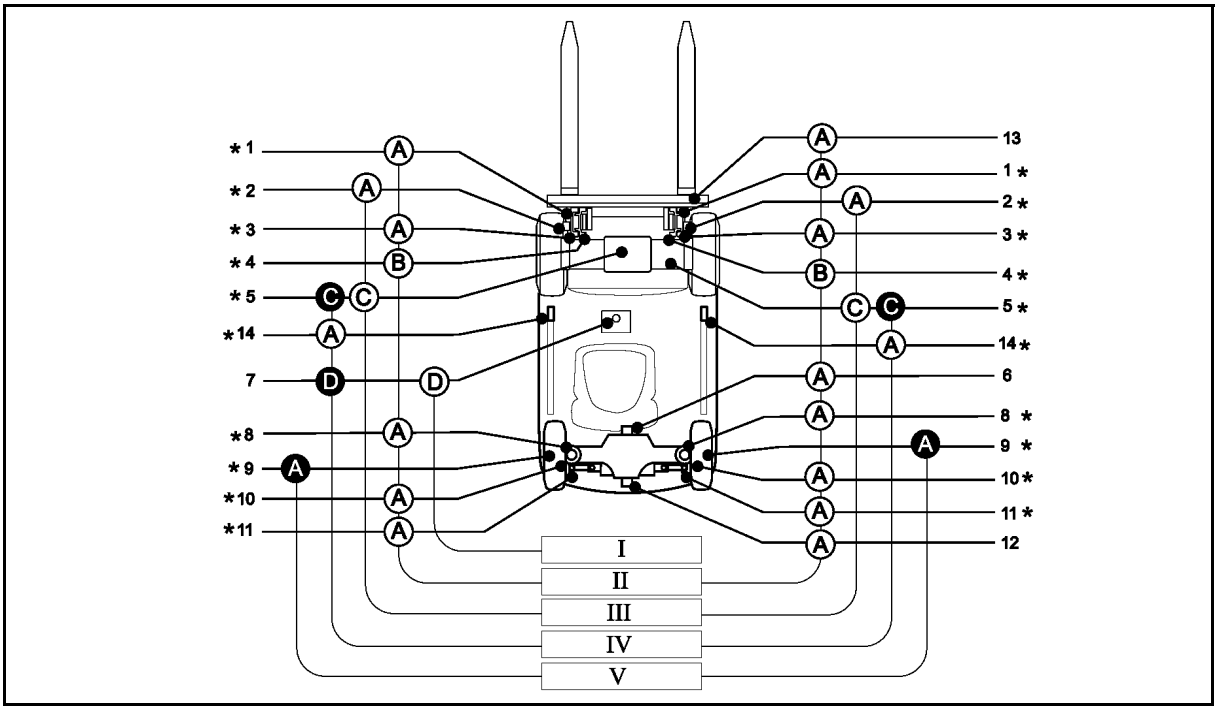
Applicable place	Capacity	Type
Drive unit - Wet disc brakes	15 l (3.963 US gal)	· Mobilube HD80W-90
Hydraulic oil	90 l (23.775 US gal)	· Standard vehicle: Agip Arnica VG46 · Cold storage vehicle: Agip Arnica VG32
Chassis and mast Grease fitting	Proper amount	· Standard vehicle: Mobilgrease Special · Cold storage vehicle: Mobiltemp SHC100
Battery	Proper amount	· Distilled water

WHEELS & TYRES

Vehicle model	Type			Tire size	Wheel size	Tire pressure bar	Remarks
Eco P 60	Front	Cushion	single tyre	713x360-560	–	–	option
		Superelastic	↑	355/65-15	9.75-15	–	standard
		Pneumatic	↑			Marangoni 9,25	option
		Non Marking	↑			–	option
		Cushion	twin tyres	713x254-560	–	–	option
		Superelastic	↑	8,25-15	6.5-15	–	option
		Pneumatic	↑			Continental 10 Marangoni 9,25	option
		Non Marking	↑			–	option
Eco P 70 Eco P 85	Front	Cushion	↑	713x254-560	–	–	option
		Superelastic	↑	8,25-15	6.5-15	–	standard
		Pneumatic	↑			Continental 10 Marangoni 9,25	option
		Non-Marking	↑			–	option
Eco P 60 Eco P 70	Rear	Cushion	single tyre	559x254-406	–	–	option
		Superelastic	↑	250-15	7.0-15	–	standard
		Pneumatic	↑			Continental 10 Marangoni 8,25	option
		Non-Marking	↑			–	option
Eco P 85	Rear	Cushion	single tyre	660x254-508	–	–	option
		Superelastic	↑	250-15	7.0-15	–	standard
		Pneumatic	↑			Continental 10 Marangoni 8,25	option
		Non-Marking	↑			–	option

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LUBRICATION CHART



1. Mast strip and bearings
2. Tilt cylinder front pin
3. Mast support bushing
4. Lift chain
5. Drive unit - Wet disc brake
6. Rear axle beam front pin
7. Oil tank
8. Steering knuckle king pin
9. Rear wheel bearing
10. Tie rod end pin
11. Rear axle cylinder end pin
12. Rear axle beam rear pin
13. Side shifter (OPT)
14. Gates locks (OPT)

I) Inspect every 8 hours (daily)
II) Inspect every 40 hours (weekly)
III) Inspect every 250 hours (6-weeks)
IV) Inspect every 1000 hours (semi-annually)
V) Inspect every 2000 hours (annually)

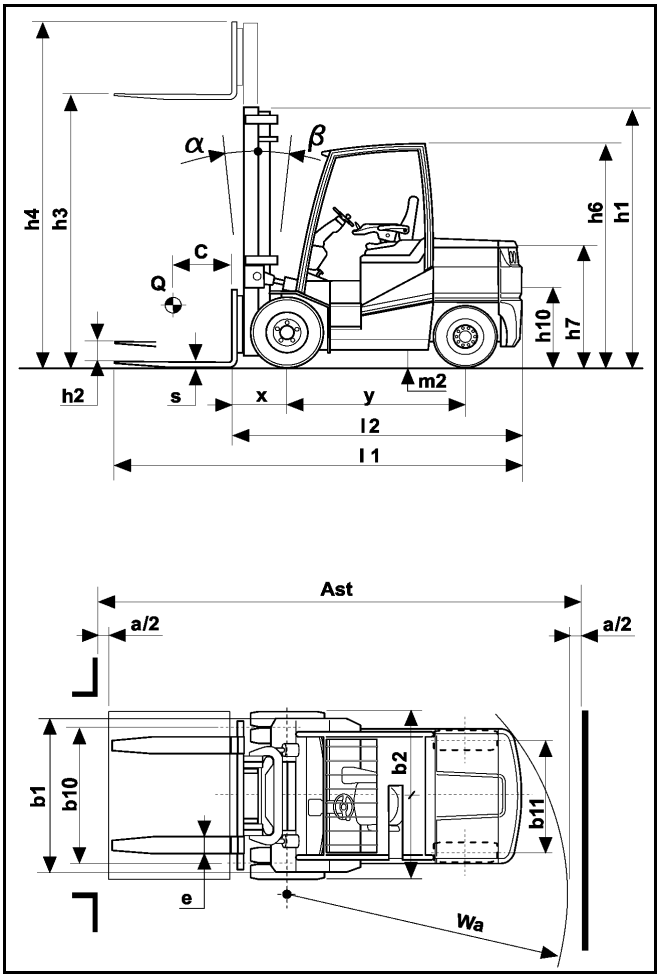
○ Inspection and supply
● Replacement
* Located both right and left

A) Molybdenum disulfide grease
B) Motor oil
C) Gear oil
D) Hydraulic oil

Note:
In case of hard operating conditions, the service interval of 170 hours or 1 month may be recommendable.

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VEHICLE DIMENSION



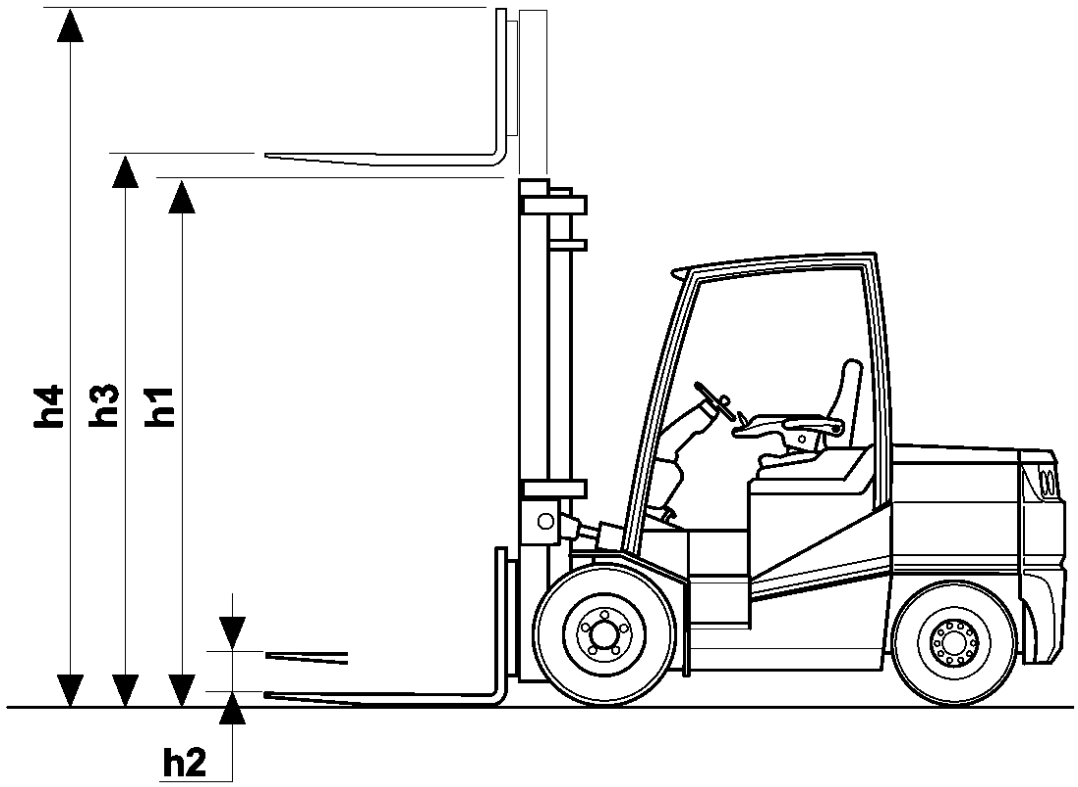
ECO P			
	60	80	85
b1	1750mm	/	/
b2	1972mm	¨	¨
b10	1472mm (*)	¨	¨
b11	1230mm	¨	¨
α/β	5°/10°	¨	¨
h1	2525mm	2575mm	¨
h2	100mm	¨	¨
h3	3150mm	¨	¨
h4	4050mm	4100mm	¨
h6	2570mm	¨	¨
h7	1379mm	¨	¨
h10	630	¨	¨
l1	4466mm	¨	4529mm
l2	3246mm	¨	¨
x	595mm	615mm	635mm
y	2000mm	¨	¨
C	600mm	¨	¨
e	200mm	¨	
s	60mm	¨	70mm
Wa	3104mm	¨	3255mm
Ast (**)	5099mm	5199mm	5290mm

Data are referred to SE tyres models

(*) 1450mm for non twin tyres (Eco P 60 only)
(**) with pallet 1200mm long

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MAST SPECIFICATIONS AND RATED CAPACITIES



A (h3)	B			G (h2)		J		
	C (h1)	D (h4)		H	I	P		S
		E	F			L	M	N
mm	mm	mm	mm	mm	mm	deg	deg	kg
V Wide Visible Mast	FW Wide Visible Full-Free Lift Two-Stage Mast			FSW Wide Visible Full-Free Lift Three-Stage Mast				

A (h3): Maximum lifting height
B: Overall Height
C (h1) Lowered
D (h4) Extended
E: Without Load Backrest
F: With Standard Load Backrest
G (h2): Free Lift (Top of Forks)
H: Without Load Backrest
I: With Standard Load Backrest
J: All tyres
K: Tilt Range
N:Load capacity
L: Forward
M: Backward
N: 600 mm Load center

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Eco P 60

	A	B			G		J		
		C	D		H	I	P		S
			E	F			L	M	600 mm LC
	mm	mm	mm	mm	mm	mm	deg	deg	kg
V	3210	2525	4050	4777	100	100	5	10	6000
	3710	2775	4550	5277	100	100	5	10	5800
	4210	3025	5050	5777	100	100	5	10	5500
	4710	3325	5600	6277	100	100	5	10	5200
	5010	3475	5900	6577	100	100	5	10	4900
	5610	3825	6550	7177	100	100	5	10	4300
	6010	4025	6950	7577	100	100	5	10	3600
FW	3710	2825	4675	5277	1800	1258	5	8	5700
	4210	3075	5175	5777	2050	1508	5	8	5400
	4710	3375	5675	6277	2350	1808	5	8	5000
	5510	3775	6475	7077	2750	2208	5	8	4100
FSW	4510	2675	5475	6077	1650	1108	5	8	6000
	5010	2825	5975	6577	1800	1258	5	8	5800
	5610	3075	6575	7177	2050	1508	5	8	5400
	6010	3175	5975	7577	2150	1608	5	8	5100
	6510	3375	7475	8077	2350	1808	5	8	4600

Height of standard load backrest is 1627 mm above ground.

Eco P 70

	A	B			G		J		
		C	D		H	I	P		S
			E	F			L	M	600 mm LC
	mm	mm	mm	mm	mm	mm	deg	deg	kg
V	3210	2575	4105	4777	100	100	5	10	7000
	3710	2825	4605	5277	100	100	5	10	6800
	4210	3075	5105	5777	100	100	5	10	6500
	4710	3375	5650	6277	100	100	5	10	6200
	5010	3525	5950	6577	100	100	5	10	5900
	5610	3825	6550	7177	100	100	5	10	5300
	6010	4075	7000	7577	100	100	5	10	4600
FW	3710	2825	4675	5277	1800	1258	5	8	6700
	4210	3075	5175	5777	2050	1508	5	8	6400
	4710	3375	5675	6277	2350	1808	5	8	6000
	5510	3775	6475	7077	2750	2208	5	8	5100
FSW	4510	2675	5475	6077	1650	1108	5	8	7000
	5010	2825	5975	6577	1800	1258	5	8	6800
	5610	3075	6575	7177	2050	1508	5	8	6400
	6010	3175	6975	7577	2150	1608	5	8	6100
	6510	3375	7475	8077	2350	1808	5	8	5600

Height of standard load backrest is 1627 mm above ground.

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Eco P 85

	A	B			G		J		
		C	D		H	I	P		S
			E	F			L	M	600 mm LC
	mm	mm	mm	mm	mm	mm	deg	deg	kg
V	3220	2580	4105	4777	100	100	5	10	8500
	3720	2830	4605	5277	100	100	5	10	8300
	4220	3080	5105	5777	100	100	5	10	800
	4720	3380	5650	6277	100	100	5	10	7700
	5020	3530	5950	6577	100	100	5	10	7400
	5620	3830	6500	7177	100	100	5	10	6800
	6020	4080	7000	7577	100	100	5	10	6100
FW	3720	2830	4675	5277	1800	1273	5	8	8200
	4220	3080	5175	5777	2050	1523	5	8	7900
	4720	3330	5675	6277	2350	1773	5	8	7500
	5520	3780	6475	7077	2750	2223	5	8	6600
FSW	4520	2680	5475	6077	1650	1123	5	8	8500
	5020	2830	5975	6577	1800	1273	5	8	8300
	5620	3080	6575	7177	2050	1523	5	8	7900
	6020	3180	6975	7577	2150	1623	5	8	7600
	6520	3355	7475	8077	2350	1798	5	8	7100

Height of standard load backrest is 1627 mm above ground.

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PÀGINA INTENCIONALMENTE BLANCA

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BATTERY

BATTERY COMPARTMENT AND REQUIRED WEIGHT 3
SERVICE STANDARDS 4
DISPLAY 4
BATTERY MANAGEMENT 5
CORRECTION VALUES FOR BDI MAX. AND BDI MIN. PARAMETERS 6
TROUBLESHOOTING ON THE BATTERY 7
BATTERY 8
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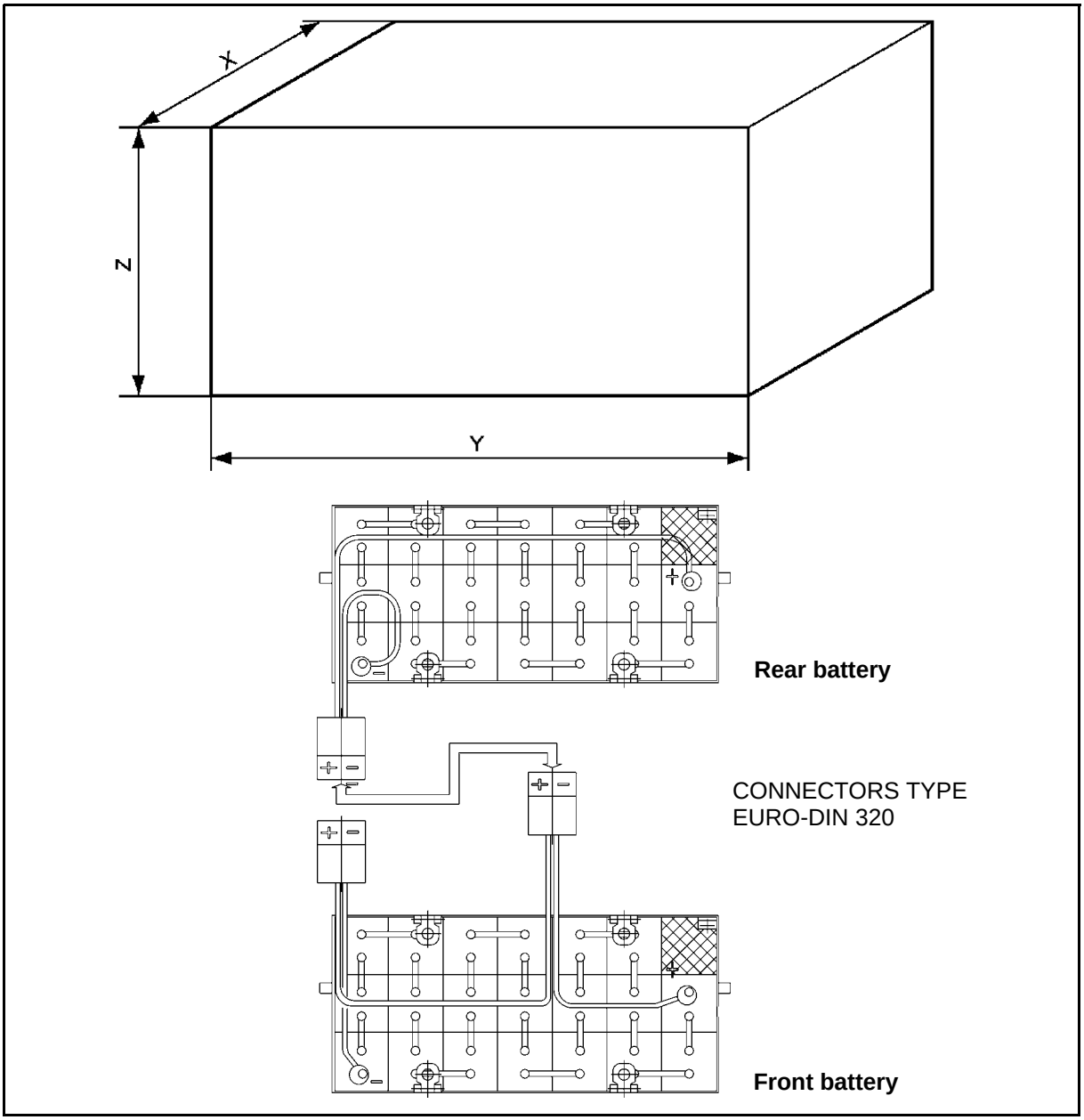
PÀGINA INTENCIONALMENTE BLANCA

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BATTERY COMPARTMENT AND REQUIRED WEIGHT

When batteries are purchased locally, always adjust the weight to satisfy the minimum required weight, as shown in the table below.

Vehicle type	Battery capacity (A H)	Dimensions of each one of the 2 battery compartments [mm]			Minimum weight of each one of the 2 batteries (with case) [Kg]
		X	Y	Z	
60 - 70	640	650	1370	455	1150
60 - 70	720	650	1370	455	1150
60 - 70	800	650	1370	455	1150
60 - 70 - 85	1050	650	1370	566	1350
60 - 70 - 85	1200	650	1370	626	1350



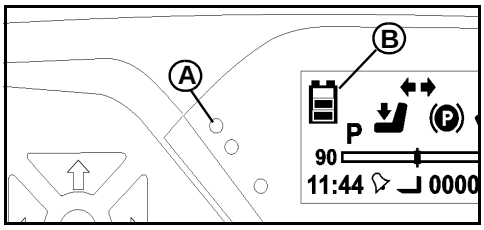
Din standard battery (DIN 43531 / 35 / 36 A, B, C, No)

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SERVICE STANDARDS

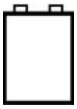
Specific gravity (Upon full charge)		1,290 kg/l [20 °C]
Specific gravity (Upon end of discharge)		1,140 kg/l [20 °C]
Discharge end battery	80 V [2 x 40 V] (2 V x 40 elements)	68 V (1,7 V each element)
Charge end battery voltage	80 V [2 x 40 V] (2 V x 40 elements)	108 V (2,7 V each element)
Electrolyte		Refined dilute sulfuric acid
Fluid to be added		Distilled or demineralized water
Insulation resistance		1 MΩ o superiore

DISPLAY



Battery Charge Indicator

(A) Diagnostic led
(B) Charge indicator

Charge Percentage	Description	Acustic notice	Notes
100-30% 	Normal working	No	No performances drop
20% 	Illuminated **(B)** Indicator	No	Performances drop Speed reduction managed from the parameters T20% BDI REDUCTION (traction) P20% BDI REDUCTION (lifting) **
10% 	Blinking **(A)** Led, illuminated **(B)** Indicator	No	Drop of performances Speed reduction managed from the parameters T10% BDI REDUCTION (traction) P10% BDI REDUCTION (lifting) **
0%  ***	Blinking **(A)** Led, illuminated **(B)** Indicator	Yes	Discharged battery, managed from the parameter BDI ADJ MIN (priority function for traction)

** The drop of performances is due to the selected profile
*** He corresponds to 20 % of the nominal battery charge

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BATTERY MANAGEMENT

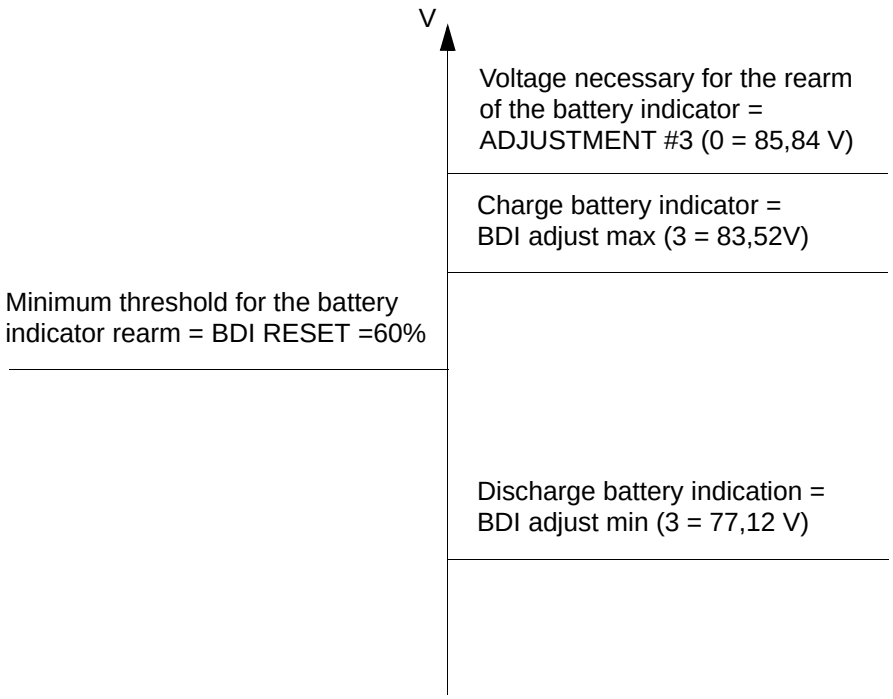
The battery discharge voltage and the battery status indicator on the dashboard are managed by the Master traction logic unit.
The personalization of the indicator is effectuated modifying the parameters below described.

BDI adjust min
This parameter determines the SET POINT of the discharge voltage.

BDI adjust max
This parameter determines the SET POINT of the charge voltage.

ADJUSTMENT #3
This parameter determines the voltage necessary to effectuate the rearm of the battery indicator on the display.
It is expressed in volts and permits an adjustment in step of 0,080 V

BDI RESET
This parameter permits the adjustment of the rears threshold when it is requested a charge with a status of battery between 70% - 90%.
The indication of THRESHOLD at 60% shows rearm not available over 70% of battery charge.



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CORRECTION VALUES FOR BDI MAX. AND BDI MIN. PARAMETERS

BDI MAX.

LEAD BATTERY	
CORRECTION	VOLT
9	86,16
8	86,68
7	85,28
6	84,80
5	84,40
4	84,00
(STD) 3	83,52
2	83,12
1	82,64
0	82,16

BDI MIN

LEAD BATTERY	
CORRECTION	VOLT
9	79,76
8	79,28
7	78,88
6	78,40
5	78,00
4	77,60
(STD) 3	77,12
2	76,72
1	76,24
0	75,76

ADJUSTMENT #3

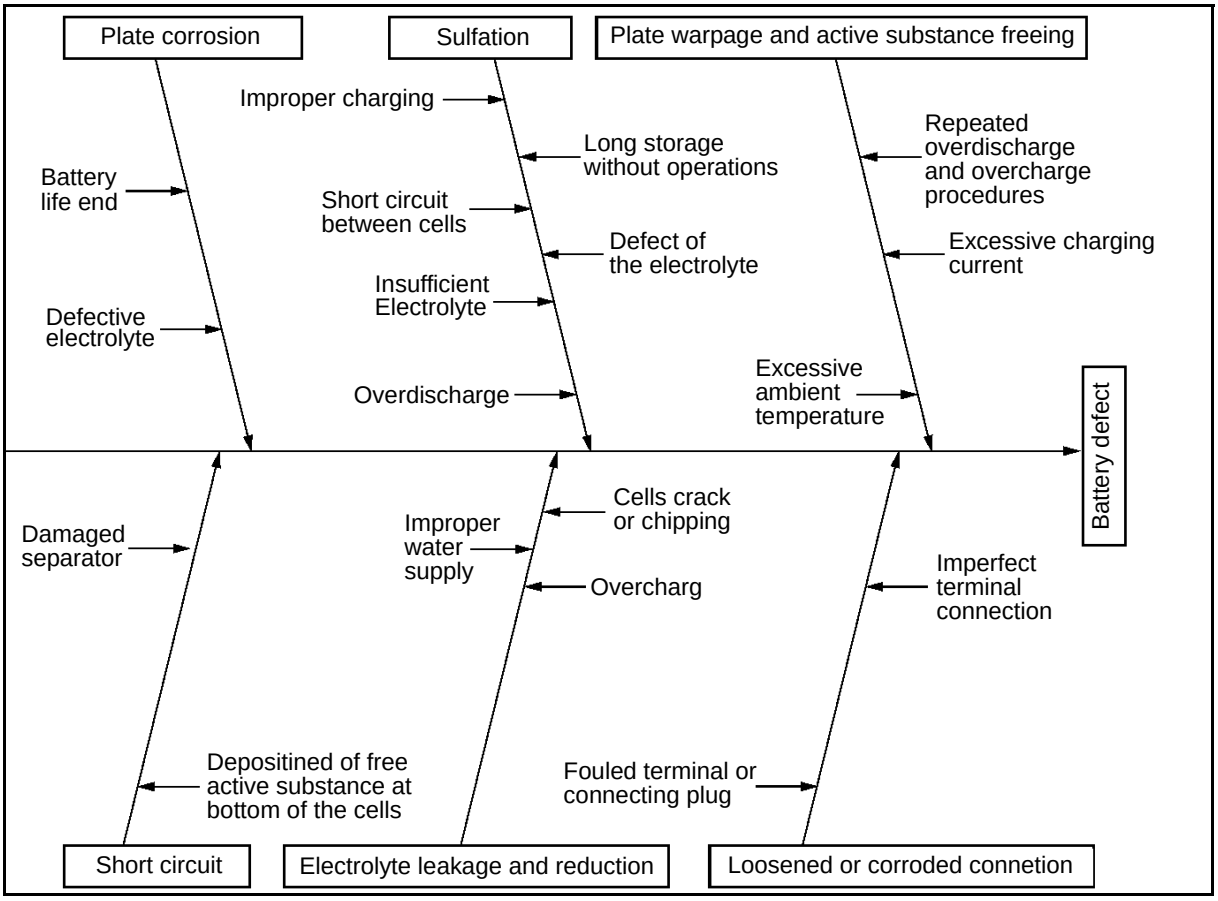
LEAD BATTERY	
etc.	etc.
+5	86,24
+4	86,16
+3	86,08
+2	86,00
+1	85,92
(STD) 0	85,84
-1	85,76
-2	85,68
-3	85,60
-4	85,52
-5	85,44
etc.	etc.

Notes:

- The “ADJUSTMENT #3” step value is always 0,08 V
- The battery indicator can be rearmed if the battery charge level is lower then 60%:
- The battery indicator can nor be rearmed if:
  - The values of the “ADJUSTMENT #3” are less than “BDI MAX”
  - After charging, the battery level does not reach a value higher than “BDI MAX”

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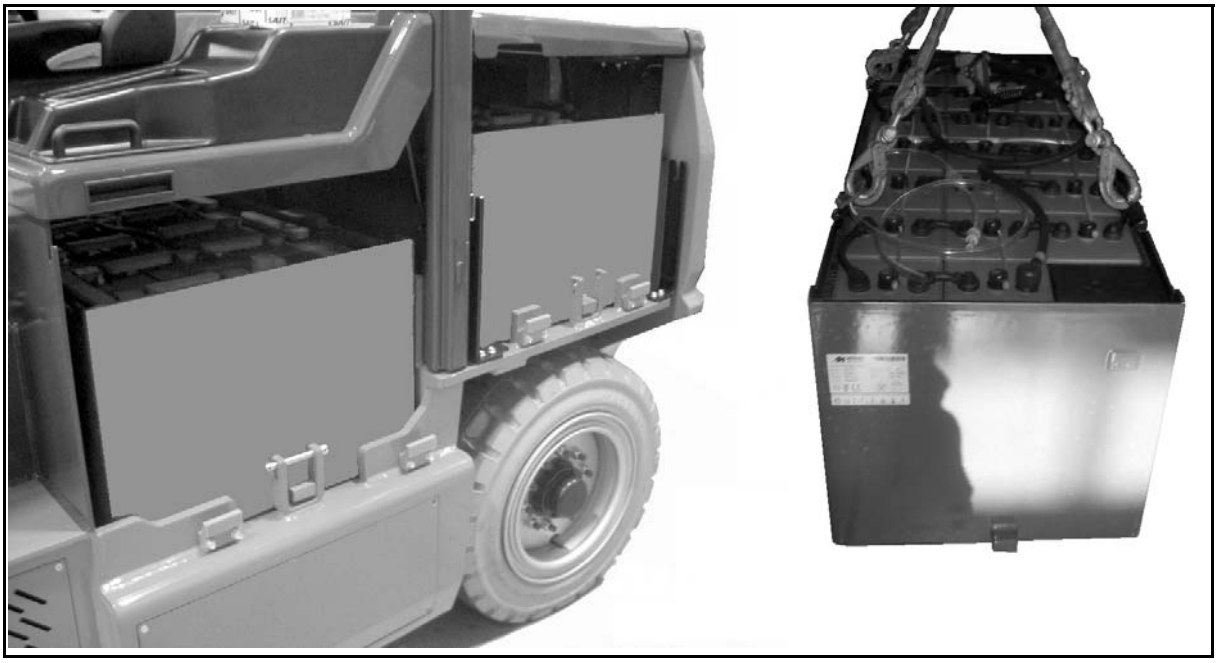
TROUBLESHOOTING ON THE BATTERY



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BATTERY

DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and activate the parking brake
2. Switch off the truck
3. Open the battery covers and disconnect the battery plugs
4. Remove the lateral sides **[Point 1]**
5. Remove the battery safety locks **[Point 2]**
6. Remove the battery **[Point 3]**

Reassembly Procedure

The installation procedure is the reverse of the disassembly procedure.

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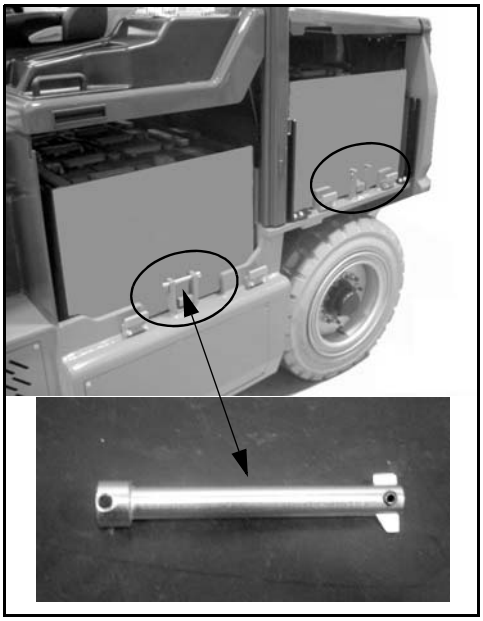
Point Operations



[Point 1]I

Disassembly:

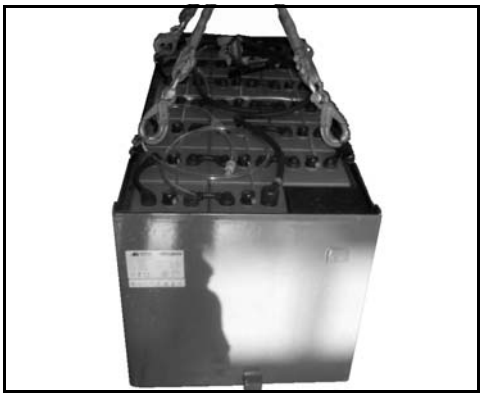
Remove the lateral sides



[Point 2]

Disassembly:

Remove the battery safety locks



[Point 3]

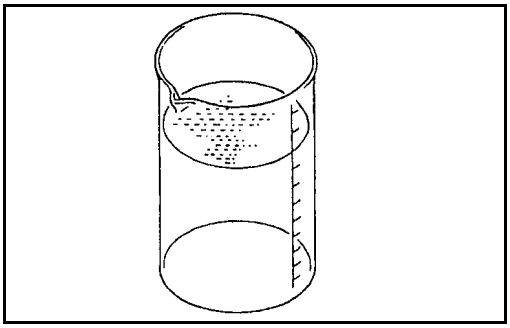
Disassembly:

Remove the battery from the truck

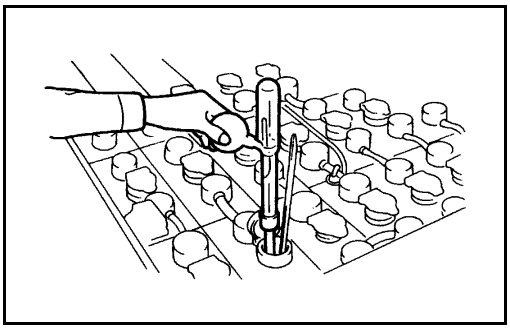
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INSPECTION

1. Electrolyte levels Inspection:
Open the caps of each single battery element and check that the electrolyte level is high enough to cover the element plates. Otherwise the electrolyte level must be restored with distilled or demineralized water up to cover the superior edge of the plates exceeding for 5÷7 mm. Avoid to fill up over this limit, because it can provoke the electrolyte leakage caused by his expansion during the operation orduring the next battery recharge, with consequent risk of battery compartment corrosion, of electric isolation reduction and of battery discharge. Carry out the level control and, if needed, the possible filling, with charged battery



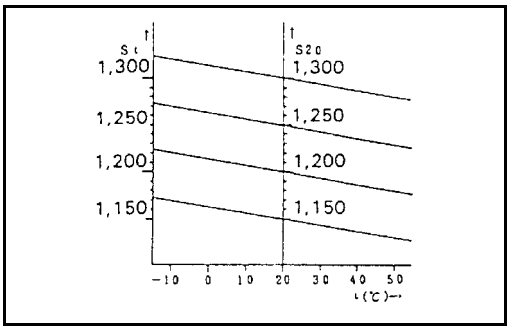
2. Electrolyte inspection:
The battery electrolyte is normal when it is transparent. Check turbidity when inspecting the specific gravity. If it cannot be checked clearly, put the electrolyte in a beaker for inspection.



3. Battery electrolyte specific gravity inspection:
Use a hydrometer to measure the specific gravity of the electrolyte.

Specific gravity upon complete charging .... 1.280 [20 °C]

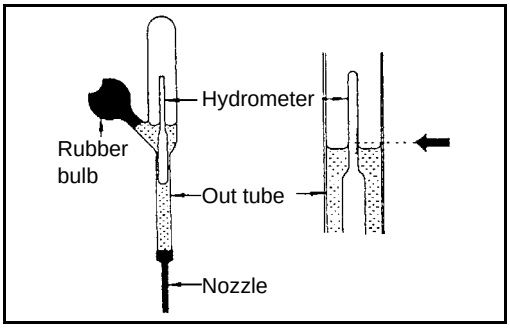
Specific gravity upon end of discharge .... 1.150 [20 °C]



The specific gravity of the electrolyte at 20 °C (68 °F) is used.

Equation for converting specific gravity
S_{20}=St+0.0007 (t-20)
S_{20}: Specific gravity at 20 °C
St: Specific gravity at t °C
t: Electrolyte temperature upon measurement (°C)

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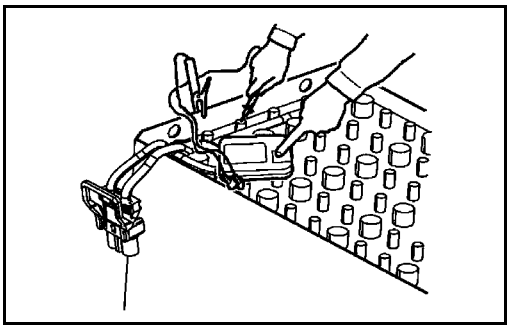


* How to use the hydrometer

(1) Insert the nozzle of the hydrometer into the electrolyte port and allow the electrolyte to be sucked into its outer tube.

(2) Let the hydrometer float correctly without contact with the outer tube, top or bottom, and read the scale at the highest point of the electrolyte surface as illustrated on the left when the bubbles in the electrolyte disappear.

(3) After the measurement, wash the inside and outside of the hydrometer well with clear water and store it after wiping water off with clean cloth.



4. Insulation resistance inspection

Measure the resistance between the battery and battery case with an insulation resistance meter (megohmmeter).

Insulation resistance .... 1 MΩ or more

Note:
When the insulation resistance is less than 1 MΩ, wash the battery with water after removing it from the vehicle.
Dry the washed battery fully and measure the insulation resistance again. Install the battery on the vehicle after confirming that the insulation resistance is 1 MΩ or more.

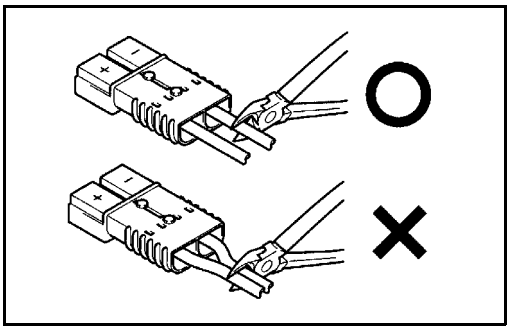
* Battery control table

Prepare a control table for each battery to record and maintain the inspection results.

Time and date Inspection	Inspected element Nr.	Specific gravity Electrolyte	Temperature Electrolyte	Capacity added water	Note	Inspector

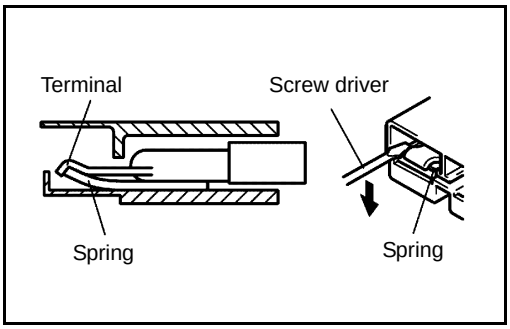
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REPLACING BATTERY PLUG TERMINAL

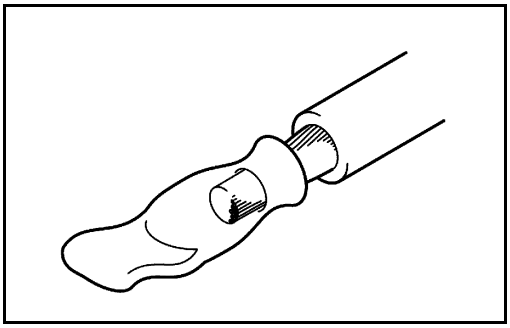


1. Disconnect battery plug cable one by one.

Caution:
Never disconnect more than one cable at the same time. Fatal accident may result by short circuit.

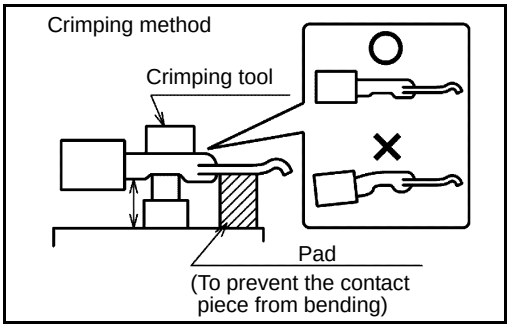


2. Insert a screwdriver from the terminal side, push down the spring at the bottom of the terminal and pull the cable to draw out the terminal.

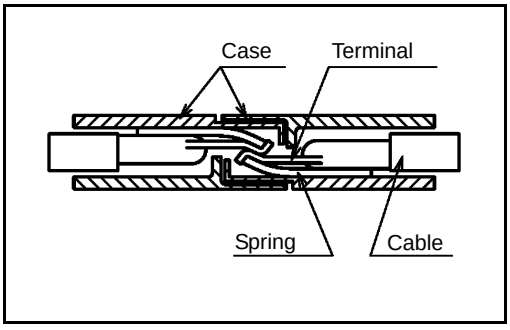


3. Peel off the tip of the cable for Approx. 30mm, solder sufficiently and insert it to the contact portion of the new terminal.

Note:
Be sure to prevent solder from pouring out and adhere to the contact surface of the terminal.



4. When crimping cables, never bend the terminal with a crimping tool.



5. Insert the terminal to the battery plug.
Check that the tip of the terminal goes over the tip of the spring and securely set in the position.

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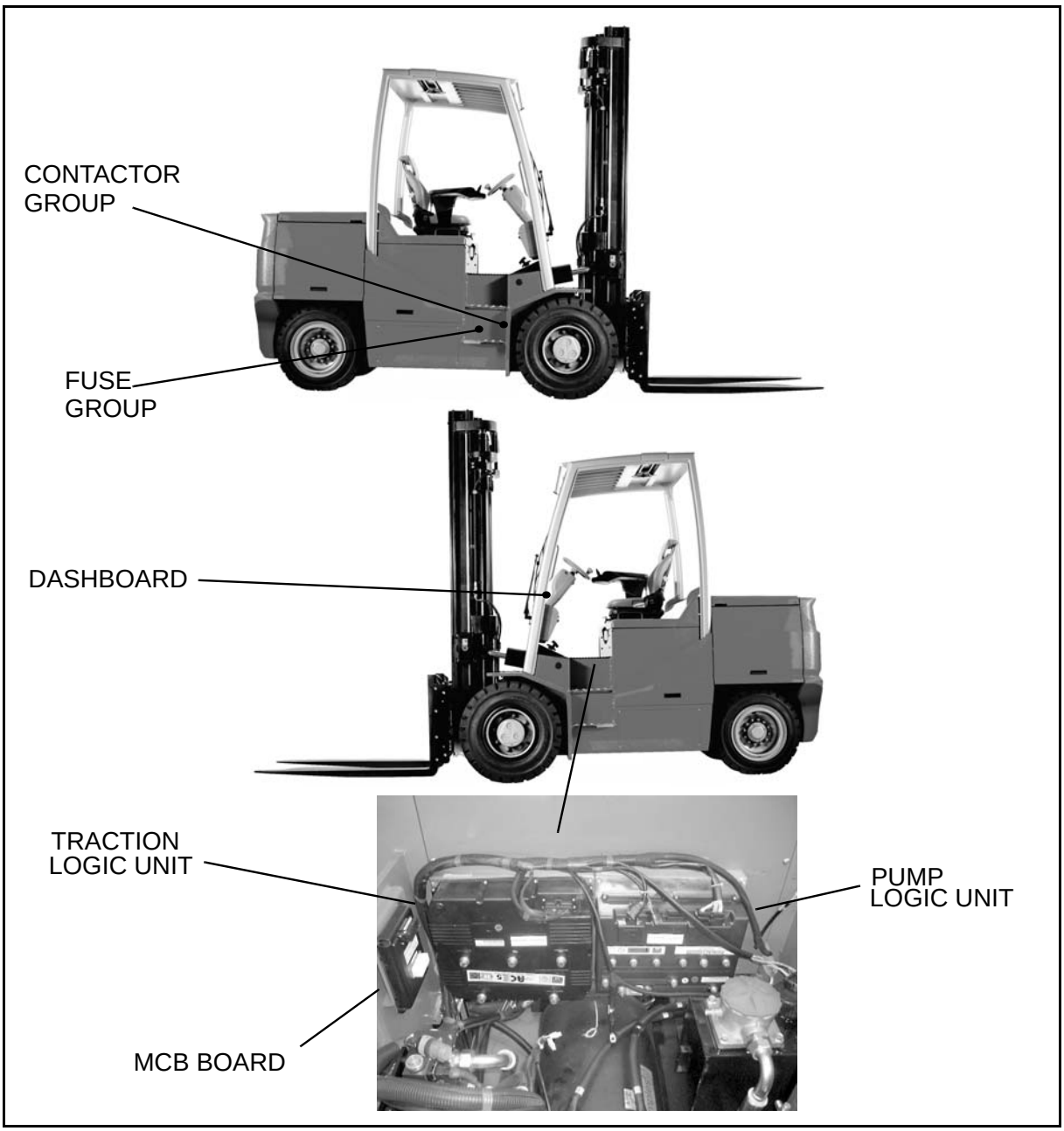
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GENERAL

The truck is equipped with traction & lifting logic units that control traveling and material handling system. They are multi-functional controllers equipped with micro computers.
The traction & lifting logic units provide high performance in a wide range by means of inverter control of the AC motor drive system.
The main controllers have a self-diagnosis function that automatically detects any abnormality of the main traction/lifting circuits, accelerator, brake or any other sensor and displays the corresponding error code together with a warning beep.
At the same time, an action such as traction disabling, lifting disabling or restriction of traveling speed is automatically taken to ensure safety.
In addition, setting the display in analyzer mode (fault analysis) it is possible to identify faulty portions and inspect the main traction / lifting circuits and each operating system and sensors.



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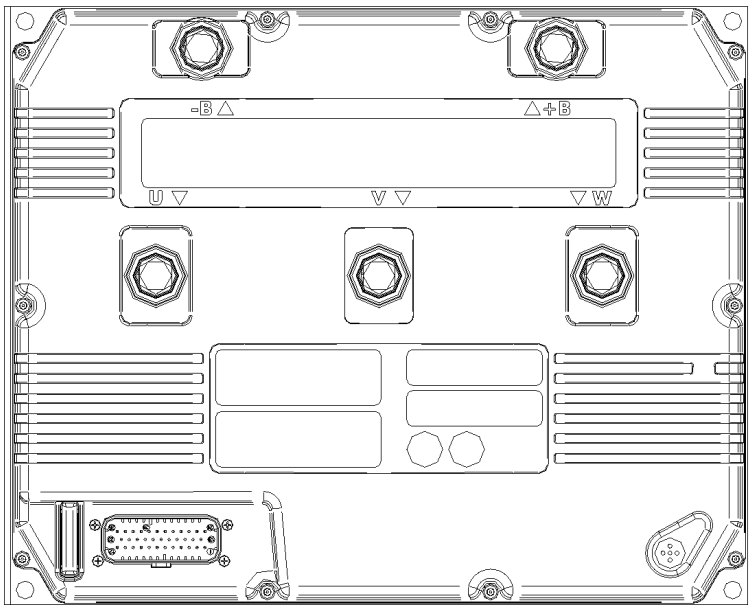
SPECIFICATIONS

FUSES	NAME AND DESCRIPTION	All
	FB General	750A
FUSES from General	FP (pump logic unit)	500A
	F1 (key switch)	6,3A
	F2 AC-5 & brake solenoid valve supply	5A
	F3 DC/DC converter (+V batt. supply)	15A
	F4 Heaters (OPT)	25 A
FUSES from DC/DC	F5 Sesam, dashboard, MCB board +24 V supply	10A
	F6 Motor drivers fan +24 V supply	5A
	F7 horn, buzzer, ligts +24 V supply	10A
FUSES from DC/DC aux.	F8 Optional equipment +24 V supply	30A
	F9 Heated seat (OPT))	10A
FUSES for optional devices	F10 (wiper motors) (OPT)	7,5A
	F11 (front working lamps) (OPT)	7,5A
	F12 (rear working lamps) (OPT)	7,5A
	F13 (dipped headlights) (OPT)	10A
	F14 (beacon lamp) (OPT)	5A
	F15 (windscreen washer motors) (OPT)	5A
	F16 (rear windows heater) (OPT)	10A
	F17 (heater fans) (OPT)	7,5A
	F18-F21 (spare)	
CONTACTORS	CT1 (key)	SW60B-238 80V
	CT2 (traction logic unit)	SU280B-1218 24V
	CT3 (pump logic unit)	SU280B-1218 24V

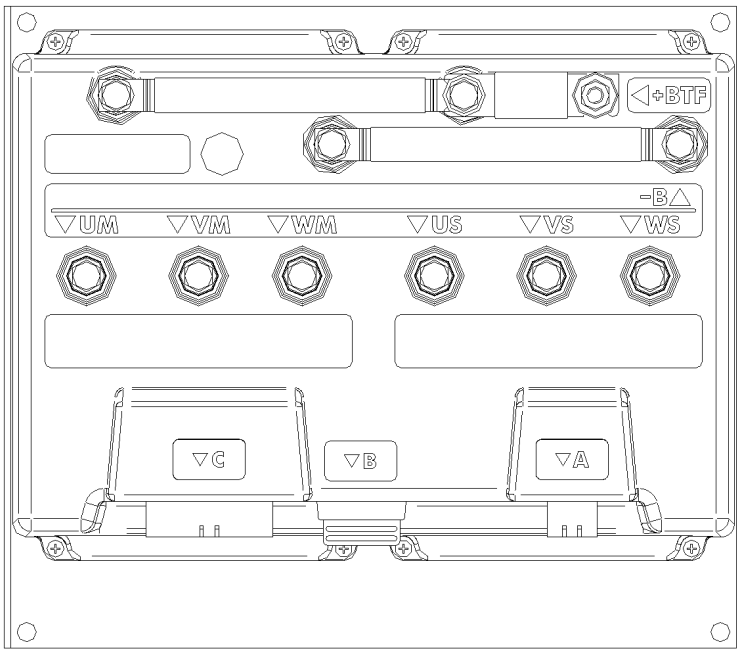
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COMPONENTS

TRACTION LOGIC UNIT

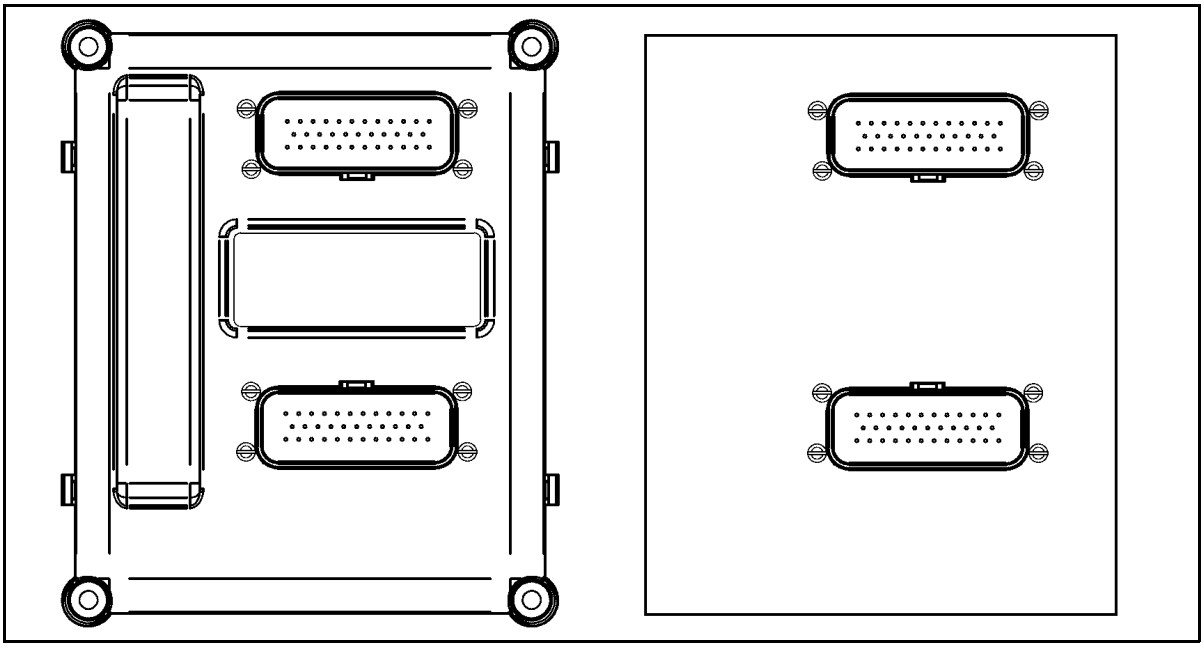


PUMP LOGIC UNIT

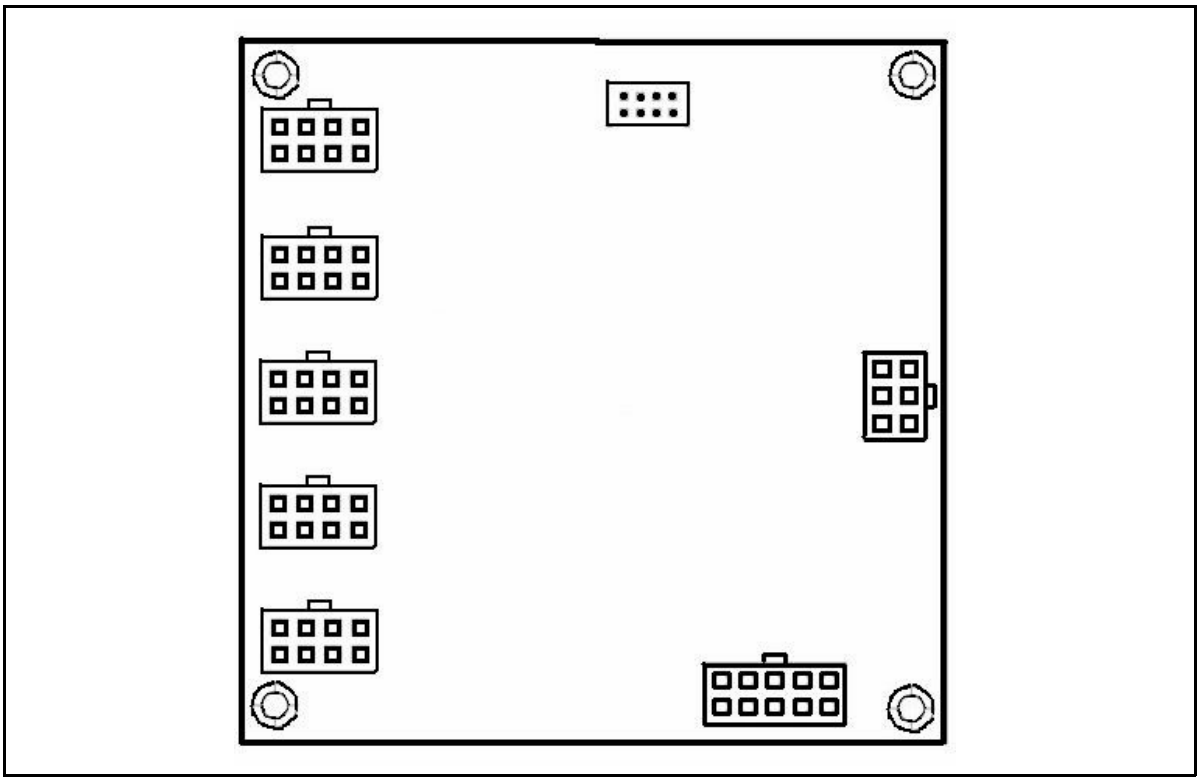


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MCB BOARD

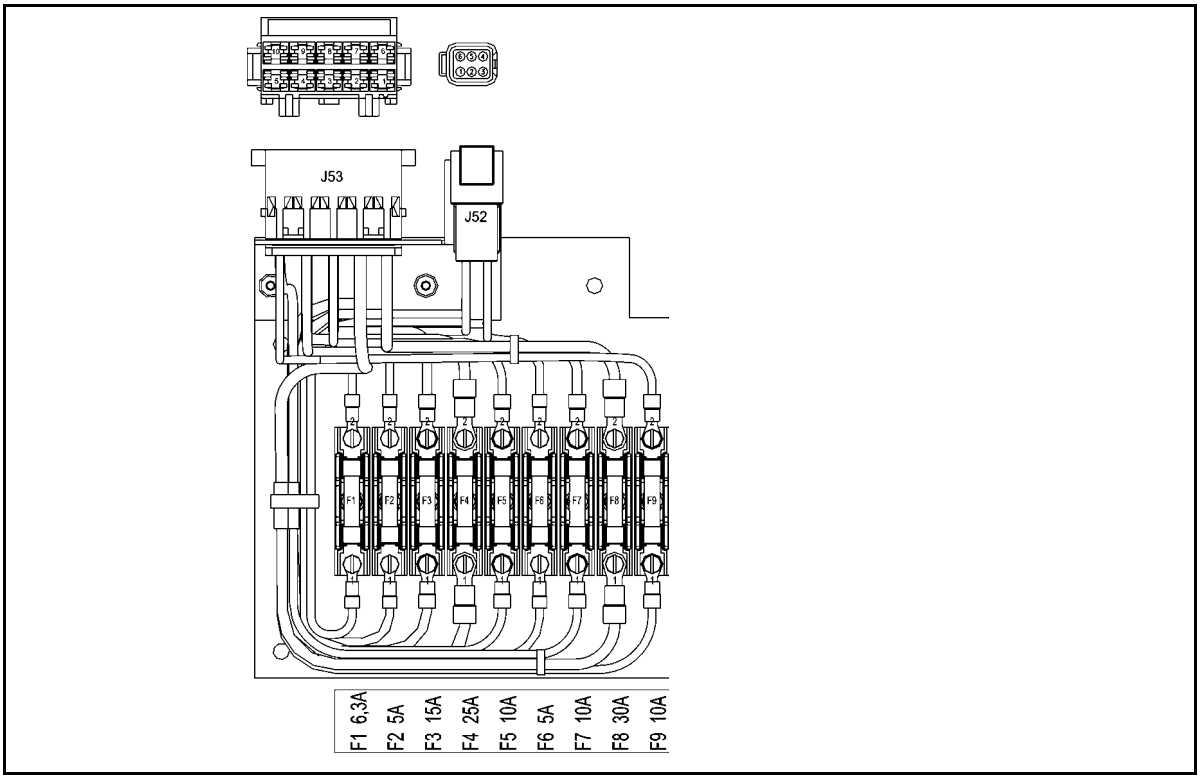


ARMREST BOARD (optional)



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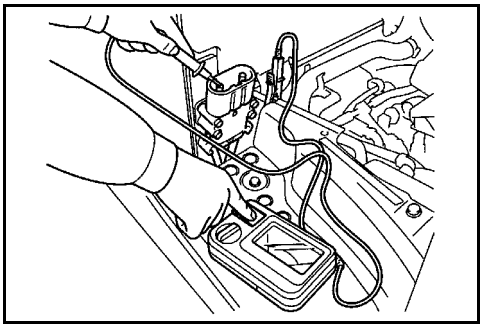
FUSE GROUP



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BEFORE REPAIR

INSPECTION



1. Insulation resistance measurement

Note:
Always carry out the measurement before inspecting the traction/lifting units.

(1) Disconnect the battery plug and measure the resistance between the plug and the battery body

Measurement terminals	Logic units side of battery plug-body
Standard:	The resistance value depends greatly on the vehicle operating state, place and weather. (Approx. 1MΩ or more)

Some components can be inspected after they are removed from the vehicle, other ones can only be inspected as installed on the vehicle.
The logic units must be inspected on the vehicle since the battery voltage must be applied
This explanation is mainly for inspection of the controller as removed from the vehicle

Disassembly Procedure

- Overhauling the control panels are rarely necessary. In most cases, failed parts are replaced after finding out the cause of the failure from inspection. Therefore, make sure to repair correctly by referring to the figures of configuration and assembly.
- Do not disassemble traction / lifting logic units and the other main controllers, as they should be replaced in a form of group not disassembled.

Caution for part replacement

- Observe the specified bolts tightening torque. An insufficient or excessive tightening torque may cause other failure
- When disconnecting the bars and harness, record the connecting location and place tags. When connecting them again, be sure to confirm with the record and tags to prevent incorrect connection. Incorrect connection may cause other failure.
- Always apply new silicon grease when reassembling parts originally coated with this material. Otherwise, overheating may occur
- After installation, check that there is no interference of the bar and harness connection with other portion

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CONNECTOR INSPECTION

When inspecting each board and the cause of the trouble is found, do not immediately replace the board but check the following items.

- **Abnormalies in related harnesses**
- **Looseness of the related connectors**
- **Bending or damage of connector pin and defective contact of any related connector pin**

If any of the above is the cause of the trouble and the board is replaced with a new one, the new board will be damaged.
Always replace the board after careful inspection.
When the trouble derives from a logic unit or board, measure the voltage and resistance of every part involved in the substitution. Always disconnect the battery plug before measuring the resistance.

Warning:
Disconnect the battery plug before connecting or disconnecting the logic unit.
Note:
When a logic unit is determined to be the cause of trouble as the result of troubleshooting, always measure the applied voltage and resistance of each related portion when replacing.

(1) Setting Method
  (a) Key switch OFF and battery plug disconnected.
  (b) Connect the multemeter to the corresponding connector pin.

Warning:
As connection of the wrong connector pin may damage normal portions, make sure to confirm the connector pin number.

(2) Measurement method and standard list
  How to read the list

CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To	Description	Standard	Notes



JAT (1-B9)	J15 (1-B9)	EN1 encoder + V	+ 12 V	



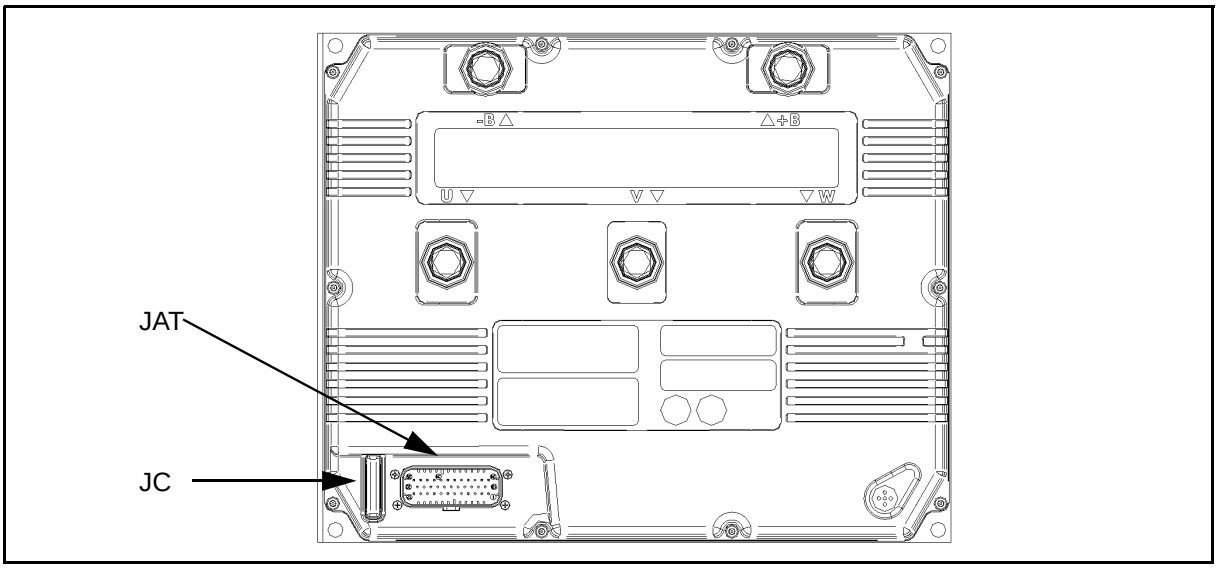
COLOUR CODING

	COLORI	COLOURS	FARBEN	COULEURS	COLORES
C	arancio	orange	orange	orange	naranja
A	azzurro	blue	blau	bleu	azul
B	bianco	white	weiß	blanc	blanco
L	blu	dark blue	dunkelblau	bleu marine	azul intenso
G	giallo	yellow	gelb	jaune	amarillo
H	grigio	grey	grau	gris	gris
M	marrone	brown	braun	marron	castaño
N	nero	black	schwarz	noir	negro
S	rosa	pink	pink	rose	rosa
R	rosso	red	rot	rouge	rojo
V	verde	green	grün	vert	verde
Z	viola/porpora	purple	violett	violet	púrpura

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MAIN CONTROLLERS

TRACTION LOGIC UNIT



Basic conditions (battery plug connected, key switch ON)
See connectors reference names in the electrical diagram.

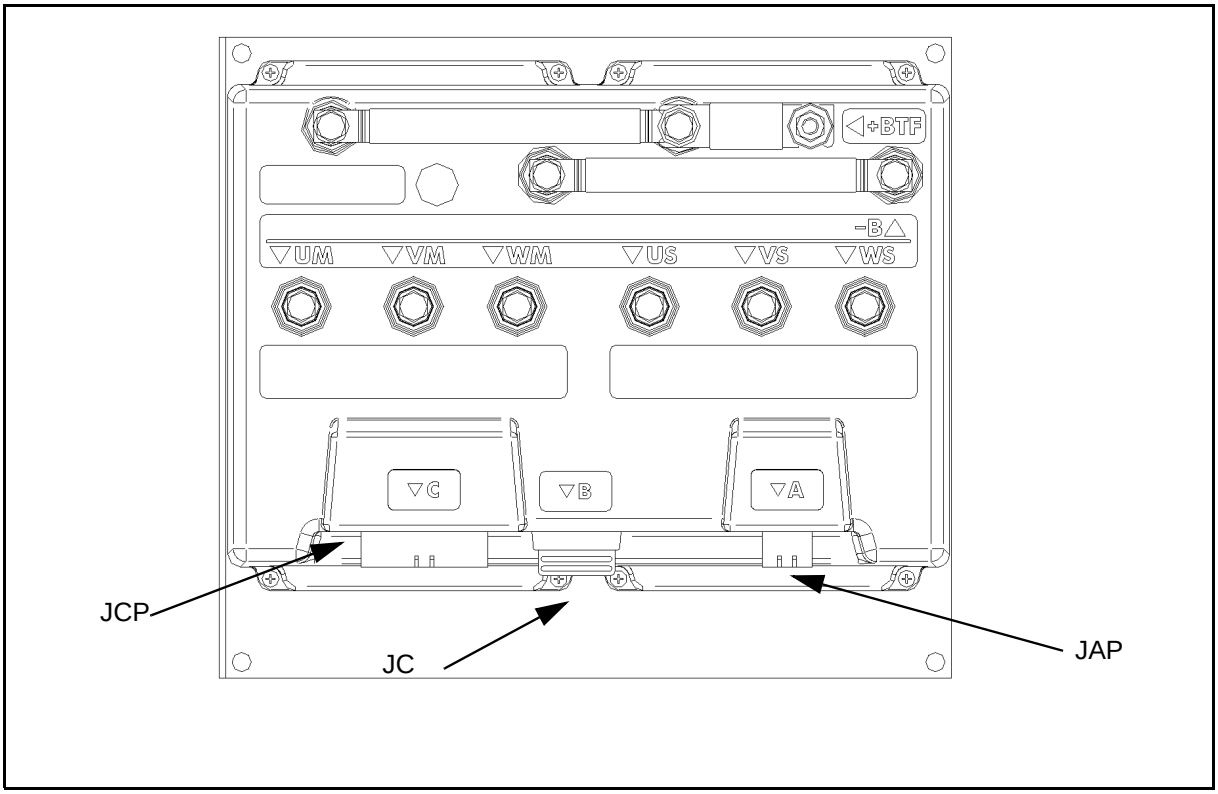
CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JC (1)	---	Console	---	
JC (2)	---	Console	---	
JC (3)	---	Console	---	
JC (4)	---	Console	---	
JC(5)	---	Console	---	
JC (6)	---	Console	---	
JC (7)	---	Console	---	
JC (8)	---	Console	---	
JAT (1-B9)	J15 (1-B9)	EN1 encoder + V	+12 V	
JAT (2-B12)	J15 (2-B12)	EN1 encoder GND	GND	
JAT (3-S)	J14 (C-S) [via J134 (8-S)]	Steering Potentiometer + V	+10 V	
JAT (4-S1) [JCP (5-S1)]	J19 (3-S1) [via J134 (11-S1)]	Seat SW N.O. (output)	+5 V	
JAT (5-S10)	J19 (2-S10) [via J134 (10-S10)]	Seat SW N.C. (output)	+5 V	
JAT (6-S12)	J49 (11-S12)	Low mast SW N.O. INPUT(SAS options)	+5 V	
JAT (7-S13)	J49 (12-S13)	Low mast SW N.C. INPUT (SAS options)	+5 V	
JAT (8)	---	Unused	---	
JAT (9)	---	Unused	---	
JAT (10)	---	BK Pressure SW (Unused)	+5 V	
JAT (11)	---	ACC. Pressure SW (Unused)	+5 V	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JAT (12-L1)	JCP (31-L1)	Safety (- Batt. from Lifting Unit)	GND	
JAT (13-B11)	J15 (4-B11)	A Phase EN1 encoder	+12 V	
JAT (14-B10)	J15 (3-B10)	B Phase EN1 encoder	+12 V	
JAT (15-S5)	J14 (B-S5) [via J134 (7-S5)]	Steer Potentiometer GND	GND	
JAT (16-S6)	J14 (A-S6) [via J134 (6-S6)]	Steer Potentiometer Cursor	0 ÷ +10 V	
JAT (17)	---	Unused	---	
JAT (18-H)	JAP (7-H)	CAN H (to lifting logic unit)	High Signal	
JAT (19-Z)	JAP (4-Z)	CAN L (to lifting logic unit)	Low Signal	
JAT (20)	---	Unused	---	
JAT (21)	---	Unused	---	
JAT (22)	---	Unused	---	
JAT (23)	---	Unused	---	
JAT (24-B13)	J16 (1-B13)	Traction motor thermic sensor GND	GND	
JAT (25-B14)	J16 (2-B14)	Traction motor thermic sensor supply	---	
JAT (26-L2)	J50 (5-L2)	CT2 traction contactor coil GND	GND	
JAT (27-R 01) [JAT (29-R 01)]	J50 (6-R01) J1 (1-R01) J52 (4-R01)	Supply to CT2 traction contactor coil Supply to brake solenoid valve Supply + V Batt. from CT1	+24 V.	
JAT (28-A)	J1 (2-A)	Brake solenoid valve GND	GND	
JAT (29-R 01) [JAT (27-R 01)]	J50 (6-R01) J1 (1-R01) J52 (4-R01)	Supply to CT2 traction contactor coil Supply to brake solenoid valve Supply + V Batt. from CT1	+24 V	
JAT (30-S11)	J49 (13-S11)	+V out	---	
JAT (31)	---	Unused	---	
JAT (32)	---	Unused	---	
JAT (33-M03) [JCP (3-M03)]	J35 (1-M03) J50 (3-M03)	Supply from key switch SW1	+80 V	
JAT (34)	---	Unused	---	
JAT (35)	---	Unused	---	

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PUMP LOGIC UNIT



Basic conditions (battery plug connected, key switch ON).
See connectors reference names in the electrical diagram.

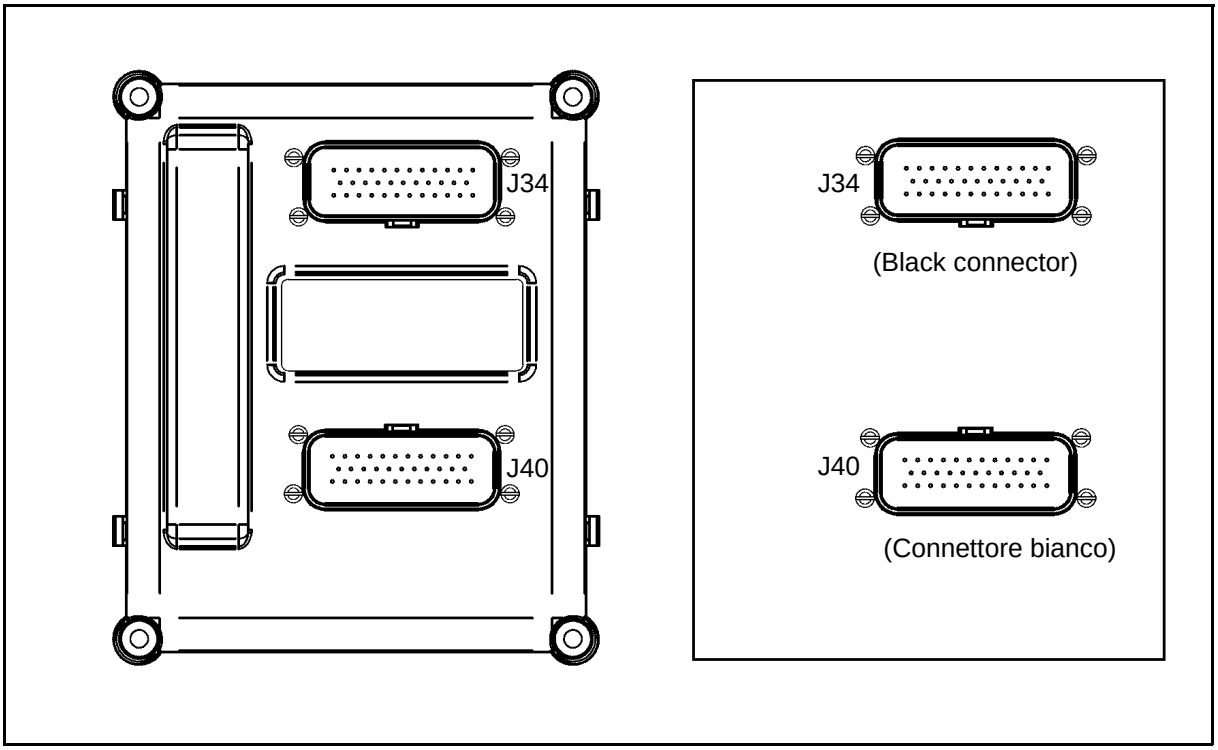
CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JC (1)	---	Console	---	
JC (2)	---	Console	---	
JC (3)	---	Console	---	
JC (4)	---	Console	---	
JC(5)	---	Console	---	
JC (6)	---	Console	---	
JC (7)	---	Console	---	
JC (8)	---	Console	---	
JAP (1-H)	J34 (19-H) J137 (1-H)	CAN H	High Signal	
JAP (2)	---	Unused	---	
JAP (3)	---	Unused	---	
JAP (4-Z)	JAT (19-Z)	CAN L (from traction logic unit)	Low Signal	
JAP (5)	---	Unused	---	
JAP (6-Z)	J34 (21-Z) J137 (2-Z)	CAN L	Low Signal	
JAP (7-H)	JAT (18-H)	CAN H (from traction logic unit)	High Signal	
JAP (8)	---	Unused	---	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JCP (1-B15)	J17 (1-B15)	EN2 encoder + V	+12 V	
JCP (2-B18)	J17 (4-B18)	EN2 encoder GND	GND	
JCP (3-M03) [JAT (33-M03)]	J35 (1-M03) J50 (3-M03)	Supply from key switch SW1	+80 V	
JCP (4-S2)	J19 (1-S2) via J134 (9-S2)	Seat SW common (supply)	0 ÷ +5 V	
JCP (5-S1) [JAT (4-S1)]	J19 (3-S1) via J134 (11-S1)	Seat SW N.O. (output)	---	
JCP (6)	---	Unused	---	
JCP (7)	---	Unused	---	
JCP (8)	---	Unused	---	
JCP (9)	---	Unused	---	
JCP (10)	---	Unused		
JCP (11-B23)	J22 (1-B23)	EN3 encoder + V	+12 V	
JCP (12-B26)	J22 (4-B26)	EN3 encoder GND	GND	
JCP (13-B17)	J17 (3-B17)	A Phase EN2 encoder	+12 V	
JCP (14-B16)	J17 (2-B16)	B Phase EN2 encoder	+12 V	
JCP (15)	---	Unused	---	
JCP (16)	---	Unused	---	
JCP (17)	---	Unused	---	
JCP (18)	---	Unused	---	
JCP (19)	---	Unused	---	
JCP (20)	---	Unused	---	
JCP (21)	---	Unused	---	
JCP (22-B25)	J22 (3-B25)	A Phase EN3 encoder	+12 V	
JCP (23-B24)	J22 (2-B24)	B Phase EN3 encoder	+12 V	
JCP (24-B19)	J18 (1-B19)	Left pump motor temp. sensor GND	GND	
JCP (25-B20)	J18 (2-B20)	Left pump motor temp. sensor supply	+12 V	
JCP (26-L3)	J50 (7-L2)	CT3 pump contactor coil GND	GND	
JCP (27-B29)	J50 (8-B29)	CT3 pump contactor coil supply	+24 V	
JCP (28)	---	Unused	---	
JCP (29)	---	Unused	---	
JCP (30)	---	Unused	---	
JCP (31-L1)	JAT (12-L1)	Safety (- Batt. to Traction Unit)	GND	
JCP (32)	---	Unused	---	
JCP (33)	---	Unused	---	
JCP (34-B22)	J23 (1-B22)	Right pump motor temp. sensor GND	GND	
JCP (35-B21)	J23 (2-B21)	Right pump motor temp. sensor supply	+12 V	

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MCB BOARD



Basic conditions (battery plug connected, key switch ON)
See connectors reference names in the electrical diagram.

CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J34 (1-B3)	J33 (5-B3)	Double pedal configuration (input)	0 ÷ +5 V	
J34 (2-V5)	J32 (5-V5)	Single pedal march enable SW8 N.O.	0 ÷ +5 V	
J34 (3-V6)	J32 (6-V6)	Single pedal march enable SW8 N.C.	0 ÷ +5 V	
J34 (4-B1)	J33 (2-B1) J39 (7-B1) via J35 (7-B1)	Double pedal FW SW4 N.O. Hand direction FW SW9 N.O.	0 ÷ +5 V	
J34 (5-B2)	J33 (3-B2)	Double pedal FW SW4 N.C.	0 ÷ +5 V	
J34 (6-B4)	J33 (8-B4) J39 (8-B4) via J35 (2-B4)	Double pedal BW SW5 N.O. Hand direction BW SW10 N.O.	0 ÷ +5 V	
J34 (7-B5)	J33 (9-B5)	Double pedal BW SW5 N.C.	0 ÷ +5 V	
J34 (8-A1)	J31 (4-A1)	Brake pedal SW6 N.C.	0 ÷ +5 V	
J34 (9-A2)	J30 (2-A2)	Brake lever SW7 N.O.	0 ÷ +5 V	
J34 (10)	---	Unused	---	
J34 (11)	---	Unused	---	
J34 (12)	---	Unused	---	
J34 (13)	---	Unused	---	
J34 (14)	---	Unused	---	
J34 (15)	---	Unused	---	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J34 (16)	---	Unused	---	
J34 (17)	---	Unused	---	
J34 (18)	---	Unused	---	
J34 (19-H)	J137(1-H) JAP (1-H)	CAN H	High Signal	
J34 (20-H)	J131 (2-H) via J134 (14-H)	CAN H (armrest)	High Signal	
J34 (21-Z)	J137 (2-Z) JAP (6-Z)	CAN L	Low Signal	
J34 (22-Z)	J131 (1-Z) via J134 (15-Z)	CAN L (armrest)	Low Signal	
J34 (23-N1)	---	GND general output	GND	
J34 (24-V4)	J49 (9-V4)	Unused	0 ÷ +5 V	
J34 (25-V1)	J32 (1-V1)	Wiper acceleretor potentiometer	+1,6 ÷ +3,2 V	
J34 (26)	---	Unused	---	
J34 (27)	---	Unused	---	
J34 (28-V2)	J32 (2-V2)	GND acceleretor potentiometer	GND	
J34 (29-V11)	J49 (8-V11)	+V lift & tilt potentiometer (SAS OPT)	0 ÷ +10 V	
J34 (30 V3)	J32 (3-V3)	+V acceleretor potentiometer	0 ÷ +10 V	
J34 (31-V10)	J49 (7-V10)	GND lift & tilt potentiometer (SAS OPT)	GND	
J34 (32)	---	Unused	---	
J34 (33-S3)	J49 (6-S3)	Unused	0 ÷ +5 V	
J34 (34-S4)	J49 (5-S4)	Unused	0 ÷ +5 V	
J34 (35)	---	Unused	---	
J40 (1-G2)	JE1 (2-G2) via J56 (1-G2)	GND EVP1 lowering	0 ÷ + 24 V	
J40 (2-G3)	JE2 (2-G3) via J56 (2-G3)	GND EVP2 lifting	0 ÷ + 24 V	
J40 (3-G1)	JE1(1-G1) via J56 (3-G1) JE2 (1-G1) via J56 (3-G1)	+V EVP1 lowering +V EVP2 lifting	+24 V	
J40 (4-G5)	JE3 (2-G5) via J56 (4-G5)	GND EVP3 Tilt BW	0 ÷ + 24 V	
J40 (5-G6)	JE3 (3-G6) via J56 (5-G6)	GND EVP4 Tilt FW	0 ÷ + 24 V	
J40 (6-G4)	JE3 (1-G4) via J56 (6-G4) JE3 (4-G4) via J56 (6-G4)	+V EVP3 Tilt BW +V EVP4 Tilt FW	+ 24 V	
J40 (7-G8)	JE4 (2-G8) via J56 (4-G8)	GND EVP5 Sideshift left	0 ÷ + 24 V	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J40 (8-G9)	JE4 (3-G9) via J56 (5-G9)	GND EVP6 Sideshift right	0 ÷ + 24 V	
J40 (9-G7)	JE4 (1-G7) via J56 (9-G7) JE4 (4-G7) via J56 (9-G7)	+V EVP5 Sideshift left +V EVP6 Sideshift righ	+24 V	
J40 (10-G11)	JE5 (2-G11) via J56 (10-G11)	GND EVP7 4TH lever	0 ÷ + 24 V	
J40 (11-G12)	JE5 (3-G12) via J56 (11-G12)	GND EVP8 4TH leve	0 ÷ + 24 V	
J40 (12-G10)	JE5 (1-G10) via J56 (12-G10) JE5 (4-G10) via J56 (12-G10)	+V EVP7 4TH lever +V EVP8 4TH leve	+24 V	
J40 (13-C01) [J40 (16-C01)] [J40 (17-C01)] [J40 (18-C01)] [J40 (28-C01)]	J53 (8-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J40 (14-N) [J40 (19-N)] [J40 (20-N)] [J40 (21-N)] [J40 (22-N)] [J40 (25-N)]	---	GND from DC/DC converter	GND	
J40 (15-V7)	J49 (2-V7)	Unused	---	
J40 (16-C01) [J40 (13-C01)] [J40 (17-C01)] [J40 (18-C01)] [J40 (28-C01)]	J53 (8-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J40 (17-C01) [J40 (13-C01)] [J40 (16-C01)] [J40 (18-C01)] [J40 (28-C01)]	J53 (8-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J40 (18-C01) [J40 (13-C01)] [J40 (16-C01)] [J40 (17-C01)] [J40 (28-C01)]	J53 (8-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	

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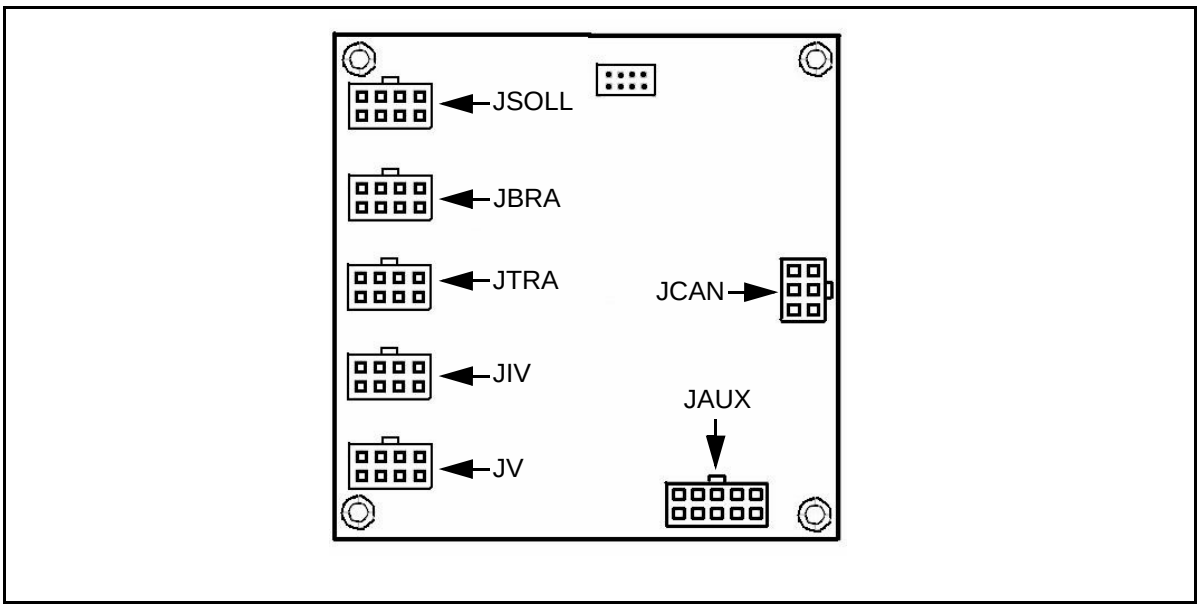
CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J40 (19-N) [J40 (14-N)] [J40 (20-N)] [J40 (21-N)] [J40 (22-N)] [J40 (25-N)]	---	GND from DC/DC converter	GND	
J40 (20-N) [J40 (14-N)] [J40 (19-N)] [J40 (21-N)] [J40 (22-N)] [J40 (25-N)]	---	GND from DC/DC converter	GND	
J40 (21-N) [J40 (14-N)] [J40 (19-N)] [J40 (20-N)] [J40 (22-N)] [J40 (25-N)]	---	GND from DC/DC converter	GND	
J40 (22-N) [J40 (14-N)] [J40 (19-N)] [J40 (20-N)] [J40 (21-N)] [J40 (25-N)]	---	GND from DC/DC converter	GND	
J40 (23)	---	Unused	---	
J40 (24-V8)	J49 (3-V8)	+V pressure sensor (SAS OPT)	---	
J40 (25-N) [J40 (14-N)] [J40 (19-N)] [J40 (20-N)] [J40 (21-N)] [J40 (22-N)]	---	GND from DC/DC converter	GND	
J40 (26-V9)	J49 (4-V9)	GND pressure sensor (SAS OPT)	---	
J40 (27-A4)	J71 (3-A4)	Motor drivers fan signal	1 = Enable	
J40 (28-C01) [J40 (13-C01)] [J40 (16-C01)] [J40 (17-C01)] [J40 (18-C01)]	J53 (8-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J40 (29-A5)	via J134(2-A5) J93 (2-A5) J92 (2-A5) J70 (2-A5)	BW march right light GND BW march left light GND Optional buzzer GND	0 = Enable	
J40 (30-A6)	via J134 (3-A6) J102 (2-A6) J91 (2-A6)	Stop right light GND Stop left light GND	0 = Enable	
J40 (31-A7)	J90/B (1-A7)	Direction ligts GND	0 = Enable	
J40 (32-G14)	JE6(2-G14) via J56(13-G14)	GND EVP9 5TH lever	0 V	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J40 (33-G13)	JE6(1-G13) via J56(14-G13)	+V EVP9 5TH lever	+24 V	
J40 (34-G16)	JE6(4-G16) via J56(15-G16)	GND EVP10 5TH lever	0 V	
J40 (35-G15)	JE6(3-G15) via J56(16-G15)	+V EVP10 5TH lever	+24 V	

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ARMREST BOARD



Basic conditions (battery plug connected, key switch ON) [Mini-lever specification vehicle]
See connectors reference names in the electrical diagram

CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JCAN (1-Z)	J131 (1-Z) via J138 (2-Z)	CAN L	Low Signal	
JCAN (2-H)	J131 (2-H) via J138 (4-H)	CAN H	High Signal	
JCAN (3-N)	J131 (5-N) via J138 (1-N)	GND converter DC/DC	GND	
JCAN (4)	---	Unused	---	
JCAN (5-C01)	J131 (4-C01) via J138 (5-C01)	+24 V converter DC/DC	+24 V	
JCAN (6-N)	J131 (3-N) via J138 (3-N)	GND converter DC/DC		
JSOLL (1)	---	+V lifting/lowering potentiometer P4	+5 V	
JSOLL (2)	---	Wiper lifting/lowering potentiometer P4	+2,5 V	0 ÷ +5 V
JSOLL (3)	---	Unused (lifting/lowering)	---	
JSOLL (4)	---	GND lifting/lowering potentiometer P4	GND	
JSOLL (5)	---	Lifting/lowering micro SW 17	+5 V	
JSOLL (6)	---	Lifting/lowering micro SW 18	+5 V	
JSOLL (7)	---	Unused (lifting/lowering)	---	
JSOLL (8)	---	GND Lifting/lowering micros SW 17 &18	GND	
JBRA (1)	---	+V tilting potentiometer P5	+5 V	
JBRA (2)	---	Wiper tilting potentiometer P5	+2,5 V	0 ÷ +5 V
JBRA (3)	---	Unused (tilting)	---	

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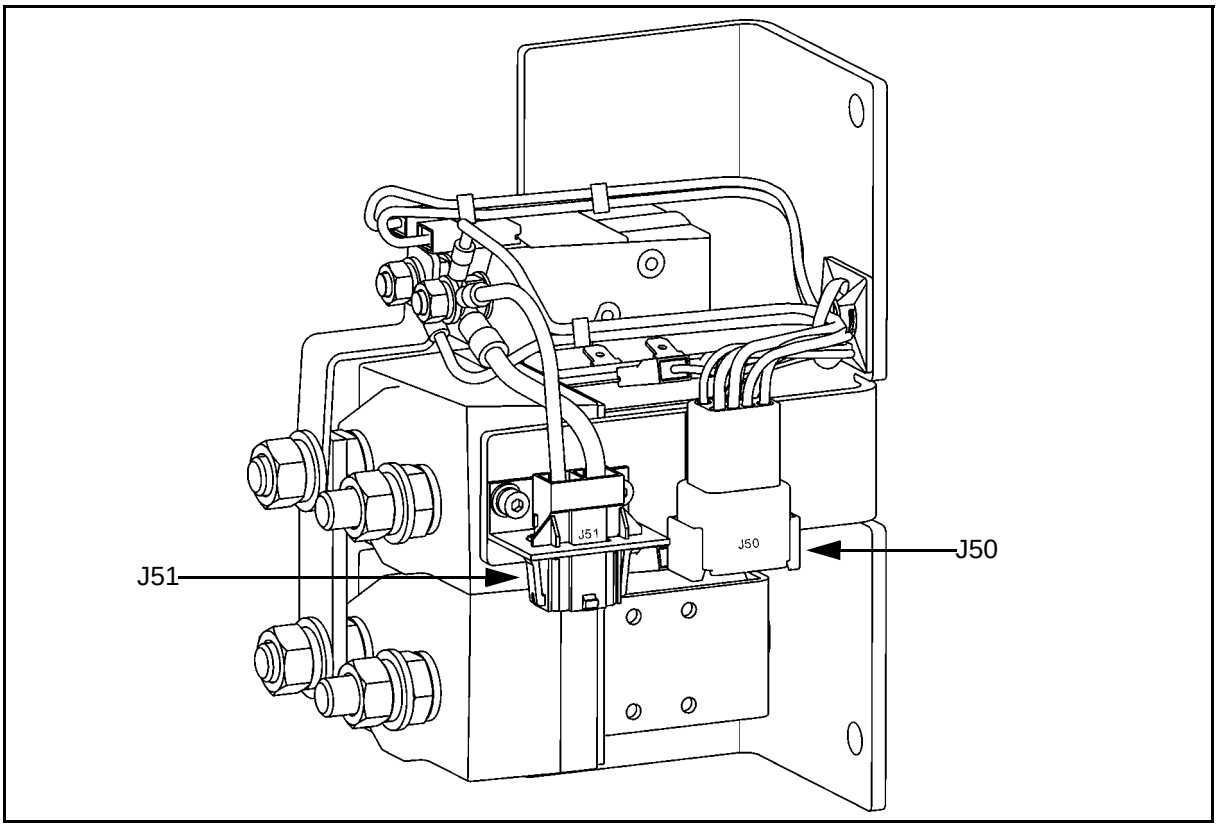
CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JBRA (4)	---	GND tilting potentiometer P5	GND	
JBRA (5)	---	Tilting micro SW 19	+5 V	
JBRA (6)	---	Tilting micro SW 20	+5 V	
JBRA (7)	---	Unused (tilting)	---	
JBRA (8)	---	GND tilting micros SW 19 & 20	GND	
JTRA (1)	---	+V sideshift potentiometer P6	+5 V	
JTRA (2)	---	Wiper sideshift potentiometer P6	+2,5 V	0 ÷ +5 V
JTRA (3)	---	Unused (sideshift)	---	
JTRA (4)	---	GND sideshift potentiometer P6	GND	
JTRA (5)	---	Sideshift micro SW 21	+5 V	
JTRA (6)	---	Sideshift micro SW 25	+5 V	
JTRA (7)	---	Unused (sideshift) [Micro PB11 (optional attacment for joystick)]	---	
JTRA (8)	---	GND tilting micros SW 21, 22 [& micro PB11 (optional attacment for joystick)]	GND	
JIV (1)	---	+V 4th lever potentiometer P7	+5 V	
JIV (2)	---	Wiper 4th lever potentiometer P7	+2,5 V	0 ÷ +5 V
JIV (3)	---	Unused (4th lever)	---	
JIV (4)	---	GND 4th lever potentiometer P7	GND	
JIV (5)	---	4th lever micro SW 23	+5 V	
JIV (6)	---	4th lever micro SW 24	+5 V	
JIV (7)	---	Unused (4th lever)	---	
JIV (8)	---	GND 4th lever micros SW 23 & 24	GND	
JV (1)	---	Unused	---	
JV (2)	---	Unused	---	
JV (3)	---	Unused	---	
JV (4)	---	Unused	---	
JV (5)	---	Unused	---	
JV (6)	---	Unused	---	
JV (7)	---	Unused	---	
JV (8)	---	Unused	---	
JAUX (1)	---	+V march single pedal potentiometer P8	+5 V	
JAUX (2)	---	Wiper march single pedal potentiometer P8	0 ÷ +5 V	
JAUX (3)	---	GND march single pedal potentiometer P8	GND	
JAUX (4)	---	Hand lever micro PB13 BW march enabling	---	
JAUX (5)	---	Hand lever micro PB14 FW march enabling	---	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
JAUX (6)	---	INPUT (unused) [Micro PB11 (optional attachment for fingertip)]	---	
JAUX (7)	---	INPUT (unused)	---	
JAUX (8)	---	INPUT (unused)	---	
JAUX (9)	---	INPUT (unused)	---	
JAUX (10)	---	GND hand lever micros PB13 & 14 [& micro PB11 (optional attachment for fingertip)]	GND	

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CONTACTOR GROUP

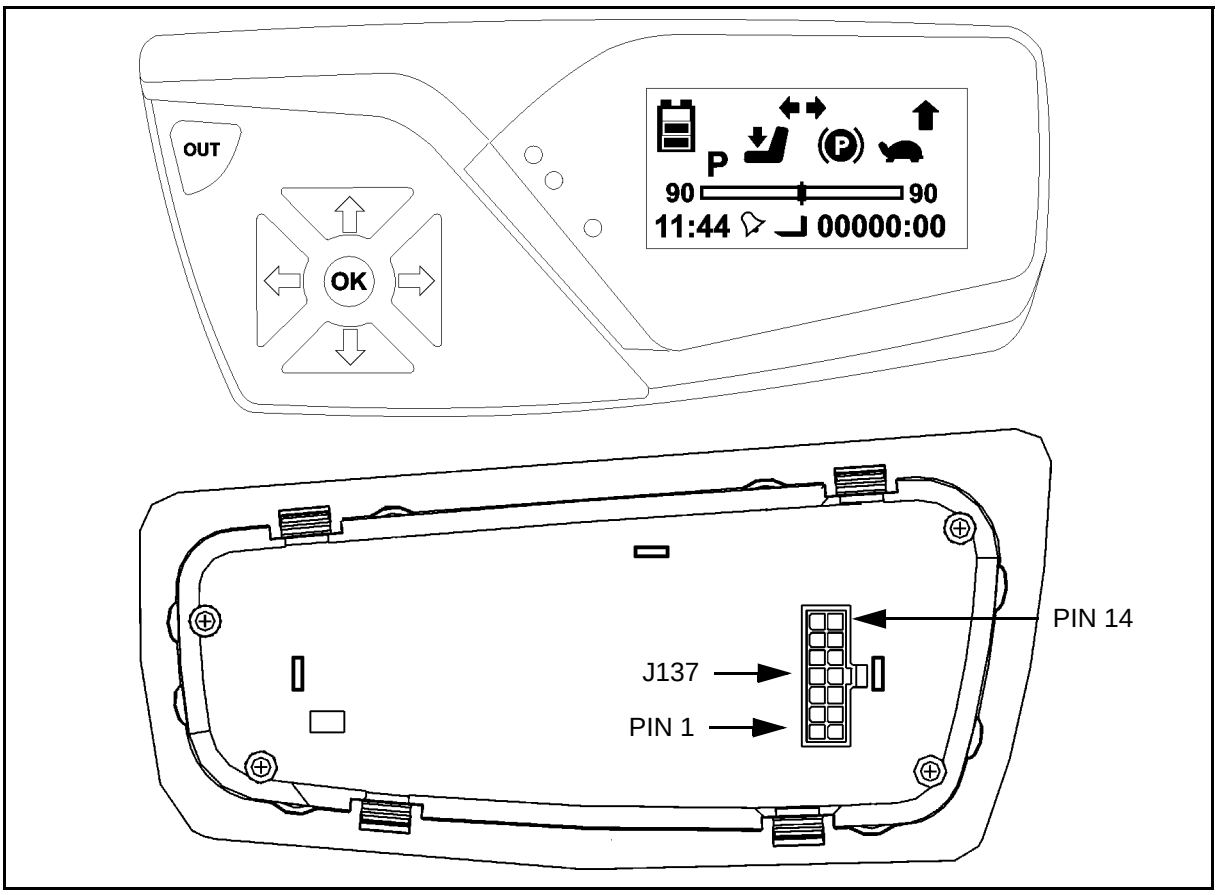


Basic conditions (battery plug connected, key switch ON)
See connectors reference names in the electrical diagram.

CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J50 (1-M)	J52 (1-M)	F1 supply	+ 80 V	
J50 (2-R)	J52 (2-R)	F2 supply	+ 80 V	
J50 (3-M03)	J35 (1-MO3) JCP (3-M03 JAT (33-M03)	CT1 line contactor coil supply from key switch SW1	+ 80 V	
J50 (4-N)	J97 (2-N) J96 (2-N)	CT1 line contactor coil GND (General battery GND)	GND	
J50 (5-L2)	JAT (26-L2)	CT2 traction contactor coil GND	GND	
J50 (6-R01)	JAT (27-R 01) JAT (29-R 01) J1 (1-R01) J52 (4-R01)	Supply input traction unit Supply input traction unit Supply to CT2 traction contactor coil Supply to brake solenoid valve	+ 24 V	
J50 (7-L3)	JCP (23-L3)	CT3 pump contactor coil GND	GND	
J50 (8-B29)	JCP (27-B29)	CT3 pump contactor coil supply	+ 24 V	
J51 (1-R)	J53 (2-R)	F4 supply	+ 80 V	
J51 (2-R)	J53 (1-R)	F3 supply	+ 80 V	

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DASHBOARD



Basic conditions (battery plug connected, key switch ON)
See connectors reference names in the electrical diagram.

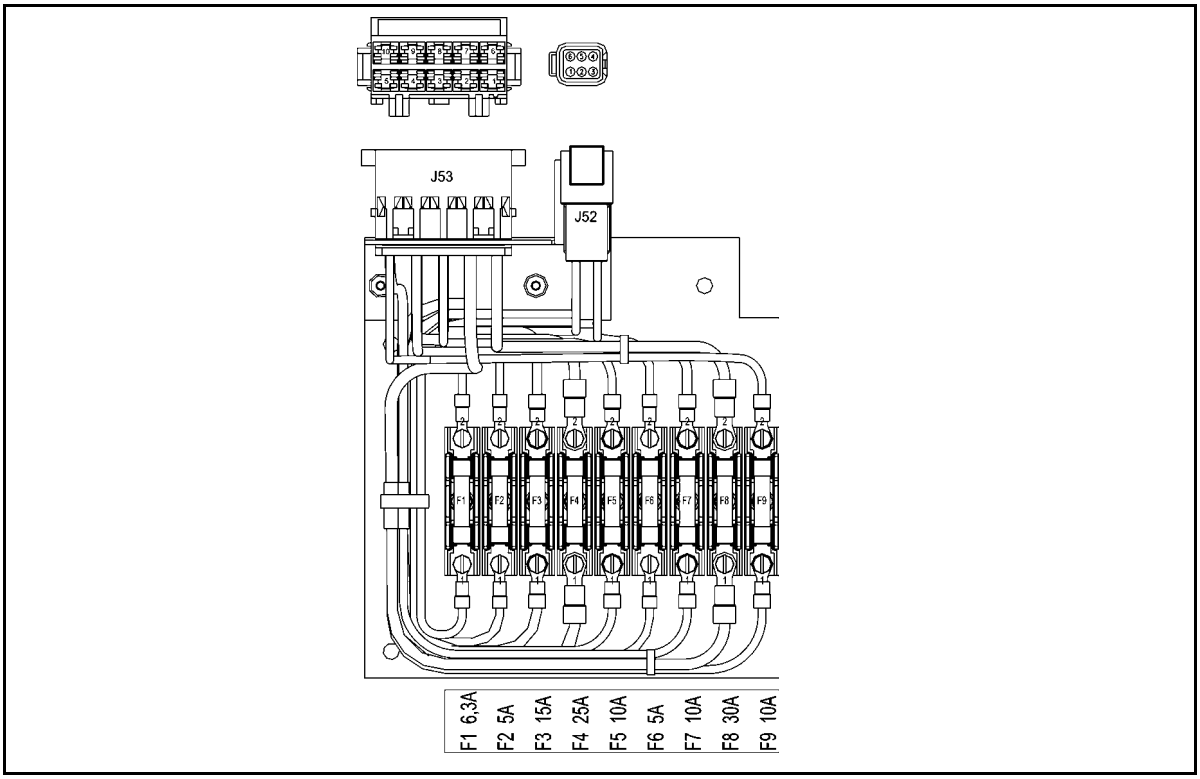
CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J137(1-H)	J133 (3-H) J34 (19-H)	CAN H	High Signal	
J137 (2-Z)	J133 (4-Z) J34 (21-Z)	CAN L	Low Signal	
J137 (3-N) [J137 (14-N)]		DC/DC converter GND	GND	
J137 (4-A8)	J37 (3-A8)	PB2 (from speed reduction)		
J137 (5-A9)	J36 (2-A9)	PB3 (from L-P-H selector)	GND	
J137 (6)	---	Unused	---	
J137 (7-C01)	J53 (8-C01) J40 (13-C01) J40 (16-C01) J40 (17-C01) J40 (18-C01) J40 (28-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J137 (8-H)	J132 (3-H) JAP (1-H)	CAN H (can bus interface) CAN H (Pump logic unit)	High Signal	

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J137 (9-Z)	J132 (4-Z) JAP (6-Z)	CAN L (can bus interface) CAN L (Pump logic unit)	Low Signal	
J137 (10-S8)	J140 (1-S8)	PB7 (accumulator pressure micro)	+ 80 V	
J137 (11-S9)	J139 (1-S9)	PB6 (brake pressure micro)		
J137 (12)	---	Unused	---	
J137 (13-A11)	J69 (2-A11) VIA J35 (5-A11)	Buzzer GND	GND	
J137 (14-N) [J137 (3-N)]		DC/DC converter GND	GND	

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FUSE GROUP



Basic conditions (battery plug connected, key switch ON)
See connectors reference names in the electrical diagram.

CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J52 (1-M)	J50 (1-M)	+V batt	+ 80 V	
J52 (2-R)	J50 (2-R)	+V batt from CT1 contactor	+ 80 V	
J52 (3-M01)	J21 (1-M01)	To key SW1 via emergency PB1	+ 80 V	
J52 (4-R01)	J50 (6-R01) JAT (27-R 01) JAT (29-R 01) J1 (1-R01)	Supply to CT2 traction contactor coil Supply input traction unit Supply input traction unit Supply to brake solenoid valve		
J52 (5-C02)	J71 (2-C02)	Motor driver fan supply from DC/DC converter	+24 V	
J52 (6)		Unused	---	
J53 (1-R)	J51(2-R)	+V batt from CT1 contactor	+ 80 V	
J53 (2-R)	J51 (1-R)	+V batt from CT1 contactor	+ 80 V	
J53 (3-R02)	J96 (1-R02) J97 (1-R02)	DC/DC converter supply	+ 80 V	
J53 (4-R03)	J107 (1-R03) J108 (1-R03)	Heater supply	+ 80 V	
J53 (5-C)	J96(4-C)	+24 V supply fron DC/DC converter	+24 V	
J53 (6-C05)	J90/A (1-C05)	+24 V supply fron DC/DC converter aux	+24 V	
J53 (7-C04)	J97 (4-C04)	+24 V supply fron DC/DC converter aux		

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CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J53 (8-C01)	J40 (13-C01) J40 (16-C01) J40 (17-C01) J40 (18-C01) J40 (28-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J40 (13-C01) [J40 (16-C01)] [J40 (17-C01)] [J40 (18-C01)] [J40 (28-C01)]	J53 (8-C01) J137 (7-C01) J133 (1-C01) J132 (1-C01) J131 (4-C01) via J134(16-C01)	+24 V from DC/DC converter fuse F5	+24 V	
J53 (9-C03)	J102 (1-C03) J90/B(5-C03) J70 (1-C03) J92 (1-C03) J91 (1-C03)	+24 V from DC/DC converter fuse F7	+24 V	
J53 (10-C06)		+24 V supply from DC/DC converter aux (Unused)	+24 V	
J53 (11)	---	Unused	---	
J53 (12)	---	Unused	---	
J53 (13)	---	Unused	---	
J53 (14)	---	Unused	---	

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CONTROL UNIT

MAIN CONTROL UNIT

	Traction Logic Unit AC5	Lifting Logic Unit DUAL AC2	
		Master	Slave
Inverter for AC asynchronous 3-phase motors	√	√	√
Regenerative braking functions	√	√	√
Can-bus interface	√	√	√
Flash Memory	√	√	√
Digital control based upon a microcontroller	√	√	√
Voltage	80 V	80 V	80 V
Maximum current	1000 A (RMS)	400 A (RMS)	400 A (RMS)
Operating frequency	8 Khz	8 Khz	8 Khz
External temperature range	-30° C + 40° C	-30° C + 40° C	-30° C + 40° C
Maximum inverter temperature	75° C	75° C	75° C

OPERATIONAL FEATURES

- Speed control
- Very good behaviour on a slope due to the speed feedback
- The motor speed follows the accelerator, starting a regenerative braking if the speed overtakes the set point of operation
- Stable speed in every position of the accelerator
- Regenerative release braking based upon deceleration ramps
- Regenerative braking when the accelerator pedal is partially released (deceleration)
- Direction inversion with regenerative braking based upon deceleration ramp
- Regenerative braking and direction inversion without contactors: only the two main contactors are present
- The release braking ramp can be modulated by an analog input, so that a proportional brake feature is obtained
- Very good sensitivity at low speeds
- Voltage boost at the start and with overload to obtain more torque (with current control)
- High efficiency of motor and battery due to high frequency commutations
- Self diagnosis with indication of the fault shown by numeric display
- Modification of parameters through the programming instrument panel interface
- Internal hour-meter with values that can be displayed on the console
- Memory of the last five alarms with relative hour-meter and temperature displayed on the console
- Test function within console for checking main parameters

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DIAGNOSIS

The microprocessor continually monitors the inverter and carries out a diagnostic procedure on the main functions. The diagnosis is made in 4 points:

1 Diagnosis on key switch closing that checks: watchdog circuit, current sensor, capacitor charging, phases' voltages, contactor drives, can-bus interface, if the switch sequence for operation is correct and if the output of the accelerator unit is correct
2 Standby diagnosis at rest that checks: watchdog circuit, phases' voltages, contactor driver, current sensor, can-bus interface
3 Diagnosis during operation that checks: watchdog circuits, contactor driver, current sensors, can-bus interface
4 Continuous diagnosis that checks: temperature of the inverter

Diagnosis is provided in two ways:

- the diagnostic ERROR DISPLAY placed to the dashboard that shows the code number for a given alarm
- the digital console, which gives more detailed information about the failure

GENERAL PRECAUTIONS

- Do not connect the inverter to a battery with a nominal value different from the value indicated on the chopper plate. If the battery value is greater, the MOS may fail; if it is lower, the control unit does not "power up"
- During the battery charge, disconnect the INVERTER from the battery
- Supply the INVERTER only with battery for traction; do not use a power supply
- When the chopper is installed, make tests with the wheels raised from the ground, in order to avoid dangerous situations due to connection errors
- After the chopper is switched off (key off), the filter capacitors remain charged for some minutes; if you need to work on the inverter, discharge them using a 10W -- 100W resistance connected from the +Batt to the -Batt
- Before carrying out any arc-welding on the trucks, disconnect the battery and short-circuit the unit between positive (+) and negative (-)

PROTECTIONS

- Connection Errors:

All inputs are protected against connection errors.

- Thermal protection:

If the chopper temperature exceeds 75°C, the maximum current is reduced in proportion to the thermal increase. The temperature can never exceeds 100°C.

- External agents:

The inverter is protected against dust and the spray of liquid to a degree of protection meeting IP54.

- Protection against uncontrolled movements:

The main contactor is not closed if:

- the Power unit is not functioning.
- the Logic is not functioning perfectly.
- the output voltage of the accelerator does not fall below the minimum voltage value stored, with 1V added
- running microswitch in closed position
- protection against accidental starting

A precise sequence of operations are necessary before the machine starts.
Operation cannot begin if these operations are not carried out correctly.
Drive requests must be made after closing the key switch.

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CHECK MOTORS PHASES BALANCING

When traveling or material handling operation seems abnormal, it is possible to accurately judge if the controller is functioning correctly or not by measuring the motor phase balancing.

CHECK TRACTION MOTOR PHASES BALANCING

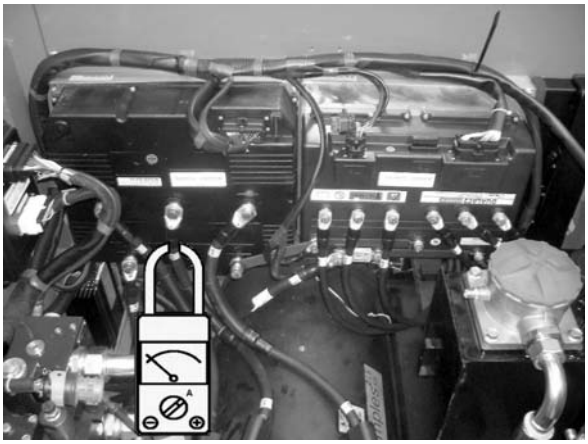
Measuring method Procedure using a clamp amperometer

(1) Remove the footboardr
(2) Jack up the front wheels
(3) Connect a clamp amperometer
(4) Selct a direction,shift the direction switch to the forward (or backward) position, and start the machine with low speed
(5) Check the value of the current of each phase
(6) If the value of one phase is higher or lower respect the others it means that the system is not balanced and the motor goes jerkling. In this situation the logic unit must be replace.

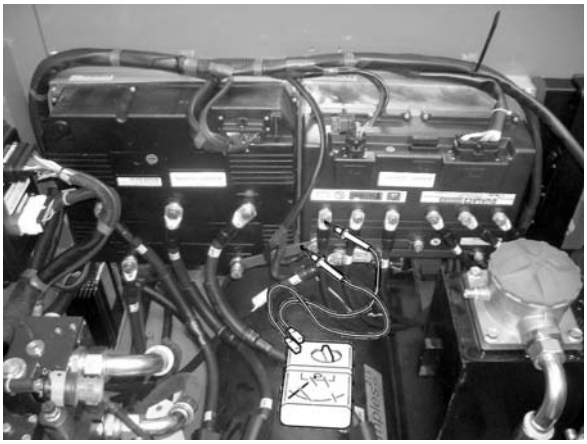
Measuring method Procedure using a multemeter

(1) Remove the footboard
(2) Jack up the front wheels
(3) Set the multemeter on V~
(4) Connect the negative of the multemeter on the battery negative
(5) Connect the positive on one of the phase of the logic unit
(6) Check the value of the voltage of each phase
(7) If the value of one phase is higher or lower respect the others it means that the system is not balanced and the motor goes jerkling. In this situation the logic unit must be replace.

In order to compare the value of the phases it is necessary to use the same tool and not different type of multimeters or clamp amperometers for each phases. This because the tool have different tollerance respect each others.



Measuring method procedure
using a clamp amperometer



Measuring method procedure
using a multemeter

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CHECK PUMP MOTORS PHASES BALANCING

Measuring method Procedure using a clamp amperometer

(1) Remove the footboard
(2) Connect a clamp amperometer
(3) Select the lifting movement on joystick, or fingertip with low speed
(4) Check the value of the current of each phase (master and then slave)
(5) If the value of one phase is higher or lower compared to the others it means that the system is not balanced and the motor goes jerkling. In this situation the logic unit must be replaced

Measuring method Procedure using a multemeter

(1) Remove the footboard
(2) Set the multemeter on V~
(3) Connect the negative of the multemeter on the battery negative
(4) Connect the positive on one of the phase of the logic unit
(5) Check the value of the voltage of each phase (master and then slave)
(6) If the value of one phase is higher or lower compared to the others it means that the system is not balanced and the motor goes jerkling. In this situation the logic unit must be replaced

In order to compare the value of the phases it is necessary to use the same tool and not different type of multimeters or clamp amperometers for each phases. This because the tool have different tollerance respect each others.

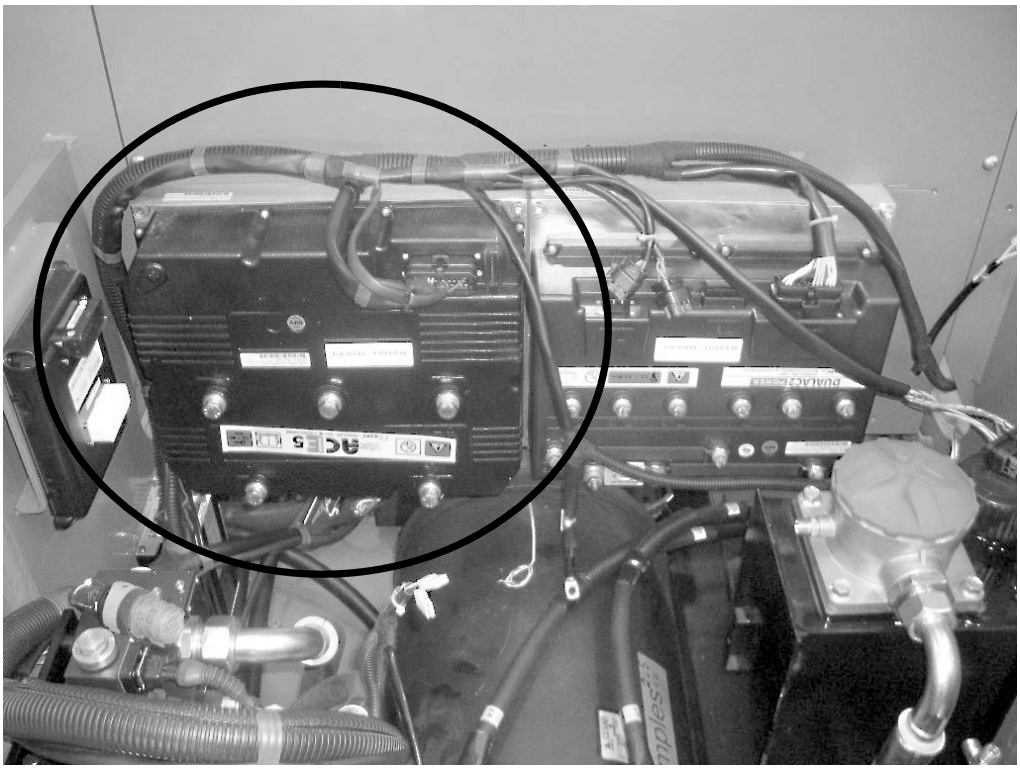
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CONTROLLERS REMOVAL AND INSPECTION

TRACTION LOGIC UNIT

DISASSEMBLY • REASSEMBLY

Caution:
Before starting the job, disconnect the battery plug and measure the voltage between + and GND; (logic units side) if there is any voltage, insert a resistor at approx. 100Ω between + and GND to discharge the capacitor.



Disassembly Procedure

1. Disconnect the battery plug
2. Remove the footboard
3. Disconnect the wiring harness and power cables from the traction logic unit.
4. Remove the 4 fixing bolts
5. Remove the traction logic unit

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.
Note:
Before connecting the wiring connectors or the cables, check the connector No. or the cable tags to ensure correct connection.

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PUMP LOGIC UNIT

DISASSEMBLY • REASSEMBLY

Caution:
Before starting the job, disconnect the battery plug and measure the voltage between + and GND; (logic units side) if there is any voltage, insert a resistor at approx. 100Ω between + and GND to discharge the capacitor.



Disassembly Procedure

1. Disconnect the battery plug
2. Remove the footboard
3. Disconnect the wiring harness and power cables from the pump logic unit.
4. Remove the 4 fixing bolts
5. Remove the pump logic unit

Reassembly Procedure

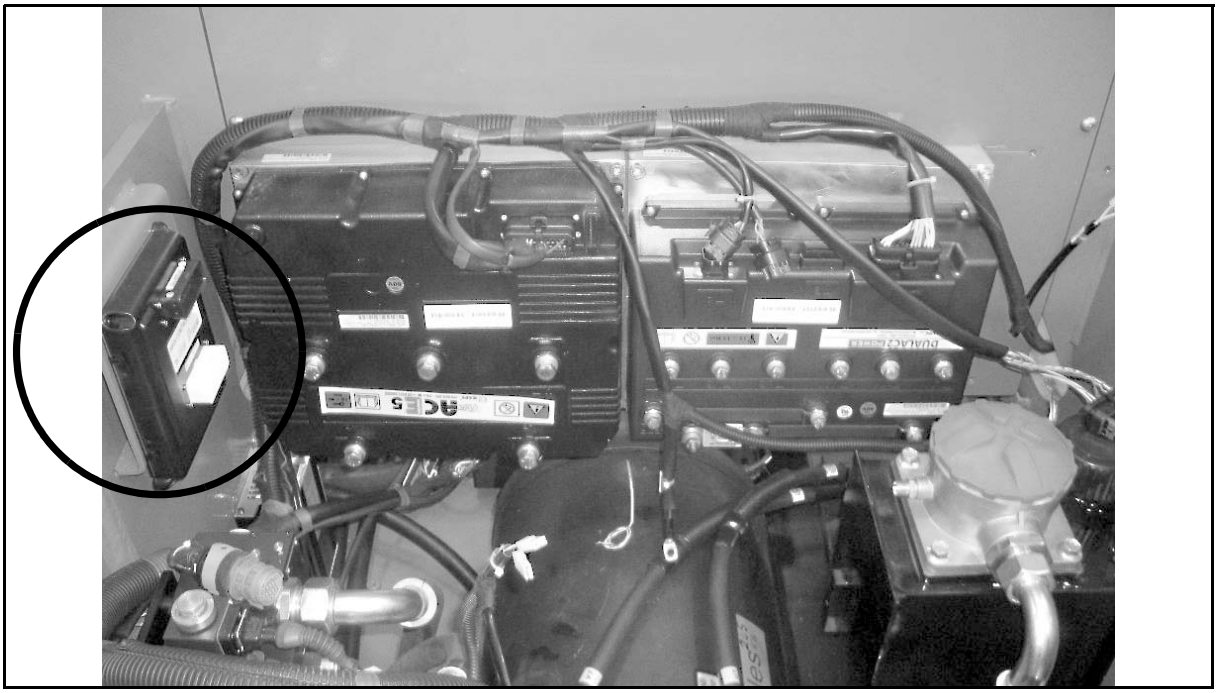
The reassembly procedure is the reverse of the disassembly procedure.
Note:
Before connecting the wiring connectors or the cables, check the connector No. or the cable tags to ensure correct connection.

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MCB BOARD

DISASSEMBLY • REASSEMBLY

Caution:
Before starting the job, disconnect the battery plug and measure the voltage between + and GND; (logic units side) if there is any voltage, insert a resistor at approx. 100Ω between + and GND to discharge the capacitor.



Disassembly Procedure

1. Disconnect the battery plug
2. Remove the footboard
3. Disconnect the wiring harness connectors from the MCB board
4. Remove the 4 fixing bolts
5. Remove the MCB board

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.
Note:
Before connecting the wiring connectors or the cables, check the connector No. or the cable tags to ensure correct connection.

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MCB BOARD DESCRIPTION

The board is placed on the right side of the truck, under the footboard. The MCB is the main control and management board of the vehicle.
The board is composed by two microprocessors:

TRCB = traction control board
EVCB = electric valve control board

TRCB is the parameter manager of the traction logic units.
EVCB is the parameter manager of electronic contol valve and of the pump logic unit.

MAIN FUNCTIONS

- Performances management (traction and pump parameters)
- Management/control of the stop and backward direction lights
- Electroproportional distributor control (optional)
- Vehicle configuration identification
- Comunication Master between all cards
- Traction control Master
- Pump control Master



1. J34 connector
   Used to check the pedals system, the parking/service brake, the negative brakes unlocking sensor and the mechanical distributor micros
2. J40 connector
   Used to check the electric distributor electrovalves, the tilting potentiometer, the rear lights and the cooling fan

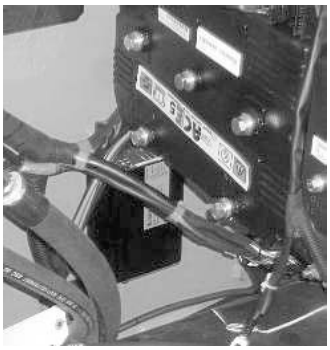
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DC/DC CONVERTER



STANDARD MACHINE (STANDARD 360 W DC / DC CONVERTER)

STANDARD DC /DC CONVERTER



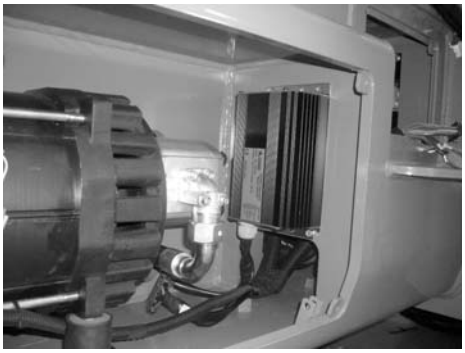
The standard truck absorbs 206 W and is equipped with a 360W DC/DC converter (80V - 24V) for the supplying of:

- rear lights (brake and reverse direction)
- console
- brakes unlocking sensor

The standard DC /DC converter is located on the right side under the pedals footboard

MACHINE WITH OPTIONAL DEVICES

AUX. DC /DC CONVERTER



For the supplying of optional devices, an aux DC/DC converter must be installed. In order to establish the complessive aux converter power, add the power of all the foreseen optional devices. Select the converter rounding up the obtained power and keeping the 10% more of the theoretical required power.

The aux DC /DC converter is located on the right side into the lifting motor compartment

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OPTIONAL DEVICES

Reverse direction acustic signaller	5 W
Flash light	3 W
Homologated rotating lamp	70 W
2 Wind-screen wipers + 2 screen wash tanks	200 + 72 W
2 working lights	30 W
Complete lights	242 W
Road lights	280 W
2 fan for heating	120 W
Heated rear window	120 W
Radio	80 W

Converter	IP
144 W	54
360 W	54
720 W	20

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COOLING FAN

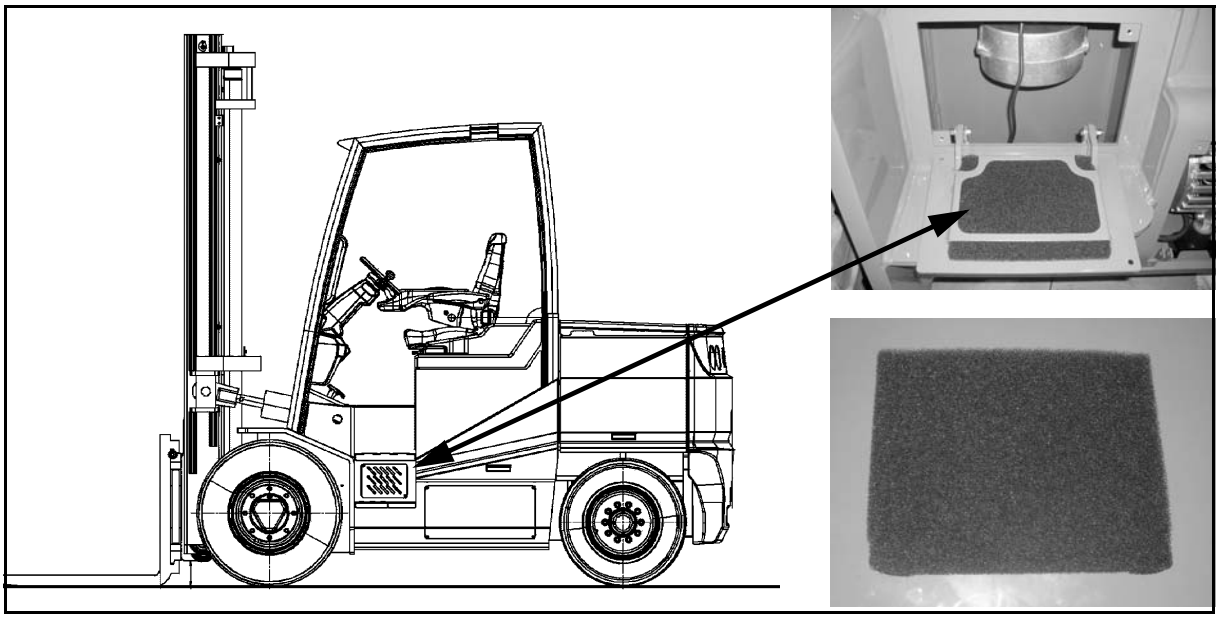


The revolving speed of the fan is based on the temperature of the traction and lifting logic units. Switching on the vehicle, the fan reaches the maximum number of turns, then it decreases after few seconds if the controllers have a temperature lower than 30°C.

Temperature managing:
- temperature < 30°C = fan speed 50%
- temperature 30°C ÷ 50°C = fan speed 70%
- temperature > 50°C = fan speed 100%

At the maximum speed and with the air filter cleaned, the fan provides 200mc/h of air to guarantee a fast cooling of the logic units

FAN FILTER



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TEMPERATURES MANAGEMENT

The logic units (traction and pump) use the signal from the temperature sensor to drive the electric motor, so that it is possible to avoid overheatings and possible damages.
The logic unit reduces the motor performances according to the data here below.

- **Reduction of the maximum current in relation with the motors temperature**

Traction and lifting

0° ÷ 120°C	no reduction
120° ÷ 155°C	80% - 50% / °C
> 155°C	-100%

- **Increase of the traction motor acceleration times in relation to the increase of the traction motor temperature**

0° ÷ 120°C	no reduction
120° ÷ 125°C	0,3 s
125° ÷ 130°C	0,7 s
130° ÷ 135°C	1,1 s
135° ÷ 140°C	1,6 s
140° ÷ 145°C	2,3 s
145° ÷ 150°C	3,0 s
150° ÷ 155°C	6,0 s
> 155°C	6,0 s

- **Reduction of the speed as regards to the traction motor temperature**

0° ÷ 140°C	no reduction
140° ÷ 150°C	20% reduction
150° ÷ 155°C	50% reduction
> 155°C	speed to 0

- **Increase of the pump motors acceleration times in relation to the increase of the pump motors temperature**

0° ÷ 130°C	no reduction
130° ÷ 140°C	0,5s
140° ÷ 150°C	1,0s
> 150°C	2,0s

- **Reduction of the speed as regards to the pump motors temperature**

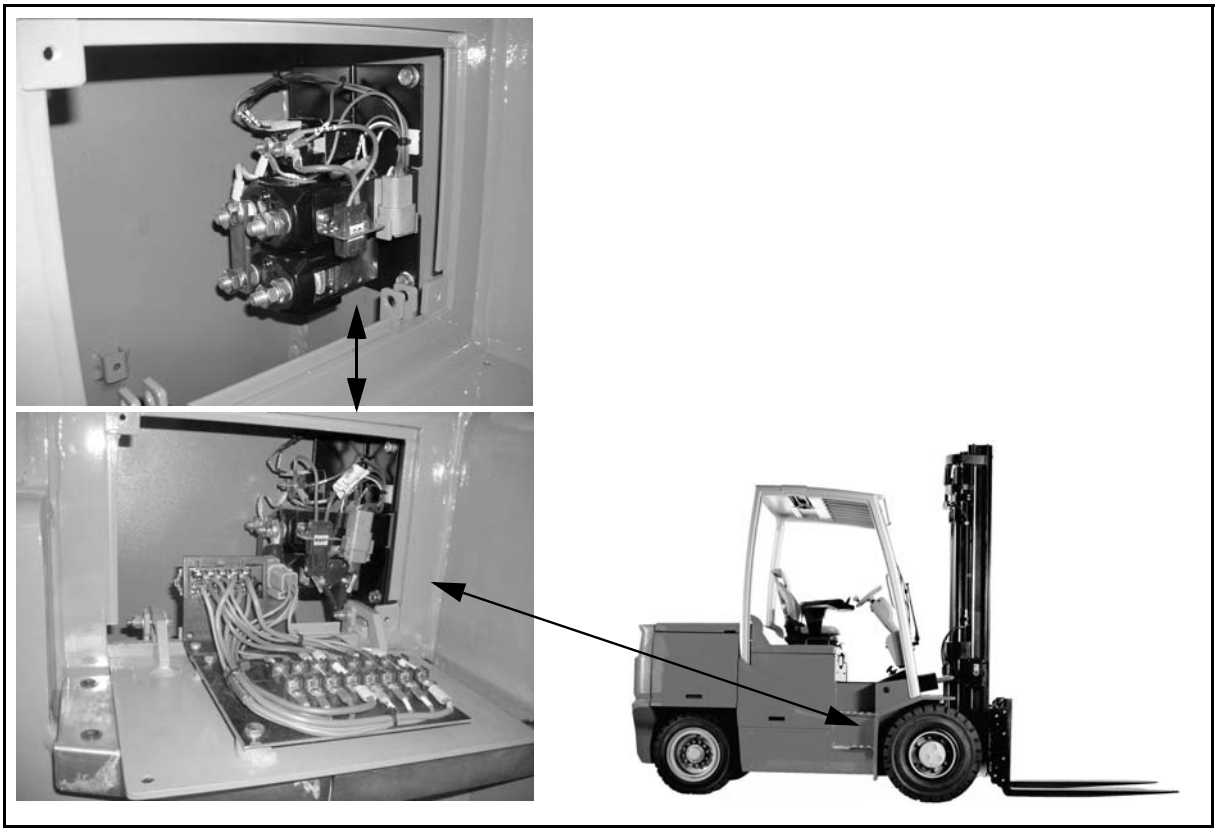
0° ÷ 130°C	no reduction
130° ÷ 150°C	20% reduction
>155°C	70% reduction

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CONTACTOR GROUP

DISASSEMBLY • REASSEMBLY

Caution:
Before starting the job, disconnect the battery plug and measure the voltage between + and GND (logic units side) if there is any voltage, insert a resistor at approx. 100Ω between + and GND to discharge the capacitor.



Disassembly Procedure

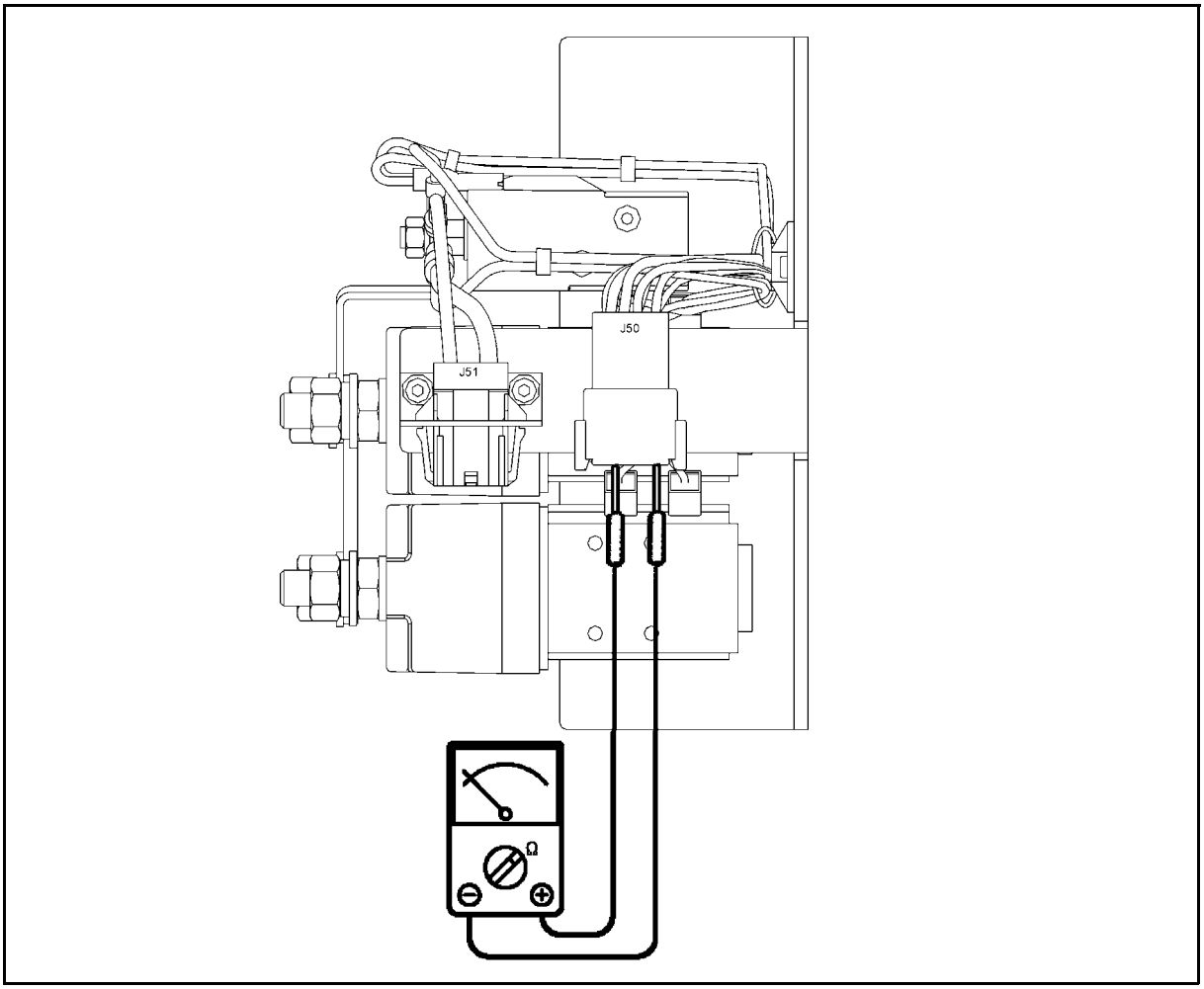
1. Disconnect the battery plug.
2. Open the right compartiment cover under the footstep
3. Disconnect the wiring harness connectors and power cables from the contactor group.
4. Remove the fixing bolts
5. Remove the contactor group.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.
Note:
Before connecting the connectors or the cables, check the connector No. or the cable tags to ensure correct connection.

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CONTACTOR GROUP INSPECTION



CONTACTORS
Inspection method
Disconnect the J50 and J51 connectors and measure the resistance between the involved terminal pins.

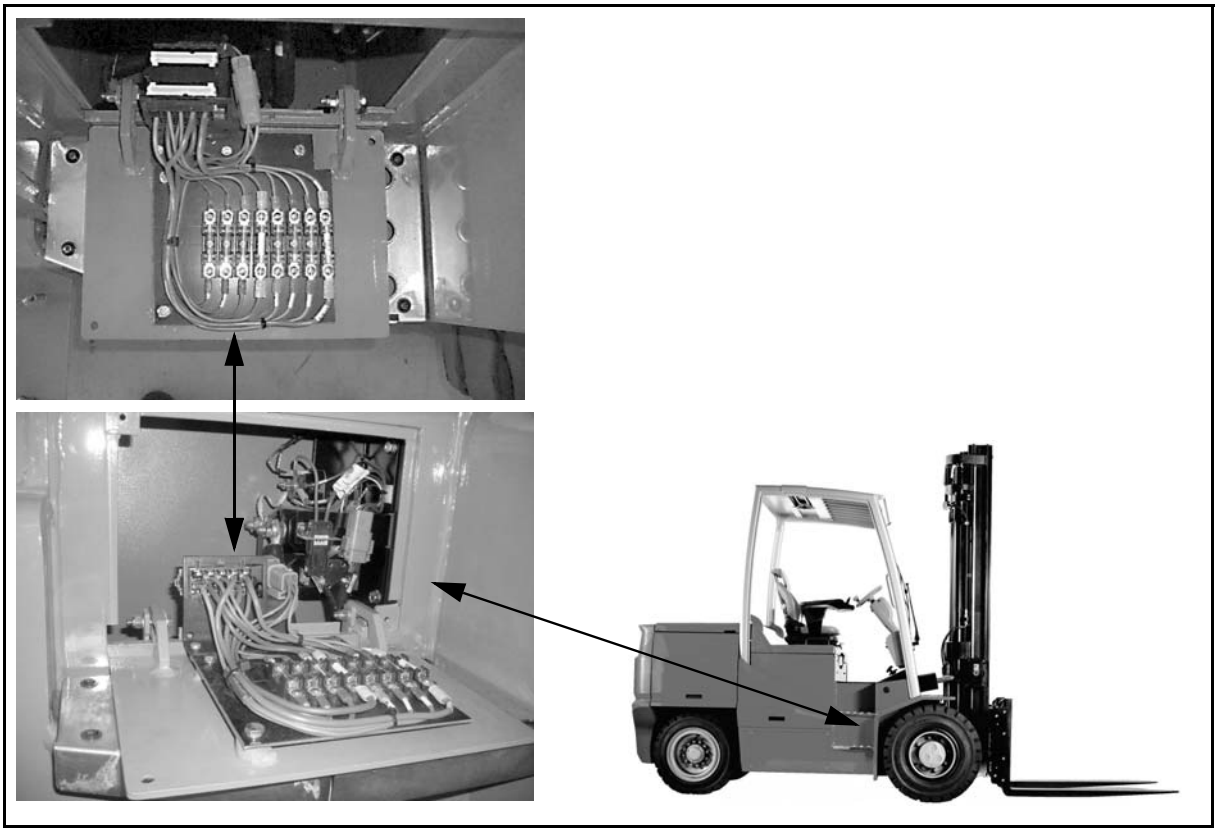
Portion to be inspected	Measurement terminals		Standard	Multimeter range (with digital multimeter)	Multimeter range (with analog multimeter)
CT1 coil	J50-3	J50-4	60 Ω	Ω x 100	Ω x 1
CT2 coil	J50-5	J50-6	46,6 Ω	Ω x 100	Ω x 1
CT3 coil	J50-7	J50-8	46,6 Ω	Ω x 100	Ω x 1

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FUSE GROUP

DISASSEMBLY • REASSEMBLY

Caution:
Before starting the job, disconnect the battery plug and measure the voltage between + and GND; (logic units side) if there is any voltage, insert a resistor at approx. 100Ω between + and GND to discharge the capacitor.



Disassembly Procedure

1. Disconnect the battery plug.
2. Open the right compartiment cover under the footstep
3. Disconnect the wiring harness connectors from the fuse group.
4. Remove the fixing bolts
5. Remove the fuse group.

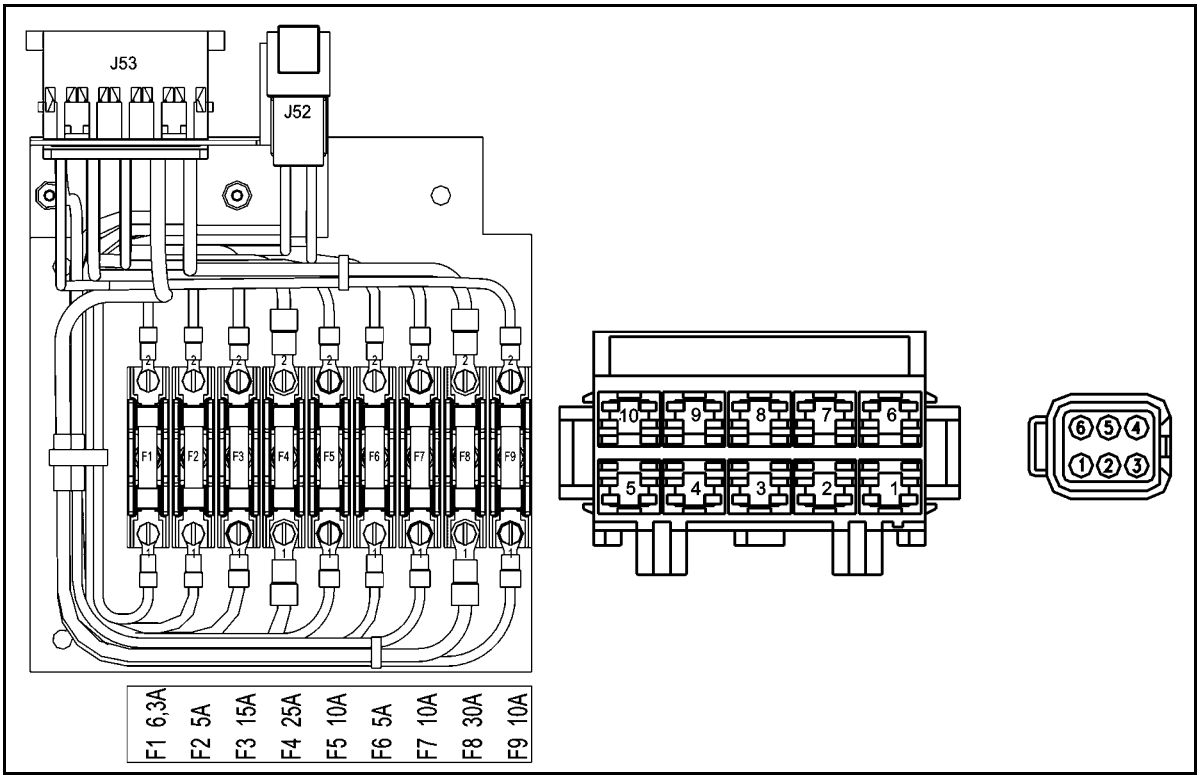
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
Before connecting the connectors or the cables, check the connector No. or the cable tags to ensure correct connection.

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FUSE GROUP INSPECTION



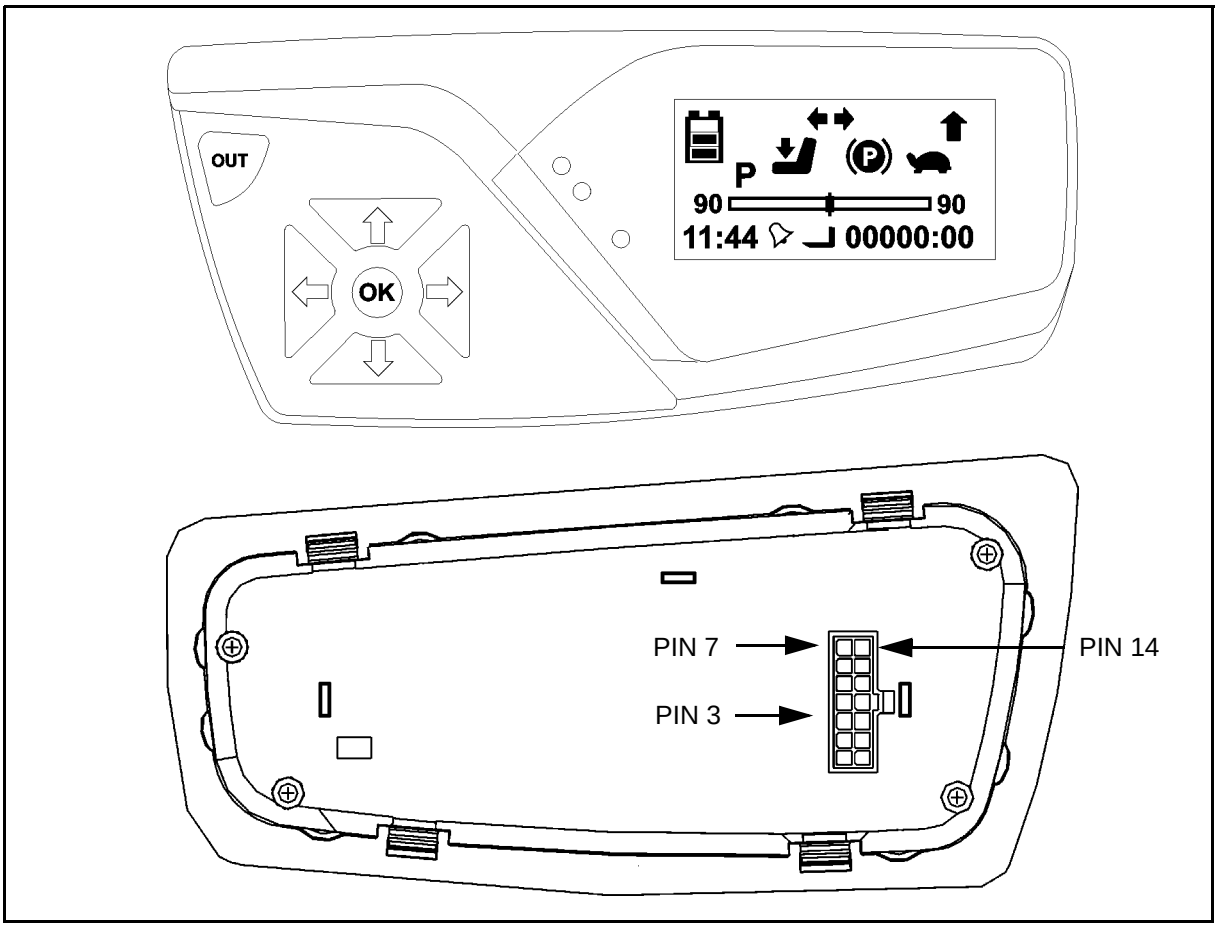
FUSES
Inspection method
Disconnect the J53 and J53 connectors and measure the resistance between the involved terminal pins.

Portion to be inspected	Name and description	A	Measurement terminals		Stan-dard	Tester range
FUSES + V batt	F1 (key switch)	6,3A	J52-1	J52-3	0 Ω	Ω x 1
	F2 AC-5 & brake solenoid valve supply	5A	J52-2	J52-4	0 Ω	Ω x 1
	F3 DC/DC converter (+V batt. supply)	15A	J53-1	J53-3	0 Ω	Ω x 1
	F4 Heaters	25 A	J53-2	J53-4	0 Ω	Ω x 1
FUSES from DC/DC	F5 Sesam, dashboard, MCB-I/O +24 V supply	10A	J53-5	J53-8	0 Ω	Ω x 1
	F6 Motor drivers fan +24 V supply	5A	J53-5	J52-5	0 Ω	Ω x 1
	F7 horn, buzzer, ligts +24 V supply	10A	J53-5	J53-9	0 Ω	Ω x 1
FUSES from DC/DC aux.	F8 Optional equipment +24 V supply	30A	J53-6	J53-7	0 Ω	Ω x 1
	F9 Available	10A	J53-7	J53-10	0 Ω	Ω x 1

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DASHBOARD

In case of trouble in the dashboard, measure the voltage at the connector to which voltage is applied.

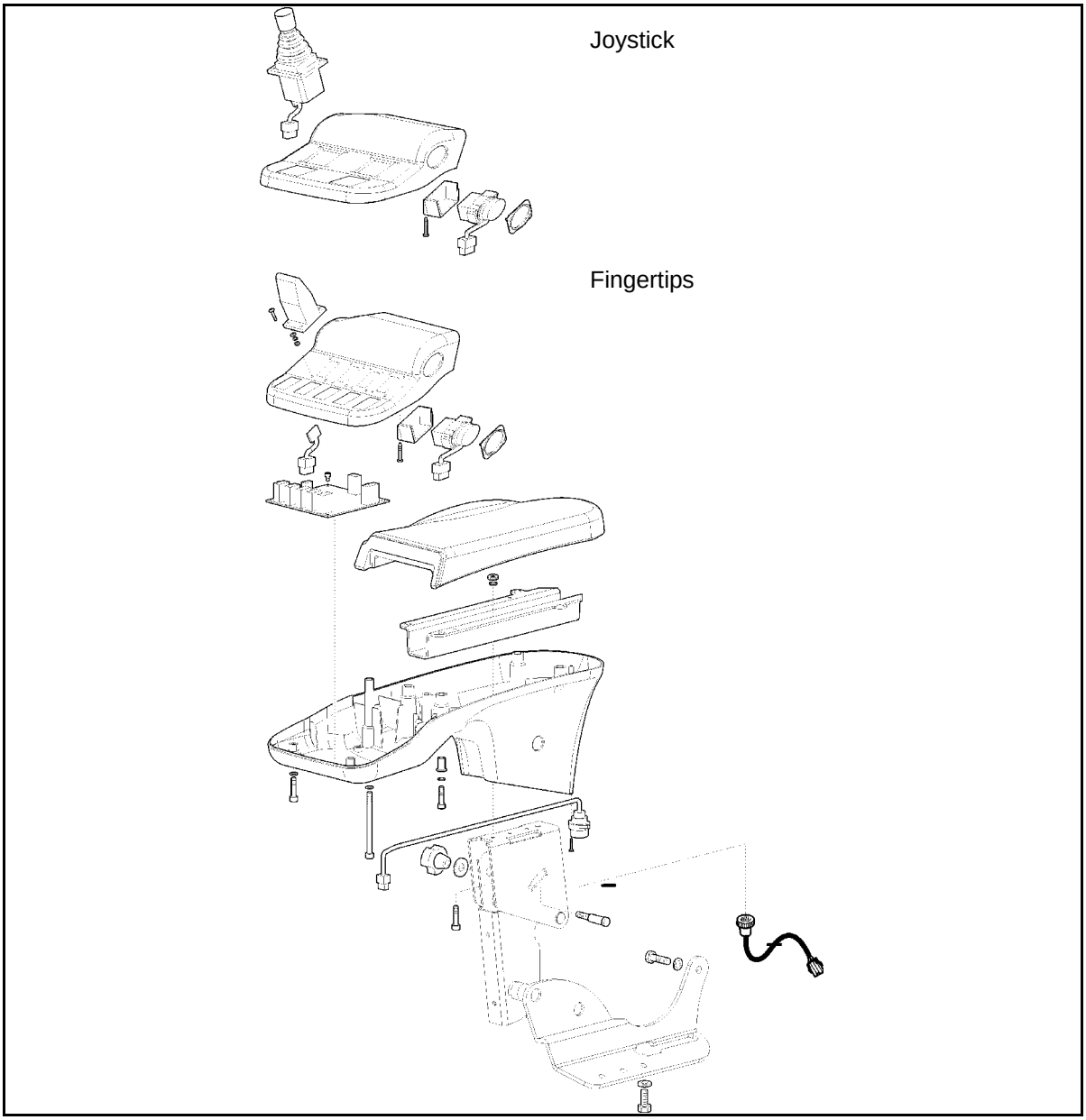


J137 connector basic condition (Battery plug connected)

CN (pin-colour) ⇔ CN (pin-colour) From ⇔ To		Description	Standard	Notes
J137 (3-N) J137 (14-N)		GND from DC/DC converter	GND	
J137 (7-C01)		+24 V from DC/DC converter fuse F5	+24 V	

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ARMREST BOARD
DISASSEMBLY • REASSEMBLY



Disassembly procedure

1 Park the truck on a level surface and activate the parking brake
2 Switch off the truck
3 Open the battery cover and disconnect the battery
4 Disconnect the wiring placed in the armrest back part **[Point 1]**
5 Remove the armrest pads
6 Remove the fixing screws placed in the armrest lower side **[Point 2]**
7 Open the armrest
8 Disconnect the armrest board wirings and remove the armrest board 4 fixing screws **[Point 3]**
9 Remove the armrest board

Reassembly procedure

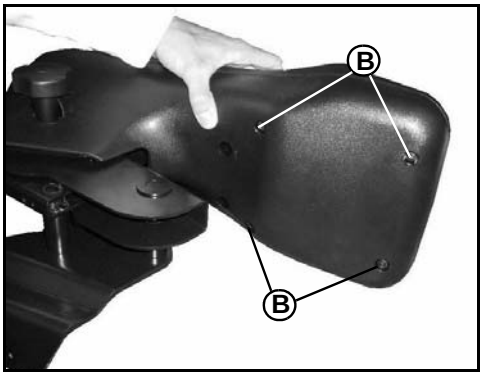
The installation procedure is the reverse of the disassembly procedure.

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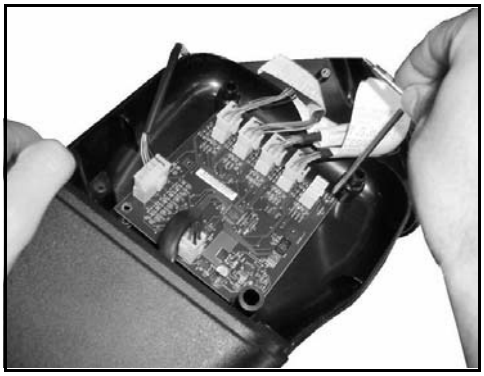
Point Operations



[Point 1]
Disassembly:
Disconnect the **(A)** wiring, placed in the armrest back part



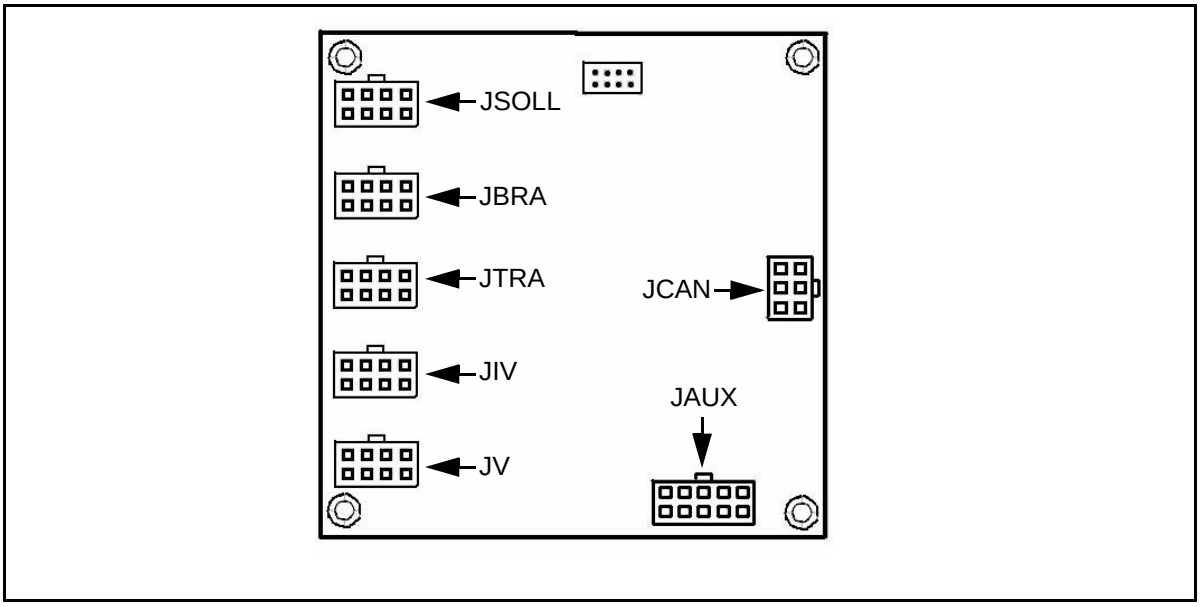
[Point 2]
Disassembly:
Remove the 4 fixing screws **(B)** placed in the armrest lower side



[Point 3]
Disassembly:
Disconnect the armrest board wirings and remove the armrest board 4 fixing screws

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ARMREST BOARD DESCRIPTION



COMPONENTS

JSOLL	Connector for the lifting
JBRA	Connector for the tilting
JTRA	Connector for the sideshift
JIV	Connector for the 4th lever
JV	Connector for the 5th lever
JAUX	Connector for auxiliary commands: forward/backward direcdion button, horn button
JCAN	Connector for the CAN-BUS

This card purpose is to pilot the horn button, forward and backward speed buttons (version with FW/BW button) and the fingertip/joystick signals.
Operating a lever on the armrest this card converts the analog signal into a digital signal that is then transferred via CAN-BUS to the lifting logic unit and to the MCB (ENCB) which converts it from digital to analog.

The card uses printed circuits that must be powered to decode the CAN-BUS signals. To supply the card we use a DC-DC converter, which, by supplying an internal circuit, creates a voltage of 5 volts to supply the joysticks or fingertips potentiometers.

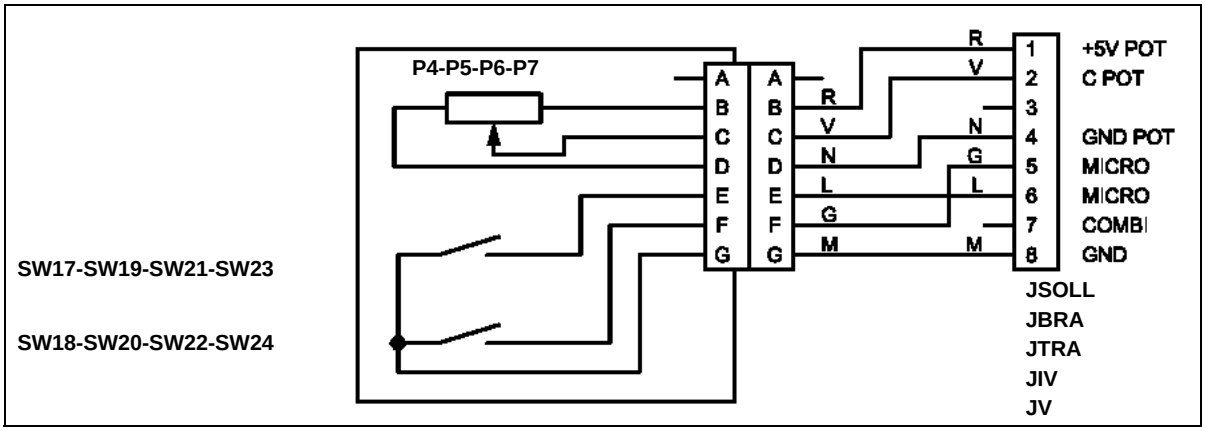
The card is used in both configurations (fingertip or joystick).

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VOLTAGES ON ARMREST POTENTIOMETERS

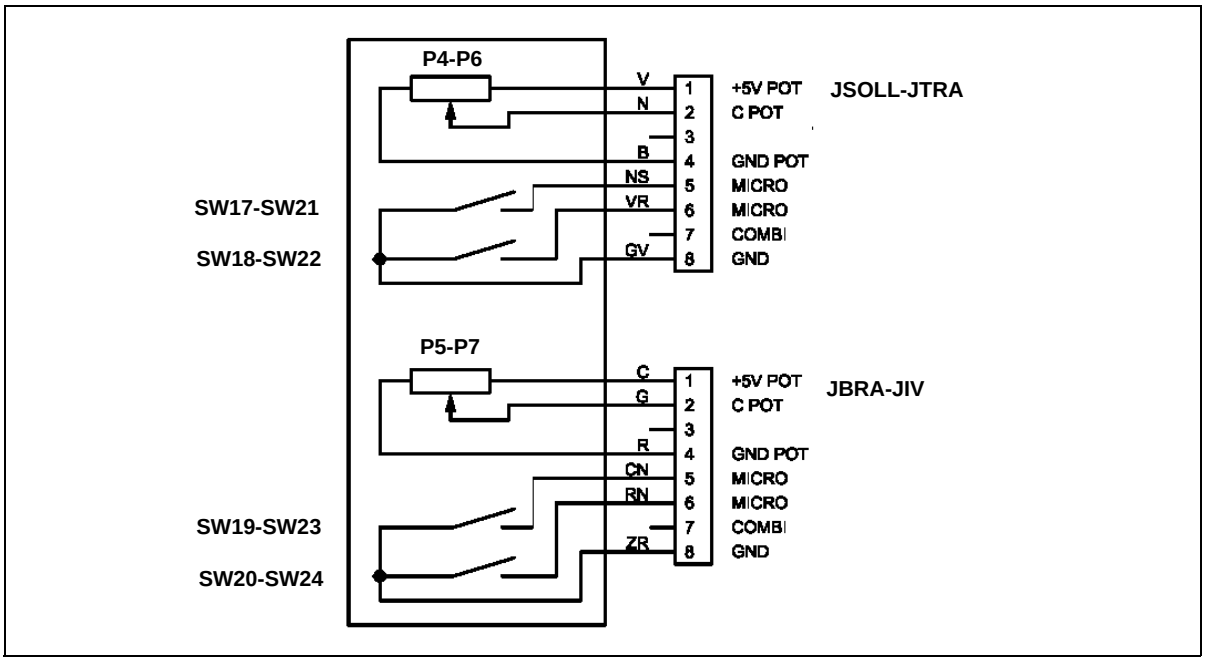
FINGERTIP version

RED: 5 V
GREEN: 0 -- 5 (AT REST 2.5 V)
BLACK: 0



JOYSTICK version

ORANGE: 5 V
YELLOW: 0 -- 5 (AT REST 2.5 V)
RED: 0 V
GREEN: 5 V
BLACK: 0 -- 5 (AT REST 2.5 V)
WHITE: 0 V



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PÀGINA INTENCIONALMENTE BLANCA

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MULTI-FUNCTION DISPLAY

MULTI-FUNCTION DISPLAY (DASHBOARD) 3
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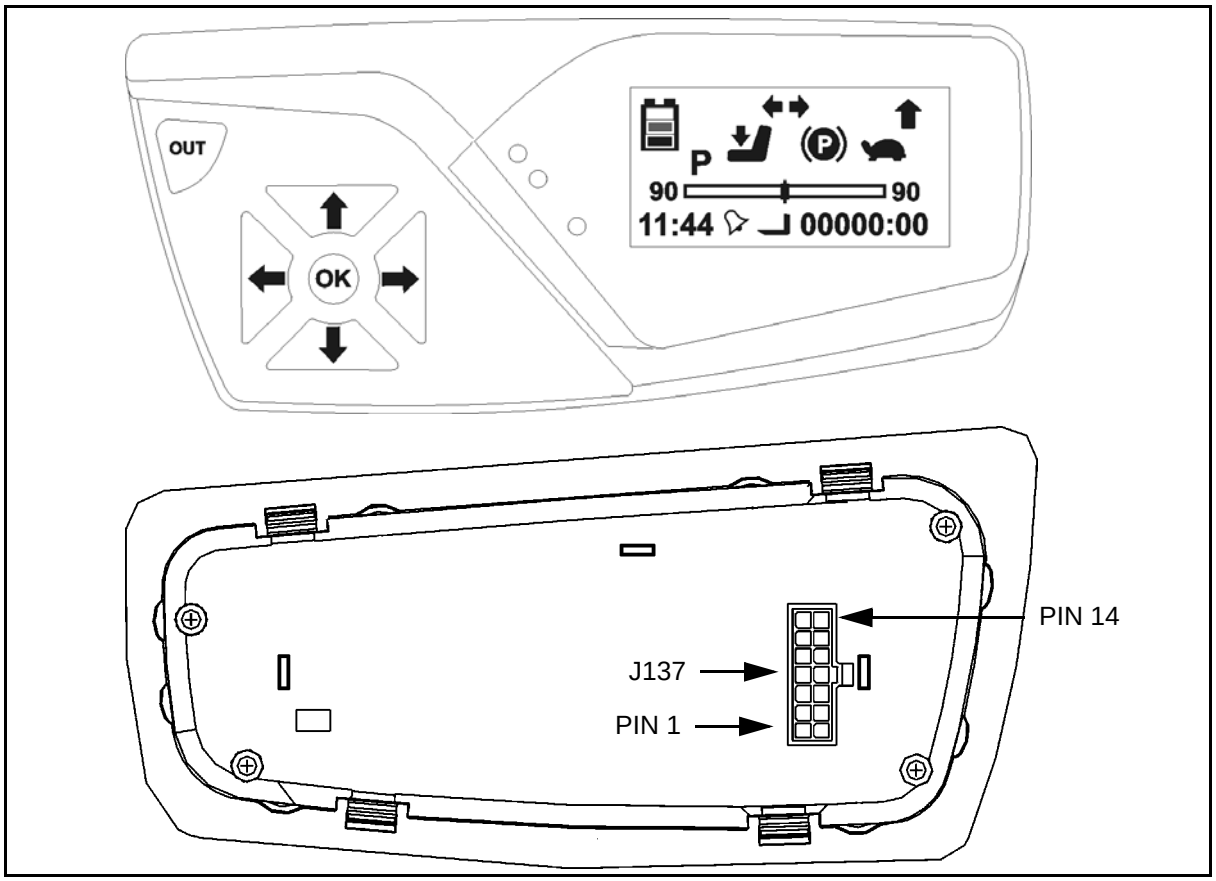
PÀGINA INTENCIONALMENTE BLANCA

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MULTI-FUNCTION DISPLAY (DASHBOARD)

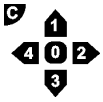
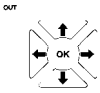
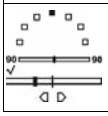
Multi-function dashboard helps operators to identify various information easily by changing screens depending on the vehicle conditions.

GENERAL



Icon	Description
	Discharge battery warning light: it flashes when the battery reaches the 20% of charge
	Parking brake on warning light
	Deadman device warning light: the pilot light comes on when the driver leaves the driving seat without switching off the truck: under these conditions, the traction and the lifting movement are disabled
00000:00	Adjustable electronic hour meter: it counts the truck working hours. It shows the working hours and the hourly fractions
	Speed reduction indication light
	Selected direction indication light

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Icon	Description
11:44	Time indication light
	Timer indication light
LPH	Selected program indication light
	Turn direction indication light
	Hour meter modality indication: lifting motor, traction motor or key switch
	Password: indication of the button on the board
	Board: it permits to digit the access password and to navigate between the menus
	Brakes system warning light: Average in the brake system. The signal is visualized when the pressure in the brake system is inadequate to unblock the brakes
	Steering direction indication: it shows the running direction

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“INCORRECT START“ MANAGEMENT

The “INCORRECT START“ are recoverables errors, generated by:
- an incorrect starting procedure
- an incorrect sequence of use of the controls

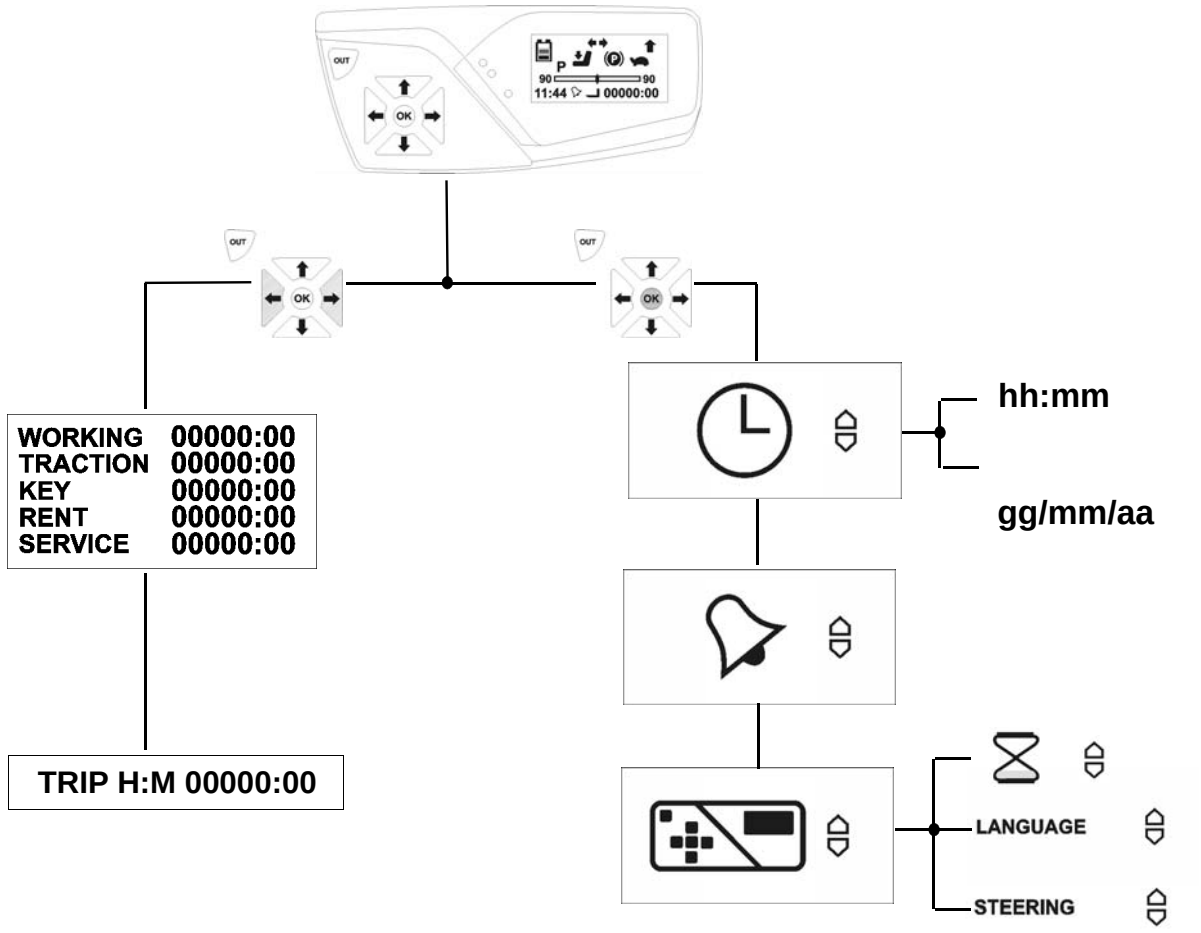
These alarms block temporarily the truck functioning, generating an alarm icon on the display.

Summary table of the “INCORRECT START“

Icon	Description	Configuration	Notes
	Direction pedal pressed during the starting procedure	Double pedal system or balanced pedal system	Traction: NO Lifting: YES
	Manual inversor in direction position	Single pedal system	Traction: NO Lifting: YES
	Hydraulic request during the starting procedure	Electric distributor	
	Double request of direction set	Double pedal system or balanced pedal system	Traction: NO Lifting: YES
	Direction request with applyed parking brake	All	Traction: NO Lifting: NO
	Seat micro opened during the direction or during the hydraulic request	All	Traction: NO Lifting: NO
	Brakes system warning light: Average in the brake system. The signal is visualized when the pressure in the brake system is inadequate to unblock the brakes In case of alarm the truck reduces the max. speed to 15%.	All	

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USER MENU MAP



www.truck-freeworkshop.com/forklift/cesab/

USER MENU DESCRIPTION

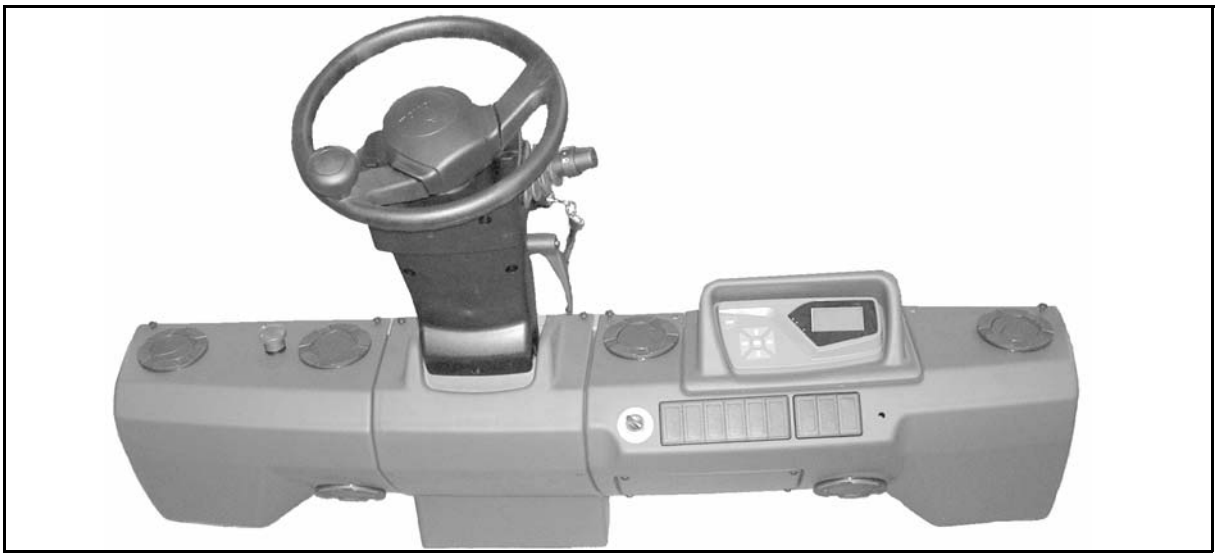
The "user"menu is accessible to any operator it allows to modify the parameters series contained in the chart USER MENU.

USER MENU PASSWORD

Notes on the password insertion

1. Making sure to operate on the display membrane buttons using fingers only. Sharped or pointed tools can damage the buttons
2. If, during the password insertion, an error is committed , turn off the vehicle with the key and restart from the beginning. If the menu of the hidden functions doesn't appear after a few attempts, the system could be defective.

USER MENU PASSWORD INSERTION PROCEDURE



Procedure	Operations	Truck feedback
1	Turn on the truck	
2	Operate the parking brake	
3	Press contemporaneously the LPH and turtle buttons	Short acoustic warning
4	Press the OK button for a few seconds to enter the menu	

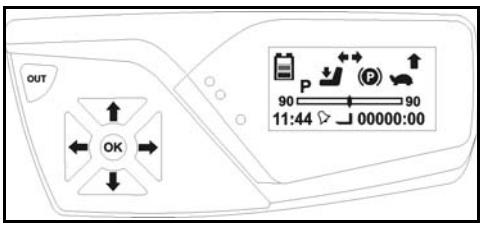
www.truck-freeworkshop.com/forklift/cesab/

USER MENU

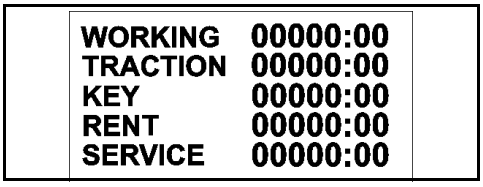
Menu	Description	Notes
HOUR METER	The display shows the effectuated working hours of: WORKING: lifting motor working TRACTION: traction motor working KEY: truck on (inserted key) RENT: rental time counter SERVICE: truck working since the last service intervention	If not otherwise specified, the count of the hours is effectuated on the use of the lifting potenti-ometer and it is possi-ble to reset it by the service staff
TRIP	It is a partial hour meter on the lifting motor use	It is possible to reset it by the operator press-ing the OK button for some seconds
CLOCK	It permits to modify hours and date	
ALARMS	It allows, if enabled, to set an alarm as memo	The activated alarm is shown on the display with the relevant light
DISPLAY SETTING	Permits to modify: - the counting of the truck working hours visualized on the diplay: None: no visualization Key: it visualize the key working hours Working: it visualizes the pump working hours Traction: it visualizes the traction working hours - the language visualized by the “user“ menu (5 languages: ita,en,fr,es,de) - the visualisation of the direction wheels position (linear or radial modality)	

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HOUR METER



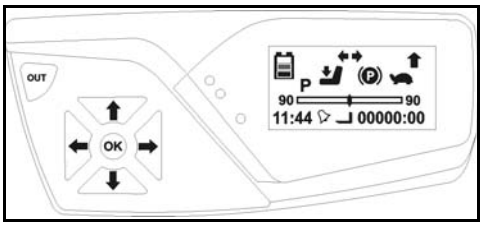
Operate the parking brake and press contemporaneously the LPH and turtle buttons to enable the keyboard



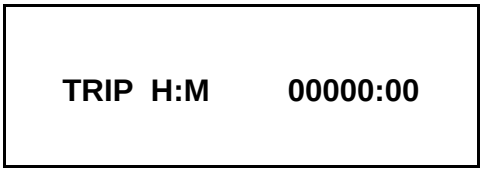
Press ➡ to visualize the information referred to the hour meter

To exit the menu use the lateral flowing arrows

TRIP



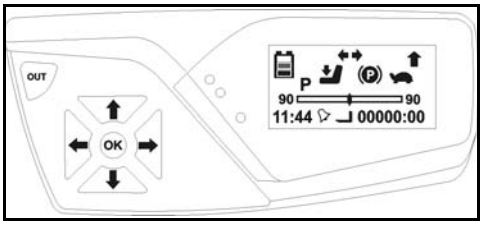
Operate the parking brake and press contemporaneously the LPH and turtle buttons to enable the keyboard



Press ➡ to visualize the information referred to the trip.
Press OK to reset the hours count

To exit the menu use the lateral flowing arrows

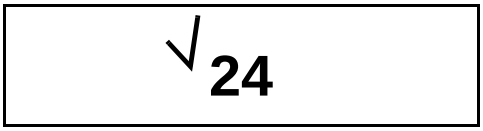
CLOCK



Enter the user menu
[see USER MENU PASSWORD INSERTION PROCEDURE paragraph]



Press OK to enter into the clock menu



Notes:
The clock icon flashes

Press ⬆ or ⬇ to modify the setting.
Press OK to confirm.



Notes:
The selected modality has a flag beside

Use the flowing arrows to set the hours.
Press OK to confirm



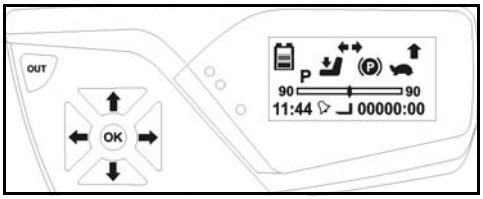
Use the flowing arrows to set the date.
Press OK to confirm

Press OUT to exit the menu

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ALARMS

SETTING



Enter the user menu
[see USER MENU PASSWORD INSERTION PROCEDURE paragraph]

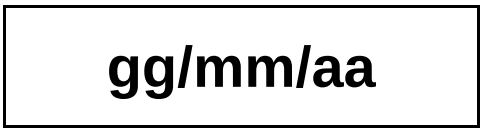
Use ⬇ to reach the clock alarm menu



Press OK to confirm

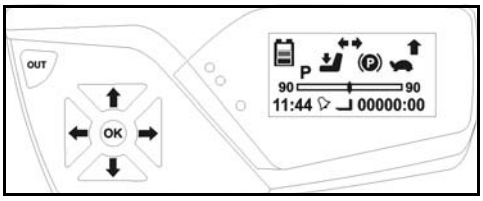
Notes:
The clock icon flashes
Press OK to confirm
Use the flowing arrows to set the hours
Press OK to confirm





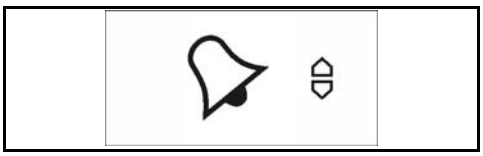
Use the flowing arrows to set the date.
Press OK to confirm
Press OUT to exit the menu

DEACTIVATION



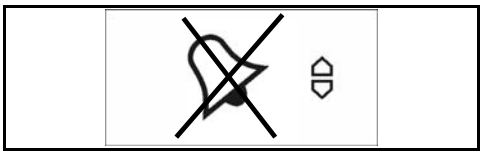
Enter the user menu
[see USER MENU PASSWORD INSERTION PROCEDURE paragraph]

Use ⬇ to reach the clock alarm menu.
Press OK to confirm



Press the buttons ⬆ or ⬇ to disable the clock alarm

Notes:
The clock icon flashes

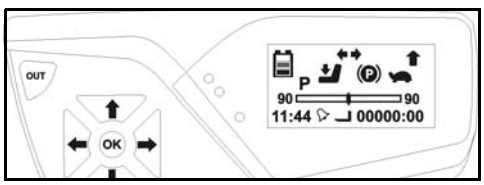


Press OK to confirm

Press OUT to exit the menu

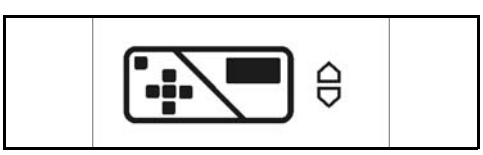
DISPLAY SETTING

TRUCK HOUR METER

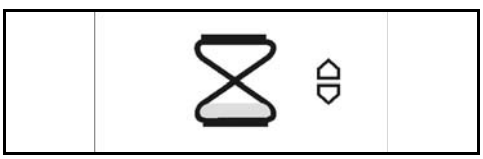


Enter the user menu
[see USER MENU PASSWORD INSERTION PROCEDURE paragraph]

Use ⬇ to reach the display setting menu.
Press OK to confirm



Press OK to confirm



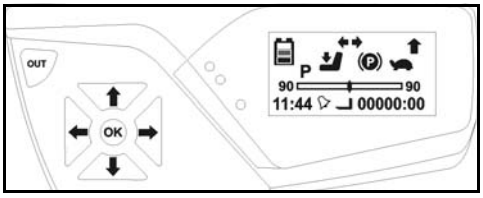
Press OK to confirm

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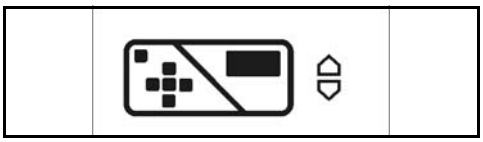
Use the flowing arrows to set the hour meter modality visualized on the display.
Press OK to confirm
Press OUT to exit the menu

LANGUAGE



Enter the user menu
[see USER MENU PASSWORD INSERTION PROCEDURE paragraph]

Use ⬇ to reach the display setting menu.
Press OK to confirm



Use ⬇ to reach the language setting menu



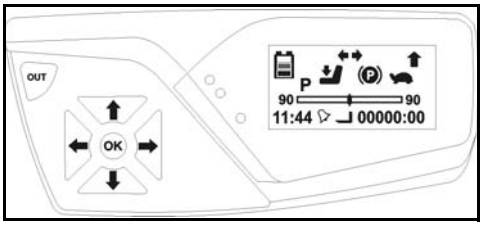
Press OK to confirm



Use ⬇ to select the desired language.
Press OK to confirm

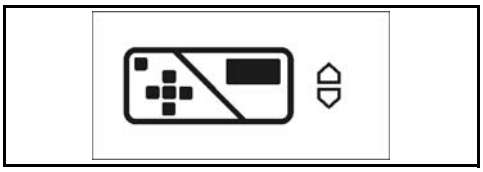
Press OUT to exit the menu

STEERING DIRECTION



Enter the user menu
[see USER MENU PASSWORD INSERTION PROCEDURE paragraph]

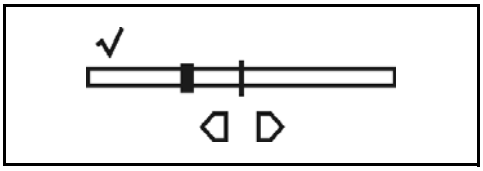
Use ⬇ to reach the display setting menu.
Press OK to confirm



Use ⬇ to reach the steering direction setting menu

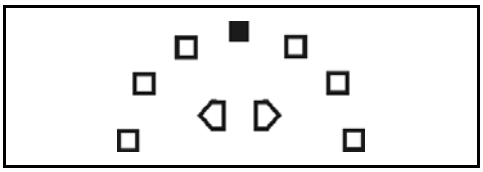


Press OK to confirm



Use ⬇ to select the desired visualisation.

Press OK to confirm



Press OUT to exit the menu

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MAPS FOR USING THE DASHBOARD

SERVICE MENU

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SERVICE MENU DESCRIPTION

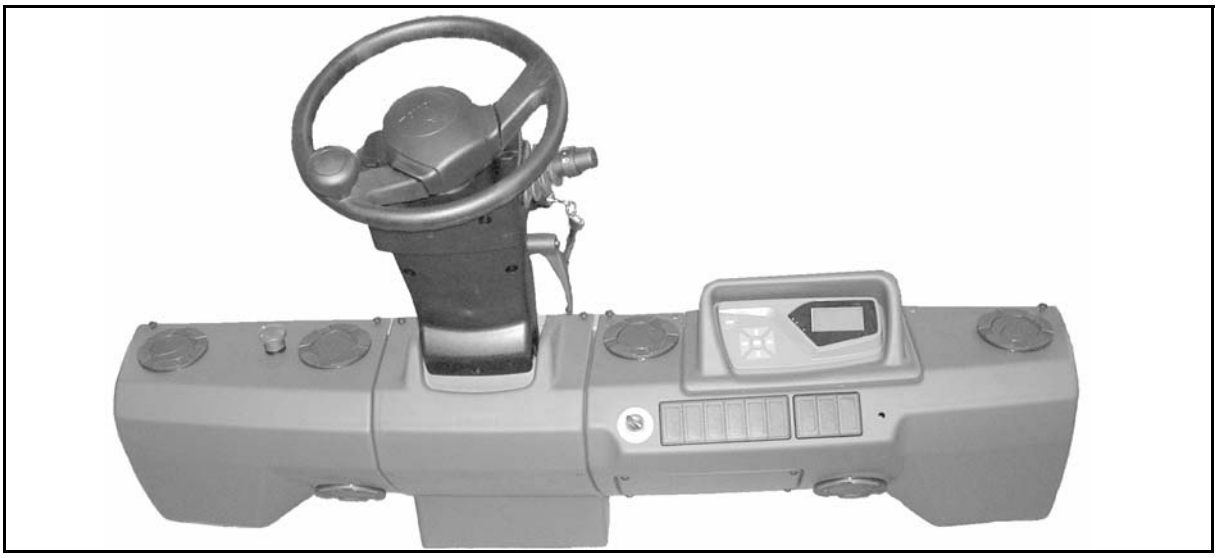
The "service" menu allows to enable all the necessary functions for assistance/maintenance/rental activities.
To acces to the menu is allowed exclusively to authorized personnel.

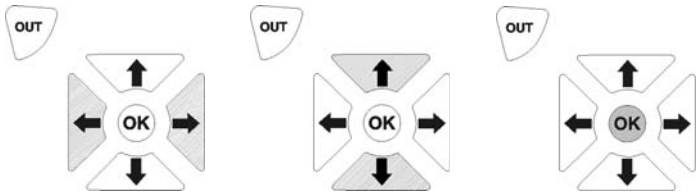
SERVICE MENU PASSWORD

Notes on the password insertion

1. Making sure to operate on the display membrane buttons using fingers only. Sharped or pointed tools can damage the buttons
2. If, during the password insertion, an error is committed , turn off the vehicle with the key and restart from the beginning. If the menu of the hidden functions doesn't appear after a few attempts, the system could be defective.

SERVICE MENU PASSWORD INSERTION PROCEDURE



Procedure	Operations	Truck feedback
1	Turn on the truck	
2	Operate the parking brake	
3	Press contemporaneously the LPH and turtle buttons	Short acoustic warning
4	Insert the combination as shown in the sequence here below 	Short acoustic warning
5	Insert the password (the password is dynamic and changes automatically each January the 1st): The password is composed by a sequence of numbers: the correspondence between the keyboard buttons and the numbers composing the password is available on the display. The OUT button, indicated as C, in the display, allows to cancel the last number typed by each pressure.	

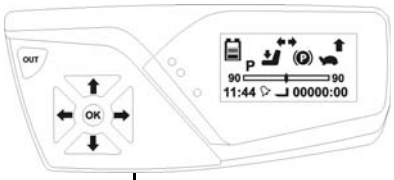
Notes: to use the truck, unlock the parking brake. To visualize the alarms in real time use the ALARMS-REAL TIME menu.

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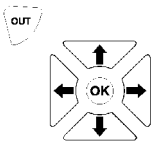
Menu	Description
SOFT VERS	Visualise the software version of boards and logic units
PARAM CHANGE	Modify the selected program parameters
TRUCK CONF	Modify the configuration parameters
SERVICE RENT	It allows to set up the programmed maintenance menu and rent menu
PSW MODIFY	It allows to modify the passwords or to restore default ones
TESTER	Visualise the analogic and digital values to analyze the truck status
ALARMS	Memorize the truck alarm codes (maximum 20 alarms). It visualize the alarms in real time
LEARNING	Permits to set the truck serial number, to acquire the potentiometer status and to effectuate the ADJUST BATTERY
DEFAULT RST	It allows to restore the default parameters of the truck

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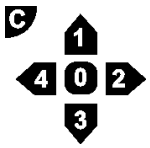
SERVICE MENU MAP



COMBINATION



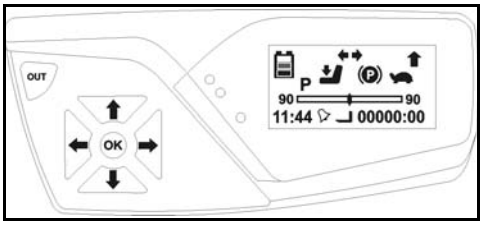
PASSWORD



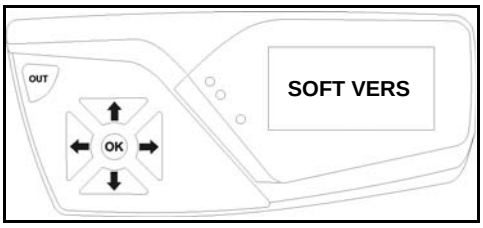
- SOFT VERS
- PARAM CHANGE
- TRUCK CONF
- SERVICE RENT
- PSW MODIFY
- TESTER
- ALARMS
- LEARNING
- DEFAULT RST

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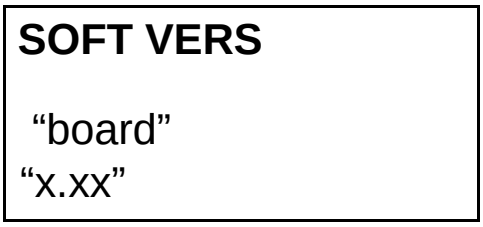
SOFT VERS



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press OK to confirm



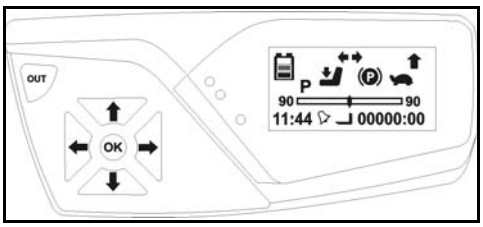
Use the right and left arrows board buttons to navigate the menu

Press OUT to exit the menu

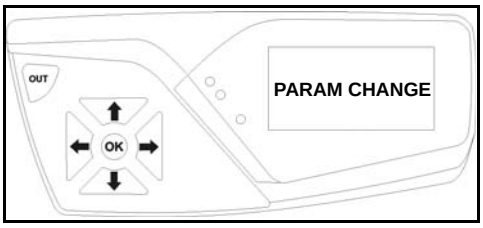
Board	Description	Notes
EVCB	Identify the MCB lifting section	
TRCB	Identify the MCB traction section	
ARMREST	Identify the armrest board	
TRAC	Identify the traction logic unit	
PUMP M	Identify the master pump logic unit	
PUMP S	Identify the slave pump logic unit	
DISPLAY	Identify the dashboard	
X.XX	Identify the software version	

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PARAM CHANGE

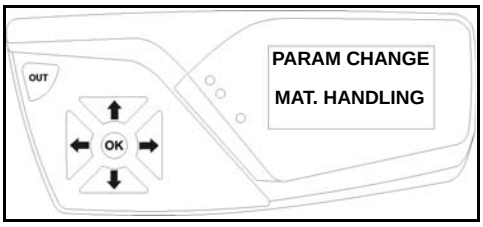


Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]

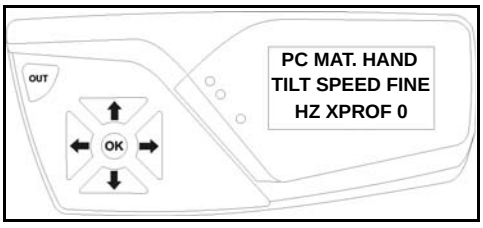


Press ➡ till reach the PARAM CHANGE menu
Press OK to confirm

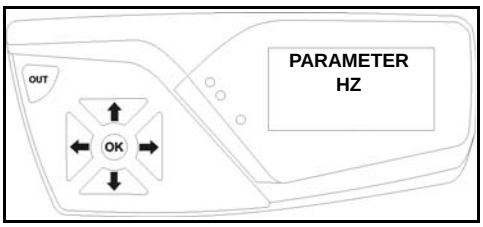
Use the right and left arrows board buttons to select TRACTION or MAT. HANDLING



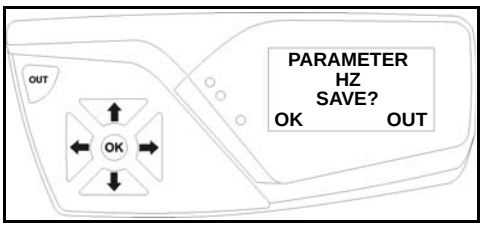
Press OK to confirm



Use the right and left arrows board buttons to navigate the menu
Press OK to modify the parameter



Press ⬆ or ⬇ to modify the value
Press OK to confirm



Press OK to save; on the display the message SAVE SUCCESSFUL appears, therefore press OUT to return to the menu

Press OK to exit without saving

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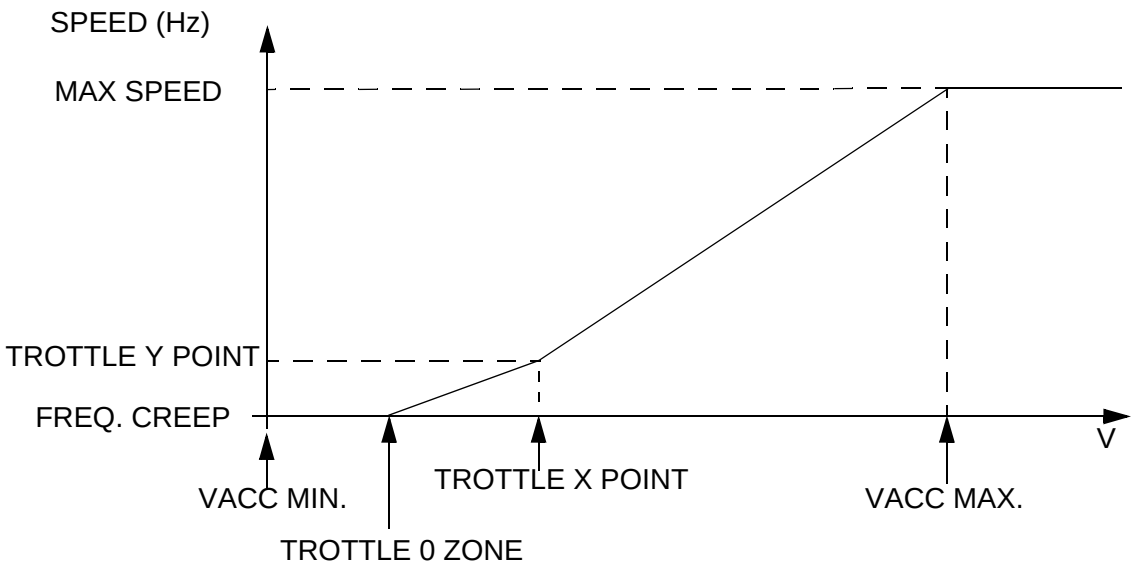
TRACTION FUNCTION

The Traction function visualizes the traction apparatus parameters. The parameter values could vary between an established range.

Parameter	Description	Notes
T turtle cutback	This parameter determines the speed reduction with the “low speed selector“ push-button (turtle function) pressed: - minimum setting = maximum cutback - maximum setting = minimum cutback	%
T curve cutback	Speed reduction in a bend	%
T brake cutback	This parameter determines the speed reduction with brake pedal micro pressed and accelerator pedal released : - minimum setting = minimum cutback - maximum setting = maximum cutback	%
T speed cutback1	This parameter determines the speed reduction if enabled. To enable the cutback, connect a normally closed micro between the CN1 connector, 11 pin of the MCB card, and the GND of one of the MCB card micros: - micro open = reduction on - micro closed = reduction off - minimum setting = maximum cutback - maximum setting = minimum cutback	%
T speed cutback2	This parameter determines the speed reduction if enabled. To enable the cut-back, connect a normally closed micro between the CN1 connector, 18 pin of the MCB card, and the GND of one of the MCB card micros: - micro open = reduction on - micro closed = reduction off - minimum setting = maximum cutback - maximum setting = minimum cutback	%
T 20 BDI reduct	This parameter determines the speed reduction when the battery indicator reaches the 20% (battery nominal value residual charge=40%): - minimum setting = minimum cutback - maximum setting = maximum cutback	%
T 10 BDI reduct	This parameter determines the speed reduction when the battery indicator reaches the 10% (battery nominal value residual charge=30%): - minimum setting = minimum cutback - maximum setting = maximum cutback	%
Max angle	This parameter determines the steering angle in which the maximum speed reduction acts	a°
Angle threshold	This parameter determines the steering angle without speed reduction	a°
Angle threshold2	Starting from "Angle threshold" this parameter determines the steering angle activing a speed reduction up to the maximum value definite from "Angle reduction Y"	a°
Angle reduct Y	This parameter determines the speed reduction percentage of the "Angle threshold 2": - minimum setting = maximum cutback - maximum setting = minimum cutback	a°
Max speed FW	This parameter determines the maximum FW speed. - minimum setting = minimum speed - maximum setting = maximum speed	Hz

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Parameter	Description	Notes
Max speed BW	This parameter determines the maximum BW speed. - minimum setting = minimum speed - maximum setting = maximum speed	Hz
T ACC delay	This parameter determines the acceleration ramp. Changing the parameter changes the acceleration time: - minimum setting = maximum acceleration - maximum setting = minimum acceleration	sec
Speed limit BRK	This parameter determines the deceleration ramp, varying the position of the accelerator pedal without releasing completely the pedal : - minimum setting = minimum deceleration - maximum setting = maximum deceleration	sec
Inversion BRK	Reversing the direction this parameter determines the deceleration ramp: - minimum setting = minimum deceleration - maximum setting = maximum deceleration	sec
Release BRK	This parameter determines the deceleration ramp on releasing the pedal. Changing the parameter changes the deceleration time: - minimum setting = minimum deceleration - maximum setting = maximum deceleration	sec
Pedal BRK	This parameter determines the deceleration ramp when the pedal brake micro is pressed and the accelerator pedal is released: - minimum setting = minimum deceleration - maximum setting = maximum deceleration	sec
T Throttle 0	This parameter determines a 0 value zone in the acceleration diagram entry (see diagram here below)	%
T Throttle X	This parameter changes the characteristics of the acceleration diagram entry	%
T Throttle Y	This parameter changes the characteristics of the acceleration diagram entry	%



Trac torque prof	This parameter determines the motor torque on the basis of the selected profile	1,2,3, 4
Initial BRK	This parameter determines the braking beginning delay	%

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MAST HANDLING FUNCTION

The Mast Handling function visualizes the lifting apparatus parameters. The parameter values could vary in an established range.

ELECTRIC CONTOL VALVE VERSION

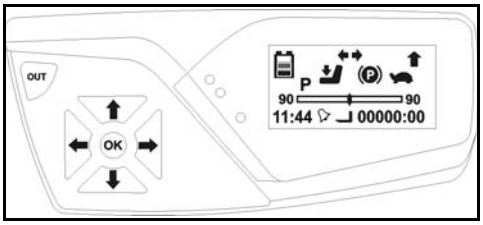
Parameter	Description	Notes
Min speed up	This parameter determines the minimum lifting speed with only the micro closed. Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
Max speed up	This parameter determines the minimum lifting speed . Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
Tilt speed fine	This parameter determines the tilting speed . Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
Shift speed fine	This parameter determines the sideshift speed . Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
IV WAY speed fine	This parameter determines the 4th lever (IV way) speed . Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
V WAY speed fine	This parameter determines the 5th lever (V way) speed . Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
Hydro speed fine	This parameter determines the power steering speed . Changing the parameter changes the speed: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
P turtle cutback	This parameter determines the speed reduction with the “low speed selector“ push-button (turtle function) pressed: - minimum setting = maximum cutback - maximum setting = minimum cutback	%
P cutback speed1	This parameter determines the speed reduction if enabled. To enable the cutback, connect a normally closed micro between the J34 connector, 11 pin of the MCB card, and the GND of one of the MCB card micros: - micro open = reduction on - micro closed = reduction off - minimum setting = maximum cutback - maximum setting = minimum cutback	%

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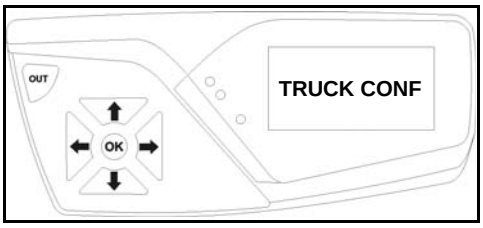
Parameter	Description	Notes
P cutback speed2	This parameter determines the speed reduction if enabled. To enable the cut-back, connect a normally closed micro between the J34 connector, 18 pin of the MCB card, and the GND of one of the MCB card micros: - micro open = reduction on - micro closed = reduction off - minimum setting = maximum cutback - maximum setting = minimum cutback	%
P 20% BDI reduct	This parameter determines the speed reduction when the battery indicator reaches the 20% (battery nominal value residual charge=40%): - minimum setting = minimum cutback - maximum setting = maximum cutback	%
P 10% BDI reduct	This parameter determines the speed reduction when the battery indicator reaches the 10% (battery nominal value residual charge=30%): - minimum setting = maximum cutback - maximum setting = minimum cutback	%
P ACC delay	This parameter determines the acceleration ramp. Changing the parameter changes the acceleration time: - minimum setting = maximum acceleration - maximum setting = minimum acceleration	sec
P DEC delay	This parameter determines the deceleration ramp. Changing the parameter changes the deceleration time: - minimum setting = maximum deceleration - maximum setting = minimum deceleration	sec
Pump torque pro-file	This parameter determines the motor torque on the basis of the selected pro-file	1,2,3, 4
Curve mode	This parameter determines the joystick sensibility as a function of the potenti-ometer stroke	1,2,3, 4

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TRUCK CONF



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the TRUCK CONF menu
Press OK to confirm

Use the right and left arrows board buttons to navigate the menu

Press OUT to exit the menu

Function	Description	Notes
OPTIONS	This function visualizes the traction apparatus parameters. The parameter values could vary in an established range.	
MOTORS	This function visualizes the motors parameters. The parameter values could vary in an established range.	
MCB OUT	This function visualizes the MCB board parameters. The parameter values could vary in an established range.	
RESET	Reset of the hours counter and of the Fingertips-Joystick configuration	
BATTERY	This function visualizes the battery parameters. The parameter values could vary in an established range.	

