TEREXLIFT

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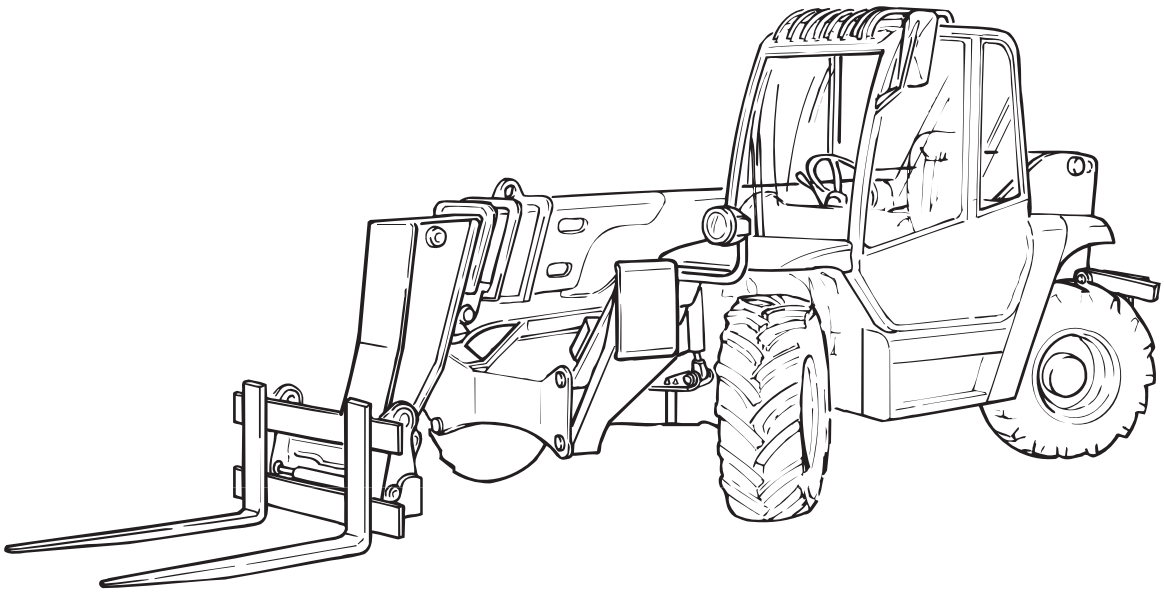
WORKSHOP MANUAL

Code 57.4400.5200 - 1st Edition 04/2003

Handler with telescopic boom

TELELIFT 3713 *Elite*

TELELIFT 3517 - TELELIFT 4010



English
Edition

INDEX

This Workshop manual has been drawn up thanks to the collaboration of all the staff of TEREXLIFT Technical Assistance office, in the person of Mr. ***Biccheri Giuseppe****, Mr.* ***Sassofrasso Ivano****, Mr.* ***Dolfi Enrico****, Mrs.* ***Longino Rossana****, Mrs.* ***Forlucci Monica*** *and of Mr.* ***Ceccagnoli Romolo*** *of TEREXLIFT Technical Office.*

WORKSHOP MANUAL

Code 57.4400.5200 - 1st Edition 04/2003

Number: .....

Consigned to: .....

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I, the undersigned.....

declare that I have received the ***Workshop manual for TEREXLIFT lifts series Telelift 3713 Elite - 3517 - 4010.***

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Yours sincerely

date .....

For acceptance

The consignee

Company stamp
and signature of the Legal representative

.....

LIST OF REVISED PAGES

Revision No.	Revision date	Revised pages	Notes	Issued by
1	04-2003		Publicated	
2				
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Sect. N DANA GEARBOX ASSEMBLY/DISMANTLING

Sect. O 3B6 LOAD MOMENT INDICATOR

Date	Previous denomination	Present denomination	Notes
05/2003	TELELIFT 3013	TELELIFT 3713 ELITE	Unchanged machine characteristics

Section A
GENERAL INFORMATION

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A.01 INTRODUCTION

This manual has been prepared to provide information about the routine and extraordinary maintenance of the main units of the machine in a safe and proper way.

STRICTLY COMPLY WITH THE INSTRUCTIONS GIVEN IN THIS MANUAL!
READ AND UNDERSTAND THIS MANUAL BEFORE CARRYING OUT ANY INTERVENTION ON THE MACHINE.

If you are unsure about anything after the reading of this manual, address to TEREXLIFT Assistance Service: addresses, phone and fax numbers are printed in the cover and in the title-page of this manual.

Keep this manual in the workshop at all times and read it before carrying out any extraordinary maintenance job.

A.02 SYMBOLS USED IN THE MANUAL

In this manual, any important information starts with a **SPECIAL SYMBOL**.
Symbols are also used to direct the reader's attention to special technical information about the tools to use, the tightening torques, etc.
There are six safety symbols in this manual, always combined with keywords that class the situations according to their degree of dangerousness.
The symbols are always followed by a text explaining the situation taken into account, the attention to be paid to such situation, the method and the behaviour to be adopted. If necessary, it stresses prohibitions or provides instructions to prevent dangers.
Sometimes, it can be followed by illustrations.

The safety symbols are the following:



Draws the attention to situations that involve your own as well as the others' safety and that can result in serious or lethal injury.



Draws the attention to electrical risks that involve your own as well as the others' safety and that can result in serious injury or lethal injury.



Draws the attention either to situations that involve your own as well as the others' safety and that can result in minor or moderate injury; or to situations that affect the machine efficiency.



Draws the attention either to situations that involve your own as well as the others' safety and that can result in minor or moderate injury; or to situations that affect the machine efficiency.



Draws the attention to important technical information or practical advice that allows for a safer and more efficient use of the machine.



Draws the attention to important environment-related information.



Indicates the number of people needed for the job



Time expected to do the intervention (except in case of troubles)



Special tools needed for the job



Weight of the unit to be handled



Tightening torque of bolts and screws



Inspection needed

A.03 ABBREVIATIONS

Abbreviation	Definition
Tab.	Table
Pag.	Page
Sect.	Section
Dwg.	Drawing
Ref.	Reference
CLS	Concrete
Mach.	Machine
Fig.	Figure
Ph.	Photo
T.O.	Technical Office
T.A.S.	Technical Assistance Service

A.04 UNITS OF MEASURE

1 FORCE

The unit of measure of force is the Newton (N)

For the conversion:

1 N	=	0.1019 kg
1 kg	=	9.81 N

2 POWER

The unit of measure of power is the kilowatt (kW). Other units of measure used are:

CV	Horsepower
HP	Horsepower

For the conversion:

1 kW	=	1.36	CV
1 kW	=	1.34	HP
1 CV	=	0.736	kW
1 CV	=	0.986	HP
1 HP	=	0.746	kW
1 HP	=	1.014	CV

3 TORQUE

The unit of measure of power is the Newton metre (Nm).

For the conversion:

1 Nm	=	0.1019	kgm
1 kgm	=	9.81	Nm
1 kgm	***=***	***10***	***Nm***

NOTE:

For simplicity, the ***Nm*** unit is converted according to the ratio 10 Nm = 1 kgm

4 SPECIFIC CONSUMPTION

The specific consumption is expressed in g/kWh (grams per kilowatt-hour). Another unit of measure used is: g/HPh (grams per horsepower-hour)

For the conversion:

1 g/kWh	=	0.736	g/CVh
1 g/CVh	=	1.36	g/kWh

5 PRESSURE

The unit of measure of pressure is the kPa (kilopascal). Other units of measure used are:

kg/cm^2	kilogram per square centimetre
Atm	Technical atmosphere
psi	Pound per square inch

For the conversion:

1 kg/cm^2	=	1	Atm
1 kg/cm^2	=	98.1	kPa
1 kg/cm^2	=	0.981	bar
1 kg/cm^2	***=***	***1***	***bar***
1 kg/cm^2	=	14.22	psi
1 bar	=	100	kPa
1 bar	=	1.02	kg/cm^2
1 bar	=	14.51	psi
1 psi	=	6.9	kPa
1 psi	=	0.069	bar
1 psi	=	0.0703	kg/cm^2
1 kPa	=	0.145	psi
1 kPa	=	0.0102	kg/cm^2
1 kPa	=	0.01	bar

NOTE:

For simplicity, the ***bar*** unit is converted according to the ratio 1 bar = 1 kg/cm^2

6 CONVERSION OF SOME METRIC UNITS OF MEASURE INTO IMPERIAL UNITS OF MEASURE

0,1 mm	=	3.937	mils
1 mm	=	0.039	inch
1 m	=	3.281	ft
1 km	=	0.621	miles
1 cm^3	=	0.061	cu. in.
1 g	=	0.035	oz.
1 kg	=	2.205	lbs.
1 t	=	1.102	short ton
1 t	=	0.9842	long ton
0°C	=	32°F	

Note: in case of differences of temperature 1°C = 1.8°F

A.05 WORKSHOP EQUIPMENT

IMPORTANT

The list below indicates the minimum equipment necessary for servicing the vehicle.

Standard tools
- 6 to 41 mm box wrench set
- 6 to 41 mm socket wrench set
- 2 to 10 mm Allen wrench set
- External circlip pliers - ø 10÷60 mm
- Internal circlip pliers - ø 20÷200 mm
- Two-leg pullers - ø 25÷200 mm
- Three-leg pullers - ø 50÷400 mm
- American cutters
- Scissors
- Screwdriver set
- Hammer set
- Mallets with plastic plugs
- Combination pliers
- Wire nippers
- Nylon collar pliers
- Wire cutter
- Wire strippers
- Shears
- Cutting nippers
- Hand-saw
- Cutter
- Slotted screw driver set - ø 2.5 ÷ 10 mm
- Crosshead screw driver set - ø 2.5 ÷ 10 mm
- Adjustable self-locking pliers
- Ring nut spanner
- Wrench set for hydraulic cylinders
- Drift bolt set
- Chisel set
- Punch
- Funnel
- Funnel with flexible extension
- Calibrated measuring beaker
- Crowbar
- Fluid collecting tanks
- Pliers for internal cylinder seals

Fittings for plugging disconnected pipes
- 1/4" gas male plug
- 3/8" gas male plug
- 1/2" gas male plug
- 1" gas male plug
- 1" 1/4 gas male plug
- 1" 1/2 gas male plug
- 1/4" gas female plug
- 3/8" gas female plug
- 1/2" gas female plug
- 1" gas female plug
- 1" 1/4 gas female plug
- 1" 1/2 gas female plug

Sealing material
- Teflon tape
- Loctite sealant
- Loctite threadlocker

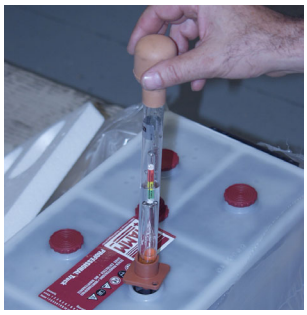
Equipment and instrumentation
- Measure instruments: metre, gauge, micrometres
- Compressor with compressed air system
- Hydraulic circuit test bench for pressures up to 400 bar
- Pressure gauges 0-60 bar / 0-240 bar / 0-600 bar
- Ammeter
- Digital tester
- Hourmeter
- Hydrometer for checking the battery charge
- Thermometer for oil temperature check
- Lamp/indicator for checking hydraulic circuit leaks
- Painting system
- Steam cleaner
- Forklift and/or pallet lift
- Stackable wooden planks and/or pallets
- Electric welding machine
- Cylinder and blowpipe
- Hoisting means with 5000 kg payload
- Textile bridles
- Two-/three-leg chains with hooks
- Pneumatic screwdriver
- Water level
- Bench drilling machine
- Portable electric drill
- Set of helical bits
- Set of screw taps and threaders
- Battery charger
- Adjustable stands

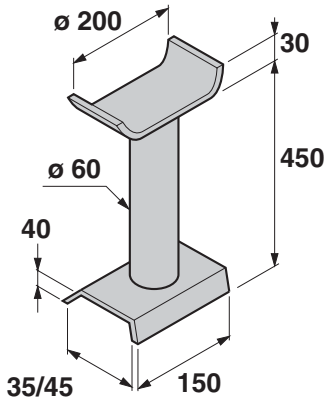
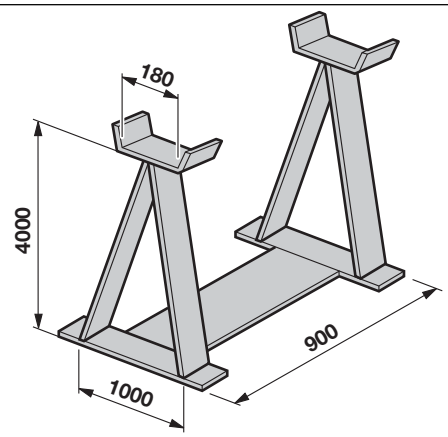
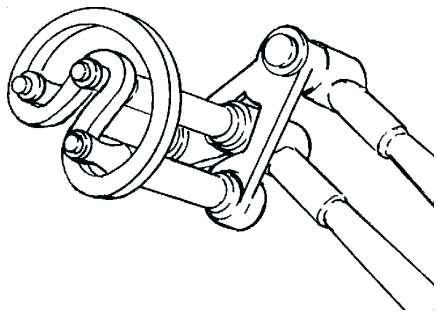
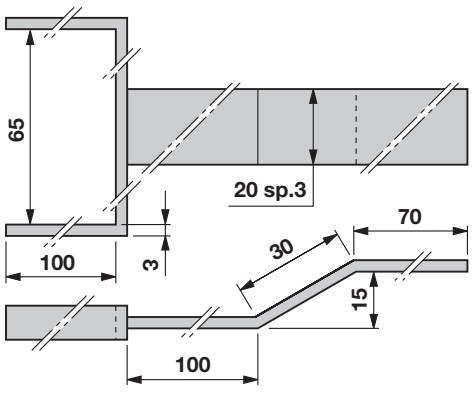
Consumable material
- Oils
- Greases
- Rags for cleaning

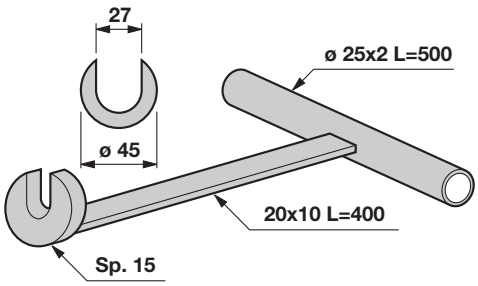
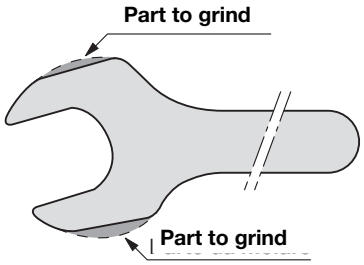
Personal protection equipment
- Goggles
- Gloves
- Ear-protectors
- Shoes
- Overall

A.06 SPECIAL TOOLS AND EQUIPMENT

	PART#	DESCRIPTION
		Pressure gauge for checking the hydraulic oil low pressure - 0÷60 bar Pressure gauge for checking the hydraulic oil medium pressure 0÷240 bar Pressure gauge for checking the hydraulic oil high pressure 0÷600 bar
		Amperometric detector
		Electronic hourmeter
		Tester for electric values

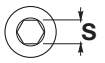
	PART#	DESCRIPTION
		Clock / chronometer
		Hydrometer for battery charge
		Lamp/indicator for hydraulic circuit leaks
		Lamp/indicator for electric circuit
		Thermometer for checking the freezing point of the radiator coolant

	PART#	DESCRIPTION
	**Dwg.01**	Wooden block for supporting the lifting jack
	**Dwg.02**	Fixed supporting stands for boom
		Wrench for internal seals
	**Dwg.03**	Wrench for boom sliding blocks

	PART#	DESCRIPTION
	**Dwg.04**	Wrench for assembling flexible hoses on the block valve of the 3rd telescope extension cyclinder
		Tester -pressurizer for accumulators
	**Dwg.05**	Wrench for Hydromatic pumps fixing screws (grind to enter the seat)
		Electrical terminal puller for boom line power outlet on cab side
		KABELSCHLEPP wrench for removing plastic carriers

	PART#	DESCRIPTION
		Dynamometric wrench for tensioning the boom extension/ retraction chain - Telelift 3517

A.07 TIGHTENING TORQUES

Thread diameter	Pitch	Wrench measure mm				Tightening torques Material class					
											
			UNI 5931/32	UNI 5933÷36	UNI 5923÷30	Normal Nm	Galvanized Nm	Normal Nm	Galvanized Nm	Normal Nm	Galvanized Nm
mm	mm										
4	0.7	7	3	2.5	2	3.2	2.8	4.4	3.9	5.3	4.8
5	0.8	8	4	3	2.5	6.1	5.5	8.7	7.8	10.3	9.3
6	1	10	5	4	3	10.6	9.5	14.8	13.3	17.8	16.0
8	1.25	13	6	5	4	25.1	22.5	35.4	31.8	42.5	30.2
	1	13	6	5	4	26.5	23.8	37.3	33.5	44.7	40.3
10	1.5	17	8	6	5	51.1	46.0	71.9	64.7	86.3	77.6
	1.25	17	8	6	5	53.4	48.1	75.1	67.5	90.2	81.1
12	1.75	19	10	8	6	86.5	77.8	121.4	109.2	145.9	131.3
	1.25	19	10	8	6	92.4	83.2	129.5	116.6	156.1	140.5
14	2	22	12	10	6	137.7	123.9	193.8	174.4	232.6	209.3
	1.5	22	12	10	6	145.9	131.3	206.1	185.5	246.9	222.0
16	2	24	14	10	8	209.1	188.2	293.8	264.4	353.0	317.7
	1.5	24	14	10	8	218.3	196.5	308.1	277.3	369.3	332.4
18	2.5	27	14	12	8	288.7	259.8	406.1	365.5	487.7	436.9
	1.5	27	14	12	8	314.2	282.8	442.8	398.5	530.6	477.5
20	2.5	30	17	12	10	408.1	367.3	573.4	516.1	687.7	618.9
	1.5	30	17	12	10	439.7	395.8	619.3	557.4	742.8	662.5
22	2.5	32	17	-	12	542.3	488.5	763.2	686.9	915.3	823.7
	1.5	32	17	-	12	582.6	524.3	819.3	737.4	983.6	885.3
24	3	36	19	-	12	705.1	634.5	990.8	891.7	1193.3	1074.4
	2	36	19	-	12	745.3	671.3	1051.0	945.9	1255.1	1129.5
27	3	41	19	-	-	1036.0	927.5	1448.9	1304.0	1734.6	1561.2
	2	41	19	-	-	1091.8	982.6	1530.6	1377.5	1836.7	1653.0
30	3.5	46	22	-	-	1307.9	1258.1	1989.3	1772.4	2357.1	2121.4
	2	46	22	-	-	1510.2	1359.1	2122.4	1910.2	2540.8	2286.7
33	3.5	50	24	-	-	2000.0	1800.0	2800.0	2520.0	3400.0	3060.0
	2	50	24	-	-	1610.0	1450.0	2300.0	2070.0	2690.0	2420.0
36	4	55	27	-	-	2600.0	2340.0	3700.0	3330.0	4300.0	3870.0
	3	55	27	-	-	2800.0	2520.0	3900.0	3510.0	4600.0	4140.0
39	4	60	27	-	-	3400.0	3060.0	4800.0	4320.0	5600.0	5040.0
	3	60	27	-	-	3600.0	3240.0	5100.0	4590.0	5900.0	5310.0

Thread diameter	Pitch	Standard nuts		Low nuts	
		5S Nm	8G Nm	5S Nm	8G Nm
4	0.7	5.5		3.5	
5	0.8	5.5		3.5	
6	1	9.5	13.0	6.0	8.0
8	1.25	23.0	32.0	14.0	20.0
	1	25.0	35.0	16.0	22.0
10	1.5	46.0	64.0	29.0	40.0
	1.25	49.0	68.0	31.0	42.0
12	1.75	80.0	110.0	50.0	69.0
	1.25	88.0	125.0	55.0	78.0
14	2	125.0	180.0	78.0	110.0
	1.5	140.0	195.0	88.0	120.0
16	2	195.0	275.0	120.0	170.0
	1.5	210.0	295.0	130.0	185.0
18	2.5	270.0	390.0	170.0	245.0
	1.5	305.0	425.0	190.0	265.0
20	2.5	305.0	540.0	190.0	340.0
	1.5	425.0	600.0	260.0	375.0
22	2.5	510.0	720.0	320.0	450.0
	1.5	570.0	800.0	360.0	500.0
24	3	660.0	930.0	410.0	580.0
	2	720.0	1000.0	450.0	630.0
27	3	980.0	1400.0	610.0	880.0
	2	1050.0	1500.0	660.0	940.0
30	3.5	1350.0	1850.0	850.0	1160.0
	2	1450.0	2050.0	910.0	1280.0
33	3.5	1650.0	2310.0	1050.0	1470.0
	2	1980.0	2770.0	1270.0	1780.0
36	4	2120.0	2970.0	1360.0	1900.0
	3	2550.0	3570.0	1630.0	2280.0
39	4	2730.0	3820.0	1750.0	2450.0
	3	3250.0	4550.0	2080.0	2910.0

A.08 DRILL DIAMETERS FOR THREADS

Thread x pitch	DRILL DIAMETER LIMITS max	min	DRILL BIT DIAMETER
M 4 x 0.7	3.42	3.24	3.30
x 0.5	3.60	3.46	3.50
M 5 x 0.8	4.33	4.13	4.20
x 0.5	4.60	4.46	4.50
M 6 x 1	5.15	4.92	5.00
x 0.75	5.38	5.19	5.20
M 8 x 1.25	6.91	6.65	6.80
x 1	7.15	6.92	7.00
M 10 x 1.5	8.87	8.38	8.50
x 1.25	9.38	9.19	9.20
M 12 x 1.75	10.44	10.10	10.20
x 1.5	10.68	10.38	10.50
M 14 x 2	12.21	11.83	12.00
x 1.5	12.68	12.38	12.50
M 16 x 2	14.21	13.84	14.00
x 1.5	14.68	14.38	14.50
M 18 x 2.5	15.74	15.29	15.50
x 1.5	16.68	16.38	16.50
M 20 x 2.5	17.74	17.29	17.50
x 1.5	18.68	18.38	18.50
M 22 x 2.5	19.74	19.29	19.50
x 1.5	20.68	20.38	20.50
M 24 x 3	21.25	20.75	21.00
x 2	22.21	21.83	22.00
M 27 x 3	24.25	23.75	24.00
x 2	25.21	24.83	25.00
M 30 x 3.5	26.77	26.21	26.50
x 3	27.25	26.75	27.00
M 33 x 3.5	27.77	29.21	29.50
x 2	31.21	30.83	31.00
M 36 x 4	32.27	31.65	32.00
x 3	33.25	32.75	33.00
M 39 x 4	35.27	34.67	35.00
x 3	36.25	35.75	36.00

A.09 STANDARD TIGHTENING TORQUES FOR FITTING SEALS

■ 60° CONICAL SEALS

Thread diameter		TIGHTENING TORQUES (0+10%)
inc.	mm	60° CONICAL SEALS Nm
G 1/8"		15
G 1/4"	M 10 x 1	20
9/16"-18		25
11/16"-16		40
13/16"-16		55
3/4"-16		62
1"-14		80
7/8"-14		80
1.1/16"-12		110
1.3/16"-12		115
1.5/16"-12		160
1.7/16"-12		130
1.11/16"-12		190
1.5/8"-12		225
1.7/8"-12		270
2"-12		245
2.1/4"-12		360

■ FRONT O-LOK (Parker) SEALS

Thread diameter		TIGHTENING TORQUES (0+10%)
inc.	mm	FRONT O-LOK (Parker) SEALS Nm
9/16"-18		25
11/16"-16		40
13/16"-16		55
1"-14		80
1.3/16"-12		115
1.7/16"-12		130
1.11/16"-12		190
2"-12		245

■ 37° COUNTER-SUNK CONICAL SEALS (JIC)

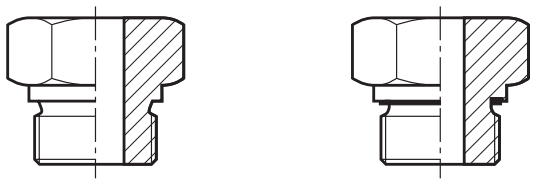
Thread diameter		TIGHTENING TORQUES (0+10%)
inc.	mm	37° CONICAL SEALS (JIC) Nm
7/16"-20	M10x1	15
1/2"-20	M12x1.5	20
9/16"-18	M14x1.5	28
	M16x1.5	62
3/4"-16	M18x1.5	62
7/8"-14	M22x1.5	80
1.1/16"-12	M27x2	110
1.3/16"-12		141
1.5/16"-12	M33x2	160
1.5/8"-12	M42x2	225
1.7/8"-12	M48x2	270
2.1/4"-12	M10x1	360

■ SEALS WITH GRIP-RING

Thread diameter				TIGHTENING TORQUE (0+10%) SEALS WITH GRIP-RING
inc.	mm	Fitting Series	Pipe ø mm	Nm
G 1/8"	M10x1	LL	4	10
G 1/8"	M10x1	LL	6	10
G 1/8"	M10x1	L	6	25
G 1/4"	M12x1.5	L	8	50
G 1/4"	M14x1.5	L	10	50
G 1/8"	M20x1.5	L	12	130
G 1/8"	M20x1.5	L	15	190
G 1/8"	M20x1.5	L	18	245
G 1/8"	M20x1.5	L	22	130
G 1/8"	M20x1.5	L	28	190
G 1/8"	M20x1.5	L	35	245
G 1/8"	M20x1.5	L	42	245
G 1/4"	M12x1.5	S	6	50
G 1/4"	M14x1.5	S	8	50
G 3/8"	M16x1.5	S	10	80
G 3/8"	M18x1.5	S	12	80
G 1/2"	M22x1.5	S	16	105
G 3/4"	M27x2	S	20	220
G 1"	M33x2	S	25	370
G 1.1/4"	M42x2	S	30	500
G 1.1/2"	M48x2	S	38	600

■ FITTING ASSEMBLY

Thread diameter		TIGHTENING TORQUES (0+10%) JOINTS	
		A	B
inc.	mm	Nm	Nm
G 1/8"	M10x1	25	12
	M12x1.5	30	18
G 1/4"		40	18
	M14x1.5	50	20
	M16x1.5	60	35
	M18x1.5	80	50
G 3/8"		95	40
	M20x1.5	140	60
G 1/2"	M22x1.5	140	75
	M26x1.5	220	85
G 3/4"		250	110
	M27x2	250	100
G 1"		400	190
	M33x2	400	150
G 1.1/4"		600	240
	M42x2	600	260
G 1.1/2"		800	300
	M48x2	800	350



A B

A Male face
Mechanical seal or copper washer

B Male face
Soft seal with O-ring

A.10 LOCKING MATERIAL

THREADLOCKERS

Product	*APPLICATION*	*Characteristics Temp. °C*	*Thread*	*Locking speed*	*Resistance*
Loctite 290	Thread locking	to 150°	M 12	Rapid	Medium
Loctite 222	Thread locking	to 150°	M 20	Moderate	Low
Loctite 243	Thread locking	to 150°	M 20	Rapid	Medium
Loctite 262	Thread locking	to 150°	M 20	Moderate	High
Loctite 270	Thread locking	to 150°	M 20	Moderate	Very high
Loctite 277	Thread locking	to 150°	M 36	Slow	High
Loctite 272	Thread locking	to 200°	M 36	Slow	High

THREAD SEALANT *For hermetic sealing. Not suitable for thermoplastic materials*

Product	*APPLICATION*	*Characteristics max °C*	*Thread max*	*type*	*Locking speed*	*Disassembly difficulty*
Loctite 511	Fitting sealant	150°	M80	Con./Cyl.	Rapid	Low
Loctite 542	Fitting sealant	150°	M36	Con./Cyl.	Rapid	Moderate
Loctite 545	Fitting sealant	150°	M36	Con./Con.	Moderate	Low
Loctite 565	Fitting sealant	150°	M80	Con./Cyl.	Instantaneous	Low
Loctite 572	Fitting sealant	150°	M80	Con./Cyl.	Moderate	Low
Loctite 577	Fitting sealant	150°	M80	Con./Cyl.	Rapid	Moderate

GASKETS *Total sealing in 24-72 hours*

Product	*APPLICATION*	*Characteristics max °C*	*Play max mm*	*Formation time*	*Resistance to fluids*
Loctite 518	Formed-in-place gasket	150°	0,5	Moderate	Excellent
Loctite 509	Formed-in-place gasket	150°	0,2	Moderate	Excellent
Loctite 573	Formed-in-place gasket	150°	0,2	Slow	Excellent
Loctite 574	Formed-in-place gasket	150°	0,5	Rapid	Excellent
Loctite 510	Formed-in-place gasket	200°	0,2	Moderate	Excellent
Loctite 5699	Formed-in-place gasket	200°	6,0	Rapid	Excellent
Loctite 5999	Formed-in-place gasket	200°	6,0	Instantaneous	Excellent
Loctite 5910	Formed-in-place gasket	200°	6,0	Rapid	Excellent
Loctite 5900	Formed-in-place gasket	200°	6,0	Instantaneous	Excellent
Loctite 5920	Formed-in-place gasket	250°	M 36	Slow	Good

A.11 HOISTING INSTRUCTIONS

DANGER

All parts weighing more than 25 kg MUST COMPULSORILY be handled with suitable hoisting means.
In the Disassembly and Assembly section there is a clear indication of the weight of the part to handle, while chapter A.12 contains a summary table with the weight of the single components.

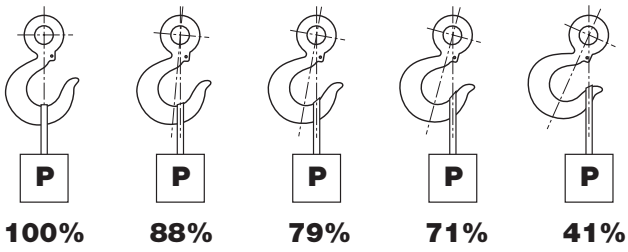
Before removing parts of the machine, make sure that:
- all fixing bolts have been removed
- all hydraulic and electrical parts have been disconnected
- the part to be removed is not blocked.

STRANDED ROPES
- Use ropes or other hoisting accessories suitable to the weight of the part to be handled. For ropes, refer to the following table:

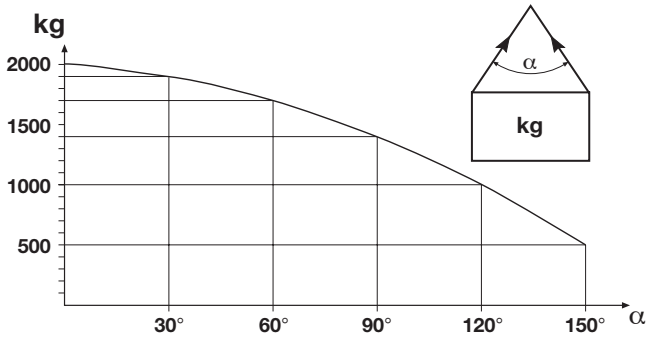
STRANDED ROPES	
Rope diameter mm	Max admissible load kg
10	1000
11.2	1400
12.5	1600
14	2200
16	2800
18	3600
20	4400
22.4	5600
30	10000
40	18000
50	28000
60	40000

The value of the admissible load has been considered as equal to 1/6 the rope breaking load.

- Attach the load to the natural seat of the hook. Attacching a load to an end can cause the load to fall down during raising and result in serious injury.



- Do not attach a heavy load to ropes forming a wide suspension angle. The total capacity of the ropes reduces proportionally to the amplitude of the angle as shown in the following chart.



A.12 WEIGHT LIST OF THE MAIN PARTS

	Part	Weight kg Telelift 3713 Elite	Telelift 3517	Telelift 4010
❑	Complete cab	440	440	440
❑	1st boom element	710	970	710
❑	2nd boom element	430	740	630
❑	3rd boom element	490	480	-
❑	4th boom element	-	500	-
❑	Complete boom	2300	3588	1846
❑	Hydraulic oil tank	102	102	102
❑	Fuel tank	72	72	72
❑	Boom raising cylinder	215	280	215
❑	2nd telescope extension cylinder	235	328	235
❑	3rd telescope extension cylinder	146	-	-
❑	Fork compensation cylinder	40	40	40
❑	Fork movement cylinder	80	80	80
❑	Rear axle locking cylinder	-	10	-
❑	RH/LH sway cylinder	22	22	-
❑	Outriggers cylinder	42	42	-
❑	Front axle	700	700	700
❑	Rear axle	770	770	720
❑	Drive pump	63	63	63
❑	Drive motor	35	35	40
❑	Perkins engine	550	550	550
❑	Distributor	34	34	23
❑	Cooler	50	50	50
❑	Complete wheel (1)	88	88	88
❑	Wheel rim (1)	40	40	40
❑	Outrigger (1)	50	50	-
❑	Exhaust silencer	20	20	20
❑	Battery (1)	24	24	24

DANGER

All parts weighing more than 25 kg MUST COMPULSORILY be handled with suitable hoisting equipment.

A.13 ADVICE TO RENEW FLEXIBLE HOSES

PROTECT THE ENVIRONMENT

Before disconnecting a hydraulic pipe, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Plug all disconnected parts to prevent dust or impurities from entering the circuit. They can cause serious damage.

DANGER

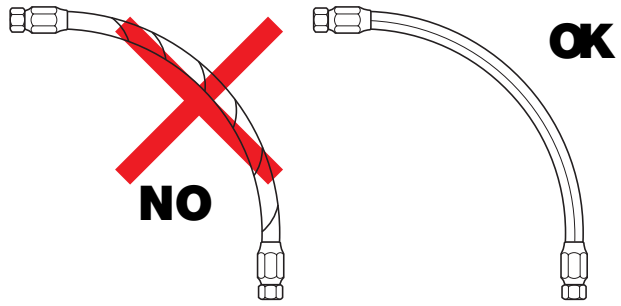
Before disconnecting the hydraulic pipe, check that there is no residual pressure. In case, eliminate the pressure operating the control levers with the engine stopped.
In any case, disconnect the hydraulic pipe with extreme caution and always wear suitable personal protection equipment -e.g. goggles, gloves, facial screen, etc.
Wrap up the end of the pipe to be disconnected with some rags and slowly loosen the pipe connector so that air comes out as slow as possible.

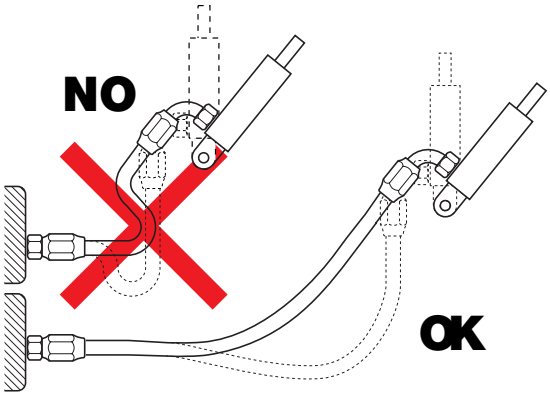
1 Before disconnecting or refitting a flexible hose, carefully clean the area all around.

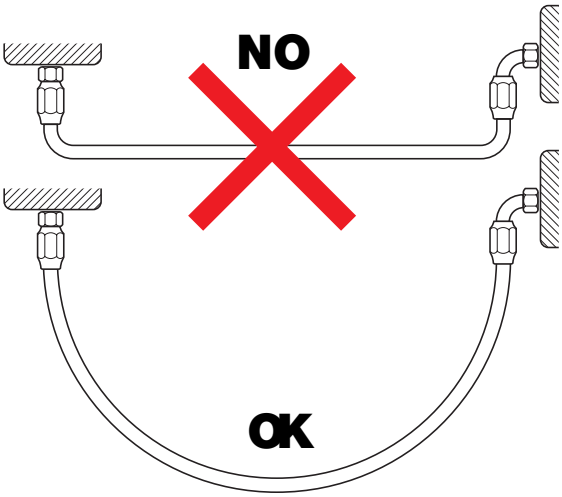
2 Blow some compressed air to remove any impurity.

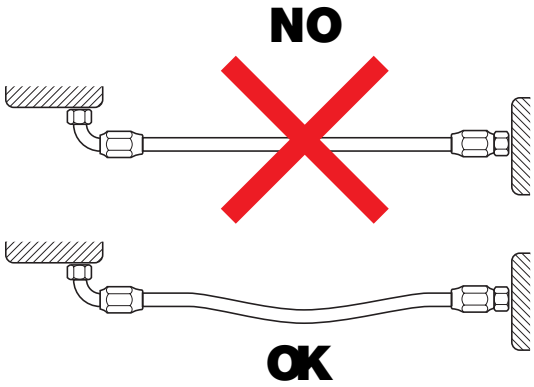
3 For an easier renewal of the hoses, whose run is not clearly visible, proceed as follows:
- disconnect the hose to be replaced from both sides
- tie a cord to one end of the hose
- remove the hose pulling the cord until it comes out completely
- untie the cord and tie it to the new hose
- pull the cord from the other side to refit the hose until reaching the connecting point to the line.

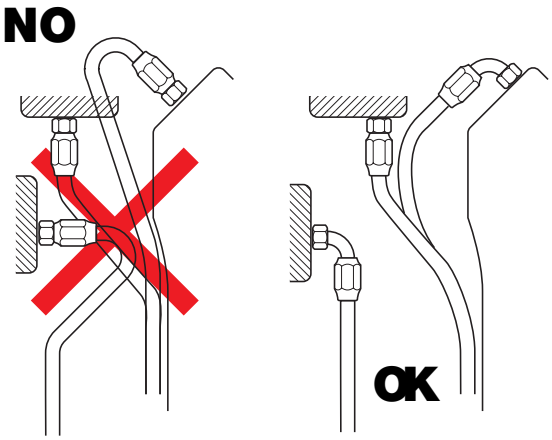
Useful advice for mounting flexible hoses:











A.14 REPAIR INTERVENTIONS WELDS AND WELD MATERIALS

ATTENTION

Before any weld on the machine, disconnect and isolate the battery cables and all the connections to positive and negative poles reaching the alternator. The ground cable of the machine must be directly connected to a metal part to be welded.

IMPORTANT

According to following specifications, repairable cracks are those with a maximum development of 100 mm which have not altered the normal deformability of the structure (crack edges open).

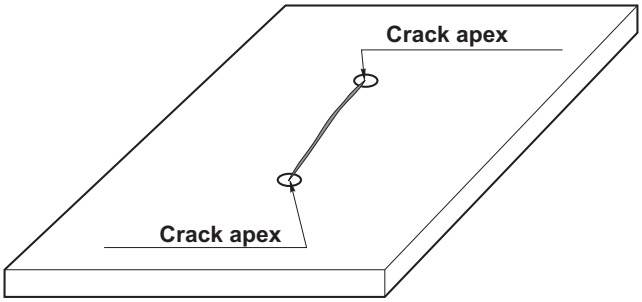
OPERATION PROCEDURE

1 Clean the area where the crack has been found thoroughly.

Remove paint, concrete or grease residues from the area.

To this end use traditional thinners.

2 Using a liquid penetrant (or another non-destructive method) inspect the areas to find the apices of the crack.



ATTENTION

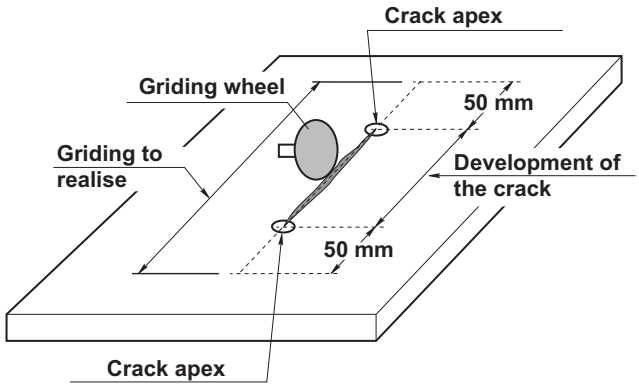
Warning: the visible apex of the crack is not the real apex. This is usually under the material skin and needs non-destructive methods to be found (liquid penetrants, magnetoscopy or ultrasounds).

IMPORTANT

It is also necessary that the operator charged of the checks is authorised to use the inspection instrumentation in accordance to UNI EN 473 standard or equivalent.

3 After inspection and once found the position of the two apices of the crack, grind the material for the entire development of the crack - see **2**.

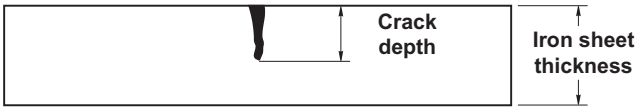
Grind 50 mm more than the development of the crack on both sides.



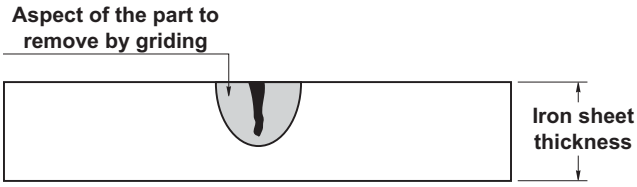
4 Check the ground area with a liquid penetrant - see **3**.

The result of this check can provide useful information on the depth of the crack:

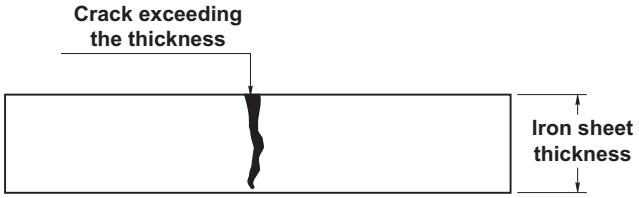
Type A *The crack does not exceed to the thickness of the iron sheet.*



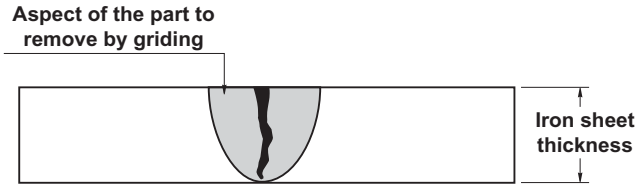
In this case, further grind the crack and check again with a liquid penetrant until the crack has been removed.



Type B *The crack exceeds the thickness of the iron sheet*



In this case grind in depth without removing too much material as this would complicate subsequent welding.



5 Grind as explained below:

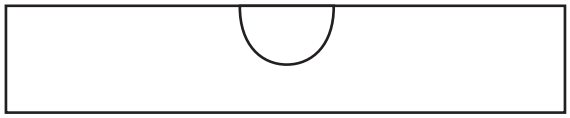
a- Use electrodes compatible with the structure material.

b- Create a seam with low voltage (V) and current (A) parameters so as not to alter the structure in the vicinity of the weld. The materials used for the structural elements of the machine have a fine grain structure which, if subject to high thermal loads, can result in a coarsening and, consequently, in a decay of the mechanical characteristics of the base material.

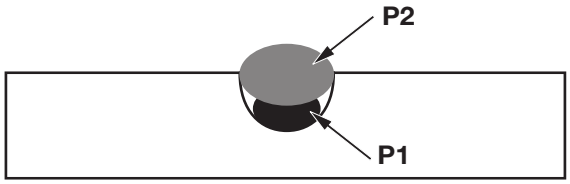
IMPORTANT

It is better to foresee an multi-pass welding with moderate parameters rather than a weld with less passes and high parameters.

Preparation after grinding
Crack not exceeding the thickness



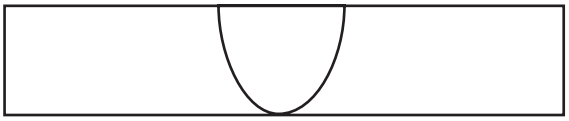
WELDING PROCEDURE

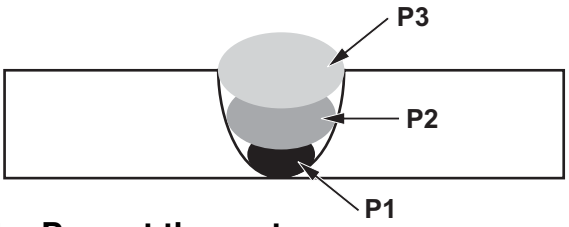


P1: Bottom pass
P2: Filling pass

PRE-HEAT AT 120°
BEFORE PASS P1

WELDING PROCEDURE





P1: Pass at the root
P2: Intermediate pass
P3: Filling pass

PRE-HEAT AT 120°
BEFORE PASS P1

IMPORTANT

For reduced thickness values (3-5 mm) the operation can be carried out in two passes eliminated pass P2.

c- The welder must be qualified and use specific materials for the structural elements in accordance with UNI EN 287 or equivalent.

6 After cooling of the welded parts, do a final check with a liquid penetrant to be sure no surface cuts or cracks have been produced during welding.

Do a magnetoscopic or ultrasound inspection to be sure there are no internal defects in the material.

If, during this last check, defects in the seams or other defects such as burns or cuts are found:

a- Grind away the defect.

b- Check again to be sure the defect has been eliminated with a non-destructive test.

c- Re-weld the defective section as indicated in point **5**..

A.15 WELD MATERIAL

For material S690 (CNR 10029-87)

Wire ø 1.2
Class ER100S-G AWS A5.28-79
Protection gas
80% Argon mixture
20% CO_2

IMPORTANT

To weld couplings S690-S690 or S690 with other material, pre-heat:

- **Recommended**: for thickness up to 7.5 mm at 100-120°C
- **Compulsory**: for thickness from 8 mm and more at 150°C

For material S490 (CNR 10029-87)

Wire ø 1.2
Class DIN 8559-84 SG3
Protection gas
80% Argon mixture
20% CO_2

A.16 CHECKS WITH LIQUID PENETRANTS

Procedure to check welds or material cracks:

1. Thoroughly clean the part to be checked making sure there are no fluids or anything else which can prevent a good penetration of the fluid; to this end, use sand paper, grinding wheel, dry rags or paper.
2. Use a red liquid and let it dry for about 5 ÷ 8 minutes
3. Thoroughly clean with a rag and some water or a sponge, then dry with a clean and dry rag
4. Spray a white liquid (detector) onto the part to be checked and let dry for about 5 ÷ 6 minutes. If after this treatment the red colour comes to surface decidedly there is a crack. Pay extreme attention as, in presence of a deep but close crack, the red colour could hardly come to surface.
5. Pay attention to the area thermally altered by welding since cracks usually appear in this area and not in the middle of the weld.
6. This check can detect any surface crack.

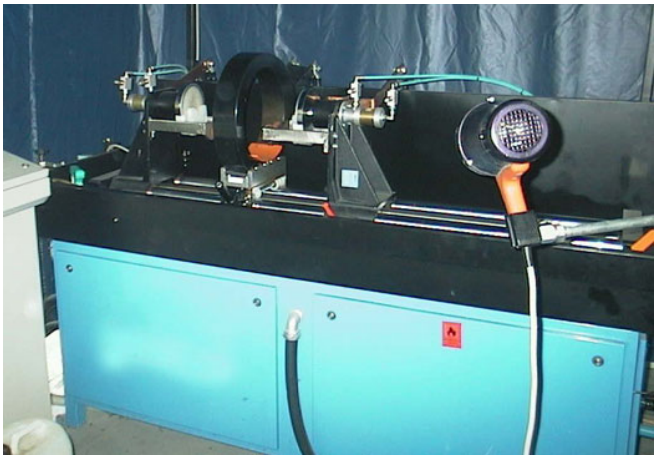
A.17 CHECKS WITH MAGNETOSCOPE

Scope:

The checks with magnescope allow to find surface and sub-surface cracks down to 2 mm to guarantee the integrity of the structure.

Equipment:

Magnetoscope



Detection method:

Black magnetic powder diluted in water. Spray the mixture onto the part to be checked during the magnetisation of the examined part.

Preparation of the surface:

The surface must be as regular as possible - e.g. absence of weld drops. The check can also be done on painted surfaces provided they are uniform.

Magnetisation mode:

The magnetisation of the area to be examined shall be done so that the lines of the magnetic field are perpendicular to the profile (course) of the defect.

Reading of the magnetoscopic image:

After magnetising the part and applied the detecting liquid, examine the area to find any indications. Indications of presence of a crack can be found on the edges and in the crack fissure with accumulation of magnetic particles.

IMPORTANT

Note all the defects with their position, length and type of indication on the drawing of the examined part to evaluate the damage.

A.18 REFILLING AND PRODUCT SPECIFICATIONS

Part	*Product*	*Telelift 3713 Elite Telelift 3517 Capacity (litres)*	*Telelift 4010 Capacity (litres)*
Diesel engine	Shell Myrina D SAE 15W-40	11,5	11,5
Engine cooling system	Caltex Polar Antifreeze (ASTM D3306-74)	15	15
Fuel tank	Diesel fuel	135	135
Oil tank	Shell Tellus T46 DENISON HF-1	150	150
Gearbox	Shell Super Gear 90 LS SAE 90W	1,5	1,5
Differential gears	Shell Super Gear 90 LS SAE 90W	8,7	8,7
Wheel reduction gears	Shell Super Gear 90 LS SAE 90W	0,75	0,75

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Section B
SAFETY INFORMATION

SECTION INDEX

B.01 General remarks ..... page 2
B.02 Servicemen's requisites 2
B.02-1 Personal protective equipment 3
B.03 General safety precautions 3
B.03-1 Working areas 3
B.03-2 Precautions during work 3

B.01 GENERAL REMARKS

Most accidents occurring while working, servicing or maintaining operation machines, are caused by not complying with the basic safety precautions.
Therefore, it is necessary to pay steady attention to the potential hazards and the effects that may come of operations carried out on the machine.

IMPORTANT

***If you recognise hazardous situations, you can prevent accidents*!**

For instance, this handbook makes use of special ***safety symbols*** to highlight potentially hazardous situations.

ATTENTION

The instructions given in this handbook are the ones established by TEREXLIFT. They do not exclude other safe and most convenient ways for the machine commissioning, operation and maintenance that take into account the available spaces and means.

If you decide to follow instructions other than those given in this manual, you must:

- be sure that the operations you are going to carry out are not explicitly forbidden;
- be sure that the methods are safe and in compliance with the indications given in this section;
- be sure that the methods cannot damage the machine directly or indirectly or make it unsafe;
- contact TEREXLIFT Assistance Service for any suggestion and the necessary written permission.

IMPORTANT

Do not hesitate to pose questions if you are in doubt! Contact TEREXLIFT: the assistance service is at your disposal. Addresses, phone and fax numbers are given in the cover and in the title-page of this manual.

B.02 SERVICEMEN'S REQUISITES

The operators who use the machine regularly or occasionally (e.g. for maintenance or transport) shall have the following requisites:

health:
before and during any operation, operators shall never take alcoholic beverages, medicines or other substances that may alter their psycho-physical conditions and, consequently, their working abilities.

physical:
good eyesight, acute hearing, good co-ordination and ability to carry out all required operations in a safe way, according to the instructions of this manual.

mental:
ability to understand and apply the rules, regulations and safety precautions. They shall be careful and sensible for their own as well as for the others' safety and shall desire to carry out the work correctly and in a responsible way.

emotional:
they shall keep calm and always be able to evaluate their own physical and mental conditions.

training:
they shall read and familiarise with this handbook, its enclosed graphs and diagrams, the identification and hazard warning plates. They shall be skilled and trained about the machine use.

IMPORTANT

It is recommended to take part in at least one technical training course organised by TEREXLIFT Assistance Office.

IMPORTANT

Ordinary and extraordinary maintenance of the machineare quite complex from a technical point of view and should be performed by an authoirsed service centre.

B.02-1 PERSONAL PROTECTIVE EQUIPMENT

During work, but especially when maintaining or repairing the machine, operators must wear suitable protective clothing and equipment:

- Overalls or any other comfortable garments. Operators should wear neither clothes with large sleeves nor objects that can get stuck in moving parts of the machine
- Protective helmet when working under or in the vicinity of suspended load
- Protective gloves
- Working shoes
- Breathing set (or dust mask)
- Ear-protectors or equivalent equipment
- Goggles or facial screen.

IMPORTANT

Use only type-approved protective equipment in good condition.

B.03 SAFETY PRECAUTIONS

DANGER

Read and understand the following safety instructions before servicing the machine.
The following list contains safety rules which must absolutely be obeyed to prevent accidents and injuries.

B.03-1 WORKING AREA

- Make sure the area all around the machine is safe. Always be aware of potential risks.
- During work, keep the working area in order. Never leave objects scattered: they could hinder the machine movements and represent a danger for personnel.

B.03-2 PRECAUTIONS DURING WORK

- Do not walk or stop under raised loads or machine parts supported by hydraulic cylinders or ropes only.
- Keep the machine handholds and access steps always clean from oil, grease or dirt to prevent falls or slips.
- When entering/leaving the cab or other raised parts, always face the machine; never turn the back.
- When carrying out operations at hazardous heights (over **3 meters** from the ground), always use type-approved safety belts or fall preventing devices.
- Do not enter/leave the machine when it is running.
- Before servicing the engine, let its parts cool down.
- Do not leave the driving place when the machine is running.
- Neither stop nor carry out interventions under or between the machine wheels when engine is running. When maintenance in this area is needed, stop the engine, engage the parking brake and chock the wheels to prevent accidental movements.
- Do not carry out maintenance or repair works without a sufficient lighting.
- When using the machine lights, the beam should be oriented in order not to blind the personnel at work.
- Before applying voltage to electric cables or components, ensure they are properly connected and efficient.
- Do not carry out interventions on electric components with voltage over 48V.
- Do not connect wet plugs or sockets.
- Signs and stickers shall never be removed, hidden or become unreadable.
- Except for maintenance purposes, do not remove safety devices, covers, guards,. Should their removal be necessary, stop the engine, remove them with the greatest care and always remember to refit them before starting the engine and using the machine again.
- Aleays stop the engine and disconnect the batteries before maintenance or service.
- Do not lubricate, clean or adjust moving parts.
- Do not carry out operations manually when specific tools are provided for this purpose.
- Absolutely avoid to use tools in bad conditions or in an improper way.
- Before carrying out operations on hydraulic lines under pressure (hydraulic oil, compressed air) and/or before disconnecting hydraulic components, ensure the relevant line has been previously depressurised and does not contain any hot fluid.

DANGER

Any intervention on the hydraulic or pneumatic circuit must be carried out by authorised personnel. Before any operation on lines under pressure, release any residual pressure from the circuit.
Do not use your fingers to check for pressure leaks. Fine jets of air, oil or fuel can injure you.

- Neither smoke nor use open flames if there is a risk of fire or close to fuel, oil or batteries.
- Do not leave fuel cans or bottles in unsuitable places.
- Do not empty catalytic mufflers or other vessels containing burning materials without taking the necessary precautions.
- Carefully handle all flammable or dangerous substances.
- After any maintenance or repair work, make sure that no tool, cloth or other object has been left within compartments with moving parts or in which suction and cooling air circulates.
- Never give orders to several people at a ime. Instructions and signs must be given by one person only.
- Always pay the due attention to the instructions given by the foreman.
- Never distract the operator during working phases or crucial manoeuvres.
- Do not call an operator suddenly, if unnecessary.
- Do not frighten an operator or throw objects by no means.
- After work, never leave the machine under potentially dangerous conditions.

PROTECT THE ENVIRONMENT

Treatment and disposal of used oils is subject to federal, national and local laws and regulations. Collect and deliver these wastes to authorised centres.

- Use the assistance of a second person to handle loads weighing 30 to 50 kg.
- For loads over 50 kg, the use of special hoisting equipment in good condition and equipped as per enforced regulations is mandatory.

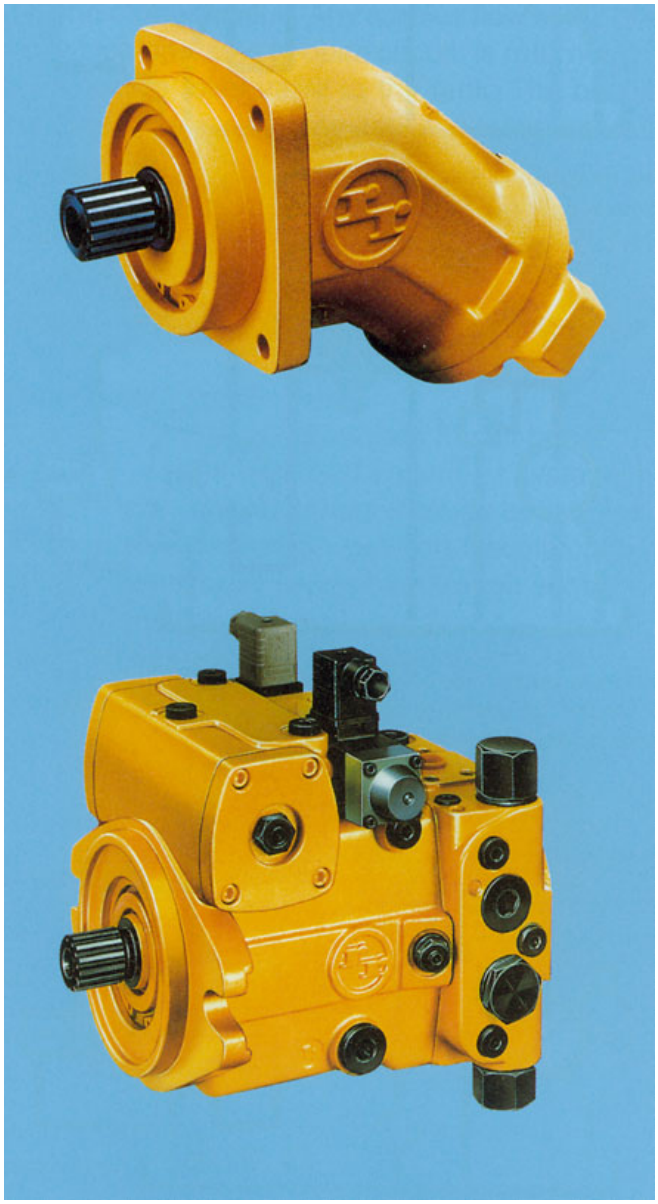
Section C
TECHNICAL OPERATING DATA

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Axial Piston Units



1 Basic Principles

1.1 Types of Hydraulic Circuit

1.1.1 Open circuit
1.1.2 Closed Circuit

2 Principles of Function

2.1 Bent-Axis

2.1.1 Bent-Axis Principle
2.1.2 Description of Function
2.1.3 Principles of Calculation
2.1.4 Rotary Group Forces
2.1.5 40°-Tapered Piston, Bent-Axis Rotary Group
2.1.6 Examples of Types
2.1.7 Symbols

2.2 Swashplate

2.2.1 Swashplate Principle
2.2.2 Description of Function
2.2.3 Principles of Calculation
2.2.4 Rotary Group Forces
2.2.5 Swashplate Rotary Group
2.2.6 Examples of Types
2.2.7 Symbols

3 Components

A Selection of Typical Models from the individual Product Groups

3.1 to 3.10 Standard Models of Bent-Axis and Swashplate Design

3.11 Summary of Control Devices

1 Basic Principles

1.1 Types of Hydraulic Circuit

For the hydraulic engineer, there are three basic types of circuit to consider:

open circuit
closed circuit
semi-closed circuit

In the following we look at open and closed circuits in some details. The semi-closed circuit is a mixture of these two types of circuit and is used in applications where volume compensation via prefill valves is necessary (e.g. when using a single rod cylinder).

1.1.1 Open Circuit

Open circuit normally means the case where the pump suction line leads below a fluid level whose surface is **open** to atmospheric pressure. Maintenance of a pressure balance between the air in the hydraulic tank and the air in the atmosphere guarantees good *pump suction characteristics*. There must be no resistance in the inlet line which might cause pressure to drop below the so-called *suction head/suction limit*.

Axial piston units are *self-priming*; in certain special cases, however, a low pressure is applied to the suction side.

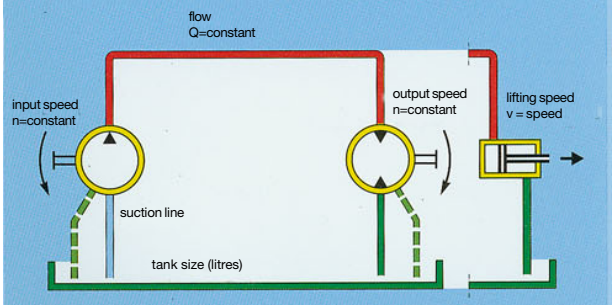
In **open** circuit hydraulic fluid is fed to the user via directional control valves and returned to the tank in the same way.

Typical features of the **open** circuit are:

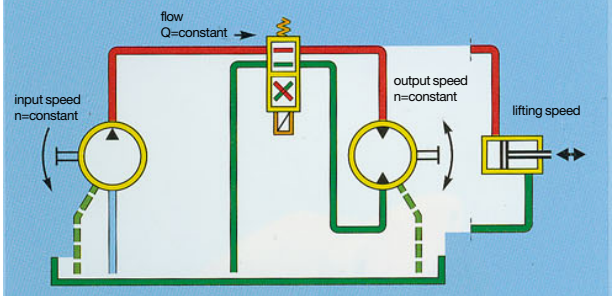
- suction lines - short length, large diameter
- directional control valves - flow-related sizes
- filter / cooler - flow-related sizes
- tank size - a multiple of the max. pump flow in litres
- pump arrangement - adjacent to or below the tank
- drive speeds - limited by the suction head
- load maintained in return by valves

The **open** circuit is standard in many industrial and mobile applications - from machine tools, through press drives to winches and mobile transmissions.

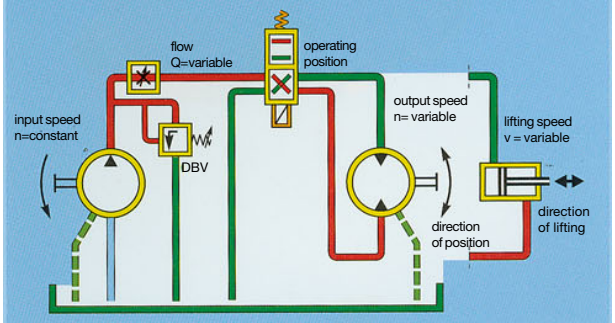
Open Circuit
The way to the complete hydraulic system:
(explanation of symbols, see page 3)



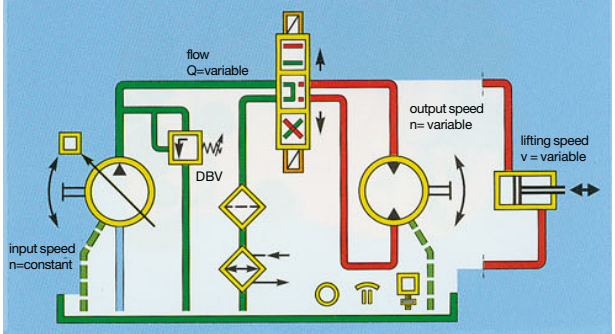
Basic system with hydraulic pump and hydraulic motor (or cylinder). **Single** direction of input, output and lift.



The directional control valve allows **reversal** of the direction of rotation or of movement at the user.



Variable output speed is achieved by installation of a flow controller for variable flow. The pressure relief valve (DBV) protects the system from overload.



Here, the fixed pump and flow controller have been replaced by a variable pump. Further valve functions have been added, e.g. free-wheeling of the user. Filter, cooler and other accessories are also fitted.

1.1.2 Closed Circuit

A hydraulic system is described as **closed** when the hydraulic fluid is returned from the user direct to the pump.

There is a high pressure and a low pressure side, depending on the direction of load (take-off torque at the user).

The high pressure side is protected by pressure relief valves which unload to the low pressure side. The hydraulic fluid remains in the circuit.

Only the continuous leakage from pump and motor (dependent on operating data) must be replaced.

This fluid is normally replenished by an auxiliary pump flanged direct onto the main pump which delivers a continuous, adequate supply of fluid (boost fluid) from a small tank via a check valve into the low pressure side of the **closed** circuit. Any surplus flow of the boost pump, which operates in *open* circuit, is returned via a boost-pressure relief valve to the tank. The boosting of the low pressure side enhances the pump-operating characteristics.

Typical features of the **closed** circuit for axial piston units are:

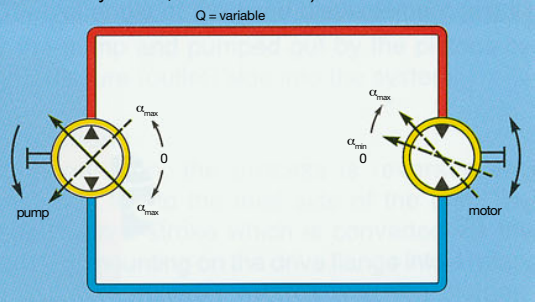
- directional control valves - small sizes for pilot operation
- filter/cooler - small sizes
- tank size - small, dimensioned to suit boost pump flow and volume of system
- speed - high limiting values through boost
- arrangement/mounting - position-flexible/optional
- drive - completely reversible through centre position
- load maintained - via the drive motor
- feedback of braking power

Explanation of Symbols / Colour Code for Open and Closed Circuits

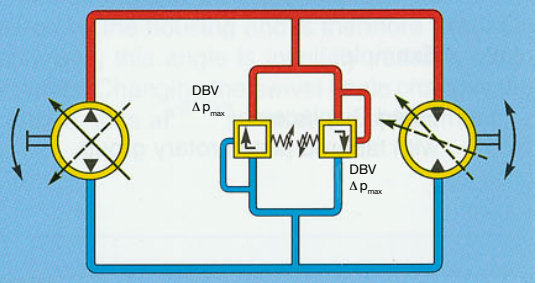
red		(high) pressure line
blue		(low, boost) pressure line
blue		suction line
green		(low, boost) pressure line
blue		leakage line
yellow		hydraulic components (pump,
motor		cylinder, valves accessories)
orange		control element (solenoids, springs)

Closed Circuit
A step-by-step guide

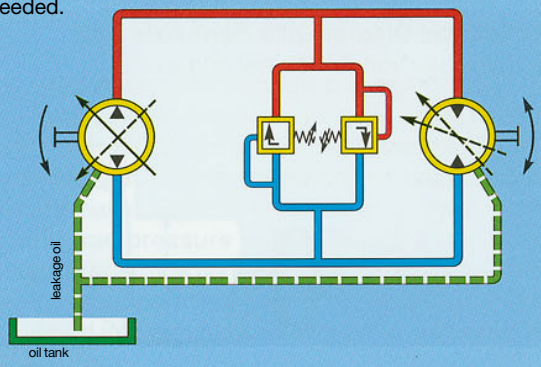
(explanation of symbols, see below left)



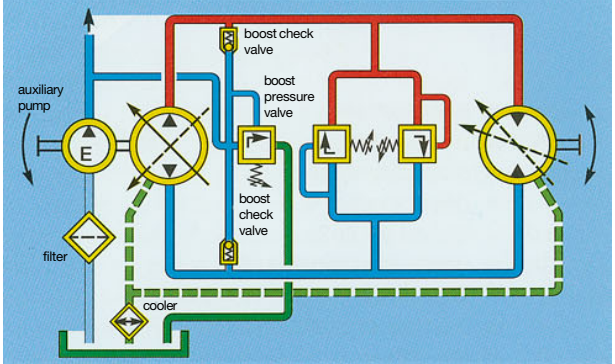
Basic system with variable pump and variable motor. **Single** pump input drive direction. Motor power take-off in **both** directions. The pump can be swivelled smoothly over centre, i.e. the direction of flow is reversible.



Pressure relief valves , one each for the high and low pressure sides, prevent the maximum permissible pressure from being exceeded.



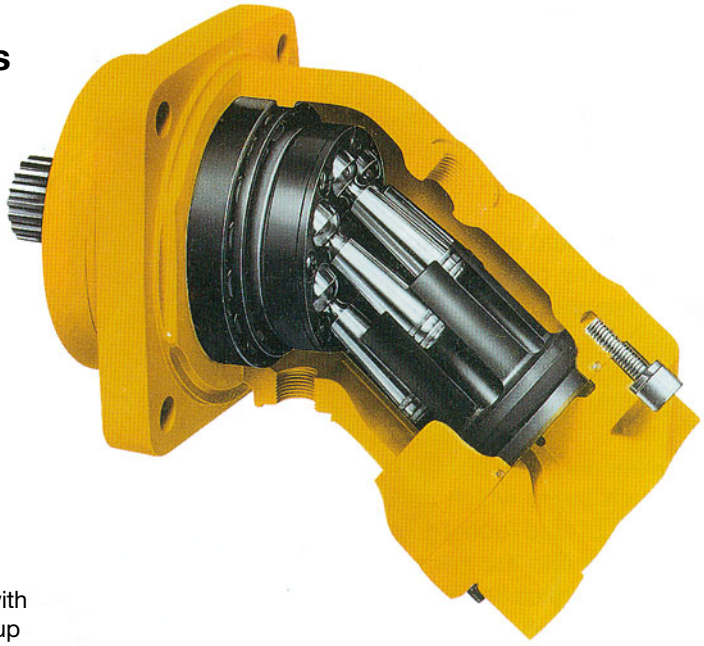
The leakage from pump and motor is led back to a small tank and must be replenished.



An auxiliary pump for replenishment of leakage oil and control of the pump. Boost check valve RV. Boost pressure relief valve DBV. Fitted filter, cooler and accessories.

2 Principles of Function

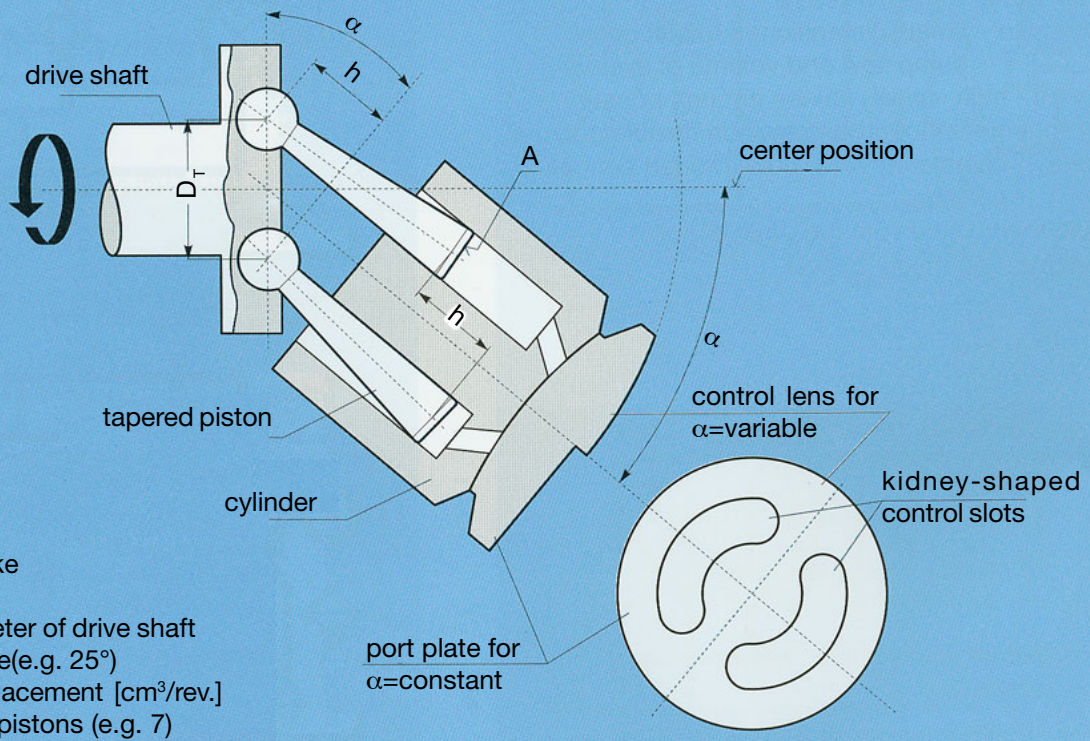
2.1 Bent Axis



Example:

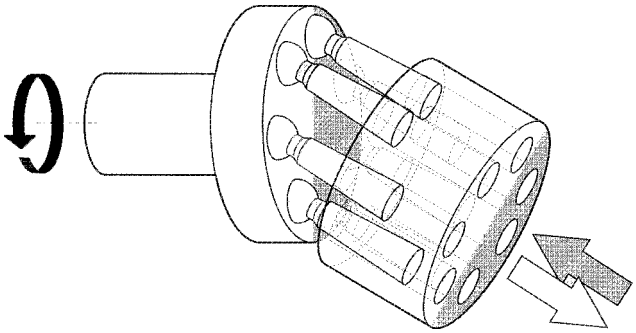
Fixed Displacement Unit with tapered piston rotary group

Schematic Diagram of a Bent-Axis Unit
with fixed or variable swivel angle α



h = piston stroke
A = piston area
D_T = pitch diameter of drive shaft
α = swivel angle(e.g. 25°)
V_g = geom. displacement [cm^3/rev.]
x = number of pistons (e.g. 7)
h = D_T • sin α
V_g = x•A•h
V_g = x•A•D_T•sin α

2.1.1 Bent-Axis Principle



The bent-axis rotary group is a displacement unit whose displacement pistons are arranged at an angle to the drive shaft.

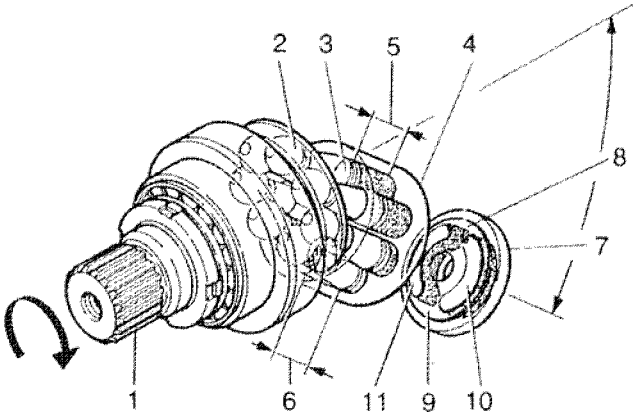
Pump Function:
Through the flexible piston/piston rod arrangement, rotation of the drive shaft also causes the cylinder to rotate without the need for a Cardan coupling. The pistons execute a stroke within the cylinder bores dependent on the angle of inclination of the bent axis. The hydraulic medium is fed to the low pressure (inlet) side of the pump and pumped out by the pistons on the high pressure (outlet) side into the system.

Motor Function:
In motor operation, the process is reversed and pressure oil is fed to the inlet side of the unit. The pistons perform a stroke which is converted via the flexible piston mounting on the drive flange into a rotary movement. The cylinder rotates with the pistons, generating an output torque on the drive shaft. Oil exiting on the outlet side flows back into the system.

Swivel Angle:
The tilt/swivel angle of the fixed displacement unit is determined by the housing and is therefore fixed. On a variable unit, this angle is infinitely variable within specific limits. Changing the swivel angle changes the piston stroke, thus allowing variable displacement.

2.1.2 Description of Function

Example: Fixed Displacement Unit



1 = drive shaft
2 = piston
3 = piston area
4 = cylinder
5 = pressure stroke
6 = suction stroke
7 = port plate
8 = upper dead point OT
9 = lower dead point UT
10 =control slot, pressure side (for direction of rotation shown)
11 = control slot, suction side (for direction of rotation shown)

Description
The axial piston units of bent-axis design with fixed or variable displacement can operate as hydraulic pumps or hydraulic motors.

When used as a pump, the flow is proportional to the input speed and the swivel angle. If the unit is used as a motor, the output speed is proportional to the flow through the unit. The input (pump) or output (motor) torque increases with the pressure drop between the high and low pressure sides. In pump operation, mechanical energy is converted into hydrostatic power, while in motor operation, inversely, hydrostatic power is converted into mechanical energy. By adjusting the swivel angle of a variable pump or motor it is possible to vary the displacement and thus the flow.

Function
... as a pump in open circuit:
On rotation of the drive shaft, the cylinder is caused to rotate by seven pistons flexibly mounted in a circular arrangement on the drive shaft. The cylinder slides on the spherical port plate which has two kidney-shaped control slots. As the cylinder rotates, each of the seven pistons moves from the upper dead point OT to the lower dead point UT and back, thereby executing a stroke dependent on the swivel angle. The piston movement from the lower to the upper dead point in the cylinder bore produces the suction stroke, whereby a quantity of oil relative to the piston area and piston stroke is sucked in through the control slot on the suction side.
On further rotation of the drive shaft, as the pistons move from the upper to the lower dead point, oil is pushed out through the other control slot (pressure side). The pistons are held against the drive shaft by hydraulic pressure.

... as a motor:
The motor function is the reverse of the pump function. In this case, hydraulic oil is fed via the connection plate through a control slot to the cylinder bores. Three or 4 cylinder bores are located over the pressure side control slot, 4 or 3 over the return-line side, with one bore possibly being covered by part of the port plate directly at the dead point. The force generated as a product of pressure and piston area acts on the drive shaft to produce the output torque.

Control Function: (with control devices fitted)
The swivel angle of the bent axis can be changed, for example, mechanically via an adjusting spindle or hydraulically via an adjusting piston. The hydraulic section of the rotary group cylinder complete with control lens (port plate) is swivelled out and, depending on the type of circuit and function, is held in the zero or starting position by either mechanical or hydraulic means. Increasing the swivel angle increases displacement and torque; decreasing the angle gives a corresponding reduction in these values. If the swivel angle is zero, the displacement is also zero.

Mechanical or hydraulic control devices are normally fitted, which can themselves be controlled and regulated by mechanical, hydraulic or electrical means. Well-known types of control are: handwheel control, electro-proportional control, constant horsepower control.

General
Because of the bent-axis design, in both pump and motor operation, the torque is generated direct at the drive shaft. The radial loading of the pistons on the cylinder is very low, giving low wear, high efficiency and good starting torque. The spherical design of the port plate means a torque-free cylinder bearing since all forces acting on the cylinder pass through one point. Axial movement caused by elastic deformation does not increase the leakage losses between cylinder and port plate. When idling and during the start-up process, the cylinder is held against the port plate by the built-in cup springs. As pressure increases, hydraulic forces balance the cylinder so that, even with high loading on the control face between cylinder and port plate, a permanent oil film is maintained and leakage is kept to a minimum. Mounted on the drive shaft is the bearing set which absorbs axial and radial forces. External sealing of the rotary group is by means of radial seal and O-rings. A retaining ring holds the complete rotary group in the housing.

2.1.3 Principles of Calculation

Calculating pump size

	Fixed displacement bent-axis pump	Variable displacement bent-axis pump
Flow	$Q=\frac{V_g \bullet n \bullet \eta_{vol}}{1000}$ (l/min)	$Q=\frac{V_g\ max \bullet n \bullet \sin\alpha \bullet \eta_{vol}}{1000 \bullet \sin\alpha_{max}}$ (l/min)
Drive speed	$n=\frac{Q \bullet 1000}{V_g \bullet \eta_{vol}}$ (rpm)	$n=\frac{Q \bullet 1000 \bullet \sin\alpha_{max}}{V_{g\ max} \bullet \eta_{vol} \bullet \sin\alpha}$ (rpm)
Drive torque	$M=\frac{V_g \bullet \Delta p}{20\pi \bullet \eta_{mh}} = \frac{1{,}59 \bullet V_g \bullet \Delta p}{100 \bullet \eta_{mh}}$ (Nm)	$M=\frac{V_{g\ max} \bullet \Delta p \bullet \sin\alpha}{20\pi \bullet \eta_{mh} \bullet \sin\alpha_{max}} = \frac{1{,}59 \bullet V_{g\ max} \bullet \Delta p \bullet \sin\alpha}{100 \bullet \eta_{mh} \bullet \sin\alpha_{max}}$ (Nm)
Drive power	$P=\frac{2\pi \bullet M \bullet n}{60000} = \frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600 \bullet \eta_{vol} \bullet \eta_{mh}} = \frac{Q \bullet \Delta p}{600 \bullet \eta_t}$ (kW)	$P=\frac{2\pi \bullet M \bullet n}{60000} = \frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600 \bullet \eta_{vol} \bullet \eta_{mh}} = \frac{Q \bullet \Delta p}{600 \bullet \eta_t}$ (kW)

Where:

Q	= flow	(l/min)	α_{max}	= max. swivel angle (varies according to design)	
M	= drive torque	(Nm)	α	= set swivel angle (between 0 and α_{max})	
P	= drive power	(kW)	η_{vol}	= volumetric efficiency	
V_g	= geometric displacement per rev.	(cm3)	η_{mh}	= mechanical - hydraulic efficiency	
$V_{g\ max}$	= max. geom. displacement per rev.	(cm3)	η_t	= overall efficiency ($\eta_t = \eta_{vol} \bullet \eta_{mh}$)	
n	= speed	(rpm)	Δp	= differential pressure (bar)	

Calculating motor size		
	Fixed displacement bent-axis pump	**Variable displacement bent-axis pump**
Consumption (Flow)	$Q=\frac{V_g \bullet n}{1000 \bullet \eta_{vol}}$ (l/min)	$Q=\frac{V_g\ max \bullet n \bullet \sin\alpha}{1000 \bullet \sin\alpha_{max} \bullet \eta_{vol}}$ (l/min)
Drive speed	$n=\frac{Q \bullet 1000 \bullet \eta_{vol}}{V_g}$ (rpm)	$n=\frac{Q \bullet 1000 \bullet \eta_{vol} \bullet \sin\alpha_{max}}{V_{g\ max} \bullet \sin\alpha}$ (rpm)
Drive torque	$M=\frac{V_g \bullet \Delta p \bullet \eta_{mh}}{20\pi}=\frac{1{,}59 \bullet V_g \bullet \Delta p \bullet \eta_{mh}}{100}$ (Nm)	$M=\frac{V_{g\ max} \bullet \Delta p \bullet \sin\alpha \bullet \eta_{mh}}{20\pi \bullet \sin\alpha_{max}}=\frac{1{,}59 \bullet V_{g\ max} \bullet \Delta p \bullet \sin\alpha \bullet \eta_{mh}}{100 \bullet \sin\alpha_{max}}$ (Nm)
Drive power	$P=\frac{2\pi \bullet M \bullet n}{60000}=\frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600} \bullet \eta_{vol} \bullet \eta_{mh}=\frac{Q \bullet \Delta p \bullet \eta_t}{600}$ (kW)	$P=\frac{2\pi \bullet M \bullet n}{60000}=\frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600} \bullet \eta_{vol} \bullet \eta_m=\frac{Q \bullet \Delta p \bullet \eta_t}{600}$ (kW)

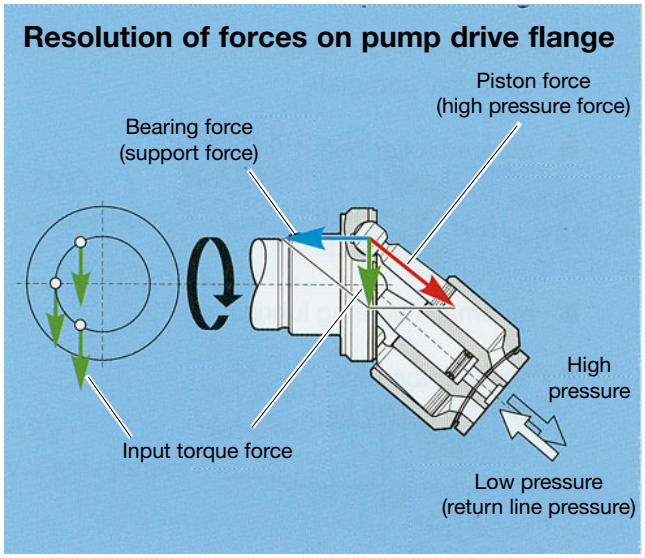
Where:

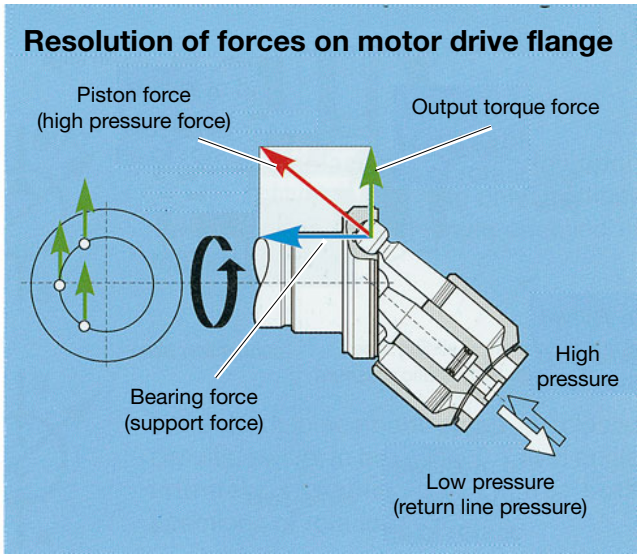
Q	= consumption (flow)	(l/min)	α_{max}	= max. swivel angle (varies according to design)
M	= output torque	(Nm)	α	= set swivel angle (between 0 and α_{max})
P	= output power	(kW)	η_{vol}	= volumetric efficiency
V_g	= geometric displacement per rev.	(cm3)	η_{mh}	= mechanical - hydraulic efficiency
$V_{g\ max}$	= max. geom. displacement per rev.	(cm3)	η_t	= overall efficiency ($\eta_t = \eta_{vol} \bullet \eta_{mh}$)
n	= speed	(rpm)	Δp	= differential pressure (bar)

2.1.4 Rotary Group Forces

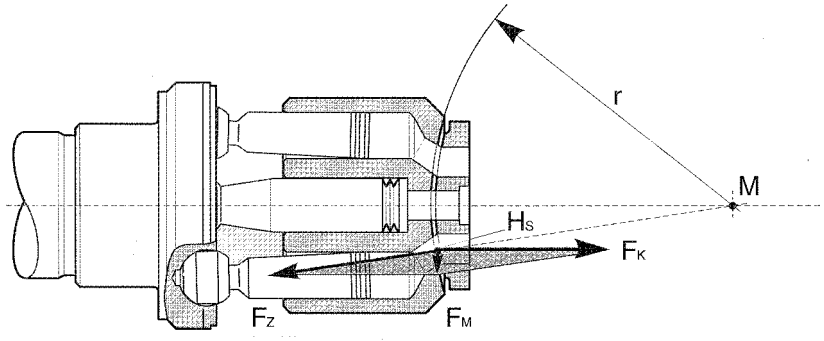
Parallelogram illustrating forces in a Fixed Displacement Unit.

The resolution of forces takes place on the drive flange, ite. direct on the drive shaft. This conversion from torque into piston force in the pump, and in reverse in the motor, guarantees the best possible efficiency. A single resolution means a single efficiency loss!





Resolution of Forces on Port Plate with Spherical Control Face



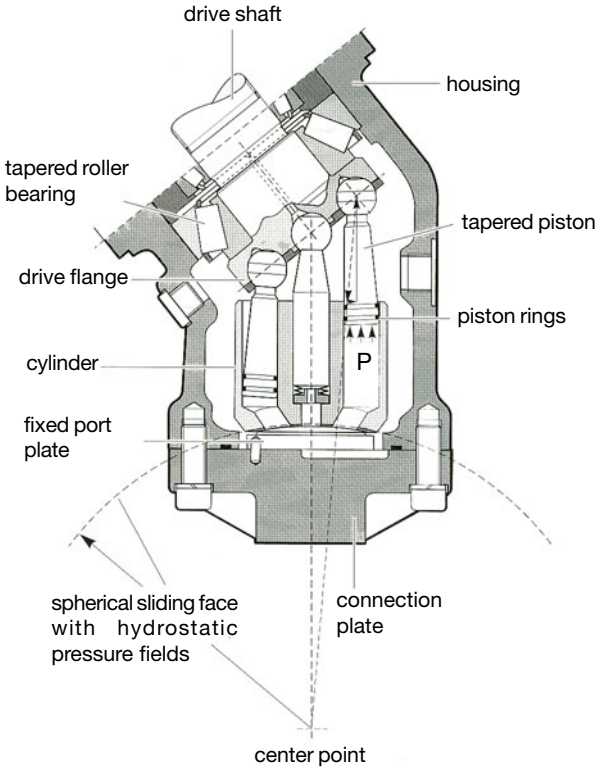
For this torque illustration, a segment of the hydraulic rotary group has been cut out and shown in simplified form in pure static condition with swivel angle 0°.

In practice, when the rotary group is swivelled out, *dynamic* loading is present since 3 or 4 of the piston areas are always under high pressure.

M	=	centre of assumed (theoretical) sphere
r	=	radius of this sphere
Hs	=	focal point of hydrostatic bearing pressure field
FK	=	sum of the force of 3 or 4 pistons
Fz	=	force of hydrostatic pressure field of cylinder
FM	=	resulting force on centre pin

2.1.5 40° Tapered Piston, Bent-Axis Rotary Group

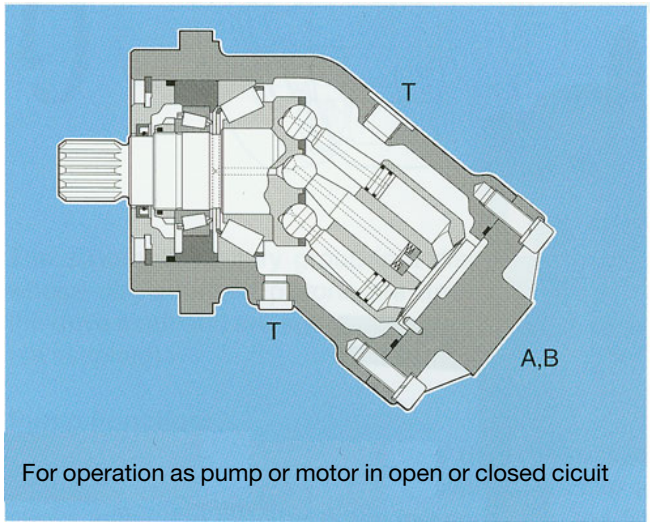
Shown here in housing with fixed swivel angle



- central swivel point
- cardanless cylinder drive
- torque-free cylinder bearing
- self-centring rotary group
- spherical port plate
- tapered roller bearings
- one-piece tapered piston with 2 piston rings
- automatic bearing lubrication
- piston-force resolution direct on drive flange

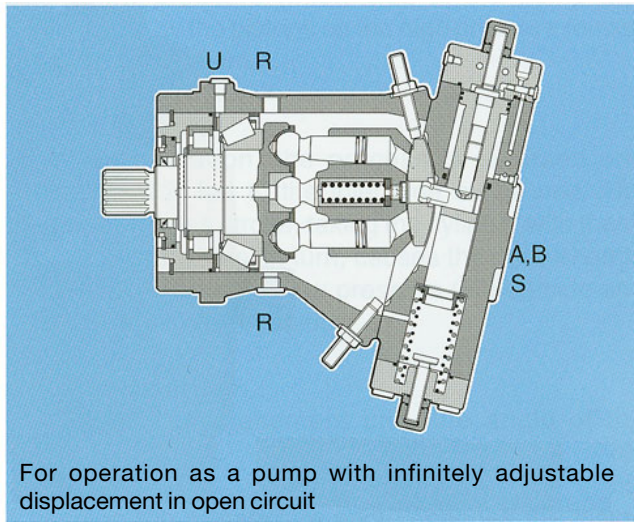
2.1.6 Examples of Types

Fixed Displacement Unit A2F (fixed swivel angle)



For operation as pump or motor in open or closed cicuit

Variable Displacement Unit A7VO (variable swivel angle)



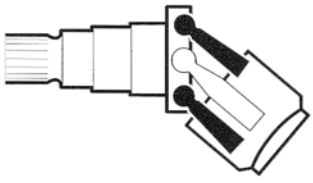
For operation as a pump with infinitely adjustable displacement in open circuit

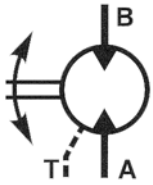
2.1.7 Symbols

Symbolic illustration of the best-known types

A,B Pressure ports
S Suction port
T,R Case drain ports
U Flushing port

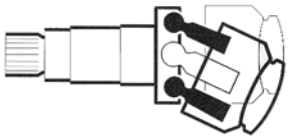
A2FM
Fixed motor





Fixed displacement motor for open or closed circuits; fixed swivel angle; both directions of rotation of power take-off.

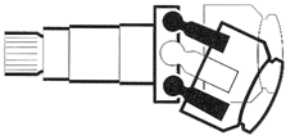
A6VM
Variable motor

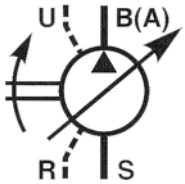




Variable displacement motor for open and closed circuits, swivel to one side only; infinitely variable swivel angle; both directions of rotation of power take-off.

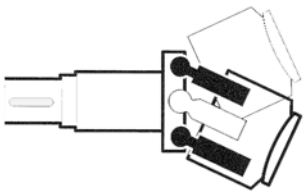
A7VO
Variable pump

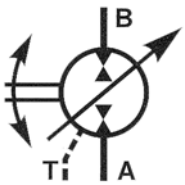




Variable displacement pump for open circuits, swivel to one side only; infinitely variable swivel angle; single direction of rotation of drive.

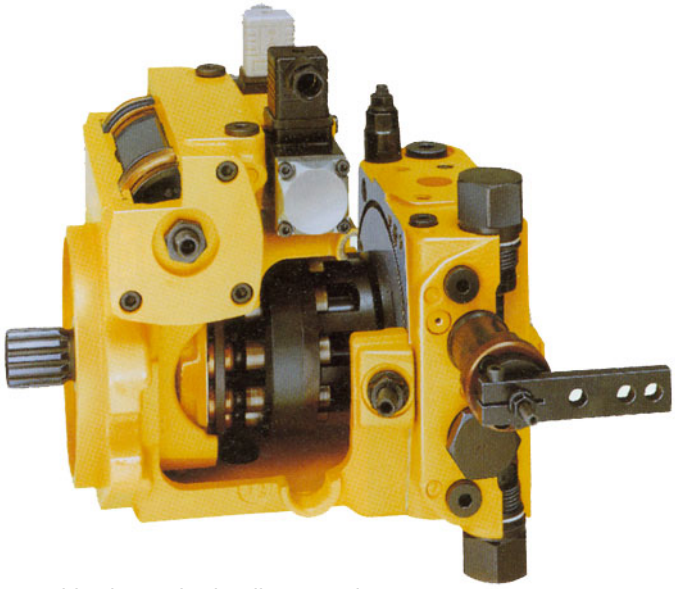
A2V
Variable pump





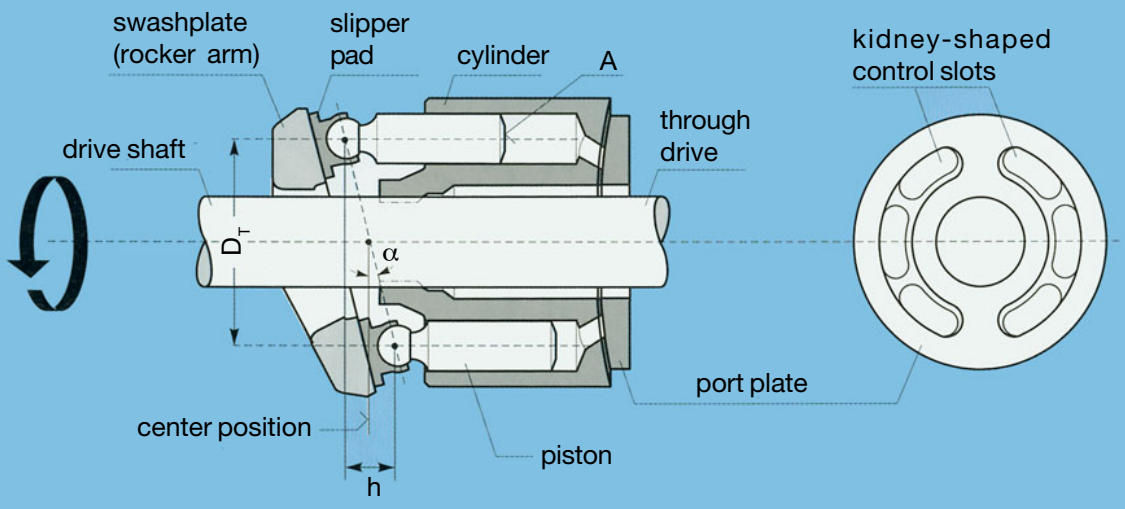
Variable displacement pump for closed circuits, swivel to both sides; swivel angle infinitely variable over centre; both directions of rotation of drive.

2.2 Swashplate



Example:
Variable Displacement Pump with electro-hydraulic control, speed-related closed loop control and built-on auxiliary pump

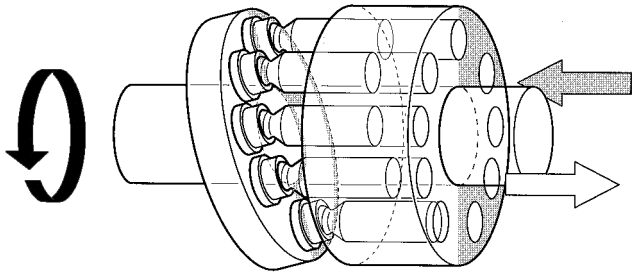
Schematic Diagram of a Swashplate Unit (with pistons parallel to axis)
with fixed or variable swivel angle α



h = piston stroke
A = piston area
D_T = pitch diameter when α=0
α = swivel angle (e.g. 20°)
V_g = geom.displacement [cm^3/rev.]

x = number of pistons (e.g. 9)
h = $D_T \bullet \tan \alpha$
V_g = $x \bullet A \bullet h$
V_g = $x \bullet A \bullet D_T \bullet \tan\alpha$

2.2.1 Swashplate Principle



The *swashplate* rotary group is a displacement unit whose displacement pistons are arranged axially to the drive shaft and are supported against a tilted plate (swashplate).

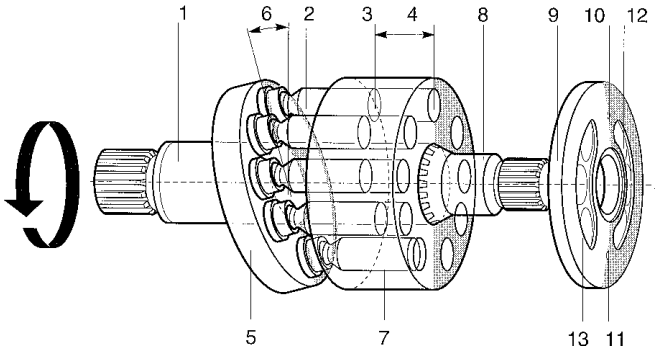
Pump Function:
Through the gearing, rotation of the drive shaft also causes the cylinder to rotate. The pistons execute a stroke within the cylinder bores dependent on the tilt angle of the *swashplate*. The hydraulic medium is fed to the low pressure (inlet) side of the pump and pumped out by the pistons on the high pressure (outlet) side into the system.

Motor Function:
In motor operation, the process is reversed and pressure oil is fed to the inlet side of the unit. The pistons perform a stroke, taking the cylinder with them. Via the gearing, this, in turn, causes the drive shaft to rotate. Oil exits on the low pressure (outlet) side and flows back into the system.

Swashplate Angle:
In the fixed displacement unit, the angle of the swashplate is fixed within the housing. In the variable unit, this angle is infinitely variable within specific limits. Changing the swashplate angle changes the piston stroke, thus varying the displacement.

2.2.2 Description of Function

Example: Variable Displacement Pump



1 = drive shaft
2 = piston
3 = piston area
4 = piston stroke
5 = swashplate
6 = angle of adjustment
7 = cylinder
8 = through drive
9 = port plate
10 = upper dead point OT
11 = lower dead point UT
12 = control slot,pressure side (for direction of rotation shown)
13 = control slot,suction side (for direction of rotation shown)

Description
The axial piston units of swashplate design, with fixed or variable displacement, can operate as hydraulic pumps or motors.
When used as a pump, the flow is proportional to the input speed and the swashplate angle. If the unit is used as a motor, the output speed is proportional to the flow through the unit. The input (pump) or output (motor) torque increases with the pressure drop between the high and low pressure sides.
In pump operation, mechanical energy is converted into hydrostatic power, while in motor operation, inversely, hydrostatic power is converted into mechanical energy.

By adjusting the swashplate angle of a variable pump or motor it is possible to *vary* the displacement and thus the flow.

Function
.....as a pump:
Driven by the prime mover, (e.g. diesel or electric motor), the drive shaft rotates and, via the gearing, also causes the cylinder to rotate, taking with it the nine pistons. The pistons are held against the sliding surface of the swashplate by the slipper pads and carry out a stroke. The slipper pads are held against the sliding surface and guided by means of a return device. As the cylinder rotates, each piston moves through the lower or upper dead point and back to its starting position. A movement from one dead point to the other (where the direction of movement is reversed) constitutes one complete stroke during which a volume of hydraulic fluid, corresponding to the piston area and the stroke, is either *sucked in* or *pumped out* via the two control slots in the portplate.

During the *suction* stroke, the hydraulic fluid is sucked - in reality *compressed* - by atmospheric pressure in open circuits, and by the boost pressure in closed circuits, into the piston area as it increases in size. During the *pressure stroke*, fluid is pushed out through the piston bores on the opposite side into the hydraulic system.

.... as a motor:
The motor function is the reverse of the pump function. In this case, hydraulic fluid is fed from the system to the hydraulic motor. Oil flows via the connection plate through a control slot to the cylinder bores. Four or 5 cylinder bores are located over the pressure side control slot. The remaining cylinder bores are located over the other control slot and are either connected with the return-line side, or may be closed when directly above the connecting strip between the two control slots. Application of pressure to the piston causes it to slide down the swashplate, taking the cylinder with it. The cylinder and the nine connected pistons rotate with the drive shaft and the pistons carry out a stroke. Hydraulic pressure generates a torque at the cylinder and thus the rotation of the drive shaft. The output speed is determined by the volume of flow into the motor.

Control Function: (with control devices fitted)
The angle of the swashplate can be changed, for example, mechanically via a pivot pin or hydraulically via an adjusting piston. The swashplate/rocker arm is mounted on roller or plain bearings and the zero position is spring-centred. Increasing the swivel angle increases displacement and torque, decreasing the angle gives a corresponding reduction in these values. If the swivel angle is zero, the displacement is also zero. Mechanical or hydraulic control devices are normally fitted, which can themselves be controlled and regulated by mechanical, hydraulic or electrical means. Well-known types of control are: electro-proportional control, constant pressure control (zero stroke control), constant horsepower control.

General
Swashplate-type pumps and motors are suitable for application in open and closed circuits. Because of their design, they are used predominantly as pumps in closed circuits. The possibility of mounting auxiliary or secondary pumps on the through drive and of making use of the integrated design of controls and valves offers a number of advantages. Through this compact and lightweight arrangement, longer service life may be expected since the slipper pads are mounted on *hydrostatic* bearings (plain bearings). The resolution of forces (piston forces/torque) takes place on the swashplate via the slipper pad. Forces within the hydraulic section of the rotary group, ie. cylinder with pistons and port plate, are balanced. The drive shaft bearings allow external forces to be absorbed. The principle of the spherical control area, its lubrication, the pre-tensioning of the cylinder via cup springs, etc., are similar to that of the bent-axis rotary group.

2.2.3 Principles of Calculation

Calculating pump size

	Fixed displacement swashplate pump	**Variable displacement swashplate pump**
Flow	$Q=\frac{V_g \bullet n \bullet \eta_{vol}}{1000}$ (l/min)	$Q=\frac{V_{g\,max} \bullet n \bullet \tan\alpha \bullet \eta_{vol}}{1000 \bullet \tan\alpha_{max}}$ (l/min)
Drive speed	$n=\frac{Q \bullet 1000}{V_g \bullet \eta_{vol}}$ (rpm)	$n=\frac{Q \bullet 1000 \bullet \tan\alpha_{max}}{V_{g\,max} \bullet \eta_{vol} \bullet \tan\alpha}$ (rpm)
Drive torque	$M=\frac{V_g \bullet \Delta p}{20\pi \bullet \eta_{mh}} = \frac{1{,}59 \bullet V_g \bullet \Delta p}{100 \bullet \eta_{mh}}$ (Nm)	$M=\frac{V_{g\,max} \bullet \Delta p \bullet \tan\alpha}{20\pi \bullet \eta_{mh} \bullet \tan\alpha_{max}} = \frac{1{,}59 \bullet V_{g\,max} \bullet \Delta p \bullet \tan\alpha}{100 \bullet \eta_{mh} \bullet \tan\alpha_{max}}$ (Nm)
Drive power	$P=\frac{2\pi \bullet M \bullet n}{60000} = \frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600 \bullet \eta_{vol} \bullet \eta_{mh}} = \frac{Q \bullet \Delta p}{600 \bullet \eta_t}$ (kW)	$P=\frac{2\pi \bullet M \bullet n}{60000} = \frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600 \bullet \eta_{vol} \bullet \eta_{mh}} = \frac{Q \bullet \Delta p}{600 \bullet \eta_t}$ (kW)

Where:

Q	= flow	(l/min)	α_{max}	= max. swivel angle (varies according to design)	
M	= drive torque	(Nm)	α	= set swivel angle (between 0 and α_{max})	
P	= drive power	(kW)	η_{vol}	= volumetric efficiency	
V_g	= geometric displacement per rev.	(cm3)	η_{mh}	= mechanical - hydraulic efficiency	
$V_{g\,max}$	= max. geom. displacement per rev.	(cm3)	η_t	= overall efficiency ($\eta_t = \eta_{vol} \bullet \eta_{mh}$)	
n	= speed	(rpm)	Δp	= differential pressure (bar)	

Calculating motor size		
	Fixed displacement swashplate pump	**Variable displacement swashplate pump**
Consumption (Flow)	$Q=\frac{V_g \bullet n}{1000 \bullet \eta_{vol}}$ (l/min)	$Q=\frac{V_g\ max \bullet n \bullet \tan\alpha}{1000 \bullet \tan\alpha_{max} \bullet \eta_{vol}}$ (l/min)
Drive speed	$n=\frac{Q \bullet 1000 \bullet \eta_{vol}}{V_g}$ (rpm)	$n=\frac{Q \bullet 1000 \bullet \eta_{vol} \bullet \tan\alpha_{max}}{V_{g\ max} \bullet \tan\alpha}$ (rpm)
Drive torque	$M=\frac{V_g \bullet \Delta p \bullet \eta_{mh}}{20\pi}=\frac{1{,}59 \bullet V_g \bullet \Delta p \bullet \eta_{mh}}{100}$ (Nm)	$M=\frac{V_{g\ max} \bullet \Delta p \bullet \tan\alpha \bullet \eta_{mh}}{20\pi \bullet \tan\alpha_{max}}=\frac{1{,}59 \bullet V_{g\ max} \bullet \Delta p \bullet \tan\alpha \bullet \eta_{mh}}{100 \bullet \tan\alpha_{max}}$ (Nm)
Drive power	$P=\frac{2\pi \bullet M \bullet n}{60000}=\frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600} \bullet \eta_{vol} \bullet \eta_{mh}=\frac{Q \bullet \Delta p \bullet \eta_t}{600}$ (kW)	$P=\frac{2\pi \bullet M \bullet n}{60000}=\frac{M \bullet n}{9549}$ (kW) $P=\frac{Q \bullet \Delta p}{600} \bullet \eta_{vol} \bullet \eta_m=\frac{Q \bullet \Delta p \bullet \eta_t}{600}$ (kW)

Where:

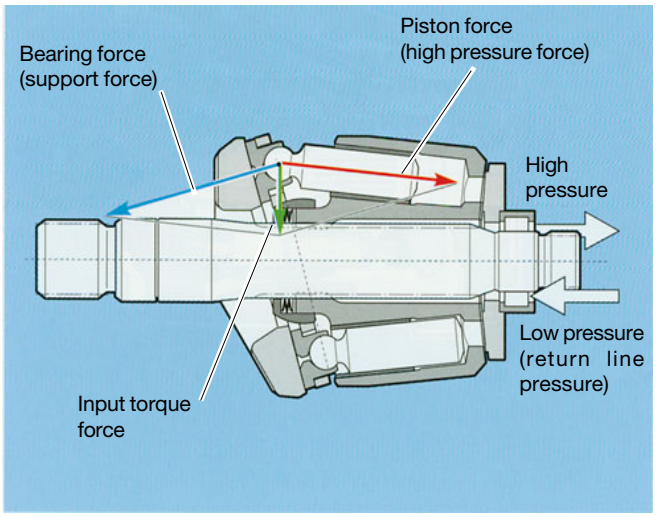
Q	= consumption (flow)	(l/min)	α_{max}	= max. swivel angle (varies according to design)
M	= output torque	(Nm)	α	= set swivel angle (between 0 and α_{max})
P	= output power	(kW)	η_{vol}	= volumetric efficiency
V_g	= geometric displacement per rev.	(cm3)	η_{mh}	= mechanical - hydraulic efficiency
$V_{g\ max}$	= max. geom. displacement per rev.	(cm3)	η_t	= overall efficiency ($\eta_t = \eta_{vol} \bullet \eta_{mh}$)
n	= speed	(rpm)	Δp	= differential pressure (bar)

2.2.4 Rotary Group Forces

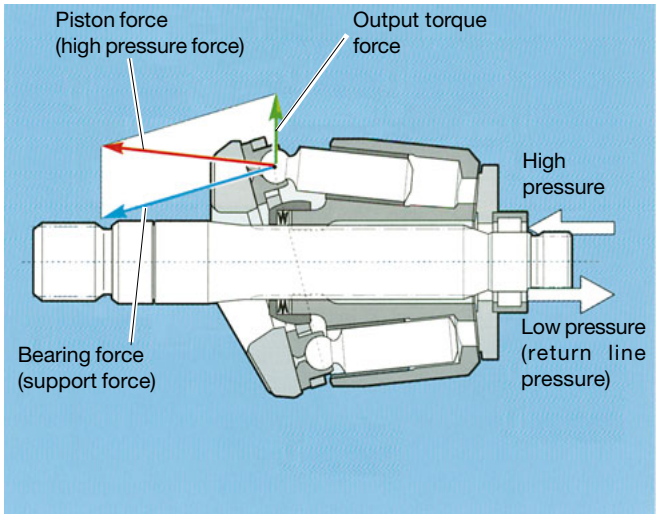
Parallelogram illustrating forces in a variable displacement unit, e.g. with piston angled inwards.

The resolution of forces takes place on the swashplate in the slipper pads and the cylinder.
The piston slipper pads are on hydrostatic bearings, and guarantee long service life of the rotary groups.

Resolution of Forces on the Pump Swashplate



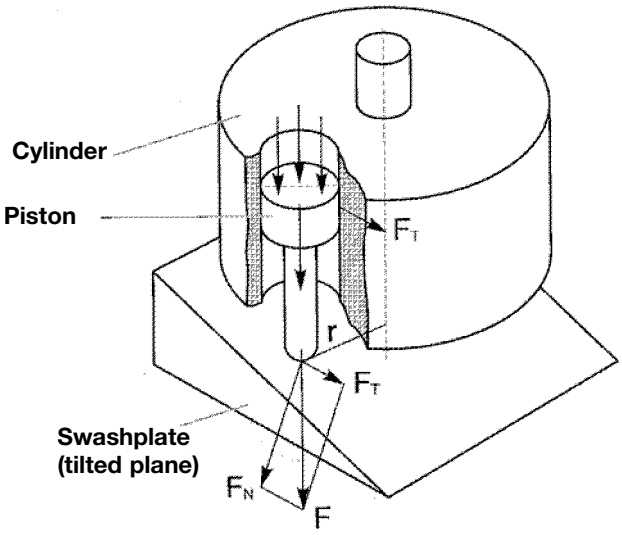
Resolution of Forces on the Motor Swashplate



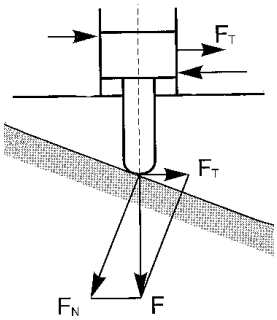
2.2.5 Swashplate Rotary Group

Simplified illustration

The basic components of a swashplate rotary group are **cylinder**, **piston** and **swashplate**.



e.g. as a motor:
As explained in the Description of Function, the piston is pressurised by oil from the pump and pressed against the tilted plate.

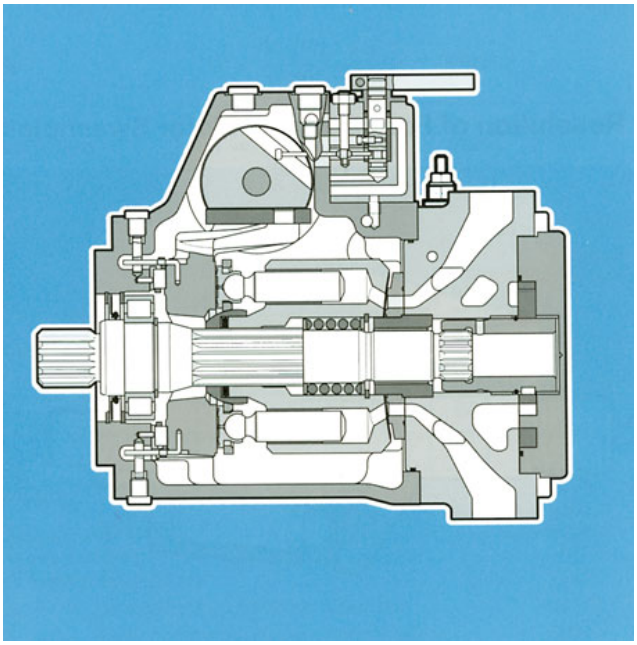


The resolution of the piston forces at the point of contact (plain bearing) with the tilted plate produces a bearing-force and a torque-force component (FN and FT). The piston slides down the tilted plate and carries out a stroke, taking with it the cylinder and drive shaft. However, because of the movement allowed by the piston tolerance within the cylinder bore, at the point of break-away (start-up), a greater frictional resistance occurs (static friction) than during a normal stroke (sliding friction). This 2-fold resolution of forces is the reason for the slightly lower starting efficiency of the *swashplate* unit as compared to the single resolution of forces in the case of the *bent-axis* unit. In practice, this can be important in motor operation, but is of little significance in pump operation.

2.2.6 Examples of Types

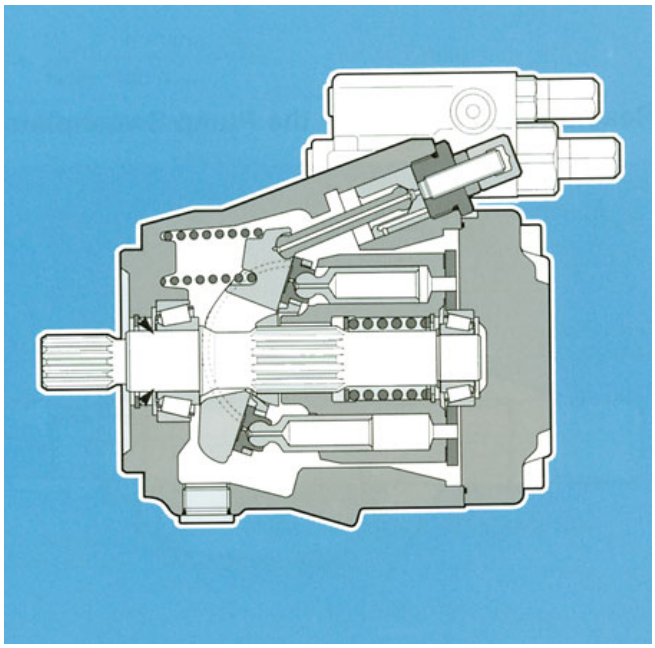
Variable Pump for Closed Circuits A4VG

High pressure range up to 450 bar



Variable Pump for Open Circuits A10VO

Medium pressure range up to 315 bar

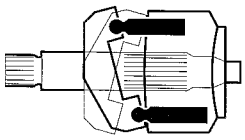


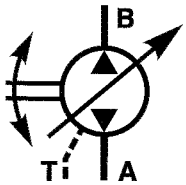
2.2.7 Symbols

Symbolic illustration of the best-known types

A,B	Pressure ports
S	Suction port
T,R,L	Case drain ports
U	Flushing port

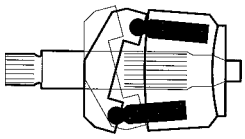
A4VG
Variable Pump

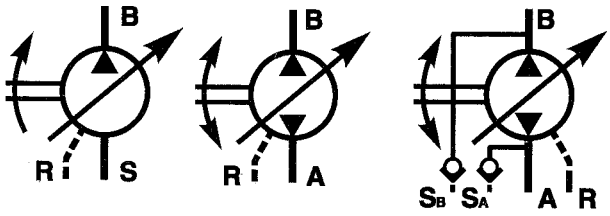




Variable displacement pump for closed circuits, swivel to both sides; swivel angle infinitely variable over centre; both directions of rotation of drive; tandem version possible by mounting additional pump at the through drive.

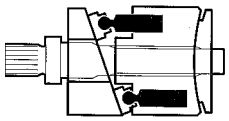
A4VSO/G/H
Variable Pump

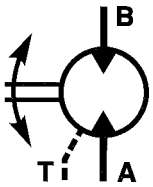




Variable displacement pump for open, closed or semi-closed circuits; swivel angle infinitely variable; single or both directions of rotation of drive and flow direction, depending on the type of circuit; auxiliary pump may be mounted at the through drive.

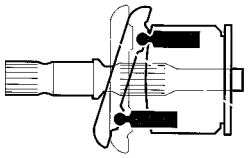
A4FM
Fixed Motor

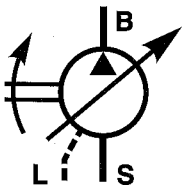




Fixed displacement motor for open or closed circuits; fixed swivel angle; both directions of rotation of power take-off; possibility of through drive for mounting brake.

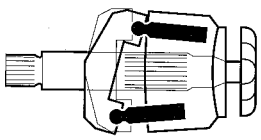
A10VO
Variable Pump

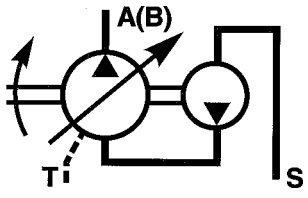




Variable displacement pump fo open circuits, swivel to one side only; infinitely variable swivel angle single direction of rotation of drive

A11VLO
Variable Pump





Variable displacement pump for open circuits, swivel to one side only; infinitely variable swivel angle; single direction of rotation of drive; with built-on charging pump at through drive.

3 Components

3.1 Fixed displacement motors and pumps of bent axis design

With high performance, modern axial-tapered piston rotary groups, series 6

Important Features:

- Cardanless cylinder drive via pistons
- tapered pistons tapered pistone with piston ring seals
- robust tapered roller bearings with long service life
- flange and shaft end to ISO or SAE standards
- two drain ports and flushing port for bearings as standard
- direct mounting of brake valve possible
- models available for special applications
- nominal pressure up to 400 bar, peak pressure up to 450 bar



3.1.1 Fixed Motor

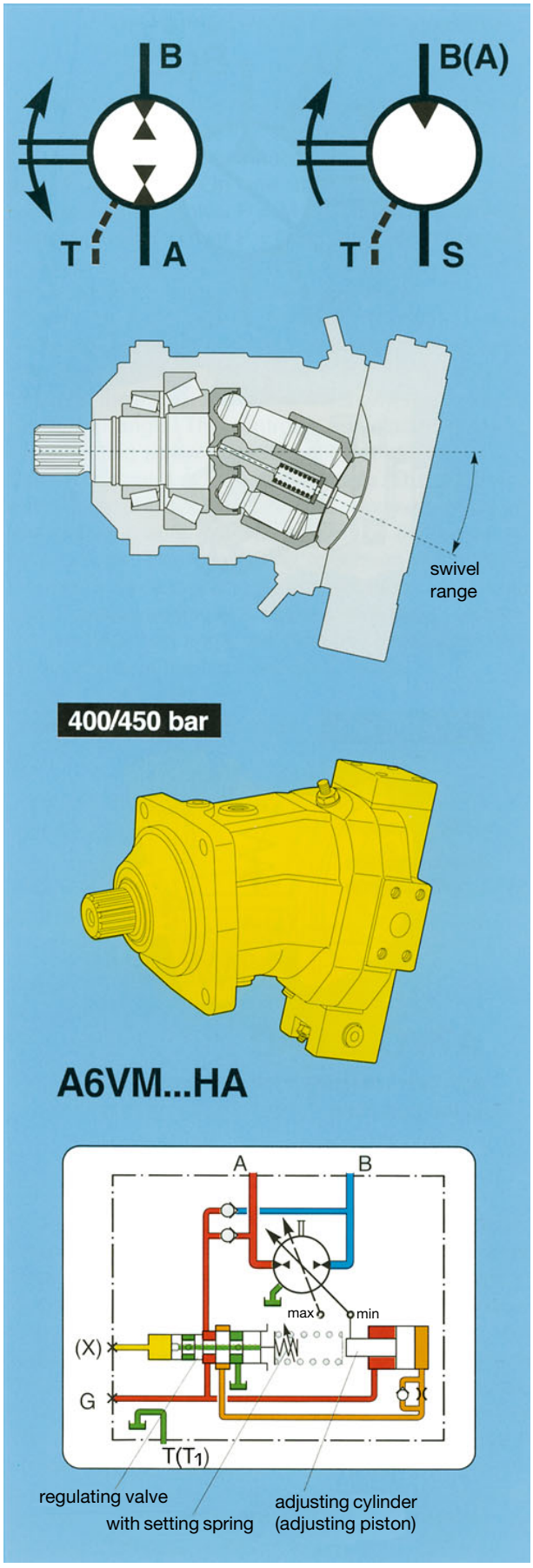
Operation as a motor in open and closed circuits; used in mobile and industrial applications, wherever a constant displacement is required for hydrostatic power transmission.

3.1.2 Fixed Pump

With a suitable connection plate fitted, the A2FM motor becomes the A2FO pump (not illustrated) which is suitable for open circuits and is noted for its robustness, reliability, long service life and quiet operation.

3.1.3 Fixed Pump for Trucks

Pump with special characteristics and dimensions for applications in mobile trucks; it is designed for a pressure range of 250/350 bar. If it is necessary to change the direction of rotation (e.g. with change of gearbox), this is simply carried out on the open-circuit pump by rotating the connection plate.



3.2 Variable Motor of Bent-Axis Design for Open and Closed Circuits

Important Features:

- gives greater control range for hydrostatic transmissions
- fulfils the requirement for high speed and high torque
- cost-saving through elimination of gearbox, and possibility of using smaller pumps
- low unit power
- good starting characteristics
- various control and regulating devices
- swivel to one side only
- nominal pressure 400 bar, peak pressure 450 bar

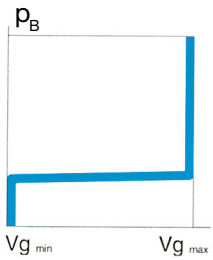
3.2.1 Automatic Control, High-Pressure-related

The A6VM variable motor has a bent-axis rotary group. The torque is therefore generated direct on the drive shaft and the cylinder is driven without a Cardan coupling directly by the tapered pistons. The swivel angle of the rotary group may be changed by moving the control lens along a spherical surface by means of the adjusting piston. Provided that the pump flow and high pressure remain constant, then
- reducing the angle gives higher speed and lower torque
- increasing the angle gives higher torque and lower speed.

The code ... HA refers to the high-pressure-related control of this motor. The displacement is set automatically dependent on operating pressure. When the operating pressure set with the regulating valve - measured internally via A or B - is reached, the motor is swivelled from V_{gmin} to V_{gmax}.Below this pressure, the motor remains at minimum swivel angle.

HA curve
Automatic control
high-pressure-related

P_B = operating pressure
V_g = displacement



3.3 Variable Pump of Bent-Axis Design, for Open Circuits

Important features:

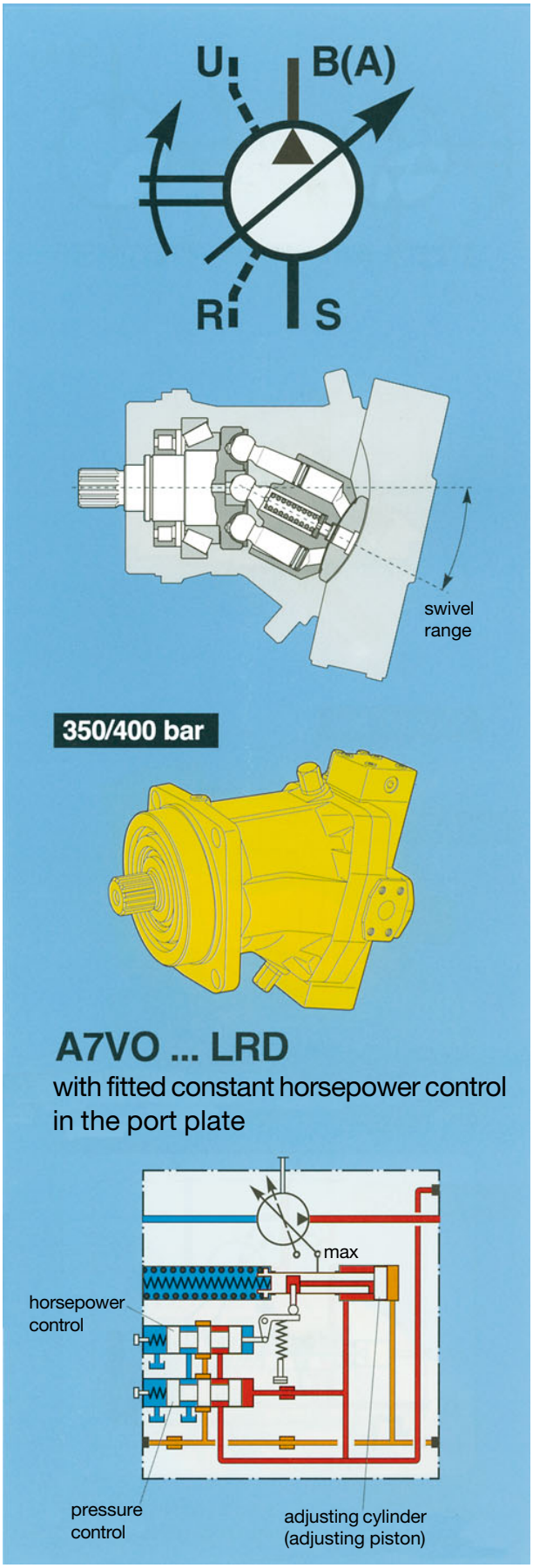
- axial-tapered piston rotary group
- Cardanless cylinder drive via tapered pistons
- robust bearings with long service life
- displacement variable between V_{90} and V_{gmax}
- constant horsepower control with exact hyperbolic curve
- constant pressure control, hydraulic and electric control devices, load-sensing operation possible
- high pressure range up to 350/400 bar
- for use in mobile and industrial applications

3.3.1 High Pressure Applications

The A7VO is a variable pump with internal drain for open hydraulic circuits. The bent-axis rotary group is characterised by its robustness and good self-priming properties. The drive shaft bearings also allow external forces to be absorbed. For particularly demanding requirements in terms of force absorption and running time, type A7VLO has a rotary group with specially strengthened bearings.

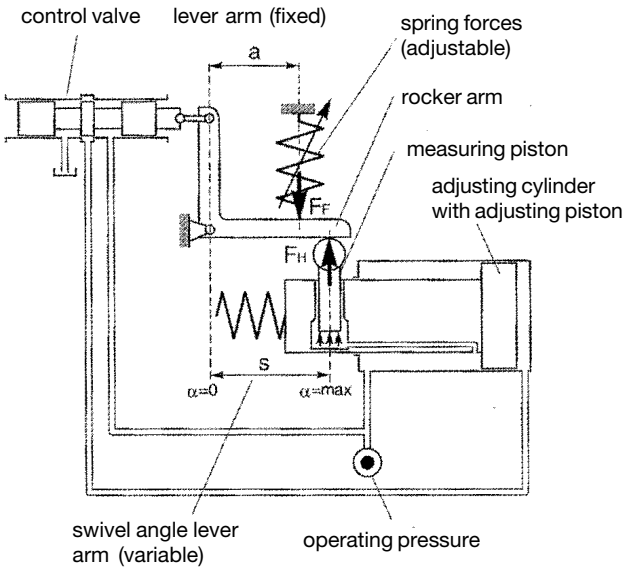
The swivel angle of the rotary group is changed by moving the control lens along a spherical surface by means of an adjusting piston. Increasing the angle increases the pump flow and the required drive torque.

Reducing the angle reduces the pump flow and the required drive torque. The maximum angle is e.g. 25° or 26.5°. The minimum 0°. The pump is controlled as a function of the operating pressure, and adjusted by means of external control signals. The necessary control pressure is taken from the pressure side via a check valve.



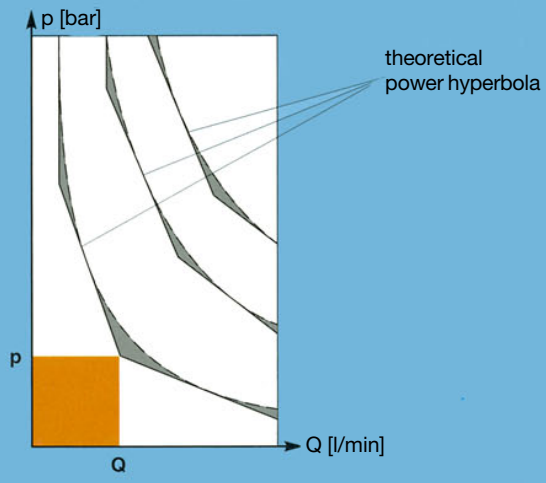
3.3.2 Constant Horsepower Control LR (see Spring-Loaded Control/Hyperbolic Control)

The control holds the pump input torque **M [Nm]** constant. The constant horsepower control is a function of this constant torque in combination with a constant input speed **n [1 /min]**. On one side we have the input mechanical drive power **P = M•n [kW]**, on the other the hydraulic output power **P = Q•p [kW]**. While operating pressure **p [bar]** is dependent on load, flow **Q [l/min]** can be varied by changing the swivel angle.
Similar to a computer, the control continuously multiplies pressure and flow, and compares the result with the set value. Any upward drift is corrected by reducing the swivel angle and, inversely, by increasing the swivel angle. The control is adjustable (screwing in the setting screw increases the set value).
Start of control is at max. swivel angle. The position at end of control is dependent on the maximum pressure. Alternatively, both end values can be limited by the stop screws. Warning: if the maximum set angle is increased there is a danger of cavitation in the pump and of over-speeding of the hydraulic motor! Increasing the minimum set angle can lead to overloading of the prime mover in the high pressure range.



Operating pressure acts via a measuring piston in the adjusting piston on a rocker arm. The opposed spring force, externally adjustable, determines the power setting. If operating pressure **p** exceeds the permissible value, calculated from the formula **P = Q•p [kW]**, the rocker arm actuates the control valve and the pump is destroked. The pump flow is reduced until the product of **Q•p** once again corresponds to the available power. The ideal power hyperbola is achieved, the drive is not overloaded, because of the “constant HP control”. Inversely, the pump flow can, depending on operating pressure and supported by a return spring, be increased up to its maximum value.

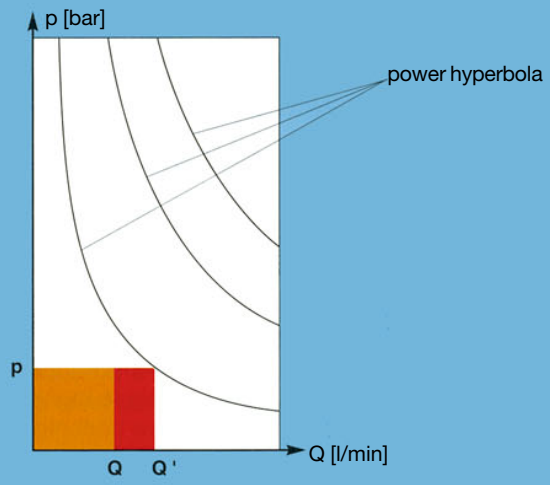
Spring-loaded Control with approximated curve



Hydraulic
Power formula: P = Q • p[kW] = constant

- power matching possible by changing the spring package
- power losses in the range shown by shaded section
- no zero swivel, i.e. residual flow against high pressure generates heat

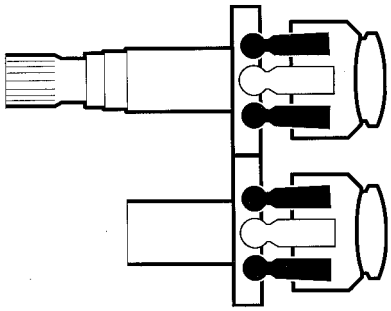
Hyperbolic Control with ideal hyperbolic curve



Hydraulic
Power formula: P = Q' • p[kW] = constant

- optimum power matching by infinitely variable spring force, settable externally
- zero swivel, i.e. no residual flow, generating less heat

3.3.3 Variable Double Pump with 2 parallel Bent Axis Rotary Groups



Two variable pumps - one drive. An advantageous combination of two individual pumps with integral distributor gear.

Models with secondary drive and/or auxiliary pump for the supply of additional hydraulic circuits are today standard, particularly in mobile applications.

As an extension of the constant horsepower control for a single pump (A7VO..LR - see pages 18/19), the double pump A8VO..SR with *summated horsepower control* is used, for example, for two parallel hydraulic circuits where the total drive power is split between the two circuits proportional to the pressures in both circuits.

The high pressure signal is averaged in the summation valve and used as the reference value. The ideal hyperbolic power curve is achieved when the torque forces acting on the rocker arm of the constant horsepower control are in balance.

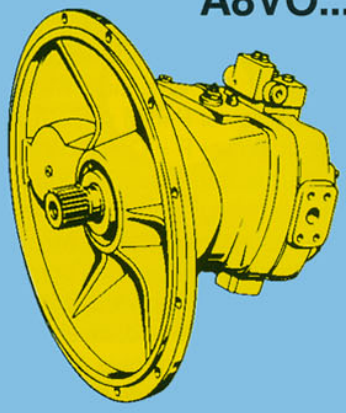
The max. hydraulic torque, which is the product of high pressure force $\mathbf{F_H}$ and swivel stroke **s**, may not exceed the mechanical torque occurring as a product of the adjustable spring force $\mathbf{F_F}$ and the fixed lever arm **a**.

Since the operating pressure **p** is predetermined by the hydraulic system and the pump can only change its flow **Q**, if the max. allowable power is exceeded, the pump is automatically swivelled back to a smaller angle. Swivel stroke **s** is reduced until the resulting hydraulic torque is once again equal to the given mechanical torque.

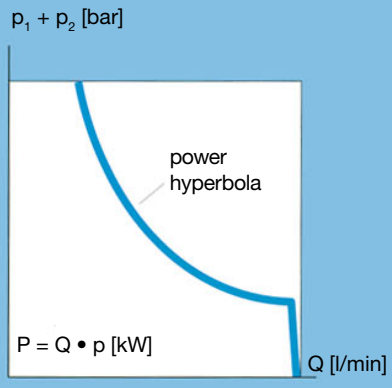
In practice, both individual or combined controls find application. Common variations are load-limit control, three-circuit control, load sensing, etc.

350/400 bar

A8VO...SR



Hyperbolic control
Summated Hp control curve

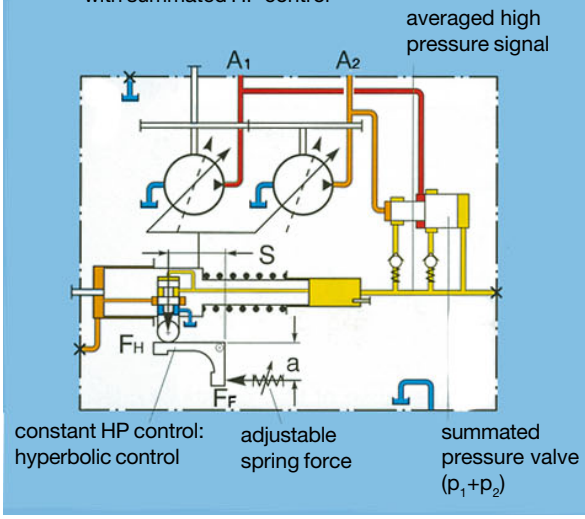


Q = flow

p_1= operating pressure 1 . pump at A_1

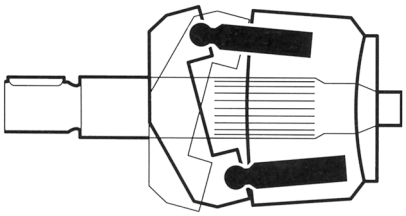
p_2= operating pressure 1 . pump at A_2

Double pump
with summated HP control



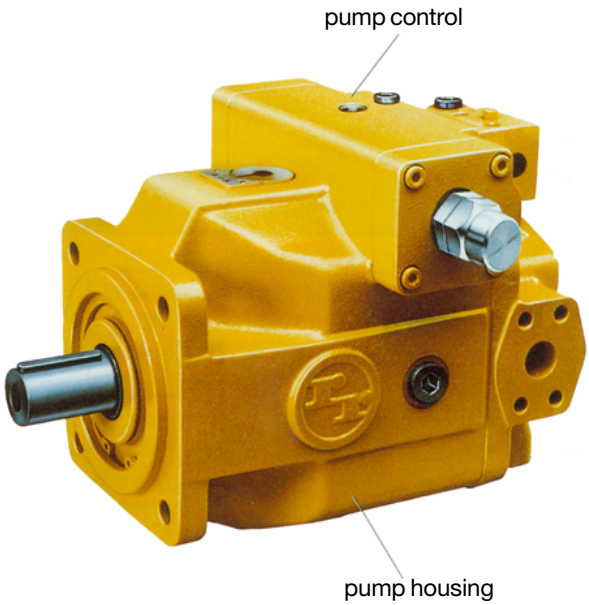
3.4 Variable Pump of Swashplate Design
for universal industrial applications

O=open circuit
G=closed circuit
H=semi-closed circuit



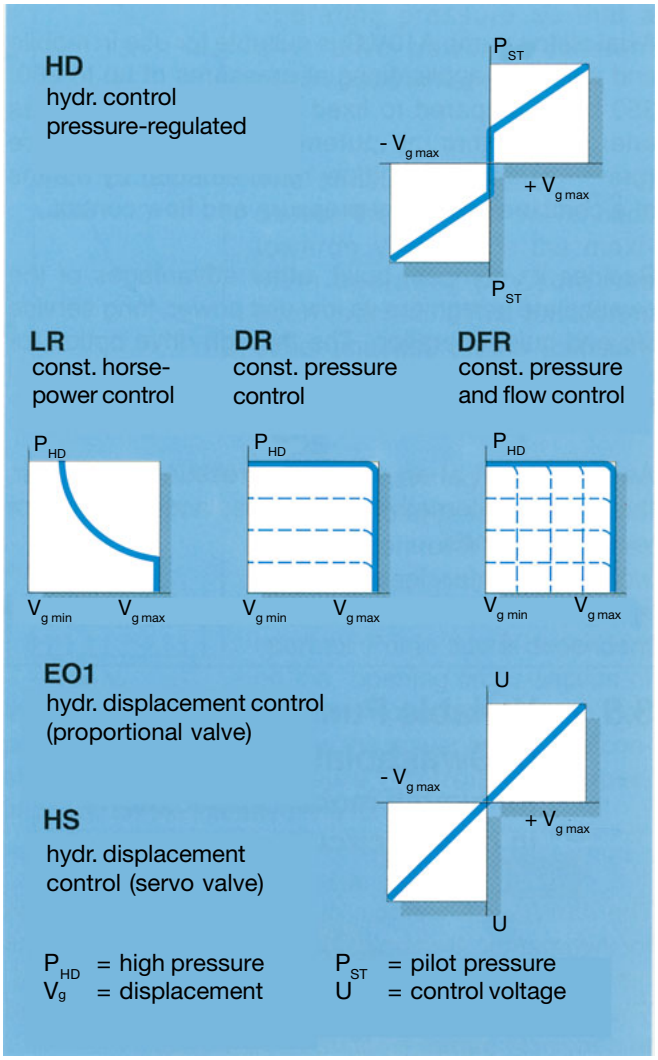
The A4VS.. variable pump is universally suitable for use in the various types of circuit (O-C-S). A wide range of controls and pump models are available. For industrial applications the A4VS..G pump e.g. (operating in closed circuit) can be extended by the addition of relevant adjusting devices and built-on valve block, auxiliary pumps at the through drive, tank and cooler to form a complete hydraulic drive unit. A semi-closed circuit **..H..** may also be extended by the use of anti-cavitation check valves. This will compensate e.g. for differences in volume when operating single rod cylinders.

350/400 bar



A4VSO

3.4.1 Pump Control Devices
of modular design for a variety of control and regulating functions



In addition to the recognised advantages of swashplate design the A4VSO pump, developed specially for use in industrial applications, also offers an extremely long bearing service life. Load-sensing control and mooring operation, as well as secondary control, can be achieved with this pump.
The system of closed loop secondary speed control, in combination with a pressure-controlled pump and a secondary-controlled motor, guarantees high control dynamics, accurate speed control, minimal power loss and energy recuperation.
Speed control DS1 regulates the variable unit to produce the necessary torque for the required speed. This torque (in the power supply with impressed pressure) is proportional to the displacement and thus also proportional to the swivel angle. The swivel ang le (adjusting distance) is recorded by means of an inductive positional transducer, and the speed is recorded by a tachogenerator.

3.5 Variable Pump of Swashplate Design for medium pressure range in open circuits

Axial piston pump A10V.O is suitable for use in mobile and industrial applications at pressures of up to 280/ 350 bar. Compared to fixed pump systems it saves energy, e.g. through automatic matching to force (pressure) and speed (flow requirements) by means of a combined constant pressure and flow control.

Besides its compact build, other advantages of the swashplate design are its low unit power, long service life and quiet operation. The through-drive option for mounting of additional pumps is a particularly useful feature.

As a fixed unit at an operating pressure of 280 bar, this is a real alternative to fixed displacement gear or vane type pumps.

Medium high pressure range

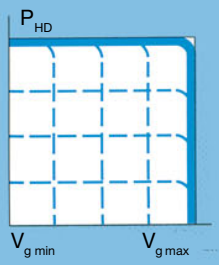
280/350 bar



A10VSO

DFR
constant pressure
and flow control

P_{HD} = operating pressure
Vg = flow



3.6 Variable Pump of Swashplate Design for simple mobile applications in closed circuit

The A10VG is a variable pump of swashplate design for hydrostatic transmissions in a closed circuit. All necessary valves and an auxiliary pump are integrated. The pump design is such that it can easily be extended to a multiple pump.

The swivel angle of the rotary group is changed, e.g. directly by tuming the pivot pin manually.

If the swivel angle is zero, the pump flow is also zero. Swivelling the pump over centre smoothly reverses the direction of flow.

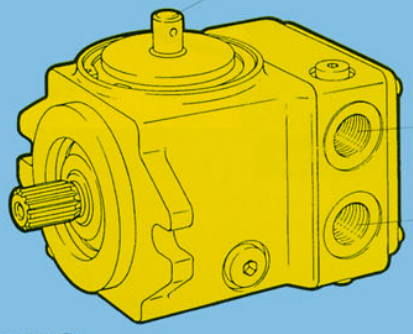
With the manual pivot pin control, the pin is connected direct to the rocker arm of the rotary group. The angle of rotation of the pin corresponds to the pump swivel angle. The necessary adjustment torque, usually applied by hand or foot force, is influenced by the high pressure and the swivel angle. Limiting of the stroke, or angle of the stroke, or angle of the control mechanism, or possible zero-centring, must be carried out within the control mechanism itself.

In addition to the manual pivot-pin control, hydraulic controls can also be fitted to this pump.

Medium high pressure range

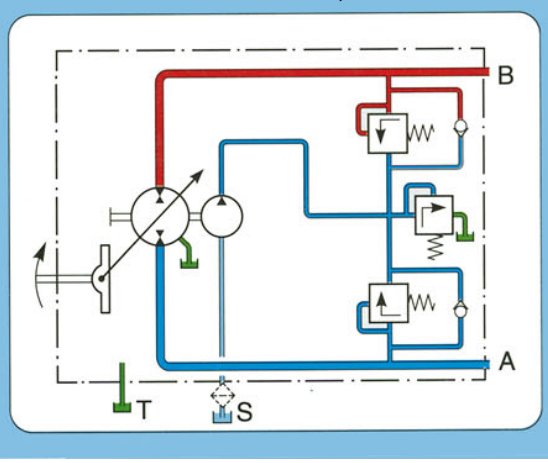
300/350 bar

e.g. pivot pin control



A10VG

A, B = service lines
T = tank, S = suction line

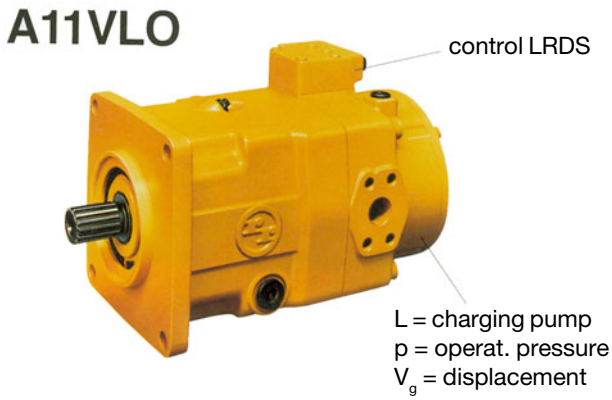


3.7 Variable Pump of Swashplate Design for mobile applications in open circuit with charging pump

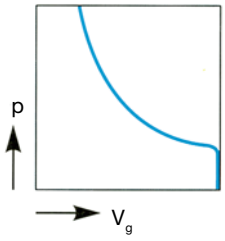
The control functions of the A11VLO illustrated here can be operated either super-imposed or as individual functions:

- constant horsepower control with hyperbolic curve
- constant pressure control via sequence valve
- load-sensing control via p-contr ol of load-pressure signa

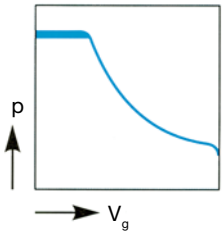
High Pressure Range 350/400 bar



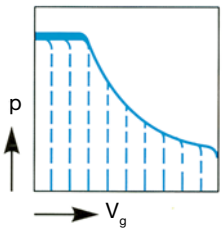
Load-Sensing control



LR
The constant horsepower control regulates the pump displacement in relation to the operating pressure so that a given drive power at constant drive speed is not exceeded.



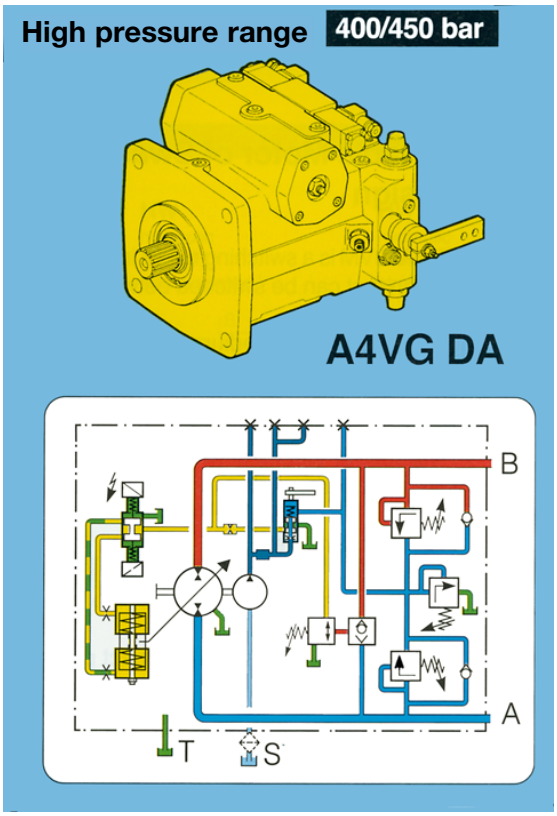
DR
The constant pressure control causes the pump to swivel back towards Vg=O, once the maximum operating pressure has been reached. This function is super-imposed on the constant horsepower control.



LRDS
The load-sensing control operates as a load-pressure dependent flow controller and matches the pump displacement to the flow requirement indicated by the operator. Pump flow is dependent on the opening cross-section of the directional valves, but is not affected by the load pressure in the range below the power curve. The constant power and pressu re controls are superimposed on the load-sensing function.

3.8 Variable Pump of Swashplate Design high-pressure mobile transmissions in closed circuit

We have here in the A4VG DA pump a power pack, complete with all componente for closed circuit operation, similar to that described in 3.6. Through hydraulic control with various control devices, we have the typical “mobile pump”. This is combined with a fixed or variable motor to give the automatic “mobile transmission”.
Illustrated here is the “speed-related automotive control”. The pump is controlled by means of the drive speed, operating pressure and, electrically, via 2 switching solenoids. The control energy is taken from the boost circuit. The pump control time is retarded by means of throttles.
The DA control is designed for mobile transmissions with combustion engines. It takes account of the fact that in combustion engines the torque increases with the speed, and that with loads around the max. torque limit a loss of speed occurs. The power capacity of a combustion engine can, therefore, more or less be equated with its current speed. Through corresponding adjustments on the hydraulic side, optimum automotive control is achieved.



3.9 Fixed Motor of Swashplate Design

The A4FM is of compact, space-saving design, offering the following technical advantages with:

Connection in series (summated pressure)
Mounting of brake possible
Insensitive to oscillations

This fixed motor for high pressures (350/ 400 bar) is suitable for connection in series. The axial pressure compensation of the hydrostatic bearing on the slipper pads ensures high loading capability and a long service life.



3.10 Variable Motor of Swashplate Design

The A10VM is a switching motor in swashplate design that can be switched between two positions. It operates in the medium pressure range (250/315 bar) in open or closed circuits.

Variable motor/switching motor
Hydraulic or electrical two-point adjustment with mounted switching valve

Adjustment range 1: 2.5

Mechanical holding brake can be built on

Also available as a small compact plug-in motor.



3.11 Summary of the most common control options on pumps and motors

The electronic components (amplifiers), used to amplify the signals, are not listed here.

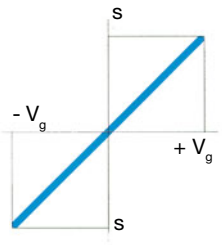
Different features of the controls are:

- type of circuit
- force transfer
- (hydraulic or mechanical)
- operation of control
- (direct or pilot operation)
- curve (position and adjustability)
- open loop control (without feedback)
  - mechanical/manual
  - mechanical/electrical
  - hydraulic/mechanical
  - hydraulic/electrical
  - hydraulic/hydraulic
- closed loop control (with feedback)
  - hydraulic/mechanical
  - hydraulic/electrical

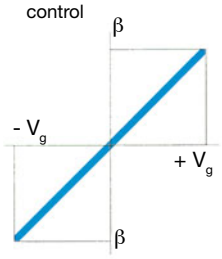
3.11.1 Pump Controls

- Mechanical - manual, proportional to:
  MA - control stroke **s**, or
  MD - control angle **ß** for pumps in reversible operation
- Mechanical/electrical, with
  EM - electric gear motor

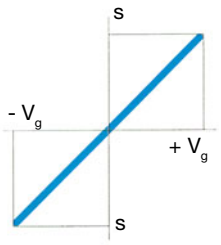
MA
manual control



MD
mechanical pivot pin control



EM
electric motor control

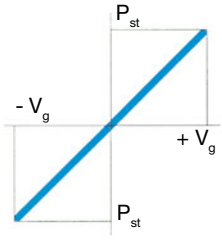


V_g = specific displacement s = control stroke β = control angle

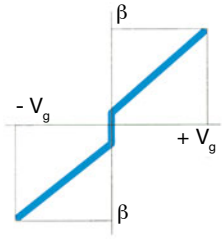
- Hydraulic - mechanical, proportional to:
  DG - pilot pressure p_{st}

  HW - control angle **ß**, or control stroke **s** for pumps in reversible operation

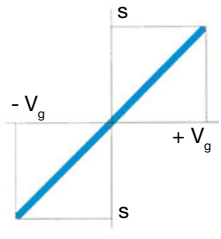
DG
direct operated hydraulic control pressure related



HW
hydraulic control stroke related [1)]



HW
hydraulic control stroke related

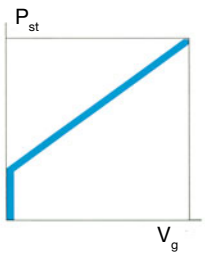


V_g = specific displacement p_{st} = pilot pressure [1)] = dead band in zero position

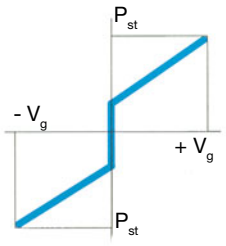
• Hydraulic - hydraulic:

HD - proportional to pilot pressure p_{st} for pumps in open circuit or reversible operation

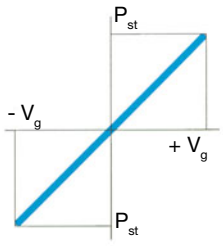
HD
hydr. control
pressure related



HD
hydr. control
pressure related"



HD
hydr. control
pressure related



V_g = specific displacement p_{st} = pilot pressure [1] = dead band in zero position

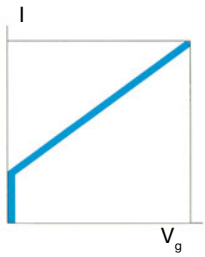
• Hydraulic - electrical:

EZ - with switching solenoids (not illust.)

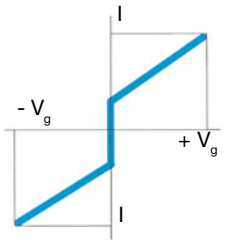
EP - with proportional solenoids, proportional to control current **I** in open or closed circuit

ES - with servo valve in closed circuit

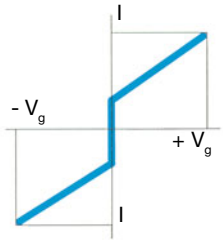
EP
electric control
with proportional
solenoid



EP
electric control
with proportional
solenoid



ES
electric control
with servo valve



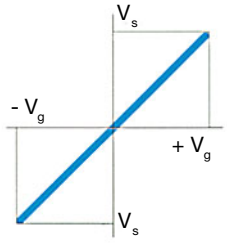
V_g = specific displacement I = control current

• Hydraulic, flow-related:

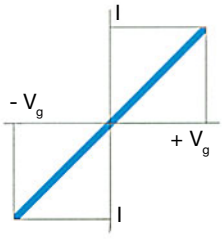
HM - proportional to pilot oil flow V_{st}, in reversible operation

HS - electrical/hydraulic with built-on servo valve, proportional to control current **I**

HM
hydr. control
flow-related



HS
hydr. control
with servo valve

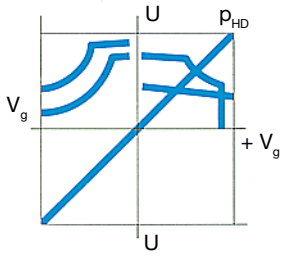


V_g = specific displacement V_s = pilot oil flow

• Hydraulic, flow-related:

EO - with built-on proportional valve in reversible operation; with electronic amplifier; closed loop control possible.

EO
electronic
control



U = control voltage P_{HD} = high pressure

3.11.2 Closed-Loop Pump Controls

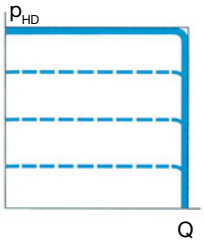
• Hydraulic:

DR - constant system pressure through suitable adjustment of pump flow

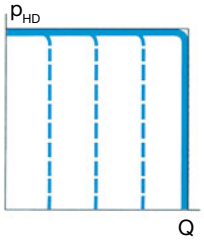
FR - constant pump flow with variable drive speed and/or flow variation to meet changing user requirement

DFR - a combination of both the above controls; the constant flow control is superimposed on a mechanically settable constant pressure control

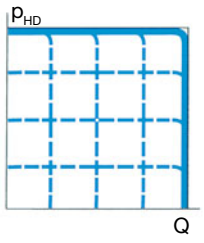
DR
constant
pressure control



FR
constant
flow control



DFR
const.
pressure and flow control



Q = flow p_{HD}= high presure

LR - constant drive torque control; power = torque x speed, **P = M x n** = constant.

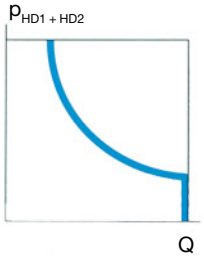
SR - for parallel operation of two pumps from one prime mover; automatic power distribution by summation of pressure

DFLR - combined constant pressure/ flow control with super-imposed constant horsepower control

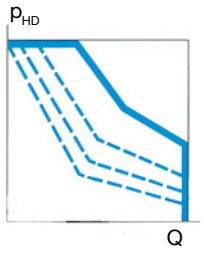
LR
constant
HP control



SR
summated
HP control



DFLR
const. pressure,
HP and flow
control



V_g = specific displacement Q = flow p_{HD}= high presure

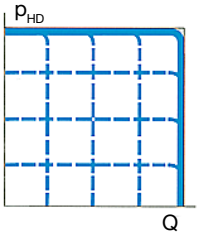
DRS - flow variation according to user requirement (load sensing) with super-imposed constant pressure control; pump is swivelled dependent on load pressure

LRDS - drive torque is limited on max. by addition of constant horsepower control; pump flow is varied according to user requirement

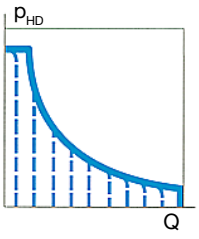
• Electronic:

DFE - alternative electronic version of combined control DFR.

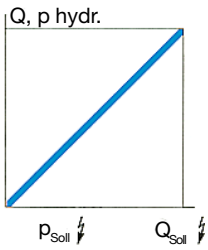
DRS
const. pressure
control with
load sensing



LRDS
const. HP control
with pressure cut-off
and load sensing



DFE
electronic const.
pressure and
flow control



V_g = specific displacement p_{HD} = high pressure ↯ = eletric signal

3.11.3 Motor Controls

• Hydraulic- hydraulic:

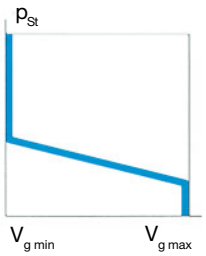
HD - proportional to pilot pressure p_{ST}.

HZ - hydraulic/hydraulic, two-point control

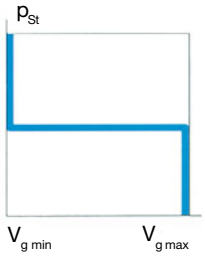
EP - hydraulic/electric, with proportional solenoid

EZ - with switching solenoid, two-point control.

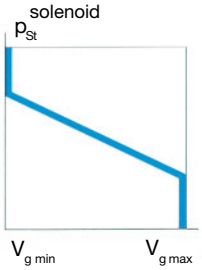
HD
hydr. control, pilot-pressure-related



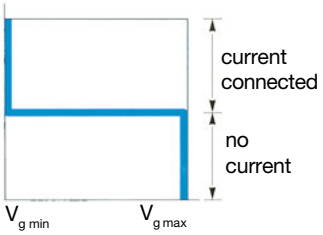
HZ
hydr. two-point control



EP
electrical control with proportional solenoid



EZ
electrical two-point control with switching solenoid



V_g = specific displacement p_{st} = pilot pressure I = control current

3.11.4 Closed-Loop Motor Controls

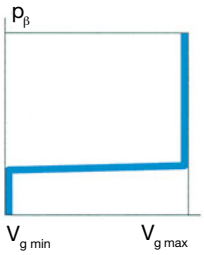
• Hydraulic:

HA - automatic high-pressure-related control; automatic adjustment to current torque requirement

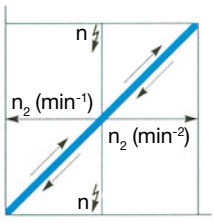
DS - pumps with DS control are used as motors for "secondary control"

DA - speed-related hydraulic control is the basis for "mobile transmission" with "automotive control".

HA
automatic control high pressure related



DS
constant speed control, with secondary control



DA
hydr. control speed related

V_g = specific displacement p_β = operating pressure n = speed

C.02 HYDRAULIC SYMBOLS

MOTORS


Fixed motor with one direction of flow


Fixed motor with two directions of flow


Variable motor with two directions of flow


Reversible fixed motor with two directions of flow

PUMP


Fixed displacement pump with one direction of flow


Fixed displacement pump with two directions of flow


Variable displacement pump with one direction of flow

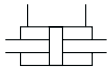

Variable displacement pump with flow regulator

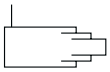
CYLINDERS


Single-acting cylinder


Single-acting cylinder with spring return


Double-acting cylinder


Double-acting cylinder with bilateral rod


Telescopic cylinder

COMMANDS AND CONTROLS


Shaft rotating in one direction


Shaft rotating in two directions


Hand-operated control

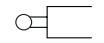

Hand-operated control with pushbutton

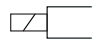

Hand-operated control with lever

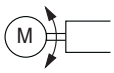

Hand-operated control with pedal


Mechanical control with pushbutton

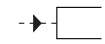

Mechanical control with spring

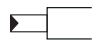

Mechanical control with roller


Electro-magnetic control with winding (solendoid)



Control with electric motor


Direct pressure control


Indirect (piloted) pressure control


Control with electromagnet and piloted distributor

PIPES AND CONNECTIONS

Induction and return pipe

Piloting pipe

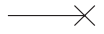
Blow-by pipe


Flexible hose

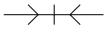

Connecting point

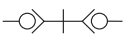

Pipe cross without connection


Breather


Closed pressure fitting


Pressure fitting with connected pipe


Quick fitting


Quick fitting with check valves

DISTRIBUTION - SETTING ELEMENTS


Non-return valve


Calibrated non-return valve

Unlockable non-return valve

Combined non-return and throttle valve

Switching valve

Pressure relief valve with direct control

Pressure relief valve with hydraulic control

Pressure reducing valve

Sequence valve

Adjustable throttle valve

Two-way flow regulator

Cut-out cock

POWER SOURCES

Electric motor

Thermal engine

OTHER EQUIPMENT

Accumulator

Water tank

Compressor

Filter

Cooler

Pressure gauge

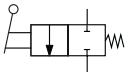
Thermometer

Flowmeter

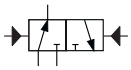
Pressure switch

Drain to tank indication

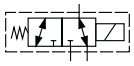
DISTRIBUTION - SETTING ELEMENTS



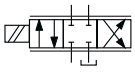
Two-position and two-way distributor, with manual lever control and spring return



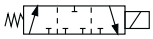
Three-way and two-position distributor, with hydraulic control



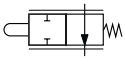
Two-position, three-way distributor, with electro-magnetic control and spring return



Distributor with mechanical control and span proportional to the action of the same control

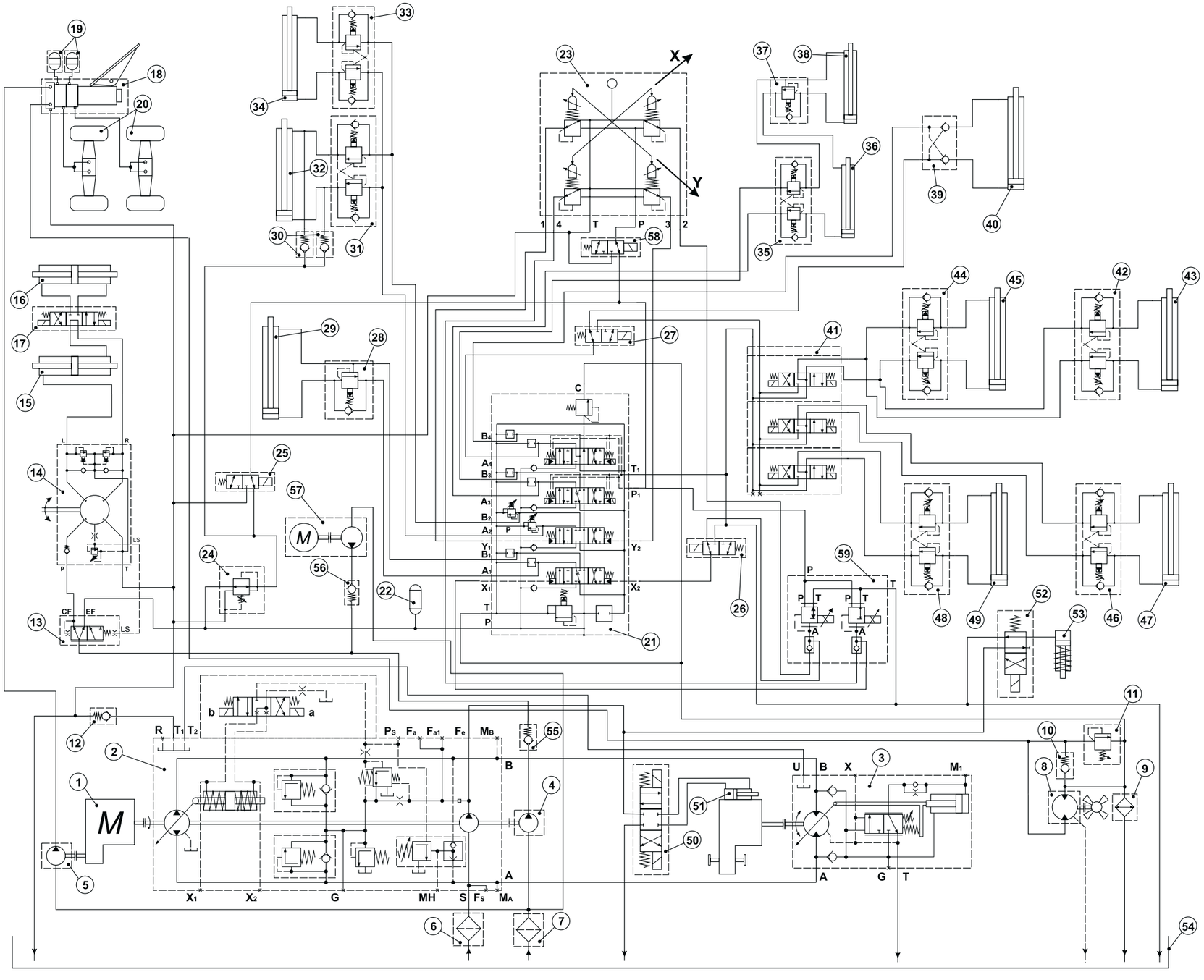


Two-position, three-way distributor, with representation of transient connection during passage phase



Electro-hydraulic single-acting servo valve

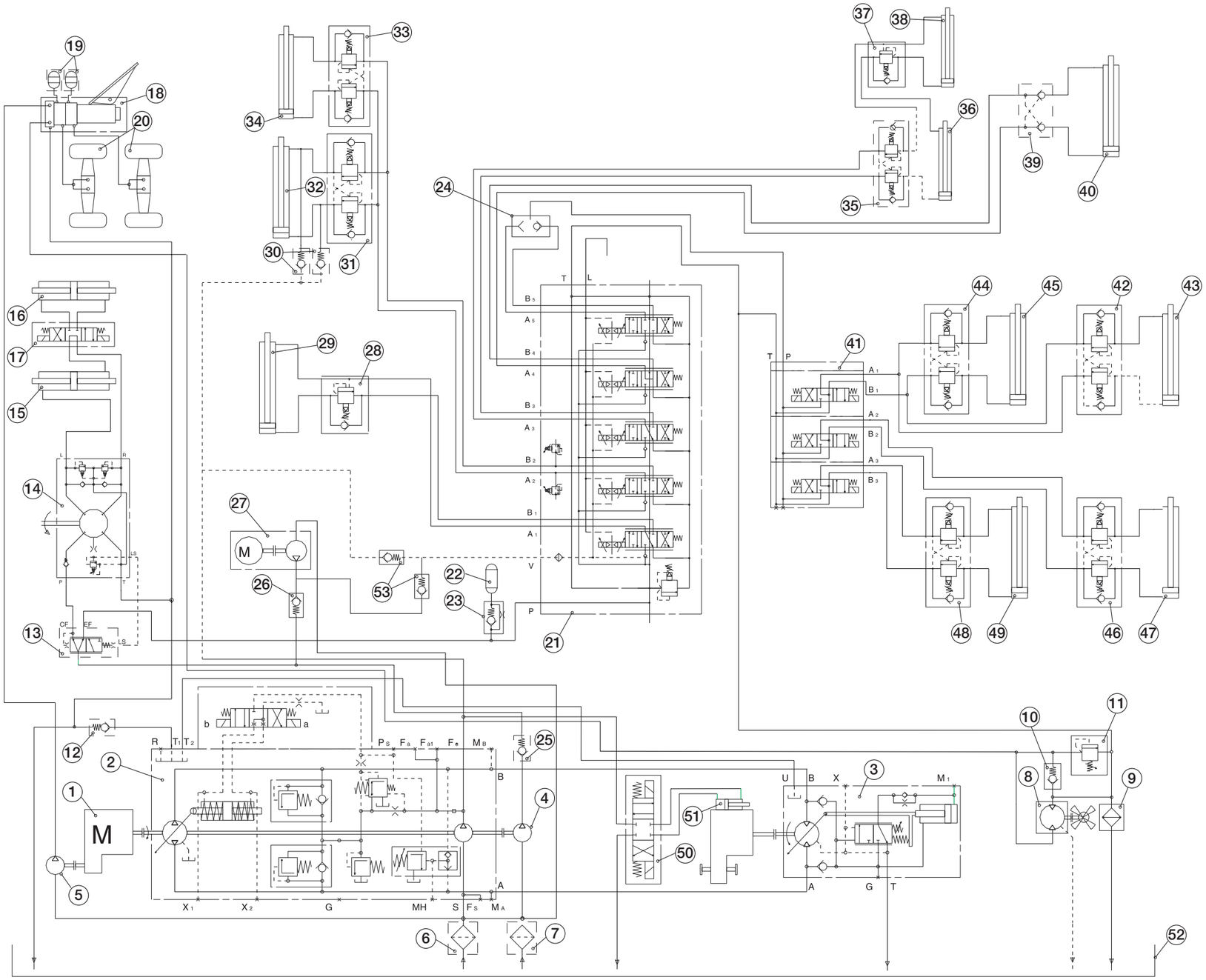
Operation: Hydraulic scheme Telelift 3013 (**up to serial no. 8450**)	*Table:* **C.03.01.01**



Ref.	Description
1	Diesel engine
2	Hydraulic drive pump
3	Hydraulic driving motor
4	Main hydraulic pump
5	Auxiliary hydraulic pump
6	Intake filter
7	Intake filter
8	Thermal exchanger fan motor
9	Thermal exchanger
10	One-way valve
11	Pressure reducing valve
12	One-way valve
13	Load sensing priority valve
14	Hydraulic steering
15	Front axle steering cylinder
16	Rear axle steering cylinder
17	Steering selection solenoid valve
18	Servo-controlled brake pump
19	Accumulator
20	Axle
21	4-section control valve
22	Accumulator
23	Hydraulic lever servo-control
24	Pressure reducing valve
25	Flow divider (deadman command)
26	Flow divider (ARB)
27	Flow divider (aux. functions)
28	Lifting cylinder block valve
29	Lifting cylinder
30	One-way valve
31	Sway cylinder block valve
32	Sway cylinder
33	Fork tilting cylinder block valve
34	Fork tilting cylinder
35	2nd boom element ext. cyl. block valve
36	2nd boom element extension cylinder
37	3rd boom element ext. cyl. block valve
38	3rd boom element extension cylinder
39	Attachment coupling cyl. block valve.
40	Attachment coupling cylinder
41	Stabilisation/sway solenoid valves panel
42	Right sway cylinder block valve
43	Right sway cylinder
44	Left sway cylinder block valve
45	Left sway cylinder
46	Right outrigger cylinder block valve
47	Right outrigger cylinder
48	Left outrigger cylinder block valve
49	Left outrigger cylinder
50	1st/2nd speed selection solenoid valve
51	Mechanical gears hydraulic actuator
52	Differential locking solenoid valve
53	Differential locking hydraulic actuator
54	Hydraulic oil tank
55	One-way valve (*)
56	One-way valve (*)
57	Emergency electric pump (*)
58	Flow divider (joystick off) (*)
59	Proportional valve (*)

(*) Only with man-platform

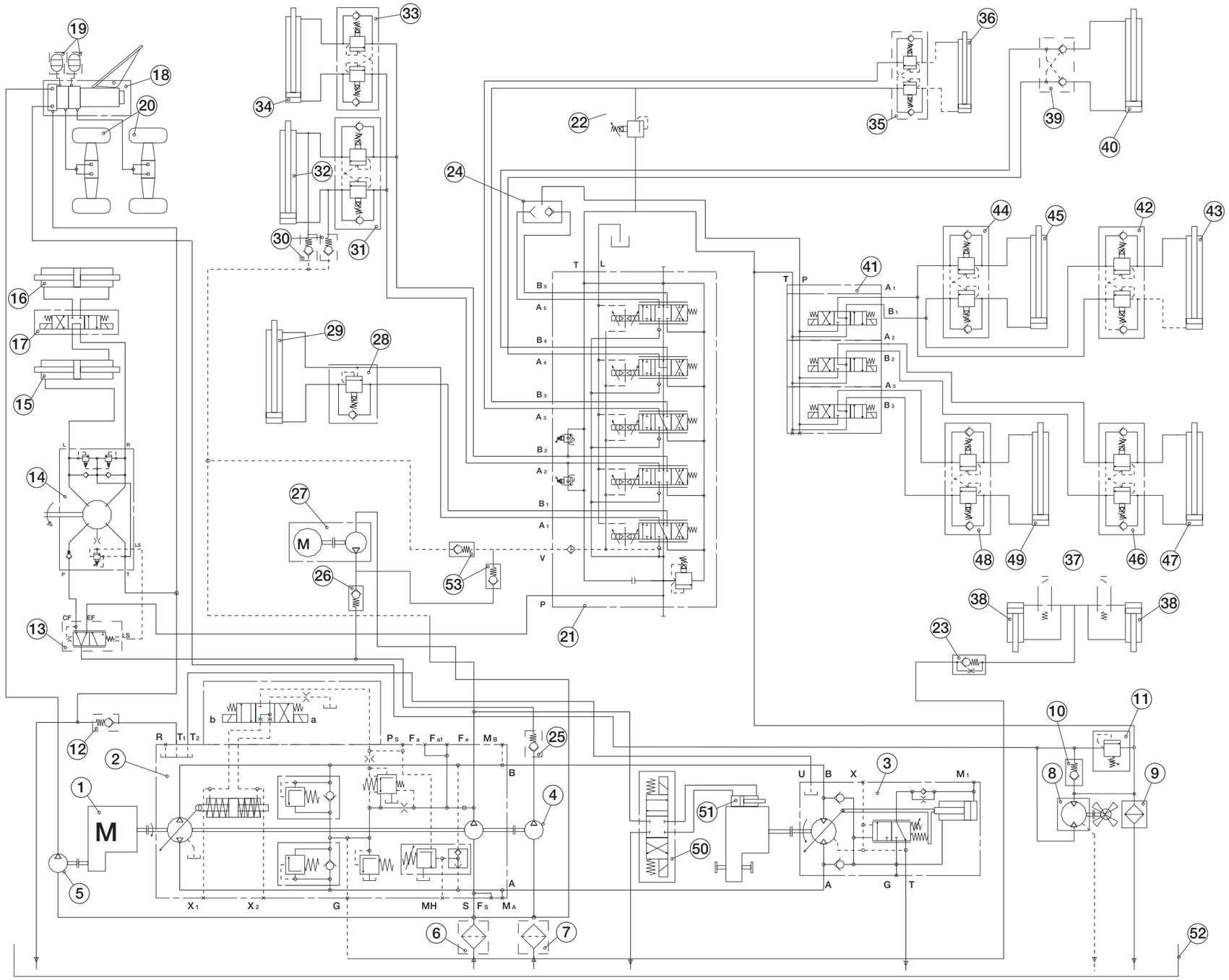
Operation: Hydraulic scheme Telelift 3013 (**from serial no. 8451**)	*Table:* **C.03.01.02**



Ref.	Description
1	Diesel engine
2	Hydraulic drive
3	Hydraulic driving
4	Main hydraulic
5	Auxiliary hydraulic pump
6	Intake filter
7	Intake filter
8	Thermal exchanger fan motor
9	Thermal exchanger
10	One-way valve
11	Pressure reducing valve
12	One-way valve
13	Load sensing priority valve
14	Hydraulic steering
15	Front axle steering cylinder
16	Rear axle steering cylinder
17	Steering selection solenoid valve
18	Servo-controlled brake pump
19	Accumulator
20	Axle
21	Control valve
22	Accumulator
23	Flow rate check valve
24	Switch valve
25	One-way valve 0 bar (*)
26	One-way valve 8 bar(*)
27	Emergency electric pump (*)
28	Lifting cylinder block valve
29	Lifting cylinder
30	One-way valve
31	Sway cylinder block valve
32	Sway cylinder
33	Fork tilting cylinder block valve
34	Fork tilting cylinder
35	2nd boom element ext. cyl. block valve
36	2nd boom element extension cylinder
37	3rd boom element ext. cyl. block.valve
38	3rd boom element extension cylinder
39	Attachment coupling cyl. block. Valve.
40	Attachment coupling cylinder
41	Stabilisation/sway solenoid valves panel
42	Right sway cylinder block valve
43	Right sway cylinder
44	Left sway cylinder block valve
45	Left sway cylinder
46	Right outrigger cylinder block valve
47	Right outrigger cylinder
48	Left outrigger cylinder block valve
49	Left outrigger cylinder
50	1st/2nd speed selection solenoid valve
51	Mechanical gears hydraulic actuator
52	Hydraulic oil tank
53	One-way valve 0,5 bar(*)

(*) Only with man-platform

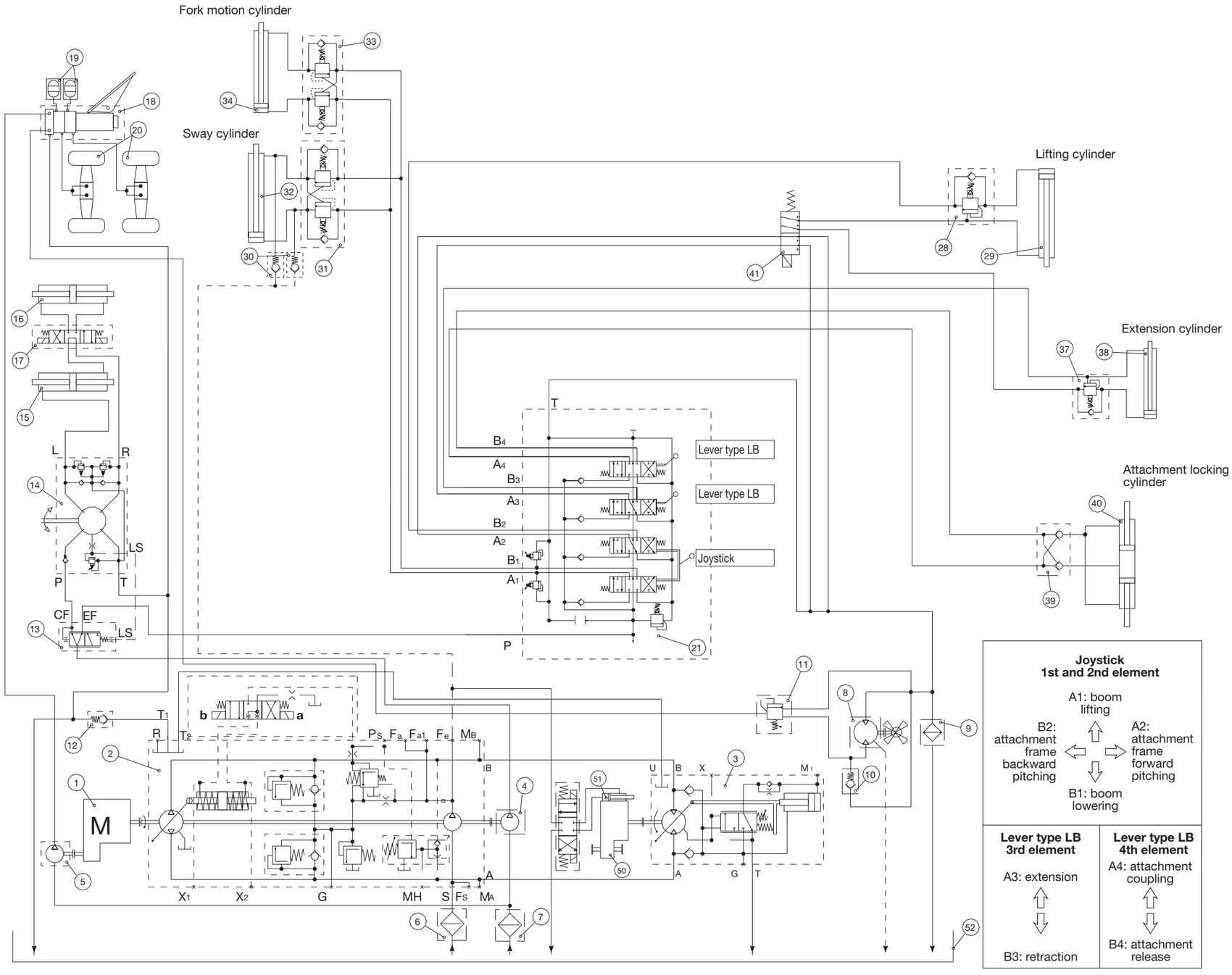
Operation: Hydraulic scheme Telelift 3517	*Table:* **C.03.02.01**



Ref.	Description
1	Diesel engine
2	Hydraulic drive
3	Hydraulic driving
4	Main hydraulic
5	Auxiliary hydraulic pump
6	Intake filter
7	Intake filter
8	Thermal exchanger fan motor
9	Thermal exchanger
10	One-way valve
11	Pressure reducing valve
12	One-way valve
13	Load sensing priority valve
14	Hydraulic steering
15	Front axle steering cylinder
16	Rear axle steering cylinder
17	Steering selection solenoid valve
18	Servo-controlled brake pump
19	Accumulator
20	Axle
21	Control valve
22	Pressure relief valve for extension cylinder
23	Flow rate check valve
24	Switch valve
25	One-way valve 0 bar (*)
26	One-way valve 8 bar(*)
27	Emergency electric pump (*)
28	Lifting cylinder block valve
29	Lifting cylinder
30	One-way valve
31	Sway cylinder block valve
32	Sway cylinder
33	Fork tilting cylinder block valve
34	Fork tilting cylinder
35	2nd boom element ext. cyl. block valve
36	2nd boom element extension cylinder
37	Rear axle cylinder block solenoid
38	Rear axle blocking cylinder
39	Attachment coupling cyl. block valve
40	Attachment coupling cylinder
41	Stabilisation/sway solenoid valves panel
42	Right sway cylinder block valve
43	Right sway cylinder
44	Left sway cylinder block valve
45	Left sway cylinder
46	Right outrigger cylinder block valve
47	Right outrigger cylinder
48	Left outrigger cylinder block valve
49	Left outrigger cylinder
50	1st/2nd speed selection solenoid valve
51	Mechanical gears hydraulic actuator
52	Hydraulic oil tank
53	One-way valve 0,5 bar(*)

(*) Only with man-platform

Operation: Hydraulic scheme Telelift 4010 (**up to serial no. 9162**)	*Table:* **C.03.03.01**



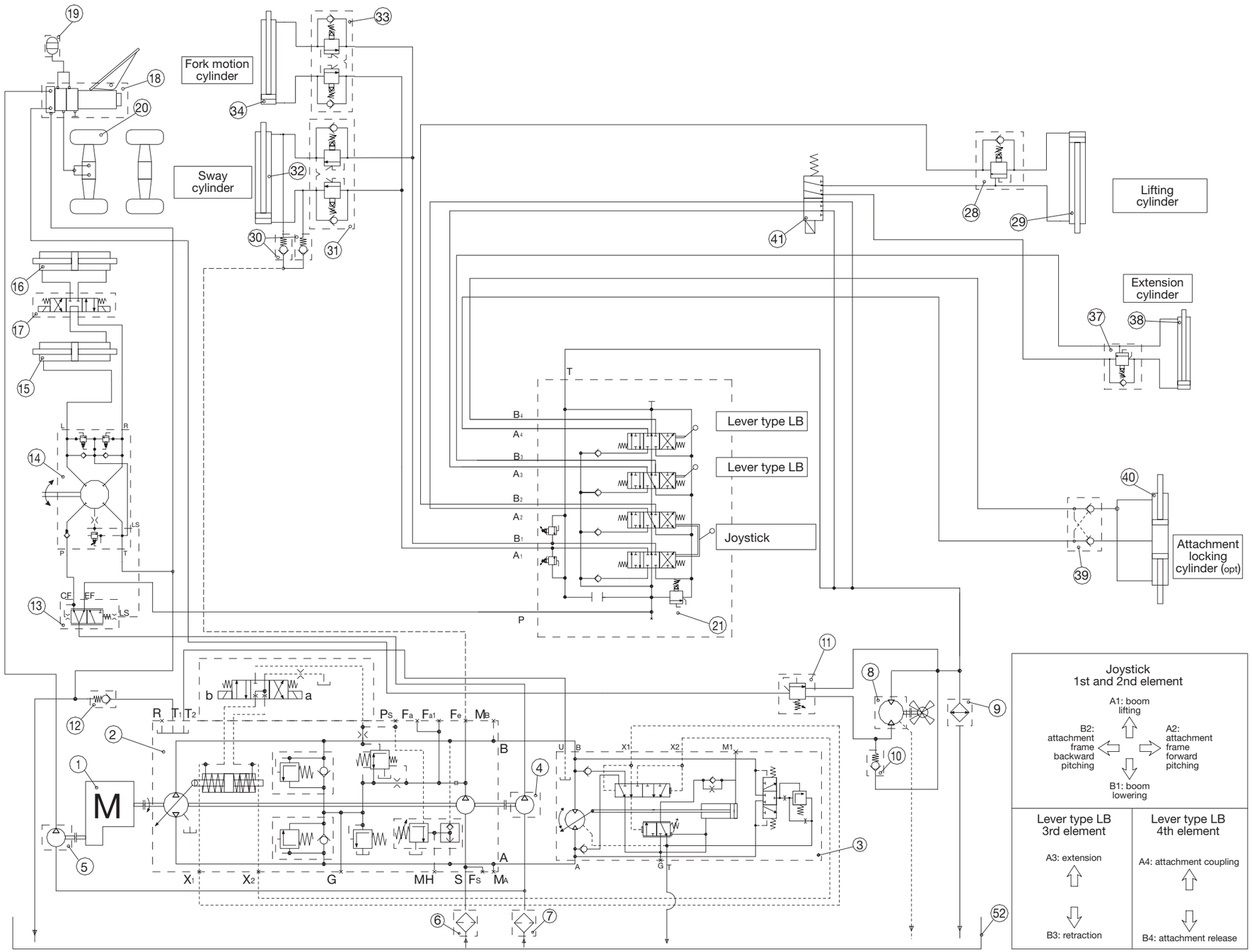
Joystick
1st and 2nd element

A1: boom lifting
B2: attachment frame backward pitching
A2: attachment frame forward pitching
B1: boom lowering

Lever type LB 3rd element	**Lever type LB 4th element**
A3: extension	A4: attachment coupling
B3: retraction	B4: attachment release

Ref.	Description
1	Diesel engine
2	Transmission hydraulic pump
3	Transmission hydraulic motor
4	Hydraulic pump for auxiliary circuits
5	Second hydraulic pump for auxiliary circuits
6	Intake filter (150 p10)
7	Submersed intake filter
8	Thermal exchanger fan motor
9	Thermal exchanger
10	One-way valve
11	Pressure relief valve
12	One-way valve
13	Load sensing priority valve
14	Power steering
15	Front axle steering cylinder
16	Rear axle steering cylinder
17	Steering selection solenoid
18	Servo-assisted brake pump
19	Accumulator
20	Axle
21	4-element monolithic distributor
22	
23	
24	
25	
26	
27	
28	Locking valve for lifting cylinder
29	Lifting cylinder
30	One-way valve
31	Locking valve for sway cylinder
32	Sway cylinder
33	Locking valve for fork motion cylinder
34	Fork motion cylinder
35	
36	
37	Locking valve for 2nd telescope extension cylinder
38	2nd telescope extension cylinder
39	Locking valve for attachment locking cylinder
40	Attachment locking cylinder
41	Flow divider
42	
43	
44	
45	
46	
47	
48	
49	
50	1st / 2nd speed selection solenoid
51	Mechanical gears hydraulic operator
52	Hydraulic oil tank
53	
54	
55	
56	
57	
58	
59	

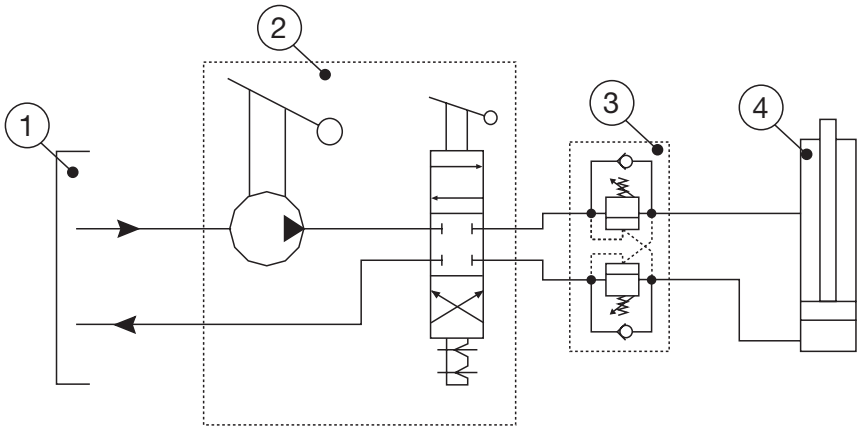
Operation: Hydraulic scheme Telelift 4010 (**from serial no. 9163**)	*Table:* **C.03.03.02**



Ref.	Description
1	Diesel engine
2	Transmission hydraulic pump (A4VG71)
3	Transmission hydraulic motor (A6VM107)
4	Main hydraulic pump for auxiliary circuits
5	Second hydraulic pump for auxiliary circuits
6	Intake filter (150 P10)
7	Submersed intake filter
8	Thermal exchanger fan motor
9	Thermal exchanger
10	One-way valve
11	Pressure relief valve
12	One-way valve
13	Load sensing priority valve
14	Power steering
15	Front axle steering cylinder
16	Rear axle steering cylinder
17	Steering selection solenoid
18	Servo-assisted brake pump (SAFIM S6)
19	Accumulator 0,5 litres
20	Front axle
21	Monolithic distributor SDM140/4P
22	
23	
24	
25	
26	
27	
28	Locking valve for lifting cylinder
29	Lifting cylinder
30	One-way valve
31	Locking valve for sway cylinder
32	Sway cylinder
33	Locking valve for fork motion cylinder
34	Fork motion cylinder
35	
36	
37	Locking valve for 2nd telescope extension cylinder
38	2nd telescope extension cylinder
39	Locking valve for attachment locking cylinder (*)
40	Attachment locking cylinder (*)
41	Flow divider
42	
43	
44	
45	
46	
47	
48	
49	
50	
51	
52	Hydraulic oil tank
53	
54	
55	
56	
57	
	(*) Optional unit

Operation: Aerial man-platform hydraulic schemes	Table: C.03.04

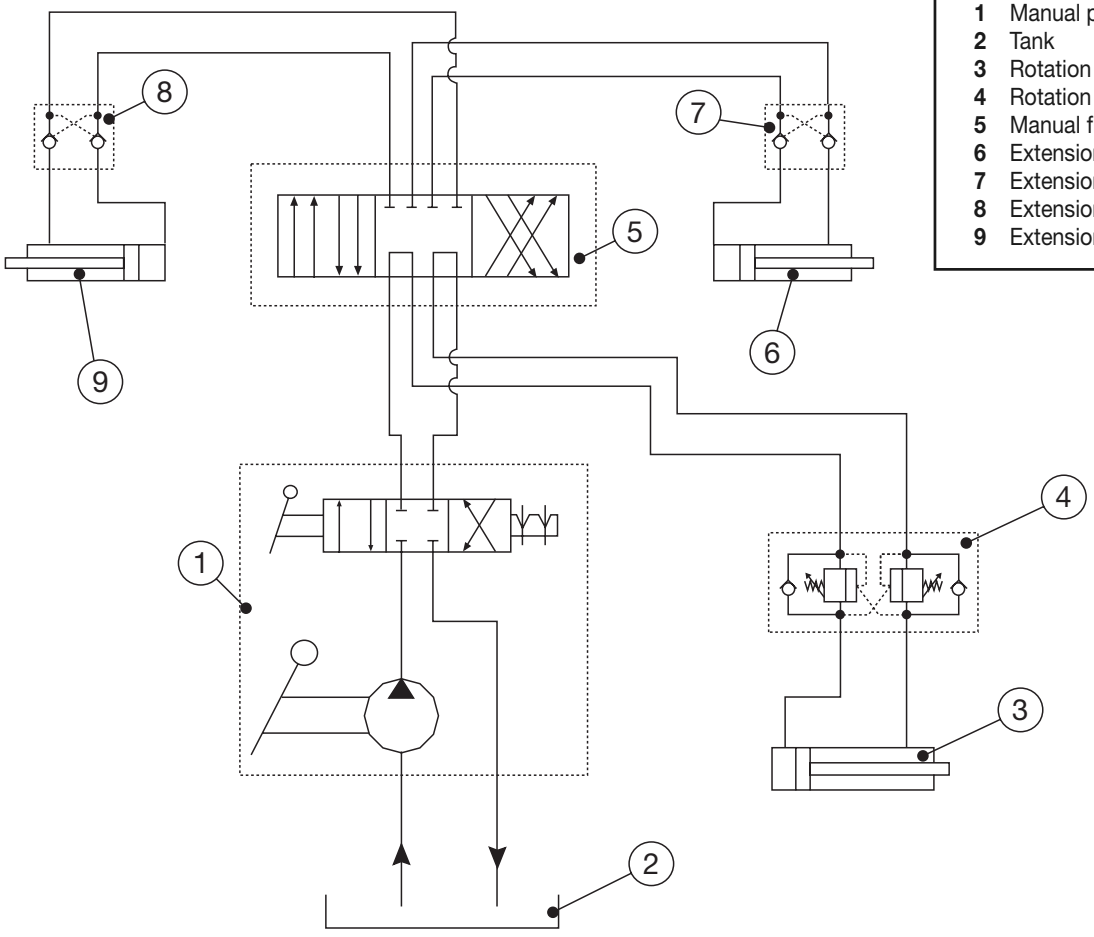
Aerial platform RNE - REM 4400



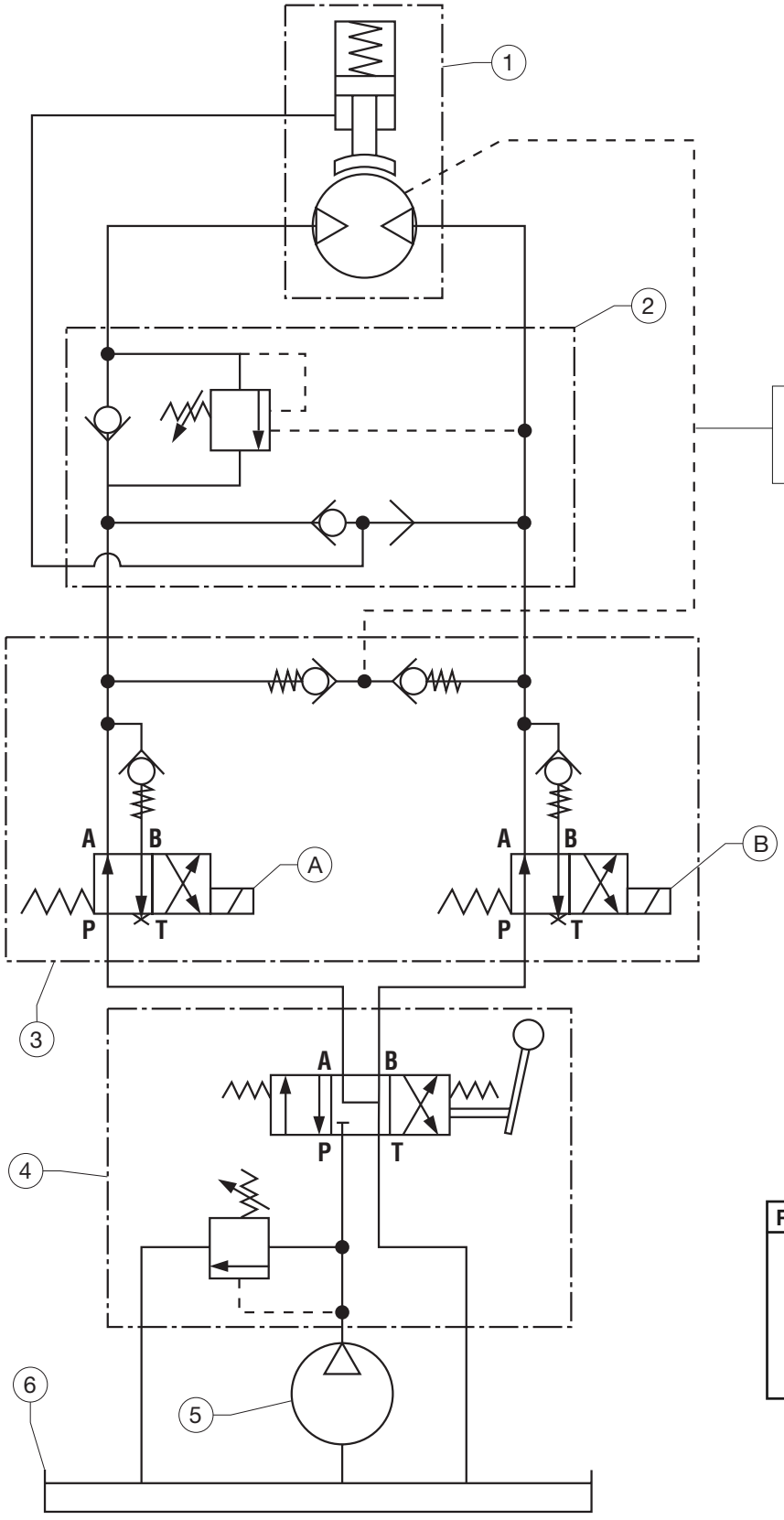
Ref.	Description
1	Tank
2	Manual pump
3	Block valve
4	Rotation cylinder

Aerial platform REM 5500

Ref.	Description
1	Manual pump
2	Tank
3	Rotation cylinder
4	Rotation cylinder block valve
5	Manual flow divider
6	Extension cylinder
7	Extension cylinder block valve
8	Extension cylinder block valve
9	Extension cylinder



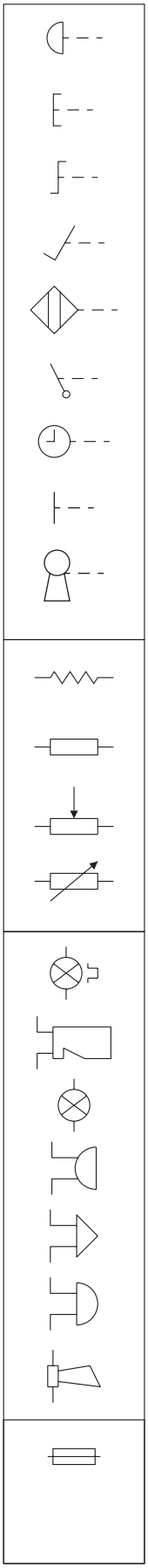
Operation: Winch hydraulic scheme	Table: C.03.05



Discharge line
External for S25 winches
Internal for P9 and P15 winches

Ref.	Description
1	Hydraulic motor
2	Valve
3	Cock
4	Control valve
5	Hydraulic pump
6	Oil tank

C.04 ELECTRICAL SYMBOLS

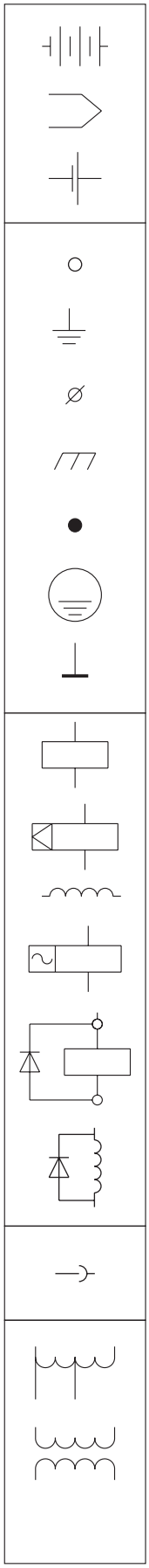


ACTUATORS
Emergency controls
Pushbutton control
Rotary control
Pedal control
Proximity control
Lever control
Timed control
Mechanical/manual control
Key control

RESISTANCES
Resistance
Resistor
Potentiometer
Variable resistance

SIGNALS
Intermittent lamp
Whistle
Lamp
Buzzer
Siren
Bell
Horn

FUSES AND RELAYS
Horizontal fuse
Relay



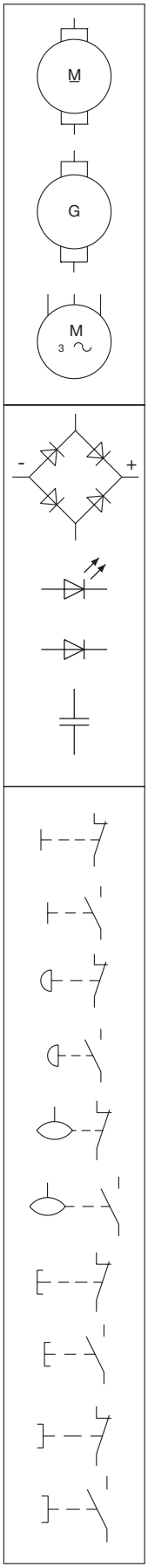
ACCUMULATORS
Battery
Thermocouple
Element

TERMINALS AND GROUNDS
Ring
Ground
Terminal
Ground to frame
Knot
Protection ground
Frame ground 2

COILS
Coil
Mechanical coupling coil
Winding
A/C coil
Coil with diode
Winding with diode

CONNECTORS
Connector

STATIC APPLICATIONS
Auto-transformer
Transformer



DYNAMIC APPLICATIONS
Motor
Generator
As_3p_motor

ELECTRONIC PARTS
Rectifier
Light-emitting diode
Diode
Condenser

PUSHBUTTONS
Manual NC contact
Manual NO contact
NC mushroom-head pushbutton
NO mushroom-head pushbutton
NC level
NO level
Pushbutton with NC return
Pushbutton with NO return
NC tie-rod
NO tie-rod

CONTACTS


Thermal


Normally open (NO)


Normally closed (NC)


NO limit switch


NC limit switch


Contactor

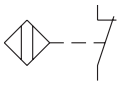

Magneto-thermal closure


Magneto-thermal opening


Thermal closure

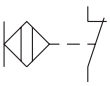

Thermal opening


Exchange


NC proximity


NO proximity

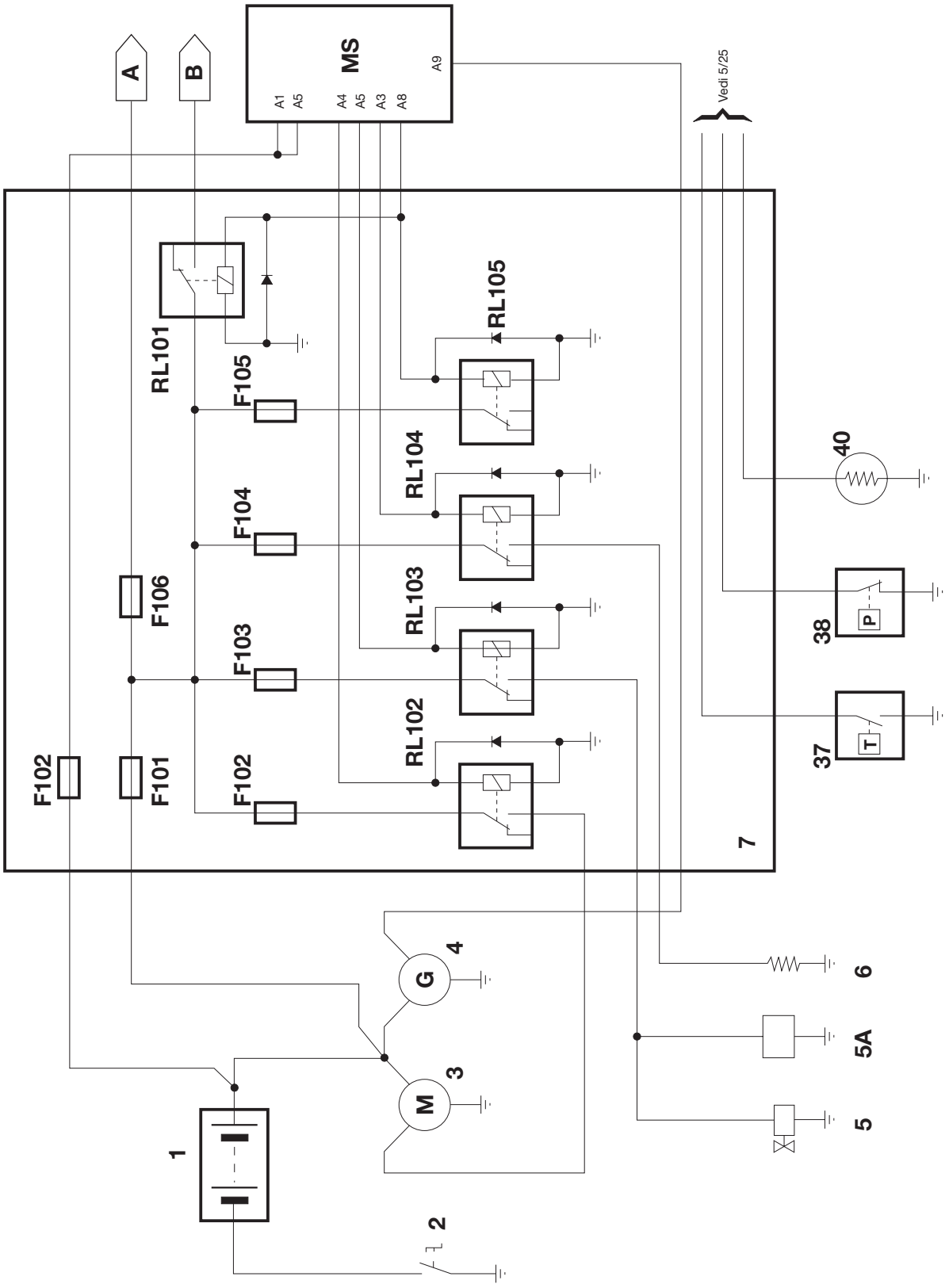

NO mechanical


NC mechanical

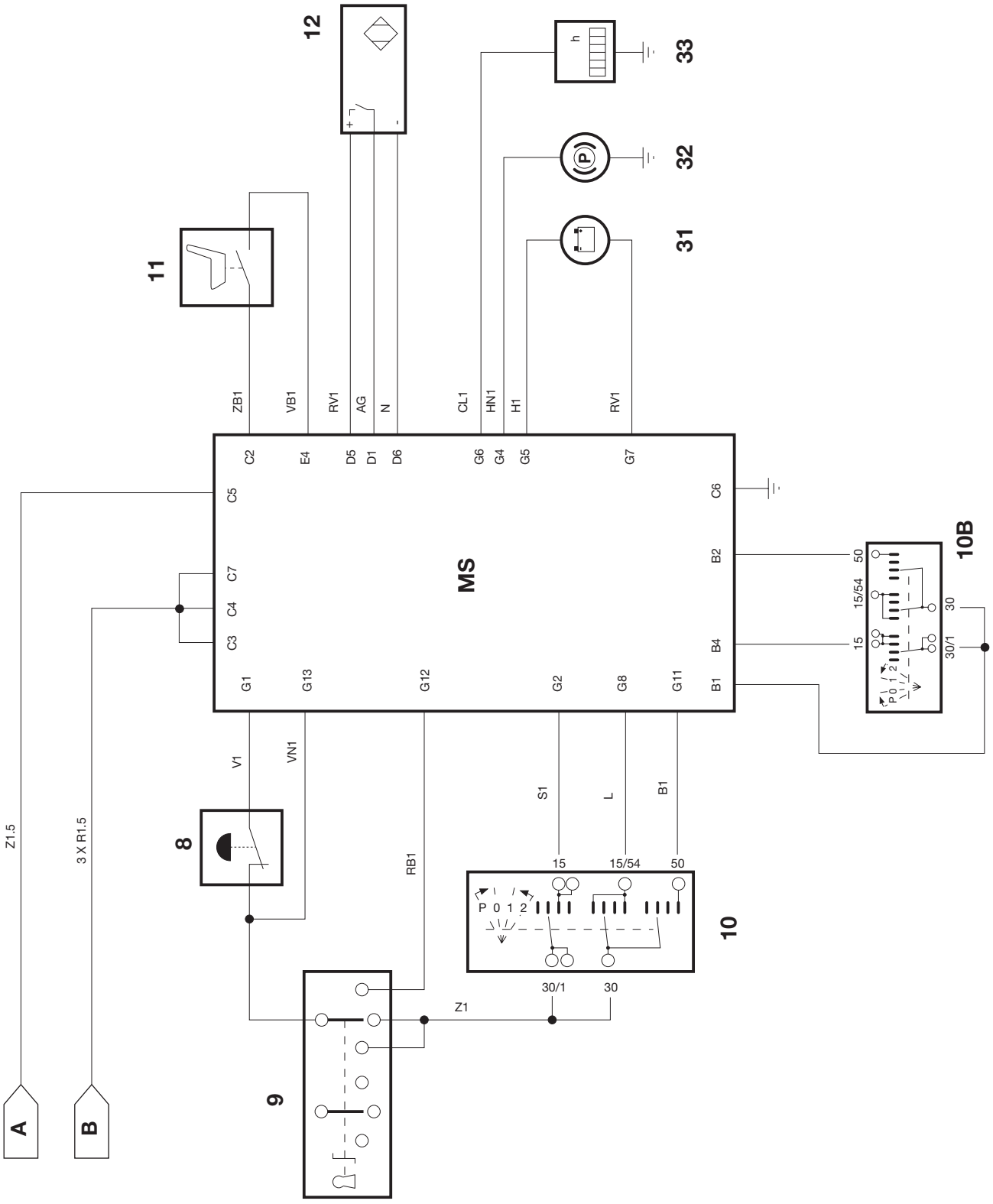

Selector


Selector2

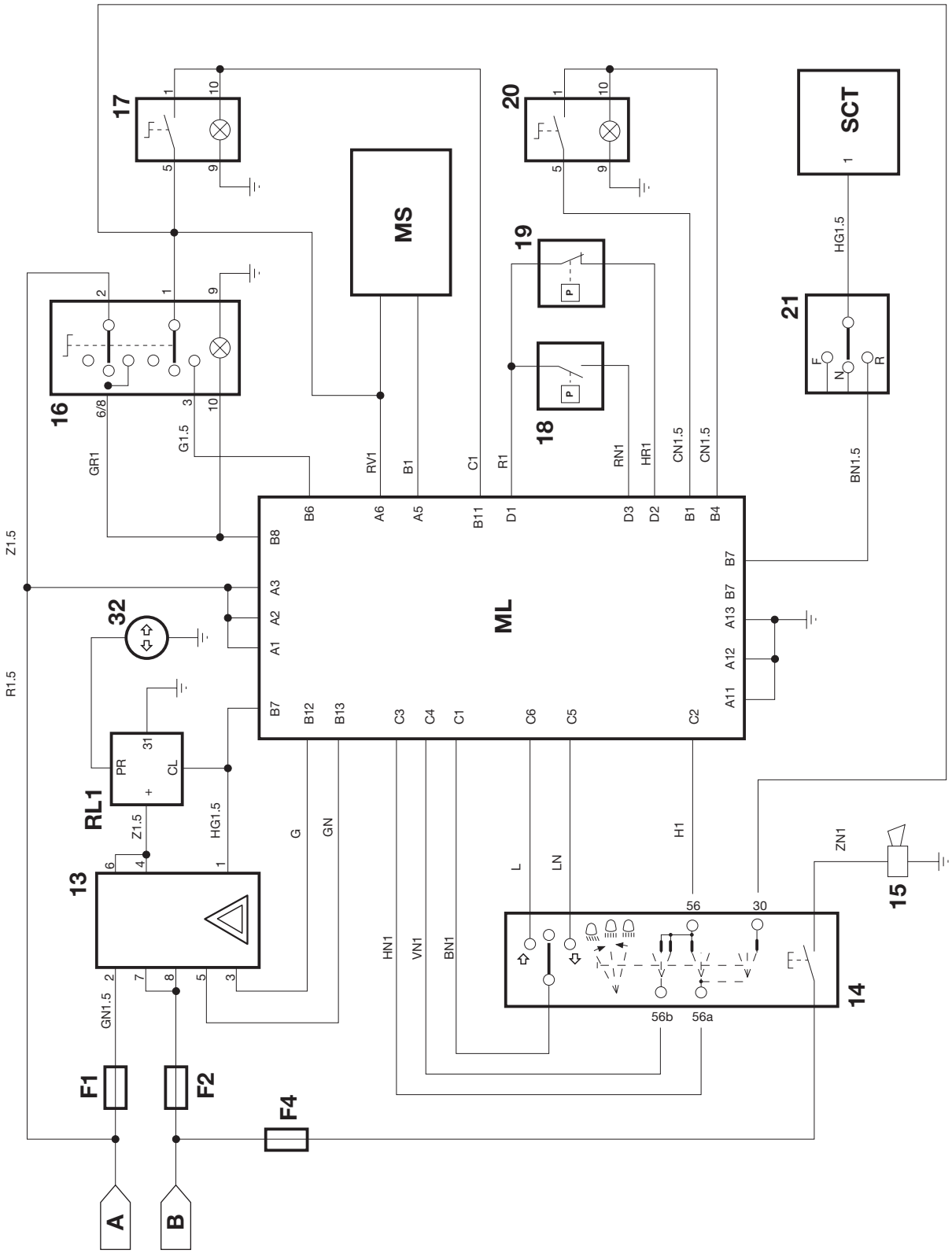
Operation: Wiring diagram 1/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.01**



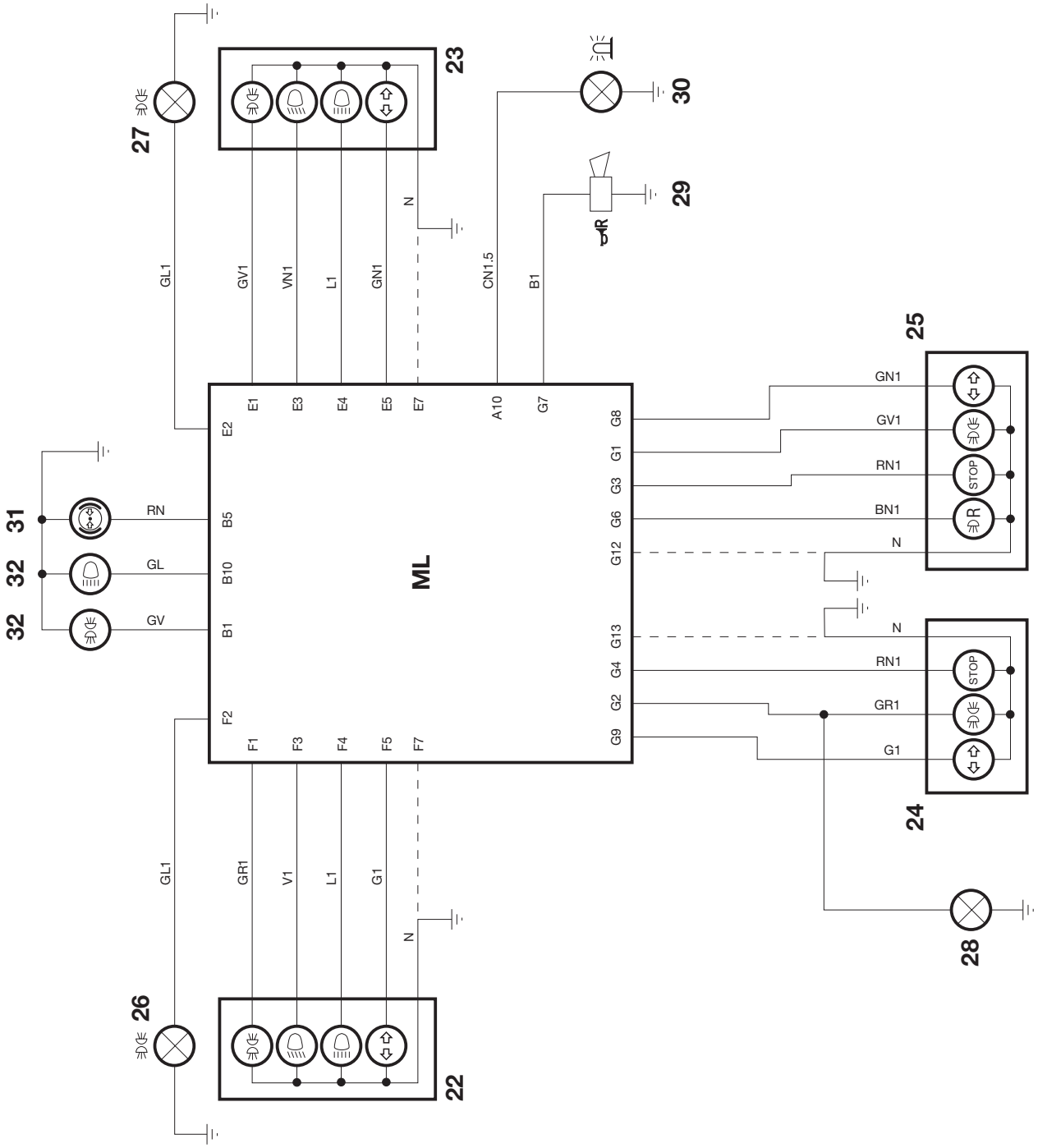
Operation: Wiring diagram 2/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.02**



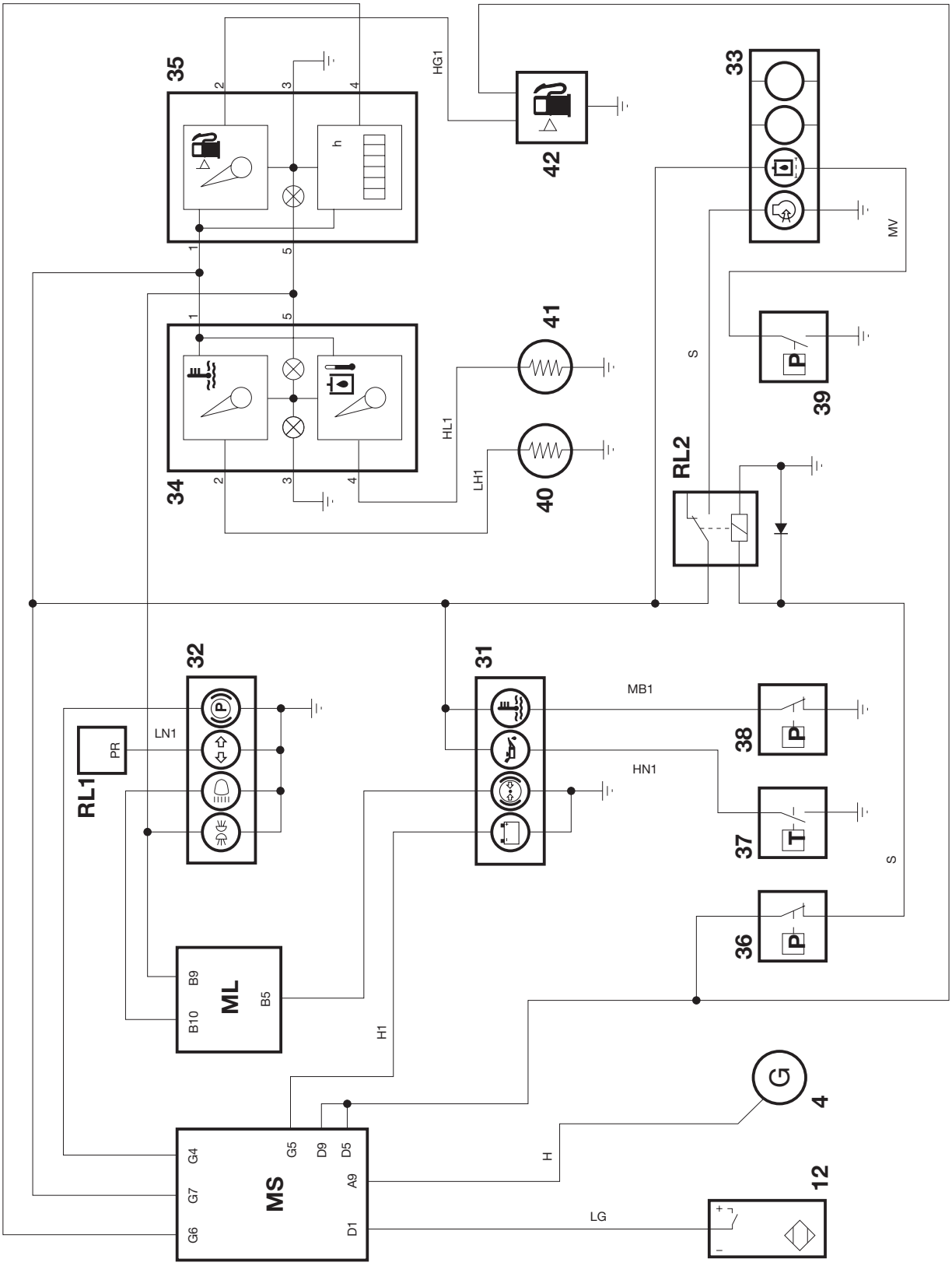
Operation: Wiring diagram 3/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.03**



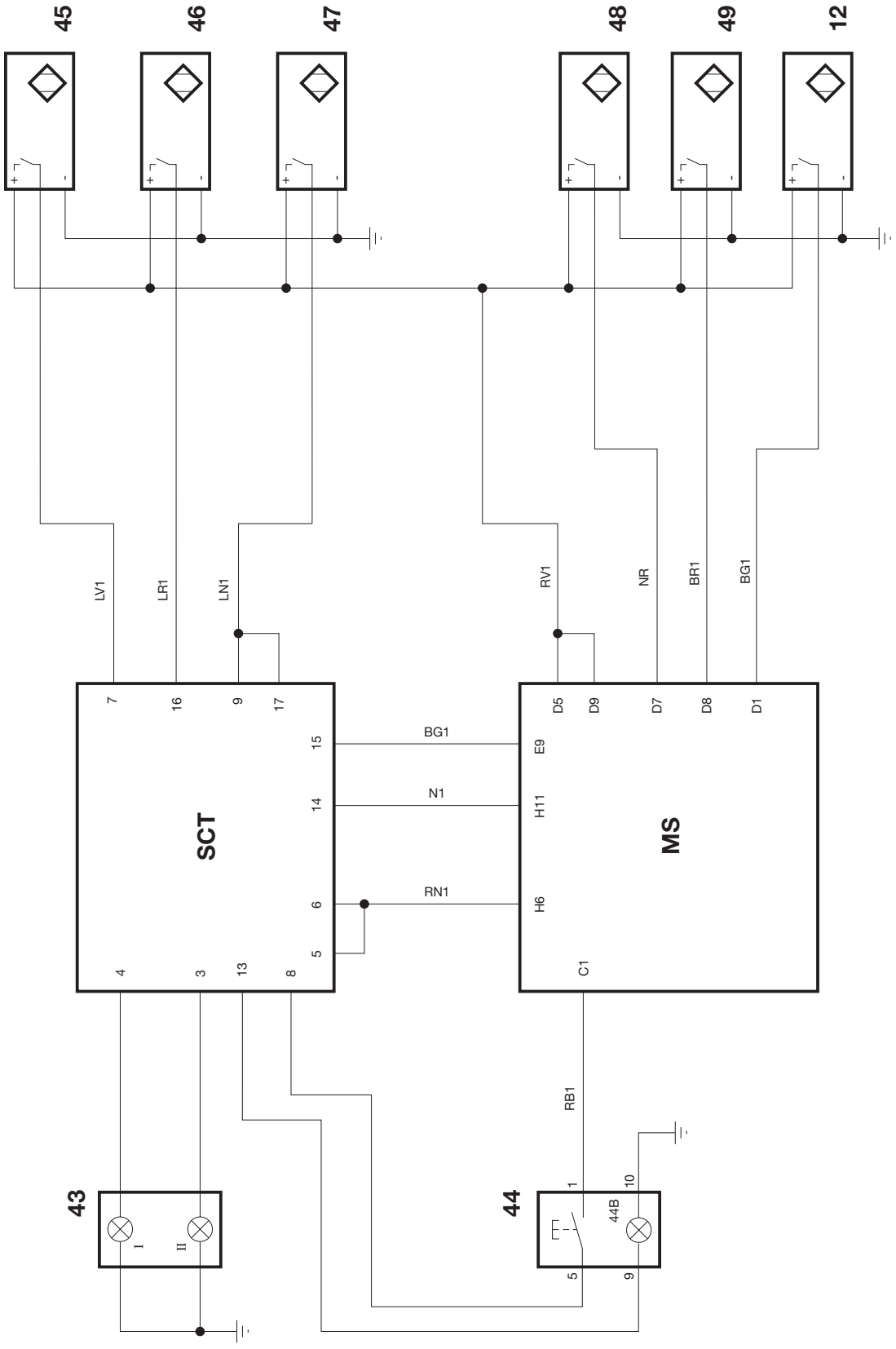
Operation: Wiring diagram 4/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.04**



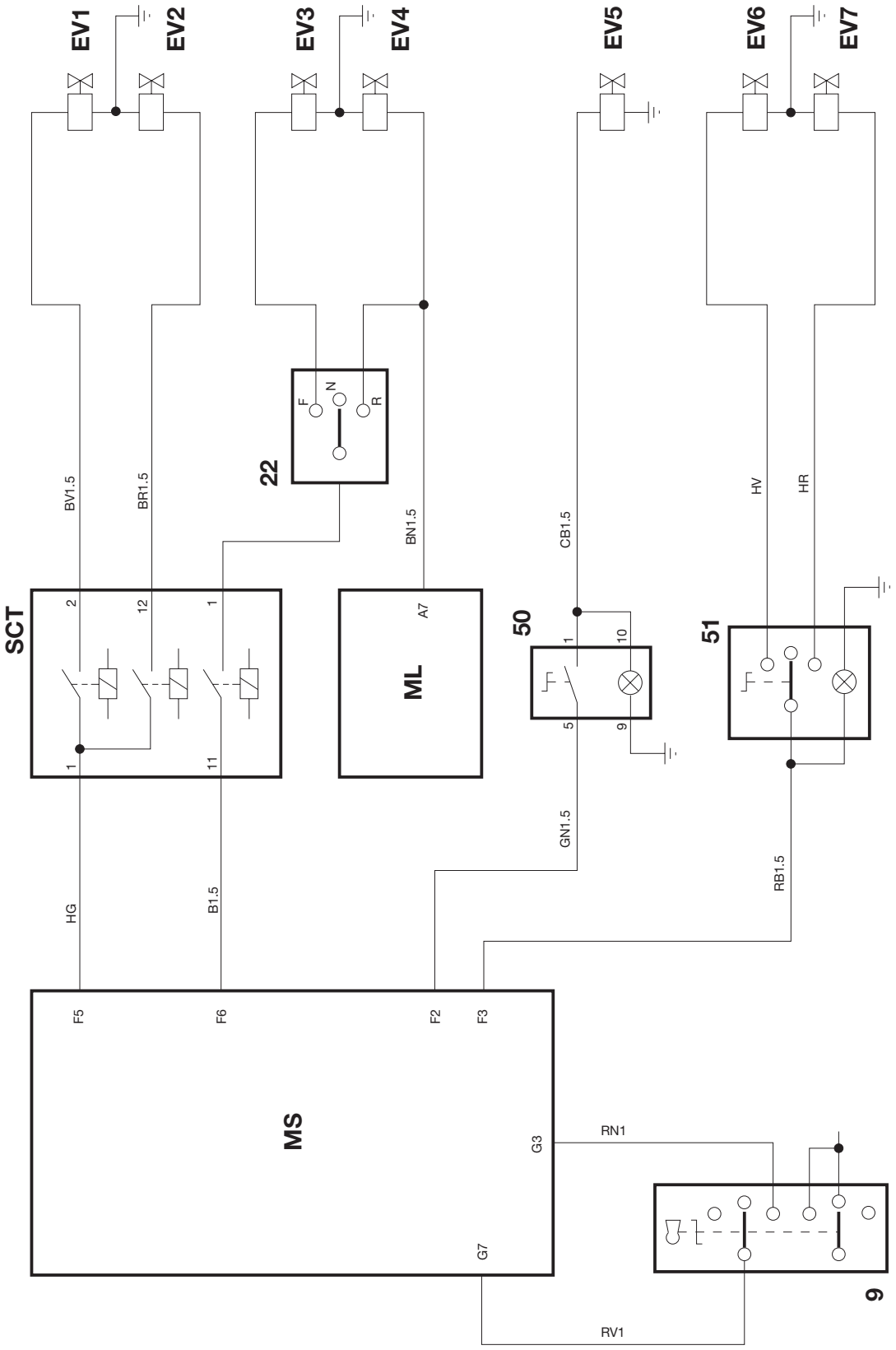
Operation: Wiring diagram 5/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.05**



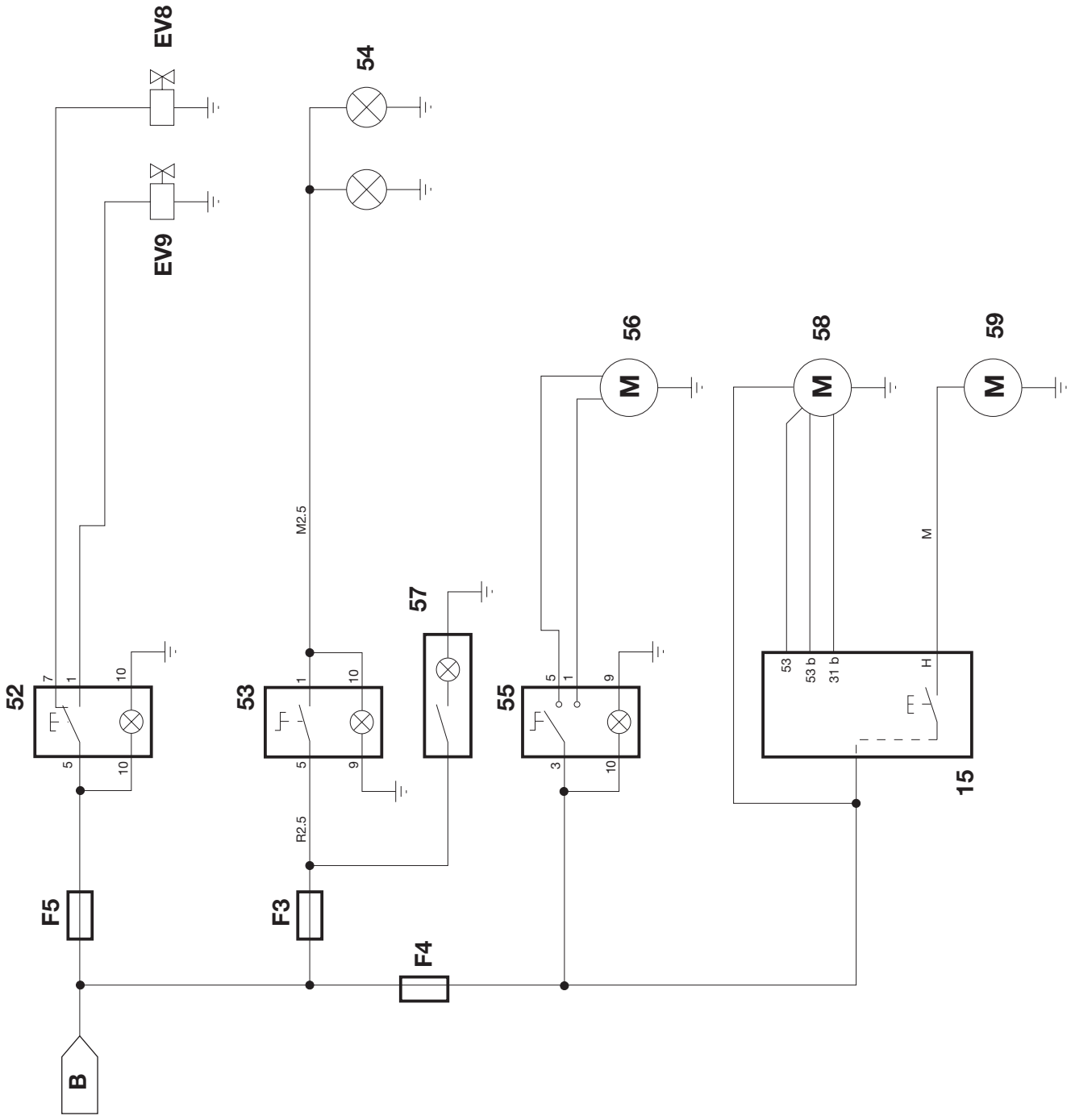
Operation: Wiring diagram 6/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.06**



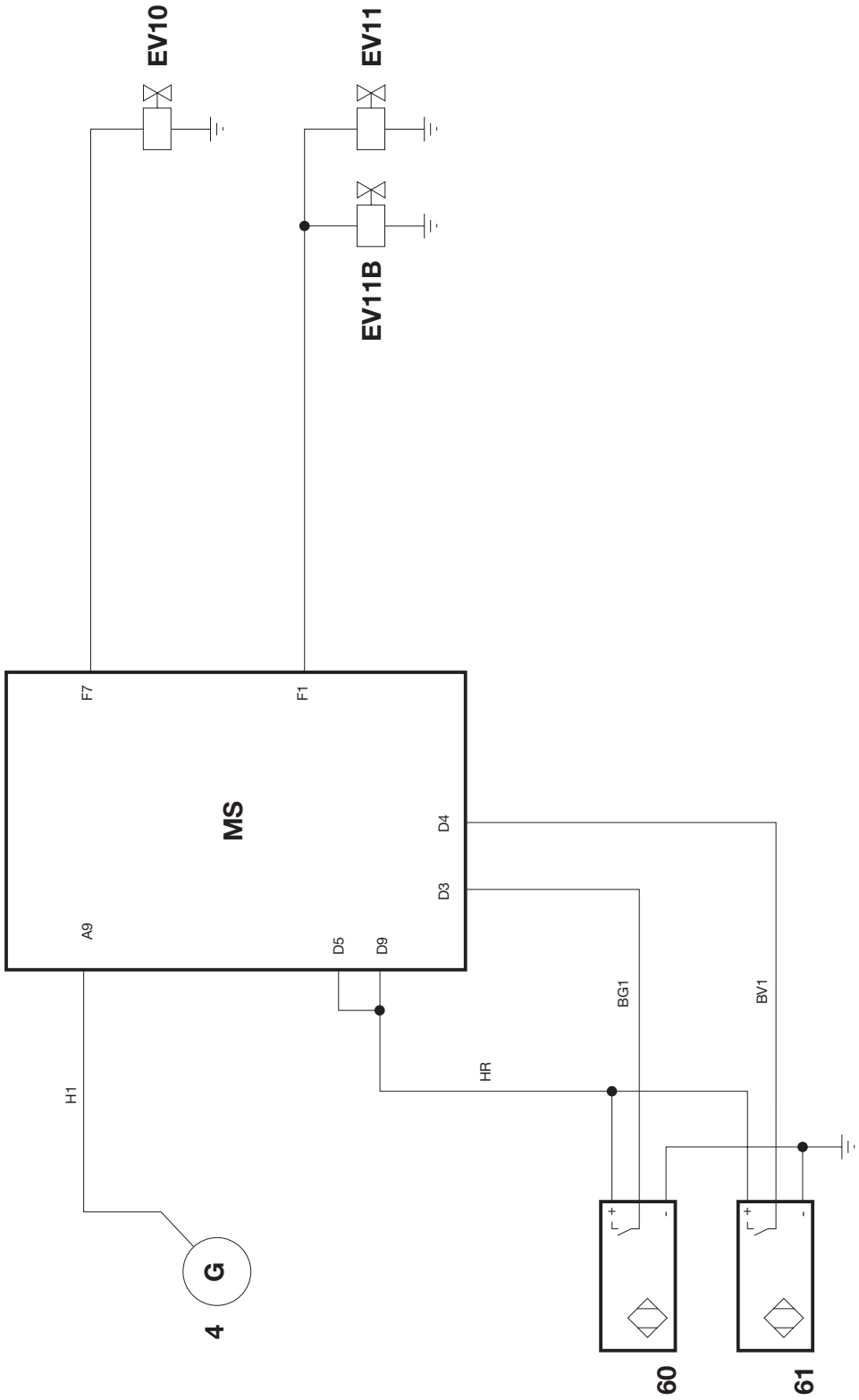
Operation:	Table:
Wiring diagram 7/25 - Telelift 3013 (**up to serial no. 7184**)	**C.05.01.07**



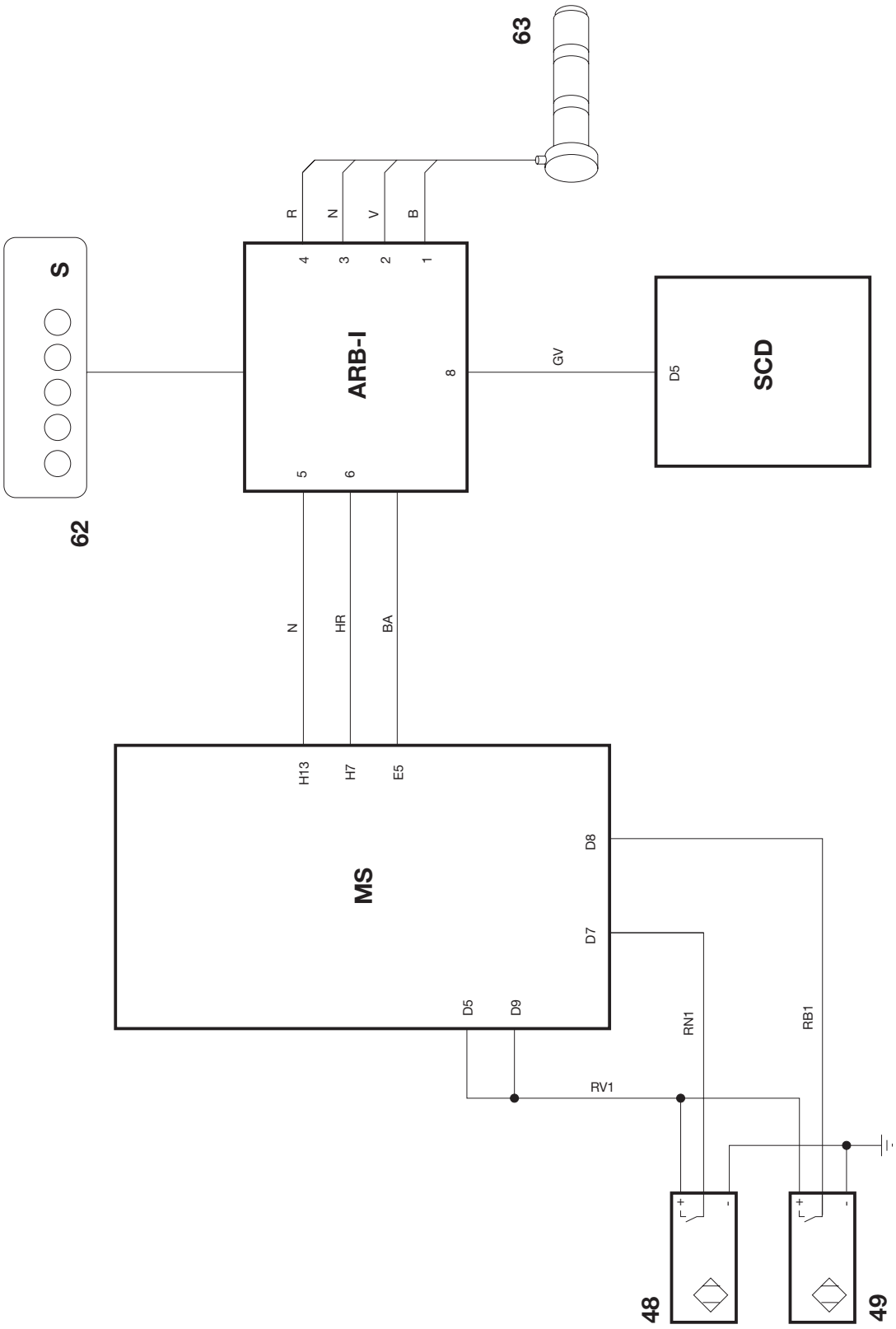
Operation: Wiring diagram 8/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.08**



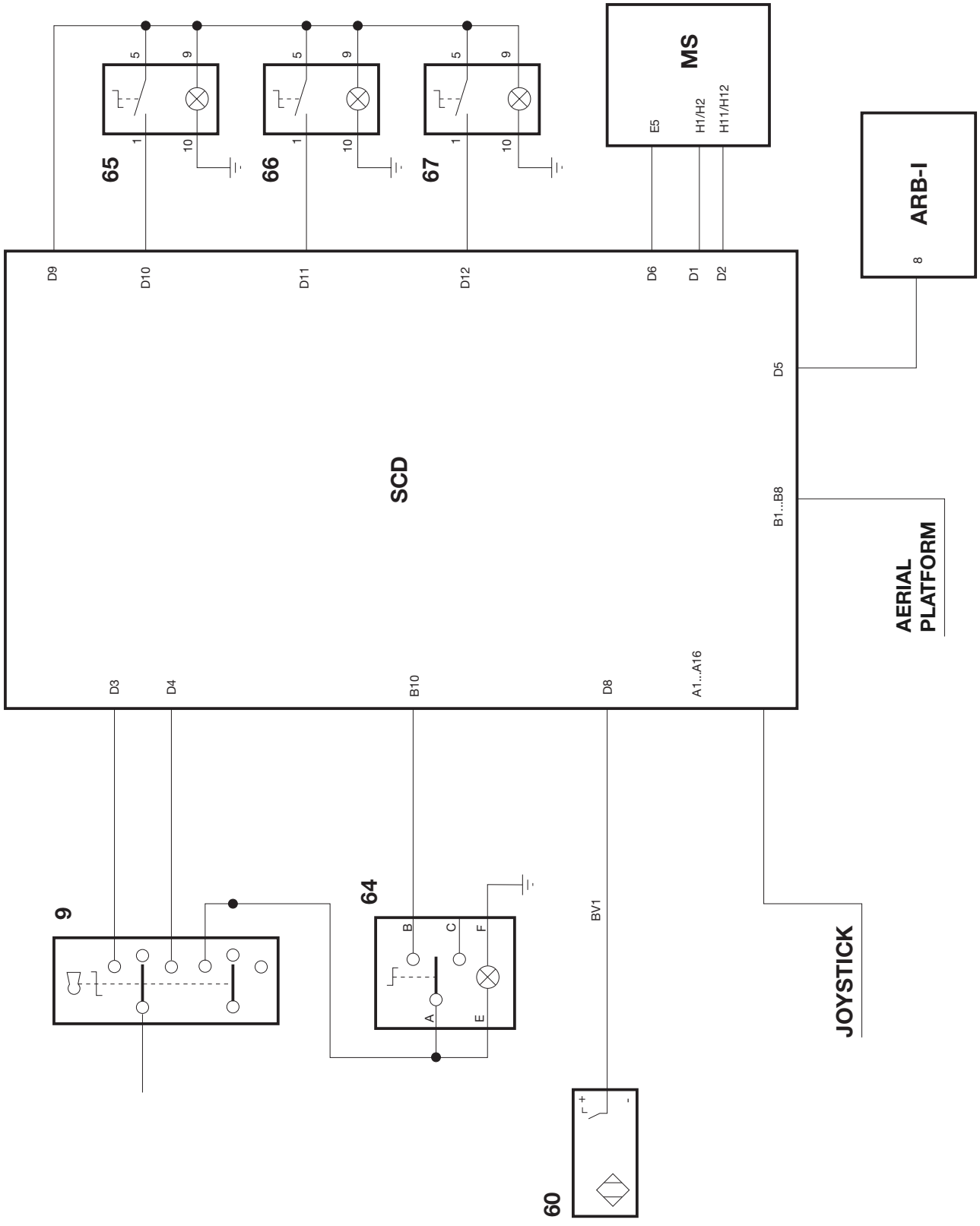
Operation:	Table:
Wiring diagram 9/25 - Telelift 3013 (**up to serial no. 7184**)	**C.05.01.09**



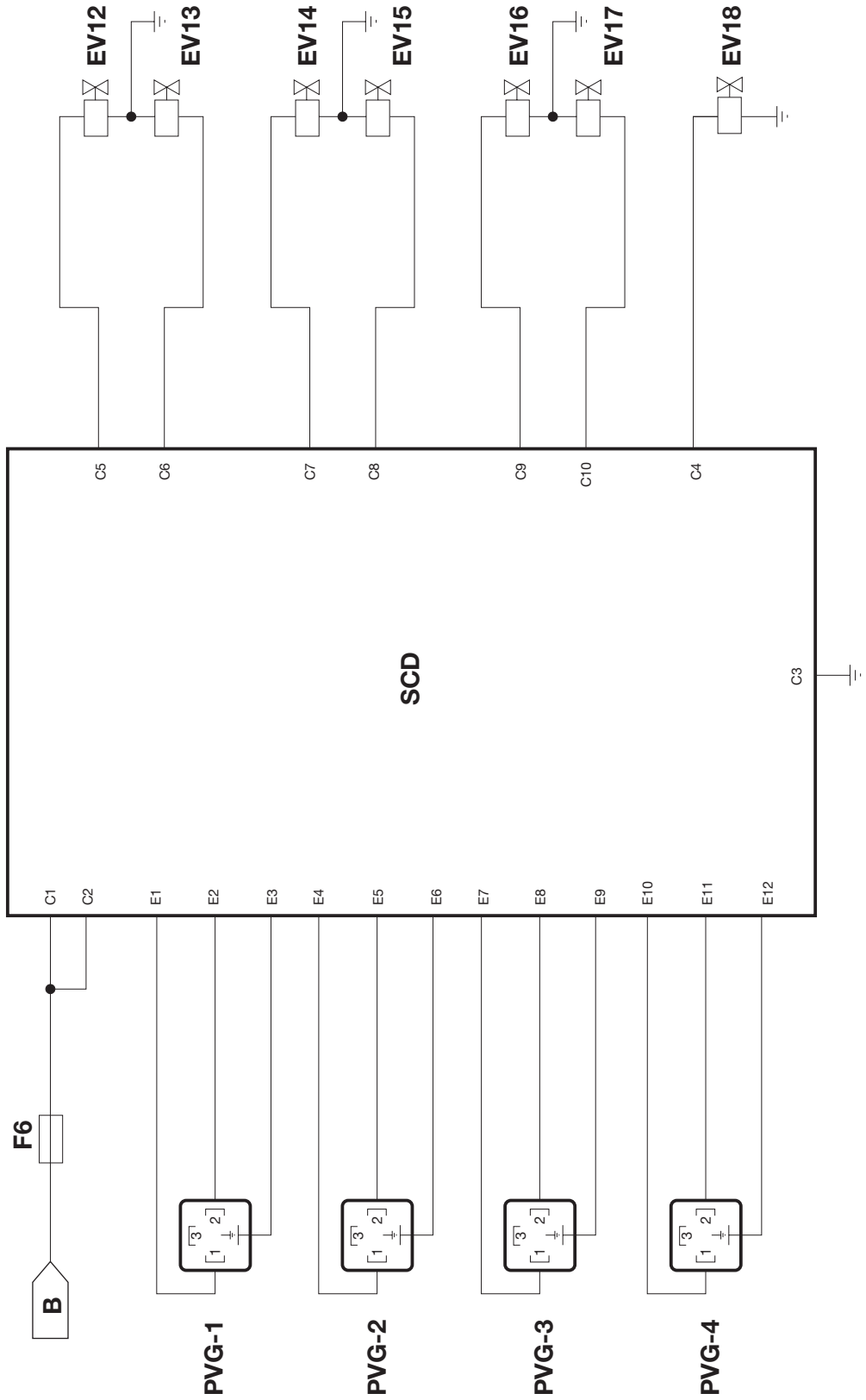
Operation: Wiring diagram 10/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.10**



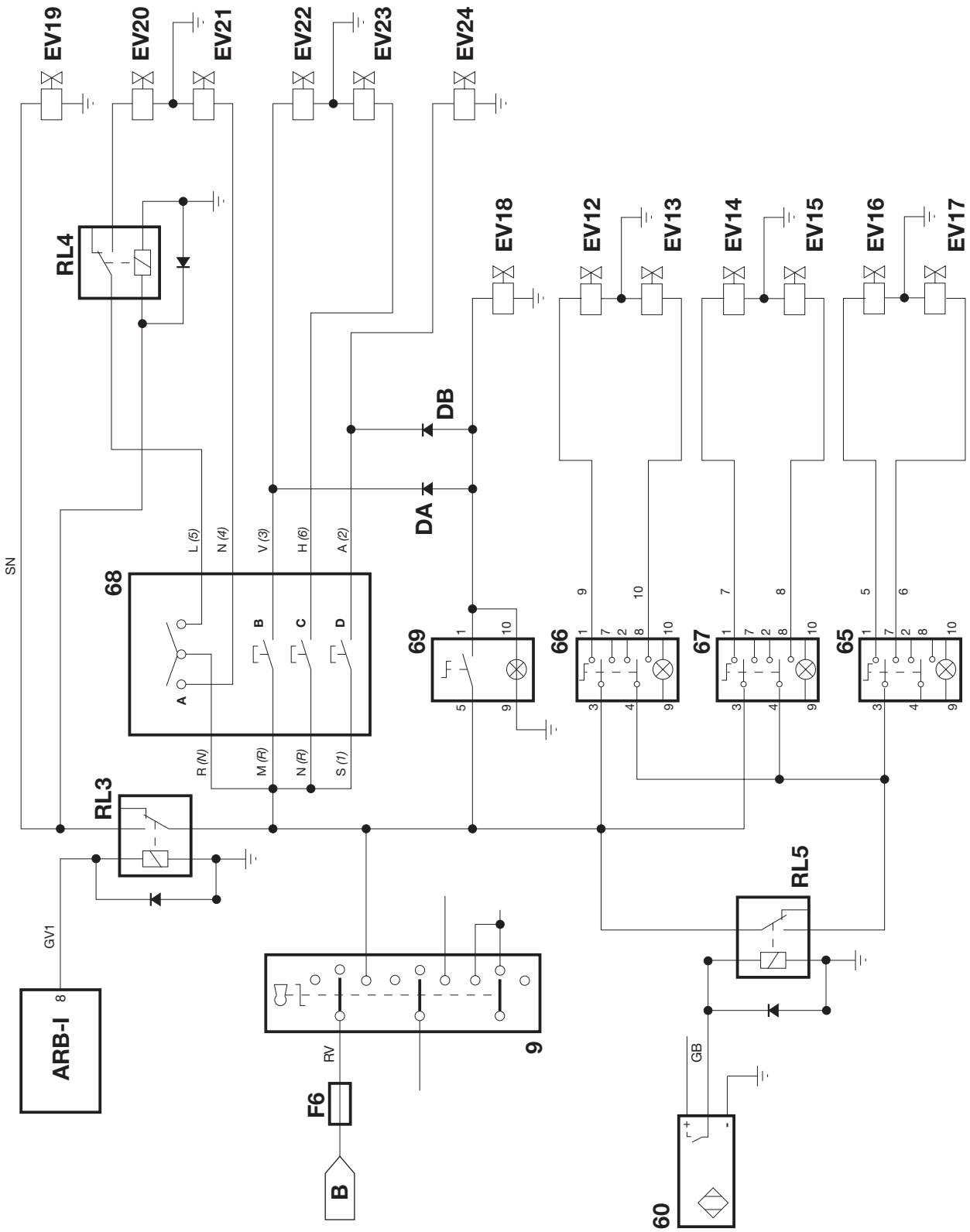
Operation: Wiring diagram 11/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.11**



Operation: Wiring diagram 12/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.12**



Operation:	Table:
Wiring diagram 13/25 - Telelift 3013 (**up to serial no. 7184**)	**C.05.01.13**



Operation: Wiring diagram 14/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.14**

LEGEND

1	Battery
2	Battery cutout switch
3	Starting motor
4	Alternator
5	Fuel solenoid valve
5A	Starting aid
6	Thermostarter
7	Junction box (engine compartment)
8	Emergency pushbutton
9	Cab/Road/Platform selector
10	Ignition switch
10B	Ignition switch (aerial man-platform)
11	Seat switch
12	Parking brake proximity switch
13	Hazard warning lights switch
14	Speed switch - right-hand side
15	Horn
16	Lights selector
17	Beacon switch
18	Stop lights pressure switch
19	Brake accumulator pressure switch
20	Back-up horn cutout switch
21	Speed switch - left-hand side
22	Front left lights
23	Front right lights
24	Rear left lights
25	Rear right lights
26	Side/tail lights - left-hand side
27	Side/tail lights - right-hand side
28	Licence plate lights
29	Back-up horn
30	Beacon
31	Warning lights board
	- Low battery charge
	- Low brake accumulator pressure
	- Low engine oil pressure
	- High engine water temperature
32	Warning lights board
	- Position lights
	- High beam
	- Turn signals
	- Parking brake
33	Warning lights board
	- Air filter clogging
	- Hydraulic oil filter clogging
34	Engine coolant thermometer
	Hydraulic oil thermometer
35	Fuel gauge
	Hour-meter
36	Pressure switch for air filter clogging

Operation: Wiring diagram 15/25 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.05.01.15**

37	Engine oil pressure switch
38	Engine thermostat
39	Pressure switch for hydraulic oil filter clogging
40	Engine coolant thermistor
41	Hydraulic oil thermistor
42	Fuel gauge sensor
43	1st/2nd mechanical gear warning lights
44	Mechanical gear change pushbutton
44B	Warning light - transmission OFF
45	1st gear proximity switch
46	2nd gear proximity switch
47	Cardan shaft proximity switch
48	Right outrigger proximity switch
49	Left outrigger proximity switch
50	Differential locking pushbutton
51	Steering selector
52	Optional attachment pushbutton
53	Work light switch
54	Work lights
55	Ventilation fan
56	CAB A/C fan
57	Cab interior lighting
58	Windscreen wiper motor
59	Windscreen washer pump
60	Low boom proximity switch
61	High boom proximity switch
62	Overload warning system display
63	Load cell
64	Bucket/forks selector
65	Sway pushbutton
66	Right outrigger pushbutton
67	Left outrigger pushbutton
68	Hydraulic joystick
68A	Boom out/in pushbutton
68B	Attachment locking/unlocking pushbuttons
68C	Deadman pushbutton
69	Sway/outrigger enabling pushbutton
DA	Diode 6A
DB	Diode 6A

MS	Aux. circuits Module
ML	Lights Module
SCT	Drive Control System
ARB-I	ARB-I overload warning system
SCT	Danfoss control module
JOY	Cab electronic joystick
NAV	Aerial man-platform

	Relays
RL1	Flashing
RL2	Air filter clogging warning light
RL3	Cab controls

Operation: Wiring diagram 16/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.16**

RL4	Boom extension locking
RL5	Sway locking/outrigger up-movement locking

	Solenoid valves
EV1	1st mechanical gear
EV2	2nd mechanical gear
EV3	Forward speed
EV4	Reverse speed
EV5	Differential locking
EV6	Convergent steering
EV7	Crab steering
EV8	Optional attachments
EV9	Optional attachments
EV10	Steering accumulator
EV11	Rear axle unlocking - right-hand side
EV11B	Rear axle unlocking - left-hand side
EV12	Right axle sway
EV13	Left axle sway
EV14	Right outrigger - up-movement
EV15	Right outrigger - down-movement
EV16	Left outrigger - up-movement
EV17	Left outrigger - down-movement
EV18	Flow selecting valve
EV19	Boom lowering lockinh
EV20	Boom extension
EV21	Boom retraction
EV22	Attachment locking
EV23	Attachment unlocking
EV24	Boom actuator locking

	Danfoss elctroproportional actuator
PVG1	Boom lifting/lowering
PVG2	Boom extension/retraction
PVG3	Fork rotation
PVG4	Attachment coupling - auxiliary circuits

Operation: Wiring diagram 17/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.17**

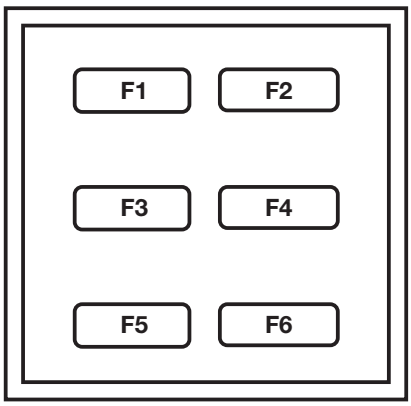
POWER LINES

A Auxiliary power line (direct)

B Main power line (key-protected)

FUSES

Ref.	Type	Protected circuit
F1	15A	Hazard warning lights
F2	15A	Turn signals
F3	20A	Work lights - Cab interior lighting
F4	20A	Horn - Cab fan - Windscreen wiper - Windscreen washer - Can roof wiper
F5	30A	Optional attachments solenoid valves
F6	30A	Flow divider solenoid valve Sway solenoid valves Outriggers solenoid valves
		Only TELELIFT 3013: Overload warning system cutout solenoid valve Boom extension/retraction solenoid valves Attachment coupling solenoid valves



Operation: Wiring diagram 18/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.18**

JUNCTION BOX

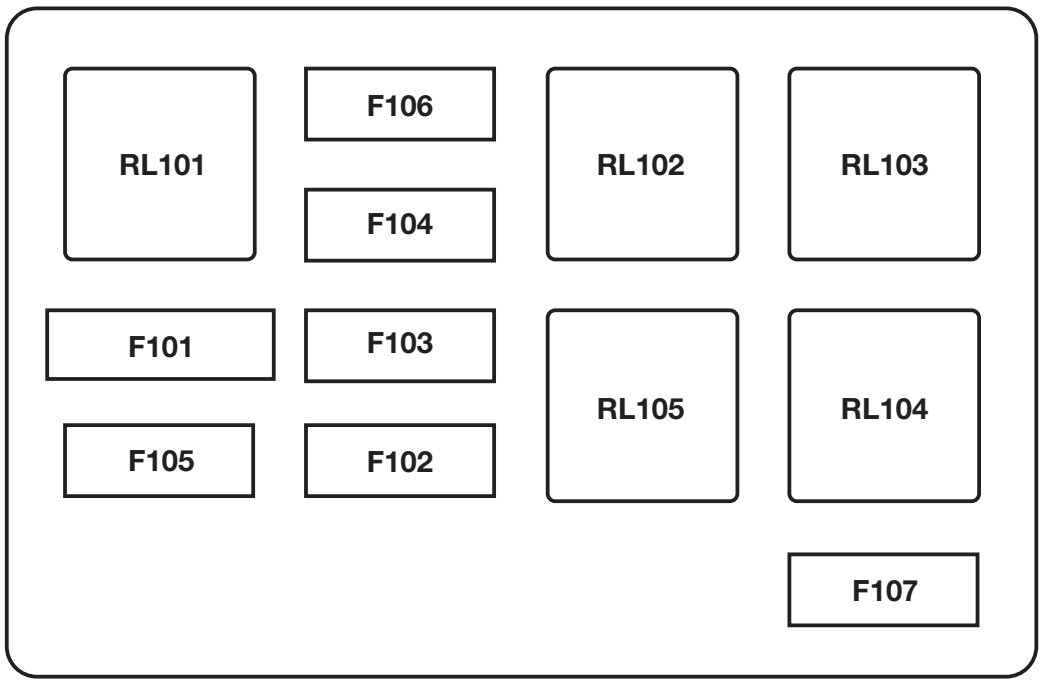
RELAYS

RL101 Main power line
RL102 Starting motor
RL103 Fuel solenoid valve
RL104 Thermostarter
RL105 [Reserved]

FUSES

Ref.	Type	Protected circuit
F101	60A	Electrical system power supply
F102	20A	Starting motor
F103	10A	Fuel solenoid valve
F104	30A	Thermostarter
F105	30A	A/C
F106	30A	Auxiliary power line
F107	20A	Electronic power line

Parts arrangement in junction box - view from above



Operation: Wiring diagram 19/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.19**

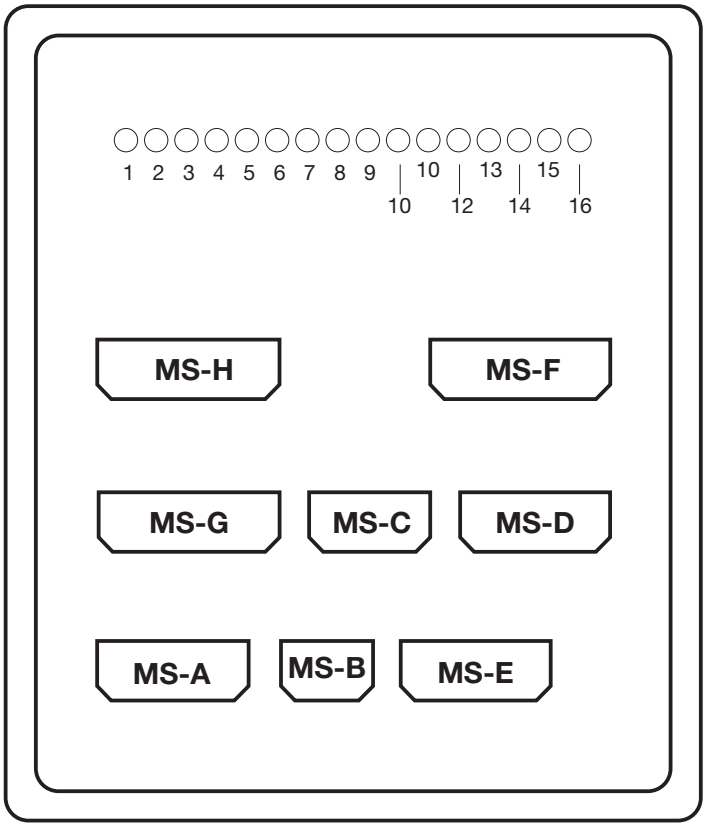
AUXILIARY CIRCUITS MODULE

Overload LED

1 Ignition relay-fuel-main power line- ignition signal (ML)
2 Electronics (ARB-I, SCT, Danfoss control module)
3 Steering selection solenoid valves
Differential locking solenoid valve
4 Mechanical gear solenoid valves
5 Forward/reverse speed solenoid valves
6 Rear axle unlocking solenoid valves
7 Auxiliary circuits module power supply
Instruments power supply
Power supply - seat switch/gear selector (not used)
Power supply: proximity switches - fuel gauge sensor - air/oil filters pressure switches

Signals input

8 Cab controls
9 Dashboard
10 Ignition
11 Rear axle unlocking
12 Parking brake
13 Seat switch
14 Neutral position (not used)
15 Right outrigger down
16 Left outrigger down



Operation: Wiring diagram 20/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.04.01.20**

MS-A		**Cable harness**
1	R	Electronic power supply
2	N	Electronic earth
3	S	Thermostarter relay
4	C	Ignition relay
5	M	Fuel solenoid valve relay
6	R	Electronic power supply
7	N	Electronic earth
8	R	Electrical system power supply relay
9	H	Alternator

MS-B		**Remote ignition switch**
1	10	Changeover switch common
2	12	Ignition
3		N/C
4	11	Dashboard
5		N/C

MS-C		**Power supply**
1	RV	Warning lights power supply
2	ZB	Seat switch power supply
3	R	Line B power supply
4	R	Line B power supply
5	Z	Line A power supply
6	N	Earth
7	R	Line B power supply

MS-D		**Proximity switches**
1	AG	Parking brake proximity switch
2		N/C
3		Low boom proximity switch
4		[Reserved]
5	BV	Sensors power supply
6		N/C
7	BR	Right outrigger proximity switch
8	BR	Left outrigger proximity switch
9	BV	Sensors power supply

MS-E		**Cable harness**
1		[Reserved]
2		[Reserved]
3	B	Auxiliary relay coil
4	BV	Seat switch input
5	BA	Low outriggers output
6		[Reserved]
7		[Reserved]
8		[Reserved]
9	C	Speed stop output

Operation:	Table:
Wiring diagram 21/25 - Telelift 3013 (**up to serial no. 7184**)	**C.04.01.21**

5	HG	Forward/reserve speed
6	B	Mechanical gear
7		Emergency steering
8		Auxiliary relay common
9		Auxiliary relay NC
10		Auxiliary relay NO
11		[Reserved]
12		[Reserved]
13		[Reserved]

MS-G Upper dashboard

1	V	Emergency button input
2	A	Ignition switch (dashboard)
3	RN	Cab/road/platform selector
4	HN	Parking brake warning light
5	H	Alternator warning light
6	CA	Hour-meter
7	RV	Dashboard warning lights power supply
8	S	Ignition switch (warm-up)
9		N/C
1 0		N/C
11	B	Ignition switch (ignition)
12	BR	Platform controls selector input
13	VN	Emergency pushbutton output

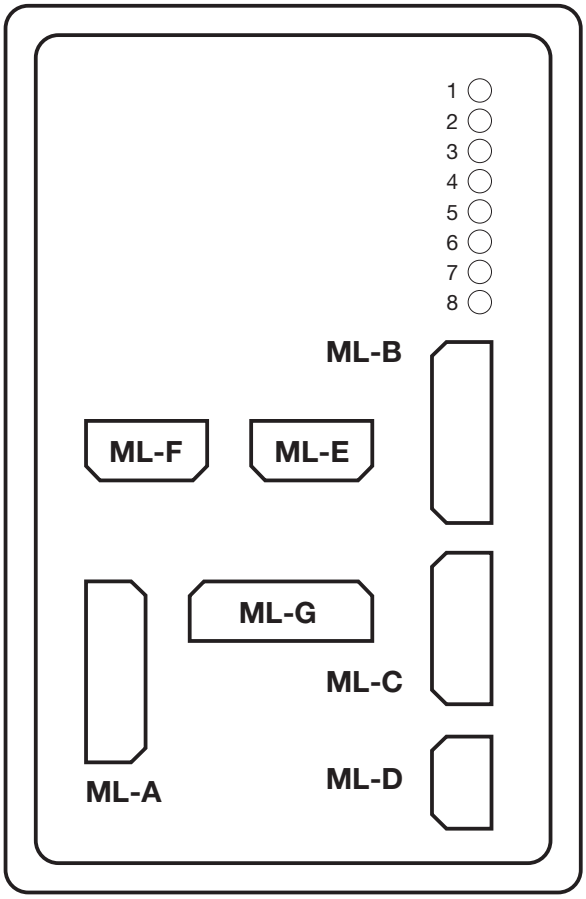
MS-H		**Electronics**
1	R	[Reserved]
2		SCD electronic power supply
3		SCD electronic power supply
4	N	Electronic earth
5		[Reserved]
6	RN	SCT power supply
7	H R	ARB-I power supply
8	N	Electronic earth
9	N	Electronic earth
10	N	Electronic earth
11	N	Electronic earth
12	N	Electronic earth
13	N	Electronic earth

Operation: Wiring diagram 22/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.22**

LIGHTS MODULE

Overload LED

1 Brake pressure switches
2 Stop lights
3 Position lights
4 Low beam
5 High beam
6 Beacons
7 Back-up lamp
8 Back-up horn



Operation:	Table:
Wiring diagram 23/25 - Telelift 3013 (**up to serial no. 7184**)	**C.05.01.23**

ML-A		**Cable harness**
1	R	Power supply
2	R	Power supply
3	R	Power supply
4		N/C
5	B	Ignition input
6	RV	Warning lights power supply
7	BN	Back-up signal input
8	Z	Power supply
9		[Reserved]
10	CN	Beacon output
11	N	Earth
12	N	Earth
13	N	Earth

ML-B		**Upper dashboard**
1	CN	Back-up horn cutout switch
2		N/C
3		N/C
4	C	Back-up cutout switch input
5	RN	Warning light - low brake accumulator pressure
6	G	Lights selector input (low beam/high beam)
7	HG	Turn signals common input
8	RG	Lights selector input (position lights)
9	GV	Position lights warning light
10	A1	High beam warning light
11	C1	Beacon switch input
12	G1	Turn signals input - right-hand
13	GN1	Turn signal input - left-hand

ML-C		**Speed switch (right-hand side)**
1	BN	Turn signals common
2	H	Low beam/high beam switch
3	HN	Low beam input
4	VN	High beam input
5	AN	Turn signals - right-hand
6	A	Turn signals - left-hand
7		[Reserved]

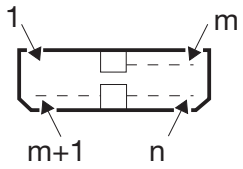
ML-D		**Brake pressure switch**
1	R	Pressure switches power supply
2	HR	Stop lights pressure switches
3	RN	Brake accumulator pressure switch
4		N/C
5		N/C

ML-E		**Front lights - right-hand side**
1	GV	Position light
2		Side/tail lights (not used)
3	VN	High beam
4	L	Low beam
5	GN	Turn signal
6		N/C
7		Earth (not used)

Operation: Wiring diagram 24/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.24**

ML-F		**Front lights - left-hand side**
1	GR	Position light
2		Side/tail lights (not used)
3	VN	High beam
4	L	Low beam
5	G	Turn signal
6		N/C
7		Earth (not used)

ML-G		**Rear lights**
1	AG	Right position light
2	RG	Left position light
3	RN	Right stop light
4	RN	Left stop light
5		[Reserved]
6	BN	Back-up lamp
7	B	Back-up horn
8	GN	Right turn signal
9	G	Left turn signal
10		N/C
11		N/C
12		Earth (not used)
13		Earth (not used)



Connectors numbering
The example in the figure shows a femal connector with male contacts seen from the contacts side (see orientation with rounded edges downwards).

