TEREX LIFTING™

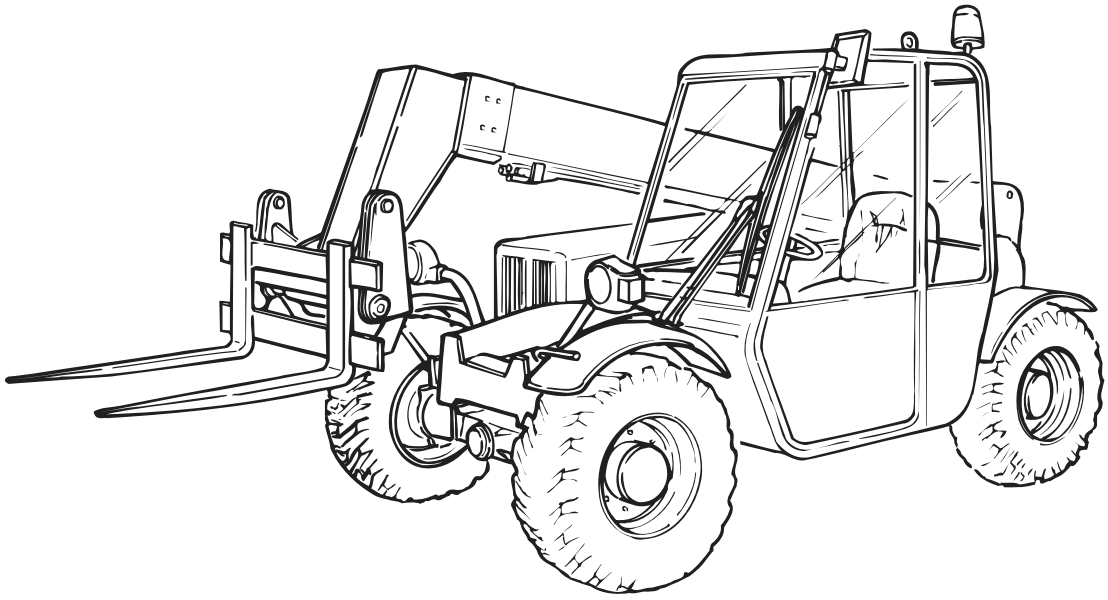
TEREXLIFT s.r.l.

WORKSHOP MANUAL

Code 57.4400.3200 - 1st Edition 09/2002

Handler with telescopic boom

TELELIFT 2306



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.*

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MANUAL CONTENTS

Sect. A GENERAL INFORMATION

Sect. B SAFETY REGULATIONS

Sect. C TECHNICAL OPERATION DATA

Sect. D CHECKS AND ADJUSTMENTS

Sect. E DISASSEMBLIES AND ASSEMBLIES

Sect. F TROUBLESHOOTING

Sect. G CARRARO AXLE ASSEMBLY/DISASSEMBLY

Sect. H PERKINS ENGINE MAINTENANCE

Sect. I REPAIR INSTRUCTIONS - REXROTH PUMP

Sect. L REPAIR INSTRUCTIONS - REXROTH MOTOR

Section A
GENERAL INFORMATION

SECTION INDEX

A.01	Introduction ..... page	2
A.02	Symbols used in the manual	3
A.03	Abbreviations	4
A.04	Units of measure	5
A.05	Minimum workshop equipment	6
A.06	Special equipment	7
A.07	Bolt and nut tightening torques	9
A.08	Drill diameters for threads	11
A.09	Fitting tightening torques	12
A.10	Locking materials	14
A.11	Hoisting instructions	15
A.12	Weight list of the main parts	16
A.13	Advice to renew flexible hoses	17
A.14	Repair interventions, welds and weld materials	19
A.15	Weld material	21
A.16	Checks with liquid penetrants	22
A.17	Checks with magnetoscope	23
A.18	Refilling and product specifications	24

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/HPh
1 g/HPh	=	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 MINIMUM WORKSHOP EQUIPMENT



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 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

A.07 TIGHTENING TORQUES

Thread diameter	Pitch	Wrench measure mm				Tightening torques Material class					
		S		S		8.8		10.9		12.9	
mm	mm		UNI 5931/32	UNI 5933÷36	UNI 5923÷30	Normal Nm	Zinc plated Nm	Normal Nm	Zinc plated Nm	Normal Nm	Zinc plated Nm
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	8G	5S	8G
		Nm	Nm	Nm	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*		*DRILL BIT DIAMETER*
	max	*min*	
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 inc.	Thread diameter mm	TIGHTENING TORQUES (0+10%) 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 inc.	Thread diameter mm	TIGHTENING TORQUES 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)

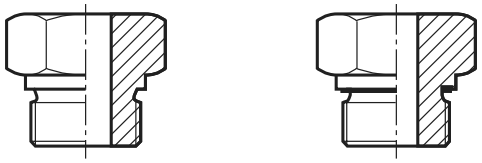
Thread diameter inc.	Thread diameter mm	TIGHTENING TORQUES (0+10%) 37° CONICAL SEALS (JIC) Nm
7/16"-20	M10x1	15
1/2"-20	M12x1.5	20
9/16"-18	M14x1.5	28
	M16x1.5	62
3/4"-16	M18x1.5	62
7/8"-14	M22x1.5	80
1.1/16"-12	M27x2	110
1.3/16"-12		141
1.5/16"-12	M33x2	160
1.5/8"-12	M42x2	225
1.7/8"-12	M48x2	270
2.1/4"-12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

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.

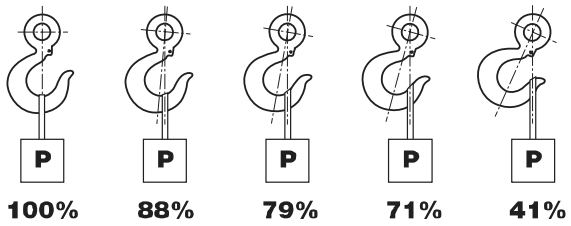
Before removing parts of the machine, make sure that:
- all fixing bolts have been removed
- all hydraulic and electrical parts have been disconnected
- the part to be removed is not blocked.

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:

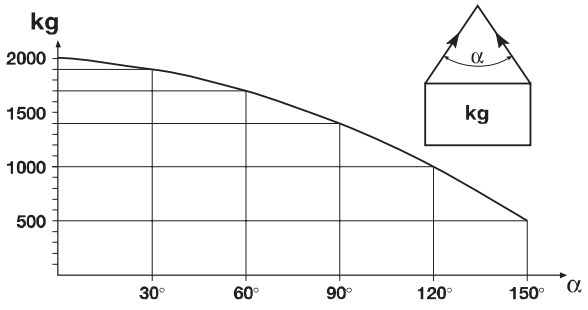
STRANDED ROPES	
Rope diameter mm	Max admissible load kg
10	1000
11.2	1400
12.5	1600
14	2200
16	2800
18	3600
20	4400
22.4	5600
30	10000
40	18000
50	28000
60	40000

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
❑	Complete cab	340
❑	Complete frame	810
❑	Load cell	7
❑	Rear counterweight	310
❑	1st boom element	260
❑	2nd boom element	225
❑	Pin fixing the boom to the frame	11
❑	Fuel tank	35
❑	Oil tank	40
❑	Boom raising cylinder	80
❑	Pin - boom raising cylinder head side	3.5
❑	Pin - boom raising cylinder rod side	3.5
❑	Boom extension cylinder	92
❑	Fork balance cylinder	30
❑	Pin - fork balance cylinder head side	1.5
❑	Pin - fork balance cylinder rod side	1
❑	Fork movement cylinder	55
❑	Pin - fork movement cylinder head side	1.5
❑	Pin - fork movement cylinder rod side	1
❑	Attachment locking cylinder	7
❑	Attachment locking cylinder pin	3
❑	Front axle	328
❑	Rear axle	248
❑	Drive pump	40
❑	Service pump	6
❑	Drive motor	44
❑	Distributor	27
❑	Perkins engine	235
❑	Silencer	7
❑	Fiberglass engine bonnet	14
❑	Distributor guard	8
❑	Guard - cab side	5
❑	Engine guard	42
❑	Cardan joint	15
❑	Cardan joint guard	18
❑	Cooler	26
❑	Complete wheel (n° 1)	88
❑	Power steering	5
❑	Front mud-guard support	3
❑	Rear mud-guard	7
❑	Batteries	19

	Part	Weight kg
❑	Joystick	4
❑	Removable part of the seat	1.5



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

A.13 ADVICE TO RENEW FLEXIBLE HOSES



Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.



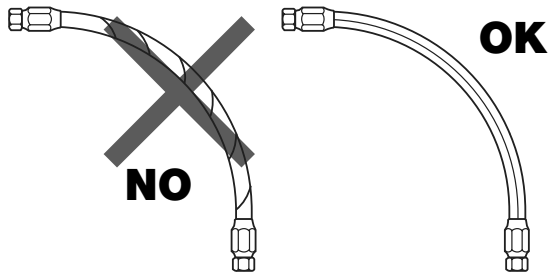
Plug all disconnected parts to prevent dust or impurities from entering the circuit. They can cause serious damage.

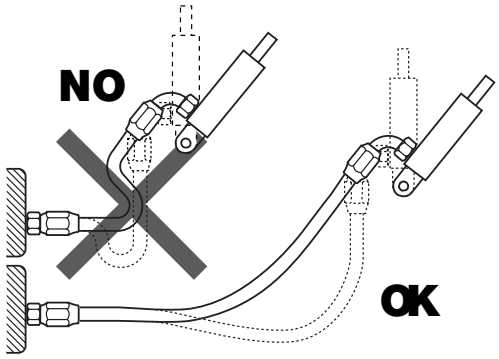


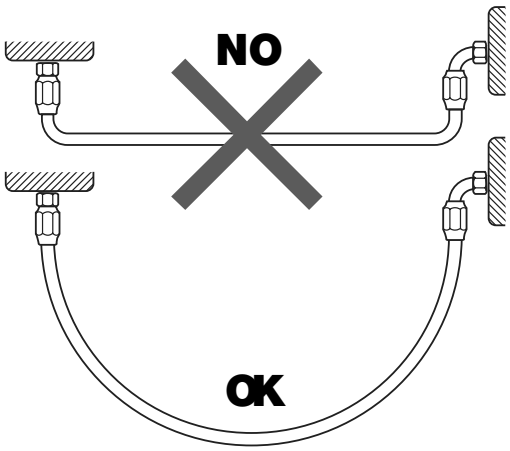
Before disconnecting the hydraulic piping, ensure there is no pressure in the line. In case, release the pressure by operating the control levers with the engine stopped.
In any case, disconnect the hydraulic piping with extreme caution and always wear suitable personal protection equipment -e.g. goggles, 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.

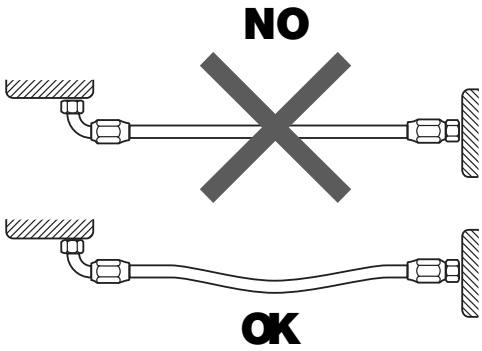
1. Before disconnecting or refitting a flexible hose, carefully clean the area all around.
2. Blow some compressed air to remove any impurity.
3. For an easier renewal of the hoses, whose run is not clearly visible, proceed as follows:
   - disconnect the hose to be replaced from both sides
   - tie 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.

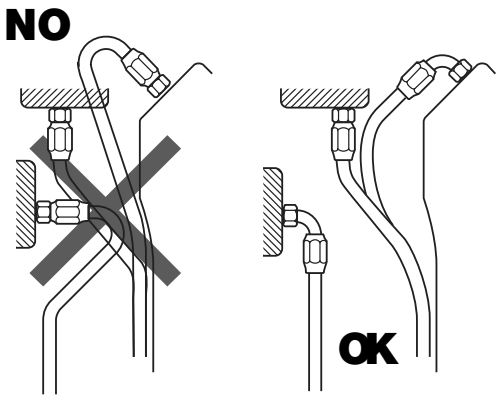
Useful advice for mounting flexible hoses:











A.14 REPAIR INTERVENTIONS WELDS AND WELD MATERIALS

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.

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).

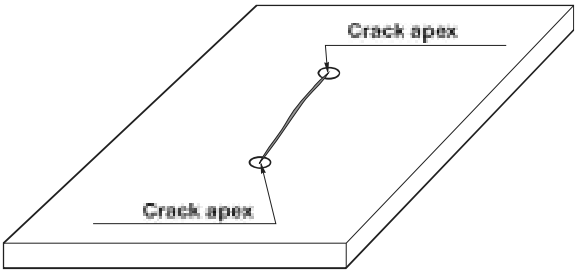
OPERATION PROCEDURE

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

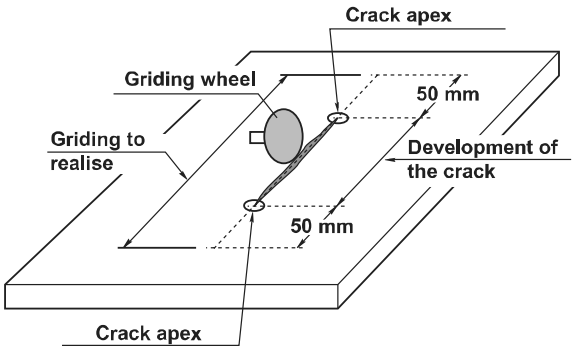
Warning: the visible apex of the crack is not the real apex. This is usually under the material skin and needs non-destructive methods to be found (liquid penetrants, magnetoscopy or ultrasounds).

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**.

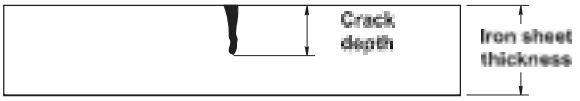
Grind 50 mm more than the development of the crack on both sides.



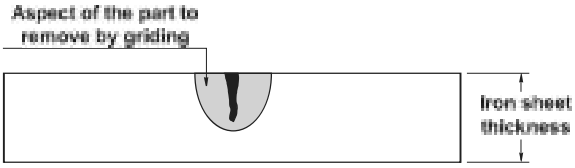
4 Check the ground area with a liquid penetrant - see **3**.

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

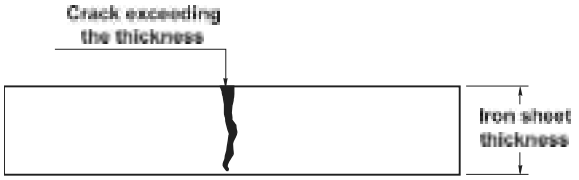
Type A *The crack does not exceed to the thickness of the iron sheet*



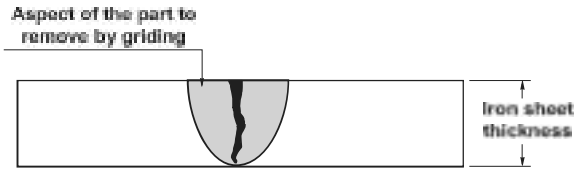
In this case, further grind the crack and check again with a liquid penetrant until the crack has been removed.



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.

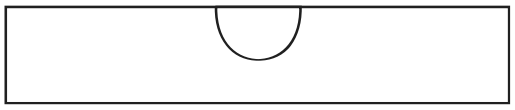
b- Create a seam with low voltage (V) and current (A) parameters so as not to alter the structure in the vicinity of the weld. The materials used for the structural elements of the machine have a fine grain structure which, if subject to high thermal loads, can result in a coarsening and, consequently,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



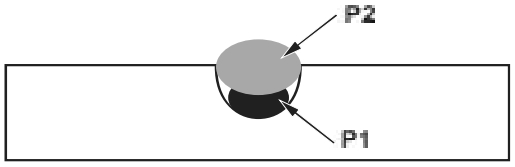
It is better to foresee an multi-pass welding with moderate parameters rather than a weld with less passes and high parameters.

Preparation after grinding

Crack not exceeding the thickness



WELDING PROCEDURE

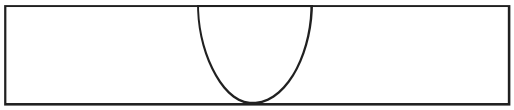


P1: Bottom pass

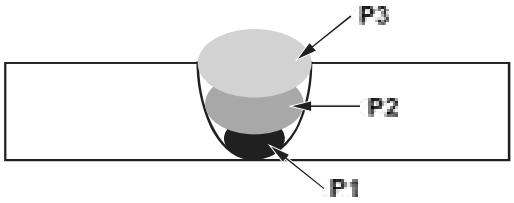
P2: Filling pass

PRE-HEAT AT 120°
BEFORE PASS P1

Preparation after grinding
Crack exceeding the thickness



WELDING PROCEDURE



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

PRE-HEAT AT 120°
BEFORE PASS P1



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



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.

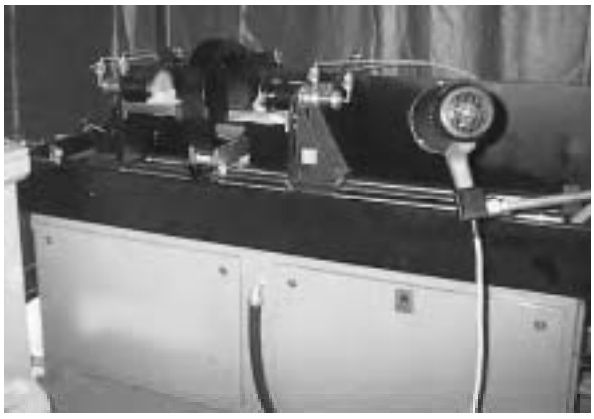
A.17 CHECKS WITH MAGNETOSCOPE

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.



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 to be refilled	*Recommended product*	*Qty lt.*
• Diesel engine	Shell Myrina D SAE 15W-40	8
• Engine cooling system	Caltex Polar Antifreeze	25
• Fuel tank	Gasolio	60
• Oil tank	Shell Tellus T46 DENISON HF-1	70
• Front differential (with reduction gear)	Shell Super Gear 90 LS SAE 90W	6
• Rear differential	Shell Super Gear 90 LS SAE 90W	5
• Front wheel reduction gears	Shell Super Gear 90 LS SAE 90W	1.5 + 1.5
• Rear wheel reduction gears	Shell Super Gear 90 LS SAE 90W	0.7 + 0.7
• Brake oil reservoir	Shell Tellus T46 DENISON HF-1	0.1



If the front differential is particularly noisy, replace the oil with one conform to API GL4*/GL5* - MIL2105 satndard.
CARRARO recommends:
- ***ESSO Torque Fluid 62***
- ***ELF Tractelf SF3***
- ***AGIP Rotra multi THT***
- ***TEXACO Textran AS***
- ***MOBIL Mobilfluid 422 - 424***
- ***Q8 T3000***

Section B
SAFETY INFORMATION

SECTION INDEX

B.01	General considerations ..... page	2
B.02	Requisites of the servicemen	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 CONSIDERATIONS

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 REQUISITES OF THE SERVICEMEN

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.

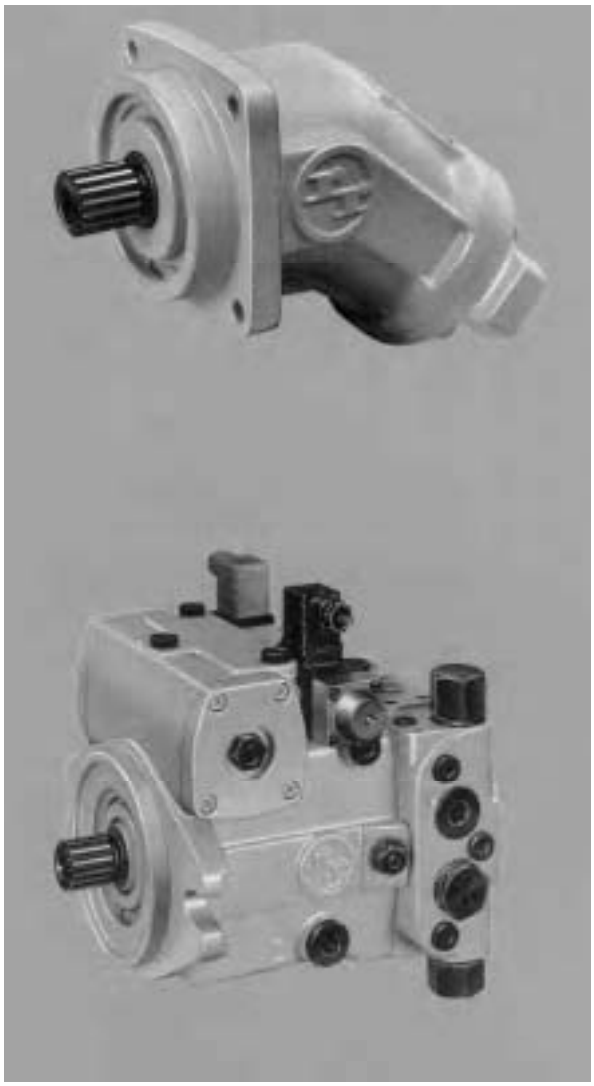
Section C
TECHNICAL OPERATING DATA

SECTION INDEX

	Principles of hydraulics ..... page	3
	Hydraulic symbols	31
C.01	Hydraulic schemes	33
	Electrical symbols	35
C.02	Wiring diagrams	37
C.03	Cylinder size	47
C.04	Control lever	52
C.05	Hydraulic distributor	53
C.06	Pumps and motors	55
C.07	Valves	57

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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.

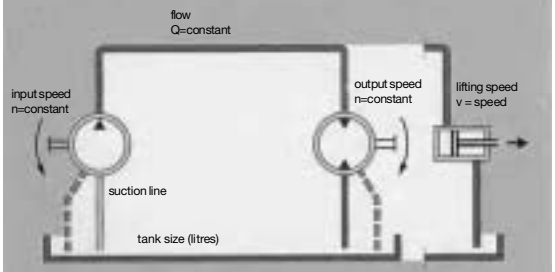
In **open** circuit hydraulic fluid is fed to the user via directional control valves and returned to the tank in the same way.

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

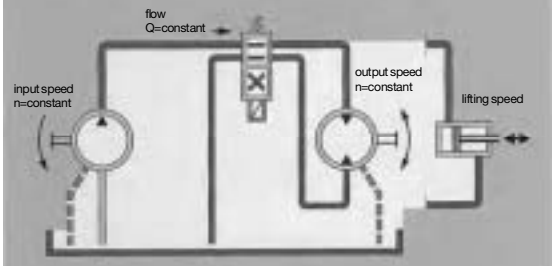
- suction lines - short length, large diameter
- directional control valves - flow-related sizes
- filter / cooler - flow-related sizes
- tank size - a multiple of the max. pump flow in litres
- pump arrangement - adjacent to or below the tank
- drive speeds - limited by the suction head
- load maintained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

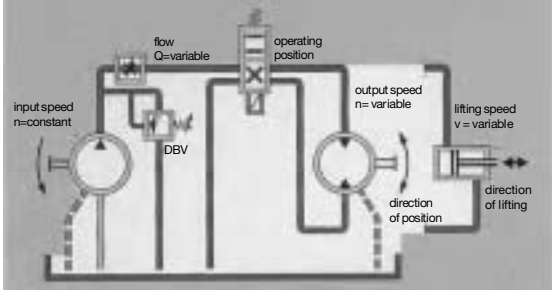
Open Circuit
The way to the complete hydraulic system:
(explanation of symbols, see page 3)



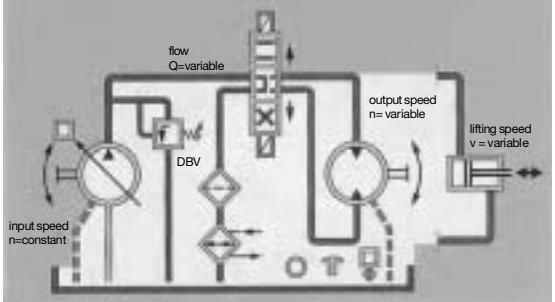
Basic system with hydraulic pump and hydraulic motor (or cylinder). **Single** direction of input, output and lift.



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

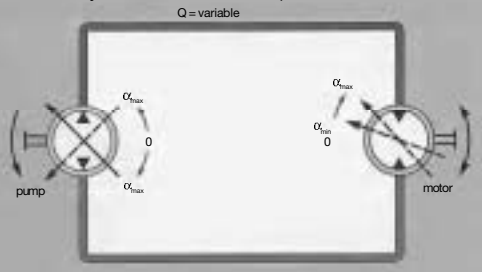
Explanation of Symbols / Colour Code for Open and Closed Circuits

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)

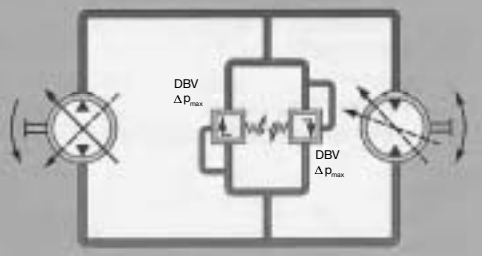
Closed Circuit

A step-by-step guide

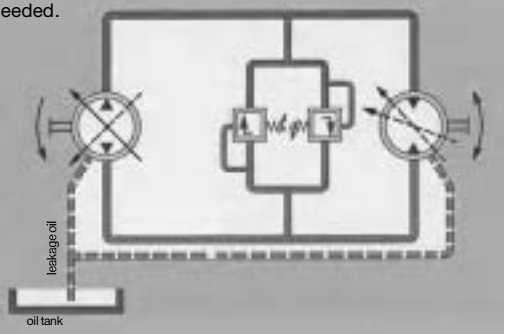
(explanation of symbols, see below left)



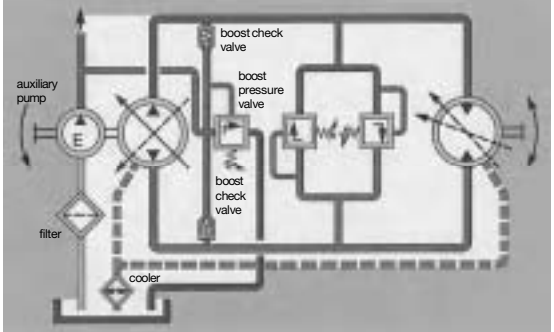
Basic system with variable pump and variable motor. **Single** pump input drive direction. Motor power take-off in **both** directions. The pump can be swivelled smoothly over centre, i.e. the direction of flow is reversible.



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

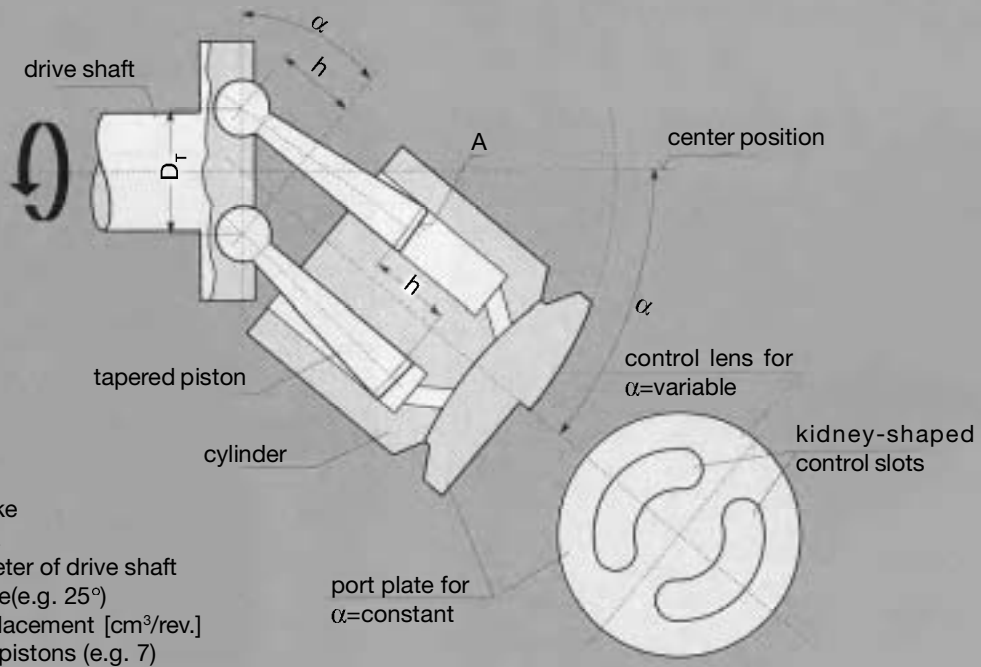
2.1 Bent Axis



Example:

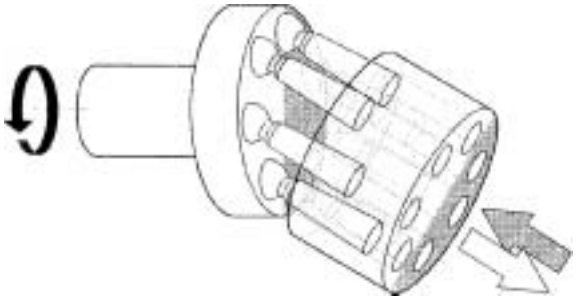
Fixed Displacement Unit with tapered piston rotary group

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)
$h = D_T \bullet \sin \alpha$
$V_g = x \bullet A \bullet h$
$V_g = x \bullet A \bullet D_T \bullet \sin \alpha$

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.

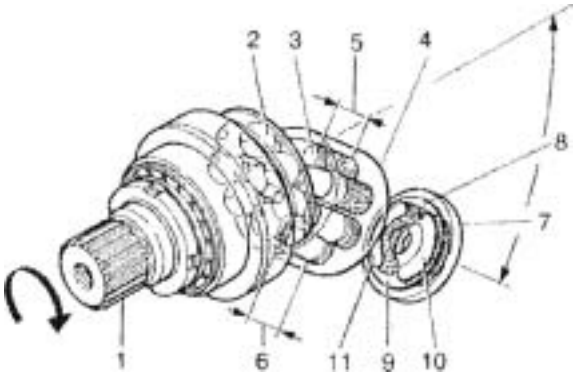
Pump Function:
Through the flexible piston/piston rod arrangement, rotation of the drive shaft also causes the cylinder to rotate without the need for a Cardan coupling. The pistons execute a stroke within the cylinder bores dependent on the angle of inclination of the bent axis. The hydraulic medium 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)

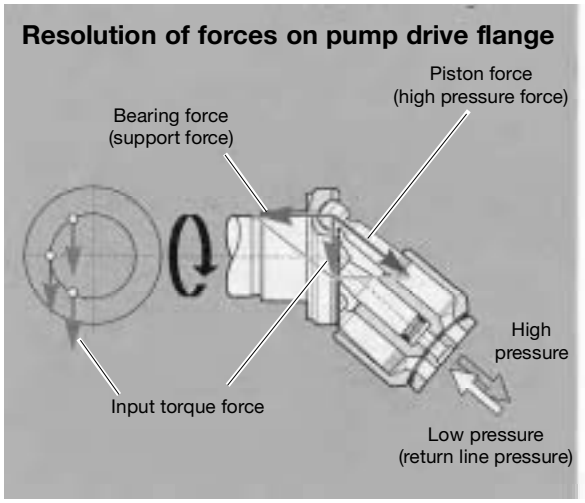
Where:

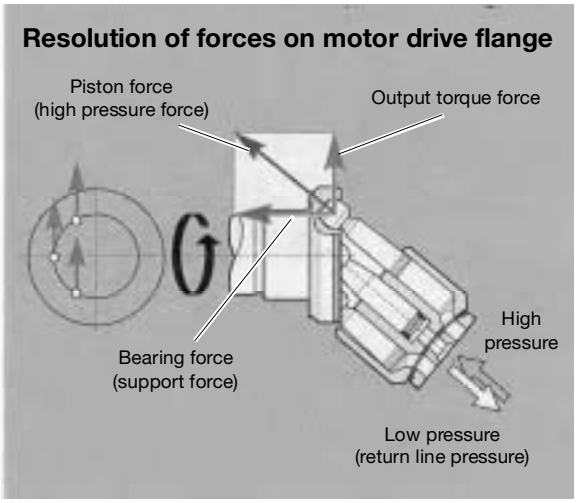
Q	= consumption (flow)	(l/min)	α_{max}	= max. swivel angle (varies according to design)	
M	= output torque	(Nm)	α	= set swivel angle (between 0 and α_{max})	
P	= output power	(kW)	η_{vol}	= volumetric efficiency	
V_g	= geometric displacement per rev.	(cm3)	η_{mh}	= mechanical - hydraulic efficiency	
$V_{g\ max}$	= 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

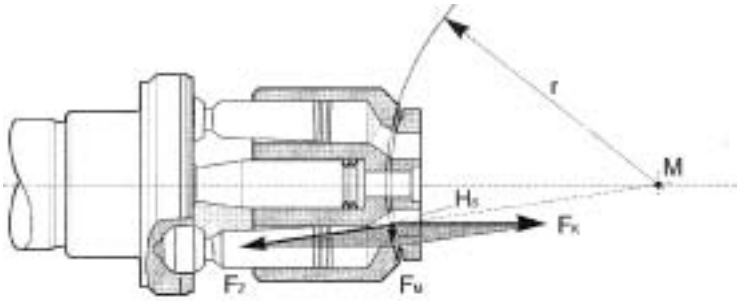
Parallelogram illustrating forces in a Fixed Displacement Unit.

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



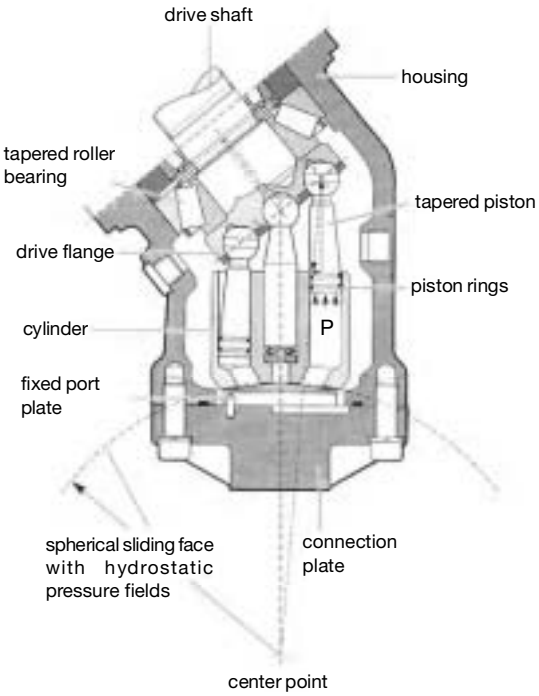
For this torque illustration, a segment of the hydraulic rotary group has been cut out and shown in simplified form in pure static condition with swivel angle 0°.

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

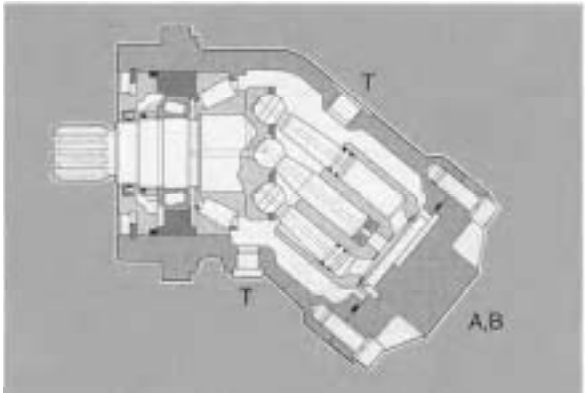
Shown here in housing with fixed swivel angle



- 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

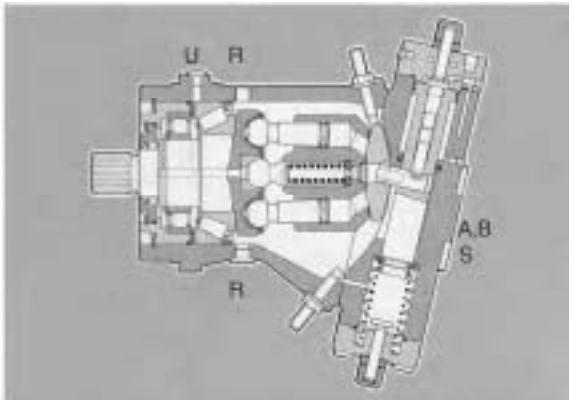
2.1.6 Examples of Types

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)



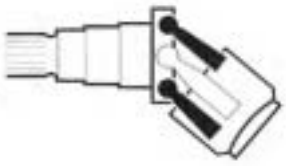
For operation as a pump with infinitely adjustable displacement in open circuit

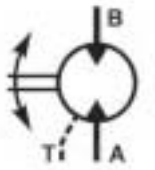
2.1.7 Symbols

Symbolic illustration of the best-known types

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

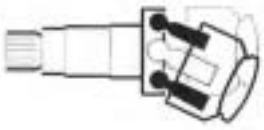
A2FM
Fixed motor





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

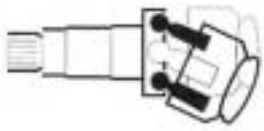
A6VM
Variable motor





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.

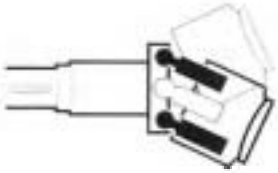
A7VO
Variable pump

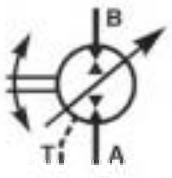




Variable displacement pump for open circuits, swivel to one side only; infinitely variable swivel angle; single direction of rotation of drive.

A2V
Variable pump





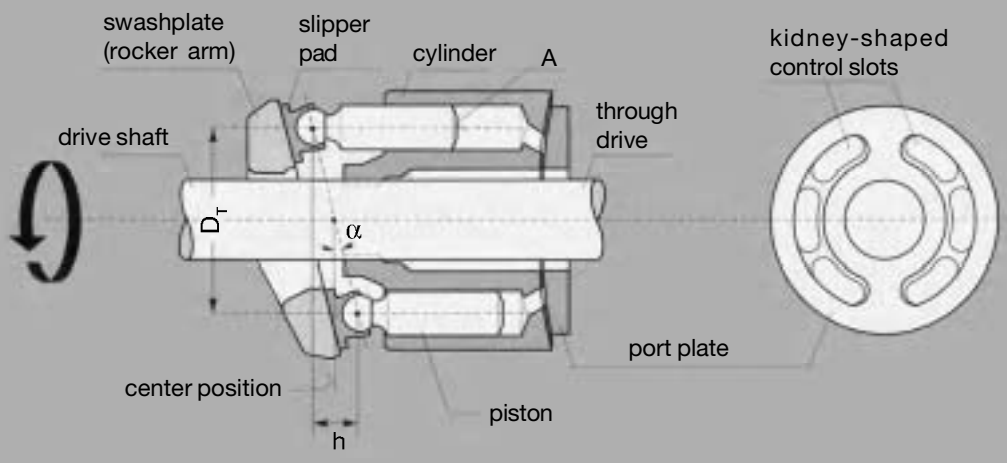
Variable displacement pump for closed circuits, swivel to both sides; swivel angle infinitely variable over centre; both directions of rotation of drive.

2.2 Swashplate



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

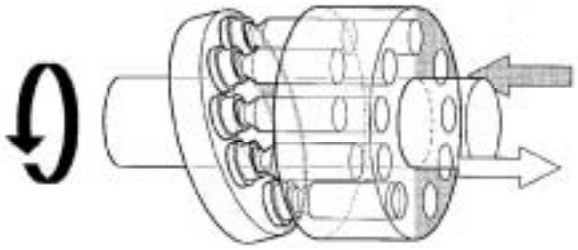
Schematic Diagram of a Swashplate Unit (with pistons parallel to axis)
with fixed or variable swivel angle α



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).

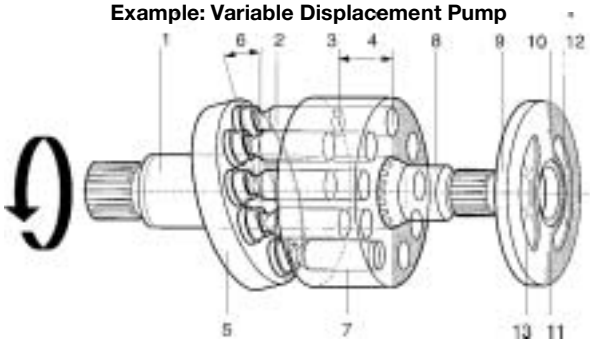
Pump Function:
Through the gearing, rotation of the drive shaft also causes the cylinder to rotate. The pistons execute a stroke within the cylinder bores dependent on the tilt angle of the *swashplate*. The hydraulic medium is fed to the low pressure (inlet) side of the pump and pumped out by the pistons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

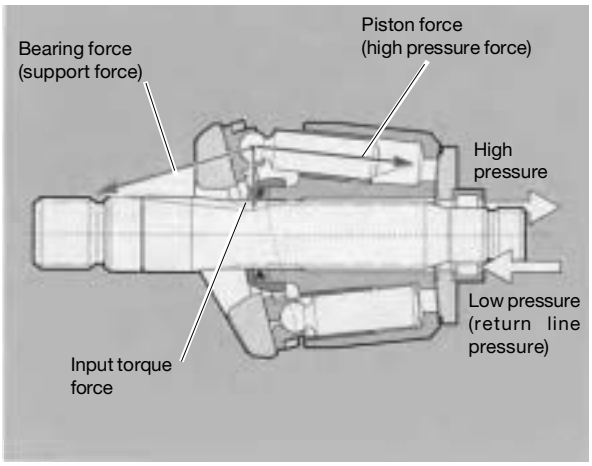
Q	= consumption (flow)	(l/min)	α_{max}	= max. swivel angle (varies according to design)	
M	= output torque	(Nm)	α	= set swivel angle (between 0 and α_{max})	
P	= output power	(kW)	η_{vol}	= volumetric efficiency	
V_g	= geometric displacement per rev.	(cm3)	η_{mh}	= mechanical - hydraulic efficiency	
$V_{g\ max}$	= 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

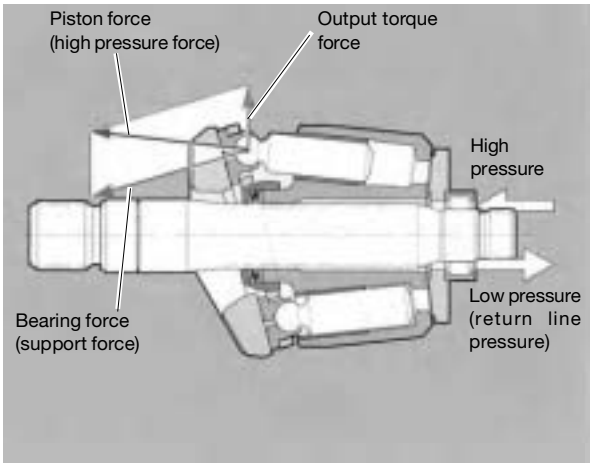
Parallelogram illustrating forces in a variable displacement unit, e.g. with piston angled inwards.

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



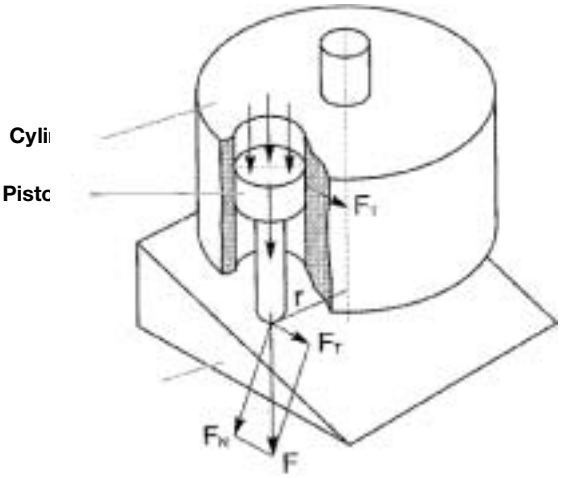
Resolution of Forces on the Motor Swashplate



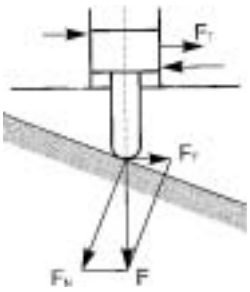
2.2.5 Swashplate Rotary Group

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.

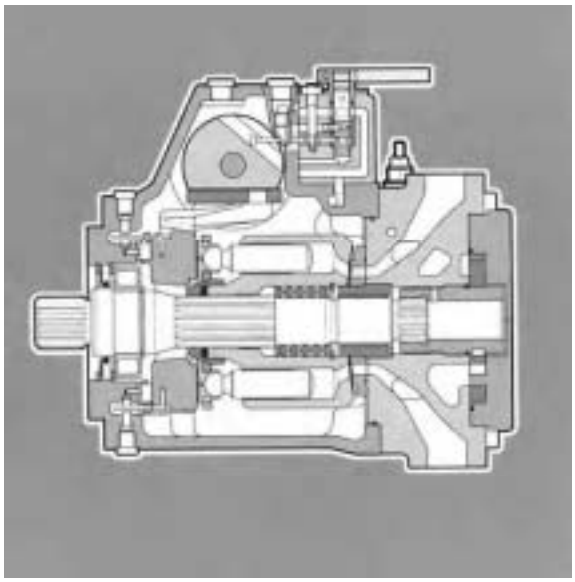


The resolution of the piston forces at the point of contact (plain bearing) with the tilted plate produces a bearing-force and a torque-force component (FN and FT). The piston slides down the tilted plate and carries out a stroke, taking with it the cylinder and drive shaft. However, because of the movement 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

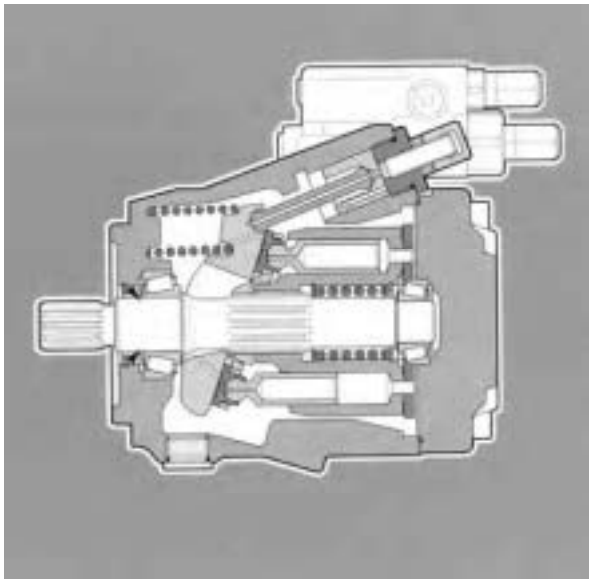
Variable Pump for Closed Circuits A4VG

High pressure range up to 450 bar



Variable Pump for Open Circuits A10VO

Medium pressure range up to 315 bar

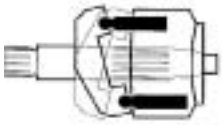


2.2.7 Symbols

Symbolic illustration of the best-known types

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

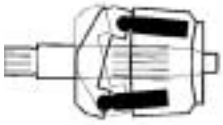
A4VG
Variable Pump





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.

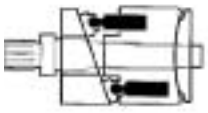
A4VSO/G/H
Variable Pump

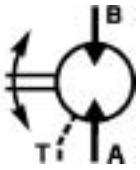




Variable displacement pump for open, closed or semi-closed circuits; swivel angle infinitely variable; single or both directions of rotation of drive and flow direction, depending on the type of circuit; auxiliary pump may be mounted at the through drive.

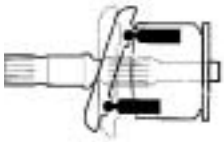
A4FM
Fixed Motor

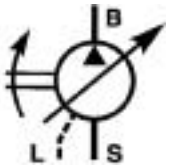




Fixed displacement motor for open or closed circuits; fixed swivel angle; both directions of rotation of power take-off; possibility of through drive for mounting brake.

A10VO
Variable Pump

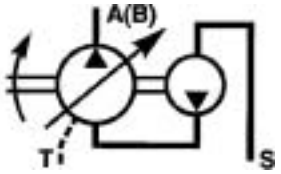




Variable displacement pump fo open circuits, swivel to one side only; infinitely variable swivel angle single direction of rotation of drive

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

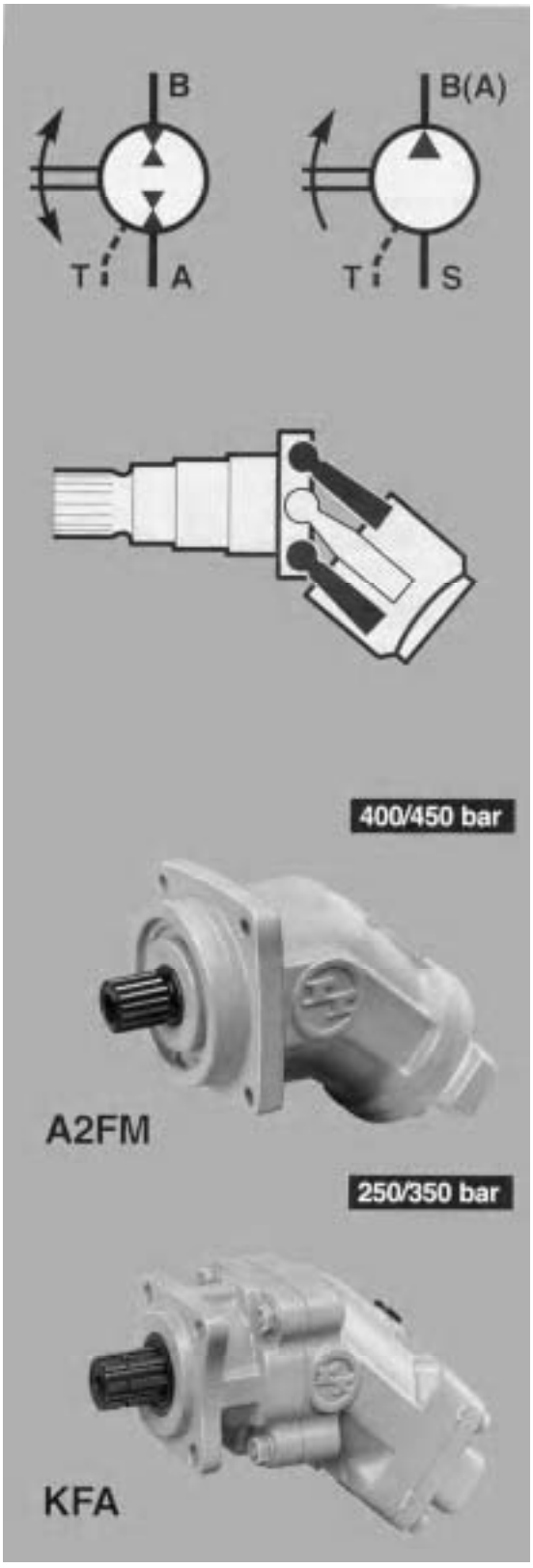
Operation as a motor in open and closed circuits; used in mobile and industrial applications, wherever a constant displacement is required for hydrostatic power transmission.

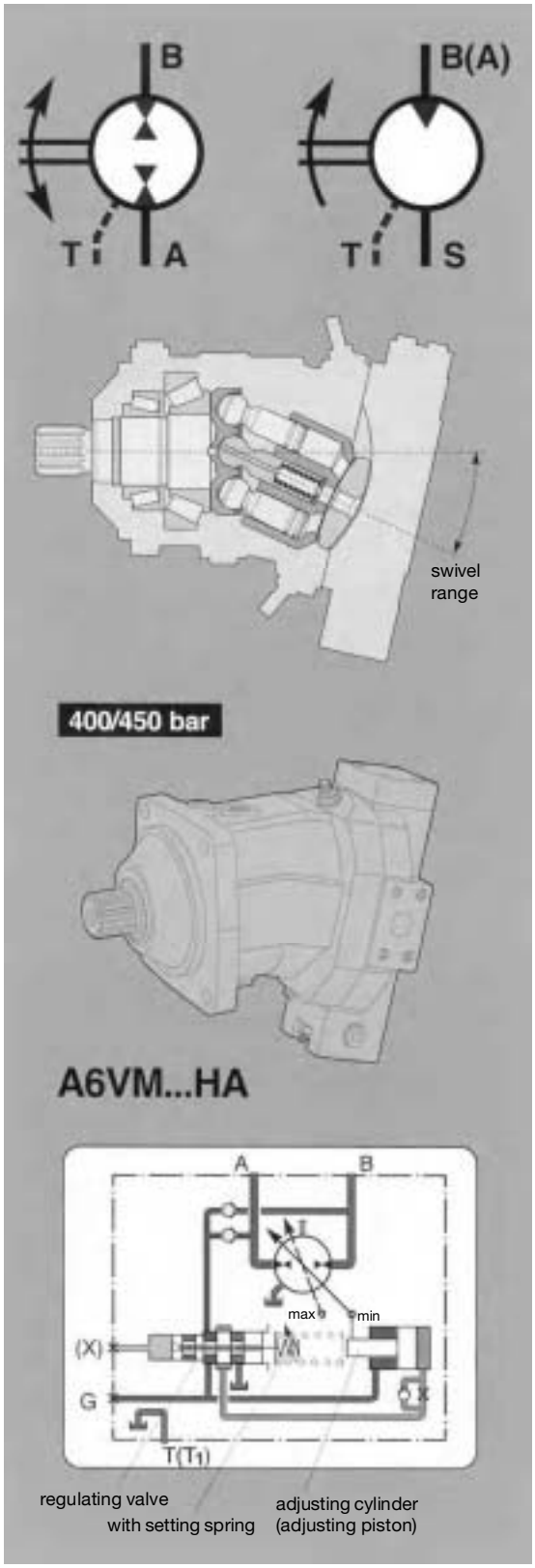
3.1.2 Fixed Pump

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

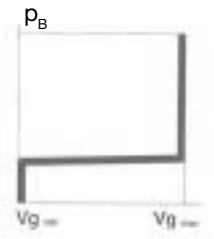
3.2.1 Automatic Control, High-Pressure-related

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:

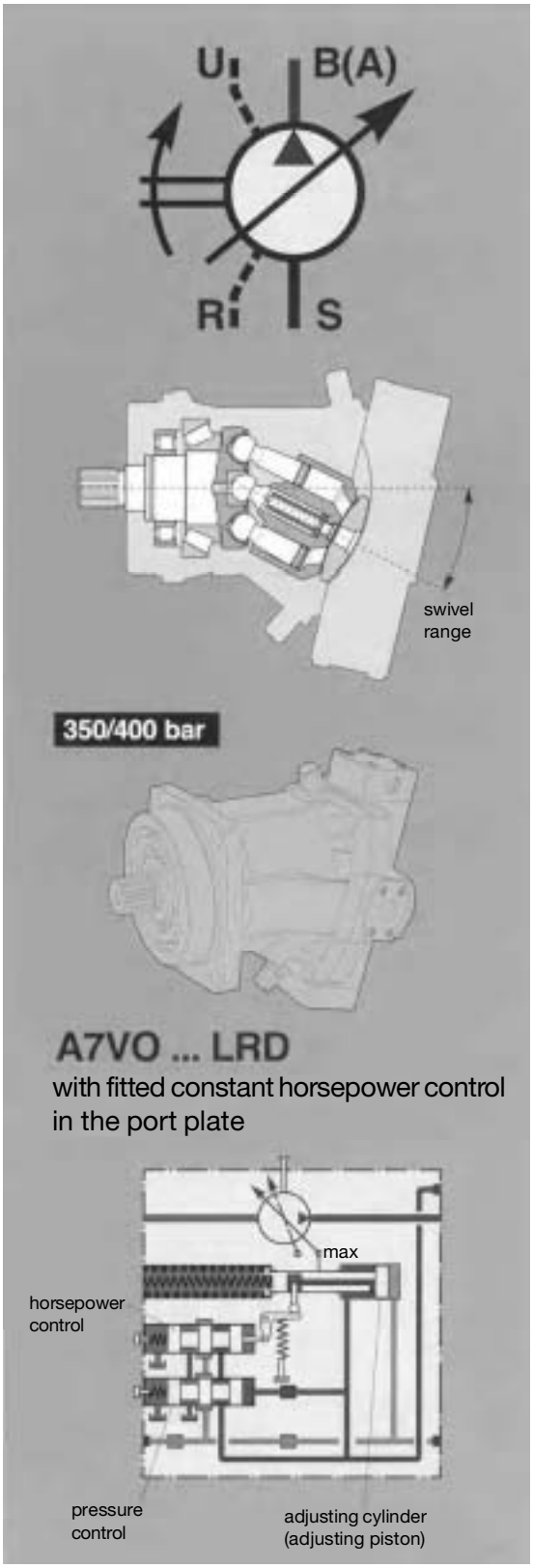
- axial-tapered piston rotary group
- Cardanless cylinder drive via tapered pistons
- robust bearings with long service life
- displacement variable between V_{90} and V_{gmax}
- constant horsepower control with exact hyperbolic curve
- constant pressure control, hydraulic and electric control devices, 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.

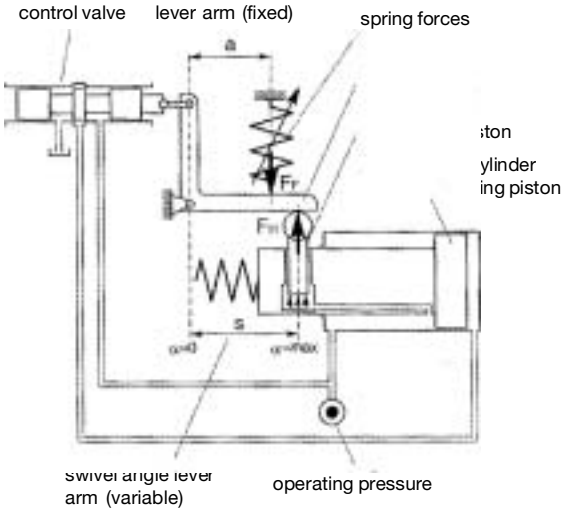
The swivel angle of the rotary group is changed by moving the control lens along a spherical surface by means of an adjusting piston. Increasing the angle increases the pump flow and the required drive torque.

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.



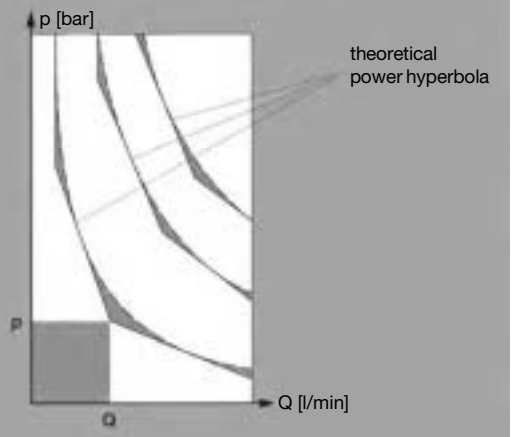
3.3.2 Constant Horsepower Control LR (see Spring-Loaded Control/Hyperbolic Control)

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.

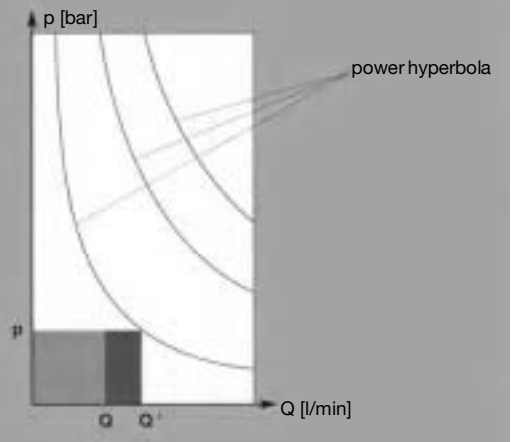
Spring-loaded Control with approximated curve



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

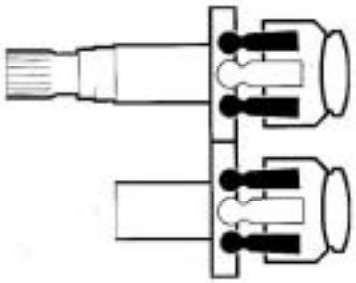
Hyperbolic Control with ideal hyperbolic curve



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.