OPTIONS		
Parameter	Description	Notes
Profile	This parameter determines the profile loaded at the start up	0,1,2,3,4
Set	This parameter determines the L-P-H setting	
Lock set	This parameter enables/disables the L-P-H push button working: ON = enabled OFF = disabled	ON-OFF
Start icon	This parameter determines which logo must be visualized at the starting	Cesab-BT
Pin code	This parameter enables/disables the Pin insertion request: NONE = disabled DISPLAY = enabled DHU = [unused] SESAM = [unused]	
DY Pin enable	This parameter determines the number of Pin Codes used	1÷40
Swaying pedal	This parameter enables/disables with balanced pedal system ON = enabled OFF = disabled	ON-OFF
Test mode	This parameter temporarily activates the lifting pump	ON-OFF

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Parameter	Description	Notes
VTH ENABLE	This parameter enables/disables the 5th lever working ON = enabled OFF = disabled	ON-OFF
CLAMPS	This parameter enables/disables the functioning of the device (clamps) on the mast (if present) ON = enabled OFF = disabled	ON-OFF
LOWER VALVE	This parameter enables/disables the descent solenoid valve ON = enabled OFF = disabled	ON-OFF
TILT SENSOR	This parameter enables/disables the tilting angle sensor [unused] ON = enabled OFF = disabled	ON-OFF
TILT 2 SPEED	This parameter determines the tilting speed as a function of the tilting angle measurement [optional]: - minimum setting = minimum speed - maximum setting = maximum speed	Hz
GEAR RATIO	This parameter determines the reduction ratio of the reduction gear in relation to the truck speed calculus	n°
BUZZER SEAT	This parameter enables/disables the buzzer when the seat micro is open ON = enabled OFF = disabled	ON-OFF
STOP ON RAMP	This parameter enables/disables the truck automatic braking ON = enabled OFF = disabled	ON-OFF
Height mast	This parameter enables/disables the speed reduction in case of mast with height superior then 6250mm	ON-OFF
Himast Sp lim	If enabled, High mast determines the maximum FW or BW speed in case of mast with height superior to 6250mm	Hz
Curve turtle	This parameter enables/disables the following functions: - COMP STEER ACC - STEER THRESHOLD	ON-OFF
Comp steer acc	This parameter determines the acceleration with steered direction wheels (the steering angle can be selected by the STEER THRESH-OLD parameter)	seconds
Steer threshold	This parameter determines the direction wheels angle beyond which the COMP STEER ACC parameter is enabled	degrees
Pumps enable	This parameter enables/disables the master or the slave pump logic unit	ON-OFF
Truck capacity	Unused	

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MOTORS		
Parameter	Description	Notes
SLIP TRAC	This parameter enables/disables the traction motor encoder control: ON = enabled OFF = disabled	ON-OFF
SLIP PUMP M	This parameter enables/disables the master pump motor encoder control: ON = enabled OFF = disabled	ON-OFF
SLIP PUMP S	This parameter enables/disables the slave pump motor encoder control: ON = enabled OFF = disabled	ON-OFF
T MAX CURRENT	This parameter determines the traction motor voltage expressed in percentage of the maximum voltage: - minimum setting = minimum voltage - maximum setting = maximum voltage	%
P M MAX CURRENT	This parameter determines the master pump motor voltage expressed in percentage of the maximum voltage: - minimum setting = minimum voltage - maximum setting = maximum voltage	%
P S MAX CURRENT	This parameter determines the slave pump motor voltage expressed in percentage of the maximum voltage: - minimum setting = minimum voltage - maximum setting = maximum voltage	%
TRAC SENS TEMP	This parameter enables/disables the traction motor temperature sensor ANALOG = analog DIGITAL = digital NONE = disabled	
PUMP M SENS TEMP	This parameter enables/disables the master pump motor temperature sensor ANALOG = analog DIGITAL = digital NONE = disabled	
PUMP S SENS TEMP	This parameter enables/disables the slave pump motor temperature sensor ANALOG = analog DIGITAL = digital NONE = disabled	

MCB OUT		
Parameter	Description	Notes
PWM OUTPUT	This parameter selects the output between PWM1_EN and PWM2_EN in accordance with the battery voltage	%
PWM1 EN	This parameter determines the EV9 solenoid valve control	ON-OFF
PWM2 EN	This parameter determines the EV10 solenoid valve control	ON-OFF

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Parameter	Description	Notes
OUT1 BLINK	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin : ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 FW+BW	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when the FW or BW direction is selected: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 ANY PUMP	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when a hydraulic function is selected (no hydraulic requirement for power steering) ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 SEAT	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when the seat micro is closed: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 JOY 1	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when the card arm, JAUX connector, 6 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 JOY 2	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when the card arm, JAUX connector, 7 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 JOY 3	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when the card arm, JAUX connector, 8 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT1 JOY 4	This parameter enables/disables the negative output on MCB card, J34 connector, 32 pin when the card arm, JAUX connector, 9 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 FW+BW	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when the FW or BW direction is selected ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF

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Parameter	Description	Notes
OUT2 ANY PUMP	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when a hydraulic function is selected (no hydraulic requirement for power steering) ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 SEAT	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when the seat micro is closed: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 JOY 1	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when the armrest board, JAUX connector, 6 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 JOY 2	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when the card arm, JAUX connector, 7 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 JOY 3	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when the card arm, JAUX connector, 8 pin is connected to a negative: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 JOY 4	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when turtle push-button is active: ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF
OUT2 FW	This parameter enables/disables the negative output on MCB card, J40 connector, 23 pin when the FW direction is selected ON = enabled OFF = disabled Characteristics of the electric applicable load: +24V/ 42W	ON-OFF

RESET

Parameter	Description	Notes
RESET PUMP HM	Pump hours counter reset	
RESET TRAC HM	Traction hours counter reset	
RESET KEY HM	Key hours counter reset	

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BATTERY		
Parameter	Description	Notes
BDI TO 100%	This parameter allows the immediate rearmament of the battery indicator	
BDI RESET	This parameter determines the regulation of the rearmament threshold when is required a charge with the battery state between the 70% and 90%	%
BDI ADJ MIN	This parameter determines the set point of the charging voltage. It is settable from 0 to 9	0 - 9
BDI ADJ MAX	This parameter determines the set point of the charging voltage. It is settable from 0 to 9	0 - 9
ADJUSTMENT 3	This parameter determines the voltage needed to rearm the battery indicator on the display. Expressed in percentage, it allows a regulation in step of 0.1% referred to the nominal tension (0,1%= 0,080V)	%
BDI GEL	This parameter enables the discharge curve in case of GEL battery	%

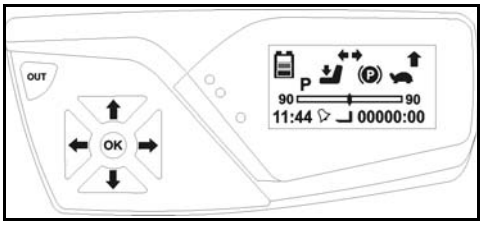
CURRENT LIST		
Parameter	Description	Notes
Min current EV1 1	This parameter determines the min. current to EV1 1 coil min. = 100 mA max. = 500 mA	mA
Min current EV1 2	This parameter determines the min. current to EV1 2 coil min. = 100 mA max. = 500 mA	mA
Min current EV2 2	This parameter determines the min. current to EV2 2 coil min. = 100 mA max. = 500 mA	mA
Min current EV1 3	This parameter determines the min. current to EV1 3 coil min. = 100 mA max. = 500 mA	mA
Min current EV2 3	This parameter determines the min. current to EV2 3 coil min. = 100 mA max. = 500 mA	mA
Min current EV1 4	This parameter determines the min. current to EV1 4 coil min. = 100 mA max. = 500 mA	mA
Min current EV2 4	This parameter determines the min. current to EV2 4 coil min. = 100 mA max. = 500 mA	mA
Max current EV1 1	This parameter determines the max. current to EV1 1 coil min. = 500 mA max. = 1500 mA	mA
Max current EV1 2	This parameter determines the max. current to EV1 2 coil min. = 500 mA max. = 1500 mA	mA

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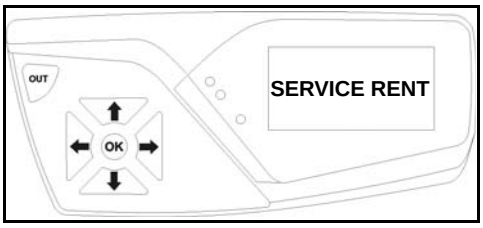
Parameter	Description	Notes
Max current EV2 2	This parameter determines the max. current to EV2 2 coil min. = 500 mA max. = 1500 mA	mA
Max current EV1 3	This parameter determines the max. current to EV1 3 coil min. = 500 mA max. = 1500 mA	mA
Max current EV2 3	This parameter determines the max. current to EV2 3 coil min. = 500 mA max. = 1500 mA	mA
Max current EV1 4	This parameter determines the max. current to EV1 4 coil min. = 500 mA max. = 1500 mA	mA
Max current EV2 4	This parameter determines the max. current to EV2 4 coil min. = 500 mA max. = 1500 mA	mA

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SERVICE RENT



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the SERVICE RENT menu
Press OK to confirm

Use the right and left arrows board buttons to navigate the menu

Press OUT to exit the menu

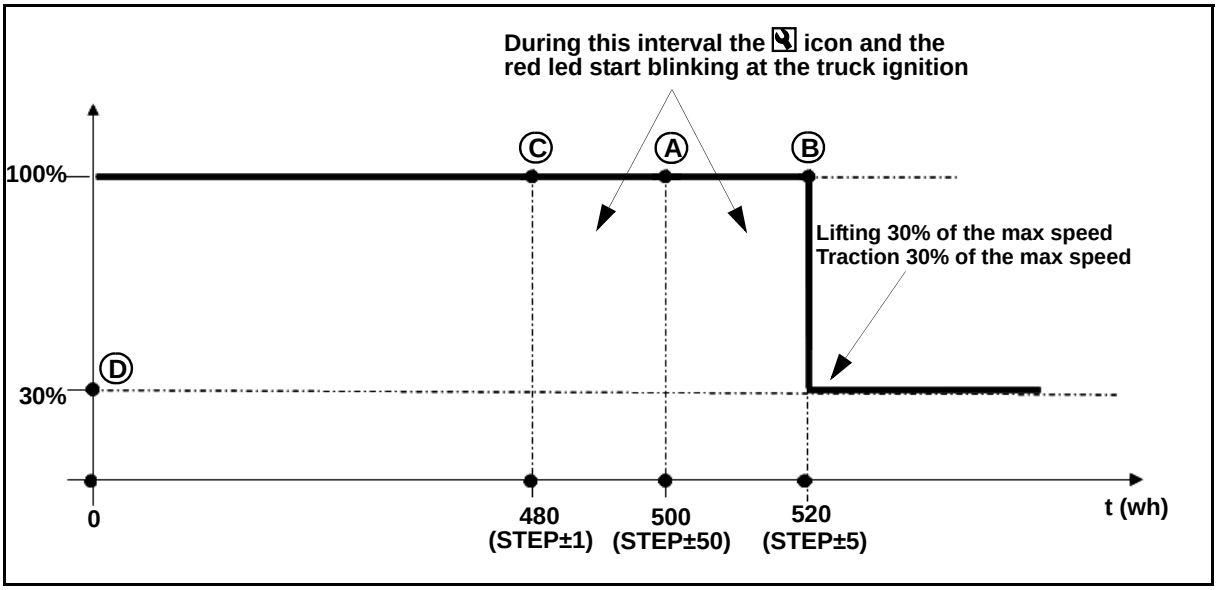
Function	Description	Notes
SERV TIMER EN (service timer enable)	This function enables/disables the timer of programmed maintenance interventions	
RESET SERV HM (reset service hourmeter)	This function resets the SERV TIMER EN timer	
SERV REQ TIME (service request time)	This function determines the maintenance interval: **A** reference (PROGRAMMED MAINTENANCE DIAGRAM)	When the set time expires the red led starts to blink
SERV CUT TIME (service cutback time)	This function determines, SERV REQ TIME expired, after how much time the truck enters in limited working system: **B** reference (PROGRAMMED MAINTENANCE DIAGRAM)	
SERV TIME BLINK (service time blink)	SERV REQ TIME expired notice: **C** reference (PROGRAMMED MAINTENANCE DIAGRAM)	The wrench icon and the red led start blinking at the truck ignition
T SERV CUTBACK (traction service cutback)	This function sets the percentage of working reduction when SERV CUT TIME is expired; **D** reference (PROGRAMMED MAINTENANCE DIAGRAM)	
P SERV CUTBACK (pump service cutback)	This function sets the percentage of working reduction when SERV CUT TIME is expired; **D** reference (PROGRAMMED MAINTENANCE DIAGRAM)	
RENT TIMER EN (rental timer enable)	This function enables/disables the timer of the rental duration	
RENT TIME/DAY	This function determines (selects) the Timer Rent working in hours or in days; if the DAY function is selected it is not possible to modify the date in the USER menu	WH = hours DAY = days

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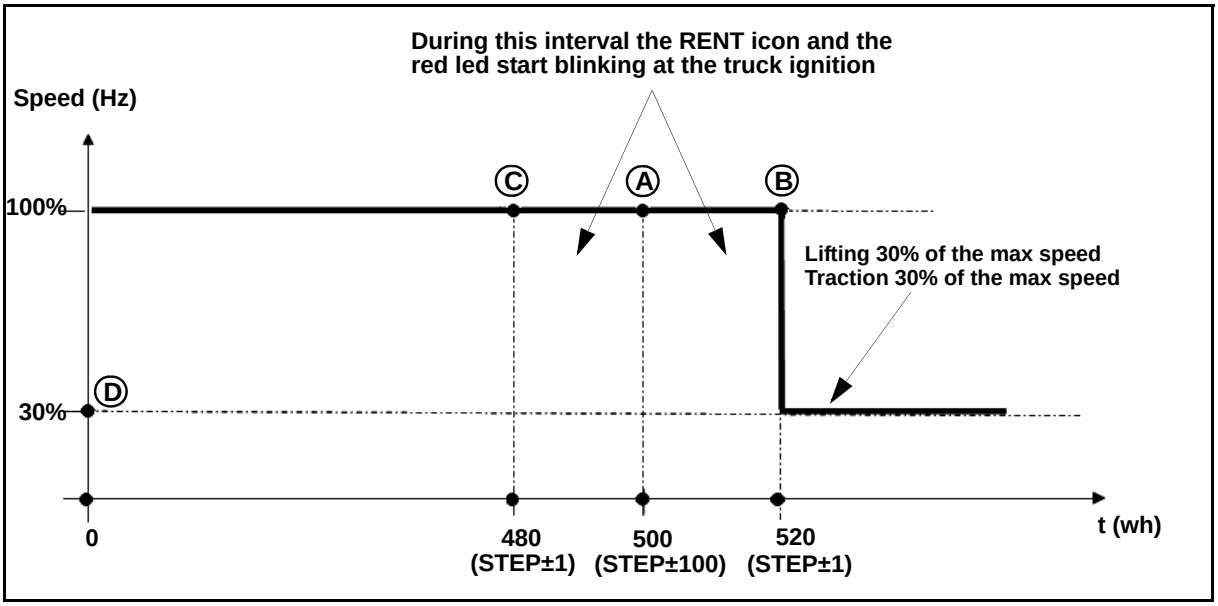
Function	Description	Notes
T RENT CUTBACK (traction rental cutback)	This function sets the percentage of working reduction when RENT CUT TIME or RENT CUT DAY are expired;	
P RENT CUTBACK (pump rental cutback)	This function sets the percentage of working reduction when RENT CUT TIME or RENT CUT DAY are expired;	
RESET RENT HM (reset rental hourmeter)	This function resets the timer RENT TIMER EN	
RENT REQ TIME (rental request time)	This function determines the rent interval; **A** reference (PROGRAMMED RENT DIAGRAM)	
RENT CUT TIME (rental cutback time)	This function determines, RENT REQ TIME expired, after how much time the truck enters in limited working system	
RENT TIME BLINK (rental time blink)	RENT REQ TIME expired notice: **B** reference (PROGRAMMED RENT DIAGRAM)	The RENT icon and the red led start blinking at the truck ignition
RENT END DAY	This function defines the day when the Rent time stops **A** reference (PROGRAMMED RENT DIAGRAM) with DAY selected	
RENT CUT DAY	This function defines the activation time of the speed reduction; **B** reference (PROGRAMMED RENT DIAGRAM)	Max duration 15 days
RENT DAY BLINK	This function determines, RENT END DAY expired, after how much time the truck enters in limited working system **C** reference (PROGRAMMED RENT DIAGRAM) with DAY selected	Max duration 15 days

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PROGRAMMED MAINTENANCE DIAGRAM

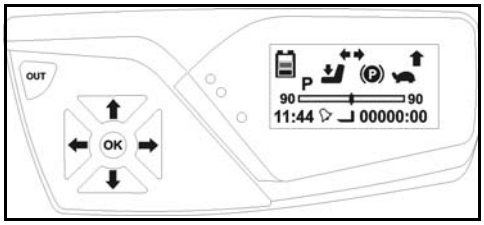


PROGRAMMED RENT DIAGRAM

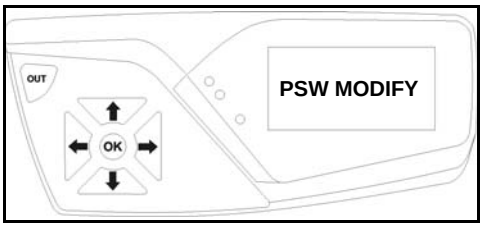


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CANGE PPASSWORD



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the PSW MODIFY menu
Press OK to confirm

Use the right and left arrows board buttons to navigate the menu

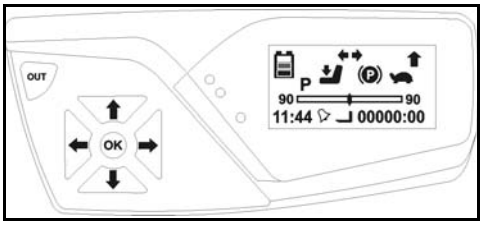
Press OK to enter the parameters modification and follow the instructions visualized in the display

Press OUT to exit the menu

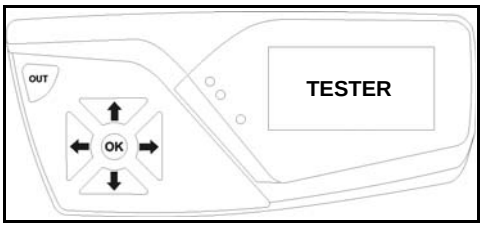
Function	Description	Notes
CHANGE	This function allows to modify the pin code and related profile	
DEFAULT	This function sets the default password	

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TESTER



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the TESTER menu

Use the right and left arrows board buttons to navigate the menu

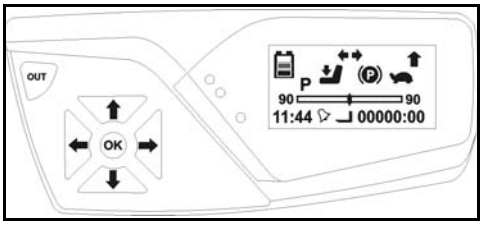
Press OUT to exit the menu

Function	Description	Notes
TRACTION	This function visualizes the traction system values	
MAT. HANDLING	This function visualizes the lifting system values	

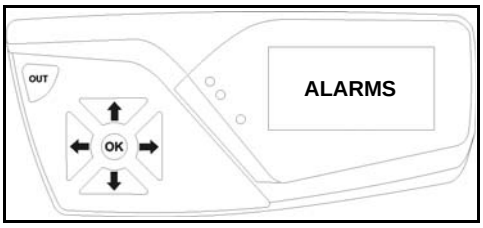
Notes:
The complete list of the parameters relevants to the TESTER menu can be consulted at the section TESTER PARAMETERS DESCRIPTION

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ALARMS



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the ALARMS menu
Press OK to confirm

Use the right and left arrows board buttons to navigate the menu

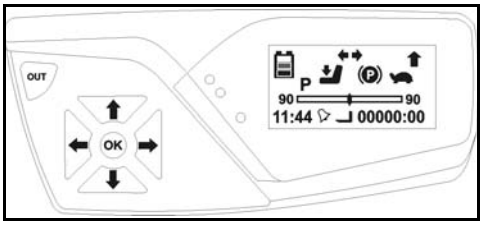
Press OUT to exit the menu

Function	Description	Notes
REALTIME	This function visualizes the alarms in real time	See diagnostic code list
LOGBOOK	This function allows to visualize the stored alarms and erase them	

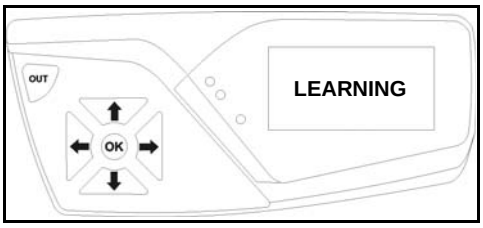
LOGBOOK		
Function	Description	Notes
READ	This function visualizes the last 20 alarms saved	See diagnostic code list
CLEAR	This function deletes the alarm list	

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LEARNING



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the LEARNING menu
Press OK to confirm

Use the right and left arrows board buttons to navigate the menu

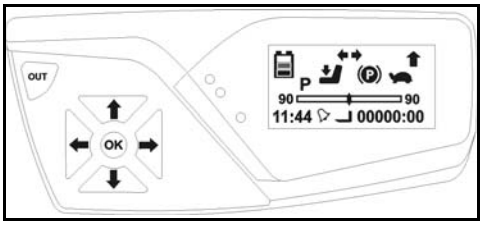
Press OK to enter the parameters modification and follow the instructions visualized on the display

Press OUT to exit the menu

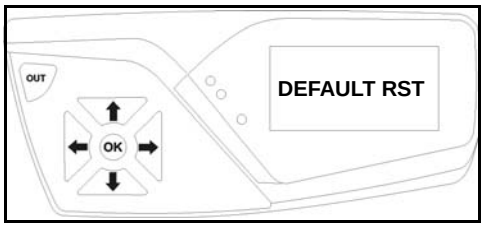
Function	Description	Notes
SERIAL NUMBER	This function identifies the truck serial number	
LEARN TRAC POT	This function determines the acceleration potentiometer stroke	minimum ~ 0,1V maximum ~3,4V
ADJUST BATTERY	This function controls the real value of the battery voltage	Modifiy with the arrows ⬆ and ⬇
SET STEER ZERO	This function determines the central position of the direction wheels	~ 2,7V
SET STEER RIGHT	This function determines the maximum right position of the direction wheels	The acquired voltage has to be ≤ 4,1 V
SET STEER LEFT	This function determines the maximum left position of the direction wheels	The acquired voltage has to be ≥1,7 V

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DEFAULT RST



Enter the service menu
[see SERVICE MENU PASSWORD INSERTION PROCEDURE paragraph]



Press ➡ till reach the DEFAULT RST menu
Press OK to confirm

Use the right and left arrows board buttons to navigate the menu

Press OK to enter the parameters modification and follow the instructions visualized on the display

Press OUT to exit the menu

Function	Description	Notes
EVCB	This function allows to reset the EVCB board	See paragraph NECESSARY ADJUSTMENTS AFTER A HARDWARE COMPONENT REPLACEMENT
TRCB	This function allows to reset the TRCB board	See paragraph NECESSARY ADJUSTMENTS AFTER A HARDWARE COMPONENT REPLACEMENT
ARMREST	This function allows to reset the ARMREST board	
TRAC	This function allows to reset the traction logic unit	See paragraph NECESSARY ADJUSTMENTS AFTER A HARDWARE COMPONENT REPLACEMENT
PUMP M	This function allows to reset the MASTER PUMP logic unit	
PUMP S	This function allows to reset the SLAVE PUMP logic unit	

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TESTER PARAMETER DESCRIPTION

TRACTION

TESTER: display of the main imput and output signals

1. **SPD SET**
   Theoretical speed of the motor requested referred to the speed reduction
2. **LH MOTOR SPEED**
   Frequency encoder motor
3. **MOTOR TEMP**
   Motor temperature
4. **CONTR TEMP**
   Traction logic unit temperature
5. **SLIP**
   Flowing values of the right motor, or the speed difference between the rotating magnetic field and the motor rotor:
   SLIP (Hz) = FREQUENCY (Hz) - ENCODER (Hz)
6. **FREQUENCY**
   Frequency of the voltage and current signals supplyed to the motor
7. **SERVICE BRAKE**
   Brake pedal micro
   OFF = not active input, open switch
   ON = active input, closed switch
8. **TRACTION POT**
   Accelerator pedal potentiometer
   Value in volt of the potentiometer
9. **PARKING BRAKE**
   Parking brake micro
   OFF = not active input, open switch
   ON = active input, closed switch
10. **BRAKE REL SENS**
    Negative brakes unblocking sensor
    OFF = not active input, open switch
    ON = active input, closed switch
11. **BATT VOLT INPUT**
    Battery voltage readed from the MCB
12. **CFG**
    Pedal system input
    1 = single pedal
    2 = double pedal or balanced pedal
13. **BATTERY VOLTAGE**
    Battery voltage readed from the traction logic
14. **BATTERY CHARGE**
    Percentage of the battery charge level, read by the traction logic unit
15. **DIR JOY**
    FW/BW directions potentiometer on the armrest

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LIFTING MCB - JOYSTICK / FINGERTIPS

TESTER: display of the main imput and output signals

1. **LIFE HM**
   Working hour counter from the first start
2. **PM SPD SET**
   Master pump motor teoric speed requested referred to the speed reduction
   PM MOT SPD
   Master pump motor encoder frequency
3. **PS SPD SET**
   Slave pump motor teoric speed requested referred to the speed reduction
   PS MOT SPD
   Slave pump motor encoder frequency
4. **PM MOT TMP/PS MOT TMP**
   Master/Slave pump motor temperature
5. **PM CTR TMP/PS CTR TMP**
   Temperature of the hardware section that controls the master/slave pump motor
6. **PM SLIP/PS SLIP**
   Flowing values of the left motor, or the speed difference between the rotating magnetic field and the master/slave pump motor rotor:
   PM SLIP/PS SLIP (Hz) = FREQUENCY (Hz) - ENCODER (Hz)
7. **PM FREQ/PS FREQ**
   Frequency of the voltage signals supplied from the master/slave pump logic units to the master/slave pump motors
8. **LIFTING SWITCH**
   Lifting fingertips/joysticks S17 and S18 microswitches status
9. **LIFTING**
   Auxiliary digital input status (optional): unused
10. **TILTING SWITCH**
    Tilting fingertips/joysticks S19 and S20 microswitches status
11. **TILTING**
    Auxiliary digital input status (optional): unused
12. **SIDESHIFT SWITCH**
    Tilting fingertips/joysticks S21 and S22 microswitches status
13. **SIDESHIFT**
    Auxiliary digital input status (optional): unused
14. **IV WAY SWITCH**
    4th way fingertips/joysticks S23 and S24 microswitches status
15. **IV WAY**
    Auxiliary digital input status (optional): unused
16. **V WAY SWITCH**
    5th way fingertips/joysticks S25 and S26 microswitches status
17. **V WAY**
    Auxiliary digital input status (optional): unused
18. **IN6_1**
    Backward direction micro
19. **IN6_2**
    Forward direction micro
20. **IN6_3**
    Habilitation button for the 4th way activation
21. **IN6_4**
    Unused
22. **IN6_5**
    Unused
23. **IN6_6**
    Available lifting speed reduction (optional)
24. **LIFT LOWER J**
    Lifting potentiometer (neutral position 2,45V ± 0,2 V)

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25. TILT J
Tilting potentiometer (neutral position 2,45V ± 0,2 V)
26. SIDESHIFT J
Sideshift potentiometer (neutral position 2,45V ± 0,2 V)
27. IV WAY J
4th way potentiometer (neutral position 2,45V ± 0,2 V)
28. V WAY J
5th way potentiometer (neutral position 2,45V ± 0,2 V)
29. 1st GRP SETPOINT
Current value requested from the armrest board to the EVCB for the lifting/lowering group
30. 2nd GRP SETPOINT
Current value requested from the armrest board to the EVCB for the tilting group
31. 3rd GRP SETPOINT
Current value requested from the armrest board to the EVCB for the sideshift group
32. 4th GRP SETPOINT
Current value requested from the armrest board to the EVCB for the 4th way group
33. CURRENT RMS
Current value requested from the armrest board to the EVCB for the 4th way group

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NECESSARY ADJUSTMENT AFTER A COMPONENT REPLACING

MCB CARD

ACQUISITION: Accelerator potentiometer (LEARN TRAC POT)
Balanced pedal configuration (SWAYING PEDAL)

TRACTION LOGIC UNIT AC5

ACQUISITION: Steering potentiometer (SET STEER ZERO/SET STEER LEFT/SET STEER RIGHT)

PUMP LOGIC UNIT DUAL AC2

No acquisition required

ARMREST BOARD

- Optional 5th way configuration via fingertips (VTH ENABLE)
- Optional attachment pilotage button activation (CLAMPS)

DASHBOARD

- Date and hour regulation

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TROUBLESHOOTING

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DASHBOARD 67
MCB BOARD (section TRCB) 69

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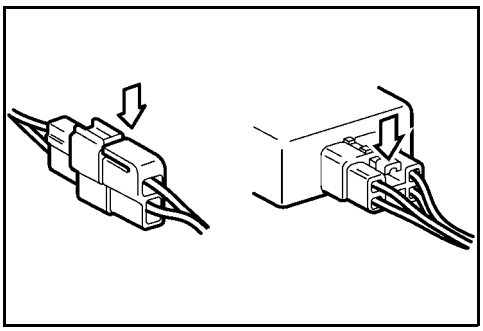
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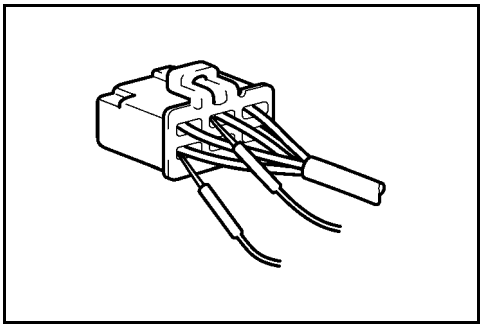
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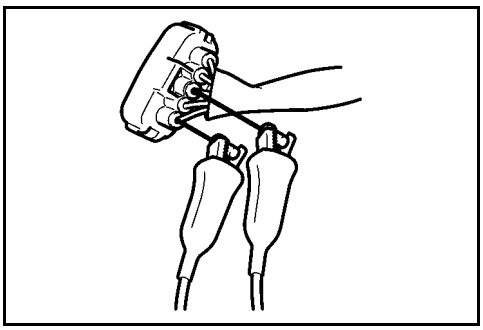
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BEFORE TROUBLESHOOTING

CONNECTOR HANDLING

1. Disconnect the battery plug before connecting or disconnecting each connector or terminal.
2. When disconnecting a connector, do not pull it at the harness but hold the connector itself and pull it after unlocking it.
   To connect, push the connector fully until it is locked in position.
3. Bring a tester probe into contact with a connector terminal from the rear side of the coupler (harness side).
4. If insertion from the rear side is impossible, as in the case of a waterproof connector, bring the tester probe carefully into contact with the terminal so as not to cause deformation of the connector terminal.
5. Do not touch connector terminals directly with your hand.
6. When bringing tester probes into contact with live terminals, prevent two tester probes from coming into contact with each other.

WIRE HARNESS AND CONNECTOR INSPECTION PROCEDURE

When any trouble occurs, first inspect the connectors and wire harness of the related circuit according to the following procedure:

Continuity check

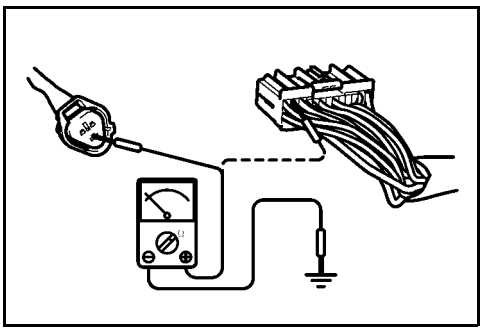
1. Disconnect the connectors at both ends of the corresponding harness.
2. Measure the resistance between corresponding terminals of the connectors at both ends.

Standard:10 Ω or less

Note:
Measure while lightly shaking the wire harness up and down and sideways.
It is unusualto have a break of the circuit along vehicle wiring mostly on the connectors or close to them. Inspect especially the sensor connectors with sufficient care.

4

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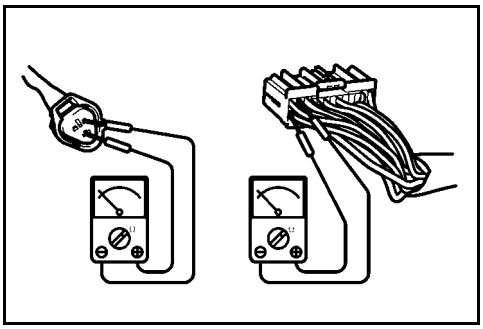


Short circuit check

1. Disconnect the connectors at both ends of the corresponding harness.
1. Measure the resistance between the corresponding connector terminal and N1. Always inspect the connectors at both ends.

   Standard: 1 MΩ or above

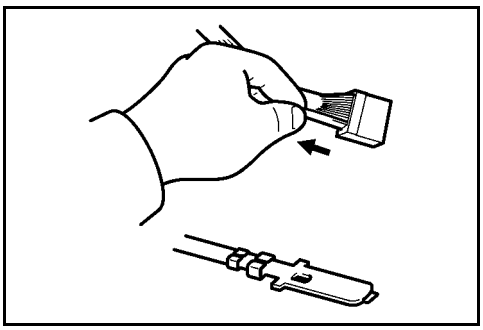
Measure while lightly shaking the wire harness up and down and sideways.



2. Measure the resistance between a terminal corresponding to the connector terminal and N1. Always inspect the connectors at both ends.

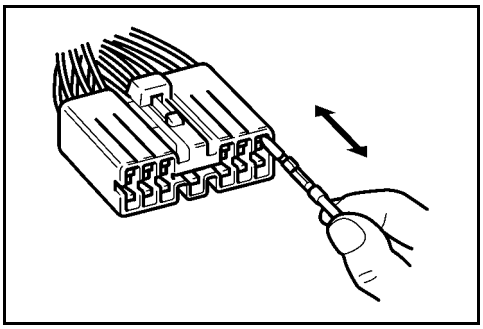
   Standard: 1 MΩ or above

The wiring may short-circuit due to pinching by the body or defective clamping.



Visual and contact pressure checks

- Disconnect the connectors at both ends of the corresponding harness.
- Visually inspect that there is neither rust nor foreign matter trapped at connector terminals.
- Inspect that there is no loosening or damage at the locked portion. Also, lightly pull the wire harness from the connector to check that it does not come off.



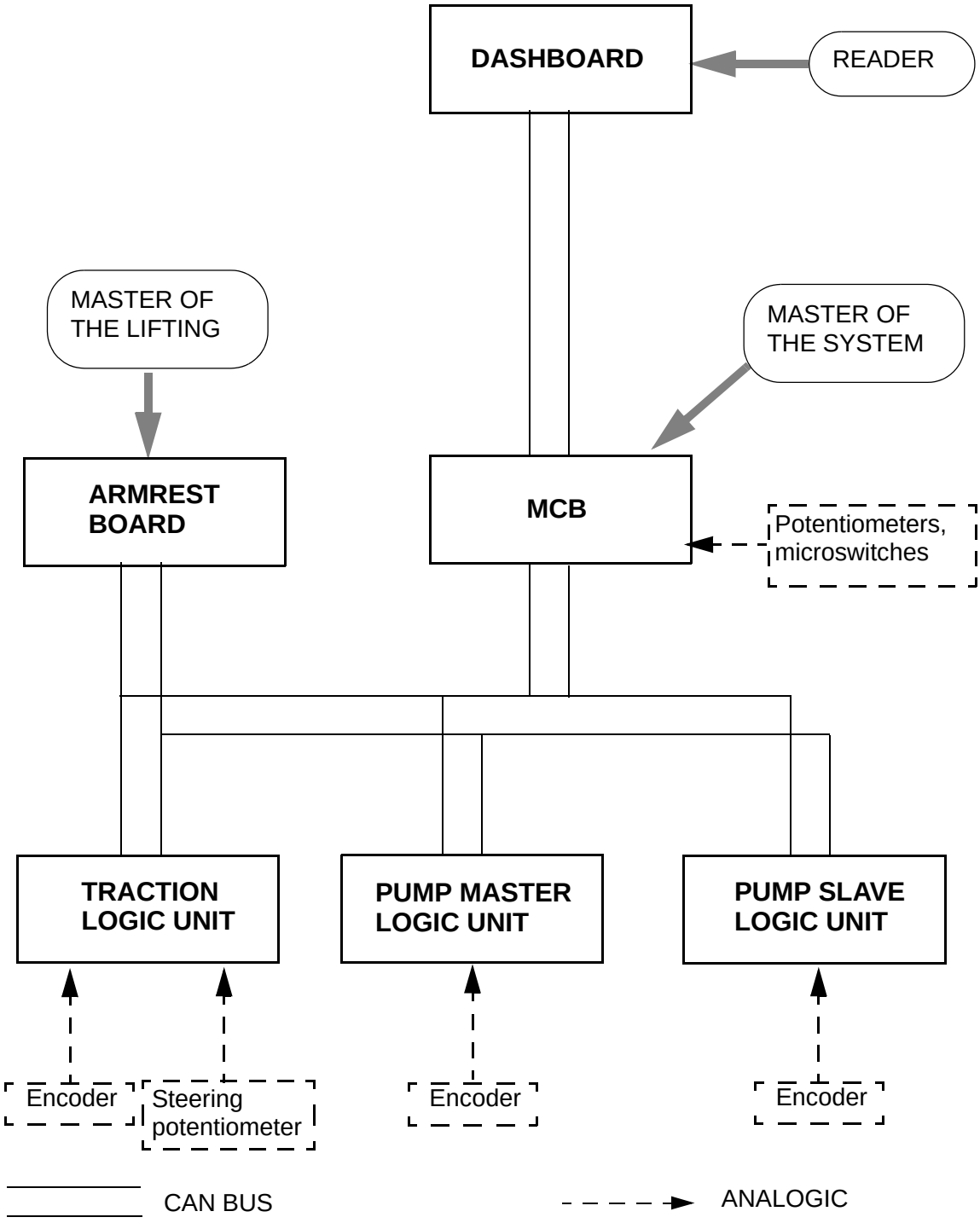
- Insert a male terminal same as that of the terminal to a female connector and check the extracting force. Defective contact may exist at a terminal where the extracting force is less than that of other terminals.

Note:
Even if there is rust or foreign matter trapped at the terminal, or the contact pressure between male and female terminals is low, abnormal contact condition may be changed to normal by disconnecting and reconnecting the connector. In that case, repeat connector connection and disconnection several times. If defect is perceived even once, terminal contact may be defective.

Caution:
Always disconnect the battery plug before SST connection and disconnection. If the battery plug is kept connected, various boards may be damaged.

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SYSTEM CONFIGURATION



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DIAGNOSIS CODE LIST

When an Error Code is Displayed

Code	Alarm specification	Board	Error mode	Page
01	WATCHDOG	TRACTION LOGIC UNIT	Self-diagnostic test	10
02	EEPROM KO	TRACTION LOGIC UNIT	Fault in the memory area	10
03	LOGIC FAILURE #3	TRACTION LOGIC UNIT	Logic defect	10
04	LOGIC FAILURE #2	TRACTION LOGIC UNIT	Fault in the hardware section	10
05	LOGIC FAILURE #1	TRACTION LOGIC UNIT	Undervoltage/overvoltage protection	11
06	VMN LOW	TRACTION LOGIC UNIT	Failure on VMN test	12
07	VMN HIGH	TRACTION LOGIC UNIT	Failure on VMN test	13
08	CONTACTOR OPEN	TRACTION LOGIC UNIT	Contactor driver failure	14
09	STBY I HIGH	TRACTION LOGIC UNIT	Current sensor failure	14
10	CAPACITOR CHARGE	TRACTION LOGIC UNIT	Capacitors not charged	15
11	HIGH TEMPERATURE	TRACTION LOGIC UNIT	Logic unit temperature	16
12	MOTOR TEMPERAT	TRACTION LOGIC UNIT	Traction motor temperature upper to 140°C	17
13	ENCODER ERROR	TRACTION LOGIC UNIT	Encoder circuit failure	18
14	THERMIC SENS KO	TRACTION LOGIC UNIT	Logic unit termic sensor out of range	18
15	SAFETY IN	TRACTION LOGIC UNIT	Logic unit arrest	19
16	CAN BUS KO	TRACTION LOGIC UNIT	Notices the comunication of another board	19
17	WAITING FOR NODES	TRACTION LOGIC UNIT	Notices a delay in the data transfer	20
18	AUX OUTPUT KO	TRACTION LOGIC UNIT	Failure on the drivers that controls the solenoid valve coil	20
19	DRIVER SHORTED	TRACTION LOGIC UNIT	Contactor driver failure	20
20	CONTACTOR DRIVER	TRACTION LOGIC UNIT	Contactor driver failure	21
21	COIL SHORTED	TRACTION LOGIC UNIT	Contactor driver failure	22
22	STEER ACQ	TRACTION LOGIC UNIT	Steering potentiometer setting not correct	22
23	INCORRECT START	TRACTION LOGIC UNIT	Incorrect start procedure	22
24	STEER WIRE KO	TRACTION LOGIC UNIT	Steering potentiometer failure	23
28	STEER SENSOR KO	TRACTION LOGIC UNIT	Potentiometer out of range or not connected	23
29	FORW + BACK	TRACTION LOGIC UNIT	Incorrect starting procedure	24
31	WATCHDOG	PUMP MASTER LOGIC UNIT	Self-diagnostic test	27
32	COIL SHORTED	PUMP MASTER LOGIC UNIT	Contactor driver failure	27
33	LOGIC FAILURE #3	PUMP MASTER LOGIC UNIT	Logic defect	28
34	CAPACITOR CHARGE	PUMP MASTER LOGIC UNIT	Capacitors not charged	28
35	VMN LOW	PUMP MASTER LOGIC UNIT	Failure on VMN test	29
36	ENCODER ERROR	PUMP MASTER LOGIC UNIT	Encoder circuit failure	30
37	CONTACTOR DRIVER	PUMP MASTER LOGIC UNIT	Contactor driver failure	30
38	VMN HIGH	PUMP MASTER LOGIC UNIT	Failure on VMN test	31
39	I=0 EVER	PUMP MASTER LOGIC UNIT	Failure on the current sensor	31
40	MOTOR STALL	PUMP MASTER LOGIC UNIT	Motor encoder failure	34
41	SLAVE WARNING	PUMP MASTER LOGIC UNIT	Logic internal error	35
42	WAITING FOR NODE	PUMP MASTER LOGIC UNIT	Notices a delay in the data transfer	35
43	WRONG SET BATT	PUMP MASTER LOGIC UNIT	Battery voltage out of range	35
44	HIGH TEMPERATURE	PUMP MASTER LOGIC UNIT	Logic unit temperature	35
45	BATTERY LOW	PUMP MASTER LOGIC UNIT	Battery voltage is low	35
46	EEPROM OFFLINE	PUMP MASTER LOGIC UNIT	Fault in the memory area	36

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Code	Alarm specification	Board	Error mode	Page
47	SENS MOT TEMP KO	PUMP MASTER LOGIC UNIT	Motor temperature upper to 140°C	37
48	THERMIC SENS KO	PUMP MASTER LOGIC UNIT	Logic unit termic sensor out of range	37
49	MOTOR TEMPERAT	PUMP MASTER LOGIC UNIT	Traction motor temperature upper to 140°C	38
61	WATCHDOG	PUMP SLAVE LOGIC UNIT	Self-diagnostic test	40
62	COIL SHORTED	PUMP SLAVE LOGIC UNIT	Contactor driver failure	40
63	LOGIC FAILURE #3	PUMP SLAVE LOGIC UNIT	Logic defect	41
64	CAPACITOR CHARGE	PUMP SLAVE LOGIC UNIT	Capacitors not charged	41
65	VMN LOW	PUMP SLAVE LOGIC UNIT	Failure on VMN test	42
66	ENCODER ERROR	PUMP SLAVE LOGIC UNIT	Encoder circuit failure	43
67	CONTACTOR DRIVER	PUMP SLAVE LOGIC UNIT	Contactor driver failure	43
68	VMN HIGH	PUMP SLAVE LOGIC UNIT	Failure on VMN test	44
69	I=0 EVER	PUMP SLAVE LOGIC UNIT	Failure on the current sensor	44
70	MOTOR STALL	PUMP SLAVE LOGIC UNIT	Motor encoder failure	48
71	NO CAN MESG N.11	PUMP SLAVE LOGIC UNIT	UNUSED	48
72	HIGH TEMPERATURE	PUMP SLAVE LOGIC UNIT	Logic unit temperature upper to 85°C	49
73	INPUT MISMATCH	PUMP SLAVE LOGIC UNIT	Control internal error	49
74	EEPROM OFFLINE	PUMP SLAVE LOGIC UNIT	Fault in the memory area	49
76	SENS MOT TEMP KO	PUMP SLAVE LOGIC UNIT	Motor temperature sensor failure	50
77	THERMIC SENS KO	PUMP SLAVE LOGIC UNIT	Logic unit termic sensor out of range	50
78	MOTOR TEMPERAT	PUMP SLAVE LOGIC UNIT	Motor temperature to 140°C	51
79	MASTER WARNING	PUMP SLAVE LOGIC UNIT	Logic internal error	52
93	NOT REP ERROR	MCB (TRCB)	Comunication error in pre-operation	71
94	CHKSUM ERROR	MCB (TRCB)	Software error	71
1A	I=0 EVER	TRACTION LOGIC UNIT	Failure on the current sensor	24
1E	CONTACTOR CLOSED	TRACTION LOGIC UNIT	Contactor driver failure	21
2A	SEAT ERROR	TRACTION LOGIC UNIT	Closed microswitch not noticed	25
2C	GAIN ACQUISITION	TRACTION LOGIC UNIT	The logic unit is in data acquisition phase	25
2D	ENCODER LOCKED	TRACTION LOGIC UNIT	Motor encoder failure	26
3A	STBY I HIGH	PUMP MASTER LOGIC UNIT	Current sensore failure	32
3B	CONTACTOR OPEN	PUMP MASTER LOGIC UNIT	Contactor driver failure	32
3C	DRIVER SHORTED	PUMP MASTER LOGIC UNIT	Contactor driver failure	32
3D	AUX OUTPUT KO	PUMP MASTER LOGIC UNIT	Failure on the contactor driver	32
3E	LOGIC FAILURE #1	PUMP MASTER LOGIC UNIT	Undervoltage/overvoltage protection	33
3F	LOGIC FAILURE #2	PUMP MASTER LOGIC UNIT	Fault in the hardware section	34
4A	DATA ACQUISITION	PUMP MASTER LOGIC UNIT	The logic unit is in data acquisition phase	39
4B	NO CAN MSG N	PUMP MASTER LOGIC UNIT	Notices the comunication of an another card	39
4C	SLAVE KO	PUMP MASTER LOGIC UNIT	Comunication failure with Slave pump logic unit	39
6A	STBY I HIGH	PUMP SLAVE LOGIC UNIT	Current sensor failure	45
6B	DRIVER SHORTED	PUMP SLAVE LOGIC UNIT	Contactor driver failure	45
6C	AUX OUTPUT KO	PUMP SLAVE LOGIC UNIT	Failure on the contactor driver	45
6D	LOGIC FAILURE #1	PUMP SLAVE LOGIC UNIT	Undervoltage/overvoltage protection	46
6E	LOGIC FAILURE #2	PUMP SLAVE LOGIC UNIT	Fault in the hardware section	47
6F	WAITING FOR MAST	PUMP SLAVE LOGIC UNIT	Notices a delay in the data transfer	47

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Code	Alarm specification	Board	Error mode	Page
7A	DATA ACQUISITION	PUMP SLAVE LOGIC UNIT	The logic unit is in data acquisition phase	52
7B	NO CAN MSG N	PUMP SLAVE LOGIC UNIT	Notices the comunication of another card	52
7C	MASTER KO	PUMP SLAVE LOGIC UNIT	Comunication failure with Master pump logic unit	52
A1	DOUBLE REQ	MCB (EVCB)	UNUSED	53
A2	RELOAD PARAM WARN	MCB (EVCB)	Occurred parameters loading signal	53
A3	PARAM LOAD ERROR	MCB (EVCB)	Error in the parameters loading in memory	53
A4	NOT REP ERROR	MCB (EVCB)	Board in waiting information	53
A5	CHKSUM ERROR	MCB (EVCB)	UNUSED	53
A6	BOOT ERROR	MCB (EVCB)	Board in waiting information from the Traction or lifting logic	53
A7	HI SIDE DRIVER SHORT	MCB (EVCB)	Board internal problem	54
A8	EV1 1 OPEN	MCB (EVCB)	EVP1 solenoid valve coil failure	54
A9	EV2 1 OPEN	MCB (EVCB)	EVP2 solenoid valve coil failure	54
AA	EV1 2 OPEN	MCB (EVCB)	EVP3 solenoid valve coil failure	54
AB	EV2 2 OPEN	MCB (EVCB)	EVP4 solenoid valve coil failure	54
AC	EV1 3 OPEN	MCB (EVCB)	EVP5 solenoid valve coil failure	55
AD	EV2 3 OPEN	MCB (EVCB)	EVP6 solenoid valve coil failure	55
AE	EV1 4 OPEN	MCB (EVCB)	EVP7 solenoid valve coil failure	55
AF	EV2 4 OPEN	MCB (EVCB)	EVP8 solenoid valve coil failure	55
B	SLIP PROFILE	TRACTION LOGIC UNIT	Error in the memory data	14
B0	TRCB MICRO ERROR	MCB (EVCB)	Board internal problem	55
B1	GROUP1 DRIVER SHORT	MCB (EVCB)	Failure on a group 1 coil of the electroproportional distributor	56
B2	GROUP2 DRIVER SHORT	MCB (EVCB)	Failure on a group 2 coil of the electroproportional distributor	56
B3	GROUP3 DRIVER SHORT	MCB (EVCB)	Failure on a group 3 coil of the electroproportional distributor	56
B4	GROUP4 DRIVER SHORT	MCB (EVCB)	Failure on a group 4 coil of the electroproportional distributor	56
B5	AUX OUT SHORT	MCB (EVCB)	Failure on a group 5 coil of the electroproportional distributor	57
B6	DASH KO	MCB (EVCB)	Comunication problem between the MCB and the dashboard	57
B7	ERR SEAT	MCB (EVCB)	Seat micro open with activated hydraulic functions	57
B8	JOY STUFFING ERR	MCB (EVCB)	Comunication problem between the MCB and the joystick board	57
B9	SET SERIAL NUMBER	MCB (EVCB)	Automatic setting of the serial not occurred	57
BA	POT TILT NOT OK	MCB (EVCB)	Incorrect reading of the tilting potentiometer voltage	58
C1	INCORRECT START	MCB (TRCB)	Incorrect starting procedure	69
C2	BAD CONF WHEELS	MCB (TRCB)	Error of configuration in the 3-4 wheels version	69
C3	PEDAL WIRE KO	MCB (TRCB)	Failure in the signal of the accelerator potentiometer at rest	69
C4	BAD MICROSWITCH	MCB (TRCB)	Pedal micro or direction lever failure	70
C5	WARN CONF ERROR	MCB (TRCB)	UNUSED	70

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Code	Alarm specification	Board	Error mode	Page
C6	BAD VACC	MCB (TRCB)	Accelerator potentiometer setting not correct	70
C7	ERR SEAT	MCB (TRCB)	Closed microswitch not noticed	70
C9	PARKING SELECTED	MCB (TRCB)	Parking brake applyed and one of the function activated	71
CA	PARAM LOAD ERROR	MCB (TRCB)	Error in the truck ignition	71
CC	TRAC STUFFING ERR	MCB (TRCB)	Problem of comunication with the traction logic unit	71
CF	FW+BW	MCB (TRCB)	Double request activated	71
D1	TRAC KO	DASHBOARD	The traction logic unit it is not read by the dashboard	67
D2	MCB TRAC KO	DASHBOARD	The MCB control board it is not read by the dashboard	67
D4	PUMP KO	DASHBOARD	The lifting logic unit it is not read by the dashboard	67
D5	MCB MHY KO	DASHBOARD	The MCB control board it is not read by the dashboard	67
D6	JOY KO	DASHBOARD	The armrest board it is not read by the dashboard	68
D8	ERROR READ PIN	DASHBOARD	The MCB prevents the password reading	68
DC	HYDRO KO	DASHBOARD	The slave lifting logic unit is not read by the dashboard	68
DF	EEPROM ERROR	DASHBOARD	Error during the eepreom data uploading	68
E1	INCORRECT START	ARMREST BOARD	Incorrect starting procedure	59
E2	BAD LIFT POT	ARMREST BOARD	Lifting potentiometer failure	60
E3	BAD TILT POT	ARMREST BOARD	Tilting potentiometer failure	61
E4	BAD SIDESH. POT	ARMREST BOARD	Sideshift potentiometer failure	62
E5	BAD IV POT	ARMREST BOARD	4th way potentiometer failure	63
E6	BAD V POT	ARMREST BOARD	5th way potentiometer failure	64
E7	ERR SEAT	ARMREST BOARD	Closed microswitch not noticed	64
E8	INVALID RESTORE STATE	ARMREST BOARD	Failed predefined parameters restore	64
E9	EEPROM CHK SUMERR	ARMREST BOARD	Error during the Eprom data uploading	65
EA	DEFAULT RESTORED	ARMREST BOARD	Unploading of the flash memory data	65
EB	POT NOT ACQUIRED	ARMREST BOARD	Uploading of the flash memory data	65
EC	RAM CHK SUMERR	ARMREST BOARD	Uploading RAM data failed	65
ED	MHYRIO STUFFING ERR	ARMREST BOARD	Comunication problem	65
EE	PUMP STUFFING ERR	ARMREST BOARD	Comunication problem	65
EF	FW+BW	ARMREST BOARD	Balanced inversor failure	66

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WHEN AN ERROR CODE IS DISPLAYED
TRACTION LOGIC UNIT AC5

In this session, in the description "Condition for error detection" if not expressly specified, the wording "traction logic unit" is refered to the TRACTION LOGIC UNIT TLU AC5

01	**WATCHDOG**

Condition for error detection

Self-diagnostic test. The test is executed in working and in standby status .
This alarm can be caused also by an incorrect can-bus functioning.
Check:
- the truck insulation
- the can-bus connections
- replace the traction logic unit

02	**EEPROM KO**

Condition for error detection

Fault in memory area where the adjustment parameters are registered; this alarm inhibits the truck working, the unit will load the default parameters.
Use the function RESET TRAC for reload the default parameters (see paragraph DEFAULT RST).
If the defect continues at the truck switching on, replace the traction logic unit.
If the alarm desappears the parameters previously stored will be cancelled and automatically will be loaded the traction logic unit default parameters.
Set again a possible personalization of the parameters.

03	**LOGIC FAILURE #3**

Condition for error detection

Logic defect.
- Replace the traction logic unit.

04	**LOGIC FAILURE #2**

Condition for error detection

Fault in the hardware section
Failure in the logic hardware section that manages the phase voltage feedback.
The alarms appears also if the CT2 contactor is opened during the running.
Check:
- the pins 5 and 6 of the J50 connector. It could be present a false connection
- the contactor coil (~ 50 ohm)
- the status of the power supply cables connected at the motor
- replace the traction logic unit

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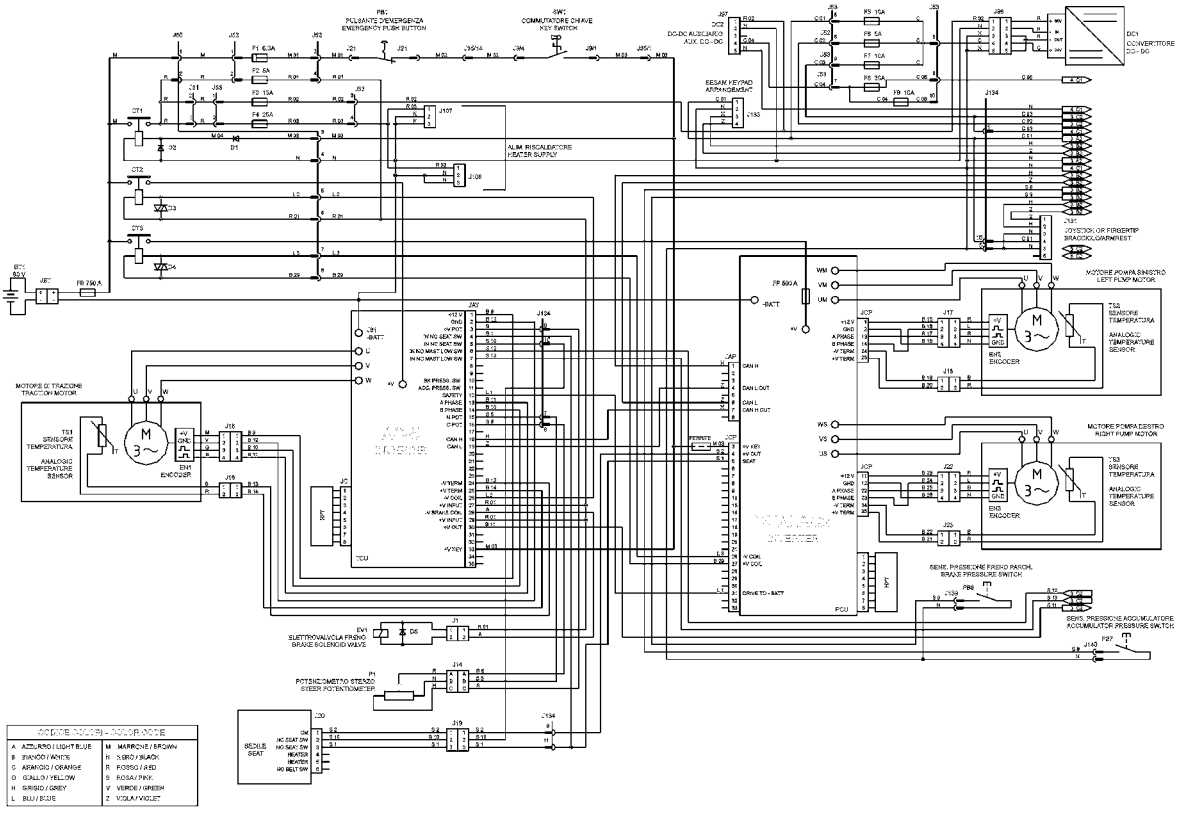
05	LOGIC FAILURE #1

Condition for error detection

Undervoltage/overvoltage protection. This alarm signals that an interruption, produced by an undervoltage/overvoltage protection, is started.
- UNDER voltage: the logic unit keeps controlled the key imput (pin 33, connector JAT, M03 cable of the traction logic unit). If the voltage has a low peak, the alarm is signalled.
- OVER voltage: the logic unit controls the internal capacitors voltage. If the voltage has a high peak during the braking, the alarm is signalled.

The possible reasons are:
a. Battery undervoltage/overvoltage, lost of voltage after the ignition key or after the battery connector.
b. If the alarm is signalled at the truck ignition and appears with the alarm 3E of the PUMP MASTER LOGIC UNIT and the alarm 6D of the PUMP SLAVE LOGIC UNIT, check:
- the key switch
- the battery plug
- the battery components status

c. The alarm appears also when one or more motor phases do not present a correct insulation at a movement request. Check the motor insulation (with disconnected battery): it has to be upper of 10 Mohm. To check the insulation verify the resistance value between the motor power cable and a screw on the chassis. If noticed a low voltage value proceed to remove the single components in order to establish the problem source. Or check the motor power cables insulation
d. Defect in the logic hardware section that controls the protection against the overvoltage.
Logic defect. Replace the traction logic unit.

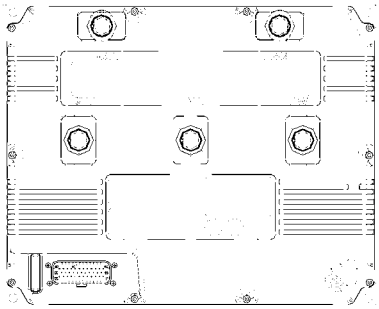


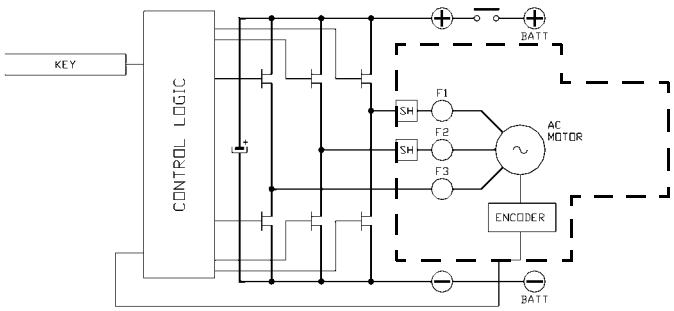
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06	VMN LOW

Condition for error detection

Failure in the VMN test.
The test begins at the switching on; check the connections of the 3 supplying cables from the logic unit to the traction motor, the status of the cables and the status of the coil of the CT2 contactor (~ 50 ohm). If the coil is damaged or disconnected, the truck will signal the alarm at the switching on. If the coil value is ok, proceed following the test below described in order to establish if the failure is produced by an internal or external cause to the traction logic unit:





To determine the cause of the fault, proceed by running one of the tests described below:

- Apply the parking brake and switch off the truck
- Open the compartment and disconnect the battery
- Check the tightening of the power cables on the motor
- Check the tightening of the power cables on the logic
- Check the continuity values between the following points on the traction logic unit using a multimeter (with the logic unit totally disconnected):

Red tip		Black tip		
U	-	+Vb	~	5 Kohm
V	-	+Vb	~	80 Kohm
W	-	+Vb	~	80 Kohm

If noticed values very different from the beside one, disconnect all the cables from the logic unit and verify the values directly on the traction logic unit

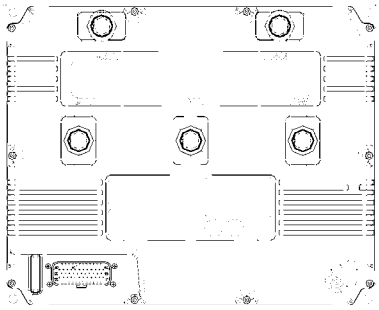
If an opened circuit is noticed replace the traction logic unit.

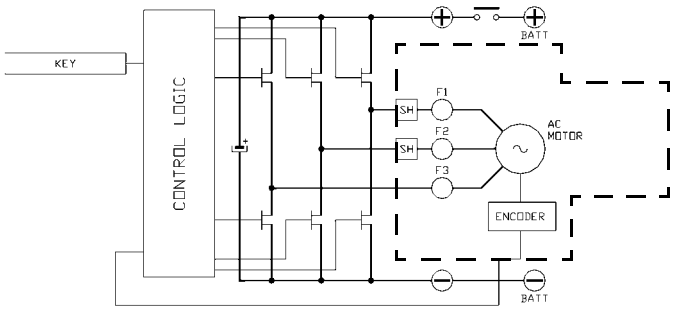
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07	VMN HIGH

Condition for error detection

Failure in the VMN test.
The test starts when the ignition key is turned on and there is no current consumption (machine stationery). The alarm appears if the power circuit connections are open; check the connection of the 3 power cables from the logic unit to the traction motor and the cables condition.





To determine the cause of the fault, proceed by running one of the tests described below:

- Apply the parking brake and switch off the truck
- Open the compartment and disconnect the battery
- Check the tightening of the power cables on the motor
- Check the tightening of the power cables on the logic
- Check the continuity values between the following points on the traction logic unit using a multimeter (with the logic unit totally disconnected):

Red tip		Black tip		
U	-	+Vb	~	5 Kohm
V	-	+Vb	~	80 Kohm
W	-	+Vb	~	80 Kohm

If noticed values very different from the beside one, disconnect all the cables from the logic unit and verify the values directly on the traction logic unit

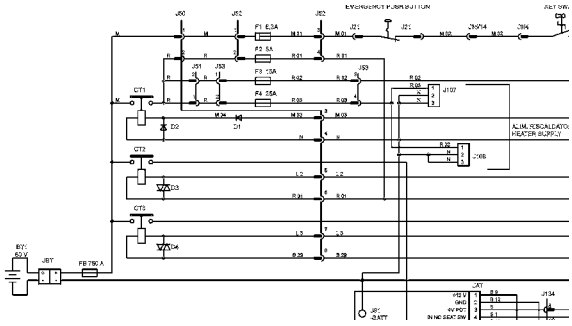
If an opened circuit is noticed replace the traction logic unit.

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08	CONTACTOR OPEN

Condition for error detection

Contactor driver failure. The contactor CT2 is supplied but the contact is not closed.
- Check the coil of the CT2 contactor (~ 50 ohm) and the relevand cables
- Check the contacts status (current passage not permitted)



09	STBY I HIGH

Condition for error detection

Current sensor failure.
- Replace the traction logic unit

B	SLIP PROFILE

Condition for error detection

Error in the memory data where the flowing parameters are loaded.
Make a RESET MASTER to re-load the default parameters.
If the problem presists replace the logic unit.

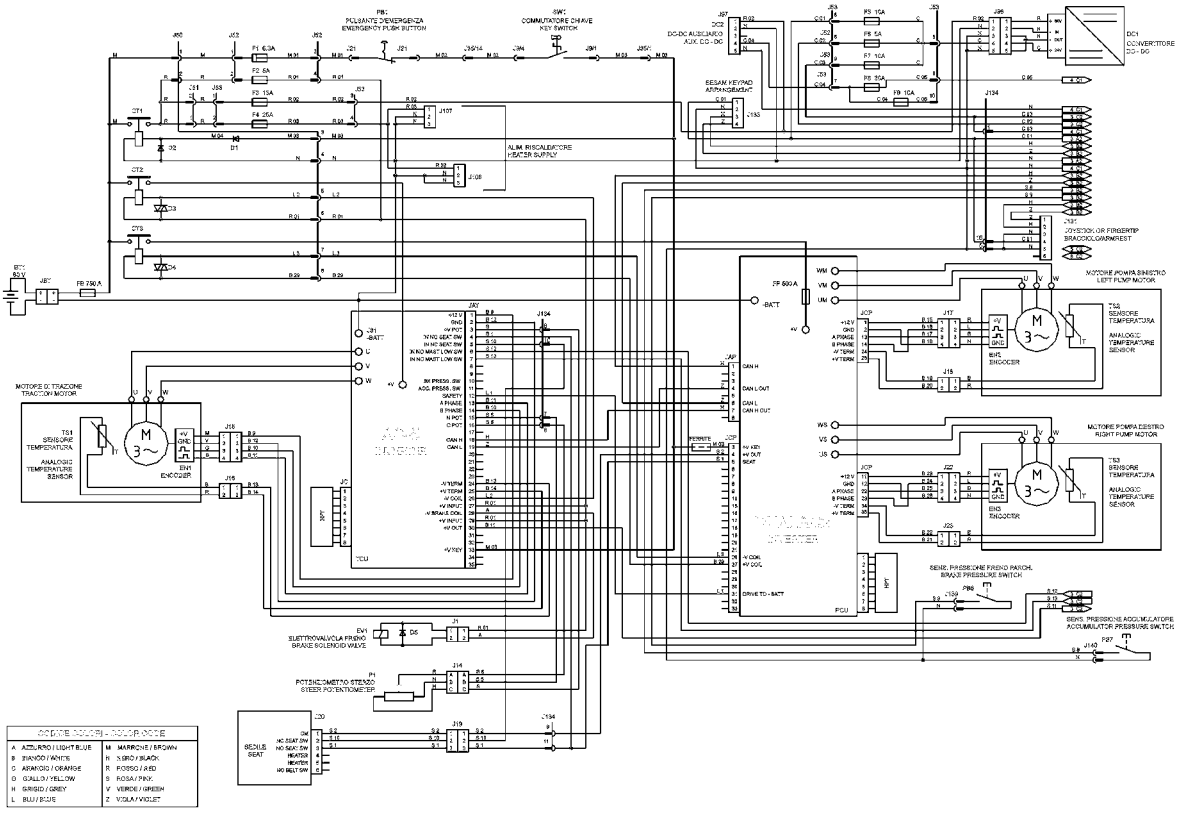
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10	CAPACITOR CHARGE

Condition for error detection

Capacitors not charged. At the ignition, the logic unit tries to charge the capacitors by an internal power resistance and an internal diode, and checks that the capacitors are charged in a fixed time. If this does not occur, an alarm is sent; the main contactor remains opened.

- Check the negative connection between the logic unit and the battery
- Check the voltage at the key entrance (pin 33, connector JAT, cable M03 of the traction logic unit): the battery voltage must be present
- Carry out a bridge between the pins of the key switch (SW1). If the alarms disappears replace the key switch
- Disconnect the J15 and J16 connectors. If the alarm disappears check the status of the temperature sensor and the motor encoder
- If the alarm persists, replace traction logic unit



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11	HIGH TEMPERATURE

Condition for error detection

Logic unit temperature.
The logic unit temperature is upper of 75°C. The maximum current is proportionally reduced at the temperature increase.
At 100°C the current is reduced at 0 and the logic unit is arrested
Check:
- the correct functioning of the fan
- the air channel must be free
- the CONTR TEMP parameter (menu TESTER of the dashboard).

If it happens under 75°C, with the alarm displayed, replace the traction logic unit.
If it happens over 100°C leave the truck stopped whith the key in order to cool down the logic unit.
If it happens over 100°C but the logic unit is cold, replace the traction logic uni

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12	MOTOR TEMPERATURE

Condition for error detection

Traction motor temperature upper to 140°C.
This alarm appears when the motor temperature sensor reaches 140°C.
After the 140°C the logic unit reduces the acceleration proportionally and the current until 150°C.
After the 155°C completely cuts the current.
If the alarm appears when the motor is cold, check:
- that the wiring harness circuit of the temperature sensor is correctly connected
- that the temperature sensor is always opened or has a voltage value upper to the relative voltage value (140°C see the following table)

AMBIENT TEMPERATURE			RESISTANCE			TEMP.	
(°C)	(°F)	(%/K)	MIN.	TYP.	MAX	ERROR (K)	
-40	-40	0,84	340	359	379	±6,48	
-30	-22	0,83	370	391	411	±6,36	
-20	-4	0,82	403	424	446	±6,26	
-10	14	0,80	437	460	483	±6,16	
0	32	0,79	474	498	522	±6,07	
10	50	0,77	514	538	563	±5,98	
20	68	0,75	555	581	607	±5,89	
25	77	0,74	577	603	629	±5,84	
30	86	0,73	599	626	652	±5,79	
40	104	0,71	645	672	700	±5,69	
50	122	0,70	694	722	750	±5,59	
60	140	0,68	744	773	801	±5,47	
70	158	0,66	797	826	855	±5,34	
80	176	0,64	852	882	912	±5,21	
90	194	0,63	910	940	970	±5,06	
100	212	0,61	970	1000	1030	±4,9	
110	230	0,60	1029	1062	1096	±5,31	
120	248	0,58	1089	1127	1164	±5,73	
130	266	0,57	1152	1194	1235	±6,17	Reduction of current
140	284	0,55	1216	1262	1309	±6,63	Reduction of current
150	302	0,54	1282	1334	1385	±7,1	Reduction of current
160	320	0,53	1350	1407	1463	±7,59	
170	338	0,52	1420	1482	1544	±8,1	
180	356	0,51	1492	1560	1628	±8,62	
190	374	0,49	1566	1640	1714	±9,15	
200	392	0,48	1641	1722	1803	±9,71	
210	410	0,47	1719	1807	1894	±10,28	
220	428	0,46	1798	1893	1988	±10,87	
230	446	0,45	1879	1982	2085	±11,47	
240	464	0,44	1962	2073	2184	±12,09	
250	482	0,44	2046	2166	2286	±12,73	
260	500	0,42	2132	2261	2390	±13,44	
270	518	0,41	2219	2357	2496	±14,44	
280	536	0,38	2304	2452	2600	±15,94	
290	554	0,34	2384	2542	2700	±18,26	
300	572	0,29	2456	2624	2791	±22,12	

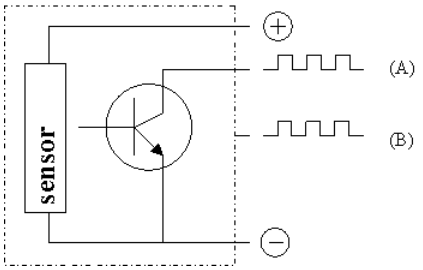
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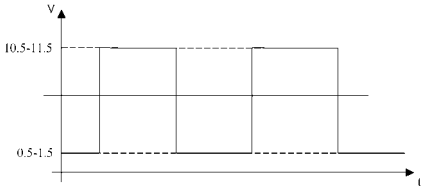
13	ENCODER ERROR

Condition for error detection

Encoder circuit failure.
This alarm shows that the encoder information are uncorrected or absent. The encoder transmits signals only when the motor is working. The alarm is noticed by the logics when 40Hz are passed.
If the alarm appears on the dashboard and the operator makes the reset of the key with the machine stopped, the alarm disappears. If the alarm is signalled before to reach 40 Hz, the problem could be an incorrect insulation of a supplying cable on the chassis: without the correct encoder signals, the machine remains stopped or it moves very slowly. To determine if the problem is from the encoder or from the logic, proceed as follows:
Set up SLIP TRAK on OFF and accelerate slowly.
The increase of the motor speed does not shows necessarily that the problem is connected at the encoder. One of the followings components could be defective:
- Internal logic unit circuit
- Wiring harness
- Encoder

Use an analogic or digital multimeter to determine where the problem is located.





Encoder basic electric diagram.
In the picture it is shown only a signal (A).
The encoder generates two same signals, but out of phase of 90°(A-B).

1. Connect the positive tip of the tester (red) to the positive one of the encoder.
2. Connect the COM tip of the tester (black) to the encoder signal (A).

Depending on the motor position, it will show the following values:

- low signal: 0,5 - 1,5 Volt
- hight signal: 10,5 - 11,5 Volt

It is not possible to read intermediate values with the motor stopped.
If the motor is working, the multimeter will automatically read the Mv (medium value)

Mv= 5,5 - 6,5 Volt

Carrying out this test directly on the logic connectors it is possible to determine if the either signals are good (see upper description) or if the channels are opened or in short circuit. If the signals are good, the problem could be on the logic unit

14	THERMIC SENSOR KO

Condition for error detection

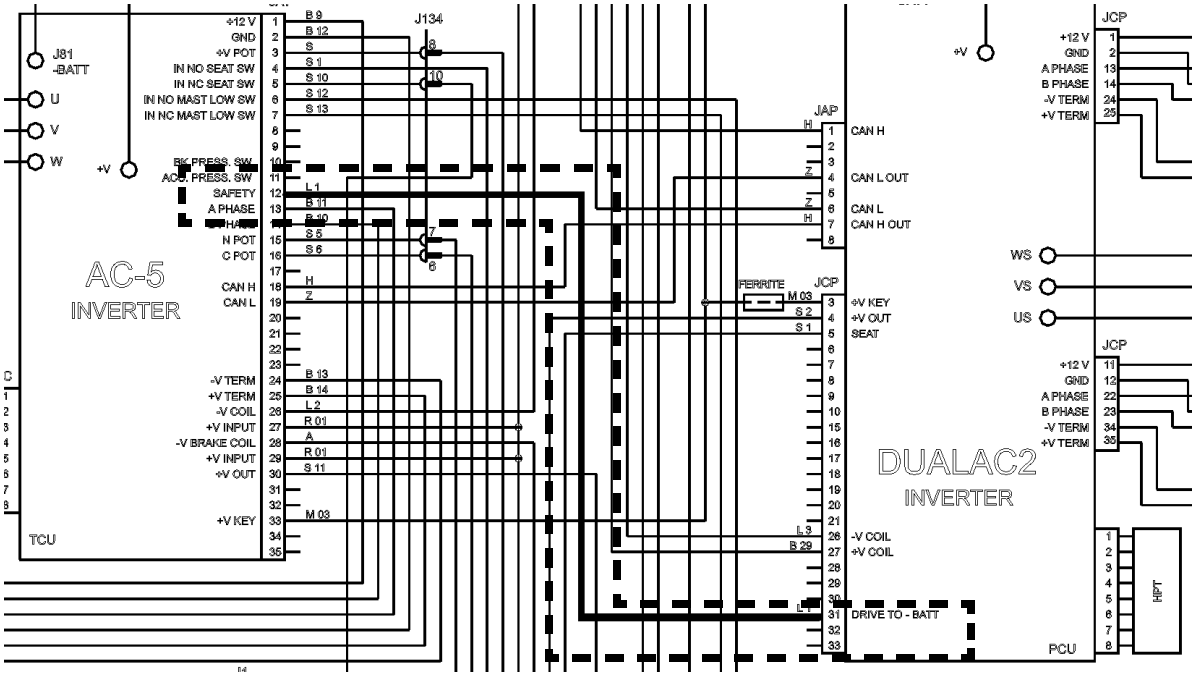
Logic unit termic sensor out of range.
- Replace the traction logic unit.

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15	SAFETY IN

Condition for error detection

Stop of the traction logic unit.
Check:
- Alarms in the traction logic unit
- If YES, the alarm it is only a consequence. Verify the traction logic unit diagnostic
- If NO, presence/connection wiring harness on JCP connector, pin 31, cable L1 of the PUMP LOGIC UNIT DUALAC2
- If NO, that the pin 12, connector JAT, cable L1 of the traction logic unit is a GND



16	CAN BUS KO

Condition for error detection

Notice the communication of another board.
Can-bus comunication failure. The alarm appears if the traction logic unit does not receive information from the MCB board or from the pump logic unit master or slave.
Before replacing any board or logic unit, verify:
- The dashboard alarms, to identify exactly the board or logic unit that does not comunicate
- Can-bus pull-up resistance presence
- dashboard 180 Ohm
- MCB 180 Ohm
- armrest 180 Ohm

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17	WAITING FOR NODE

Condition for error detection

Notice a delay in the data transfer.
This warning alarm signals that the PUMP MASTER LOGIC UNIT and/or the PUMP SLAVE LOGIC UNIT have noticed an alarm.
Check:
- All the alarms referred to the PUMP MASTER LOGIC UNIT and/or the PUMP SLAVE LOGIC UNIT.

18	AUX OUTPUT KO (AUX DRIVER OPEN/AUX DRIVER SHORTED)

Condition for error detection

Failure the driver that controls the solenoid valve coil of the negative brakes.
Verify:
- Correct connection of the EV1 negative brakes solenoid valve coil
- Resistive value of the EV1 (25 Ohm) negative brakes solenoid valve coil; if different replace the coil

If the first two conditions are ok, proceed as following:
- Switch off the truck and disconnect the coil
- Verify that between the 28 PIN, JAT connector, cable A of the traction logic unit and GND there is no continuity

If YES: replace the traction logic unit;
If NO: verify again the connections and the coil status

19	DRIVER SHORTED

Condition for error detection

Contactor driver failure
Verify:
- the F2 (5 A) fuse integrity
- that between the pin 26, JAT connector, cable L2 of the the traction logic unit and the GND there is no continuity.

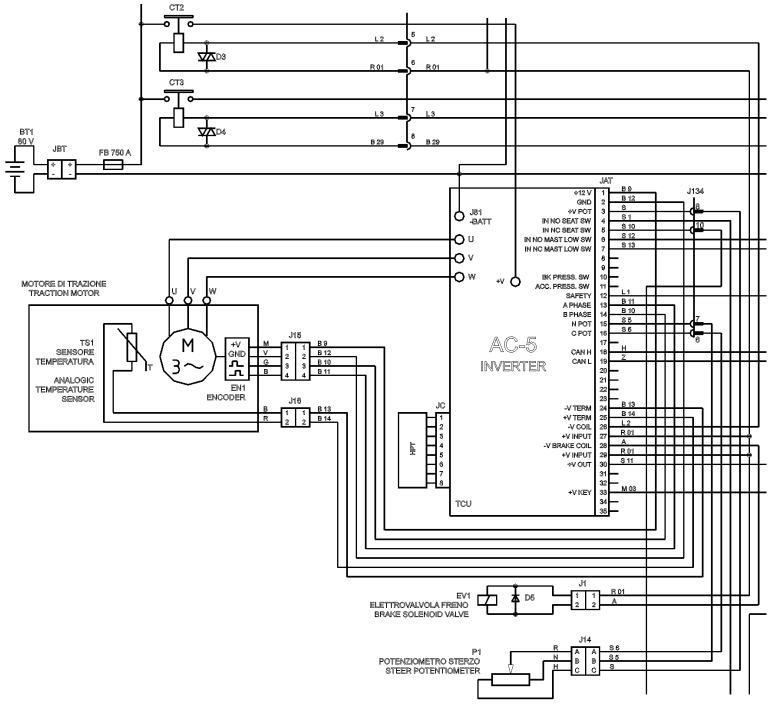
If YES: replace the traction logic unit
If NO: verify the EV1 negative brakes solenoid valve coil status: (Resistive value: 25 Ohm)

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1E	CONTACTOR CLOSED

Condition for error detection

Contactor driver failure.
The logic unit cuts the curret to the CT2 contactor coil, but the contacts remain closed.
Disconnect the battery and check:
- The CT2 contactor windings and the relevant wiring harness
- Clean the contactor connections



20	CONTACTOR DRIVER

Condition for error detection

Contactor driver failure
Defect to the driver that controls the CT2 contactor.
- Replace the traction logic unit.

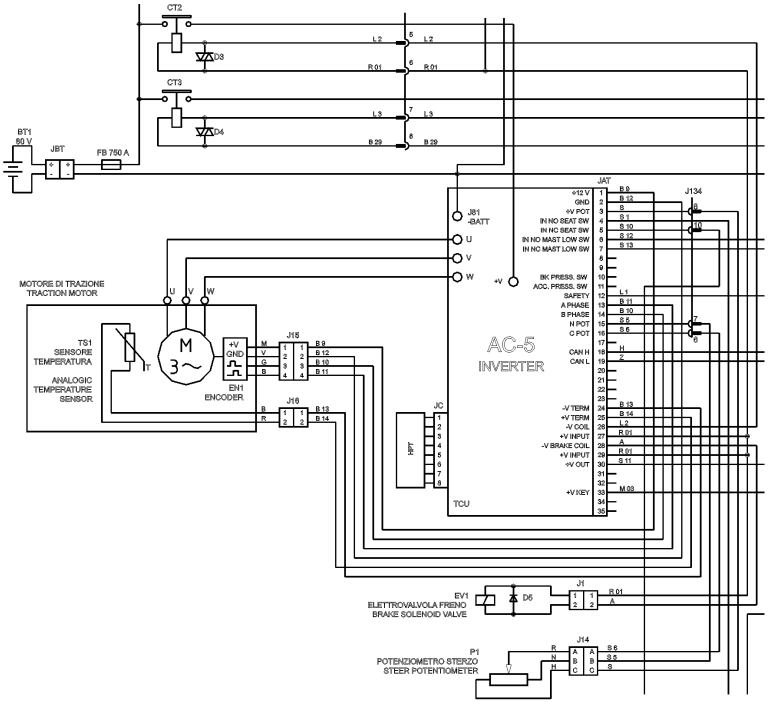
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21	COIL SHORTED

Condition for error detection

Contactor driver failure
CT2 contactor defect.
- Check the coil (50 ohm) status
- Check that there is no short circuit on the wiring harness

If the defect has external causes, replace the traction logic unit.



22	STEER ACQ

Condition for error detection

Steering potentiometer setting not correct
Fault in the steering potentiometer.
Effect the steering potentiometer setting (LEARN TRAC POT).

23	INCORRECT START

Condition for error detection

Incorrect starting procedure.

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24	STEER WIRE KO

Condition for error detection

Steering potentiometer failure
This alarm signals a failure in the steering potentiometer or in the relevant wiring harness.
Verify:
- Correct functioning of the pontentiometer using a multemeter
- Correct wiring harness connection (positive and negative)

28	STEER SENSOR KO

Condition for error detection

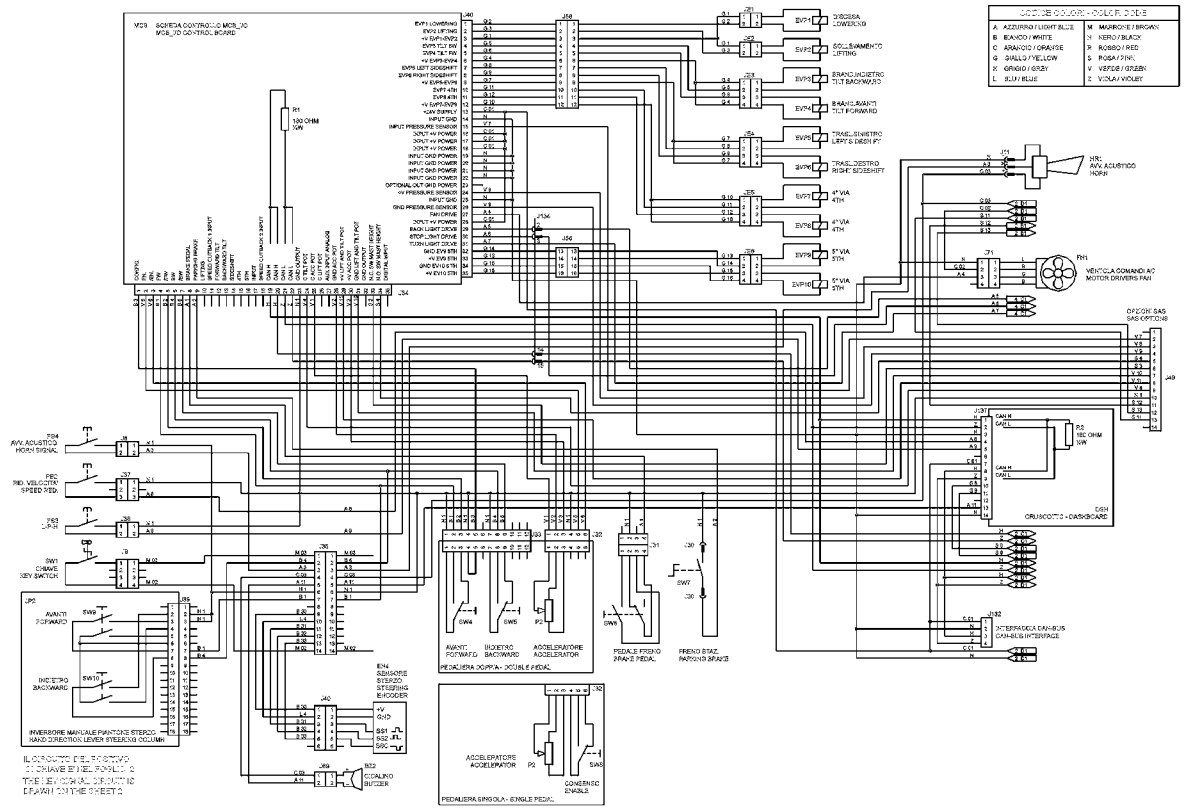
This alarm signals a failure of the steering potentiometer cursor or of the relevant wiring harness.
Verify:
- The correct functioning of the potentiometer with a multimeter
- The correct connection of the wiring harness
- Effect again the steering potentiometer setting (LEARN TRAC POT)

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29	FORW + BACK

Condition for error detection

Incorrect starting procedure.
Check:
- Microswitches for the backward and forward direction and the relevant wiring harness



1A	I=0 EVER

Condition for error detection

Failure on the current sensor.
- Replace the traction logic unit.

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2A	SEAT ERROR

Condition for error detection

Closed microswitch not noticed
Opened seat micro during the traction.
Verify:
- The S2 micro status
- Connection S1 cable, pin 4, JAT connector of the traction logic unit
- Connection HZ cable, pin 5, JCP connector of the LIFTING LOGIC UNIT DUALAC2

If the information of the seat micro is not arriving on both logics the alarm is signalled.

2C	GAIN ACQUISITION

Condition for error detection

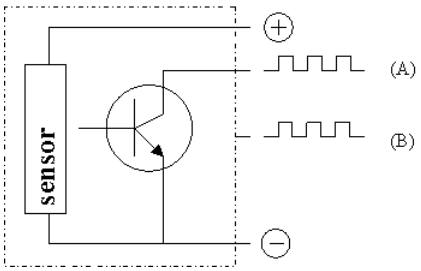
The logic unit is in data acquisition phase.
This warning communicates that the logic is in current acquisition phase.
In this phase the logic is not working.
If the alarm persists after the key reset, replace the logic unit.

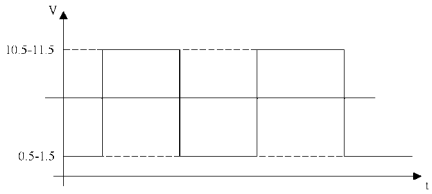
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2D	ENCODER LOCKED

Condition for error detection

Motor encoder failure
Interrupted or disconnected motor encoder.
The alarm appears after 20 seconds approximately with the accelerator pedal pressed.
The machine works at reduced speed and at maximum current.





Encoder basic electric diagram.
In the picture it is shown only a signal (A).
The encoders generate two same signals, but out of phase of 90°(A-B).

1. Connect the positive tip of the tester (red) to the positive one of the encoder.
2. Connect the COM tip of the tester (black) to the encoder signal (A).

Depending on the motor position, it will show the following values:

- low signal: 0,5 - 1,5 Volt
- hight signal: 10,5 - 11,5 Volt

It is not possible to read intermediate values with the motor stopped.
If the motor is working, the multemeter will automatically read the Mv (medium value)

Mv= 5,5 - 6,5 Volt

Carrying out this test directly on the logic connectors it is possible to determine if the either signals are good (see upper description) or if the channels are opened or in shour circuit. If the signals are good, the problem could be on the the logic unit.

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PUMP MASTER LOGIC UNIT

In this session, in the description "Condition for error detection" if not expressly specified, the wording "pump logic unit" is refered to the PUMP LOGIC UNIT PLU DUALAC2

31	WATCHDOG

Condition for error detection

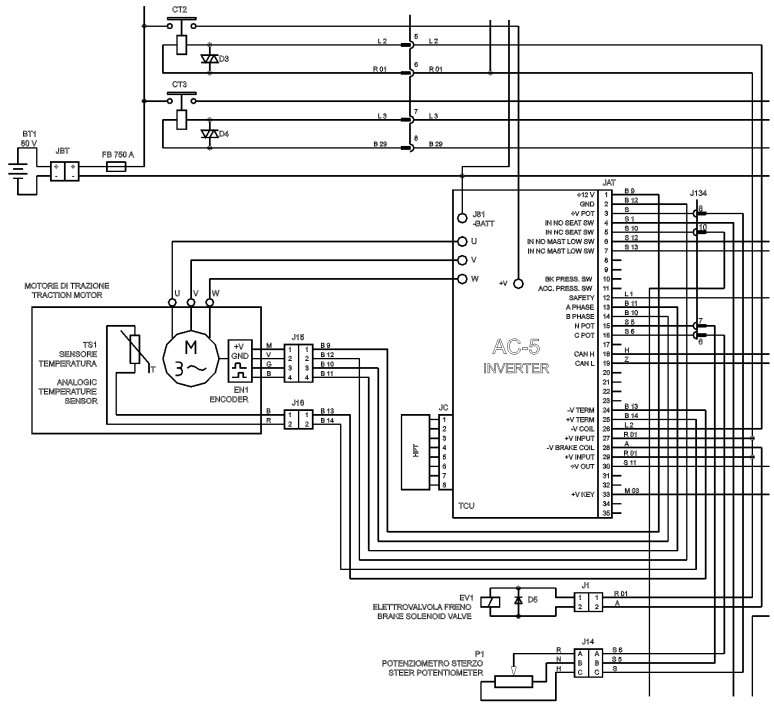
Self-diagnostic test. The test is executed in working and in standby status .
This alarm can be caused also by an incorrect functioning of the can-bus.
Check:
- check the truck insulation
- check the can-bus connections
- replace the pump logic unit

32	COIL SHORTED

Condition for error detection

Contactor driver failure
CT3 contactor defect.
- Check the coil (50 ohm) status
- Check that there is no short circuit on the wiring harness

If the defect has external causes, replace the pump logic unit.



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33	LOGIC FAILURE #3

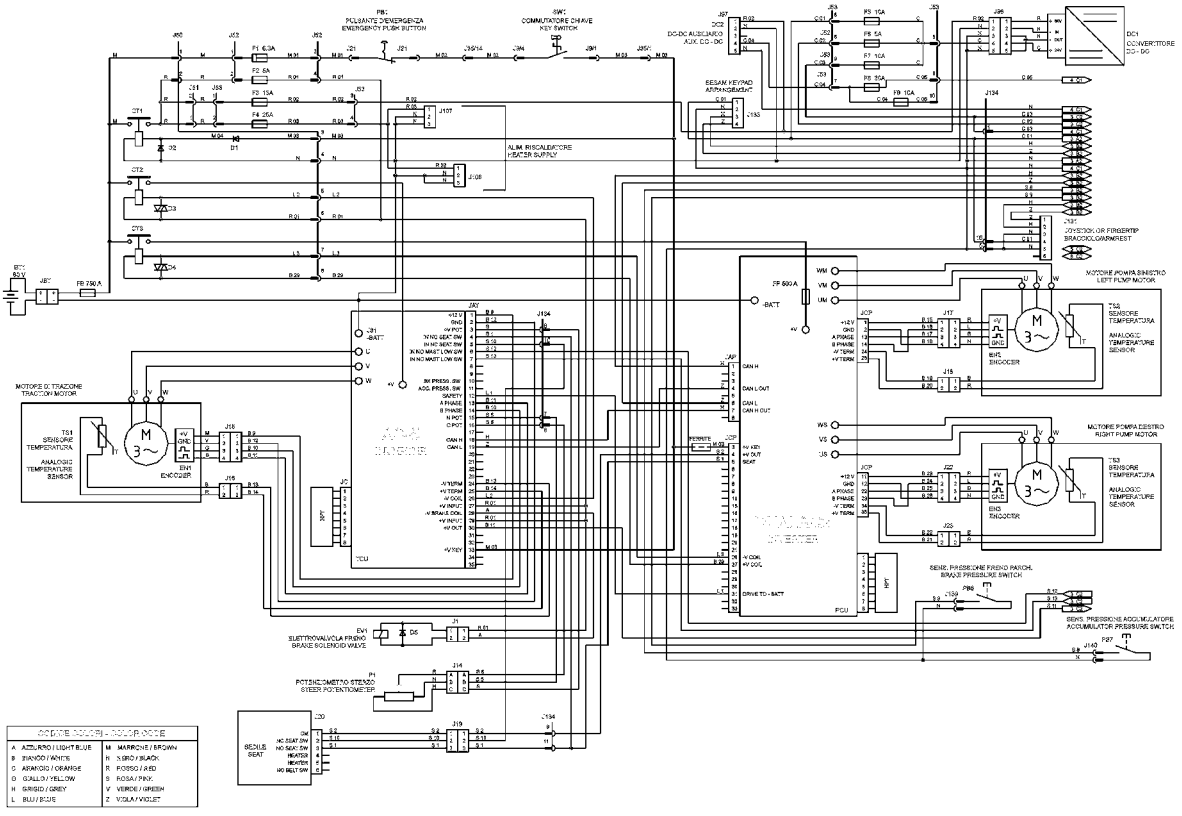
Condition for error detection

Logic defect.
- Replace the pump logic unit.

34	CAPACITOR CHARGE

Condition for error detection

Capacitors not charged. At the ignition, the logic unit tries to charge the capacitors by an internal power resistance and an internal diode, and checks that the capacitors are charged in a fixed time.
If this does not occur, an alarm is sent; the main contactor remains opened.
- Check the negative connection between the logic unit and the battery
- Check the voltage at the key entrance (pin 3, connector JCP, cable M03 of the pump logic unit): the battery voltage must be present
- Carry out a bridge between the pins of the key switch (SW1). If the alarms disappears replace the key switch
- Disconnect the J17 and J18 connectors. If the alarm disappears check the status of the temperature sensor and motor encoder
- If the alarm persists, replace the pump logic unit

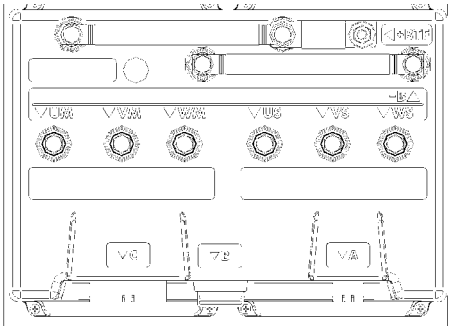


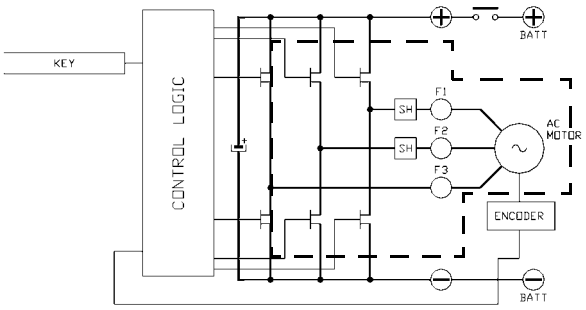
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35	VMN LOW

Condition for error detection

Failure in the VMN test.
The test begins at the switching on; check the connections of the 3 supplying cables from the logic unit to the traction motor, the status of the cables and the status of the coil of the CT3 contactor (~ 50 ohm). If the coil is damaged or disconnected, the truck will signal the alarm at the switching on. If the coil value is ok, proceed following the test below described in order to establish if the failure is produced by an internal or external cause to the pump logic unit:





To determine the cause of the fault, proceed by running one of the tests described below:

- Apply the parking brake and switch off the truck
- Open the compartment and disconnect the battery
- Check the tightening of the power cables on the motor
- Check the tightening of the power cables on the logic
- Check the continuity values between the following points on the pump logic unit using a multimeter (with the logic unit totally disconnected):

Red tip		Black tip		
Um	-	+Vb	~	7 Kohm
Vm	-	+Vb	~	90 Kohm
Wm	-	+Vb	~	90 Kohm

If noticed values very different from the beside one, disconnect all the cables from the logic unit and verify the values directly on the pump logic unit

If an opened circuit is noticed replace pump logic unit.

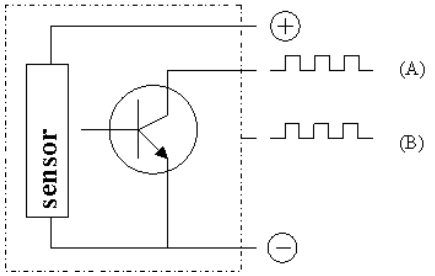
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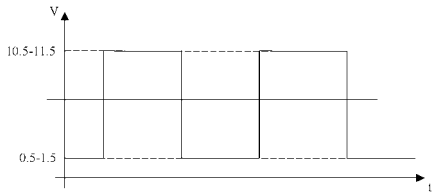
36	ENCODER ERROR

Condition for error detection

Encoder circuit failure.
This alarm shows that the encoder information are uncorrected or absent. The encoder transmits signals only when the motor is working. The alarm is noticed by the logics when 40Hz are passed.
If the alarm appears on the dashboard and the operator makes the reset of the key with the machine stopped, the alarm disappears. If the alarm is signalled before to reach 40 Hz, the problem could be an incorrect insulation of a supplying cable on the chassis: without the correct encoder signals, the machine remains stopped or it moves very slowly. To determine if the problem is from the encoder or from the logic, proceed as follows:
Set up SLIP PUMP M on OFF and accelerate slowly.
The increase of the motor speed does not shows necessarily that the problem is connected at the encoder. One of the followings components could be defective:
- Internal logic unit circuit
- Wiring harness
- Encoder

Use an analogic or digital multimeter to determine where the problem is located.





Encoder basic electric diagram.
In the picture it is shown only a signal (A).
The encoder generates two same signals, but out of phase of 90°(A-B).

1. Connect the positive tip of the tester (red) to the positive one of the encoder.
2. Connect the COM tip of the tester (black) to the encoder signal (A).

Depending on the motor position, it will show the following values:

- low signal: 0,5 - 1,5 Volt
- hight signal: 10,5 - 11,5 Volt

It is not possible to read intermediate values with the motor stopped.
If the motor is working, the multemeter will automatically read the Mv (medium value)

Mv= 5,5 - 6,5 Volt

Carrying out this test directly on the logic connectors it is possible to determine if the either signals are good (see upper description) or if the channels are opened or in short circuit. If the signals are good, the problem could be on the logic unit.

37	CONTACTOR DRIVER

Condition for error detection

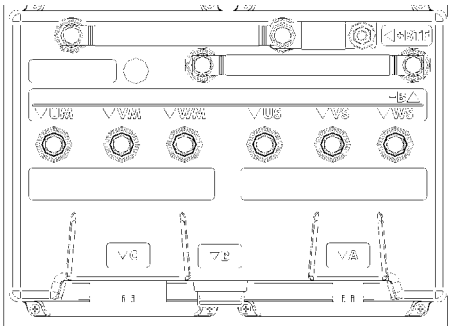
Contactor driver failure
Defect to the driver that controls the CT3 contactor.
- Replace the pump logic unit.

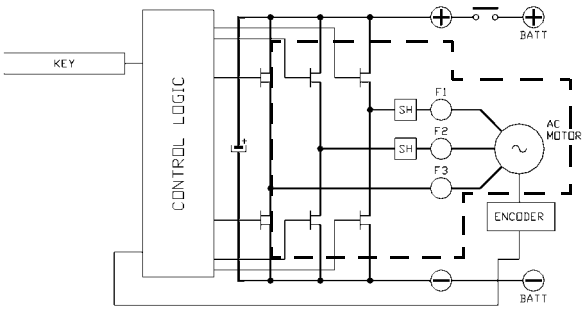
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38	VMN HIGH

Condition for error detection

Failure in the VMN test.
The test starts when the ignition key is turned on and there is no current consumption (machine stationery). The alarm appears if the power circuit connections are open; check the connection of the 3 power cables from the logic unit to the the pump motor and the cables condition.





To determine the cause of the fault, proceed by running one of the tests described below:

To determine the cause of the fault, proceed by running one of the tests described below:
- Apply the parking brake and switch off the truck
- Open the compartment and disconnect the battery
- Check the tightening of the power cables on the motor
- Check the tightening of the power cables on the logic
- Check the continuity values between the following points on the pump logic unit using a multimeter (with the logic unit totally disconnected):

Red tip		Black tip		
Um	-	+Vb	~	7 Kohm
Vm	-	+Vb	~	90 Kohm
Wm	-	+Vb	~	90 Kohm

If noticed values very different from the beside one, disconnect all the cables from the logic unit and verify the values directly on the pump logic unit

If an opened circuit is noticed replace the pump logic unit.

39	I=0 EVER

Condition for error detection

Failure on the current sensor.
- Replace the pump logic unit.

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3A	STBY I HIGH

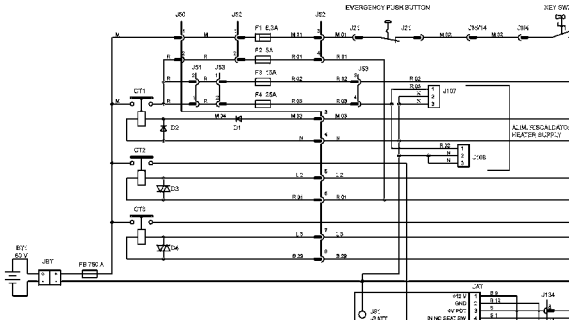
Condition for error detection

Current sensor failure.
- Replace the pump logic unit

3B	CONTACTOR OPEN

Condition for error detection

Contactor driver failure. The contactor CT3 is supplyied but the contact is not closed.
- Check the coil of the CT3 contactor (~ 50 ohm) and the relevand cables
- Check the contacts status (current passage not permitted)



3C	DRIVER SHORTED

Condition for error detection

Contactor driver failure
Switch off the truck and disconnect the CT3 contactor coil.
Verify:
- that between the pin 26, JCP connector, cable L3 of the lifting logic and the GND there is no continuity.
  If YES: replace the pump logic unit
  If NO: verify the CT3 contactor coil status: (Resistive value: 50 Ohm)

3D	AUX OUTPUT KO

Condition for error detection

Failure on the contactor driver.
- If appears replace the pump logic unit

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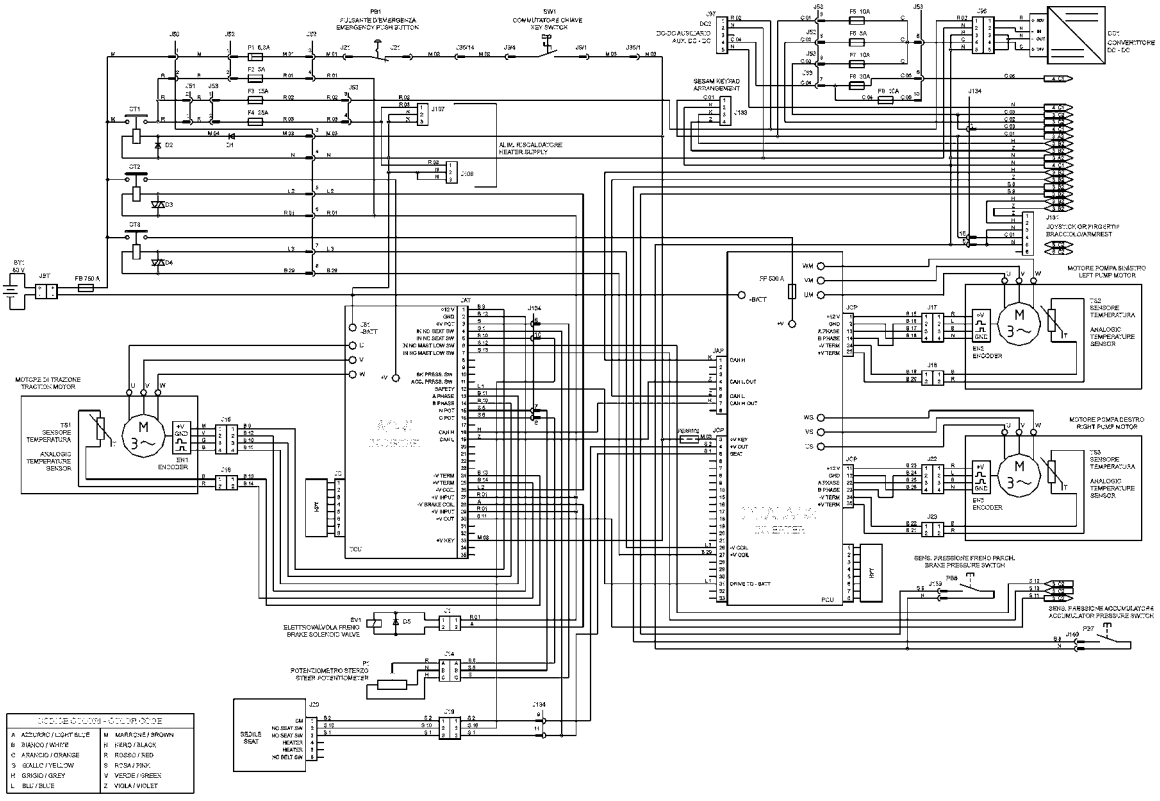
3E	LOGIC FAILURE #1

Condition for error detection

Undervoltage/overvoltage protection. This alarm signals that an interruption, produced by an undervoltage/overvoltage protection, is started.
- UNDER voltage: the logic unit keeps controlled the key input (pin 3, connector JCP, M03 cable of the pump logic unit). If the voltage has a low peak, the alarm is signalled.
- OVER voltage: the logic unit controls the internal capacitors voltage. If the voltage has a high peak during the braking, the alarm is signalled.