Connectors are numbered in the order 1...m, m+1...n

The connector in the picture is a 13-pole connector (n = 13); the contact at the top right is n.7 (m), the one at the bottom left is n.8 (m+1), the last contact (13) is at the bottom right.

All the remaining connectors (with more or less contacts) follow the same numbering order.

Operation: Wiring diagram 25/25 - Telelift 3013 (**up to serial no. 7184**)	*Table:* **C.05.01.25**

CABLE COLOURS

A	Blue
B	White
C	Orange
G	Yellow
H	Grey
M	Brown
N	Black
R	Red
S	Pink
V	Green
Z	Purple

INDEX

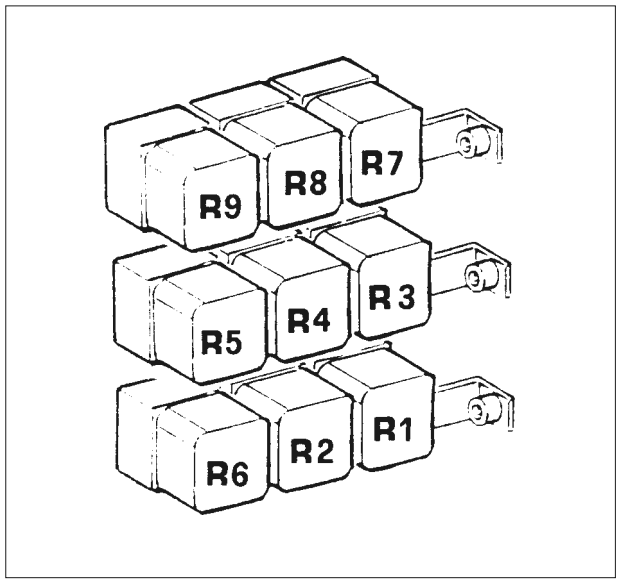
1		Engine - Junction box
2		Ignition
3		Lights Module inputs
4		Lights Module outputs
5		Instruments and warning lights board
6		Drive Control System - inputs
7		Drive Control System - outputs
8		Auxiliary circuits
9		Emergency steering - axle unlocking
10		ARB-I overload warning system
11	§	Danfoss Control Module - inputs
12	§	Danfoss Control Module - outputs
13	§§	Hydraulic joystick
14-16		Legend
17		Power lines – Fuses
18		Junction box
19-21		Auxiliary Circuits Module
22-24		Lights Module
25		Cabke colours

§ Only TELELIFT 3514
§§ Only TELELIFT 3013

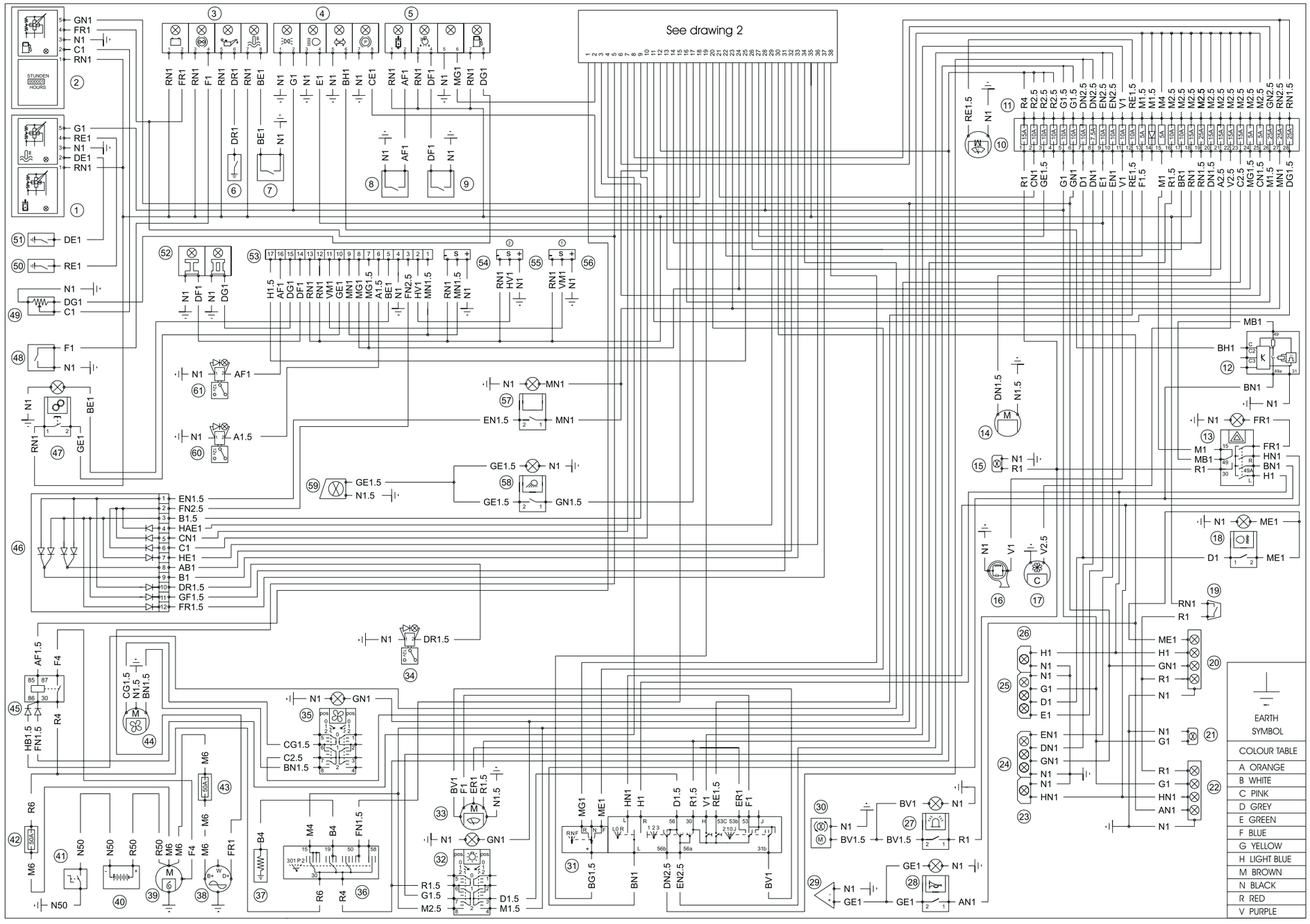
Operation:	Wiring diagram Telelift 3013 (**up to serial no. 7184**) Relays	*Table:* **C.05.01.26**

RELAYS

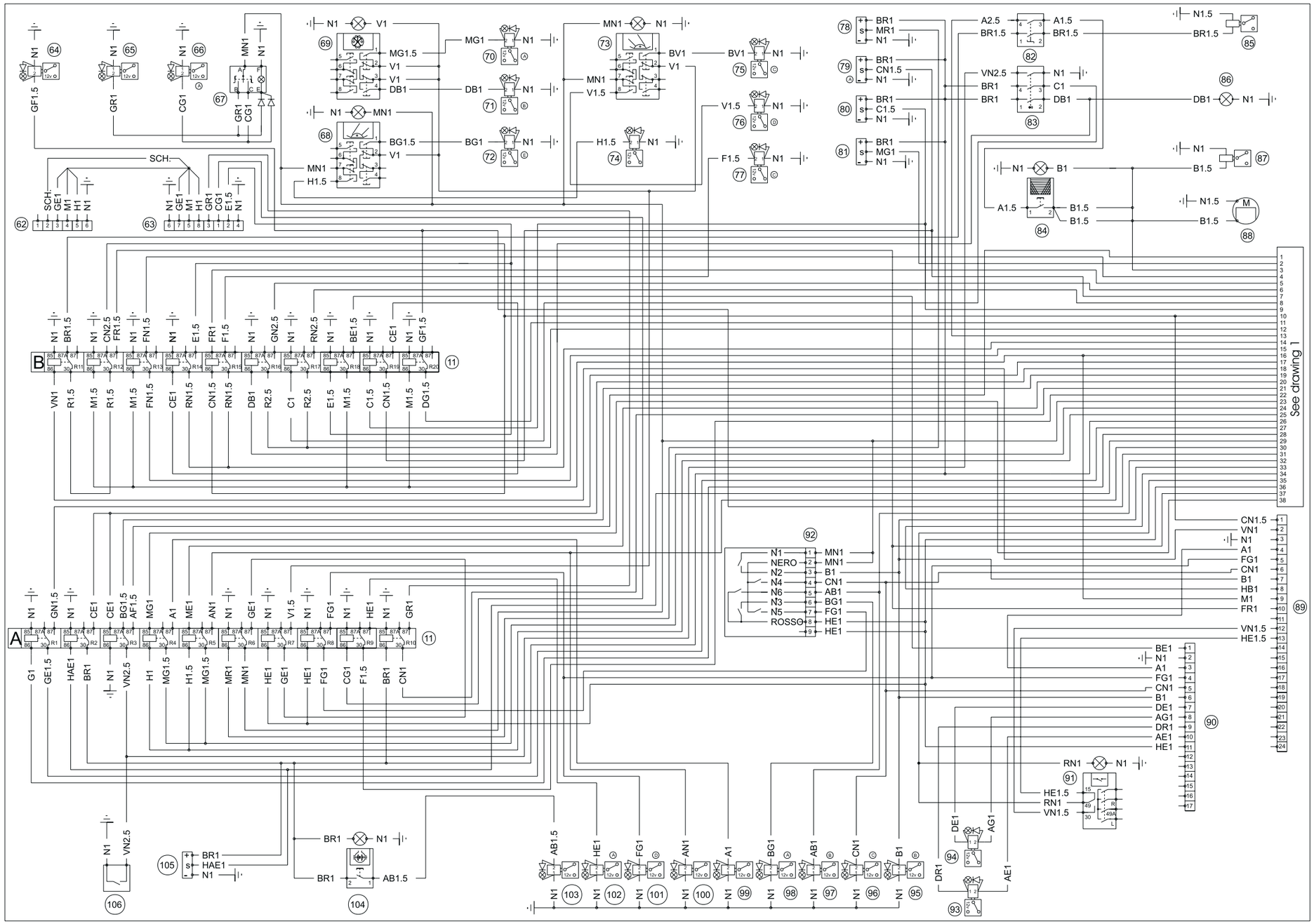
R1 Extension overload warning system locking
R2 Overload warning system relay
R3 Flashing
R4 Sway and outriggers up-movement locking
R5 N. C.
R6 N. C.
R7 Outriggers signals for platform
R8 Platform power supply
R9 N. C.



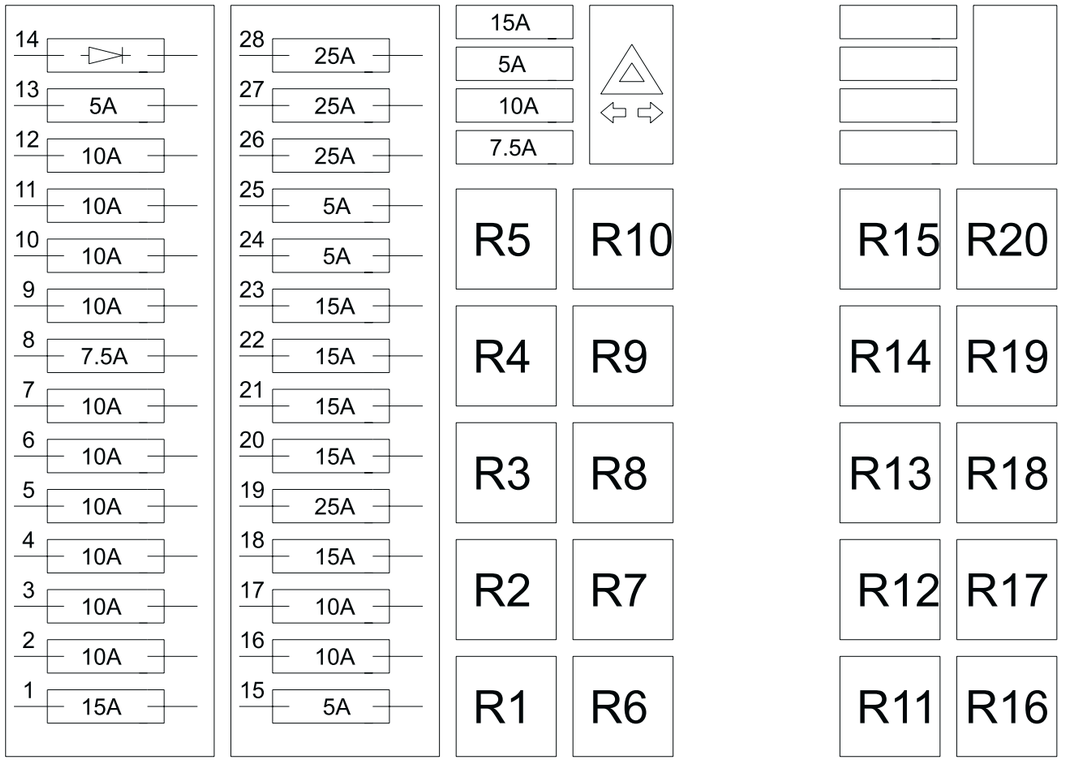
Operation: Wiring diagram 1/2 - Telelift 3013 (**from serial no. 7185 to serial no. 8450**)	*Table:* **C.05.02.01**



Operation: Wiring diagram 2/2 - Telelift 3013 (**from serial no. 7185 to serial no. 8450**)	*Table:* **C.05.02.02**



Operation: Fuse wiring diagram - Telelift 3013 (**from serial no. 7185 to serial no. 8450**)	*Table:* **C.05.02.03**



FUSE-BOX UNIT

Pos.	User
1	+30 turn signals emergency switch power supply, beacon switch
2	E10 relay power supply
3	E1 relay power supply
4	Blank
5	Right front/rear left position lights, license plate lights, position lights indicator, water temperature indicator light, hydraulic oil temperature indicator light, E1 relay energizing coil
6	Front left/rear right position lights, position lights switch light, fuel gauge - hourmeter light
7	Right low beam, fog lamp switch power supply
8	Left low beam
9	Right high beam, high beam indicator
10	Left high beam
11	Horn
12	Windscreen washer kit power supply
13	E9 relay power supply
14	Blank
15	+ 15 turn signals emergency switch power supply
16	Windscreen wiper/washer motor power supply, wiper switch
17	E2 relay power supply, wheel centering sensor, right outrigger sensor, low boom sensor, left stabillzer sensor, platform-road-cabin switch
18	Hydraulic stop power supply, 1st speed sensor, 2nd speed sensor
19	Cardan shaft motion sensor, S.C.T. control unit connector, hydraulic oil temperature sensor, air filter clogging sensor, fuel reserve, water temperature sensor, engine oil pressure indicator, brake failure indicator, gen-set indicator, fuel gauge hourmeter, water temperature hydraulic oil temperature indicator, speed change button, optional attachment switch
20	Wiper motor power supply
21	Emergency pump switch power supply
22	Air conditioning compressor power supply
23	Heating fan switch power supply
24	Power supply - S.C.T. control unit connector E4 relay, E5 relay
25	Power supply - 4-way platform system connector, E5 relay, E2 relay
26	Power supply - 15-way platform system connector, E8 relay, E2 relay energizing coil, E3 relay, E10 relay
27	Power supply - crab/4 steering wheels switch, joystick connector, E6 relay, left and right outrigger switch
28	E10 relay power supply

RELAYS UNIT

Pos.	User
R1	Work light switch power supply
R2	Parking brake indicator
R3	Fwd speed enabling command
R4	Fwd speed
R5	Reverse speed
R6	E7 relay power supply
R7	Right/left outrigger switch power supply, ARB switch
R8	Boom extension
R9	ARB system
R10	ARB1 control unit
R11	Engine stop
R12	Enabling command - stop engine from platform
R13	Start enabling command
R14	E8 relay power supply enabling command, self-levelling control unit
R15	T.Ü.V. standard solenoid enabling command
R16	Fuse 26 power supply
R17	Fuse 27-28 power supply
R18	Platform power supply enabling command
R19	E4 relay enabling command
R20	Solenoid to cut off the cab hand-control from platform

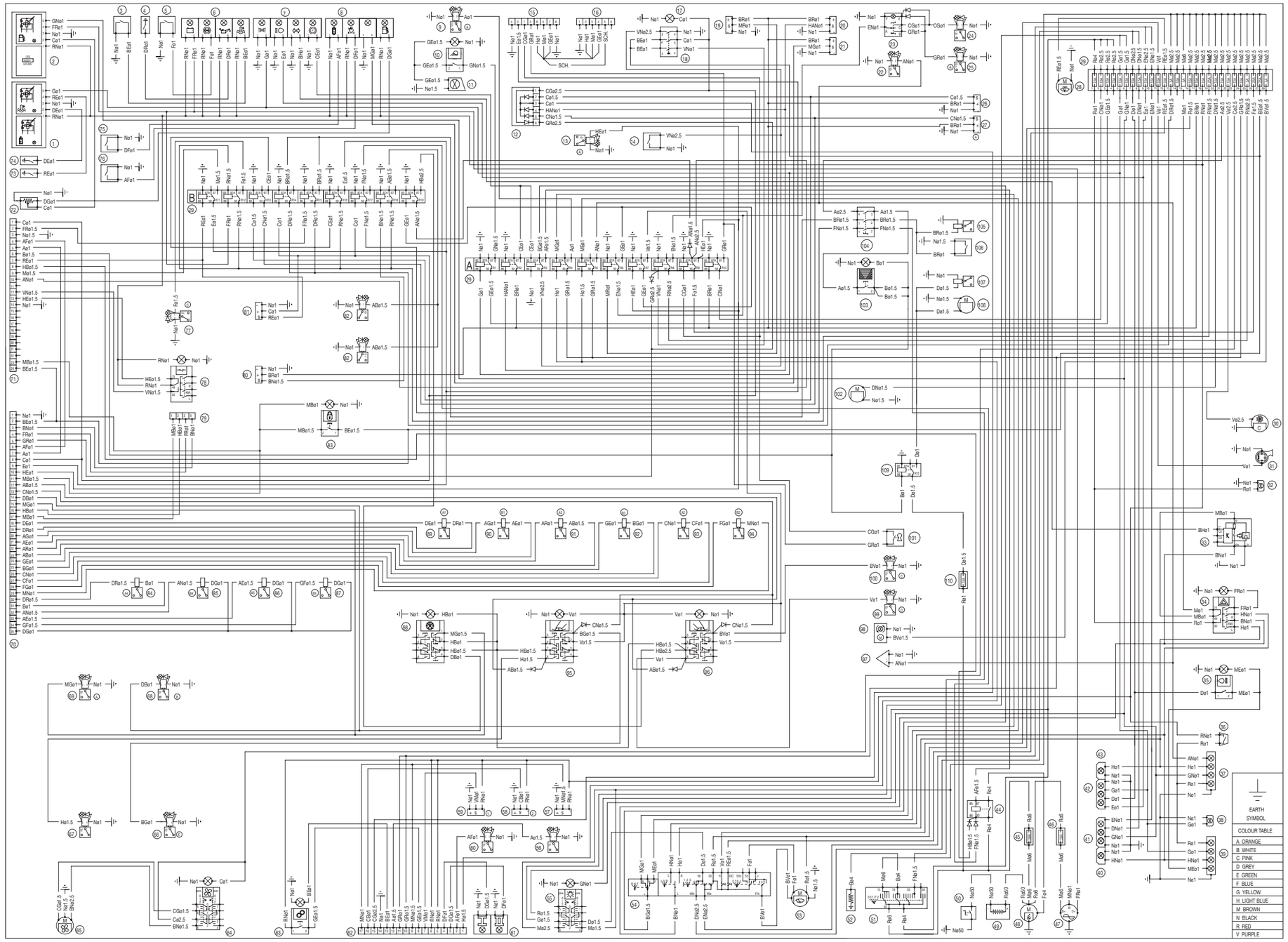
Operation:	Table:
Legend wiring diagram - Telelift 3013 (**from serial no. 7185 to serial no. 8450**)	**C.05.02.04**

Ref.	Description
1	Water temperature/hydraulic oil temperature indicator
2	Fuel gauge - hourmeter indicator
3	Indicators: gen-set, brake failure, engine oil pressure, water temperature
4	Indicators: position lights, high beam, turn signals, parking brake
5	Indicators: hydraulic oil temperature, air filter clogged, wheel centering, fuel reserve
6	Engine oil pressure sensor
7	Water temperature sensor
8	Hydraulic oil temperature sensor
9	Air filter clogging sensor
10	Windscreen washer motor
11	Fuse/relay box
12	Turn signals
13	Hazard warning lamp switch
14	Wiper motor
15	Cab interior lamp
16	Horn
17	Air conditioning compressor
18	Fog lamp switch
19	Hydraulic stop
20	Rear right light
21	License plate lights
22	Rear left light
23	Left turn signal
24	Front left beam
25	Front right beam
26	Right turn signal
27	Beacon switch
28	Back-up horn cutout switch
29	Back-up horn
30	Beacon
31	Light switch - wiper/reverse control
32	Position lights switch
33	Windscreen wiper/washer switch
34	Hydraulic switch solenoid for outrigger
35	Heating fan switch
36	Ignition key switch
37	Thermostarter
38	Alternator
39	Starter
40	12V battery
41	Battery cutout switch
42	System protection fuse
43	Alternator protection fuse
44	Heating fan motor
45	Start enabling command relay
46	Rectifier box
47	Speed change button

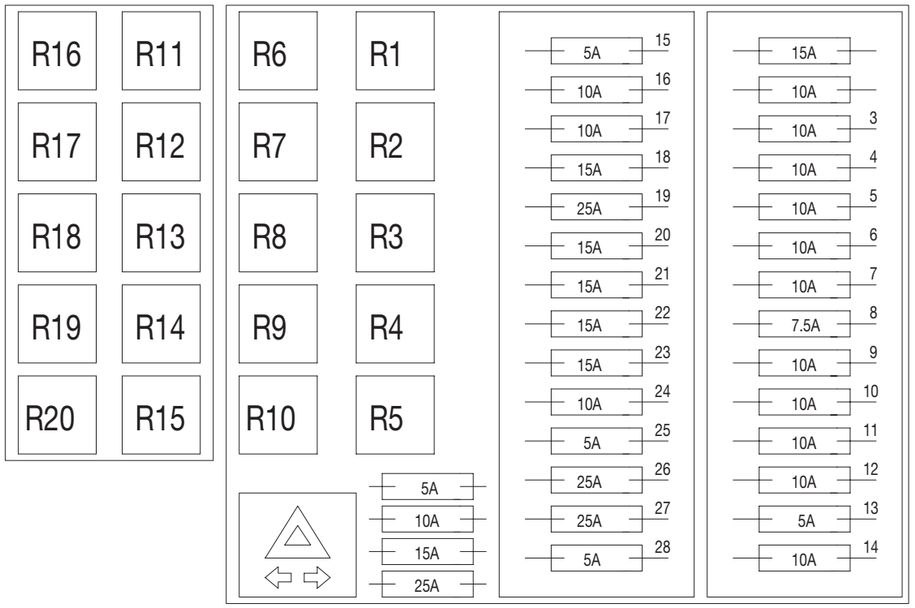
Ref.	Description
48	Brake failure sensor
49	Fuel gauge float
50	Hydraulic oil temperature indicator sensor
51	Water temperature indicator sensor
52	1st/2nd speed indicators
53	S.C.T. control unit connector
54	Cardan shaft motion speed
55	2nd speed sensor
56	1st speed sensor
57	Sway and outrigger selection switch
58	Work light switch
59	Work light
60	2nd speed solenoid
61	1st speeed solenoid
62	Loading cell
63	ARB1 connector
64	Solenoid - cab hand-control cutout from platform
65	4wd solenoid
66	Crab solenoid
67	Crab - 4 steering wheels switch
68	Left outrigger switch
69	Left-right sway switch
70	Right sway solenoid
71	Left sway solenoid
72	Solenoid - left outrigger up
73	Right outrigger switch
74	Solenoid - left stabilzer down
75	Solenoid - right outrigger up
76	Solenoid - right outrigger down
77	T.Ü.V. standard solenoid
78	Low boom sensor
79	Left outrigger sensor
80	Right outrigger sensor
81	Wheel centering sensor
82	Mushroom-head switch - engine stop
83	Platform-road-cabin switch
84	Emergency pump switch
85	Engine stop solenoid
86	Platform-road-cabin switch indicator
87	Solenoid - emergency pump motor relay enabl. command
88	Emergency pump motor
89	24-way platform system connector
90	17-way platform motion control unit connector
91	Optional attachment switch
92	Joystick
93	Proportional solenoid - platform down
94	Proportional solenoid - platform up
95	Deadman solenoid
96	Solenoid - boom in

Ref.	Description
97	Solenoid - attachment coupling
98	Solenoid - attachment release
99	Solenoid - fwd speed
100	Solenoid - reverse speed
101	Solenoid - boom out
102	Solenoid - ARB
103	Solenoid - differential locking
104	Differential locking switch
105	Parking brake sensor
106	Seat switch

Operation:	*Table:*
Wiring diagram - Telelift 3013 (**from serial no. 8451 to serial no. 9407**) - Telelift 3517 (**to serial no. 9362**)	**C.05.03.01**



Operation:	*Table:*
Fuse wiring diagram - Telelift 3013 (**from serial no. 8451 to serial no. 9407**) - Telelift 3517 (**to serial no. 9362**)	**C.05.03.02**



FUSE-BOX UNIT

Pos.	User
1	+30 turn signals emergency switch power supply, beacon switch
2	R10 relay power supply
3	R1 relay power supply
4	Blank
5	Right front/rear left position lights, license plate lights, R1 relay energizing coil, position lights indicator, water temperature indicator light, hydraulic oil temperature indicator light
6	Front left/rear right position lights, fuel gauge - hourmeter light, position lights switch light
7	Right low beam, fog lamp switch power supply
8	Left low beam
9	Right high beam, high beam indicator
10	Left high beam
11	Horn
12	Blank
13	R14 relay power supply
14	Blank
15	+ 15 turn signals, emergency switch power supply
16	Power supply: windscreen wiper/washer motor - lights switch
17	R2, R10 relay power supply, right outrigger sensor, left stabillzer sensor, low boom sensor, parking brake sensor, wheel centring sensor, 17m boom sensor
18	Hydraulic stop power supply, cardan shaft motion sensor, 1st speed sensor, 2nd speed sensor, speed change button, S.C.T. control unit connector, fuel reserve, air filter clogging sensor, hydraulic oil temperature indicator, water temperature sensor, engine oil pressure indicator, brake failure indicator, gen-set indicator, fuel gauge hourmeter, water temperature hydraulic oil temperature indicator, optional attachment switch
19	Power supply: R12 - R16 relays, R12 relay pickup
20	Wiper motor power supply
21	Emergency pump switch power supply
22	Air conditioning compressor power supply
23	Power supply and lighting of the heating fan switch
24	Power supply - S.C.T. control unit connector R4 relay, R5 relay
25	R8 relay power supply
26	R9 relay power supply
27	Power supply: road safety switch, 35-pole plug for electronic control unit, platform-road-cabin switch
28	Beacon power supply

RELAYS UNIT

Pos.	User
R1	Work light switch power supply
R2	Parking brake indicator, R3 relay pickup enabling
R3	Engine start with parking brake engaged
R4	Fwd speed
R5	Reverse speed
R6	R7 relay power supply
R7	Outriggers enabling command
R8	R6 relay enabling command, crab/4-wheel steer selector
R9	ARB system
R10	ARB1 control unit
R11	Platform power supply enabling command
R12	Solenoid in accordance with T.Ü.V regulations
R13	R14 relay enabling command
R14	Engine shutdown from platform
R15	Enabling command for engine shutdown from platform
R16	R11 relay enabling command, ARB1 connector
R17	Start-up relay pickup enabling command
R18	17m boom
R19	Outriggers up/down movement with low boom sensor ON
R20	Blank

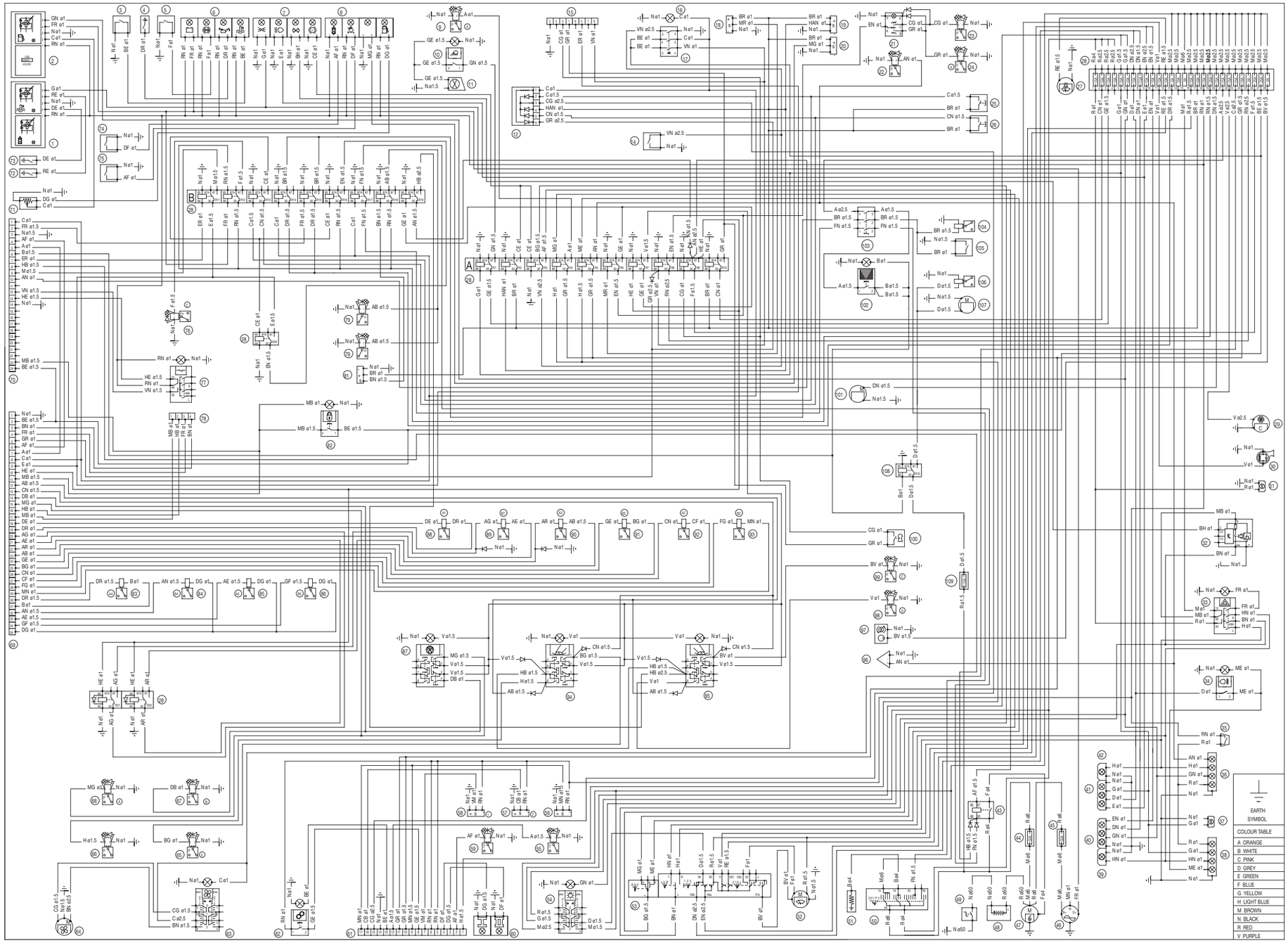
Operation:	Table:
Legend wiring diagram - Telelift 3013 (**from serial no. 8451 to serial no. 9407**) - Telelift 3517 (**to serial no. 9362**)	**C.05.03.03**

Ref.	Description
1	Water temperature/hydraulic oil temperature indicator
2	Fuel gauge - hourmeter indicator
3	Water temperature sensor
4	Engine oil pressure sensor
5	Brake failure sensor
6	Indicators: gen-set, brake failure, engine oil pressure, water temperature
7	Indicators: position lights, high beam, turn signals, parking brake
8	Indicators: hydraulic oil temperature, air filter clogged, wheel centering, fuel reserve
9	Solenoid - fwd speed
10	Beacon switch
11	Beacon
12	Diode group
13	Solenoid - ARB
14	Seat switch
15	ARB1 connector
16	Loading cell
17	Platform-road-cabin switch indicator
18	Platform-road-cabin switch
19	Low boom sensor
20	Parking brake sensor
21	Wheel centering sensor
22	Solenoid - reverse speed
23	Crab - 4 steering wheels switch
24	Crab solenoid
25	4wd solenoid
26	Right outrigger sensor
27	Left outrigger sensor
28	Wiper motor
29	Fuse/relay box
30	Air conditioning compressor
31	Horn
32	Cab interior lamp
33	Blinking
34	Hazard warning light/turn signal switch
35	Fog lamp switch
36	Hydraulic stop
37	Rear right light
38	License plate lights
39	Rear left light
40	Left turn signal
41	Front left beam
42	Front right beam
43	Right turn signal
44	Start enabling command relay
45	System protection fuse
46	Alternator protection fuse
47	Alternator

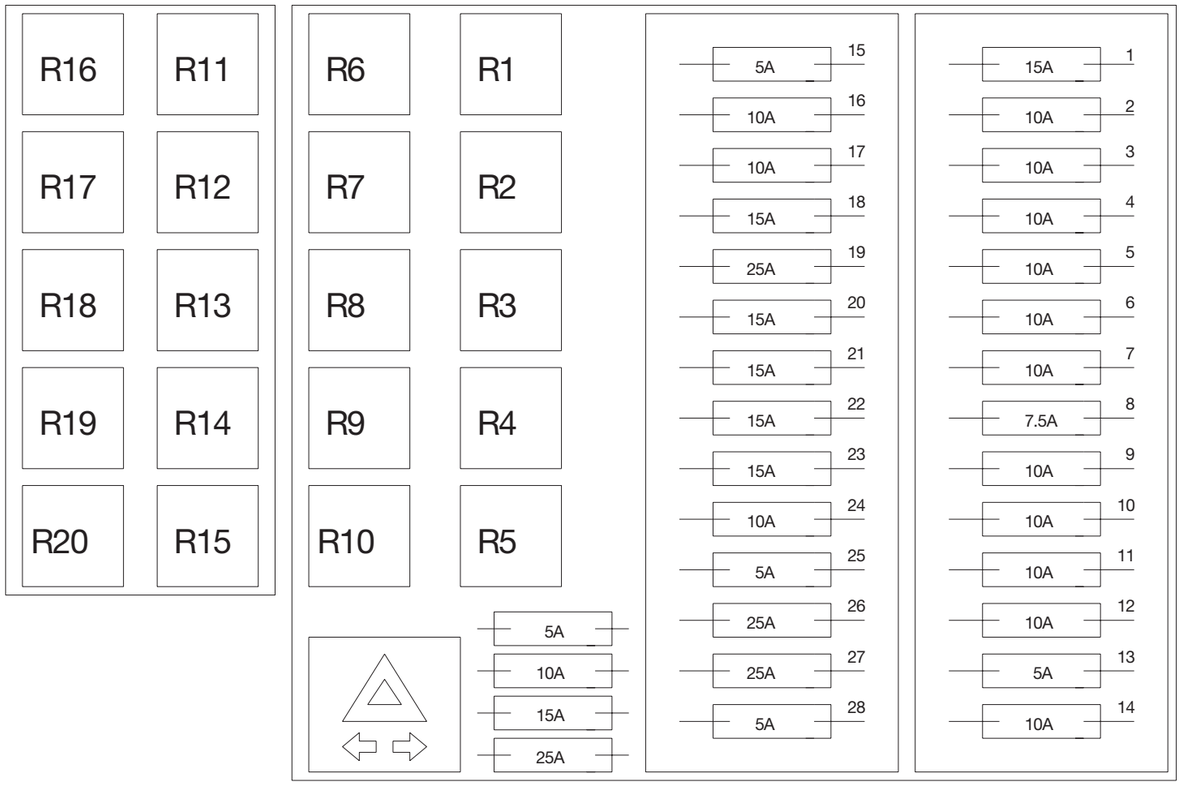
Ref.	Description
48	Starter
49	12V battery
50	Battery cutout switch
51	Ignition key switch
52	Thermostarter
53	Windscreen washer motor
54	Light switch - wiper/reverse control
55	Position lights switch
56	2nd speed solenoid
57	Cardan shaft motion speed
58	2nd speed sensor
59	1st speed sensor
60	1st speeed solenoid
61	1st/2nd speed indicators
62	S.C.T. control unit connector
63	Speed change button
64	Heating fan switch
65	Heating fan motor
66	Solenoid - left outrigger up
67	Solenoid - right outrigger up
68	Left sway solenoid
69	Right sway solenoid
70	35-pin plug - control unit
71	24-way platform system connector
72	Fuel gauge float
73	Hydraulic oil temperature indicator sensor
74	Water temperature indicator sensor
75	Air filter clogging sensor
76	Hydraulic oil filter clogged
77	T.Ü.V. standard solenoid
78	Optional attachment switch
79	Joystick connector
80	Sensor - 17 m boom
81	Sensor - platform coupling
82	Solenoid valve - 17 m boom relay
83	Road safety switch
84	Solenoid - attachment release
85	Solenoid - attachment coupling
86	Solenoid valve - fifth element
87	Solenoid valve - fifth element
88	Left-right sway switch
89	Proportional solenoid - platform up
90	Proportional solenoid - platform down
91	Solenoid - boom out
92	Solenoid - boom in
93	Solenoid valve - fork pitching forward
94	Solenoid valve - fork pitching back
95	Left outrigger switch
96	Right outrigger switch

Ref.	Description
97	Back-up horn
98	Beacon
99	Solenoid - right outrigger down
100	Solenoid - left stabilzer down
101	Overload warning system control unit cutout switch
102	Rear windscreen washer motor
103	Emergency pump switch
104	Mushroom-head switch
105	Engine stop solenoid
106	Engine stop solenoid
107	Solenoid - emergency pump motor relay enabl. command
108	Emergency pump
109	Enabling relay for emergency pump supply
110	Emergency pump protection fuse

Operation:	*Table:*
Wiring diagram - Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	**C.05.04.01**



Operation:	*Table:*
Fuse wiring diagram - Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	**C.05.04.02**



FUSE-BOX UNIT

Pos.	User
1	+30 turn signals emergency switch power supply, beacon switch
2	R10 relay power supply
3	R1 relay power supply
4	Blank
5	Right front/rear left position lights, license plate lights, R1 relay energizing coil, position lights indicator, water temperature indicator light, hydraulic oil temperature indicator light
6	Front left/rear right position lights, fuel gauge - hourmeter light, position lights switch light
7	Right low beam, fog lamp switch power supply
8	Low beam
9	Right high beam, high beam indicator
10	Left high beam
11	Horn
12	Windscreen washer motor
13	R14 relay power supply
14	Blank
15	+ 15 turn signals, emergency switch power supply
16	Power supply: windscreen wiper/washer motor - lights switch
17	R2, R10 relay power supply, right outrigger sensor, left stabillzer sensor, low boom sensor,parking brake sensor, wheel centring sensor, 17m boom sensor
18	Hydraulic stop power supply, cardan shaft motion sensor, 1st speed sensor, 2nd speed sensor, speed change button, S.C.T. control unit connector, fuel reserve, air filter clogging sensor, hydraulic oil temperature indicator, water temperature sensor, engine oil pressure indicator, brake failure indicator, gen-set indicator, fuel gauge hourmeter, water temperature hydraulic oil temperature indicator, optional attachment switch
19	Power supply: R12 - R16 relays, R12 relay pickup
20	Wiper motor power supply
21	Power supply: emergency pushbutton switch
22	Air conditioning compressor power supply
23	Power supply and lighting of the heating fan switch
24	Power supply - S.C.T. control unit connector R4 relay, R5 relay
25	R8 relay power supply
26	R9 relay power supply
27	Power supply: road safety switch, 35-pole plug for electronic control unit, platform-road-cabin switch
28	Beacon power supply

RELAYS UNIT

Pos.	User
R1	Work light switch power supply
R2	Parking brake indicator, R3 relay pickup enabling
R3	Engine start with parking brake engaged
R4	Fwd speed
R5	Reverse speed
R6	R7 relay power supply
R7	Outrigger switch enabling command
R8	R6 relay enabling command, crab/4-wheel steer selector
R9	ARB system
R10	3B6 overload warning system supply enabling command, overload warning system by-pass key
R11	Platform power supply enabling command
R12	Solenoid in accordance with T.Ü.V regulations
R13	R16 relay supply enabling command
R14	Engine shutdown from platform
R15	Enabling command for engine shutdown from platform
R16	R20 relay supply enabling command
R17	Start-up relay pickup enabling command
R18	Rear axle locking (only mod. 3517)
R19	Outriggers up/down movement with low boom sensor ON
R20	R11 relay enabling command, 35-pole plug for electronic control unit, control unit for 3B6 overload warning system
R21	Enabling command for boom lowering proportional solenoid valve
R22	Enabling command for boom extension proportional solenoid valve

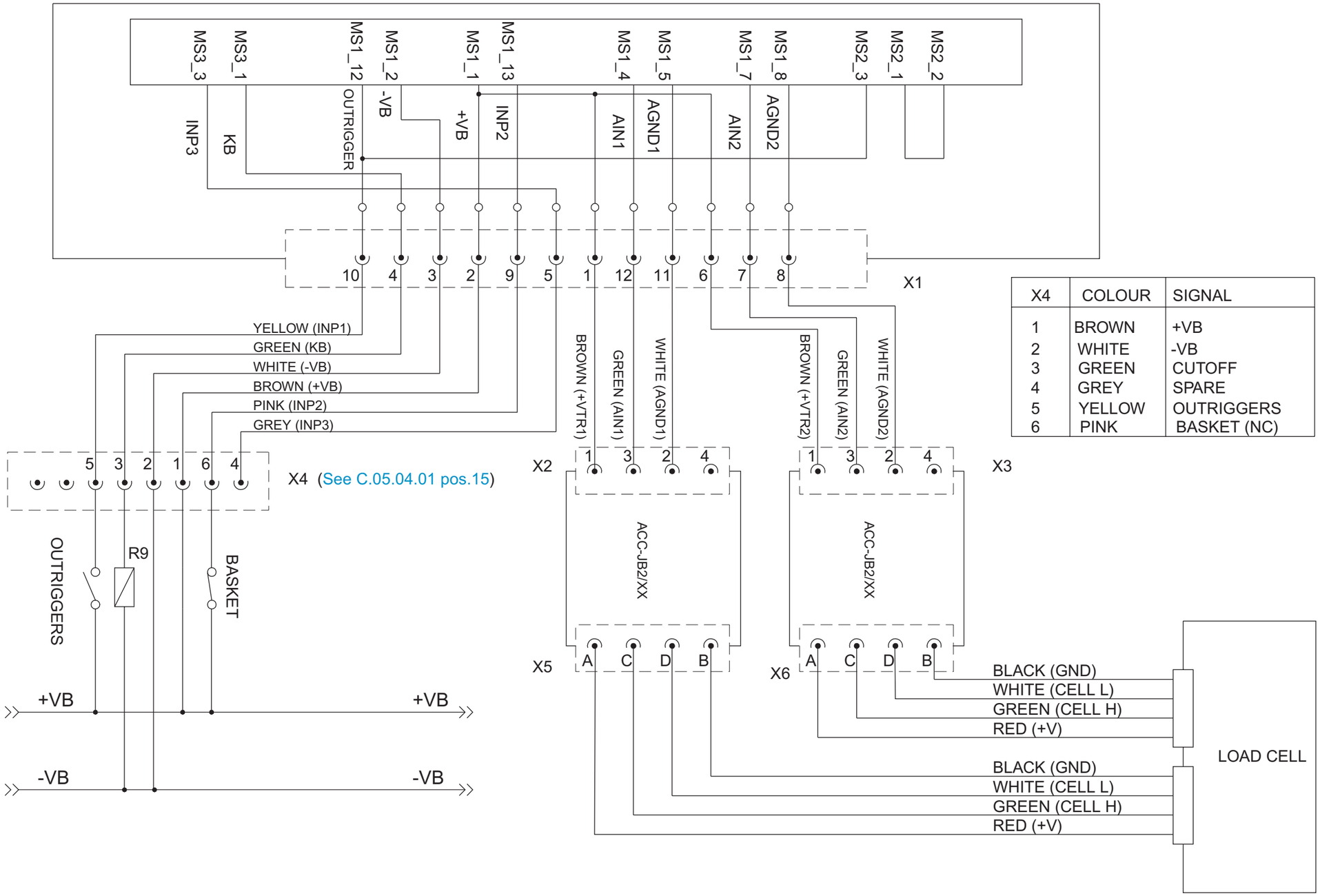
Operation:	Table:
Legend wiring diagram - Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	**C.05.04.03**

Ref.	Description
1	Water-hydraulic oil temperature indicator
2	Fuel gauge-hourmeter
3	Engine water temperature transducer
4	Motor oil temperature transducer
5	Brake failure sensor
6	Indicators: gen-set brake failure engine oil pressure water temperature
7	Indicators: position lights, high beam, turn signals, parking brake
8	Indicators: hydraulic oil temperature, air filter clogged, wheel centering, fuel reserve
9	Solenoid valve - fwd speed
10	Switch - work lights
11	Work light
12	Diode group
13	
14	Switch - seat
15	ARB-1 connector
16	Platform-road-cabin switch indicator
17	Platform-road-cabin switch
18	Sensor - boom down
19	Parking brake micro
20	Sensor - carriage alignment
21	Crab - 4 steering wheels switch
22	Solenoid valve - reverse
23	Solenoid valve - crab steering
24	4wd solenoid
25	Right outrigger micro
26	Left outrigger micro
27	Windscreen wiper/washer motor
28	Fuse and relay box
29	Air conditioning compressor
30	Horn
31	Cab lighting
32	Blinking
33	Hazard warning light/turn signal switch
34	Fog lamp switch
35	Hydraulic stop
36	Right rear light
37	Licence plate light
38	Left rear light
39	Left turn signal
40	Left front light
41	Right front light
42	Right turn signal
43	Relay - starter
44	System protection fuse
45	Alternator protection fuse
46	Alternator
47	Starter

Ref.	Description
48	12V battery
49	Battery cutout switch
50	Ignition key-switch
51	Thermostarter
52	Windscreen wiper/washer motor
53	Light switch - wiper/reverse control
54	Switch - lights
55	Solenoid valve - 2nd speed
56	Sensor - cardan shaft
57	Sensor - 2nd speed engaged
58	Sensor - 1st speed engaged
59	Solenoid valve - 1st speed
60	1st/2nd speed indicators
61	S.C.T. control unit connector
62	Speed change button
63	Heating fan switch
64	Electric fan motor
65	Solenoid valve - left outrigger up
66	Solenoid valve - left outrigger down
67	Solenoid valve - left sway
68	Solenoid valve - right sway
69	35-pin plug - control unit
70	24-way platform system connector
71	Fuel gauge float connector
72	Hydraulic oil temperature sensor
73	Water temperature sensor
74	Pressure switch - air filter clogged
75	Pressure switch - hydraulic oil filter clogged
76	T.U.V. standard solenoid
77	Optional attachment switch
78	Joystick connector
79	Solenoid valve - 17 m boom relay
80	
81	Sensor - 17 m boom
82	Road safety switch
83	Solenoid valve - attachment released
84	Solenoid valve - attachment coupled
85	Solenoid valve - fifth element
86	Solenoid valve - fifth element
87	Switch - axle levelling
88	Solenoid valve - boom raised
89	Solenoid valve - boom lowered
90	Solenoid valve - boom extension
91	Solenoid valve - boom retraction
92	Solenoid valve - fork pitching forward
93	Solenoid valve - fork pitching back
94	Switch - left outriggers up/down
95	Switch - right outriggers up/down

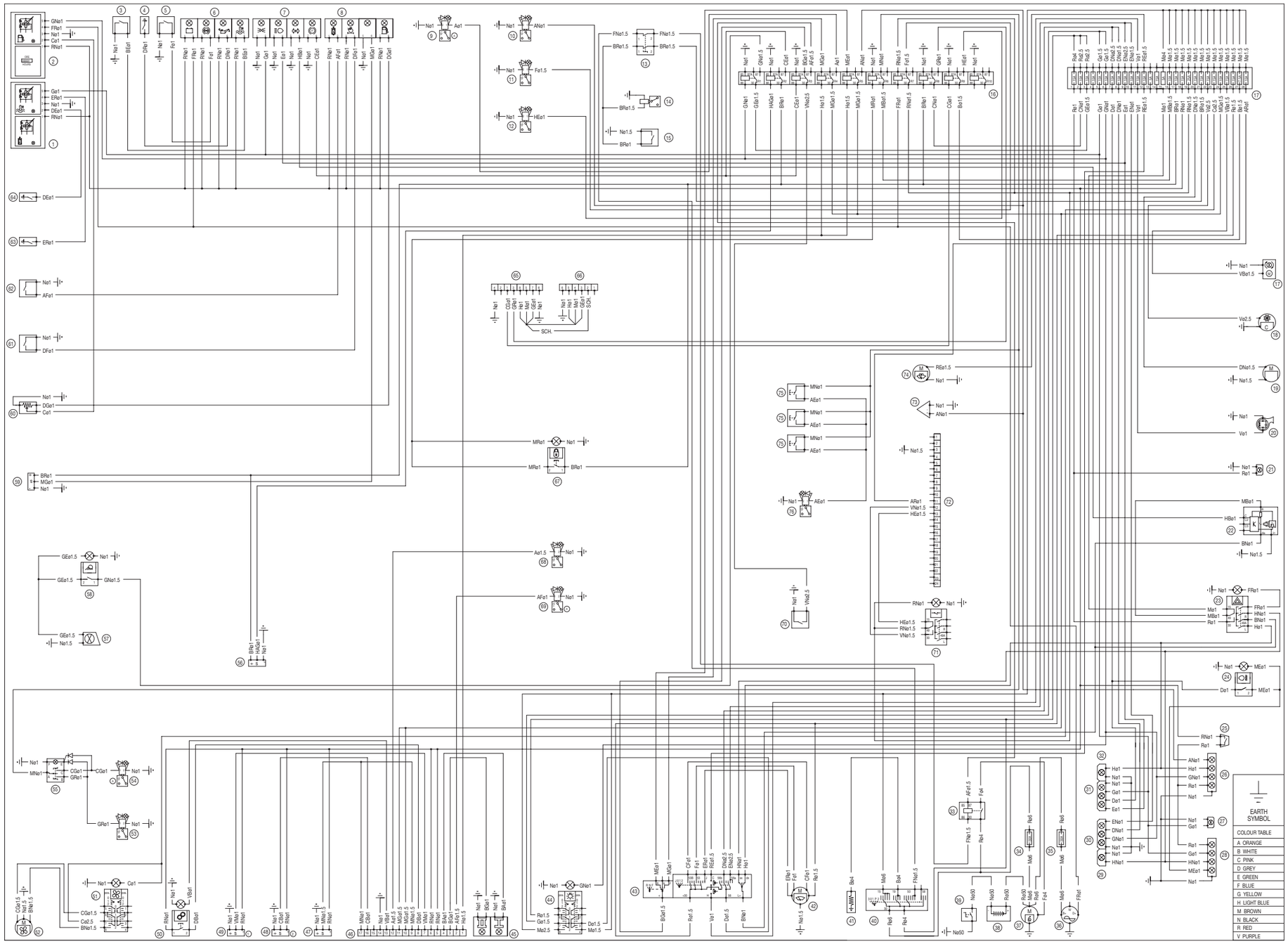
Ref.	Description
96	Back-up horn
97	Beacon
98	Solenoid valve - right outrigger down
99	Solenoid valve - left outrigger down
100	Overload warning system control unit cutout switch
101	Rear windscreen wiper/washer motor
102	Switch - emergency pump
103	Mushroom-head button
104	Solenoid valve - engine stop
105	Engine stop solenoid
106	Solenoid - emergency pump motor relay enabl. command
107	Emergency pump
108	Enabling relay for emergency pump supply
109	Emergency pump protection fuse

Operation:	Table:
Infolift 3B6 wiring diagram - Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	**C.05.04.04**

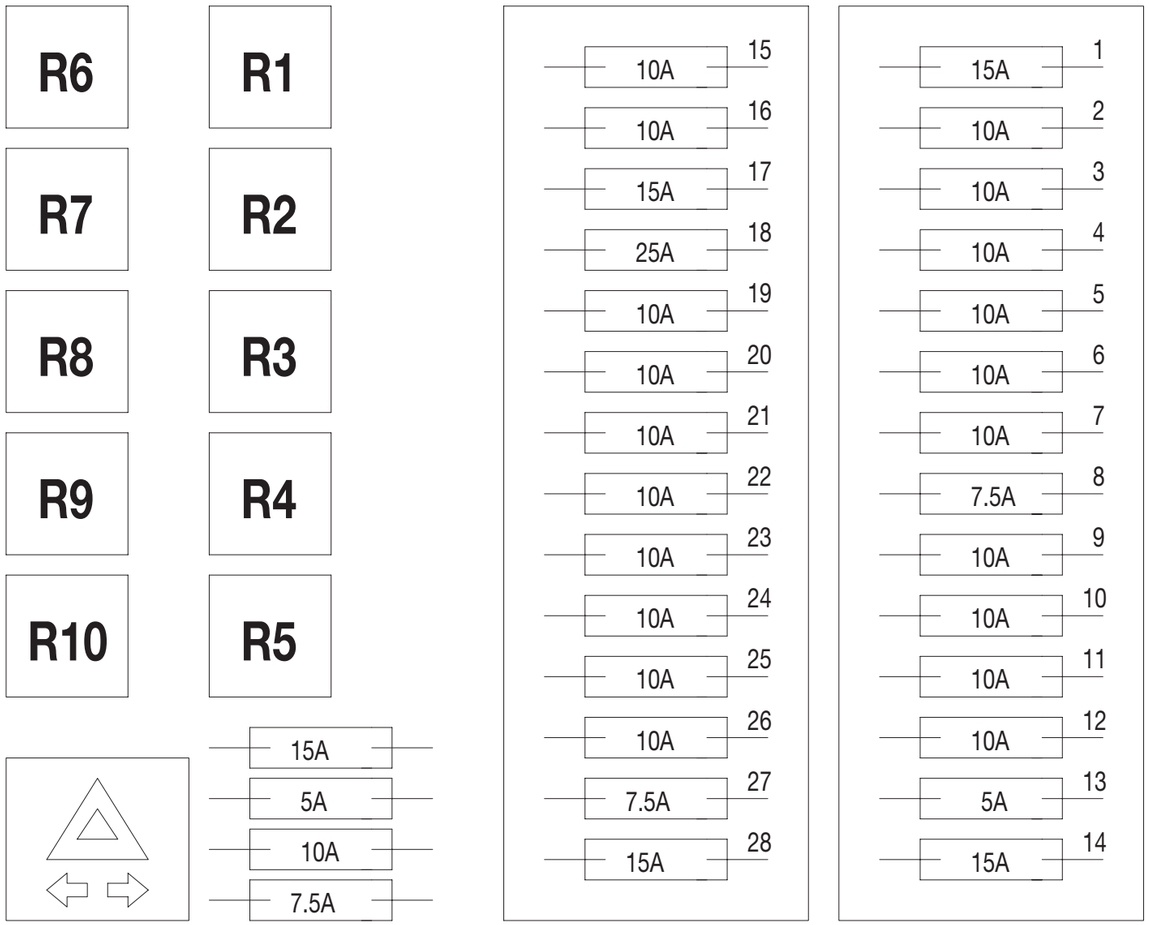


X4	COLOUR	SIGNAL
1	BROWN	+VB
2	WHITE	-VB
3	GREEN	CUTOFF
4	GREY	SPARE
5	YELLOW	OUTRIGGERS
6	PINK	BASKET (NC)

Operation: Wiring diagram - Telelift 4010 (**up to serial no. 9162**)	*Table:* **C.05.05.01**



Operation: Fuse wiring diagram - Telelift 4010 (**up to serial no. 9162**)	*Table:* **C.05.05.02**



FUSE-BOX UNIT

Pos.	User
1	Power supply: cab lights, hazard warning lights switch, turn signals +30
2	Power supply: R8 relay
3	Power supply: R1 relay
4	Blank
5	Front right/rear left position lights, license plate lights, position lights indicator, water temperature and hydraulic oil temperature gauge lighting
6	Front left/rear right position lights, position lights switch lighting, fuel gauge and hourmeter, R1 relay pickup
7	Right low beam, fog lamp switch power supply
8	Left low beam
9	Right high beam, high beam indicator
10	Left high beam
11	Horn
12	Windscreen washer motor
13	Blank
14	Blank
15	Power supply: hazard warning lights and turn signals +15
16	Power supply: R6 relay
17	Power supply: R2, road safety switch, shafting sensor, parking brake sensor, R8 relay pickup
18	Power supply: fuel reserve indicator, air filter clogging indicator, hydraulic oil temperature indicator, water temperature indicator, engine oil pressure indicator, brake fault indicator, gen-set indicator, water temperature and hydraulic oil temperature gauge light, fuel gauge and hourmeter, hydrostop, SCT management control unit connector, Cardan shaft motion sensor, 2nd speed sensor, 1st speed sensor, speed pushbutton
19	Power supply: R7 relay, optional attachment switch
20	Power supply: rear windscreen wiper
21	Power supply: emergency pushbutton switch
22	Power supply: A/C compressor
23	Power supply and lighting of the heating fan switch
24	Power supply: R4 relay, R5 relay, SCT management control unit connector
25	Power supply: beacon
26	Power supply: windscreen wiper/washer motor, forward motion switch
27	Power supply: R9 relay
28	Power supply: optional boom power socket

RELAYS UNIT

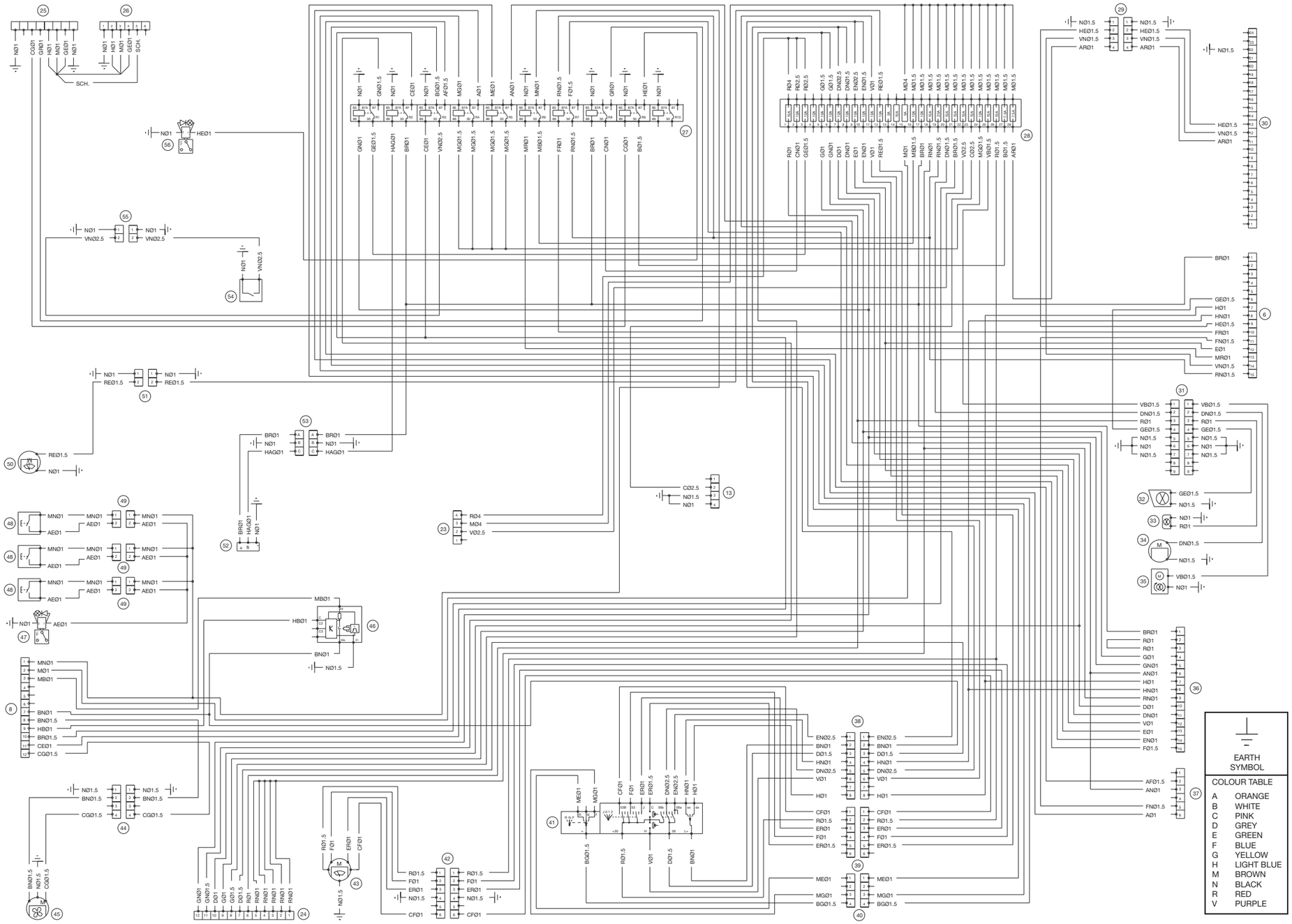
Pos.	User
R1	Work lights switch power supply enabling
R2	Parking brake indicator, R3 relay pickup enabling
R3	Engine start with parking brake engaged
R4	Forward speed
R5	Reverse speed
R6	Movements locked
R7	Solenoid in accordance with T.Ü.V regulations
R8	ARB1 connector power supply enabling
R9	Overload warning system
R10	Blank

Operation:	*Table:*
Legend wiring diagram - Telelift 4010 (**up to serial no. 9162**)	**C.05.05.03**

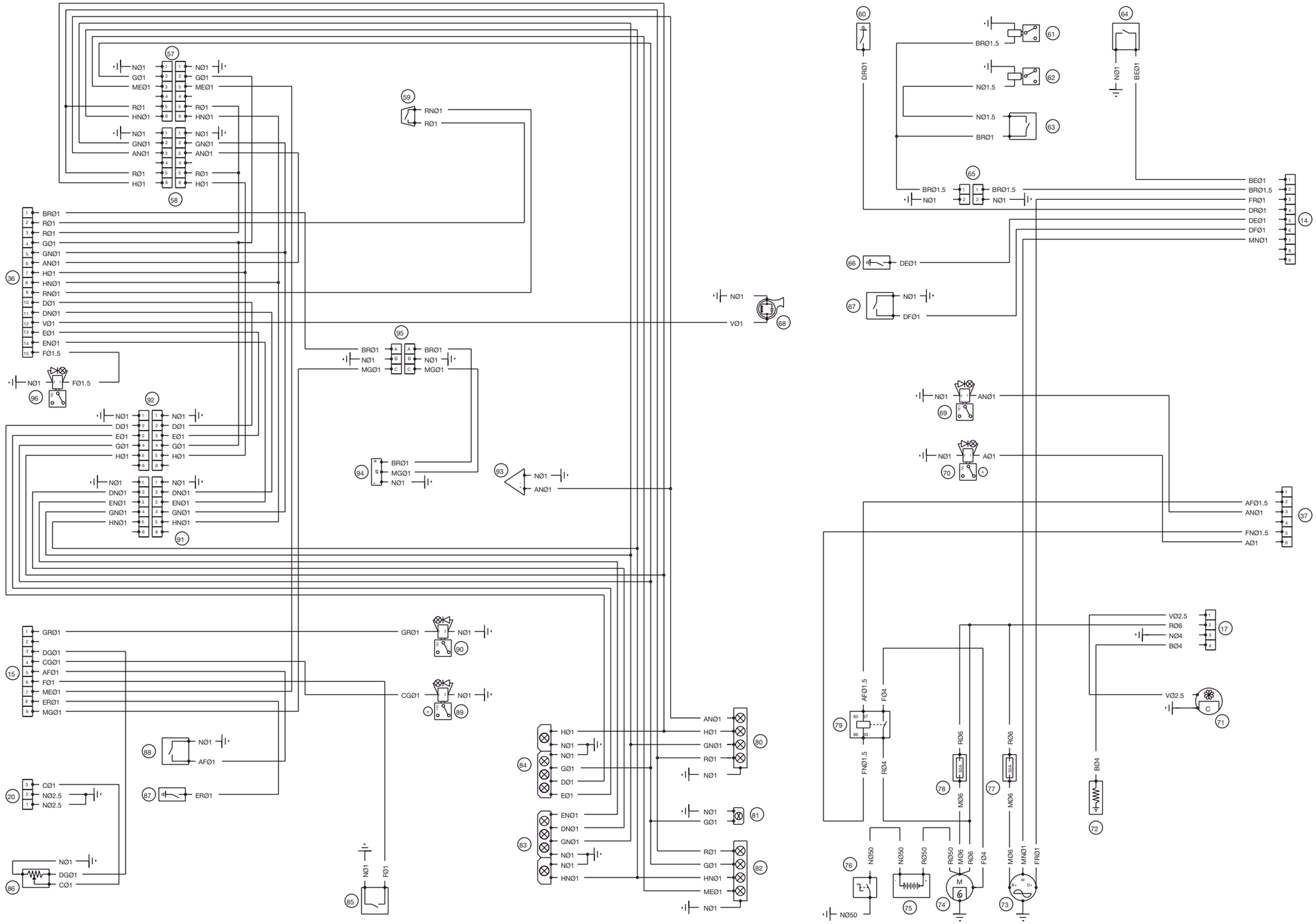
Ref.	Description
1	Water temperature gauge, hydraulic oil gauge
2	Fuel gauge, hourmeter
3	Water temperature sensor
4	Engine oil pressure sensor
5	Brake failure sensor
6	Warning lights: gen-set, brake failure, engine oil pressure, water temperature
7	Warning lights: position lights, high beam, turn signals, parking brake
8	Warning lights: hydraulic oil temperature, air filter soiled, wheel shafting, fuel reserve
9	Forward speed solenoid
10	Reverse speed solenoid
11	Solenoid in accordance with T.Ü.V regulations
12	Overlaod warning system solenoid
13	Mushroom-head emergency pushbutton
14	Engine stop solenoid
15	Engine stop sensor
16	Fuses and relays box
17	Beacon
18	Compressor motor
19	Rear windscreen wiper motor
20	Horn
21	Interior lights
22	Turn signals flashing
23	Hazard warning lights/turn signals switch
24	Fog lamp switch
25	Hydrostop
26	Right rear light
27	License plate lamp
28	Left rear light
29	Left turn signal
30	Left front light lamp
31	Right front light lamp
32	Right turn signal
33	Starting relay
34	Maxi fuse for system protection
35	Maxi fuse for alternator protection
36	Alternator
37	Starting motor
38	12V battery
39	Battery cutout switch
40	Ignition key switch
41	Thermal starter
42	Windscreen wiper/washer motor
43	Lights/ wiper / turn signals switch
44	Position lights switch
45	1st / 2nd speed warning lights
46	SCT management control unit connector
47	Cardan shaft motion sensor

Ref.	Description
48	1st speed sensor
49	2nd speed sensor
50	Speed change button
51	Fan switch
52	Fan motor
53	4-wheel steering solenoid
54	Crab solenoid
55	Crab/4-wheel steering selector
56	Parking brake sensor
57	Optional work light
58	Optional work light switch
59	Wheel shafting sensor
60	Fuel level float
61	Air filter clogging sensor
62	Hydraulic oil filter clogging sensor
63	Hydraulic oil temperature gauge sensor
64	Water temperature gauge sensor
65	ARB1 connector
66	Loading cell
67	Road safety switch
68	2nd speed solenoid
69	1st speed solenoid
70	Seat switch
71	Extension jib and hydraulic winch optional line switch
72	Ilme 24-pin connector for extension jib and hydraulic winch optional line
73	Back-up horn
74	Windscreen washer motor
75	Attachment locking distributor levers enabling switch
76	Attachment locking solenoid

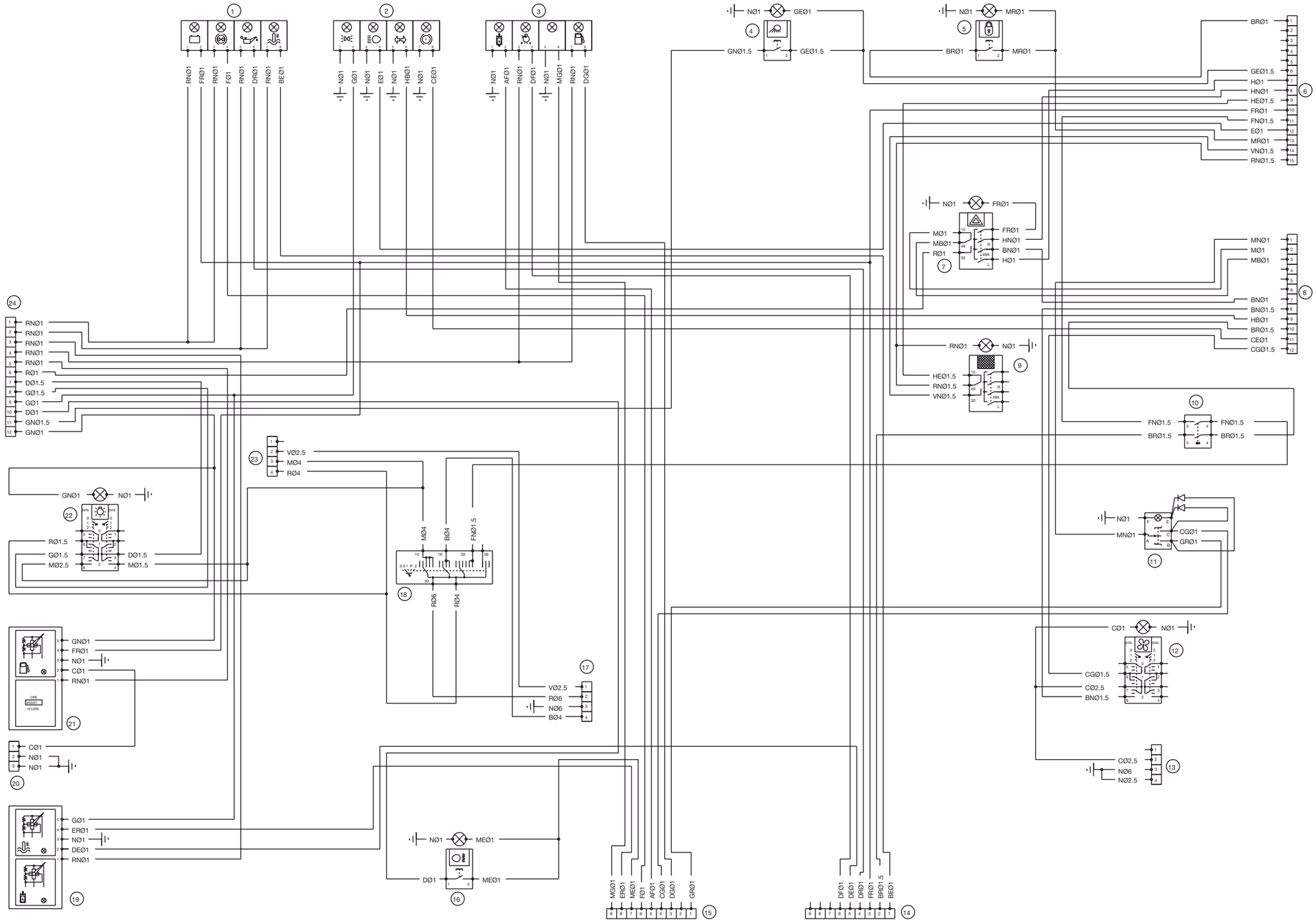
Operation: Wiring diagram 1/3 - Telelift 4010 (**from serial no. 9163**)	*Table:* **C.05.06.01**



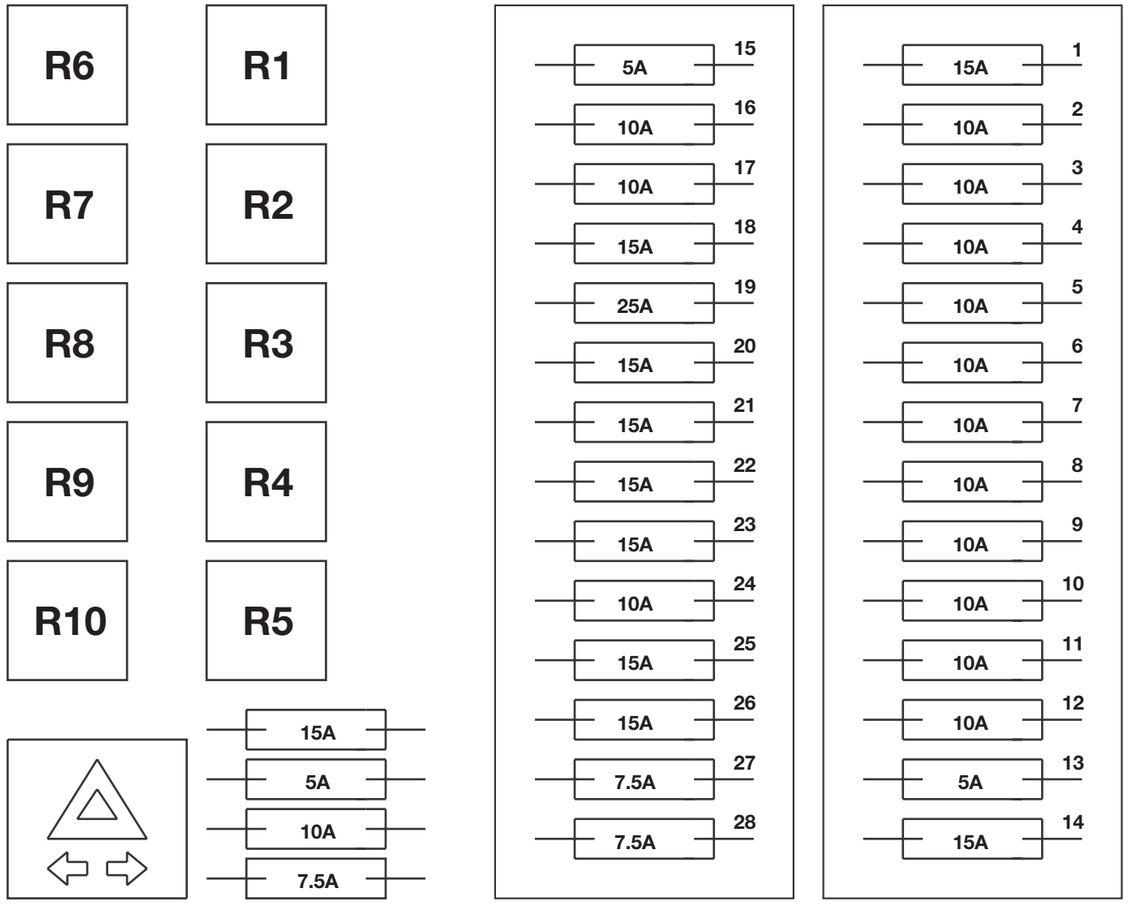
Operation: Wiring diagram 2/3 - Telelift 4010 (**from serial no. 9163**)	*Table:* **C.05.06.02**



Operation: Wiring diagram 3/3 - Telelift 4010 (**from serial no. 9163**)	*Table:* **C.05.06.03**



Operation: Fuse wiring diagram - Telelift 4010 (**from serial no. 9163**)	*Table:* **C.05.06.04**



FUSE-BOX UNIT

Pos.	User
1	Power supply: cab lights, hazard warning lights switch, turn signals +30
2	Power supply: R8 relay
3	Power supply: R1 relay
4	Blank
5	Front right/rear left position lights, license plate lights, position lights indicator, water temperature and hydraulic oil temperature gauge lighting
6	Front left/rear right position lights, position lights switch lighting, fuel gauge and hourmeter, R1 relay pickup
7	Right low beam, fog lamp switch power supply
8	Left low beam
9	Right high beam, high beam indicator
10	Left high beam
11	Horn
12	Windscreen washer motor
13	Blank
14	Blank
15	Power supply: hazard warning lights and turn signals +15
16	Power supply: R6 relay
17	Power supply: R2, road safety switch, shafting sensor, parking brake sensor, R8 relay pickup
18	Power supply: fuel reserve indicator, air filter clogging indicator, hydraulic oil temperature indicator, water temperature indicator, engine oil pressure indicator, brake fault indicator, gen-set indicator, water temperature and hydraulic oil temperature gauge light, fuel gauge and hourmeter, hydrostop
19	Power supply: R7 relay, optional attachment switch
20	Power supply: rear windscreen wiper
21	Power supply: emergency pushbutton switch
22	Power supply: A/C compressor
23	Power supply and lighting of the heating fan switch
24	Power supply: R4 relay, R5 relay
25	Power supply: beacon
26	Power supply: windscreen wiper/washer motor, forward motion switch
27	Power supply: R9 relay
28	Power supply: optional boom power socket

RELAYS UNIT

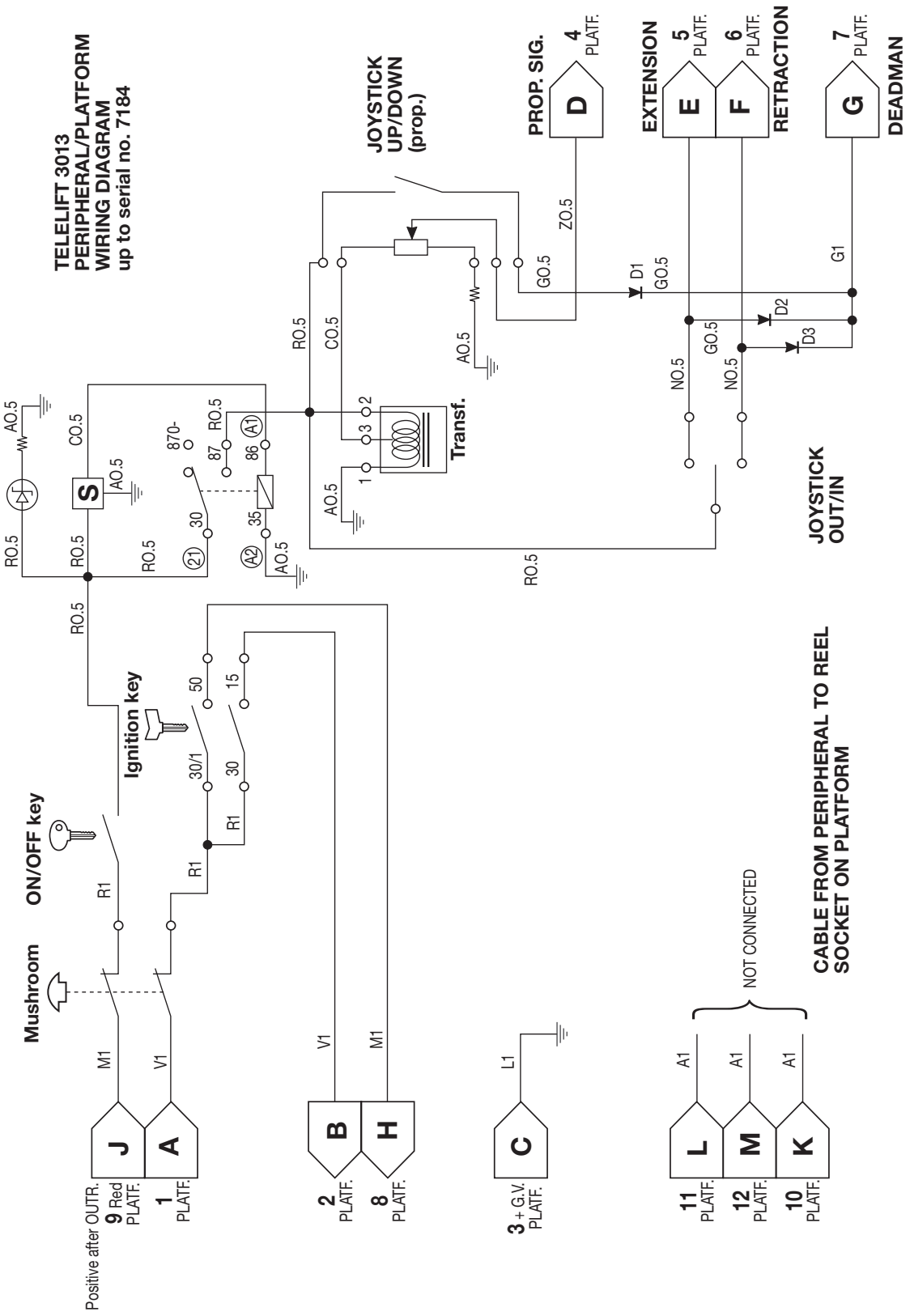
Pos.	User
R1	Work lights switch power supply enabling
R2	Parking brake indicator
R3	Engine start with parking brake engaged
R4	Forward speed
R5	Reverse speed
R6	Movements locked
R7	Solenoid in accordance with T.Ü.V regulations
R8	ARB1 connector power supply enabling
R9	Overload warning system
R10	Blank

Operation:	Table:
Legend wiring diagram - Telelift 4010 (**from serial no. 9163**)	**C.05.06.05**

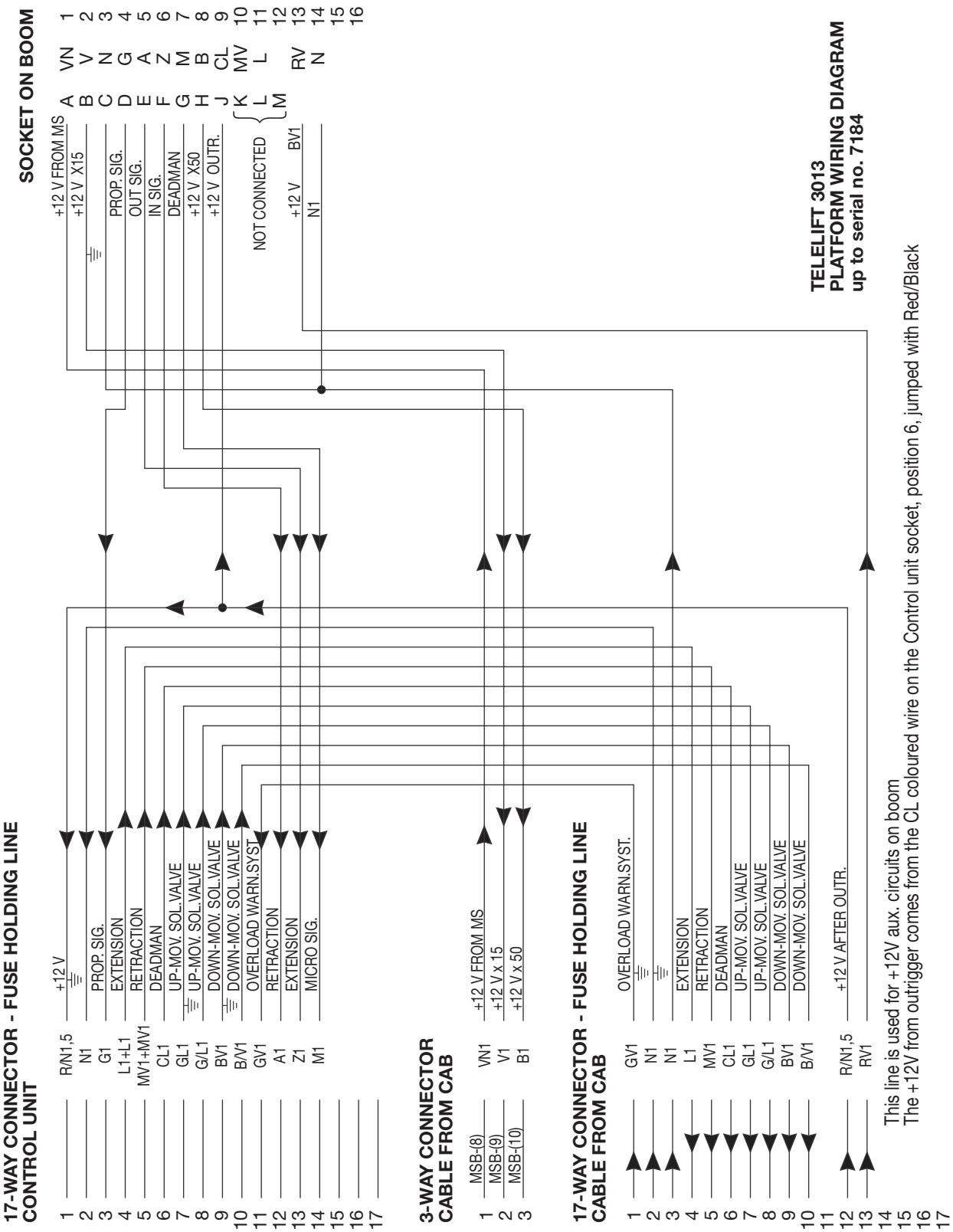
Ref.	Description
1	Warning lights: gen-set, brake failure, engine oil pressure, water temperature
2	Warning lights: position lights, high beam, turn signals, parking brake
3	Warning lights: hydraulic oil temperature, air filter soiled, wheel shafting, fuel reserve
4	Optional work light switch
5	Road safety switch
6	15-way connector - fuse holder line / dashboard line
7	Hazard warning lights/turn signals switch
8	12-way connector - fuse holder line / dashboard line
9	Optional jib/winch line switch
10	Mushroom-head emergency pushbutton
11	Crab/4-wheel steering selector
12	Fan switch
13	4-way connector - fuse holder line (black)
14	9-way connector - engine line/dashboard line
15	9-way connector - rear line/dashboard line
16	Fog lamp switch
17	4-way connector - engine line (black)
18	Ignition key switch
19	Water temperature gauge, hydraulic oil gauge
20	3-way connector - rear line/dashboard line (black)
21	Fuel gauge, hourmeter
22	Position lights switch
23	4-way connector - fuse holder line (black)
24	12-way connector - fuse holder line / dashboard line
25	ARB1 connector
26	Loading cell connector
27	Fuses and relays box
28	Fuses and relays box
29	4-way connector - jib line extension connection
30	24-pole ILME connector - optional jib/winch line
31	9-way connector - cab connection
32	Work light
33	Interior lights
34	Rear windscreen wiper motor
35	Beacon
36	15-way connector - rear line/ fuse holder line
37	6-way connector - engine line/fuse holder line
38	8-way connector - lights switch/speed switch connection
39	6-way connector - lights switch/speed switch connection
40	4-way connector - lights switch/speed switch connection
41	Lights/ wiper / turn signals switch
42	6-way connector - windscreen wiper/washer motor connection
43	Windscreen wiper/washer motor
44	4-way connector - fan motor connection
45	Fan motor
46	Turn signals flashing
47	Attachment locking solenoid

Ref.	Description
48	Attachment locking distributor levers enabling switch
49	2-way connectors - Attachment locking distributor levers connection
50	Windscreen washer motor
51	2-way connector - windscreen washer motor connection
52	Parking brake sensor
53	3-way connector - parking brake connection
54	Seat switch
55	2-way connector - seat switch connection
56	Overlaod warning system solenoid
57	6-way connector - rear LH lights connection
58	6-way connector - rear RH lights connection
59	Hydraulic stop
60	Engine oil pressure sensor
61	Engine stop solenoid
62	Cold starting solenoid valve
63	Cold starting sensor
64	Water temperature sensor
65	2-way connector - engine stop connection
66	Water temperature gauge sensor
67	Air filter clogging sensor
68	Horn
69	Reverse speed solenoid
70	Forward speed solenoid
71	Compressor motor
72	Thermal starter
73	Alternator
74	Starting motor
75	12V battery
76	Battery cutout switch
77	Maxi fuse for alternator protection
78	Maxi fuse for system protection
79	Starting relay
80	Right rear light
81	License plate lamp
82	Left rear light
83	Front light lamp - left turn signal
84	Front light lamp - right turn signal
85	Brake failure sensor
86	Fuel level float
87	Hydraulic oil temperature gauge sensor
88	Hydraulic oil filter clogging sensor
89	Crab solenoid
90	4-wheel steering solenoid
91	6-way connector - front LH lights connection
92	6-way connector - front RH lights connection
93	Back-up horn
94	Wheel shafting sensor
95	3-way connector - wheel shafting connection
96	Solenoid in accordance with T.Ü.V regulations

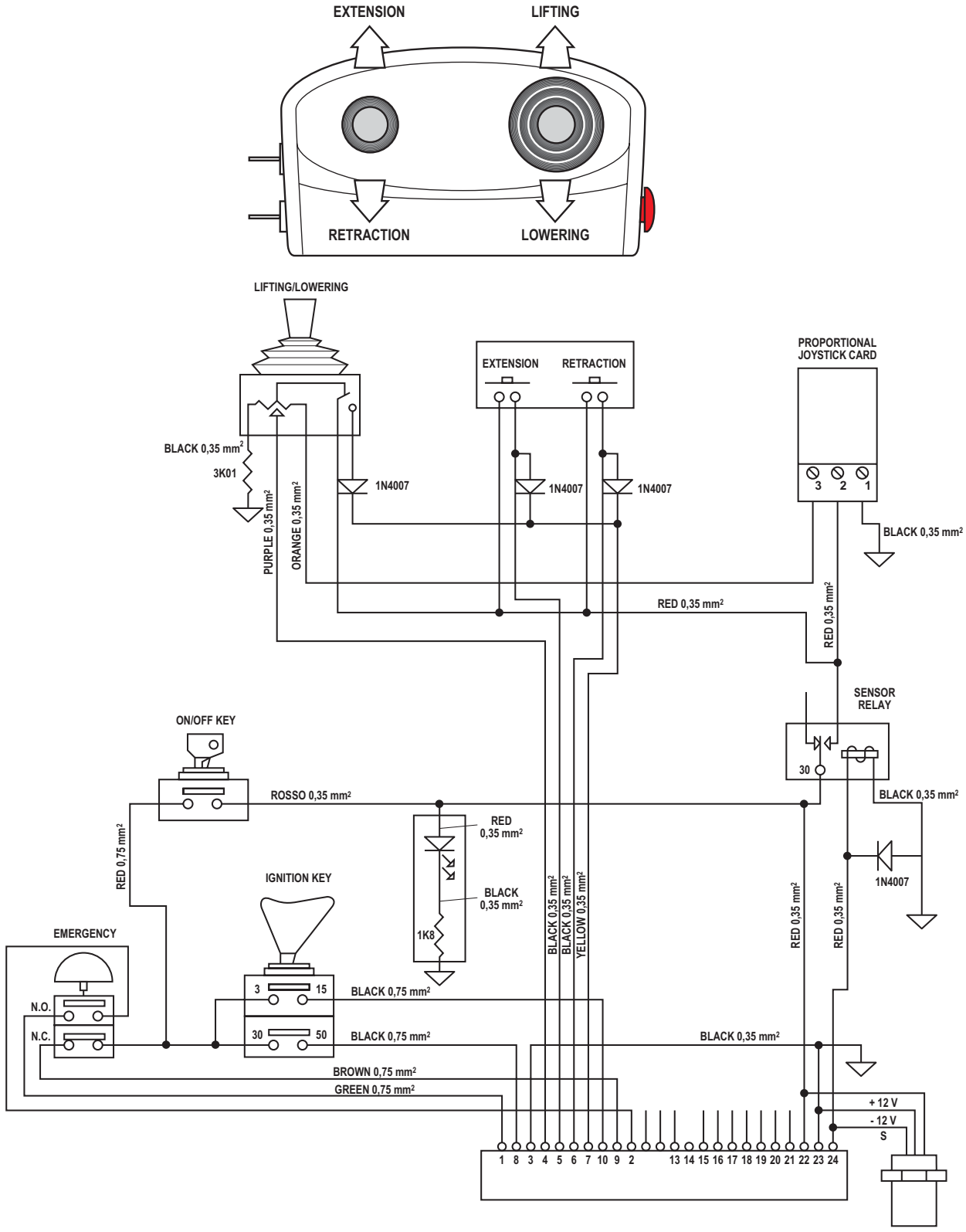
Operation:	Aerial platform wiring diagram 1/2 - Telelift 3013 (**up to serial no. 7184**)	Table: **C.06.01.01**



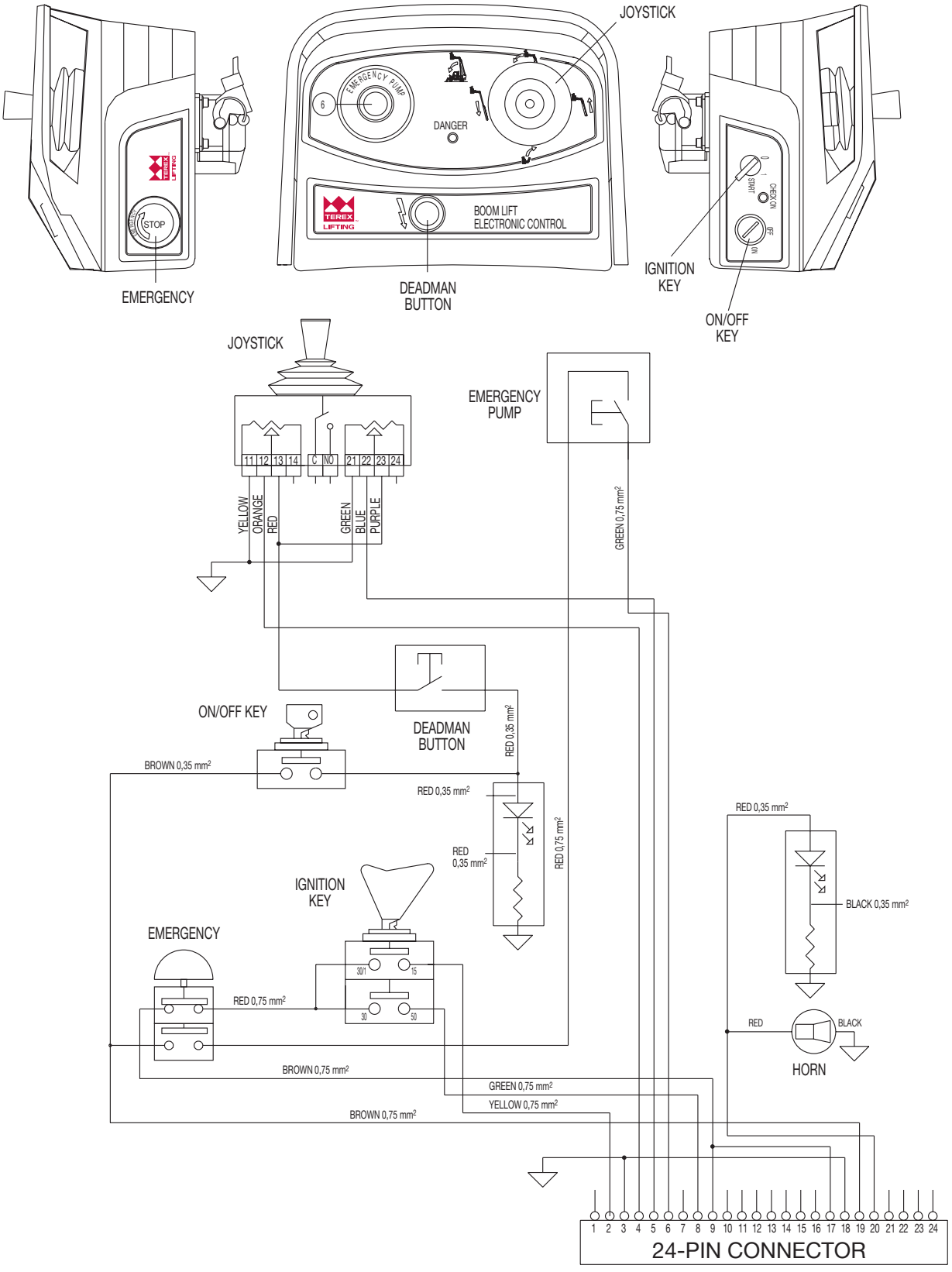
Operation:	Table:
Aerial platform wiring diagram 2/2 - Telelift 3013 (**up to serial no. 7184**)	**C.06.01.02**



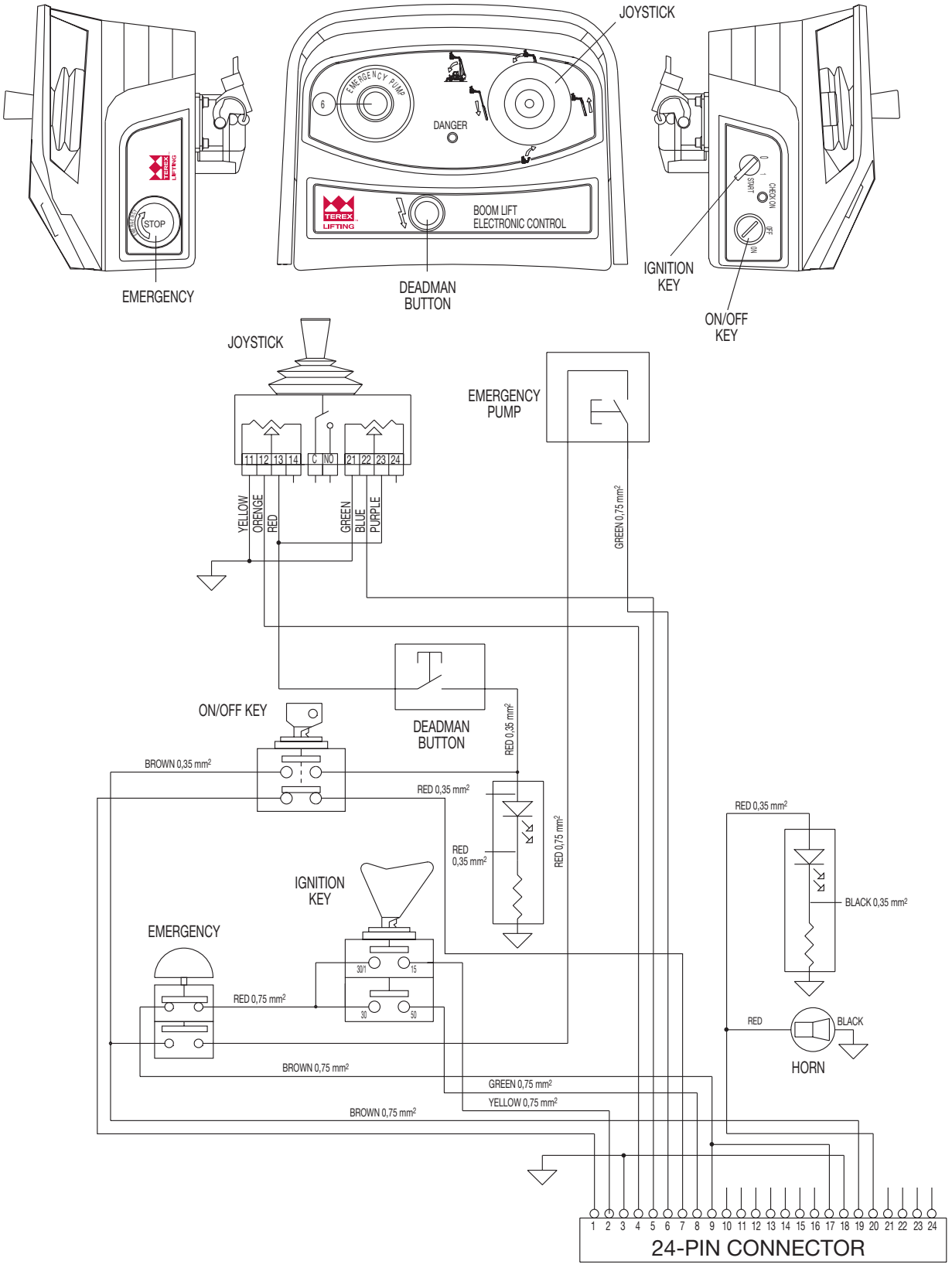
Operation:	Table:
Aerial platform wiring diagram - Telelift 3013 (**from serial no. 7185 to serial no. 8450**)	**C.06.02.01**



Operation:	Table:
Aerial platform wiring diagram - Telelift 3013 (**from serial no. 8451 to serial no. 9407**) - Telelift 3517(**up to serial no. 9362**)	**C.06.03.01**



Operation:	Aerial platform wiring diagram - Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **C.06.04.01**

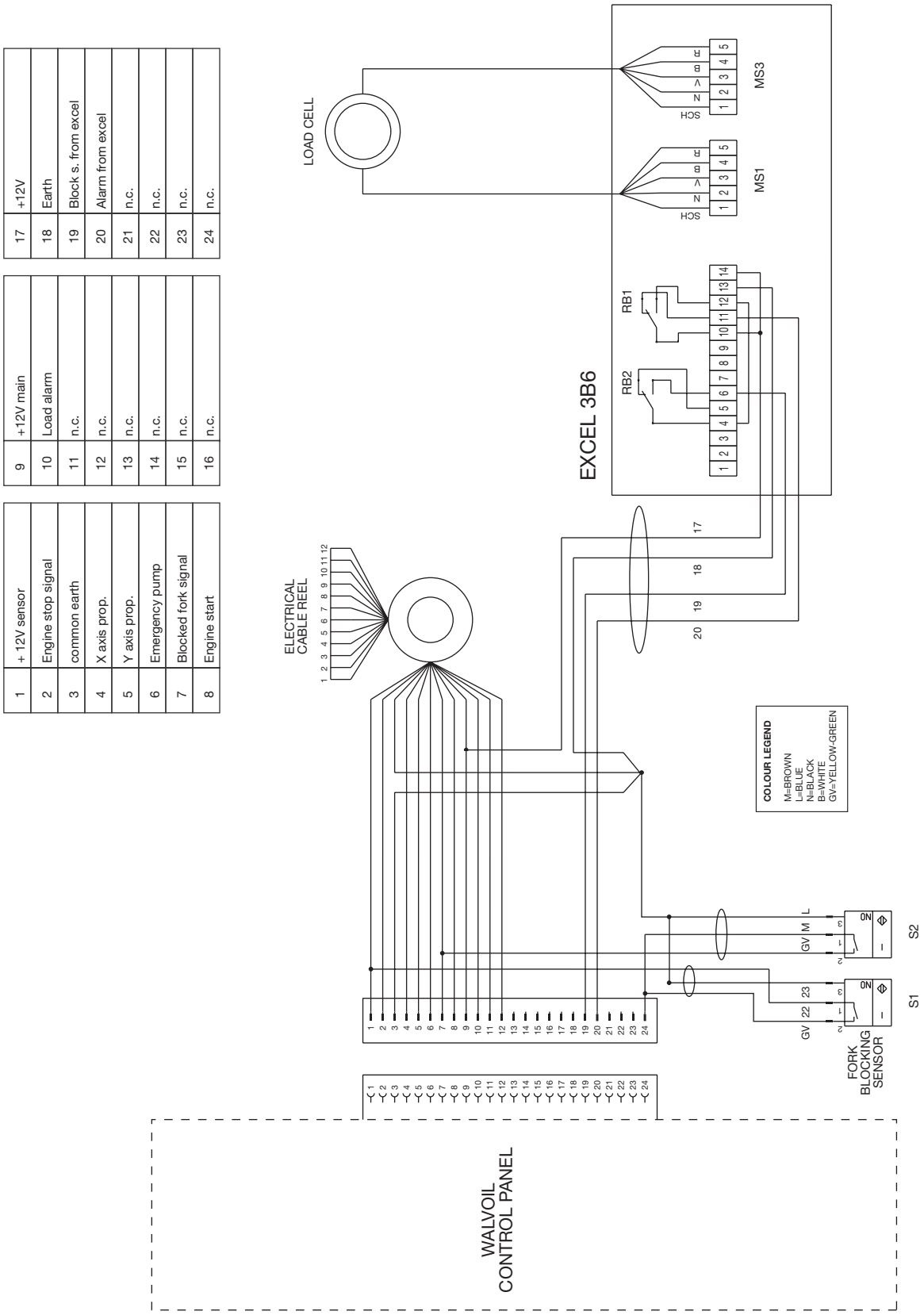


Operation:	Table:
Wiring diagram - Platform/boom connection - Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	**C.06.05.01**

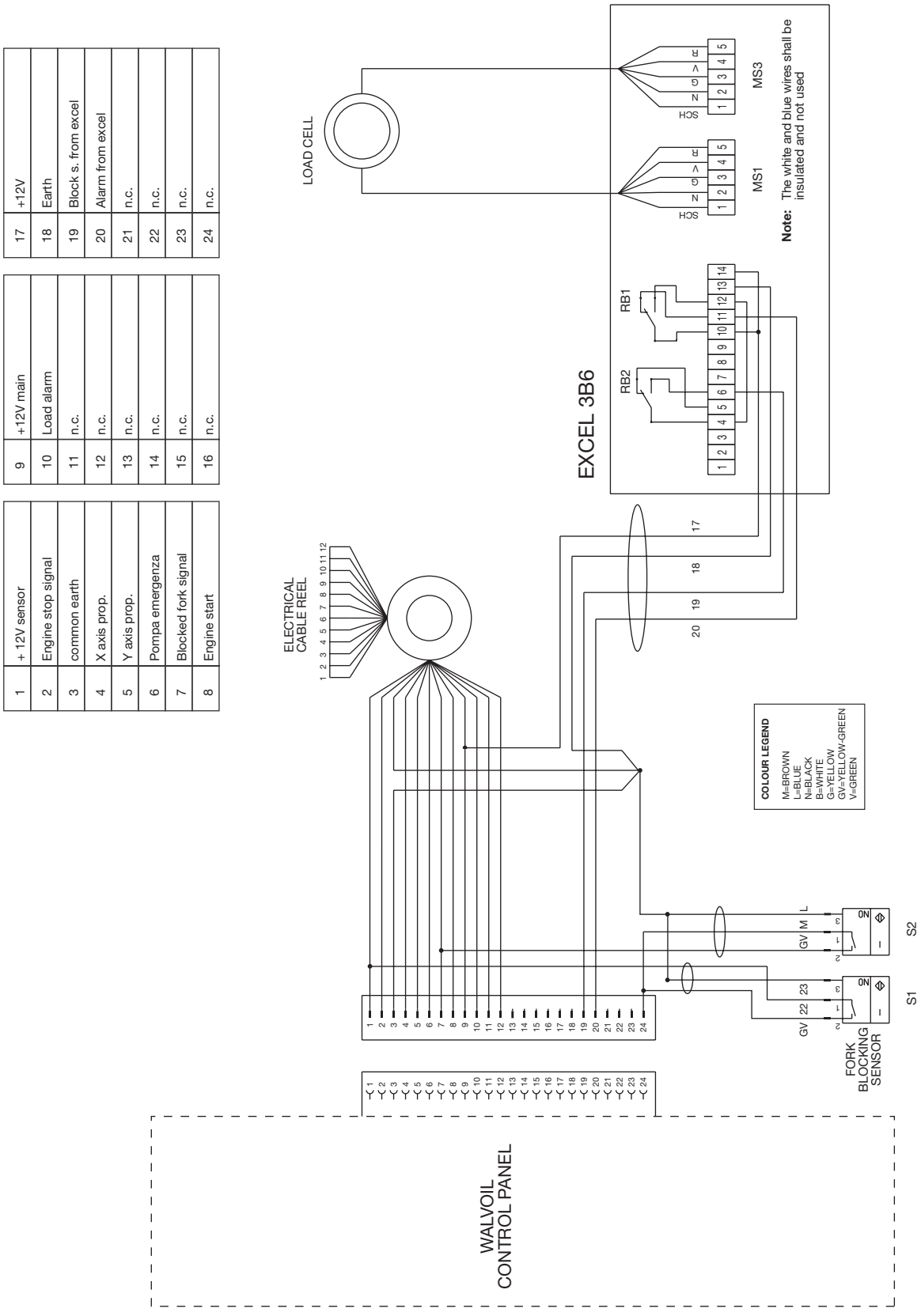
1	+ 12V sensor
2	Engine stop signal
3	common earth
4	X axis prop.
5	Y axis prop.
6	Emergency pump
7	Blocked fork signal
8	Engine start

9	+12V main
10	Load alarm
11	n.c.
12	n.c.
13	n.c.
14	n.c.
15	n.c.
16	n.c.

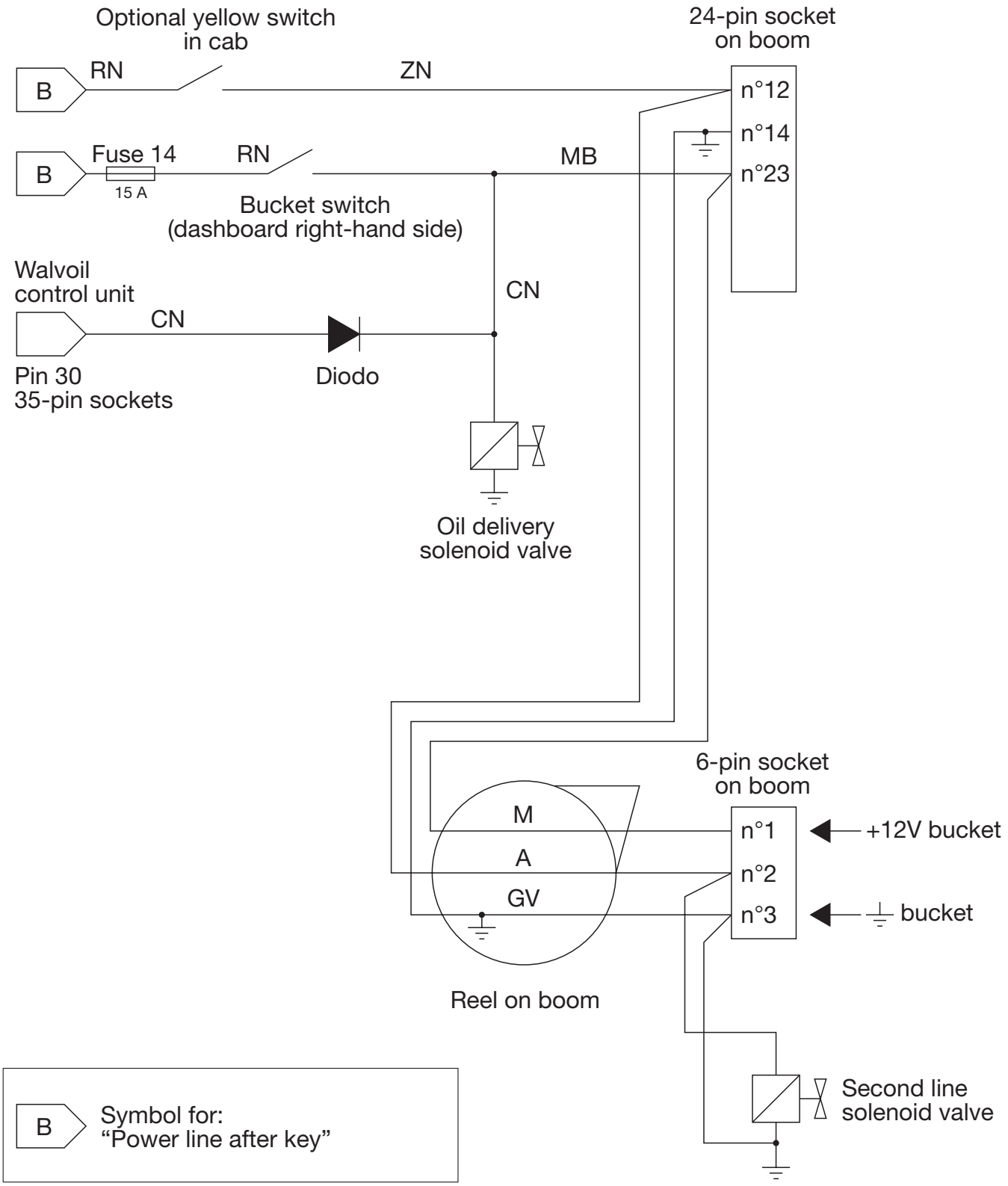
17	+12V
18	Earth
19	Block s. from excel
20	Alarm from excel
21	n.c.
22	n.c.
23	n.c.
24	n.c.



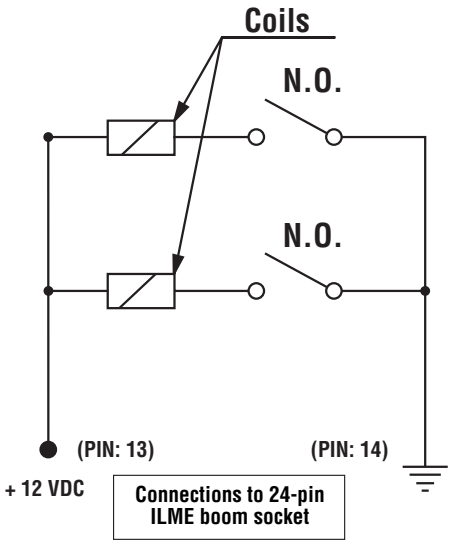
Operation:	Table:
Wiring diagram - Platform/boom connection - for **ROTARY** platforms **from serial no. 55116**	**C.06.05.02**



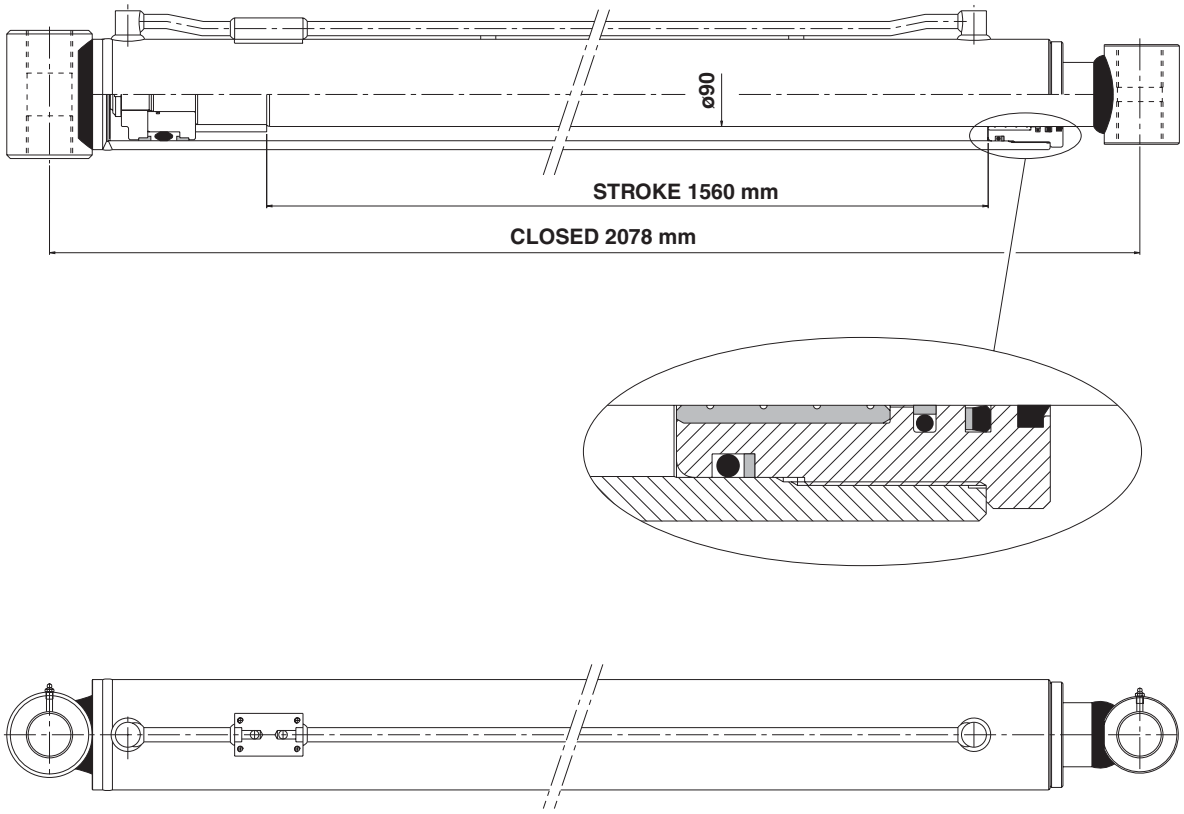
Operation: Mixing buckets wiring diagram	Table: C.06.06



Operation: Winches wiring diagram	*Table:* **C.06.07**

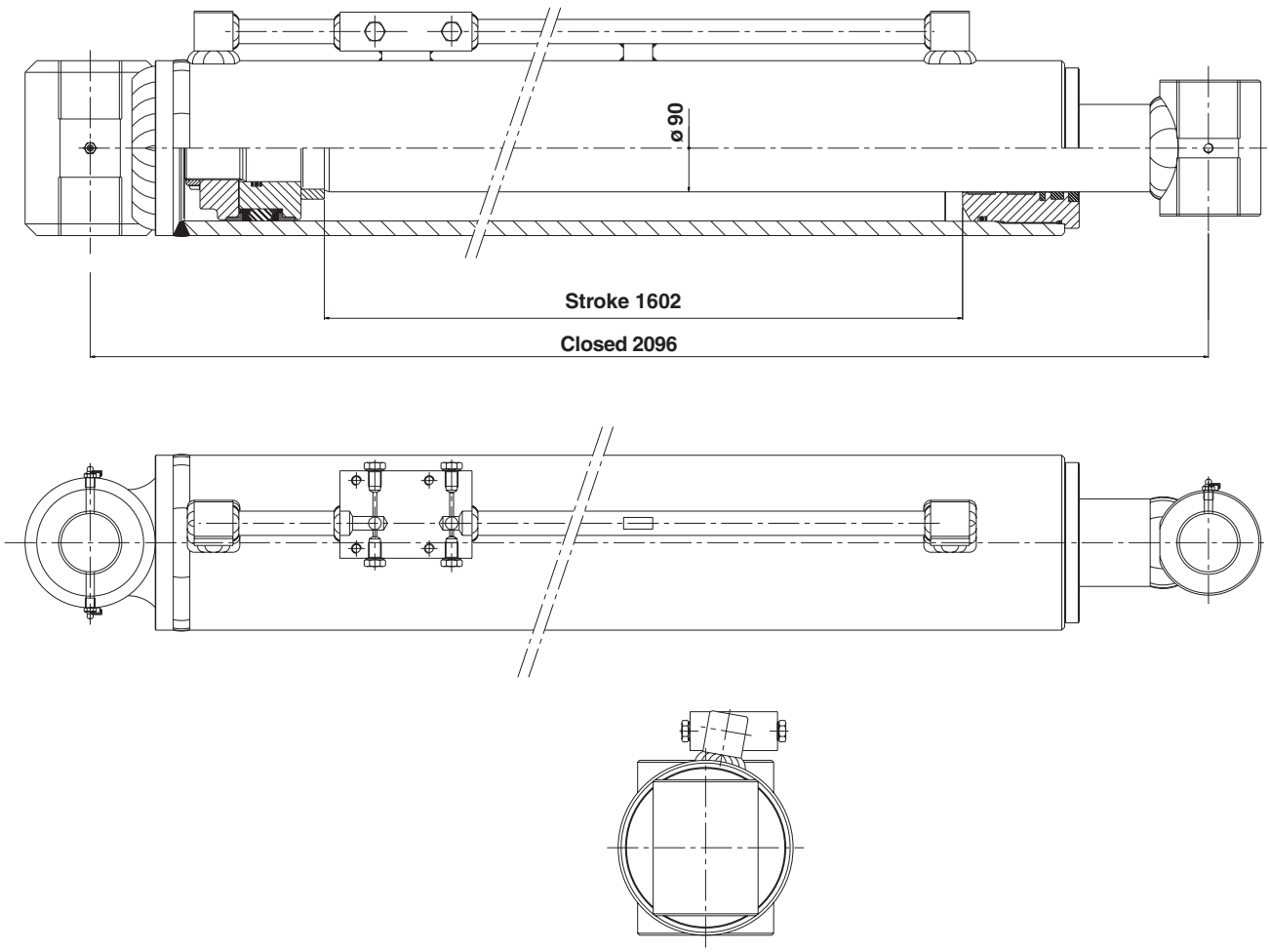


Operation:	Table:
Boom raising cylinder - Telelift 3713 Elite - Telelift 4010	C.07.01.01



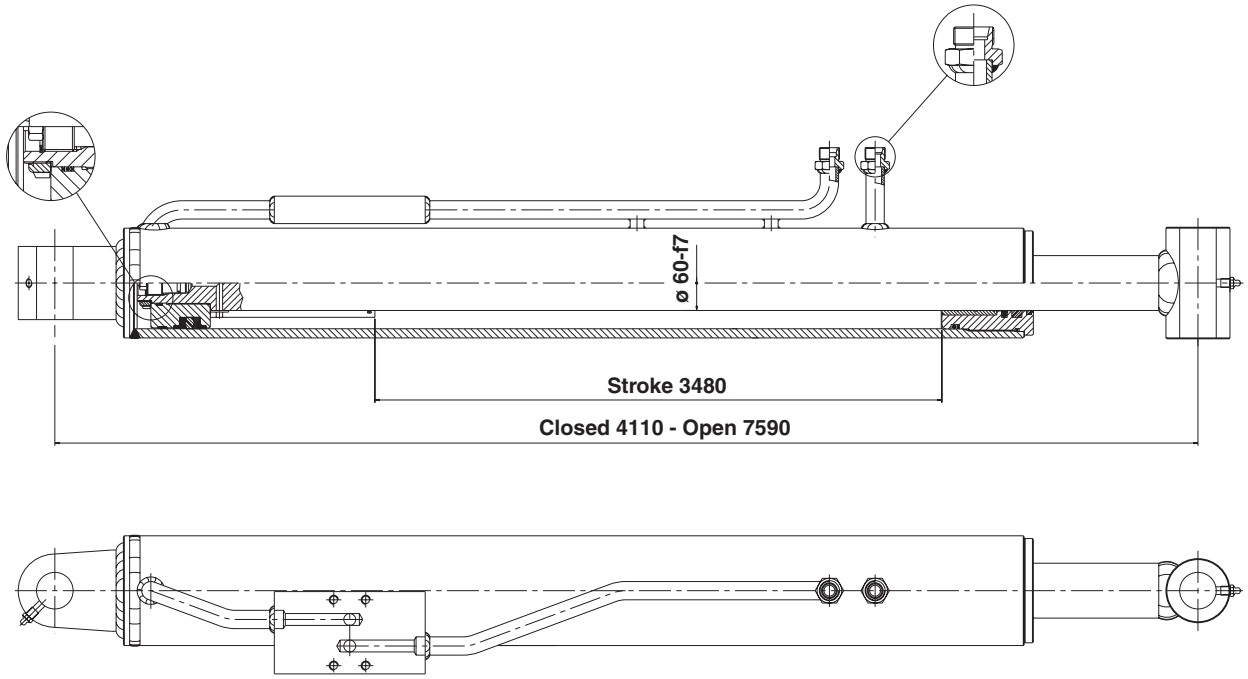
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45 NORMALIZED
Rod tolerance	f7
Rod roughness	Ra max 0.3 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.3 my

Operation: Boom raising cylinder - Telelift 3517	*Table:* **C.07.01.02**



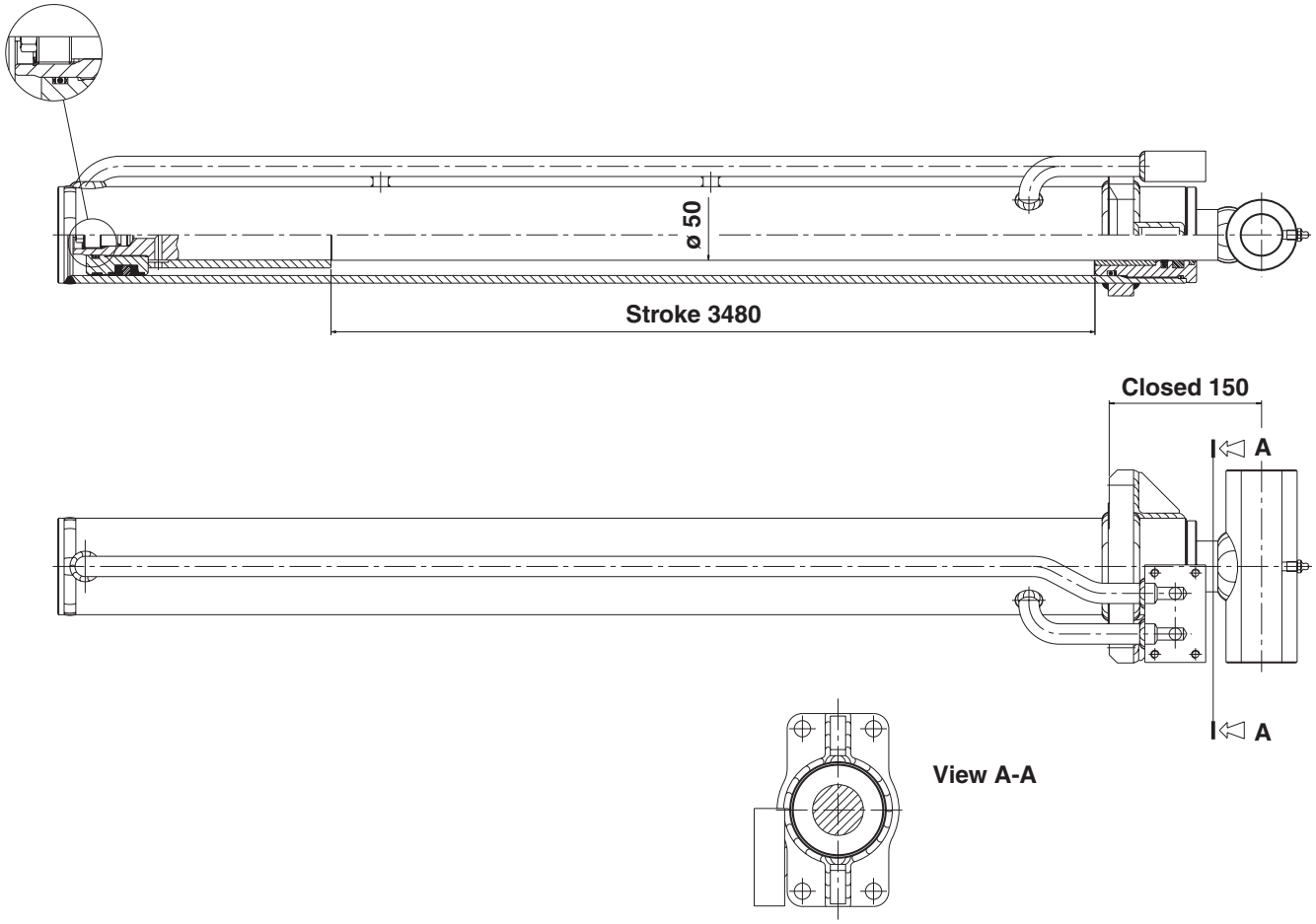
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

Operation: 2nd boom element extension cylinder - Telelift 3713 Elite	*Table:* **C.07.02.01**



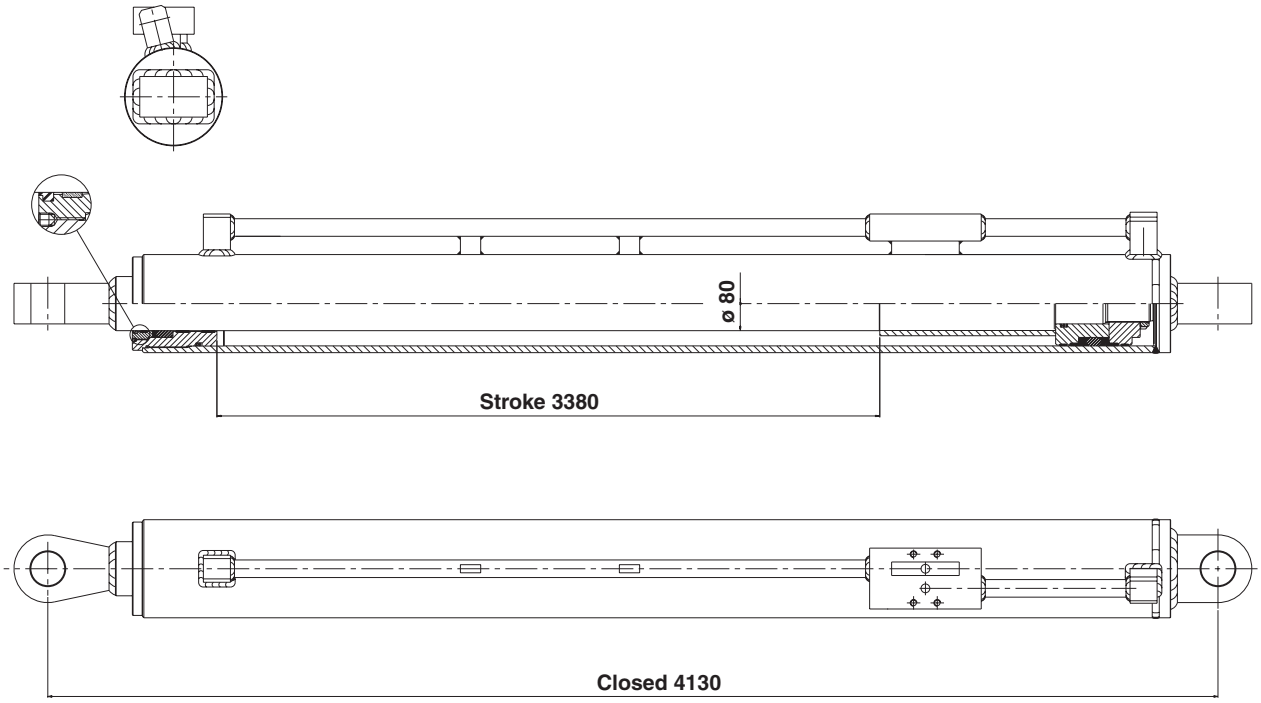
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

Operation: 3rd boom element extension cylinder - Telelift 3713 Elite	*Table:* **C.07.02.02**



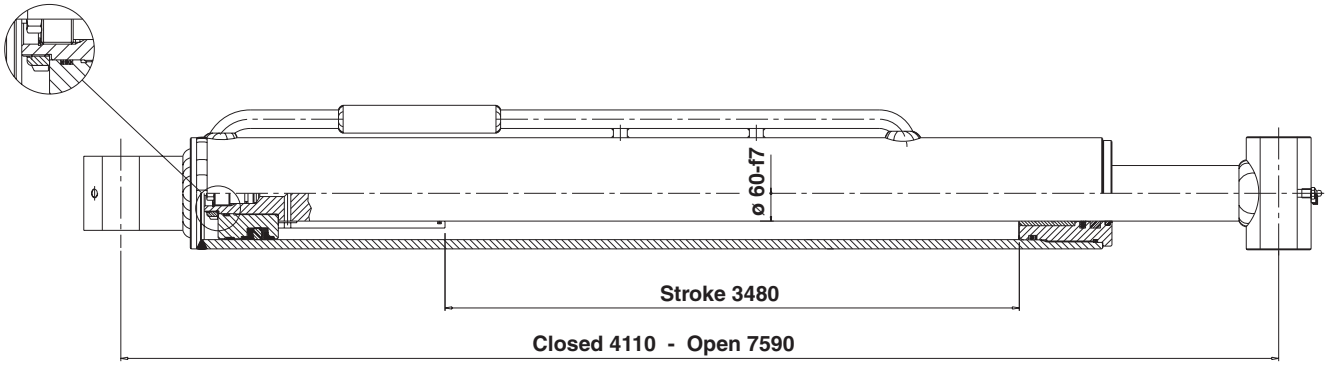
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

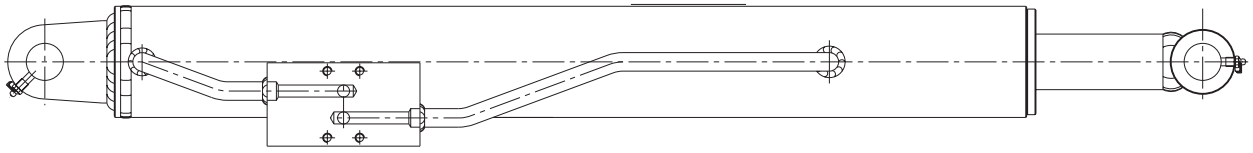
Operation: Boom extension cylinder - Telelift 3517	Table: C.07.02.03



DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	42 Cr Mo4
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

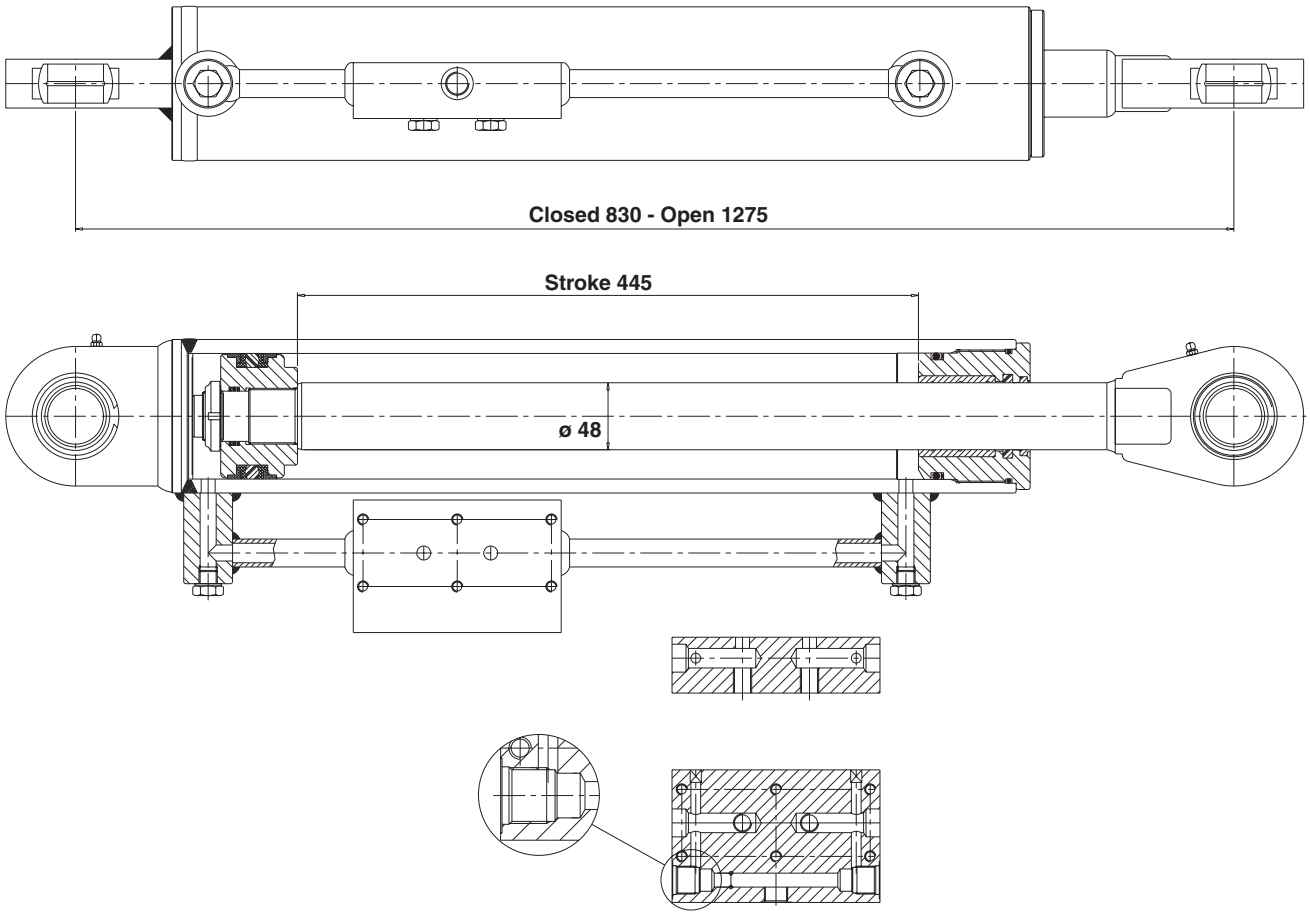
Operation: Boom extension cylinder - Telelift 4010	*Table:* **C.07.02.04**





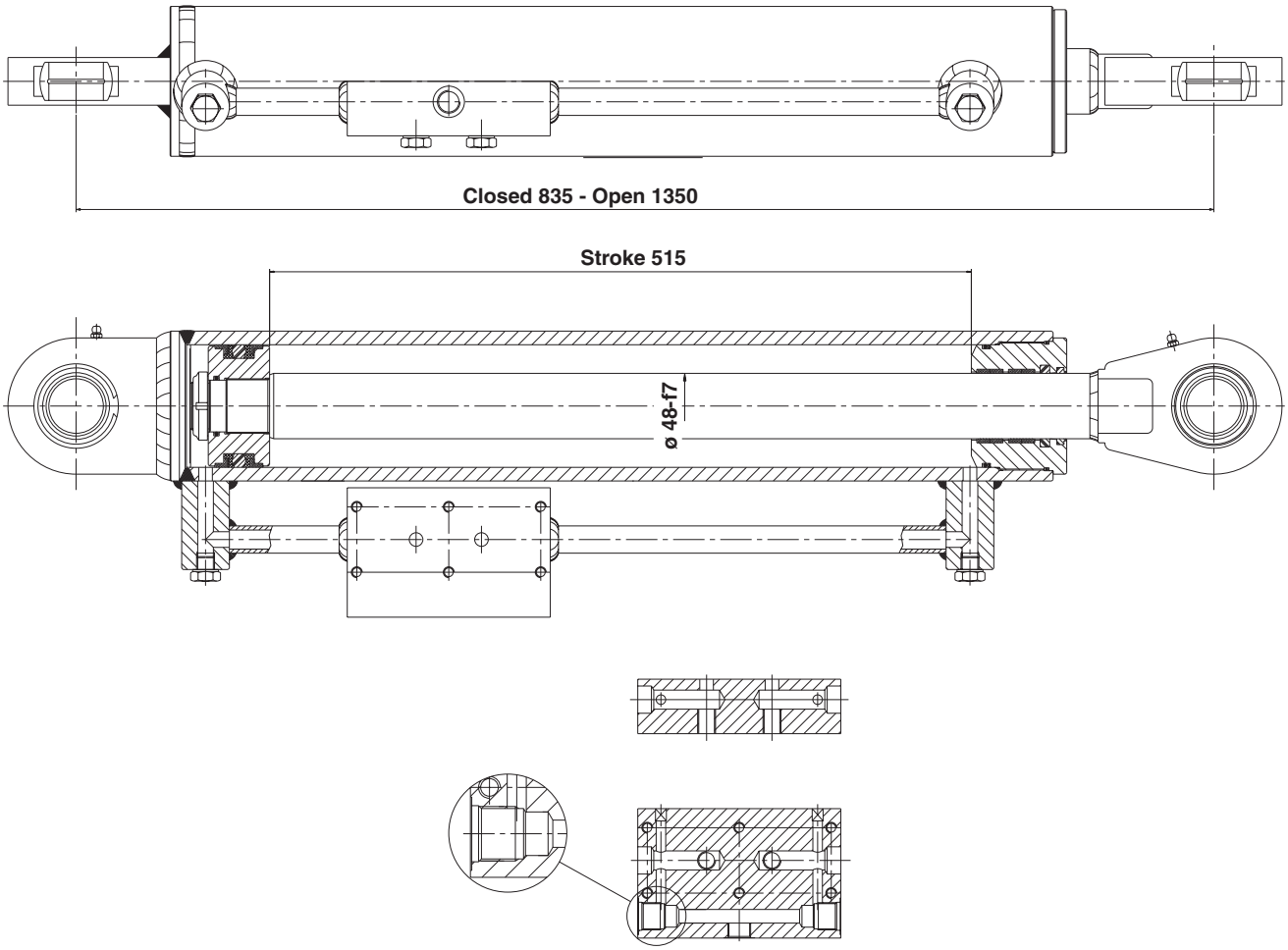
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

Operation: Balance cylinder - Telelift 3713 Elite - Telelift 4010	*Table:* **C.07.03.01**



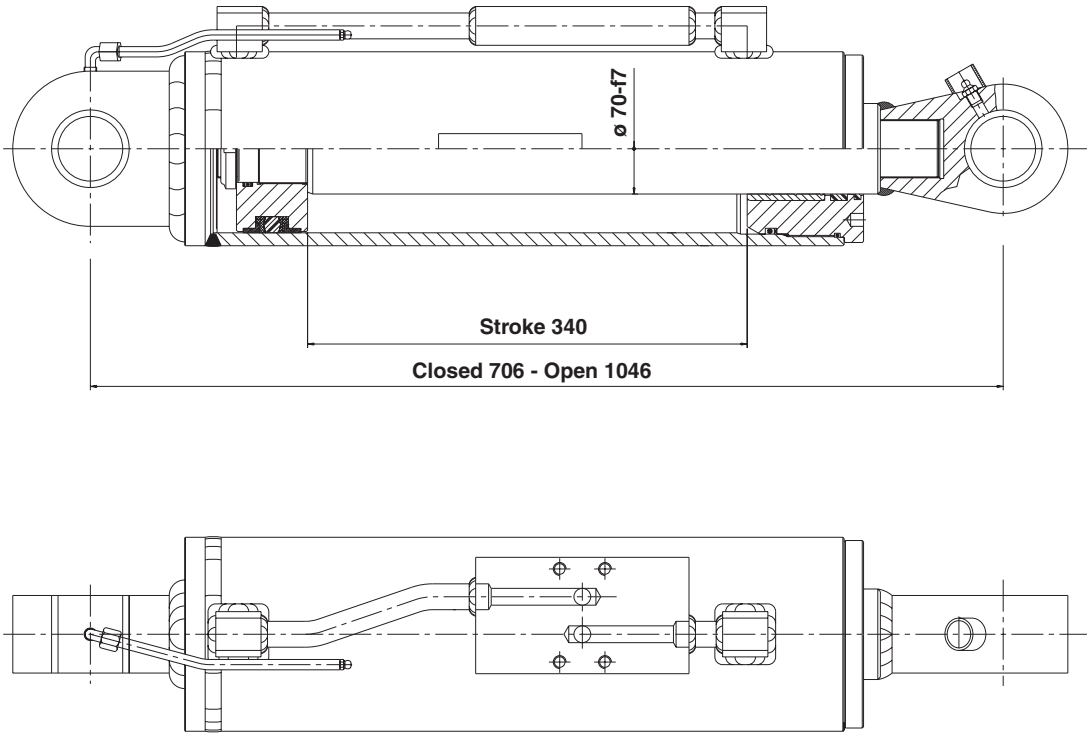
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45 NORMALIZED
Rod tolerance	f7
Rod roughness	Ra max 0.3 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.3 my

Operation: Balance cylinder - Telelift 3517	*Table:* **C.07.03.02**



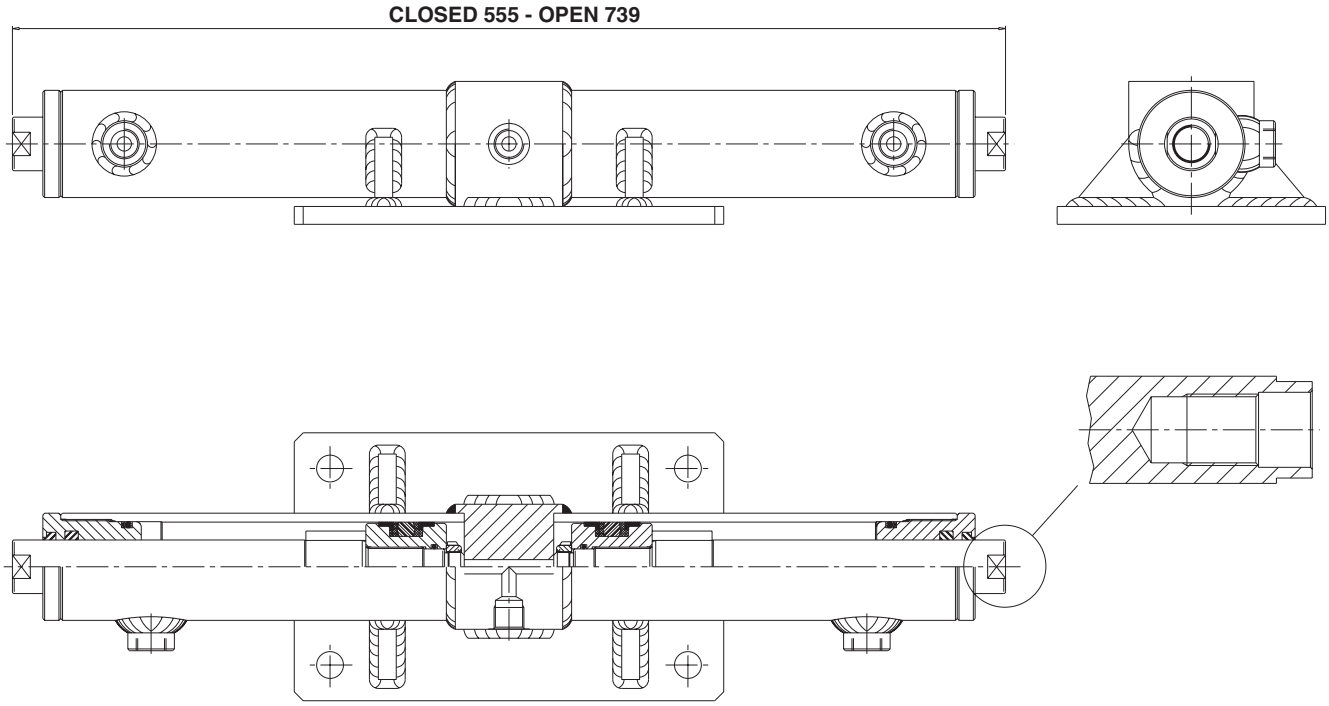
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

Operation:	Table:
Fork movement cylinder - Telelift 3713 Elite - Telelift 3517 - Telelift 4010	C.07.04



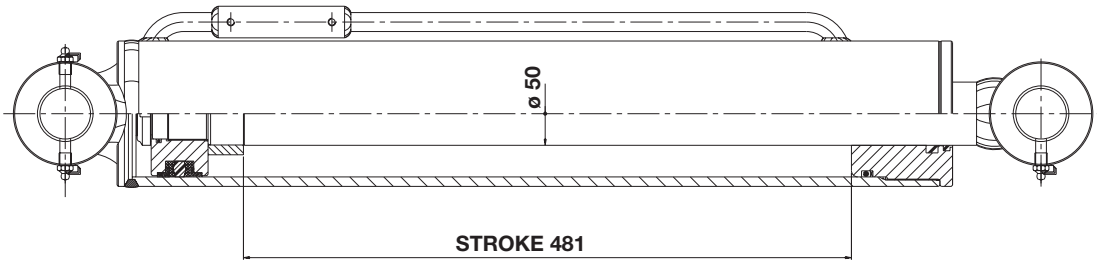
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

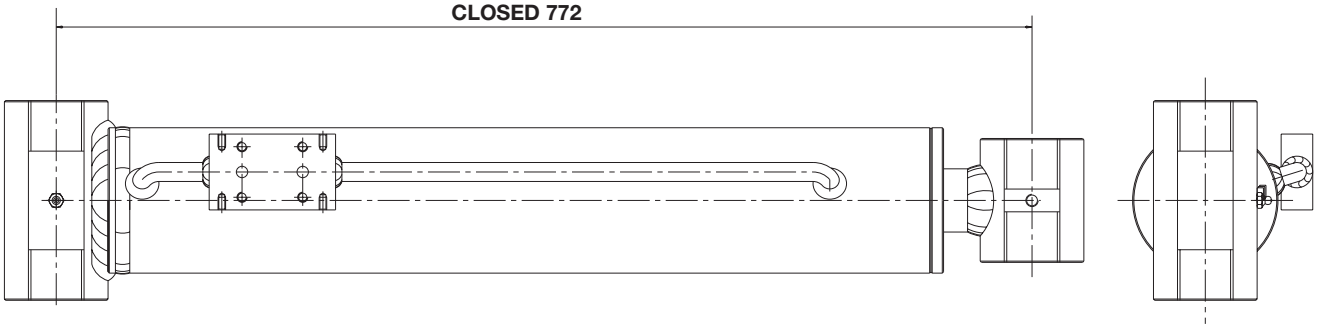
Operation:	Attachment locking cylinder - Telelift 3713 Elite - Telelift 3517 - Telelift 4010	*Table:* **C.07.05**



DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H9
Liner roughness	Ra max 0.6 my

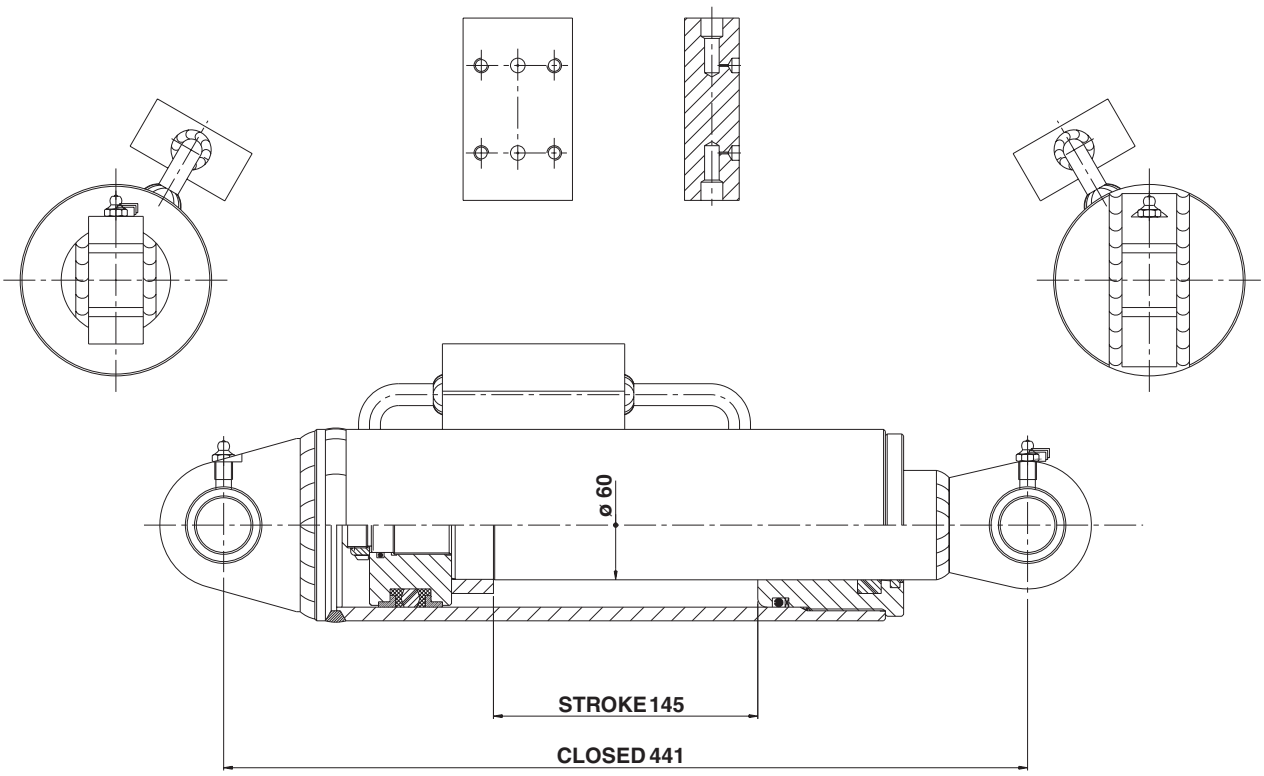
Operation:	Table:
Stabilizer cylinder - Telelift 3713 Elite - Telelift 3517	C.07.06





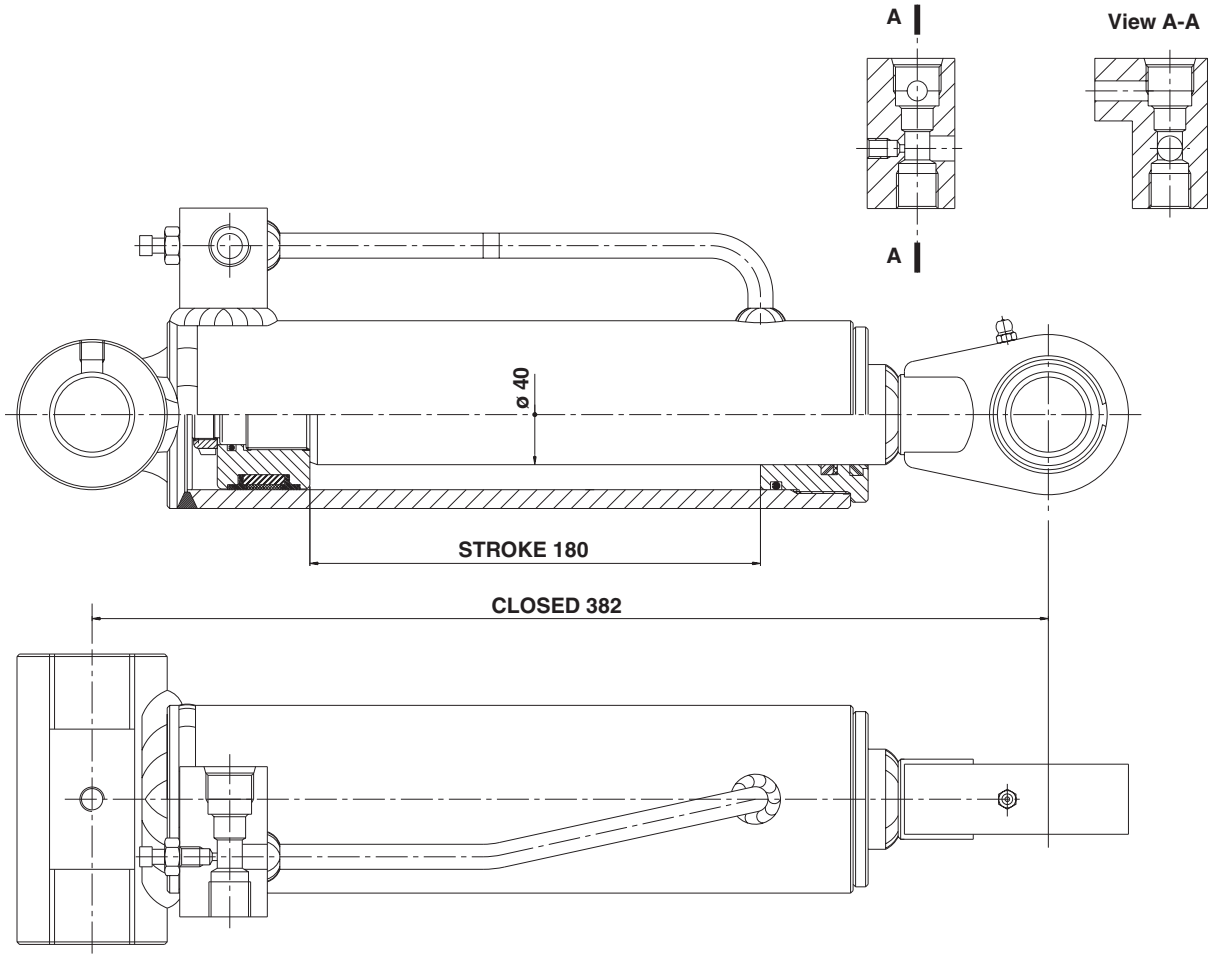
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

Operation: Sway cylinder - Telelift 3713 Elite - Telelift 3517	*Table:* **C.07.07**



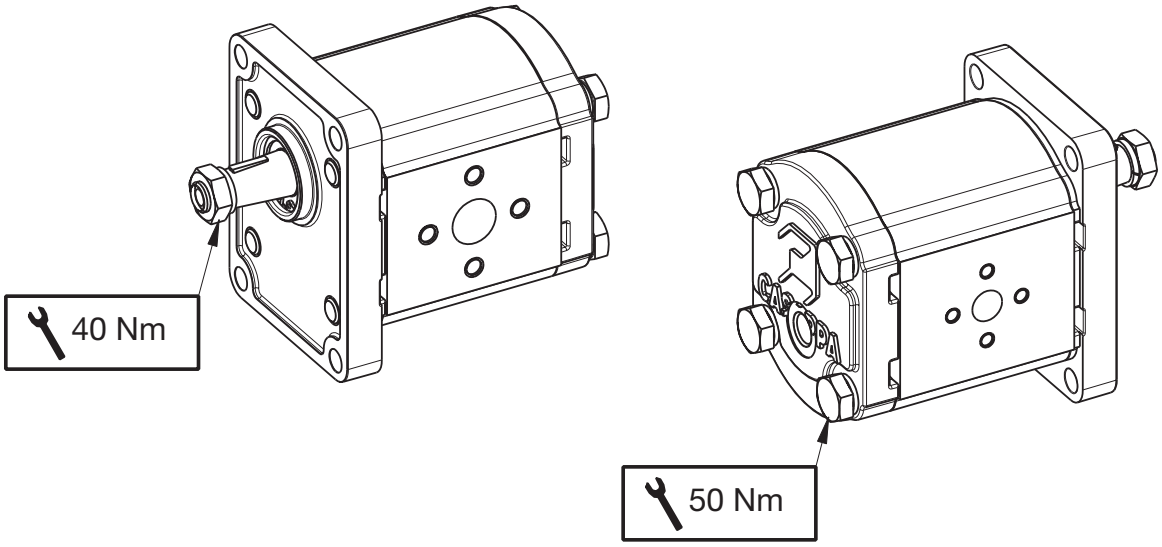
DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H9
Liner roughness	Ra max 0.2 my

Operation: Rear axle blocking cylinder - Telelift 3517	Table: C.07.08



DESCRIPTION	INDICATIVE CHARACTERISTICS
Working pressure	250 bar
Working temperature	-15°C +70°C
Rod material	C45
Rod tolerance	f7
Rod roughness	Ra max 0.2 my
Chrome-plating thickness	25 (+5/-5) my
Chrome-plating hardness	900-1100 HV (Vichers 100 g)
Liner material	St 52.3
Liner tolerance	H8
Liner roughness	Ra max 0.2 my

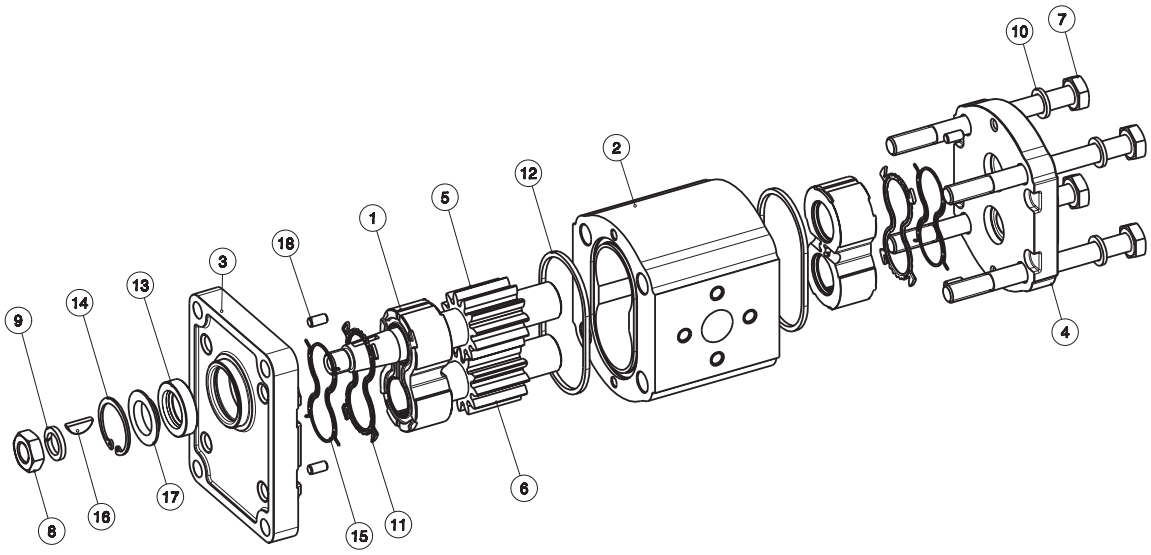
Operation: Radiator motor - technical features	*Table:* **C.08.01.01**



MOTOR DATA

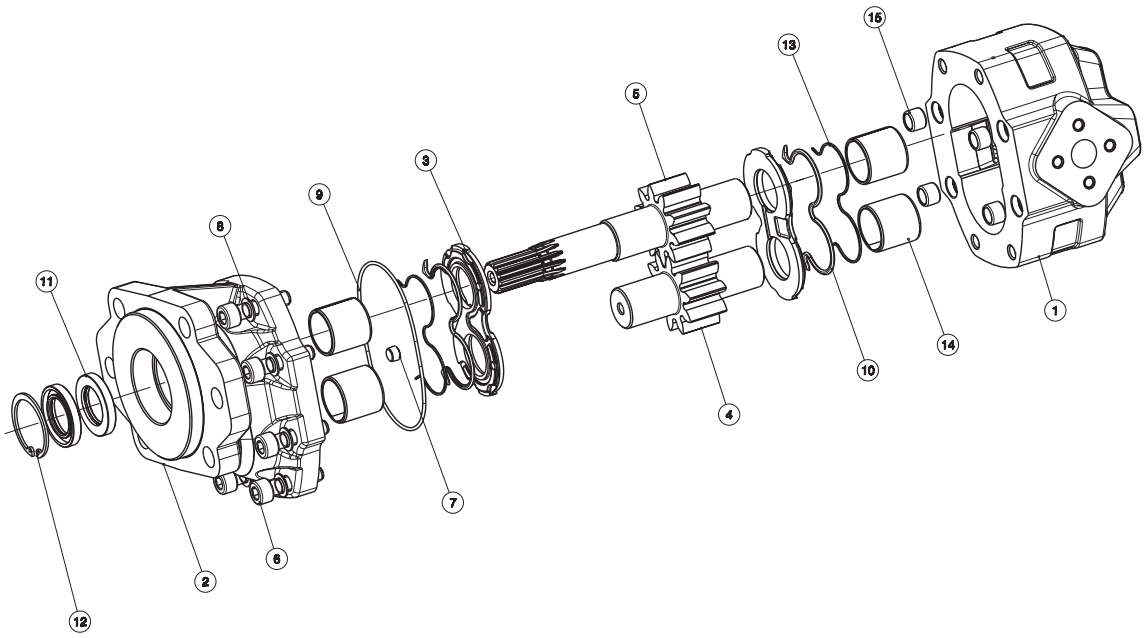
Direction of rotation (looking on drive shaft)		Reversible (R)
Displacement		21.139 [cm3/rev]
Max continuous pressure	P1	200 [bar]
Max intermittent pressure	P2	220 [bar]
Max peak pressure	P3	240 [bar]
Max back pressure for single rotation motors	P1 (cont)	- [bar]
	P2 (20 s)	- [bar]
	P3 (8 s)	- [bar]
Max drain line pressure on the reversible rotation motors		5 [bar]
Speed	min P1	500 [min^-1]
	max P1	3000 [min^-1]
Seals type		NBR
Operating temperature		-25 to + 80 [°C]
Viscosity range	recommended	12 to 100 mm^2/s (cSt)
	permitted	max 750 mm^2/s (cSt)
Contamination class	Δp > 200 bar	8 - Nas 1838
	ßx – 75-10 μm	19/17/14 - ISO 4406
	Δp < 200 bar	10 - Nas 1638
	ßx – 75-25 μm	21/19/16 - ISO 4406
Prototype code		-
Customer code		04.4235.00
Relief valve		[bar]
Stand-by pressure LS valve		[bar]
Weight		2.960 [kg]
Painting		
Special treatment		

Operation: Radiator motor - components	Table: C.08.01.02



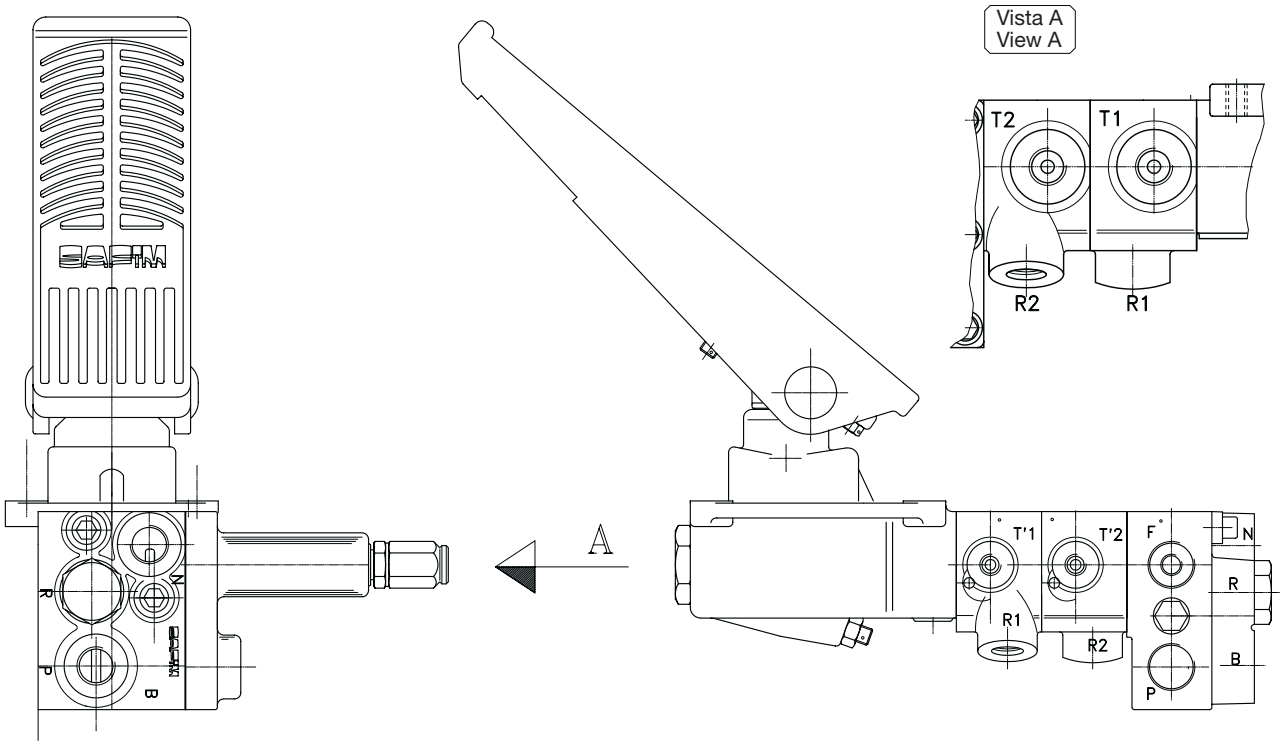
POS.	DESCRPTION
1	THRUST PLATE PL20 R Z (SIC)
2	BODY PL20.20-LEB/EA (H=76)
3	FRONT COVER PL20/AL
4	REAR COVER PL20R/AL TN
5	DRIVE SHAFT K-PL20.20-82
6	DRIVEN GEAR F-K-PL20.20
7	SCREW TE M 10X110 UNI 5737-10.9
8	NUT M 12X1,5 UNI 5589-A-6S-F-CD-8-II
9	WASHER 12 (12.2x18.3x2.5) DIN7980
10	WASHER 10 (10.5x16x2) HV200
11	SEAL PL20 R N T.N.
12	STANDARD SEAL PL 20 SQUARE SECTION
13	SHAFT SEAL BAU2 18X30X7
14	RING 30 UNI 7437
15	ANTIEXTRUSION Z PL20 R T.N.
16	KEY 3.16X6.6
17	BACK-UP WASHER GR.2
18	DOWEL PIN MM.5x10 UNI1707 H8

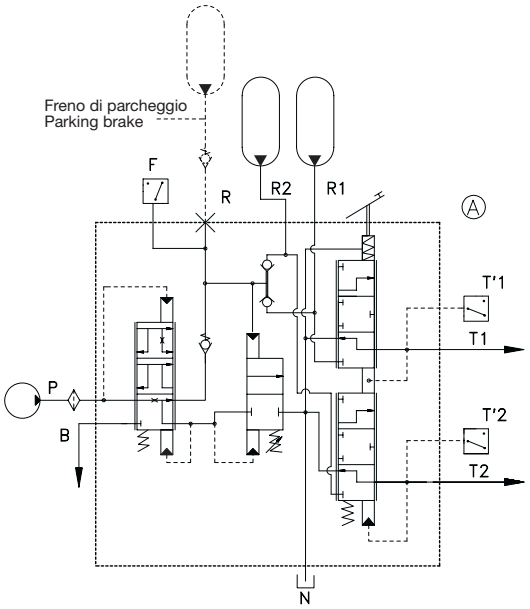
Operation: Boom movement pump - components	Table: C.08.02



POS.	DESCRIPTION
1	BODY KP30.43-LED/EB
2	COVER FP- KP30-0-S3
3	THRUST PLATE FP-KP-HDP30/AL S/D (37DEGREES)
4	DRIVEN GEAR F-K-HD-PL30.43/F
5	DRIVE SHAFT FP-KP-HD30.43-04-6
6	SCREW TCEI M 10X40 5931-12.9
7	GRUB SCREW 1/8” NPT LEVL-SEAL
8	WASHER KNURLED 10
9	O-RING OR 100x96x2 90GRA SH.A
10	SEAL FP-KP-HD30 S/D
11	SHAFT SEAL BAU2 25X42X6
12	RING 42 UNI 7437
13	ANTIEXTRUSION RING Z-FP-KP-H D30 S/D
14	SLEEVE BEARING MB 28.30 DU F30-K30-HD30
15	STEEL BUSHES 14x10,5

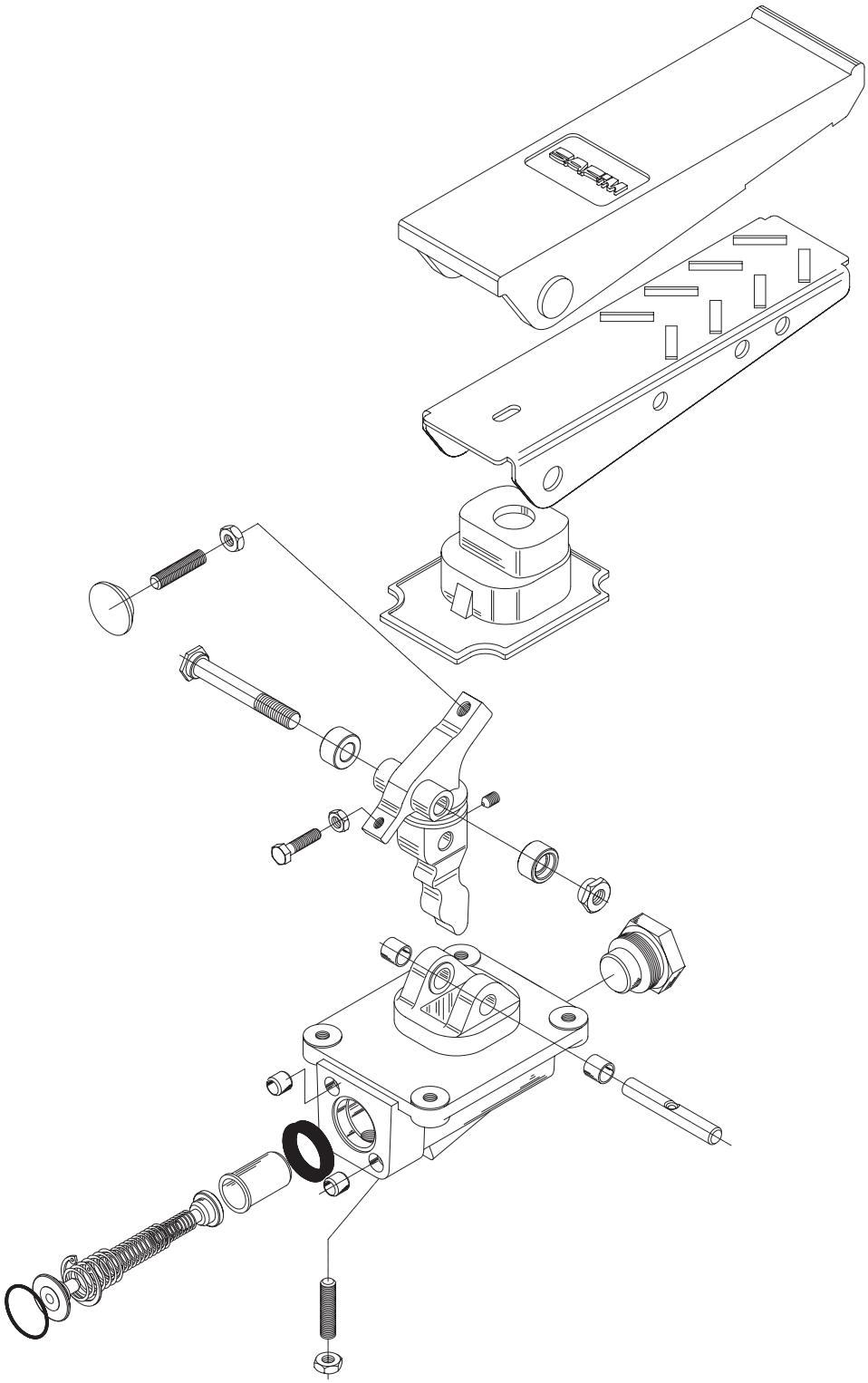
Operation: Brake pump - technical features	Table: C.08.03.01



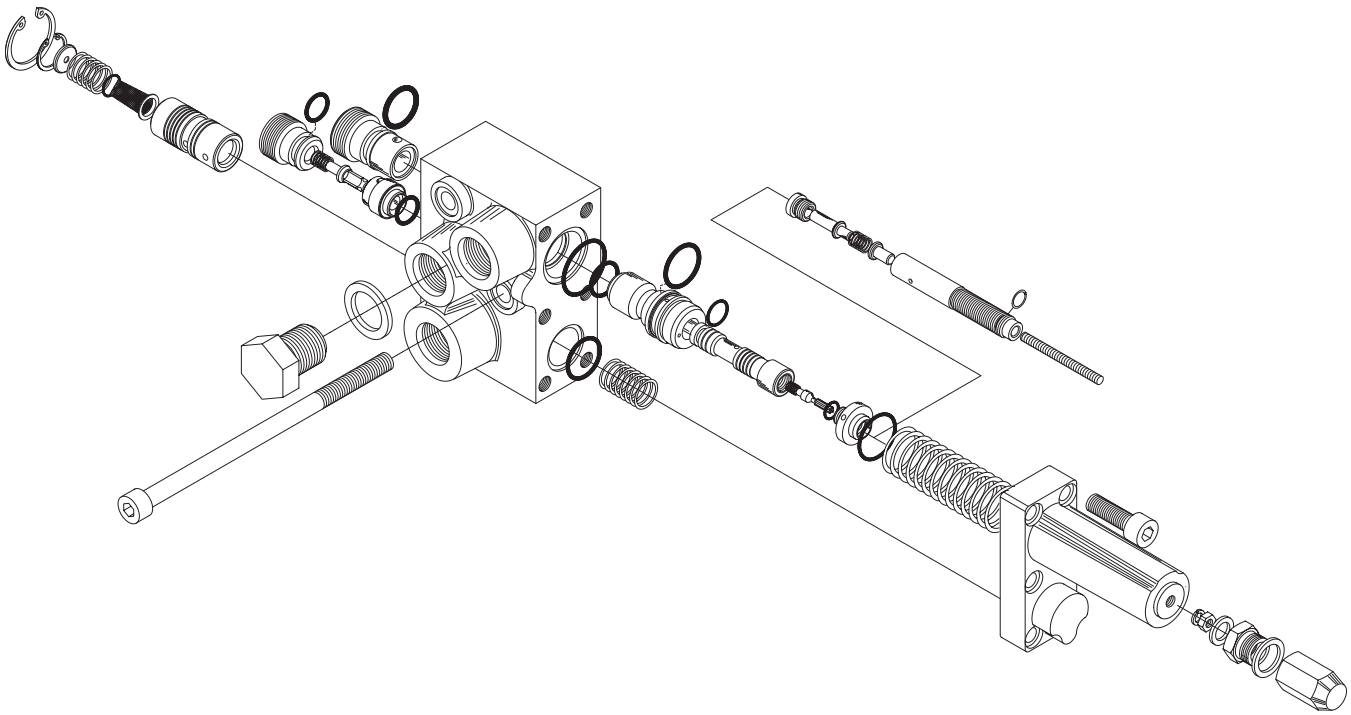


F	Accumulator pressure switch M10x1
R	Accumulator (Closed) M18x1.5
R1	Accumulator M14x1.5 ISO 6149
R2	Accumulator M14x1.5 ISO 6149
T1	Brake M14x1.5 ISO 6149
T'1	Brake pressure switch M10x1 ISO 6149
T2	Brake M14x1.5 ISO 6149
T'2	Brake pressure switch M10x1 ISO 6149
B	Other service or tank
P	Inlet
N	Tank M 18x 1.5

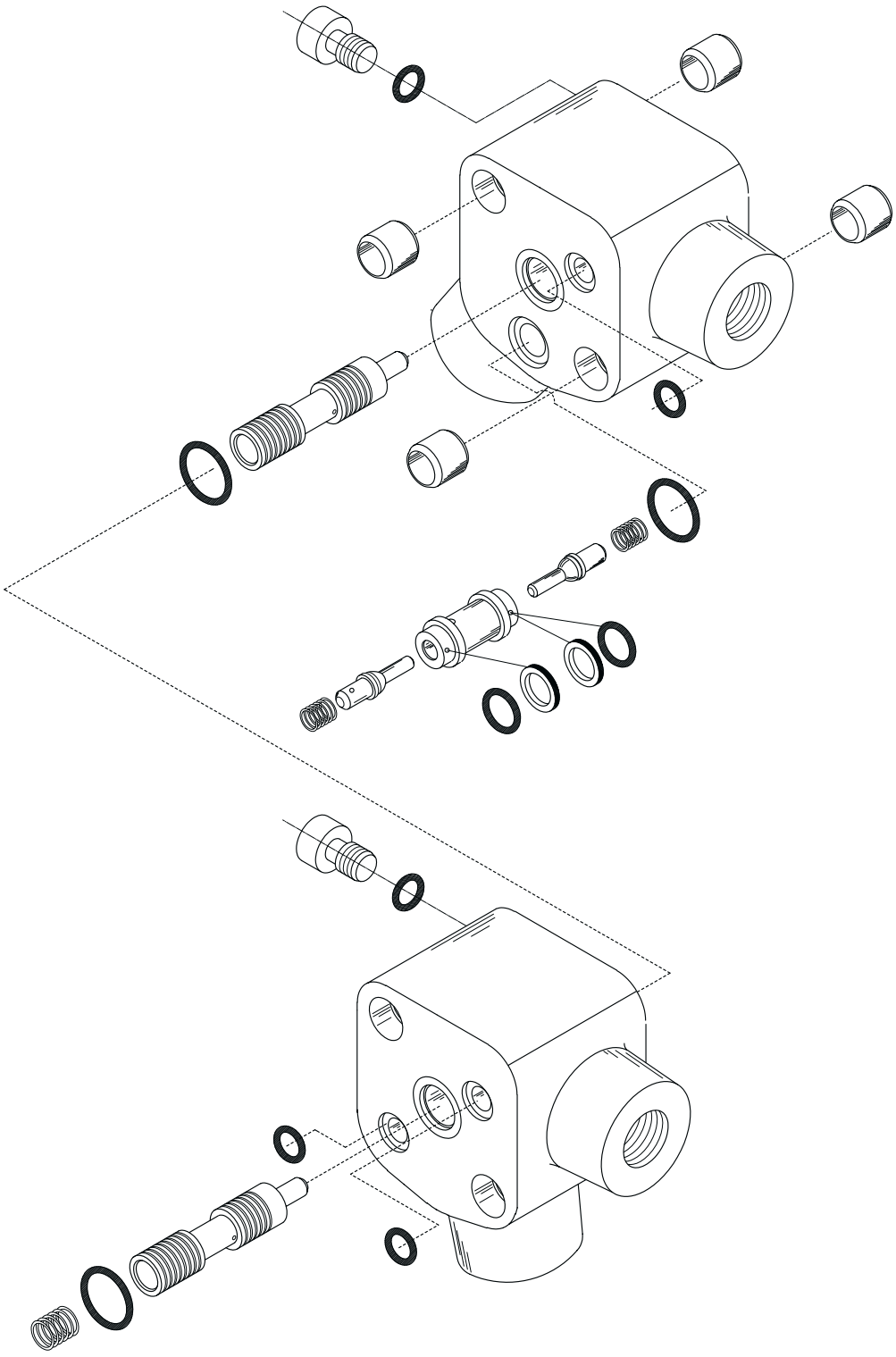
Operation: Brake pump - pedal support	Table: C.08.03.02



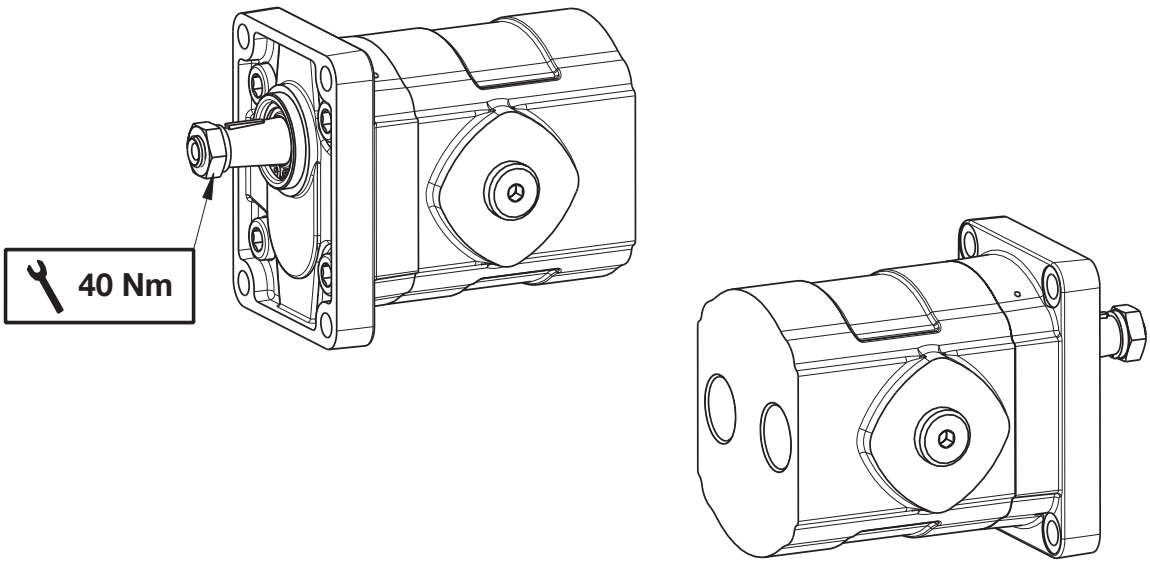
Operation: Brake pump - braking unit	*Table:* **C.08.03.03**



Operation: Brake pump - accumulators	Table: C.08.03.04



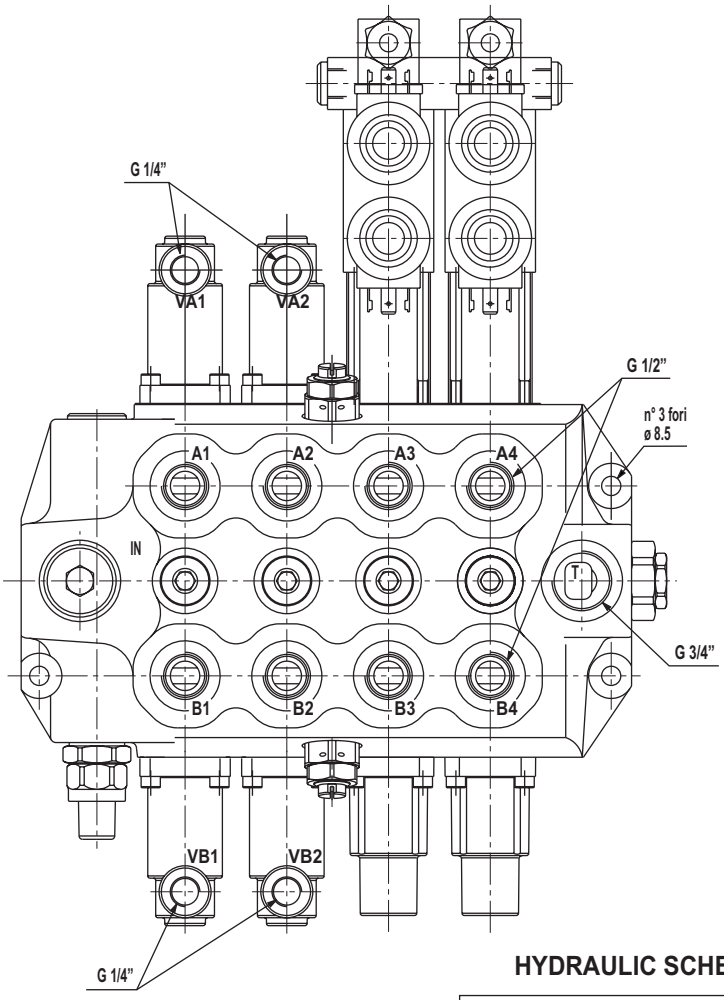
Operation: Transfer pump - technical features	Table: C.08.04

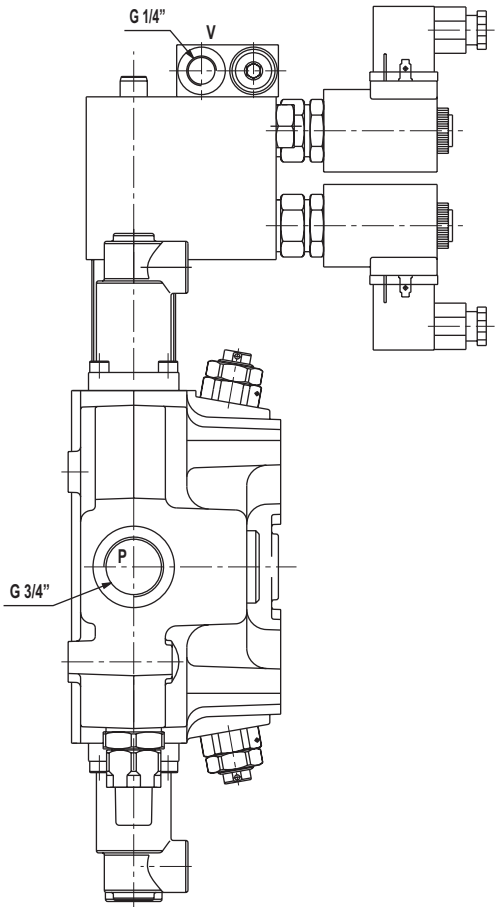


PUMP DATA

Direction of rotation (looking on drive shaft)		Clockwise (D)
Displacement		26.42 [cm3/rev]
Inlet pressure range for pump		0.7 - 3 [bu abs.]
Max continuous pressure	P1	180 [bar]
Max intermittent pressure	P2	200 [bar]
Max peak pressure	P3	220 [bar]
Speed	min P1	300 [min^-1]
	max P1	2500 [min^-1]
Seals type		NBR
Operating temperature		-25 to + 80 [°C]
Viscosity range	recommended	12 to 100 mm^2/s (cSt)
	Permitted	max 750 mm^2/s (cSt)
Contamination class	Δp > 200 bar	8 - Nas 1638
	ßx – 75-10 μm	19/17/14 - ISO 4406
	Δp > 200 bar	10 - Nas 1638
	ßx – 75-25 μm	21/19/16 - ISO 4406
Protoype code		-
Customer code		-
Relief valve		- [bar]
Stand-by pressure LS valve		- [bar]
Weight		5.710 [kg]
Painting		BLACK - RAL 9004
Special treatment		

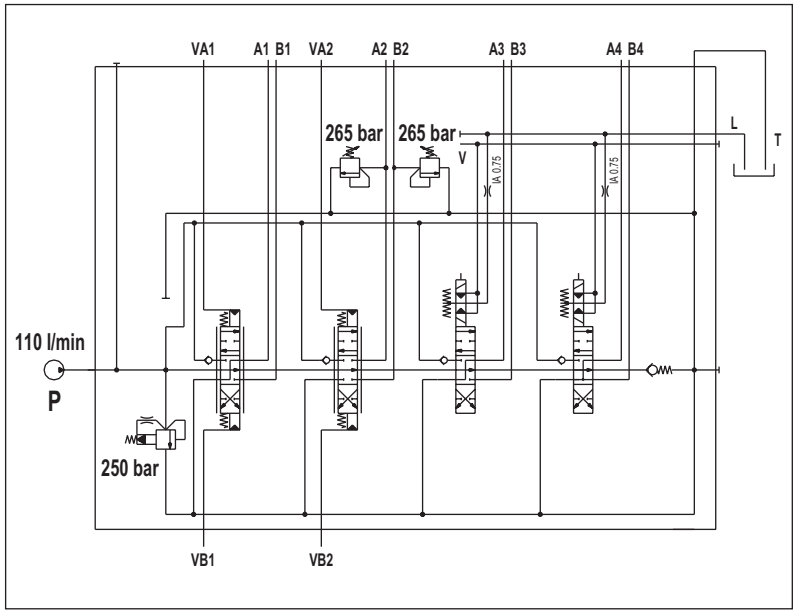
Operation: Hydraulic actuator Telelift 3013 (**up to serial no. 8450**)	*Table:* **C.09.01.01**



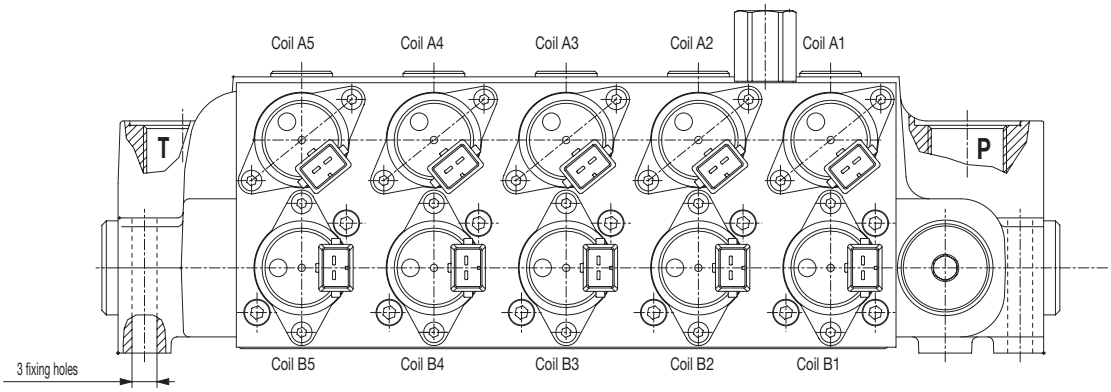


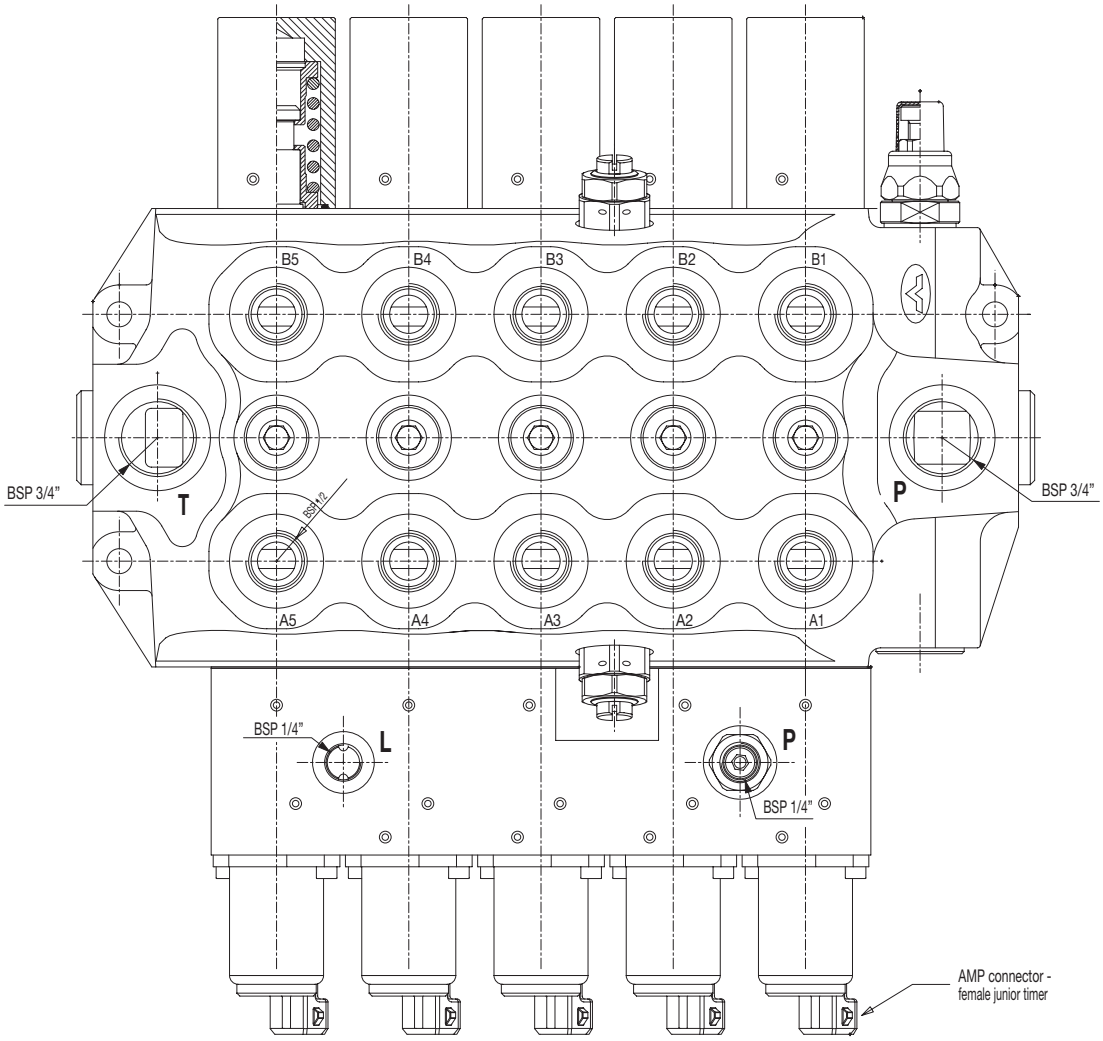
CHARACTERISTICS		
One-block distributor with parallel circuit		
Working sections		4
Slider diameter		18 mm
WORKING CONDITIONS (mineral oil with 46 mm2/s viscosity at 40/BC)		
Nominal flow		80 l/min
Nominal pressure		250 bar
Max pressure on V		50 bar
Max back-pressure to drain T		25 bar
Internal leakage A(B)->T at 100 bar :		3 cm³/min
Viscosity	working field	15 - 75 mm²/s
	minimum	12 mm²/s
	maximum	400 mm²/s
Ambient temperature		-40°IB a +60°IBC
Fluid temperature field		-20°IB a +80°IBC
Admissible contamination degree		19/16 - ISO 4406
ELECTRICAL CHARACTERISTICS		
Voltage		12 Vdc
Current		21 W
Measuring circuit		100

HYDRAULIC SCHEME

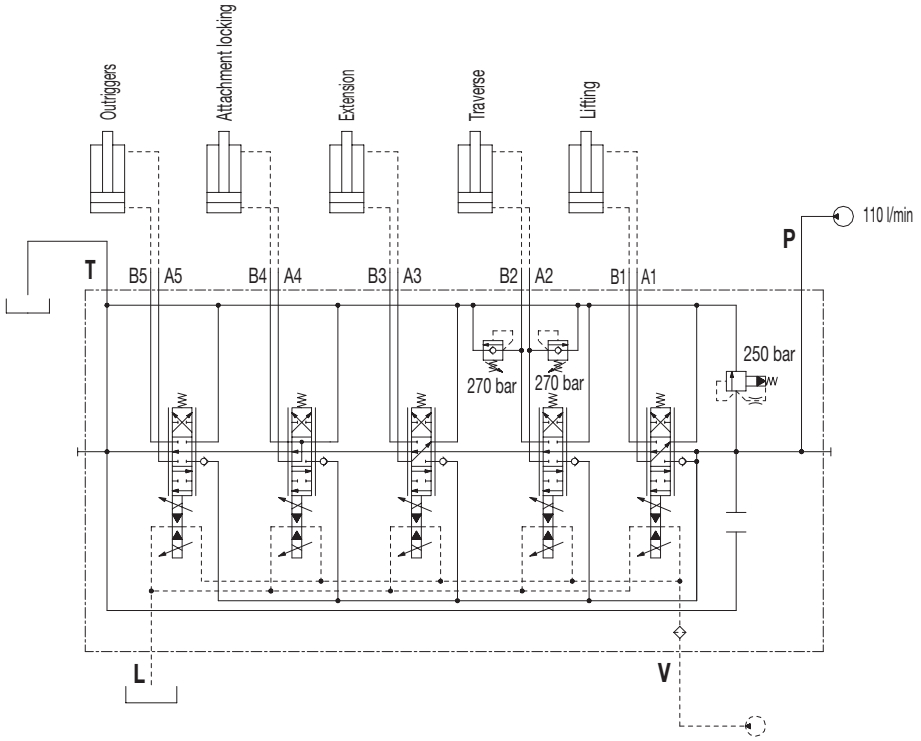


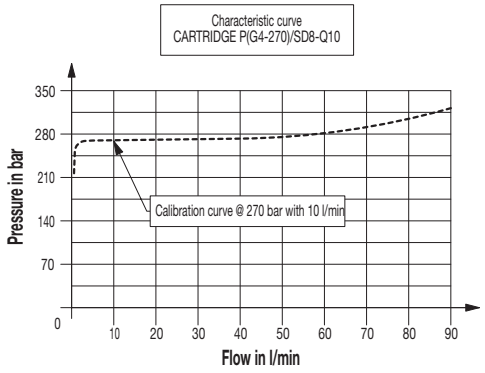
Operation: Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **C.09.01.02**

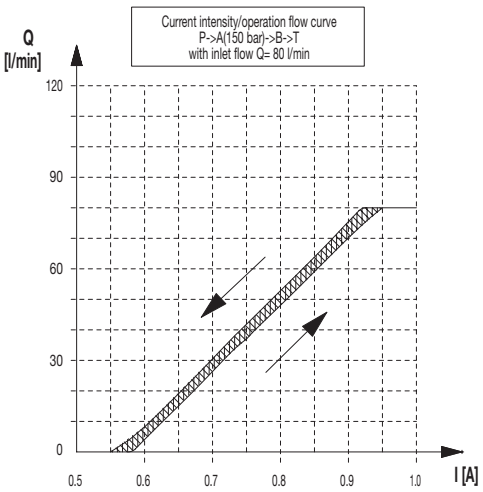




Operation: Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **C.09.01.03**

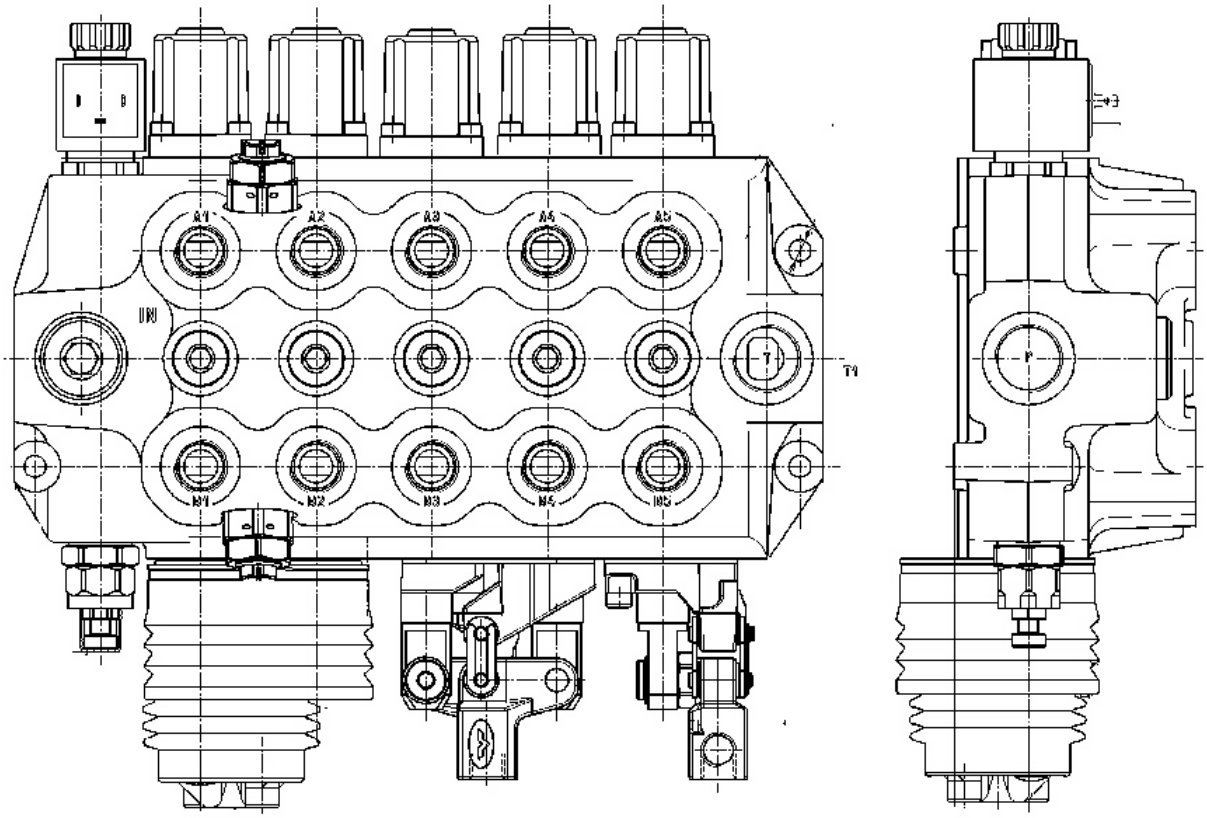




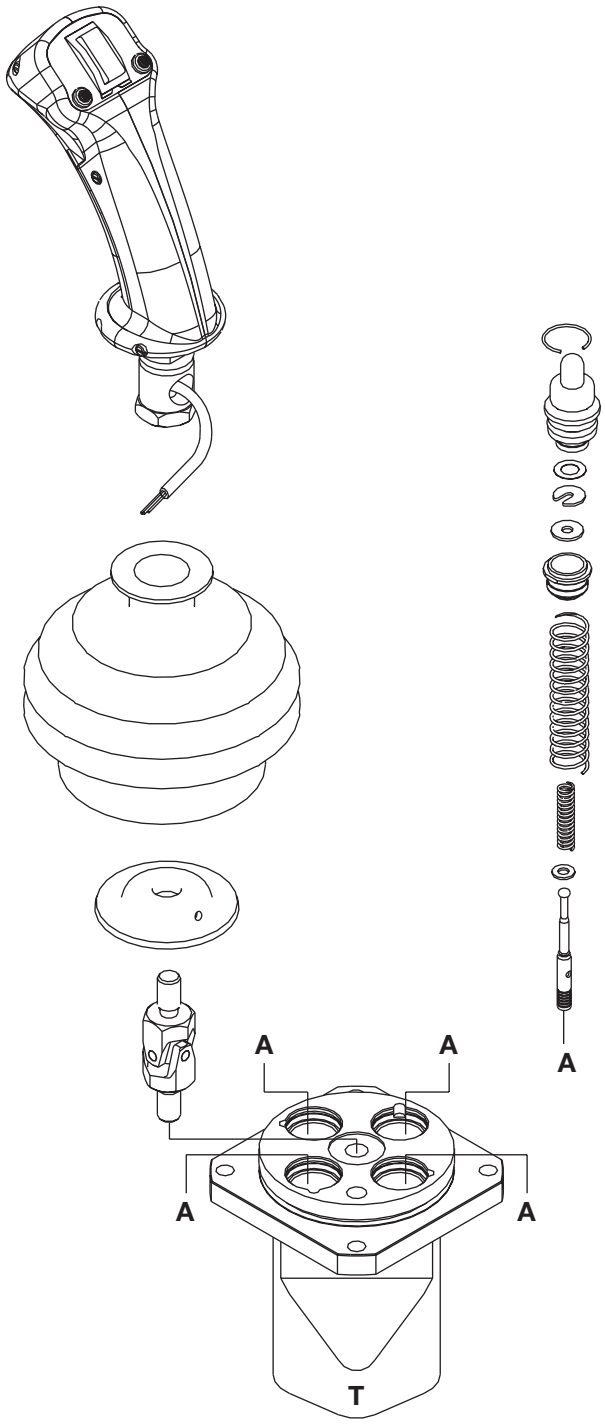


DATA		
Monobloc actuator with paralleled circuit		
Working elements		5
Slider diameter		18 mm
OPERATING CONDITIONS (mineral oil - viscosity 46 mm²/s @ 40IBC)		
Nominal flow		80 l/min
Nominal pressure		315 bar
Max pressure on V		
Max back-pressure to drain T		25 bar
Max back-pressure to drain L		20 bar
Max internal leakage @ 100 bar:	B1->T	7 cm³/min
	A2(B2)->T	
	B3->T	
	A5(B5)->T	
Viscosity	working range	15 - 75 mm²/s
	minimum	12 mm²/s
	maximum	400 mm²/s
Ambient temperature		-40IB @ +60IBC
Fluid temperature rangeì		-20IB @ +80IBC
Admissible contamination degree		19/16 - ISO 4406
electro-hydraulic control	Voltage	12 VDC
	Coil resistance (20°C)	5.3 Ohm
	Max current	1.5 A
	Measuring circuit	100 %

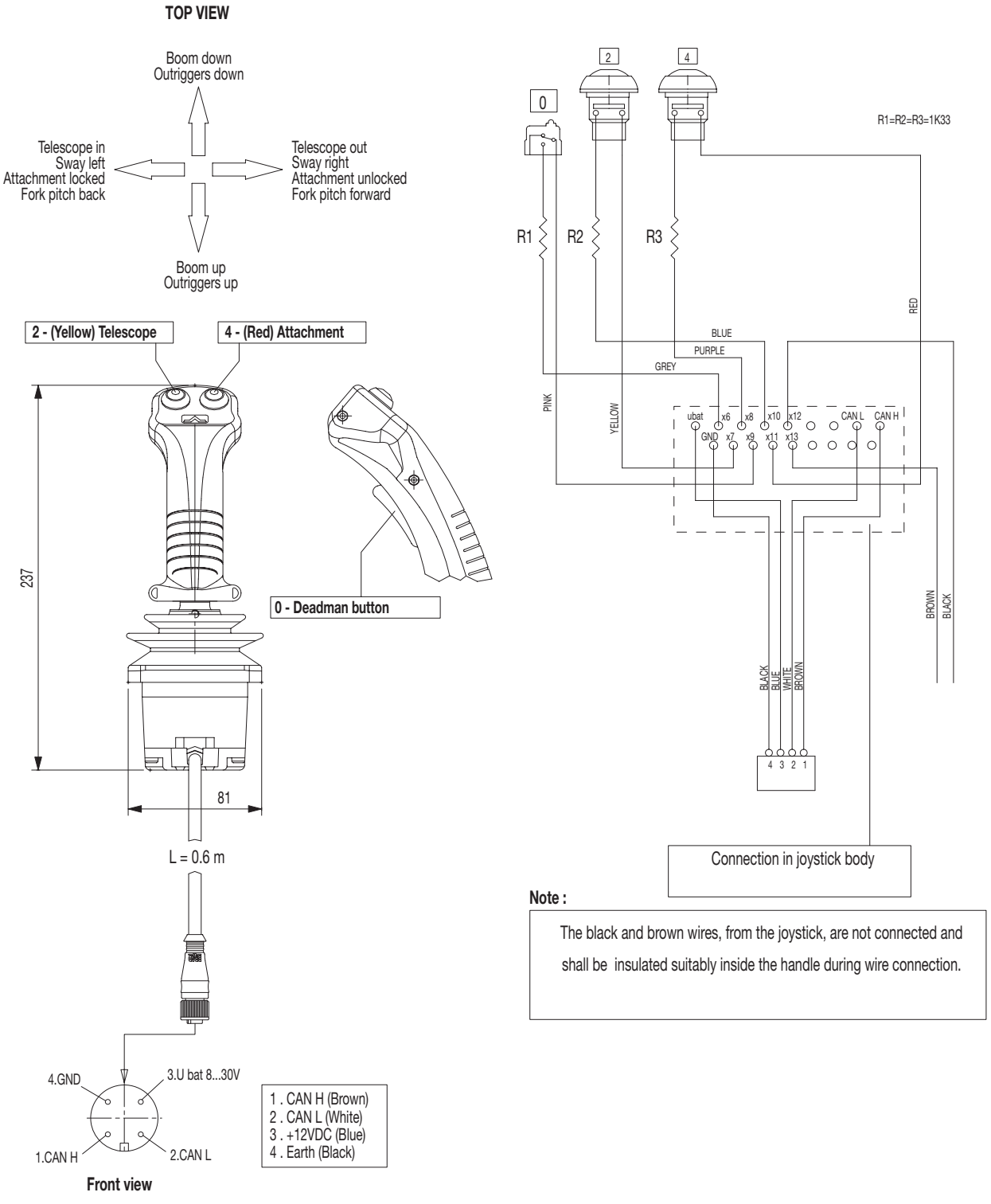
Operation: Hydraulic actuator Telelift 4010	Table: C.09.02



Operation: Hand-lever Telelift 3013 (**fino a matr. 8450**)	*Table:* **C.10.01.01**



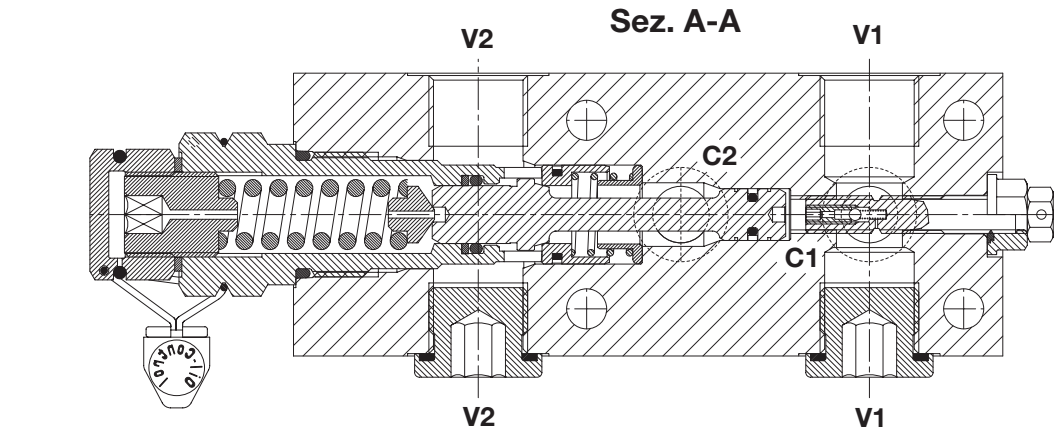
Operation: Hand-lever Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **C.10.01.02**

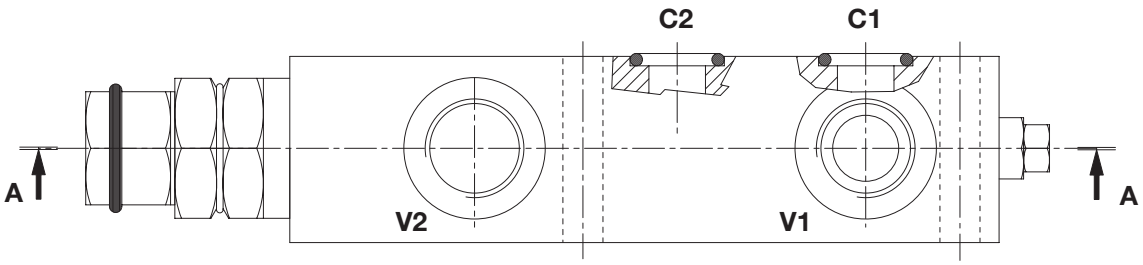


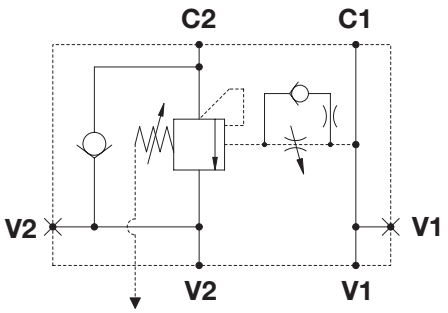
Note :

The black and brown wires, from the joystick, are not connected and shall be insulated suitably inside the handle during wire connection.

Operation:	Boom raising cylinder block valve Telelift 3713 Elite - Telelift 4010	*Table:* **C.11.01.01**





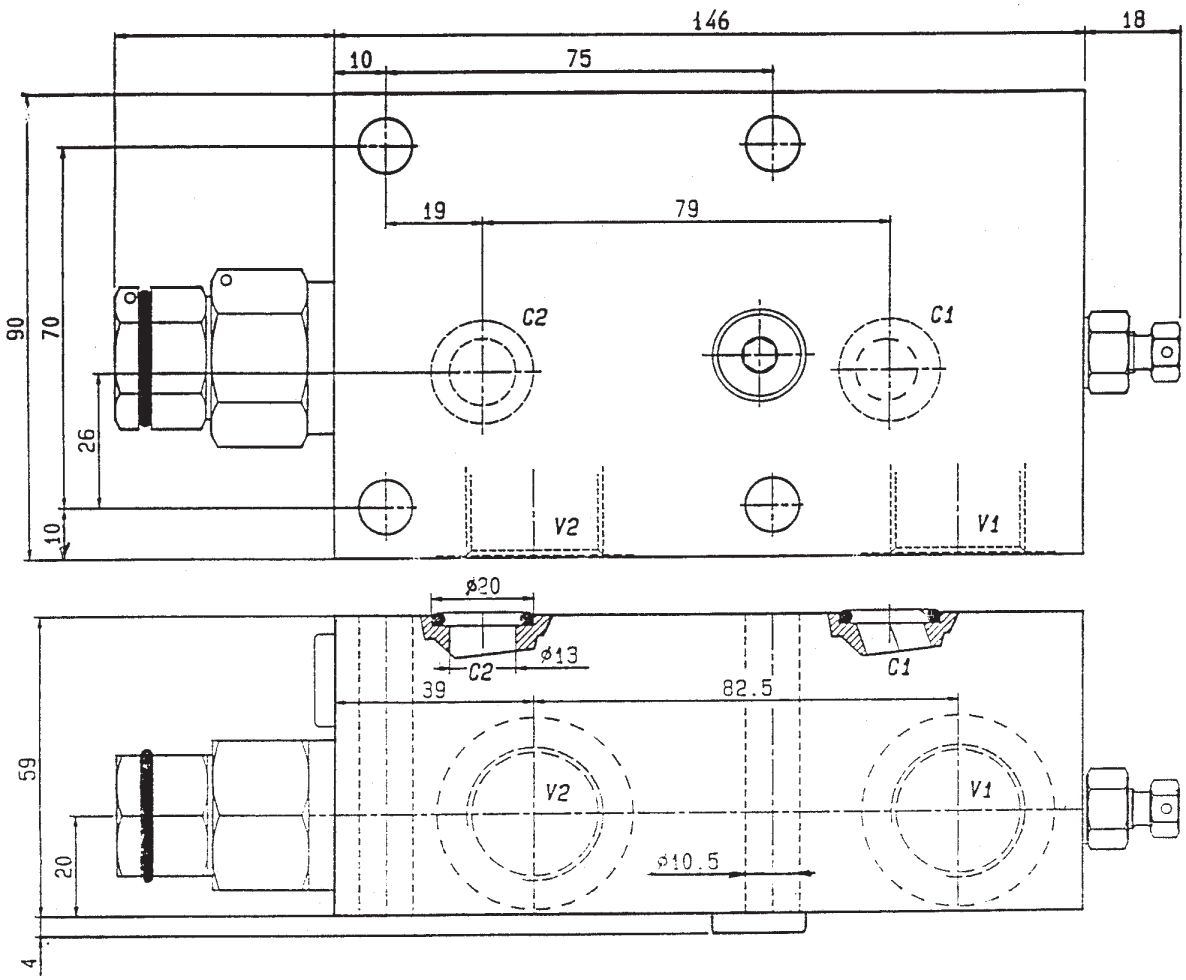


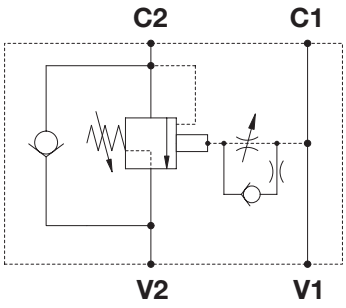
FITTINGS
V1-V2: G 1/2”
C1-C2: ø 12

TECHINCAL DATA

- Max working pressure .....350 bar
- Piloting ratio 4:1
- Valve setting .....1.3 times higher than the load induced pressure
- Manifold.....steel
- Weight .....2,5 kg

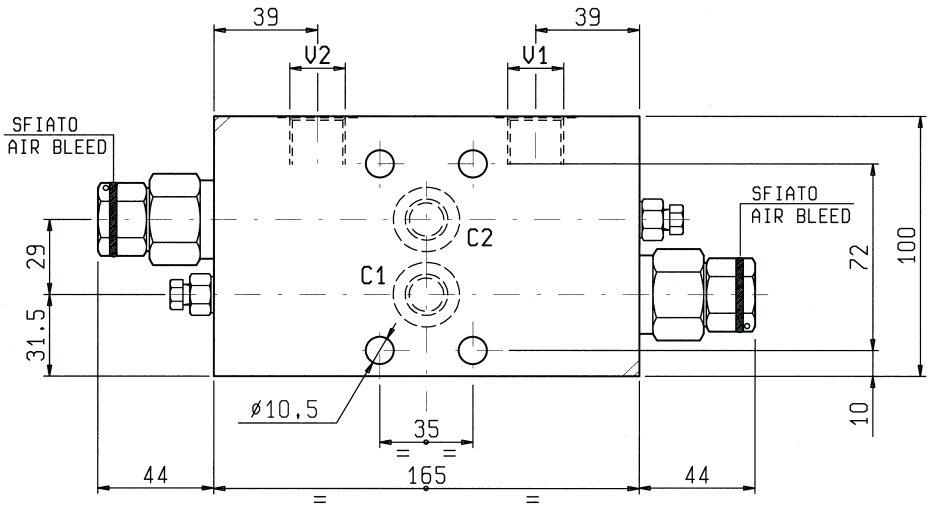
Operation:	Boom raising cylinder block valve Telelift 3517	Table: **C.11.01.02**

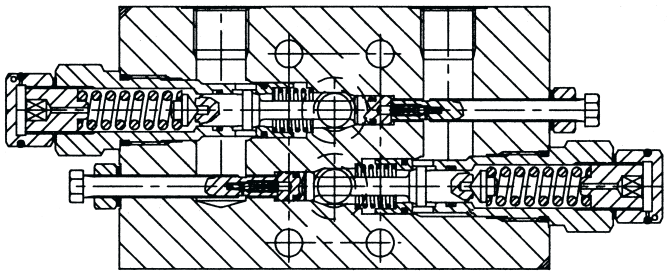


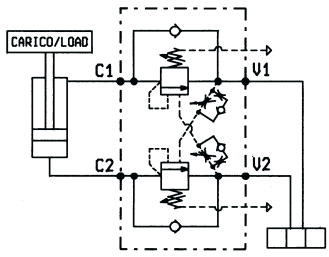


FITTINGS
V1-V2: G 3/4”
C1-C2: ø 13

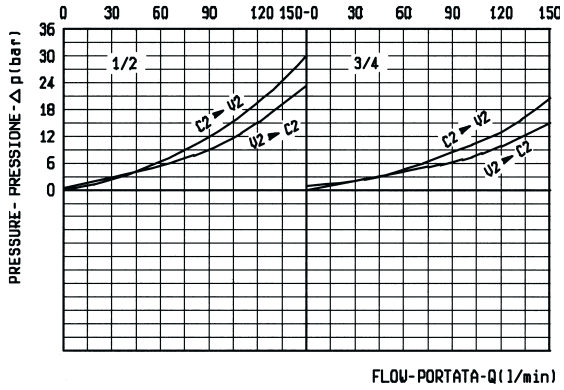
Operation:	2nd telescope extension cylinder block valve Telelift 3713 Elite - Telelift 4010	*Table:* **C.11.02.01**







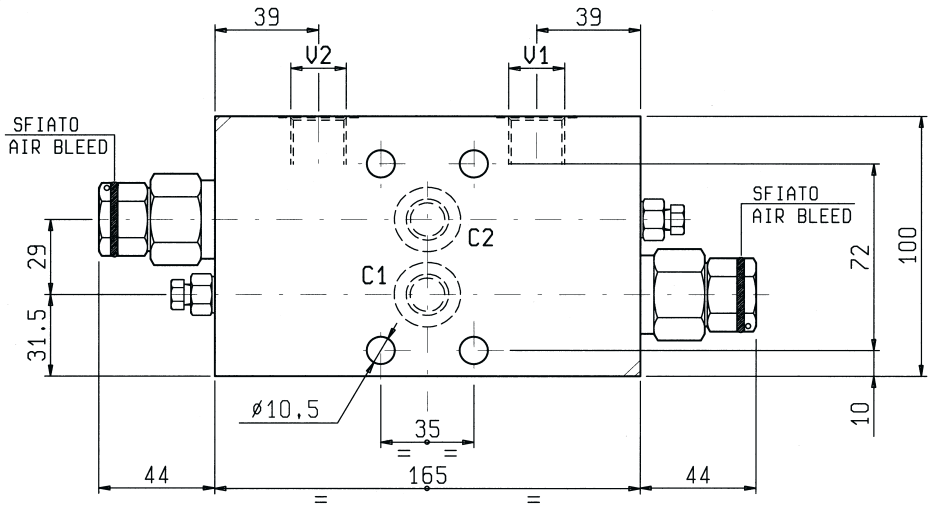
FITTINGS
V1-V2: G 1/2" • C1-C2: ø 13

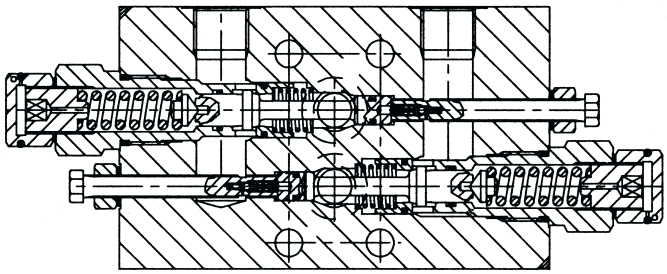


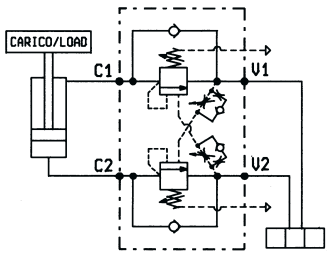
TECHINCAL DATA

- Max working pressure .....350 bar
- Piloting ratio 4:1
- Max flow.....see diagram
- Valve setting .....1.3 times higher than the load induced pressure
- Spring setting .....100-350 min/max bar
- Weight .....2,8 kg

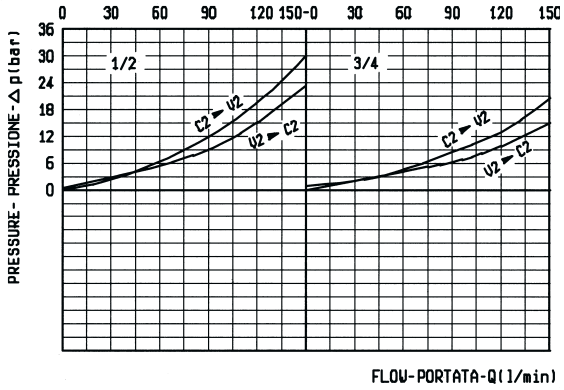
Operation:	Table:
2nd telescope extension cylinder block valve Telelift 3517	**C.11.02.02**







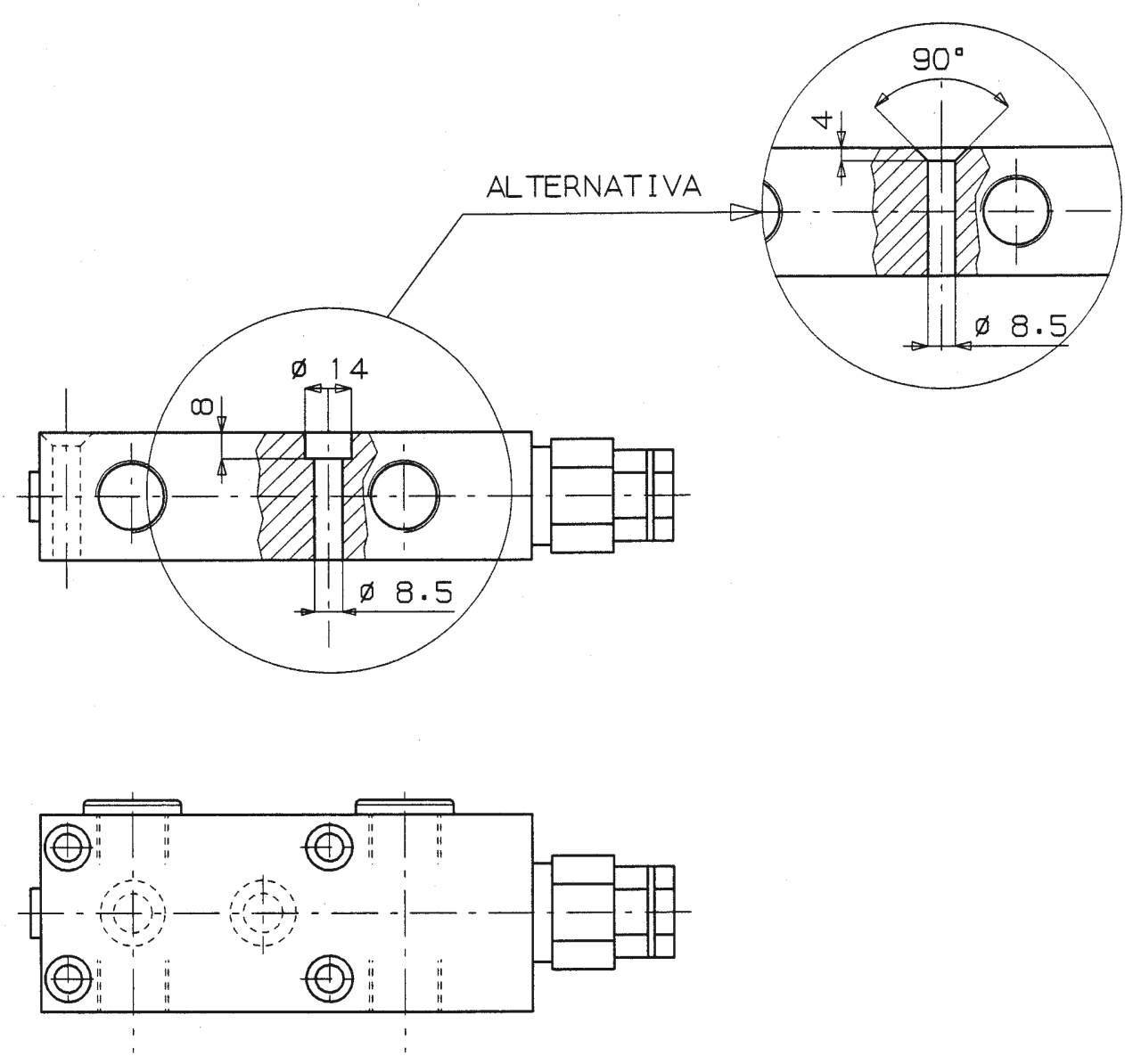
FITTINGS
V1-V2: G 1/2" • C1-C2: ø 13



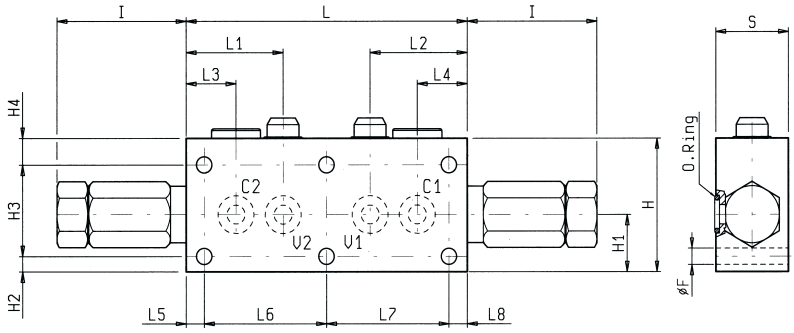
TECHINCAL DATA

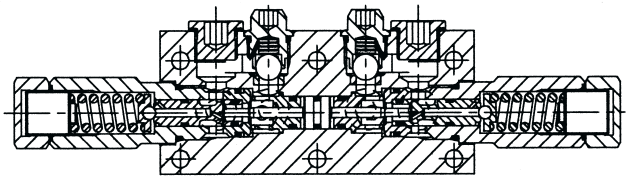
- Max working pressure .....350 bar
- Piloting ratio 4:1
- Max flow .....see diagram
- Valve setting .....1.3 times higher than the load induced pressure
- Spring setting .....100-350 min/max bar
- Weight .....2,8 kg

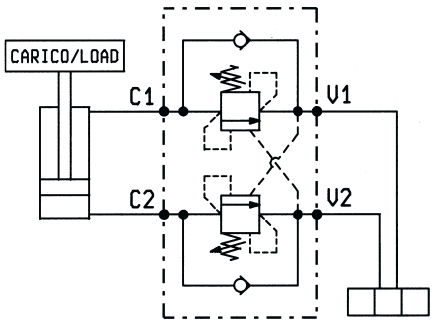
Operation:	3rd telescope extension cylinder block valve Telelift 3713 Elite	Table: **C.11.02.03**



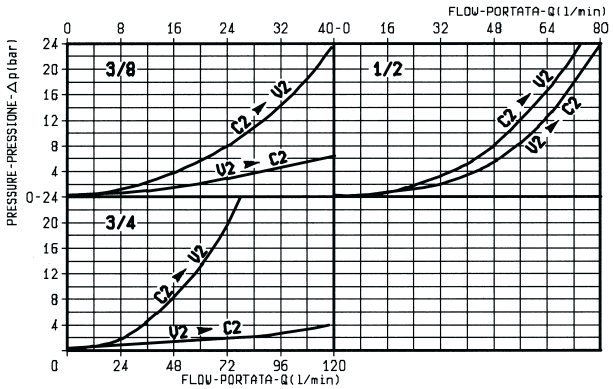
Operation:	*Table:*
Compensation cylinder block valve Telelift 3713 Elite - Telelift 3517 - Telelift 4010	**C.11.03**







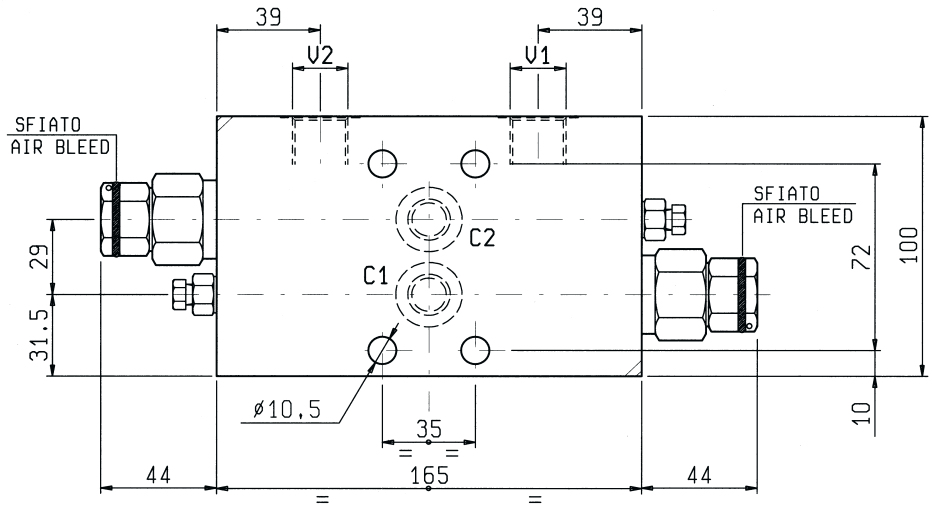
FITTINGS
V1-V2-C1-C2: 1/2”

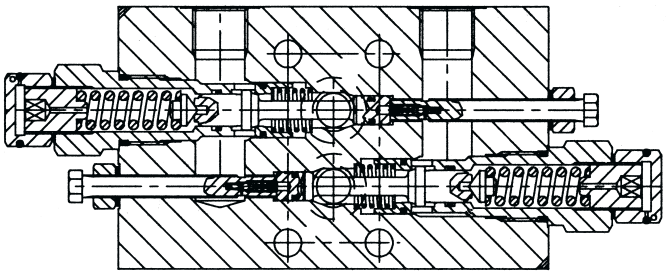


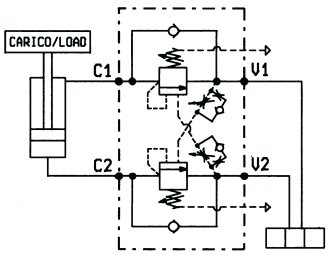
TECHINCAL DATA

- Max working pressure .....350 bar
- Piloting ratio 7,55:1
- Max flow .....see diagram
- Valve setting .....1.3 times higher than the load induced pressure
- Spring setting .....100-350 min/max bar
- Weight .....2,1 kg

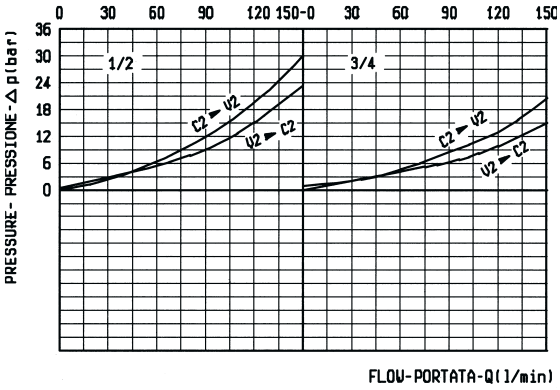
Operation:	Fork movement cylinder block valve Telelift 3713 Elite - Telelift 4010	*Table:*
		C.11.04.01







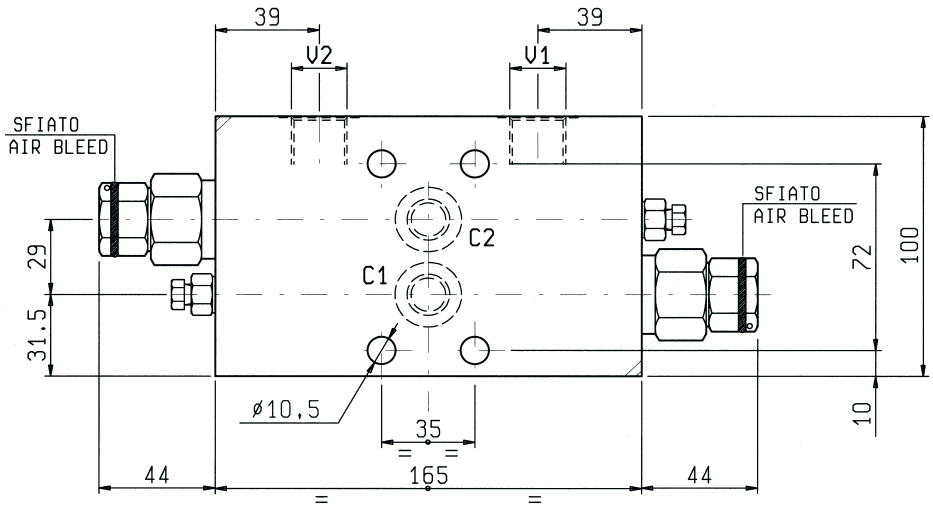
FITTINGS
V1-V2: G 1/2" • C1-C2: ø 13

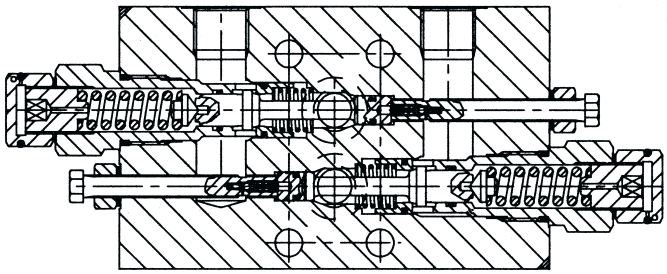


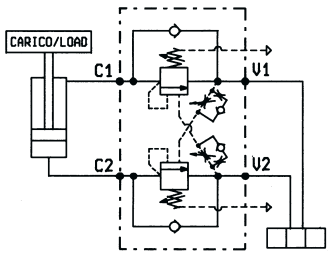
TECHINCAL DATA

- Max working pressure .....350 bar
- Piloting ratio 4:1
- Max flow .....see diagram
- Valve setting .....1.3 times higher than the load induced pressure
- Spring setting .....100-350 min/max bar
- Weight .....2,8 kg

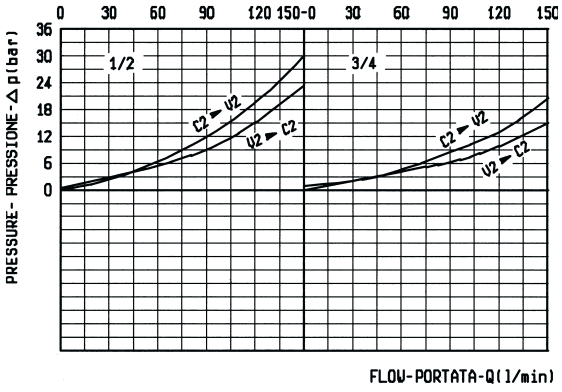
Operation:	Table:
Fork movement cylinder block valve Telelift 3517	**C.11.04.02**







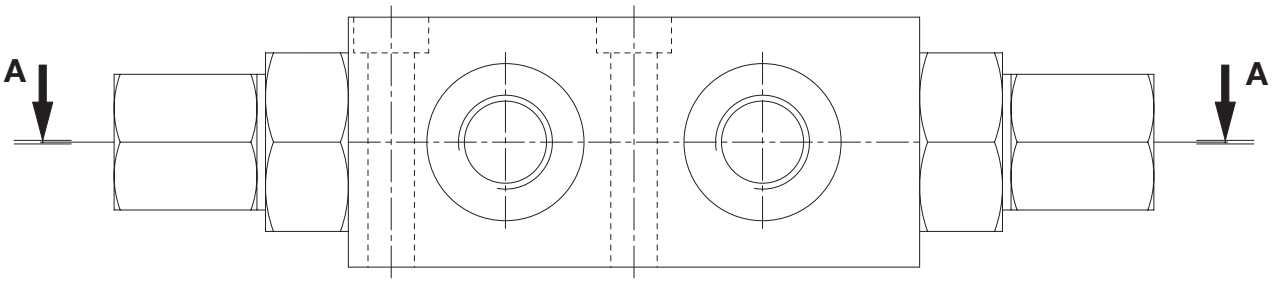
FITTINGS
V1-V2: G 1/2" • C1-C2: ø 13



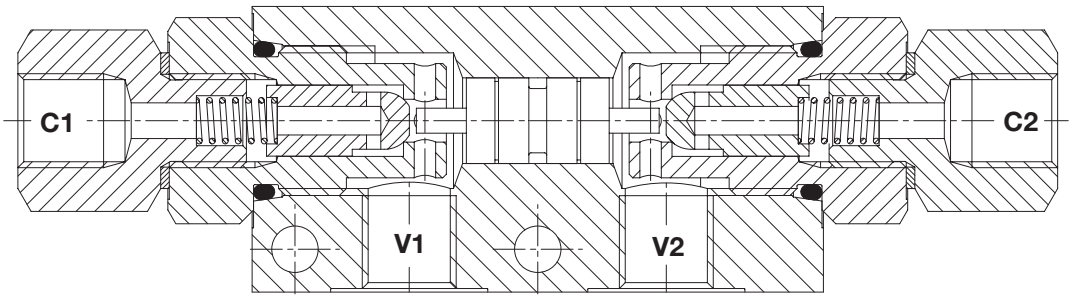
TECHINCAL DATA

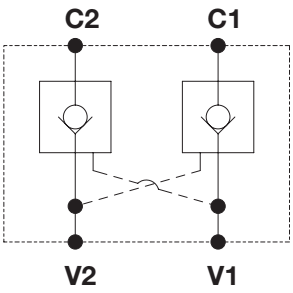
- Max working pressure .....350 bar
- Piloting ratio 4:1
- Max flow .....see diagram
- Valve setting .....1.3 times higher than the load induced pressure
- Spring setting .....100-350 min/max bar
- Weight .....2,8 kg

Operation:	Attachment cylinder block valve Telelift 3713 Elite - Telelift 3517 - Telelift 4010	*Table:* **C.11.05**



Sez. A-A



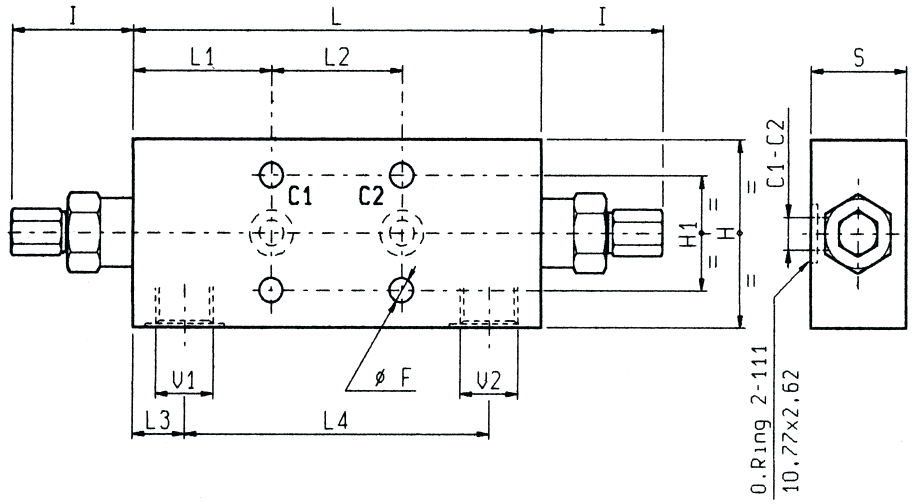


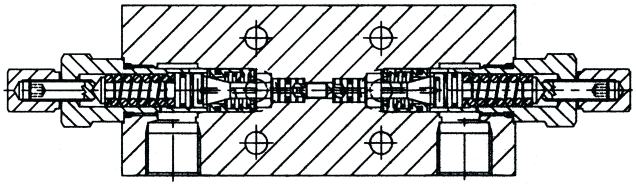
FITTINGS
V1-V2-C1-C2: G 1/4”

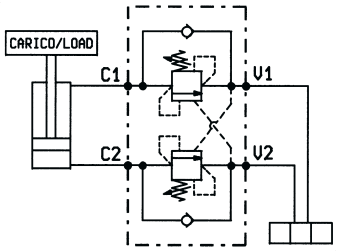
TECHINCAL DATA

- Max working pressure .....350 bar
- Piloting ratio 4:1
- Weight .....0,7 kg

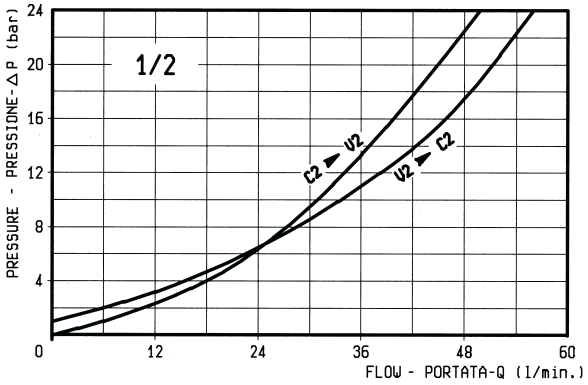
Operation:	Table:
Outriggers cylinders and axle sway block valve Telelift 3713 Elite - Telelift 3517	**C.11.06**







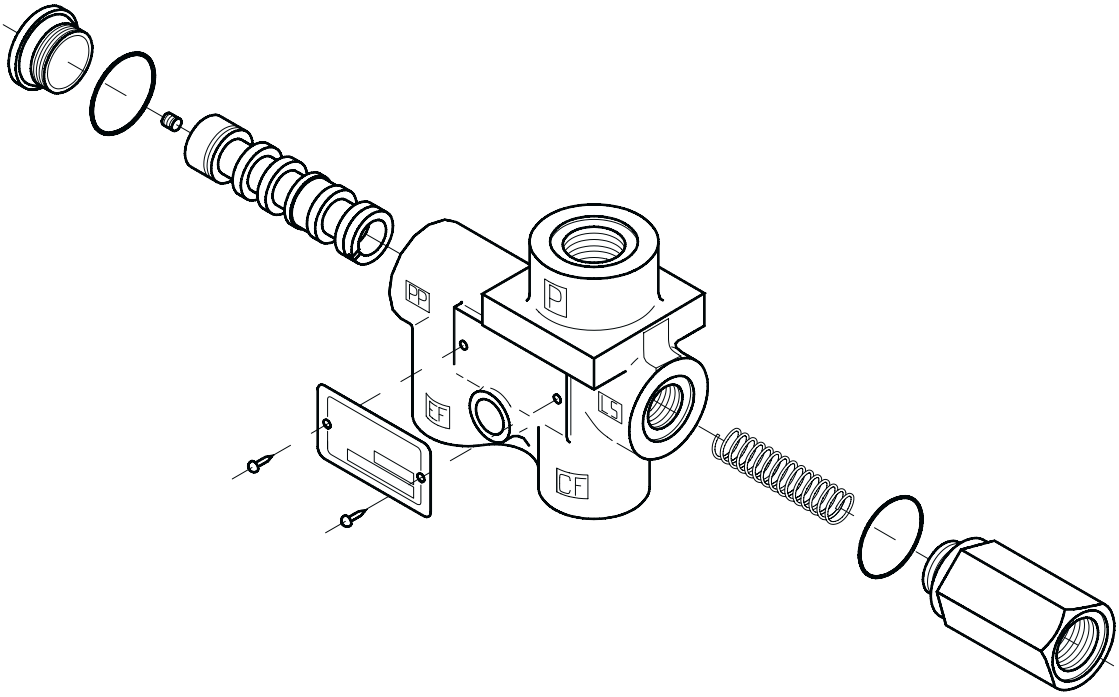
FITTINGS
V1-V2: G 1/2" • C1-C2: ø 9



TECHINCAL DATA

- Max working pressure .....350 bar
- Piloting ratio 4,25:1
- Max flow .....see diagram
- Valve setting .....1.3 times higher than the load induced pressure
- Spring setting .....100-350 min/max bar
- Weight .....2,3 kg

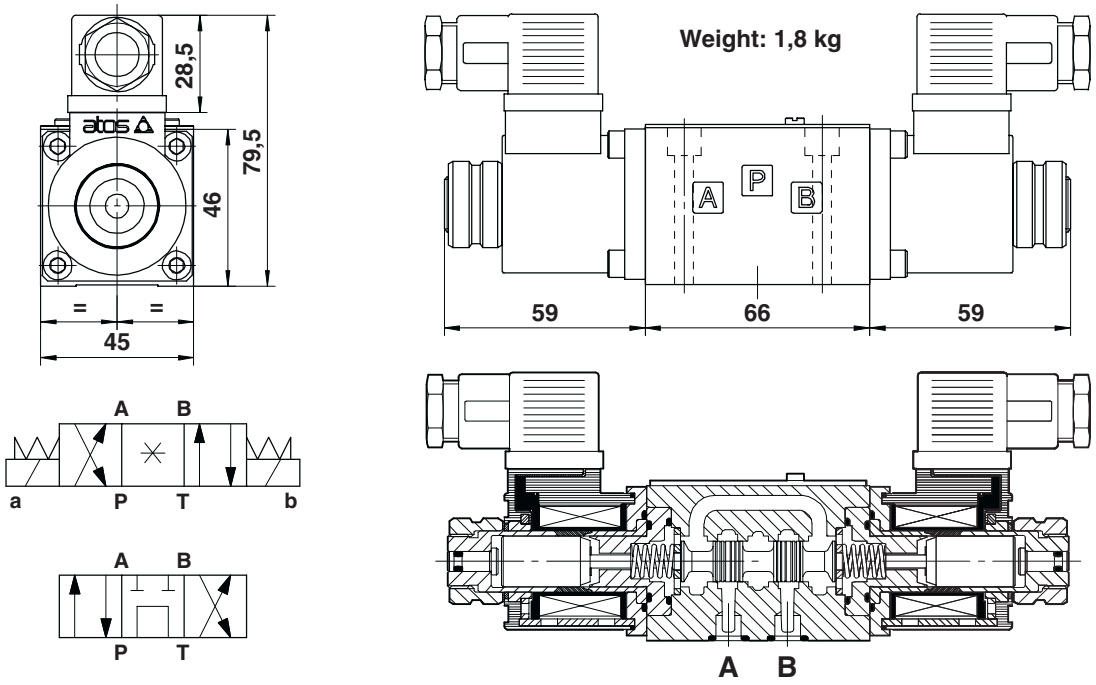
Operation:	Table:
OLS 80 priority valve Telelift 3713 Elite - Telelift 3517 - Telelift 4010	C.11.07





Operation: DHI solenoid valve
Telelift 3713 Elite - Telelift 3517 - Telelift 4010

Table: **C.11.08**



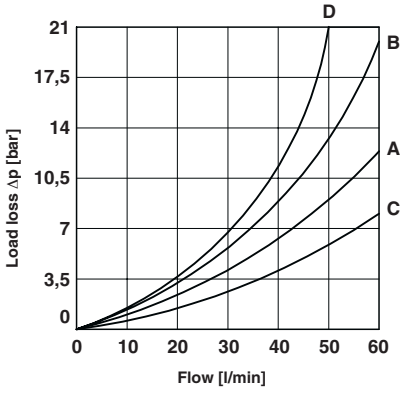
MAIN CHARACTERISTICS OF THE DHI SOLENOID VALVES

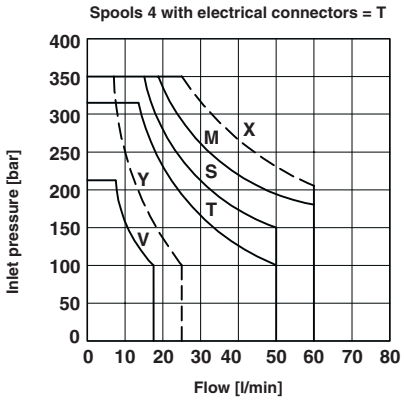
Installation position	Any
Coupling surface condition	Surface texture index $\sqrt{}^{0,4}$, flatness ratio 0.01/100 (ISO 1101)
Ambient temperature	-20 °C to +70 °C
Fluid	Hydraulic oil as per DIN 51524
Recommended viscosity	15÷100 mm²/s at 40 °C (ISO VG 15÷100)
Fluid contamination class	ISO 19/16, obtained through 25 μm and ß25≥ 75 line filters (recommended)
Fluid temperature	T ≤ 80 °C, if T ≤ 60 °C choose PE seals
Pressure limits	P, A, B ports: 350 bar – T port: 120 bar
Maximum flow	60 l/min for DI
Utilisation factor	100%
Voltage and power frequency	12 DC
Threshold tolerance	±10%

Q/Δp CHARTS

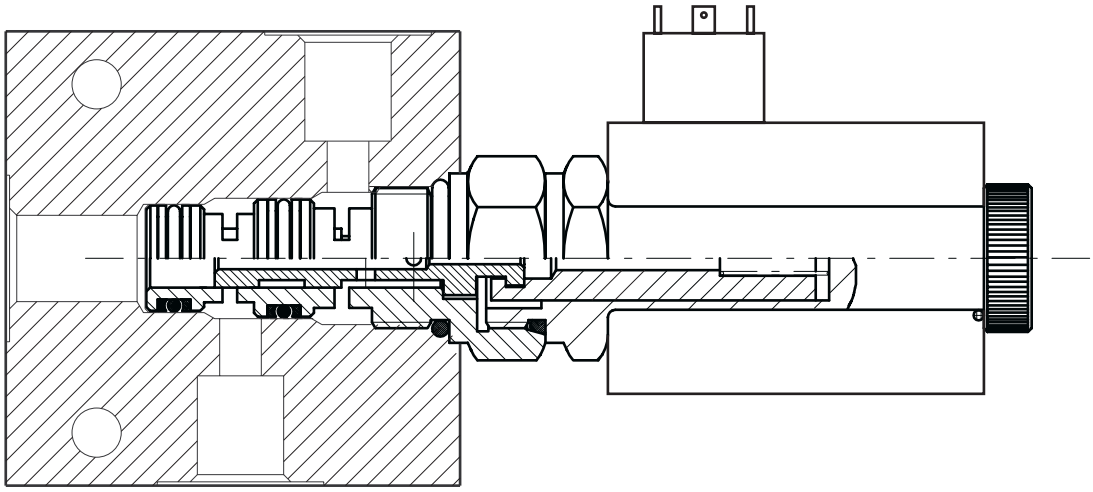
Port / Spool type	P-A	P-B	A-T	B-T	P-T
4	D	D	D	D	A

Tests done with fluid viscosity of 43 mm²/s at 40 °C



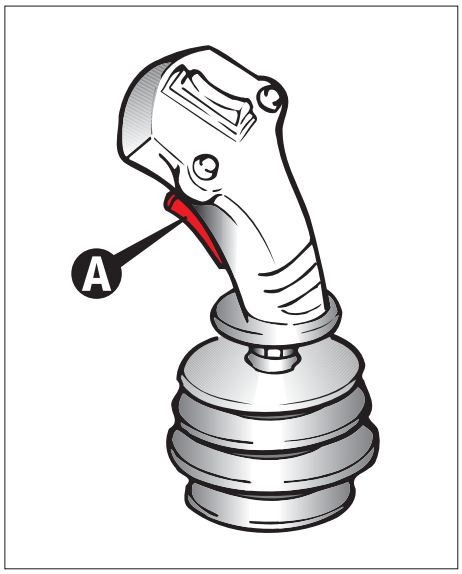


Operation:	Dead man - Boom lowering block valve Telelift 3013 (**up to serial no. 8450**)	Table: **C.11.09**



IMPORTANT

In the machine there are two valves. The first, after pressing the dead man pushbutton A placed on the front part of the joystick, powers up the joystick itself. The second blocks the down-movement of the boom when the overload warning system is in alarm.