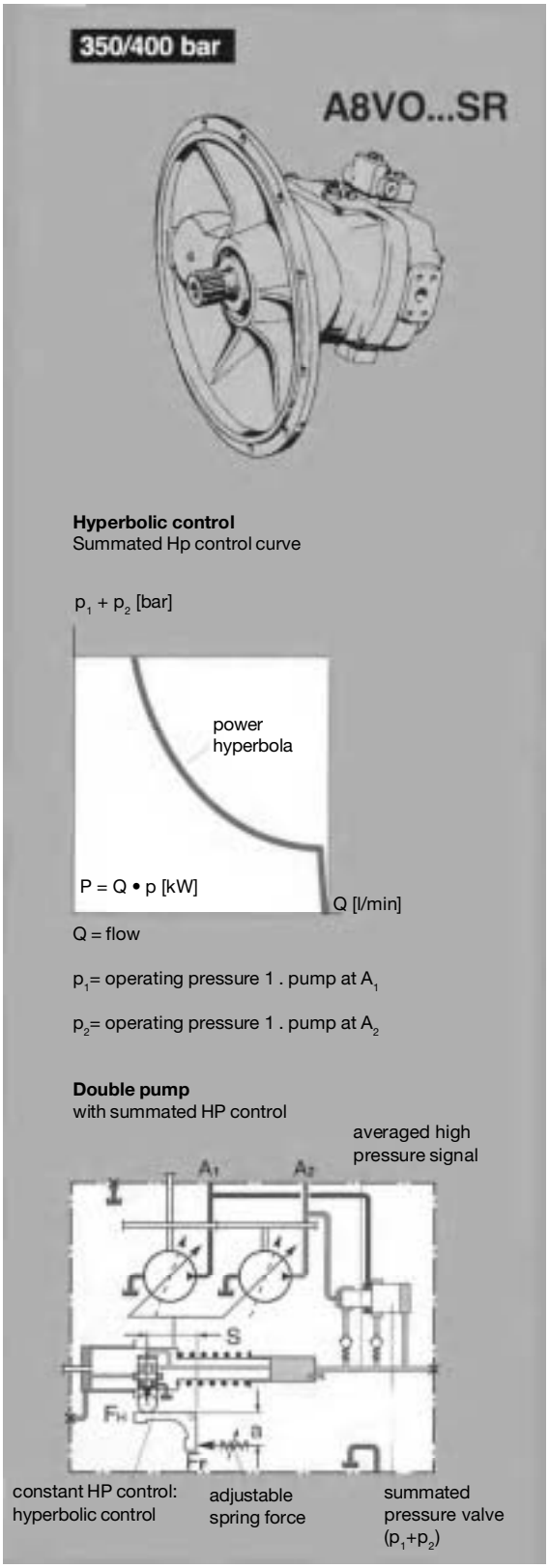
As an extension of the constant horsepower control for a single pump (A7VO..LR - see pages 18/19), the double pump A8VO..SR with *summated horsepower control* is used, for example, for two parallel hydraulic circuits where the total drive power is split between the two circuits proportional to the pressures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

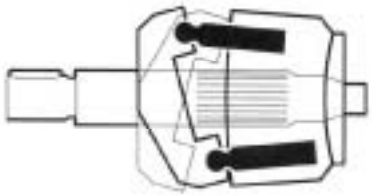
Since the operating pressure **p** is predetermined by the hydraulic system and the pump can only change its flow **Q**, if the max. allowable power is exceeded, the pump is automatically swivelled back to a smaller angle. Swivel stroke **s** is reduced until the resulting hydraulic torque is once again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



3.4 Variable Pump of Swashplate Design
for universal industrial applications

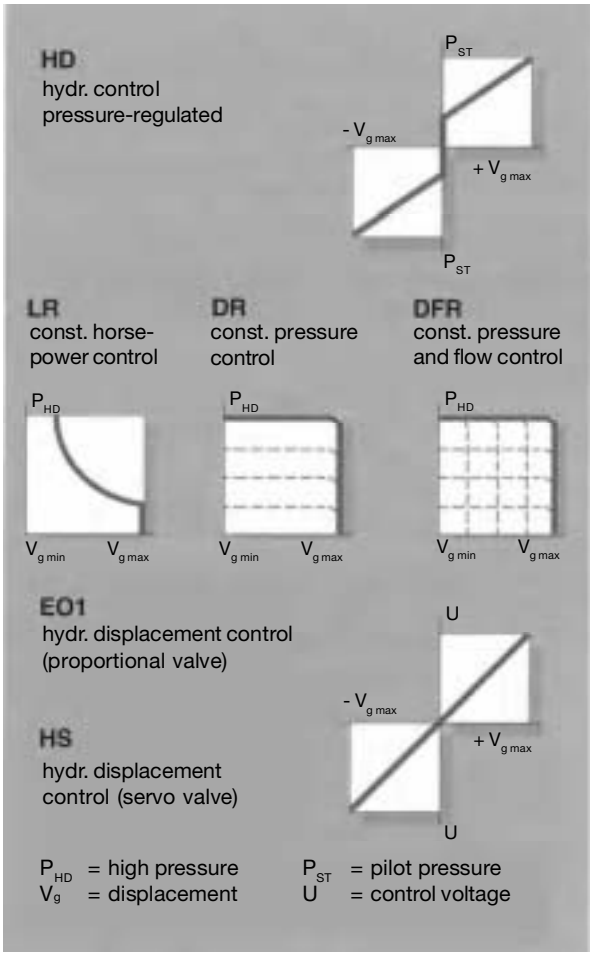
O=open circuit
G=closed circuit
H=semi-closed circuit



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.



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.

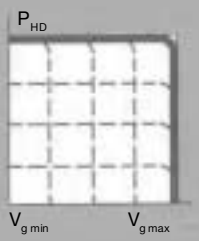
Medium high pressure range

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.

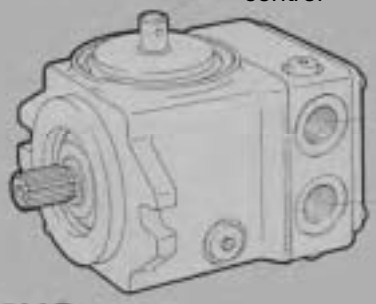
With the manual pivot pin control, the pin is connected direct to the rocker arm of the rotary group. The angle of rotation of the pin corresponds to the pump swivel angle. The necessary adjustment torque, usually applied by hand or foot force, is influenced by the high pressure and the swivel angle. 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

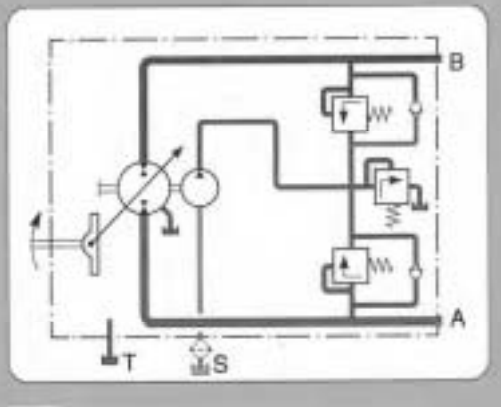
300/350 bar

e.g. pivot pin control



A10VG

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

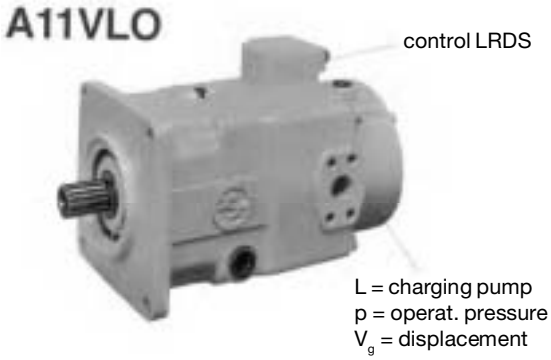


3.7 Variable Pump of Swashplate Design for mobile applications in open circuit with charging pump

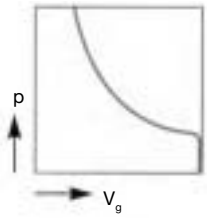
The control functions of the A11VLO illustrated here can be operated either super-imposed or as individual functions:

- constant horsepower control with hyperbolic curve
- constant pressure control via sequence valve
- load-sensing control via Δp-control of load-pressure signa

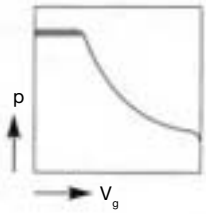
High Pressure Range 350/400 bar



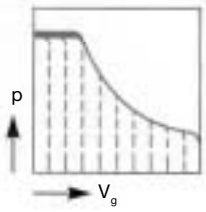
Load-Sensing control



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.



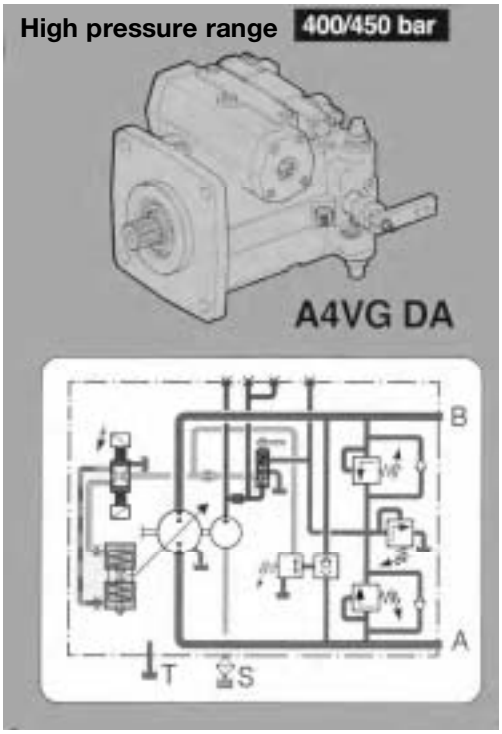
DR
The constant pressure control causes the pump to swivel back towards Vg=O, once the maximum operating pressure has been reached. This function is super-imposed on the constant horsepower control.



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

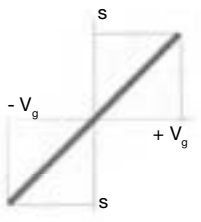
The electronic components (amplifiers), used to amplify the signals, are not listed here.

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

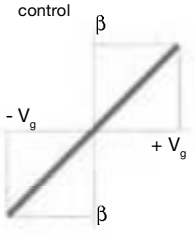
3.11.1 Pump Controls

- 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

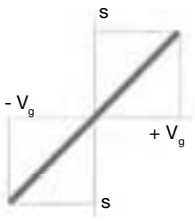
MA
manual control



MD
mechanical pivot pin control



EM
electric motor control

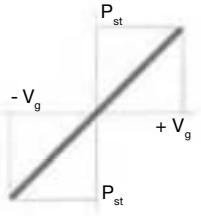


V_g = specific displacement s = control stroke β = control angle

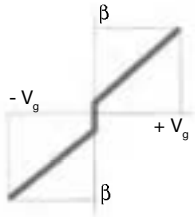
- Hydraulic - mechanical, proportional to:
  DG - pilot pressure $\mathbf{p_{st}}$

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

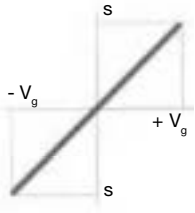
DG
direct operated hydraulic control pressure related



HW
hydraulic control stroke related [1)]



HW
hydraulic control stroke related

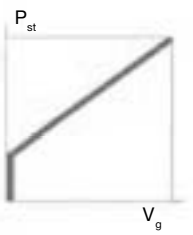


V_g = specific displacement p_{st} = pilot pressure [1)] = dead band in zero position

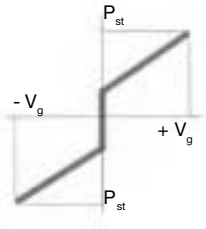
• Hydraulic - hydraulic:

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

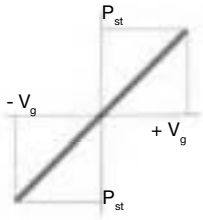
HD
hydr. control
pressure related



HD
hydr. control
pressure related"



HD
hydr. control
pressure related



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

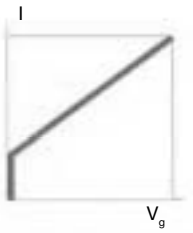
• Hydraulic - electrical:

EZ - with switching solenoids (not illust.)

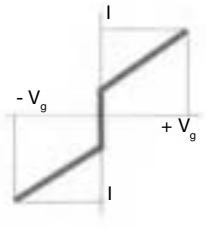
EP - with proportional solenoids, proportional to control current **I** in open or closed circuit

ES - with servo valve in closed circuit

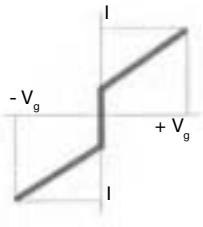
EP
electric control
with proportional
solenoid



EP
electric control
with proportional
solenoid



ES
electric control
with servo valve



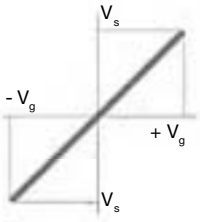
V_g = specific displacement I = control current

• Hydraulic, flow-related:

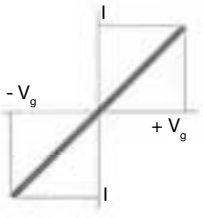
HM - proportional to pilot oil flow V_{st}, in reversible operation

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

HM
hydr. control
flow-related



HS
hydr. control
with servo valve

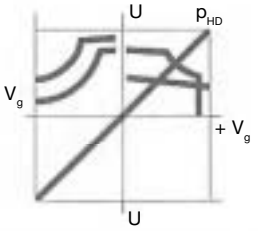


V_g = specific displacement V_s = pilot oil flow

• 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

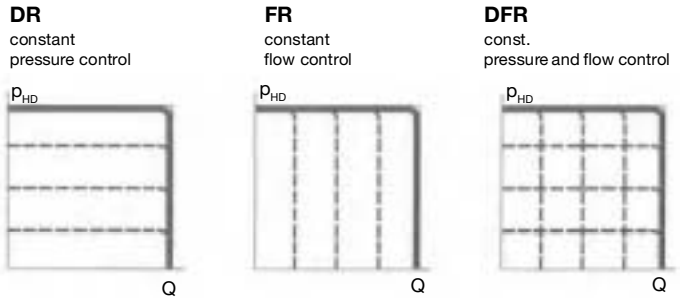
3.11.2 Closed-Loop Pump Controls

• 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

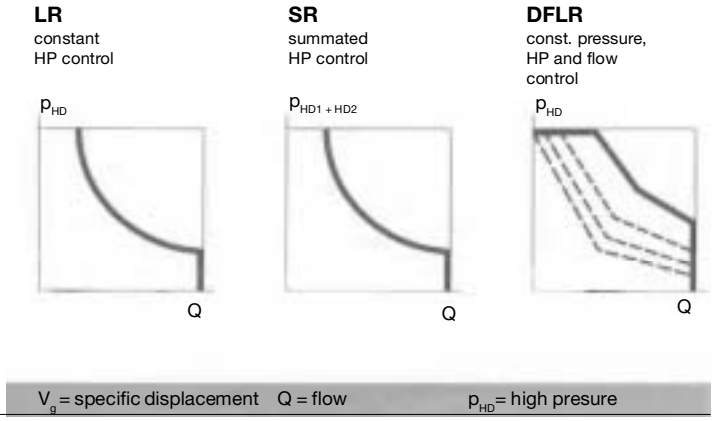
DFR - a combination of both the above controls; the constant flow control is superimposed on a mechanically settable constant pressure control



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

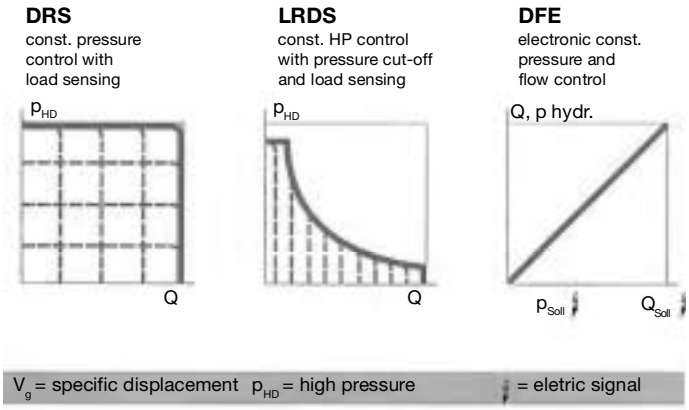


DRS - flow variation according to user requirement (load sensing) with super-imposed constant pressure control; pump is swivelled dependent on load pressure

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.



3.11.3 Motor Controls

• Hydraulic- hydraulic:

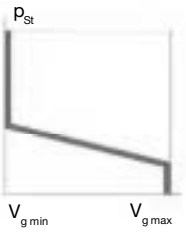
HD - proportional to pilot pressure p_{ST}.

HZ - hydraulic/hydraulic, two-point control

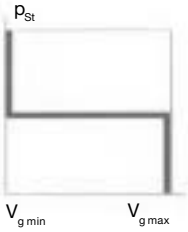
EP - hydraulic/electric, with proportional solenoid

EZ - with switching solenoid, two-point control.

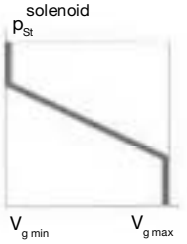
HD
hydr. control, pilot-pressure-related



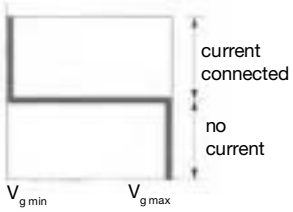
HZ
hydr. two-point control



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

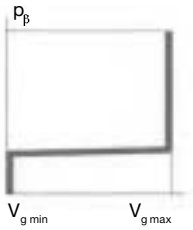
• Hydraulic:

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

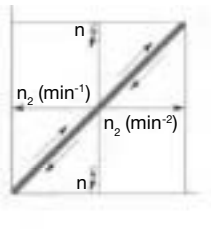
DS - pumps with DS control are used as motors for "secondary control"

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

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

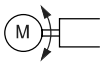

Hand-operated control with pedal


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

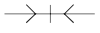

Connecting point

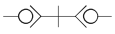

Pipe cross without connection


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

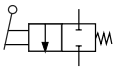
Thermometer

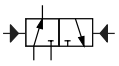
Flowmeter

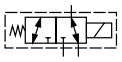
Pressure switch

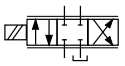
Drain to tank indication

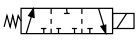
DISTRIBUTION - SETTING ELEMENTS

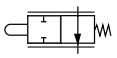

Two-position and two-way distributor, with manual lever control and spring return


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

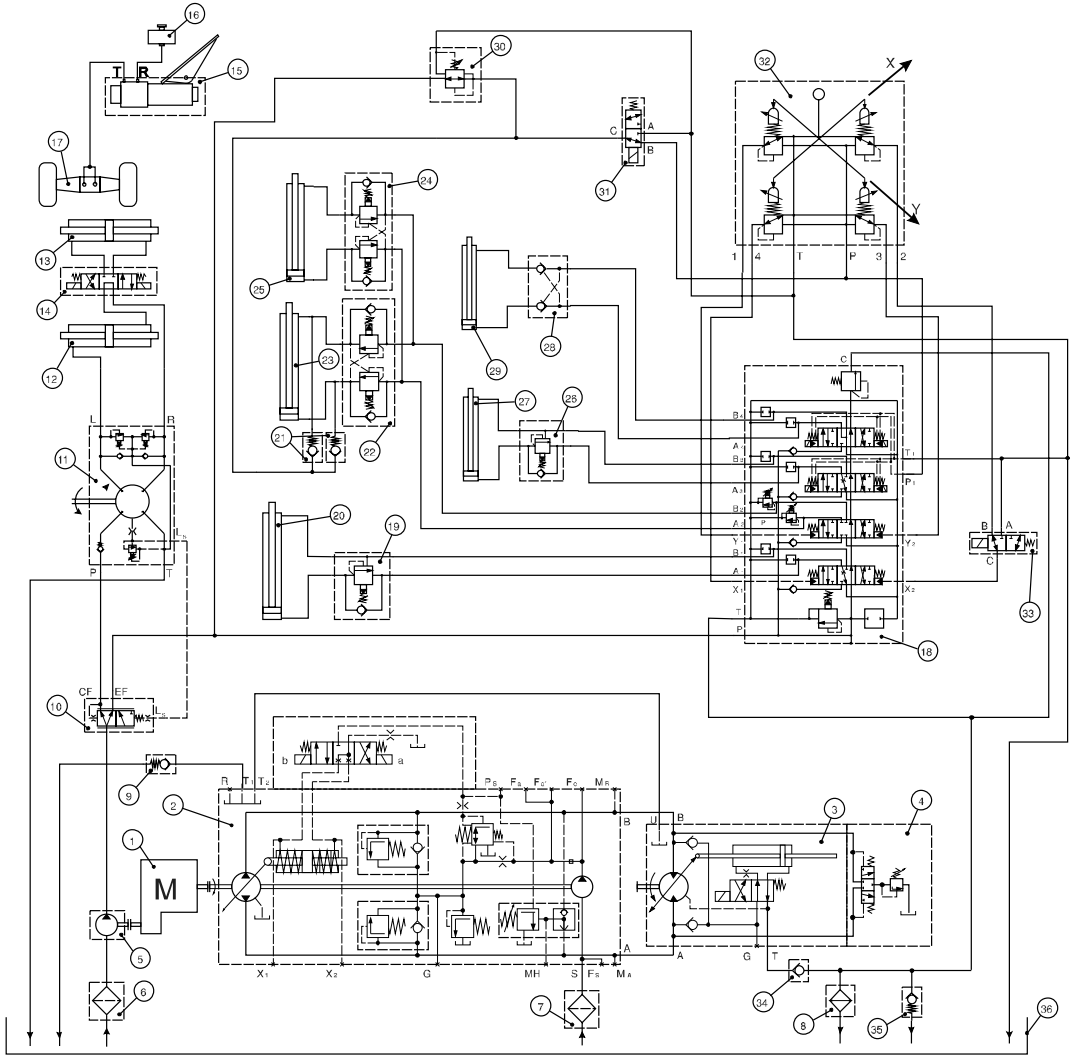

Two-position, three-way distributor, with electro-magnetic control and spring return


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

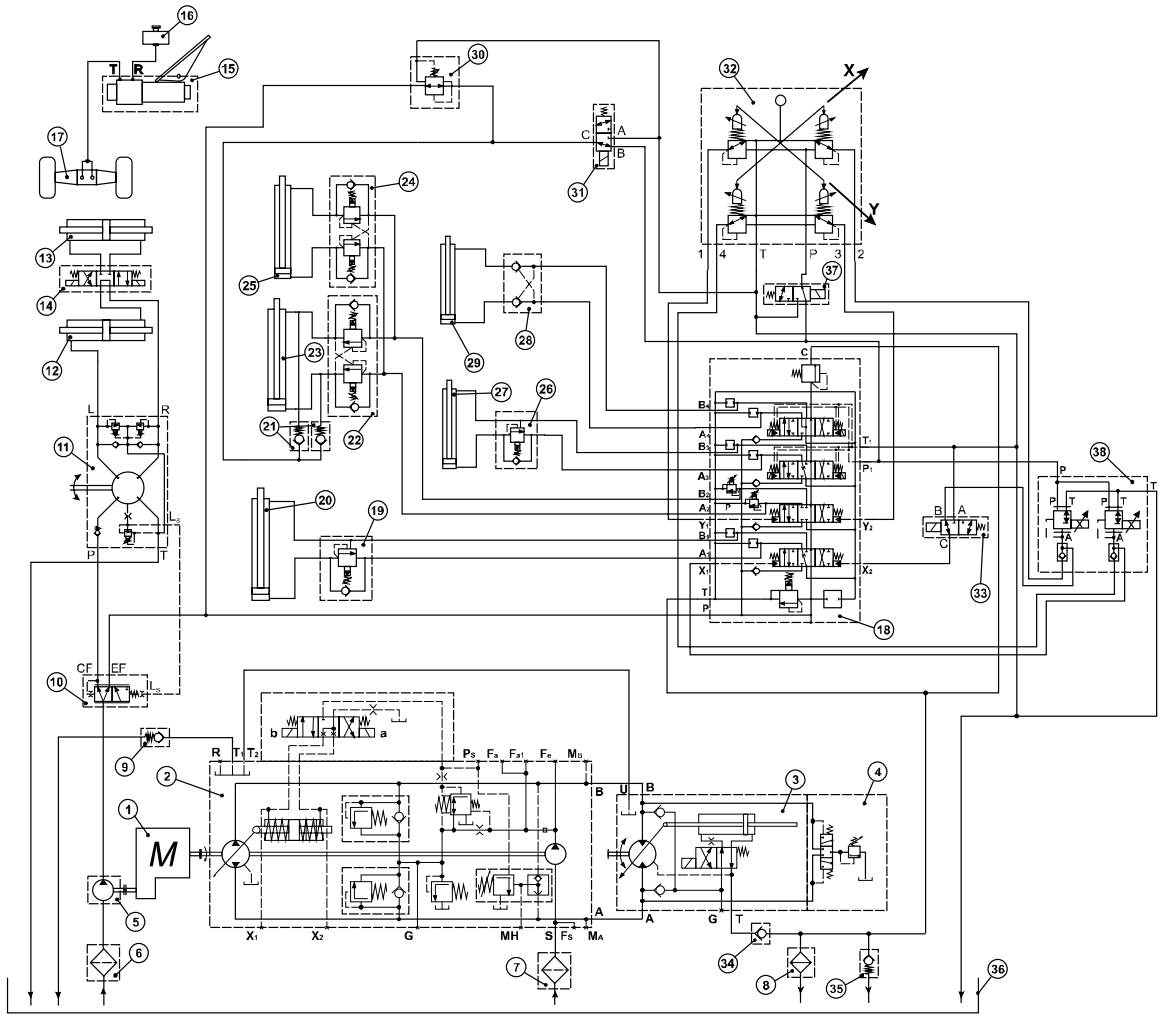
Procedure: General hydraulic scheme	Table: C.01.01



Ref	Description
1	DIESEL ENGINE
2	HYDRAULIC DRIVE PUMP
3	HYDRAULIC DRIVE MOTOR
4	WASHING VALVE
5	SERVICE PUMP
6	INDUCTION FILTER
7	INDUCTION FILTER
8	THERMAL EXCHANGER
9	ONE-WAY VALVE
10	“LOAD SENSING” PRIORITY VALVE
11	POWER STEERING
12	FRONT AXLE STEERING CYLINDER
13	REAR AXLE STEERING CYLINDER
14	STEERING SELECTION SOLENOID
15	BRAKE PUMP
16	BRAKE OIL SUMP
17	FRONT AXLE
18	4-ELEMENT DISTRIBUTOR
19	RAISING CYLINDER BLOCKING VALVE
20	RAISING CYLINDER
21	ONE-WAY VALVE
22	BALANCE CYLINDER BLOCKING VALVE
23	BALANCE CYLINDER
24	FORK MOVEMENT CYLINDER BLOCKING VALVE
25	FORK MOVEMENT CYLINDER
26	EXTENSION CYLINDER BLOCKING VALVE
27	EXTENSION CYLINDER
28	ATTACHMENT CYLINDER BLOCKING VALVE
29	ATTACHMENT CYLINDER
30	PRESSURE RELIEF VALVE
31	ELECTRIC FLOW DIVIDER (DEAD MAN)
32	HYDRAULIC SERVOCONTROL WITH LEVER
33	ELECTRIC FLOW DIVIDER (OVERLOAD WARN. SYSTEM)
34	ONE-WAY VALVE
35	ONE-WAY VALVE
36	HYDRAULIC TANK

CUTTING LINE for BINDING

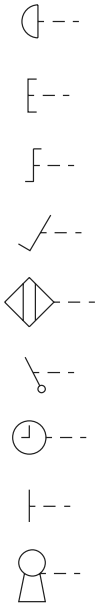
Procedure: Man-platform hydraulic scheme	Table: C.01.02



Ref	Description
1	DIESEL ENGINE
2	HYDRAULIC DRIVE PUMP
3	HYDRAULIC DRIVE MOTOR
4	WASHING VALVE
5	SERVICE PUMP
6	INDUCTION FILTER
7	INDUCTION FILTER
8	THERMAL EXCHANGER
9	ONE-WAY VALVE
10	"LOAD SENSING" PRIORITY VALVE
11	POWER STEERING
12	FRONT AXLE STEERING CYLINDER
13	REAR AXLE STEERING CYLINDER
14	STEERING SELECTION SOLENOID
15	BRAKE PUMP
16	BRAKE OIL SUMP
17	FRONT AXLE
18	4-ELEMENT DISTRIBUTOR
19	RAISING CYLINDER BLOCKING VALVE
20	RAISING CYLINDER
21	ONE-WAY VALVE
22	BALANCE CYLINDER BLOCKING VALVE
23	BALANCE CYLINDER
24	FORK MOVEMENT CYLINDER BLOCKING VALVE
25	FORK MOVEMENT CYLINDER
26	EXTENSION CYLINDER BLOCKING VALVE
27	EXTENSION CYLINDER
28	ATTACHMENT CYLINDER BLOCKING VALVE
29	ATTACHMENT CYLINDER
30	PRESSURE RELIEF VALVE
31	ELECTRIC FLOW DIVIDER (DEAD MAN)
32	HYDRAULIC SERVOCONTROL WITH LEVER
33	ELECTRIC FLOW DIVIDER (OVERLOAD WARN. SYSTEM)
34	ONE-WAY VALVE
35	ONE-WAY VALVE
36	HYDRAULIC TANK
37	ELECTRIC FLOW DIVIDER (AUXILIARY FUNCTIONS)
38	PROPORTIONAL VALVE

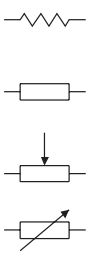
CUTTING LINE for BINDING

ACTUATORS



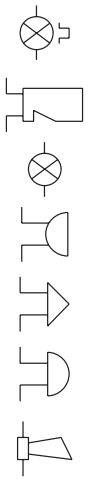
Emergency controls
Pushbutton control
Rotary control
Pedal control
Proximity control
Lever control
Timed control
Mechanical/manual control
Key control

RESISTANCES



Resistance
Resistor
Potentiometer
Variable resistance

SIGNALS

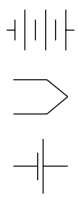


Intermittent lamp
Whistle
Lamp
Buzzer
Siren
Bell
Horn

FUSES AND RELAYS

Horizontal fuse
Relay

ACCUMULATORS



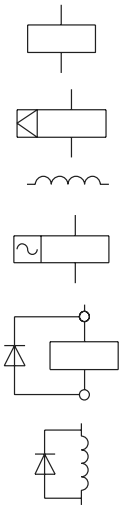
Battery
Thermocouple
Element

TERMINALS AND GROUNDS



Ring
Ground
Terminal
Ground to frame
Knot
Protection ground
Frame ground 2

COILS



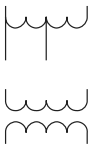
Coil
Mechanical coupling coil
Winding
A/C coil
Coil with diode
Winding with diode

CONNECTORS



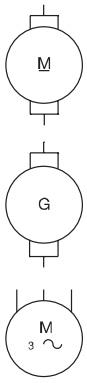
Connector

STATIC APPLICATIONS



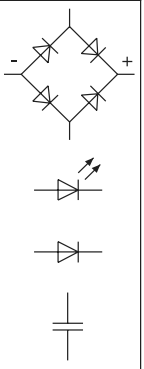
Auto-transformer
Transformer

DYNAMIC APPLICATIONS



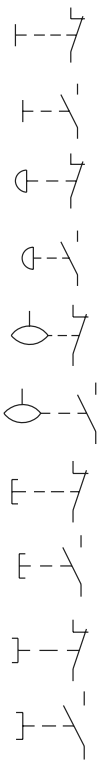
Motor
Generator
As_3p_motor

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

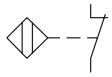

Magneto-thermal closure


Magneto-thermal opening


Thermal closure

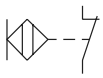

Thermal opening


Exchange


NC proximity


NO proximity

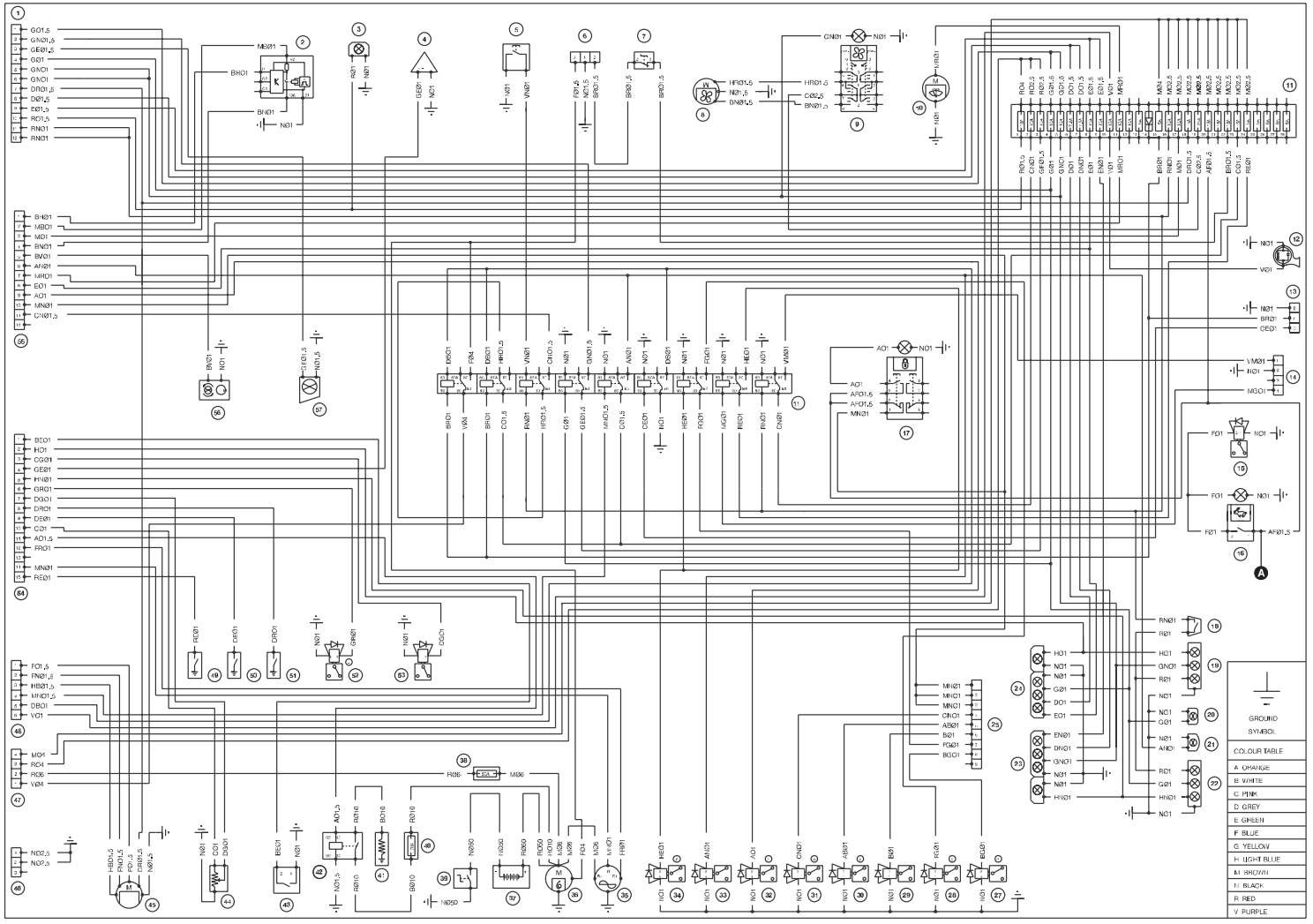

NO mechanical


NC mechanical


Selector


Selector2

Procedure:	Steering column wiring diagram (machines produced until December 2001)	Table: C.02.01



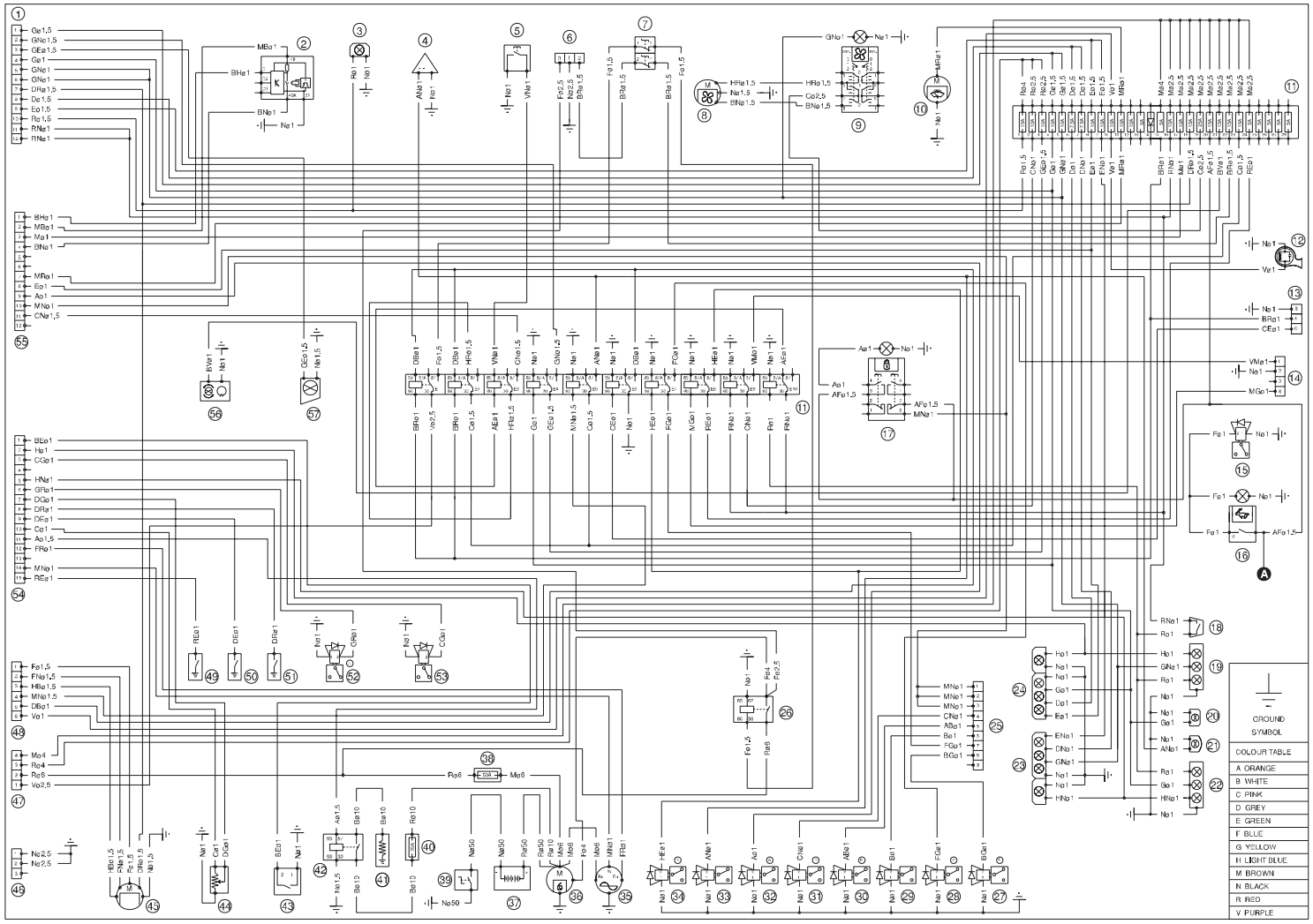
CUTTING LINE for BINDING

Operation:	Table:
General witing diagram (machines produced until December 2001)	C.02.01

Ref	Description
1	12-WAY FEMALE CONNECTOR - STEERING COLUMN
2	TURN SIGNAL BLINKING
3	INTERIOR LAMPS
4	BACK-UP HORN
5	SEAT MICRO-SWITCH
6	ENGINE STOP SOLENOID CONNECTOR
7	MUSHROOM-HEAD EMERGENCY PUSHBUTTON
8	HEATING FAN MOTOR
9	HEATING FAN SWITCH
10	WINDSCREEN WASHER MOTOR
11	FUSE AND RELAY BOX
12	SOUND ALARM
13	PARKING BRAKE SENSOR
14	OVERLOAD WARN. SYST. CTR UNIT CONNECTOR
15	HIGH SPEED SWITCH
16	LOW SPEED SWITCH
17	ROAD SAFETY SWITCH
18	HYDROSTOP
19	RIGHT TAIL LIGHT
20	LICENSE PLATE LIGHT
21	BACK-UP LAMP
22	LEFT TAIL LIGHT
23	FRONT POSITION LIGHT - LEFT TURN SIGNAL
24	FRONT POSITION LIGHT - RIGHT TURN SIGNAL
25	JOYSTICK CONNECTOR
27	ATTACHMENT UNLOCKING SOLENOID
28	BOOM EXTENSION SOLENOID
29	DEAD MAN SOLENOID
30	ATTACHMENT LOCKING SOLENOID
31	BOOM RETRACTION SOLENOID
32	FORWARD MOV. SOLENOID
33	REVERSE MOV. SOLENOID
34	OVERLOAD WARN. SYSTEM SOLENOID
35	ALTERNATOR
36	STARTER MOTOR
37	12V-BATTERY
38	MAXI FUSE - SYSTEM PROTECTION
39	BATTERY CUT-OUT SWITCH
40	MAXI FUSE - THERMAL STARTER PROTECTION
41	THERMAL STARTER
42	MAXI RELAY - THERMAL STARTER
43	WATER TEMPERATURE SENSOR
44	FUEL FLOAT
45	FRONT WIPER MOTOR

Ref	Description
46	2-WAY MALE MAXI CONNECTOR - STEERING COLUMN
47	4-WAY MALE POWER CONNECTOR - STEERING COLUMN
48	6-WAY FEMALE CONNECTOR - STEERING COLUMN
49	HYDRAULIC OIL TEMPERATURE INDICATOR SENSOR
50	WATER TEMPERATURE INDICATOR SENSOR
51	ENGINE OIL PRESSURE SENSOR
52	STEERING SELECTION SOLENOID VALVE
53	STEERING SELECTION SOLENOID VALVE
54	15-WAY FEMALE CONNECTOR - STEERING COLUMN
55	12-WAY MALE CONNECTOR - STEERING COLUMN
56	BEACON
57	WORK LIGHT

Procedure: General wiring diagram (machines produced from January 2002)	Table: C.02.02



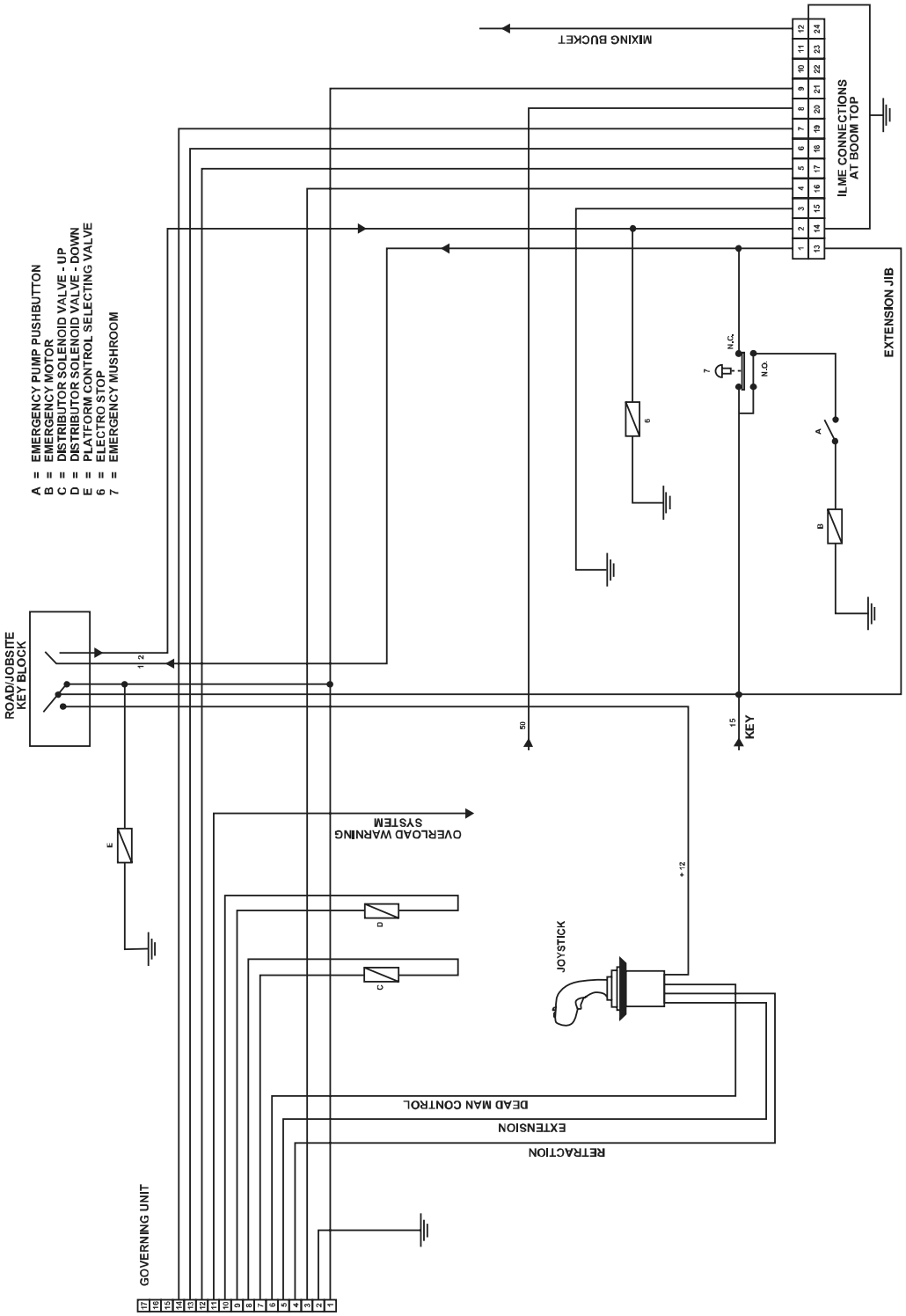
CUTTING LINE for BINDING

Operation:	Table:
General witing diagram (machines produced from January 2002)	C.02.02

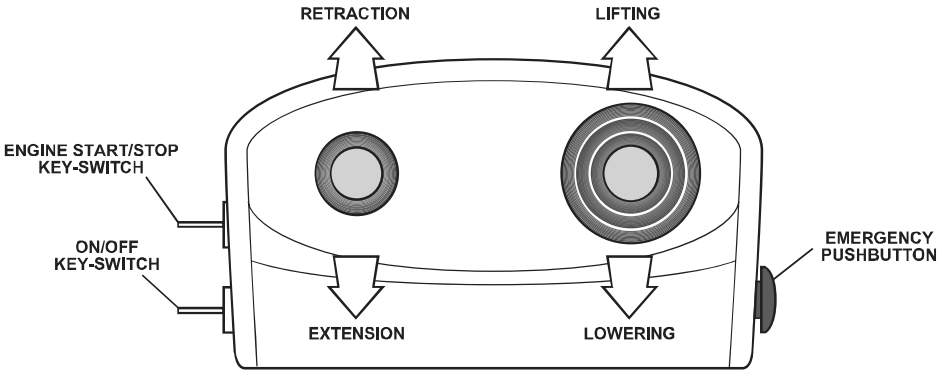
Ref	Description
1	12-WAY FEMALE CONNECTOR - STEERING COLUMN
2	TURN SIGNAL BLINKING
3	INTERIOR LAMPS
4	BACK-UP HORN
5	SEAT MICRO-SWITCH
6	ENGINE STOP SOLENOID CONNECTOR
7	MUSHROOM-HEAD EMERGENCY PUSHBUTTON
8	HEATING FAN MOTOR
9	HEATING FAN SWITCH
10	WINDSCREEN WASHER MOTOR
11	FUSE AND RELAY BOX
12	SOUND ALARM
13	PARKING BRAKE SENSOR
14	OVERLOAD WARN. SYST. CTR UNIT CONNECTOR
15	HIGH SPEED SOLENOID
16	HIGH SPEED SWITCH
17	ROAD SAFETY SWITCH
18	HYDROSTOP
19	RIGHT TAIL LIGHT
20	LICENSE PLATE LIGHT
21	BACK-UP LAMP
22	LEFT TAIL LIGHT
23	FRONT POSITION LIGHT - LEFT TURN SIGNAL
24	FRONT POSITION LIGHT - RIGHT TURN SIGNAL
25	JOYSTICK CONNECTOR
26	POWER RELAY
27	ATTACHMENT UNLOCKING SOLENOID
28	BOOM EXTENSION SOLENOID
29	DEAD MAN SOLENOID
30	ATTACHMENT LOCKING SOLENOID
31	BOOM RETRACTION SOLENOID
32	FORWARD MOV. SOLENOID
33	REVERSE MOV. SOLENOID
34	OVERLOAD WARN. SYSTEM SOLENOID
35	ALTERNATOR
36	STARTER MOTOR
37	12V-BATTERY
38	MAXI FUSE - SYSTEM PROTECTION
39	BATTERY CUT-OUT SWITCH
40	MAXI FUSE - THERMAL STARTER PROTECTION
41	THERMAL STARTER
42	MAXI RELAY - THERMAL STARTER
43	WATER TEMPERATURE SENSOR
44	FUEL FLOAT

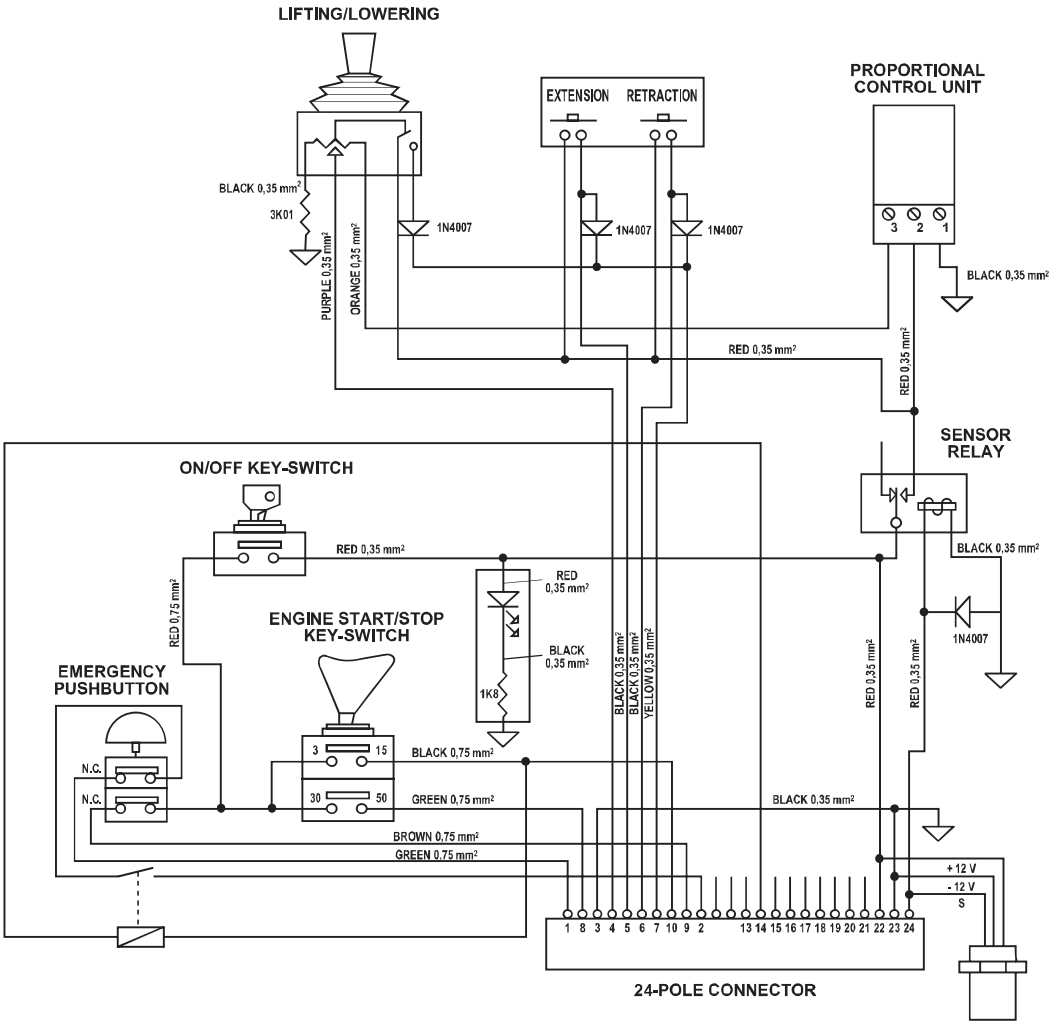
Ref	Description
45	FRONT WIPER MOTOR
46	2-WAY MALE MAXI CONNECTOR - STEERING COLUMN
47	4-WAY MALE POWER CONNECTOR - STEERING COLUMN
48	6-WAY FEMALE CONNECTOR - STEERING COLUMN
49	HYDRAULIC OIL TEMPERATURE INDICATOR SENSOR
50	WATER TEMPERATURE INDICATOR SENSOR
51	ENGINE OIL PRESSURE SENSOR
52	STEERING SELECTION SOLENOID VALVE
53	STEERING SELECTION SOLENOID VALVE
54	15-WAY FEMALE CONNECTOR - STEERING COLUMN
55	12-WAY MALE CONNECTOR - STEERING COLUMN
56	BEACON
57	WORK LIGHT

Operation:	Table:
General wiring diagram integration for man-platform application	C.02.03

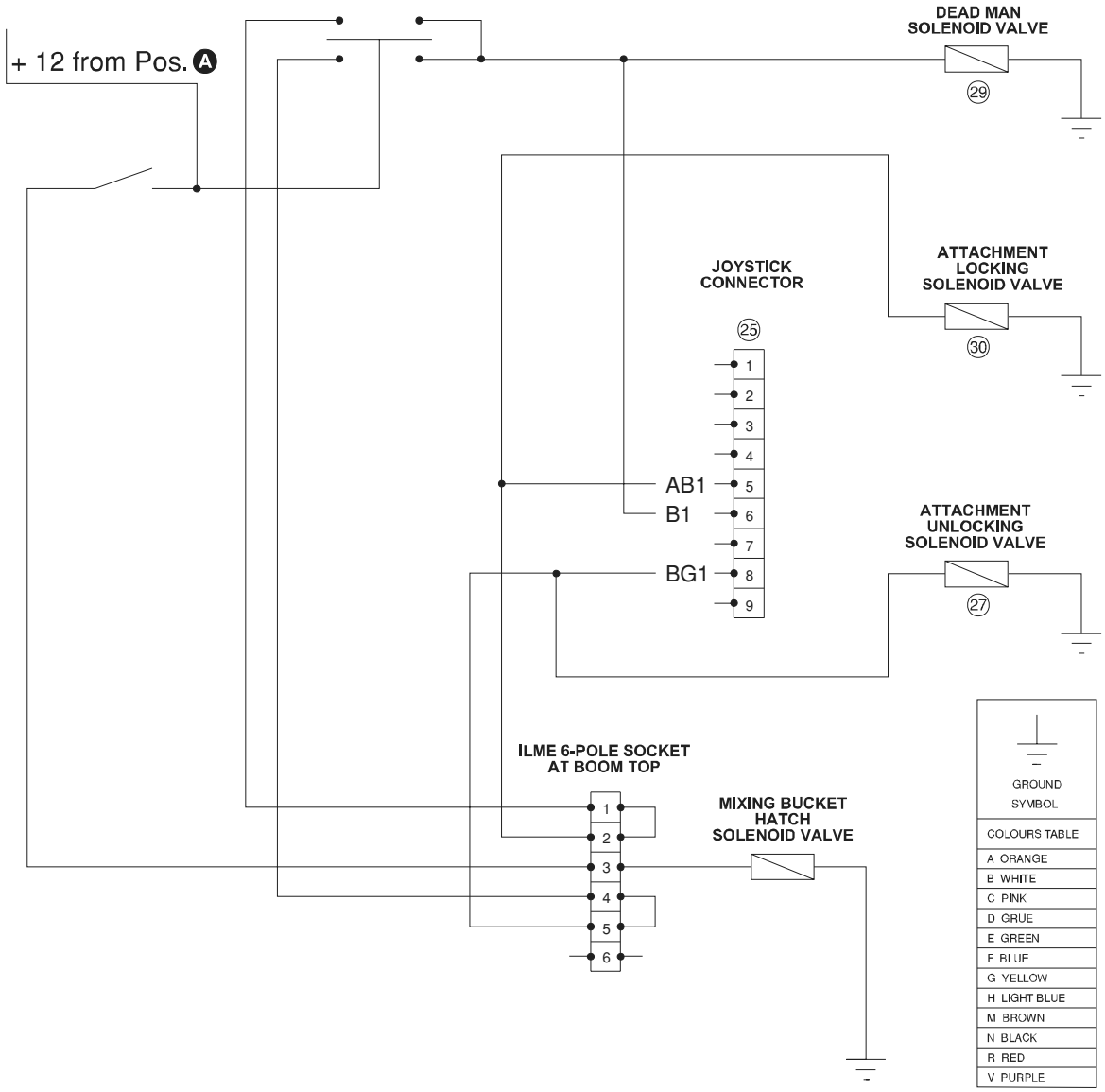


Operation: Wiring diagram - pushbutton panel on man-platform	Table: C.02.04

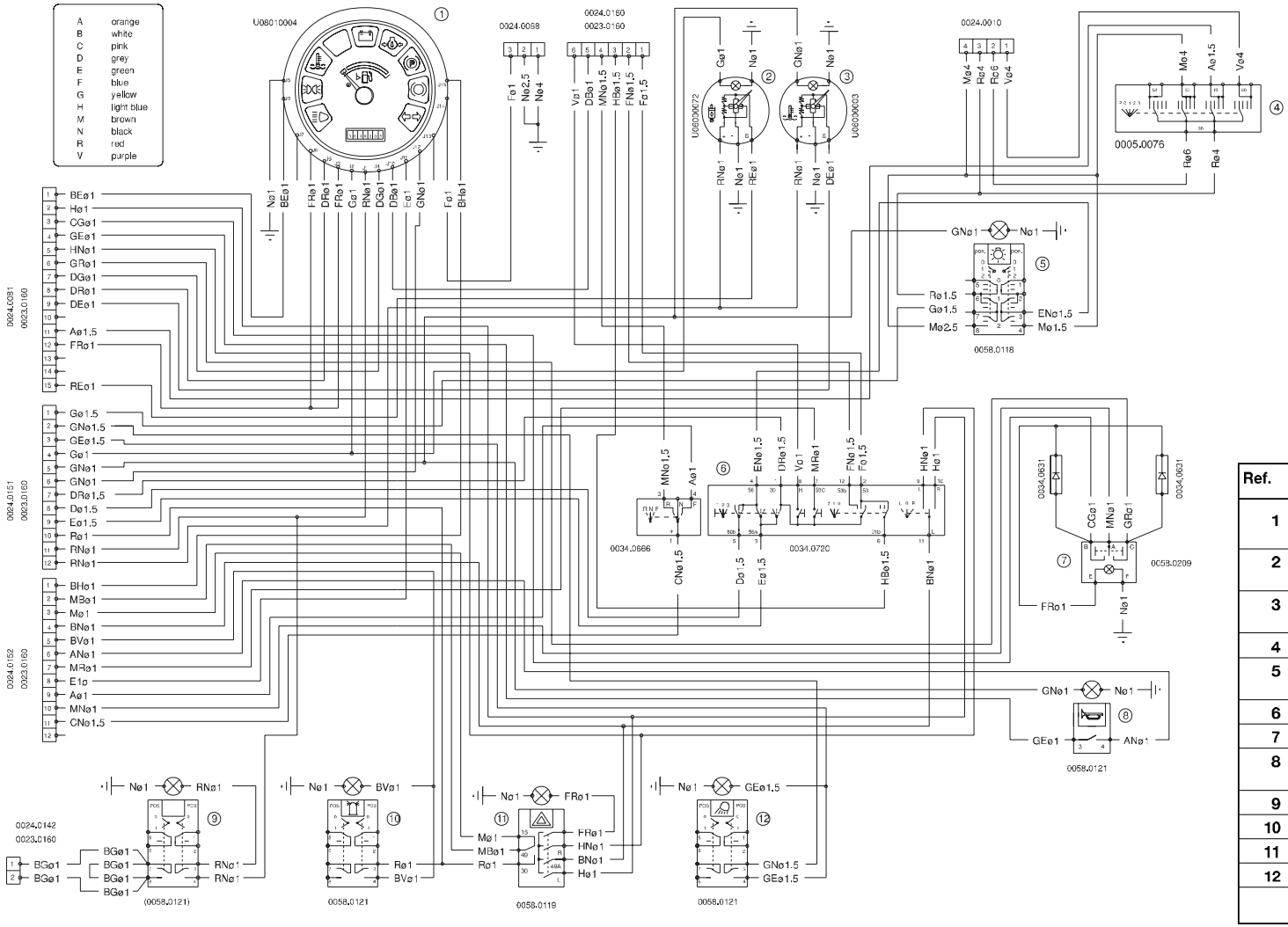




Operation: Mixing bucket wiring diagram	Table: C.02.05



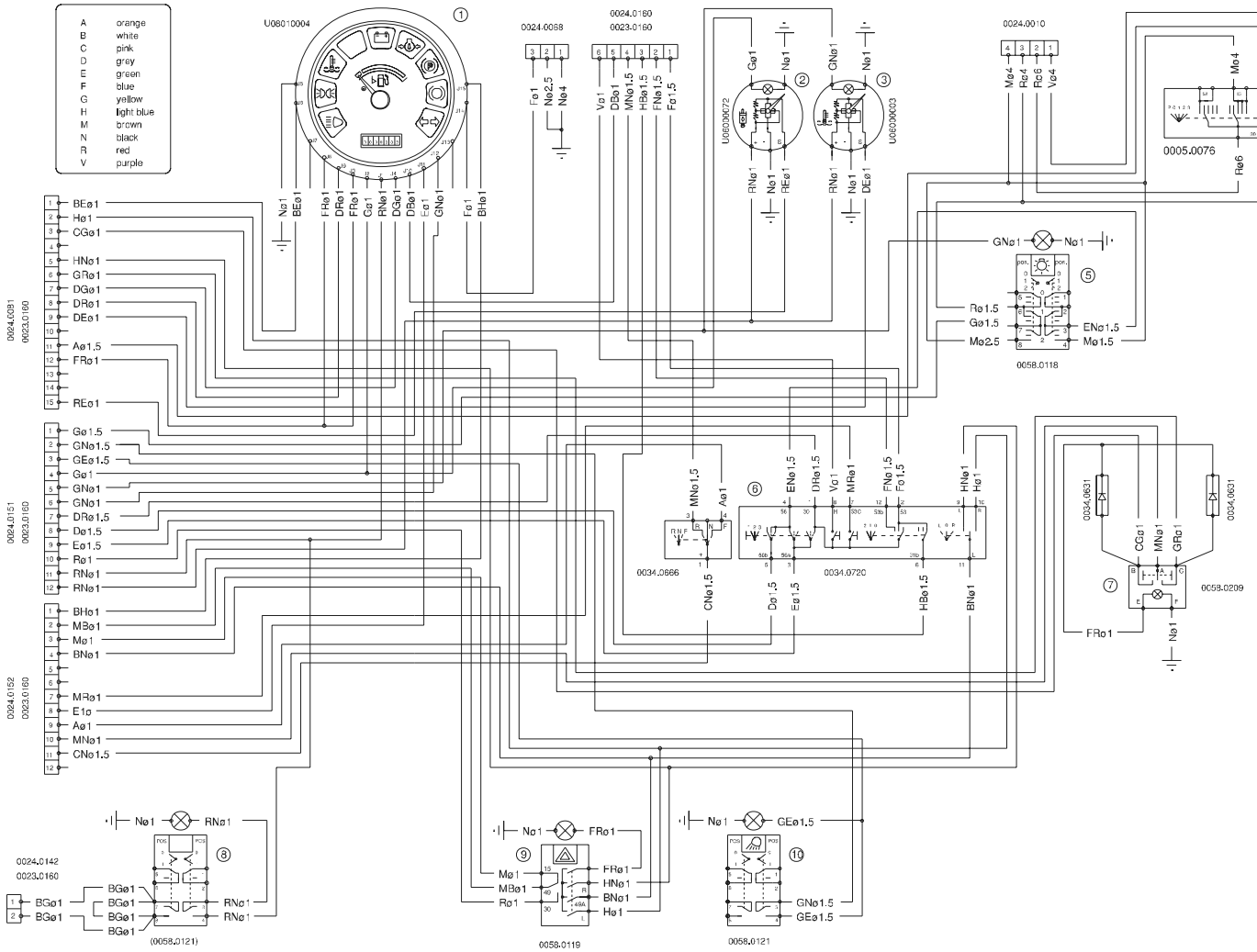
Procedure:	Table:
Steering column wiring diagram (machines produced until December 2001)	C.02.06