The possible reasons are:
a. Battery undervoltage/overvoltage, lost of voltage after the ignition key or after the battery connector.
b. If the alarm is signalled at the truck ignition and appears with the alarm 05 of the TRACTION LOGIC UNIT and the alarm 6D of the PUMP SLAVE LOGIC UNIT, check:
- the key switch
- the battery plug
- the battery components status

c. The alarm appers also when one or more motor phases do not present a correct insulation at a movement request. Check the motor insulation (with disconnected battery): it has to be upper of 10 Mohm. To check the insulation verify the resistence value between the motor power cable and a screw on the chassis. If noticed a low voltage value proceed to remove the single components in order to establish the problem source. Or check the motor power cables insulation
d. Defect in the logic hardware section that controls the protection against the overvoltage.
Logic defect. Replace the pump logic unit.



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3F	LOGIC FAILURE #2

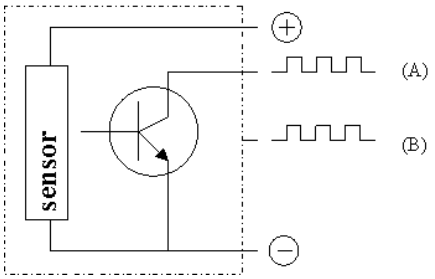
Condition for error detection

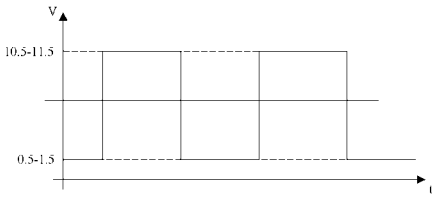
Fault in the hardware section
Failure in the hardware section of the logic that manages the phase voltage feedback.
The alarms apperas also if the CT3 contactor is open during the running.
Check:
- the pins 7 and 8 of the J50 connector. It could be present a false connection
- the contactor coil (~ 50 ohm)
- the status of suppling cables connected at the motor
- replace the pump logic unit

40	MOTOR STALL

Condition for error detection

Motor encoder failure
Interrupted or disconnected motor encoder.
The alarm appears after 8 seconds approximately with the motor pump request.
The machine works at reduced speed and at maximum current.





Encoder basic electric diagram.
In picture it is shown only a signal (A).
The encoders generate two same signals, but out of phase of 90°(A-B).

1. Connect the positive tip of the tester (red) to the positive one of the encoder.
2. Connect the COM tip of the tester (black) to the encoder signal (A).

Depending on the motor position, it will show the following values:

- low signal: 0,5 - 1,5 Volt
- hight signal: 10,5 - 11,5 Volt

It is not possible to read intermediate values with the motor stopped.
If the motor is working, the multemeter will automatically read the Mv (medium value)

Mv= 5,5 - 6,5 Volt

Carrying out this test directly on the logic connectors it is possible to determine if the either signals are good (see upper description) or if the channels are opened or in short circuit. If the signals are good, the problem could be on the logic unit.

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41	SLAVE WARNING

Condition for error detection

Internal logic error
- If appears replace the pump logic unit

42	WAITING FOR NODE

Condition for error detection

Notice a delay in the data transfer.
This warning alarm signals that the TRACTION LOGIC UNIT and/or the PUMP SLAVE LOGIC UNIT notice an alarm.
Check:
- All the alarms referred to the TRACTION LOGIC UNIT and/or the PUMP SLAVE LOGIC UNIT.

43	WRONG SET BATTERY

Condition for error detection

Battery voltage out of range
If the key is inserted on ON, the controller verify the battery voltage and compares it with the parameter set in "SET BATTERY" (Battery setting). If the real value is upper or lower of 20% of the nominal values, it is present a failure.
- Check the battery status and, if necessary, replace the battery.

Note: parameter set battery diplayed in the menu Adjustment, reachable by console

44	HIGH TEMPERATURE

Condition for error detection

Logic unit temperature.
The logic unit temperature is upper of 75°C. The maximum current is proportionally reduced at the temperature increase.
At 100°C the current is reduced at 0 and the logic unit is arrested
Check:
- the correct functioning of the fan
- the air channel must be free
- the PM MOT TMP parameter (menu TESTER of the dashboard).

If it happens under 75°C, with the alarm displayed, replace the pump logic unit.
If it happens over 100°C leave the truck stopped whith the key in order to cool down the logic unit.
If it happens over 100°C but the logic unit is cold, replace the pump logic uni

45	BATTERY LOW

Condition for error detection

Battery discharged

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46	EEPROM OFFLINE

Condition for error detection

Fault in memory area where the adjustment parameters are registered; this alarm inhibits the truck working, the unit will load the default parameters.
If the defect continues after the truck is switched on, replace the pump logic unit.
If the alarm desappears, remember that the parameters previously stored are cancelled and replaced by the default parameters.
Set again a possible personalization of the parameters.

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47	SENS MOT TEMP KO

Condition for error detection

Interrupted or disconnected pump master motor temperature sensor.
Verify:
- Wiring harness
- Sensor resistive value

AMBIENT TEMPERATURE			RESISTANCE			TEMP. ERROR (K)	
(°C)	(°F)	(%/K)	MIN.	TYP.	MAX		
-40	-40	0,84	340	359	379	±6,48	
-30	-22	0,83	370	391	411	±6,36	
-20	-4	0,82	403	424	446	±6,26	
-10	14	0,80	437	460	483	±6,16	
0	32	0,79	474	498	522	±6,07	
10	50	0,77	514	538	563	±5,98	
20	68	0,75	555	581	607	±5,89	
25	77	0,74	577	603	629	±5,84	
30	86	0,73	599	626	652	±5,79	
40	104	0,71	645	672	700	±5,69	
50	122	0,70	694	722	750	±5,59	
60	140	0,68	744	773	801	±5,47	
70	158	0,66	797	826	855	±5,34	
80	176	0,64	852	882	912	±5,21	
90	194	0,63	910	940	970	±5,06	
100	212	0,61	970	1000	1030	±4,9	
110	230	0,60	1029	1062	1096	±5,31	
120	248	0,58	1089	1127	1164	±5,73	
130	266	0,57	1152	1194	1235	±6,17	Reduction of current
140	284	0,55	1216	1262	1309	±6,63	Reduction of current
150	302	0,54	1282	1334	1385	±7,1	Reduction of current
160	320	0,53	1350	1407	1463	±7,59	
170	338	0,52	1420	1482	1544	±8,1	
180	356	0,51	1492	1560	1628	±8,62	
190	374	0,49	1566	1640	1714	±9,15	
200	392	0,48	1641	1722	1803	±9,71	
210	410	0,47	1719	1807	1894	±10,28	
220	428	0,46	1798	1893	1988	±10,87	
230	446	0,45	1879	1982	2085	±11,47	
240	464	0,44	1962	2073	2184	±12,09	
250	482	0,44	2046	2166	2286	±12,73	
260	500	0,42	2132	2261	2390	±13,44	
270	518	0,41	2219	2357	2496	±14,44	
280	536	0,38	2304	2452	2600	±15,94	
290	554	0,34	2384	2542	2700	±18,26	
300	572	0,29	2456	2624	2791	±22,12	

48	THERMIC SENSOR KO

Condition for error detection

Logic unit termic sensor out of range.
- Replace the pump logic unit.

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49	MOTOR TEMPERAT

Condition for error detection

Pump master motor temperature upper to 140°C.
This alarm appears when the motor temperature sensor reaches 140°C.
After the 140°C the logic unit reduces the acceleration proportionally and the current until 150°C.
After the 155°C completely cuts the current.
If the alarm appears when the motor is cold, check:
- that the wiring harness circuit of the temperature sensor is correctly connected
- that the temperature sensor is always opened or has a voltage value upper to the relative voltage value (140°C see the following table)

AMBIENT TEMPERATURE			RESISTANCE			TEMP.	
(°C)	(°F)	(%/K)	MIN.	TYP.	MAX	ERROR (K)	
-40	-40	0,84	340	359	379	±6,48	
-30	-22	0,83	370	391	411	±6,36	
-20	-4	0,82	403	424	446	±6,26	
-10	14	0,80	437	460	483	±6,16	
0	32	0,79	474	498	522	±6,07	
10	50	0,77	514	538	563	±5,98	
20	68	0,75	555	581	607	±5,89	
25	77	0,74	577	603	629	±5,84	
30	86	0,73	599	626	652	±5,79	
40	104	0,71	645	672	700	±5,69	
50	122	0,70	694	722	750	±5,59	
60	140	0,68	744	773	801	±5,47	
70	158	0,66	797	826	855	±5,34	
80	176	0,64	852	882	912	±5,21	
90	194	0,63	910	940	970	±5,06	
100	212	0,61	970	1000	1030	±4,9	
110	230	0,60	1029	1062	1096	±5,31	
120	248	0,58	1089	1127	1164	±5,73	
130	266	0,57	1152	1194	1235	±6,17	Reduction of current
140	284	0,55	1216	1262	1309	±6,63	Reduction of current
150	302	0,54	1282	1334	1385	±7,1	Reduction of current
160	320	0,53	1350	1407	1463	±7,59	
170	338	0,52	1420	1482	1544	±8,1	
180	356	0,51	1492	1560	1628	±8,62	
190	374	0,49	1566	1640	1714	±9,15	
200	392	0,48	1641	1722	1803	±9,71	
210	410	0,47	1719	1807	1894	±10,28	
220	428	0,46	1798	1893	1988	±10,87	
230	446	0,45	1879	1982	2085	±11,47	
240	464	0,44	1962	2073	2184	±12,09	
250	482	0,44	2046	2166	2286	±12,73	
260	500	0,42	2132	2261	2390	±13,44	
270	518	0,41	2219	2357	2496	±14,44	
280	536	0,38	2304	2452	2600	±15,94	
290	554	0,34	2384	2542	2700	±18,26	
300	572	0,29	2456	2624	2791	±22,12	

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4A	DATA ACQUISITION

Condition for error detection

This warning communicates that the logic is in current acquisition phase.
In this phase the logic is not working.
If the alarm persists after the key reset, replace the pump logic unit.

4B	NO CAN MSG N

Condition for error detection

Notice the communication of another board.
Can-bus communication failure. The alarm appears if the logic unit does not receive the information from the MCB board, from the traction logic units, or from the slave pump logic unit.
Before replacing any board, verify:
- The dashboard alarms, to identify exactly the board that does not comunicate
- Can-bus pull-up resistance presence
• Dashboard 180 Ohm
• MCB 180 Ohm
• Armrest 180 Ohm

4C	SLAVE KO

Condition for error detection

Communication fault with SLAVE pump logic unit. The alarm can be originated by:
1. Interferences on the CAN-BUS: in this condition the alarm appears in combination with other alarms

Check:
- truck insulation
- presence of the antistatic discharger if the truck is equipped with no marking tyres
- verify pump logic unit connectors JCP; all the pins must be in line and not lifted
- verify MCB connector J34 and J40; all pin must be correctly connected

2. Defective logic unit

Check:
- communication between MASTER pump logic unit and SLAVE pump logic unit by the console

YES: see point 1
NO: replace pump logic unit

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PUMP SLAVE LOGIC UNIT

In this session, in the description "Condition for error detection" if not expressly specified, the wording "pump logic unit" is refered to the PUMP LOGIC UNIT PLU DUALAC2

61	WATCHDOG

Condition for error detection

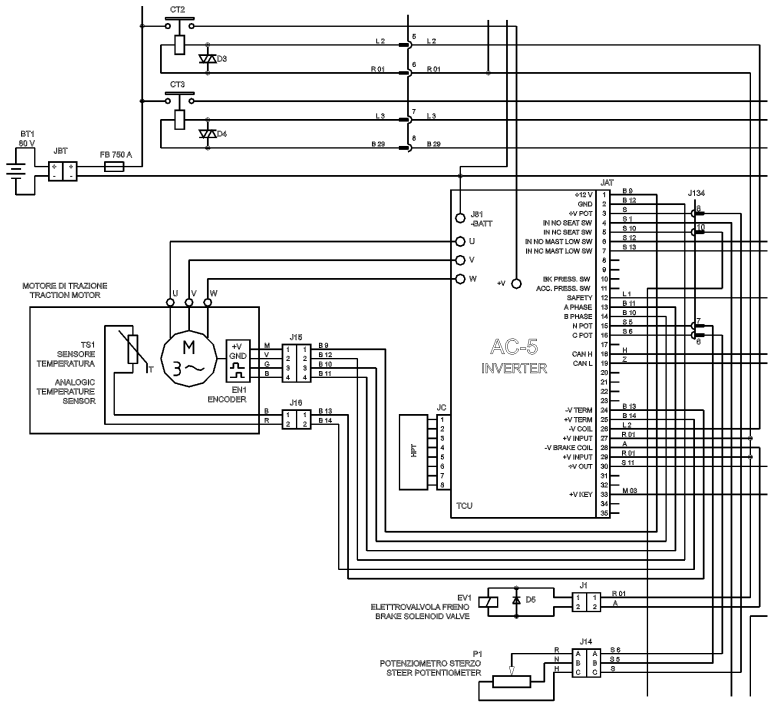
Self-diagnostic test. The test is executed in working and in standby status .
This alarm can be caused also by an incorrect functioning of the can-bus.
Check:
- check the truck insulation
- check the can-bus connections
- replace the pump logic unit

62	COIL SHORTED

Condition for error detection

Contactor driver failure
CT3 contactor defect.
- Check the coil (50 ohm) status
- Check that there is no short circuit on the wiring harness

If the defect has external causes, replace the pump logic unit.



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63	LOGIC FAILURE #3

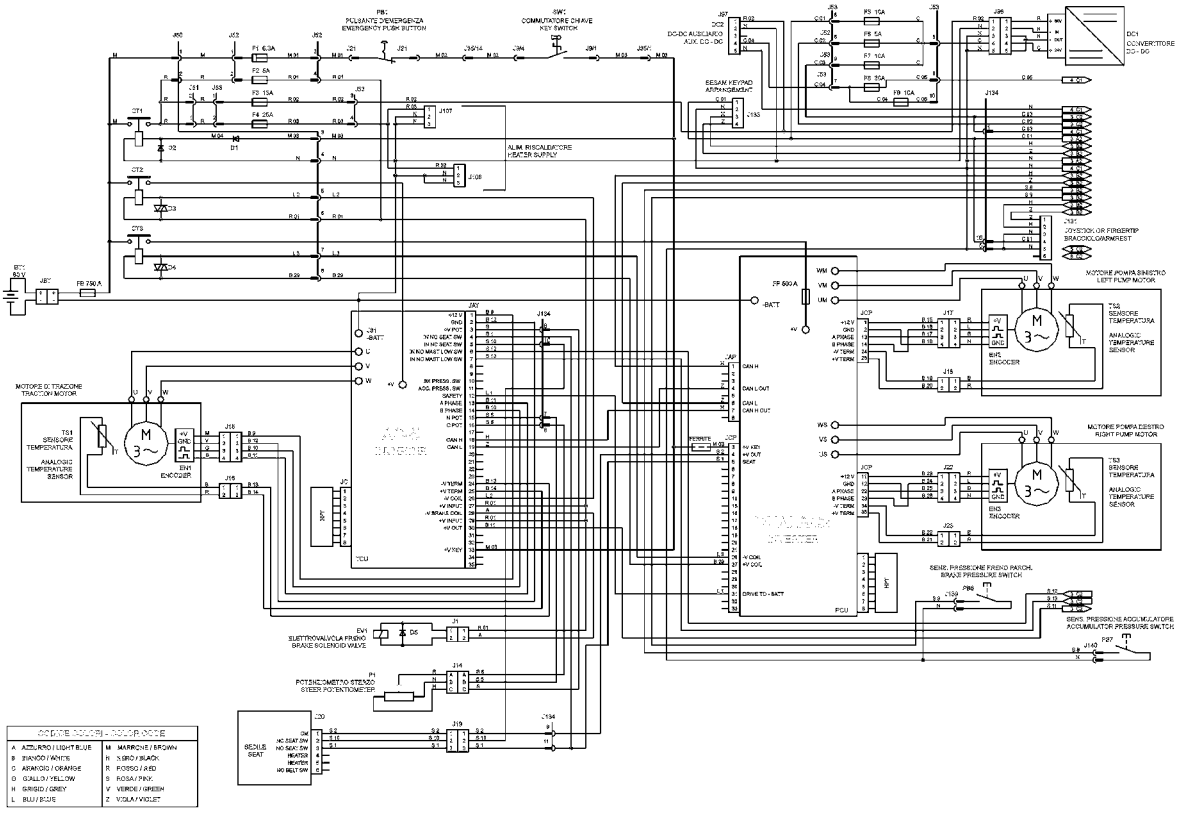
Condition for error detection

Logic defect.
- Replace the pump logic unit.

64	CAPACITOR CHARGE

Condition for error detection

Capacitors not charged. At the ignition, the logic unit tries to charge the capacitors by an internal power resistance and an internal diode, and checks that the capacitors are charged in a fixed time. If this does not occur, an alarm is sent; the main contactor remains open.
- Check the negative connection between the logic unit and the battery
- Check the voltage at the key entrance (pin 3, connector JCP, cable M03 of the pump logic unit): the battery voltage must be present
- Carry out a bridge between the pins of the key switch (SW1). If the alarms disappears replace the key switch
- Disconnect the J17 and J18 connectors. If the alarm disappears check the status of the temperature sensor and of the motor encoder
- If the alarm persists, replace the pump logic unit

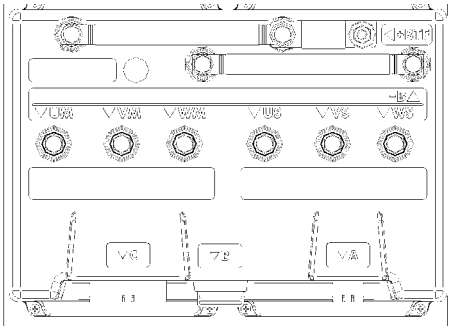


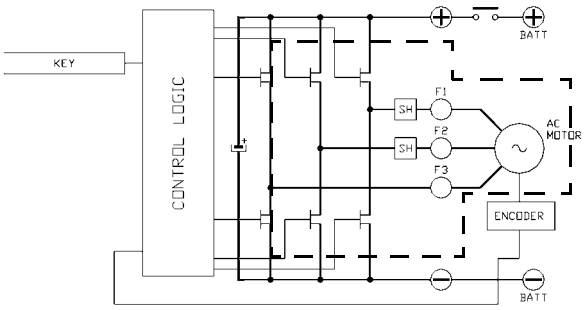
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65	VMN LOW

Condition for error detection

Failure in the VMN test.
The test begins at the switching on; check the connections of the 3 supplying cables from the logic unit to the traction motor, the status of the cables and the status of the coil of the CT3 contactor (~ 50 ohm). If the coil is damager or disconnected, the truck will signal the alarm at the switching on. If the coil value is ok, proceed following the test below described in order to establish if the failure is produced by an internal or external cause to the pump logic unit:





To determine the cause of the fault, proceed by running one of the tests described below:

- Apply the parking brake and switch off the truck
- Open the compartment and disconnect the battery
- Check the tightening of the power cables on the motor
- Check the tightening of the power cables on the logic
- Check the continuity values between the following points on the pump logic unit using a multimeter (with the logic unit totally disconnected):

Red tip		Black tip		
Us	-	+Vb	~	7 Kohm
Vs	-	+Vb	~	90 Kohm
Ws	-	+Vb	~	90 Kohm

If noticed values very different from the beside one, disconnect all the cables from the logic unit and verify the values directly on the pump logic unit

If an opened circuit is noticed replace the pump logic unit.

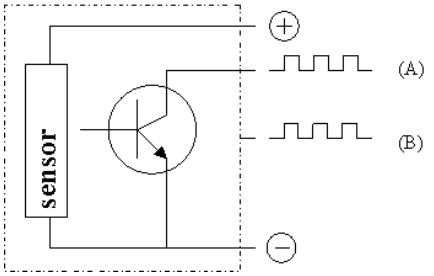
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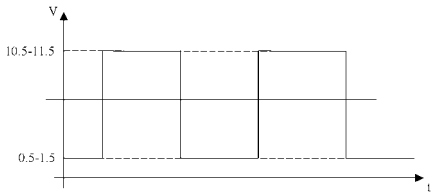
66	ENCODER ERROR

Condition for error detection

Encoder circuit failure.
This alarm shows that the encoder information are uncorrected or absent. The encoder transmits signals only when the motor is working. The alarm is noticed by the logics when 40Hz are passed.
If the alarm appears on the dashboard and the operator makes the reset with the key with the machine stopped, the alarm disappears. If the alarm is signalled before to reach 40 Hz, the problem could be an incorrect insulation of a supplying cable on the chassis: without the correct encoder signals, the machine remains stopped or it moves very slowly. To determine if the problem is from the encoder or from the logic, proceed as follows:
Set up SLIP PUMP S on OFF and accelerate slowly.
The increase of the motor speed does not shows necessarily that the problem is connected at the encoder. One of the followings components could be defective:
- Internal logic unit ciruit
- Wiring harness
- Encoder

Use an analogic or digital multimeter to determine where the problem is located.





Encoder basic electric diagram.
In the picture it is shown only a signal (A).
The encoder generates two same signals, but out
phase of 90°(A-B).

1. Connect the positive tip of the tester (red) to th positive one of the encoder.
2. Connect the COM tip of the tester (black) to th encoder signal (A).

Depending on the motor position, it will show the following values:

- low signal: 0,5 - 1,5 Volt
- hight signal: 10,5 - 11,5 Volt

It is not possible to read intermediate values with th motor stopped.
If the motor is working, the multemeter will automatically read the Mv (medium value)

Mv= 5,5 - 6,5 Volt

Carrying out this test directly on the logic connecto it is possible to determine if the either signals are good (see upper description) or if the channels are opened or in short circuit. If the signals are good, th problem could be on the logic unit.

67	CONTACTOR DRIVER

Condition for error detection

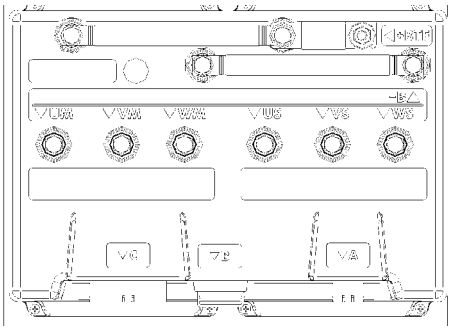
Contactor driver failure
Defect to the driver that controls the CT3 contactor.
- Replace the pump logic unit.

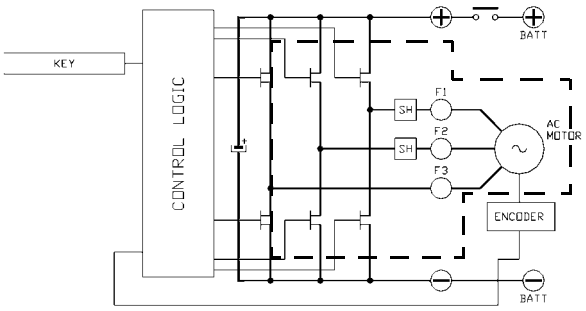
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68	VMN HIGH

Condition for error detection

Failure in the VMN test.
The test starts when the ignition key is turned in ON position and there is no current consumption (machine stationery). The alarm appears if the power circuit connections are open; check the connection of the 3 power cables from the logic unit to the pump motor and the cables condition.





To determine the cause of the fault, proceed by running one of the tests described below:

- Apply the parking brake and switch off the truck
- Open the compartment and disconnect the battery
- Check the tightening of the power cables on the motor
- Check the tightening of the power cables on the logic
- Check the continuity values between the following points on the pump logic unit using a multimeter (with the logic unit totally disconnected):

Red tip		Black tip		
Us	-	+Vb	~	7 Kohm
Vs	-	+Vb	~	90 Kohm
Ws	-	+Vb	~	90 Kohm

If noticed values very different from the beside one, disconnect all the cables from the logic unit and verify the values directly on the pump logic unit

If an opened circuit is noticed replace the pump logic unit.

69	I=0 EVER

Condition for error detection

Failure on the current sensor.
- Replace the pump logic unit.

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6A	STBY I HIGH

Condition for error detection

Current sensor failure.
- Replace the pump logic unit

6B	DRIVER SHORTED

Condition for error detection

Contactor driver failure
Switch off the truck and disconnect the CT3 contactor coil.
Verify:
- that between the pin 26, JCP connector, cable L3 of the lifting logic and the GND there is no continuity.
  If YES: replace the pump logic unit
  If NO: verify the CT3 contactor coil status: (Resistive value: 50 Ohm)

6C	AUX OUTPUT KO

Condition for error detection

Failure on the contactor driver.
- If appears replace the pump logic unit

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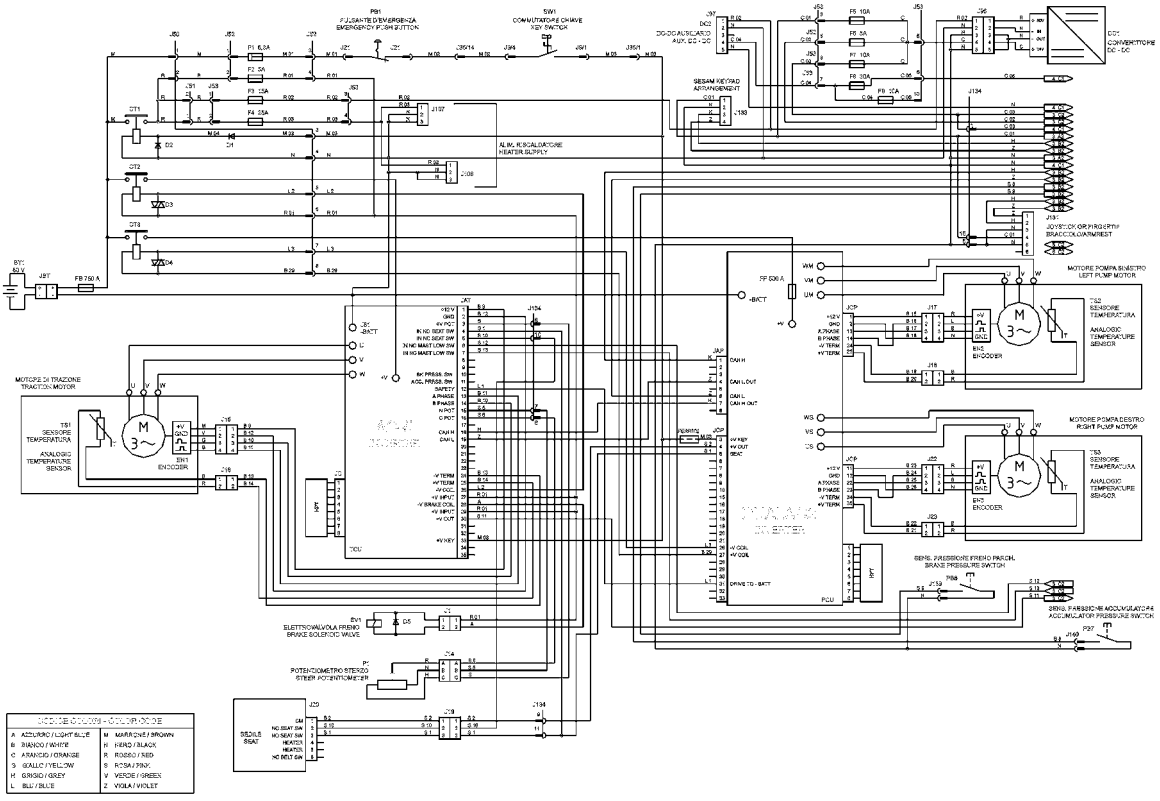
6D	LOGIC FAILURE #1

Condition for error detection

Undervoltage/overvoltage protection. This alarm signals that an interruption, produced by an undervoltage/overvoltage protection, is started.
- UNDER voltage: the logic unit keeps controlled the key imput (pin 3, connector JCP, M03 cable of the pump logic unit). If the voltage has a low peak, the alarm is signalled.
- OVER voltage: the logic unit controls the internal capacitors voltage. If the voltage has a high peak during the braking, the alarm is signalled.

The possible reasons are:
a. Battery undervoltage/overvoltage, lost of voltage after the ignition key or after the battery connector.
b. If the alarm is signalled at the truck ignition and appears with the alarm 05 of the TRACTION LOGIC UNIT and the alarm 3E of the PUMP MASTER LOGUC UNIT, check:
- the key switch
- the battery plug
- the battery components status

c. The alarm appears also when one or more motor phases do not present a correct insulation at a movement request. Check the motor insulation (with disconnected battery): it has to be upper of 10 Mohm. To check the insulation verify the resistence value between the motor power cable and a screw on the chassis. If noticed a low voltage value proceed to remove the single components in order to establish the problem source. Or check the motor power cables insulation
d. Defect in the logic hardware section that controls the protection against the overvoltage.
Logic defect. Replace the pump logic unit.



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6E	LOGIC FAILURE #2

Condition for error detection

Fault in the hardware section
Failure in the hardware section of the logic that manages the phase voltage feedback.
The alarms appearas also if the CT3 contactor is opened during the running.
Check:
- the pins 7 and 8 of the J50 connector. It could be present a false connection
- the contactor coil (~ 50 ohm)
- the status of supplying cables connected at the motor
- replace the pump logic unit

6F	WAITING FOR MAST

Condition for error detection

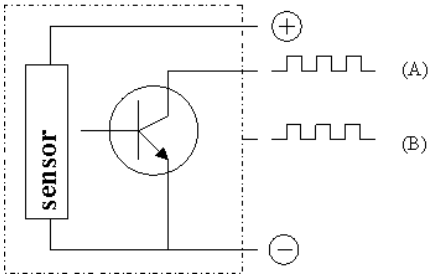
Notice a delay in the data transfer.
This warning alarm signals that the TRACTION LOGIC UNIT and/or the PUMP MASTER LOGIC UNIT notice an alarm.
Check:
- All the alarm referred to the TRACTION LOGIC UNIT and/or the PUMP SLAVE LOGIC UNIT.

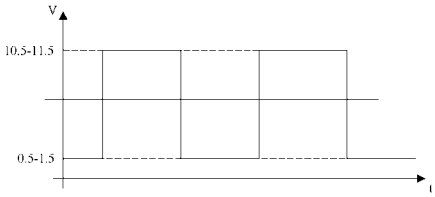
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70	MOTOR STALL

Condition for error detection

Motor encoder failure
Interrupted or disconnected motor encoder.
The alarm appears after 8 seconds approximately with the accelerator pedal pressed.
The machine works at reduced speed and at maximum current.





Encoder basic electric diagram.
In the picture it is shown only a signal (A).
The encoders generate two same signals, but out of phase of 90°(A-B).

3. Connect the positive tip of the tester (red) to the positive one of the encoder.
4. Connect the COM tip of the tester (black) to the encoder signal (A).

Depending on the motor position, it will show the following values:

- low signal: 0,5 - 1,5 Volt
- hight signal: 10,5 - 11,5 Volt

It is not possible to read intermediate values with the motor stopped.
If the motor is working, the multemeter will automatically read the Mv (medium value)

Mv= 5,5 - 6,5 Volt

Carrying out this test directly on the logic connectors it is possible to determine if the either signals are good (see upper description) or if the channels are opened or in short circuit. If the signals are good, the problem could be on the electronic control.

71	NO CAN MESG N.° 11 - UNUSED

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72	HIGH TEMPERATURE

Condition for error detection

Logic unit temperature.
The logic unit temperature is upper of 75°C. The maximum current is proportionally reduced at the temperature increase.
At 100°C the current is reduced at 0 and the logic unit is arrested
Check:
- the correct functioning of the fan
- the air channel must be free
- the PS MOT TMP parameter (menu TESTER of the dashboard).

If it happens under 75°C, with the alarm displayed, replace the traction logic unit.
If it happens over 100°C leave the truck stopped whith the key in order to cool down the logic unit.
If it happens over 100°C but the logic unit is cold, replace the pump logic unit

73	INPUT MISMATCH

Condition for error detection

Control internal error.
Replace the pump logic unit.

74	EEPROM OFFLINE

Condition for error detection

Fault in memory area where the adjustment parameters are registered; this alarm inhibits the truck working, the unit will load the default parameters.
If the defect continues after the truck is switched on, replace the pump logic unit.
If the alarm desappears, remember that the parameters previously stored are cancelled and replaced by the default parameters.
Set again a possible personalization of the parameters.

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76	SENS MOT TEMP KO

Condition for error detection

Interrupted or disconnected pump slave motor temperature sensor.
Verify:
- Wiring harness
- Sensor resistive value

AMBIENT TEMPERATURE			RESISTANCE			TEMP. ERROR (K)	
(°C)	(°F)	(%/K)	MIN.	TYP.	MAX		
-40	-40	0,84	340	359	379	±6,48	
-30	-22	0,83	370	391	411	±6,36	
-20	-4	0,82	403	424	446	±6,26	
-10	14	0,80	437	460	483	±6,16	
0	32	0,79	474	498	522	±6,07	
10	50	0,77	514	538	563	±5,98	
20	68	0,75	555	581	607	±5,89	
25	77	0,74	577	603	629	±5,84	
30	86	0,73	599	626	652	±5,79	
40	104	0,71	645	672	700	±5,69	
50	122	0,70	694	722	750	±5,59	
60	140	0,68	744	773	801	±5,47	
70	158	0,66	797	826	855	±5,34	
80	176	0,64	852	882	912	±5,21	
90	194	0,63	910	940	970	±5,06	
100	212	0,61	970	1000	1030	±4,9	
110	230	0,60	1029	1062	1096	±5,31	
120	248	0,58	1089	1127	1164	±5,73	
130	266	0,57	1152	1194	1235	±6,17	Reduction of current
140	284	0,55	1216	1262	1309	±6,63	Reduction of current
150	302	0,54	1282	1334	1385	±7,1	Reduction of current
160	320	0,53	1350	1407	1463	±7,59	
170	338	0,52	1420	1482	1544	±8,1	
180	356	0,51	1492	1560	1628	±8,62	
190	374	0,49	1566	1640	1714	±9,15	
200	392	0,48	1641	1722	1803	±9,71	
210	410	0,47	1719	1807	1894	±10,28	
220	428	0,46	1798	1893	1988	±10,87	
230	446	0,45	1879	1982	2085	±11,47	
240	464	0,44	1962	2073	2184	±12,09	
250	482	0,44	2046	2166	2286	±12,73	
260	500	0,42	2132	2261	2390	±13,44	
270	518	0,41	2219	2357	2496	±14,44	
280	536	0,38	2304	2452	2600	±15,94	
290	554	0,34	2384	2542	2700	±18,26	
300	572	0,29	2456	2624	2791	±22,12	

77	THERMIC SENSOR KO

Condition for error detection

Logic unit termic sensor out of range.
- Replace the pump logic unit.

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78	MOTOR TEMPERAT

Condition for error detection

Pump slave motor temperature upper to 140°C.
This alarm appears when the motor temperature sensor reaches 140°C.
After the 140°C the logic unit reduces the acceleration proportionally and the current until 150°C.
After the 155°C completely cuts the current.
If the alarm appears when the motor is cold, check:
- that the wiring harness circuit of the temperature sensor is correctly connected
- that the temperature sensor is always opened or has a voltage value upper to the relative voltage value (140°C see the following table)

AMBIENT TEMPERATURE			RESISTANCE			TEMP.	
(°C)	(°F)	(%/K)	MIN.	TYP.	MAX	ERROR (K)	
-40	-40	0,84	340	359	379	±6,48	
-30	-22	0,83	370	391	411	±6,36	
-20	-4	0,82	403	424	446	±6,26	
-10	14	0,80	437	460	483	±6,16	
0	32	0,79	474	498	522	±6,07	
10	50	0,77	514	538	563	±5,98	
20	68	0,75	555	581	607	±5,89	
25	77	0,74	577	603	629	±5,84	
30	86	0,73	599	626	652	±5,79	
40	104	0,71	645	672	700	±5,69	
50	122	0,70	694	722	750	±5,59	
60	140	0,68	744	773	801	±5,47	
70	158	0,66	797	826	855	±5,34	
80	176	0,64	852	882	912	±5,21	
90	194	0,63	910	940	970	±5,06	
100	212	0,61	970	1000	1030	±4,9	
110	230	0,60	1029	1062	1096	±5,31	
120	248	0,58	1089	1127	1164	±5,73	
130	266	0,57	1152	1194	1235	±6,17	Reduction of current
140	284	0,55	1216	1262	1309	±6,63	Reduction of current
150	302	0,54	1282	1334	1385	±7,1	Reduction of current
160	320	0,53	1350	1407	1463	±7,59	
170	338	0,52	1420	1482	1544	±8,1	
180	356	0,51	1492	1560	1628	±8,62	
190	374	0,49	1566	1640	1714	±9,15	
200	392	0,48	1641	1722	1803	±9,71	
210	410	0,47	1719	1807	1894	±10,28	
220	428	0,46	1798	1893	1988	±10,87	
230	446	0,45	1879	1982	2085	±11,47	
240	464	0,44	1962	2073	2184	±12,09	
250	482	0,44	2046	2166	2286	±12,73	
260	500	0,42	2132	2261	2390	±13,44	
270	518	0,41	2219	2357	2496	±14,44	
280	536	0,38	2304	2452	2600	±15,94	
290	554	0,34	2384	2542	2700	±18,26	
300	572	0,29	2456	2624	2791	±22,12	

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79	MASTER WARNING

Condition for error detection

Internal logic error
- If appears replace the pump logic unit

7A	DATA ACQUISITION

Condition for error detection

This warning communicates that the logic is in current acquisition phase.
In this phase the logic is not working.
If the alarm persists after the key reset, replace the pump logic unit.

7B	NO CAN MSG N

Condition for error detection

Notice the communicatiun of another board.
Can-bus communication failure. The alarm appears if the logic unit does not receive information from the MCB board, from the traction logic units, or from the master pump logic unit.
Before to replace every board, verify:
- The dashboard alarms, to identify exactly the board that does not comunicate
- Can-bus pull-up resistance presence
• Dashboard 180 Ohm
• MCB 180 Ohm
• Armrest 180 Ohm

7C	MASTER KO

Condition for error detection

Communication fault from MASTER pump logic unit. The alarm can be originated by:
1. Interferences on the CAN-BUS: in this condition the alarm appears in combination with other alarms

Check:
- truck insulation
- presence of the antistatic discharger if the truck is equipped with no marking tyres
- verify pump logic unit connectors JCP; all the pins must be in line and not lifted
- verify MCB connector J34 and J40; all pin must be correctly connected

2. Defective logic unit

Check:
- communication between SLAVE pump logic unit and MASTER pump logic unit by the console

YES: see point 1
NO: replace pump logic unit

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MCB BOARD (section EVCB)

In this session, in the description "Condition for error detection" if not expressly specified, the wording "board" is refered to the MCB BOARD

A1	**DOUBLE REQ - UNUSED**

A2	**RELOAD_PARAM_WARN**

Condition for error detection

The alarm signals the occured parameters loading. The truck remains in pre-operational status.
- Switch off and switch on again the truck.

A3	**PARAM. LOAD ERROR**

Condition for error detection

The alarm signals that the board has not loaded the memory parameters. The truck remains in pre-operational status.
Switch off and switch on again the truck:
- If the alarm persists, replace the board
- If the alarm disappears, but the truck has a rough behavior replace the board.

A4	**NOT_REP_ERROR**

Condition for error detection

The alarm signals that the board is waiting information. The truck remains in pre-operational status.
- Insert the truck serial number (LEARNING function SERIAL NUMBER parameter)

Switch off and switch on the truck.

A5	**CHKSUM_ERROR - UNUSED**

Condition for error detection

Error in the board ram
- Switch off and switch on the truck
- If the alarm persists, replace the board

A6	**BOOT_ERROR**

Condition for error detection

The alarm signals that the board is waiting for information from the traction logic unit or the lifting logic unit. The truck remains in pre-operational status. Verify:
- Alarms on the dashboard to identify which logic unit is not communicating.

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A7	HI SIDE DRIVER SHORT

Condition for error detection

The alarm signals an internal problem of the MCB board.
- Replace the MCB board.

A8	EV1_1 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP1 lowering solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)

If the problem persists replace the MCB board.

A9	EV2_1 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP2 lifting solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)

If the problem persists replace the MCB board.

AA	EV1_2 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP3 backward tilting solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)

If the problem persists replace the MCB board.

AB	EV2_2 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP4 forward tilting solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)

If the problem persists replace the MCB board.

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AC	EV1_3 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP6 right sideshift solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

AD	EV2_3 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP5 left sideshift solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

AE	EV1_4 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP7 4th way solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

AF	EV2_4 OPEN

Condition for error detection

The alarm signals a failure at the coil of the EVP8 4th way solenoid valve. The coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

B0	TRCB_MICRO_ERROR

Condition for error detection

The alarm signals an internal problem of the MCB board.
- Replace the MCB board.

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B1	GROUP1 DRIVER SHORT

Condition for error detection

The alarm signals a failure at one of the coils of the group 1 of the electroproportional oil control valve: EVP1 lowering solenoid valve or EVP2 lifting solenoid valve.
A coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

B2	GROUP2 DRIVER SHORT

Condition for error detection

The alarm signals a failure at one of the coils of the group 2 of the electroproportional oil control valve: EVP3 backward tilting solenoid valve or EVP4 forward tilting solenoid valve.
A coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

B3	GROUP3 DRIVER SHORT

Condition for error detection

The alarm signals a failure at one of the coils of the group 3 of the electroproportional oil control valve: EVP6 right sideshift solenoid valve or EVP5 left sideshift solenoid valve.
A coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

B4	GROUP4 DRIVER SHORT

Condition for error detection

The alarm signals a failure at one of the coils of the group 4 of the electroproportional oil control valve: EVP7 4th way solenoid valve or EVP8 4th way solenoid valve.
A coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)
If the problem persists replace the MCB board.

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B5	AUX_OUT_SHORT

Condition for error detection

The alarm signals a failure at one of the coils of the group 5 of the electroproportional oil control valve: EVP9 5th way solenoid valve or EVP10 5th way solenoid valve.
A coil could be opened or disconnected.
Check:
- Value in Ohm of the coils and the relevant wiring harness (see chapter 15)

If the problem persists replace the MCB board.

B6	DASH_KO

Condition for error detection

The alarm signals a comunication problem between the MCB board and the dashboard.
The alarm remains stored in the logbook of the MCB board alarms.
- Replace the dashboard.

B7	ERR_SEAT

Condition for error detection

The alarm signals the seat micro opened with activated hydraulic functions.

B8	JOY_STUFFING_ERR

Condition for error detection

The alarm signals a communication problem between the MCB board and the armrest board.
Verify:
- The can-bus connections between the MCB board and the armrest board
- Armrest board supplying (J CANconnector pin 5 cable C03 and pin 6 cable N)
- Replace the armrest board

B9	SET_SERIAL_NUMBER

Condition for error detection

The alarm signals the failed automatic serial number setting.
- Insert truck serial number (function LEARNING parameter SERIAL NUMBER)

Switch the truck off and on again.

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BA	POT TILT NOT OK

Condition for error detection

The alarm signals an incorrect reading of the voltage of the tilting potentiometer (optional):
- Repeat the tilting potentiometer acquisition
- If the alarm persits, check the potentiometer status and the relevant wiring harness.

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ARMREST BOARD

In this session, in the description "Condition for error detection" if not expressly specified, the wording "board" is refered to the ARMREST BOARD

E1	**INCORRECT_START**

Condition for error detection

Incorrect starting procedure.
- Check if one of the potentiometers is activated before to turn the key in the ON position
- Verify by dashboard
Enter the function TESTER menu MAT HANDLING and verify the potentiometer status at rest condition

LIFTING SWITCH = OFF
TILTING SWITCH = OFF
SIDESHIFT SWITCH = OFF
IV WAY SWITCH = OFF
V WAY SWITCH = OFF

LIFT LOWER J = 2,5 ± 0,2 V
TILT J = 2,5 ± 0,2 V
SIDESHIFT J = 2,5 ± 0,2 V
IV WAY J = 2,5 ± 0,2 V
V WAY J = 2,5 ± 0,2 V

Once identificated the potentiometer with different values proceed as follows:
- reverse the potentiometer with another one of the board (fingertips version)
- reverse the lifting potentiometer with the sideshift one or the tilting with the 4th way one (joystick version)

- If the problem remains in the same position replace the board
- If the problem is noticed on an different potentiometer (where has been connected the faulty potentiometer) replace the potentiometer

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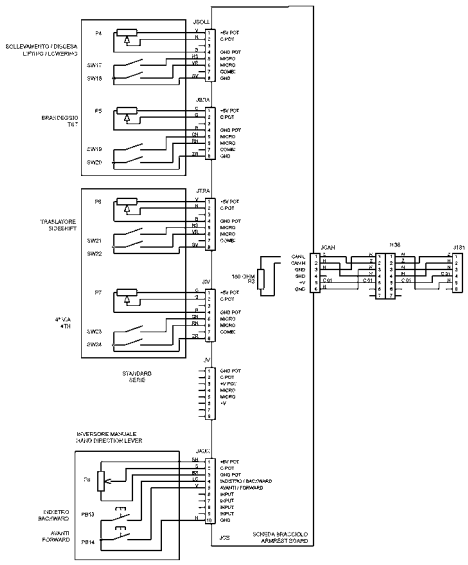
E2	BAD LIFT POT

Condition for error detection

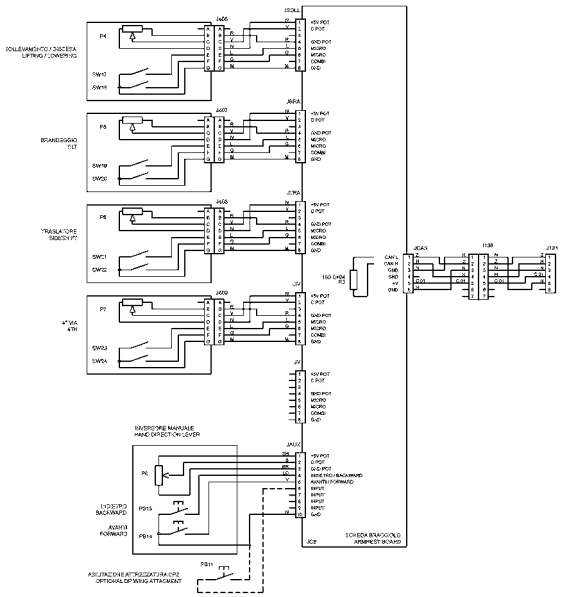
Failure at the P4 lifting potentiometer in the joystick-fingertip group.
Verify the potentiometer status at rest.
Enter the function TESTER menu MAT HANDLING and verify the paramenters LIFTING SWITCH and LIFT LOWER J.
Rest conditions:
- LIFT LOWER J = 2,5 ± 0,2 V
- LIFTING SWITCH = OFF

If the rest conditions are different the potentiometer could be mechanically blocked or faulty.
Check:
- reverse the lifting potentiometer with the tilting one (fingertips version) and verify the correct functioning by display
- reverse the lifting potentiometer with the sideshift one (joystick version) and verify the correct functioning by display

joystick version



fingertip version



If the alarm persists replace the board.

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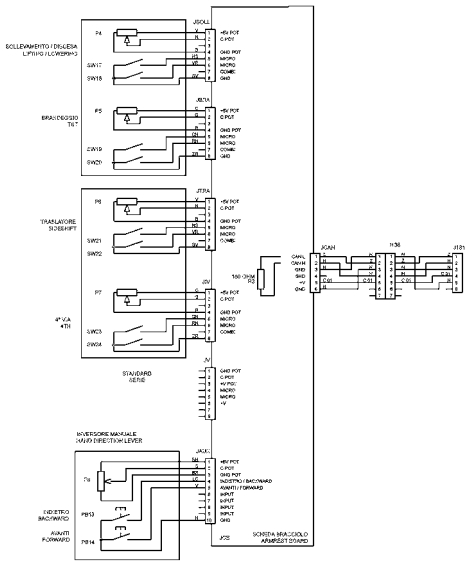
E3	BAD TILT POT

Condition for error detection

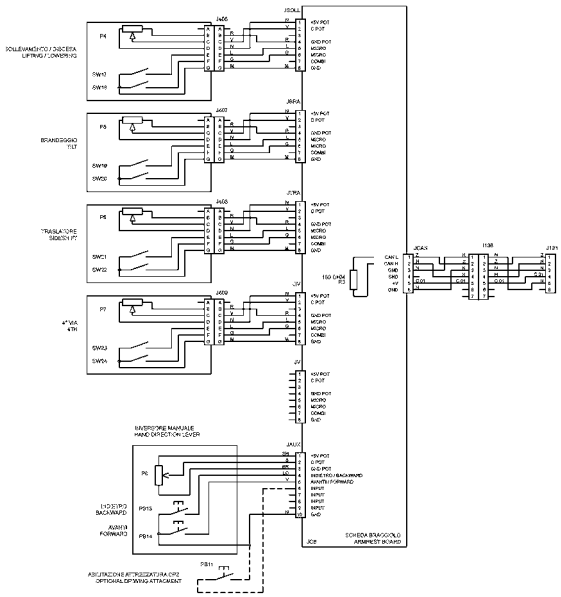
Failure at the P5 tilting potentiometer in the joystick-fingertip group.
Verify the potentiometer status at rest.
Enter the function TESTER menu MAT HANDLING and verify the paramenters TILTING SWITCH and TILT J.
Rest conditions:
- TILT J = 2,5 ± 0,2 V
- TILTING SWITCH = OFF

If the rest conditions are different the potentiometer could be mechanically blocked or faulty.
Check:
- reverse the tilting potentiometer with the lifting one (fingertips version) and verify the correct functioning by display
- reverse the tilting potentiometer with the 4th way one (joystick version) and verify the correct functioning by display

joystick version



fingertip version



If the alarm persists replace the board

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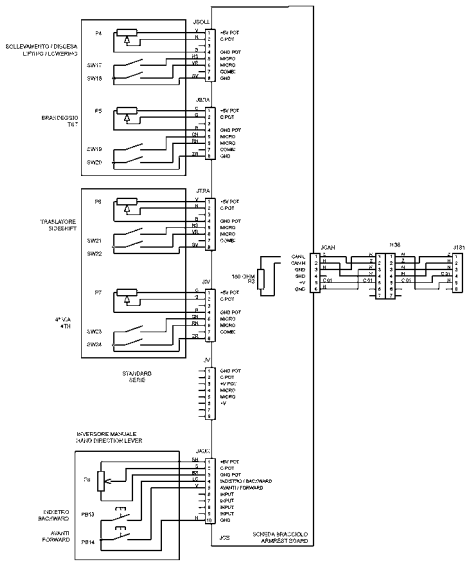
E4	BAD SIDESH. POT

Condition for error detection

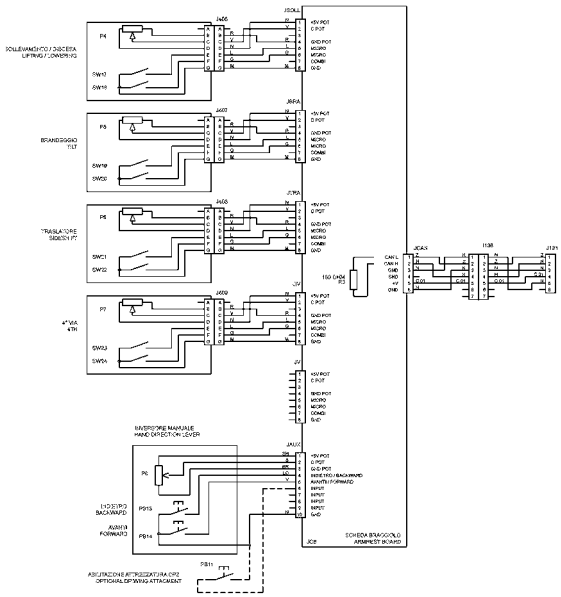
Failure at the P6 sideshift potentiometer in the joystick-fingertip group.
Verify the potentiometer status at rest.
Enter the function TESTER menu MAT HANDLING and verify the paramenters SIDESHIFT SWITCH and SIDESHIFT J.
Rest conditions:
- SIDESHIFT J = 2,5 ± 0,2 V
- SIDESHIFT SWITCH = OFF

If the rest conditions are different the potentiometer could be mechanically blocked or faulty.
Check:
- reverse the sideshift potentiometer with the tilting one (fingertips version) and verify the correct functioning by display
- reverse the sideshift potentiometer with the lifting one (joystick version) and verify the correct functioning by display

joystick version



fingertip version



If the alarm persists replace the board.

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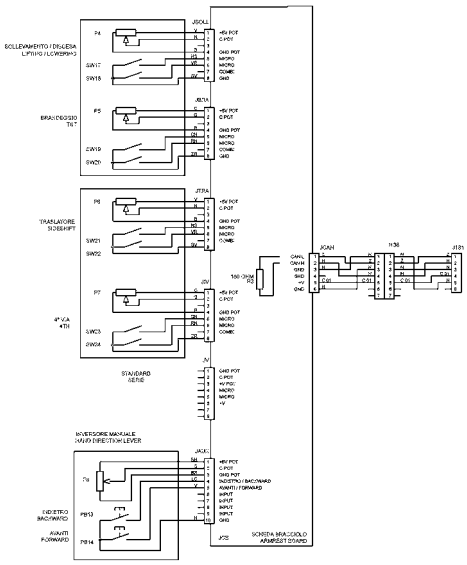
E5	BAD IV POT

Condition for error detection

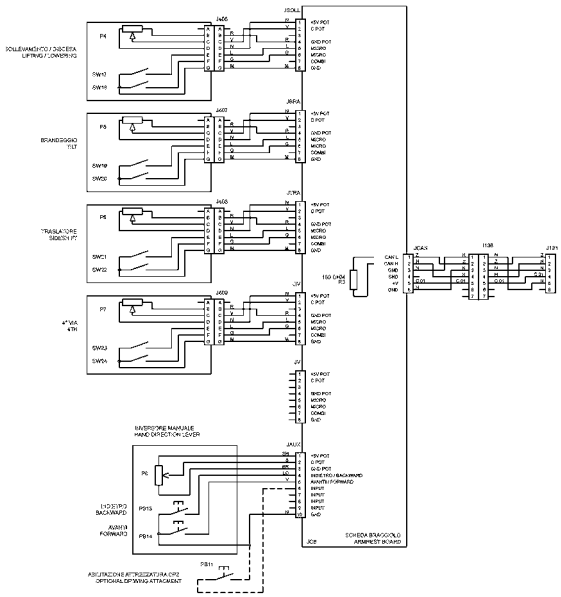
Failure at the P7 4th way potentiometer in the joystick-fingertip group.
Verify the potentiometer status at rest.
Enter the function TESTER menu MAT HANDLING and verify the paramenters IV WAY SWITCH and IV WAY J.
Rest conditions:
- IV WAY J = 2,5 ± 0,2 V
- IV WAY SWITCH = OFF

If the rest conditions are different the potentiometer could be mechanically blocked or faulty.
Check:
- reverse the 4th way potentiometer with the sideshift one (fingertips version) and verify the correct functioning by display
- reverse the 4th way potentiometer with the tilting one (joystick version) and verify the correct functioning by display

joystick version



fingertip version



If the alarm persists replace the board.

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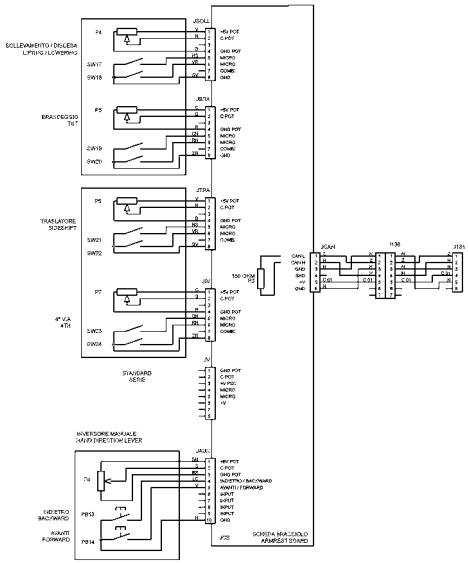
E6	BAD V POT

Condition for error detection

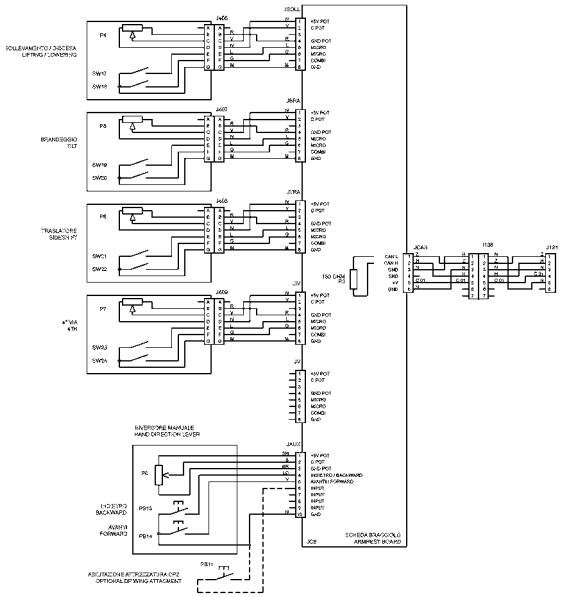
Failure at the 5th way potentiometer (optional) in the joystick-fingertip group.
Verify the potentiometer status at rest.
Enter the function TESTER menu MAT HANDLING and verify the paramenters V WAY SWITCH and V WAY J.
Rest conditions:
- V WAY J = 2,5 ± 0,2 V
- V WAY SWITCH = OFF

If the rest conditions are different the potentiometer could be mechanically blocked or faulty.
Check:
- reverse the 5th way potentiometer with 4th way one (fingertips version) and verify the correct functioning by display

joystick version



fingertip version



If the alarm persists replace the board.

E7	ERR_SEAT

Condition for error detection

The alarm signals the seat micro opened with activated hydraulic functions.
Verify the seat micro status.

E8	INVALID RESTORE STATE

Condition for error detection

Incompleated restore of the parameters. Repeat the operation.

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E9	EEPROM_CHKSUM_ERR

Condition for error detection

Eprom data loading unsuccessful.
If the alarm persists at the key reset, replace the board.

EA	DEFAULT RESTORED

Condition for error detection

Flash memory data loading. Switch the truck off and ON twice.

EB	POT NOT ACQUIRED

Condition for error detection

Flash memory data loading. Switch the truck off and off again.

EC	RAM_CHKSUM_ERR

Condition for error detection

RAM data loading unsuccessful.
If the alarm persists at the key reset, replace the board.

ED	MHYRIO_STUFFING_ERR

Condition for error detection

The logic unit has a communication problem with the MCB board (EVCB) unit.
Check the other alarms on the dashboard.

EE	PUMP_STUFFING_ERR

Condition for error detection

The logic unit does not receive the information from the lifting logic unit.
If the armrest is not present, the alarm is sent by the MCB board.

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EF	**FW + BW**

Condition for error detection

Balanced switch on armrest faulty. Verify:
- The connections of the JAUX wiring harness, joystick board. Replace the balanced switch.

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DASHBOARD

In this session, in the description "Condition for error detection" if not expressly specified, the wording "board" is refered to the DASHBOARD

D1	TRAC_KO

Condition for error detection

This alarm signals that the traction logic unit is not communicating.
Check:
- The supplying: 80V must be present in the connector JAT pin 33 cable M03 of the traction logic unit
- The can-bus connections

If the supply is ok, but it does not permit the truck working, replace the traction logic unit.

D2	MCB_TRAC_KO

Condition for error detection

This alarm signals that the MCB logic unit is not communicating.
Check:
- The supplying: 24V must be present in the connector J40 pin 13 cable C01 of the MCB board
- The can-bus connections

If the supply is ok, but it does not permit the truck working, replace the MCB boardt.

D4	PUMP_KO

Condition for error detection

This alarm signals that the pump logic unit is not communicating.
Check:
- The supplying: 80V must be present in the connector JCP pin 3 cable M03 of the pump logic unit
- The can-bus connections

If the supply is ok, but it does not permit the truck working, replace the pump logic unit.

D5	MCB_MHY_KO

Condition for error detection

This alarm signals that the MCB logic unit is not communicating.
Check:
- The supplying: 24V must be present in the connector J40 pin 13 cable C01 of the MCB board
- The can-bus connections

If the supply is ok, but it does not permit the truck working, replace the MCB board.

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D6	JOY_KO

Condition for error detection

This alarm signals that the (JA/FA) armrest logic unit is not communicating.
(FA: fingertips version - JA: joysticks version)
- The supplying: 24V must be present in the connector JCAN pin 5 cable C01 of the armrest board
- The can-bus connections
If the supply is ok, but it does not permit the truck working, replace the armrest board.

D8	ERROR READ PIN

Condition for error detection

This alarm signals that the MCB board does not permit the password reading.
It is the MCB section that manages the signals
- The supplying: 24V must be present in the connector J40 pin 13 cable C01 of the MCB board.
- The can-bus connections
Replace the MCB board.

DC	HYDRO_KO

Condition for error detection

This alarm signals that the Slave pump logic unit is not communicating.
Check:
- The supplying: 80V must be present in the connector JCP pin 3 cable M03 of the pump logic unit
- The can-bus connections
If the supply is ok, but it does not permit the truck working, replace the pump logic unit.

DF	EEPROM ERROR

Condition for error detection

Error during the eepreom data uploading
Fault in memory area where the adjustment parameters are registered.
When the alarm desappears the parameters previously stored will be cancelled and automatically the dashboard default parameters will be loaded.
Set again a possible personalization of the parameters.

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MCB BOARD (section TRCB)

In this session, in the description "Condition for error detection" if not expressly specified, the wording "board" is refered to the MCB BOARD

C1	INCORRECT START

Condition for error detection

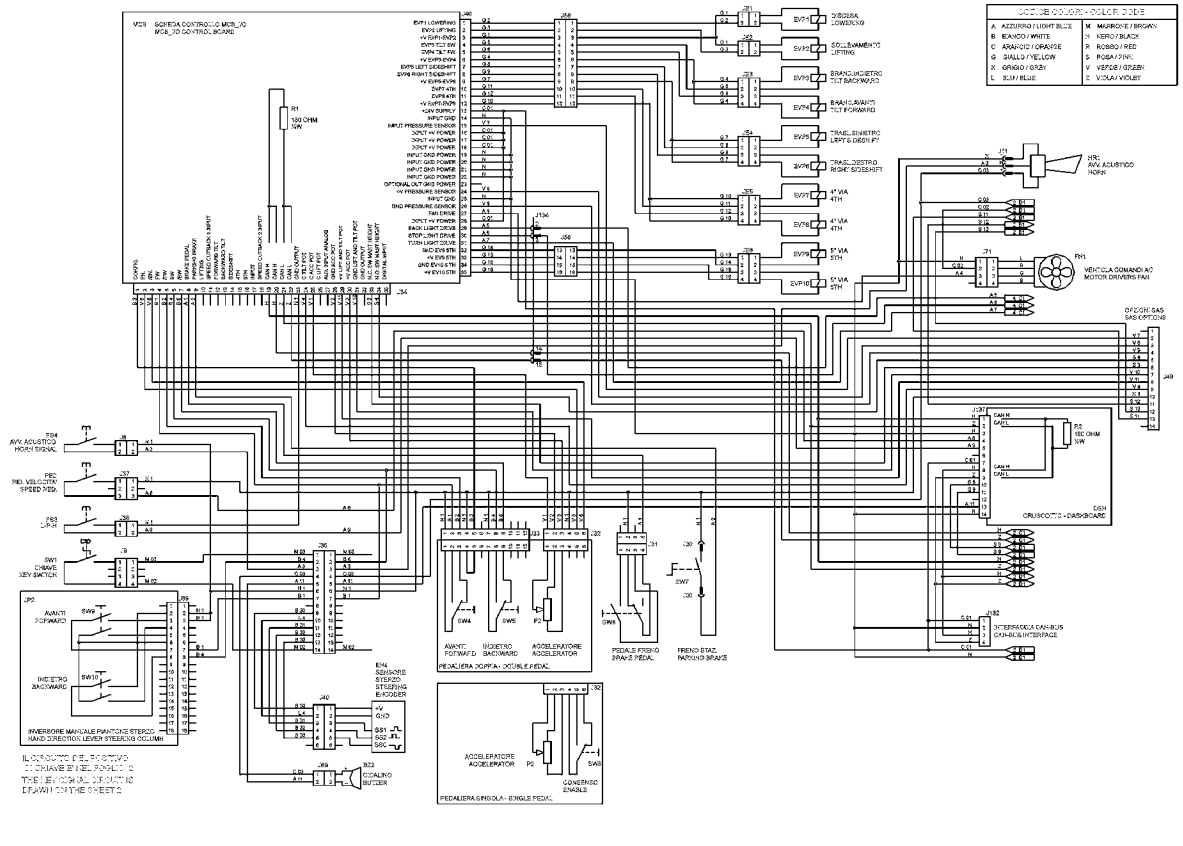
Incorrect starting procedure.
Check:
- The forward and backward microswitches and the relevant cables
-The parking brake microscwitch and the relevant cables

C2	BAD_CONF_WHEELS - UNUSED

C3	PEDAL WIRE KO

Condition for error detection

Failure at the accelerator potentiometer at rest. Check:
- Steering potentiometer that could be damaged
- The traction potentiometer wiring harness



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C4	BAD MICROSWITCH

Condition for error detection

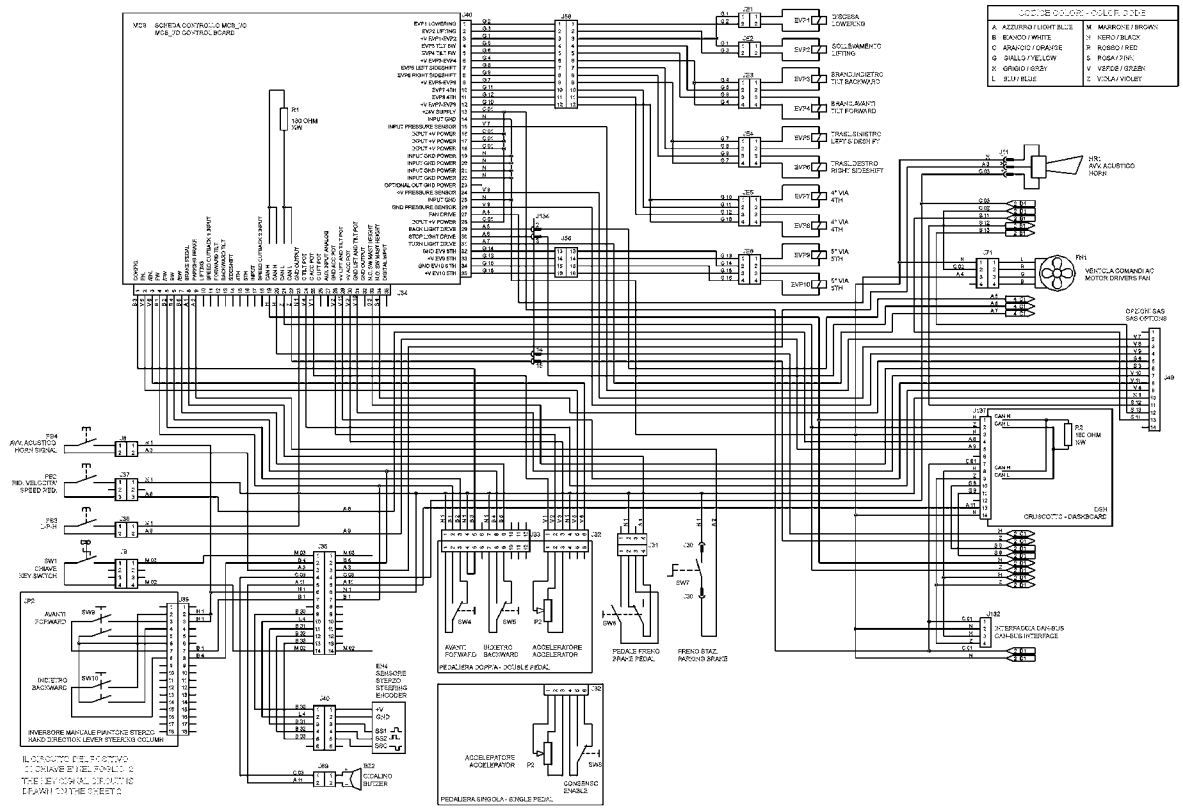
The pedal microswitch or the manual direction lever is broken.

C5	WARN_CONF_ERROR - UNUSED

C6	BAD_VACC

Condition for error detection

The alarm signals an incorrect voltage reading of the accelerator potentiometer:
- Repeat the P2 accelerator potentiometer acquisition(function LEARNING parameter LEARN TRAC POT)
-If the alarm persists, check the potentiometer status and the relevant wiring harness



C7	ERR_SEAT

Condition for error detection

One of the fuction is activated while the seat microswitch is opened.

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C9	PARKING_SELECTED

Condition for error detection

One of the function is activated while the parking brake is applied.

CA	PARAM. LOAD ERROR

Condition for error detection

The alarm appears when the truck is switched on or if the change progam button is pressed.
Replace the MCB logic unit.

CC	TRAC_STUFFING_ERROR

Condition for error detection

Problem of communication with the traction logic unit.
The alarm disappears after the key reset.
If the alarm appears frequently and blocks the truck, check the can-bus connections between the traction logic unit and MCB.

CF	FW + BW

Condition for error detection

Double request activated.
The backward/forward direction microswitches are closed at the same time.

93	NOT_REP_ERROR

Condition for error detection

The alarm signals that the MCB board is waiting informations. The truck remains in pre-operational status.
- Insert the truck serial number (LEARNING function SERIAL NUMBER parameter)
Switch the truck off and on.

94	CHKSUM_ERROR

Condition for error detection

Software error.
Replace the board.

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PÀGINA INTENCIONALMENTE BLANCA

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MOTORS

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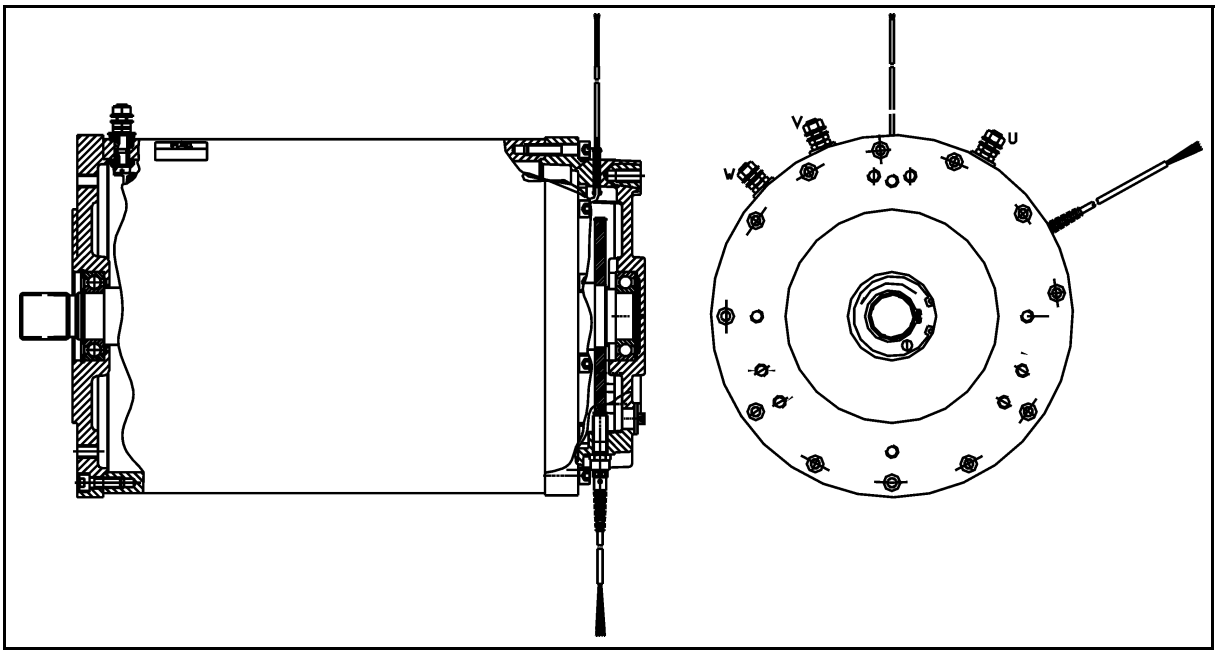
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DRIVE MOTOR

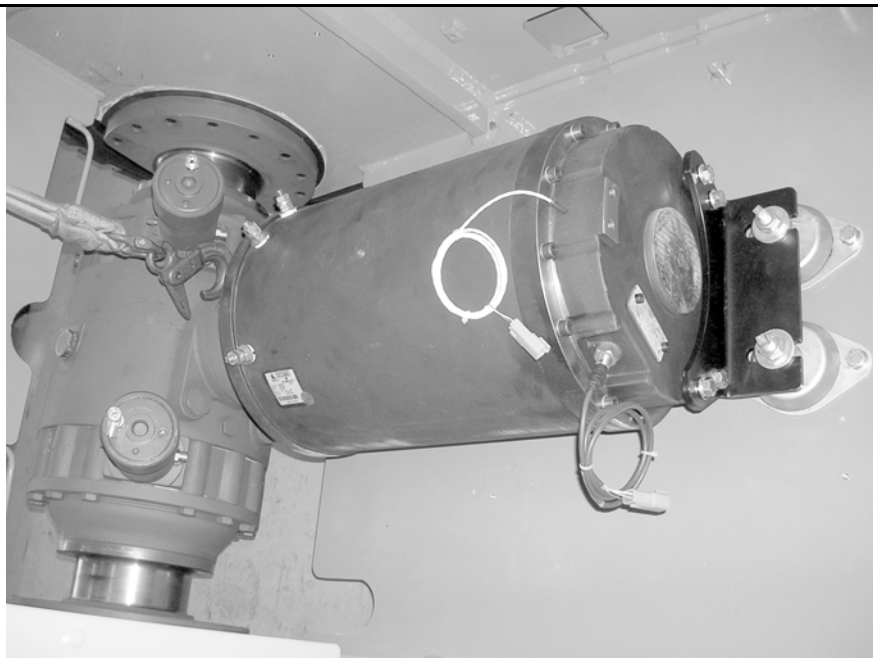
GENERAL



SPECIFICATIONS

TRACTION MOTOR	
RATED OUTPUT POWER	27,1 kW
DIMENSIONS	ϕ348 × 546
NOMINAL VOLTAGE	53 V (AC)
NOMINAL MAX. CURRENT	371 A
FREQUENCY	42 Hz
POWER FACTOR (cos phi)	0,92
INSULATION CLASS	00
PROTECTION CLASS (IP)	43
SERVICE	S2 60’
POLES NUMBER	4
R.P.M.	1205 rpm

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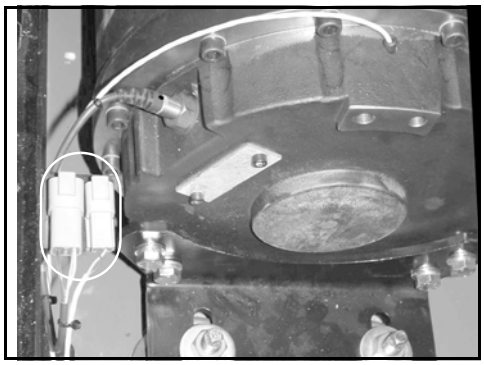
Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover, disconnect the battery plugs and remove the front battery
4. Remove the footboard mat and the footboard
5. Remove all the pedals (accelerator and brake)
6. Disconnect the power cables and the auxiliary wiring harness connectors from the traction and pump logic units
7. Disconnect the air conveyor for the logic unit cooling
8. Hook the logic units support plate with a suitable chain to a bridge crane, unscrew the fixing bollts and remove the group (plate + logic units)
9. Disconnect the thermic sensor and the encoder connectors **[POINT 1]**
10. Insert and screw on an eyebolt in the concerned threaded hole, in the middle of the motor, hook the eyebolt by a chain to the bridge crane, pull the chain until tightened **[POINT 2]**
11. Remove the motor fixing nuts to the shock absorbers **[POINT 3]**
12. Remove the motor fixing bolts to the traction group
13. Lift the motor from the frame paying attention to the plastic cross joint integrity
14. Recover the plastic cross joint from the motor shaft **[POINT 4]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure

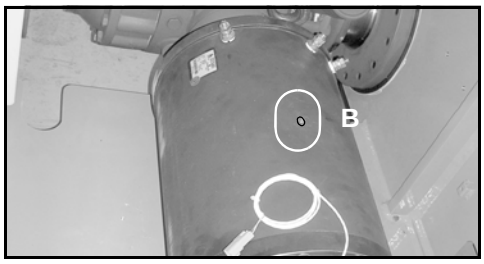
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Point Operations

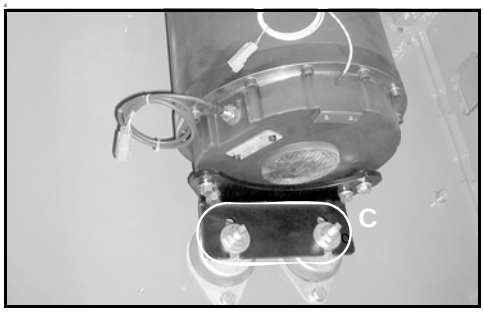
[POINT 1]
Disassembly

Disconnect the thermic sensor and the encoder connectors.



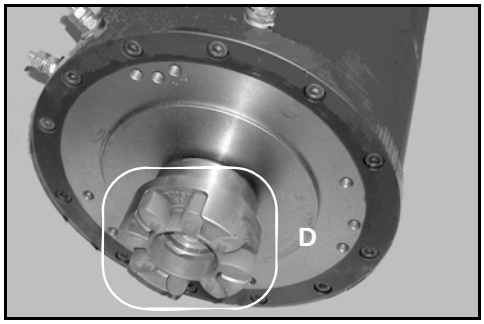
[POINT 2]
Disassembly

Insert and screw on an eyebolt in the threaded hole **B**, in the middle of the motor, hook the eyebolt by a chain to the bridge crane, pull the chain until tightened



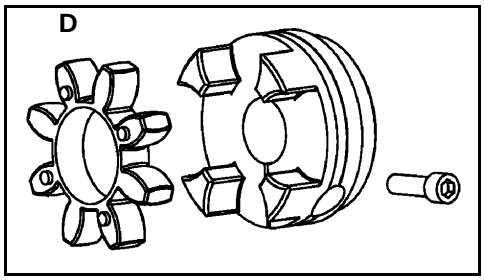
[POINT 3]
Disassembly

Remove the motor fixing nuts **C** to the shock absorbers



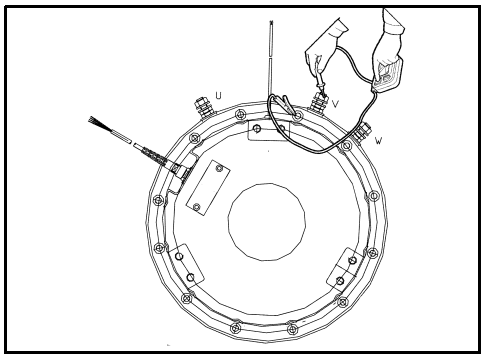
[POINT 4]
Disassembly

Recover the plastic cross joint **D** from the motor shaft



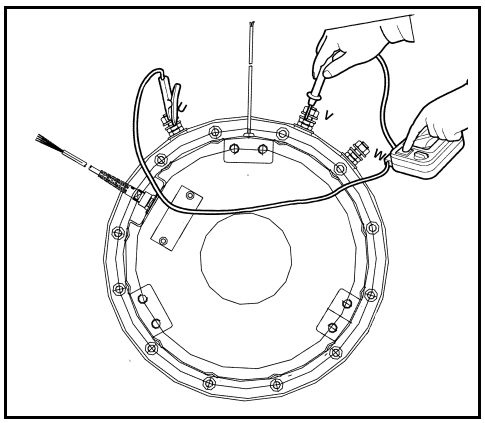
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INSPECTION

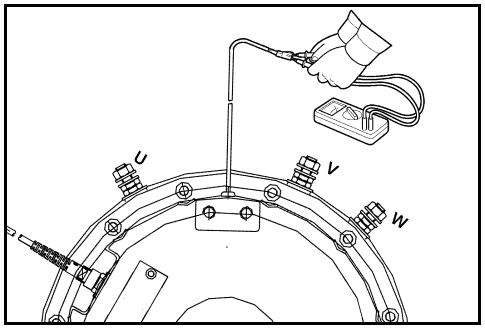


Inspection:

1. Measure the insulation resistance of the stator.
   Measurement terminals: between motor cable and body
   Standard: 10 MΩ or more



2. Check continuity between motor cables:
   Measurement terminals: U-V, V-W, W-U: 0 Ω

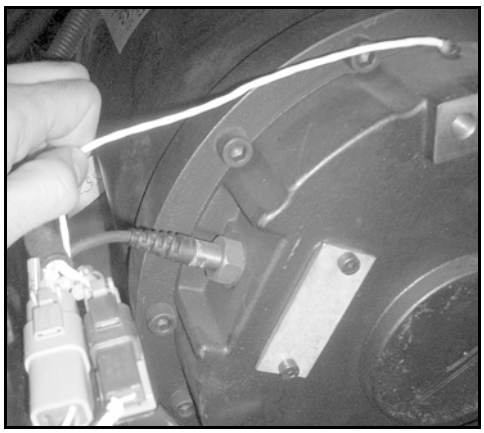


3. Measure the resistance of the thermo-sensor.
   Measurement terminals:
   Both terminals of temperature sensor connector

   Standard: 0 Ω
   (see table reported in chapter 04, alarm no. 12: MOTOR TEMPERATURE)

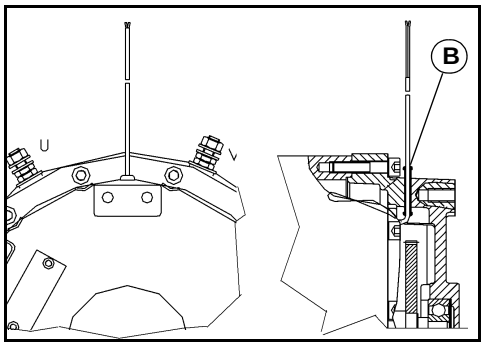
www.truck-freeworkshop.com/forklift/cesab/

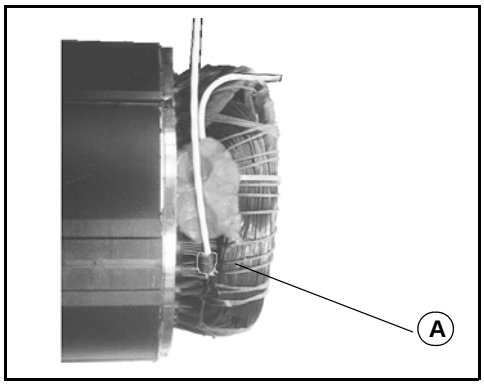
TEMPERATURE SENSOR REPLACEMENT (TRACTION MOTOR)



Disassembly procedure

1. Park the truck on a level surface and operate the parking brake
2. Switch off the truck
3. Remove the traction motor (see the appropriate section)
4. Mark the position of the back cover as regards the stator
5. Take off the pins from the temperature sensor connector
6. Loosen and remove the 12 fixing Alen screws
7. Remove the cover,
8. Let slide out the sensor cable through the cover hole **B**
9. Cut the damaged sensor wiring close to the motor carcass



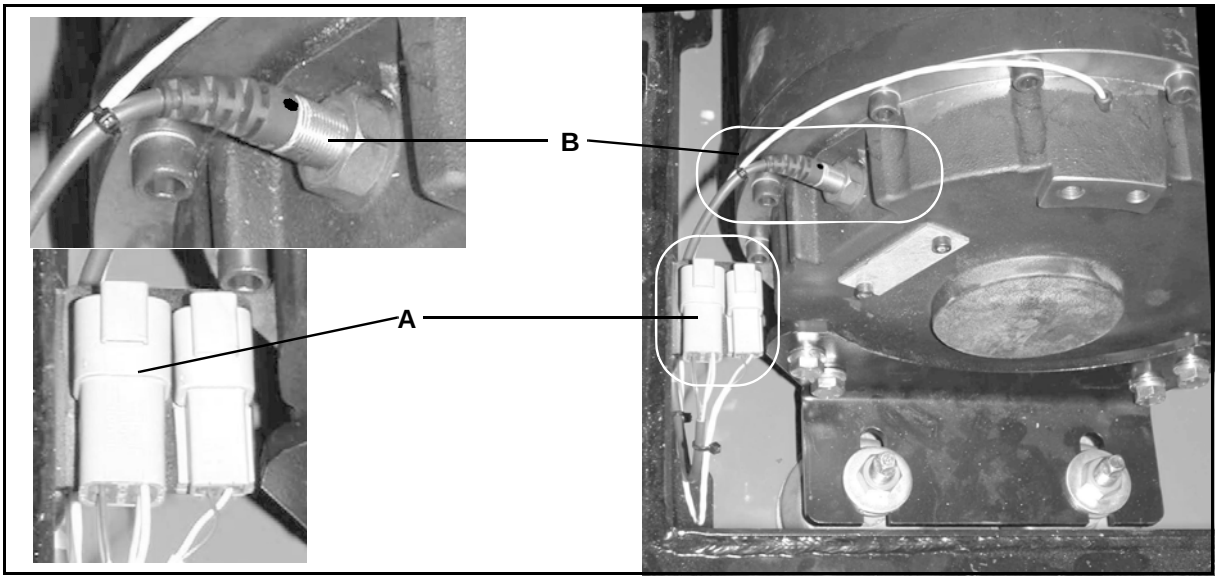


Reassembly procedure

1. Position the new sensor **A** on the motor winding and fix it with silicone paste (see Service Tools List)
2. Let slide in the sensor cable through the cover hole
3. Assemble the cover as according the markings made on the cover and the stator during the disassembly; pay attention to the status of the bearing
4. Screw the 12 fixing Alen screws
5. Insert the sensor pins into the temperature sensor connector
6. The traction motor reassembly procedure is the reverse of the disassembly procedure (see the appropriate section)

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ENCODER REPLACEMENT (TRACTION MOTOR)



Disassembly procedure

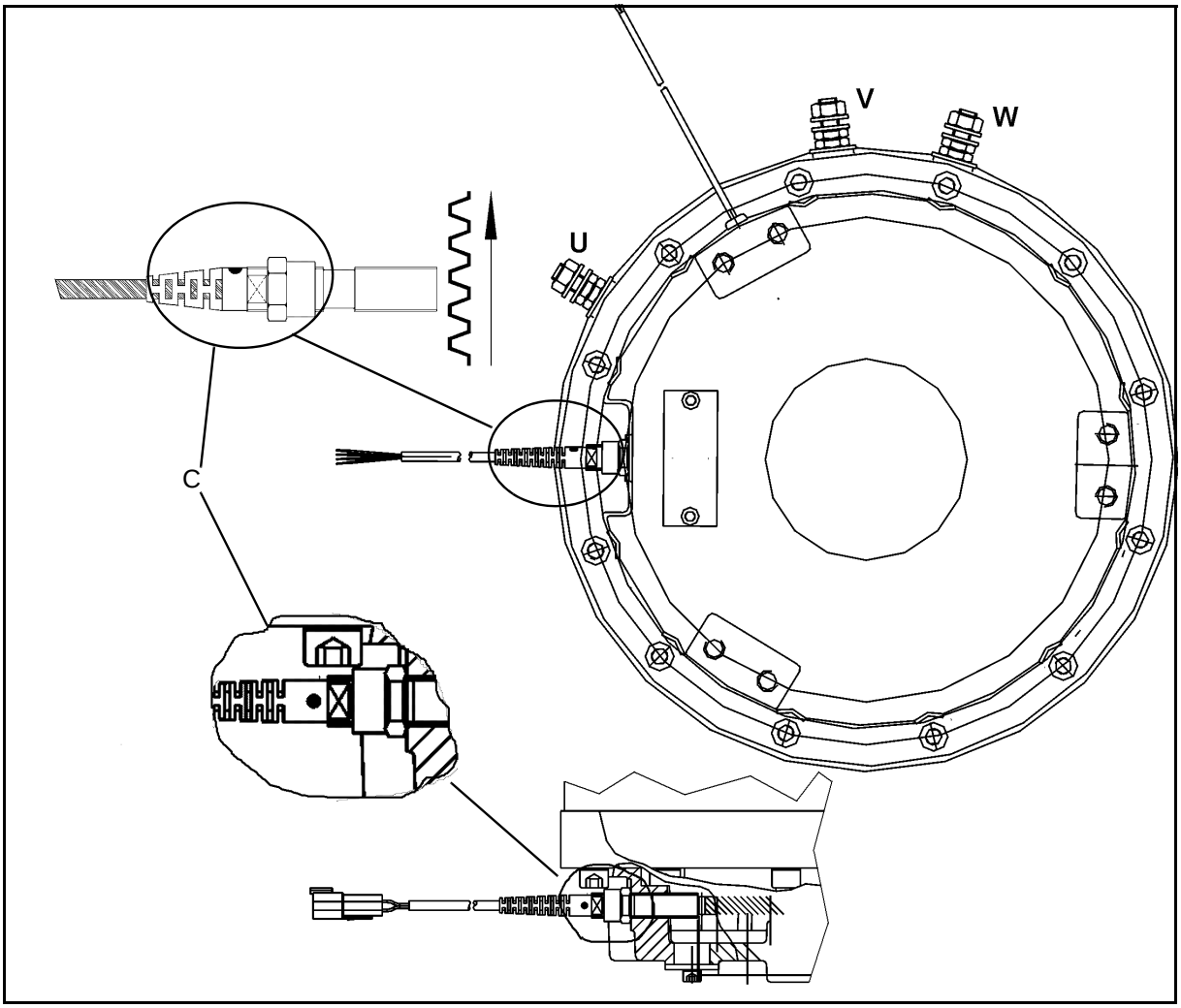
1. Park the truck on a level surface and operate the parking brake
2. Switch off the truck
3. Open the battery cover and disconnect the battery
4. Remove the front battery
5. Remove the encoder connector **A** from its support
6. Disconnect the encoder connector **A** from the auxiliary wiring
7. Unscrew the encoder **B** from its seat

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Reassembly Procedure

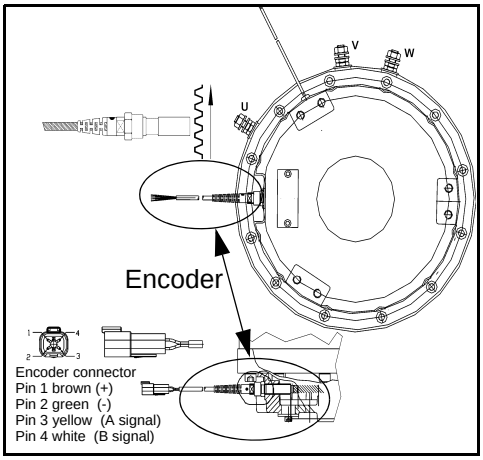
The reassembly procedure is the reverse of the disassembly procedure

Warning:
Take care that the new encoder is fitted correctly, with the black point A aligned according with the motor motion, as shown in the picture below

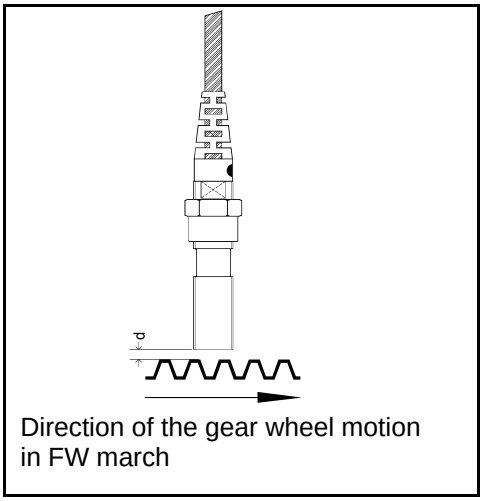


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ENCODER



The encoder generates feedback signals from the motor and send them to the control logic unit, monitoring the motor state, the R.P.M and the sense of rotation.
The encoder is positioned in the traction motor back part.

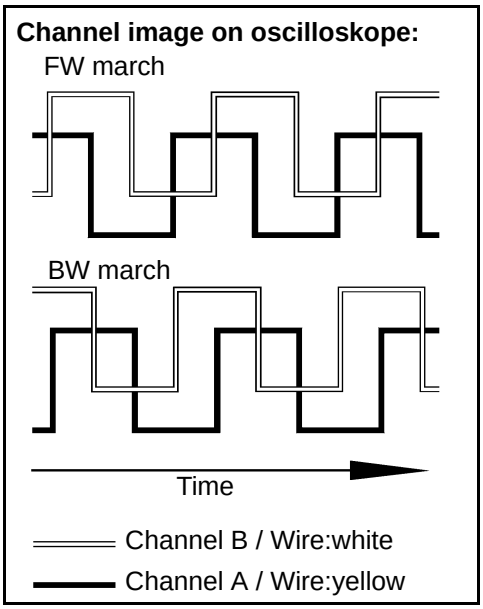


Direction of the gear wheel motion in FW march

Irreversible damages:

- +V > 13Volts
- Short circuit between the signal and the power supply
- Heating by induction
- Assembly with hammer

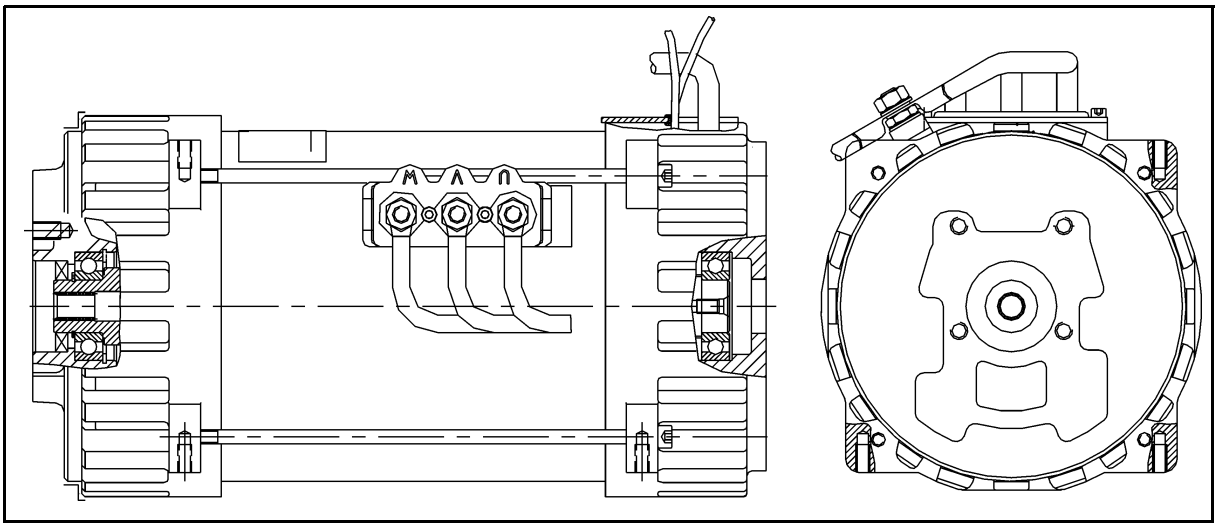
Channel image on oscilloskope:



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PUMP MOTORS

GENERAL

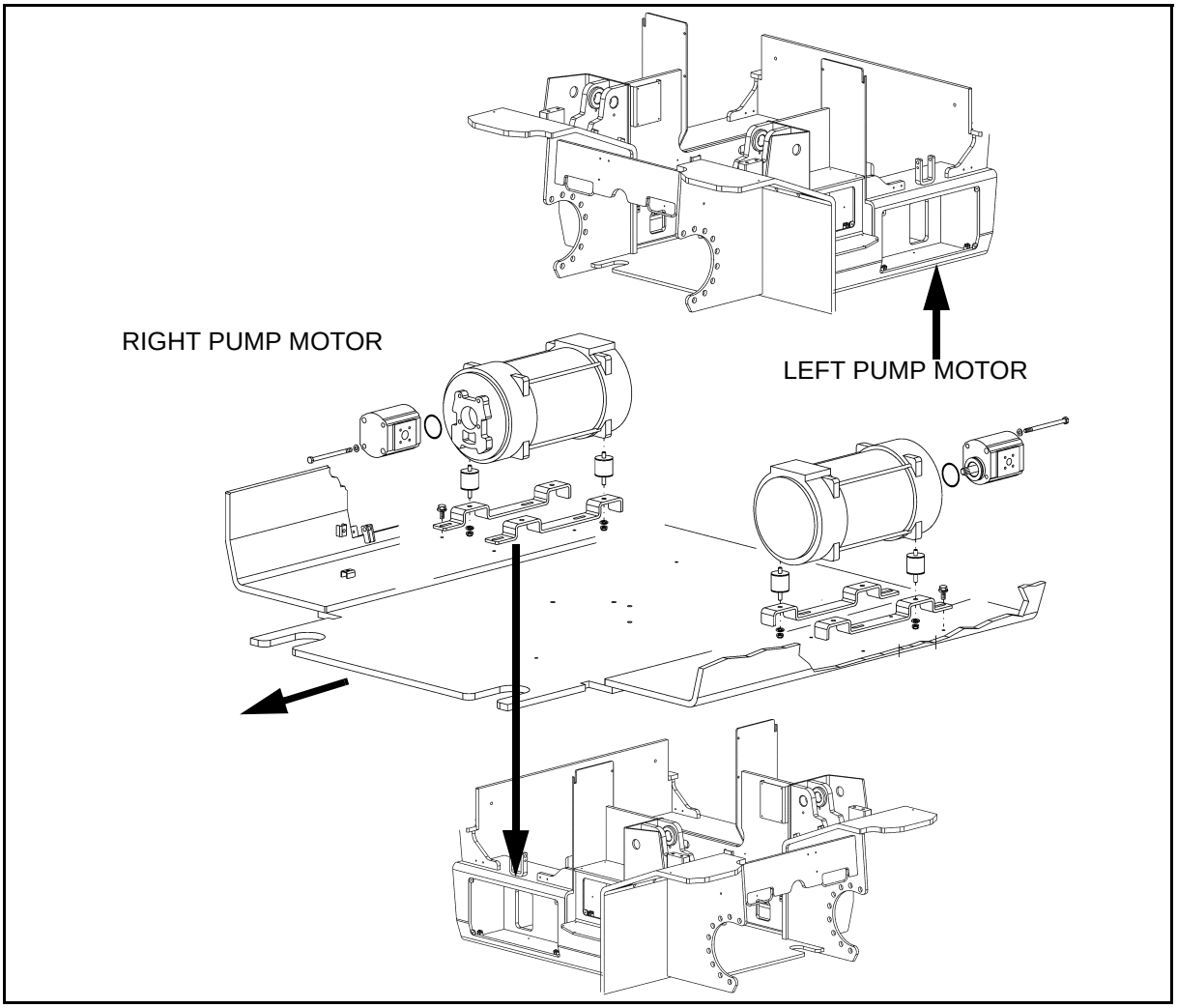


SPECIFICATIONS

PUMP MOTORS	
RATED OUTPUT POWER	20 kW
DIMENSIONS	ϕ218 × 420
NOMINAL VOLTAGE	50 V (AC)
NOMINAL MAX. CURRENT	350 A
FREQUENCY	85 Hz
POWER FACTOR (cos phi)	0,9
INSULATION CLASS	F
PROTECTION CLASS (IP)	20
SERVICE	S3 22 %
POLES NUMBER	4
R.P.M.	2450 rpm
PUMP CAPACITY	19 l/m at 1000 rpm

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DISASSEMBLY • REASSEMBLY



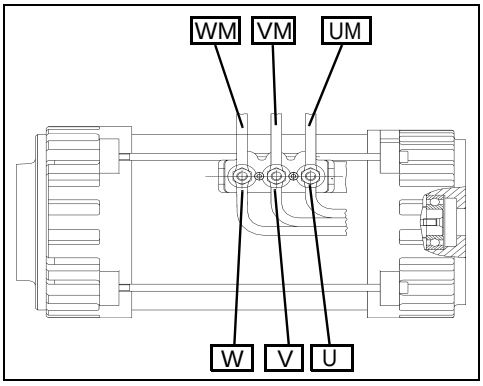
Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Disconnect the battery
4. Remove the concerned side compartment cover
5. Disconnect motor power cables, encoder and temperature sensor connectors
6. Remove the pump fixing bolts and remove the concerned pump **[Point 1]**
7. Unscrew and remove the motor support fixing bolts to the frame **[Point 2]**
8. Insert 2 eyebolts with a chain, lift and remove, by a bridge crane, the concerned pump motor **[Point 3]**

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Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure, taking care that the motor cables are fitted correctly as illustrated below:

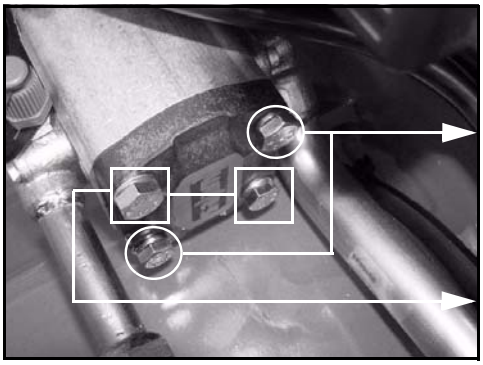


Left pump motor (MASTER, contol valve)
- Power cable UM connected to phase U
- Power cable VM connected to phase V
- Power cable WM connected to phase W

Right pump motor (SLAVE steering)
Power cable US connected to phase U
- Power cable VS connected to phase V
- Power cable WS connected to phase W

To fix the power cable lugs to the motor terminals, the nuts tightening torque is **15 Nm**

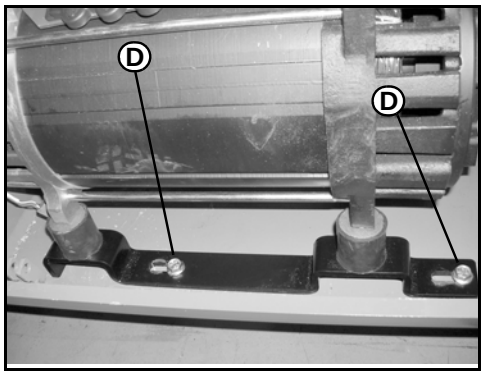
Points of operation



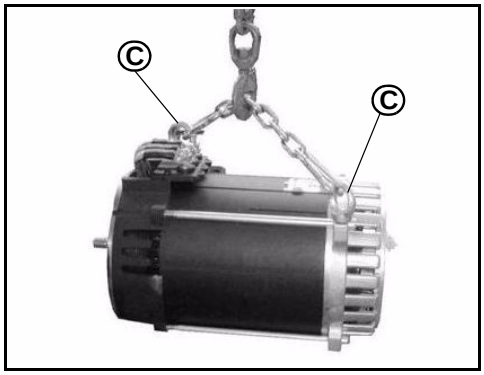
[Point1]
Removal:
Remove the pump fixing bolts and remove the pump

pump fastening screws **45 Nm** (do not remove)

screws fastening pump to motor **45Nm**



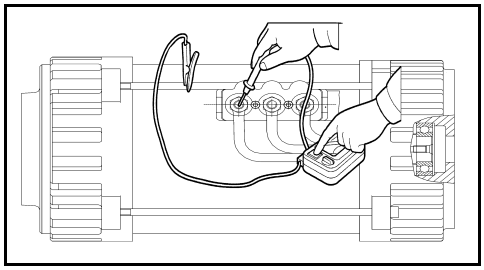
[Point 2]
Unscrew and remove motor support fixing bolts **D** from the frame



[Point 3]
Insert the 2 eyebolts **(C)** with the chain and lift the motor by a bridge crane

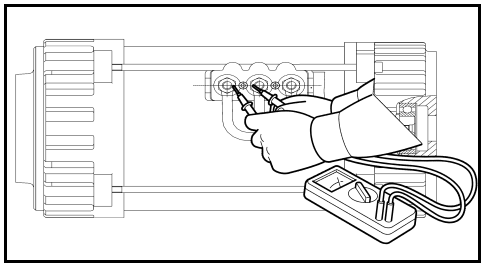
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INSPECTION

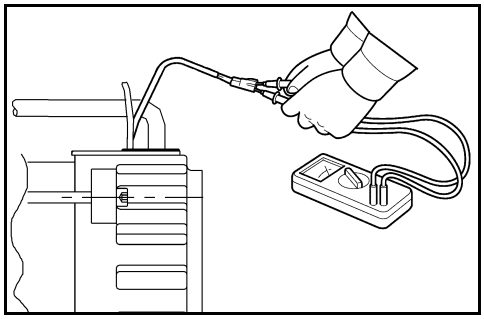


Inspection:

1. Measure the insulation resistance of the stator.
   Measurement terminals: between motor cable and body
   Standard: 10 MΩ or more



2. Check continuity between motor cables:
   Measurement terminals: U-V, V-W, W-U: 0 Ω

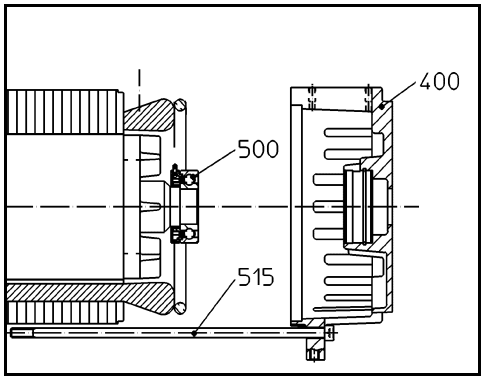


3. Measure the resistance of the thermo-sensor.
   Measurement terminals:
   Both terminals of temperature sensor connector

   Standard: 0 Ω
   (see table reported in chapter 04, alarm no. 47 or 76: SENS MOT TEMP KO)

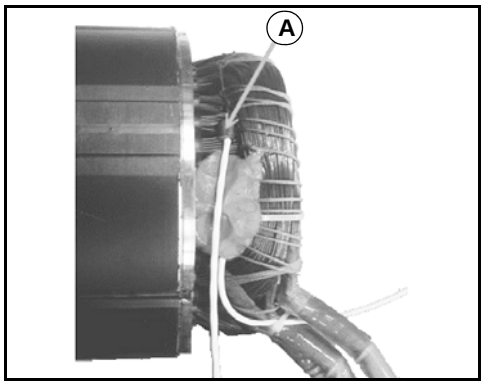
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TEMPERATURE SENSOR REPLACEMENT (PUMP MOTORS)



Disassembly procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the battery cover and disconnect the battery
4. Remove the left or right pump motor
5. Mark the position of the cover (item 400) with regards to the stator
6. Loosen the four M8 Alen screws (item 515) and remove the cover (item 400)
7. Cut the motor power cables fastening wrappers
8. Cut the damaged sensor wiring close to the motor carcass

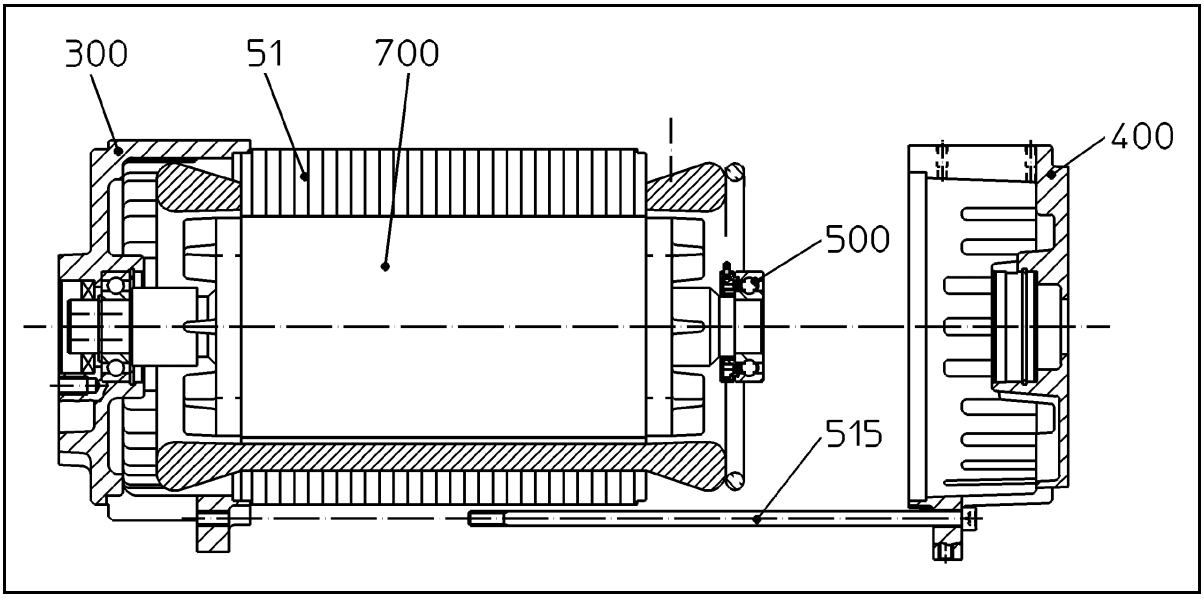


Reassembly procedure

1. Position the new sensor **(A)** on the motor winding and fix it with silicone paste (see Service Tools List)
2. Crimp the pins to the sensor wires
3. Insert the sensor wiring pins into the connector
4. The reassembly procedure is the reverse of the disassembly procedure, paying attention that the power an the sensor cables must be mounted correctly

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ENCODER REPLACEMENT (PUMP MOTORS)



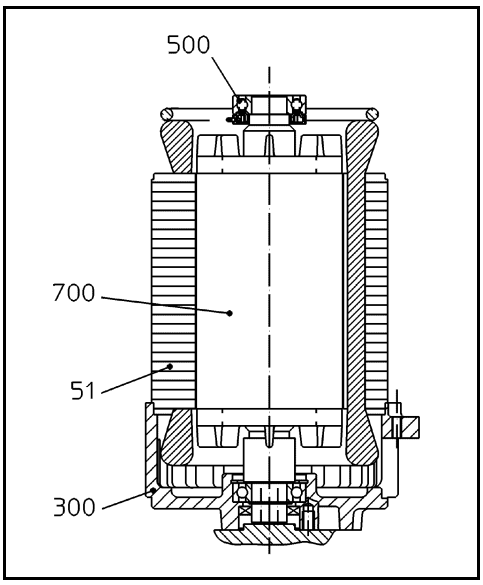
Disassembly procedure

1. Park the truck on a level surface and operate the parking brake
2. Switch off the truck
3. Open the battery cover and disconnect the battery
4. Remove the left and/or right pump motor
5. Mark the position of the cover (item 300) and of the opposite cover (item 400) as regards the stator (item 51)
6. Loosen the four M8 Alen screws (item 515) and remove the cover (item 400)
7. Extract the encoder (item 500) from the rotor (item 700) using an appropriate extractor

Note:
For the encoder extraction use a separator extractor type
Warning:
During the extraction be sure to act only on the bearing involved parts excluding the encoder parts

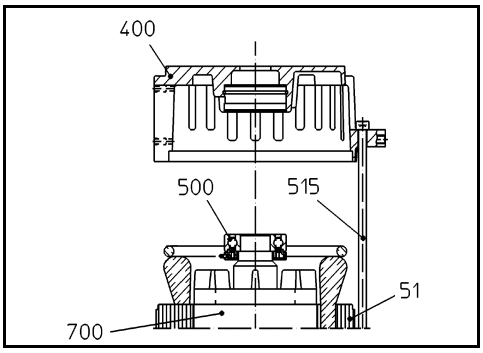
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Reassembly procedure



1. Insert the new encoder (item 500) into the rotor shaft (item 700) axle and push on its inner ring with a slight pressure up to the attainment of the correct position. For this purpose use a bushing.
2. Insert the cover (item 400) on the encoder (item 500), placed on the rotor (item 700) axle, according to the marked position between of the stator (item 51) and the cover. Push it slightly up to the attainment of the correct position.