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Section D
CHECKS AND ADJUSTMENTS

SECTION INDEX

D.01 Checking the cylinder speed ..... page 2
D.02 Checking and calibrating the circuit pressure 4
D.03 Calibration of the Excel card for aerial man-platforms (Telelift 3013 - 3517) 34
D.04 Calibration of the 3B6 load moment indicator (Telelift 3013 - 3517) 38
D.05 Description of the SCT module operation 45
D.06 Description of the Perkins engine bulbs 46

Procedure: Checking the cylinder movement times	*Table:* **D.01.01**

IMPORTANT

The check of the movement times of the cylinders shall be done with the hydraulic oil at a temperature of 60°.

IMPORTANT

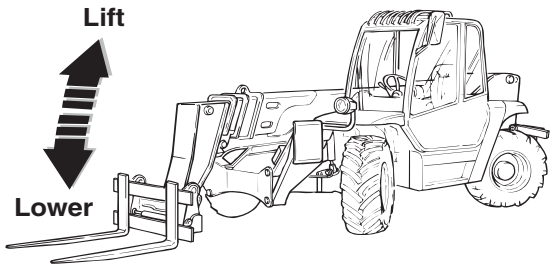
To check the engine speed, the area easy to reach is the external pulley of the output shaft.

BOOM LIFTING/LOWERING

Telelift 3713 Elite	Time (s)	
	up	down
Max engine speed	18”	9”
Min. engine speed	32”	23”

Telelift 3517	Time (s)	
	up	down
Max engine speed	17”	12”
Min. engine speed	47”	30”

Telelift 4010	Time (s)	
	up	down
Max engine speed	12”	9”
Min. engine speed	25”	20”

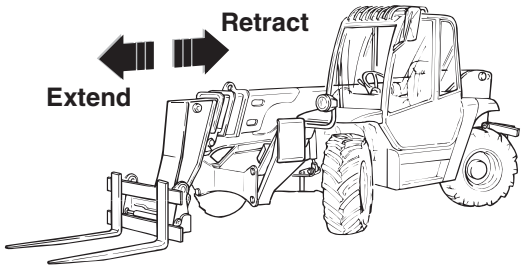


BOOM EXTENSION/RETRACTION

Telelift 3713 Elite	Time (s)	
	out	in
Max engine speed	19”	16”
Min. engine speed	38”	21”

Telelift 3517	Time (s)	
	out	in
Max engine speed	30”	16”
Min. engine speed	55”	36”

Telelift 4010	Time (s)	
	out	in
Max engine speed	17”	10”
Min. engine speed	45”	30”



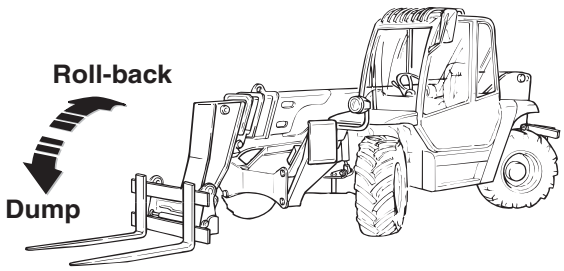
Procedure: Checking the cylinder movement times	*Table:* **D.01.01**

ATTACHMENT DUMPING

Telelift 3713 Elite	Time (s)	
	dumping	roll-back
Max engine speed	4”	4”
Min. engine speed	9”	8”

Telelift 3517	Time (s)	
	dumping	roll-back
Max engine speed	4”	4”
Min. engine speed	9”	8”

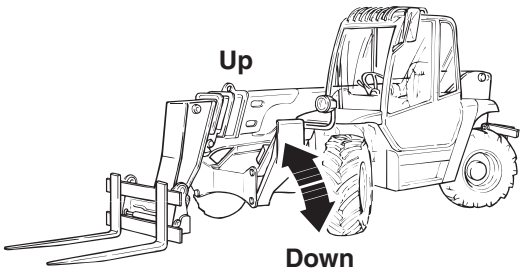
Telelift 4010	Time (s)	
	dumping	roll-back
Max engine speed	4”	4”
Min. engine speed	9”	8”



OUTRIGGERS MOVEMENT

Telelift 3713 Elite	Time (s)	
	up	down
Max engine speed	5”	5”
Min. engine speed	8”	8”

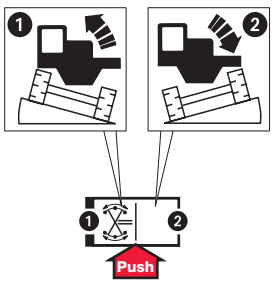
Telelift 3517	Time (s)	
	up	down
Max engine speed	5”	5”
Min. engine speed	8”	8”



MACHINE SWAY

Telelift 3713 Elite	Time (s)	
	right to left	left to right
Max engine speed	9”	9”
Min. engine speed	10”	10”

Telelift 3517	Time (s)	
	right to left	left to right
Max engine speed	9”	9”
Min. engine speed	10”	10”



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

1. PRELIMINARY OPERATIONS

Warm up the hydraulic oil to 80°C by keeping one of the elements of the boom distributor to full stroke under pressure.
To reach this temperature in a faster way, cover the oil core of the radiator with a carton in the case of a water-oil combined cooler, or the oil radiator if the machine is equipped with a separate oil radiator.

2. SETTING THE BOOM DISTRIBUTOR

Find the manometer mini-socket **ref. F** on the **Walvoil** distributor (see **annex 1**).

2.1 SETTING THE DISTRIBUTOR PRESSURE CONTROL VALVE

Connect a 0-400 bar manometer to **pos. F** of the distributor. Fully raise the boom to stroke end.
Calibrate valve **A** (see **annex 1**) to 260 bar with the the Diesel engine fully accelerated.
Mentre si effettua questa taratura si devono tarare anche le valvole di sicurezza inclinazione benna posizione **B** del distributore Walvoil (see **annex 1**):

- By means of valve **A** set the distributor pressure to 280 bar while moving one of the cylinders to stroke end.
- With the engine running at maximum speed, tilt the forks to one direction by means of the joystick and act on one of the two valves **B** until reaching a pressure of 275-280 bar.
- Proceed in calibrating the second valve **B** by tilting the forks to the opposite direction.
- When both fork inclination safety valves have been calibrated, reset the pressure control valve to 260 bar by adjusting the register.

3. SETTING THE BLOCK VALVES OF THE FORK COMPENSATION CYLINDER (annex 1)

- Loosen the lock nuts of the valve and tighten the two registers of cartridges **E**.
- Re-loosen of one turn and a half both valves and re-tighten the lock nuts.

4. SETTING THE PRESSURE RELIEF VALVE

- Connect a 0-60 bar manometer to the mini-socket **ref. D** (see **annex 2**), with the engine running at idle speed by moving any of the elements of the distributor to stroke end, set valve **C** (see **annex 1**) to 25 bar.
- Remove the manometer from the mini-socket and re-tighten the protection cap.

5. SETTING THE HYDROMATIK PUMP HYDROSTATIC TRANSMISSION

Do the calibration of the hydrostatic transmission with the hydraulic oil at a temperature of 80°C.

- Connect a **T** 0-60 bar manometer to the mini-socket **ref. G** (see **annex 3**) to read the low-pressure value.
- Connect a **B** 0-600 bar manometer to the mini-socket **ref. H** to read the high-pressure value.

CAUTION

Do not fit the manometer to the application point corresponding to the reverse speed. This operation is extremely dangerous for the serviceman who is calibrating the transmission.

- Hold the selector to neutral position and make sure the maximum speed of the engine does not exceed 2500 rpm. The engine must run at a idle speed of 900 rpm. Otherwise, adjust the minimum speed.
- Measure the boost pressure and ensure it is about 26/28 bar with the engine running at idle speed. The boost pressure has not a fixed value but varies from pump to pump.
  Note: In older pump models, it was possible to adjust this value by means of a register.
- Engage the 2nd mechanical speed and fully depress the brake pedal with the left foot to bring the machine to a stop. Do not use the parking brake.

Procedure: Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	Table: **D.02.01**

STARTING THE CALIBRATION

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at 1100 rpm. Check the value on the tachometer.
- Adjust the shutter **I** by means of the register until reading a value of 60 bar on high-pressure manometer **B** (see **annex 3**).

5.1 CALIBRATION OF THE "DA" CURVE

Do this operation with extreme caution. The proper functioning of pump and transmission depends on this calibration.

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at maximum speed and check the high-pressure value sul manometro **B** (see **annex 3**) : If this value is less than 430 bar, increase the pressure to 425-430 bar by means of the pressure cut-off valve **L**.
- Gradually increase the engine rpm and steadily check the high-pressure manometer. As soon as the value of 400 bar is reached, hold the gas pedal fully depressed and attempt to keep the pressure on this value.
- If, with the engine running at 2000 rpm, the value of 400 bar is not reached, adjust the spark advance valve **M** (see **annex 3**).

ATTENTION

The spark advance screw must never be rotated beyond the vertical axis of the pump (observe the reference mark on the screw).

Model	Pump pressure	Diesel engine rpm
TELELIFT 3013	400 BAR	2000

5.2 CALIBRATION OF THE PRESSURE CUT-OFF VALVE

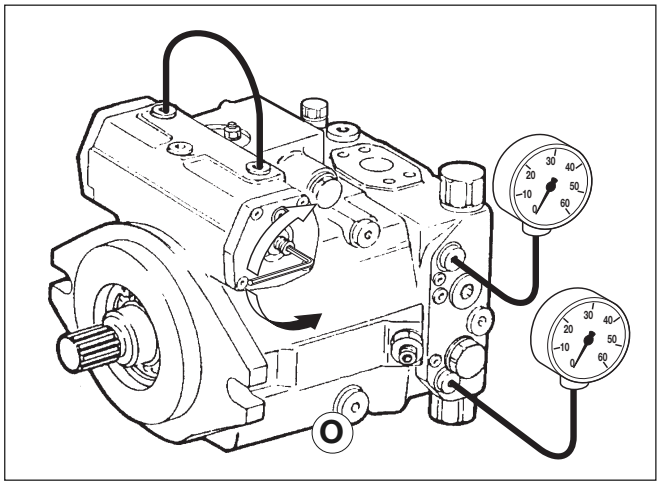
- With the engine running at maximum speed and the forward speed engaged, adjust the pressure cut-off valve **L** to 420 bar.

  The two pressure control valves **N** must not be calibrated since they are of cartridge type and already set to 450 bar by Rexroth.

5.3 CALIBRATION OF THE MECHANICAL ZERO

The calibration of the mechanical zero **O** is required if the machine is set to neutral position with the forward-reverse speed lever.

- Set the forward-neutral-reverse selector to neutral position.
- With the engine running at idle speed, adjust the mechanical zero screw by rotating it until the high-pressure manometer reads the same value measured by the boost pressure manometer.



5.4 CHECK AT THE BEGINNING OF THE DRIVING MOTOR ADJUSTMENT

- Connect a 0-600 bar manometer to point **P** of the driving motor and a 0-600 bar manometer to mini-socket **H** of the transmission pump (see **annex 3**).
- With the machine braked and the forward speed engaged, gradually increase the engine speed; when the manometer applied to the pump reads a value of 250 bar, the manometer applied to the motor must start increasing.

Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	Table: **D.02.01**

- If calibration begins before reaching the value of 250 bar, loosen screw **Q**; otherwise, tighten it.
- Remove the manometers from the mini-sockets and refit and tighten the protection caps.

6. SETTING THE BRAKING SYSTEM PRESSURE

- Connect a 0-250 bar manometer to position **R** (see **annex 4**).
- Depress the foot brake some times until the manometer starts increasing. When it stops, the value shown is the calibration value of valve **S** (see **annex 4**) which must be 140 bar. If the displayed value is inferior, loosen valve **S**; if the value is greater, tighten the valve.

  Note: To check the pressure, it is necessary to depress the foot brake some times until the manometer restarts increasing; when it stops in stable position, it shows the calibration value.

  Pay special attention while disconnecting the hose from the accumulator. Oil can splash all around. First of all, release any residual pressure from the accumulators.

7. SETTING THE POWER STEERING

- Connect a 0-250 bar manometer to position **T** (see **annex 5**).
- Select the front axle steering mode.
- Move the steering cylinder to stroke end and make sure the value of the power steering **A** is 140 bar. If the value is less, tighten valve **X**; if the value is greater, loosen the valve.

  Note: To gain access to valve **X**, remove the protection cap (see **annex 3**).

8. SETTING THE ARB 1 OVERLOAD WARNING SYSTEM

To adjust the ARB1 overload warning system, use a weight of 750 kg to be applied on the forks.

With the machine resting on the wheels:

- Set the boom angle to 0 degrees and extend the boom up to 6 metres measured from the front of the wheels to the centre of the weight loaded on the forks.
- Switch on the overload warning system.

With the machine resting on the outriggers:

- Set the boom angle to 0 degrees and extend the boom up to 8 metres measured from the front of the wheels to the centre of the weight loaded on the forks.
- Switch on the overload warning system.

For the adjustment of the ARB overload warning system refer to the manual supplied along with the technical literature.

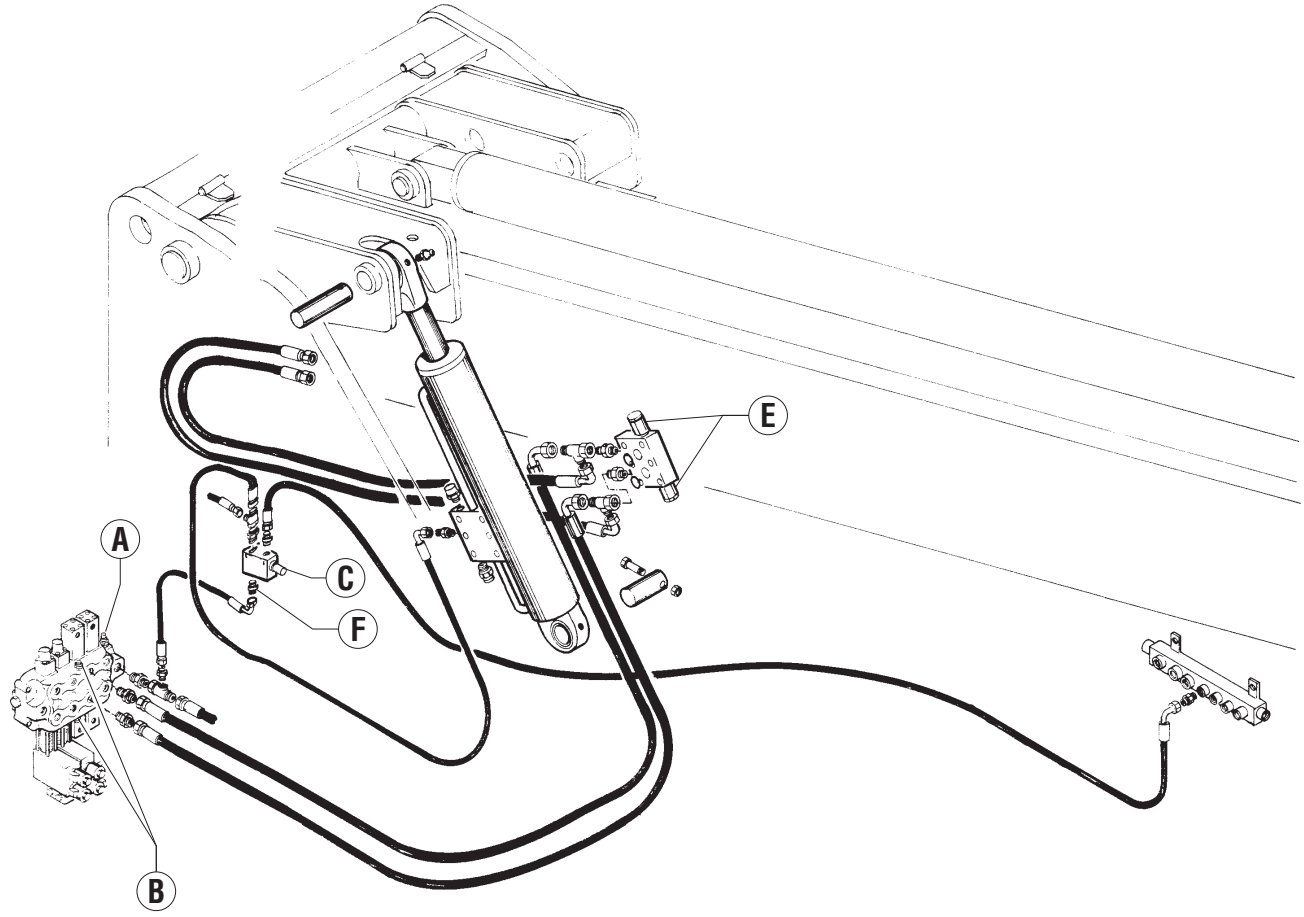
9. SETTING THE SAFETY VALVE OF THE RADIATOR FAN MOTOR

- Valve **9** (see **annex 6**) has been factory-set to **160 bar** and cannot be tampered with and/or adjusted by third parties.

Procedure: Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

HYDRAULIC SYSTEM - FORK COMPENSATION

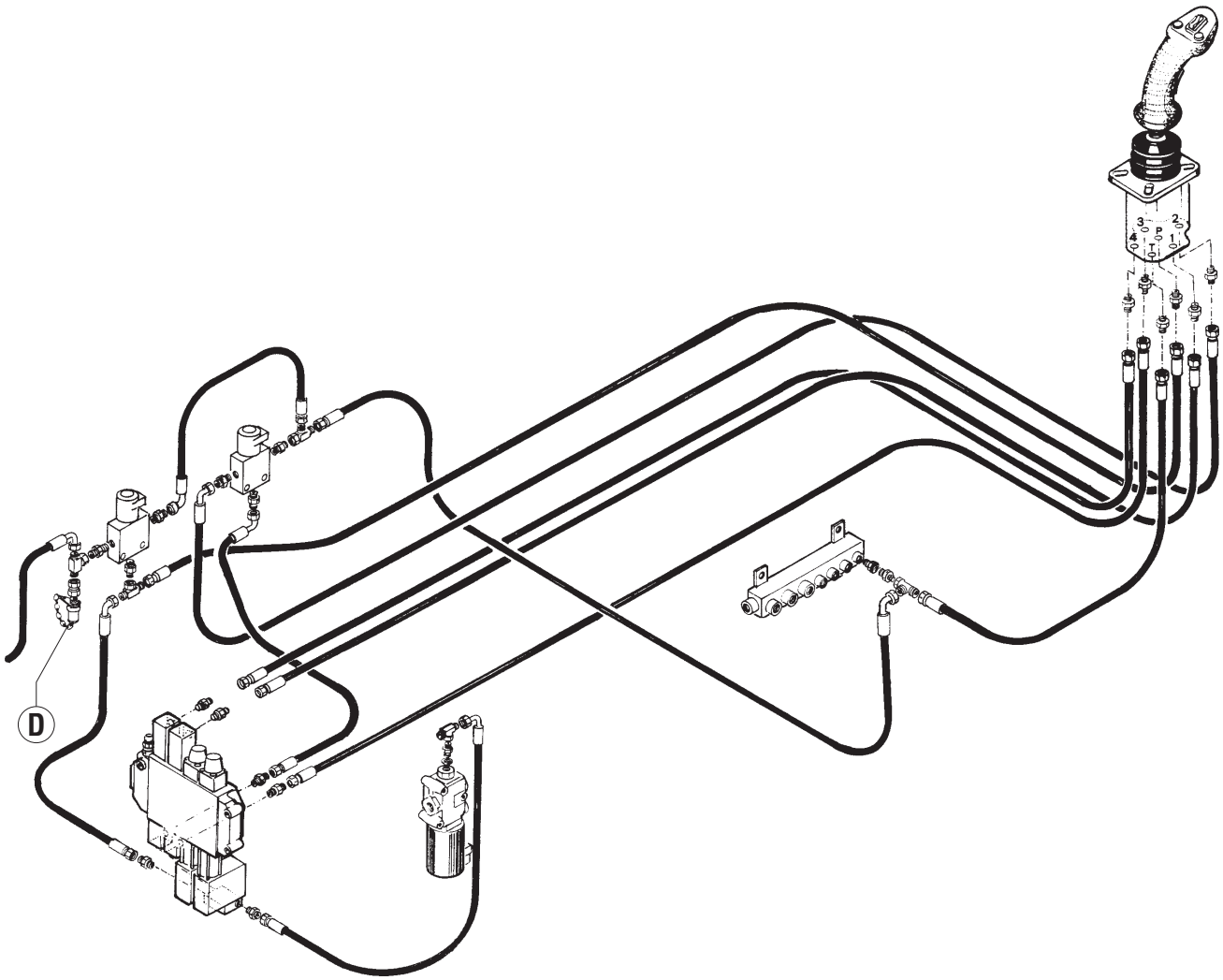
Annex 1



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

HYDRAULIC SYSTEM - JOYSTICK 1ST PART

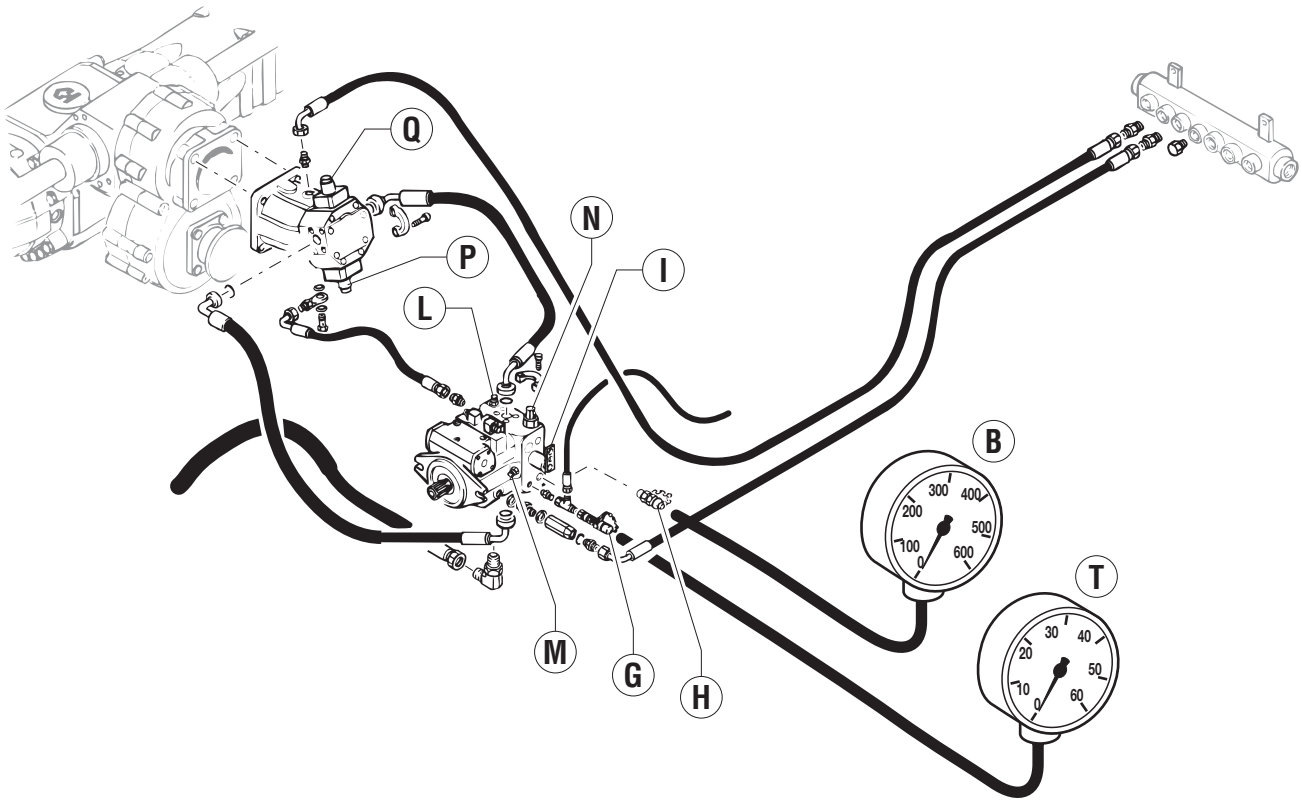
Annex 2



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

HYDRAULIC SYSTEM - TRANSMISSION

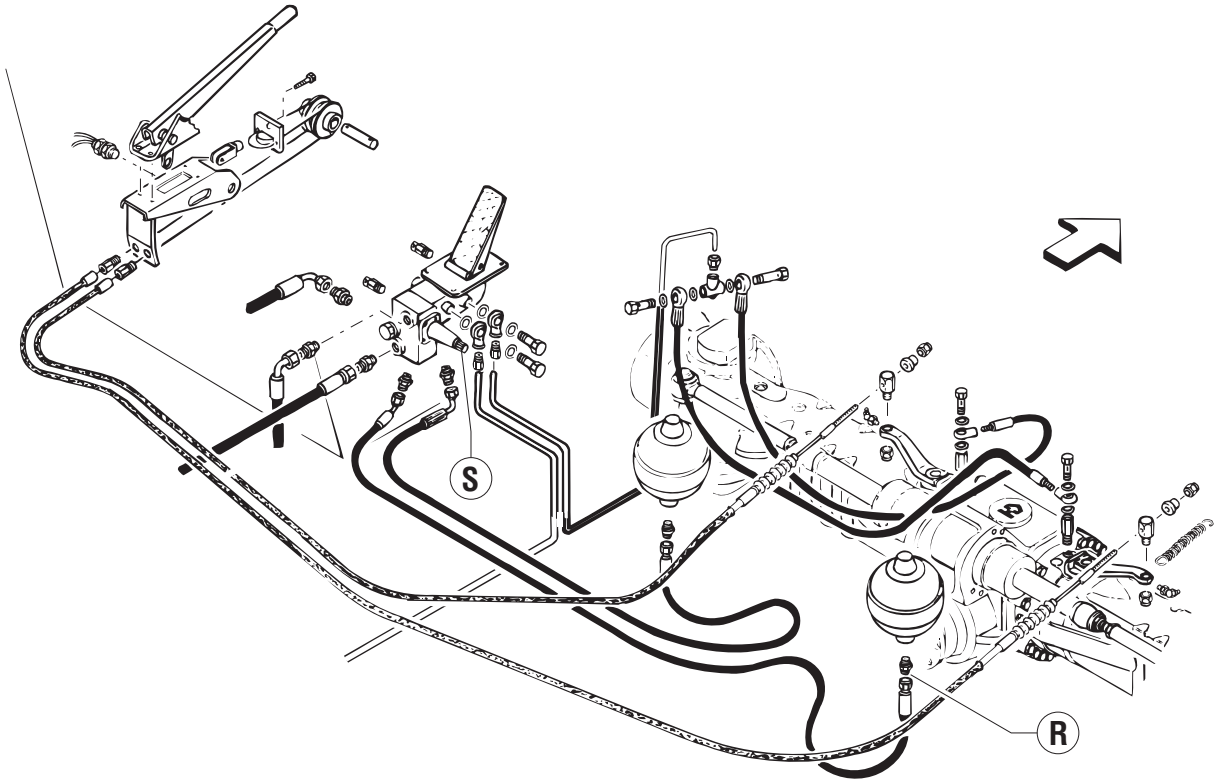
Annex 3



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

HYDRAULIC SYSTEM - SERVICE AND PARKING BRAKES

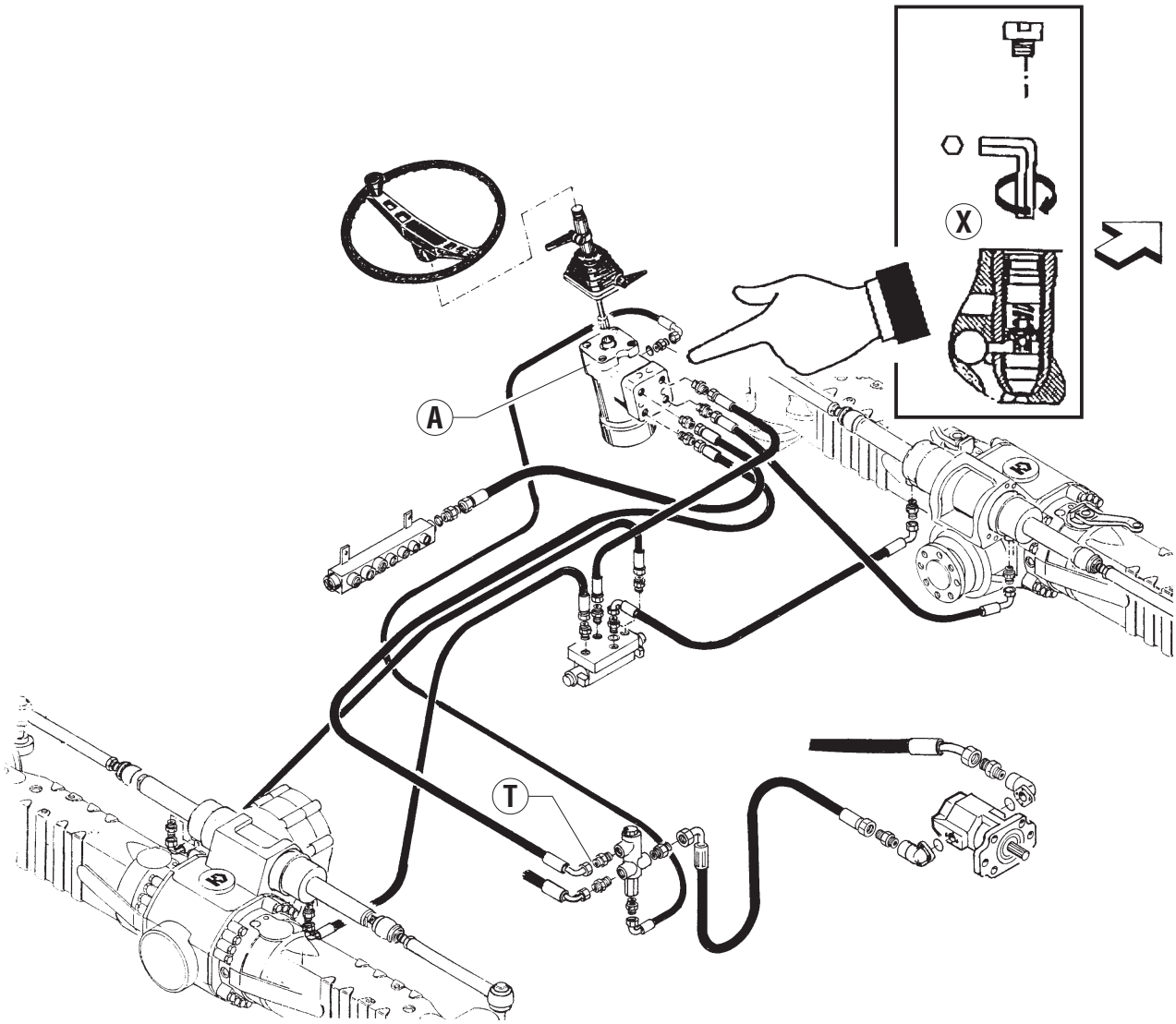
Annex 4



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

HYDRAULIC SYSTEM - HYDRAULIC STEERING UNIT

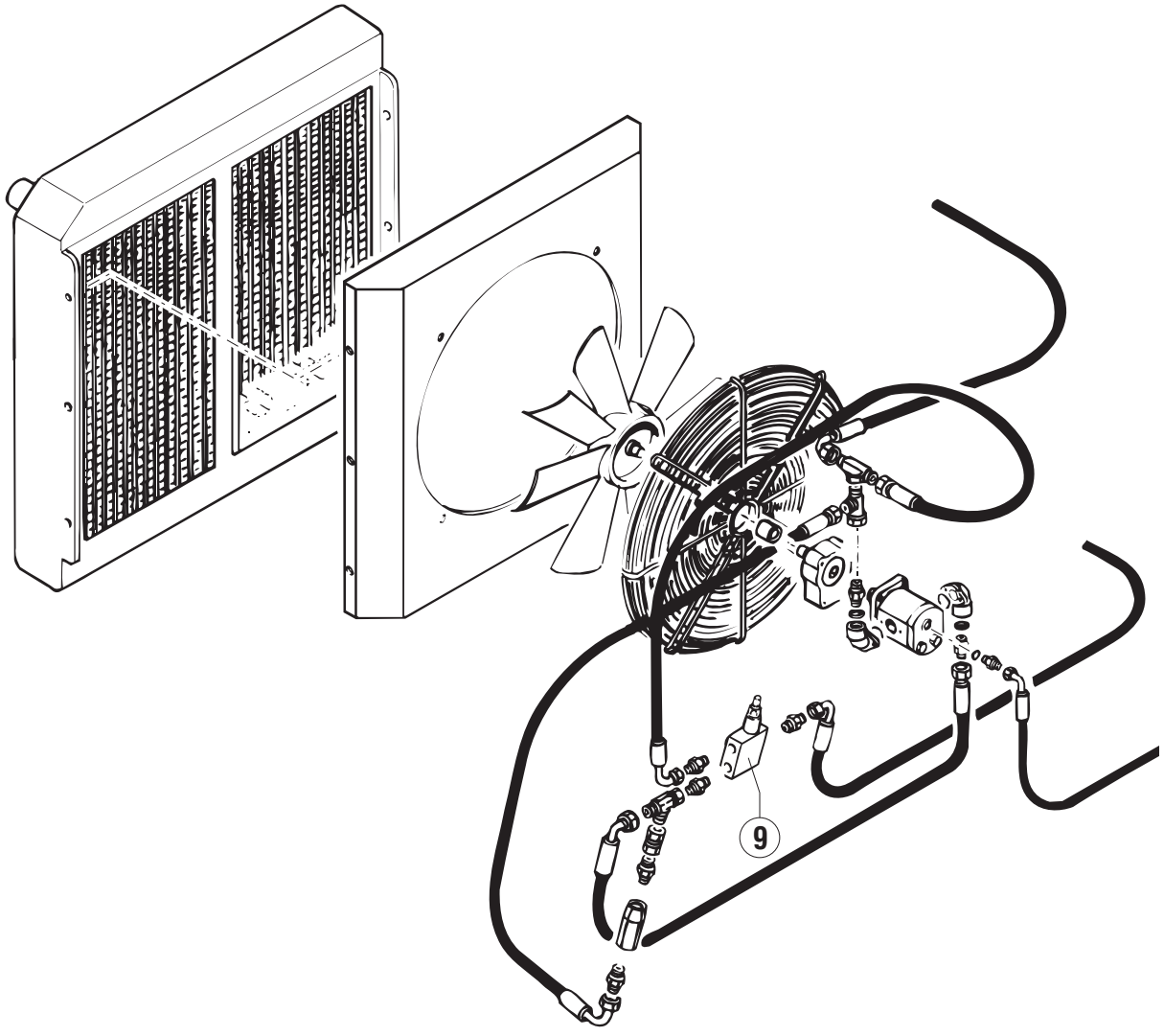
Annex 5



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**up to serial no. 8450**)	*Table:* **D.02.01**

HYDRAULIC SYSTEM - OIL COOLER

Annex 6



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

1. PRELIMINARY OPERATIONS

Warm up the hydraulic oil to 80°C by keeping one of the elements of the boom distributor to full stroke under pressure.
To reach this temperature in a faster way, cover the oil core of the radiator with a carton in the case of a water-oil combined cooler, or the oil radiator if the machine is equipped with a separate oil radiator.

2. SETTING THE BOOM DISTRIBUTOR

Find the manometer mini-socket **ref. 2** on the **Walvoil** distributor (see **annex 1**).

2.1 SETTING THE DISTRIBUTOR PRESSURE CONTROL VALVE

Connect a 0-400 bar manometer to the mini-socket **ref. 2**. Fully raise the boom to stroke end.
Calibrate valve **A** (see **annex 1**) of the Walvoil distributor to 260 bar for the Telelift 3013 and to 280 bar for the Telelift 3517 while keeping the cylinder under pressure and the thermal engine fully accelerated.
During this calibration, also adjust the bucket inclination safety valves, **ref. B**, of the Walvoil distributor(see **annex 2**) as follows:

- By means of valve **A** set the distributor pressure to 280 bar for model 3013 or to 300 bar for model 3517 while moving one of the cylinders to stroke end.
- With the engine running at maximum speed, tilt the forks to one direction by means of the joystick and act on one of the two valves **B** until reaching a pressure of 275 bar for model 3013 or of 295 bar for model 3517.
- Proceed in calibrating the second valve **B** by tilting the forks to the opposite direction.
- When both fork inclination safety valves have been calibrated, reset the pressure control valve **A** to 260 bar for model 3013 or to 280 bar for model 3517 by adjusting the register.

3. SETTING THE BLOCK VALVES OF THE FORK COMPENSATION CYLINDER (annex 2)

- Loosen the lock nuts of the valve and tighten the two registers of cartridges **3**.
- Re-loosen of one turn and a half both valves and re-tighten the lock nuts.

4. SETTING THE BOOM EXTENSION VALVE (only for model 3517)

- Load a weight of 3 tons on the forks, fully raise the boom to stroke end, then extend the telescopic section by two metres (measured on the second element).
- Adjust the pressure relief valve **T** (see **annex 3**) iso that the telescopic section stops at the set distance. Usually, this result is attained by calibrating the valve to 170-180 bar when the oil is cold.
  Note: Test the machine and ensure the telescopic section stops at the set distance.
  For this calibration, run the Diesel engine at maximum speed.

Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

5. SETTING THE HYDROMATIK PUMP HYDROSTATIC TRANSMISSION

Do the calibration of the hydrostatic transmission with the hydraulic oil at a temperature of 80°C and with the 2nd mechanical speed engaged.

- Connect a 0-60 bar manometer to the mini-socket **ref. C** (see **annexes 4 and 5**) to read the low-pressure value.
- Connect a 0-600 bar manometer to the mini-socket **ref. D** to read the high-pressure value.

CAUTION

Do not fit the manometer to the application point corresponding to the reverse speed. This operation is extremely dangerous for the serviceman who is calibrating the transmission.

- Hold the selector to neutral position and make sure the maximum speed of the engine does not exceed 2500 rpm. The engine must run at a idle speed of 900 rpm. Otherwise, adjust the minimum speed.
- Measure the boost pressure and ensure it is about 26/28 bar with the engine running at idle speed. The boost pressure has not a fixed value but varies from pump to pump.
  Note: In older pump models, it was possible to adjust this value by means of a register. In these machines, the low pressure is also used for the re-sequencing cylinder and for the distributor.
- Engage the 2nd mechanical speed and fully depress the brake pedal with the left foot to bring the machine to a stop. Do not use the parking brake.

STARTING THE CALIBRATION

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at 1100 rpm. Check the value on the tachometer.
- Adjust the shutter **E** by means of the register until reading a value of 60 bar on high-pressure manometer **D** (see **annex 4** - 3013 / **annex 5** - 3517) .

5.1 CALIBRATION OF THE "DA" CURVE

Do this operation with extreme caution. The proper functioning of pump and transmission depends on this calibration.

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at maximum speed and check the high-pressure value. If this value is less than 430 bar, increase the pressure to 425-430 bar by means of the pressure cut-off valve **F**.
- Gradually increase the engine rpm and steadily check the high-pressure manometer. As soon as the value of 400 bar is reached, hold the gas pedal fully depressed and attempt to keep the pressure on this value.
- If, with the engine running at 2000 rpm, the value of 400 bar is not reached, adjust the spark advance valve **G** (see **annex 4** - 3013 / **annex 5** - 3517).

ATTENTION

The spark advance screw must never be rotated beyond the vertical axis of the pump (observe the reference mark on the screw).

Model	Pump pressure	Diesel engine rpm
TELELIFT 3514	400 BAR	2000
TELELIFT 3013	400 BAR	2000
LIFT 4020	400 BAR	1600
LIFT 3513	400 BAR	2300
TELELIFT 3517	400 BAR	2000

Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	Table: **D.02.02**

5.2 CALIBRATION OF THE PRESSURE CUT-OFF VALVE

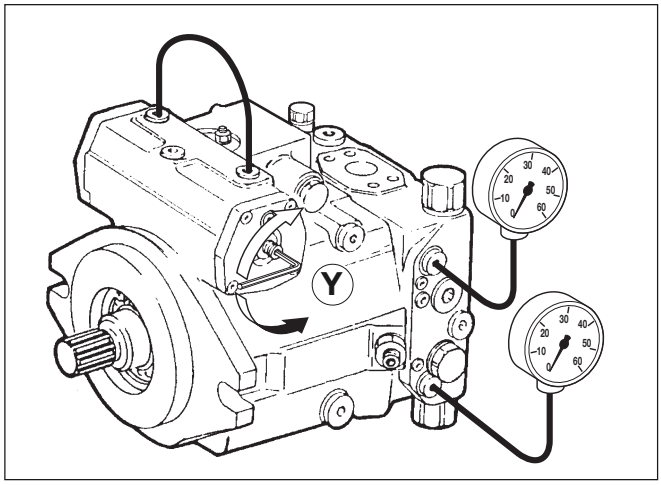
- With the engine running at maximum speed and the forward speed engaged, adjust the pressure cut-off valve **F** to 420 bar.

  The two pressure control valves **H** must not be calibrated since they are of cartridge type and already set to 450 bar by Rexroth.

5.3 CALIBRATION OF THE MECHANICAL ZERO

The calibration of the mechanical zero **I** is required if the machine is set to neutral position with the forward-reverse speed lever.

- Set the forward-neutral-reverse selector to neutral position.
- With the engine running at idle speed, adjust the mechanical zero**Y** screw by rotating it until the high-pressure manometer reads the same value measured by the boost pressure manometer.



5.4 CHECK AT THE BEGINNING OF THE DRIVING MOTOR ADJUSTMENT

- Connect a 0-600 bar manometer to point **L** of the driving motor and a 0-600 bar manometer to mini-socket **D** of the transmission pump.
- With the machine braked and the forward speed engaged, gradually increase the engine speed; when the manometer applied to the pump reads a value of 250 bar, the manometer applied to the motor must start increasing.
- If calibration begins before reaching the value of 250 bar, loosen screw **M**; otherwise, tighten it.
- Remove the manometers from the mini-sockets and refit and tighten the protection caps.

6. SETTING THE BRAKING SYSTEM PRESSURE

- Connect a 0-250 bar manometer to position **T** (see **annex 6**).
- Depress the foot brake some times until the manometer starts increasing. When it stops, the value shown is the calibration value of valve **R** (see **annex 6**) which must be 140 bar. If the displayed value is inferior, loosen valve **R**; if the value is greater, tighten the valve.

  Note: To check the pressure, it is necessary to depress the foot brake some times until the manometer restarts increasing; when it stops in stable position, it shows the calibration value.
  Pay special attention while disconnecting the hose from the accumulator. Oil can splash all around. First of all, release any residual pressure from the accumulators.

7. SETTING THE POWER STEERING

- Connect a 0-250 bar manometer to position **Z** (see **annex 7**).
- Select the front axle steering mode.
- Move the steering cylinder to stroke end and make sure the value of the power steering **A** is 140 bar. If the value is less, tighten valve **X**; if the value is greater, loosen the valve.

  Note: To gain access to valve **X**, remove the protection cap (see **annex 7**).

Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	Table: **D.02.02**

8. SETTING THE ARB 1 OVERLOAD WARNING SYSTEM TELELIFT 3013

To adjust the ARB1 overload warning system, use a weight of 750 kg to be applied on the forks.

With the machine resting on the wheels:

- Set the boom angle to 0 degrees and extend the boom up to 6 metres measured from the front of the wheels to the centre of the weight loaded on the forks.
- Switch on the overload warning system.

With the machine resting on the outriggers:

- Set the boom angle to 0 degrees and extend the boom up to 8 metres measured from the front of the wheels to the centre of the weight loaded on the forks.
- Switch on the overload warning system.

Fatto questo si eseguono una serie di controlli con pesi diversi, in modo tale che la macchina vada in blocco nel rispetto del grafico riportato nel vetro e nel manuale di uso e manutenzione.

9. SETTING THE ARB 1 OVERLOAD WARNING SYSTEM TELELIFT 3517

To adjust the ARB1 overload warning system, use a weight of 1000 kg to be applied on the forks.

With the machine resting on the wheels:

- Set the boom angle to 0 degrees and extend the boom up to 4.70 metres measured from the front of the wheels to the centre of the weight loaded on the forks.
- Switch on the overload warning system.

With the machine resting on the outriggers:

- Set the boom angle to 0 degrees and extend the boom up to 8.80 metres measured from the front of the wheels to the centre of the weight loaded on the forks.
- Switch on the overload warning system.
- In any case, make sure that, when the outriggers are fully lowered and the boom is set to 0 degrees and fully extended, it is possible to apply a weight 100 kg on the forks without the intervention of the overload warning system (max payload at this length = 150 kg).

For the calibration, refer to the ARB1 manual which is part of the technical literature of the course.
Regarding the boom extension with the boom set to vertical position, adjust the pressure relief valve of the distributor which also reduces the extension when the boom is raised. The instructions for this calibration are contained in the section dealing with the Walvoil distributor setting.
After the calibration, make sure the values fully match those indicated in the chart applied on the windscreen glass and in the operator handbook.

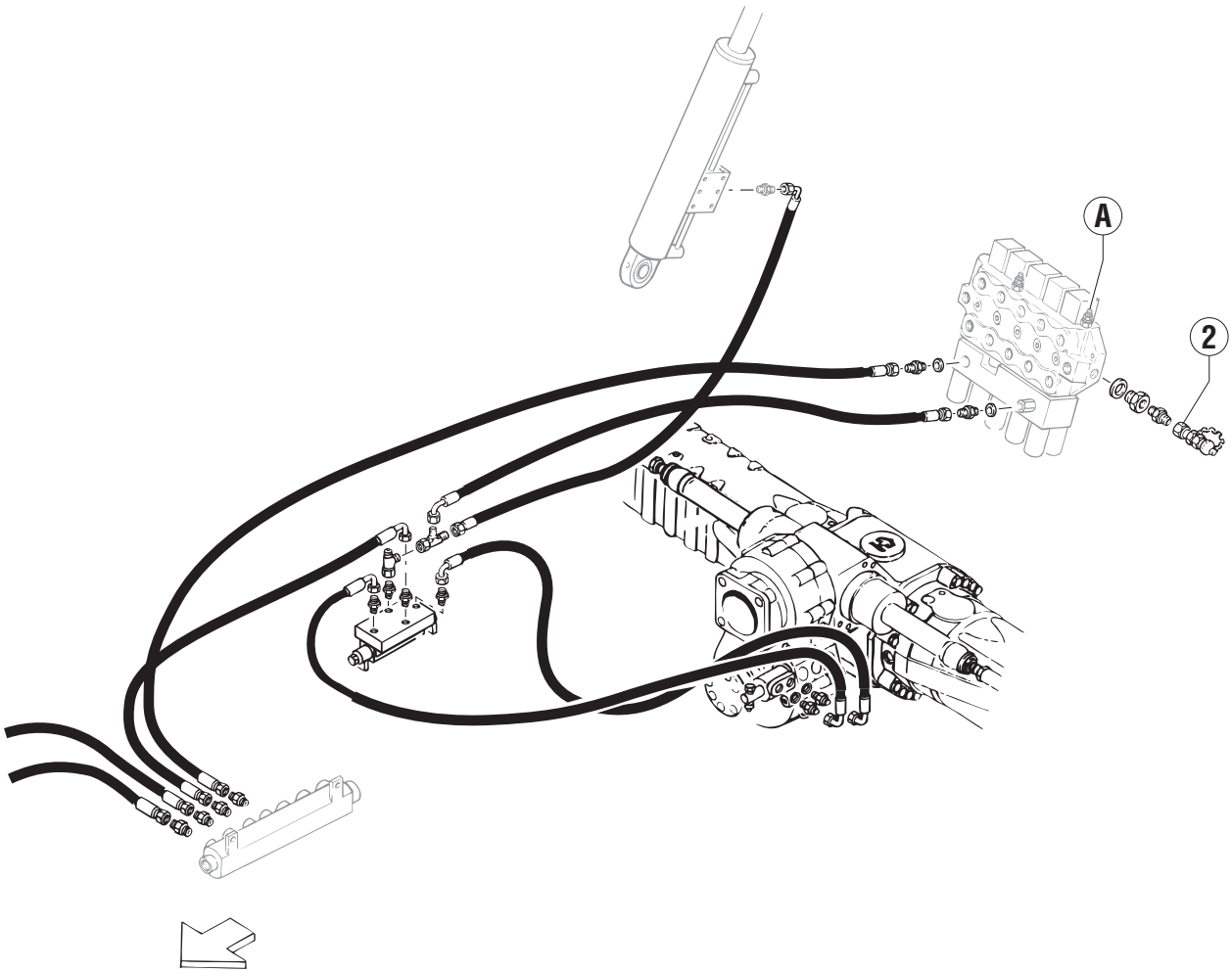
10. SETTING THE SAFETY VALVE OF THE RADIATOR FAN MOTOR

- Valve **9** (see **annex 8**) has been factory-set to **160 bar** and cannot be tampered with and/or adjusted by third parties.

Procedure: Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - GEARBOX

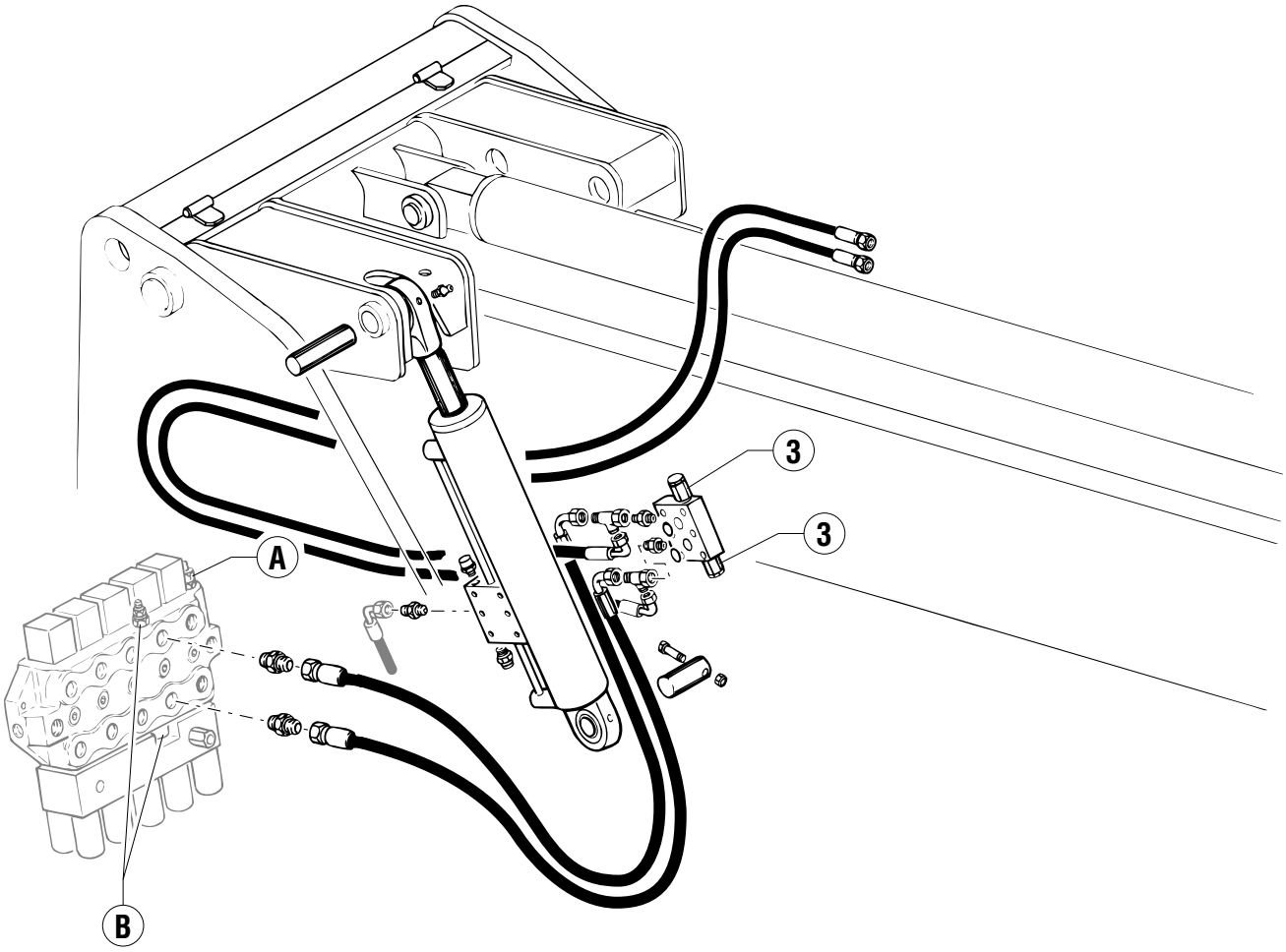
Annex 1



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - FORK COMPENSATION

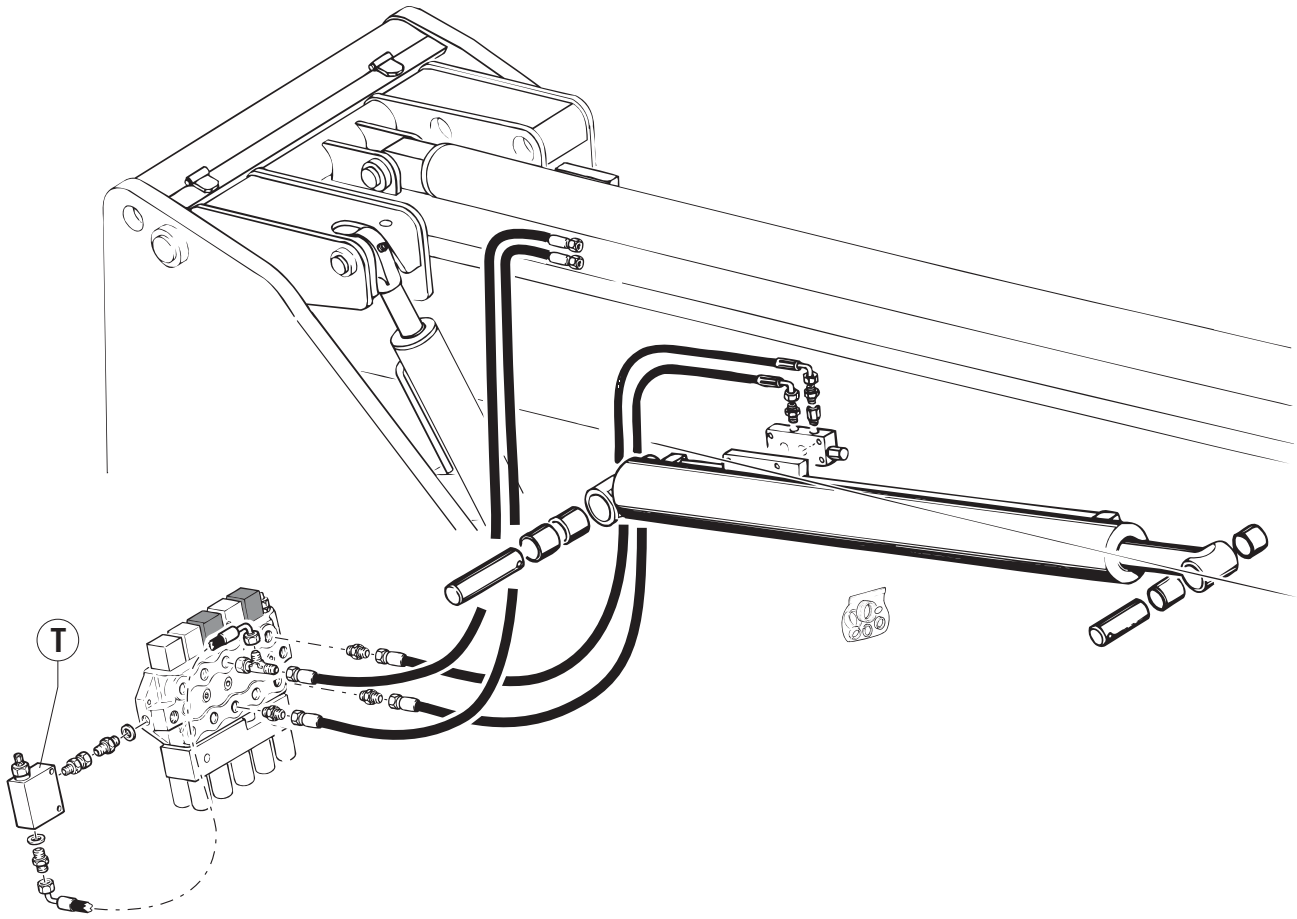
Annex 2



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - LIFTING

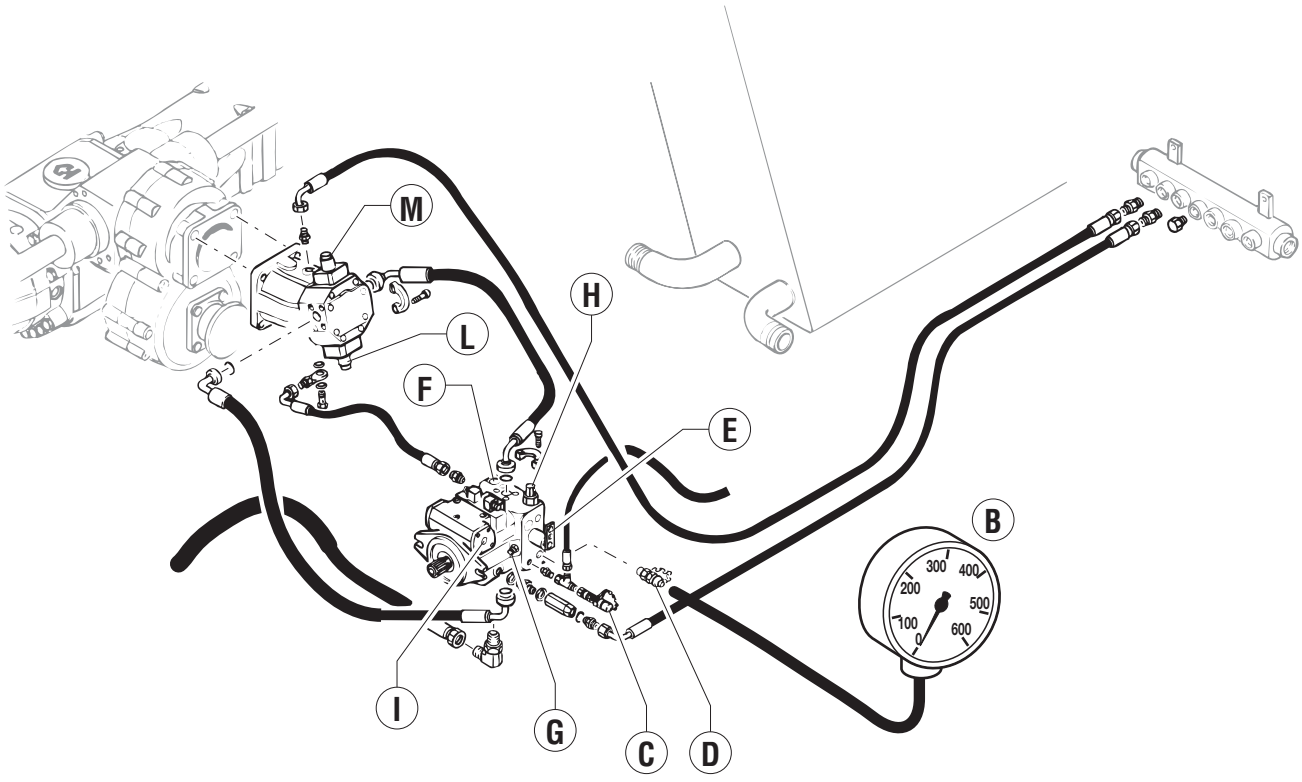
Annex 3



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - TRANSMISSION 3013

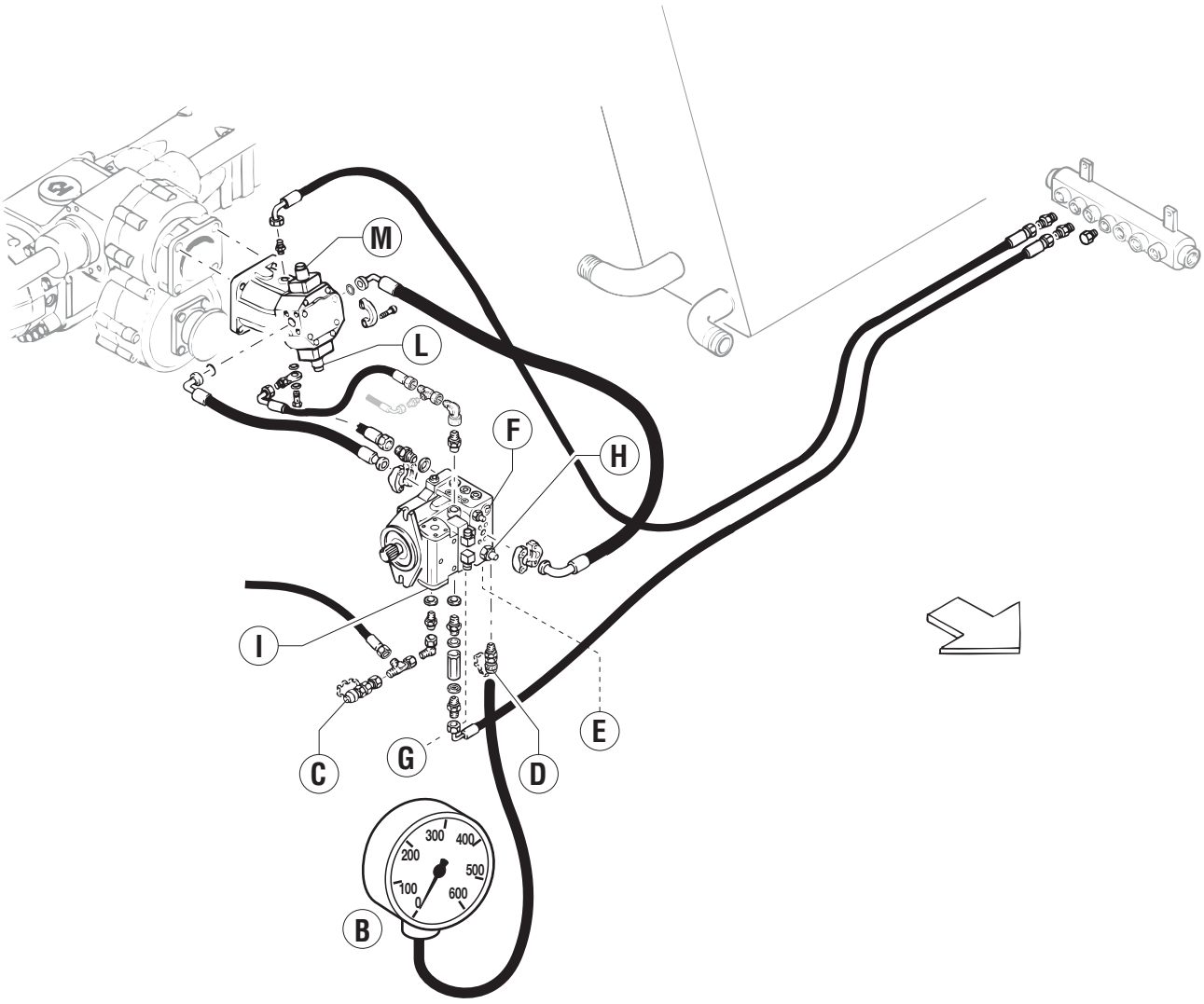
Annex 4



Procedure: Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - TRANSMISSION 3517

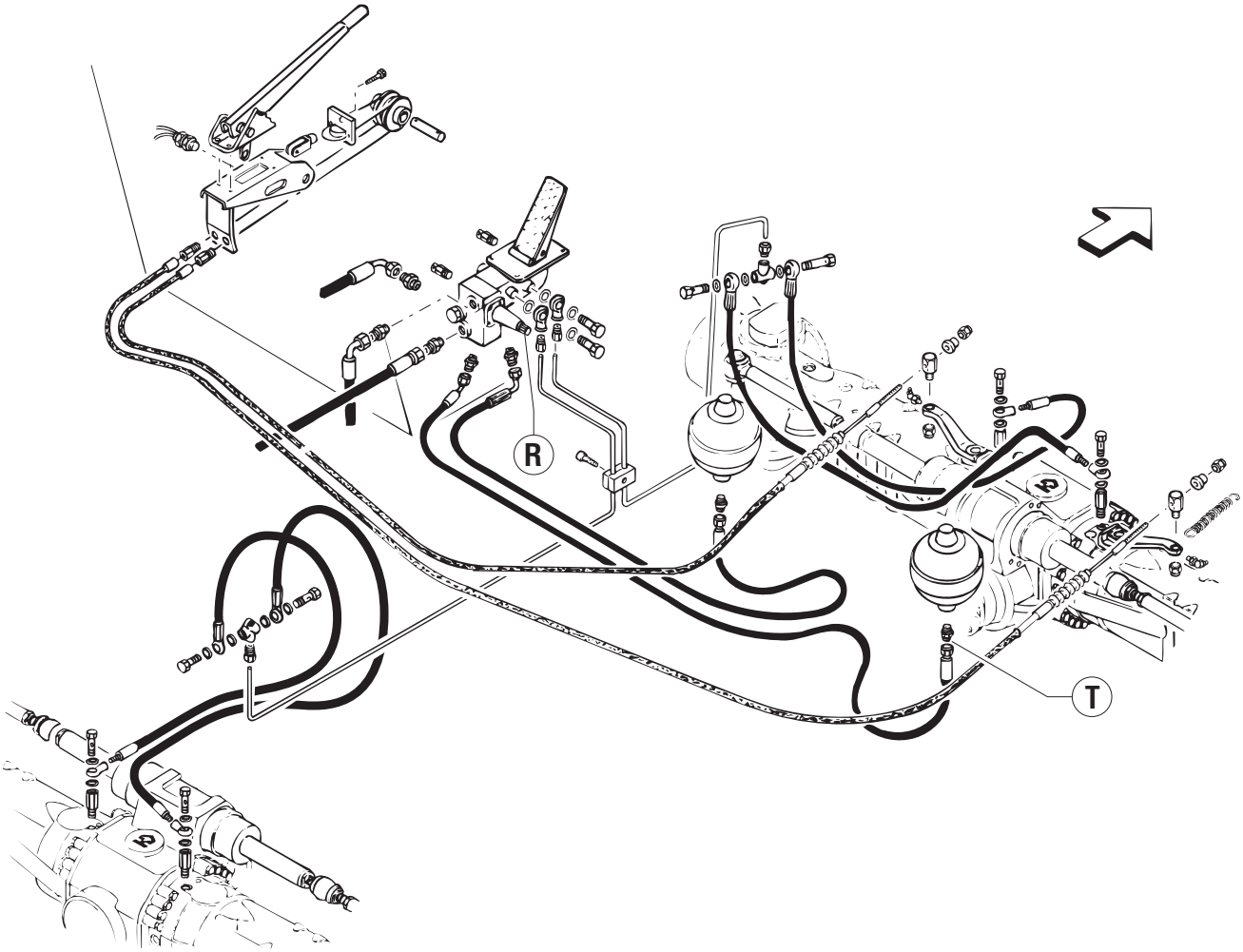
Annex 5



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	Table: **D.02.02**

HYDRAULIC SYSTEM - SERVICE AND PARKING BRAKES

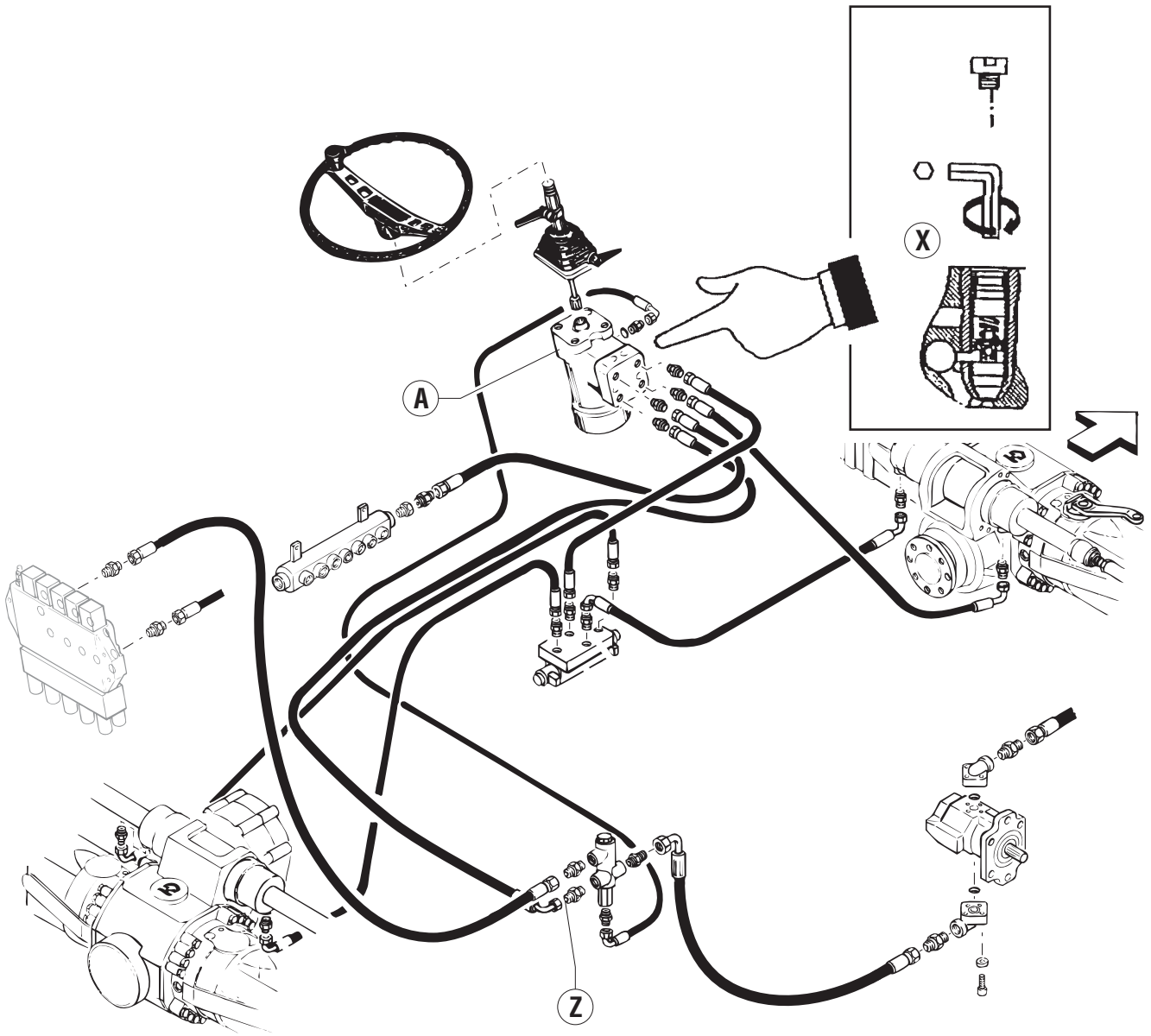
Annex 6



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - HYDRAULIC STEERING UNIT

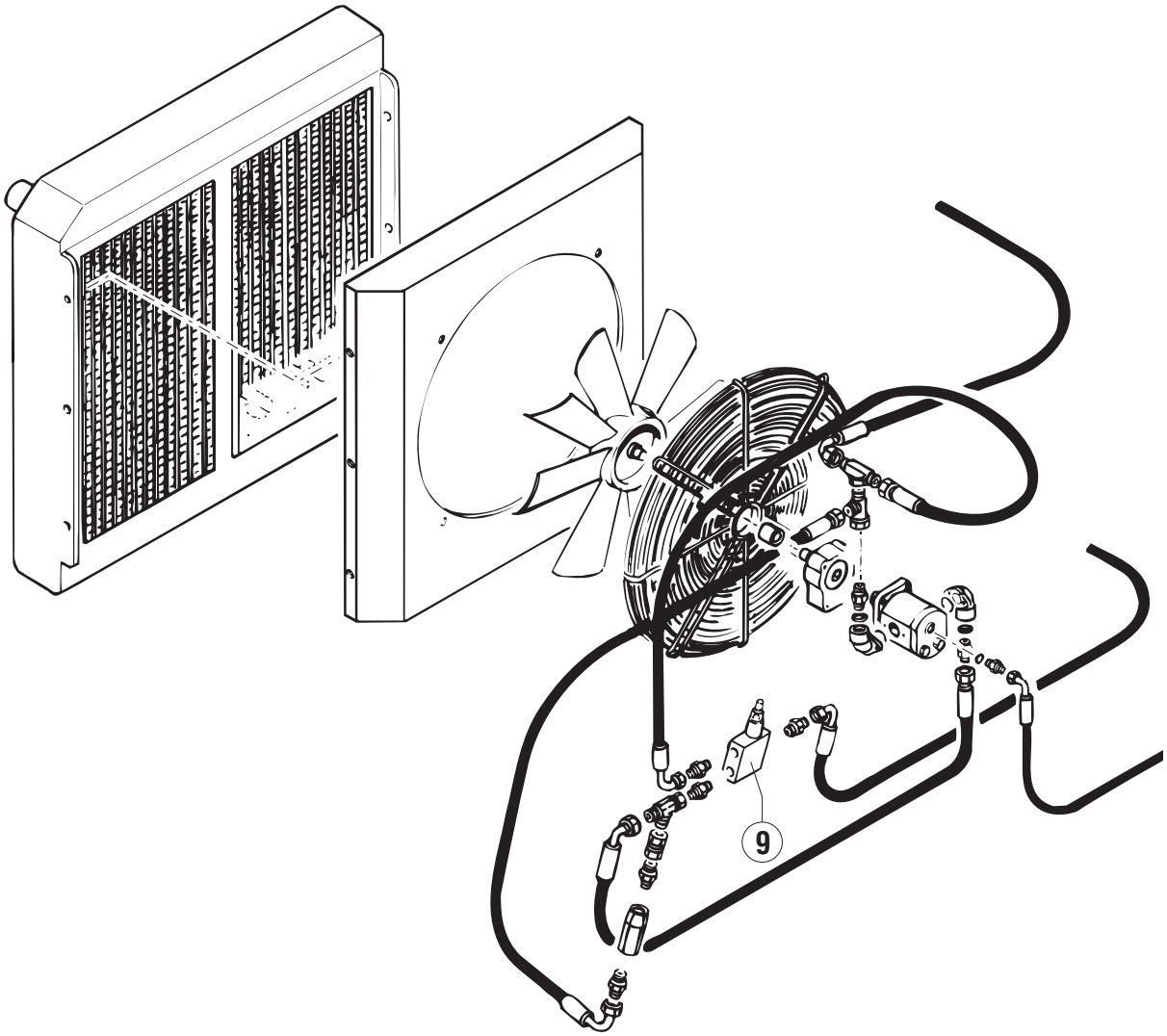
Annex7



Procedure:	Check and calibration of the circuit pressure Telelift 3013 (**from serial no. 8451**) - Telelift 3517	*Table:* **D.02.02**

HYDRAULIC SYSTEM - OIL COOLER

Annex 8



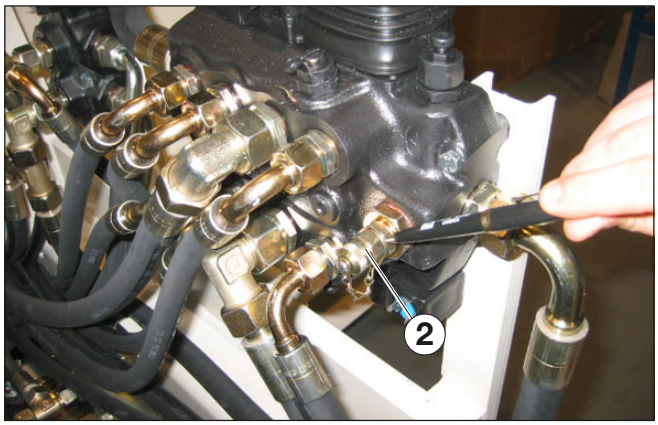
Procedure:	Check and calibration of the circuit pressure Telelift 4010	Table: **D.02.03**

1. PRELIMINARY OPERATIONS

Warm up the hydraulic oil to 80°C by keeping one of the elements of the boom distributor to full stroke under pressure.
To reach this temperature in a faster way, cover the oil core of the radiator with a carton in the case of a water-oil combined cooler, or the oil radiator if the machine is equipped with a separate oil radiator.

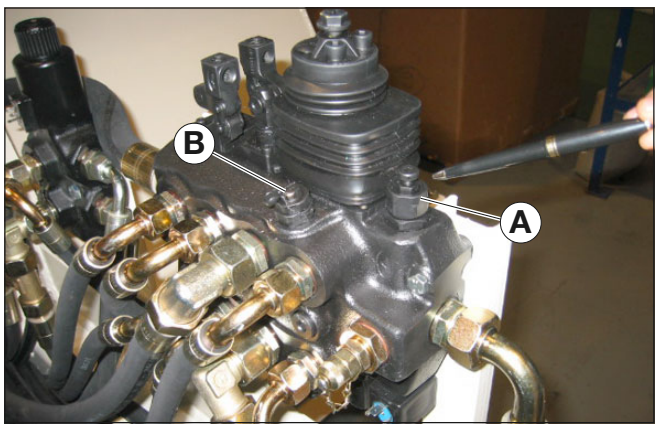
2. SETTING THE BOOM DISTRIBUTOR

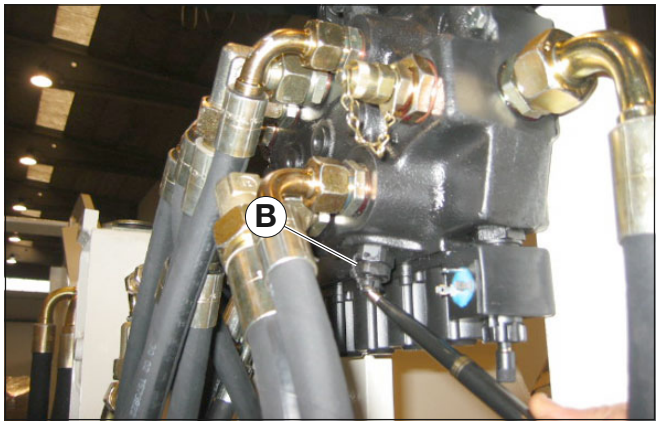
Find the manometer mini-socket **ref. 2** on the **Walvoil** distributor (see **annex 1**).



2.1 SETTING THE DISTRIBUTOR PRESSURE CONTROL VALVE

Connect a 0-400 bar manometer to the mini-socket **ref. 2**. Fully raise the boom to stroke end.
Calibrate valve **A** (see **annex 1**) of the Walvoil distributor to 280 bar while keeping the cylinder under pressure and the thermal engine fully accelerated.





During this calibration, you can also check or change the calibration of the bucket inclination safety valves **ref. B** of the Walvoil distributor (see **annex 2**) as follows:

- By means of valve **A** (see **annex 1**) set the distributor pressure to 300 bar while moving one of the cylinders to stroke end.
- With the engine running at maximum speed, tilt the forks to one direction by means of the joystick and act on one of the two valves **B** until reaching a pressure of 295 bar.
- Proceed in calibrating the second valve **B** by tilting the forks to the opposite direction.
- When both fork inclination safety valves have been calibrated, reset the pressure control valve **A** to 280 bar by adjusting the register.

IMPORTANT

Safety valves B are calibrated by the manufacturer Walvoil and are supplied with a lead seal.
Proceed with the operations mentioned above to check the correct calibration or in case of troubles.

Procedure:	Check and calibration of the circuit pressure Telelift 4010	Table: **D.02.03**

3. SETTING THE BLOCK VALVES OF THE FORK COMPENSATION CYLINDER (annex 2)

- Loosen the lock nuts of the valve and tighten the two registers of cartridges **3**.
- Re-loosen of one turn and a half both valves and re-tighten the lock nuts.

4. SETTING THE HYDROMATIK PUMP HYDROSTATIC TRANSMISSION

Calibrate the hydrostatic transmission with the hydraulic oil at a temperature of 80°C and the 2nd mechanical gear put in.

- Connect a 0-60 bar **T** manometer to the mini-socket **ref. C** (see **annex 3**) to read the low-pressure value.
- Connect a 0-60 bar **U** manometer to the mini-socket **ref. D** to read the high-pressure value.

CAUTION

Do not fit the manometer to the application point corresponding to the reverse speed. This operation is extremely dangerous for the serviceman who is calibrating the transmission.

- Hold the selector to neutral position and make sure the maximum speed of the engine does not exceed 2500 rpm. The engine must run at a idle speed of 950 rpm. Otherwise, adjust the minimum speed.
- Measure the boost pressure and ensure it is about 26/28 bar with the engine running at idle speed. The boost pressure has not a fixed value but varies from pump to pump.
  Note: In older pump models, it was possible to adjust this value by means of a register. In queste macchine la bassa pressione viene usata anche per il cilindro di rifasamento e per il distributore.
- Put in the forward or reverse gear, fully depress the brake pedal with the left foot to block the machine. Do not put the parking brake.

STARTING THE CALIBRATION

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at 1100 rpm. Check the value on the tachometer.
- Adjust the shutter **E** by means of the register, until reading a value of 60 bar on the high-pressure manometer (see **annex 3**).

4.1 CALIBRATION OF THE "DA" CURVE

Do this operation with extreme caution. The proper functioning of pump and transmission depends on this calibration.

- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at maximum speed and check the high-pressure value. If this value is less than 430 bar, increase the pressure to 425-430 bar by means of the pressure cut-off valve **F** (see **annex 3**).
- Gradually increase the engine rpm and steadily check the high-pressure manometer. As soon as the value of 400 bar is reached, hold the gas pedal fully depressed and attempt to keep the pressure on this value.
- If, with the diesel engine running at 2000 rpm, the value of 400 bar is not reached, adjust the spark advance valve **G**.

ATTENTION

The spark advance screw must never be rotated beyond the vertical axis of the pump (observe the reference mark on the screw).

Model	Pump pressure	Diesel engine rpm
TELELIFT 3514	400 bar	2000
TELELIFT 3013	400 bar	2000
LIFT 4020	400 bar	1600
LIFT 3513	400 bar	2300
TELELIFT 3517	400 bar	2000
TELELIFT 4010	400 bar	2000

tral-reverse selector to neutral position.

Procedure:	Check and calibration of the circuit pressure Telelift 4010	Table: **D.02.03**

4.2 CALIBRATION OF THE PRESSURE CUT-OFF VALVE

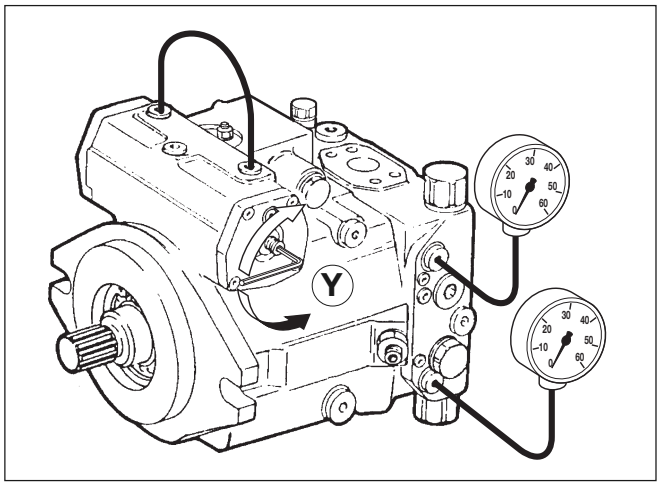
- With the engine running at maximum speed and the forward speed engaged, adjust the pressure cut-off valve **F** (see **annex 3**) to 430 bar.

  The two pressure control valves **H** must not be calibrated since they are of cartridge type and already set to 450 bar by Rexroth.

4.3 CALIBRATION OF THE MECHANICAL ZERO

The calibration of the mechanical zero **I** is required if the machine is set to neutral position with the forward-reverse speed lever.

- Set the forward-neutral-reverse selector to neutral position.
- With the engine running at idle speed, adjust the mechanical zero**Y** screw by rotating it until the high-pressure manometer reads the same value measured by the boost pressure manometer.



5. SETTING THE BRAKING SYSTEM PRESSURE

- Connect a 0-250 bar manometer to position **T** (see **annex 4**).
- Depress the foot brake some times until the manometer starts increasing. When it stops, the value shown is the calibration value of valve **R** (see **annex 4**) which must be 140 bar. If the displayed value is inferior, loosen valve **R**; if the value is greater, tighten the valve.

  Note: To check the pressure, it is necessary to depress the foot brake some times until the manometer restarts increasing; when it stops in stable position, it shows the calibration value.
  Pay special attention while disconnecting the hose from the accumulator. Oil can splash all around. First of all, release any residual pressure from the accumulators.

6. SETTING THE POWER STEERING

- Connect a 0-250 bar manometer to position **Z** (see **annex 5**).
- Select the front axle steering mode.
- Move the steering cylinder to stroke end and make sure the value of the power steering **S** is 140 bar.If the value is less, tighten valve **X**; if the value is greater, loosen the valve.

  Note: To gain access to valve **X**, remove the protection cap (see **annex 5**).

7. SETTING THE ARB 1 OVERLOAD WARNING SYSTEM

To adjust the ARB1 overload warning system, load a weight of 1000 kg on the forks.

With the machine resting on the wheels:

- Extend the boom to end of stroke while holding it horizontal:
- Switch on the overload warning system.

Proceed with a number aof tests with different weights and check that the machine stops at the values shown in the load chart in the cab and in the operator handbook.

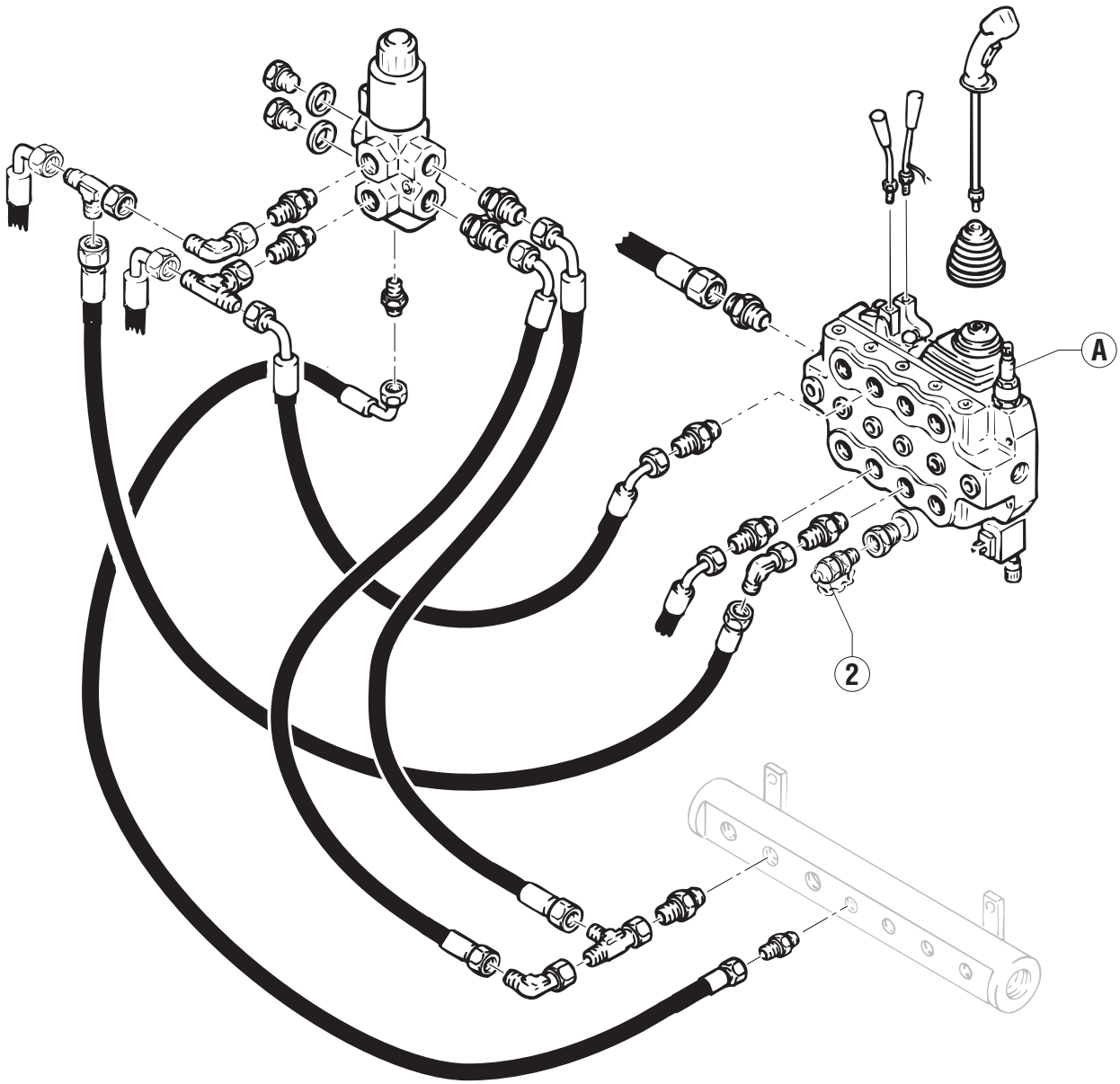
8. SETTING THE SAFETY VALVE OF THE RADIATOR FAN MOTOR

- Valve **9** (see **annex 6**) has been factory-set to **160 bar** and cannot be tampered with and/or adjusted by third parties.

Procedure: Check and calibration of the circuit pressure Telelift 4010	*Table:* **D.02.03**

CONTROL VALVE

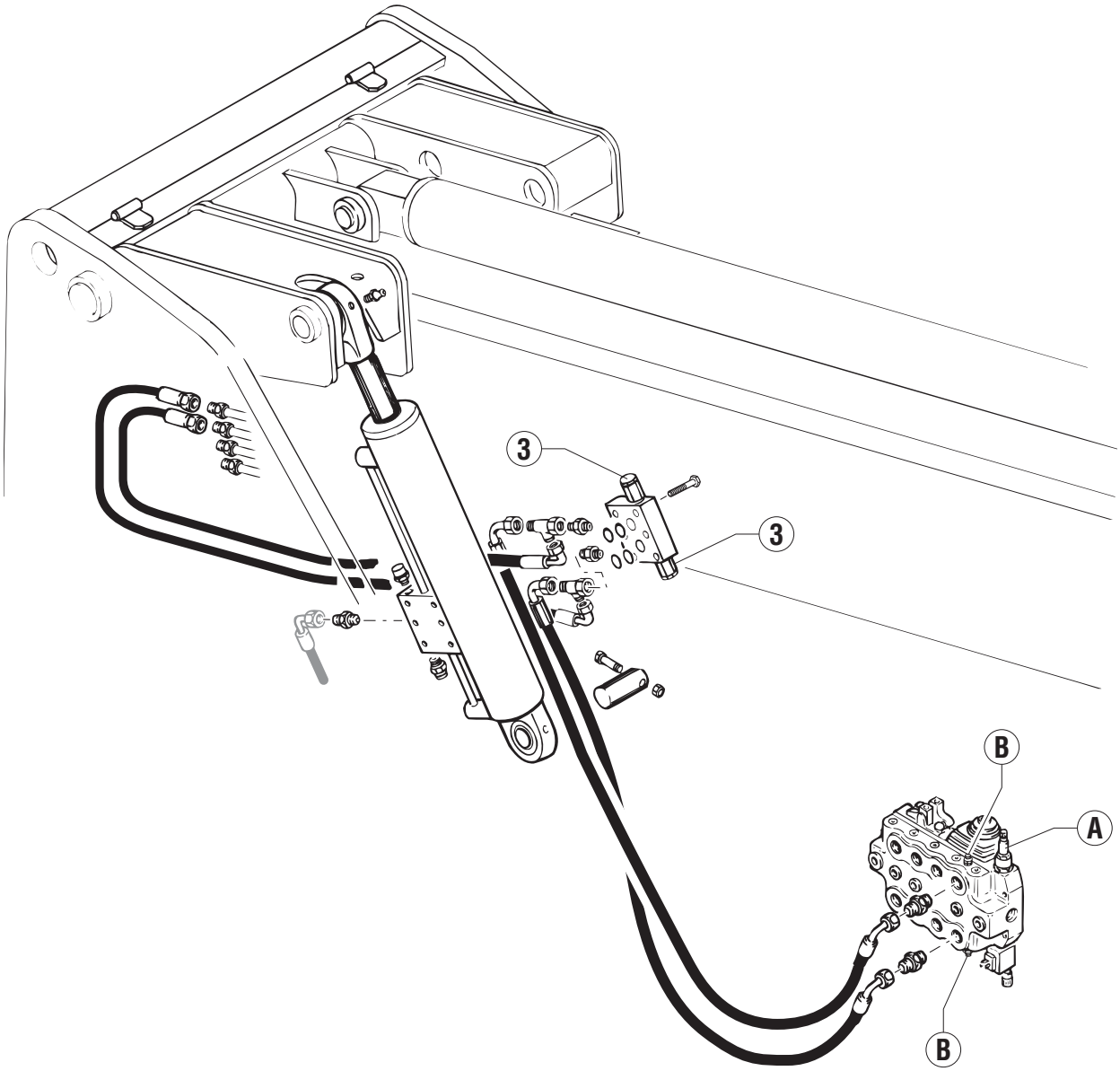
Annex 1



Procedure: Check and calibration of the circuit pressure Telelift 4010	*Table:* **D.02.03**

HYDRAULIC SYSTEM - FORK COMPENSATION

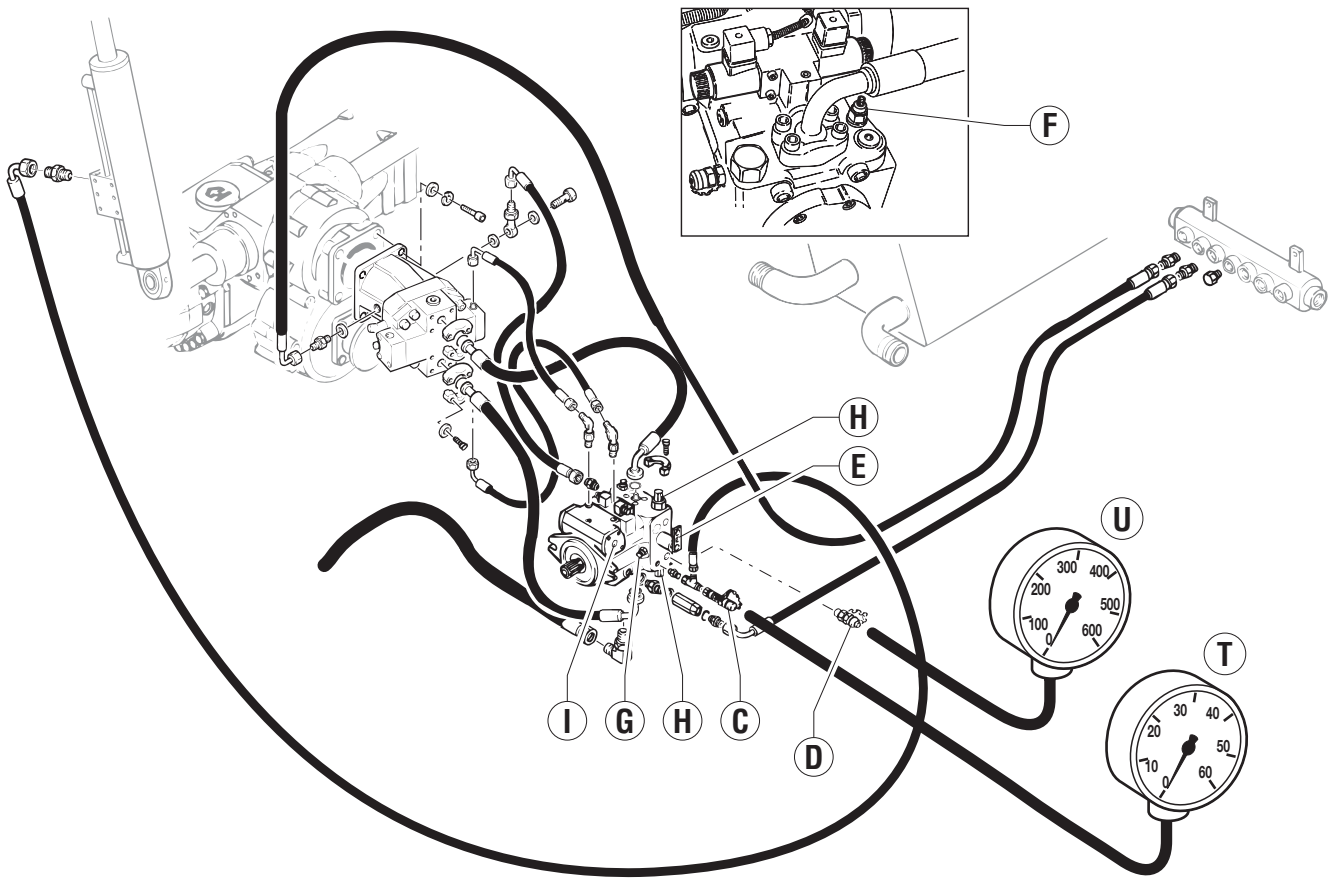
Annex 2



Procedure: Check and calibration of the circuit pressure Telelift 4010	*Table:* **D.02.03**

HYDRAULIC SYSTEM - TRANSMISSION

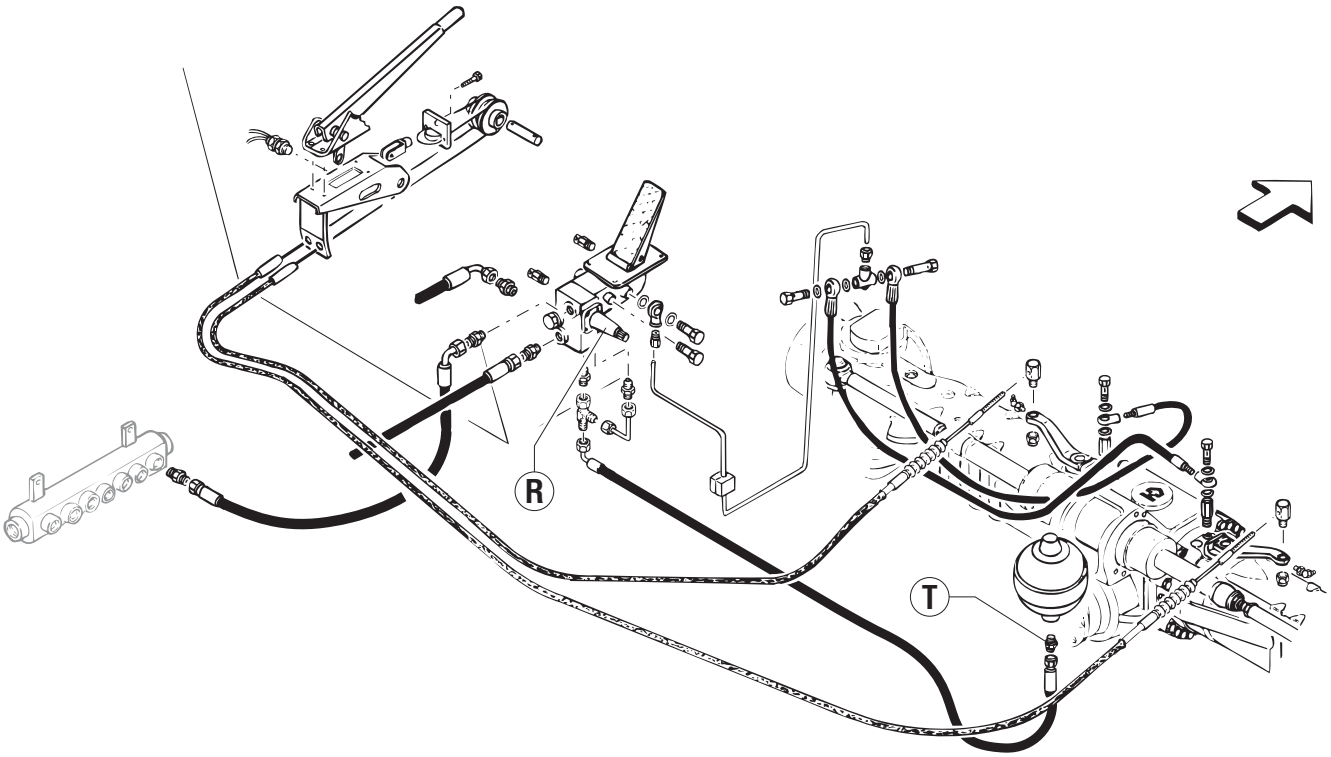
Annex 3



Procedure: Check and calibration of the circuit pressure Telelift 4010	*Table:* **D.02.03**

HYDRAULIC SYSTEM - SERVICE AND PARKING BRAKES

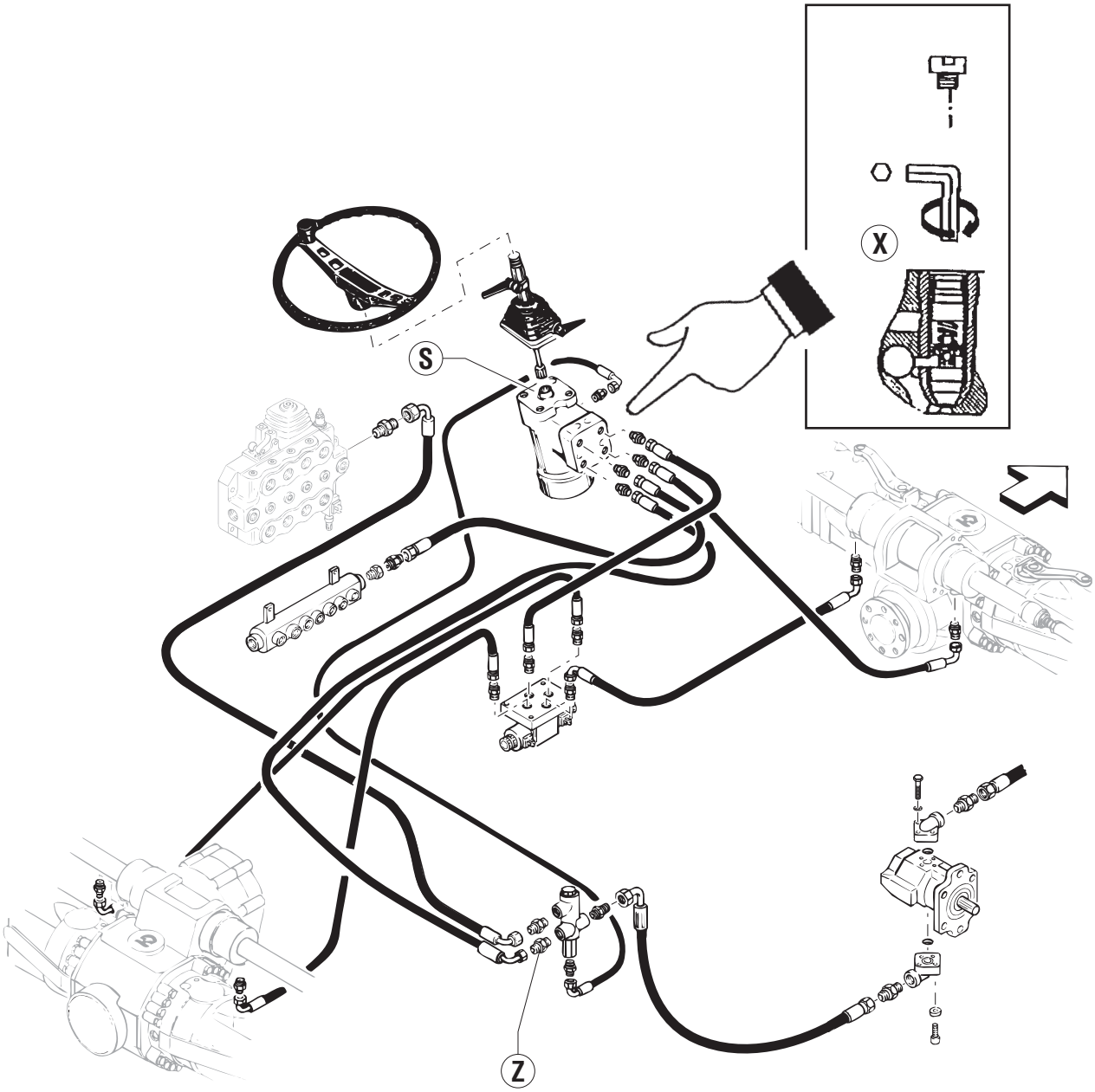
Annex 4



Procedure: Check and calibration of the circuit pressure Telelift 4010	*Table:* **D.02.03**

HYDRAULIC STEERING

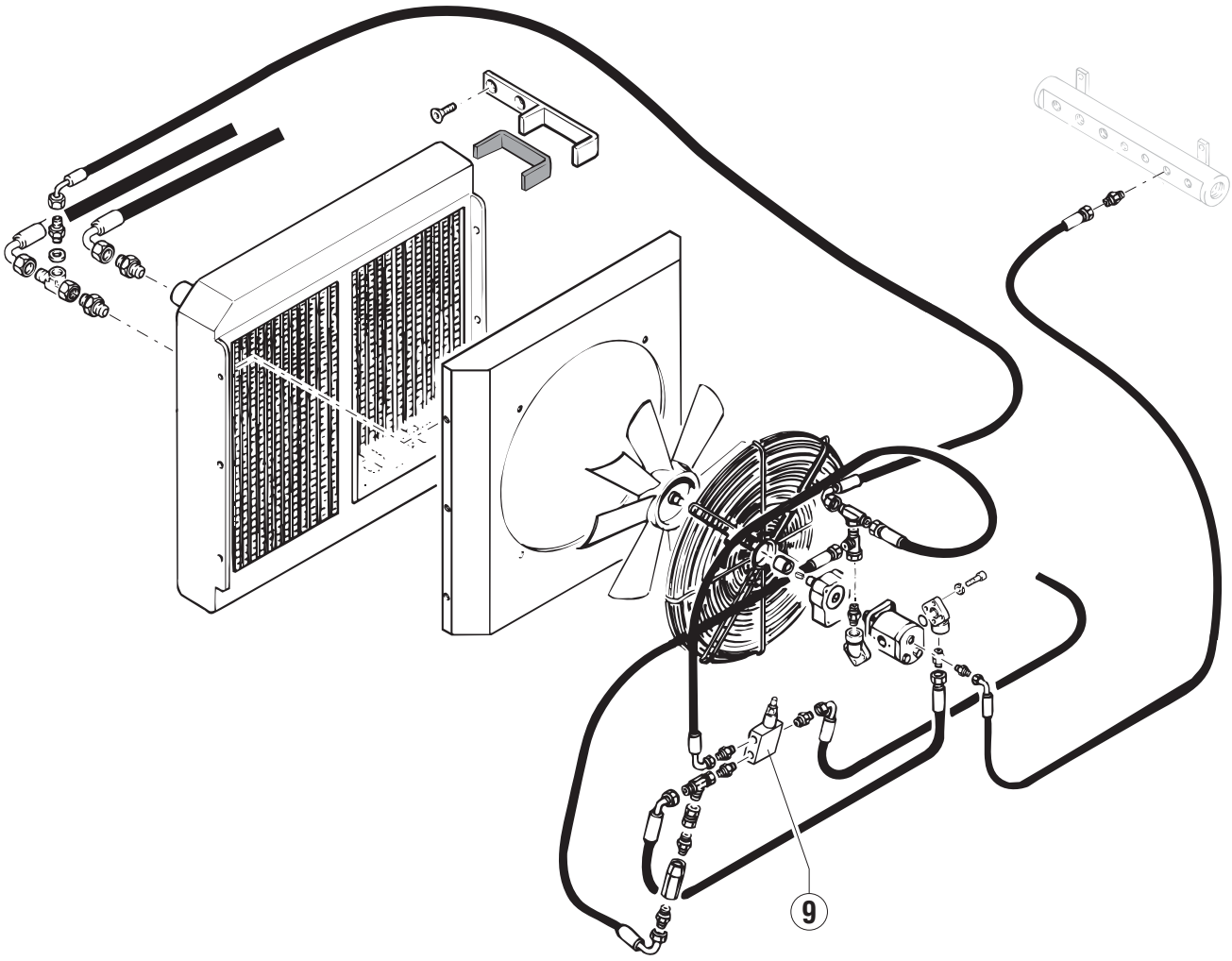
Annex 5



Procedure: Check and calibration of the circuit pressure Telelift 4010	*Table:* **D.02.03**

HYDRAULIC SYSTEM - OIL COOLER

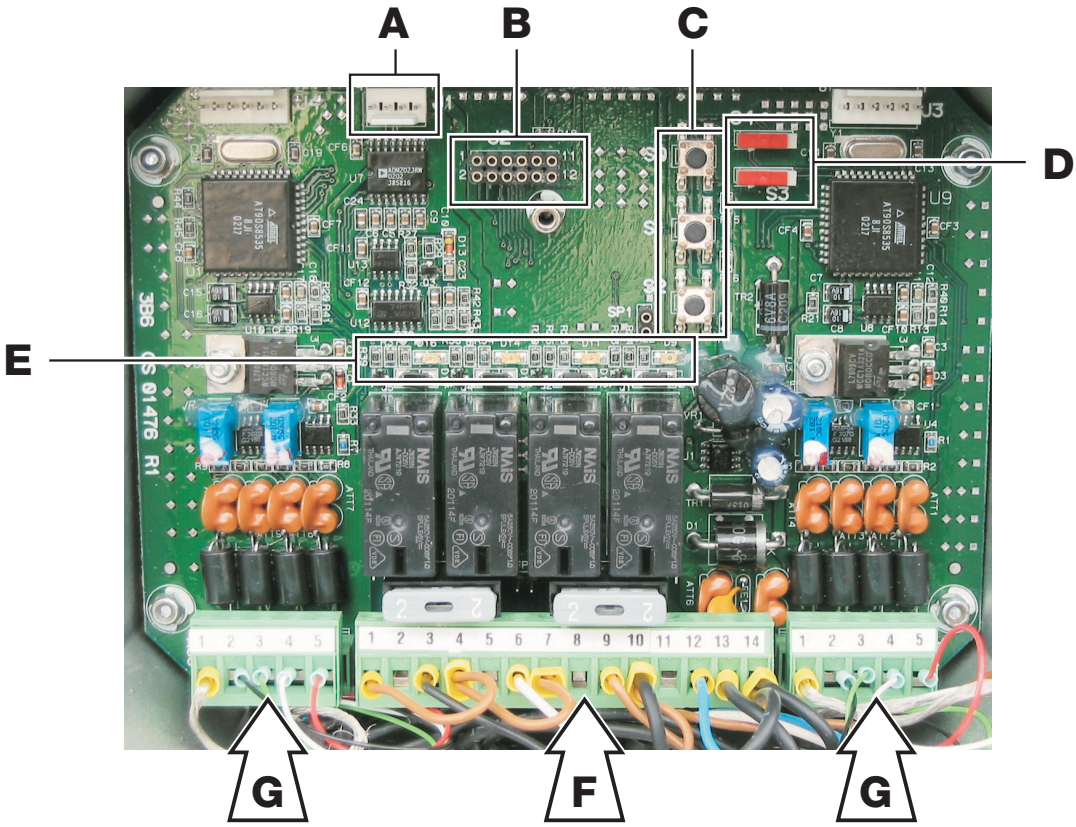
Annex 6



Procedure:	Calibration of the Excel card for aerial man-platforms - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.03.01**

CARD DESCRIPTION

The EXCEL card is installed in the man-platform, inside a protective box.
Removing the cover of the box, the card appears as follows:



The photo shows the parts involved in the calibration and view of the card.

- **J1** (ref. **A**): connector for the PC power cable
- **J2** (ref. **B**): monitor connector.
- Pushbuttons **S0**, **S1** and **S2** (ref. **C**): used for the quick calibration of the cell.
- Trimmers **S3** and **S4** (ref. **D**): used to view the parameters of one of the sensors of the load moment cell in the platform.

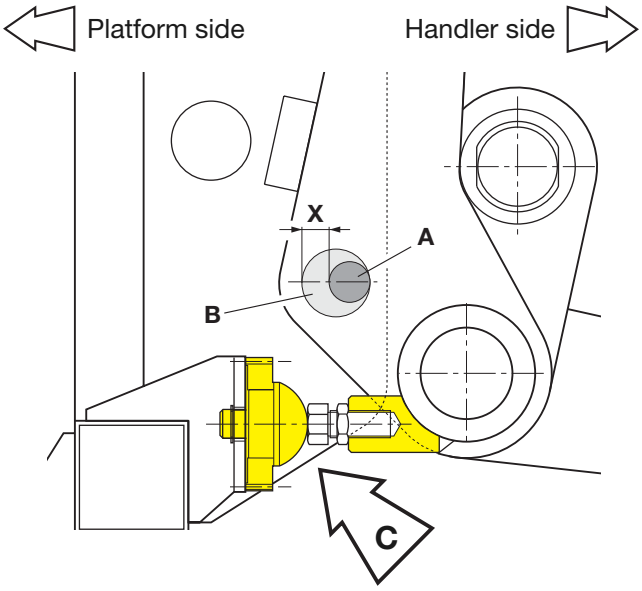
Procedure:	Calibration of the Excel card for aerial man-platforms - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.03.01**

- LEDs (ref. **E**): signal a pre-alarm or alarm condition.
  - During regular operation, the LED's are all lit when in the platform there is a load ranging from 0% to 90% of the maximum admissible charge.
  - When the load ranges from 90% to 120% of the maximum admissible, the platform enters in pre-alarm and 2 of the 4 LED's are lit.
  - When the load is higher than 120%, all LEDS's are off and the alarm is activated.

- Connectors at the bottom of the card:
  - the arrow (ref. **F**) shows the power connector
  - the arrows (ref. **G**) show the connectors of the two sensors of the platform's load moment cell.

PLATFORM CALIBRATION

The nose of the boom shall be equipped with a small block where the screw which enters in contact with the semi-spherical bulb of the load cell must be screwed in. Couple the platform to the handler and with a 41mm hexagonal wrench tighten or loosen the stop screw **C** fitted to the boom terminal so as to align the holes on the platform with those on the handler.
Ensure the aperture **X** between the locking pin **A** and the platform anchoring hole **B** is oriented toward the platform and at least **5 mm**.



IMPORTANT

For rotary man-platforms (from serial no. 55116), the procedure described before is not necessary. It is enough to connect the platform to the handler nose and follow the instructions below.



Stabilise the machine. Switch the controls to the platform by turning the Road-Jobsite-Platform key to Platform (ensure the green indicator close to the key comes on).

Check the type of platform coupled to the handler, then select it on the cab display.

Remove the he Road-Jobsite-Platform key, leave the driving cab and connect the electrical plug of the platform to the socket on the handler nose.

Procedure: Calibration of the Excel card for aerial man-platforms - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.03.01**

Switch on the platform pushbutton pendant using the key removed from the driving cab and turning this key to **I - ON**.

Now you can start the calibration. Don't interrupt the calibration sequence: the machine would enter in alarm che blocca la macchina per evitarne il ribaltamento.

- Open the box cover removing the four screws and gain access to the EXCEL card.

ZERO SETTING

1 Make sure there is no load on the platform.

2 Power down by removing connector ref. **F**.

3 Reconnect the power connector, ensure all LED's come on and, using buttons ref. **C**, type in the following sequence:

TELELIFT Series with single reel
S1 S0 S0 S1 S2

Type in the code within 10 seconds after reconnecting the power connector.

IMPORTANT

Keep the code within reach before reconnecting the power connector.

IMPORTANT

When the zero has been set, ensure the procedure has been done correctly by checking that all LED's are off.

Procedure: Calibration of the Excel card for aerial man-platforms - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.03.01**

MAXIMUM LOAD SETTING

1 Load the platform with the maximum admissible load (consider 100 kg per person).

2 Power down by removing connector ref. **F**.

3 Reconnect the power connector and, using buttons ref. **C**, type in the following sequence:

S1 S1 S0 S1 S2

Type in the code within 10 seconds after reconnecting the power connector.

IMPORTANT

Keep the code within reach before reconnecting the power connector.

IMPORTANT

When the maximum load has been set, ensure the procedure has been done correctly by checking that the second and fourth LED on the left come on. After removing the load, all LED's must go off.

Now the platform calibration procedure has ended.

ATTENTION

Before switching the controls back to the driving cab, disconnect the 24-pole ILME socket at the top of the boom.

SIGNALS ON DISPLAY WITH PC

Parameters:

15 **PercLevel1** load percent value corresponding to the first payload for load charts with 3 payloads.

16 **PercLevel2** load percent value corresponding to the second payload for load charts with 3 payloads.

17 **PercLevel3** load percent value corresponding to the third payload for load charts with 3 payloads or to the payload for one-payload load charts.

18 **Mode** this is 2 for rotating platforms and 1 for fixed platforms.

19 **Command** accepts values which are command codes.

20 **Cell_Adc1** this is the value of a calibration without load coming from the A/D converter of the displayed sensor.

21 **Cell_Known1** = 0.

22 **Cell_Adc2** this is the value of a calibration with maximum load coming from the A/D converter of the displayed sensor.

23 **Cell_Known2** =1000.

31 **CurPerc** ranges from 0 to 120; when 90 is displayed the system enters in pre-alarm.

32 **Cell_Actual** this is the value of the cell scale ranging from 0 to 1000.

33 **Cell_Adc** this is the value of the coming from the 12 bits A/D converter of the displayed sensor (therefore it ranges from 0 to 4096).

34 **SwVersion** = 300 for rotating platforms.

LED BEHAVIOUR DURING WORK

ALL LED'S ON: the loaded weight is within the accepted limits, **correct functioning**.

2 LED'S ON: the loaded weight is close the maximum admissible weight, **pre-alarm condition**.

ALL LED'S OFF: machine in **alarm condition** and platform movements blocked.

Procedure:	Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.04.01**

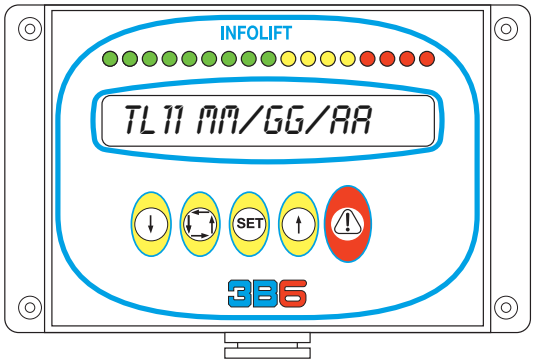
Description of the procedure:

For the calibration, run the Diesel engine to 3/4 throttle since, during the extension of the boom, the limit distances, with the system in overload mode, can slightly change.

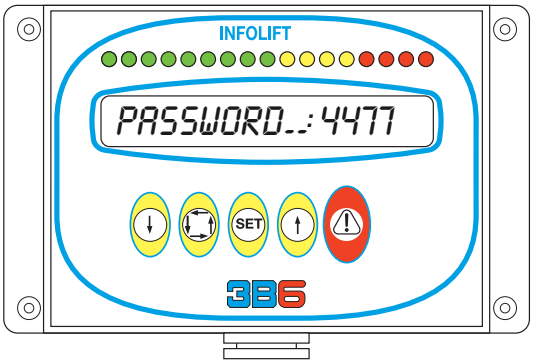
Before starting calibration, select **forks** as machine attachment.

1 Lower the outriggers to the ground, unload the weight of **1000 kg** previously loaded, retract the boom and lower it to end of stroke, then stop the engine.

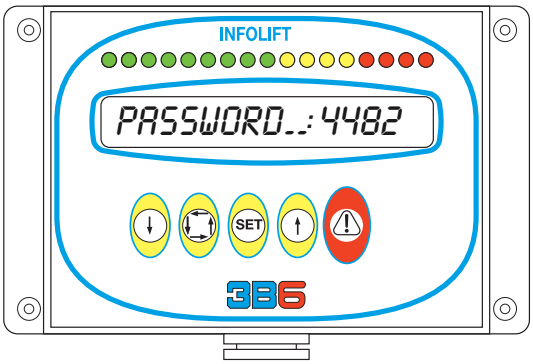
2 Start the engine of the machine and when the current day/month/year will appear on the display, press the key SET.



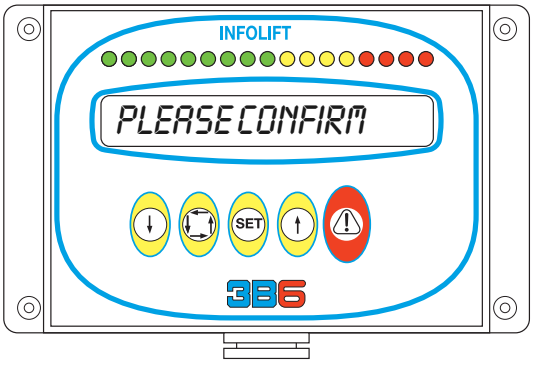
3 The following page will appear on the display:



4 Press ↑ until displaying **4482**.

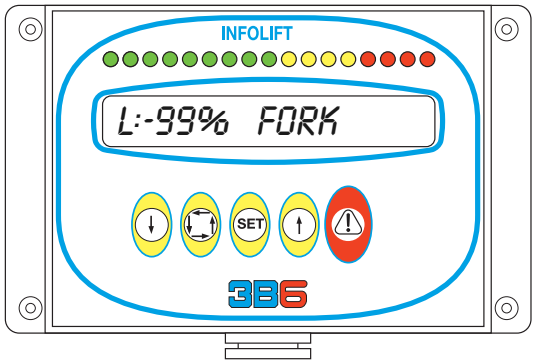


5 Press SET. The following page will appear on the display:



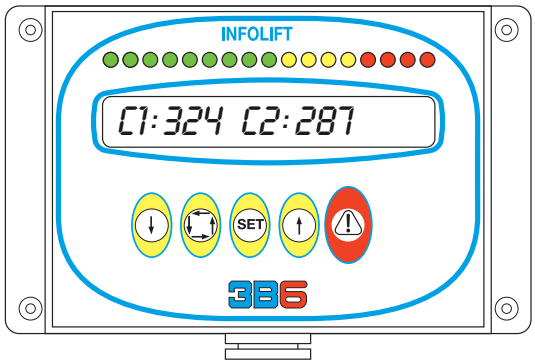
Procedure:	Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.04.01**

alternated with the page:



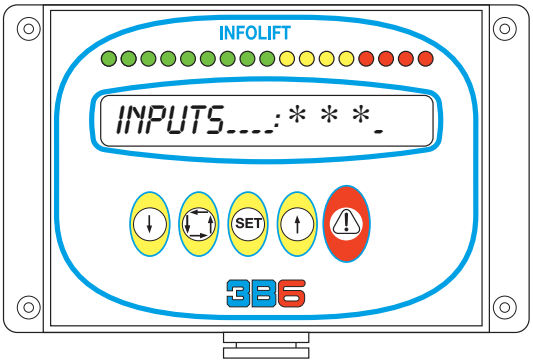
Note: the percentage has an indicative value only.

6 Press ↑ to enter the following page:



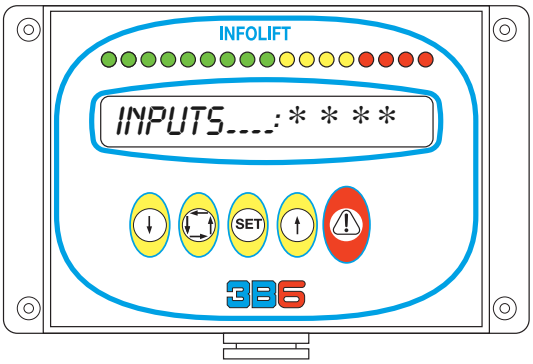
Note. The value of **C1** and **C2** shown in the page above can be reversed, thus depending on the cell connections, and can vary. If this value is equal to 0 or quite different from the one shown on the display the wires on the return line from the load cell are damaged. Also if the cell was mounted in the wrong way, the value read would be close to 0.

7 Press ↑ again to view the **INPUTS** page.



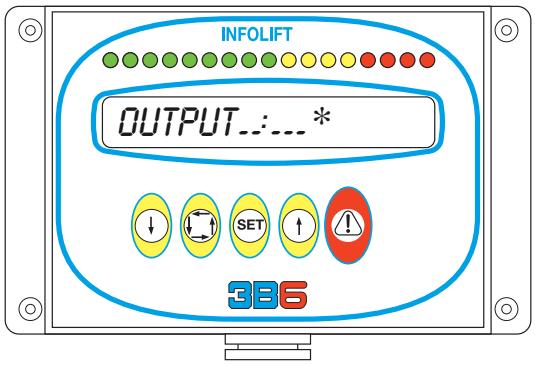
If 3 stars appear (as above) the machine is perfectly stabilised.

8 Turn the cut-out key of the overload warning system and ensure the fourth star will come one.

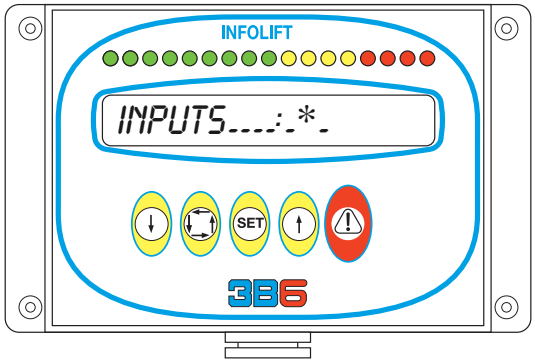


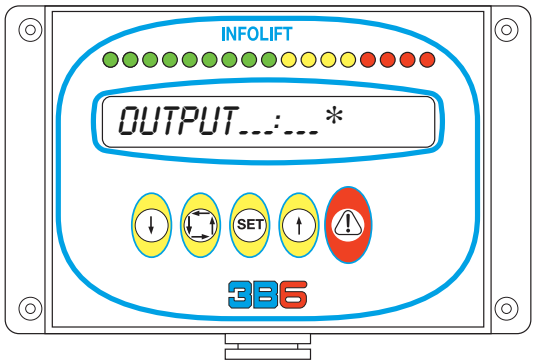
Procedure:	Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.04.01**

9 Press ↑ to view the **OUTPUT** page.

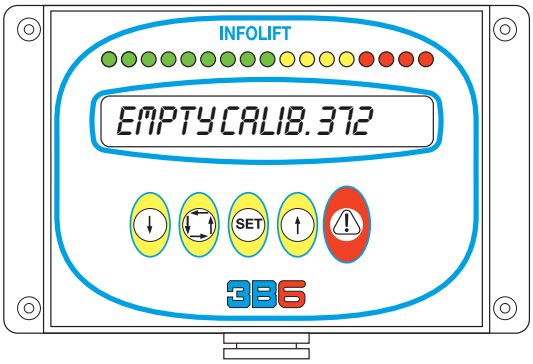


If the machine is not perfectly stabilised the following pages will appear:



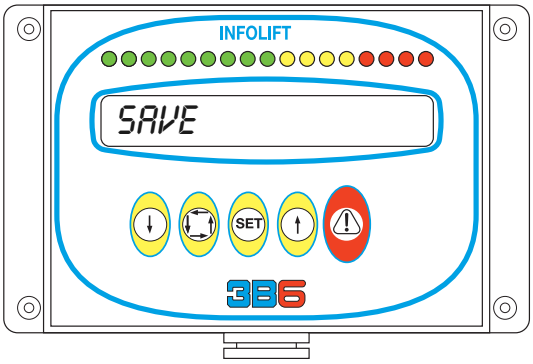


10 Press ↑ as long as the message "**EMPTY CALIB.**" will appear. Now press SET to confirm. A sound will be emitted to confirm that the device has accepted the command:



Note: the numerical value is indicative.

11 Move on the display with the key ↑ until viewing the message "**SAVE**". Now press SET to confirm. A sound will be emitted to confirm the selection.



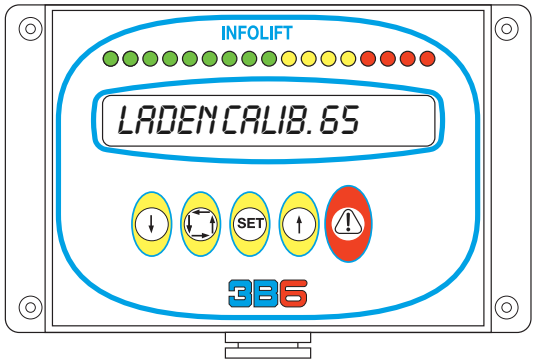
Procedure: Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.04.01**

12 Turn the cut-out key of the overload warning system.

13 Load a weight of **1000** kg onto the forks and extend to the maximum distance (7.30 metres for mod. Telelift 3013 - 8.40 metres for Telelift 3517).

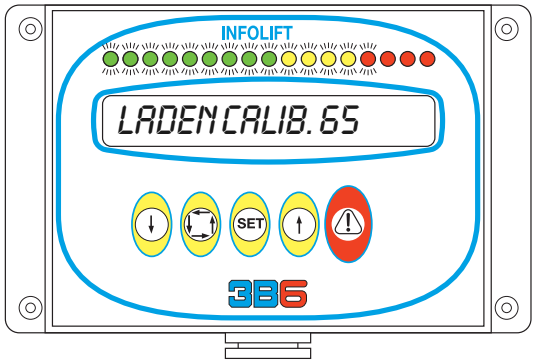
14 Press ↑ until viewing "**LADEN CALIB.**".

Press SET to confirm.

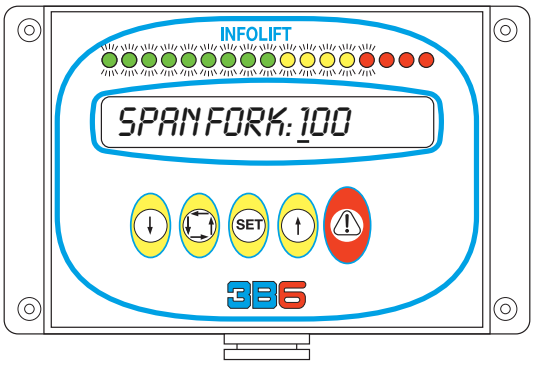


Note: the numerical value is indicative.

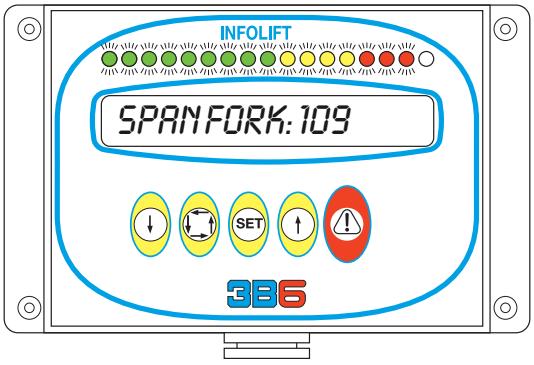
In the bar at the top, the LED's shall come on in sequence: first all the green lights, then the yellow and finally the first of the red ones.



16 Press ↑ to view "**SPAN FORK**", then press SET to confirm and enter the page.



Press ↔ to shift the flashing hyphen under the numerical value of the page under the last digit, then press ↑ until viewing **109**.

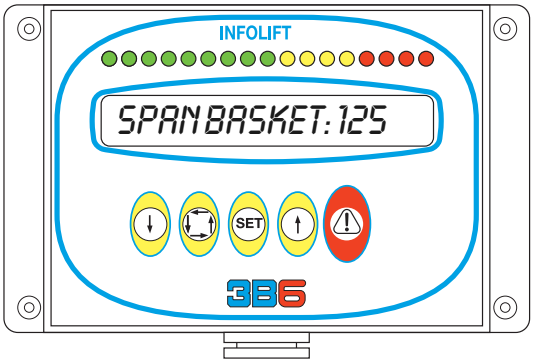


Now all green and yellow lights and three of the red lights should be on.

Confirm pressing SET.

Procedure:	Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.04.01**

17 Press ↑ until viewing the following page:



Confirm pressing SET.

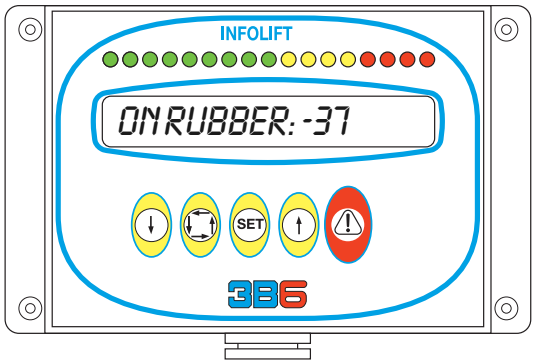
Press ↔ to shift the flashing hyphen under the numerical value of the page under the last digit, then press ↓ and change the value as follows:

Telelift 3013 = 100
Telelift 3517 = 110.

Ensure the load chart with the basket installed is obeyed.

Press SET to confirm.

18 Press ↑ until viewing the following page:



Note: the numerical value is indicative.

Confirm pressing SET.

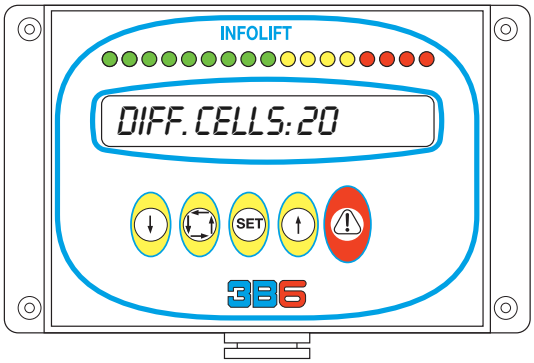
Press ↔ to shift the flashing hyphen under the numerical value of the page under the last digit, then press ↑ and change the value as follows:

Telelift 3013 = -23
Telelift 3517 = -0.

Press SET to confirm.

Procedure: Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	*Table:* **D.04.01**

19 Press ↑ until viewing the following page:



Note: the numerical value is indicative.

Confirm pressing SET.

Press ⟲ to shift the flashing hyphen under the numerical value of the page under the last digit, then press ↓ and change the value as follows:

Telelift 3013 = 80
Telelift 3517 = 150.

Press SET to confirm.

20 Press ↑ to view the page "**SAVE**". now press SET to save the new calibration values. A sound will be emitted to confirm that the device has accepted the command.

Stop the engine of the machine, then restart and wait for 6 seconds before confirming with the key SET.

Summary tables: applicable load - distance to reach:

Telelift 3013		
	Load (kg)	**Distance (m)**
on outriggers	1000	7,30
on wheels	1000	5,15

Telelift 3517		
	Load(kg)	**Distance (m)**
on outriggers	1000	8,40
on wheels	1000	4,80

IMPORTANT

If the machine does not keep within the distances mentioned above, proceed as follows:

stop and restart the machine, confirm pressing SET,

type in the password and, moving with the arrow ↑, select "SPAN FORK". Change the value 109 to modify the distance to reach. Increasing this value the boom extension will decrease; decreasing this value, the boom extension will increase (machine stabilised). To change the distance of the boom extension with the machine standing on the wheels, move with the arrow ↑ to "ON RUBBER" and change the number 23.Increasing this value, the boom extension will increase before the intervention of the overload warning system. Decreasing this value, the boom is retracted before the intervention of the overload warning system.

Procedure:	Calibration of the 3B6 load moment indicator - valid for Telelift 3013 (**from serial no. 9408**) - Telelift 3517 (**from serial no. 9363**)	Table: **D.04.01**

Tolerance variation of redundant signals from the load cell

To change the tolerance between two redundant signals from the load cell, enter the page "**DIFF.CELLS**" on the display and change the value setting it from 20 to 80 for Telelift 3013, or from 20 to 150 for Telelift 3517, then confirm pressing SET.

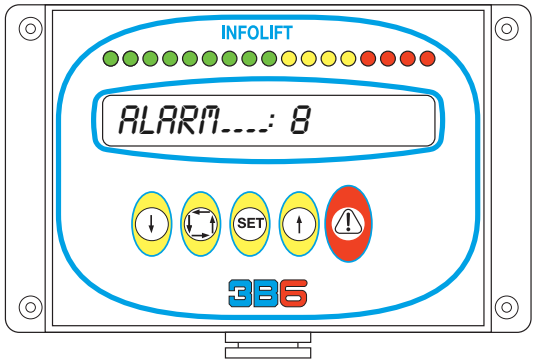
Changing attachment

To change the attachment:

- start the machine
- confirm pressing SET
- press ↕, select the attachment you wish and press SET to confirm.

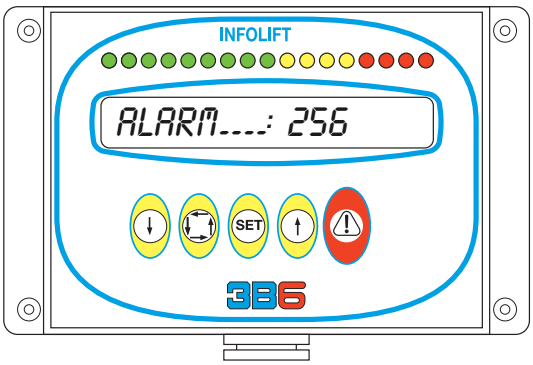
Alarm description

Several alarm messages can appear on the display of the overload warning system. The most frequent is **alarm 8**, which appears when the cut-out key of the overload warning system is used.

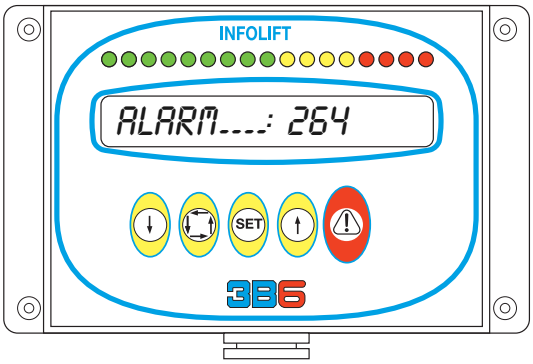


To deactivate this alarm press SET.

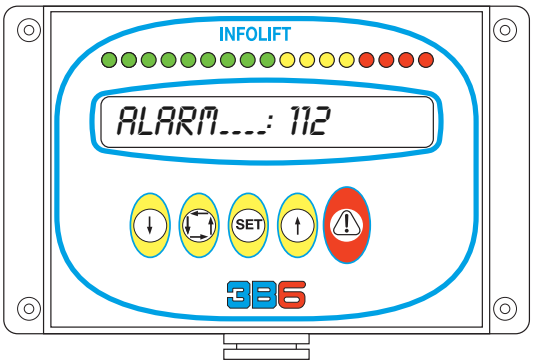
Other possible alarm messages are:



This alarm shows a problem due to a cell difference. To resolve this trouble enter the page "**DIFF CELLS**".



This alarm is displayed after alarm 256, when the cut-out key of the overload warning system is turned.



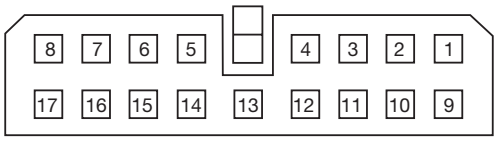
This alarm appears when the cut-out key of the overload warning system is turned before confirmation and immediately after the machine start-up.

Procedure: SCT module connections - for Telelift 3013 - 3517	*Table:* **D.05.01**

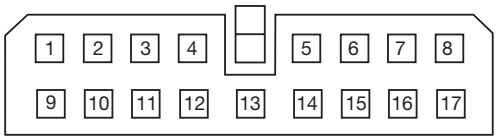
CONNECTIONS LIST

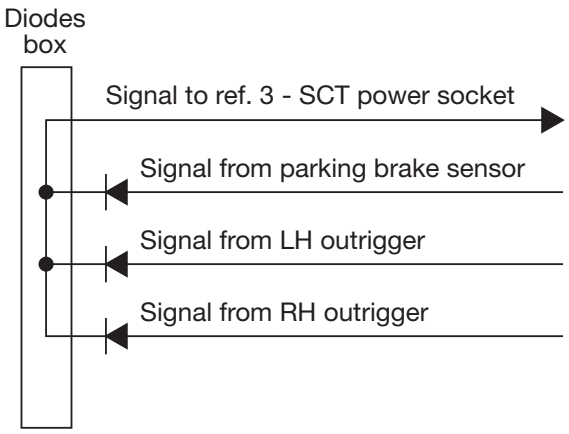
1 Cardan sensor input
2 1st speed sensor input
3 Signal from diodes box (parking brake and outriggers)
4 Earth
5 Speed change pushbutton warning light output
6 1st speed solenoid valve output
7 SCT power supply
8 SCT power supply
9 Cardan sensor input
10 Speed change pushbutton input
11 2nd speed sensor input
12 SCT power supply
13 SCT power supply
14 2nd speed warning light output
15 1st speed warning light output
16 2nd speed solenoid valve output
17 Forward/reverse speed output

Connector on SCT
Front view



Rear view





Procedure: Perkins engine bulbs - Description	*Table:* **D.06.01**

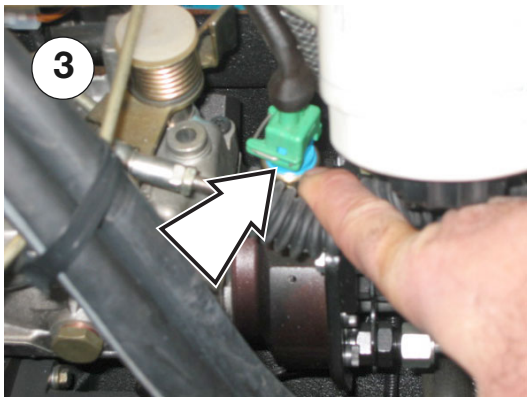
1 Absorption on positive (+) lead on the battery with ignition key turned to “1”.
Correct absorption: **12÷20 A**



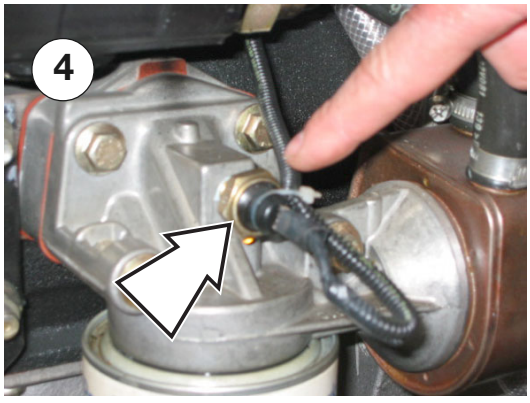
2 Absorption on positive (+) lead on the battery during the engine start-up.
Correct absorption: **max. ~ 700 A**



3 Injection pump power socket.
Correct absorption: **12 V**

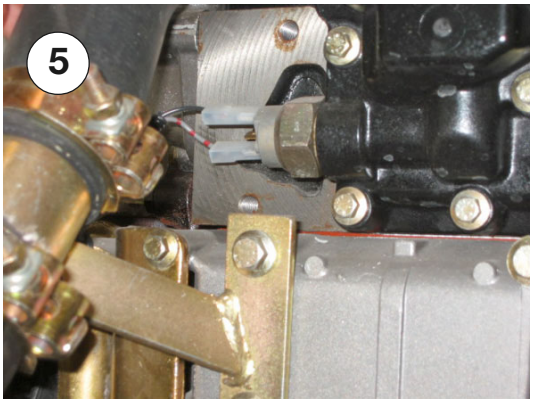


4 Engine oil pressure measuring bulb.

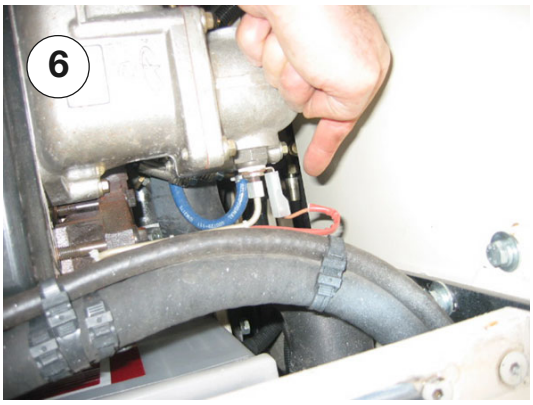


Procedure: Perkins engine bulbs - Description	*Table:* **D.06.01**

5 Water temperature measuring bulb (light indicator on dashboard).



6 Glow plug pre-heating bulb.
Absorption during pre-heating: **~ 13 A**



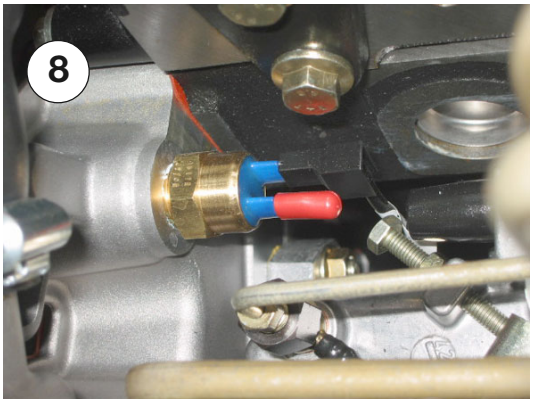
7 Water temperature measuring bulb (pressure gauge power supply on dashboard).



8 Cold advance adjustment bulb.

IMPORTANT

Do not, at any time, operate on this bulb. Call in an expert technical engineer in case of troubles.

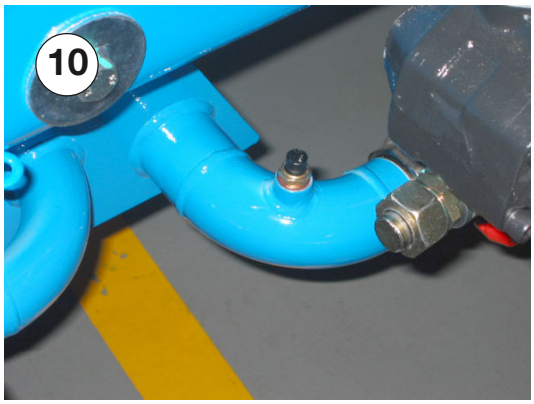


Procedure: Perkins engine bulbs - Description	*Table:* **D.06.01**

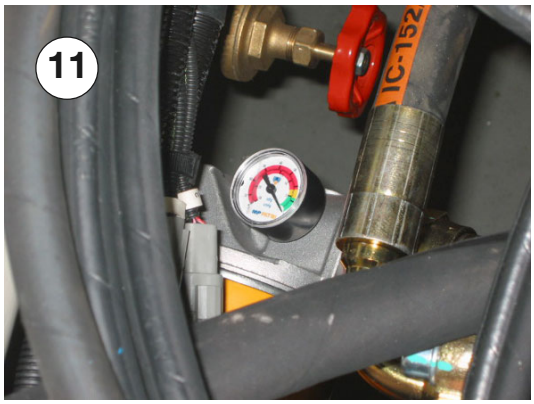
9 Air filter clogging sensing bulb.



10 Hydraulic oil temperature measuring bulb.



11 Vacuometro rilevamento intasamento filtro olio idraulico.



Section E
DISMANTLING AND ASSEMBLY

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Time schedule

Job	Operators needed	Expected time (h)
change the ignition key	1	1.00
change the speed switch	1	0.30
change the lights and horn switch	1	0.30
change the overload warning system display	1	0.15
re-claibrate the 3B6 system	1	1.00
change the 3B6 amplifiers	1	1.00
change the load cell	1	2.00
change the ARB1 box and calibrate	1	1.00
change the transmission control unit	1	0.10
test the transmission control unit	1	0.30
change the joystick	1	1.30
change the deadman button	1	0.30
change the joystick movement switch pushbutton	1	0.30
change the brake pump	1	1.00
change the 2 gearbox sensors	1	0.30
change the Cardan shaft sensor	1	0.15
change the low boom sensor (only Telelift 3713 Elite-3517)	1	0.15
change the high boom sensor (only Telelift 3517)	1	0.15
change the boom lifting cylinder	1	2.15
change the boom lifting cylinder kit (omplete overhaul)	1	1.30
change the block valve of the boom lifting cylinder	1	0.30
change the cylinder inside the boom (only Telelift 3713 Elite)	1	2.50
change the extension cyl. kit inside the boom (only Telelift 3713 Elite)	1	1.30
change the block valve of the extension cylinder inside the boom (Telelift 3713 Elite)	1	0.30
change the extension cylinder on the boom	1	1.00
change the extension cylinder kit on the boom	1	1.30
change the valve of the extension cylinder on the boom	1	0.30
change the cylinder re-sequencing valve inside boom (Telelift 3713 Elite)	1	2.00
change the fork pitching cylinder	1	1.30
change the fork pitching cylinder kit	1	1.30
change the valve of the fork pitching cylinder	1	0.30

Job	Operators needed	Expected time (h
change the attachment locking cylinder	1	1.00
change the attachment locking cylinder kit	1	1.15
change the block valve of the attachment locking cylinder	1	0.30
change the outrigger up/down mov. cylinder	1	1.30
change the outrigger up/down mov. cylinder kit	1	1.30
change the valve of the outrigger up/down mov. cylinder	1	0.30
change the fork compensation cylinder	1	2.00
change the fork compensation cylinder kit	1	1.30
change the valve of the fork compensation cylinder	1	0.45
check the one-way valves of the fork compensation cylinder	1	0.20
change the machine sway cylinder	1	1.30
change the machine sway cylinder kit	1	1.30
change the machine sway cylinder valve	1	0.30
change the boom internal line for the boom extension (only Telelift 3713 Elite)	1	1.00
change the boom internal line for the fork pitching	1	1.30
change the boom internal line for the fork locking	1	1.30
change the boom slide pads (Telelift 3713 Elite)	1	2.30
change the boom slide pads (Telelift 3517)	1	3.00
change the boom slide pads (Telelift 4010)	1	1.30
check the pressure of the drive pump	2	0.20 cad.
check the pressure of the main actuator operating the boom movements	2	0.20 each
check the pressure of brake pump and hydrostatic steer.unit	1	0.15
check the safety valves	1	0.15
change the drive pump	1	2.00
change the drive motor	1	2.00
change and test motor. pump and transmission lines	1	5.00
change the actuator control pump	1	1.30
change and calibrate the actuator	1	2.00
change the pump on the engine injection line	1	1.00
change the electrical flow divider	1	0.30
change relays and fuses	1	0.10
change the windscreen wiper motor	1	1.00
change and test the emergency pump coil	1	0.30
change the emergency pump	1	1.00

Job	Operators needed	Expected time (h
change a solenoid valve	1	0.20
change the gas pedal complete with cord	1	1.00
change the manual throttle complete with cord	1	0.30
change the front axle shaft	1	3.00
change the rear axle shaft	1	3.00
change 1 Cardan joint	1	1.00
change the Cardan joints	1	2.00
change the axle shaft hub	1	1.30
change the boom assy	2	5.00 each
change the boom anchoring pin	2	1.00 each
schange the attachment locking cylinder pins	1	0.30
change the outrigger cylinder pin	1	0.20
change the platform power socket at the top of the boom	1	0.20
change the electrical reel (only Telelift 3713 Elite)	1	2.00
change the platform joystick	1	0.20
change a cab pushbutton	1	0.30
change the platform pushbuttons	1	0.10
change and test the actuator pressure relief valve or the sliders	1	0.30
change and test the actuator safety valve	1	0.30
change the one-way valve	1	0.20
change the maxi-fuses and search for troubles	1	0.10
bleed the braking system	2	0.15 each
change the hydraulic oil filter of the drive pump injection line	1	0.20
change the hydrostatic steering unit	1	1.30
change the beacon	1	0.20
change the battery	1	0.10
change the exhaust pipe	1	0.30
change the mud-guard supports	1	0.20
change the mud-guards	1	0.10
change the parking brake cord	1	0.30
change the steering wheel	1	0.10
dismantle the hydraulic oil tank	1	2.00
dismantle the fuel tank	1	2.00
change a wheel (n° 1)	1	0.15
change the rear axle locking cylinder (only Telelift 3517)	1	1.00
change the outriggers (only Telelift 3713 Elite- 3517)	1	1.00
change flexible hoses	1	0.15
change the parking brake lever	1	0.30

Some useful hints:

A Before disconnecting a hydraulic line, put some coloured adhesive tape or a numbered tag for an easier reassembly.

B Before disconnecting electrical wires/ connectors, put some coloured adhesive tape or a numbered tag for an easier reassembly.

Procedure: **Removing a wheel**	Table: **T-001**			kg: 88
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: - / Min.: 15
Bridge crane, payload 500 kg (2000 lb) Lifting jack	Standard tools Adjustable stands Screwing machine, torque 300 Nm			1

Procedure:

1 With a 24mm socket spanner fitted to the pneumatic screwing machine loosen the 8 nuts without removing them from their housings.

1



2 For versions 3713 Elite - 3517 or when a front wheel shall be removed, lower the outrigger near the wheel to be removed so that the latter raises some centimetres above the ground.

2



3 For the version 4010 or when a rear wheel shall be removed, place a hydraulic jack under the axle after increasing the supporting surface of the jack if the ground is not firm. The hydraulic jack shall have a force of at least 5000 kg.

4 Place a stand under the axle to prevent damage in case of an accidental collapse of the ourigger.

3



Procedure: Removing a wheel	Table: T-001

5 Remove the wheel rolling it on the ground.

DANGER

Every wheel weighs 88 kg. Use an adequate hoisting gear.

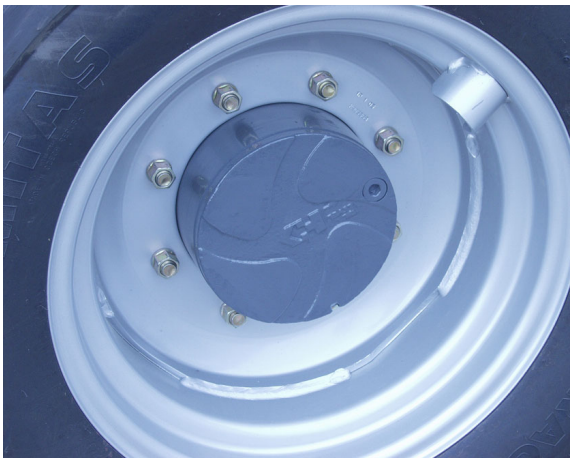
Procedure: **Assembling a wheel**	Table: **T-001**

Procedure:

6 Line up the wheel with the axle and fit the 8 nuts.

.

6



7 Raise the outrigger or the hydraulic jack and tighten the nuts with the pneumatic screwing machine. Cross-tighten as shown.

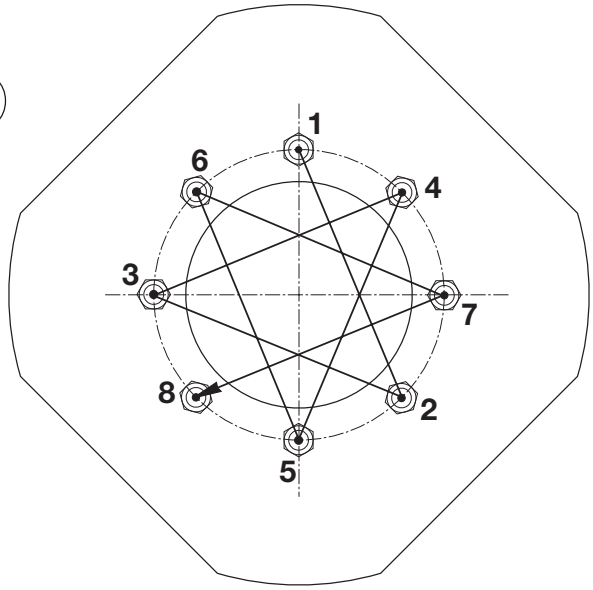
8 Lower the machine to the ground.

9 ***Re-tighten all nuts to a torque 300 Nm.***

DANGER

Check the tightening of wheels one hour after the job. They might get loose until they do not stay correct.

7



Characteristics	*Telelift 3713 Elite*	*Telelift 3517*	*Telelift 4010*
Dimensions (front and rear)	400/70-20	400/70-20	400/70-20
Load index / P.R.	14	14	14
Rim	13 x 20	13 x 20	13 x 20
Wheel disc	8 holes DIN 70361	8 holes DIN 70361	8 holes DIN 70361
Pressure bar/Psi	4/58	4/58	4/58

Procedure: **Assembling a wheel**	Table: **T-001**

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Procedure: **Dismantling the cylinders**	*Table:* **T-002**			kg	See table
	3713 Elite ✔	*3517* ✔	*4010* ✔		
					Hours / Min.
Swing hoist, payload 500 kg (2000 lb)	Wrench USAG 282T SN/50-80 with pin ø 4.5 mm Wrench USAG 281C/215 with pins ø6 mm				- / 30
					1

Cylinder	Fork compensation 3713 Elite-4010	Fork compensation 3517	Attachment locking	Attachment rotation	2nd telescope extension 3713 Elite
Part#	53.0300.0000	53.0300.0900	53.0500.0000	53.0400.0000	53.0100.0000
Weight kg lb	40	43	11,4	80	235
Cylinder ø mm in	110	110	60	150	120
Rod ø mm in	48	48	30	70	60
Closed mm in	830	835	555	706	4110
Stroke mm in	445	515	92+92	340	3490
Pressure bar max	300	300	300	300	300
SEALS					
HEAD					
Type	OR ø79,77 + PBK 620	OR ø82,14 + PBK 236	OR ø42,86 + PBK 826	OR ø120 + PBK 351	OR ø89,69 + PBK 621
Type	B 236188	B 236188	WRM 118149	WRM 275307	I/GR 0600
Type	WRM 188220	WRM 188220	B 157118	EU 7080	EU 6075
Type	OR ø88.5	OR ø88.57		OR ø129.8	OR ø98.02
Type					WRM 236267
PISTON					
Type	OR ø36.1 + PBK 221	OR ø37.69	OR ø20.24	OR ø52.39 + PBK 832	OR ø44.12 + PBK 132
Type	DBM 354275	DBM 354275	DBM 196133	DBM 511413	DBM 393295
Type					
Type					
Tools	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/50-80 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/120-180 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")

Procedure: **Dismantling the cylinders**	*Table:* **T-002**

Cylinder	3rd telescope extension 3713 Elite	2nd telescope extension 4010	Extension 3517	Lifting 3713 Elite-4010	Lifting 3517
Part#	53.0200.0000	53.0100.0700	53.0100.0600	53.0000.0000	53.0000.1000
Weight kg lb	146	235	328	215	280
Cylinder ø mm in	95	120	145	155	180
Rod ø mm in	50	60	80	90	90
Closed mm in	3849	4110	4130	2078	2096
Stroke mm in	3480	3480	3380	1560	1602
Pressure bar max	300	300	300	300	300
SEALS					
HEAD					
Type	OR ø69,2 + PBK 335	OR ø89,69 + PBK 621	OR ø113,7 + PBK 349	OR ø116,84 + PBK 426	OR ø139,70 + PBK 867
Type	I/GR 0500	I/GR 0600	SM 393314/1AX	WRM 354401	SWP 90110
Type	EU 5065/1	EU 6075	OR ø123.7	EU 90105	TS 90 105 12/LA
Type	OR ø78.97	OR ø98.02	WRM 314346	I/GR ø90	OR ø148.80
Type	WRM 196228	WRM 236267			BFR 90
PISTON					
Type	OR ø39.69 + PBK 824	OR ø44.12 + PBK 132	OR ø59.69 + PBK 332	OR ø47.63	OR ø69.22 + PBK 335
Type	DBM 314236	DBM 393295	DSM 492393/1A	DSM 511413/1A	DSM 590492/1A
Type					
Type					
Tools	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/120-180 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/120-180 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	282T SN/120-180 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")

Procedure: **Dismantling the cylinders**	*Table:* **T-002**

Cylinder	**Sway 3713 Elite-3517**	**Outriggers 3713 Elite-3517**	**Rear axle locking 3517**		
Part#	53.0600.0100/0200	53.0800.0400/0500	53.0700.0000		
Weight kg lb	22	42	10		
Cylinder ø mm in	105	115	75		
Rod ø mm in	60	50	40		
Closed mm in	441	772	382		
Stroke mm in	145	481	180		
Pressure bar max	300	300	300		
SEALS					
HEAD					
Type	OR ø79,77 + PBK 620	OR ø86,69 + PBK 621	OR 52,39		
Type	WRM 236267	WRM 196228	WRM 157188		
Type	B 295236	B 244196/1	B 188157		
Type					
Type					
PISTON					
Type	OR ø29.75	OR ø39.69	OR ø23.81		
Type	DBM 354275	DBM 393295	DPS 6048		
Type					
Type					
Tools	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/80-120 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")	USAG 282T SN/50-80 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")		

Procedure: Dismantling the cylinders	Table: T-002

Procedure:

■ **Opening the cylinder**

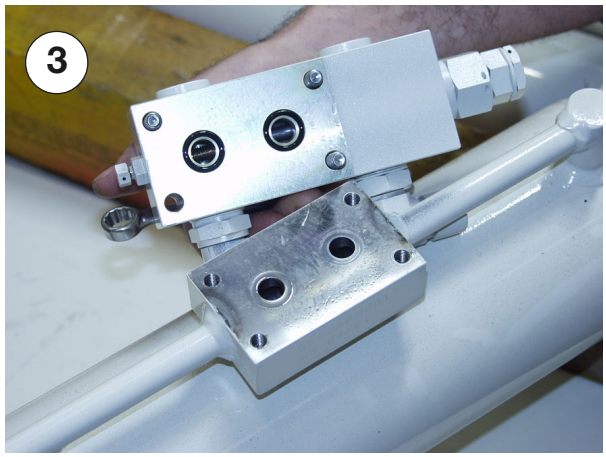
1 Clamp the cylinder in a vice with jaws of soft material (copper, aluminium, etc.).

2 Position a container of suitable size under the cylinder head to prevent oil spillage.

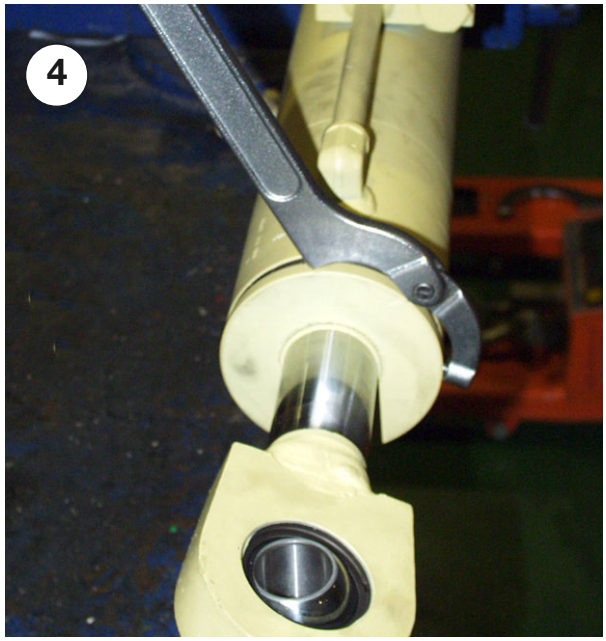


Used oils must be handled and disposed of according to local regulations. Address to legally authorised centres.

3 Remove the block valve (if fitted). Oil will gush out. Use special personal protective equipment.



4 Loosen and remove the head from the cylinder with an adequate wrench (see table).



5 Pull out the cylinder rod with extreme caution. It might be full of oil.

6 Check the following parts:
- chrome-plated rod worn and/or scored
- liner worn and/or scored
- wear of seals
- wear of sliding runners

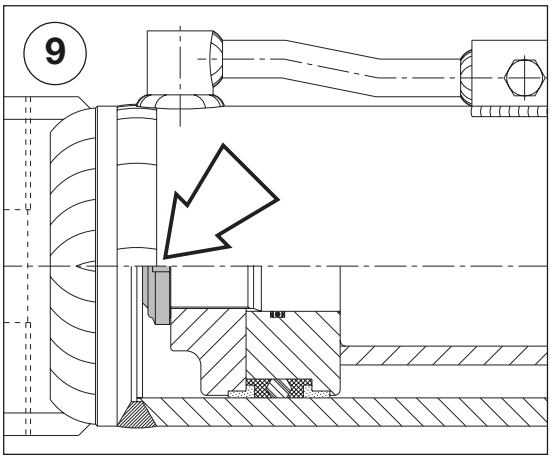
7 Remove the cylinder from the vice.

Procedure: **Dismantling the cylinders**	*Table:* **T-002**

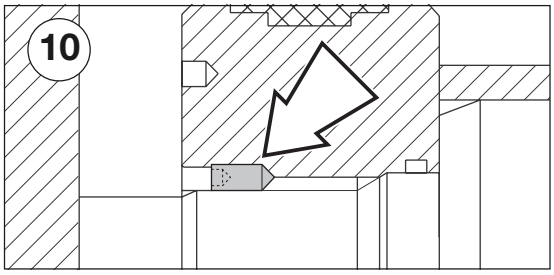
■ Removing piston and seals

8 Clamp the rod in a vice with jaws of soft material (copper, aluminium, etc.).

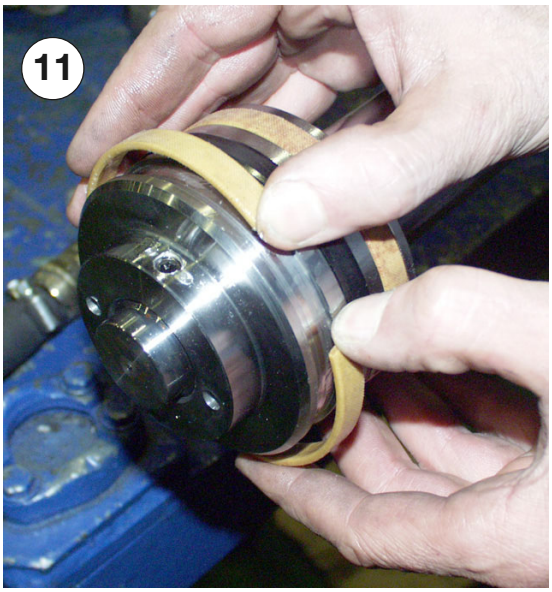
9 Unscrew the ring nut locking the cylinder piston.



10 Remove the anti-rotation pin (if any) fitted axially to the rod with an hexagonal wrench.

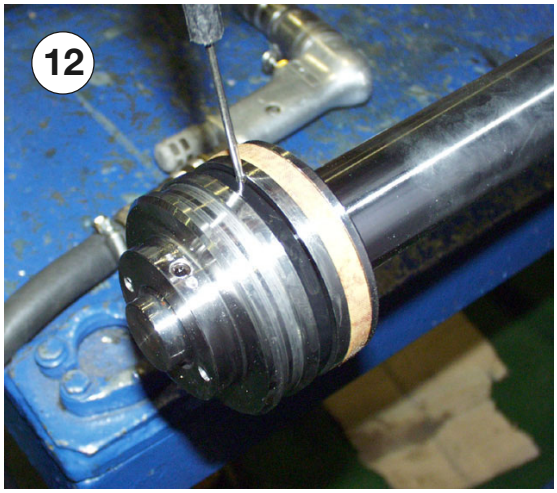


11 Press on the slotted edges to remove the two guide rings.



Procedure: Dismantling the cylinders	Table: T-002

12 With a screwdriver, pry off the seal from the housing.



13 With the USAG 281C/215 wrench with ø 6mm pins, unscrew the piston completely.

14 With a small screwdriver, pry off the O-ring between rod and piston.



■ Dismantling head and seals

15 With a small screwdriver, pry off the O-ring and the relevant extrusion-proof ring from the head.

16 Pull out the head from the chrome-plated rod

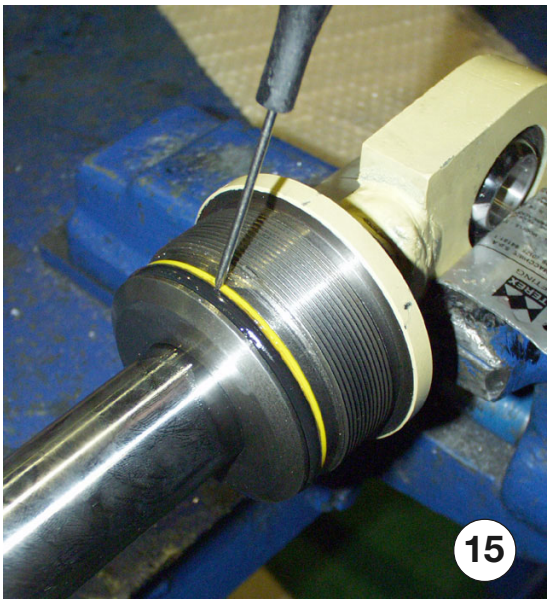
17 With a small screwdriver, pry off the mud-scraper from its housing.

18 Using the same screwdriver, pry off the seal between head and rod.

19 Carefully clean the parts, renew any damaged parts and reassemble.

IMPORTANT

Once removed, seals cannot be cleaned and refitted. They must be replaced.



Procedure: Dismantling the cylinders	Table: T-002

■ Re-assembling the cylinder

IMPORTANT

Before reassembling the parts, carefully clean them. Anoint seals, housings, threads and sliding parts.

20 Refit first internal and external seals to the head.

21 Refit internal and external seals to piston and guide rings.

22 Pull the head into the chrome-plated rod. Do not slide the internal seals against the rod thread.

23 Re-tighten the piston to the rod. Do not slide the rod thread against the internal seal of the piston.

24 Re-tighten and lock the grub-screw of the cylinder paying attention not to dent its edge to prevent loosening.

25 Clamp the cylinder with the vice.

26 Carefully anoint pistons, seals and cylinder rod.

27 Pull the piston into the cylinder paying attention not to slide the seals against the cylinder thread.

28 Push the cylinder to stop.

IMPORTANT

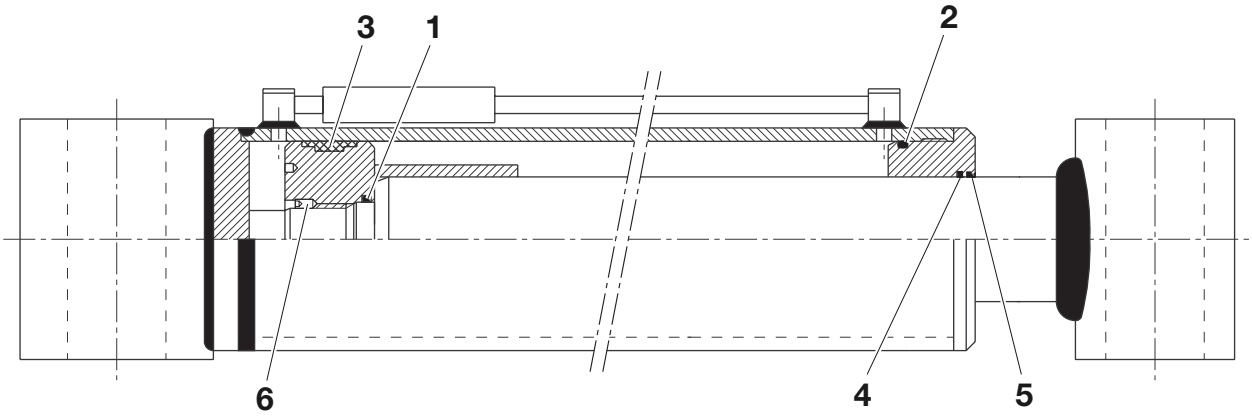
When the block valves are mounted, remove their canisters and eliminate the air.

29 Push the rod to stop into the cylinder, screw in and tighten the head. Check the hole of the grub-screw is aligned.

30 Fit the grub-screw and lock it in position with some Loctite.

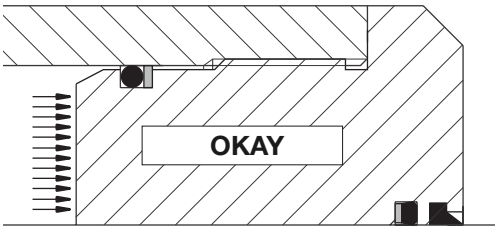
31 Before refitting the block valve, check and, if necessary, renew any worn seal. Smear the seals with some grease to hold them in position during re-assembly.

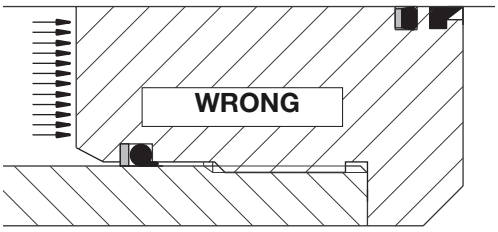
Procedure: How to refit the cylinder seals	Table: T-002



1 *Seal between rod and piston*
It is usually an O-ring. This seal hardly wears out or get damaged since pressure is maintained by the mechanical coupling of piston and stem held in position by the grub-screw **6**. A probable damage can result from a worng installation.

2 *Seal between head and cylinder*
It is usually an O-ring. This seal wers out easily if fitted in a wrong way. The extrusion-proof ring shall





be mounted so as to prevent oil leaks through the seal.

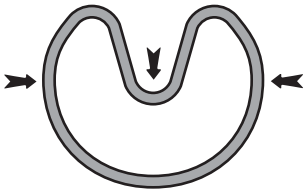
3 *Piston-cylinder seal*
This seal is subject to heavy wear. When the seal is worn, oil flows out between the two cylinder chambers and the movement is unstable and delayed. They are usually made of an elastic sealing element with a number of lips which guarantee sealing, a retaining ring of polyester resin with channels through which the fluid passes and lubricates the sealing lips, and guide ring of acetalic resin with an anti-extrusion function and a guiding function.

4 *Seal between rod and cylinder head*
This seal is subject to heavy wear. When the seal is worn, sweat and oil leaks can be noted on the head and the rod.

5 *Mud-scraper*
This seal is subject to heavy wear. The correct operation of this seal is an essential factor for the lifetime and efficiency of the rod seals.

Procedure: How to refit the cylinder seals	Table: T-002

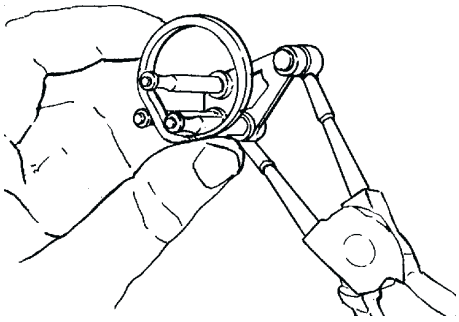
■ Refitting the seals into the internal housings

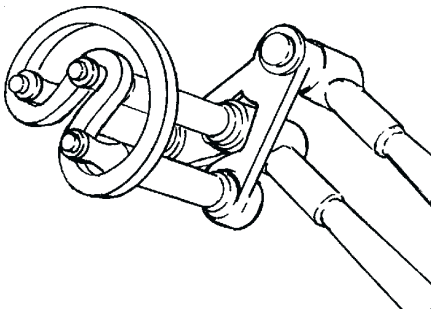


To refit a seal into its internal housing, bend it as shown to reduce its dimensions.
Once released, the seal will get back to its original shape.
To this end, use the special tool for seals (if available).

Before refitting a seal:

- Ensure all metal parts, the seal and the mounting tools are clean
- Oil the seal and the surfaces along which it has to slide with the same fluid of the system or an equivalent oil
- Make sure the seal enters the special notches and that there are no sharp edges
- Avoid a prolonged deformation of the seal during mounting.





Procedure: How to refit the cylinder seals	Table: T-002

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Procedure:	Table: T-003			
Dismantling the cylinders **Boom lifting cylinder**	3713 Elite ✔	3517 ✔	4010 ✔	3713/4010=215 3517=280

Hours	Min.
2	15

1

Bridge crane, payload 5000 kg (20000 lb)
Textile bridles or chains with hooks

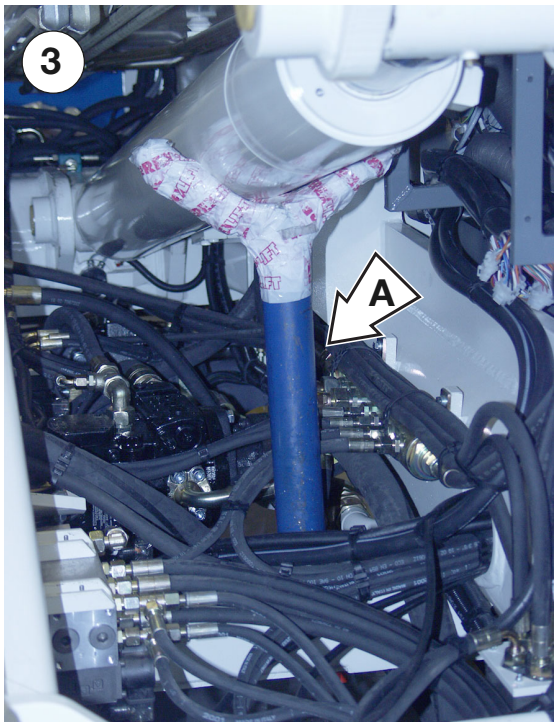
Standard tools
Adjustable stands

Dismantling:

1 Release the attachment.

2 Remove the side cover of the cab using a 5mm Allen wrench.

3 Raise the boom and put a support **A** underneath (for the preparation see A.06 “Special equipment” - dwg.01); lower the boom onto the block.

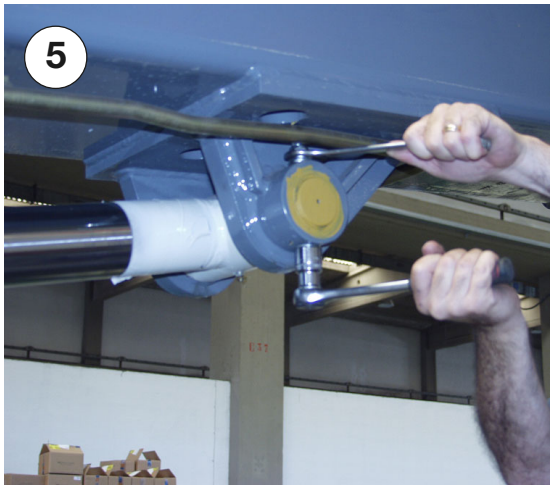


4 Secure the chains with hooks of the bridge crane to the special lugs. Pull the chains to support the boom.



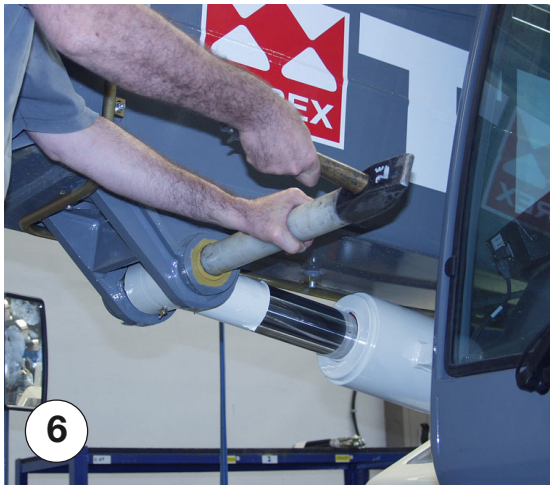
Procedure:	Table:
Dismantling the cylinders **Boom lifting cylinder**	**T-003**

5 Remove the screw fixing the pin with two 22mm wrenches for model *Telelift 3517* or two 19mm wrenches for models *Telelift 3713 Elite and 4010*

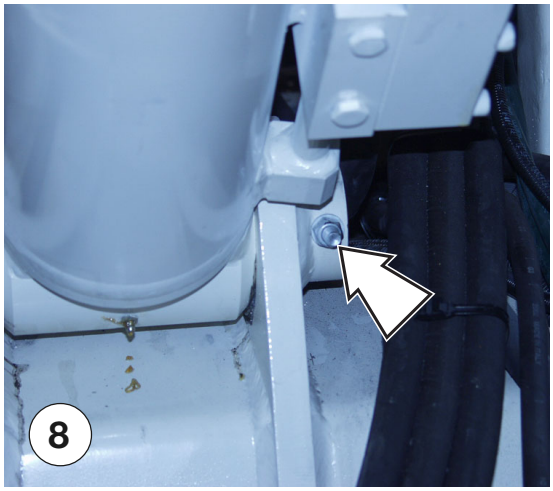


6 Knock out and extract the pin using a mallet of soft material (aluminium, copper, wood, etc.).

7 Using the bridge crane raise the boom and place a supporting stand (see A.06 “Special equipment” - dwg.02) under the attachment coupling beam to support the boom.



8 Remove the screw fixing the rear pin with two 19mm wrenches.



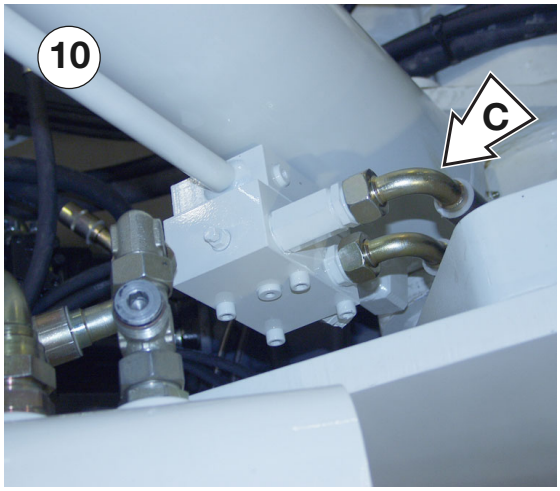
Procedure:	Dismantling the cylinders Boom lifting cylinder	Table: T-003

9 Place a container to collect oil leaks under the hydraulic lines before disconnecting.

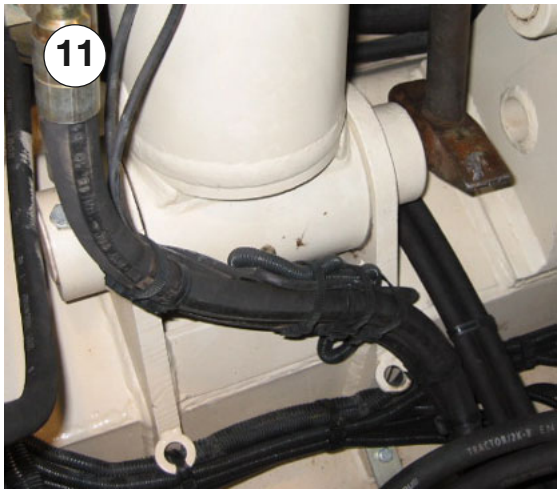


Used oils must be handled and disposed of according to local regulations. Address to legally authorised centres.

10 Disconnect the hydraulic pipes **C** from the block valve using a 27mm wrench. Plug to protect the circuit from dust and impurities.



11 Knock out and extract the rear pin using a mallet of soft material (aluminium, copper, wood, etc.).



Procedure:	Dismantling the cylinders Boom lifting cylinder	Table: T-003

12 Tie a textile bridle around the cylinder and remove it from the machine using the bridge crane.

IMPORTANT

To reassemble the cylinder, repeat the steps above in reversed order. Remember to set the circuit under pressure before moving the bridge crane away.

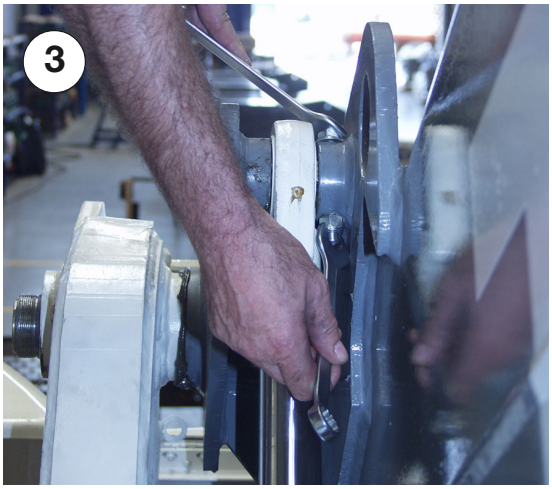
Procedure:	Table: T-004			
Dismantling the cylinders **Fork compensation cylinder**	3713 Elite ✔	3517 ✔	4010 ✔	

Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools Adjustable stands	kg	3713/4010=40 3517=43
			Hours: 2 — Min.: -
			1

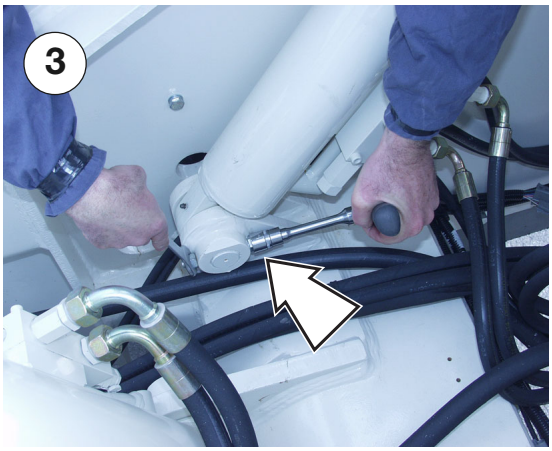
Dismantling:

1 Release the attachment.

2 Raise the boom and place a fixed stand underneath (see A.06 “Special equipment” - dwg.02) to support its weight.



3 Remove the screws fixing the cylinder pins with two 19mm wrenches.



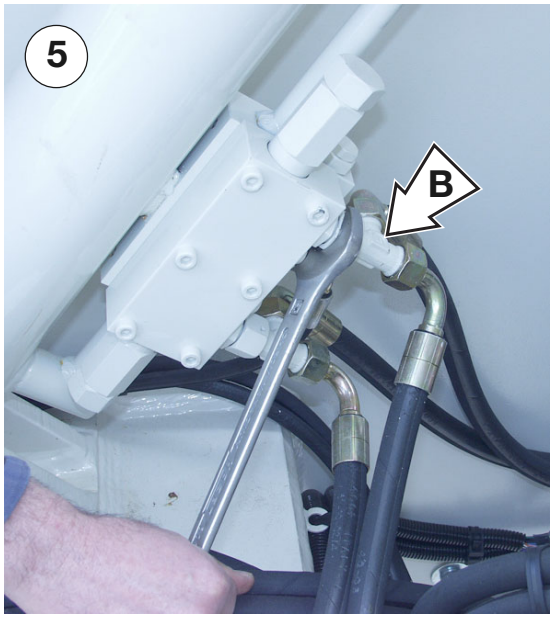
4 Place a container to collect oil leaks under the hydraulic lines before disconnecting.

PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local regulations. Address to legally authorised centres.

Procedure:	**Dismantling the cylinders** **Fork compensation cylinder**	*Table:* **T-004**

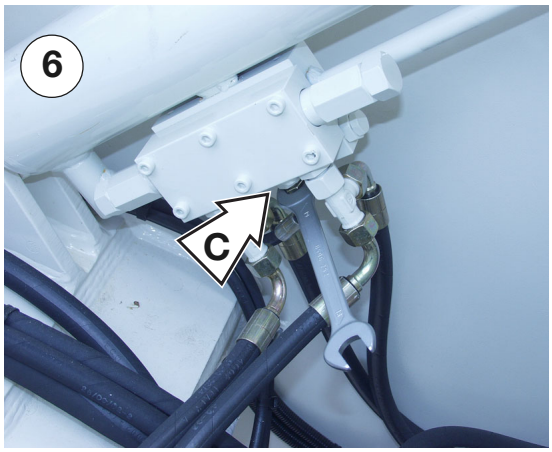
5 Disconnect the tee-joints **B** from the block valve with a 27mm wrench. Plug to protect the circuit against dust and impurities.



6 Disconnect the feeding hose **C** from the block valve with a 19mm wrench.

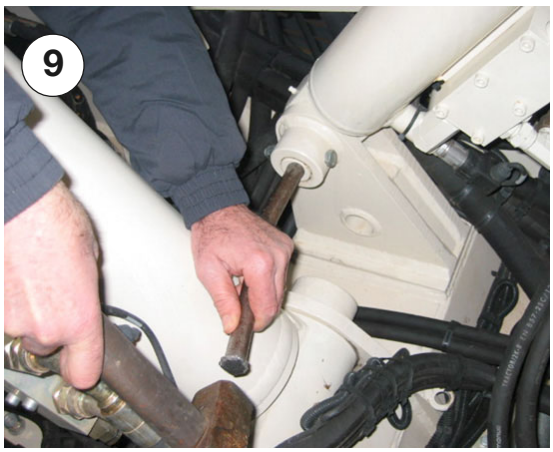
7 Knock out and extract the pin (rod side) using a mallet of soft material (aluminium, copper, wood, etc.).

8 Fix the cylinder with a textile bridle connected to the bridge crane to support its weight.



9 Premove the bottom pin.

10 Remove the cylinder from the machine using the bridge crane. Store the cylinder in a place where it does not hinder other operations.



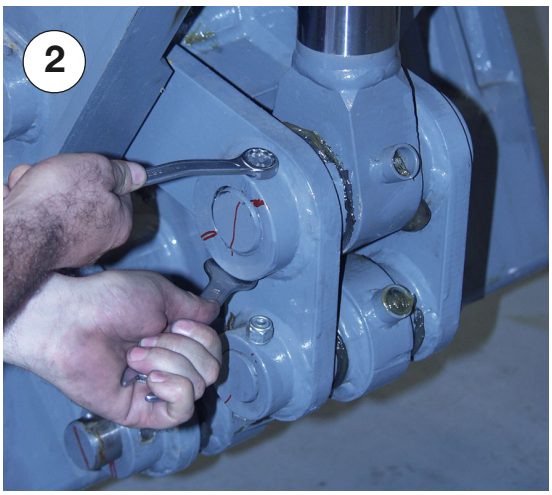
Procedure:	Table: T-005			
Dismantling the cylinders **Attachment rotation cylinder**	3713 Elite ✔	3517 ✔	4010 ✔	

Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools Adjustable stands	kg	80
			Hours: 1 — Min.: 30
			1

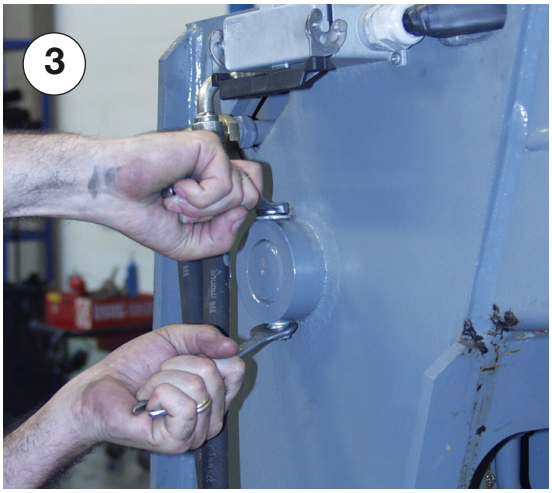
Dismantling:

1 Release the attachment.

2 Remove the screw fixing the pin (rod side) with two 19mm wrenches.



3 Remove the screw fixing the pin (bottom side) with two 19mm wrenches.



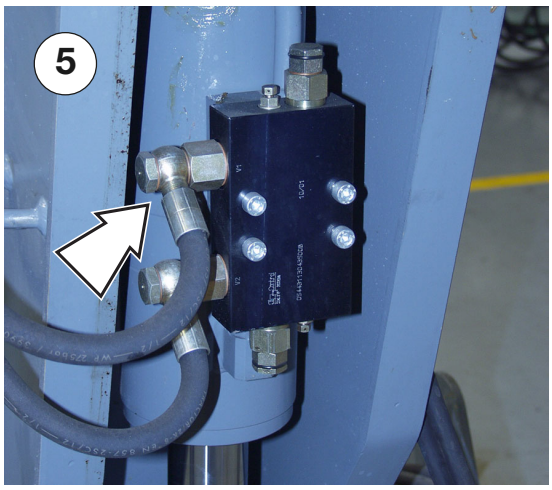
4 Place a container of suitable size under the hydraulic lines before disconnecting.

PROTECT THE ENVIRONMENT

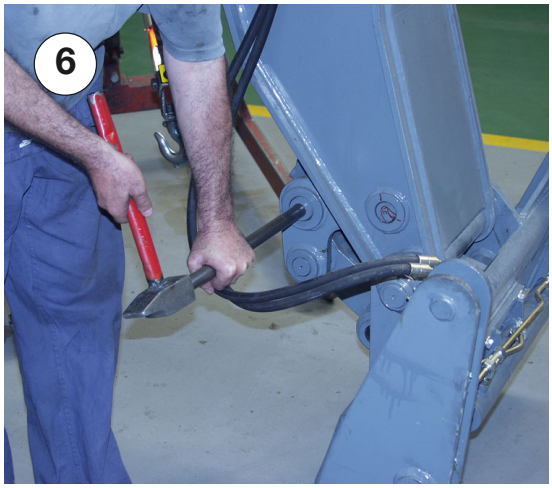
Used oils must be handled and disposed of according to local regulations. Address to legally authorised centres.

Procedure:	Dismantling the cylinders Attachment rotation cylinder	Table: T-005

5 Disconnect the two hydraulic pipes from the block valve with a 27mm wrench. Plug to protect the circuit from dust and impurities.

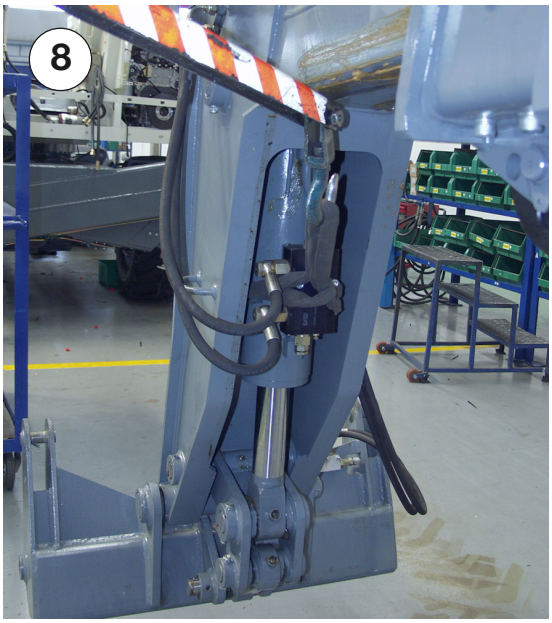


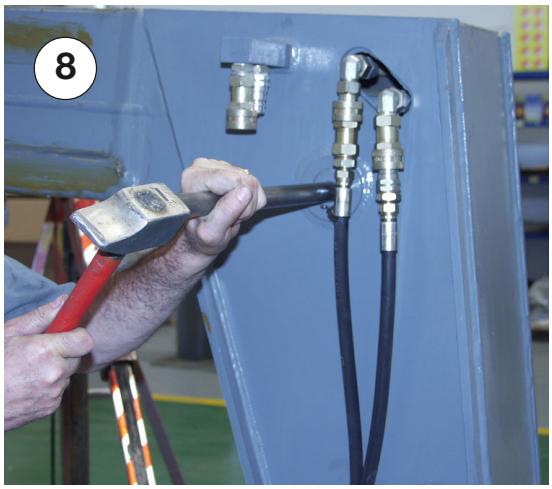
6 Knock out and extract the pin (rod side) using a mallet of soft material (aluminium, copper, wood, etc.).



7 Tie a textile bridle around the cylinder and secure the bridle to a hydraulic elevator which shall support the cylinder once the pin is removed.

8 Pull the bridle and extract the pin from the bottom side. Store the cylinder in a place where it does not hinder other operations.



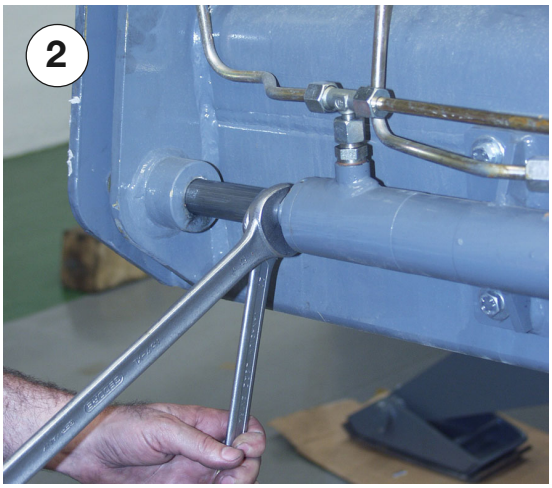


Procedure:	Table: T-006			
Dismantling the cylinders **Attachment locking cylinder** **(up to serial no. 9261)**	3713 Elite ✔	3517 ✔	4010 ✔	kg: 11.4
				Hours: 1 — Min.: -
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools			1

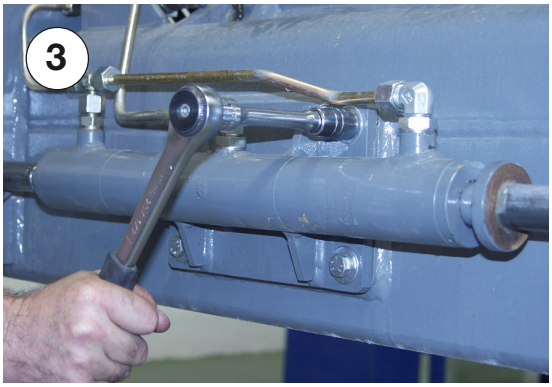
Dismantling:

1 Release the attachment.

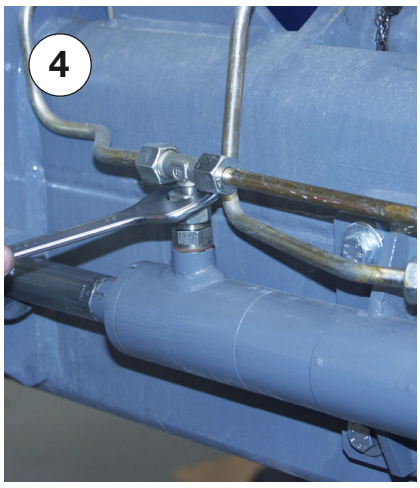
2 Unscrew the cylinder coupling terminals using two 27mm wrenches.

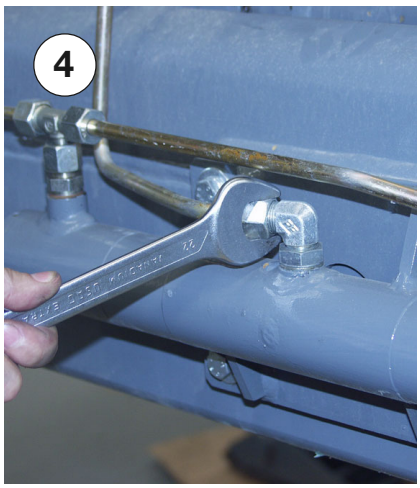


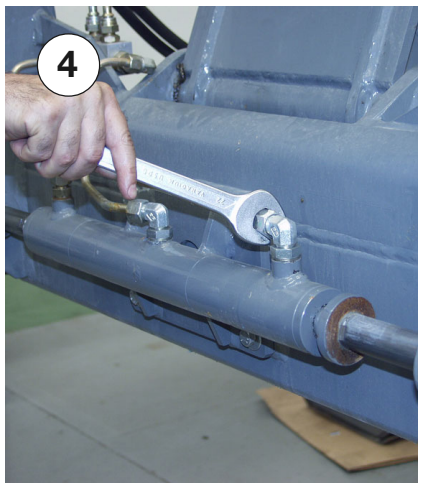
3 Loosen the 4 screws fixing the cylinder to the attachment holding plate with two 17mm wrenches.



4 Disconnect the iron pipes from the cylinder with a 22mm wrench.

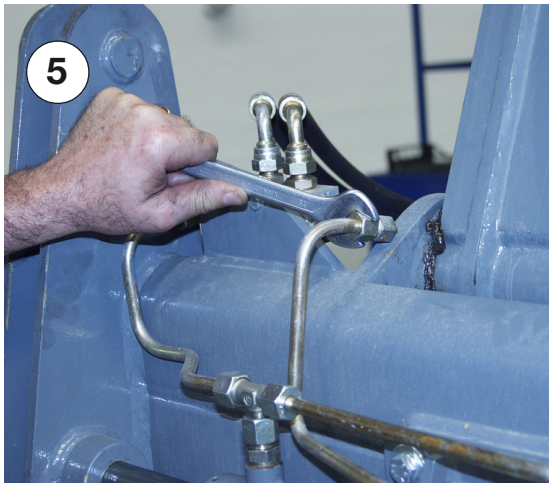






Procedure:	Dismantling the cylinders Attachment locking cylinder (up to serial no. 9261)	Table: T-006

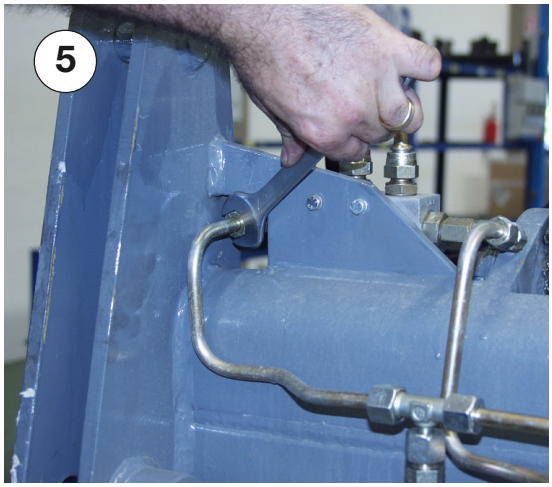
5 With a 19mm hexagonal wrench, loosen the iron pipes coming from the block valve.



CAUTION

Iron pipes are under pressure being upstream the block valve. Proceed with extreme caution.

6 Free the pipes, remove the screws fixing the cylinder to the attachment holding frame and remove the cylinder.



Reassembly:

IMPORTANT

To reassemble the cylinder, repeat the steps above in reversed order considering the precautions below.

1 Block the terminal pins on the cylinder rods after smearing the threads with Loctite 245. Clean and use the amount indicated in the bottle.

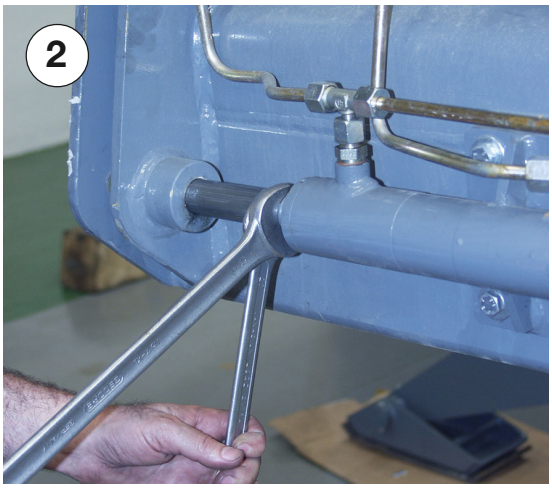
2 Lock the four fixing screws of the cylinder to the holding frame with the terminal pins completely driven into their housing but free to rotate (line up the pins with the holes).

Procedure:	Table: T-006.1			kg	11.4
Dismantling the cylinders **Attachment locking cylinder** **(from serial no. 9262)**	3713 Elite ✔	3517 ✔	4010 ✔	Hours: 1	Min.: -
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools				1

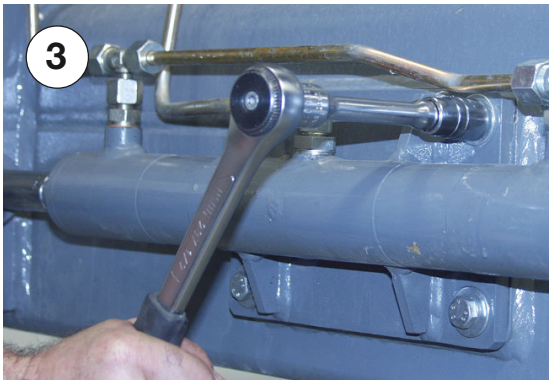
Dismantling:

1 Release the attachment.

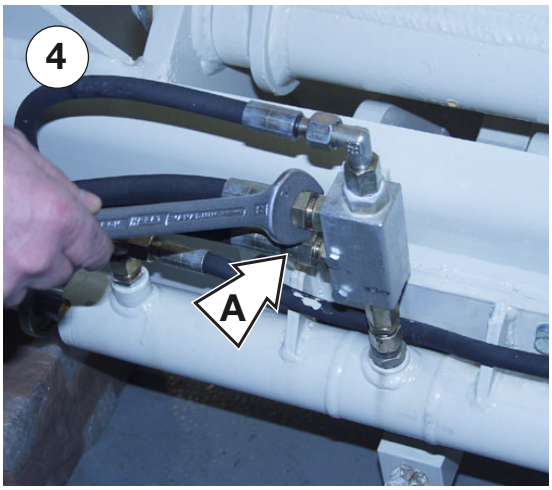
2 Unscrew the cylinder coupling terminals using two 27mm wrenches.



3 Loosen the 4 screws fixing the cylinder to the attachment holding plate with two 17mm wrenches.

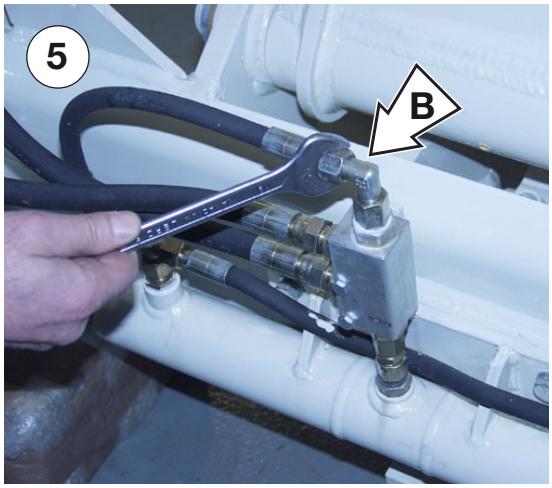


4 Disconnect the delivery hoses **A** coming from the boom using a 22mm wrench.



Procedure:	Dismantling the cylinders Attachment locking cylinder (from serial no. 9262)	Table: T-006.1

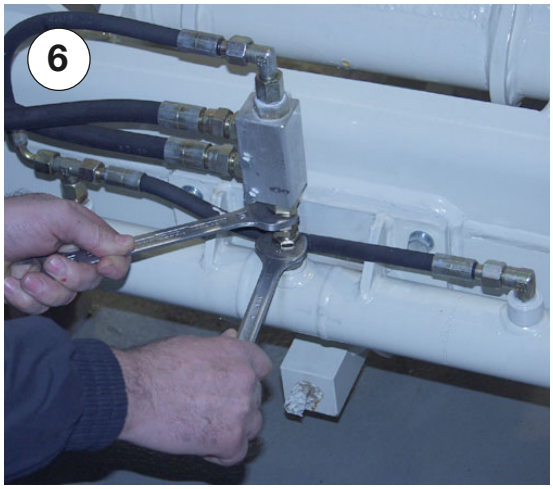
5 With a 19mm hexagonal wrench, loosen the flexible hose **B**.



CAUTION

Flexible hoses are under pressure being upstream the block valve. Proceed with extreme caution.

6 Using two 19mm wrenches, free the cylinder of the block valve.



Reassembly:

IMPORTANT

To reassemble the cylinder, repeat the steps above in reversed order considering the precautions below:

1 Block the terminal pins on the cylinder rods after smearing the threads with Loctite 245. Clean and use the amount indicated in the bottle.

2 Lock the four fixing screws of the cylinder to the holding plate with the terminal pins completely driven into their housing but free to rotate (line up the pins with the holes).

Procedure:	Table: T-007			
Dismantling the cylinders **Rear axle locking cylinder**	3713 Elite ☐	3517 ☑	4010 ☐	kg: 10
				Hours: 1 — Min.: -
Standard tools				1

Dismantling:

1 Place a container to collect oil leaks under the hydraulic lines before disconnecting them.

PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local and national regulations. Address to legally authorised centres.

2 Lower the boom to the ground.

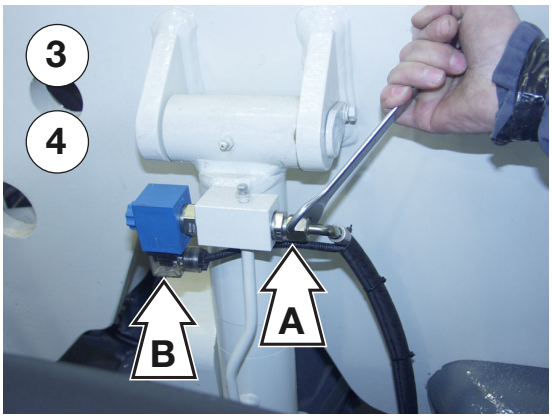
3 With a 19mm wrench, disconnect the hydraulic line **A** from the block valve. Plug the couplings to protect the circuit against dust and impurities.

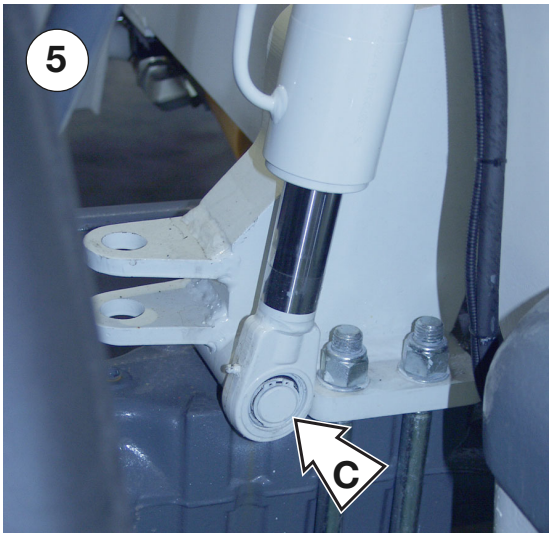
4 Disconnect the electrical connector **B**.

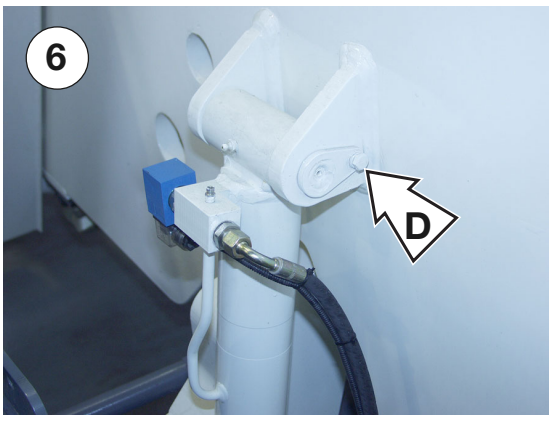
5 Remove the spring ring **C** fixing the cylinder to the pin (rod side).

6 With a 13mm wrench, remove the fixing screw **D**; remove the upper locking pin from the cylinder.

7 Extract the cylinder from the lower pin and store it in a safe place.





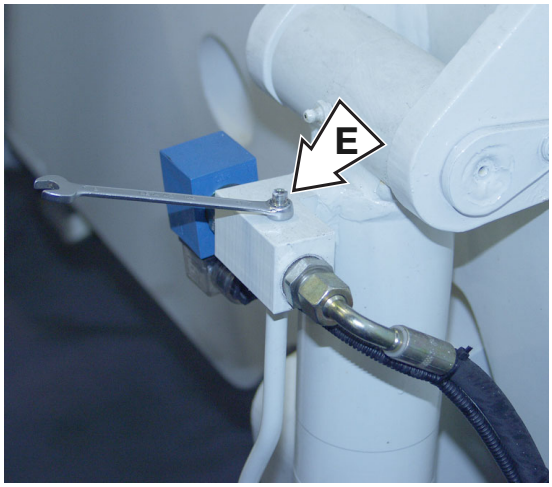


Procedure:	Dismantling the cylinders Rear axle locking cylinder	Table: T-007

Reassembly:

8 Refit the cylinder and replace the pins, then eliminate any residual air from the circuit.

9 Sway the machine to the right and to the left while opening the air vent valve **E** with an 8mm wrench. Repeat the operation until oil without air bubbles starts flowing out of the valve.



Procedure:	Table: T-008				
Dismantling the cylinders **Outriggers' cylinder (2)**	3713 Elite ✔	3517 ✔	4010 ☐	kg	42
				Hours	Min.
				1	30
	Standard tools				1

Dismantling:

1 Lower the boom to the ground.

2 Lower the outrigger whose cylinder shall be dismatled to the ground.

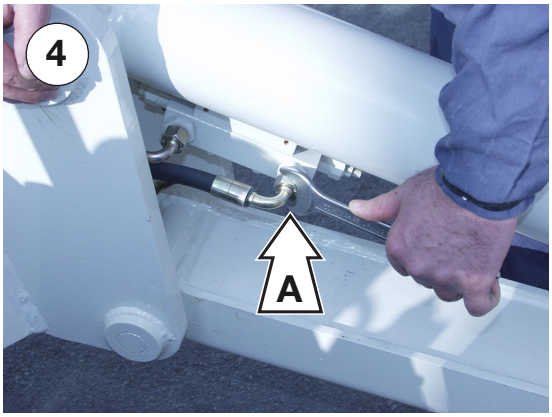


3 Place a container to collect oil leaks under the hydraulic lines before disconnecting them.

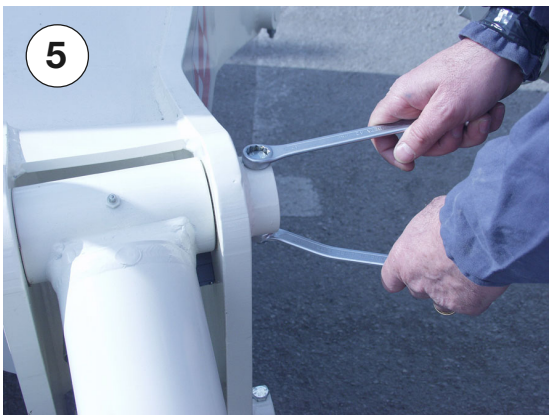
PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local and national regulations. Address to legally authorised centres.

4 With a 22mm wrench, disconnect the hydraulic lines **A** from the block valve. Plug to protect the circuit against dust and impurities.



5 With two 17mm wrenches, remove the screw fixing the pin (bottom side)



Procedure:	**Dismantling the cylinders** **Outriggers' cylinder (2)**	*Table:* **T-008**

6 With two 17mm wrenches, remove the screw fixing the pin (rod side).



7 Sling the cylinder with a textile bridle connected to a tackle.

8 Knock out and extract the fixing pins of the cylinder with a mallet of soft material (aluminium, copper, wood, etc.).

Procedure:	Table: T-009			kg	22
Dismantling the cylinders **Machine sway cylinders**	3713 Elite ✔	3517 ✔	4010 ☐	Hours	Min.
				1	30
	Standard tools				1

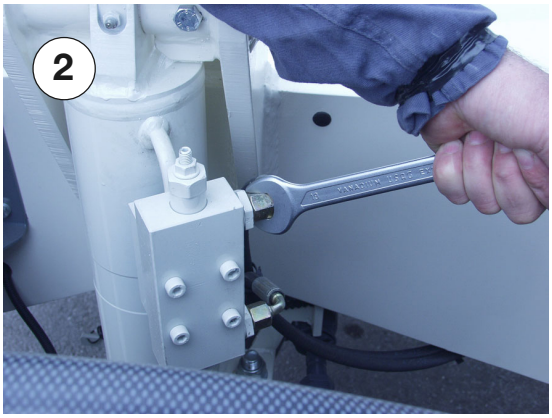
Dismantling:

1 Place a container to collect oil leaks under the hydraulic lines before disconnecting them.

PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local and national regulations. Address to legally authorised centres.

2 With a 19mm wrench, disconnect the hydraulic lines from the block valve. Plug to protect the circuit against dust and impurities.



3 With two 17mm wrenches, remove the screw fixing the pin (bottom side).



Procedure:	Dismantling the cylinders Machine sway cylinders	Table: T-009

4 With two 17mm wrenches, remove the screw fixing the pin (rod side).

5 Knock out and extract the pins with a mallet of soft material (aluminium, copper, wood, etc.).

6 Remove and store the cylinder in a safe place.



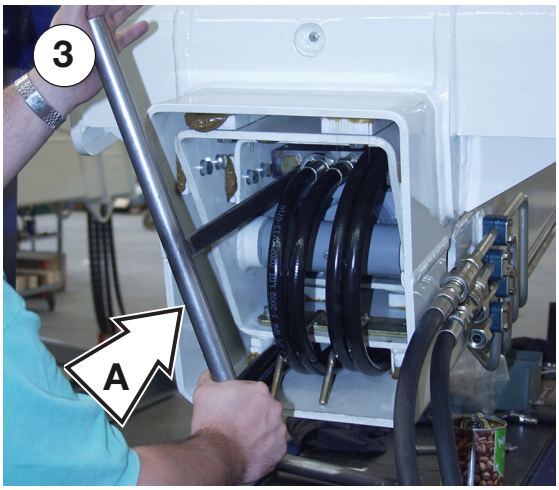
Procedure:	Table: T-010			
Dismantling the cylinders **3rd telescope extension cylinder**	3713 Elite ✔	3517 ☐	4010 ☐	kg 146
				Hours 2 / Min. 30
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools			1

Dismantling:

1 Set the boom to horizontal position.

2 Remove the attachment holding plate from the boom nose.

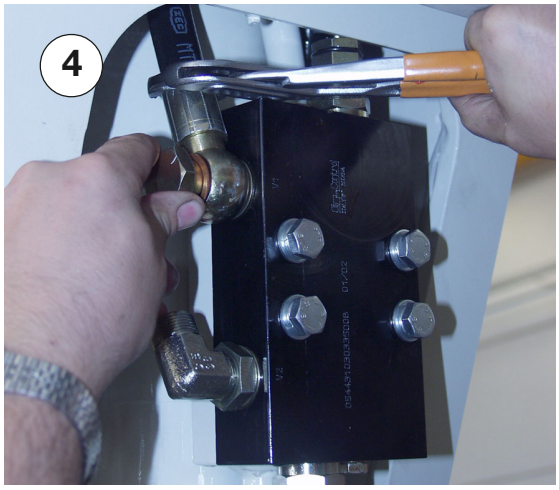
3 Disconnect the hydraulic lines from the block valve of the third telescope extension cylinder using the special wrench **A** (see A-06 dwg.04).



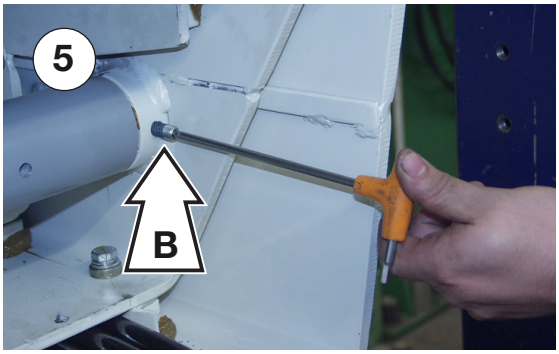
PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local and national regulations. Address to legally authorised centres.

4 Disconnect and plug the hydraulic lines from both the block valve of the fork pitching cylinder and the hose-ring fitted to the boom nose. Tie a cord of suitable length around the lines for the subsequent reassembly, then extract the hydraulic hoses from the rear side of the boom.

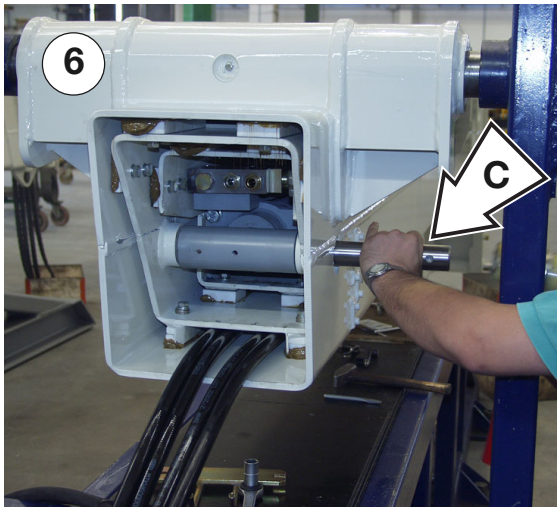


5 Extract the grubscrew **B** locking pin **C** (see step 6).



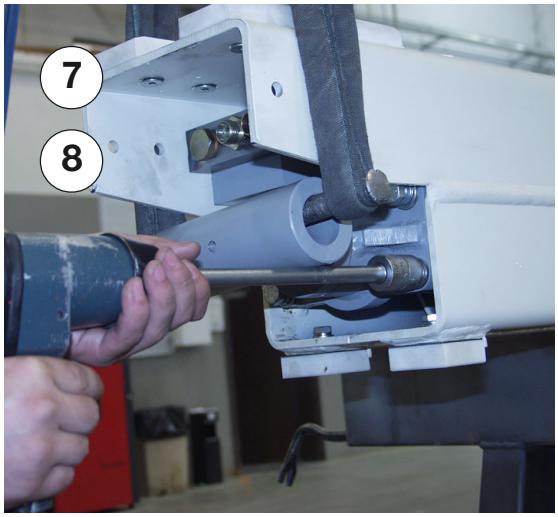
Procedure:	Table:
Dismantling the cylinders **3rd telescope extension cylinder**	**T-010**

6 Extract pin **C** to free the extension cylinder.

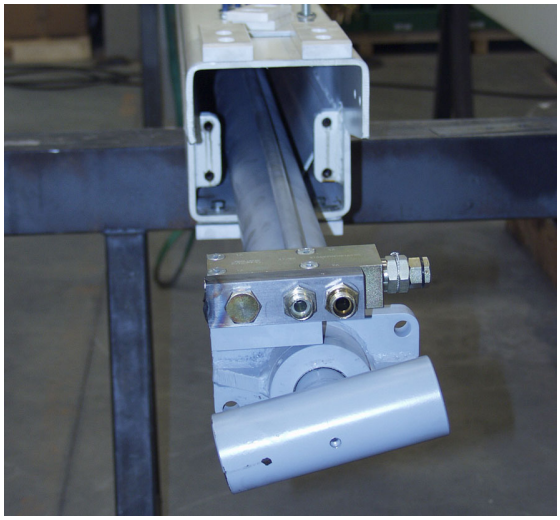


7 Using a screwing machine with extension and a 22mm wrench, remove the 4 screws fixing the cylinder to the boom tube.

8 Tie a textile bridle connected to the bridge crane around the cylinder (see figure) and start pulling the cylinder out of the boom tube.



9 Store the cylinder in an area where it does not hinder other operations.



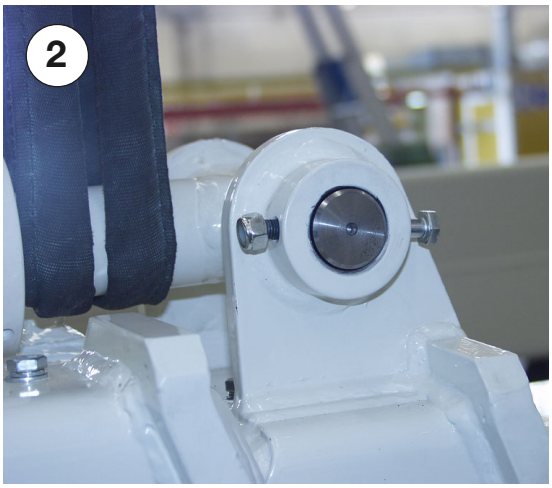
Procedure:	Table: T-011		
Dismantling the cylinders **2nd telescope extension cylinder**	3713 Elite ✔	3517 ☐	4010 ☐

Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools	kg	235
			Hours: 1 — Min.: -
			1

Dismantling:

1 Set the boom to horizontal position.

2 Remove the screw fixing the pin (rod side) using two 17mm wrenches.



3 Knock out and extract the pin with a mallet of soft material (aluminium, copper, wood, etc.).



4 Using a 27mm ring spanner, remove the cylinder guide U-bolt.



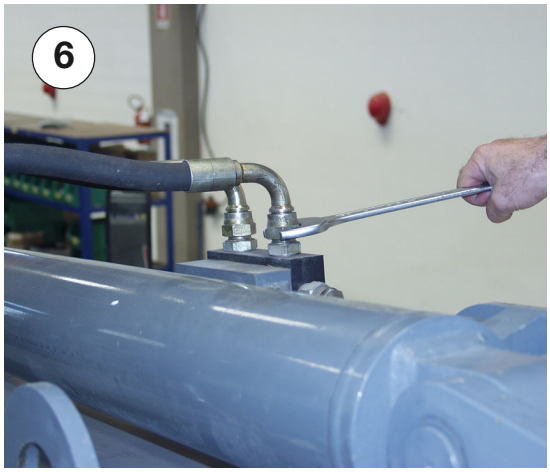
Procedure:	Dismantling the cylinders 2nd telescope extension cylinder	Table: T-011

5 Using two 17mm wrenches, remove the screw fixing the pin (bottom side).



PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local and national regulations. Address to legally authorised centres.



6 With a 27mm wrench, disconnect the two hydraulic lines from the block valve. Plug the couplings to protect the circuit against dust and impurities.

7 Secure the cylinder with textile bridles. Slightly pull the bridles and remove the pin from the bottom side.

8 Remove and lower the cylinder to the ground.

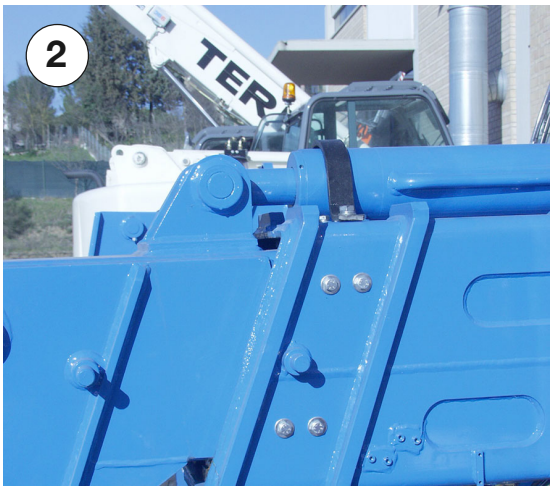


Procedure:	Table: T-011.1			
Dismantling the cylinders **2nd telescope extension cylinder**	3713 Elite ☐	3517 ☐	4010 ☑	kg: 235
				Hours: 1 — Min.: -
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools			1

Dismantling:

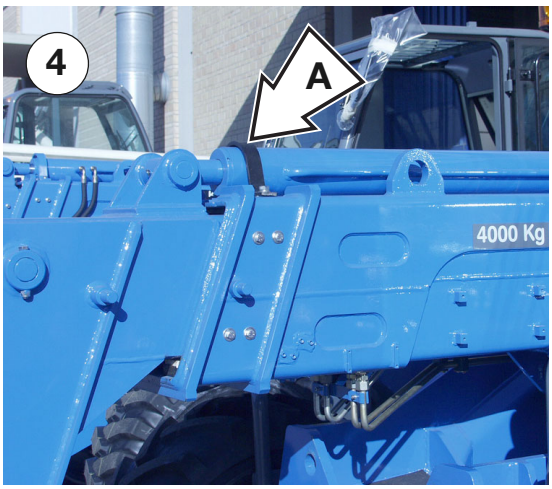
1 Set the boom to horizontal position

2 Remove the screw fixing the pin (rod side) using two 17mm wrenches.



3 Knock out and extract the pin with a mallet of soft material (aluminium, copper, wood, etc.).

4 Using a 27mm ring spanner, remove the cylinder guide U-bolt **A**.



5 Using two 17mm wrenches, remove the screw fixing the pin (bottom side).



Procedure:	Dismantling the cylinders 2nd telescope extension cylinder	Table:
		T-011.1

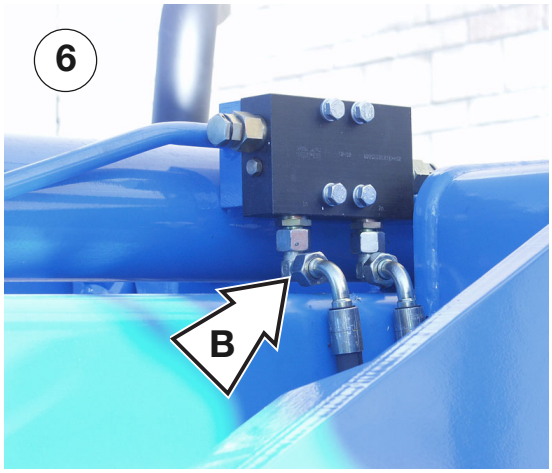
PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to local and national regulations. Address to legally authorised centres.

6 With a 27mm wrench, disconnect the two hydraulic lines **B** from the block valve. Plug the couplings to protect the circuit against dust and impurities.

7 Secure the cylinder with textile bridles. Slightly pull the bridles and remove the pin from the bottom side.

8 Remove and lower the cylinder to the ground.

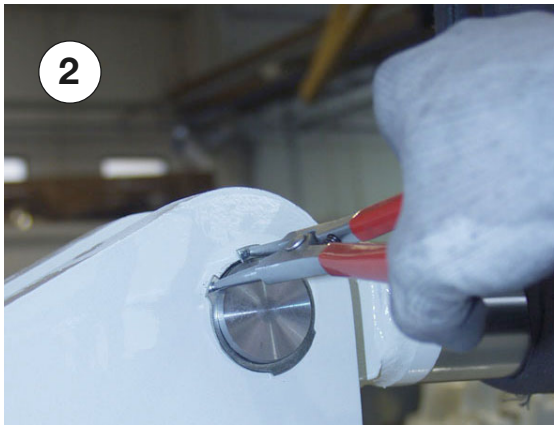


Procedure:	Table: T-011.2			
Dismantling the cylinders **2nd telescope extension cylinder**	3713 Elite ☐	3517 ☑	4010 ☐	kg: 328
				Hours: 1 — Min.: -
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools			1

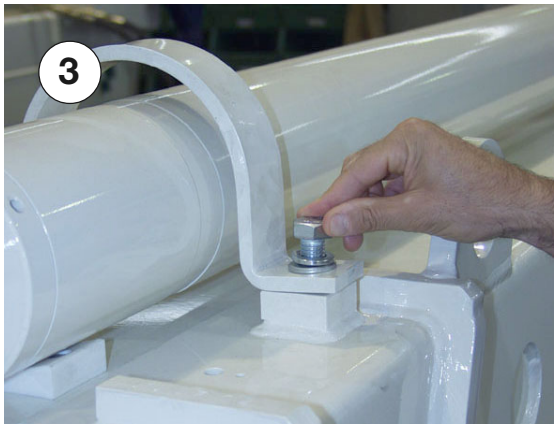
Procedure:

1 Set the boom to horizontal position and fully withdrawn.

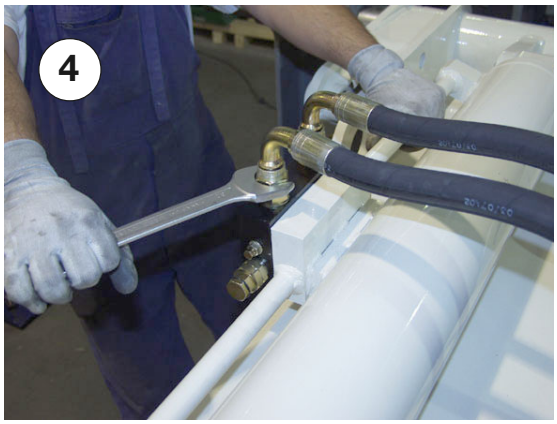
2 Remove the retaining ring locking the pin of the cylinder (rod side), then knock out and extract the pin with a hammer of soft material.



3 Remove the U-bracket locking the cylinder with a 27mm wrench.



4 With a 32mm wrench, disconnect the two hydraulic lines feeding the cylinder. Plug both lines and the valve to protect the circuit against dust and impurities.

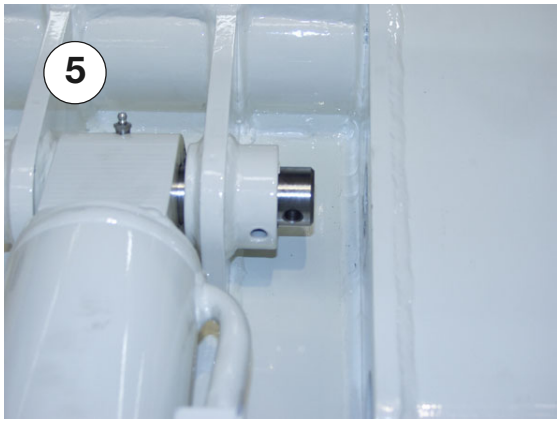


Procedure: **Dismantling the cylinders 2nd telescope extension cylinder**	*Table:* **T-011.2**

5 Remove the screw locking the cylinder pin (bottom side). Knock out and extract the pin with a hammer of soft materia

6 Secure the cylinder with a textile bridle of adequate capacity, connected to the bridge crane. Lift out and store the cylinder in a safe place.

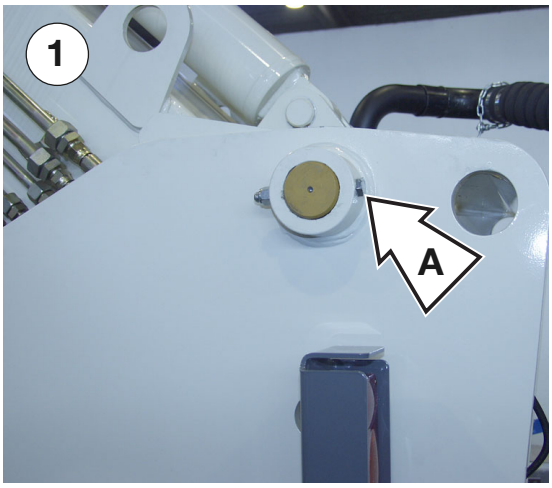
7 Reassemble following the previous steps in reversed order.



Procedure: **Dismantling the boom**	Table: **T-012**			see table
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: 5 — Min.: -
Bridge crane, payload 6000 kg Textile bridles or chains with hooks	Standard tools			2

Dismantling:

Machine	Boom weight (kg)
Telelift 3713 Elite	2300
Telelift 3517	3588
Telelift 4010	1846



1 Remove the fixing screw from the boom pin **A** with a 22mm wrench.

2 Sling the boom with a 4-leg chain of approx. 3.5 metres. Secure the chain to the anchoring lugs and pull it.

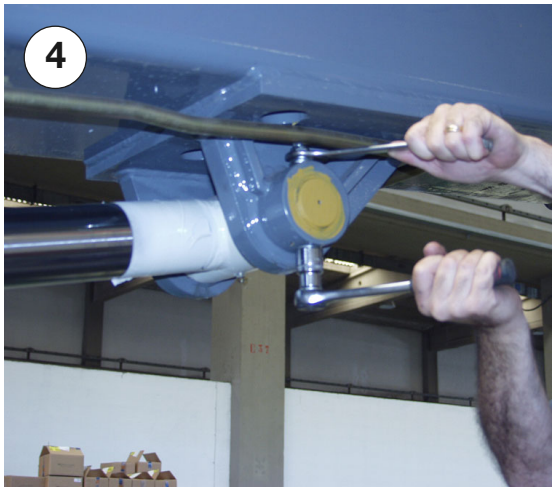


DANGER

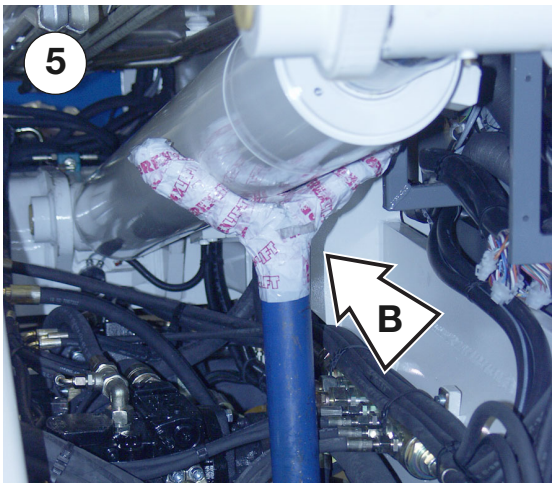
Make sure that the minimum capacity of the chain is at least 6 tons.

Procedure: **Dismantling the boom**	Table: **T-012**

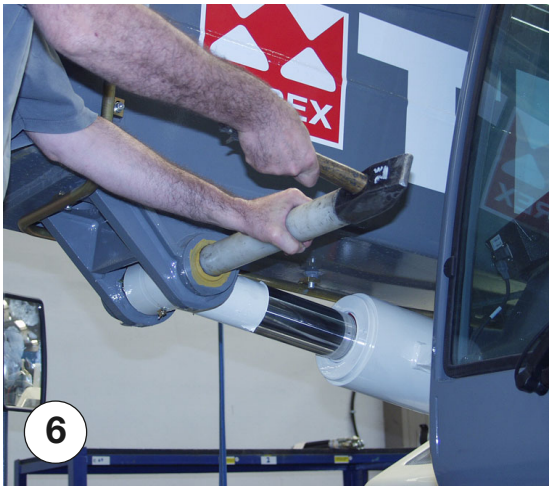
4 With two 24mm wrenches, remove the screw fixing the lifting cylinder (rod side).



5 Place support **B** (see A.06 “special equipment” - dwg.01)

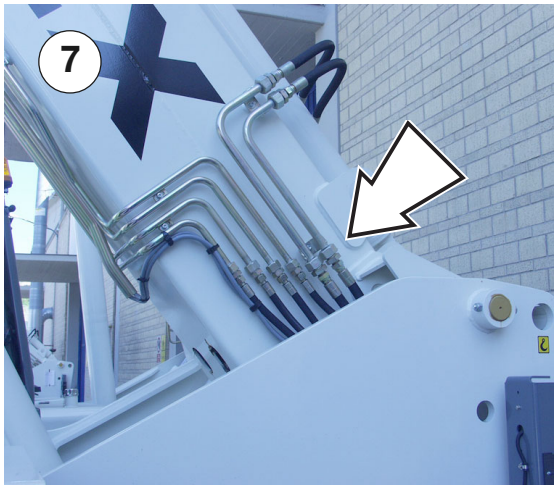


6 Knock out and extract the pin with a mallet of soft material (aluminium, copper, wood, etc.).

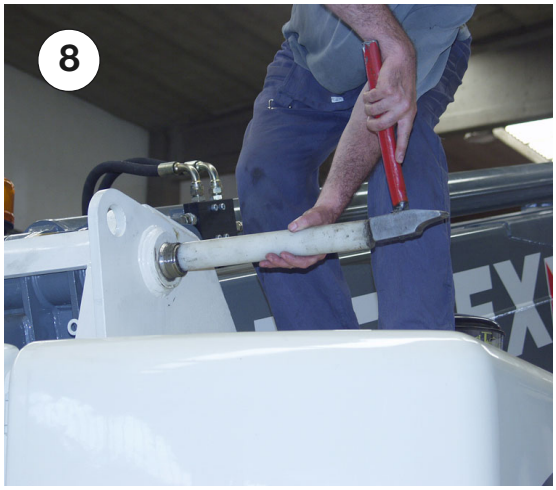


Procedure: **Dismantling the boom**	*Table:* **T-012**

7 Eliminate any residual pressure from the hydraulic circuit before disconnecting the flexible hoses from the pipes with a 27mm wrenck and loosening the counter-nut with a 30mm wrench (or 27+30+41 mm for Telelift 3517)



8 Knock out and extract the boom joint pin with a mallet of soft material (aluminium, copper, wood, etc.).



9 Raise the boom so that it does not hinder other operations.



Procedure: **Dismantling the boom**	*Table:* **T-012**

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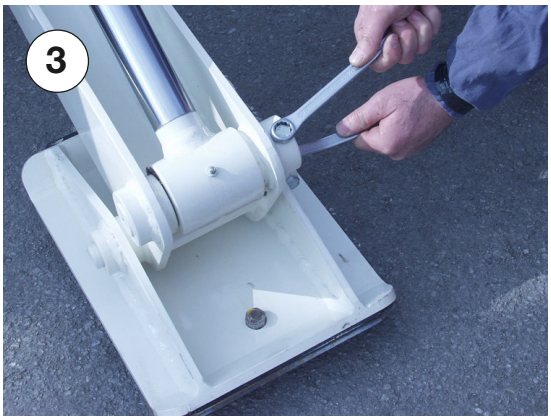
Procedure: **Dismantling the outriggers**	Table: **T-013**			kg: **50 cad.**
	3713 Elite ✔	3517 ✔	4010 ☐	Hours: **1** Min.: **-**
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools			**1**

Dismantling (operation referred to a single outrigger but applicable to both):

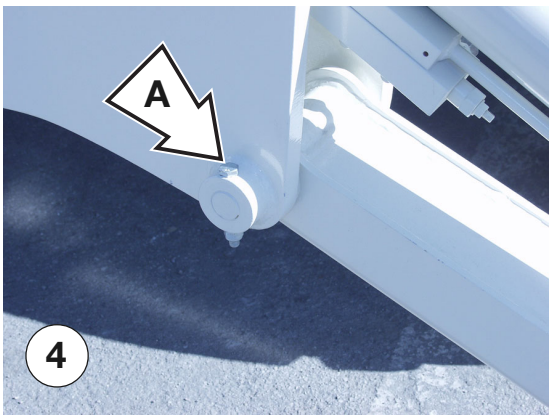


1 Lower the boom to the ground.

2 Lower the outrigger you wish to dismantle.



3 With two 17mm wrenches, remove the screw fixing the pin of the outrigger cylinder (rod side).



4 With two 17mm wrenches remove the screw of the pin fixing the outrigger to the machine frame.

5 Place a wooden block between the outrigger leg and the rod to support the weight.

Procedure: **Dismantling the outriggers**	Table: **T-013**

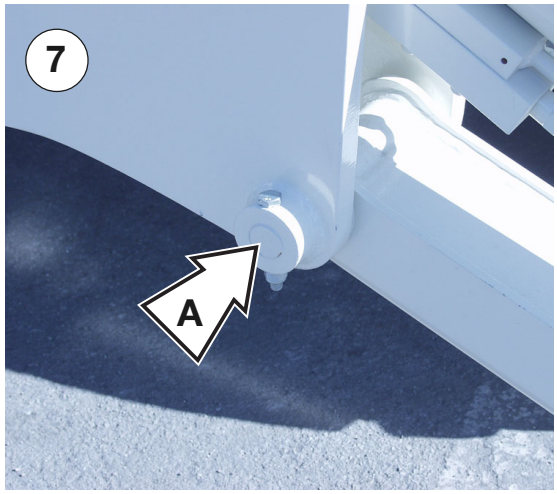
6 Knock out and extract the pin (rod side) with a mallet of soft material (aluminium, copper, wood, etc.).



IMPORTANT

Don't knock the pins from the insertion side of the transversal locking screw.

7 Knock out and extract the pin of the outrigger leg with a plug (ø25 x 300) of soft material (aluminium, copper, wood, etc.) and support the outrigger before extracting the plug.

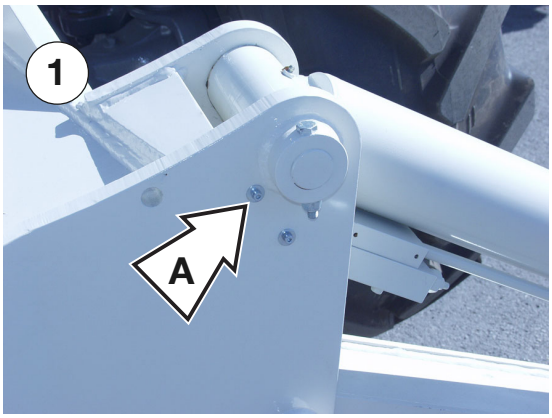


8 Lower the outrigger leg to the ground and remove the wooden block.

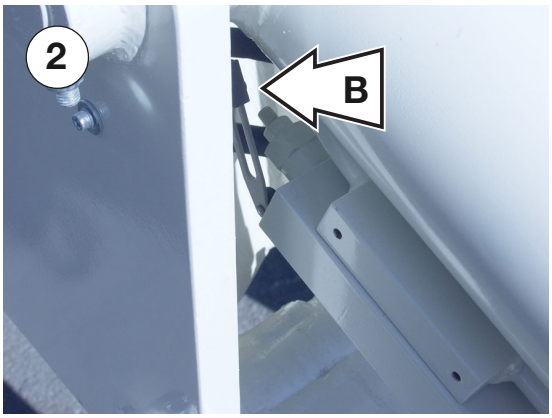
Procedure: **Removing the outriggers' micro-switch**	Table: **T-014**			kg	0.3
	3713 Elite ✔	3517 ✔	4010 ☐	Hours	Min.
Standard tools				30	-
				1	

Dismantling:

1 With a 4mm hexagonal wrench, remove the fixing screws of the micro-switch.



2 Remove the end plate of micro-switch **B**.



3 Disconnect the electrical wires **C** of the micro-switch.



Procedure: **Removing the outriggers' micro-switch**	*Table:* **T-014**

Assembly:

4 Refit the micro-switch and adjust its position so that it is activated when the outrigger is lowered to the ground.

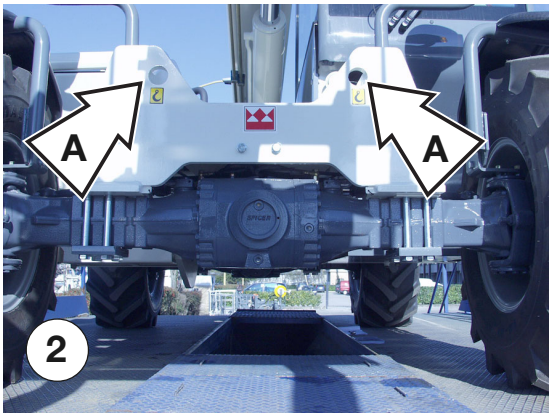
Procedure: **Dismantling the front axle**	Table: **T-015**			kg: 700
	3713 Elite	3517	4010	Hours: 3 / Min.: -
Bridge crane, payload 1000 kg Textile bridles or chains with hooks	✔	✔	✔	Standard tools 1

Dismantling:

1 Lower the 4 outriggers to the ground to raise the front wheels slightly above the ground.



2 For Telelift 4010: Raise the chassis securing some chains connected to the bridge crane to the special lugs **A**. Place some wooden blocks underneath.

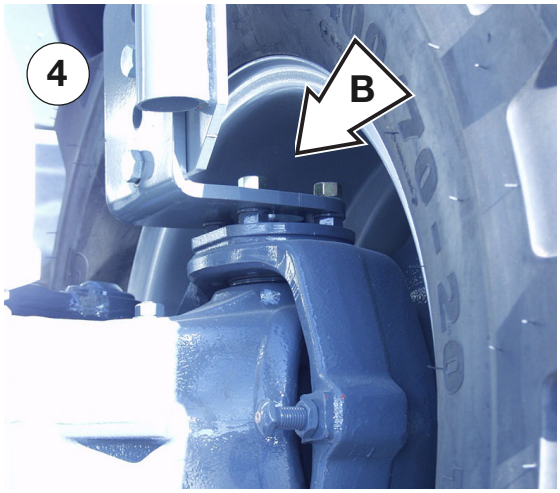


3 Remove the front wheels - see T-001.



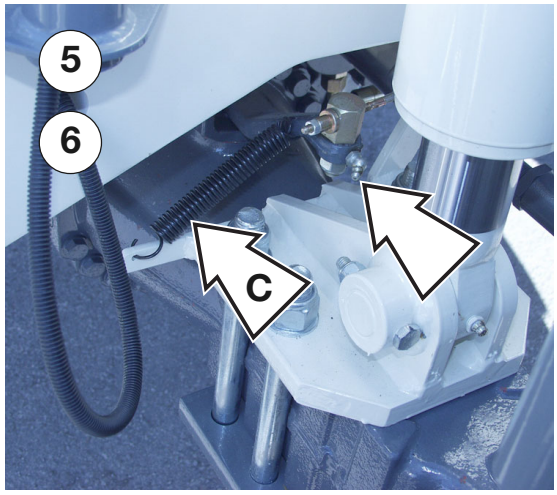
Procedure: **Dismantling the front axle**	*Table:* **T-015**

4 Loosen the bridge-shaped fixing screws **B** with a 19mm wrench and remove the mud-guard.

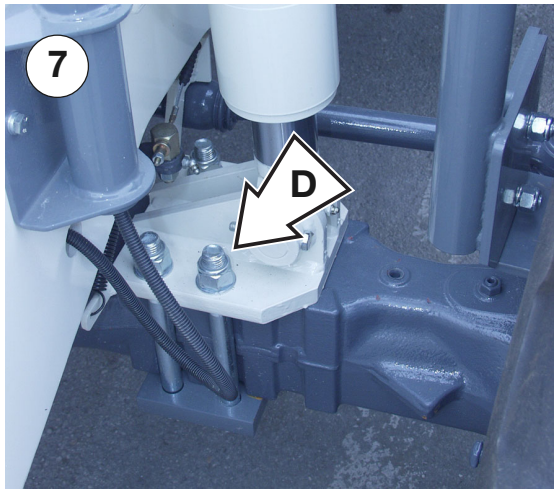


5 Disconnect the brake return spring **C**.

6 Remove the anchor of the brake cable using a 19mm wrench.

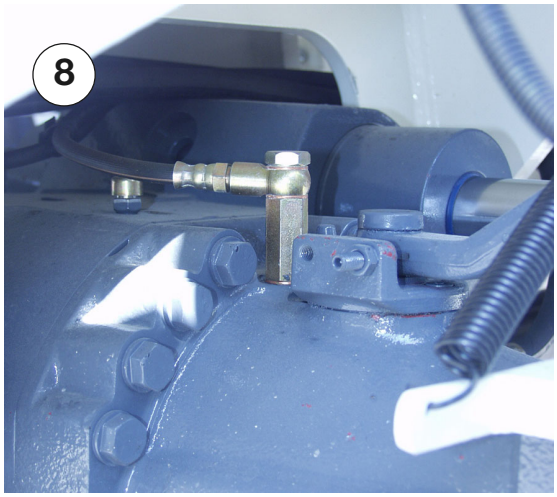


7 With a 30 mm wrench, remove the 4+4 screws **D** fixing the anchoring brackets of the machine sway cylinders.



Procedure: **Dismantling the front axle**	Table: **T-015**

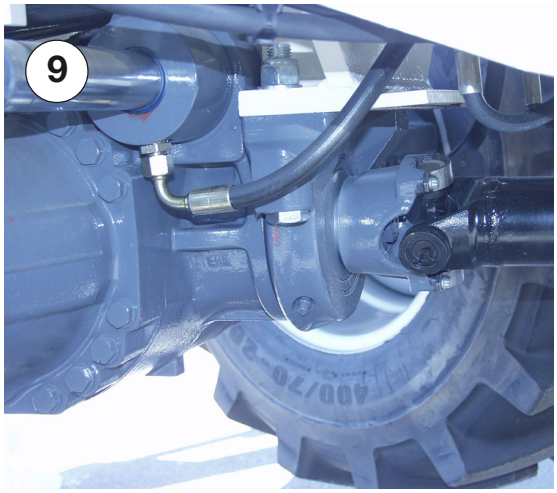
8 Place of container of suitable size to collect oil leaks and disconnect the flexible hoses of the brakes with a 19mm wrench.



PROTECT THE ENVIRONMENT

Handling and disposal of used oils may be ruled by local or national regulations. Address to authorised centres.

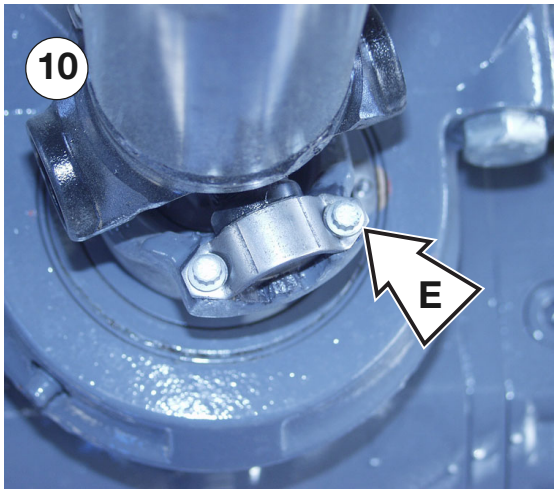
9 Disconnect the flexible hoses of the steering cylinder with a 22mm wrench.



10 With an 8mm ring spanner, loosen screws **E** of the Cardan shaft spider.

11 Secure the front axle with two textile bridles of adequate capacity connected to the bridge crane.

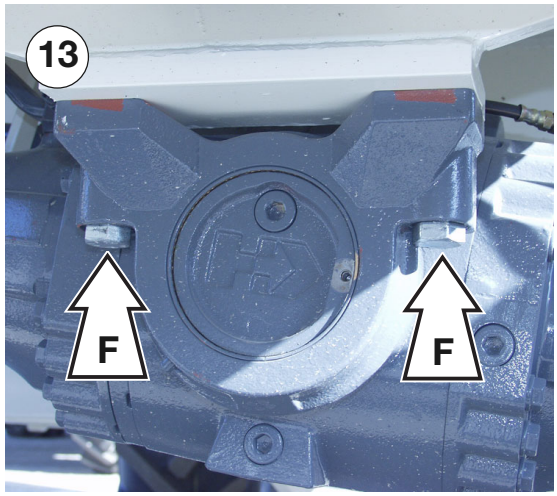
12 Place an adjustable stand underneath the chassis.



Procedure: **Dismantling the front axle**	*Table:* **T-015**

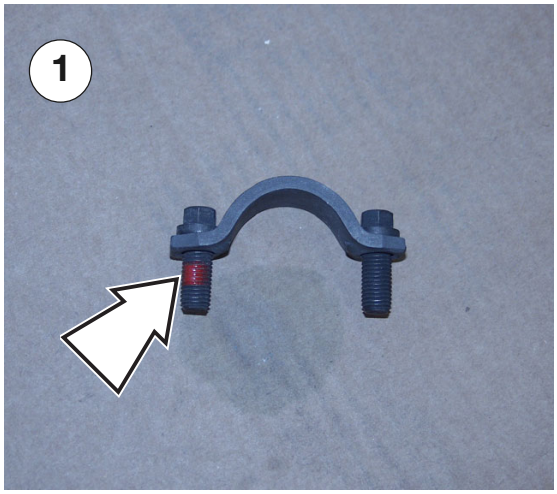
13 With a 30mm hexagonal wrench, remove the 2+2 screws **F** fixing the central joint of the front axle.

14 Lower the axle on to a wheeled trolley and store it in a safe place.



Reassembly:

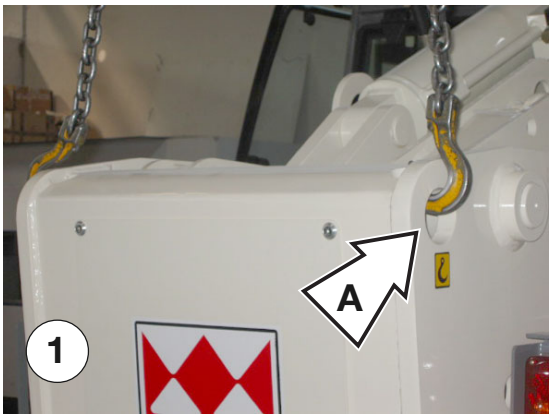
1 To re-assemble the rear axle, repeat the previous steps in reversed order. Remember to smear the threads of the screws with some threadlocker before refitting the Cardan shaft spiders.



Procedure: **Dismantling the rear axle**	Table: **T-016**			kg: 700
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: 3 / Min.: -
Bridge crane, payload 1000 kg Textile bridles or chains with hooks	Standard tools			1

Dismantling:

1 Secure a two-leg chain of adequate capacity and connected to the bridge crane to the anchoring lugs **A** and slightly raise the rear part of machine.

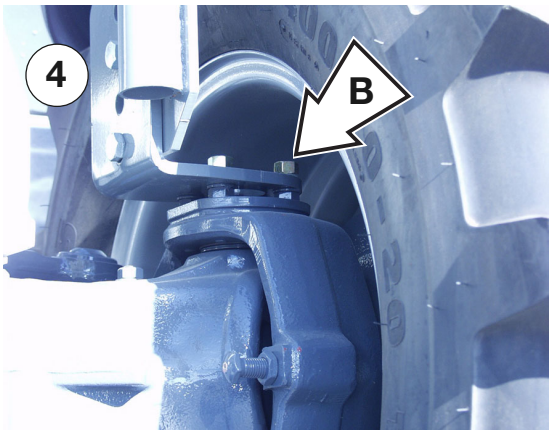


2 Place some adjustable stands under the chassis.

3 Remove the rear wheels - see T-001.

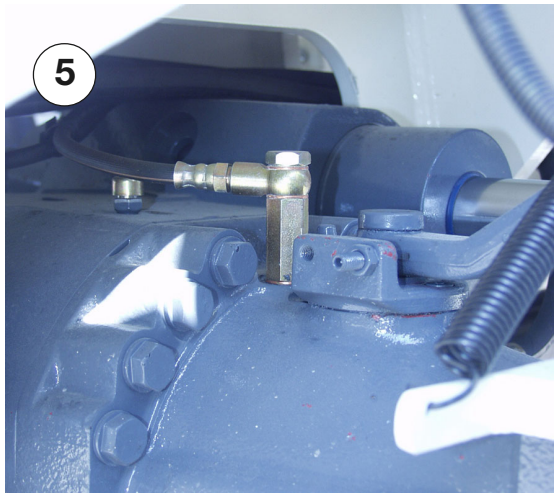


4 Loosen the bridge-shaped fixing screws **B** with a 19mm wrench and remove the mud-guard.



Procedure: **Dismantling the rear axle**	Table: **T-016**

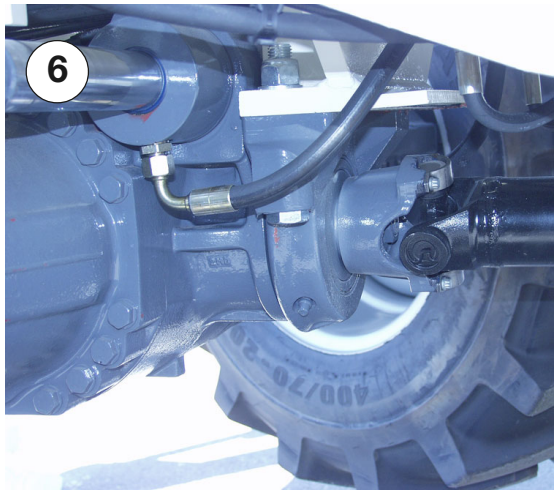
5 Place of container of suitable size to collect oil leaks and disconnect the flexible hoses of the brakes with a 19mm wrench.