Ref.	Description
1	HOURMETER - FUEL GAUGE - INDICATORS
2	HYDRAULIC OIL TEMPERATURE PRESSURE GAUGE
3	COOLANT TEMPERATURE PRESSURE GAUGE
4	IGNITION KEY
5	POSITION LIGHTS - LOW BEAM - HIGH BEAM SELECTOR
6	FWD/REVERSE - SPEED SWITCH
7	STEERING SELECTOR
8	BACK-UP HORN CUT-OUT PUSHBUTTON
9	OPTIONAL SWITCH
10	BEACON SWITCH
11	HAZARD WARNING LIGHTS SWITCH
12	EXTRA WORK LIGHT SWITCH

CUTTING LINE for BINDING

Procedure:	Table:
Steering column wiring diagram (machines produced from January 2002)	C.02.07

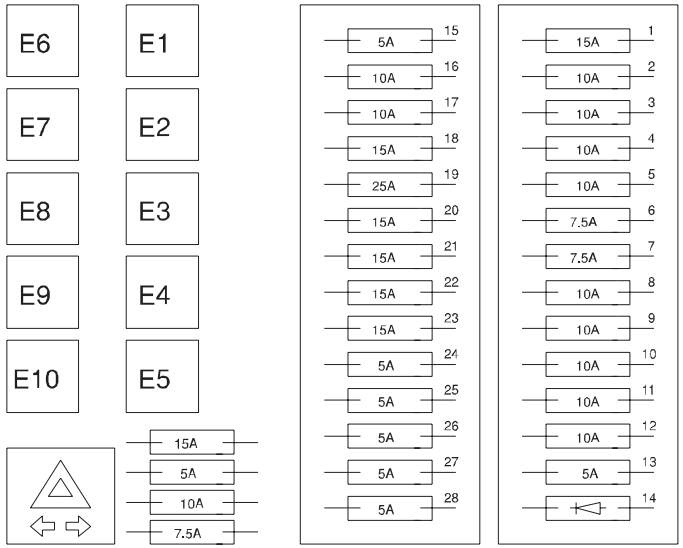


Ref.	Description
1	HOURMETER - FUEL GAUGE - INDICATORS
2	HYDRAULIC OIL TEMPERATURE PRESSURE GAUGE
3	COOLANT TEMPERATURE PRESSURE GAUGE
4	IGNITION KEY
5	POSITION LIGHTS - LOW BEAM - HIGH BEAM SELECTOR
6	FWD/REVERSE - SPEED SWITCH
7	STEERING SELECTOR
8	OPTIONAL SWITCH
9	HAZARD WARNING LIGHTS SWITCH
10	EXTRA WORK LIGHT SWITCH

CUTTING LINE for BINDING

Procedure: Fuse wiring diagram	Table: C.02.08

RELAYS - FUSES



RELAYS

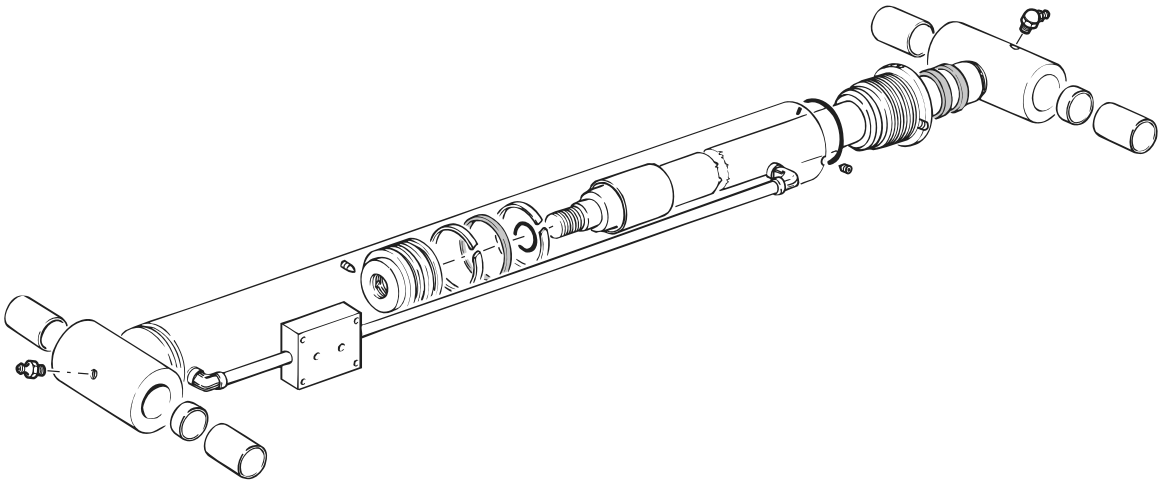
RELAY E1 ENABLING START-UP
RELAY E2 ENABLING POWER TO E3 WITH PARKING BRAKE ENGAGED
RELAY E3 ENABLING POWER TO SPEED SWITCH WITH SEAT SWITCH DEPRESSED
RELAY E4 ENABLING POWER TO WORK LIGHT SWITCH
RELAY E5 ENABLING POWER TO BACK-UP HORN CUT-OUT SWITCH, BACK-UP LAMP
RELAY E6 ENABLING POWER TO PARKING BRAKE, RELAY E1, RELAY E2
RELAY E7 ENABLING BOOM EXTENSION SOLENOID VALVE
RELAY E8 ENABLING OVERLOAD WARNING SYSTEM SOLENOID VALVE, RELAY E7
RELAY E9 ENABLING POWER TO THE CONTROL UNIT OF THE OVERLOAD WARNING SYSTEM
RELAY E10 ENABLING POWER TO THE SPEED SWITCH WITH HYDROSTOP SWITCH DISENGAGED

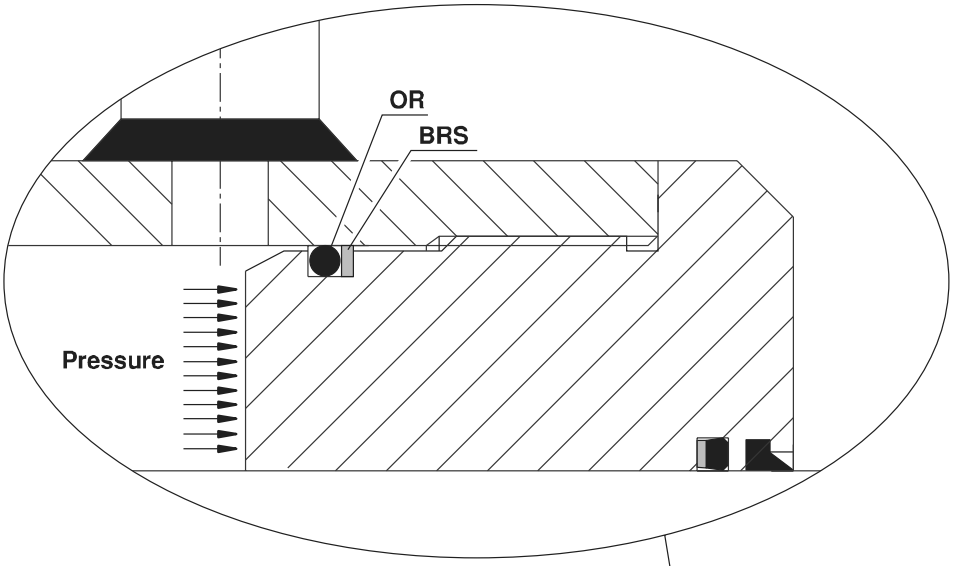
FUSES

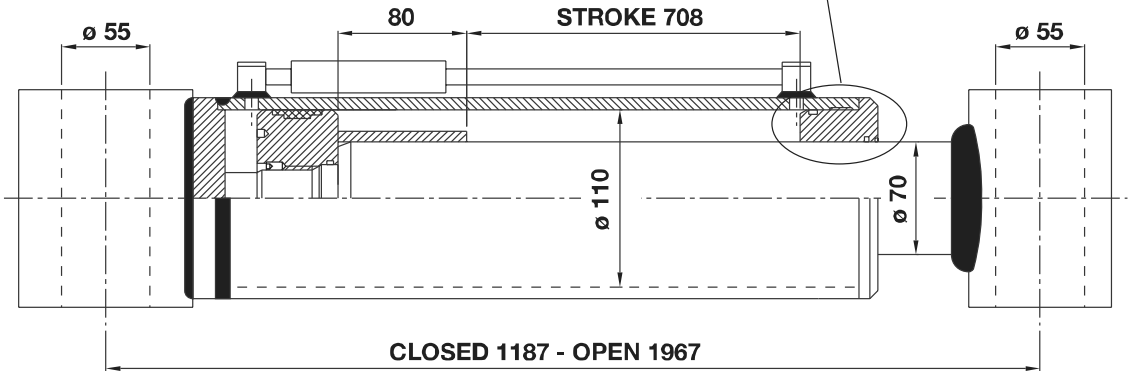
Pos.	User
1	POWERING INTERIOR LAMP, BEACON SWITCH, HAZARD WARNING LIGHTS/TURN SIGNALS SWITCH
2	POWERING: RELAY E9
3	POWERING: RELAY E4
4	FRONT RIGHT/REAR LEFT POSITION LIGHT, LICENCE PLATE LIGHT, POSITION LIGHTS INDICATOR, HYDRAULIC OIL TEMPERATURE INDICATOR, E4 RELAY ENABLING COMMAND
5	FRONT LEFT/REAR RIGHT POSITION LIGHT, INSTRUMENTATION LIGHTING, FUEL GAUGE - HOURMETER - INDICATORS, WATER TEMPERATURE LIGHTING, POSITION LIGHTS SWITCH LIGHTING
6	RIGHT LOW BEAM
7	LEFT LOW BEAM
8	RIGHT HIGH BEAM, HIGH BEAM INDICATOR
9	LEFT HIGH BEAM
10	HORN
11	WINDSCREEN WASHER KIT
12	BLANK
13	BLANK
14	BLANK
15	POWERING: PARKING BRAKE SENSOR, RELAY E1 ENABLING COMMAND, RELAY E2 ENABLING COMMAND
16	POWERING HYDROSTOP, FUEL GAUGE-HOURMETER-INDICATORS, HYDRAULIC OIL TEMPERATURE INDICATOR, WATER TEMPERATURE INDICATOR, RELAY 10, RELAY E9 EXCITATION
17	POWERING: HAZARD WARNING LIGHTS/TURN SIGNALS SWITCH
18	POWERING: LIGHTS/WIPER SWITCH, WIPER MOTOR
19	POWERING: HEATING FAN SWITCH
20	POWERING: ROAD SAFETY SWITCH, HIGH SPEED SWITCH
21	POWERING: BEACON
22	POWERING: ENGINE STOP RED EMERGENCY
23	POWERING: RELAY E2 , RELAY E5
24	POWERING: RELAY E8
25	BLANK
26	BLANK
27	BLANK
28	BLANK

CUTTING LINE for BINDING

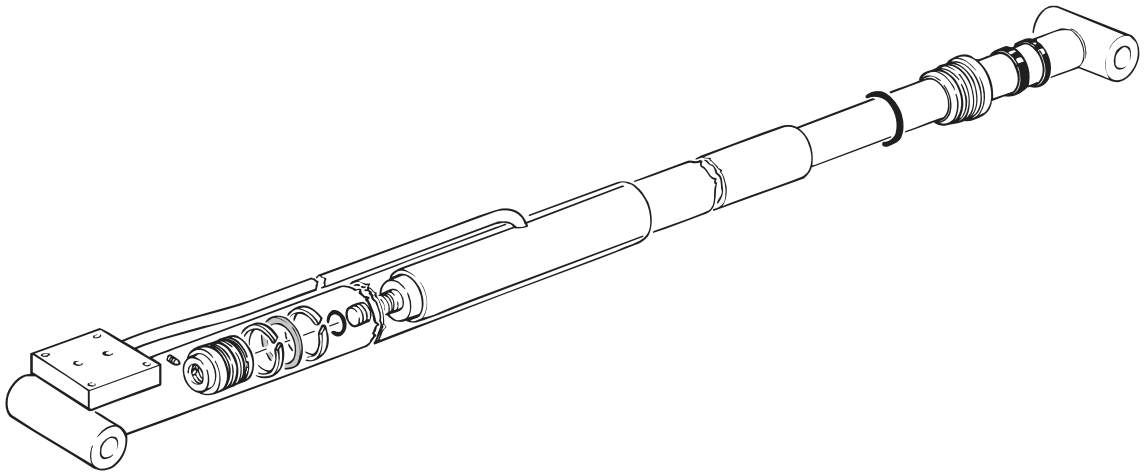
Operation: Boom raising cylinder	Table: C.03.01

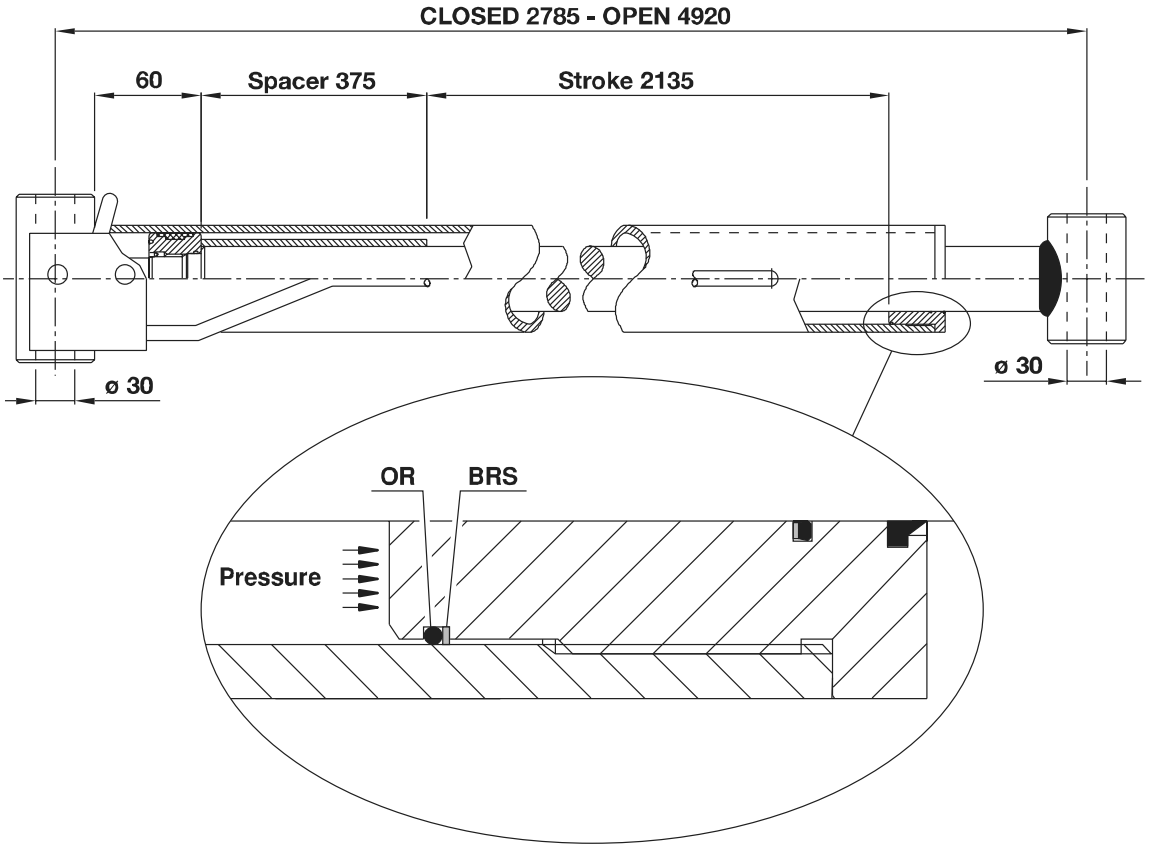




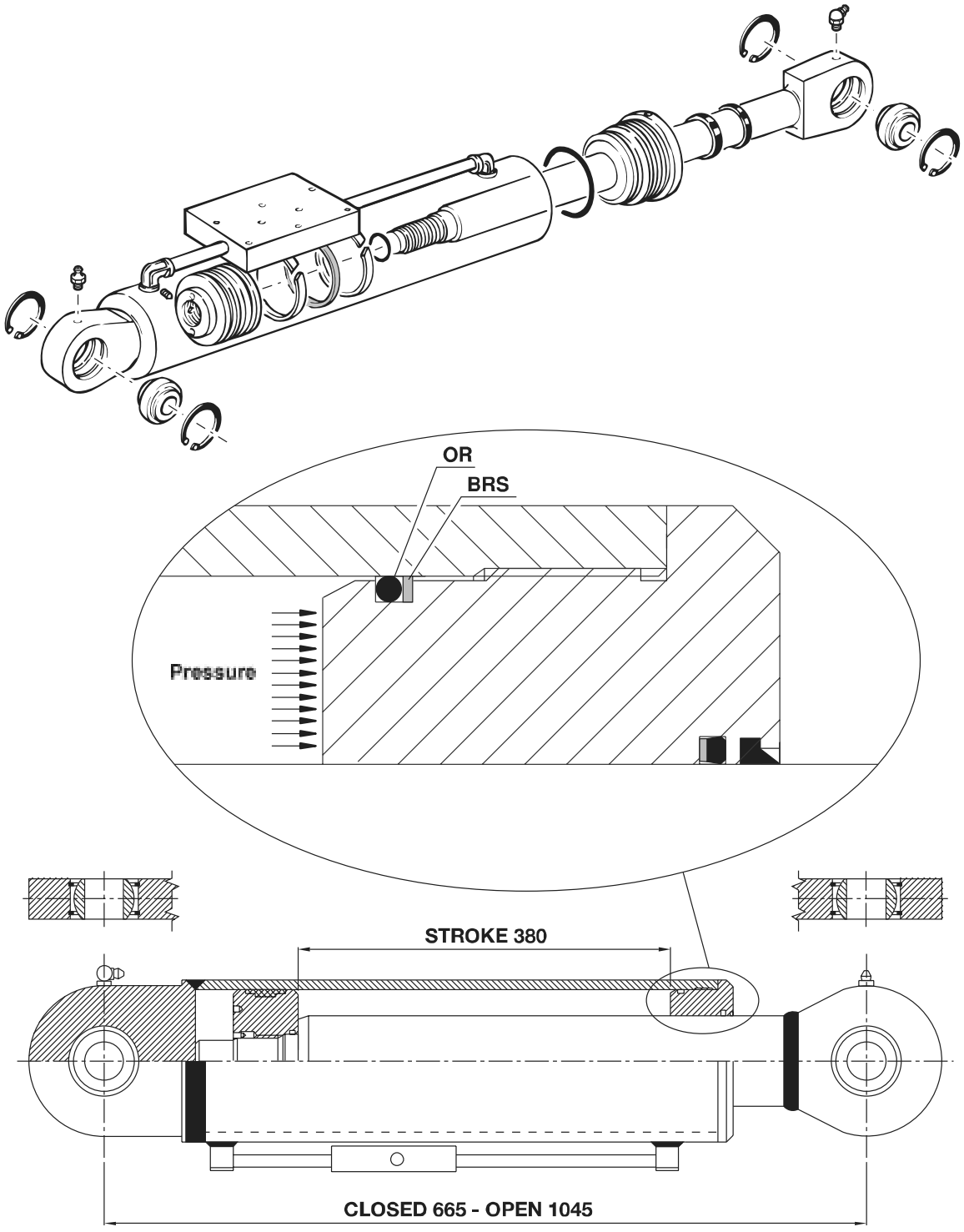


Operation: Boom extension cylinder	Table: C.03.02

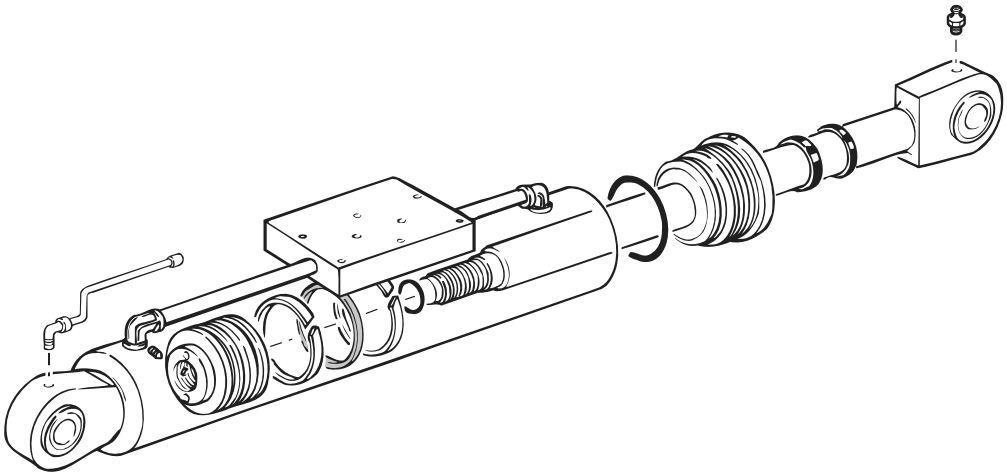


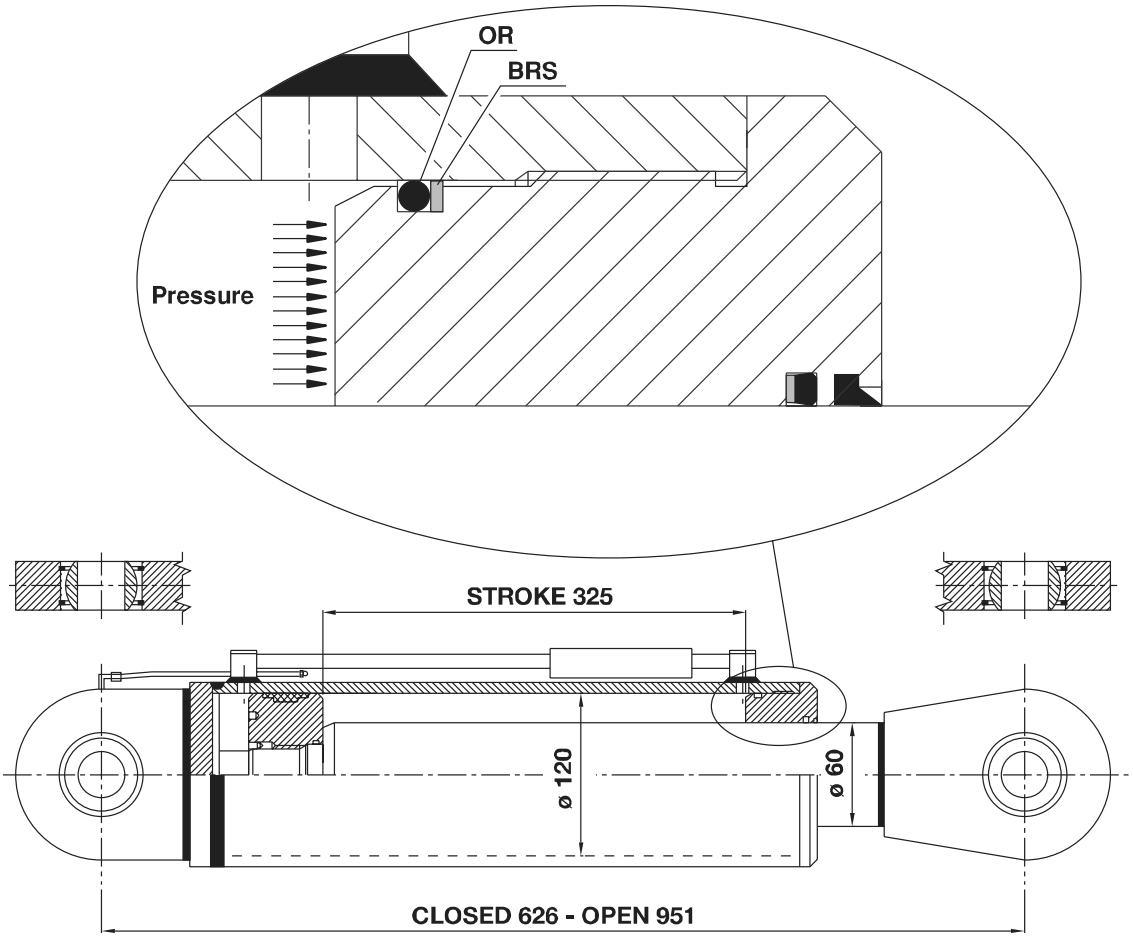


Operation: Balance cylinder	Table: C.03.03

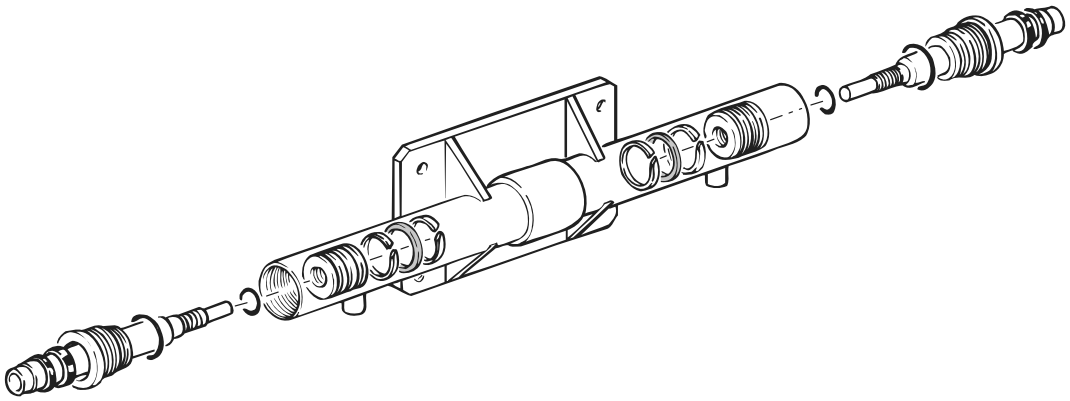


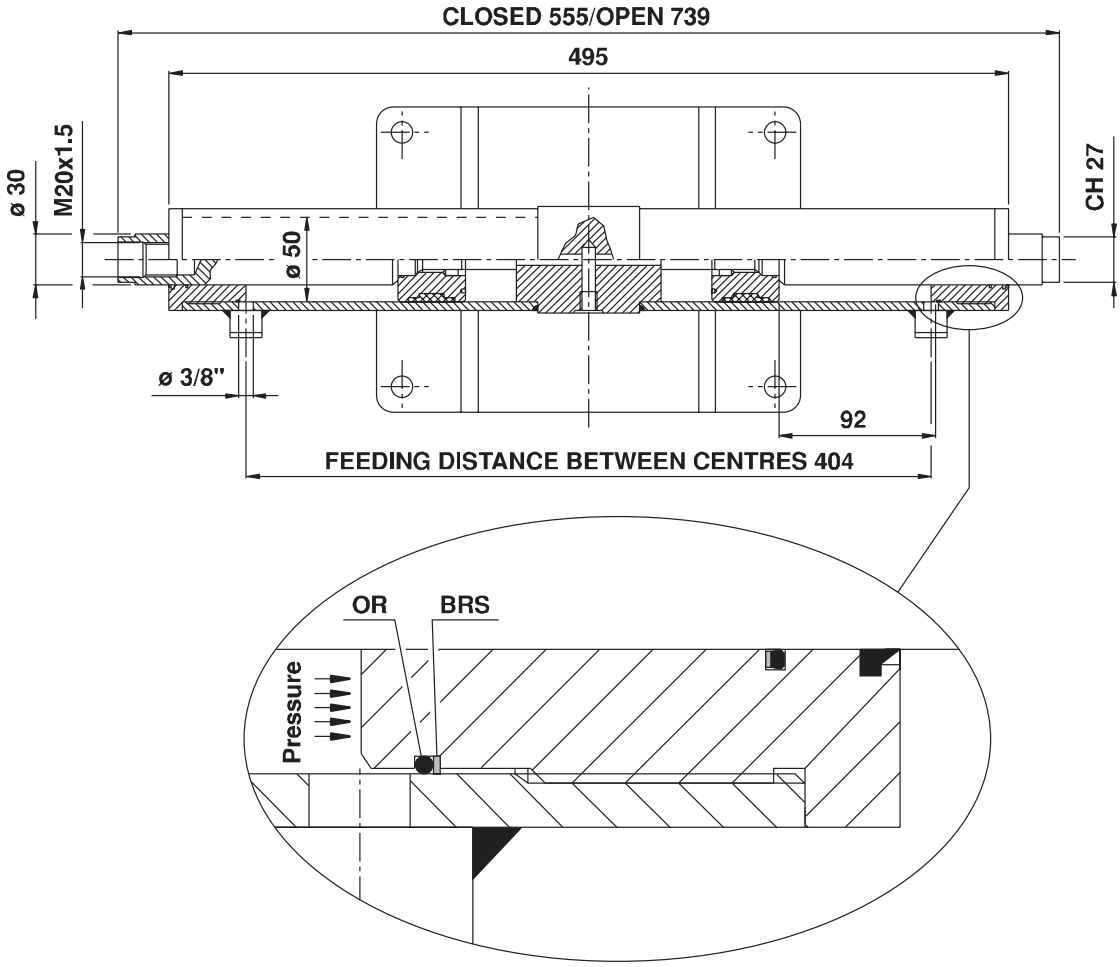
Operation:	Table:
Fork movement cylinder	C.03.04



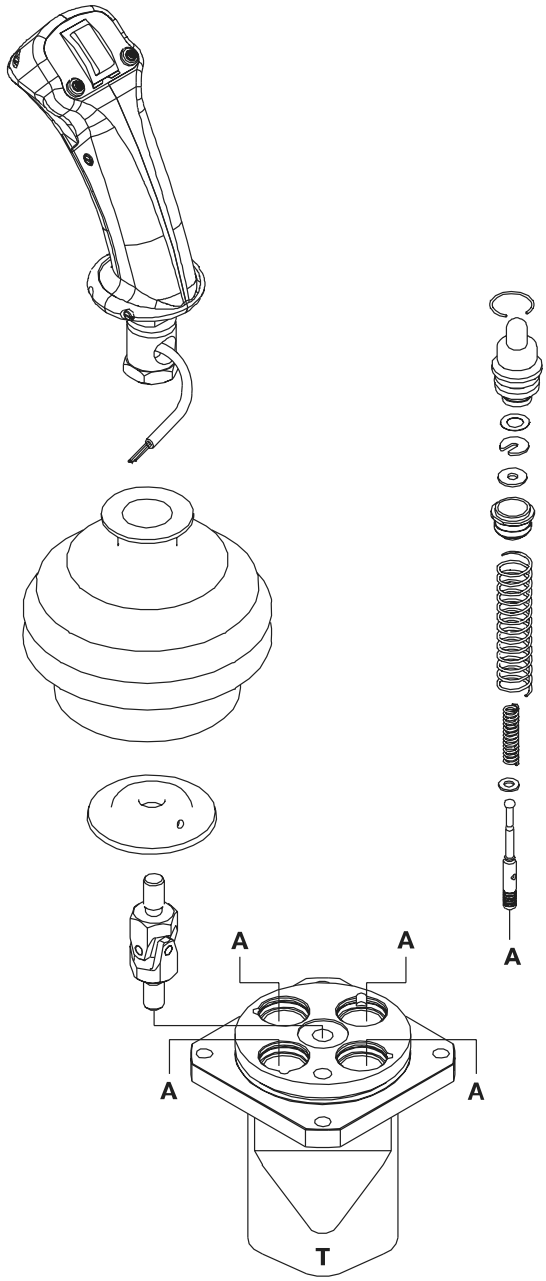


Operation: Attachment locking cylinder	Table: C.03.05

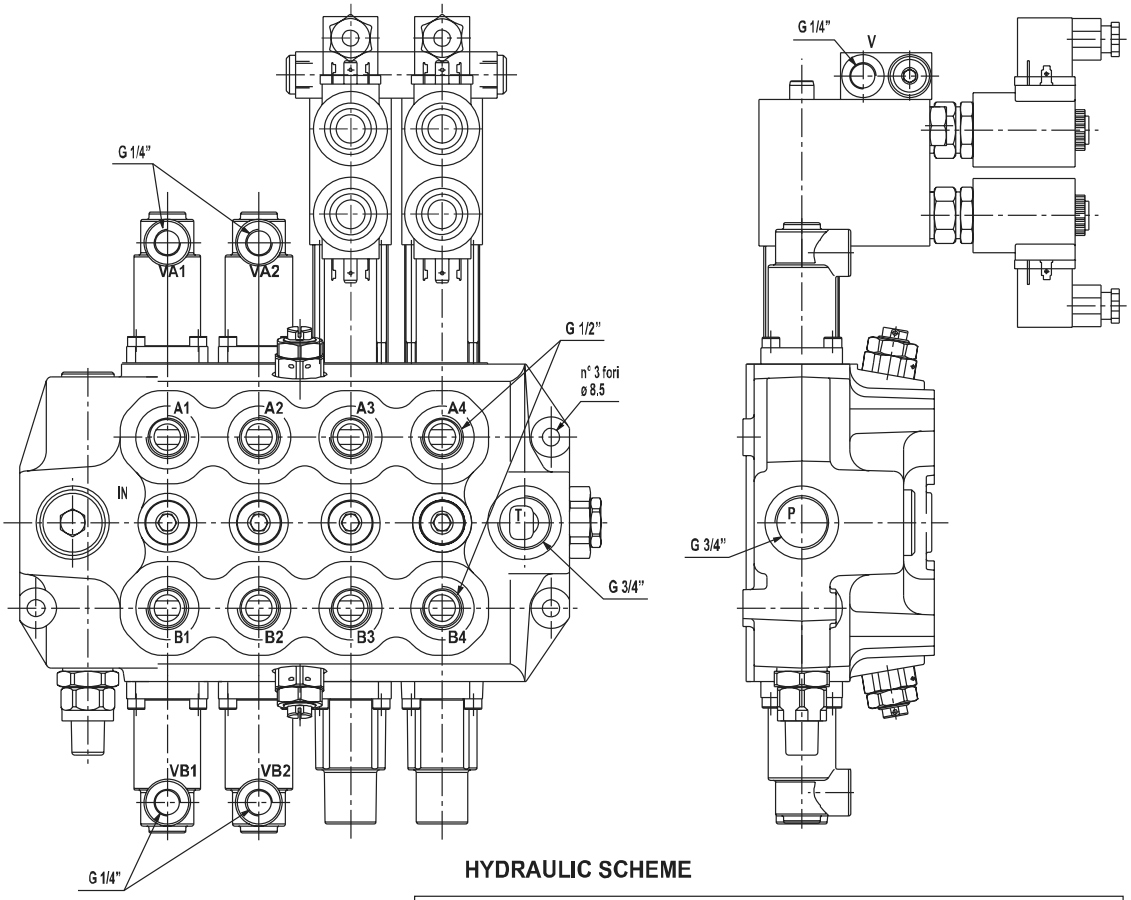




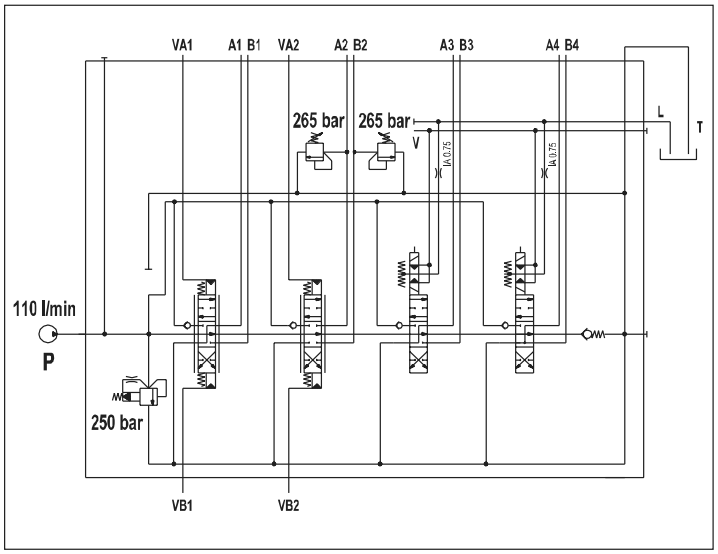
Operation: Hand-lever	Table: C.04.01



Operation: Hydraulic distributor	Table: C.05.01

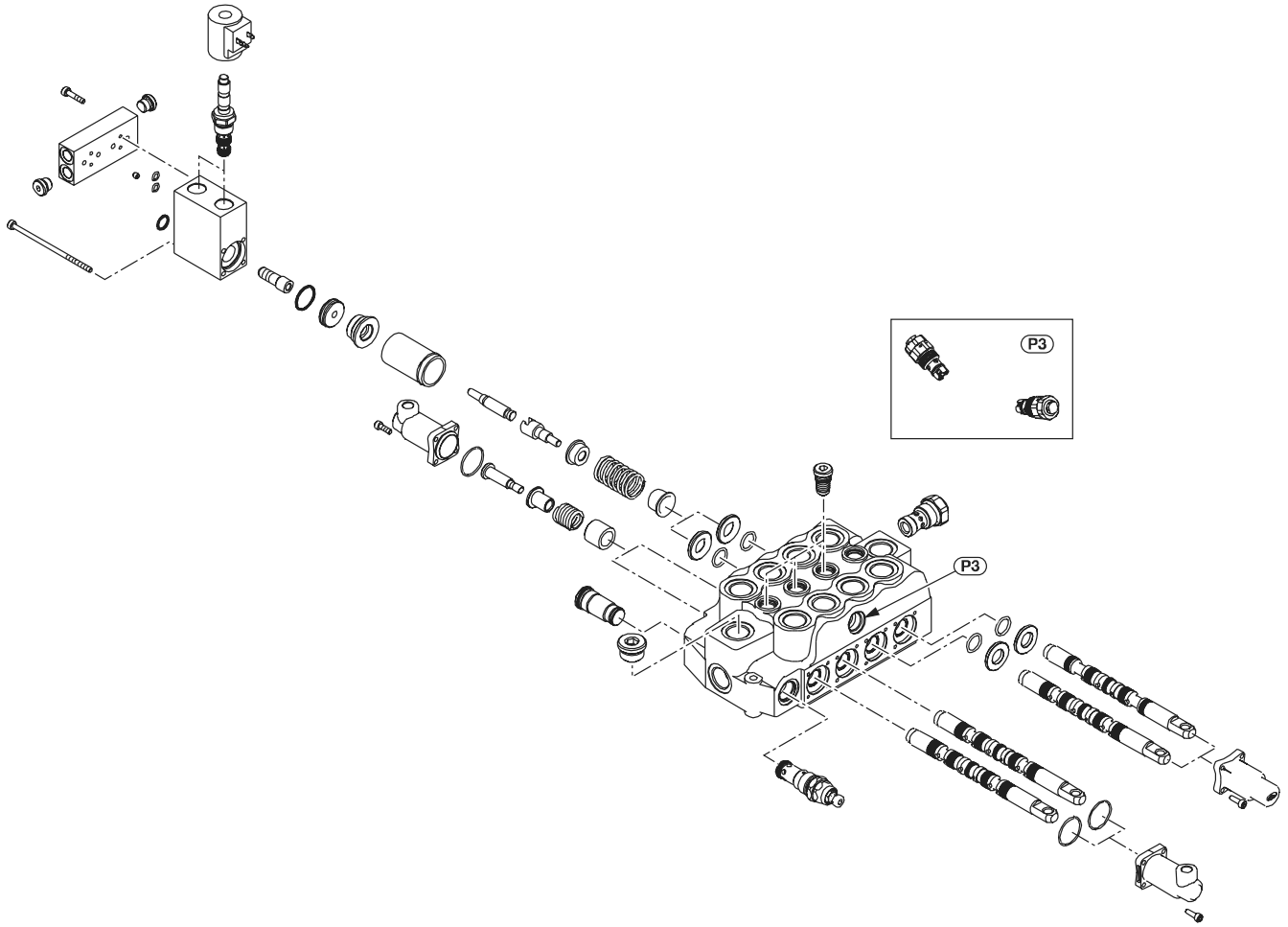


HYDRAULIC SCHEME



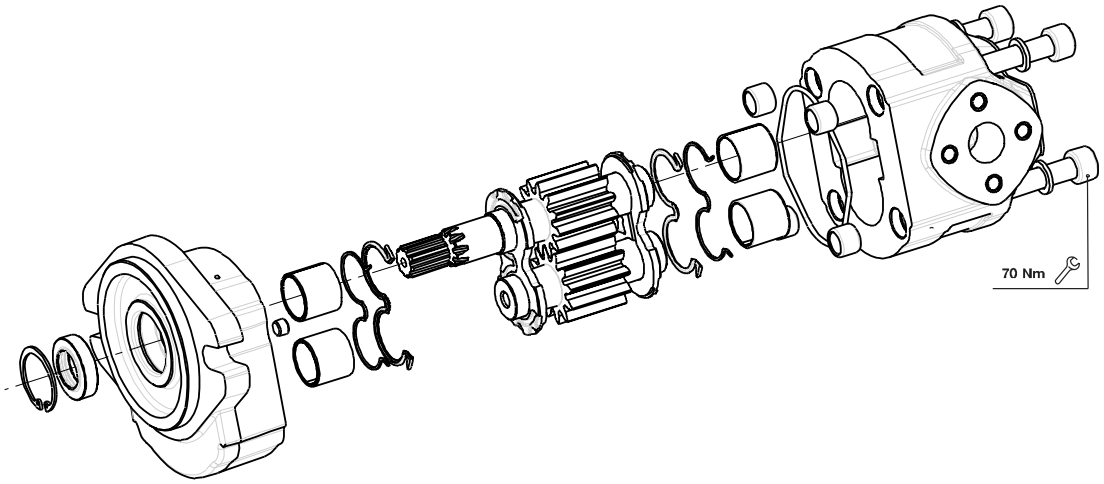
CHARACTERISTICS		
One-block distributor with parallel circuit		
Working sections		4
Slider diameter		18 mm
WORKING CONDITIONS (mineral oil with 46 mm2/s viscosity at 40/BC)		
Nominal flow		80 l/min
Nominal pressure		250 bar
Max pressure on V		50 bar
Max back-pressure to drain T		25 bar
Internal leakage A(B)->T at 100 bar :		3 cm^3/min
Viscosity	working field	15 - 75 mm^2/s
	minimum	12 mm^2/s
	maximum	400 mm^2/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

Procedure: Hydraulic distributor	Table: C.05.02



CUTTING LINE for BINDING

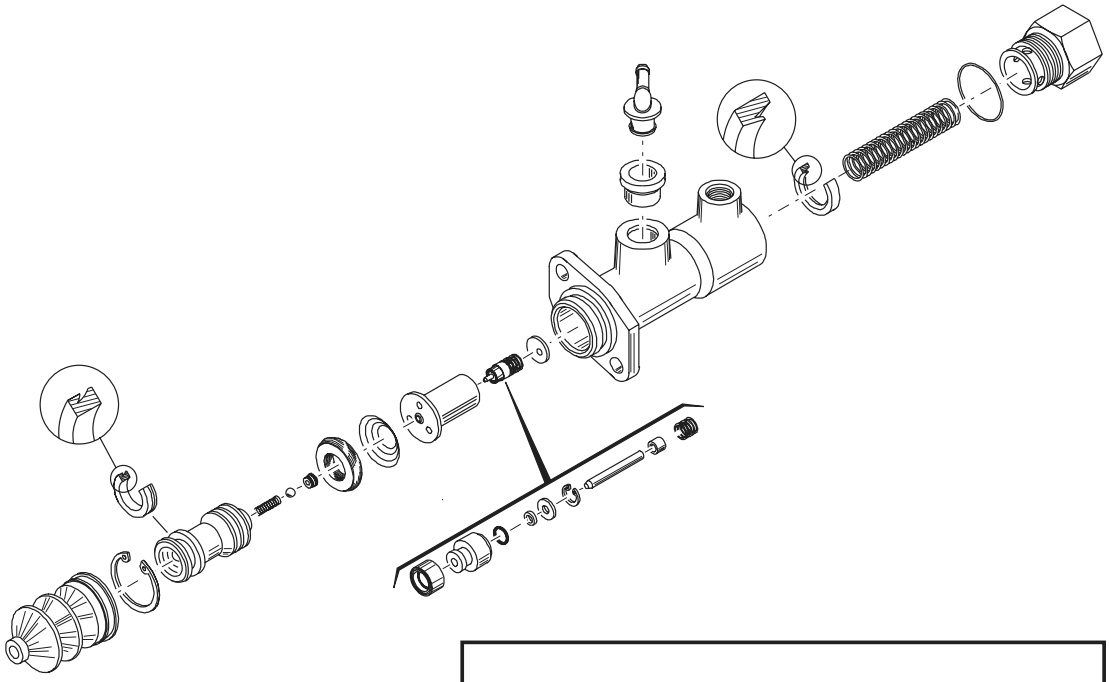
Operation: Hydraulic pump	Table: C.06.01

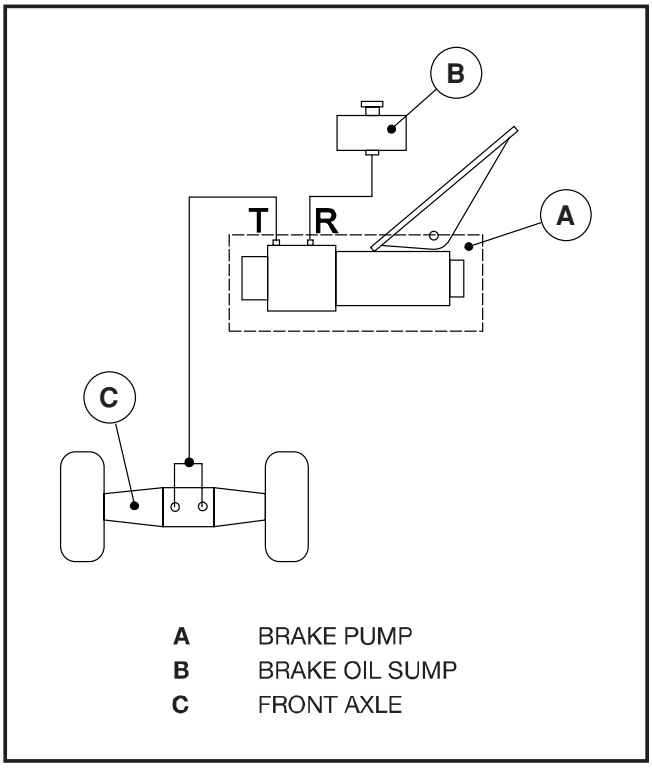


PUMP TECHNICAL DATA

- Rotation direction		left
- Displacement		21.14 cm³
- Feeding pressure field for pumps		0.3 - 3 bar
- Max continuous pressure	P1	210 bar
- Max intermittent pressure	P2	230 bar
- Max peak pressure	P3	250 bar
- Speed	min P1	300 min^-1
	max P1	3000 min^-1
- Gaskets		NBR
- Working temperature		-25°C +80°C
- Viscosity field	recommended	12-100 mm^2/s
	admissible	max 750 mm^2/s
- Contamination class	ΔP > 200 bar	8 - Nas 1638
	βx = 75-10 μm	19/17/14 - ISO 4406
	ΔP < 200 bar	10 - Nas 1638
	βx = 75-25 μm	21/19/16 - ISO 4406

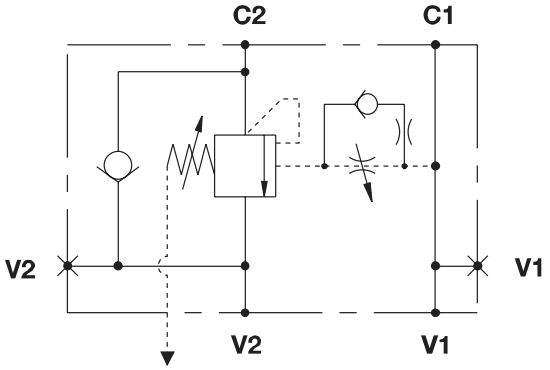
Operation: Brake pump	Table: C.06.02



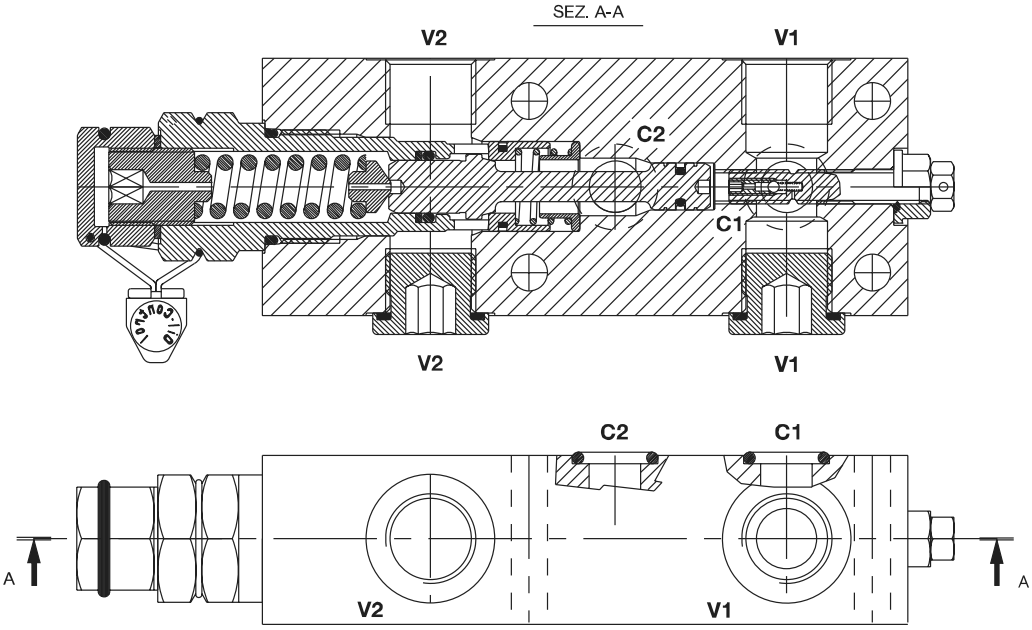


A BRAKE PUMP
B BRAKE OIL SUMP
C FRONT AXLE

Operation: Boom raising and extension cylinder blocking valve	Table: C.07.01



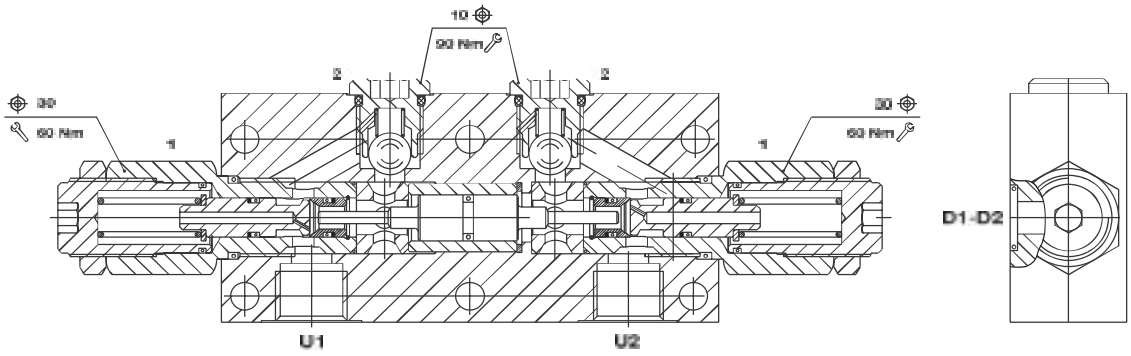
FITTINGS V1-V2: G 1/2"
C1-C2: ø12



TECHNICAL DATA

- Max working pressure = 350 bar
- Piloting ratio = 4:1
- Weight = 2.5 kg
- Valve setting = 1.3 times higher than the load induced pressure
- Steel manifold

Operation: Balance cylinder blocking valve	Table: C.07.02



FILTRATION - OIL CONTAMINATION

TYPE OF SYSTEM TYPE OF VALVE	RECOMMENDED CONTAMINATION LEVEL - ISO 4406
- High performance systems - Systems with working pressures from 210 to 350 bar - Systems with proportional controls - Systems with high frequency cycles	16/13
- Systems with working pressures up to 210 bar - Spool valves - Valves with calibrated orifice	18/14
- Systems with low working pressures - Piloting systems - Systems with low frequency cycles	19/15

MATERIAL

Body: Aluminium 702 State T6
Internal parts: case-hardened and tempered steel

TECHNICAL DATA

Max flow = 70 l/min
Max pressure = 210 Bar
Setting = 50 - 350 bar
(test setting 40 bar with 5 l/min)
Piloting ratio = 1:7
Fluid: 20-200 cSt mineral oil
Ambient temperature = 0 +50 °C
Gaskets : BUNA N

BLOW-BY

Blow-by from U1 to D1: 0.25 cc/min (5 drops) at 210 bar and 80% the setting value of the spring with oil with 46 cSt viscosity

FITTINGS

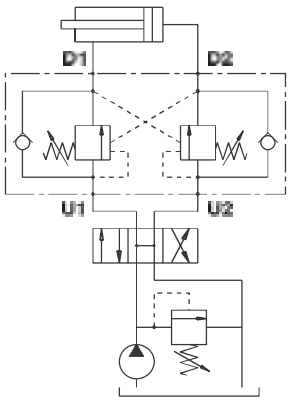
U1 - U1 = G 1\2"
D1 - D2 = FLANGED

Cylindrical fitting tightening torque 0 60 Nm (do not use conical fittings)

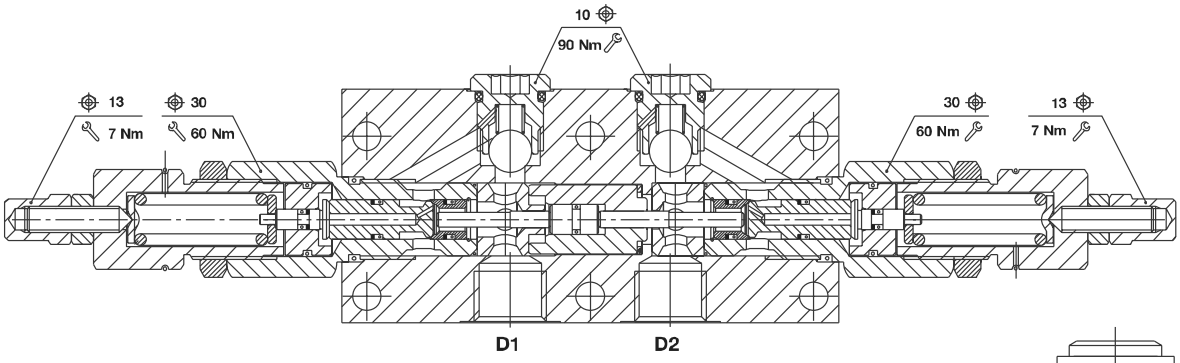
VALVES

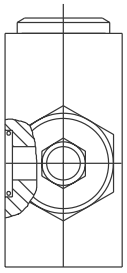
1 = VMPD/CC 38
2 = VR 12

INSTALLATION SCHEME



Operation: Fork movement cylinder blocking valve	Table: C.07.03





FILTRATION - OIL CONTAMINATION

TYPE OF SYSTEM TYPE OF VALVE	RECOMMENDED CONTAMINATION LEVEL - ISO 4406
- High performance systems - Systems with working pressures from 210 to 350 bar - Systems with proportional controls - Systems with high frequency cycles	16/13
- Systems with working pressures up to 210 bar - Spool valves - Valves with calibrated orifice	18/14
- Systems with low working pressures - Piloting systems - Systems with low frequency cycles	19/15

MATERIAL

Body: Aluminium 702 State T6
Internal parts: case-hardened and tempered steel

TECHNICAL DATA

Max flow = 70 l/min
Max pressure = 210 Bar
Setting = 50 - 350 bar
(best setting 40 bar with 5 l/min)
Piloting ratio = 1:3
Fluid: 20-200 cSt mineral oil
Ambient temperature = 0 +40 °C
Gaskets : BUNA N

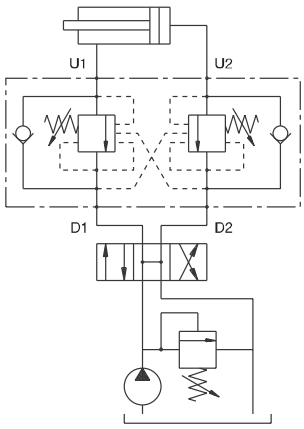
BLOW-BY
Blow-by from U1 to D1: 0.25 cc/min (5 drops) at 210 bar and 80% the setting value of the spring with oil with 46 cSt viscosity

FITTINGS

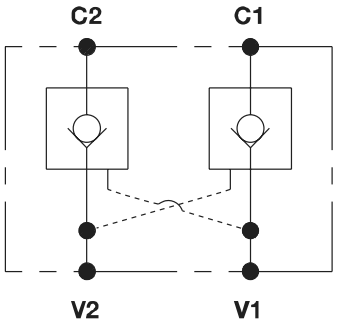
D1 - D2 = G 1\2"
U1 - U2 = FLANGED

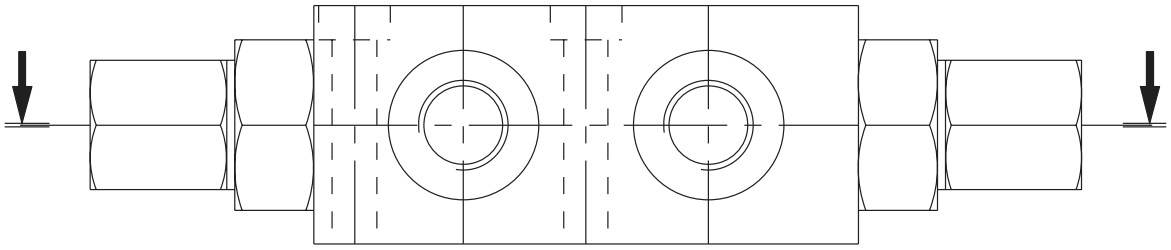
Cylindrical fitting tightening torque = 60 Nm (do not use conical fittings)

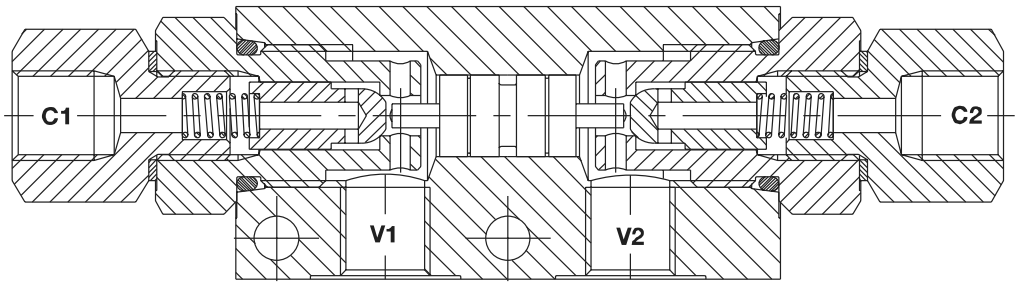
INSTALLATION SCHEME



Operation: Attachment cylinder blocking valve	Table: C.07.04



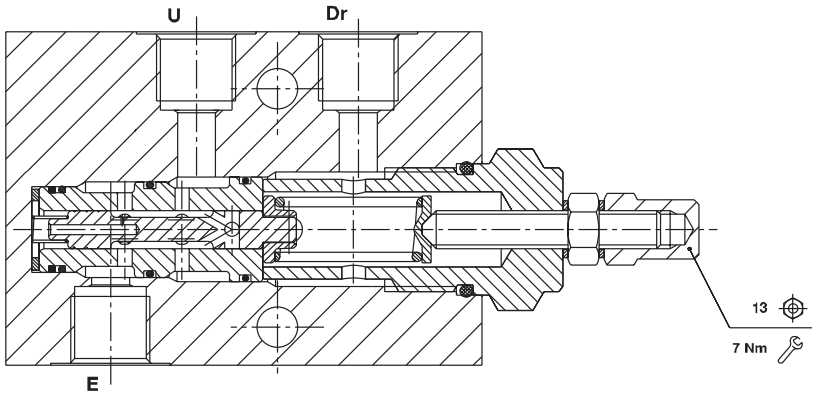




TECHNICAL DATA

- Max working pressure = 350 bar
- Opening pressure = 3 bar
- Max flow = 15 l/min
- Piloting ratio = 4:1
- Weight = 0.7 kg