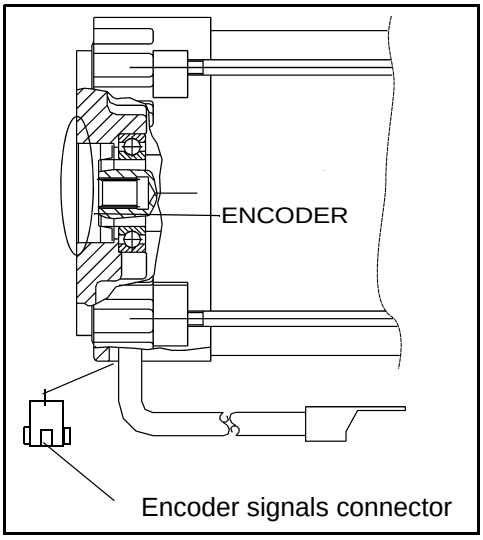
Warning:
In the lifting motor, to prevent any contact between the cables with the rotor and any compression, drive them through the proper cover hole



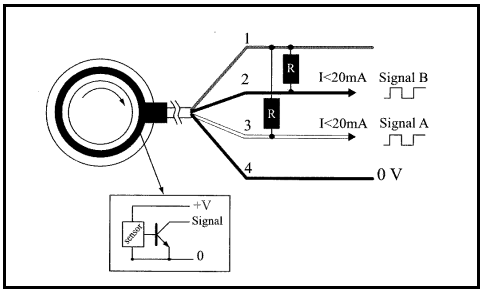
3. Fit the cover (item 400) screwing the 4 cylindrical M8 screws (item 515) with a tightening torque = **20 Nm**
4. Crimp the pins to the sensor wires
5. Insert the sensor wiring pins to the connector
6. Reassembly the left and/or the right pump motor

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ENCODER



The encoder generates feedback signals from the motor and send them to the control logic unit, monitoring the motor state, the R.P.M and the sense of rotation.
The encoder has positioned in the bearing mounted in the motor back part.



Irreversible damages:

- +V > 13Volts
- Short circuit between the signal and the power supply
- Heating by induction
- Assembly with hammer

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FRONT AXLE

FRONT AXLE 3
GENERAL 3
COMPONENTS 4
DRIVE UNIT HUB 5
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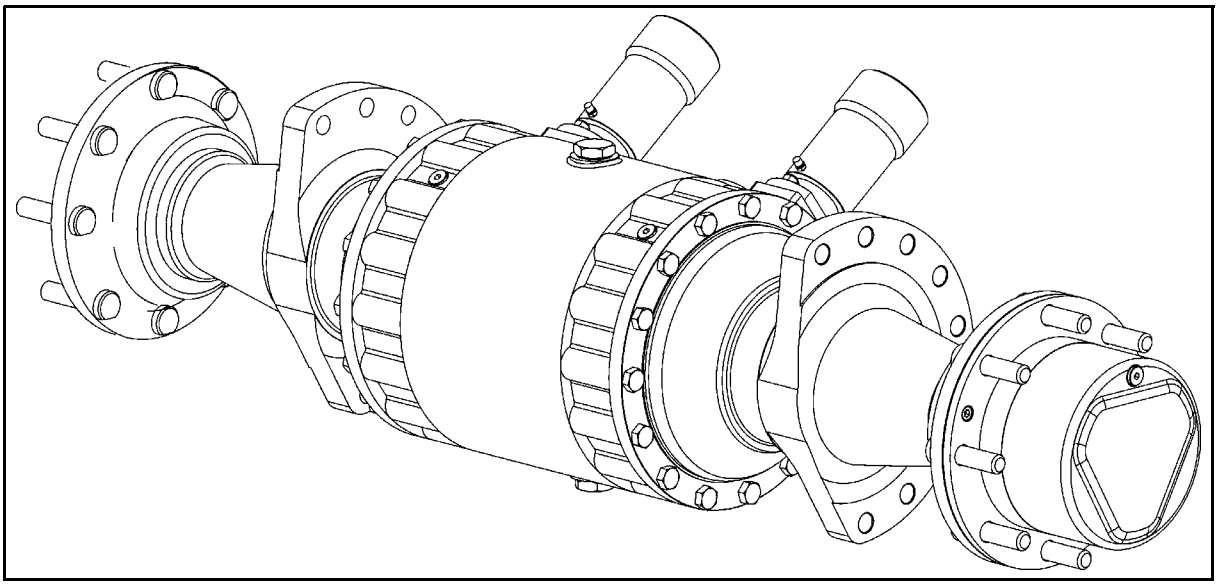
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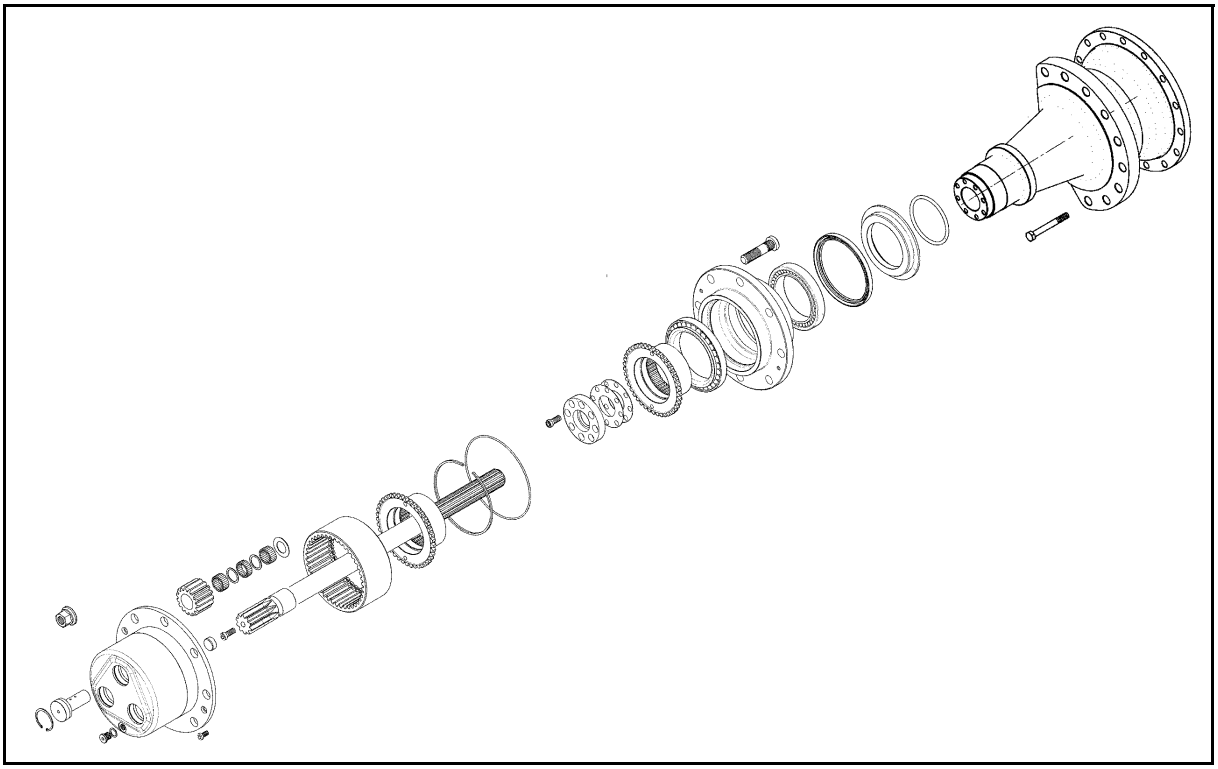
FRONT AXLE

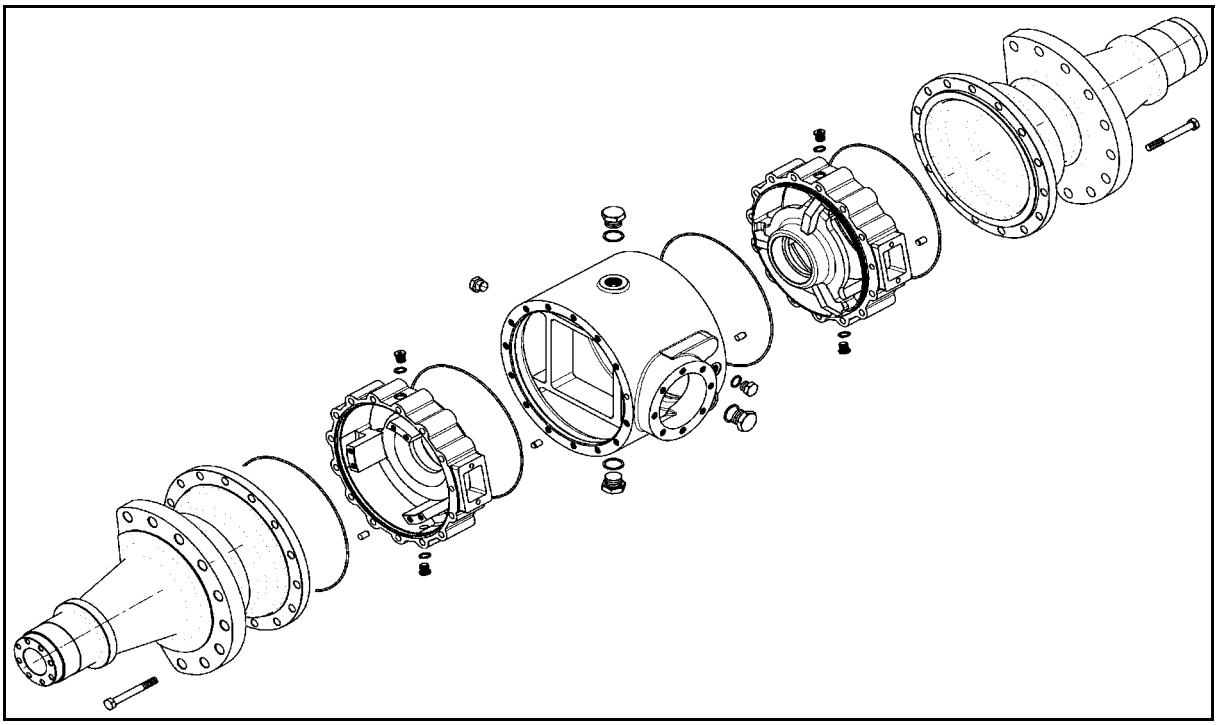
GENERAL



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COMPONENTS

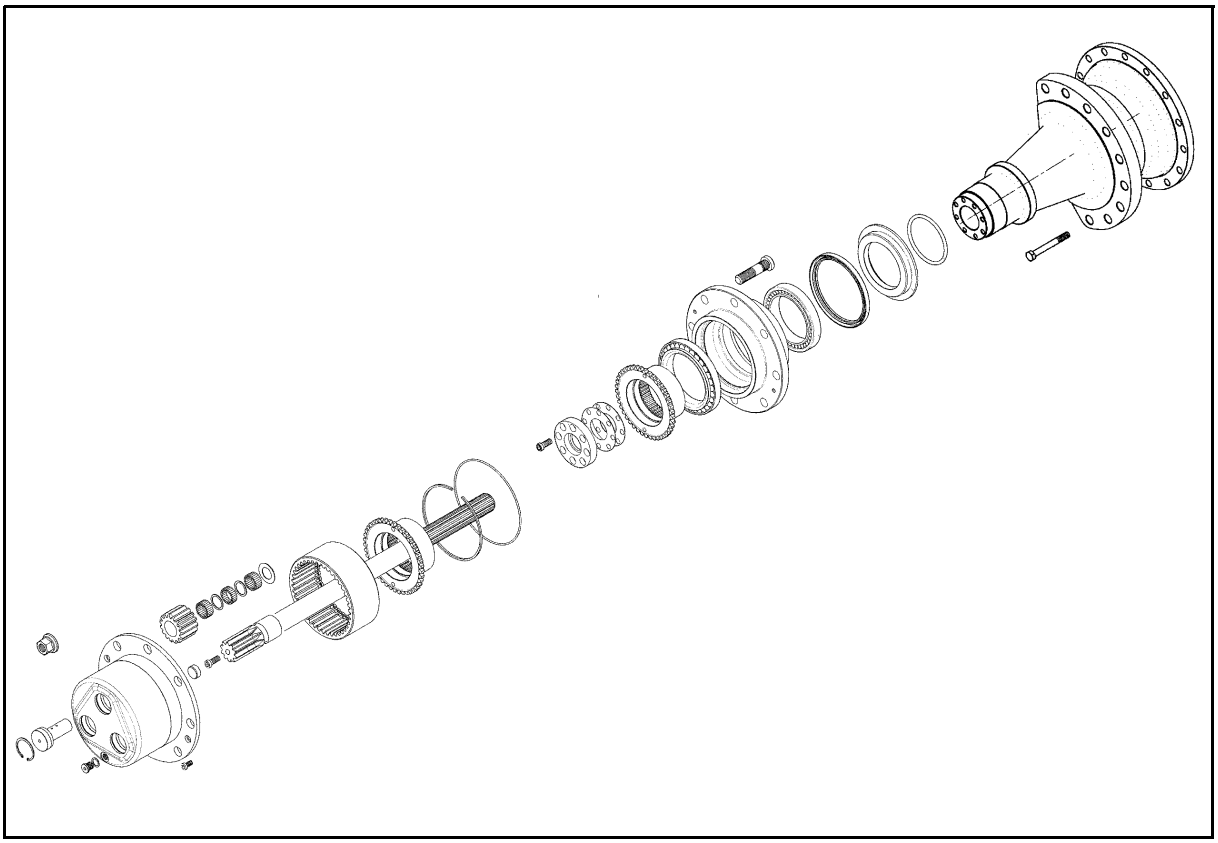




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DRIVE UNIT HUB

DISASSEMBLY · REASSEMBLY



Disassembly Procedure

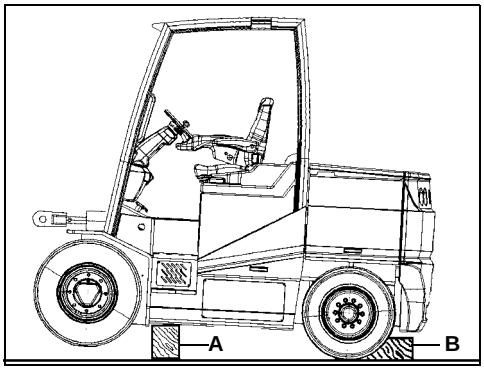
1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover and disconnect the battery plugs
4. Jack up the front part of the vehicle and place wooden or metallic blocks under the chassis. Block the steering wheels by wedges **[Point 1]**
5. Remove the front wheels
6. Remove the oil from the hub **[Point 2]**; let il flow into suitable containers
7. Remove the hub **[Point 3]**

Reassembly Procedure

The installation procedure is the reverse of the removal procedure

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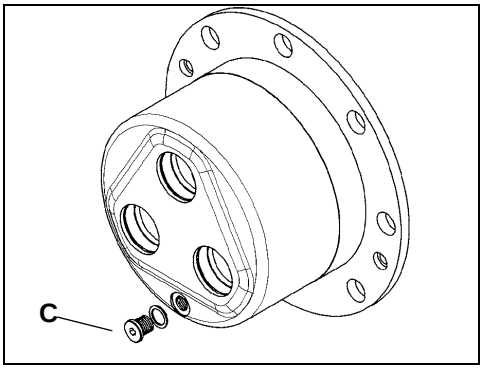
Point Operations



[Point 1]

Disassembly:

Jack up the front part of the vehicle and place wooden or metallic blocks **A** under the chassis. Block the steering wheels by wedges **B**



[Point 2]

Disassembly:

Remove the oil from the hub:

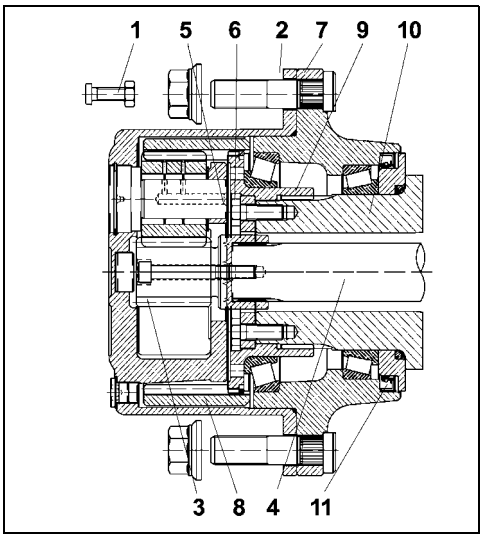
Turn the hub until plug **C** reaches the lowest position. Remove the plug and let flow out all the used oil in a suitable container with a capacity of ~ 10 liters

Reassembly:

Rotate the hub of 90° in counterclockwise direction until the hole of the plug **C** is in the middle of the axle. Fill with new oil, of the same type of the old one, from the plug **C** hole, until the oil grazes the hole inferior edge. If the hub is completely empty, around 2 kg of oil are needed. (each hub). Mount again the plug **C** with its washer.

Control of the oil levels

Check the oil levels with cold vehicle to avoid that the oil in circle induces an inappropriate oil refill



[Point 3]

Disassembly:

Remove the screws **1** fixing the planet carrier **2** to the wheel hub . Extract the planet carrier **2** of approx. 15 mm from the hub.

If completely extracted, the planet spider group can fall down to the ground. It weighs about 25 kg. Support it with appropriate tools. Support the planetary drive with a sling, hold it allined with the hub and extract it completely.

Pull out the sun gear **3** and the axle shaft **4**

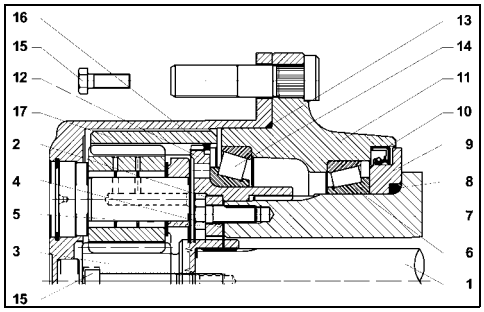
Remove the screws **5**, the flange **6** and the adjusting shims.

Maintain the hub **7** (it weighs approx. 17kg) in position and pull out the crown **8** and the crown plate **9** from the seat **10**.

Slide out the hub from the seat supporting it with a sling and a crane. Be careful because the bearing can fall down and pay attention to not ruin the oil splash guard **11**.

The hub weighs about 30 kg.

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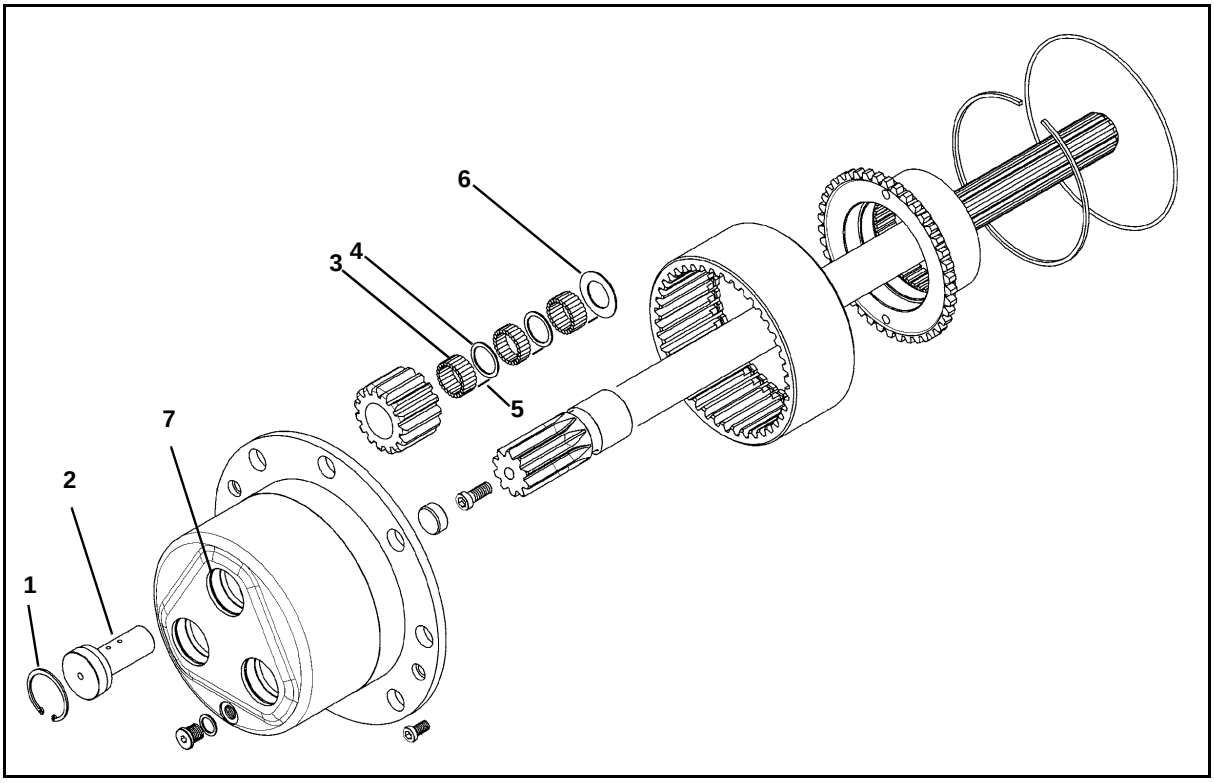


Reassembly:

Insert the “O”-ring seal **8** on the spindle **7**. Clean and degrease the seal. Insert the wear sleeve **9**. Mount the bearing **6** on the spindle. Mount the bearing cone **6** and the oil seal **10** on the wheel hub **11**. Insert the hub on the spindle **7**, taking care to prevent damage to the oil seal **10**. Insert the bearing cone **14** on the hub. Mount the crown **17** on the crown plate **12** and block them together with the retaining ring **16**. Mount the bearing **14** on the crown plate **12** and insert the crown plate on the spindle. Put in place the adjusting shims **4** and the flange **9** and to block the flange with the screw **5**. Tighten the screws **5** to the torque of **120 Nm** and check for taper bearings adjustment by turning the wheel hub. The bearing adjustment is correct if the resistant torque is about **28-32 Nm**. Otherwise increase or decrease the adjusting shims until this value is reached.
Note: a higher preload causes overheating and a rapid bearings damaging.
Remove the screws **5**, clean them and apply medium strength threadlocker on their threads. Mount them and tighten to the specified torque of **120 Nm**.
Mount the sun gear **3** on the axle shaft **1**.
Screw the bolt **15** with threadlocker on it.
Insert the axle shaft, matching the differential teeth.
Fit the ‘O’-ring seal on the wheel hub **13**.
Insert the planet carrier group, slightly turning it to match the gears.
Mount the two M12 screws **15** fixing the hub **11** to the planetary gear with threadlocker on the thread.

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PLANETARY GEAR
DISASSEMBLY·REASSEMBLY



Disassembly Procedure

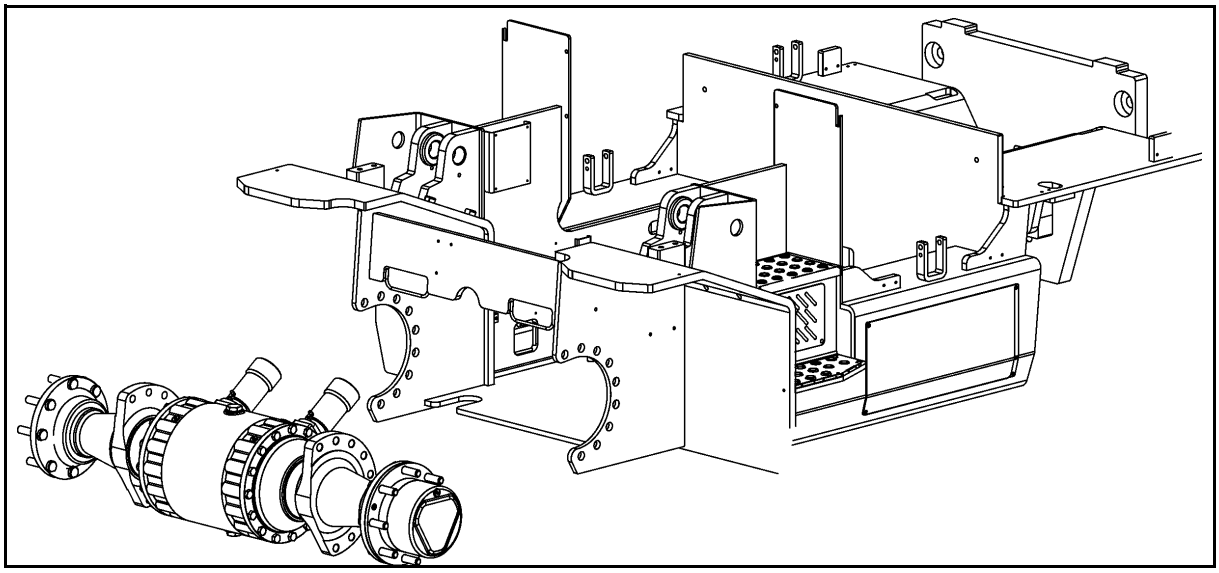
1. Execute the DRIVE UNIT HUB disassembly procedure
2. Remove the three snap rings **1** of arrest of the three satellit gear support pins
3. Remove the three satellit gear support pins **2** by the suitable extractor
4. Remove the satellit gears **3 (**three satellit gears each pin), spacer rings **4**, needles **5**, and external thrust washers **6**.

Reassembly Procedure

1. Check that the three satellit gears **3** are perfectly clean. Spread their central holes with a film of hard grease. Use grease type FINA MARSON EPL 3, NLGI:3 degree or equivalent..
2. Position the needles **5** inside the gears **3** so that it's fully filled, placing a spacer ring **4** between each row of needles.
3. Insert the three pins **2** into the spider holes **7**
4. Insert on the pin the thrust washers and the gears. Position the external thrust washers pos.**6**.
5. Insert the snap rings **1**
6. Execute the DRIVE UNIT HUB reassembly procedure

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FRONT AXLE GROUP
DISASSEMBLY·REASSEMBLY



Disassembly Procedure

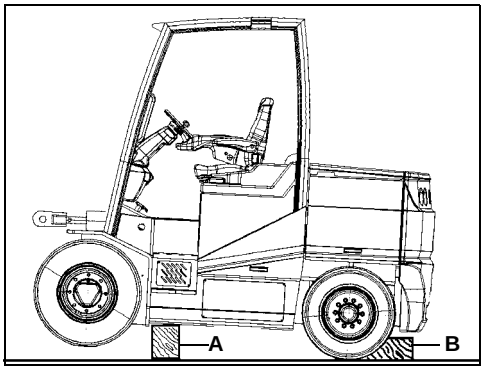
1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover, disconnect the battery plugs
4. Remove the forks and the mast (see chapter 12f)
5. Jack up the front part of the vehicle and place wooden or metallic blocks under the chassis. Block the steering wheels by wedges **[Point 1]**
6. Remove the front wheels
7. Remove the footboard mat and the footboard
8. Remove all the pedals (accelerator and brake)
9. Insert and screw on an eyebolt in the traction motor threaded hole, in the middle of the motor, hook the eyebolt by a chain, to the bridge crane, pull the chain until it is tightened **[Point 2]**
10. Support the traction motor weight placing a wooden block between the traction motor and the chassis.
11. Remove the motor fixing bolts to the traction group
12. Remove pipes and wirings from axle brakes
13. Place a transpallet under the front alxle. Place a wooden block on the transpallet forks to support the front axle flange **[Point 3].** Lift the front axle group
14. Unscrew all the bolts fixing the front axle to the chassis **[Point 4]** and remove the axle paying attention to the plastic cross joint integrity **[Point 5]**

Reassembly Procedure

The installation procedure is the reverse of the removal procedure

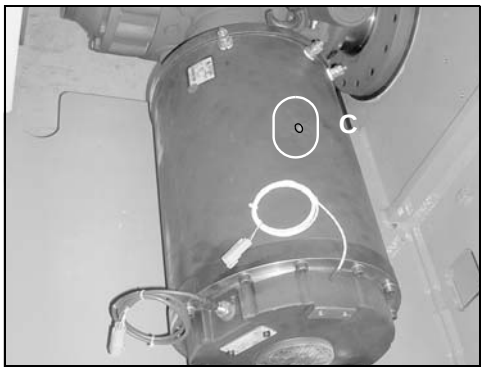
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Point Operations



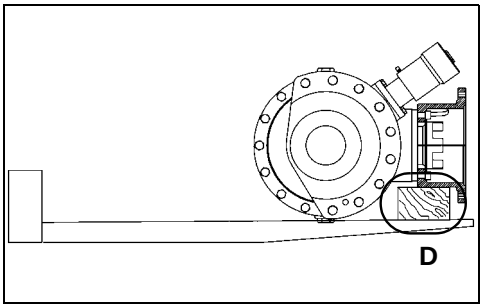
[Point 1]
Disassembly:

Jack up the front part of the vehicle and place wooden or metallic blocks **A** under the chassis. Block the steering wheels by wedges **B**



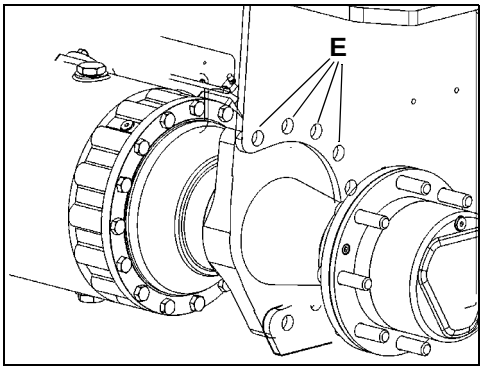
[Point 2]
Disassembly

Insert and screw an eyebolt in the threaded hole **C**, in the middle of the motor, hook the eyebolt by a chain, to the bridge crane, pull the chain until tightened



[Point 3]
Disassembly:

Place a transpallet under the front alxle. Place a wooden block **D** on the transpallet forks to support the front axle flange



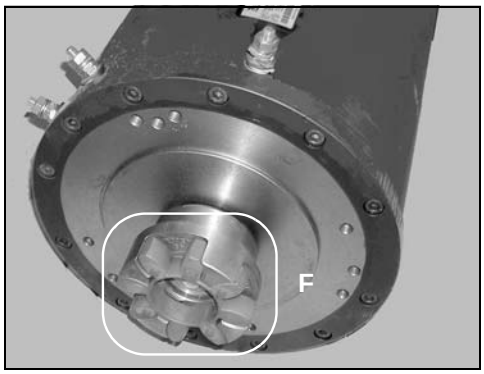
[Point 4]
Disassembly

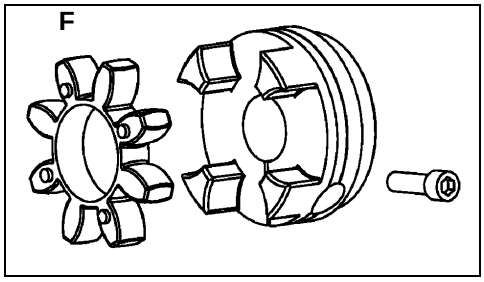
Unscrew all the 18 **E** bolts (9 in the lelt side and 9 in the right side) fixing the front axle to the chassis

Reassembly:

After the installation, tightening torque for the 18 **E** fixing bolts = **900 Nm**

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[Point 5]
Disassembly
Pay attention to the plastic cross joint **F** integrity.

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PÀGINA INTENCIONALMENTE BLANCA

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REAR AXLE

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STEERING STROKE END ANGLE ADJUSTMENT 7
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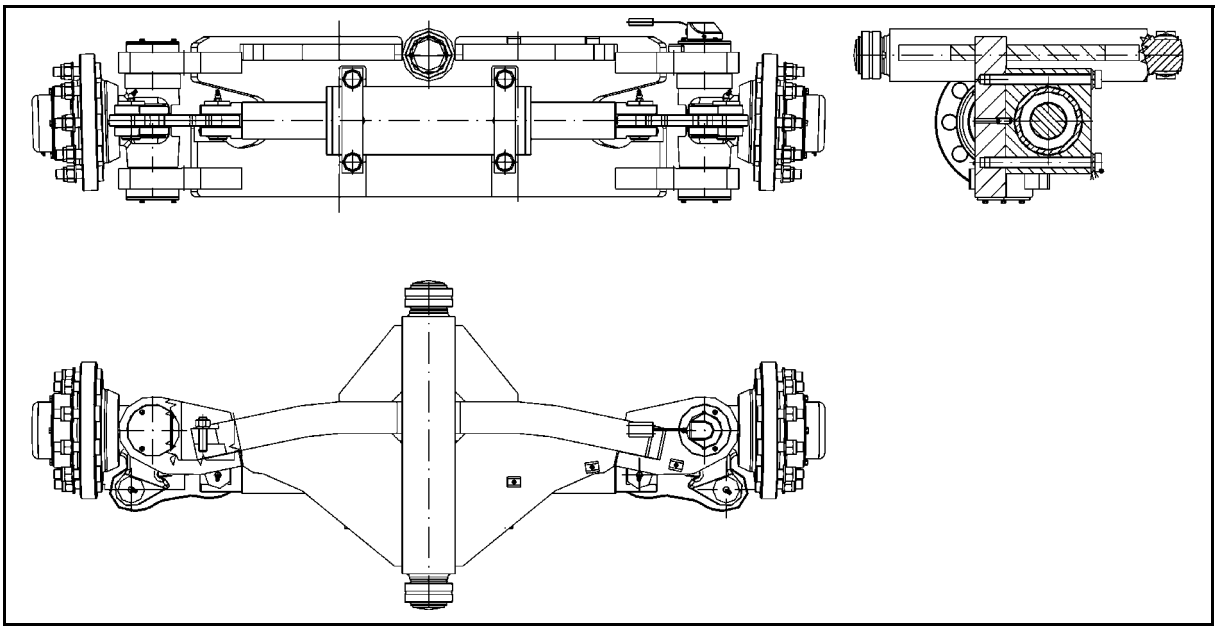
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PÀGINA INTENCIONALMENTE BLANCA

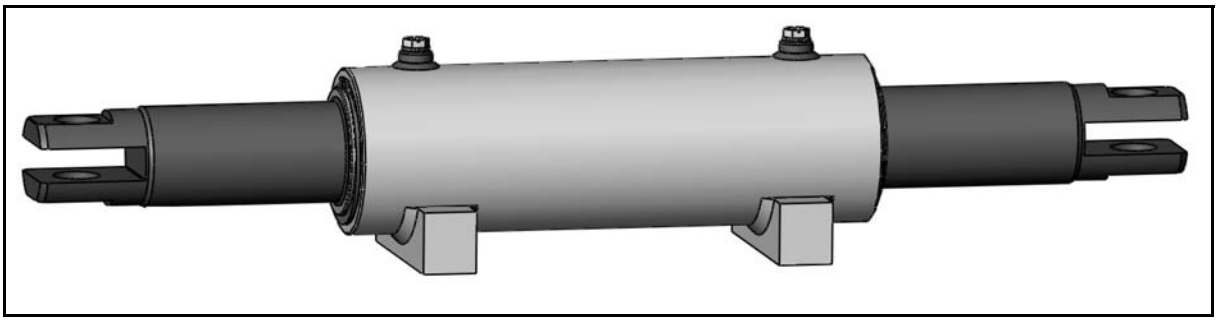
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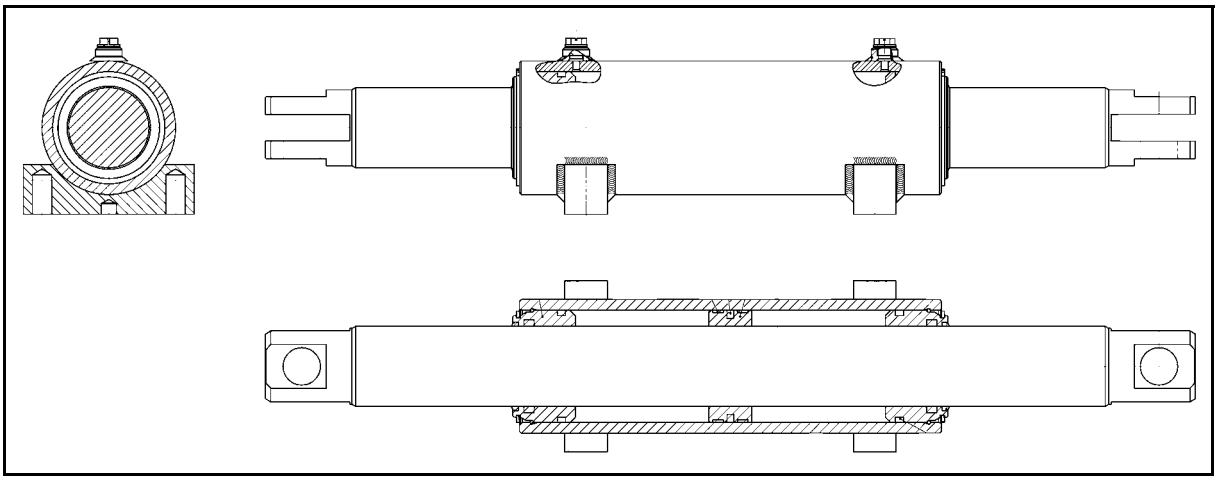
REAR AXLE

GENERAL



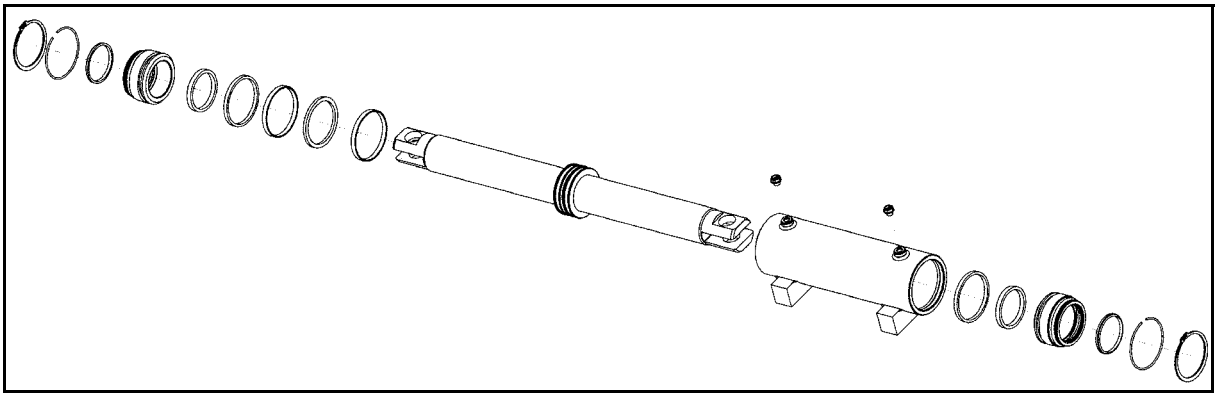
REAR AXLE CYLINDER





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DISASSEMBLY·INSPECTION·REASSEMBLY



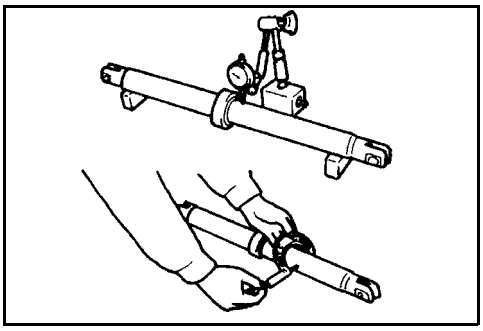
Disassembly Procedure

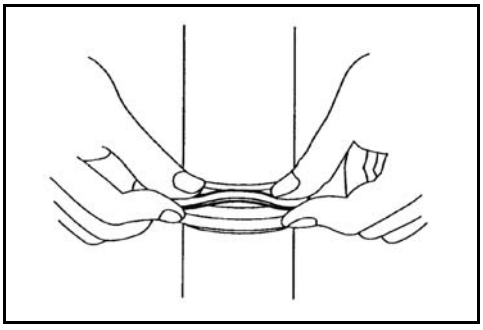
1. Remove the piston rod guide
2. Remove the piston rod **[Point 1]**
3. Inspect the cylinder **[Point 2]**

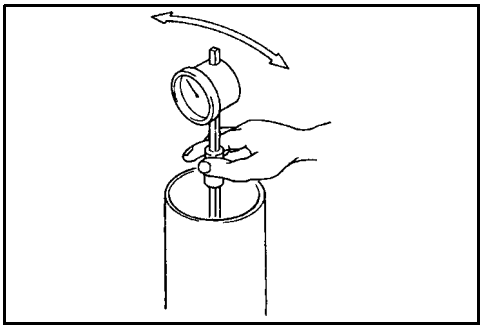
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:
Coat hydraulic oil before reassembly.







Point Operations

[Point 1]

Inspection:
Measure the piston rod outside diameter.

Standard: 75 mm

Limit: 74,94 mm

Inspection:
Measure the bend of the piston rod.

Limit: 0.2 mm (0.020 in)

Reassembly:
Warm the seal ring to a little below 80°C (176°F) in hot oil or water before installation. Do not stretch it excessively.

Caution:
Operation carefully to avoid scalding.

[Point 2]

Inspection:
Measure the rear axle cylinder.

Standard: 105 mm

Limit: 105,09 mm

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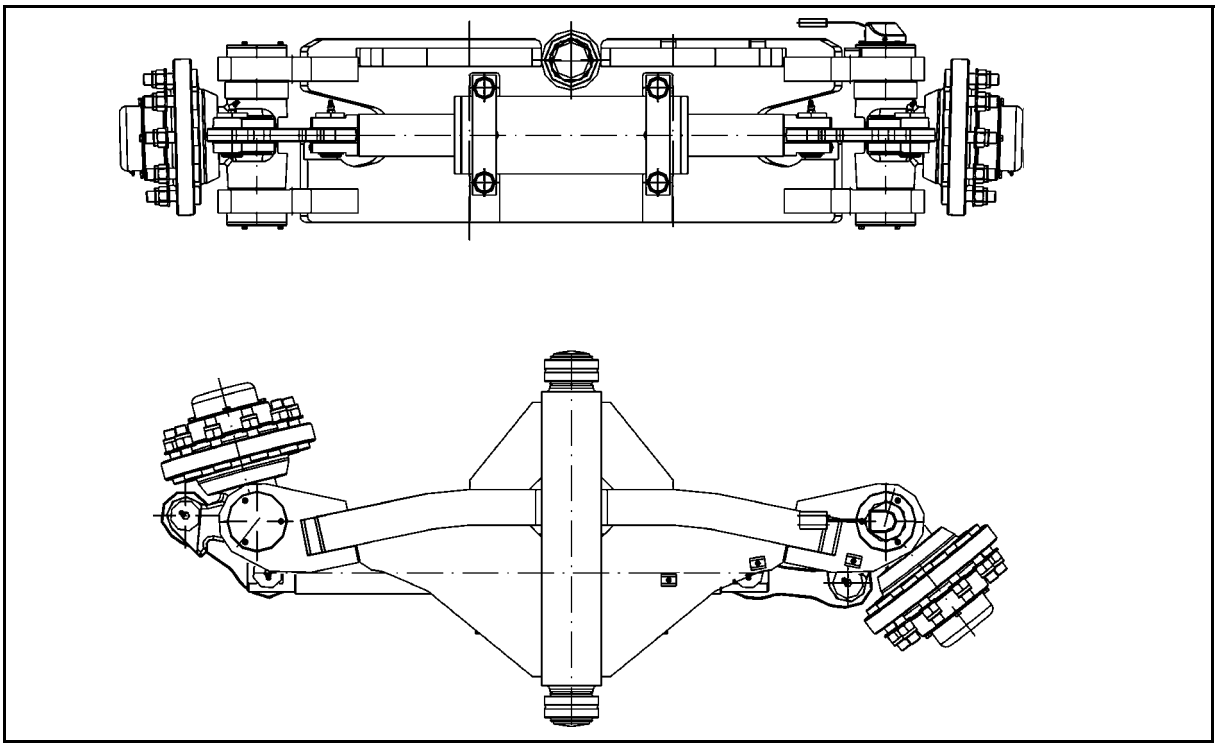
SPECIFICATIONS

Rear axle type			Elliot type
Rear axle suspension type			Center-supported right-left rocking type
Wheel alignment	Toe-in	mm	min 0 - max 13
	Camber	degree	1° each side
Maximum turning radius (outermost)		degree	75°
Rear axle cylinder	Cylinder type		Double acting
	Piston rod outsidediameter	mm	75
	Cylinder boremm (in)		105

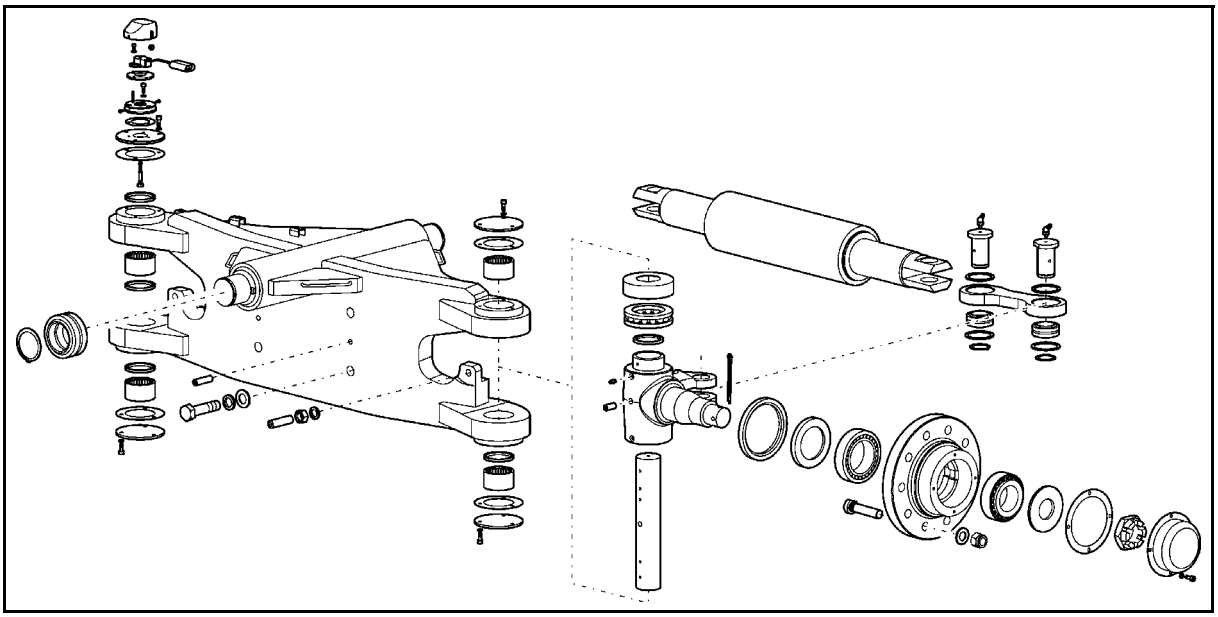
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REAR AXLE

GENERAL

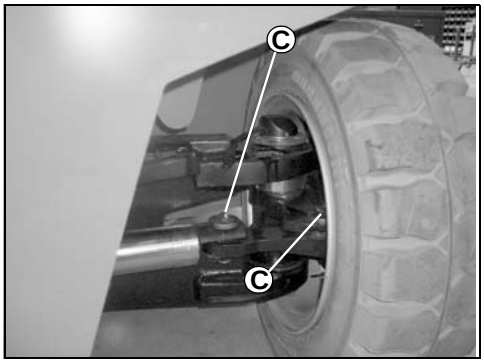


COMPONENTS



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CONTROL OF REAR AXLE



Every 1000 hours

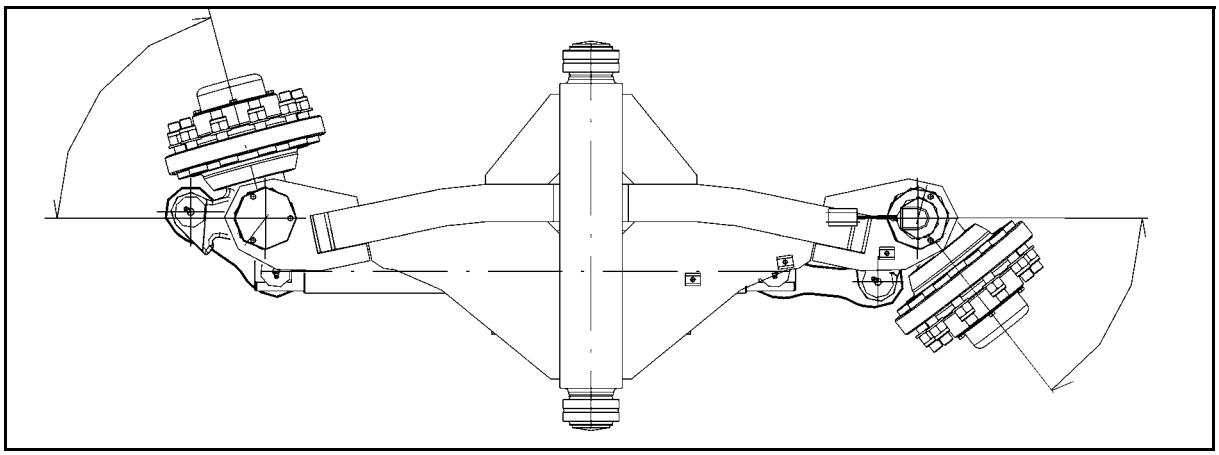
- lubricate the steering group articulations, using the appropriate grease nipples **(C)**
- control the steering locks
- check the conditions of the wheel hub bearings and adjust them if necessary

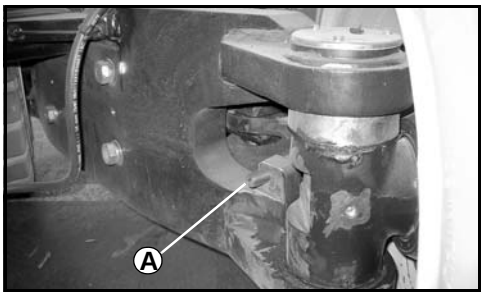
If any abnormal wear on the wheel tread is noticed, carry out the following controls:

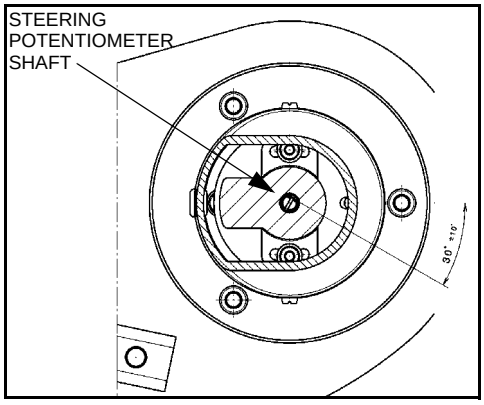
- check the parallelism of the steered wheels
- check that wheel lock is the same on both directions

STEERING STROKE END ANGLE ADJUSTMENT

REAR AXLE



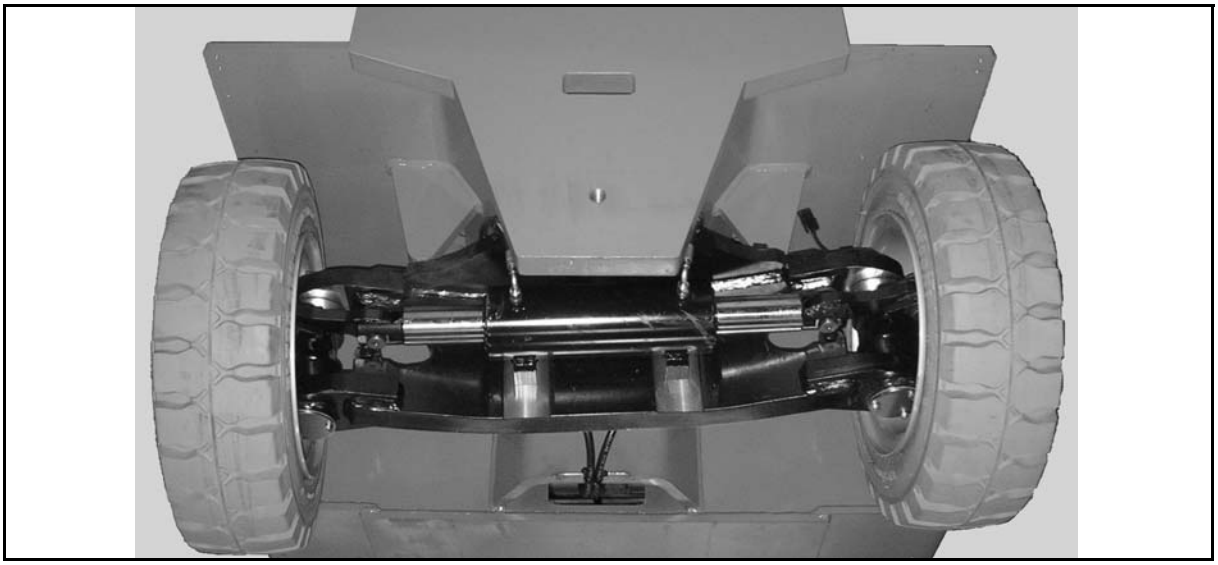




(1) Drive the steering cylinder to the stroke end
(2) Check the steering angle as shown in the picture above
(3) To vary the steering stroke end angle, act on the grub screw **(A)**:
Std value 70°
(4) Repeat the same operation on the other wheel

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DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the compartment and disconnect the battery
4. Lift the rear part of the vehicle and place shims under the chassis **[Point 1]**
5. Disconnect the pipes of the steering axle cylinder and plug them
6. Disconnect the potentiometer connector from the wiring harness **[Point 2]**
7. Keep the steering axle raised with a transpallet
8. Loosen and remove the fixing screws **[Point 3]**
9. Remove the steering axle

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

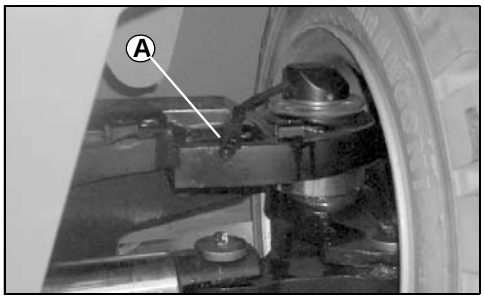
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Point Operations



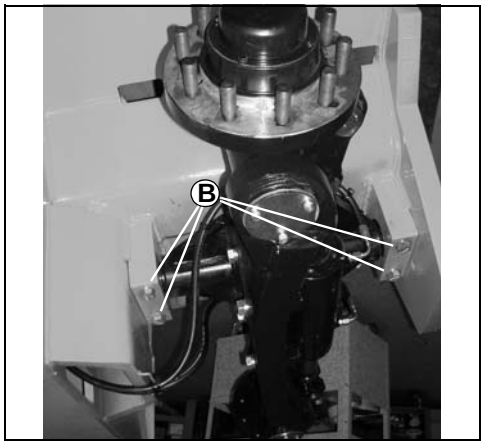
[Point 1]
Disassembly:

Lift the rear part of the vehicle and place wooden or metallic blocks under the chassis



[Point 2]
Disassembly:

Disconnect the potentiometer connector **(A)** from the wiring harness



[Point 3]
Disassembly:

Loosen and remove the 4 axle fixing screws **B**

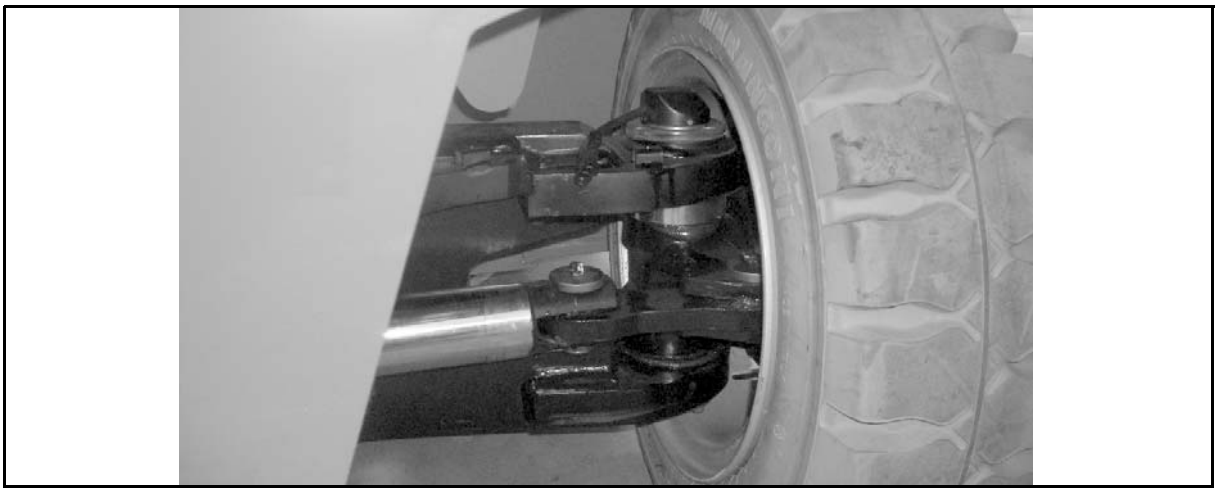
Reassembly:

After the installation, tightening torque for the 4 screws = **545 Nm**

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STEERING POTENTIOMETER

DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Disconnect the potentiometer connector from the auxiliary wiring
2. Remove the potentiometer cover fixing screws **[Point 1]**
3. Remove the potentiometer from the axle **[Point 2]**
4. Remove the potentiometer fixing screws from his support **[Point 3]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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Point Operations



[Point 1]
Disassembly:
Remove the potentiometer cover fixing screws



[Point 2]
Disassembly:
Remove the potentiometer from the axle



[Point 3]
Disassembly:
Remove the potentiometer fixing screws from his support (foto P1010012)

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Point Operations



[Point 1]
Disassembly:
Remove the potentiometer cover fixing screws



[Point 2]
Disassembly:
Remove the potentiometer from the axle



[Point 3]
Disassembly:
Remove the potentiometer fixing screws from his support (foto P1010012)

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STEERING

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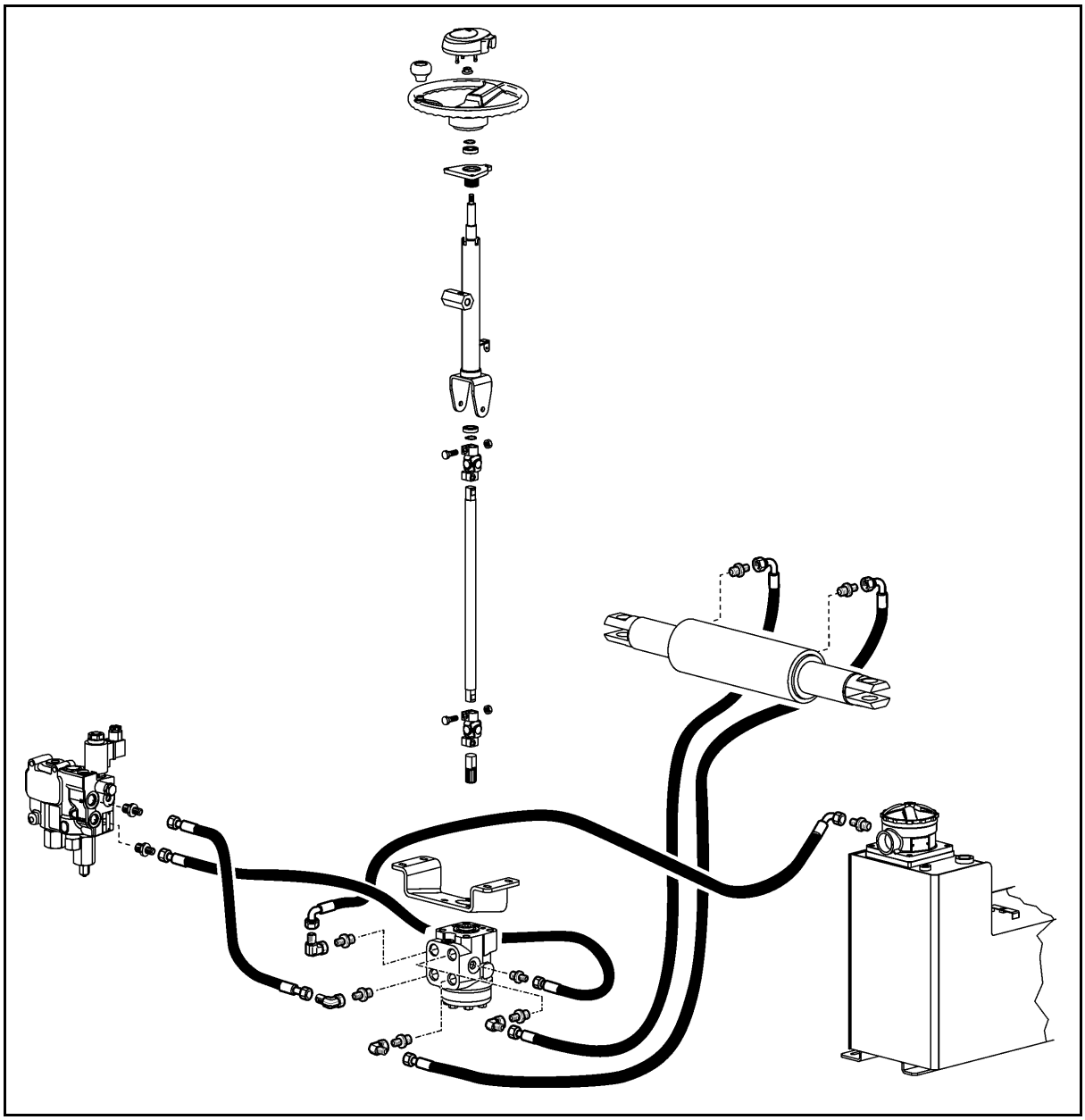
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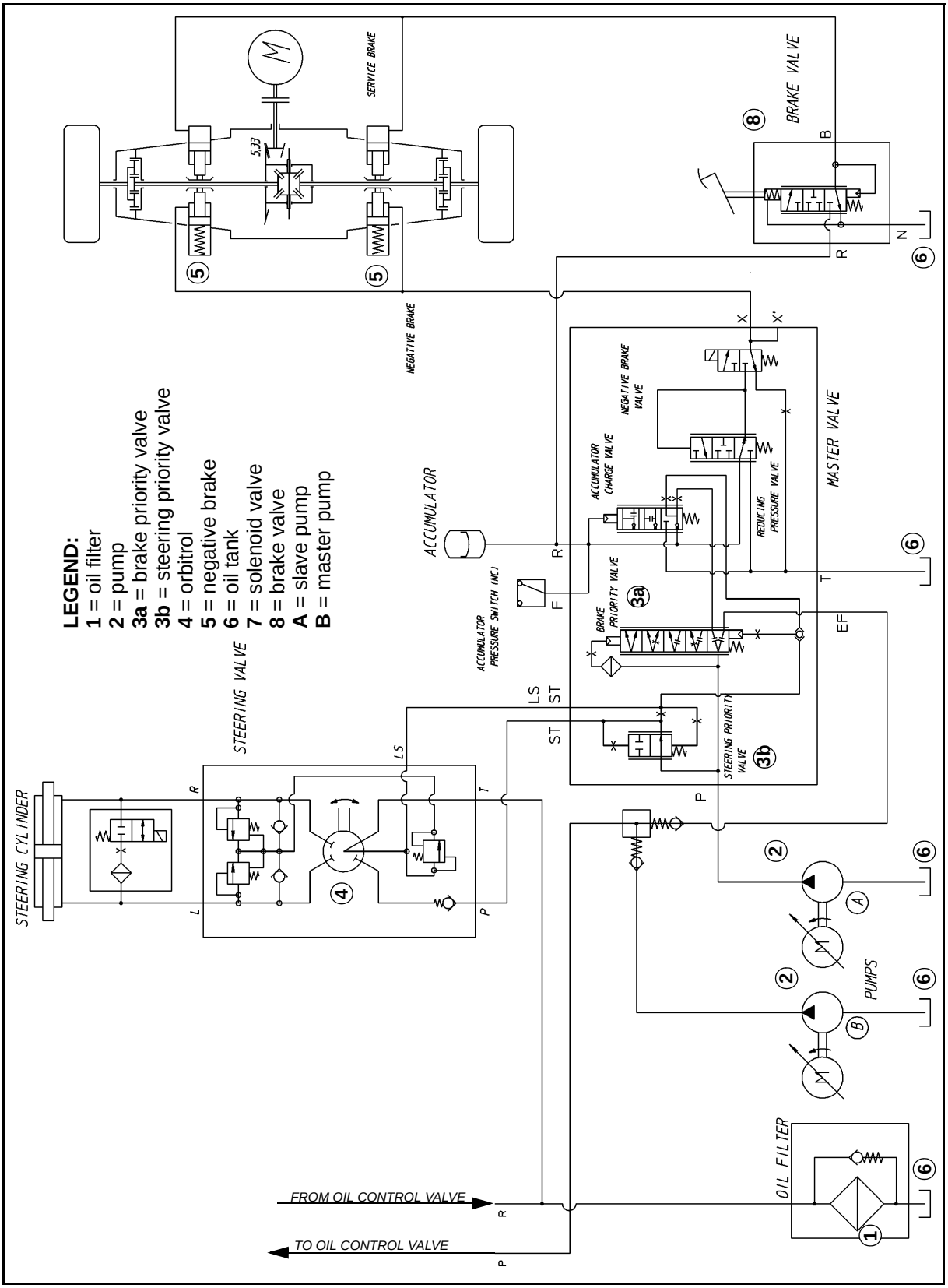
STEERING SYSTEM

GENERAL



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HYDRAULIC DIAGRAM



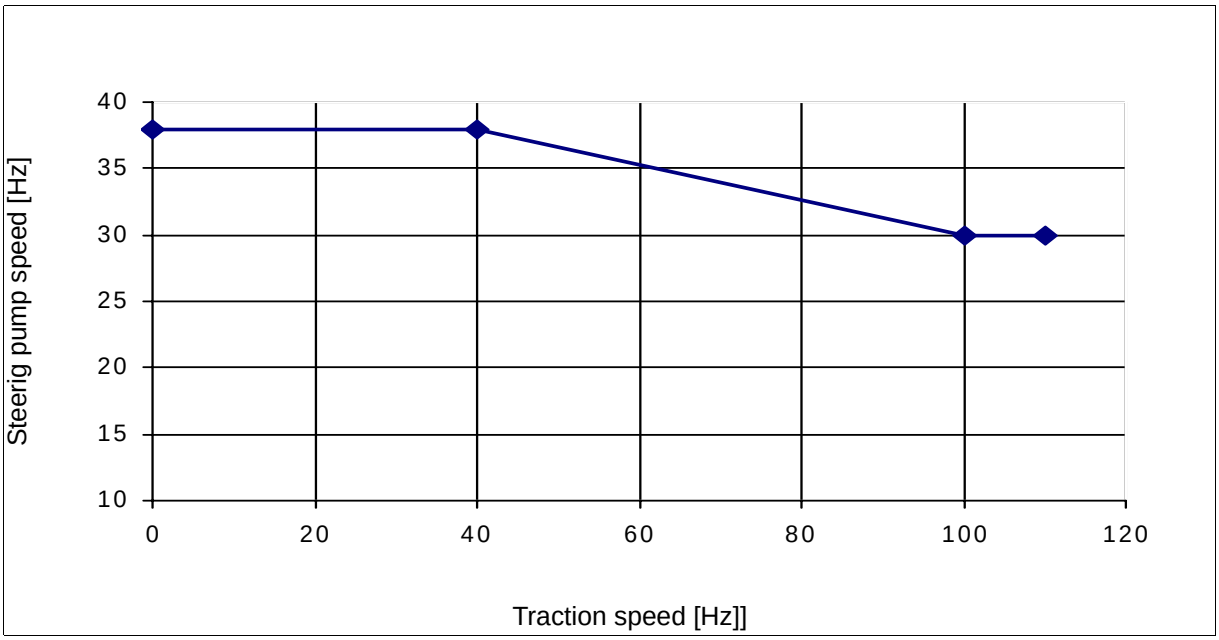
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STEERING COMMAND

The steering uses the same oil as the lifting by means of the steering priority valve (inside the master valve).
The oil flow is delivered from the 2 pumps to the steering priority valve so that there is always a sufficient oil flow to the power steering.
The flow rate partition is controlled by the LS (Load-Sensing) signal from the steering unit and it happens so that the flow rate sent to the power steering is equal to its real requirement.
The exceeding delivery is sent to the control valve for other functions.
When the steering wheel is turned, the steering unit “measures” an oil volume proportional to the rotation and sends it to the steering cylinder. The steering unit automatically goes back into its neutral position when the manoeuvre is ended.

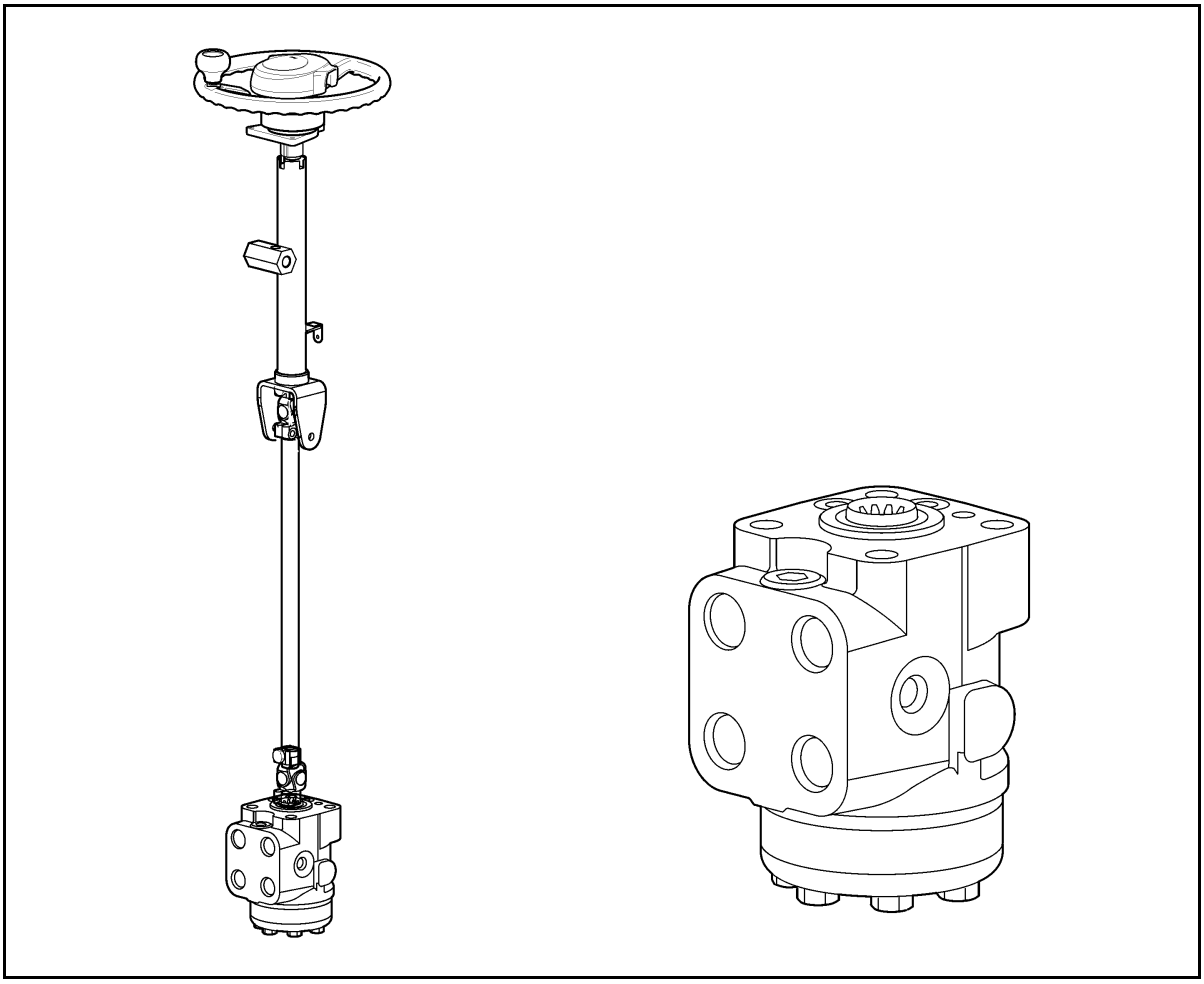
The steering wheel hardness depends proportionally from the truck traction speed, as shown in the diagram here below.
Increasing the traction speed the pump R.P.M. decrease.
This allows an improvement of the truck speed control.

Traction speed [Hz]	Steerig pump speed [Hz]
0	38
40	38
100	30
110	30



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POWER STEERING (ORBITROL)



SPECIFICATIONS

Parts		Load capacity	60 - 70 - 85
Steering wheel diameter		mm	360
Steering wheel clearence		mm	20 ~ 50
Power steering (orbitrol) type			Dynamic
Dynamic power steering	Oil flow rate:	ℓ·min	24
	Maximum pressure:	Bar	~ 160

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DYNAMIC POWER STEERING

TROUBLESHOOTING

Only hydraulic related items are listed.

Symptom	Probable cause	Action
The steering wheel cannot be rotated	• The piping is damaged	Replace
	• The shaft from the steering wheel to the power steering is incorrectly installed or damaged	Inspect and adjust or replace
The steering wheel is heavy	• Tyre pressure is low	Adjust the tyre pressure
	• The oil pressure does not rise	Inspect and adjust the pressure relief valve(**)
	• The high and low pressure pipes are connected in reverse	Correct or replace
The oil pressure does not rise	• The high and low pressure pipes are connected in reverse	Correct or replace
	• Pressure relief valve faulty or not closed	Inspect and correct
	• Oil pump function is deteriorated	Inspect and adjust or replace
	• Hydraulic oil level is low	Add
The steering wheel does not return properly into neutral	• Tyre pressure is low	Adjust the tyre pressure
	• The orbitrol shuttle does not move easily	Correct or replace the orbitrol
	• The rear axle does not move smoothly	Add lubricant or correct
The steering wheel pulls to one side when released	• The orbitrol shuttle does not move easily	Correct or replace the orbitrol
	• The steering valve drive shaft is damaged	Replace the steering valve
	• The piping is blocked (crushed or clogged)	Inspect and correct or replace
Play is excessive and the vehicle wobbles	• Oil moves in the steering valve	Replace the steering valve
	• The orbitrol shuttle does not move easily	Correct or replace the orbitrol
	• Air is sucked from the piping	Inspect and adjust or replace
	• The steering shaft is defective	Correct or replace
The steering wheel shimmies	• The shaft is not installed correctly	Correct or replace
The tyres are steered opposite to the steering wheel operated direction	• The piping to the hydraulic motor is connected in reverse	Inspect and correct the pipe connections

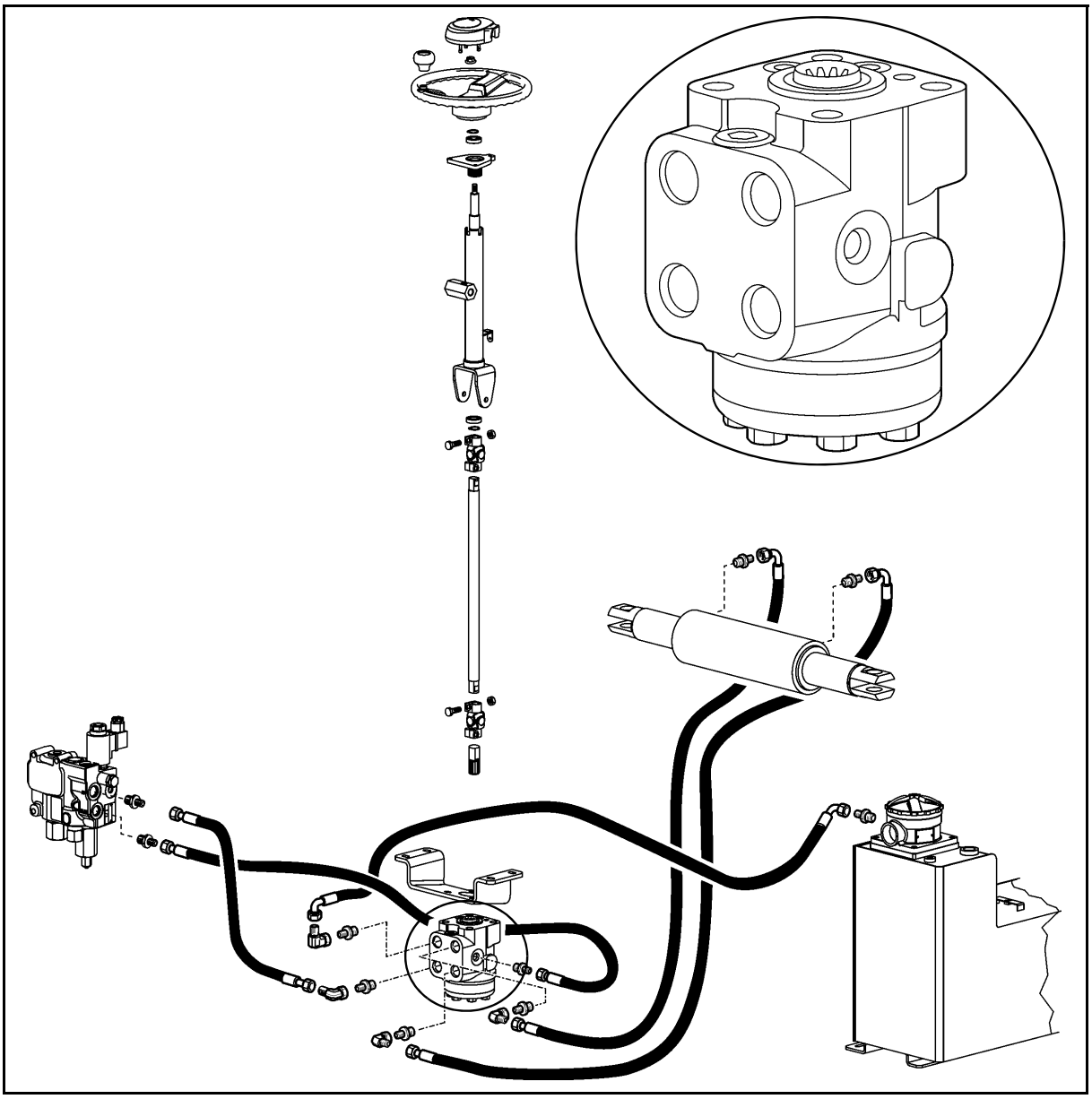
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Symptom	Probable cause	Action
Abnormal noise is generated	• The pressure relief valve is defective	Check and adjust the pressure
	• Air is sucked from the piping	Inspect and adjust or replace
	• The piping is blocked (crushed or clogged)	Inspect and correct or replace
The steering wheel is heavy to rotate	• damaged priority valve (obstructed, clogged or out of order)	Inspect or replace

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POWER STEERING (ORBITROL)

DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and activate the parking brake
2. Lift the forks for 1,5 ÷ 2 m to facilitate the power steering replacement **[Point 1]**
3. Switch off the truck
4. Open the battery cover and disconnect the battery
5. Remove the front cover
6. Empty the steering oil circuit
7. Disconnect the pipes
8. Remove the power steering (orbitrol) by unscrewing the 4 support fixing screws **[Point 2]**

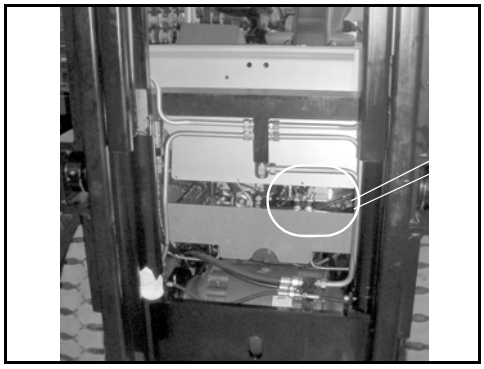
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Notes:
Add grease to the coupling between the steering shaft and steering valve using paste type CASTROL OPTIMOL T WHITE.