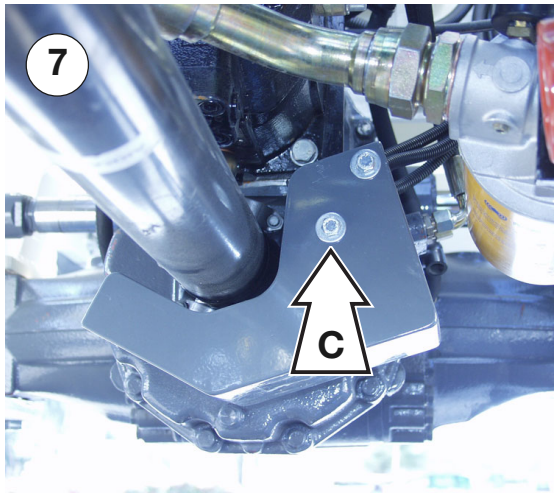
PROTECT THE ENVIRONMENT

Handling and disposal of used oils may be ruled by local or national regulations. Address to authorised centres.

6 Disconnect the flexible hoses of the steering cylinder with a 22mm wrench.

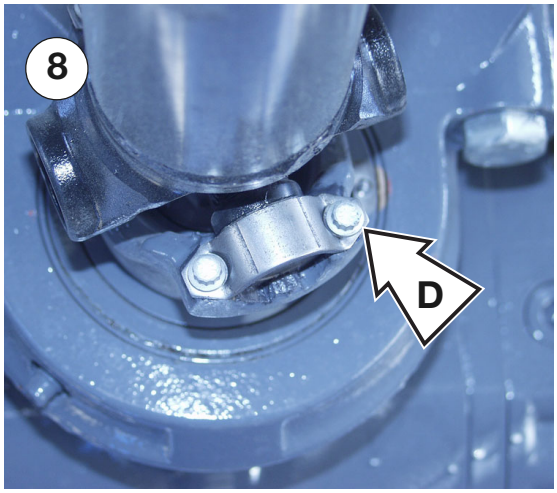


7 Using a 13mm wrench, loosen screws **C** fixing the Cardan shaft protection cover.

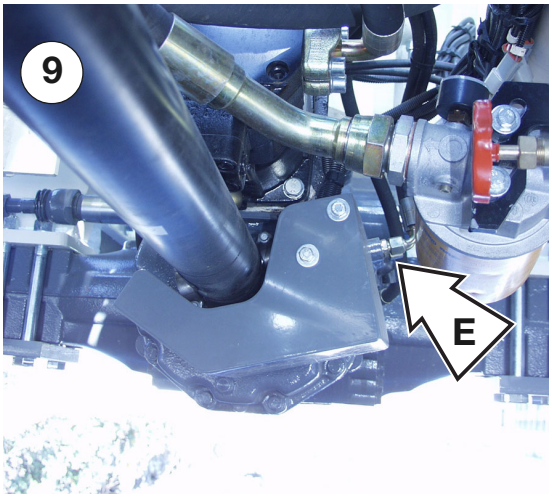


Procedure: **Dismantling the rear axle**	Table: **T-016**

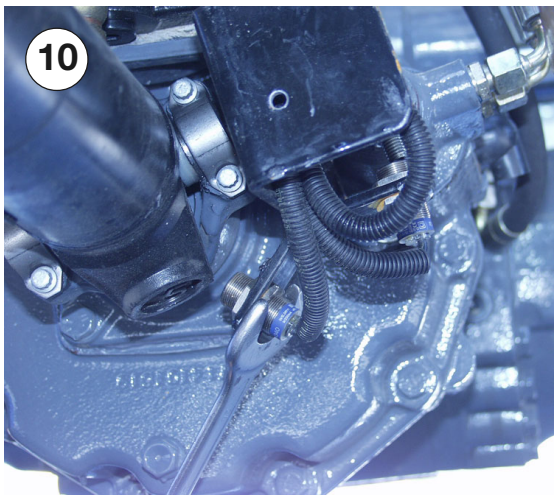
8 With an 8mm ring spanner, loosen screws **D** of the Cardan shaft spider.



9 Disconnect the hydraulic pipes **E** of the mechanical gearbox *(only for Telelift 3713 Elite - 3517)*

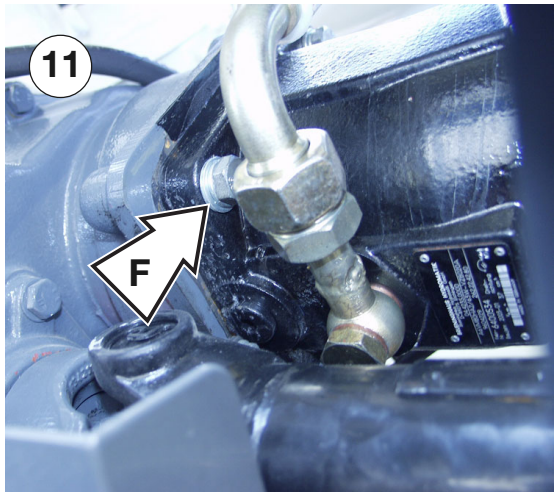


10 With a 17mm wrench, remove the supporting bracket of the first and second gear sensors *(only for Telelift 3713 Elite - 3517)*



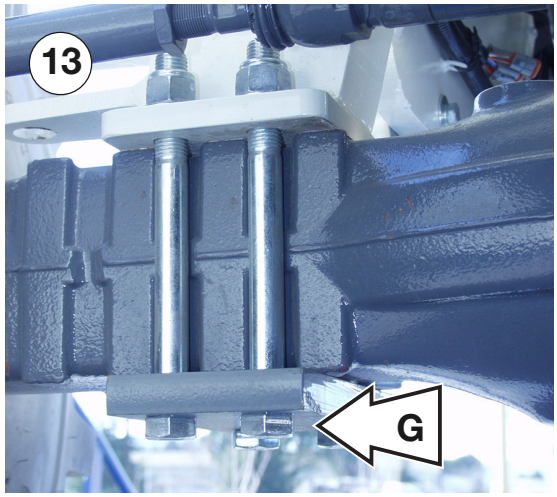
Procedure: **Dismantling the rear axle**	*Table:* **T-016**

11 Secure the hydraulic motor to the gearbox with a textile bridle, remove the 4 fixing screws **F** with a 19mm wrench and extract the motor.



12 Place an adjustable stand or a wheeled jack under the rear axle to support its weight.

13 Remove the 4+4 screws **G** fixing the rear axle with a 30mm hexagonal wrench.

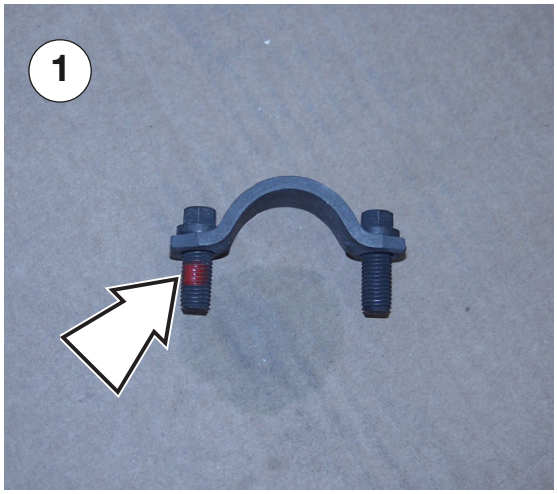


14 Remove the axle and position it in a safe place.

Procedure: **Dismantling the rear axle**	Table: **T-016**

Reassembly:

1 To re-assemble the rear axle, repeat the previous steps in reversed order. Remember to smear the threads of the screws with some threadlocker before refitting the Cardan shaft spiders.



Procedure: Dismantling the rear axle	Table: T-016

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Procedure: **Dismantling the drive motor**	Table: **T-017**			kg: 35
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: 2 — Min.: -
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools			1

Procedure:

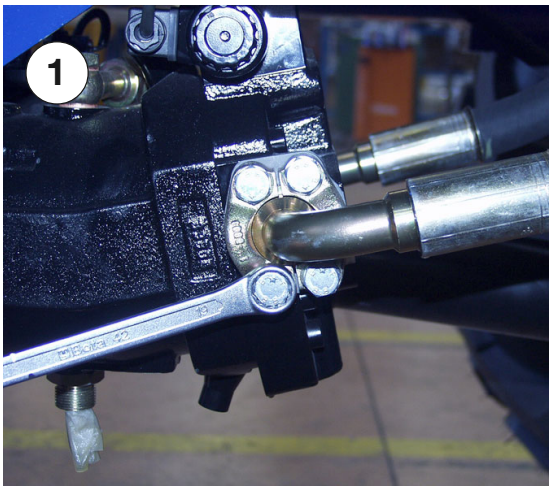
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

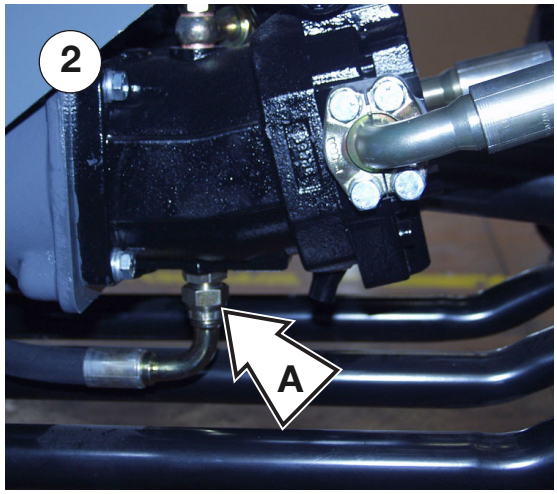
Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

1 Disconnect the 2 high-pressure hoses (1 per side) removing the screws of the fixing flanges with a 10mm hexagonal wrench.

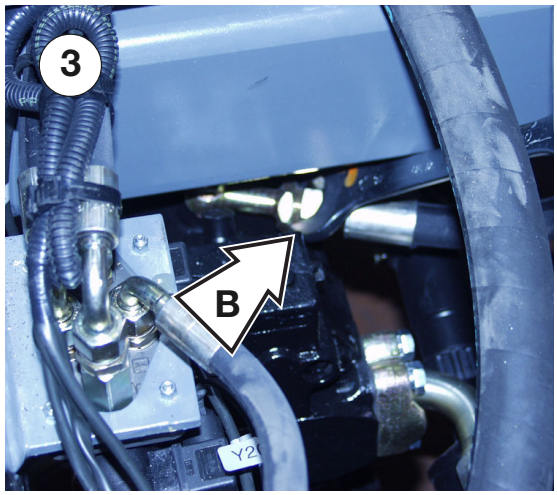


Procedure: **Dismantling the drive motor**	*Table:* **T-017**

2 Remove the lower draining duct **A** with a 36mm wrench.



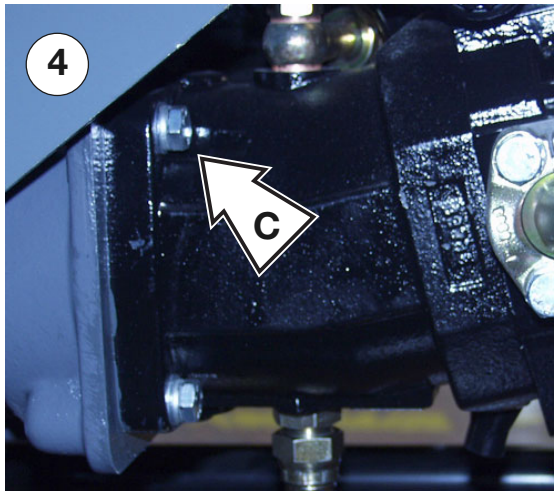
3 Remove the upper draining duct **B** with a 36mm wrench.



4 Remove the 4 screws **C** with flat and spring washers fixing the motor using a 19mm wrench.

5 Pull out the motor from the power divider coupled to gearbox placed in the central part of the machine. Hold the motor horizontal!

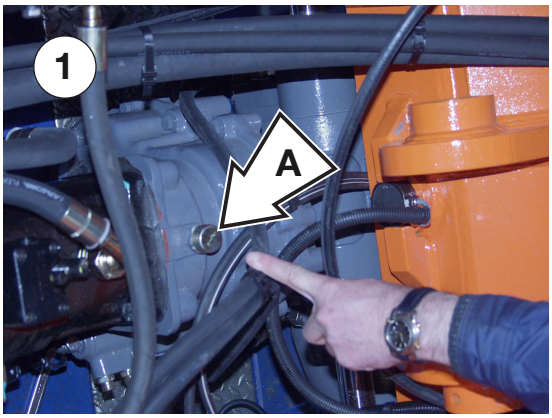
6 Protect the motor coupling point against impurities.



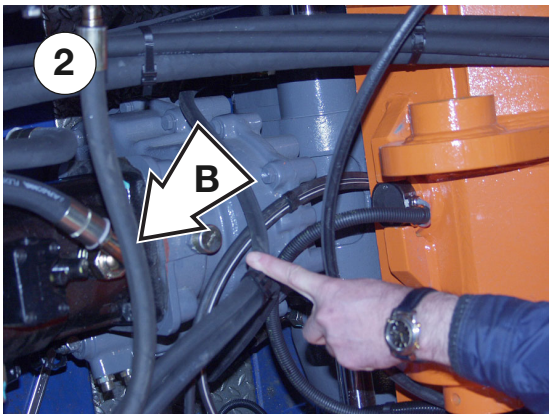
Procedure: **Replacing the load cell**	Table: **T-018** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg: 7
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks Transpallet with shims	Standard tools	Hours: 2 Min.: 15 1

Procedure:

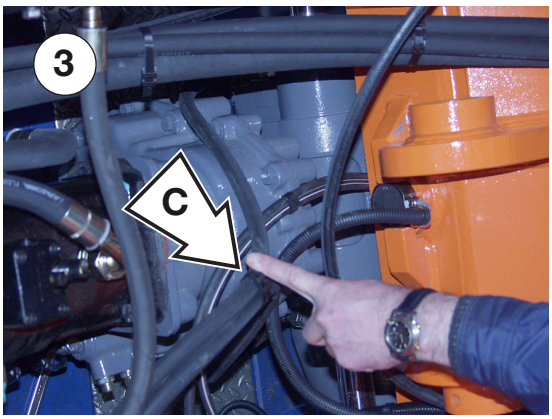
1 Remove the oil filler **A** of the gearbox.
Only for Telelift 3713 Elite - 3517



2 Remove the top drain fitting **B** of the drive motor and plug it.



3 Cut the binders and disconnect the power cables from the load cell to:

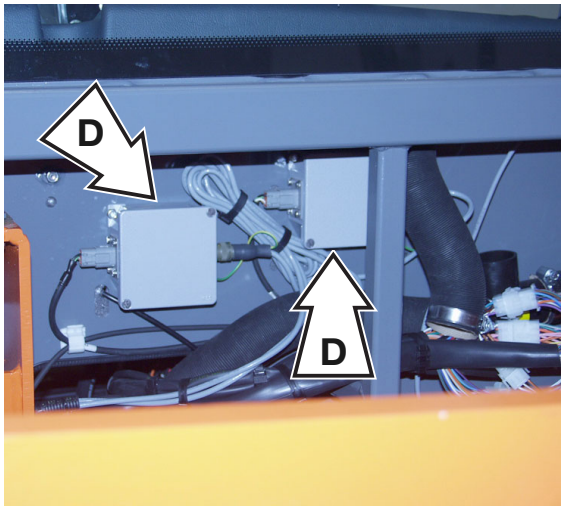


Procedure: **Replacing the load cell**	Table: **T-018**

- the junction boxes **D** (from serial no.9408 for Telelift 3013, and serial no.9363 for Telelift 3517)

- the cab input socket (up to serial no. 9407 for Telelift 3013, serial no. 9362 for Telelift 3517)

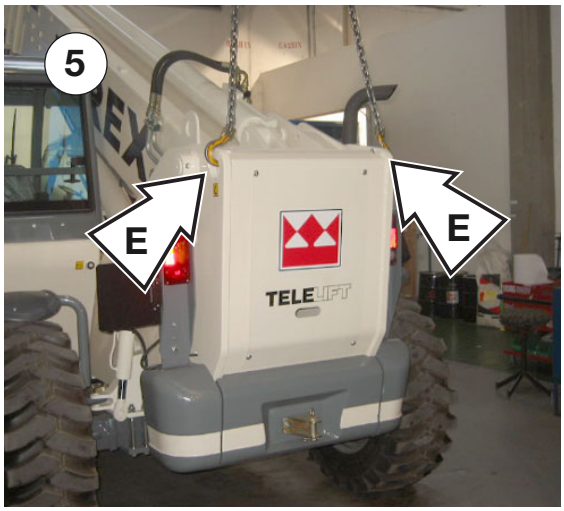
- the ARB box in the cab (Telelift 4010)



4 Remove the ring nut.

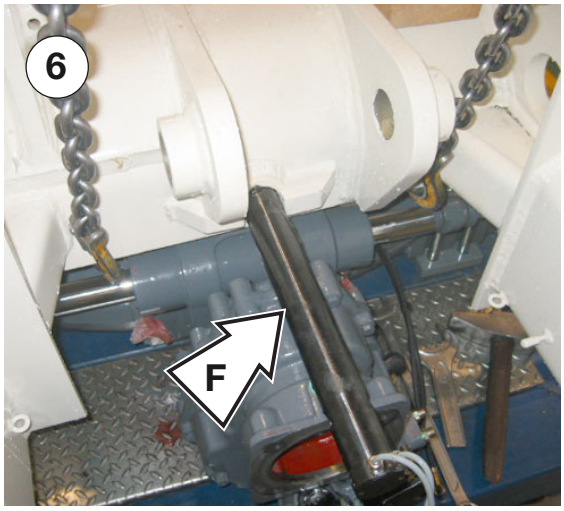


5 Secure the hoisting chain to the rear anchoring lugs **E**. Pull the slinging chain to support the weight of the machine.



Procedure: **Replacing the load cell**	Table: **T-018**

6 Knock out and extract the load cell **F** with a wooden block.



IMPORTANT

When reassembling the load cell, place the electrical cables upwards and knock the cell lightly home with a rubber hammer to avoid damage.



Procedure: Replacing the load cell	Table: T-018

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Procedure: **Dismantling a solenoid valve**	Table: **T-019** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg **1.4 each.**
		Hours **-** Min. **20**
Standard tools		**1**

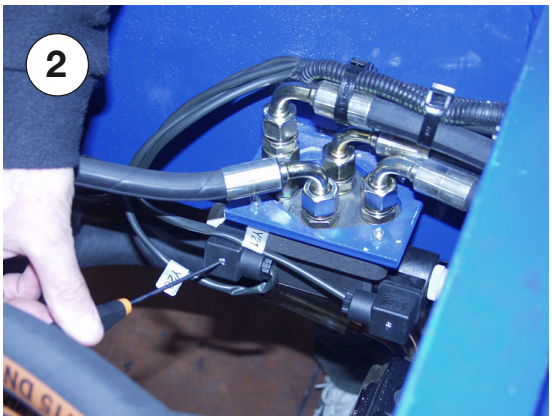
Procedure:

IMPORTANT

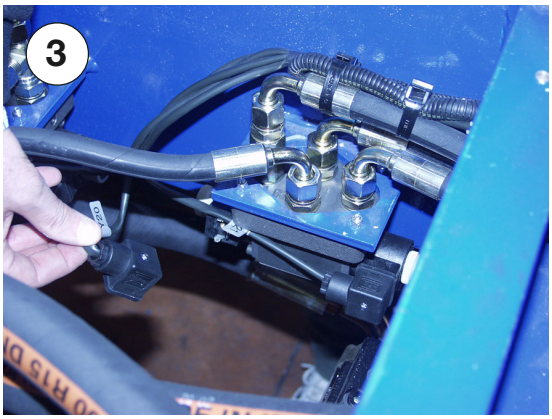
Before dismantling a solenoid valve, identify it with a letter or a number for a correct reassembly.

1 With a cable-tester, check the functionality of every coil; if necessary, remove the solenoid valve and check that the slider is not damaged or blocked.

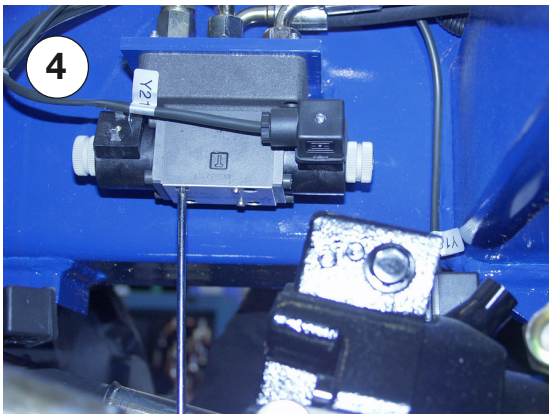
2 With a crosstip screwdriver, pry off the connector of the solenoid valve.



3 Pay attention not to loose the gasket on the connector.

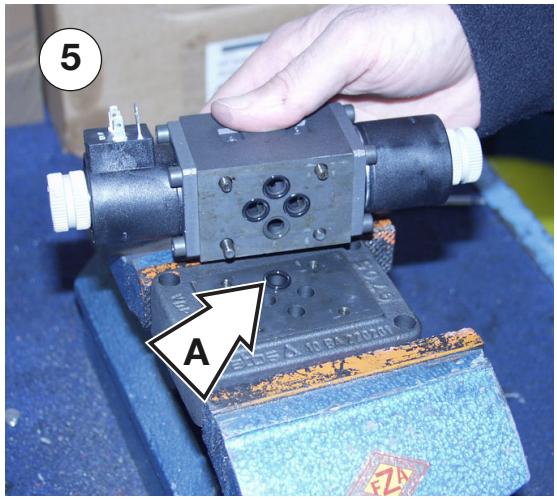


4 Using a 4mm hexagonal wrench, remove the 4 fixing screws of the solenoid valve.

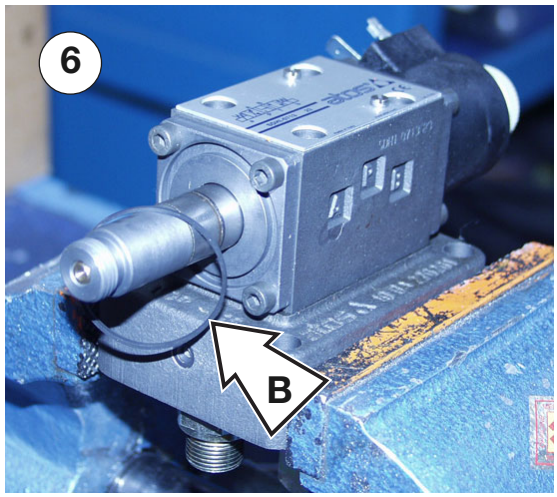


Procedure: **Dismantling a solenoid valve**	Table: **T-019**

5 Pay attention to the 4 gaskets **A** placed between the solenoid valve and the block. Check and replace them if damaged before reassembly.



6 If also the coils of the solenoid valve shall be removed, pay attention to the seal **B**. Check and replace this seal if damaged.



Procedure:	Dismantling the solenoid valves' block for outriggers and sway function	Table: T-020		
		3713 Elite ✔	3517 ✔	4010 ☐

kg	7		
	Hours	Min.	
	2	-	
	1		

Standard tools

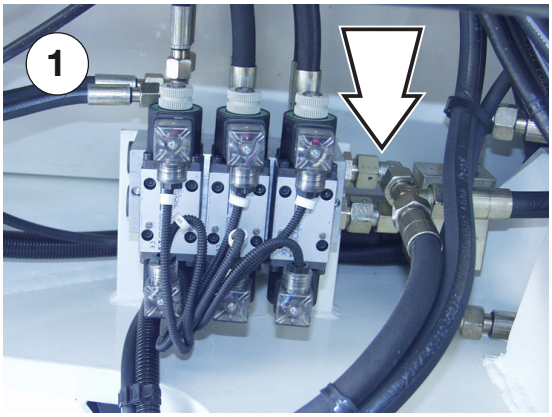
Procedure:

PROTECT THE ENVIRONMENT

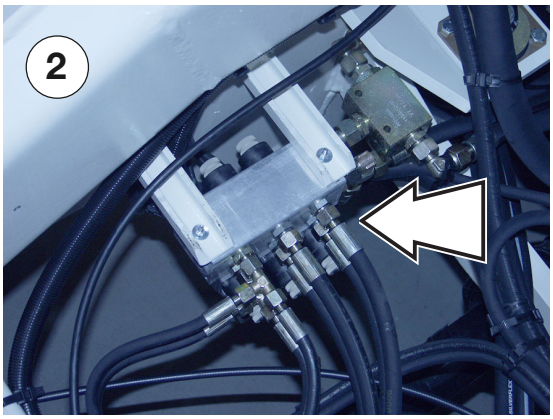
Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.



1 Using a 27mm wrench, disconnect the pressure and drain flexible hoses.

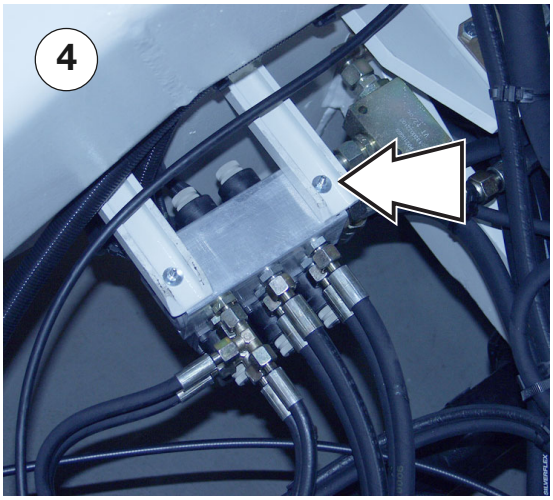


2 Using a 22mm wrench, disconnect the 6 flexible hoses feeding the outriggers.

Procedure:	**Dismantling the solenoid valves' block for outriggers and sway function**	*Table:* **T-020**

3 Mark the position, then disconnect the connectors of the solenoid valves with a crosstip screwdriver.

4 Using a 4mm hexagonal wrench, remove the 2 fixing screws of the solenoid valves block while holding the locking nut blocked with an 8 mm wrench.



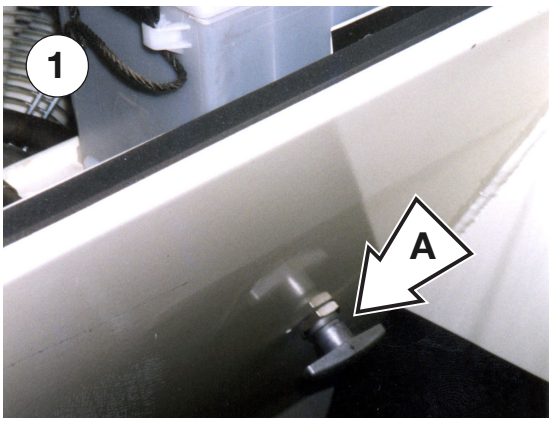
Procedure: Dismantling the battery	Table: T-021			kg	24
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			-	30
					1

Procedure:

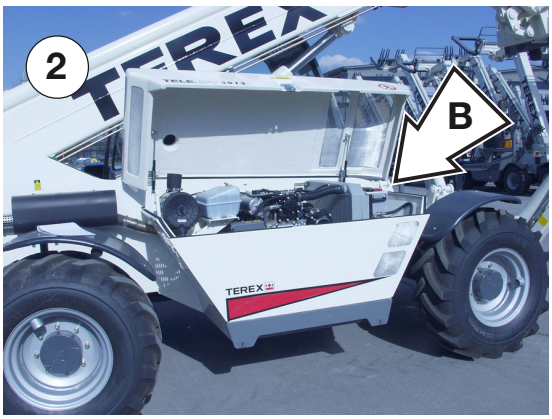
PROTECT THE ENVIRONMENT

Never pour used batteries on the ground. Deliver the batteries to specialised collection and disposal centres.

1 Switch off the batteries operating switch **A**.

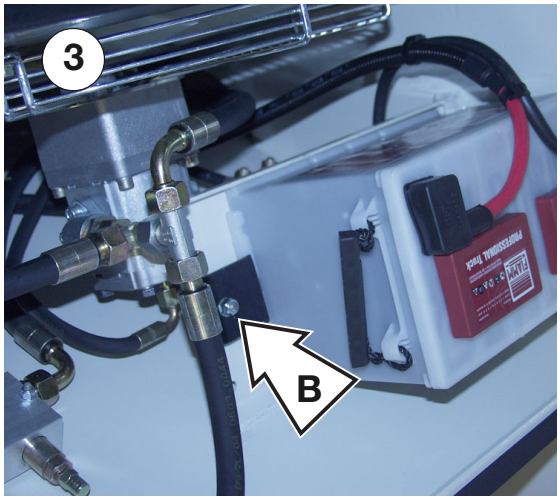


2 Open the right-hand side cover and access to battery **B**.

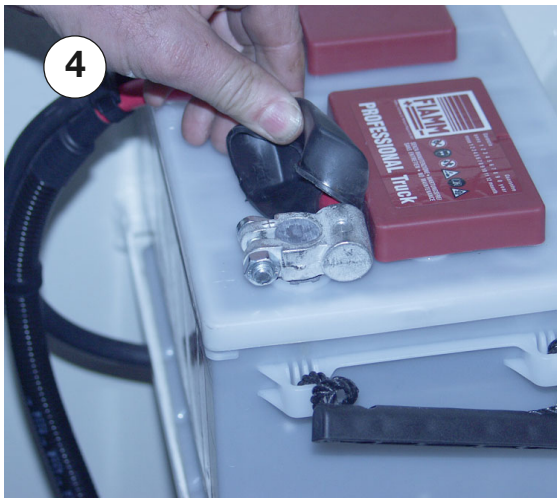


Procedure: **Dismantling the battery**	*Table:* **T-021**

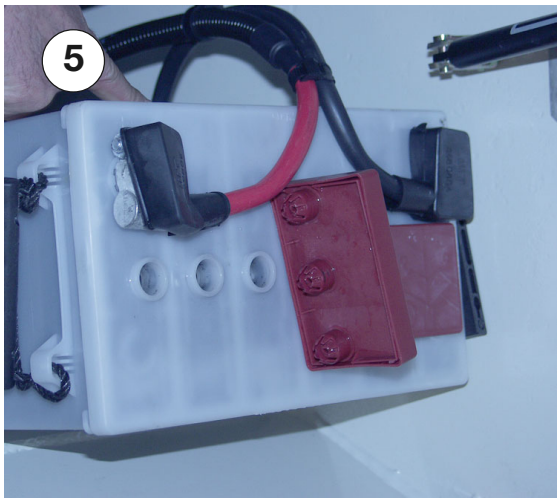
3 With a 13mm wrench, remove nut **B** locking the battery support.



4 With a 13mm wrench, disconnect the battery leads taking off first the negative "-" earth lead (black) and then the positive "+" lead (red).



5 Check the charge of the battery with a densimeter (see A.06). Replace if necessary.



Procedure: Dismantling the battery	Table: T-021

ATTENTION

Keep the battery away from sparks, flames or lit cigarettes.

ATTENTION

When reconnecting the battery, fit the positive (+) lead first.

Procedure: **Dismantling the battery**	*Table:* **T-021**

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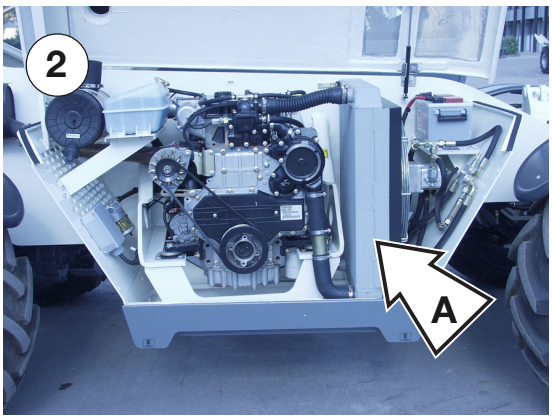
Procedure: **Dismantling the water/oil cooler**	Table: **T-022** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 50
		Hours 1 Min. 30
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools	1

Procedure:

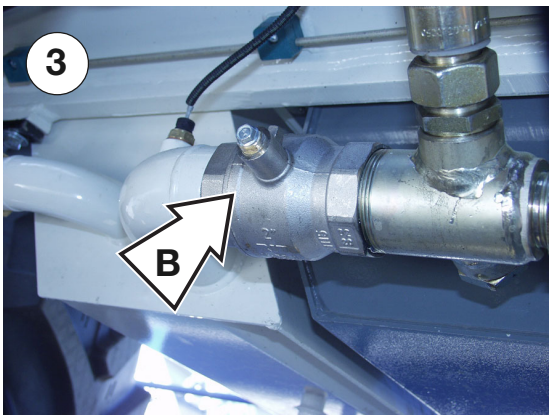
1 Move to the right-hand side of the machine and remove the side cover with a 17mm wrench.



2 Raise the top cover and access to cooler **A**.



3 Close cock **A** placed at the outlet of the hydraulic oil tank, at the base of the machine.

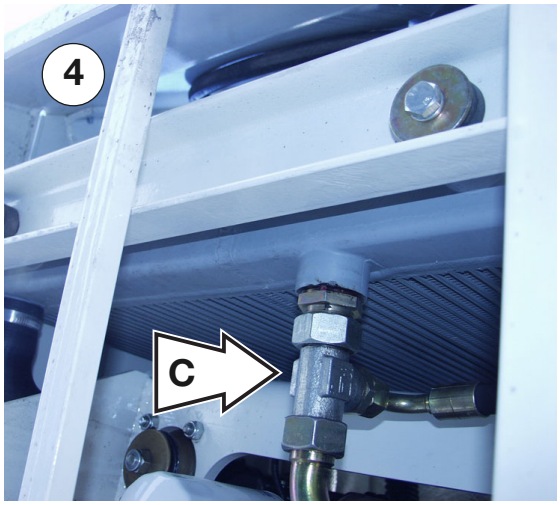


IMPORTANT

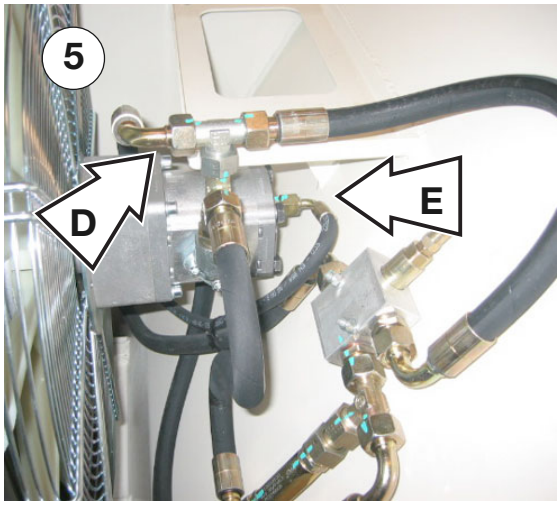
This operation is not indispensable but it guarantees greater protection for the hydraulic system.

Procedure: **Dismantling the water/oil cooler**	*Table:* **T-022**

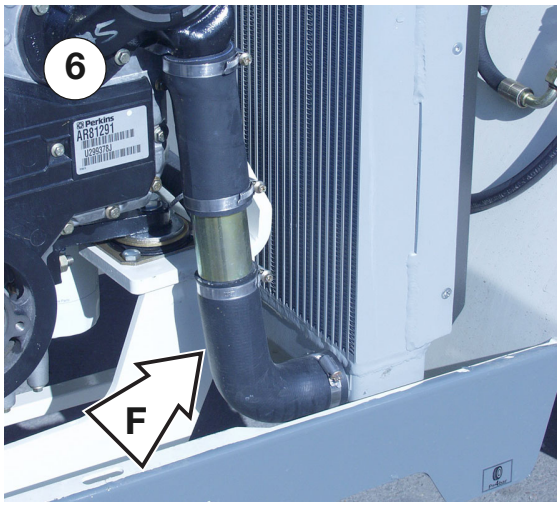
4 Using a 41mm wrench, disconnect the inlet/ outlet flexible hoses **C** of the cooler circuit.



5 Using a 27mm wrench, disconnect the flexible hoses **D** from the cooler fan motor. With a 19mm wrench, disconnect the draining tube **E**.

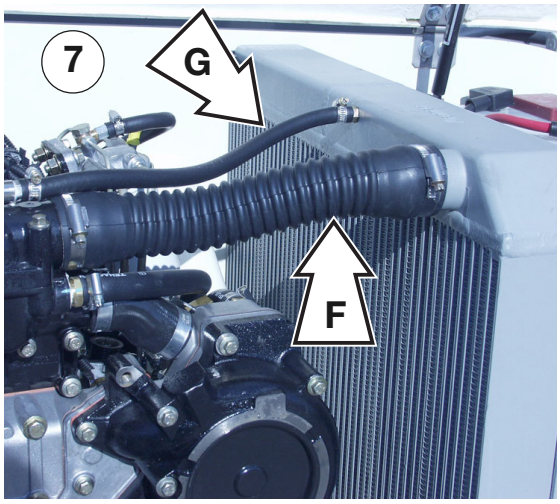


6 With a crosstip screwdriver, remove the clamps fixing the water tubes **F**.



Procedure: **Dismantling the water/oil cooler**	Table: **T-022**

7 With a screwdriver, remove the clamp and the small tank filling tube **G**.



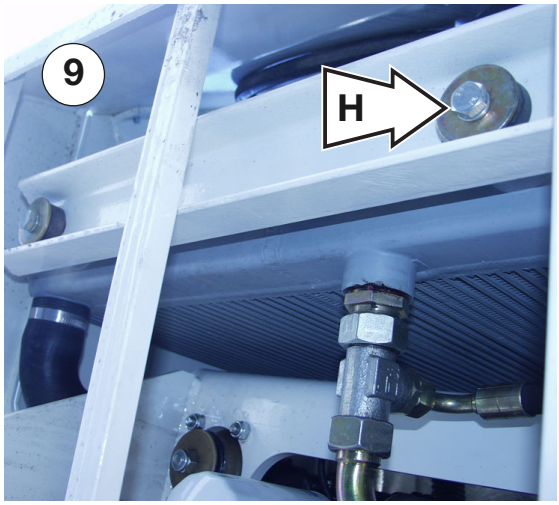
8 Secure the cooler with a textile bridle connected to the bridge crane as shown. Slightly pull the bridle.





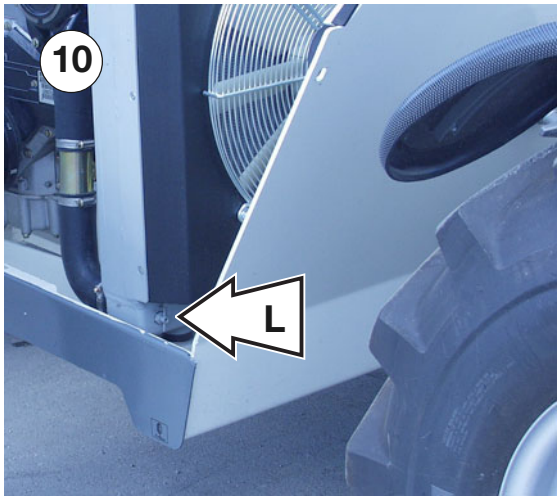
Procedure: **Dismantling the water/oil cooler**	*Table:* **T-022**

9 Remove the screws **H** fixing the cooler to the vibration supports using a 19mm wrench. Slowly lift out the cooler and position it in a safe place.



VIEW FROM THE BOTTOM

10 Once the cooler has been removed, check that there is no air in the circuit. Loosen cock **L** and check that water without air bubbles flows out.



Procedure:	Dismantling the gear pump of boom and hydrostatic steering unit	Table: T-023	3713 Elite	3517	4010	kg	14
			✔	✔	✔	Hours	Min.
Bridge crane, payload 500 kg Textile bridles or chains with hooks		Standard tools				1	30
							1

Procedure:

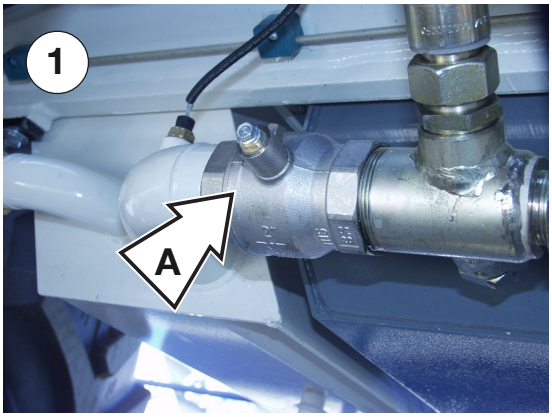
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

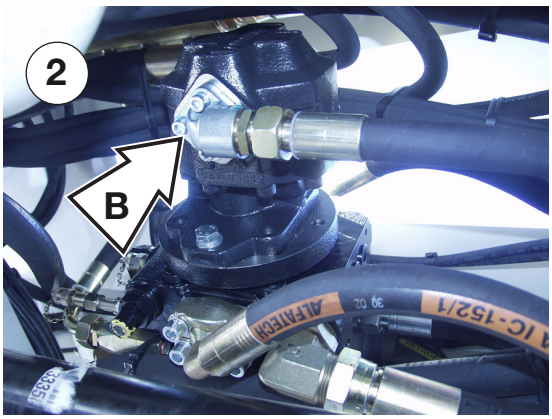
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

1 Close cock **A** placed at the outlet of the hydraulic oil tank.

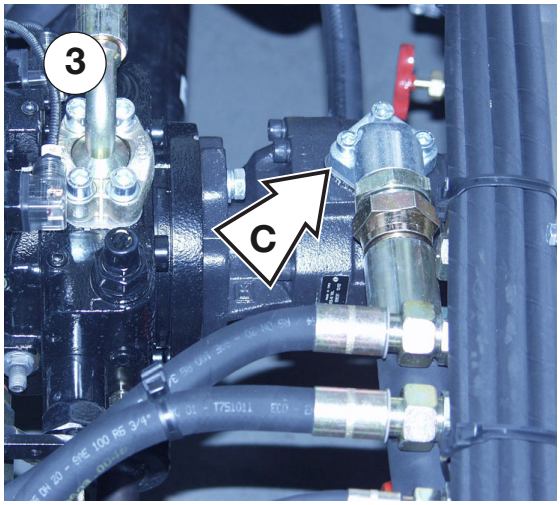


2 Using a 6mm hexagonal wrench, remove the flange **B** fixing the injection hose.

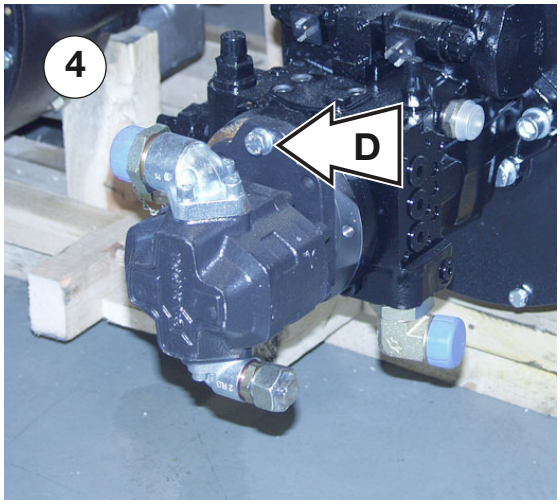


Procedure:	Dismantling the gear pump of boom and hydrostatic steering unit	Table: T-023

3 Using a 8mm hexagonal wrench, disconnect the delivery hose **C**.



4 Remove the pump loosening the two fixing screws with a 19mm hexagonal wrench.



IMPORTANT

When reassembling the boom pump, add hydraulic oil through the hole of the top plug. Plug with caution to avoid that impurities may enter the pump, then reassemble.

Procedure: **Dismantling the Hydromatic pump**	Table: **T-024** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 63
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools	Hours 2 Min. -
		1

Procedure:

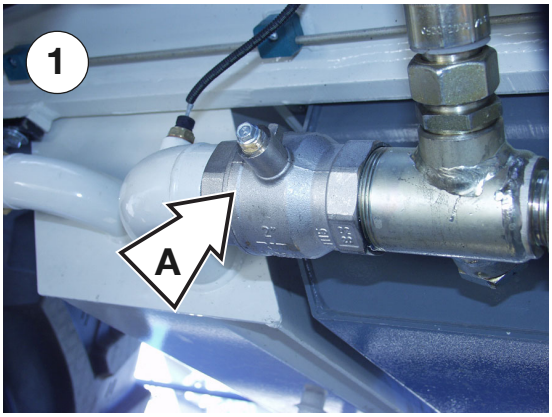
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

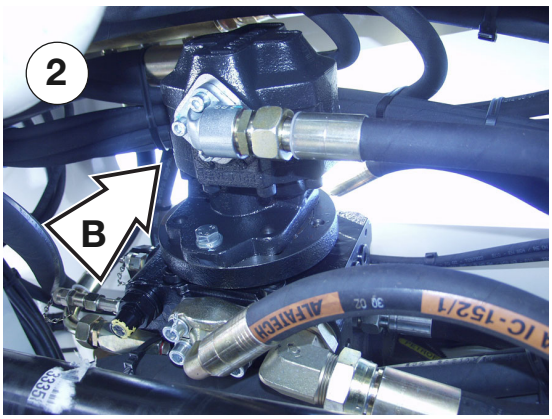
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

1 Close cock **A** placed at the outlet of the hydraulic oil tank.

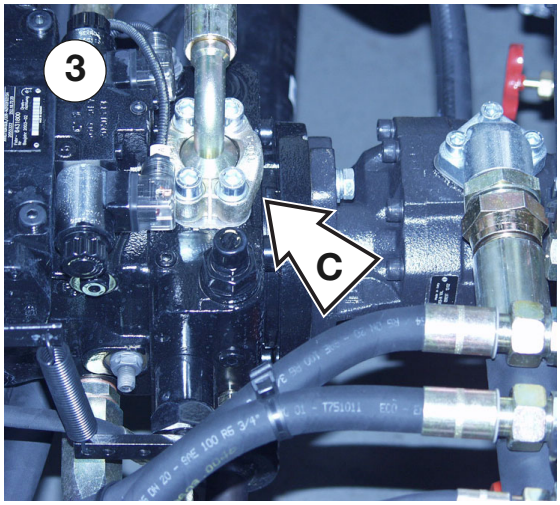


2 Dismantle the pump of boom **B** - see T-023.

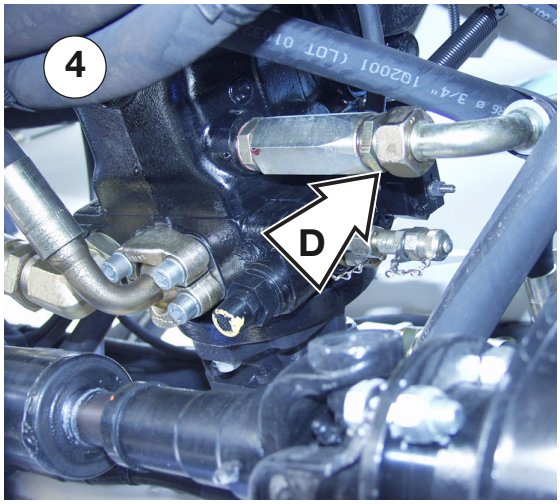


Procedure: **Dismantling the Hydromatic pump**	*Table:* **T-024**

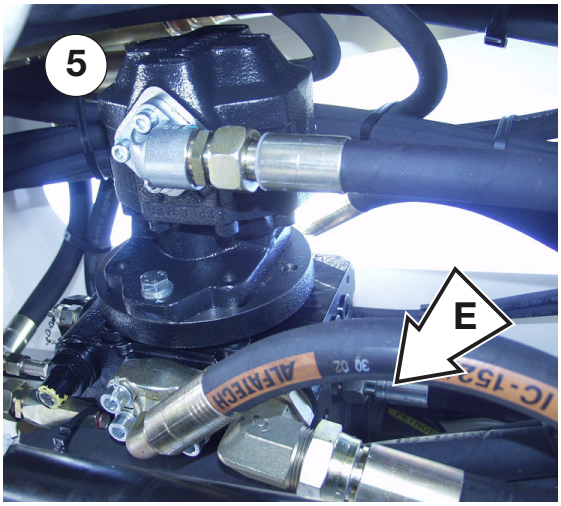
3 Disconnect the two HP hoses removing their flanges **C** on both sides of the pump.



4 With a 36mm wrench, disconnect the draining hose **D** and plug it.

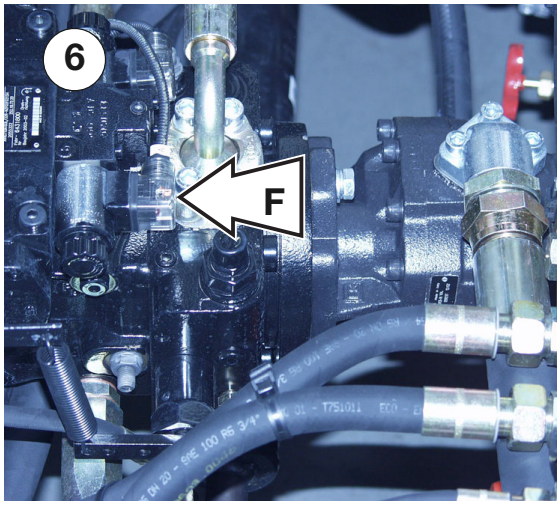


5 Using a 50mm wrench, disconnect the pump feeding hose **E**.

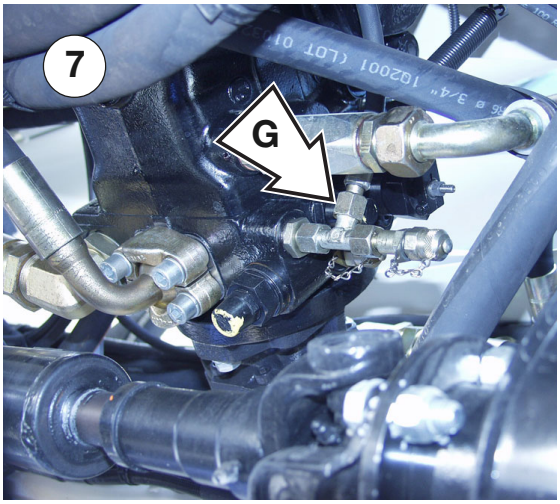


Procedure: **Dismantling the Hydromatic pump**	Table: **T-024**

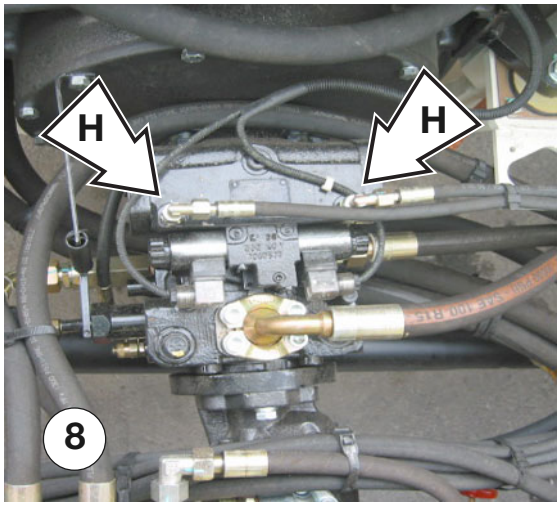
6 With a crosstip screwdriver remove the two connectors **F** of the solenoid valve.



7 Using a 19mm wrench, disconnect the overfeeding hose **G**.

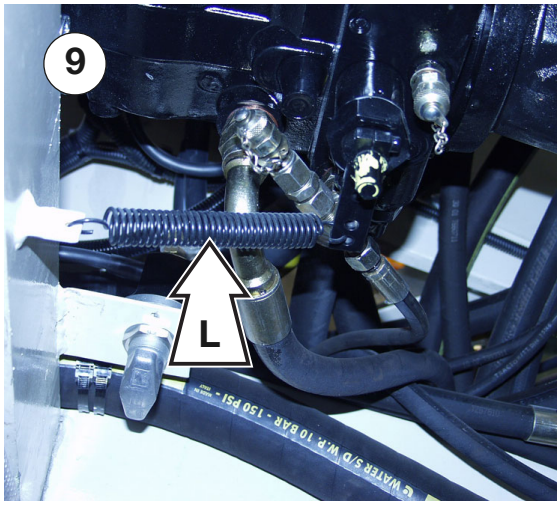


8 Using a 19mm wrench, disconnect the pilot hoses **H**.
Only for Telelift 4010



Procedure: **Dismantling the Hydromatic pump**	Table: **T-024**

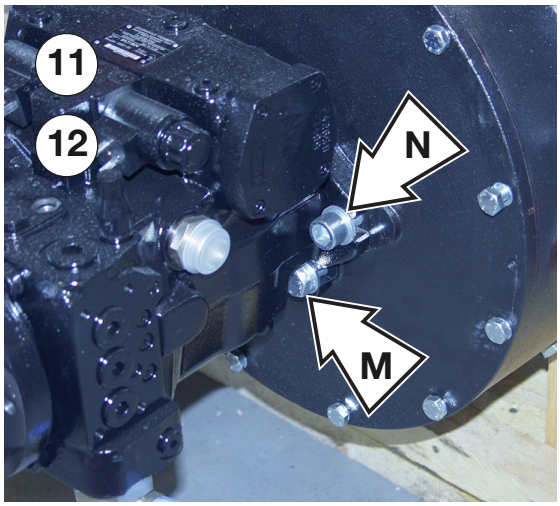
9 Release the Inching valve **L**.



10 Secure the pump with a textile bridle connected to the bridge crane. Slightly pull the bridle.

11 Prepare a 22mm wrench grinding the external edge and reducing its thickness so that it can enter the screw housing (see A-06 dwg.05). Remove the 4 screws **M**.

12 Using a 14mm hexagonal wrench, remove the two screws **N** fixing the pump. Pull out and raise the pump using the bridge crane.

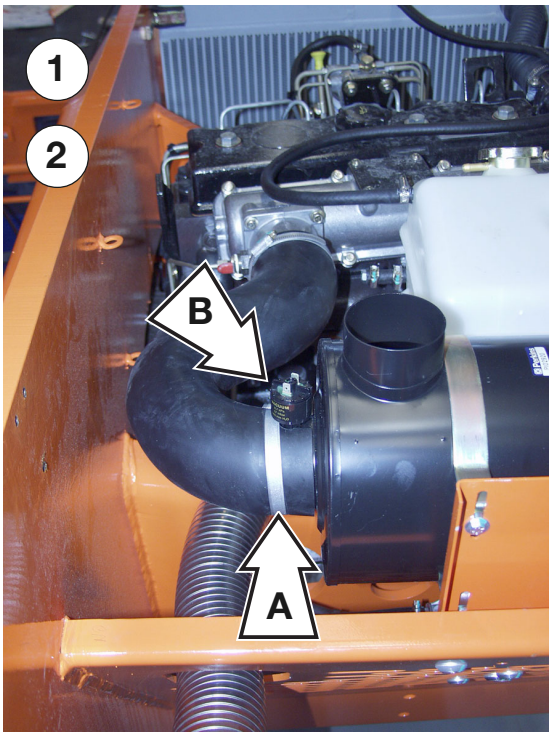


Procedure: **Dismantling the air filter**	Table: **T-025** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 8
		Hours - Min. 30
Standard tools		1

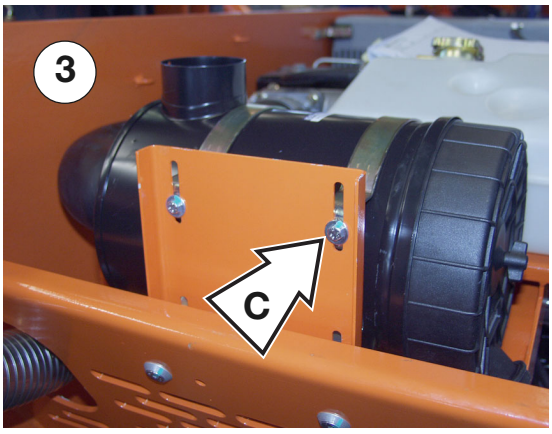
Procedure:

1 With a flat screwdriver, loosen binder **A** fixing the rubber hose.

2 Disconnect the connector of the clogging indicator **B**.



3 With a 10mm wrench, remove the 4 screws **C** fixing the air filter. Remove the filter.



Procedure: **Dismantling the air filter**	*Table:* **T-025**

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Procedure:	Table: T-026			kg	6.8
Dismantling feeding pump, brake pump and radiator motor	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
				1	-
	Standard tools				1

Procedure:

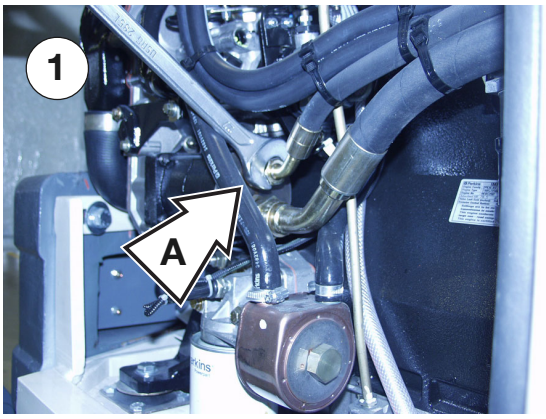
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

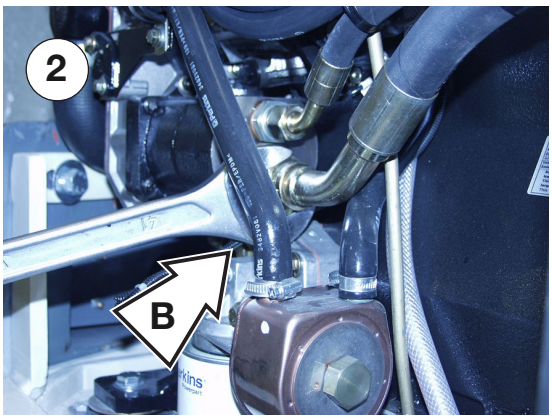
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

1 Using a 27mm wrench, disconnect the delivery hose **A**.

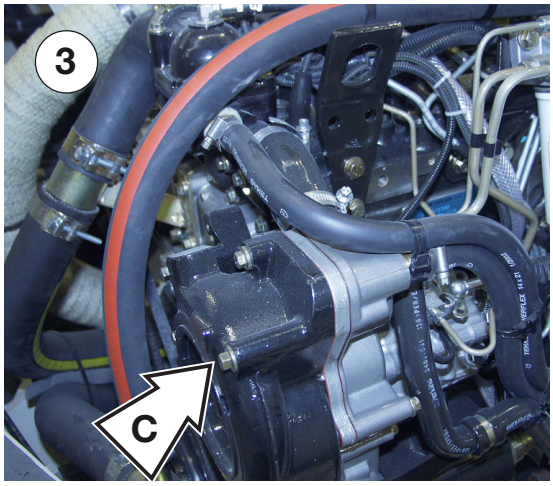


2 Using a 41mm wrench, disconnect the injection hose **B**.

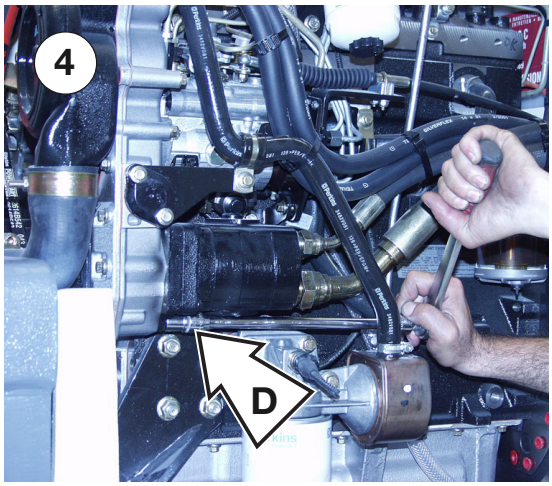


Procedure: **Dismantling feeding pump, brake pump and radiator motor**	*Table:* **T-026**

3 With a 3/8” wrench, remove the front screw **C** aligned with the pump.



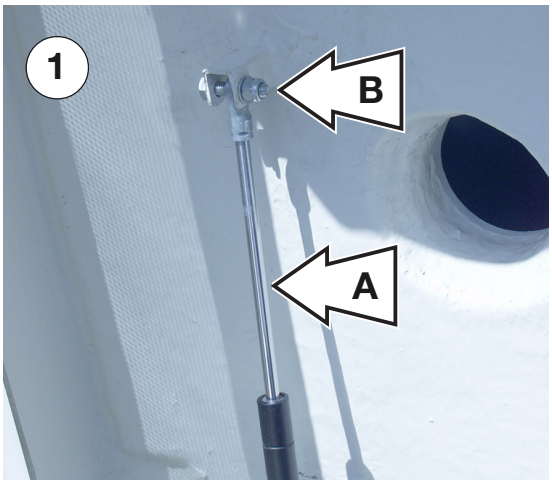
4 Using a 13mm socket spanner with extension, remove the 4 fixing nuts **D** of the pump.



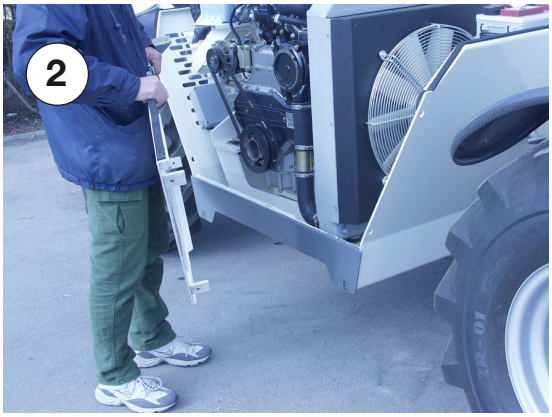
Procedure: **Dismantling the Diesel engine**	Table: **T-027**			kg: 550
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: 3 — Min.: -
Bridge crane, payload 1000 kg (4000 lb) Textile bridles or chains with hooks	Standard tools			2

Procedure:

1 Remove the two gas springs of the engine bonnet loosening the screws and the self-locking nuts **B** with two 13mm wrenches; move the bonnet backwards.



2 With a 17mm wrench, loosen and remove the four screws fixing the side cover of the engine and remove the cover.



PROTECT THE ENVIRONMENT

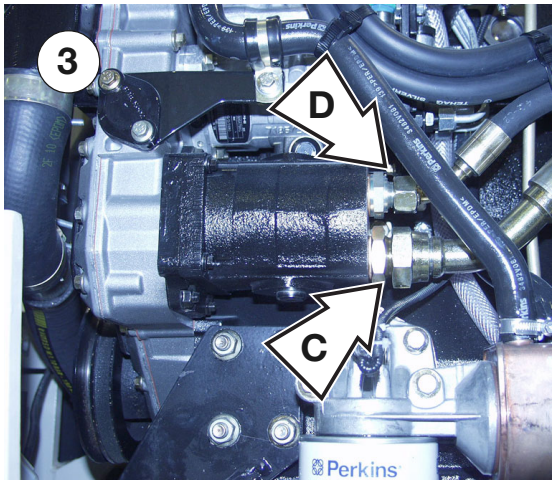
Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

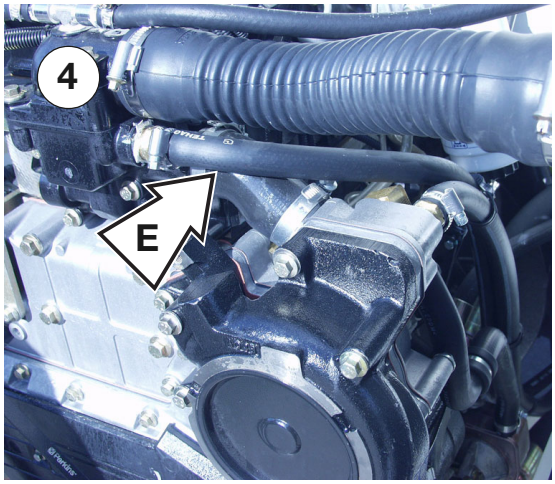
Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

Procedure: **Dismantling the Diesel engine**	*Table:* **T-027**

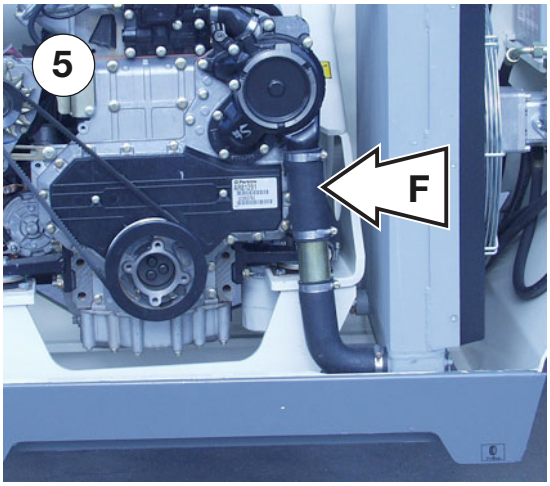
3 Disconnect the two hoses of the pump on the distribution line: disconnect the intake hose **C** with a 41mm wrench and the delivery hose **D** with a 27mm wrench.



4 Disconnect the heater hoses **E** removing the clamps with a crosstip screwdriver.

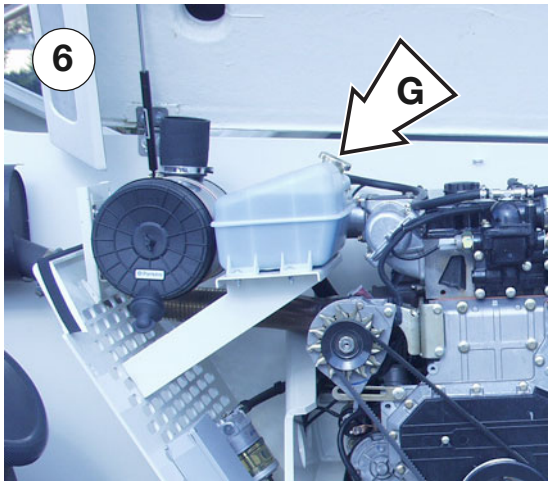


5 Using a 13mm wrench or a crosstip screwdriver, remove clamps **F** fixing the hoses to the water pump after having drained off any water from the radiator by opening the special cock.

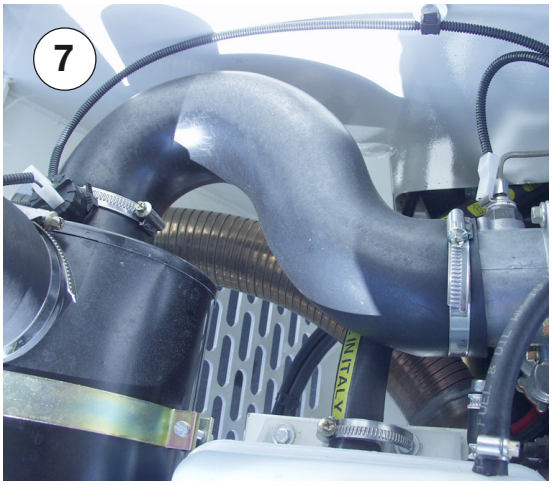


Procedure: **Dismantling the Diesel engine**	*Table:* **T-027**

6 Disconnect the coolant hoses (engine side) using a 7mm wrench or a crosstip screwdriver; remove the pan **G** complete with support.

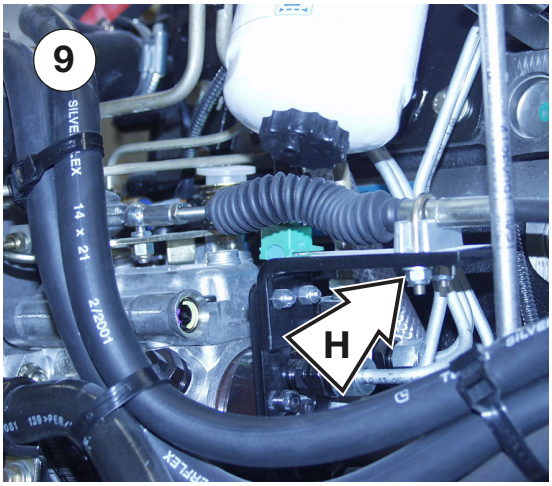


7 Using a flat screwdriver disconnect the rubber hose of the air filter rubber (engine side).



8 Cut all the plastic binders fixing the electrical cables and the rubber hoses to the engine.

9 Using a 10mm wrench remove the fixing screws, then pull out the U-bolt **H** which fixes the throttle cord. Remove the clip fixing the joint and free the throttle cord.



Procedure: **Dismantling the Diesel engine**	*Table:* **T-027**

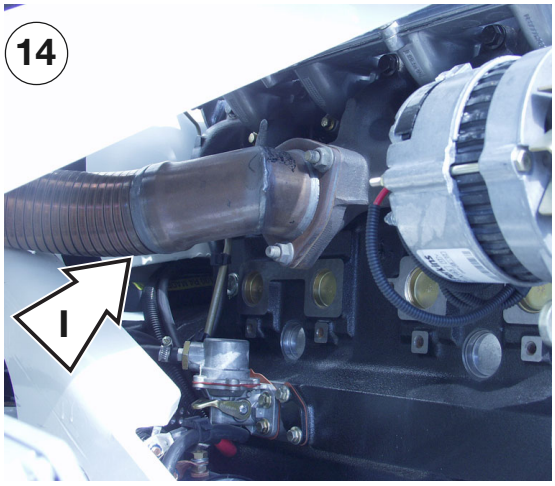
10 Disconnect the electrical cables of the alternator and the starting motor using a 13mm wrench. Remove the ground cable between chassis and engine.

11 Disconnect the bulbs:
- pre-heating
- water temperature (2)
- oil pressure

12 Disconnect the fuel solenoid valve.

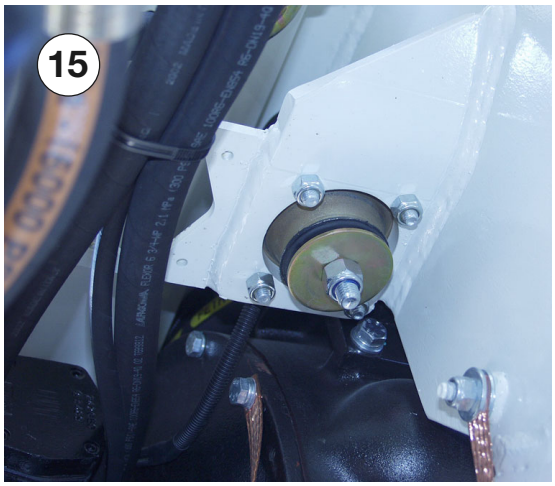
13 Disconnect the fuel hoses from the filters.

14 Remove the exhaust manifold **I**.

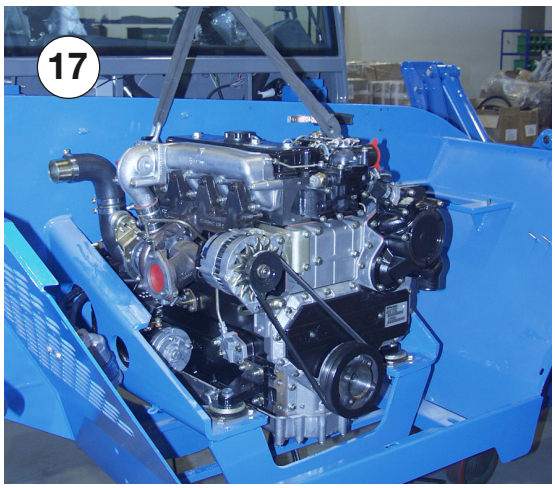


15 Remove the 4 screws fixing the engine to the vibration devices using two 22mm wrenches.

16 Disconnect the oil flexible hoses of the Hydromatic pump and the Casappa pump.



17 Hook a two-leg chain connected to the bridge crane to the engine hoisting lugs. Slightly pull the chain.



Procedure: **Dismantling the Diesel engine**	Table: **T-027**

18 Check that all the connections between engine and machine (e.g. hoses, electrical cables, etc.) have been disconnected.

19 Pull out the engine with extreme caution and place it on to a wooden pallet.



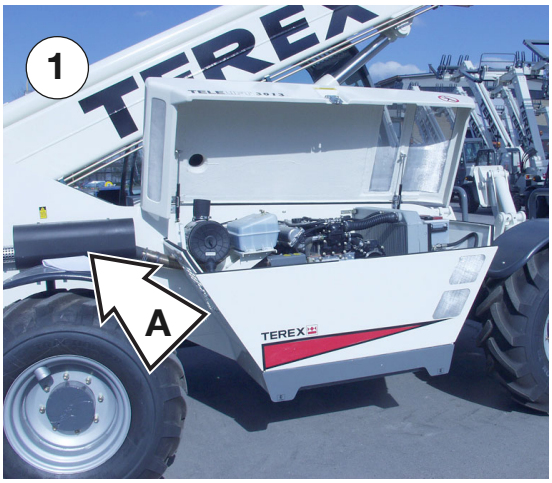
Procedure: **Dismantling the Diesel engine**	*Table:* **T-027**

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Procedure: **Dismantling the exhaust pipe**	Table: **T-028**			kg: 20
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: - / Min.: 30
Standard tools				1

Procedure:

1 Move to the rear right-hand side of the machine and access to the exhaust pipe **A**.



2 Remove the U-bolt fixing the flexible hose to the exhaust pipe loosening the nuts with a 17mm wrench.

3 From the internal side of the frame, loosen the 3 fixing screws of the exhaust pipe with a 17mm wrench.

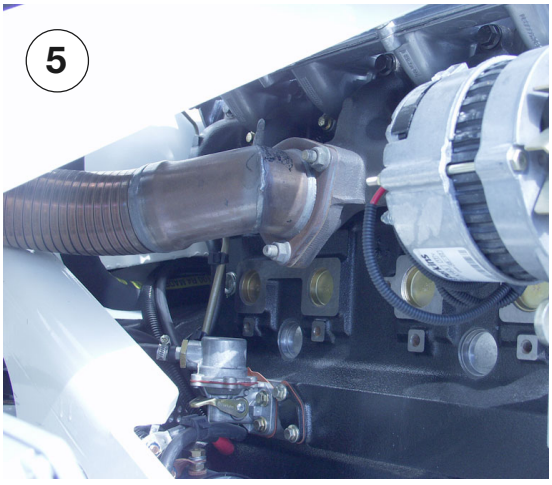
CAUTION

Before dismantling the exhaust pipe, make sure it is cold. The pipe shall be supported by a second operator while re-tightening the fixing screws.

Changing the exhaust flexible hose:

4 Remove the exhaust pipe.

5 Loosen the 3 nuts fixing the flexible hose to the exhaust manifold of the engine using a 15mm wrench.



Procedure: Dismantling the exhaust pipe	Table: T-028

Reassembling the exhaust flexible hose:

IMPORTANT

When installing the new flexible hose, also replace the triangle seal of the manifold.

Procedure: **Dismantling the actuator**	Table: **T-029** 3713 Elite ✔ 3517 ✔ 4010 ☐	kg	34
			Hours: 2 Min.: -
Bridge crane, payload 500 kg Textile bridles or chains with hook	Standard tools		1

Procedure:

PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

DANGER

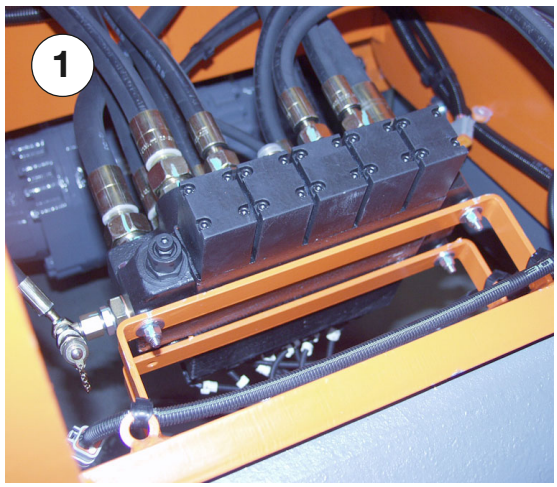
Before disconnecting the hydraulic lines, check that there is no pressure. Eliminate any residual pressure if necessary by operating the control levers with the engine stopped.
Disconnect the hydraulic piping with extreme caution and always wear suitable personal protection equipment -e.g. goggles, gloves, facial screen, etc.
Wrap up the end of the pipe to be disconnected with some rags and slowly loosen the pipe connector so that air comes out as slow as possible.

Procedure: Dismantling the actuator	Table: T-029

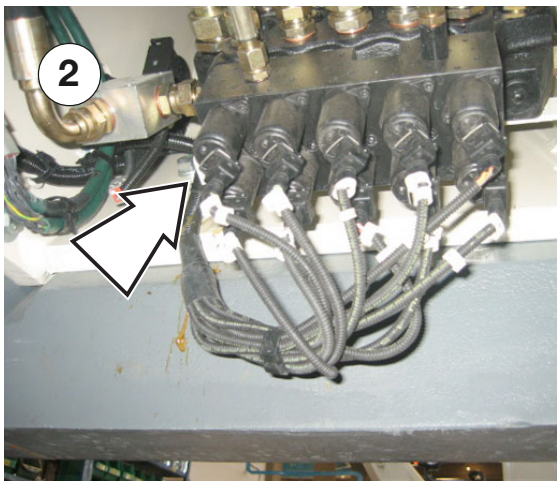
IMPORTANT

Before disconnecting any flexible hoses, label them for an easier re-assembly.

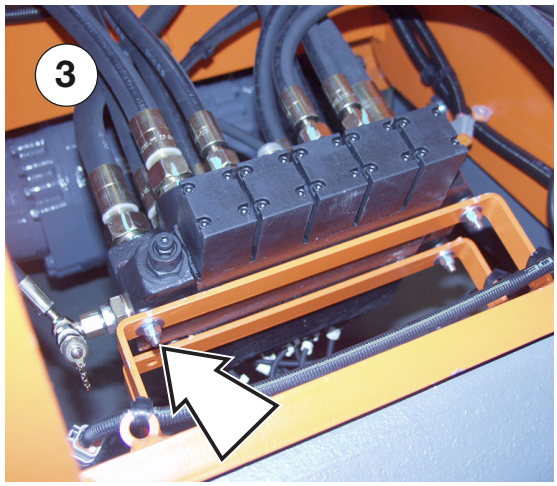
1 Using a set of wrenches (19, 27, 36, 41 and 32 mm) (only for Telelift 3517), disconnect all flexible hoses connected to the actuator.



2 With a crosstip screwdriver disconnect the spools of the solenoid valves after labelling them for an easier re-assembly.



3 Sling the actuator with a textile bridle connected to the bridge crane, slightly pull the bridle, then remove the fixing screws with washers using a 13mm wrench.



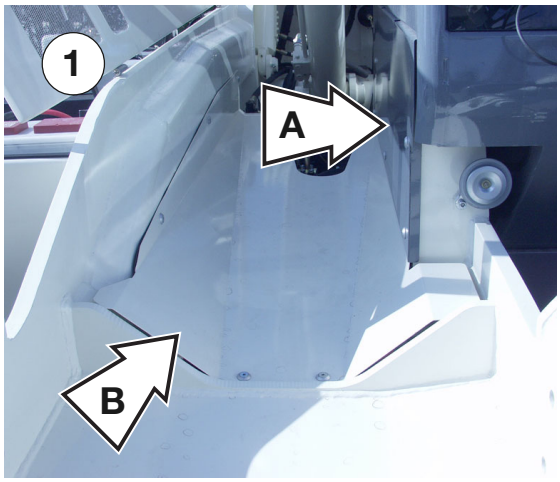
IMPORTANT

Before re-assembling the actuator, smear the thread of the fixing screws with some threadlocker.

Procedure: **Dismantling the actuator**	Table: **T-029.1** 3713 Elite ☐ 3517 ☐ 4010 ☑	kg 23
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools	Hours 2 · Min. -
		1

Procedure:

1 Raise the boom, remove the covers **A-B** with a 5mm hexagonal wrench to access to the actuator and support the lifting cylinder adequately (see A.06 - dwg. 01)



PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

DANGER

Before disconnecting the hydraulic lines, check that there is no pressure. Eliminate any residual pressure if necessary by operating the control levers with the engine stopped. Disconnect the hydraulic piping with extreme caution and always wear suitable personal protection equipment - e.g. goggles, gloves, facial screen, etc. Wrap up the end of the pipe to be disconnected with some rags and slowly loosen the pipe connector so that air comes out as slow as possible.

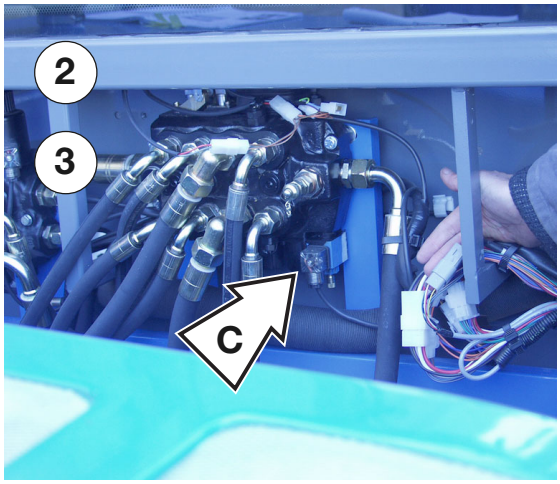
Procedure: **Dismantling the actuator**	Table: **T-029.1**

IMPORTANT

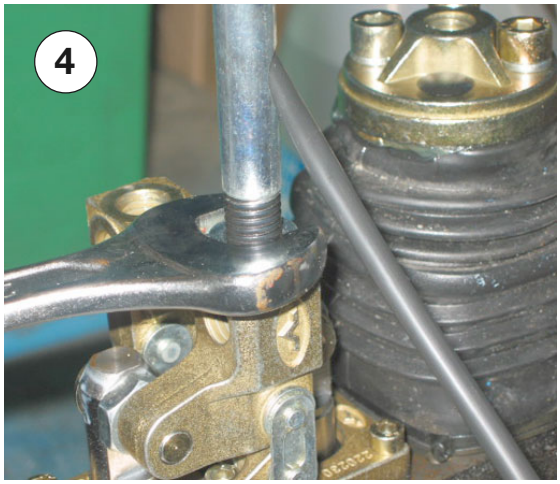
Before disconnecting any flexible hoses, label them for an easier re-assembly.

2 Disconnect all flexible hoses connected to the actuator using a set of wrenches (27, 36, 41 mm)

3 Disconnect the electrical connector **C** of the valve with a crosstip screwdriver.



4 Using a 17mm wrench, remove the three control levers of the actuator.



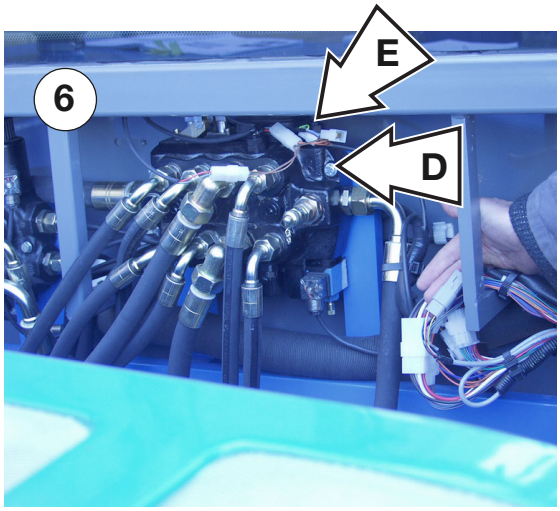
Procedure: **Dismantling the actuator**	Table: **T-029.1**

5 Disconnect the 3 electrical wires **E**.

IMPORTANT

Before disconnecting the electrical wires, label them for an easier re-assembly.

6 Sling the actuator with a textile bridle connected to the bridge crane, slightly pull the bridle, then remove the fixing screws **D** using a 13mm wrench.



IMPORTANT

Before re-assembling the actuator, smear the thread of the fixing screws with some threadlocker.

Procedure: **Dismantling the actuator**	*Table:* **T-029.1**

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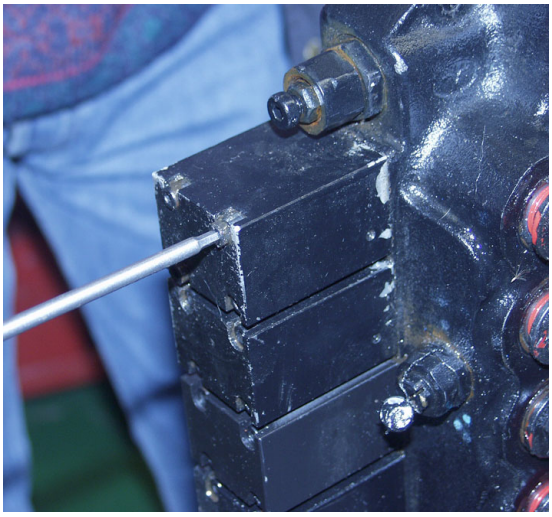
Procedure: Dismantling the actuator on bench (slider and valves)	Table: T-030			kg: 34
	3713 Elite ✔	3517 ✔	4010 ☐	Hours: - / Min.: 30
Standard tools				1

Procedure:

❑ **Dismantling the slider**

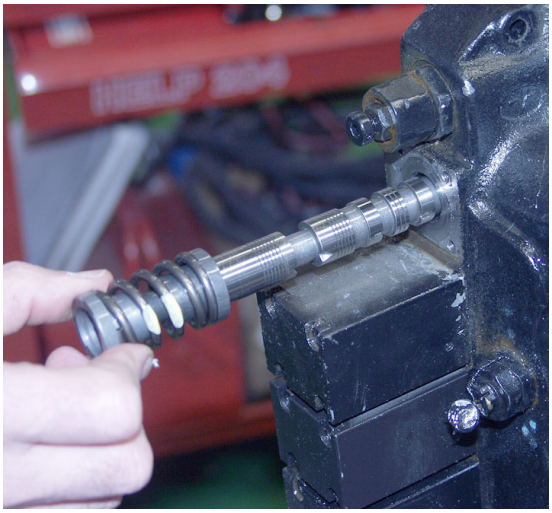
1 Remove the 4 screws fixing the cap with a 4mm hexagonal wrench.

1



2 Remove the cap and extract the slider.

2



IMPORTANT

Replace the slider if it is scored. Also check the slider housing using a portable lamp. If the housing is scored, replace the block.

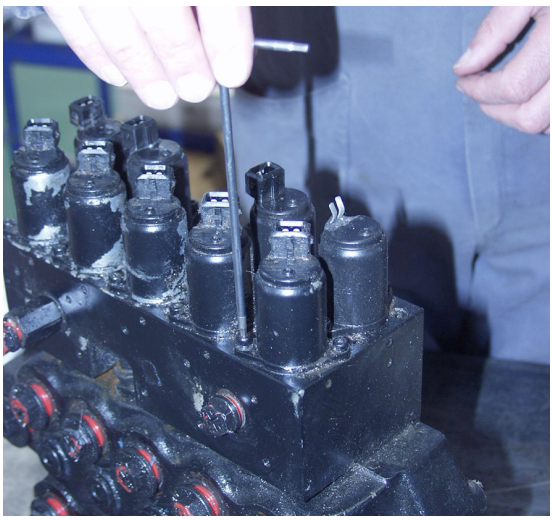
3 Clean thoroughly, check the seals and, if necessary, replace, anoint with hydraulic oil and reassemble.

Procedure:	**Dismantling the actuator on bench (slider and valves)**	*Table:* **T-030**

❑ **Dismantling the spool**

4 With a 3mm hexagonal wrench, remove the screws fixing the spool.

4



5 Check the seals for damage. If necessary, replace.

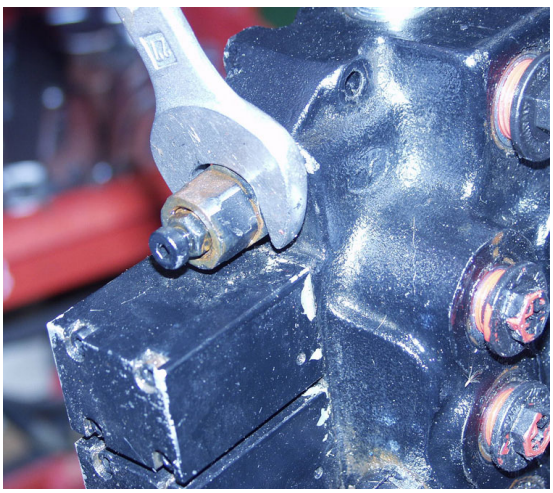
5



❑ **Dismantling the pressure relief valve**

6 With a 27mm hexagonal wrench, remove the valve block.

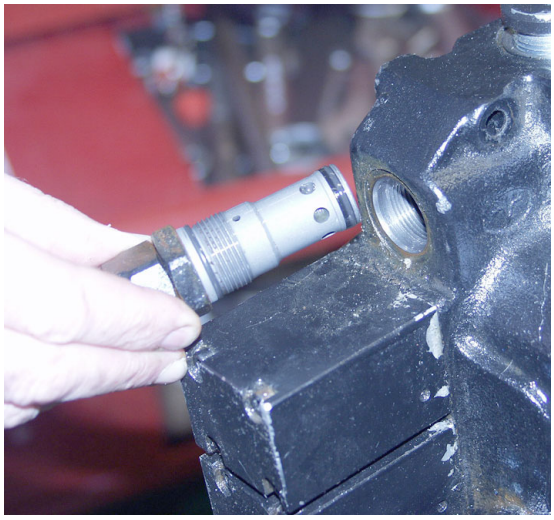
6



Procedure:	Dismantling the actuator on bench (slider and valves)	Table: T-030

7 Clean thoroughly, check the seals and, if necessary, replace, anoint with hydraulic oil and reassemble.

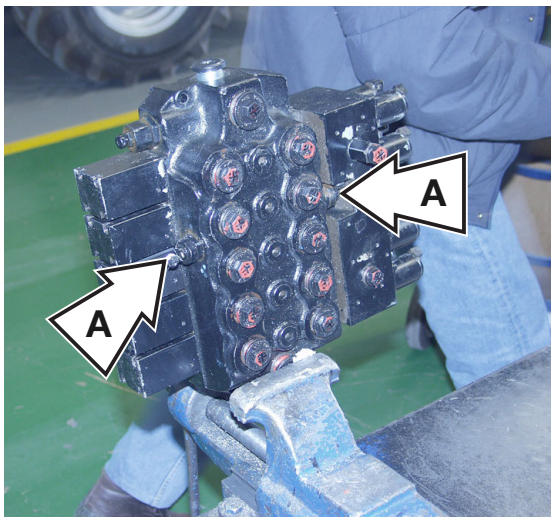
7



❑ **Dismantling the shock-proof valves**

8 The shock-proof valves **A** are calibrated and lead-sealed by the manufacturer prior to delivery. If they have to be re-calibrated, they shall be removed with a 22mm wrench and a 12mm wrench, re-calibrated and cleaned thoroughly. Check they have been re-sealed by the repair workshop after re-calibration.

8



Procedure:	Dismantling the actuator on bench (slider and valves)	Table: T-030

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Procedure:	Table: T-030.1			
Dismantling the actuator on bench (slider and valves)	3713 Elite ☐	3517 ☐	4010 ☑	kg: 23
				Hours: - Min.: 30
	Standard tools			1

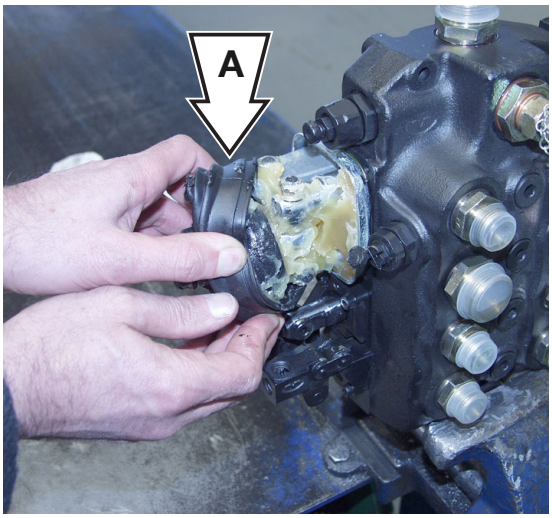
Procedure:

❑ **Dismantling the control lever**

1 Remove the fastener and lift out the rubber cap.

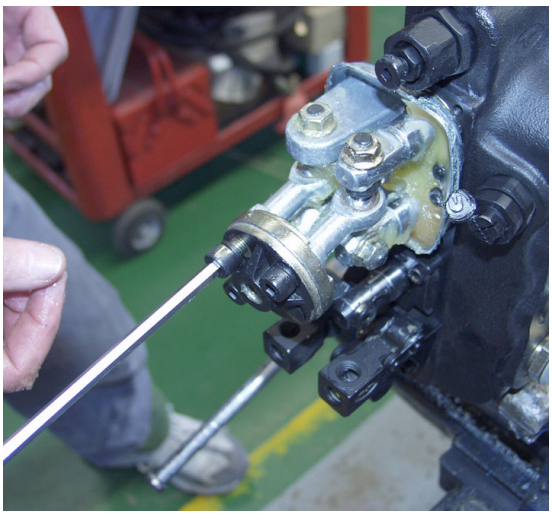
2 Eliminate any residual grease.

1



3 With a 6mm hexagonal wrench, remove the screws fixing the joints.

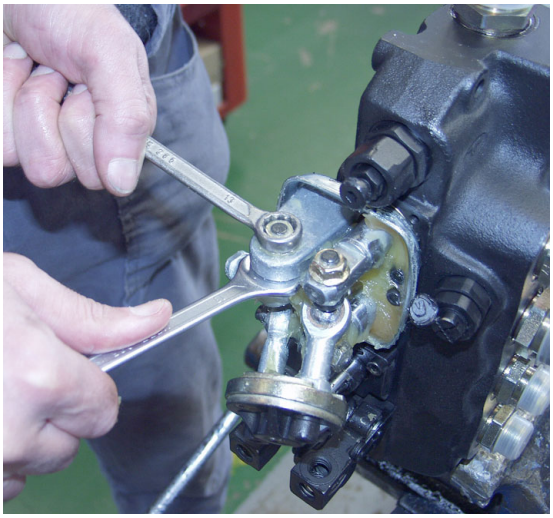
3



Procedure:	**Dismantling the actuator on bench (slider and valves)**	*Table:* **T-030.1**

4 Using two 13mm wrenches, free the joint pivot pins.

4

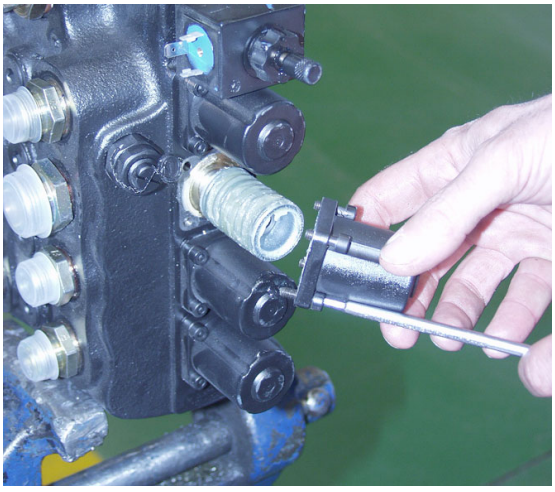


4



5 Remove the cap from the side opposite to the actuator using a 4mm hexagonal wrench and extract the slider.

5



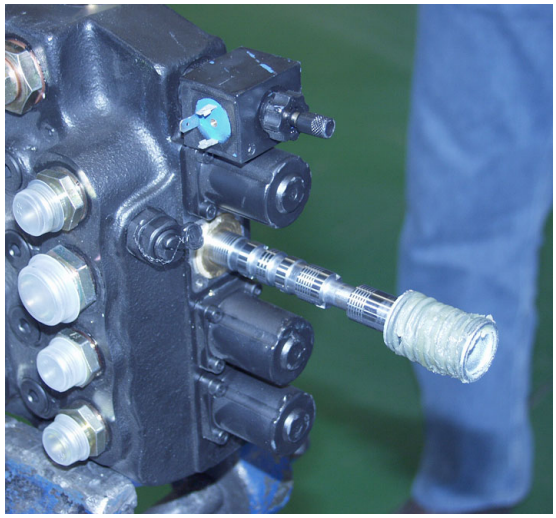
Procedure:	Dismantling the actuator on bench (slider and valves)	Table: T-030.1

IMPORTANT

Replace the slider if it is scored. Also check the slider housing using a portable lamp. If the housing is scored, replace the block.

6 Clean thoroughly, check the seals and, if necessary, replace, anoint with hydraulic oil and reassemble.

6



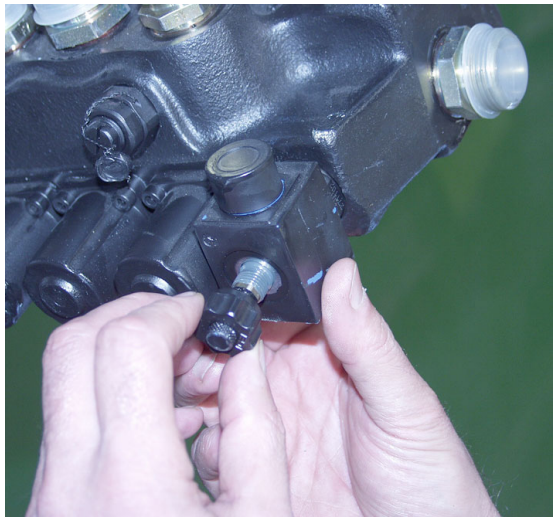
❑ **Dismantling the discharge valve**

IMPORTANT

The valve pin, if pressed down and turned clockwise, let you use the actuator also when the spool or joystick is damaged. Pay special attention!

7 Hand-unscrew the spool ring nut.

7



8 Pull out the spool.

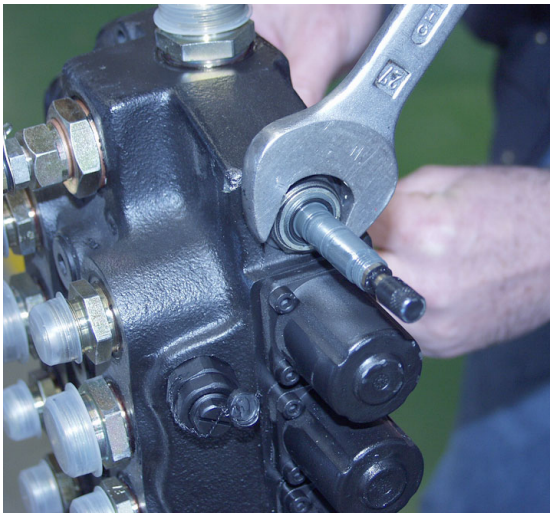
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Procedure:	**Dismantling the actuator on bench (slider and valves)**	*Table:* **T-030.1**

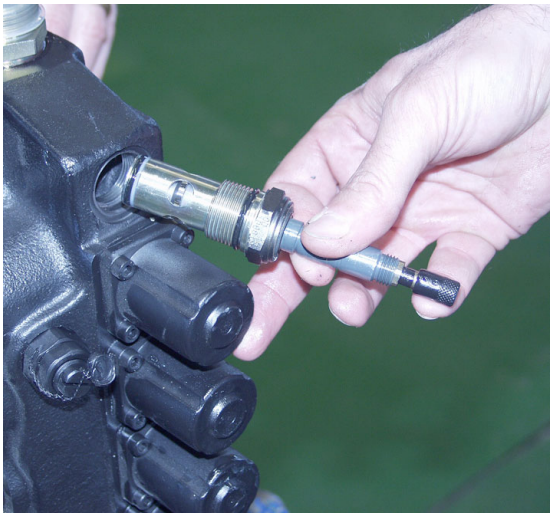
9 With a 27mm hexagonal wrench, loosen the valve cartridge.

9



10 Clean thoroughly, check the seals and, if necessary, replace, anoint with hydraulic oil and reassemble.

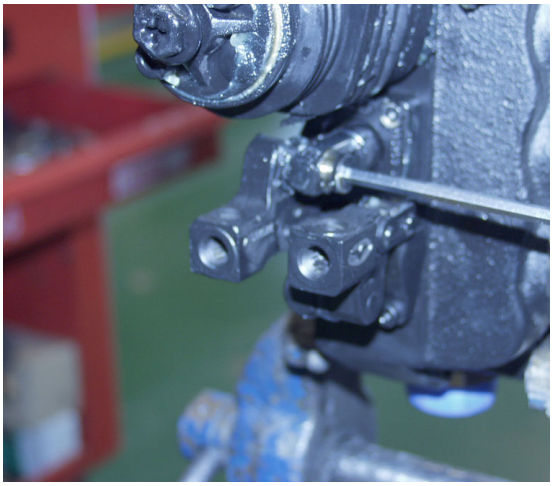
10



❑ **Dismantling the sliders (telescope and attachment locking/unlocking cylinder)**

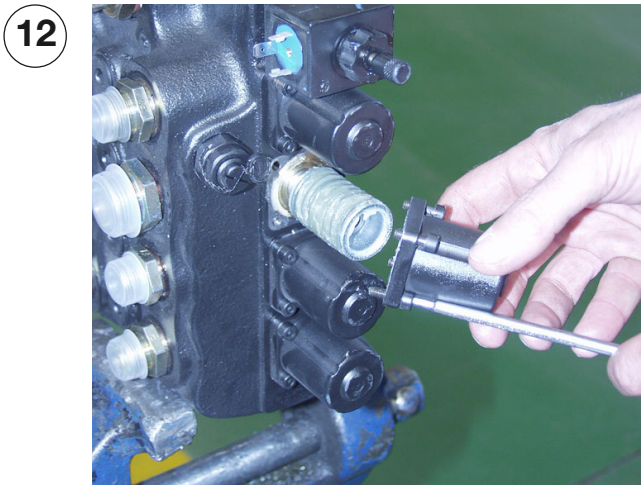
11 Remove the slider using a 13mm wrench and a 5mm hexagonal wrench.

11



Procedure:	Dismantling the actuator on bench (slider and valves)	Table: T-030.1

12 Remove the cap opposite to the slider.



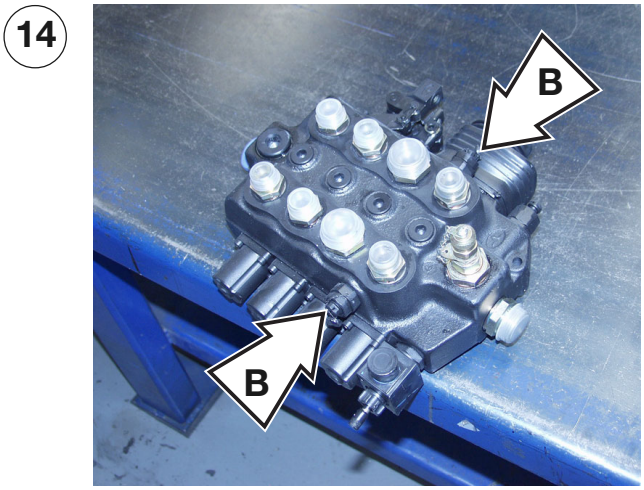
IMPORTANT

Replace the slider if it is scored. Also check the slider housing using a portable lamp. If the housing is scored, replace the block.

13 Clean thoroughly, check the seals and, if necessary, replace, anoint with hydraulic oil and reassemble.

❑ **Dismantling the shock-proof valves**

14 The shock-proof valves **B** are calibrated and lead-sealed by the manufacturer prior to delivery. If they have to be re-calibrated, they shall be removed with a 22mm wrench and a 12mm wrench, re-calibrated and cleaned thoroughly. Check they have been re-sealed by the repair workshop after re-calibration.



Procedure:	Dismantling the actuator on bench (slider and valves)	Table: T-030.1

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Procedure:	Table: T-031				
Overload warning system valid for Telelift 4010 and up to serial no. 9407 for 3013, 9362 for 3517.	3713 Elite ✔	3517 ✔	4010 ✔	kg	-
				Hours	Min.
				1	-
					1

Standard tools

INTRODUCTION

This technical card describes the procedures for installing, calibrating and troubleshooting the ARB-I Overload Warning System.

The manual is meant for trained and qualified personnel: ***Terexlift*** technicians or technicians from authorised ***Terexlift*** service centers.

IMPORTANT

Since the Overload Warning System is a device of maximum importance for the safety of machine and personnel, any intervention in contrast with the procedures or guidelines contained herein is strictly forbidden.

Circulation of this card is reserved to authorised ***Terexlift*** service centers and their employees. Reproduction or disclosure of this technical card or of the information contained herein is a violation of agreements.

Additional copies of this manual can be ordered to ***Terexlift***.

Procedure: **Overload warning system**	Table: **T-031**

A-1 SYSTEM OVERVIEW

The ARB-I Overload Warning System includes:

- a load cell, placed on the rear axle of the machine
- a main module
- a display

The main module **A** (Fig.1) contains the electronics and the trimmers for calibrating the system. The 8-pin screw connector **B** connects the main module to the electric system of the machine and to the load cell. The display **D** is connected to the main module **A** by a flat cable **C**. The connector on the end of the flat cable can be inserted in the display in one way only.
The display (Fig. 2) indicates the stability of the machine by means of a five-LED (Light Emitting Diode) bar graph: three are green (LED1, LED2, LED3), one yellow (LED4) and one red (LED5). LED1 is always on, therefore indicating presence of the supply voltage. On the right of the display a yellow "**S**" (LED6) lights when both stabilisers are lowered (if fitted on the machine). The alarm buzzer is contained inside the display. Behind the display is located the plug for connecting to the main module.

An external relay, connected to the alarm output, controls the solenoid valve that locks out the extension and descent movements of the boom, which would decrease the stability of the machine.

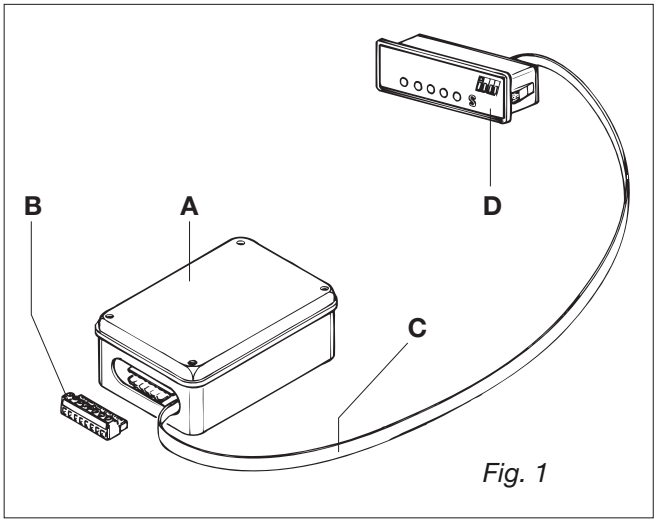


Fig. 1

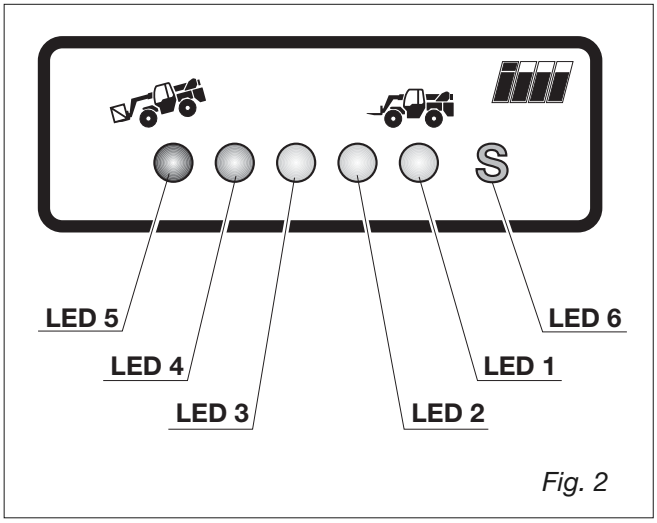


Fig. 2

SPAER PARTS

Part#	*description*
637275	main module (A-B-C)
637276	display (D)

Procedure: **Overload warning system**	Table: **T-031**

A - 2 TECHNICAL SPECIFICATIONS

Electrical specifications

- Supply voltage: 12 ÷ 15 Vdc
- Maximum current: 350 mA
- Fuse (external): 0.5 A F (fast-acting) 5x20mm
- Protected against power inversions

Environmental

- Temperature: -20 ÷ 50 °C
- Humidity (non-condensing): 95%

Inputs/outputs

- Stabiliser status input
  Input voltage: 10 ÷ 15 V
  Input current: 30 mA

- Alarm relay output
  Output voltage: 12 V
  Maximum load: 200 mA

Load cell specifications

- Excitation voltage 5 V
- Sensitivity: 1 mV/V

Procedure: Overload warning system	Table: T-031

B-1 OPERATION

The output from the load cell is a signal of a few milliVolt, which depends on the weight applied on the cell and on the excitation voltage of the cell. The nominal excitation voltage of the load cell is 5 V; in practice it may vary between 4.75 V and 5.25 V.

Remember that the number of LEDs that are lit is inversely proportional to the output voltage of the load cell. When the load on the cell decreases (because the boom is being extended, for example), the output of the load cell also decreases, but the number of LEDs that are lit increases from right to left.

When the fifth LED lights up, the buzzer sounds and current stops flowing from the alarm output (pin **8** on connector **B**). This output is connected to the coil of a relay which, upon opening, controls a solenoid valve that locks out the extension and descent movements of the boom.

The alarm is deactivated when the stability of the machine returns within safety (the red LED turns off) and after approximately a 3-second delay, in order to allow any oscillations of the machine to dampen out.

When both stabilisers are lowered, a positive voltage (10 V minimum) is present at the stabiliser input (pin **7**). The "**S**" on the display lights up and the instruments changes range.

To ensure a stable display, the turn-on threshold of every LED is different from its turn-off threshold. For example, suppose that a weight of 1010 kg is applied on the cell, that the turn-on threshold of a LED corresponds to a weight of 1000 kg and the turn-off threshold to a weight of 1005 kg. If the weight on the cell is gradually reduced, the LED turns on when the weight is less than 1000 kg. To turn the LED off again, the weight on the cell must increase above the turn-off threshold (1005 kg). This hysteresis ensures that every LED is steadily on or off, in spite of the vibrations of the vehicle.
The fifth LED (alarm) has a greater hysteresis compared to the other LEDs: when the alarm is activated, this ensures that the stability of the vehicle is well back within safety before the alarm is deactivated.
A fact to be held in mind is that, due to inevitable friction between load cell and bushings, the cell can remain slightly loaded, sensing a higher-than-normal weight. The result is that, with the vehicle in

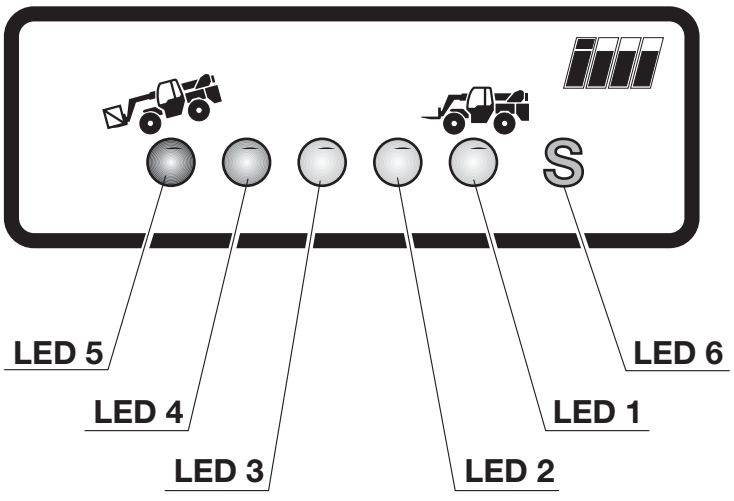


Fig. 3

Procedure: **Overload warning system**	Table: **T-031**

the same conditions and with same weight on the forks, the alarm will be activated when the boom is extended at a greater distance than the distance set during
calibration.
When the vehicle is moving or operating, the vibrations on the rear axle cancel out the residual tension of the cell, and the system works perfectly. Since during calibration the vehicle is standing still, it is important to “bounce” the vehicle before every calibration step, abruptly lowering and raising the boom. This ensures that the weight sensed by the cell is the actual weight applied on the rear axle.

DANGER

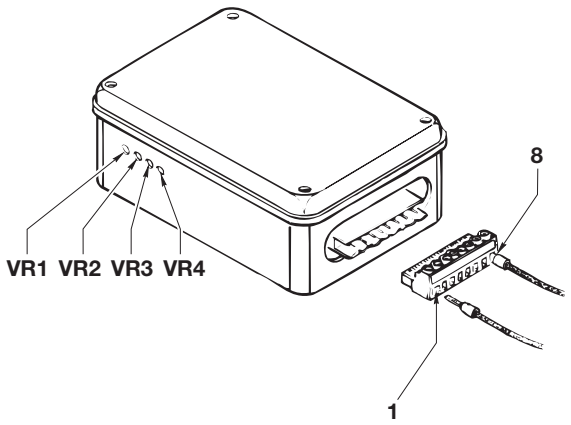
Carry out all maneuvers in safety, making sure the working range of the machine is clear of persons or objects.

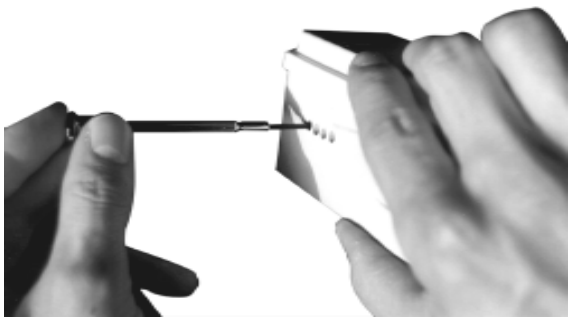
The upper and lower ends of the readout scale are adjusted with multiturn trimmers. The system allows to choose between two ranges, depending whether the stabilisers are up or down. In the former case, trimmers **VR1** and **VR2** will be adjusted; in the latter case (both stabilisers down), trimmers **VR3** and **VR4** will be adjusted (see Fig. 4)

The function of the trimmers is the following:

	Range with stabilisers up	Range with stabilisers down
lower setpoint	VR1	VR3
upper setpoint	VR2	VR4

When the lower setpoint of the readout scale is being calibrated, the vehicle must have the forks unloaded and the boom completely retracted. When calibrating the upper setpoint, the vehicle must have a known weight loaded on the forks and the boom must be extended at the distance shown on the appropriate load chart. In either case, the boom shall be perfectly horizontal.
Turning the adjustment screws on the trimmers counterclockwise will turn on more LEDs (from right to left); rotating the screws clockwise turns off more LEDs (from left to right). The adjustment screws have no mechanical stops.





Procedure: Overload warning system	Table: T-031

C-1 C-1 INSTALLATION GUIDELINES

ATTENTION

Before arc-welding on the machine:

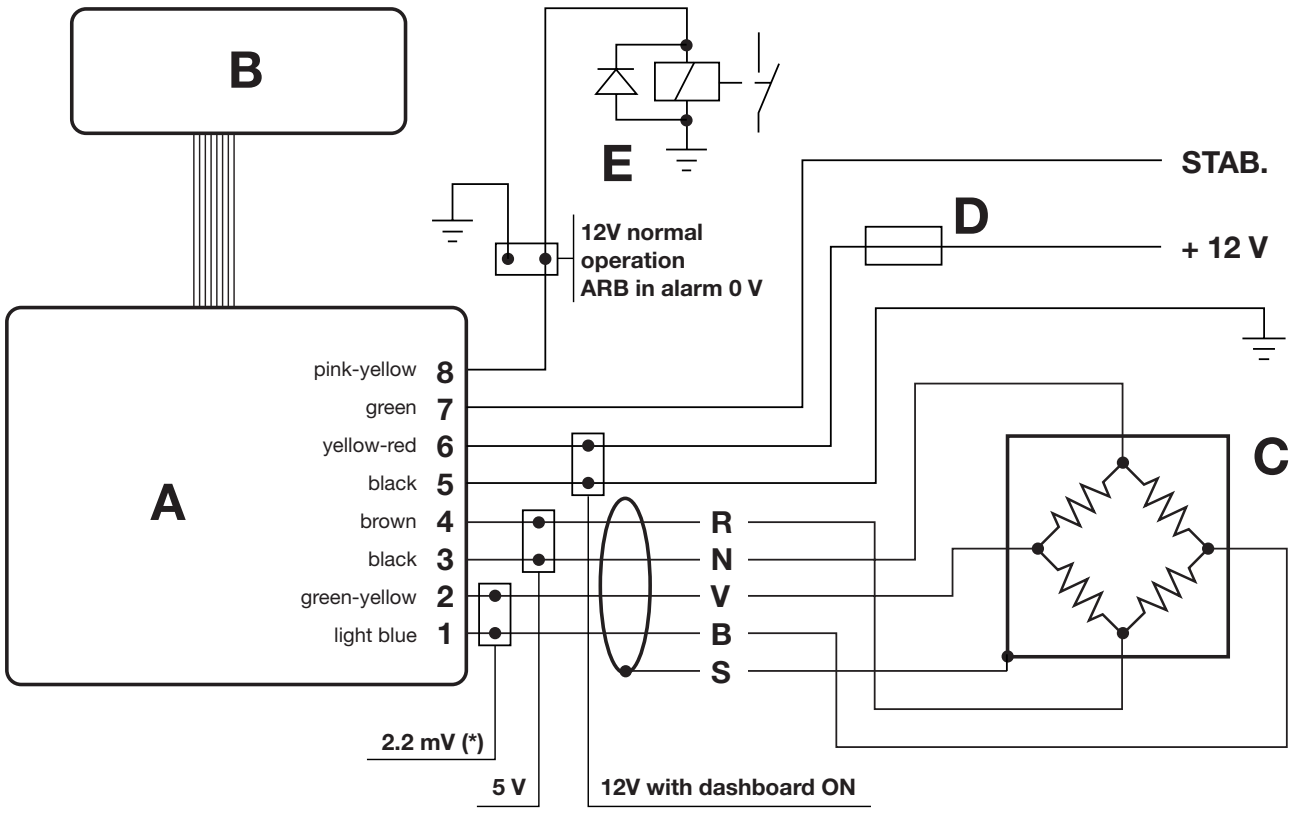
- ***disconnect the battery (use the battery cut-out switch if fitted on the machine)***
- ***remove the connector from the main module***

ATTENTION

Never run the diesel engine when the battery is disconnected, to avoid damage to the electrical system.

- The shielded cable from the load cell to the instrument should be kept as short as possible. By all means avoid coiling the cable, since it could pick up interferences. This is also true for the wires coming from the dashboard.
- Avoid installing the instrument close to devices which generate electromagnetic noise (windshield motor, fan motor etc.).
- Use only a wire stripper to remove insulation from the wires. Scissors can nick the copper conductor and, in the long run, cause the wire to break.
- The cable from the load cell (blue cable) is a four-conductor shielded cable. To remove the external insulation use a pair of scissors or a blade, avoiding to cut through the shield.
- Do not pull on the flat cable that connects the display.
- The electronic circuit inside the main module is extremely sensitive. Soot, dust, fingerprints, oil or grease can compromise the operation of the system. During installation and calibration, ensure maximum cleanness of hands and tools.
- Should the connectors become soiled, clean them with contact-cleaning spray for electronics provided it is not a “lubricant” type of spray.
- Avoid foreign objects from entering the main module. In particular, look out for wire clippings.
- Do not open the main module box.
- Always remove power (turn off the ignition key) before inserting or removing the connector of the main module or display.
- The adjustment screws on the trimmers are delicate: use a small screwdriver with a swivel top and gently turn the screws, without applying excessive pressure.
- The system is protected against polarity inversions. In any case be careful when making connections.
- The relay connected on the alarm output must have a diode mounted across the coil (see connection diagram).
- If arc welders are used after the load cell is installed, make sure the return of the welder is direct and does not cross the load cell.

Procedure: **Overload warning system**	Table: **T-031**



(*) This value is given as a reference and can vary according to cell model (ADOS or NBC). Find the value with the boom horizontal and full retracted without any weight applied on the forks.

Legend:

A - main module
B - display
C - load cell
D - fuse
E - alarm relay + diode

R - red
N - black
V - green
B - white
S - shield

Procedure: **Overload warning system**	Table: **T-031**

Connections:

1 - load cell output
2 + load cell output
3 - load cell excitation
4 + load cell excitation
5 - power supply (connected to ground)
6 + power supply (protected by a fuse)
7 stabiliser input (positive signal when both stabilisers are down)
8 alarm output (200 mA max.) A positive voltage is present when the alarm is not activated.
S load cell shield (not connected to the instrument). The shield of the cable is connected to the body of the load cell: once the cell is fitted on the rear axle, the shield is connected to ground (chassis).

The **ADOS** or **NBC** load cells are interchageable. Refer to the following table for the wire coulour identification.

Pos.	ADOS cell	NBC cells
1	White (cell output)	Yellow
2	Green (cell output)	Green
3	Red (+ 5V cell power supply)	Red and white (join the wires)
4	Black (ground)	Black and blue (join the wires)

Procedure: **Overload warning system**	Table: **T-031**

C-2 INSTALLATION

Tools required for installation:

- 1.2 mm swivel-top screwdriver (Fig. 6a)
- wire stripper (Fig. 6b)
- scissors or a knife (Fig. 6c)
- cutters (Fig. 6d)
- crimping tool for pin terminals (Fig. 6e)
- pin terminals (Fig. 6f)
- cable ties (Fig. 6g)

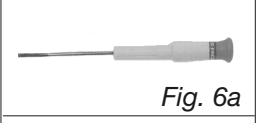

Fig. 6a


Fig. 6b


Fig. 6c


Fig. 6d

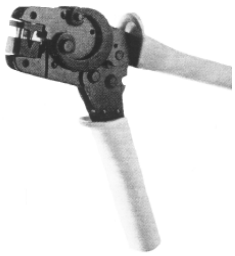

Fig. 6e


Fig. 6f


Fig. 6g

Main module installation:

- mount the main module on the cab.
- open the battery disconnect switch; remove the fuse from the fuse holder on the power supply of the system (see connection diagram).
- gather the load cell cable and the wires coming from the dashboard near the connector on the side of the main module and cut to length.
- strip 30 mm from the outside insulation of the load cell cable (Fig. 7)
- separate the shield from the wires and cut the shield flush with the outside insulation (Fig. 8, item “A”).
- strip 8 mm of insulation from the four wires of the load cell cable (Fig. 7).
- strip 8 mm of insulation from the wires coming from the dashboard.

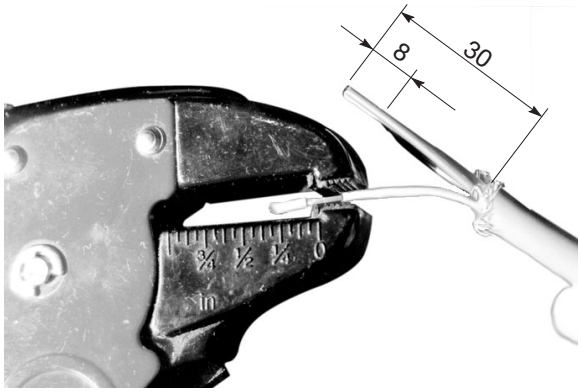


Fig. 7

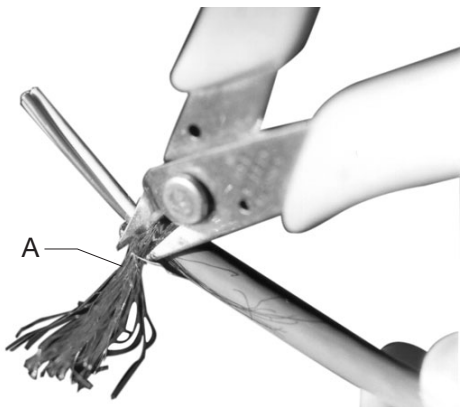


Fig. 8

Procedure: **Overload warning system**	Table: **T-031**

- using the crimping tool, secure the pin terminals on every wire (Fig. 9). If the pin terminals are unavailable, it is advisable to tin the tips of the wires before securing them to the screw connector.
- gently pull on the wires to check that the pin terminals are secure.
- connect the wires on the screw connector B following the diagram. Tighten the screws on the connector, checking that all wires are securely fastened. Tie the wires with a cable tie (Fig. 10).

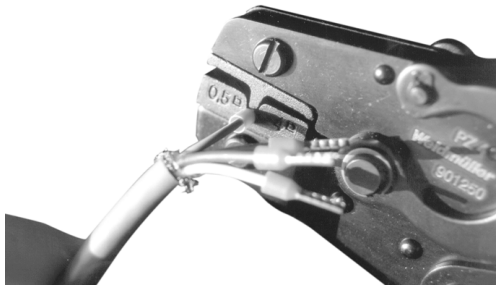


Fig. 9

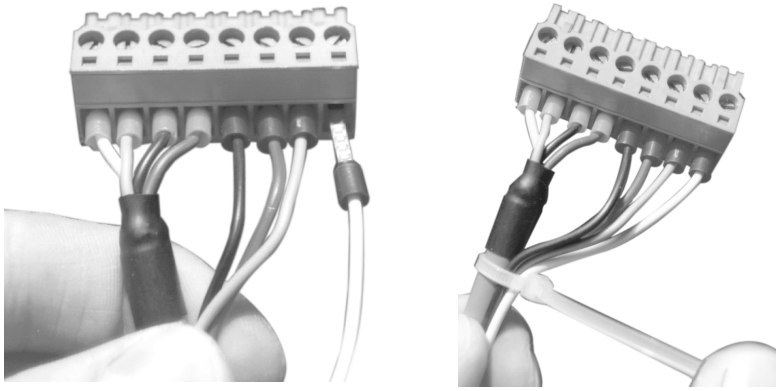


Fig. 10

- after checking that every wire has been connected as shown on the diagram, insert the connector on the plug on the main module. The connector can be inserted in one way only (Fig. 11).
- secure the cell cable, the flat cable and the wires from the dashboard with a cable tie and self-adhesive cable tie mount.

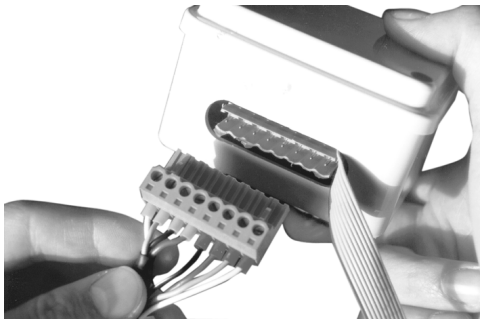


Fig. 11

Procedure: **Overload warning system**	Table: **T-031**

Display installation:

- connect the flat cable from the main module to the plug on the display (Fig. 12); the connector can be inserted in one way only.
- insert a cable tie on the mount on the display and secure the flat cable (Fig. 13).
- insert the display in the hole on the dashboard; the display must be locked. Otherwise it should be secured to the dashboard with RTV silicone or hot-melt glue, applied between the lower side of the dashboard and the display housing.



Fig. 12

At the end of the installation, close the battery disconnect switch and insert the fuse in the fuse holder. Make sure the fuse is a 0.5 A fast-acting type only.



Fig. 13

Procedure: Sistema antiribaltamento	Table: T-031

C-3 CALIBRATION

DANGER

Carry out all maneuvers in safety, making sure the working range of the machine is clear of persons or objects.

Calibration must be carried out with the machine on a hard, level surface.
The forks shall be loaded with a known weight. According to the load on the forks, refer to the load charts for the maximum distance the boom can be extended horizontally. If the machine is fitted with stabilisers, there will be two values (one with stabilisers up, one with the stabilisers down).

IMPORTANT

The distance shall be measured from the front of the tyres to the center of gravity of the load.

Fig. 14 shows an example load chart: without stabilisers on the right side, with stabilisers down on the left. When the stabilisers are up, the maximum extension distance for the boom is 3.2 m with 3000 kg on the forks, 4.4 m with 2000 kg, 5.8 m with 1000 kg, 7 m with 800 kg and so on. When both stabilisers are down, the maximum reach is 3.5 m with 3500 kg on the forks, 5.5 m with 2000 kg and so on.

Example load chart
Do not use for actual calibration

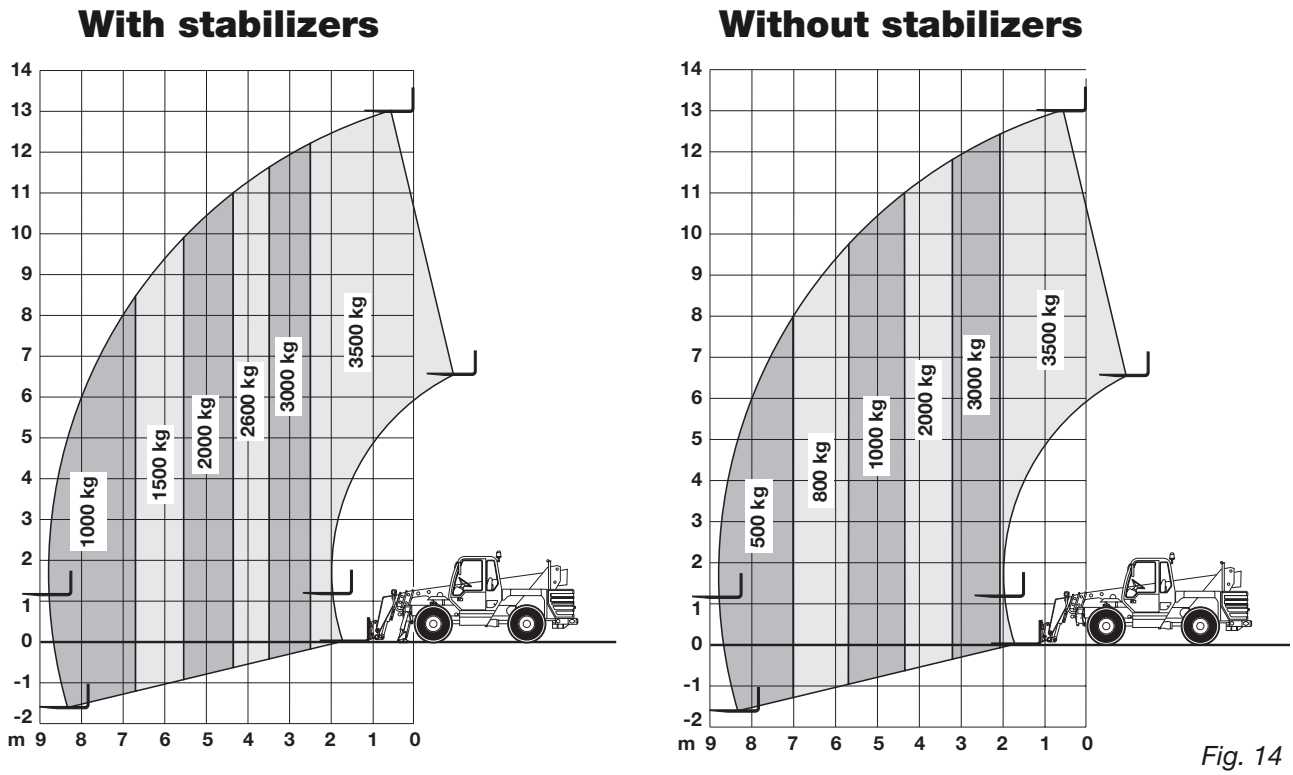


Fig. 14

Procedure: **Sistema antiribaltamento**	Table: **T-031**

Calibration procedure:

1 - Retract the boom all the way, bringing it in a horizontal position.

2 - Lower the boom with an abrupt movement of the control lever, in order to “bounce” the machine; return the boom to the horizontal position and wait for oscillations to dampen out.

3 - Rotate trimmer **VR1** (see Fig.15) until LED2 turns off (rotating the trimmer clockwise turns off more LEDs, and viceversa); after LED2 turns off, rotate the trimmer clockwise two and half turns more.

4 - Load the forks with the known weight.

5 - Extend the boom to the distance previously found on the load chart. If LED5 turns on while the boom is being extended (and therefore the boom locks out), turn trimmer **VR2** clockwise approximately five turns.

6 - Lower the boom with an abrupt movement of the control lever, in order to “bounce” the machine; return the boom to a horizontal position and wait for oscillations to dampen out.

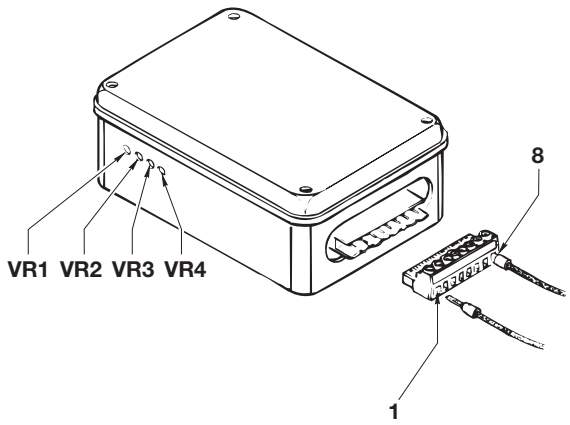
7 - Rotate trimmer **VR2** counterclockwise until LED5 is lit; at this point, rotate **VR2** counterclockwise another half turn.

After completing the calibration procedure, make sure the alarm is activated at the required distance. Then replace the main module on its support.

IMPORTANT

If, during the calibration procedure, the LEDs light up in an unusual manner (for example, LEDs 2 and 3 off, LEDs 4 and 5 on) proceed as follows:

- turn trimmer **VR1** counter-clockwise approximately ten turns.
- turn trimmer **VR2** clockwise approximately ten turns.



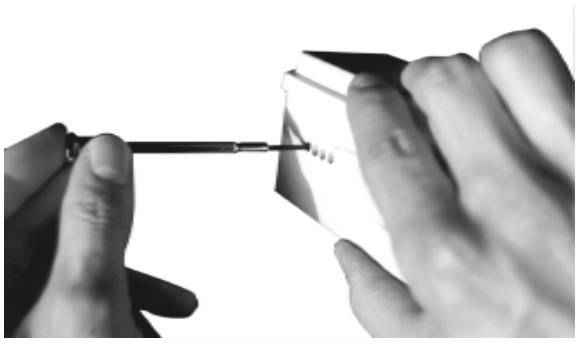


Fig. 15

Procedure: **Overload warning system**	Table: **T-031**

Final Inspection

A final inspection must be carried out after any intervention on or calibration of the overload warning system:

- Ensure the system is functioning properly and is correctly calibrated.
- Make sure the main module case and the display are firmly in place inside the cab and are not touching hydraulic hoses or any moving part.
- Make sure all cables are firmly held in place, in order to prevent them from rubbing or vibrating.
- Check the main module and its connector for cleaness. To remove oil residues, use a clean towel and ethyl alcohol; blow off any dust with compressed air.
- Fill out the calibration seal with date and signature.
- Apply the calibration seal on the main module, over the trimmer access holes.

Procedure: **Overload warning system**	Table: **T-031**

D-1 CHECKS AND INSPECTIONS

1) Checking the overload system power supply:

- Check the supply voltage (12÷14.5 V) between pins **6** (+) and **5** (-) on connector **B**.

2) Checking the load cell excitation voltage:

- Check the load cell excitation voltage (from 4.75 V to 5.25 V) between pins **3** (+) and **4** (-) on connector **B**.

3) Checking connections on the main module:

- Remove connector **B** from the main module.
- Ensure all wires are hooked up on the connector exactly as shown on the electrical schematic.
- Gently pull on each wire, to make sure they are securely fastened on the connector.
- Check every wire for nicks, cuts or abrasions.

4) Checking the load cell connections:

- Remove connector **B** from the main module (always remember to cut off main power before removing or inserting the connector).
- Set the multimeter on the resistance (“ohm”) range; the measured resistance between pins **1** and **2** should be 351 ± 5 . Between pins **3** and **4** the measured resistance should be 350 ±20 . If this is not the case, a br oken wire in the load cell cable or a defective load cell could be the problem.
- Check for electrical continuity between the shield of the load cell cable and chassis ground.
- Ensure every wire from the load cell is insulated from ground: the reading must show resistance greater than 20 M . Smaller measur ed values can be caused by a damaged insulation (usually a result of arc-welding): replace the load cell.

5) Checking the weight applied on the load cell:

- Remove any load from the forks, retract the boom all the way and place the machine on a hard, level surface.
- Set the multimeter on the 200 mV range and measure the output of the load cell, between pins **2** (+) and **1** (-) on connector **B**.
  - If the voltage is negative, the load cell signal wires (white and green) must be inverted.
  - If the voltage exceeds 1.3 mV, go to step 6.
  - If the voltage does not exceed 1.3 mV, calculate the corresponding weight (see Appendix **A**) and make sure it does not exceed the maximum weight on the rear axle (see the identification plate on the machine). If the maximum rear axle weight is exceeded, go to step 6.
- If, after checking the rear axle, the problem still persists, a defective load cell is likely.

6) Checking mechanical components:

- Ensure the oscillation of the rear axle is not restricted by any part or object.
- Check the correct axial positioning of the load cell. The cell should not have any longitudinal play. If this occurs, tighten the locking ring.
- Ensure there is no axial play between load cell and axle support, and between load cell and chassis.
- Lubricate the load cell bushings (see Operator Handbook).

Procedure: **Overload warning system**	Table: **T-031**

E-1 CALCULATING THE WEIGHT APPLIED ON THE CELL

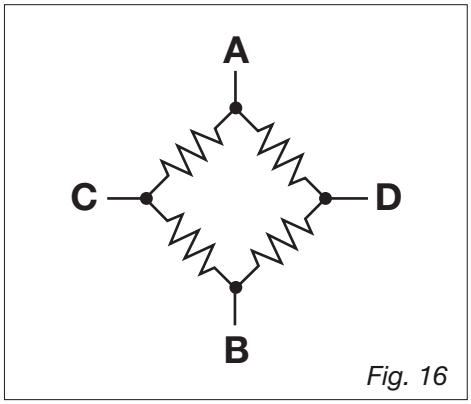


Fig. 16

To find out the weight on the load cell, you need to know:

- the excitation voltage (in V)
- the load cell capacity (in kg)
- the sensitivity of the cell (in mV/V)
- the load cell output voltage (in mV)

The excitation voltage is the voltage applied between terminals **A** and **B** of the load cell (Fig. 16). The nominal value is 5 V, but in practice it can vary between 4.75 V and 5.25 V.

The load cell capacity is the maximum weight that can be applied on the cell, resulting in the maximum output from the cell (see following table).

The output voltage is measured between terminals **C** and **D** of the cell.

The sensitivity of the load cell is the ratio between the output voltage (in milliVolt) and the excitation voltage (in Volt), when the cell is loaded with a weight equal to its capacity. All load cells fitted in the rear axle have a 1 mV/V sensitivity. This means that, considering a 10000 kg capacity load cell, under a 10 000 kg load and with a 1 V excitation voltage, the output voltage is 1 mV; if the excitation voltage is 2 V, the output voltage is 2 mV and so on.

Use the following formula to compute the weight:

$$\frac{\textbf{cell capacity}}{\textbf{maximum output}} \times \textbf{output voltage} = \textbf{weight on the cell}$$

The maximum output voltage is:

excitation voltage x sensitivity = maximum output

In this example, since the load cell sensitivity is 1 mV/V and the nominal excitation voltage is 5 V, the full-scale voltage is 5 mV.

Example:

10 000 kg capacity load cell, with 3.2 mV output voltage

the weight on the cell is: $\frac{10000\ \text{kg}}{5\ \text{mV}} \times 3.2\ \text{mV} = 6400\ \text{kg}$

Procedure: Dismantling the emergency pump	Table: T-032			kg	10,2
	3713 Elite ✔	3517 ✔	4010 ☐	Hours	Min.
	Standard tools			1	30
					1

Procedure:

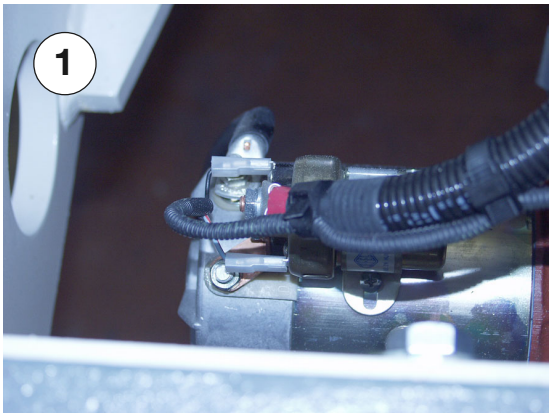
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

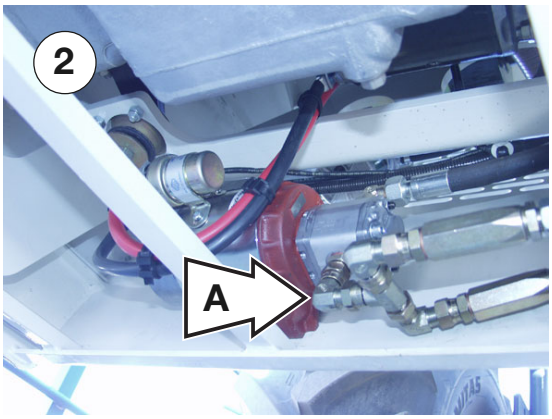
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

1 Disconnect the battery and unplug all of the electrical connections of the pump.

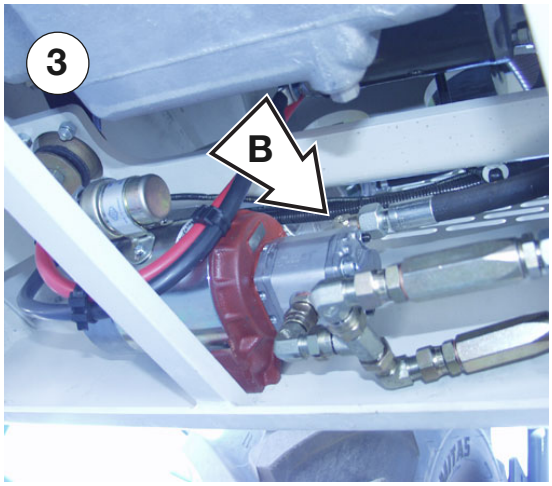


2 Using a 22mm wrench, disconnect the delivery hose **A** of the pump.



Procedure: **Dismantling the emergency pump**	Table: **T-032**

3 Using a 27mm wrench, disconnect the intake hose **B**.



4 Using a 22mm wrench, disconnect the screws fixing the pump to the frame.

IMPORTANT

Before reassembling the emergency pump, smear the threads of the fixing screws with some threadlocker.

Procedure: Dismantling the DFE valve	Table: T-033			kg	4
	3713 Elite ☐	3517 ☐	4010 ☑	Hours	Min.
Standard tools				-	30
					1

Procedure:

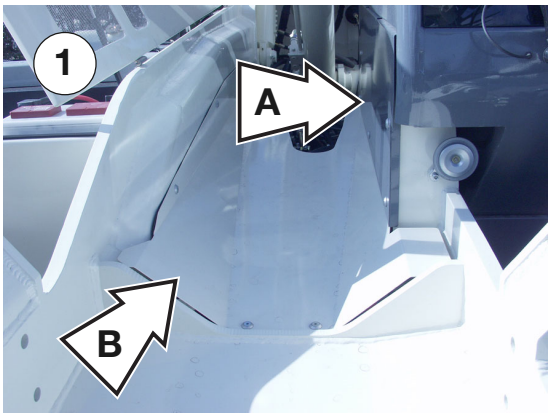
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

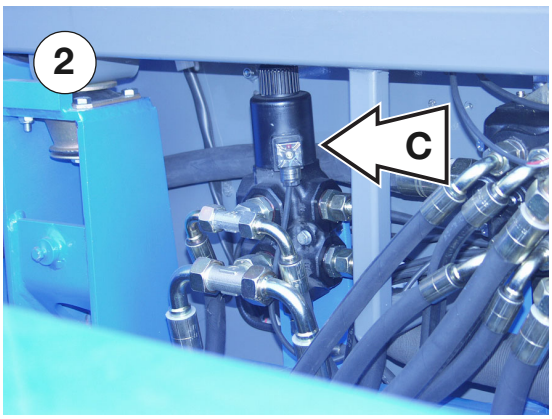
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

1 Raise the boom, remove covers **A-B** and access to the DFE valve. Place a support under the lifting cylinder (see A.06 - dwg. 01)

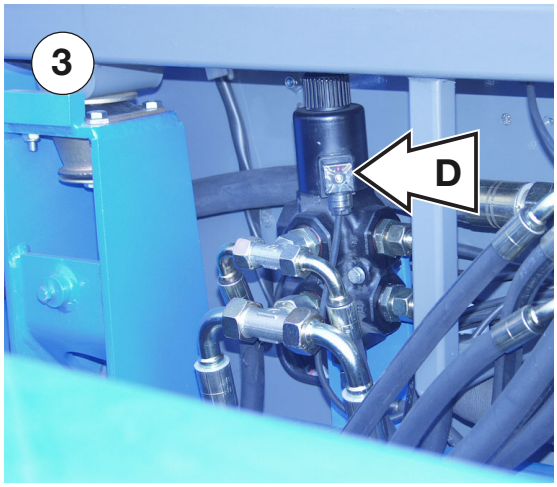


2 Access to the DFE valve **C** and disconnect the flexible hoses with a set of wrenches (19, 27, 36 mm).

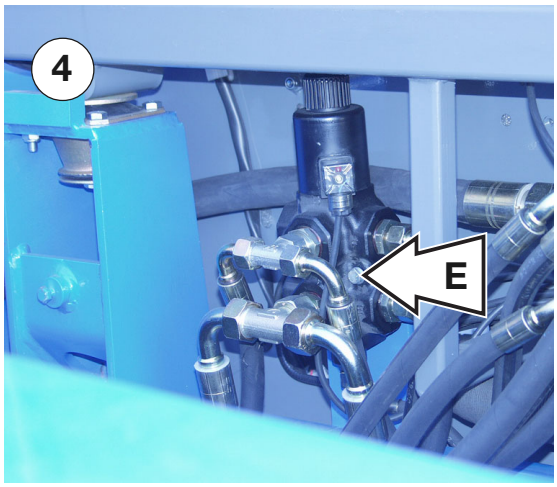


Procedure: Dismantling the DFE valve	Table: T-033

3 Disconnect the spool connector **D**.



4 With two 13mm wrenches, remove the electrical flow divider and check its functionality on the bench.



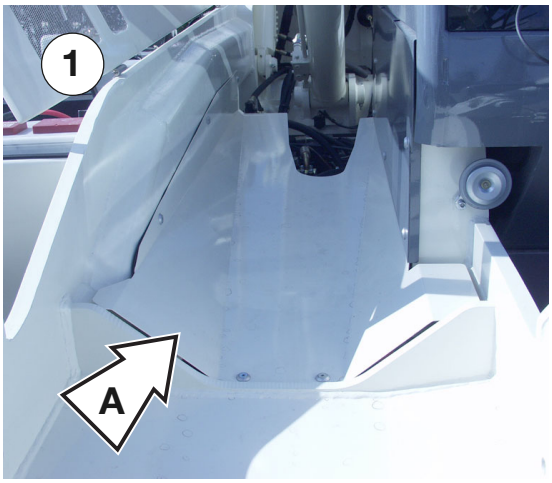
IMPORTANT

Before reassembling the valve, smear the threads of the fixing screws with some threadlocker.

Procedure: Dismantling the Load Sensing valve	Table: T-034			kg	0,8
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			-	30
					1

Procedure:

1 Raise the boom, remove cover **A** with a 5mm hexagonal wrench and access to the valve. Place a support under the lifting cylinder (see A.06 - dwg. 01)



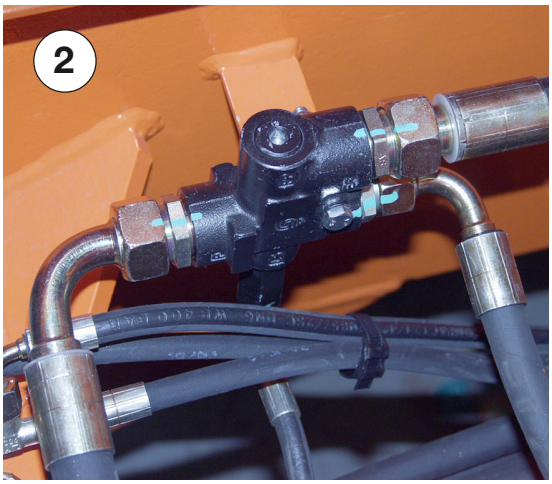
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

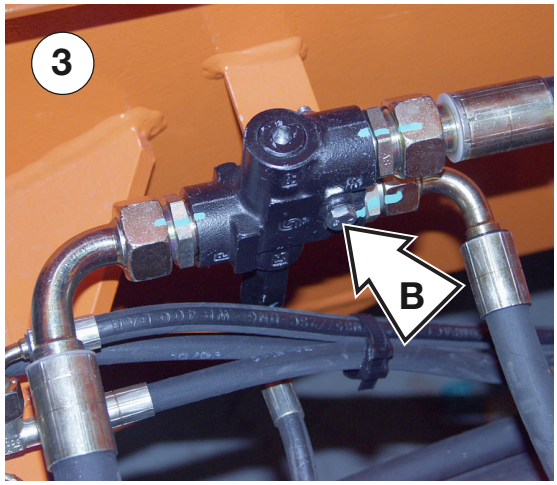
Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

2 Disconnnect the hydraulic lines connected to the valve using a set of wrenches (19, 27, 36 mm).



Procedure: **Dismantling the Load Sensing valve**	*Table:* **T-034**

3 Loosen the screw **B** with two 13mm wrenches and dismantle the valve.



Procedure: Dismantling the accumulators	Table: T-035			7.2 (1.5 l) 4.1 (0.5 l)
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: - Min.: 30
Standard tools				1

- ***Actuator accumulators (15 litres)***

1 on Telelift 3713 Elite

- ***Brake accumulators (0.5 litres)***

2 on Telelift 3713 Elite/3517
1 on Telelift 4010

Procedure:

■ Actuator accumulator

DANGER

Before dismantling and disconnecting the accumulator from the hydraulic line operate the actuator levers forward and back until they can hardly move.

PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of in accordance with local and national regulations. Address to legally authorised centres.

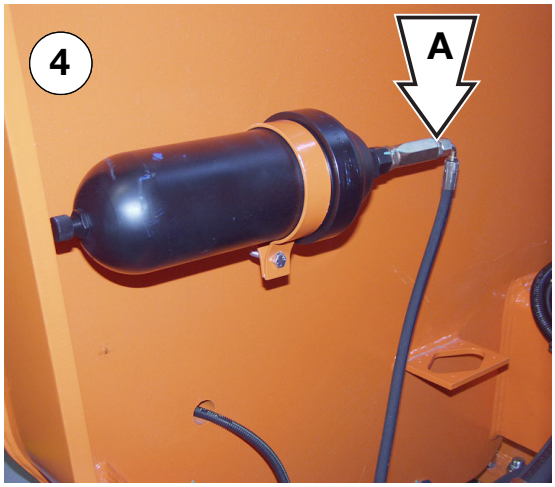
1 Place a container of suitable size under the feeding connector to prevent oil spillage.

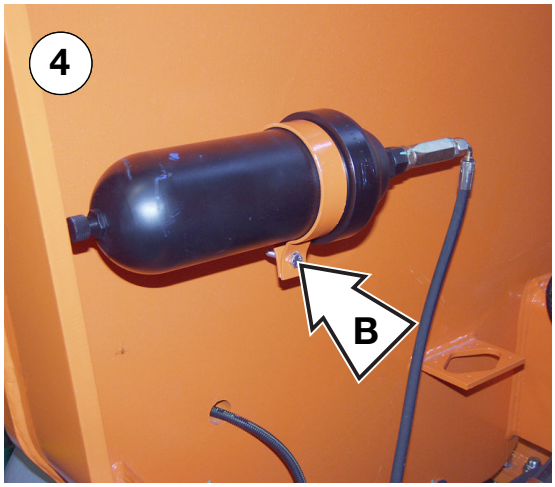
2 Hydraulically disconnect the accumulator with extreme caution:
- protect your hands with gloves
- protect your face with a screen
- protect your eyes with goggles

3 Wrap up the accumulator with a rag, then slowly loosen the feeding connector **A** with a 19mm wrench.

Procedure: **Dismantling the accumulators**	*Table:* **T-035**

4 Remove the screw **B** with two 13mm wrenches to open the accumulator clamp.





Procedure: Dismantling the accumulators	Table: T-035

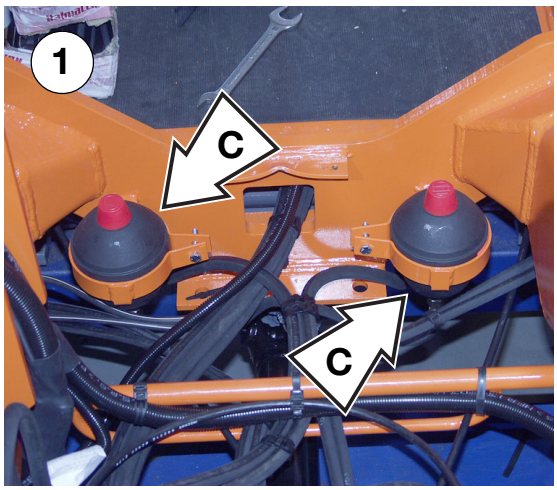
■ Service and parking brakes' accumulators

DANGER

With the engine stopped, the accumulator is not at pressure. In any case, proceed with extreme caution when disconnecting the hydraulic lines.

PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of in accordance with local and national regulations. Address to legally authorised centres.

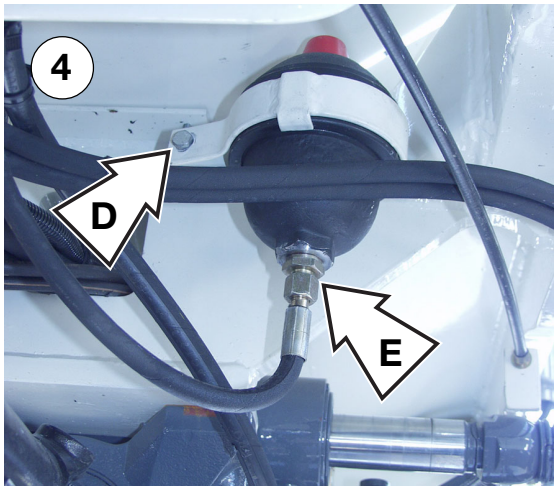


1 Place a container of suitable size under the feeding connector to prevent oil spillage.

2 Hydraulically disconnect the accumulator with extreme caution:
- protect your hands with gloves
- protect your face with a screen
- protect your eyes with goggles

3 Wrap up the accumulator **C** with a rag, then slowly loosen the feeding connector **E** with a 19mm wrench.

4 Remove the screw **D** with two 13mm wrenches to open the accumulator clamp



Procedure:	Dismantling the accumulators	Table:
		T-035

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Procedure: Checking the accumulator	Table: T-036 3713 Elite ✔ 3517 ✔ 4010 ✔	kg: -
		Hours: - Min.: 30
Standard tools		1

• GENERAL DESCRIPTION

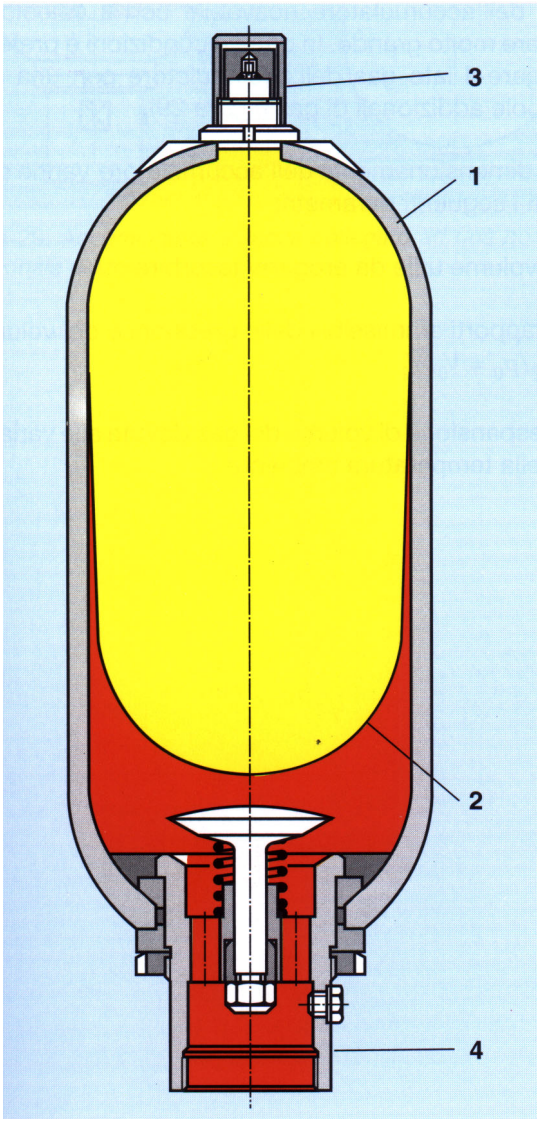
BLADDER ACCUMULATORS

In bladder accumulators, gas and liquid sides are separated by a flexible bladder. The liquid area is located in connection with the hydraulic circuit. As a result, when the hydraulic pressure rises fluid enters the accumulator and the gas is compressed. Vice versa, when the pressure sinks, the gas relaxes and displaces the liquid from the accumulator to the hydraulic circuit.

Bladder accumulators can be installed vertically (preferably) or horizontally or, in certain conditions, also inclined.

In the inclined or vertical positions, the liquid valve shall be turned downwards.

Bladder accumulators consist of a pressure vessel (**1**) in welded or forged execution, an elastic bladder, (**2**), gas connection (**3**) and oil connection (**4**).



Bladder accumulator

Procedure: Checking the accumulator	Table: T-036

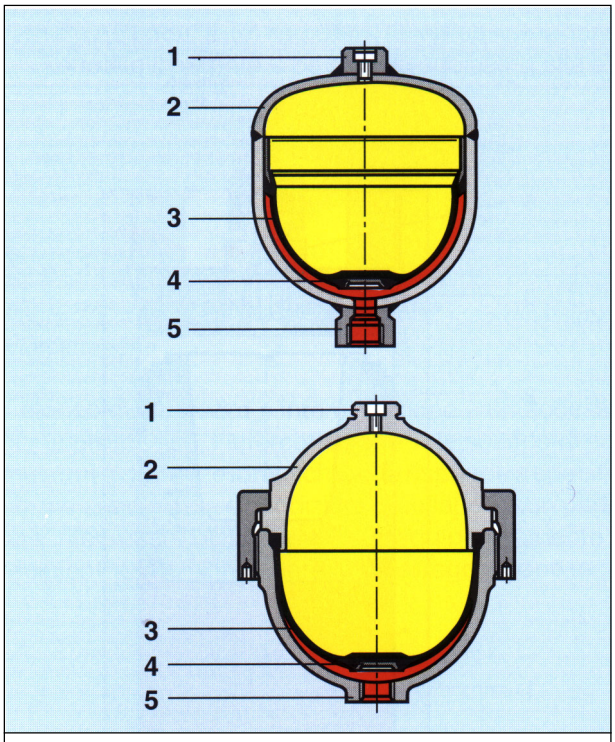
DIAPHRAGM ACCUMULATORS

Diaphragm accumulators consist of a pressure resistant steel vessel, usually of spherical or cylindrical shape, with a diaphragm of flexible material used as a separation element.

The diaphragm accumulators are manufactured in two different executions:
- welded execution
- screwed-on execution

In the accumulators in welded execution, the diaphragm is pressed to the bottom before the weld of the two steel cups. In this way, thanks to special proceedings (e.g. electronic welding) and a special arrangement of the diaphragm, damages can be avoided.

In the screwed-on execution, the diaphragm is fastened with a ring nut placed between the two cups of the shell.



1 gas valve
2 vessel
3 diaphragm
4 plate valve
5 liquid side fitting

Diaphragm accumulators; (top) welded execution; (bottom) screwed-on execution.

Procedure: **Checking the accumulator**	Table: **T-036**

• SAFETY PRECAUTIONS

Accumulators can only be repaired by the manufacturer. Welding, soldering or mechanical working of the shell are prohibited.

The compressed gas inside the accumulator is highly dangerous due to the accumulated energy. Strictly observe the manufacturer's instructions on installation and maintenance.

The most important routine job is the check of the precharge pressure.

Accumulators shall be installed in easily accessible areas and fastened with strong supports to withstand rebounds in case the tubing breaks.

A check valve shall be installed between pump and accumulator to avoid dynamic reactions on the tubes.

Every accumulator, being a pressure vessel, shall be equipped with a gauge able to indicate the instantenous operating pressure. On the gauge, the maximum admissible pressure shall be clearly visible.

The accumulator shall also be equipped with a safety valve and protected against tampering.

The safety valve shall be designed so as not to block the discharge of the accumulator. Easily accessible on-off devices shall be mounted on the tube connecting the accumulator to the hydraulic circuit and as close to the accumulator as possible.

In Germany, accumuators shall fulfil the "Rules on pressure vessels". Installation and operation are regulated by the "Technical rules for pressure vessels (TRB)".

The pressure vessel forming the accumulator body is classed in relation to the admissible pressure ***p*** (bar), the capacity ***l*** (litres) and the operating pressure per capacity ***p x l***.

The following table lists the checks to be done in relation to the groups.

For the accumulators installed outside Germany, the testing documents valid in the destination country shall be issued as the testing of TÜV (German Technical Inspectorate) is not accepted all over the world. In this case, the admissible operating pressure can differ from the nominal pressure.

Group	Factory-checks pior to placing in service	Checks by the users	Routine checks
II $p > 25$ bar and $p \times l$ 200	Pressure check. With the "HP" mark, or a certificate, the manufacturer declares the conformity of the product and the testing of the pressure check.	Efficiency check (equipment and installation) done by inspectors.	The time intervals of the routine checks shall be defined by the user on the basis of his experience and the type of liquid used.
III $p > 1$ bar $p \times l > 200$ and $p \times l$ 1000	Preventive check by TÜV inspectors and manufacture and pressure check. Certificate issued by the Manufacturer (prototype identification) or by TÜV inspectors.	Check done by inspectors (TÜV).	See group II.
IV $p > 1$ bar and $p \times l > 1000$	See group III.	See group III.	Internal check: every 10 years when non-corrosive fluids are used; or every 5 years. Pressure check: every 10 years by inspectors (TÜV).

Procedure: Checking the accumulator	Table: T-036

• PLACING IN SERVICE

CONDITION ON DELIVERY

The accumulators are delivered:

- either pre-charged with nitrogen to a storage pressure of approx. 5 bar,
- or pre-charged with nitrogen to a pressure corresponding to the one calculated according to its working characteristics.

PRESSURIZING WITH NITROGEN

- Use the OLAER charging and gauge device to check the charging pressure with respect to the calculate dpressure. The charging pressure must compulsorily be less than the calculated pressure stamped on the shell.
  If the charging pressure read on the gauge is less than 1.5 bar, follow the bladder recharging procedure (see re-assembly point **U** and following).
- Check the charging valve for leaks (using soapy water for example).
- Tighten the protective cap manually.
- Periodically check the inflation pressure. Use the charging and gauge device to check the inflation pressure on start-up.
  Repeat this operation during the first week of operation, and then every six months in case of normal operating conditions or every month in case of intensive use

IMPORTANT

It is essential to use dry nitrogen from a bottle equipped with a pressure reducing valve. The use of an air compressor and of oxygen is strictly forbidden.

INSTALLATION

For maximum efficiency, the accumulator should be placed as close as possible to the system on which it is used. Leave a free space of 200mm around the charging valve to install the OLAER charging and gauge device (see accessories guide).

The accumulators may be installed in any position from horizontal to vertical (charging valve at the top).

The name plate must be visible and the vent screw accessible.

The accumulators are connected by means of the threaded connector or the SAE or CETOP flange according to the specific model; or they may be equipped with a reducer fitting, a flange or a counter-flange (see guide for specific model).

FIXING

See sheet of each accumulator.

HYDRAULIC PRESSURIZING

Vent the pipework of any air that it might contain carefully loosening the vent screw according to the model until the liquid begins to flow, then re-close the vent.

Procedure: Checking the accumulator	Table: T-036

• CHARGING AND TESTING DEVICE

GENERAL DESCRIPTION

Nitrogen leaks from accumulators are usually negligible. However, to avoid that the piston rests on the head or the bladder/diaphragm due an excessive loss in pressure, it is recommended to check the gas precharge pressure regulalry.

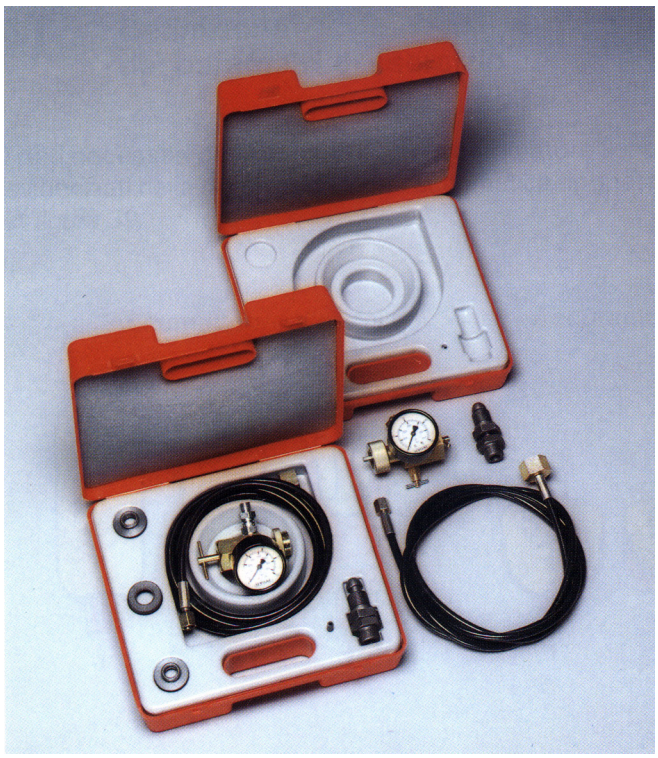
A single charging and testing device allows precharging the accumulator with nitrogen and to check and, if necessary, adjust the gas pressure.

To precharge the accumulator, the device is screwed onto the gas valve of the accumulator and connected to the nitrogen bottle by means of a flexible hose. The nitrogen bottle is not necessary to check or reduce the precharge pressure.

The precharge value stamped on the accumulator data plate shall be verified and, if necessary, restored before putting in service the accumulator or after a repair work. After the accumulator has been put in service, the precharge pressure should be checked at least once in the first week.

If this check reveals no loss in pressure, the precharge should be checked after 4 months and subsequently every year.

The charging and testing device is an indispensable instrument for checking inflation up to a max pressure of 550 bar and for checking the nitrogen loss from all OLAER accumulators.

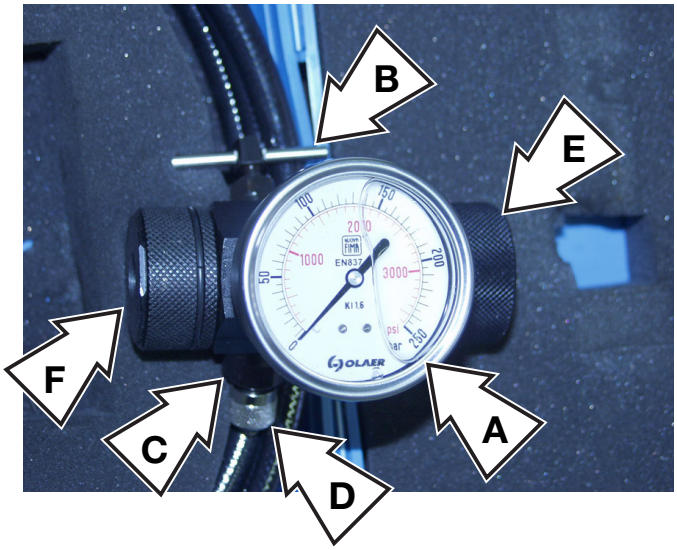


The instrument consists of 3 different parts:

- VG3 inflator tester
- Flexible hose cut to fit the nitrogen bottle fitting
- Case.

Procedure: Checking the accumulator	Table: T-036

GENERAL TECHNICAL DATA



- Pressure gauge (pos. **A**) with standardised scale: 6, 10, 25, 100, 250, 400, 600 bar.
- Venting key (pos. **B**).
- Inflation fitting with check valve for connecting the 60°1/4" BSP male hose (Pos. **C**).
- Knurled plug (pos. **D**).
- Regulator (pos. **E**).
- 3 fittings (screwed on coupling **F**) to connect the accumulator-inflator tester:
  - SAE 7/8" 14 NF2;
  - SAE 5/8" 18 NF2;
  - 0.305"-32 NFT (for Schraeder valve).
- Flexible hose:
  - standard TS2 - max working pressure: 400 bar;
  - standard TS6 - max working pressure: 550 bar.

  Length: 2 m roughly. The hose has one female coupling to each end:
  - 60°1/4" BSP coupling for connection to the inflation fitting (pos. **C**);
  - ø 21.7x1.814 Sl fitting with seal for connection to a pressure source (nitrogen bottle, portable nitrogen source, inflation unit. etc.).

CODES

VG3	250	TS2
type	pressure gauge	flexible hose
	6 bar	
	10 bar	
	25 bar	
	100 bar	
	250 bar	
	400 bar	
	600 bar	

Flexible hose
TS2: max working pressure: 400 bar
TS3: max working pressure: 550 bar

INSTALLATION AND USE

To inflate with a nitrogen bottle, commonly sold on the market, it is advisable to fit a pressure reducing valve between flexible hose and bottle.

Procedure: **Checking the accumulator**	*Table:* **T-036**

CHECKS

Check that the accumulator has been disconnected from the circuit and that it discharges and returns to the liquid side.

- Loosen the plugs of the inflation valve (pos. **F**).
- Unscrew the regulator (pos. **E**).
- Open the vent (pos. **B**).
- Hand-tighten the tester on the inflation valve.
- Hand-lock the fitting and position the pressure gauge.
- Lock the vent key (pos. **B**).
- Screw down the regulator (pos. **E**) and start checking the needle. Screw down when the needle moves from position 0 (1/2 turn is enough; do not tighten).
- Read the inflation pressure on the pressure gauge.
- To reduce the pressure, open the vent key slowly until reaching the pressure you wish.
- To increase the inflation pressure:
  - remove the knurled plug (pos. D);
  - connect the fitting (pos. **C**) to one end of the 60° 1/4" BSP flexible hose;
  - connect the other end of the hose to the nitrogen source and set under pressure.

Compulsorily wait for the stabilisation of the thermal exchange caused by the movement of the pressures before any check or pre-charge. For safety reasons, cut out the nitrogen source during stabilisation.

DISMANTLING

Repeat the check phase in reversed order. After removing the inflator tester, check the tightness of the inflation valve.

Re-tighten the plug/s of the inflation valve.

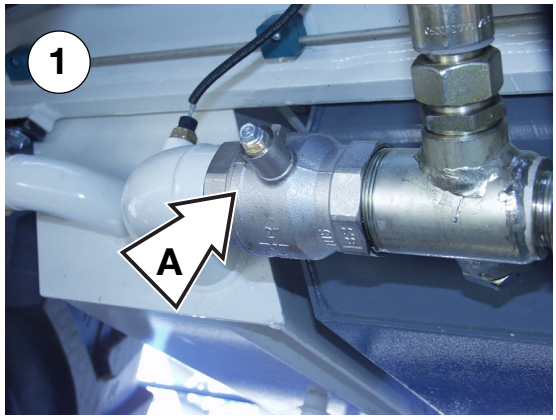
Procedure: **Checking the accumulator**	*Table:* **T-036**

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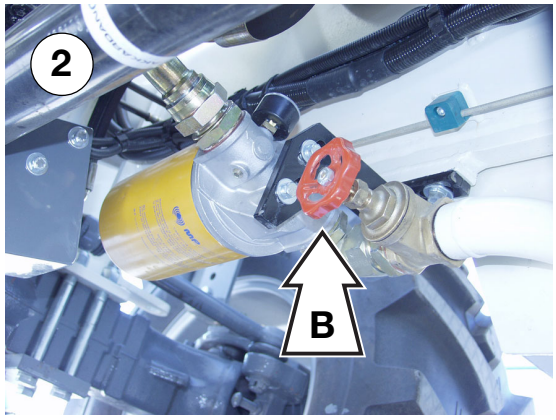
Procedure: **Dismantling the hydraulic oil tank**	Table: **T-037** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 102
		Hours 3 Min. 00
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools	1

Procedure:

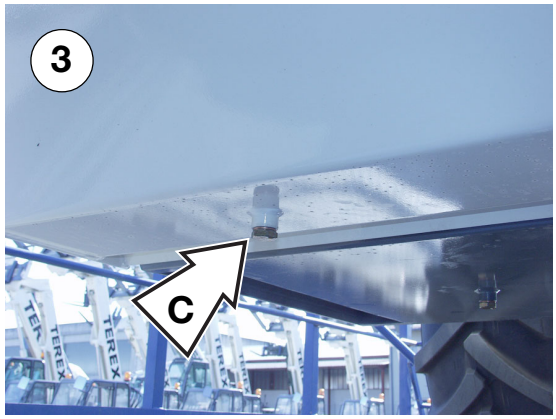
1 Move to the rear side of the machine, close the hydraulic oil intake valve **A** using the lever provided.



2 Close valve **B** of the hydraulic oil filter.



3 Place a container of adequate capacity under the hydraulic oil drain plug **C**; remove the plug with a 27mm wrench.



Procedure:	Dismantling the hydraulic oil tank	Table:
		T-037

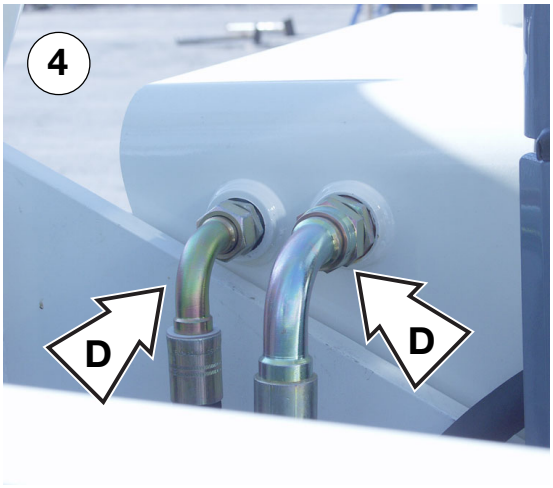
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

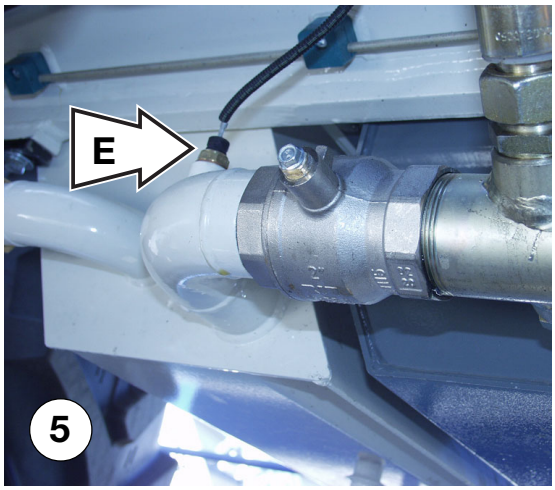
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

4 Disconnect all hydraulic lines **D** at the inlet and outlet of the oil tank using a 41mm wrench and a 50mm wrench.

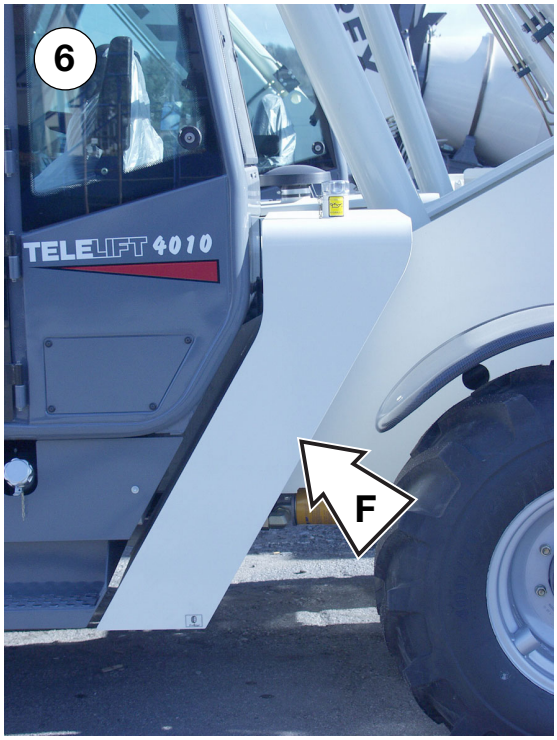


5 Disconnect the electrical connectors **E**.

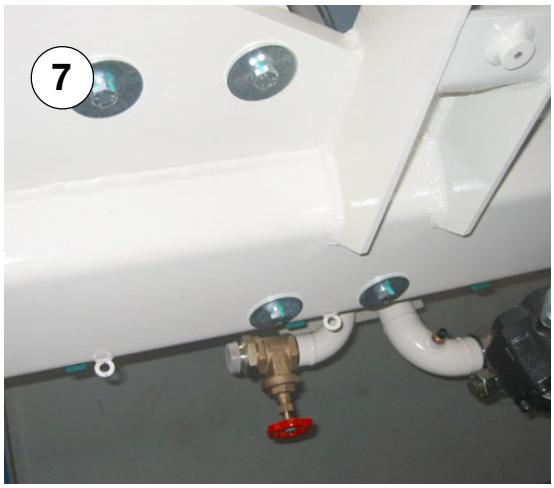


Procedure: **Dismantling the hydraulic oil tank**	Table: **T-037**

6 Firmly sling the hydraulic oil tank **F** with a textile bridle connected to the bridge crane. Tension the bridle slightly.



7 With a 22mm wrench remove the fixing screws from the internal side of the frame; pull out the tank with extreme caution and lower it to the ground in a site where it cannot hinder other operations.



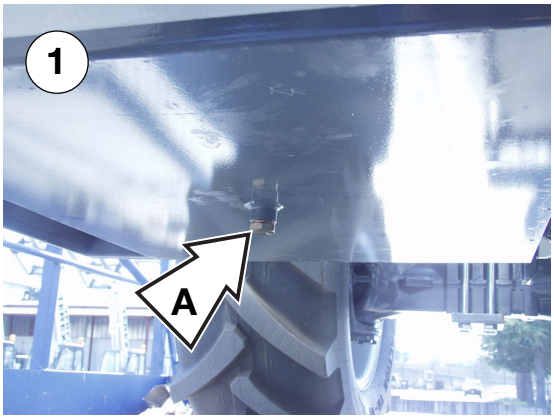
Procedure:	Dismantling the hydraulic oil tank	Table:
		T-037

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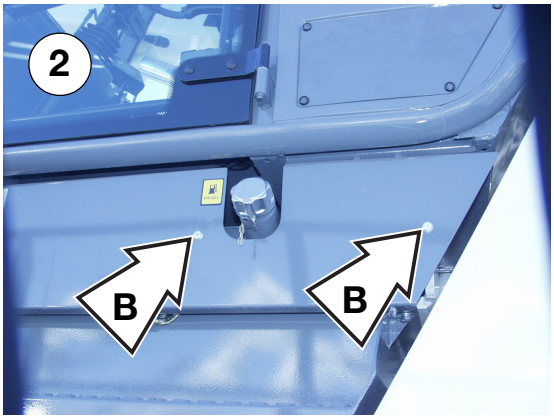
Procedure: **Dismantling the fuel tank**	Table: **T-038** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 72
Bridge crane, payload 500 kg Textile bridles or chains with hooks	Standard tools	Hours 3 Min. 00 1

Procedure:

1 Place a container of adequate capacity under the drain plug **A**, remove the plug with a 27mm wrench.



2 With a 4mm hexagonal wrench, loosen the screws **B** and lift out the protection cover.



PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

Procedure: Dismantling the fuel tank	Table: T-038

IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

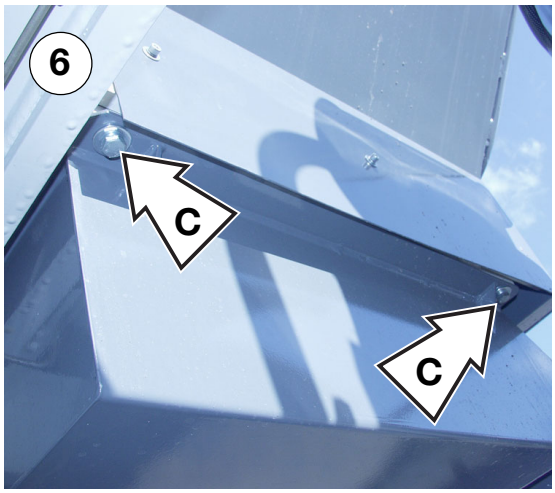
3 Disconnect all hydraulic lines at the inlet and outlet of the fuel tank.

4 Disconnect the terminal of the fuel gauge.

5 Support the fuel tank with a wheeled jack or a forklift.

6 With a 17mm wrench, remove all screws **C** di fixing the tank.

7 Lower the jack or the forklift and extract the tank.



Procedure: Dismantling the hydrostatic steering unit	Table: T-039			kg	6.2
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			1	30
					1

Procedure:



1 Pry off the protection cover underneath the steering wheel with a crosstip screwdriver and access to the power steering unit.

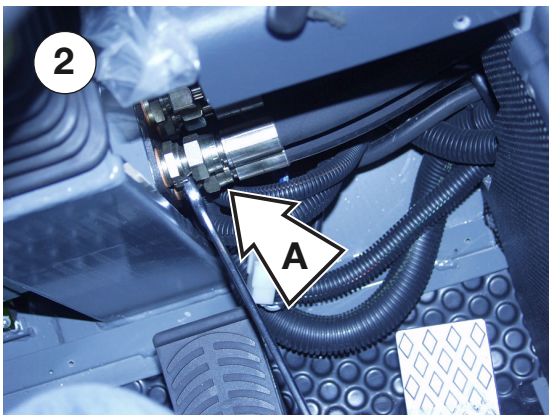
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

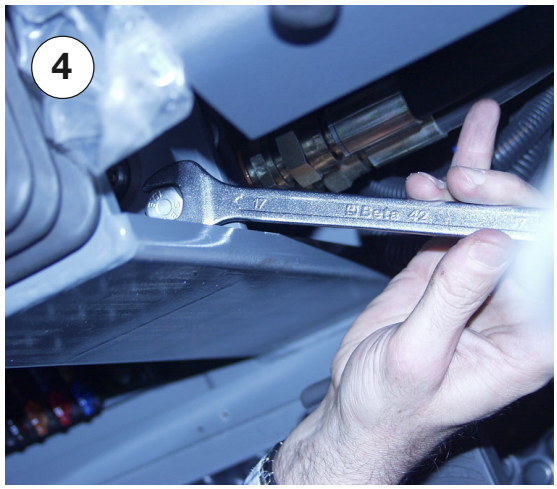
2 With a 27mm wrench, disconnect the four side pipelines **A**.



Procedure: **Dismantling the hydrostatic steering unit**	*Table:* **T-039**

3 Using a 19mm wrench, disconnect the front flexible hose.

4 With a 17mm hexagonal wrench, remove the four screws fixing the power steering unit to the steering column.

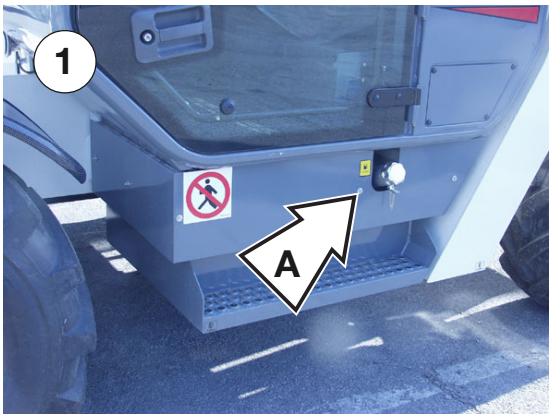


5 Extract the hydrostatic steering unit from the bottom.

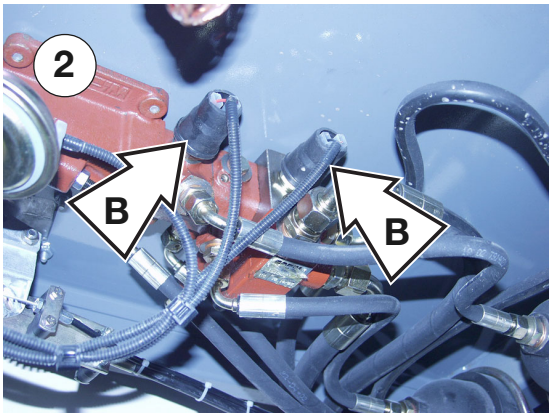
Procedure: **Dismantling the brake pump**	Table: **T-040** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg: 5
		Hours: 1 — Min.: -
Standard tools		1

Procedure:

1 Lift out the protection cover after loosening all screws **A** with a 4mm hexagonal wrench.



2 Move to the bottom of the cab and access to the brake pump. Disconnect the two electrical connectors **B**.



PROTECT THE ENVIRONMENT

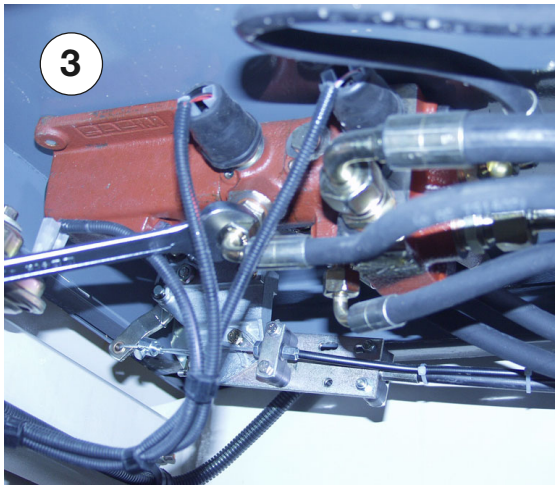
Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

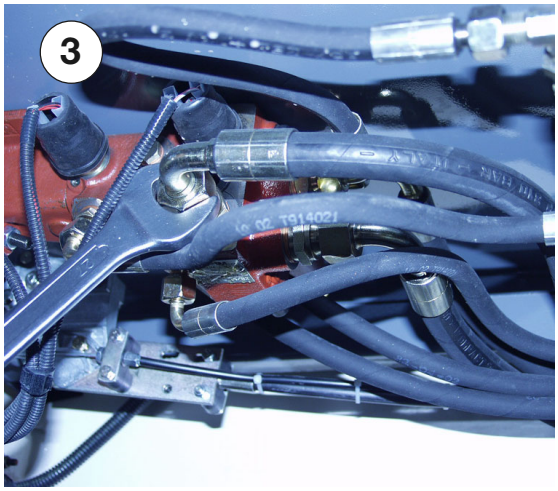
IMPORTANT

Thoroughly clean the area around the hydraulic lines to be disconnected. Plug all disconnected parts with couplings, rags or adhesive tape to prevent that dust and impurities may enter the circuit and cause damage.

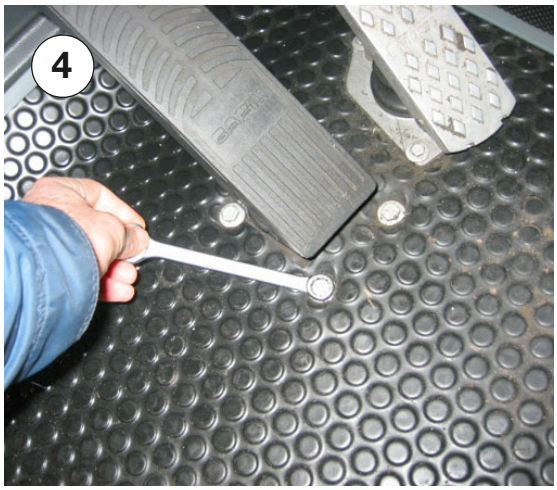
Procedure: **Dismantling the brake pump**	*Table:* **T-040**

3 Disconnect the flexible hoses:
- n°5 using a 19mm wrench
- n°1 using a 22mm wrench
- n°1 using a 27mm wrench





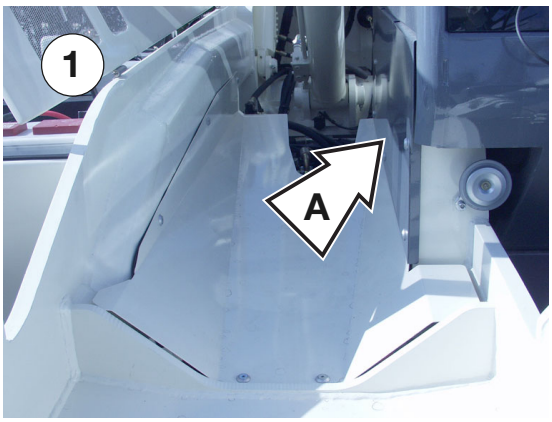
4 Remove the 4 fixing screws of the brake pedal using a 13mm wrench. Remove the pedal-brake pump assy.



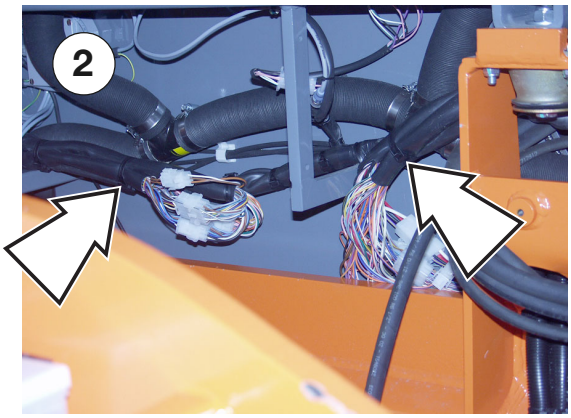
Procedure: **Dismantling the cab**	Table: **T-041** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 440
		Hours 2 Min. 30
Bridge crane, payload 5000 kg Textile bridles or chains with hooks	Standard tools	2

Procedure:

1 Remove the protection cover of the fuel tank and the side cover **A** using a 5mm hexagonal wrench.

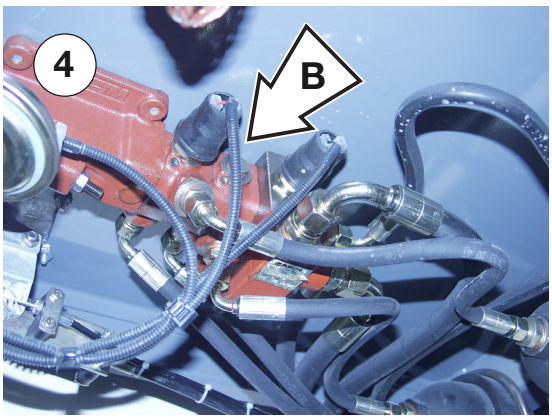


2 Cut the plastic binders fixing the electrical cables, then disconnect all of the electrical wires.



3 Disconnect the hydraulic lines of the power steering unit (see T-039) and of the heater (see T-045).

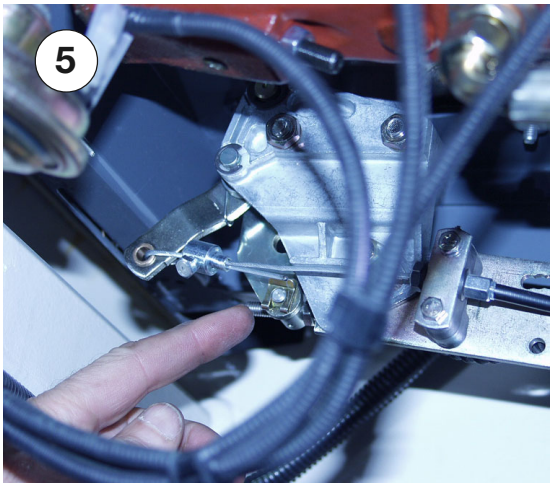
4 Disconnect the electrical and hydraulic connections of the brake pump **B** as indicated in T-040.



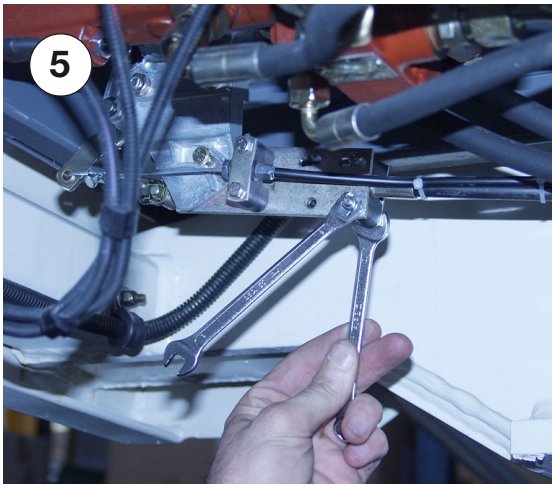
Procedure: **Dismantling the cab**	Table: **T-041**

5 Disconnect the wire of the throttle pedal:

- Remove the locking clip

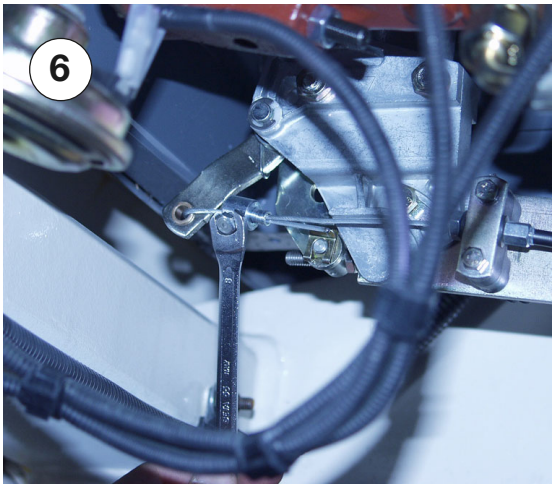


- With two 8mm wrenches remove the screws fixing the throttle cord.



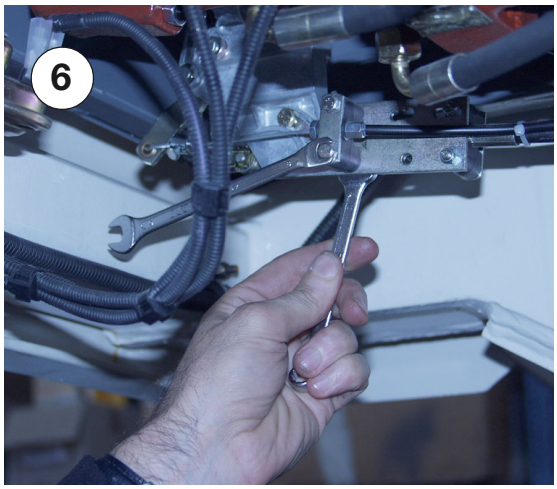
6 Disconnect the wire of the manual throttle:

- With an 8mm wrench disconnect the wire of the manual throttle.

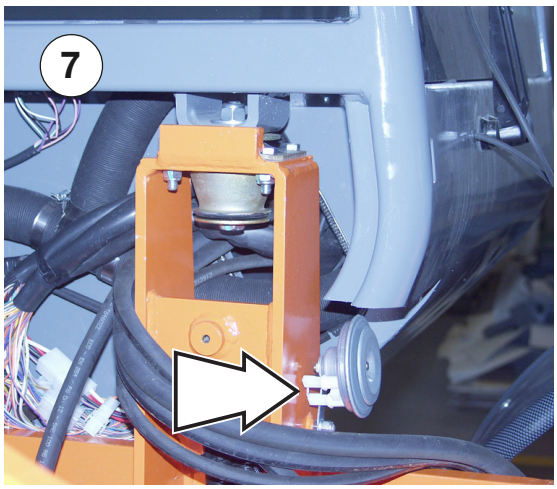


Procedure: **Dismantling the cab**	Table: **T-041**

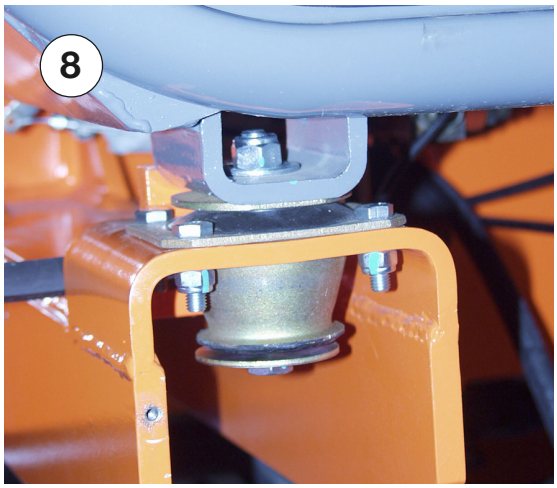
- With two 8mm wrenches remove the screws fixing the throttle bracket.



7 Hand-disconnect the power cables of the horn.

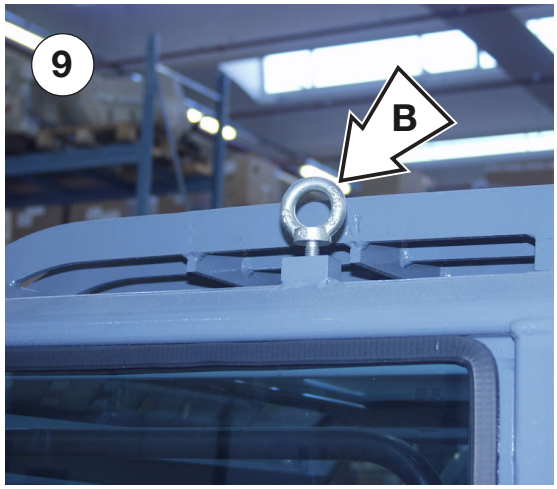


8 Using two 22mmm wrenches, remove the 4 fixing screws of the cab.



Procedure: Dismantling the cab	Table: T-041

9 Fit and screw down two eyebolts **B** to the top of the cabin in the special housings.



10 Fix a two-leg chain connected to the bridge crane, to the cab. Raise slowly after having checked that all electrical and hydraulic connections have been disconnected. Avoid crashing against parts of the machine. Lower the cab to the ground in a site where it cannot hinder other operations.

IMPORTANT

In the Telelift 4010 version, it is necessary to dismantle the levers of the actuator as explained in T.029.1.

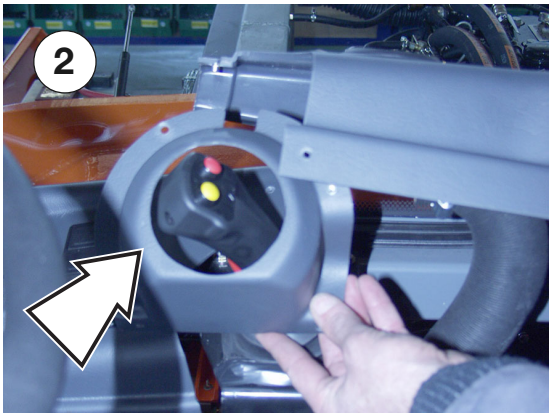
Procedure: **Dismantling the control lever**	Table: **T-042**			kg	1
	3713 Elite ✔	3517 ✔	4010 ☐	Hours	Min.
Standard tools				1	30
					1

Procedure:

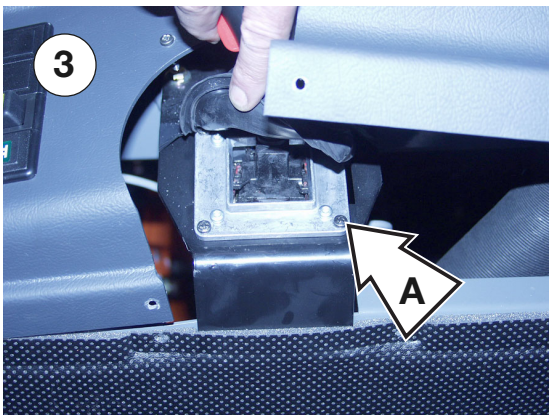
1 Using an electrical screwing machine with crosstip, loosen the fixing screws of plastic covers of dashboard **A**.



2 Remove the plastic cover from the control lever.

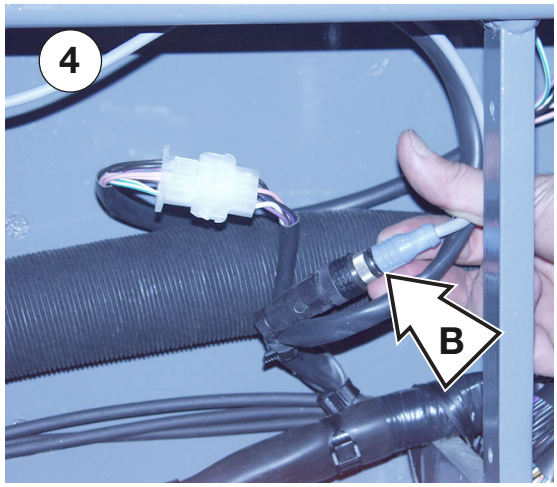


3 Lift out the rubber cap and remove the screws **A** fixing the control lever to the relevant support. Use a 7mm wrench and a crosstip screwdriver.



Procedure: **Dismantling the control lever**	*Table:* **T-042**

4 Disconnect the electrical wire **B** and pull out the control lever.



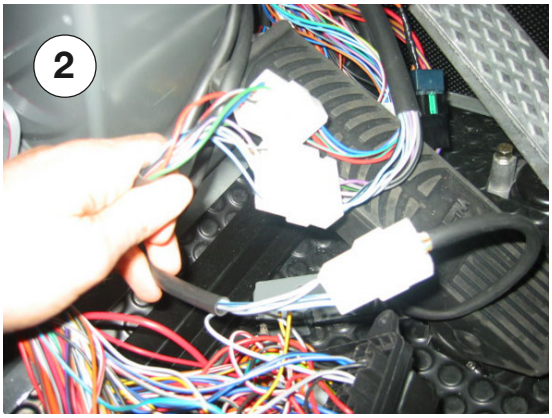
Procedure:	Table: T-043			
Dismantling the control levers on the steering wheel	3713 Elite ✔	3517 ✔	4010 ✔	kg: 0.5 each.
				Hours: - / Min.: 30
	Standard tools			1

Procedure:

1 Access to the driving place and pry off the protection cover with a crosstip screwdriver.



2 Disconnect the electrical wire before removing the lever.



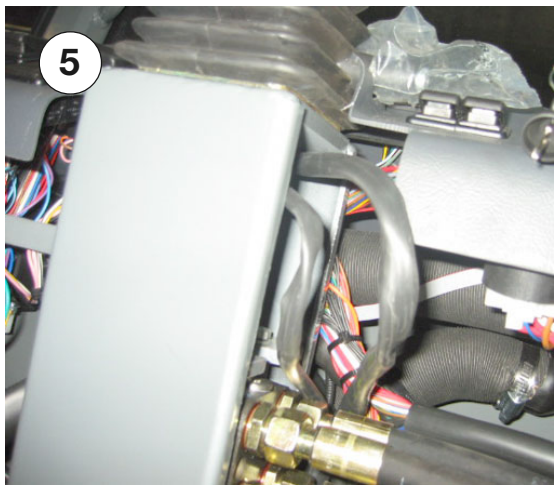
3 With a star screwdriver, drive out the screw fixing the two parts of the control lever.



Procedure: **Dismantling the control levers on the steering wheel**	*Table:* **T-043**

4 Separate the two parts and replace the damaged one/s.

5 Re-assemble checking that the plug on the right switch matches the hole on the steering column. Re-connect the electrical wire paying attention to the correct position of the cables inside the steering column.



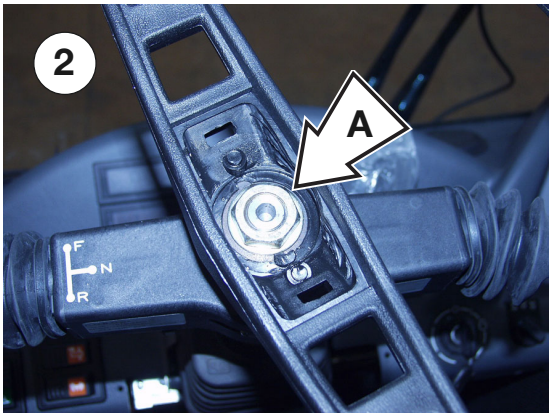
Procedure: **Dismantling the steering wheel**	Table: **T-044** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg 1.8
		Hours - Min. 10
Standard tools		2

Procedure:

1 Access to the driving place and remove the protection cover at the top of the steering wheel.



2 With a 27mm box spanner, remove the ring nut locking the steering wheel **A**.





Procedure: **Dismantling the steering wheel**	Table: **T-044**

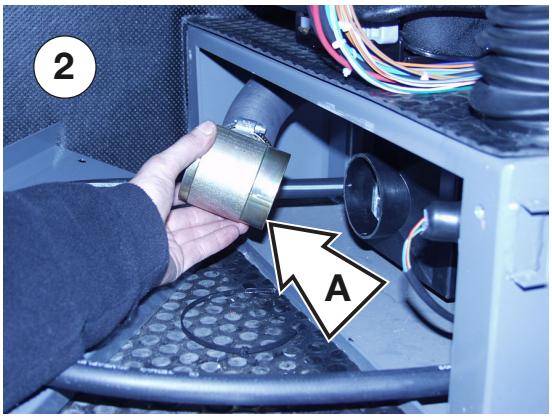
3 Pull the steering wheel while knocking out the terminal on the shaft with a rubber hammer to disconnect the conical coupling.

Procedure: **Dismantling the cab heater**	Table: **T-045**			kg	3
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			1	-
					1

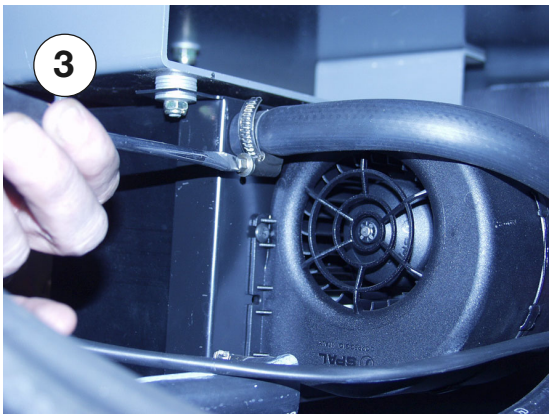
Procedure:

1 Remove the panel covering the heater driving out the fixing screws.

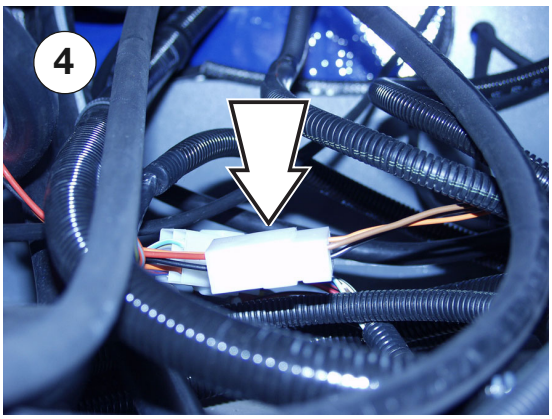
2 Pull out the hot air sleeve **A**.



3 With a straight screwdriver, remove the clamps fixing the water tubes.

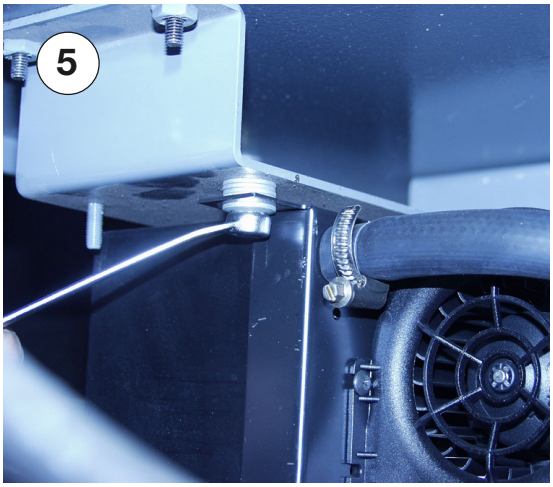


4 Disconnect the electrical wire powering the heater.



Procedure: **Dismantling the cab heater**	Table: **T-045**

5 Remove the heater nuts with a 10mm wrench.

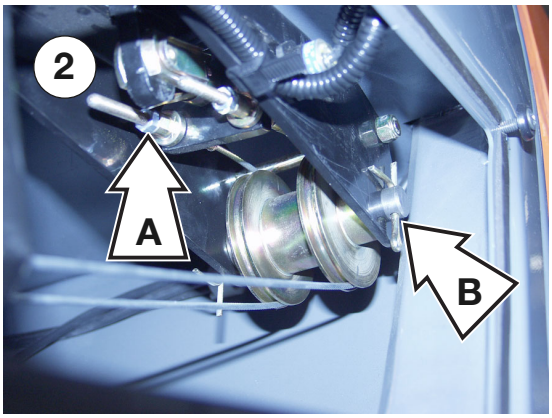


Procedure: **Dismantling the lever of the parking brake**	Table: **T-046** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg	2
		Hours / Min.	- / 30
Standard tools			1

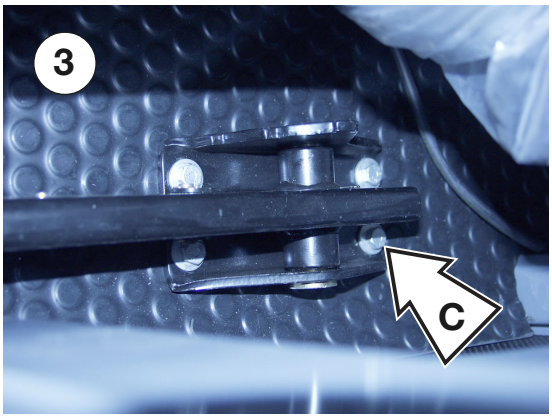
Procedure:

1 Using a 10mm wrench, loosen the adjusting nuts **A** of the brake cord.

2 Remove the clamps place to the ends and extract pin **B**.



3 With a 13mm box spanner remove the 4 screws **C** fixing the parking brake lever.



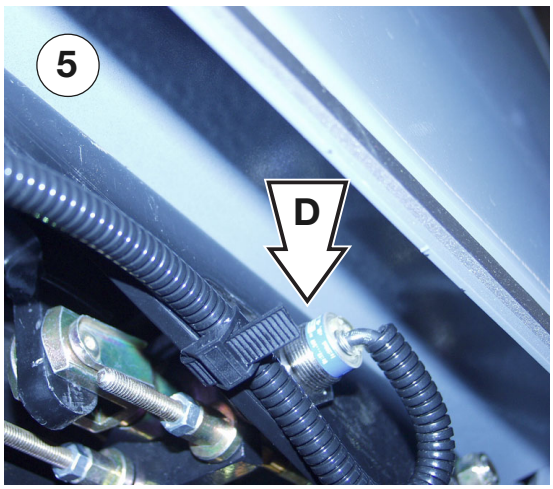
Assembly:

4 During reassembly, adjust the nuts **A** of the brake cord so that, when the brake lever is pulled up, its stroke correspond to max 4-5 teeth.

Procedure: Dismantling the lever of the parking brake	Table: T-046

Replacing the sensor:

5 Disconnect the electrical connection and loosen the rear nut with a 24mm hexagonal wrench. Dismantle sensor **D**.



IMPORTANT

During reassembly, adjust the distance of sensor as explained in T-047.

Procedure: Adjusting the sensors' distance	Table: T-047			kg	-
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			-	15
				1	

Procedure:

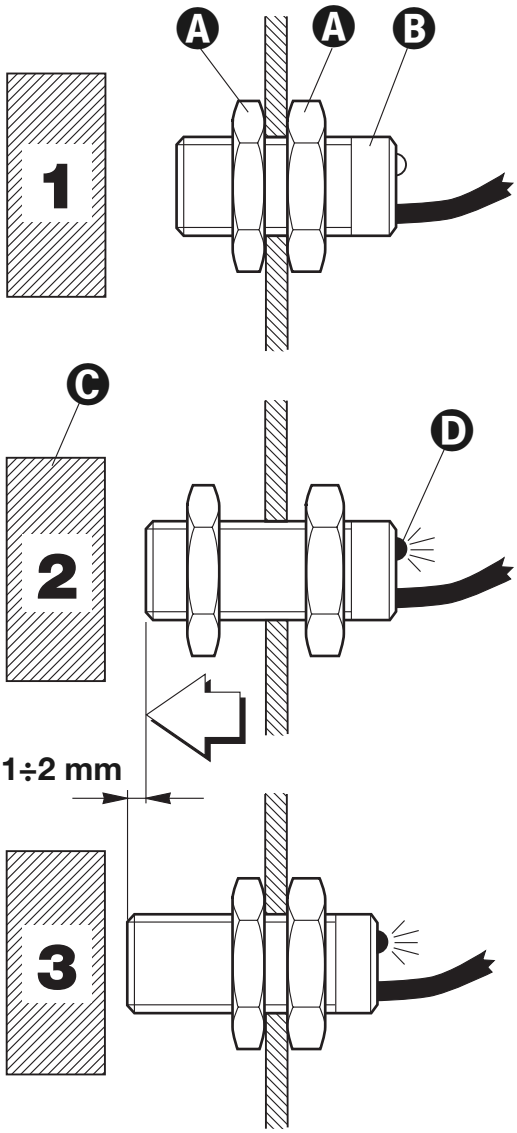
In case of a failure or complete malfunctioning of the sensors due to a loosening of their ring nuts, re-adjust as follows:

1 Loosen nuts **A** fixing sensor **B**.

2 Near the mobile part **C** of the machine, controlled by the sensor, to the maximum proximity position of the sensor.
Near the sensor to the component until the LED indicator **D** will come on.

3 Near the sensor another 1÷2 mm. Tighten the sensor fixing nut and the relevant lock nut.

The machine is equipped with a sensor on the parking brake which prevents any start-up when the parking brake is not engaged.



ATTENTION

Tighten the nuts of the sensor to a torque of 15 Nm.

Procedure: **Adjusting the sensors' distance**	*Table:* **T-047**

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Procedure: **Replacing the ignition key block**	Table: **T-048**			kg	-
	3713 Elite	3517	4010	Hours	Min.
	✔	✔	✔	-	15
Standard tools				1	

Procedure to replace the ignition key:

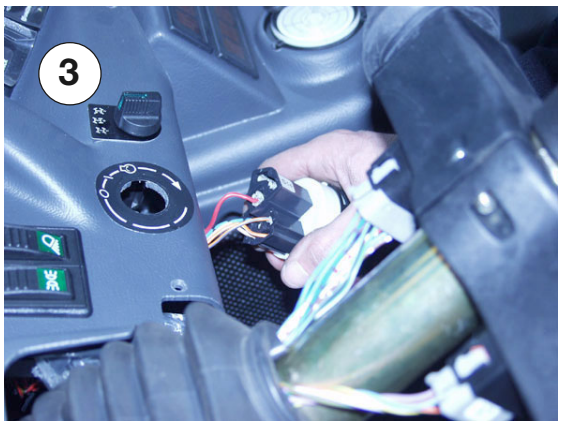
1 With a crosstip screwdriver pry off the dashboard cover.



2 Loosen the nut fixing the block to the dashboard using a 30mm wrench.



3 Disconnect all wires from the block. Re-connect them in the same position during reassembly.



Procedure: **Replacing the ignition key block**	*Table:* **T-048**

4 Change the ignition key block and re-connect all the terminals correctly.

Procedure: **Dismantling the steering selector**	Table: **T-049**			kg: -
	3713 Elite ✔	3517 ✔	4010 ✔	Hours: - / Min.: 15
Standard tools				1

Procedure:

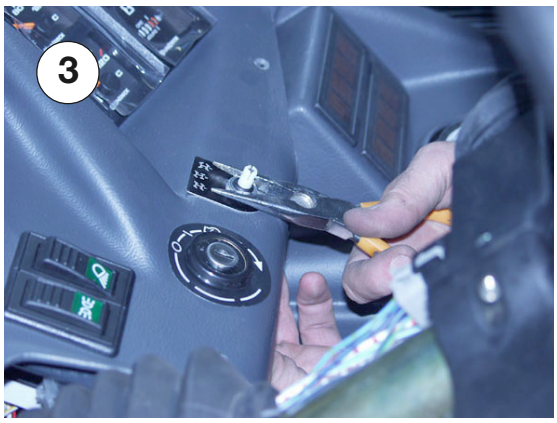
1 With a crosstip screwdriver pry off the dashboard cover.



2 Lift out the plastic cap.

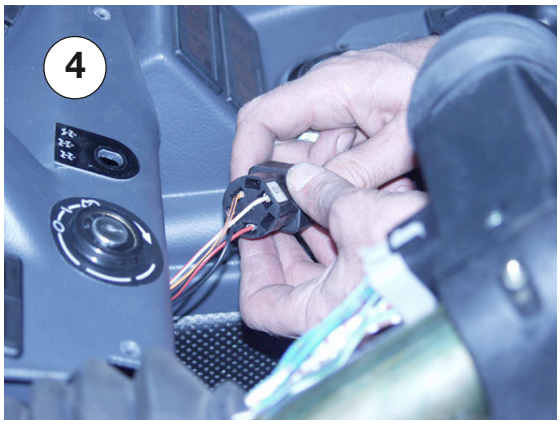


3 Loosen the nut locking the selector to the dashboard with pliers. Push out the selector.



Procedure: **Dismantling the steering selector**	*Table:* **T-049**

4 Disconnect the wires and re-connect them to the new selector in the same position.



Procedure: **Changing the rocker switches**	Table: **T-050** 3713 Elite ✔ 3517 ✔ 4010 ✔	kg: -
		Hours: - Min.: 15
Standard tools		1

Procedure:

1 With a crosstip screwdriver pry off the dashboard cover.



2 Push out the pushbutton.



3 With a flat screwdriver, pry off the pushbutton tabs.



Procedure: **Changing the rocker switches**	Table: **T-050**

4 Lift out the pushbutton base.



5 Disconnect the terminals powering the pushbutton warning light.

6 Fit a new pushbutton and reconnect.



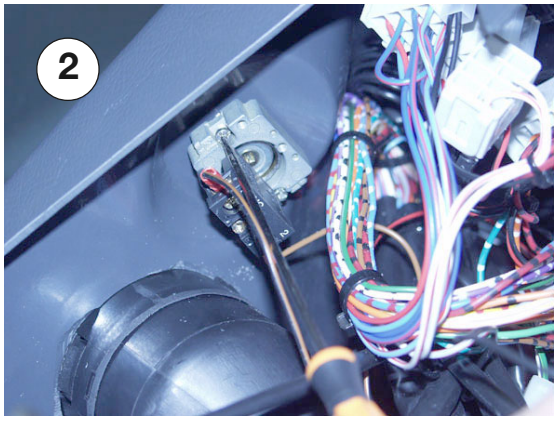
Procedure: **Changing the emergency pushbutton**	Table: **T-051**			kg	-
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			-	15
				1	

Procedure:

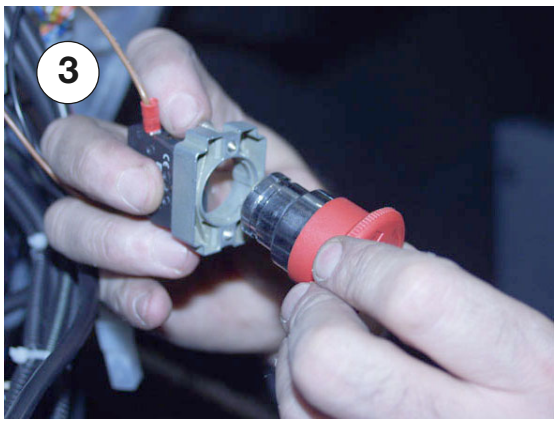
1 With a crosstip screwdriver, pry off the dashboard cover.



2 Using a screwdriver, unscrew and remove the screws fixing the base of the mushroom to the dashboard.



3 Pull out the top of the mushroom and, if necessary, replace the pushbutton. Refit all parts disassembled.



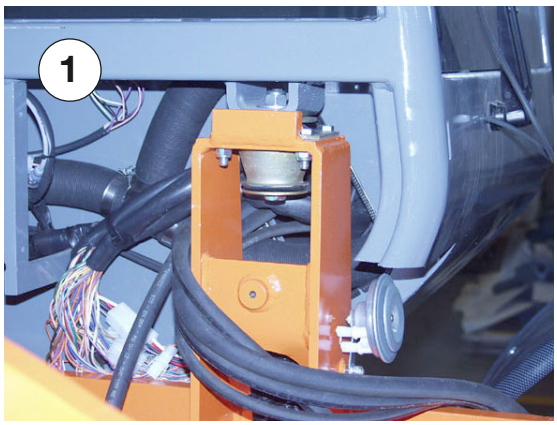
Procedure: Changing the emergency pushbutton	Table: T-051

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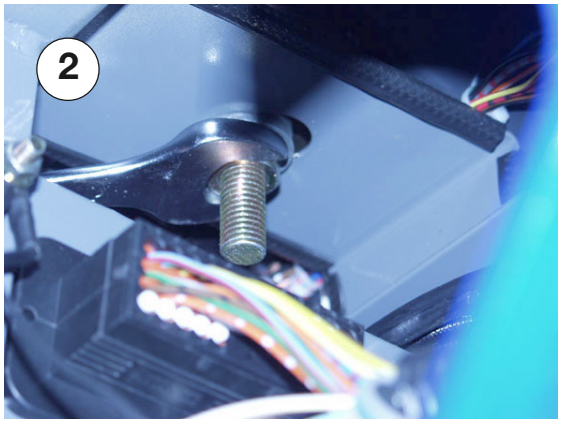
Procedure: **Changing the water level**	Table: **T-052**			kg	-
	3713 Elite ✔	3517 ✔	4010 ✔	Hours	Min.
	Standard tools			-	30
				1	

Procedure:

1 Remove the cover from the lifting cylinder side and access to the dashboard bottom.



2 With a 22mm wrench loosen the nut locking the water level to the dashboard and lift out.



3 Fit a new water level. Then move the machine to a flat surface and with a 3mm Allen wrench adjust the water level so that the air bubble is right in the middle when the machine is perfectly level.



Procedure: **Changing the water level**	*Table:* **T-052**

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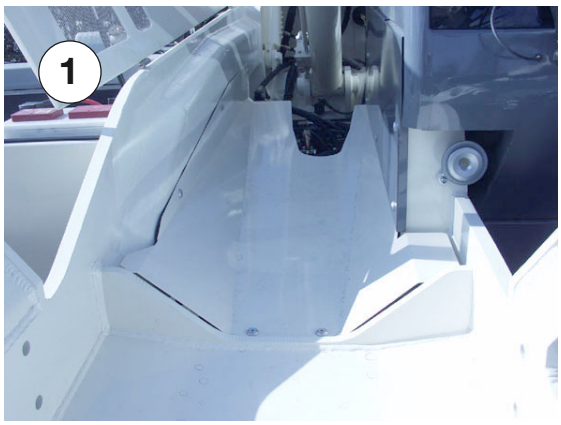
Procedure:	Changing the road/jobsite/platform switch	Table: T-053		
		3713 Elite ✔	3517 ✔	4010 ✔

kg	-	
	Hours	Min.
	-	30
	1	

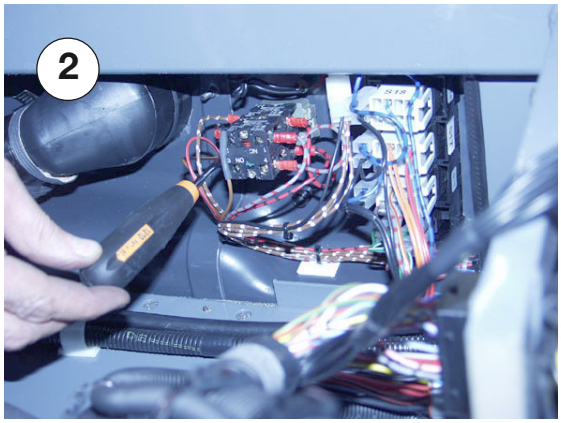
Standard tools

Procedure:

1 Remove the cover from the lifting cylinder side using a 5mm hexagonal wrench.



2 With a crosstip screwdriver, free the bottom part housing the contacts and extract the contacts.



3 Lift out the cap of the selector and fit a new selector proceeding in reversed order.



Procedure: **Changing the road/jobsite/platform switch**	*Table:* **T-053**

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Procedure:	Changing the warning lights' blocks on the dashboard	Table: T-054		
		3713 Elite ✔	3517 ✔	4010 ✔

kg	-	
	Hours	Min.
	-	15
	1	

Standard tools

Procedure:

1 Pry off the dashboard cover with a crosstip screwdriver.



2 Push out the block to replace.



3 Disconnect the electrical wires and replace the block with a new one.Fit the new block.

Procedure: Changing the warning lights' blocks on the dashboard	Table: T-054

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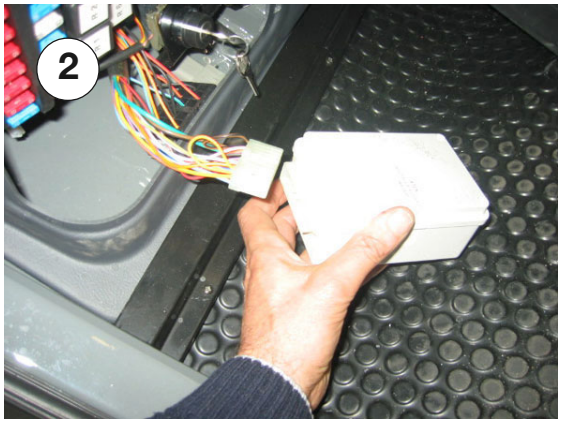
Procedure: **Changing the SCT box**	Table: **T-055**			kg: -
	3713 Elite ✔	3517 ✔	4010 ☐	Hours: - / Min.: 15
Standard tools				1

Procedure:

1 Open the cover protecting fuses and relays and search for the white SCT box. Remove the box from its housing.



2 Disconnect the electrical wires and replace the box with a new one. Fit the new box in the original position.



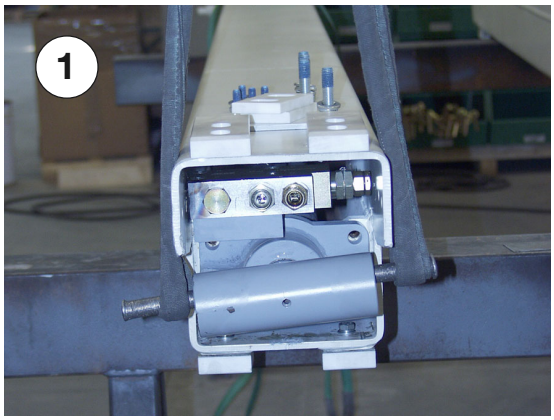
Procedure: Changing the SCT box	Table: T-055

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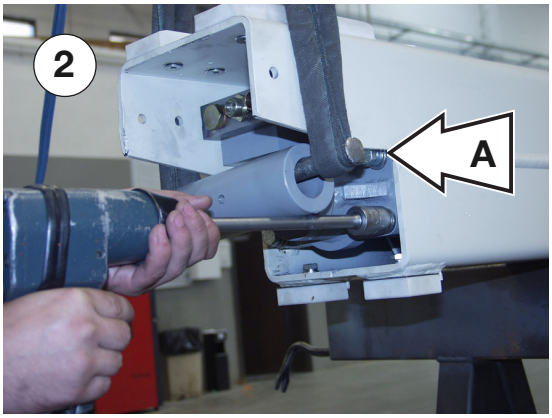
Procedure: **Pre-assembling the boom assy**	Table: **T-056**			kg: 2300
	3713 Elite ✔	3517 ☐	4010 ☐	Hours: 12 — Min.: -
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks Forklift	Standard tools Special spanners (see A-06)			1+1

Procedure:

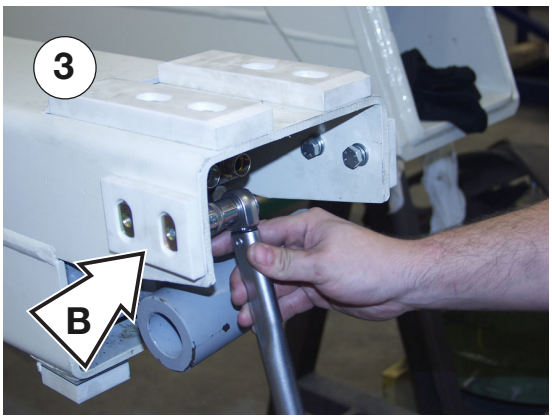
1 Firmly sling the extension cylinder and place it into the third boom tube.



2 Insert the screws **A** with relevant washers after smearing their threads with some threadlocker. Tighten with an electrical screwing machine using a 22mm wrench and a wrench extension. With a dynamometric wrench tighten to a torque of 150 Nm.

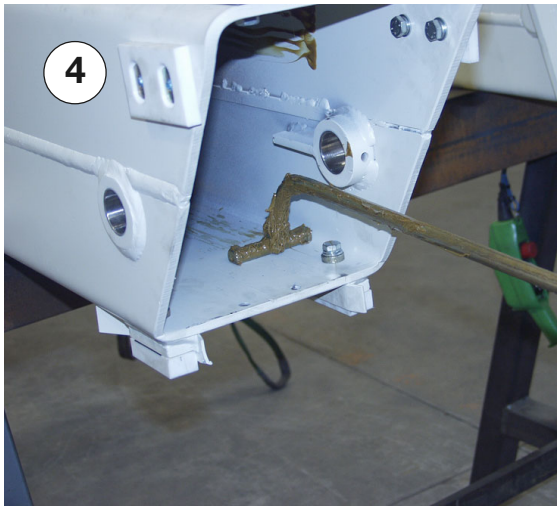


3 Fit the pads **B** to the two sides of the boom tube and tighten the relevant screws to a torque of 30 Nm with a 17mm dynamometric wrench.

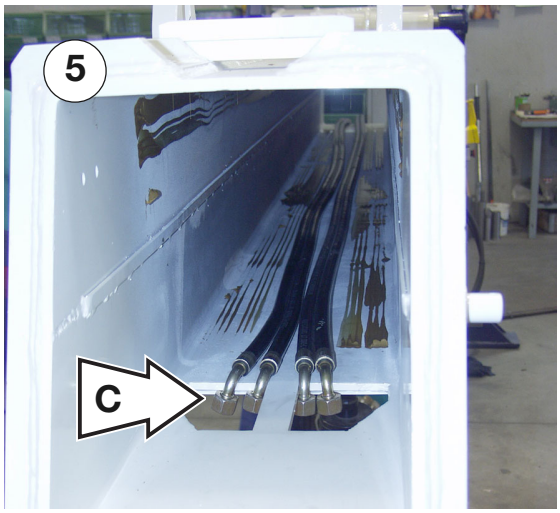


Procedure: **Pre-assembling the boom assy**	Table: **T-056**

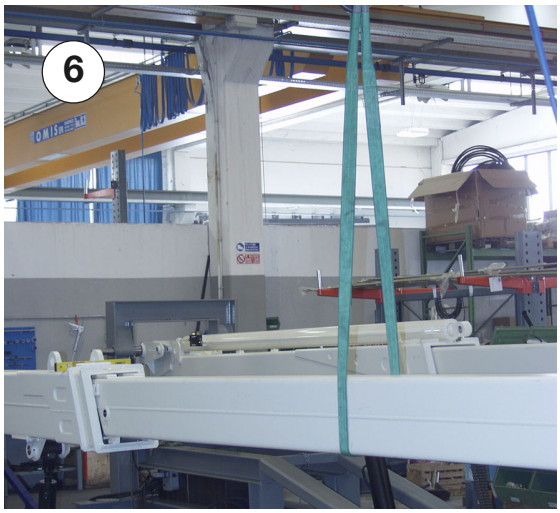
4 Smear the slide areas of the pads of the first boom section with some Interflon LS grease.



5 Place the hydraulic hoses **C** in the first boom tube.

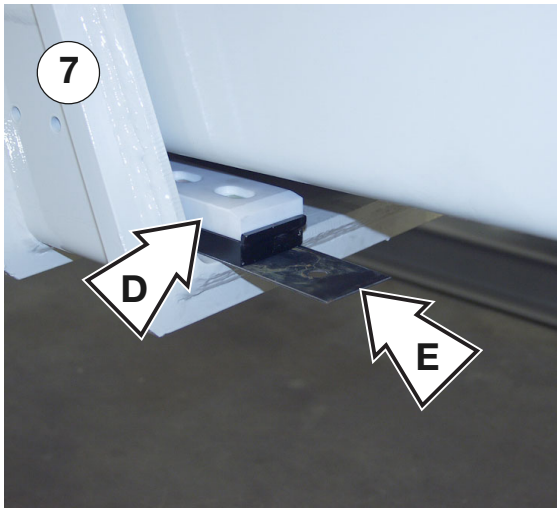


6 Sling the second boom tube with a textile bridle connected to the bridge crane and insert it into the first boom section.

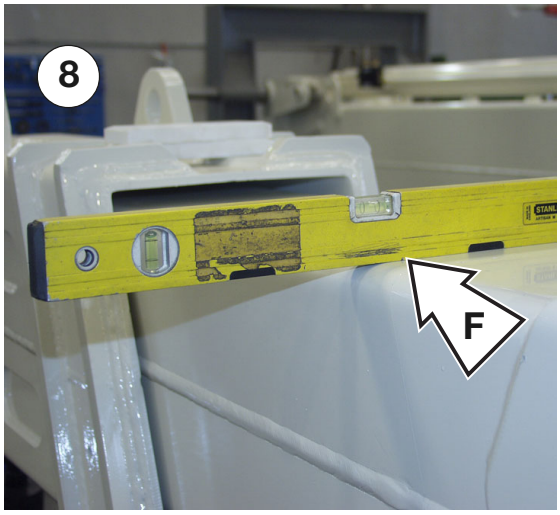


Procedure: **Pre-assembling the boom assy**	Table: **T-056**

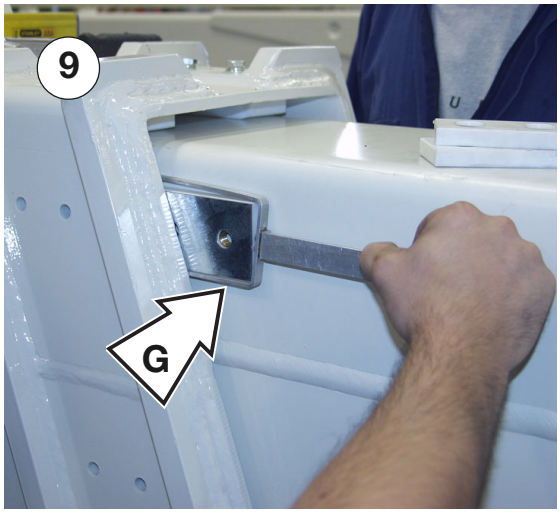
7 While holding the second boom tube slightly raised with the bridle connected to the bridge crane, fit the bottom pads **D** placing shims **E** in-between. Tighten the pad screws to 30 Nm using a dynamometric wrench.



8 With a water level **F** check that the second boom tube is level.



9 Fit the side pads to the first boom tube (2 per side). Insert the pads using the special wrench **G** (see A-06 dwg.03).



Procedure: **Pre-assembling the boom assy**	Table: **T-056**

10 With a forklift, push the second boom tube into the first one paying extreme caution so as not to damage the flexible hoses already installed.

11 Sling the third boom tube with a textile bridle connected to the bridge crane and place it into the second boom section.



12 Fit the lower pin to fix the attachment holding plate to the boom nose. With a water level, make sure that the plate is level.

13 Add some shims if necessary, to the slide pads of the third boom tube so as to get a distance of at least 1 mm.

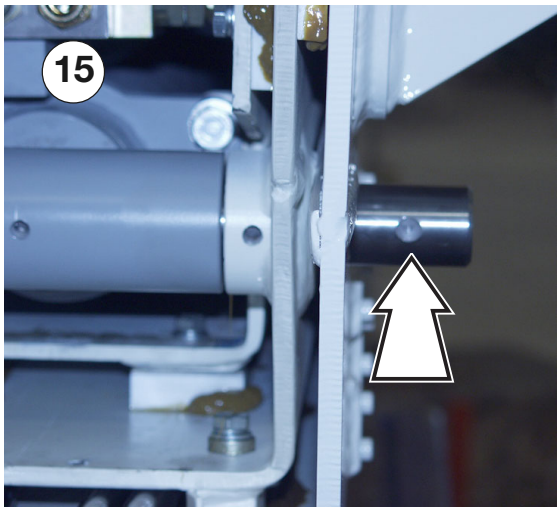
14 Insert the third boom tube into the second one.



15 Fit the locking pin of the third telescope extension cylinder (rod side).

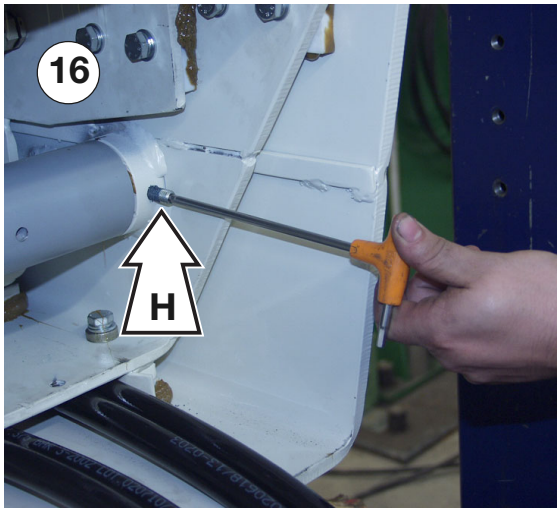
IMPORTANT

Check that the blind hole on the pin is lined up with the hole on the bushing in order to insert the locking grubscrew.



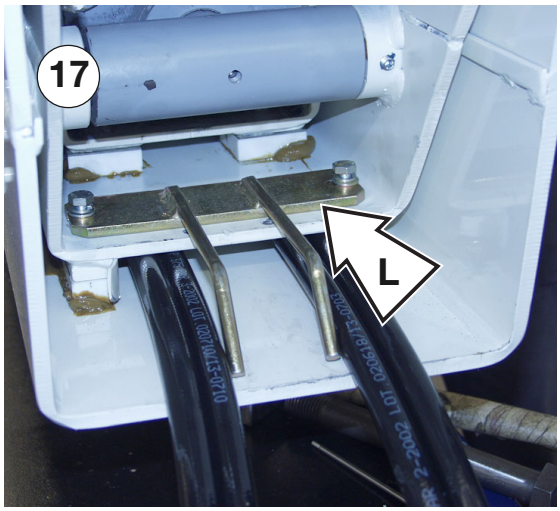
Procedure: **Pre-assembling the boom assy**	Table: **T-056**

16 Tighten the locking grubscrew **H** with a 5mm hexagonal wrench. Pour a few drops of threadlocker before inserting the screw.

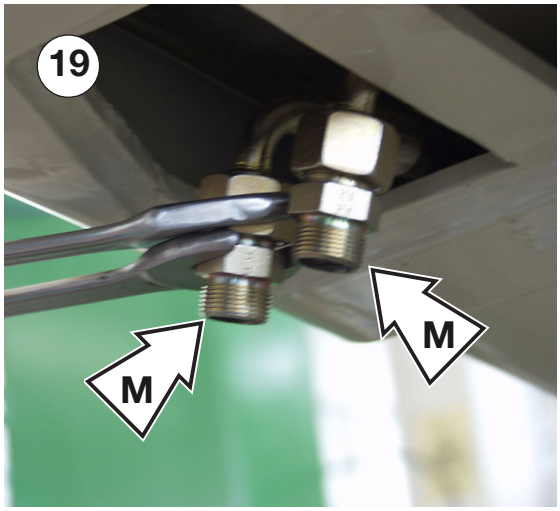


17 Mount the hose guiding bracket **L** using a 17mm wrench.

18 Mount the second telescope extension cylinder following the procedure described inT-011 in reversed order.

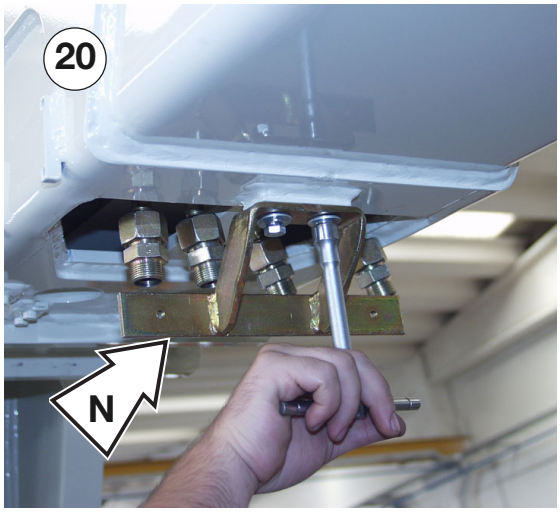


19 Fit couplings **M** to the flexible hoses inside the boom and tighten with a 27mm wrench and a 30mm wrench.

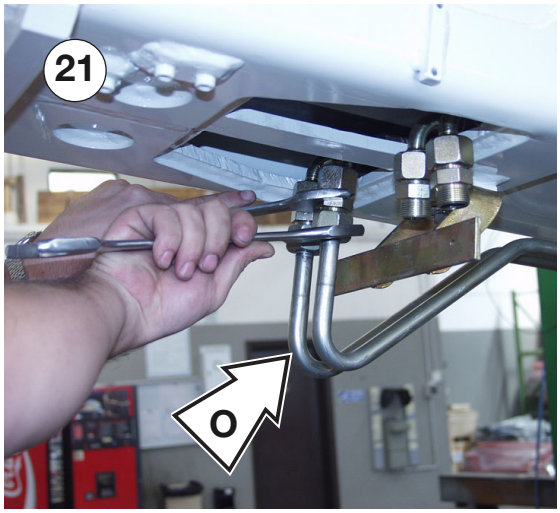


Procedure: **Pre-assembling the boom assy**	*Table:* **T-056**

20 Mount the pipes' holding bracket **N** with a 13mm wrench.



21 Mount pipes **O** using a 30mm wrench to tighten the nuts and a 27mm wrench for the couplings.

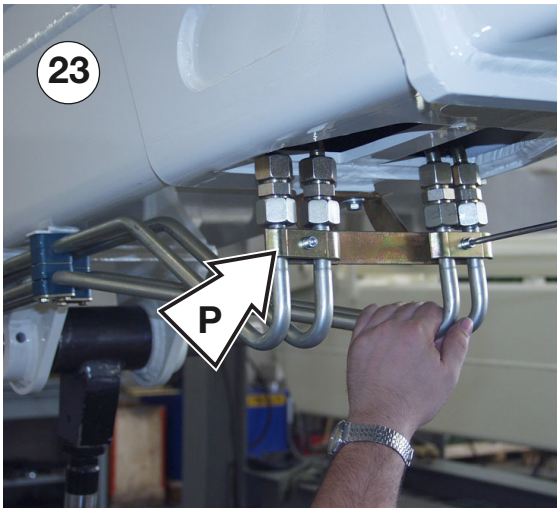


22 Fit the pipe clamps tightening the relevant screws with a 10mm wrench. The screws of the special clamps fixing two pipes together shall be tightened using an 11mm wrench.

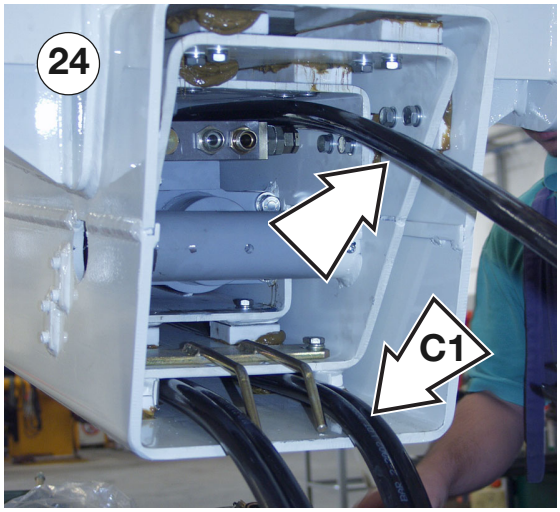


Procedure: **Pre-assembling the boom assy**	Table: **T-056**

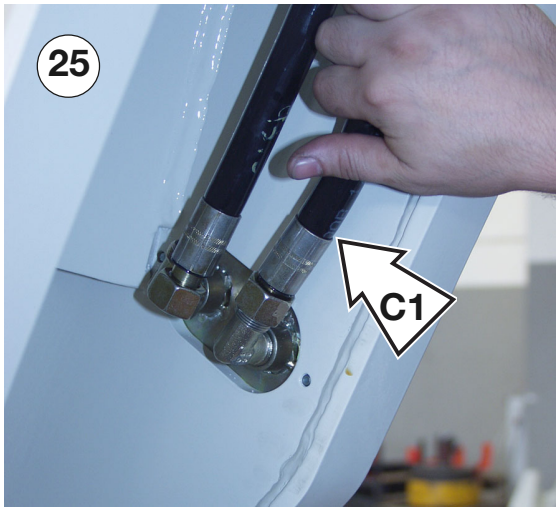
23 With a 5mm hexagonal wrench, mount the iron plates **P** on to the pipes' holding bracket.



24 Place the flexible hoses in the third boom tube. Place them correctly and check that they come out of the internal part of the nose.

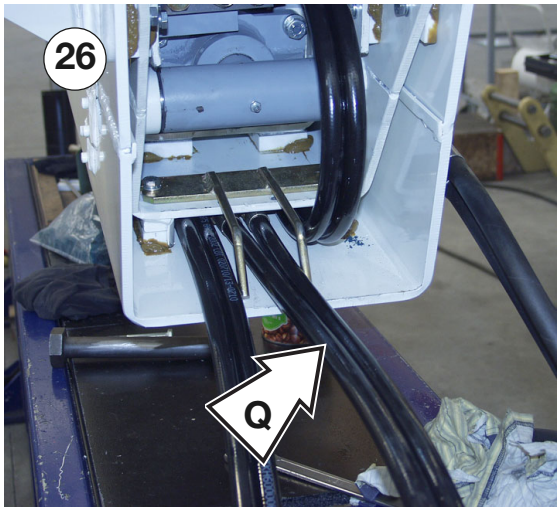


25 With a 27mm wrench, tighten hoses **C1** to the guiding slit connecting the internal hose with the external coupling (machine side). Pressurise the line and tighten the hose clamps.

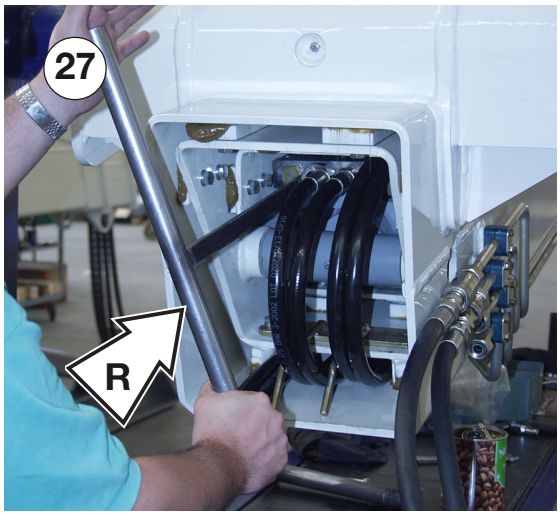


Procedure: **Pre-assembling the boom assy**	Table: **T-056**

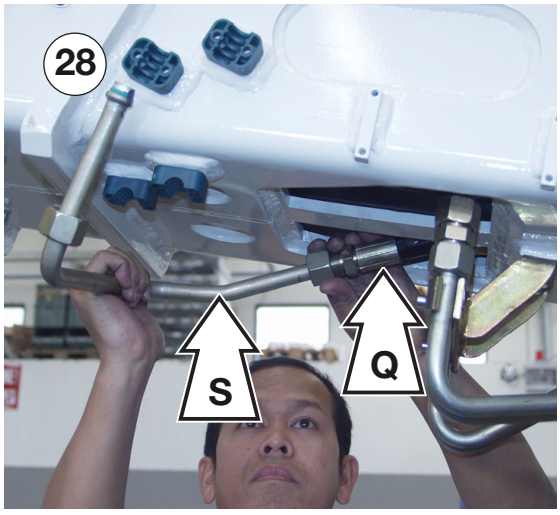
26 Fit the assembled hose **Q** feeding the extension cylinder in the middle of the guiding bracket.



27 Using the special wrench **R** connect the assembled hose to the block valve of the third telescope extension cylinder. To prepare the wrench **R**, see A-06 dwg.04

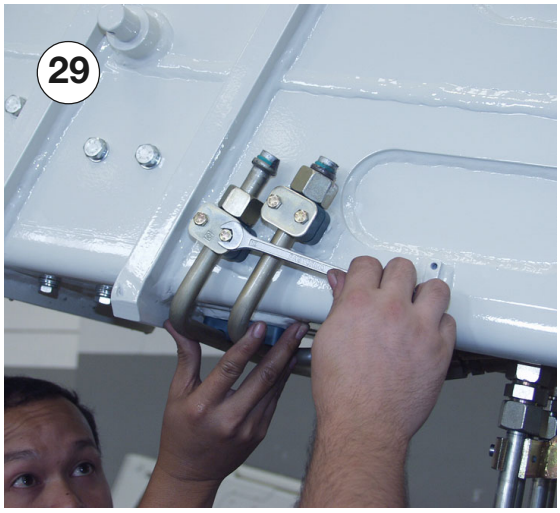


28 Connect the outlet (nose side) of the assembled hose **Q** to pipes **S** using a 27mm wrench and a 30mm wrench.

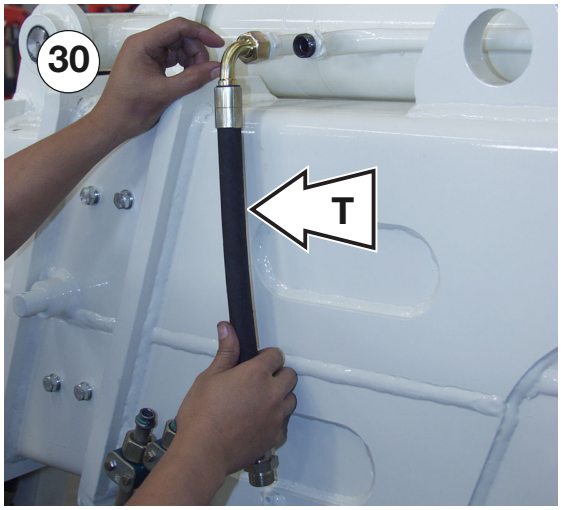


Procedure: **Pre-assembling the boom assy**	*Table:* **T-056**

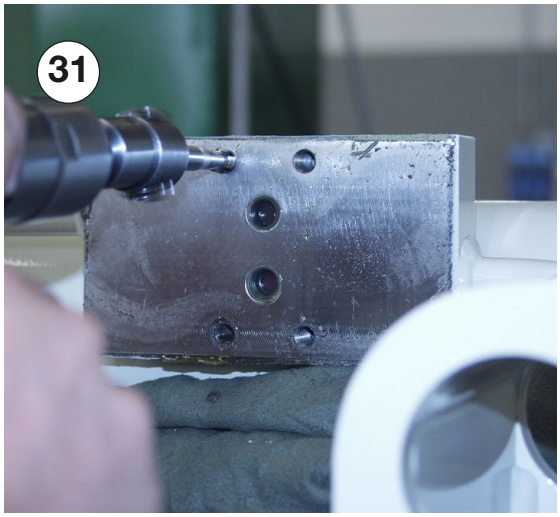
29 Place and tighten the clamps with a 10mm wrench.



30 Connect the outlets of the extension cylinder with the pipes placing the flexible hoses **T** in-between. For the assembly, use a 27mm wrench and a 30mm wrench.

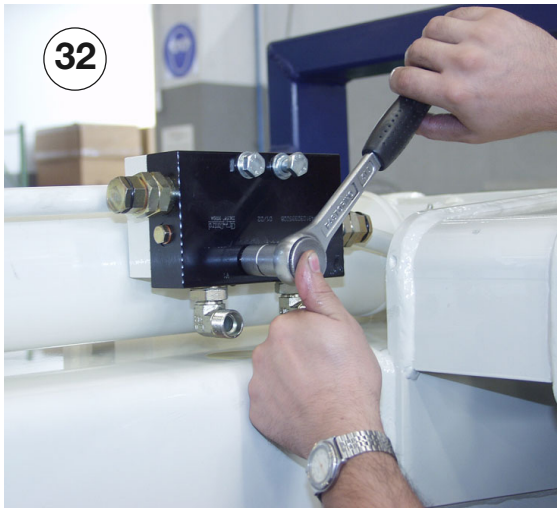


31 Re-thread M10 the threaded holes of the plate of the second telescope extension cylinder. Remove any impurities with compressed air.

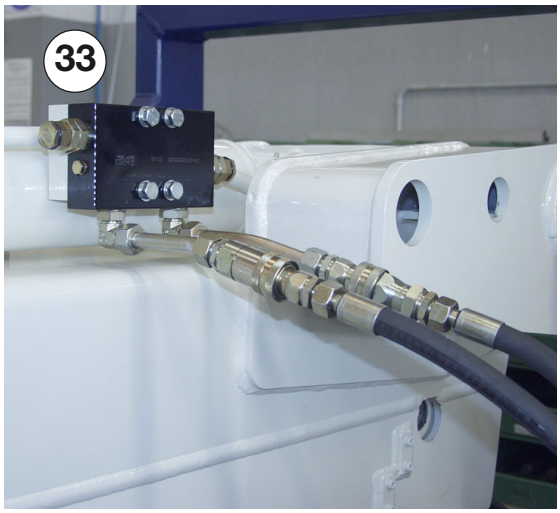


Procedure: **Pre-assembling the boom assy**	*Table:* **T-056**

32 Mount the block valve with the couplings downwards and lock in position with a 17mm wrench.

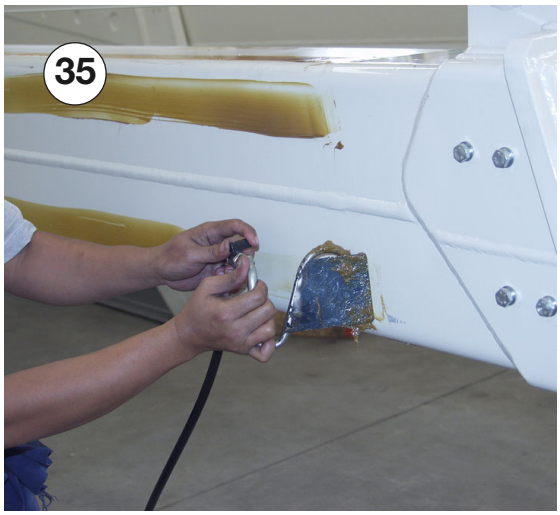


33 Connect the flexible hoses with quick-coupling as shown.



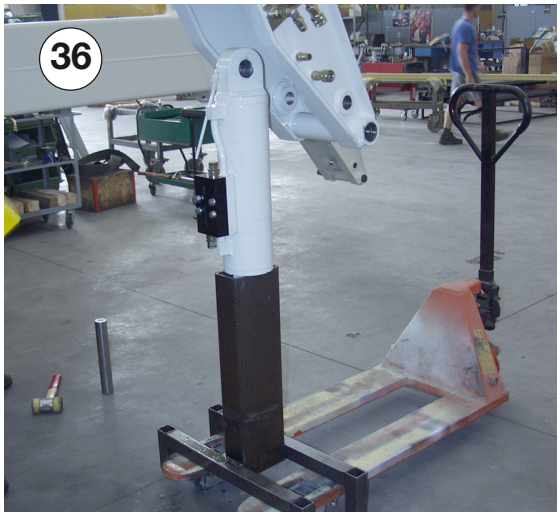
34 Pressurise the circuit and extend the boom approx. 10 cm. Move the boom fully in and hold the system over relief to eliminate any air.

35 Fully extend the boom and smear the contact areas of the pads with some Interflon LS2 grease.



Procedure: **Pre-assembling the boom assy**	Table: **T-056**

36 Near the fork pitching cylinder and align the hole on the cylinder with the one on the boom nose.

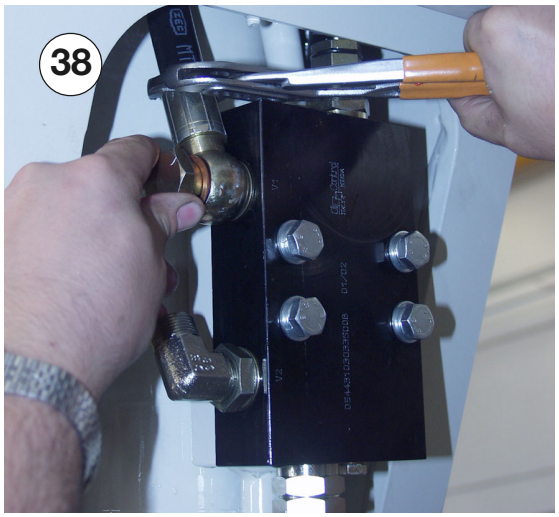


37 Fit the fixing pin and lock it in position with a screw and a nut using two 19mm wrenches.



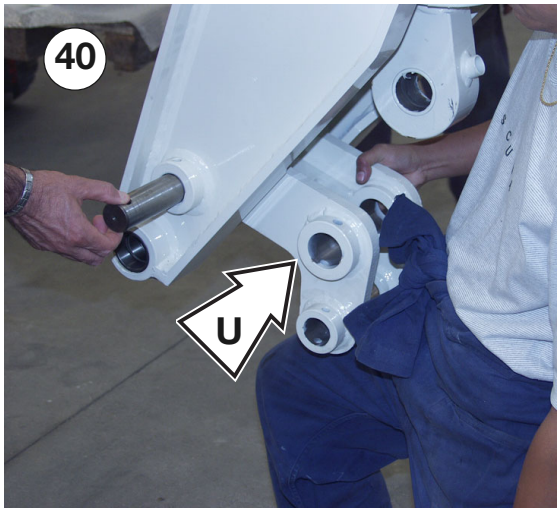
38 Connect the line with eye-terminal to the block valve pulling slightly the other line with a Polygrip (Beta 1048-240), so that the hose with eye-terminal forms a slight curve and rests on the cylinder. Tighten the hollow pin with a 27mm wrench.

39 Connect the line with straight terminal to the 90° connector on the block valve using a 27mm wrench.

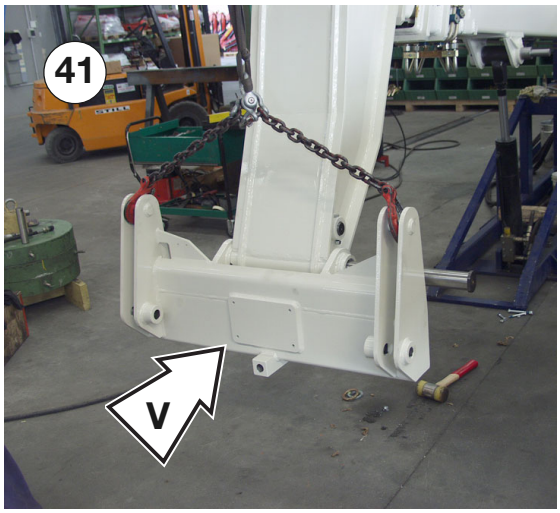


Procedure: **Pre-assembling the boom assy**	Table: **T-056**

40 Mount the connecting rod **U** to the boom nose fitting the relevant pin. Lock in position with a screw and a nut and tighten with a 17mm wrench.



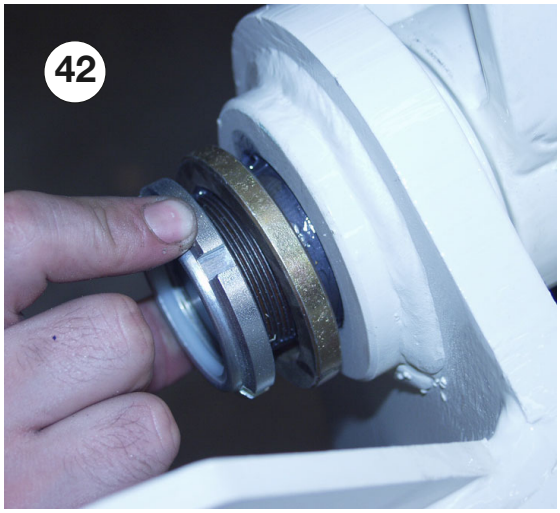
41 Raise the holding plate **V** using a two-leg chain connected to the bridge crane. Place the plate close to the fixing hole on the nose.