Operation: Pressure reducing valve	Table: C.07.05



FILTRATION - OIL CONTAMINATION

TYPE OF SYSTEM TYPE OF VALVE	RECOMMENDED CONTAMINATION LEVEL - ISO 4406
- High performance systems - Systems with working pressures from 210 to 350 bar - Systems with proportional controls - Systems with high frequency cycles	16/13
- Systems with working pressures up to 210 bar - Spool valves - Valves with calibrated orifice	18/14
- Systems with low working pressures - Piloting systems - Systems with low frequency cycles	19/15

MATERIAL

Body: Aluminium 702 State T6
Internal parts: case-hardened and tempered steel

TECHNICAL DATA

Max flow = 20 l/min
Max pressure = 210 Bar
Setting = 5 - 50 bar
(best setting 40 bar with 5 l/min)
Piloting ratio = 1:7
Fluid: 20-200 cSt mineral oil
Ambient temperature = 0 +40 °C
Gaskets : BUNA N

BLOW-BY

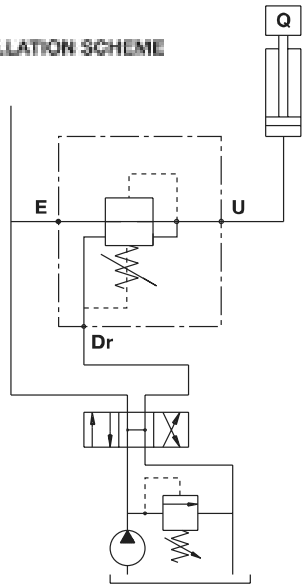
Blow-by in Dr: 20 cc/min at a pressure of 150 bar with oil with 46 cSt viscosity

FITTINGS

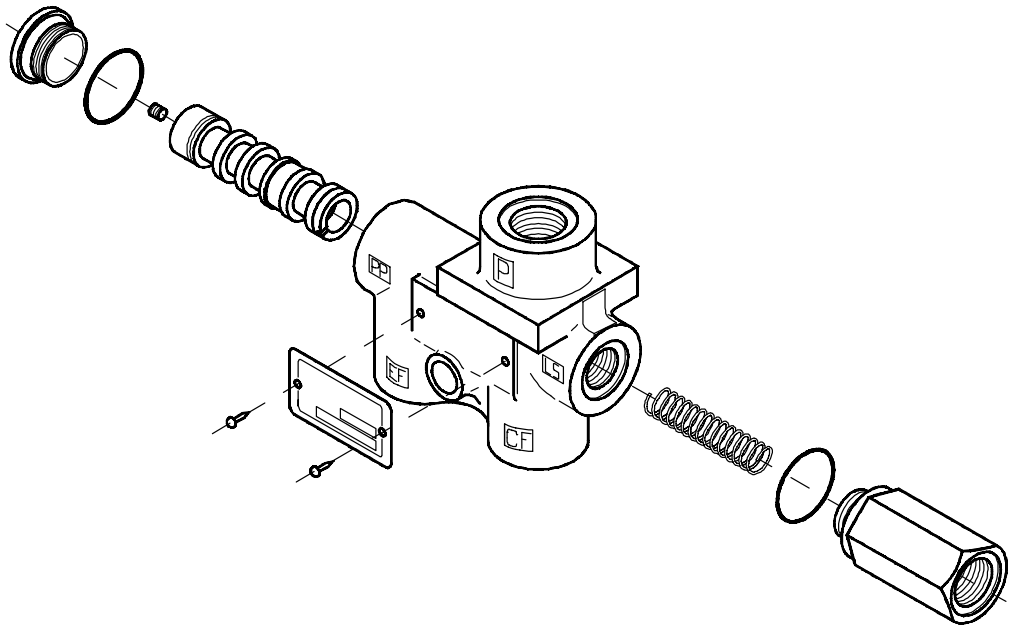
U - E - Dr = G 3/8"

Cylindrical fitting tightening torque 0 60 Nm (do not use conical fittings)

INSTALLATION SCHEME



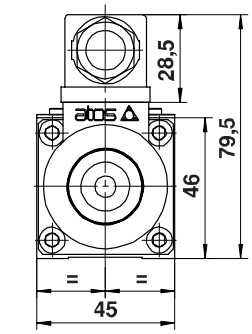
Operation: OLS 80 priority valve	Table: C.07.06

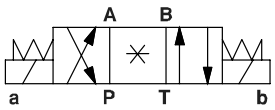


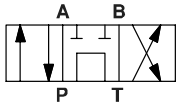


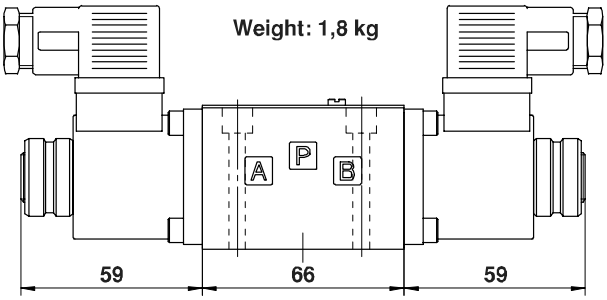
Operation: DHI solenoid valve

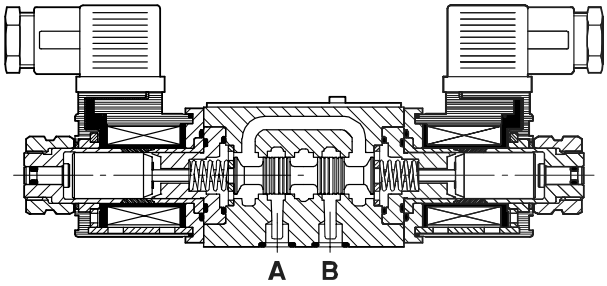
Table: **C.07.07**











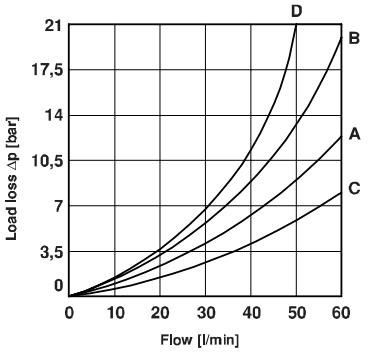
MAIN CHARACTERISTICS OF THE DHI SOLENOID VALVES

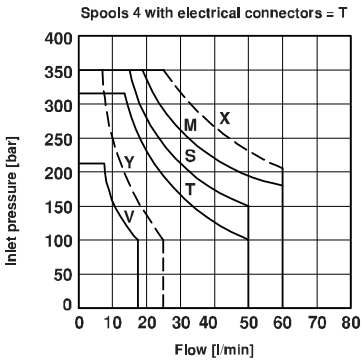
Installation position	Any
Coupling surface condition	Surface texture index $\sqrt{}^{0,4}$, flatness ratio 0.01/100 (ISO 1101)
Ambient temperature	-20 °C to +70 °C
Fluid	Hydraulic oil as per DIN 51524
Recommended viscosity	15÷100 mm²/s at 40 °C (ISO VG 15÷100)
Fluid contamination class	ISO 19/16, obtained 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

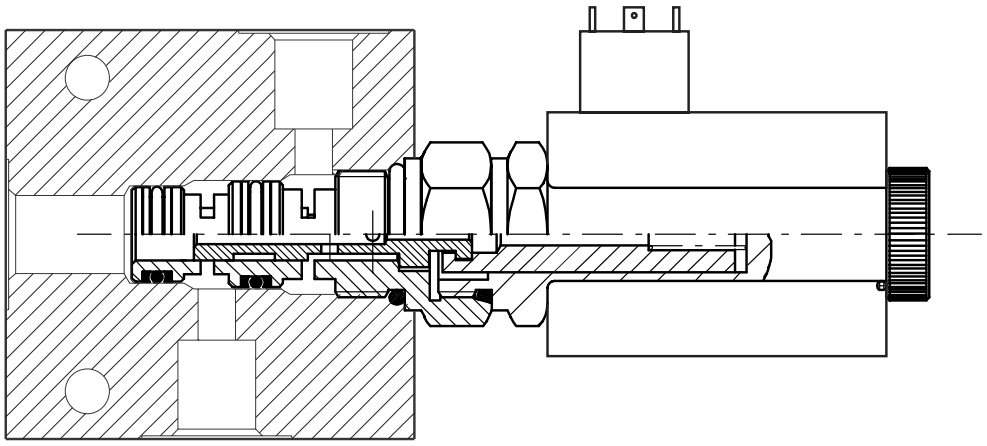
Port / Spool type	P-A	P-B	A-T	B-T	P-T
4	D	D	D	D	A

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



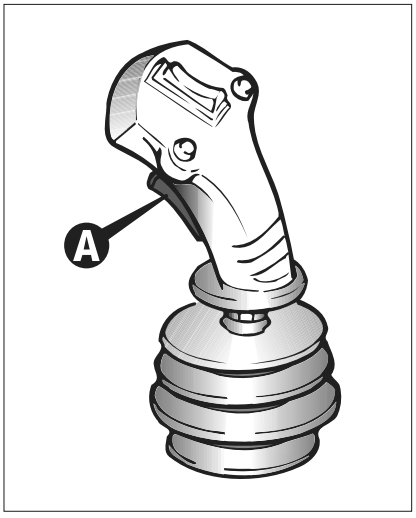


Operation:	Table:
Dead man Boom lowering blocking valve	**C.07.08**



IMPORTANT

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



Section D
CHECKS AND ADJUSTMENTS

SECTION INDEX

D.01 **Speed check** ..... **page** **2**
D.02 **Checking the max. current of the solenoid coils** **4**
D.03 **Checking and calibrating the circuit pressure** **8**

Operation: Checking the movement times of cylinders	Table: D.01.01

IMPORTANT

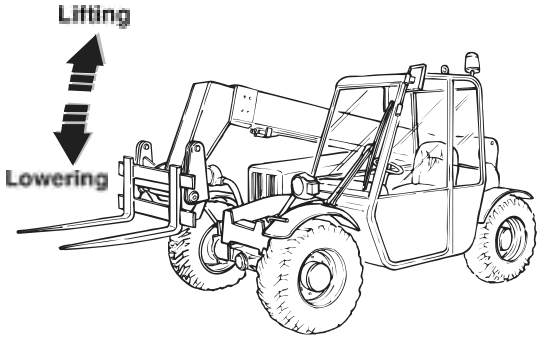
The check of the movement times of the cylinders shall be done with the hydraulic oil at a temperature of 60°.

IMPORTANT

To check the engine speed, the area easy to reach is the shaft of the cooling fan.
However, the value measured on this shaft does not correspond to the real rpm of the engine, but to a 1:1.09 ratio.
Nominal setting value for engine rpm:
2600 ($^{0}/_{+10\%}$) = 2600÷2860 rev./min.
Measured value on fan shaft: 3050 rev./min.
$\frac{3050}{1,09}$ ***= 2800 giri/min***

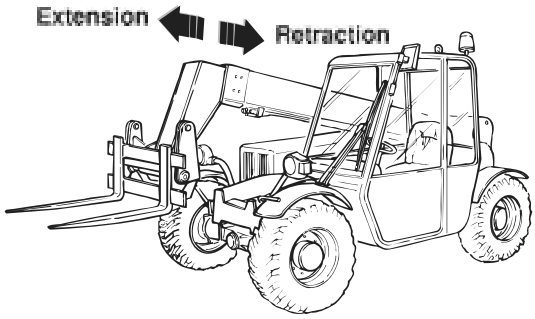
BOOM LIFTING/LOWERING

Time (s)	up	down
Max engine speed	7” 50	4” 50
Min. engine speed	20”	12”



BOOM EXTENSION/RETRACTION

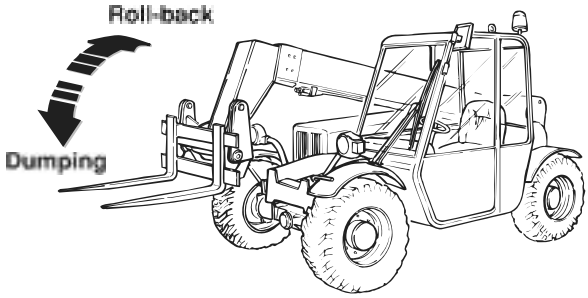
Time (s)	out	in
Max engine speed	8”	4”
Min. engine speed	21”	12”



Operation: Checking the movement times of cylinders	Table: D.01.01

ATTACHMENT DUMPING

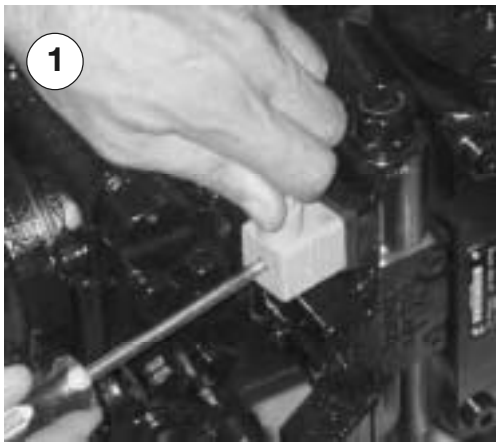
Time (s)	dumping	roll-back
T. Max	3”	4”
T. Min	17”	19”

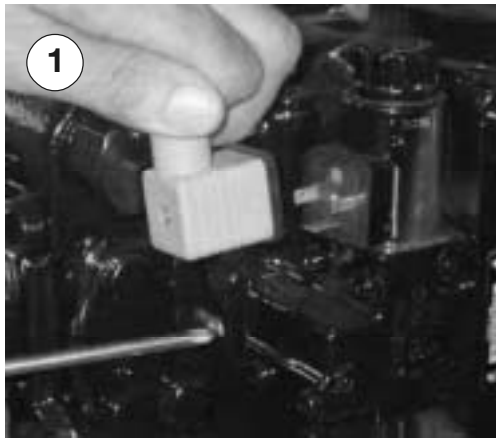


The maximum speed that can be attained on a level ground is 24 km/h in both forward and reverse speed.

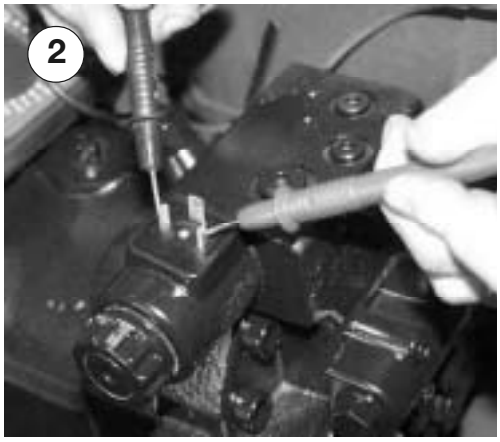
Operation: **Checking the max current of solenoid coils**	Table: **D.02.01**

1) Remove the connector from the coil socket.





2) For the check use a digital tester. Check the instrument is set to Ω (ohm), connect the leads to the two opposite poles of the coil and check the continuity.



Operation: **Checking the max current of solenoid coils**	Table: **D.02.01**

3) If necessary, use a tester with amperometric clamp passing the positive cable into the special ring to measure the value.



	Coil use	Check on	Max normal current
2	Steering solenoid coils	Contacts	2.80 A
2	REXROTH motor displacement change solenoid coil	Contacts	2.25 A
2	WALVOIL distributor solenoid coil	Contacts	1.84 A
2	REXROTH pump solenoid coil	Contacts	2.20 A
2	ARB and dead man solenoid coil	Contacts	1.75 A
2	Start-up solenoid coil (motor electro-stop)	Red+black cables	1.02 A
3	Peak-up solenoid coil	Black+white cables	27 A
	Spark plugs (with amperometric clamp)	Bat.cable+starter mot.	62 A
	Starter motor power supply (with amperometric clamp)	Battery cable	330 A

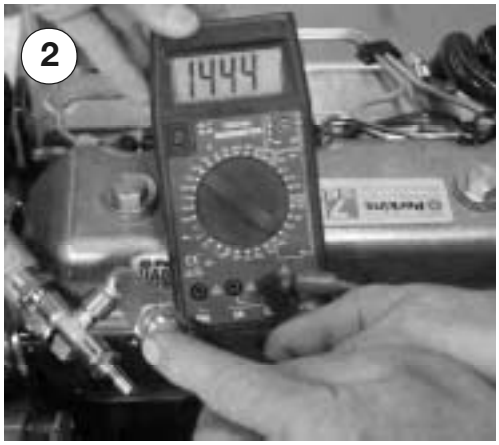
Operation: **Checking the bulbs**	Table: **D.02.01**

For the check use a digital tester checking it is set to Ω.

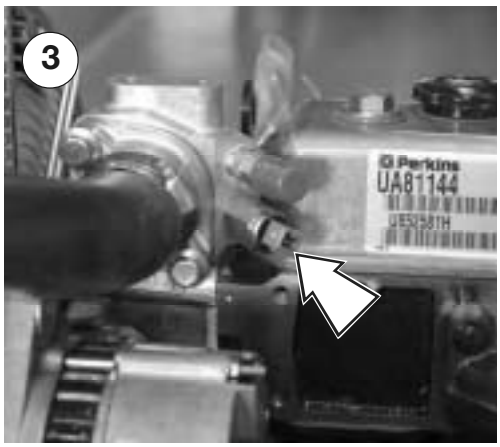
1) Checkof the thermistor bulb of the hydraulic oil temperature. Measure on lead and ground.
Value: **1640** Ω



2) Check the thermistor bulb of the engine water temperature.
Value: **1445** Ω (from cold)

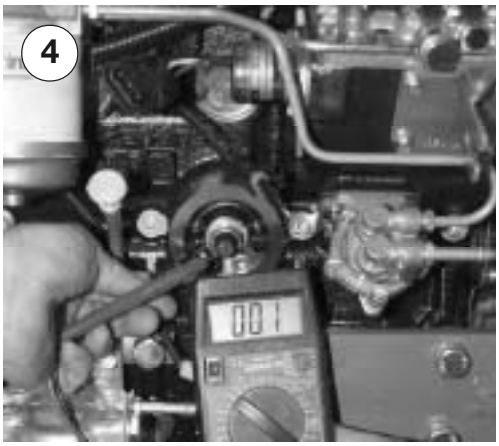


3) Check the thermistor bulb of the engine water temperature.
Value: **1** Ω (from cold)
0 Ω (continuity - with temperature > 90°)

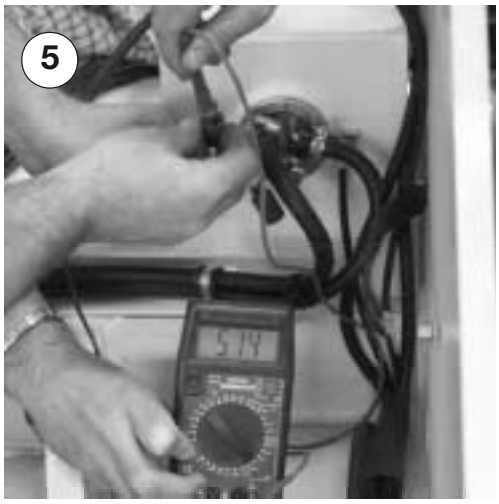


Operation: **Checking the bulbs**	Table: **D.02.01**

4) Check of the engine oil bulb.
Value: **1** Ω (from cold)
0 Ω (continuity - with temperature > 90°)



5) Check of the fuel gauge bulb. Measure on pink cable and ground.
Value: **1440** Ω (from cold)



Operation: Checking and calibrating the circuit pressure	Table: D.03.01

1. PRELIMINARY OPERATIONS

Portare l'olio idraulico alla temperatura di 80°C, mantenendo in pressione a finecorsa uno qualsiasi degli elementi del distributore del braccio.
Per raggiungere più rapidamente tale temperatura è necessario coprire con un cartone la sola massa radiante olio del radiatore se il radiatore è combinato acqua-olio, oppure il radiatore olio se la macchina è dotata di un radiatore olio separato.

2. SETTING THE BOOM DISTRIBUTOR

Find the mini-socket for the pressure gauge **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 by means of joystick **1**.
Calibrate valve **A** (see **annex 1**) to 240 bar with the Diesel engine at full speed.
To calibrate the safety valves **B** (see **annex 1**), proceed as follows:

- Connect a 0-400 bar manometer to the mini-socket **ref. 2**.
- Increase the pressure of valve **A** of the distributor to 270 bar moving the raising cylinder to stroke end (fully out).
- With the engine running at maximum speed, pitch the forks forward by means of the joystick and act on one of the two valves **B** until reaching a pressure of 260 bar.
- Proceed in adjusting the second valve **B** (260 bar) by pitching the forks back.
- When both fork inclination safety valves have been calibrated, reset the pressure control valve to 240 bar by adjusting the register **A**.

3. SETTING THE BLOCKING VALVES OF THE FORK BALANCE CYLINDER (see **annex 2**)

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

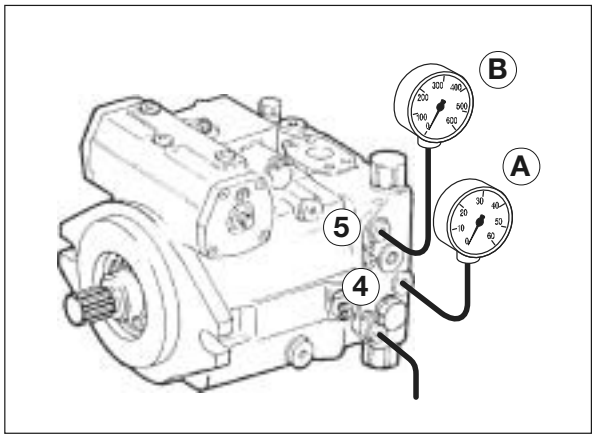
4. SETTING THE PRESSURE RELIEF VALVE

- Connect a 0-60 bar manometer to the mini-socket **ref. 3** (see **annex 1**), with the engine running at minimum speed moving any of the elements of the distributor to stroke end, then set valve **E** (see an**nex 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 80°C.

- Connect a 0-60 bar manometer **A** to the mini-socket **ref. 4** to read the boost pressure value.
- Connect a 0-600 bar manometer **B** to the mini-socket **ref. 5** to read the high-pressure value.



Operation: Checking and calibrating the circuit pressure	Table: D.03.01

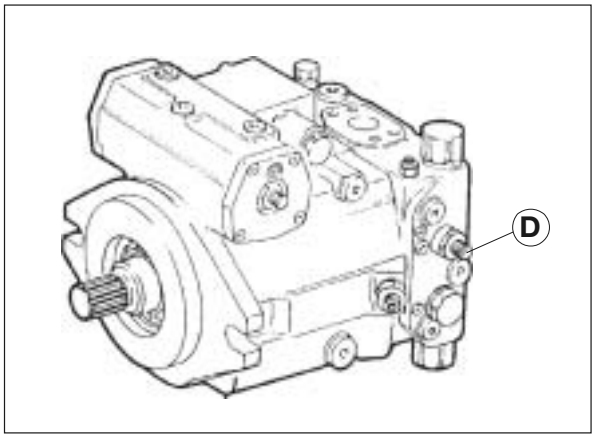
CAUTION

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.
- Read the boost pressure on manometer **A** 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 hydraulic speed (hare).
- Fully depress the foot brake or pull the parking brake to stroke end by removing the proximity switch **Y** (see **annex 3**) from the bracket (otherwise, once excited, it would stop any power supply to the pump solenoid). If the proximity switch is fitted with an electric connector, it is enough to disconnect the latter.

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.
  Note: since it is not possible to get access to the main pulley of the driving shaft to measure the rpm of the Diesel engine, it is necessary to measure a value of 1200 rpm on the transmission pulley.
- Adjust shutter **D** by means of the register until reading a value of 50 bar on the high-pressure manometer **B**.

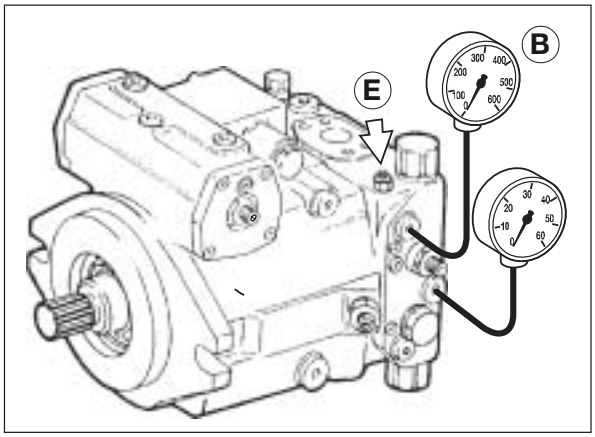


Operation: Checking and calibrating the circuit pressure	Table: D.03.01

5.1 CALIBRATION OF THE MAXIMUM PRESSURE

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

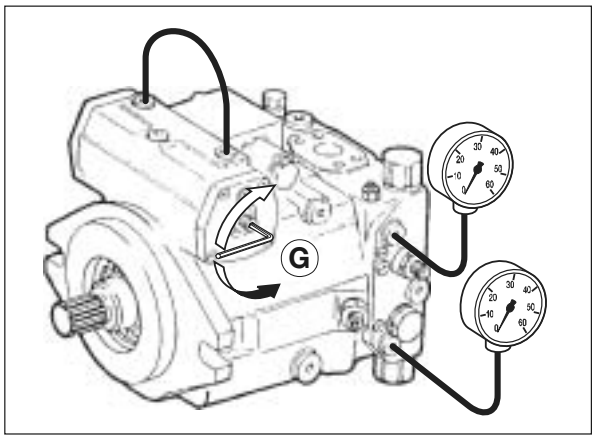
- Set the forward-neutral-reverse selector to the forward position.
- Run the engine at maximum speed and check the high-pressure value. If this value is less than 420 bar, increase the pressure to 430 bar by means of the pressure cut-off valve **E**.
- Remove the manometers and do an attempt.



5.2 CALIBRATION OF THE MECHANICAL ZERO

The calibration of the mechanical zero **G** 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.



6. SETTING THE POWER STEERING

- Connect a 0-250 bar manometer to position **Z** (see **annex 4**).
- 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 4**).

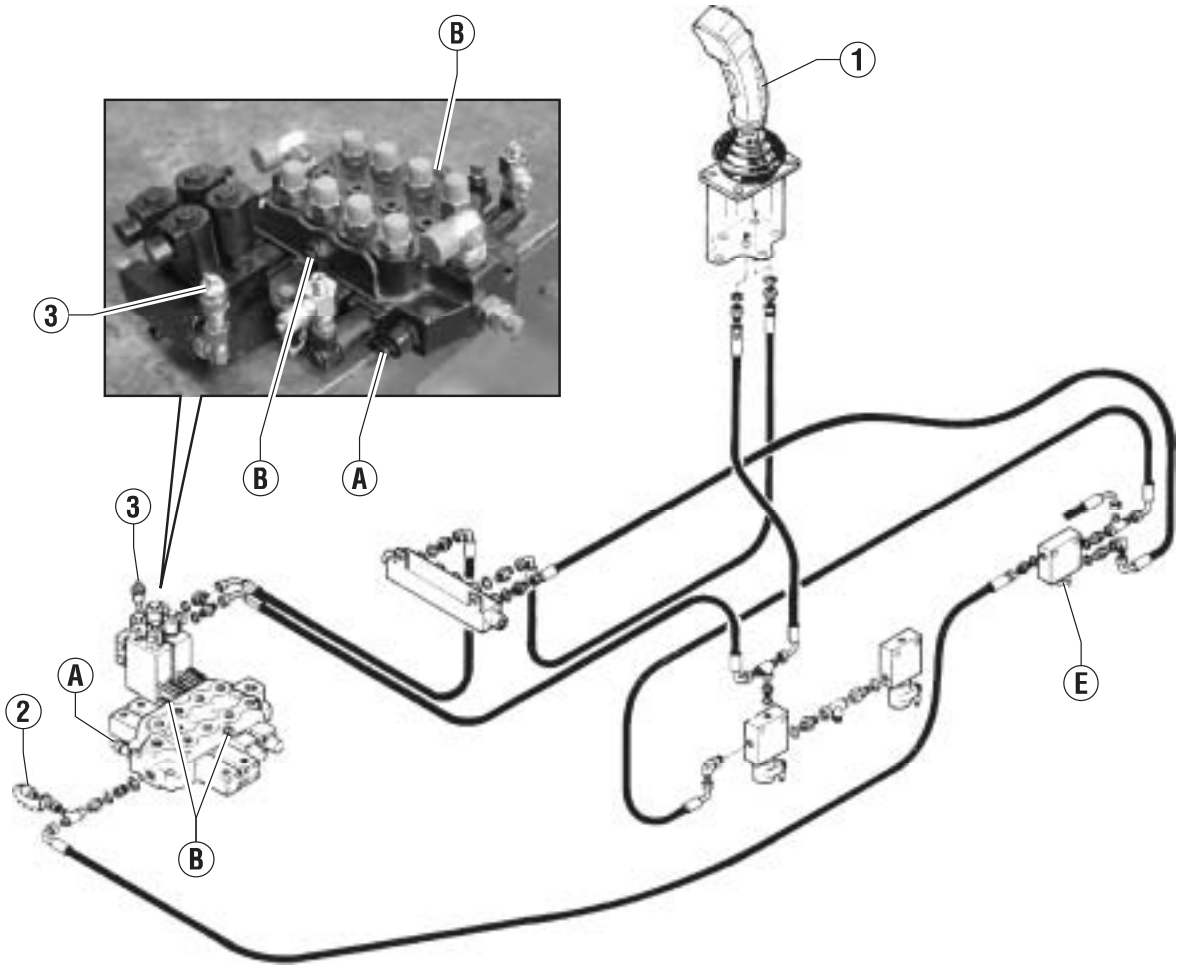
7. SETTING THE ARB 1 OVERLOAD WARNING SYSTEM

To adjust the ARB1 overload warning system, use a weight of 750 kg to be applied on the forks.
This machine must lift a weight of 750 kg with the boom extended; as a consequence, when the boom is fully extended, the overload warning system must enter the warning mode.

For the adjustment of the ARB overload warning system refer to the manual enclosed with the technical literature and to card **T2306-019** of this manual.

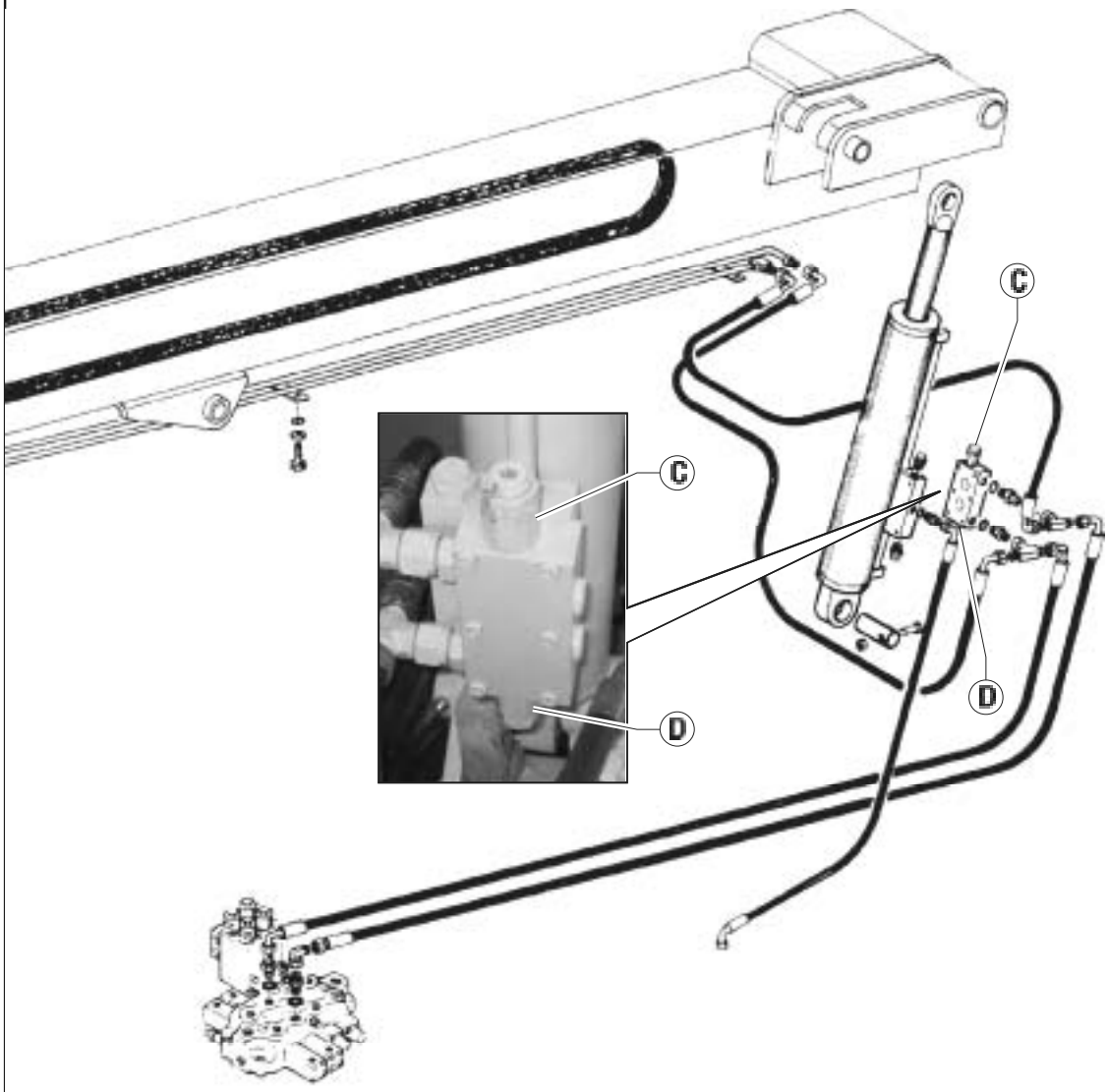
Operation: Checking and calibrating the circuit pressure	Table: D.03.01

Annex 1



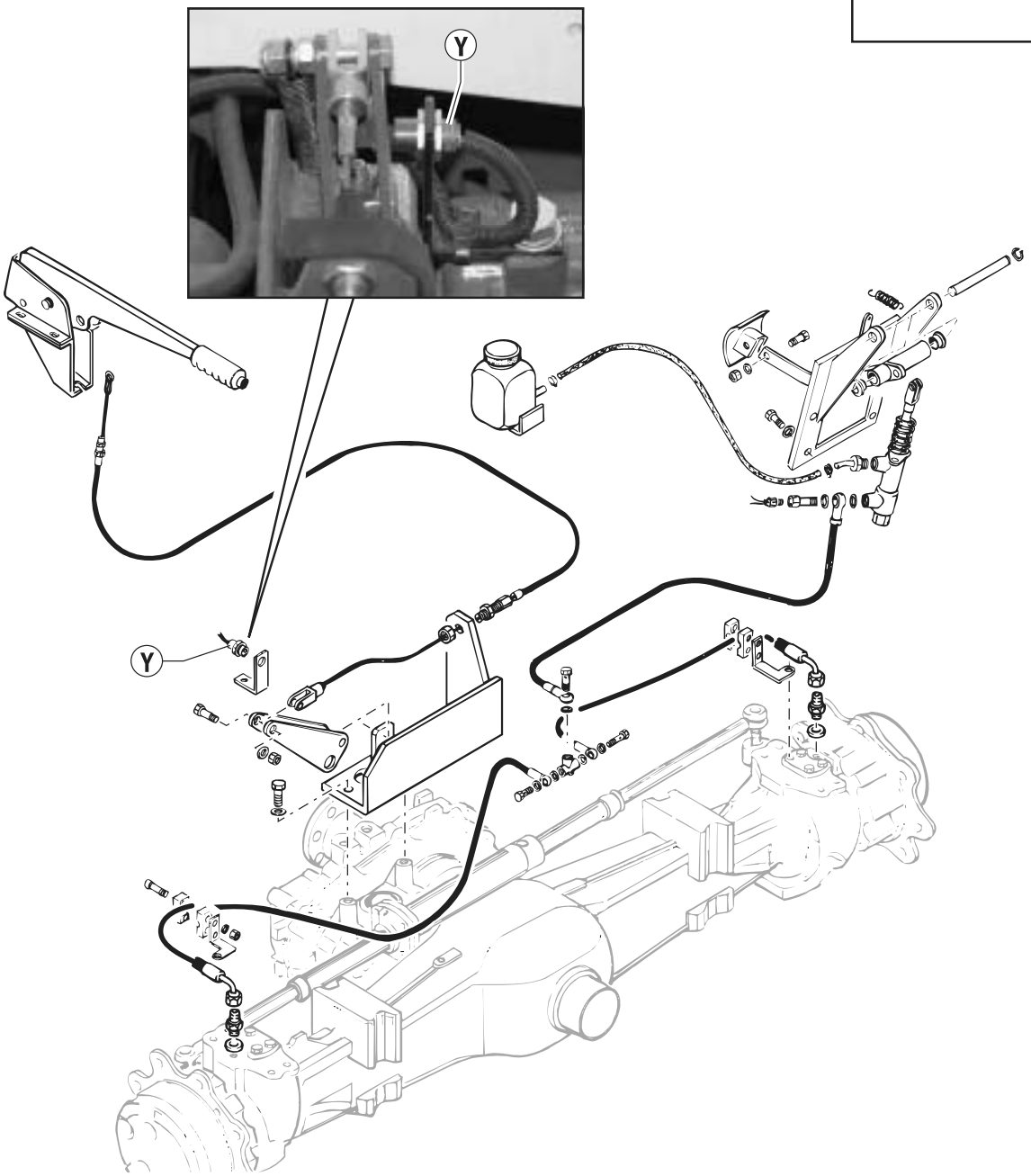
Operation: Checking and calibrating the circuit pressure	Table: D.03.01

Annex 2



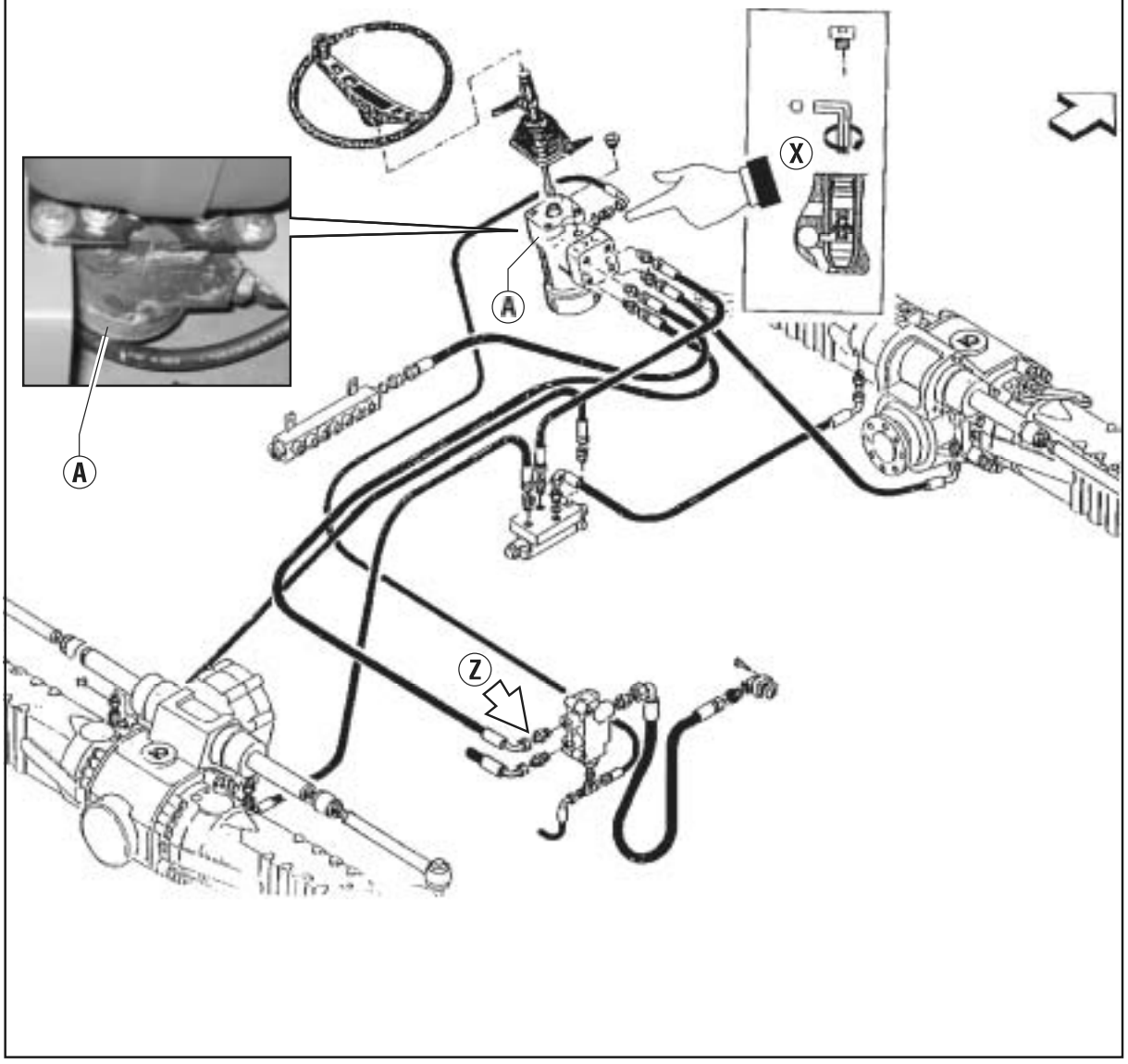
Operation: Checking and calibrating the circuit pressure	Table: D.03.01

Annex 3



Operation: Checking and calibrating the circuit pressure	Table: D.03.01

Annex 4



Section E
DISASSEMBLY AND REASSEMBLY

SECTION INDEX

	Service schedule ..... Page	3
E.01	Wheel disassembly	7
E.02	Cylinder disassembly	9
E.03	Boom raising cylinder	17
E.04	Fork balance cylinder	21
E.05	Attachment rotation cylinder	23
E.06	Attachment locking cylinder	25
E.07	Boom extension cylinder	27
E.08	Removing the engine from the machine	29
E.09	Hydrostatic pump disassembly	33
E.10	Hydrostatic motor disassembly	35
E.11	Cardan shaft disassembly	37
E.12	Oil tank disassembly	39
E.13	Fuel tank disassembly	41
E.14	Water-oil cooler disassembly	43
E.15	Disassembling the fork joint support	45
E.16	Control lever disassembly	49
E.17	Distributor disassembly	51
E.18	Disassembling slider and valves of the distributor	53
E.19	Overload warning system -ARB-	57
E.20	Engine bonnet disassembly	73
E.21	Adjusting the parking brake	75
E.22	Bleeding the braking circuit	77
E.23	Adjusting the distance of the proximity switches	79
E.24	Renewing the canister of the engine air filter	81
E.25	Checking the seals of the steering cylinder	83
E.26	Shafting alignment	85
E.27	Service pump disassembly	87
E.28	Power steering disassembly	89
E.29	Removing the blocking valves from the cylinders	91
E.30	Renewing the slide pads of the telescopic boom	93

E.31 Renewing the flexible hoses inside the boom 97
E.32 Changing the control levers of the steering wheel 99
E.33 Front axle disassembly 101
E.34 Rear axle disassembly 105
E.35 Replacing the load cell 109

Service schedule

Job	Operators needed	Expected time (h)
Changing the starter key	1	1.00
Changing the gear switch lever	1	0.15
Changing the lights and horn switch lever	1	0.15
Changing the overload warning system box + test	1	1.00
Changing the load cell + test	1	2.15
Changing the joystick	1	1.00
Changing the dead man device	1	0.30
Changing the boom in/out pushbutton	1	0.20
Changing the fork locking/releasing pushbuttons (red)	1	0.20
Changing the brake pump	1	0.30
Changing the parking brake sensor	1	0.15
Changing the boom raising cylinder	1	2.15
Changing the boom raising cylinder kit (complete overhaul)	1	1.30
Changing the blocking valve of the boom raising cylinder	1	0.30
Changing the telescope cylinder	1	2.00
Changing the telescope cylinder kit	1	1.30
Changing the blocking valve of the telescope cylinder	1	0.30
Changing the fork pitching cylinder	1	1.30
Changing the fork pitching cylinder kit	1	1.30
Changing the blocking valve of the fork pitching cylinder	1	0.30
Changing the attachment locking cylinder	1	1.00
Changing the attachment locking cylinder kit	1	1.15
Changing the blocking valve of the attachment locking cylinder	1	0.30
Changing the fork levelling cylinder	1	2.00
Changing the fork levelling cylinder kit	1	1.30
Changing the blocking valve of the fork levelling cylinder	1	0.45
Checking the one-way valves of the fork levelling cylinder	1	0.20
Changing the boom pipe for the boom extension	1	1.00
Changing the boom pipe for the fork back-pitching	1	1.00
Changing the boom pipe for the fork locking	1	1.00
Complete renewal of the boom pads	1	1.30
Checking the transmission pump pressures	2	0.20 each
Checking the pressure of the boom main distributor	2	0.20 each
Checking the pressure of brake pump and power steering	1	0.15

Job	Operators needed	Expected time (h)
Checking the pressure of pressure relief valves and safety valves	1	0.15
Changing the drive pump	1	2.00
Changing the drive motor	1	2.00
Changing motor. pump. transmission piping + tests	1	5.00
Changing the distributor driving pump	1	1.30
Replacing the distributor + calibration tests	1	2.30
Changing the DFE valve	1	0.30
Changing relays and fuses	1	0.10
Changing the wiper motor	1	1.00
Replacing the emergency pump coil+ test	1	0.30
Replacing the emergency pump	1	1.00
Changing the solenoid valves	1	0.20
Changing the gas pedal with cord	1	1.00
Changing the gas lever with cord	1	0.30
Changing the front axle	1	2.30
Changing the rear axle	1	2.00
Changing one Cardan joints	1	1.00
Changing the Cardan joints	1	2.00
Changing the axle hub	1	1.30
Changing the boom	2	4.00 each
Changing the pin anchoring the boom to the frame	2	1.00 each
Changing the pins of the attachment locking cylinder	1	0.30
Changing the pin of the stabiliser cylinder	1	0.20
Changing the power socket for the man-platform at the top of the boom	1	0.20
Changing the electrical reel	1	1.15
Changing the platform joystick	1	0.20
Changing a a pushbutton in the cab	1	0.30
Changing the man-platform pushbuttons	1	0.10
Changing the pressure relief valve or the distributor slider + test	1	0.30
Changing the distributor safety device + test	1	0.30
Changing the one-way valve	1	0.20
Replacing the maxi-fuses + troubleshooting	1	0.10
Bleeding the brake circuit	2	0.15 each
Disassembling and reassembling a wheel	1	1.00
Disassembling the Perkins engine	2	2.30
Changing the hydraulic oil tank	1	3.00
Changing the fuel tank	1	2.00

Job	Operators needed	Expected time (h)
Changing the oil-water cooler	1	2.00
Changing the fork pivot pin support	1	2.00
Replacing the engine bonnet	1	0.30
Renewing the canister of the air filter	1	0.05
Checking the seals of the steering cylinder	2	0.15
Renewing the hydraulic oil filter of the transmission pump	1	0.20
Changing the power steering	1	1.30
Changing the beacon	1	0.20
Replacing the battery	1	0.10
Changing the silencer	1	0.30
Changing the mudguard support	1	0.20
Changing the mudguards	1	0.10
Changing the hand-brake cord	1	0.30
Changing the steering wheel	1	0.10

Page left intentionally blank

Operation: Wheel disassembly	Table: T2306-001	kg	88
			Hrs. / Min.
Bridge crane, payload 5,000 kg (20,000 lb) Lifting jack	Standard tools Adjustable stands Screwdriver, torque 300 Nm		1 / -
			1

Operation:

1 Using a 24mm socket wrench fitted to the pneumatic screwdriver loosen the 8 nuts without removing them from their housings.

2 Raise the axle as detailed below:

- ***With hydraulic jack***

  Place a hydraulic jack under the axle paying attention to increase the supporting surface if the jack does not rest on a solid ground. The lifting capacity of the hydraulic jack must be at least 5,000 kg (20,000 lb).

- ***With bridge crane***

  Secure the machine frame to the bridge crane equipped with textile bridles or chains with hooks. Hook the slings to the lug bolts on the machine. Bridge crane and slings must have a lifting capacity of at least 5,000 kg (20,000 lb).

3 Place a stand under the axle to prevent damage in case of an accidental collapse of the jack or the bridge crane.

4 Remove the wheel from its housing rolling it on the ground.

DANGER

Each wheel weighs 88 kg and must be handled using a special hoisting appliance.

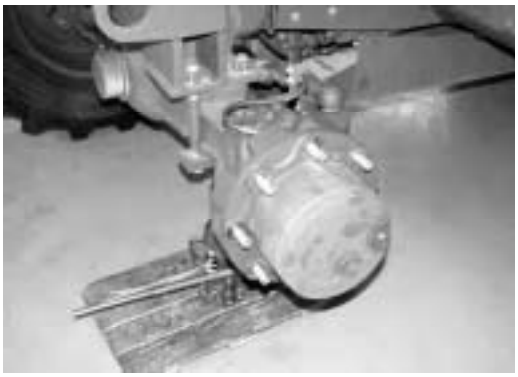
1



2



4



Operation: Wheel reassembly	Table: T2306-001

Operation:

5 Centre the wheel on the axle and fit at least two opposite screws with special washers paying attention to position the convex head toward the wheel rim.

6 Refit all nuts and tighten them alternately with the pneumatic screwdriver as shown in figure.

7 Lower the machine to the ground.

8 ***Re-tighten all nuts (torque 300 Nm)***.

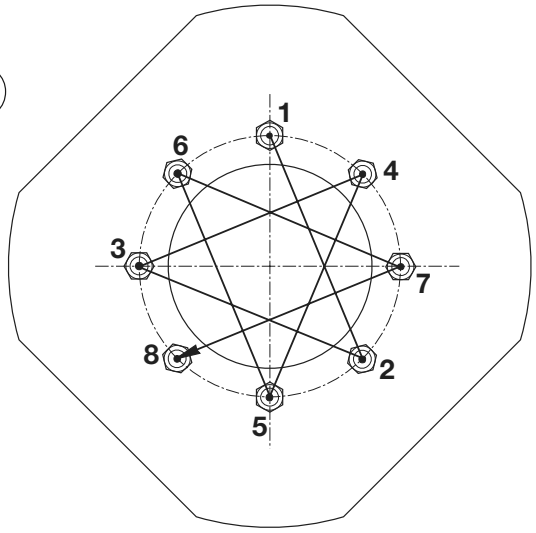
DANGER

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

5



6



TYRE CHARACTERISTICS		
Dimensions		12/16.5
Load index / Pr.		140-13 / pr 10
Rim		9.00x15.3
Wheel disc		8 holes DIN 70361
Pressure	bar	4.5
	Psi	65.3

Operation: **Cylinder disassembly**	Table: **T2306-002**	kg	See table
			Hrs. / Min.
Swing hoist, payload 500 kg (2,000 lb)	Wrench USAG 282T SN/50-80 with pin ø 4.5 mm Wrench USAG 281C/215 with pins ø 6 mm		- / 30
			1

Cylinder	Fork balance	Attachment blocking	Attachment rotation	Boom section extension	Boom raising
Part	696006	605254b	696005c	696004d	696003b
Weight kg lb	26	12	36		76
Cylinder ø mm in	90	50	120	70	110
Rod ø mm in	45	30	60	50	70
Closed mm in	665	555	626	2785	1187
Stroke mm in	380	92+92	325	2135	780
Pressure bar max	300	300	300	300	300
SEALS					
Head					
Type	OR 620 + BRS	OR 836 + BRS	OR 623 + BRS	OR 839 + BRS	OR 622 + BRS
Type	WRM 177208	WRM 118149	WRM 236267	WRM 196228	WRM 275322
Type	B 216177	B 157118	B 283236	B 236196	B 334275/1
Type					
PISTON					
Type	OR 219	DBM 196133	OR 824	OR 117	OR 824
Type	DBM 354275		DBM 472374	DBM 275196	DBM 433334
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/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")	USAG 282T SN/120-180 pin ø 4.5 (3/16") USAG 281/215 pin ø 6 (1/4")

Operation: Cylinder disassembly	Table: T2306-002

Operation:

■ **Opening the cylinder**

1 Remove the grub-screw between cylinder head and cylinder rod with an Allen wrench (only on boom raising cylinder).

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

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

PROTECT THE ENVIRONMENT

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

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

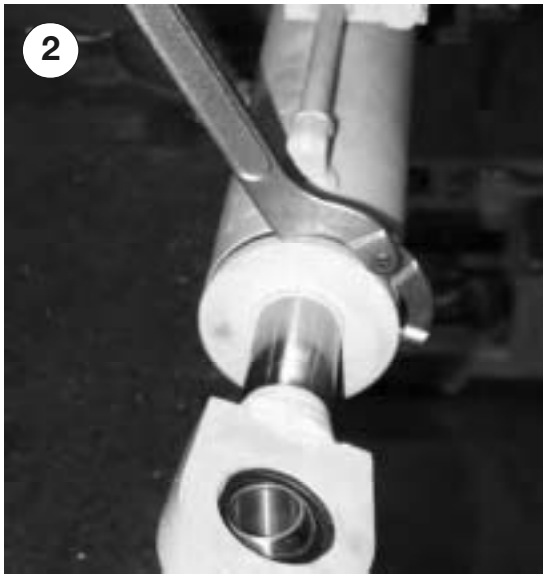
5 Loosen and remove the head from the cylinder with an adequate wrench (see table).

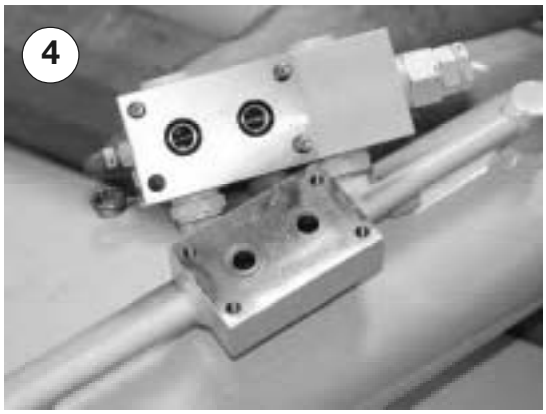
6 Pull out the cylinder rod with extreme caution. It might be full of oil.

7 Check the following parts for wear and/or damage:
- wear and/or scoring of chrome-plated rod
- wear and/or scoring of liner
- wear of seals
- wear of sliding runners

8 Remove the cylinder from the vice







Operation: Cylinder disassembly	Table: T2306-002

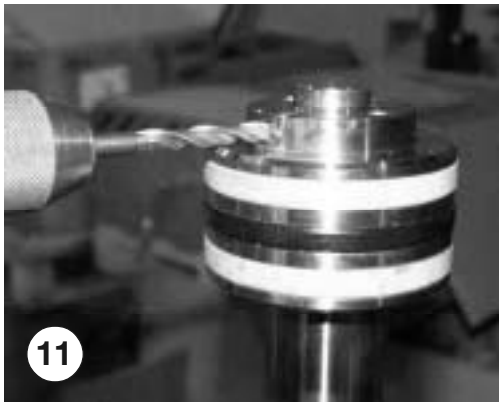
■ **Disassembling piston and seals**

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

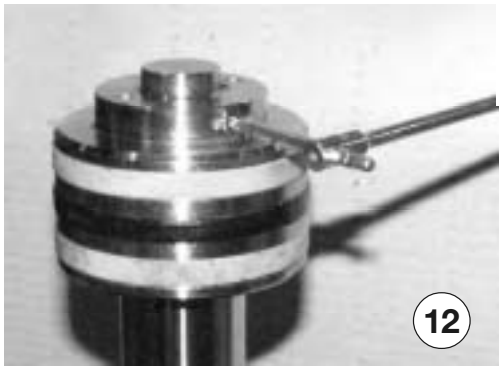
10 The rod grub-screw has riveted edges to prevent the screw from getting loose with serious consequences. Therefore, it is necessary to surface-drill to unscrew the grub-screw.



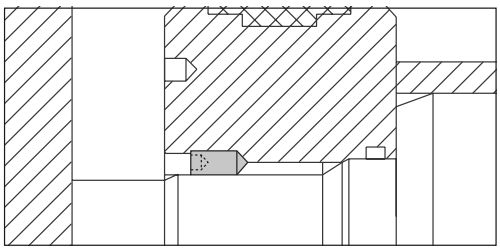
11 Fit a 12mm (1/2") helical bit or a counter-sink and remove the dented edges.



12 With a 5mm hexagonal wrench, remove the grub-screw.



13 Remove the anti-rotation pin (if any) fitted axially to the rod with a 5mm hexagonal wrench.

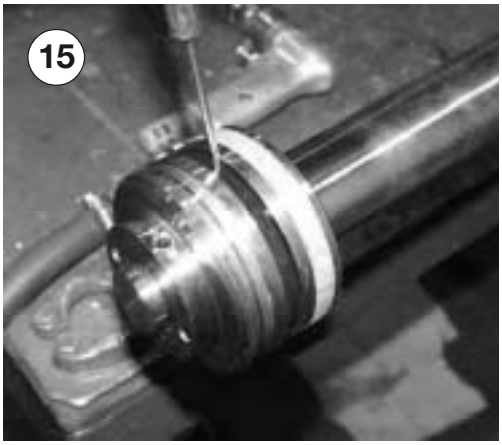


Operation: Cylinder disassembly	Table: T2306-002

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

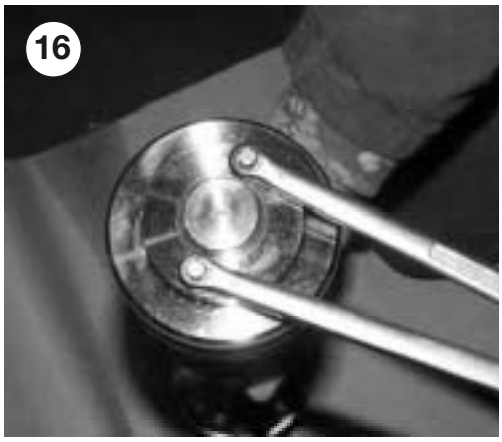


15 With a hand-screwdriver, pry off the seal from the housing.



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

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



Operation: Cylinder disassembly	Table: T2306-002

■ Disassembling head and seals

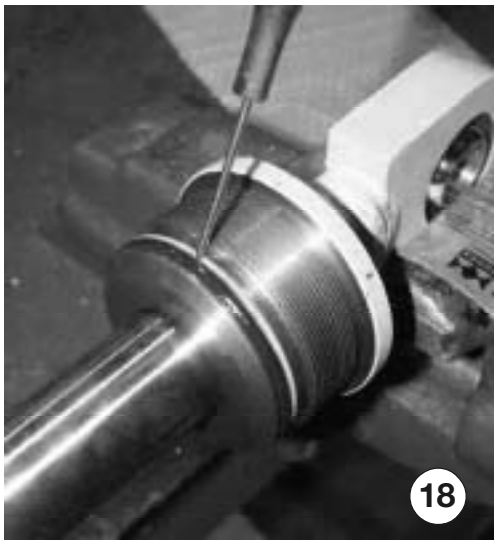
18 With a small hand-screwdriver, pry off the sealing O-ring and the relevant extrusion-proof ring from the head.

19 Pull out the head from the chrome-plated rod

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

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

22 Carefully clean the parts reassemble; renew any damaged parts.



IMPORTANT

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

Operation: Cylinder re-assembly	Table: T2306-002

■ Reassembling the cylinder

IMPORTANT

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

23 Refit first internal and external seals to the head.

24 Also refit internal and external seals to piston and guide rings.

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

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

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

28 Clamp the cylinder with the vice.

29 Carefully anoint pistons, seals and cylinder rod.

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

31 Push the cylinder to stop.

IMPORTANT

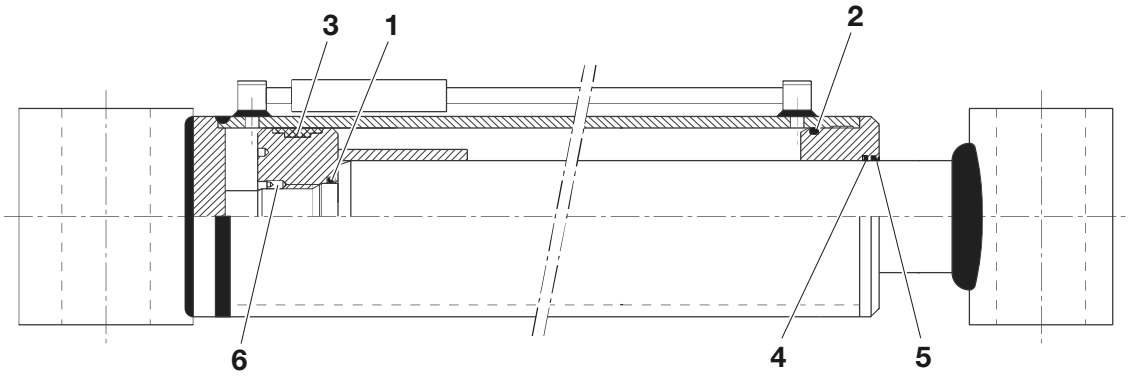
When the blocking valves are mounted, remove their canisters and eliminate the air.

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

33 Fit the grub-screw and lock it in position with some Loctite.

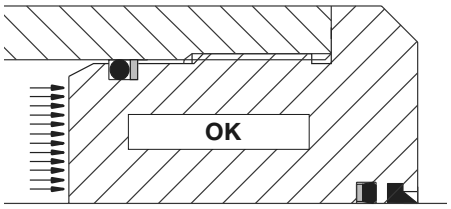
34 Before refitting the blocking valve, check and, if necessary, renew any worn seal. Smear the seals with some grease to hold them in position during re-assembly.