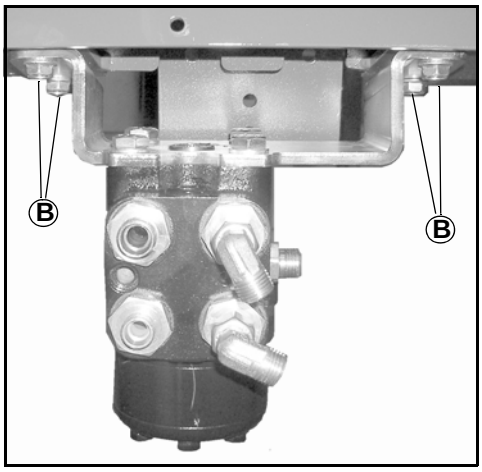
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Point Operations



[Point 1]
Disassembly:

Lift the forks for 1,5 ÷ 2 m to facilitate the power steering replacement



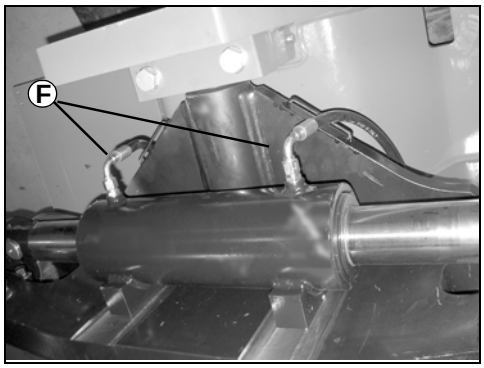
[Point 2]
Disassembly:

Remove the power steering unscrewing the support fixing screws **(B)**

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STEERING UNIT (ORBITROL)

CHECKING SEALS AND CLEANING THE POWER STEERING SYSTEM

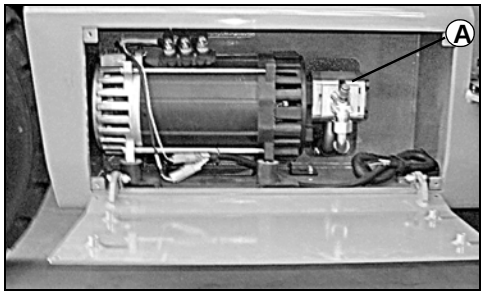


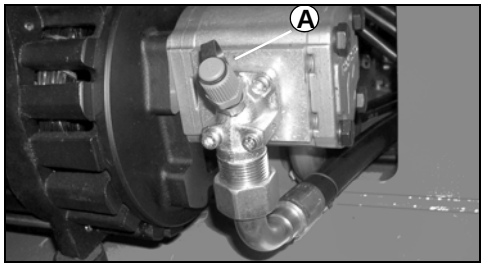
Every 1000 hours
- check the entire system, to identify any leaks; any intervention must be carried out without pressure in the system

Every 5000 hours
- replace the hoses connecting **(F)** the power steering to the steering cylinder

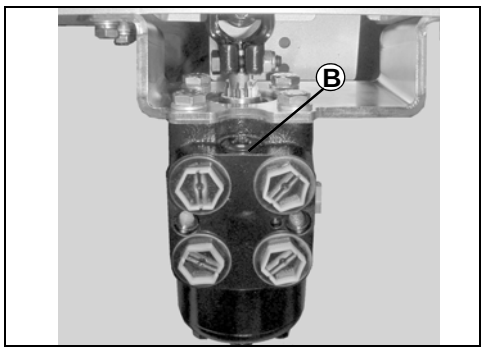
Every 10 000 hours
- replace the hydraulic piping system

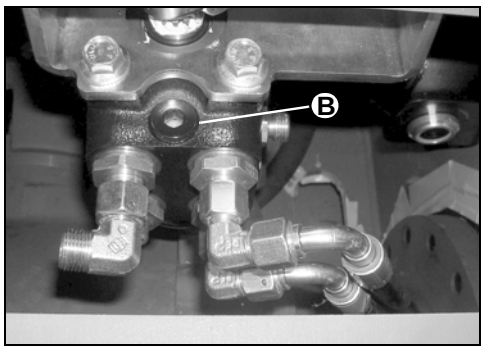
INSPECT AND ADJUST THE PRESSURE RELIEF VALVE





1. Open the right side compartment
2. Connect a pressure gauge on the pump pressure point **(A)**
3. When the steering wheel is rotated until the stroke end, relief state is achieved, so read the pressure on the pressure gauge at that time
4. Open the right side compartment
5. Connect a pressure gauge on the pump pressure point **(A)**
6. When the steering wheel is rotated until the stroke end, relief state is achieved, so read the pressure on the pressure gauge at that time





Standard

Bar	Max. 160

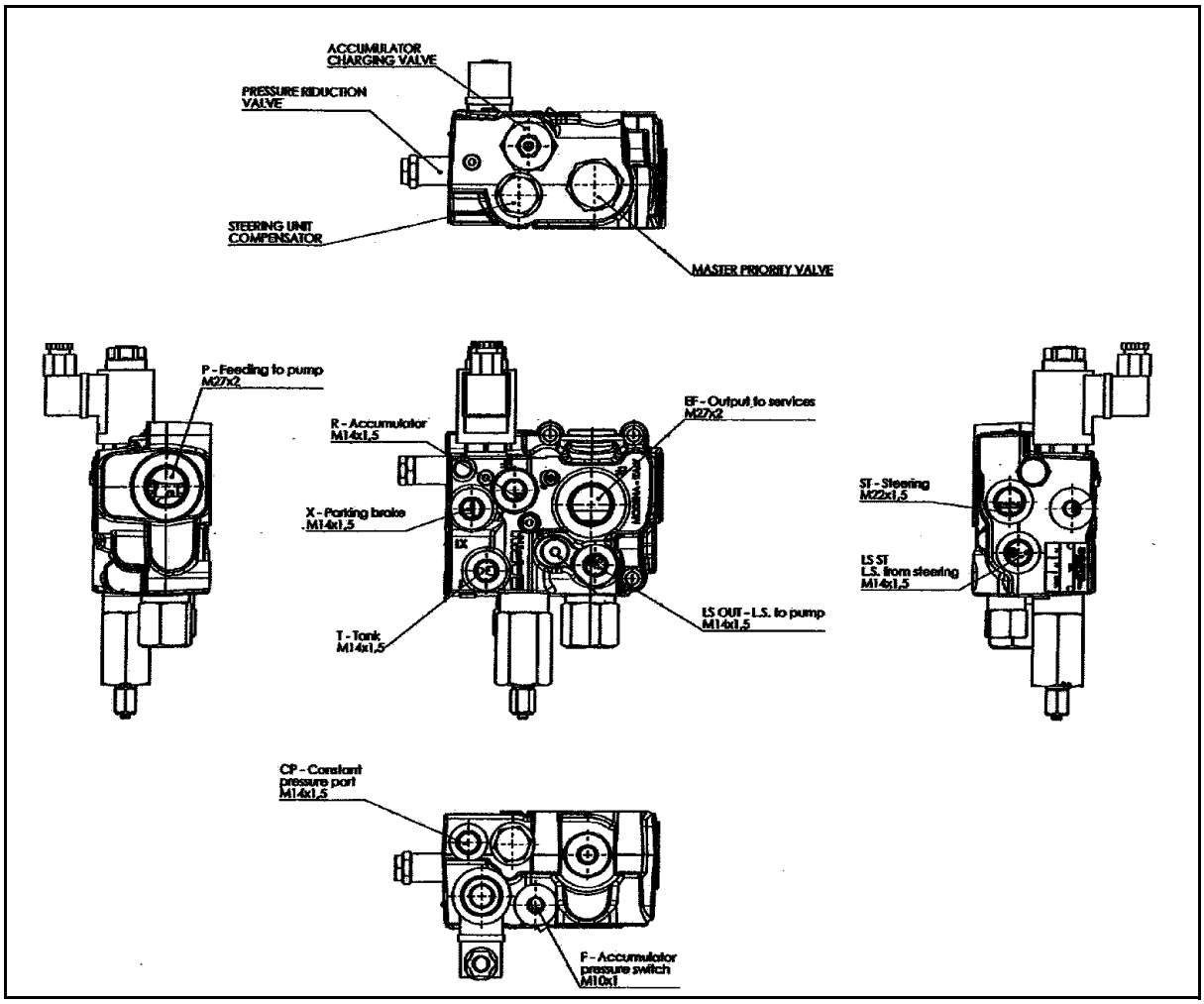
7. If the relief pressure is greater or lower than the standard value, adjust the orbitrol setting screw **(B)**

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MASTER VALVE

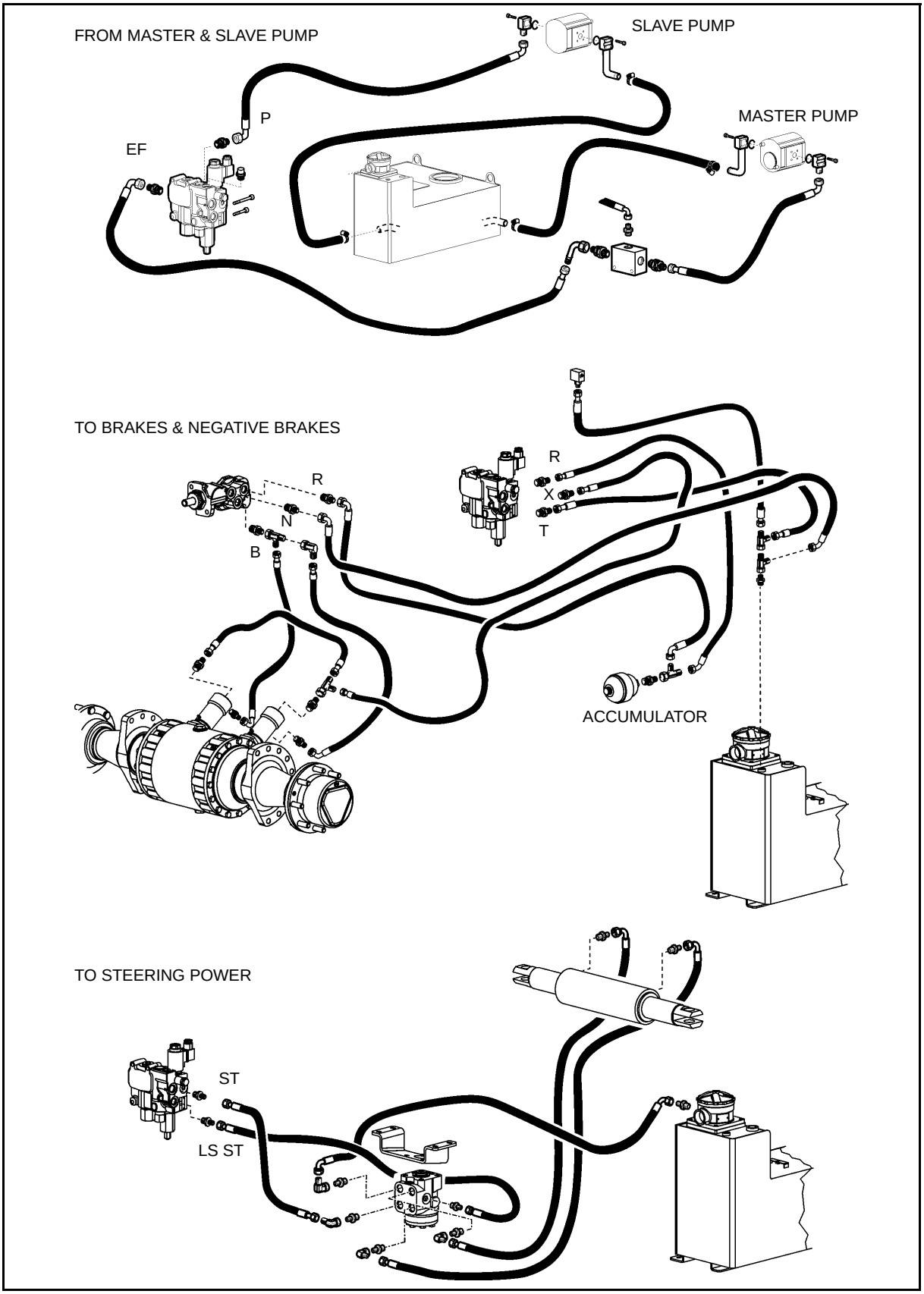
This group is an exchange valve which divides the master pump oil flow for different applications according to the following priorities:

1. Steering
2. Accumulator for brake system



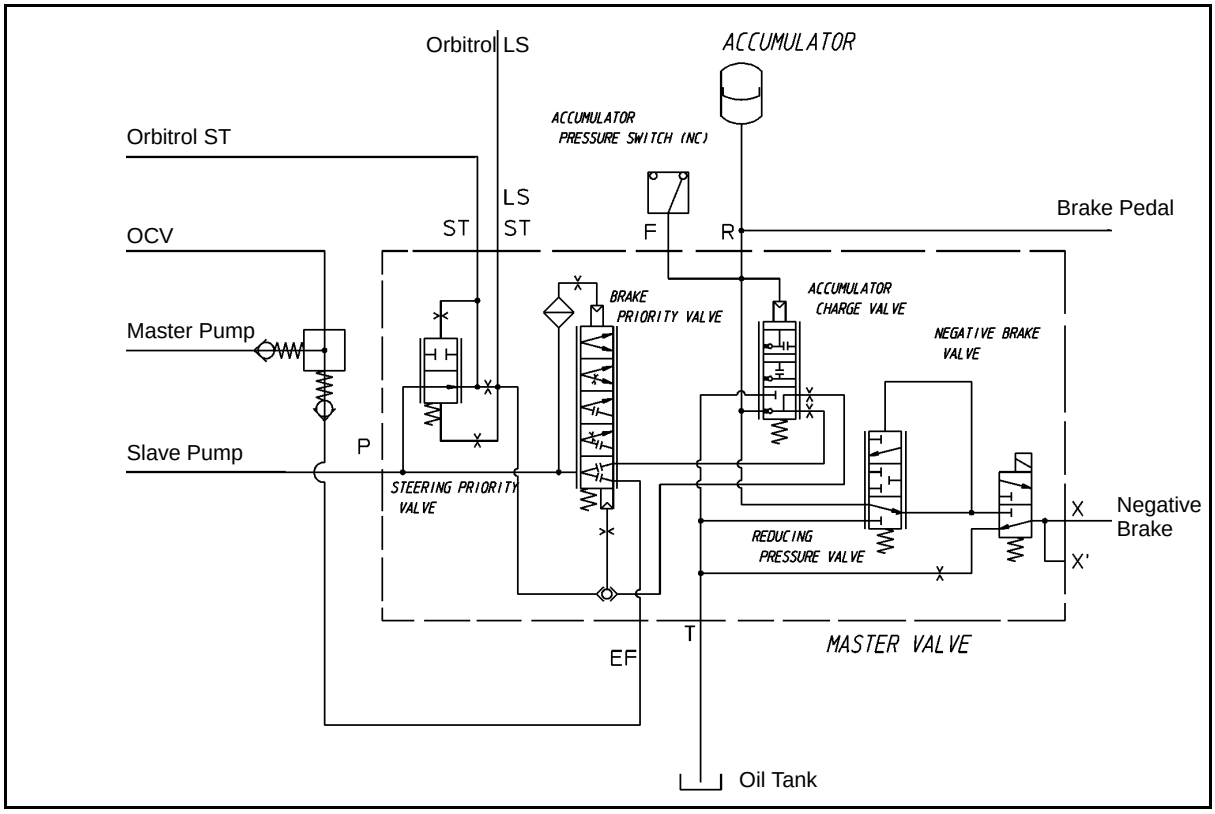
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GENERAL HYDRAULIC DIAGRAM



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MASTER VALVE HYDRAULIC DIAGRAM



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DISASSEMBLY • REASSEMBLY



Disassembly Procedure

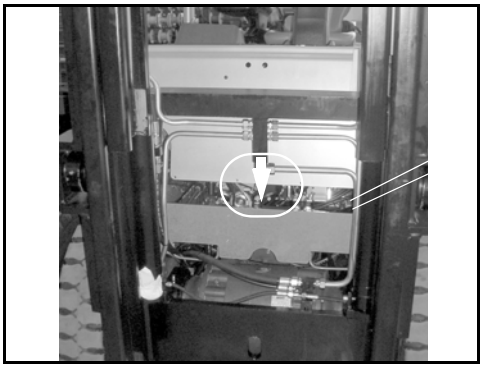
1. Park the truck on a level surface and activate the parking brake
2. Lift the forks for 1,5 ÷ 2 m to facilitate the master valve replacement; please refer to paragraph "OPERATION ON THE MAST" **[Point 1]**
3. Switch the truck off
4. Open the battery cover and disconnect the battery
5. Remove the front cover and the footboard
6. Empty the oil circuit
7. Disconnect the pipes and the wiring harness from the pressure switch and solenoid valve.
8. Unscrew the 3 fixing screws and remove the master valve from the truck **[Point 2]**
9. Remove the accumulator pressure switch
10. Remove the solenoid valve
11. Remove the accumulator charging valve
12. Remove the master priority valve

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

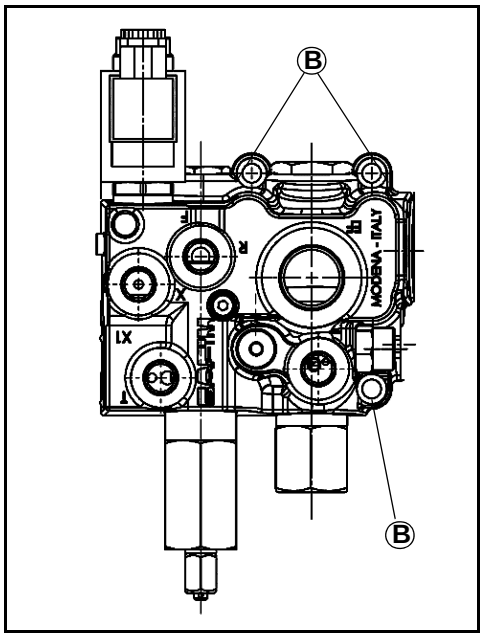
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Point Operations



[Point 1]
Disassembly:

Lift the forks for 1,5 ÷ 2 m to facilitate the power steering replacement



[Point 2]
Disassembly:

Remove the power steering unscrewing the 3 fixing screws **(B)**

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BRAKES

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BRAKE PEDAL 4
HYDRAULIC BRAKE CYLINDER 5
BRAKE DISC WEAR CONTROL AND ADJUSTMENT 6
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ACCUMULATOR 13
GENERAL 13

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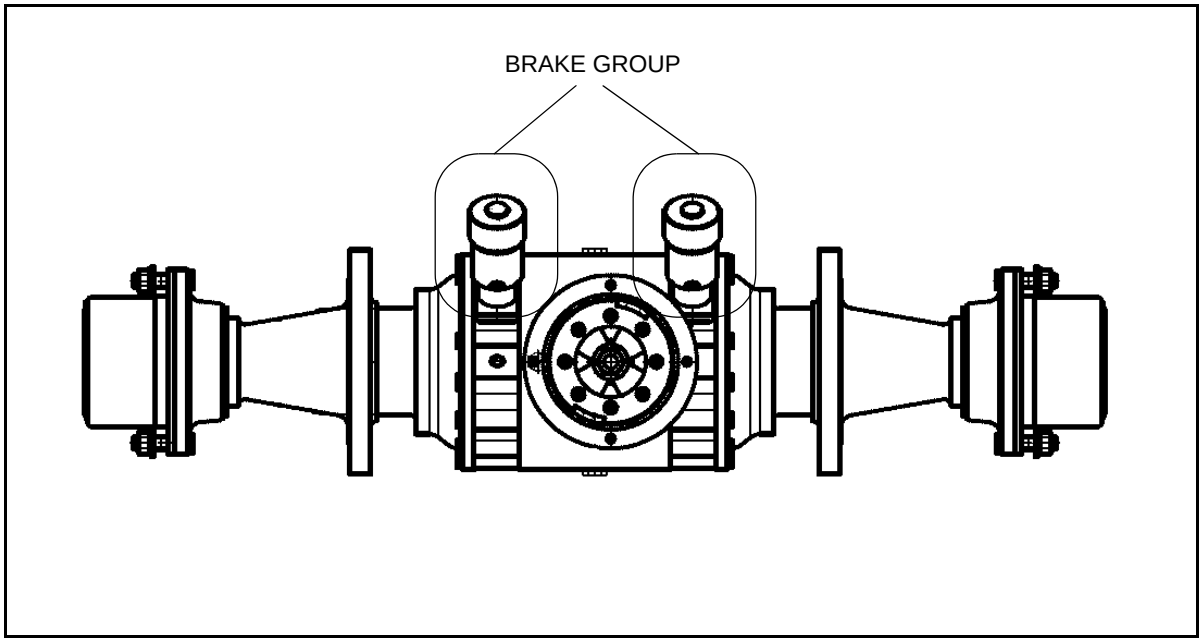
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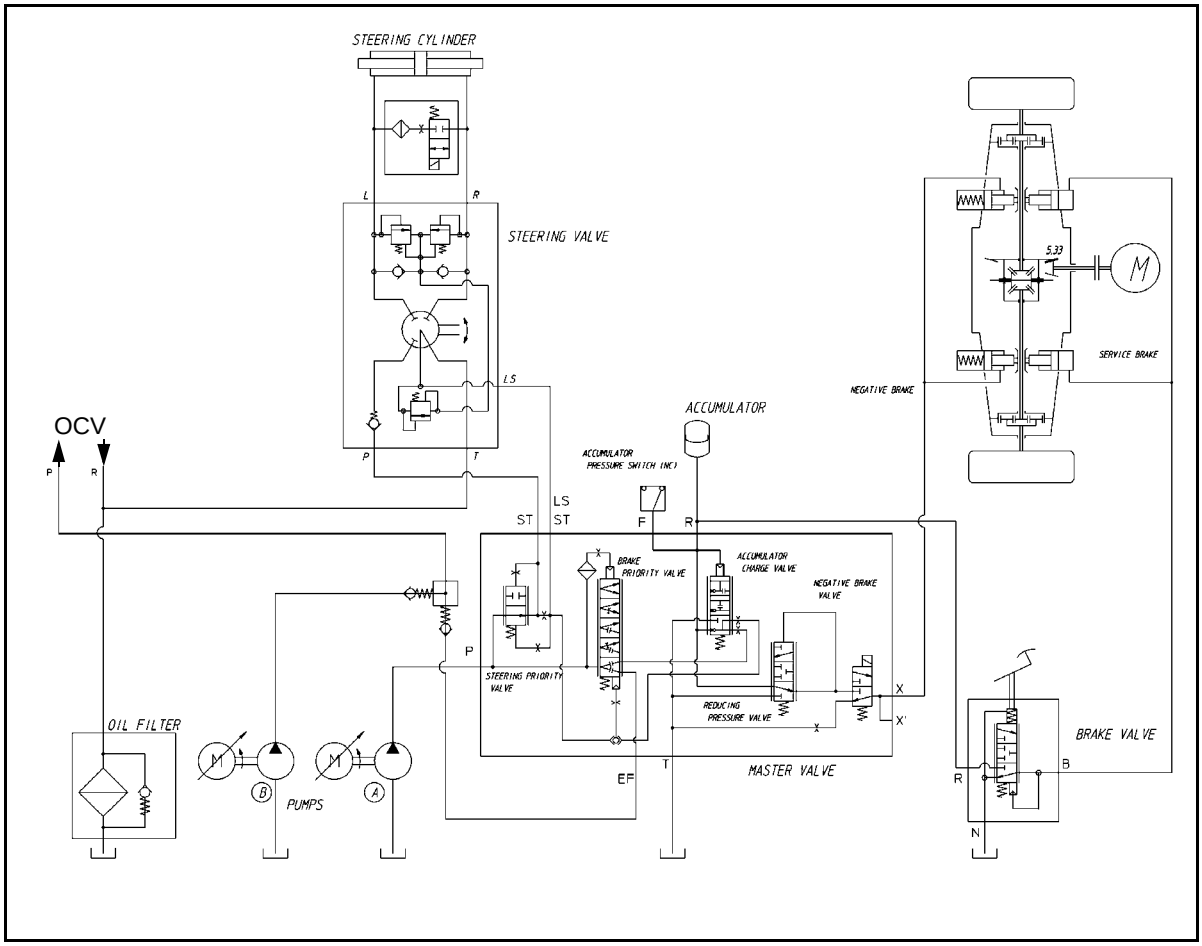
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GENERAL

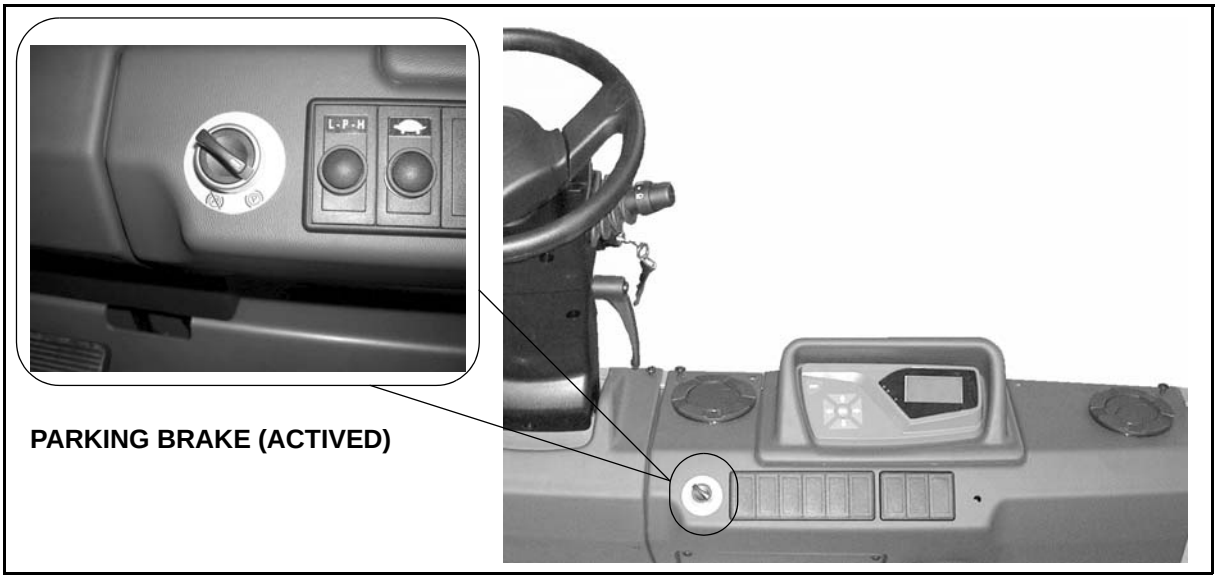


HYDRAULIC DIAGRAM



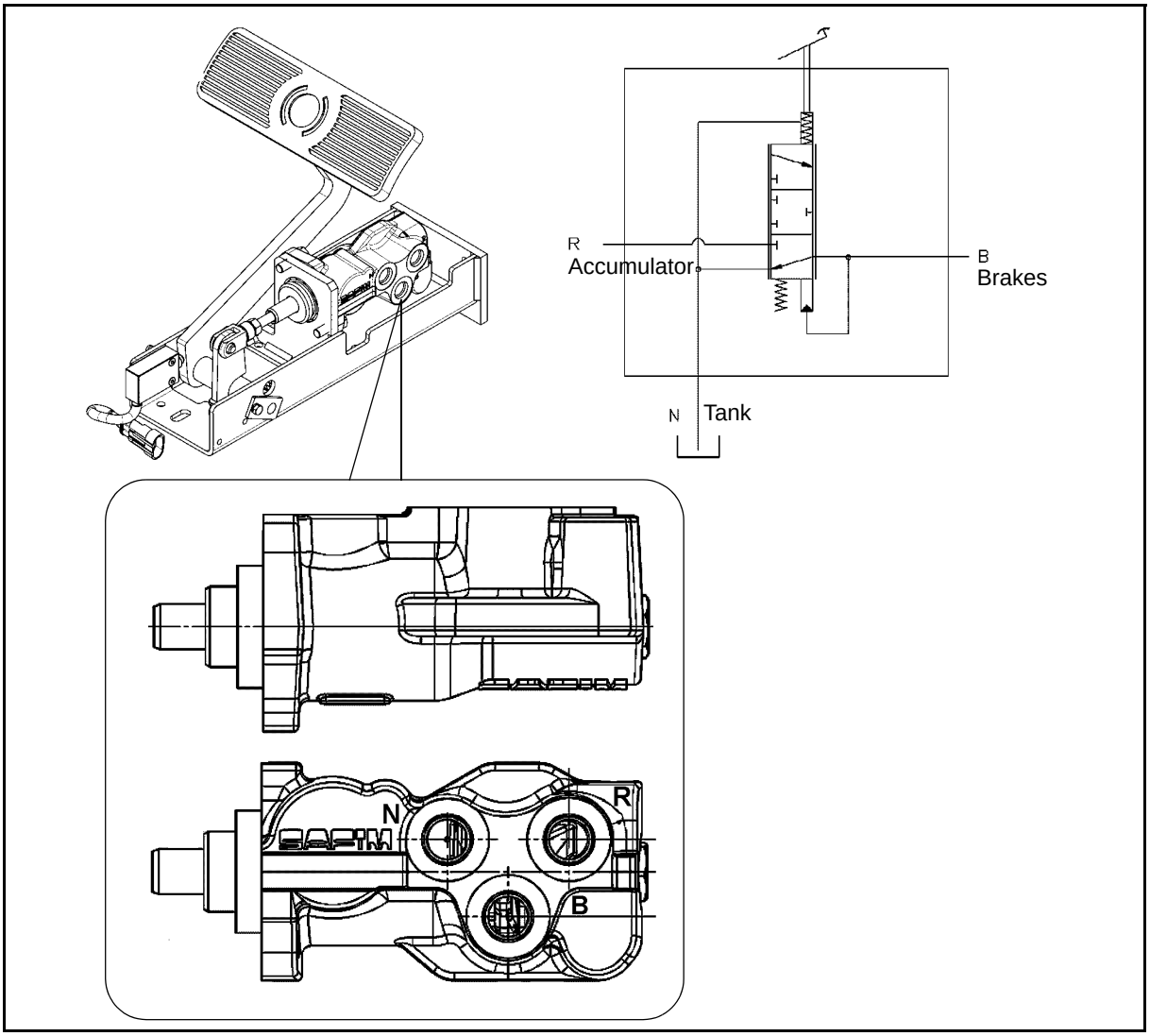
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PARKING BRAKE



PARKING BRAKE (ACTIVED)

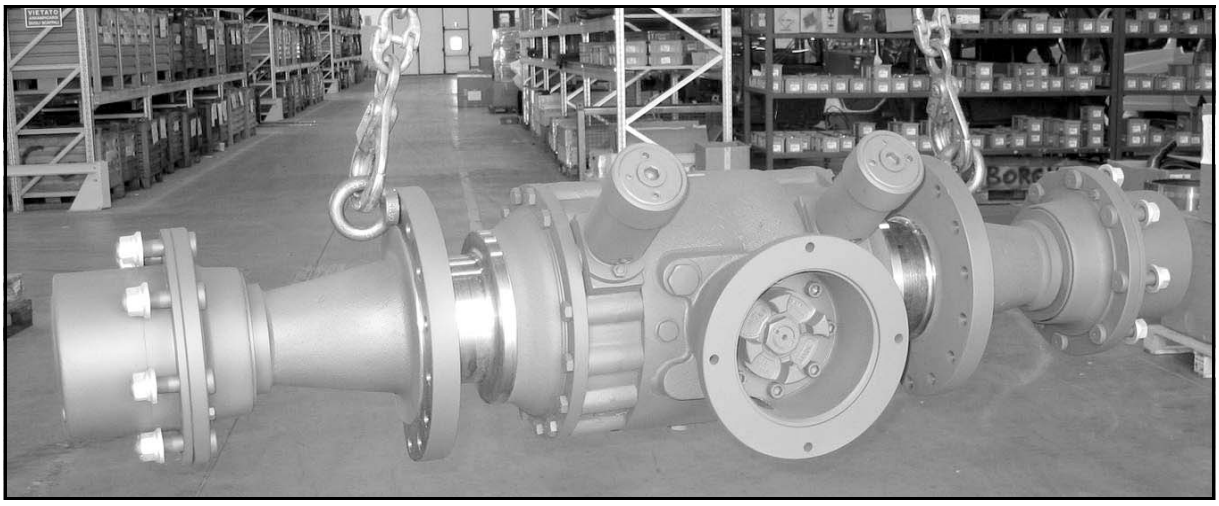
BRAKE PEDAL

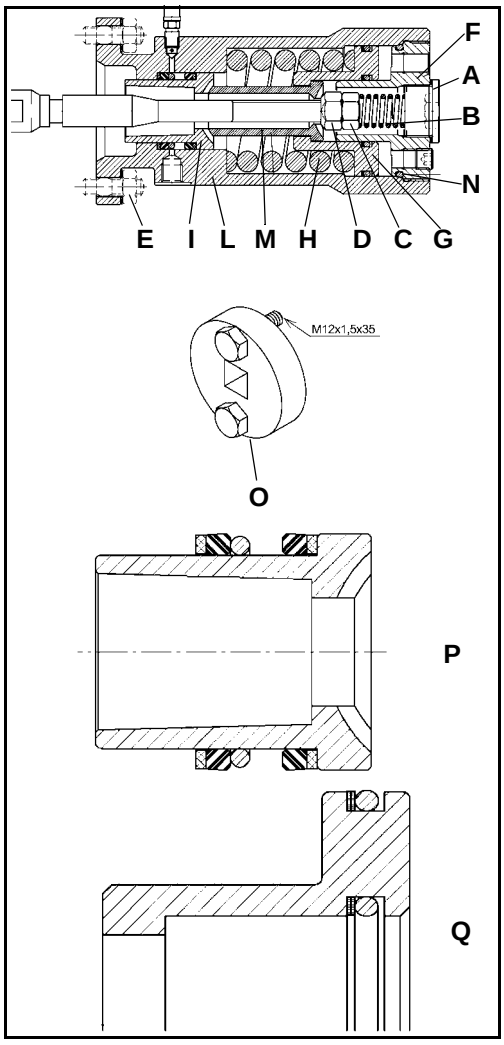


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HYDRAULIC BRAKE CYLINDER

DISASSEMBLY·REASSEMBLY





Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover, disconnect the battery plugs
4. Remove the footboard mat and the footboard
5. Remove the **A** rear plug and extract the **B** spring
6. Unscrew completely the **C** locknut and the **D** nut
7. Unscrew the **E** nuts and remove the brake cylinder from the seat. In case use a plastic hammer to unstick it from the silicone seal.
8. Apply the **O** key to the cover **F** and unscrew it.
9. Take off the **G** piston, the **H** spring and the **I** piston Replace all the damaged gaskets
   Note: gaskets, seals and joints replacement is always suggested to avoid a subsequent equipment stop because of a oil blow-by

Reassembly Procedure

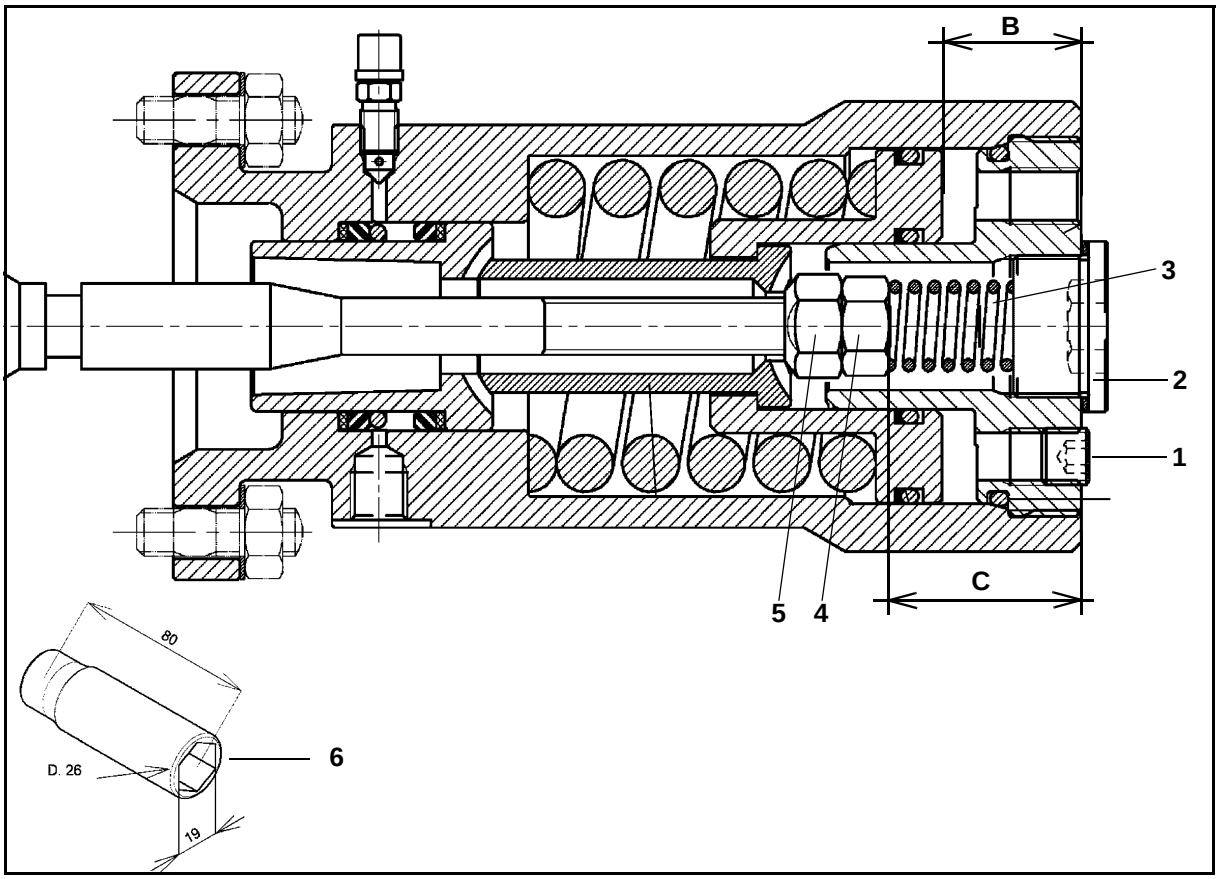
1. Verify that all the the seal surfaces are not marked or damged and that they could guarantee the correct pressure seal
2. Mount the gaskets on the pistons in the correct way as shown in the pictures **P** and in **Q**
3. Insert the **I** piston, with its gaskets in the **L** cylinder
4. Proceed with the hydraulic brake cylinder reassembly procedure. The reassembly procedure is the reverse of the disassembly procedure.

Note:
Pay a particular attention to avoid gaskets damage during the pieces assemblage: if gaskets are damged and/or the seal surfaces are marked the brake does not work correctly.

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BRAKE DISC WEAR CONTROL AND ADJUSTMENT

DISASSEMBLY·REASSEMBLY



BRAKE DISC WEAR CONTROL

- Park the truck on a level surface and apply the parking brake
- Switch off the truck
- Open the front battery cover, disconnect the battery plugs
- Remove the footboard mat and the footboard
- On the hydraulic brake cylinder, unscrew the **1** plug, then, with a caliber dipstick, measure the value of the **B** dimension. If the dimension is between 24,5 and 29,5 mm the brake is in perfect state and it doesn't require any adjustment. If the measure is less then 24,5 mm the brake needs to be adjusted.. If the brake has been previously adjusted verify if the disks are not completely weared out
- To do this unscrew the **2** plug, remove the **3** spring, then, with a caliber dipstick, measure the value of the **C** dimension. If the value is equal or less then15 mm the brake disks need to be replaced

BRAKE DISC WEAR ADJUSTMENT

- Unscrew the **1** and **2** plugs
- Remove the **3** spring
- By the **6** key , unscrew the **4** lock nut
- Through the **1** hole measure the **B** dimension
- By the **6** key , screw the **5** nut until the **B** dimension reach the max. value of 29,5 mm
- Reassembly and tighten the **4** lock nut then verify once again the **B** dimension as described here above. If the **B** dimension is wrong once again, repeat all the operations as described here above
- Reassembly the **3** spring and screw on the **1** and **2** plugs

Note:

If the **B** dimension goes over 29,5 mm the complete brake unblocking is not allowed, therefore the brake gets overheated with a quick. deterioration

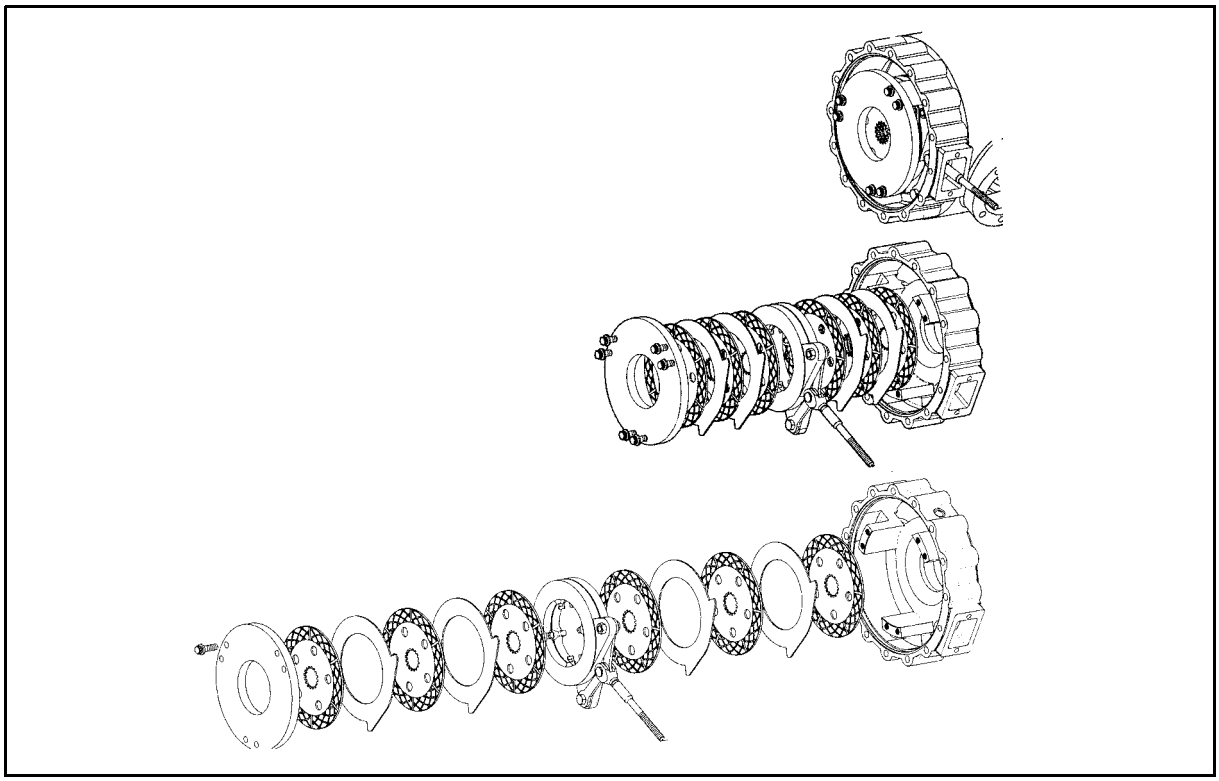
WARNING!!

A wrong adjustment could cause serious damages and rapid destruction of the brakes. If the 4 and 5 are excessively unscrewed the truck doesn't brake!

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BRAKE DISCS SOBSTITUTION

DISASSEMBLY·REASSEMBLY



Disassembly Procedure

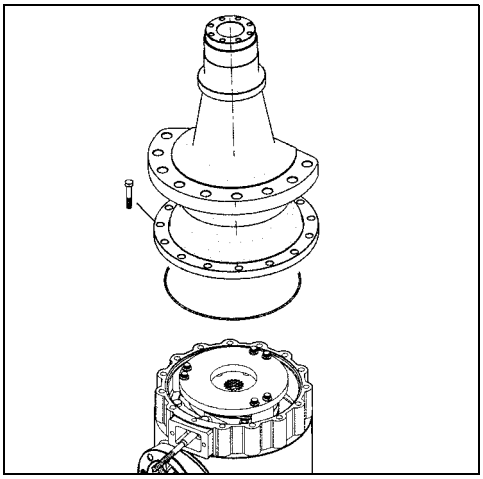
1. Remove the front axle group (see chapter 06f)
2. Remove the planetary gear and the drive unit hub (see chapter 06f)
3. Remove the hydraulic brake cylinder (see concerned section in this chapter)
4. Put the axle in vertical position with one hub on the top and the other on the bottom.
5. Unscrew the fixing screws and remove the half-housing **[Point 1]**
6. Unscrew the the six fixing screws and remove the brake cover **[Point 2]**
7. Extract the first series of discs, the actuator and the second series of discs **[Point 3].** Remove the brake housing to reach the differential gears, if required

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure

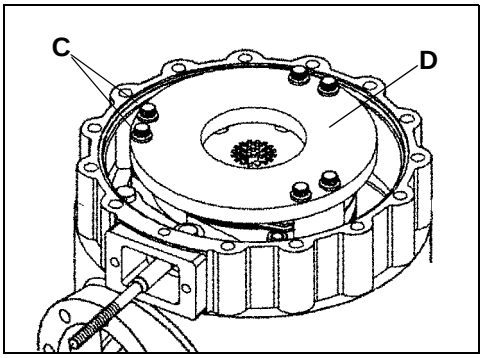
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Point Operations



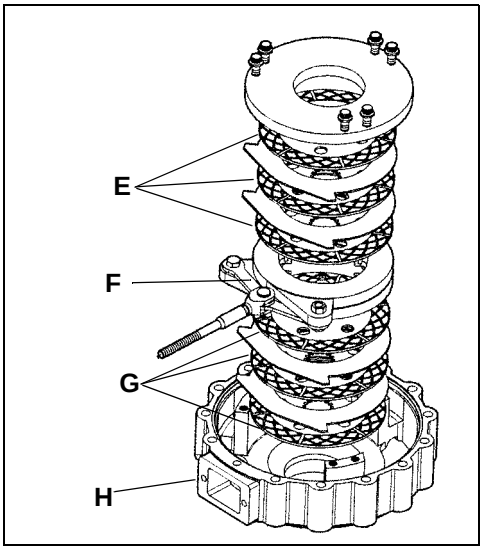
[Point 1]
Disassembly:

Unscrew the 14 **A** screws and remove the **B** half-housing



[Point 2]
Disassembly:

Unscrew the the six **C** fixing screws and remove the **D** brake cover



[Point 3]
Disassembly:

Extract the **E** first series of discs, the **F** actuator and the **G** second series of discs. **.** Remove the **H** brake housing to reach the differential gears, if required

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BRAKE BLEEDING PROCEDURE

After the first power steering pump starting (the steering pump feeds the service and parking brake hydraulic system) proceed as in the following procedure:



1. Keeping the wheels stopped, operate the service brake pedal several times



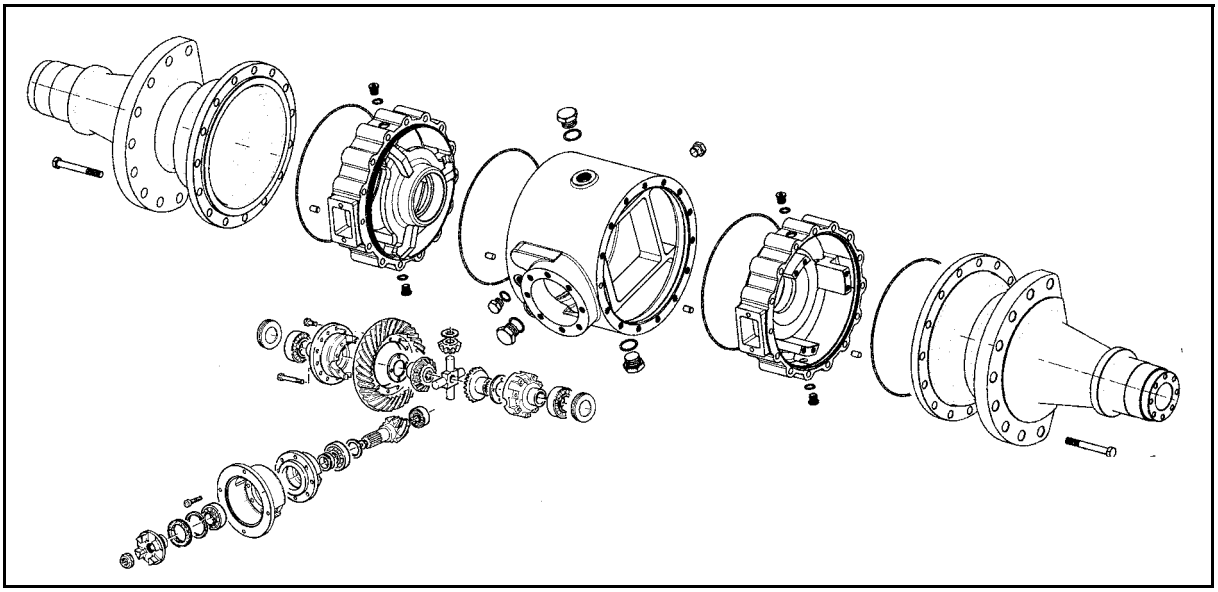
2. Keeping the brake pedal pressed, loosen the bleeding screws on the axle brake cylinders till the total leakage of the air inside the system; then tighten the bleeding screws

3. Perform several braking actions with truck the running

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DIFFERENTIAL GEARS

DISASSEMBLY·REASSEMBLY



Disassembly Procedure

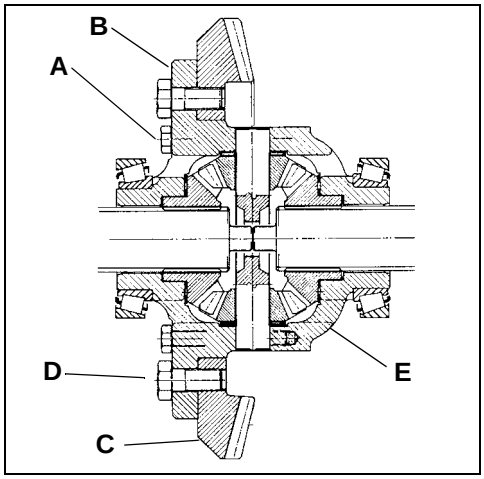
1. Remove the front axle group (see chapter 06f)
2. Remove from the front axle group left side the planetary gear and the drive unit hub (see chapter 06f). The axle left side is the side of the bevel ring gear of the differential gears
3. Remove the left side hydraulic brake cylinder (see concerned section in this chapter)
4. Remove the brake discs with the brake housing, to reach the differential gears, (see concerned section in this chapter)
5. Extract the differential unit **[Point 1]**
6. Remove the bevel gear **[Point 2]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure

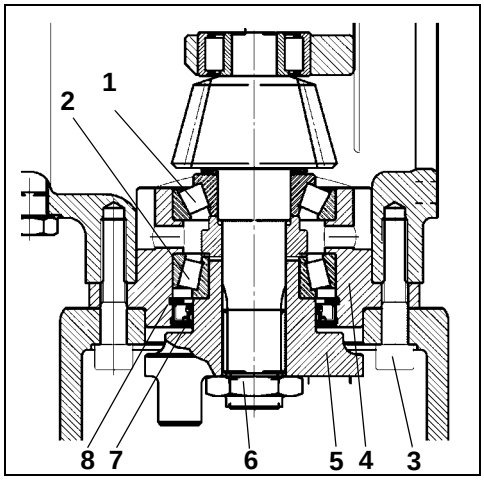
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Point Operations



[Point 1]
Disassembly:

Extract the differential unit:
Remove the eight **A** screws to divide the housing into its two parts **B** and **E**. Then take out all the gears.
To separate the **C** bevel ring gear from its **B** support unscrew the **D** screws



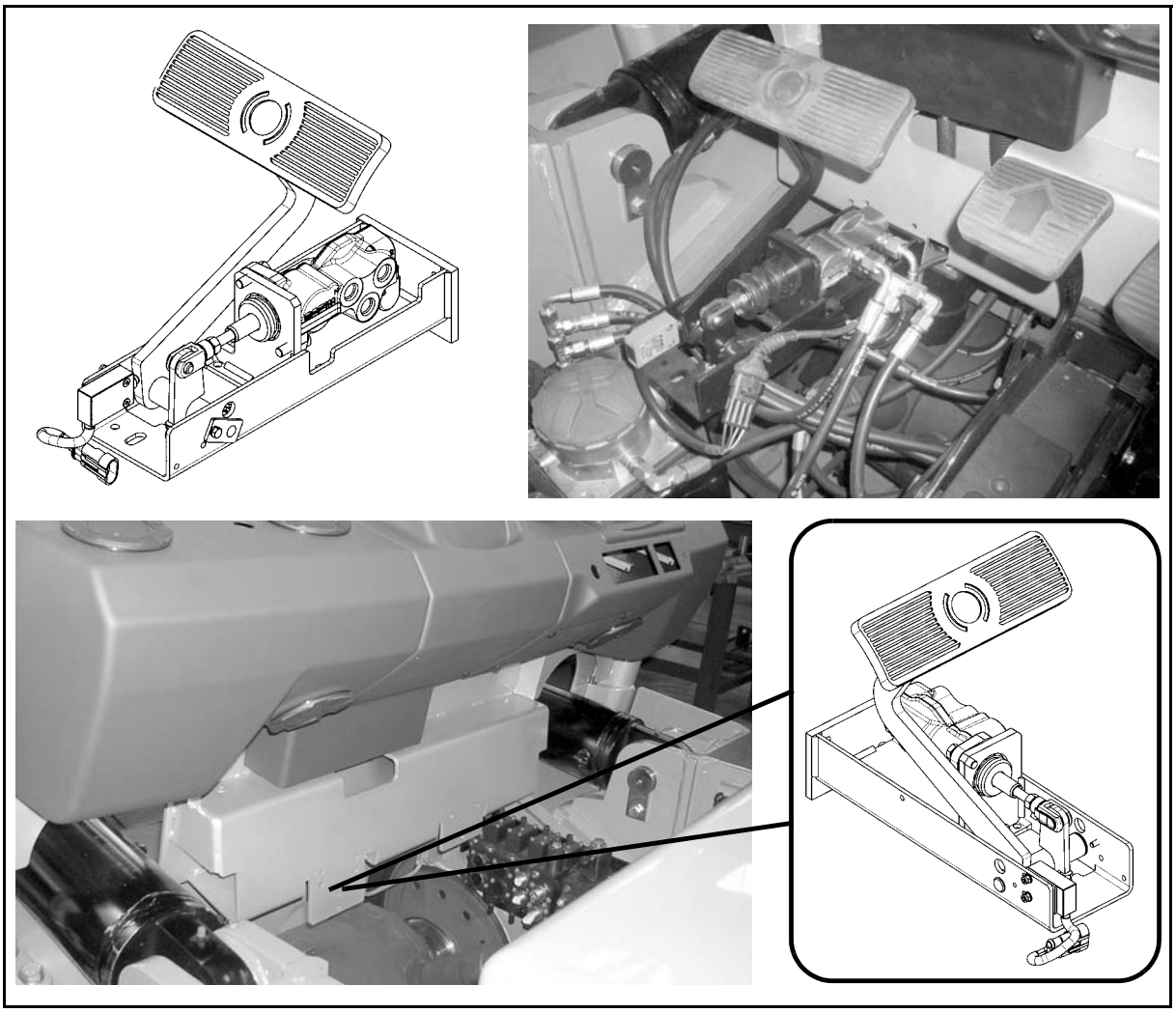
[Point 2]
Disassembly:

Remove the bevel gear:
Unscrew the eight **3** screws and remove the pinion group. Unscrew the **6** pinion nut. Push out the pinion and extract the **5** coupling hub. Remove the **7** oil seal and the **8** snap-ring. Extract the **1** and **2** bearings from their support.

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BRAKE PEDAL

DISASSEMBLY·REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover, disconnect the battery plugs
4. Remove the footboard mat and the footboard
5. Disconnect the brake pedal micro wirings from the auxiliary wiring
6. Disconnect all pipes from pedal brake valve
7. Unscrew and remove the 3 pedal fixing bolts from the over head guard and remove the pedal

Reassembly Procedure

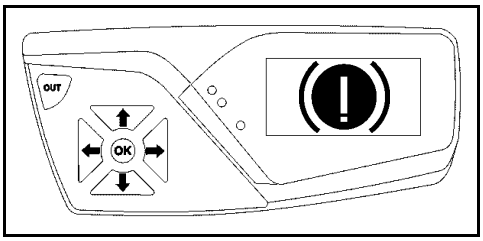
The installation procedure is the reverse of the removal procedure

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ACCUMULATOR

GENERAL

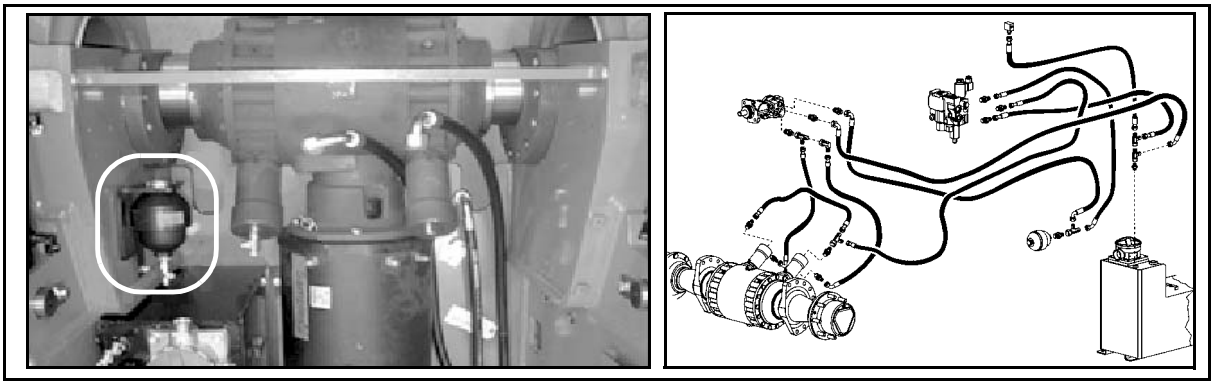
The accumulator is a tank with hydraulic oil under pressure (min 70Bar - max 120 Bar). The oil under pressure is sent to the brake system through the brake valve on the service brake pedal.



In case the accumulator pressure drops down lower than 70 bar an alarm is displayed on the dashboard.

This pressure is kept under control using a pressure sensor located on the Master valve (see dedicated section).

DISASSEMBLY·REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the compartment and disconnect the battery
4. Remove the footboard
5. Push the brake pedal for ~ 30 times (to lower the pressure)
6. Disconnect the nipple - **Note:** this operation generates oil leakages.
7. Remove the fixing nut of the accumulator
8. Remove the accumulator

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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BODY

COMPONENTS 3
BATTERY HOODS 4
BATTERY CONNECTOR 5
COUNTERWEIGHT 6
OPERATOR'S SEAT 7

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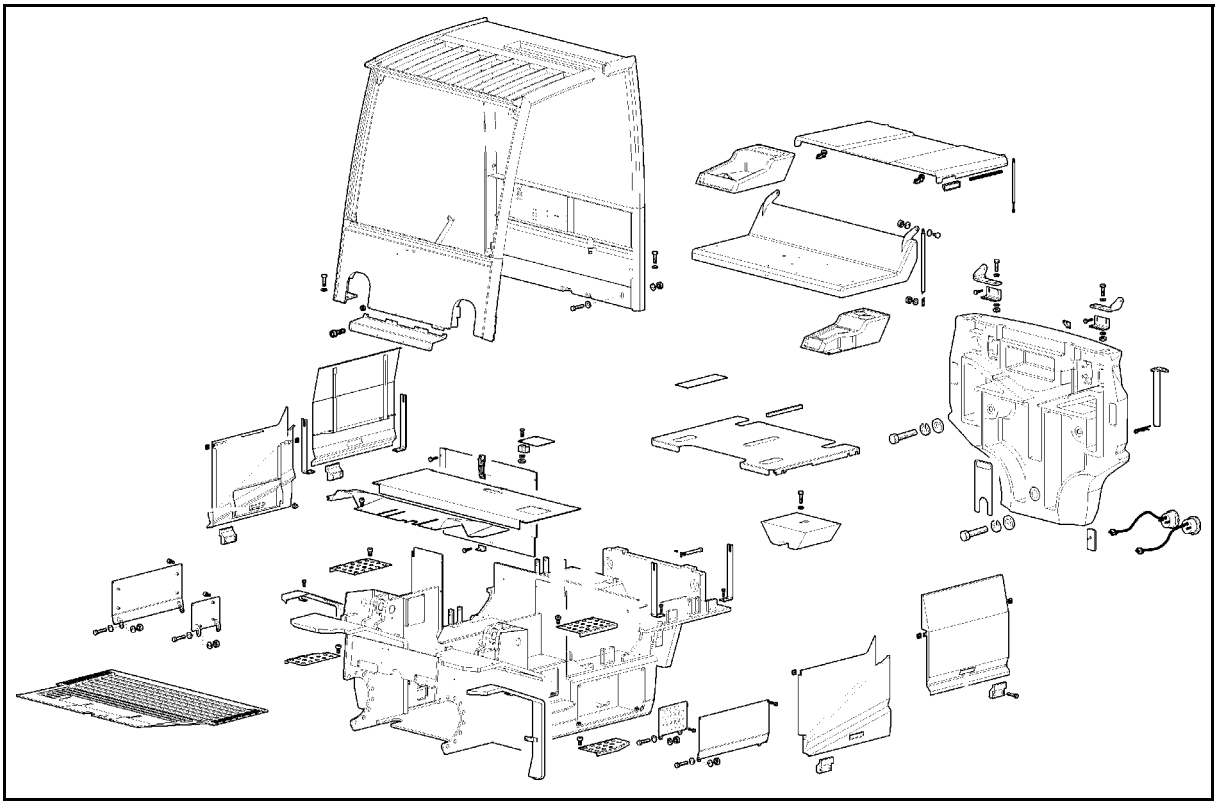
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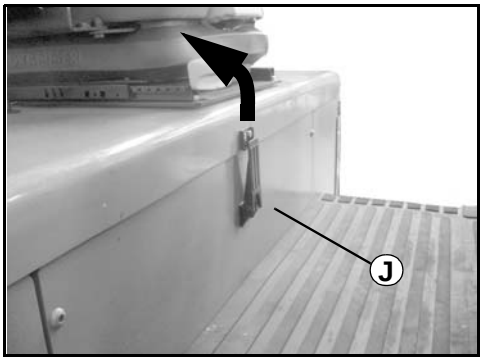
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COMPONENTS

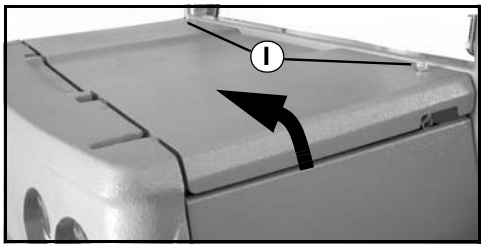


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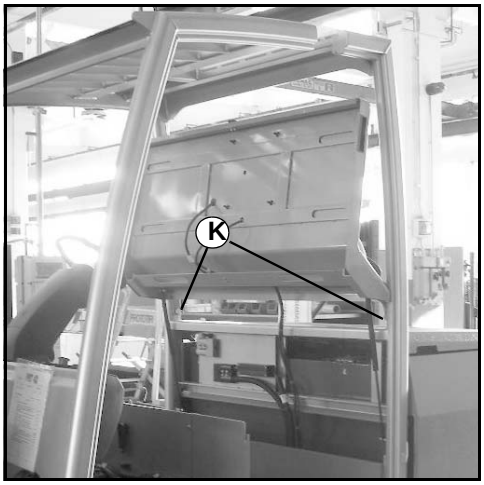
BATTERY HOODS



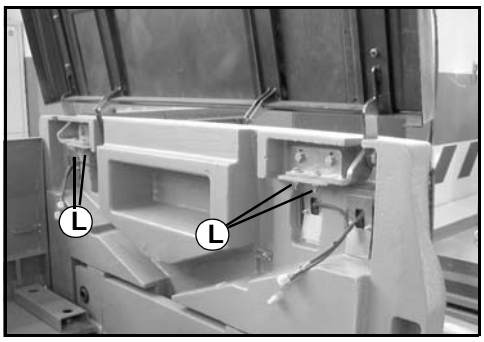
FRONT BATTERY COVER LIFTING
Unblock the **J** hooking then raise the hood cover; two air springs make easier the complete lifting of hood cover



BACK BATTERY COVER LIFTING
Rotate the two knobs then raise the hood cover; two air springs make easier the complete lifting of hood cover

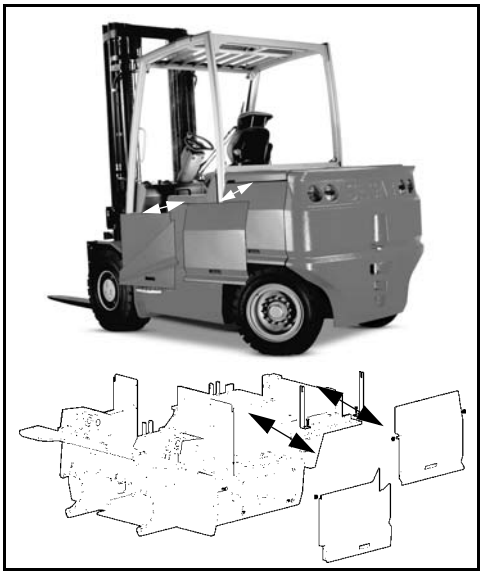


FRONT COVER DISASSEMBLY PROCEDURE
1. Disconnect the battery plug.
2. Open the battery cover.
3. Tie the battery cover with the seat to the head guard roof or to a bridge crane
4. Disconnect the seat and armrest wirings to the auxiliary wiring
5. Disconnect the battery cover gas spring (on the frame side)
6. Remove the battery cover pivots **K**
7. Remove the battery cover with the seat



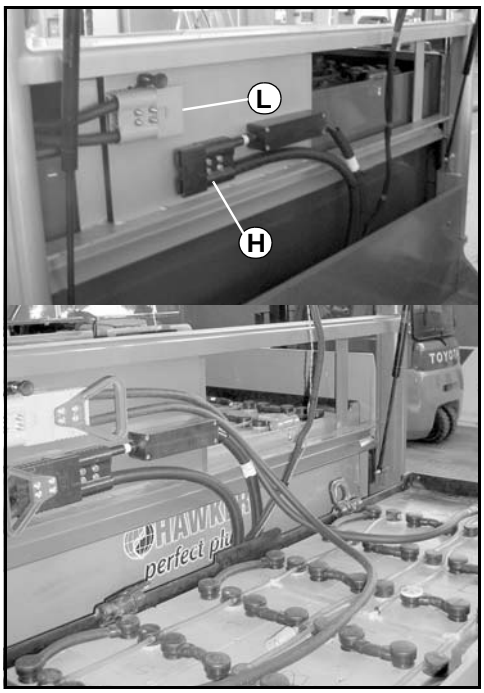
BACK COVER DISASSEMBLY PROCEDURE
1. Disconnect the battery plug.
2. Open the battery cover.
3. Remove the battery
4. Tie the battery cover to a bridge crane
5. Disconnect the battery cover gas spring (on the counterweight side)
6. Remove the 4 battery cover fixing bolts **L**
7. Remove the battery cover

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NOTE:
Before performing all the described operations it could be necessary a battery sides disassembly

BATTERY CONNECTOR



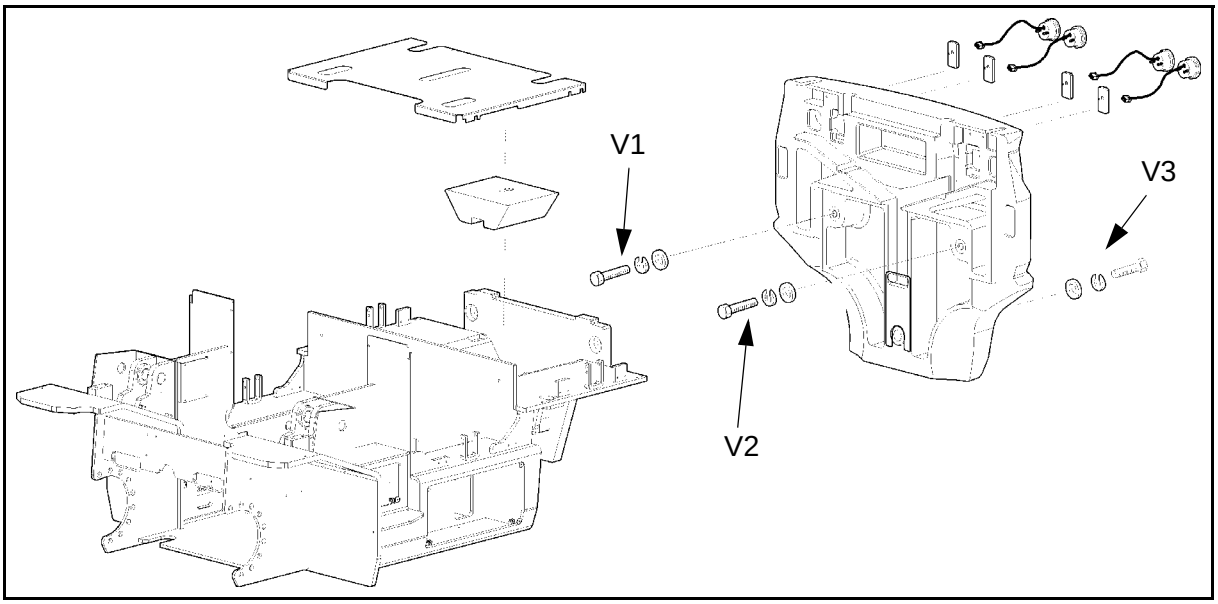
The general battery connector **H** is the black (80 V) one and is located inside the front battery hood cover, at the back.
It is the result of the serial connection of the two 40 V batteries; the grey connector **L** is to be connected to the front battery

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COUNTERWEIGHT

DISASSEMBLY · REASSEMBLY

Note:
Check the weight of the counterweight and select an appropriate wire, rope or chain to handle it

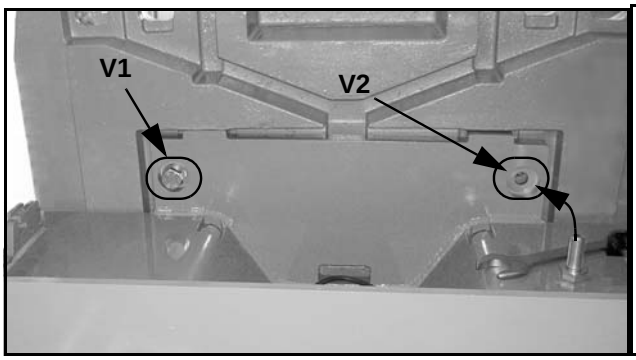


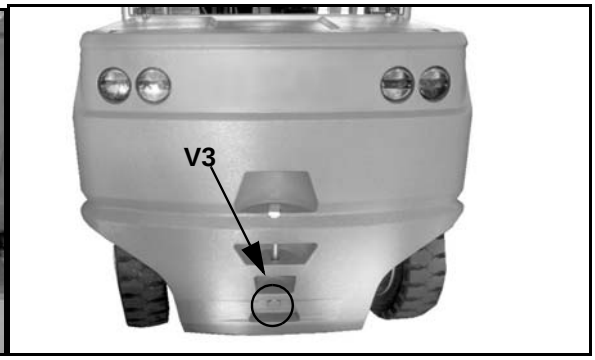
Disassembly Procedure

1. Park the truck on a level surface and activate the parking brake
2. Switch off the truck
3. Open the battery covers and disconnect the battery plugs
4. Remove the back battery (see 01 battery chapter)
5. Remove the battery cover (see “Back cover disassembly procedure” in this chapter)
6. Disconnect the rear light cables from the auxiliary wiring
7. Remove the rear lights
8. Fit two wire ropes, slings or belts, having proportionate load capacity (is advisable to use belts with a capacity of 2000kg under linear traction) , through the rear light holes, hook them on a bridge crane and lift until they are tight
9. Remove the counterweight set bolts (V1, V2 and V3).
10. Remove the counterweight.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.
Note:
- The lifting system used MUST be able to support the counterweight weight.
- Tightening torque of the 3 bolts of the counterweight = 300 Nm. (Tighten the bolts with the sequence: V3, V1, V2)





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OPERATOR'S SEAT

DISASSEMBLY · REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Tie the seat to a bridge crane
4. Open the battery compartment
5. Disconnect the battery plug.
6. Disconnect the seat microswitch and the armrest wiring from the auxiliary wiring
7. Remove the set of nuts fastening the operator's seat (take care not to drop the operator's seat)
8. Remove the operator's seat (use a sling, not the seat belt)
9. Open the battery cover.



Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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MATERIAL HANDLING SYSTEM

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HYDRAULIC SYSTEM 4
PUMPS SYSTEM 4
STEERING SYSTEM 4
TILTING SYSTEM 5
BRAKES SYSTEM 5
MAST 2M T.V. 6
MAST 2M F.F.L. 6
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COMPONENTS 8
HYDRAULIC OIL TANK 8
HYDRAULIC SYSTEM OIL FILTER 10
HYDRAULIC OIL 11
LIFTING LOAD DOWN TEST 12
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LIFTING CYLINDERS 13
TILTING CYLINDERS 13

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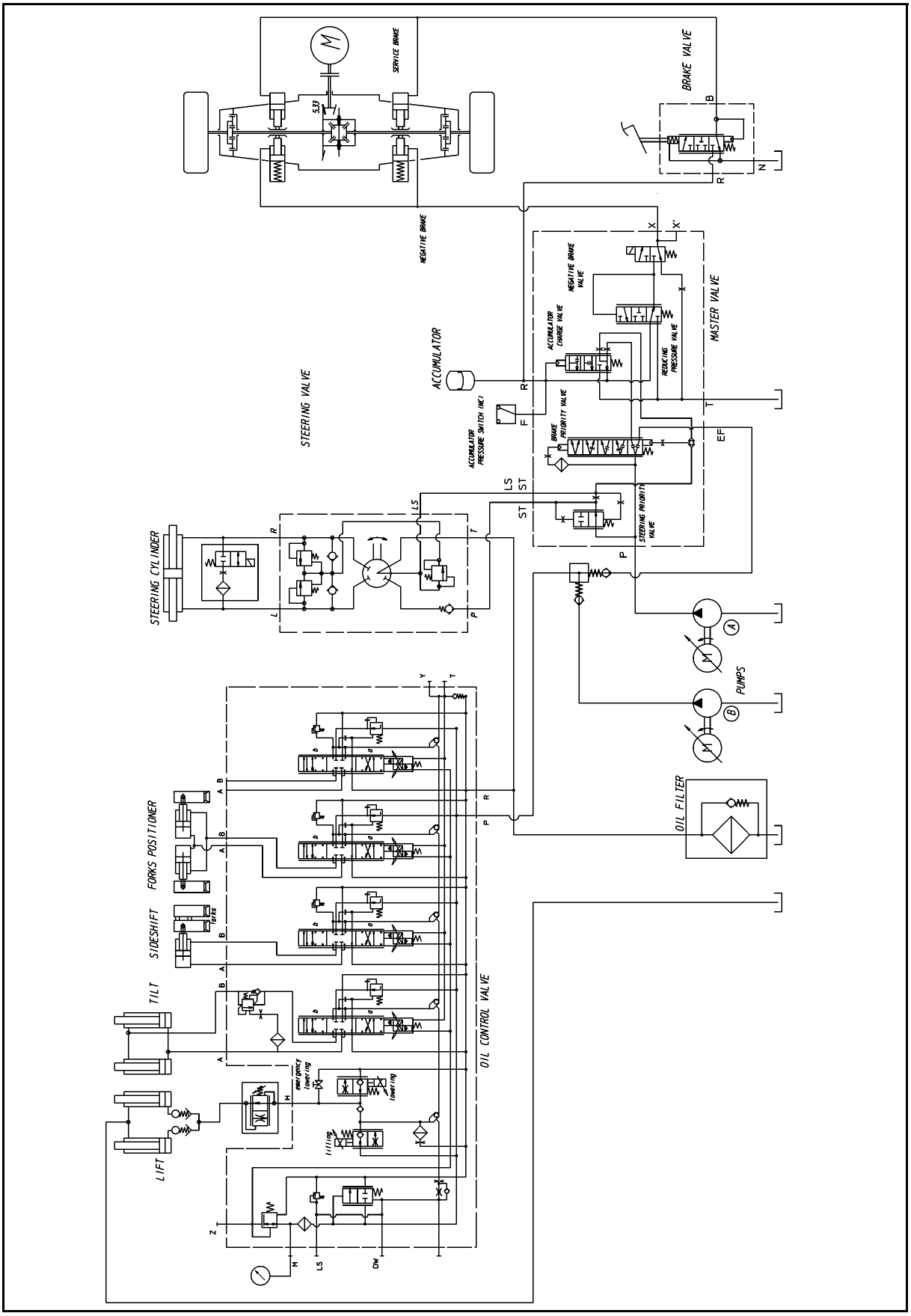
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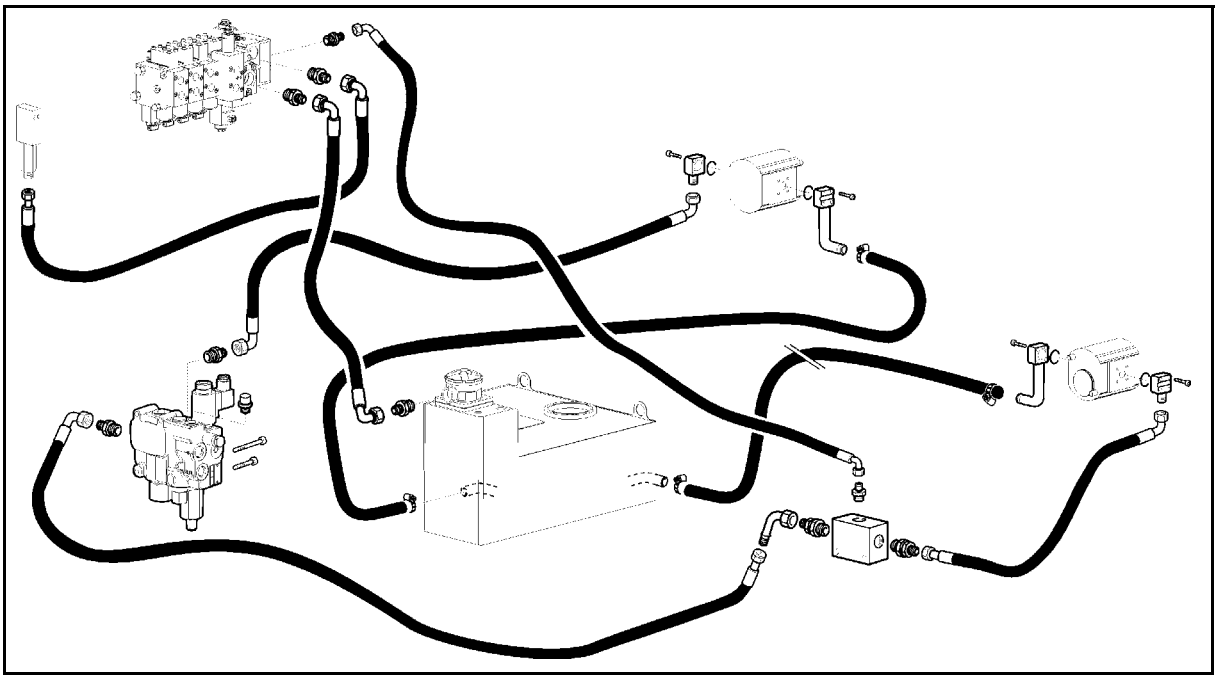
HYDRAULIC CIRCUIT



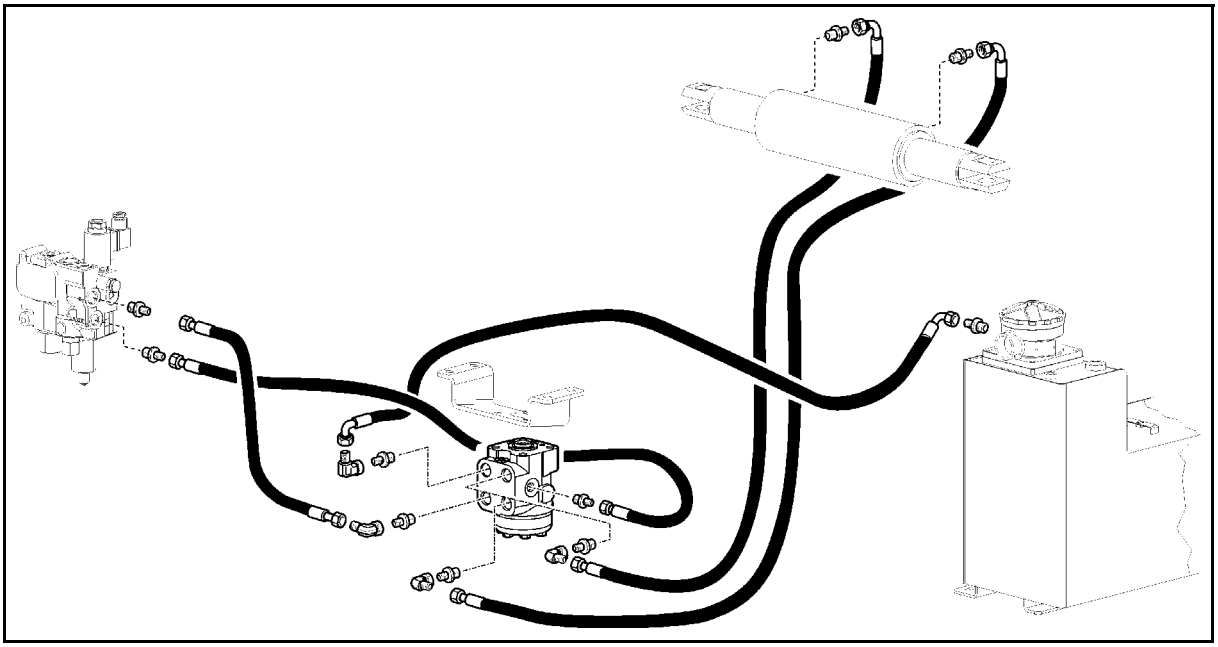
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HYDRAULIC SYSTEM

PUMPS SYSTEM

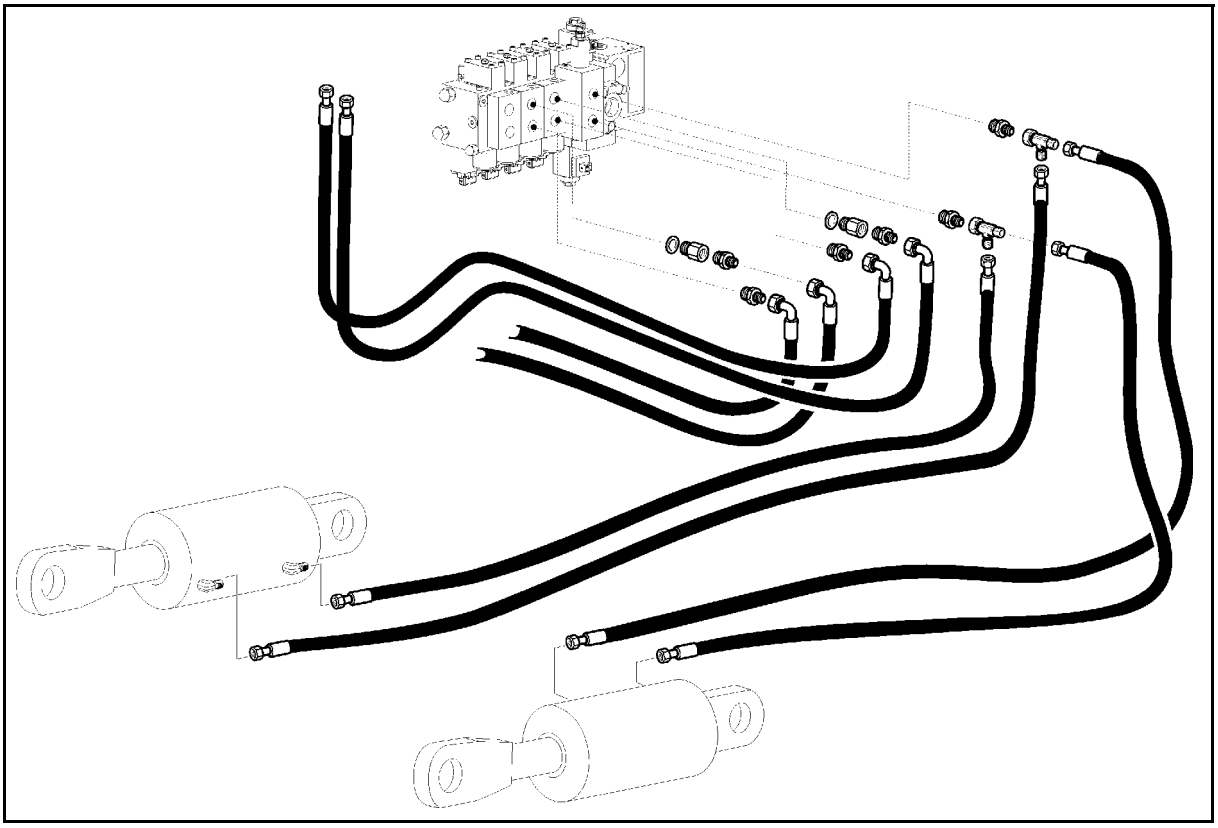


STEERING SYSTEM

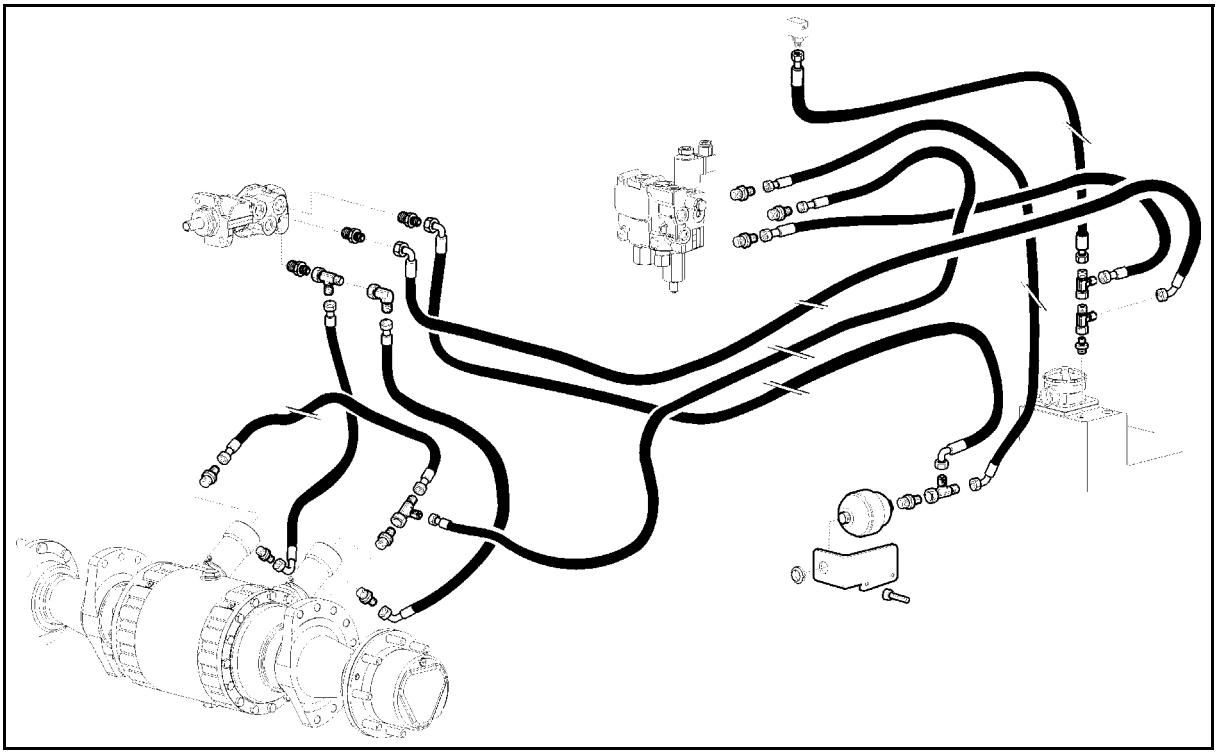


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TILTING SYSTEM

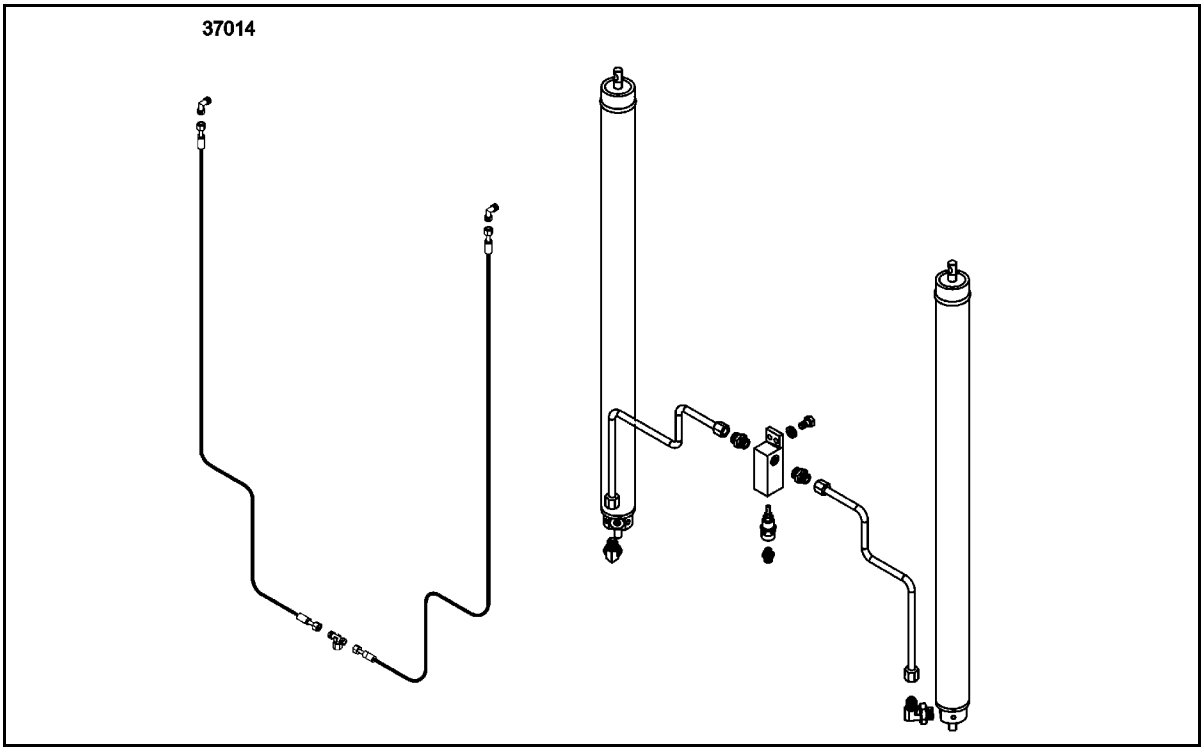


BRAKES SYSTEM

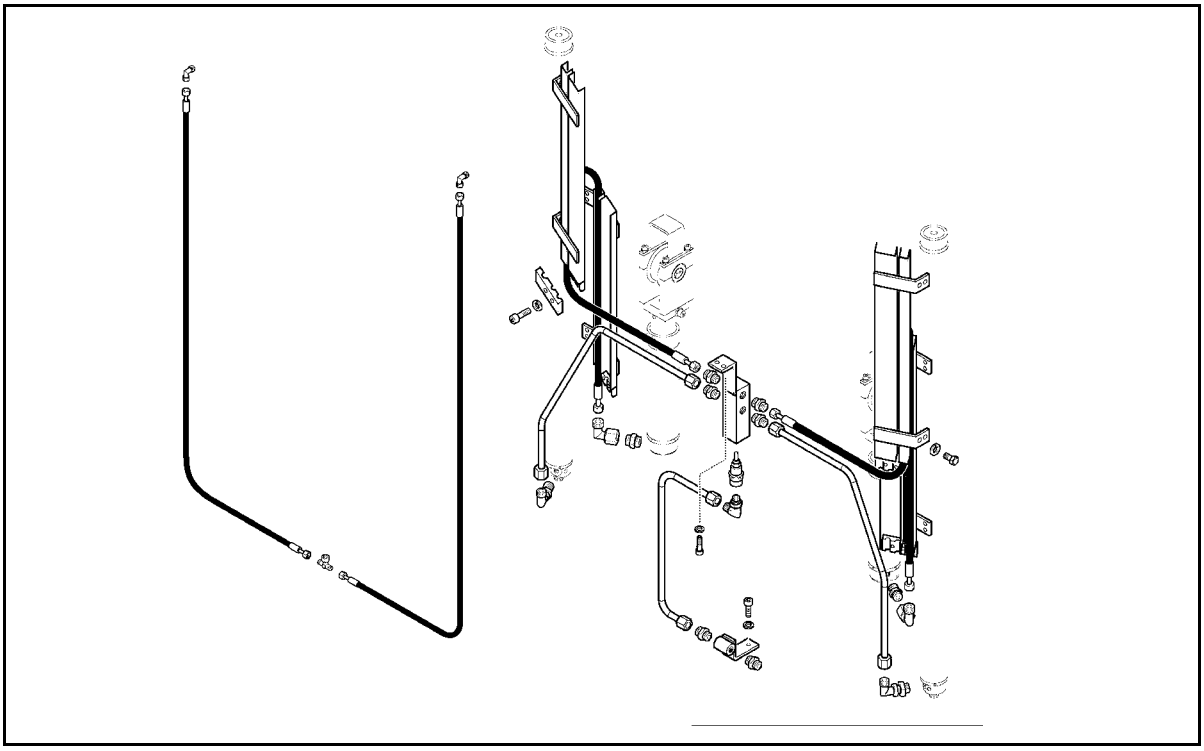


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MAST 2M T.V.

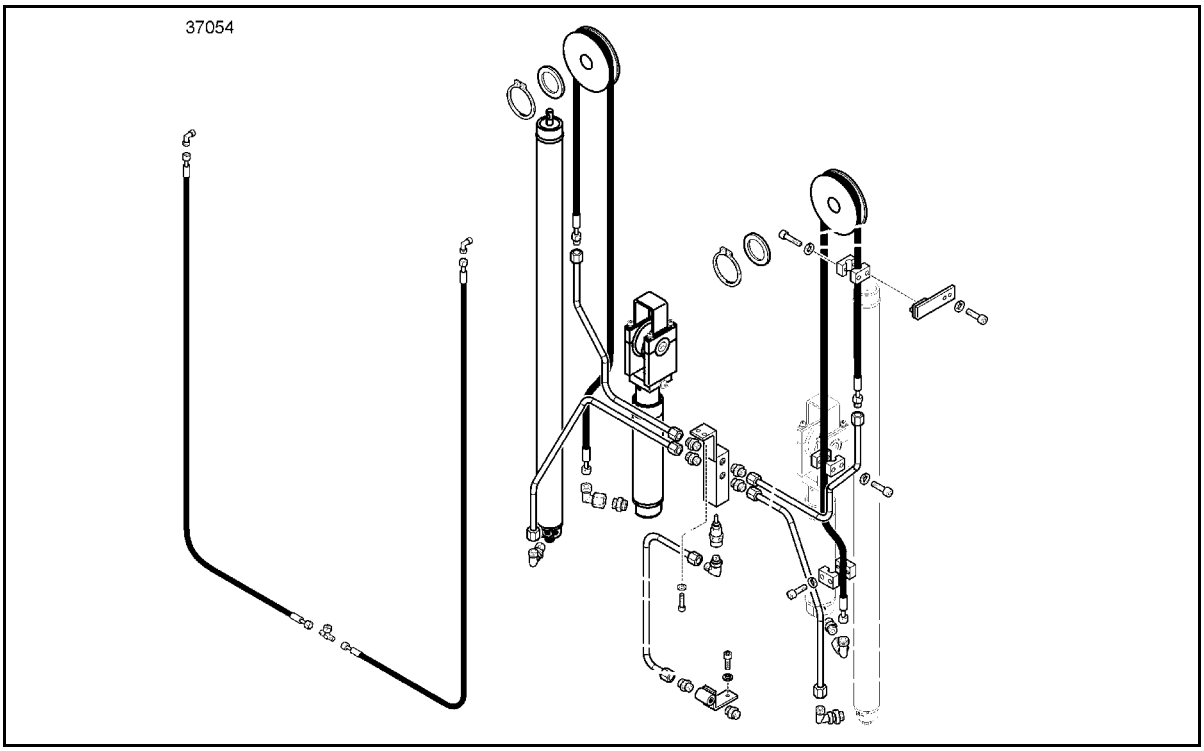


MAST 2M F.F.L.



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MAST 3M F.F.L.

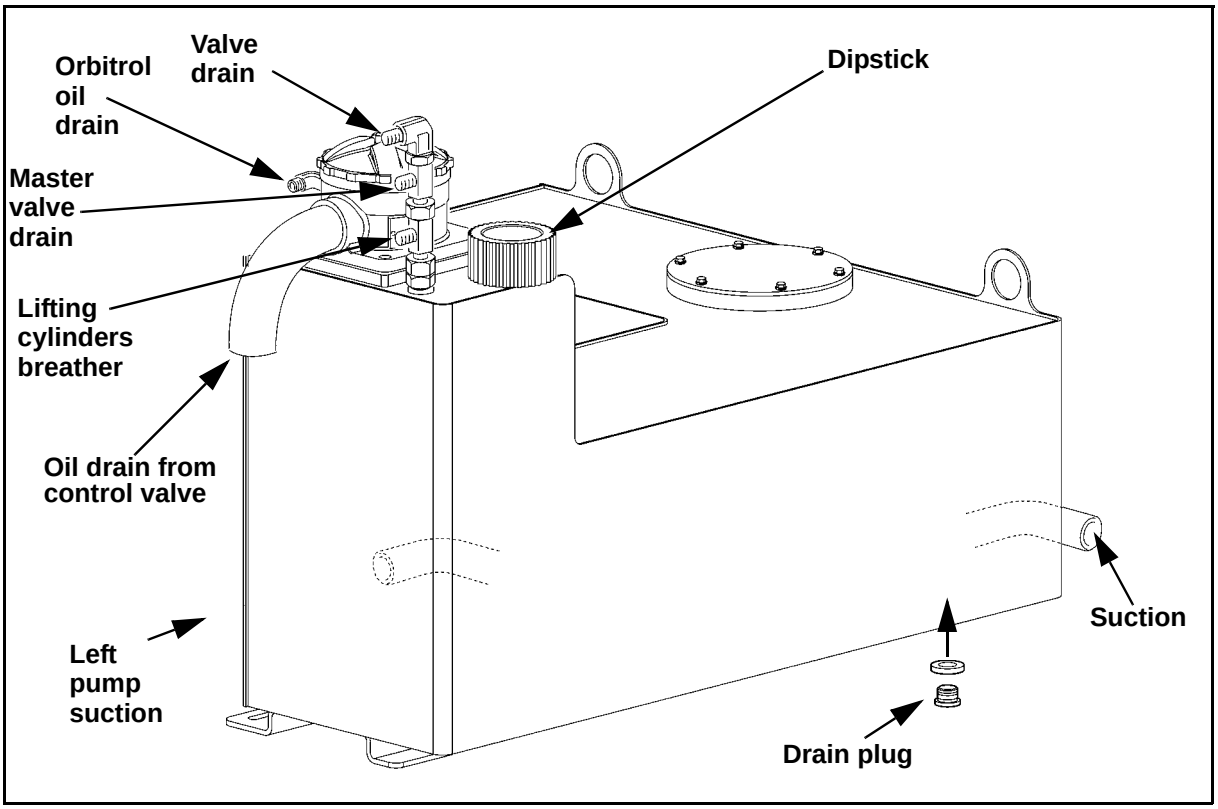


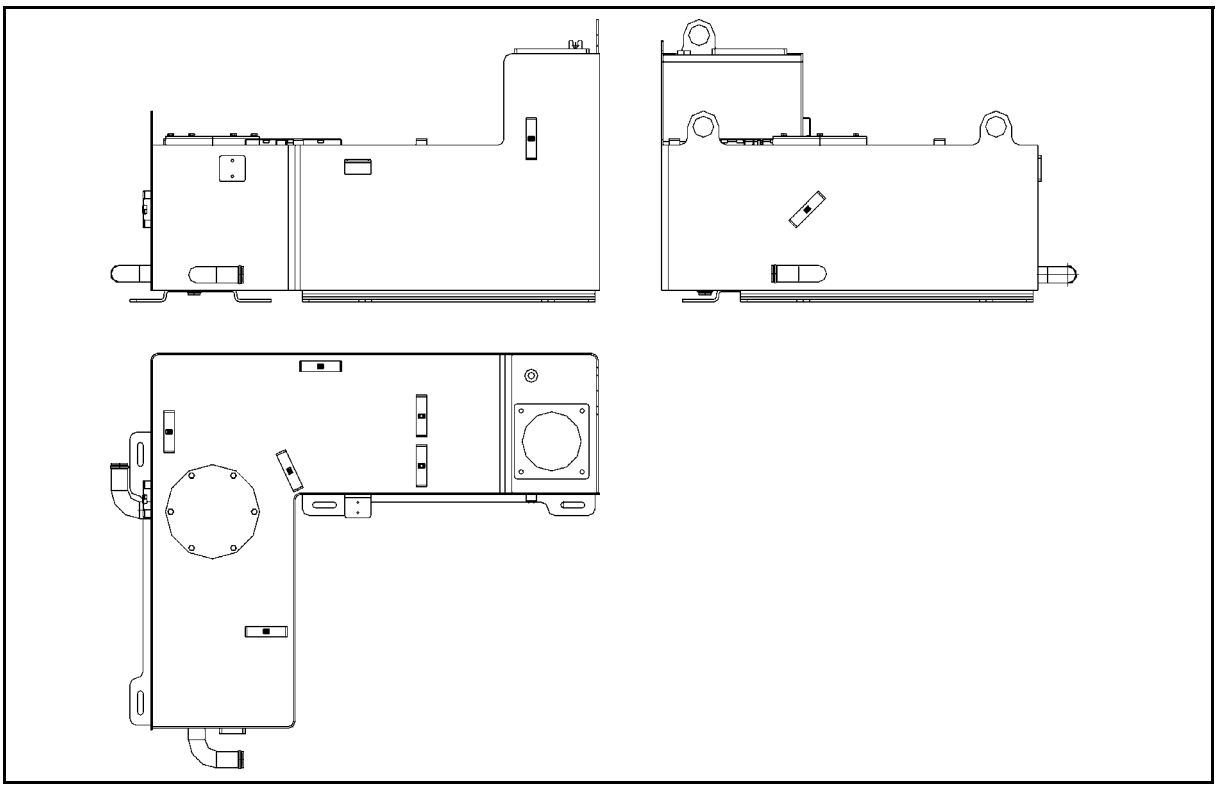
www.truck-freeworkshop.com/forklift/cesab/

COMPONENTS

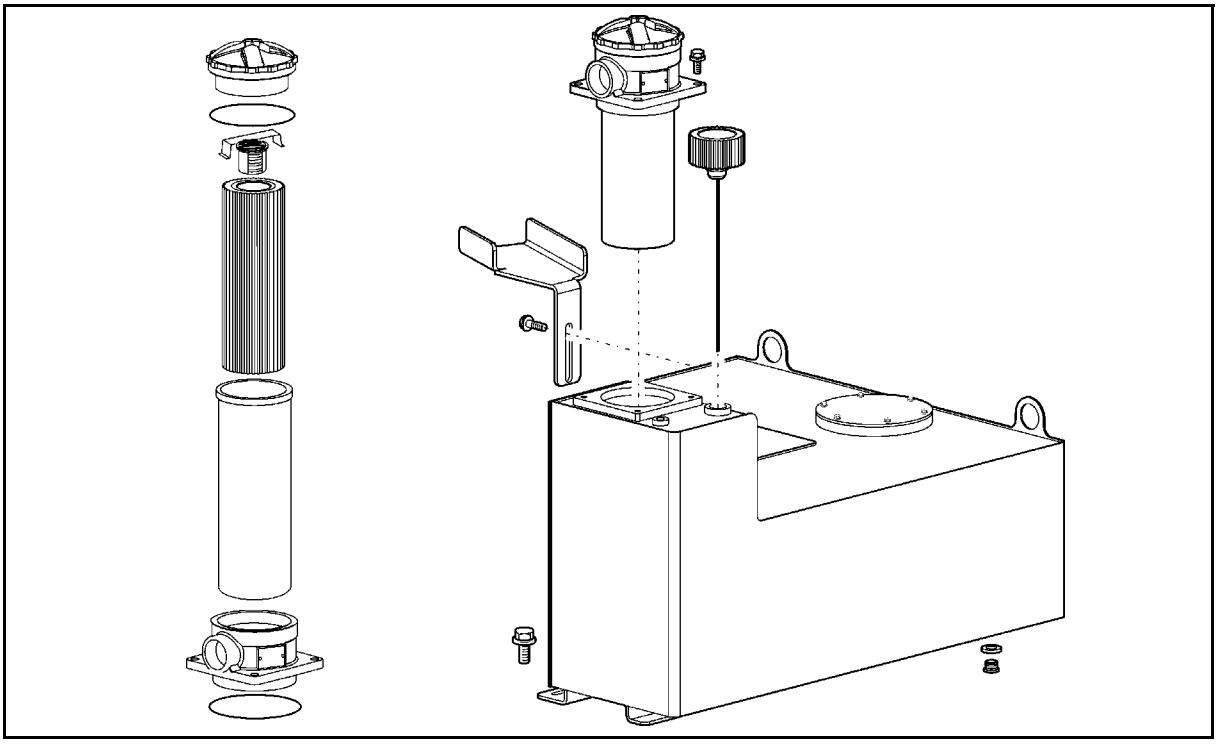
HYDRAULIC OIL TANK

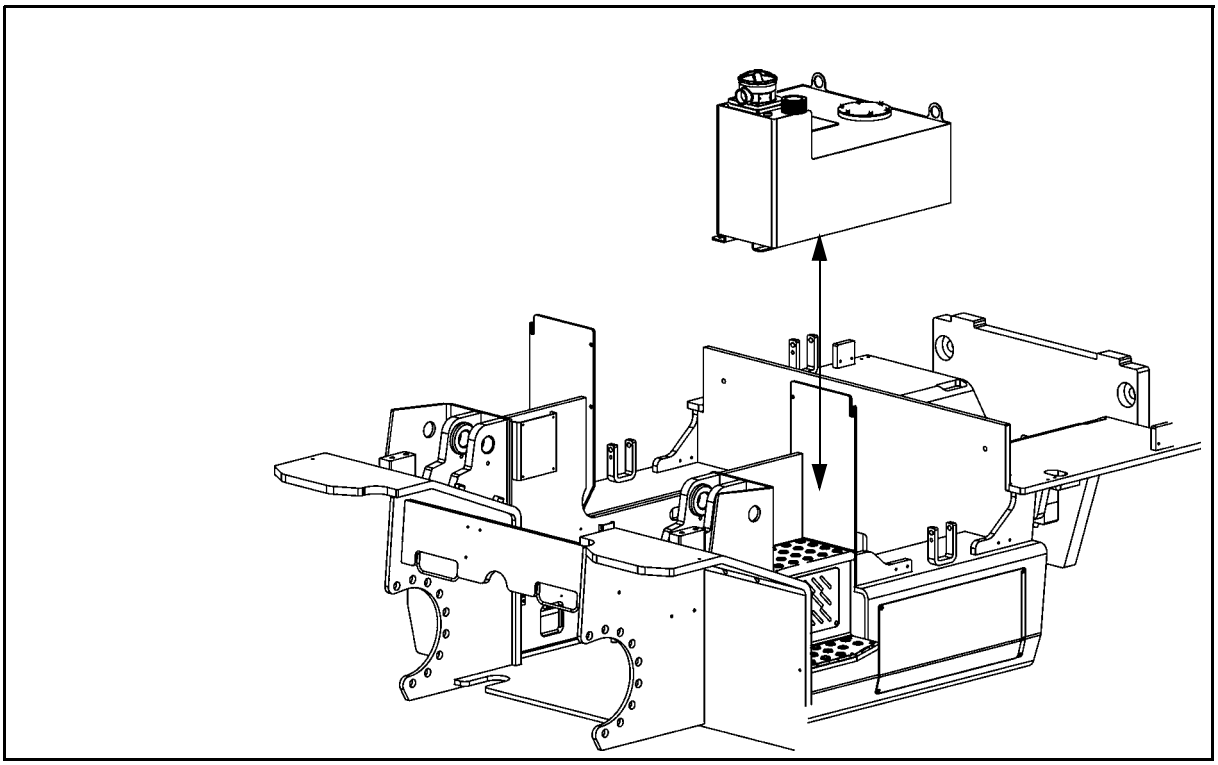
The tank filter plug is positioned under the footboard, on the left side.
The tank capacity is 90 liters.





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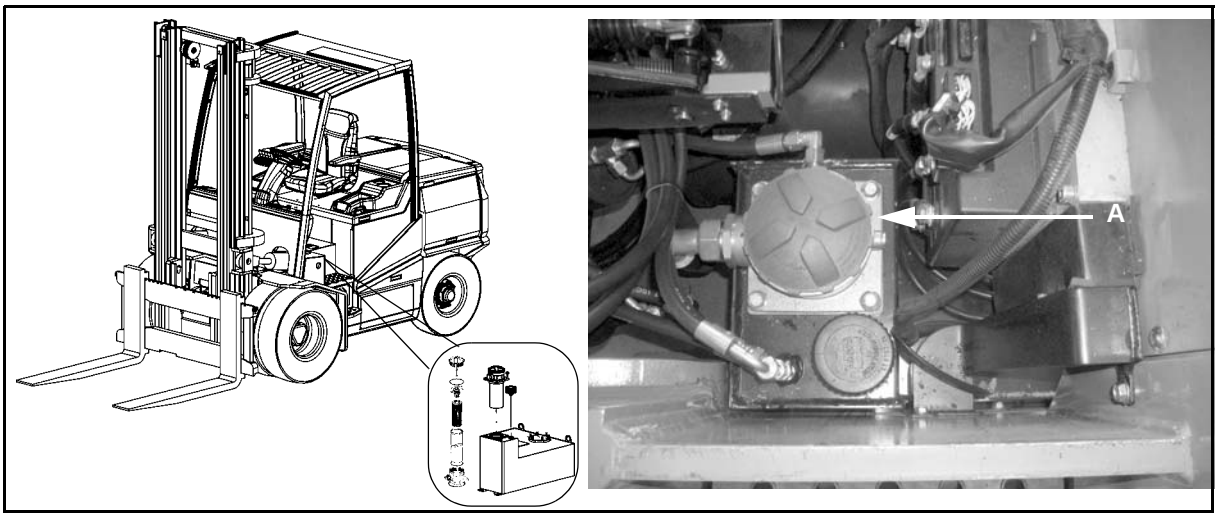




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HYDRAULIC SYSTEM OIL FILTER

DISASSEMBLY · REASSEMBLY

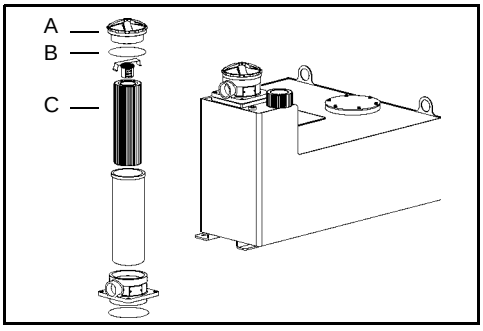


Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover and disconnect the battery plugs
4. Remove the footboard and the tank plug **(A)**
5. Remove the filter. **[Point 1]**

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.



Point Operations

[Point 1]

Disassembly:

1) Remove the plug **A**
2) Remove the ring **B**
3) Remove the filter **C**

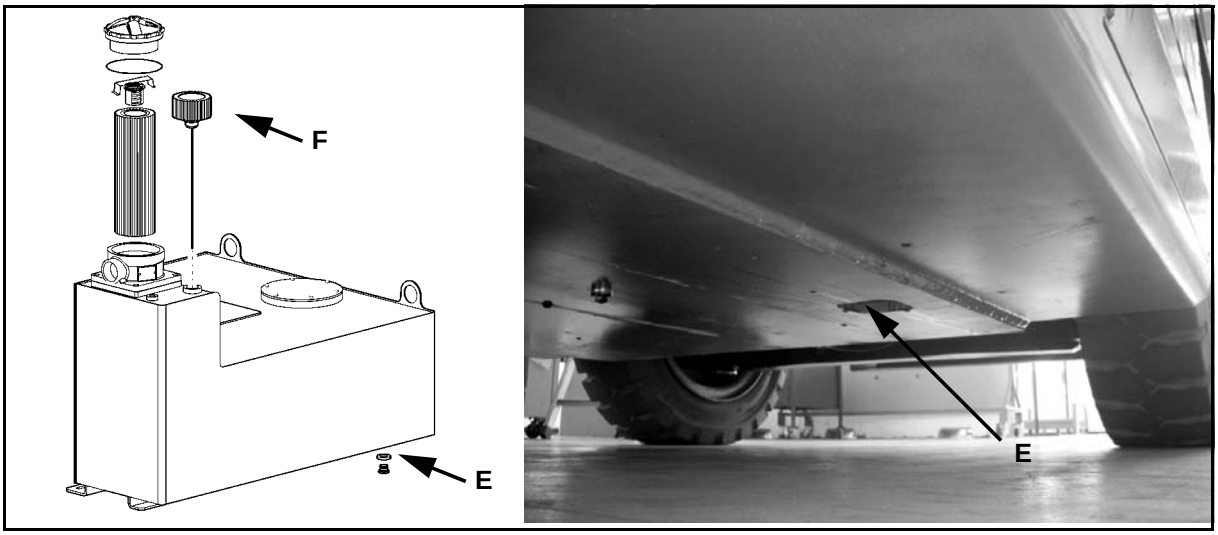
Note:

Holding the filter with the handle pointed up, insert it into the tank.

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HYDRAULIC OIL

REPLACEMENT



Replacement Procedure

1. Park the truck on a level surface and apply the parking brake
2. Switch off the truck
3. Open the front battery cover and disconnect the battery plugs
4. Remove the footboard and the tank plug
5. Remove the filter
6. Lift the truck
7. Loose and remove the oil discharge plug **E**
8. Let flow all the oil in a suitable recipient
9. Check the oil level using the oil dipstick **F**
10. Reposition the plug **E**
11. Introduce new oil
12. Reinsert the filter
13. Reposition the plug and the footboard

Notes:
Check the state of the seals and if there are no oil leaks.
Check the oil level in the tank, using the dip-stick (D) with the mast in vertical position and the forks lowered

Oil/filter changing:

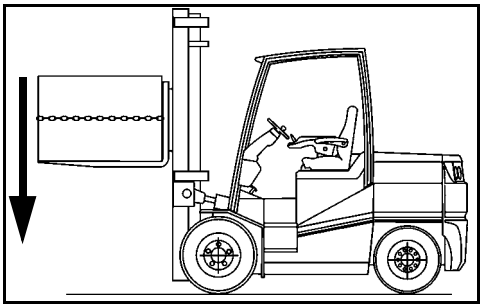
After the first 50 hours
first changing of the filter

Every 500 hours
check the oil level in the tank using the dipstick **F**

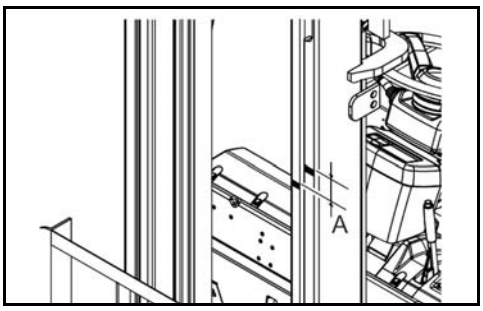
Every 2.000 hours
change the oil of the system and the filter

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LIFTING LOAD DOWN TEST

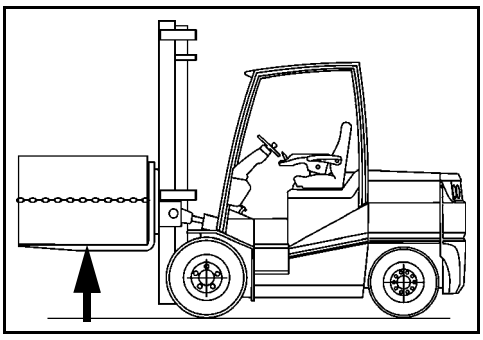


1. Set the mast in vertical position with the standard load on the fork,
2. Lift the fork at 2,5 to 3 m and leave the key switch ON
3. Take the measure between the forks and the ground with a meter or draw datum lines on the inner and outer masts

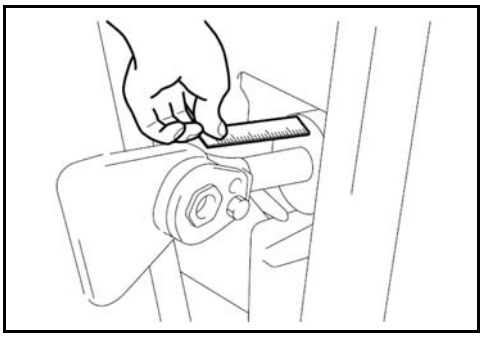


4. Make the measurement between the forks and the ground or between the datum lines on the inner and outer masts again after 10 minutes
   Limit: A = 100 mm

TILTING LOAD DOWN TEST



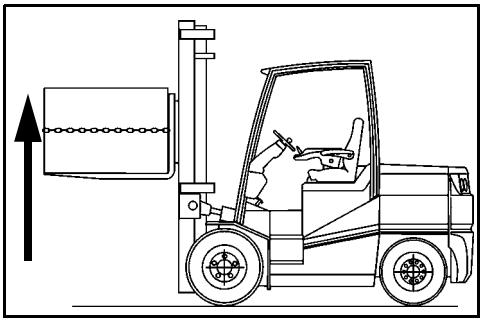
1. Set the mast in vertical position with the standard load on the fork
2. Lift the fork by 500 mm and leave the key switch ON



3. Measure the tilting cylinder rod extension after 10 minutes.
   Limit: 20 mm or less

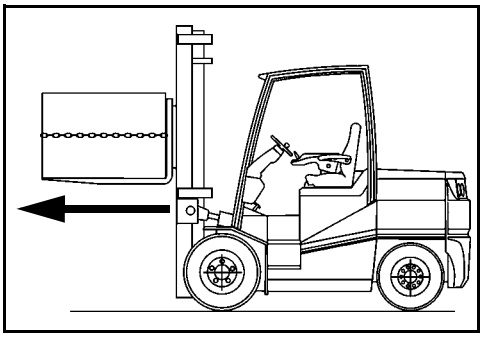
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OIL LEAK TEST



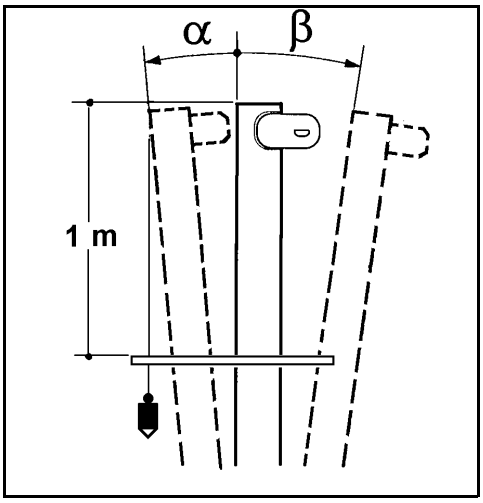
LIFTING CYLINDERS

1. Set the mast in vertical position with the standard load on the fork
2. Lift the fork at 2,5 to 3 m and take the measure between the forks and the ground with a meter and leave the key switch ON
3. Make the measurement between the forks and the ground again after 10 minutes
   Limit: A = 100 mm
4. If oil leakages are present on the body of the lifting cylinders, check if the cylinder connections are well tight. Replace the cylinder if necessary.