42 Fit the pin of the holding plate and lock it with the special ring nut placing in-between the shim supplied. Use a USAG 282 SN 50-80 spanner to tighten the ring nut.

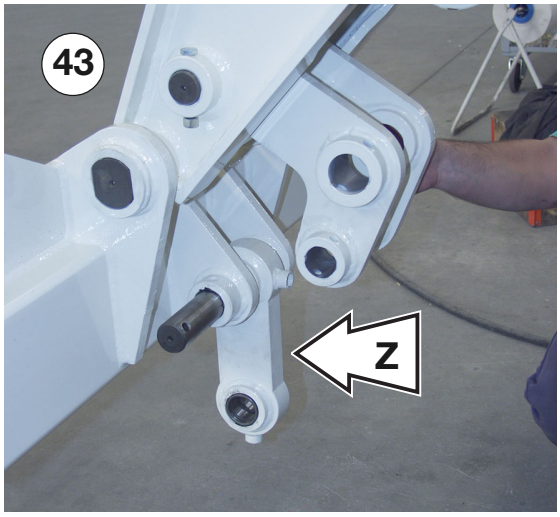
IMPORTANT

Thoroughly grease the housings of the pins to fit them home easier.

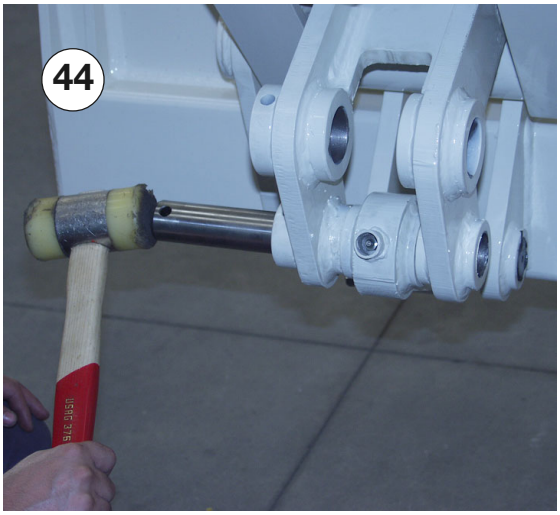


Procedure: **Pre-assembling the boom assy**	Table: **T-056**

43 Mount the straight connecting rod **Z** as shown. Fit the locking pin and tighten the locknut on the screw with a 17mm wrench.



44 Fit the pin of the connecting rod and knock it lightly home with a rubber hammer. Fit the screw and the nut and tighten all parts with a 17mm wrench.



45 Connect the connecting rod **U** with the fork pitching cylinder fitting the special pin and locking all the parts with the screw and locknut using a 19mm wrench.

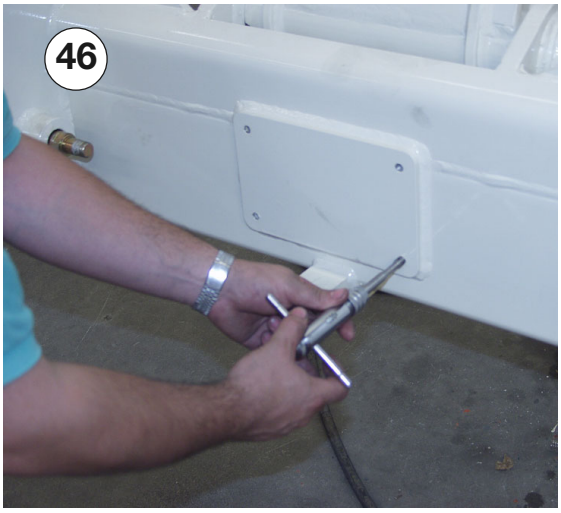


IMPORTANT

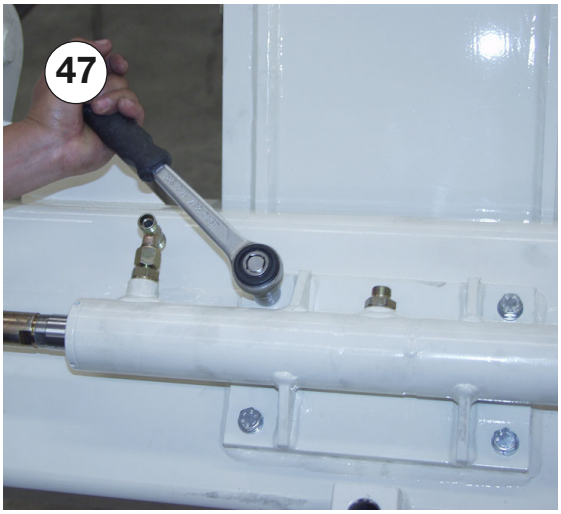
Once all connections have been made, lubricate all pins injecting grease with a greasing gun into the greasing nipples and check they are in efficient working order.

Procedure: **Pre-assembling the boom assy**	Table: **T-056**

46 Thread M10 the 4 holes on the plate used to connect the attachment locking cylinder.



47 Fit the attachment locking cylinder following the instructions in T-006 in reversed order.



Procedure: **Pre-assembling the boom assy**	Table: **T-056.1**			kg	1846
	3713 Elite ☐	3517 ☐	4010 ☑	Hours	Min.
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks	Standard tools			10	-
				1+1	

Procedure for assembling the boom:

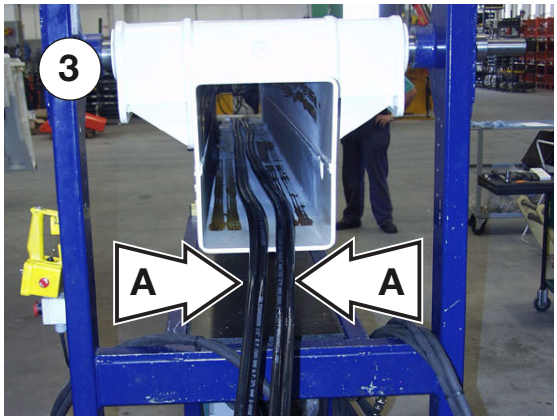
1 Place the two boom tubes on to some stands and check that the first tube is parallel to the ground.

2 Fit the pads to the rear side of the second boom tube. Use a 6mm hexagonal wrench for the side and top pads and a 17mm wrench for the screws of the bottom pads.

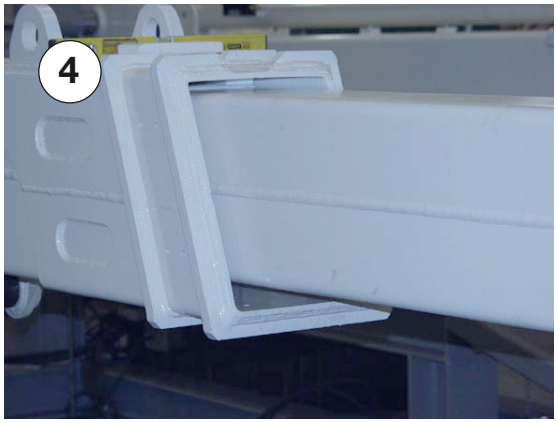
3 Grease the slide part of the first tube pads and fit two pairs of flexible hoses **A**.

IMPORTANT

The flexible hose for the fork coupling/release is optional.

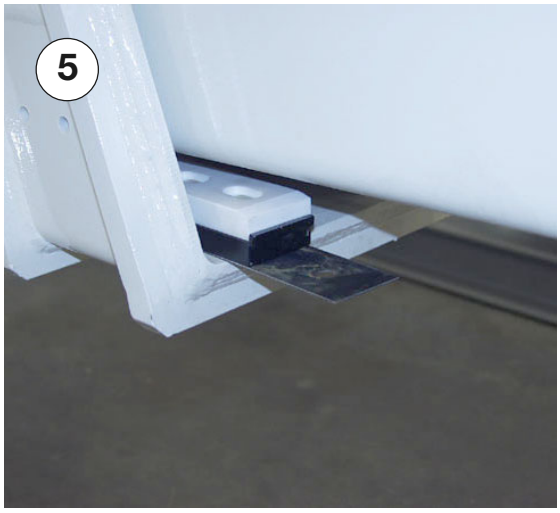


4 Raise the second boom tube with some chains connected to the bridge crane and fit it into the first boom section.



Procedure: **Pre-assembling the boom assy**	Table: **T-056.1**

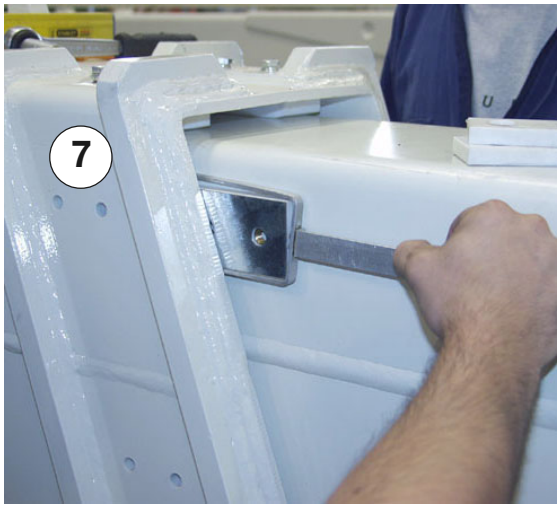
5 Fit the slide pads with the relevant pad housing in the front part of the first boom tube using a 17mm wrench.



6 When fitting the bottom pads, check that the connecting point of the fork pivot pin is perfectly level.

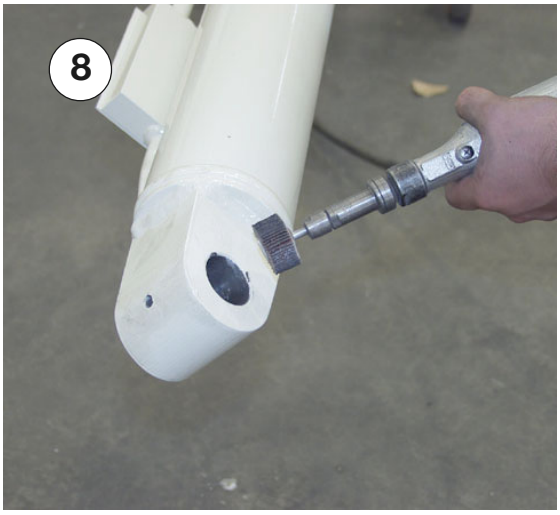


7 Fit the side and top pads of the first boom tube.



Procedure: Pre-assembling the boom assy	Table: T-056.1

8 Thoroughly clean the holes of the boom extension cylinder with a grinding wheel.



9 Try to drive the pin in the housing and check that it enters correctly.

IMPORTANT

Before inserting the pins, smear them with grease.



10 Sling the extension cylinder and place it into the hole of the rear connection of the first boom tube.

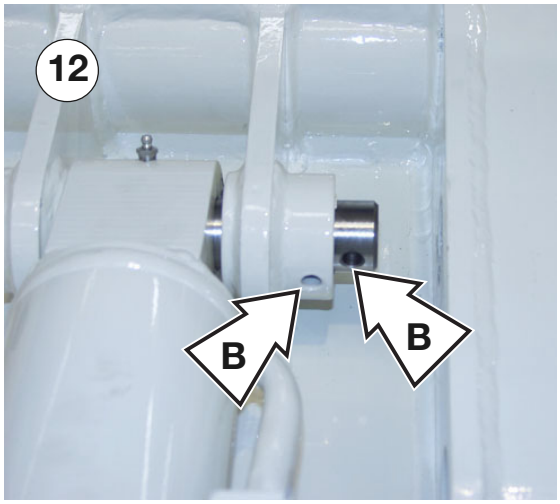


Procedure: **Pre-assembling the boom assy**	Table: **T-056.1**

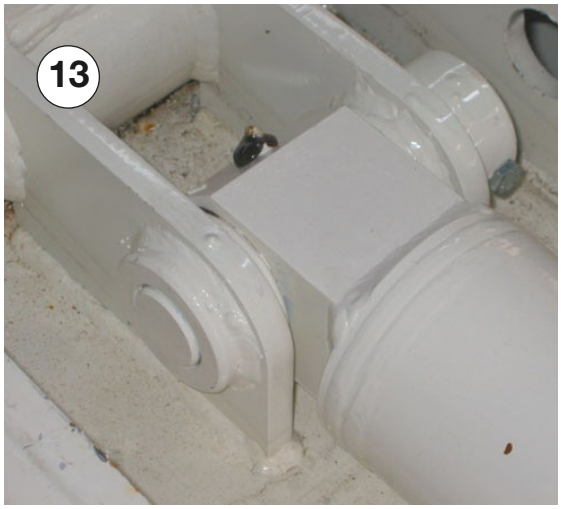
11 If necessary, move the cylinder with a lever so that the pin enters the holes perfectly.



12 While inserting the pin, make sure that the two locking holes **B** are aligned.



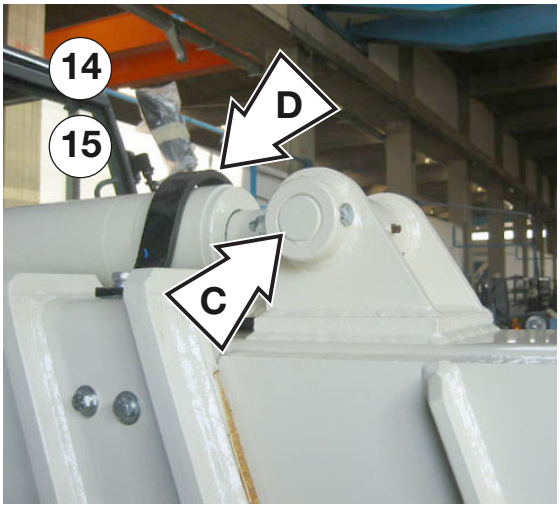
13 Fit the locking screw and tighten the relevant nut with two 17mm wrenches.



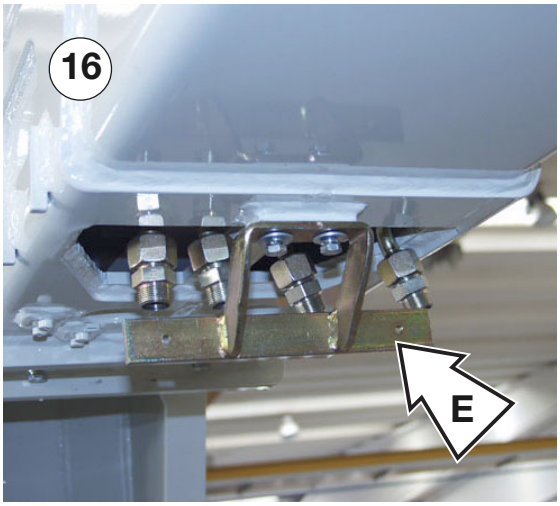
Procedure: **Pre-assembling the boom assy**	Table: **T-056.1**

14 Lower the cylinder (rod side) and insert it into the lower bracket of the second boom tube. Lock with pin **C** tightening the relevant screw with two 17mm wrenches.

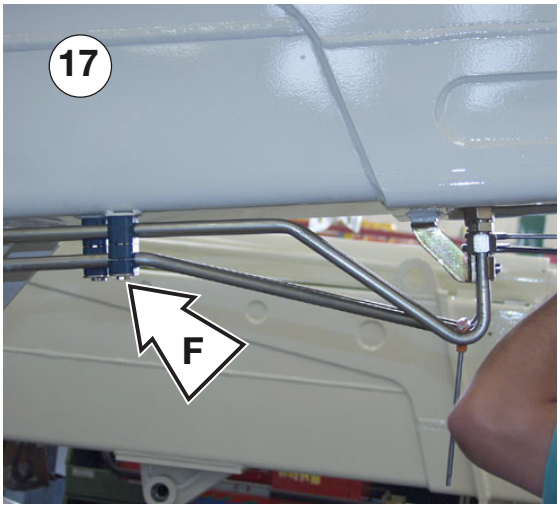
15 Fit bracket **D** and tighten the relevant screws with a 27mm wrench.



16 With a 13mm wrench, mount the pipes' holding bracket **E** underneath the first boom tube.

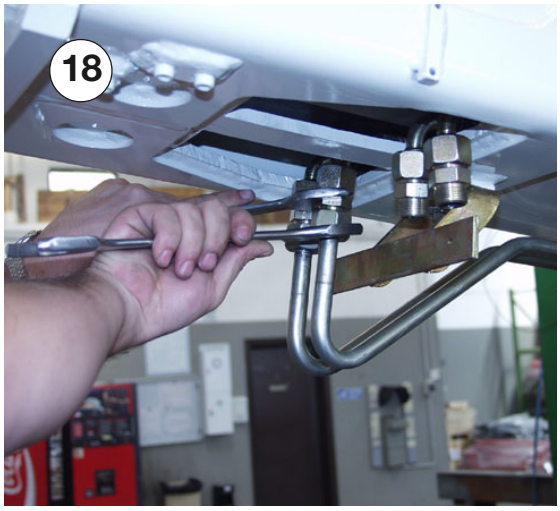


17 Mount the iron pipes under the first boom section, fit clamps **F** and fix with a 10mm wrench.

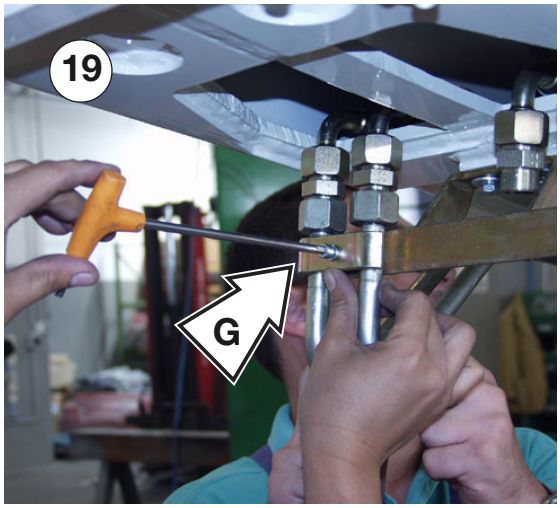


Procedure: **Pre-assembling the boom assy**	*Table:* **T-056.1**

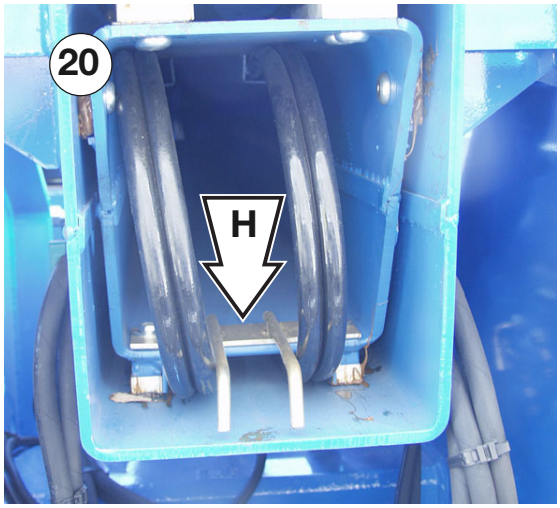
18 Fix the couplings of the boom internal hoses to the iron pipes using a 27mm wrench and a 30mm wrench.



19 Fix the rigid pipes fitting and blocking brackets **G** with a 5mm hexagonal wrench.

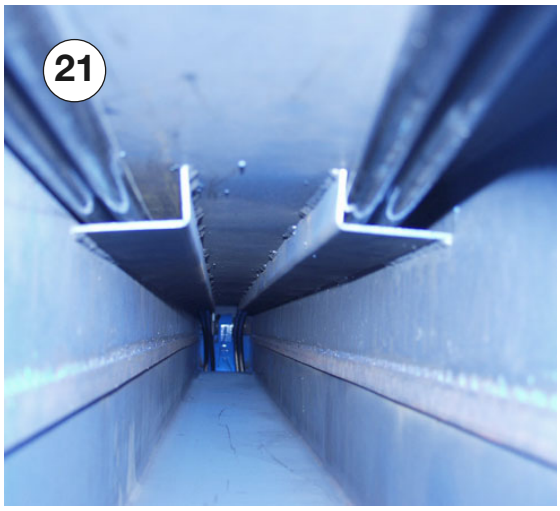


20 Place the rack **H** at the rear side of the second boom tube. Lock in position with a 17mm wrench.

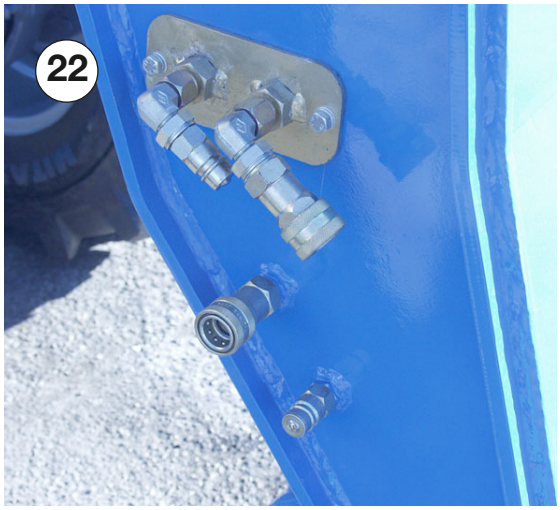


Procedure: **Pre-assembling the boom assy**	*Table:* **T-056.1**

21 Insert the flexible hoses in the special channels of the second boom tube.



22 Fit the guiding slit for optional attachments using a 13mm wrench.

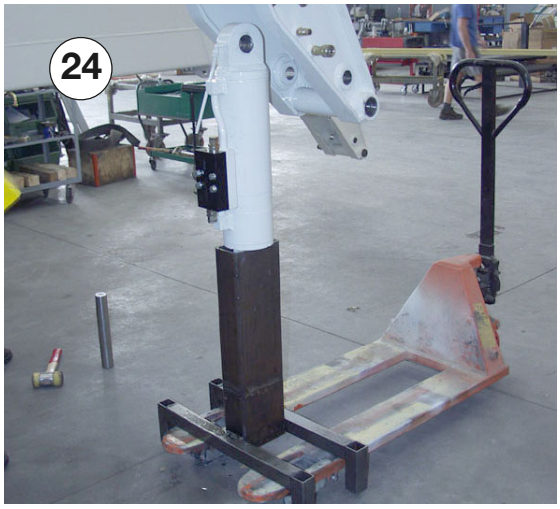


23 Access to the flexible hoses placed in the front part of the second boom tube; connect the pair on the right to the connectors of the guiding slit for optional attachments using a 27mm wrench.



Procedure: **Pre-assembling the boom assy**	Table: **T-056.1**

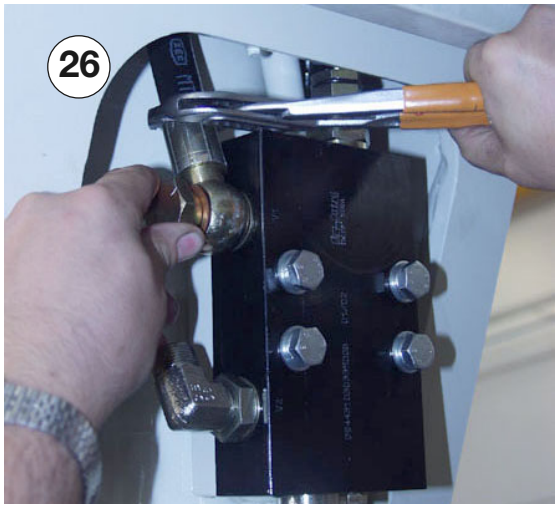
24 Near the fork pitching cylinder to the pin hole on the boom nose using a hydraulic lift.



25 Align the holes, insert the locking pin of the second boom tube and lock in position with the screw and the nut using two 19mm wrenches.

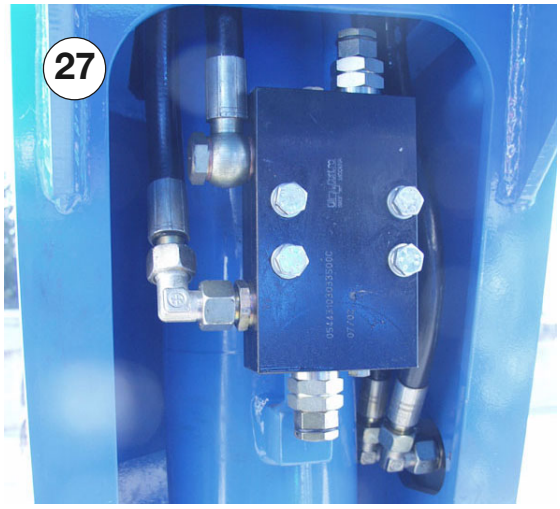


26 Connect the second pair of flexible hoses to the block valve on the cylinder using a 27mm wrench.

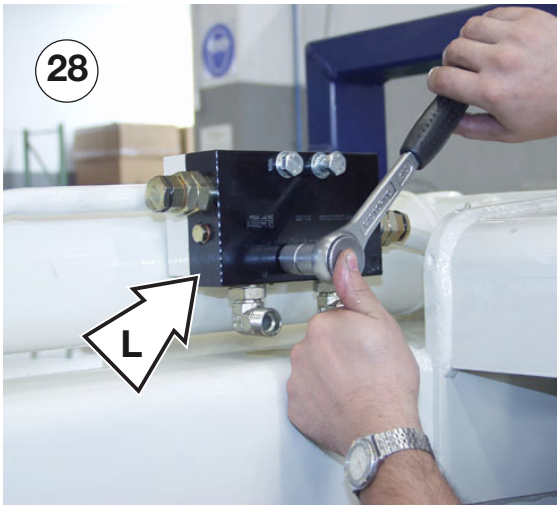


Procedure: **Pre-assembling the boom assy**	Table: **T-056.1**

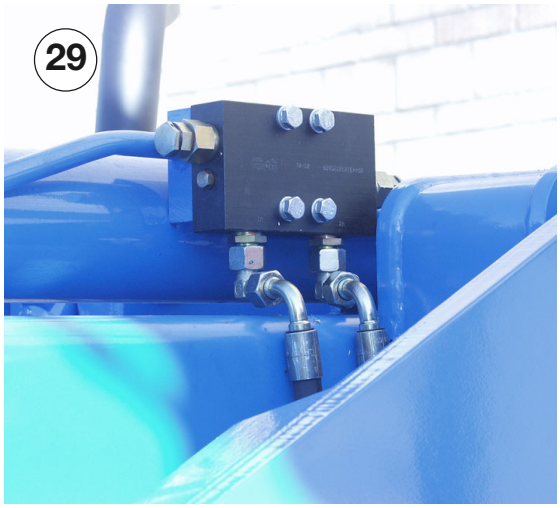
27 Make sure the flexible hoses, the cylinder and the structural metal parts do not interfere one with the other.



28 Place the block valve **L** of the second telescope extension cylinder and tighten with a 17mm box spanner.

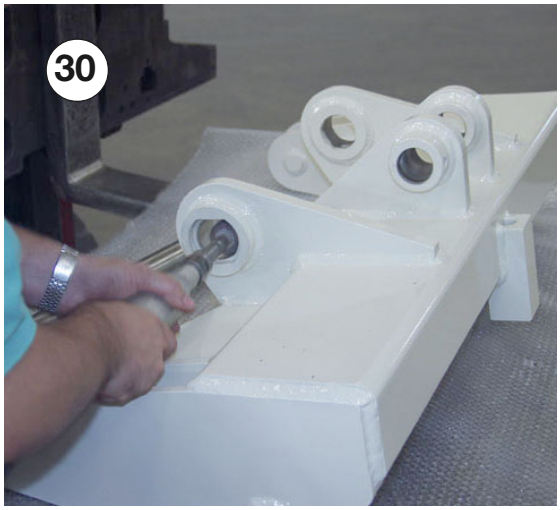


29 Connect the hoses coming from the actuator to the connectors on the valve using a 27mm wrench.

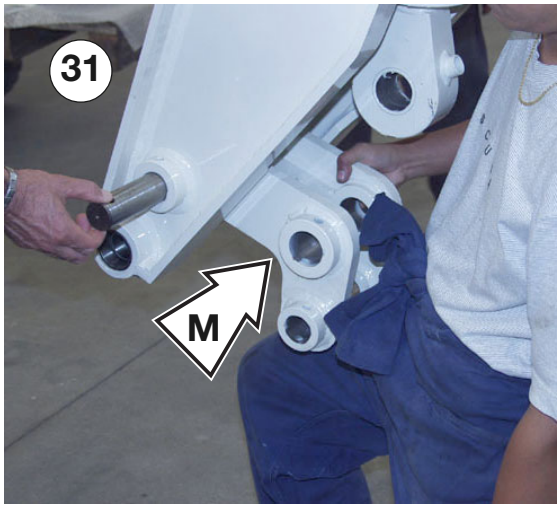


Procedure: **Pre-assembling the boom assy**	*Table:* **T-056.1**

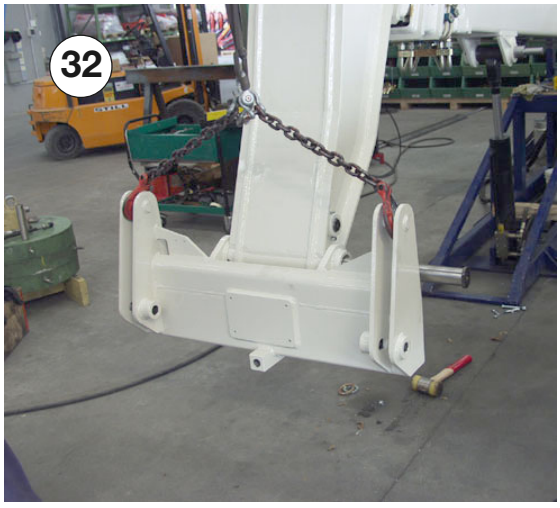
30 Prepare the attachment holding plate and check that all holes are drilled to size. In case, use a grinding wheel.



31 Mount the connecting rod **M** to the boom nose and lock the relevant pin with one screw using two 17mm wrenches.

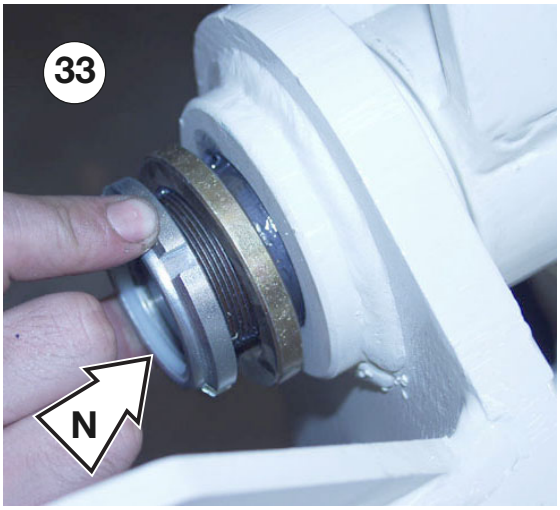


32 Sling the attachment holding plate with some chains connected to the bridge crane and move it on the boom. Lock the plate in position with the relevant pin.

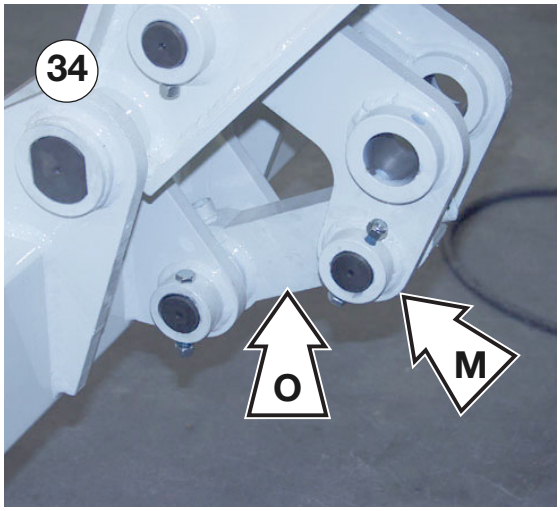


Procedure:	Pre-assembling the boom assy	Table:
		T-056.1

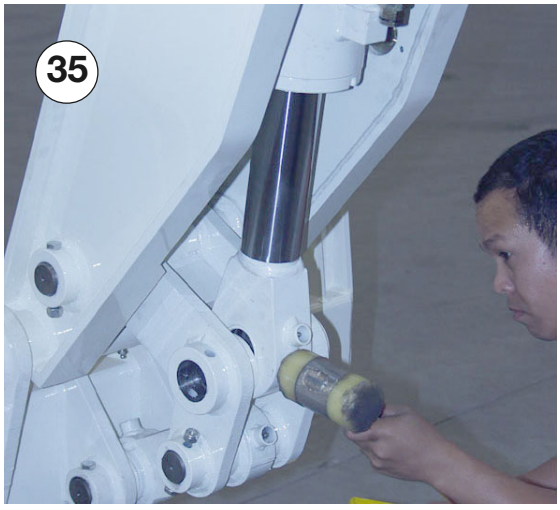
33 Lock the pin with the ring nut **N**.



34 Mount the connecting rod **O** joining the attachment holding plate to the connecting rod **M** and lock the two pins with the special screws using two 17mm wrenches, placing the nut at the top.

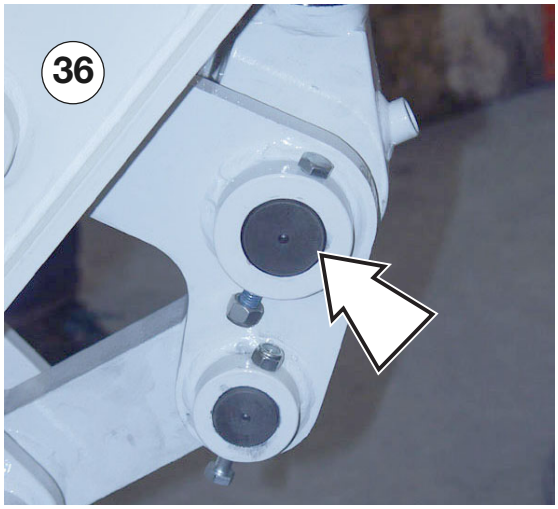


35 Place the fork pitching cylinder in the connecting rod **M** and fit the relevant locking pin.

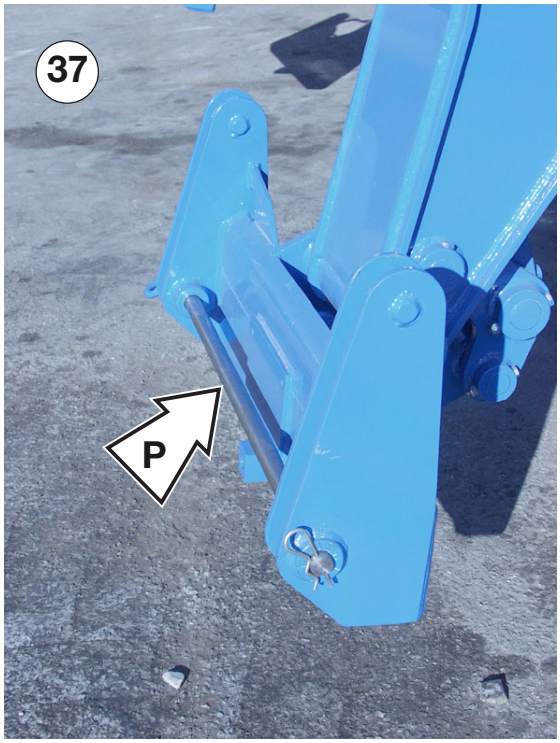


Procedure: Pre-assembling the boom assy	Table: T-056.1

36 Lock the pin with one screw using two 19mm wrenches.



37 Now fit pin **P** to lock the attachment holding plate and lock it in position with a splint pin.



IMPORTANT

If the attachment locking cylinder shall be fitted, proceed as explained in T-006, T-006.1 in this manual.

Procedure: **Assembling the boom**	Table: **T-056.2**			kg: 3588
	3713 Elite ☐	3517 ☑	4010 ☐	Hours: 16 — Min.: -
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks	Standard tools			1+1

Procedure:

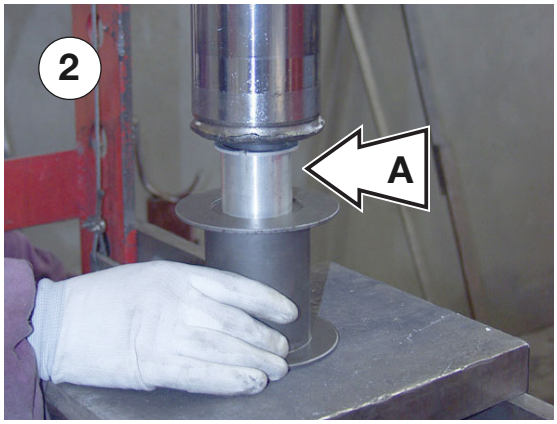
The assembly order of the different boom parts is the following: 4th boom tube into 3rd boom tube; 4th+3rd boom tubes into 2nd boom tube; 4th+3rd+2nd boom tubes into 1st boom tube.

Prepare the four boom tubes and proceed as follows:



1 Remove the paper protecting the mechanical slide part of the pads; clean with a grinding wheel until the surfaces are perfectly smooth.

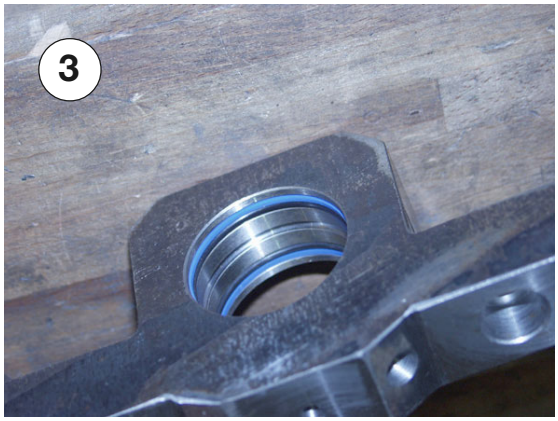
2 Fit bushings **A** (EKF 4550) into the sheaves where the boom extension chains slide.



IMPORTANT

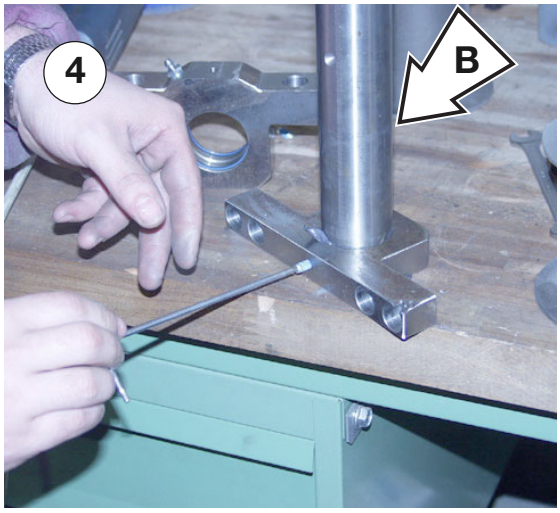
Do this operation with a press.

3 Fit the O-rings into the outer grooves of the pad locking supports.

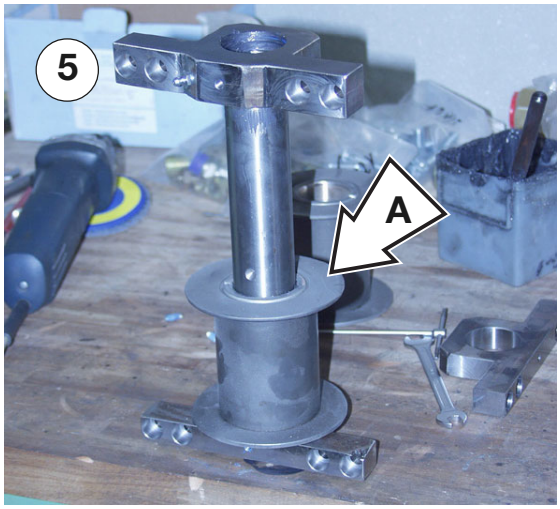


Procedure: **Assembling the boom**	*Table:* **T-056.2**

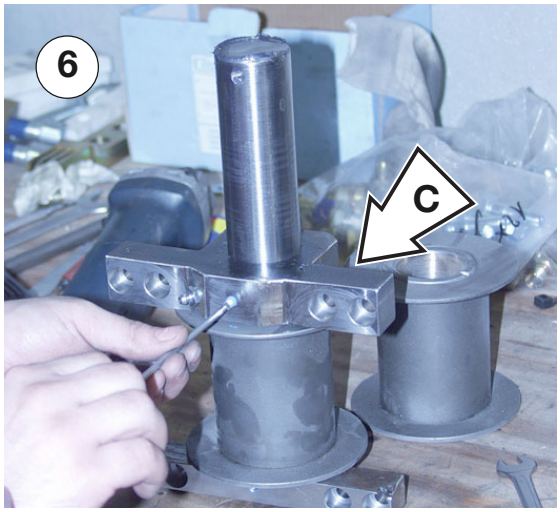
4 Mount the fixing bracket to the boom and line up the hole of pin **B** with the hole on the bracket; lock the two parts with a grubscrew using a 3mm hexagonal wrench.



5 Fit the sheave to the pin.

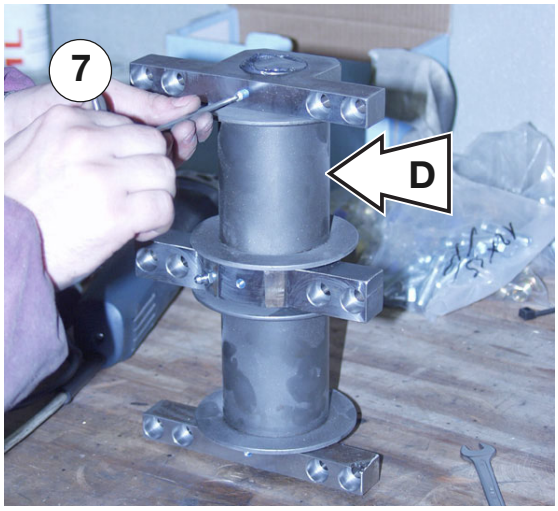


6 Fit the second bracket **C** and check that the hole is aligned with the blind hole on the pin; lock the two parts with a grubscrew using a 3mm hexagonal wrench.

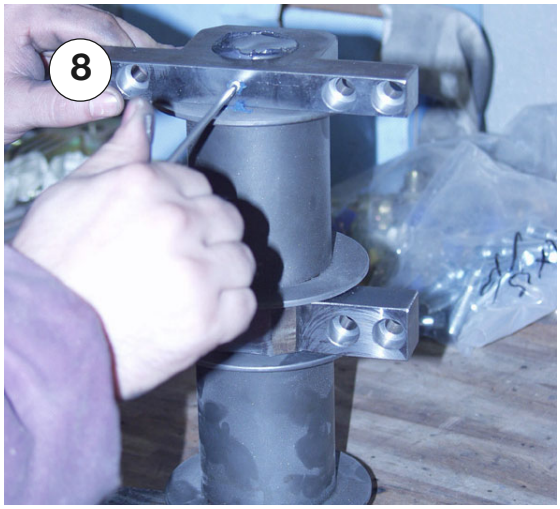


Procedure: **Assembling the boom**	Table: **T-056.2**

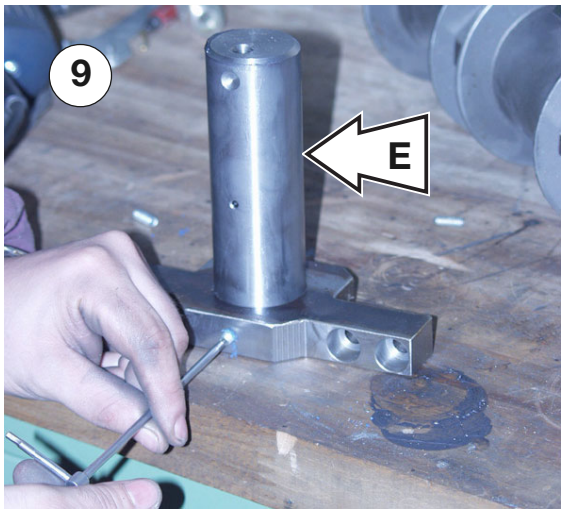
7 Mount the second sheave **D**.



8 Mount the third bracket and lock with the grubscrew provided.

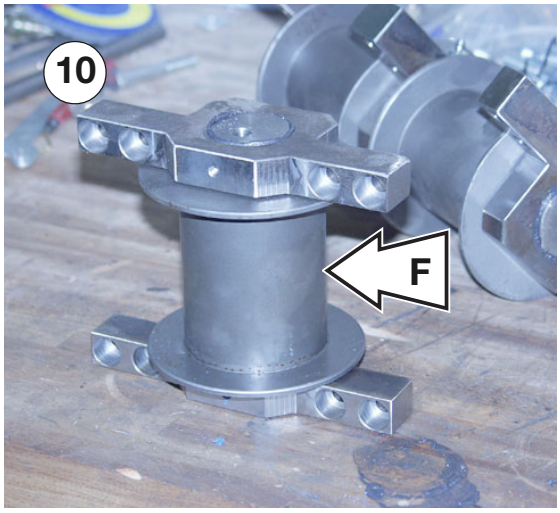


9 Mount the lower bracket on pin **E** and check that the holes are aligned; lock with the grubscrew provided.

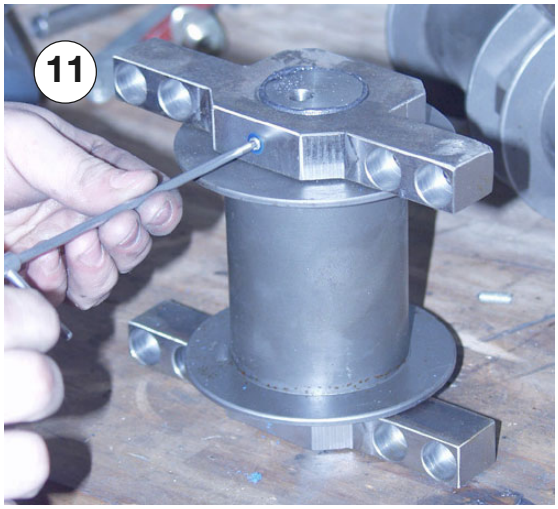


Procedure: **Assembling the boom**	Table: **T-056.2**

10 Mount the single sheave **F** on the pin after smearing with some grease.



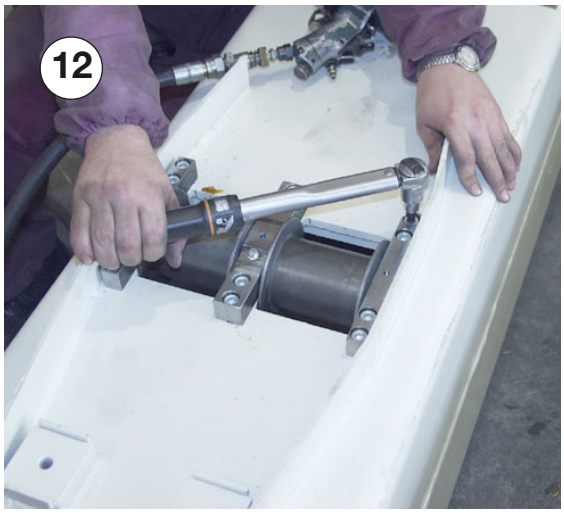
11 Mount the end bracket after smearing it with grease; lock with a grubscrew M6.



IMPORTANT

The greasing nipple of the rolls is placed outside. Oil reaches the pin centre through a hole.

12 The double sheave shall be fitted at the bottom rear side of the second boom tube and fixed with 12 screws (10.9) M10x40. Smear the screws with some threadlocker and tighten with a 8mm hexagonal dynamometric wrench to a torque of 7 Kgm.

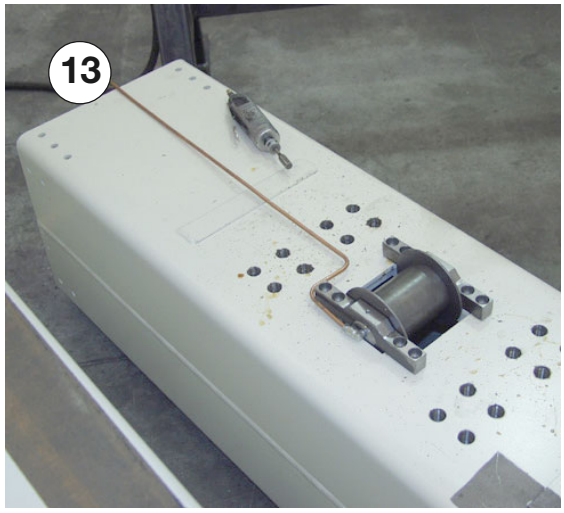


IMPORTANT

Cross-tighten all screws for a perfect locking of the bracket.

Procedure: **Assembling the boom**	*Table:* **T-056.2**

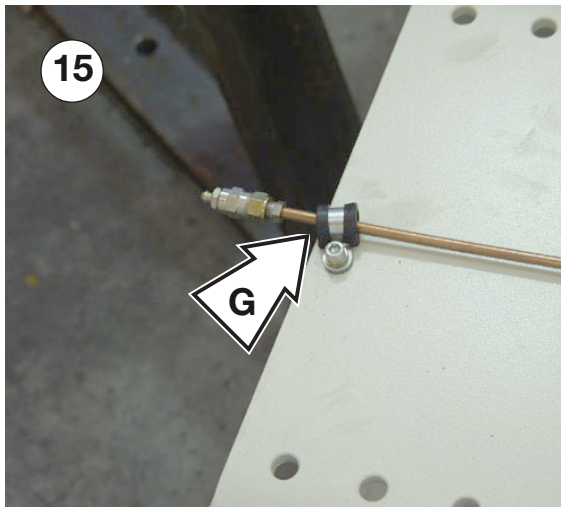
13 Fit the greasing nipple and check it is oriented toward the rear side of the boom.



14 Mount the single sheave to the bottom of third boom tube. Cross-tighten the screws with a 8mm hexagonal dynamometric wrench to a torque of 7 Kgm.

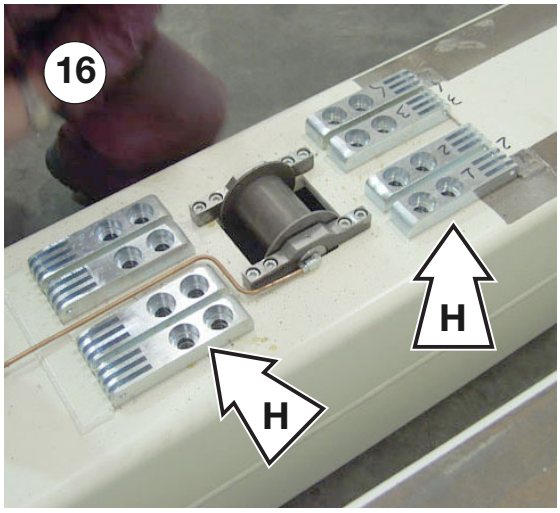


15 Fit a 90° connector after smearing the sheave pins with some threadlocker; fit a copper tube and place it toward the rear side of the boom. Fix with a clamp **G** at the end of the boom tube.



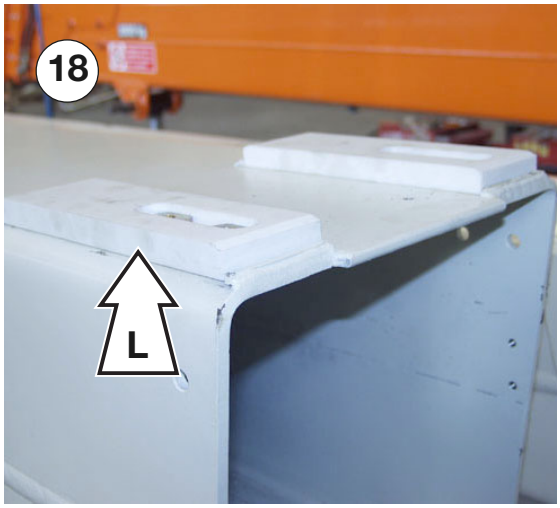
Procedure: **Assembling the boom**	*Table:* **T-056.2**

16 Mount the supports **H** to fix the metal chains.



17 Mount the greasing nipples for the top rear pads of the second, third and fourth boom tubes.

18 Place the four boom tubes on to stands and fit the top pads **L** of the second and third boom sections with two screws M14x40 each; tighten with a 22mm wrench.

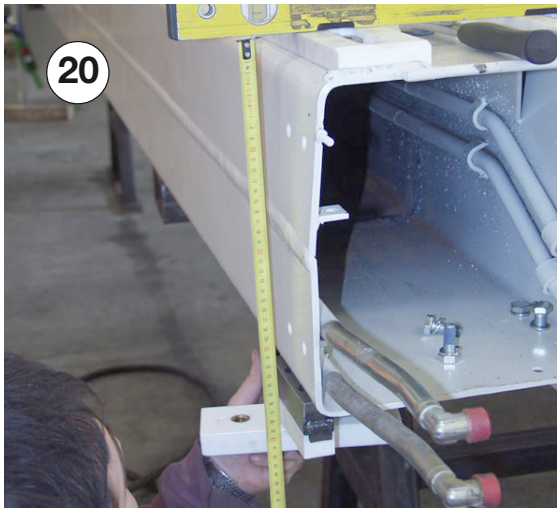


19 The top pads of the fourth boom tube shall be blocked with two screws M14x20 each and tightened to a torque of 5 Kgm; the bottom pads shall be blocked with three screws M12x30 each and tightened to 7 Kgm.



Procedure: **Assembling the boom**	Table: **T-056.2**

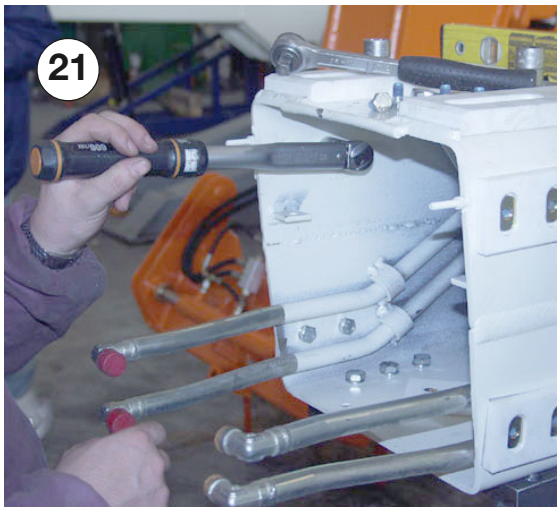
20 The width tolerance of the boom tubes shall be min. 0.5 mm - max. 1 mm.





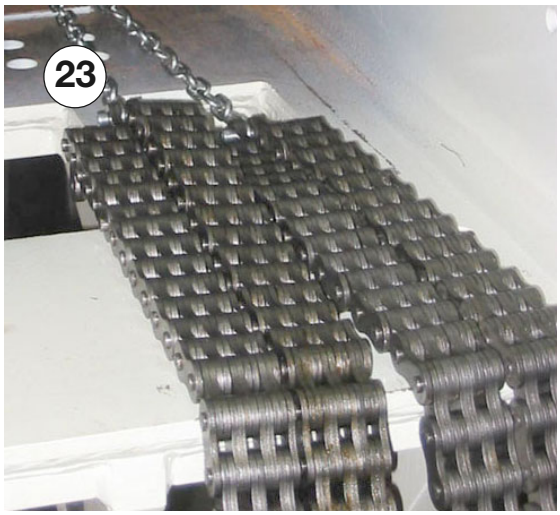
21 Tighten the side pads to a torque of 3 Kgm with a dynamometric wrench.

22 Fit the rear pads of the third boom tube.

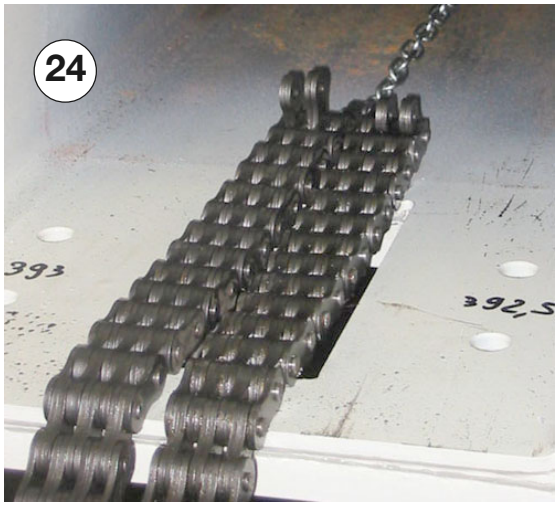


Procedure: **Assembling the boom**	Table: **T-056.2**

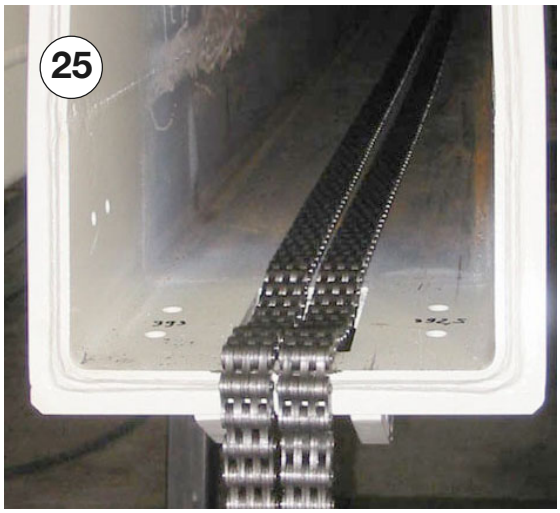
23 Place the slide chain in the second boom tube.



24 Place the slide chain in the third boom tube.

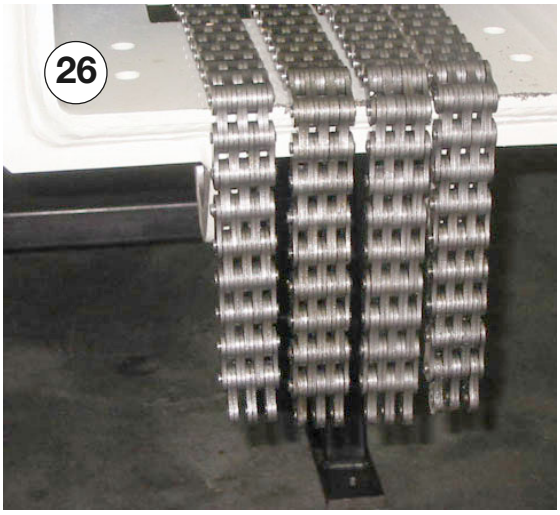


25 Leave a length of chain out of the front part of the third boom section.

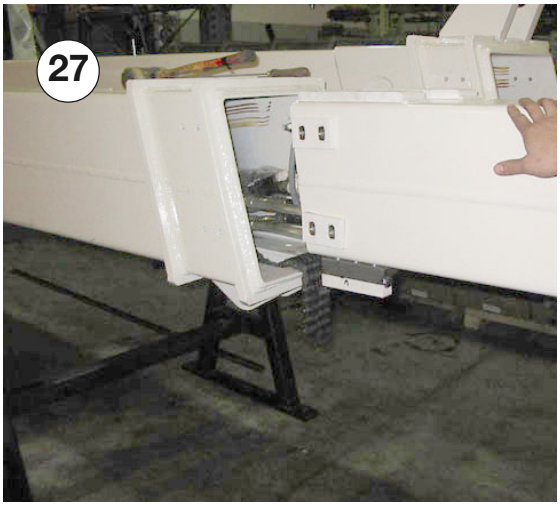


Procedure: **Assembling the boom**	*Table:* **T-056.2**

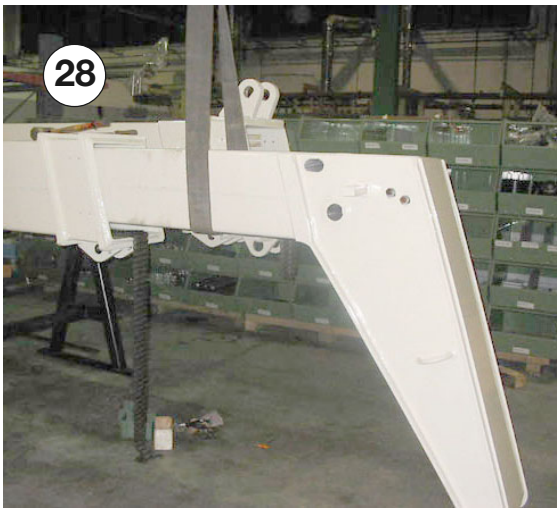
26 Leave a length of chain out of the front part of the second boom section.



27 After placing the plastic chain cover as indicated in T-059, fit the fourth boom tube into the third one using a textile bridle of suitable capacity connected to a bridge crane.



28 Let the fourth boom tube slide into the third tube to stop.



Procedure: **Assembling the boom**	Table: **T-056.2**

29 With a textile bridle connected to the bridge crane, sling the third and fourth boom tubes and place them into the second one.

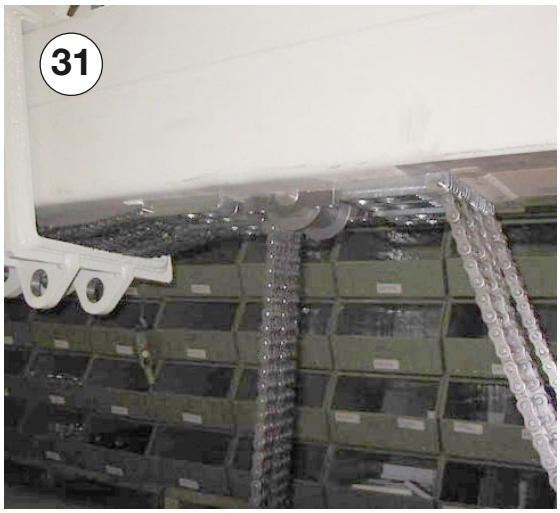


30 Block the chain under the fourth boom tube.



31 Fix the chain to the third boom tube.

32 Place second, third and fourth boom tubes into the first one.



Procedure: **Assembling the boom**	Table: **T-056.2**

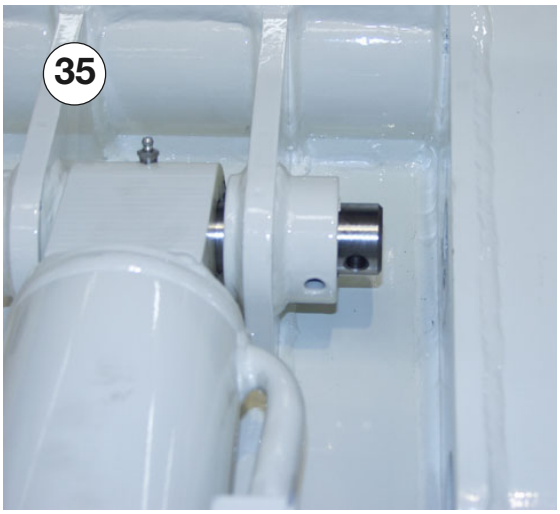
33 Sling the boom extension cylinder and raise it with the bridge crane.



34 Place the cylinder on the boom and fit the locking pin after smearing the relevant hole. Check that holes are aligned and fit the fixing screw.

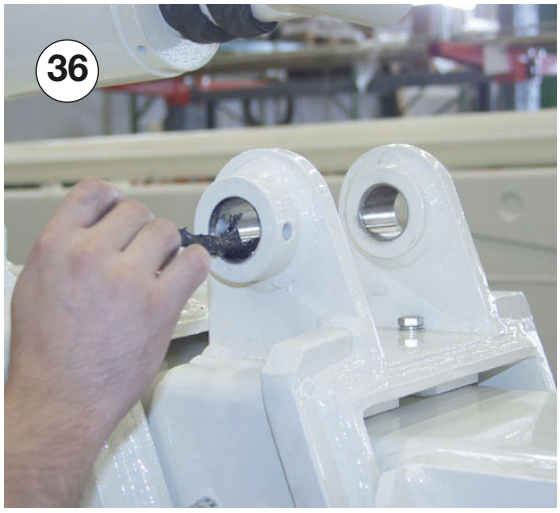


35 Insert the fixing screw and tighten the nut with two 17mm wrenches.

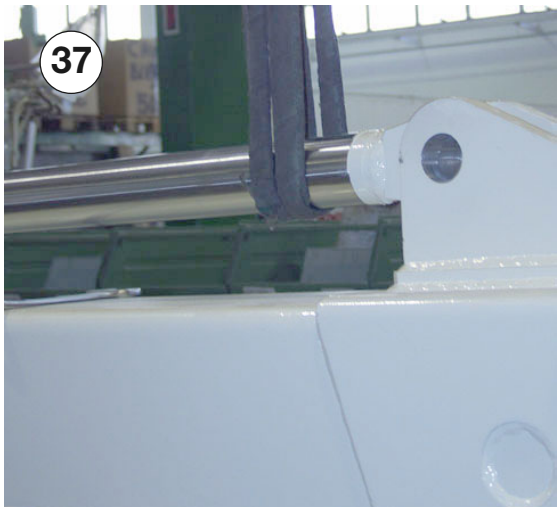


Procedure: **Assembling the boom**	*Table:* **T-056.2**

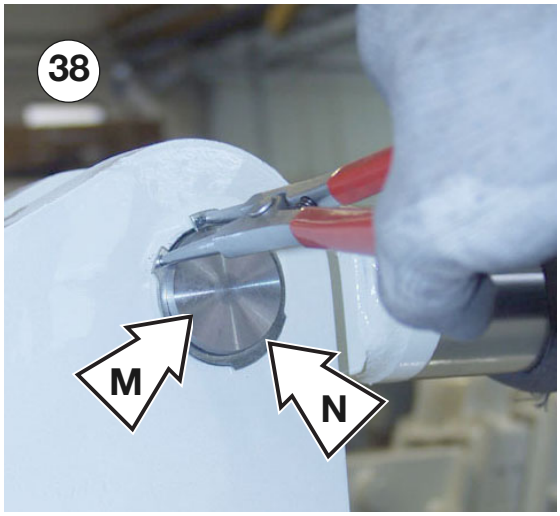
36 Thoroughly grease the bushings of the front connection of the second boom tube.



37 Lower the cylinder and align the hole with the one on the boom.

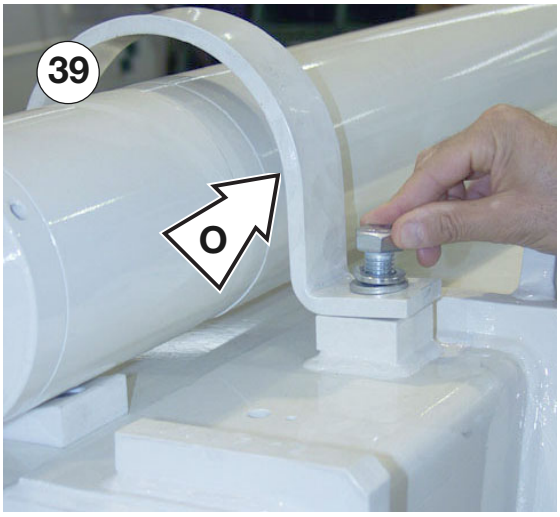


38 Fit pin **M** and lock it with 2 retaining rings **N**. Use a USAG 128 40-100 wrench.

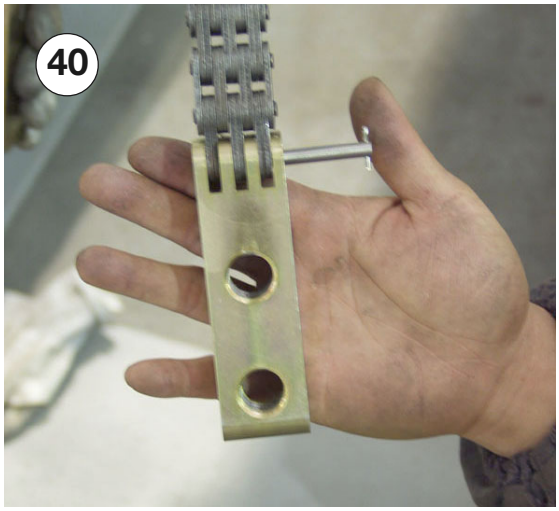


Procedure: **Assembling the boom**	Table: **T-056.2**

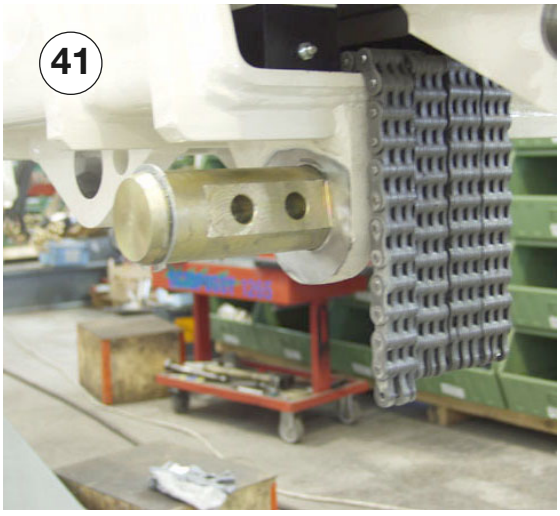
39 Mount the fixing bracket **O** of the extension cylinder and lock with the special screws using a 27mm wrench.



40 Fit the terminals to the boom slide chains, fix with the special splint pins and leave them out of the boom before fixing them to the bottom of the boom tube.

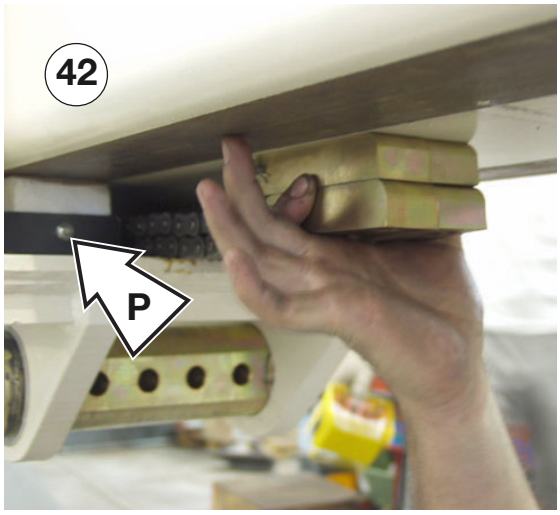


41 Use the second end of the chain to fit the tie-rods.

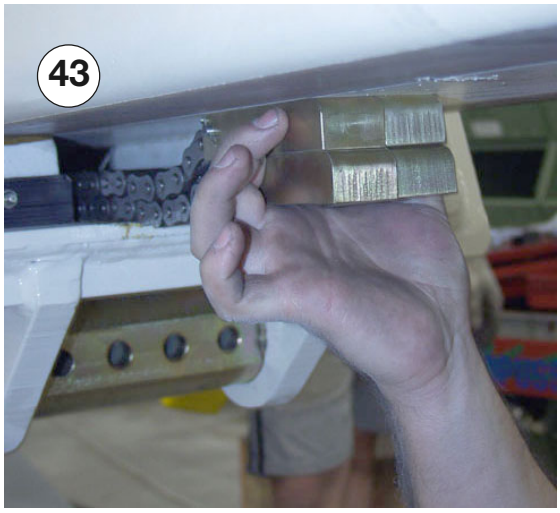


Procedure: **Assembling the boom**	*Table:* **T-056.2**

42 Mount all bottom pads of the boom tubes (in the pad housing there is a greasing nipple **P** which, through a hole, releases oil into the bushing seat of the slide pad).



43 Mount the fixed brackets and fix the chain to the boom tubes. Position the brackets with a screwdriver.



44 Smear the screws with some Loctite, fit and tighten with a 17mm hexagonal wrench.



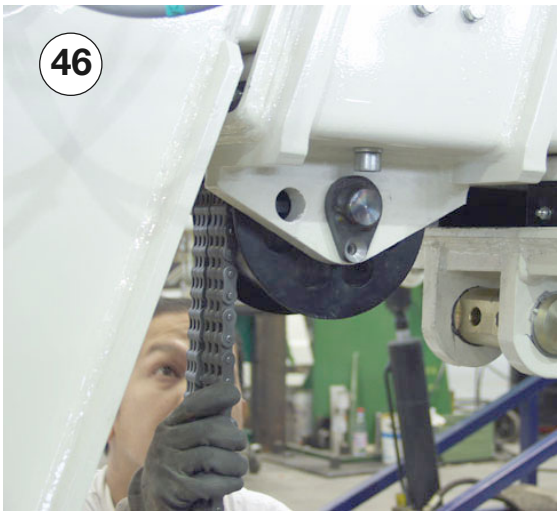
Procedure: **Assembling the boom**	Table: **T-056.2**

45 Using a dynamometric wrench, tighten the screws to 500 Nm.



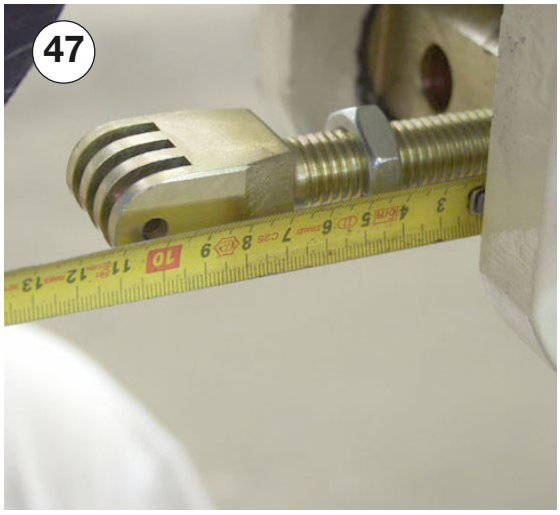
46 Fit the pin into the hole of the sheave of the second boom section. First let the 4 chains slide and the fixing plate rest on the boom surface. Tighten the screw with a 5mm hexagonal wrench.





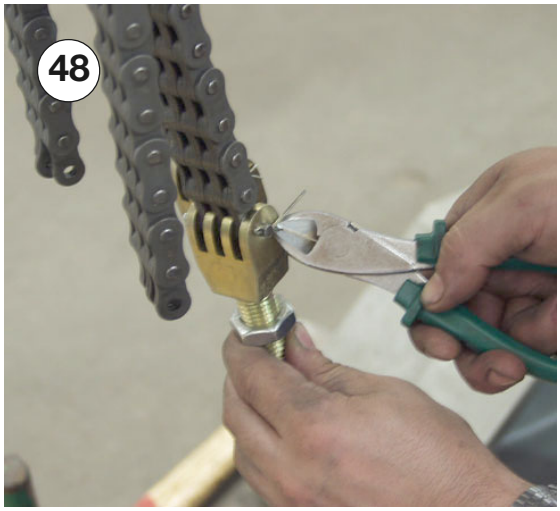
Procedure: **Assembling the boom**	*Table:* **T-056.2**

47 Place the chain tensioners leaving a minimum distance of 100 mm between the face of the boom locking pin and the centre of the chain fixing hole.



48 Mount the threaded tie-rods to the chains.

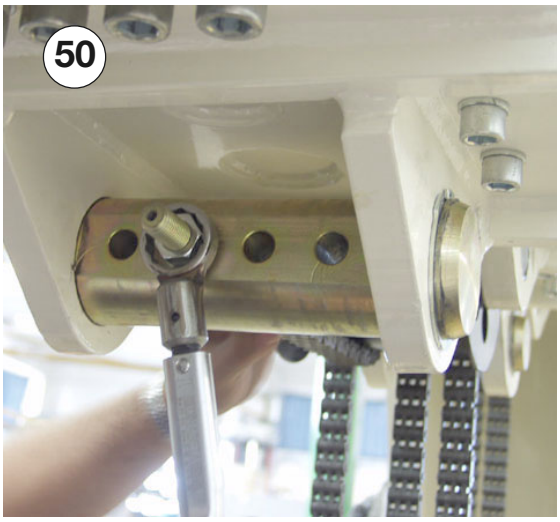
49 Fix the pin with 2 splint pins.



50 Fit the tie-rod to the chain locking pin and tighten nuts and counter-nuts with a 27mm hexagonal wrench. Tighten to 250 Nm with a dynamometric wrench.



Procedure: **Assembling the boom**	*Table:* **T-056.2**

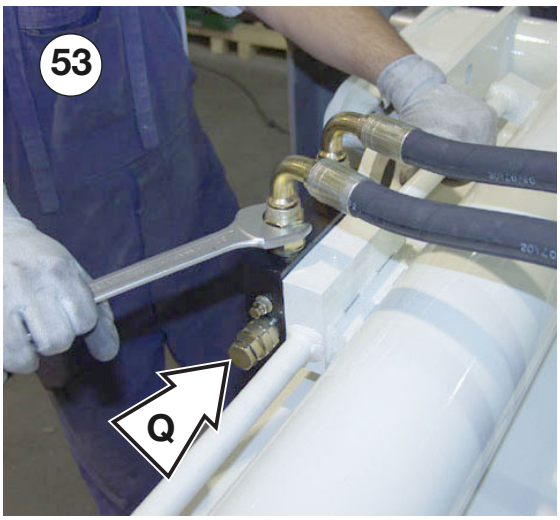


51 While tensioning the chains, tighten them with an adjustable wrench to avoid any rotation.

52 Check that the pads and the mechanical parts stay correctly before proceeding with the hydraulic connections.

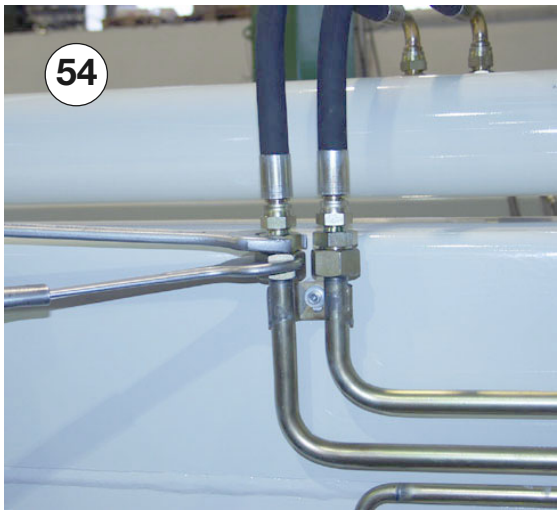


53 Mount the block valve **Q** of the boom extension cylinder and the relevant flexible hoses with a 32mm wrench.

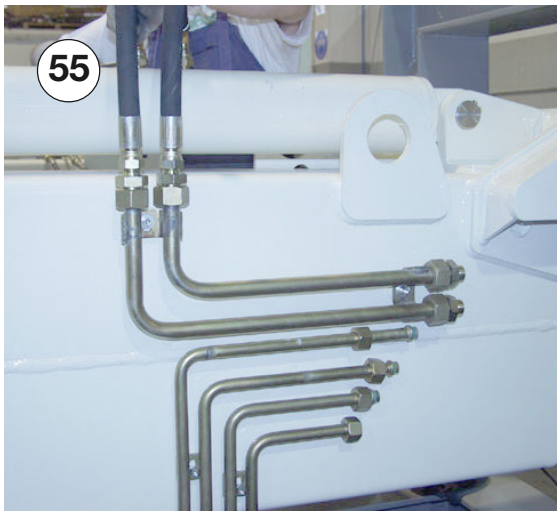


Procedure: **Assembling the boom**	*Table:* **T-056.2**

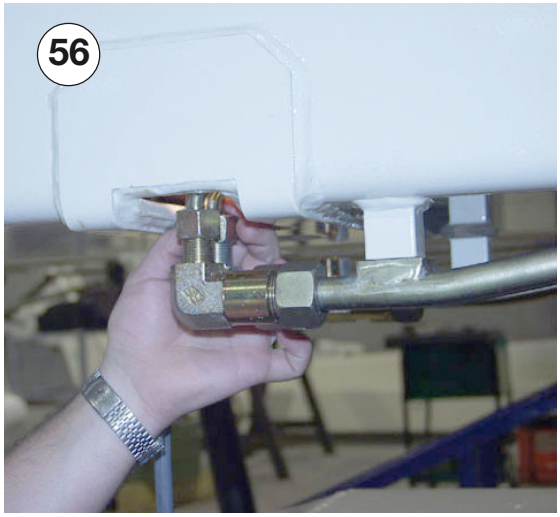
54 Fit a connector to the metal tubes sited to the left of the boom and tighten with two wrenches (46 and 41 mm).



55 Tighten the tube nut with two wrenches (41 and 32 mm), then fix the tubes to the side of the boom with a 6mm hexagonal wrench.

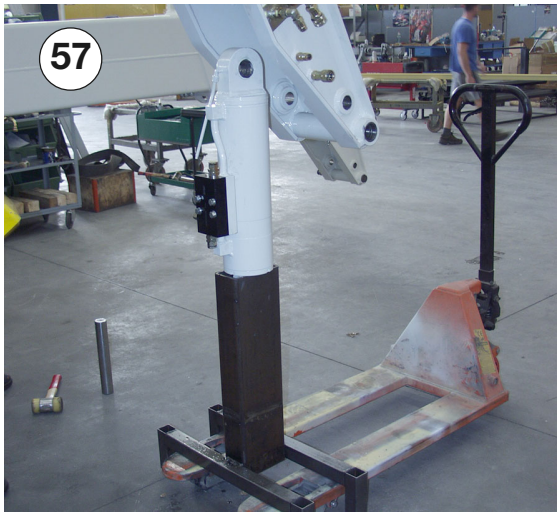


56 Connect the tubes to the bottom of the boom with a 27mm wrench.



Procedure: **Assembling the boom**	Table: **T-056.2**

57 Near the fork pitching cylinder and align the hole on the cylinder with the one on the boom nose.

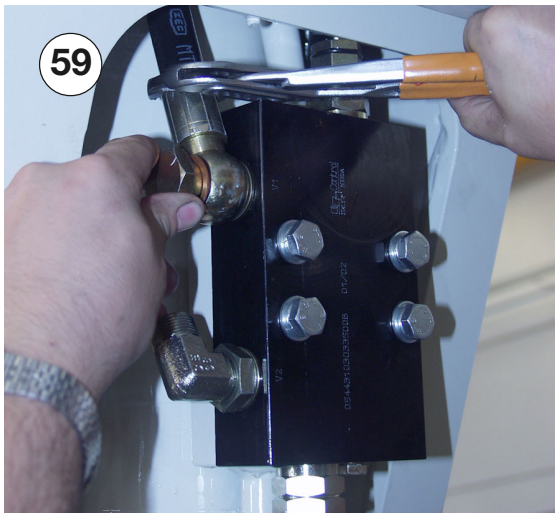


58 Fit the fixing pin and lock it in position with a screw and a nut using two 19mm wrenches.



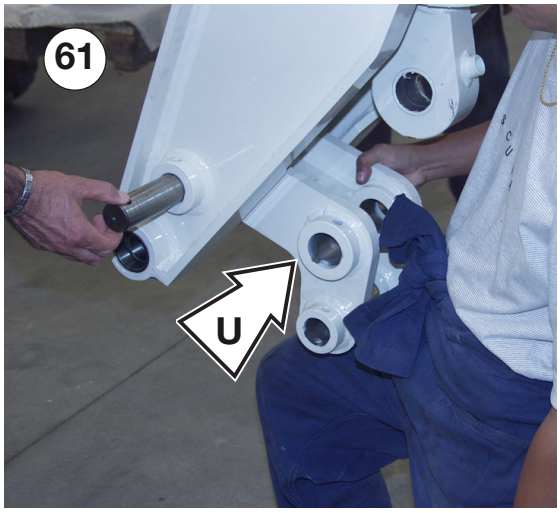
59 Connect the line with eye-terminal to the block valve pulling slightly the other line with a Polygrip (Beta 1048-240), so that the hose with eye-terminal forms a slight curve and rests on the cylinder. Tighten the hollow pin with a 27mm wrench.

60 Connect the line with straight terminal to the 90° connector on the block valve using a 27mm wrench.

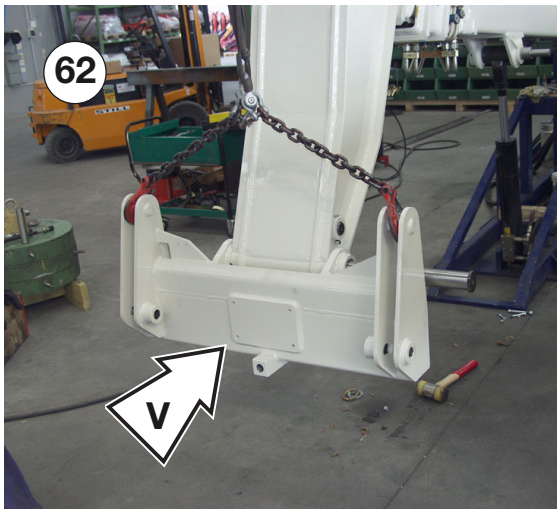


Procedure: **Assembling the boom**	Table: **T-056.2**

61 Mount the connecting rod **U** to the boom nose fitting the relevant pin. Lock in position with a screw and a nut and tighten with a 17mm wrench.



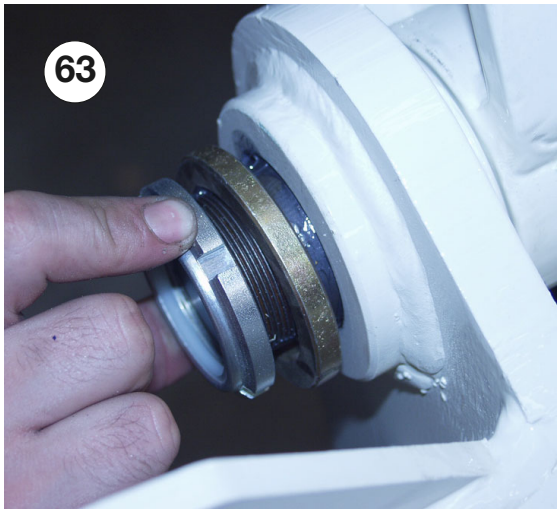
62 Raise the holding plate **V** using a two-leg chain connected to the bridge crane. Place the plate close to the fixing hole on the nose.



63 Fit the pin of the holding plate and lock it with the special ring nut placing in-between the shim supplied. Use a USAG 282 SN 50-80 spanner to tighten the ring nut.

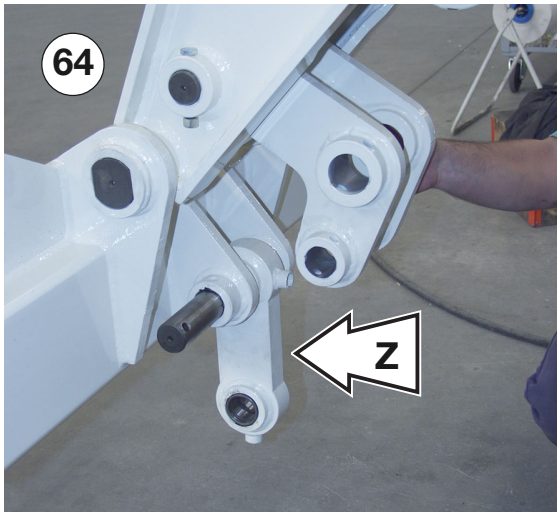
IMPORTANT

Thoroughly grease the housings of the pins to fit them home easier.

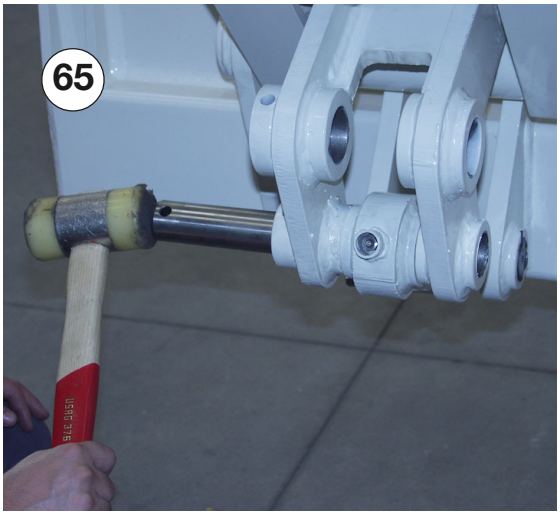


Procedure: **Assembling the boom**	Table: **T-056.2**

64 Mount the straight connecting rod **Z** as shown. Fit the locking pin and tighten the locknut on the screw with a 17mm wrench.



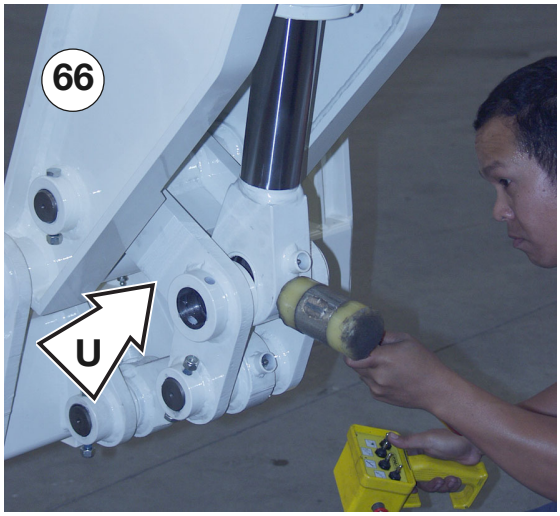
65 Fit the pin of the connecting rod and knock it lightly home with a rubber hammer. Fit the screw and the nut and tighten all parts with a 17mm wrench.



66 Connect the connecting rod **U** with the fork pitching cylinder fitting the special pin and locking all the parts with the screw and locknut using a 19mm wrench.

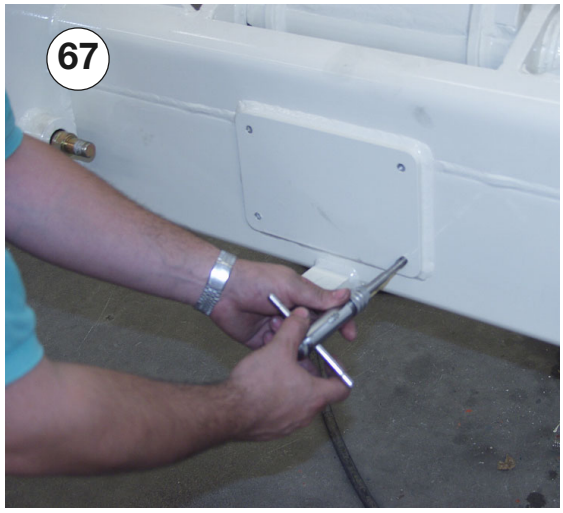
IMPORTANT

Once all connections have been made, lubricate all pins injecting grease with a greasing gun into the greasing nipples and check they are in efficient working order.

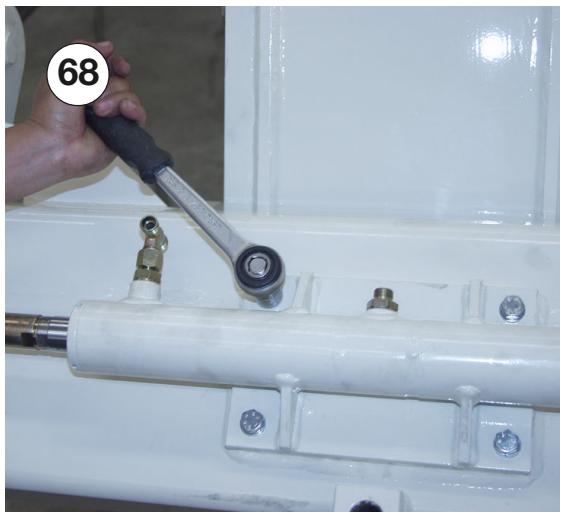


Procedure: **Assembling the boom**	Table: **T-056.2**

67 Thread M10 the 4 holes on the plate used to connect the attachment locking cylinder.



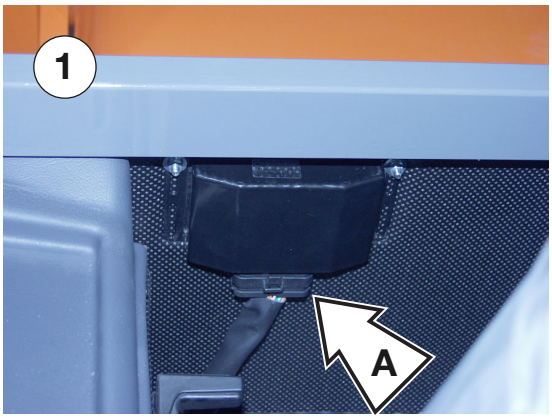
68 Fit the attachment locking cylinder following the instructions in T-006 in reversed order.



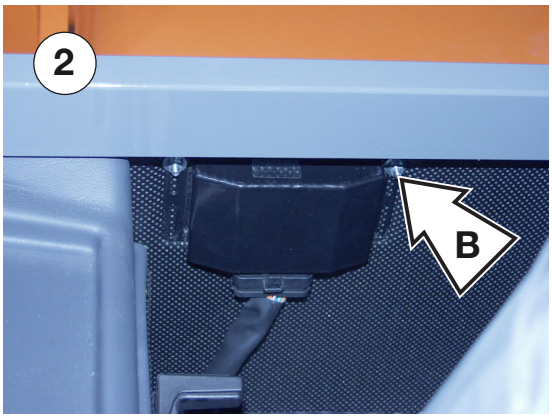
Procedure: **Dismantling the Walvoil control unit**	Table: **T-057**			kg	1
	3713 Elite ✔	3517 ✔	4010 ☐	Hours	Min.
	Standard tools			-	15
					1

Procedure:

1 Disconnect the 35-pin power socket **A**.



2 Remove the screws **B** fixing the control unit using a 5mm hexagonal wrench and a 10mm wrench.



Procedure: Dismantling the Walvoil control unit	Table: T-057

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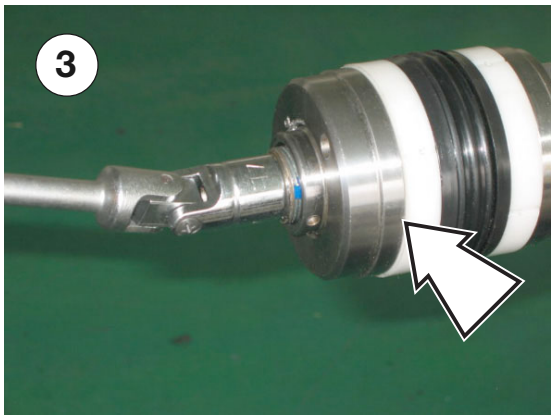
Procedure: **Dismantling the re-sequencing valve**	Table: **T-058** 3713 Elite ✔ / 3517 / 4010	kg: 0,2
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks Forklift	Standard tools	Hours: 2 / Min.: -
		1

Procedure:

1 Remove the extension cylinder on which you shall intervene as explained in T-010 or T-011

2 Extend the cylinder to free the rod as indicated in T-002

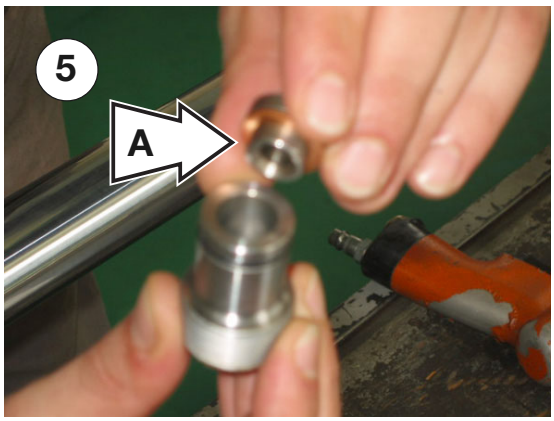
3 With a 17mm socket spanner, loosen the re-sequencing valve from the rod.



4 Remove the valve out of its housing. Plug the housing to avoid that impurities may enter the circuit.

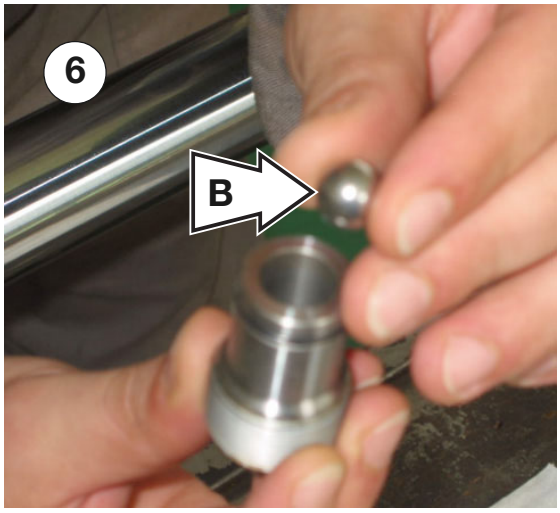


5 Disconnect the valve removing cap **A**.

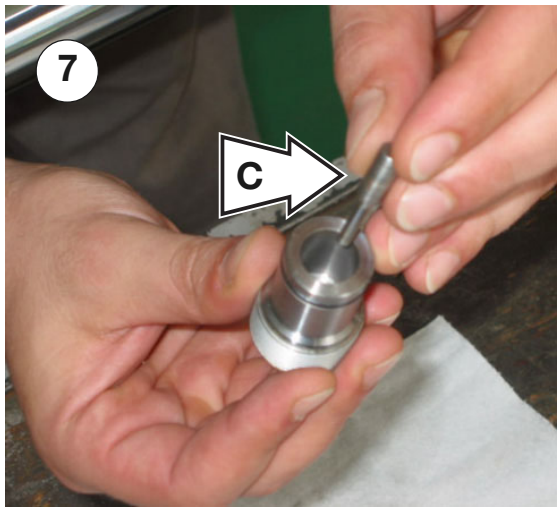


Procedure: **Dismantling the re-sequencing valve**	Table: **T-058**

6 Remove the ball **B**.



7 Pull out the slider **C**.



8 Clean all of the removed parts thoroughly, then re-assemble the valve repeating the steps above in reversed order.

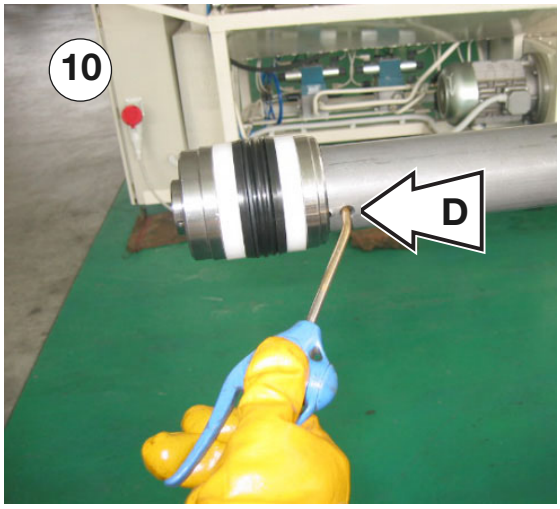


Procedure: **Dismantling the re-sequencing valve**	*Table:* **T-058**

9 Smear the valve with some threadlocker before refitting it in the housing on the rod.

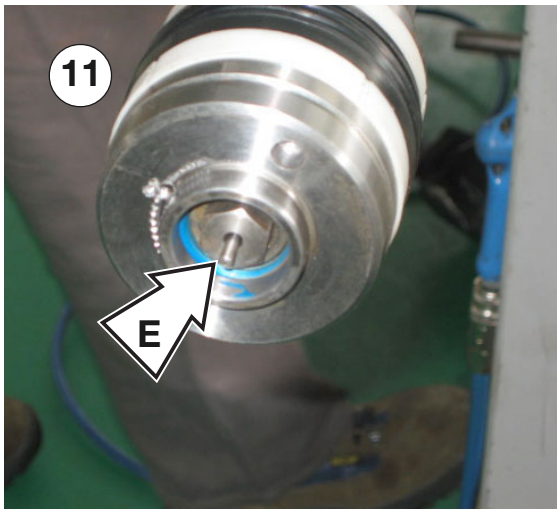


10 Check the efficiency of the valve as follows. Fit the nozzle of a compressed air gun into hole **D** on the rod, immediately after the sealing pack, then blow some air.



11 If the valve is efficient, the small piston **E** moves outwards avoiding air from flowing out.

12 Re-assemble and refit the cylinder to the machine.



Procedure: Dismantling the re-sequencing valve	Table: T-058

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Procedure: **Assembling the boom chain**	Table: **T-059**			kg	see table
	3713 Elite	3517	4010	Hours	Min.
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks		Standard tools		10	-
				2	

Weights:

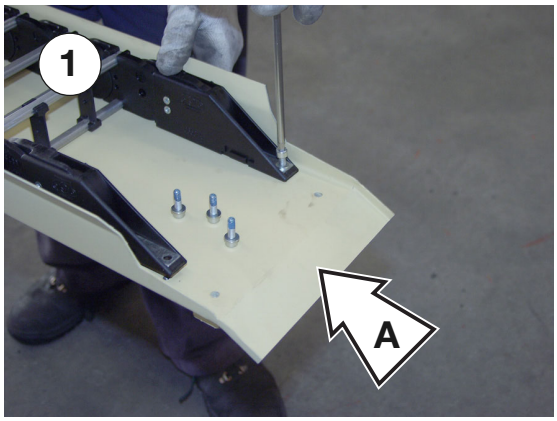
Chain ..... 25 kg
Iron chain cover ..... 22 kg
Chain c/w cable and lines ..... 80 kg
Complete chain and chain cover ..... 126 kg

Procedure to assemble chain and chain cover:

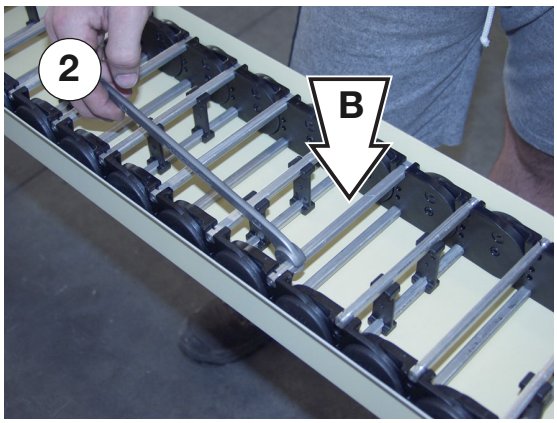
1 Place the plastic chain on cover **A** and, with a 5mm hexagonal wrench, fit and tighten the fixing screw after having checked that the two parts are parallel.

IMPORTANT

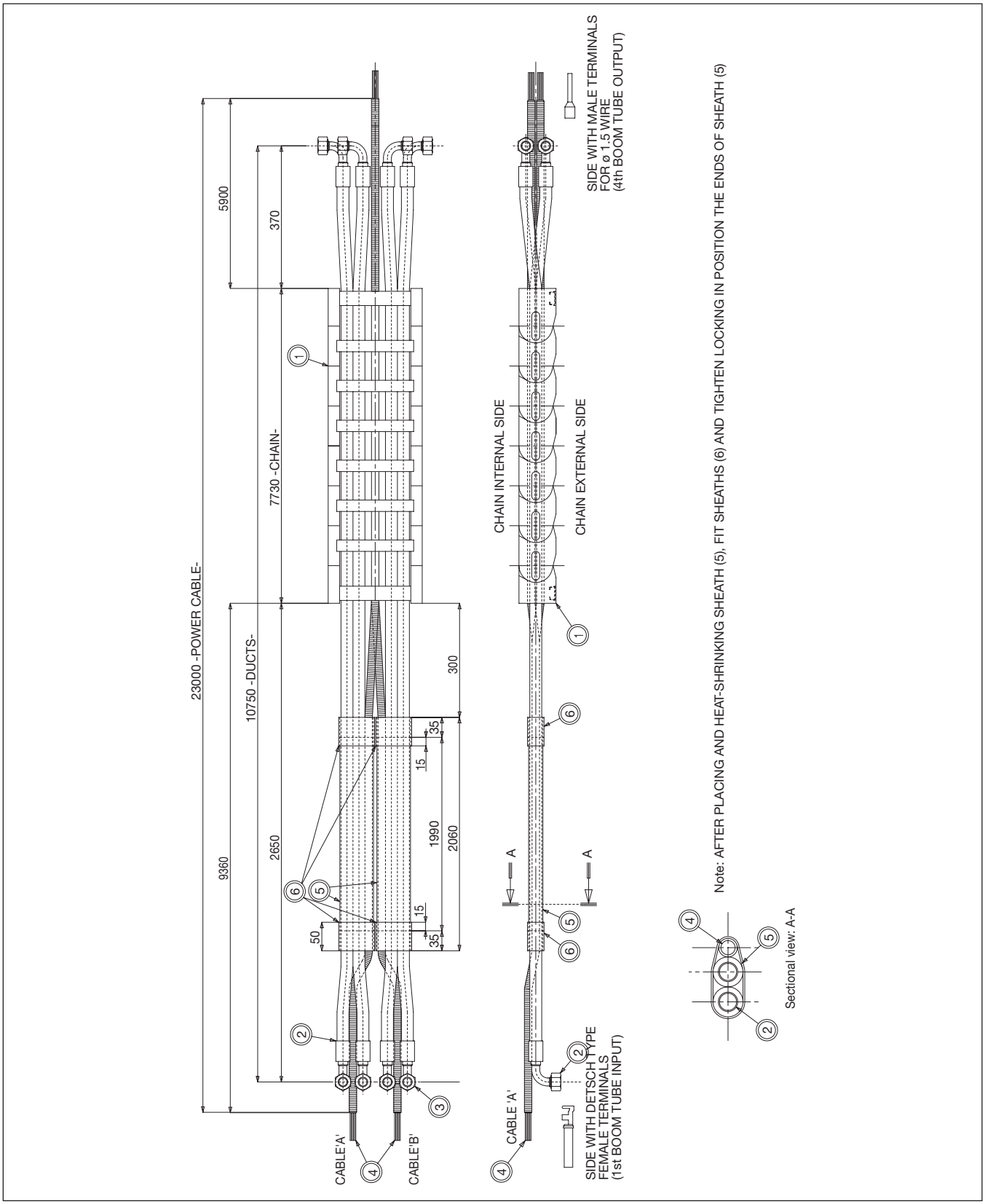
Before assembly smear the chain screws with some threadlocker.



2 Remove all carriers **B** of the chain using the special wrench (see paragraph A.06).

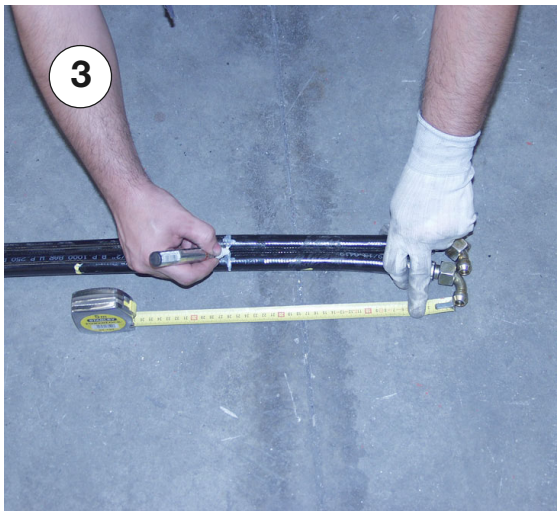


Procedure: **Assembling the boom chain**	Table: **T-059**



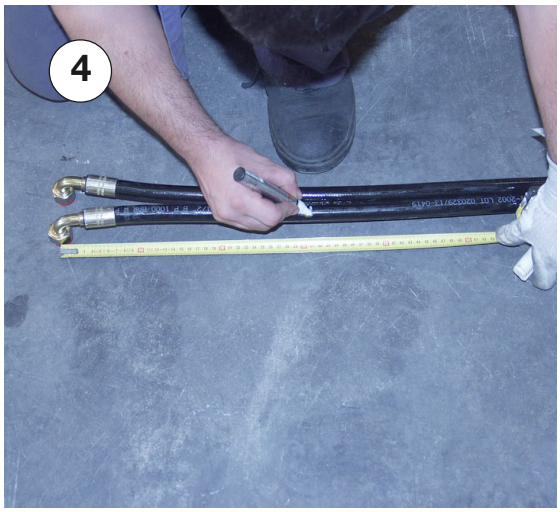
Procedure: **Assembling the boom chain**	*Table:* **T-059**

3 Using the scheme on the previous page, find the measure corresponding to the distance between the flexible hose connection (4th boom tube side) and the plate (**1**) and mark such measure on the hoses.

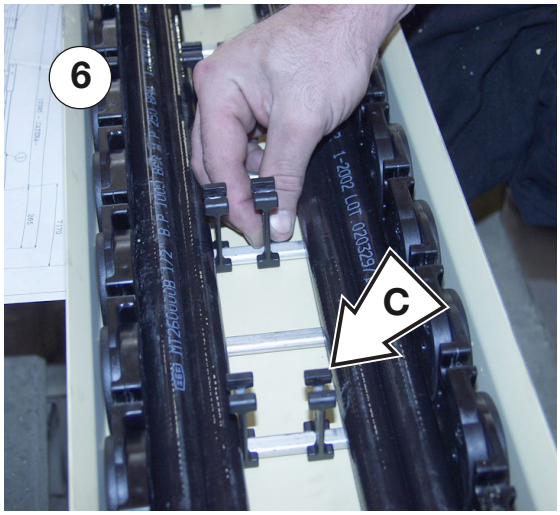


4 Find and mark the distance between connection and sheathing (**6**) on the opposite side of the flexible hoses (1st boom tube side).

5 Fit the assembled flexible hoses in the chain.

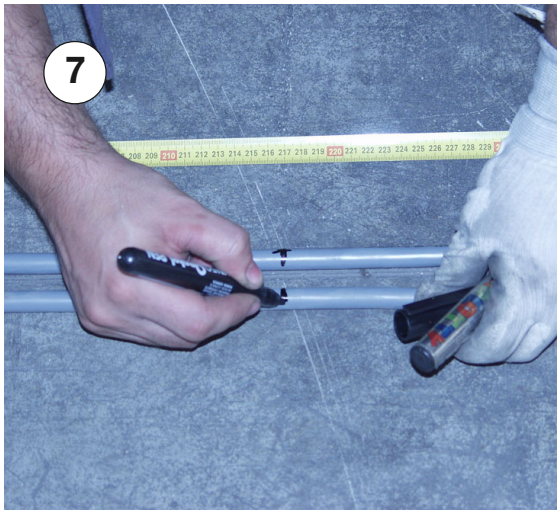


6 Space the internal spacers **C** and place the power cables of the chain right in the middle.



Procedure: **Assembling the boom chain**	Table: **T-059**

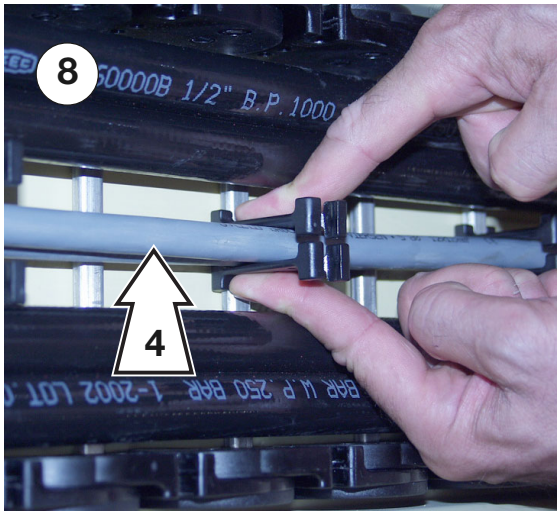
7 Mark the correct length on the power cables.



8 Fit the power cables (**4**) in the plastic chain one above the other; tighten spacers **C**.

IMPORTANT

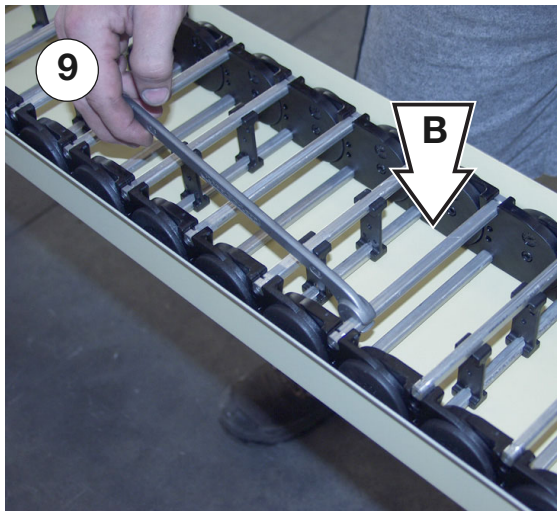
Place cable B above cable A and check that the male terminals to be connected to the ILME socket at the top of the boom and the female terminals to be connected to the power outlet under the cab are oriented correctly.



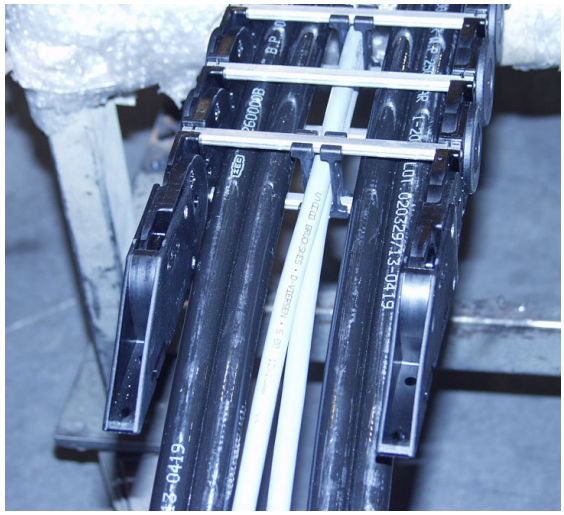
9 Refit all carriers **B** previously removed in the special housing using the wrench indicated in paragraph A.06, and turn 90°.

IMPORTANT

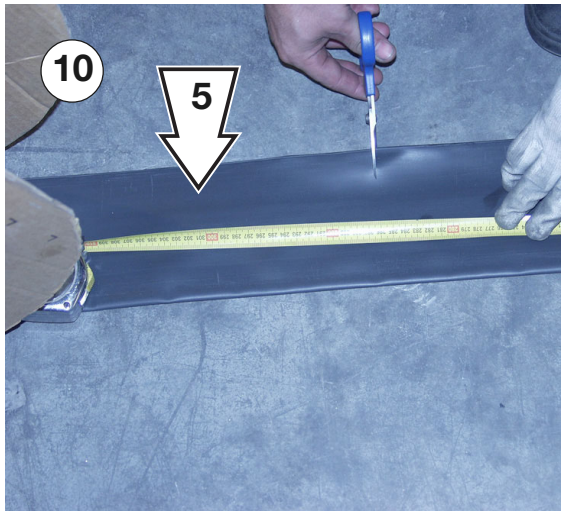
Fit the carriers with extreme caution as they play a fundamental role for the life of the chain.



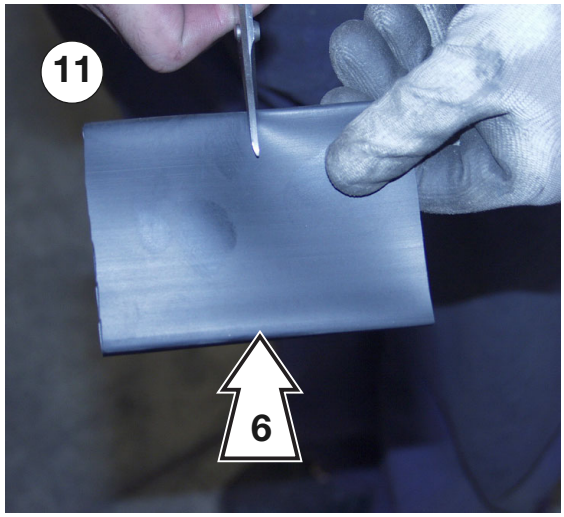
Procedure: **Assembling the boom chain**	Table: **T-059**



10 Cut to size two lengths of the large heat-shrinking sheathing (**5**, see drawing above).

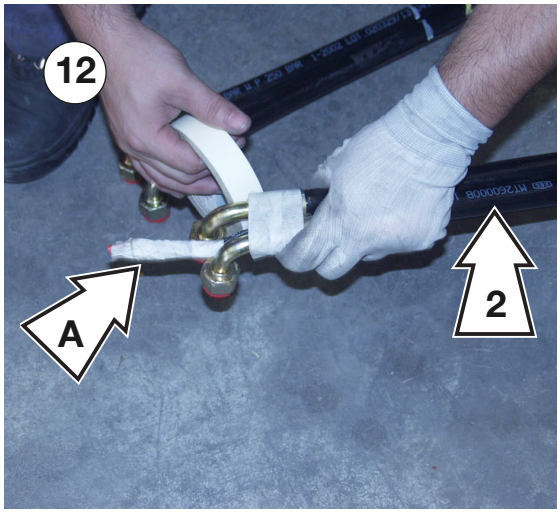


11 Cut to size four lengths of the small heat-shrinking sheathing (**6**, see drawing above).

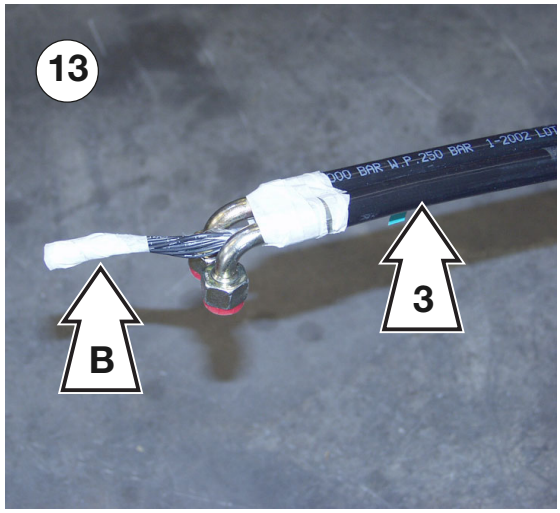


Procedure: **Assembling the boom chain**	Table: **T-059**

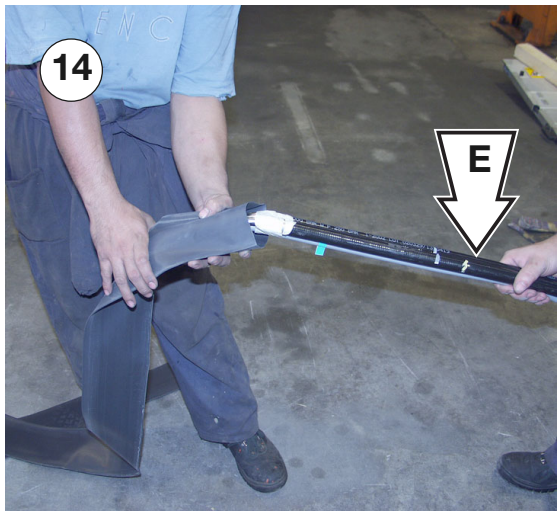
12 Join the top power cable (**A**) to the assembled flexible hose (**2**) with some adhesive tape.



13 Join the bottom power cable (**B**) to the assembled flexible hose (**3**).

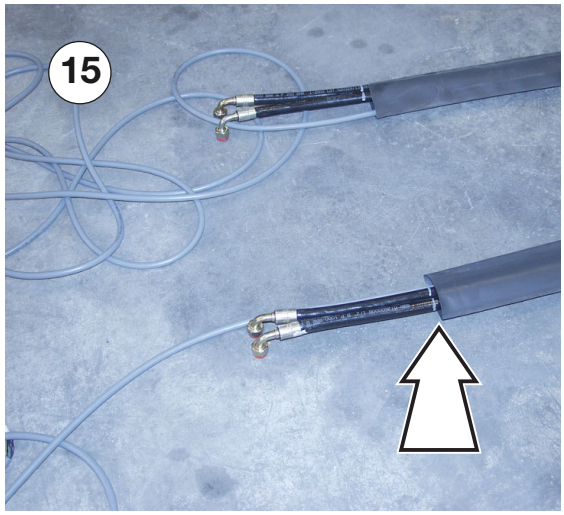


14 Fit the flexible hoses and power cables into the large sheathing previously prepared.



Procedure: **Assembling the boom chain**	Table: **T-059**

15 Extend the flexible hoses and make sure that the power cables are placed in the internal part. Line up the sheathing (**5**) with the marks previously traced on the flexible hoses.



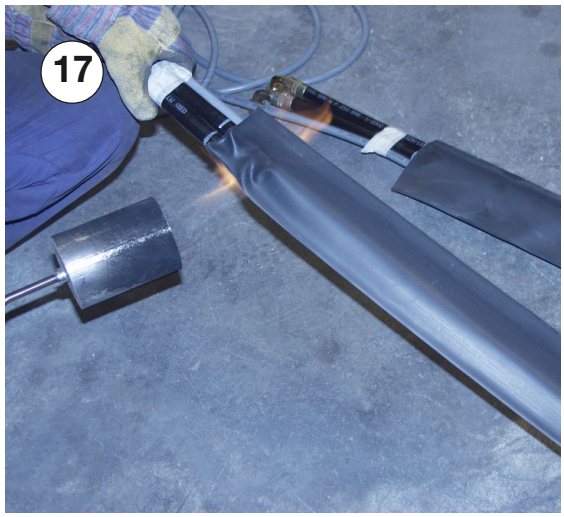
16 Prepare a bottle to machine the heat-shrinked sheathing.

DANGER

Before starting machining the sheathing, wear protective clothes and a facial screen to protect the eyes.
Proceed with extreme caution.

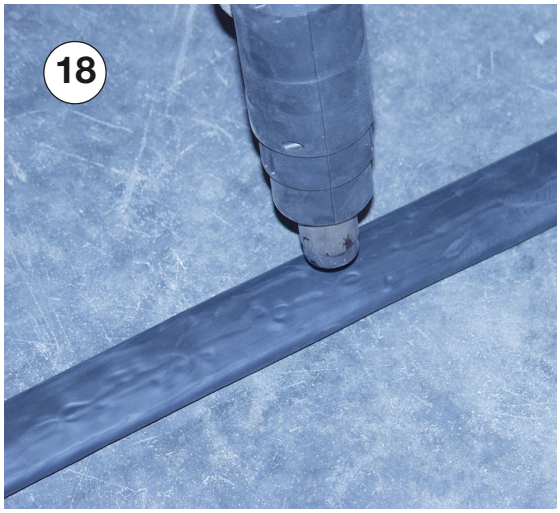


17 Start heating the sheathing paying attention not to burn it. Regularly check the correct position of the hoses.

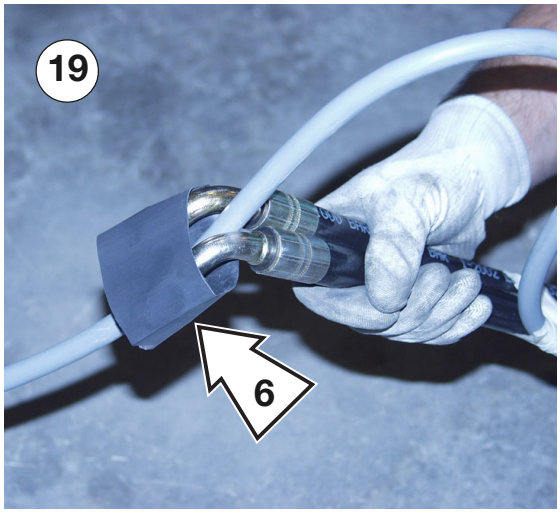


Procedure: **Assembling the boom chain**	*Table:* **T-059**

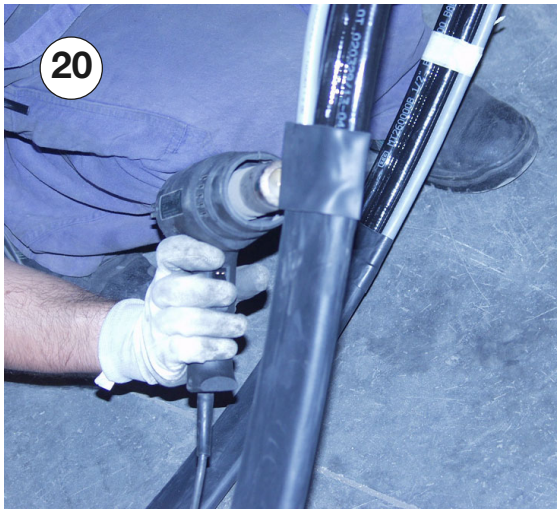
18 With an electrical heater, rectify all points of the sheathing with air bubbles or imperfections until obtaining a uniform surface.



19 Place the two lengths of the small sheathing (**6**) to the sides of the large sheathing (**5**).



20 Again with the electrical heater, join the sheaths.

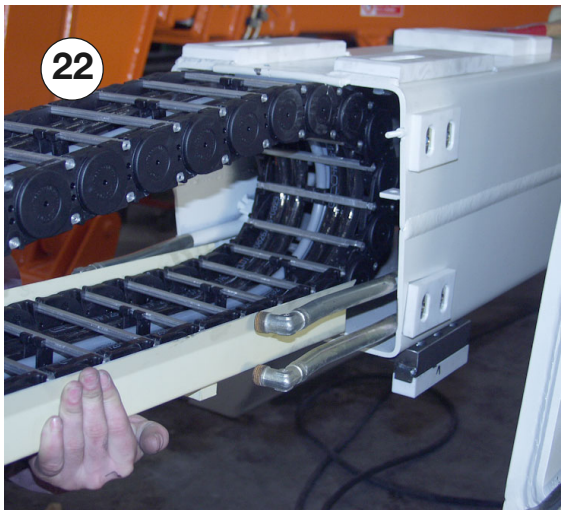


Procedure: **Assembling the boom chain**	Table: **T-059**

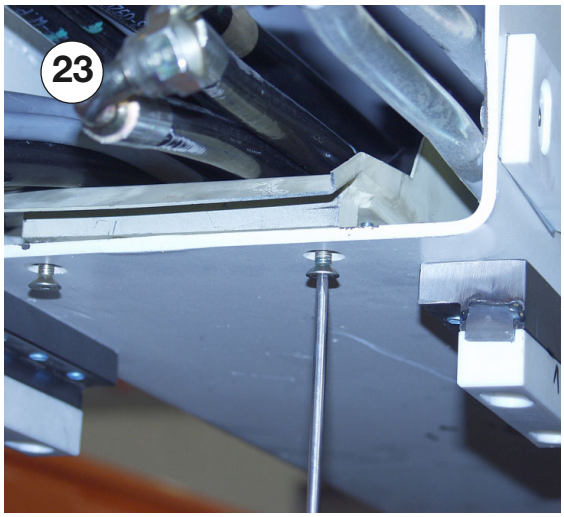
21 Bend the chain and prepare it for the assembly on the machine boom.



22 Position the chain cover and the chain into the 4th boom tube.



23 With a 5mm allen wrench, fix the chain cover to the rear side of the boom.

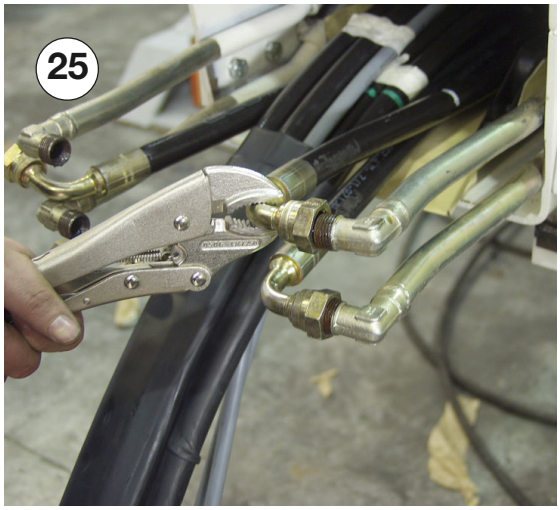


Procedure: **Assembling the boom chain**	*Table:* **T-059**

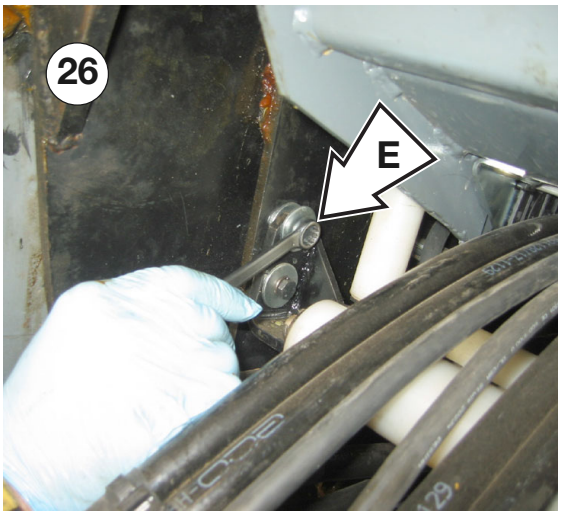
24 Using a 27mm box spanner, fix the chain bracket **D** to the top of the 2nd boom tube.



25 Move to the rear side of the machine and connect the flexible hoses to the tubes using a 27mm wrench.

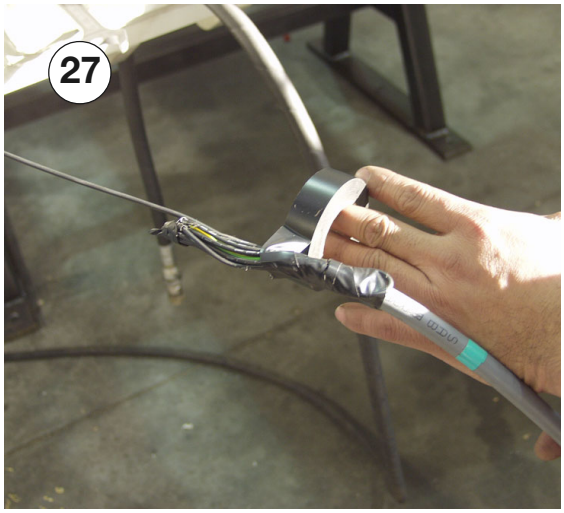


26 Place the slide rolls on the 3rd boom tube using two 13mm wrenches to tighten screws **E**.

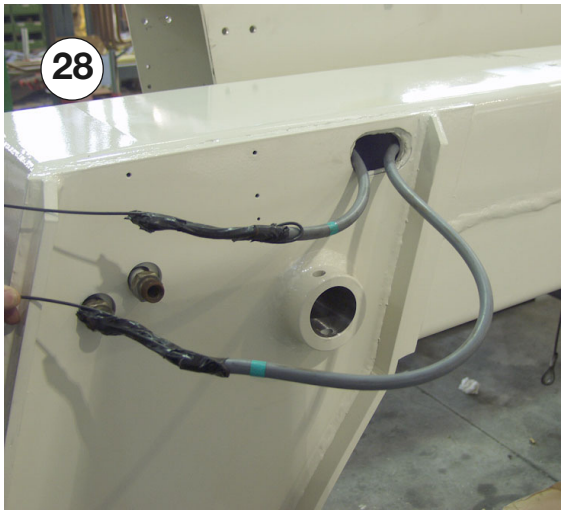


Procedure: **Assembling the boom chain**	Table: **T-059**

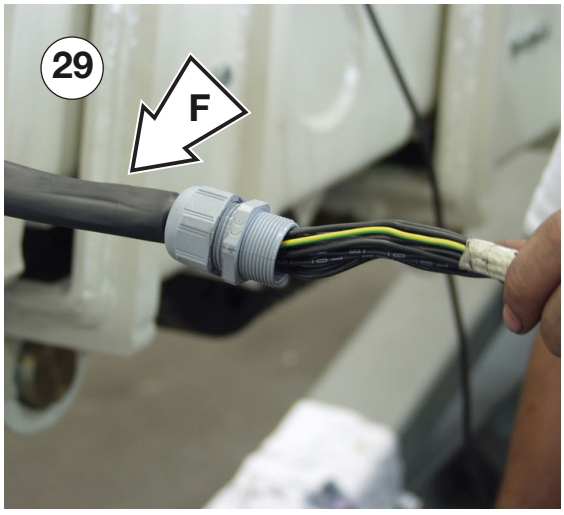
27 With some tape, join the new power cables with the ones present in the 4th boom tube (previously connected to the old power cables).



28 Pull the guide cables to extract the new power cables out of the hole on the boom nose.

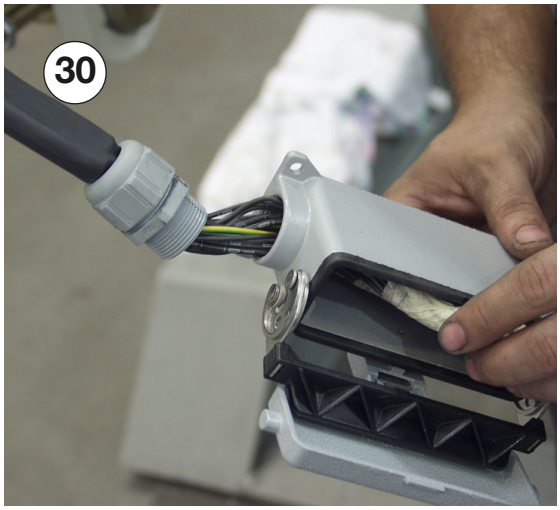


29 Cut the power cable sheathing, fit sheathing **F** and fix it with the electrical heater, then fit the mouths of the ILME socket.

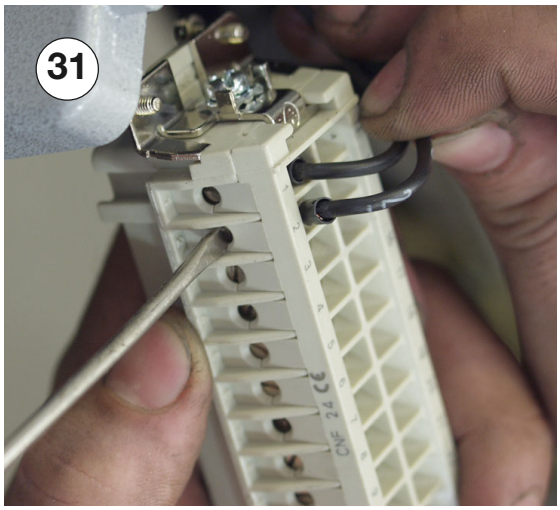


Procedure: **Assembling the boom chain**	Table: **T-059**

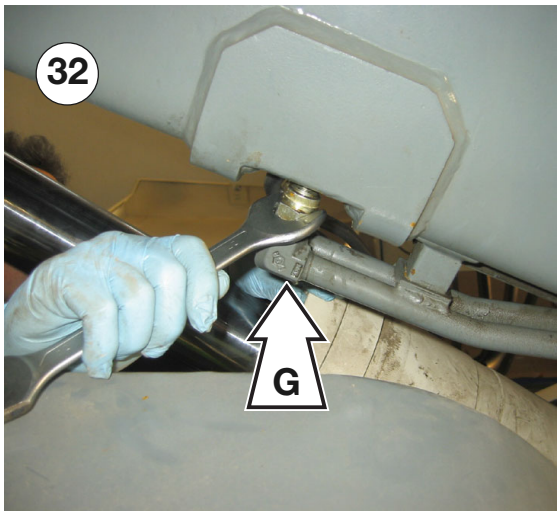
30 Fit the cables into the socket.



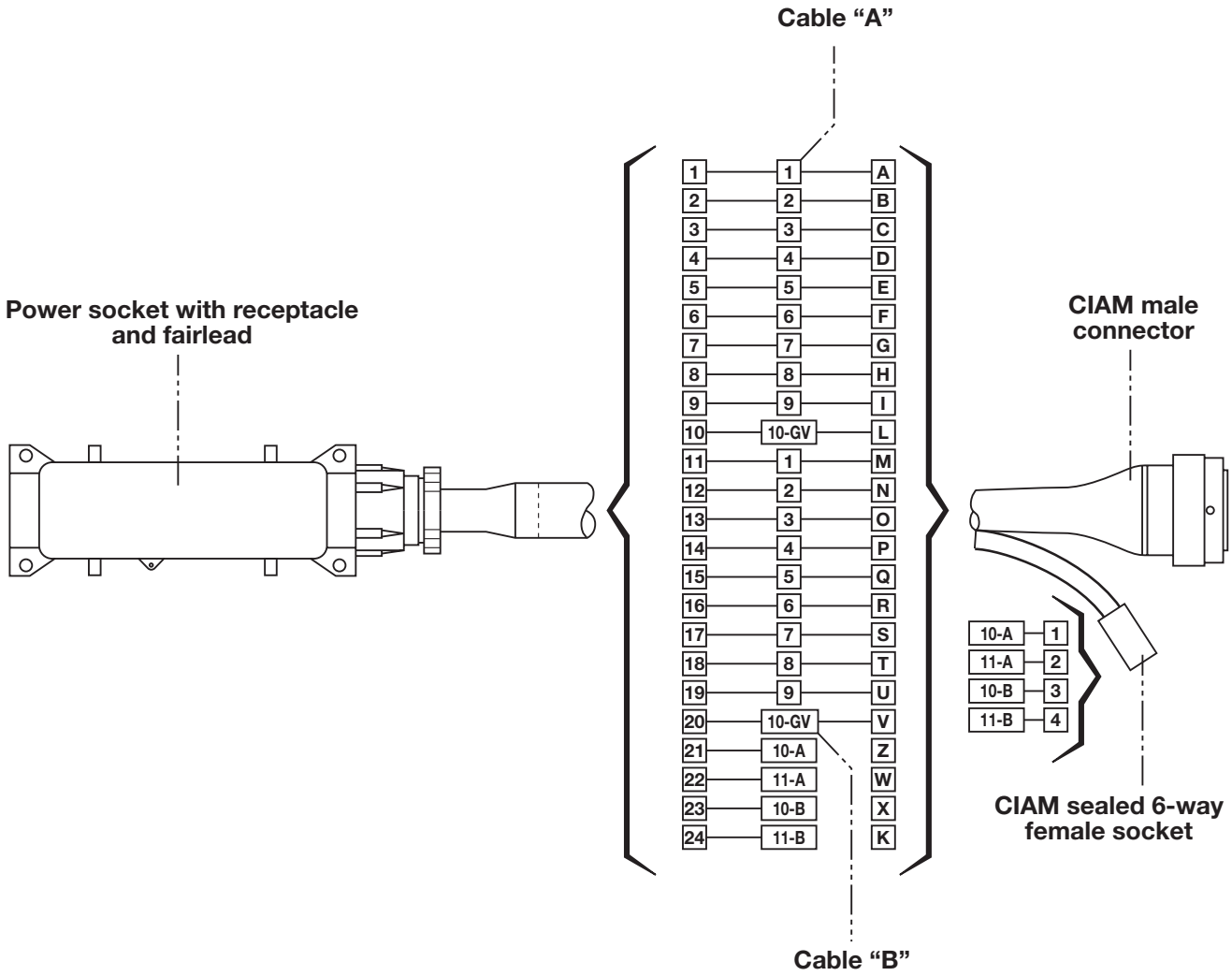
31 Consult the wiring diagram on next page to connect the cables to the socket receptacle, then re-assemble.



32 With a 27mm wrench, connect the tubes **G** with the flexible hoses inside the boom.



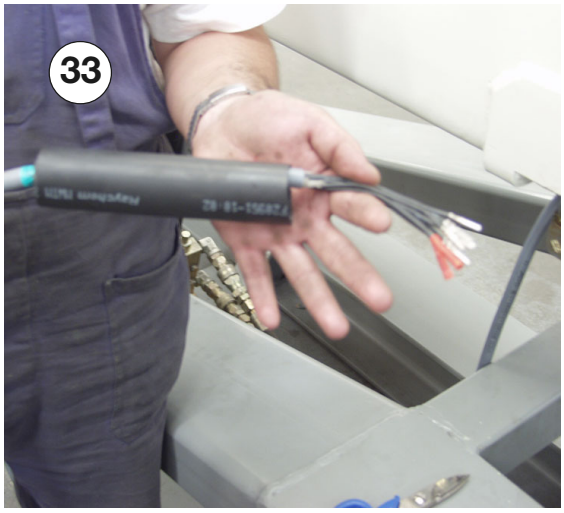
Procedure: Assembling the boom chain	Table: T-059



Note: Wire pos. 10 is yellow-green

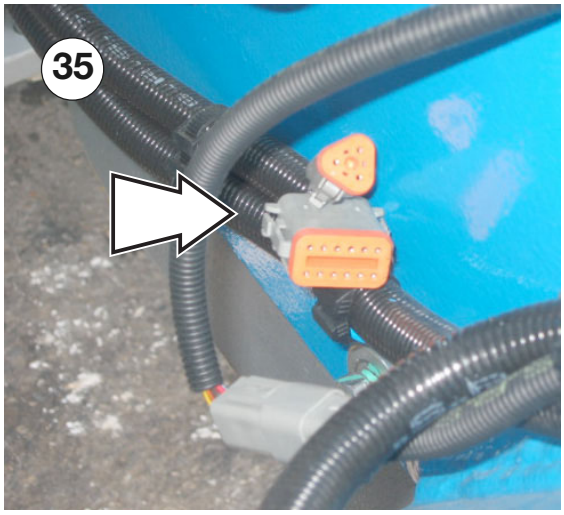
Procedure: **Assembling the boom chain**	*Table:* **T-059**

33 Fit and weld the sheathing to the opposite side of the power cables.



34 Move the power cables close to the connection in the internal side of the cab and place some plastic binders to the tubes passing under the boom.

35 Consult the wiring diagram on the previous page and fit the terminals to the connectors.



36 Fit the connector to the special power outlet and extend the boom.

37 With a 5mm hexagonal wrench, tighten the chain cover with screws **H**.



38 Attempt to extend the boom and check that the manoeuvre is correct.

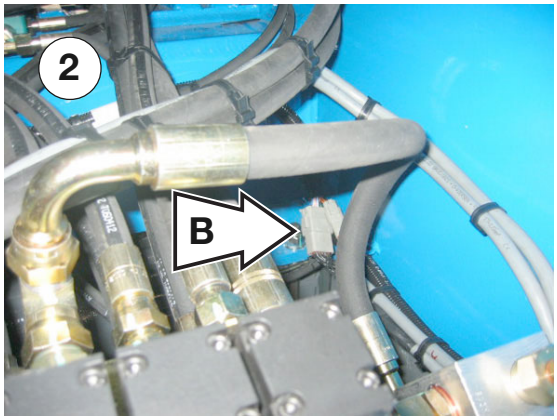
Procedure: **Dismantling the boom chain**	Table: **T-060**			kg: 126
	3713 Elite ☐	3517 ☑	4010 ☐	Hours: 8 — Min.: -
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks	Standard tools			2

Procedure to dismantle chain and cover:

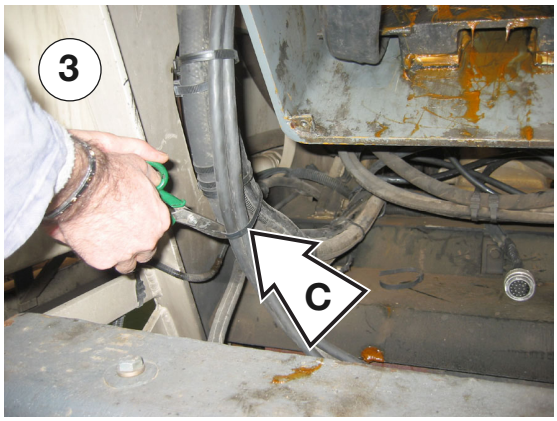
1 With a 5mm wrench, unscrew all fixing screws and remove cover **A**.



2 Unplug the power plugs **B** powering the boom line.

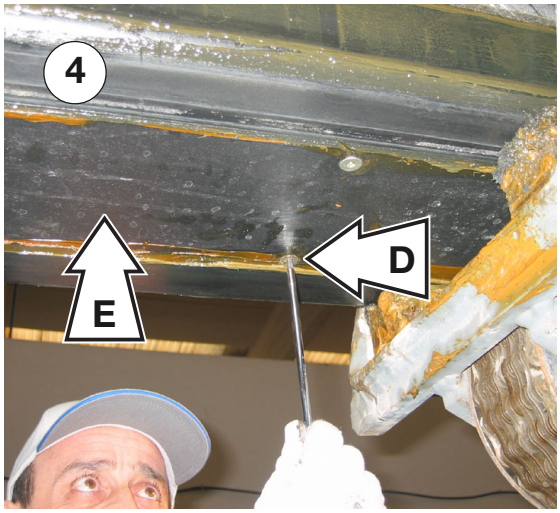


3 Cut all binders **C** fixing the power cable from the cab to the boom rear side

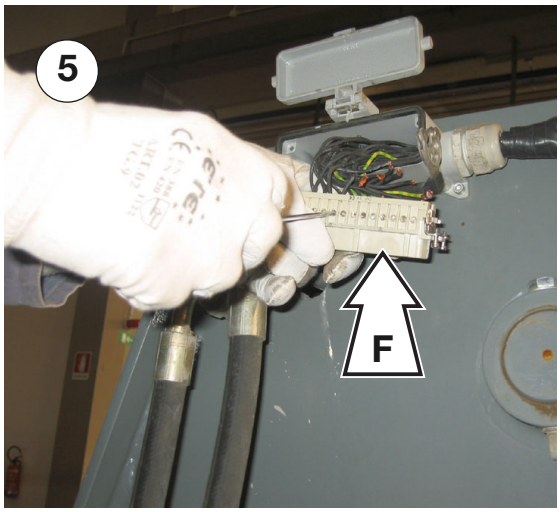


Procedure: **Dismantling the boom chain**	Table: **T-060**

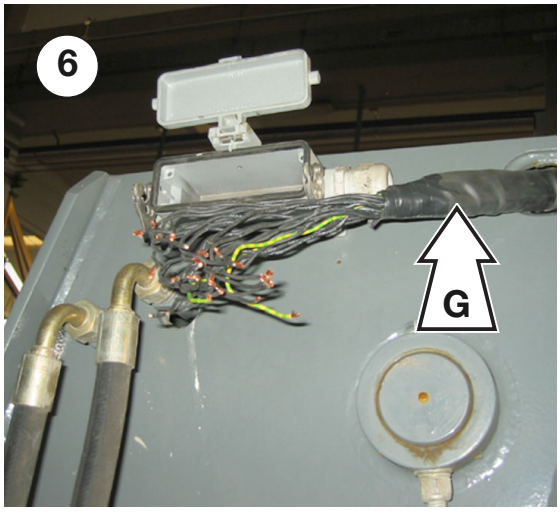
4 Lower and extend the boom (if necessary) and, with a 5mm hexagonal wrench, remove the screws **D** fixing the chain cover **E**; move in the boom telescopes.



5 Using a crosstip screwdriver remove the fixing screws and pull out the receptacle **F** of the ILME socket placed on the boom nose.
With a flat screwdriver, free all electrical wires, loosen the socket mouth and remove the wires.

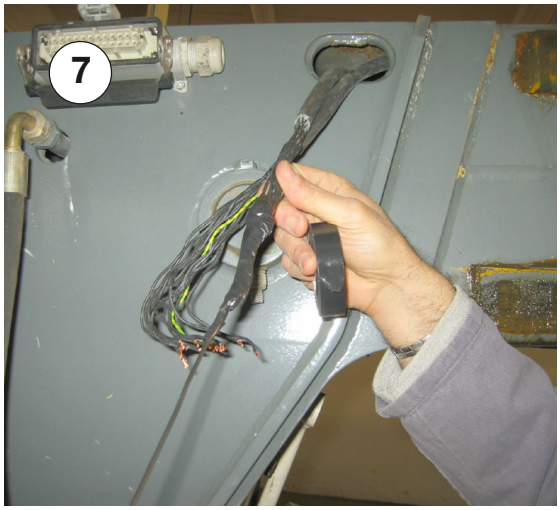


6 Cut the sheathing **G** which keeps the two power cables joined.



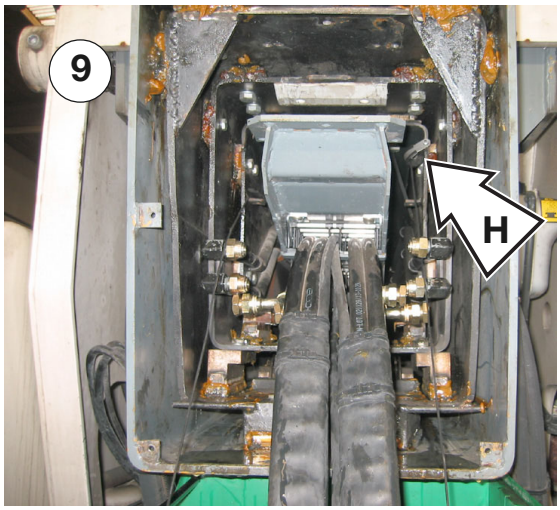
Procedure: **Dismantling the boom chain**	Table: **T-060**

7 With some tape, fix a 15m cable to the end of each power cable; this will let you replace the cables in the boom easily.



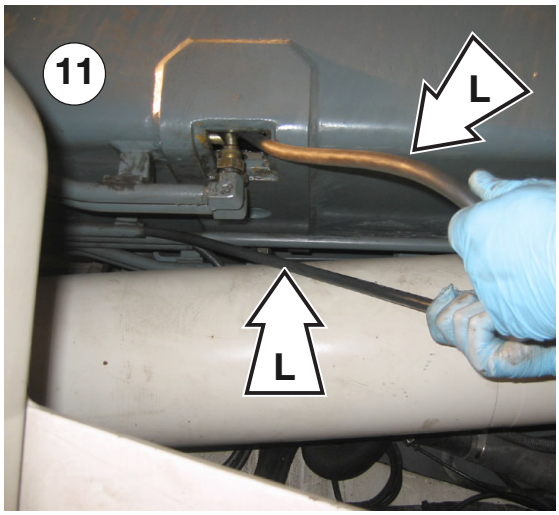
8 Move to the rear side of the machine and pull out the cable connecting the boom to the cab; extract all electrical terminals from the connector using the special tool (see paragraph A.06).

9 Remove the clamps **H** placed on the 4th telescope using a 10mm hexagonal wrench; extract the power cables (the ones previously removed from the ILME socket).



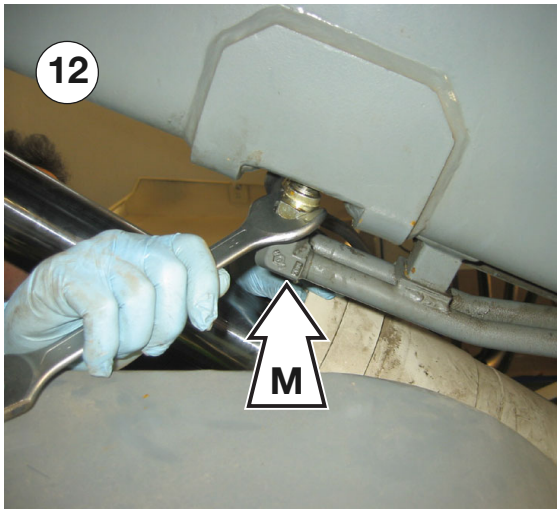
10 Raise again the boom to easily access to the couplings of the internal flexible hoses.

11 Pull out both power cables **L** of the rigid protection tubes.



Procedure: Dismantling the boom chain	Table: T-060

12 With a 27mm wrench loosen the couplings **M** of the hydraulic lines, place them in the boom and remove them from the rear side.



PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic lines, place containers of suitable size underneath to prevent oil spillage.

13 Plug the 4 couplings of the tubes to avoid oil spillage when the machine will be started.

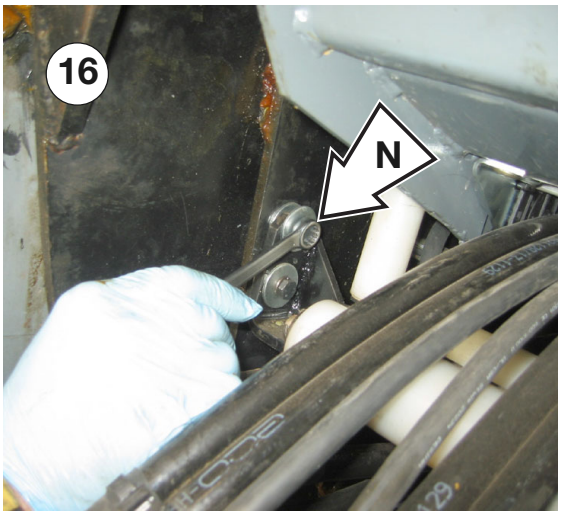
14 Start the engine and lower the boom to horizontal position.

15 Move to the rear side of the machine and, with a 27mm wrench, extract the lines previously disconnected after plugging them.



16 With a 13mm wrench remove the screws **N** and the rear slide roll fitted to the 3rd telescope.

17 Remove also the second slide roll using two 13mm wrenches.

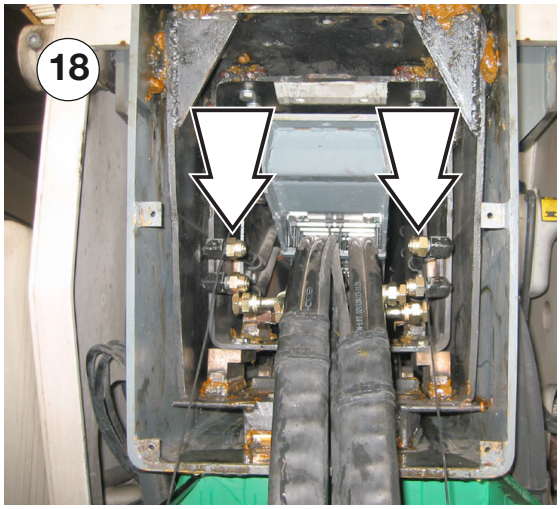


IMPORTANT

Note the position of the rolls before removing them so as to replace them correctly during reassembly.

Procedure: **Dismantling the boom chain**	Table: **T-060**

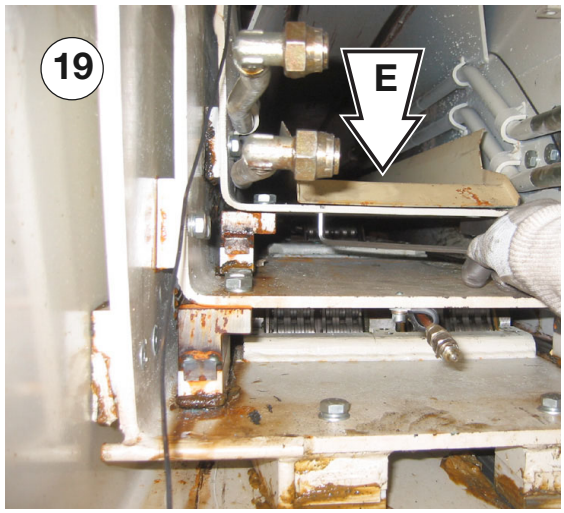
18 Disconnect the flexible hoses from the tubes. Plug to avoid that dust and impurities may enter the circuit.



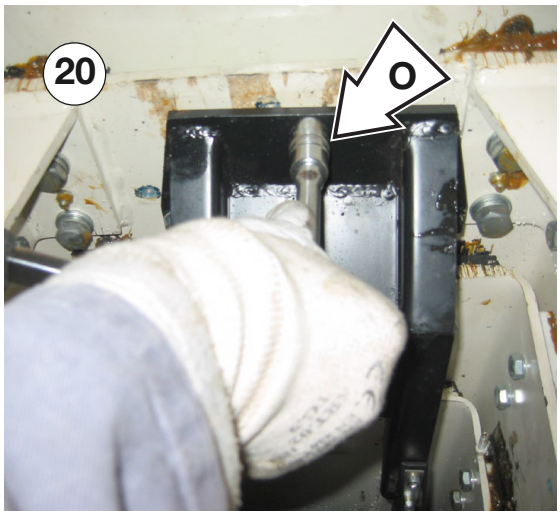
IMPORTANT

Before disconnecting the flexible hoses, mark their position for an easy reassembly.

19 With a 5mm Allen wrench remove the two rear screws fixing the chain cover **E**.



20 With a 17mm socket spanner remove the screws **O** fixing the chain supporting bracket.

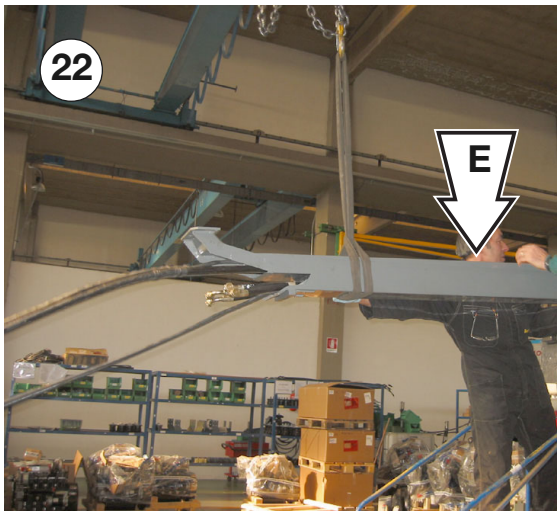


Procedure: **Dismantling the boom chain**	*Table:* **T-060**

21 Clamp the ends of the hydraulic lines and pull outwards to extract the chain cover complete with chain and hydraulic lines.



22 Sling the chain cover **E** with a textile bridle connected to the bridge crane, able to support it once pulled out completely of the boom.

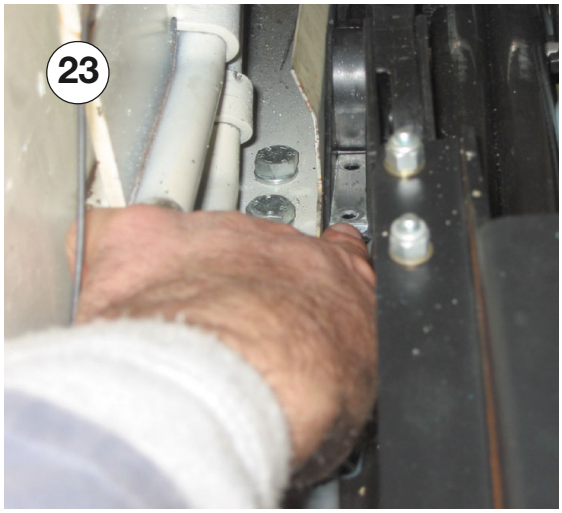


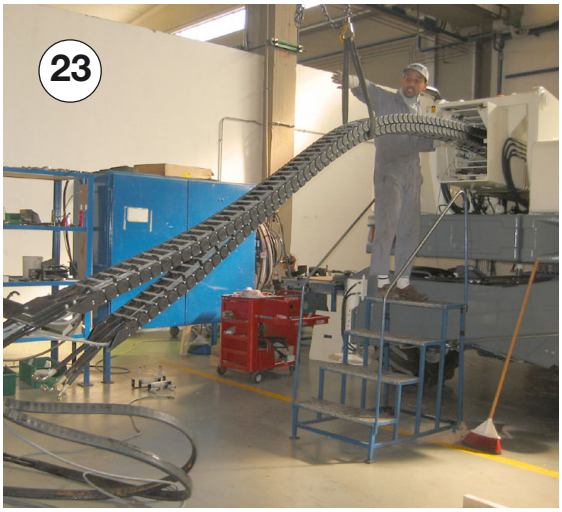
Procedure: **Dismantling the boom chain**	*Table:* **T-060**

Procedure for dismantling the chain:

23 If you shall remove only the chain without cover:

- proceed as explained in steps **1** to **21,** except for steps **4** and **20**.
- using a 5mm Allen wrench, remove the screws fixing the bottom terminal of the plastic chain to the chain cover
- pull out the chain of the boom and sling with some textile bridles connected to the bridge crane to avoid that the chain can bend and break.







Procedure:	Dismantling the boom chain	Table:
		T-060

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Section F
TROUBLESHOOTING

SECTION INDEX

Hydraulic faults ..... page 2
Electrical faults 8
Brake pump faults 16

DANGER

Any service, maintenance or troubleshooting must be carried out with the machine stopped, the boom in rest position lowered to the ground, and the transportation locking devices fitted.

For the troubleshooting, use a $3^{1}/_{2}$ - digit tester or the device indicated on page A7-A8 of this manual.

Use the wiring diagrams enclosed for finding solenoid valves (EV), fuses (F), relays (E) or other electrical components in an easier way - see ***chapter C - Technical data*** of this manual.

Trouble	Cause	Solution
The machine does not move	• Drive pump maladjusted • DA valve damaged • Hydraulic oil filter clogged	• Recalibrate - see manual enclosed • Check and replace if necessary • Check and replace if necessary
Overfeeding insufficient	• Overfeeding pump defective • Hydraulic motor damaged	• Change the pump • Change the motor
The machine drive is not enough	• Hydraulic oil filter clogged • Low hydraulic oil level • Hydraulic oil contaminated	• Renew the oil filter • Top up • Clean tank and pipes, empty the pumps and change the oil
No shifting between 1st and 2nd mechanical gear	• Low overfeeding pressure • Gearbox solenoid valve ref. **50** • Mechanical gear piston ref. **51** • Gearbox gearing damaged	• Check the overfeeding pressure • Check the mechanical movement of the solenoid valve pin ref. **50** • Check the efficiency of the piston ref. **51** • Check the gears and replace if necessary
No selection of the steering mode	• Solenoid valve ref. **17** damaged	• Check that the solenoid valve internal pin ref. **17** slides correctly
Low parking brake action	• Insufficient cable tensioning • Parking brake lever damaged	• Re-tension the cable and check the clamps • Check the efficiency of the lever

Trouble	Cause	Solution
No sway function	• Sway cylinders ref. **43** and **45** damaged • Block solenoid valves ref. **41** damaged • Valves ref. **44** and **42** defective • Divider ref. **27** damaged *(3013 up to serial no.8450)* • Actuator ref. **21** damaged	• Check the seals of cylinders ref. **43** and **45** • Check the sliding of the sliders of the solenoid valves ref. **41** • Check the efficiency and the sliding of the sliders of valves ref. **42** and **44** • Check the sliding of the slider of the EFD ref. **27** • Check the efficiency and replace if necessary
The outriggers do not work	• Outrigger cylinders ref. **47** - **49** damaged • Block valves ref. **46** - **48** of the outrigger cylinders damaged • Outriggers' solenoid valve block ref. **41** damaged • Divider ref. **27** damaged *(3013 up to serial no.8450)* • Actuator ref. **21** damaged	• Check the efficiency and the internal seals of the cylinders ref. **47** - **49** • Check the efficiency of the valves and the correct sliding of the internal pistons • Check the efficiency of solenoid valves of the block ref. **41** • Check the efficiency of the EFD ref. **27**. • Check the element of the Walvoil actuator
The machine does not steer	• Main pump ref. **4** damaged • The priority valve does not select the oil delivery • Power steering unit damaged • Steering cylinders ref. **15** - **16** damaged	• Check the efficiency of the gear pump ref. **4**. • If the priority valve ref. **13** does not select the delivery of the hydraulic oil to the power steering unit, replace the valve • Check the efficiency of the power steering unit ref. **14** and if the pilot control activates the valve ref. **13** • Check the efficiency and the seals of cylinders ref. **15** - **16**
The boom does not move ***(up to serial no. 8450)***	• Main pump ref. **4** damaged • Priority valve damaged	• Check the efficiency of the gear pump ref. **4** • If the priority valve ref. **13** is clogged or damaged, remove it from its housing, check the seals and refit or, if necessary, replace

Trouble	Cause	Solution
	• Actuator ref. **21** damaged	• Check that the actuator ref. **21** is in efficient working order *(up to serial no. 8450):* the pressure gauge connected to the mini-socket of the actuator shall read about 13 bar when the joystick is not operated. *From serial no. 8451* the pressure gauge shall read about …..
	• Pressure relief valve ref. **24** damaged *(3013 up to serial no. 8450)*	• Check that the valve pressure is 25 bar when an element of the actuator is moved. In case, re-calibrate.
	• Flow divider ref. **25** (deadman) damaged *(3013 up to serial no. 8450)*	• Check the efficiency; replace if necessary
	• Joystick ref. **23** damaged *(3013 up to serial no.8450)*	• Check the efficiency; in case repair or replace the damaged parts
Stepping down on the brake pedal, the machine does not brake	• Pump ref. **5** damaged	• Check the pump thoroughly
	• Brake pump damaged	• Check efficiency and calibration of the pump (see Section D)
	• Failure of the axle shaft brakes	• Check the discs (see Setion G)
The attachment locking cylinder does not function	• Seals of cylinder ref. **40** damaged	• Check and replace if necessary
	• Quick couplings damaged	• Check and replace if necessary
	• Hydraulic quick couplings-distributor line defective	• Check and replace the damaged or clogged lines if necessary
the fork pitching does not function perfectly	• Sealing failure of cylinder ref. **34**	• Replace the gaskets and check the sealing of the cylinder
	• Block valve ref. **33** damaged	• Check and clean the valve; if necessary, replace
	• Hydraulic block valve-distributor line defective	• Check and replace the damaged or clogged lines if necessary

Trouble	Cause	Solution
	• Safety valves maladjusted or damaged	• Check the efficiency of the safety valves mounted at outlets A and B of the actuator; re-calibrate or replace
No boom extension	• Internal boom extension cylinder ref. **38** damaged *(only Telelift 3013)*	• Check the seals of cylinder, rod and timing adjustment valve fitted to the top of the rod; re-calibrate or replace the cylinder, if necessary
	• External boom extension cylinder damaged	• Check the seals of cylinder, rod and timing adjustment valve fitted to the top of the rod; repair or replace the cylinder
	• Block valve of the internal boom extension cylinder damaged *(only Telelift 3013)*	• Remove and clean the valve and check the seals; in case, replace the valve
	• Block valve of the external boom extension cylinder damaged	• Remove and clean the valve and check the seals; in case, replace the valve
	• Boom hydraulic feed line defective	• Check and replace the damaged or clogged lines if necessary
	• Actuator maladjusted	• Check the efficiency
No boom lifting	• Seals of lifting cylinder damaged	• Replace the gaskets and check the cylinder sealing
	• Block valve damaged	• Remove and clean the valve and check the seals; in case, replace the valve
The boom jerks when moving down	• Accumulator damaged	• Check the accumulator thoroughly (1.5 litres); if necessary replace the internal diaphragm and recharge to the original pressure (35 bar) - see T-036
	• Block valve damaged	• Check and re-calibrate or replace the valve
	• Cylinder seals damaged	• Replace the gaskets and check the cylinder sealing
	• Seals of the timing adjustment valve damaged	• Remove and clean the valve and check the seals; in case, replace the valve

Trouble	Cause	Solution
	• Air in the circuit	• Bleed (see Operator's Handbook)
When the boom is moved up or down, forks do not level	• Compensation cylinder damaged	• Check the efficiency and internal seals of the cylinder
	• Actuator safety valves damaged	• Check the efficiency of the safety seals fitted to the outlets A and B of the actuator; re-calibrate or replace
	• One-way valves fitted to the valve plate of the compensation cylinder damaged	• Remove and clean the valve and check the seals; in case, replace the valves
	• Pressure relief valve ref. **24** damaged *(3013 up to serial no. 8450)*	• Remove and clean the valve and check the seals; in case, replace the valve The machines *from serial no. 8451* use the overfeed of the Rexroth pump (about 27/28 bar)
	• Block valves of compensation and fork movement cylinders damaged	• Remove and clean the valve and check the seals; in case, replace the valves
	• Hydraulic line defective	• Check the damaged or clogged lines; replace if necessary
The boom jerks when extended	• Sliding pads worn	• Check the pads for wear; replace if necessary
	• Boom is badly greased	• Smear the sliding area of the boom on the pad with some grease of the type recommended by TEREX
	• Paint or abrasion on the pad rail	• Grind out any signs of abrasion on the boom and polish the sliding area of the pad, then smear with grease.
	• Accumulator damaged	• Check the efficiency of the accumulator fitted to the distributor

Trouble	Cause	Solution
Boom hardly retracts when it is fully extended and horizontal	• Pads worn	• Thoroughly check the pads placed in the front and rear part of the boom; lubricate with special grease
The rear axle shaft locking cylinders do not move ***(only Telelift 3517)***	• Cylinders damaged • Block valves damaged • One-way valve damaged	• Check the seals of cylinder, rod and liner; re-calibrate or replace the cylinder, if necessary • Dismantle and check the efficiency, clean the sliders and replace any damaged parts • Check the efficiency of the valve and the bypass function; if necessary, repair
The radiator fan does not work	• Bushing between motor and radiator damaged • Radiator motor damaged • Pressure relief valve fitted to line of the parking brake maladjusted • Reduction between motor and radiator fan damaged	• Check the bushing; replace if necessary • Check the efficiency of the motor; replace if necessary • Re-calibrate (see D.02.01). • Check the efficiency and replace

Trouble	Cause	Solution
No power to dashboard with the key inserted	• Battery down	• Check the battery; replace if necessary
	• Battery cutout switch	• Check and restore the cutout switch
	• Earth	• Check the efficiency of the earth connection to the frame
	• Maxifuse 50A blown	• Replace the fuse
	• Ignition key block	• Check the key input ref. **30** and the output ref. **15**. If necessary, change the ignition key
	• Electrical line damaged	• Check the efficiency and continuity of the wires up to the fuses input
	• Dashboard fuses	• Check the supply and efficiency of all dashboard fuses
The machine cannot be started with the cab controls	• Ignition key	• Check that 12V are supplied from ref. **50** of the key when the machine is started
	• Mushroom-head emergency pushbutton	• Check the efficiency; repair or replace the contacts
	• Relays **R17 - R2** - **R3** and 70A relay damaged (box close to the engine)	• Check and rectify the trouble or replace
	• 70A relay dashboard line in box close to the engine	• Check and replace if necessary
	• Seat sensor defective	• Check the efficiency
	• 10A fuse **R17** defective (power supply of parking brake sensor and 30A relay **R2**)	• Check the efficiency; replace if necessary
	• Parking brake sensor	• Check the efficiency; replace if necessary
	• Relay **R2** damaged	• Check the efficiency; replace if necessary
	• Line connecting relay **R3** - 70A relay defective	• Check the efficiency; re-connect the line
	• 70A relay damaged	• Check the efficiency; replace if necessary
	• Starting motor relay damaged	• Check the efficiency; replace if necessary
	• Starting motor damaged	• Check the efficiency
	• Earth efficiency	• Check and, if necessary, re-connect the earth to the frame

Trouble	Cause	Solution
The machine cannot be started with the platform controls	• Ignition key • Fuses **F17** - **F19** - **F27** damaged • 24-pin socket at the top of the boom defective • Outriggers' limit switches damaged • Relays **R11** - **R13** - **R16** - **R20** damaged • Road/jobsite/platform key • Boom line and continuity of wires 1/7/9 • Platform reel damaged *(only Telelift 3013)* • Platform sensors damaged • Control pushbuttons on platform damaged	• Check the key; replace if necessary • Check the efficiency of the fuses; replace if necessary • Check that 12V are supplied to terminal **1** powering the platform locking sensors • Check the efficiency; replace if necessary • Check the efficiency; replace if necessary • Check the contacts; replace if necessary • Check the continuity of the boom wires; replace any defective parts • Check and replace any damaged parts • Check the efficiency of the sensors • Check the enabling key, the emergency mushroom-head pushbutton and the ignition switch; in case, replace Check that 12V are supplied to terminal 8 to power the 70A relay coil for the engine ignition. **Note:** to start the engine from the platform, turn the ignition key in the cab to ON, the road/jobsite/platform key to platform and put the parking brake
The engine runs but does not start	• No fuel • Fuse **F4A** blown • Line from pos. **5** socket **X8** to pos. **1** socket **X137** • Temperature bulb **S22** and solenoid valve **Y29** damaged	• Refuel • Change the fuse • Check the continuity • Check and, if necessary, replace

Trouble	Cause	Solution
The battery charge gets down easily	• Break of internal parts • The alternator does not recharge • Incorrect absorption	• Change the battery • Check and replace the alternator • Check and rectify the trouble
The machine does not move	• Speed switch damaged • Fuses **F17 - F24** blown • Relays **R2 - R3 - R4 - R5** damaged • Operator's presence sensor damaged • Parking brake sensor damaged • Troubles to the SCT box (mechanical gear signal) *(only Telelift 3013-3517)* • Rexroth pump solenoid valves damaged • Cables interrupted • Outriggers' sensors damaged *(only Telelift 3013-3517)* • First/second mechanical gear sensors damaged *(only Telelift 3013-3517)*	• Check and replace the speed switch if necessary • Replace the fuses • Replace the relays • Check the efficiency of the sensor; repair if necessary • Check the efficiency of the sensor; repair if necessary • Check there is a 12V voltage at the output from pos. 1 of the socket powering relays **R4** and **R5**. • Check and replace the solenoid valves if necessary • Check the continuity of all cables; re-connect if necessary • Check the efficiency of the sensors; repair if necessary • Check the efficiency of the sensors; repair if necessary
No shifting between 1st and 2nd mechanical gear ***(only Telelift 3013-3517)***	• Fuses **F17 - F18** blown • Mechanical gearbox pushbutton defective • Cardan shaft sensor • First/second mechanical gear sensors damaged • SCT box damaged • Change solenoids damaged • Cables interrupted	• Replace the fuses • Change the pushbutton • Check the efficiency of the sensor; repair if necessary • Check the efficiency of the sensors; repair if necessary • Check and replace if necessary • Check and replace if necessary • Check the continuity of all cables; re-connect if necessary

Trouble	Cause	Solution
The boom does not move (IDENTIFICATION A)	• Fuse **F27** (Walvoil control unit power supply) blown • Walvoil control unit, joystick, outriggers' movement and levelling pushbuttons defective • Road/jobsite/platform selector damaged • Cables interrupted	• Change the fuse • Using the diagnostic program supplied by Terexlift, check and find the defective element and replace • Check and replace the selector, if necessary • Check the continuity of all cables; re-connect if necessary
The boom cannot be raised or lowered	• See **IDENTIFICATION A** • Relays **R9 - R21** damaged • Fuse **F26** blown • Walvoil actuator solenoids **A1**-**B1** damaged • Cables interrupted	• See **IDENTIFICATION A** • Change the relays • Change the fuse • Check the efficiency and replace if necessary • Check the continuity of all cables; re-connect if necessary
The boom cannot be moved out or in	• See **IDENTIFICATION A** • Relays **R9 - R22** damaged • Fuse **F26** blown • Walvoil actuator solenoids **A3**-**B3** damaged • Cables interrupted	• See **IDENTIFICATION A** • Change the relays • Change the fuse • Check the efficiency and replace if necessary • Check the continuity of all cables; re-connect if necessary
The boom does not move the the forks	• See **IDENTIFICATION A** • Relay **R9** damaged • Fuse **F26** blown • Walvoil actuator solenoids **A2**-**B2** damaged • Cables interrupted	• See **IDENTIFICATION A** • Change the relay • Change the fuse • Check the efficiency and replace if necessary • Check the continuity of all cables; re-connect if necessary
The outriggers do not work ***(only Telelift 3013-3517)***	• See **IDENTIFICATION A** • Relay **R9** damaged • Fuse **F26** blown • Walvoil actuator solenoids **A5**-**B5** damaged • Cables interrupted	• See **IDENTIFICATION A** • Change the relay • Change the fuse • Check the efficiency and replace if necessary • Check the continuity of all cables; re-connect if necessary

Trouble	Cause	Solution
	• Outriggers' control and levelling pushbutton damaged • Movement control solenoid valves on sol. valve block defective • Low boom sensor damaged	• Check and replace the pushbuttons if necessary • Check and replace the solenoid valves if necessary • Check the efficiency of sensor; repair if necessary
The attachment locking/ unlocking cylinder does not work	• See **IDENTIFICATION A** • Relay **R9** damaged • Fuse **F26** blown • Walvoil actuator solenoids **A4**-**B4** damaged • Cables interrupted	• See **IDENTIFICATION A** • Change the relay • Change the fuse • Check the efficiency and replace if necessary • Check the continuity of all cables; re-connect if necessary
Rear axle locked ***(only Telelift 3517)***	• High sensor damaged • Fuses **F25** - **F17** blown • Relay **R18** damaged • Solenoids of the rear axle locking cylinder solenoid valves damaged • Cables interrupted	• Check the efficiency of sensor; repair if necessary • Change the fuse • Change the relay • Check the efficiency and, if necessary, replace • Check the continuity of all cables; re-connect if necessary
The 3B6 system does not change scale when the machine outriggers are lowered ***(only Telelift 3013-3517)***	• Outriggers' sensors damaged • Fuses **F17** - **F19** blown • Relays **R13** - **R16** - **R20** damaged • 3B6 control unit display cable	• Check the efficiency of sensors; repair if necessary • Change the fuses • Change the relays • Check the continuity of all cables; re-connect if necessary
No selection of the steering mode (only two-wheel steer, crab-steer or four-wheel steer)	• Fuses **F25** - **F27** blown • Relay **R8** damaged • Road/jobsite/platform selector defective • Steering selector damaged • Electrical swivel joint defective • Solenoids of the steering selection control solenoid valves damaged	• Change the fuses. • Change the relay • Check the efficiency of the selector; replace if necessary • Check the efficiency of the selector; replace if necessary • Check the efficiency; replace if necessary • Check the efficiency; replace if necessary

Trouble	Cause	Solution
The horn does not work	• Horn pushbutton on switch damaged • Cables interrupted	• Check the efficiency; replace if necessary • Check the continuity of all cables; re-connect if necessary
The beacon does not work	• Fuse **F28** blown • Beacon damaged • Cables interrupted	• Change the fuse • Check the efficiency and replace • Check the continuity of all cables; re-connect if necessary
The emergency pump does not work	• Pushbutton damaged (mushroom- head emergency button) • 50A maxifuse blown • Fuse **F21** blown • Emergency pump button damaged • Relay in box close to Perkins engine damaged • Coil of the emergency pump solenoid valve damaged • Emergency pump defective • Battery down	• Check the efficiency and replace • Change the fuse • Change the fuse • Check the efficiency and replace • Change the relay • Check the efficiency and replace if necessary • Replace the pump • Check and recharge or replace
The heating fan does not work	• Fuse **F23** blown • Fan switch defective • Heating motor	• Change the fuse • Check the efficiency and replace • Check the efficiency and replace
Low boom sensor defective	• Fuse **F17** blown • Low boom sensor damaged	• Change the fuse • Check the efficiency and replace if necessary

Trouble	Cause	Solution
High boom sensor defective (only 3517)	• Fuse **F17** blown • High boom sensor damaged	• Change the fuse • Check the efficiency and replace if necessary
Air filter clogging warning light defective	• Fuse **F18** blown • Dashboard warning light damaged • Pressure switch warning of an air filter clogging damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
High engine water temperature warning light defective	• Fuse **F18** blown • Dashboard warning light damaged • Water temperature bulb damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
Low engine oil pressure warning light defective	• Fuse **F18** blown • Dashboard warning light damaged • Low engine oil pressure switch damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
Engine water temperature thermometer defective	• Fuse **F18** blown • Dashboard thermometer damaged • Engine water temperature transducer damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
Hydraulic oil temperature thermometer defective	• Fuse **F18** blown • Dashboard thermometer damaged • Hydraulic oil temperature transducer damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
Hydraulic oil filter clogging warning light defective	• Fuse **F18** blown • Dashboard warning light damaged • Hydraulic oil filter clogging pressure switch **S34** damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
Low brake pressure warning light defective	• Fuse **F18** blown • Dashboard warning light damaged • Pressure switch **S35** warning of low brake pressure damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary

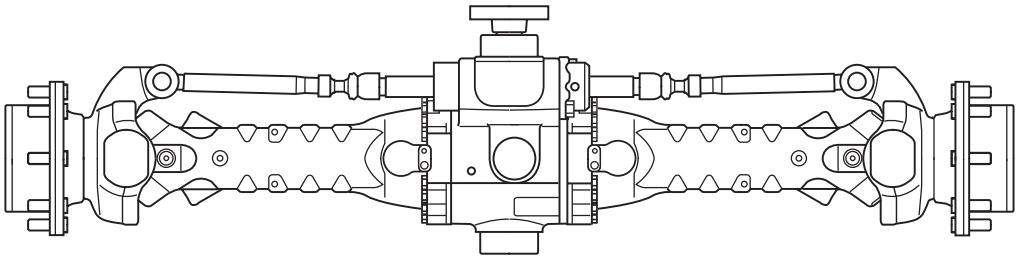
Trouble	Cause	Solution
Fuel gauge defective	• Fuse **F18** blown • Dashboard fuel gauge damaged • Fuel gauge transducer damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
Hourmeter defective	• Fuse **F18** blown • Hourmeter damaged • Alternator damaged	• Change the fuse • Check the efficiency and replace if necessary • Check the efficiency and replace if necessary
3B6 overload warning system defective	• Fuses **F2 - F17** blown • Relays **R9 - R10** damaged • Cables interrupted	• Change the fuse • Change the relays • Check the continuity of all cables; re-connect if necessary

Trouble	Cause	Solution
Abrupt braking	• Wrong pressure calibration	• Reduce the pressure turning the adjusting screw under the pedal while checking the pressure on the gauge
Low braking action	• Wrong pressure calibration	• Reduce the pressure turning the adjusting screw under the pedal while checking the pressure on the gauge. Don't exceed the admissible brake pressures
Delayed brake application and release	• Low brake feed velocity and discharge • High viscosity of the hydraulic fluid	• Check that the diameter of the brake system tubes is not too small in relation to the length and the oil flow • Drain off the circuit and add fluid with an adequate viscosity
Inconstant brake pressure	• Minimum pressure of the accumulators less than the braking pressure	• Check that the accumulators' pressure calibration is correct. If necessary, turn the adjusting screw on the cylindrical end of the accumulator charge valve
Continuous recharge of the accumulators	• Accumulator's nitrogen precharge too low or too high • Big capacity of the brakes in relation to the accumulators' volume	• Drain off the oil from the accumulators and check the pressure of the nitrogen with the special instrument, then recharge at the correct pressure • Re-dimension the accumulators and/or check the adjustment of the brakes
Boost pump always at pressure	• Pump defective • Valve dirty	• Check and replace the pump if necessary • Check the valve thoroughly: correct sliding of the parts, integrity of the seal housing and couplings

Trouble	Cause	Solution
Accumulator don't get recharged	• Foreign matter blocking the sliding of the priority valve	• Check the sliding of all parts, especially those at the valve inlet • Check the hydraulic connection • After repairing the accumulator charge valve, check the position of the piston stop ring placed in front of the feeding coupling
Brakes cannot be released	• Incorrect discharge of the S6 system • Pedal does not spring back	• The system does not discharge freely and some pressure interferes with the brakes • Check that the pedal stop screw leaves a small play between transmission and operating pistons • In the horizontal system, eliminate any clogging inside the chamber under the pedal opening the front plug
The dashboard warning light does not come on or does not go off	• Check the adjustment of the pressure switch	• Set the pressure switch placed on the charge valve to a lower value than the minimum pressure of the accumulators, however sufficiently high to guarantee 3/4 braking actions when the light comes on
The brake pedal pulsates	• Abrupt pressure variations in the discharge	• High brake discharge flow; increase the discharge tube diameter or add an independent discharge on the pedal

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Section G
DANA AXLE
ASSEMBLY - DISASSEMBLY



SECTION INDEX

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INTRODUCTION

The efficiency and continued operation of mechanical units depend on constant, correct maintenance and also on efficient repair work, should there be a break-down or malfunction.
The instructions contained in thismanual have been based on a complete overhaul of the unit. However, it is up to the mechanic to decide whether or not it is necessary to assemble only individual components, when partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to be performed.
All the information needed for correct disassembly, checks and assembly of each individual component is set out below.
All the information needed for correct disassembly, checks and assembly of each individual component is set in the Chapter **E - Disassembly and Reassembly**.
In describing the following operations it is presumed that the unit has already been removed from the vehicle.

IMPORTANT

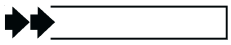
In order to facilitate work and protect both working surfaces and operators, it is advisable to use proper equipment such as: trestles or supporting benches, plastic or copper hammers, appropriate levers, extractors and specific spanners or wrenches.
Before going on to disassemble the parts and drain the oil, it is best to thoroughly clean the unit, removing any encrusted or accumulated grease.

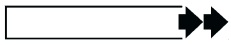
Introductory remarks

All the disassembled mechanical units should be thoroughly cleaned with appropriate products and restored or replaced if damage, wear, cracking or seizing have occurred.
In particular, thoroughly check the condition of all moving parts (bearings, gears, crown wheel and pinion, shafts) and sealing parts (O-rings, oil shields) which are subject to major stress and wear. In any case, it is advisable to replace the seals every time a component is overhauled or repaired. During assembly, the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly, the prescribed pre-loading, backlash and torque of parts must be maintained.

Classification

This manual classifies units according to part numbers. For a correct interpretation, classification is indicated as follows:


= up to the part number


= from the part number on

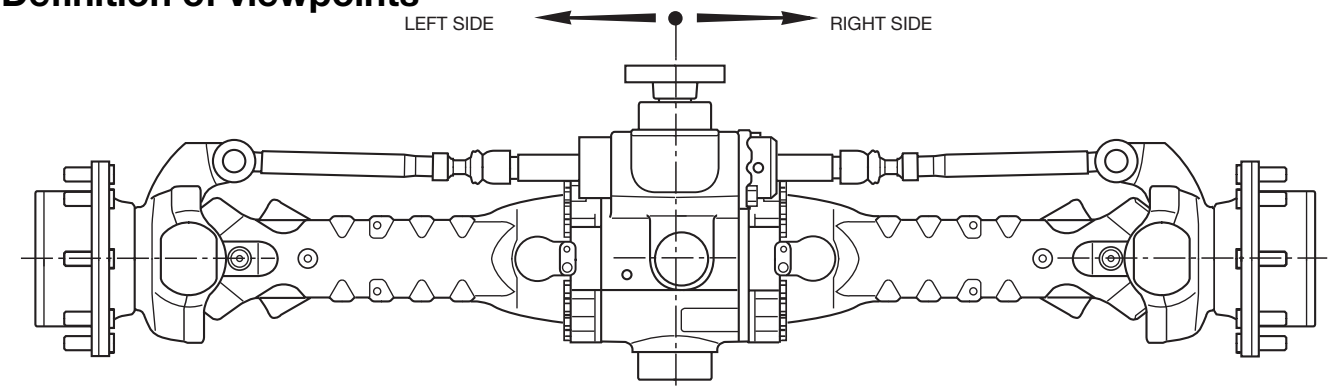
When no classification is given, disassembly and assembly operations are the same for all versions.

Specific equipment and spare parts

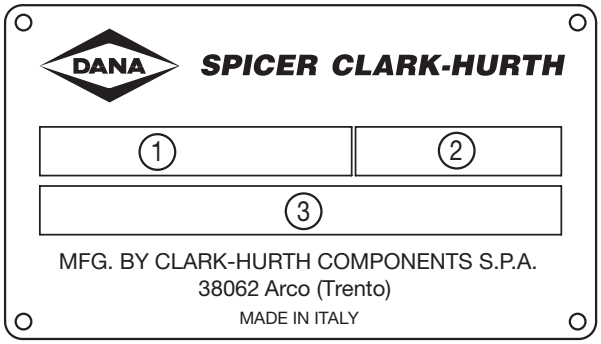
The drawings of all specific tools required for maintenance and repair work can be found at the end of this manual ; spare parts may be ordered either from the vehicle manufacturer or directly from the Service Centers or Authorised Distributors of SPICER CLARK-HURTH.

MAINTENANCE AND LUBRICANT

Definition of viewpoints

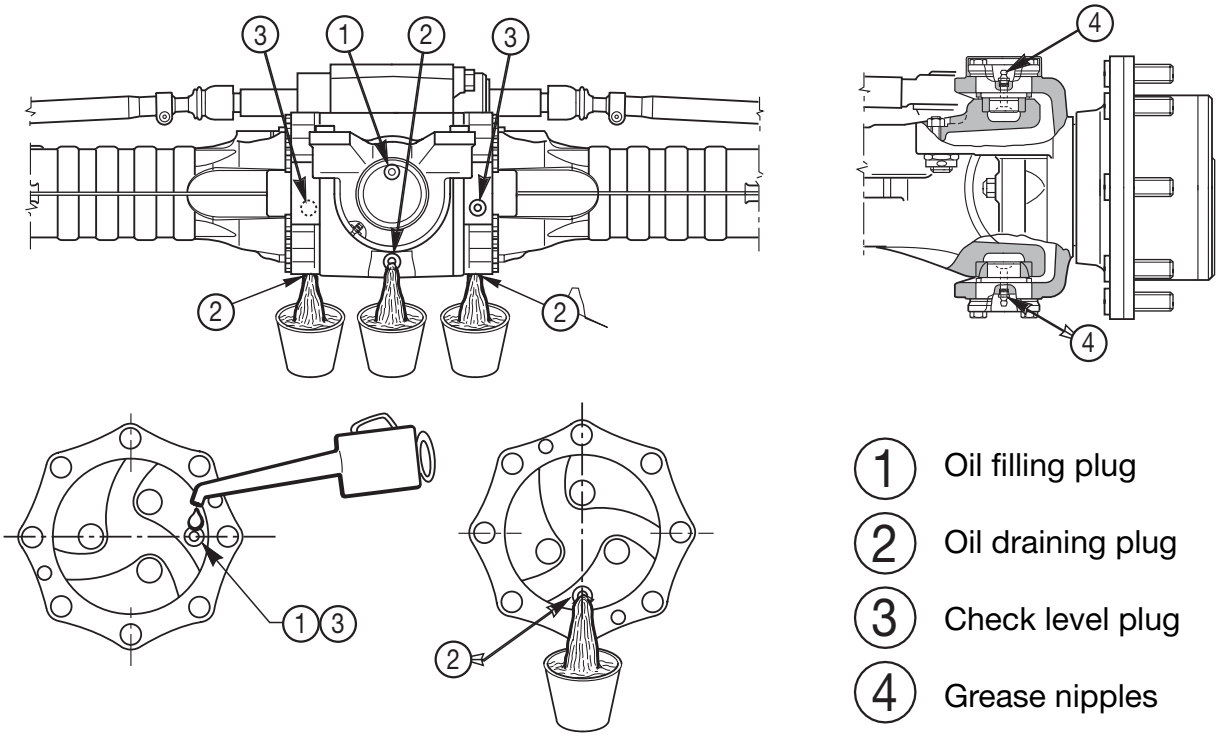


Data plate



1. Type and model unit - modification index
2. Serial number
3. Lubrificant

Maintenance points



1. Oil filling plug
2. Oil draining plug
3. Check level plug
4. Grease nipples

Maintenance points

OPERATION		FREQUENCY	LUBRICANTS
• Check levels:	Differential	monthly	**SAE85W90 (API GL4 - MIL L-2105)** With additives for oil-bath brakes
	Riduzione epicicloidale	ogni 200 ore	
• Oil change:	Differential	every 800 hours (*)	**SAE85W90 (API GL5 - MIL 2105-B)** With additives for oil-bath brakes, for units presenting hypoid crown wheel and pinion and /or self-locking differential gear.
	Planetary reduction	every 1000 hours	
	Self-locking differential gear	every 700 hours (*) (§)	

(*) Initially after 100 working hours

(§) When it starts sounding noisy

OPERATION	MEMBER	CONDITIONS	FREQUENCY	LUBRICANTS
Greasing	Articulations	Normal work	monthly	MOLIKOTE
		Awkward work	Weekly	MOLIKOTE

Adjustment and checks

UNIT	OPERATION	FREQUENCY	SERVICE BRAKE CIRCUIT
Negative brake	Adjustment	every 1000 hours (*)	Only for mineral oil use e.g. ATF Dexron II. Make sure that master cylinder seals are suitable for mineral oil.
Service brake	Adjustment	every 500 hours	
Wheel nuts	Tightening	every 200 hours	

(*) Initially after 100 working hours

CONVERSION TABLES

Units of pressure: 1 Atm = 1 bar = 10^5 PA = 14.4 PSi

Units of weight

	N	daN	kN	kg	lbs
1N	1	0,1	0,001	0,102	0,225
1daN	10	1	0,01	1,02	2,25
1kN	1000	100	1	102	225
1kg	9,81	0,981	0,00981	1	2,205

Units of torque

	Nm	daNm	kNm	kgm	lb-in
1Nm	1	0,1	0,001	0,102	8,854
1daNm	10	1	0,01	1,02	88,54
1kNm	1000	100	1	102	8854
1kgm	9,81	0,981	0,00981	1	86,8
1lb-in	0,1129	0,01129	0,0001129	0,01152	1

Tightening torques

Unit: Nm

SIZE OF BOLT		TYPE OF BOLT					
		8.8		10.9		12.9	
		Normali + Loctite 242	Normali + Loctite 270	Normali + Loctite 242	Normali + Loctite 270	Normali + Loctite 242	Normali + Loctite 270
COARSE PITCH	M6x1	9,5-10,5	10,5-11,5	14,3-15,7	15,2-16,8	16,2-17,8	18,1-20,0
	M8x1,25	23,8-26,2	25,6-28,4	34,2-37,8	36,7-40,5	39,0-43,0	43,7-48,3
	M10x1,5	48-53	52-58	68-75	73-81	80-88	88-97
	M12x1,75	82-91	90-100	116-128	126-139	139-153	152-168
	M14x2	129-143	143-158	182-202	200-221	221-244	238-263
	M16x2	200-221	219-242	283-312	309-341	337-373	371-410
	M18x2,5	276-305	299-331	390-431	428-473	466-515	509-562
	M20x2,5	390-431	428-473	553-611	603-667	660-730	722-798
	M22x2,5	523-578	575-635	746-824	817-903	893-987	974-1076
	M24x3	675-746	732-809	950-1050	1040-1150	1140-1260	1240-1370
	M27x3	998-1103	1088-1202	1411-1559	1539-1701	1710-1890	1838-2032
	M30x3,5	1378-1523	1473-1628	1914-2115	2085-2305	2280-2520	2494-2757
FINE PITCH	M8x1	25,7-28,3	27,5-30,5	36,2-39,8	40,0-44,0	42,8-47,2	47,5-52,5
	M10x1,25	49,4-54,6	55,2-61,0	71,5-78,5	78,0-86,0	86,0-94,0	93,0-103,0
	M12x1,25	90-100	98-109	128-142	139-154	152-168	166-184
	M12x1,5	86-95	94-104	120-132	133-147	143-158	159-175
	M14x1,5	143-158	157-173	200-222	219-242	238-263	261-289
	M16x1,5	214-236	233-257	302-334	333-368	361-399	394-436
	M18x1,5	312-345	342-378	442-489	485-536	527-583	580-641
	M20x1,5	437-483	475-525	613-677	674-745	736-814	808-893
	M22x1,5	581-642	637-704	822-908	903-998	998-1103	1078-1191
	M24x2	741-819	808-893	1045-1155	1140-1260	1235-1365	1363-1507
	M27x2	1083-1197	1178-1302	1520-1680	1672-1848	1834-2027	2000-2210
	M30x2	1511-1670	1648-1822	2138-2363	2332-2577	2565-2835	2788-3082

Screw-locking, sealing and lubricating materials

- Locking, sealing and lubricating materials referred to in this manual are the same used in the shop-floor.

- The table below gives an account of the typical applications of each single material, in order to facilitate replacement with similar products marketed by different brand names with different trade marks.

DENOMINATION	APPLICATION
Loctite 242	Anaerobic product apt to prevent the loosening of screws, nuts and plugs. Used for medium-strength locking. Before using it, completely remove any lubricant by using the specific activator.
Loctite 243	The oleocompatible alternative to 242. Does not require the activation of lubricated surfaces.
Loctite 270	Anaerobic product for very-high strength locking of screws and nuts. Before using it, completely remove any lubricant by using the specific activator. To remove parts, it may be necessary to heat them at 80°C approx.
Loctite 275	Anaerobic product suitable for high-strength locking and sealing of large threaded parts, bolts and stud bolts, for pipe sealing and for protecting parts against tampering; suitable for sealing coupling surfaces with a max. diametrical clearance of 0,25 mm.
Loctite 510	Anaerobic product for the hermetic sealing of flanged units and screw holes communicating with fluids. Can seal clearances between flanges up to 0,2 mm.
Loctite 577	Quick anaerobic sealant for sealing threaded portions of conical or cylindrical unions up to M80. Before using it, remove any lubricant with the specific activator. After polymerisation, disassembly may result rather difficult, so heating may be necessary for larger diameters.
Loctite 638	Anaerobic adhesive for fast and high-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with clearance ranging between 0,1 and 0,25 mm.
Loctite 648	Anaerobic adhesive for fast and medium-strength gluing of cylindrical metal joints (hub on shaft). Can glue together parts with radial clearance below 0,1 mm.
(AREXONS) Repositionable jointing compound for seals	Solvent-based sealing compound for elastic seals, drying through evaporation. Used for sealing the outer diameter of sealing rings for rotating shafts with outer metal reinforcement.

DENOMINATION	APPLICATION
Silicone	Semi-fluid adhesive material used for sealing and filling and to protect components from environmental and physical elements. Polymerises with non-corrosive dampness.
(TECNO LUPE/101) Silicone-based grease	Highly adhesive synthetic grease, with silicone compounds added. Applied to adjustment screws with hole communicating with oil-type fluids. Used when frequent adjusting is required.
Molikote	Lubricating compound containing molybdenum disulphide, used to lubricate articulation pins and to prevent sticking and oxidation of parts that are not lubricated on a regular basis.
(Lithium-based) Grease	Applied to bearings, sliding parts and used to lubricate seals or parts during assembly.

NOTES ON SAFETY PRECAUTIONS

1 - During all operations described in this manual, the axle should be fastened onto a trestle, while the other parts mentioned should rest on supporting benches.

2 - When removing one of the arms, an anti-tilting safety trestle should be placed under the other arm.

3 - When working on an arm that is fitted on the machine, make sure that the supporting trestles are correctly positioned and that the machine is locked lengthways.

4 - Do not admit any other person inside the work area; mark off the area, hang warning signs and remove the ignition key from the machine.

5 - Use only clean, quality tools; discard all worn, damaged, lowquality or improvised wrenches and tools. Ensure that all dynamometric wrenches have been checked and calibrated.

6 - Always wear gloves and non-slip rubber shoes when performing repair work.

7 - Should you stain a surface with oil, remove marks straight away.

8 - Dispose of all lubricants, seals, rags and solvents once work has been completed. Treat them as special waste and dispose of them according to the relative law provisions obtaining in the country where the axles are being overhauled.

9 - Make sure that only weak solvents are used for cleaning purposes; avoid using turpentine, dilutants and toluol-, xylolbased or similar solvents; use light solvents such as Kerosene, mineral spirits or water-based, environment friendly solvents.

10- For the sake of clarity, the parts that do not normally need to be removed have not been reproduced in some of the diagrams.

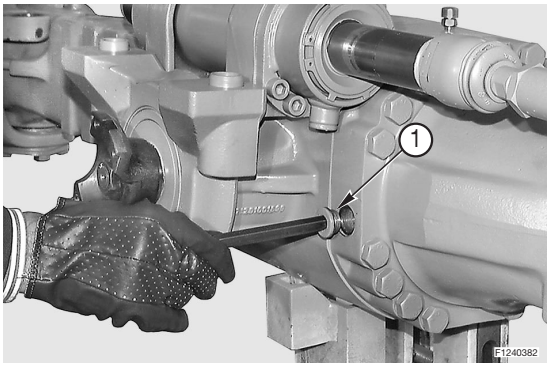
11- The terms RIGHT and LEFT in this manual refer to the position of the operator facing the axle from the side opposite the drive.

12- After repair work has been completed, accurately touch up any coated part that may have been damaged.

Symbols

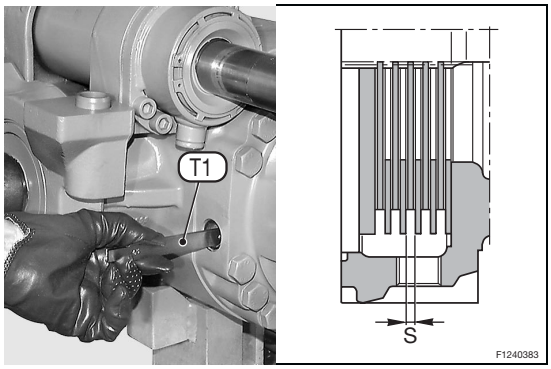
	Disassembly of assembly groups
	Reassemble to from assembly groups
	Remove obstruction parts
	Reinstall-remount parts which had obstructed disassembly
	Attention ! Important notice
	Check - adjust e.g. torque, dimensions, pressures, etc.
	T=Special tool P=Page
	Note direction of installation
	Visual inspection
	Possibly still serviceable, renew if necessary
	Renew at each reassembly
	Unlock - lock e.g. split pin, locking plate, etc.
	Lock-adhere (liquid sealant)
	Guard against material damage, damage to parts
	Mark before disassembly, observe marks when reassembly
	Caricare - riempire (olio - lubrificante)
	Drain off oil, lubricant
	Tighten
	Apply pressure into hydraulic circuit
	To clean
	Lubricate - grease

CHECKING WEAR AND REPLACING THE BRAKING DISKS



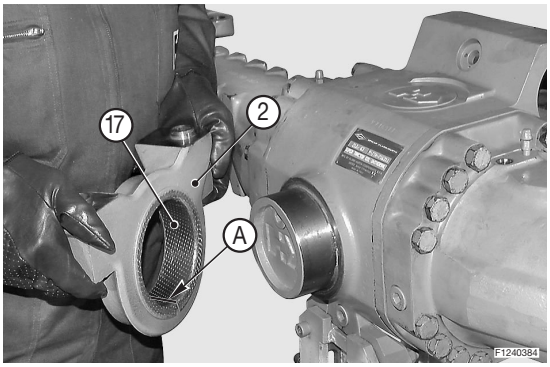
GB a

CAUTION! Perform all operations on both arms.
Remove the oil-level plug (1).



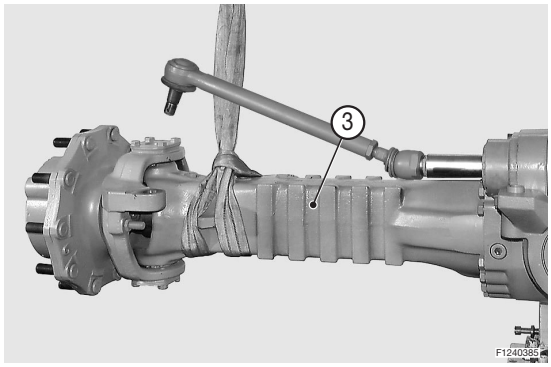
bar GB b

Apply the brakes and, keeping them under pressure, check the linings “S” between the disks using tool T1. Minimum “S”: 4.5 mm.
CAUTION! Replace the braking disks and the intermediate disks on both sides if necessary.



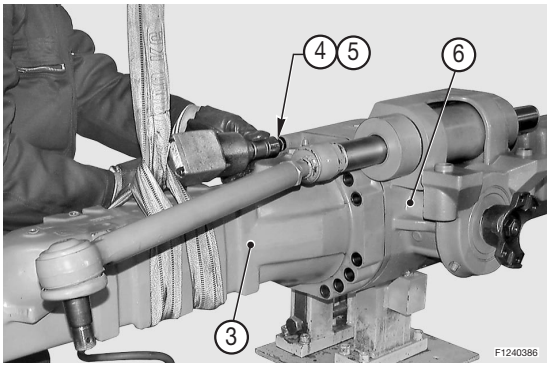
GB c

Remove the swinging support (2) on the side opposite the drive.
NOTE. If the bushing (17) is worn and needs replacing, note down the assembly side of the connection notch “A”.



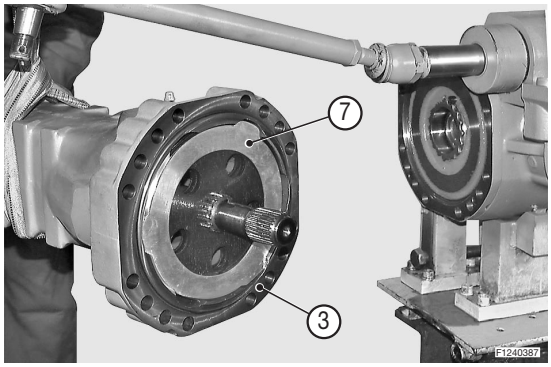
GB d

Disconnect the pins of the steering bars from the steering case (See "HOW TO REMOVE THE STEERING CYLINDER").
Sling the arm (3) to be removed and put the rod under slight tension.



GB e

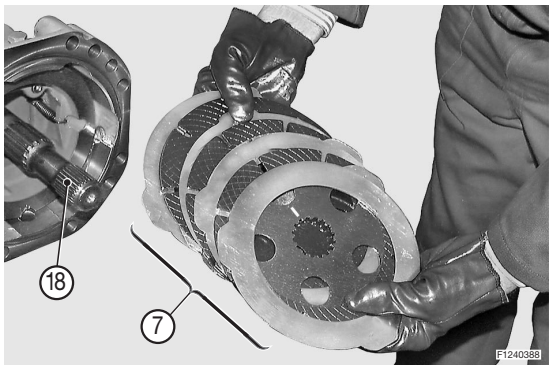
Unloose and remove the screws (4) and the washers (5) that fix the arm (3) to the central body (6).



GB f

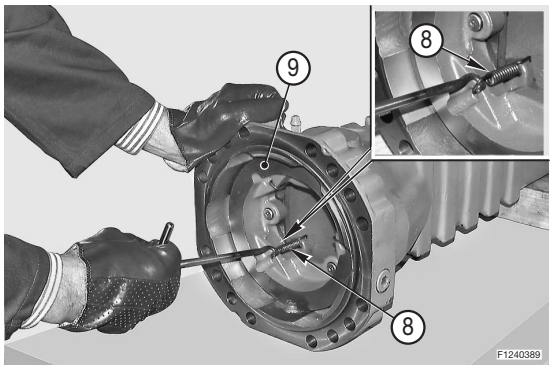
Remove the arm (3) together with the pack of the braking disks (7).
Place the arm on a bench.

Disassembly the braking units



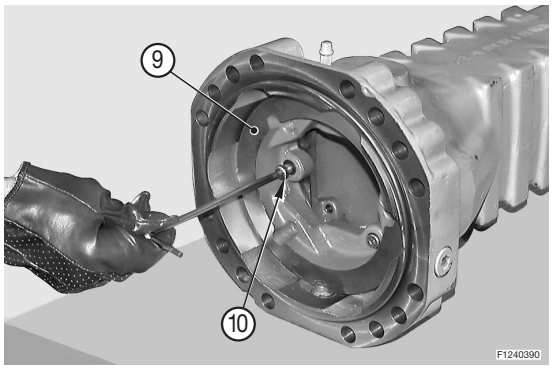
GB a

Remove the braking disks (7) and note down their order of assembly.
NOTE. 1 - If the disks do not need replacing, avoid switching their position.
2 - Extract the u-joint (18).



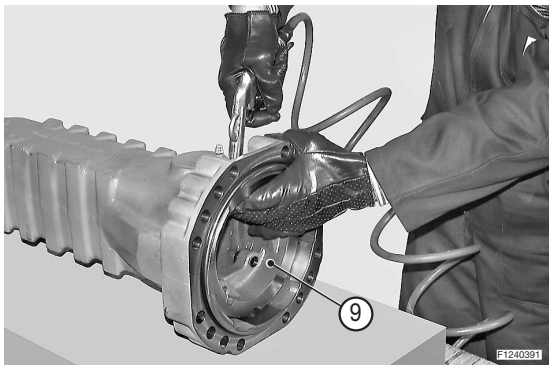
GB b

Remove the reversal springs (8) from the piston (9).
NOTE. If the springs (8) are weak or deformed they must be replaced.



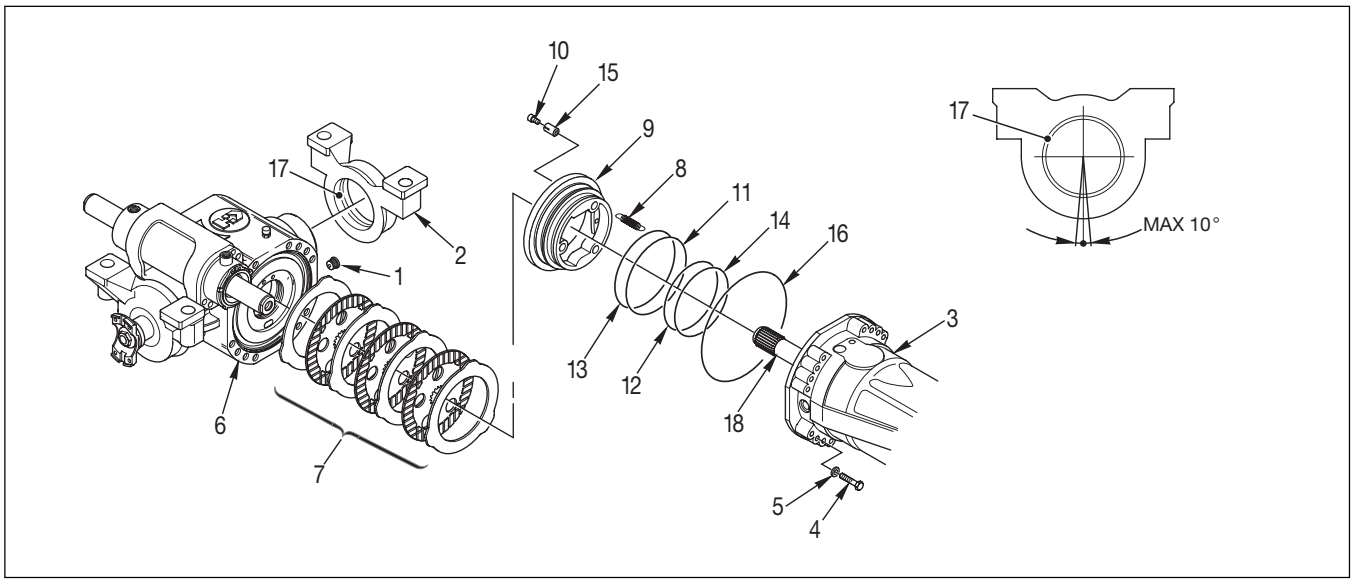
GB c

Remove the pin screws (10) guiding the piston (9).
CAUTION! If the screws are to be replaced, note down the different colours for the different brake gap.
(See "HOW TO ASSEMBLE THE BRAKING UNITS")

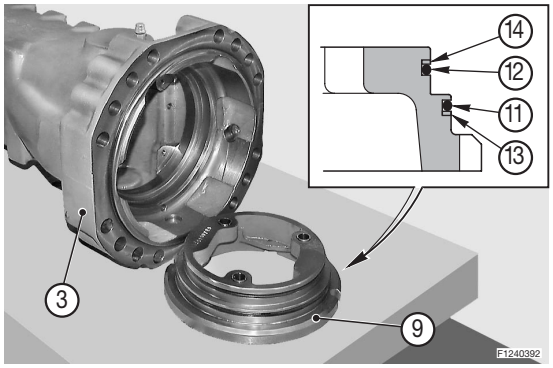


GB d

Slowly introduce compressed air through the connection of the braking circuit in order to extract the entire piston.
CAUTION! Hold on to the piston as it may be suddenly ejected and damaged.

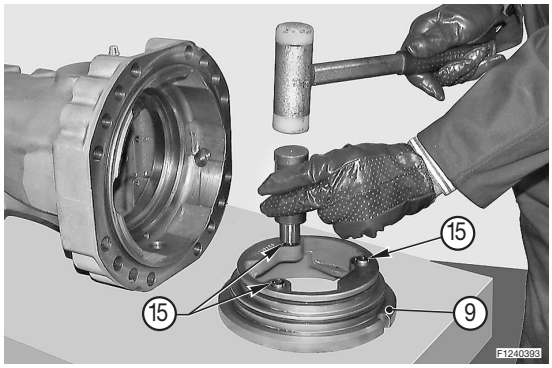


Assembly the braking units



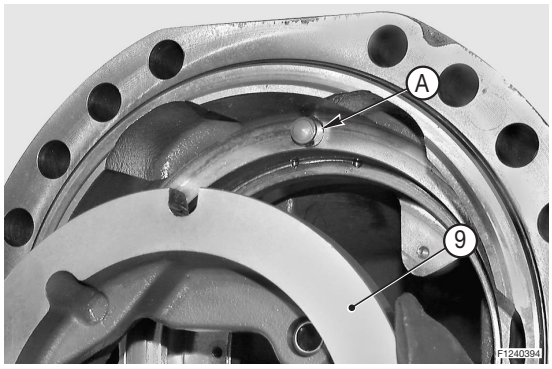
GB a

Accurately clean the piston (9) and the seats of slide and seal. Replace the O-rings (11) and (12) and the anti-extrusion rings (13) and (14); make sure that the assembly side is correct.
CAUTION! Accurately check the positioning of the anti-extrusion rings (13) and (14).



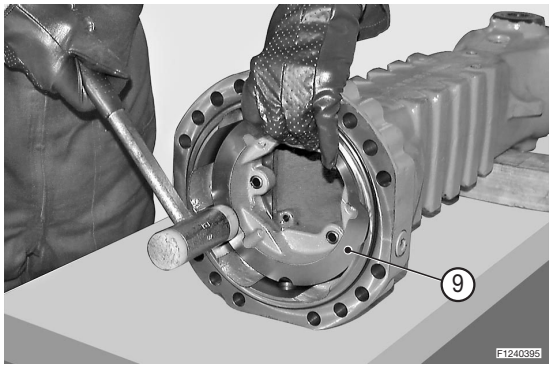
GB b

Insert the stroke automatic regulation springs (15); place them in line with the piston (9).



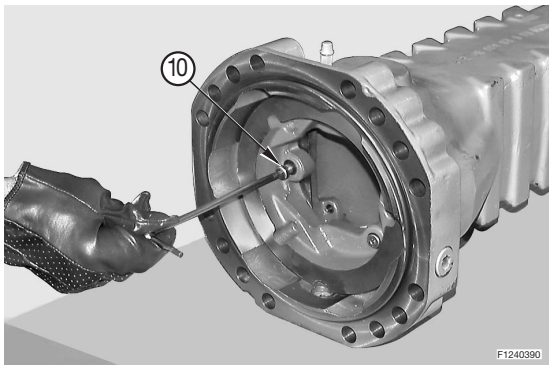
GB c

Lubricate the seals (11) and (12) and fit the piston (9) into the arm (3).
CAUTION! Make sure that the piston seat fits into the stop pin (A) inside the arm.



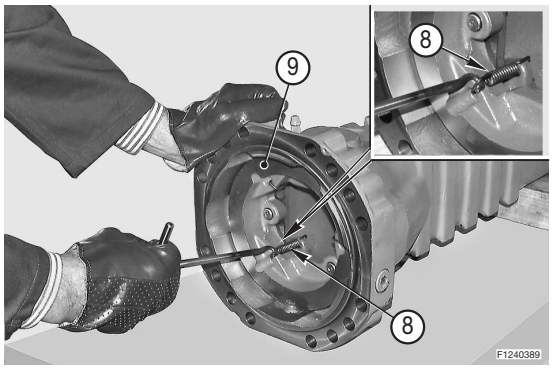
GB d

Assist the insertion of the piston (9) by lightly hammering around the edge with a plastic hammer.



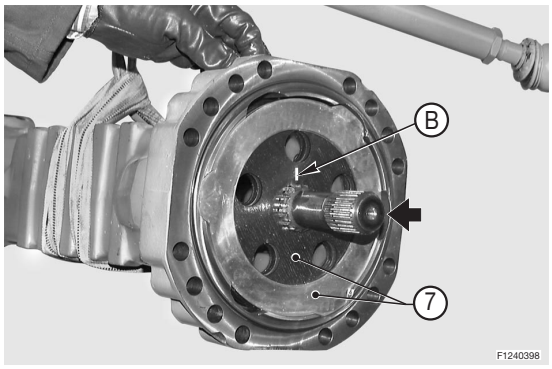
GB e

Fit the pin screws (10) making sure that they are all of the same colour. White: 1 mm gap, Yellow: 0,75 mm gap, Blue: 0,5 mm gap. Apply Loctite 270 to the thread.
Torque wrench setting: 5÷7 Nm.



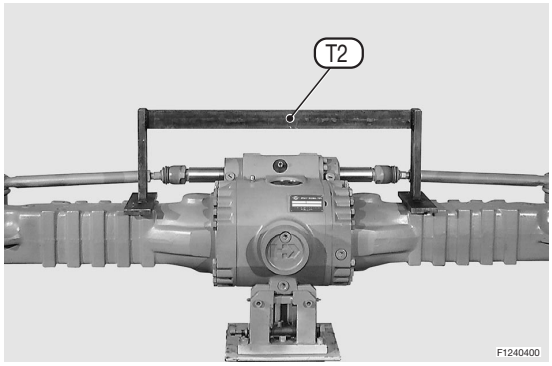
GB f

Fit the reversal springs (8) on the piston (9).
CAUTION! Pay due attention not to deform the connections of the springs.



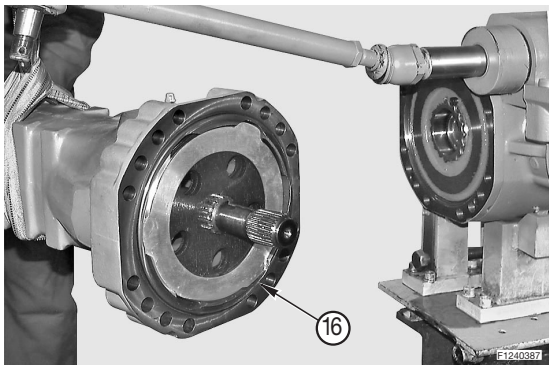
GB a

Slightly lubricate the braking disks (7) and fit them in the arm following the correct sequence; orient them so that the oil circulation holes and the marks “B” are perfectly lined up.
NOTE. When installing the steel discs, the slot corresponding to the oil level cap should always be kept free.



GB c

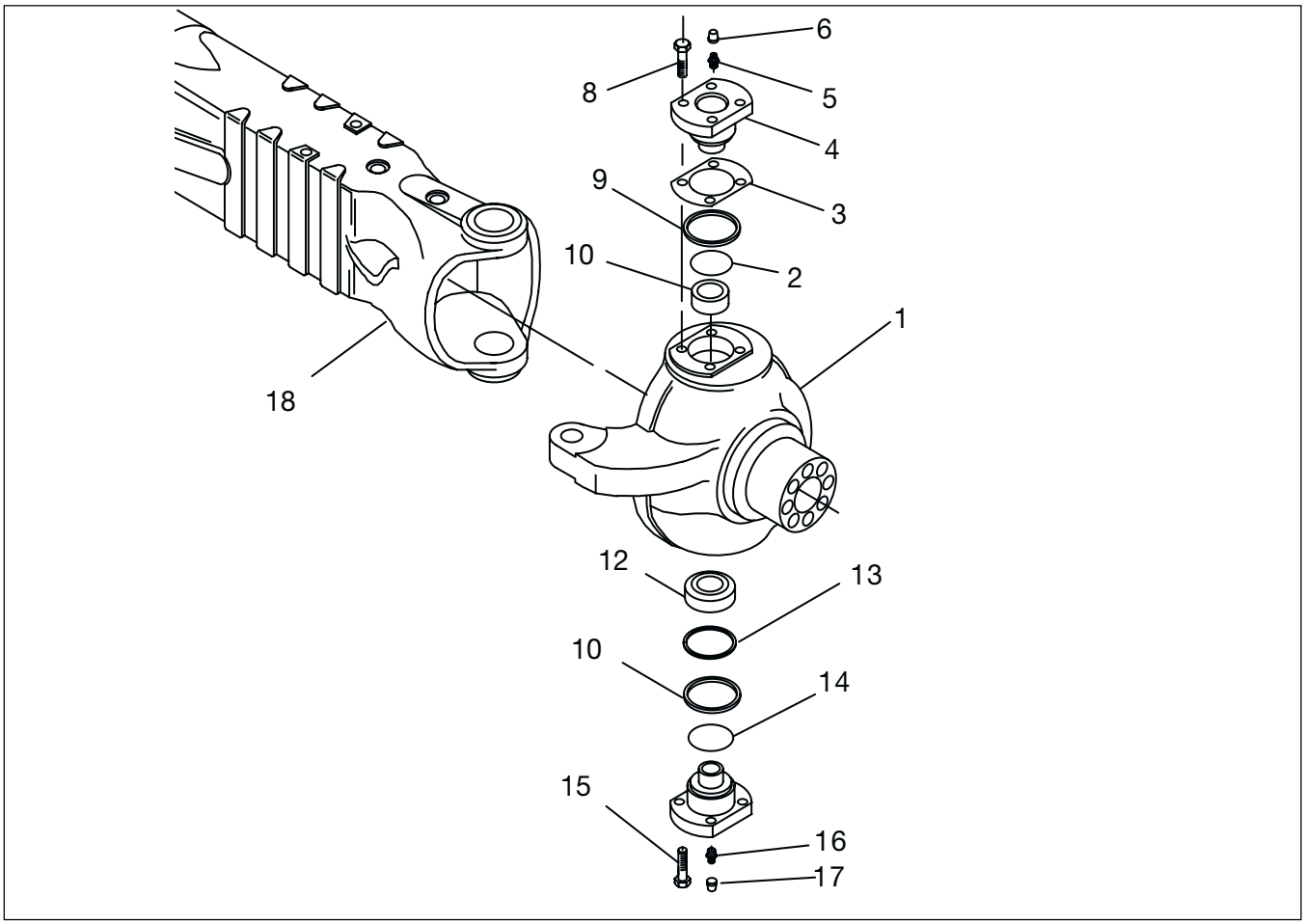
Check the flatness of the arms using tool T2 and finally lock the arms with the screws (4) and the washer (5) using the crosstightening method.
Torque wrench setting: 298 Nm

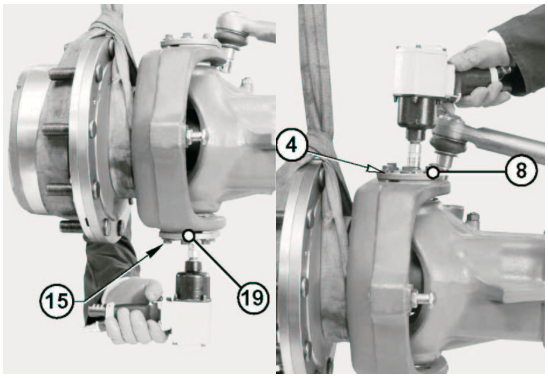


GB b

Check that the positioning of the sealing ring (16) on the arm is intact; install the complete arm. Lock it into position using two facing screws (4) and washers (5).

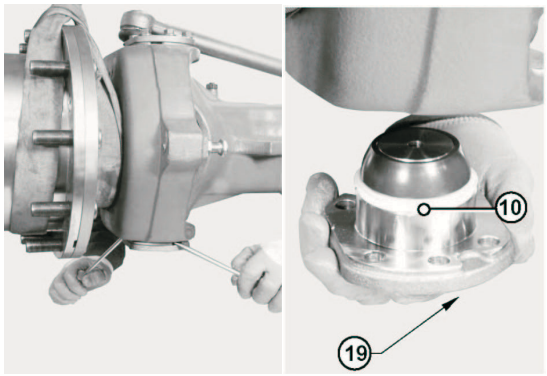
STEERING CASE - Removal and disassembly





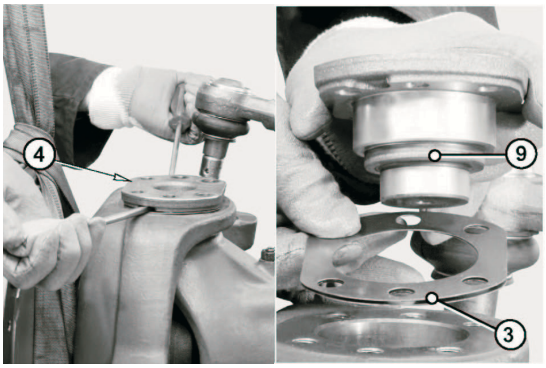
GB e

Unloose and remove the fittin screws (15)(8) from the articulation pin (19)(4).

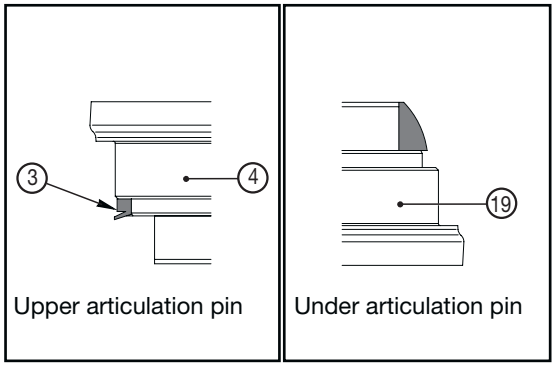


GB f

Remove the bottom articulation (19) pin complete with front sealing ring (10).

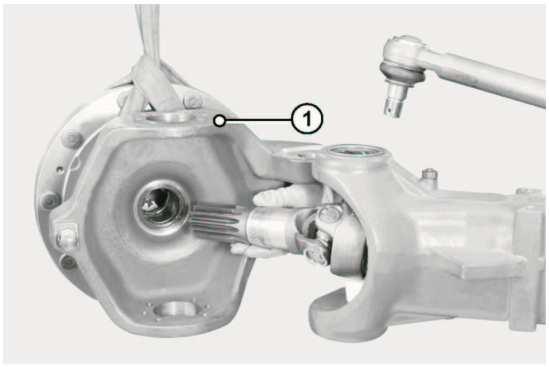


GB a



GB b

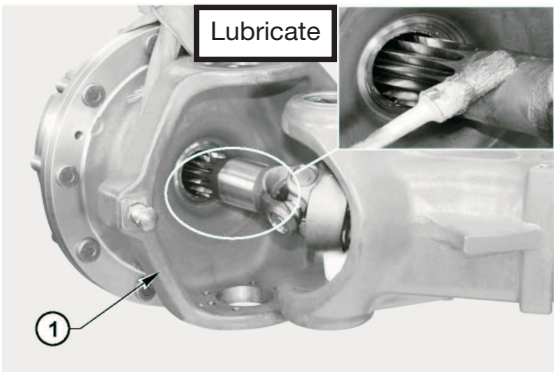
Using two revers, remove the top articulation pin (4) comple te with front seal (9) and shims (3).
Pay attention not to damage the surfaces.



GB c

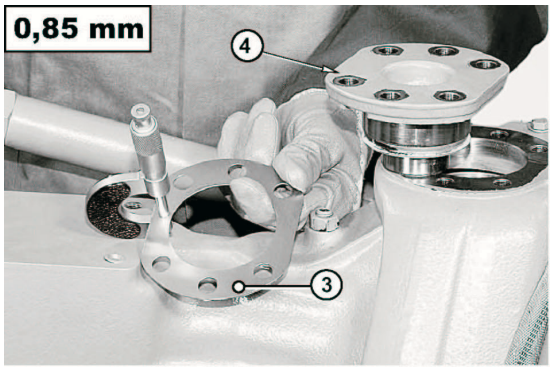
Remove the complete steering case (1).

Assembly and installation



GB a

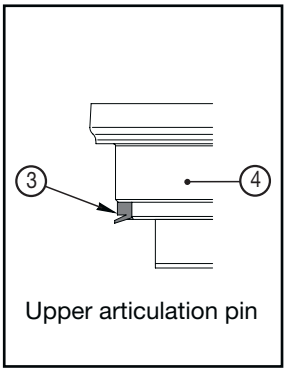
Lubricate the terminal of the ujoint and instali the steering case (1).
Pay due attention not to damage the dust cover rings and the sealing rings.



GB b

Prepare a series of shims (3) of 0,85 mm. To be assemblea under the upper pin (4).





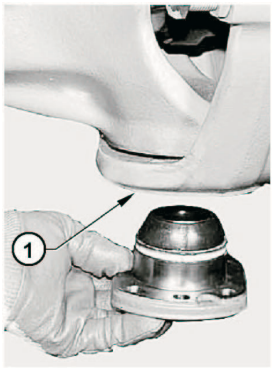
GB c

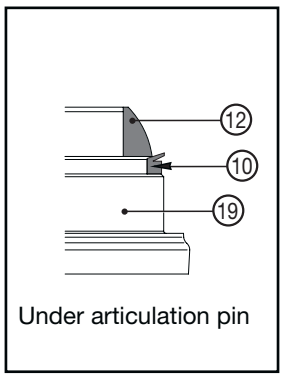
Fit a new seal (3) onto the top articulation pin (4). Lubricate and instali the unit in the steering case. Position the screws (8) and tight wrench 140Nm.
Check the correct assembly side of the seal (3).



GB d

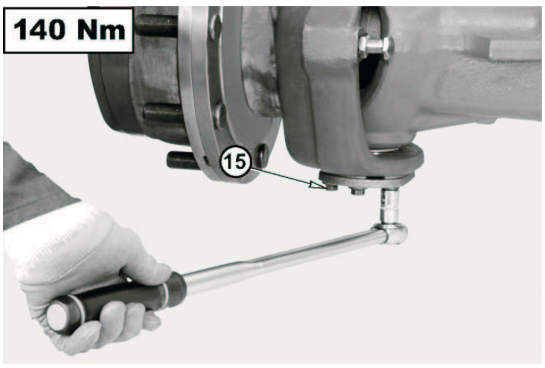
Lubricate and the unit in the steering case.





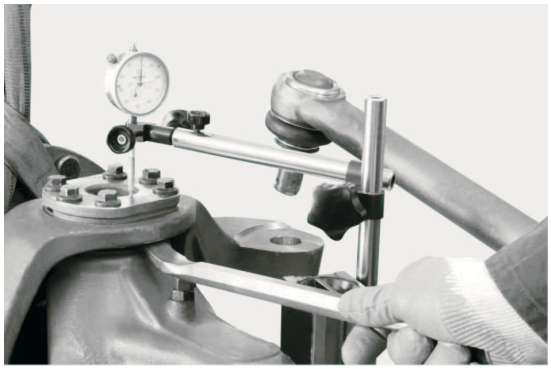
GB e

Fit the unit (19) in the steering case (1). Position the screws (15) and tightly tighten.
Check for the correct assembly side of the seal (10).



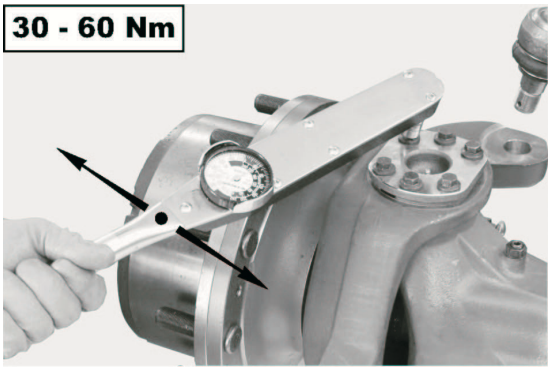
GB f

Tighten the new fittin screws (15) of top and bottom articulation pins in sequence using the cross tightening method.
Torque wrench setting: 140 Nm



GB a

Check by means of a lever that there is no vertical gap.
In case there is any gap, determine the width and reduce it by removing shims.



GB b

Check the torque of the pins, which has to be between 30 and 60 Nm. If the preliminary measured value is too high, the shims trave to be increased.

U-JOINT - Removal and disassembly

NOTE. The u-joint can only be removed after extraction of the steering case has been performed (See: “REMOVING THE STEERING CASE”). Different procedures need to be followed depending on the kind of repair operation needed and the type of axle:

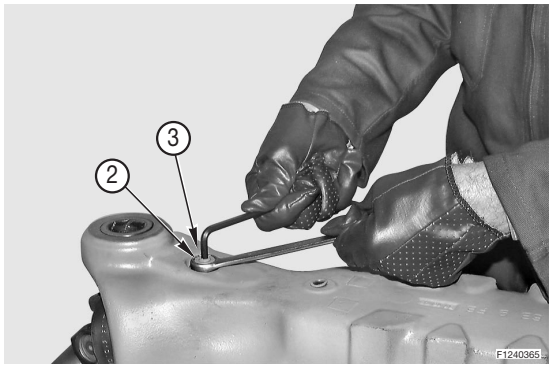
1 - Axle without parking brakes: compressed air (7 bar approx.) should be introduced in the braking circuit in order to hold the braking disks in position.

2 - Axle with negative brake: does not require any preparation as the disks are mechanically locked in position.

3 - Axle with mechanical brake: requires that the external control levers are put under tension in relation to each other.

4 - Disassembly to be carried out with the arm resting on the bench.

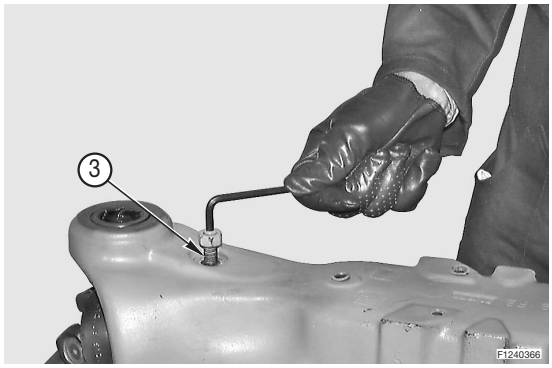
The explanations reported herewith refer to removal operations carried out on the bench; the different stages of u-joint removal also apply to all other solutions or versions.



G
B

a

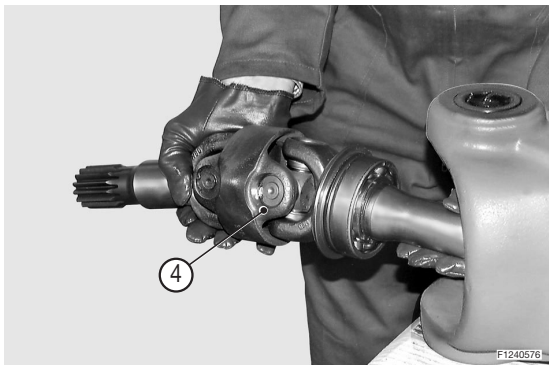
Unloose and remove the top and bottom check nuts (2) from the dowels (3).



GB

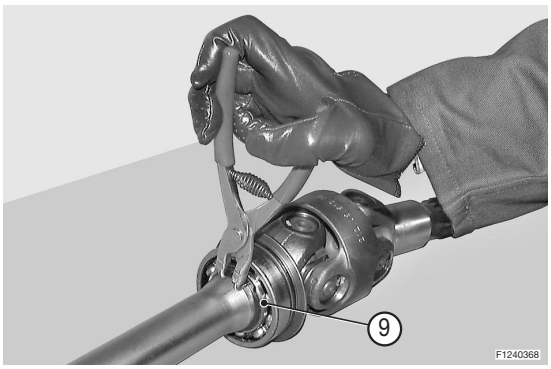
b

Remove top and bottom check dowels (3) from the flange (5) or bush (13).



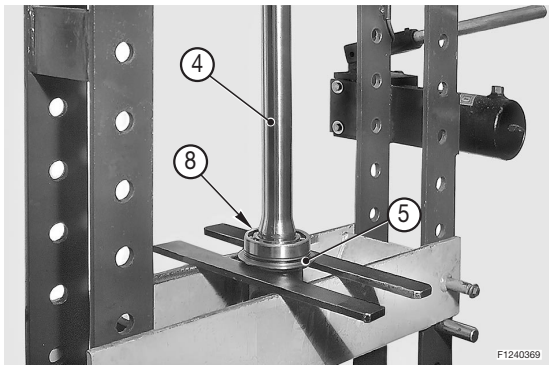
GB a

Remove the u-joint (4).
NOTE. To remove the u-joint use, if necessary, a plastic hammer or a lever.



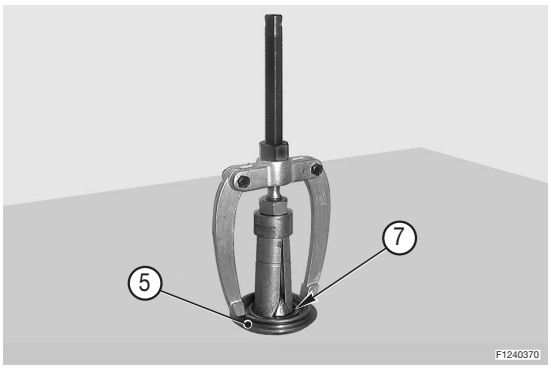
GB b

Remove the snap ring (9) from the bearing as well as the packing ring (5).



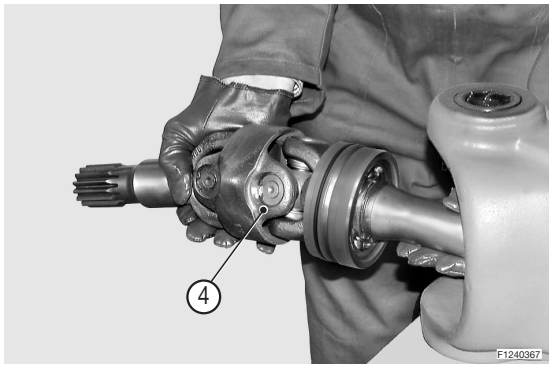
GB c

Position the entire u-joint (4) under a press and remove the bearing (8) and the ring (5) simultaneously.



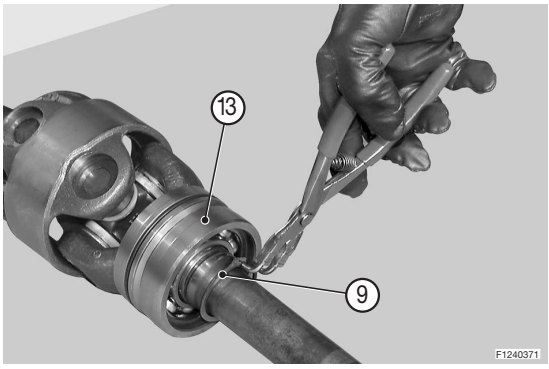
GB d

Extract the sealing ring of the shaft from the flange (5).
NOTE. Note down the assembly side of the ring.



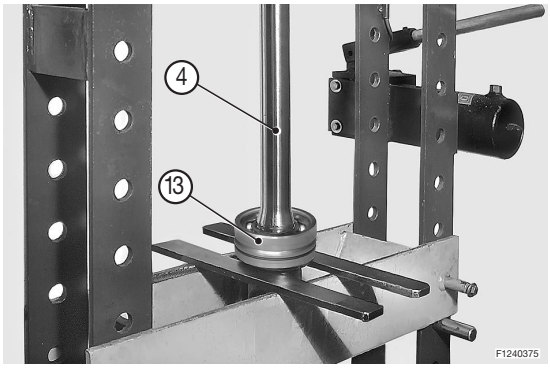
GB e

Remove the entire u-joint (4).
NOTE. To remove the u-joint use, if necessary, a plastic hammer or a lever.



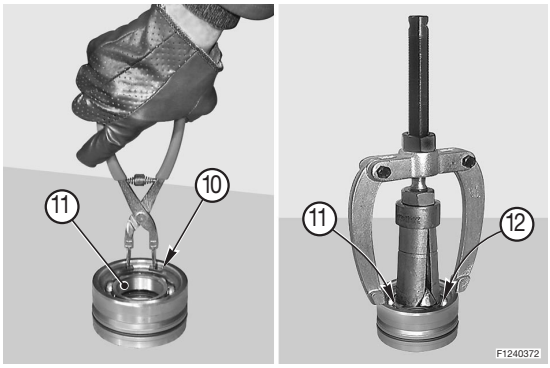
GB f

Remove the snap ring (9) from the bushing unit (13).



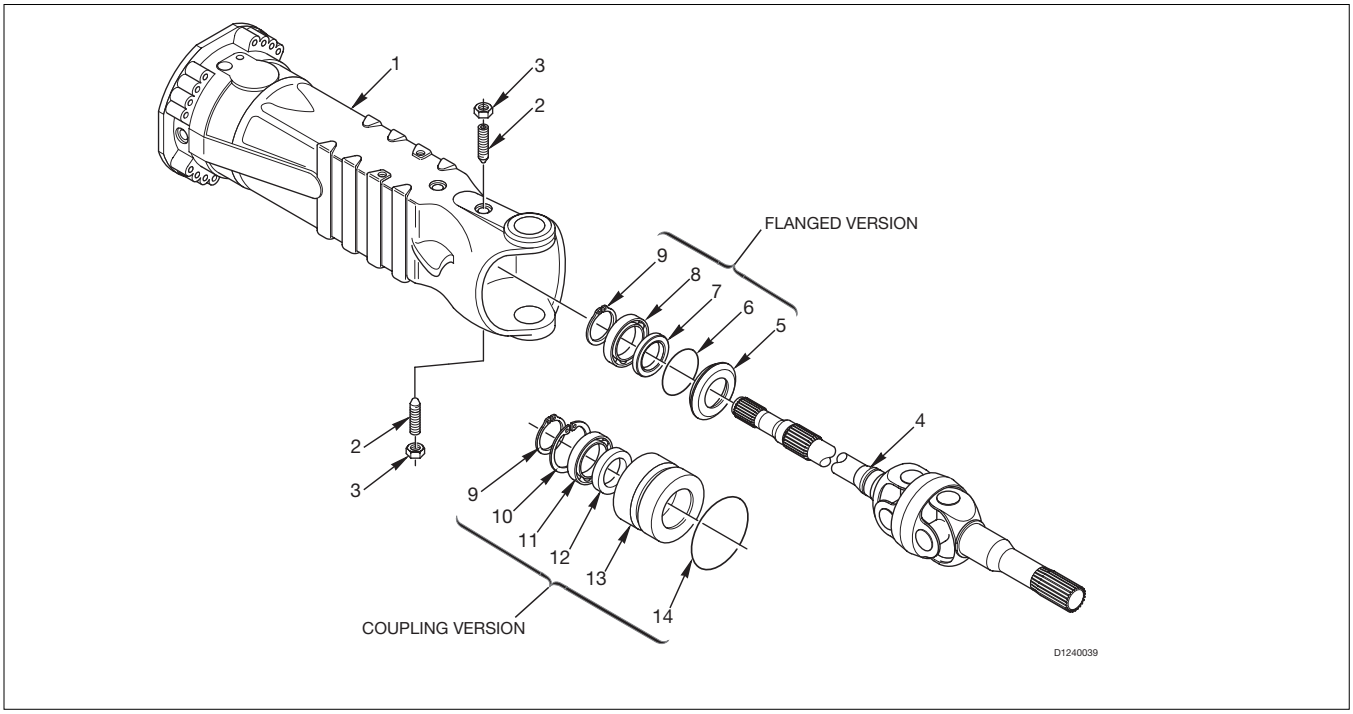
GB a

Position the entire u-joint (4) under a press and remove the complete bush (13).

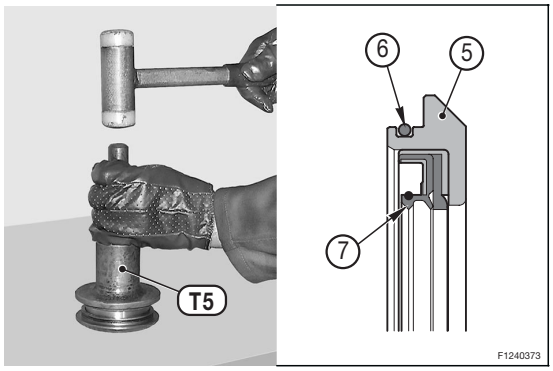


GB b

Remove the snap ring (10) from the bearing (11). Use a puller to remove the bearing (11), the sealing ring (12) and the O-ring (14).
NOTE. Note down the assembly side of the ring (12).

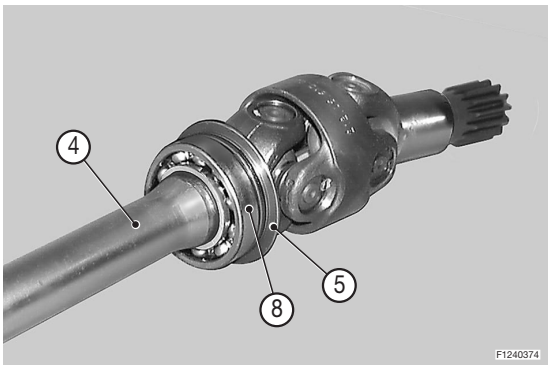


Assembly and installation



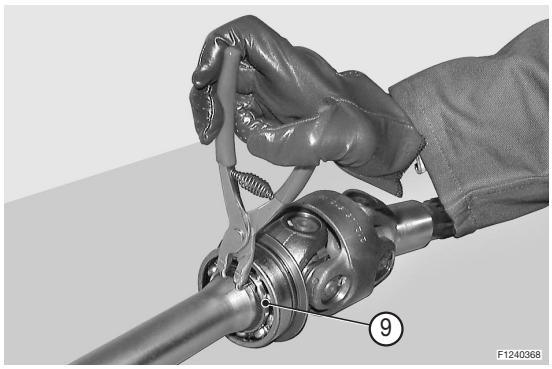
GB a

Insert the sealing ring (7) of the shaft in the flange (5), using tool T5.
NOTE. Carefully check the assembly side. Also replace the outer O-ring (6).



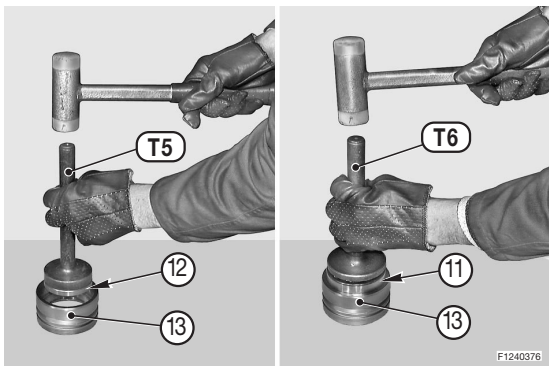
GB b

Fit the flange (5) onto the u-joint (4).
Heat the bearing (8) at an approx. temperature of 100° C, fit it on the u-joint and fasten.



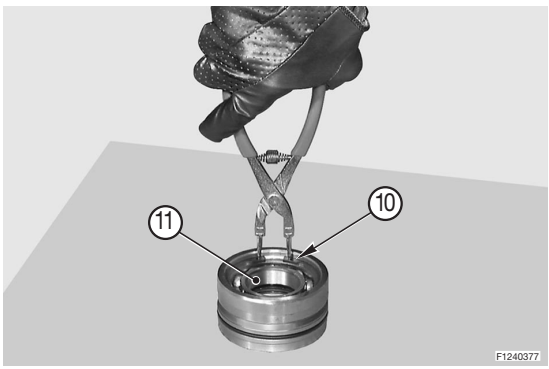
GB c

Fit the snap ring (9) on the bearing (8).



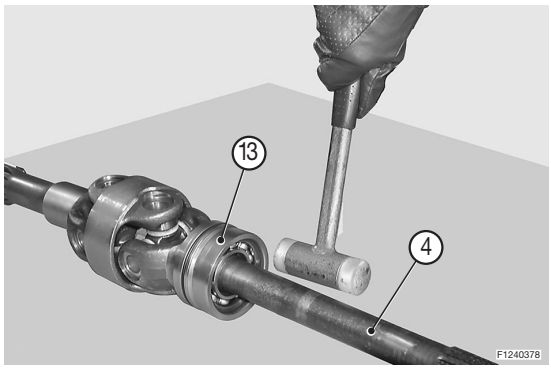
GB e

Using tools T5 and T6, insert the sealing ring (12) and the bearing (11) in the bush (13).
NOTE. Carefully check the assembly side of the seal (12).



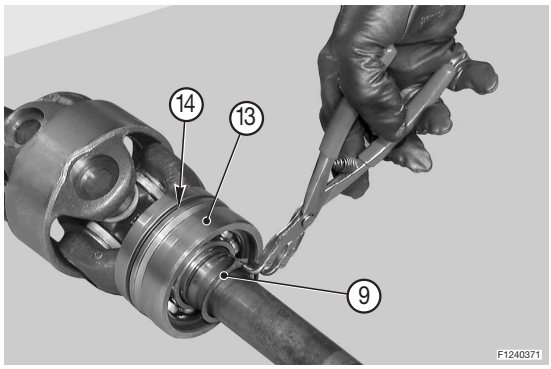
GB f

Fit the snap ring (10) on the bearing (11).



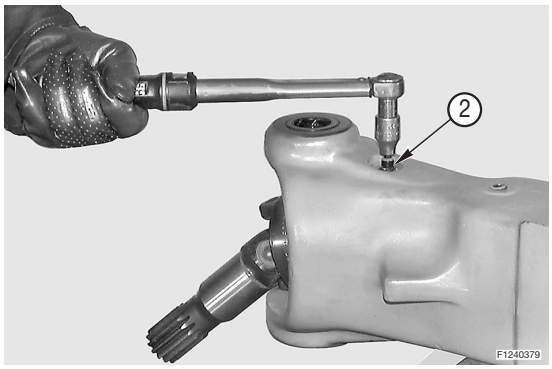
GB a

Heat the bearing in oil at an approx. temperature of 100°C and fit the entire bush (13) on the u-joint (4).



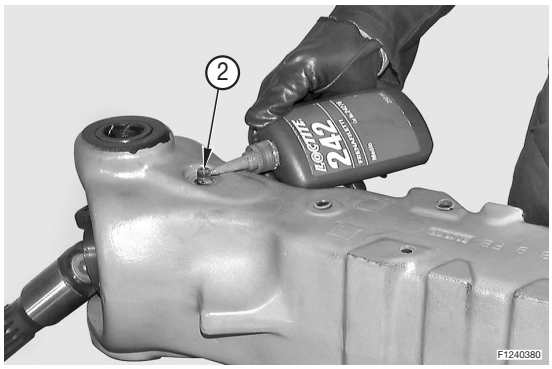
GB b

Fit the check ring (9) on the bushing unit (13); also put the O-ring (14) into position.



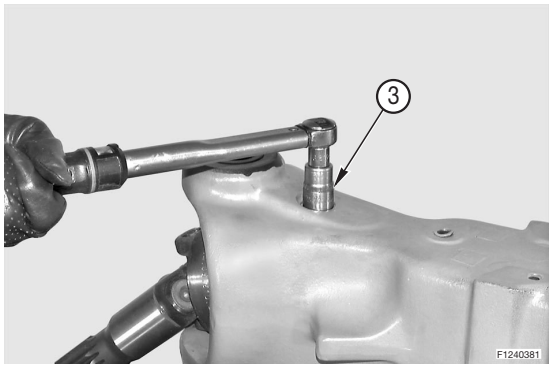
GB c

Insert the u-joint and tighten the top and bottom dowels (2).
Torque wrench setting: Max. 15 Nm.
NOTE. For u-joint coming with a bush, centre the point of the check dowels in the slot.



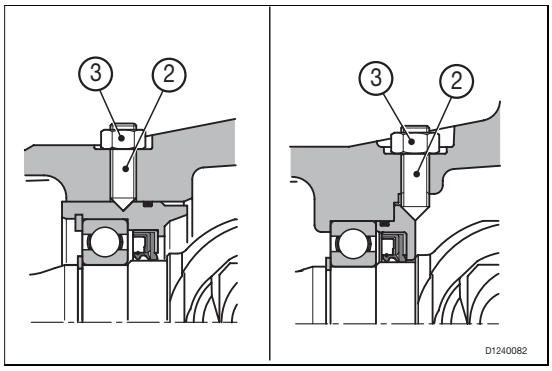
GB d

Apply Loctite 242 to the jutting parts of the dowels (2).

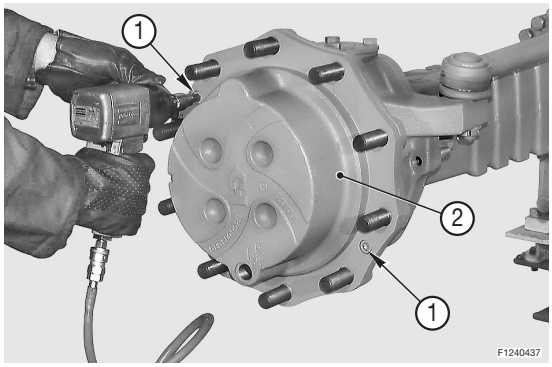


GB e

Screw the check nuts (3) of the dowels (2) and lock them using a dynamometric wrench.
Torque wrench setting: 122 Nm

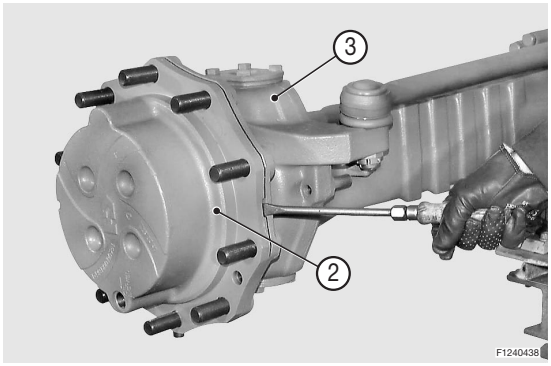


PLANETARY REDUCTION - Disassemble



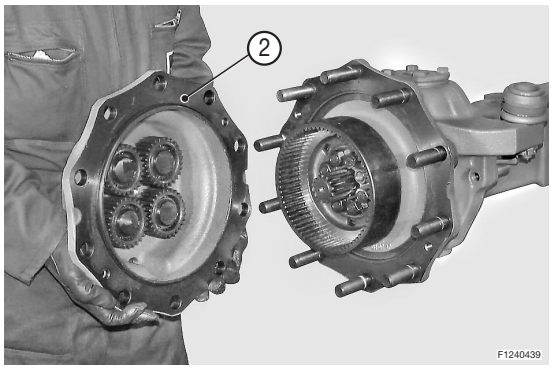
GB a

Disconnect the steering bars from the steering case (3).
For details, see "HOW TO REMOVE THE COMPLETE STEERING CASE".
Remove the securing screws (1) from the planetary carrier cover (2).



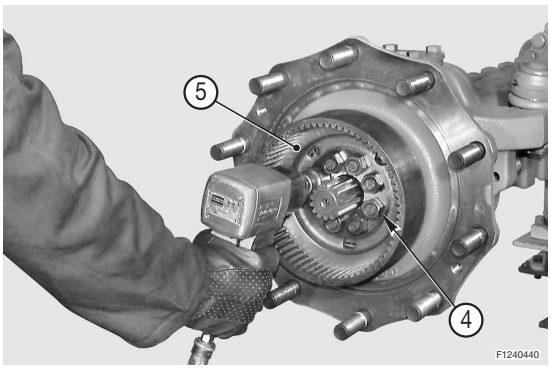
GB b

Disjoint the planetary carrier cover (2) from the steering case (3) by alternatively forcing a screwdriver into the appropriate slots.



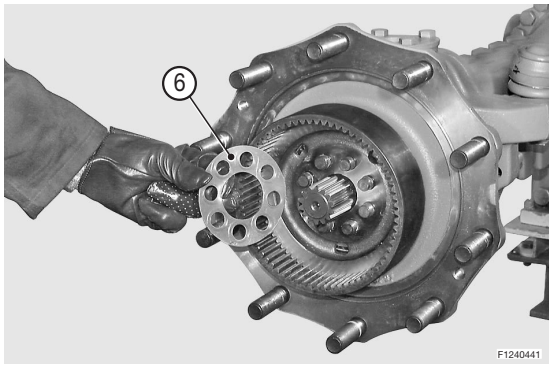
GB c

Remove the complete planetary carrier cover (2).



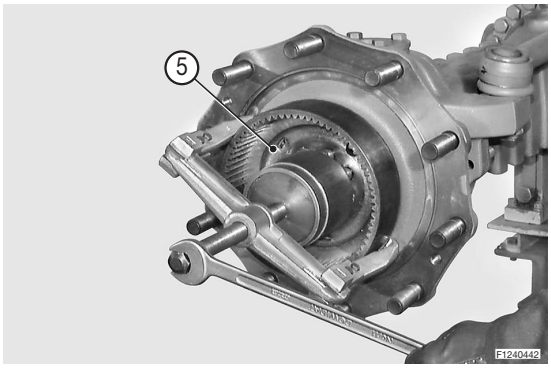
GB d

Unloose and remove the tightening nuts (4) from the crown flange (5).



GB e

Remove the safety flange (6).



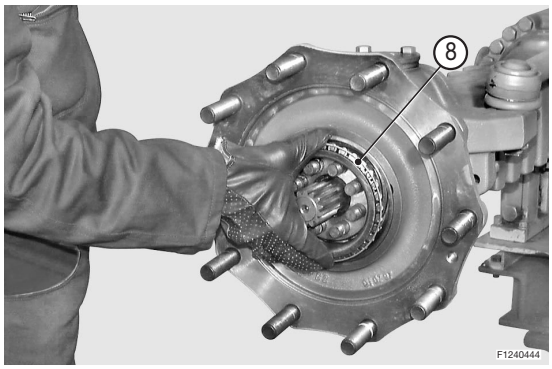
GB f

Using a puller, remove the complete crown flange (5) by acting onthe stud bolts.



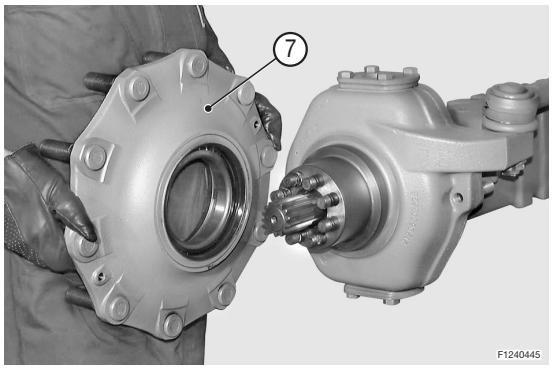
GB a

Partially extract the hub (7) using a plastic hammer.
NOTE. Alternately hammer on several equidistant points.



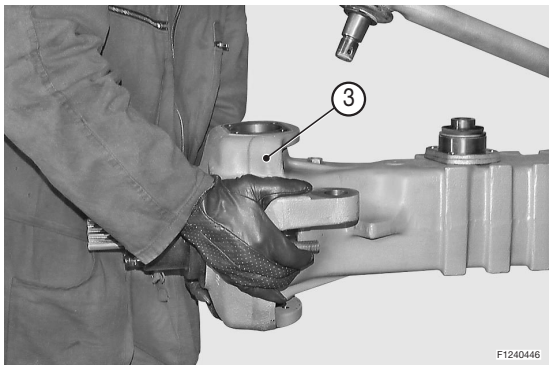
GB b

Remove the external bearing (8).



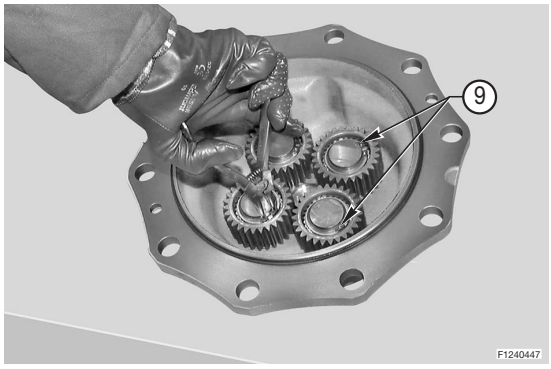
GB c

By hand remove the complete hub (7).



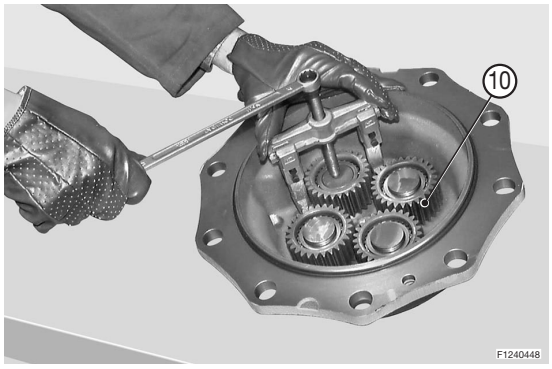
GB d

Remove the pins and remove the steering case (3).
For details, see "HOW TO REMOVE THE COMPLETE STEERING CASE".



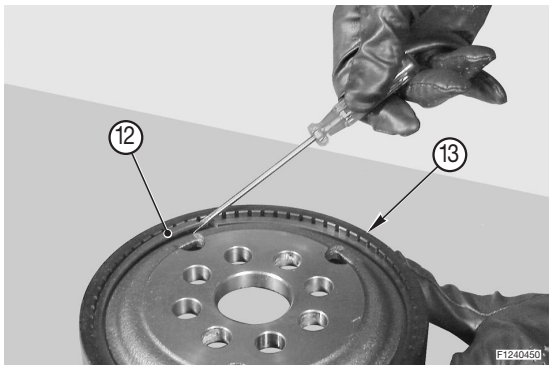
GB e

Remove the snap rings (9).



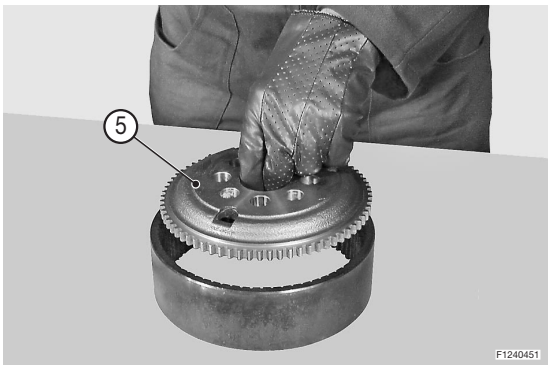
GB f

With the help of a puller, remove the planet wheel gears (10).
NOTE. Note down the assembly side of planet wheels.