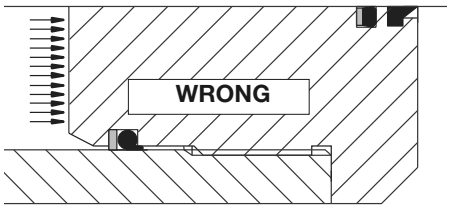
Operation: How to refit the cylinder seals	Table: T2306-002



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.

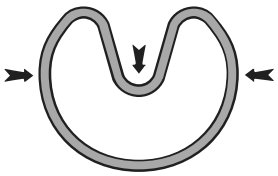
3 *Piston-cylinder seal*
This seal is subject to heavy wear. When the seal is worn, oil flows out between the two cylinder chambers and the movement is unstable and delayed. They are usually made of an elastic sealing element with a number of lips which guarantee sealing, a retaining ring of polyester 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.

Operation: How to refit the cylinder seals	Table: T2306-002

■ Refitting the seals into the internal housings



To refit a seal into its internal housing, it is recommended to bend it as shown to reduce its dimensions.
Once released, the seal will get back to its original shape.

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.

Operation:	Table:		
Cylinder disassembly **Boom raising cylinder**	**T2306-003**	kg	76
		Hrs.	Min.
		2	15
			1

Bridge crane, payload 5000 kg (20000 lb)
Textile bridles or chains with hooks

Standard tools
Adjustable stands

Operation:

1 Release the attachment.

2 Anchor the attachment holding frame to the hooks of the slinging chain.

3 Raise the boom to max. height (the hinging pin of the cylinder rod must be over the driving cabin) operating alternately the bridge crane and the hydraulic boom raising control of the machine.

4 Stop raising when the slinging chains are slightly under tension.

5 Place a container of suitable size under the hydraulic piping before disconnecting.

PROTECT THE ENVIRONMENT

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

6 With a 27mm wrench, disconnect two hydraulic hoses from the blocking valve, then plug the disconnected connectors to prevent dust and impurities from entering the circuit.





Operation: Cylinder disassembly	Table: T2306-003

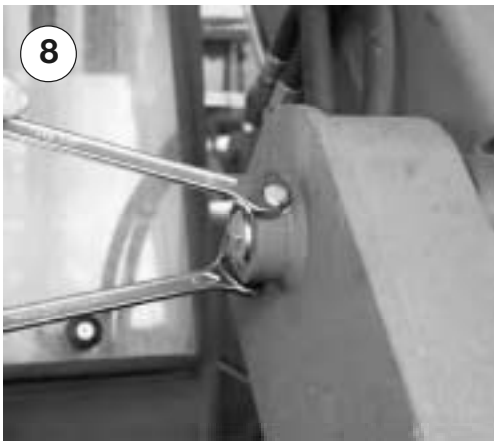
7 To move the boom using the up/down controls of the bridge crane, previously disconnect the rod of the fork balance cylinder.

8 Remove the screw fixing the pin with two 13mm wrenches.

9 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).

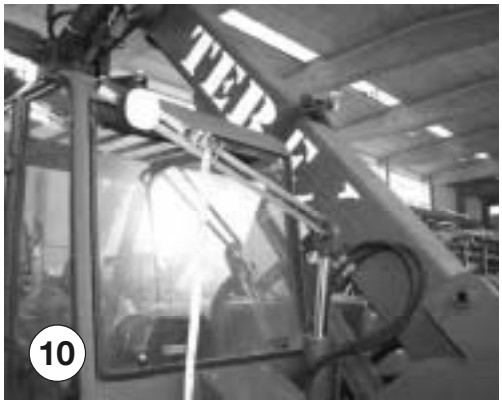
10 Fix the balance cylinder to the cabin with a sling and esnure it does not hinder the movement of the boom.

11 Secure the raising cylinder to the cabin with a sling.



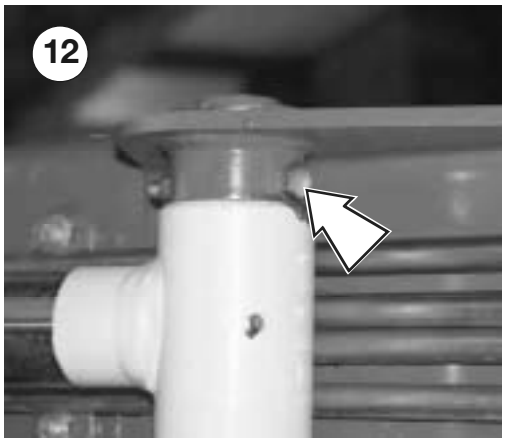






Operation:	Table:
Cylinder disassembly	**T2306-003**

12 Remove the screw which fixes the rod pin to the boom using two 19mm wrenches.



13 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).

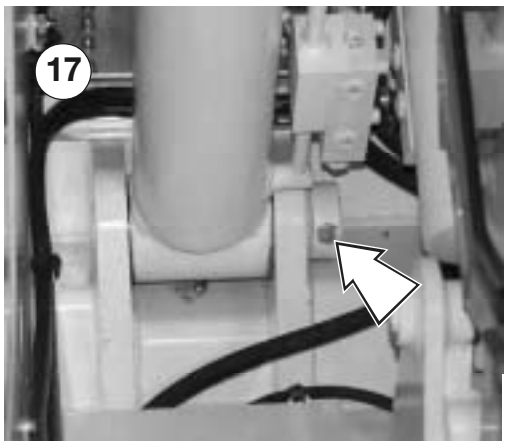
14 Put two wooden plugs, each 100mm high, on the oil cylinder to support the raising cylinder.

15 Lower the boom until the cylinder rests on the supporting plugs previously positioned.

16 Untie the sling fixing the cylinder to the boom, then raise the boom with the bridge crane to go on working.



17 Remove the screw which fixes the bottom-side pin of the cylinder using two 19mm wrenches.



Operation:	Cylinder disassembly	Table:
		T2306-003

18 Knock out the pin using a plug of soft material (aluminium, copper, wood, etc.) and extract it through the hole on the frame.

19 Lower the boom onto the adjustable stand to remove the slinging chains.

20 Sling the cylinder with a textile bridle 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 releasing the bridge crane.



Operation:	Table:		
Cylinder disassembly **Fork balance cylinder**	**T2306-004**	kg	26
		Hrs.	Min.
		2	-
			1

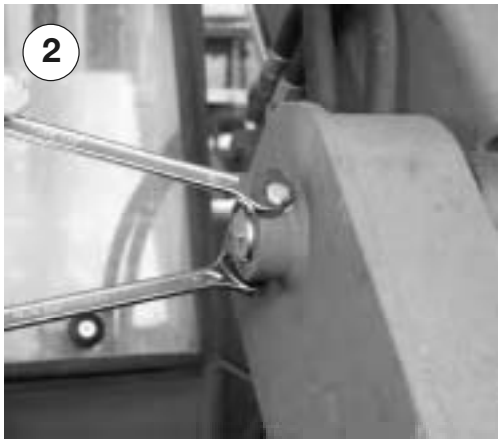
Bridge crane, payload 5000 kg (20000 lb)
Textile bridles or chains with hooks

Standard tools
Adjustable stands

Operation:

1 Release the attachment.

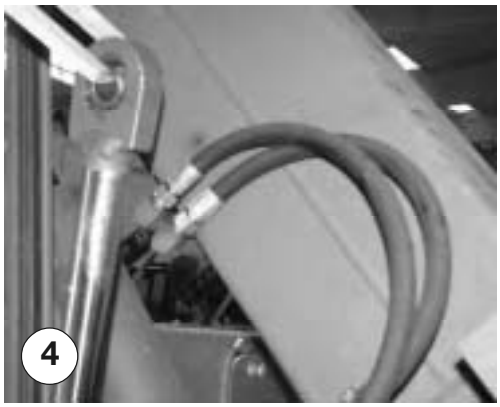
2 Remove the screw fixing the rod pin with two 13mm wrenches.



3 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).



4 Fix the cylinder with a textile bridle connected to the bridge crane to support its weight.



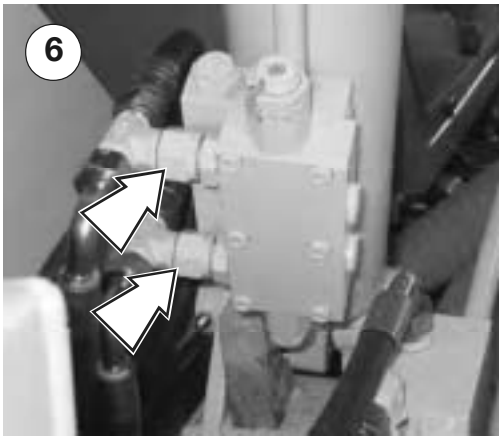
Operation:	Table:
Cylinder disassembly Fork balance cylinder	T2306-004

5 Place a container of suitable size under the hydraulic piping before disconnecting.

PROTECT THE ENVIRONMENT

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

6 With a 27mm wrench, disconnect two hydraulic hoses from the blocking valve, then plug the disconnected connectors to prevent dust and impurities from entering the circuit.
7 Drive out the lower pin.
8 Unscrew and extract the screw fixing the pin with two 13mm wrenches.



9 Knock out the pin using a plug of soft material (aluminium, copper, wood, etc.) and extract it through the hole on the frame.
10 Remove the cylinder from the machine using the bridge crane.



Operation:	Table:		
Cylinder disassembly **Attachment rotation cylinder**	**T2306-005**	kg	36
			Hrs. / Min.
			1 / 30
			1

Bridge crane, payload 5000 kg (20000 lb)
Textile bridles or chains with hooks

Standard tools
Adjustable stands

Operation:

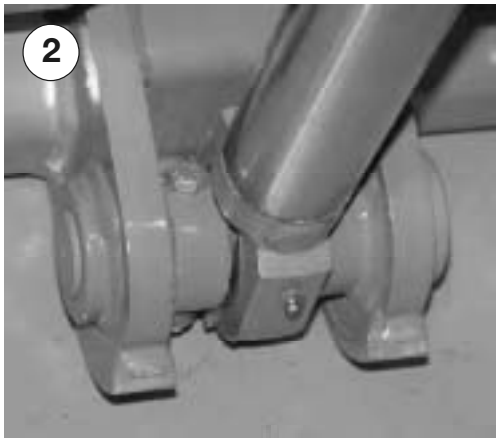
1 Release the attachment.

2 Remove the screw fixing the pin (rod side) with two 17mm wrenches.

3 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).

4 Fully open the cylinder using the hydraulic control of the machine, then stop the machine engine.

5 Place a container of suitable size under the hydraulic piping before disconnecting.



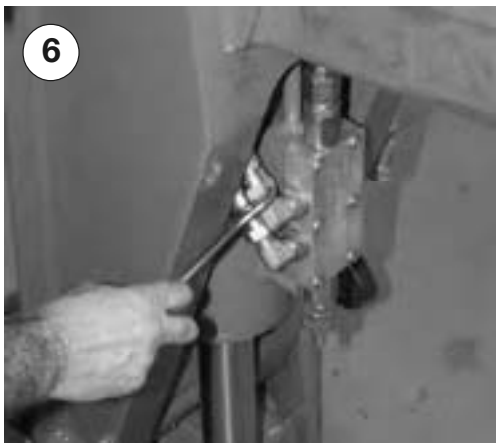


PROTECT THE ENVIRONMENT

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

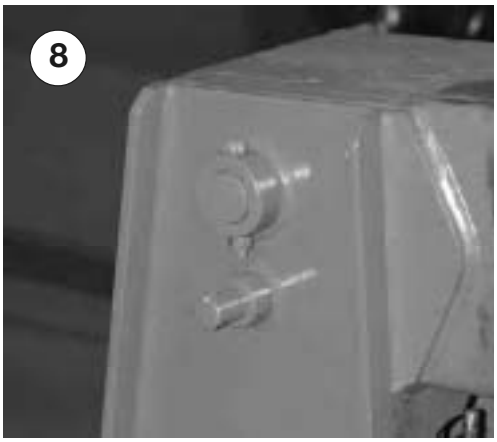
6 With a 27mm wrench, disconnect two hydraulic hoses from the blocking valve, then plug the disconnected connectors to prevent dust and impurities from entering the circuit.

7 Place a wooden plug under the cylinder rod, then lower the boom using the hydraulic controls as far as the rod rests on the wooden plug.



Operation:	Table:
Cylinder disassembly **Attachment rotation cylinder**	**T2306-005**

8 Remove the screw fixing the cylinder pin (bottom side) with two 17mm wrenches.



9 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).



10 Secure the cylinder to the bridge crane with a textile bridle, then slightly raise the boom to set the cylinder free.

11 Remove the cylinder using the bridge crane.

Operation:	Table:		
Cylinder disassembly **Attachment locking cylinder + DFE valve (if any)**	**T2306-006**	kg	12
		Hrs.	Min.
		1	-
			1

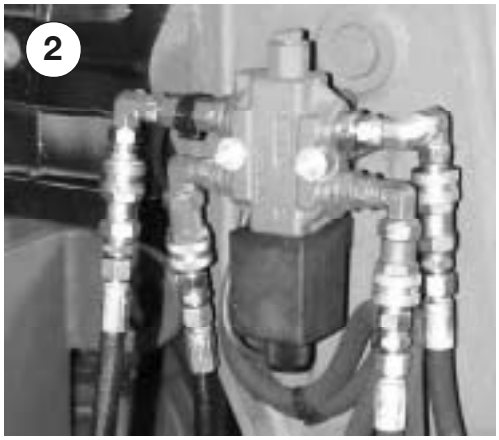
Bridge crane, payload 5000 kg (20000 lb)
Textile bridles or chains with hooks

Standard tools

Operation:

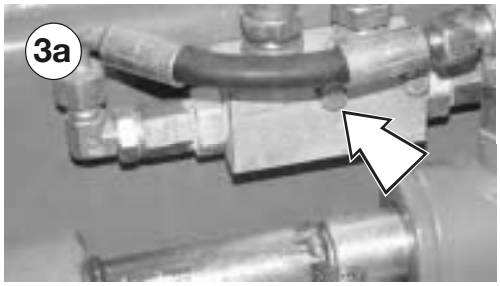
1 Release the attachment.

2 Disconnect the flexible hoses connected to the DFE valve (if present; usually it is used when the attachment needs an additional hydraulic line) from the quick connectors on the telescopic section of the boom.



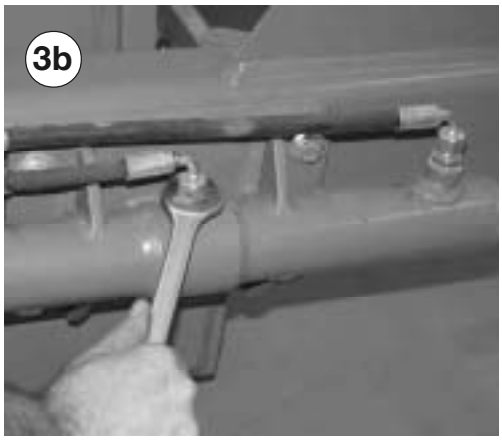
Operation to be done if the cylinder is connected with iron pipes:

3a With a 13mm wrench, remove the two screws fixing the valve to the attachment holding frame.



Operation to be done if the cylinder is connected with flexible hoses:

3b With a 19mm wrench, disconnect the flexible hoses from the attachment locking cylinder



Operation:	Table:
Cylinder disassembly **Attachment locking cylinder**	**T2306-006**

4 With a 17mm wrench, loosen the four screws fixing the cylinder without removing them.

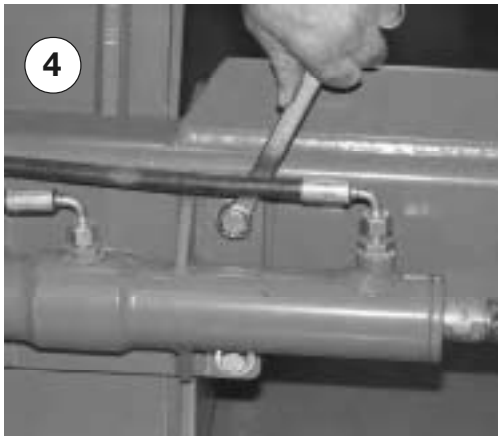
5 With a 2.5mm hexagonal wrench, remove the grub-screw fixing the terminal pin on both sides of the cylinder (if present)

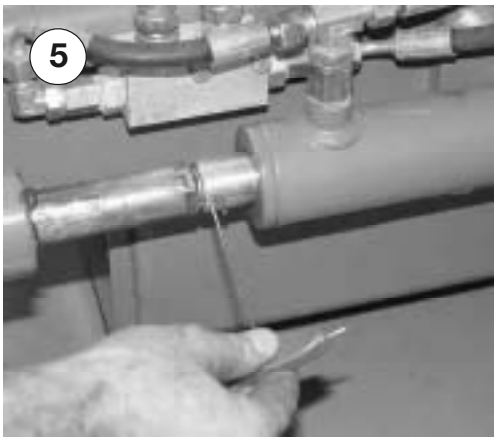
6 With two 27mm wrenches, loosen and pull out the terminal pins from their housings.

7 Remove the four screws, previously loosened, to set the cylinder free.

8 Seize and remove the cylinder.

9 If necessary, position the cylinder on the bench and disconnect the pipes with 19mm and 23mm wrenches.





Reassembling the cylinder:

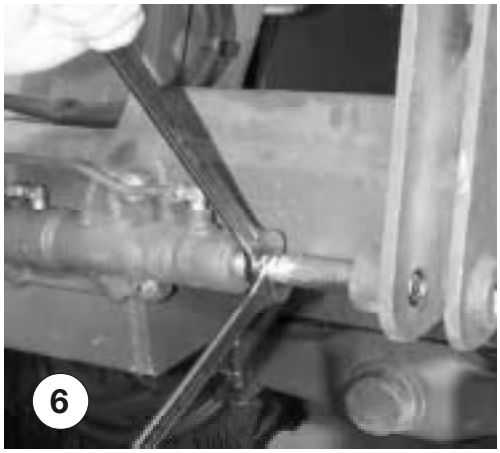
IMPORTANT

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 (correct alignment of the pins with the holes).

3 Block the grub-screws of the terminal pins with Loctite 245.



Operation:	Table:		
Cylinder disassembly **Boom extension cylinder**	**T2306-007**	kg	92
			Hrs. / Min.
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or chains with hooks	Standard tools		2 / -
			1

Operation:

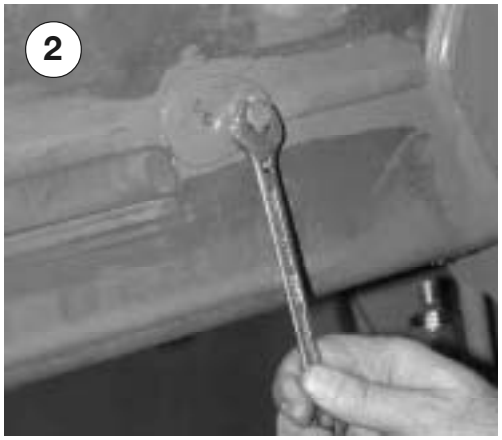
1 Set the boom to horizontal position with the telescope slightly extended to work on the cylinder connecting pin (rod side).

2 With a 13mm wrench, remove the screw fixing the pin drop-shaped head.

3 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).

4 Remove the rear guard to gain access to the rear part of the boom.

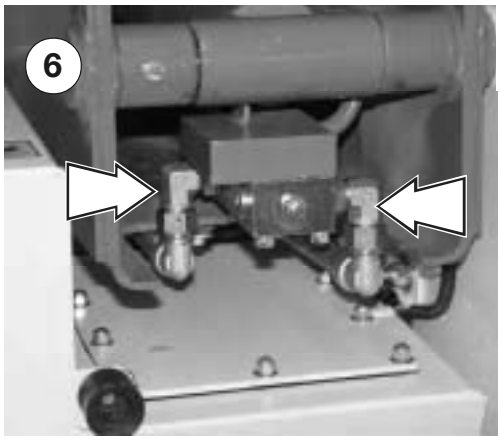
5 Place a container of suitable size under the hydraulic piping before disconnecting.



PROTECT THE ENVIRONMENT

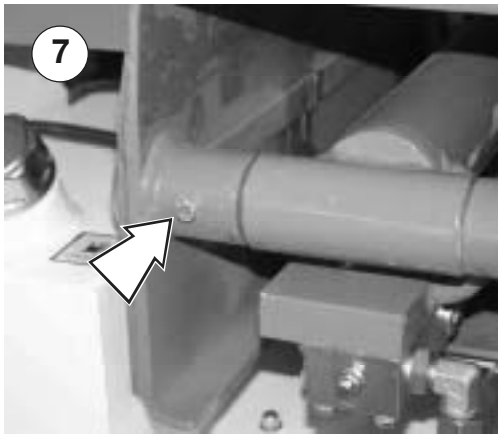
Used oils must be handled and disposed of according to local regulations. Address to legally authorised centres.

6 With a 27mm wrench, disconnect the two hydraulic hoses from the blocking valve, then plug the disconnected connectors to prevent dust and impurities from entering the circuit.



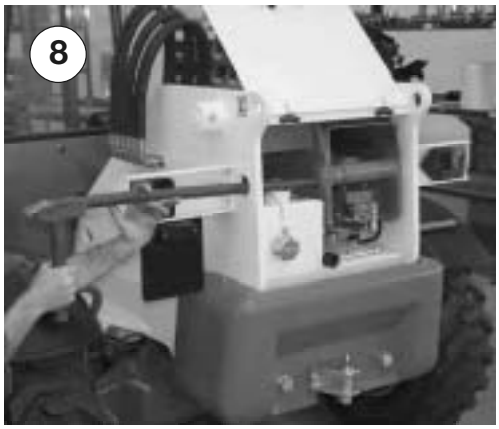
Operation:	Table:
Cylinder disassembly **Boom extension cylinder**	**T2306-007**

7 Loosen and remove the screw fixing the cylinder pin (bottom side) with two 13mm wrenches.



8 Knock out and extract the pin using a plug of soft material (aluminium, copper, wood, etc.).

9 Pull out the cylinder from the boom section and sling it with the textile bridles connected to the bridge crane.



Operation: **Removing the engine from the machine**	Table: **T2306-008**	kg: 340
Bridge crane, payload 500 kg (2000 lb) Textile bridles or chains with hooks	Standard tools	Hrs. 2 Min. 30
		2

Operation:

1 Remove the engine bonnet (see tableT2306-020)

2 Remove the guard under the engine (weight: 40 kg) held in position by four M8 screws (13mm wrench).

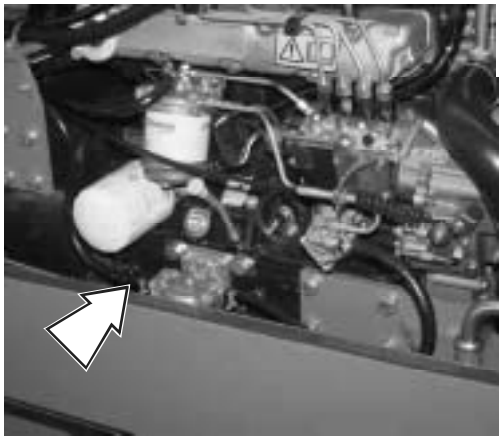
3 With a screwdriver, disconnect the fuel feeding and return piping held in position by the special hose-clamps.

4 Disconnect the throttle control cable removing the locking clip; loosen the cable register with a 17mm wrench to pull out the cable.

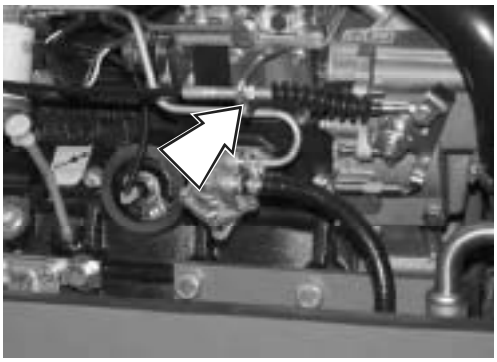
5 Remove batteries and battery tray using a 19mm wrench to loosen the 8 fixing screws.

6 Close the oil tank cocks.

3



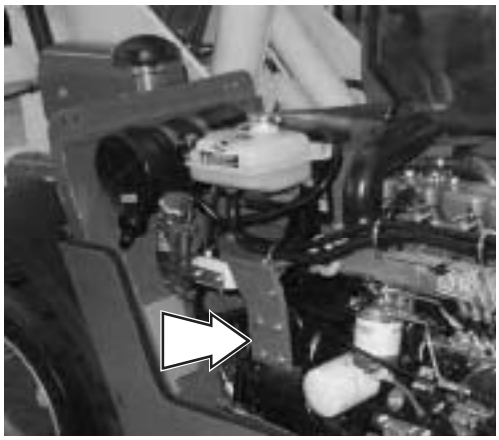
4



6



5



Operation:	Removing the engine from the machine	Table:
		T2306-008

7 Disconnect the filler extension of the oil tank using a 19mm wrench and a 10mm wrench.

8 Disconnect the flexible hose of the silencer loosening the clamps with a 10mm wrench.

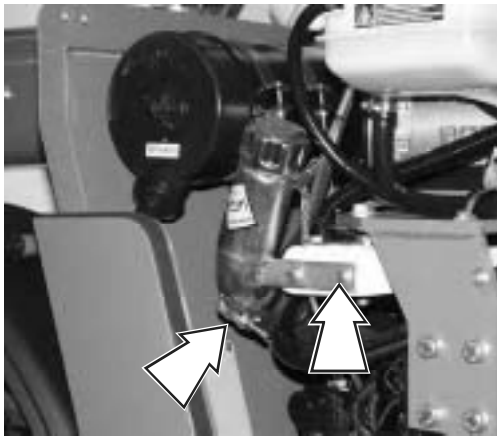
9 Remove the manifold with a 17mm wrench.

10 With a screwdriver or a 7mm wrench, loosen the hose-clamps of the air filter sleeve; then disconnect the air filter.

11 Disconnect the following electrical cables:

- ❑ oil pressure bulb,
- ❑ electrical stop,
- ❑ cylinder block high temperature bulb,
- ❑ water temperature bulb,
- ❑ the three alternator connections,
- ❑ starter motor,
- ❑ ground between chassis and engine,
- ❑ the two coils of the transmission pump solenoid valve.

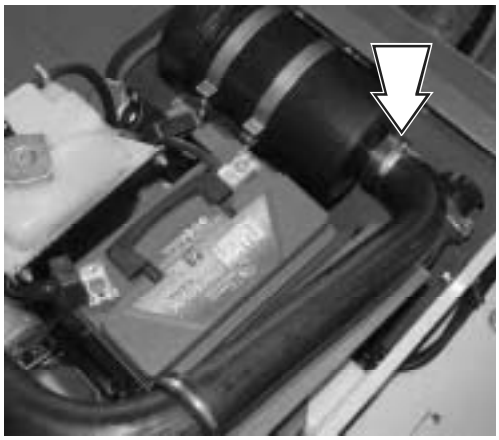
7



8



10



Procedura:	Removing the engine from the machine	Tabella:
		T2306-008

12 Disconnect the hydraulic piping:

PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

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

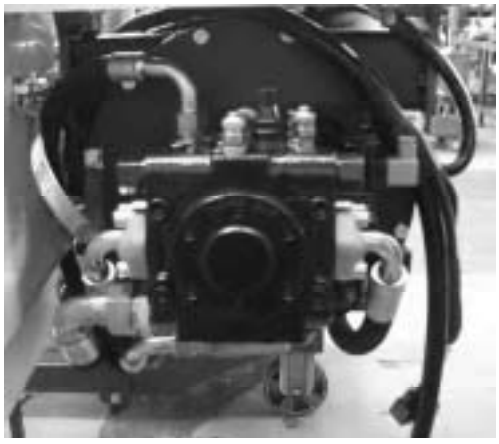
- ❑ 2 drains of the hydraulic pump with a 32mm wrench,
- ❑ the intake line of the hydraulic pump with a 46mm wrench,
- ❑ the two feeding lines of the hydraulic pump with a 18mm hexagonal wrench,
- ❑ the pump delivery line on the distribution with a 32mm wrench,
- ❑ the pump intake line on the distribution with a 38mm wrench,
- ❑ the two hoses on the water-oil cooler with a 32mm wrench.
- ❑ the two heating water pipes with a cross-head screwdriver.

13 Remove the four screws (two on the front and two at the back) of the vibration supports with a 22mm wrench.

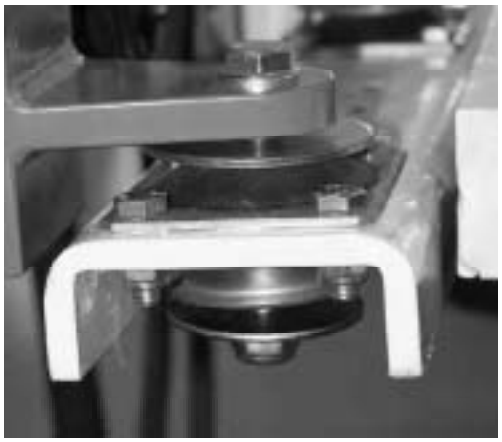
12



12

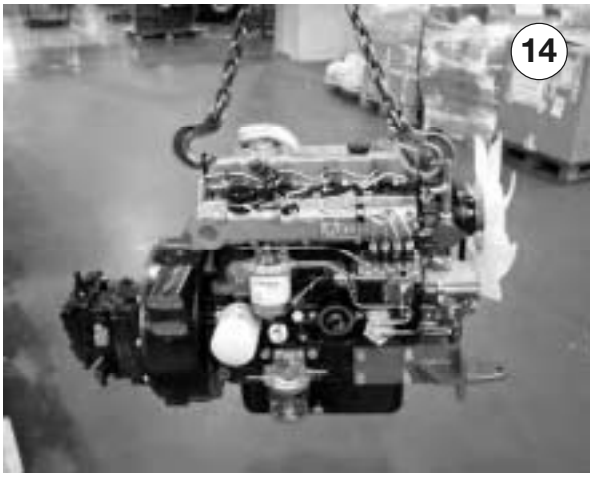


13



Operation:	Removing the engine from the machine Reassembling the engine on the machine	Table: T2306-008

14 Sling the engine using a two-leg chain with hook to be coupled to the front lug and the rear supporting bracket of the battery.



15 Raise the engine with caution and ensure no parts are still connected.

16 Remove the engine from the machine, rest it on a wooden pallet and hold it in position with some plugs.

Reassembling the engine:

IMPORTANT

To reassemble the engine, repeat the steps above in reversed order considering the precautions below.

1 Handle the engine with extreme caution to prevent it from crashing against the machine.

Operation: Hydrostatic pump disassembly	Table: T2306-009	kg	40
		Hrs.	Min.
Bridge crane or swing hoist, payload 500 kg (2,000 lb)	Standard tools	2	-
			1

Operation:

PROTECT THE ENVIRONMENT

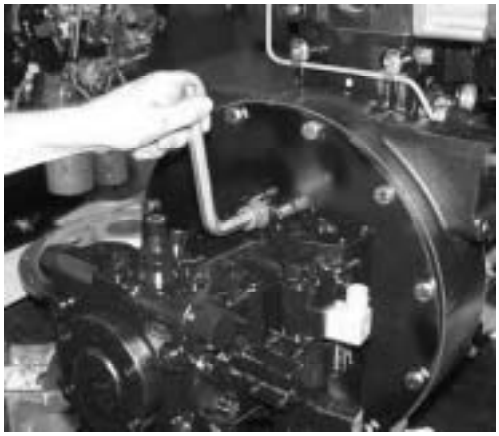
Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Carefully clean the area around the piping to be disconnected, plug all disconnected parts with caps, rags or adhesive tape to prevent dust or impurities from entering the circuit. They can cause serious damage.

1. Remove the engine bonnet (see table T2306-020)
2. Disconnect the draining hoses with a 32mm wrench.
3. Disconnect the booster feeding hose with a 18mm wrench.
4. Disconnect the two delivery hoses with an 8mm hexagonal wrench.
5. Close the oil tank cocks.
6. Disconnect the intake hose with a 48mm wrench.
7. Remove the two screws locking the pump with a 14mm hexagonal wrench.
8. Sling the pump with a textile bridle and secure it to the bridge crane, then pull it out axially from the machine.

7



8



Operation:	Hydrostatic pump disassembly	Table:
		T2306-009

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Operation: Disassembling the hydraulic motor	Table: T2306-010	kg	44
			Hrs. / Min.
Bridge crane or swing hoist, payload 500 kg (2,000 lb)	Standard tools		2 / -
			1

Operation:

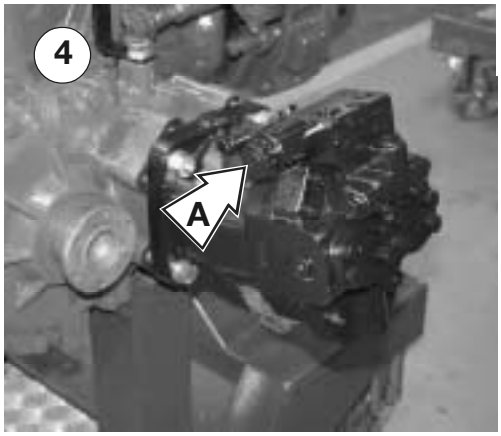
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Carefully clean the area around the piping to be disconnected, plug all disconnected parts with connectors, clothes or adhesive tape to prevent dust or impurities from entering the circuit. They can cause serious damage.

1 Remove the engine bonnet (see table T2306-020)
2 Disconnect the draining hoses with a 32mm wrench.
3 Disconnect the two delivery hoses with an 8mm hexagonal wrench.
4 Disconnect the connectors from coil **A**.

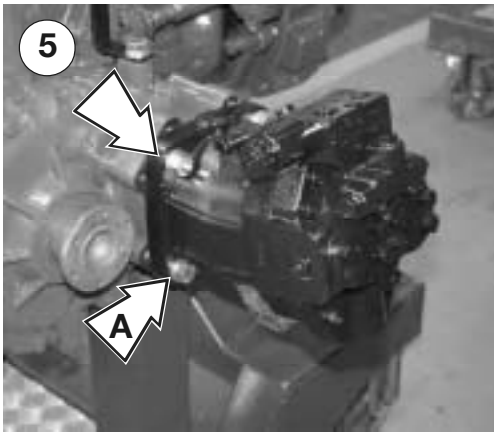


Operation:	Table:
Disassembling the hydraulic motor	**T2306-010**

5 Remove the four locking screws of the motor with a 24mm wrench.

6 Pull out the motor from the power divider fitted to the front axle.

7 Protect the engine compartment to prevent the entrance of impurities.



Operation: Cardan shaft disassembly	Table: T2306-011	kg	18
		Hrs.	Min.
Standard tools		1	-
			1

Operation:

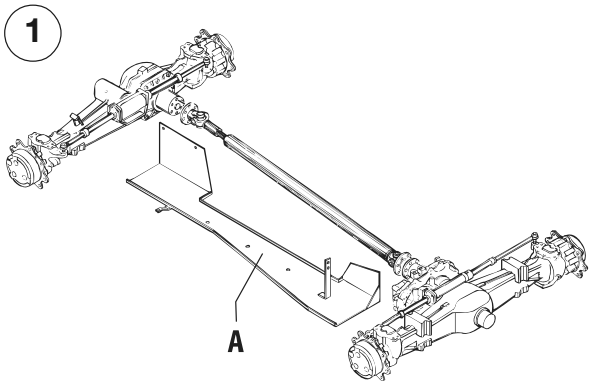
IMPORTANT

This job becomes easier if it can be done in a working pit.

1 Remove guard **A** of the Cardan shaft (weight: 18 kg) by loosening the four locking screws with a 13mm wrench.

2 Using two 13mm wrenches, remove the six screws fixing the Cardan shaft (18 kg) to the gearbox side and the rear axle side.

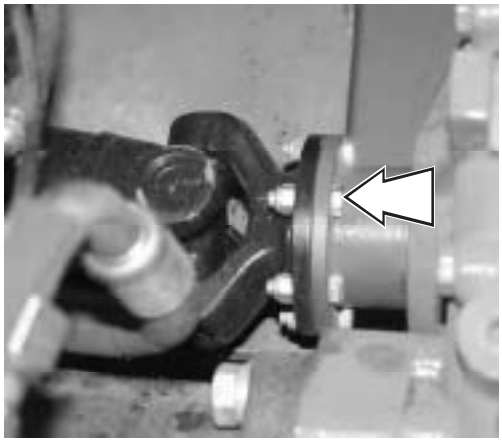
1



CAUTION

Do not to pull out the two parts of the Cardan transmission. If necessary, mark a reference line on both parts for a proper re-assembly. If this precaution is not taken, you risk loosing the balancing of the drive shaft. This can cause serious damage due to the resulting vibrations.

2



IMPORTANT

To reassemble the Cardan shaft, repeat the steps above in reversed order.
M8 screws, class 10.9, must be tightened to 37.3 Nm if their pitch is =1, or to 35.4 if their pitch is =1.25.

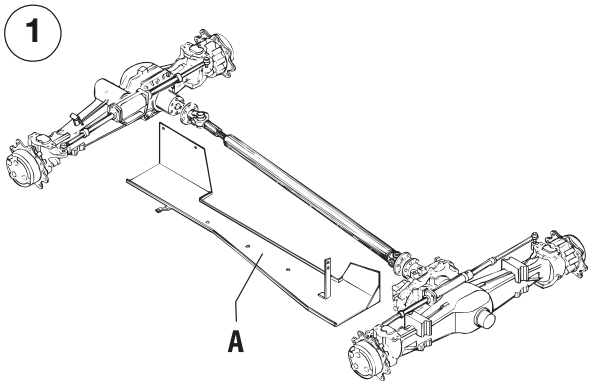
Operation:	Cardan shaft disassembly	Table:
		T2306-011

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Operation: **Oil tank disassembly**	Table: **T2306-012**	kg: 45
Swing hoist, payload 500 kg (2,000 lb)	Standard tools	Hrs. 3 / Min. -
		1

Operation:

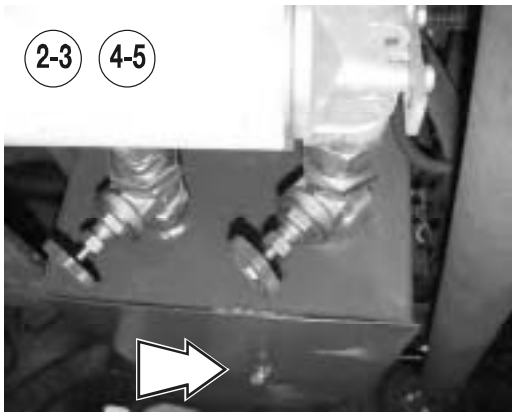
1 Remove guard **A** of the Cardan shaft protection as indicated in table T2306-011.
2 Carefully clean the area around the drain plug of the tank.
3 Place a container of at least 100 l capacity underneath the tank drain plug.
4 Remove the drain plug with a 32mm wrench and let oil flow out completely into the container.



PROTECT THE ENVIRONMENT

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

5 Close the oil cocks.



Operation:	Oil tank disassembly	Table:
		T2306-012

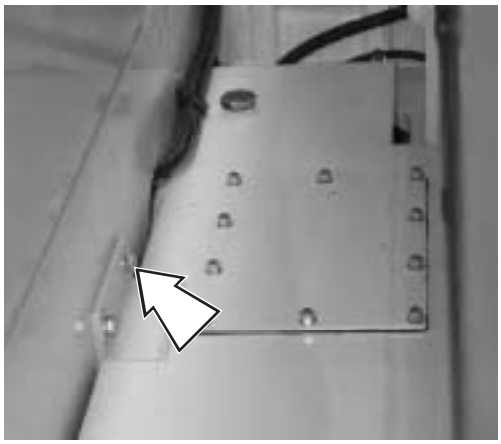
6 Proceed in disconnecting:
- valve piping with a 32mm wrench
- valve with a 36mm wrench
- flexible hose with a 32mm wrench
- three lateral flexible hoses with 22-27-32mm wrenches
- electrical wire from the bulb
- flexible hoses under the cocks with a 38mm wrench and a 50mm wrench
- hose-clamp of the filler extension with a 10mm wrench.

7 Place a pallet with shims under the tank to support its weight.

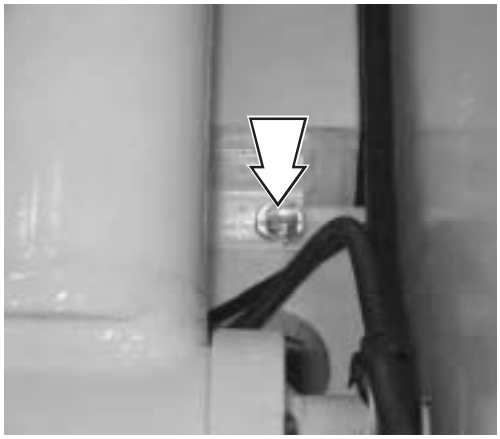
8 Remove the 4 screws locking the tank with a 17mm wrench and a 19mm wrench.

9 Lower and remove the tank from the machine.

6-8



8



IMPORTANT

To reassemble, repeat the steps above in reversed order taking the following precautions:

- ***After re-assembling all parts and filling the tank with oil, open the cocks of the intake line before starting the machine engine.***
- ***After a few minutes, check the oil level and, if necessary, add new oil.***

Operation: **Fuel tank disassembly**	Table: **T2306-013**	kg: 254+28
		Hrs. 2 / Min. -
Bridge crane, payload 1,000 kg (4,000 lb) Wooden pallet	Standard tools	1

Operation:

1 Raise the rear guard and gain access to the fuel tank

2 With a 17mm wrench loosen and remove the two screws M10 from the counterweight and replace them with two eyebolts M10.

3 Hook the two-leg chain with hooks fitted to the end of the bridge crane to the two eyebolts, previously screwed on the counterweight.

4 Tension the chain.

5 Remove the two screws M24 with a 36mm wrench and disconnect the counterweight (weight: 254 kg).

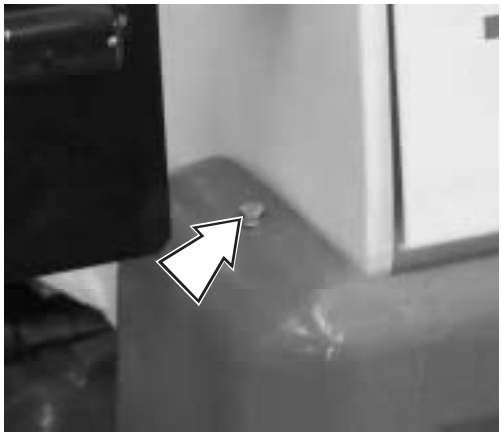
6 Remove the counterweight and lower it to the ground onto the wooden pallet.

7 Carefully clean the area around the drain plug of the tank.

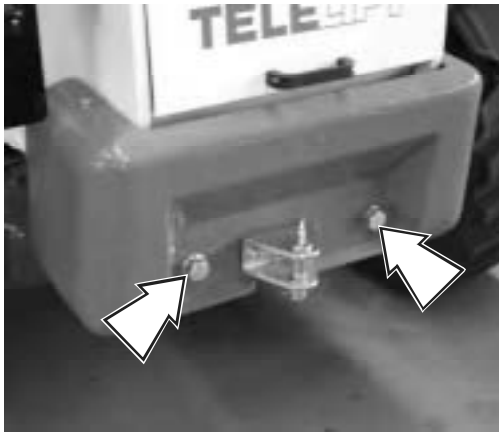
8 Place a container of at least 60 l capacity underneath the tank drain plug.

9 Remove the drain plug with a 32mm wrench and allow fuel to flow out completely into the container.

2



5



Operation: **Fuel tank disassembly**	Table: **T2306-013**

10 With a screwdriver, pry off the clamps of the feeding and return hoses and disconnect the hoses.

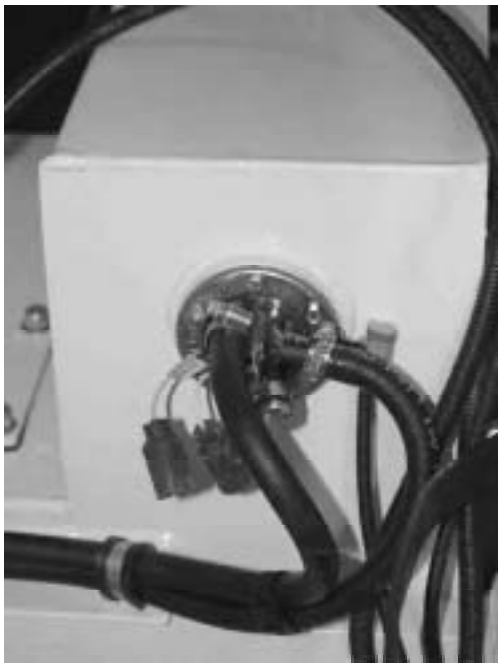
11 Disconnect the electrical fuel gauge.

12 Place the tank (28 kg) onto a wooden pallet complete with blocks.

13 Remove the 3 tank fixing screws with a 19mm wrench and a 13mm wrench.

14 Lower and rest the tank to the ground.

10



Operation: Water-oil cooler disassembly	Table: T2306-014	kg	24
		Hrs.	Min.
Standard tools		2	-
			1

Operation:

PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Carefully clean the area around the piping to be disconnected, plug all disconnected parts with connectors, clothes or adhesive tape to prevent dust or impurities from entering the circuit. They can cause serious damage.

1 Empty the cooler opening the special cock.

2 Disconnect the two inlet and outlet hoses from the cooler with a 32mm wrench.

3 Disconnect the water pipes from/to the engine loosening the hose-clamps with a screwdriver.

4 Disconnect the water gauge bulb.

2



3



Operation:	Water-oil cooler disassembly	Table:
		T2306-014

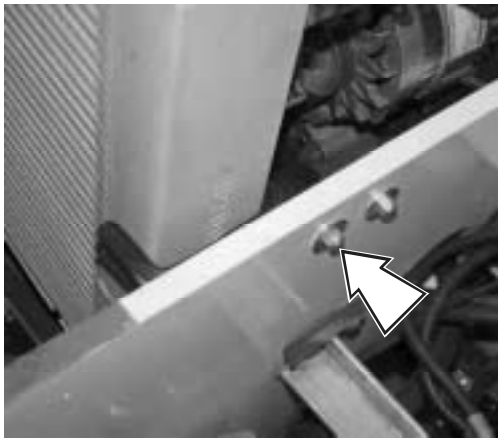
5 Remove the two fixing screws on the chassis using a 13mm wrench.

6 Remove the two screws of the vibration supports with a 22mm wrench.

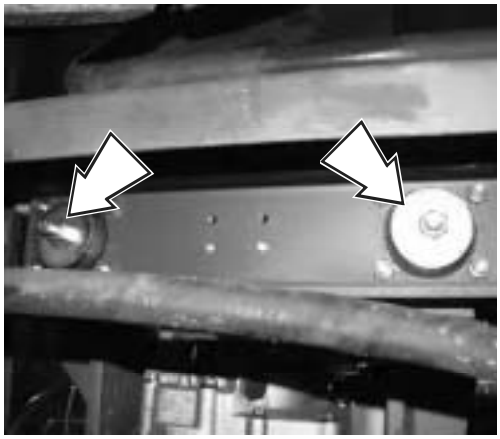
7 Secure the cooler with a textile bridle connected to the swing hoist.

8 Hoist with caution by tilting the cooler forward to prevent damage to the fixed fan of the engine.

5



6



VIEW OF THE MACHINE FROM THE BOTTOM

Operation: **Disassembling the fork joint support**	Table: **T2306-015**	kg	110
			Hrs. / Min.
Swing hoist, payload 500 kg (2,000 lb) Two-leg chain with hooks	Standard tools		2 / -
			1

Operation:

1 Disconnect the quick connectors of the attachment on the boom.

2 Release the attachment and lower it onto a transport pallet.

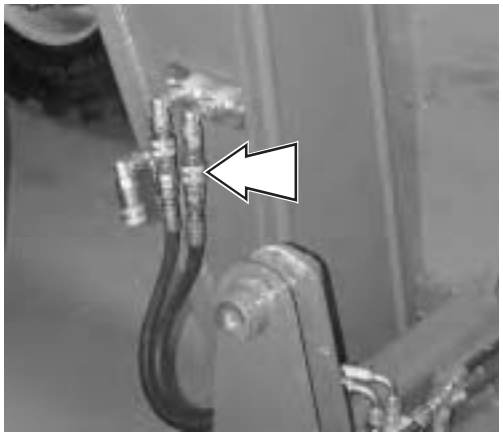
3 Sling the attachment holding frame to the chain complete with terminal hooks and tension the chain to support the frame weight.

4 Disconnect the quick connectors of the attachment locking cylinder.

2



4



Operation:	Table:
Disassembling the fork joint support	**T2306-015**

5 Remove the screw fixing the rod pin of the attachment rotation cylinder with two 17mm wrenches.

6 Knock out and extract the pin with a plug of soft material (aluminium, copper, wood, etc.).

7 Remove the screw fixing the hinging pin of the attachment holding frame with two 19mm wrenches.

8 Knock out and extract the pin with a plug of soft material (aluminium, copper, wood, etc.) of at least 600mm.

9 Lower the attachment holding frame onto a transport pallet.

5



6



7-8



Operation: Disassembling the fork joint support	Table: T2306-015

Reassembling the attachment holding frame

IMPORTANT

To reassemble the attachment holding frame, repeat the steps above in reversed order taking into account the following precautions

1 Smear pins and seats with a thin coat of oil before refitting the pins.

DANGER

Do not at any time use your fingers to align holes. You could be seriously injured.

Operation:	Disassembling the fork joint support	Table:
		T2306-015

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Operation: Control lever disassembly	Table: T2306-016	kg: 2
	Standard tools	Hrs. 1 / Min. -
		1

Operation:

1 Open and hold the engine bonnet in raised position.

2 Raise and hold the boom in position by positioning a spacer on the cylinder to prevent an accidental fall.

3 With a 10mm wrench, remove the two screws which fix the side guard of the cabin; remove the guard.

3



PROTECT THE ENVIRONMENT

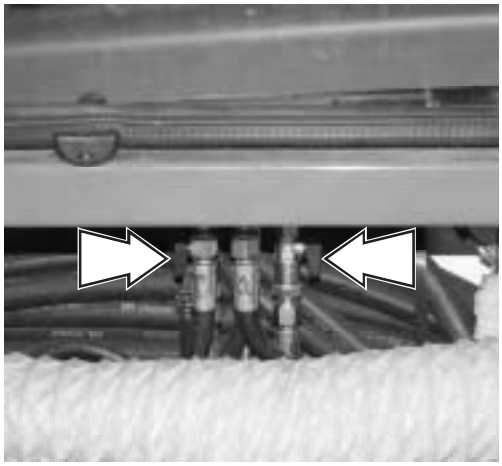
Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Carefully clean the area around the piping to be disconnected, plug all disconnected parts with connectors, clothes or adhesive tape to prevent dust or impurities from entering the circuit. They can cause serious damage.

4 Disconnect the hydraulic piping of the servo-assisted controls with a 17mm wrench.

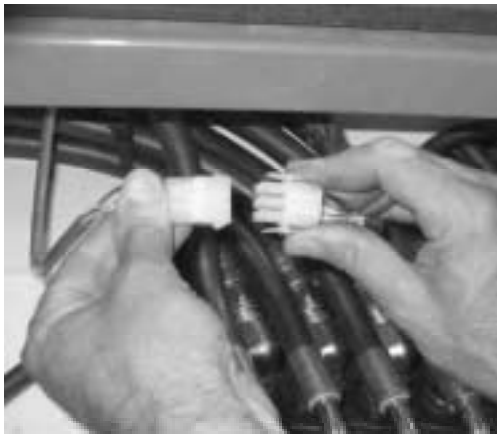
4



Operation: Control lever disassembly	Table: T2306-016

5 Cut out the electrical circuit using the special terminal board.

5



6 Remove the locking screws of the side dashboard with a cross-slotted screwdriver, then raise the dashboard.

6



7 Remove the 4 screws fixing the control lever with a 5mm hexagonal wrench.

7



Operation: Distributor disassembly	Table: T2306-017	kg 27	
			Hrs. 2 / Min. 30
Standard tools			1

PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Carefully clean the area around the piping to be disconnected, plug all disconnected parts with connectors, clothes or adhesive tape to prevent dust or impurities from entering the circuit. They can cause serious damage.

DANGER

Before disconnecting the hydraulic piping, ensure the line is not under pressure. Release the pressure if necessary by operating the control levers with the engine stopped.
In any case, 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.

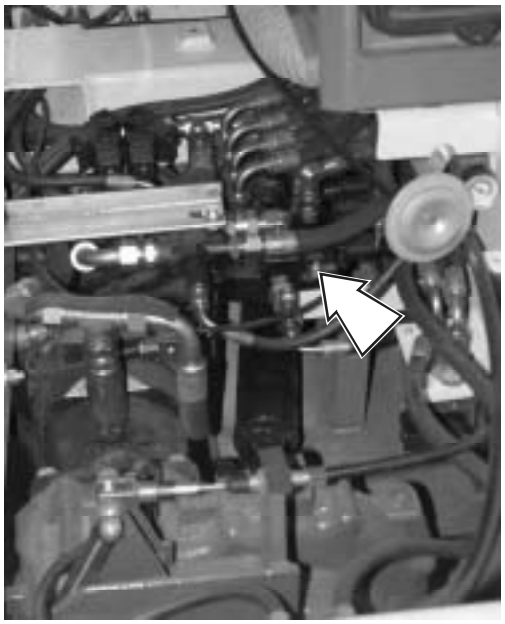
Operation:	Distributor disassembly	Table:
		T2306-017

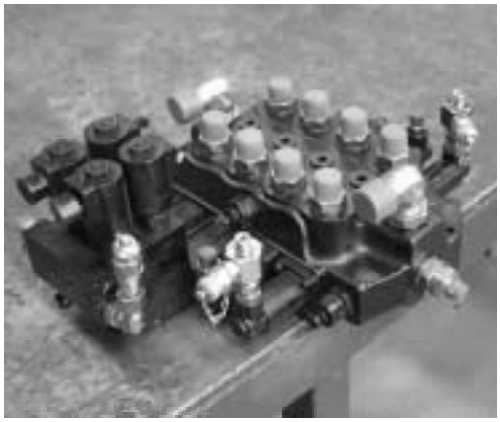
IMPORTANT

Before disconnecting any flexible hoses, label them for an easier reassembly.

Operation:

1. Disconnect the delivery and return pipes with a 32mm wrench.
2. Disconnect all users with a 27mm wrench.
3. Disconnect all pilot systems with a 19mm wrench.
4. Remove the 3 fixing screws with two 13mm wrenches (screw + lock nut).



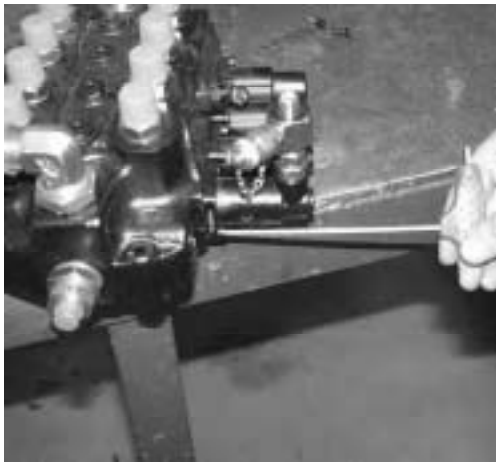


Operation: Disassembling the distributor on bench (slider and valves)	Table: T2306-018	kg	8
			Hrs. / Min.
Standard tools			- / 30
			1

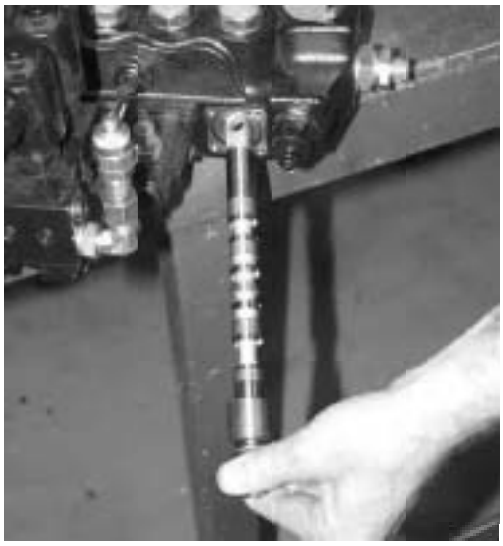
Operation:

❑ **Disassembling the slider**

1 Remove the 4 screws fixing the cap with a 4mm hexagonal wrench.



2 Remove the cap and pull out the slider.



IMPORTANT

Replace the slider if scratched. Also check the slider housing using a portable lamp. If also the housing is damaged, replace the block.

3 Carefully clean and anoint with some hydraulic oil before refitting the parts.

Operation:	Disassembling the distributor on bench (slider and valves)	Table: T2306-018

❑ **Removing the pressure relief valve with canister**

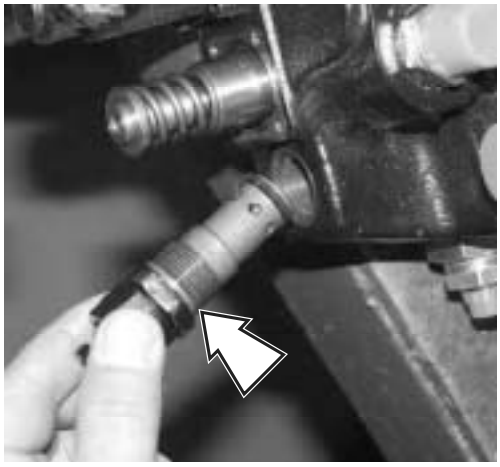
4 Unscrew the valve with a 27mm wrench.

4



5 Check the seal for damage. If worn, replace.

5



IMPORTANT

Dry-clean before refitting the valve.

Operation:	Disassembling the distributor on bench (slider and valves)	Table: T2306-018

❑ **Removing the fork tilting safety valve**

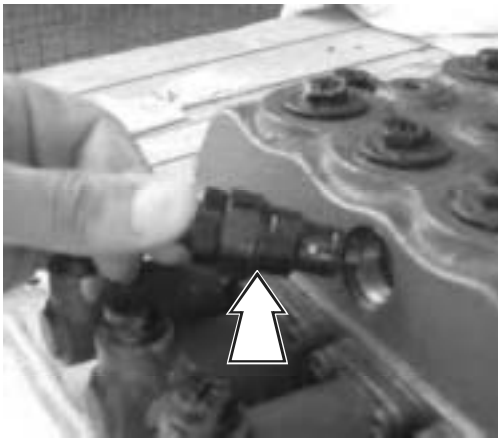
6 Unscrew the valve with a 24mm hexagonal wrench.

6



7 Check the seal for damage. If worn, replace.

7



8 To check the valve cleanliness better, clamp it with a vice with soft jaws and with a 22mm hexagonal wrench loosen the lock nut.

8



Operation:	Table:
Disassembling the distributor on bench (slider and valves)	**T2306-018**

9 With a 12mm hexagonal wrench, loosen the top of the valve and pull it out.

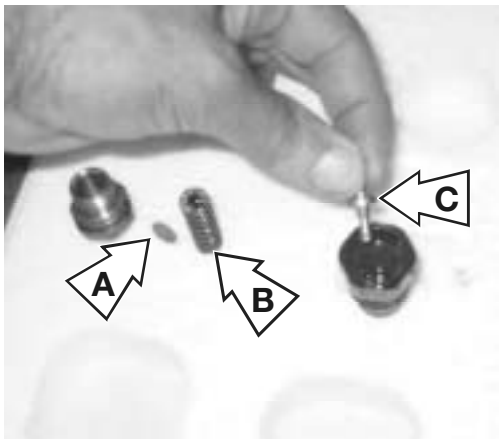
(9)



10 Remove shim **A**, spring **B** and shutter **C** and clean them thoroughly.

Reassemble the top of the valve in reverse order.

(10)



IMPORTANT

Dry-clean before refitting the valve.

ATTENTION

After refitting the valve to the distributor, proceed in calibrating the valve as described in chapter D.03.01, paragraph 2.1.

Operation: Overload warning system	Table: T2306-019	kg: -
	Standard tools	Hrs.: 1 / Min.: -
		1

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 authorized ***Terexlift*** service centers.

IMPORTANT

Since the Overload Warning System is a device of maximum importance for the safety of the machine and personnel, any intervention in contrast with the procedures or guidelines contained in this manual is strictly forbidden.

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Additional copies of this manual can be ordered ***Terexlift***.

Operation:	Table:
Overload warning system	**T2306-019**

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.

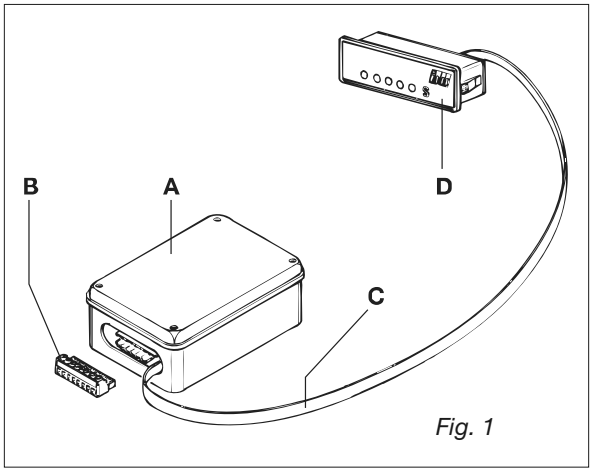


Fig. 1

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.