TILTING CYLINDERS

1. Set the mast in vertical position with the standard load on the fork, lift the fork at 2,5 to 3 m and leave the key switch ON



2. Secure the lead rope on the front edge of the top of the mast; measure the distance between the rope and the mast 1 m lower
3. Perform the same measurement 10 minutes after. (1° = 17.5 mm).

Limit: Maximum forward angle (°) <= 0.5 (°/min)
Time (10 min)

4. If the truck is out of the above limit lower completely the mast and turn the key switch OFF
5. Invert the tilting hoses with the sideshift hoses (if present) on the control valve. This operation is necessary to understand if there is any internal leakage inside the tilting cylinder or inside the control valve
6. Turn the key switch ON and repeat the test from point 1 to 3; after that
   a) The test result is within the set limits:
      replace the control valve.
   b) The test result is not within the set limits:
      replace the tilting cylinders.

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MAST

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MAST

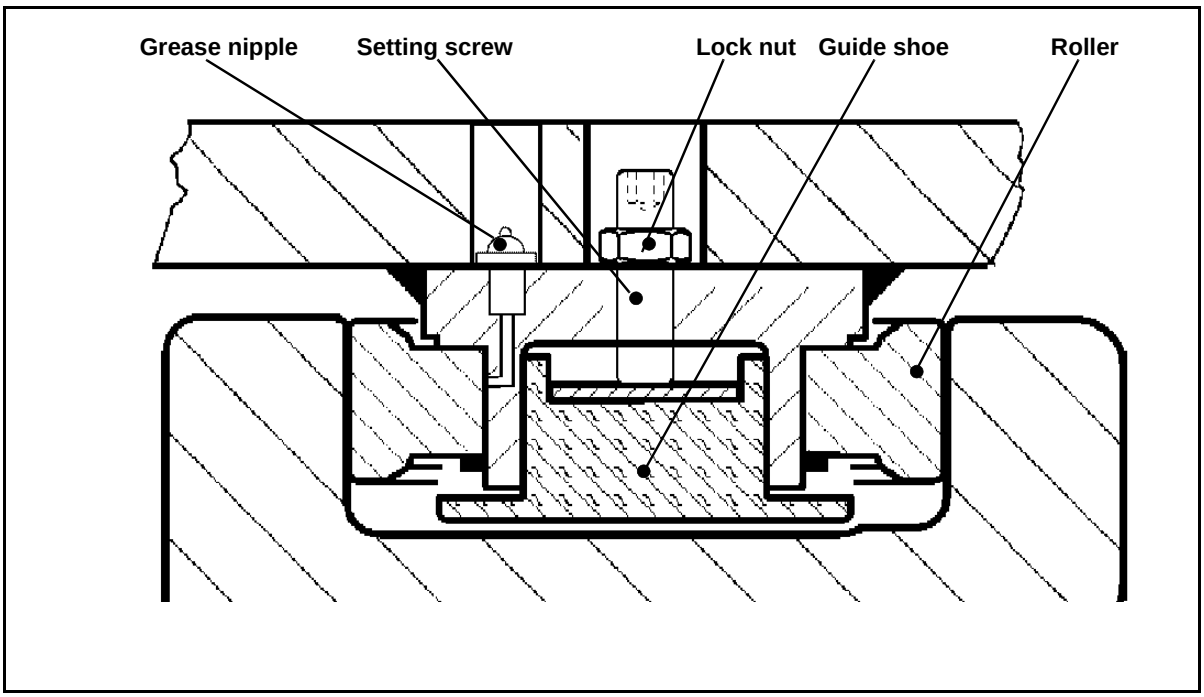
GENERAL

The profile of the mast with a double strengthening wing features great rigidity to bending and twisting. It allows wide visibility thanks to the reduced dimensions of the profile itself.
Cylinders are single-acting type.
The sideshift system has been housed inside the profiles.
The mast group is a roller type with a variable center distance (i.e. a fixed roller is fitted on the outer mast and a mobile one on the inner mast). This solution ensures better grip and stability on operation.

Others: side clearance adjustable from outside. Plastic guide shoes.

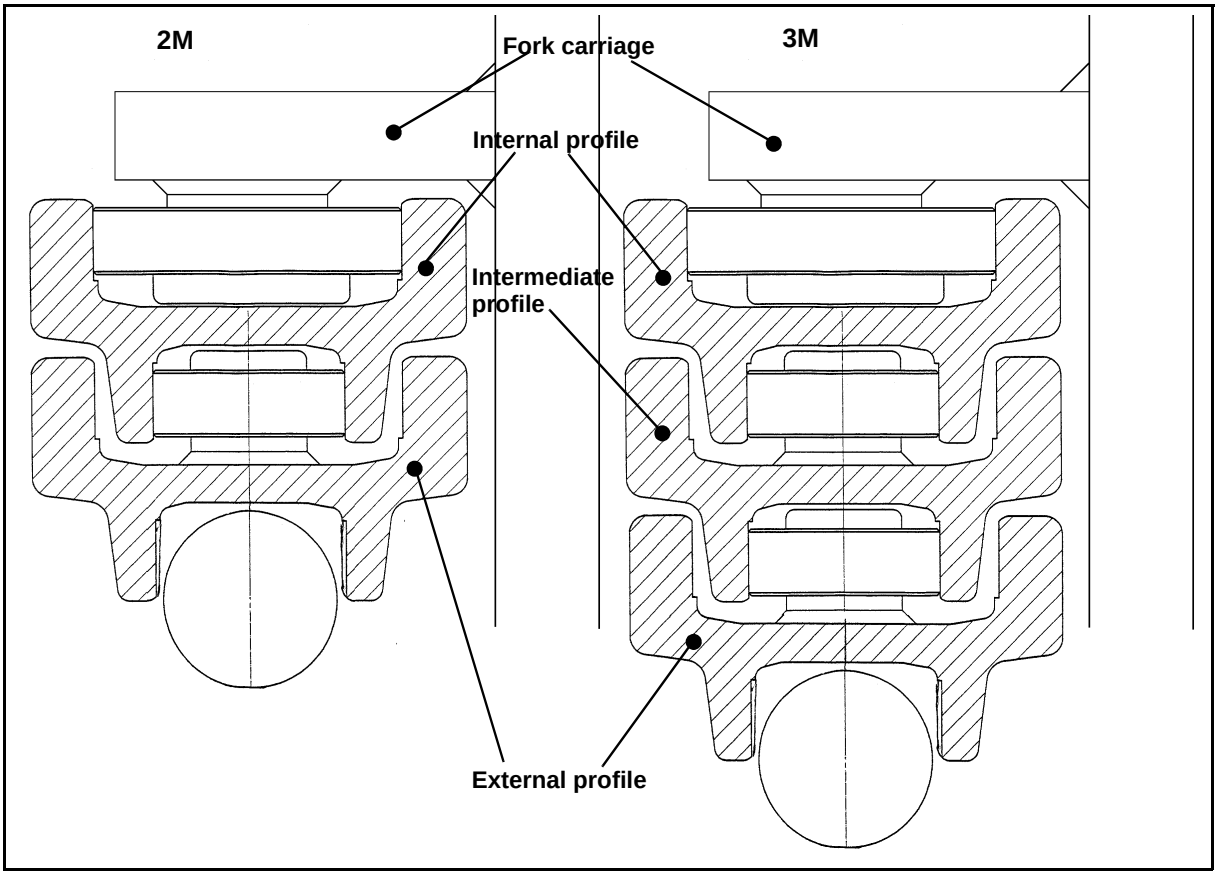
Lifting cylinders:

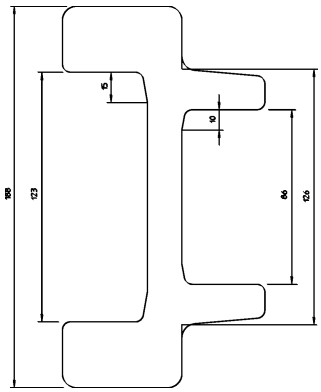
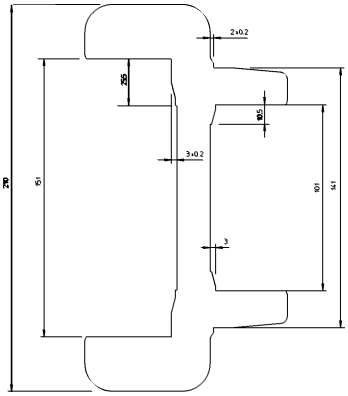
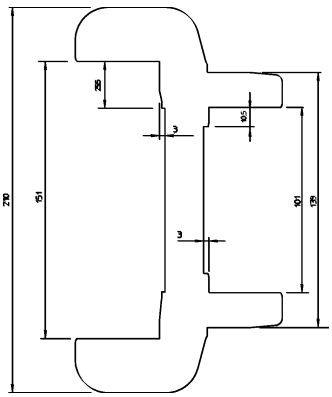
Double mast	2M TV	No. 2 rear cylinders
	2M FFL	No. 2 rear cylinders
		No. 2 front cylinders
Triple mast	3M FFL	No. 2 rear cylinders
		No. 2 front cylinders



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MAST SECTION



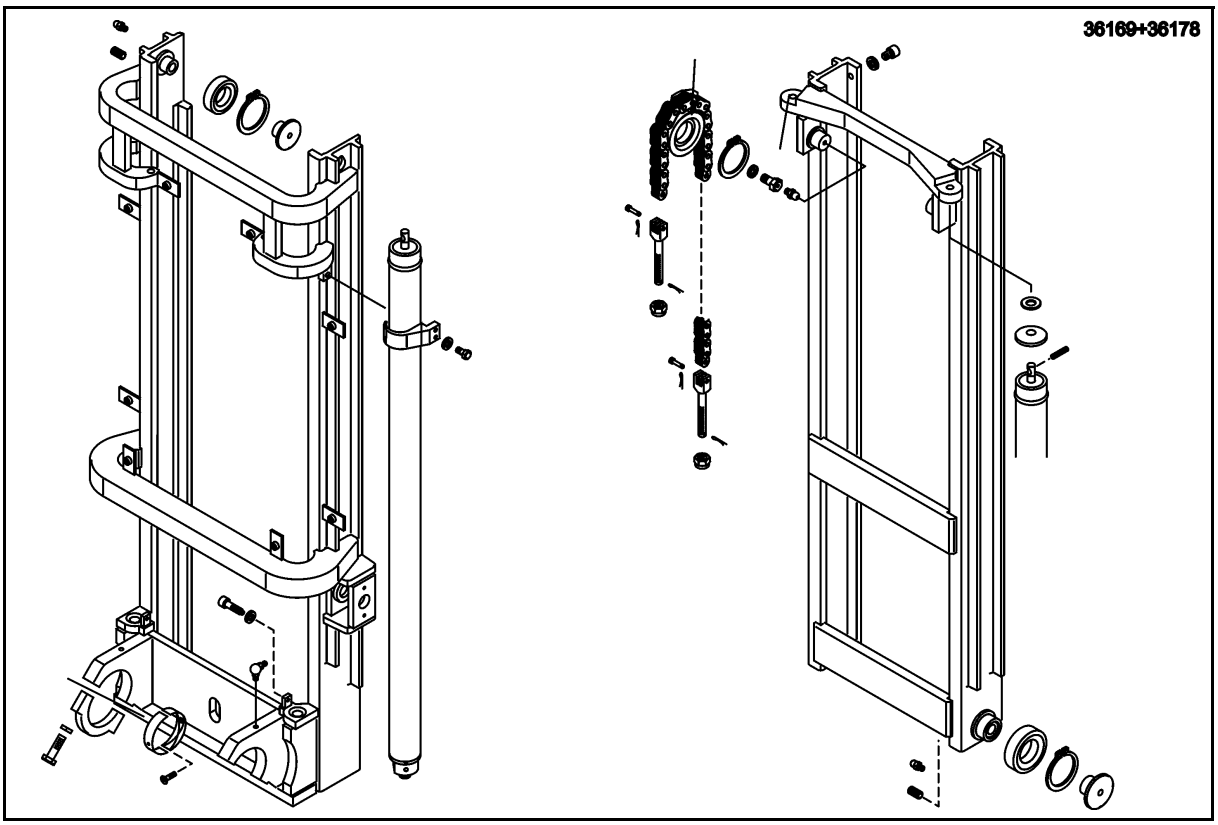
	6,0 t	7,0 t	8,5 t
PROFILE			

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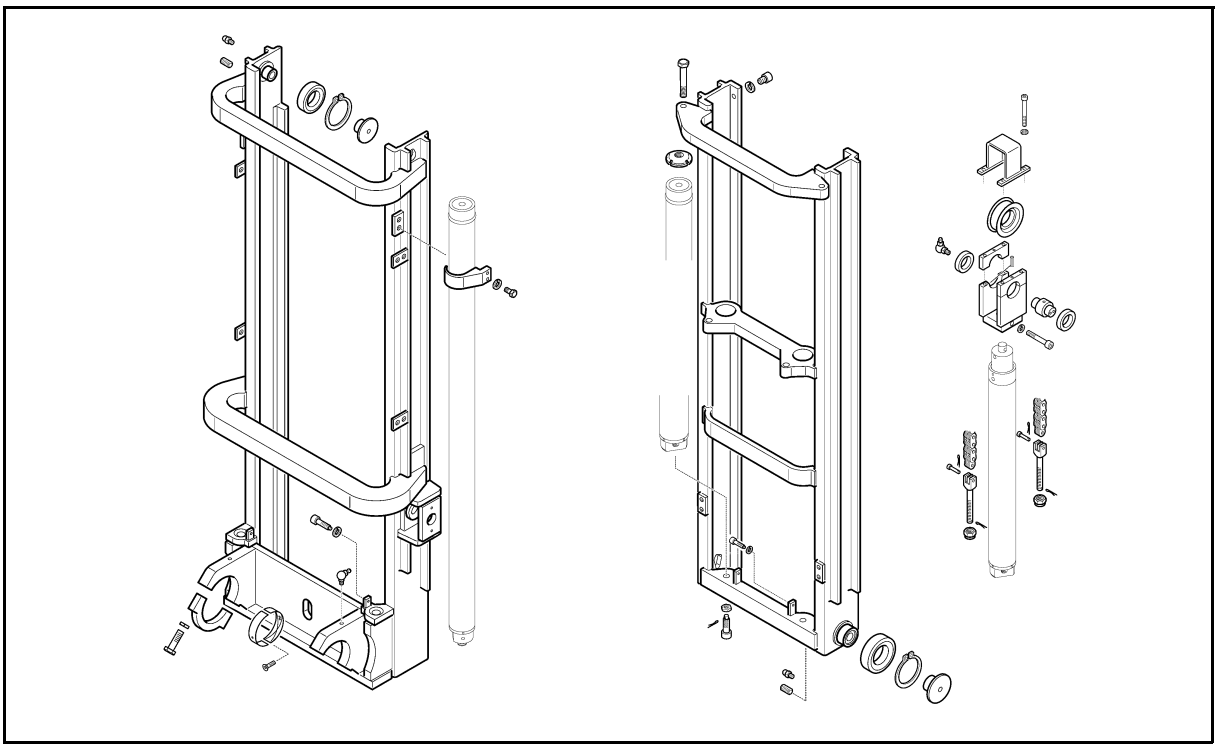
MAST GROUP

COMPONENTS

2M TV MAST, MAST CHAIN AND CHAIN WHEEL GROUP

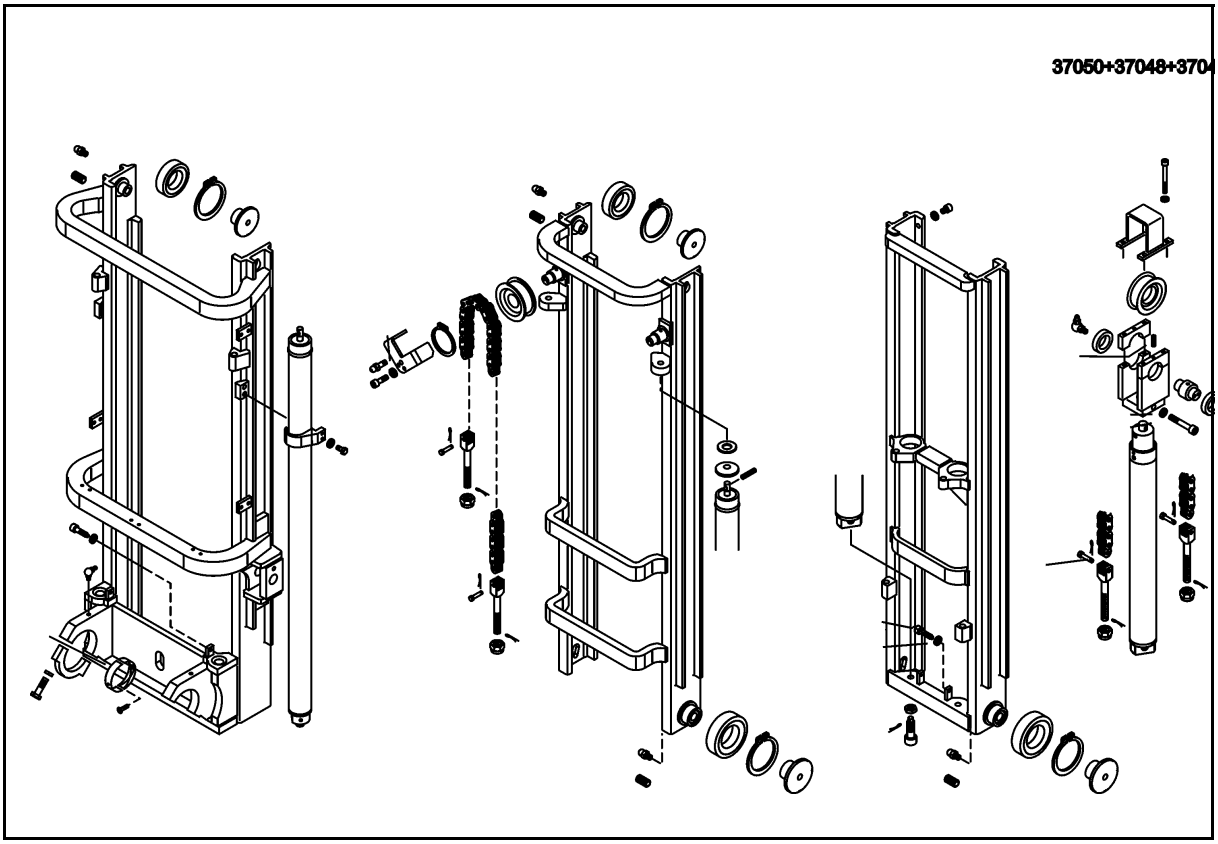


2M FFL MAST, MAST CHAIN AND CHAIN WHEEL GROUP



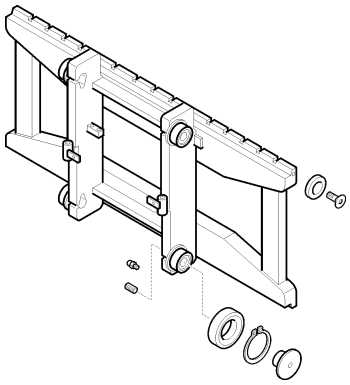
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3M FFL MAST, MAST CHAIN AND CHAIN WHEEL GROUP

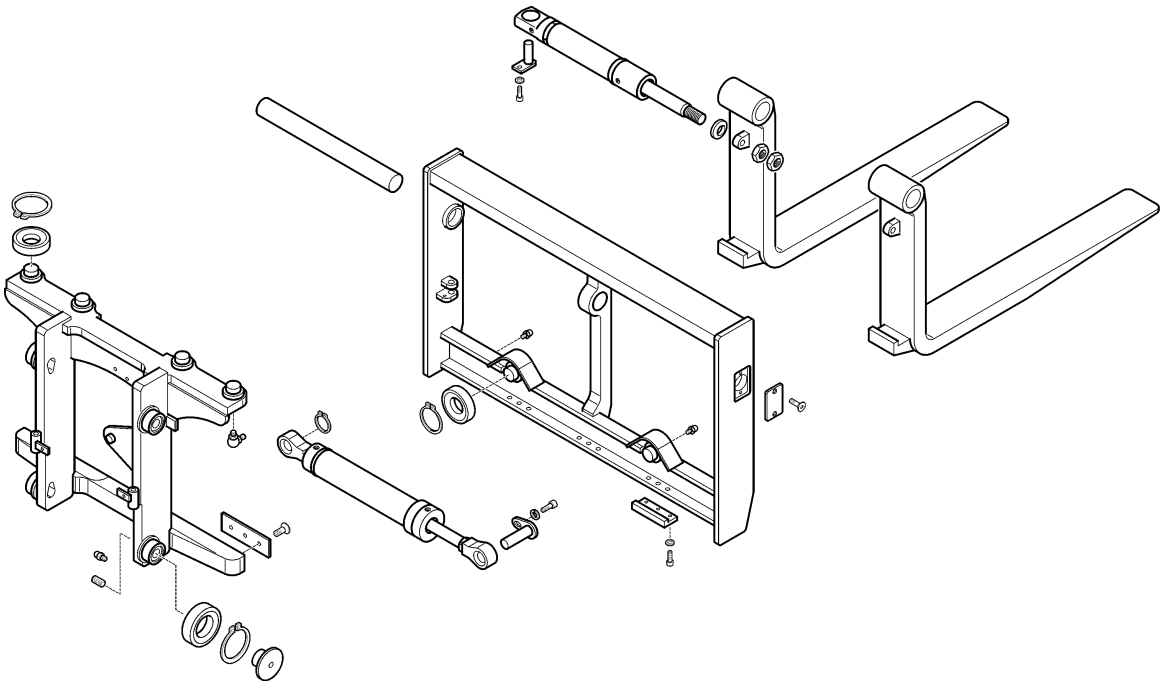


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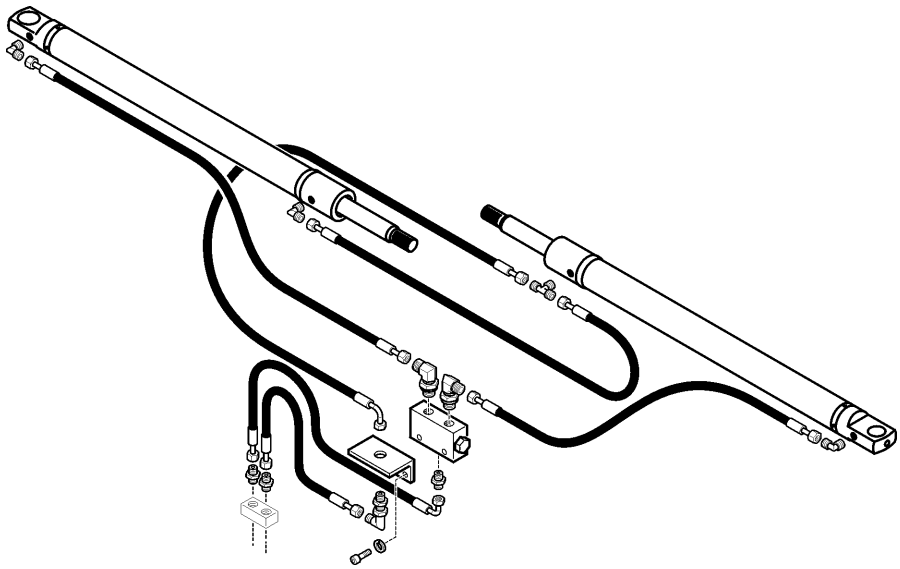
MAST FORK CARRIAGE (ALL MODELS)



WITH SIDESHIFT

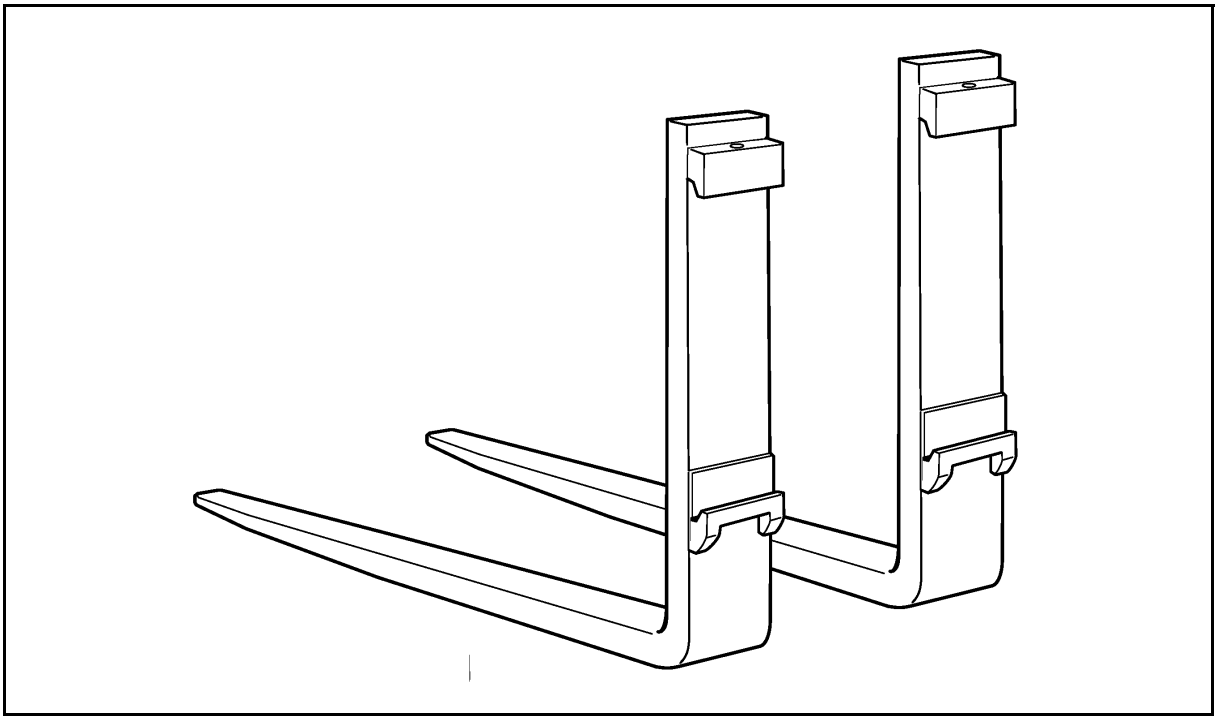


SIDESHIFT HYDRAULIC DIAGRAM



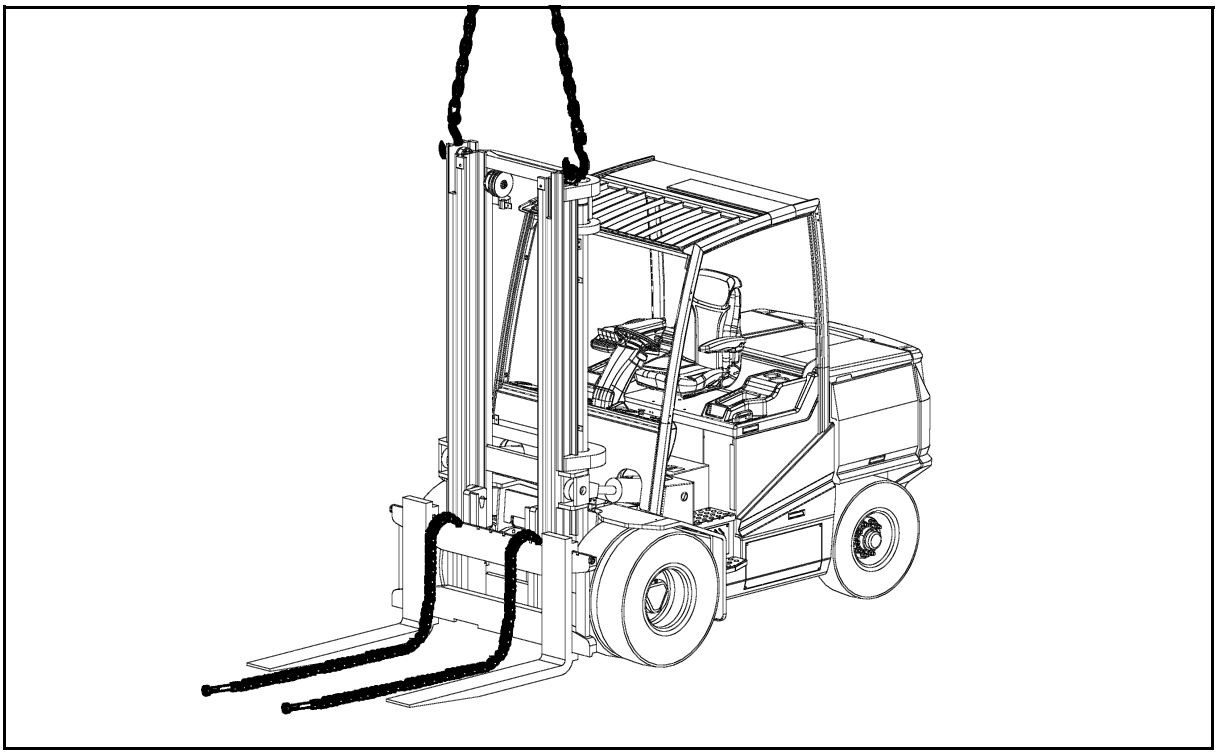
www.truck-freeworkshop.com/forklift/cesab/

FORKS (ALL MODELS)



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FORK CARRIAGE GROUP AND MAST REMOVAL
DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Set the mast the vertical position and lower the forks completly
2. Disconnect the chain from the mast side
3. Remove the chain wheel, if needed
4. Remove the fork carriage (raise the inner mast until it comes off the fork carriage, and slowly run the vehicle in reverse to detach from the fork carriage)
5. Disconnect the overflow hose and high pressure hoses. (Before hose disconnection, fully lower the r mast completly.)
6. Slightly hoist the mast. **[Point 1]**
7. Remove the tilt cylinder front pin from the mast side.
8. Remove the mast support cap.
9. Remove the mast.
10. Verify the bushing condition on the mast support

Reassembly Procedure

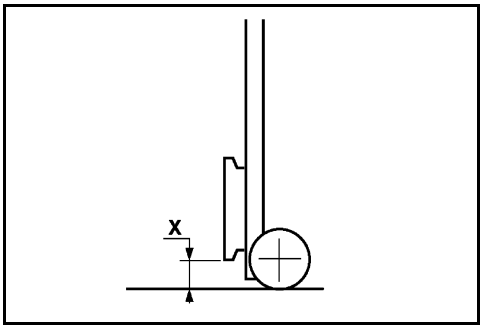
The reassambly procedure is the reverse of the disassembly procedure.

Note:

- Apply molybdenum disulfide grease on the mast support bushing and mast support cap interior surfaces. Apply MP grease to the tilt cylinder front pin.
- Perform shim adjustment of the lift cylinder rod when the mast ASSY, outer mast, inner mast or either lift cylinder is replaced.
- Adjust the chain tension after installation.

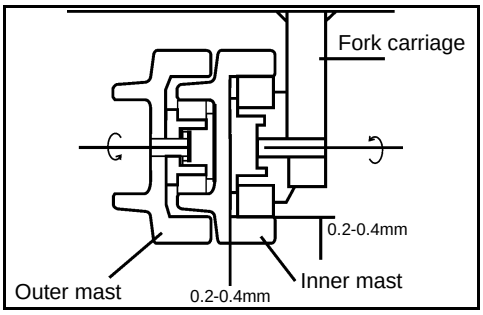
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Point Operations



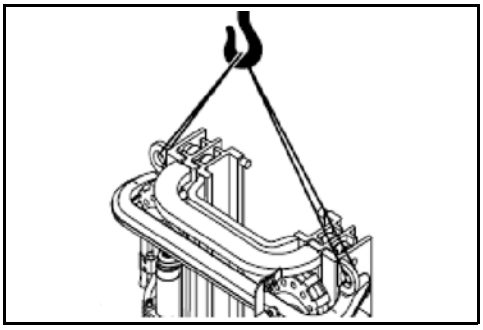
Inspection:

Remove the fork, completely lower the fork carriage and measure the height X:
Standard measure X = 127 mm.
(see “POSITION OF THE FORK CARRIAGE”)
If the height have a different measure, set the adjustment nuts of the chains.



Inspection:

Check the clearence between the inner mast and the pad of lift bracket:
Standard clearence: 0.2-0.4 mm

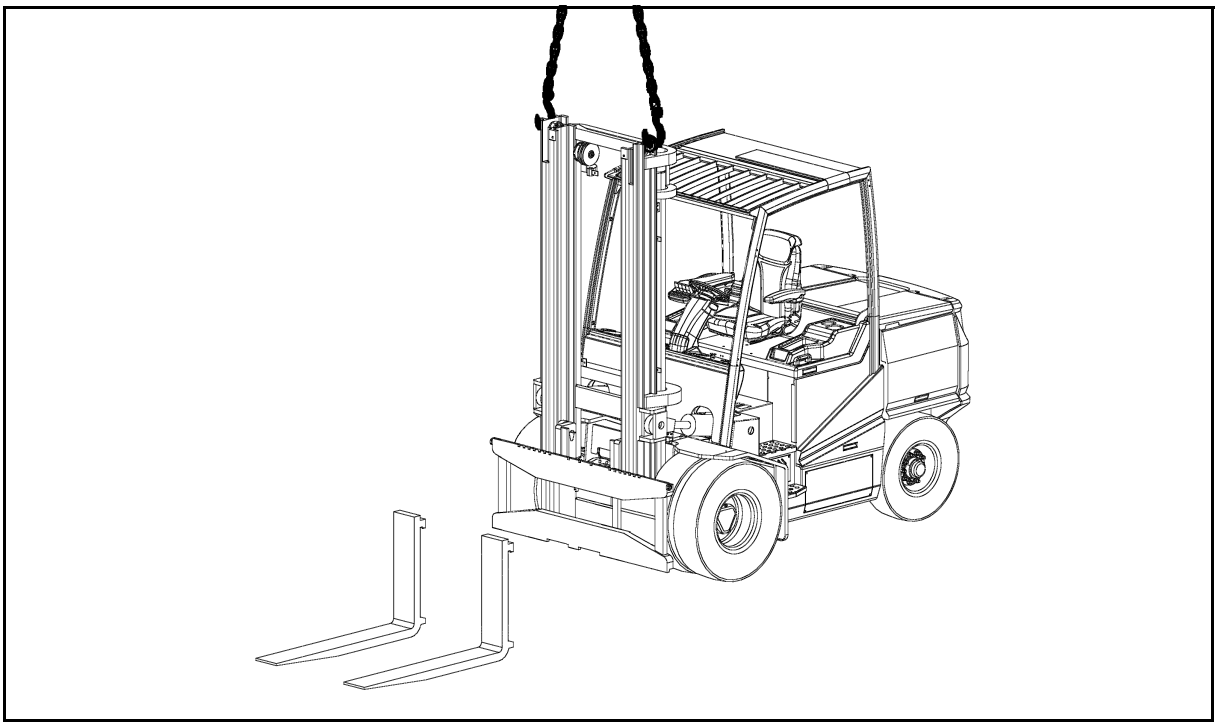


[Point 1]
Disassembly:

To remove the mast, use the eyebolt at the top of fix mast.

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MAST GROUP (WITH FORK CARRIAGE)
DISASSEMBLY • REASSEMBLY



Disassembly Procedure

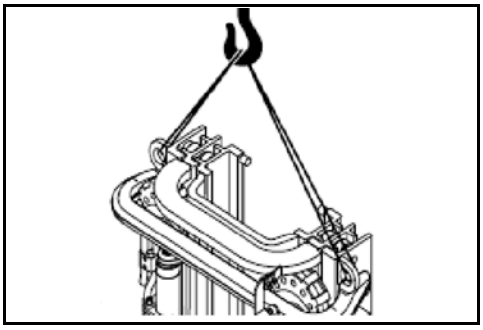
1. Set the mast in vertical position and lower the forks completly
2. Remove the forks
3. Disconnect the overflow hose and high pressure hoses. (Before hose disconnection, fully lower the inner mast)
4. Tie the fork carriage and outer mast with a wire rope
5. Slightly hoist the mast **[Point 1]**
6. Remove the tilt cylinder front pin
7. Remove the mast support cap
8. Remove the mast group with the fork carriage

Reassembly Procedure

The reassambly procedure is the reverse of the disassembly procedure.

Note:

- Apply chassis special grease to the mast support bushing and mast support cap interior surfaces. Apply MP grease to the tilt cylinder front pin
- Perform shim adjustment of the lift cylinder rod when the mast ASSY, outer mast, inner mast or either lift cylinder is replaced
- Adjust the chain tension after installation



Point Operations

[Point 1]

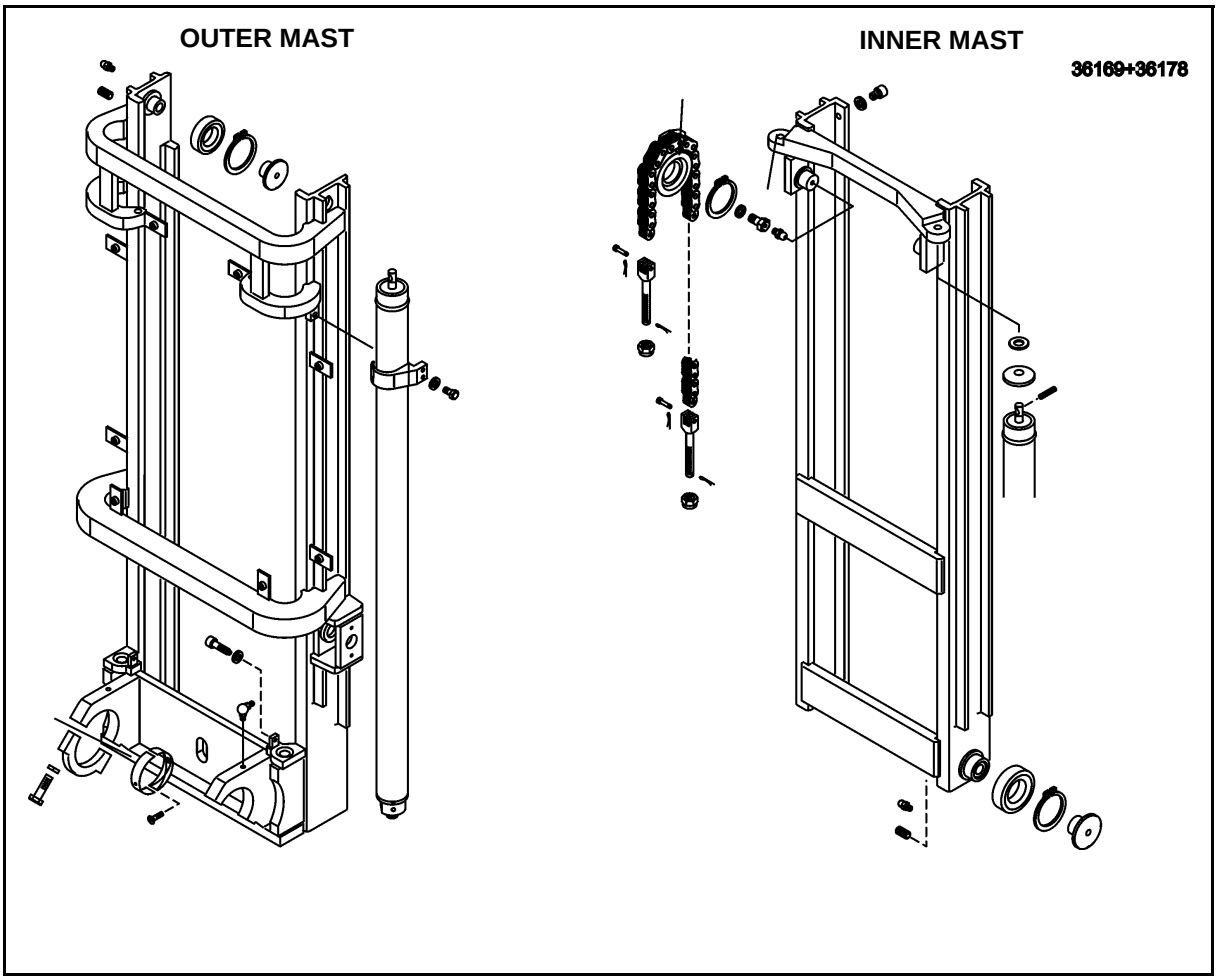
Disassembly:

To remove the mast, use the eyebolt at the top of fix mast.

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2M TV MAST GROUP

DISASSEMBLY • INSPECTION • REASSEMBLY



Disassembly Procedure

1. Remove the overflow hose and high pressure hoses
2. Disconnect the chain
3. Remove the fork carriage group (Raise the inner mast until it comes off the fork carriage, and run slowly the vehicle in reverse to detach from the fork carriage)
4. Remove each cylinder rod end set bolt, and take each rod end off
5. Remove each cylinder support
6. Remove each cylinder bottom set bolt, and remove each lift cylinder
7. Remove the outer mast

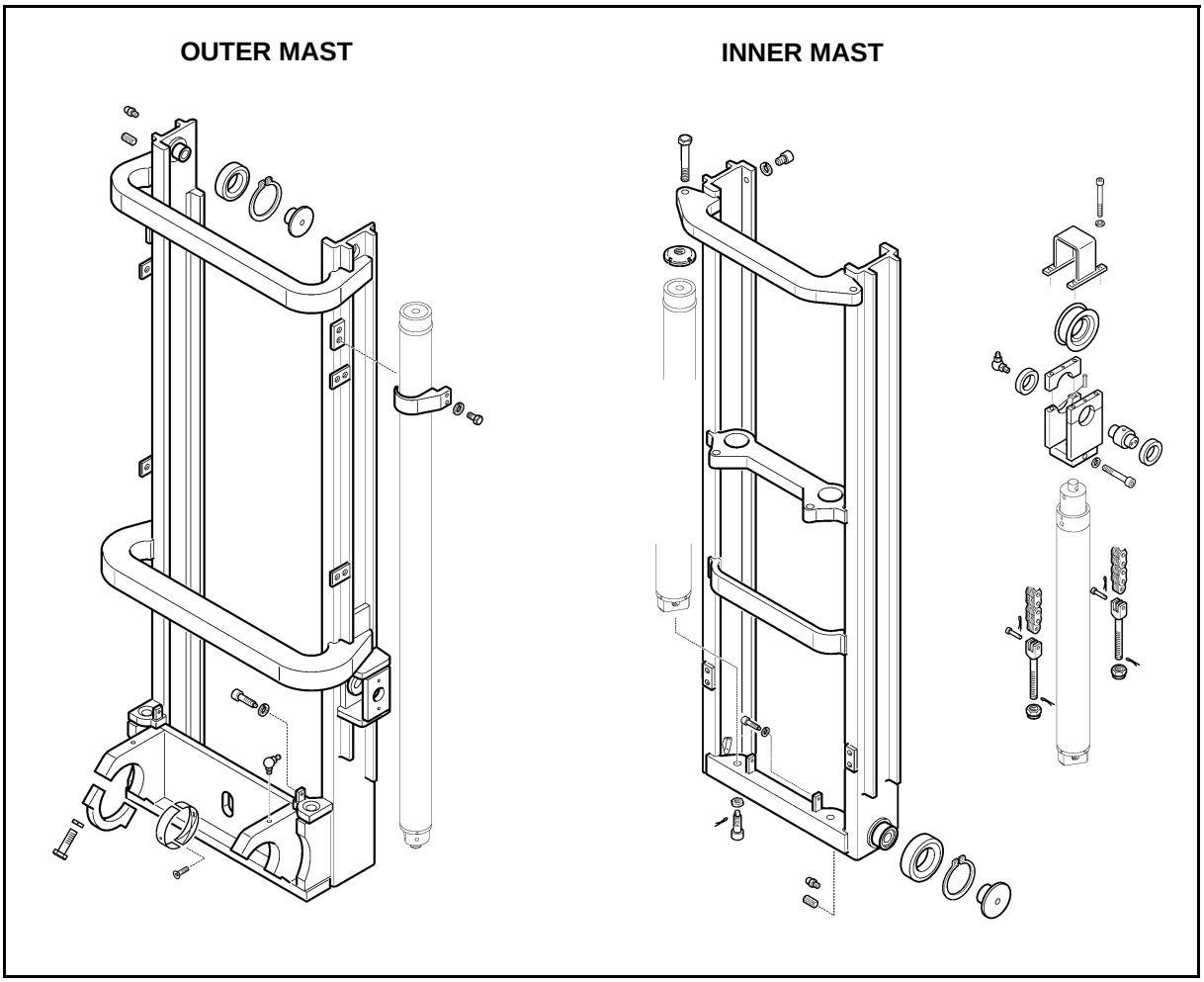
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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2M FFL MAST GROUP

DISASSEMBLY • INSPECTION • REASSEMBLY



Disassembly Procedure

1. Remove the overflow hose and high pressure hoses.
2. Disconnect the chain
3. Remove the fork carriage group (Raise the inner mast until it comes off the fork carriage, and run slowly the vehicle in reverse to detach from the fork carriage)
4. Remove the pulley support (Chain and hydraulic pipes)
5. Remove the front lifting cylinder support and the bottom set bolts
6. Remove the front lifting cylinder
7. Remove each cylinder rod end set bolt, and take each rod end off
8. Remove each cylinder support
9. Remove each cylinder bottom set bolt, and remove each rear lift cylinder
10. Remove the outer mast in rollers and inner mast rollers

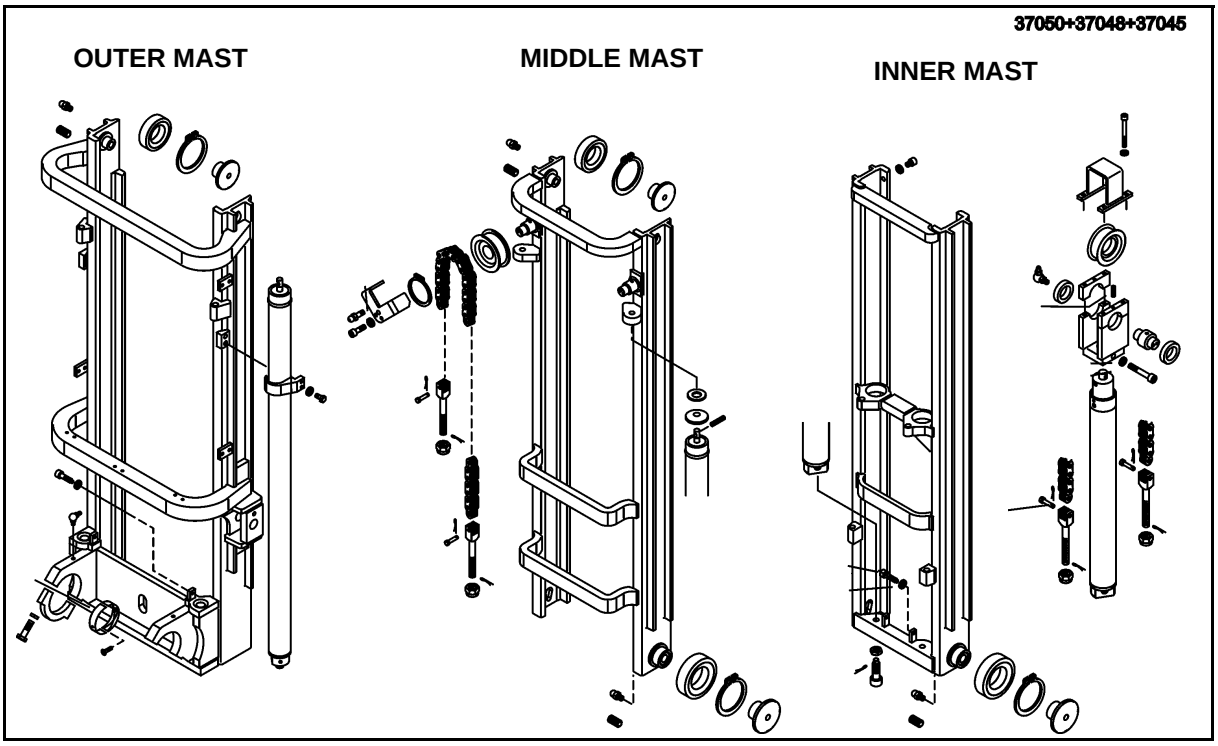
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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3M FFL MAST GROUP

DISASSEMBLY • INSPECTION • REASSEMBLY



Disassembly Procedure

1. Remove the overflow hose and high pressure hoses
2. Disconnect the chain
3. Remove the fork carriage group (Raise the inner mast until it comes off the fork carriage, and run slowly the vehicle in reverse to detach from the fork carriage)
4. Remove the pulley support.
5. Remove each front lift cylinder rod end set bolts and take each rod end off
6. Remove the front lift cylinder support and the bottom set bolts
7. Remove the front lift cylinder
8. Remove the chains of middle mast
9. Remove each rear lift cylinder rod end set bolts and take each rod end off
10. Remove the rear lift cylinder support and the bottom set bolts
11. Remove the rear lift cylinder support
12. Slide the inner mast downward and remove the lift rollers and pads
13. Remove the inner mast
14. Slide the middle mast downward and remove the lift rollers and pads
15. Remove the central mast

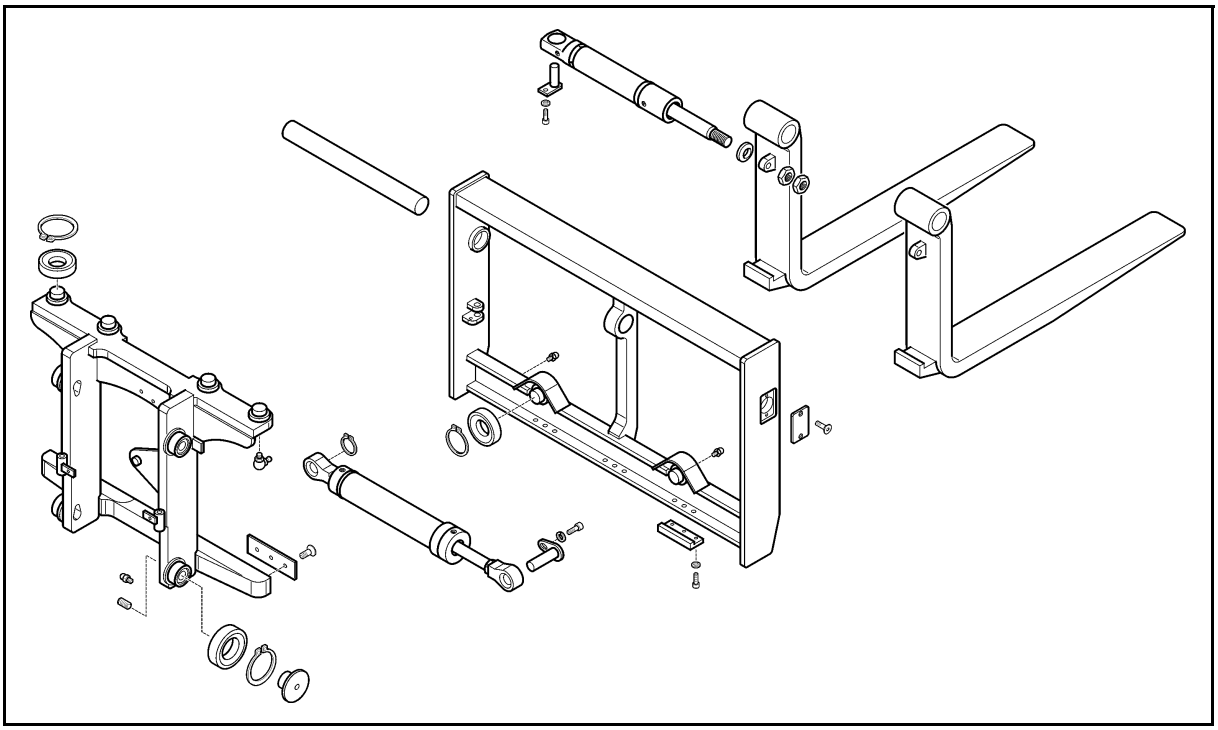
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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SIDE SHIFT CYLINDER

DISASSEMBLY • INSPECTION • REASSEMBLY



Disassembly Procedure

1. Set the mast in vertical position and lower the forks completly
2. Disconnect the pipes from the cylinder
3. Disconnect the cylinder from the side
4. Disconnect the cylinder from the fork carriage

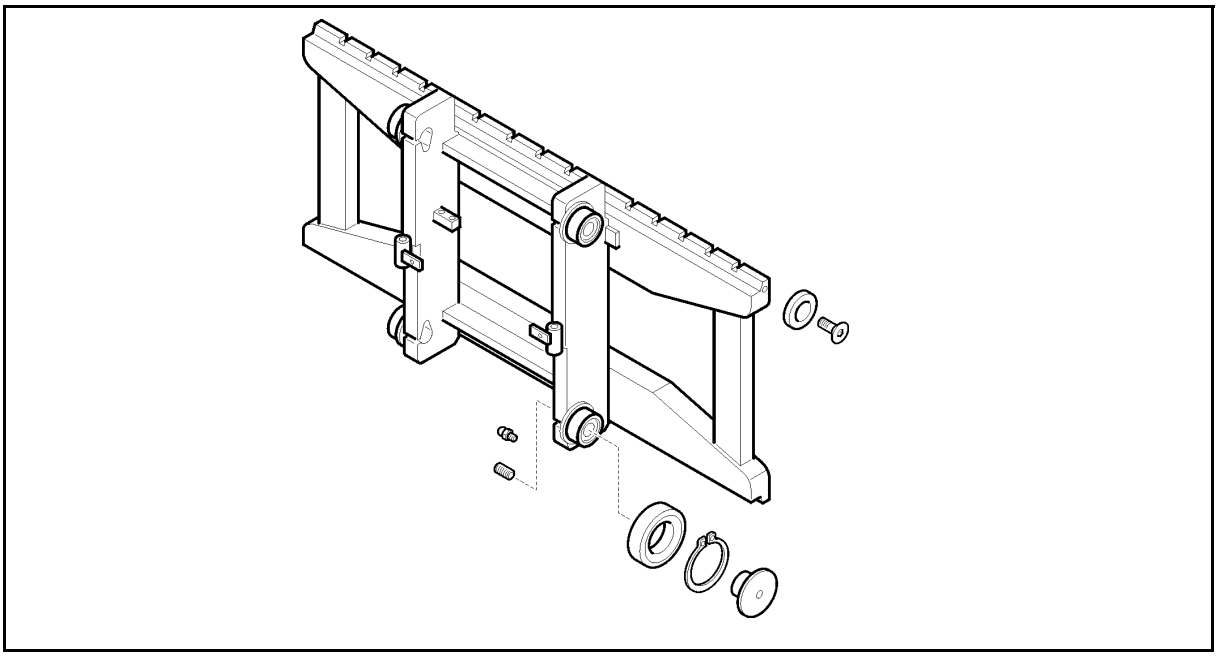
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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FORK CARRIAGE

DISASSEMBLY • INSPECTION • REASSEMBLY



Disassembly Procedure

1. Remove the guide shoes
2. Loosen the adjuster screw
3. Remove the snap ring
4. Remove the roller

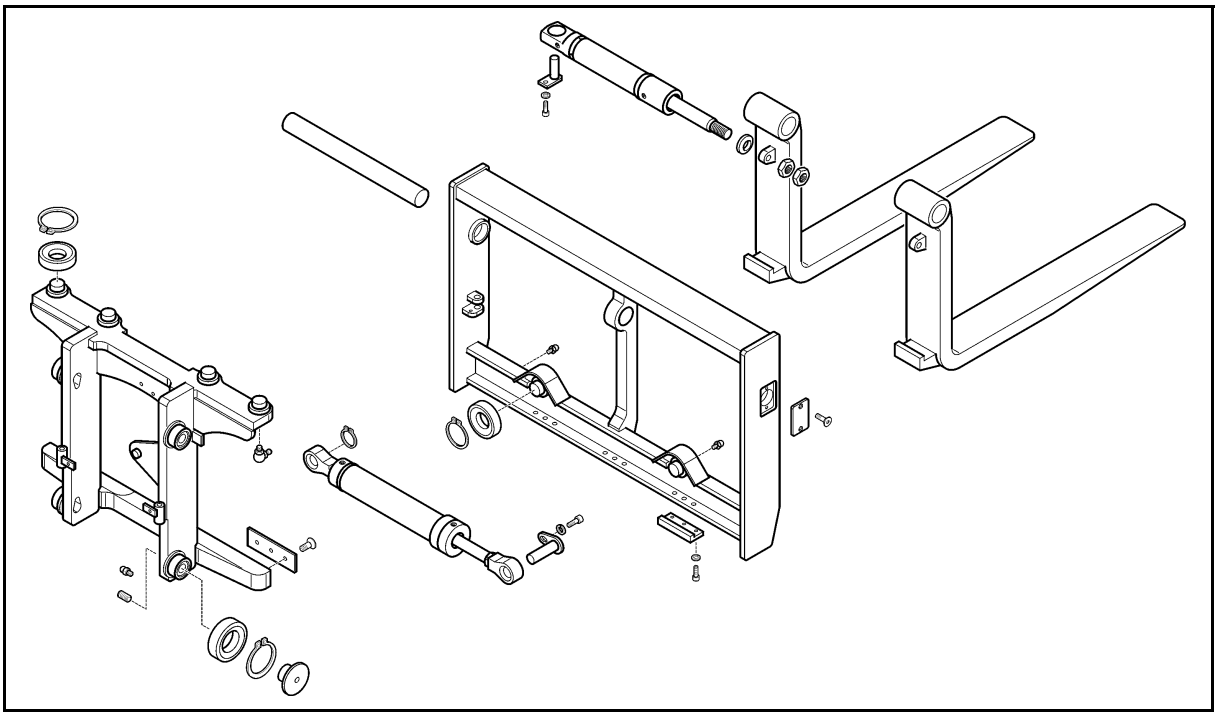
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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FORK CARRIAGE GUIDE SHOES REPLACING

DISASSEMBLY • REASSEMBLY



Disassembly Procedure

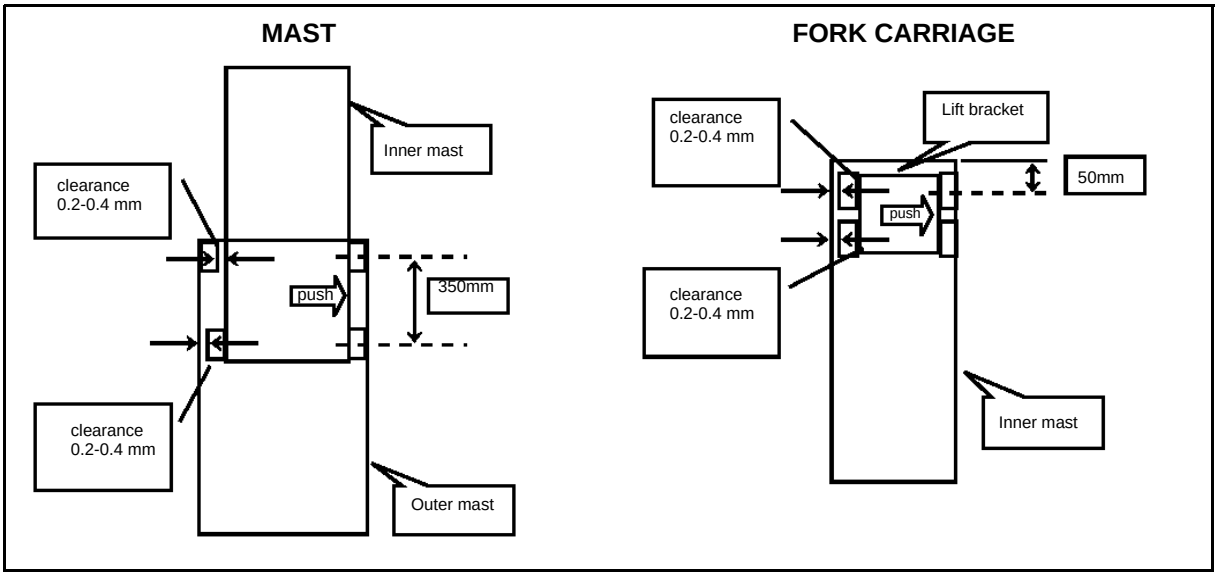
1. Park the truck on a flat surface and apply the parking brake
2. Switch off the truck
3. Disconnect the battery plug
4. Remove the 2 forks from the fork carriage
5. Remove the lower security locks
6. Remove the sideshift carriage
7. Unscrew the brass fixing screws

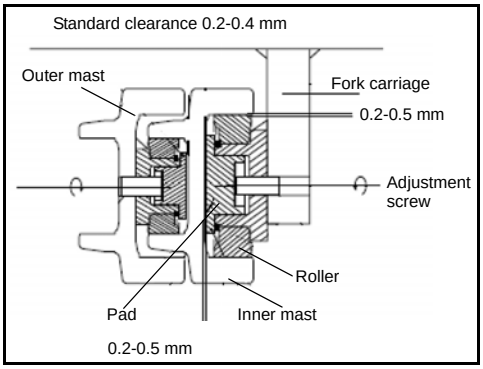
Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

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MAST AND FORK CARRIAGE PADS ADJUSTMENT





(1) Unscrew the adjustment screw
(2) Set the frames (mast or fork carriage) as shown in the figure above
(3) Put the frames (mast or fork carriage) in one side
(4) Measure the clearance between the frame and the pads
(5) Adjust RH pads (upper and lower) for half of clearance (considering that for each turn the screw move 1.25mm: 1/4=0.3mm)
(6) Put shim (0.3mm (0.0118 in)) on the LH side and tight the adjustment screw until the shim does not move
(7) Remove the shim

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MAST CHAINS CHECK

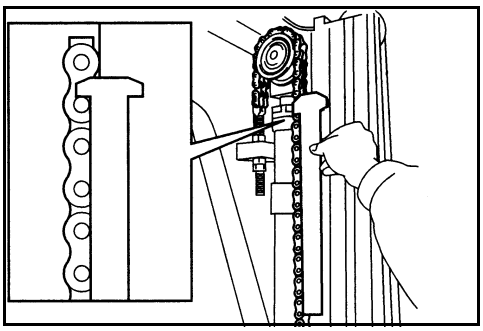
Every 500 hours (in any case check the chains every 3 months)
- check the condition of the chains which must not be worn or faulty. To check the links for wear, use the appropriate gauge

Every 1000 hours
- remove the chains, clean them thoroughly, refit them inverting the original working position and lubricate them

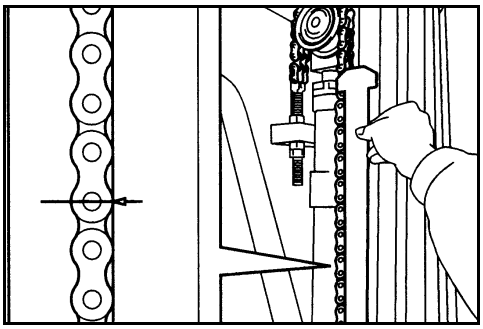
Every 10000 hours
- replace the chains and the fixing tie rods

The original chains use guarantee the complied with safety requirements stated in the regulations in force

INSPECTION • ADJUSTEMENT

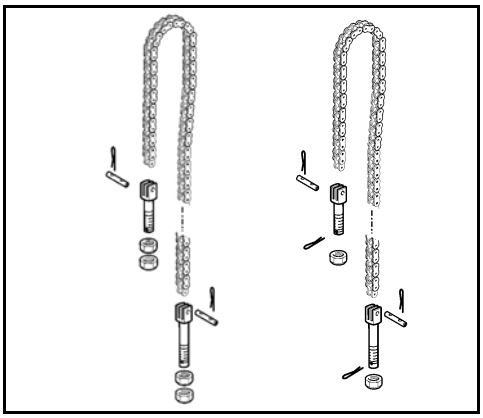


Inspections:
1. Check if the chain links are worn out, use the appropriate rule:



2. The chains must be replaced when, in a portion corresponding to 34 pitches, only 33 pitches are found.

Note:
Perform measurement without removing the chain from the vehicle.
Inspect elongation over the entire chain length as it may be localized



Adjustment
1. Park the truck on a level surface and apply the parking brake
2. Put the mast in vertical position
3. Switch off the truck
4. Open the compartment and disconnect the battery
5. Remove the forks
6. To compensate for any chain sag, turn the self-locking nut on the fork carriage
7. Check to see if the chain tension is equal on left and right sides
8. Check that the chains are not twisted
9. Check that the lifting higher meets the standard
10. In the upper position, check that the end stroke plate is not in contact with the fork carriage
11. Check that the measurement X agrees with the ISO tables in “POSITION OF THE FORK CARRIAGE”

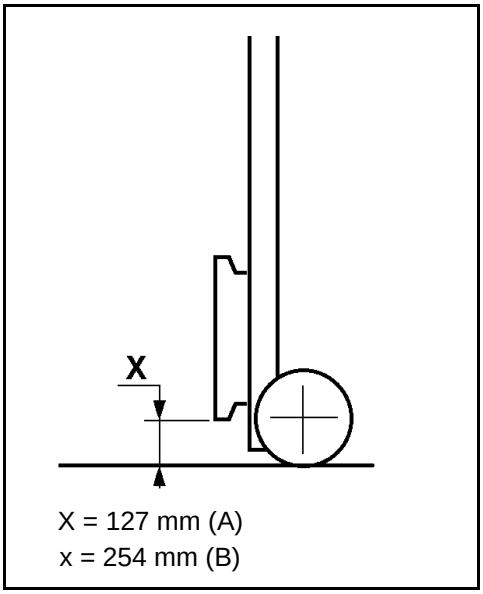
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POSITION OF THE FORK CARRIAGE

Every 500 hours

After testing the chains, with the truck on an even surface and the mast in vertical position, check the position of the fork carriage plate, as follows:

- remove the forks, lower the fork carriage completely, measure the height (X) and compare it with the value corresponding to the truck capacity in kg, as shown in the table below
  example: the correct value of (X) for a truck with a capacity of 6000 kg (class IV B), must be 254 ± 5 mm.



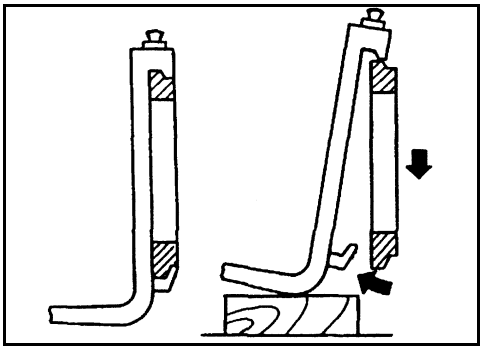
X = 127 mm (A)
x = 254 mm (B)

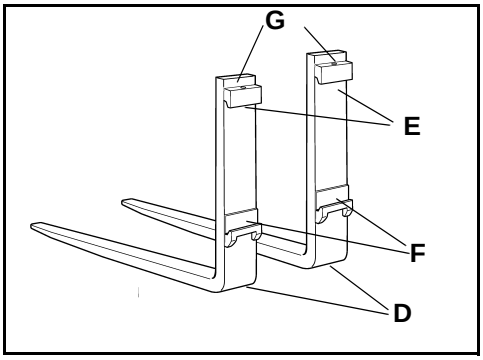
ISO 2328 - 1993

Class	Capacity (kg)	"X" (± 5)
I A	0 ÷ 999	76 mm
II A	1000 ÷ 2500	76 mm
III A	2500 ÷ 4999	76 mm
IV A	5000 ÷ 8000	127 mm
V A	8001 ÷ 10999	127 mm
Class	Capacity (kg)	"X" (± 5)
I B	0 ÷ 999	114 mm
II B	1000 ÷ 2500	152 mm
III B	2500 ÷ 4999	203 mm
IV B	5000 ÷ 8000	254 mm
V B	8001 ÷ 10999	257 mm

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FORKS
DISASSEMBLY • INSPECTION • REASSEMBLY





Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Lift the fork to approx. 20 cm from the ground
3. Place a wood block under the notched section of the fork rail
4. Unlock the fork by lifting the fork stopper pin and shift one fork per time to the fork carriage bottom notch
5. Slowly lower the fork for removal

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Inspection

Fork arm inspection must be carried out carefully by trained personnel abble to detect any damage, failure, deformation, etc., which may impair safe use

1. Surface cracks:
   The fork arm must be thoroughly examined visually for cracks giving special attention to the heel (**D**) and top (**E**) and bottom (**F**) hooks. If necessary, the forks may be subjected to a non-destructive crack detection process.
2. Difference in height of fork tips
   Check the difference in height between the tips on each pair of forks; this must not be more than 3% of the thickness of the forks fitted on the fork plate
3. Positioning lock
   Check that the fork positioning lock **(G)** is in good working order
4. Legibility of marking
   If the fork arm marking is not clearly readable, it must be renewed by the original fork supplier
5. Fork wear control
   The fork arm blade and shank must be thoroughly checked for wear, paying special attention to the area around the heel **(D)**. When maximum wear is detected, with thickness reduced to 90% of the original, the fork arm must be replaced
6. Fork mounting wear control
   The horizontal supporting surface of the top hook **(E)** and the contact surfaces of both hooks **(E)** and **(F)** must be checked for wear and any damage
7. Withdrawal of the forks from service
   Any fork with defects revealed during the above controls must be withdrawn from service

Note:

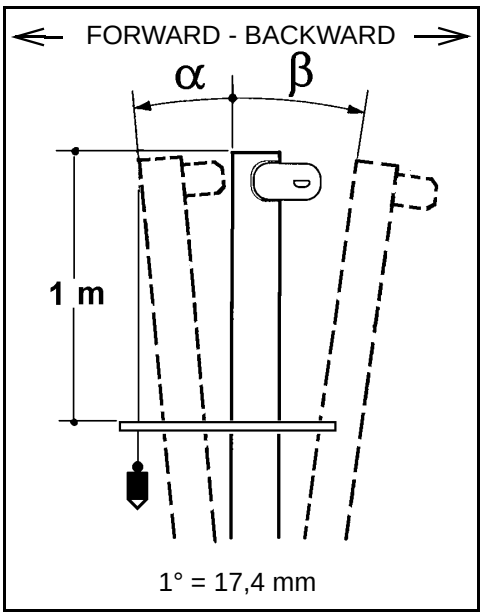
Any component or system tampering can endanger the vehicle safety. Any repair and replacement operation should be performed only by authorised and well trained personnel.

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MAST UNIT TILTING SETTING

Every 500 hours

- Check the tilting of the mast; the standard values are:



α = 5°FORWARD
β = 10°BACKWARD (standard)
β = 8°BACKWARD (optional)
β = 6°BACKWARD (optional)

The tilt angle can easily be checked using a plumb-line dropped from the front outside edge of the top of the fixed masts and measuring the distance between the line and the front edge at a metre from the top of the masts

NB. 1 tilting degree corresponds to a 17.4 mm movement on 1 m

α = 5°FORWARD= 87,5 mm
β = 10°BACKWARD (standard)= 176,3 mm
β = 8°BACKWARD (optional)= 140,5 mm
β = 6°BACKWARD (optional)= 105,1 mm

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CYLINDER

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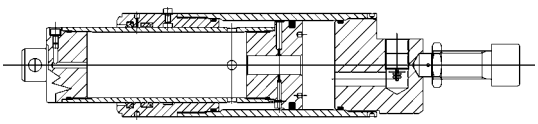
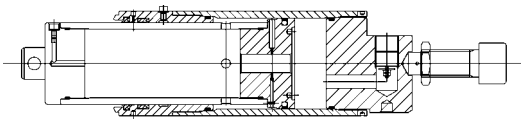
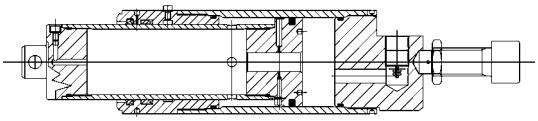
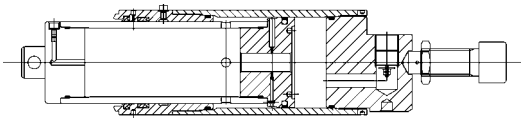
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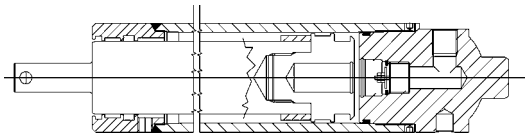
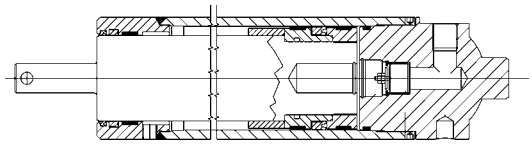
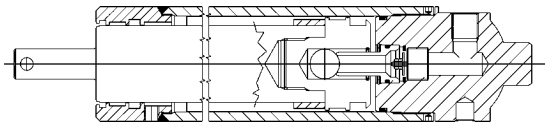
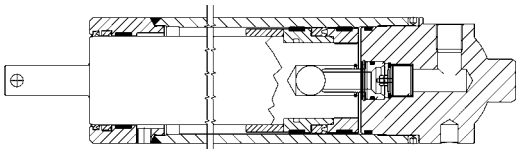
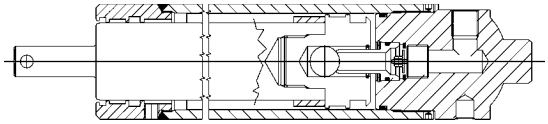
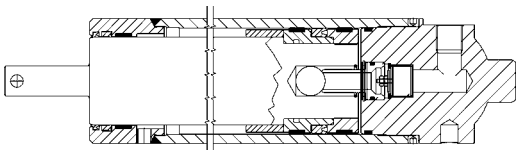
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LIFTING CYLINDERS

GENERAL

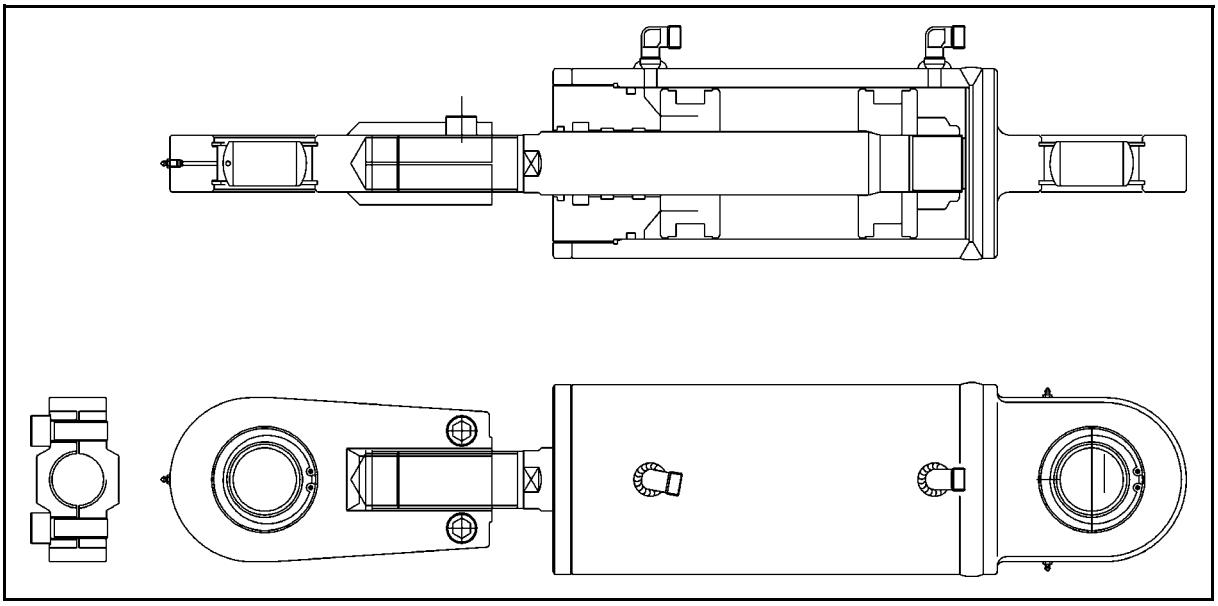
	FRONT CYLINDERS	
	6,0 to 7,0 t	**8,5 t**
2M TV		
3M TV		
2M FFL	2 displacement cylinders with brake effect on the lifting 	2 displacement cylinders with brake effect on the lifting 
3M FFL	2 displacement cylinders with brake effect on the lifting 	2 displacement cylinders with brake effect on the lifting 

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	REAR CYLINDERS	
	6,0 to 7,0 t	**8,5 t**
2M TV	2 telescopic cylinders without brake effect 	2 telescopic cylinders without brake effect 
3M TV		
2M FFL	2 telescopic cylinders with brake effect on the lowering 	2 telescopic cylinders with brake effect on the lowering 
3M FFL	2 telescopic cylinders with brake effect on the lowering 	2 telescopic cylinders with brake effect on the lowering 

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TILTING CYLINDER SPECIFICATION						
Mark		Forward tilting degree	Backward tilting degree	Stroke (mm)	Cylinder inside diameter (mm)	Piston rod outside diameter (mm)
A	standard	5°	10°	156,5	120	50
B	optional	5°	8°	135	120	50
C	optional	5°	6°	113,5	120	50



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SPECIFICATIONS

REAR LIFTING CYLINDER 2M TV MAST

		6,0 t	7,0 t	8,5 t
Cylinder type		Single effect		
Cylinder inside diameter	mm	75	75	85
Piston rod outside diameter	mm	60	60	70
Parachute valve R	mm	2,2	2,2	2,2

REAR LIFTING CYLINDER 2M FFL-3M FFL MAST

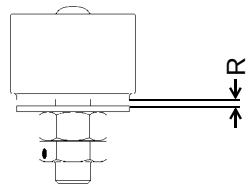
		6,0 t	7,0 t	8,5 t
Cylinder type		Single effect		
Cylinder inside diameter	mm	75	75	85
Piston rod outside diameter	mm	60	60	70
Parachute valve R	mm	2,2	2,2	2,2

FRONT LIFTING CYLINDER 2M FFL-3M FFL MAST

		6,0 t	7,0 t	8,5 t
Cylinder type		Single effect		
Cylinder inside diameter	mm	95	95	100
Piston rod outside diameter	mm	80	80	90
Parachute valve R	mm	2,2	2,2	2,2

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PARACHUTE VALVE (SAFETY DOWN VALVE)



R= Setting portion

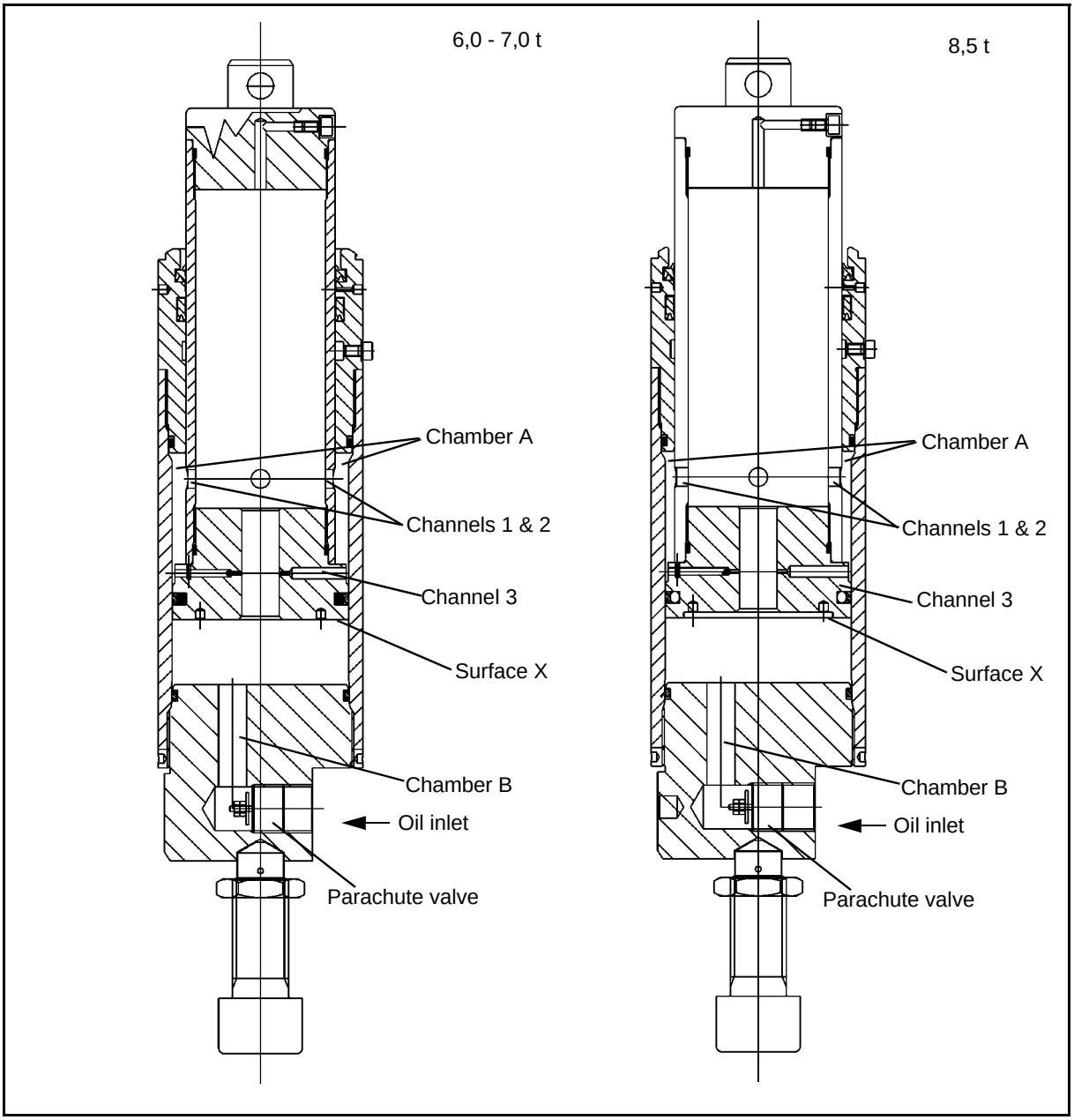
The parachute valve enables the locking of the load in the position where the actuator is in the moment of failure (as it might happen in case of hose failure, the flow is blocked)

Note:
We recommend to verify the valve integrity and replace it in case of a pressure spike, generated by hose failure, particurarly dangerous to damage some valve components permanently.

Standard: 6,0 to 8,5 t 2.2 mm

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FRONT DISPLACEMENT CYLINDER WITH BRAKING EFFECT ON LIFTING

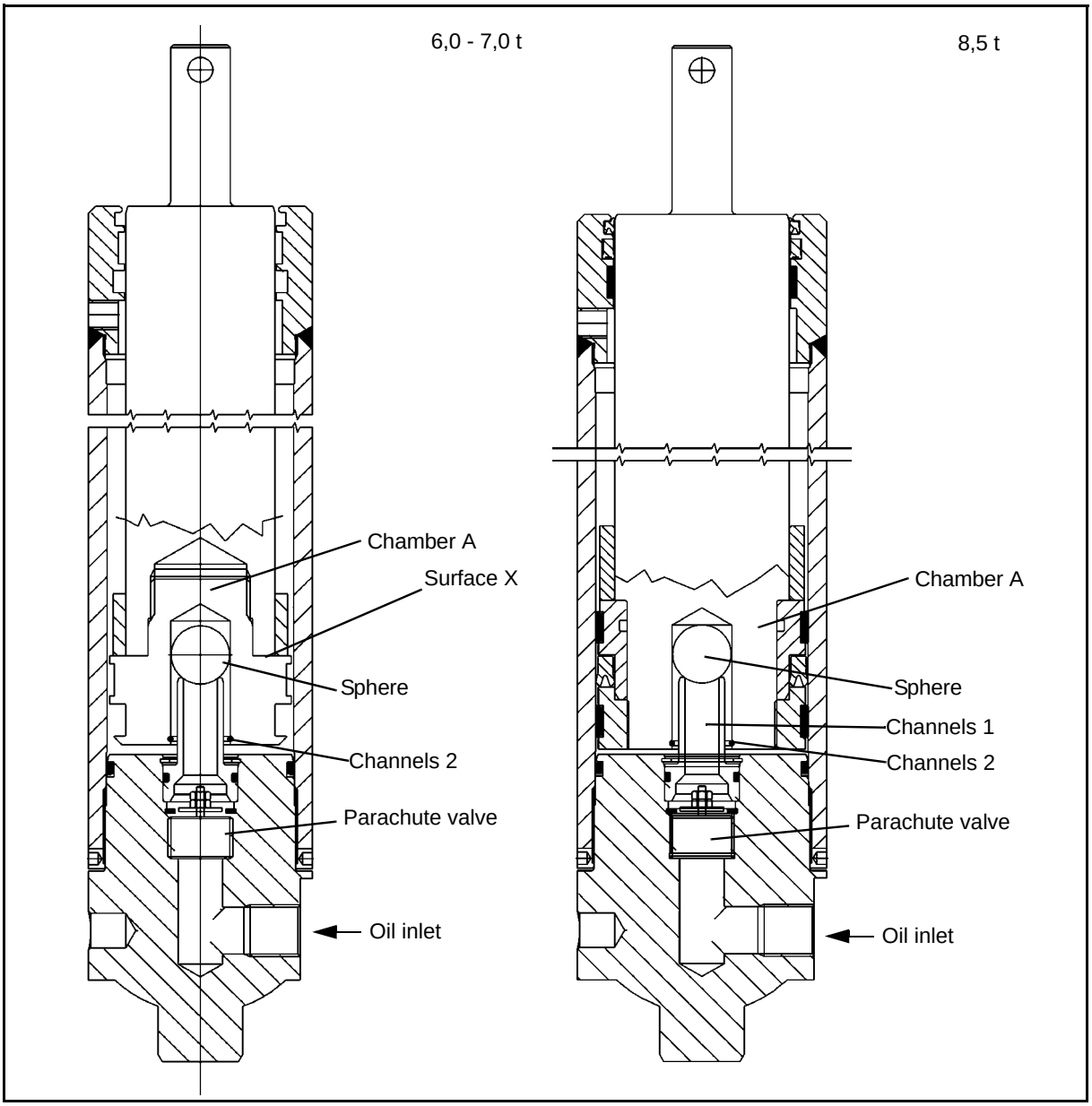


Lifting phase:
When acting on the control valve, the oil flows into the cylinder via the “oil inlet”. Through channels 1, 2 and 3 the oil fills the chamber A until the internal pressure of the oil exerts an upward thrust against the surface X. The rod coming out will close the above mentioned channels.
Near the limit of the stem, the channels 1 and 2 are plugged by the head, so the oil flowing between the two chambers passes only through channel 3 (calibrated hole), obtaining a lower flow of oil.

Lowering phase:
Opening the supply circuit (oil inlet) allows the stern to come down so that the oil can return to the tank via the control valve. At the start of this phase, chamber A contains no oil. Better constant filling is enabled by the channel 3 that by opening avoid jerking.
After passing the cylinder head, the oil flow between the two chambers passes through channels 1 and 2 which are now open.

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REAR TELESCOPIC CYLINDER WITH BRAKING EFFECT ON LOWERING

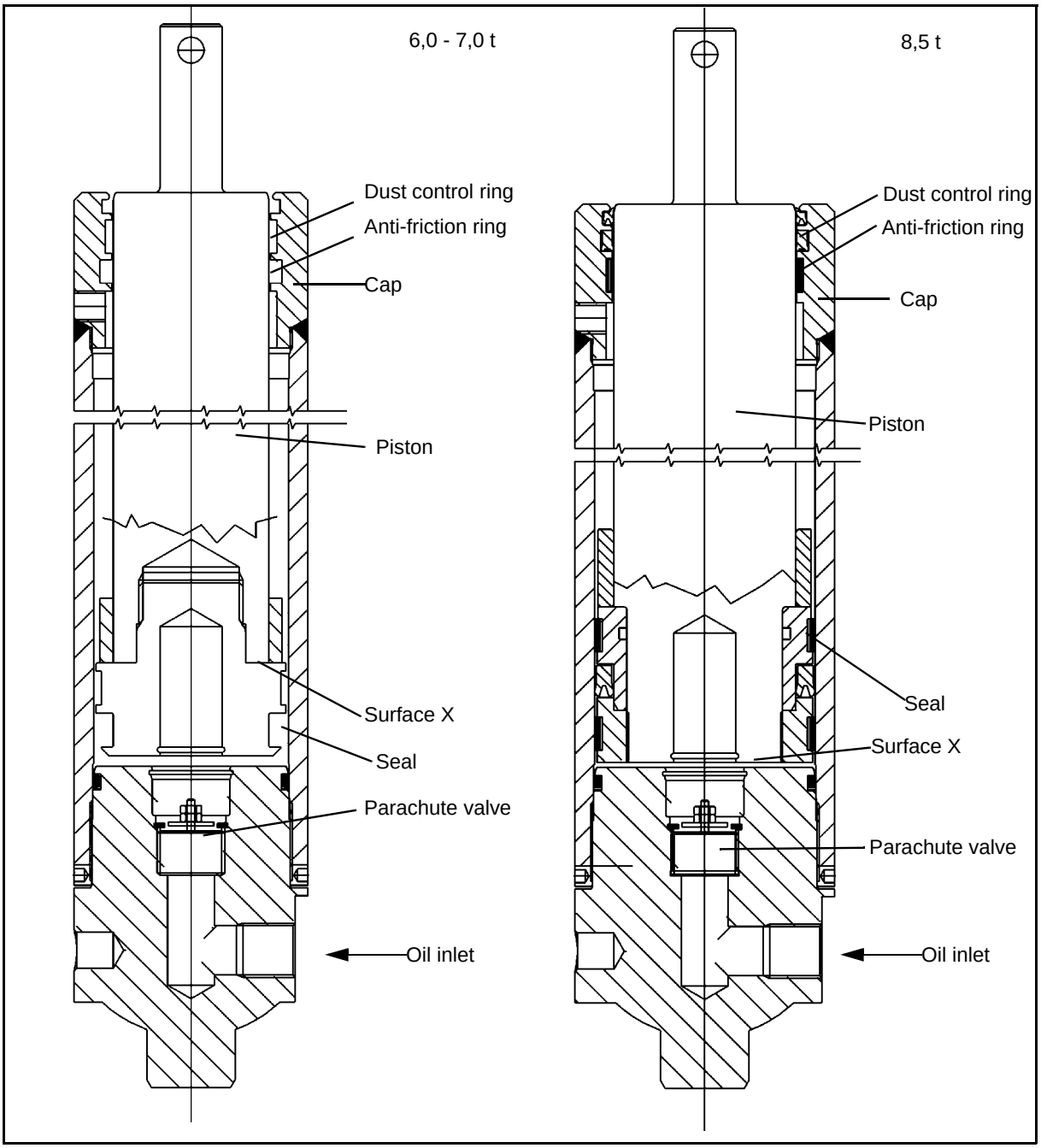


Lifting phase:
By operating on the control valve with the lifting lever, the oil flows to the cylinder through the oil inlet. It reaches channels 1 and 2 until the hydraulic pressure formed in chamber A produces a thrust upwards on the surface X thereby stem extraction.

Lowering phase:
Lowering is permitted by operating on the hydraulic control valve, opening the oil return circuit to the tank through the control valve.
At the start of this phase, all the oil in chamber A flows out through the channel 1. Only afterwards, when the sphere comes into contact with the top of the brake body, does the braking action begin, directing the oil through the cannel on the brake body, which being very small in proportion causes the oil coming out to slow down (braking effect).

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REAR TELESCOPIC CYLINDER WITHOUT BRAKING EFFECT



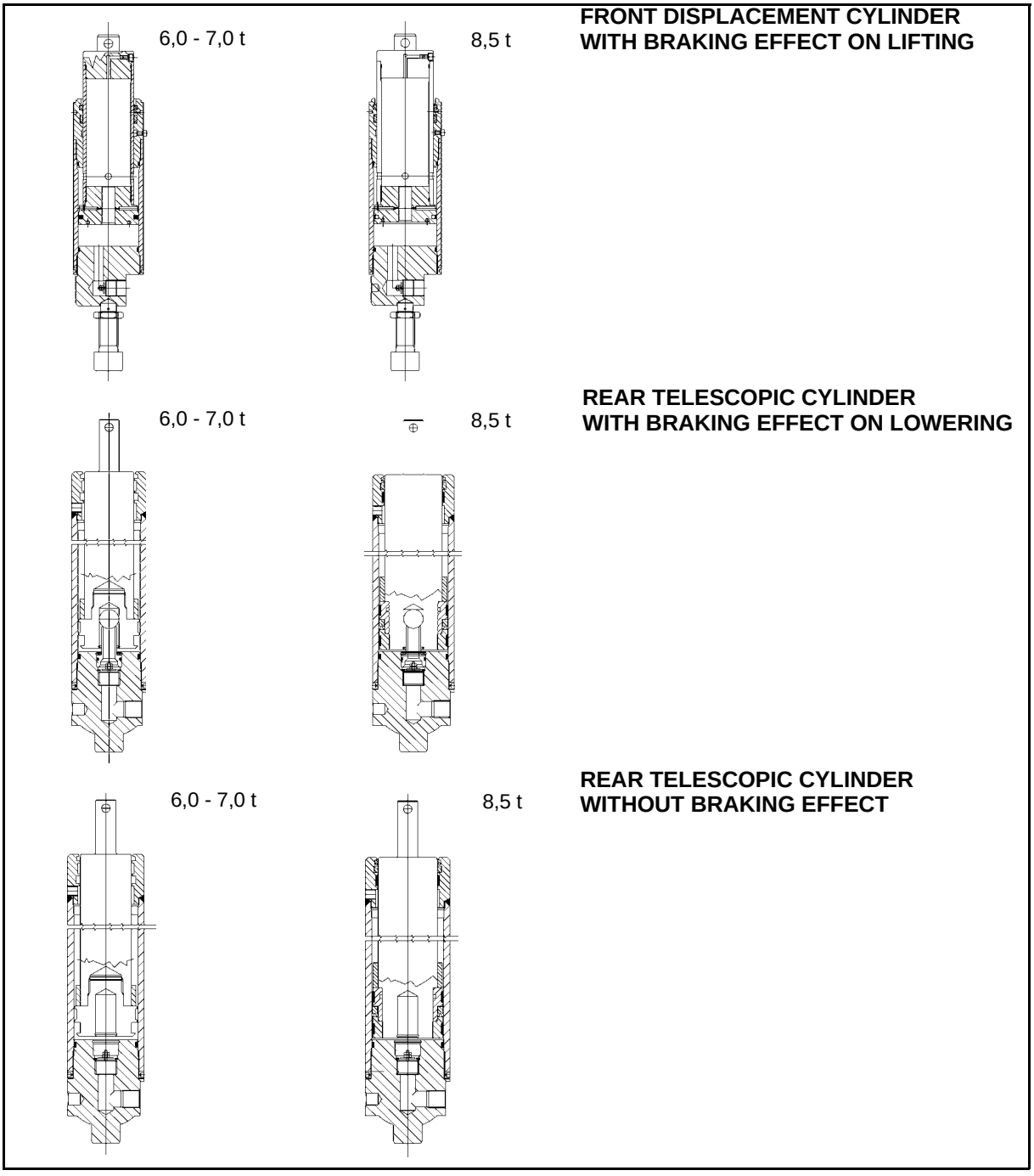
These cylinders are fitted with a seal on the piston that works on the inner surface of the cylinder liner.
The rod guide is made by the top cap and by the piston through anti-friction rings.
The dust control ring prevents any dirty and water to penetrate into the cylinder.

Lifting phase:
By operating on the control valve with the lifting lever, the oil flows to the cylinder through the oil inlet. Through this channels the oil fills the chamber A until the internal pressure of the oil exerts an upward thrust against the surface X thereby stem extraction.

Lowering phase:
Opening the supply circuit (oil inlet) allows the stem to come down so that the oil can return to the tank via the control valve.

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DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Remove the cylinder cup (upper side)
2. Remove the cylinder rod guide
3. Remove the piston rod
4. Remove the seals on the piston rod
5. Remove the cylinder cup (botton side)
6. Remove the brake system (bushing brake body)
7. Remove the parachute valve (safety down valve)
8. Remove the cylinder

Reassembly Procedure

The reassambly procedure is the reverse of the removal procedure.

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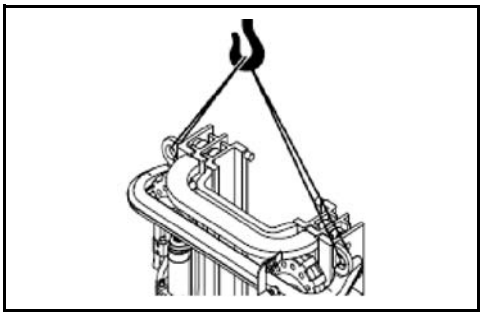
TILTING CYLINDER

DISASSEMBLY • REASSEMBLY



Disassembly Procedure

1. Park the truck on a level surface and apply the parking brake
2. Set the mast in vertical position
3. Switch off the truck
4. Open the compartment and disconnect the battery
5. Remove the footboard
6. Disconnect the hoses
7. Remove the tilting cylinder front pin
8. Remove the tilting cylinder rear pin
9. Remove the tilting cylinder.



Note:
If both tilting cylinders are removed, fix the mast with a chain in order to avoid the mast overturning.

Reassembly Procedure

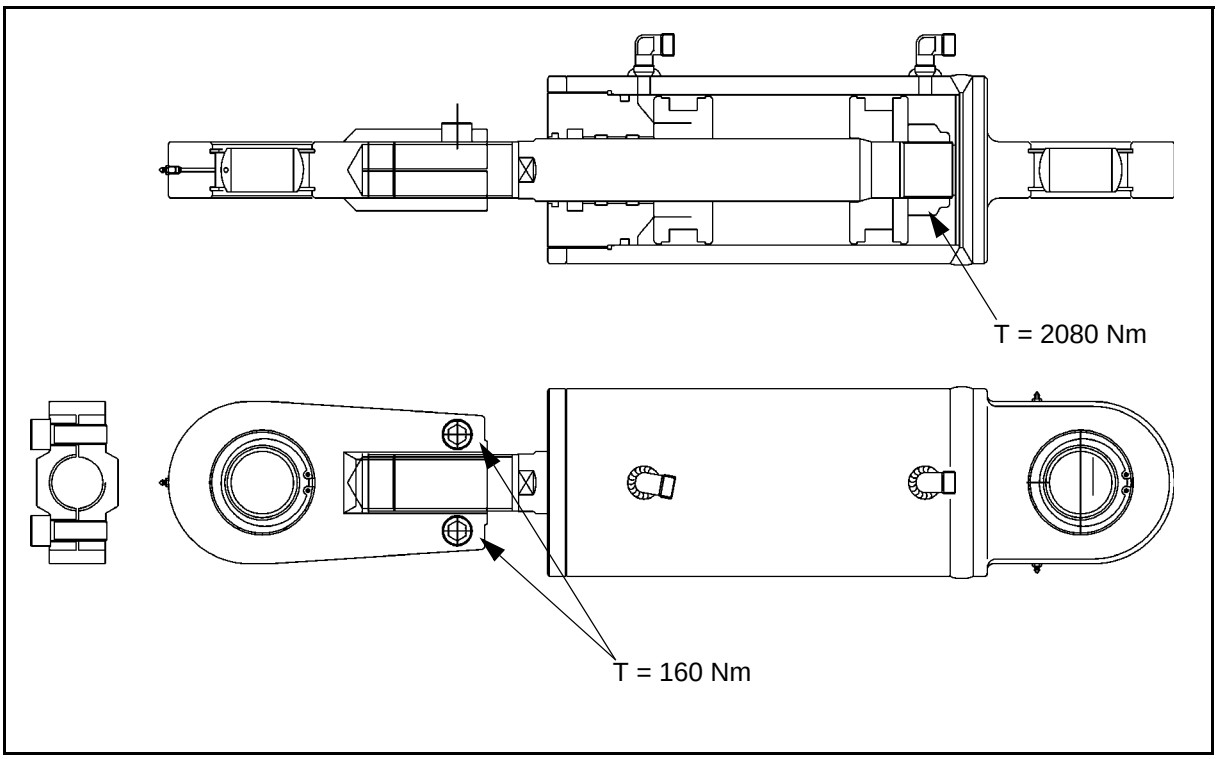
The reassembly procedure is the reverse of the removal procedure.

Notes:

- **Before installation apply grease to the insertion portions of the cylinder front and rear pins .**
- **Don't tilt the mast backward maximum before adjust the mast tilt angle.**
- **Check the hydraulic oil level and add if insufficient.**
- **After the installation, tilt slowly the mast forward and backward a few times without charge to bleed the air in the hydraulic circuit and to check the normal functioning.**
- **Adjust the mast forward and backward tilting angle (to prevent uneven tilting) when the tilting cylinder and mast are replaced or disassembled**

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DISASSEMBLY • INSPECTION • REASSEMBLY



Disassembly Procedure

1. Remove the rod connection.
2. Loosen the rod guide
3. Extract the piston rod W/piston.
4. Loosen the piston nuts.
5. Inspect the cylinder **[Point 1]**
6. Inspect the piston rod **[Point 2]**

Reassembly Procedure

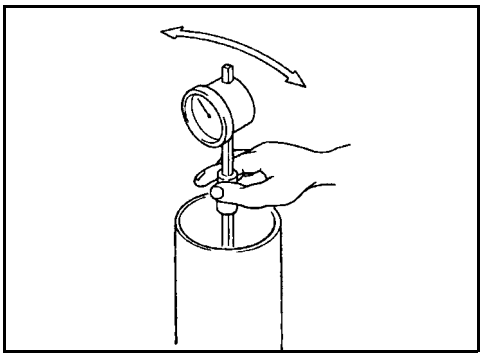
The installation procedure is the reverse of the removal procedure.