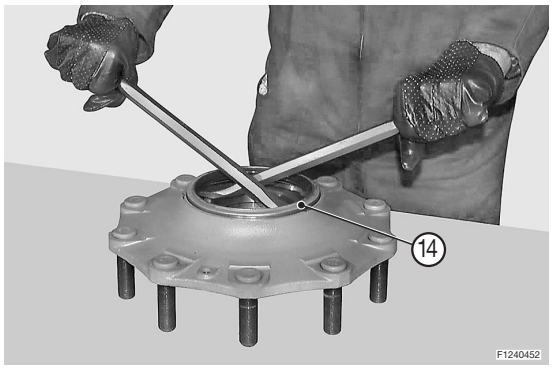
GB a

Remove the snap ring (12) from the crown (13).



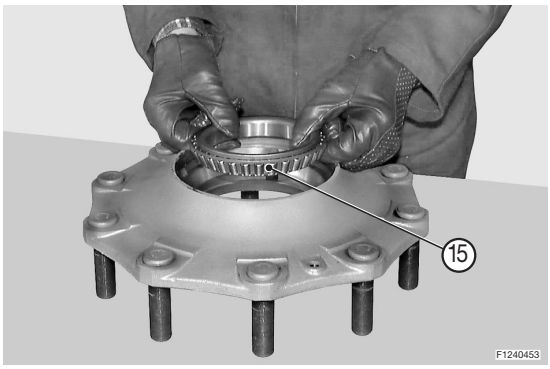
GB b

Remove the crown flange (5).



GB c

Remove the sealing ring from the hub (14).



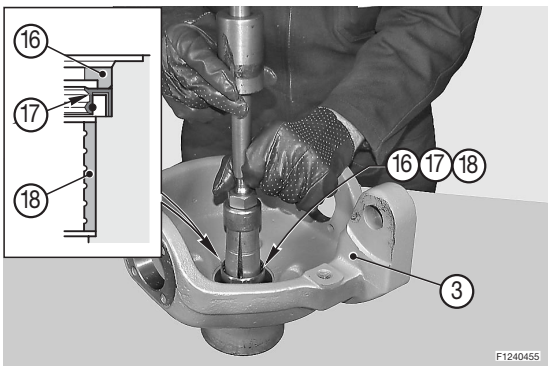
GB d

Remove the internal bearing (15).



GB e

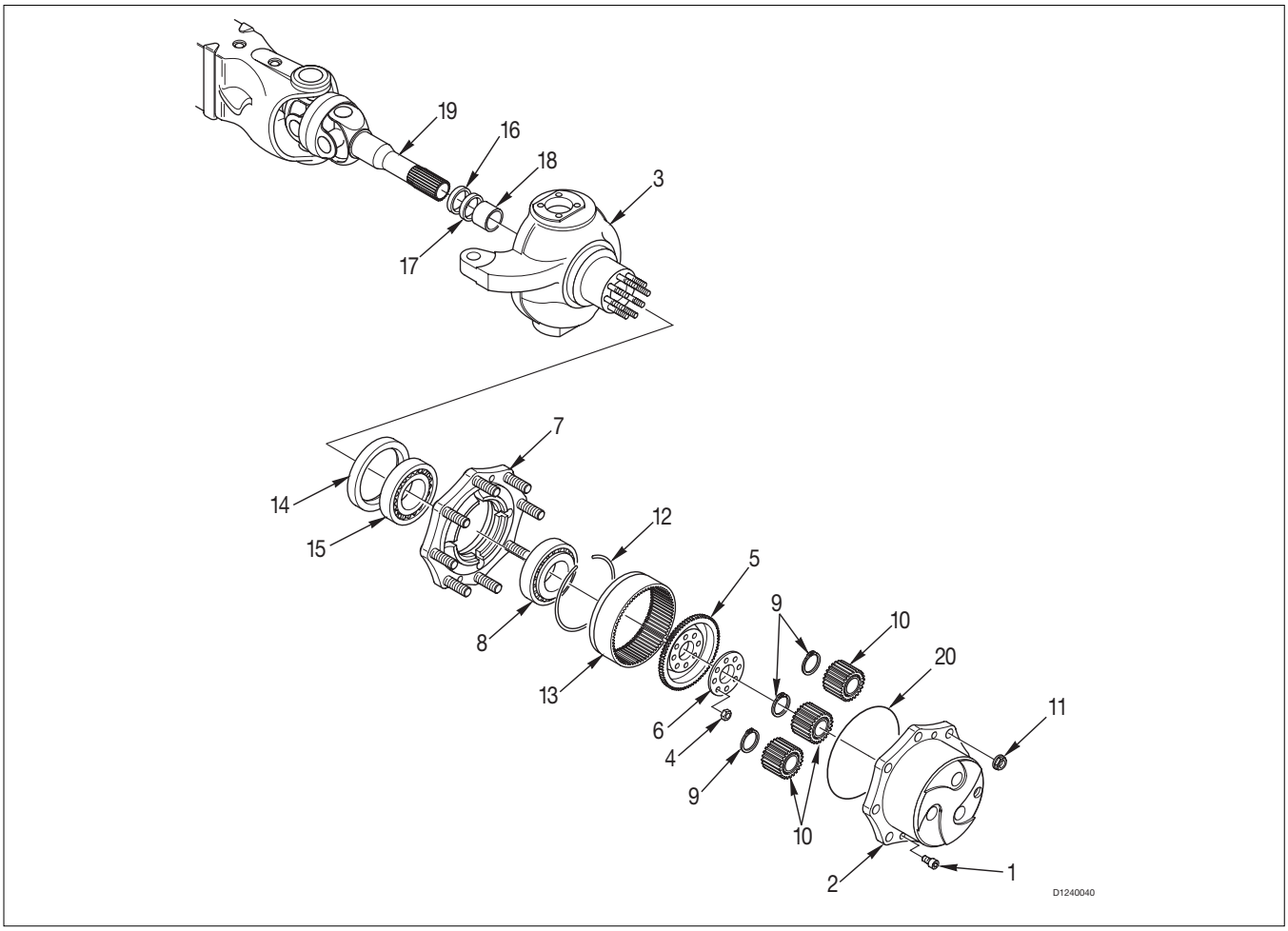
Remove the external thrust blocks from the bearings (8) and (15) forcing a pin-driver into the appropriate slots on the hub (7).
NOTE. Hammer in an alternate way so as to avoid crawling or deformation of the thrust blocks.



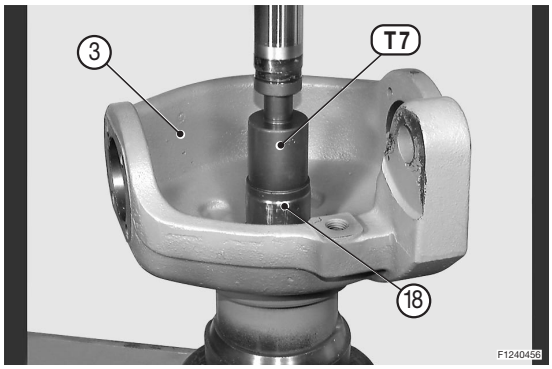
GB f

Use a puller to remove the centring ring (16), the sealing ring (17) and the bearing (18) from the steering case (3).
NOTE. Note down the orientation of both centring ring (16) and sealing ring (17).

AXLE ASSEMBLY - DISASSEMBLY

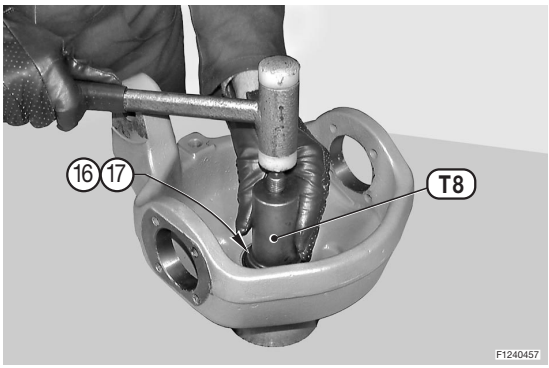


Assembly



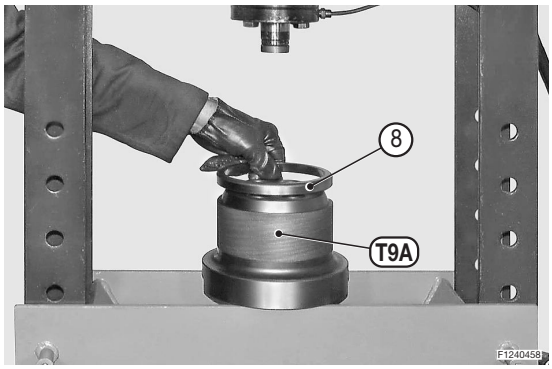
GB a

Lubricate the bushing (18) and the seat of the steering case (3).
Install the bushing (18), using tool T7.



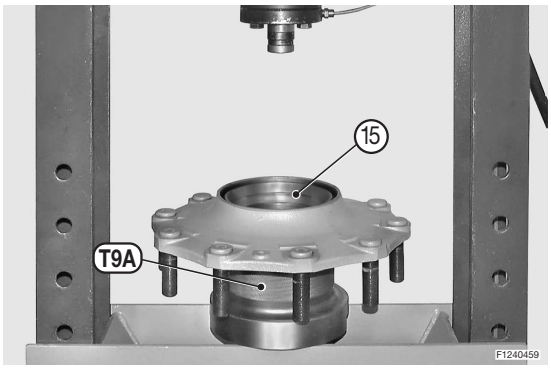
GB b

Lubricate the outer surface of the sealing ring (17) and centring ring (16); fit them into their seat using tool T8.



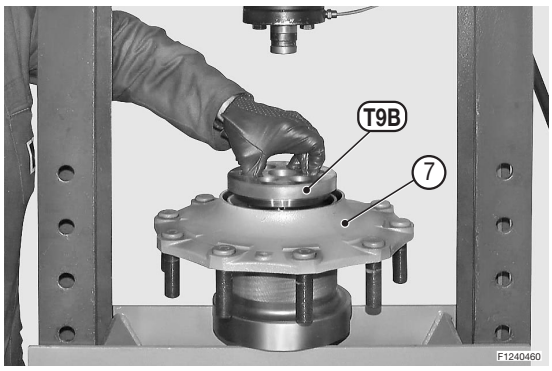
GB c

Position the lower part of tool T9A and the thrust block of the external bearing (8) under the press.



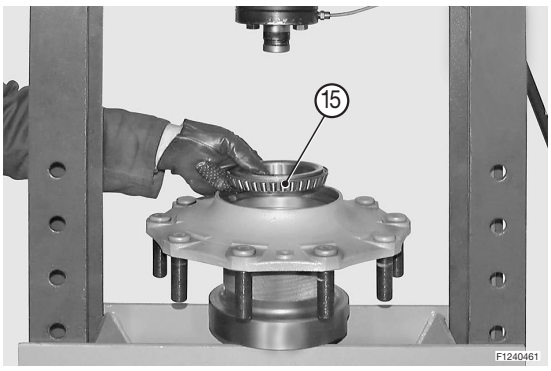
GB d

Lubricate the seats of the bearings and position the hub (7) on tool T9A; position the thrust block of the internal bearing (15).
NOTE. Check that the thrust block is correctly oriented.



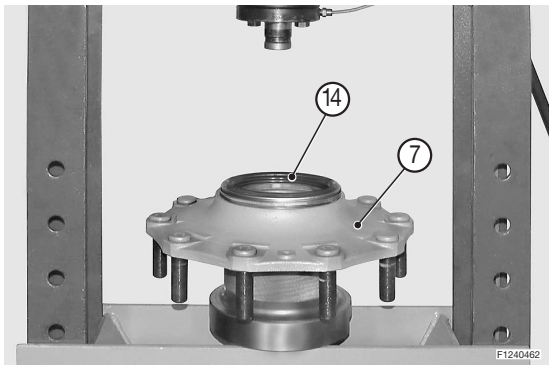
GB e

Position the upper part of tool T9B and press the thrust blocks into the hub (7) all the way down.



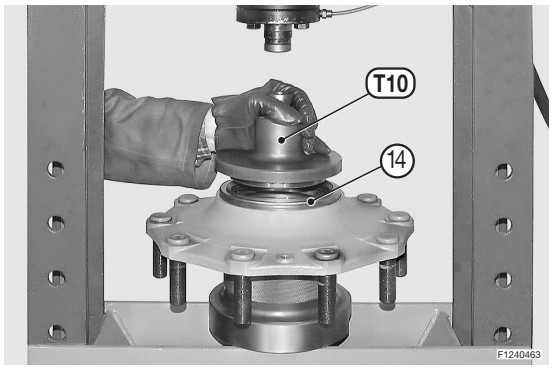
GB f

Fit the bearing (15) into the internal thrust block.



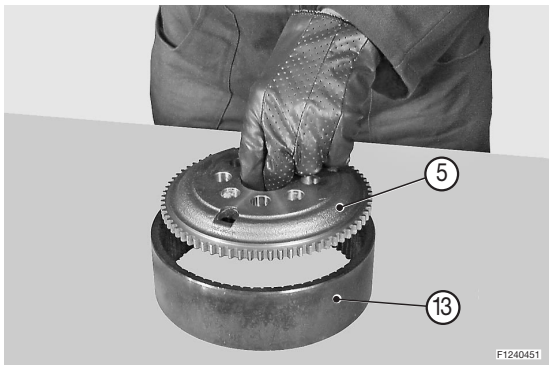
GB a

Apply a repositionable jointing compound for seals to the outer surface of the sealing ring (14). Position the sealing ring (14) in the hub (7).
NOTE. Check that the ring (14) is correctly oriented.



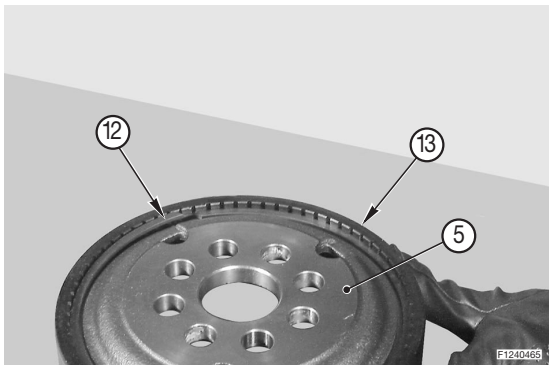
GB b

Position tool T10 and press the sealing ring (14) into its seat.



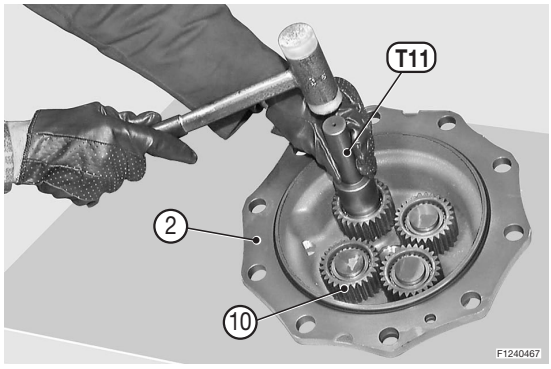
GB c

Insert the flange (5) in the crown (13).



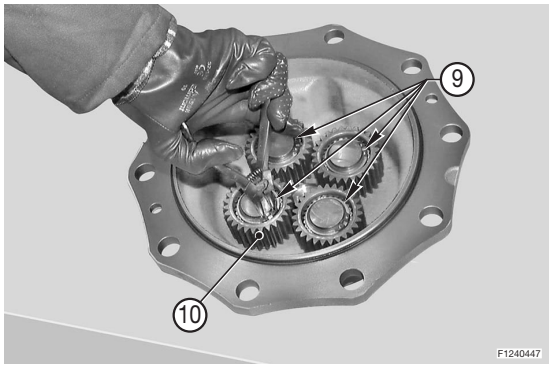
GB d

Insert the snap ring (12) in order to fix the flange (5) in the crown (13).
NOTE. Carefully check that ring (12) is properly inserted in the slot of the crown (13).



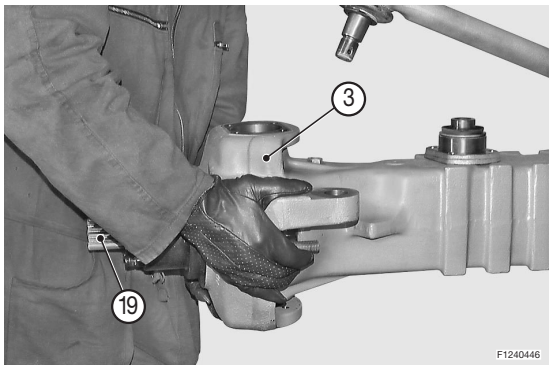
GB e

With the help of tool T11, insert the planet wheel gears (10) into the cover (2).
Accurately check the orientation.



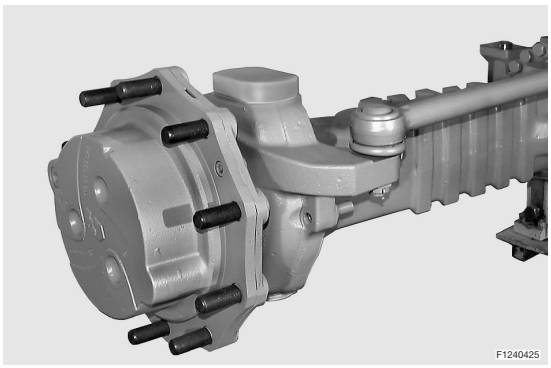
GB f

Lock the gears (10) into position by fitting the snap rings (9).



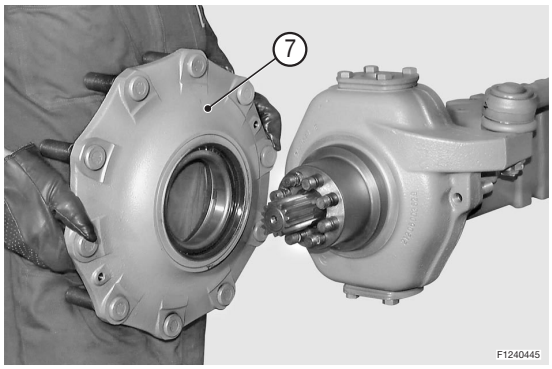
GB a

Fit the steering case (3) onto the U-joint (19) and install the articulation pins.
For pin assembly details, see "HOW TO ASSEMBLE THE COMPLETE STEERING CASE".



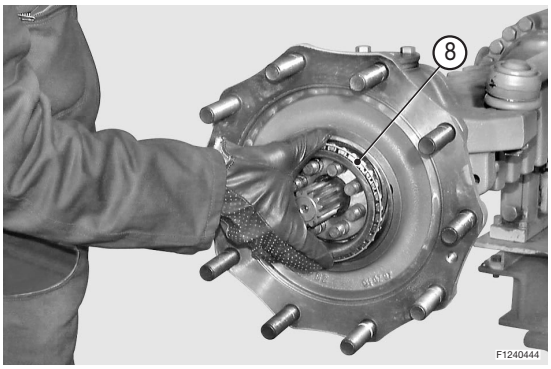
GB b

Connect the steering bars.
For details, see "HOW TO INSTALL THE COMPLETE STEERING CASE".



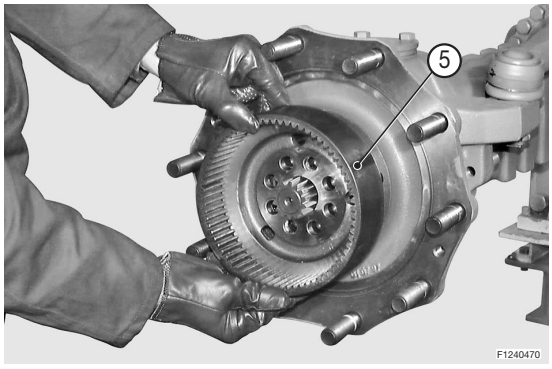
GB c

Install the hub (7).



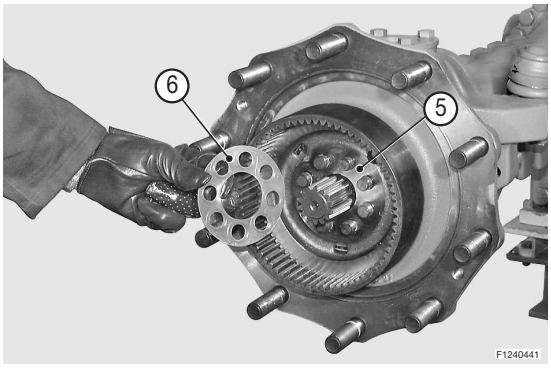
GB d

Install the external bearing (8).
NOTE. Using a plastic hammer, drive the bearing to the limit stop by lightly hammering around the edge.



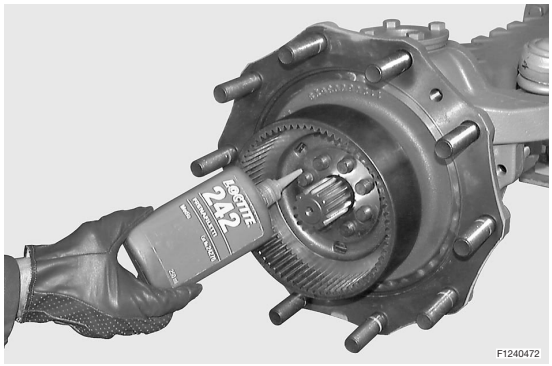
GB e

Fit the complete crown flange (5).
NOTE. In order to fasten the flange (5), use a plastic hammer and alternately hammer on several equidistant points.



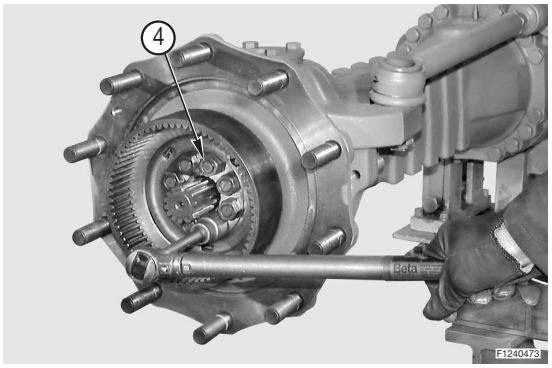
GB f

Apply Tecnolube Seal 101 grease to the surface of the safety flange (6) which touches the crown flange (5).
Fit the safety flange (6).



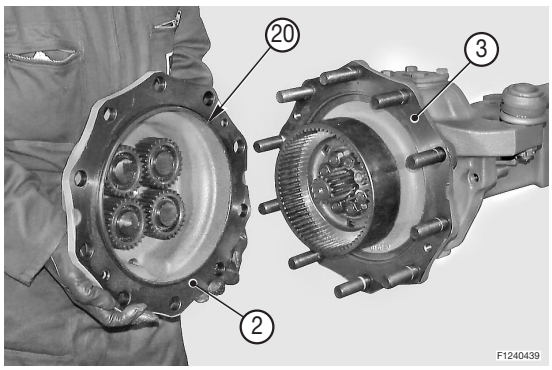
GB a

Apply Loctite 242 to the studs and fit in the nuts (4).



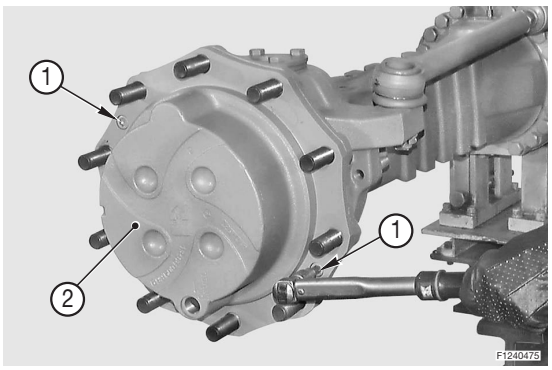
GB b

Cross tighten the nuts (4) in two stages.
Initial torque wrench setting: 120 Nm
Final torque wrench setting: 255÷285 Nm



GB c

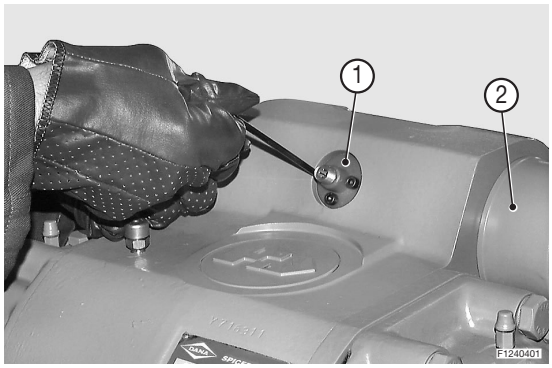
Fit the planetary carrier cover (2) onto the hub (3).
CAUTION! Check that the O-ring (20) is in good condition and in position.



GB d

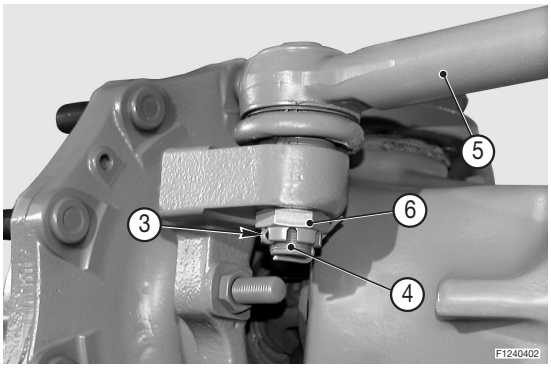
Lock the planetary carrier cover (2) by tightening the screws (1).
Torque wrench setting for screws: 40÷50 Nm

STEERING CYLINDER - Removal



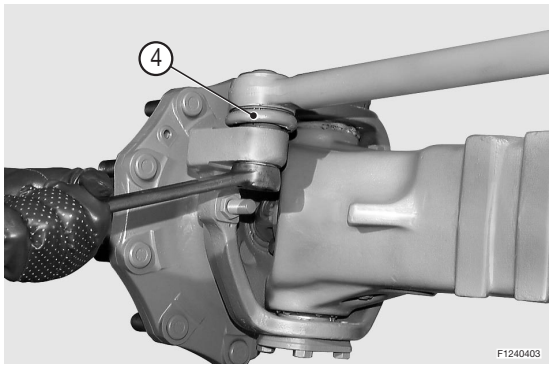
GB a

Remove the centring sensor (1) of the steering piston (2), if supplied.



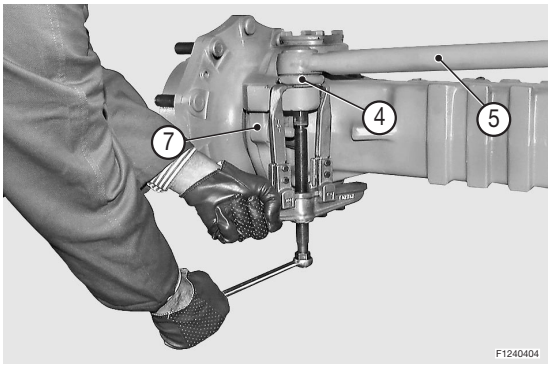
GB b

Remove the safety cotter pins (3) from the articulation pins (4) of the steering bars (5).
CAUTION! Dispose of used cotter pins.



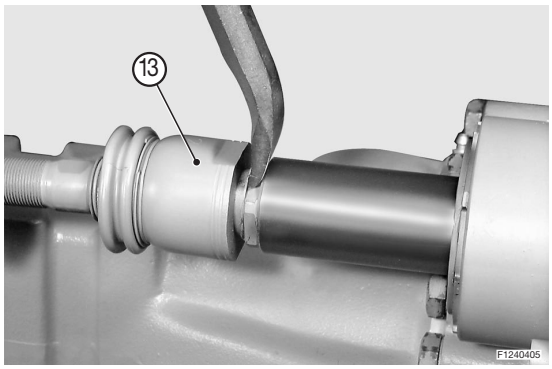
GB c

Remove the castellated nuts (6) that lock the articulation pins (4).



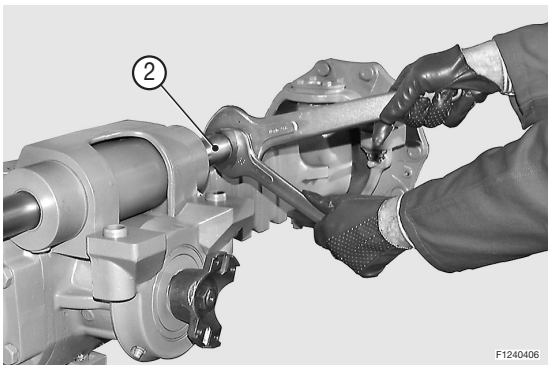
GB d

Disconnect the tapered pins of the articulation (4) from the steering case (7) by means of a puller.



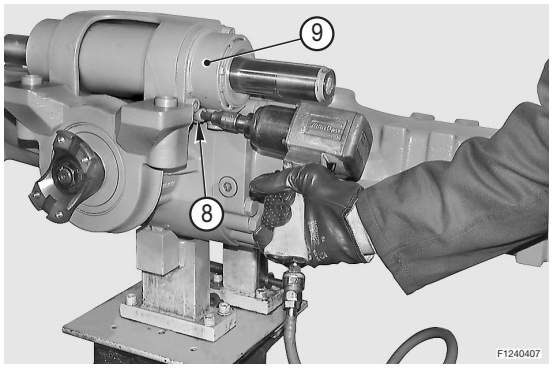
GB e

If the connection of the steering bars includes a safety collar (13), raise the border.



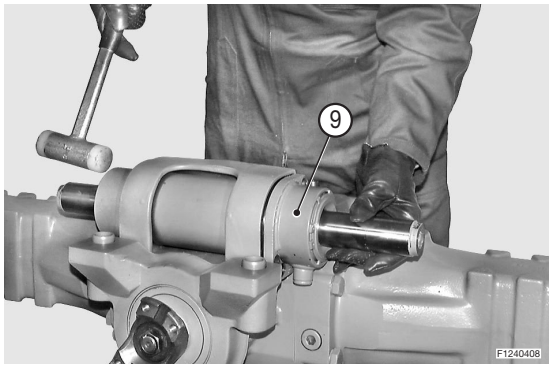
GB f

Disconnect left and right steering bars (5) from the piston (2).



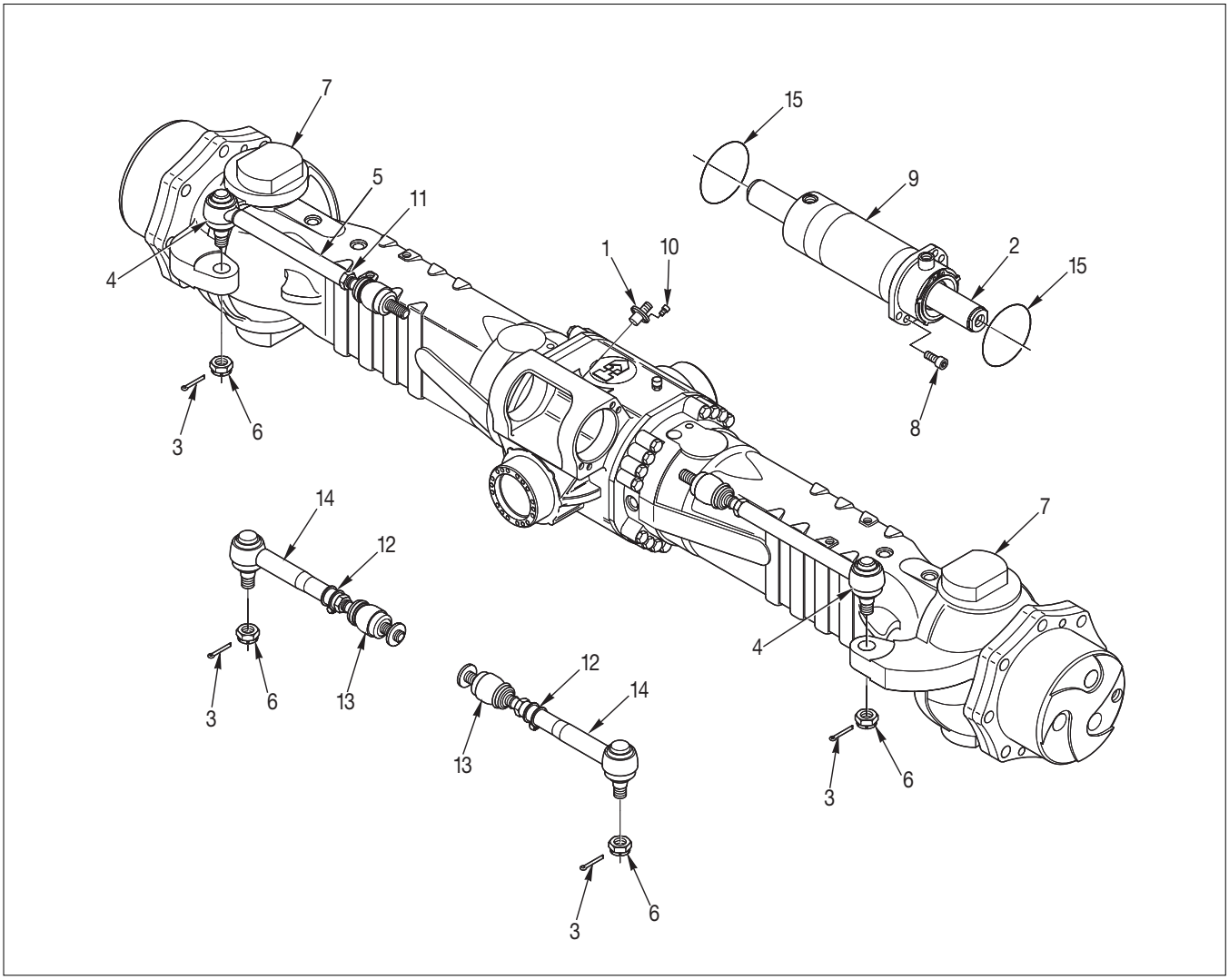
GB a

Remove the securing screws (8) from the steering cylinder (9).

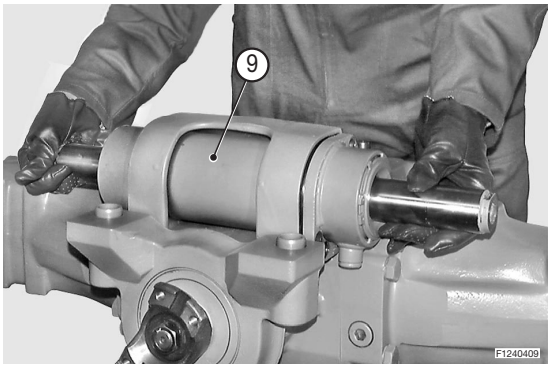


GB b

Extract the cylinder (9) using a plastic hammer.
NOTE. For cylinder disassembly, refer to "HOW TO DISASSEMBLE THE STEERING CYLINDER".

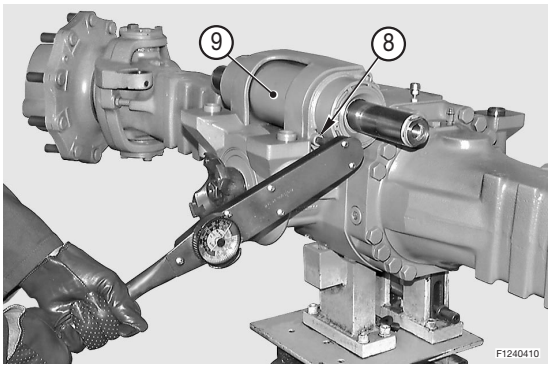


Installation



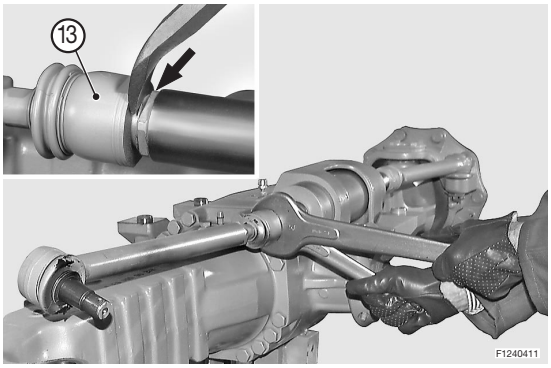
GB a

Check that the O-rings (15) of the axle unit are in good condition; lubricate the seats of the seals (15) and fit the steering cylinder (9) into its seat.
Lock the cylinder by cross- tightening the screws (8).
Torque wrench setting: 116÷128 Nm



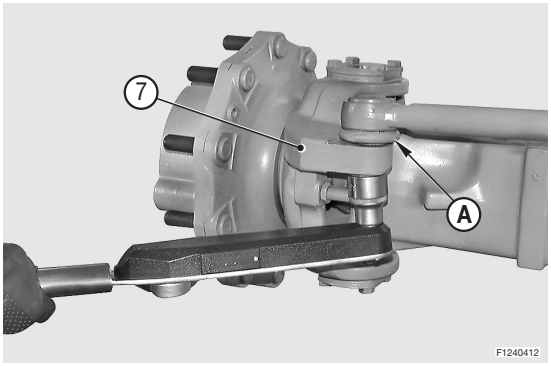
GB b

Apply Loctite 242 to the thread and connect the steering bars by screwing the terminals onto the piston stem.
Torque wrench setting: 240÷270 Nm
NOTE. Versions with coupling require that the rim of the articulation (13) is riveted onto the surfaces of the piston stem.



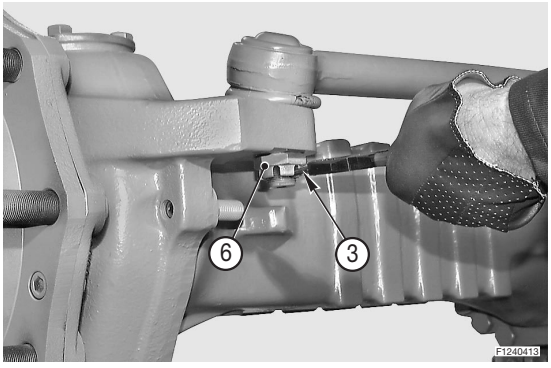
GB c

Insert the pins (4) in the steering case (7) and lock into position using a torque wrench setting of 260÷290 Nm.



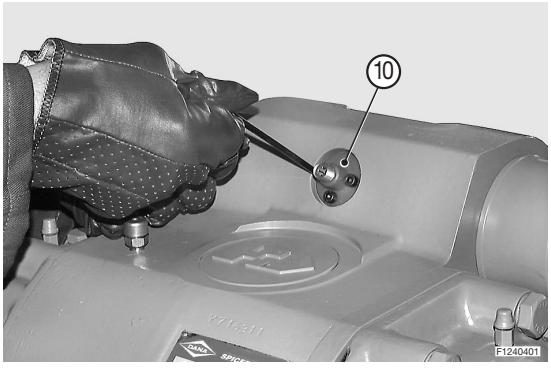
GB d

Find the position of the notching in relation to the hole of the cotter pins and tighten the nut (6) further.
CAUTION! Check that rubber guards (A) are intact.



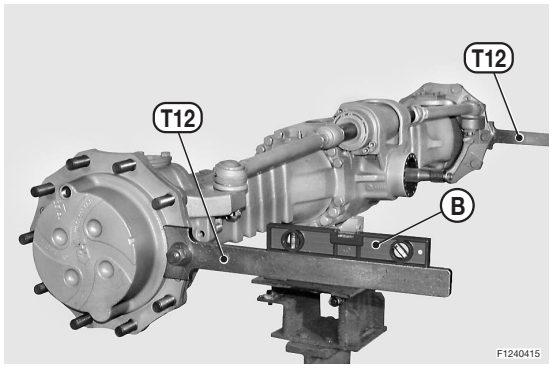
GB e

Insert the cotter pins (3) and bend the safety stems.
CAUTION! Use new cotter pins.



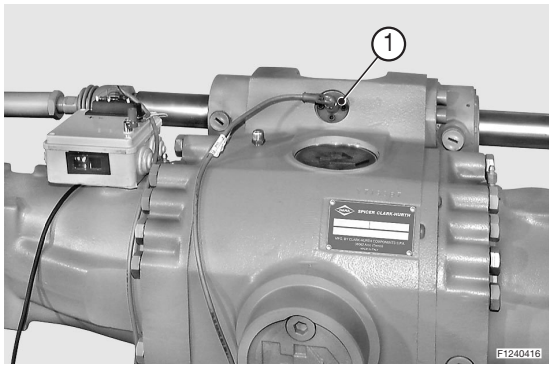
GB f

Install the proximity (1) for checking piston centring - if applicable - and tighten the screws (10).
Torque wrench setting: 5÷6 Nm



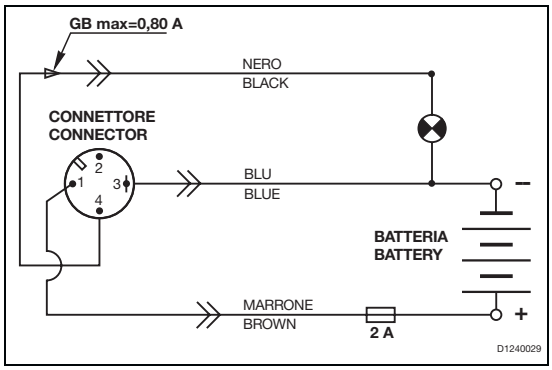
GB a

CAUTION. Eliminate the action of the negative brake, if fitted.
Apply tools T12 to the hubs and lock them.
Using a level “B”, check that tools are perfectly flat and parallel to each other.



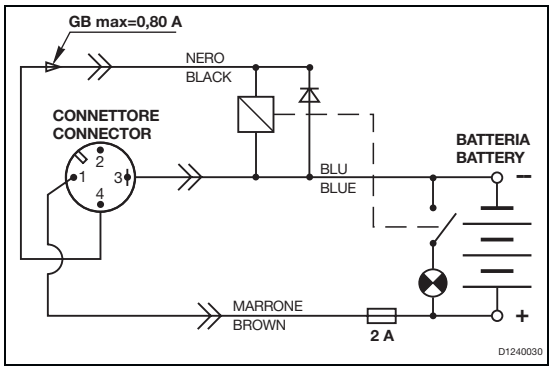
GB b

Connect the sensor (1) to the inspection device according to either diagram.



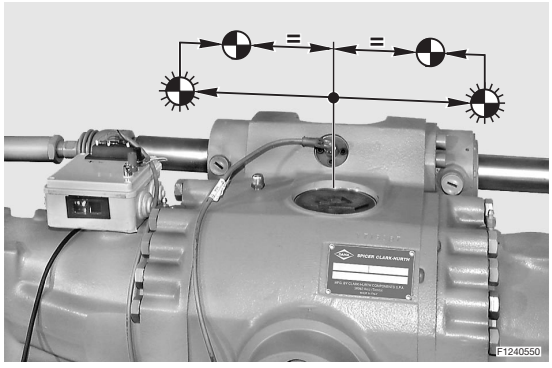
GB c

Sensor connection card, STANDARD version.



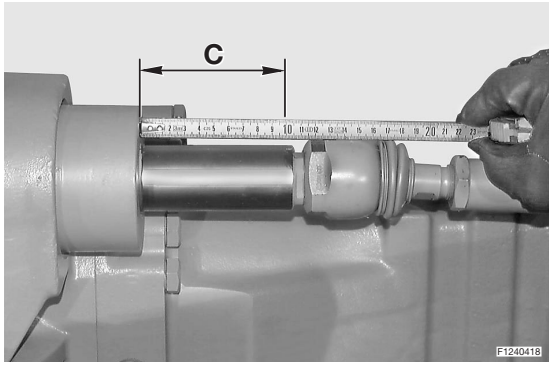
GB d

Sensor connection card, OPTIONAL version.



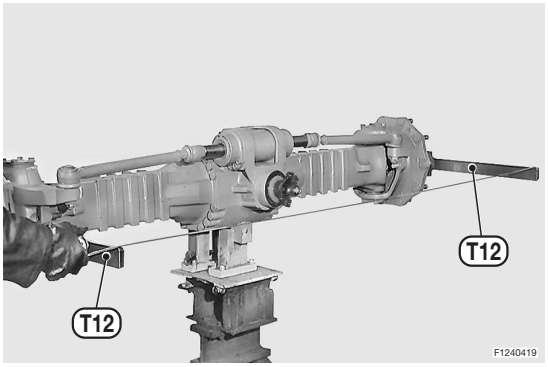
GB e

Centre the piston by slowly moving it first in one direction then in the other and position it half way on the stroke, which is determined by the switching on and off of the signal lamp of the inspection device in the reversal stage.



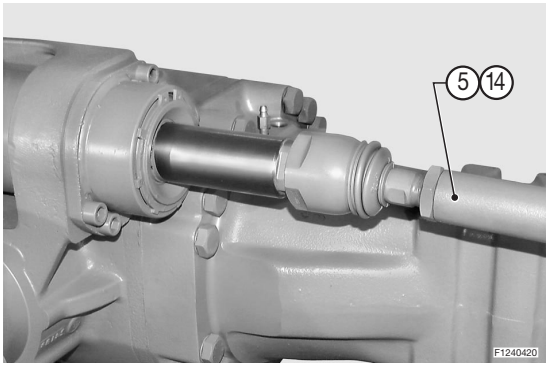
GB f

Inspect jut “C” on one side of the piston and note down the size for checking later adjustments.
NOTE. If cylinders come without a sensor, the centring of the piston must be carried out on the basis of the maximum stroke.



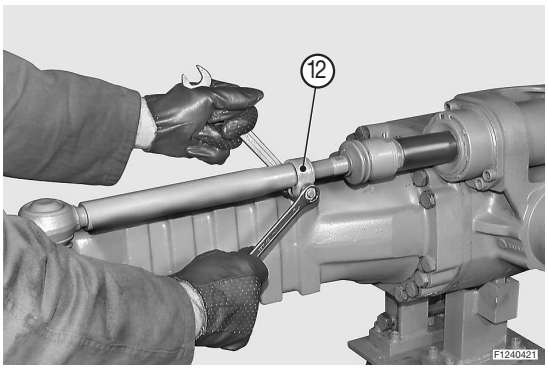
GB a

Without moving the piston, check front and rear size at the edge of tools T12.
Max. difference: 0.6÷0.7 mm
NOTE. In order to check the rear size, rotate the bevel pinion and check that tools T12 are flat.



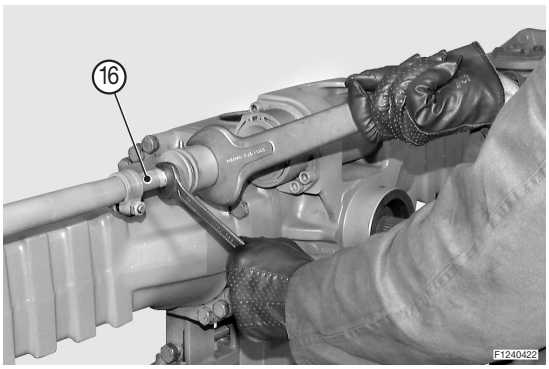
GB b

If necessary, adjust convergency without moving the centring of the piston and adjust the length of the steering bars (5) or (14).
NOTE. With a half turn of screw, the front size is reduced by about 3 mm, whereas the rear one is increased by about 3 mm.



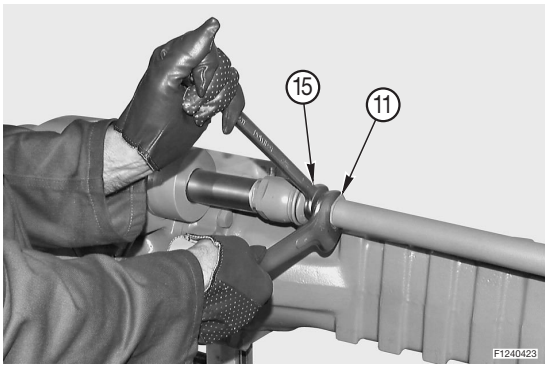
GB c

CONVERGENCY ADJUSTMENT ON UNITS WITH COLLAR
Unloose the nuts on the collars (12).



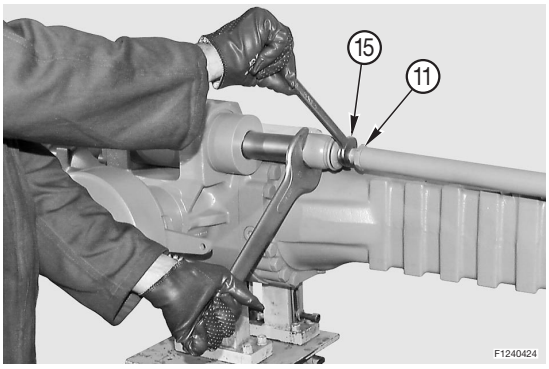
GB d

Rotate the ball-and-socket joints (16) until convergency has been obtained.
Check that articulations move easily and lock the collars (12).
Torque wrench setting for nuts: 42÷52 Nm



GB e

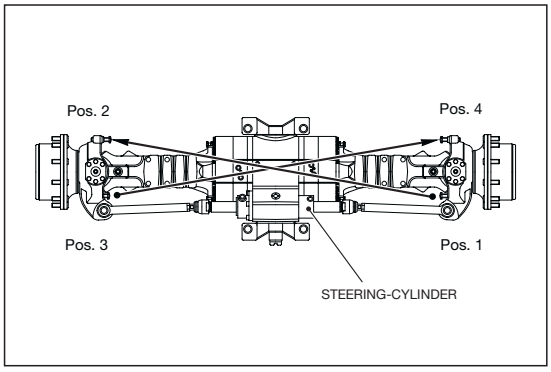
CONVERGENCY ADJUSTMENT ON ALTERNATIVE VERSIONS
Unloose the nuts (11) and screw them onto the ball-and-socket joints (15).



GB f

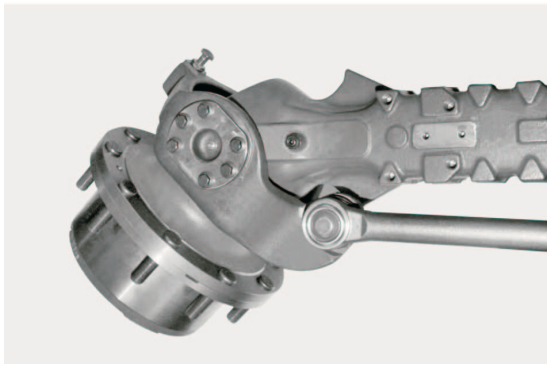
Hold the articulations still and rotate the ball-and-socket joints (15).
Once the convergency has been adjusted, lock the nuts (11).
Torque wrench setting for nuts: 298÷328 Nm

Disassembly



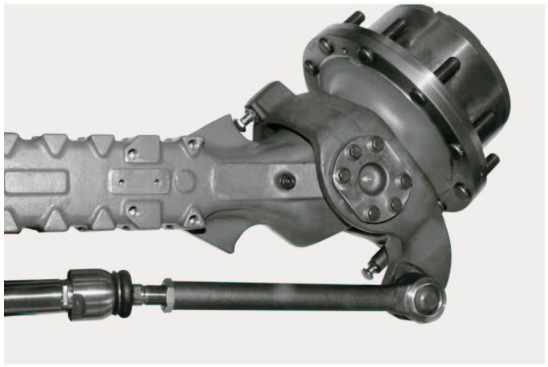
GB a

ADJUSTING THE STEERING ANGLE
NOTE. Perform the same operations on both sides (see diagram). Loosen the nut of one of the adjusting screws on cylinder side.



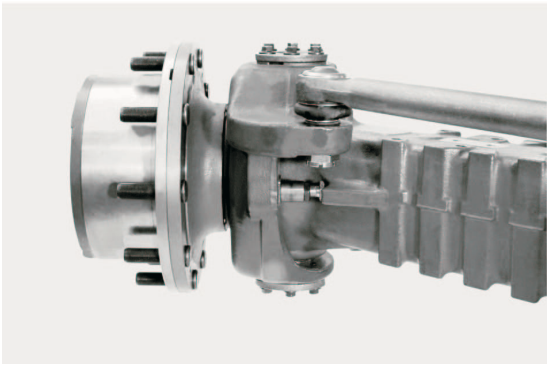
GB b

Perform one full steering operation until the adjusted screw leans against the arm stop.



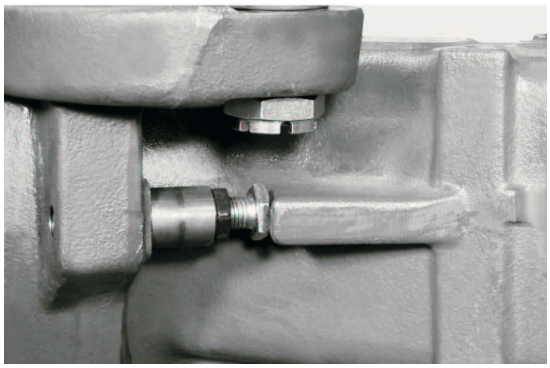
GB c

Perform one full steering operation until the adjusted screw leans against the arm stop.



GB d

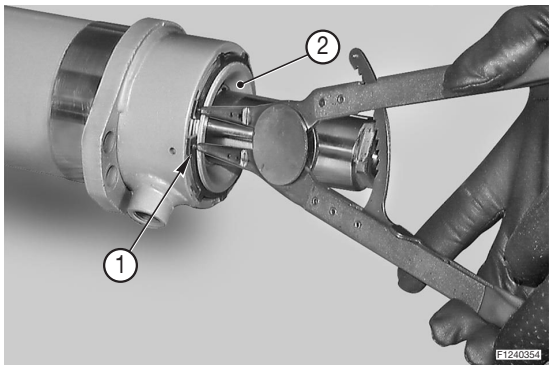
As you hold the adjusted screw in position against the arm stop, adjust the screw opposite, on non-cylinder side, until it jeans against the arm stop.



GB e

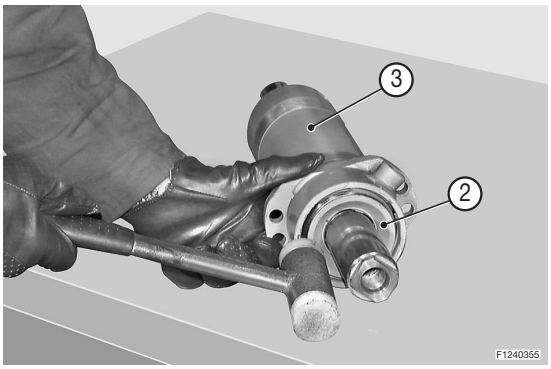
IMPORTANT! The screws must lean against the respective arm stops ail at the same time.

STEERING ANGLE		40°	37°	36°	35°	30°	29°
DISTANCE	"B" mm	30	37	39,4	41,8	53,3	38,2



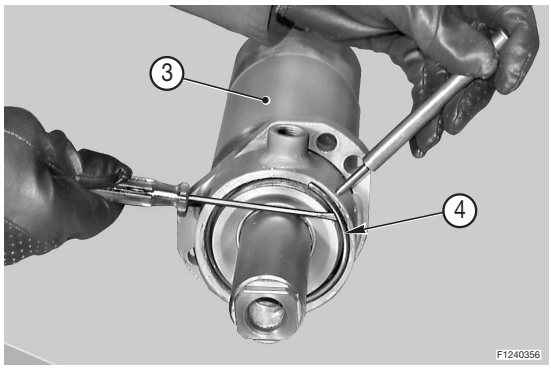
GB a

Remove the snap ring (1) from the cylinder head (2).



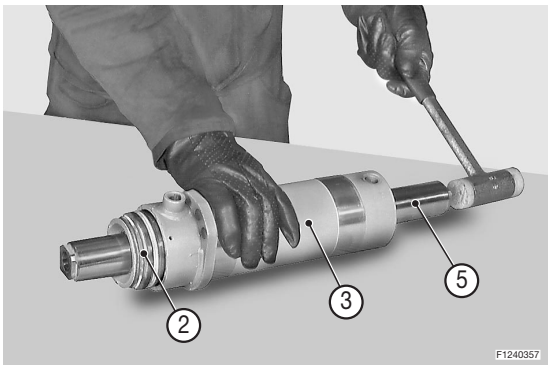
GB b

With the help of a plastic hammer, push the head (2) inside the cylinder (3).
NOTE. The head should line up with the edge of the cylinder.



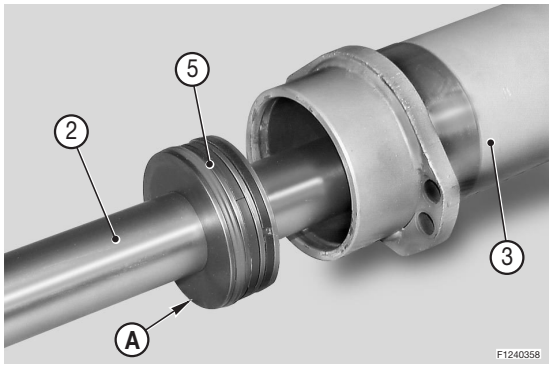
GB c

With the help of a drift, apply pressure to the stop ring (4) that is placed inside the cylinder (3) and extract the ring using a screwdriver.



GB d

Hammer the piston (5) on the rear of the head (2) using a plastic hammer.
Continue hammering until the head (2) is ejected from the cylinder (3).



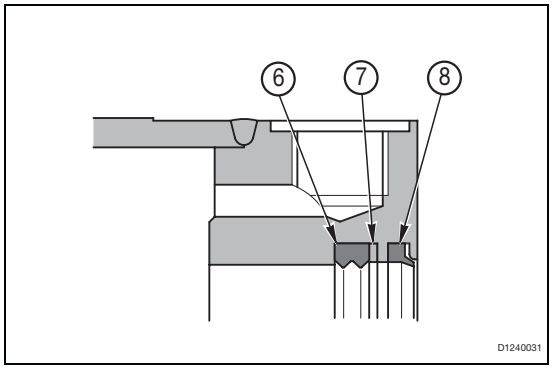
GB e

Disassemble the cylinder unit (3) by extracting first the head (2), then the piston (5).
CAUTION! Note down the assembly side of the piston (5). The bevelled part "A" of the piston is oriented towards the head (2).

GB f

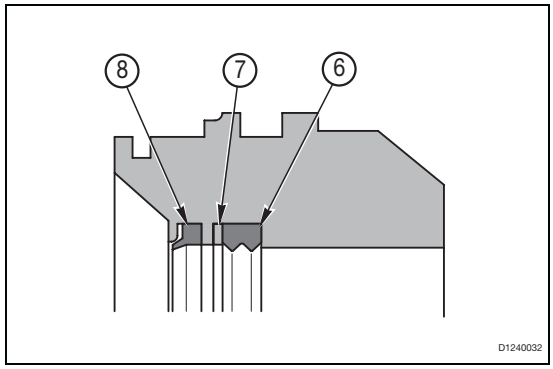
Remove all seals, anti-extrusion rings and scraper rings from head (2), cylinder (3) and piston (5).
NOTE. 1 - All seals must be replaced every time the unit is disassembled. 2 - Particular attention must be paid not to damage the seats of both seals and piston slide

Assembly



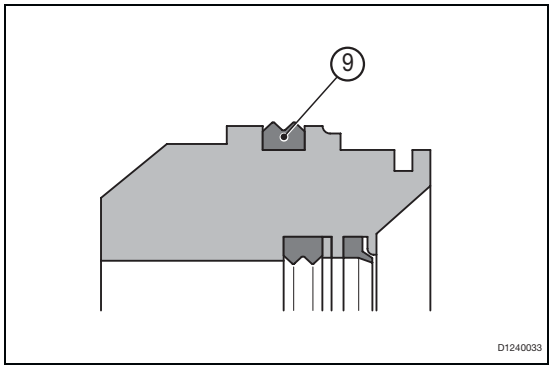
GB a

After applying grease, install the sealing ring (6) of the shaft, the anti-extrusion ring (7) and the scraper ring (8) inside the cylinder (3).
CAUTION! Thoroughly check that positioning of the anti-extrusion ring (7) is correct.



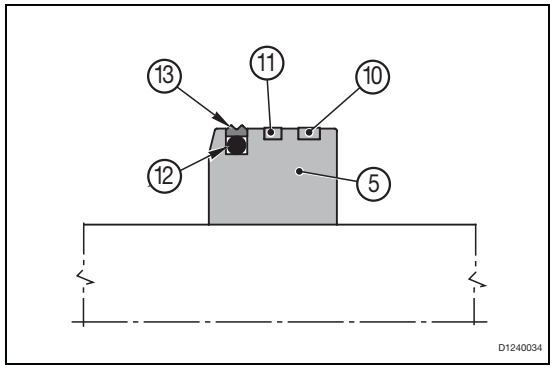
GB b

After applying grease, install the sealing ring (6) of the shaft, the anti-extrusion ring (7) and the scraper ring (8) in the head (2).
CAUTION! Thoroughly check that positioning of the anti-extrusion (7) ring is correct.



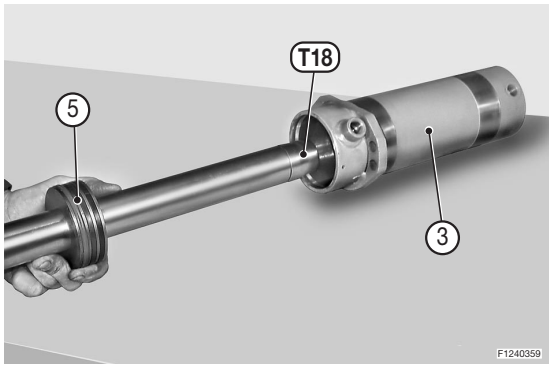
GB c

Fit the seal (9) onto the outside of the head (2).
CAUTION!
1 - In order to facilitate assembly, apply grease to the outer surface of the piston.
2 - Do not roll the seal (9) up.



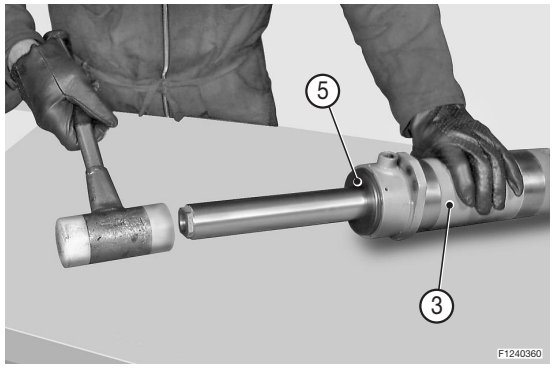
GB d

Prepare the piston (5) by fitting it with the guide ring (10), the magnetic ring (11), the O-ring (12) and the seal (13).
CAUTION! 1 - In order to facilitate assembly, apply grease.
2 - If a centring sensor is not fitted, then the magnetic ring (11) should be replaced by another guide ring (10).



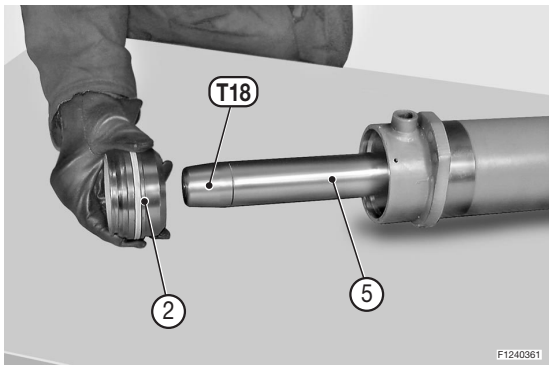
GB e

Apply tool T18 to the shaft on the opposite side of the head (2) and centre it on the cylinder (3) so that it fits into the piston (5).
NOTE. Apply a little grease to seals and cylinder.



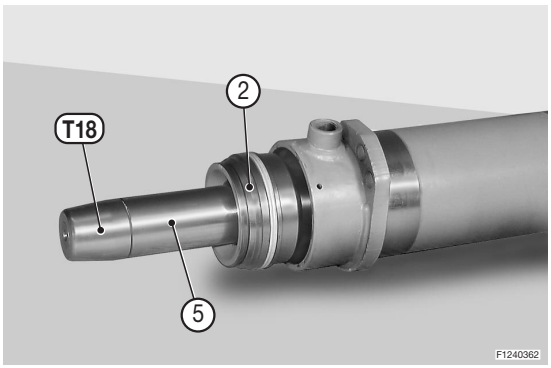
GB f

Push the piston (5) into the cylinder for 100 mm using a plastic hammer.



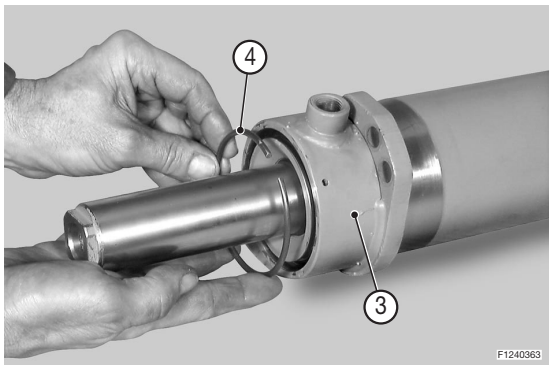
GB a

Remove tool T18 and apply it to the opposite side of the piston (5).



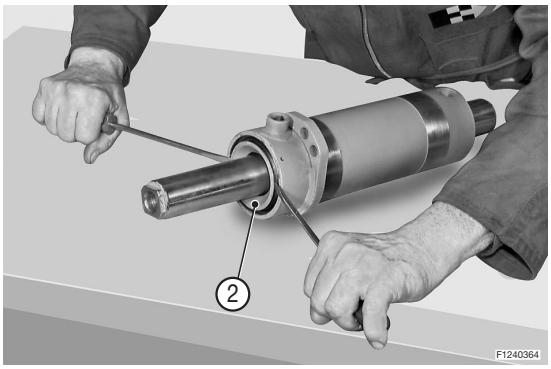
GB b

Apply grease to head (2) seals, fit the head onto the piston and push it into the cylinder (3) using a plastic hammer.
NOTE. Insert the head as to line it up with the edge of the cylinder.



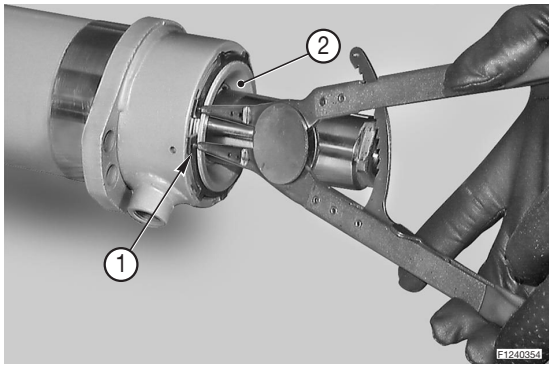
GB c

Insert the stop ring (4) ensuring that it fits into the seat of the cylinder (3).



GB d

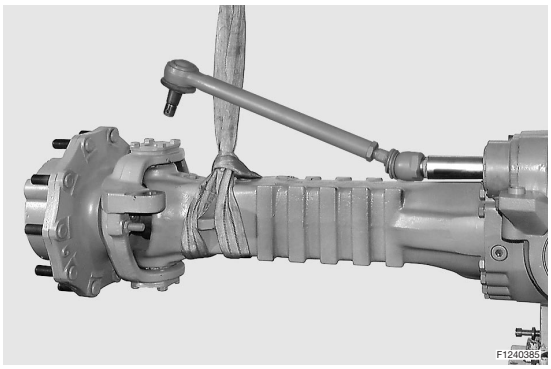
Apply pressure to the head using two screwdrivers or levers until the head is fastened onto the stop ring (4).



GB e

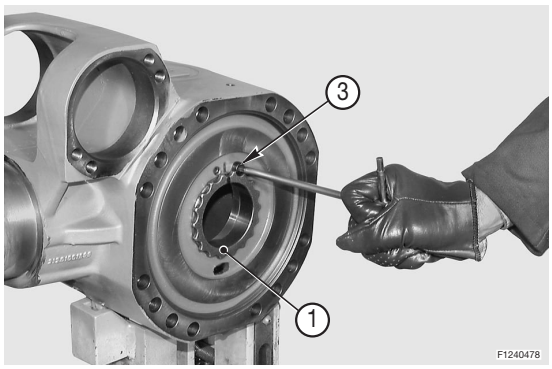
Fit the snap ring (1) on the head (2).
CAUTION! Make sure that the snap ring (1) is securely fastened in its seat.
If necessary, force it into its seat using a drift and a hammer.

DIFFERENTIAL UNIT - Removal and disassembly



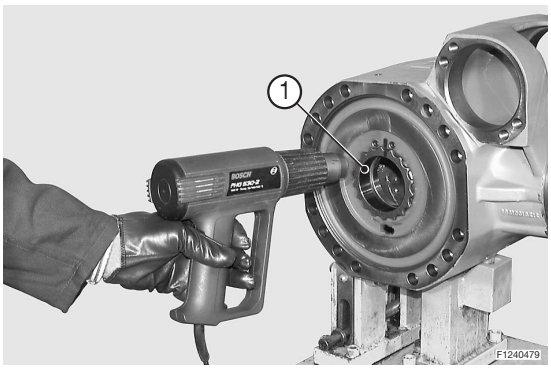
GB a

Remove the complete arms.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS".



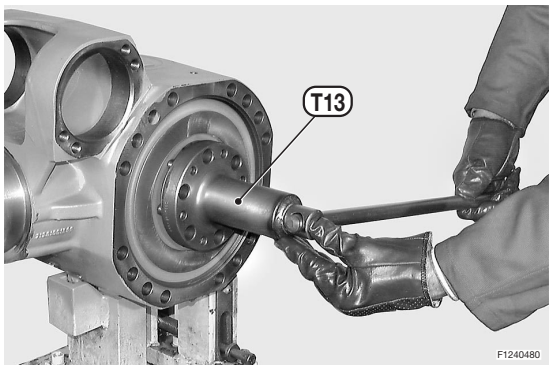
GB b

Mark the position of the ring nuts (1).
Remove the fittin screws (3) from the ring nuts (1).



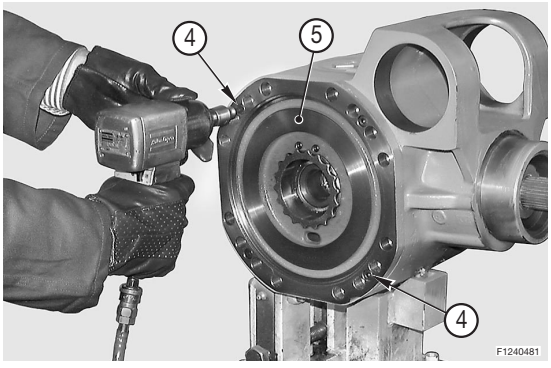
GB c

Uniformly heat the ring nuts (1) up to a temperature of 80° C.



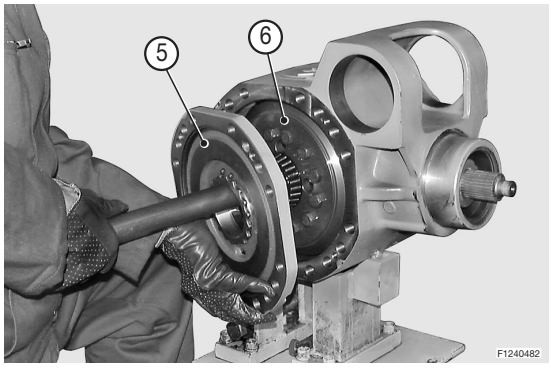
GB d

Apply tool T13 and remove the ring nuts.
NOTE. Accurately clean the threaded portions on ring nuts of body and cover.



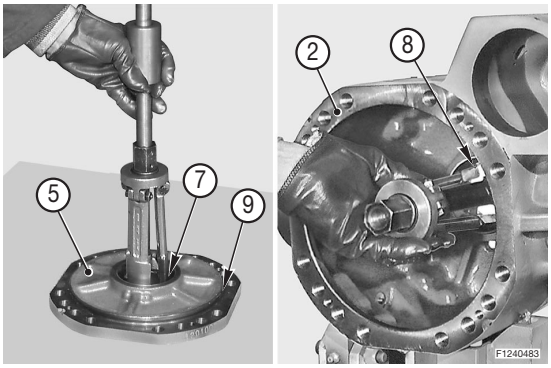
GB e

Remove the fittin screws (4) from the middle cover (5).



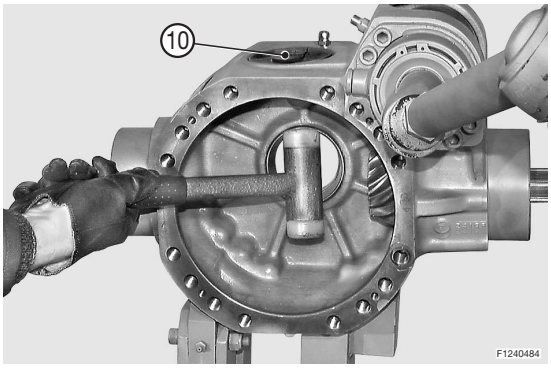
GB f

Insert a screw-driver in the opposing slots then force and remove the middle cover (5) and the complete differential unit (6).
NOTE. Support the pieces using a rod.



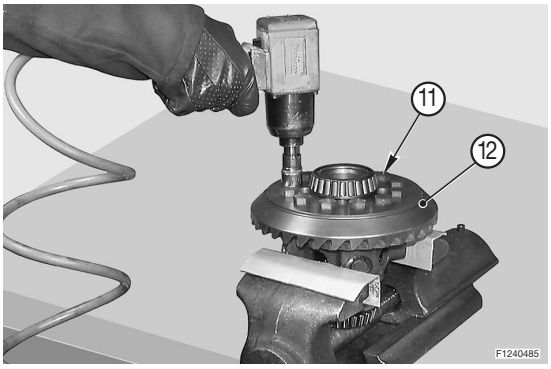
GB a

If the bearings need replacing, extract the external thrust blocks of the bearings (7) and (8) from middle cover (5) and central body (2).
NOTE. Accurately check the O-ring (9).



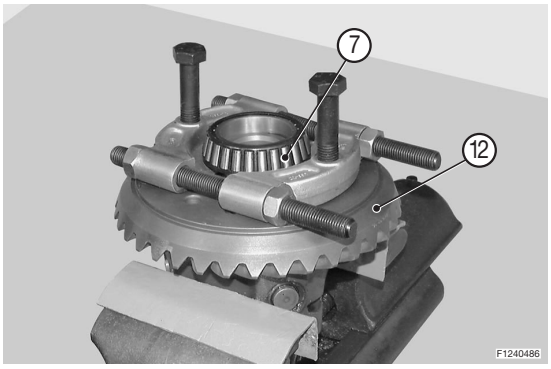
GB b

Remove the top plug (10).



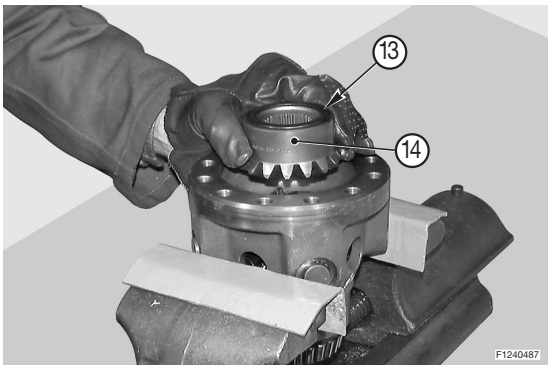
GB c

Remove the fittin screws (11) from the crown (12).



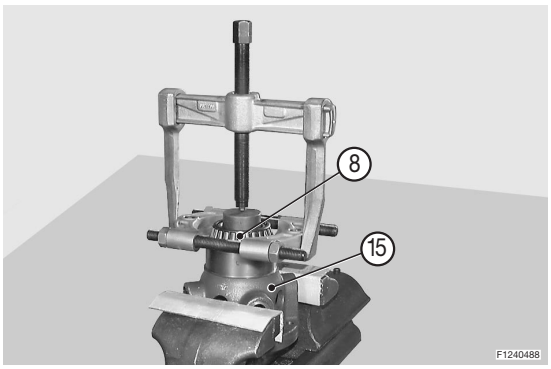
GB d

If the bearing need replacing, extract the bearing (7) and remove the crown (12).



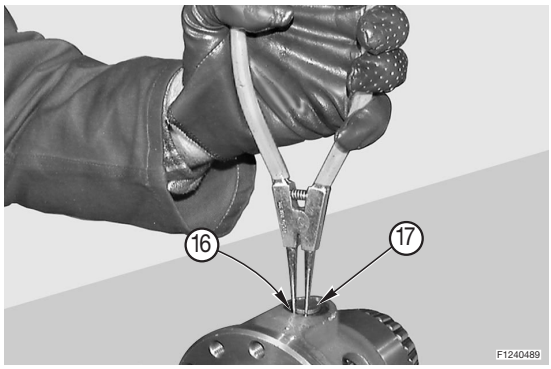
GB e

Remove the shim washer (13) and the planetary gear (14).



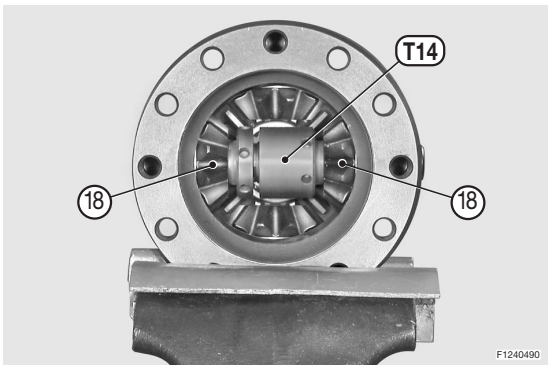
GB f

If the bearing need replacing, extract the bearing (8) from the differential carrier (15).



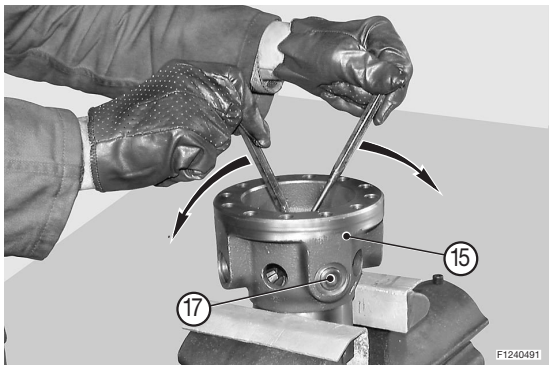
GB a

Remove the snap rings (16) from the two pins (17) of the planet wheel gears (18).



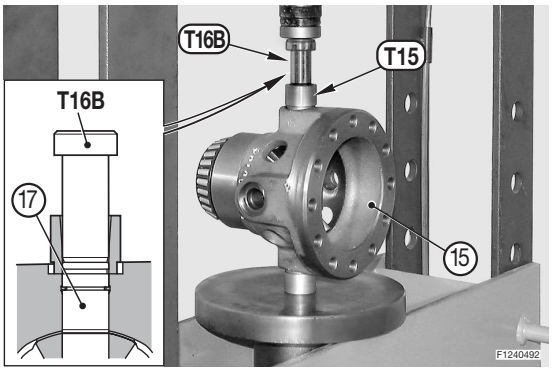
GB b

Insert tool T14 between the planet wheel gears (18).



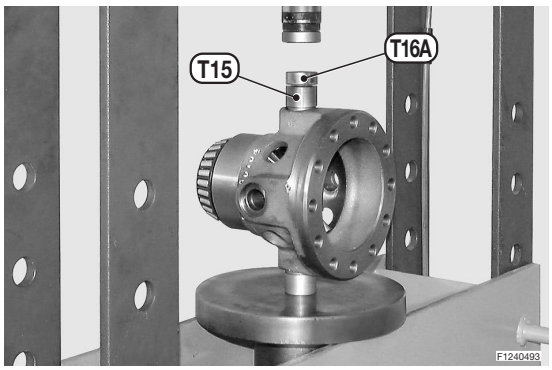
GB c

Force tool T14 in-between the planet wheel gears (18) using two pin-drivers.
CAUTION! Make sure that tool T14 is perfectly lined up with the pins (17) when locked.



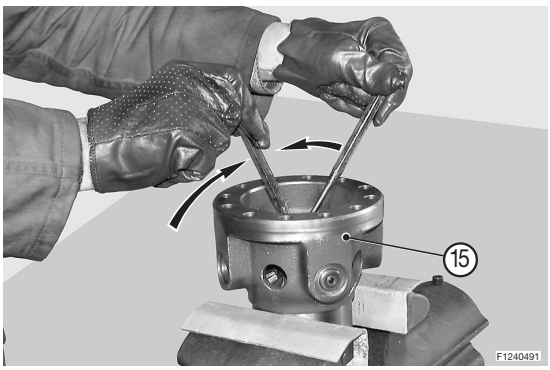
GB d

Place the differential carrier (15) under a press, position bush T15 and insert gudgeon T16A. Press T16A pin to limit position.



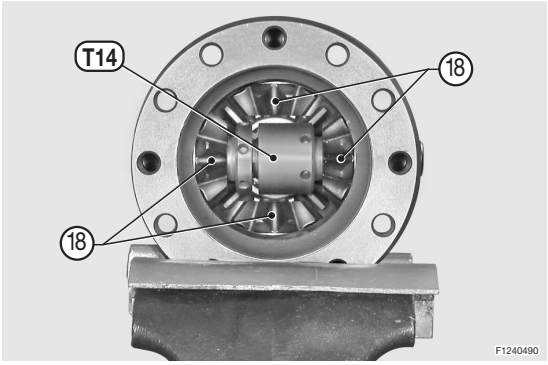
GB e

Remove gudgeon T16A and bush T15.
NOTE. In this condition the tool T14 contains pin (17).



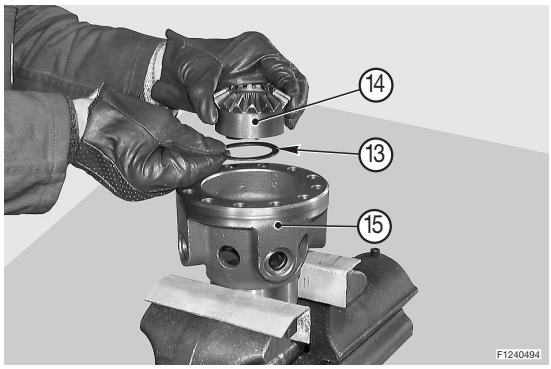
GB f

Remove tool T14 together with the pin (17) of the planet wheel.



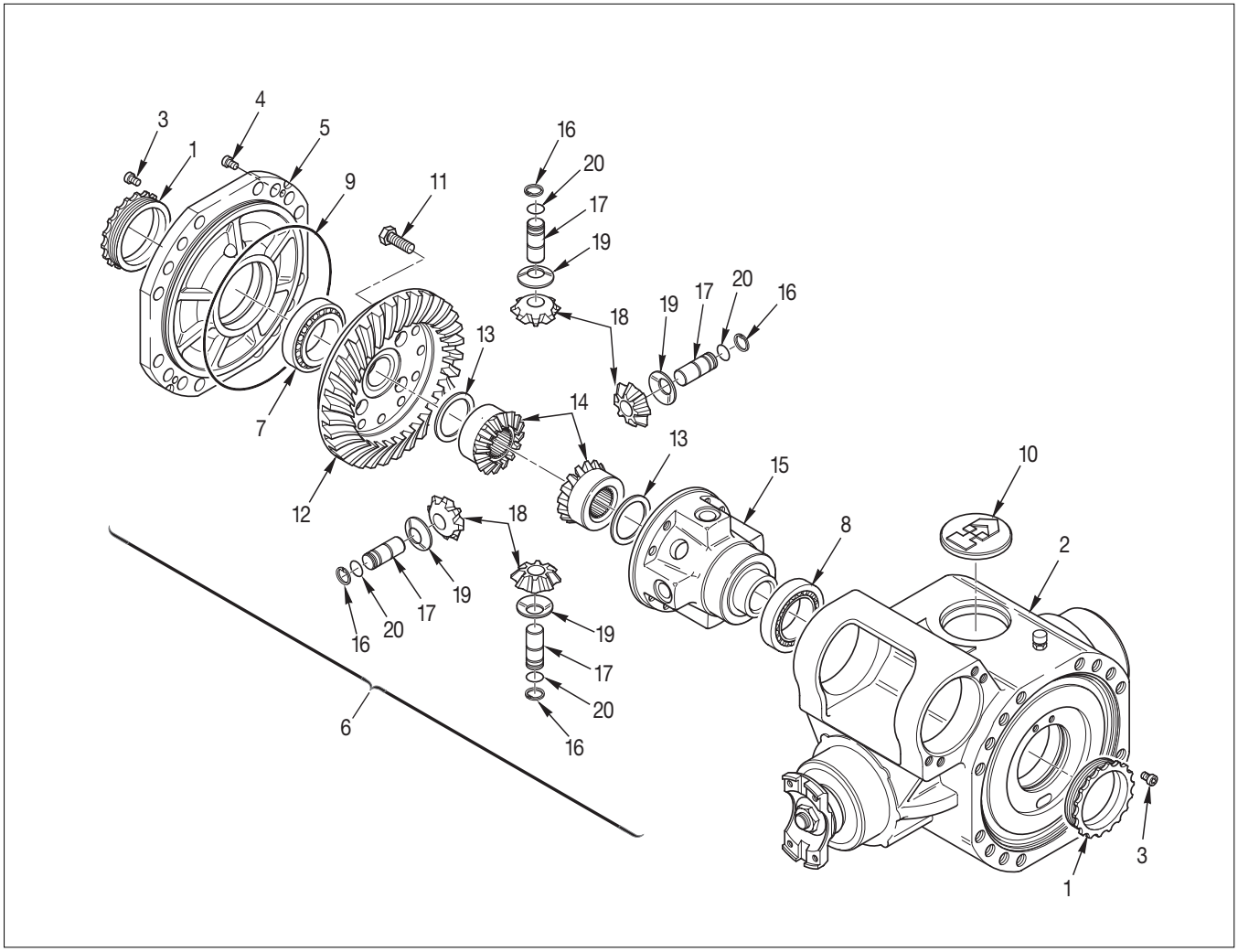
GB a

Leave the released planetary gear in position and again lock tool T14.
Repeat the operations for the extraction of the pin of the 2nd planet wheel (17).
Repeat the operations for all other pins.

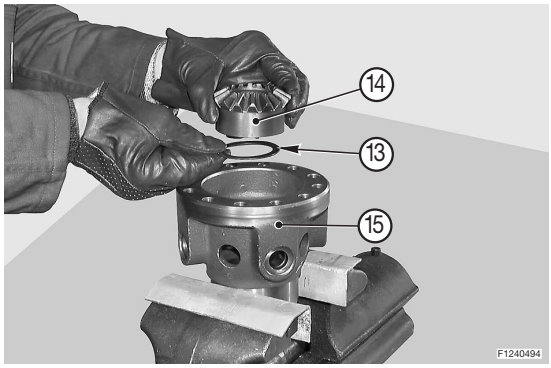


GB b

Remove tool T14 and remove the last two planet wheel gears (18), the 2nd differential unit gear (14) and the relative shim washer (13) from the differential carrier.

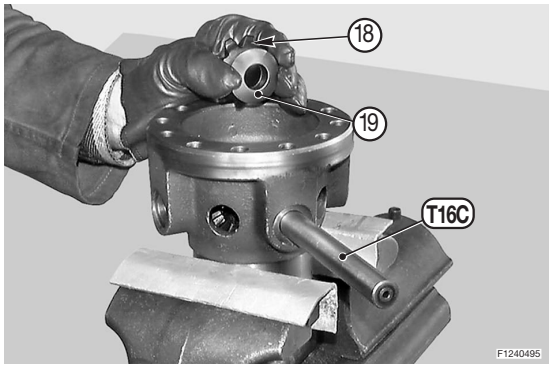


Assembly, adjusting and installation



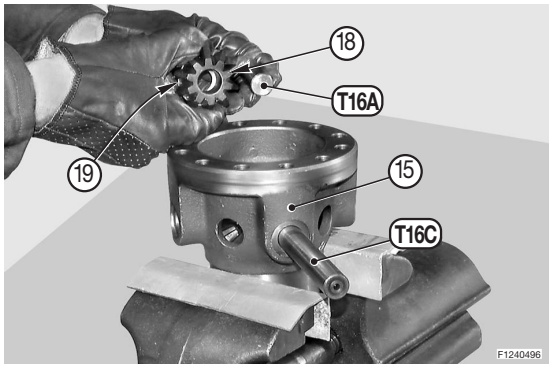
GB a

Insert the shim washer (13) and the planetary gear (14) in the differential carrier (15).



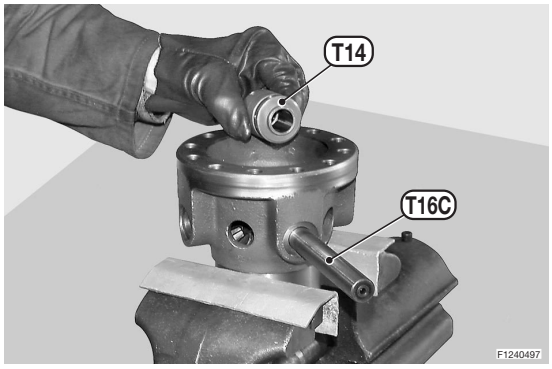
GB b

Position the shim washer (19) and the first planet wheel gear (18).
Hold them in position using bar T16C.



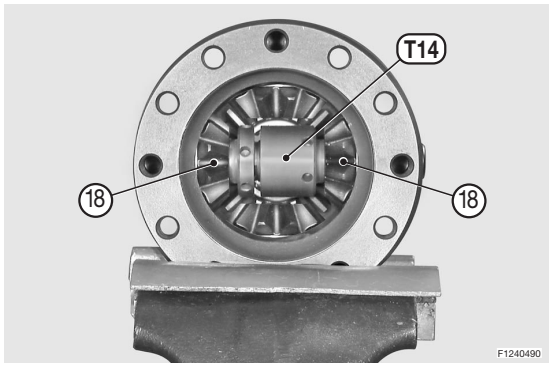
GB c

With the help of gudgeon T16A, position the second planet wheel gear (18) and the relative shim washer (19).



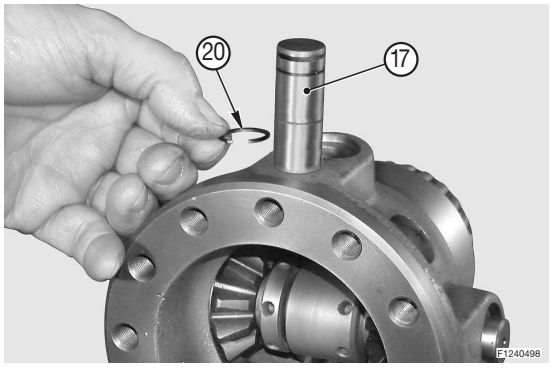
GB d

Insert tool T14 between the two planetary gears (18). Line up the entire unit by pushing bar T16C all the way down until gudgeon T16A is ejected.



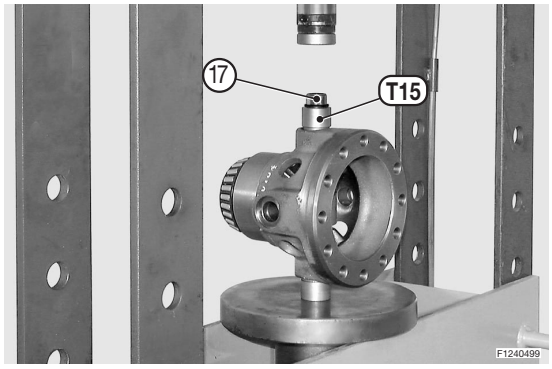
GB e

Lock tool T14 behind the planet wheel gears (18).
After locking, remove bar T16C.



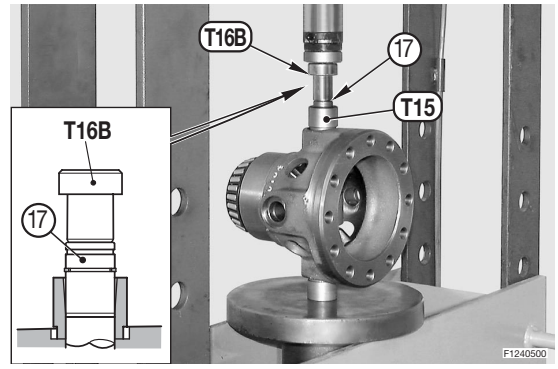
GB f

Fit the snap rings (20) onto the pins (17).



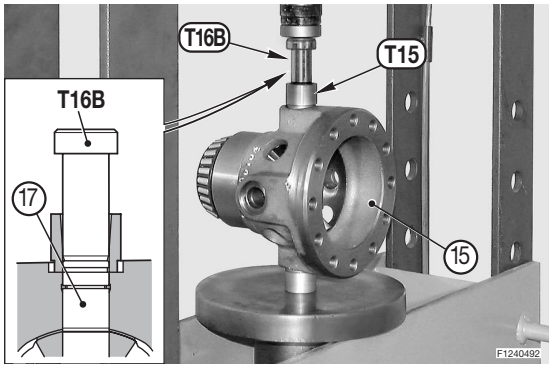
GB a

Place the differential carrier (15) under the press, position bush T15 and insert the planet wheel pin (17).



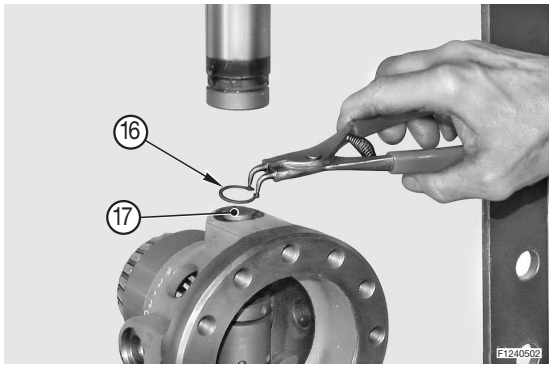
GB b

Put gudgeon T16B on top of the planet wheel pin (17).



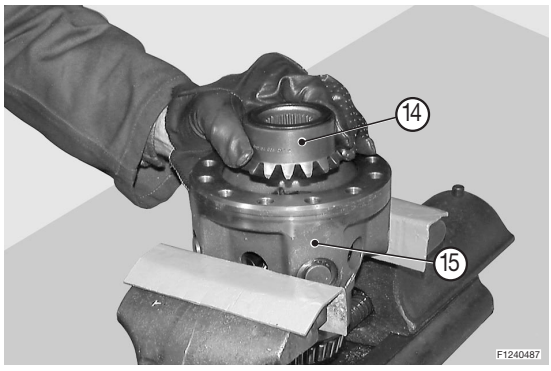
GB c

Press T16B pin all the way down.



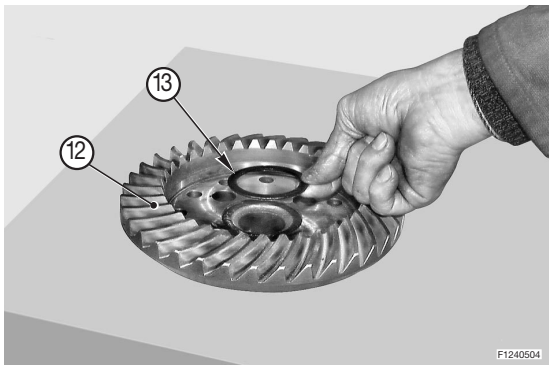
GB d

Remove gudgeon T16B, bush T15 and fit the snap ring (16) on the pin (17).
CAUTION! Make sure that the snap ring centres the seat and that it rests on the surface of the differential carrier. Repeat the operations on the other planet wheel pin or planet wheel axle.



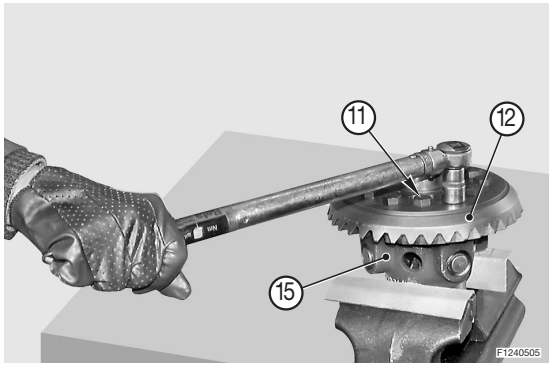
GB e

Position the second planetary gear (14) in the differential carrier (15).



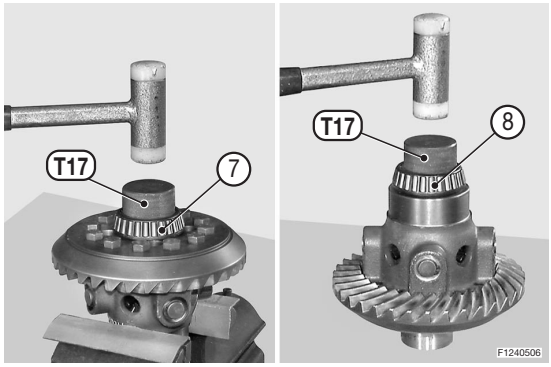
GB f

Position the shim washer (13) on the crown (12).
NOTE. In order to hold the shim washer (13) in position, apply grease to it.



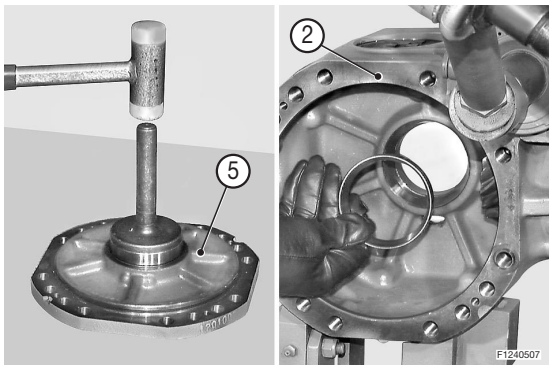
GB a

Position the crown (12) on the differential carrier (15) and lock it with screws (11) applied with Loctite 242.
Torque wrench setting for screws: 128÷142 Nm
NOTE. Secure the screws using the cross-tightening method.



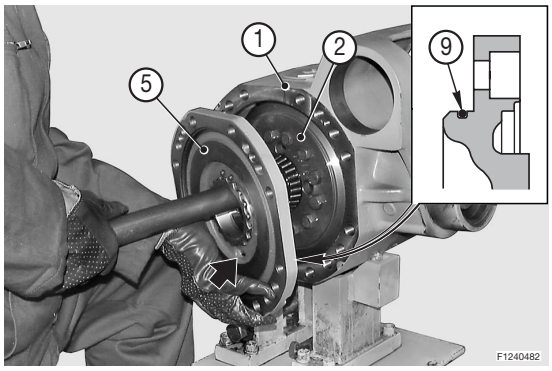
GB b

Install the bearings (7) and (8) using tool T17.



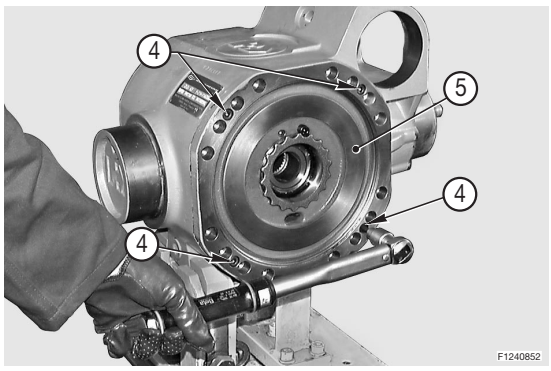
GB c

If the bearings are replaced, insert the external thrust blocks in the middle cover (5) and in the central body (2).



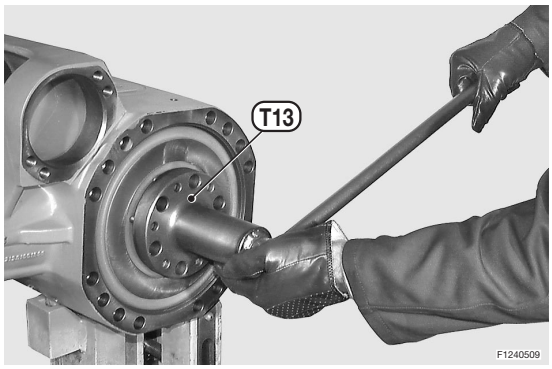
GB e

Position the differential unit (6) in the central body (2) with the help of a bar and fit the middle cover (5).
NOTE. Thoroughly check the state of the O-ring (9) and make sure that the cover is fitted with the oil discharge in the lower position.



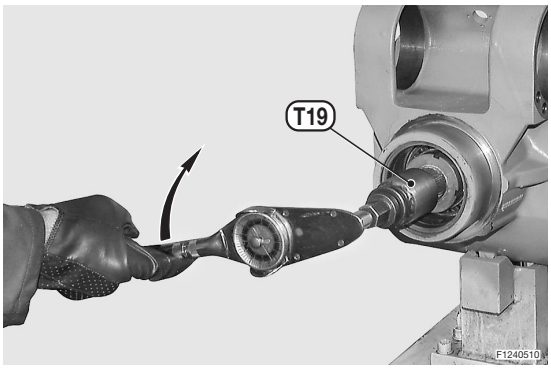
GB f

Lock the middle cover (5) with screws (4).
Torque wrench setting for screw: 23.8÷26.2 Nm



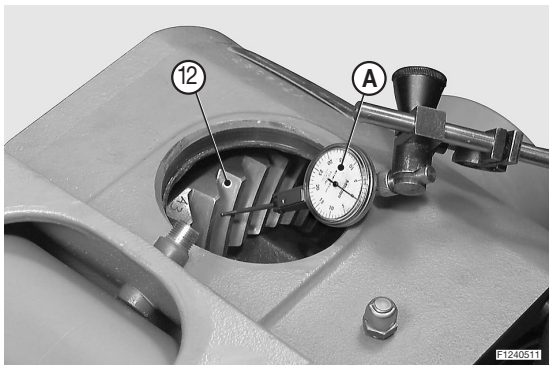
GB a

NOTE. If the ring nuts (1) are removed, spread them with Loctite 242.
Tighten ring nuts on the crown side until clearance between pinion and crown is zero, then lock the crown; go back 1/4÷1/2 turn.



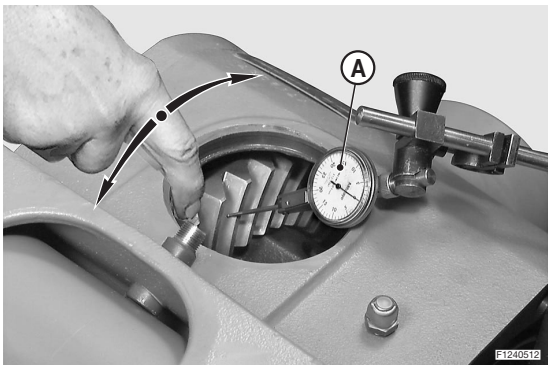
GB b

Pre-set the bearings by means of the ring nut situated on the opposite side of the crown, so as to increase pinion torque up to 140÷210 Ncm.
CAUTION! If bearings are not new, check the static torque; if bearings are new, check the continuous torque.



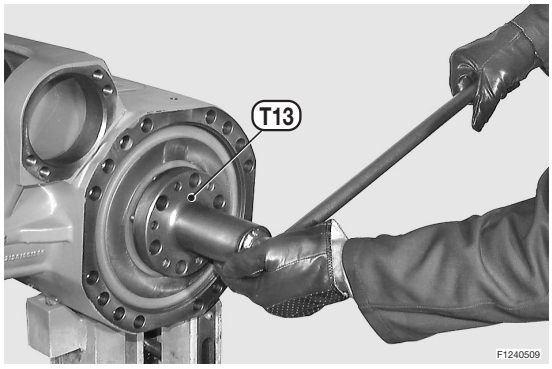
GB c

Introduce a comparator with rotary key “A” through the top plug hole (10). Position the comparator on the centre of one of the teeth of the crown (12), pre-set it to 1mm and reset it.



GB d

Manually move the crown (12) in both directions in order to check the existing backlash between the pinion and the crown.

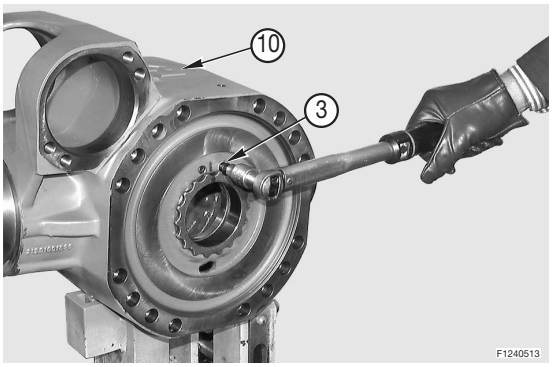


GB e

Adjust the backlash between the pinion and the crown by unloosing one of the ring nuts (1) and tightening the opposite to compensate.
Normal backlash: see table.

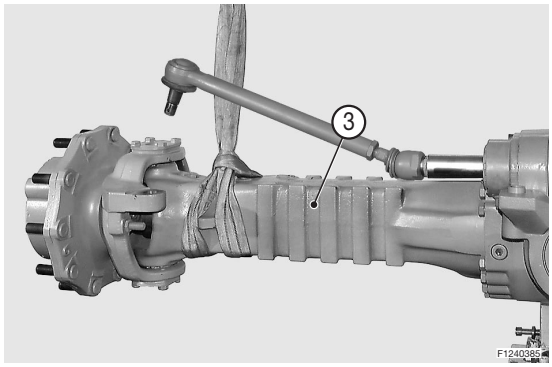
RATIO	CLEARANCE	
	MIN.	MAX.
9÷34	0,18	0,23
9÷35	0,13	0,18
11÷31	0,20	0,28
11÷35	0,13	0,18
12÷35	0,13	0,18
12÷41	0,15	0,20
14÷32	0,18	0,23
14÷36	0,15	0,20
14÷41	0,15	0,20
15÷32	0,18	0,23
15÷47	0,13	0,18

Difference between MIN and MAX clearance for whole circumference should not exceed 0,09 mm.



GB a

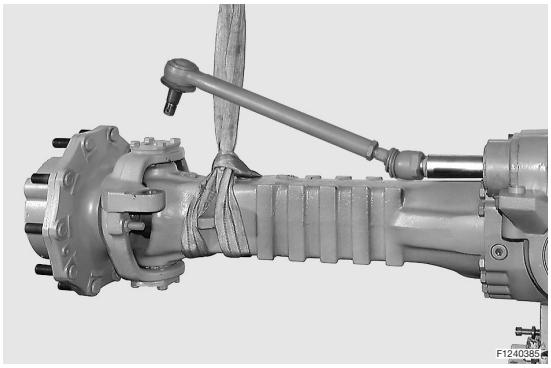
Apply Loctite 242 to the screws (3), fit them into one of the two holes and tighten.
Torque wrench setting: 23.8÷26.2 Nm
Fit the top plug (10) after applying repositionable jointing compound for seals to the rims.



GB b

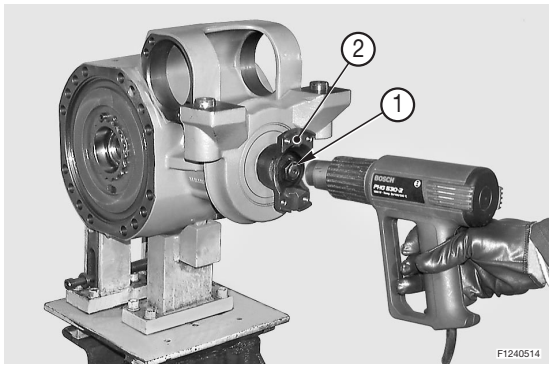
Re-install the complete arms.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS".

BEVEL PINION - Removal



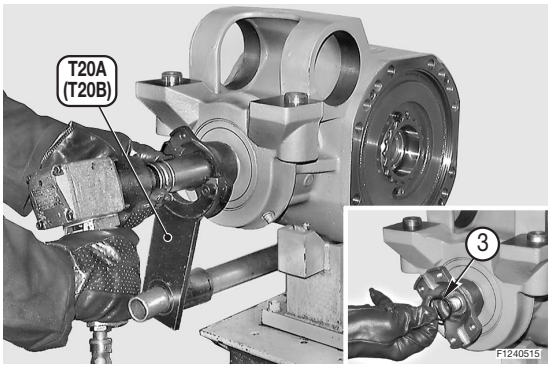
GB a

Remove the complete arms and the differential unit.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS" and "REMOVING THE DIFFERENTIAL UNIT".



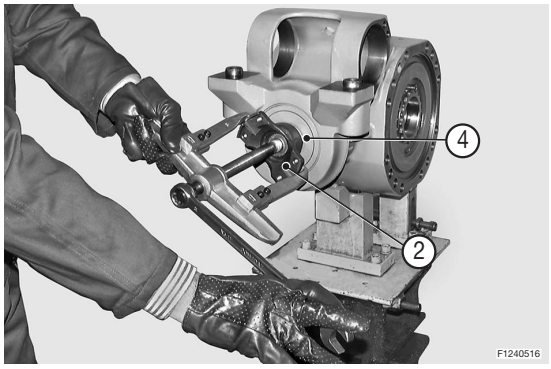
GB b

If disassembly is awkward, heat the check nut (1) of the flange (2) at 80°C.
NOTE. Heating is meant to unloose the setting of Loctite on the nut (1).



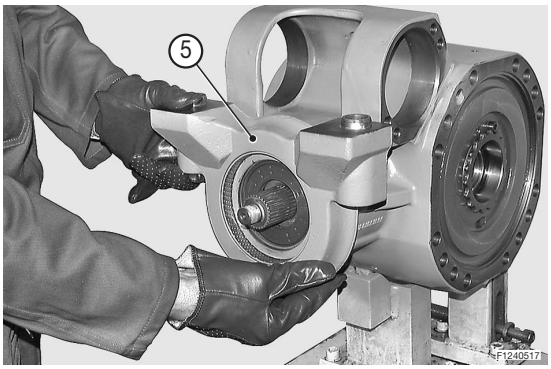
GB c

Position tool T20A (or T20B), so as to avoid pinion rotation.
Unloose and remove the nut (1); also remove the O-ring (3).



GB d

Remove the flange (2) complete with guard (4) by means of a puller.



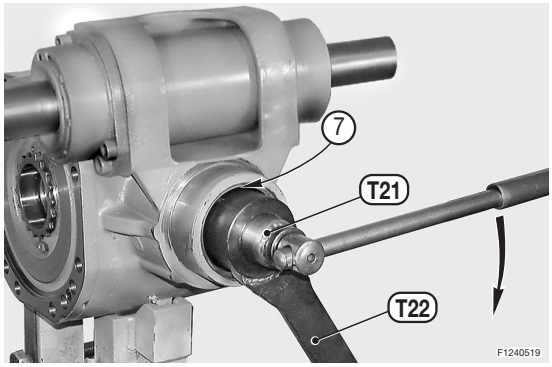
GB e

Remove the swinging support (5).



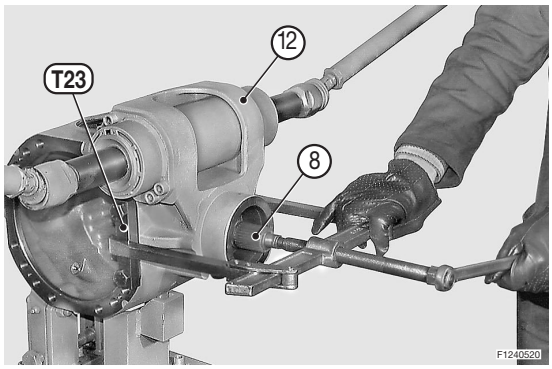
GB f

Remove the sealing ring (6).



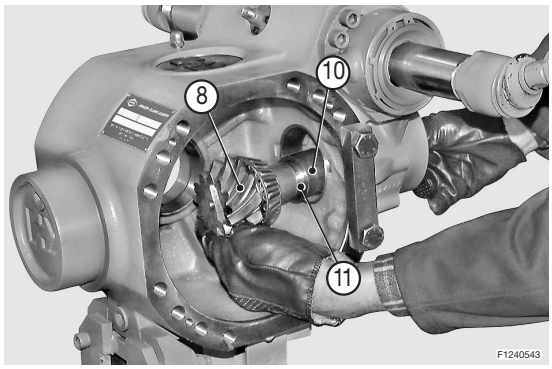
GB a

Position wrench T22 onto the ring nut (7) and apply bar hold T21 to the pinion (8). Stop wrench T22 and rotate the pinion so as to release and remove the ring nut (7).
NOTE. If disassembly proves awkward, weld the ring nut at approx. 80°C.



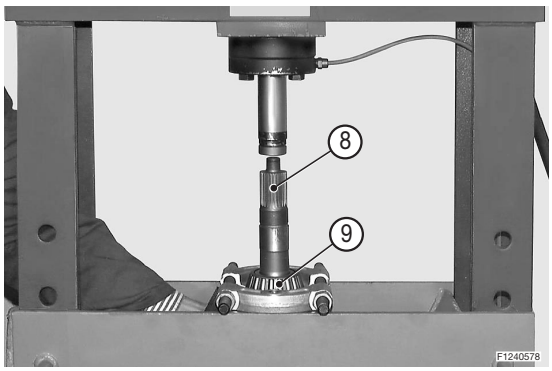
GB b

Apply blocks T23 and, with the help of a puller, extract the pinion (8) complete with the internal bearing (9), the distance piece (10) and shims (11).
NOTE. The thrust blocks of the bearings remain in the central body (12).



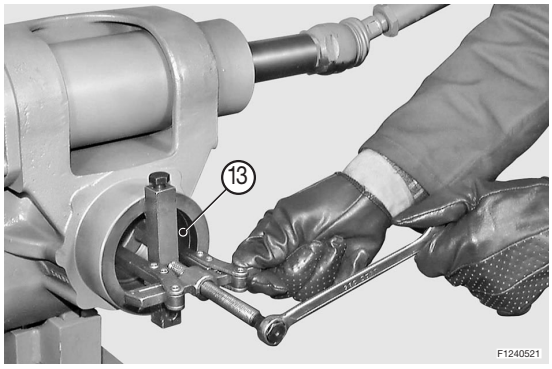
GB c

Remove the pinion (8), shims (11) and distance piece (10).



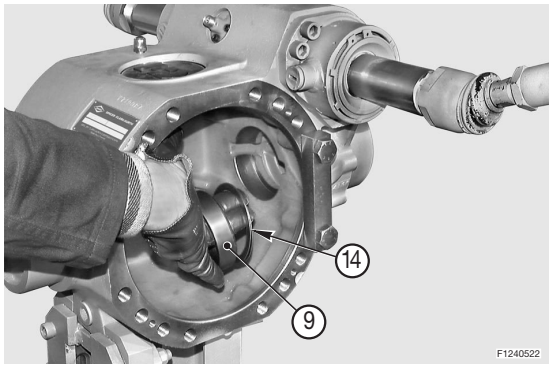
GB d

Using a puller and a press, remove the inner bearing (9) from the pinion (8).



GB e

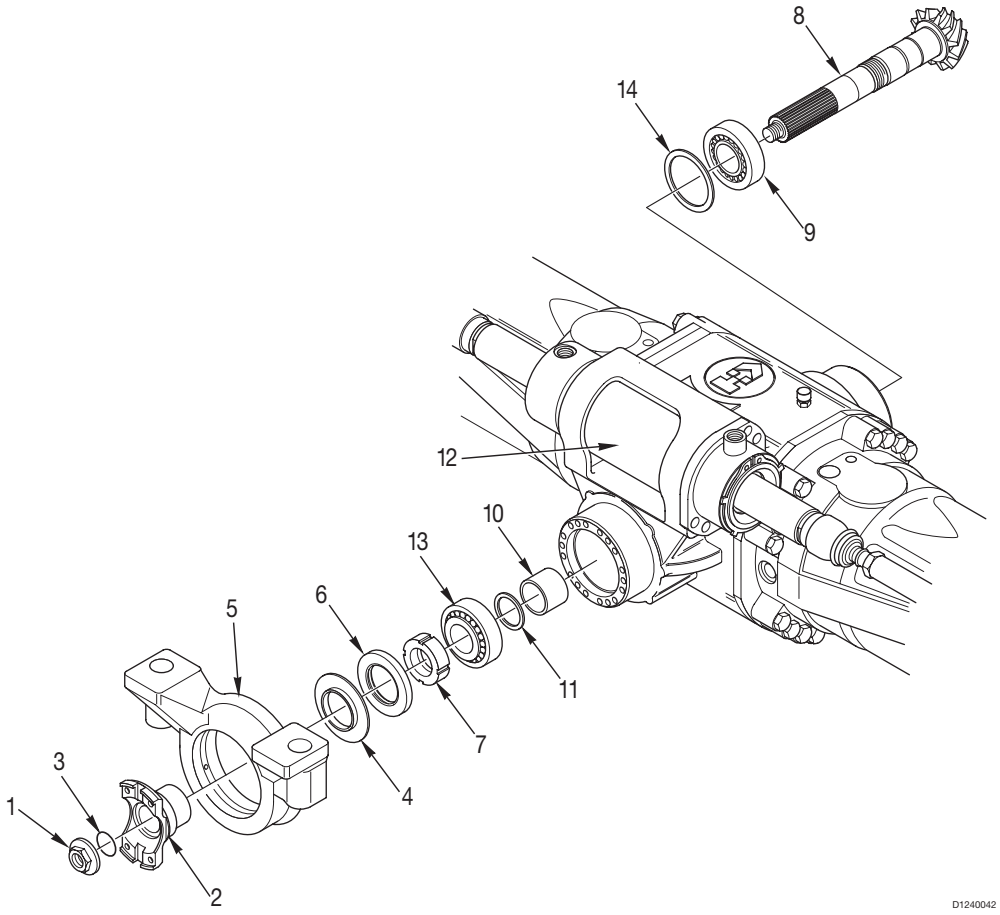
Remove the thrust block of the external bearing (13).



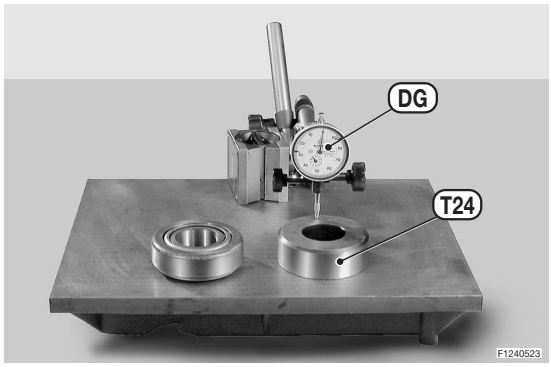
GB f

Insert a drift in the appropriate holes and remove the thrust block of the internal bearing (9) as well as the shim washers (14).

AXLE ASSEMBLY - DISASSEMBLY

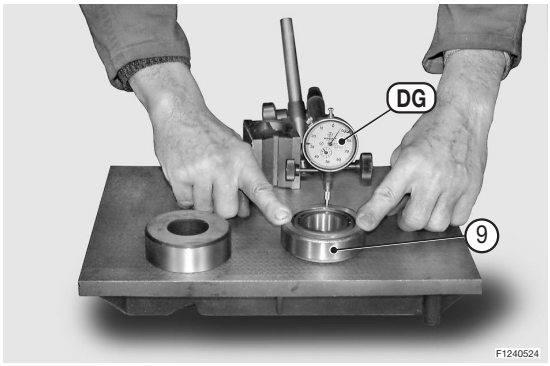


Adjusting and installation



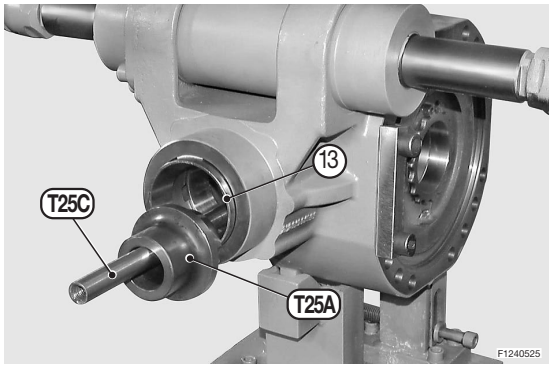
GB a

Using a surface plate, reset a centesimal comparator “DG” and place it on the measurement ring T24 (with a thickness of 30,2 mm).
Preset the comparator to approx. 2 mm.



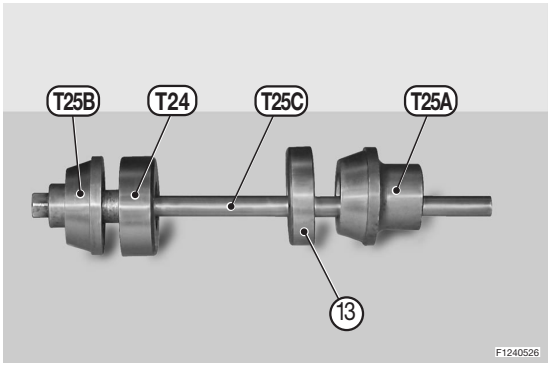
GB b

Bring the internal bearing (9), complete with its thrust block, under the comparator “DG”. Determine overall thickness “D” of the bearing checking the discrepancy between this size and the size of the measurement ring.
CAUTION! Press the thrust block in the centre and take several measurements while rotating the thrust block.



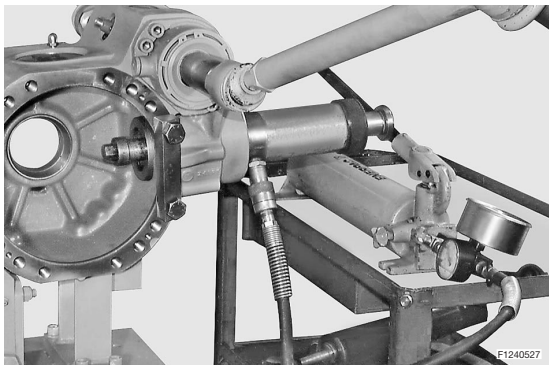
GB c

Partially insert the thrust block of the external bearing (13).



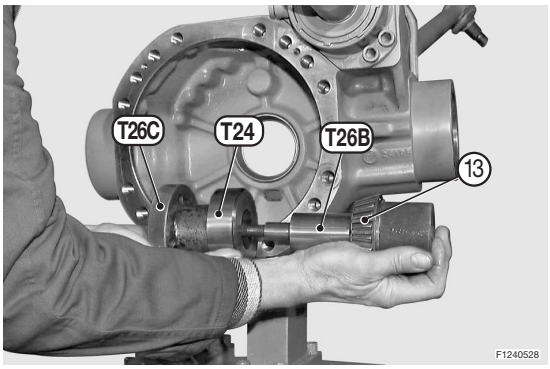
GB d

Install tension rod T25C, measurement ring T24 and front guide tool T25A on the thrust block of the external bearing (13).



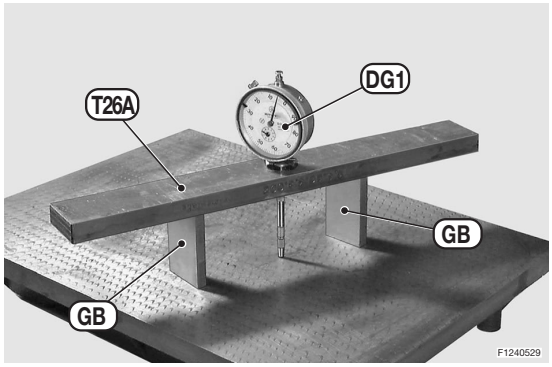
GB e

Connect the tension rod to the press and move the thrust block of the external bearing (13) into its seat. Disconnect the press and remove the tension rod.
NOTE. Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.



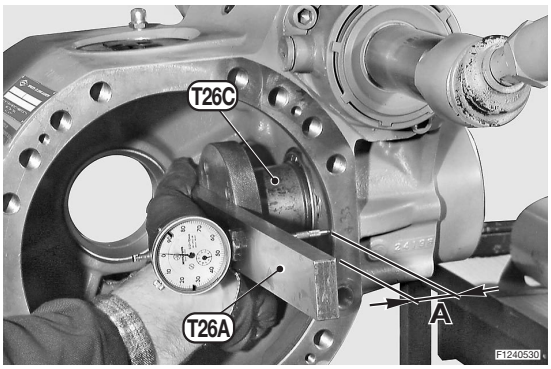
GB f

Insert tool T26B complete with external bearing (13), measurement ring T24 and gauged ring nut T26C.
Manually tighten.



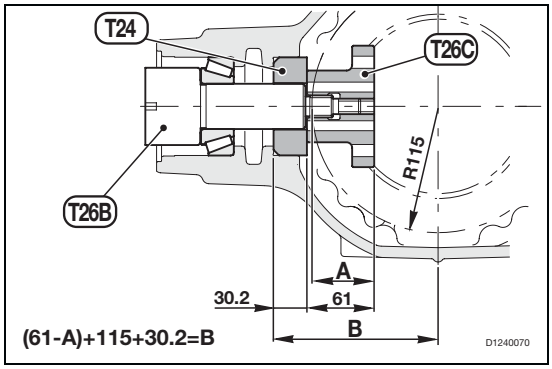
GB a

Fit a centesimal comparator “DG1” with long stem into bar T26A; when the bar rests on two size- blocks “GB” of 57 mm, reset the comparator.
Preset the comparator to approx. 2 mm and reset.



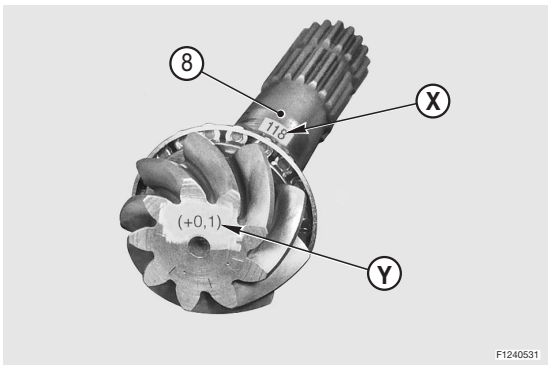
GB b

Lay bar T26A on gauged nut T26C and take the size “A” at about 57 mm corresponding to the maximum diameter of arms centring.



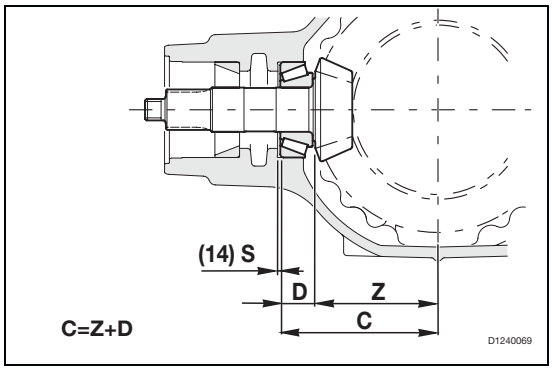
GB c

Calculate size “B” which will be the first useful value for calculating the size of the shims (14) that are to be inserted under the thrust block of the internal bearing (9).



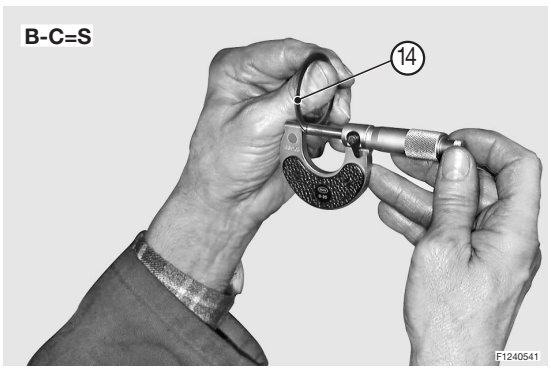
GB d

Check the nominal size (X) marked on the pinion and add or subtract the indicated variation (Y) so as to obtain size “Z”.
e.g.: Z= 118 + 0.1 = 118,1
Z= 118 ÷ 0,2 = 117,8



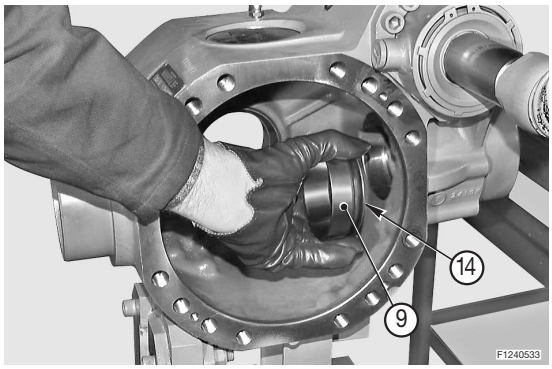
GB e

Calculate size “C” which represents the second value for calculating the size of the shims “S” that are to be placed under the thrust block of the internal bearing (9).



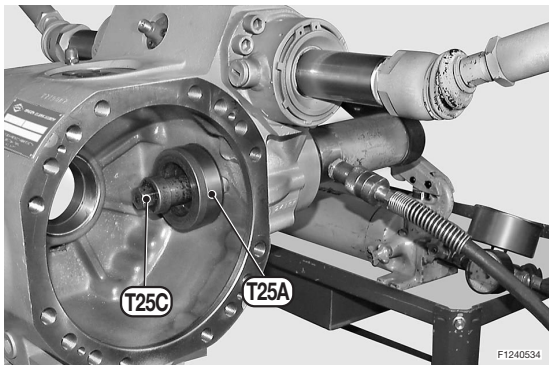
GB f

Calculate the difference between sizes “B” and “C” so as to obtain the size “S” of the shim (14) that will go under the thrust block of the internal bearing (9).



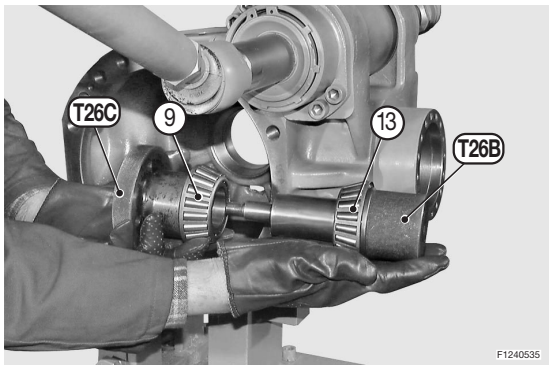
GB a

Insert shim “S” (14) and the thrust block of the internal bearing (9) in the central body.
NOTE. To hold shim “S” (14) in position, apply grease.



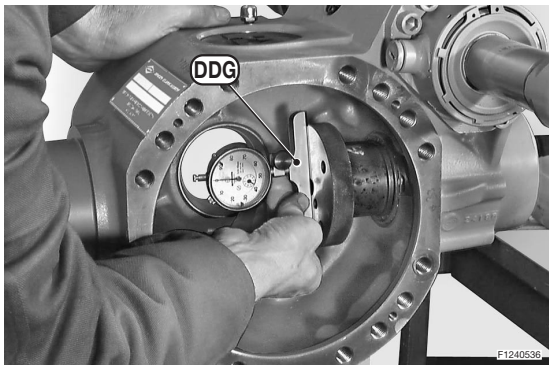
GB b

Position tool T25A and tension rod T25C.
Connect the tension rod to the press, fasten the thrust block and then remove the tools.
NOTE. Before going on to the next stage, make sure that the thrust block has been completely inserted.



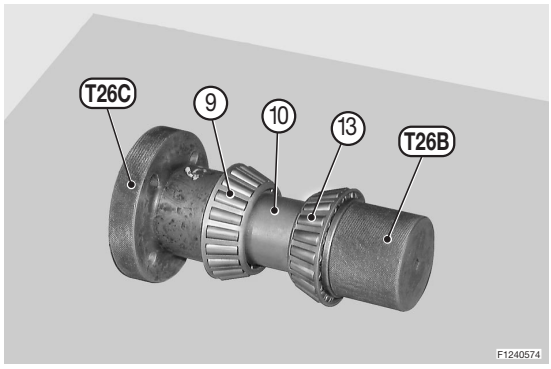
GB c

Position tools T26C and T26B complete with tapered bearings (9) and (13); manually tighten until a rolling torque has been obtained.



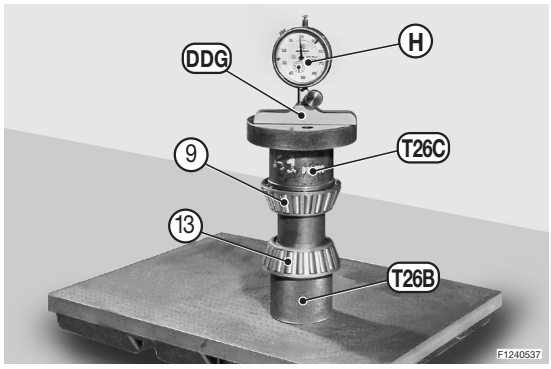
GB d

Insert the stem of a depth comparator “DDG” in either side hole of tool T26C; reset the comparator with a presetting of approx. 3 mm.



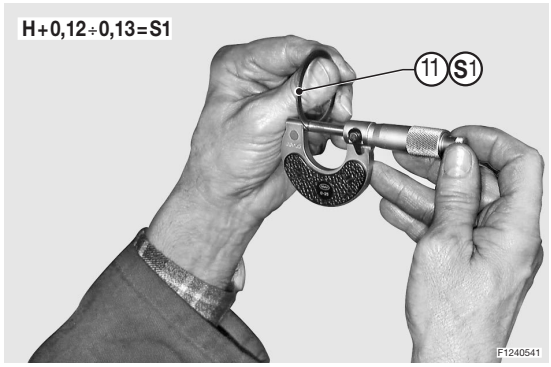
GB e

Remove the comparator and release tools and bearings from the central body.
Re-install all and insert the distance piece (10) between bearings (9) and (13); manually tighten the whole pack.



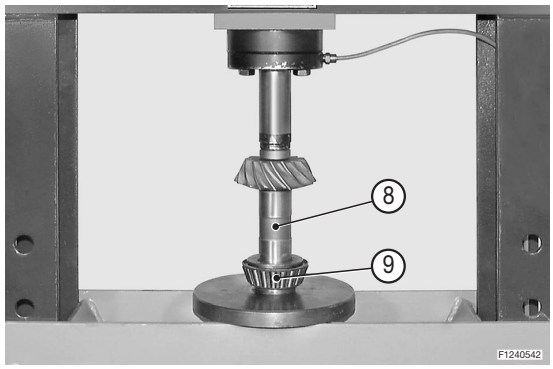
GB f

Insert depth comparator “DDG” into tool T26B-T26C and measure variation “H” in relation to the zero setting performed back at point.



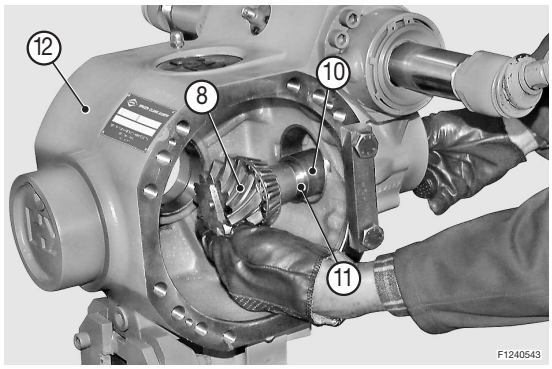
GB a

The variation is to be added to a set value of 0.12÷0.13 mm., so as to obtain the size of shim “S1” (11) which will be inserted between the external bearing (13) and the distance piece (10) and subsequently, to determine the preload for the bearings.



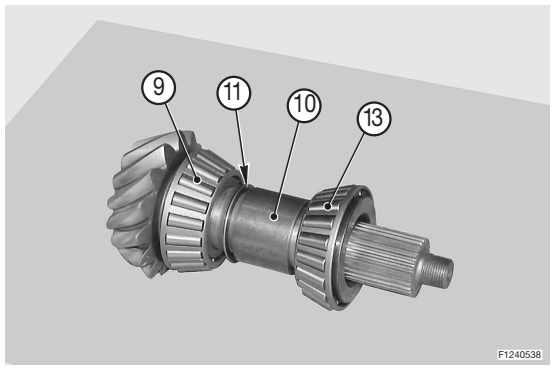
GB b

Position the internal bearing (9) and the pinion (8) under a press; force the bearing onto the pinion.



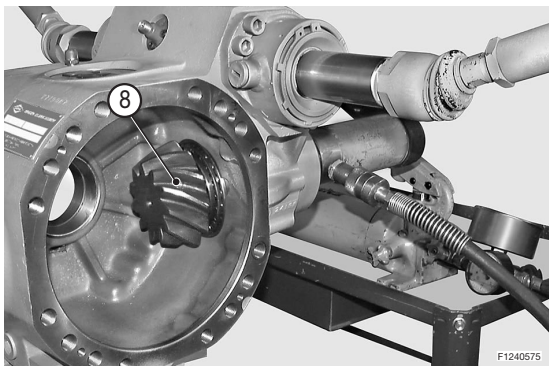
GB c

Fit the pinion (8), shim “S1” (11) and distance piece (10) in the main body (12).
NOTE. The finer shims must be placed in- between the thicker ones



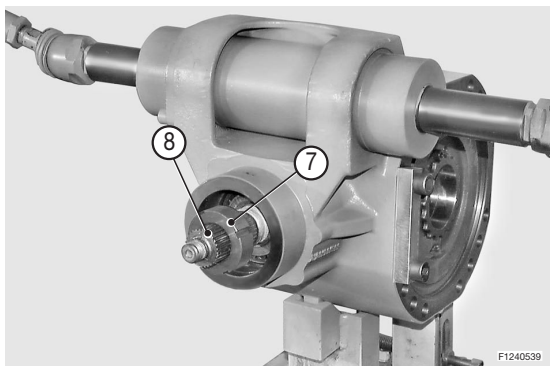
GB d

Insert the external bearing (13) in the central body in order to complete the pack arranged as in the figure.



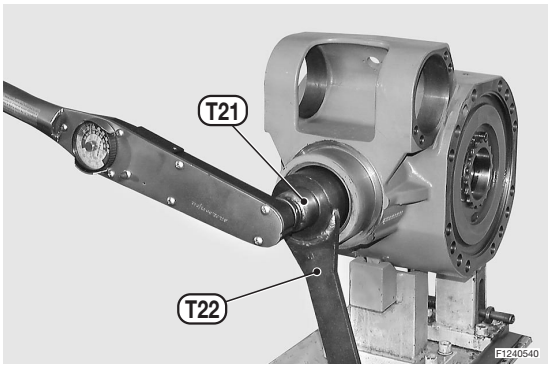
GB e

Connect the pinion (8) to the tie rod T28A and T28B; connect the tie rod T28C (see special tools) to the press and block.



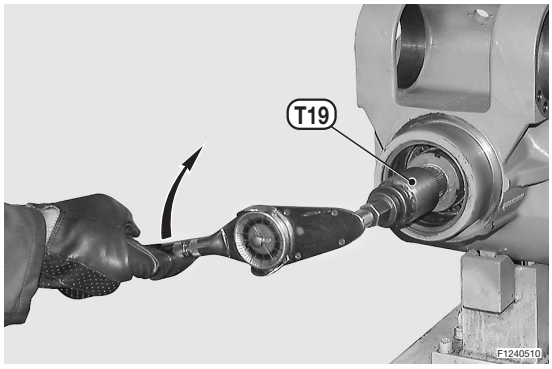
GB f

Apply Loctite 242 to the thread of the ring nut (7) and screw the nut onto the pinion (8).



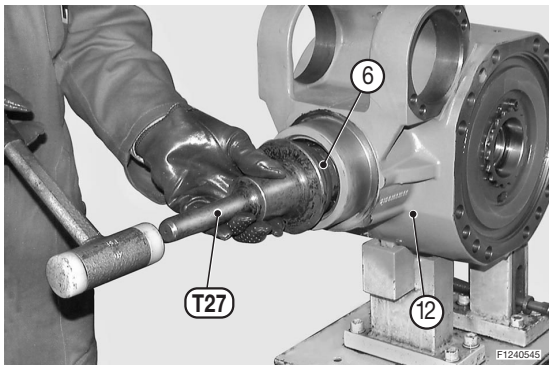
GB a

Apply special wrench T22 to the ring nut (7) and bar-hold T21 to the pinion (8).
Lock the wrench T22 and rotate the pinion using a dynamometric wrench, up to a minimum required torque setting of 500 Nm.



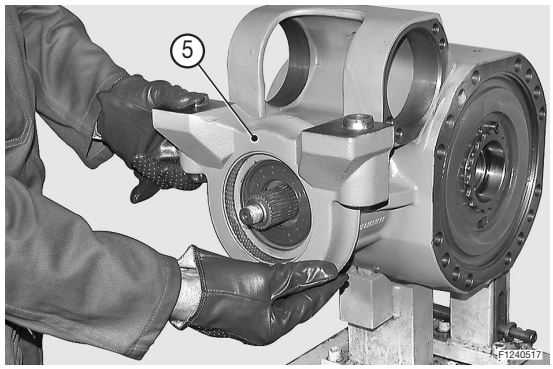
GB b

Apply onto the pinion (8) the bar-hold and with the help of a torque
metre, check the torque of the pinion (8).
Torque: 120÷170 Ncm
CAUTION! If torque exceeds the maximum value, then the size of shim “S1” (11) between the bearing (13) and the distance piece (10) needs to be increased.
If torque does not reach the set value, increase the torque setting of the ring nut (7) in different stages to obtain a maximum value of 570 Nm.
CAUTION! If torque does not reach the minimum value, then the size of shim “S1” (11) needs to be reduced.
CAUTION! When calculating the increase or decrease in size of shim “S1”, bear in mind that a variation of shim (11) of 0.01 mm corresponds to a variation of 60 Ncm in the torque of the pinion (8).



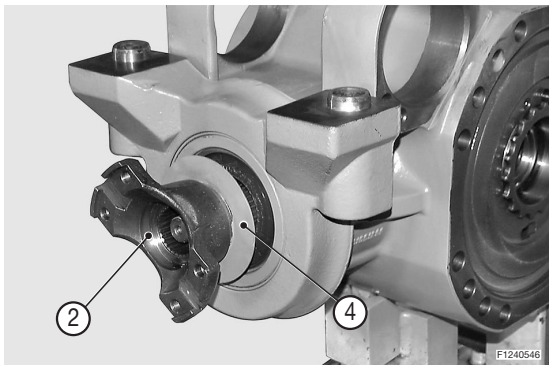
GB a

Lubricate the outer surface of the new sealing ring (6) and fit it onto the central body (12) using tool T27.



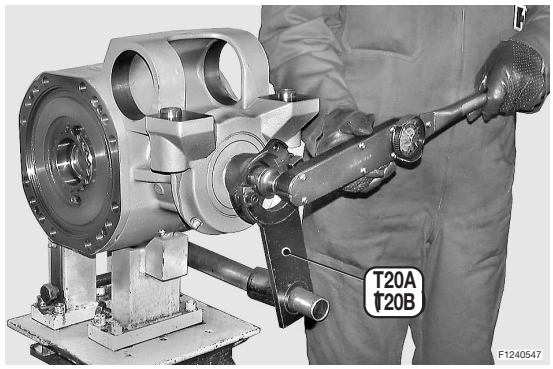
GB b

Install the swinging support (5).
NOTE. Check that it is properly oriented.



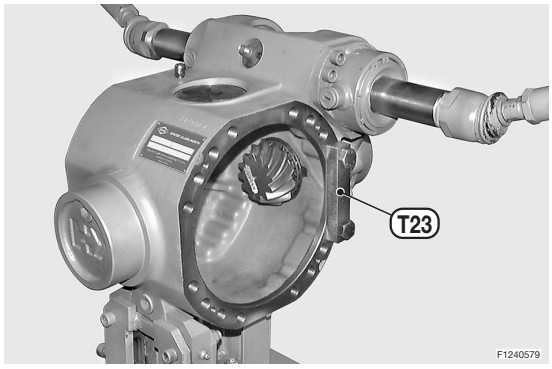
GB c

Fit the flange (2) complete with the guard (4) and fasten it.
For keying the flange (2), use a plastic hammer if necessary.
NOTE. Make sure that the guard (4) is securely fastened onto the flange and that it is not deformed.



GB d

Apply Loctite 242 to the threaded part of the pinion (8).
Position tool T20A (or T20B) and fasten it in order to avoid rotation.
Insert O-ring (3) the nut (1) and tighten it using a dynamometric wrench.
Torque wrench setting: 280÷310 Nm

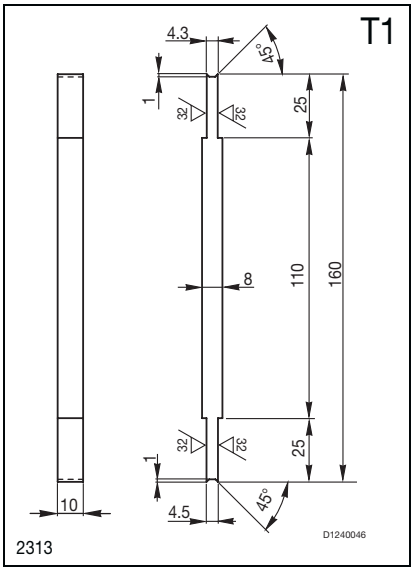


GB e

Remove blocks T23 (used for extracting the pinion) and re-install the arms.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS".

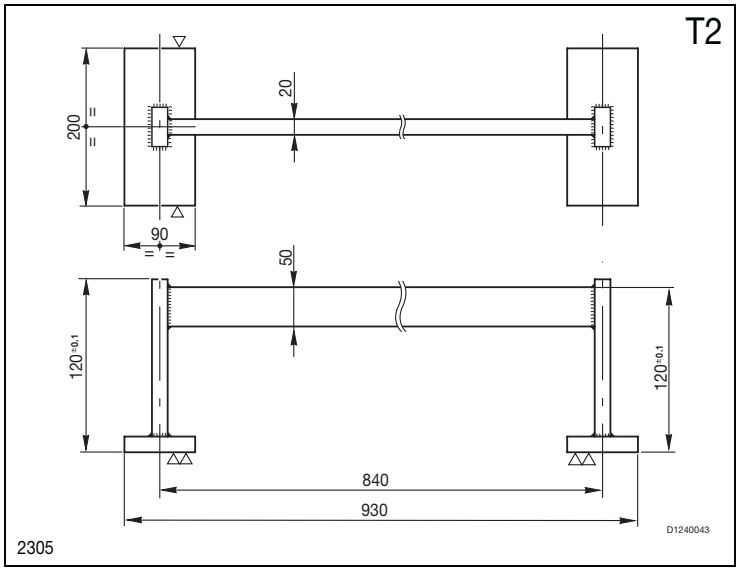
SPECIAL TOOLS

T1



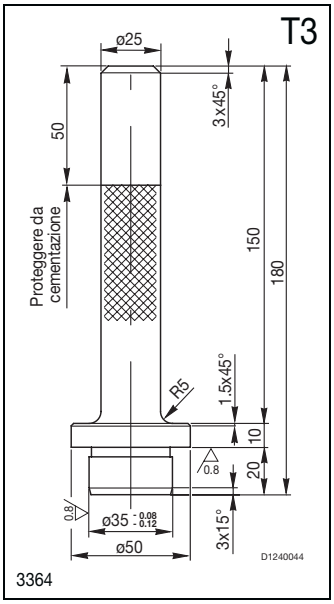
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T2



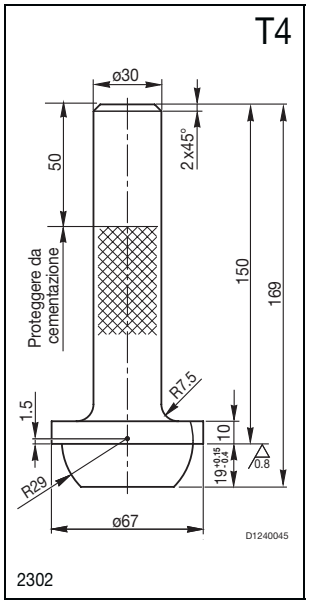
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T3



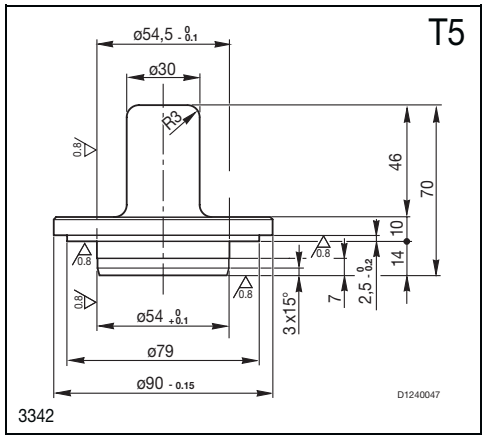
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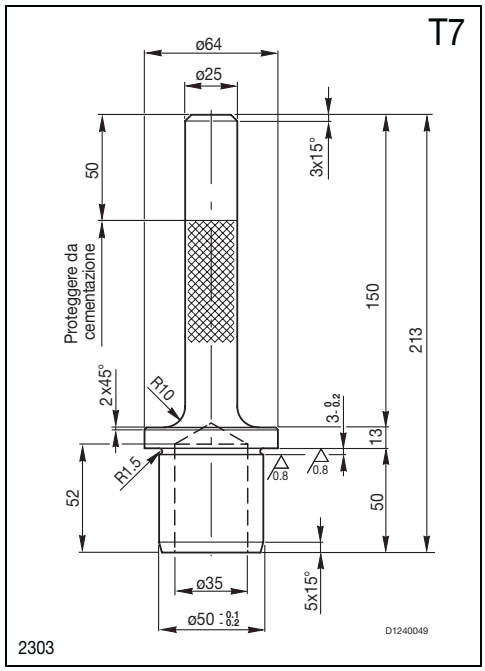
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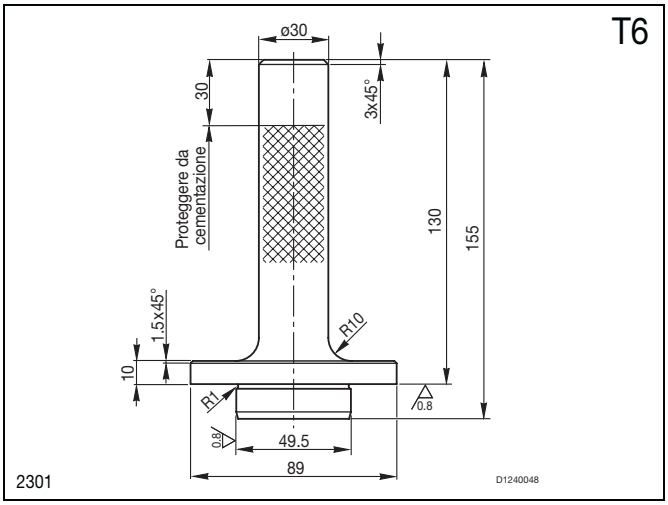
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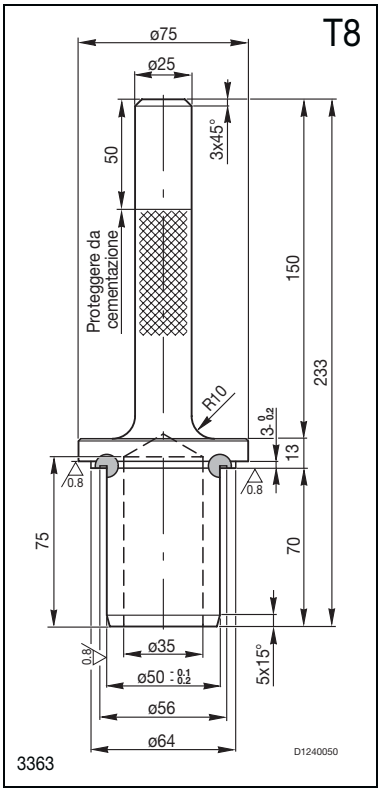
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T6



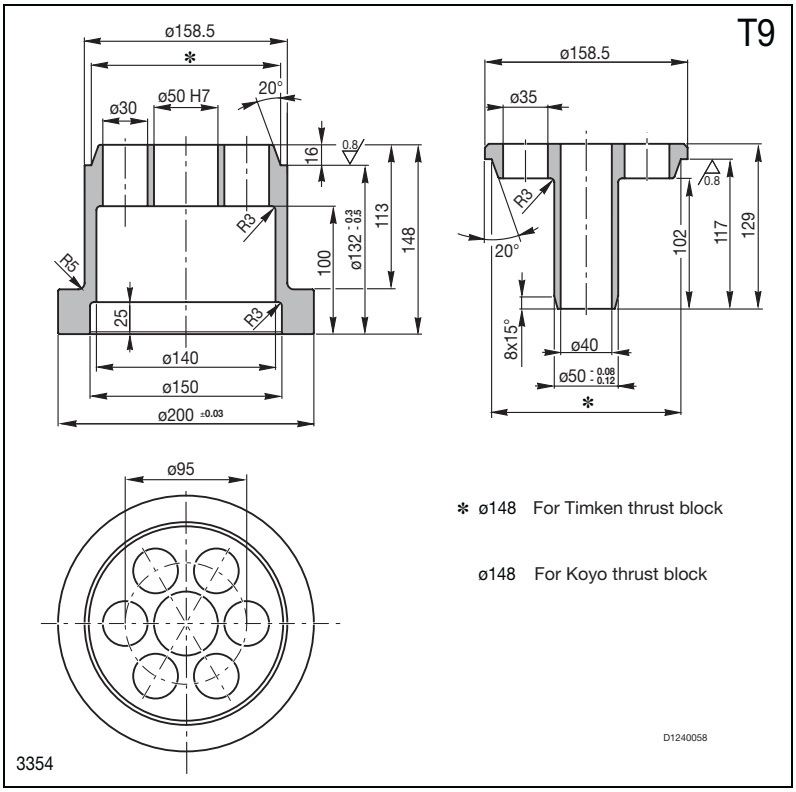
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T8



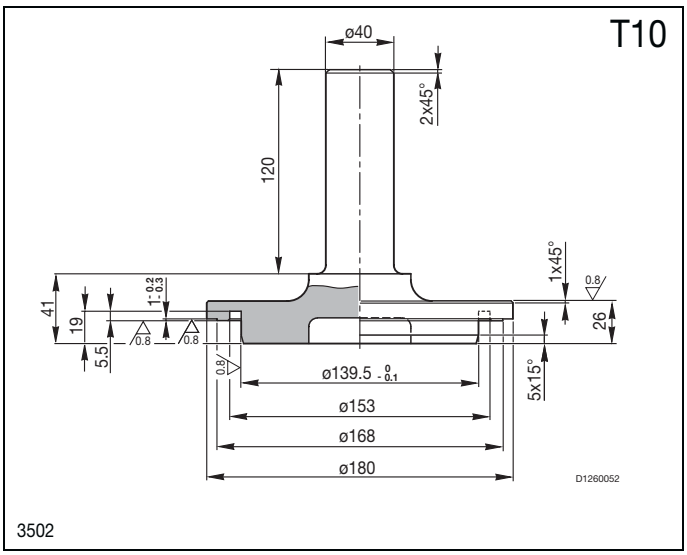
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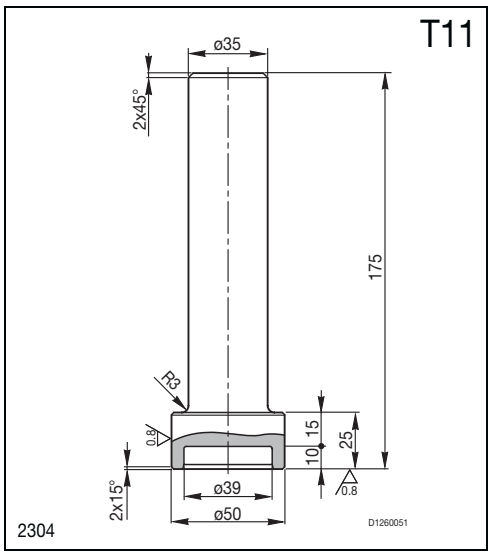
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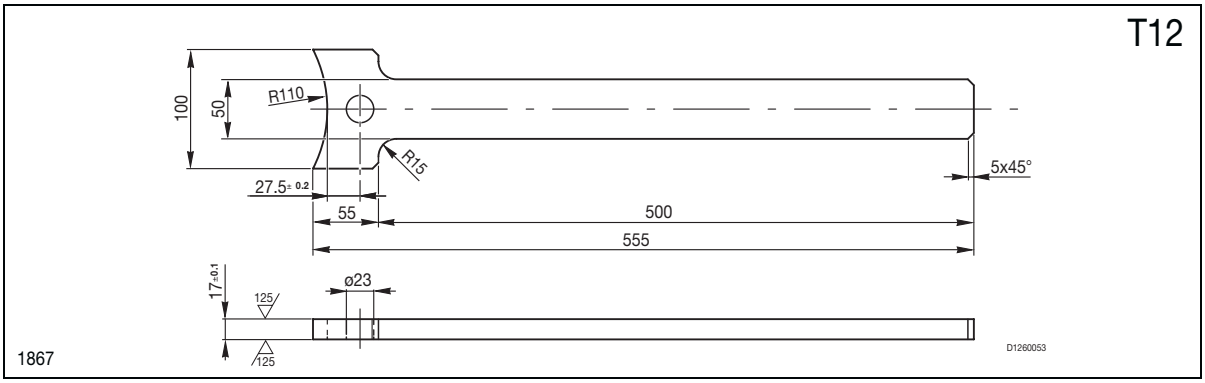
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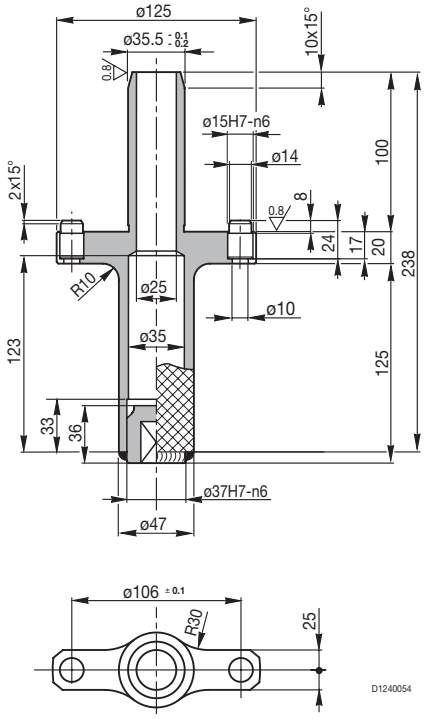
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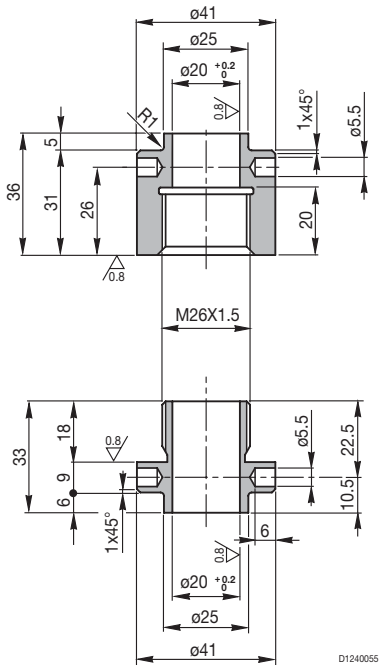
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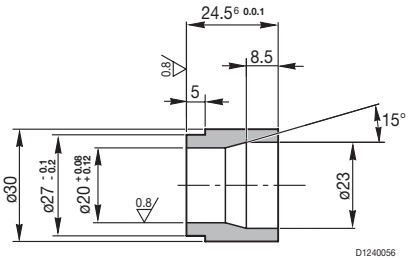
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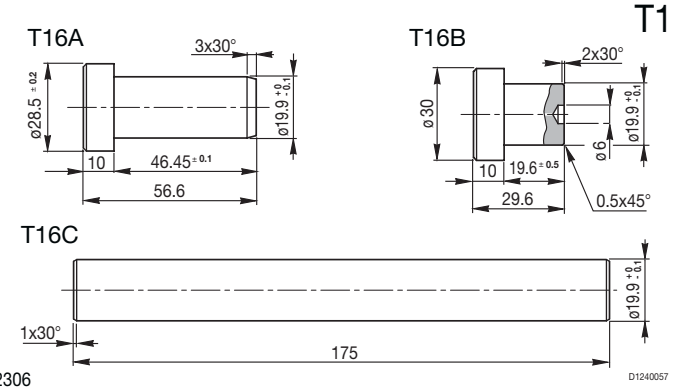
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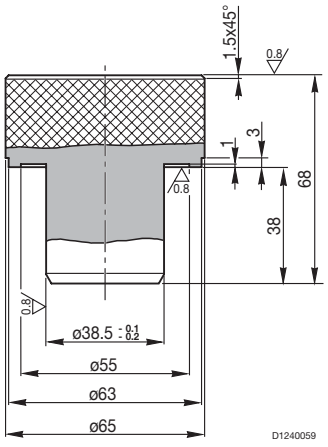
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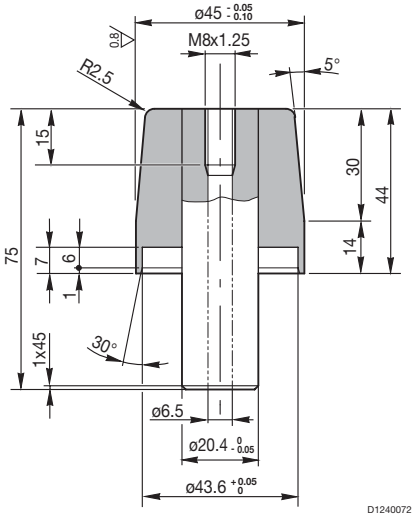
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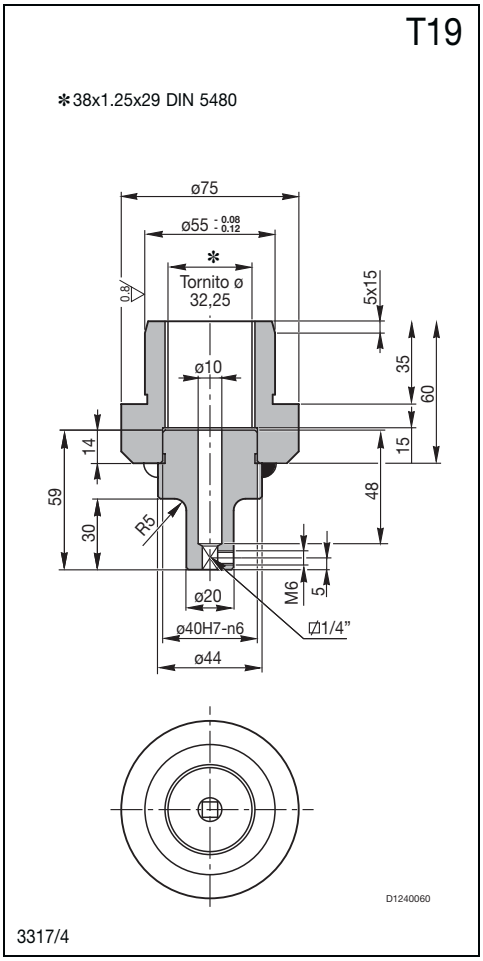
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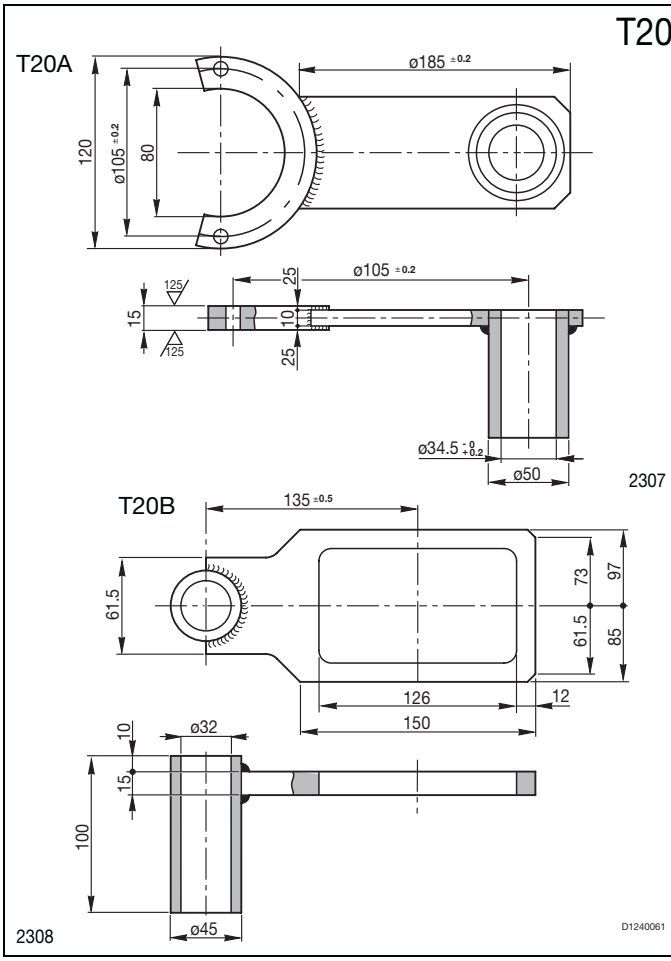
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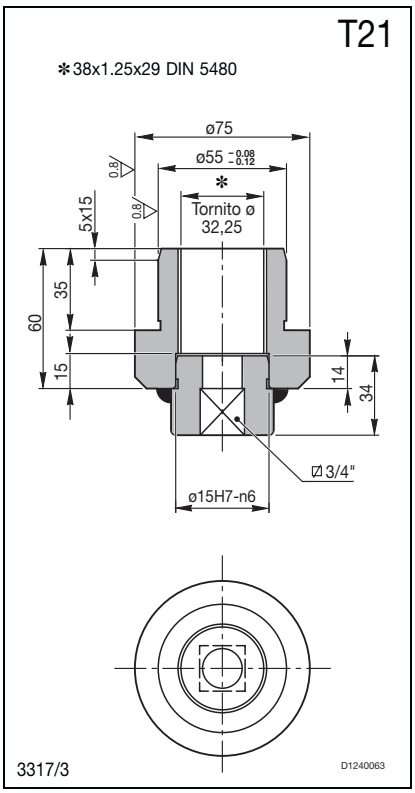
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T20



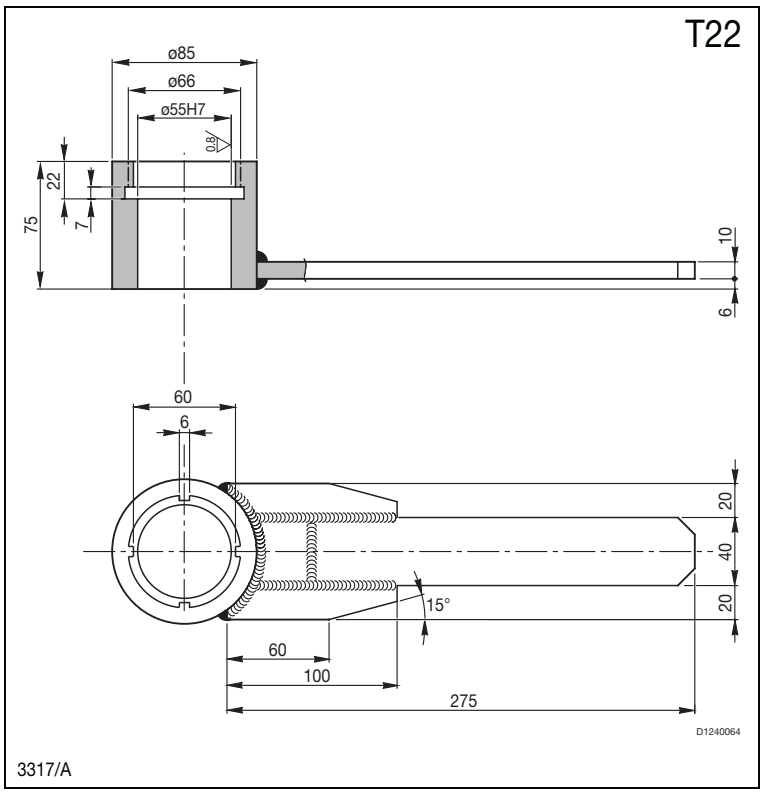
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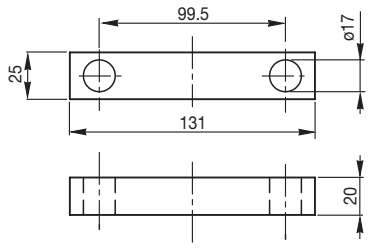
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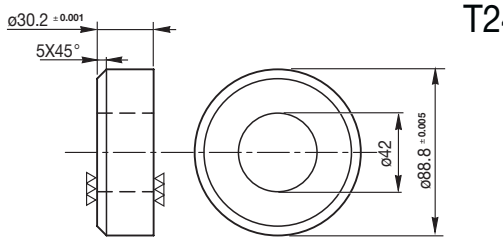
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AXLE ASSEMBLY - DISASSEMBLY

T23

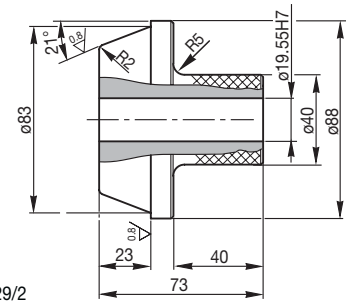


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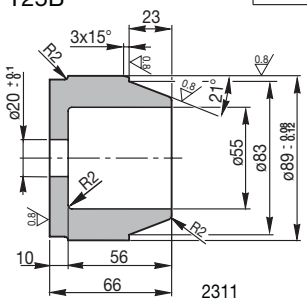


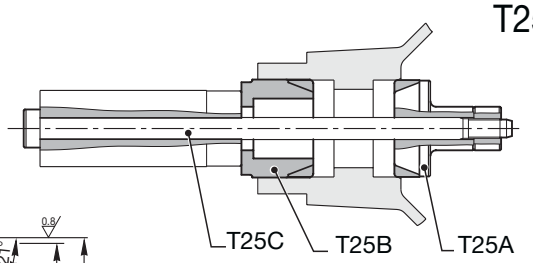
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T25A

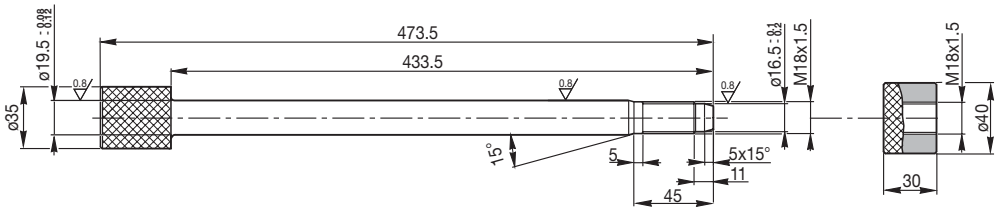


T25B



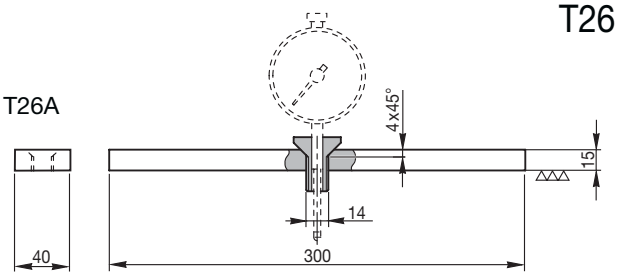


T25C

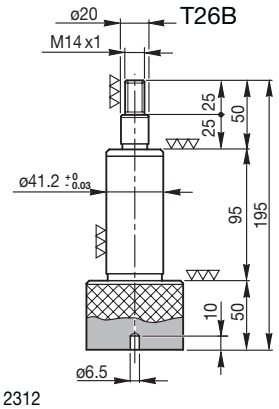


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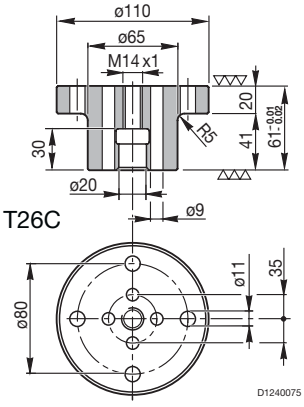
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T26B

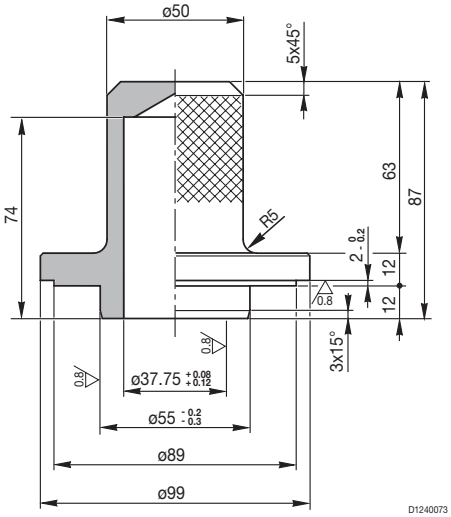


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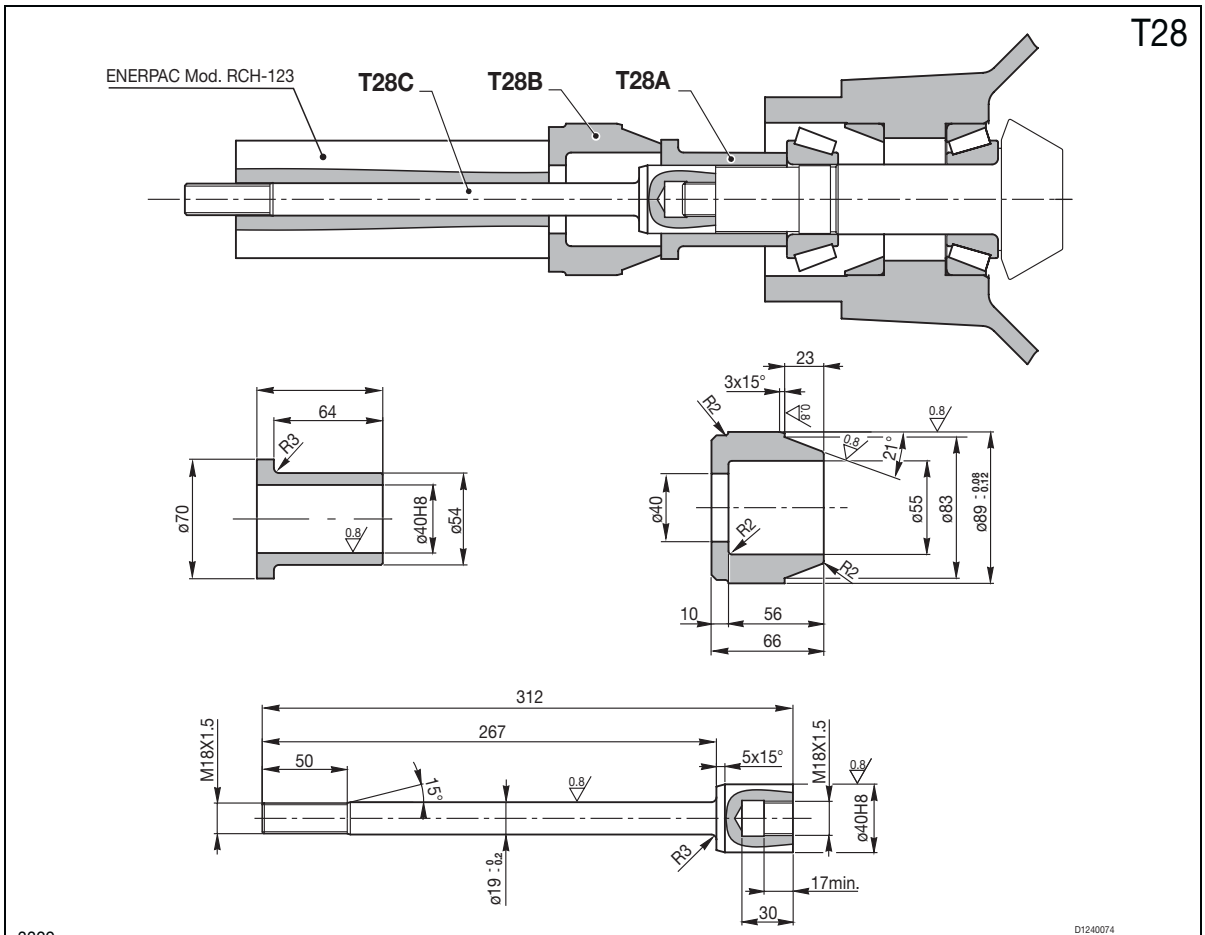
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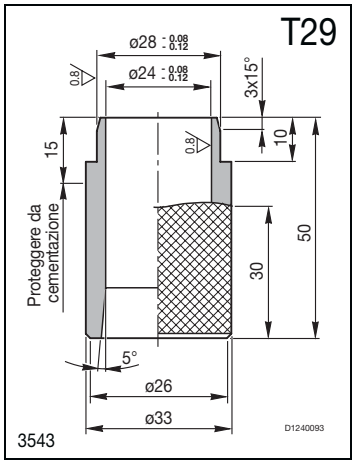
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T28



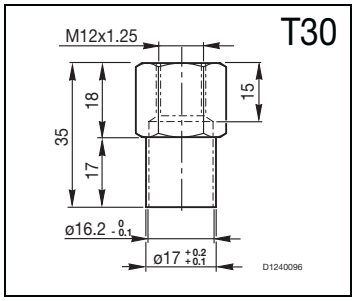
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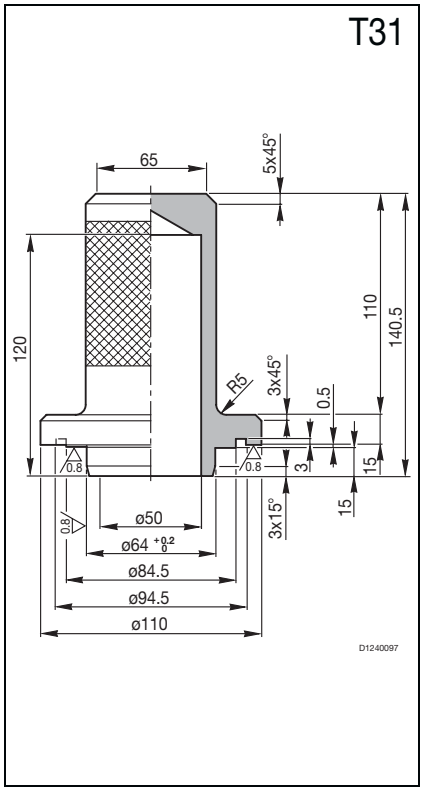


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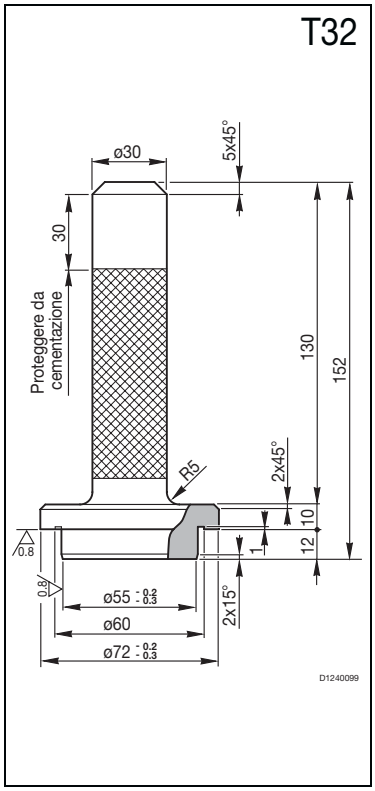
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T31



T32



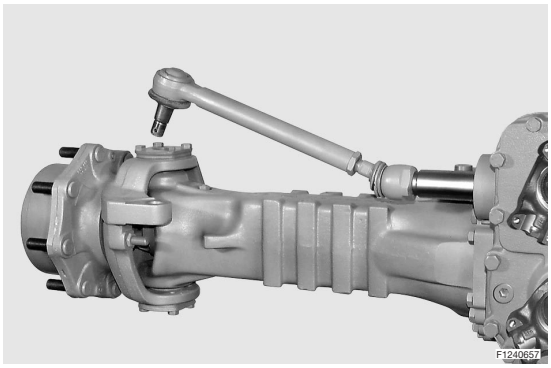
TROUBLESHOOTING

PROBLEM	CAUSE	CORRECTION
Insufficient braking	1. Incorrect adjustment	Inspect disc thickness and if discs are usable readjust brakes to the specifications in the vehicle's manual.
	2. Brake discs worn out	Inspect disc thickness and replace if necessary.
	3. Incorrect brake fluid	Replace all seals in axle and master cylinder that have made contact with the incorrect fluid and all brake hoses. If incorrect fluid leaked into axle oil, seals and o-rings in axle must be replaced.
	4. Loss of brake fluid	Inspect for and repair any leaks in outside circuit or master cylinder. If caused by incorrect brake fluid see correction N. 3. If leak is to the outside replace the o-rings between the center and intermediate housings. If leak is to the inside replace above o-rings and brake piston o-rings.
	5. Overheated axle causing brake fluid to vaporize. (Brake return when axle cools)	See "overheating" problem.
Soft brake pedal	6. Air in brake circuit	Bleed brakes as described in the vehicle's service manual.
Ineffective safety brake	7. Incorrect adjustment	See correction N. 1.
	8. Brake disc worn out	See correction N. 2.
Overheating	9. Oil level wrong	Drain, flush and refill oil to proper level.
	10. Too small of a brake gap	Readjust brakes to the specifications in the vehicle's service manual.
	11. Park brake dragging	Unlock the brake and adjust the correct gap.
	12. Incorrect brake fluid in system	See correction N. 3.
	13. No free-pedal at master cylinder	Readjust brake pedal as described in the vehicle's service manual.
	14. Restriction in brake lines	Inspect for and replace damage lines.
	15. Restriction in return line of brake Servo system	Inspect for and replace damaged return line. Inspect for and remove any filter, tee'd in line or any other source of back pressure from the return line.
	16. Incorrect lubricant	Change the retaining rings of the brake circuit and brake pump.

PROBLEM	CAUSE	CORRECTION
Diff-lock inoperative	17. If manual control, loose or misadjusted linkage	Inspect and correct linkage and readjust as indicated in vehicle's service manual.
	18. If hydraulic control, problems in the hydraulic or electrical circuits of the vehicle	Refer to the servi ce manual for the vehicle.
	19. If hydraulic control: problems in actuating cylinder (noteable through loss of hydraulic oil or increase of the oillevel in axle)	Rebuilt cylinder.
	20. If with lim. slip differential, worn discs	Replace discs.
Oil coming out of breather	21. Leak in internal brake system	See correction N. 2 and 3.
	22. Leak in diff-lock actuating cylinder	See correction N. 19.
NoSpin indexing noise when driving straight **CAUTION! With NoSpin, fatigue damage can occur on the side with the larger tire.**	23. Unequal tire pressure left anal right	Inflate tires to the recommended pressure in the service manual, or until the rolling radius is equal.
	24. Different style, size or brand of tires between left and right hand side	Change tires to make the rolling radius equal. Vary the tire pressure within the specifications until the rolling radius is equal.
Noise during coast and under power the same	25. Wheel bearings damaged	Replace and adjust.
Noise under power greater than during coast	26. Low oil level	Refill oil to proper level.
	27. Incorrect lubricant	See correction N. 16.
	28. Ring and pinion worn	Controllare attraverso il coperchio superiore. Sostituire la coppia conica.
	29. Worn ring and pinion bearings	Inspect through top cover. Replace and adjust.
	30. Worn planetary gears or bearings	Replace.
Noise during coast greater than under power	31. Loose pinion nut	Inspect ring, pinion and pinion bearings. If undamaged, retighten nut.
	32. Only pinion bearing damaged	See correction N. 29.
Noise during turn (without NoSpin)	33. Worn spider and/or side gears	Replace.
A "Stick slip" noise when going from forward to reverse	34. Worn or damaged cardanshaft	Inspect and replace as described in vehicle's service manual.

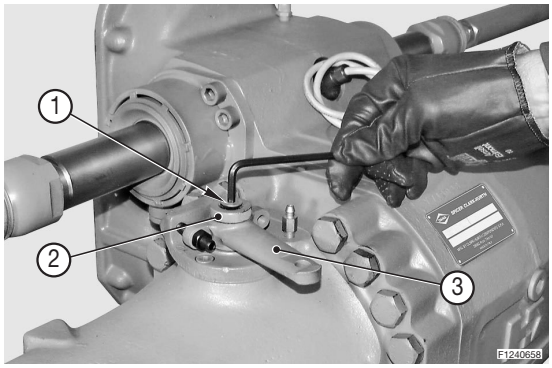
PROBLEM	CAUSE	CORRECTION
A "Stick slip" noise when going from forward to reverse	35. Loose wheel	Inspect for wheel and wheel stud damage. Replace if needed and retorque lugnuts.
	36. Articulation box joint and achsel shaft damaged	Inspect and replace.
	37. Spider pins loose in diff-carrier	Inspect through top cover. Replace.
	38. Damaged or missing spider and/or side gear washers	See correction N. 33.

OPTIONALS - HOW TO DISASSEMBLE THE MECHANIC PARKING BRAKE UNIT



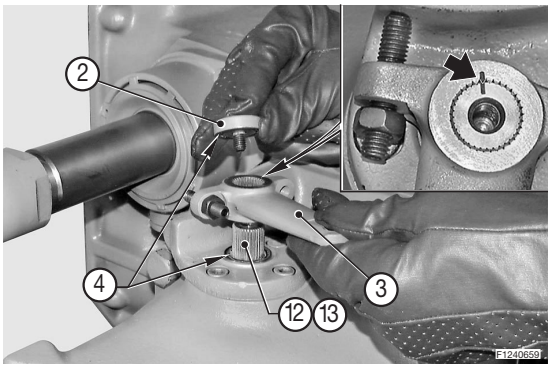
GB a

NOTE. The same disassembly procedure applies to both arms and may only be carried out when levers (3) are released.
Disconnect the tension bar from the steering case. For details, see "HOW TO REMOVE THE STEERING CYLINDER".



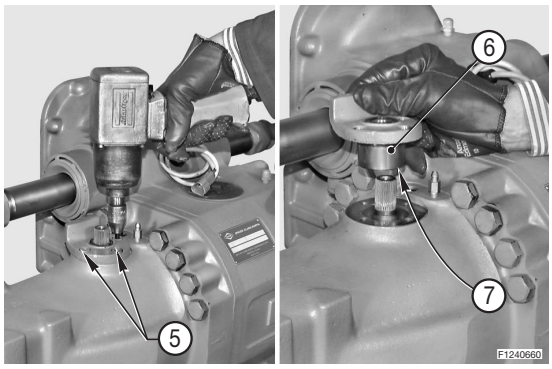
GB b

Draw out the screw (1) locking the washer (2) that stops the lever (3).



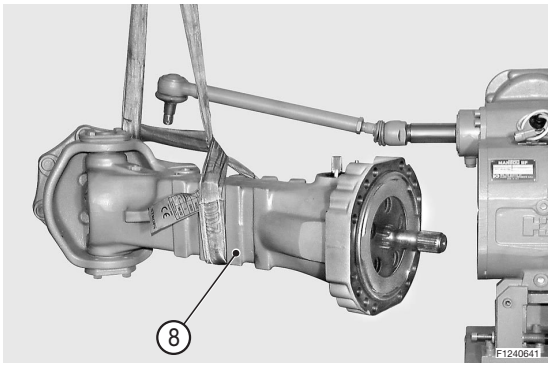
GB c

Remove washer (2), lever (3) and O-rings (4).
Mark the positions of levers (3) in relation to the thrust levers (12) and (13).



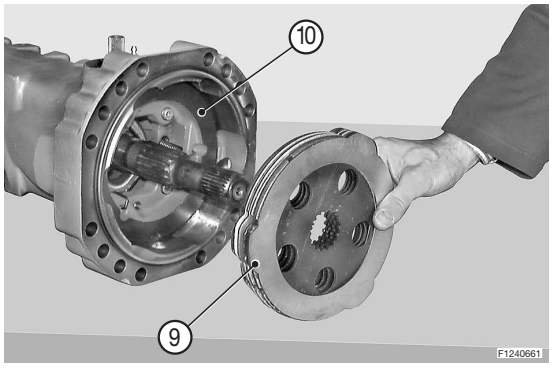
GB d

Draw out the screws (5) and remove bush (6) along with O-ring (7).



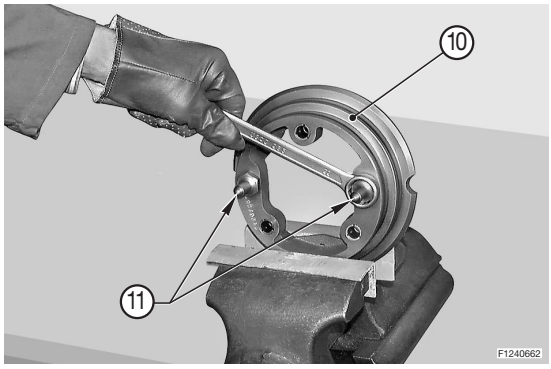
GB e

Connect the whole arm (8) to the hoist and put the rod under light tension.
Remove the whole arm; for details, see "CHECKING AND REPLACING THE BRAKING DISKS"



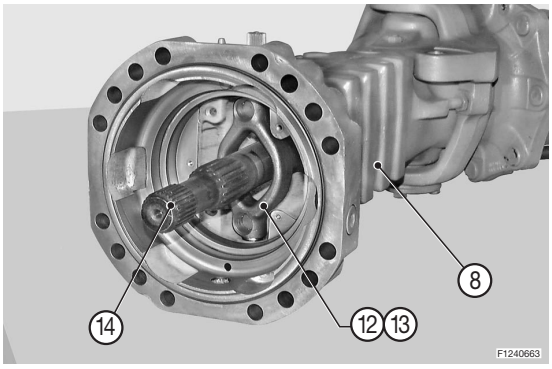
GB f

Remove the braking disks (9) and the whole piston (10).
For details, see "CHECKING AND REPLACING THE BRAKING DISKS".



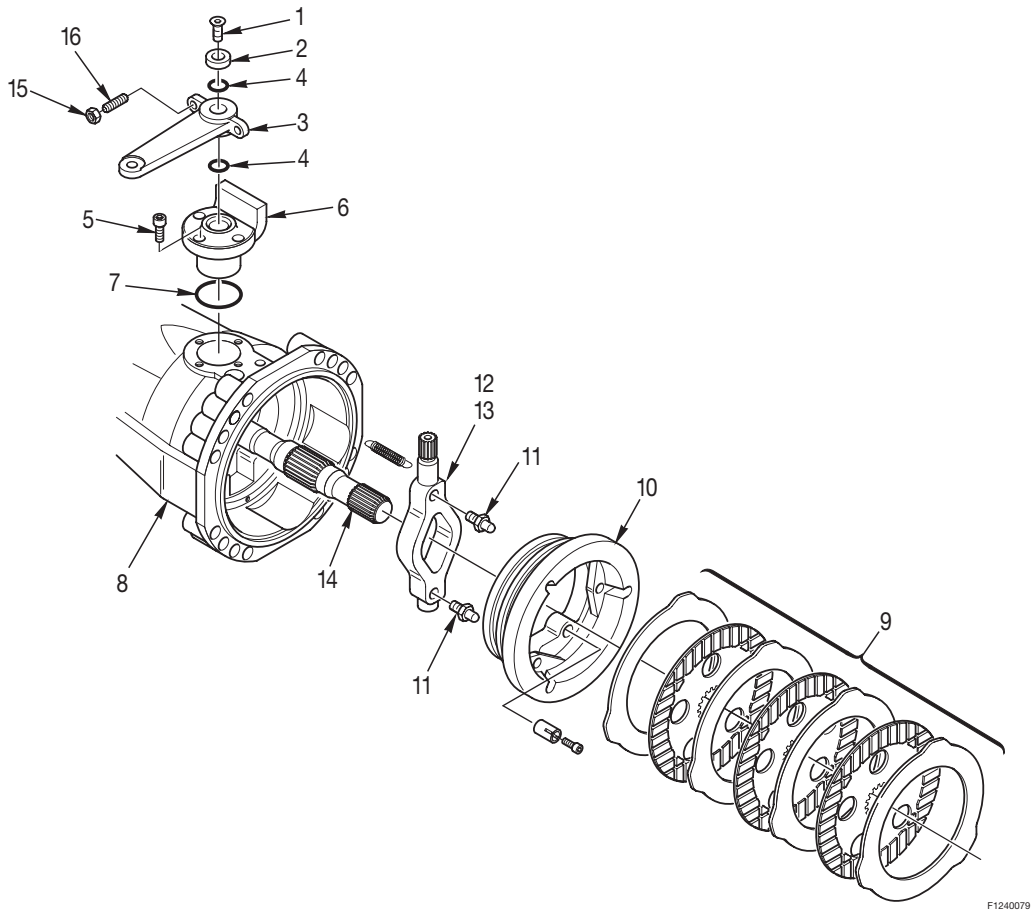
GB a

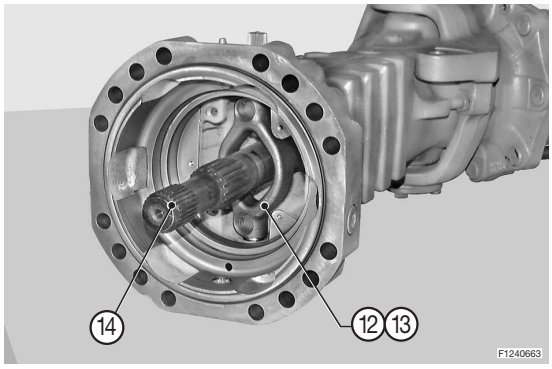
If pins (11) need replacing, block the piston (10) into a vice whose
jaws are covered in smooth material and remove the pins.



GB b

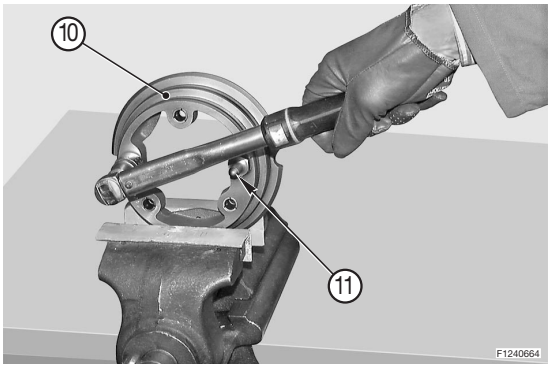
If thrust levers (12) and (13) need replacing, remove the U-joint (14)
before removing the arms (8).
For details, see "HOW TO REMOVE THE U-JOINT".





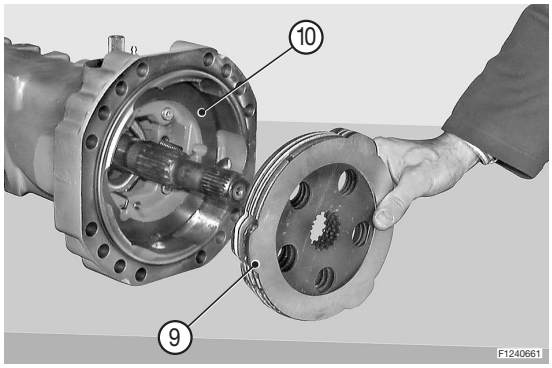
GB a

Install thrust levers (12) and (13), then install the U-joint (14). For details, see "HOW TO INSTALL THE U-JOINT".



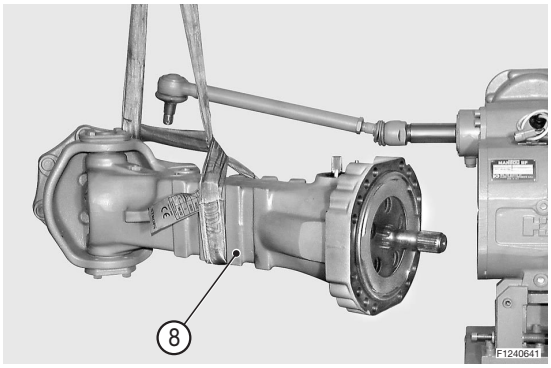
GB b

Apply Loctite 270 to the threaded portion of the pins (11) and fit them onto the piston (10).
Block them: torque wrench setting 30 ÷ 35 Nm.



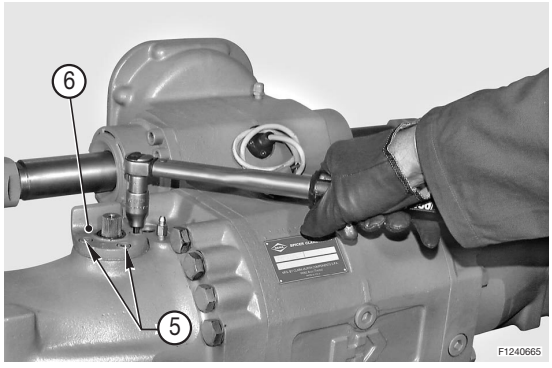
GB c

Re-install the piston (10) and the braking disks (9). For details, see "HOW TO ASSEMBLE THE BRAKING UNITS".



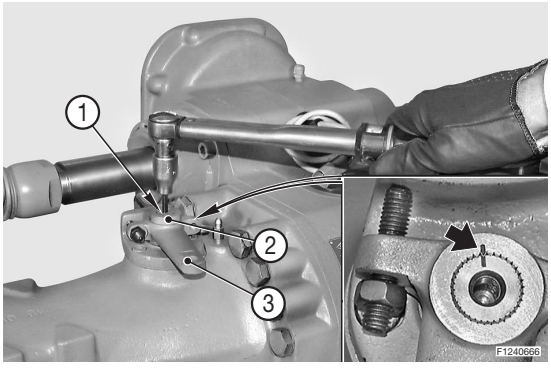
GB d

Install the arms (8) into the main body; check flatness and block arms following the appropriate procedures illustrated in section "HOW TO ASSEMBLE THE BRAKING UNITS".



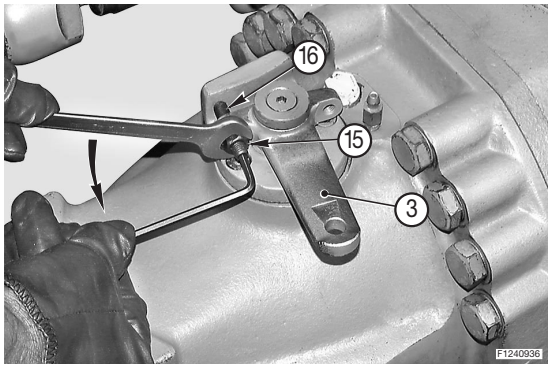
GB e

Install the bush (6) complete with O-ring (7) and block it with screws (5). Tighten screws with a torque wrench setting of 23.8 ÷ 26.2 Nm.



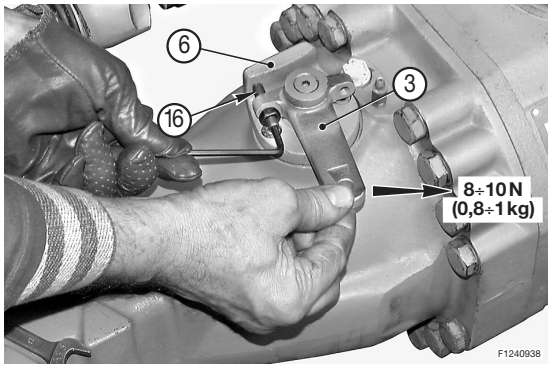
GB f

Install in sequence the lower O-ring (4), the lever (3) and the washer (2) with the relative O-ring (4). Block with screw (1) and tighten using a torque wrench setting of 23.8 ÷ 26.2 Nm.
CAUTION! Refer and keep to the positions marked during disassembly.



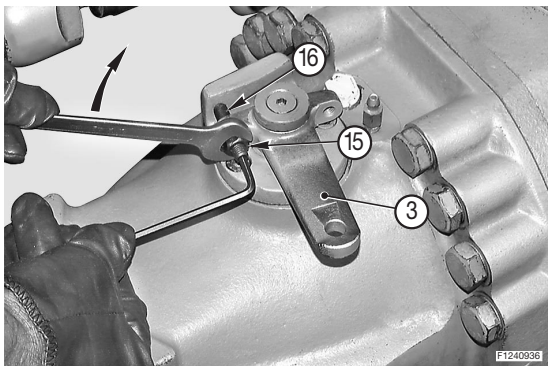
GB a

Connect the braking circuit and apply maximum working pressure to set the disks.
Release the pressure, loosen nut (15) and unscrew dowel (16) by a few turns.



GB b

Apply a force of 8 ÷ 10 N (0.8 ÷ 1 kg) to lever (3). Direct the force towards the braking direction in order to eliminate the idle stroke.
While the force is being applied, tighten dowel (16) until it is caused to rest onto bush (6).



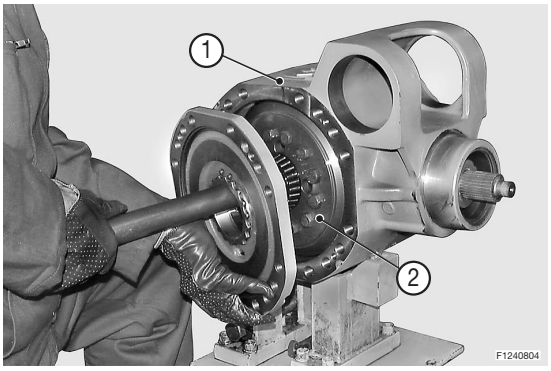
GB c

Lock dowel (16) in this position with nut (15).
Torque wrench setting: 20 ÷ 25 Nm.
CAUTION! The idle stroke should be eliminated without preloading thrust levers (12) and (13).

GB d

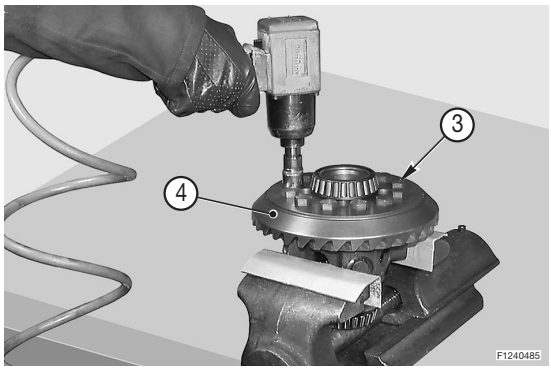
CAUTION! After connecting the control cable, check that when brakes are released both dowels (16) do lean against bush (6).

DISASSEMBLY LIMITED SLIP DIFFERENTIAL UNIT (25% AND 45%)



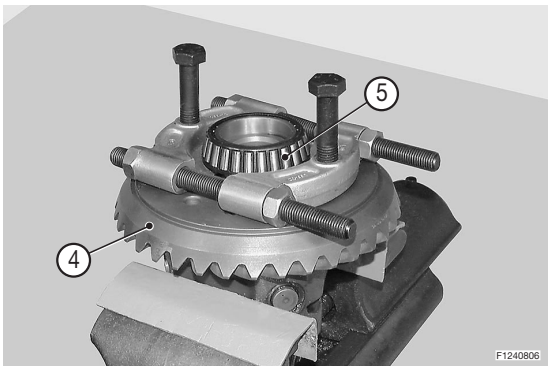
GB a

Remove the whole differential unit (2) from the central axle unit (1).
For details, see "REMOVING THE DIFFERENTIAL UNIT".



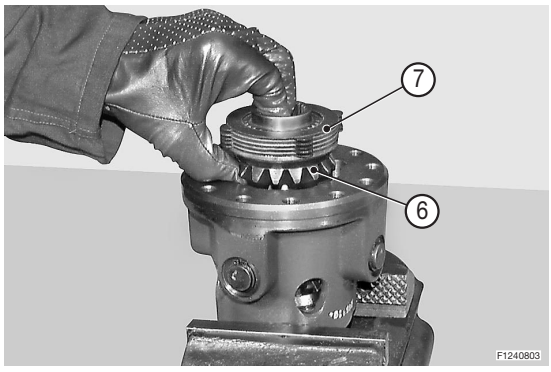
GB b

Remove the check screws (3) of the crown (4).
NOTE. Note down the position of the niches of the central hole in relation to the protrusions of the friction unit steel discs.



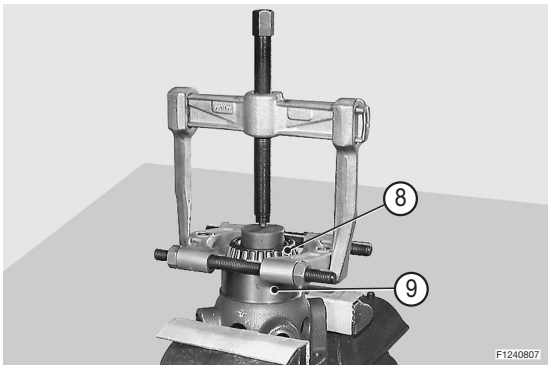
GB c

If bearing (5) needs replacing, remove it; remove crown (4).



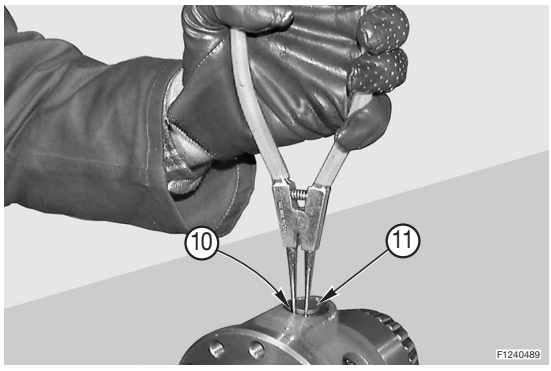
GB d

Remove the planetary gear (6) and the whole friction unit (7).



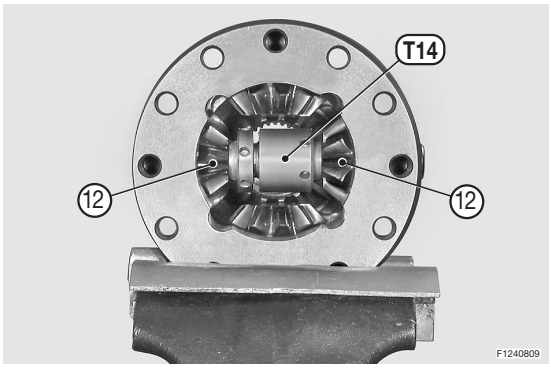
GB e

If bearing (8) needs replacing, extract it from the differential unit (9).



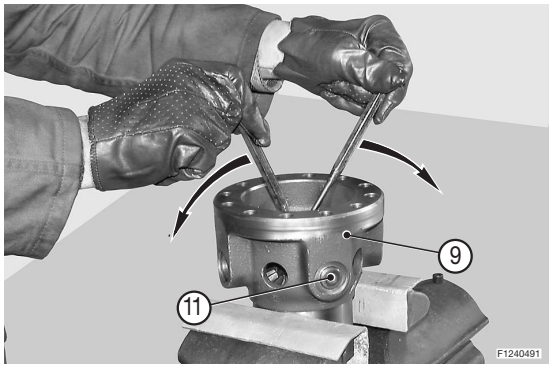
GB f

Remove the snap rings (10) from the pins (11) of the planet gears



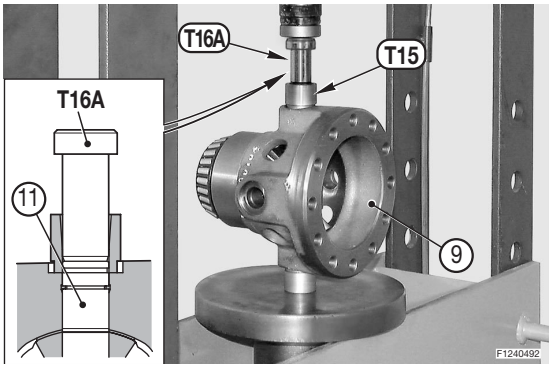
GB a

Introduce tool T14 in-between the planet gears (12).



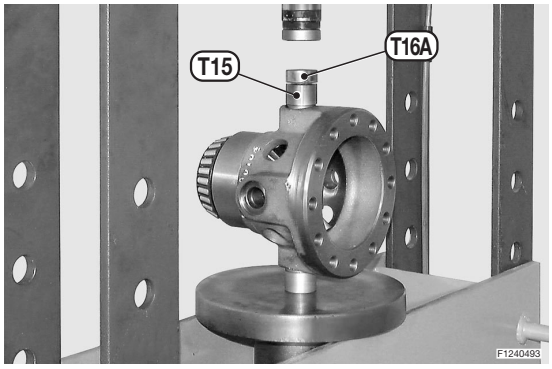
GB b

Using two pin-drivers, engage tool T14 in between the planet gears (12).
CAUTION! Carefully check that tool T14 keeps in an aligned position with the pins (11) when locked.



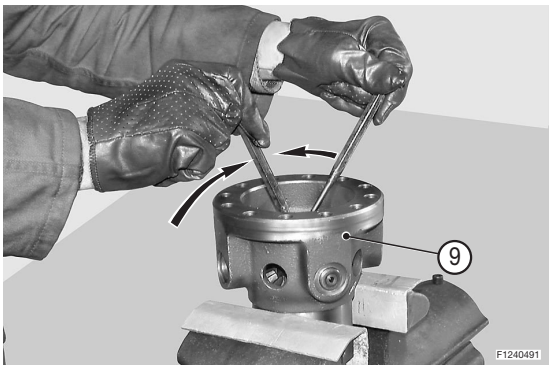
GB c

Place the differential unit (9) under a press, position bush T15 and insert gudgeon T16A. Press gudgeon T16A to end of stroke.



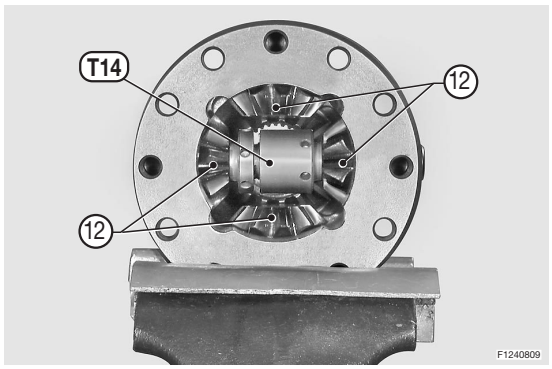
GB d

Remove gudgeon T16A and bush T15.
NOTE. In this state, the pin (11) is contained within tool T14.



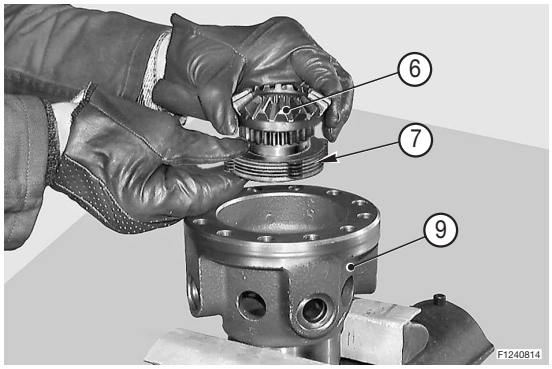
GB e

Remove tool T14 and planet pin (11) with it.



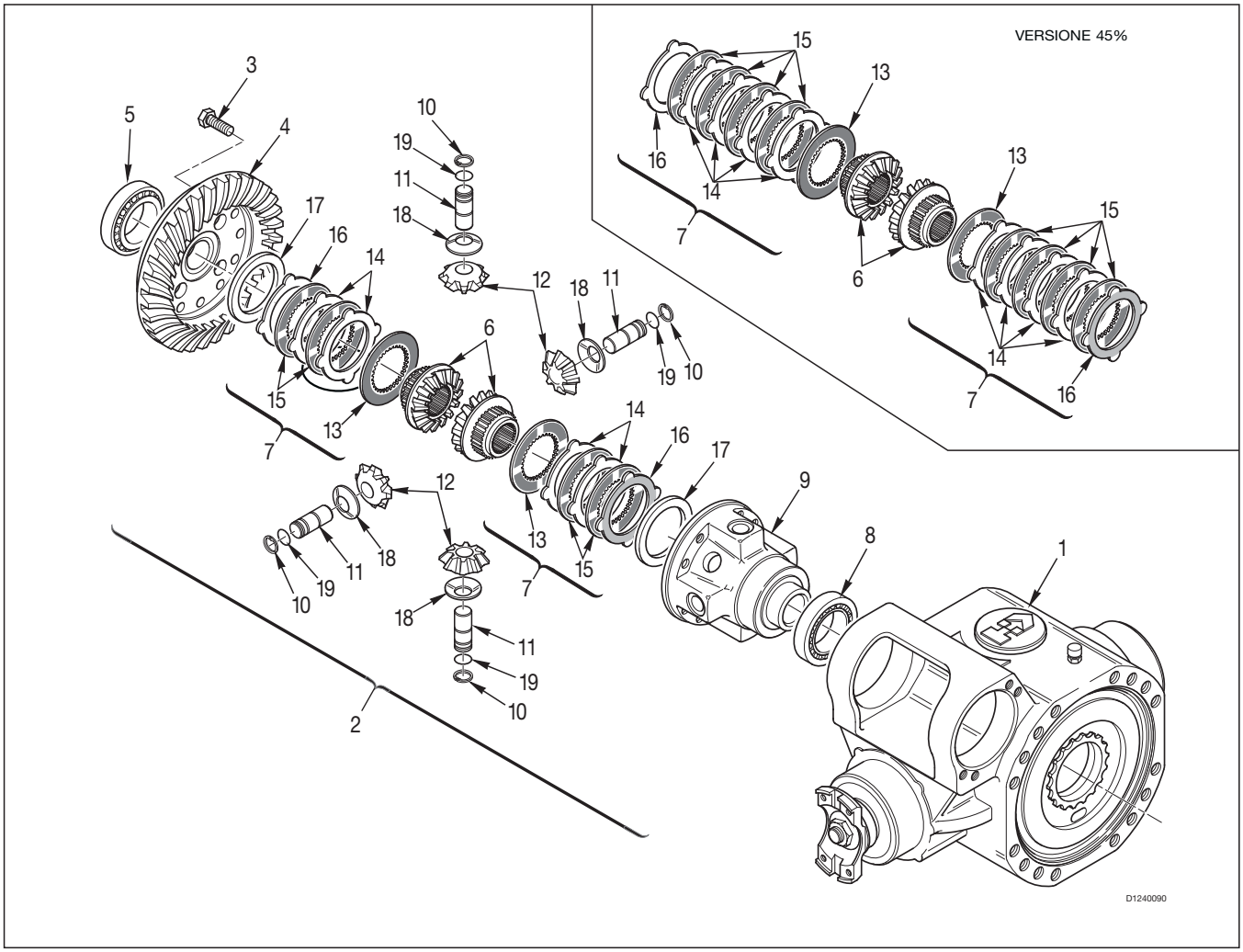
GB f

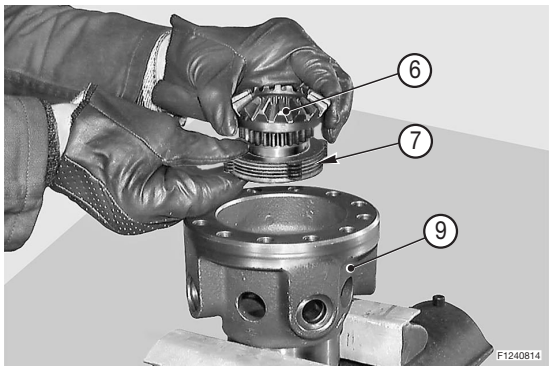
Leaving the released planet in its position, lock again tool T14.
Repeat pin extraction operation on the second planet pin (11).
Repeat the same operations on the remaining pins.



GB a

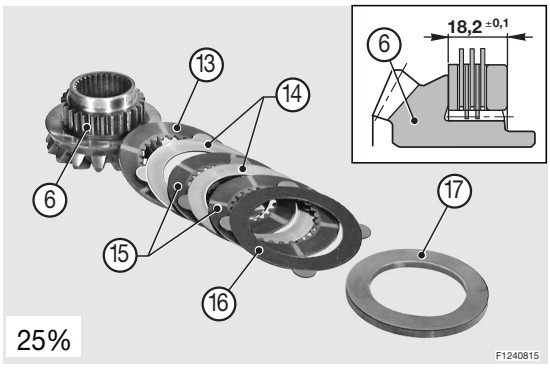
Remove tool T14 and extract from the differential unit (9) the two final planet gears (12), the 2nd planet gear (6) and the whole friction assembly concerned (7).





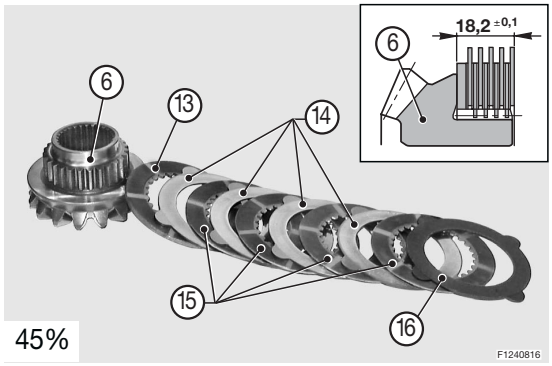
GB a

Place a friction unit (7) - suitable for the specific type of slipping - and planetary gear (6) into the differential unit (9).
The composition of the unit is illustrated in the points below.



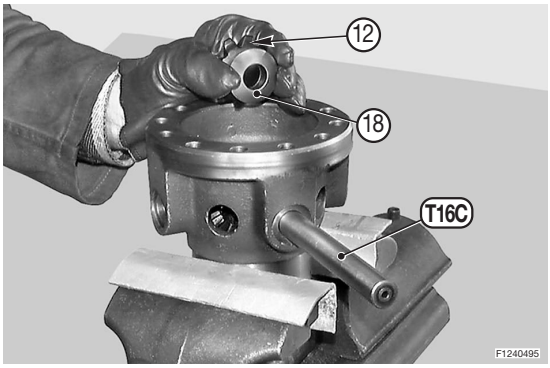
GB b

25% FRICTION UNIT COMPOSITION
Friction ring with increased shim (13), steel rings (14) and friction rings (15) alternated, end ring (16) and distance piece (17).
CAUTION! As to rings (13) and (16), the side without notches must face outwards.



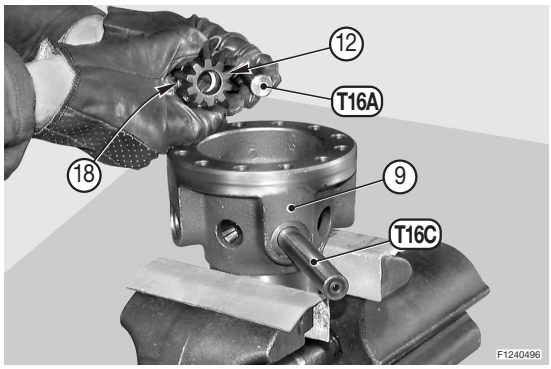
GB c

45% FRICTION UNIT COMPOSITION
Friction ring with increased shim (13), steel rings (14) and friction rings (15) alternated, end ring (16) and distance piece (17).
CAUTION! As to rings (13) and (16), the side without notches must face outwards.



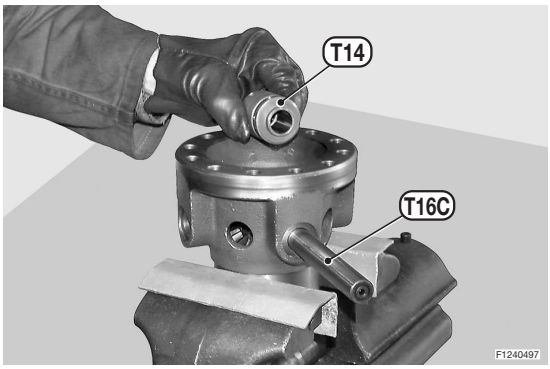
GB d

Position shim washer (18) and the first planet gear (12).
Hold them in position with bar T16C.



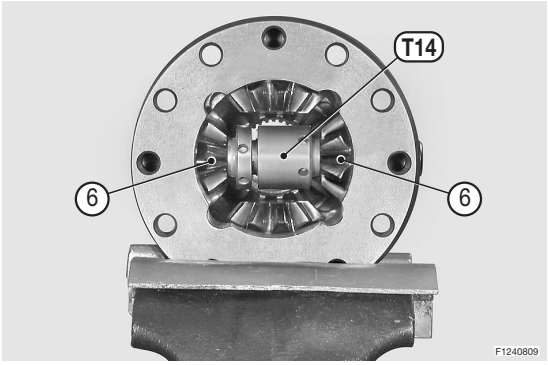
GB e

Using gudgeon T16A, position the second planet gear (12) and relative shim washer (18).



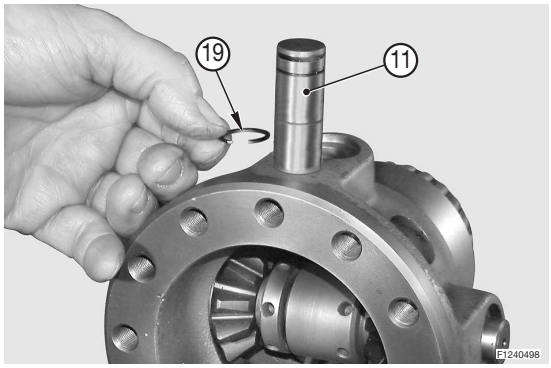
GB f

Insert tool T14 in-between the two planet gears (12). Align the whole unit, pushing bar T16C in as far as it will go, until gudgeon T16A is expelled.



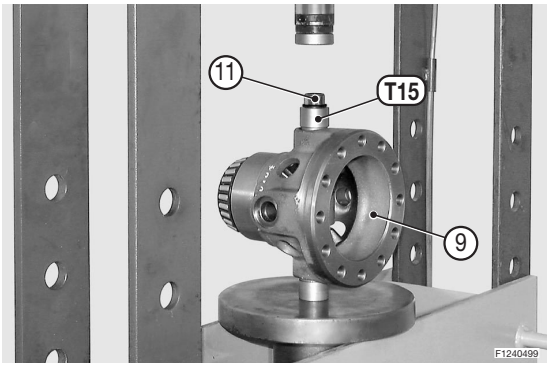
GB a

Lock tool T14 behind the planet gears (12).
After locking the tool, remove bar T16C.



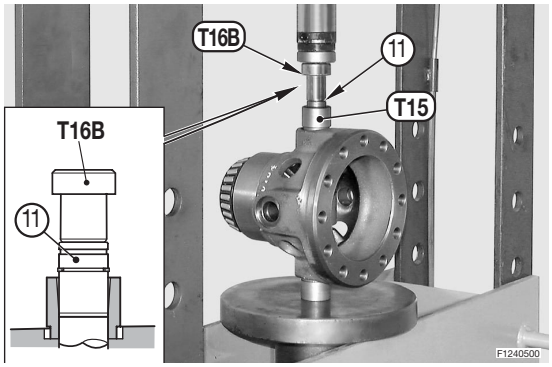
GB b

Fit snap rings (19) onto the pins (11).



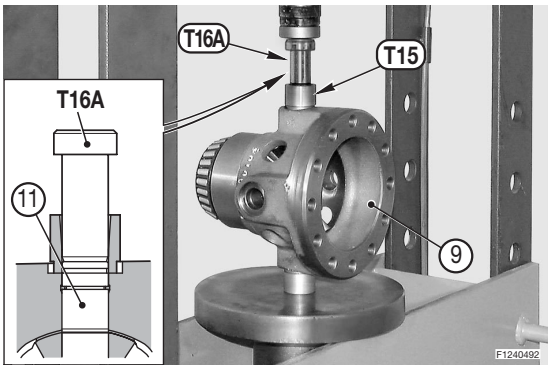
bar GB c

Position the differential unit (9) under the press, position bush T15 and insert the planet pin (11).



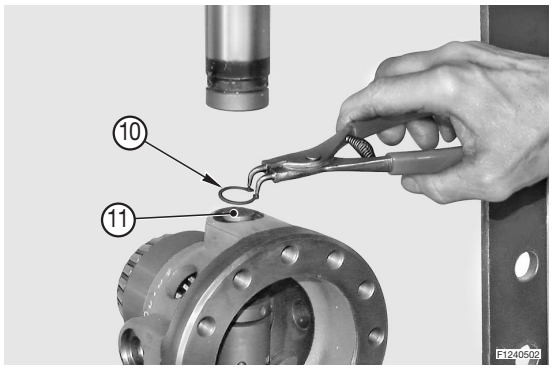
GB d

Place gudgeon T16B on top of the planet pin (11).



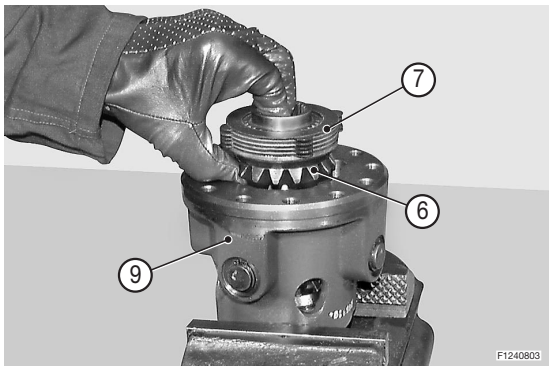
bar GB e

Press gudgeon T16B as far down as it will go.



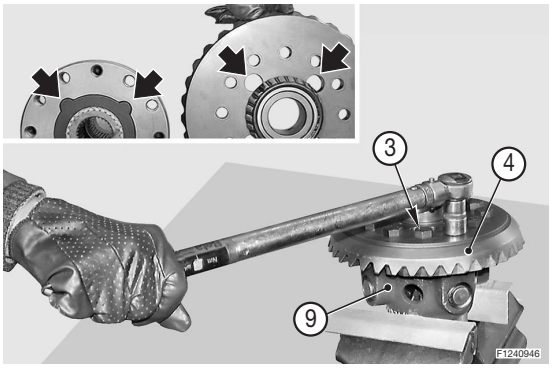
GB f

Remove gudgeon T16B, bush T15, and fit the snap ring (10) onto the pin (11).
CAUTION! Make sure that the snap ring centers the seat and positions itself on the differential unit face.
Repeat the operations on the other planet pin and on the other planet unit.



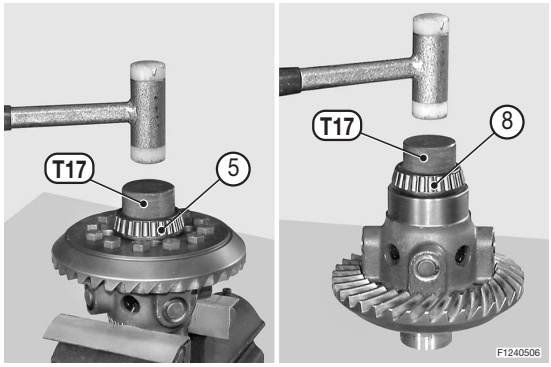
GB a

Check that planets have a light clearance in relation to the first planet gear.
Position the second planetary gear (6) and the second friction unit (7) into the differential unit (9).



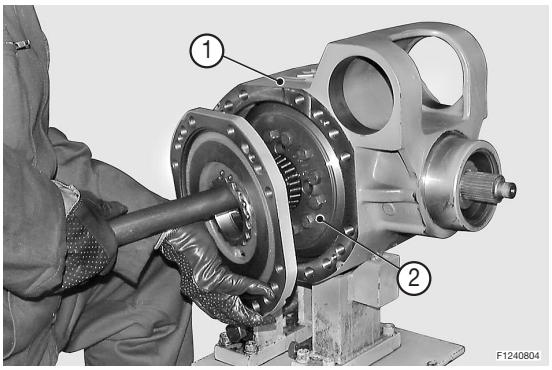
GB b

Line the lubrication holes up with the slots in the differential carrier.
Orient the holes of the crown (4) towards the protrusions of the braking unit. Position the crown (4) on the differential unit (9) and lock it with the screws (3) previously coated with Loctite 242.
Torque wrench setting for screws: 128 ÷ 142 Nm.
NOTE. Tighten screws using the criss-cross method.



GB c

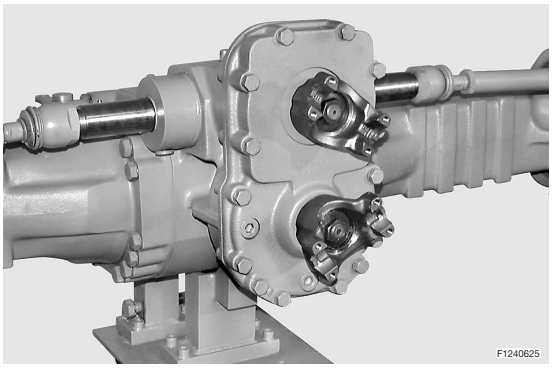
If bearings (5) and (8) have been removed, install them using tool T17.



GB d

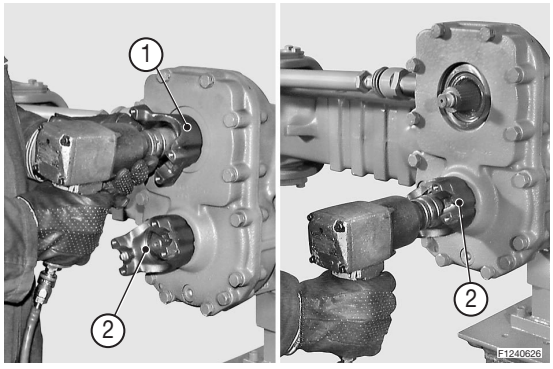
Install the whole differential assembly (2) into the central body (1).
For details, see "INSTALLING THE DIFFERENTIAL UNIT".

DISASSEMBLE INCORPORATED REDUCTION GEAR AND PINION (602)



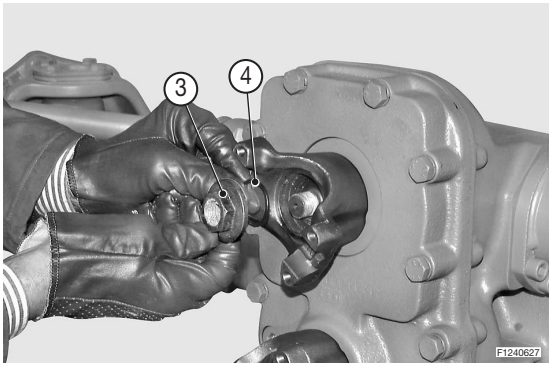
GB a

The figure shows the axle with incorporated reduction gear with Mechanic flanges, disassembly and assembly procedures also apply to DIN flanges.



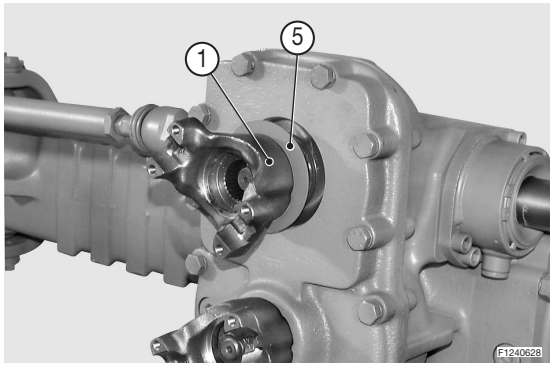
GB b

Unloose the check nuts on upper (1) and lower (2) flange.



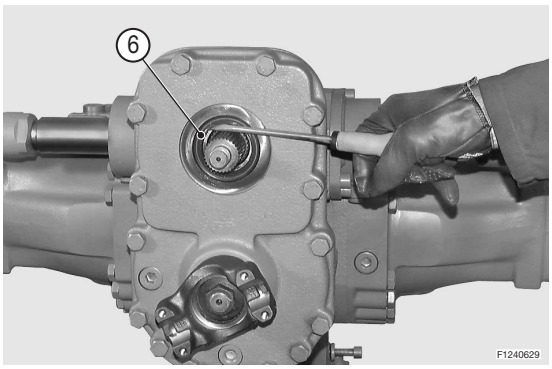
GB c

Draw out nuts (3) and O-rings (4).



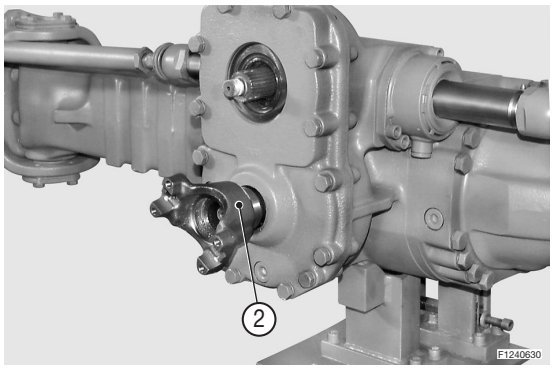
GB d

Remove the upper flange (1) together with dust ring (5).



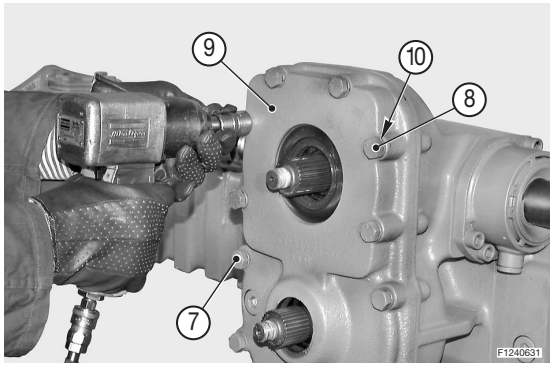
GB e

Remove the snap ring (6) and discard it.



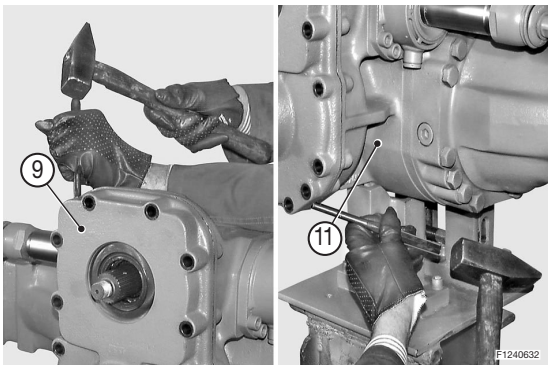
GB f

Remove the lower flange (2).



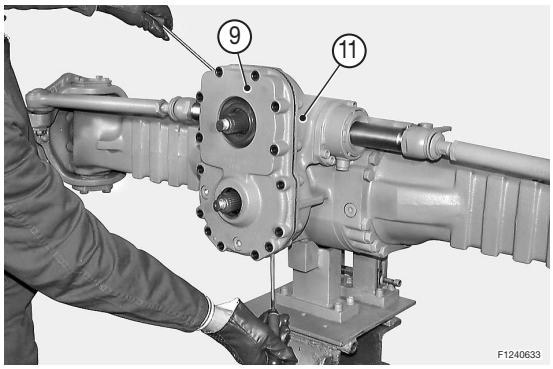
GB a

Remove check screws (7), (8) and relative washers (10) from cover (9).



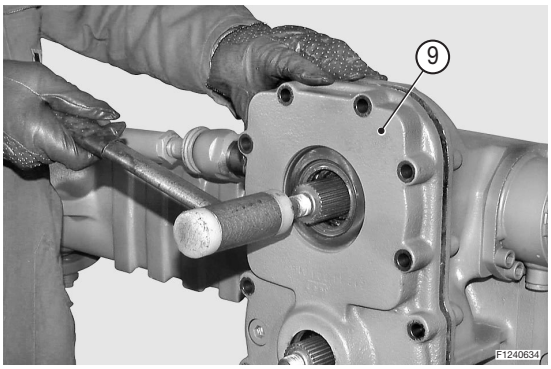
GB b

In turn, insert a punch in the slots provided and, tapping lightly with a hammer, separate the cover (9) from the body of the reduction gear (11).



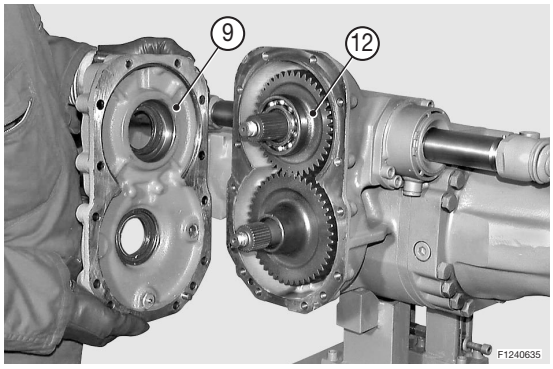
GB c

Insert two levers in the provided slots and move the cover (9) away from the body of the reduction gear (11).



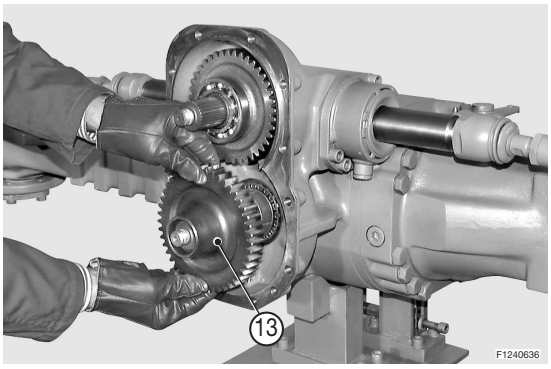
GB d

Lightly tap with a hammer to disengage cover (9) from upper gear (12).



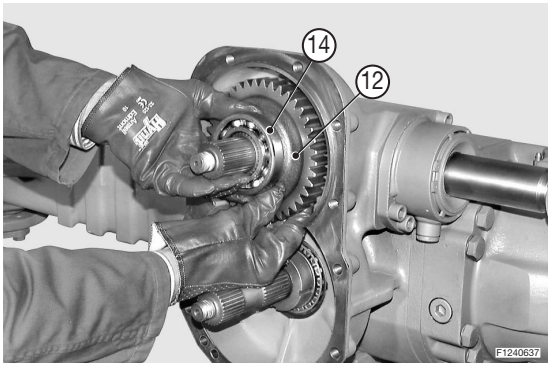
GB e

Draw out cover (9) and remove any sealant left.



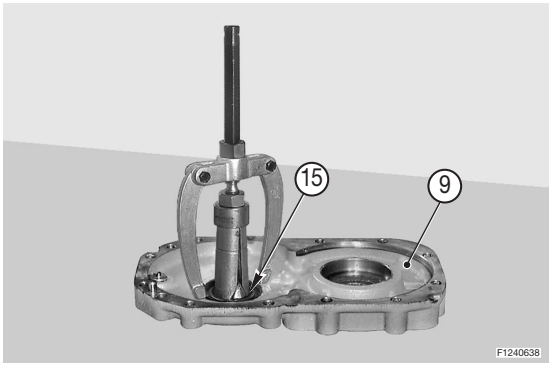
GB f

Remove lower gear (13).



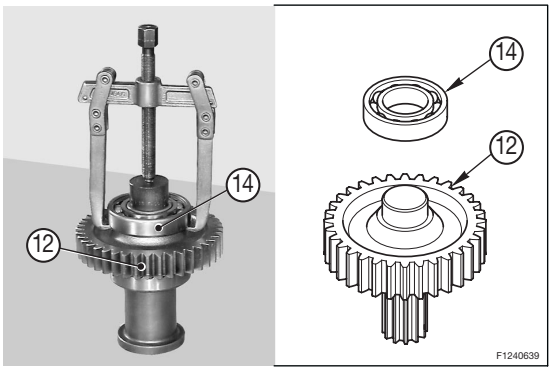
GB a

Remove upper gear assembly (12) complete with bearings (14).



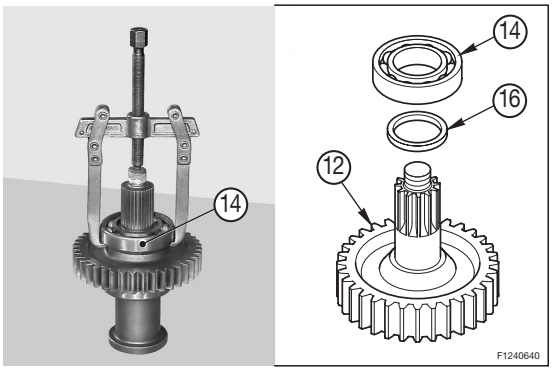
GB b

Using a puller, remove snap ring (15) from cover (9) and discard it.
NOTE. Note down direction of installation.



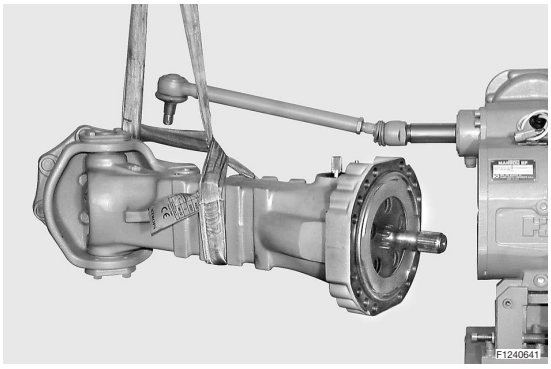
GB c

Remove inner bearing (14) from gear assembly (12).



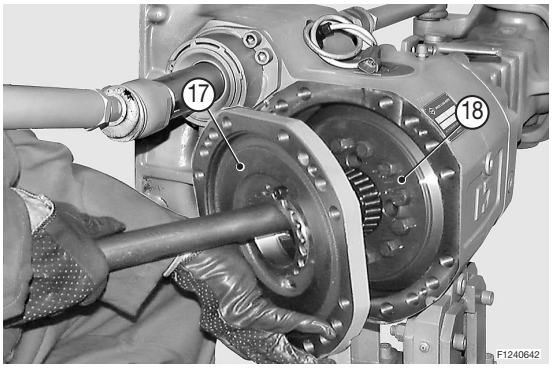
GB d

Remove outer bearing (14) and distance piece (16).



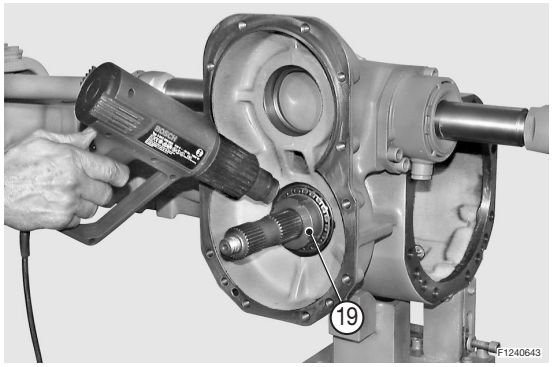
GB e

Disjoin from the steering case the steering bar located by the side of the intermediate cover (17). Remove the complete arm.
For details, see “CHECKING WEAR AND REPLACING THE BRAKING DISCS”.



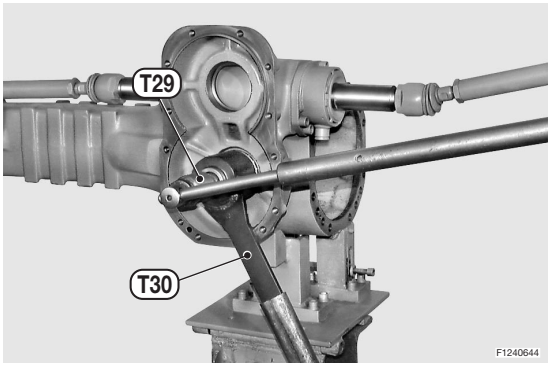
GB f

Remove the intermediate cover (17) and the whole differential unit (18)
For details, see “HOW TO REMOVE THE DIFFERENTIAL UNIT”.



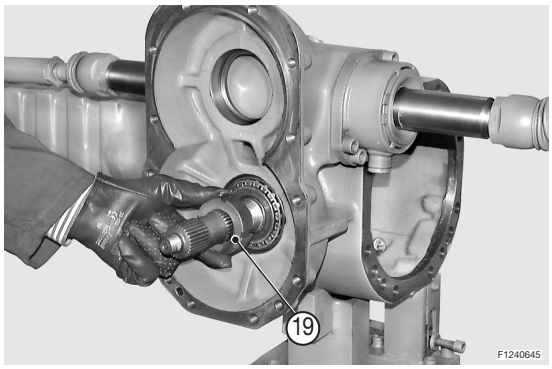
GB a

Heat the ring nut (19) at approx. 80°C.



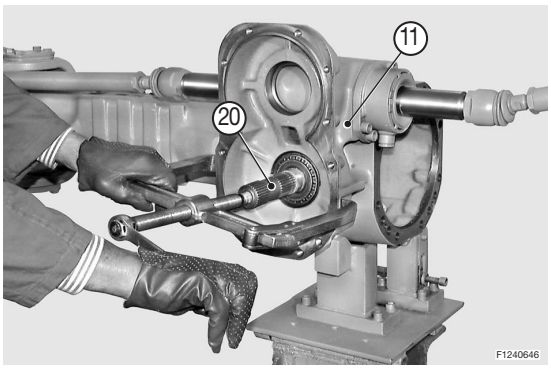
GB b

Engage special wrench T30 on the ring nut (19) and apply bar-hold T29 on the pinion (20).



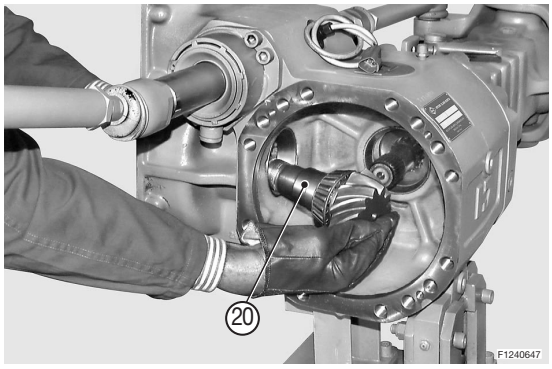
GB c

Remove ring nut (19)



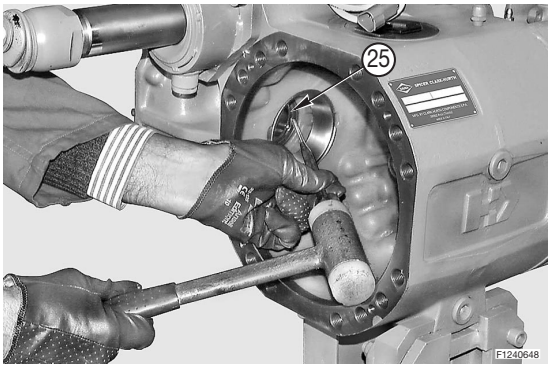
GB d

Using a puller, extract pinion (20) complete with inner bearing (21) distance piece (22) and distance washers.
NOTE. The thrust blocks of the bearings remain in the central body (11).



GB e

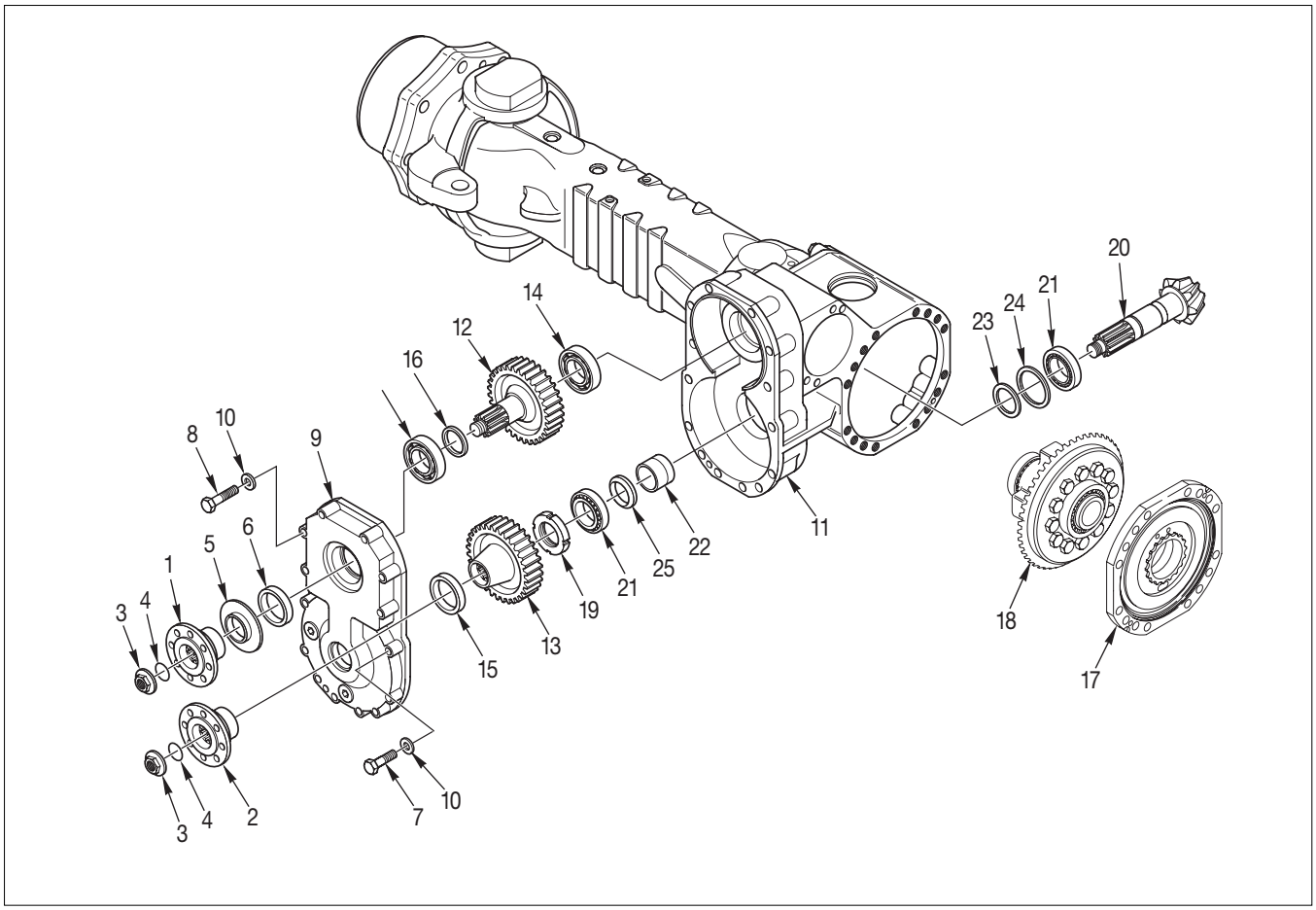
Remove the complete pinion (20).
NOTE. Carefully check and note direction of installation of distance piece.



GB f

Using a punch and a hammer, extract the snap ring (25).
NOTE. Note direction of installation of snap ring (24).

AXLE ASSEMBLY - DISASSEMBLY

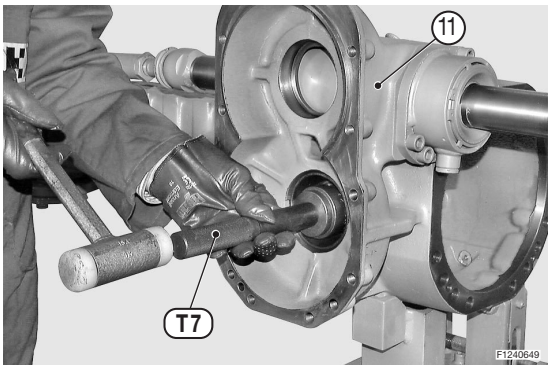


CAUTION!

1- If disassembly has been carried out only as a means to replace the snap ring (24), position the new ring and reassemble the unit by keeping to the torque wrench settings indicated in the following section and using the prescribed locking products.

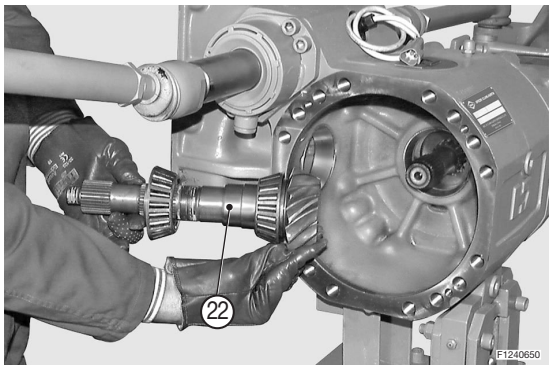
2 - If disassembly is carried out in order to replace crown wheel and pinion, bearings, or planetary gear, break up distance washers and calculate clearances as indicated in the sections regarding removal, disassembly, assembly and installation of differential unit and bevel pinion.

Assembly



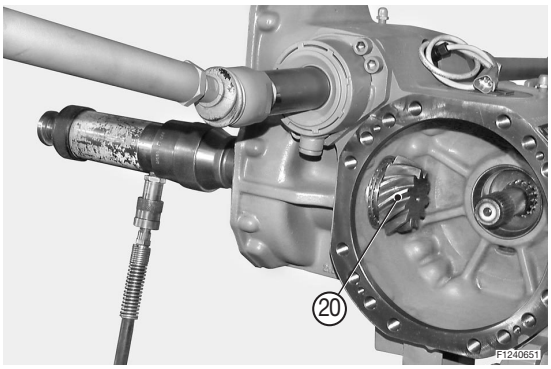
GB a

Find the value of the distance washers (23) and (24) and insert the thrust blocks of the conical bearing of the pinion into the body of the reduction gear (11) (See “HOW TO INSTALI AND ADJUST THE BEVEL PINION”). Using tool T7 insert the snap ring (25) previously lubricated with grease.



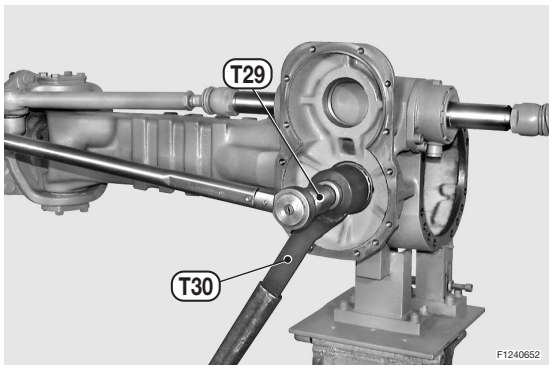
GB b

Assemble the pinion assembly as shown in the picture, checking that distance piece (22) is correctly oriented.
NOTE. Apply grease to the outer surface of the distance piece (22)



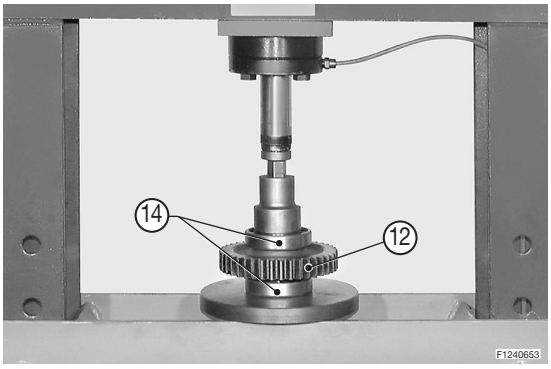
GB c

With tools T28C, T28D and T28B connected to a press, insert the complete pinion assembly (20).



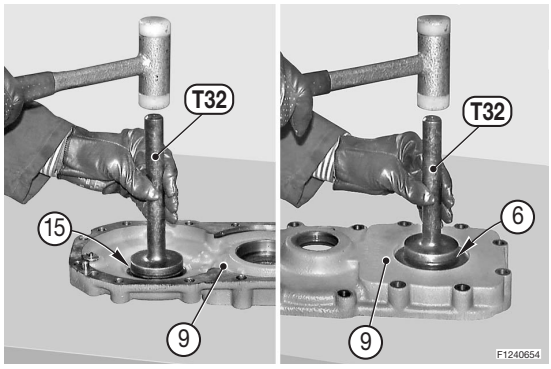
GB d

Apply Loctite 242 to the thread of the pinion and screw the ring nut (19). Engage special wrench T30 on the ring nut and apply bar-hold T29 to the pinion (20). Tighten the ring nut (19) following the appropriate procedure (See “HOW TO INSTALI AND ADJUST THE BEVEL PINION”) and check that torque is 170÷220Ncm.



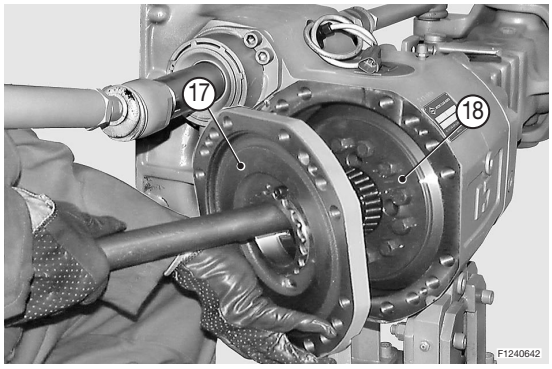
GB e

Using a press, fit the bearings (14) and the distance piece (16) on the upper gear (12).
CAUTION! The distance piece (16) must be positioned between the outer bearing and the gear.



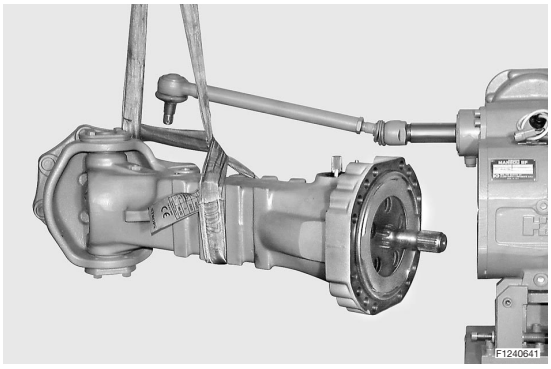
GB f

Grease snap rings (15) and (6); position the snap rings in the cover (9) using tool T32.



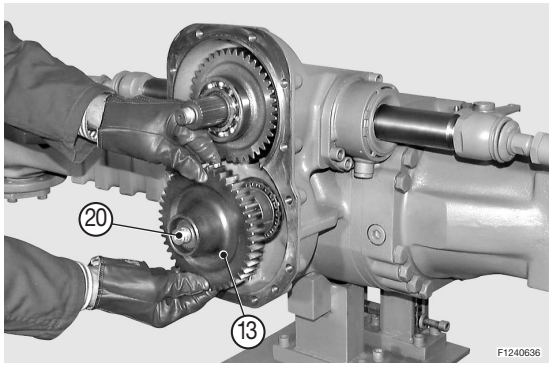
GB a

Re-install the differential unit (18) and the intermediate cover (17).
CAUTION! If the crown has been replaced, reinstate clearances.
For details, see “HOW TO ASSEMBLE AND ADJUST THE DIFFERENTIAL UNIT”.



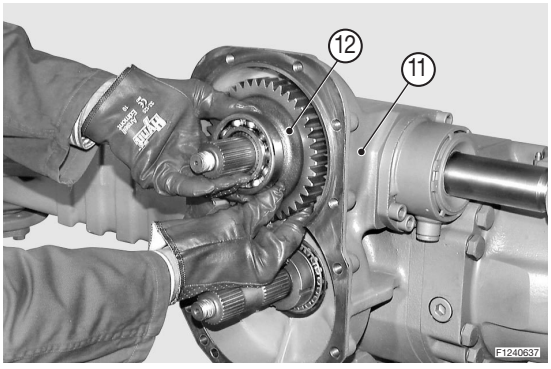
GB b

Re-install the complete arm checking flatness and blocking the arm by keeping to the appropriate procedures illustrated in section “HOW TO ASSEMBLE THE BRAKING UNITS”. Also connect the steering bar.



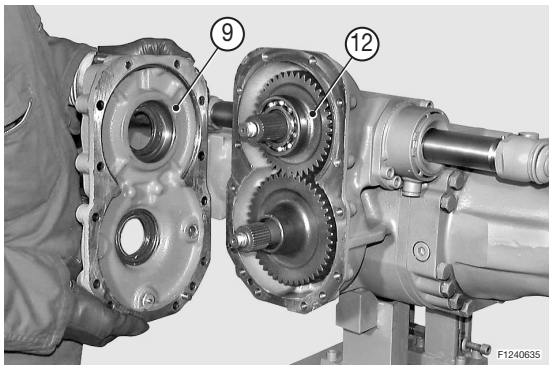
GB c

Fit the lower gear (13) into the pinion (20).



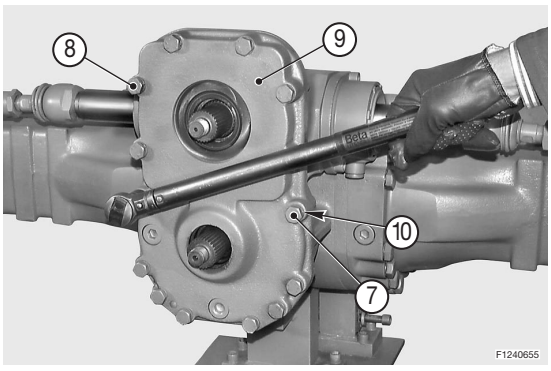
GB d

Insert the upper gear unit (12) into the body of the reduction gear (11)



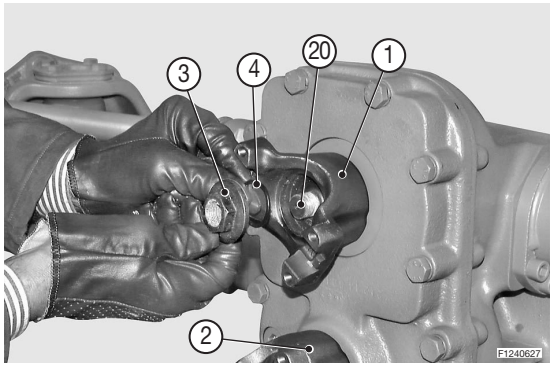
GB e

Apply Loctite 510 to the locking surface of the body of the reduction gear (11).
Lubricate snap rings (6) and (15); fit cover (9) and set cover (if necessary) by lightly tapping with a plastic hammer.