SPARE PARTS

Part #	*description*
637275 637276	main module (A-B-C) display (D)

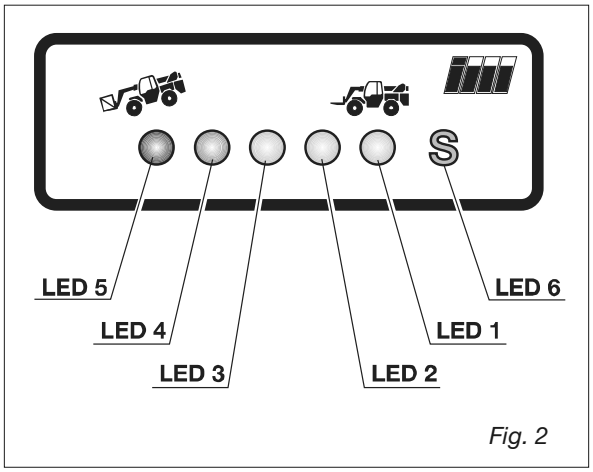


Fig. 2

Operation: Overload warning system	Table: T2306-019

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

Operation: Overload warning system	Table: T2306-019

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-

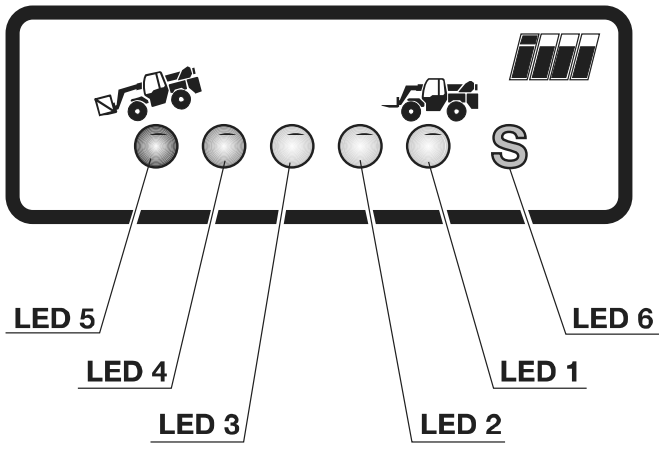


Fig. 3

Operation: Overload warning system	Table: T2306-019

normal weight. The result is that, with the vehicle in 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

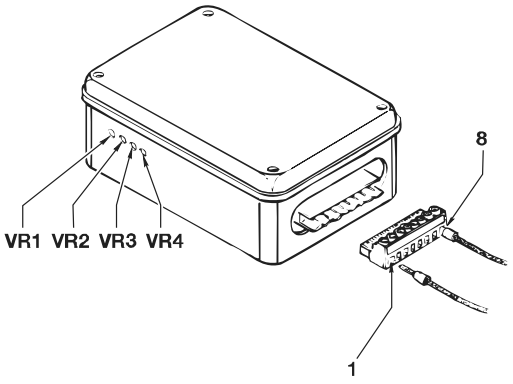
Carry out all maneuvers in safety, making sure the working range of the machine is clear of persons or objects.

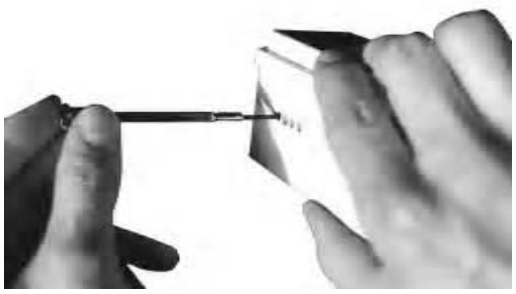
The upper and lower ends of the readout scale are adjusted with multiturn trimmers. The system allows to choose between two ranges, depending whether the stabilisers are up or down. In the former case, trimmers **VR1** and **VR2** will be adjusted; in the latter case (both stabilisers down), trimmers **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.





Operation: Overload warning system	Table: T2306-019

C-1 INSTALLATION GUIDELINES

ATTENTION

Before arc-welding on the machine:

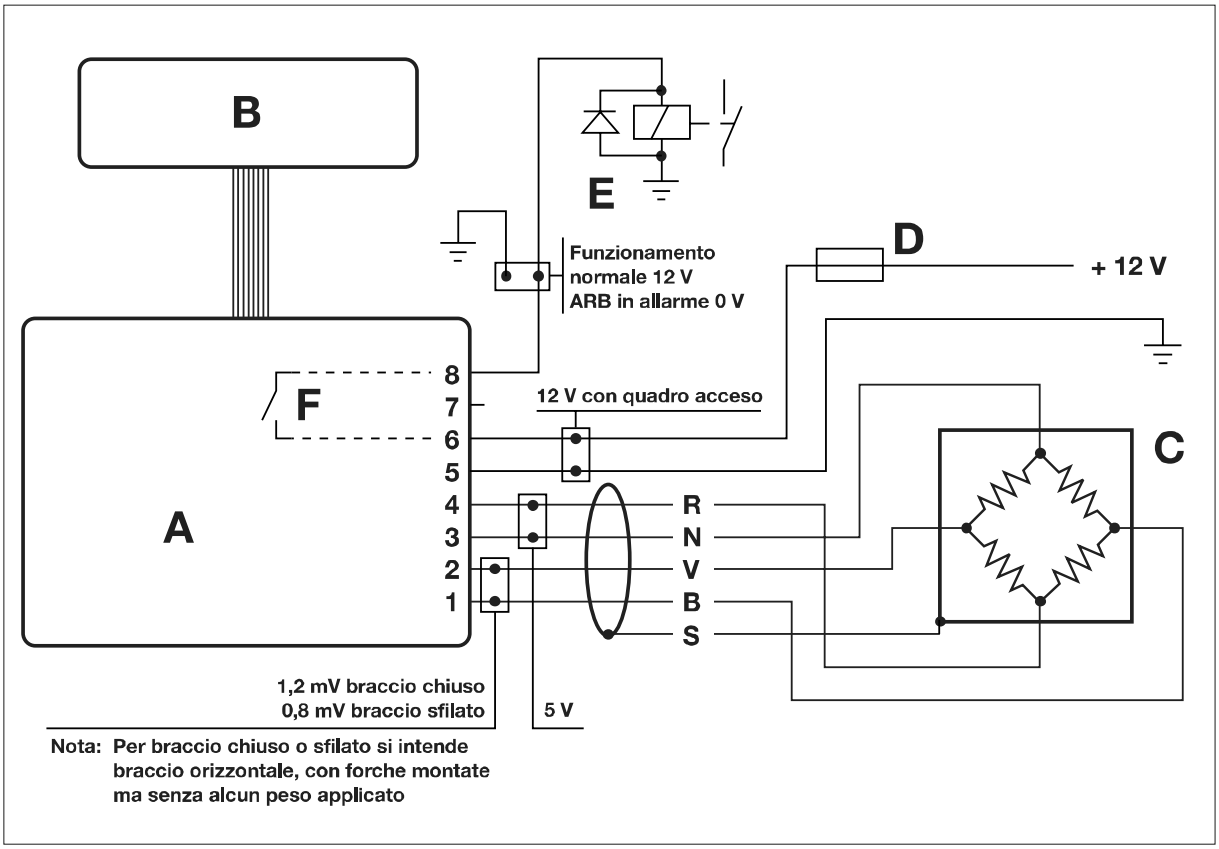
- ***disconnect the battery (use the battery cut-out switch if fitted on the machine)***
- ***remove the connector from the main module***

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.

Operation: Overload warning system	Table: T2306-019



A - main module
B - display
C - load cell
D - fuse
E - alarm relay + diode
F - ARB cut-out key (if any)
N - black
R - red
V - green
B - white
S - shield

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).

Operation: **Overload warning system**	Table: **T2306-019**

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)

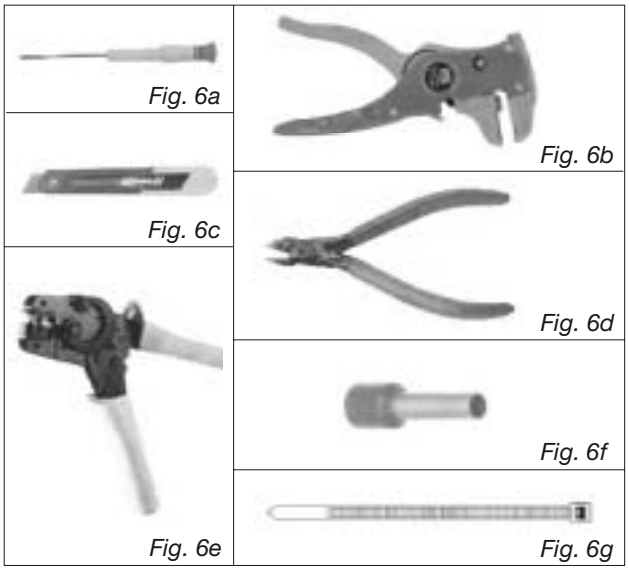


Fig. 6a *Fig. 6b* *Fig. 6c* *Fig. 6d* *Fig. 6e* *Fig. 6f* *Fig. 6g*

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.
- using the crimping tool, secure the pin terminals on every wire (Fig. 9). If the pin terminals are

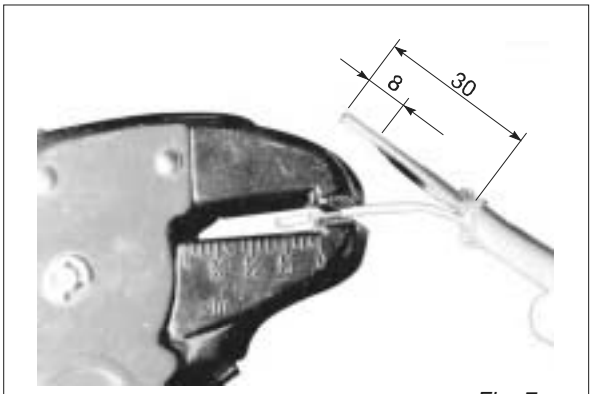


Fig. 7

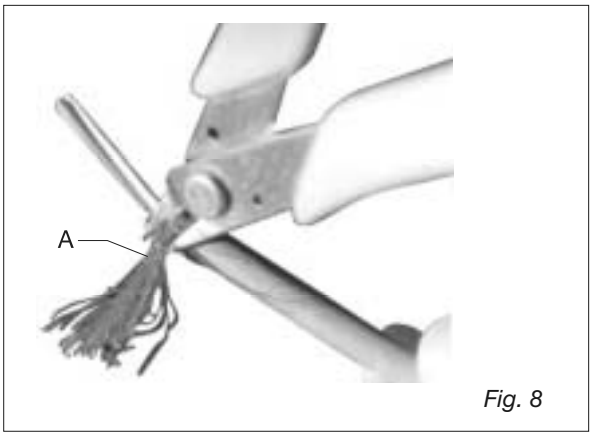


Fig. 8

Operation: **Overload warning system**	Table: **T2306-019**

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

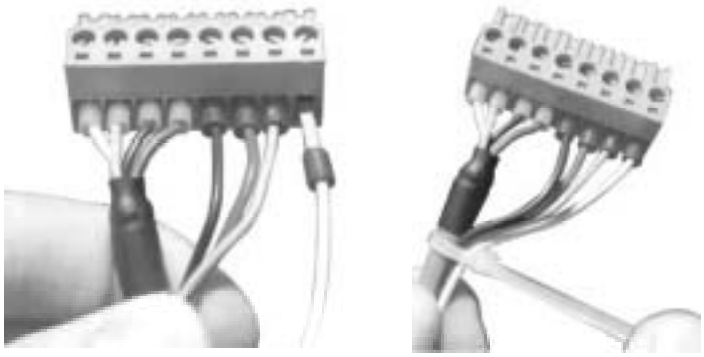


Fig. 10

- 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

Operation: **Overload warning system**	Table: **T2306-019**

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

Operation: Overload warning system	Table: T2306-019

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

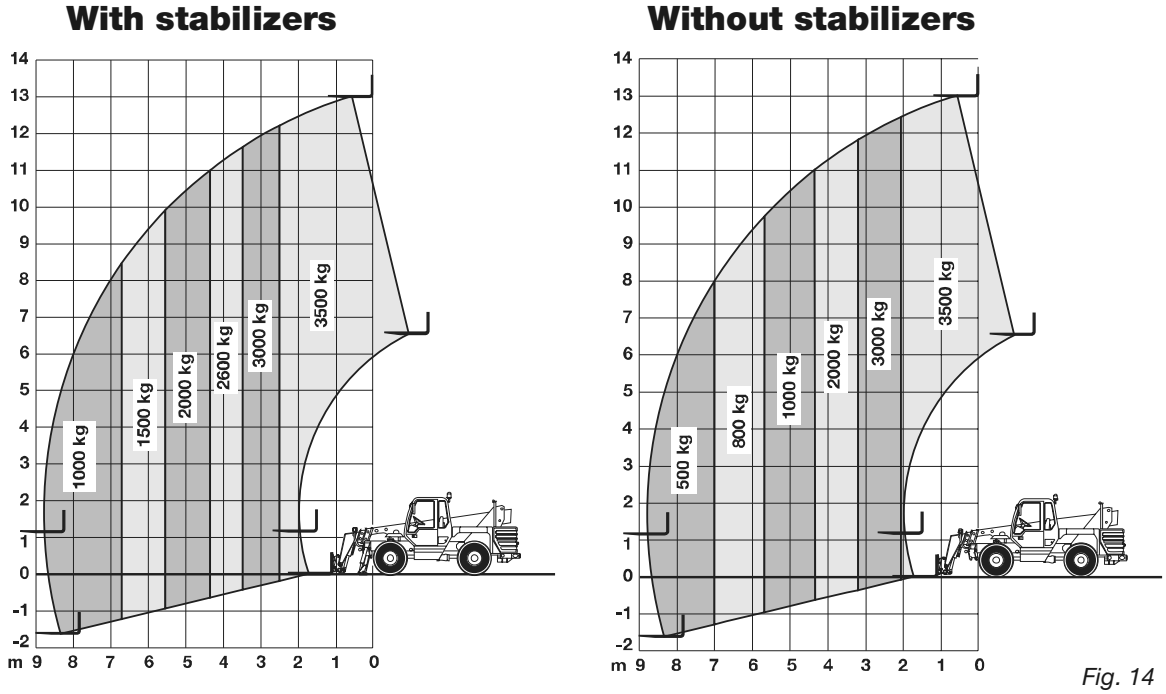


Fig. 14

Operation: **Overload warning system**	Table: **T2306-019**

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.

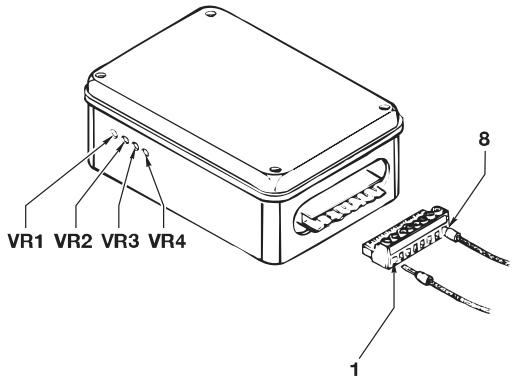
7 - Rotate trimmer **VR2** counterclockwise until LED5 is lit; at this point, rotate **VR2** counterclockwise another half turn.

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.



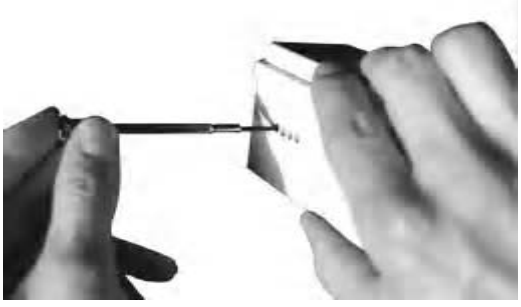


Fig. 15

Operation: **Overload warning system**	Table: **T2306-019**

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.

Operation: Overload warning system	Table: T2306-019

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"Ω) range; the measured resistance between pins **1** and **2** should be 351 ± 5 Ω. Between pins **3** and **4** the measured resistance should be 350 ±20 Ω. If this is not the case, a broken 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 MΩ. Smaller measured 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).

Operation: Overload warning system	Table: T2306-019

E-1 CALCULATING THE WEIGHT APPLIED ON THE CELL

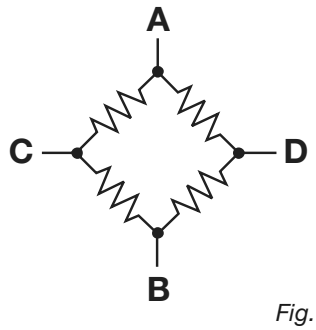


Fig. 16

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 outputà

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: $\frac{10000\ \text{kg}}{5\ \text{mV}} \times 3.2\ \text{mV} = 6400\ \text{kg}$

Operation:	Overload warning system	Table:
		T2306-019

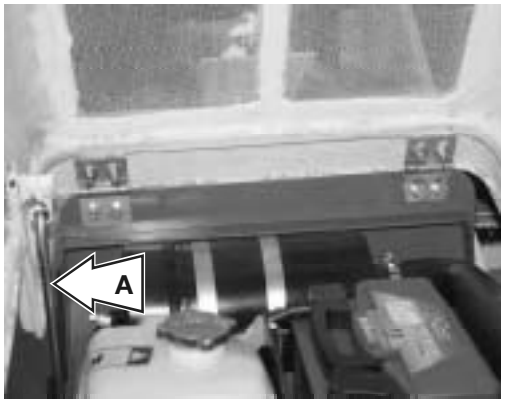
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Operation: **Engine bonnet disassembly**	Table: **T2306-020**	kg	14
			Hrs. / Min.
Bridge crane or swing hoist	Standard tools		- / 30
			1

Operation:

1 Open and hold the bonnet in raised position with a textile bridle connected to the bridge crane.

2 With two 13mm wrenches remove the locknut M8 fixing the bonnet gas spring **A**.



3 With two 13mm wrenches, remove the four screws M8 with lock nut and plain washer **B** fixing the bonnet.

4 Remove the bonnet.



Operation:	Engine bonnet disassembly	Table:
		T2306-020

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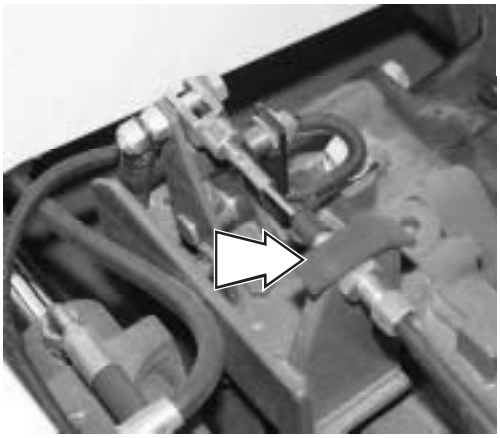
Operation: Adjusting the parking brake	Table: T2306-021	kg: -
		Hrs.: - / Min.: 30
Standard tools		2

Operation:

1 Pull the parking brake lever all the way down.

2 Loosen the front nut of the register with a 22mm wrench.

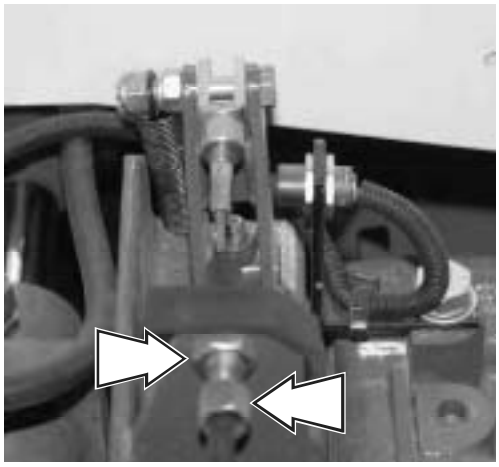
2



3 Using a 17mm wrench, hold the sheath in position while rotating the register with a 22mm wrench:
- clockwise to tighten the brake
- counter-clockwise to loosen the brake.

4 Lock in position with the lock nut placed under the rubber protection (see fig. 2).

3



IMPORTANT

The brake is adjusted when, by pulling the lever up to the fifth-sixth click, the axle is locked.

Operation:	Adjusting the parking brake	Table:
		T2306-021

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Operation: **Bleeding the braking circuit**	Table: **T2306-022**	kg: -
		Hrs.: - / Min.: 30
Standard tools		2

Operation:

1 Replenish the brake reservoir with hydraulic oil (0.1 lt. approx.).

2 Remove the protection cap from the brake breather.

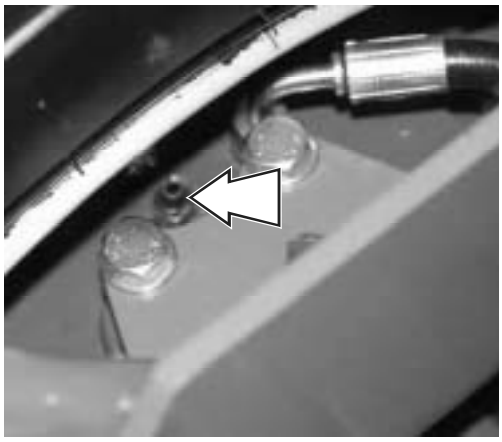
3 Use the assistance of a second operator. One will operate from the cab, while the other will work on the brake breather.

1



4 The operator in the cab will step on the brake pedal some times until it gets harder, then, while he holds the brake fully depressed, the second operator will loosen and re-tighten the breather with a 13mm wrench to eliminate air from the circuit.

4



5 The operator in the cab will step again on the brake pedal and hold it fully deprssed while the second operator will eliminate again the air from the brake circuit.

6 Operation shall be repeated until air-free oil will flow out from the breather.

7 Protect the breather with the special cap.

8 Repeat the steps above with the other wheel.

Operation: Bleeding the braking circuit	Table: T2306-022

9 Check and, if necessary, replenish the oil reservoir.

ATTENTION

While bleeding the brake circuit, do not empty the oil reservoir completely to avoid air from entering the pump.

Operation:	Adjusting the distance of the proximity switches	Table: T2306-023	kg	-
			Hrs.	Min.
	Standard tools		-	15
			1	

Operation:

In case of a failure or complete malfunctioning of the proximity switches due to a loosening of their ring nuts, re-adjust as follows:

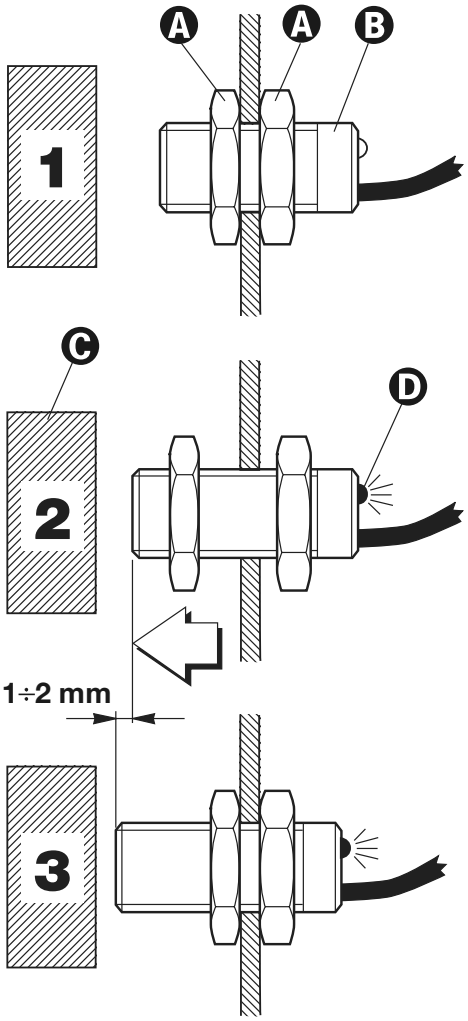
1 Loosen nuts **A** fixing the proximity switch **B**.

2 Near the mobile part **C** of the machine, controlled by the proximity switch.

Near the proximity switch to the component until the LED indicator **D** will come on.

3 Near the proximity switch another 1÷2 mm. Smoothly tighten the proximity switch fixing nut and the relevant lock nut.

The machine is equipped with a proximity switch on the parking brake. This switch prevents the machine start-up when the parking brake is not engaged.



ATTENTION

Tighten the nuts of the proximity switch to 15 Nm.

Operation:	Adjusting the distance of the proximity switches	Table:
		T2306-023

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Operation: **Renewing the canister of the engine air filter**	Table: **T2306-024**	kg: -
		Hrs.: - / Min.: 5
Standard tools		1

Operation:

To renew the canister of the engine air filter, proceed as follows:

1 Gain access to the engine compartment, on the rear right-hand side of the machine; raise the cover.

2 Hand-loosen the wing nut fixing the cover of the air filter.

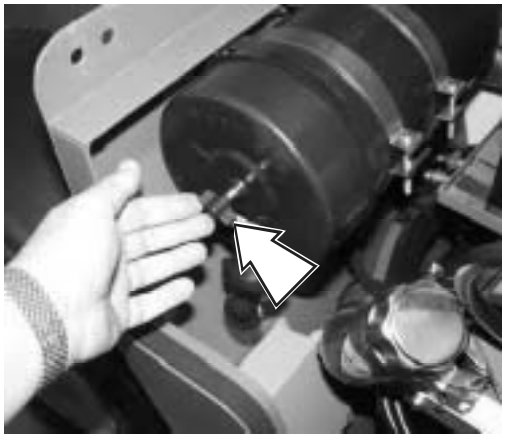
3 Reach the filter canister, loosen the wing nut and pull out the canister.

4 Attempt to dry-clean the canister (max. pressure: 6 bar). Check the filter element for cracks or damage by introducing a lamp inside.

5 If the canister is very soiled (the relevant LED in the cab is lit), renew.

6 Clean the internal part of the filter, smear the seal with grease, refit the filter element and fit a new canister.

2



3



Operation:	Renewing the canister of the engine air filter	Table:
		T2306-024

Page left intentionally blank

Operation: Checking the seals of the steering cylinder	Table: T2306-025	kg	-
		Hrs.	Min.
Standard tools		-	15
		2	

Operation:

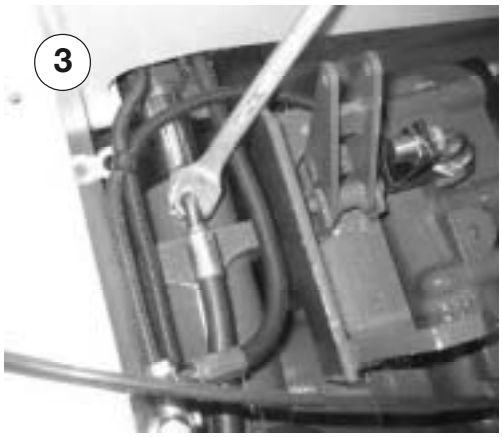
1 Position a container of suitable size under the steering cylinder of the rear axle to prevent oil spillage.

PROTECT THE ENVIRONMENT

Used oils must be handled and disposed of according to national egulations. Address to legally authorised centres.

2 Steer to end of stroke.

3 Disconnect with caution the flexible hose of the cylinder drain line with a 22mm hexagonal wrench.



4 Hold the cylinder under pressure steering beyond the end-of-stroke position.

5 No oil shall flow out from the flexible hose. If a leakage is noticed, proceed in renewing the seals.

6 Check the second cylinder.

7 To remove the steering cylinders, refer to the instructions provided by CARRARO - see section G of this manual.

Operation:	Checking the seals of the steering cylinder	Table:
		T2306-025

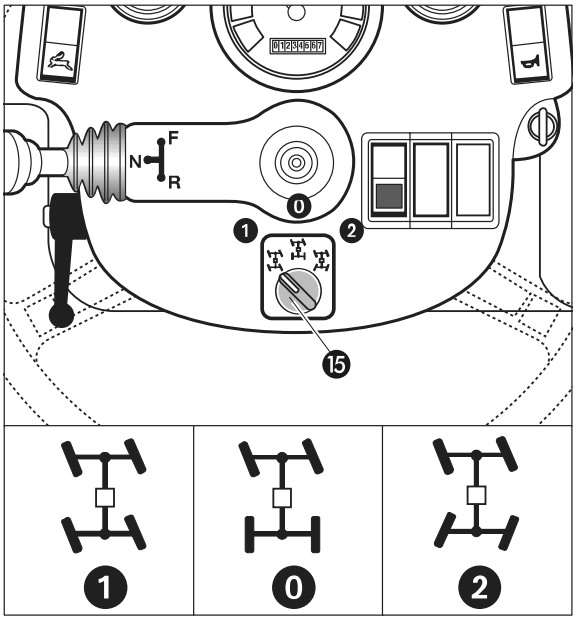
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Operation: **Shafting alignment**	Table: **T2306-026**	kg: -
		Hrs.: - / Min.: 10
Standard tools		1

Operation:

During operation, the alignment of the front and rear axles of the machine can be subject to variations. This can depend on an oil blow-by from the steering control circuit, or on a steering of both axles when front and rear wheels are not perfectly aligned.

To fix this problem, rather than checking the alignment visually, follow the procedure below:



- Move to a solid and level ground.
- Set the steering selection switch **15** to "four-wheel steer"(pos. **2**)
- Turn the steering to end of stroke (either to the right or to the left)
- Set the steering selection switch to "two-wheel steer" (pos. **0**)
- Turn the steering to the opposite end of stroke
- Reset the steering selection switch to "four-wheel steer"(pos. **2**)
- Turn the steering so that the rear axle reaches the end of stroke position (either to the right or to the left)
- Reset the steering selection switch to "two-wheel steer" (pos. **0**)
- Turn the steering so that the front axle reaches the end of stroke position

Operation: **Shafting alignment**	Table: **T2306-026**

- Reset the steering selection switch to "four-wheel steer"(pos. **2**)

- Set the wheels parallel to the longitudinal axis of the machine and move forward for 10÷15 meters, then reset the steering selection switch to “two-wheel steer” (pos. **0**)

Operation: Service pump disassembly	Table: T2306-027	kg 6
		Hrs. 1 Min. -
Standard tools		1

Operation:

PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

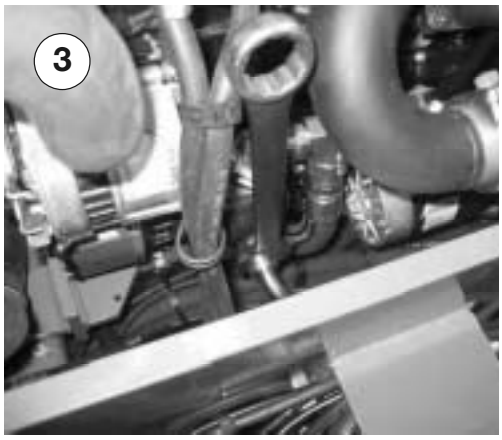
1 Remove the engine bonnet - see table T2306-020.

2 With a 38mm hexagonal wrench disconnect the induction hose from the tank.

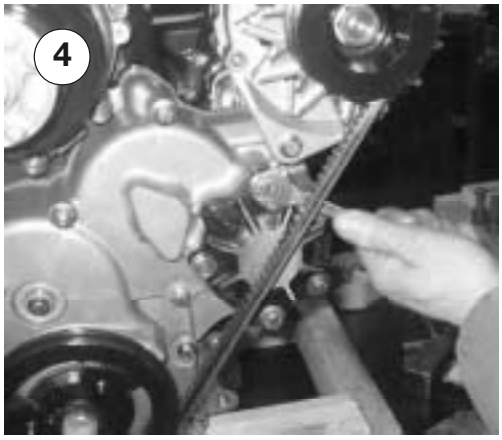


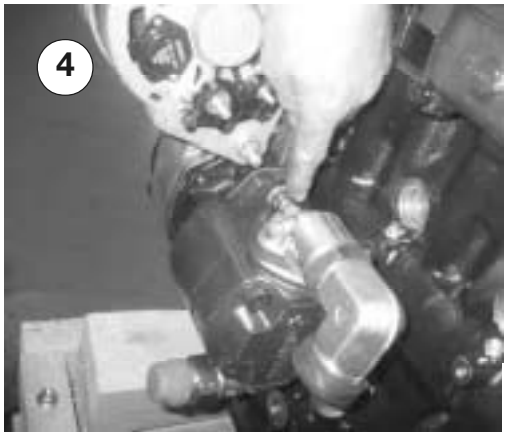
Operation:	Service pump disassembly	Table:
		T2306-027

3 With a 32mm wrench disconnect the delivery hose.



4 With a 13mm hexagonal wrench and a 15mm hexagonal wrench remove the two screws complete with nuts from the engine; then remove the pump.





Operation: Power steering disassembly	Table: T2306-028	kg	5
		Hrs.	Min.
Standard tools		1	30
			1

Operation:

1 Remove the guard to gain access to the power steering.



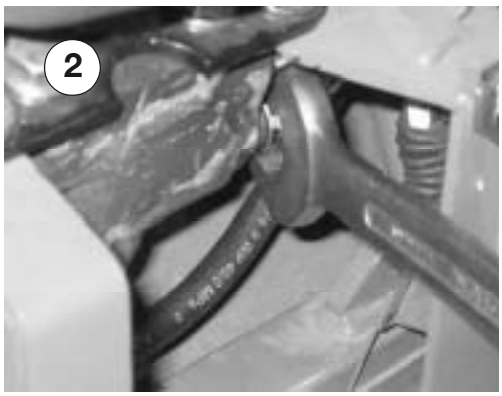
PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

IMPORTANT

Before disconnecting the hydraulic piping, place containers of suitable size underneath to prevent oil spillage.

2 With a 27mm hexagonal wrench disconnect the four rear pipelines.

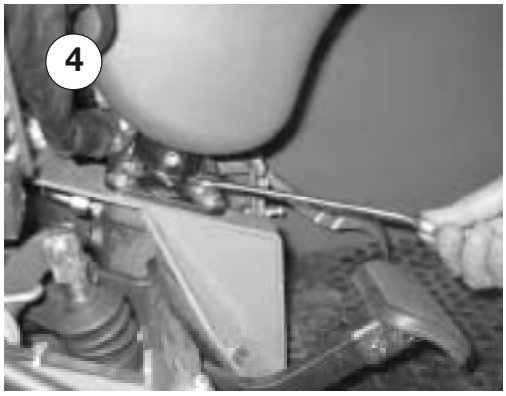


Operation:	Power steering disassembly	Table:
		T2306-028

3 With a 19mm wrench, disconnect the pilot hose.



4 With a 17mm hexagonal wrench, remove the four screws fixing the power steering unit to the steering column.



Operation:	Removing the blocking valves from the cylinders	Table: T2306-029	kg	-
			Hrs.	Min.
	Standard tools		-	30
			1	

Operation:

If the blocking valves shall be removed from the cylinder block, proceed as follows:

1 Place a container of suitable size under the valve to be removed to prevent oil spillage.

PROTECT THE ENVIRONMENT

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

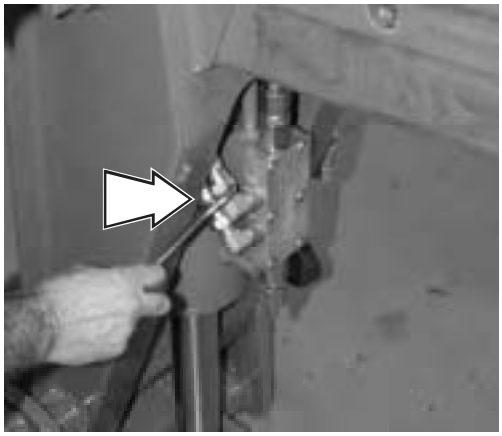
2 Fully unload the weight of the component on which the cylinder of the valve to be removed acts. To this end, use suitable hoisting means or support the component with special struts or a stand.

DANGER

Wear suitable personal protection equipment - e.g. goggles, gloves, facial screen in good condition and conform to the safety at work legislation. Cover the valve with some rags.

3 Slowly disconnect the hoses to release any residual pressure.

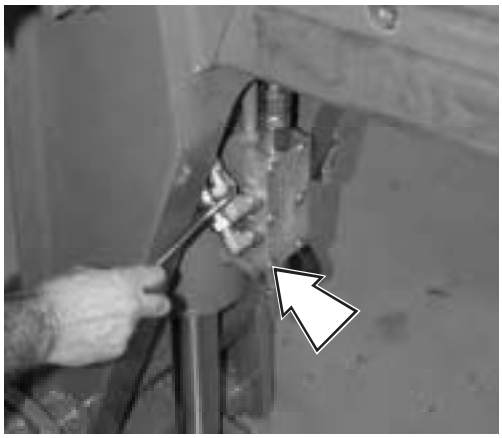
3



Operation:	Removing the blocking valves from the cylinders	Table:
		T2306-029

4 Slowly remove the screws fixing the valve and release any pressure from the cylinder.

(4)



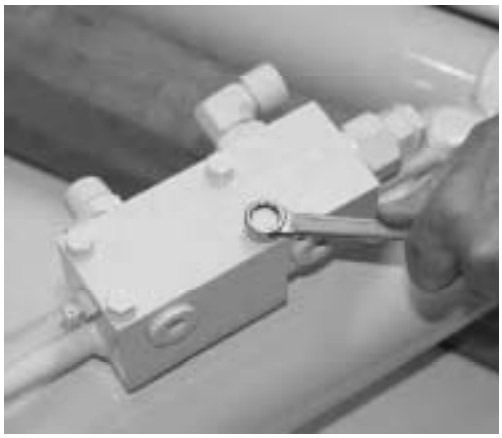
5 After removal, proceed in dismantling the valves on the bench.

6 Dry-clean the valve canister.

7 Replace any damaged or scored component, worn seals or broken springs.

8 Refit the valve after renwing the seals between valve and cylinder.

(8)



IMPORTANT

NOTE FOR THE RAISING CYLINDER VALVE
Before removing this valve, raise the boom some centimetres above the ground with the engine stopped. The valve is of single-acting type and this simple operation allows to release the internal pressure.

IMPORTANT

Valves are calibrated by the manufacturer and they must never be calibrated or adjusted. They can only be cleaned. If after cleaning the problem persists, renew the valve canister.

Operation:	Renewing the slide pads of the telescopic boom	Table: T2306-030	kg	-
			Hrs.	Min.
	Standard tools		1	30
			1	

ADJUSTING THE PLAY WITH SHIMS

f the play between the boom sections is too great (2 mm or more), proceed in shimming the guide pads of the boom sections.

Usually, the guide pads subject to premature wear are:

- bottom pads of the fixed section
- top pads of the telescope.

Proceed as follows:

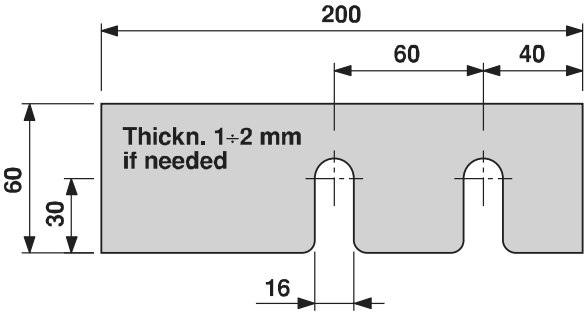
1 Lower the boom to the ground and ensure the telescope is fully retracted.

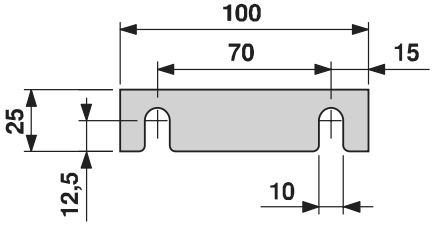
2 With a thickness gauge, check the play of all pads.
After adjustment, the minimum play in the narrowest point must be **0.5÷1 mm**.

3 Measure the thickness of the slide pads. The value of the bottom pads of the fixed section and of the top pads of the telescope must be at least 13 mm. For the remaining pads, the minimum thickness must never be less than 9 mm.

4 If the thickness reaches the minimum value, renew the pads before adjusting the residual play with some shims.

5 Remove the fixing screws from the pads and position as many shims as necessary to reach the normal thickness value.

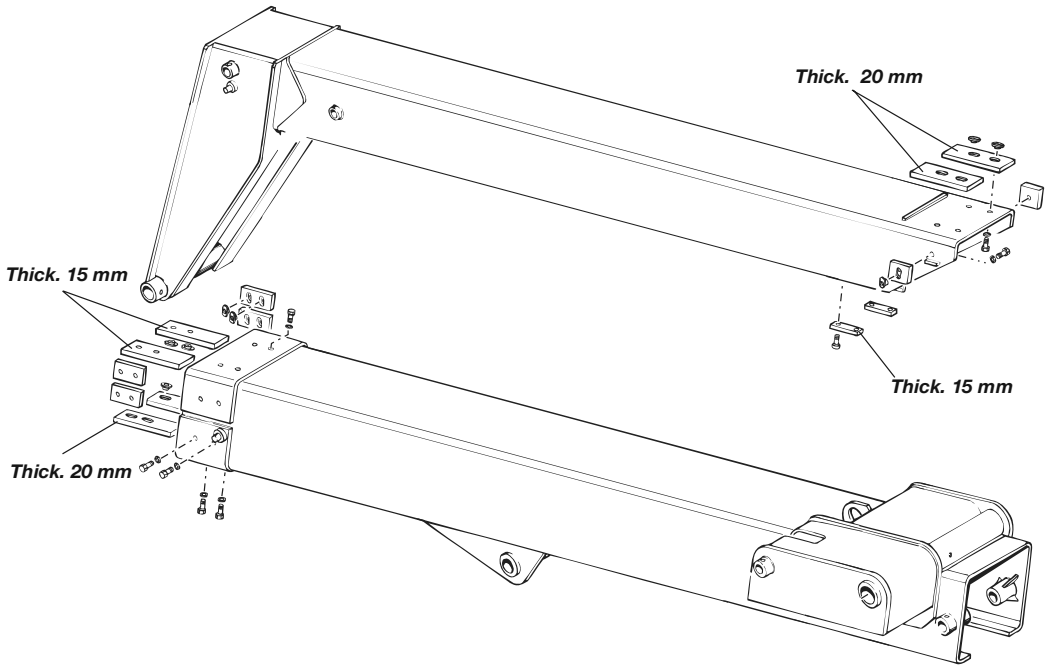


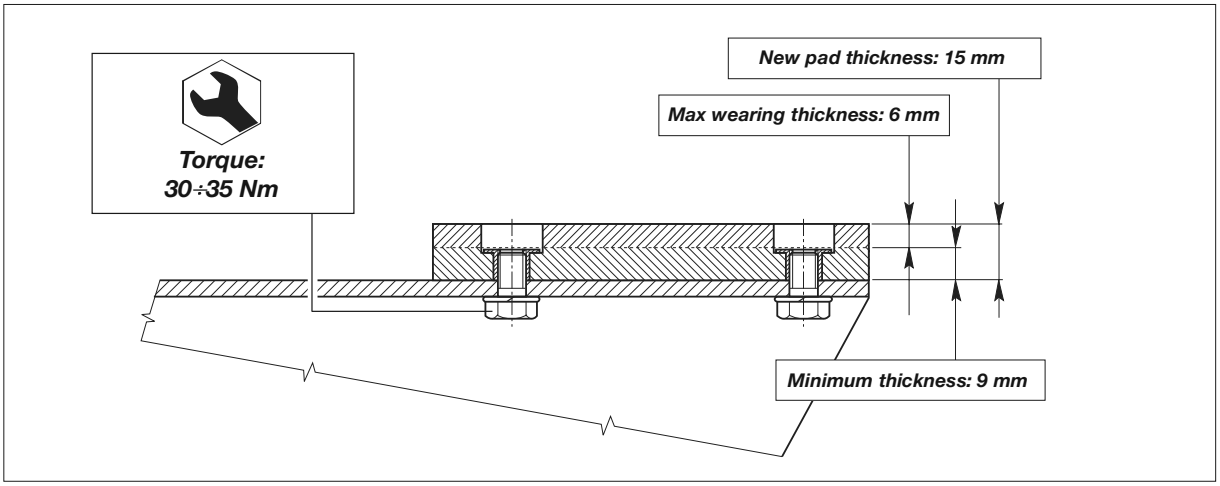


Operation:	Renewing the slide pads of the telescopic boom	Table:
		T2306-030

6 Refit the fixing screws after pouring some Loctite 495 on their threads.

7 After shimming, fully extend the boom, carefully clean the sliding rails of the pads, then smear with a thin coat of grease
INTERFLON FIN GREASE LS2





Operation:	Renewing the slide pads of the telescopic boom	Table:
		T2306-030

RENEWING THE PADS

To renew the pads of the **fixed section**, proceed as follows:

8 Stop the machine, extend the telescope and lower the nose to the ground for an easier removal of the bottom pads. Hold it in horizontal position for removing the top pads.

9 With a 17mm hexagonal wrench, remove the pad fixing screws.

10 With a screwdriver, pry off the worn pads. Fit new pads after applying a few drops of Loctite 495 on the threads.





IMPORTANT

Tighten the pad fixing screws to 30÷35 Nm.

To renew the pads of the **telescope**, proceed as follows:

11 Remove all pads from the fixed section to extend the telescope - see instructions above.

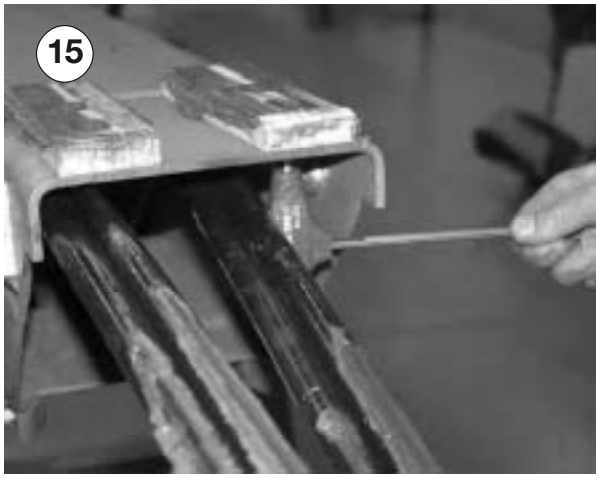
12 Fully extend the boom, then lower the nose to the ground and place a stand underneath the telescope near the fixed section.

13 Remove the pin from the extension cylinder (rod side) - see table T2306-007.
Move back with the machine slowly to extend about 20 cm of the telescope out of the fixed section.

Operation:	Renewing the slide pads of the telescopic boom	Table:
		T2306-030

14 Check the internal measure of the fixed section and the external measure of the telescope to verify if some shims are necessary considering that the final tolerance must range from **+ 1.0 mm** to **+ 1.5 mm**

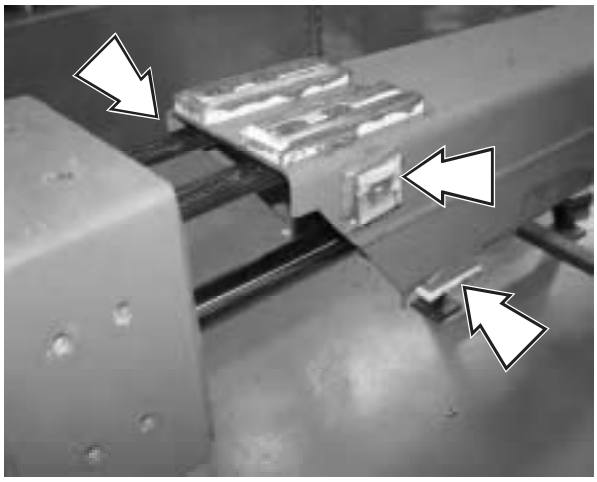
15 With a 6mm hexagonal wrench, remove the worn pads. Fit new pads after applying a few drops of Loctite 495 on the threads.



IMPORTANT

Tighten the pad fixing screws to 30÷35 Nm.

15 Clean and grease the internal and external walls of the boom sections in the sliding points of the pads. To this end, use **INTERFLON FIN GREASE LS2**



16 Retract the telescope into the fixed section and refit the pin of the extension cylinder.

17 With a thickness gauge, ensure the play between the boom sections is correct in both positions -i.e. with the boom fully extended and fully retracted.

Operation:	Renewing the flexible hoses inside the boom	Table: T2306-031	kg	-
			Hrs.	Min.
	Standard tools		1	-
			1	

How to renew flexible hoses:

PROTECT THE ENVIRONMENT

Before disconnecting the hydraulic piping, 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.

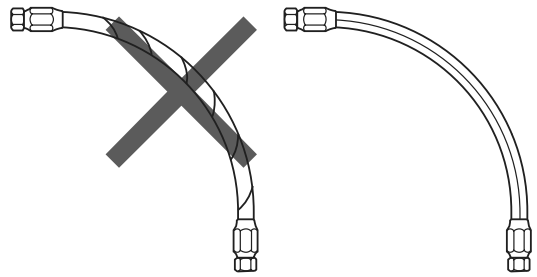
DANGER

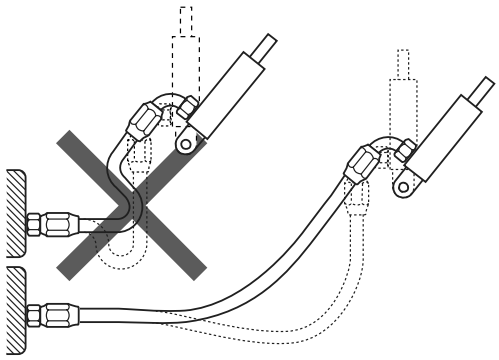
Before disconnecting the hydraulic piping, ensure there is no pressure in the line. In case, release the pressure by operating the control levers with the engine stopped.
In any case, disconnect the hydraulic piping with extreme caution and always wear suitable personal protection equipment -e.g. goggles, 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.

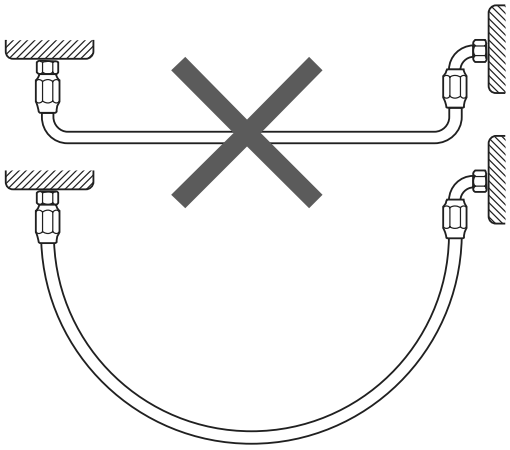
1 Before disconnecting or refitting a flexible hose, carefully clean the area all around.
2 Blow some compressed air to remove any impurity.
3 For an easier renewal of the hoses, whose run is not clearly visible, proceed as follows:
- disconnect the hose to be replaced from both sides
- tie a cord to 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.

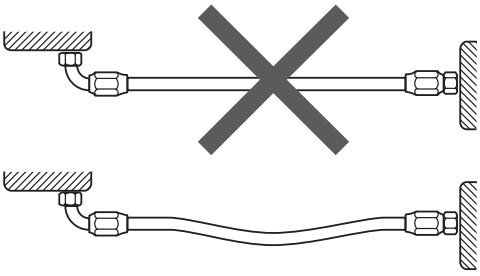
Operation:	Renewing the flexible hoses inside the boom	Table:
		T2306-031

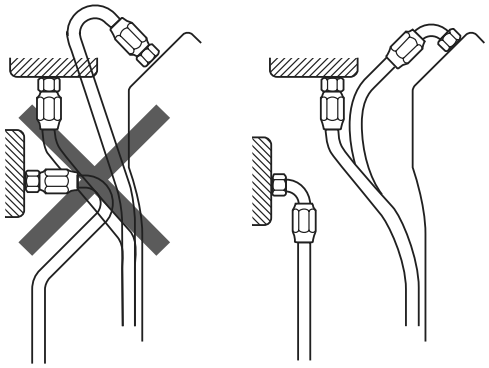
Useful advice for mounting flexible hoses:











Operation:	Changing the control levers of the steering wheel	Table: T2306-032	kg	-
			Hrs.	Min.
	Standard tools		-	30
			1	

Operation:

1 Enter the driving place and with a star screwdriver remove the screw fixing the two elements of the control levers.

1



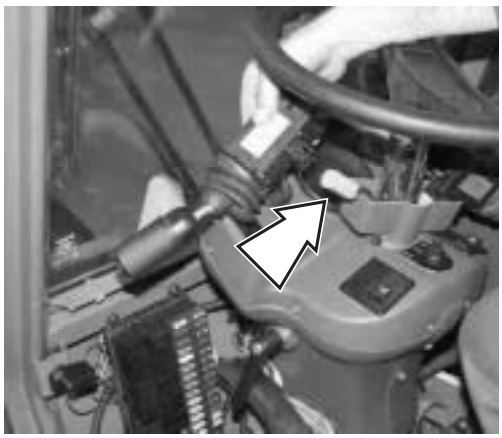
2 Separate the two elements.

2



3 Remove the electrical connector and change the lever. Reassemble the two elements and fix with the special screw.

3



Operation:	Changing the control levers of the steering wheel	Table:
		T2306-032

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Operation: **Front axle disassembly**	Table: **T2306-033**	kg: 378
		Hrs. 2 / Min. 30
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or two-leg chain with hooks, length 3m Wooden pallet with supporting blocks	Standard tools	1

Operation:

1 Raise the boom above the ground as far as the length of the slings.

2 Fix the hooks of the chain to the special eyebolts and tension the chain.

3 Remove the wheels - see table T2306-001.

4 Remove the Cardan shaft guard and disconnect the Cardan shaft from the front axle side - see table T2306-011.

5 Dismount the hydraulic motor (44 kg) without disconnecting the hydraulic lines by unscrewing the four locking screws with a 24mm wrench.

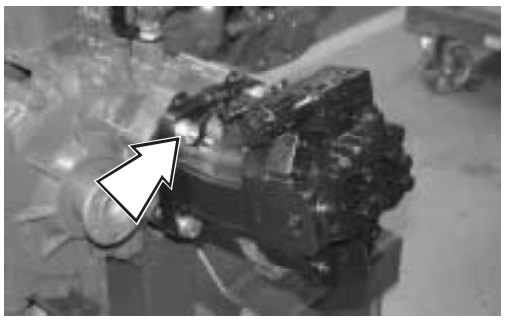
6 Remove the cab guards (8 kg) by unscrewing the two fixing screws with a 5mm hexagonal wrench.

7 Remove the hydraulic system guard (8 kg) by unscrewing the four fixing screws with a 6mm Allen wrench.

2



5



6



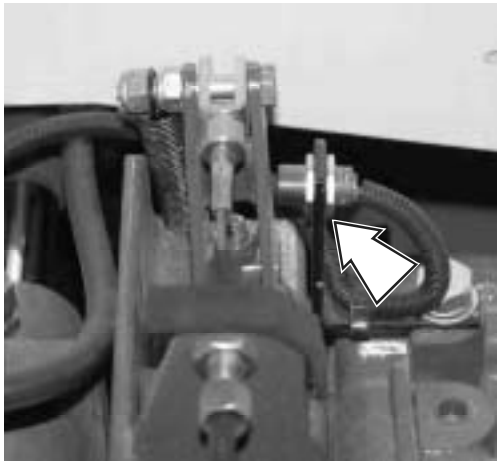


7

Operation:	Front axle disassembly	Table:
		T2306-033

8 Remove the proximity switch with a 24mm wrench.

8

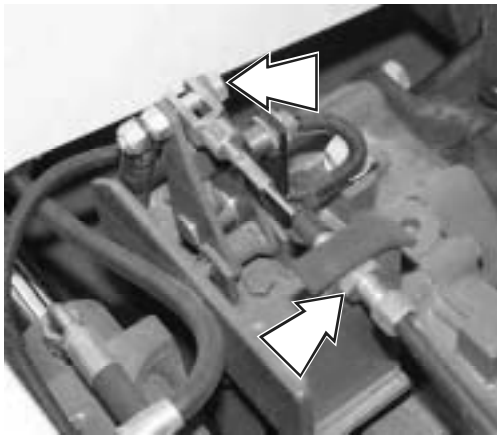


9 Remove the screw fixing the fork of the brake cable with two 17mm wrenches.

10 Disconnect the fork from the cable using a 6mm hexagonal wrench.

11 With two 19mm wrenches remove the register to set the cable free.

9
10
11

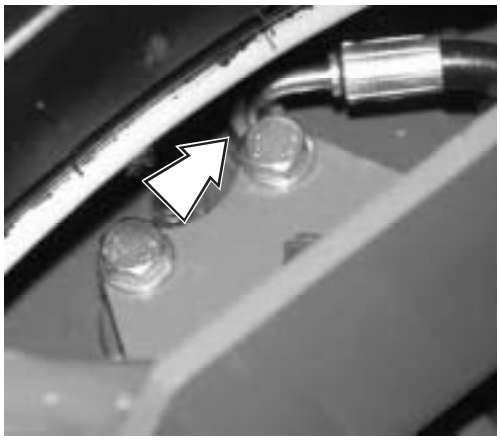


12 Carefully clean the areas around the oil feeding connectors of the braking circuit and the steering cylinder.

13 Place a container of suitable size underneath the feeding connector of the braking circuit.

14 Disconnect the feeding piping of the braking circuit with a 14mm wrench. Plug the disconnected parts.

14



PROTECT THE ENVIRONMENT

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

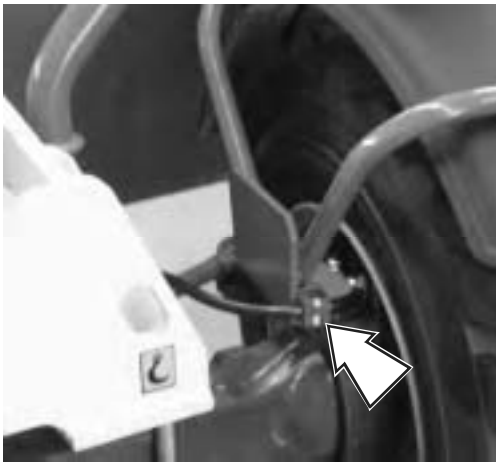
Operation:	Front axle disassembly	Table:
		T2306-033

15 Disconnect the hose clamp with a 10mm wrench and a 5mm hexagonal wrench.

16 With a pair of scissors, cut the plastic ties holding flexible hoses and electrical cables in position.

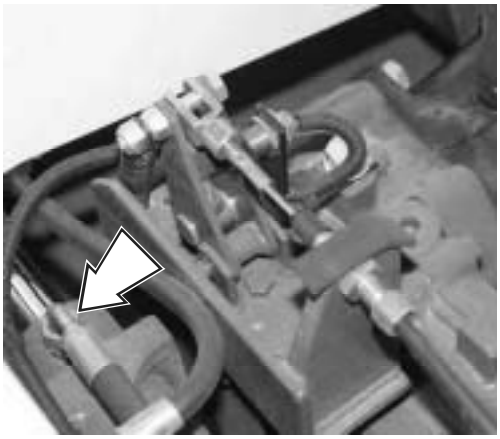
17 Place a container under the steering cylinder to prevent oil spillage.

15



18 With a 22mm wrench, disconnect the hose connectors on the steering cylinder. Plug all disconnected elements with care.

18



19 Using a 14mm wrench, disconnect the raised air vent connector.

20 Position a pallet with blocks under the axle; lower the axle to the blocks.

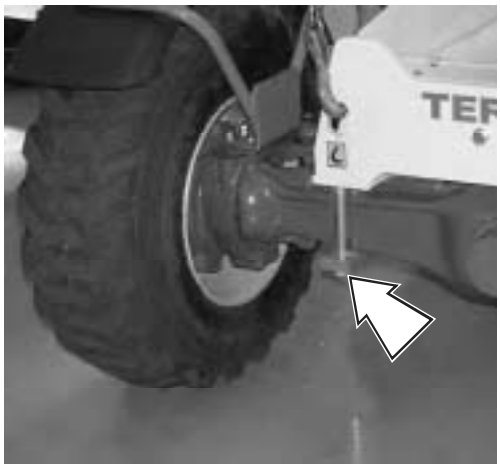
19



Operation:	Table:
Front axle disassembly **Front axle reassembly**	**T2306-033**

21 Remove the 4 screws fixing the axle with two 36mm wrenches (one on the screw and the other on the lock nut).

22 Slightly lower the pallet and remove the axle from the machine.



Reassembling the front axle

IMPORTANT

To reassemble the front axle, repeat the steps above in reversed order taking into account the following precautions.

1 Adjust the parking brake - see table T2306-021.

2 Bleed the braking circuit - see table T2306-022.

3 Adjust the proximity switch distance - see table T2306-023.

Operation: **Rear axle disassembly**	Table: **T2306-034**	kg: 248
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or two-leg chain with hooks Wooden pallet with supporting blocks	Standard tools	Hrs.: 2 — Min.: -
		1+1 if necessary

Operation:

1 Fix the terminal hooks of the chain to the special eyebolts on the machine and tension the chain to unload the axle weight.

2 Remove the wheels - see table T2306-001.

3 Remove the raised ford piping with a 14mm wrench.

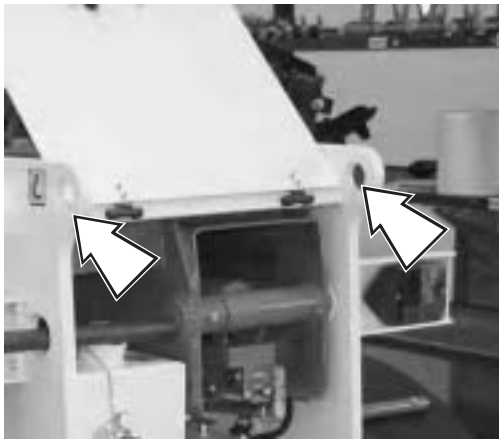
4 Remove the Cardan shaft guard and disconnect the Cardan shaft from the rear axle side - see table T2306-011.

5 Carefully clean the areas around the feeding connectors of the steering cylinder.

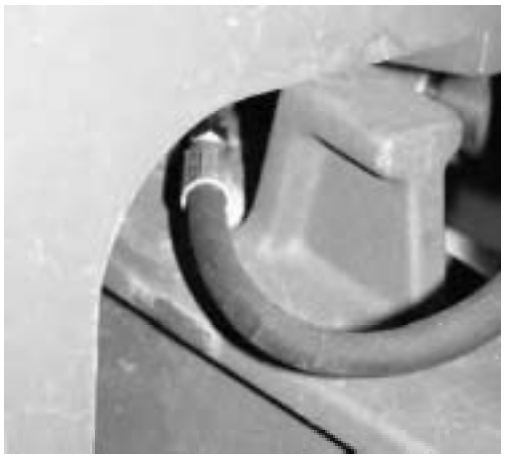
6 Place a container of suitable size underneath the steering cylinder.