Note:

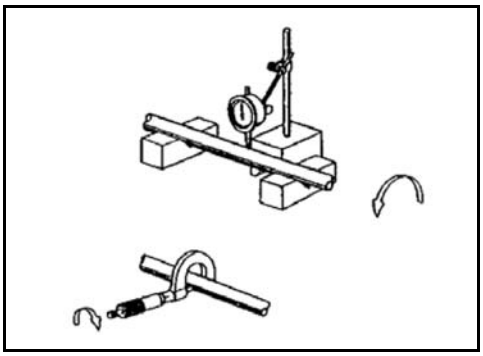
- **Apply hydraulic oil to packings, O-rings and dust seal lips.**
- **Apply antioxidant on rod eye threads.**
- **Replace the piston nut after every removal procedure.**

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Point Operations



[Point 1]
Inspection:
Measure the cylinder bore.
Standard: 120 mm
Limit: 120,087 mm



[Point 2]
Inspection:
Measure the piston rod outside diameter.
Standard: 50.0 mm
Limit: 50,05 mm

Inspection:
Measure the bend of the piston rod.
Limit: 0.2 mm

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SERVICE PUMPS

SERVICE PUMPS 3
GENERAL 3
SPECIFICATIONS 3
TEST METHOD 5
PERFORMANCE TABLE 5
COMPONENTS 6

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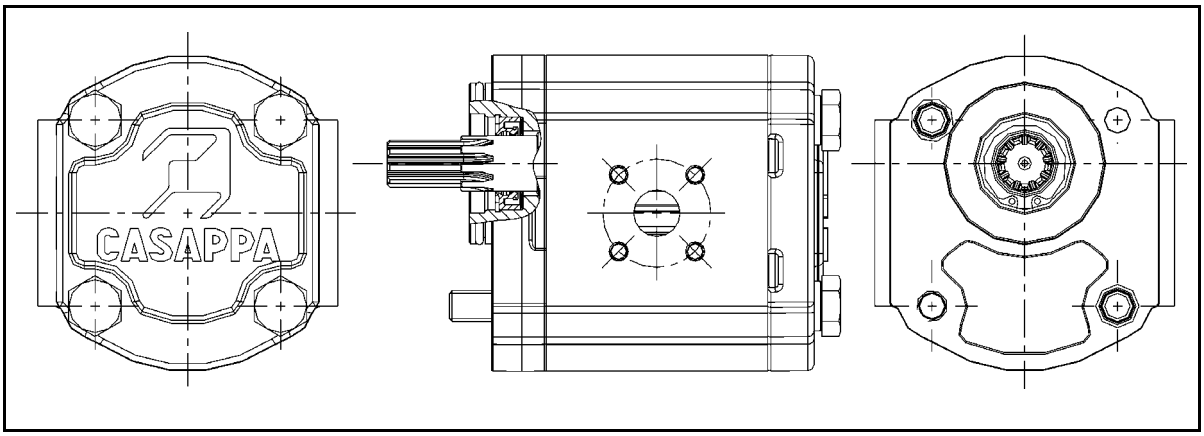
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SERVICE PUMPS

GENERAL

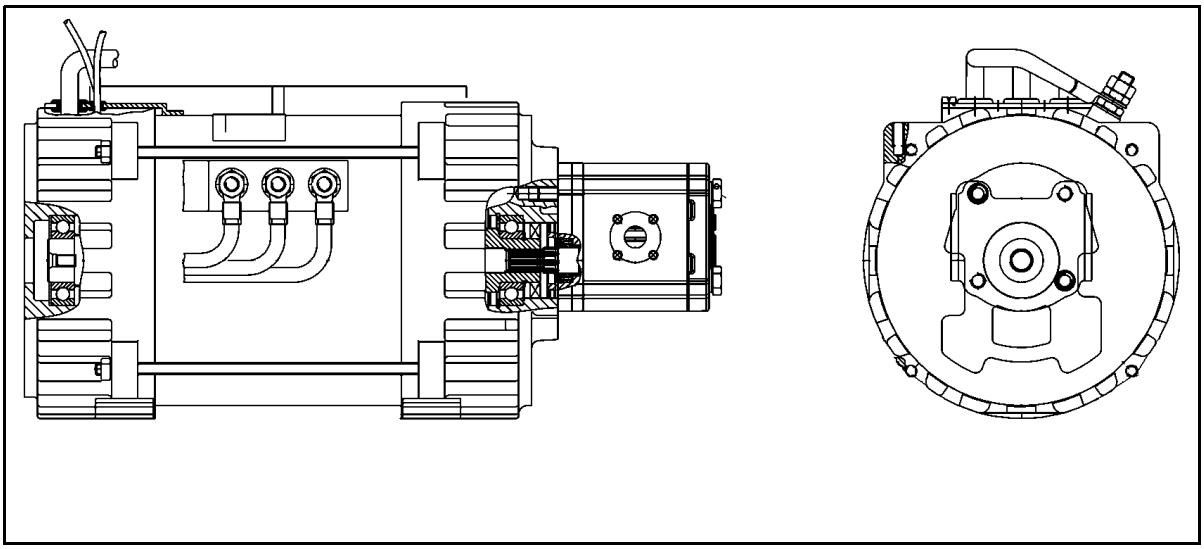


SPECIFICATIONS

Vehicle model		6,0 - 7,0 - 8,5 t
Oil pump name		Gear pump
Oil pump model		WSP 20.18
Transmission		Direct motor drive
Capacity (at 1000 rpm)	ℓ/m	19,37
Theoretical displacement	cm^3	19,376

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DISASSEMBLY • REASSEMBLY

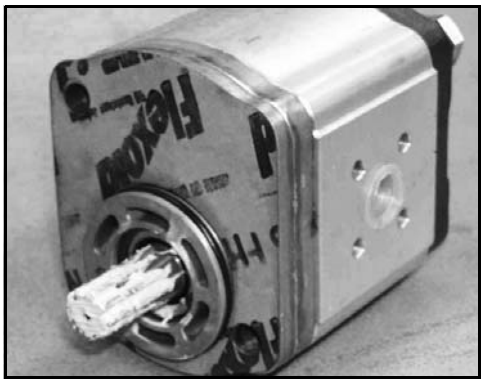


Disassembly procedure

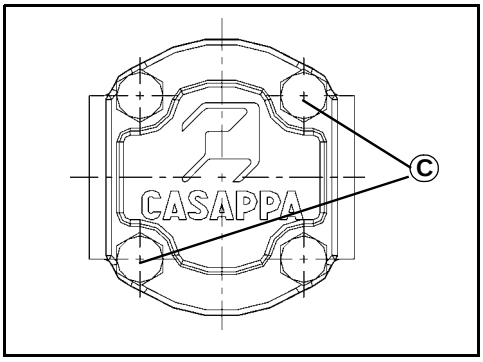
1 Park the truck on a level surface and activate the parking brake
2 Switch off the truck
3 Open the battery cover and disconnect the battery
4 Remove the footboard
5 Empty the oil tank (see chapter 11f)
6 Remove the left and / or the right panel
7 Disconnect the delivery and suction pipes from the pump
8 Remove the pump fixing bolts **[Point 1]**

Reassembly procedure

The reassembly procedure is the reverse of the disassembly procedure.



Note:
Before the assembly, grease the pump-motor coupling with CASTROL OPTIMOL T WHITE paste type. Always, before the assemblage, clean the flange of interface between pump and motor



Point Operations

[Point 1]

Disassembly:
Remove the 2 pump fixing bolts **(C)**
Reassembly:
After installation, tightening torque for pump fixing bolts = **45 Nm**

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TEST METHOD

For strict testing, a bench test should be performed, but it is generally impossible in service operation, so, the pump performance can be judged, with the pump installed on the truck, by cylinder operation.

- Verify that the battery charge is sufficient by observing the battery charge indicators.
- Check that the oil control valve set relief pressure is as specified.

Lift relief pressure = 250 bar

- Perform all measures with the hydraulic oil temperature at 50 to 55 °C. Calculate the lifting speed. However, caused by lifting logic unit soft start, the lifting speed is 10 to 20 mm/sec lower than the table value. Calculate the lifting speed more accurately measuring the full stroke time excluding the start.

The lifting speed depends by different conditions: battery status, hydraulic oil temperature and mast adjustment. The values below are refered to certain conditions.

PERFORMANCE TABLE

LIFTING

Q1 MAX LOAD
Q2 MAX LOAD MAX HIGT
Perform the test with the electrolyte density from 1,18 to1,26 kg\l and electrolytetemperature from 20° C to 50° C

6.0 t

Load	FFL						TV					
Kg	m/sec		amp		bar		m/sec		amp		bar	
0	0,35	0,37	max	165	max	35	0,40	0,42	max	227	max	62
Q1	0,28	0,30	max	481	max	151	0,30	0,32	max	536	max	190
Lowering												
Q1	max	0,48					max	0,60				
Lifting end stoke (max. pressure valve adjustment)									max	654	max	220

7.0 t

Load	FFL						TV					
Kg	m/sec		amp		bar		m/sec		amp		bar	
0	0,34	0,36	max	189	max	44	0,39	0,41	max	257	max	85
Q1	0,25	0,27	max	510	max	170	0,25	0,27	max	568	max	205
Lowering												
Q1	max	0,43					max	0,49				
Lifting end stoke (max. pressure valve adjustment)									max	711	max	255

8.5 t

Load	FFL						TV					
Kg	m/sec		amp		bar		m/sec		amp		bar	
0	0,26	028	max	155	max	35	0,30	0,32	max	173	max	55
Q1	0,22	0,24	max	490	max	175	0,22	0,24	max	530	max	202
Lowering												
Q1	max	0,30					max	0,44				
Lifting end stoke (max. pressure valve adjustment)									max	601	max	255

TILTING

Test to be done at 1m. height with Q1 charge
Perform the test with the electrolyte density from 1,18 to1,26 kg\l and electrolytetemperature from 20° C to 50° C

STD. Tilt 5° FW 10°BW (standard)

	sec		amp		bar	
BW-FW	6,2	7,5	max	120	max	75
FW-BW	5,0	6,2	max	220	max	145

STD. Tilt 5° FW. 8°BW. (optional)

	sec		amp		bar	
BW-FW	5,0	6,0	max	120	max	75
FW-BW	4,0	5,0	max	220	max	145

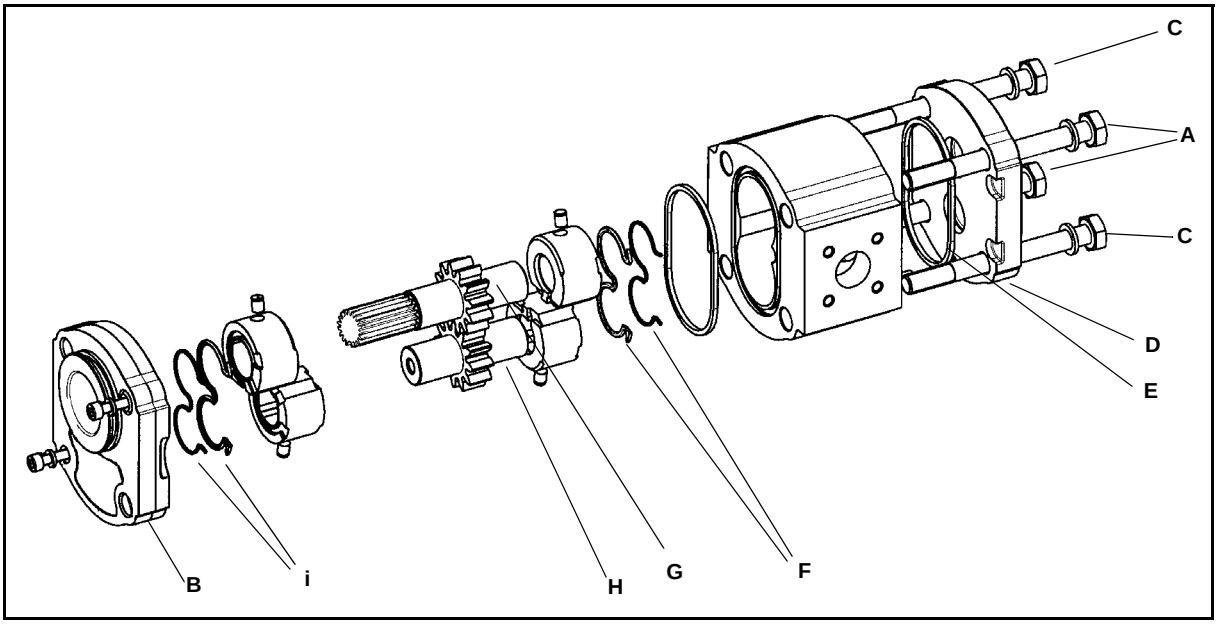
STD. Tilt 5° FW. 6°BW. (optional)

	sec		amp		bar	
BW-FW	3,7	4,5	max	120	max	75
FW-BW	3,0	3,7	max	220	max	145
Tilting end stroke			max	---	max	255

STD sideshift visible check

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COMPONENTS



DISASSEMBLY • REASSEMBLY

Disassembly Procedure

1. Remove the 2 **(A)** pump fixing bolts and remove the oil pump
2. Place the front cover **(B)** face downward, and remove the 2 **(C)** bolts
3. Remove the **(D)** rear cover, **(E)** gasket and the **(F)** figure 3 gasket first group
4. Remove the drive gear, driven gear and side plate. **[Point 3]**
5. Remove the **(G)** driver gear, the **(H)**driven gear and side plate. **[Point 4]**
6. Remove the and the **(I)** figure 3 gasket second group

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.

Note:

- **Wash each parts, blow compressed air and apply hydraulic oil before installation.**
- **Always use new seals for reassembly.**

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OIL CONTROL VALVE

OIL CONTROL VALVE 3
GENERAL 3
PERFORMANCE TABLE 7
COMPONENTS 8
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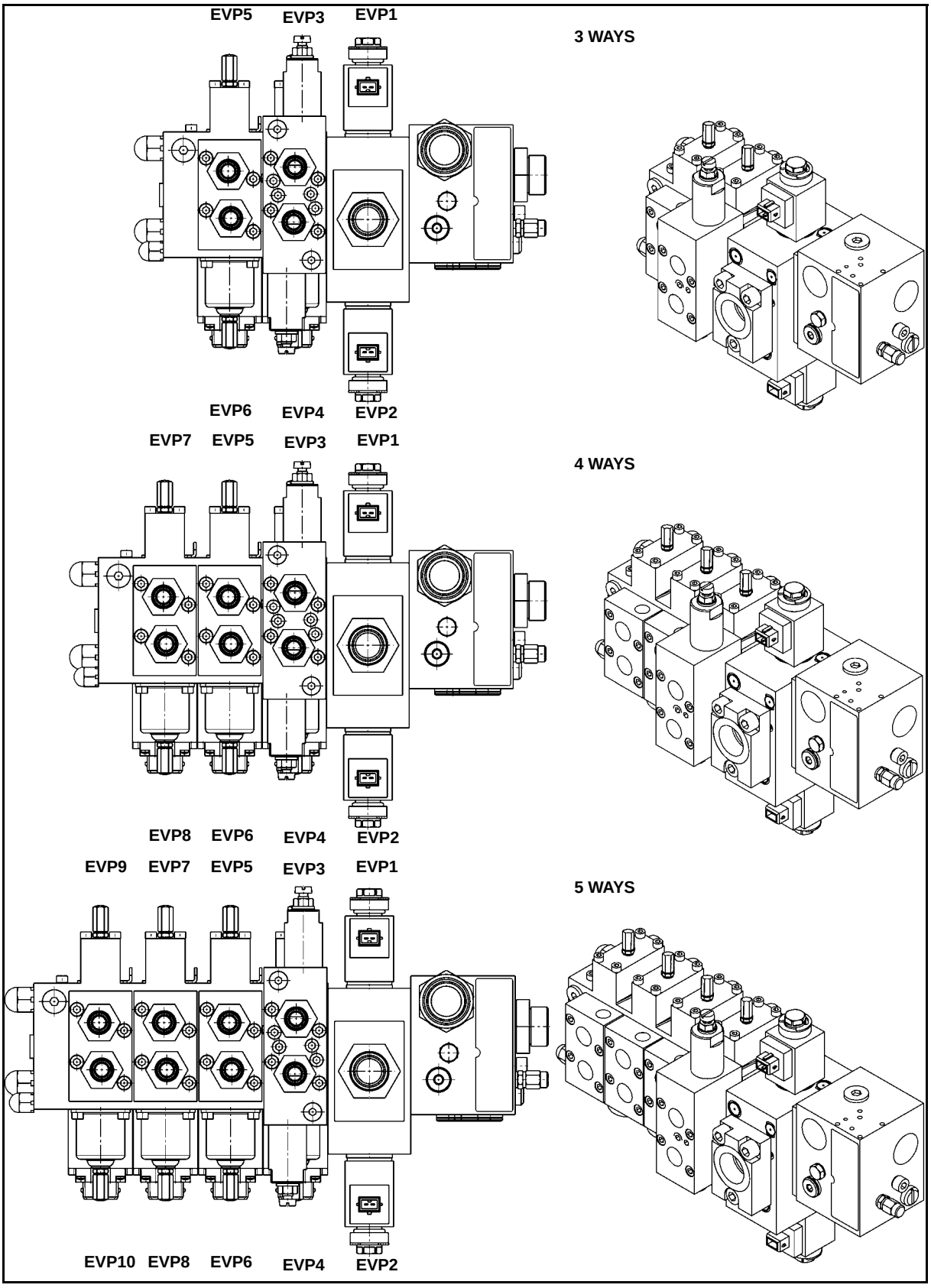
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OIL CONTROL VALVE

GENERAL

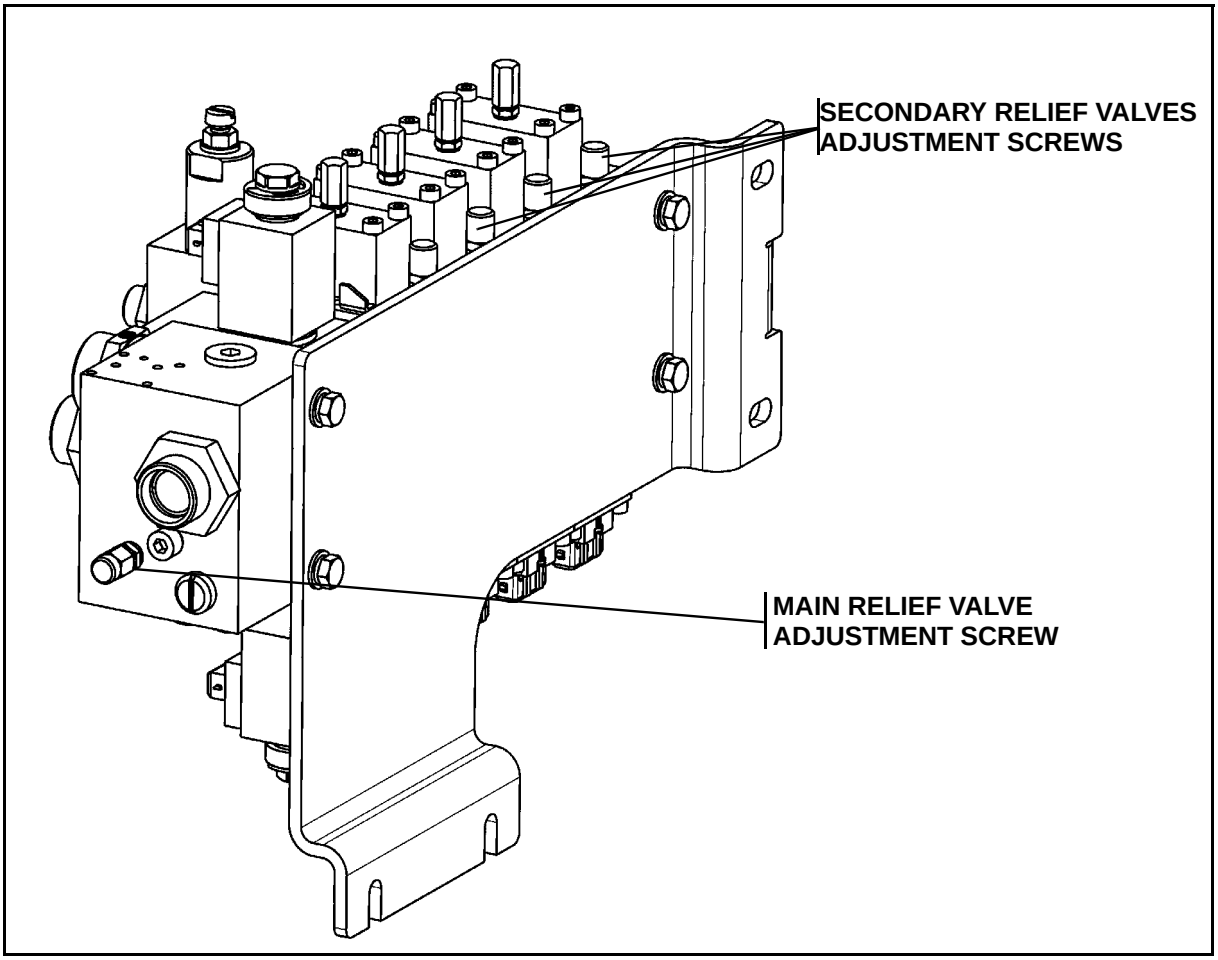


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Valve	Function	Value in ohms of the coils	Voltage on the coils
EVP1	Lifting	19,2 ohm	0÷24 V
EVP2	Lowering	19,2 ohm	0÷24 V
EVP3	Backward tilting	26,6 ohm	0÷24 V
EVP4	Forward tilting	26,6 ohm	0÷24 V
EVP5	Left sideshift	26,6 ohm	0÷24 V
EVP6	Right sideshift	26,6 ohm	0÷24 V
EVP7	4th way	26,6 ohm	0÷24 V
EVP8	4th way	26,6 ohm	0÷24 V
EVP9	5th way	26,6 ohm	0÷24 V
EVP10	5th way	26,6 ohm	0÷24 V

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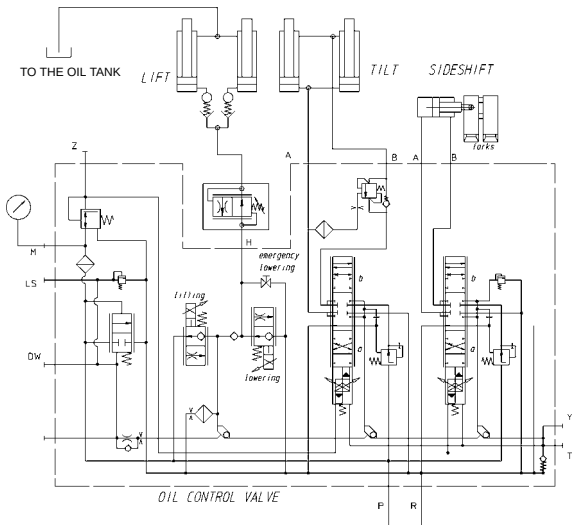
RELIEF VALVES ADJUSTMENT SCREW



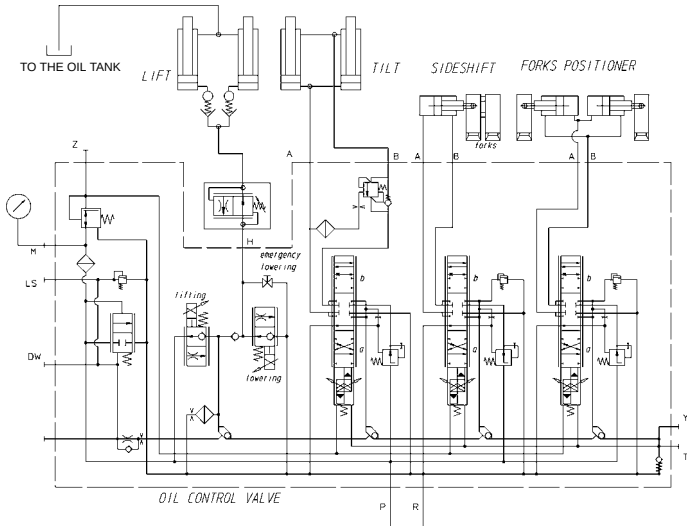
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HYDRAULIC CIRCUIT DIAGRAM

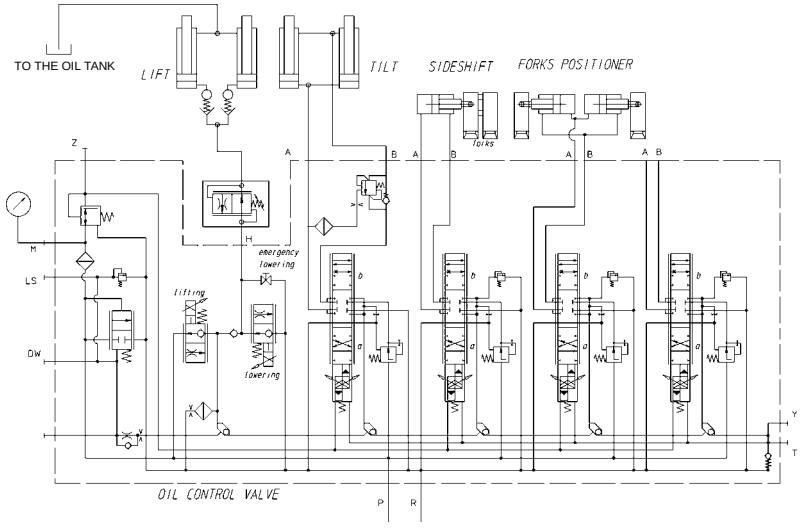
3 WAYS



4 WAYS



5 WAYS



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PERFORMANCE TABLE

LIFTING

Q1 MAX LOAD
Q2 MAX LOAD MAX HIGT
Perform the test with the electrolyte density from 1,18 to1,26 kg\l and electrolytetemperature from 20° C to 50° C

6.0 t

Load	FFL						TV					
Kg	m/sec		amp		bar		m/sec		amp		bar	
0	0,35	0,37	max	165	max	35	0,40	0,42	max	227	max	62
Q1	0,28	0,30	max	481	max	151	0,30	0,32	max	536	max	190
Lowering												
Q1	max	0,48					max	0,60				
Lifting end stoke (max. pressure valve adjustment)									max	654	max	220

7.0 t

Load	FFL						TV					
Kg	m/sec		amp		bar		m/sec		amp		bar	
0	0,34	0,36	max	189	max	44	0,39	0,41	max	257	max	85
Q1	0,25	0,27	max	510	max	170	0,25	0,27	max	568	max	205
Lowering												
Q1	max	0,43					max	0,49				
Lifting end stoke (max. pressure valve adjustment)									max	711	max	255

8.5 t

Load	FFL						TV					
Kg	m/sec		amp		bar		m/sec		amp		bar	
0	0,26	028	max	155	max	35	0,30	0,32	max	173	max	55
Q1	0,22	0,24	max	490	max	175	0,22	0,24	max	530	max	202
Lowering												
Q1	max	0,30					max	0,44				
Lifting end stoke (max. pressure valve adjustment)									max	601	max	255

TILTING

Test to be done at 1m. height with Q1 charge
Perform the test with the electrolyte density from 1,18 to1,26 kg\l and electrolytetemperature from 20° C to 50° C

STD. Tilt 5° FW 10°BW (standard)

	sec		amp		bar	
BW-FW	6,2	7,5	max	120	max	75
FW-BW	5,0	6,2	max	220	max	145

STD. Tilt 5° FW. 8°BW. (optional)

	sec		amp		bar	
BW-FW	5,0	6,0	max	120	max	75
FW-BW	4,0	5,0	max	220	max	145

STD. Tilt 5° FW. 6°BW. (optional)

	sec		amp		bar	
BW-FW	3,7	4,5	max	120	max	75
FW-BW	3,0	3,7	max	220	max	145
Tilting end stroke			max	---	max	255

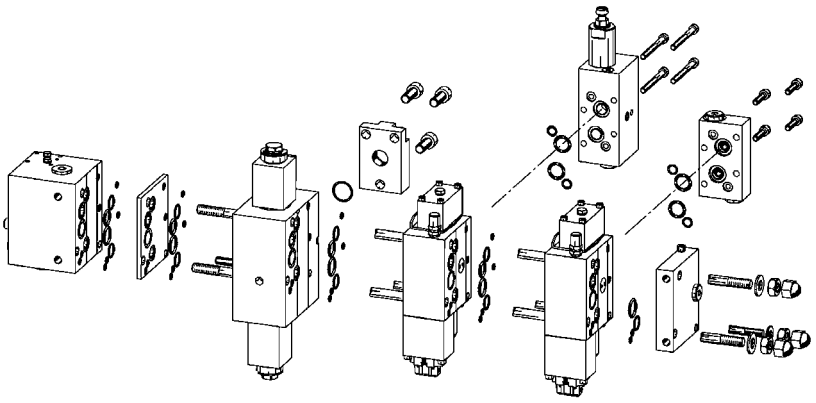
STD sideshift visible check

WARNING:
The installation of a hydraulic control valve finalized to operate a clamp (for example a paper roll) implicates an obligatory application of a double command device avoiding the risk of accidental release of the load (ISO 3691-1, 5.4.4.1).

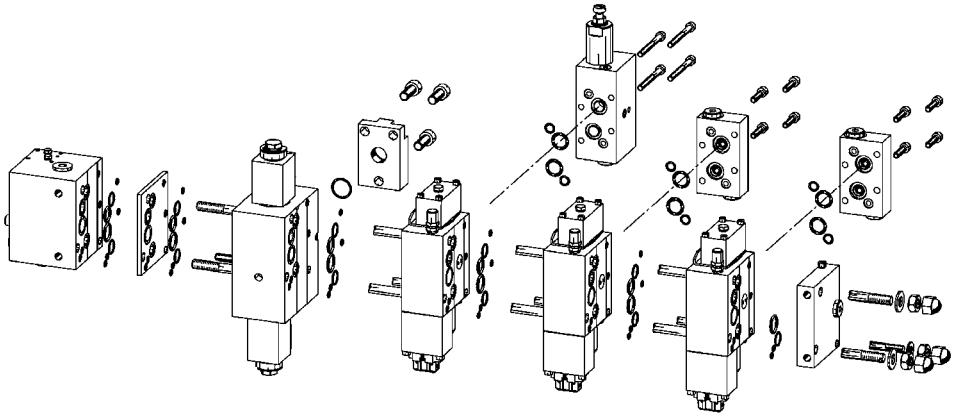
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COMPONENTS

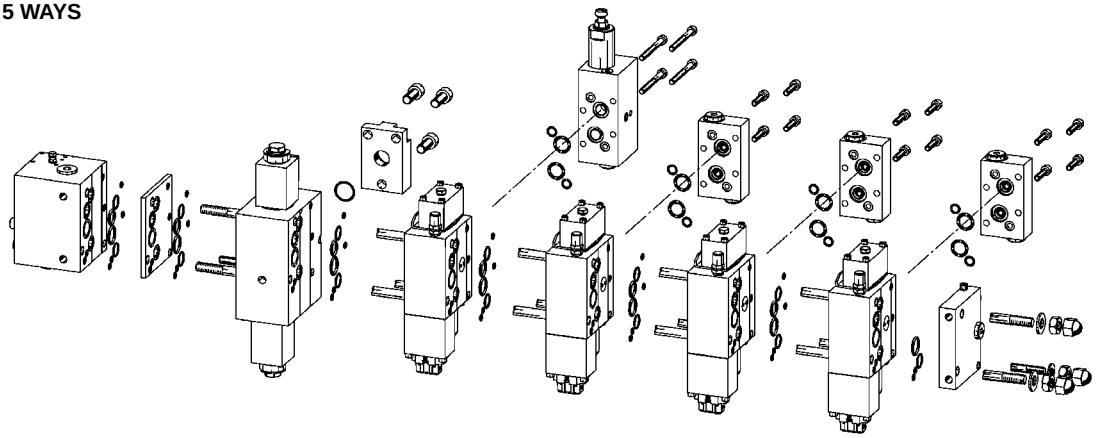
3 WAYS



4 WAYS



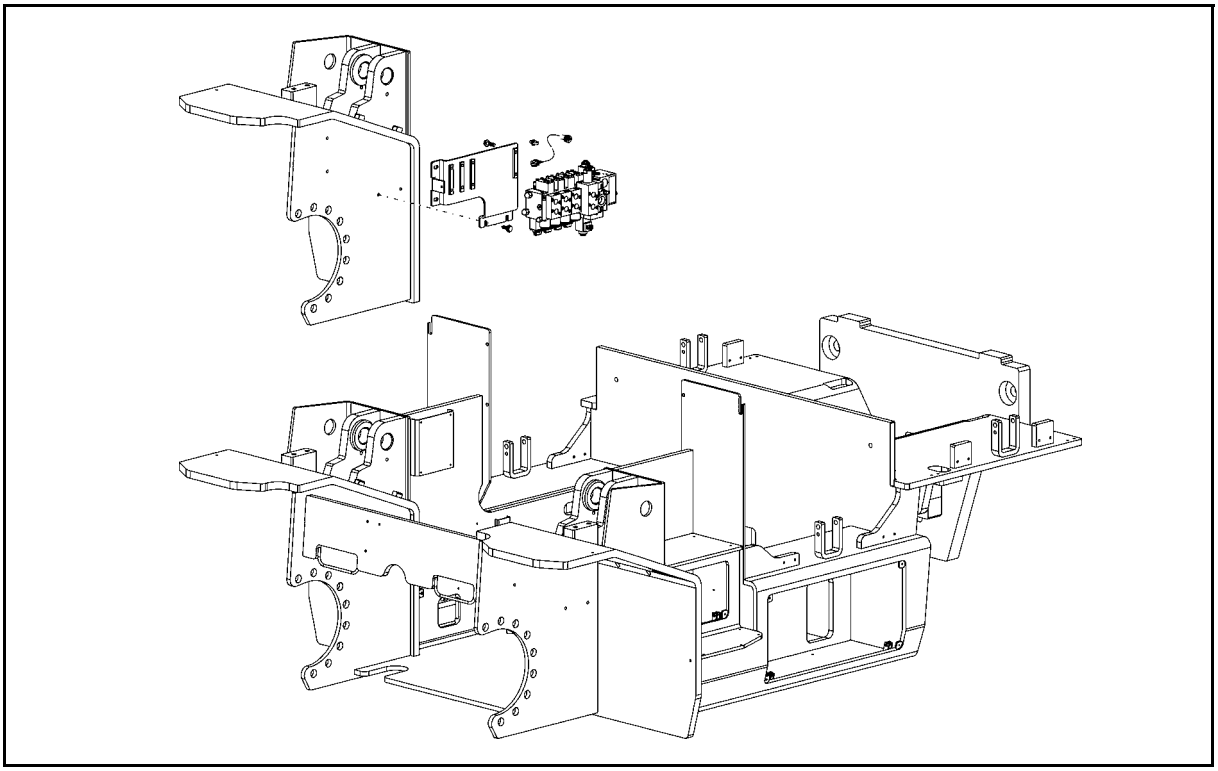
5 WAYS



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DISASSEMBLY · REASSEMBLY

Note:
Operate the control lever to bring the mast and fork to the vertical and lowermost positions, respectively, to release the residual pressure in the material handling system before starting removal.



Disassembly Procedure

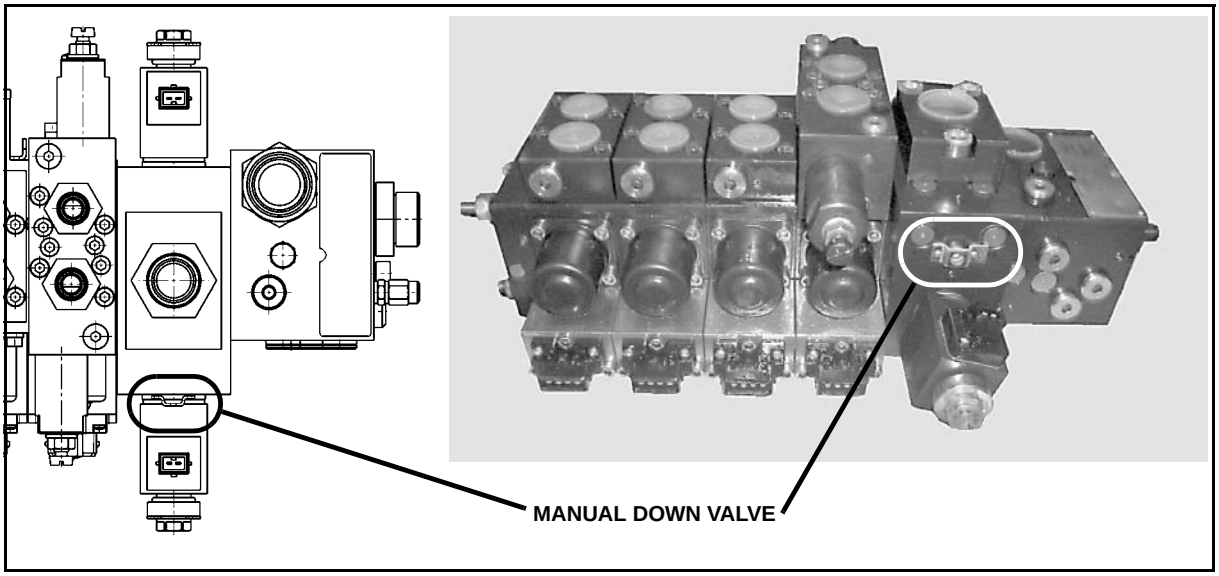
1. Park the truck on a level surface
2. Set the mast in vertical position and lower fully the mast to reach the lowest pressure.
3. Switch off the truck
4. Open the front battery cover and disconnect the battery plugs
5. Remove the footboard
6. Empty the oil circuit
7. Disconnect the hoses.
8. Sling the oil control valve bracket by belts.
9. Unscrew the oil control valve support fixing bolts .
10. Remove the oil control valve with its support.

Reassembly Procedure

The reassembly procedure is the reverse of the disassembly procedure.
Note:
Check the hydraulic oil level, and add if insufficient.

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MANUAL DOWN VALVE



If the forks do not descend due to a malfunction or other cause, loosen the manual down valve to lower the forks in emergencies.
When loosening the manual down valve, do not rotate it more than one full turn.
After making repairs, tighten it securely.

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APPENDIX

AUXILIARY WIRING HARNESS 3
CONNECTORS 4
ELECTRIC DIAGRAMS 6
LIGHTS EQUIPMENT ELECTRIC DIAGRAM 12
WORKING LAMPS ELECTRIC DIAGRAM 13
FLASH / ROTATING BEACON ELECTRIC DIAGRAM 14
REAR WINDOW HEATER ELECTRIC DIAGRAM 14
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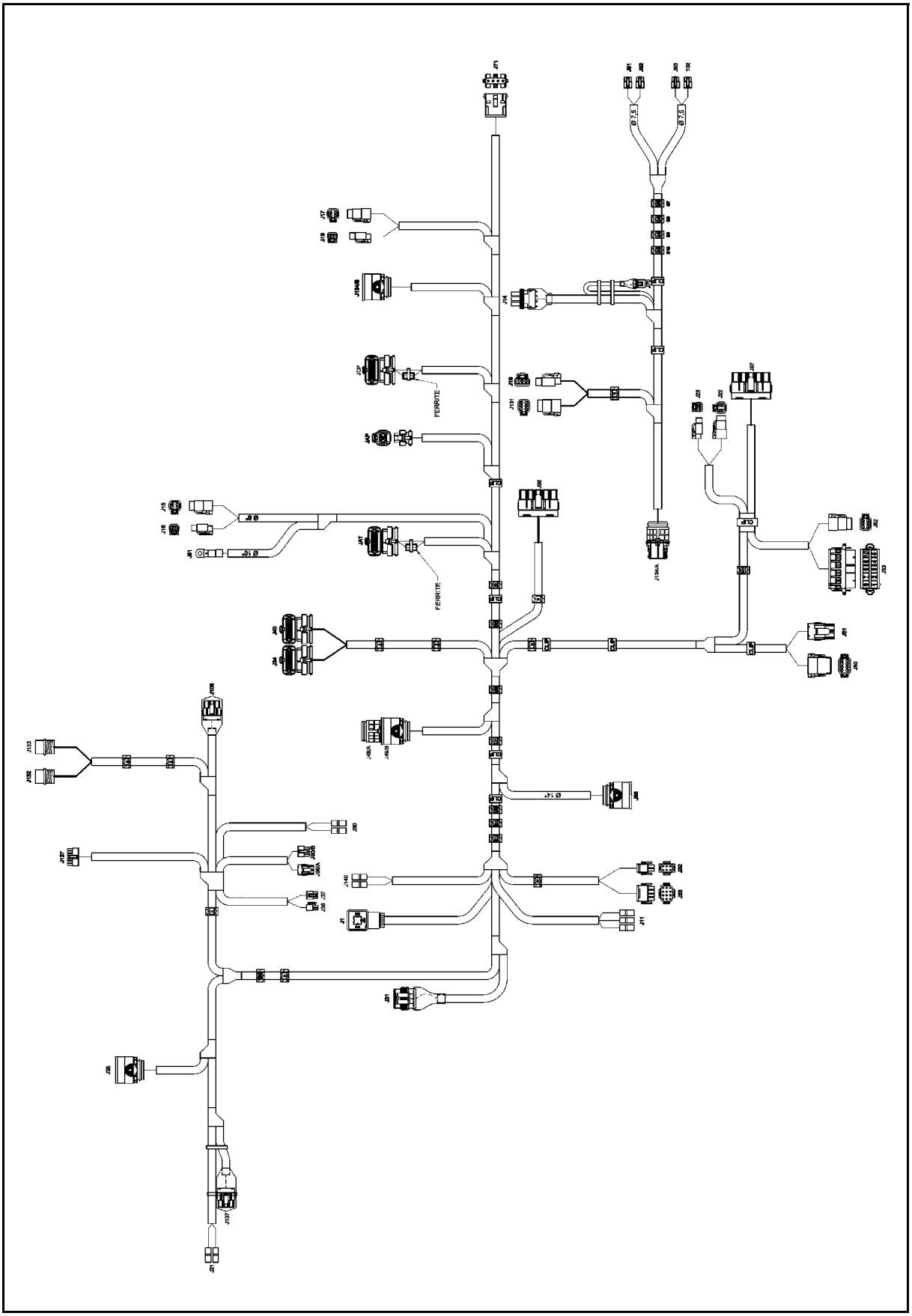
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AUXILIARY WIRING HARNESS



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CONNECTORS

J1 — 36 — BRAKE SOLENOID VALVE

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	0.50	01			S2		+V SUPPLY
2	A	0.50				JAT	28	GND
⏚								

J11 — HORN

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
-	N	0.50			37-39	S4		GND
IN	A	0.50	3		37-39	J35	3	CONTROL INPUT
+	C	0.50	03		37-39	S6		+V

J14 — 22-10 — STEER POTENTIOMETER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
A	S	0.50	6		23-24	J134/A	6	C POT
B	S	0.50	5		23-24	J134/A	7	GND POT
C	S	0.50			23-24	J134/A	8	+V POT

J15 — 62-63 — ENCODER TRACTION MOTOR

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	9		64	JAT	1	+ V SUPPLY
2	B	0.50	12		64	JAT	2	GND
3	B	0.50	10		64	JAT	14	B PHASE SIGNAL
4	B	0.50	11		64	JAT	13	A PHASE SIGNAL

J16 — 60-61 — TEMPERATURE SENSOR TRACTION MOTOR

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	13		64	JAT	24	GND
2	B	0.50	14		64	JAT	25	+ V SUPPLY

J17 — 62-63 — ENCODER LEFT PUMP MOTOR

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	15		64	JCP	1	+ V SUPPLY
2	B	0.50	16		64	JCP	14	B PHASE SIGNAL
3	B	0.50	17		64	JCP	13	A PHASE SIGNAL
4	B	0.50	18		64	JCP	2	GND

J18 — 60-61 — TEMPERATURE SENSOR LEFT PUMP MOTOR

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	19		64	JCP	24	GND
2	B	0.50	20		64	JCP	25	+ V SUPPLY

J19 — 66-67 — SEAT

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	S	0.50	2		74	J134/A	9	CM
2	S	0.50	10		74	J134/A	10	NC SEAT SW
3	S	0.50	1		74	J134/A	11	NO SEAT SW

J21 — EMERGENCY PUSH BUTTON

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
	M	1.00	01		38-39	J52	3	IN
	M	1.00	02		38-39	J35	14	OUT

J22 — 62-63 — ENCODER RIGHT PUMP MOTOR

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	23		64	JCP	11	+ V SUPPLY
2	B	0.50	24		64	JCP	23	B PHASE SIGNAL
3	B	0.50	25		64	JCP	22	A PHASE SIGNAL
4	B	0.50	26		64	JCP	12	GND

J23 — 60-61 — TEMPERATURE SENSOR RIGHT PUMP MOTOR

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	22		64	JCP	34	GND
2	B	0.50	21		64	JCP	35	+ V SUPPLY

J30 — PARKING BRAKE SWITCH

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
	N	0.50	1		37-39	S23		GND
	A	0.50	2		37-39	J34	9	PARKING BRAKE PEDAL

J31 — 31-32 — BRAKE PEDAL SWITCH

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1					35			
2	N	0.50	1		33-34	S23		GND
3					35			
4	A	0.50	1		33-34	J34	8	BRAKE PEDAL SIGNAL

J32 — 46-49-51 — ACCELERATOR PEDAL SYSTEM

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	V	0.50	1		55	J34	25	C ACC POT
2	V	0.50	2		55	J34	28	GND ACC POT
3	V	0.50	3		55	J34	30	+V ACC POT
4	N	0.50	1		55	S23		GND
5	V	0.50	5		55	J34	2	EN
6	V	0.50	6		55	J34	3	/EN

J33 — 47-50-52 — DIRECTION PEDAL SYSTEM

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	N	0.50	1		55	S23		GND
2	B	0.50	1		55	S11		FW
3	B	0.50	2		55	J34	5	/FW
4	N	0.50	1		55	S23		GND
5	B	0.50	3		55	J34	1	CONFIG.
6					56			
7	N	0.50	1		55	S23		GND
8	B	0.50	4		55	S12		BW
9	B	0.50	5		55	J34	7	/BW
10					56			
11					56			
12					56			

J35 — 26 — STEERING COLUMN

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	M	1.00	03		27	S1		+VBATT OUT KEY
2	B	0.50	4		29	S12		BW
3	A	0.50	3		29	J11	IN	DRIVE HORN
4	C	0.50	03		29	S6		+ 24V
5	A	0.50	11		29	J137	13	GND
6	N	0.50	1		29	S23		GND
7	B	0.50	1		29	S11		FW
8					65			
9					65			
10					65			
11					65			
12					65			
13					65			
14	M	1.00	02		27	J21		+ VBATT OUT PS1

J36 — 12 — L-P-H

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	N	0.50	1		16	S23		
2	A	0.50	9		16	J137	5	

J37 — 13 — SPEED REDUCTION

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	N	0.50	1		16	S23		
2								
3	A	0.50	8		16	J137	4	

J49/A — 28-30 — SEAL PLUG

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1					65			
2					65			
3					65			
4					65			
5					65			
6					65			
7					65			
8					65			
9					65			
10					65			
11					65			
12					65			
13					65			
14					65			

J49/B — 26 — OPTIONAL DEVICE

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1					65			
2	V	0.50	7		29	J40	15	IN PRESSURE SENSOR
3	V	0.50	8		29	J40	24	+V PRESSURE SENSOR
4	V	0.50	9		29	J40	26	GND PRESSURE SENSOR
5	S	0.50	4		29	J34	34	N.O. SW MAST HEIGHT
6	S	0.50	3		29	J34	33	N.C. SW MAST HEIGHT
7	V	0.50	10		29	J34	31	GNG LIFT+TILT POT
8	V	0.50	11		29	J34	29	+V LIFT+TILT POT
9	V	0.50	4		29	J34	24	C TILT POT
10	N	0.50	1		29	S23		GND
11	S	0.50	12		29	JAT	6	N.O. MAST LOW SW
12	S	0.50	13		29	JAT	7	N.C. MAST LOW SW
13	S	0.50	11		29	JAT	30	IN MAST LOW SWITCH
14					65			

J50 — 70-71 — CONTACTORS

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	M	1.00			74	J52	1	+ VBATT
2	R	1.00			74	J52	2	+ VBATT OUT CT1
3	M	0.50	03		74	S1		+ VBATT OUT KEY
4	N	0.50			74	S21		- V KEY CONTACTOR COIL
5	L	0.50	2		74	JAT	26	V TRACTION CONTACTOR COIL
6	R	0.50	01		74	S2		+ VBATT OUT F2
7	L	0.50	3		74	JCP	26	- V PUMP CONTACTOR COIL
8	B	0.50	29		74	JCP	27	+ V PUMP CONTACTOR COIL

J51 — 17 — CONTACTORS

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	4.00			21	J53	2	+ VBATT OUT CT1
2	R	2.50			20	J53	1	+ VBATT OUT CT1

J52 — 68-69 — + 80V FUSES

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	M	1.00			74	J50	1	+ VBATT
2	R	1.00			74	J50	2	+ VBATT OUT CT1
3	M	1.00	01		74	J21		+V BATT OUT F1
4	R	1.00	01		74	S2		+ VBATT OUT F2
5	C	1.00	02		74	J71	2	+ 24V OUT F6
6					75			

J53 — 19-25 — + 80V FUSES

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	2.50			20	J51	2	+ VBATT OUT CT1
2	R	4.00			21	J51	1	+ VBATT OUT CT1
3	R	2.50	02		20	S24		+ VBATT OUT F3
4	R	4.00	03		21	S3		+ VBATT OUT F4
5	C	2.50			20	J96	4	+ 24V
6	C	6.00	05		21	J90/A	1	+24V OUT F8
7	C	6.00	04		21	J97	4	+24V IN F8
8	C	1.50	01		20	S5		+ 24V OUT F5
9	C	1.50	03		20	S6		+ 24V OUT F7
10								

J56 — 101 — SOLENOID CONTROL VALVE

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	G	0.50	2		29	J40	1	EVP1 LOWERING
2	G	0.50	3		29	J40	2	EVP2 LIFTING
3	G	0.50	1		29	J40	3	+V EVP1-EVP2
4	G	0.50	5		29	J40	4	EVP3 TILT BW
5	G	0.50	6		29	J40	5	EVP4 TILT FW
6	G	0.50	4		29	J40	6	+V EVP3-EVP4
7	G	0.50	8		29	J40	7	EVP5 LEFT SIDESHIFT
8	G	0.50	9		29	J40	8	EVP6 LEFT SIDESHIFT
9	G	0.50	7		29	J40	9	+V EVP5-EVP6
10	G	0.50	11		29	J40	10	EVP7 4 TH
11	G	0.50	12		29	J40	11	EVP8 4 TH
12	G	0.50	10		29	J40	12	+V EVP7-EVP8
13	G	0.50	14		29	J40	32	GND EVP9 5TH
14	G	0.50	13		29	J40	33	+V EVP9 5TH
15	G	0.50	16		29	J40	34	GND EVP10 5TH
16	G	0.50	15		29	J40	35	+V EVP10 5TH

J70 — 96-97-98 — BACKING BUZZER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	03		33-34	S7		+ 24V
2	A	0.50	5		33-34	S8		GND

J71 — 45-48 — FAN

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	N	1.00			54	S4		NEGATIVE
2	C	1.00	02		54	J52	5	+V SUPPLY
3	A	0.50	4		53	J40	27	CONTROL INPUT
4					56			

J81 — NEGATIVE

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
	N	4.00			11	S20		
	N	2.50			#	S21		

J90/A — 17 — OPTIONAL FUSES

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	6.00	05		21	J53	6	+ 24V
2	N	6.00			21	J97	5	GND

J90/B — 95 — OPTIONAL FUSES

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	A	1.00	7		100	J40	31	TURN LIGHTS DRIVE
2	B	0.50	6		16	J134/E	4	TAIL LIGHT DRIVE
3	B	0.50	7		16	J134/E	12	LEFT TURN LIGHT
4	B	0.50	8		16	J134/E	13	RIGHT TURN LIGHT
5	C	1.00	03		100	S6		TAIL+TURN LIGHTS
6	N	0.50			16	S22		NEGATIVE
7								
8								

J91 — 14 — LEFT LIGHTING EQUIPMENT

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	03		16	S7		+ 24V
2	A	0.50	6		16	S9		STOP LIGHT
3								STOP LIGHT
4								+ 24V
5	B	0.50	7		16	J134/A	12	LEFT TURN LIGHT
6	B	0.50	6		16	S10		TAIL LIGHT

J92 — 13 — LEFT LIGHTING EQUIPMENT

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	03		16	S7		+ 24V
2	A	0.50	5		16	S8		BACK LIGHT
3								BACK LIGHT

J93 — 13 — RIGHT LIGHTING EQUIPMENT

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	03		16	S7		+ 24V
2	A	0.50	5		16	S8		BACK LIGHT
3								BACK LIGHT

J96 — 18 — DC/DC CONVERTER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	1.50	02		20	S24		+ V BATT
2	N	1.50			20	S21		GND IN
3	N	2.50			20	S4		GND OUT
4	C	2.50			20	J53	5	+24 V
5	N	2.50			20	S4		GND OUT

J97 — 18 — AUX. DC/DC CONVERTER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	1.50	02		20	S24		+ V BATT
2	N	1.50			20	S21		GND IN
3								
4	C	6.00	04		21	J53	7	+24 V
5	N	6.00			21	J90/A	2	GND OUT

J102 — 14 — RIGHT LIGHTING EQUIPMENT

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	03		16	S7		+ 24V
2	A	0.50	6		16	S9		STOP LIGHT
3								
4								+ 24V
5	B	0.50	8		16	J134/A	13	RIGHT TURN LIGHT
6	B	0.50	6		16	S10		TAIL LIGHT

J107 — 107 — SUPPLY LEFT HEATER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	2.50	03		20	S3		+V HEATER
2	N	1.50			20	S20		NEGATIVE
3	N	1.50			20	S20		NEGATIVE

J108 — 107 — SUPPLY RIGHT HEATER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	R	2.50	03		20	S3		+V HEATER
2	N	1.50			20	S20		NEGATIVE
3	N	1.50			20	S20		NEGATIVE

J131 — 68-69 — ARMREST CAN-BUS

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	Z	0.50		TW9	74	J134/A	15	CAN L
2	H	0.50		TW9	74	J134/A	14	CAN H
3	N	0.50			74	S19		NEGATIVE
4	C	0.50	01		74	J134/A	16	+ 24V
5	N	0.50			74	S19		NEGATIVE
6					75			

J132 — 57-59 — +24V / CAN-BUS TAP

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	01		58	S5		+ 24V
2	N	0.50			58	S22		GND
3	H	0.50		TW7	58	S13		CAN H
4	Z	0.50		TW7	58	S14		CAN L

J133 — 57-59 — +24V / CAN-BUS TAP

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	0.50	01		58	S5		+ 24V
2	N	0.50			58	S22		GND
3	H	0.50		TW8	58	S13		CAN H
4	Z	0.50		TW8	58	S14		CAN L

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J137 — 15 — DASHBOARD CAN-BUS

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	H	0.50		TW5	16	S15		CAN H
2	Z	0.50		TW5	16	S16		CAN L
3	N	0.50			16	S22		NEGATIVE (SHIELD)
4	A	0.50	8		16	J37	3	SPEED LIMIT
5	A	0.50	9		16	J36	2	L-P-H
6								
7	C	0.50	01		16	S5		+ 24V
8	H	0.50		TW6	16	S13		CAN H
9	Z	0.50		TW6	16	S14		CAN L
10	S	0.50	8			J140		ACCUMULATOR PRESS. SW
11								
12								DIGITAL INPUT
13	A	0.50	11		16	J35	5	GND OUT BUZZER
14	N	0.50			16	S22		POWER NEGATIVE

J140 — ACCUMULATOR PRESSURE SWITCH

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
	S	0.50	8		37-39	J137	10	
	N	0.50			37-39	S4		

J34 — 40 — I/O CONTROL BOARD

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	3		43	J33	5	CONFIG.
2	V	0.50	5		43	J32	5	EN
3	V	0.50	6		43	J32	6	/EN
4	B	0.50	1		43	S11		FW
5	B	0.50	2		43	J33	3	/FW
6	B	0.50	4		43	S12		BW
7	B	0.50	5		43	J33	9	/BW
8	A	0.50	1		43	J31	4	BRAKE PEDAL
9	A	0.50	2		43	J30		PARKING BRAKE
10					44			
11					44			
12					44			
13					44			
14					44			
15					44			
16					44			
17					44			
18					44			
19	H	0.50		TW2	43	S15		CAN H
20	H	0.50		TW1	43	J134/E	14	CAN H
21	Z	0.50		TW2	43	S16		CAN L
22	Z	0.50		TW1	43	J134/E	15	CAN L
23	N	0.50	1		43	S23		OUT GND
24	V	0.50	4		43	J49/B	9	C TILT POT
25	V	0.50	1		43	J32	1	C ACC POT
26					44			
27					44			
28	V	0.50	2		43	J32	2	GND ACC POT
29	V	0.50	11		43	J49/B	8	+V LIFT+TILT POT
30	V	0.50	3		43	J32	3	+V ACC POT
31	V	0.50	10		43	J49/B	7	GND LIFT+TILT POT
32					44			
33	S	0.50	3		43	J49/B	6	N.C. SW MAST HEIGHT
34	S	0.50	4		43	J49/B	5	N.O. SW MAST HEIGHT
35					44			

J40 — 41 — I/O CONTROL BOARD

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	G	0.50	2		43	J56	1	EVP1 LOWERING
2	G	0.50	3		43	J56	2	EVP2 LIFTING
3	G	0.50	1		43	J56	3	+V EVP1-EVP2
4	G	0.50	5		43	J56	4	EVP3 TILT BW
5	G	0.50	6		43	J56	5	EVP4 TILT FW
6	G	0.50	4		43	J56	6	+V EVP3-EVP4
7	G	0.50	8		43	J56	7	EVP5 LEFT SIDESHIFT
8	G	0.50	9		43	J56	8	EVP6 LEFT SIDESHIFT
9	G	0.50	7		43	J56	9	+V EVP5-EVP6
10	G	0.50	11		43	J56	10	EVP7 4 TH
11	G	0.50	12		43	J56	11	EVP8 4 TH
12	G	0.50	10		43	J56	12	+V EVP7-EVP8
13	C	0.50	01		43	S5		+ 24V SUPPLY
14	N	0.50			43	S4		IN GND
15	V	0.50	7		43	J49/B	2	IN PRESSURE SENSOR
16	C	0.50	01		43	S5		+ V POWER
17	C	0.50	01		43	S5		+ V POWER
18	C	0.50	01		43	S5		+ V POWER
19	N	0.50			43	S4		IN POWER GND
20	N	0.50			43	S4		IN POWER GND
21	N	0.50			43	S4		IN POWER GND
22	N	0.50			43	S4		IN POWER GND
23					44			
24	V	0.50	8		43	J49/B	3	+V PRESSURE SENSOR
25	N	0.50			43	S4		IN GND
26	V	0.50	9		43	J49/B	4	GND PRESSURE SENSOR
27	A	0.50	4		43	J71	3	FAN DRIVE
28	C	0.50	01		43	S5		+ V POWER
29	A	1.00	5		43	J134/E	2	BACK LIGHT
30	A	1.00	6		43	J134/E	3	STOP LIGHT
31	A	1.00	7		43	J90/B	1	TURN LIGHT
32	G	0.50	14		43	J56	13	GND EVP9 5 TH
33	G	0.50	13		43	J56	14	+V EVP9 5 TH
34	G	0.50	16		43	J56	15	GND EVP10 5 TH
35	G	0.50	15		43	J56	16	+V EVP10 5 TH

JAT — 40 — TRACTION MOTOR INVERTER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	9		43	J15	1	+ V ENCODER SUPPLY
2	B	0.50	12		43	J15	2	GND ENCODER
3	S	0.50			43	J134/E	8	+ V STEER POT.
4	S	0.50	1		43	S17	1	SEAT (NO SW)
5	S	0.50	10		43	J134/E	10	SEAT (NC SW)
6	S	0.50	12		43	J49/B	11	MAST (NO LOW SW)
7	S	0.50	13		43	J49/B	12	MAST (NC LOW SW)
8					44			
9					44			
10					44			
11					44			
12	L	0.50	1		43	JCP	31	SAFETY
13	B	0.50	11		43	J15	4	A PHASE SIGNAL
14	B	0.50	10		43	J15	3	B PHASE SIGNAL
15	S	0.50	5		43	J134/E	7	GND STEER POT.
16	S	0.50	6		43	J134/E	6	C STEER POT.
17					44			
18	H	0.50		TW4	43	JAP	7	CAN H
19	Z	0.50		TW4	43	JAP	4	CAN L
20					44			
21					44			
22					44			
23					44			
24	B	0.50	13		43	J16	1	GND ANALOG TEMP. SENSOR
25	B	0.50	14		43	J16	2	+ V ANALOG TEMP. SENSOR
26	L	0.50	2		43	J50	5	- V MAIN CONTACTOR COIL
27	R	0.50	01		43-8	S2		+V INPUT
28	A	0.50			43	J1	2	- V BRAKE COIL
29	R	0.50	01		43-8	S2		+V INPUT
30	S	0.50	11		43	J49/B	13	+ V OUT
31					44			
32					44			
33	M	0.50	03		43	S1		+ V KEY
34					44			
35					44			

JAP — 42 — PUMP MOTOR INVERTER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	H	0.50	15	TW3	43	S15		CAN H
2					44			
3					44			
4	Z	0.50		TW4	43	JAT	19	CAN L
5					44			
6	Z	0.50		TW3	43	S16		CAN L
7	H	0.50		TW4	43	JAT	18	CAN H
8					44			

JCP — 40 — PUMP MOTOR INVERTER

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	B	0.50	15		43	J17	1	+V ENCODER SUPPLY
2	B	0.50	18		43	J17	4	GND ENCODER
3	M	0.50	03		43-8	S1		+V KEY
4	S	0.50	2		43	J134/E	9	+ V OUT
5	S	0.50	1		43	S17		SEAT
6					44			
7					44			
8					44			
9					44			
10					44			
11	B	0.50	23		43	J22	1	+V ENCODER SUPPLY
12	B	0.50	26		43	J22	4	GND ENCODER
13	B	0.50	17		43	J17	3	A PHASE SIGNAL
14	B	0.50	16		43	J17	2	B PHASE SIGNAL
15					44			
16					44			
17					44			
18					44			
19					44			
20					44			
21					44			
22	B	0.50	25		43	J22	3	A PHASE SIGNAL
23	B	0.50	24		43	J22	2	B PHASE SIGNAL
24	B	0.50	19		43	J18	1	GND ANALOG TEMP. SENSOR
25	B	0.50	20		43	J18	2	+V ANALOG TEMP. SENSOR
26	L	0.50	3		43	J50	7	-V CONTACTOR COIL
27	B	0.50	29		43	J50	8	+V CONTACTOR COIL
28					44			
29					44			
30					44			
31	L	0.50	1		43	JAT	12	SAFETY
32					44			
33					44			
34	B	0.50	22		43	J23	1	+ V ANALOG TEMP. SENSOR
35	B	0.50	21		43	J23	2	GND ANALOG TEMP. SENSOR

J134/A — 102

PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	1.00	03		104	S7		+ 24V
2	A	1.00	5		104	S8		BACK LIGHT DRIVE
3	A	1.00	6		104	S9		STOP LIGHT DRIVE
4	B	0.50	6		105	S10		TAIL LIGHT DRIVE
5	N	0.50			105	S19		DC/DC GND OUT
6	S	0.50	6		105	J14	A	C POT
7	S	0.50	5		105	J14	B	GND POT
8	S	0.50			105	J14	C	+ V POT
9	S	0.50	2		105	J19	1	CM
10	S	0.50	10		105	J19	2	NC SEAT SW
11	S	0.50	1		105	J19	3	NO SEAT SW
12	B	0.50	7		105	J91	5	LEFT TURN LIGHT
13	B	0.50	8		105	J102	5	RIGHT TURN LIGHT
14	H	0.50		TW9	105	J131	2	CAN H
15	Z	0.50		TW9	105	J131	1	CAN L
16	C	0.50	01		105	J131	4	+ 24V

J134/B — 101

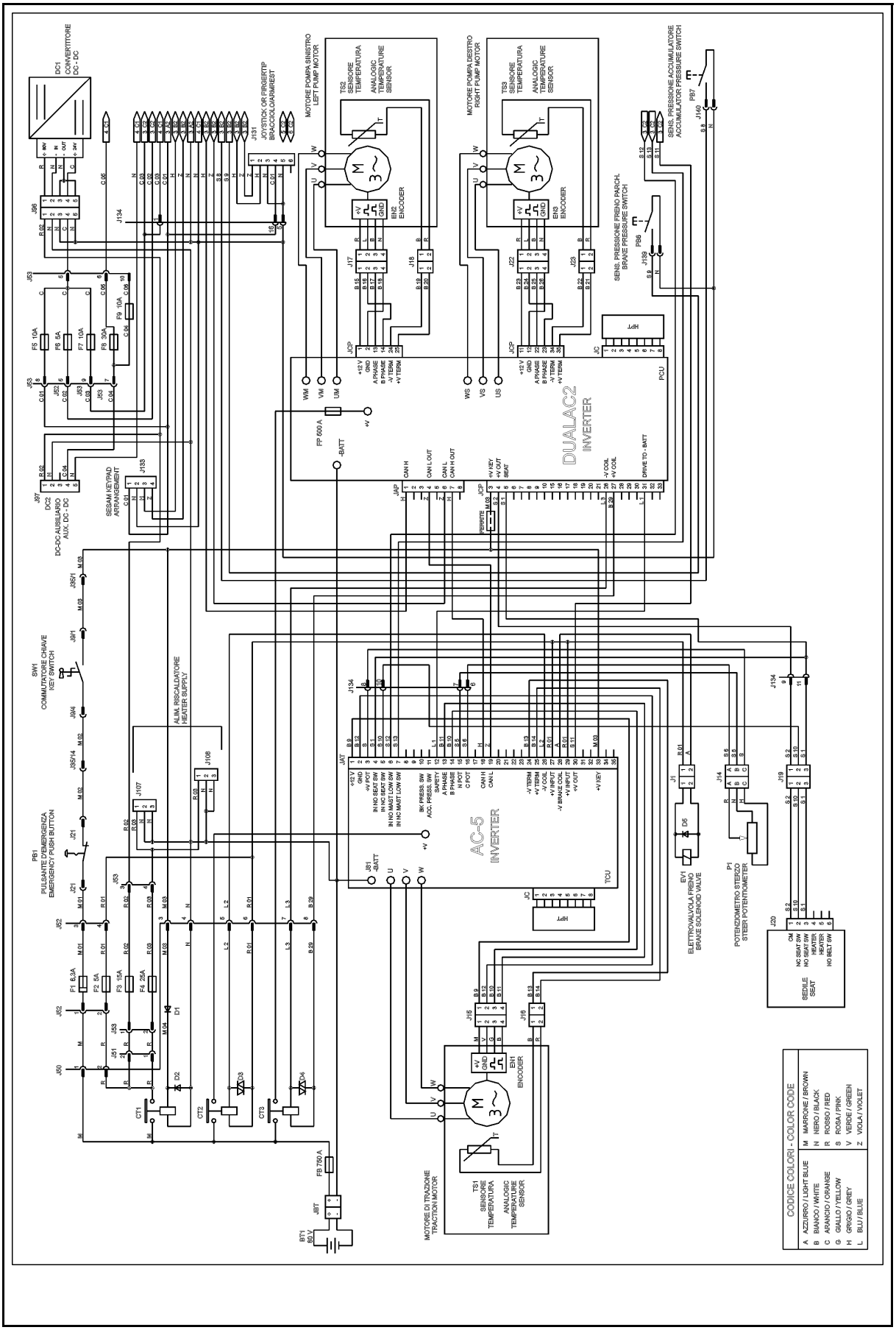
PIN	COL	mm²	MARK	TW	TERM	DEST CONN	DEST PIN	FUNCTION
1	C	1.00	03		103	S6		+ 24V
2	A	1.00	5		103	J40	29	BACK LIGHT DRIVE
3	A	1.00	6		103	J40	30	STOP LIGHT DRIVE
4	B	0.50	6		29	J90/B	2	TAIL LIGHT DRIVE
5	N	0.50			29	S4		DC/DC GND OUT
6	S	0.50	6		29	JAT	16	C POT
7	S	0.50	5		29	JAT	15	GND POT
8	S	0.50			29	JAT	3	+ V POT
9	S	0.50	2		29	JCP	4	CM
10	S	0.50	10		29	JAT	5	NC SEAT SW
11	S	0.50	1		29	S17		NO SEAT SW
12	B	0.50	7		29	J90/B	3	LEFT TURN LIGHT
13	B	0.50	8		29	J90/B	4	RIGHT TURN LIGHT
14	H	0.50		TW1	29	J34	20	CAN H
15	Z	0.50		TW1	29	J34	22	CAN L
16	C	0.50	01		29	S5		+ 24V

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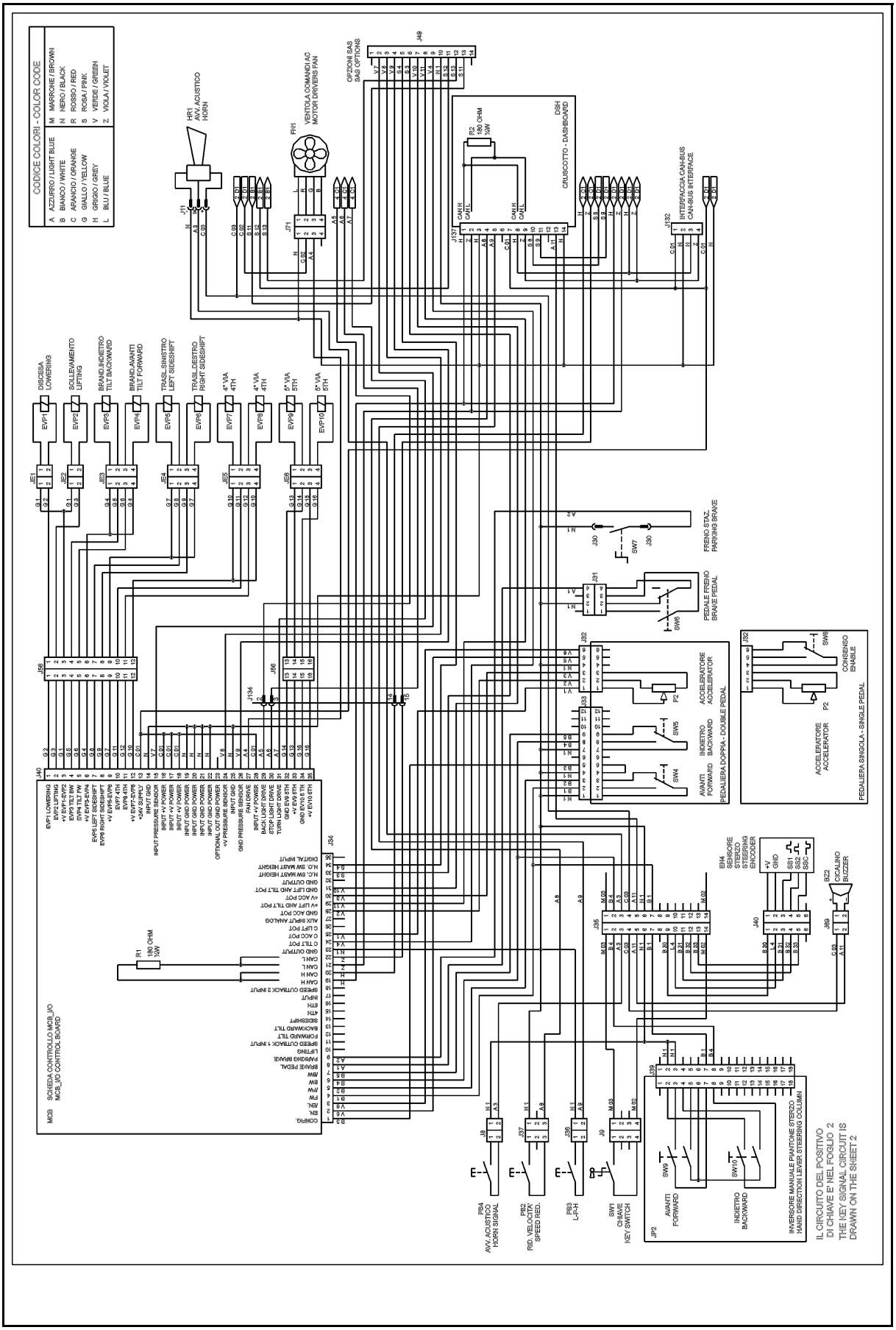
ELECTRIC DIAGRAMS



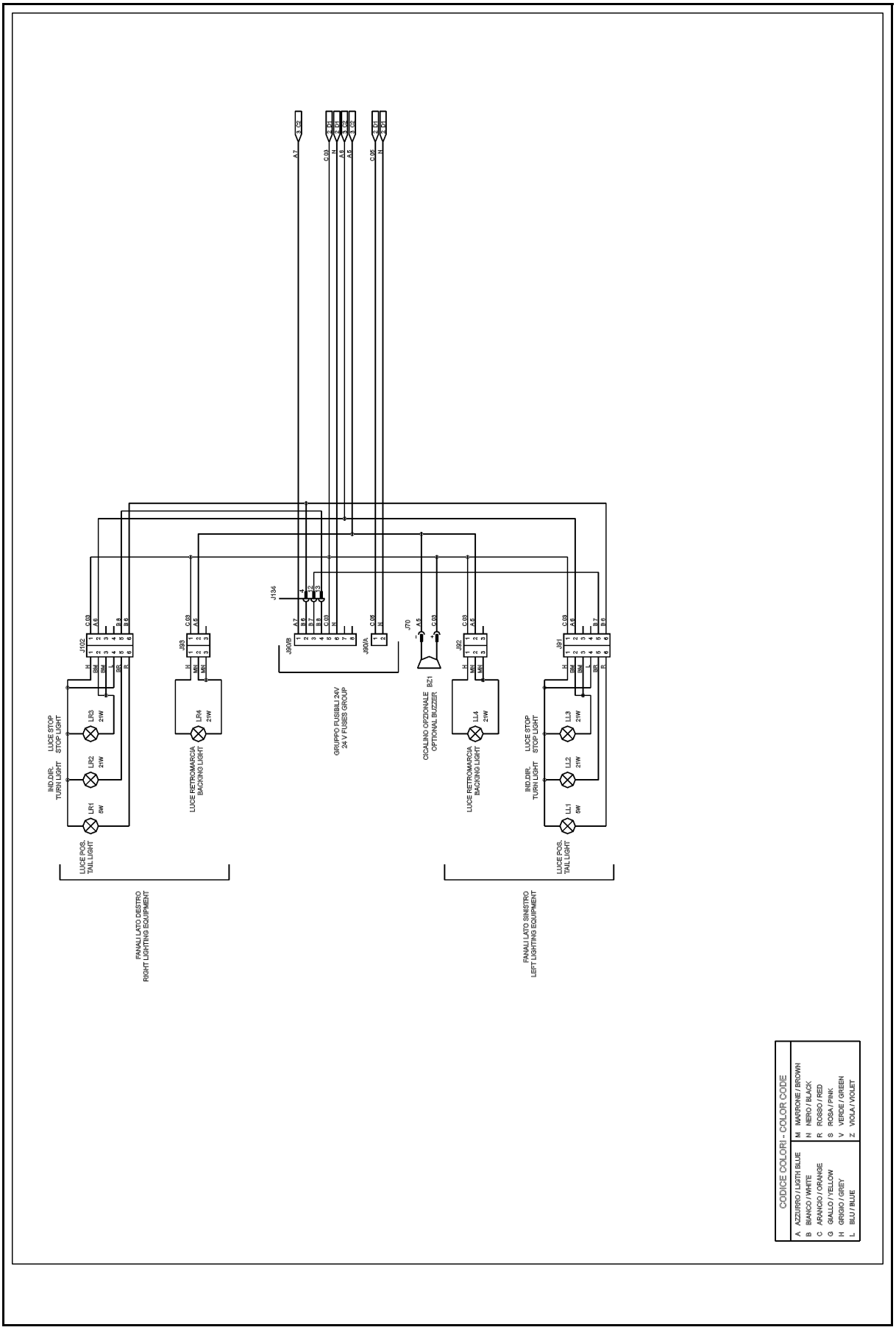
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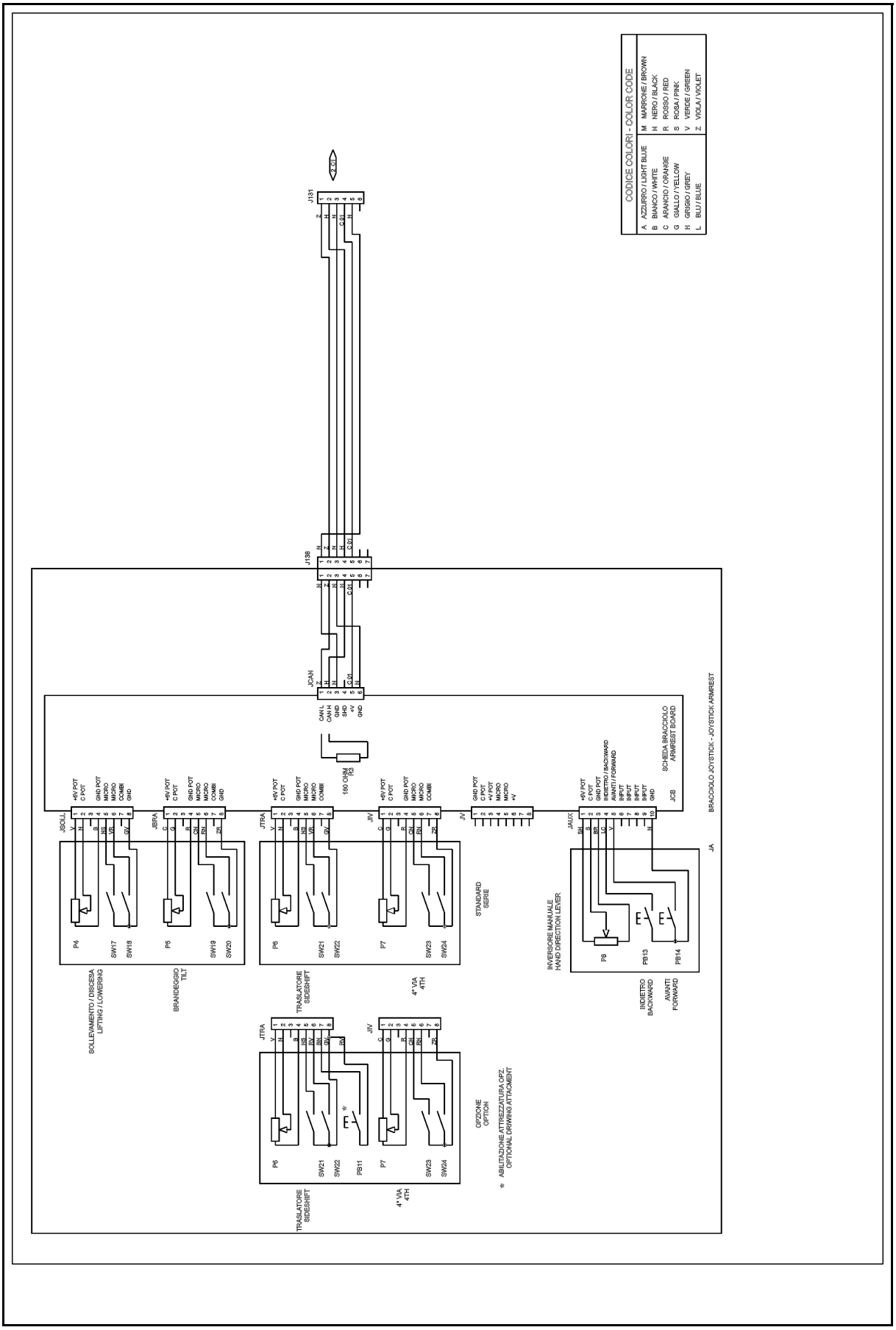
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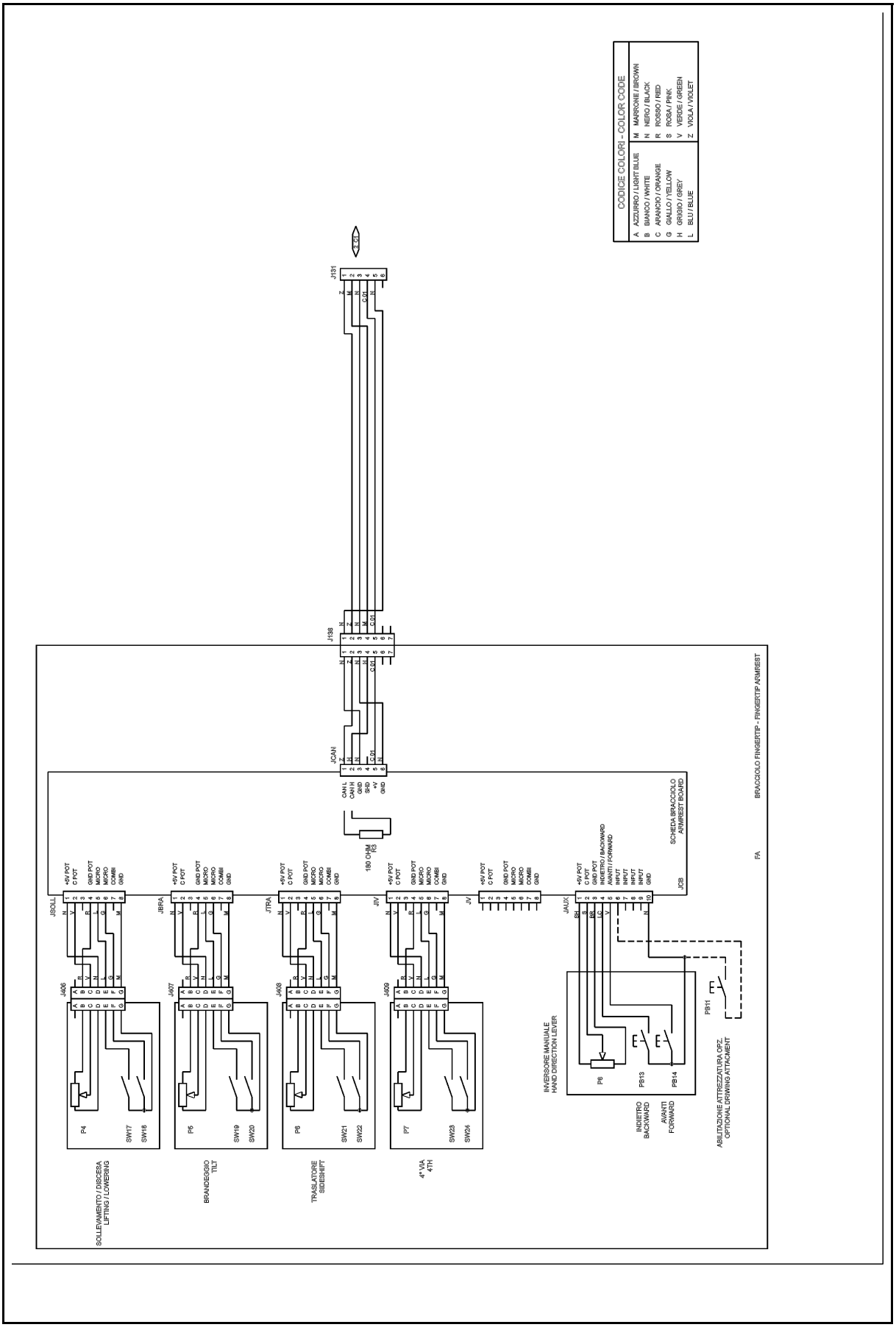
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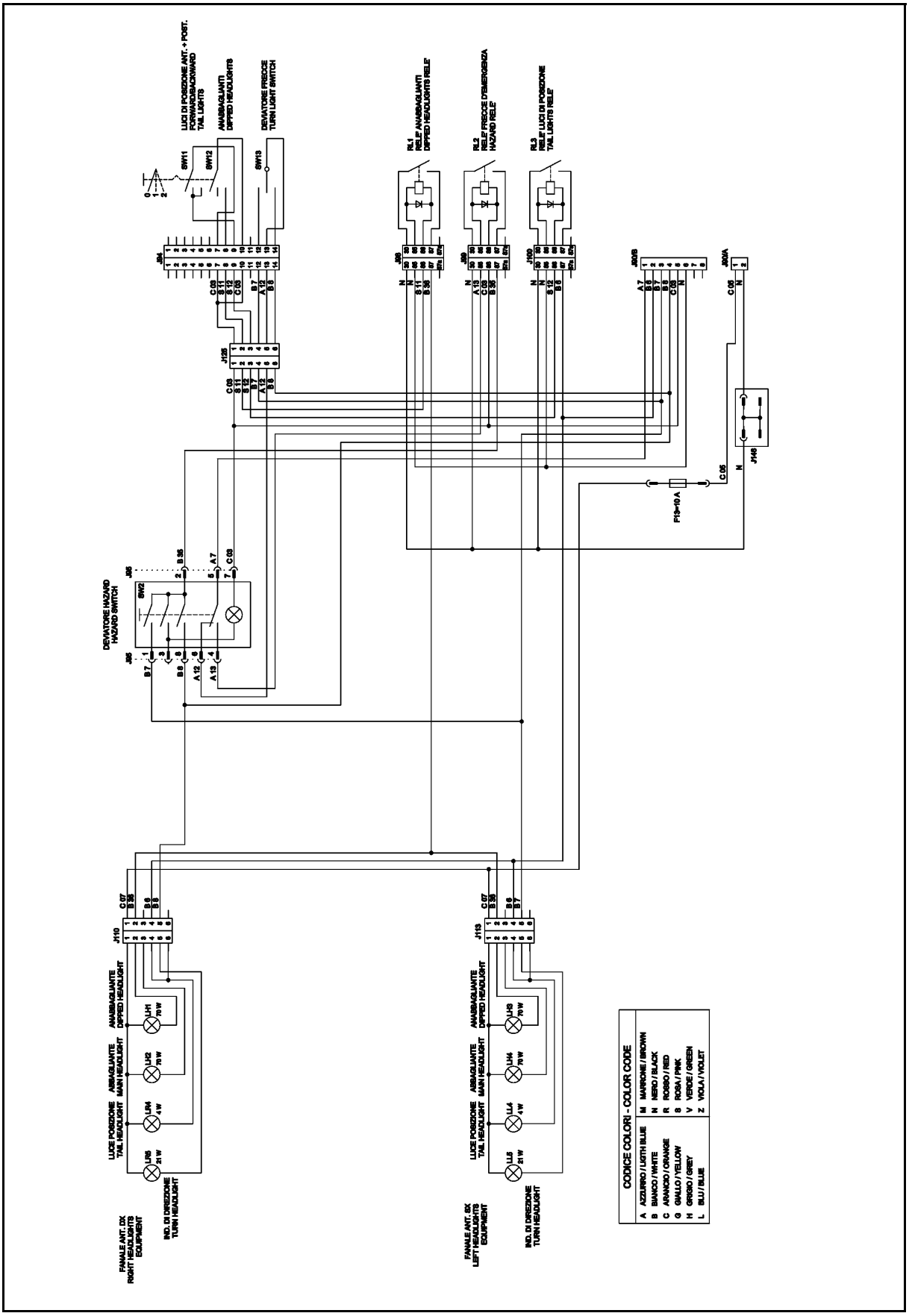


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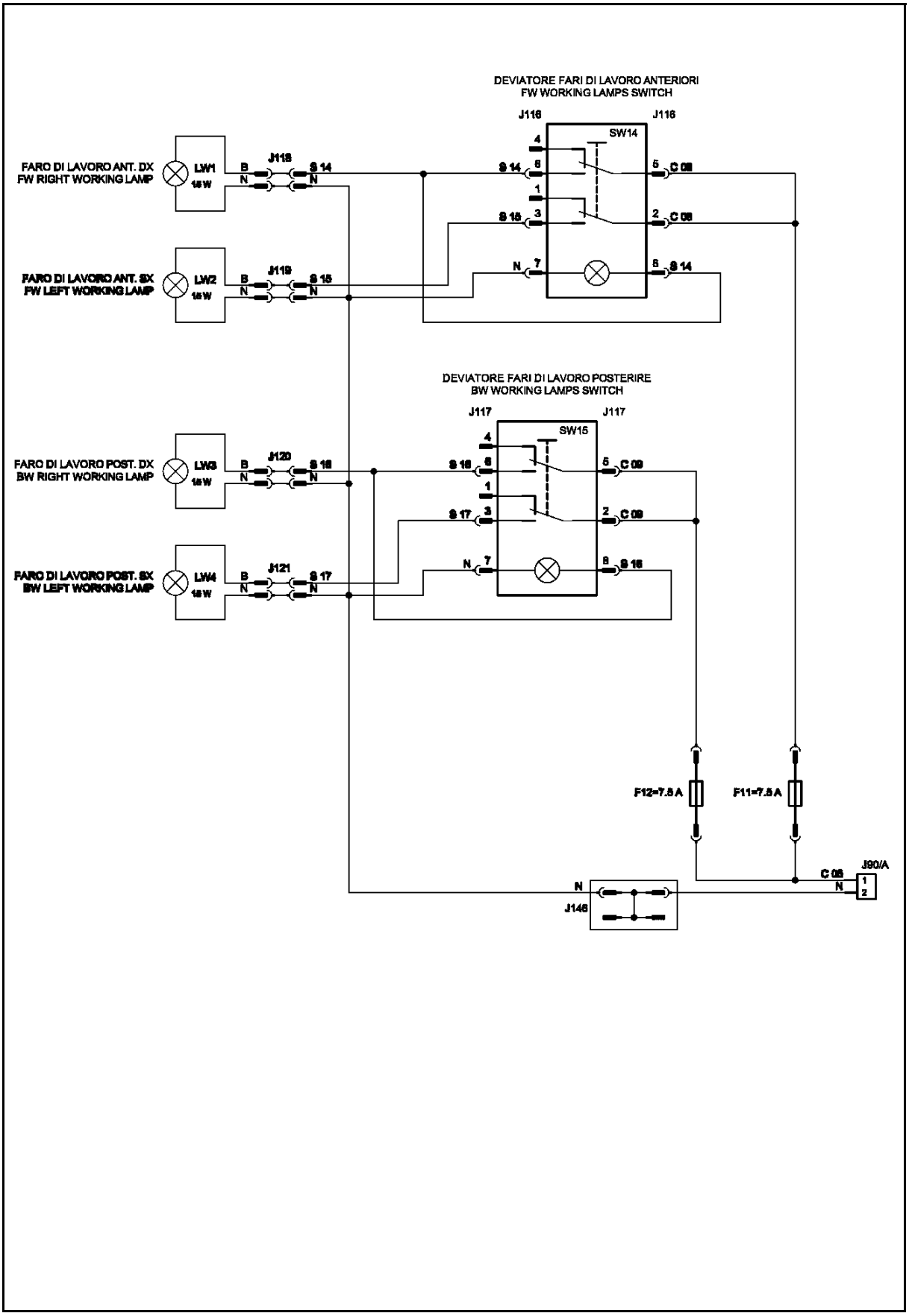
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LIGHTS EQUIPMENT ELECTRIC DIAGRAM



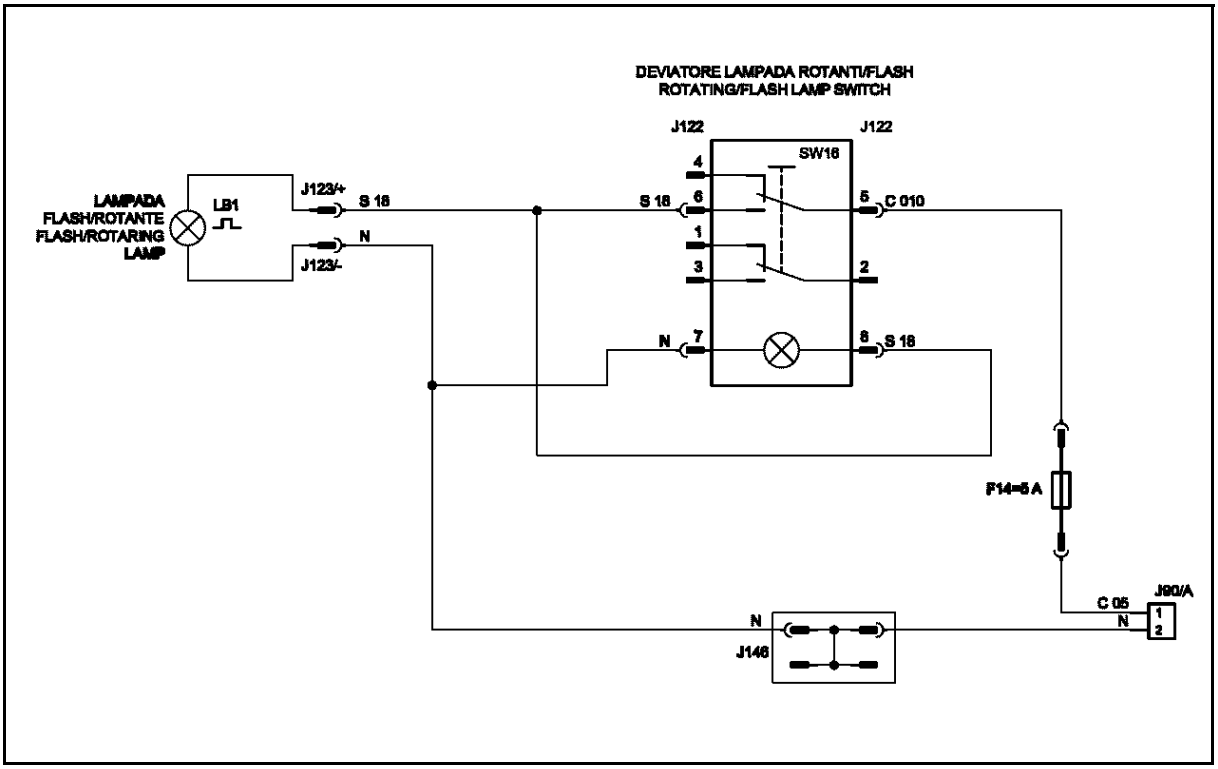
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WORKING LAMPS ELECTRIC DIAGRAM

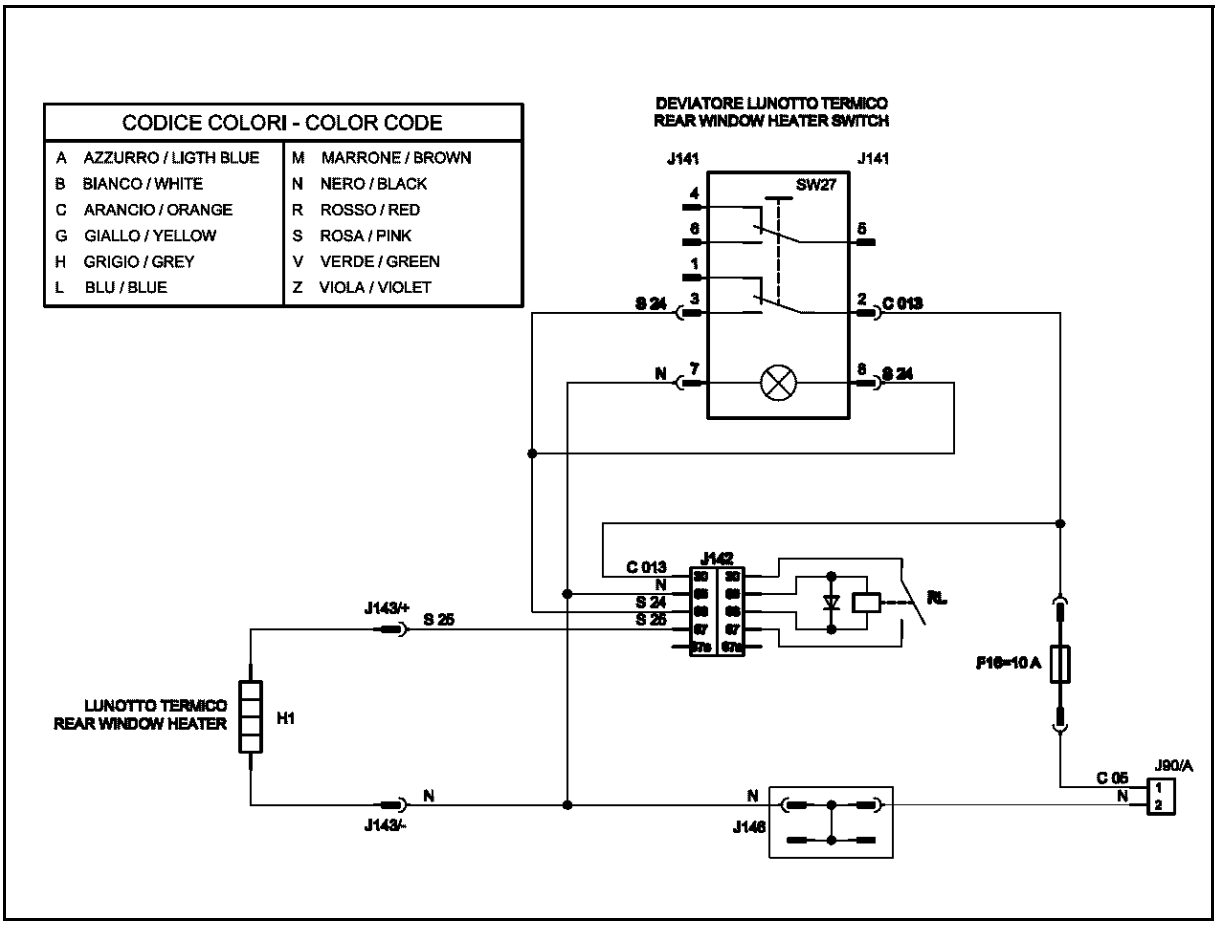


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FLASH / ROTATING BEACON ELECTRIC DIAGRAM

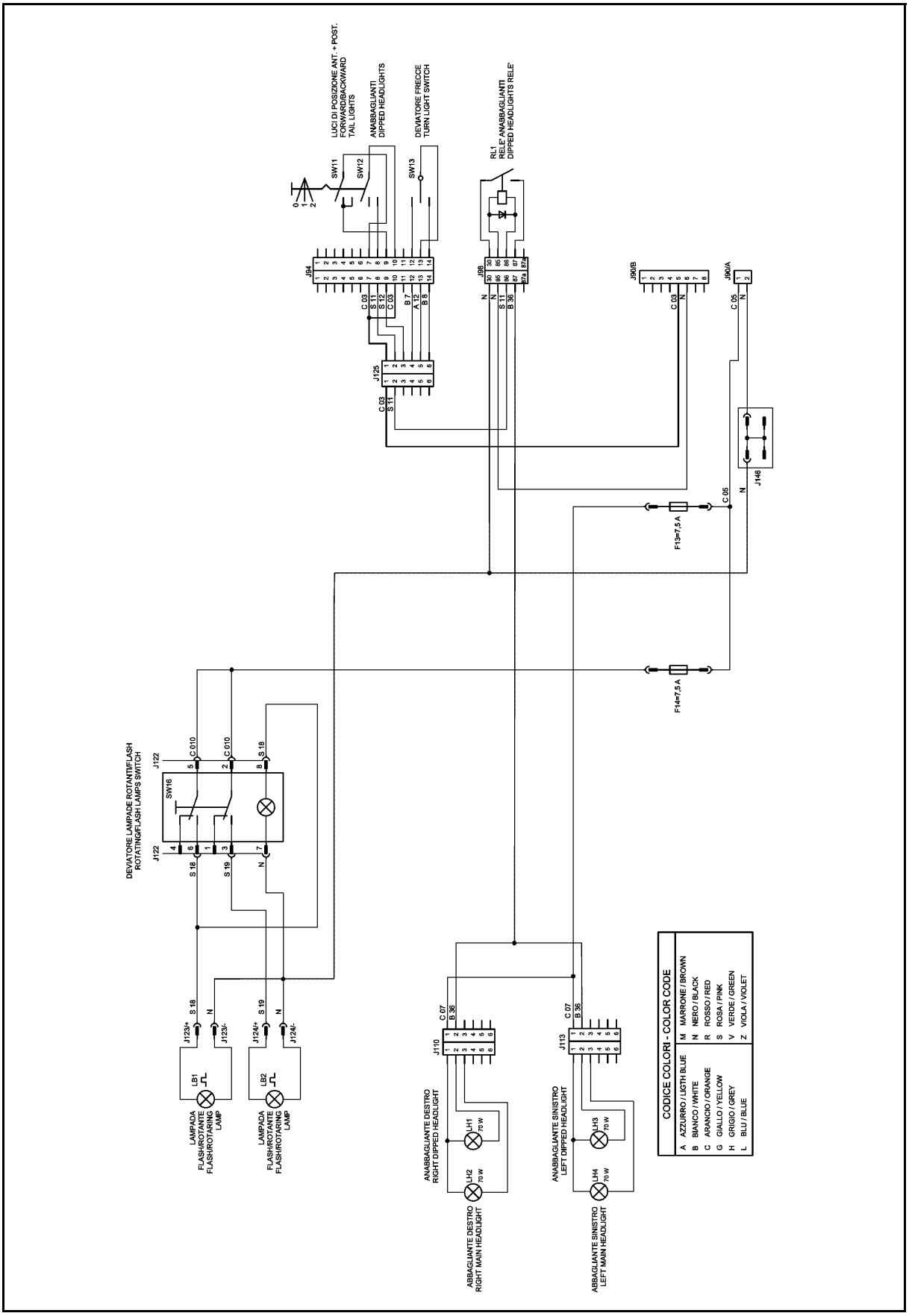


REAR WINDOW HEATER ELECTRIC DIAGRAM



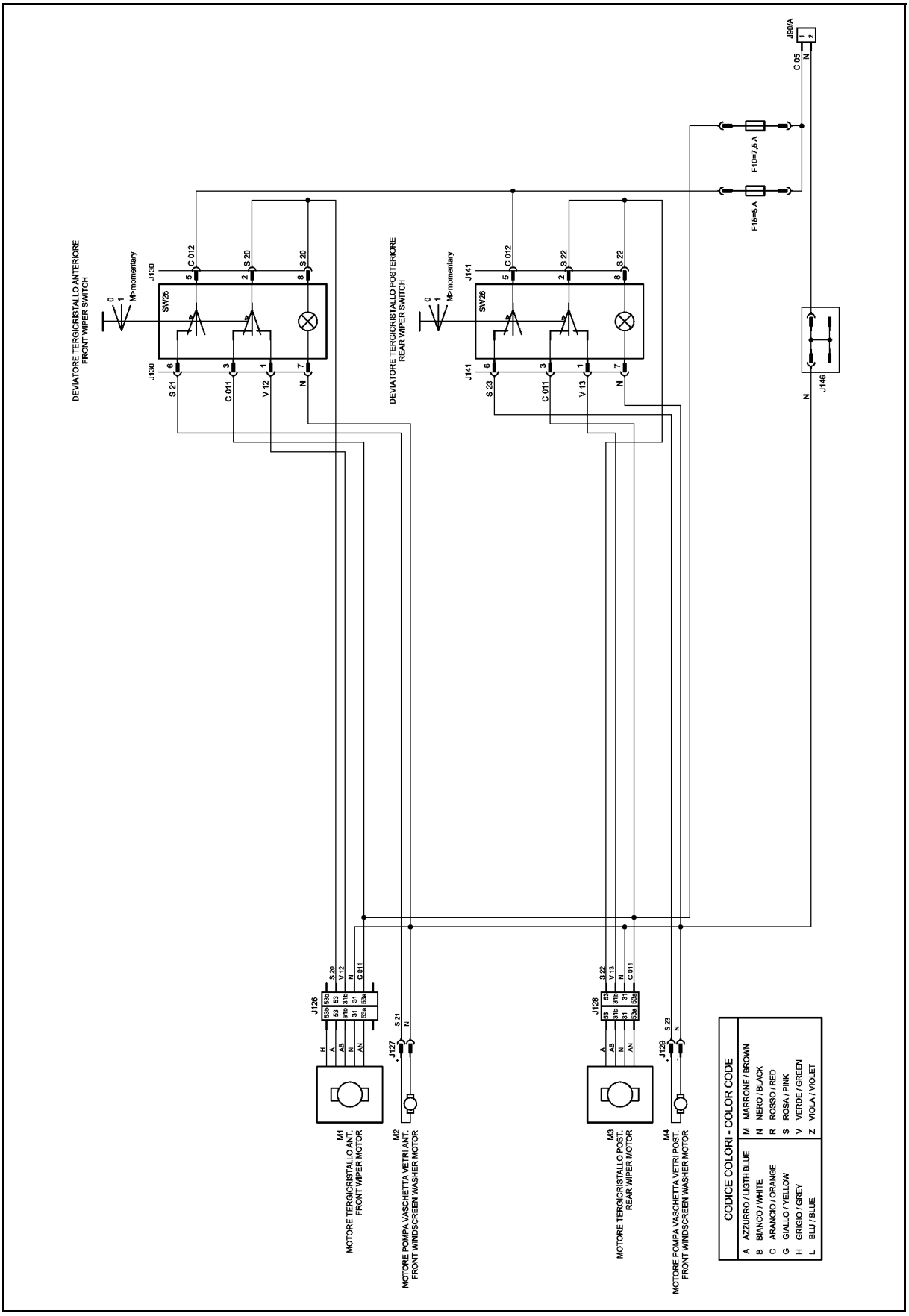
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ROAD CIRCULATION ELECTRIC DIAGRAM



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WINDSCREEN ELECTRIC DIAGRAM



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