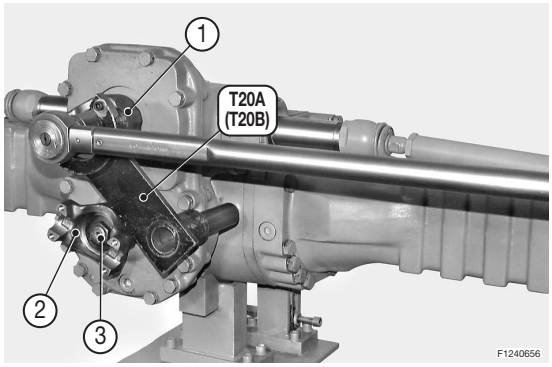
GB f

Block cover (9) with screws (7) and (8) and relative washers (10). Tighten using the criss-cross method.
Torque wrench setting: 82÷91 Nm



GB a

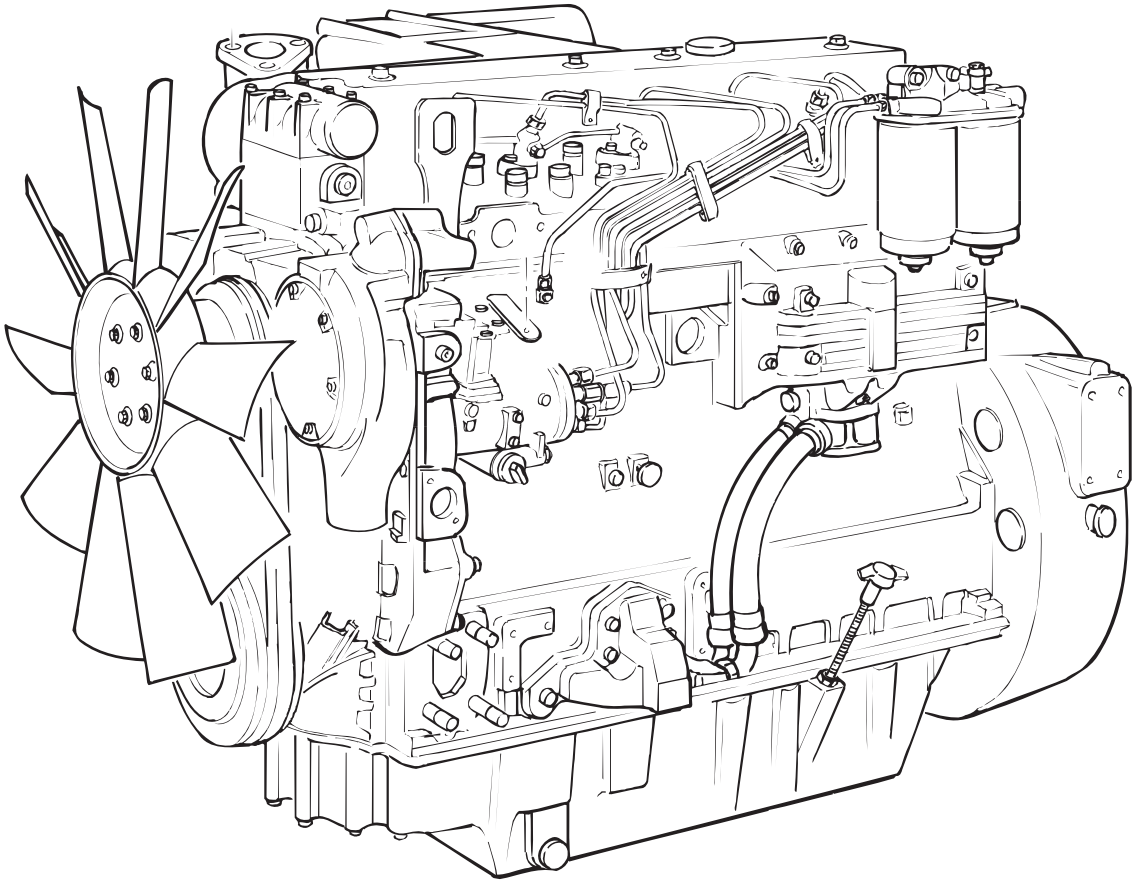
Fit the upper (1) and lower (2) flanges.
Apply Loctite 242 to the threaded portion of pinion (20) and upper gear (12). Fit O-rings (4) and nuts (3).



GB b

Apply tool T20A (or T20B) to flanges (1) and (2) and tighten nuts (3) using a dynamometric wrench. Torque wrench setting: 280÷310 Nm

Section H
PERKINS ENGINE MAINTENANCE



SECTION INDEX

PREVENTIVE MAINTENANCE 2
ENGINE FLUIDE 28
FAULT DIAGNOSIS 31
ENGINE PRESERVATION 33

PREVENTIVE MAINTENANCE

PREVENTIVE MAINTENANCE PERIODS

These preventive maintenance periods apply to average conditions of operation. Check the periods given by the manufacturer of the equipment in which the engine is installed. If necessary, use shorter periods. When the operation of the engine must conform to the local regulations these periods and procedures may need to be adapted to ensure correct operation of the engine.

It is good preventive maintenance to check for leakage and loose fasteners at each service.

These maintenance periods apply only to engines that are operated with fuel, lubricating oil and coolant which conform to the specifications given in this handbook.

Use the procedures in this chapter to maintain your engine in accordance with the preventive maintenance schedule.

Preventive maintenance schedules

The schedules which follow must be applied at the interval (hours or months) which occur first.

Note: For atomisers refer to “Atomiser maintenance” on page 15.

A First service at 20/40 hours
B Every day or every 8 hours
C Every 250 hours or 6 months
D Every 500 hours or 12 months
E Every 1000 hours
F Every 2000 hours
G Every 8000 hours

A	B	C	D	E	F	G	Operation
•	•						Check the amount of coolant in the header tank
	•						Check the engine for leakage of oil and coolant
			•				Check the specific gravity of the coolant (5) (1)
•		•					Check the tension and condition of the drive belt(s)
			•				Clean the sediment chamber and the strainer of the fuel lift pump
		•					Check for water in the pre-filter bowl (or earlier if your fuel supply is contaminated)
			•				Renew the element(s) of the fuel filter(s)
•							Ensure that the idle speed is checked and adjusted, if it is necessary (1)
	•						Check the amount of lubricating oil in the sump
	•						Check the lubricating oil pressure at the gauge
•			•				Renew the engine lubricating oil (2)
•			•				Renew the canister(s) of the lubricating oil filter (2)
					•		Clean the gauze element of the engine open breather system
						•	Renew the open/closed breather assembly (3)
							Empty the dust bowl of the air filter
•	•						- extremely dusty conditions
		•					- normal conditions
			•				Clean or renew the air filter element, if it has not been indicated earlier
					•		Ensure that the turbocharger impeller and turbocharger compressor casing are cleaned (1)
		•					Check all hoses and connections
		•					Clean the compressor air filter
					•		Ensure that the exhauster or compressor is checked (1)
•		•					Check all electrical cables and connections (4)
•				•			Ensure that the valve tip clearances of the engine are checked and, if necessary, adjusted (1)
					•		Ensure that the alternator and the starter motor are checked (1)

(1) By a person who has had the correct training.
(2) The oil service interval will change with the amount of sulphur in the fuel (see the table and the fuel specification - page 28). The interval to change the canister of the lubricating oil filter is not affected.
(3) Or at every complete engine overhaul.
(4) ***Caution:*** *Damage to the engine will occur if there is a failure in the electrical circuit for the cold start advance. The engine will run continuously with the timing fully advanced.*
5) Renew the antifreeze every 2 years. If a coolant inhibitor is used instead of antifreeze, it should be renewed every 6 months. If combustion gases are released into the cooling system, the coolant must be renewed.

Lubricating oil and oil filter canister service interval by application

Note: The service interval for the lubricating oil and oil filter canister is normally 500 hours. This may be reduced to 250 hours ***for applications which have engines operating at high load conditions***. Refer to your equipment supplier's handbook for the application, or the table above for guidance. If further advice is necessary, refer to your nearest Perkins distributor.

250 Hours	*500 Hours*	*500 Hours*
Agricultural	**Agricultural**	**Material handling**
Tractors over 120 bhp and all four wheel drives	Tractors under 120 bhp, not drive	Fork-lift trucks
Logging machinery	Ride-on mowers	Rough terrain fork-lift trucks
Combine harvesters	Woodchippers	Baggage handlers
All other agricultural applications except those listed under 500 hours	**Construction**	Straddle carriers
Construction	Wheeled shovel loaders	Mobile handling equipment
Road making plant	Telescopic handlers	Stationary material handling equipment
Rock crushing equipment	Road rollers, Backhoe loaders	**Vehicle**
Bulldozers, Trenchers	Skid steer loaders	Cars, vans and mini cars
Graders, Dumpers	Excavators, Cranes	Buses, Ambulances
Scrapers, Concrete mixers	**Industrial**	Fire appliances
Crawler tractors	Combined heat and power generating sets	Refuse collectors
All other construction applications except those listed under 500 hours	Mine personnel carriers	
Generating sets	Mine dumpers	
Base and prime power generating sets	Underground drill equipment	
Industrial	Welding sets	
Locomotives and rail equipment	Sweepers	
Compressors, Loaders	Aircraft towing tractor	
Pumping equipment	Refrigeration equipment	
Mine loaders	**Generating sets**	
Road sweepers (auxiliary engines)	Aircraft ground power units	
All other industrial applications except those listed under 500 hours	Stand-by generating sets	
Vehicle	Lighting towers	
All other vehicle applications except those listed under 500 hours		

How to fill the cooling system

Warning! *Refer to your equipment supplier's handbook for the application to fill the cooling system. If coolant is to be added to the system during service, allow the engine to cool before the coolant is added. Remove the filler cap slowly as dangerous coolant could be discharged if the coolant is still hot and the system under pressure.*

Caution: *If coolant is added to the system during service, it must consist of the same original mixture as used to fill the system. See "Coolant specification on page 30 for details of the correct coolant to be used in the system.*

For engines fitted with intercoolers:

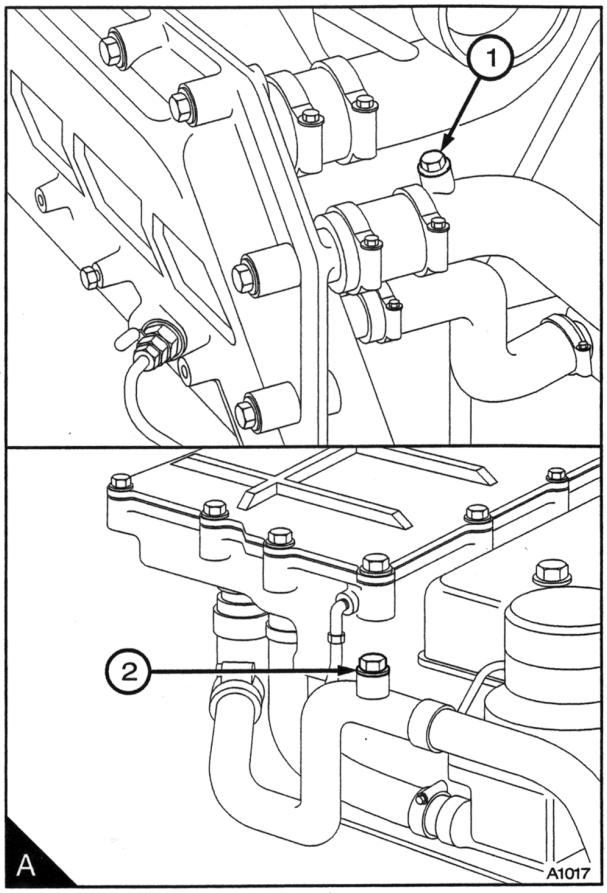
Caution: *When the cooling system is filled it is important to eliminate air from the intercooler to prevent an overheated engine.*

1 Ensure that the top and bottom hose connections are fitted correctly.

2 Fill the cooling system with coolant of the correct specification. Refer to "Coolant specification" on page 30.

3 Open the vent screw (A1 or A2) on the top pipe of the intercooler until coolant free of air flows from the screw. Then tighten the vent screw.

4 Continue to slowly fill the cooling system to the correct level in the radiator, refer to the user's handbook for the application.



How to drain the cooling system

Warning! *Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.*

1 Ensure that the vehicle or machine is on level ground.

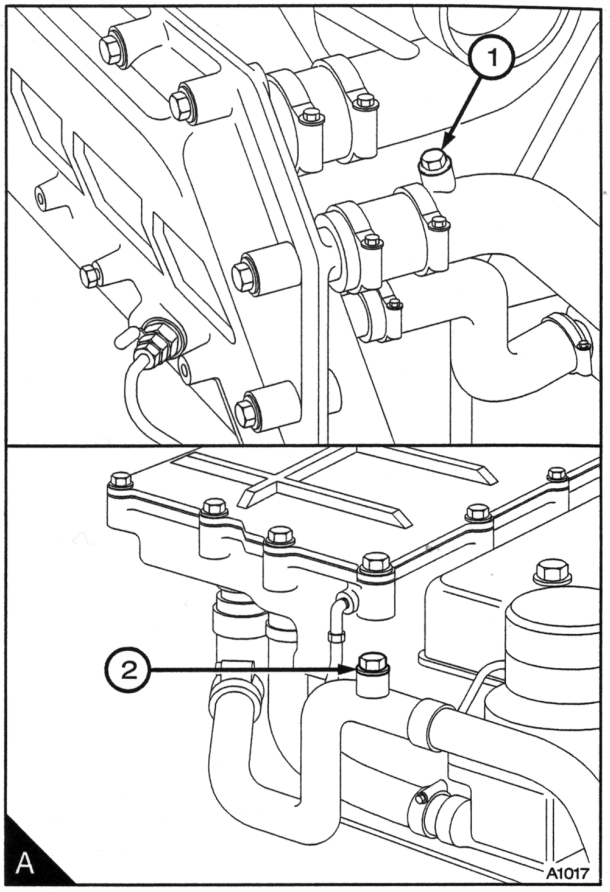
2 Remove the filler cap of the coolant system.

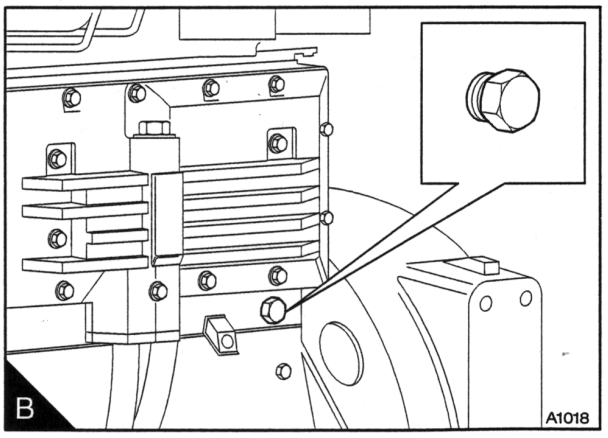
Caution: *To prevent frost damage, ensure that all of the coolant is removed from the engine. This is important if the system is drained after it has been flushed with water, or if an antifreeze solution too weak to protect the system from frost has been used.*

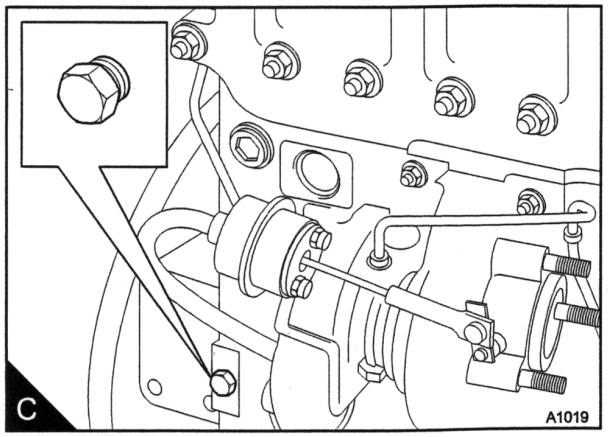
3 For engines fitted with intercoolers: Open the vent screw (A1) for vertical intercoolers or (A2) for horizontal intercoolers. This will ensure that all of the coolant is drained from the intercooler.

4 Remove the drain plug (B or C) from the side of the cylinder block in order to drain the engine. Ensure that the drain hole is not restricted.

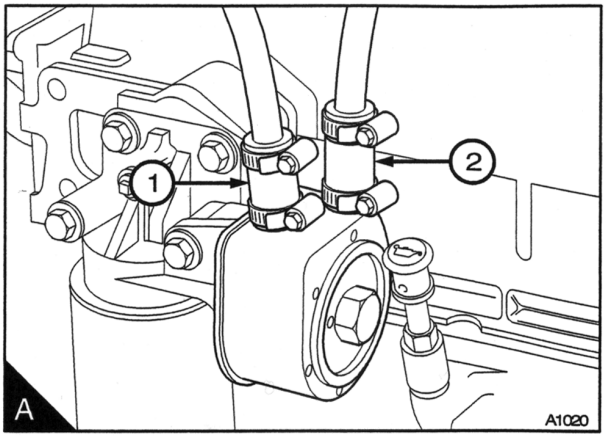
5 Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a tap or drain plug, disconnect the hose at the bottom of the radiator.







6 If a lubricating oil cooler is fitted to the filter head instead of the cylinder block, then this must also be drained and flushed. To do this, disconnect the hoses (A1 and A2) at the top of the cooler and flush the oil cooler through the outlet connection (E1) until clean water flows from the inlet (A2).



Caution: *If the cooling system is to remain empty temporarily after it is flushed with clean water, drain the oil cooler and fill it with 165 ml (~/3 pint) of antifreeze. This will protect the oil cooler against frost if any clean water drains down from the water jacket when the vehicle is moved.*

7 Flush the coolant system with clean water.

8 Fit the hoses to the top of the cooler and tighten the clips.

9 Fit the drain plugs and the filler cap. Close the radiator tap or connect the radiator hose.

How to check the specific gravity of the coolant

For mixtures which contain inhibited ethylene glycol:

1 Ensure that the machine is on level ground.

2 Operate the engine until it is warm enough to open the thermostat. Continue to run the engine until the coolant has circulated the cooling system.

3 Stop the engine.

4 Allow the engine to cool until the temperature of the coolant is below 60°C (140°F).

Warning! *Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.*

5 Remove the filler cap of the cooling system.

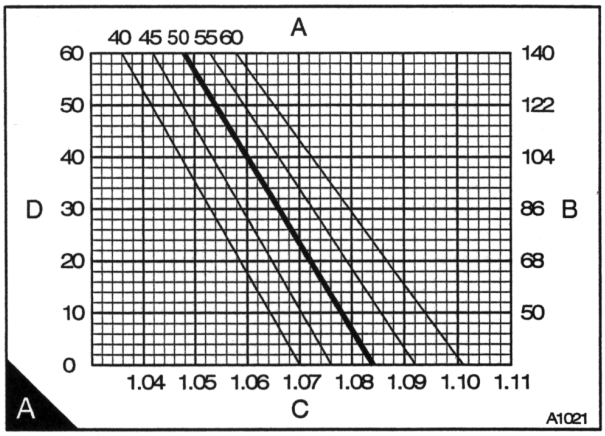
6 Drain some coolant from the cooling system into a suitable container.

7 Use a special coolant hydrometer that will check the temperature and the specific gravity of the coolant, follow the manufacturer's instructions.

Note: If a special coolant hydrometer is not available, put a hydrometer and a separate thermometer into the antifreeze mixture and check the readings on both instruments. Compare the readings with the chart (A).

8 Adjust the strength of the mixture as necessary.

Note: If it is necessary to fill or replenish the cooling system in service, mix the coolant to the correct strength before it is added to the cooling system. Perkins POWERPART antifreeze with a concentration of 50% will give protection against frost to a temperature of –35°C (-31°F). It will also give protection against corrosion. This is especially important when there are aluminium components in the cooling system.



Specific gravity chart

A = Percentage antifreeze by volume
B = Mixture temperature in °F
C = Specific gravity
D = Mixture temperature in °C

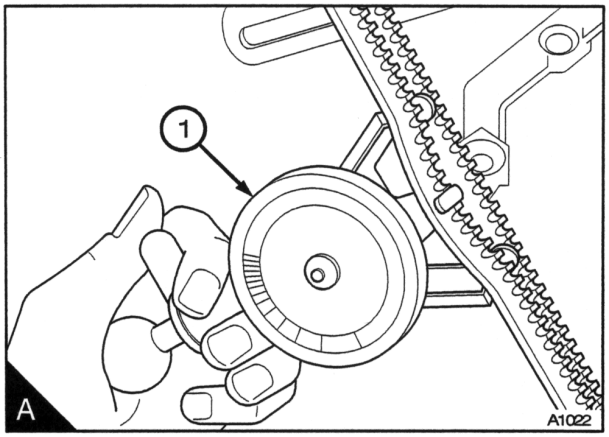
How to check the drive belt(s)

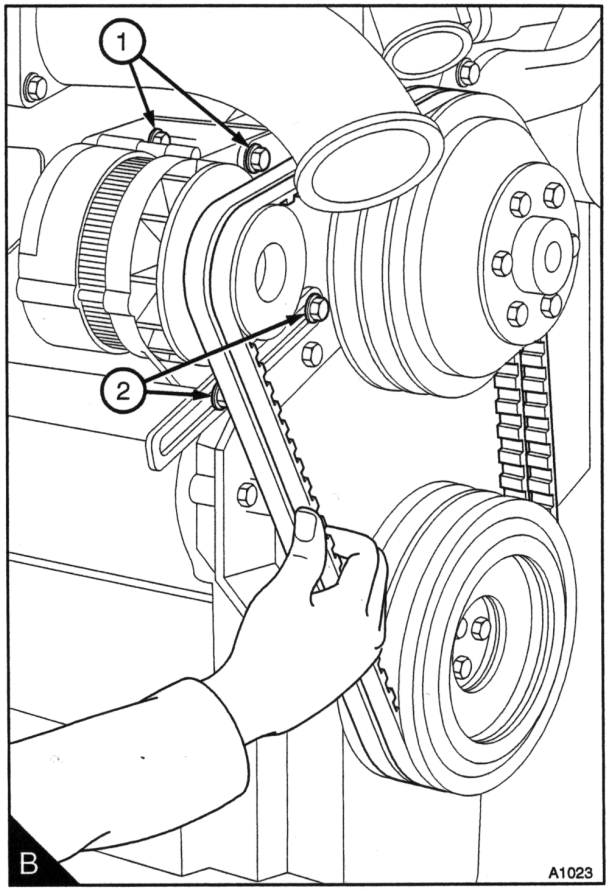
Renew a belt if it is worn or damaged. If twin belts are fitted, they must be renewed together.

To ensure maximum belt life, it is recommended that a belt tensioner gauge is used to check the belt tension. Fit the gauge (A1) at the centre of the longest free length and check the tension. If a “Burroughs” gauge is used, the correct tension is 355 N (80 lbf) 36 kgf. If the tension is 220 N (50 lbf) 22 kgf or below, adjust it to 355 N (80 lbf) 36 kgf as indicated below:

If a gauge is not available, press down the belt with the thumb at the centre of the longest free length and check the deflection (B). With moderate thumb pressure - 45N (10 lbf) 4,5 kgf - the correct deflection of the belt is 10mm(3/8in).

If twin belts are fitted, check/adjust the tension on the tighter belt.





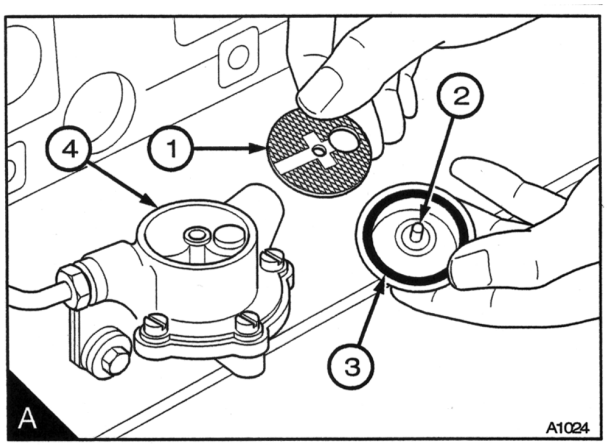
How to adjust the belt tension

1 Loosen the pivot fasteners (B1) of the alternator and the adjustment link fasteners (B2).

2 Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator and the adjustment link fasteners.

3 Check the belt tension again to ensure that it is still correct. If a new belt is fitted, the belt tension must be checked again after the first 20 hours of operation.

How to clean the gauze strainer of the fuel lift pump



1 Release the fastener (A2) and remove the cover and the joint (A3) from the top of the fuel lift pump (A4). Remove the gauze strainer (A1). On some turbocharged engines, it will be necessary to remove the small heat shield which is fitted above the pump.

2 Wash carefully all of the sediment from the lift pump body.

3 Clean the gauze strainer, the joint and the cover.

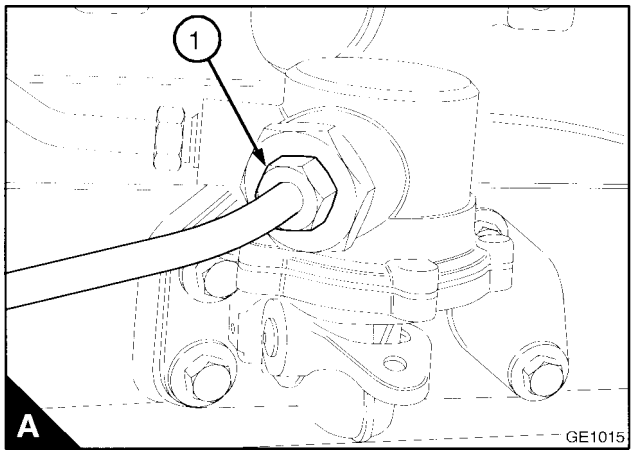
4 Assemble the lift pump. Use a good joint and ensure that the lift pump body and the cover are fitted together correctly because leakage at this point will let air into the fuel system. Fit the heat shield, if one is fitted.

5 Eliminate the air from the fuel system through the filter vent point, refer to “How to eliminate air from the fuel system” on page 18.

New fuel lift pump

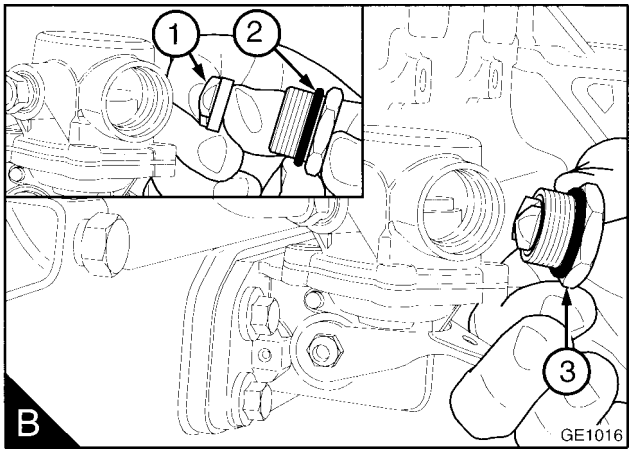
A new fuel lift pump (A) has been introduced for use on four cylinder New 1000 Series. The new pump is a one-piece assembly and should not be dismantled. A strainer (B1) is fitted inside the fuel inlet connection (B3). This strainer is cleaned at the same service interval as the strainer fitted to other fuel lift pumps. The procedure to remove and to fit this fuel lift pump is as the earlier fuel lift pumps.

A kit, is available that provides a fuel lift pump and a joint.



To clean the strainer

1 Turn off the fuel supply.
2 Release the union nut (A1) and remove the pipe from the fuel inlet.
3 Release the hexagonal fuel inlet connection (B3).
4 Remove the strainer (B1) together with the 'O' ring (B2) from the fuel inlet connection.
5 Clean the strainer in clean diesel fuel and dry it with low pressure compressed air. A kit, is available, which provides a strainer and an 'O' ring.
6 Fit the strainer into the fuel inlet connection and fit a new 'O' ring, if necessary.
7 Fit and tighten the fuel inlet connection to 20 Nm (15 lbf ft) 2,0 kgf m.



Caution: *Ensure that the olive on the fuel inlet pipe is in good condition. If it is not, renew the olive or the pipe. If there is not a good seal, air will enter the fuel system when the engine is run.*

8 Fit the pipe to the fuel inlet connection and tighten the union nut.
9 Turn on the fuel supply and check for fuel leakage. Correct any leakage. Eliminate air from the fuel system see "How to eliminate air from the fuel system" on page 18.

Fuel pre-filter

A pre-filter, if fitted, is installed between the fuel tank and the engine. Check the pre-filter bowl for water at regular intervals and drain as necessary, refer to "Preventive maintenance schedules" on page 3.

How to renew the fuel filter

Warning! *Discard the used canister and fuel oil in a safe place and in accordance with local regulations.*

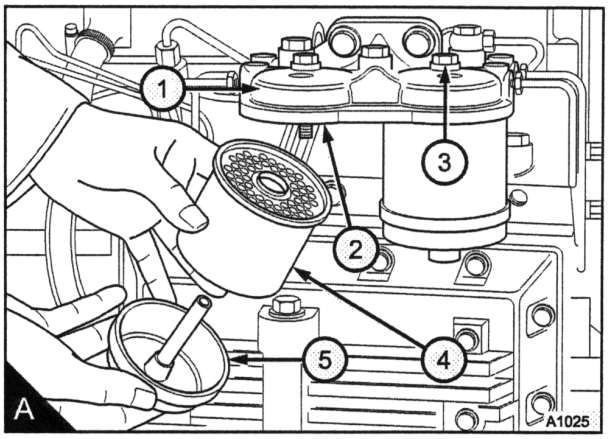
Cautions:

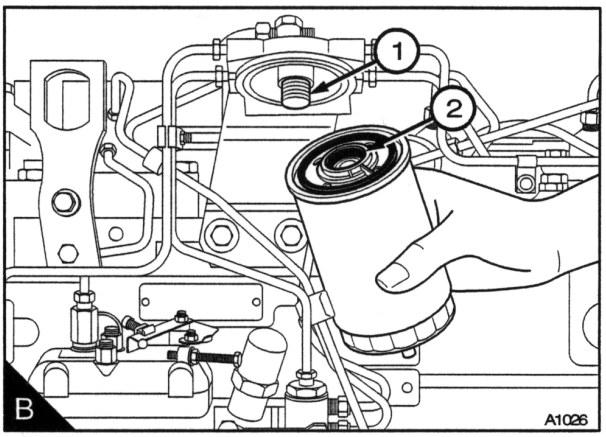
- *It is important that only the genuine Perkins parts are used. damage the fuel injection pump*
- *The pre-filter and main filter canisters must be renewed at the same time*
- *Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.*

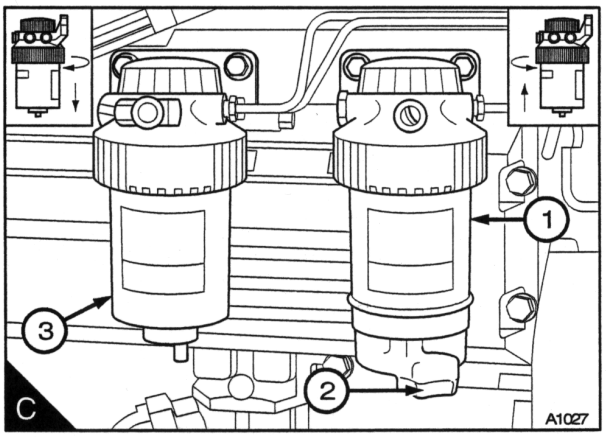
There are three types of fuel filter element in use: The separate element type where the filter element (A4) is held between the filter head and the bottom cover. The filter can have two elements (A).

The canister type where the filter element has an internal thread (B2) at the top and is fastened to a threaded adaptor in the filter head (B1).

A fuel filter with a quick release canister (C). The filter can have two canisters. Some engines are fitted with a pre-filter (C1) of the same type. This filter is fitted next to the main filter (C3), but connected in the fuel system before the fuel lift pump.







How to renew the element(s) of the separate element type

1. Clean the outside surfaces of the fuel filter assembly. If a drain tap (C2) is fitted to the bottom of the filter bowl, drain the fuel from the filter.
2. Hold the bottom cover of the filter element and release the set screw (A3) which is fitted through the filter head (A1) above the centre of the element.
3. Lower the bottom cover of the filter.
4. Remove the element (A4) and discard it.
5. Clean the inside surfaces of the filter head and of the cover.
6. Renew the seals (A2) and (A5) and lightly lubricate them with clean fuel.
7. Put the bottom cover under the new element and hold the element squarely to the filter head. Ensure that the element is fitted in the centre against the joint in the filter head. With the assembly in this position, engage and tighten the set screw.
8. Eliminate the air from the fuel filter, refer to “How to eliminate air from the fuel system” on page H18.

How to renew the filter canister of the canister type

Caution: *It is important that only the genuine Perkins fuel filter canister is used. The use of a wrong canister can cause damage to the fuel injection pump.*

1 Thoroughly clean the outside surfaces of the fuel filter assembly.

2 Loosen the drain device (A1) at the bottom of the filter and allow the water/fuel to drain into a suitable container.

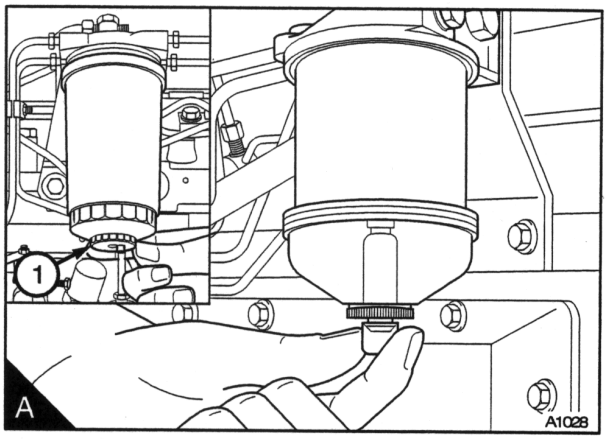
3 Use a strap wrench or similar tool to loosen the filter canister and remove the canister.

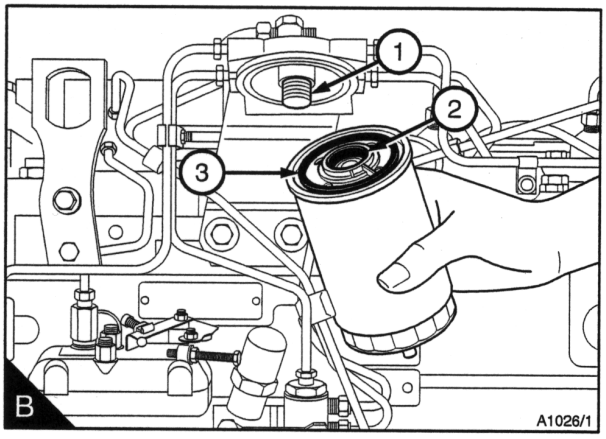
4 Ensure that the threaded adaptor (B1) is secure in the filter head and that the inside of the head is clean.

Caution: *Some of the fuel filter canisters fitted in the factory have a special sealant applied to the threads of the adaptor. Filter canisters supplied in service have an inner seal assembly (B2) instead. The seal is held in position by a plastic clip. Damage to the fuel injection pump may occur if the canister seals are not fitted correctly.*

5 Lubricate lightly the two top seals (B2) and (B3) of the new canister with clean fuel. Fit the new canister to the filter head and tighten, by hand only.

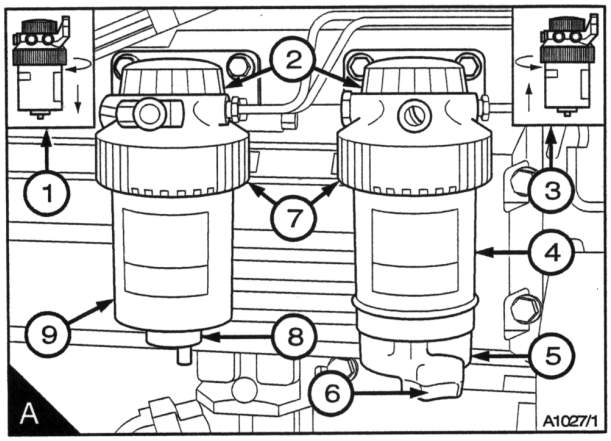
6 Eliminate the air from the fuel filter, refer to “How to eliminate air from the fuel system” on page 18.





How to renew the canister of the quick release canister type

Caution: *Discard used fuel filters and any spilt fuel in a safe place and in accordance with local regulations.*



1 Thoroughly clean the outside surfaces of the filter assembly.

2 Loosen the drain device (A8), or (A6) if a pre-filter is fitted, at the bottom of the canister or sediment bowl (A5) and allow the water or fuel to drain into a suitable container.

Note: If the filter does not have a drain device fitted release the cap (A2) on top of the filter head. Remove the nylon insert to lower the level of the fuel in the filter canister. This will prevent fuel spill when the clamp ring (A7) is released.

3 Support the filter canister(s) (A4) and (A9) and rotate the clamp ring to the left (A1) and remove the clamp ring.

4 Remove the canister from the filter head by a direct pull downwards (A1), and discard the old canister.

5 If a sediment bowl is fitted, remove the bowl and thoroughly clean the cover of the bowl.

6 Check the two ‘O’ ring seals of the sediment bowl for damage and renew them if necessary.

7 Clean the threads of the sediment bowl and fit the bowl to the canister and tighten by hand only.

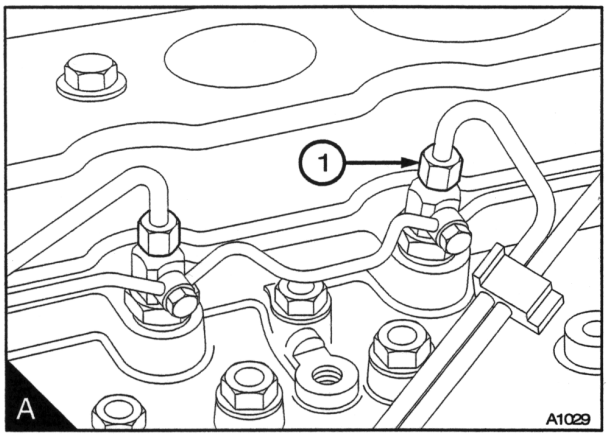
8 Ensure the filter head is clean. Push the new canister fully into the filter head (A3).

9 Support the canister, fit the clamp ring and rotate it to the right (A3) to fasten the canister to the filter head.

10 If the nylon insert was removed to lower the fuel level in the filter, ensure that it is fitted correctly and fit the cap.

11 Eliminate the air from the fuel filter, refer to “How to eliminate air from the fuel system” on page 18.

Atomiser maintenance



Caution: *A faulty atomiser must be renewed by a person who has had the correct training.*

Regular maintenance of the atomisers is not necessary. The atomiser nozzles should be renewed and not cleaned, and renewed only if an atomiser fault occurs. Some of the problems that may indicate that new nozzles are needed are listed below:

Engine will not start or is difficult to start

Not enough power

Engine misfires or runs erratically

High fuel consumption

Black exhaust smoke

Engine knocks or vibration

Excessive engine temperature

Atomiser fault

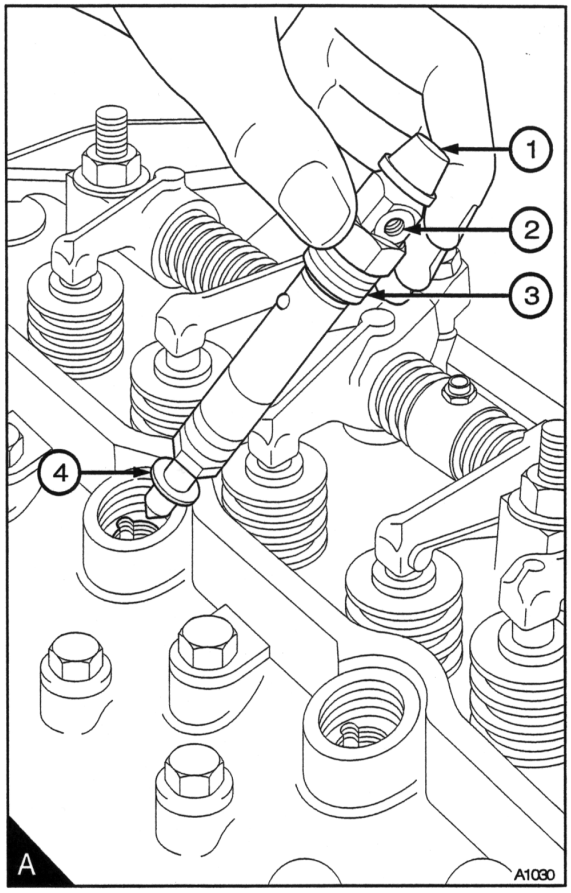
Warnings!

- *If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.*

- *Keep away from moving parts during engine operation. Some moving parts cannot be seen clearly while the engine runs.*

In order to find which atomiser is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut (A1) of the high-pressure fuel pipe at each atomiser. Do not loosen the union nut more than half a turn. When the union nut of the defective atomiser is loosened, it has little or no effect on the engine speed.

How to remove an atomiser



Cautions:

- *Atomisers must be removed and fitted by a person with the correct training*
- *Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.*

1 Remove the fuel leak-off pipe from the connection (A2).

2 SRemove the union nuts of the high-pressure pipe from the atomiser and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamps. Fit a plastic cap (A1) to cover the fuel inlet connection.

Caution: *Remove and discard the seat washer (A4). If the original seat washer remains in the recess for the atomiser, the nozzle protrusion will be incorrect when a new seat washer is added.*

3 Release the clamp nut (A3) and remove the atomiser and its seat washer from the recess in the cylinder head.

How to fit an atomiser

Special requirements

Consumable products	
Description	**Part number**
POWERPART Universal jointing compound	21825474

Cautions:

- *Atomisers must be removed and fitted by a person with the correct training*
- *Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.*

1 Thoroughly clean the threads of the clamp nut and the cylinder head.

Caution: *Do not allow any thread sealant to get below the clamp nut threads.*

2 Ensure that the wire clip (A1) is in position. Put a 6 mm (0.24 in) long, 1 mm (0.04 in) wide bead of POWERPART Universal jointing compound, part number 1861117, around the first two threads of the atomiser clamp nut.

3 Put the new seat washer (A3) into the seat recess in the cylinder head.

4 Put the atomiser in position, ensure that the location ball (A4) is fitted in the groove (A2) correctly. Carefully engage the threads of the clamp nut with the threads in the cylinder head.

Caution: *Do not move the clamp nut after it has been tightened, the seal that is made when torque has been applied will be broken and leakage past the atomiser seat may occur.*

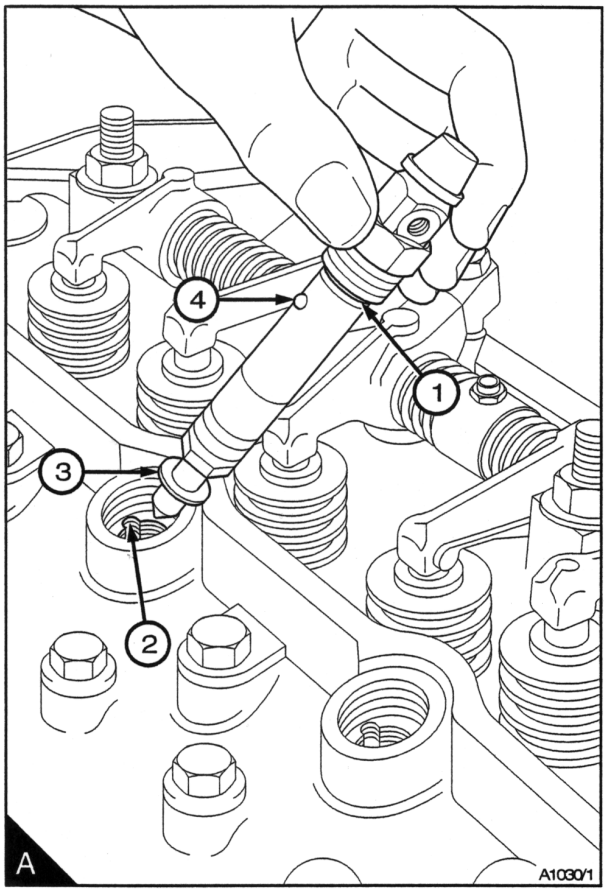
5 Ensure that the clamp nut is not cross threaded and tighten the nut **gradually and evenly** to 40 Nm (29 lbf ft) 4,1 kgf m. As the nut is tightened the atomiser will rotate clockwise as the bali moves in the slot. Remove any excess thread sealant.

Caution: *Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension. If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet. Do not tighten the atomiser union nut more, as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.*

6 Remove the plastic cap and fit the high-pressure fuel pipe and tighten the union nuts to 27 Nm (20 lbf ft) 2,8 kgf m. If necessary, fit the pipe clamps.

7 Renew the sealing washers and fit the leak-off pipe. Tighten the M6 banjo bolt to 3,0 Nm (26.5 lbf in) 30,6 kgf cm.

8 Operate the engine and check for leakage of fuel and air.



How to eliminate air from the fuel system

Warning! *If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.*

If air enters the fuel system, it must be removed before the engine can be started. Air can enter the system if:

- The fuel tank is drained during normal operation
- The low-pressure fuel pipes are disconnected
- A part of the low-pressure fuel system leaks during engine operation.

In order to eliminate air from the fuel system, proceed as follows: Vent screws are not fitted to the fuel injection pump. Air will usually be removed from the fuel pump automatically.

Caution: *If the fuel system is empty or if the canister(s) of the fuel filter have been renewed, it will be necessary to eliminate air from the fuel system, especially the fuel injection pump.*

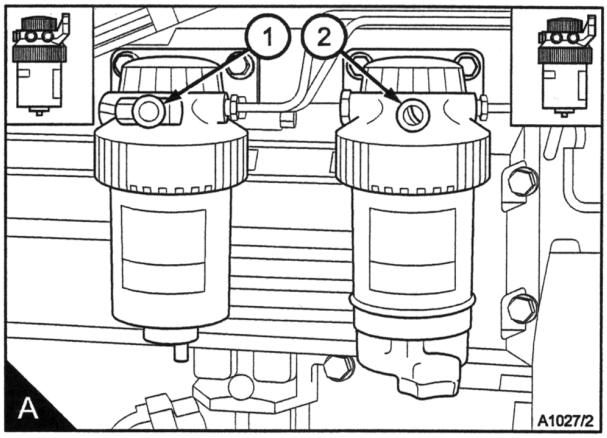
1 Loosen the vent plug on the filter head of the pre-filter (A2). Operate the priming lever of the fuel lift pump (B) until fuel, free of air, comes from the vent plug. Tighten the vent plug.

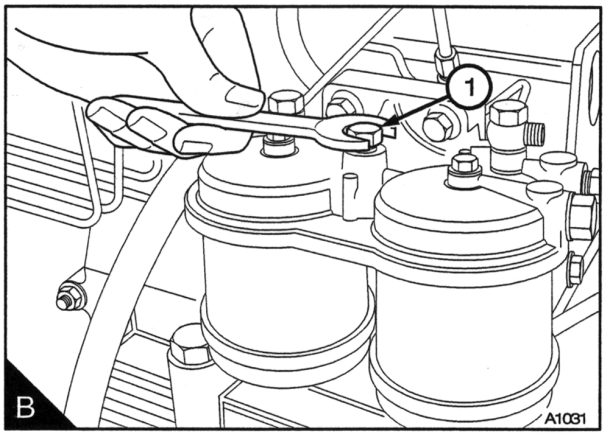
Note: If the drive cam of the fuel lift pump is at the point of maximum lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated one revolution.

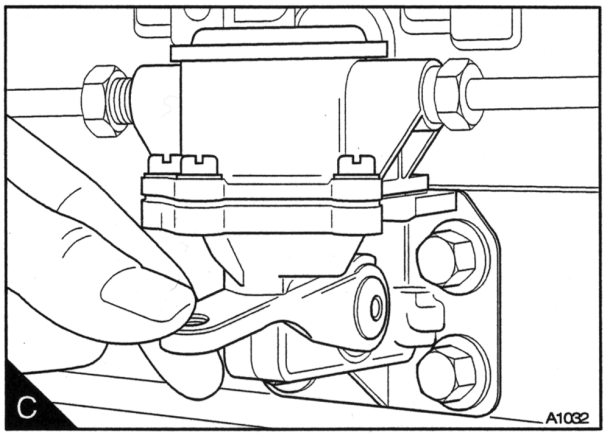
Loosen the vent screw (A1) on the main filter. Operate the priming lever of the fuel lift pump until fuel, free of air, comes from the banjo bolt. Tighten the vent screw.

For filters with a separate element: Loosen the vent plug (B1) or banjo bolt on the top of the filter head.

2 Operate the priming lever of the fuel lift pump (C) until fuel, free of air, comes from the banjo bolt or vent plug. Tighten the banjo bolt or vent plug.







Caution: *Use a spanner to prevent movement of the fuelled starting aid (A1) when the union nut (A2) is loosened or tightened.*

3 Loosen the union nut (A2) at the fuelled starting aid and operate the priming lever of the fuel lift pump until fuel, free of air, comes from the connection. Tighten the union nut at the starting aid.

Note: For Delphi fuel injection pumps: Loosen the union nut at the outlet connection of the low pressure fuel leak off pipe which is on top of the governor housing of the fuel injection pump. Operate the priming lever of the fuel lift pump until fuel, free of air, comes from the connection. Tighten the union nut.

Caution: *Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension. If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet. Do not tighten the atomiser union nut more, as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.*

4 Loosen the high-pressure connections at two of the atomisers (B1).

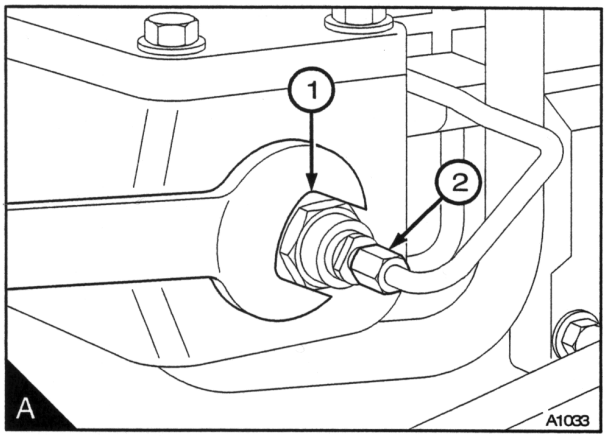
Caution: *Damage to the fuel injection pump, battery and starter motor can occur if the starter motor is used excessively to eliminate air from the fuel system.*

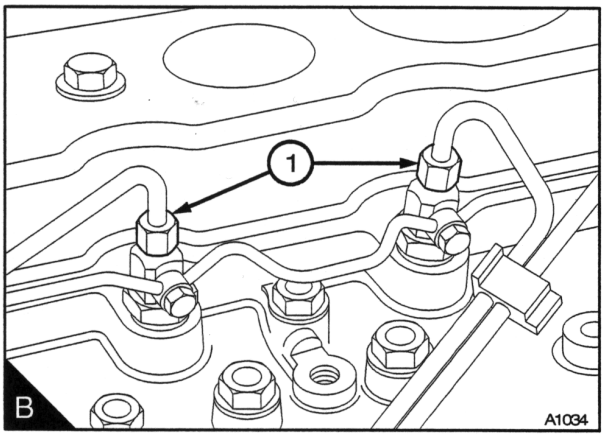
5 Put the electrical system switch to the “On” position. Ensure that the manual stop control, if one is fitted, is in the “Rue” position. Operate the starter motor until fuel, free from air, comes from the pipe connections. Tighten the high-pressure pipe connections to 27 Nm (20 lbf ft) 2,8 kgf m. Return the switch to the “Off” position.

6 The engine is now ready to star

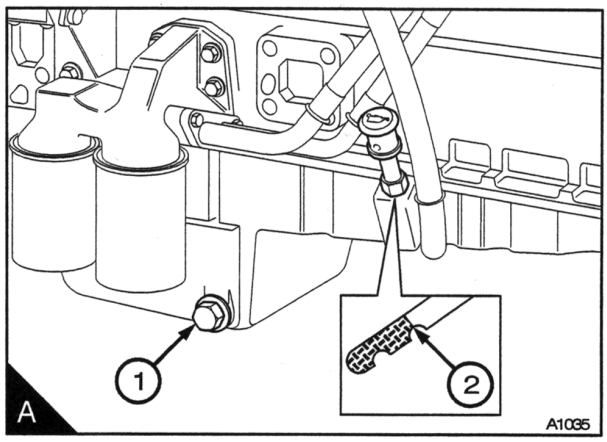
Caution: *Operate the engine at low idle speed for a minimum of two minutes immediately after air has been removed from the fuel system. This will ensure that the pump is free of air and prevent any damage to the pumps internal parts by metal to metal contact.*

If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system.





How to renew the lubricating oil of the engine



Warning! *Do not exceed the correct level of lubricating oil in the sump especially if a closed circuit breather is fitted to the engine. If there is too much lubricating oil, the excess must be drained to the correct level. An excess of lubricating oil could enter the breather valve. This could cause the engine speed to increase rapidly without control.*

Cautions:

- *Discard the used lubricating oil in a safe place and in accordance with local regulations*
- *Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.*

1 Operate the engine until it is warm.

2 Stop the engine, remove the sump drain plug (A1) and its “O” ring and drain the lubricating oil from the sump. Ensure that the “O” ring is not damaged. Fit the drain plug and its “O” ring and tighten the plug to 34 Nm (25 lbf ft) 3,5 kgf m.

3 Fill the sump to the mark (A2) on the dipstick with new and clean lubricating oil of an approved grade, refer to “Lubricating oil specification” on page 29.

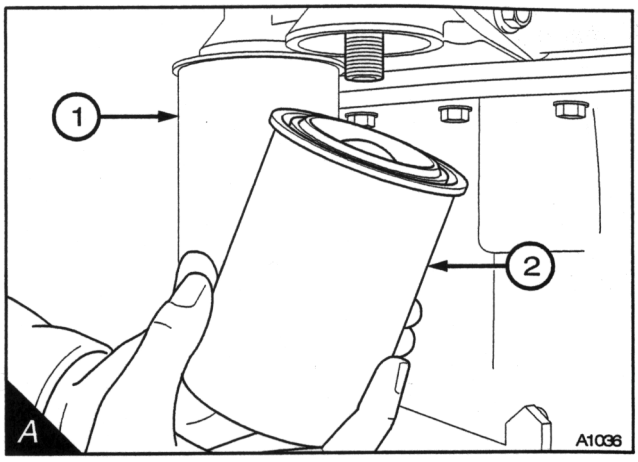
How to renew the canister of the lubricating oil filter

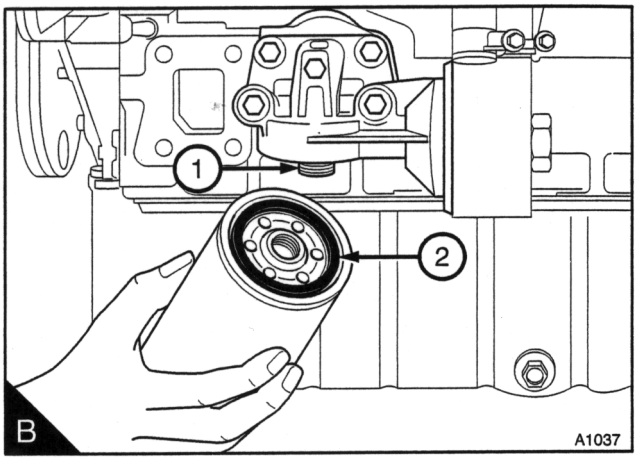
Warning! *Discard the used canister and lubricating oil in a safe place and in accordance with local regulations.*

Cautions:

- *The canister contains a valve and special tube to ensure that lubricating oil does not drain from the filter. Therefore, ensure that the correct Perkins POWERPART canister is used*
- *Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.*

The filter can have one or two canisters. When two canisters (A1) and (A2) are fitted, both must be renewed at the same time.





1 Put a tray under the filter to retain spilt lubricating oil.

2 Remove the filter canister with a strap wrench or similar tool. Ensure that the adaptor (B1) is secure in the filter head. Discard the canister.

3 Clean the filter head.

4 Add clean engine lubricating oil to the new canister. Allow the oil enough time to pass through the filter element.

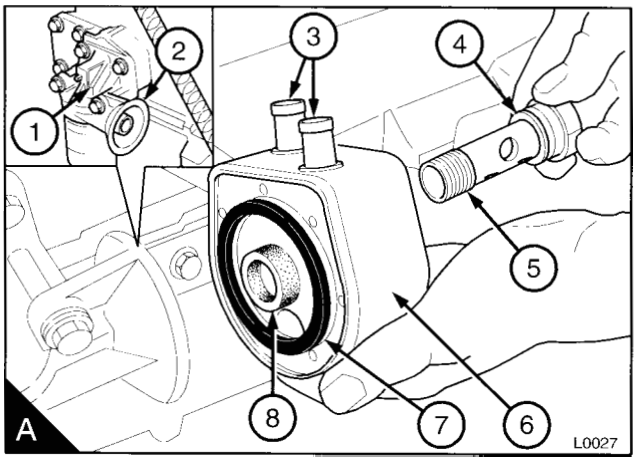
5 Lubricate the top of the canister seal (B2) with clean engine lubricating oil.

6 Fit the new canister and tighten it by hand only. Do not use a strap wrench.
Ensure that there is lubricating oil in the sump. On turbocharged engines ensure that the engine will not start and operate the starter motor until oil pressure is obtained. To ensure that the engine will not start, either put the manual stop control in the “Stop” position or disconnect the electrical stop control of the fuel injection pump. Oil pressure is indicated when the warning light is extinguished or by a reading on the gauge.

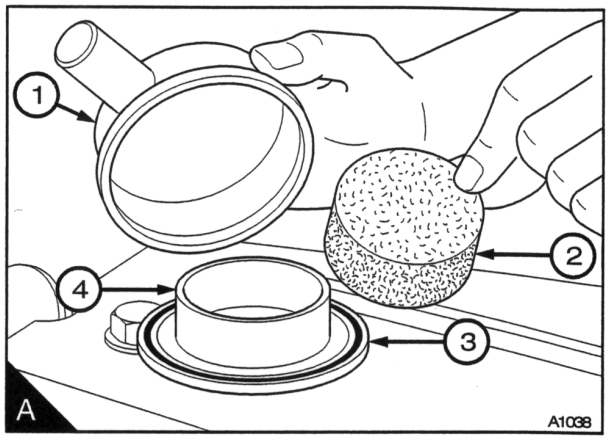
7 Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump, if necessary.

To service the canister type lubricating oil cooler

1 Remove the lubricating oil cooler from the ergine.
2 Clean thoroughly the outside of the cooler plates with a proprietary clearing fluid. Clean thoroughly the inside of the cooler plates with clean water.
3 Fit the oil cooler to the engine.



How to maintain the engine open breather system



Caution: *The material used for the cover, fitted to the engine breathers has been changed to a harder plastic. As a result, the maintenance procedure and the maintenance period have changed. Also the part number has changed from 4133J005 to 4133J008. The part number is marked on the top of the cover of the latest oil separator. Do not try to remove the cover of the oil separator as it will break. The whole oil separator should be renewed at every engine overhaul or 8000 hours.*

Some engines are fitted with an open breather which has a steel gauze (A2) to separate the oil from the crankcase gases before they leave the engine.

Note: It is not necessary to remove the body of the breather from the rocker cover to obtain access to the gauze.

1 Release the hose clip from the breather cover (A1).

2 Use a suitable lever between the outlet nozzle and the rocker cover to remove the breather cover from the body of the breather (A4). Ensure that the breather cover and the rocker cover are not damaged.

3 Use a cloth made damp with a proprietary clearing fluid to clean the body of the breather.

4 Renew the “O” ring seal (A3).

5 Check that the inside of the breather pipe is clean. If the pipe is not clean, release the setscrews and remove the pipe. Wash the pipe with kerosene and dry it with low-pressure air.

6 Wash the steel gauze (A2) with kerosene and dry it with low-pressure air.

7 Fit the cover to the breather body, ensure that it is securely fitted.

8 Fit the breather pipe and tighten the hose clips.

How to maintain the engine closed circuit breather system

Caution: *It is very important that closed circuit breather systems are fitted correctly to the engine. Incorrect installation can cause extreme damage to the engine.*

Below is a series of safety precautions that must be applied at all times.

- Do not operate the engine if any of the breather valve or the induction hoses are loose or disconnected as this could allow dirt into the engine and damage to the engine could occur.

- Do not operate the engine if any of the breather valve or the induction hoses are bent such as to cause a restriction to the gases that flow through them. This can cause lubricating oil to enter the cylinders through the breather valve.

- Do not alter the design or any settings for the closed breather system.

- Ensure that the vent hole (A1) is not restricted during service. The closed circuit breather used on the New 1000 Series engine comprises a body (A4) and a valve assembly (A5). The whole assembly must be renewed every complete overhaul of the engine or 8000 hours.

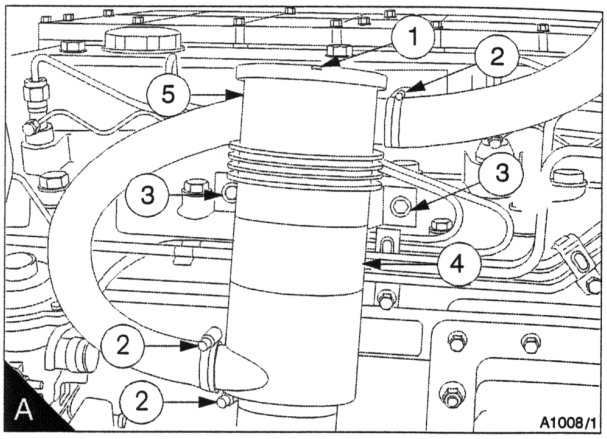
To renew the engine breather assembly

1 Release the three hose clips (A2) and remove the hoses.

2 Release the two setscrews (A3) and remove the breather assembly.

3 Clean the inside of the pipes with a proprietary clearing fluid and dry them.

4 Fit a new breather assembly. Fit and tighten the two setscrews. Fit the three hoses in their correct positions on the breather and tighten the three hose clips.



Air filter

Caution: *Do not operate the engine if there is a blockage in the air filter or the induction hose. This can cause lubricating oil to enter the cylinders through the breather valve.*

Environmental conditions have an important effect on the frequency at which the air filter needs service.

Certain air filters have a separate dust bowl (A1) which must be cleaned at intervals. The amount of dust in the bowl shows if it has been removed at the correct time for the conditions of operation. Do not let dust completely fill the bowl, because this will reduce the life of the filter element (A2).

Certain air filters have automatic dust valves (B1) through which dust is expelled from the filter. The rubber dust valve must be kept clean. Ensure that the sides of the valves close completely together and that they can separate freely.

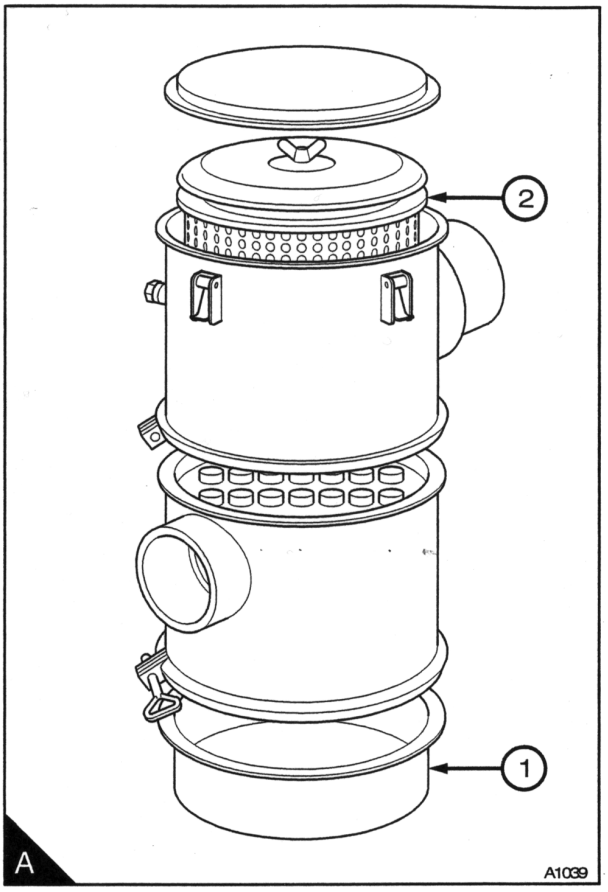
If a restriction indicator is fitted, see “Restriction indicator” on page 45, it will indicate precisely when the air filter element needs service. This prevents the premature removal of the filter element which causes extra cost or late removal of the element which can cause loss of engine power. The filter element must be cleaned or renewed according to the manufacturers recommendations.

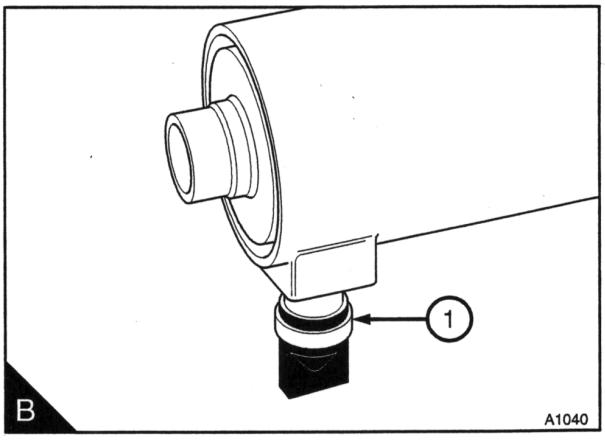
Restriction indicator

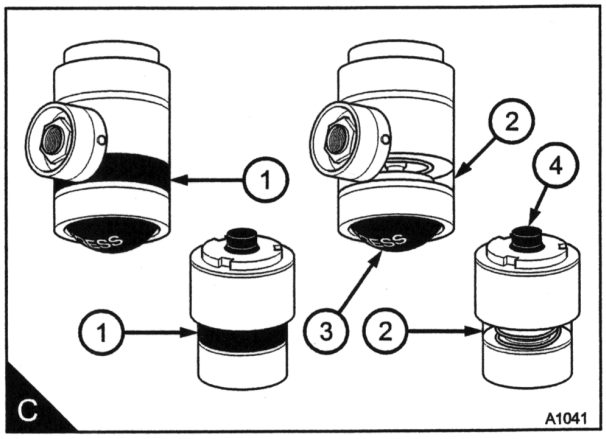
The restriction indicator is fitted on the air filter outlet or between the air filter and the induction manifold.

When the red warning indicator (C1) is seen through the clear panel (C2) after the engine has stopped, the air filter element must be removed for service.

After a clean element has been fitted, press the rubber bottom (C3) or the button (C4) of the restriction indicator to reset the red warning indicator.







How to check the valve tip clearances - four cylinder engines

These are checked between the top of the valve stem and the rocker lever (A), with the engine hot or cold. The correct clearance for inlet valves is 0,20 mm (0.008 in) and 0,45 mm (0.018 in) for exhaust valves. The valve positions are shown at (B).

The sequence of valves from number 1 cylinder is shown in the table below.

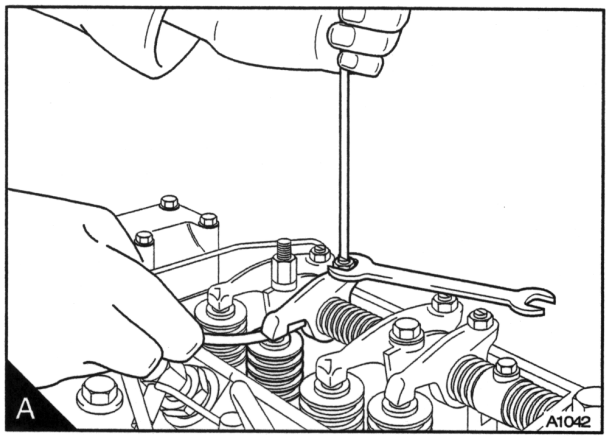
Note: Number 1 cylinder is at the front of the engine.

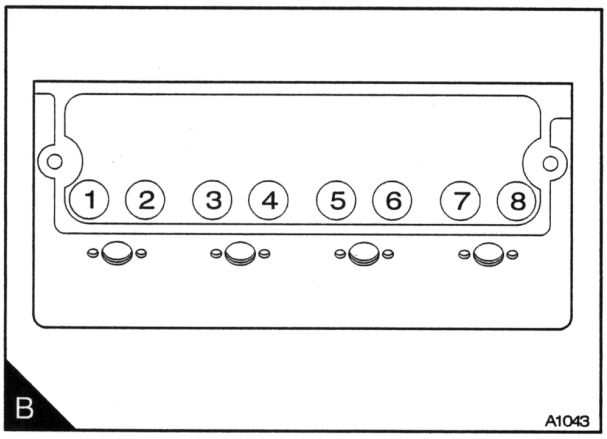
1 Rotate the crankshaft in the normal direction of rotation until the inlet valve (B7) of number 4 cylinder has just opened and the exhaust valve (B8) of the same cylinder has not closed completely. Check the clearances of the valves (B1 and B2) of number 1 cylinder and adjust them, if necessary.

2 Set the valves (B3 and B4) of number 2 cylinder as indicated above for number 4 cylinder. Then check / adjust the clearances of the valves (B5 and B6) of number 3 cylinder.

3 Set the valves (B1 and B2) of number 1 cylinder. Then check / adjust the clearances of the valves (B7 and B8) of number 4 cylinder.

4 Set the valves (B5 and B6) of number 3 cylinder. Then check / adjust the clearances of the valves (B3 and B4) of number 2 cylinder.





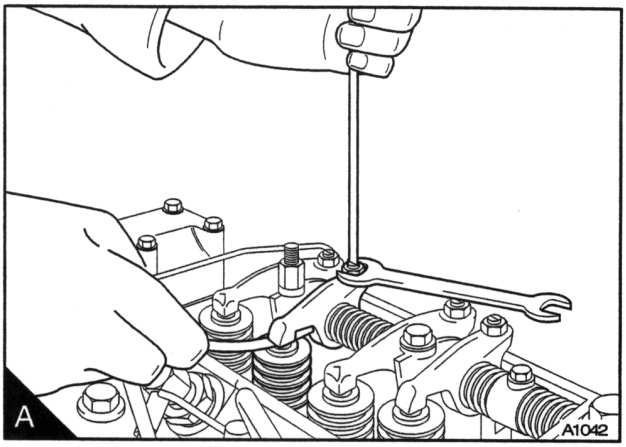
Cylinder and valve number	1		2		3		4	
	1	2	3	4	5	6	7	8
Valve **I = Inlet** **E = Exhaust**	I	E	I	E	I	E	I	E

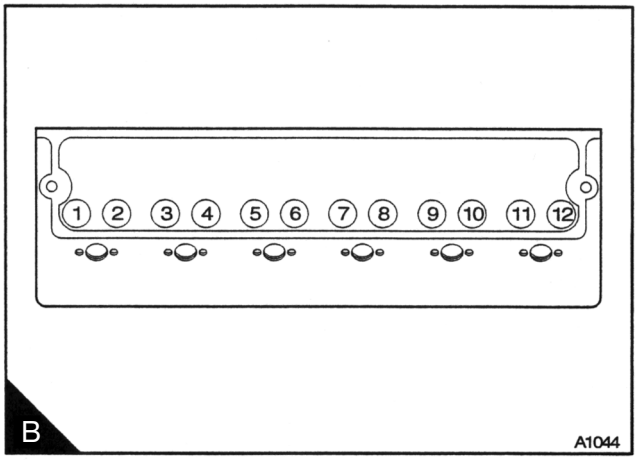
How to check the valve tip clearances -six cylinder engines

These are checked between the top of the valve stem and the rocker lever (A), with the engine hot or cold. The correct clearance for inlet valves is 0,20 mm (0.008 in) and 0,45 mm (0.018 in) for exhaust valves. The valve positions are shown at (B).

The sequence of valves from number 1 cylinder is shown in the table below.

Note: Number 1 cylinder is at the front of the engine.





1 Rotate the crankshaft in the normal direction of rotation until the inlet valve (B11) of number 6 cylinder has just opened and the exhaust valve (B12) of the same cylinder has not closed completely. Check the clearances of the valves (B1 and B2) of number 1 cylinder and adjust them, if necessary.

2 Set the valves (B3 and B4) of number 2 cylinder as indicated above for number 6 cylinder. Then check / adjust the clearances of the valves (B9 and B10) of number 5 cylinder.

3 Set the valves (B7 and B8) of number 4 cylinder. Then check / adjust the clearances of the valves (B5 and B6) of number 3 cylinder.

4 Set the valves (B1 and B2) of number 1 cylinder. Then check / adjust the clearances of the valves (B11 and B12) of number 6 cylinder.

5 Set the valves (B9 and B10) of number 5 cylinder. Then check / adjust the clearances of the valves (B3 and B4) of number 2 cylinder.

6 Set the valves (B5 and B6) of number 3 cylinder. Then check / adjust the clearances of the valves (B7 and B8) of number 4 cylinder.

Cylinder and valve number	**1**		**2**		**3**		**4**		**5**		**6**	
	1	2	3	4	5	6	7	8	9	10	11	12
Valve I = Inlet E = Exhaust	I	E	I	E	I	E	I	E	I	E	I	E

ENGINE FLUIDE

Fuel specification

To get the correct power and performance from your engine, use good quality fuel. The recommended fuel specification for Perkins engines is indicated below:

Cetane number: 45 minimum
Viscosity: 2.0/4.5 centistokes at 40° C
Density: 0,835/0,860 kg/litre at 15° C
Sulphur: 0.20% of mass, maximum
Distillation: 85% at 350° C

Cetane number indicates ignition performance. A fuel with a low cetane number can cause cold start problems and affect combustion.

Viscosity is the resistance to flow and engine performance can be affected if it is outside the limits.

Density: A lower density reduces engine power, a higher density increases engine power and exhaust smoke.

Sulphur: A high amount of sulphur (not normally found in Europe, North America or Australasia) can cause engine wear.

Percentage of sulphur in the fuel (%)	**Oil change interval**
< 0,5	Normal
0,5 to 1,0	0,75 of normal
> 1,0	0,50 of normal

Distillation: This is an indication of the mixture of different hydrocarbons in the fuel. A high ratio of light-weight hydrocarbons can affect the combustion characteristics.

Low temperature fuels

Special winter fuels may be available for engine operation at temperatures below 0°C. These fuels have a lower viscosity and also limit the wax formation in the fuel at low temperatures. If wax formation occurs, this could stop the fuel flow through the filter.

If you need advice on adjustments to an engine setting or to the lubricating oil change periods which may be necessary because of the standard of the available fuel, consult your nearest Perkins distributor.

Aviation kerosene fuels

Warning! *Aviation kerosene fuels are more flammable than diesel fuel and need careful storage. Ensure that the relevant safety precautions are conformed to*

These fuels can be used but they can affect engine performance. It is recommended that you consult the Perkins Technical Service Department at Peterborough.

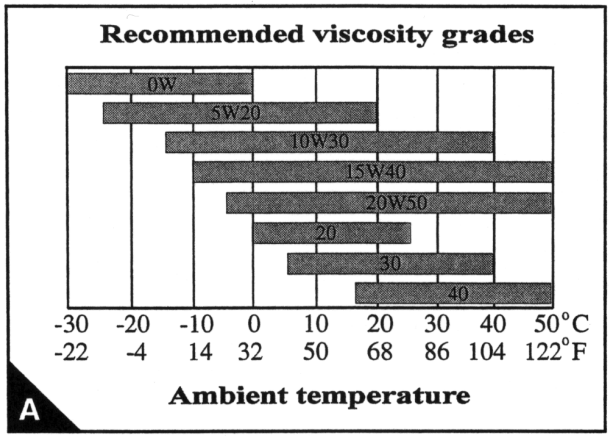
Lubricating oil specification

If you need advice on adjustments to an engine setting or to the lubricating oil change periods which may be necessary because of the standard of available fuel, consult your nearest Perkins distributor or the Technical Service Department.

Use only a good quality lubricating oil to the relevant specification as shown in the table below.

Caution: *The type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details see "Fuel specification" on page 28 and the "Preventive maintenance schedules" on page 3.*

Always ensure that the correct viscosity grade of lubricating oil is used for the ambient temperature range in which the engine will run as shown in the chart (A) and the table below:



Engine type	Specifications	
	API CF4 o ACEA E2	API CG4 o ACEA E3
Naturally aspirated	•	•(1)
Turbocharged	•	•(1)

(1) Recommended for applications which have engines that operate at high load conditions. Refer to your equipment supplier's handbook for the application or the table on page 4 for guidance. If further advice is necessary, refer to your nearest Perkins distributor.

Coolant specification

The quality of the coolant which is used can have a great effect on the efficiency and life of the cooling system. The recommendations indicated below can help to maintain a good cooling system and to protect it against frost and/or corrosion.

If the correct procedures are not used, Perkins cannot be held responsible for damage caused by frost or corrosion.

Caution:

- *An antifreeze which contains the correct inhibitor must be used at all times to prevent damage to the engine by corrosion, because of the use of aluminium in the cooling system*

- *If frost protection is not necessary, it is stili extremely important to use an approved antifreeze mixture because this gives a protection against corrosion and also raises the boiling point of the coolant*

- *If the approved antifreeze mixture is not available, add a correct mixture of corrosion inhibitor to the water. If the correct inhibitor is not used, the engine will be damaged by corrosion. If there is doubt about the corrosion inhibitor to be used, It is recommended that you consult the Perkins Service Department, Peterborough.*

Note: If combustion gases are released into the cooling system, the coolant must be renewed after repair of the fault.

The antifreeze which is recommended for this engine is the latest POWERPART Antifreeze, refer to “POWERPART recommended consumable products” on page 6. This antifreeze contains the correct corrosion inhibitor which is especially suitable for this engine.

If it is possible, use clean soft water in the coolant.

The quality of the antifreeze coolant must be checked at least once a year, for example, at the beginning of the cold period. The coolant must be renewed every two years.

The antifreeze mixture must consist of equal quantities of antifreeze and water. The corrosion inhibitor in the antifreeze will be diluted if a concentration of less than 50% of antifreeze is used. Concentrations of more than 50% of antifreeze may have an adverse effect on the performance of the coolant.

FAULT DIAGNOSIS

Problems and possible causes

Problem	Possible causes	
	Checks by the user	Checks by the workshop personnel
The starter motor turns the engine too slowly	1, 2, 3, 4	
The engine does not start	5, 6, 7, 8, 9, 10, 12, 14, 15, 17	13, 34, 35, 36, 37, 38, 40, 42, 43, 44
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 14,15,16, 17,19	13, 34, 36, 37, 38, 40, 42, 43, 44
Not enough power	8, 9, 10, 11, 12, 16, 17, 18, 19, 20, 21	13, 34, 36, 37, 38, 39, 42, 43, 44, 61, 63, 64
Misfire	8, 9, 10, 12, 15, 20, 22	13, 34, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11,15,17,18,19, 21, 22	13, 34, 36, 37, 38, 39, 40, 42, 43, 44, 63
Black exhaust smoke	11, 15,17,19, 21, 22	13, 34, 36, 37, 38, 39, 40, 42, 43, 44, 61, 63
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 62
The pressure of the lubricating oil is too low	4, 24, 25, 26	46, 47, 48, 50, 51, 59
The engine knocks	9,15, 17, 20, 22, 23	13, 36, 37, 40, 42, 44, 46, 52, 53, 60
The engine runs erratically	7, 8, 9,10,11,12,15, 16, 18, 20, 22, 23	13, 34, 38, 40, 41, 44, 52, 60
Vibration	18, 20, 27, 28	13, 34, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil is too high	4, 25	49
The engine temperature is too high	11,15,19, 27, 29, 30, 32	13, 34, 36, 37, 39, 52, 55, 56, 57, 64
Basamento sotto pressione	31, 33	39, 42, 44, 45, 52
Crankcase pressure	11, 22	37, 39, 40, 42, 43, 44, 45, 53, 60
The engine starts and stops	10,11, 12	

List of possible causes

1 Battery capacity low.
2 Bad electrical connections.
3 Fault in starter motor.
4 Wrong grade of lubricating oil.
5 Starter motor turns engine too slowly.
6 Fuel tank empty.
7 Fault in stop control.
8 Restriction in a fuel pipe.
9 Fault in fuel lift pump.
10 Dirty fuel filter element.
11 Restriction in filter/cleaner or air induction system.
12 Air in fuel system.
13 Fault in atomisers or atomisers of an incorrect type.
14 Cold start system used incorrectly.
15 Fault in cold start system.
16 Restriction in fuel tank vent.
17 Wrong type or grade of fuel used.
18 Restricted movement of engine speed control.
19 Restriction in exhaust pipe.
20 Engine temperature is too high.
21 Engine temperature is too low.
22 Valve tip clearances are incorrect.
23 To much oil or oil of wrong specification used in wet type oil cleaner.
24 Not enough lubricating oil in sump.
25 Defective gauge.
26 Dirty lubricating oil filter element.
27 Fan damaged.
28 Fault in engine mounting or flywheel housing.
29 Too much lubricating oil in sump.
30 Restriction in air or water passages of radiator.
31 Restriction in breather pipe.
32 Insufficient coolant in system.
33 Vacuum pipe leaks or fault in the exhauster.
34 Fault in fuel injection pump.
35 Broken drive on fuel injection pump.
36 Timing of fuel injection pump is incorrect.
37 Valve timing is incorrect.
38 Bad compression.
39 Cylinder head gasket leaks.
40 Valves are not free.
41 Wrong high-pressure pipes.
42 Worn cylinder bores.
43 Leakage between valves and seats.
44 Piston rings are not free or they are worn or broken.
45 Valve stems and/or guides are worn.
46 Crankshaft bearings are worn or damaged.
47 Lubricating oil pump is worn.
48 Relief valve does not closet
49 Relief valve does not open.
50 Relief valve spring is broken.
51 Fault in suction pipe of lubricating oil pump.
52 Piston is damaged.
53 Piston height is incorrect.
54 Flywheel housing or flywheel is not aligned correctly.
55 Fault in thermostat or thermostat is of an incorrect type.
56 Restriction in coolant passages.
57 Fault in water pump.
58 Valve stem seal is damaged (if there is one fitted).
59 Restriction in sump strainer.
60 Valve spring is broken.
61 Turbocharger impeller is damaged or dirty.
62 Lubricating oil seal of turbocharger leaks.
63 Induction system leaks (turbocharged engines).
64 Turbocharger waste-gate does not work correctly (if there is one fitted).

ENGINE PRESERVATION

Introduction

The recommendations indicated below are designed to prevent damage to the engine when it is withdrawn from service for a prolonged period. Use these procedures after the engine is withdrawn from service. The instructions for the use of POWERPART products are given on the outside of each container.

Procedure

1 Completely clean the outside of the ergine.

2 When a preservative fuel is to be used, drain the fuel system and fill it with the preservative fuel. POWERPART Lay-Up 1 (Protective liquid 1) can be added to the normal fuel to change it to a preservative fuel. If preservative fuel is not used, the system can be kept full with normal fuel but the fuel must be drained and discarded at the end of the storage period together with the fuel filter element(s).

3 Operate the engine until it is warm. Then correct leakages of fuel, lubricating oil or air. Stop the engine and drain the lubricating oil from the sump.

4 Renew the canister(s) of the lubricating oil filter.

5 Fill the sump to the full mark on the dipstick with new and clean lubricating oil and add POWERPART Lay-Up 2 (Protective liquid 2) to the oil to protect the engine against corrosion. If POWERPART Lay-Up 2 is not available, use a correct preservative fluid instead of the lubricating oil. If a preservative fluid is used, this must be drained and the lubricating oil sump must be filled to the correct level with normal lubricating oil at the end of the storage period.

6 Drain the cooling system, see page 21. In order to protect the cooling system against corrosion, fill it with an approved antifreeze mixture because this gives protection against corrosion. If an approved antifreeze mixture is not available, add a correct mixture of corrosion inhibitor to the water - see page 43.

Attention: *Certain corrosion inhibitor mixtures could cause damage to some engine componente. Consult the Perkins Service Department, Peterborough if a corrosion inhibitor is to be used.*

7 Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the ergine.

8 Disconnect the battery. Then put the battery into safe storage in a fully charged condition. Before the battery is put into storage, protect its terminals against corrosion. POWERPART Lay-Up 3 (Protective liquid 3) can be used on the terminals.

9 Clean the engine breather pipe (if one is fitted) and seal the end of the pipe.

10 Remove the atomisers and spray POWERPART Lay-Up 2 for one to two seconde into each cylinder bore with the piston at BDC.

11 Slowly turn the crankshaft one revolution and then fit the atomisers with new seat washers and new dust seals - see page 16.

12 Remove the air filter. Then, if necessary, remove the pipe(s) installed between the air filter and induction manifold or turbocharger. Spray POWERPART Lay-Up 2 into the induction manifold or turbocharger. It is recommended that the spray time for the turbocharger is 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold or the turbocharger with waterproof tape.

13 Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold or the turbocharger. It is recommended that the spray time for the turbocharger is 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold or the turbocharger with waterproof tape.

14 If the lubricating oil filler is fitted onto the rocker cover, remove the filler cap. If the lubricating oil filler is not fitted onto the rocker cover, remove the rocker cover. Spray POWERPART Lay-Up 2 around the rocker shaft assembly. Fit the filler cap or rocker cover.

15 Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.

16 Remove the drive belts and put them into storage.

17 In order to prevent corrosion, spray the engine with POWERPART Lay-Up 3. Do not spray the area inside the alternator cooling fan.

Attention: *After a period in storage, but before the engine is started, operate the starter motor with the engine stop control (A page 14) in the "stop" position until oil pressure is indicated. Oil pressure can be indicated either by a gauge or when a low pressure warning light is extinguished. If a solenoid stop control is used on the fuel injection pump, it must be disconnected for this operation.*

If the engine protection is done correctly according to the above recommendations, no corrosion damage will normally occur. Perkins are not responsible for damage which may occur when an engine is in storage after a period in service.

PROCEDURE FOR FILLING THE COOLING CIRCUIT

A special attention must be paid when filling and bleeding the cooling circuit of the Perkins engines, 1000 series, and of engines in general to avoid potential damage due to an abrupt reduction of the liquid flow in the cooling circuit or a stall of the pump impeller.

Filling the engine and radiator circuit

Before starting filling, it is necessary to check that the heating circuit in the cabin or any other remote radiator is closed when filling the first time.

The filling velocity values recommended are:

- Max filling velocity 7 l/min
- Recommended filling velocity 5 l/min

At these filling velocities, with a continuous and uniform water flow, the air is eliminated from the circuit in an efficient way.

If such conditions do not exist, because of a particular arrangement of the circuit, it is possible to fill at 10 l/min. after having checked that the system is conform to the requisites of a correct installation. In any case, it may occur that some air remains inside the circuit. This air can be eliminated letting the engine run for 30 seconds at 50% speed than the maximum speed. The air in the circuit is normally eliminated through the vent point on the thermostatic valve. Bleeding does not occur if a thermostat is placed horizontally. Sometimes it may be necessary to repeat the procedure described to be sure that all the air has been eliminated from the circuit.

Filling and bleeding the heating circuit in the cab or other accessories

It is fundamental that the air of these circuits does not reach the pump body. This can be obtained with a vent hole in the highest point of the auxiliary circuit or in other ways that allow to eliminate the air in the circuit through the expansion cup.
The guarantee of a complete filling can only be given by a vacuum pump or a pressure equipment or if the entire auxiliary heating system in the cab is under the top tank of the radiator and an adequate vent point is accessible.

In most applications, this is not the case and it is necessary to intervene so that the return line of the auxiliary heating system does not allow to convey air into the pump body. In these cases, the connection at the pump inlet shall not be used in order to prevent cavitation. Air would remain inside the pump body until the opening of the thermostat and the application of a load to the engine, as it occurs during testing, could cause serious damage.
In this case, we suggest some adequate connection points:

- Bottom tank of the radiator
- Return pipe from the radiator to the pump, only if it is possible to prepare an air vent point in the radiator body or if there is a tube from the expansion tank between the circuit connection and the pump.

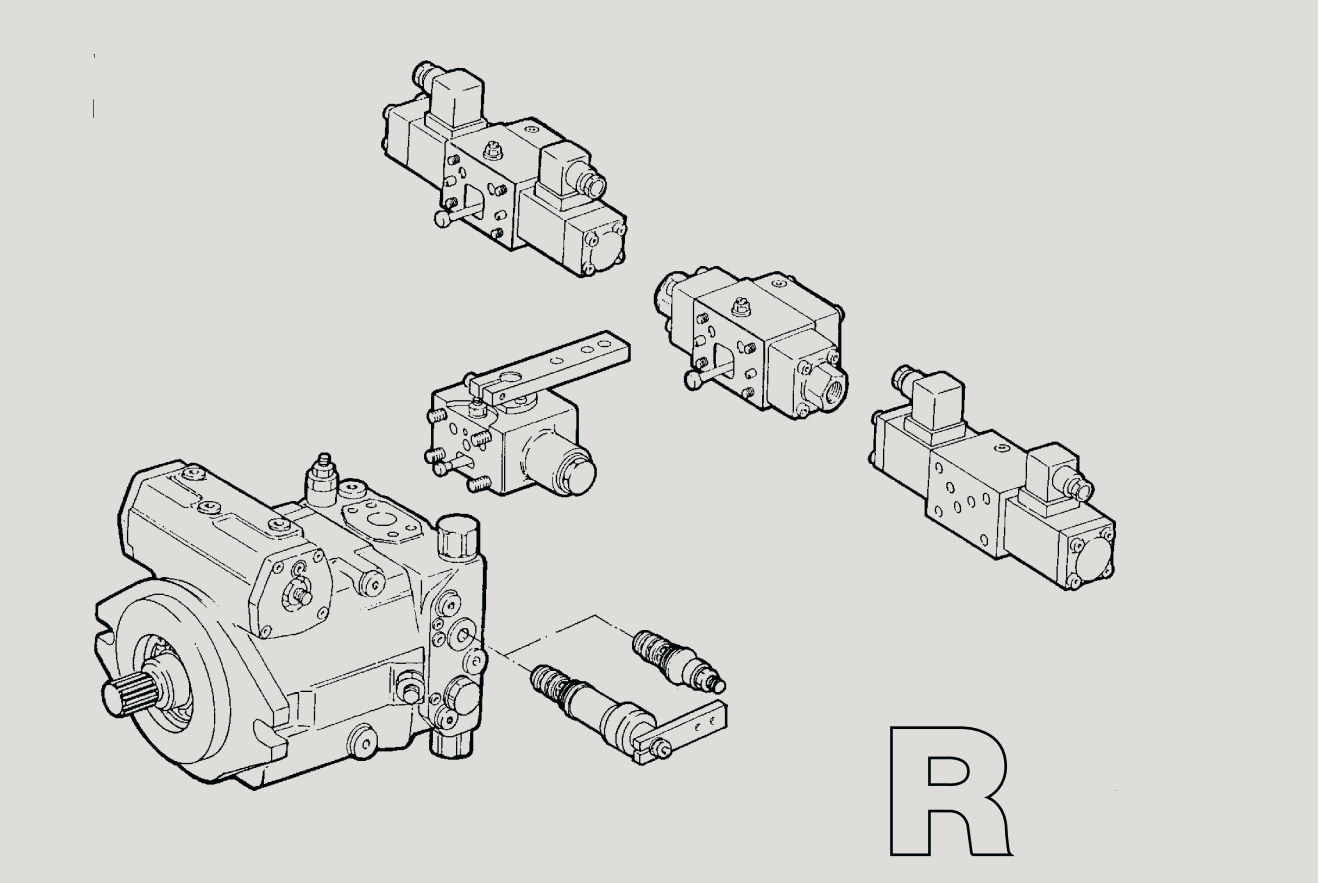
If these solutions cannot be realised, the installation cannot be considered safe. In this case, special filling and bleeding procedures shall be developed and adopted for any single application. The realisation can however be quite difficult; for instance, the return circuit from the heating shall be blocked with special restrictions (e.g. shut-off valves) and the engine shall be run loadless until all the air has been eliminated from the circuit, then the separate filling of the auxiliary circuit shall be done before opening the circuit and checking the efficiency.

In any case, this kind of solutions require a precise verification and can be affected by a number of variables, not necessarily depending on the engine, but on single production processes.

A more accurate check of the real efficiency of the filling of the cooling system can be done during the installation tests measuring the pressure in the circuit using the connection already fitted to the body of the thermostat seat for the temperature bulb. In this point, the pressure increases due to the increase in volume of the water. An

increase of about 40 kPa (0.4 bar) can be noted if the engine is run gradually from idle to about 2000 rev./min. If no variations are recorded, it is likely that some air has remained in the pump body and there are stall conditions.

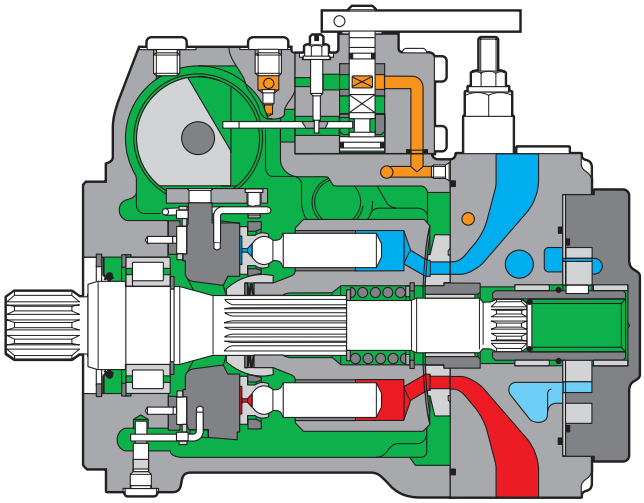
Section I
REPAIR INSTRUCTIONS REXROTH PUMP



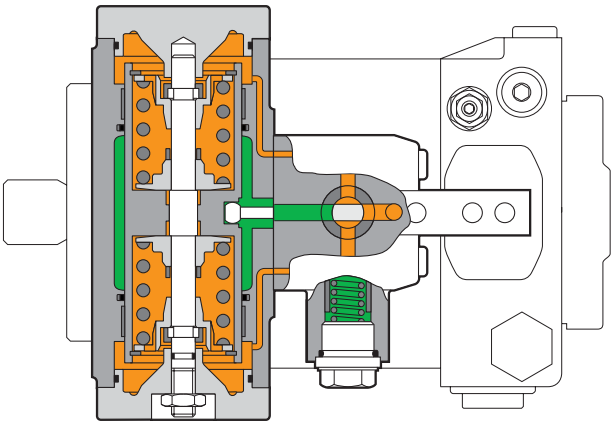
Repair instructions
Mod. A4VG

NOTICE

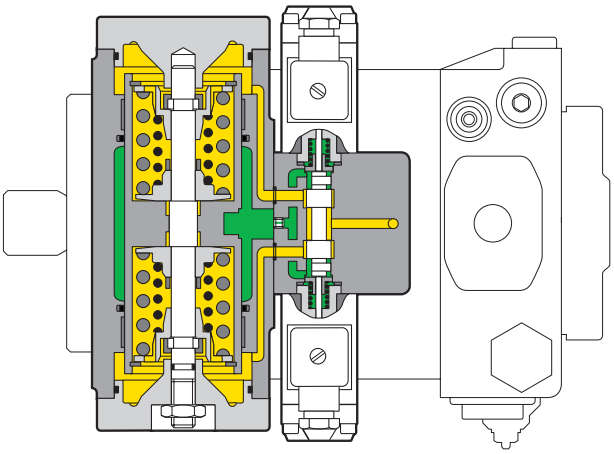
Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing.
BRUENINGHAUS HYDROMATIK reserves the right to discontinue models or options at any time or to change specifications, materials, or design without notice and without incurring obligation.
Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options.
For the available combinations refer to the relevant data sheet for the basic unit and the desired option.
Adjustment and tests have to be carried out on the test bench under operating temperatures.
Protection of personnel and property has to be guaranteed by appropriate measures.
Expert knowledge, the precondition of any service work, can be obtained in our training courses.



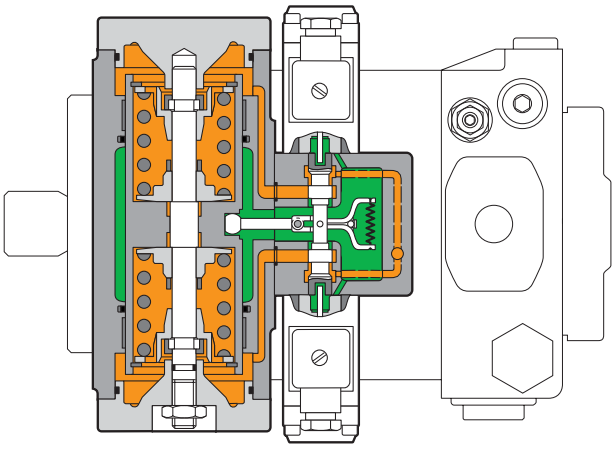
HWD



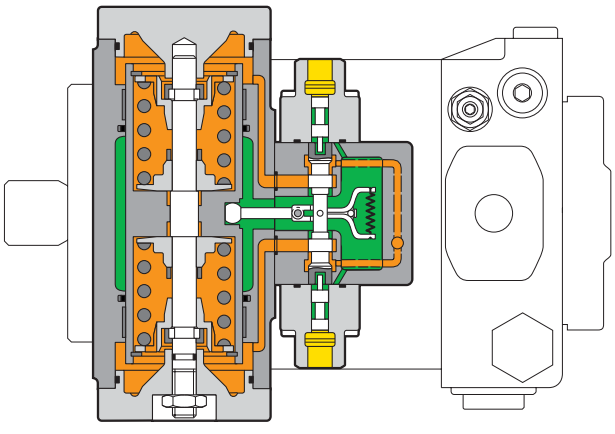
DAD



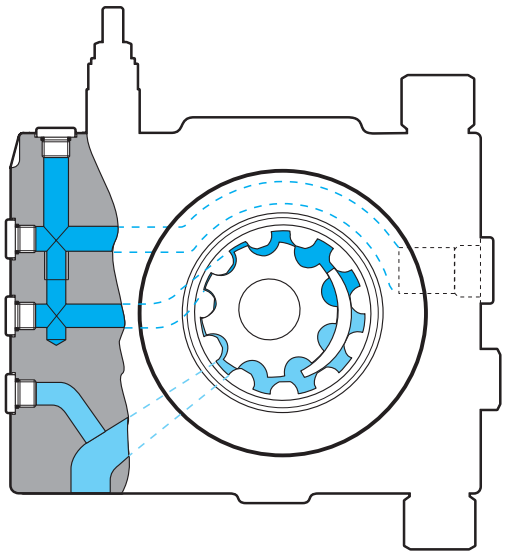
EPD

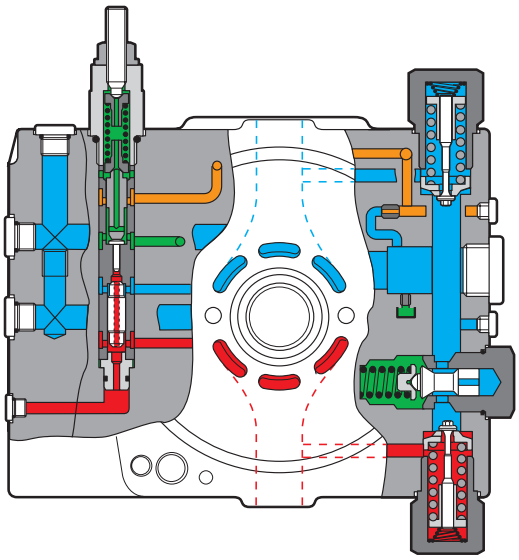


HDD

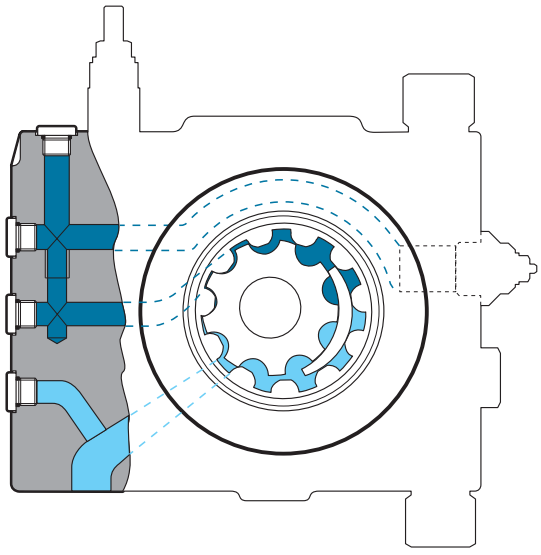


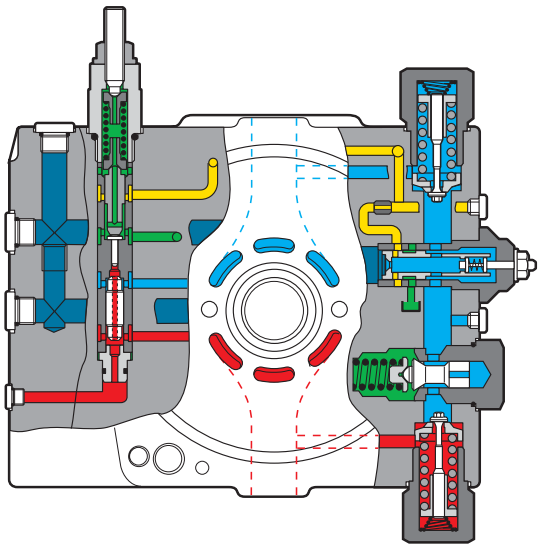
HWD / EPD / HDD

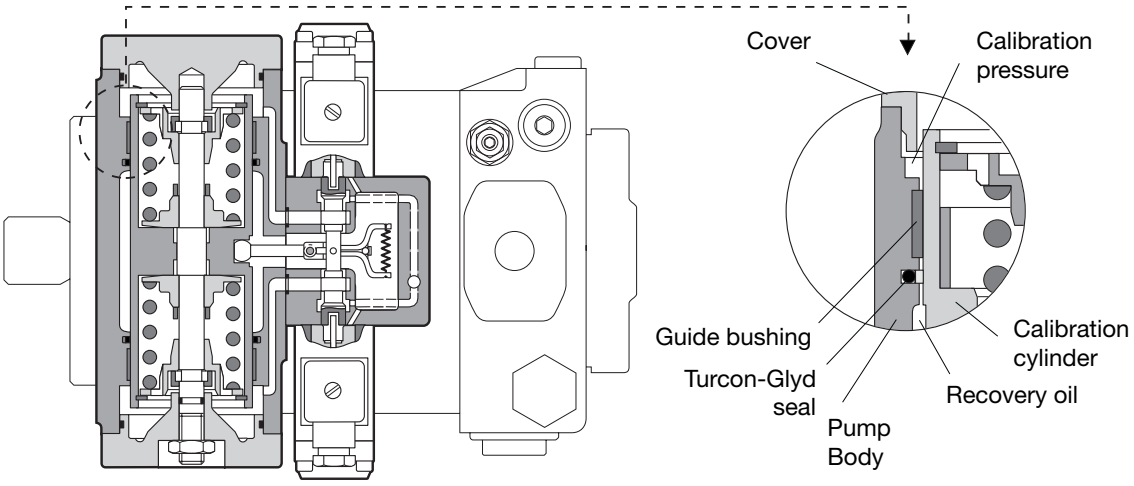




DAD



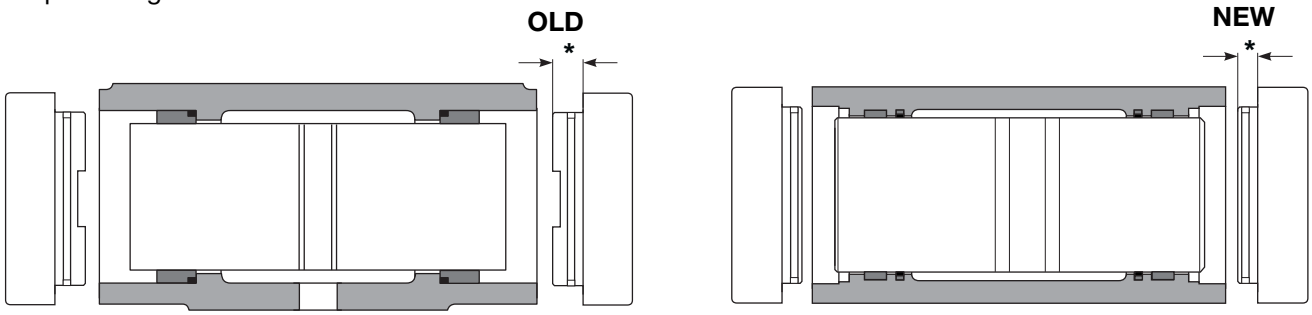




At present the change of the control into Turcon seal is made for A4VG.
The parts list of the complete unit will receive a new identification number.
Type reference and outside dimensions remain unchanged (pump housing will change at the area of the positioning piston. Positioning piston will change into chamfering design).

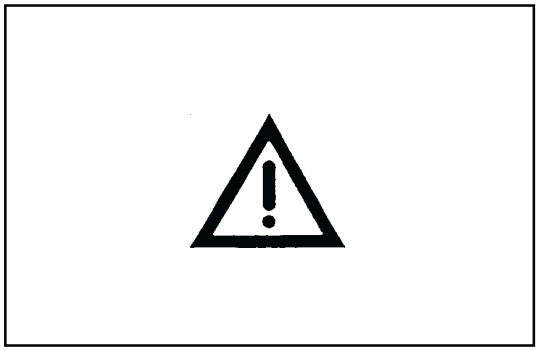
⚠ Do not use old positioning piston with Turcon seal (sharp edged - seal will be damaged)

Pump housing with Turcon seal

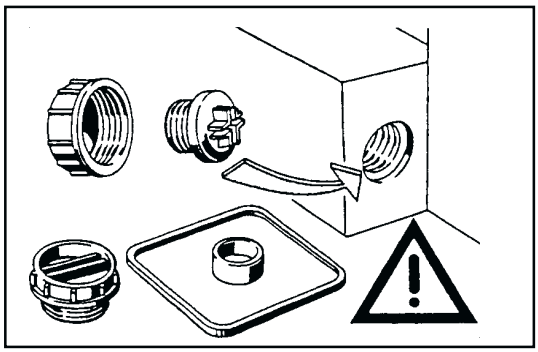


⚠ The change of the control into Turcon seal design improves in general the function (DA-behaviour, lower temperature-influence on control times).

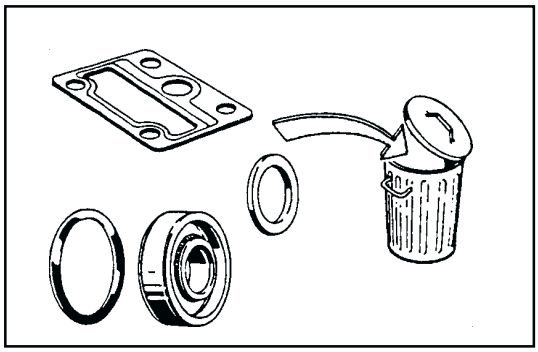
⚠ The control times will slightly change with the same throttle sections. Therefore our customers have to be informed about this change.



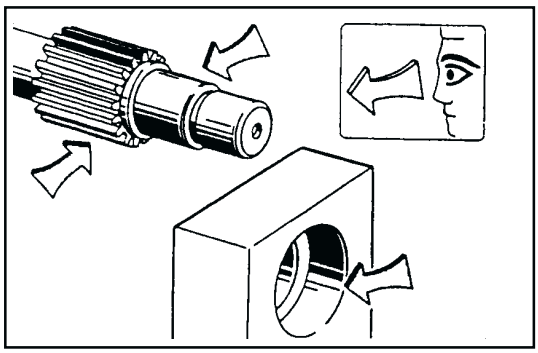
Attention!
Observe the following notices when carrying out repair work at hydraulic aggregates!



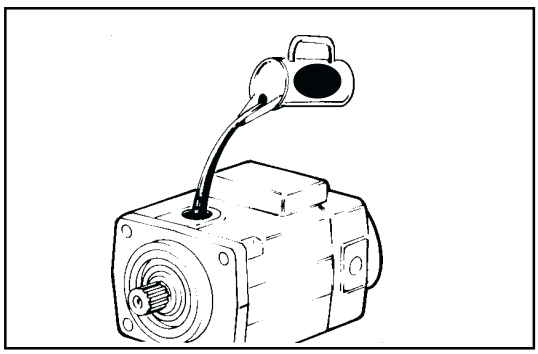
Close all ports of the hydraulic aggregates.



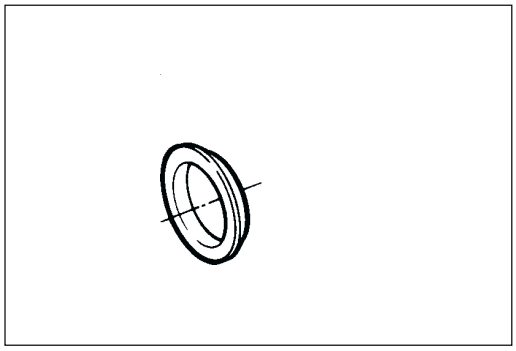
Replace all seals.
Use only original BRUENINGHAUS HYDROMATIK spare parts.



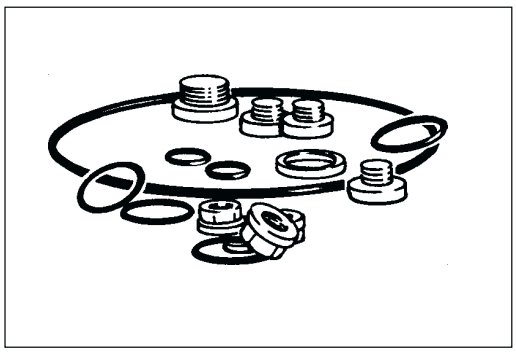
Check all seal and sliding surfaces for wear.
Attention: Rework of sealing area f. ex. with abrasive paper can damage surface.



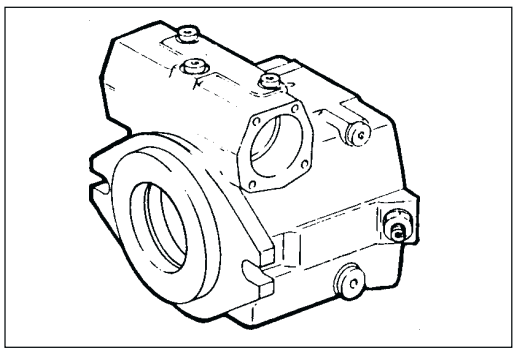
Fill up hydraulic aggregates with medium before start-up.



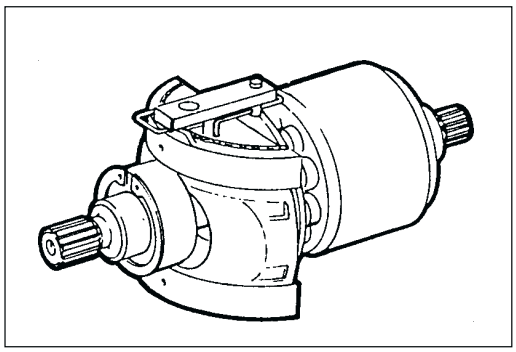
1 Seal kit for drive shaft.



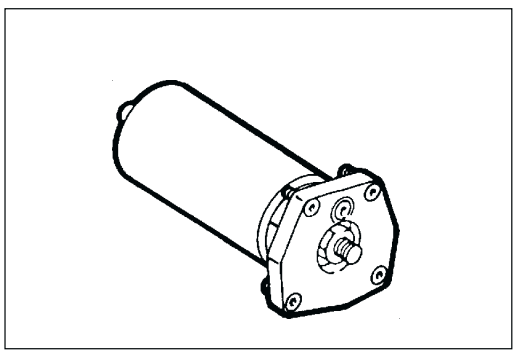
2 External seal kit.



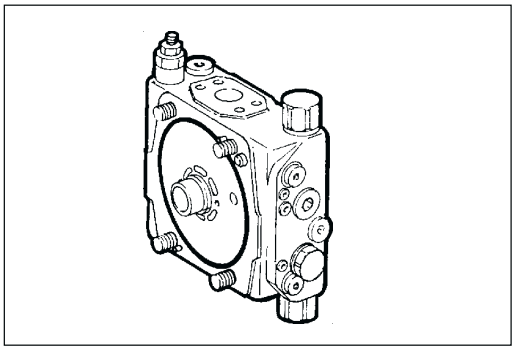
3 Housing.



4 Complete rotary group.

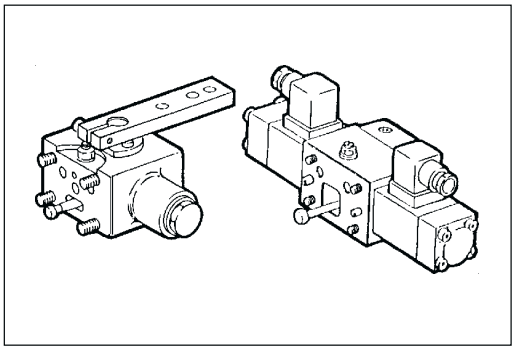


5 Positioning piston.



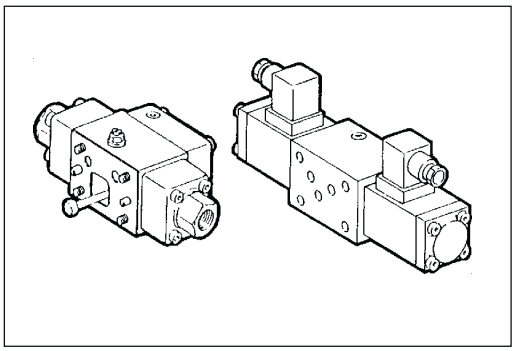
6

Port block.



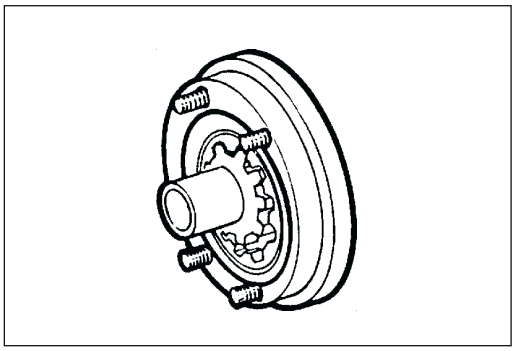
7

Control moduls **HW - EP.**



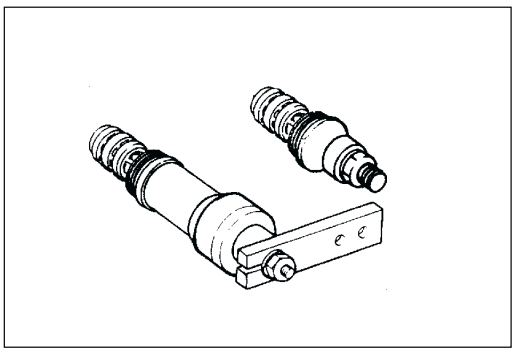
8

Control moduls **HD - DA.**



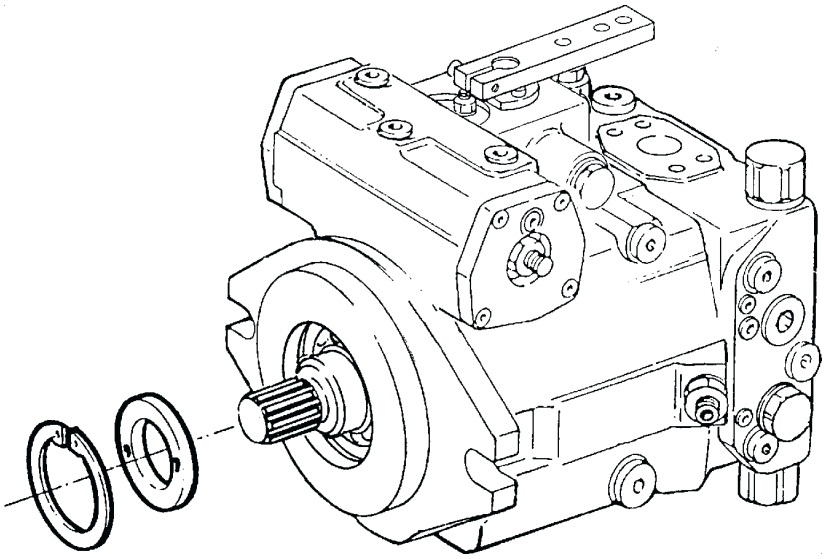
9

Boost pump.

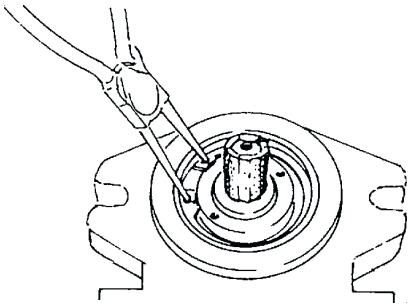


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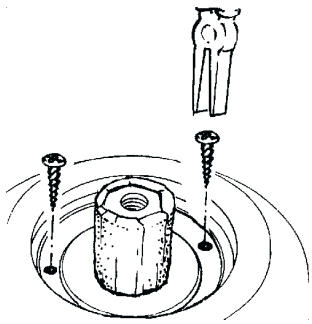
Control valve.



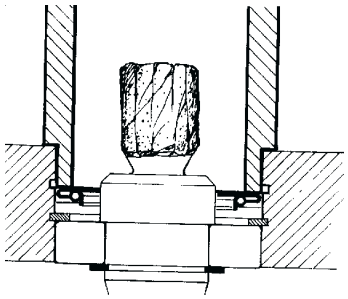
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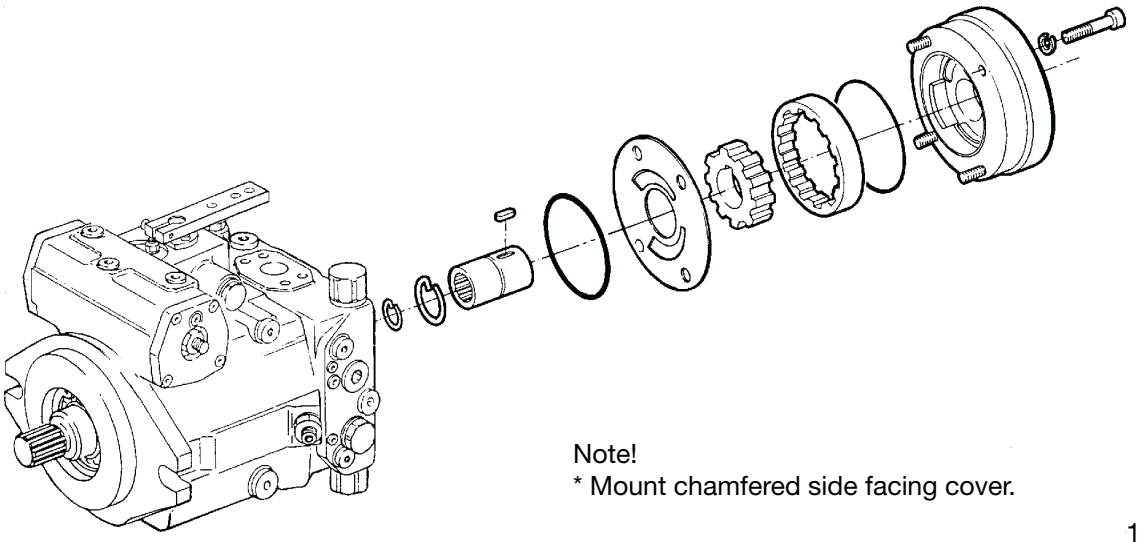
12 Protecting the drive shaft.
Remove retaining ring.



13 Screw in sheet metal screw into the holes fitted with rubber.
Pull out shaft seal with pliers.

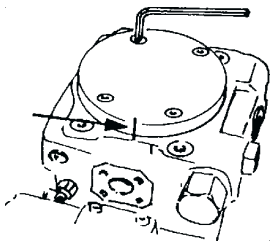


14 Press-in shaft seal with bush to stop.

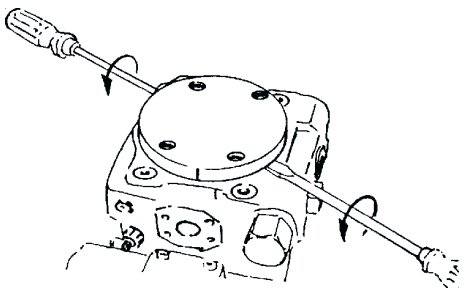


Note!
* Mount chamfered side facing cover.

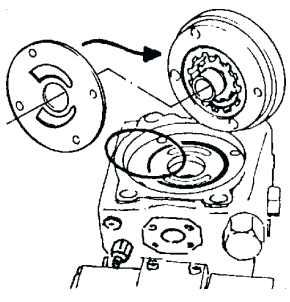
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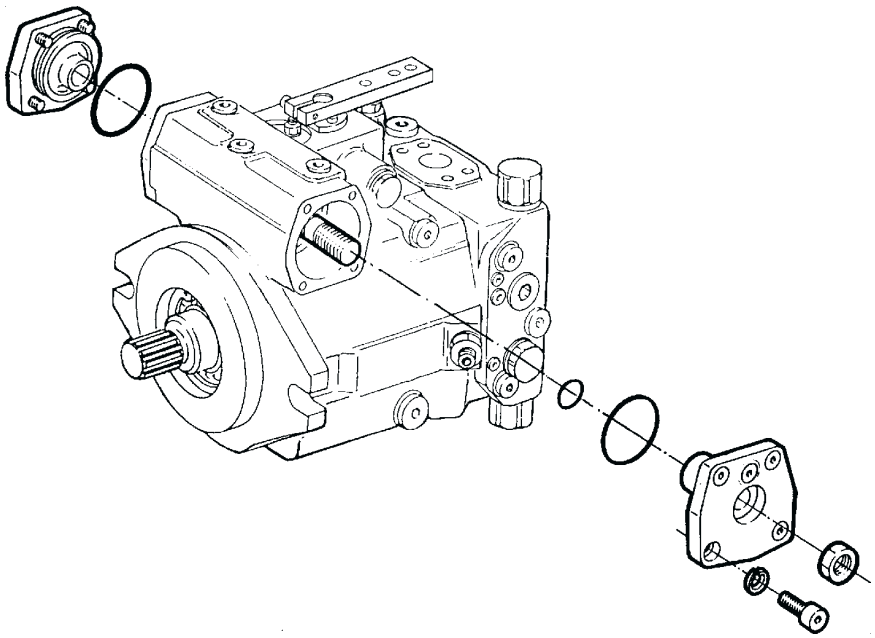
16 Mark position, remove fixing screws.



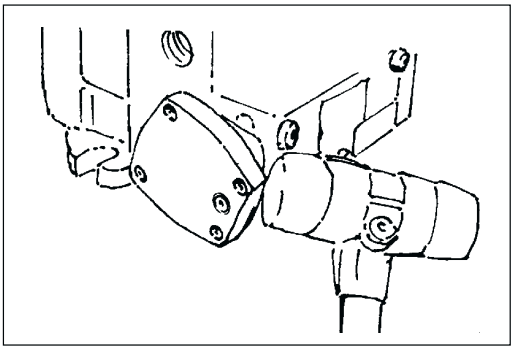
17 Pry-off cover.



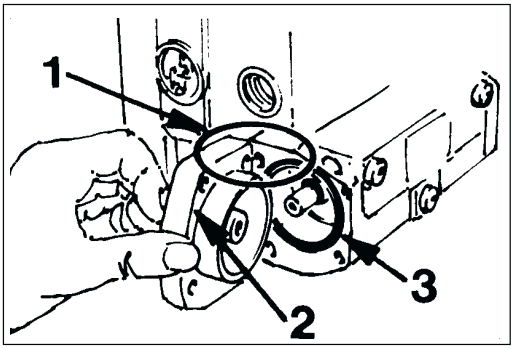
18 Inspect the parts of the boost pump and wear parts.
Boost pump can only be interchanged completely.



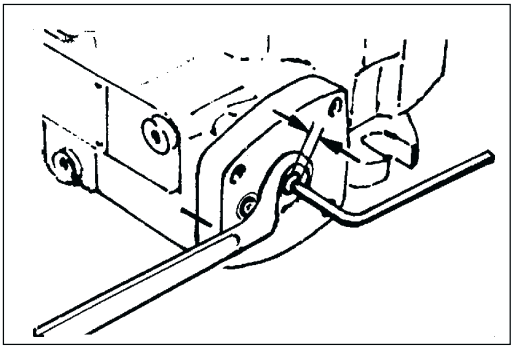
19



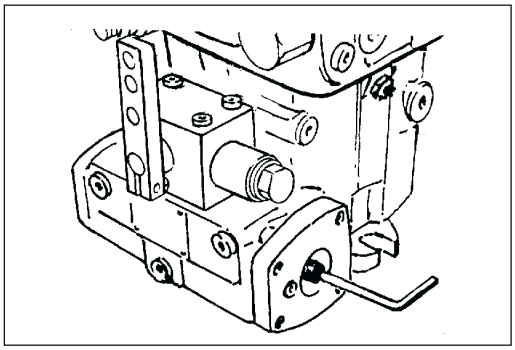
20 Loosen mounting screws.
Rotate cover and release by tapping gently with hammer.



21 Check!
O-ring (1), groove (2), housing (3).

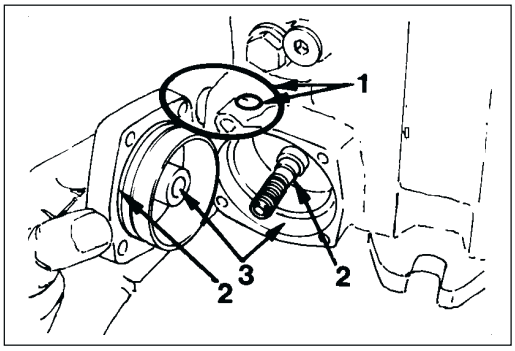


22 Remove locknut whilst holding setting screw.
Mark cover. Must be fixed, loosen counter nut.



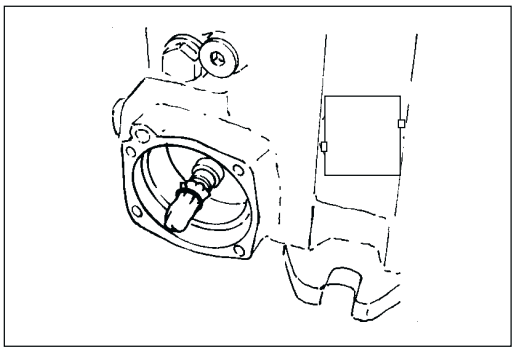
23

Pull cover off using zero position adjustment screw.



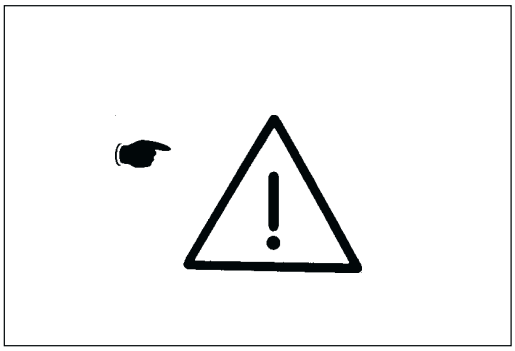
24

Check!
O-ring (19), groove (2), housing (3).



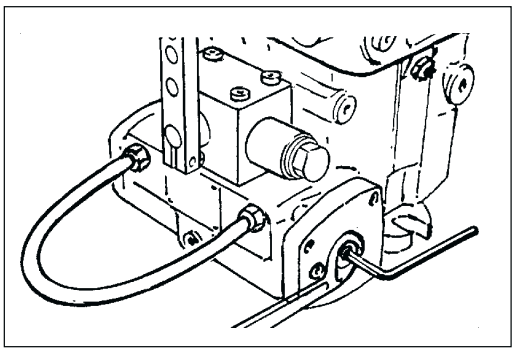
25

Cover threads, push on small O-ring.
Assemble in reversed order.



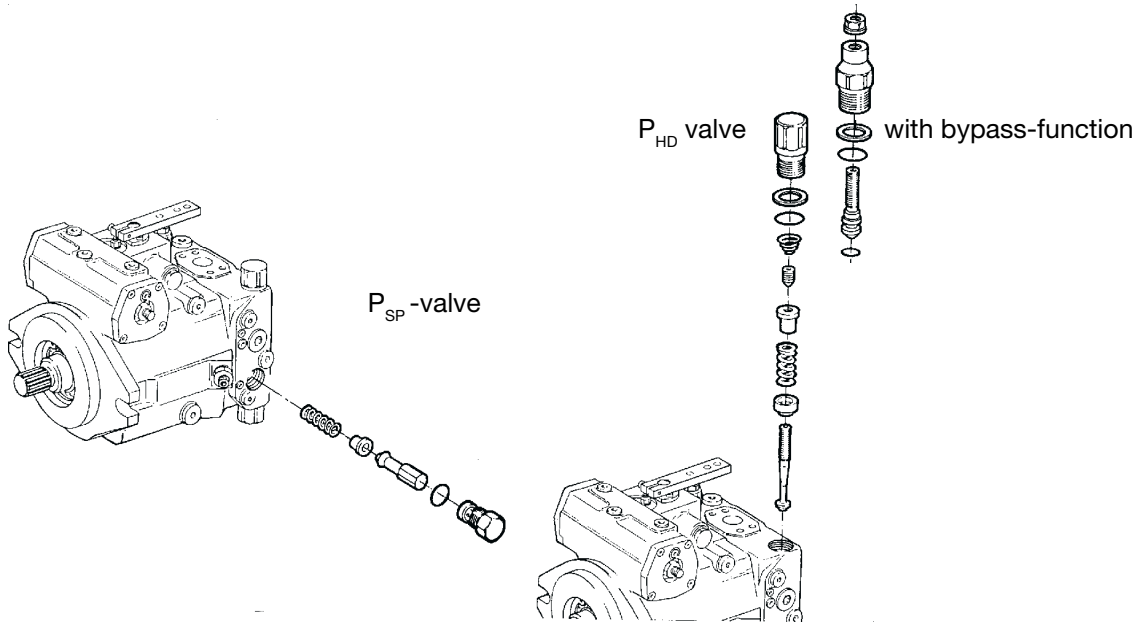
26

Attention!
Adjustment of the correct zero position to be carried out after installation into the machine or on the test bench.

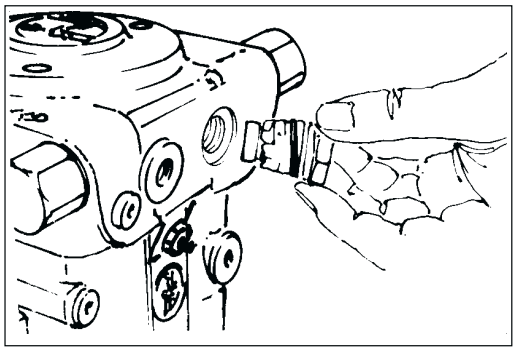


27

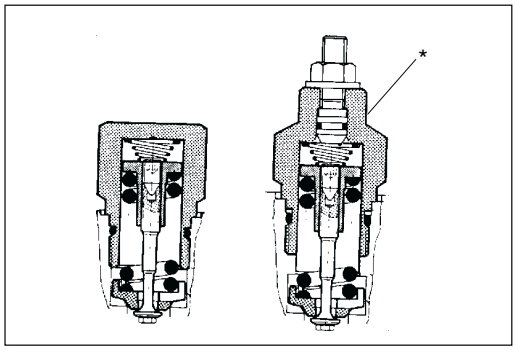
Reset mechanical zero position. To do this, connect X_1 to X_2 (size > 6).



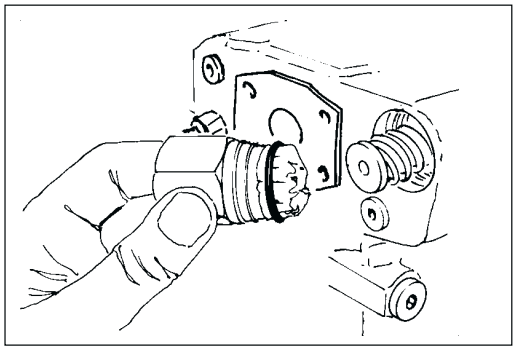
28



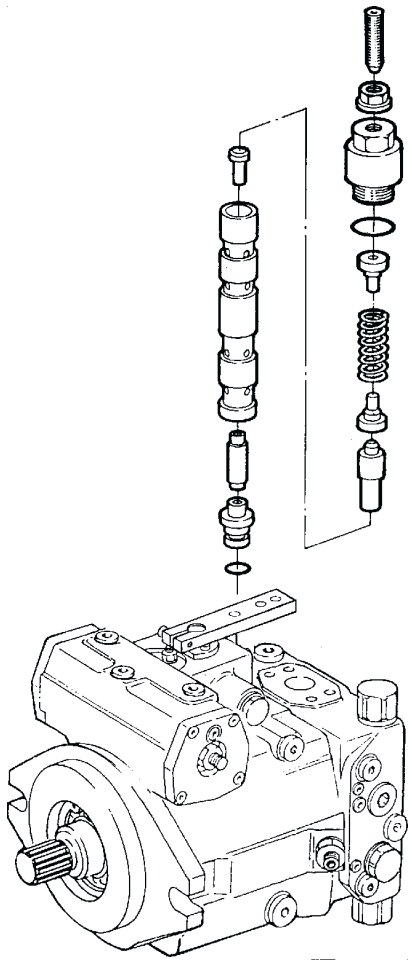
29 Cover threads before fitting new O-rings.
(Damage protection).



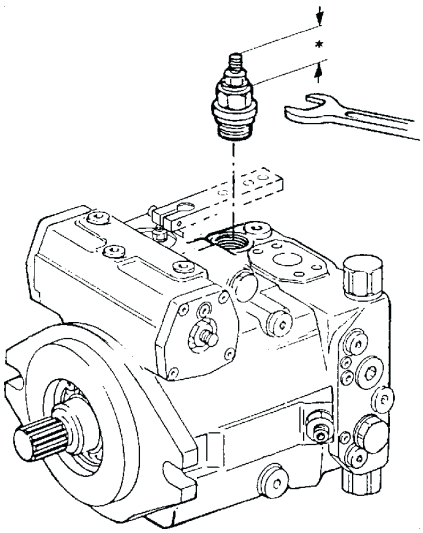
30 Remove valve poppet with spring.
* with bypass-function



31 Cover threads before fitting new O-rings.
(Damage protection).



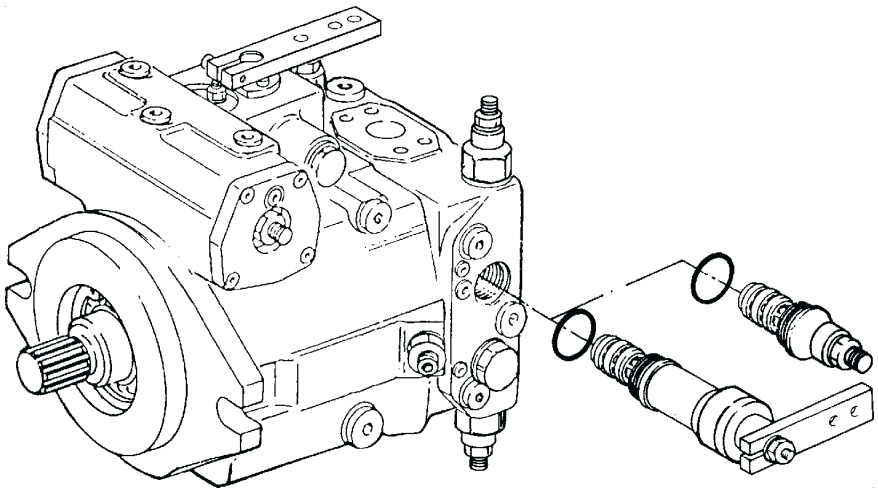
32



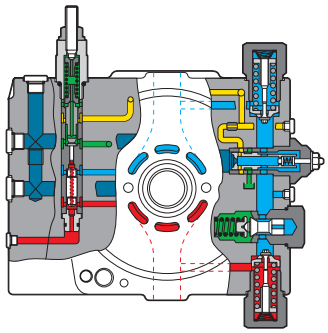
33

Change of the sealing nut.
Note setting measure (*).

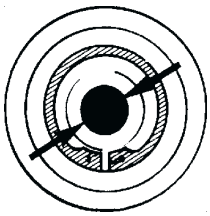
Attention!
After assembly check “valve setting”.



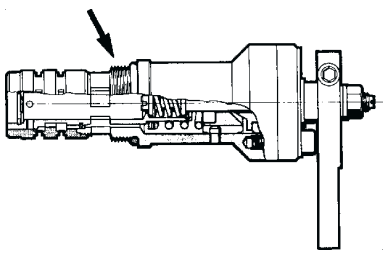
34



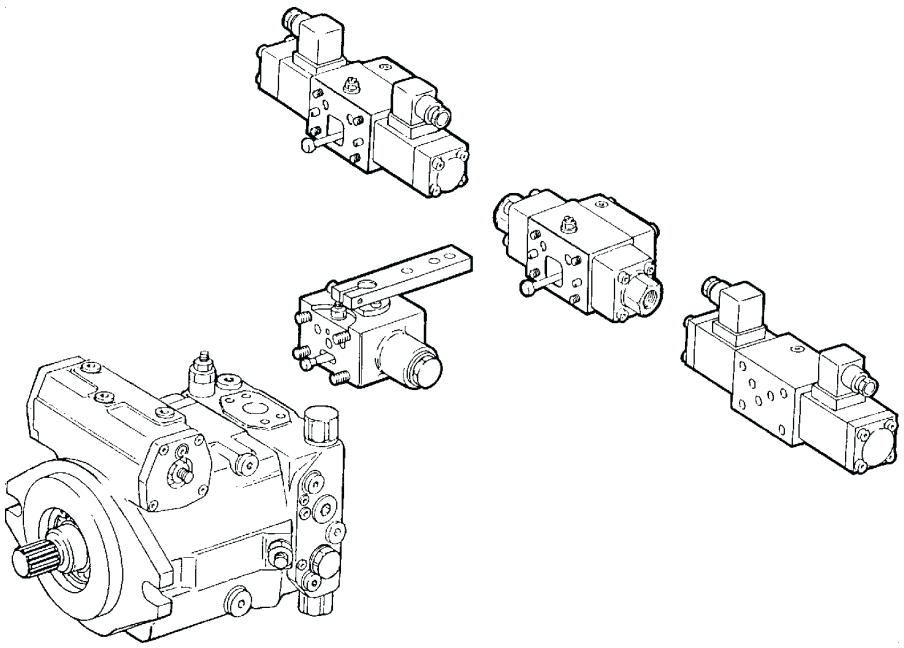
35 Remove control valve.



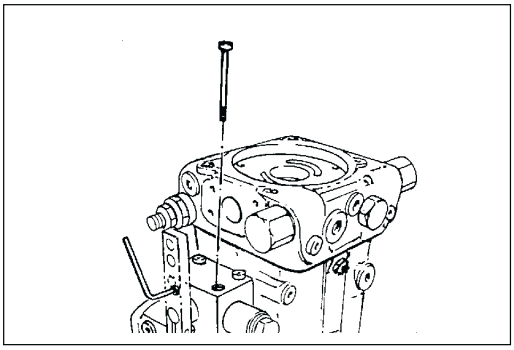
36 Do not damage throttle diameter.



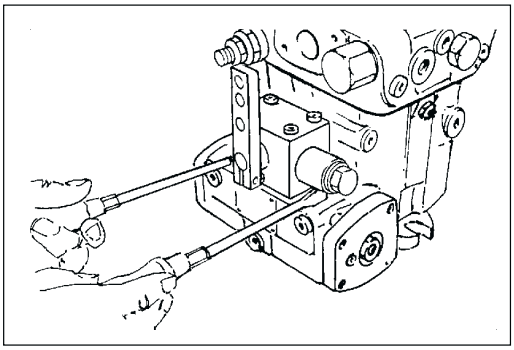
37 Before installing the new O-ring, tape the threads.



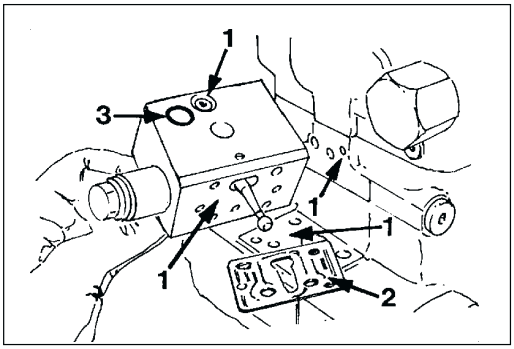
38



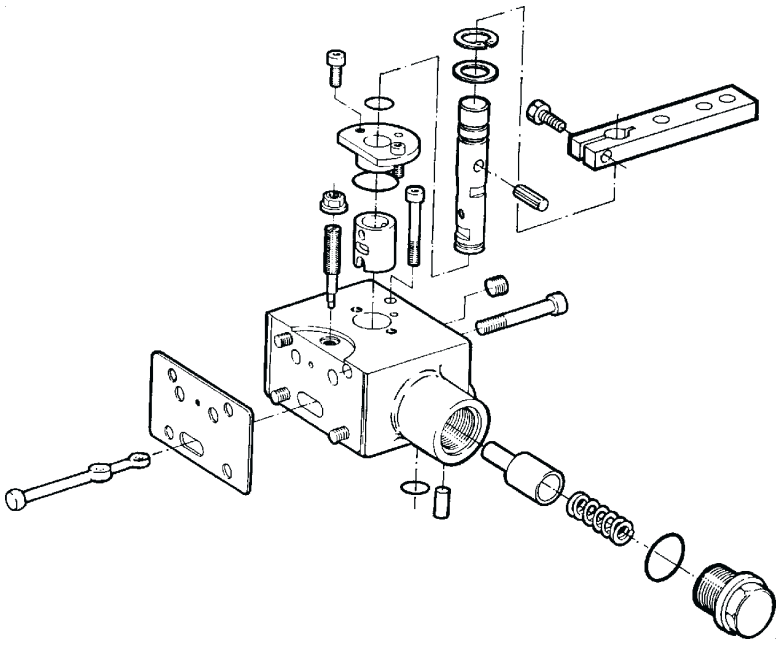
39 Remove fixing screws.



40 Pry-off the control module.

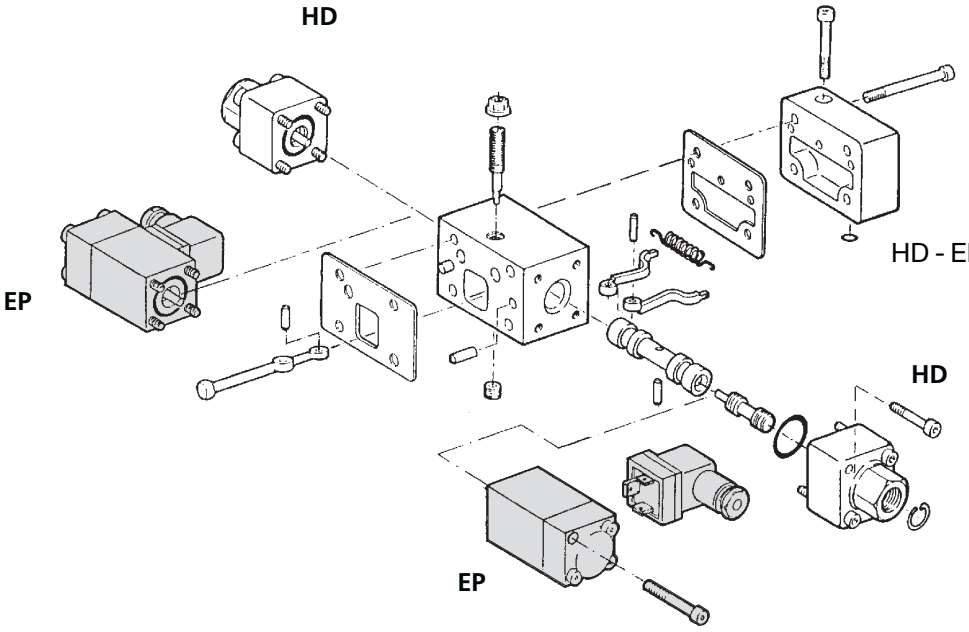


41 Check
Sealing surface (1), gasket (2), o-rings (3).



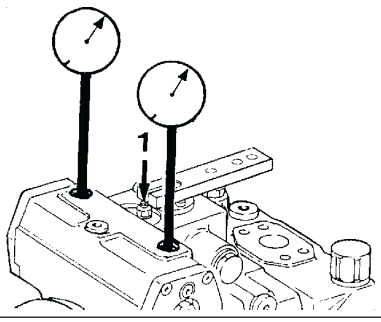
HW control module

42



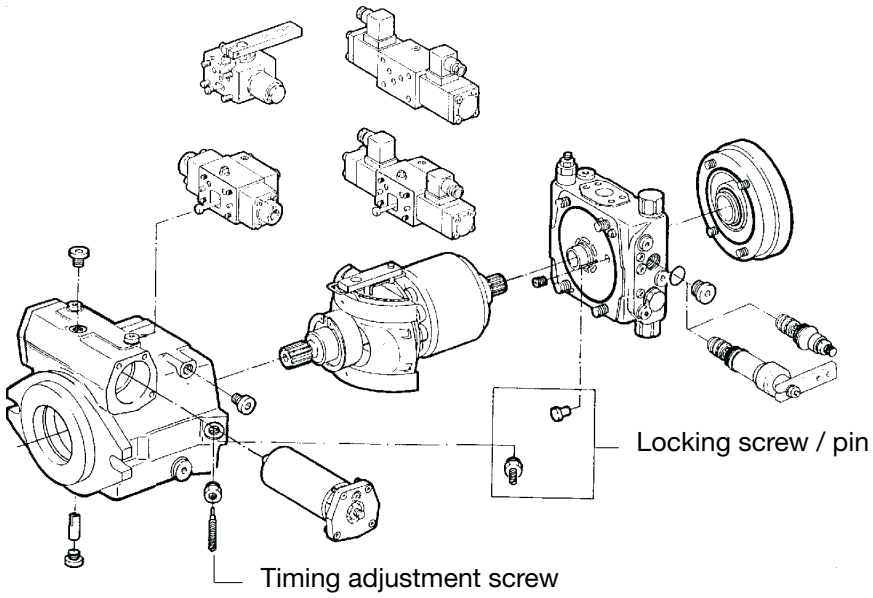
HD - EP control module

43

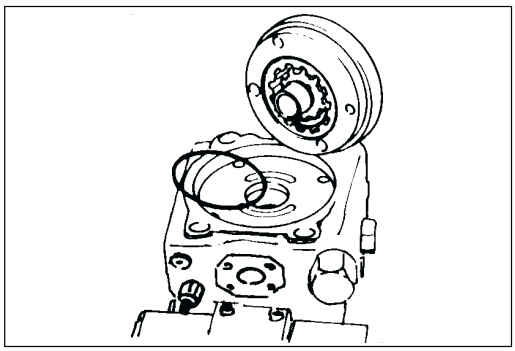


44

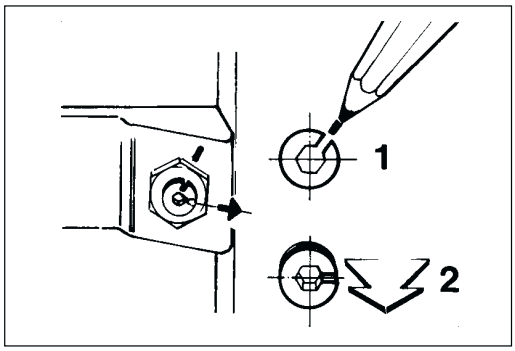
Reset hydraulic zero position (1).
Both gauges must indicate the same pressure.



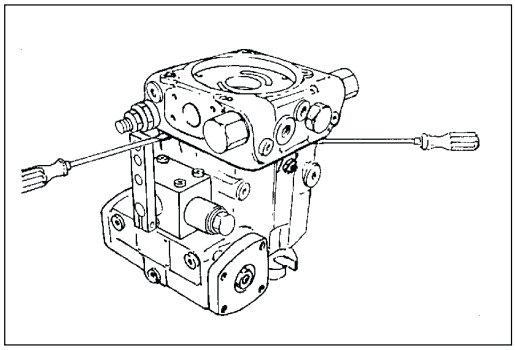
45



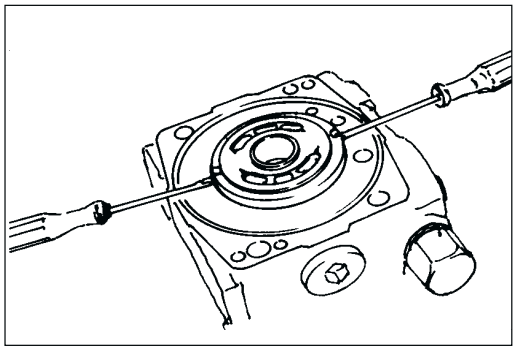
46 Mark position of the boost pump and the port plate.
Remove the boost pump.



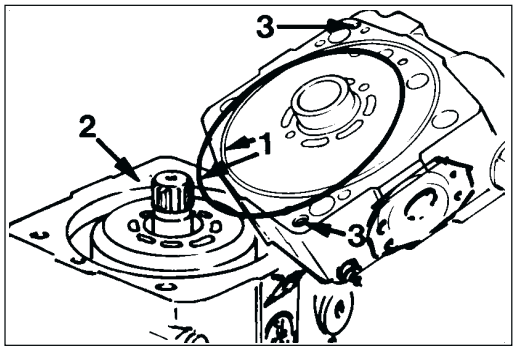
47 Mark the position of the indexing screw (1).
Set the indexing screw to disassembly position (2).



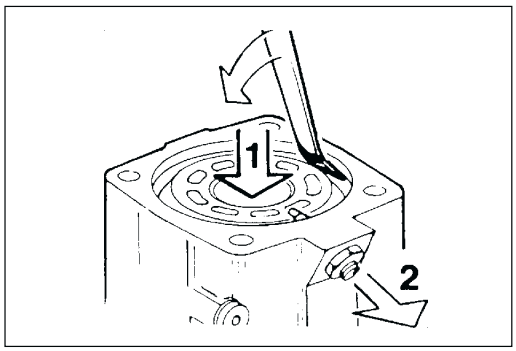
48 Release port plate fitting.
Take off port plate. If necessary, use screwdriver.
Attention! Sealing surface.



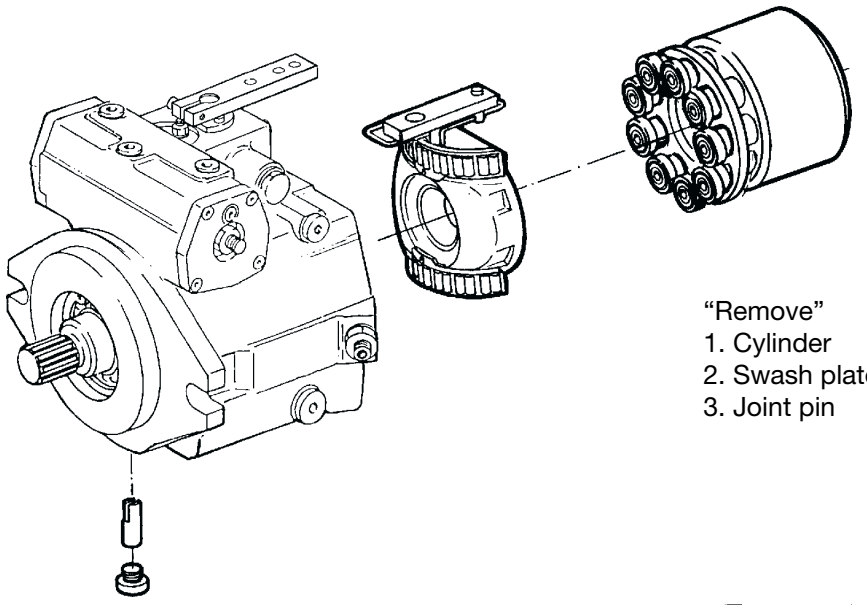
49 Lift off control plate.
Note position.



50 Check!
O-ring and groove (1), housing (2), Quad-ring and groove (3).

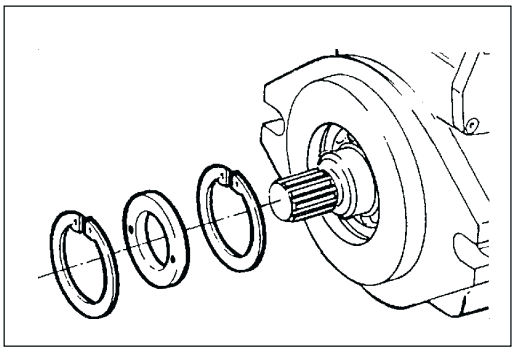


51 Press the cylinder to the bottom (1).
Remove fiming indexing screw (2).
Lift out rotary group (3).

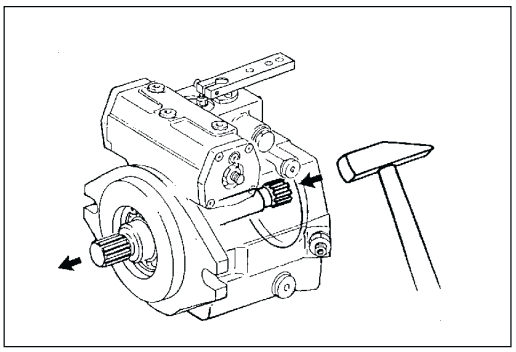


"Remove"
1. Cylinder
2. Swash plate
3. Joint pin

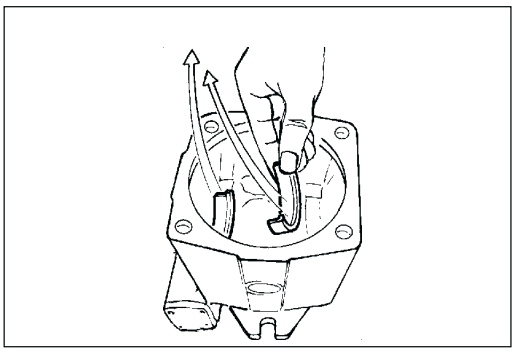
52



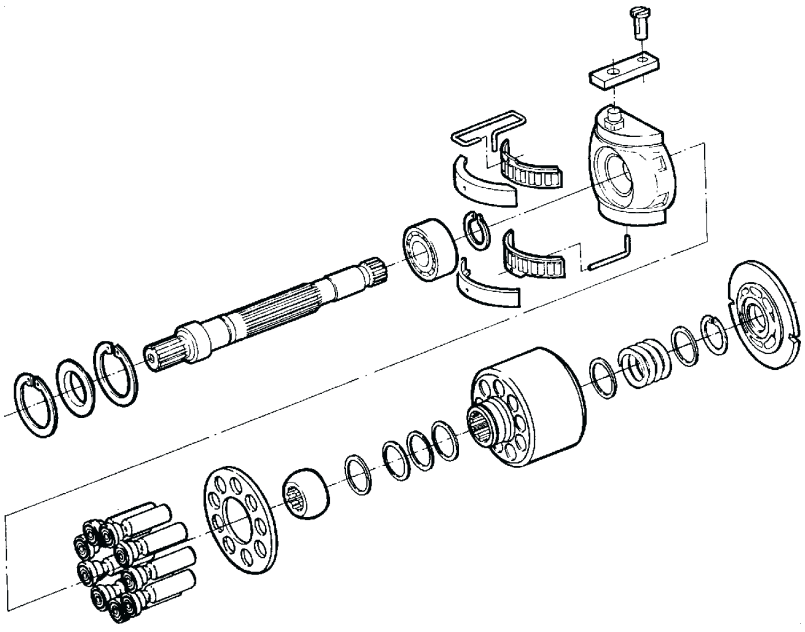
53 Remove retaining ring, radial seal ring.



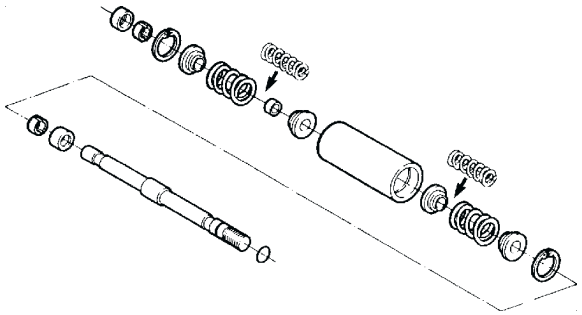
54 Remove drive shaft with slight hammer strokes.



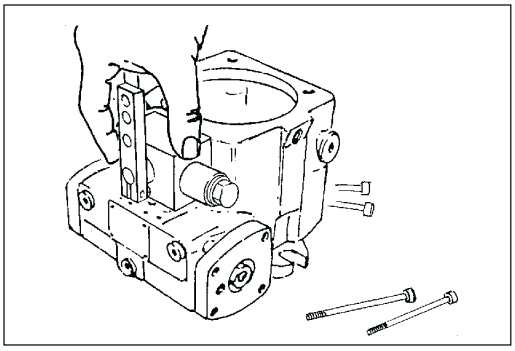
55 Remove bearing cups.



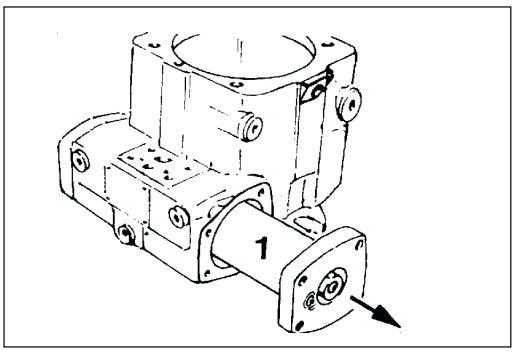
56



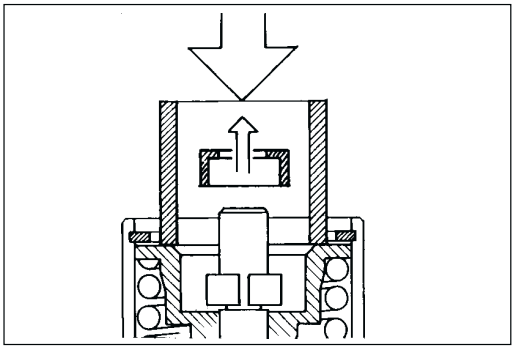
57



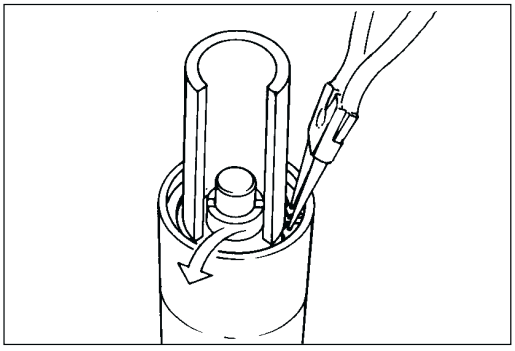
58 Remove control module.



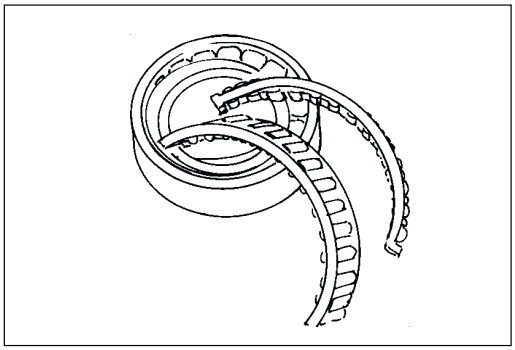
59 Pull out control piston (1).



60 Mount fixture and tension spring.
Remove receiving ring.

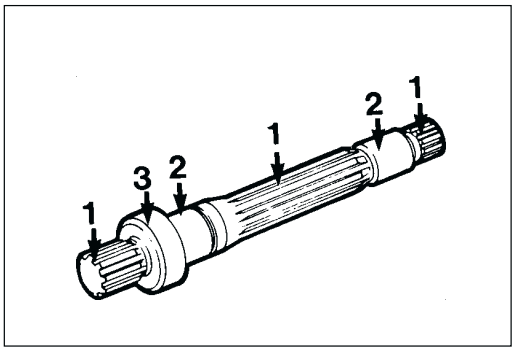


61 Take out rings.
Remove retaining ring.
Note! Parts are spring loaded.



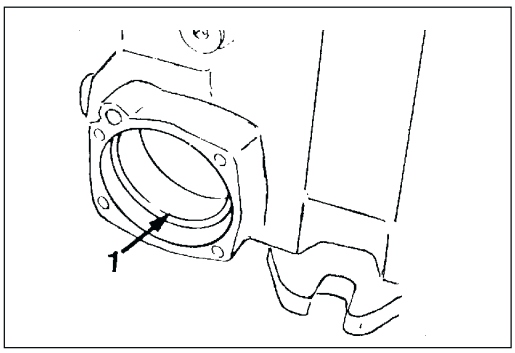
62

Replace all bearings.



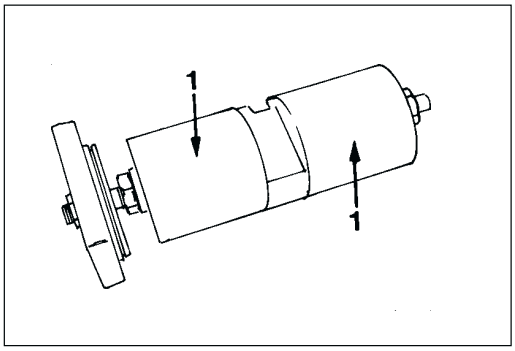
63

Check!
1. Splines for damage or fretting.
2. Running surfaces.
3. Groove cut by shaft seal.



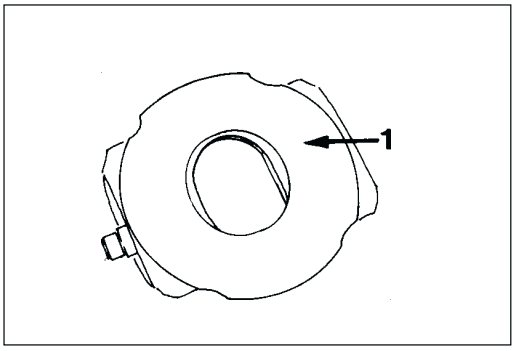
64

Check that the control piston guide bush (1) is free of grooves and has not worn out.



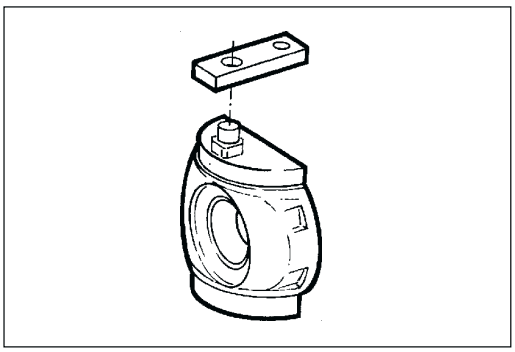
65

Check!
Control piston (1) is not scored.



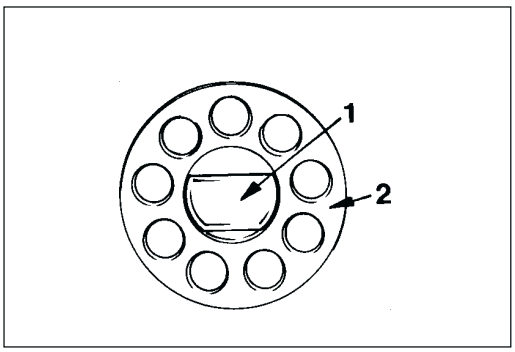
66

Check!
Sliding surface free of grooves.



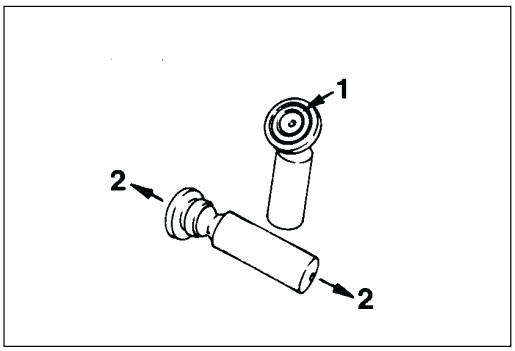
67

Check!
Make sure sliding ring/swivel pin are free of play.



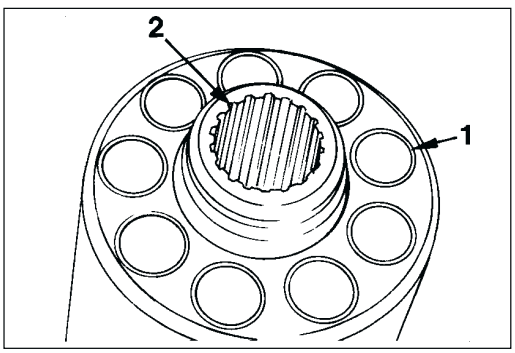
68

Check!
Check that return device is free of grooves (1) no wear in slipper pad area.



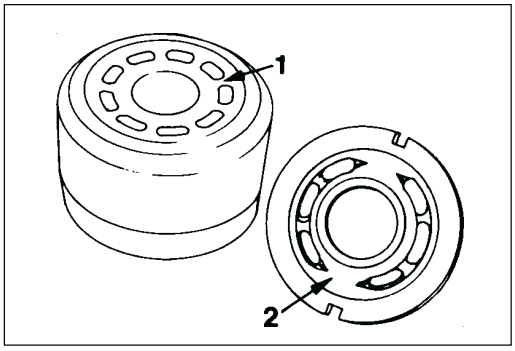
69

Check!
Check that there are no scratches or metal deposits on sliding surface (1), and there is no axial play (2), (otherwise: pistons must be replaced in sets).



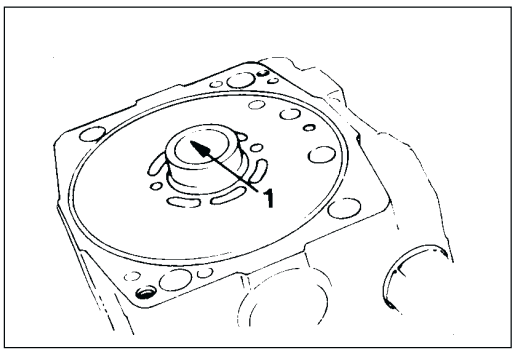
70

Check!
Cylinder bores (1), splines (2).



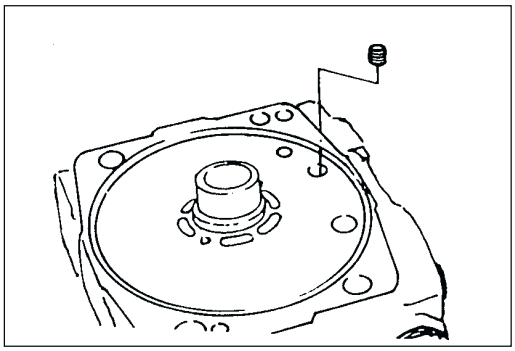
71

Check!
Cylinder gilding surface (1) free of scratches, no traces of wear and no embedded foreign particles. No scratches on the valve plate (2). (Replace ONLY in sets).



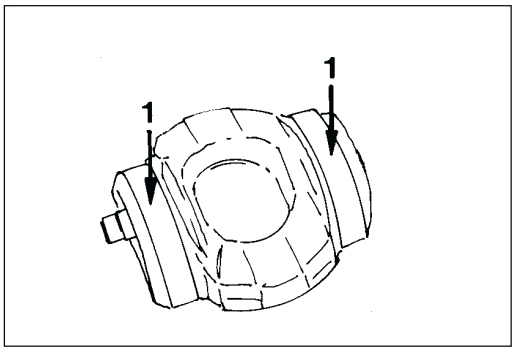
72

Check!
DU-bearing bush (1) is not worn out.



73

Information:
Boring for DA-control open.
Without DA-control closed.



74

Check!
Bearing surfaces (1).

Assemble housing - Turcon-Glyd-ring

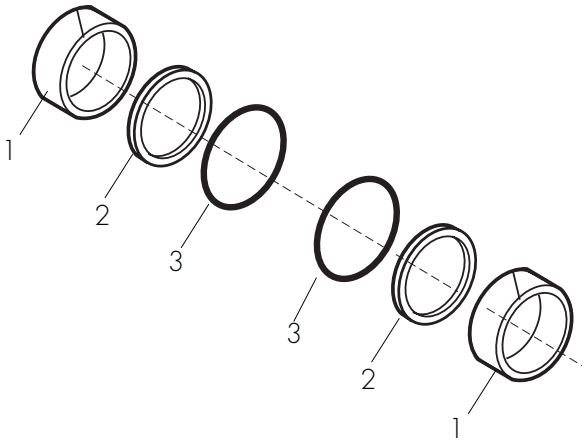
Auxiliary tools:

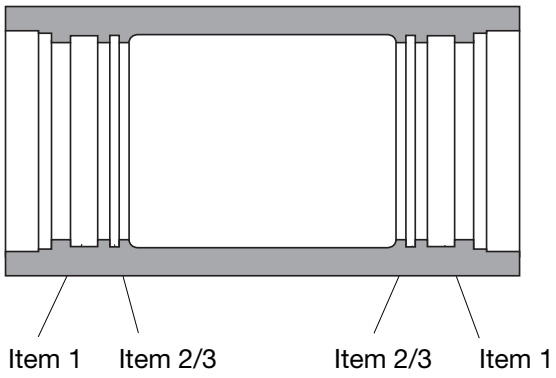
Assembly pliers: B+S x M22

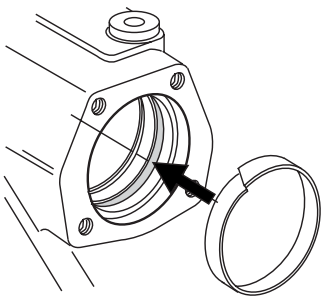
Guide thorn:

A4VG28	I: 277 4 347
A4VG40	I: 277 4 049
A4VG56	I: 277 4 050
A4VG71	I: 277 4 051
A4VG90	I: 277 4 052
A4VG125	I: 277 4 053
A4VG180	I: 277 4 054
A4VG250	I: 277 4 072

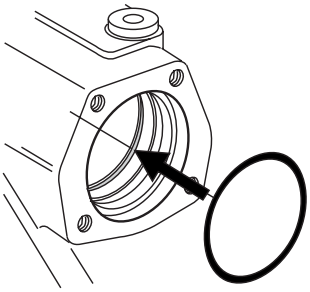
Assembly A4VG





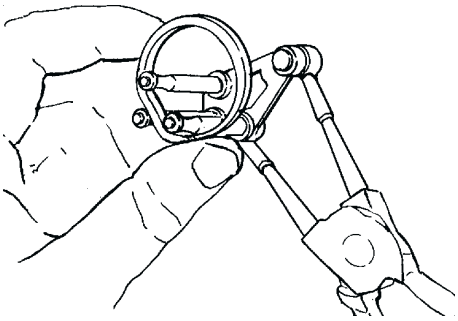


Item 1: Install barguide ring.

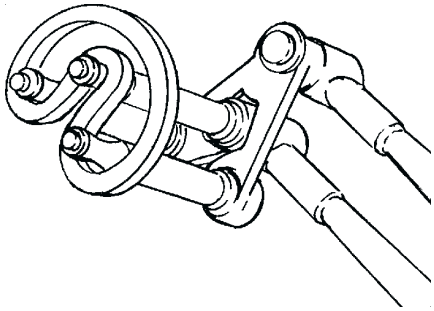


Item 3: Install O-ring.

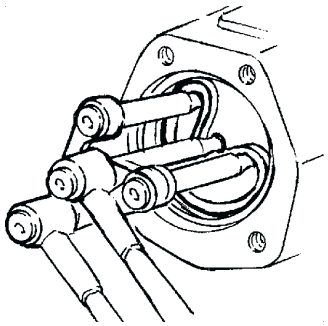
Assemble housing - Turcon-Glyd-ring



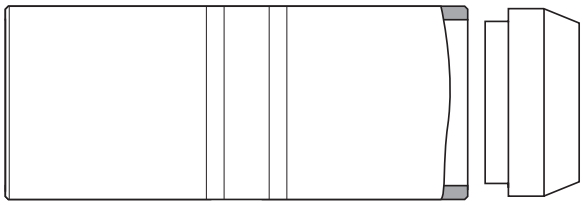
Fit the seal ring (Item 2) into the assembly tool.



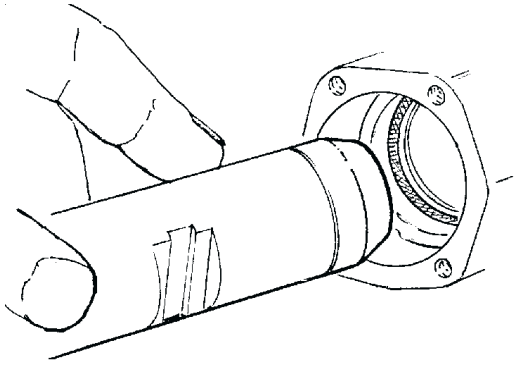
Press the seal ring into the kidney shape using the assembly tool. The deformation of the Turcon seal has to be done with care so as not to damage the sealing edges.



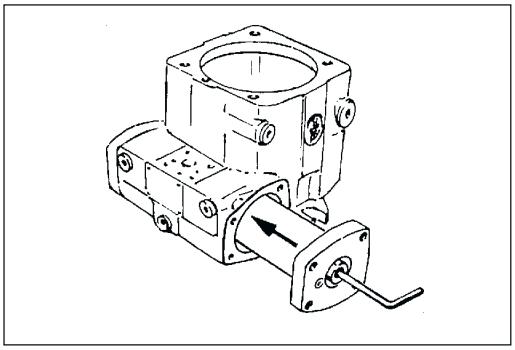
Position the seal ring into the housing and place it into the groove. Release the tension and withdraw the assembly tool. Check the position of the seal ring if necessary straighten using a finger.



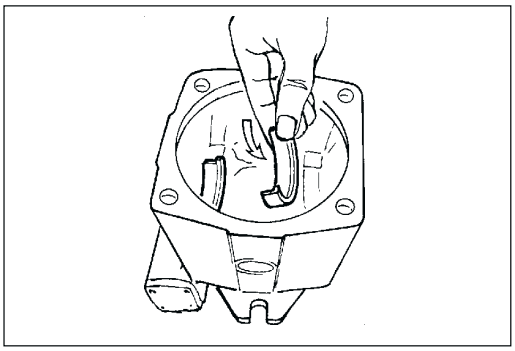
Insert guide thorn into the positioning piston.



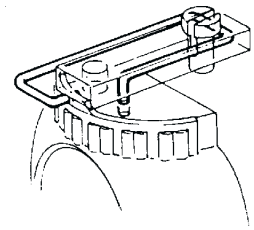
Grease slightly guide thorn.
Install positioning piston with guide thorn.

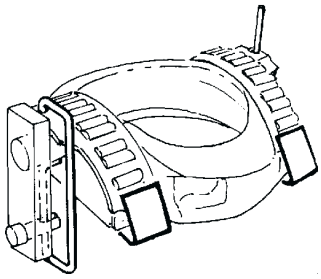


75 Insert positioning piston into the housing.
Instruction:
Oil positioning piston before assembly.

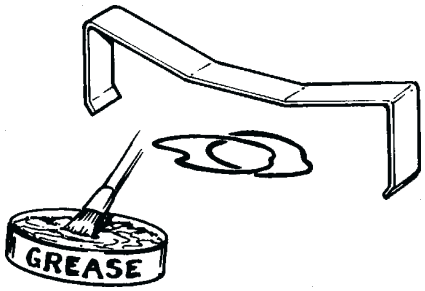


76 Insert bearing cup set.

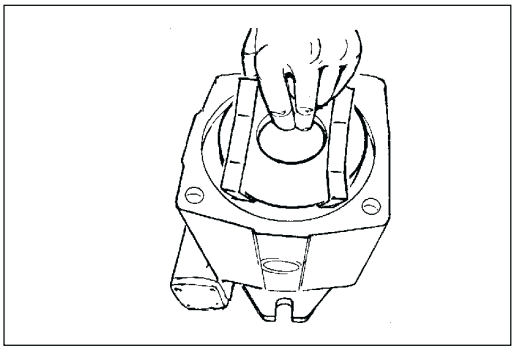




Assemble bearing, wire, gliding stone and articulating pin.
Assistance: Devices e.g. - Clamp / rubber rings / grease

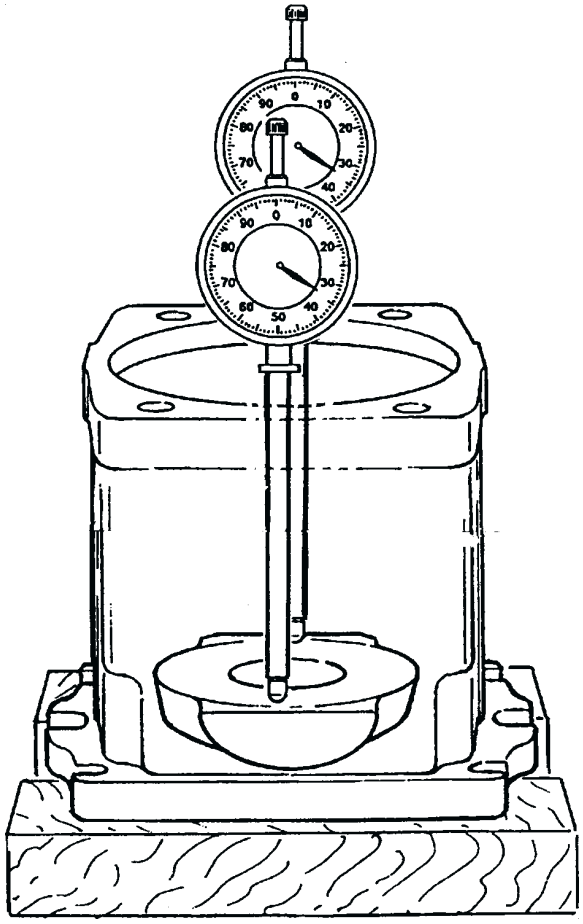


77



78 Insert completely swivel cradle into the housing.
Pay attention for correct seat of the swivel cradle in the housing.

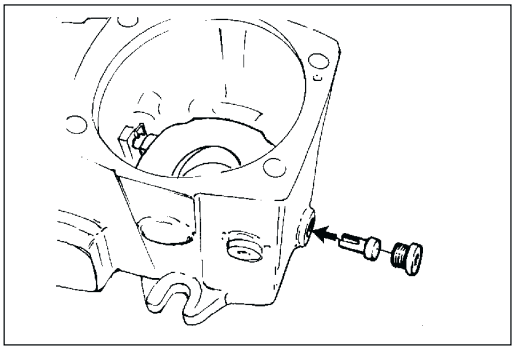
⚠ Remove auxiliary device.



⚠ Check: Location of the swivel-bearing in the bearing.

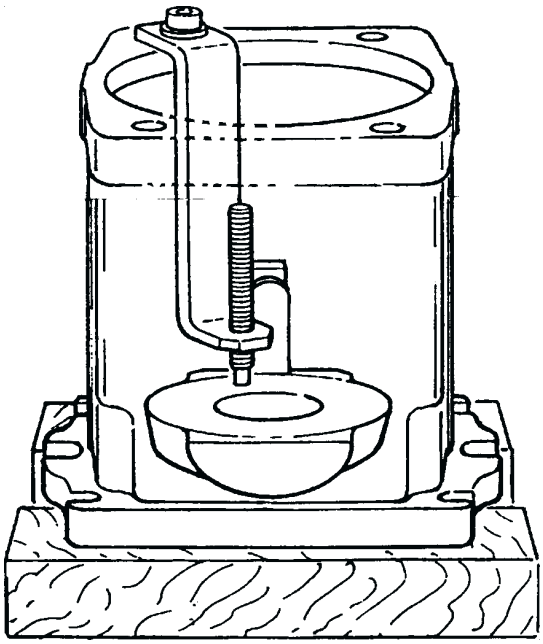
Swivel the swivel bearing by using the control piston “it should move easily”.
Centralise by using a measuring device (dial gauge or depth measurement).
Check points 1 and 2 - they should have the same dimension.

79



80

Fit joint pin.

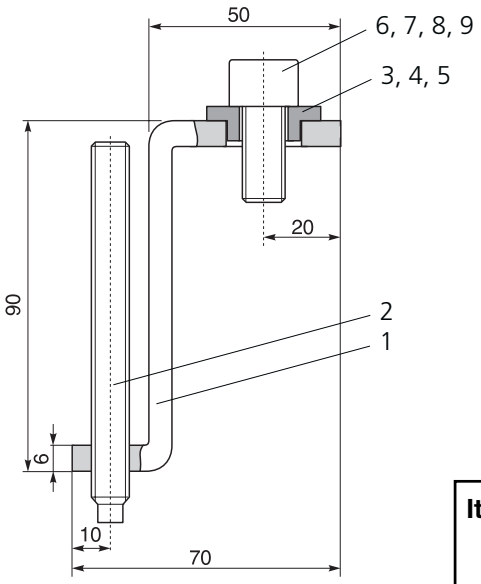


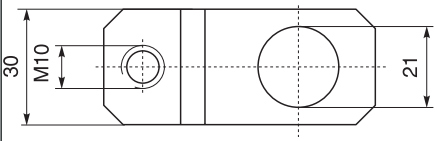
Fit holding device.
Hold swash plate in position utilising the set screw.

⚠ Do not use force.

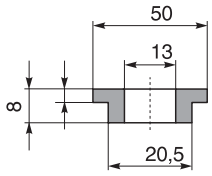
81

Holding device “swivel cradle” A4V

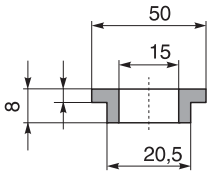




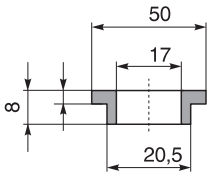
Part 3



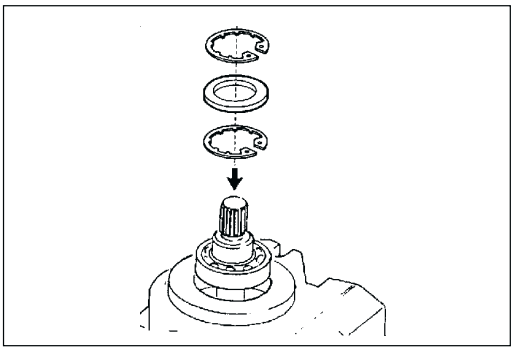
Part 4



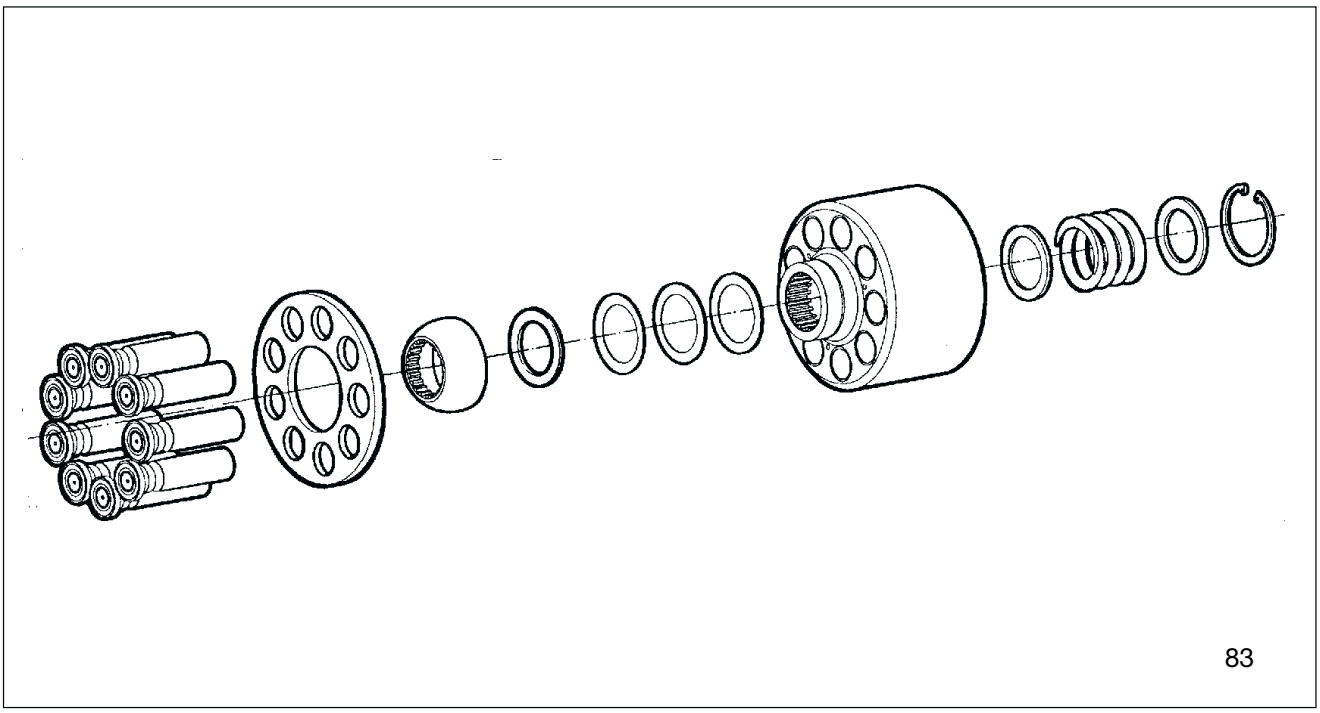
Part 5



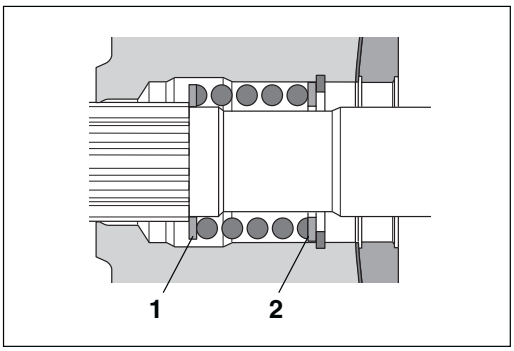
Item	Designation	Qty.
1	Angle	2
2	Threaded pin	2
3	Shim	2
4	Shim	2
5	Shim	2
6	Cyl. screw M12 x 25 DIN 912	2
7	Cyl. screw M14 x 25 DIN 912	2
8	Cyl. screw M16 x 30 DIN 912	2
9	Cyl. screw M20 x 35 DIN 912	2



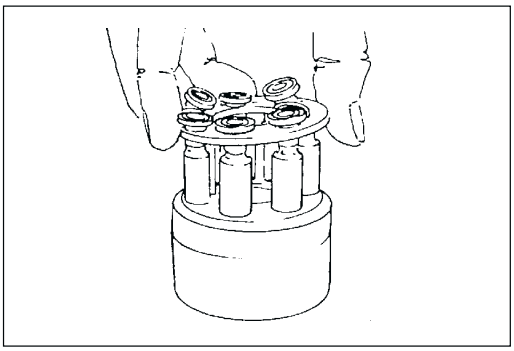
82 Assemble drive shaft with bearings and radial seal rings.



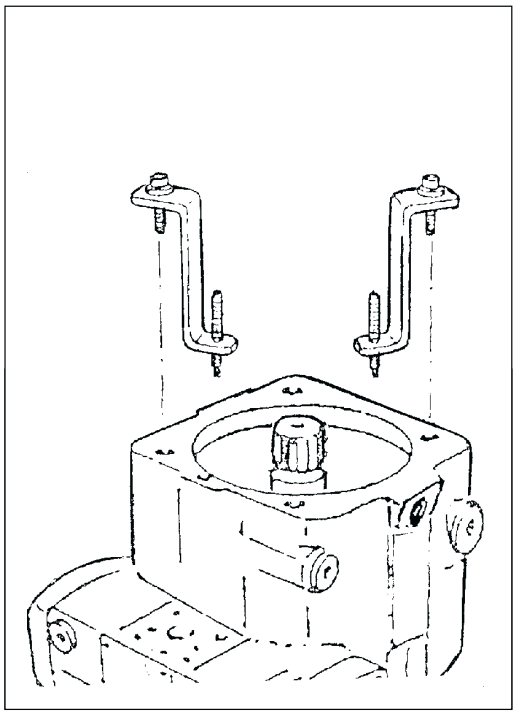
83



84 Disc 1, 2.

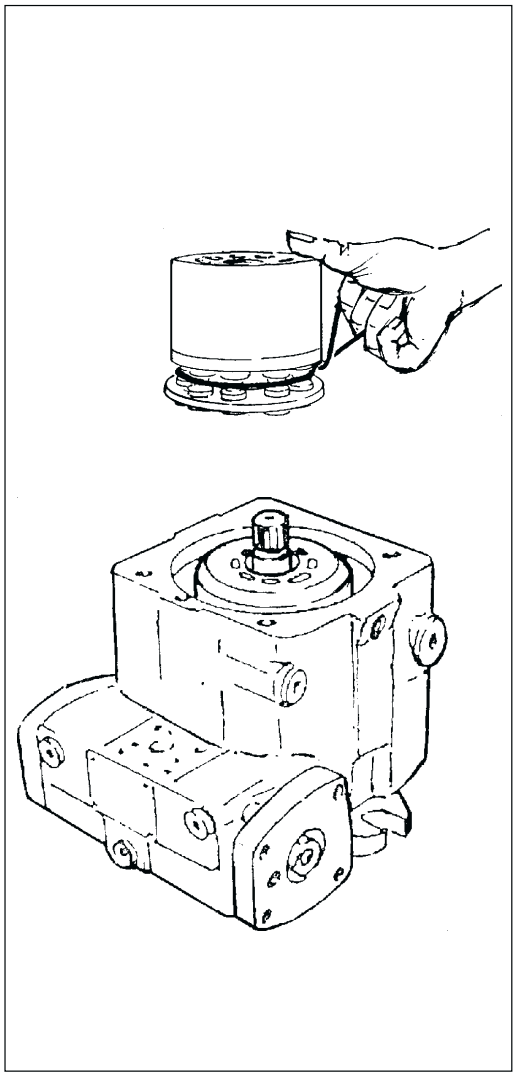


85 Assemble piston with retaining plate.
Note:
Oil piston and piston pad.



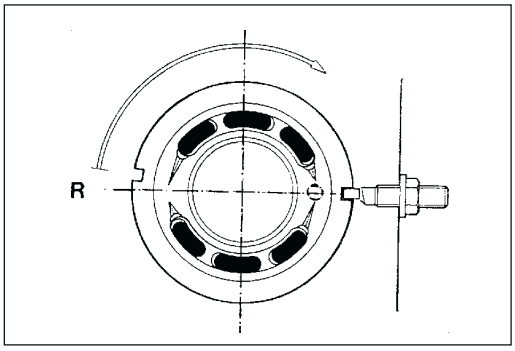
86

Remove holding device.
Fit cylinder complete with pistons and retaining device.



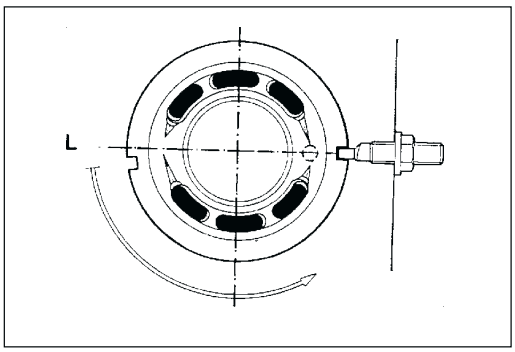
87

Assembly aid:
Hold the pistons by using an O-ring.



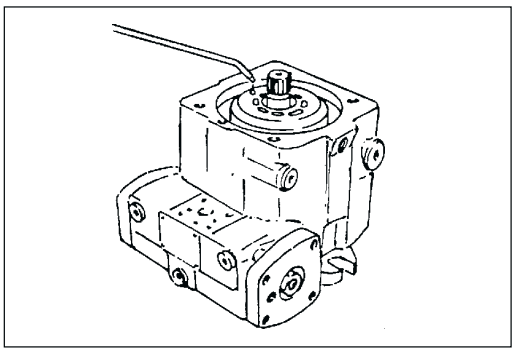
89

Control plate clockwise rotation - indexed in the direction of rotation.
Note! Noise grooves are machined - in based on direction of rotation.



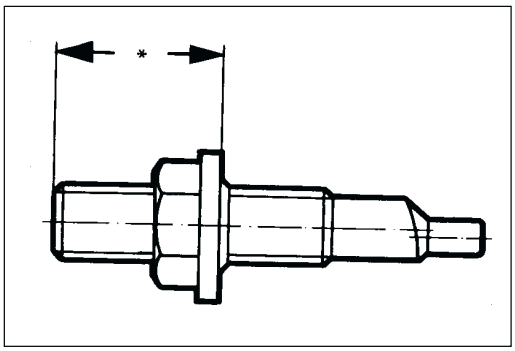
90

Control plate counter clockwise rotation - indexed in the direction of rotation.
Note! Noise grooves are machined - in based on direction of rotation.



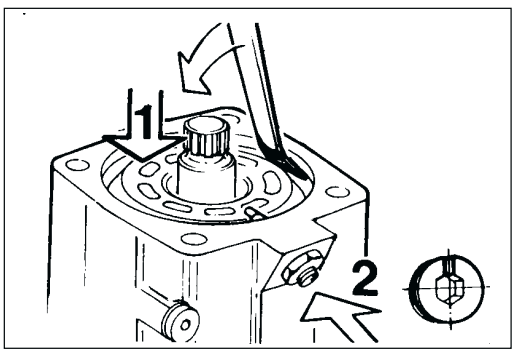
91

Oil the running surfaces of the cylinder barrel and the DU- bearing. Grease the O-rings and insert in grooves.



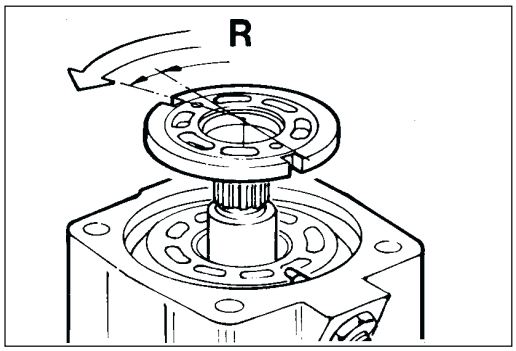
92

Basic setting - indexing screw
A4VG...40 * = 24 ± 0,75 mm.
A4VG...56 * = 21 ± 0,75 mm.

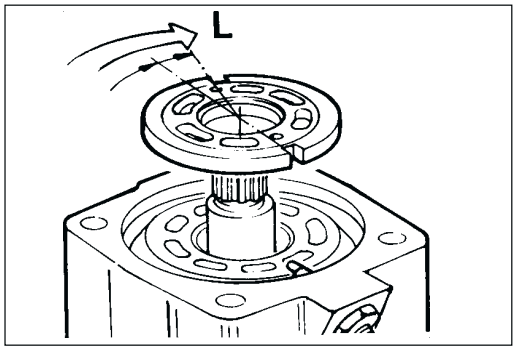


93

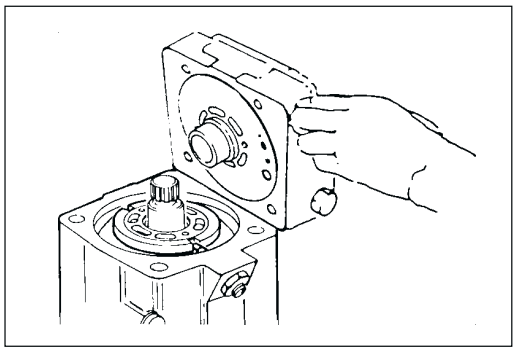
Press the cylinder to the bottom (1).
Screw in the indexing screw (2).
Groove in mounting position.



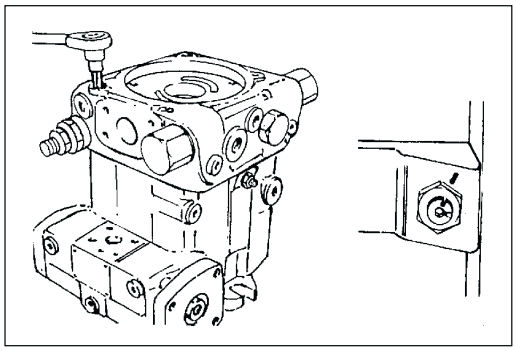
94 Insert the control plate - clockwise rotation.



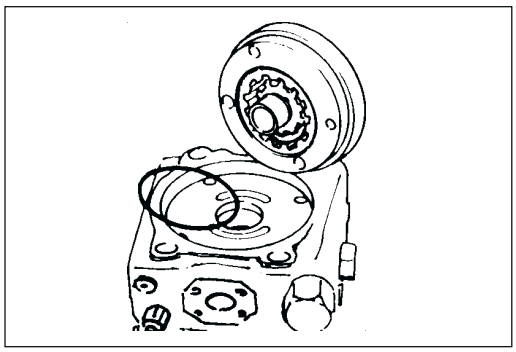
95 Insert the control plate - Counter- clockwise rotation.



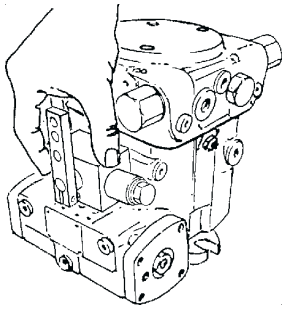
96 Place in correct position.
Note:
HW, HD, EP - Put control plate with greas to the port block.



97 Tighten screws (Cross-corner).
Turn the indexing screw to marking.

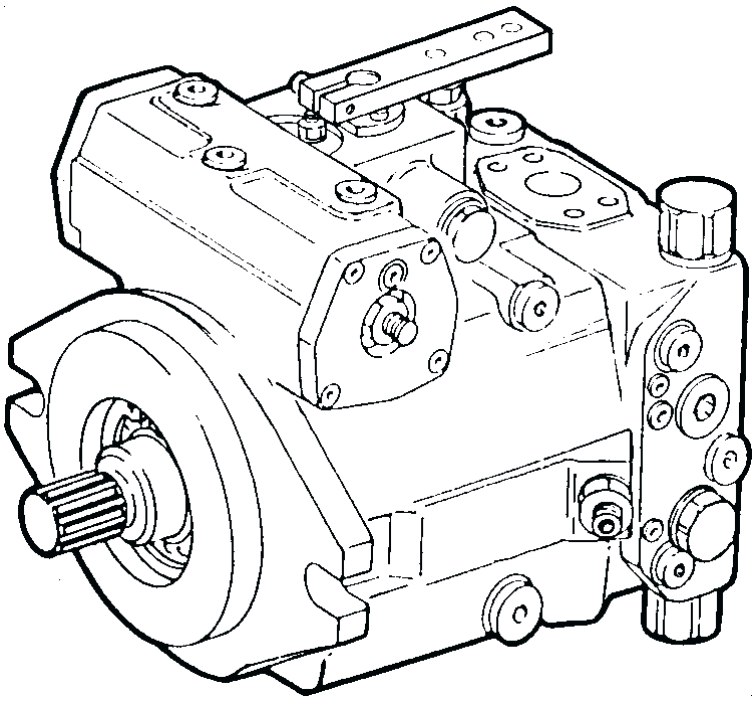


98 Assemble boost pump.



99

Mount control module.



100

Tightening torques for shaft bolts (Metric ISO Standard Thread)

The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO- standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or unoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 3	1,3	2,0	2,3
M 4	3,1	4,5	5,3
M 5	6,1	8,9	10,4
M 6	10,4	15,5	18.0
M 8	25	37	43
M10	51	75	87
M12	87	130	150
M14	140	205	240
M16	215	310	370
M18	300	430	510
M 20	430	620	720
M 22	580	830	970
M 24	740	1060	1240
M 27	1100	1550	1850
M 30	1500	2100	2500

Tightening torques for locking screws VSTI (Metric ISO fine thread)

Thread size	Designation	Tightening torques(lb.ft)
M 8 x 1	VSTI 8 x 1 -ED/SA	= 4
M 10 x 1	VSTI 10 x1 -ED	= 7
M 12 x 1,5	VSTI 12 x 1,5 -ED	= 15
M 14 x 1,5	VSTI 14 x 1,5 -ED	= 22
M 16 x 1,5	VSTI 16 x 1,5 -ED/SA	= 22
M 18 x 1,5	VSTI 18 x 1,5 -ED/SA	= 29
M 20 x 1,5	VSTI 20 x 1,5 -ED/SA	= 37
M 22 x 1,5	VSTI 22 x 1,5 -ED	= 44
M 26 x 1,5	VSTI 16 x 1,5 -ED/SA	= 51
M 27 x 2	VSTI 27 x 2 -ED	= 66
M 30 x 1 ,5	VSTI 30 x 1,5 -ED/SA	= 74
M 33 x 2	VSTI 33 x 2 -ED/SA	= 88
M 42 x 2	VSTI 42 x 2 -ED/SA	= 147
M 48 x 2	VSTI 48 x 2 -ED	= 220

Tightening torques for seal-lock nuts (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening torque (lb.ft)		
M 6	7,4	-	-
M 8	16,2	-	-
M10	29,5	-	-
M12	50,9	-	-
M14	81,1	-	-
M16	125,3	-	-

Tightening torques for cross-slotted lens head screws DIN 7985 (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening torques (lb.ft)		
M 3	0,8	-	-
M 4	2,1	-	-
M 5	4,4	-	-
M 6	7,4	-	-
M 8	18,4	-	-
M10	36,1	-	-

General advice

- Make yourself familiar with the equipment of the machine.
- Only operate the machine if your are completely familiar with the operating and control elements as well as the functioning of the machine.
- Use your safety equipment like helmet, safety shoes and hearing protection.
- Make yourself familiar with your working field.
- Only operate the machine for its intended purpose.

Please observe the guidelines of the Professional Association and the machine manufacturer.



Before starting

- Observe the operating instructions before starting.
- Check the machine for obvious faults.
- Do not operate the machine with defective instruments, warning lights or control elements.
- All safety devices must be in a secure position.

- Do not carry with you movable objects or secure them to the machine.
- Keep oily and inflammable material away from the machine.
- Before entering thc driver's cabin, check if persons or obstacles are beside or beneath the machine.

- Be careful when entering the driver's cabin, use stairs and handles.

- Adjust your seat before starting.

Start

- When starting all operating levers must be in “neutral position”.
- Only start the machine from the driver’s seat
- Check the indicating instruments after start to assure that all functions are in order.
- Do not leave the machine unobserved when the motor is running.
- When starting with battery connection cables connect plus with plus and minus with minus.
  Always connect negative (-) cable last and disconnect negative cable first.

Attention

- Exhaust gas is dangerous. Assure sufficient fresh air when starting in closed rooms!

Hydraulic equipment

1. Hydraulic equipment is standing under high pressure.

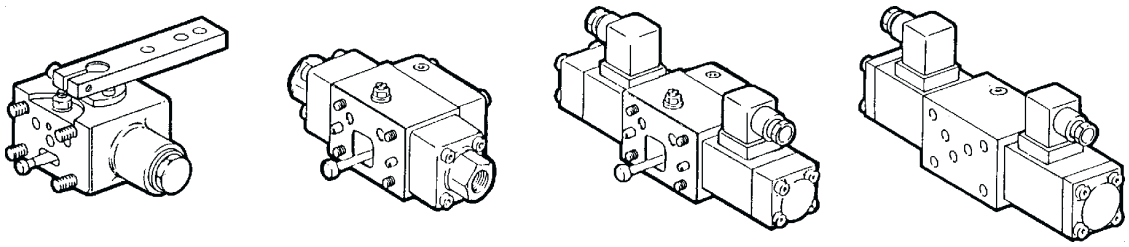
⚠ High pressure fluids (fuel, hydraulic oil) which escape under high pressure can penetrate the skin and cause heavy injuries.
Therefore immediately consult a doctor as otherwise heavy infections can be caused.

2. When searching leakages use appropriate auxiliary devices because of the danger of accidents.
3. Before working at the hydraulic equipment, lower pressure to zero and lower working arms of the rnachine.
4. When working at the hydraulic equipment, absolutely stop motor and secure machine against rolling away (parking brake, shim)!

5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. In case of exchanging the ports, the tunctions are vice versa (f. ex. lift-up/lower) - danger of accidents!

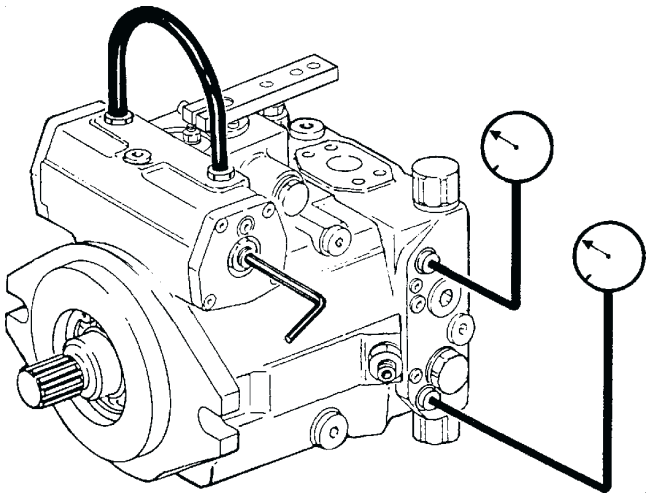
7. Check hydraulic flexible hoses regularly and replace them in case of dammage or wear! The new hose pipes must comply with the technical requirements of the machine manufacturer!

⚠ Orderly disposal or recycling of oil, fuel and filters!



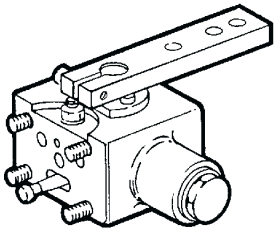
HW HD EP DA

101

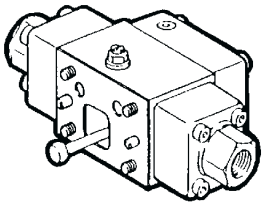


Attention!
Observe safety regulations!
Connect both control chambers with hose NW6.
Avoidance of rest signal from hydraulic zero position.
Connect manometer to M_A and M_B.
Adjust zero position so that at blocked drive both manometer indicate the same pressure valve.
Note:
Adjust death line of zero position.

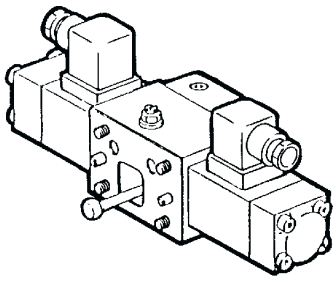
102



HW



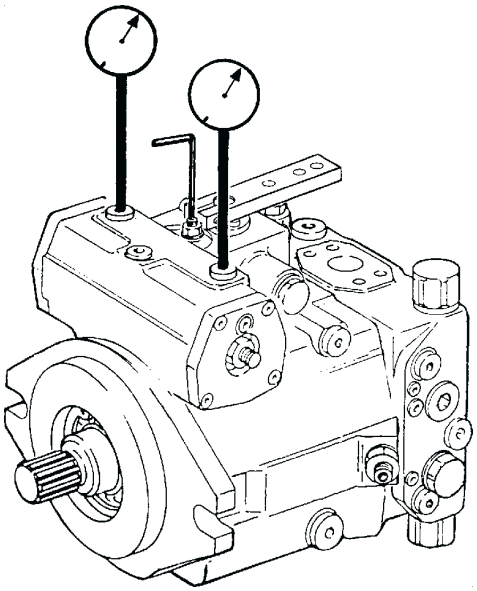
HD



EP

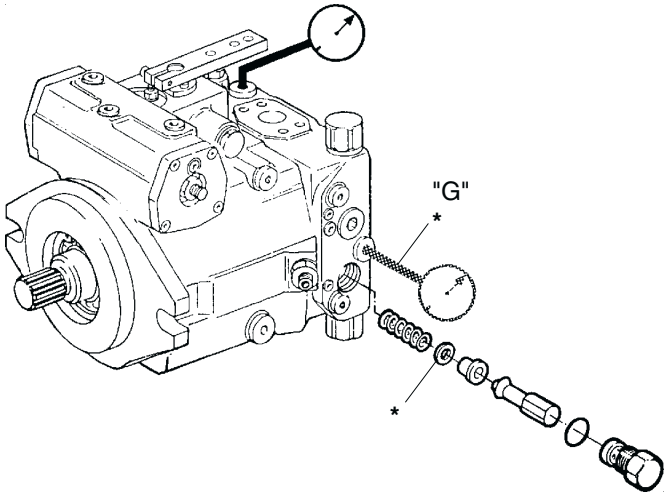
Attention!
Observe safety regulations!

103



Connect manometer to X_1 and X_2.
Adjust zero position so that at blocked drive both manometer indicate the same pressure value.
Note:
Eccentric adjusting
- Do not turn over ±90°.

104



Attention!
Observe safety regulations!

Note:
Readjusting only at operating temperature.

Connect manometer to “G”.

Attention!
* Boost pressure setting!
Nominal pressure p_H- 18 bar
Peak pressure p_H- 40 bar
at max. speed.

Note:
Adjusting data according to order.

105

Attention!
Observe safety regulations.

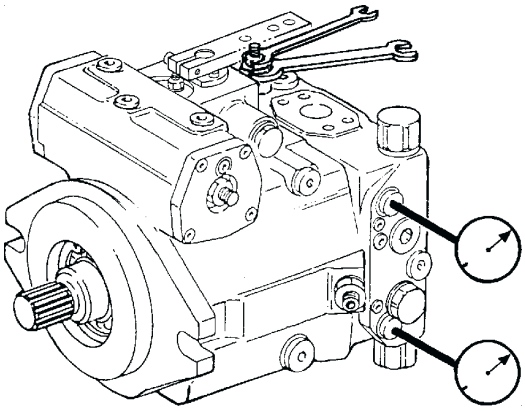
HP valve without bypass-function

1. HP valves are always adjusted 10% higher than the pressure cut-off.
   If one setting value is changed, always check both values.
2. Readjusting only at operating temperature.

Connect manometer M_A and M_B.
Pressure cut-off: Note measure X setting screw! Turn setting screw on block.
HP valves: Operate valves with small pump flow volume.
Check setting value. (“temperature“ only for a short time).
Change “setting value“ - check.

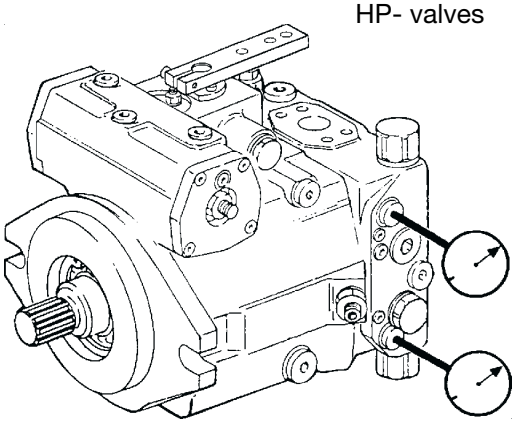
Pressure cut-off:
Turn back setting screw to measure (*).
Check pressure value and readjust.
Attention! Observe 10% pressure difference HP valves and pressure cut-off!

Pressure cut-off

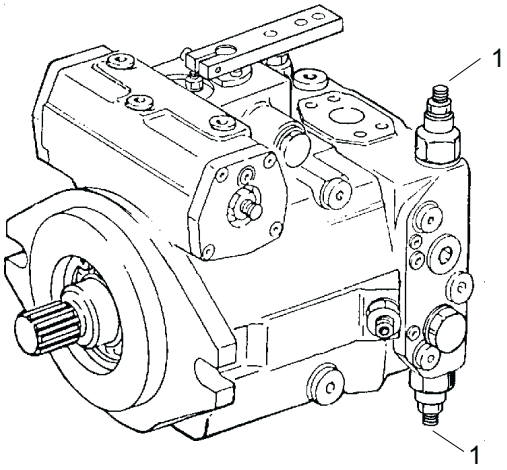


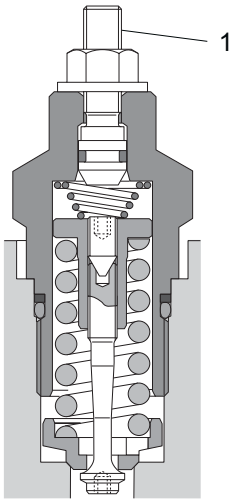
106

HP- valves



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Vehicle with hydrostatic transmission and gear shift without idling setting position (free wheeling).

Hydrostatic transmission / Bypass-switching

In this case the travel transmission is switched on to free wheeling. For this purpose the variable displacement pump has incorporated high pressure relief valves with bypass function.
The screw (item 1) is unscrewed to such an extent, that the valve cartridge is released and free oil circulation is possible.

⚠ Bypass: Screw in item1 up to planeness with nut. Screw up nut again.

Towing speed

The max. towing speed of 2 km/h should not be exceeded.
- Higher admissible towing speeds depend on the available hydr. motor speed and engaged gear shift.

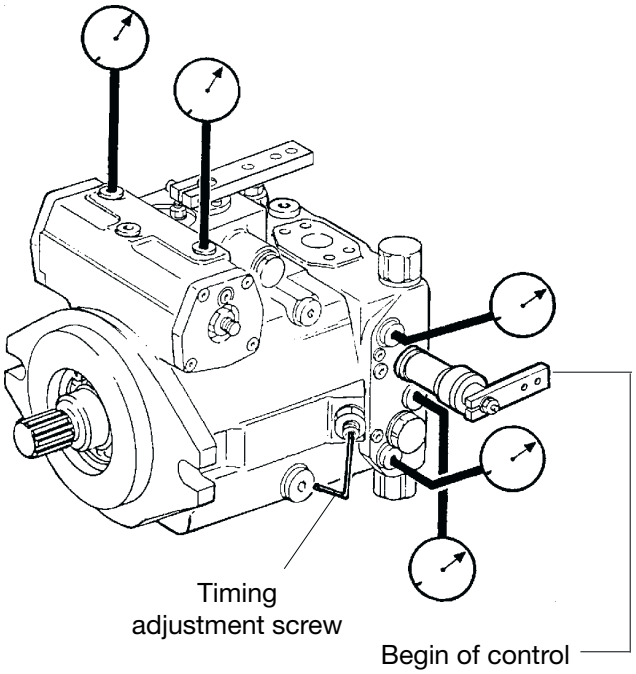
Towing distance

The towing distance should not exceed 1 km.
- If there is a lack of oil boosting, the hydraulic circuit will get empty.
  Take care of the heat development in the hydr. motor-rotary group.

Towing operation terminated

After termination of the towing operation turn item 1 back. The original pressure value setting of the high pressure relief valves will be avaiable again.

⚠ Valve function: Screw back item 1 up to stop. Screw up the nut.



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Attention!
Observe safety regulations!

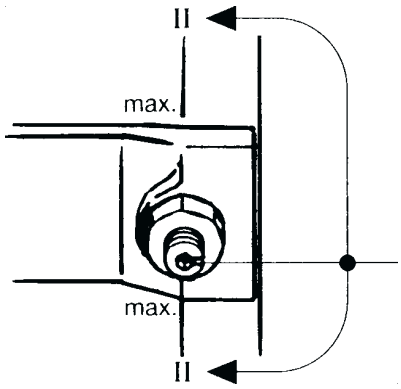
Check setting data.
Operating temperature should be kept largely constant during the check procedure.
Start prime mover, idle speed.

Block position
Drive direction switch - **"0"**.
Slowly increase motor speed up to the max. motor speed and thereby observe measuring instruments.

Boost pressure:
Idle speed of prime mover
Psp = approx. 15-20 bar
max. motor speed
Psp = ... bar*

Block position
Drive direction switch - **forward**
(Road gear and fully applied brake)

Check setting data pump A4VIDA
Begin of control:
HD 40-50 bar
Motor speed . . . . . rpm* Psp . . . . . bar*
HD . . . . . bar*
Readjusting - control start screw



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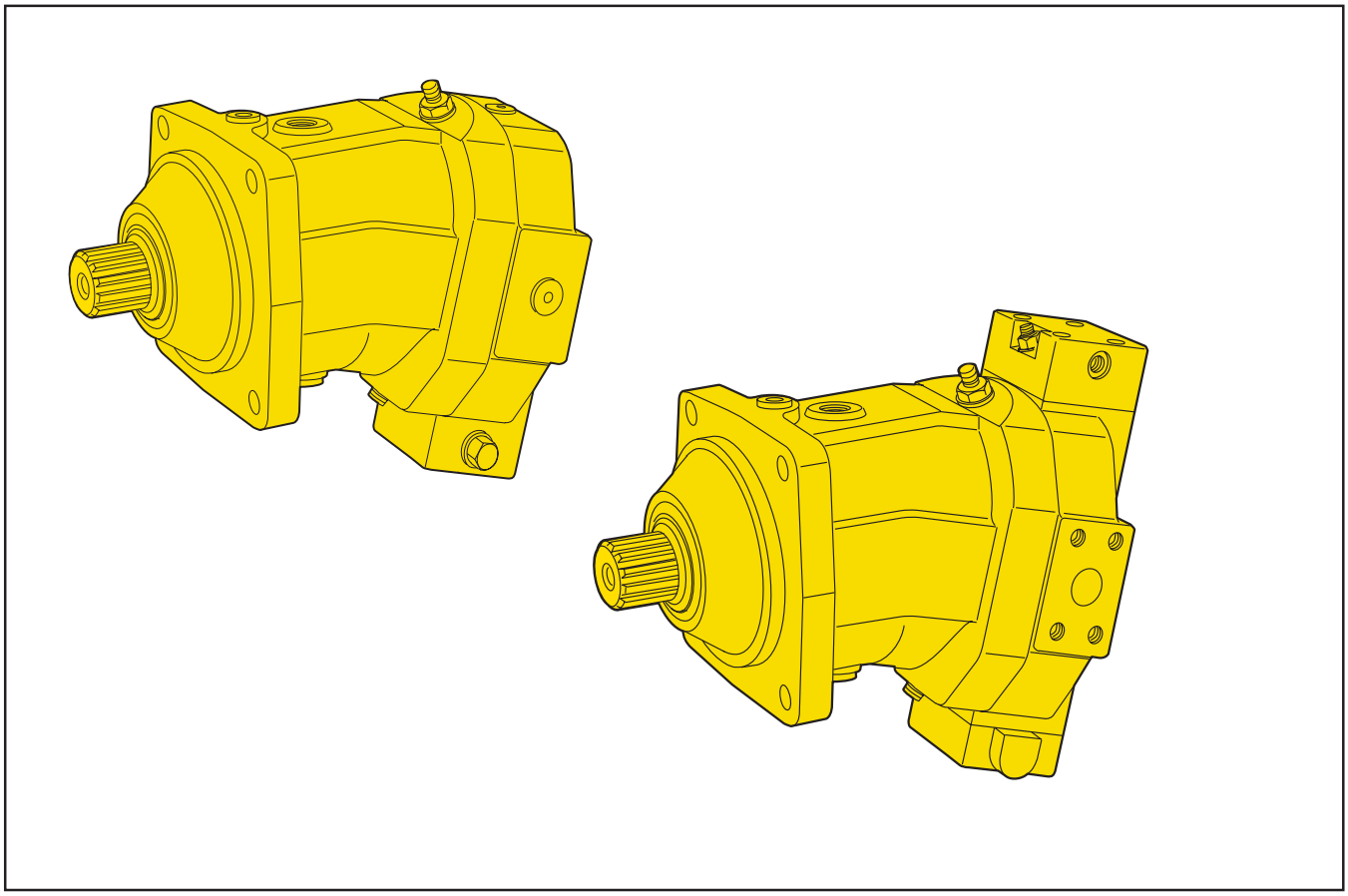
End of control
HD . . . . . bar
Motor speed . . . . . rpm* Psp . . . . . bar*
Readjusting timing adjustment screw

Note:
Eccentric adjusting - observe direction of rotation

* Setting data according to order!

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Section L
REPAIR INSTRUCTIONS
REXROTH MOTOR



Repair instructions
Mod. A6VM

REPAIR INSTRUCTIONS - REXROTH MOTOR

Type code A6V M _ _ / 6 3 W

Axial piston unit
Bent axis design, variable displacement — A6V

Mode of operation
Motor — M

Size
≙ Displacement $V_{g\,max}$ in cm³ — 28 55 80 107 140 160 200
Size 250 - 1000 see RE 91603

Control and regulating device					28	55	80	107	140	160	200	
Hydraulische Verstellung, steuerdruckabhängig	HD	1			●	●	●	●	●	●	●	HD1
	HD		2		●	●	●	●	●	●	●	HD2
	HD	1		D	●	●	●	●	●	●	●	HD1D
	HD		2	D	●	●	●	●	●	●	●	HD2D
Hydraulic two-position control	HZ1				●	-	-	-	●	●	●	HZ1
	HZ3				-	●	●	●	-	-	-	HZ2
Electrical control, with proportional solenoid	EP	1			●	●	●	●	●	●	●	EP1
	EP		2		●	●	●	●	●	●	●	EP2
	EP	1		D	●	●	●	●	●	●	●	EP1D
	EP		2	D	●	●	●	●	●	●	●	EP2D
Electr. two-position control, w. switching solenoid	EZ	1			●	-	-	-	●	●	●	EZ1
	EZ		2		●	-	-	-	●	●	●	EZ2
	EZ	3			-	●	●	●	-	-	-	EP3
	EZ		4		-	●	●	●	-	-	-	EP4
Automatic control, high pressure related	HA	1			●	❍	❍	❍	●	●	●	HA1
	HA		2		●	●	●	●	●	●	●	HA2
	HA	3			-	●	●	●	-	-	-	HA3
Hydraulic control, speed related												
p_{ST}/p_{HD}=5/100, hydraulic valve for travel direction					●	●	●	●	●	●	●	DA1
el. valve for travel direction (12 V) + el. Q_{max} switch (12 V)					●	●	●	●	●	●	●	DA2
el. valve for travel direction (24 V) + el. Q_{max} switch (24 V)					●	●	●	●	●	●	●	DA3
p_{ST}/p_{HD}=8/100, hydraulic valve for travel direction					●	●	●	●	●	●	●	DA4
el. valve for travel direction (12 V) + el. Q_{max} switch (12 V)					●	●	●	●	●	●	●	DA5
el. valve for travel direction (24 V) + el. Q_{max} switch (24 V)					●	●	●	●	●	●	●	DA6

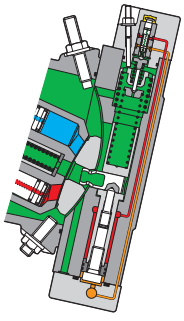
Pilot pressure increase Δ p = 10 bar
Pilot pressure increase Δ p = 25 bar
with constant pressure control

Control voltage 12 V
Control voltage 24 V
with constant pressure control

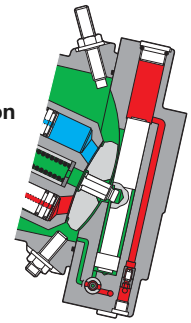
Model without pressure increase
Model with pressure increase Δ p = 100 bar

Override	HA1	HA2	HA3	
without override (no code)	●	●	●	
hydraulic override	●	●	●	T
electrical override, 12 V	●	●	●	U1
electrical override, 24 V	●	●	●	U2
el. override + el. valve for travel direction, 12 V	❍	❍	-	R1
el. override + el. valve for travel direction, 24 V	❍	❍	-	R2

Synchronizing piston



Differential piston

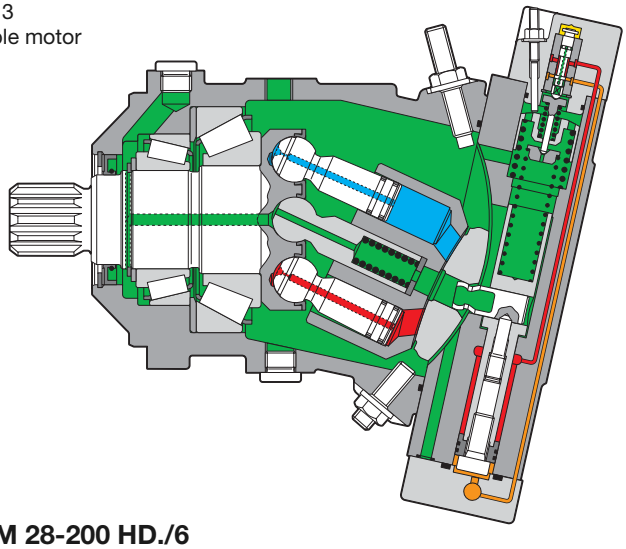


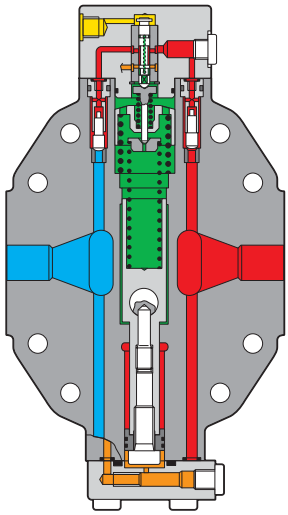
NOTICE

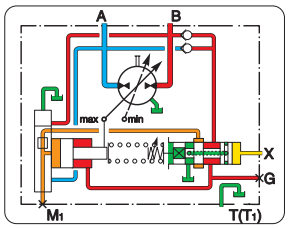
Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing.
BRUENINGHAUS HYDROMATIK reserves the right to discontinue models or options at any time or to change specifications, materials, or design without notice and without incurring obligation.
Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options.
For the available combinations refer to the relevant data sheet for the basic unit and the desired option.
Adjustment and tests have to be carried out on the test bench under operating temperatures.
Protection of personnel and property has to be guaranteed by appropriate measures.
Expert knowledge, the precondition of any service work, can be obtained in our training courses.

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Index 3
Variable motor

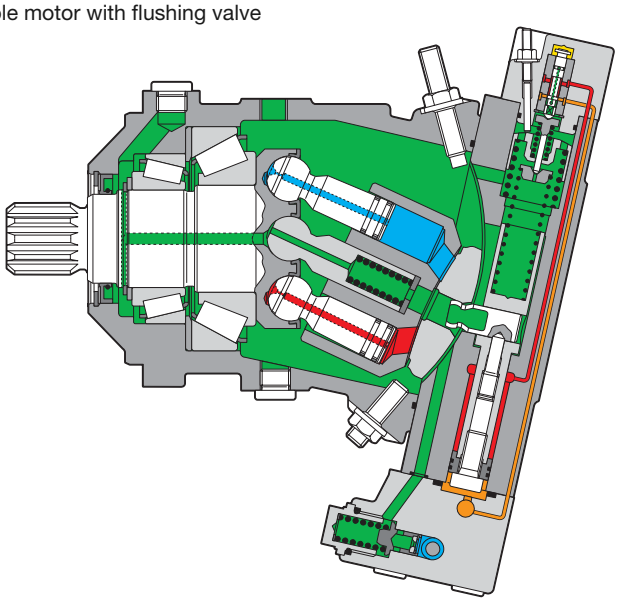


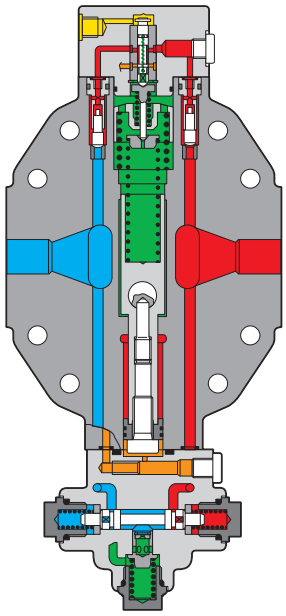


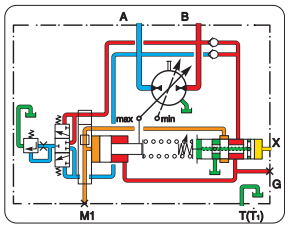


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Variable motor with flushing valve

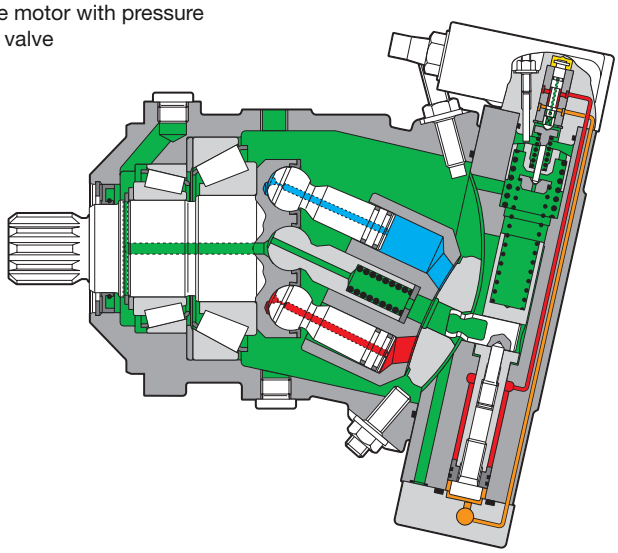


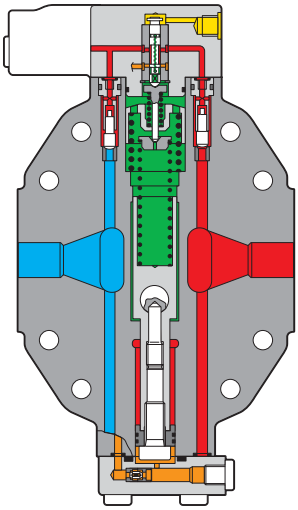


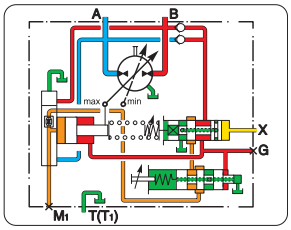


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Variable motor with pressure control valve

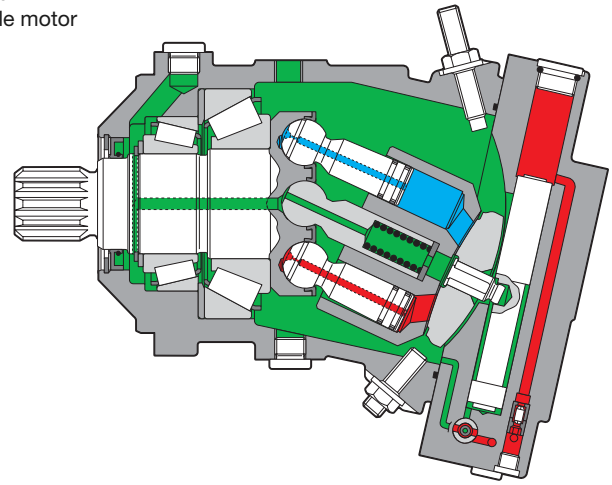


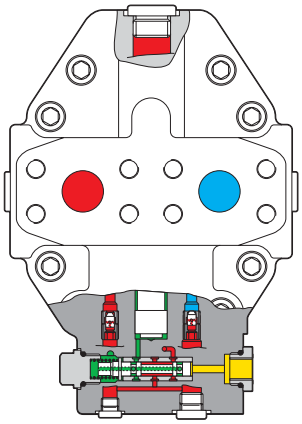


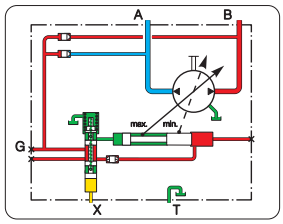


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Variable motor

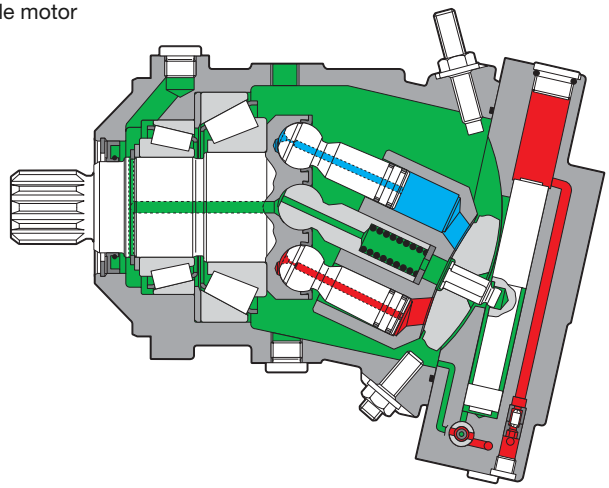


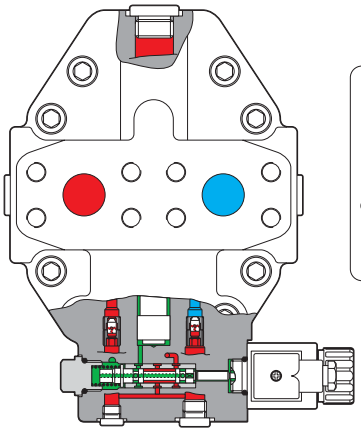


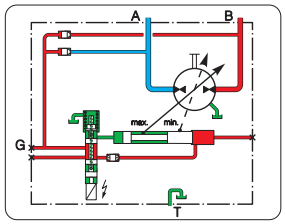


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Variable motor

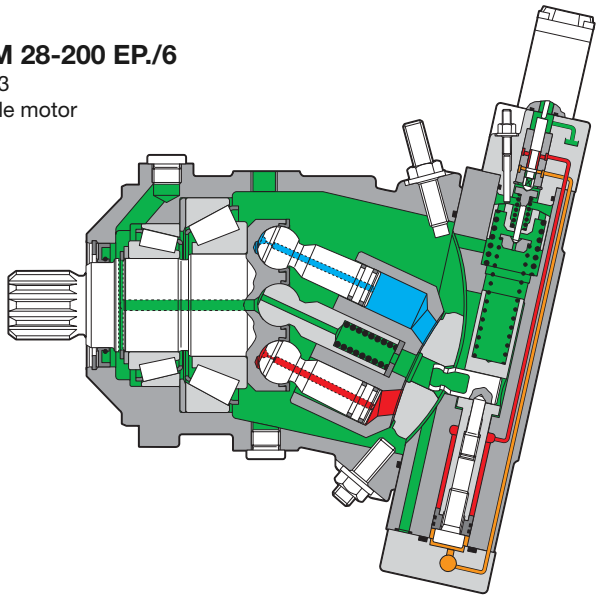


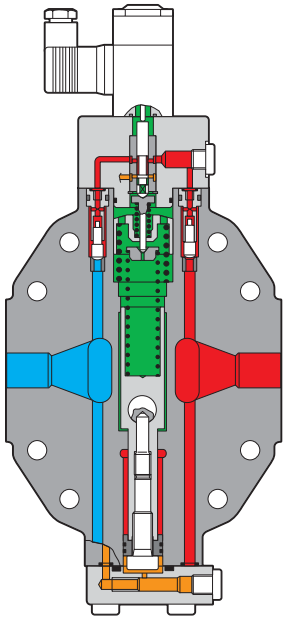


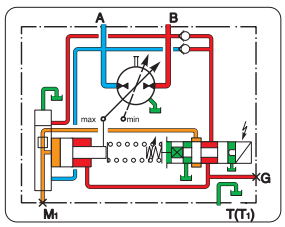


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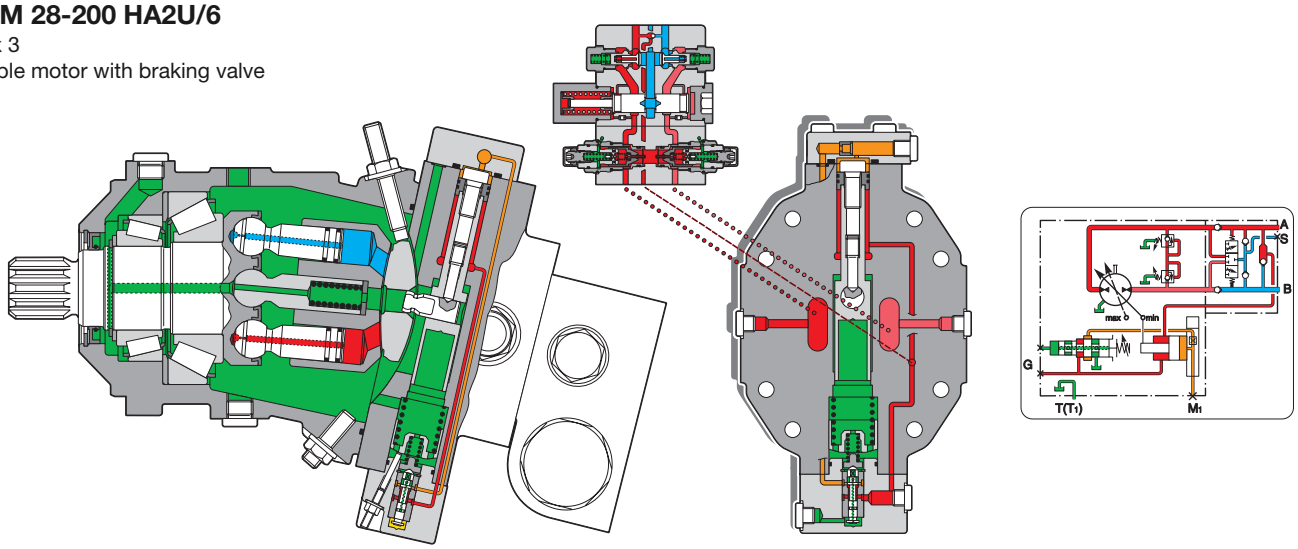






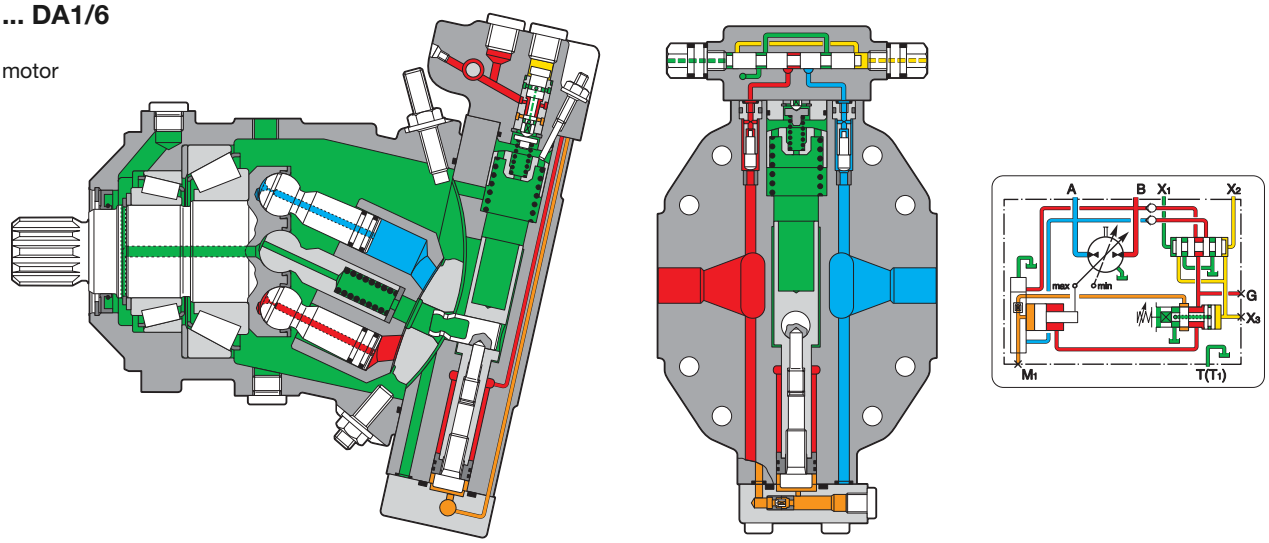
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Variable motor with braking valve



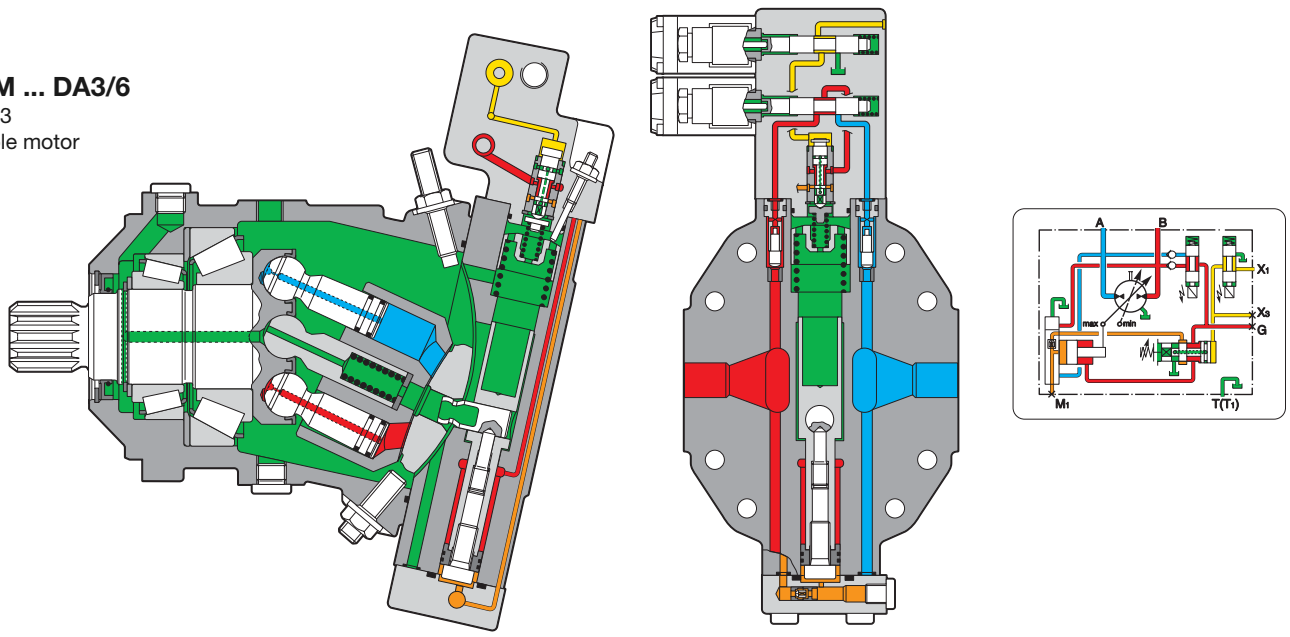
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Index 3
Variable motor



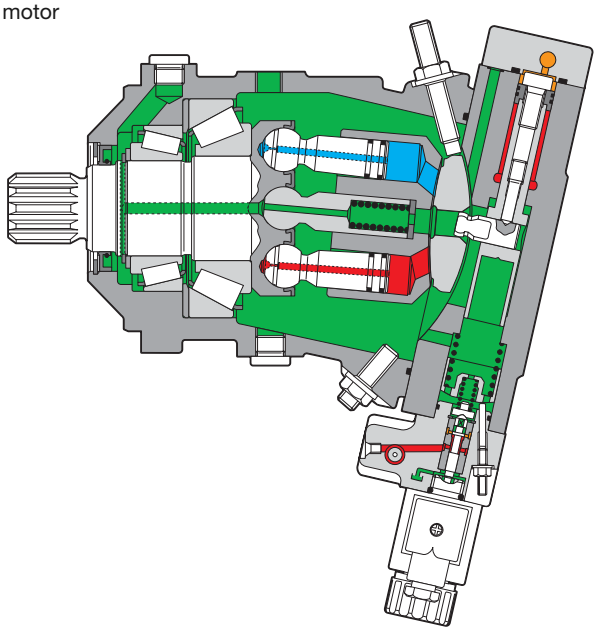
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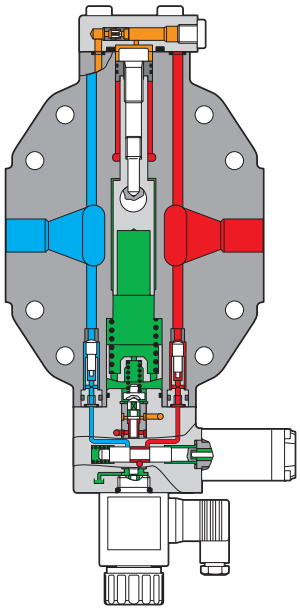
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Variable motor

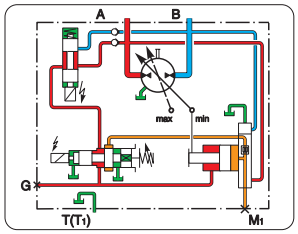


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Variable motor

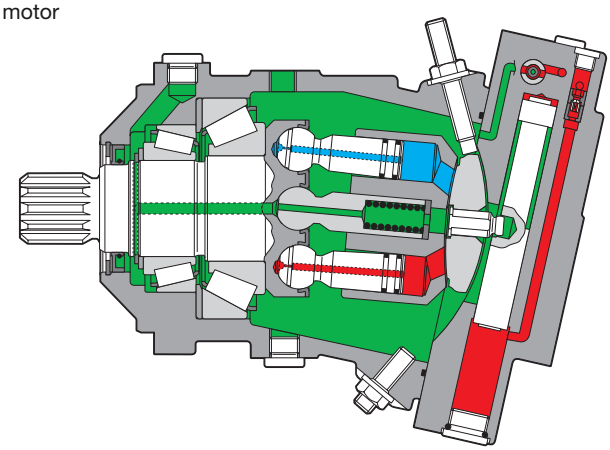


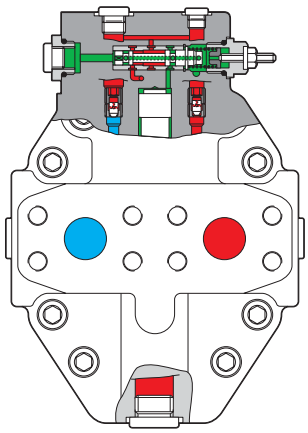


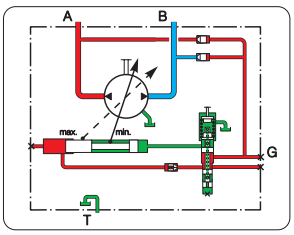


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Variable motor

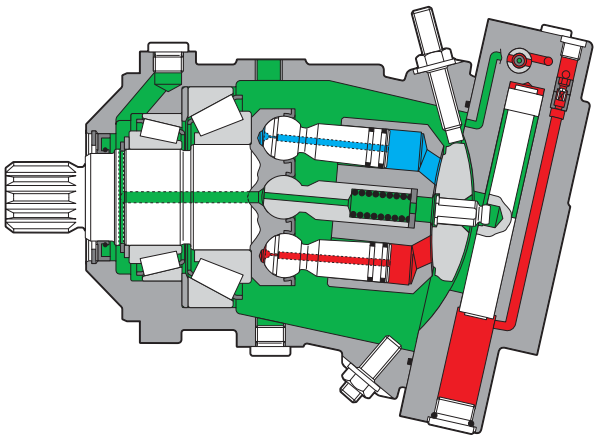


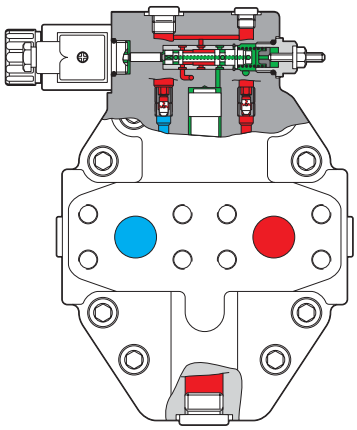


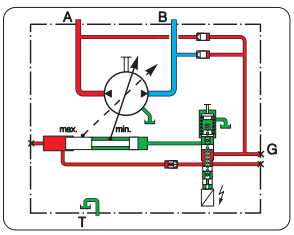


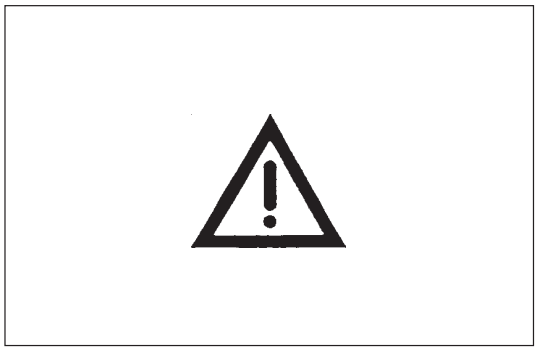
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Variable motor

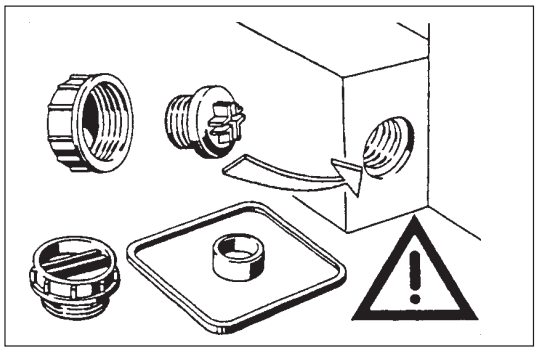




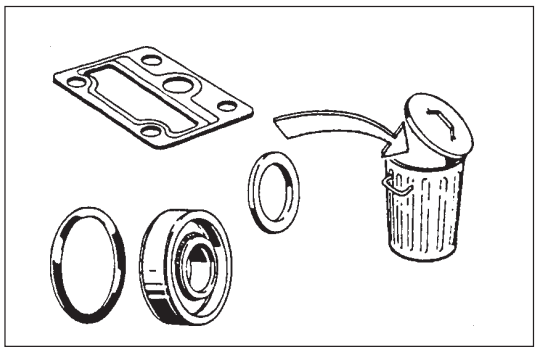




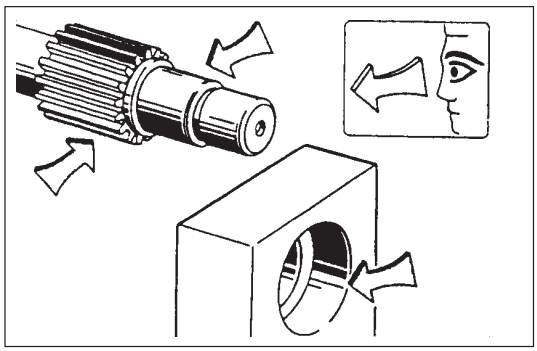
Attention!
Observe the following notices when carrying out repair work at hydraulic aggregates!



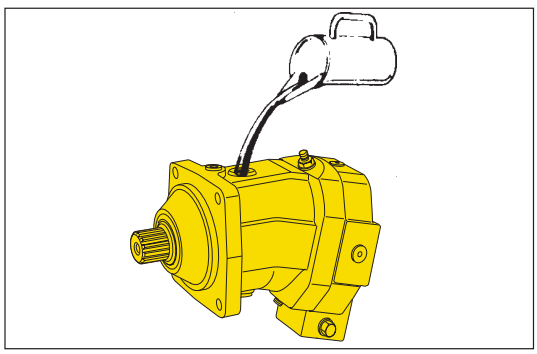
Close all ports of the hydraulic aggregates.



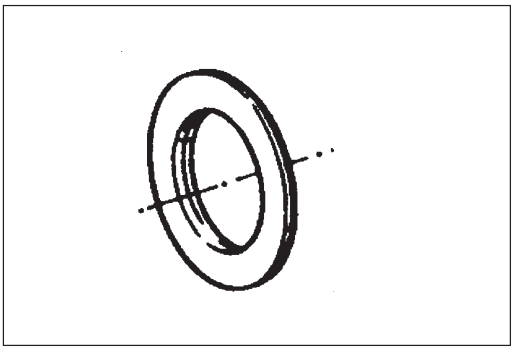
Replace all seals.
Use only original HYDROMATIK spare parts.



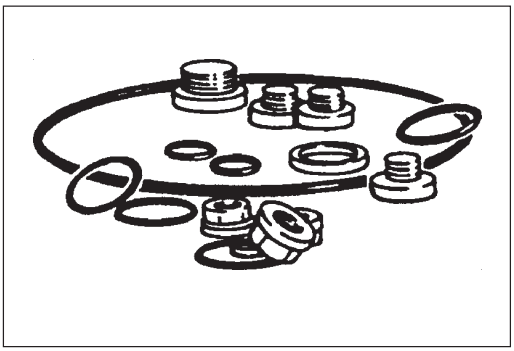
Check all seal and sliding surfaces for wear.
Attention: Rework of sealing area f. ex. with abrasive paper can damage surface.



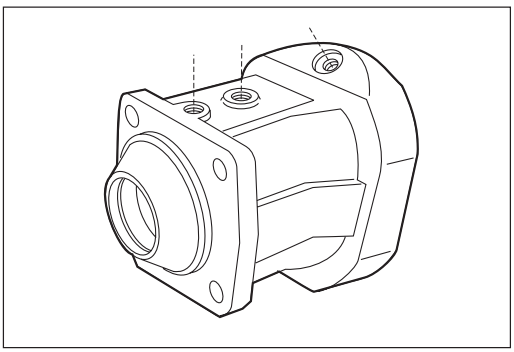
Fill up hydraulic aggregates with medium before start-up.



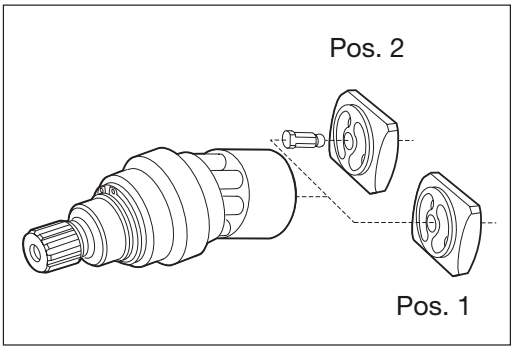
1 Seal kit for drive shaft.



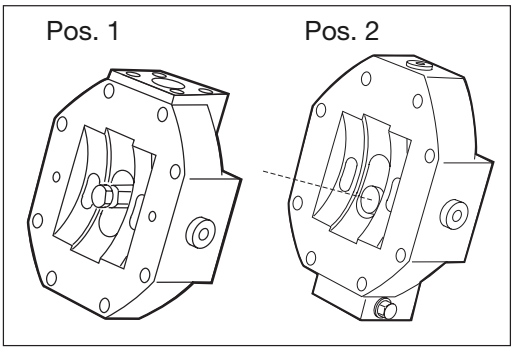
2 External seal kit.



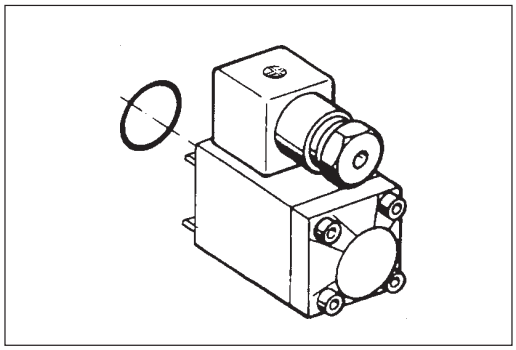
3 Housing.



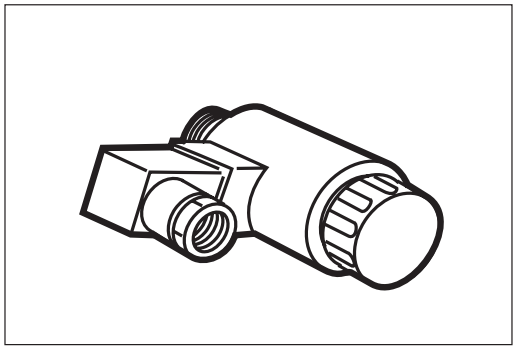
4 Complete rotary group
Note:
Pos. 1 - For port plate with differential piston
Pos. 2 - For port plate with synchronizing piston



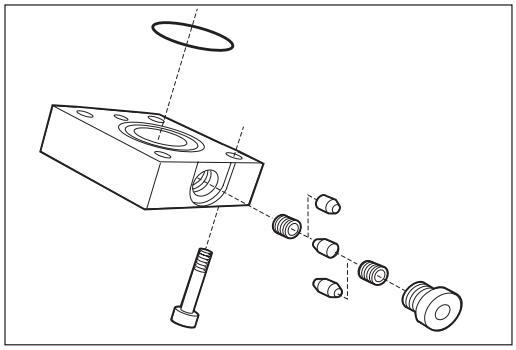
5 Port plate with control piston
Note:
Pos. 1 - For port plate with differential piston
Pos. 2 - For port plate with synchronizing piston



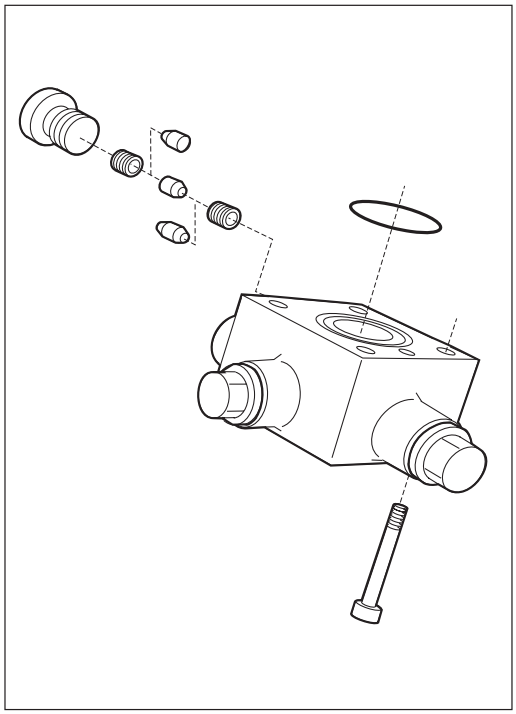
6 Proportional solenoid (EP).