7 With a 22mm wrench, disconnect the connectors of the flexible hoses. Plug all disconnected parts.

1



3



Operation: Rear axle disassembly	Table: T2306-034

PROTECT THE ENVIRONMENT

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

8 With two 19mm wrenches remove the screw with lock nut fixing the axle pivot pin.

9 Put a screw (or an eyebolt) into the hole M14 of the pin.

10 Position a pallet with blocks under the rear axle and lower the axle.

11 If the pin is not loaded, it can be pull out by hand. If necessary, increase the load on the pallet or the bridge crane. If the pin can hardly be removed, connect an extractor to the pin or the thread M14 and extract the pin mechanically.

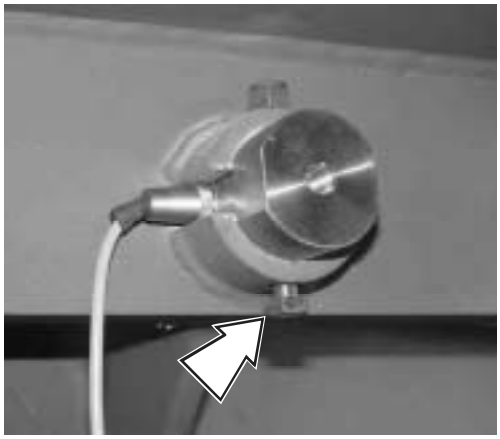
ATTENTION

Do not attempt to knock out the pin with a hammer or other tools. The load cell can get damaged.

7



8



9



Operation:	Rear axle reassembly	Table:
		T2306-034

Reassembling the rear axle

2



IMPORTANT

To reassemble the rear axle, repeat the steps above in reversed order taking into account the following precautions:

DANGER

Do not use your fingers to align the holes. You could be injured.

1 Press the pin home with your hands. Do not knock it home.

2 When refitting the pin, pay maximum attention. The load cell must be perfectly aligned with the slot and shall not get damaged during re-assembly.

Operation:	Rear axle reassembly	Table:
		T2306-034

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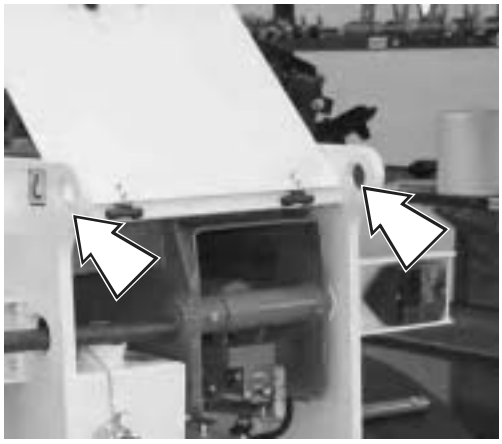
Operation: **Replacing the load cell**	Table: **T2306-035**	kg	7
			Hrs. / Min.
Bridge crane, payload 5000 kg (20000 lb) Textile bridles or two-leg chain with hooks Wooden pallet with supporting blocks	Standard tools		2 / 15
			1

Operation:

1 Fix the terminal hooks of the chain to the special eyebolts on the machine and tension the chain to support the machine weight.

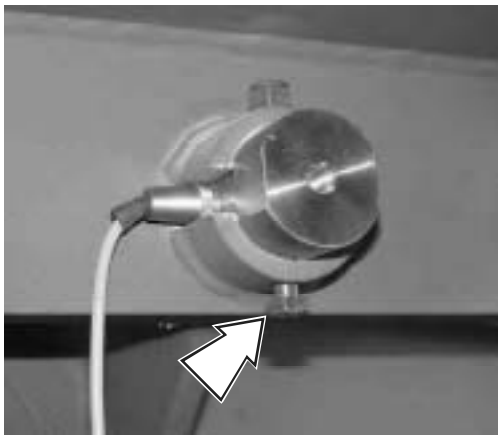
2 Disconnect the load cell power cable from the box of the overload warning system

1



3 With two 19mm wrenches remove the screw with lock nut fixing the axle pivot pin.

3



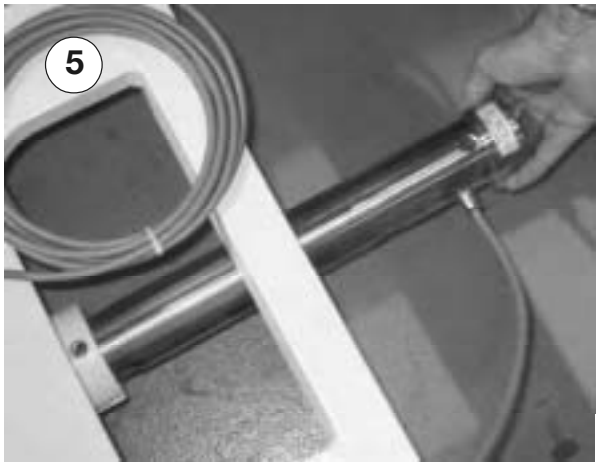
Operation: Replacing the load cell	Table: T2306-035

4 Put a screw (or an eyebolt) into the hole M14 of the pin.

4



5 If the pin is not loaded, it can be pull out by hand. If necessary, increase the load on the bridge crane. If the pin can hardly be removed, connect an extractor to the pin or the thread M14 and extract the pin mechanically.



6 Replace the defective load cell, then reconnect the new cell to the box of the overload warning system.

ATTENTION

Do not attempt to knock out the pin with a hammer or other tools. The load cell can get damaged.

Section F
TROUBLESHOOTING

SECTION INDEX

Overload warning system ..... **page 2**
Electrical faults **4**
Hydraulic faults **10**

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
Overload warning system in alarm	• Overload warning system in alarm • Control unit damaged • Load cell damaged	• Retract the boom within safety limits • Replace • Replace
Panel is on, but instrument does not switch on	• Fuses **F2** - **F16** blown • The connector on the back of the display is not inserted or the flat cable is damaged • Power supply wrong • Relay **E9** defective	• Check and replace the fuses • Insert the connector and check or replace the flat cable connecting the ARB system • Check the power supply (see card T2306-019 chapter **D1** "Checks and Adjustments") • Check and replace the relay
Boom does not move	• If the boom cannot be moved to **any** direction, the problem is not with the overload system (which locks out only the descent and extension of the boom) • Fuse **F20** blown • "ROAD/JOBSITE" switch set to ROAD • Joystick not powered • Pressing the dead man button, valve **EV29** is not powered up (see wiring diagram, p. C5)	• See Operator Handbook • Check and replace • Switch to "JOBSITE" • Check the position of the "ROAD/CAB" switch and switch to "CAB" • Check the continuity of the connecting wires • Check and replace the valve coil

Trouble	Cause	Solution
Boom cannot be moved out or down	• The maximum load capacity has been exceeded (the alarm is activated: the buzzer sounds and the red LED is lit)	• Retract the boom within safety limits (red LED off) • Wrong calibration: calibrate again according to the payload indicated in the windscreen decal and in the operator handbook. Use a known weight for the calibration • Mechanical cause: see card T2306-019 chapter **D1** "Checks and Adjustments"
	• If the alarm sounds when using the shovel, the maximum load of the shovel has been exceeded	• Dump excess load from the shovel • Wrong calibration: calibrate again • Mechanical cause: see card T2306-019 chapter **D1** "Checks and Adjustments"
	• If the instrument alarm is off and the boom does not move down	• Check fuse **F24**, relay **E8**, solenoid **EV34** and the efficiency of the solenoid coil (under normal conditions, the coil voltage is 12 V) • Check if there is power (11÷14V) between terminals **8** (+) and **5** (-) of connector **B** (see card T2306-019) • Disconnect the connector from the main module and check the wiring from terminal **8** to alarm relay **E8** with the tester in the "ohm"(Ω) position (see card T2306-019)
	• If the instrument alarm is off and the boom does not move out	• Check the wiring from position **7** of connector **25** (see wiring diagram - chap. **C**) powering relay **E7**. The coil of this relay is powered directly by relay **E8**.

Trouble	Cause	Solution
		If both wires are functioning, relay **E7** powers the coil of solenoid valve **EV28** placed under the element of the distributor which controls the extension • Check if there is power (11÷14V) between **8** (+) and **5** (-) of connector **B** (see card T2306-019) • Disconnect the connector from the main module and check the wiring from terminal **8** to alarm relay **E8** with the tester in the "ohm"(Ω) position (see card T2306-019)
Display reading is unstable, although the machine is still and the weight on the forks does not change	• This is a typical problem of false contacts or broken connections	• Do the checks detailed in chapter **D1** of card T2306-019
Instrument cannot be calibrated	• Ensure the calibration procedure has been done correctly	• Do the checks detailed in chapter **D1**, points 1,2,3,4,5, and 6 of card T2306-019 to verify if the fault depends on the load cell or the instrument
LEDs are not lit in the correct order (e.g.: LED1 on, LED2 and LED3 off, LED4 and LED5 on), or all LEDs are always on	• Trimmers are maladjusted	• Turn trimmer **VR1** counter-clockwise about 10 times; turn trimmer **VR2** clockwise about 10 times; repeat the adjustment procedure. See card T2306-019
Dashboard does not turn on	• The 50A fuse **ref. 38** powering the dashboard is blown (engine compartment) • Dashboard defective • Battery disconnected • Battery down • Battery cut-out disconnected • Wire broken or cable disconnected	• Replace • Replace • Reconnect by the special switch • Check the battery charge • Switch on • Check the line and tighten all disconnected cables

Trouble	Cause	Solution
Engine does not start *Starter motor does not run*	• The 50A fuse **ref.38** powering the dashboard is blown (engine compartment) • Parking brake engaged • Emergency button pressed down • Parking brake proximity switch defective (powers relay **E6**) • Ignition switch damaged • Relay **E6** damaged • Relay **E1** damaged • Fuse **F15** powering relay **E1** blown • Battery cut-out disconnected • Battery down • Relay **ref.26** damaged • 70A maxi-fuse **rif.40** blown • Internal relay of starter motor **ref. 36** damaged • Starter motor **ref. 36** damaged • Perkins engine damaged	• Replace the fuse • Engage the parking brake and ensure the relevant light in the dashboard comes on • Reset to zero • Check and adjust the distance (see card T2306-023) • Replace the switch • Change or check the relay ground • Replace • Replace the fuse • Switch on • Recharge or renew the battery • Replace • Replace the fuse • Replace • Replace the motor • Check the mechanism transforming electrical movement into mechanical movement
Engine does not start *Starter motor runs, but engine does not start*	• No fuel • Fuel filter soiled • Fuel hose empty (fuel used up) • Engine stop solenoid valve blocked	• Refuel • Clean or replace if necessary • Refuel then eliminate any air from the fuel system • Check if power is supplied; also check the power value as detailed in chapter **D** "*Checks and Adjustments*". Change if damaged

Trouble	Cause	Solution
The machine does not move	• Forward/reverse gear switch in neutral	• Switch to correct position
	• Parking brake engaged	• Disengage
	• Relays **E2** - **E3** - **E6** - **E10** damaged	• Check and replace if necessary
	• Inching valve defective	• Change
	• No current to the pump solenoid	• Check the line with a tester
	• Fuses **F15 - F16 - F23** blown	• Replace fuses
	• No power to relay **E5** from hand-lever	• Check the line with a tester, change the relay if necessary
	• No power to hand-lever from relay **E3**	• Check the line with a tester, change the relay if necessary
	• No power to the reverse gear solenoid **EV33**	• With a tester check the line from relay **E5** to the coil of the drive pump solenoid
	• No power to the forward gear solenoid **EV32**	• With a tester check the line from hand-lever to the drive pump solenoid
	• Coils of the drive pump solenoid shorted	• Check the coils; replace if damaged
No selection of the steering mode	• Steering control fuse **F20** blown	• Change the fuse
	• "ROAD/JOBSITE" switch set to ROAD	• Switch to JOBSITE
	• Selector damaged	• Replace
	• Coil **EV52** / **EV53** shorted	• Check with a tester, change the coil or the solenoid if necessary
	• Valve spool damaged	• Replace
Low parking brake action	• Insufficient cable tensioning	• Check and adjust the brake cable tension See card T2306-021
Boom moves neither down nor out, and does not tilt the attachment holding frame	• Fuses **F2**-**F16**-**F24** blown	• Change the fuses
	• Emergency stop button pressed down	• Reset the pushbutton
	• Relays **E8** - **E9** damaged	• Check with a tester, change if necessary
	• **E8** - **E9** relay power lines defective	• Check with a tester and reconnect the line
	• **ARB** control unit damaged and/or in alarm	• Check the control unit - See card T2306-019
	• **EV7** - **EV34** solenoid shorted	• Check with a tester and replace if necessary

Trouble	Cause	Solution
The thermometer of the hydraulic oil does not function	• Oil temperature bulb damaged • Fuse **F16** blown • Hydraulic oil temperature indicator damaged • Power cables of hydraulic oil temperature indicator defective	• Check the functioning of the tank fitted bulb as detailed in chapter **D** "*Checks and Adjustments*"; replace if damaged • Replace fuse **F16** • Check and replace if necessary • Check and reconnect
The parking brake indicator does not light up	• Fuses **F15 - F16** blown • Relay **E6** damaged • The parking brake sensor is damaged or maladjusted • Indicator light damaged • Cable broken or disconnected	• Replace the fuses • Check and replace if necessary • Check the sensor and replace if necessary • Adjust - see card T2306-021 • Replace the light • Check the line and retighten any disconnected cables
The fuel gauge does not function	• Fuel gauge damaged • Cab instrument damaged • Cable broken • Fuse **F16** blown • Tank fitted fuel gauge damaged	• Replace • Replace • Check with the tester and reconnect • Replace the fuse • Check the functioning of the indicator as detailed in chapter **D** "*Checks and Adjustments*"; replace if damaged
Overload warning system never in alarm or in alarm with no load applied on the machine	• Check IN/OUT voltage from/to load cell • Cell damaged	• See card T2306-019 • Replace - see card T2306-035

Trouble	Cause	Solution
The lighting system does not function	• Check the fuse circuit with a wiring diagram	• See card C-02.01 • See card C-02.06
The position lights do not function	• Battery cut-out to ON • 50A maxi-fuse **ref.38** blown • Position lights switch **ref.5** damaged • Fuses **F4 - F5** blown • Cables disconnected • Lamps broken	• Set to OFF • Replace the fuse • Change (see card C-02.04) • Replace the fuses • Check the line powering the optical groups • Check and replace the lampps if necessary
The low/high beam does not function	• Battery cut-out to ON • 50A max-fuse **ref.38** blown • Key-switch damaged • Low/high beam switch **ref.5** damaged • Light switch damaged • Fuses **F6 - F7 - F8 - F9** blown • Cables disconnected • Lamps broken	• Set to OFF • Replace the fuse • Check the current value at output **ref.15** (see card C-02.04); it shall be 12 V • Change (see card C-02.04) • Replace • Replace the fuses • Check the line powering the optical groups • Check and replace the lamps if necessary
The windshield wiper motor does not run	• Motor damaged • Fuse **F11** blown • Light switch damaged	• Change • Replace fuse **F11** • Change
The light switch does not function	• No 12V power • Lever contacts defective	• Check with a tester and reconnect • Replace the lever
The front or rear windshield wiper does not function	• No 12V power • Motor shorted • Fuse **F18** blown	• Check with a tester and reconnect • Replace the motor • Replace fuse **F18**

Trouble	Cause	Solution
The heater does not function	• Lever damaged	• Replace
	• No 12V power • Fan motor **ref.8** shorted • Fuse **F19** blown • Water cock blocked or damaged • Air lines blocked or broken • Pipelines are crushed and water does not circulate • Pushbutton contacts **ref.9** damaged	• Check with a tester and reconnect • Change the motor • Replace fuse **F19** • Replace • Check and restore • Check and replace if necessary • Change the pushbutton
The upper windshield wiper does not function (if any)	• No 12V power • Fuse **F1** blown • Upper wiper motor shorted	• Check with a tester and reconnect • Replace fuse **F1** • Change the motor

Trouble	Cause	Solution
Boom does not move	• Max pressure in hydraulic circuit not enough	• Adjust HP to 240 bar See card D.03.01
	• Minimum pressure insufficient	• Adjust LP to 23÷24 bar See card D.03.01
	• Control lever damaged	• Check and replace the lever if necessary See card T2306-016
	• Distributor slider blocked	• Check and replace the slider if necessary See card T2306-018
	• Pump **ref.5** defective (see hydraulic scheme)	• Change the pump See card T2306-027
	• Load sensing valve **ref.10** soiled or damaged	• Check the valve; replace if necessary. See card D.03.01
	• Pressure reducing valve **ref.30** soiled or damaged	• Ensure the valve outlet is set to 25 bar. Replace, if necessary. See card D.03.01
Wheels misaligned	• Internal cylinder blow-by	• Check the seals; replace if necessary - see card T2306-025 and sect. G "CARRARO axles maintenance"
		• For the wheel shafting see card T2306-026
	• Solenoid blow-by	• Check the solenoid valve
The steering column is hard (low force in the cylinders)	• Pressure insufficient	• Check the pressure of the power steering circuit (140 bar) as described in card D.03.01
	• Priority valve **ref.10** with spool blocked	• Check the valve; replace if necessary
	• Power steering damaged	• Change the power steering
	• Solenoid **ref.14** damaged	• Replace
Service brake action insufficient	• No oil in the brake tank	• Check the level; if necessary, replenish
		• Check the brake circuit for oil leaks
	• Pump seals worn	• Disassemble the pump and change the seals
	• Brake discs are worn	• Change the brake discs as per CARRARO instructions. See sect. G
	• Air in the circuit	• Bleed - see card T2306-022

Trouble	Cause	Solution
With engine shut down: the raising cylinder does not support the boom, the forks do not rotate, the boom telescope cannot be retracted	• Blocking valves damaged or soiled • Cylinder seals worn	• Dismount and clean the valves; replace if the trouble persists. See card T2306-029 • Remove the cylinders and change the seals - see cards T2306-002 for replacing the seals and T2306-003, T2306-004, T2306-005, T2306-006, T2306-007 for disassembling the cylinders
When the boom is raised, the machine does not balance the load	• Balance cylinder seals worn • Shock-proof valves on distributor soiled or maladjusted • One-way valves on balance cylinder soiled or maladjusted	• Disassemble the cylinder as per card T2306-004 and renew the seals (see card T2306-002) • Disassemble the valves, dry-clean (replace if damaged), and calibrate (see card T2306-018) • Disassemble valves **ref. 21** of the hydraulic scheme in card C.01.01, dry-clean or renew if damaged
Forks cannot hold the load, cylinder does not lock the load	• Seals of the attachment rotation cylinder sworn • Blocking valves damaged • Feeding circuit pressure insufficient	• Disassemble the cylinder as per cardT2306-005 and renew the seals (see card T2306-002) • Remove and clean the valves; or change the valves. See card T2306-029 • Check the circuit

Trouble	Cause	Solution
By moving the control lever, no function is activated	• Control lever damaged	• Check if the trouble depends on an electric trouble. If the trouble persists, change the control lever. See card T2306-016
	• Pressure relief valve of distributor damaged	• Check maximum pressure • Change the valve. See card T2306-018
	• Pressure reducing valve soiled or damaged	• Check valve calibration; replace if necessary. See card D.03.01
	• Valve soiled or damaged	• Check valve and replace if necessary
The hydraulic oil thermometer does not function	• This is normal, when the outside temperature is low and/or the machine is used for short periods, since the hydraulic oil cannot warm up over 40÷50°C	
	• Oil temperature bulb damaged	• Check and replace the bulb. See card D.02.01
Engine coolant temperature too high	• Water level in the cup	• Check and replenish if necessary • Check the rubber sleeves for leaks
	• Temperature bulb defective	• Check and replace the bulb. See card D.02.01
	• Cooler defective	• Check; or replace
	• Dashboard manometer defective	• Replace
Low hydraulic oil level	• Oil leaks	• Add new oil
Hydraulic oil temperature too high	• Radiator grille dirty	• Periodically remove dust and particles from the grille
	• Dashboard manometer defective	• Check; or replace
	• Temperature bulb defective	• Check and replace the bulb. See card D.02.01
Low engine performance	• Air filter soiled	• Clean or renew
	• Fuel filter soiled	• Clean or renew

Trouble	Cause	Solution
Steering column slow or noisy	• Joints damaged • Power steering damaged	• Replace • Replace the power steering. See card T2306-028
Differential noisy with high body temperature	• No oil • Bearings damaged	• Check and refill. In case, add special additives to the front axle. See par. A.18 • Renew bearings as per CARRARO instructions. To disassemble the axle from the machine see card T2306-033 for the front axle and card T2306-034 for the rear axle
Oil leaks from axles and/or gearbox	• Seals damaged	• Renew as per CARRARO instructions. See sect. G
During extension the 2nd boom element moves right or left	• Sliding pads worn	• Check the play; in case, shim or renew the pads. See card T2306-030
During extension the 2nd boom element bounces	• Grease insufficient or inadequate • Foreign matters between pads and boom sliding surfaces	• Check the grease used is *INTERFLON FIN GREASE LS2*; add fresh grease if necessary • Check and remove foreign matters
Machine drive insufficient	• Drive pump inefficient	• Check the pressure values as per card D.03.01 points 5 - 5.1 - 5.2 • If the booster pressure drops remarkably, replace the pump and, in case, the motor and clean the hydraulic drive lines

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Section G
CARRARO AXLE
ASSEMBLY-DISASSEMBLY

SECTION CONTENTS

A	General information ..... page	2
B	Safety	9
	FRONT AXLE	
C	General specifications	13
D	Disassembly operations	24
E	Assembly operations	41
F	Troubleshooting	73
	REAR AXLE	
C	General specifications	81
D	Disassembly operations	90
E	Assembly operations	104
F	Troubleshooting	130
G	Special tools	138

A INFORMAZIONI GENERALI

A.1 Utilizzo del manuale

Destinatari

- Installatore.
- Utilizzatore.
- Manutentore.

Manutenzione

PRENDERE VISIONE DI TUTTO IL MANUALE poiché il buon funzionamento ed il rendimento degli organi meccanici dipendono principalmente da una costante e corretta manutenzione e assicurano la durata e l'integrità del prodotto.
Nell'eventualità di guasti od anomalie il tempestivo intervento da parte di personale specializzato garantisce una durata più lunga del gruppo, evitando danni maggiori nel tempo.

Riparazione

Le procedure per lo smontaggio/montaggio consentono di eseguire la revisione totale del prodotto e sono descritte in sequenza con l'ausilio di illustrazioni, per una guida completa e sicura all'esecuzione di ogni operazione.
Nella descrizione delle operazioni si presuppone che il gruppo sia stato rimosso dal veicolo. Per la rimozione dal veicolo si dovrà consultare il manuale fornito a tale proposito dal costruttore del veicolo stesso.
La conoscenza approfondita del prodotto consente la corretta valutazione del tipo di intervento da eseguire, che può richiedere solamente lo smontaggio di alcuni componenti operando solo parzialmente nel gruppo.

A GENERAL INFORMATION

A.1 Manual use

End users

- *Installer*
- *User*
- *Maintenance operator*

Maintenance

CONSULT THIS MANUAL THOROUGHLY, as proper functioning and good efficiency of mechanical organs depends mostly on constant and correct routine maintenance ensuring product integrity and expected life duration.
In case of any damages or anomalies, quick intervention of specialized personnel can avoid future impairment and lengthen the working life.

Repair

The disassembly/assembly procedures have been outlined for a total product overhauling. They have also been described in sequence through photographs with relevant explanation for specific interventions, thus obtaining a complete and safe guide for each and every phase of an operation.
Operation description presumes that the unit has already been removed from the vehicle. The manual supplied by the vehicle manufacturer should be consulted in case of a overhauling or maintenance intervention requiring the removal of the machine.
Moreover, the attentive product inspection leads to a correct repair work estimation that could merely require dismounting only few components, and thus operating partially on the group.

A.2 Proprietà delle informazioni

Questo manuale contiene informazioni di proprietà riservata. Tutti i diritti sono riservati.

Questo manuale non può essere riprodotto o fotocopiato, tutto o in parte, senza il preventivo consenso scritto di CARRARO S.p.A. L'uso di questo materiale documentale è consentito solo al cliente a cui il manuale è stato fornito come corredo del prodotto, e solo per scopi di uso, manutenzione e riparazione.

CARRARO S.p.A. dichiara che le informazioni contenute in questo manuale sono congruenti con le specifiche tecniche e di sicurezza della macchina a cui il manuale si riferisce. Il fabbricante non si assume alcuna responsabilità per danni diretti o indiretti a persone, cose o animali, conseguenti all'uso di questo materiale documentale o della macchina in condizioni diverse da quelle previste.

A.2 Information property

This manual should be considered as CARRARO S.p.A. confidential information. All rights reserved.

No part of this manual may be reproduced, in any form or by any means, without prior written permission of CARRARO S.p.A. Only the customer, whom the manual, together with the product, has been issued to, is allowed to use this document, and only in order to use, maintain and repair the unit.

CARRARO S.p.A. declares that the subject of this manual consists with the technical and safety specifications of the machine that the manual is referred to. The manufacturer shall not be held liable for direct or indirect damages to persons, things or animals due to an improper use of this document or of the machine or to a different use of them, which does not comply with what is provided for in this manual.

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A.3 Convenzioni e definizioni

Convenzioni

Le illustrazioni nel manuale NON sono in scala quindi NON sono attendibili valutazioni delle dimensioni dei componenti basate sulle stesse.
Le illustrazioni hanno il compito di evidenziare le corrette procedure da condurre sulla macchina e sui suoi componenti, per questo potrebbero non rappresentare esattamente gli elementi di questa macchina ma componenti meccanici simili.

Definizioni

Lato sinistro: parte sinistra del gruppo vista nel senso di marcia del veicolo.
Lato destro: parte destra del gruppo vista nel senso di marcia del veicolo.

Convenzioni tipografiche

Nota: informazioni importanti, evidenziate al di fuori del testo a cui si riferiscono.
Attenzione: procedure la cui totale o parziale inosservanza può produrre danni alla macchina o alle apparecchiature ad essa collegate.
Pericolo: procedure la cui totale o parziale inosservanza può produrre lesioni o danni alla salute dell'operatore.

Unità di misura

Nel manuale si utilizzano le unità di misura del sistema internazionale (SI). Per la conversione al sistema anglosassone riferirsi alla seguente tabella.

Tabella di conversione

S.I.		GB/USA SYSTEM	
1	(mm)	0.03937	(in)
10	(mm)	0.3937	(in)
25.4	(mm)	1	(in)
6.4516	(cm•)	1	(sq. in)
1	(m•)	1550	(sq. in)
16.378	(cm•)	1	(cu. in)
0.473	(dm•)	1	(U.S. pint)
1	(l)	61.02	(cu. in)
1	(l)	0.2642	(U.S. gal)
1.772	(g)	1	(oz)
0.4536	(kg)	1	(lb)
0.00070308	(kg/mm•)	1	(lb/sq. in)
1	(bar)	14.51	(psi)
1	(kg.m)	7.246	(lb.ft)
1(daN)= 10 (N)= 1,02 (kg.f)		2.24	(lb.f)

A.3 Agreements and definitions

Agreements

Illustrations like pictures, drawings and components of this manual are NOT in scale, because of limited space and editing limits, therefore they are NOT reliable to obtain values about size or weight.
Illustrations are supposed to point out the correct methods to working on the machine and its components, therefore they could not display exactly the same elements.

Definitions

***Left side:** it is the left side of the unit considering the vehicle running conditions.*
***Right side:** it is the right side of the unit considering the vehicle running conditions.*

Typographic agreements

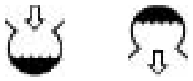
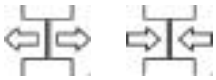
***Note:** The notes, pointed out externally to the text they refer, include important information.*
***Warning:** Warning indications point out the procedures, whose partial or complete non-observance can damage the machine or the connected equipment.*
***Danger:** Danger indications point out the procedures, whose partial or complete non-observance can injure the operator.*

Measurements

This manual indicates all measurements in International System (SI). Use the following conversion table to convert Imperial Measure.

Conversion table

Simbologia *Symbology*

DESCRIZIONE	SIMBOLI / SYMBOLS	DESCRIPTION
ATTENZIONE/PERICOLO		WARNING/DANGER
RIMOZIONE/INSTALLAZIONE anelli-guarnizioni-filtri		REMOVE/INSTALL seals-gaskets-filters
RIEMPIMENTO o RABBOCCO OLIO/ SCARICO OLIO		OIL FILLING OR OIL LEVEL/OIL DRAIN
LUBRIFICAZIONE/INGRASSAGGIO		LUBRICATION/GREASING
REGOLAZIONE/MISURAZIONE coppie di serraggio-precarichi-giochi		ADJUSTMENTS/MEASUREMENTS tightening torques-preloads-backlash
ATTREZZATURE SPECIALI		SPECIAL TOOLS
APPLICAZIONE SIGILLANTI/COLLANTI		SEALING/LOCKING FLUIDS APPLICATION
TRACCIATURA		MARKING
SMONTAGGIO/MONTAGGIO DI PARTICOLARI INGOMBRI O SOTTOGRUPPI		DISASSEMBLY/ASSEMBLY OF BULKY PARTS OR SUBASSEMBLIES
ATTENZIONE: rispettare il verso di montaggio		WARNING: respect assembly orientation
PULIRE ACCURATAMENTE		CLEANING CAREFULLY
IMMETTERE FLUIDO IN PRESSIONE		APPLY PRESSURIZED FLUID

A.4 Indicazioni generali

La macchina deve essere controllata e/o riparata solo da personale tecnico specializzato che sia a conoscenza delle sue particolari caratteristiche e delle relative norme di sicurezza (prevenzione infortuni).

Prima di svolgere qualsiasi operazione, pulire accuratamente il gruppo rimuovendo eventuali incrostazioni ed accumuli di terriccio e/o grasso.

Tutti gli organi meccanici smontati devono essere accuratamente puliti con prodotti adeguati, per evitare possibili danni. Verificarne l'integrità, sostituendoli in caso di danni, usura, incrinature, grippaggi o difetti che potrebbero comprometterne il buon funzionamento.
In particolar modo si deve verificare l'integrità delle parti in movimento (cuscinetti, ingranaggi, alberi) e delle parti di tenuta (anelli OR, anelli di tenuta), soggette a maggiori sollecitazioni, usura, invecchiamento.
Si raccomanda di sostituire ad ogni revisione o riparazione gli organi di tenuta.
Si ricordi che l'eventuale sostituzione di un componente della coppia conica comporta la sostituzione anche dell'altro.

Utilizzare solo le parti di ricambio e la viteria indicate, inoltre usare utensili metrici per la viteria metrica e inglesi per la viteria inglese.

Come indicato, alcune operazioni sono distruttive per gli elementi rimossi. Leggere attentamente le descrizioni delle varie fasi dell'intervento ed operare con attenzione per non compromettere la funzionalità di altri elementi.

A.4 General description

The machine should be checked and/or repaired only by qualified technicians, acquainted with its peculiar features and well aware of all safety instructions.

Before performing any operation it is advisable to carry out unit cleaning accurately by removing oil/ grease encrustations and accumulation.

All disassembled mechanical parts must be cleaned accurately with suitable products to avoid possible damage. Parts should be replaced if damaged, worn out, cracked, seized, etc. as they could affect proper working.
Rotating parts (bearings, gears, shafts) and that of hardware/fasteners (O-Ring, oil seals) should be examined carefully, as they are subject to major stress, wearing and ageing.
We highly advise to replace tightening parts during every teardown or repair.
In case of replacement of one part of the bevel gear set this operation requires the replacement of the other part too.

Use appropriate spare parts, nuts and bolts to avoid any other problems. Moreover, use metric tools for metric nuts and bolts and Imperial tools for the others.

Some repairs are destructive for some axle components. Carefully reading and thorough understand of these instructions will avoid damage to other components unnecessarily

A.5 Indicazioni generali per le operazioni di riparazione

Prima di iniziare le operazioni di smontaggio e montaggio leggere attentamente le seguenti avvertenze.

Anelli di tenuta per alberi

Per il montaggio degli anelli di tenuta attenersi alle seguenti raccomandazioni:
- Pulire accuratamente l'albero ed assicurarsi che non sia danneggiato, rigato od ovalizzato nelle zone di contatto con gli anelli.
- Montare gli anelli in modo che il labbro sia rivolto verso il lato olio.
- Lubrificare il labbro degli anelli (usare preferibilmente olio) e riempire per 3/4 di grasso la camera degli anelli stessi.
- Montare gli anelli usando un appropriato calettatore. Non usare il martello direttamente sugli anelli.
- Non danneggiare gli anelli durante il montaggio dell'albero.

Anelli OR

Lubrificarli adeguatamente prima di inserirli nella propria sede evitando "arrotolamenti" durante il montaggio dell'albero.

Spessori di registro

Per le registrazioni utilizzare gli appropriati spessori di registro, misurandoli singolarmente.
La misurazione del pacco completo o la stampigliatura riportata sugli spessori stessi può risultare non sempre affidabile: verificare.

Cuscinetti

Per un corretto montaggio è consigliabile riscaldarli in forno ad una temperatura di 80°C - 90°C prima di montarli sui rispettivi alberi o raffreddarli prima di inserirli nelle relative sedi con piantaggio esterno.
Usare sempre gli estrattori idonei per rimuovere i cuscinetti.
Prima di rimontarli, pulirli, ispezionarli e lubrificarli.

Spine elastiche

Al montaggio delle spine elastiche ad intaglio assicurarsi che l'intaglio delle stesse sia orientato nel senso dello sforzo sollecitante la spina. Le spine elastiche a spirale invece non necessitano di alcun orientamento.

Sigillante

Usare sigillanti secondo le specifiche. Assicurarsi che le parti da sigillare siano pulite, asciutte e completamente prive di grasso.

A.5 Recommendations for repair operations

Before starting any disassembly and assembly operations, read carefully the following recommendations.

Shafts seals

Respect the following recommendations during shaft seal assembly:
- Clean shaft very carefully and ensure that the part in contact with the shaft seal is not damaged, cut or out of roundness.
- Assemble the seals so that the lip is fitted towards the oil side.
- Lubricate seal lips (use oil) and fill 3/4 of seal cavity with grease.
- Use appropriate drivers. Do not use a hammer directly on the seals.
- Do not damage the seals while assembling the shaft.

O-rings

Lubricate adequately before inserting them at the right place and avoid o-ring rolling while inserting the shaft.

Adjusting shims

Use appropriate adjusting shims and measure each one separately.
Complete group measurement or stampings on the shims are not always reliable: check

Bearings

Its advisable to heat up bearings to 80°C - 90°C before assembling them onto their respective shafts or to cool them (dry ice) before inserting them into corresponding bore.
Always use suitable extractors to remove the bearings.
Before reassembling the bearings, clean, check and lubricate them.

Split pins

Before assembling elastic pins, make sure that the notch is oriented towards the stressing force.
Spiral elastic pins do not need orientation.

Sealing

Use sealing as advised by specifications. Ensure that parts to be sealed are clean, dry and completely grease free.

Scarico dell'olio

Prima di intervenire sul prodotto è necessario scaricare l'olio dal gruppo.
Attenzione: Smaltire gli oli esausti nel rispetto delle vigenti norme.

Oil drain

Before disassembly, oil should be drained out.

Warning: *Disposal of used oil must be done according to laws*

Pulizia

Lavare accuratamente tutte le parti in movimento relativo (ingranaggi, cuscinetti, ecc.) utilizzando gasolio o cherosene.
E' da evitare l'uso di benzina e soluzioni acquose alcaline. Evitare lavaggi con vapore o acqua calda perché sarebbe difficile eliminare completamente l'umidità superficiale.
Asciugare accuratamente tutti i particolari mediante un getto d'aria o stracci per evitare di rigare le superfici con residui abrasivi.
Tutte le superfici devono essere ricoperte da un leggero strato di lubrificante per proteggerle da eventuali ossidazioni.

Cleaning

Wash all moving parts (gears, bearings, etc.) accurately with diesel fuel or kerosene.
Avoid gasoline and watery alkaline solutions. Do not wash with steam or hot water, as it will be very difficult to eliminate surface humidity.
Dry all parts with a rag or air jet to avoid scratching from abrasive residuals.
All surfaces should be covered with lubricant so as to protect it from future oxidation.

Controlli

Verificare accuratamente tutti i cuscinetti, gli anelli esterni eventualmente ancora piantati nelle proprie sedi e i perni su cui rotolano i rullini. Sostituire quei particolari che presentano tracce di usura o di danneggiamento.
Controllare che tutti gli ingranaggi non presentino avarie od usure eccessive delle dentature: gli smussi dei denti non devono essere deteriorati.
Controllare che tutti i tratti scanalati siano privi di usure eccessive o di altri danneggiamenti.
Sostituire i particolari avariati con ricambi originali.
Dopo ogni smontaggio è buona norma sostituire le guarnizioni di tenuta sugli alberi rotanti.

Checks

Examine accurately all bearings, external rings which may be still stuck in their position and pivot pins on which rolls rotate. Replace those which are worn out or damaged.
Gears should not be spoiled and teething should not be excessively worn out. Teeth smoothing should not be deteriorated.
Check all grooves: assure that they are not worn out or damaged.
Replace spoiled parts with original spare parts.
Replace seals on rotating shafts, before reassembly.

Estremità di flange ed attrezzi

Prestare la massima attenzione quando si martellano le estremità di attrezzi o di flange per evitare di compromettere la funzionalità e l'integrità sia degli attrezzi che dei componenti su cui si opera.

Ends of flanges and tools

Be careful when hammering tool or flange ends, in order to avoid jeopardizing functionality and integrity of either the tools or the components on which you are operating.

Metodi di riassemblaggio

Per riassemblare il gruppo si deve impiegare un'adeguata attrezzatura di sostegno.
Per posizionare il gruppo, per smontare e rimontare la corona dentata e per sostenere la scatola ingranaggi è necessario un sistema di sollevamento.
Per facilitare le operazioni di smontaggio e montaggio utilizzare un disegno di assieme del gruppo.

Reassembly methods

In order to reassemble the group, an appropriate fixture must be used.
In order to position the group, to disassemble and reassemble the ring gear and to support the gear housing, a lifting system is needed.
To make disassembling and assembling operations easier, use a group assembly drawing.

Impiego di lubrificante

Per ottenere una corretta lubrificazione ed una esatta temperatura di funzionamento negli assali CARRARO, è importante usare i lubrificanti raccomandati (Sez.C.4), mantenendone il livello costante secondo quanto indicato nel presente manuale.

Lubricant use

In order to lubricate the CARRARO axles correctly and to reach the exact operation temperature, it is important to use the recommended lubricants (Section C.4), keeping their level constant as indicated in this manual.

B SICUREZZA

B.1 Indicazioni generali per la sicurezza

IMPORTANTE:
Prima di iniziare qualsiasi tipo di operazione leggere attentamente questo capitolo.



Precauzioni per la sicurezza:

Il corretto uso e la corretta riparazione dei prodotti Carraro e dei loro componenti sono molto importanti per la sicurezza e l'affidabilità.
Le procedure raccomandate e descritte in questo manuale sono testate, quindi sono effettivi metodi operativi. Seguire strettamente ogni procedura facendo uso sia del testo che delle illustrazioni.
Alcune di queste procedure mostrano l'uso di appositi strumenti progettati perché le operazioni vengano condotte in modo chiaro e corretto.
Alcuni strumenti specifici devono essere usati dove necessario per eseguire determinate operazioni.
E' impossibile trattare ogni metodo di lavoro o tutte le possibili metodologie per svolgerlo e le rischiose conseguenze di ognuna, perciò chi usa procedure o strumenti non consigliati deve sapere che la sicurezza dell'operatore e del veicolo saranno messi a repentaglio.

Pericolo
Gli occhiali di sicurezza devono essere indossati sempre durante l'esecuzione di tutte le operazioni di montaggio o smontaggio.



B SAFETY

B.1 General safety recommendations

IMPORTANT:
Before proceeding with any operations please read this chapter very carefully.



Safety precautions:

Correct use and repair of Carraro products and of their components is very important for safety and reliability.
Recommendations and all described procedures given in this manual have been experimented and hence are effective operational methods. Please follow every procedure. Use the text as well as the illustrations.
Certain procedures show use of special tools, designed so that the operations can be carried out in a clear and correct manner.
Special tools must be used when a particular operation is being carried out.
It is impossible to advise every working method or know all possible methodologies for carrying it out or to predict risky consequences of each operation. Hence, performing procedures or using instruments which have not been advised could be dangerous for the operator/mechanic as well as the vehicle.

Danger
Safety goggles must be worn while carrying out every assembling or disassembling operations.



B.2 Simboli di sicurezza

Identificazione delle informazioni sulla sicurezza



Questo è il simbolo di allarme per la sicurezza; quando lo trovate sulla macchina o sul manuale, siete avvisati del pericolo potenziale di incidenti o danni alla persona. Seguite i suggerimenti e le raccomandazioni per operare in sicurezza.

Significato delle scritte di avvertimento

PERICOLO

AVVISO

ATTENZIONE

Una scritta di avvertimento (PERICOLO, AVVISO o ATTENZIONE), viene usata sulla macchina insieme al simbolo di allarme per la sicurezza.
I segnali PERICOLO o AVVISO sono utilizzati vicino ad aree pericolose. PERICOLO identifica la situazione più pericolosa.
Precauzioni generali sono invece segnalate da ATTENZIONE.

Seguire le istruzioni di sicurezza !

Leggere con cura tutti i messaggi sulla sicurezza di questo manuale.



Modifiche non autorizzate possono compromettere il funzionamento, la sicurezza d'impiego e la durata.
Se non comprendete le istruzioni del manuale, contattate il rappresentante a voi più vicino.

B.2 Safety symbols

Recognize safety information



This is the safety alarm symbol; whenever you find it in the manual or see it on the machine, you are being warned about potential danger of accidents or harm to personnel. Follow the do's and don't's to operate in total safety.

Understanding written warnings

DANGER

WARNING

CAUTION

Written warning (DANGER, WARNING or CAUTION) is used along with an alarm symbol on the machine. DANGER or WARNING signs are used near danger zones, while CAUTION sign indicates general precaution.

Follow safety instructions !

Read all suggestions given in this instruction manual very carefully.



Unauthorized changes could endanger the functioning, work safety and work span.
If you do not understand this instruction manual, contact the nearest sales representative.

B.3 Precauzioni generali

In ogni movimento dovranno essere osservate le norme sulla prevenzione infortuni, tutte le regole generali di sicurezza e di medicina del lavoro.
Prima di procedere nelle operazioni di manutenzione o sistemazione di eventuali problemi, assicurarsi del buon stato e del buon funzionamento delle attrezzature quali banchi di sostegno, cavalletti, martelli, leve, estrattori e chiavi apposite facilitando le operazioni da svolgere in modo ottimale riducendo i rischi sia per gli organi ed i componenti del prodotto che della incolumità dell'operatore.
Tutte le modifiche arbitrarie apportate al prodotto sollevano la CARRARO SpA da ogni responsabilità per qualsiasi danno o incidente.
Il prodotto, se utilizzato in un impiego diverso da quello previsto, è da considerarsi soggetto a "uso non previsto". CARRARO SpA declina ogni responsabilità per danni o incidenti risultanti da un uso diverso da quello previsto; tali conseguenze saranno a carico esclusivo del cliente.

Norme per la manutenzione in sicurezza

1 Operare in ambiente pulito e asciutto.
2 Non lubrificare, manipolare o registrare il gruppo in moto.
3 Tenere lontani mani, piedi, indumenti da parti in movimento.
4 Essere sempre pronti per i principi di incendio. Tenere a portata di mano estintore e cassetta di pronto soccorso.
5 Tenere in evidenza il n° di telefono di un medico, ambulanza, ospedale e vigili del fuoco presso il proprio telefono.

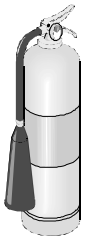
B.3 General precautions

Observe safety instructions, accident prevention rules and all general safety regulations in each and every step at work.
Before going ahead with maintenance or repair work ensure that all the tools, the supporting bench, stands, levers, extractors and spanners are in good condition so that the work can be carried out easily.
Risks to various parts and components will also be reduced in this way and working condition for the operator will also be safer.
CARRARO SpA declines any responsibility in case of an accident or damage resulting due to changes made arbitrarily on product.
The product is used for any other purpose different from the one foreseen, than CARRARO SpA declines any responsibility.
In this case all consequences will be at the customer's expense.

Safety maintenance rules

1 Operate in a clean and dry environment.
2 Do not lubricate, handle or adjust the group underway.
3 Keep off your hands, feet and clothing from moving parts.
4 Be always prepared for fires. Keep the extinguisher and the first aid kit within reach.
5 Keep the phone numbers of a doctor, of an ambulance, of a hospital and of the fire department within reach near the telephone set.







6 Usare indumenti e protezioni adatte allo scopo come: tuta, guanti protettivi e cuffie.
7 Usare protezioni auricolari appropriate a salvaguardare l'udito, come tappi o cuffie per le orecchie contro rumori molesti o fastidiosi.

6 Wear suitable clothing and protections as overalls, safety gloves and ear safety devices.
7 Use suitable ear protections, like ear plugs, to keep out noise and prevent injury to the ears.

Una prolungata esposizione al rumore può danneggiare l'udito.



8 Le attrezzature richiedono la piena attenzione dell'operatore. Non usare cuffie per ascoltare musica mentre si interviene sul prodotto o gruppo.

Eliminazione dei rischi residui

- Rischio di schiacciamento e cesoiamento dovuto alla presenza di elementi in movimento.
  Attenzione
  Eseguire tutte le operazioni di manutenzione a macchina ferma.
- Rischio dovuto all'inalazione di gas nocivi che si possono sviluppare scaldando le vernici durante eventuali saldature.
  Attenzione
  Utilizzare postazioni di lavoro dotate di sistemi di evacuazione di polveri e fumi.
  Lasciate disperdere i fumi per almeno 15 minuti prima di saldare o riscaldare, o riprendere a lavorare sul gruppo.
- Rischio di incendio dovuto ai solventi utilizzati e all'olio presente.
  Attenzione
  Tenere lontano dalla zona di lavoro ogni fonte di calore.
  Quando si usano solventi o svernicianti, rimuoverli con acqua e sapone prima di saldare.
  Rimuovere i contenitori di solvente, sverniciante o altri prodotti infiammabili dall'area di lavoro.
- Rischio dovuto alla caduta, allo sganciamento o alla violenta espulsione di oggetti od olio.
  Attenzione
  Questi rischi residui e le procedure per eliminarli completamente, sono evidenziati dettagliatamente nelle procedure di montaggio e smontaggio. Seguire attentamente, durante la manutenzione, tutte le procedure di sicurezza indicate nel manuale.

A prolonged exposure to noise can damage your hearing.



8 The operator must be very careful with the equipment. Do not use headphones to listen music while you are working on the product or on the group.

Residual risk elimination

- *Risk of squashing and shearing due to the presence of moving parts.*
  Warning
  Carry out all maintenance operations when the machine is stationary.
- *Risk due to inhalation of poison gases that can be produced by heating the varnishes during any welding.*
  Warning
  Use work stations equipped with dust and fume discharging systems.
  Let the fumes disperse for at least 15 minutes, before welding or reheating, or working on the group again.
- *Risk of fire due to the solvents used and to the oil in the machine.*
  Warning
  Keep off any heat sources from the working area.
  When solvents or paint removers are used, they should be removed with soap and water, before welding.
  Remove any containers of solvent, paint remover or any other inflammable products from the working area.
- *Risk due to fall, drop or violent ejection of objects or oil.*
  Warning
  These residual risks and the suitable relative procedures to eliminate them completely are pointed out, in detail, in the assembly and disassembly procedures. During maintenance, follow carefully all the safety procedures indicated in the manual.

C CARATTERISTICHE GENERALI

C.1 Usi previsti

Questo assale è stato progettato e costruito per essere installato in macchine di tipo industriale. L'assale è un componente che ha la funzione di trasmettere la potenza dal motore alle ruote.
L'assale in oggetto, costruito secondo specifiche fornite dal cliente, permette:

- l'aumento della forza di trazione riducendo il numero di giri;
- la compensazione della velocità delle ruote interne con quelle esterne durante la sterzata.

Non installare mai questo assale su macchine diverse da quelle per cui e stato progettato e costruito.

L'assale, se utilizzato in un impiego diverso da quello previsto, è da considerarsi soggetto ad "uso non previsto".
CARRARO SpA declina ogni responsabilità per danni o incidenti risultanti da un uso diverso da quello previsto; tali conseguenze saranno a carico esclusivo del cliente.
Costituisce inoltre un elemento essenziale, nell'ambito dell'uso previsto, l'osservanza scrupolosa delle modalità di funzionamento e delle regolari manutenzioni e riparazioni specificate da CARRARO SpA.

C GENERAL SPECIFICATIONS

C.1 Foreseen uses

This axle has been designed and manufactured to be mounted on industrial machines.
The axle is a component that transmits the power from the engine to the wheels.
The axle, manufactured according to the customer's technical specifications, allows:

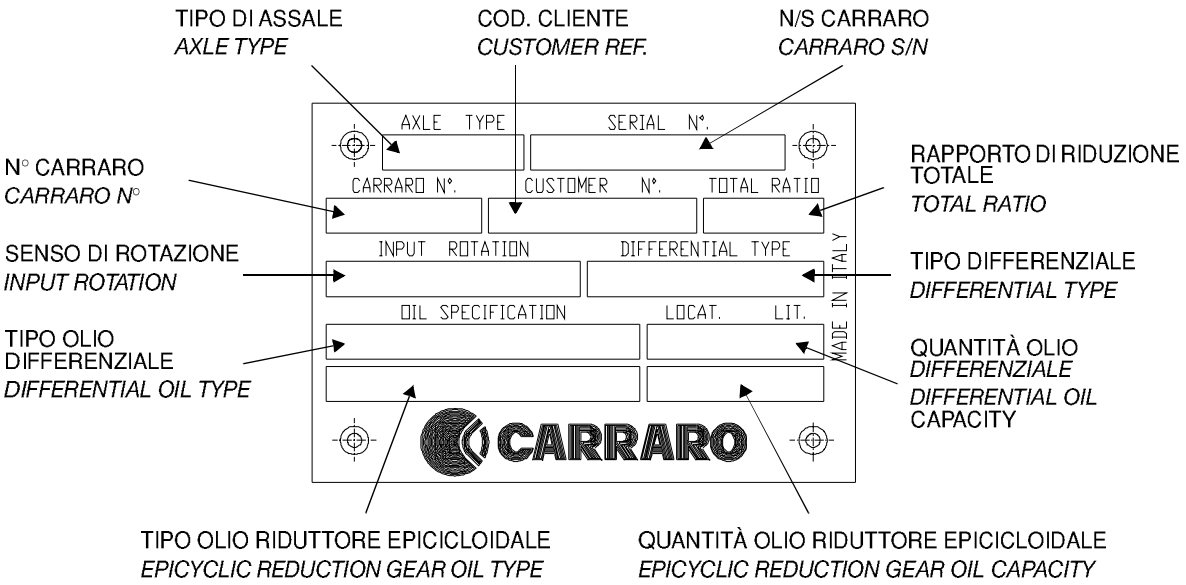
- *increasing of tractive force, reducing the number of revolutions*
- *adjusting of inner wheels' speed with outer wheels' speed during steering.*

Never mount this axle on machines different from the ones for which it has been designed and manufactured

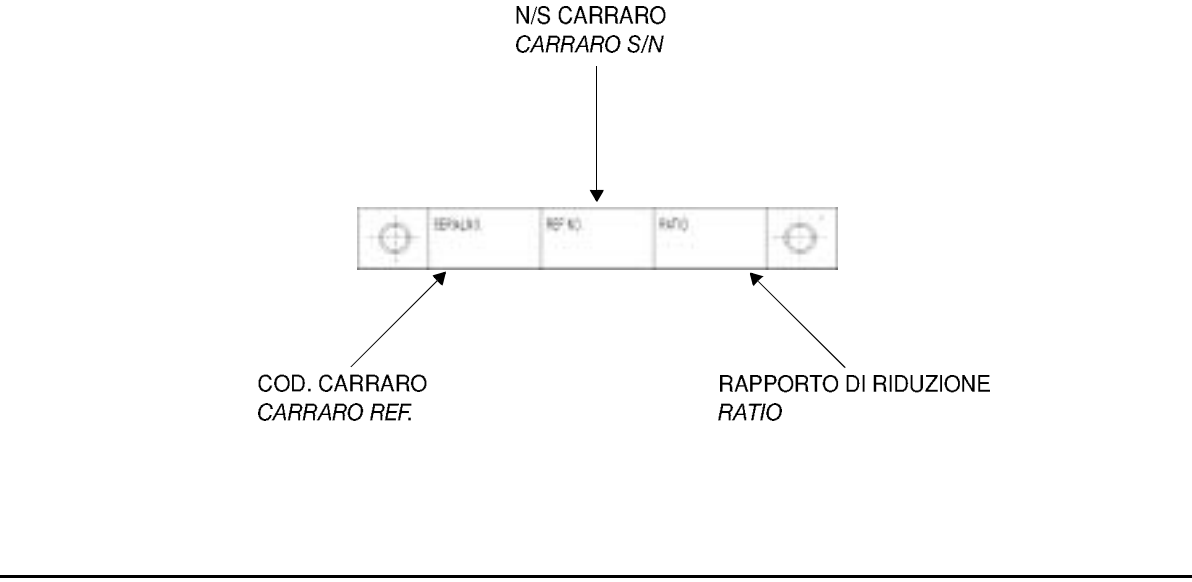
If the axle is used for any other purpose than the one foreseen, CARRARO SpA declines any responsibility regarding damages or accidents caused by it. All consequences will be at the expense of the client.
However, when used as foreseen, operational formalities as well as regular maintenance repair specifications given by CARRARO SpA are to be observed strictly.

C.2 Identificazione del prodotto — *C.2 Product identification*

Targhetta di identificazione dell'assale — *Axle serial plate*



Targhetta di identificazione della trasmissione — *Transmission serial plate*

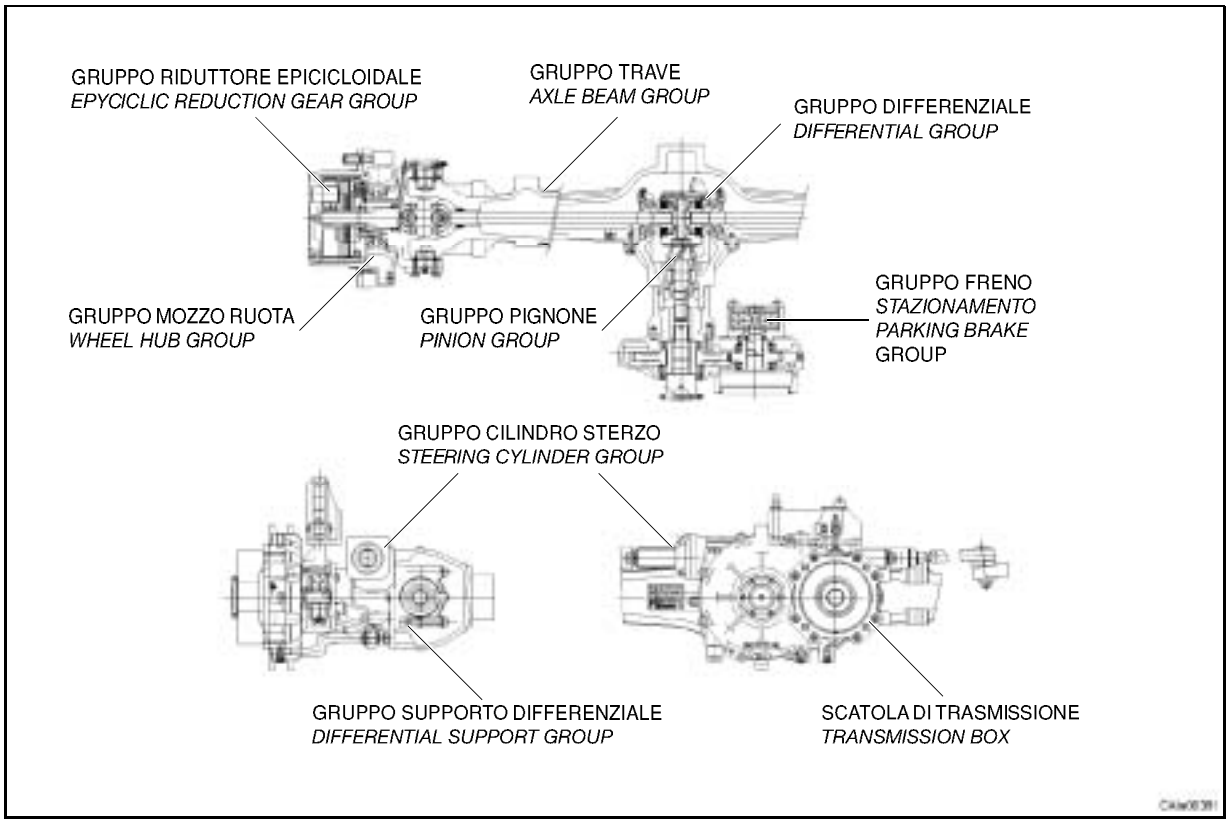


C.3 Descrizione generale

L'assale in oggetto, progettato e costruito secondo le richieste del cliente, è costituito da un corpo trave contenente il gruppo differenziale nella parte centrale e dai gruppi mozzo ruota alle estremità.
Il gruppo differenziale è supportato da due cuscinetti montati in un'apposita struttura ove è possibile effettuare le operazioni di registrazione della coppia conica.
La posizione della corona conica si registra agendo su due ghiere contrapposte, mentre quella del pignone conico, supportato da due cuscinetti, si effettua mediante interposizione di spessori di registro.
I mozzi ruota contenenti i riduttori epicicloidali, sono supportati da due cuscinetti a rulli conici e vengono comandati da un gruppo sterzante ad azionamento idraulico con aste guida registrabili per la regolazione della convergenza.
L'assale dispone inoltre di un proprio sistema frenante idraulico e di un freno di servizio meccanico.
La struttura viene completata da una scatola di trasmissione/riduzione, che permette il pieno controllo dei parametri del moto all'ingresso della coppia conica.

C.3 General description

The axle described in this manual designed and manufactured following the client requests, consists of a beam casing housing the differential and a wheel hub unit at each end.
The differential is supported by two bearings mounted on a suitable structure allowing the bevel gear set to be adjusted.
The ring bevel gear is adjusted by means of ring nuts located opposite each other.
The position of the bevel pinion, supported by two bearings, is adjusted by inserting adjusting shims.
The wheel hubs containing the epicyclic reduction gears are supported by two tapered roller bearings and are powered by a hydraulically-operated steering unit by means of adjustable guide rods to correct the toe-in.
Furthermore the axle has a hydraulic braking system and a meccanical parking brake.
The frame is completed with a transmission/reduction box, which allows to control fully the motion parameters at the bevel gear input.