7 Solenoid.



8 Cover with * throttle pin.
* Throttle pin “as to order requirement”.

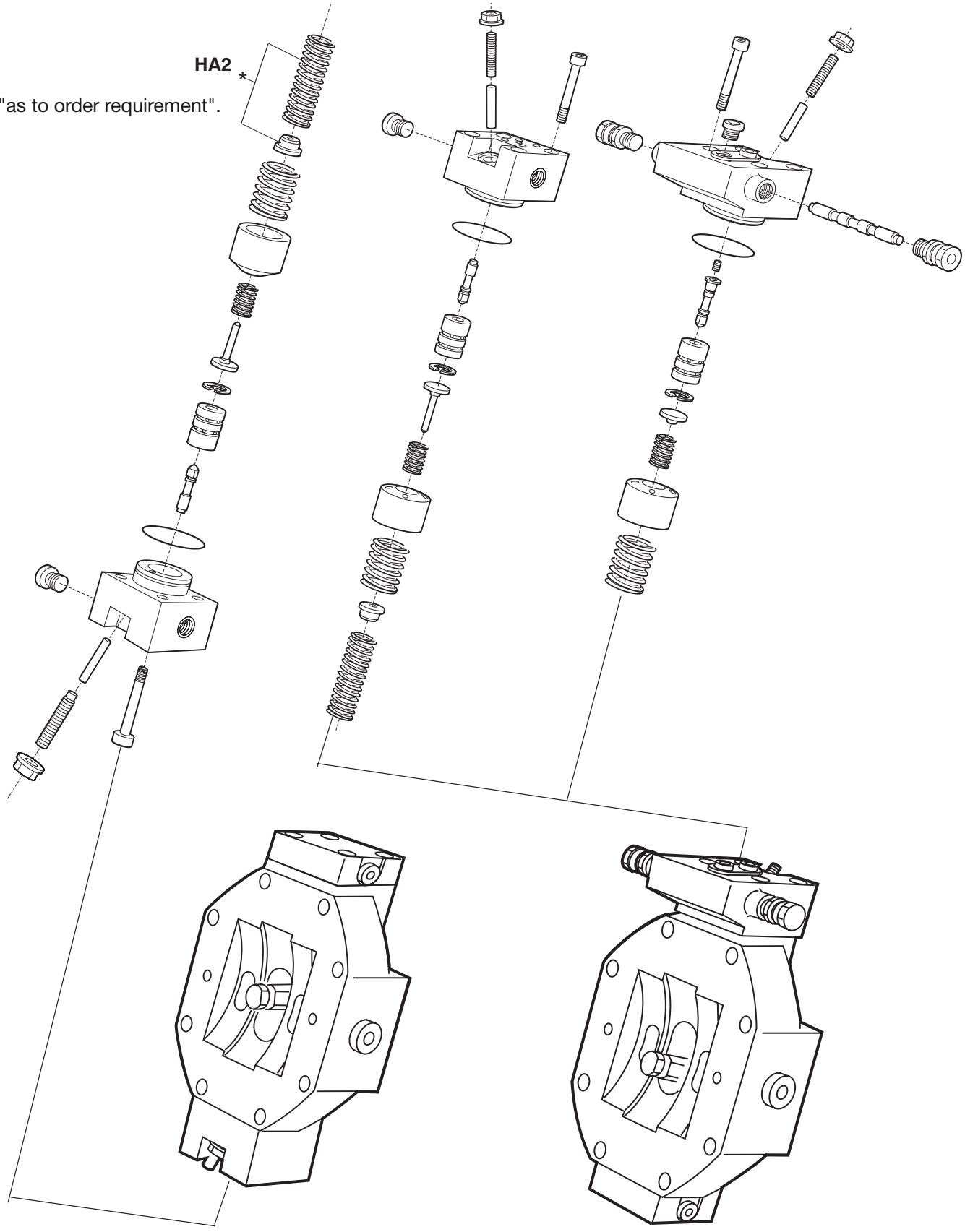


9 Cover with flushing and boost pressure valve and
* throttle pin.
* Throttle pin “as to order requirement”.

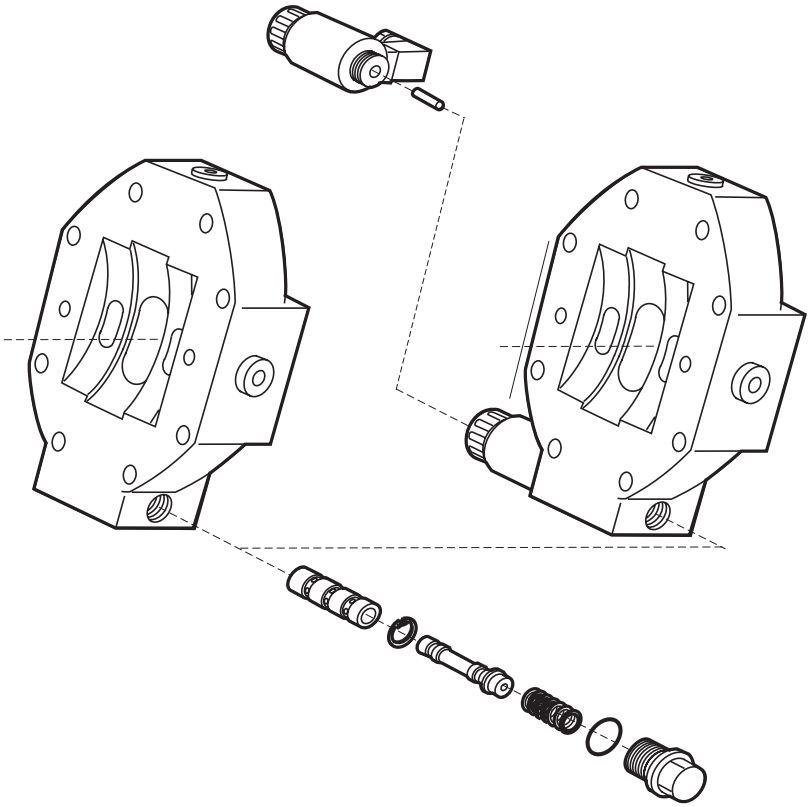
z. B. **HA** **HD** **DA**

HA2 *

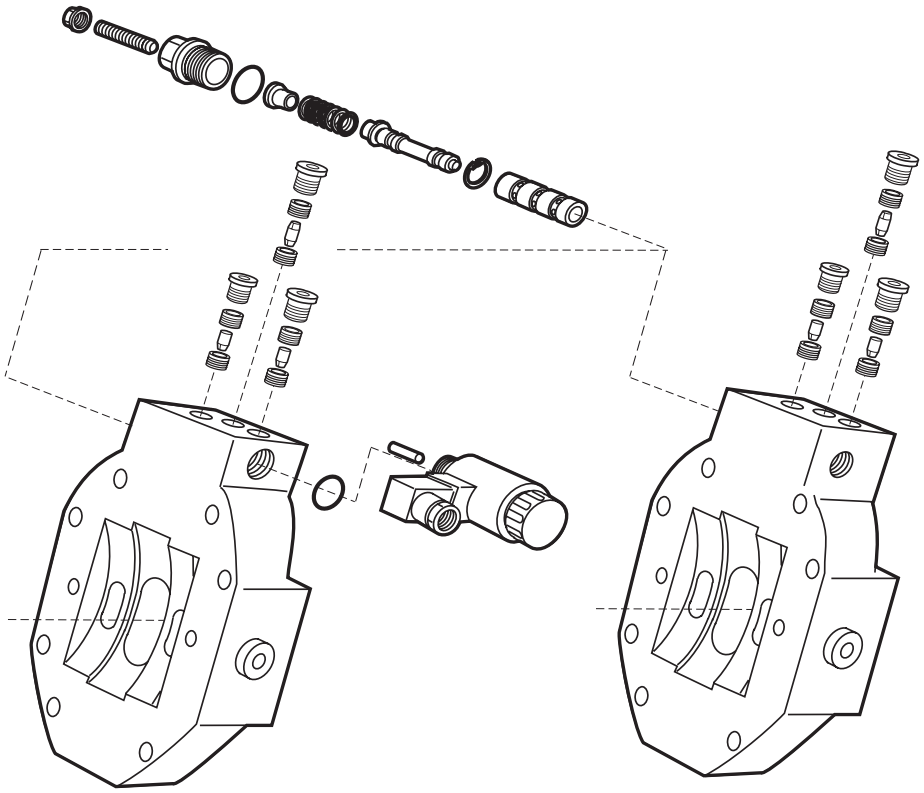
"as to order requirement".

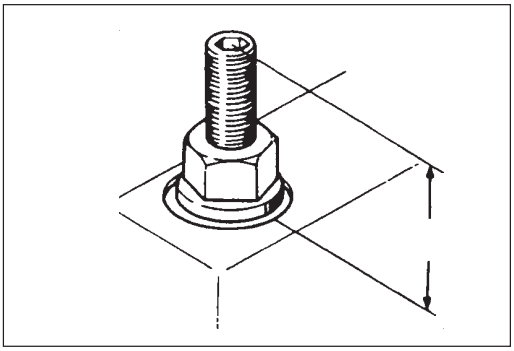


z. B. **HZ3 / EZ3**

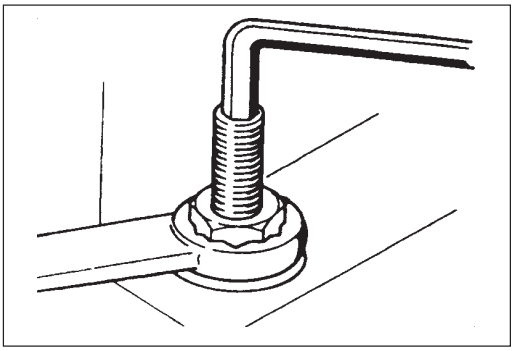


HA3 / HA3U

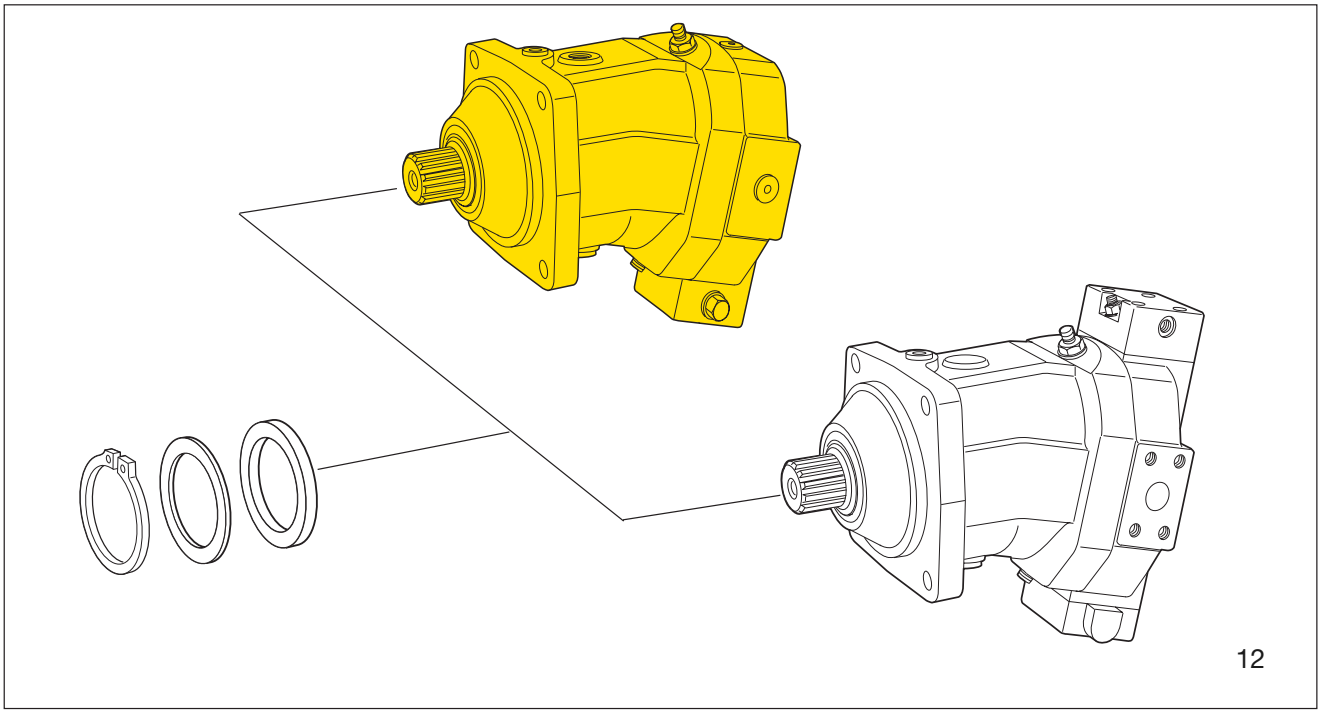




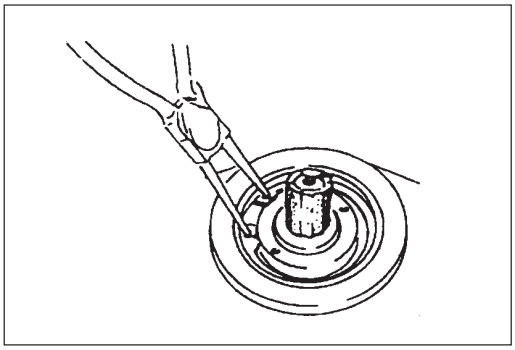
10 Replace seal nut.
First measure and record setting height.



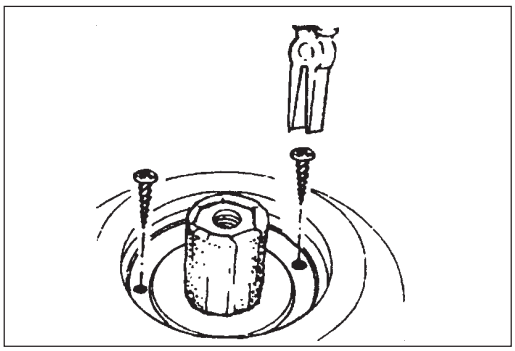
11 When tightening, counterhold setting screw, then check setting height.



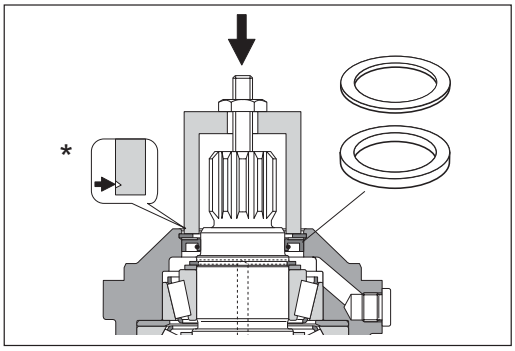
12



13 Protecting the drive shaft.
Remove retaining ring and shim.

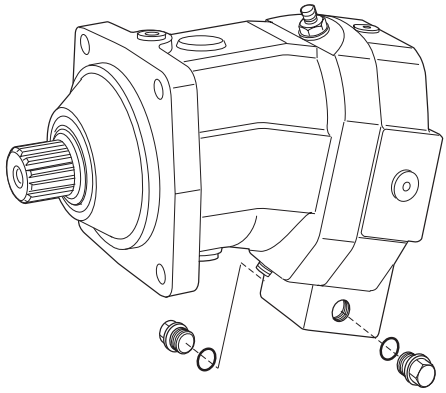


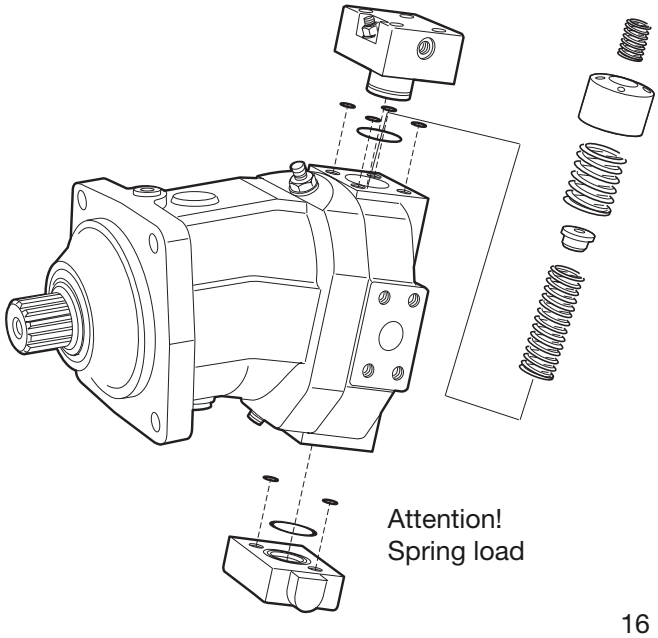
14 Screw in sheet metal screw into the holes fitted with rubber.
Pull out seal with pliers.



15 Press in shaft seal ring and shim with bush to stop.

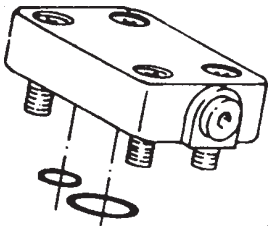
⚠ Take note of press-in depth!
Install mark for press-in depth of safety ring.





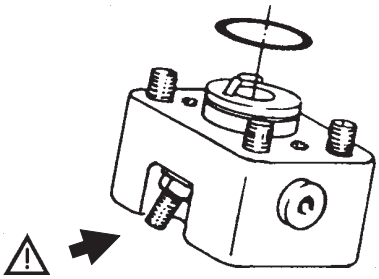
Attention!
Spring load

16



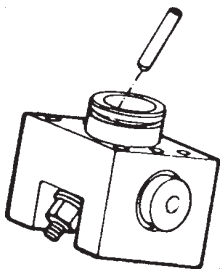
17

Inspect
Drilling in housing, O-ring, groove.



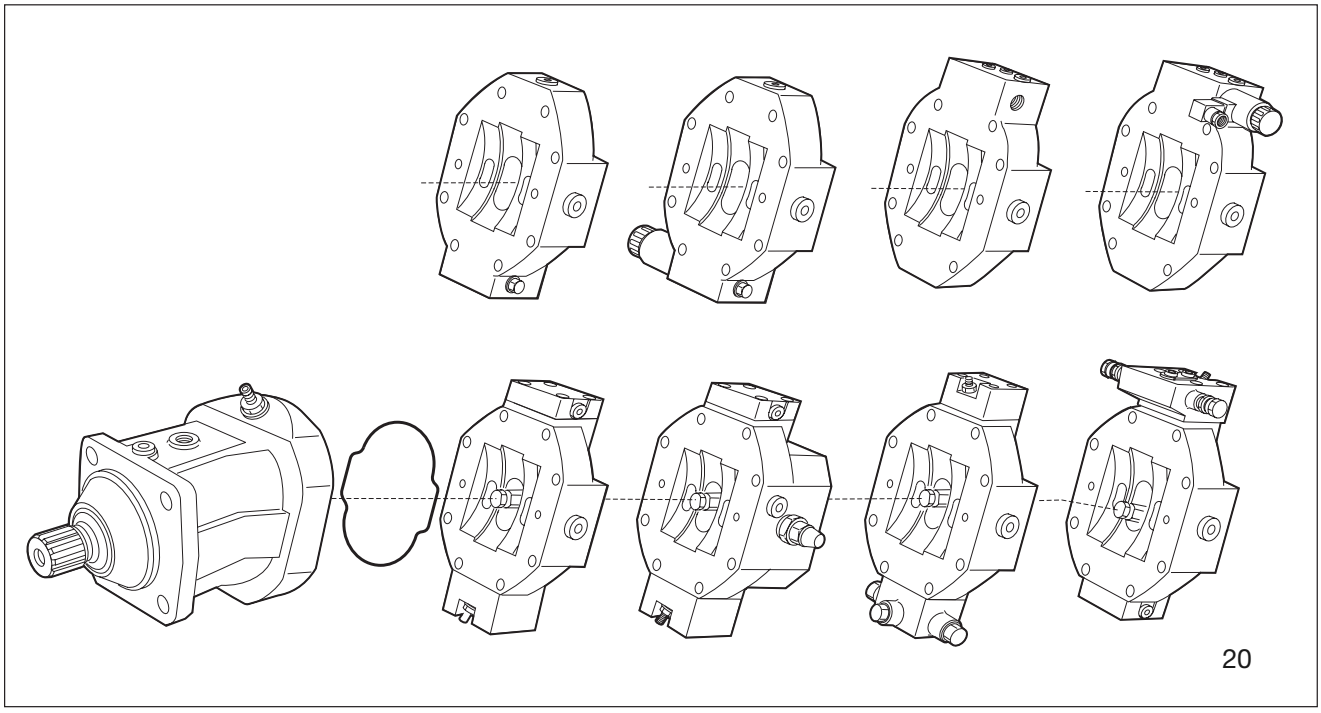
18

⚠ Do not remove adjustment screw.
Inspect
O-ring, O-ring groove, housing.

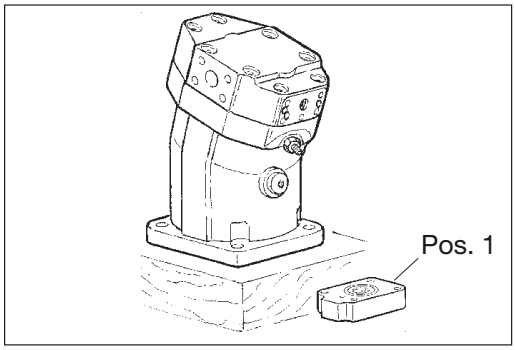


19

Assembly aid
Insert pin with grease.

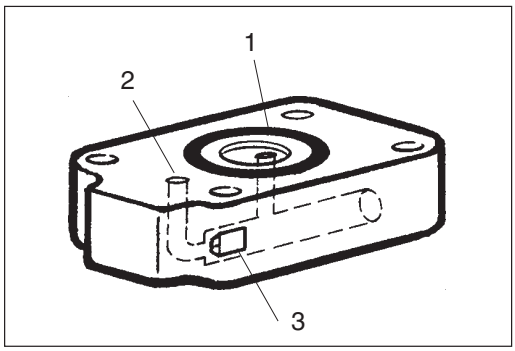


20



21

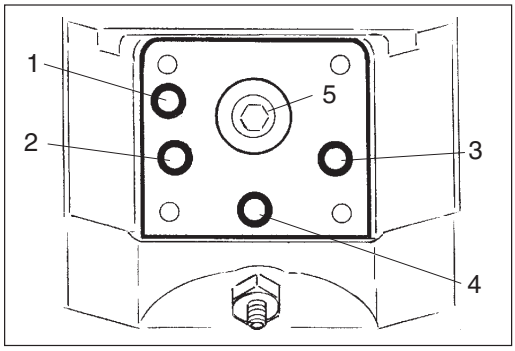
Example: A6VM ... HD control
Disassembly position:
Remove cover pos. 1



22

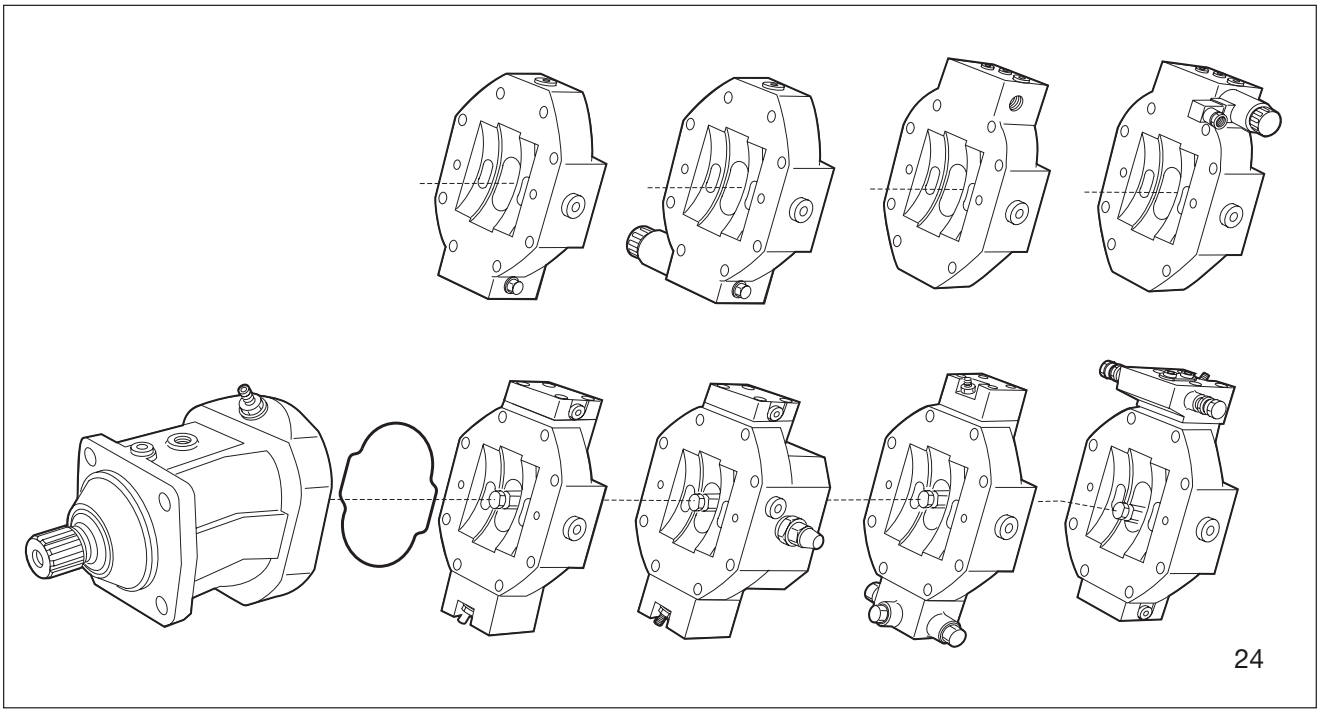
1. O-ring
2. Input flow of oil control
3. Throttle pin

⚠ Installation position differs according to the control components

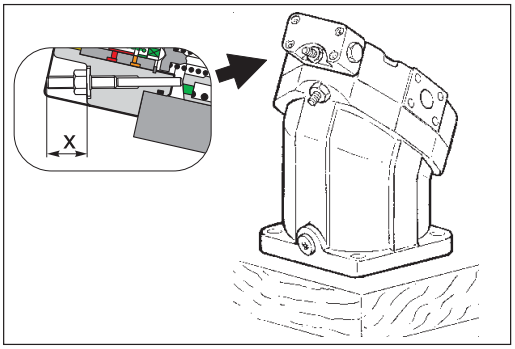


23

1. Input flow of oil control
2. High pressure/ low pressure
3. High pressure/ low pressure
4. Leckage oil
5. Control piston



24

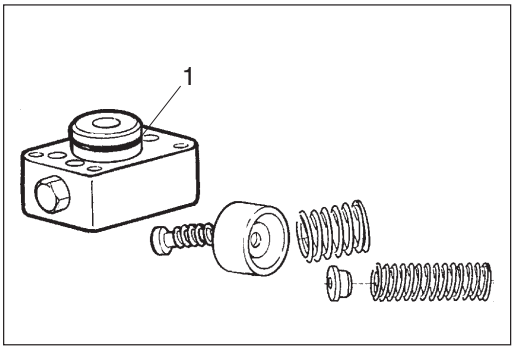


25

Example: A6VM... control - **differential piston**
Disassembly position: Remove cover pos. 2.

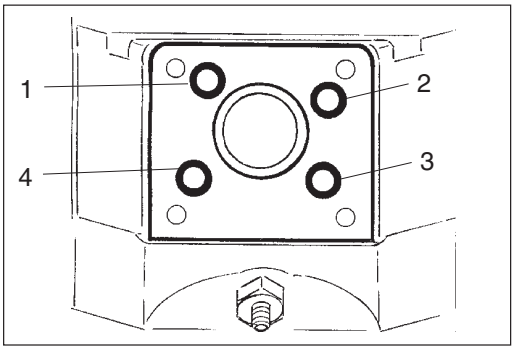
⚠ Attention! Spring load.

Dimension x: Note dimension (begin of regulation).



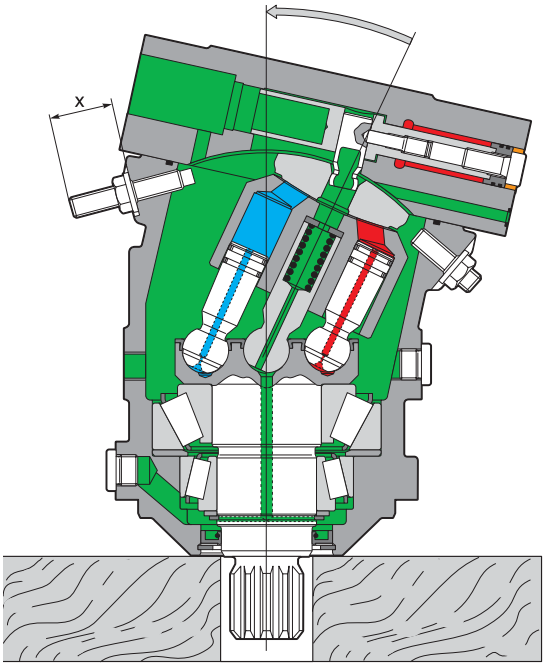
26

1. Check of O-ring



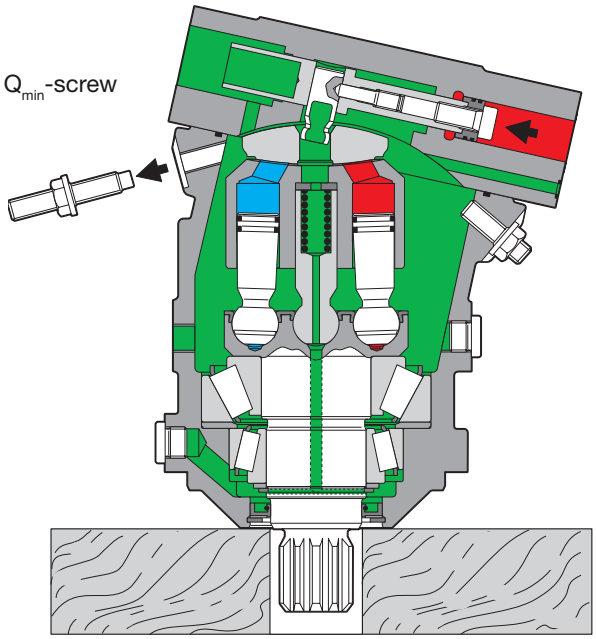
27

1. High pressure - small control piston side
2. Control pressure
3. High pressure - check valve
4. High pressure - check valve

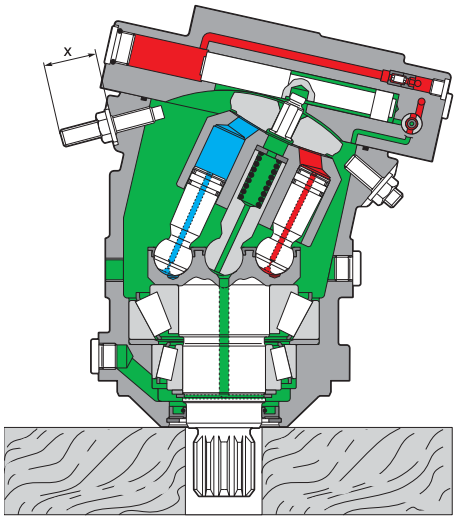


Diferential piston:
Note dimension x

⚠
For disassembly of the port plate, swivel always rotary group to zero position.
Piston rings to hang out of the cylinder boring.

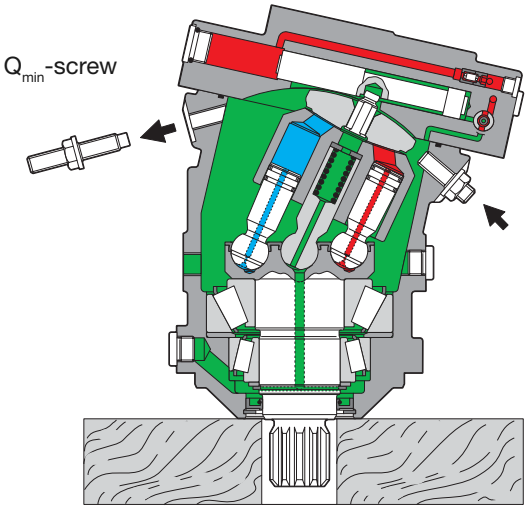


Remove Q_{min}-screw.
Swivel rotary group to 0°.

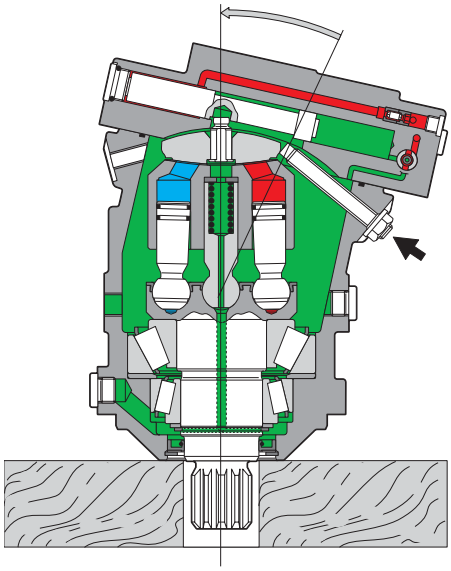


Synchronizing piston:
Note dimension x.

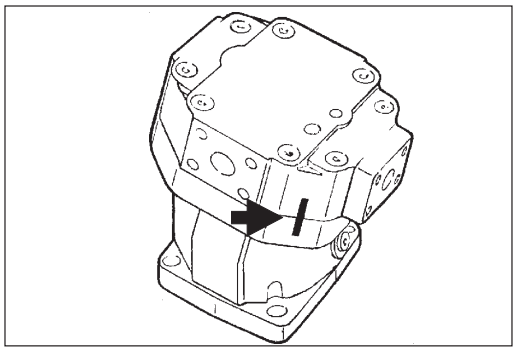
⚠
For disassembly of the port plate, swivel always rotary group to zero position.
Piston rings to hang out of the cylinder boring.



Remove Q_{min}-screw and plug.

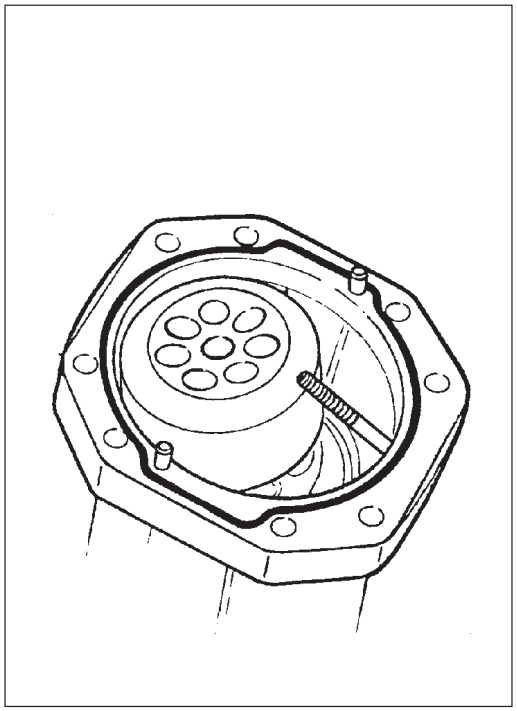


Swivel rotary group to zero position with screw Q_{min}.



28

Port plate
Mark position. Loosen screws.
Removal

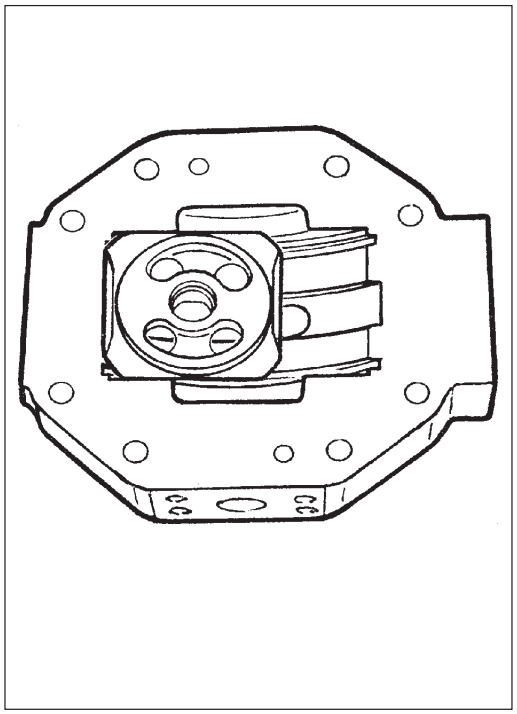


29

Check O-ring.

⚠ Stick new O-ring with some grease.

Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.



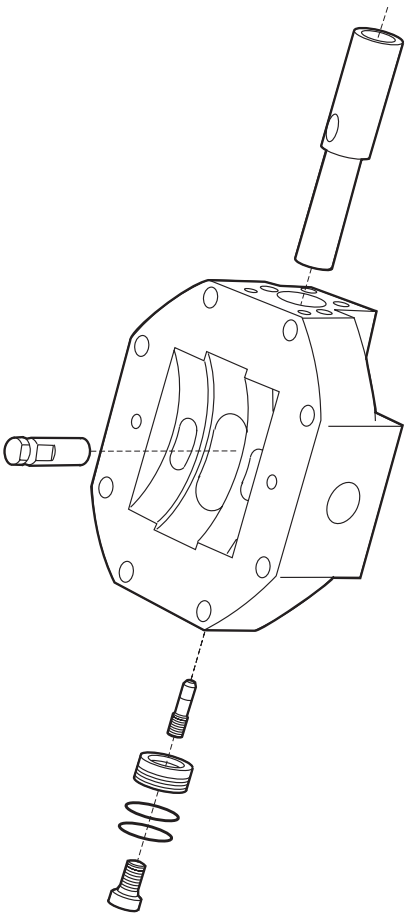
30

⚠ Stick control lens in sliding surface with grease.

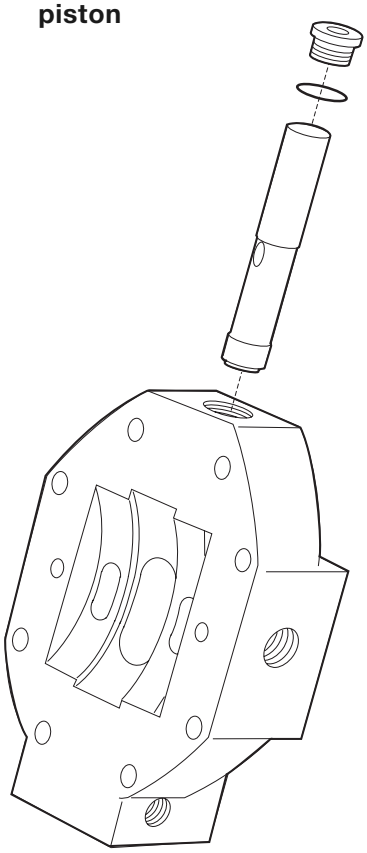
Assembly in reversal order.
Mount port plate.

⚠ Rotary group vertical.

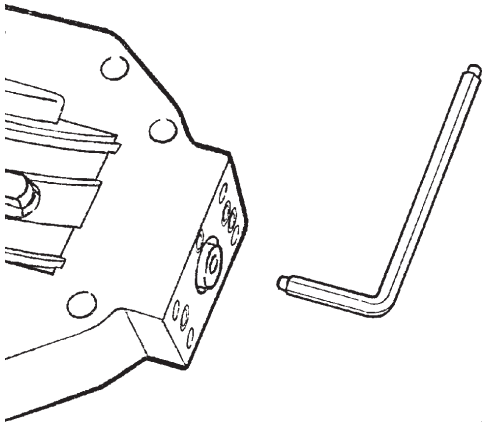
Differential piston



Synchronizing piston

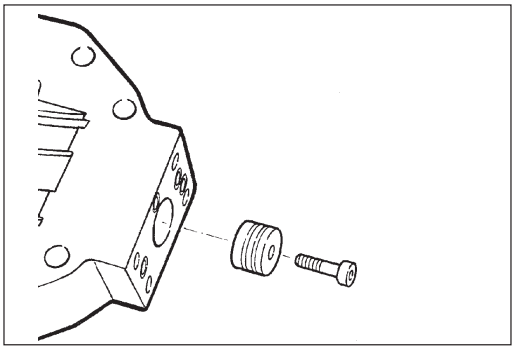


31



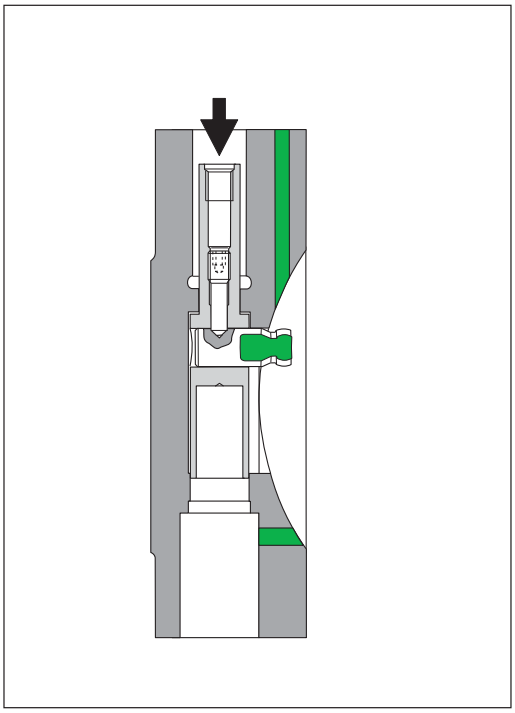
32

Loosen fixing screw.
Use only socket wrench.



33

Remove piston with piston ring.



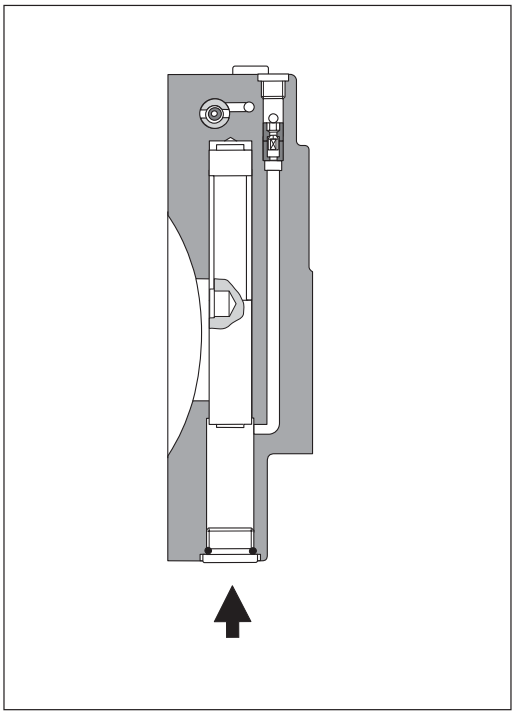
34

Differential piston

Warm up fixation screw for positioning plug via boring (screw glued - to turn out).

⚠ Use new screw.

Precote coating.
Note tightening torque!

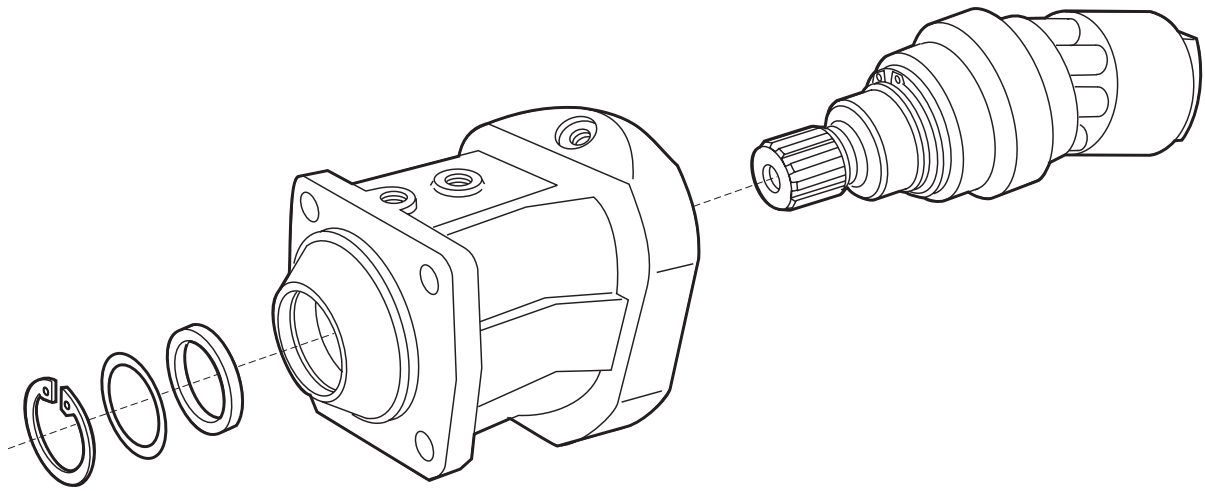


35

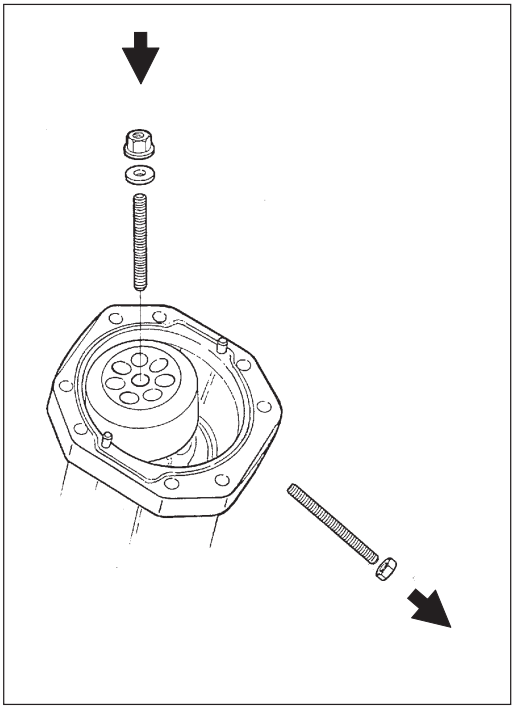
Synchronizing piston

Remove screw.
Remove piston.

⚠ Note installation position.



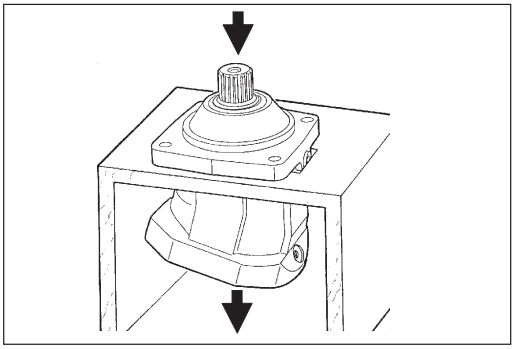
36



37

Screw in threaded pin into center pin.
Fix the cylinder with disc and locknut.
Remove Q_{max}-stop screw.

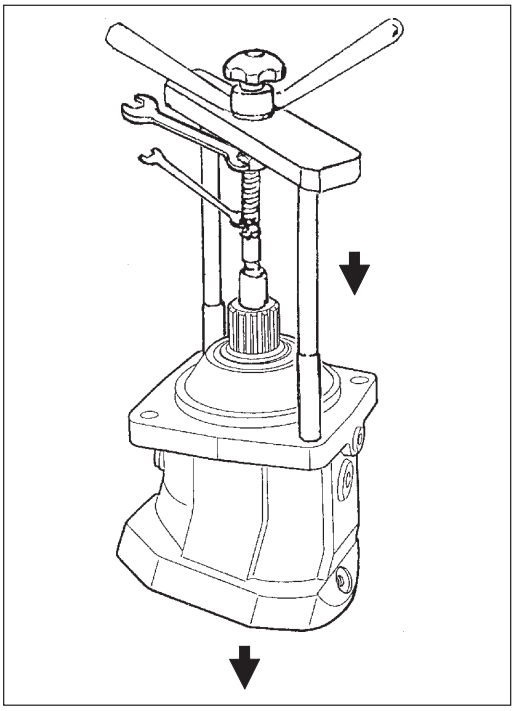
Size	
	28: M4 x 58 mm
	55: M5 x 71 mm
	80: M6 x 82 mm
	107: M6 x 92 mm
	140: M8 x 105 mm
	160: M8 x 105 mm
	200: M8 x 109 mm



38

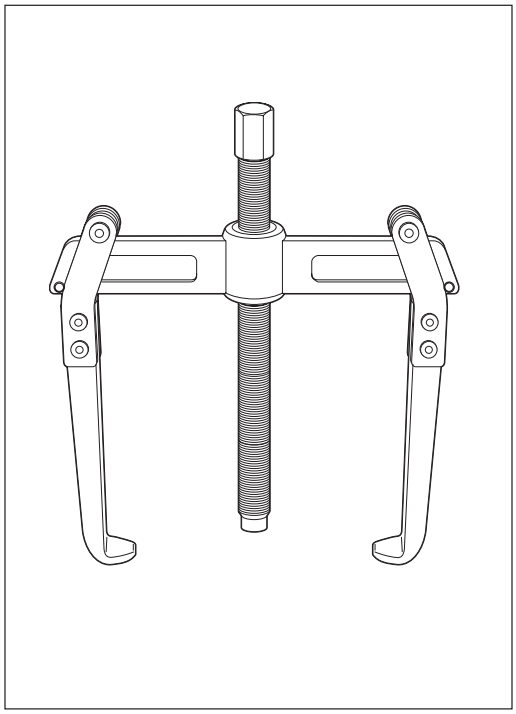
Press out rotary group!

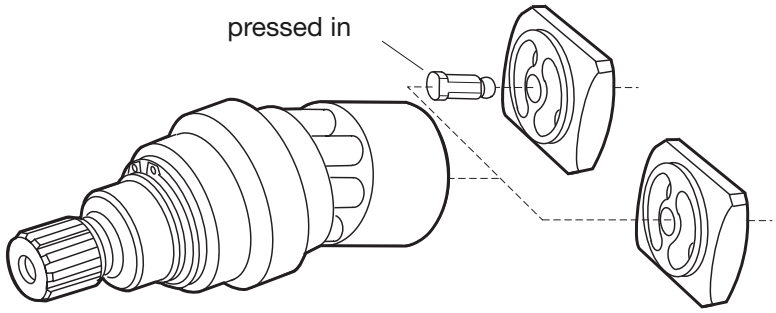
⚠ If the bearings are used again do not hit on the drive shaft.



39

Or press-out with extraction device.

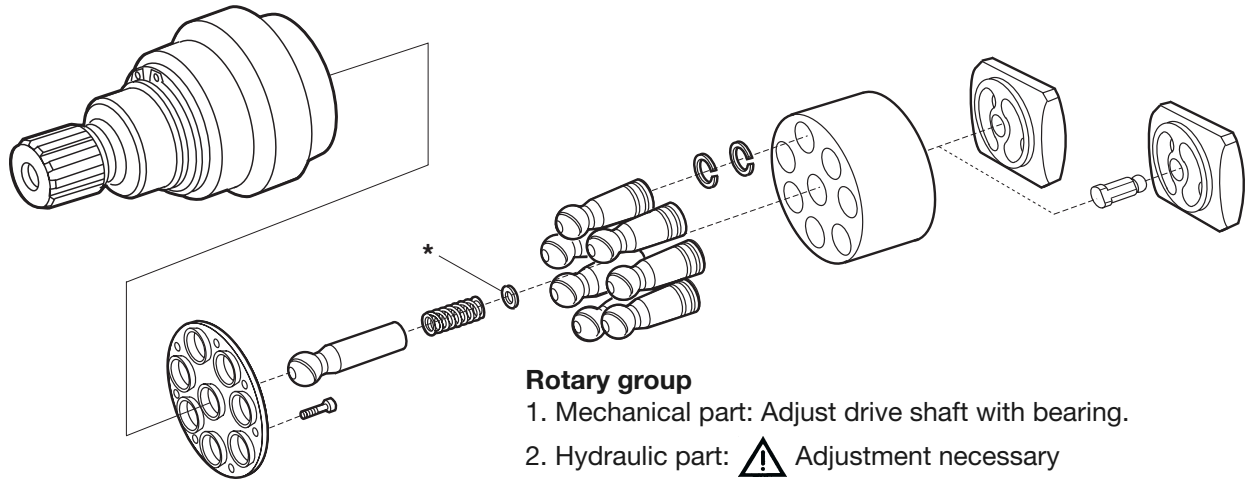




Complete rotary group

⚠ Setting of hydraulic part necessary.

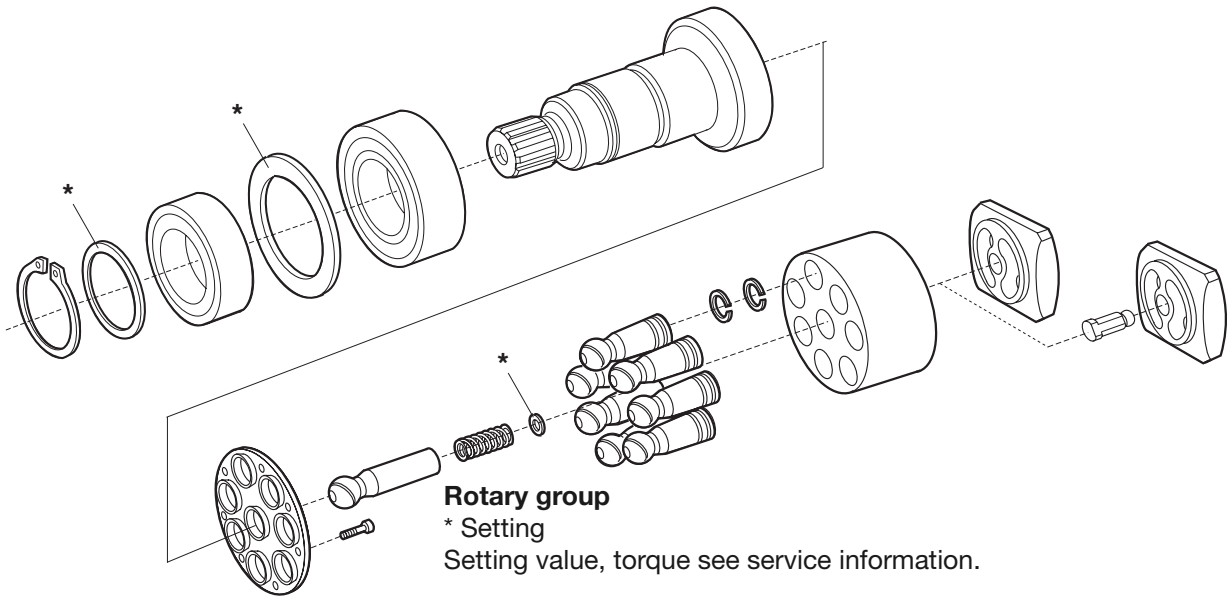
40



Rotary group

1. Mechanical part: Adjust drive shaft with bearing.
2. Hydraulic part: ⚠ Adjustment necessary

41

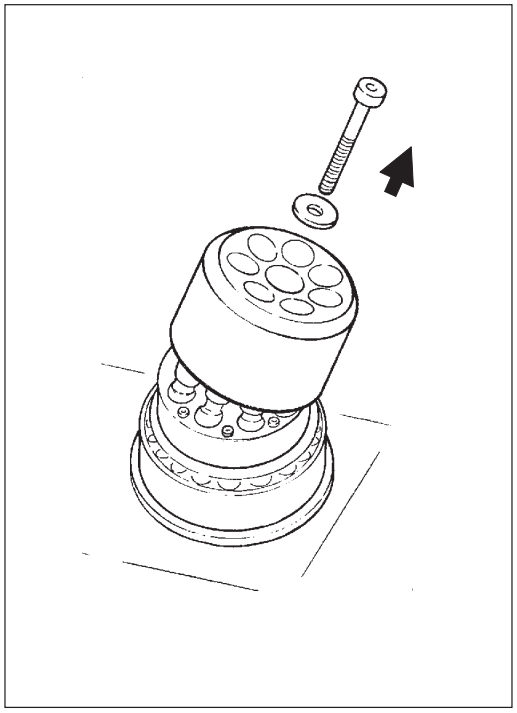


Rotary group

* Setting

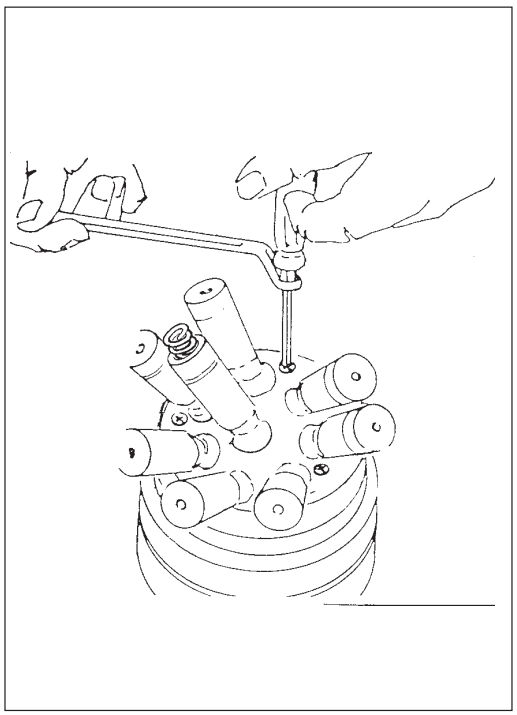
Setting value, torque see service information.

42



43

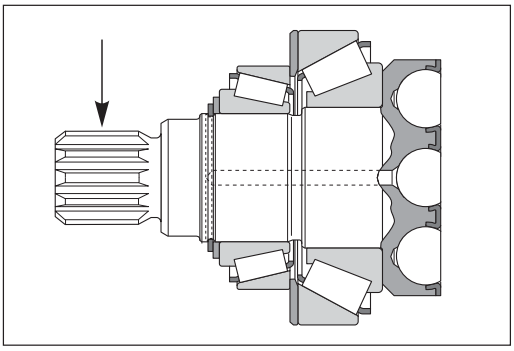
Remove fixing screw (cylinder).
Remove cylinder.



44

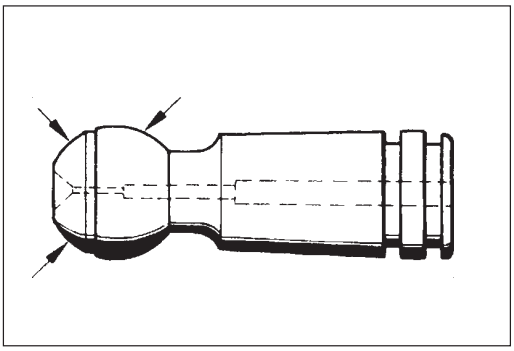
Disassemble retaining plate.

⚠ Screws are glued.
Use Torx-tools.



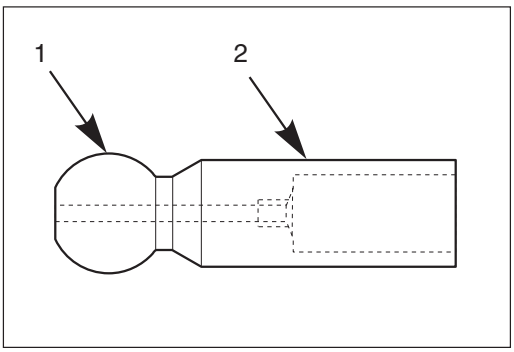
45

Free of corrosion, erosion or fretting; no damage to splines or keyways.



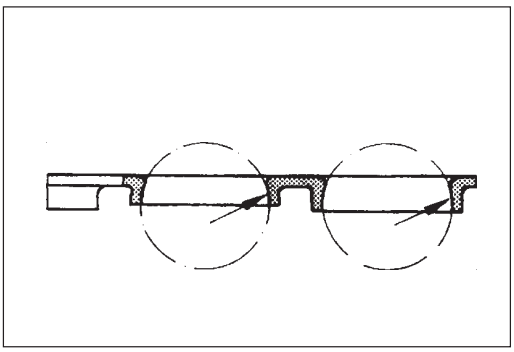
46

Pistons
No scoring and no pittings.



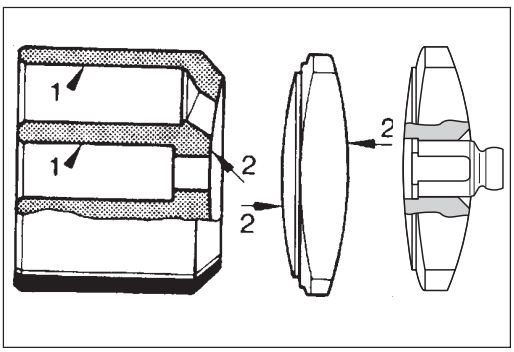
47

Center pin
No scoring and no pittings.



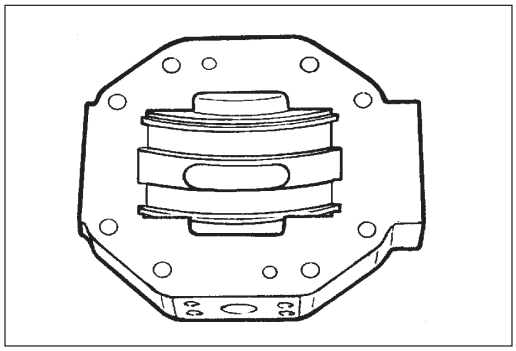
48

Retaining plate
No scoring and no evidence of wear



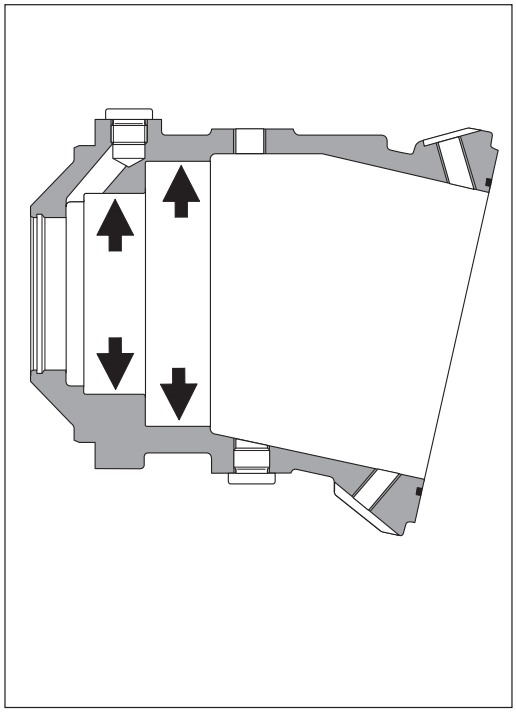
49

Cylinder block / control lens
1 Bores free of scoring, no evidence of wear.
2 Faces smooth and even, free of cracks and scoring.



50

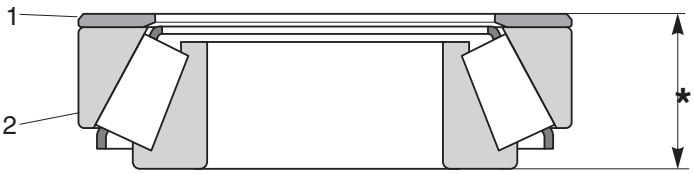
Control housing
Sliding surface and side guides free of scoring and no wear.



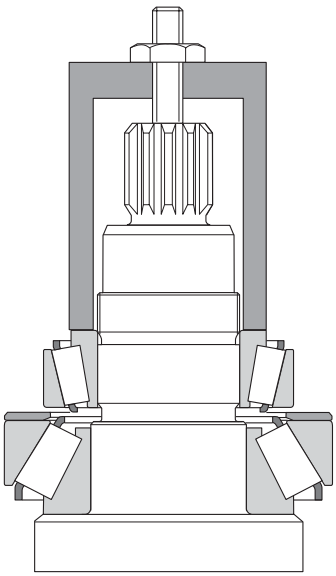
51

Visual check:
Bearing areas free of scoring and no evidence of wear.

Rotary group: mechanical part

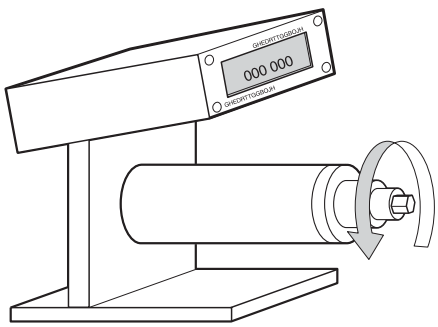


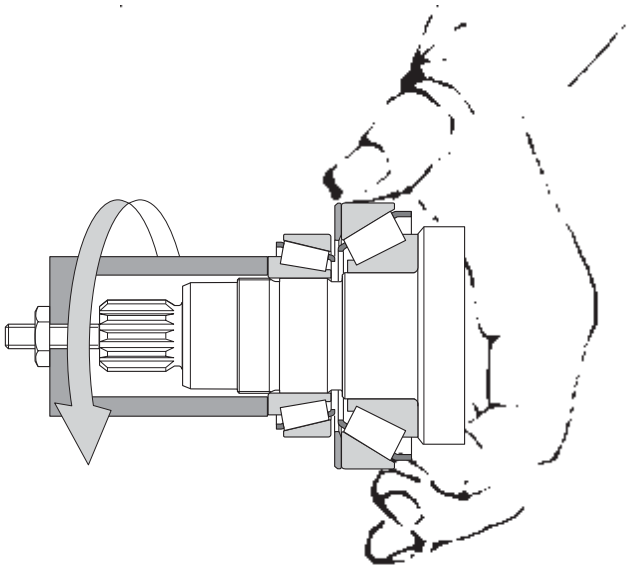
Adjustment dimension * and bearing torque see service information.



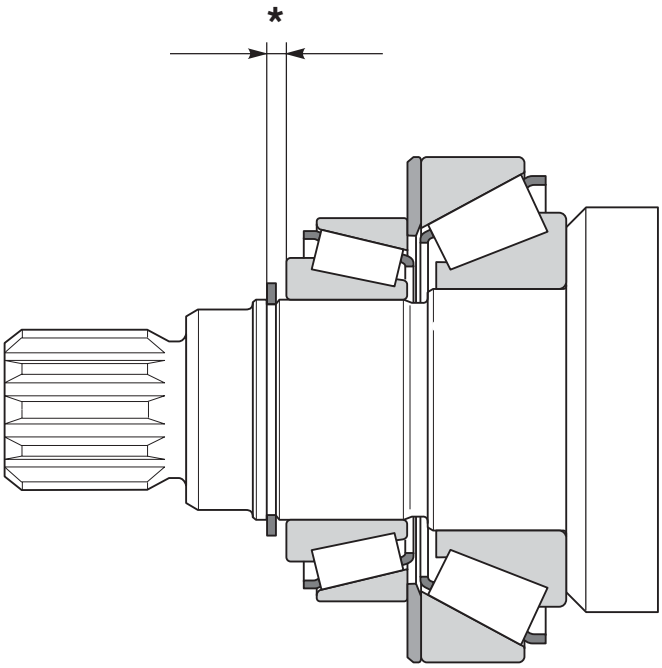
Press on bearing.
Do not exeed bearing torque during press-on.

Preload bearing with assembly sleeve and steady control of torque.

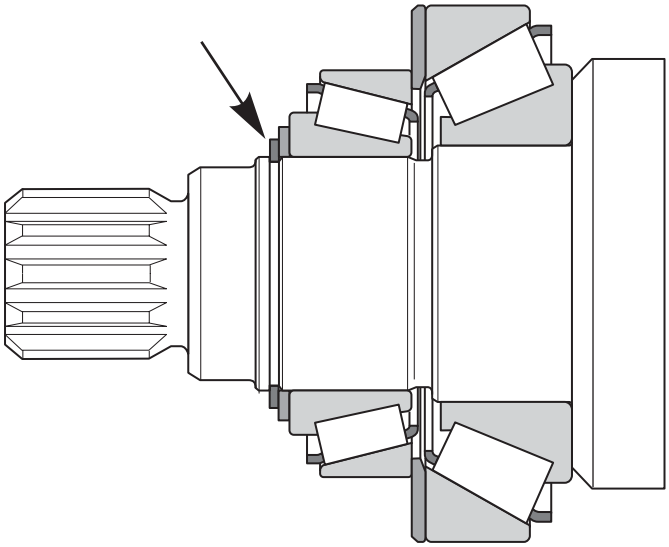




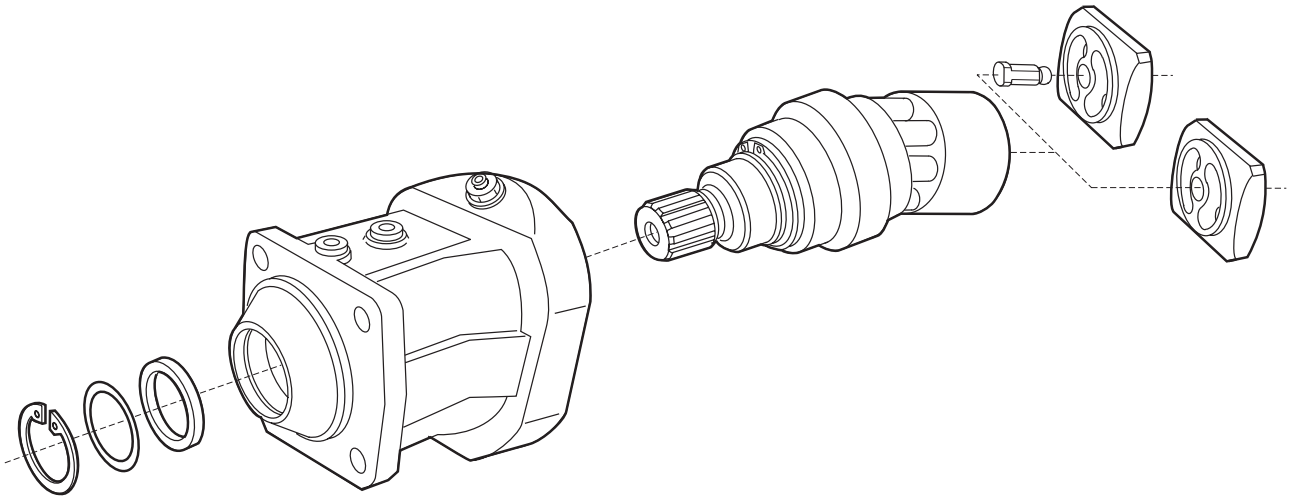
Rotary group: mechanical part



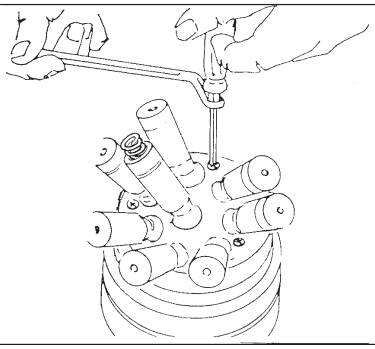
Assemble safety ring.
Determine dimension for adjustment disc with final dimensions (crossover).



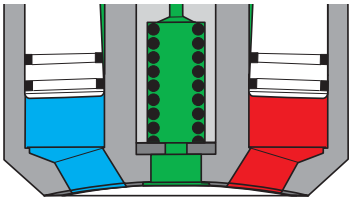
Install adjustment disc.
Assemble safety ring.
Drive shaft ready for assembly.



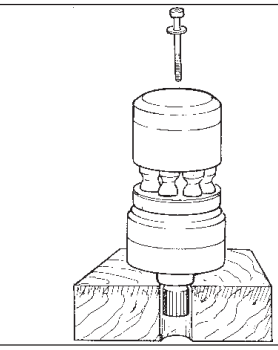
52



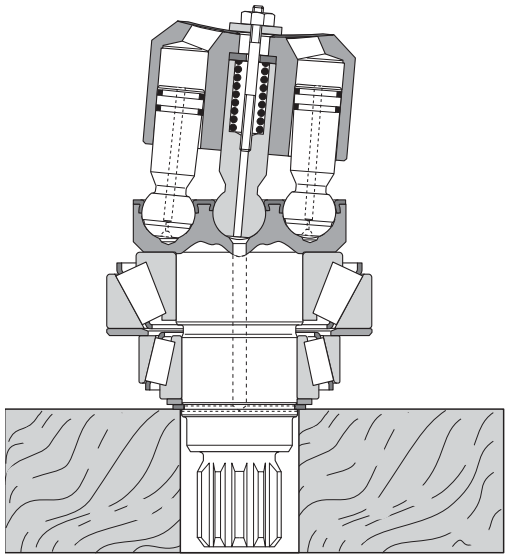
53 Insert retaining plate with piston and center pin.
Use screw with Precote-coating.



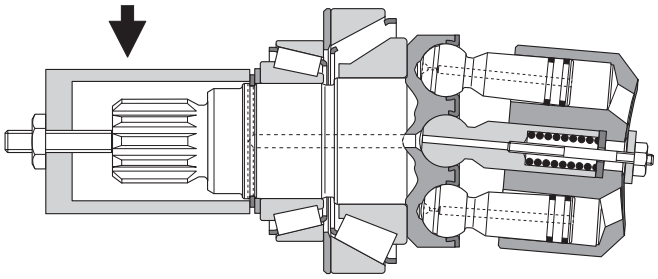
54 Make sure all parts are fitted in correctly.



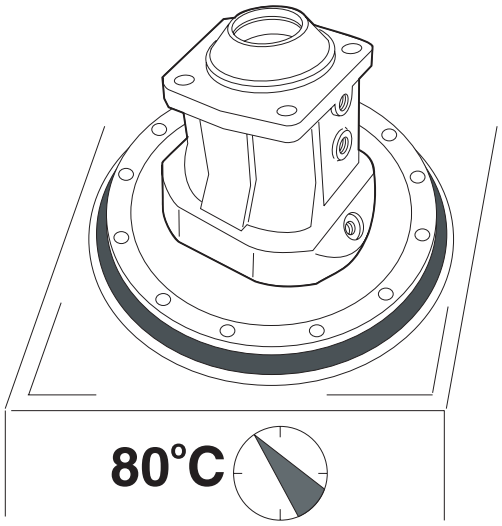
55 Swivel cylinder block to max. and fix the cylinder.



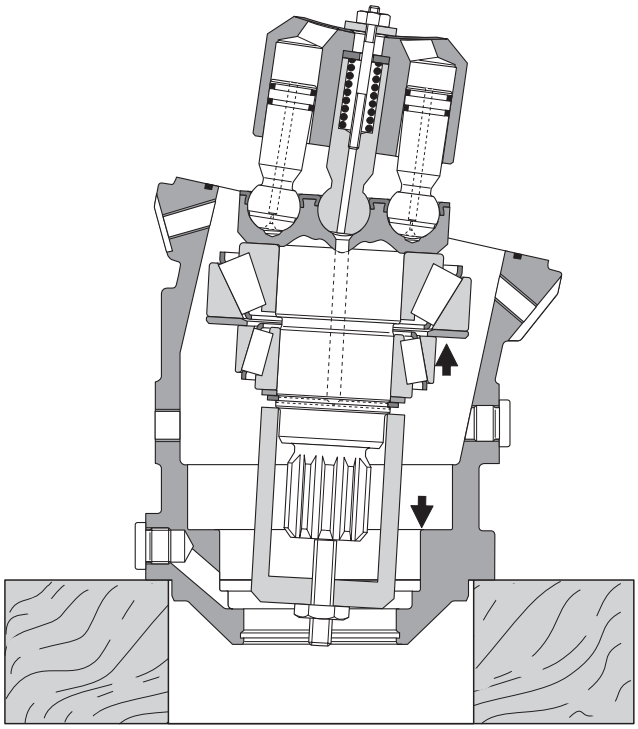
Rotary group completely assembled ready for assembly.



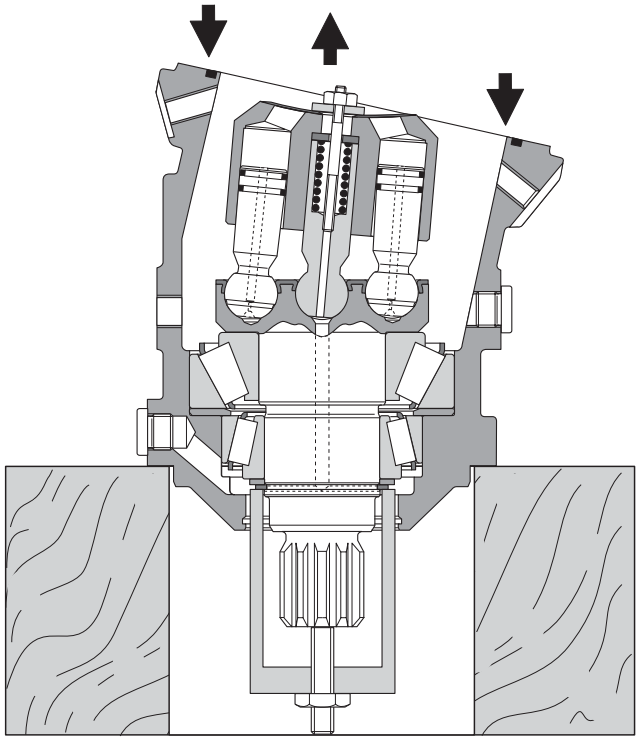
Place assembly sleeve.



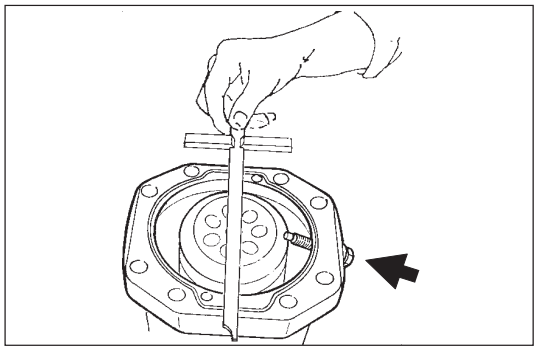
Warm up housing to 80°C.



Insert rotary group into housing to seat position.

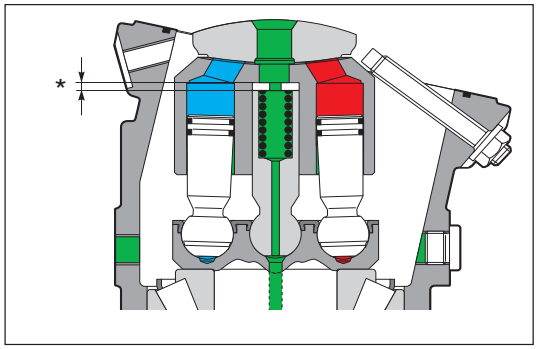


Fix zero position of cylinder with Q_{max}-screw.
1. Disassemble cylinder fixing screw.
2. Insert O-ring.



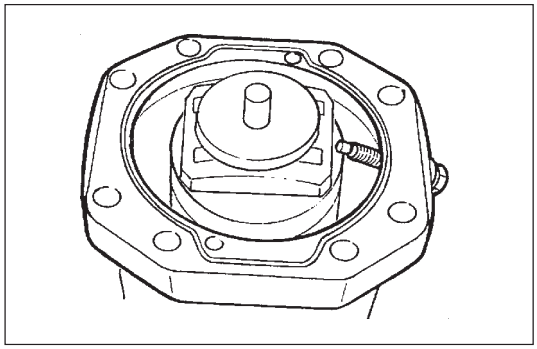
56

Determine cylinder swivel range to max. angle with screw.



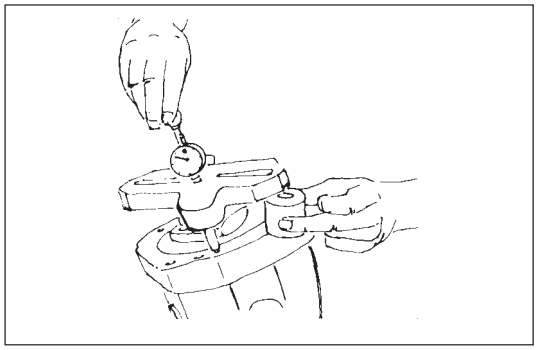
57

* Disc



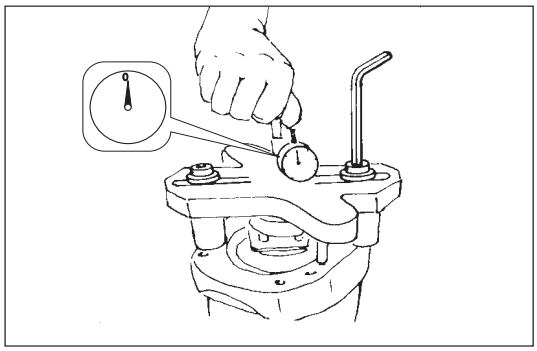
58

Place centering disc.



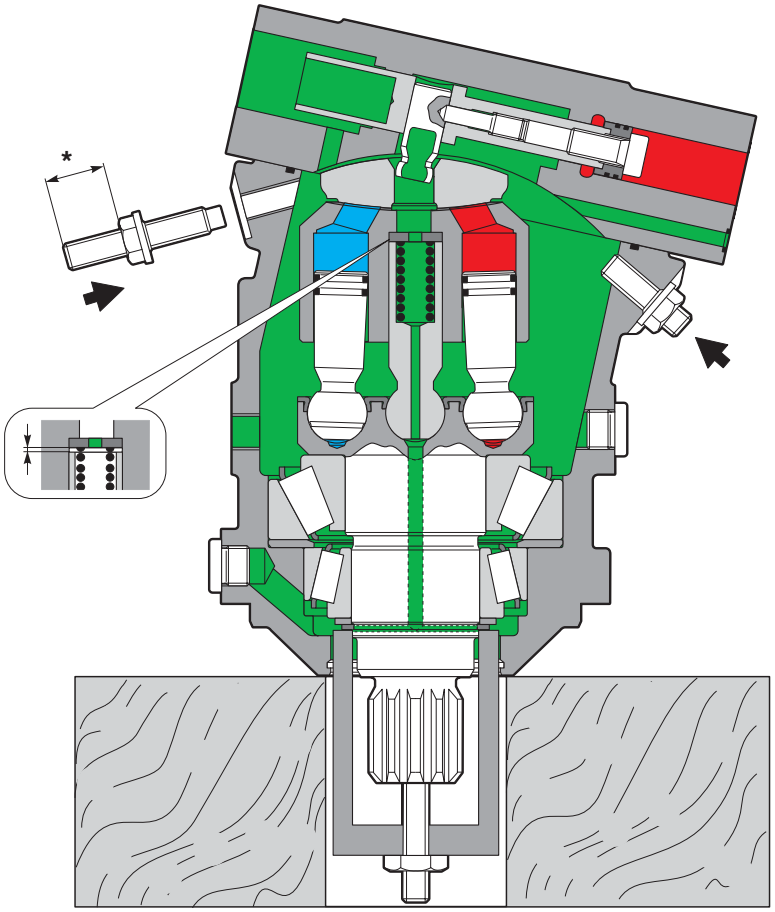
59

Mount measuring device.



60

Check dimension X.



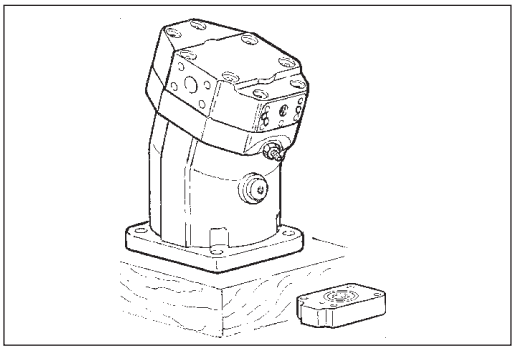
1. Assemble port plate with differential piston.

⚠ Take care of assembly design!

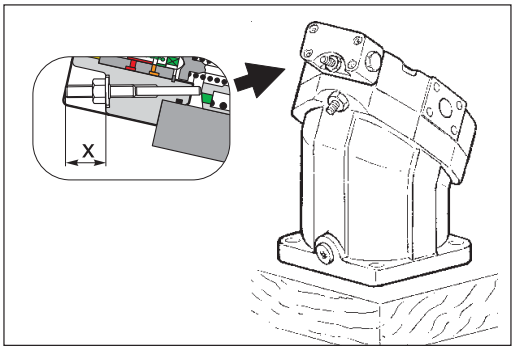
⚠ Tighten fixing screws with torque.

2. Swivel rotary group to “starting position”.
3. Set Q_{min}-screw to dimension*.
4. Assemble plug.
5. Remove assembly sleeve.

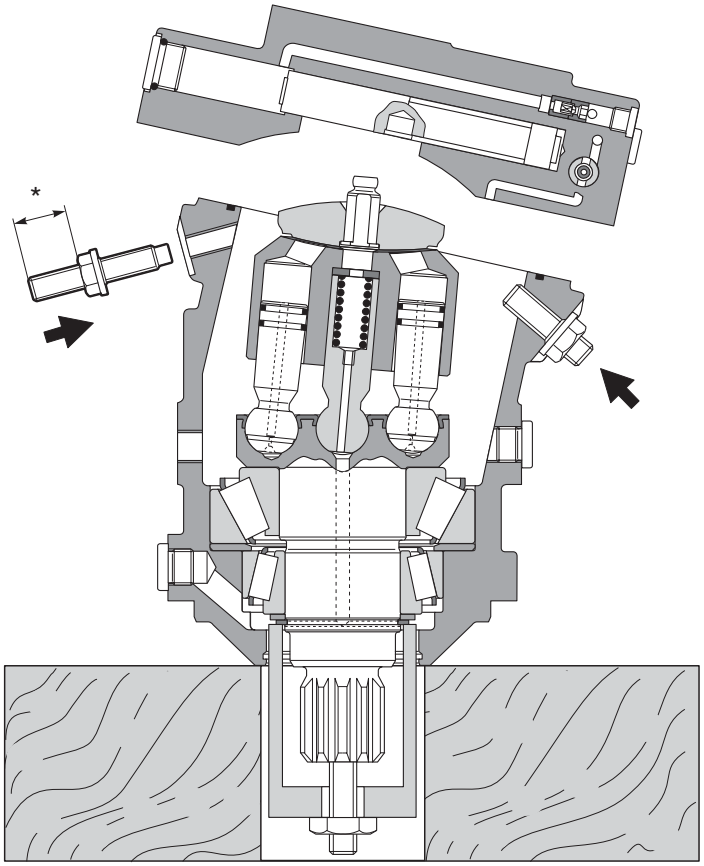
61



62 Assemble cover.



63 Assemble control components.



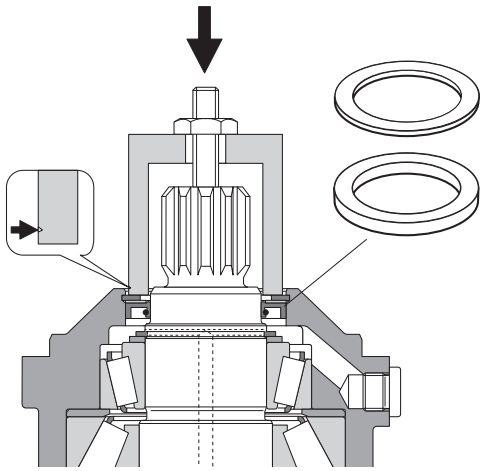
1. Assemble port plate with synchronizing piston.

⚠ Take care of assembly design!

⚠ Tighten fixing screws with torque.

2. Swivel rotary group to “starting position”.
3. Set Q_{min}-screw to dimension*.
4. Assemble plug.
5. Remove assembly sleeve.

64



65

Assemble shaft seal, disc and safety ring.
Press-in with assembly sleeve.

⚠ Take care of press-in depth.

Tightening torques for shaft bolts (Metric ISO Standard Thread)

The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO-standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or unoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 3	1,1	1,6	1,9
M 4	2,9	4,1	4,9
M 5	6	8,5	10
M 6	10	14	17
M 8	25	36	41
M10	49	69	83
M12	86	120	145
M14	135	190	230
M16	210	295	355
M18	290	405	485
M 20	410	580	690
M 22	550	780	930
M 24	710	1000	1200
M 27	1050	1500	1800
M 30	1450	2000	2400

Tightening torques for locking screws VSTI (Metric ISO fine thread)

Thread size	Designation	Tightening torques(lb.ft)
M 8 x 1	VSTI 8 x 1 -ED/SA	= 5
M 10 x 1	VSTI 10 x1 -ED	= 10
M 12 x 1,5	VSTI 12 x 1,5 -ED	= 20
M 14 x 1,5	VSTI 14 x 1,5 -ED	= 30
M 16 x 1,5	VSTI 16 x 1,5 -ED/SA	= 30
M 18 x 1,5	VSTI 18 x 1,5 -ED/SA	= 40
M 20 x 1,5	VSTI 20 x 1,5 -ED/SA	= 50
M 22 x 1,5	VSTI 22 x 1,5 -ED	= 60
M 26 x 1,5	VSTI 16 x 1,5 -ED/SA	= 70
M 27 x 2	VSTI 27 x 2 -ED	= 90
M 30 x 1 ,5	VSTI 30 x 1,5 -ED/SA	= 100
M 33 x 2	VSTI 33 x 2 -ED/SA	= 120
M 42 x 2	VSTI 42 x 2 -ED/SA	= 200
M 48 x 2	VSTI 48 x 2 -ED	= 300

Tightening torques for seal-lock nuts (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 6	10	-	-
M 8	22	-	-
M10	40	-	-
M12	69	-	-
M14	110	-	-
M16	170	-	-

Tightening torques for cross-slotted lens head screws DIN 7985 (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 3	1,1	-	-
M 4	2,9	-	-
M 5	6	-	-
M 6	10	-	-
M 8	25	-	-
M10	49	-	-

General advice

- Make yourself familiar with the equipment of the machine.
- Only operate the machine if your are completely familiar with the operating and control elements as well as the functioning of the machine.
- Use your safety equipment like helmet, safety shoes and hearing protection.
- Make yourself familiar with your working field.
- Only operate the machine for its intended purpose.

Please observe the guidelines of the Professional Association and the machine manufacturer.



Before starting

- Observe the operating instructions before starting.
- Check the machine for obvious faults.
- Do not operate the machine with defective instruments, warning lights or control elements.
- All safety devices must be in a secure position.

- Do not carry with you movable objects or secure them to the machine.
- Keep oily and inflammable material away from the machine.
- Before entering thc driver's cabin, check if persons or obstacles are beside or beneath the machine.

- Be careful when entering the driver's cabin, use stairs and handles.

- Adjust your seat before starting.

Start

- When starting all operating levers must be in “neutral position”.
- Only start the machine from the driver’s seat
- Check the indicating instruments after start to assure that all functions are in order.
- Do not leave the machine unobserved when the motor is running.
- When starting with battery connection cables connect plus with plus and minus with minus.
  Always connect mass cable (minus) at last and cut off at first.

Attention

- Exhaust gas is dangerous. Assure sufficient fresh air when starting in closed rooms!

Hydraulic equipment

1. Hydraulic equipment is standing under high pressure.

⚠ High pressure fluids (fuel, hydraulic oil) which escape under high pressure can penetrate the skin and cause heavy injuries.
Therefore immediately consult a doctor as otherwise heavy infections can be caused.

2. When searching leakages use appropriate auxiliary devices because of the danger of accidents.
3. Before working at the hydraulic equipment, lower pressure to zero and lower working arms of the machine.
4. When working at the hydraulic equipment, absolutely stop motor and secure machine against rolling away (parking brake, shim)!

5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. In case of exchanging the ports, the tunctions are vice versa (f. ex. lift-up/lower) - danger of accidents!

7. Check hydraulic flexible hoses regularly and replace them in case of dammage or wear! The new hose pipes must comply with the technical requirements of the machine manufacturer!

⚠ Orderly disposal or recycling of oil, fuel and filters!

Note!
In order to supply proper spare parts, please provide following specifications when ordering spares:

Type Code
Type Number
Serial Number
Assembly Group
Item
Designation

In repairing the unit, we recommend the use of pre-assembled partially tested assembly groups.

HYDROMATIK GmbH

Glockeraustraße 2
D-89275 Elchingen
Postanschrift: Postfach 22 60, D-89012 Ulm
Telefon (0 73 08) 8 20
Telex 712538
Telefax (0 73 08) 72 74, 72 73

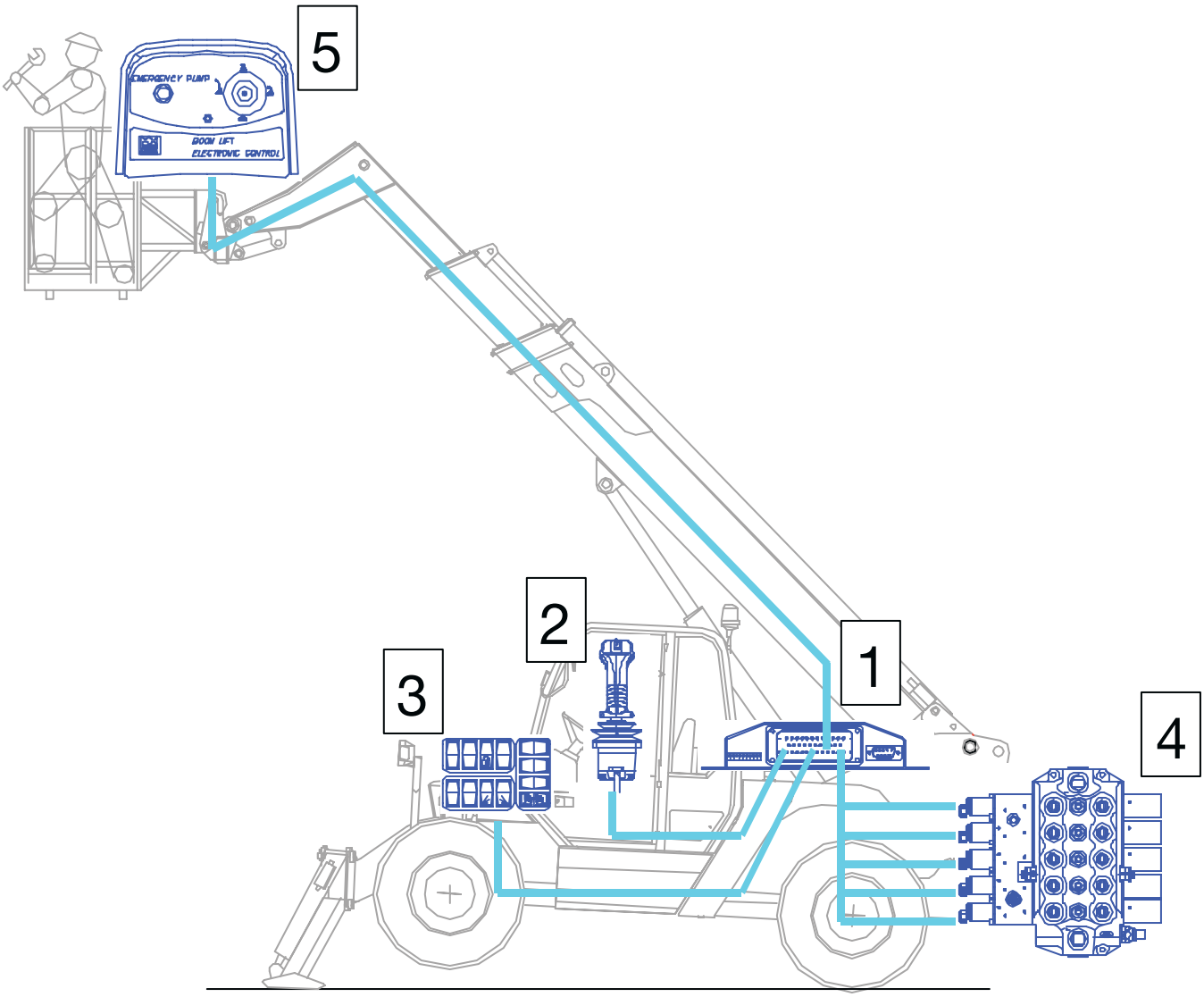
Section M
PROPORTIONAL ELECTRONIC SYSTEM

Valid for Telelift 3013 (from serial no. 8451) - Telelift 3517

SECTION INDEX

GENERAL DESCRIPTION 2
GENERAL CONNECTION DIAGRAM 3
CED 250 CONTROL UNIT 4
MDT220HA73C JOYSTICK 5
CONTROL PANEL 6
SDM140/5-P CONTROL VALVE 7
UPD22 CONTROL BOARD 8
OPERATION 9

GENERAL DESCRIPTION

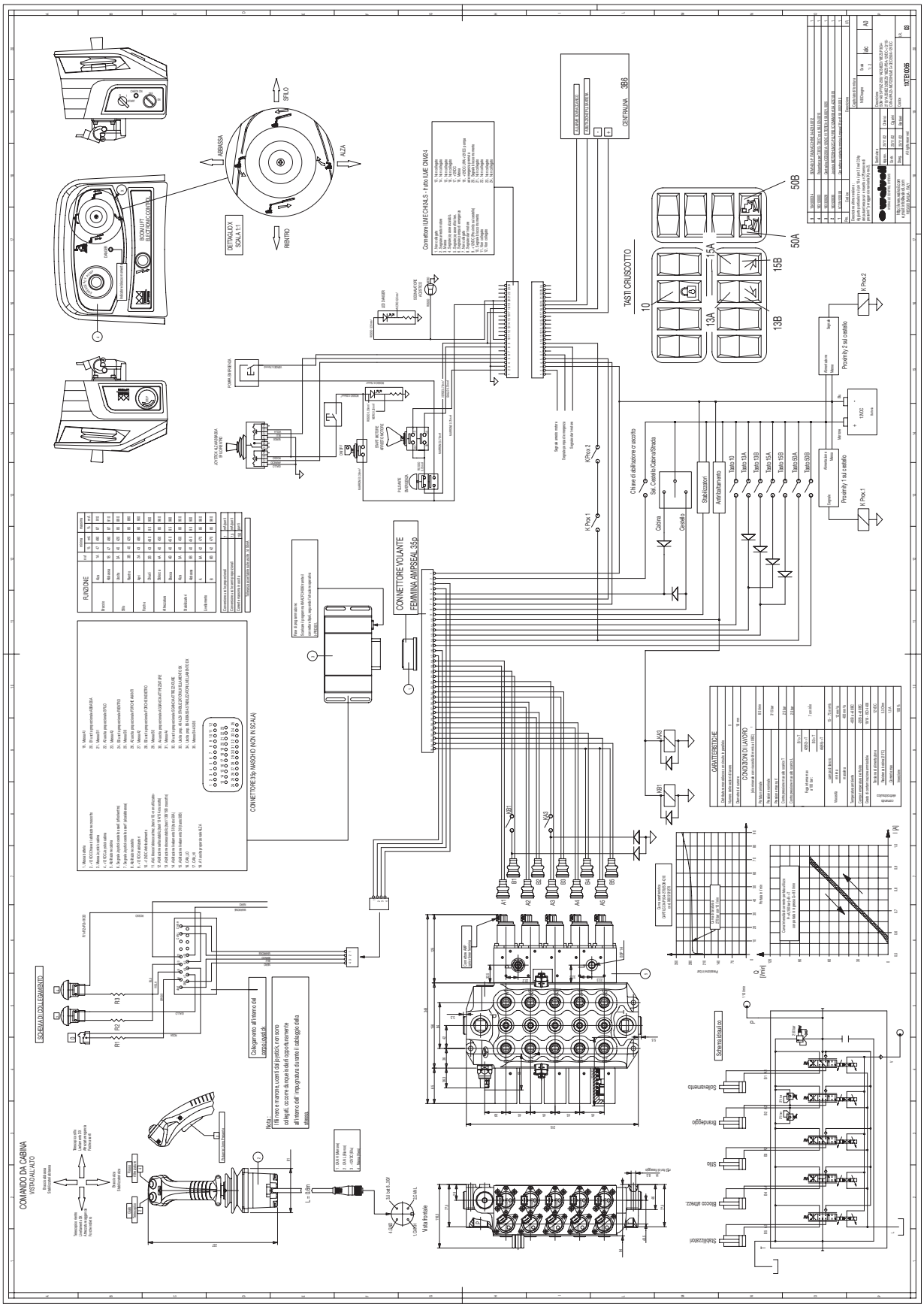


The proportional control system comprises:

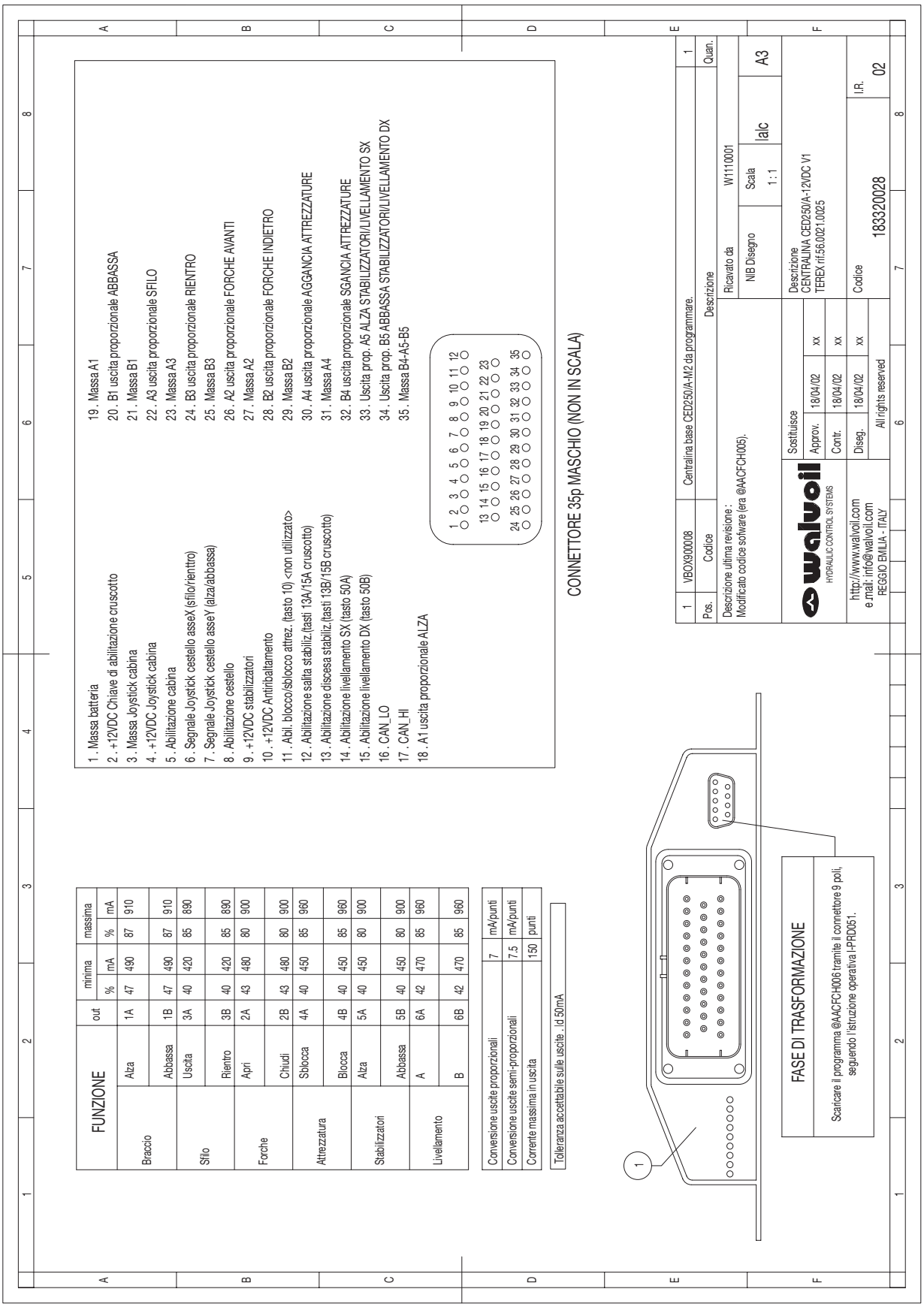
1 CED 250 electronic control unit;
2 MDT220HA73C digital joystick;
3 Control panel;
4 SDM140/5-P actuator;
5 UPD22 man lift control board (optional).

The various components are connected by means of the machine's wiring.

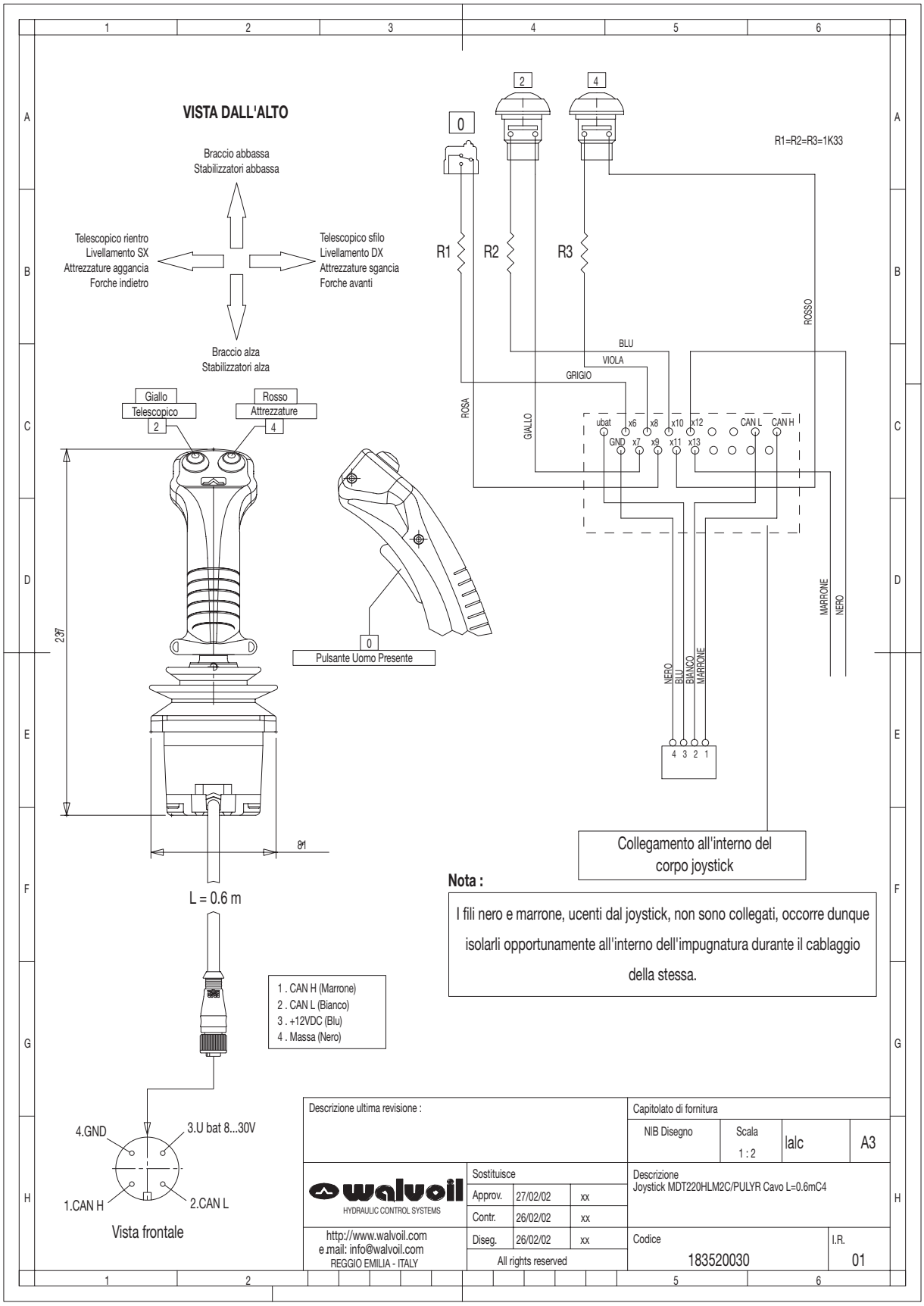
General connection diagram



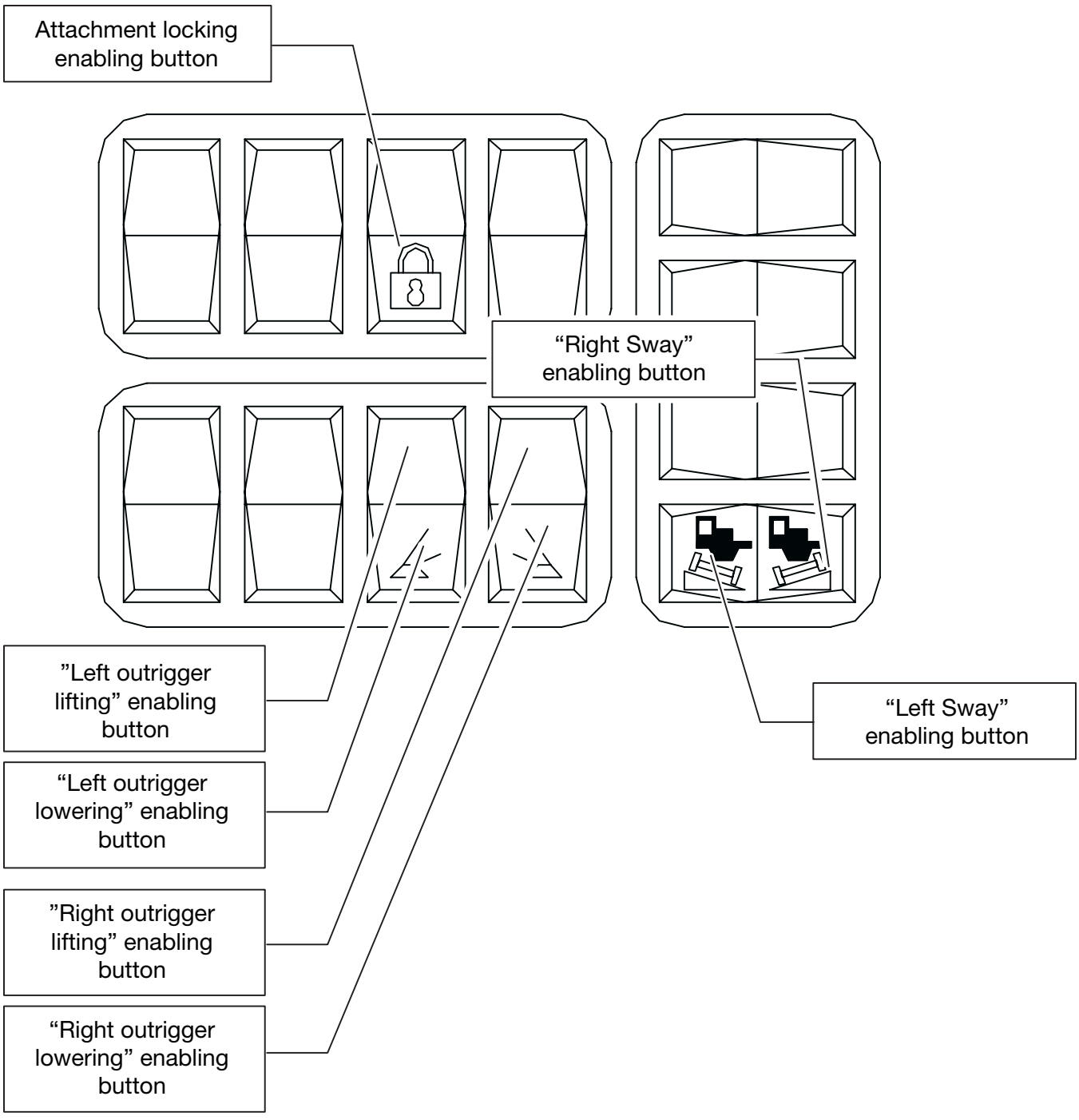
1 - CED 250 Control unit



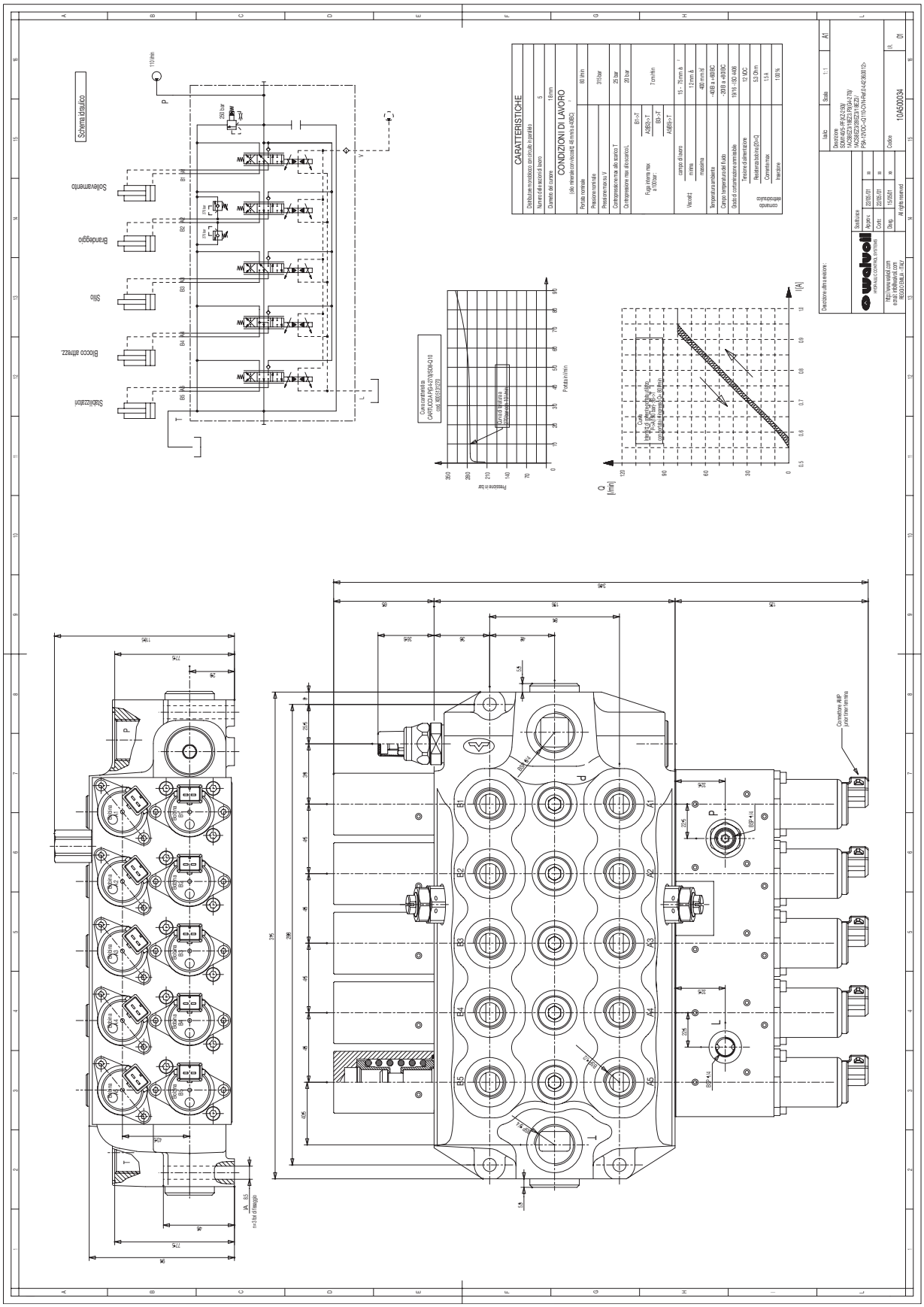
2 - MDT220HA73C Joystick



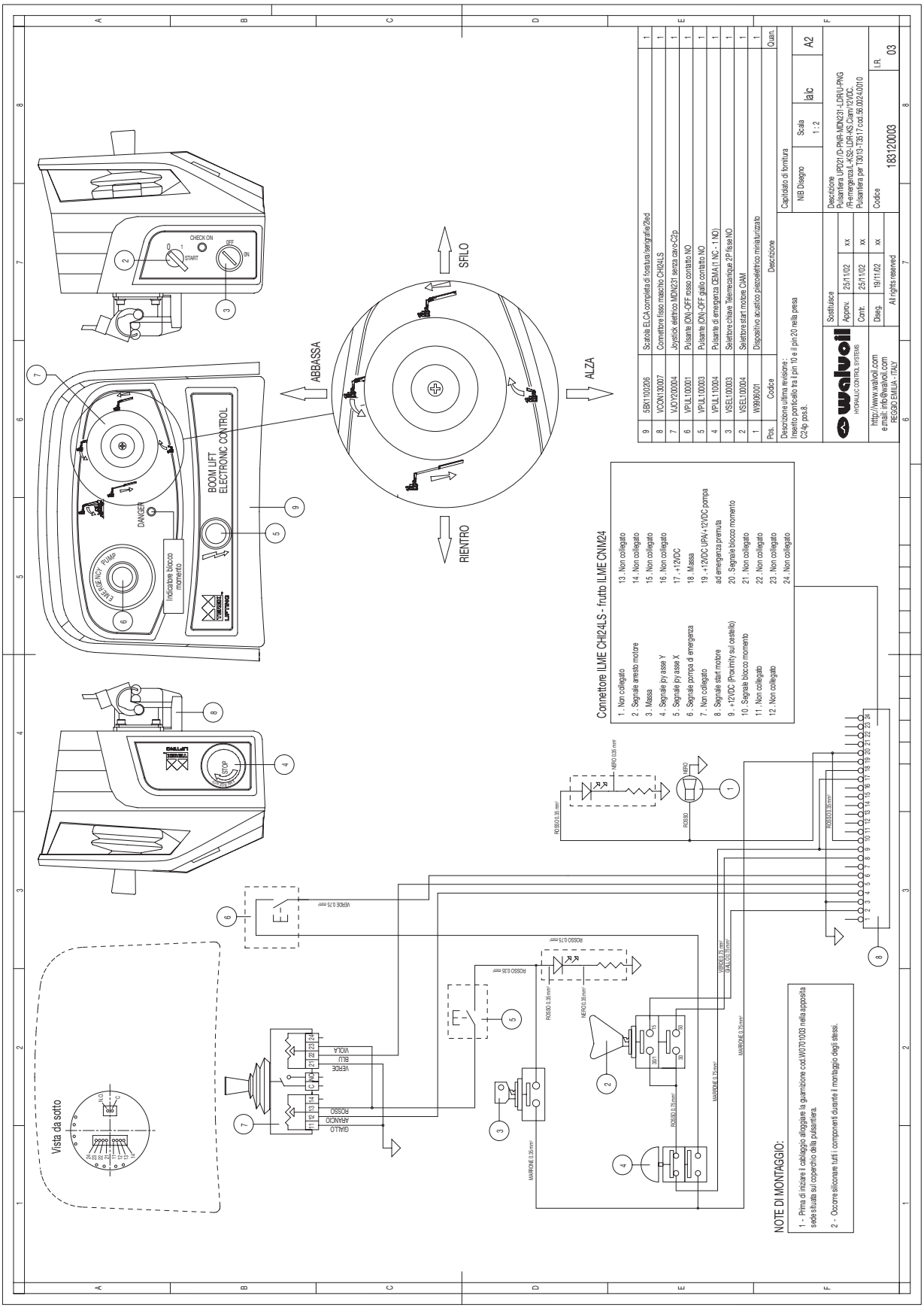
3 - Control panel



4 - SDM140/5-P Actuator

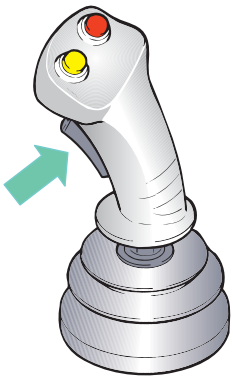


5 - UPD22 Control board



Operation

Important: whenever you wish to select a function different from the one in use (using the rocker switch or the control board) the joystick must be brought back to the central position.



Deadman

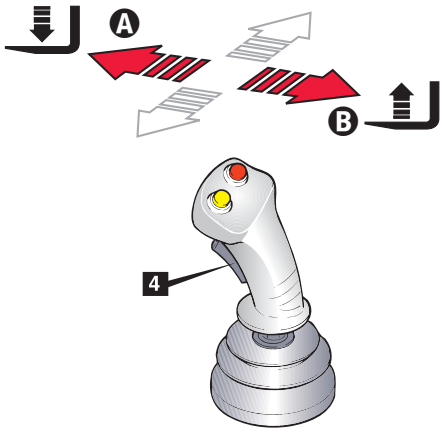
Note: Before any operation, press the “deadman” button.

Standard Functions:

- **Boom lifting/lowering**

4+A Boom up

4+B Boom down

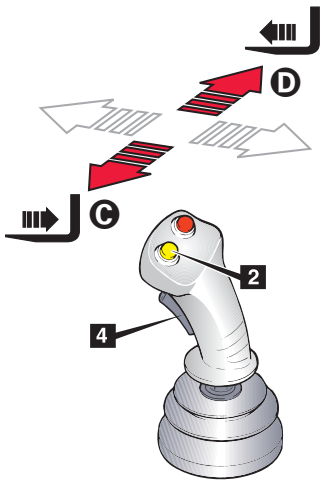


Fork up/down

- **Boom extension/retraction**

4+2+C Boom in

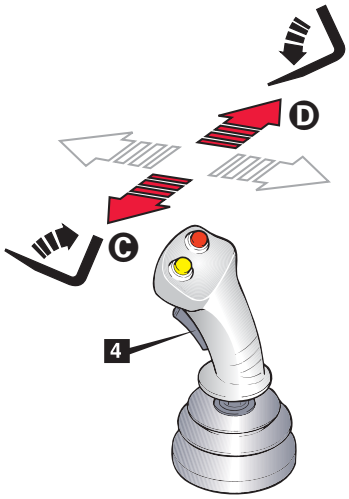
4+2+D Boom out



- **Attachment holding plate pitching forwards/back**

4+C Pitching back

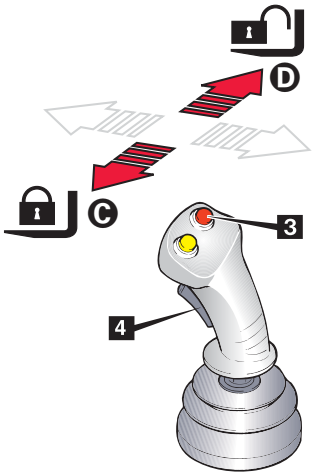
4+D Pitching forwards



- **Attachment locking**

4+3+C Attachment locked

4+3+D Attachment unlocked



- **Outriggers' movement**

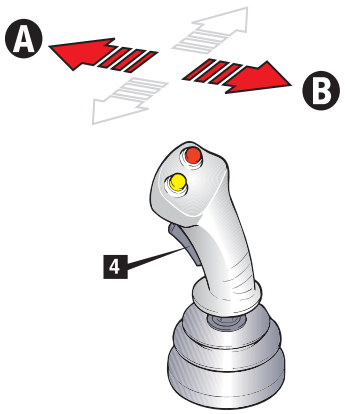
Press the button on the dashabord to enable the movement you wish to perform

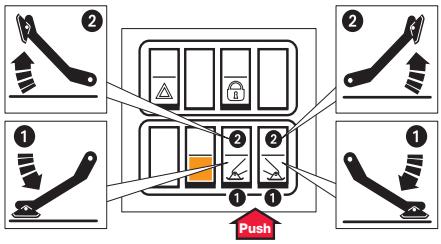
4+(X in ❶)+A Left outrigger down

4+(X in ❷)+B Left outrigger up

4+(Y in ❶)+A Right outrigger down

4+(Y in ❷)+B Right outrigger up

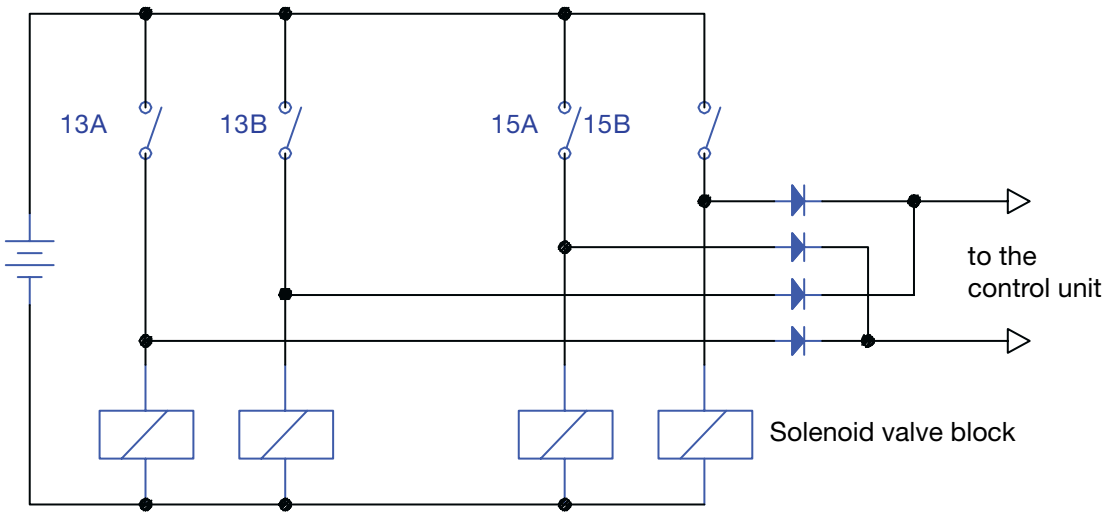




Note:

1 In order to move the outriggers up or down pulling or pushing the joystick, the control unit must be informed which button has been pressed, especially whether you wish to lift or lower. To do this, a connection like the one shown below must be included in the machine's wiring.

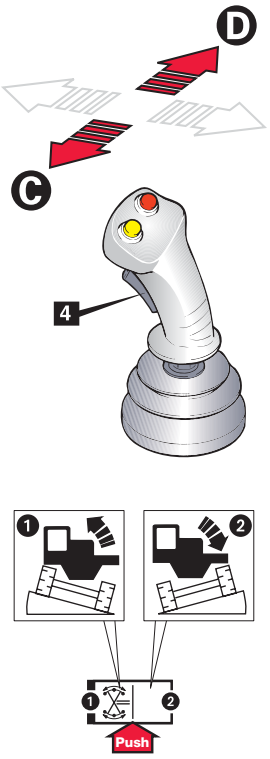
2 Hydraulically, downstream of the control valve, the 2 ports must be connected together, before the solenoid valve block intake.



- **Machine sway**

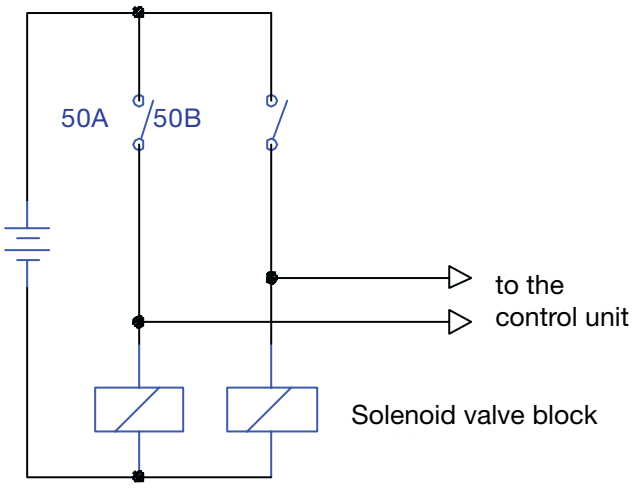
4+❶+C Right-hand side up

4+❷+D Left-hand side up



Note:

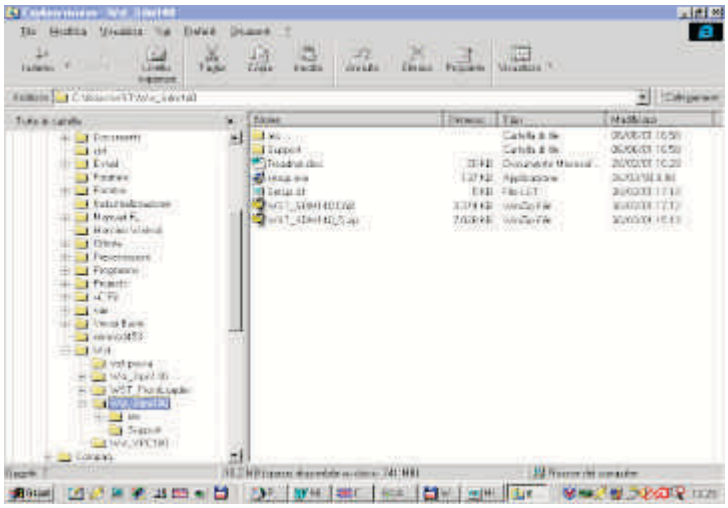
1 In order to link the 2 sway procedures to the 2 movements of the joystick, the control unit must be informed which button has been pressed on the control panel.
To obtain this, the connection shown on the right must be made.



Calibration

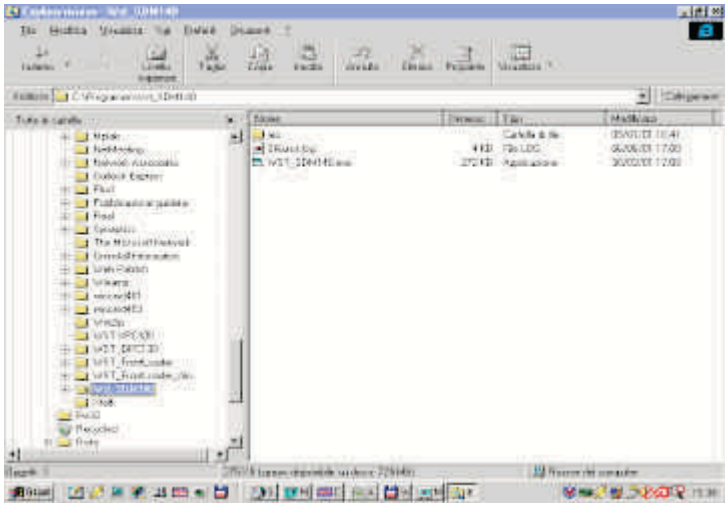
All the adjustments can only be made by means of a computer and a dedicated programming software called WST SDM140.

Installing the WST SDM140 software
The files supplied for installation are highlighted in the illustration below (if they are sent by email they will be packed in a file called WST_SDM140.zip).



1 Run the file “setup.exe” and follow the instructions.
2 When installation is complete, copy the “res” directory into the directory in which the program itself has been installed (e.g. C:\programs\WST_SDM140).

The working directory will appear as shown in the picture below.



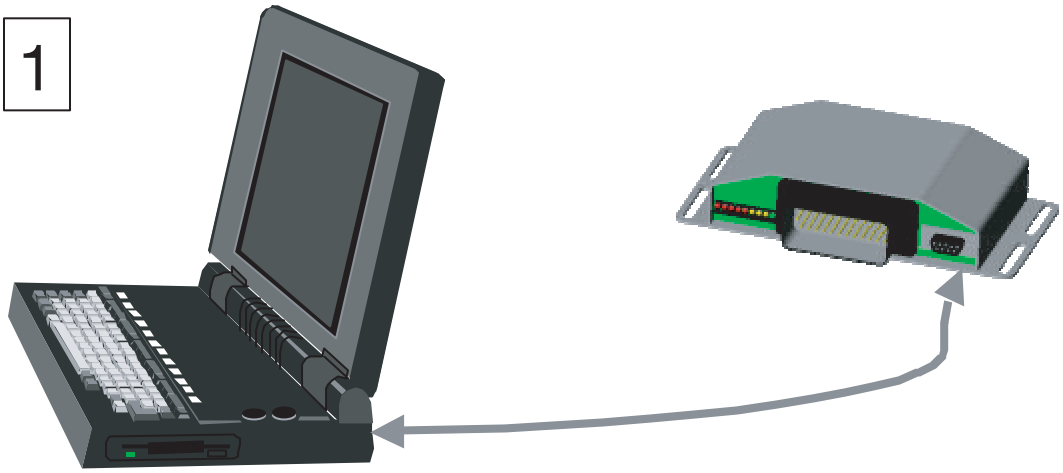
Using the WST SMD140 software

Computer - Control Unit connection and communications

1 Connect the serial port of the computer to the 9-pin connector on the electronic control unit (***183320023***) using the TEREXLIFT communications cable code ***07.0704.0069***.

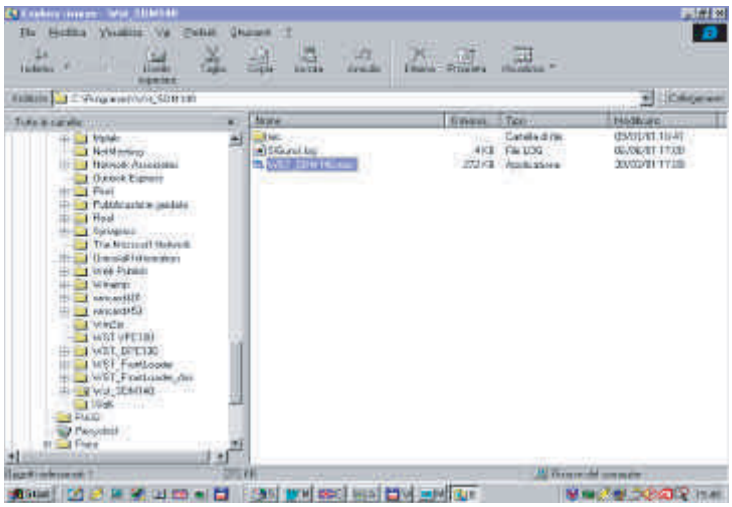
Power up the entire system using the machine's ignition key.

1



2 Run the " WST_SDM140.exe" file.

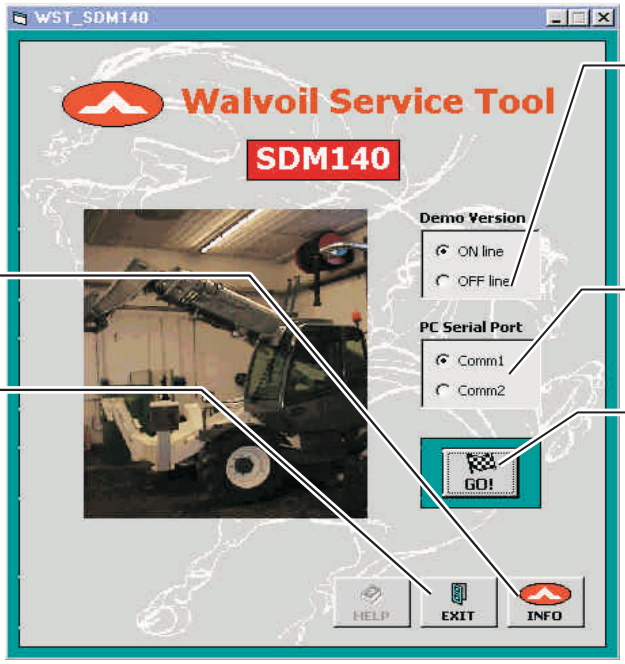
2



The first page will open.



3 Select “ON line” in the “Demo Version” field;
- set the serial port to which the communications cable has been connected in the “PC Serial Port” field;
- Click on the “GO!” button.



Information about the WST program version

Exit the WST program

Note: The “EXIT” and “INFO” buttons have the same function in all pages of the program.

ON line = Communication OFF lin = Demo (the program can be accessed even without the control unit connected)

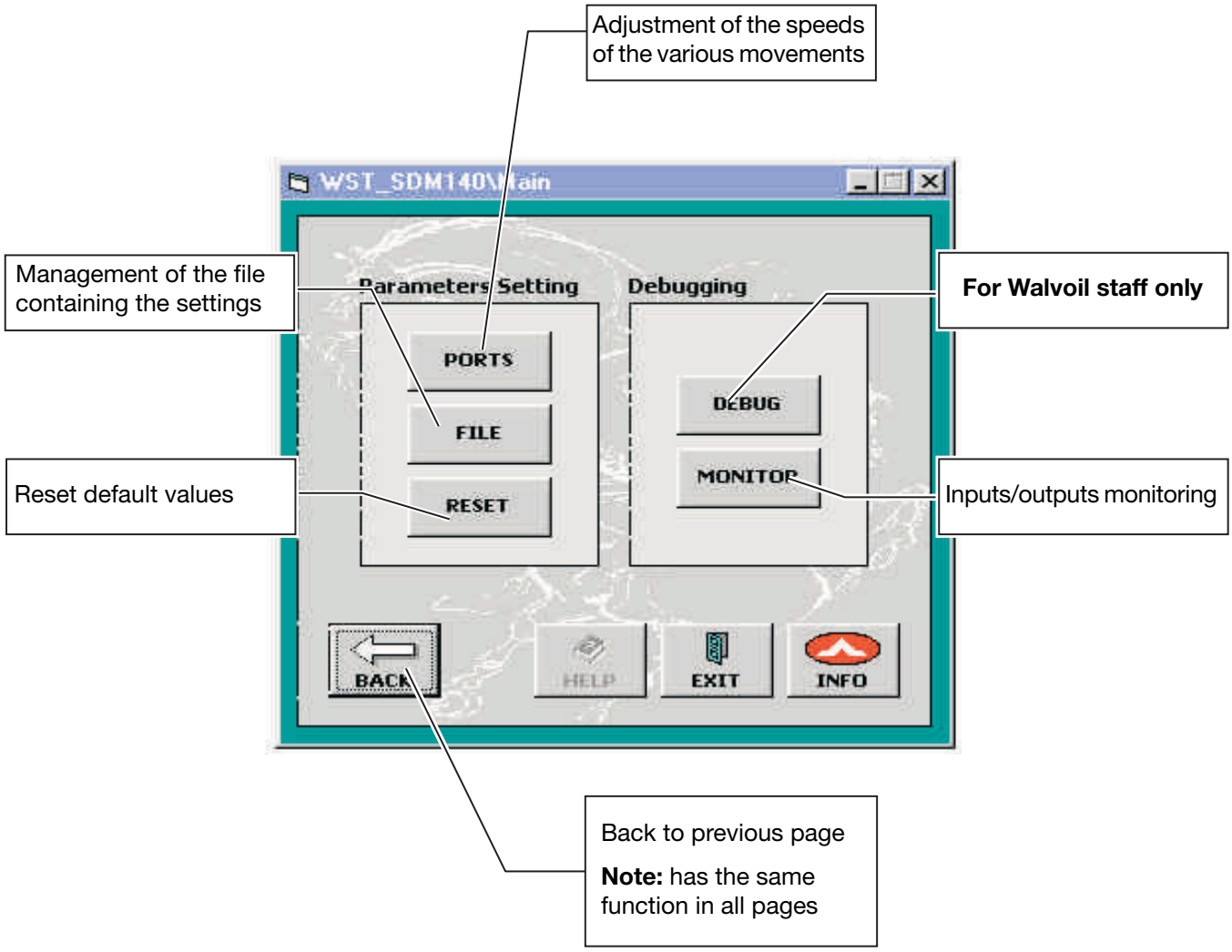
Computer serial port selection

Start of communications with the control unit.

Description of commands in the various pages of the WST SDM140 software

"MAIN" page

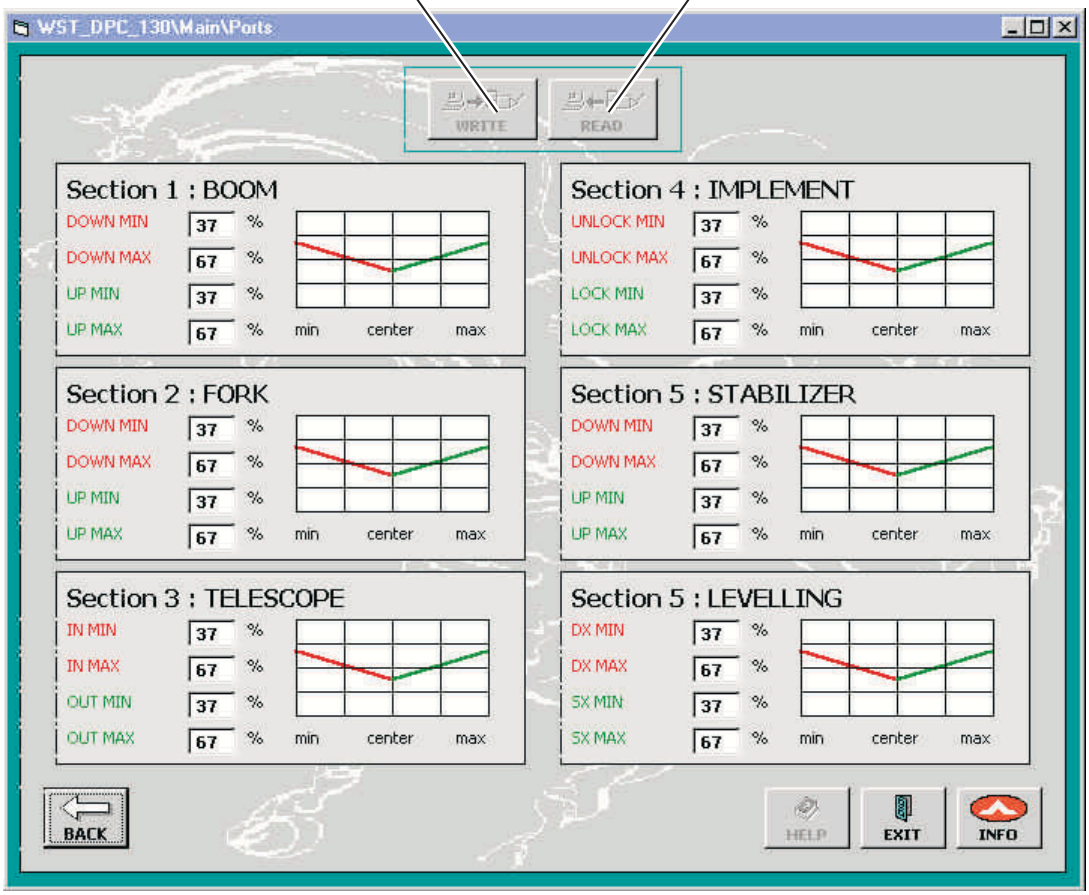
This is the main page from which the other, specific pages of the program can be accessed:
- Ports;
- File;
- Reset;
- Debug;
- Monitor.



"PORTS" page
This is the page which allows the user to modify the speeds of the machine's 5 different movements.

Write: downloads the settings shown on the screen into the control unit

Read: reads the settings in the control unit and displays them on the screen



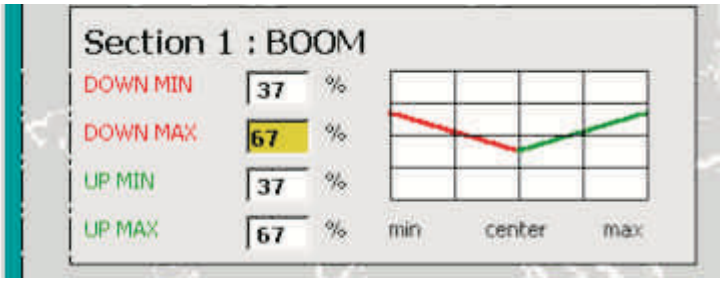
The minimum speeds (DOWN MIN, IN MIN, etc.) set the speed obtained when the joystick is moved beyond the central dead band. The higher this speed, the more sharply the movement will start and stop.

The maximum speeds (DOWN MAX, IN MAX, etc.) set the speed obtained when the joystick is moved to the limit positions.

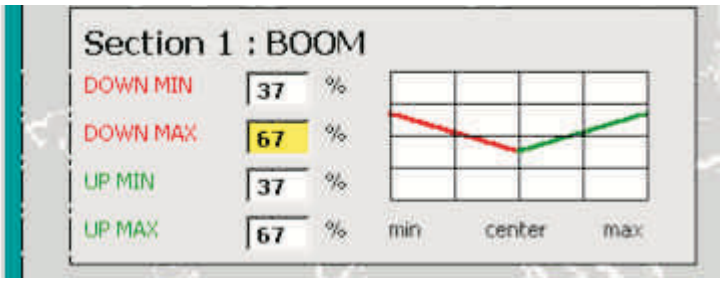
Note: The default values allow fairly smooth starts and permit the user to obtain the highest possible speed by moving the joystick to the limit positions.

How to modify the values of the various speeds:

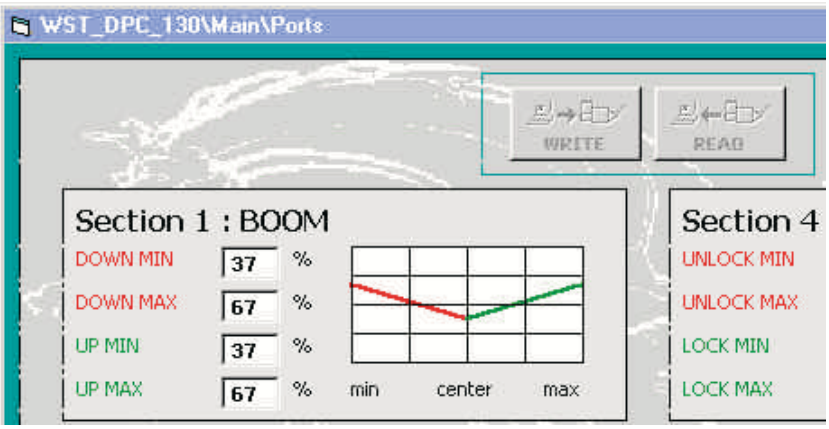
1 Type the value required in the corresponding field. The background of the field turns dark yellow (see illustration below).



2 Press “ENTER”. The background of the field turns light yellow (see illustration below).



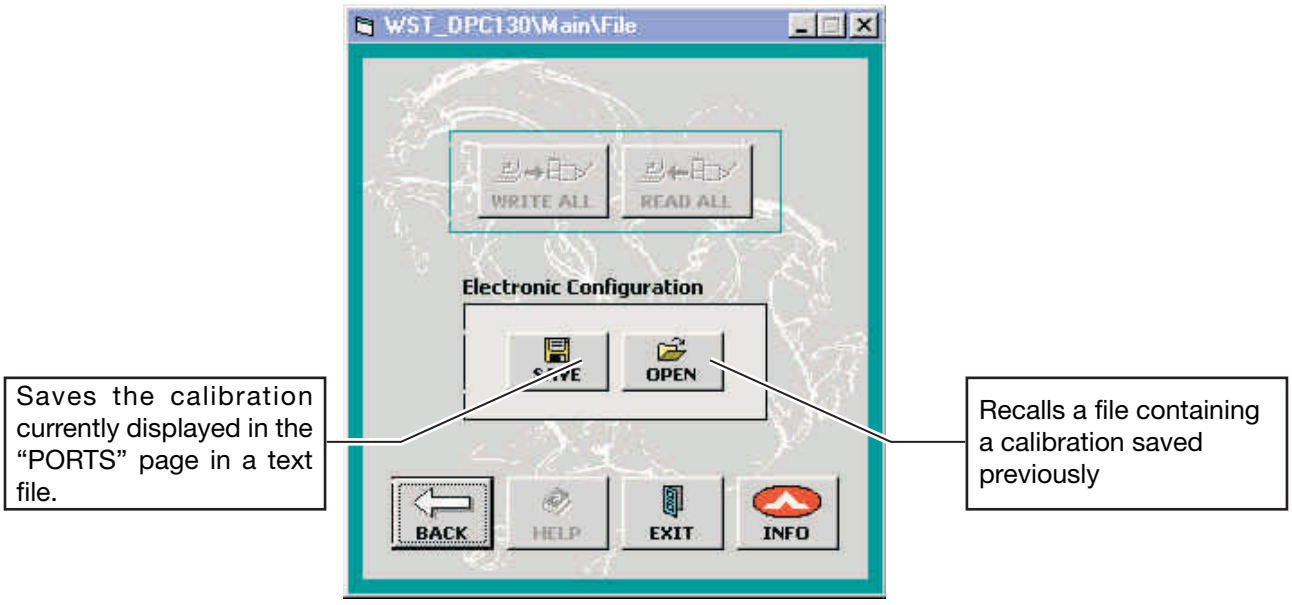
3 Press the “WRITE” button. Once the writing in the control unit operation is complete, the background of the field turns white again (see illustration below).



Note: if the user does not press enter before downloading the new setting (“WRITE” button), the modification will have no effect on the control unit.

FILE Page

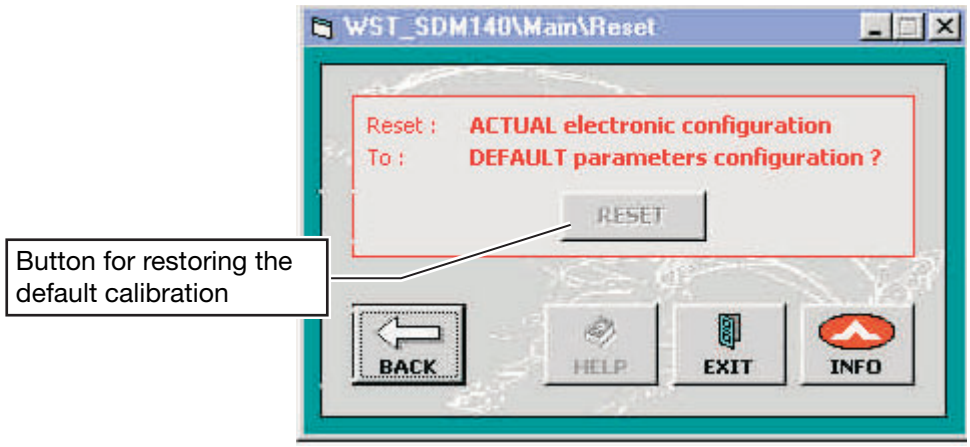
Used to file or recall customised settings.



Nota: once the file containing the calibration of choice has been recalled, you can download it into the control unit directly from this page by pressing the "WRITE ALL" button.
If you wish to save the calibration of the control unit currently connected, it can be recalled directly from this page by pressing the "READ ALL" button and then saved using the "SAVE" button

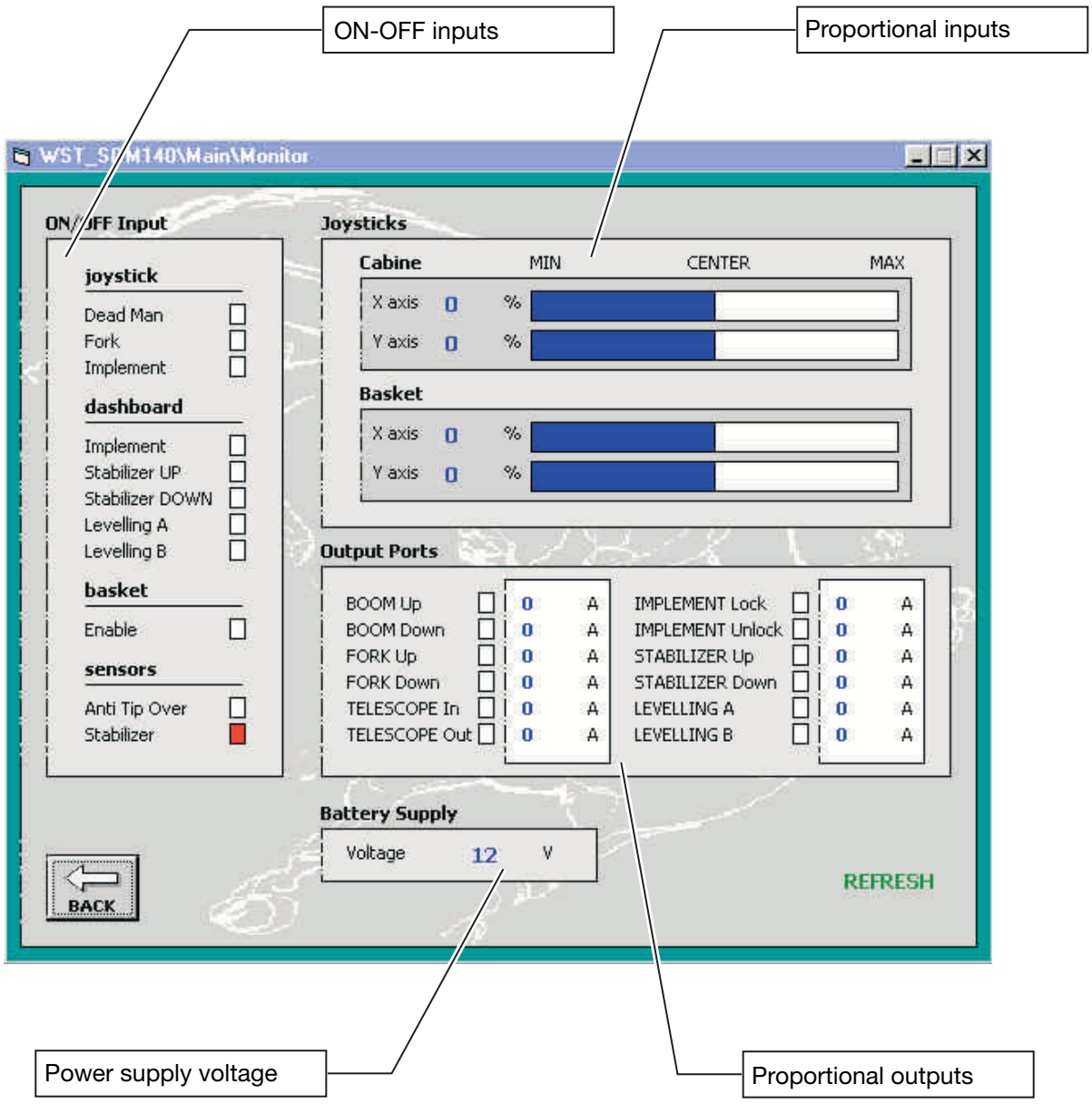
RESET Page

Allows the default calibration to be restored at any moment.

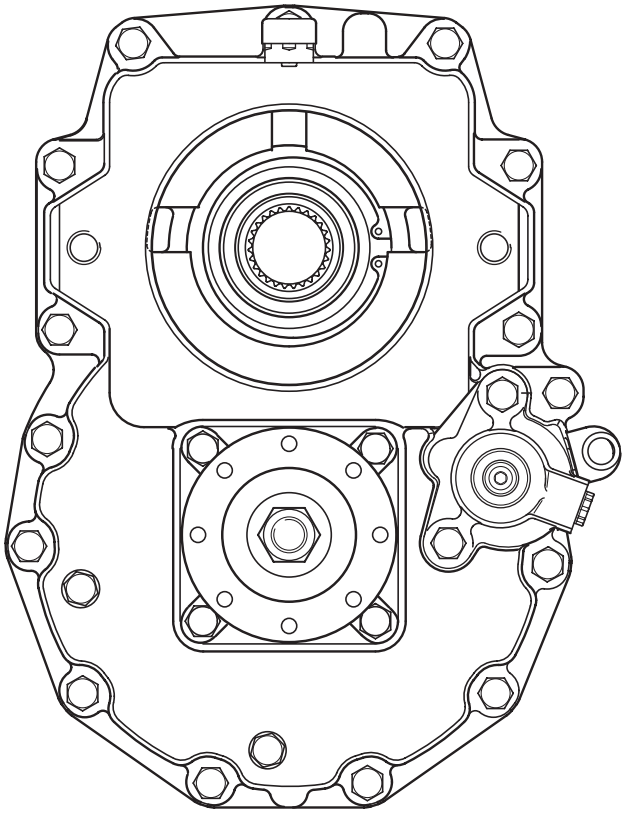


MONITOR Page

Allows the user to monitor the status of the various inputs and outputs connected to the control unit and the power supply voltage.



Section N
DANA GEARBOX
ASSEMBLY - DISASSEMBLY



SECTION INDEX

INTRODUCTION 2
MAINTENANCE AND LUBRICANT 3
CONVERSION TABLES 4
TIGHTENING TORQUES 4
DIAGRAMS OF REDUCTION UNIT AND EXPLODED VIEWS 5
DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 8
REMOVAL OF HYDRAULIC GEAR CONTROL 9
ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357 17
INSTALLATION OF HYDRAULIC GEAR CONTROL 25

INTRODUCTION

The efficiency and continued operation of mechanical units depend on constant, correct maintenance and also on efficient repair work, should there be a break-down or malfunction. The instructions contained in thismanual have been based on a complete overhaul of the unit. However, it is up to the mechanic to decide whether or not it is necessary to assemble only individual components, when partial repair work is needed. The manual provides a quick and sure guide which, with the use of photographs and diagrams illustrating the various phases of the operations, allows accurate work to be performed.
All the information needed for correct disassembly, checks and assembly of each individual component is set out below.
All the information needed for correct disassembly, checks and assembly of each individual component is set in the Chapter **E - Disassembly and Reassembly**.
In describing the following operations it is presumed that the unit has already been removed from the vehicle.

IMPORTANT

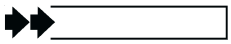
In order to facilitate work and protect both working surfaces and operators, it is advisable to use proper equipment such as: trestles or supporting benches, plastic or copper hammers, appropriate levers, extractors and specific spanners or wrenches.
Before going on to disassemble the parts and drain the oil, it is best to thoroughly clean the unit, removing any encrusted or accumulated grease.

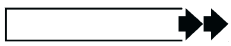
Introductory remarks

All the disassembled mechanical units should be thoroughly cleaned with appropriate products and restored or replaced if damage, wear, cracking or seizing have occurred.
In particular, thoroughly check the condition of all moving parts (bearings, gears, crown wheel and pinion, shafts) and sealing parts (O-rings, oil shields) which are subject to major stress and wear. In any case, it is advisable to replace the seals every time a component is overhauled or repaired. During assembly, the sealing rings must be lubricated on the sealing edge. In the case of the crown wheel and pinion, replacement of one component requires the replacement of the other one. During assembly, the prescribed pre-loading, backlash and torque of parts must be maintained.

Classification

This manual classifies units according to part numbers. For a correct interpretation, classification is indicated as follows:


= up to the part number

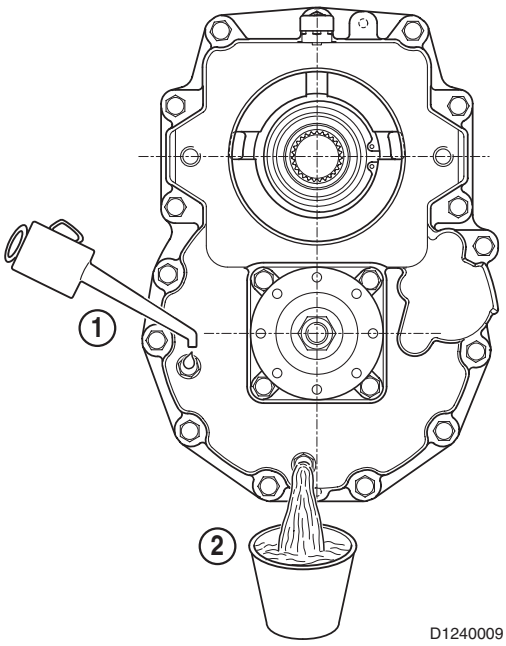

= from the part number on

When no classification is given, disassembly and assembly operations are the same for all versions.

Specific equipment and spare parts

The drawings of all specific tools required for maintenance and repair work can be found at the end of this manual ; spare parts may be ordered either from the vehicle manufacturer or directly from the Service Centers or Authorised Distributors of SPICER CLARK-HURTH.

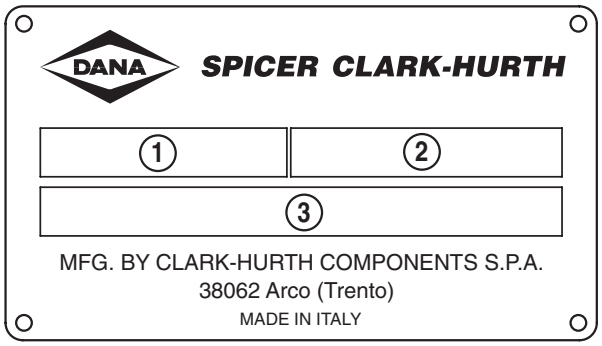
MAINTENANCE AND LUBRICANT



1 Oil fill and level plug

2 Oil drain plug

Data plate



1 Type and model unit

2 Serial number

3 Lubrificant

Maintenance points

OPERATION	FREQUENCY	LUBRICANTS
• Check levels:	monthly	**SAE85W90 API GL3**
• Oil change:	every 1000 hours (*)	

(*) Initially after 100 working hours

CONVERSION TABLES

Units of pressure: 1 Atm = 1 bar = 10^5 Pa = 14.4 Psi

Units of weight

	N	daN	kN	kg	lbs
1N	1	0,1	0,001	0,102	0,225
1daN	10	1	0,01	1,02	2,25
1kN	1000	100	1	102	225
1kg	9,81	0,981	0,00981	1	2,205

Units of torque

	Nm	daNm	kNm	kgm	lb-in
1Nm	1	0,1	0,001	0,102	8,854
1daNm	10	1	0,01	1,02	88,54
1kNm	1000	100	1	102	8854
1kgm	9,81	0,981	0,00981	1	86,8
1lb-in	0,1129	0,01129	0,0001129	0,01152	1

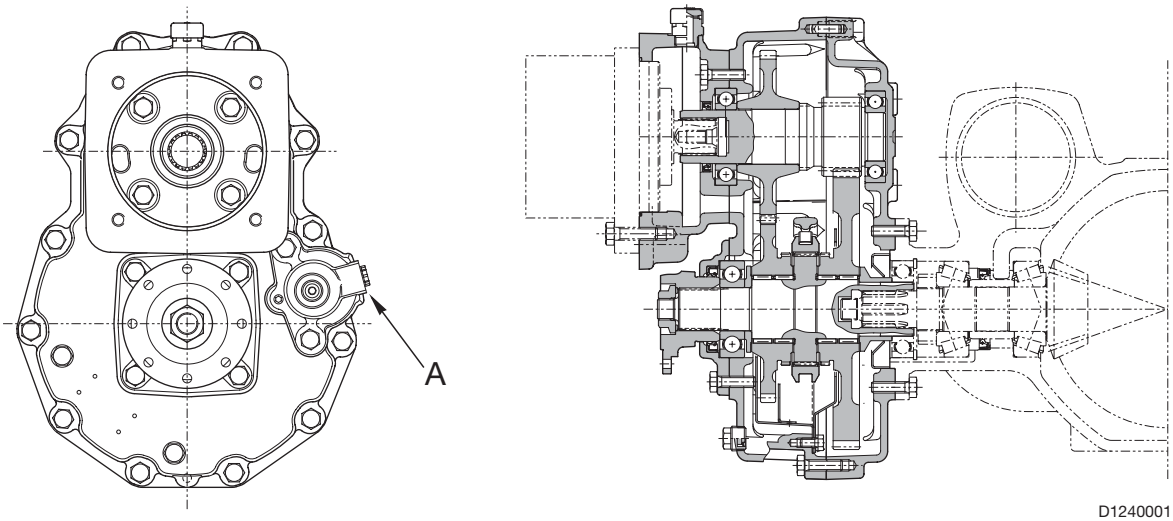
Tightening torques

Unit: Nm

SIZE OF BOLT	TYPE OF BOLT		
	8G/8.8 Nm	10k/10.9 Nm	12k/12.9 Nm
M4	2,9	4,1	-
M6	10,0	14,0	-
M8	25,0	35,0	-
M10	49,0	69,0	-
M10x1,25	52,0	73,0	88,0
M12	86,0	120,0	-
M14	135,0	190,0	-
M14x1,5	150,0	210,0	250,0
M16	210,0	295,0	-
M18x1,5	325,0	460,0	550,0
M22	550		

DIAGRAMS OF REDUCTION UNIT AND EXPLODED VIEWS

DIAGRAM

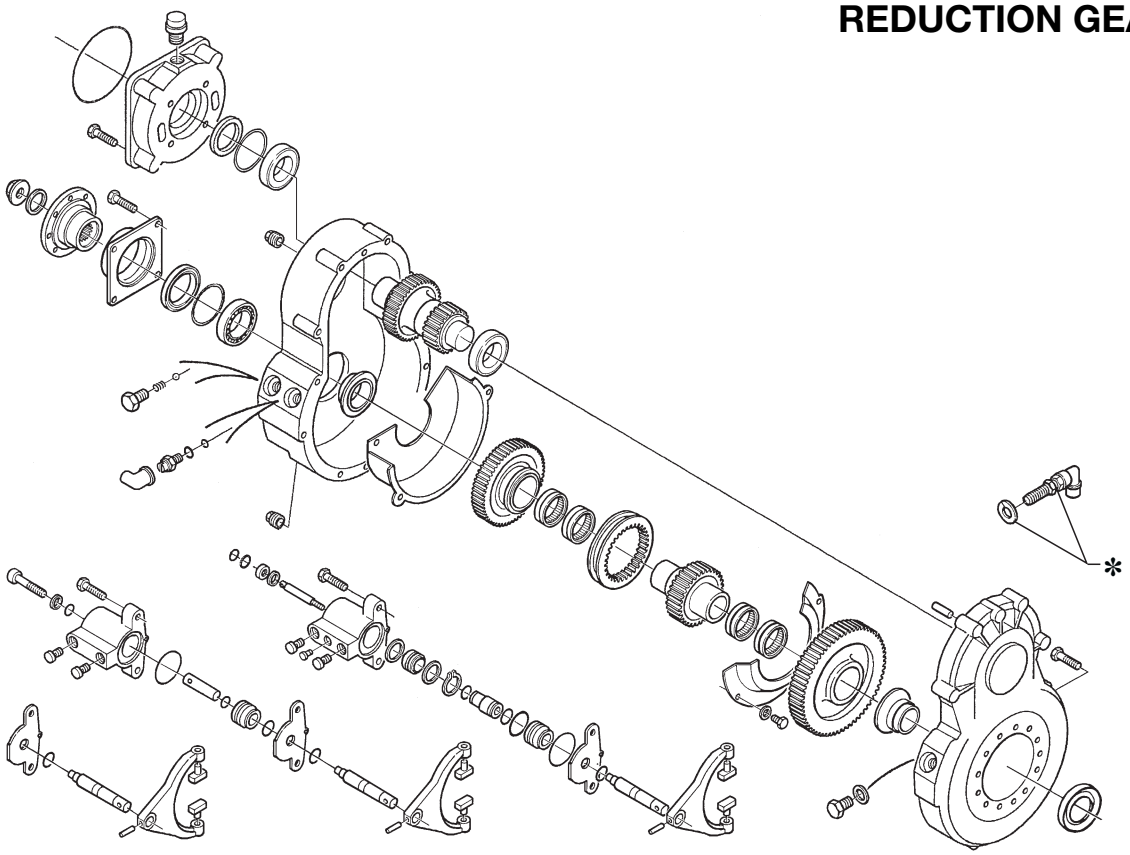


D1240001

TECHNICAL DATA

A - Connector for hydraulic gear control - Pressure required 15÷30 bar

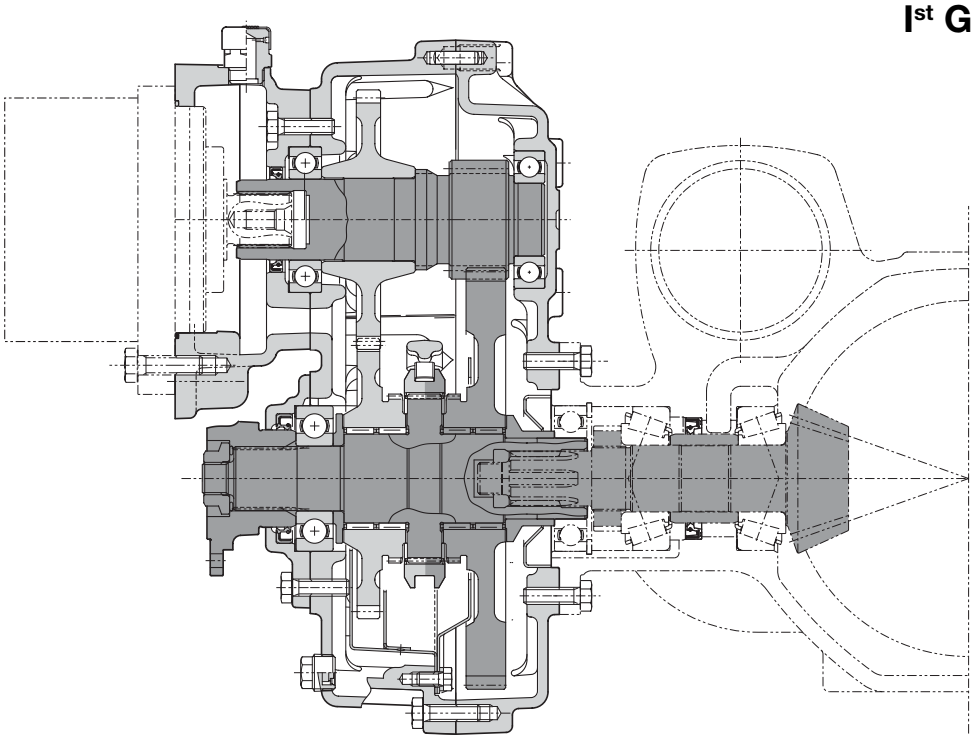
REDUCTION GEAR



*** OPTIONAL**

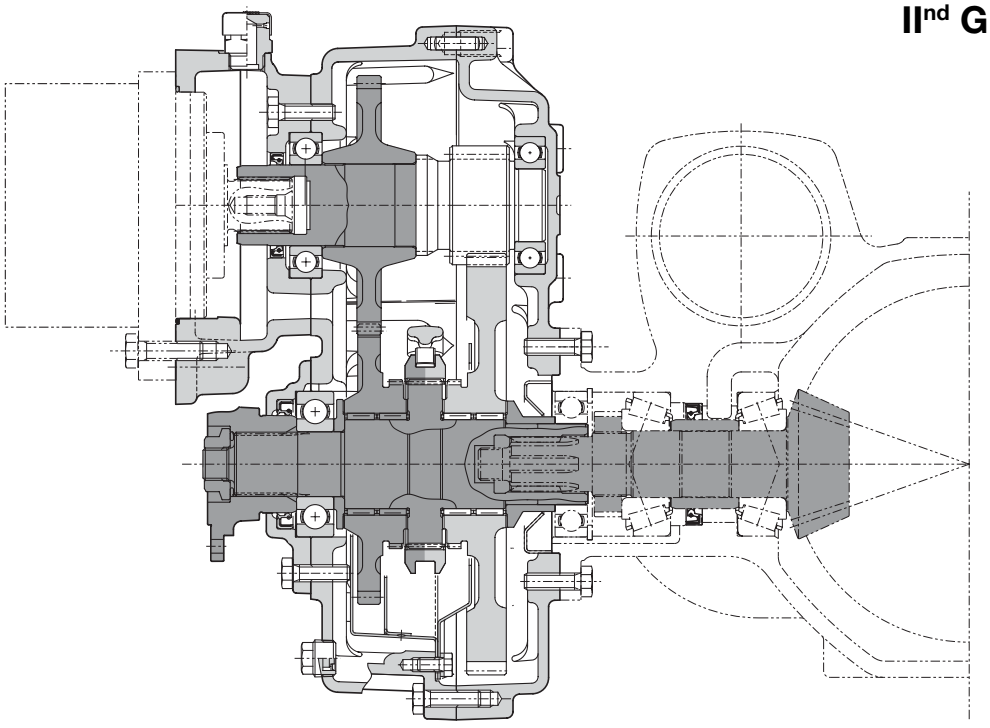
D1240012

Ist GEAR



D1240002

IInd GEAR

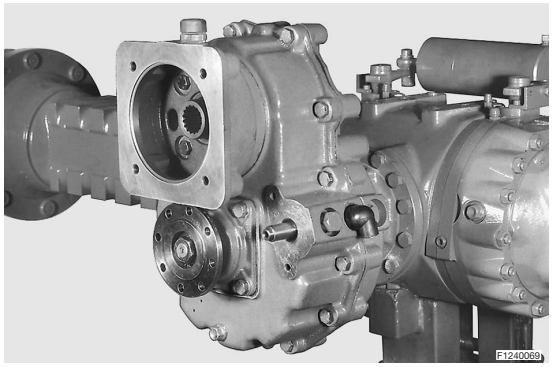


D1240003

Symbols

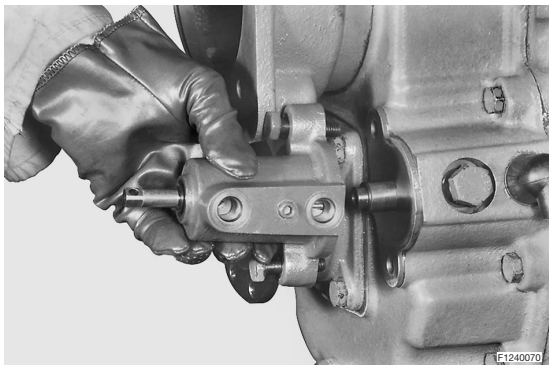
	Disassembly of assembly groups
	Reassemble to from assembly groups
	Remove obstruction parts
	Reinstall-remount parts which had obstructed disassembly
	Attention ! Important notice
	Check - adjust e.g. torque, dimensions, pressures, etc.
	T=Special tool P=Page
	Note direction of installation
	Visual inspection
	Possibly still serviceable, renew if necessary
	Renew at each reassembly
	Unlock - lock e.g. split pin, locking plate, etc.
	Lock-adhere (liquid sealant)
	Guard against material damage, damage to parts
	Mark before disassembly, observe marks when reassembly
	Caricare - riempire (olio - lubrificante)
	Drain off oil, lubricant
	Tighten
	Apply pressure into hydraulic circuit
	To clean
	Lubricate - grease

DISASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357



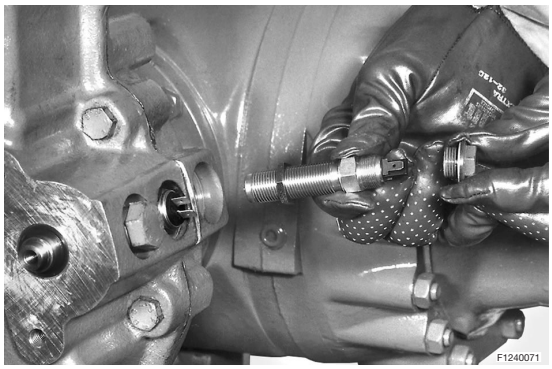
GB a

Reduction gear directly flanged on the axle with mechanic gear control.



GB b

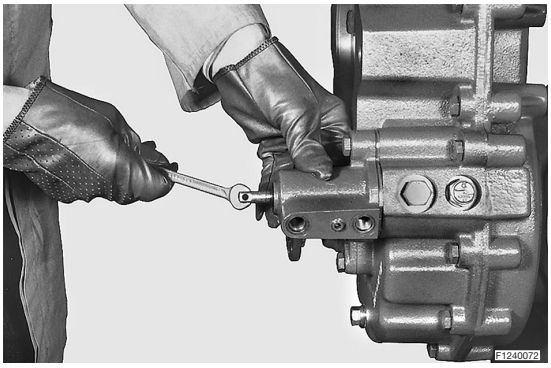
Reduction gear directly flanged on the axle with hydraulic gear control.



GB c

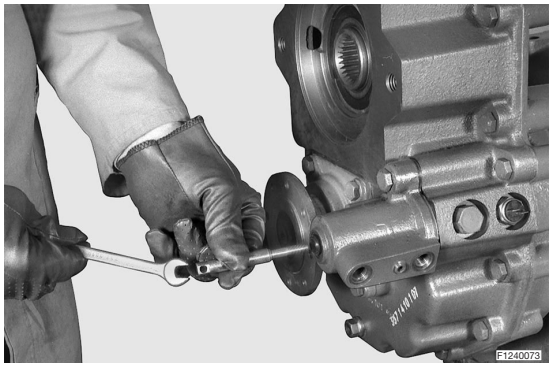
Reduction gear directly flanged on the axle with or without revolution indicator.

REMOVAL OF HYDRAULIC GEAR CONTROL



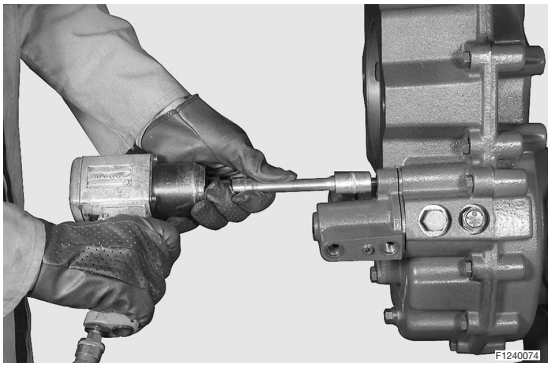
GB a

Remove the gear control rod.



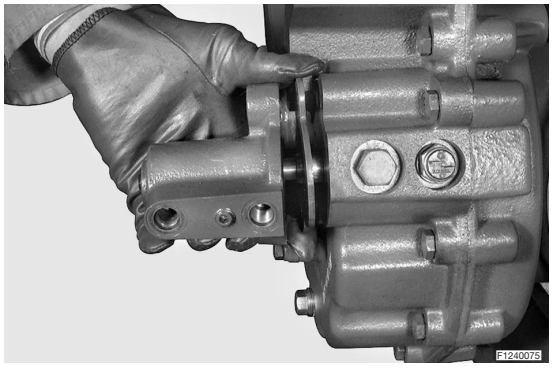
GB b

Pull out the control rod.



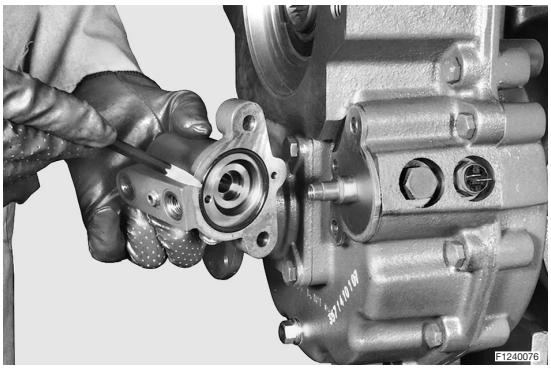
GB c

Remove screws on the gear control cylinder.



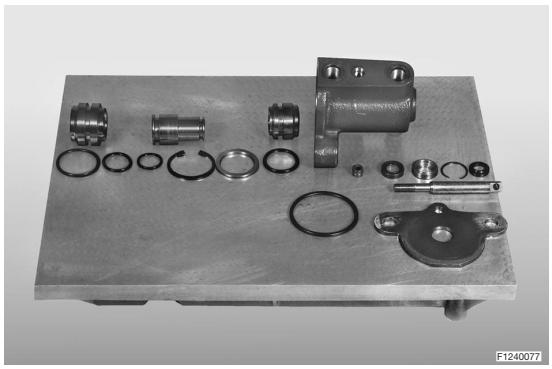
GB d

Remove the gear control cylinder.



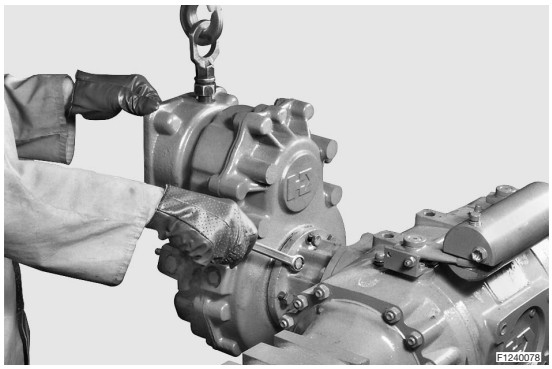
GB e

Pull out the gear control cylinder.
Pay attention to the position of the O-rings.
Remove the protection plate.



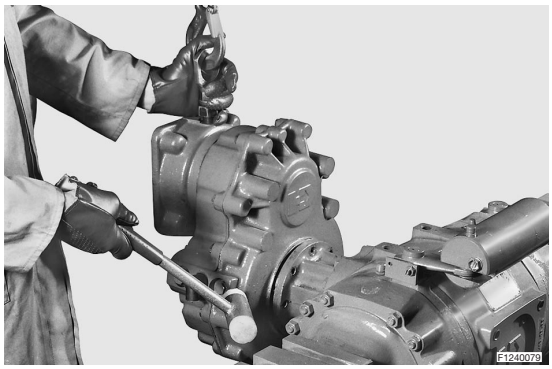
GB f

Re-assembly arrangement of gear control cylinder parts.



GB a

Remove fastening screws from the reduction unit.



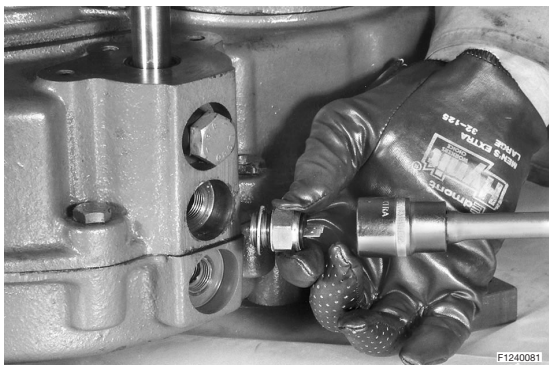
GB b

Disjoin the entire reduction unit from the axle and place it on a bench.



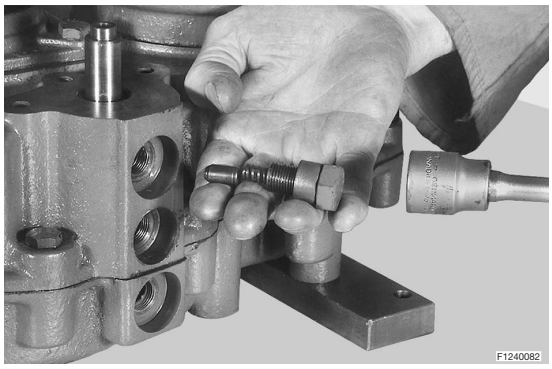
GB c

Remove the sealing cover with the relative washer or the revolution indicator.



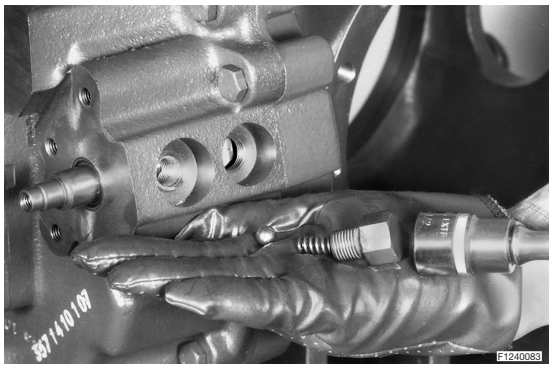
GB d

Remove gear-in position switch, O-ring and washer.



GB e

Remove screw, spring, together with gear-and-neutral position spindle (mechanical version).



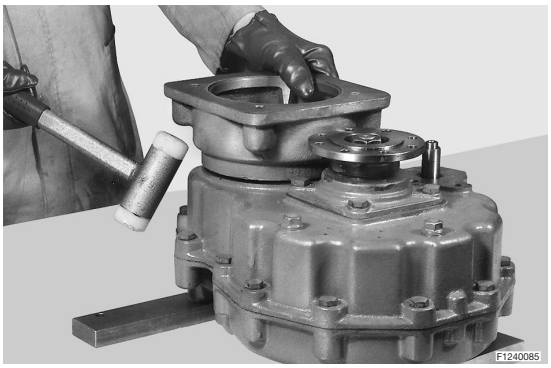
GB f

Remove screw, spring and neutral position ball (hydraulic version).



GB a

Remove screws from the motion input cover.



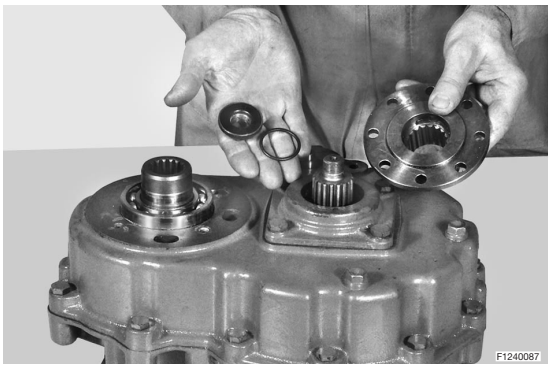
GB b

Disjoin the motion entrance cover.



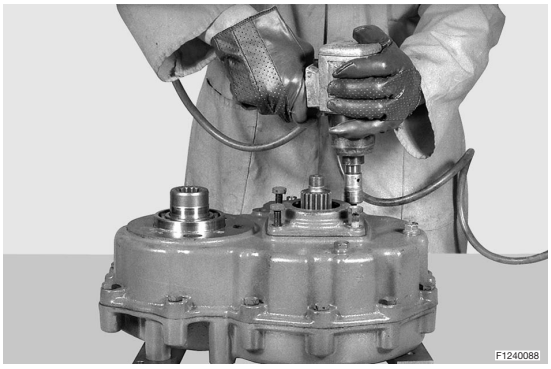
GB c

Remove the nut from the flange.



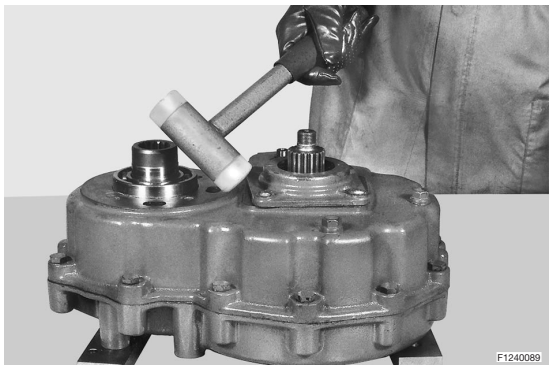
GB d

Remove the O-ring and pull out the flange.



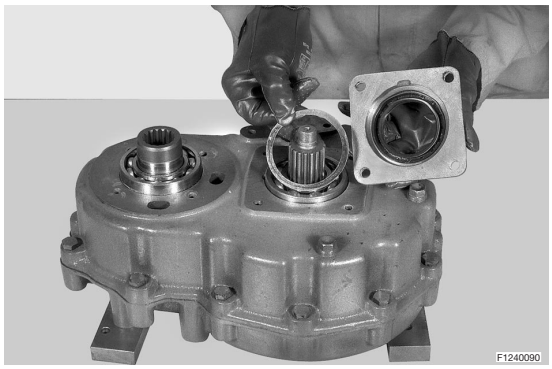
GB e

Remove screws from the cover.



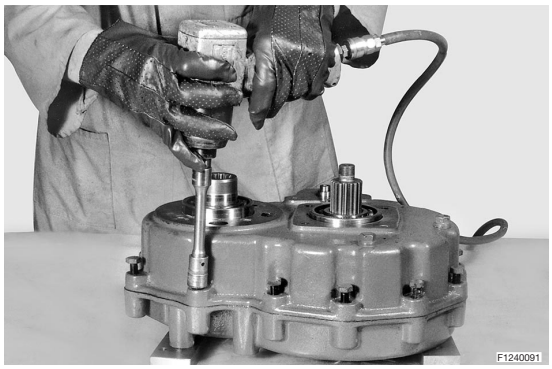
GB a

Disjoin the cover.



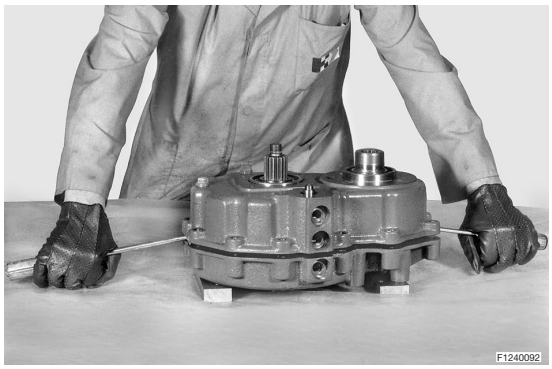
GB b

Remove the cover by fixing the distance washers onto the cover itself.
Caution: the niche must be facing upwards.



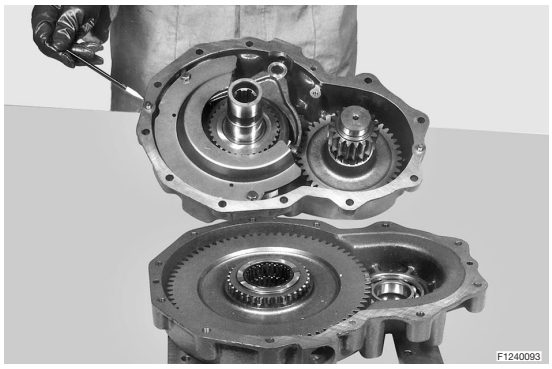
GB c

Remove screws.



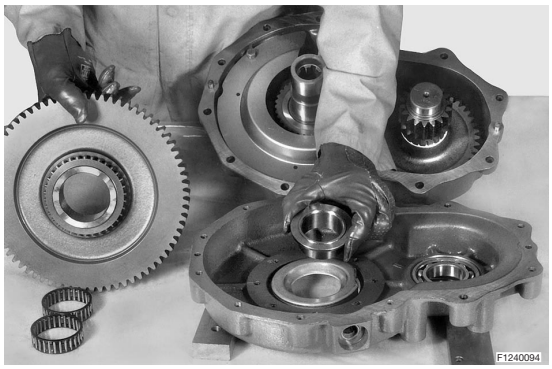
GB d

Remove the cover.
Take care not to damage planes.



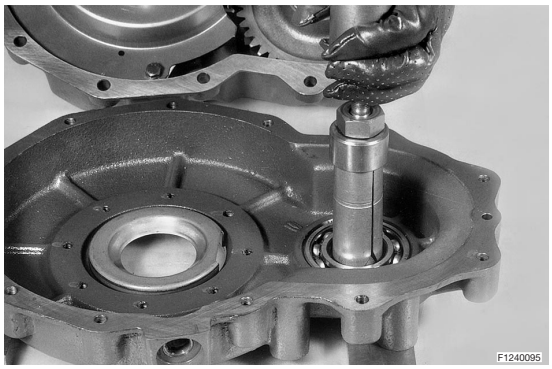
GB e

Take away the cover.
Pay attention to the position of the pins.



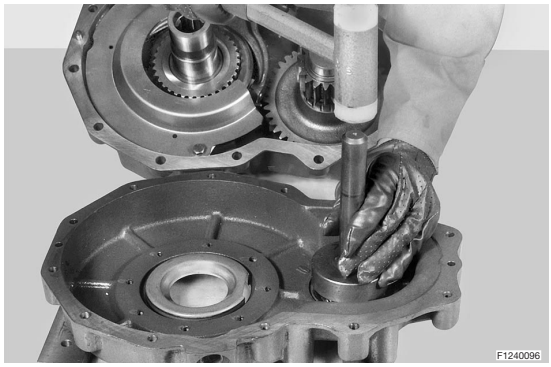
GB a

Pull out gear, needle bearings and distance piece form the box.



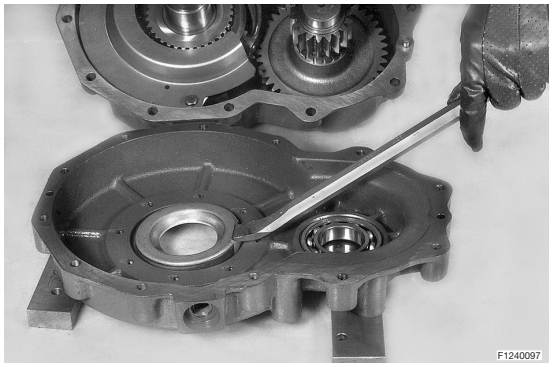
GB b

Remove the bearing if it needs replacing.



GB c

Re-introduce the bearing into the box.



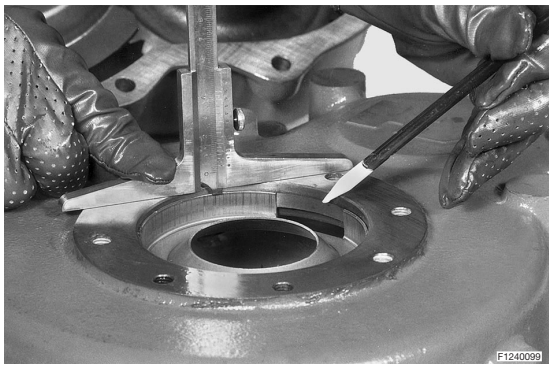
GB d

Remove the oil shield plate only if necessary.
Caution: the oil inlet must face upwards.



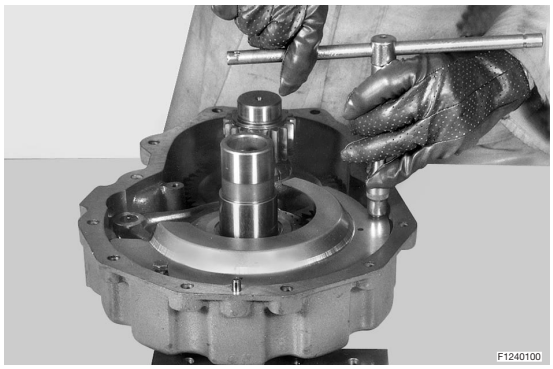
GB e

Re-introduce the oil shield plate with oil inlet facing upwards.
Apply LOCTITE 510 on the outside.



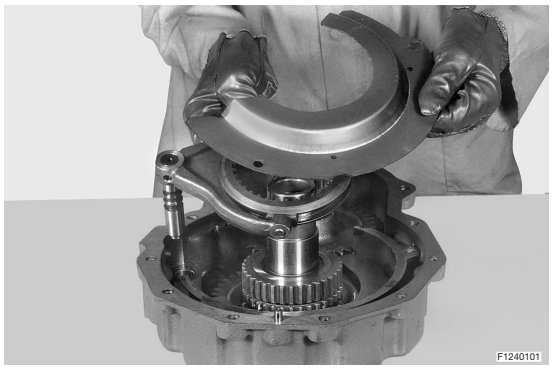
GB f

Fit the oil shield plate into position 5÷5.5 mm from box plane.



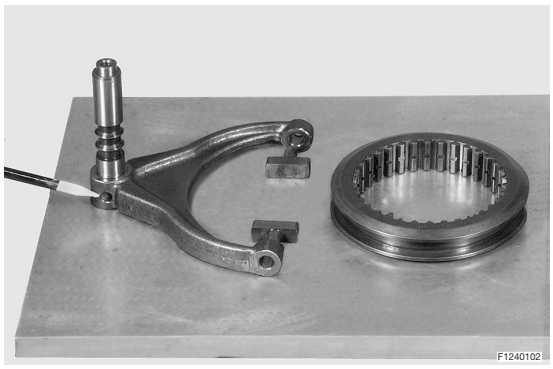
GB a

Remove the check screws from the flow regulator plate.



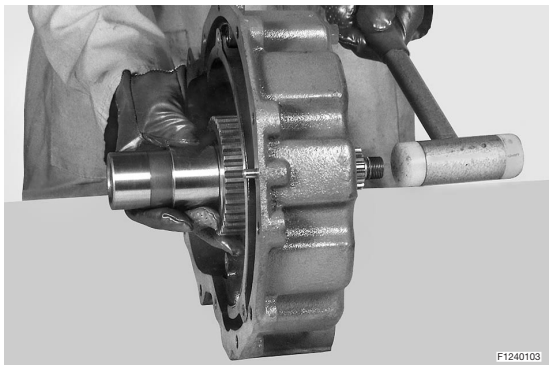
GB b

Remove the plate and pull out coupling and fork at the same time.



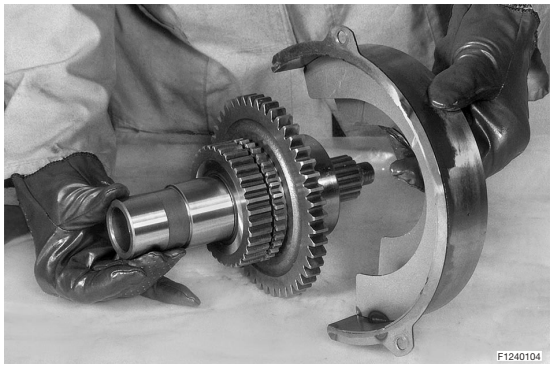
GB c

Check: sliding blocks, pin, and sliding coupling. Replace if worn.



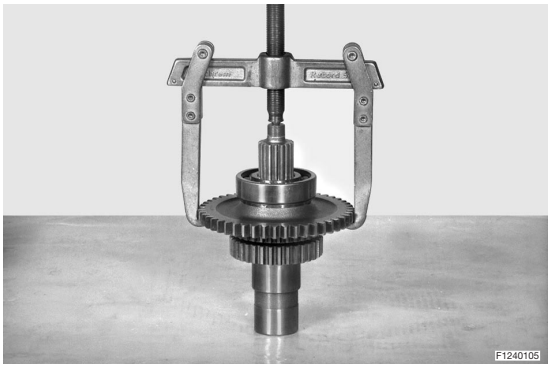
GB d

Remove the lower shaft.



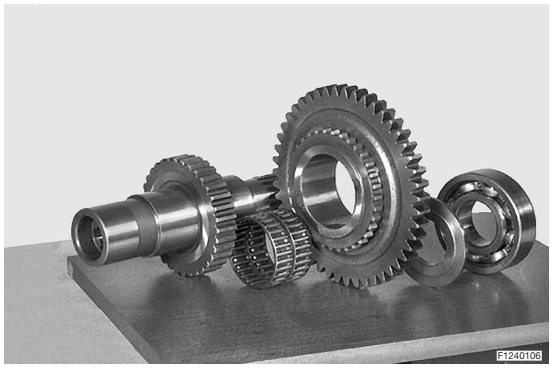
GB e

Remove the entire shaft and the flow regulator plate.



GB a

Disassembly of the entire lower shaft.



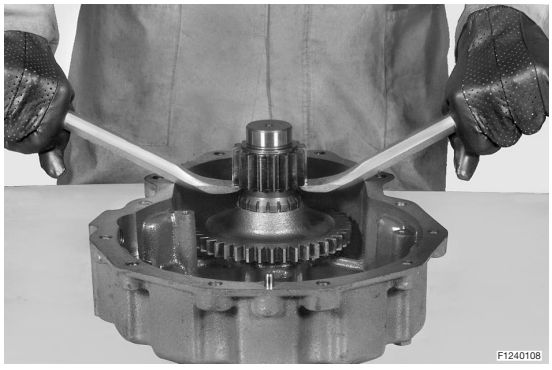
GB b

Progressive arrangement of parts fitted onto the lower shaft.



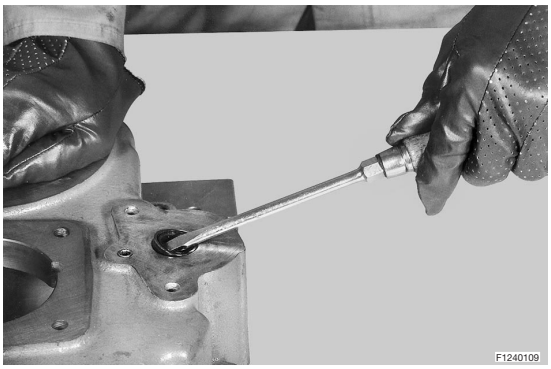
GB c

Assembly of lower shaft.



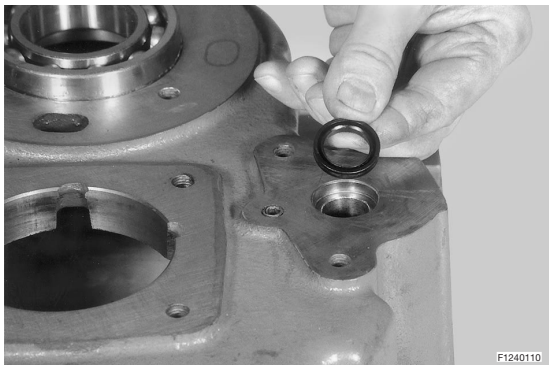
GB d

Removal of upper shaft.
(In case of replacement, the shaft is supplied already assembled).



GB e

Pull out the sealing ring.



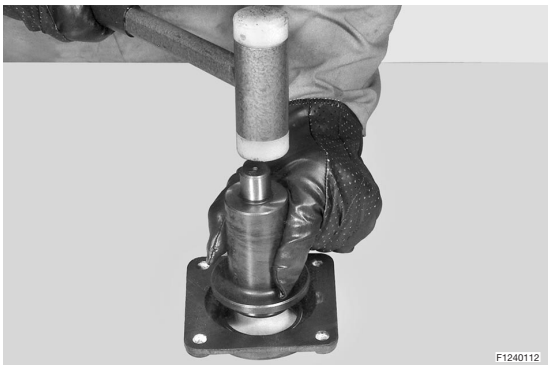
GB f

Re-insert a new sealing ring.



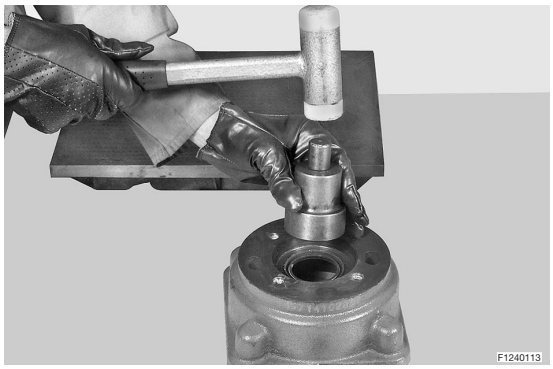
GB a

Pull out the sealing ring of the cover.



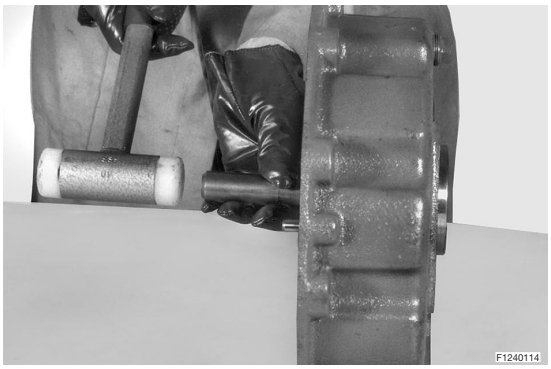
GB b

Re-insert a new sealing ring.



GB c

Pull out the sealing ring from the motion input cover.



GB d

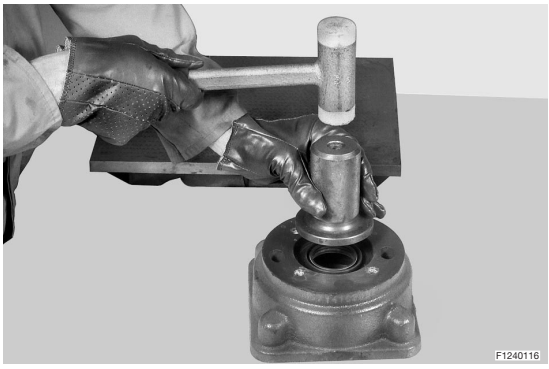
Remove the bearing from the cover of the reduction unit.

ASSEMBLY OF DIRECTLY FLANGED REDUCTION GEAR 357



GB a

Re-fit the bearing in the cover of the reduction unit using ordinary tools.



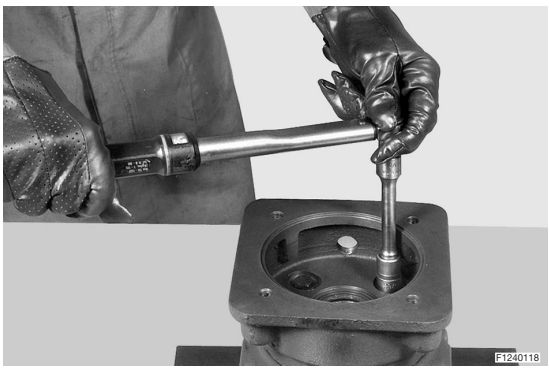
GB b

Re-insert the new sealing ring in the motion input cover.



GB c

Re-assemble the cover, spreading LOCTITE 510 on planes and screws.



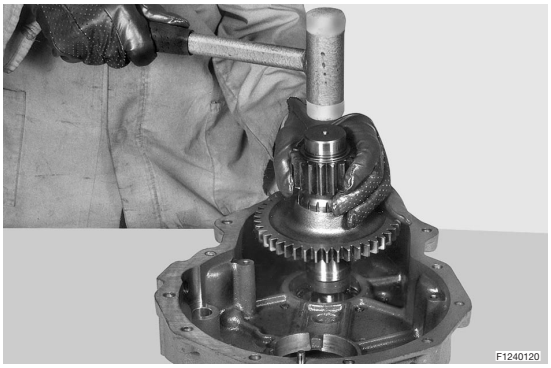
GB d

Tighten screws using a torque wrench setting of 49÷51 Nm.



GB e

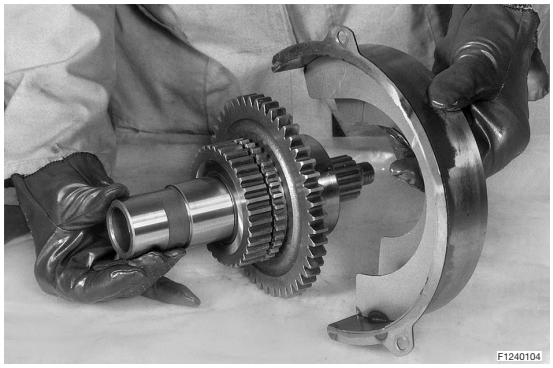
Lubricate the lip of the sealing ring with grease.



GB

a

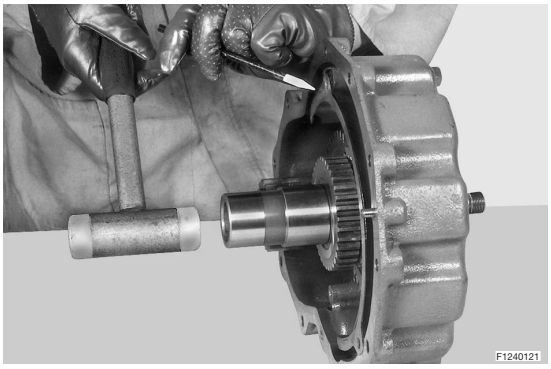
Re-assemble the motion upper shaft.



GB

b

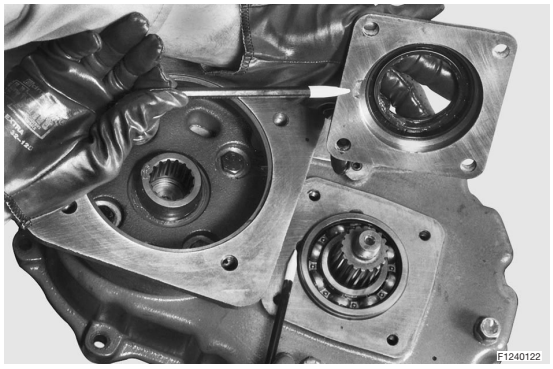
Re-assemble the full lower shaft and the flow regulator plate.



GB

c

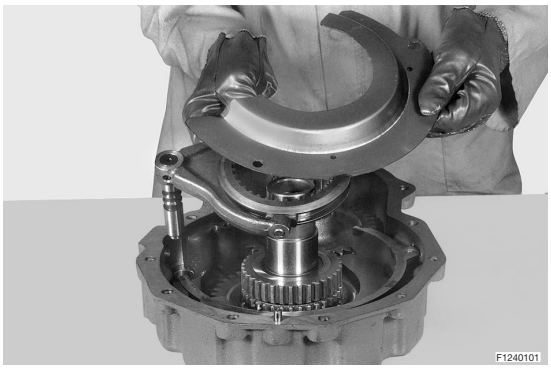
Position the shaft so that the bearing juts out approximately 5 mm from the cover of the reduction unit.



GB

d

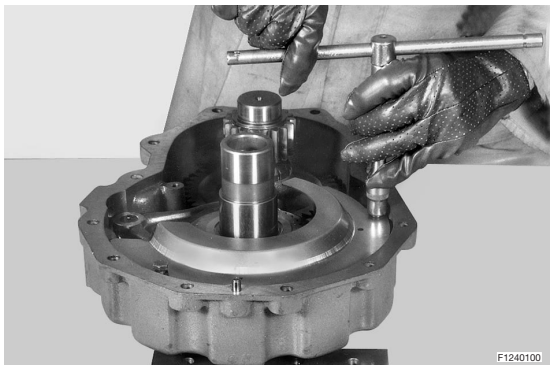
Temporarily re-assemble the cover with screws. (Be sure that the niche faces upwards).



GB

e

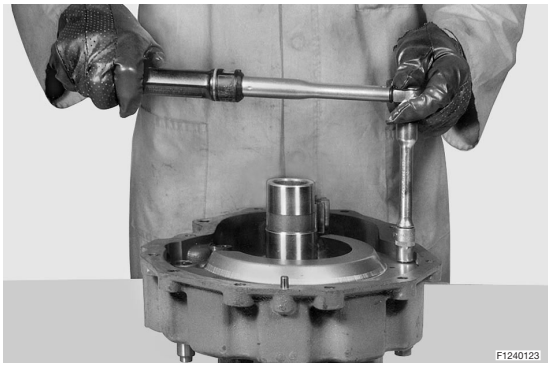
Simultaneously insert: fork and sliding blocks, coupling and flow regulator plate.



GB

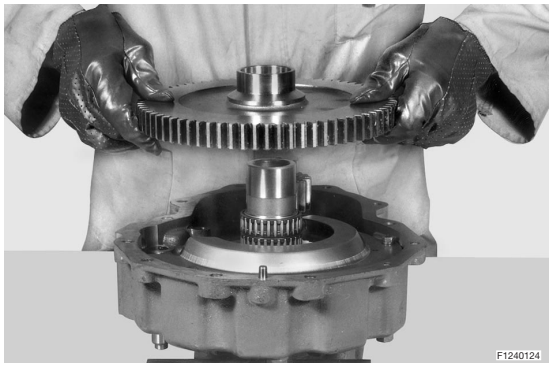
f

Re-insert screws and tighten.



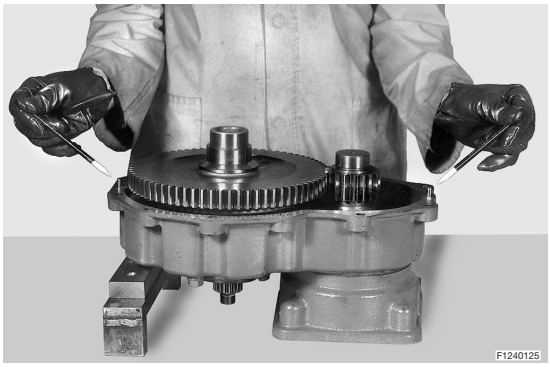
GB a

Tighten screws using a torque wrench setting of 25÷26 Nm.



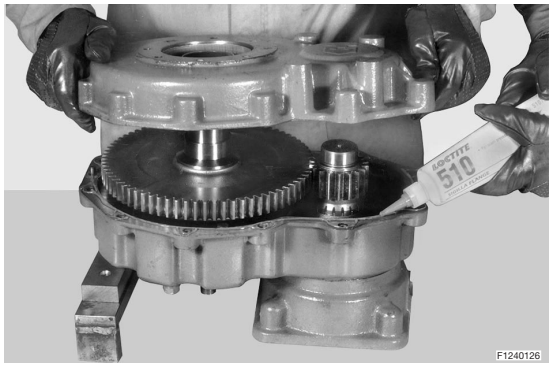
GB b

Re-assemble needle bearings, gear and distance piece.



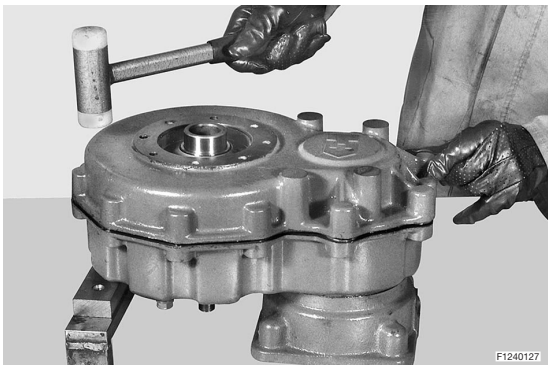
GB c

Check the insertion of pins.



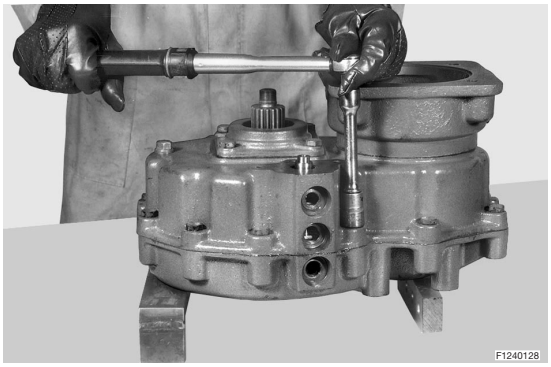
GB d

Spread LOCTITE 510 on the surface and assemble the cover.



GB e

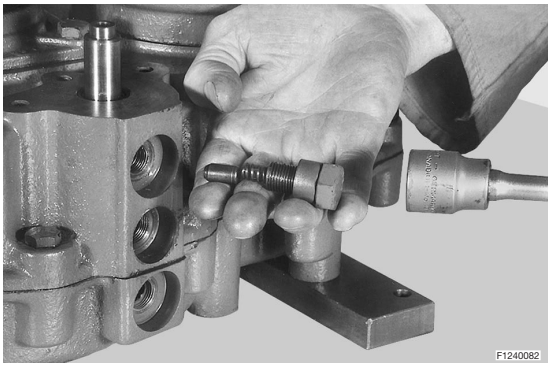
Fasten the cover.



GB

a

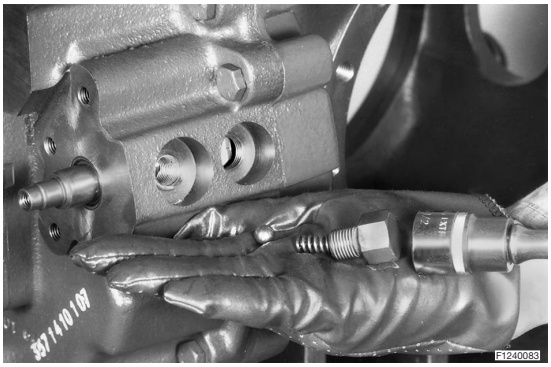
Tighten screws using a torque wrench setting of 49÷51 Nm.
Caution: tighten using the crossed method.



GB

b

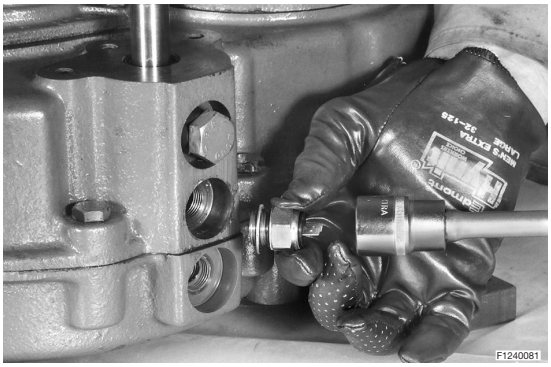
Grease components and re-introduce spindle, spring and screw (mechanical version).
Tighten using a max. torque wrench setting of 80÷100 Nm.



GB

c

Grease components and re-introduce ball, spring and screw (hydraulic version).
Tighten using a max. torque wrench setting of 80÷100 Nm.



GB

d

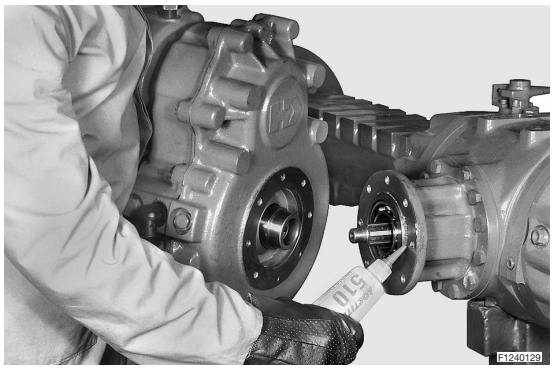
Fix the gear-in position switch with washer and O-ring.
Tighten with torque wrench setting of max. 54,2 Nm.



GB

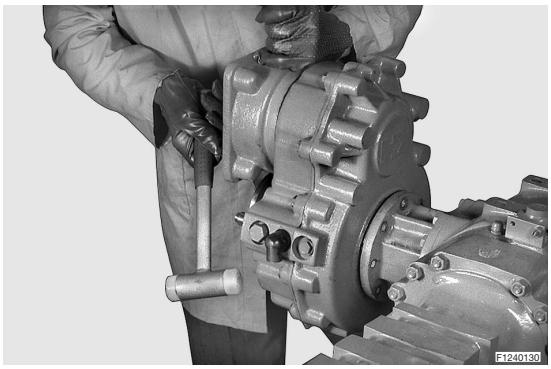
e

Assemble the sealing cover with washer and revolution indicator.
Tighten using a torque wrench setting of max. 25 Nm.



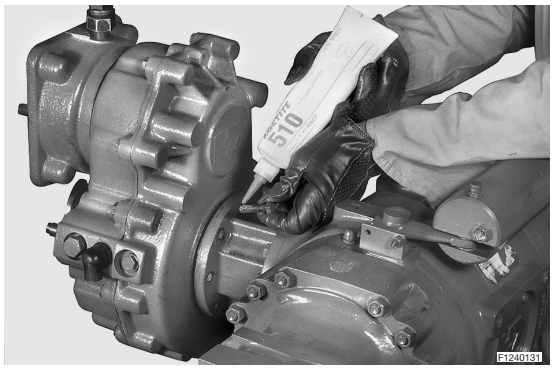
GB a

Re-fit the reduction unit onto the axle by spreading LOCTITE 510 on the planes.



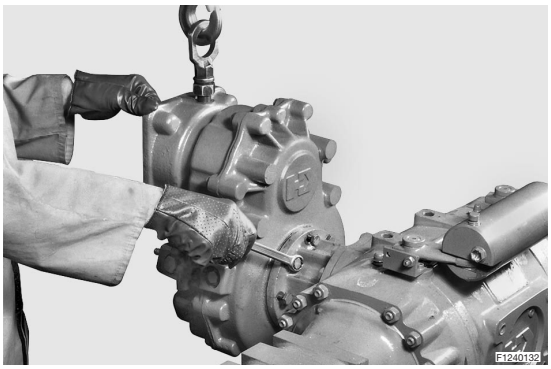
GB b

Fasten the support planes (turn flange to assist assembly).



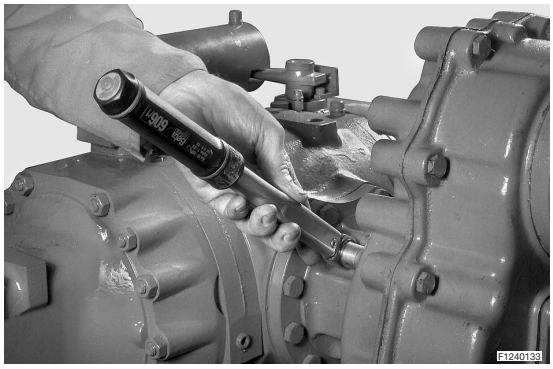
GB c

Insert screws by applying LOCTITE 510.



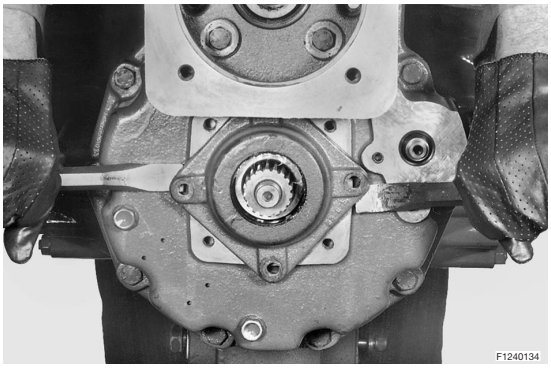
GB d

Screw down by placing the reduction unit in a vertical position in relation to the axis.



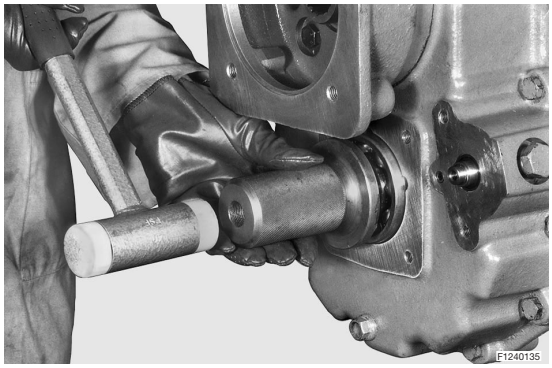
GB e

Tighten screws using a torque wrench setting of 49÷51 Nm.



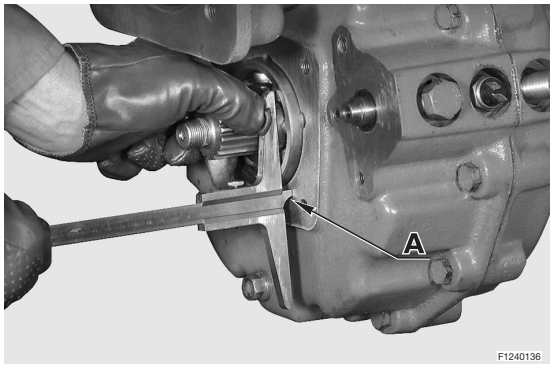
GB f

Extract screws and remove the temporarily assembled cover.



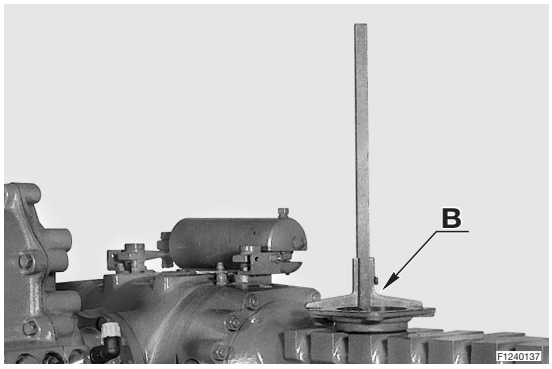
GB a

Fasten the bearing by using a standard tool.



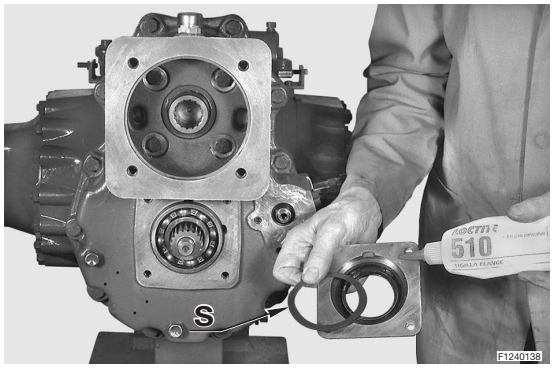
GB b

Measure dimension “A” between the bearing and the box plane using an ordinary depth gauge.
(if parts are not replaced, use disassembled distance washers).



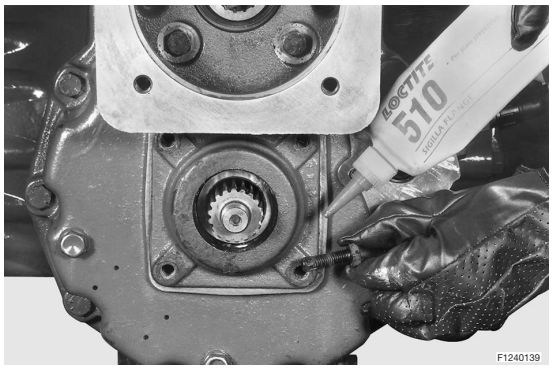
GB c

Measure dimension "B" on the cover, between the bearing plane and bearing support. Calculate the dimension of the distance washers required: S=Dimension B±Dimension A
Es: B=5,2±A=4,6 mm ± Backlash 0,2÷0,3= Distance washer required= 0,4÷0,3



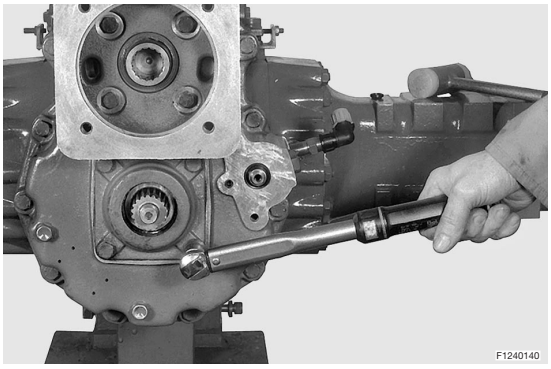
GB d

Apply LOCTITE 510 on the surface, lubricate the sealing ring, insert the distance washers and re-assemble the cover with niche facing upwards.



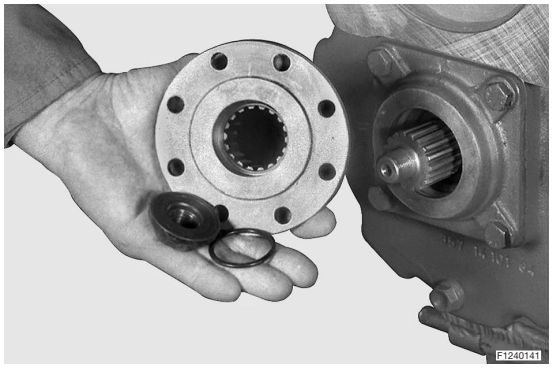
GB e

Fit screws after applying LOCTITE 510.



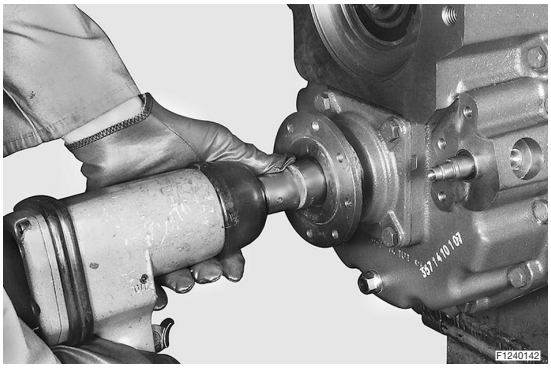
GB a

Tighten screws using a torque wrench setting of 49÷51 Nm.



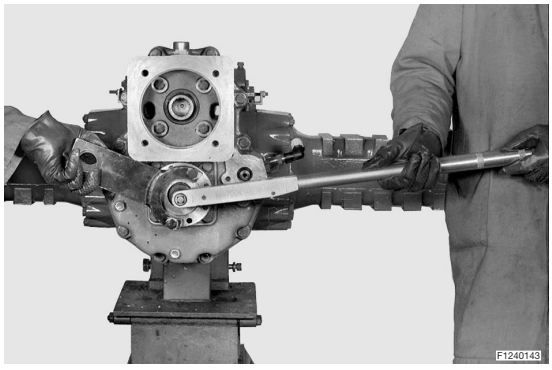
GB b

Assemble flange, O-ring and nut using LOCTITE 242.



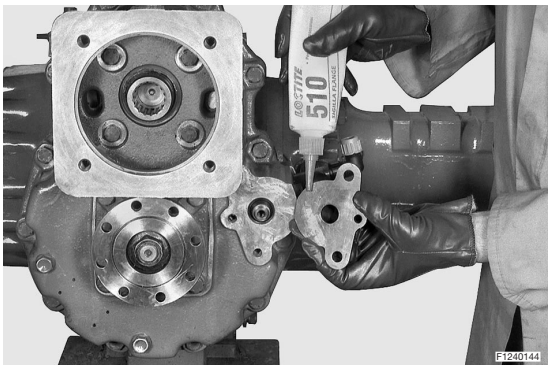
GB c

Screw down the nut of the flange.



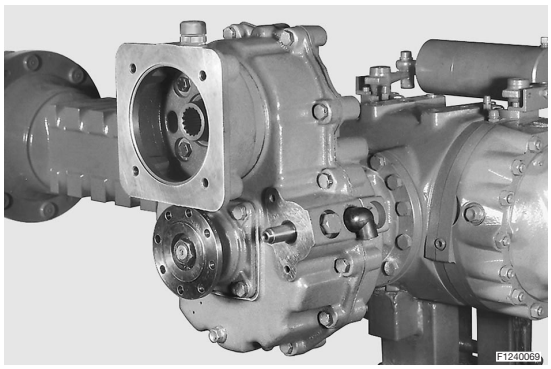
GB d

Tighten the nut using a torque wrench setting of 260÷280 Nm.



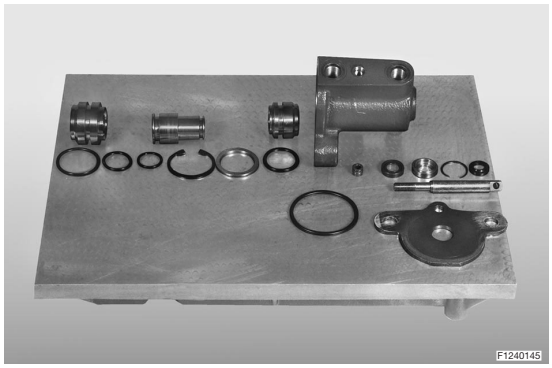
GB e

Re-fix the protection plate after applying LOCTITE 510.



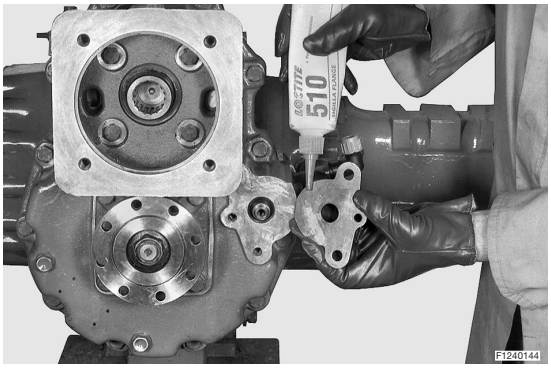
GB f

Complete flanged reduction gear 357 with mechanical gear control.



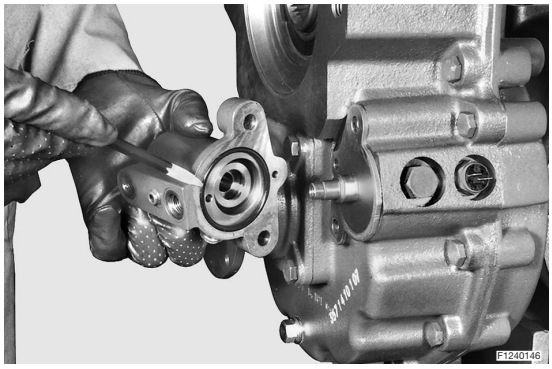
GB a

Re-assemble all the parts of the gear control cylinder, according to their arrangement.



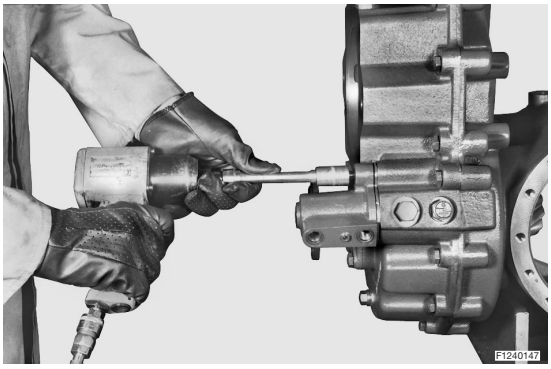
GB b

Re-fix the protection plate after applying LOCTITE 510 on it.



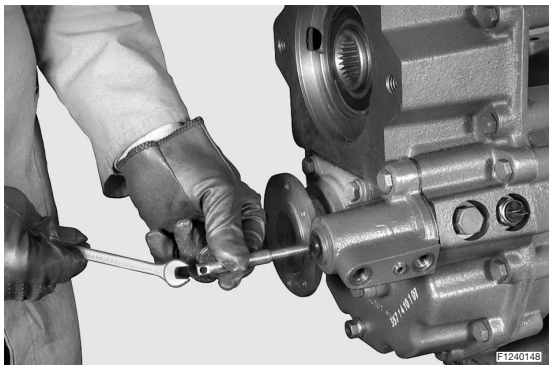
GB c

Re-fit the gear control cylinder into place with its O-ring.



GB d

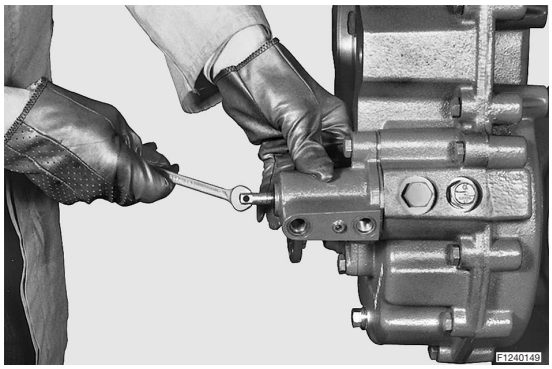
Re-fit screws and screw down.



GB e

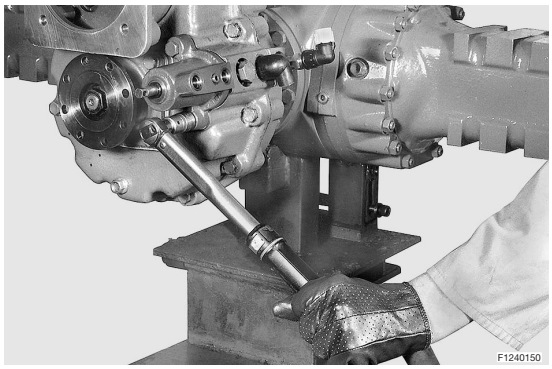
Re-introduce the gear control rod after applying LOCTITE 242 on it.

INSTALLATION OF HYDRAULIC GEAR CONTROL



GB a

Tighten the gear control rod using a torque wrench setting of 25÷26 Nm.



GB b

Tighten gear control cylinder screws using a torque wrench setting of 49÷51 Nm.

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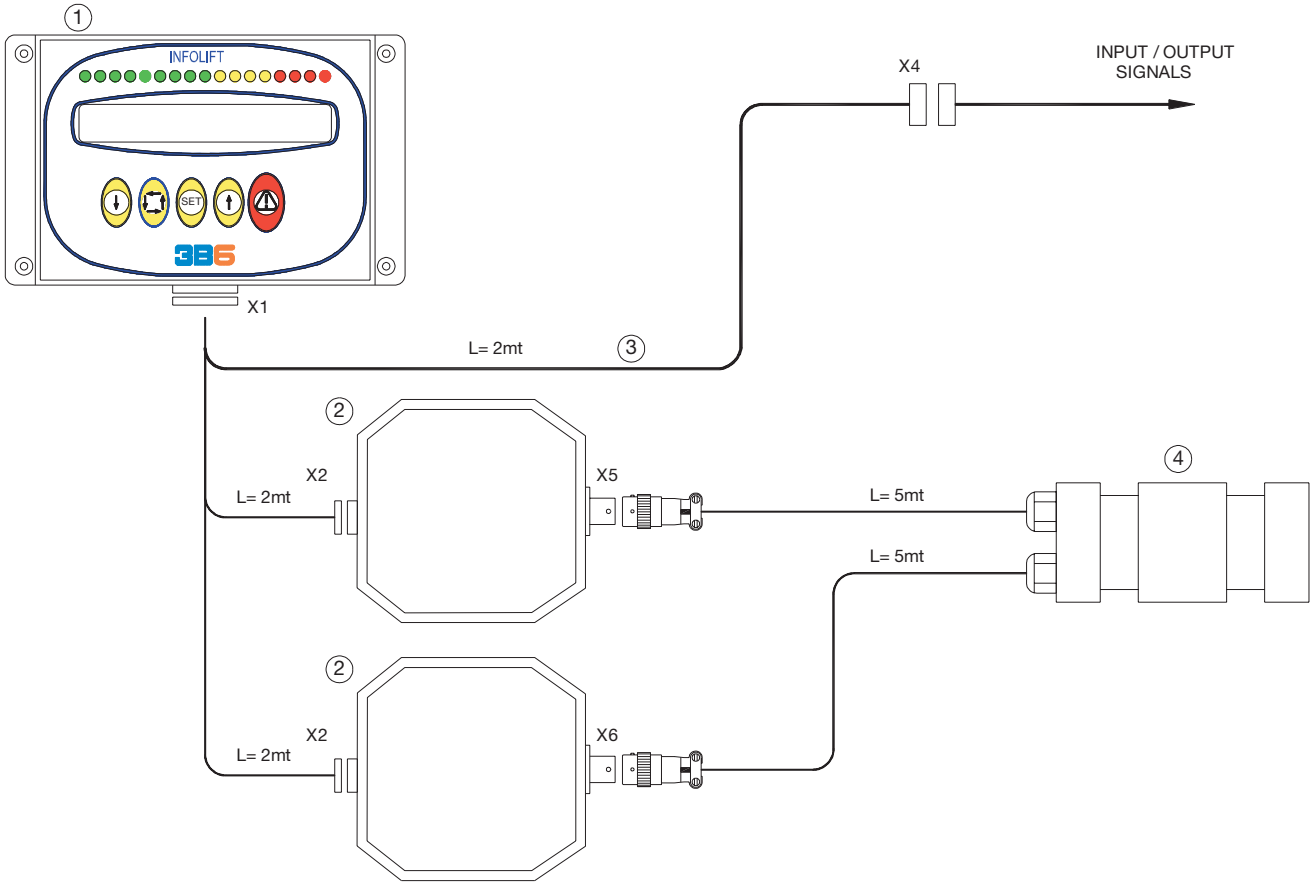
Section O
3B6
OVERLOAD WARNING SYSTEM

Valid for Telelift 3013 (from serial no. 9408) - Telelift 3517 (from serial no. 9363)

SECTION INDEX

SYSTEM LAY-OUT AND CONNECTIONS 2
COMPONENTS LOCATION ON THE MACHINE 3
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INFOLIFT MAIN UNIT: DIMENSIONS 5
LOAD CELL AMPLIFIER: DIMENSIONS, CHARACTERISTICS 6
CONTROL PANEL DESCRIPTION 7
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PANEL MONITORING 9
AUTO-DIAGNOSTIC 11
ALARM CODES AND ACTIONS TO TAKE 12
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SYSTEM LAY-OUT AND CONNECTIONS



Ref.	Quantity	Title/Name	Article
1	1	INFOLIFT MAIN UNIT	INFOLIFT-4/XX
2	2	LOAD CELL AMPLIFIER	ACC-JB2/XX
3	1	CABLE	CV2 ILFST/XX
4	1	LOAD CELL	Y11 PRV-10000

COMPONENTS LOCATION ON THE MACHINE



Infolift main unit

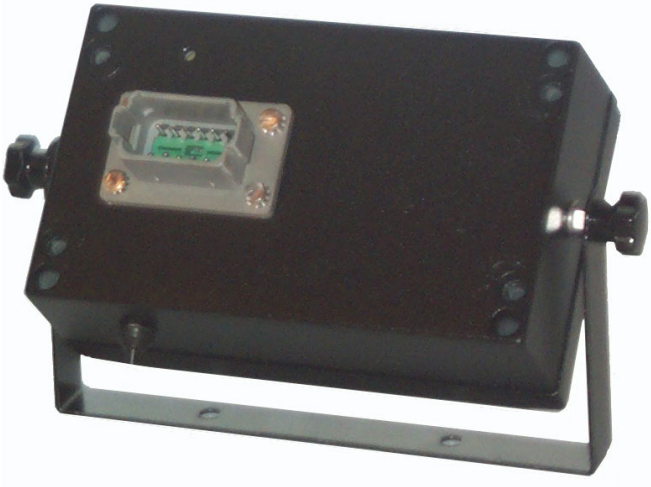
Load cell amplifier

Load cell pin

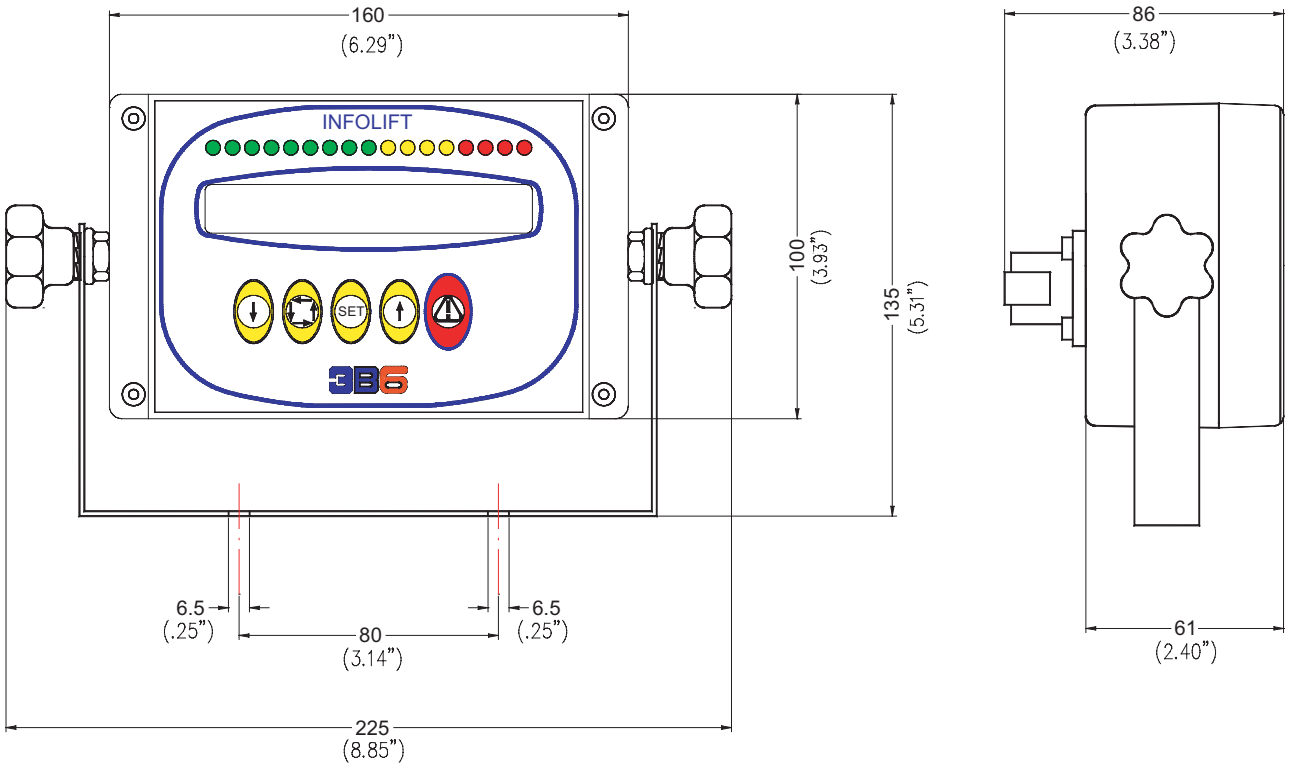
INFOLIFT MAIN UNIT: CHARACTERISTICS

- LCD alphanumerical back-lit display, 16 characters, 9.6 mm (.37”) height.
- Limit load percentage 20 LED’s bar (extended version).
- 4 pushbuttons, for limit setting, buzzer enable/disable, test activation and set-up functions.
- Red alarm lamp.
- Power supply: 10 to 30 V, protected against short circuits and polarity reverse.
- Full EMC “Heavy Duty” compliance.
- Environmental: suitable to work in Harsh Environments.
- Degree of protection: IP 65; PCB’s coated with thermoplastic varnish.
- Dimensions: 160x100x60 mm (6.29”x3.93”x2.36”) housing
- System supervision: FLASH ROM and EEPROM power on test, supply voltage, sensor integrity, relay status checks, dynamic “ Emergency” Output.

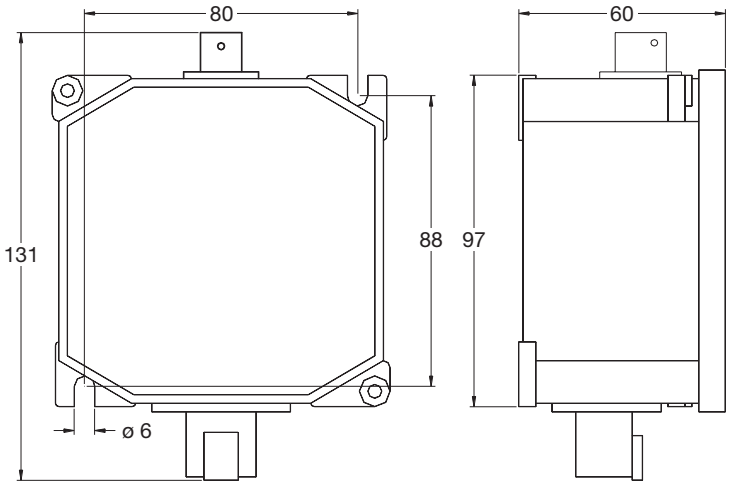


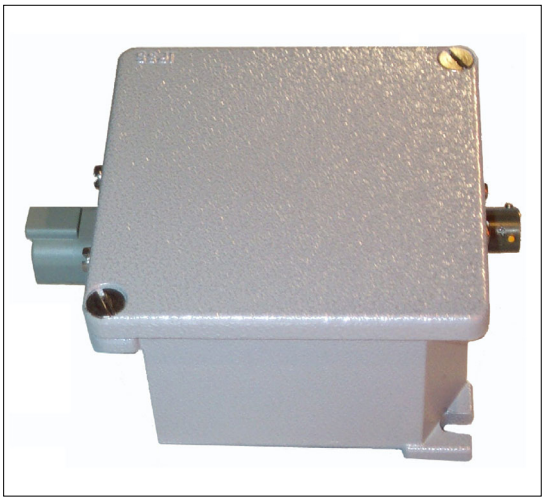


INFOLIFT MAIN UNIT: DIMENSIONS



LOAD CELL AMPLIFIER : DIMENSIONS, CHARACTERISTICS





CHARACTERISTICS

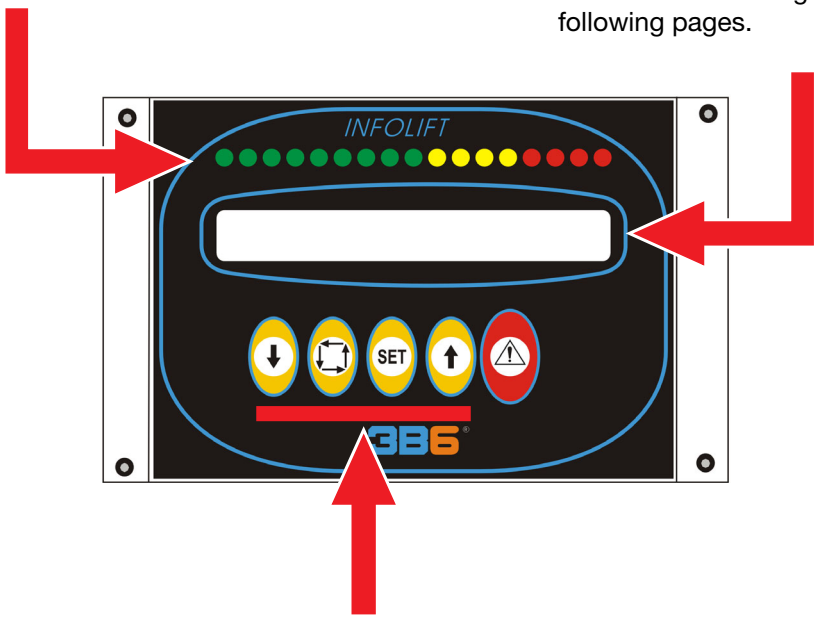
- Power Supply: 10-30 Vdc (from battery)
- Working Temperature: -20 ÷ +70°C (-4°F÷158°F)
- Input Voltage: 0 ÷ 20mV
- Output Voltage: 0,5 ÷ 4,5V
- Degree of protection: IP 65

CONTROL PANEL DESCRIPTION

Green/Amber/Red Led's bar showing the current load percentage (SWL) (Safety/ Alarm/Shutdown).
Load percentage Led Activated Conditions:

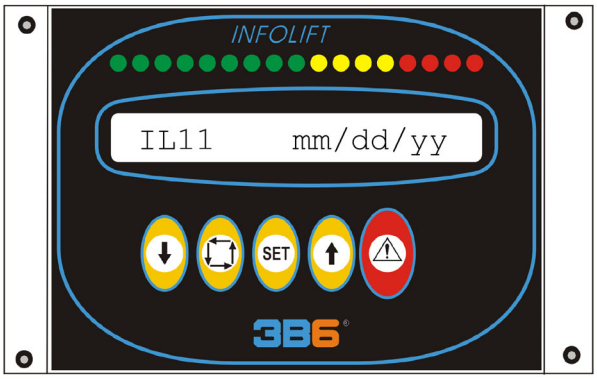
- 0% < 90 % Green, Normal Operating area
- 90% to 100% Yellow, Pre-warning area
- > 100 % Red, Overload area

16 character alphanumeric display for working messages and calibration menu. The list of all messages is shown in following pages.

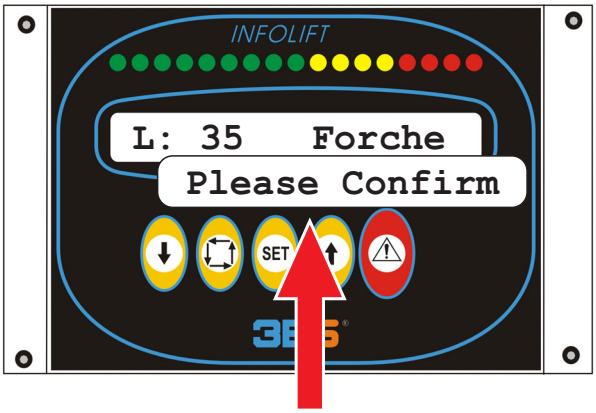


4 Set-up Pushbuttons

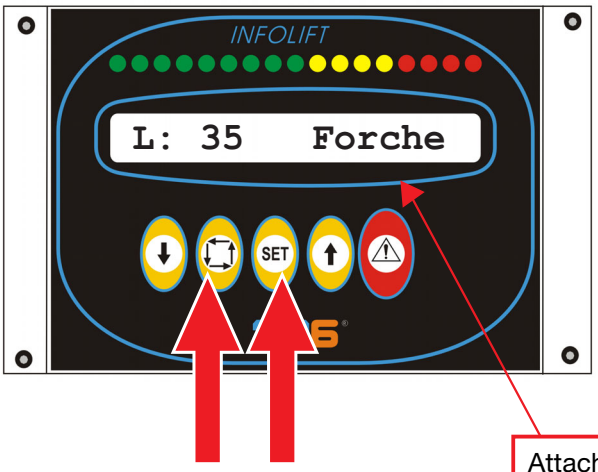
SWITCHING THE MACHINE ON



When the machine is started, the system is automatically activated and the installed software version and relevant issue date appear for a few seconds on the display (dd.mm.yy).



Acknowledgement of the attachment is then requested. During this operation the system is automatically blocked. If the working condition of the machine is correct, confirm pressing SET.

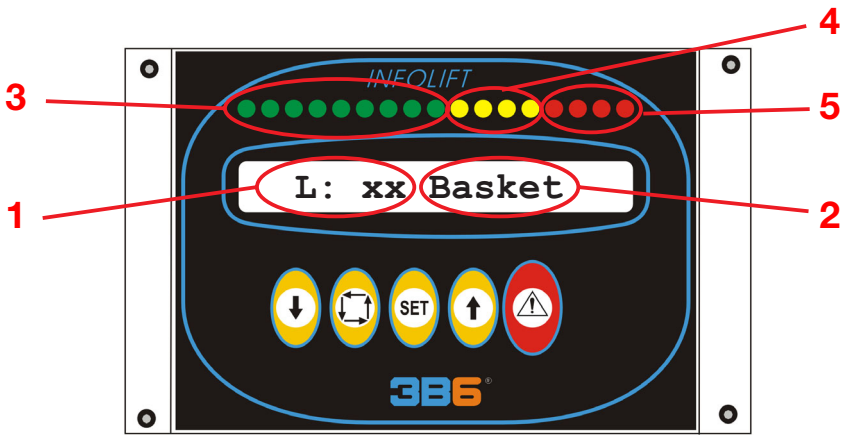


If the operating conditions have been changed, it is necessary to set the correct attachment as follows:

- Repeatedly press the INDEX key to select the right table; one of the available accessories will be selected in sequence, each time the key is pressed.
- After selection of the right table, press the SET key to confirm the selection and enable the control.

Attachments available:
Forks
Basket
Winch
Jib

PANEL MONITORING
Lifting Conditions % and alarms.



1) L: xx = is the percentage of the overturning moment with respect to the limit value.

2) Basket = is the attachment actually used.

3) Green LED's = these will light up when the percentage of the overturning moment ranges between 0 and 89%, corresponding to normal operating conditions.

The sound alarm is disabled in safety conditions.

4) Yellow LED's = These will light up when the percentage of the overturning moment with respect to the limit value ranges between 90 and 100%, corresponding to the pre-alarm condition.

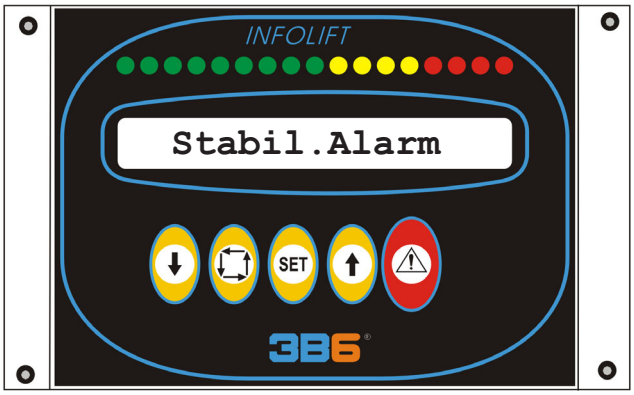
In pre-alarm, the sound alarm is intermittently activated.

5) Red LED's = These Leds light up when the percentage of the overturning moment exceeds 100% and the system is blocked.

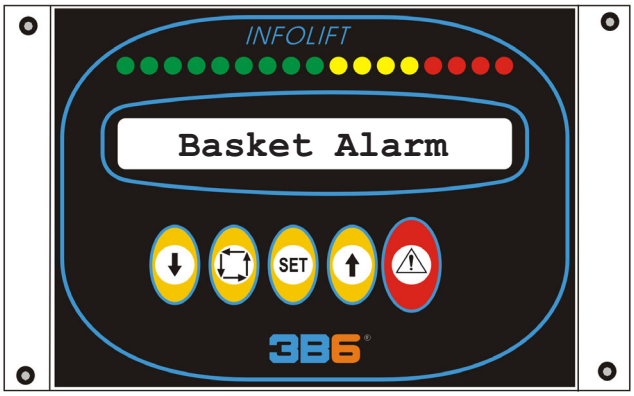
In this condition, the sound signal is activated continuously while lowering and extension are inhibited.

PANEL MONITORING

Working alarms:



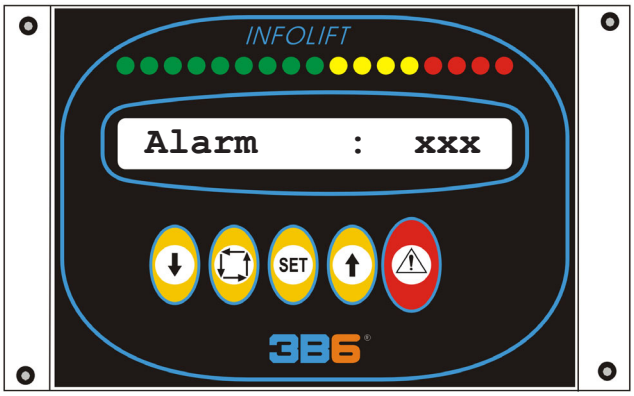
This message is displayed when the Basket is selected as an accessory and the outriggers are not lowered to the ground.
Lower the outriggers to the ground.



This message is displayed when an attachment other than the man-platform is selected but the latter is actually installed.
Select the Basket from the accessories.

AUTO-DIAGNOSTIC

The LMI is equipped with an auto diagnostic system which is able to detect faulty pressure transducers, or boom angle/length sensors, broken cables or internal electronic faults.
When an alarm occurs, the LMI puts itself in a safe condition stopping the dangerous movements and at the same time the display shows an alarm message on the first row.
According to alarm code and message, it will be possible to identify the fault.

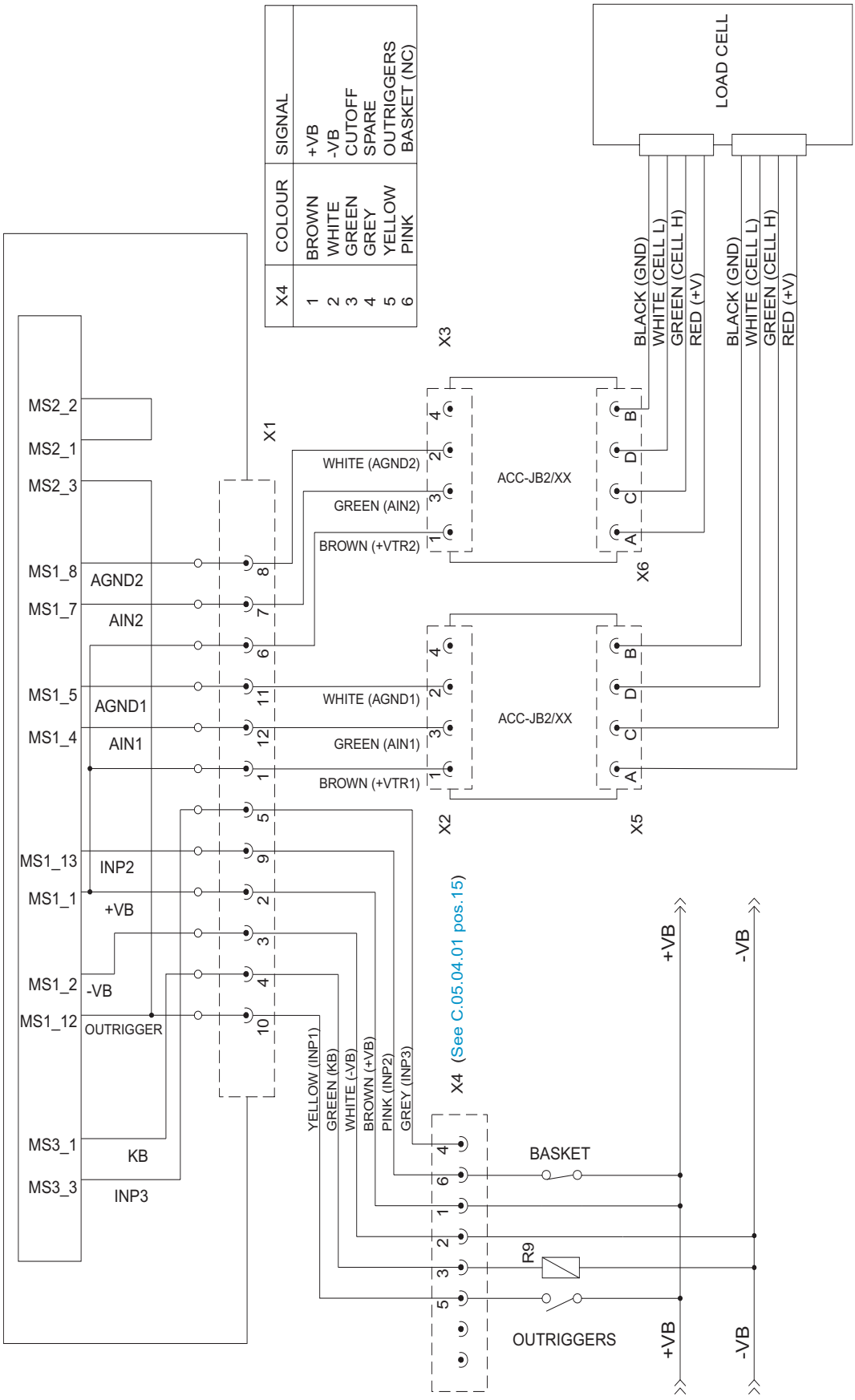


The codes are reported in the following list, that also includes some hints to solve the problem and get back to normal working conditions.

ALARM CODES AND ACTIONS TO TAKE

Alarm codes	Description	What to do
1	E2PROM Error	Switch the system OFF and ON. If the alarm persists, please, contact TEREX Technical Assistance to: Recalibrate the machine
2	Reading of the Load Cell 1 higher than the maximum value.	Check the wiring from INFOLIFT / Amplifier and from Amplifier / Load. Verify that the wiring and the connectors are not in short circuit. If the alarm persists, please, contact TEREX Technical Assistance to: Verify the load cell integrity.
4	Reading of the Load Cell 2 higher than the maximum value.	Check the wiring from INFOLIFT / Amplifier and from Amplifier / Load. Verify that the wiring and the connectors are not in short circuit. If the alarm persists, please, contact TEREX Technical Assistance to: Verify the load cell integrity.
8-16-32-64-128	Fault in Cut-off Relay	Hardware Fault. Please, contact TEREX Technical Assistance.
256	Load Cell 1 and Load Cell 2 consistency	Verify the Load Cells integrity.
512	CHECK SUM Error	Please, contact TEREX Technical Assistance.
1024	Outrigger Consistency	Check Input. Please, contact TEREX Technical Assistance.
2048	A.D.C. reading Fault	Please, contact TEREX Technical Assistance.

EXTERNAL WIRING



WARNINGS

- The LMI is an electronic device designed to help the operator in the current use of the machine, warning him of imminent dangerous conditions by means of visual and acoustic signals.
- However this device can't replace the operator's experience in the safe use of the machine.
- The responsibility of the operations in safe conditions of the machine is up to the operator as well as the accomplishment of all prescribed safety rules.
- The Operator must be able to detect if the data given by the LMI are correct and correspond to actual working conditions.
- He must be able to use the data given by the LMI in order to operate in safe conditions at any time.
- The LMI is an electronic device including several sensing components, therefore it can be subject to failures or defects.
  The operator must recognise these events and take proper actions (repair if possible or call TEREX Assistance).
- Before starting the operations with the machine, the user must read this manual from front to back and obey its instructions at any time.
- The LMI is supplied with a key to by-pass the shutdown function.
- In normal working operations, this key must not be positioned to by-pass shutdown.
- It is forbidden to use the key to lift loads exceeding the load values allowed by the Manufacturer.
- The key can only be used in an emergency, in case of malfunctioning or whenever a situation justifying its use occurs.
- Only Authorised Personnel is allowed to use the key; these people are also responsible for it.
- The LMI has a powerful FAIL -SAFE autodiagnosis program suitable to verify its good operation and the efficiency of its transducers.
  If a trouble is detected, the LMI puts itself in a safe state stopping the manoeuvres (see the **AUTODIAGNOSTIC** chapter).
- Notwithstanding this, before starting the operation with the machine, the Operator must check that the LMI is *working correctly*.
  To do this, he must verify the validity of the displayed values doing some tests.
  He must verify that there are no messages or alarm indications; he must verify the correct operation of the manoeuvre stopping functions.
  The operator is responsible for the correct setting of the machine load table and therefore for the right LMI setting.
- When the machine is started, the last selected Table is kept valid to enable the Operator to check.
  For this check, refer to the instructions given in the **ATTACHMENTS SELECTION** chapter.
  An incorrect setting of the tables can cause an incorrect operation of the LMI and lead to a dangerous situation for the machine.
- Operating conditions usually change when:
  Attachments are fitted or removed (jib, winch, basket, forks) and the relevant Table selecting mode is set on the control panel.
  Outriggers Extension / Withdrawn, Turret Front/360° rotation, On Wheels/Outriggers, Operating Modes are set in automatic way by micro-switches.

As a general rule, it is compulsory to follow the Manufacturer's instructions and procedures at any time.