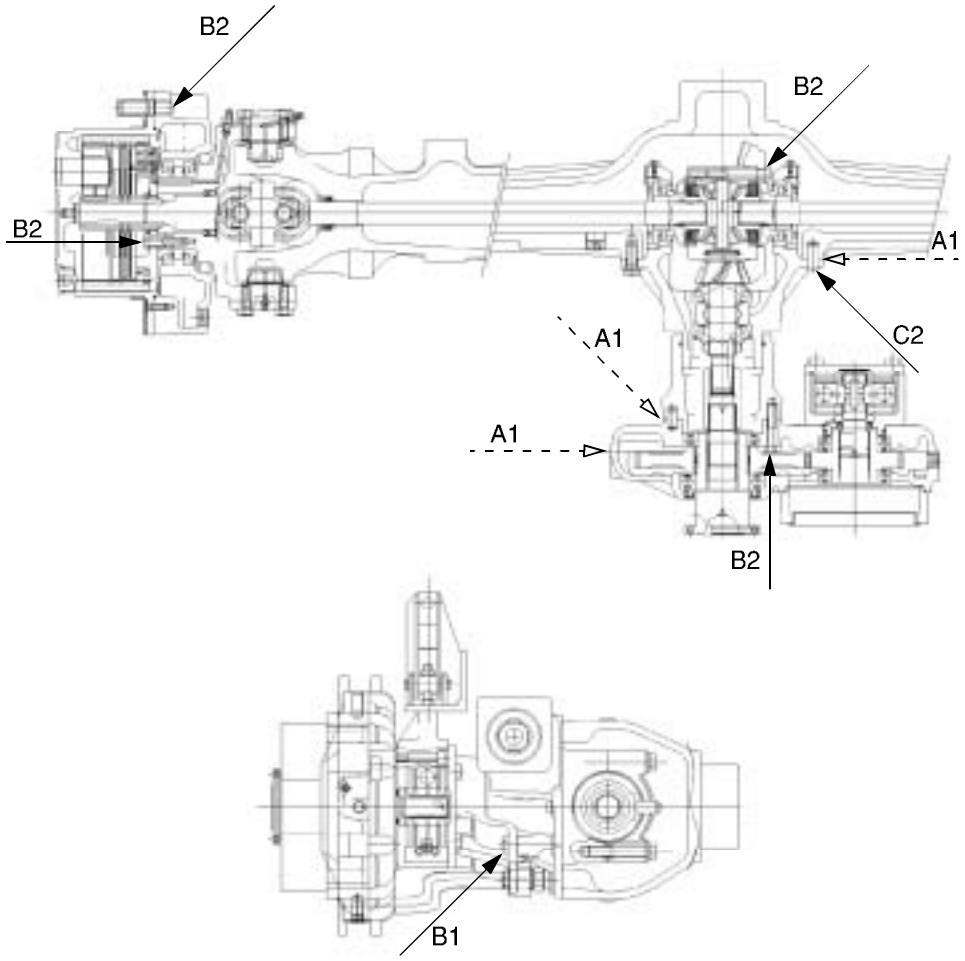
C.4 Caratteristiche Tecniche — *C.4 Technical Features*

MACCHINA	**Assale Anteriore - *Front Axle***	*MACHINE*
CODICE	**CA140112**	*CODE*
MODELLO	**26.11+TB172**	*MODEL*
TIPO DIFFERENZIALE	**Limited Slip**	*DIFFERENTIAL TYPE*

DESCRIZIONE	**VALORI** ***VALUES***	***DESCRIPTION***
Riduzione coppia conica	2.46 / 1	*Bevel gear ratio*
Riduzione riduttore epicicloidale	6.00 / 1	*Epicyclic reduction gear ratio*
Riduzione Scatola di Trasmissione (T.B.)	1.85 / 1	*Transfer Box ratio*
Riduzione totale	27.33 / 1	*Total ratio*
Peso a secco	341 Kg	*Dry weight*
Rotazione in entrata SENSO ORARIO SENSO ANTIORARIO		*Input rotation* *CLOCK WISE (C.W.)* *COUNTER CLOCK WISE (C.C.W.)*
Angolo di sterzata	$36^{\circ}\ ^{0}_{-0,2}$	*Steering angle*
Convergenza	$A\ ^{0}_{-0,2}$	*Toe-in*
Gioco di accoppiamento coppia conica	0.16÷0.22 mm	*Bevel gear set backlash*
Precarico cuscinetti pignone conico (misurato su D=30.5 mm senza anelli tenuta)	P= 10.5÷15.7 daN	*Pinion bearings preloading (measured D=30.5 mm without seal)*
Precarico totale cuscinetti corona-pignone (misurato su D=30.5 mm senza anelli tenuta)	T= (P+3.9)÷(P+5.9) daN	*Pinion-ring gear bearing total preloading (measured D=30.5 mm without seal)*
Spessore nominale disco differenziale	1.6 mm	*Nominal differential disc thickness*
Spessore nominale controdisco differenziale	1.5-2.8 mm	*Nominal differential counterdisc thickness*
Usura max disco differenziale	0.15 mm	*Maximum differential disc wearing*
Usura max controdisco differenziale	0.10 mm	*Maximum differential counterdisc wearing*
Tipo freno	A dischi in bagno d'olio *Wet discs brake*	*Type of brake*
N° dischi freno (per lato)	2	*Number of brake discs (each side)*
N° controdischi freno (per lato)	3	*Number of brake counterdiscs (each side)*
Spessore nominale disco freno	4.75 ÷ 4.90 mm	*Nominal brake disc thickness*
Spessore nominale controdisco freno	9.5/3/8 mm	*Nominal brake counterdisc thickness*
Usura max disco freno (per lato)	0.25 mm	*Maximum brake disc wearing (each side)*
Corsa massima pistone freno	0.8 mm	*Maximum brake piston stroke*
Pressione max di esercizio	68.9 bar	*Maximum operating pressure*

DESCRIZIONE	VALORI *VALUES*	*DESCRIPTION*
Coppia frenante massima alle ruote	11360 Nm	*Max. wheels braking torque*
Specifica olio IN PRESENZA DI DIFFERENZIALE LIMITED SLIP, USARE I TIPI DI OLIO INDICATI OPPORTUNAMENTE ADDITIVATI Nota: NON USARE OLIO DI SINTESI O VEGETALE SENZA IL CONSENSO DEL COSTRUTTORE DELL'ASSALE	SAE 80W *to comply* API GL4 *respectively* MIL-L-2105	*Oil specification* *IN PRESENCE OF DIFFERENTIAL LIMITED SLIP, USE RECOMMENDED OIL ENRICHED IN ADDITIVES* *Note:* *DO NOT USE SYNTHETIC OR VEGETABLE OIL WITHOUT CONSENT OF THE AXLE MANUFACTURER*
Quantità olio differenziale	6 litri	*Differential oil capacity*
Quantità olio riduttore epicicloidale per lato	*1.6 litri/Liter*	*Epicyclic reduction gear oil capacity each side*
Specifica olio per azionamento freno	MINERAL OIL	*Oil specification for brake actuation*
Volume olio per azionamento freni	10 cc	*Oil displacement for brakes actuation*
Specifica grasso	TECNOLUBE SEAL POLYMER 400/L DIN = KHER1R ISO-I-XMR-XM2	*Grease specification*
Flangia ingresso differenziale	DIN1310	*Differential input flange*
Attacco motore idraulico	DIN5480	*Hydraulic motor flange*

Sigillanti e collanti *Sealing compounds and adhesives*

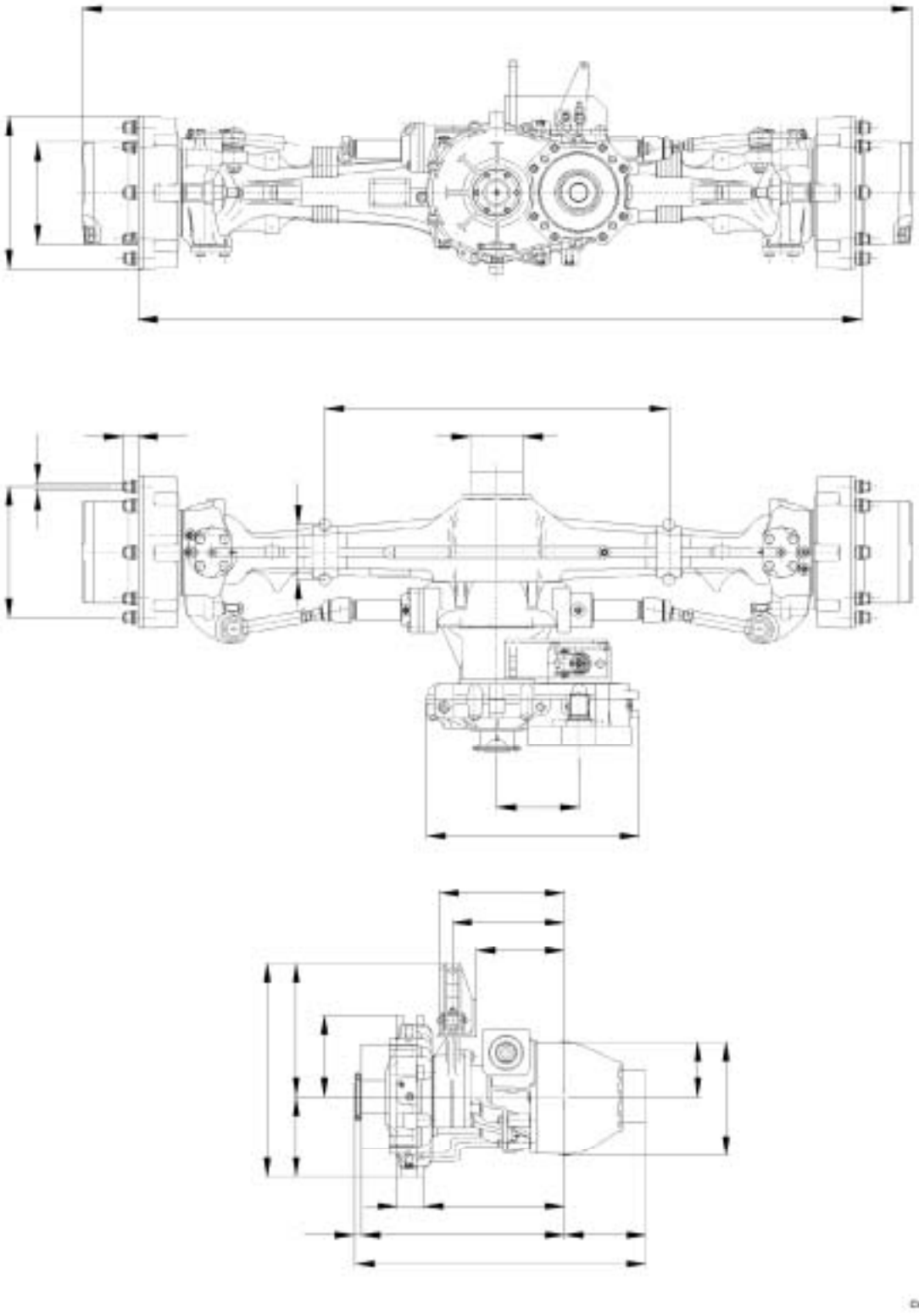


A1= LOCTITE® 510		B2= LOCTITE® 270	
A2= LOCTITE® 573		C1= LOCTITE® 405	
A3= LOCTITE® 518		C2= LOCTITE® 496	
B1= LOCTITE® 542		C3= LOCTITE® 638	

◁ - - - - - -	Applicare sulle superifici a contatto
	Apply on the contact surfaces
←	Applicare sulla filettatura delle viti / sui perni
	Apply on bolt screws / on pins

Dimensioni d'ingombro

Overall dimensions

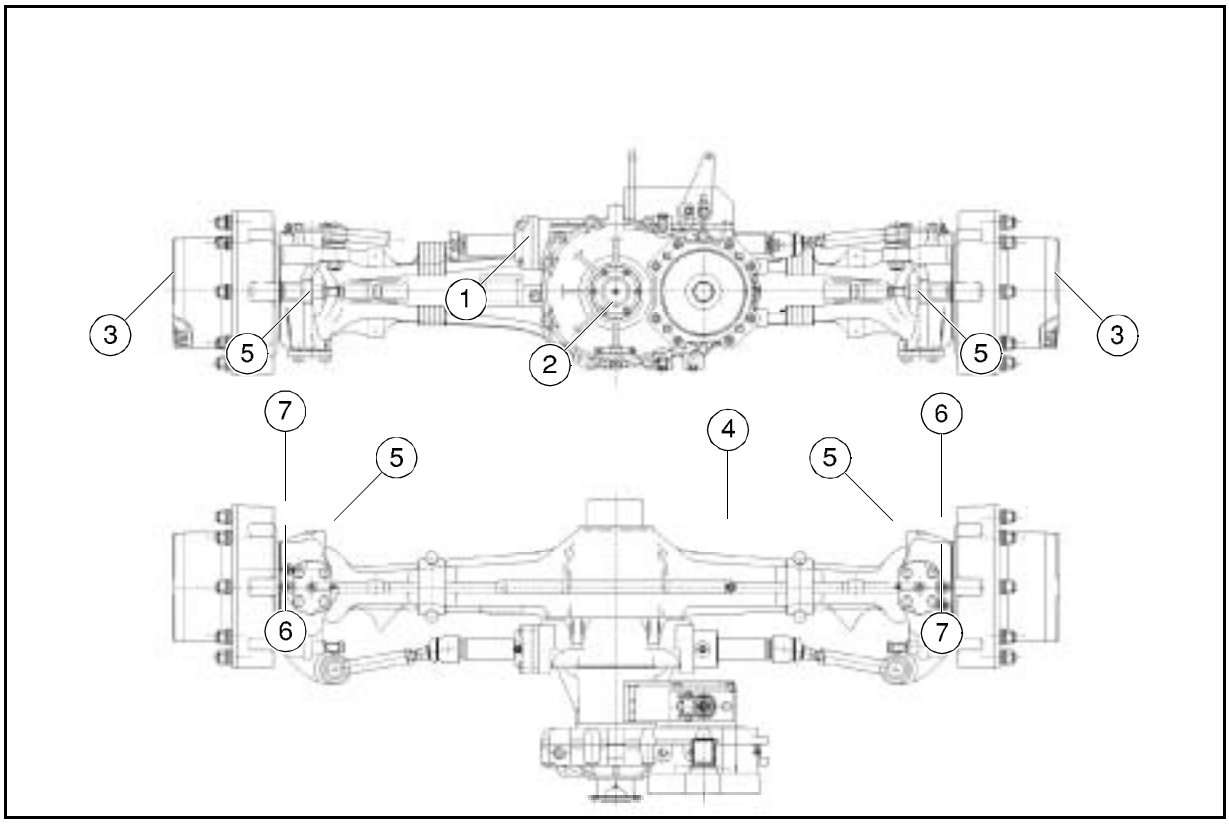


C.5 Rifornimento e verifiche

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

C.5 Filling and checks

Some of the following pictures may not show exactly your axle, but the procedure is the same.



DESCRIZIONE	POSIZIONE / POSITION	DESCRIPTION
Tappo carico e livello olio	1	*Oil filling and level plug*
Tappo scarico olio	2	*Oil drain plug*
Tappo livello, carico e scarico olio riduttore epicicloidale	3	*Level, filling and drain plug of epicyclic reduction gear oil*
Sfiato olio	4	*Oil breather*
Punti di ingrassaggio	5	*Greasing point*
Spurgo freno	6	*Oil bleed plug*
Connessione olio freni	7	*Oil brake connection*

Controlli periodici:

Il livello dell'olio deve essere a filo dei tappi di controllo, altrimenti provvedere al rabbocco con lubrificante dello stesso tipo, come di seguito indicato.

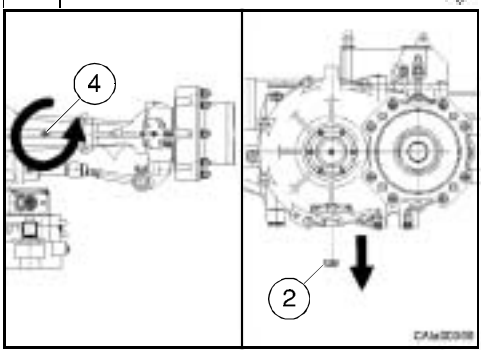
Routine checks:

Oil should be flush with control plugs, if not, make up level with the same lubricant, as shown in following procedures.

Nel caso in cui si riscontri una perdita o altro che determini l'abbassamento del livello, è opportuno intervenire immediatamente onde evitare possibili danni agli organi meccanici.

If leakage or any other factor determining fall in the oil level is found, then it is advisable to check immediately, in order to avoid damages to the mechanical parts.

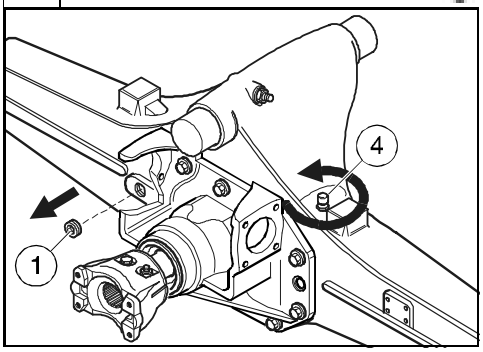
1



Prima di effettuare l'operazione di scarico dell'olio, svitare l'apposito sfiato (4) per eliminare eventuale pressione interna. Richiuderlo poi con chiave dinamometrica serrandolo alla coppia prevista (Sez.C.7).
Per effettuare lo scarico dell'olio dal corpo centrale svitare il tappo (2) del foro di scarico.
Richiudere il tappo (2) alla coppia prevista (Sez.C.7).

Before draining the oil, loosen the breather (4) to release possible internal pressure, then tighten the plug with a torque wrench to the prescribed torque (Sec.C.7).
Drain the oil from the appropriate plug (2).
Tighten the plug (2) to the prescribed torque (Sec.C.7).

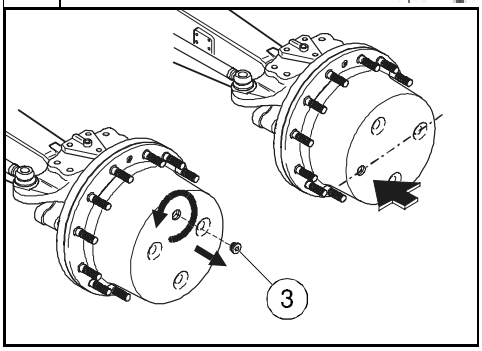
2



Prima di agire sul tappo di livello dell'olio (1), svitare sempre l'apposito sfiato (4) per eliminare l'eventuale pressione interna.
Verificare il livello dell'olio (alla soglia del foro) ed eventualmente rabboccare.
Riavvitare il tappo (1) serrandolo alla coppia prevista (Sez.C.7)

Before draining the oil from the plug (1), always loosen the breather (4) to release possible internal pressure.
Check oil level and top up if necessary.
Tighten the plug (1) to the prescribed torque (Sec.C.7).

3



Prima di effettuare l'operazione di scarico o rabbocco dell'olio, posizionare il mozzo ruota con il tappo (3) nel punto più alto e svitarlo di qualche giro in modo da eliminare l'eventuale pressione interna, quindi rimuoverlo completamente.
Ruotare gradualmente il mozzo fino a disporlo con il foro all'altezza dell'asse ruota in modo che la linea di livello dell'olio sia orizzontale.
Verificare il livello dell'olio ed eventualmente rabboccare.
Riavvitare il tappo (3) serrandolo alla coppia prevista (Sez.C.7).

Before draining the oil, position the wheel hub so that the filer cap is in the highest point, then loosen the plug (3) to release possible internal pressure.
Position the wheel hub so that the filer cap is on the centre line of the horizontal axis.
Check oil level and top up if necessary.
Tighten the plug (3) to the prescribed torque (Sec.C.7).

C.6 Programma di lubrificazione — *C.6 Service schedule*

Operazione	▲ Primo Intervento *First time*	◆ Ad ogni stagione od ogni 1500 ore(1) *Seasonally or every 1500 operating hours*(1)	*Operation*
Cambio olio assale	150 - 200 ore/*hours* ●	◆ ■	*Axle oil change*
Operazioni di lubrificazione	▲ ■	◆ ■	*Lubrication works*
Controllo e rabbocco olio	50 - 100 ore/*hours* ■	mensilmente/*monthly* ●	*Check and adjust oil level*
Pulizia tappo magnetico scarico olio	150 - 200 ore/*hours* ■	ad ogni cambio olio/ *every oil change* ●	*Clean magnetic oil plugs*
Pulizia sfiato olio	▲ ■	mensilmente/*monthly* ●	*Clean oil breather*
Ingrassaggio	150 - 200 ore/*hours* ●	settimanalmente/*weekly* ●	*Greasing*

legenda

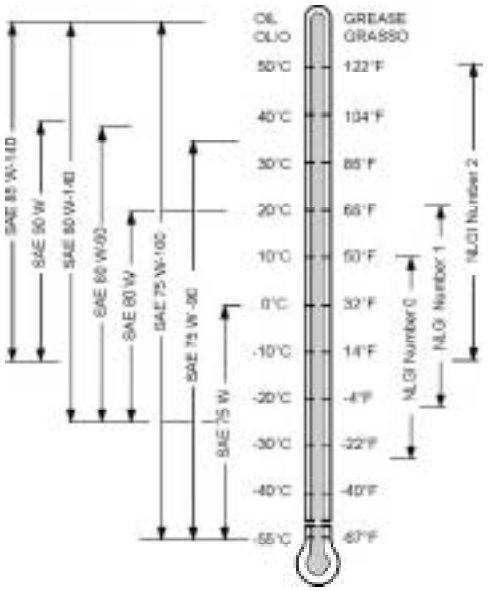
● operazioni eseguibili solamente da personale autorizzato dal costruttore
■ operazioni eseguibili solamente da personale addestrato
(1) quale delle due condizioni si verifica prima

remarks

● *operation performed only by personnel authorized by the manufacturer*
■ *operation performed only by trained personnel*
(1) *which of both conditions comes first*

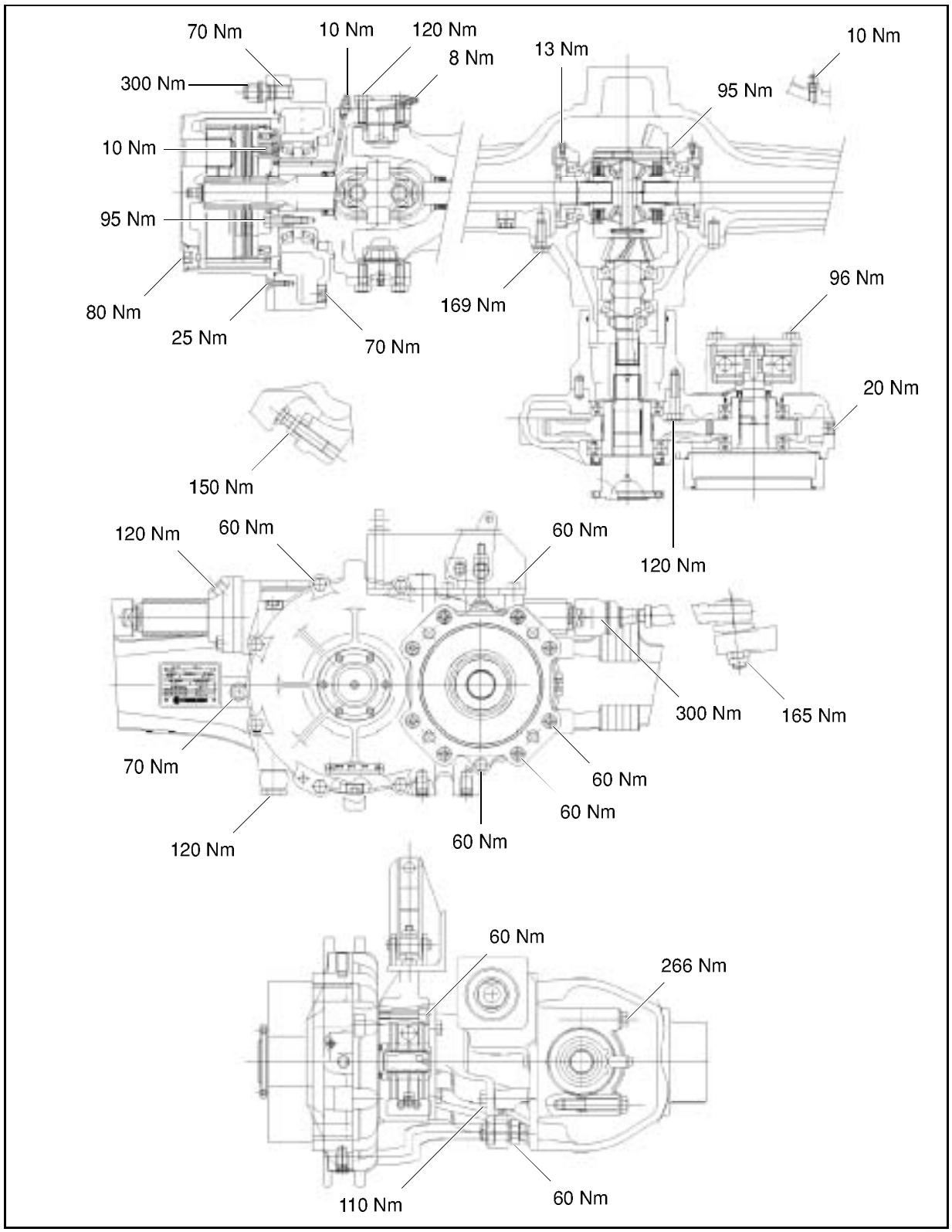
Lubrificazione / ingrassaggio:
gradazioni e relativi campi di applicazione

Lubrication / greasing:
grades and application range



C.7 Coppie di serraggio

C.7 *Tightening torques*



D OPERAZIONI DI SMONTAGGIO

D.1 Smontaggio freno di stazionamento

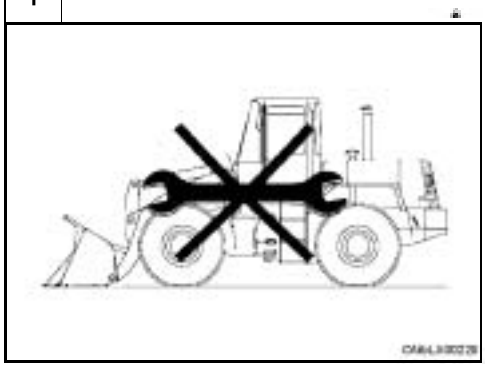
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D DISASSEMBLY OPERATIONS

D.1 Parking brake disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

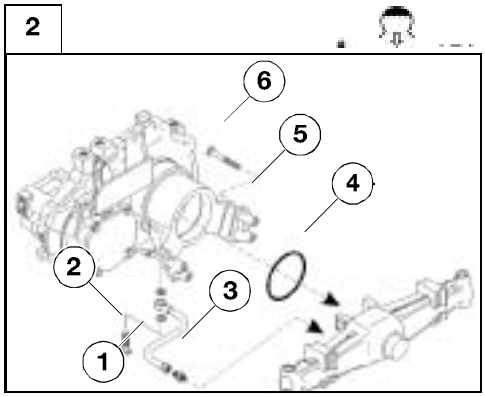
1



Attenzione: le operazioni di disassemblaggio qui descritte, prevedono che l'assale ed il relativo gruppo di trasmissione siano già stati rimossi dal veicolo e posizionati su un adatto banco di lavoro; se si opera sul gruppo installato sul veicolo, seguire le istruzioni del costruttore del veicolo per scollegare il comando freno in condizioni di totale sicurezza.

Warning: *execute disassembly operation only if the axle and related transmission group are removed from the vehicle and placed on a suitable workbench; if the group is on the vehicle, see the vehicle manufacturer instructions to disconnect brake control with totally safety.*

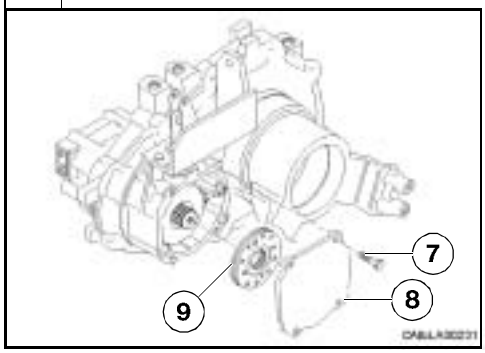
2



Prima di intervenire sul gruppo effettuare lo scarico dell'olio.
Vedi: sez.C.8.
Rimuovere il tubo di ricircolo dell'olio (**1**), svitandone gli elementi di fissaggio (**2**) e (**3**).
Recuperare la vite forata (**2**), il raccordo (**3**), le relative rondelle ed eventuali anelli OR.
Separare la scatola di trasmissione dal gruppo svitando le viti di fissaggio (**6**) del supporto (**5**).
Rimuovere l'anello OR (**4**) dal supporto (**5**).

Before operating on the group, drain the oil.
See: *section C.8.*
*Remove the oil recirculating pipe (**1**), unscrewing fastening parts (**2**) and (**3**).*
*Collect the drilled screw (**2**), the pipe (**3**), related washers and O-Rings.*
*Unscrew fastening screws (**6**) from the support (**5**) and disassembly transmission box from the group.*

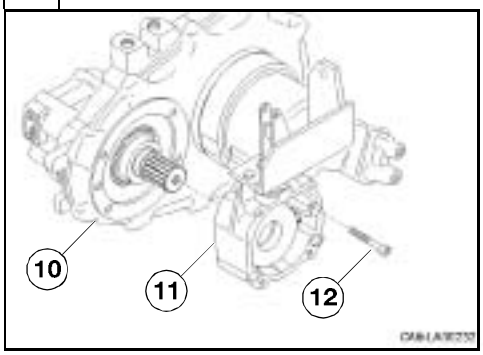
3



Svitare le viti di fissaggio (**7**) del coperchio (**8**).
Rimuovere il coperchio (**8**) e il disco freno (**9**).

*Unscrew the cover (**8**) fastening screws (**7**).*
*Remove the cover (**8**) and the brake disk (**9**).*

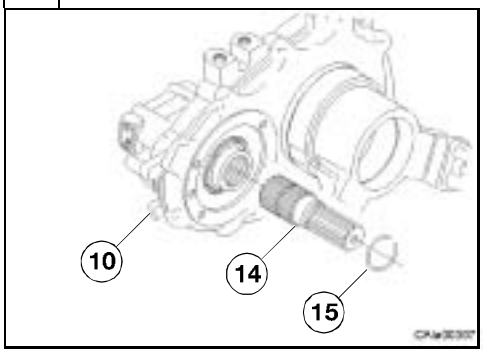
4



Svitare le viti di fissaggio (**12**) della scatola freno (**11**).
Rimuovere la scatola freno (**11**) dalla scatola di trasmissione (**10**).

*Unscrew the brake box (**11**) fastening screws (**12**).*
*Remove the brake box (**11**) from transmission box (**10**).*

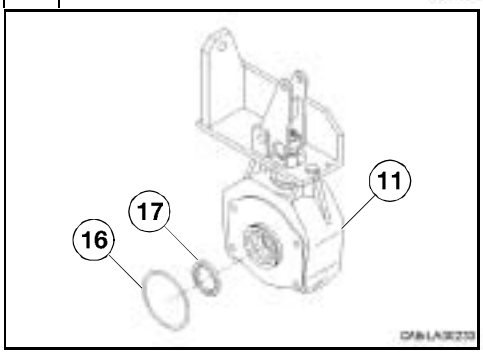
5



Estrarre l'albero freno (**14**) dalla scatola di trasmissione (**10**).
Solo se necessario, rimuovere l'anello d'arresto (**15**) dall'albero (**14**).

*Extract the brake shaft (**14**) from transmission box (**10**).*
*Only if necessary, remove the lock ring (**15**) from shaft (**14**).*

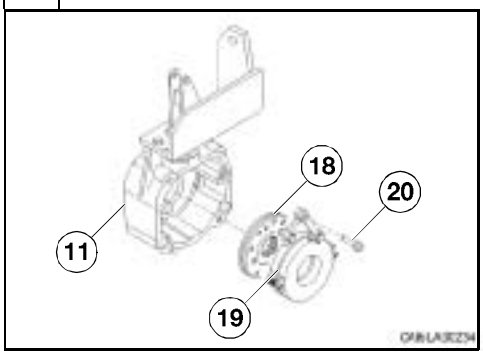
6



Rimuovere l'anello OR (**16**) e l'anello di tenuta (**17**) dalla scatola freno di stazionamento (**11**).
Nota: operazione distruttiva per l'anello di tenuta.

*Remove the O-Ring (**16**) and the seal ring (**17**) from the parking brake box (**11**).*
***Note:** this is a destructive operation for the seal ring.*

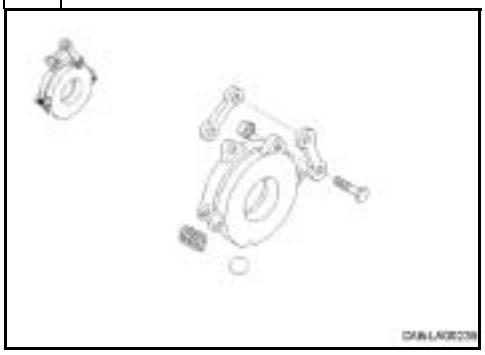
7



Sfilare il perno (**20**) e rimuovere l'attuatore (**19**) e il disco freno (**18**).

*Extract the pin (**20**) and remove the actuator body (**19**) and the brake disk (**18**).*

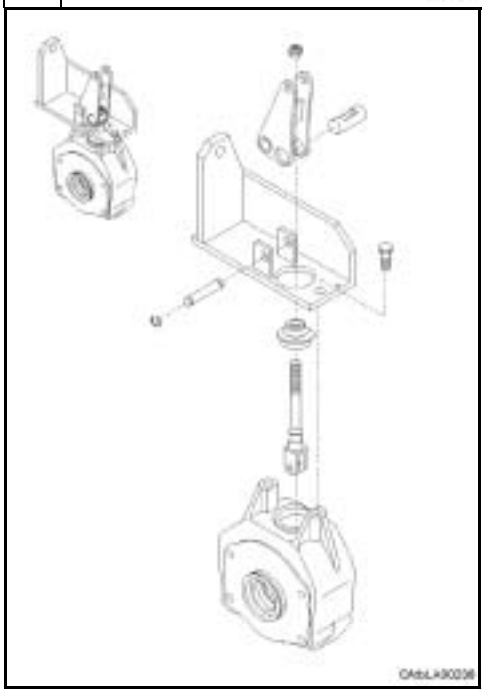
8



Solo se necessario disassemblare l'attuatore, separandone i componenti come illustrato in figura.

If necessary, disassembly actuator body as in figure.

9



Se necessario, disassemblare i componenti del comando freno, come illustrato in figura.

If necessary, disassembly control brake parts as in figure.

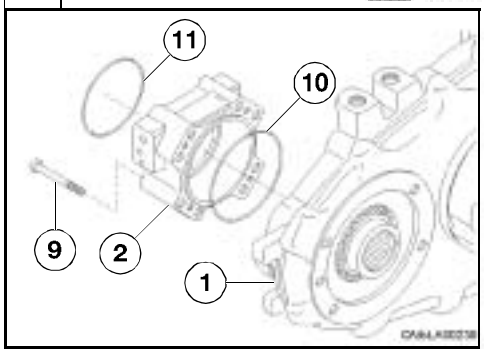
D.2 Smontaggio scatola trasmissione

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.2 Transmission box disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

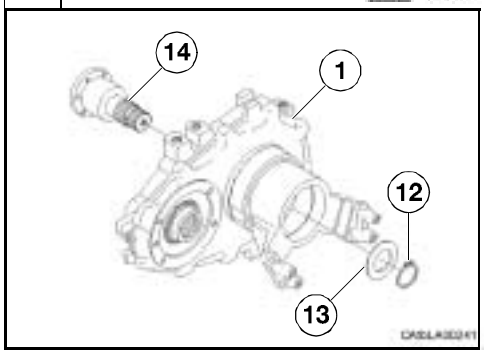
1



Posizionare la scatola di trasmissione (**1**) su un adatto banco di lavoro. Rimuovere la flangia motore (**2**), svitandone le viti di fissaggio (**9**). Rimuovere gli anelli OR (**10**) e (**11**) dalla flangia motore (**2**).

*Position the transmission box (**1**) on a suitable workbench. Unscrew fastening screws (**9**) and remove the motor flange (**2**). Remove O-Rings (**10**) and (**11**) from motor flange (**2**)*

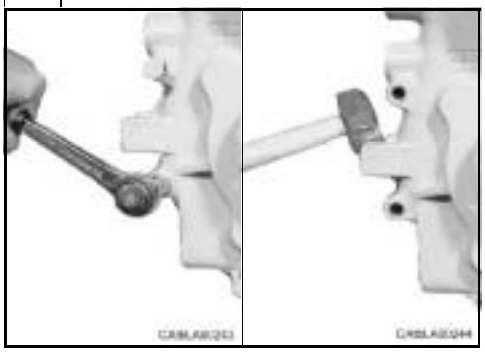
2



Rimuovere l'anello d'arresto (**12**) e la rondella (**13**) dall'albero (**14**). Sfilare l'albero (**14**) dalla scatola di trasmissione (**1**).

*Remove the lock ring (**12**) and the washer (**13**) from the shaft (**14**). Extract the shaft (**14**) from the transmission box (**1**).*

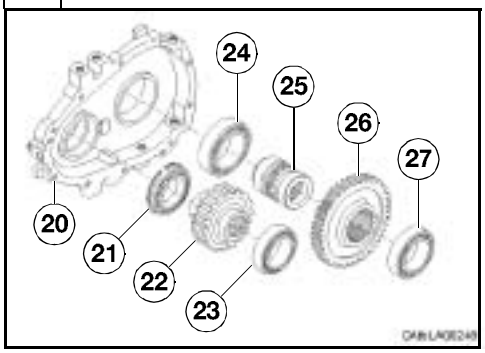
3



Svitare e rimuovere le viti di fissaggio della semiscatola. Disassemblare le semiscatole battendo con un martello in materiale tenero sulle zone predisposte.

Remove fastening screws from the half box. Separate half boxes by beating on the fitting parts with a hammer made of soft material.

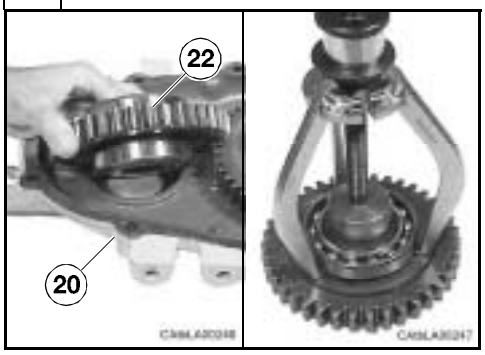
4



Vedi: ordine disassemblaggio componenti

See: *parts disassembly numbering.*

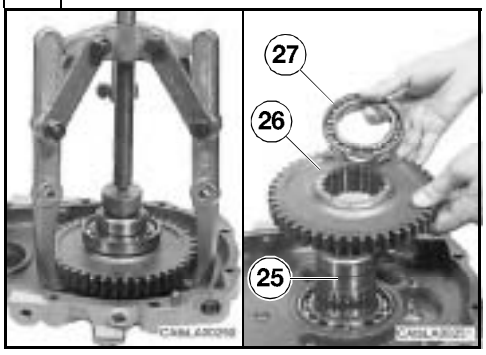
5



Posizionare la semiscatola (**20**) su un banco di lavoro.
Rimuovere la ruota dentata (**22**) con i cuscinetti.
Estrarre i cuscinetti (**21**) e (**23**) con estrattore a tre punti di presa.

*Position the half box (**20**) on a workbench.*
*Collect the gear (**22**) with the bearings.*
*Take the bearings (**21**) and (**22**) out with a three-hold extractor.*

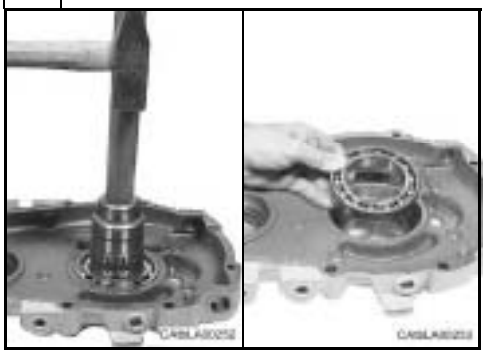
6



Estrarre la ruota dentata (**26**) ed il cuscinetto a sfere (**27**) dal manicotto scanalato (**25**), utilizzando un estrattore a tre punti di presa che agisca sull'ingranaggio.

*Take the gear (**26**) and the ball bearing (**27**) out of the shaft (**25**), using a special three-hold extractor clamping the gear.*

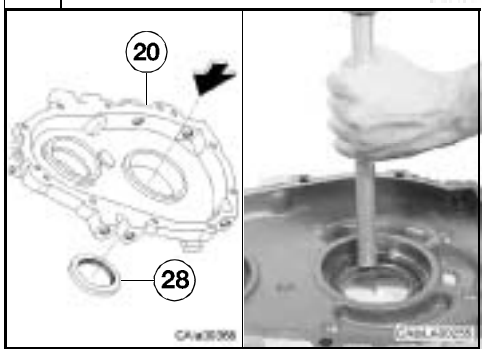
7



Estrarre il manicotto (**25**) dal cuscinetto (**24**) aiutandosi con un martello ed un battitoio.
Rimuovere il cuscinetto (**24**).

*Remove the shaft (**25**) with a hammer and a pad.*
*Remove the bearing (**24**).*

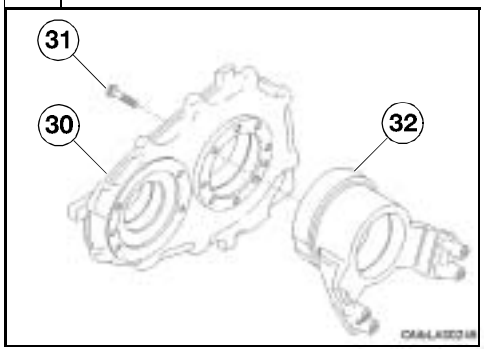
8



Rimuovere dalla semiscatola (**20**) l'anello di tenuta (**28**) con un martello ed un battitoio.
Nota: operazione distruttiva per l'anello di tenuta.

*Remove the seal ring (**28**) from the half box (**20**) with a hammer and a drift.*
***Note:** this is a destructive operation for the seal ring.*

9



Disassemblare la semiscatola (**30**) dal supporto (**32**) svitandone le viti di fissaggio (**31**).

*Remove the screws (**31**) and remove off the support (**32**) from the transmission half box (**30**).*

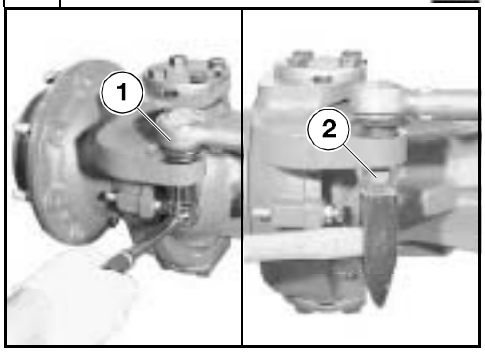
D.3 Smontaggio gruppo cilindro sterzo

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.3 Steering cylinder group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

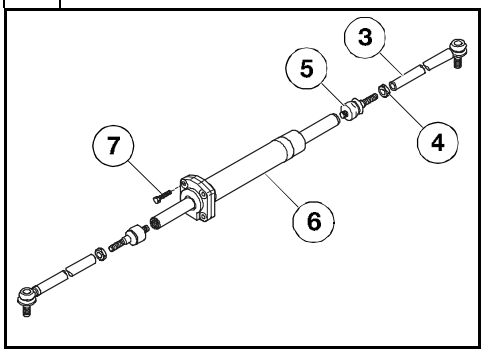
1



Allentare il dado di fissaggio (**2**) dell'asta guida (**1**) di qualche giro fino a portarlo oltre l'estremità del perno filettato.
Con un martello battere sul dado per staccare l'asta guida dalla calotta.
Attenzione: non colpire l'estremità del perno filettato.
Nota: questa operazione è distruttiva per il dado.

*Unloose the guide rod (**1**) locknut (**2**) of some turns till it is over the end of the threaded pin.*
Beat on the nut with a hammer in order to disjoin the guide rod from the swivel housing.
***Warning:** do not beat on the end of the threaded pin.*
***Note**: this is a destructive operation for the nut.*

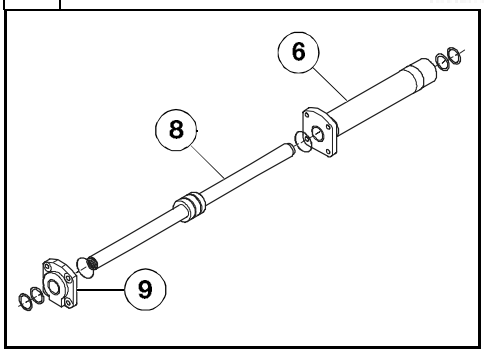
2



Rimuovere il tirante (**3**) dell'asta guida allentando con chiave adatta il dado (**4**), controllarne poi le condizioni.
Svitare le viti di fissaggio (**7**) del martinetto (**6**), quindi sfilarlo dalla sua sede, se necessario aiutandosi con un martello di gomma.
Rimuovere solo i particolari che devono essere revisionati e/o sostituiti.

*Remove the guide rod link (**3**) by unloosing the nut (**4**) with a suitable wrench, then check its conditions.*
*Unscrew the fastening screws (**7**) of the cylinder, then take the cylinder (**6**) out of its housing and, if necessary, use a rubber hammer.*
Remove only that parts that need to be overhauled and/or replaced.

3



Staccare la testata (**9**) dal corpo del cilindro (**6**).
Sfilare la testata e lo stelo (**8**) dal corpo cilindro.
Rimuovere tutti gli anelli di tenuta.

*Detach the cylinder head (**9**) from the cylinder case (**6**).*
*Remove off the cylinder head and the rod (**8**) from the cylinder case.*
Remove all the seals and O-Rings.

D.4 Smontaggio gruppo riduttore epicicloidale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.4 Epicyclic reduction gear disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

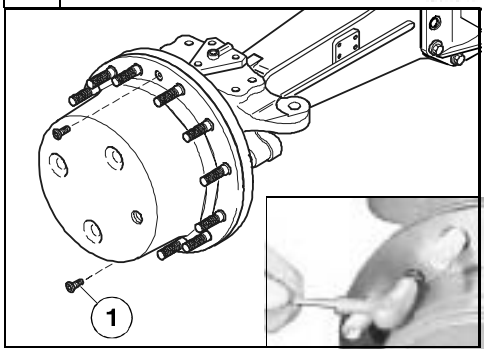
1



Vedi: sezioni C.5 e C.8.
Prima di effettuare l'operazione di scarico dell'olio, posizionare il mozzo ruota con il tappo nel punto più alto e svitarlo di qualche giro per eliminare l'eventuale pressione interna, quindi rimuoverlo completamente.
Ruotare il mozzo fino a portare il foro nel punto più basso.
Scaricare completamente l'olio.

See: *sections C.5 and C.8.*
Before draining the oil, position the wheel hub with the plug on the upper part and loosen it of some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside-down till the hole is in the lowest point.
Drain the oil completely.

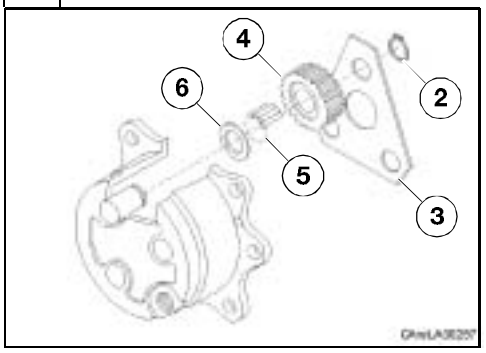
2



Svitare e togliere le due viti di fissaggio (**1**) del treno portasatelliti con una chiave da commercio.
Rimuovere il treno portasatelliti dal mozzo ruota e togliere il relativo anello OR.
Posizionare il treno portasatelliti su di un piano e verificarne le condizioni di usura.

*Unscrew and remove both fastening screws (**1**) of the planetary carrier with a wrench.*
Remove the planetary carrier from the wheel hub and collect the relative O-Ring.
Position the planetary carrier on a workbench and check its wear conditions.

3



<u>Per eseguire l'eventuale sostituzione degli ingranaggi satelliti:</u>
- rimuovere gli anelli d'arresto (**2**) da ogni perno;
- rimuovere la piastra triangolare (**3**);
- estrarre gli ingranaggi satellite (**4**) dai perni;
- recuperare i rullini (**5**) verificandone le condizioni;
- recuperare la rondella (**6**).

Nota: con nuovi satelliti è consigliabile montare rullini nuovi.

<u>*To carry out any possible replacements of the planetary gears:*</u>
- *remove the Seeger rings (**2**) on every pin;*
- *remove the triangular plate (**3**);*
- *take the planetary gears (**4**) out of the pins;*
- *collect the roller bearings (**5**), checking their conditions;*
- *collect the washer (**6**).*

Note: *with new planetary gears is advisable to assembly new roller bearings.*

D.5 Smontaggio gruppo mozzo ruota

Prima di smontare il mozzo ruota, assicurarlo con una cinghia o una fune ad un paranco od altro sistema di sostegno, per evitarne la caduta accidentale che potrebbe danneggiare sia l'operatore che il gruppo.

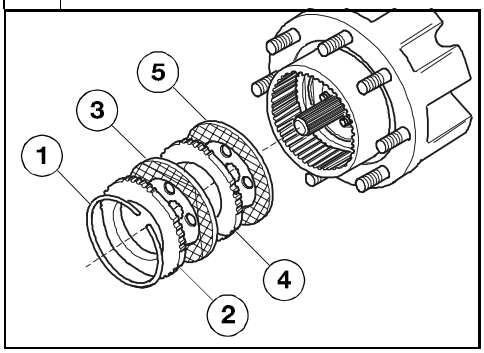
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.5 Wheel hub group disassembly

Before disassembling the wheel hub, it is advisable to secure it with a belt or a rope on a hoist or any other supporting device, in order to avoid its accidental fall that could damage either the operator or the wheel hub group.

Some of the following pictures may not show exactly your axle, but the process is the same.

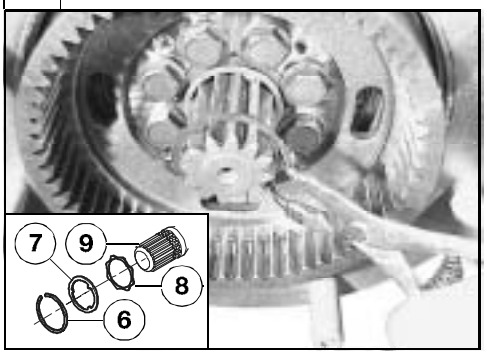
1



Togliere l'anello di arresto (**1**).
Rimuovere i controdischi (**2, 4**) e i dischi freno (**3, 5**) nell'ordine illustrato in figura.

*Remove the lock ring (**1**).*
*Take separator disks (**2, 4**) and brake disks (**3, 5**) out, as in figure.*

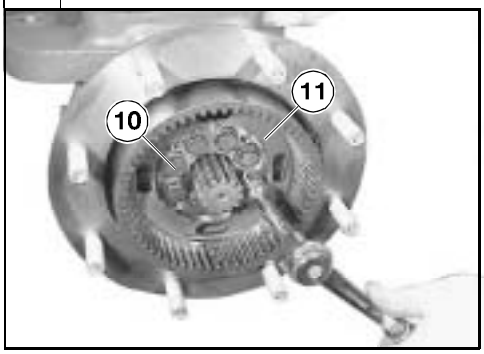
2



Rimuovere dal semiasse (**9**) l'anello d'arresto (**6**), utilizzando una pinza adatta.
Recuperare le rondelle (**7**, **8**) dal semiasse.

*Remove the lock ring (**6**) from the U-Joint shaft (**9**) using a suitable pliers.*
*Collect the U-Joint shaft washers (**7, 8**).*

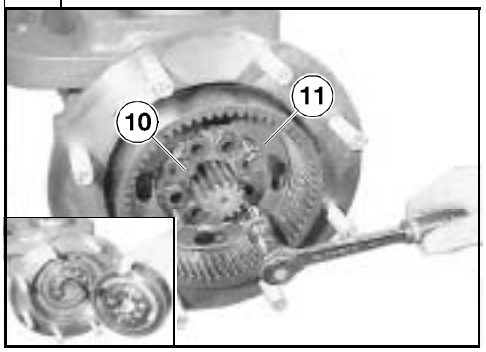
3



Svitare e togliere le viti di fissaggio (**10**) del mozzo fermo corona (**11**).

*Unscrew and remove the fastening screws (**10**) from the wheel carrier group (**11**).*

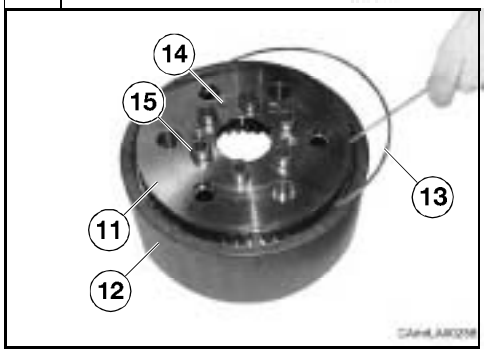
4



Per sfilare il mozzo-fermo corona dalla sua sede, recuperare due delle viti (**10**) appena tolte ed avvitarle nei fori filettati di estrazione.
Estrarre e rimuovere il mozzo fermo corona (**11**) completo di corona epicicloidale (**12**).

*In order to remove the wheel carrier group from its housing, screw two of the just removed screws (**10**) in the threaded extraction holes.*
*Extract and remove the wheel carrier (**11**) together with the epicyclic ring gear (**12**).*

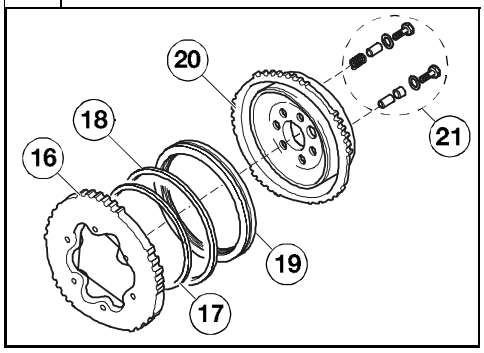
5



Rimuovere l'anello di arresto d'acciaio (**13**) e separare il mozzo fermo corona (**11**) dalla corona epicicloidale (**12**).
Rimuovere gli anelli OR (**14**)
Solo se necessario, togliere le bussole di centraggio (**15**) del mozzo fermo corona con un martello e l'attrezzo CA715086.

*Remove the steel lock ring (**13**) and disjoin the wheel carrier (**11**) from the epicyclic ring gear (**12**).*
*Remove the O-Rings (**14**).*
*Only if necessary, remove the centering bushes (**15**) from the wheel carrier with a hammer and the special tool* CA715086.

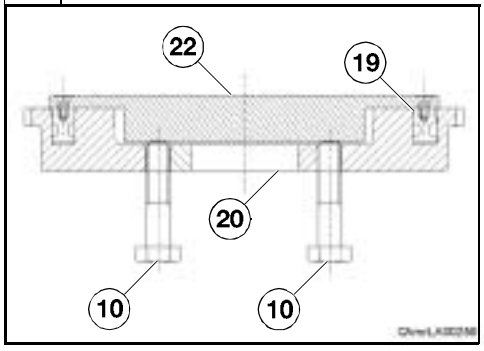
6



Disassemblare il controdisco freno (**16**) dal mozzo-fermo corona (**20**) rimuovendo le viti di fissaggio del kit self-adjust (**21**).
Nota: recuperare tutti i componenti del kit self-adjust.

*Unscrew the kit self-adjust fastening screws (**21**) to disassembly the separator disk (**16**) from the wheel carrier (**20**).*
***Note:** collect all the kit self-adjust parts.*

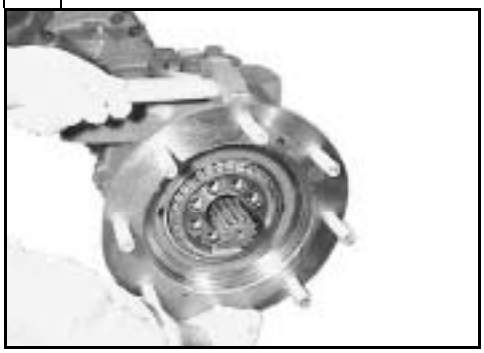
7



Per rimuovere il pistone (**19**) montare l'attrezzo speciale CA715492 (**22**) e due viti (**10**) già utilizzate per l'estrazione del mozzo fermo corona (**20**), come in figura.
Avvitare le viti (**10**) per estrarre il pistone (**19**).
Rimuovere gli anelli QUAD-Ring (**17**, **18**) dal pistone (**19**).
Verificare lo stato di usura dei componenti smontati.

*To remove the piston (**19**) assemble the special tool CA715492 (**22**) and two fastening screw (**10**) just used to remove the wheel carrier group (**20**), as in figure.*
*Screw the two bolts (**10**) to extract the piston (**19**).*
*Remove the QUAD-Rings (**17, 18**) from the piston (**19**).*
Check the wear conditions of the components.

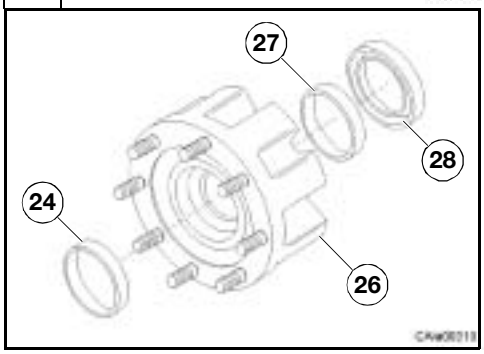
8



Sfilare il mozzo ruota, facilitando lo smontaggio con leve e martello.
Nota: recuperare la pista interna del cuscinetto.

Remove the wheel hub, using levers and a hammer to facilitate the operation.
***Note**: collect the bearing cone.*

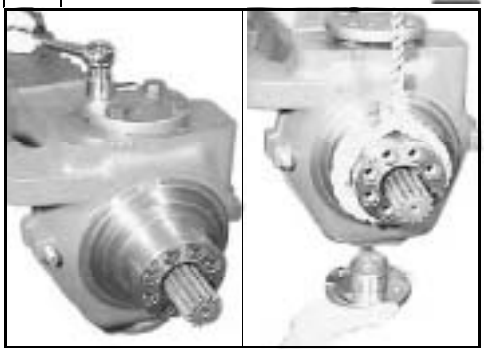
9



Posizionare su di una superficie piana il mozzo ruota (**26**) ed estrarre l'anello di tenuta (**28**) con una leva.
Nota: è un'operazione distruttiva per l'anello di tenuta.
Estrarre le piste esterne dei cuscinetti (**27**, **24**), con un battitoio ed un martello.o utilizzando un estrattore da commercio.

*Position the wheel hub (**26**) on a flat surface and take the seal ring (**28**) out with a lever.*
***Note**: this is a destructive operation for the seal ring.*
*Take the bearing cups (**27**, **24**) out, using a hammer and a suitable drift or using a suitable extractor.*

10



Rimuovere le viti di fissaggio del perno snodo superiore ed inferiore.
Pericolo: prima di rimuovere i perni snodo, assicurare la calotta con una cinghia o una fune ad un paranco od altro sistema di sostegno.
Rimuovere i perni.
Nota: recuperare le molle a tazza e lo spessore dall'assale.

Remove the fastening screws from the upper and lower king pin.
***Danger:** before removing the king pins, secure the swivel housing with a belt or a rope to a hoist or any other supporting device.*
Remove the king pins.
***Note:** collect the belleville washers and the shim.*

11



Sfilare la calotta dal trave e dal semiasse corto del doppio giunto.
Posizionare la calotta su di una superficie piana ed estrarre l'anello di tenuta con una leva.
Nota: operazione distruttiva per l'anello di tenuta.
Girare la calotta ed estrarre la bronzina utilizzando un battitoio ed un martello.

Remove the swivel housing from the axle beam and from the short shaft of the U-Joint.
*Position the swivel housing on a flat surface and take the seal ring out with a lever. **Note**: this is a destructive operation for the seal ring.*
Turn the swivel housing and take the bush out, using a drift and a hammer.

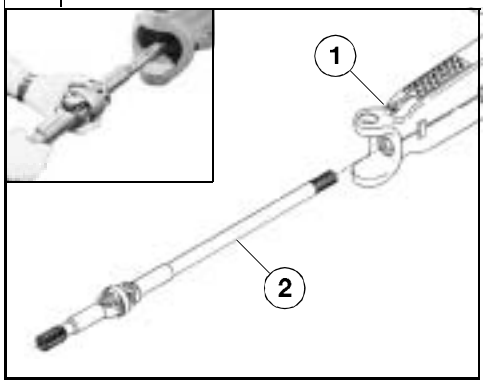
D.6 Smontaggio gruppo trave

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.6 Axle beam group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

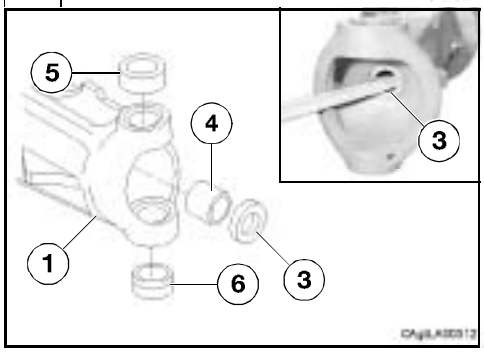
1



Sfilare il doppio giunto (**2**) dal trave (**1**).

*Remove the U-Joint (**2**) from the axle beam (**1**).*

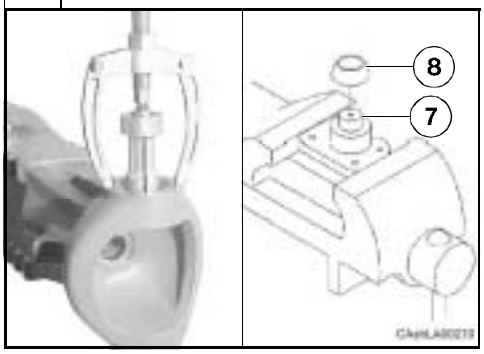
2



Estrarre l'anello di tenuta (**3**) dal trave (**1**) con una leva.
Nota: è un'operazione distruttiva per l'anello di tenuta.
Rimuovere la bronzina (**4**) dal trave con estrattore da commercio.
Nota: esaminare la bronzina prima della rimozione ed eseguire la sua sostituzione solo se le condizioni di usura lo richiedono.

*Take the seal ring (**3**) out of the axle beam (**1**) with a lever.*
***Note:** this is a destructive operation for the seal ring.*
*Remove the bush (**4**) from the beam with a suitable extractor.*
***Note:** examine the bush before the removal and replace it only if the wear conditions require this.*

3



Estrarre le boccole superiori (**5**) ed inferiori (**6, 8**) dalle sedi dei perni snodo e dai perni snodo (**7**) con estrattore da commercio.

*Take the upper (**5**) and lower (**6, 8**)bushes out of the king pin housings (**7**) and out of king pin with a suitable extractor.*

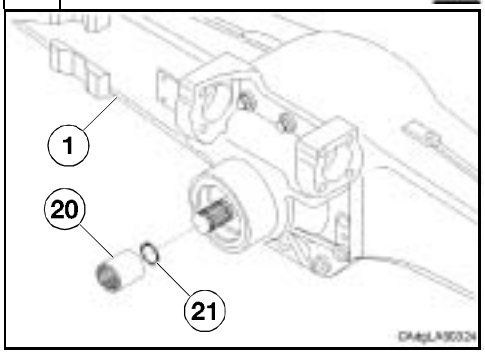
D.7 Smontaggio gruppo supporto differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.7 Differential support group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

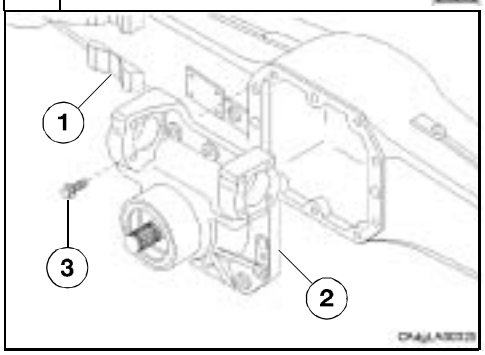
1



Rimuovere il manicotto scanalato (**20**).
Se necessario rimuovere l'anello d'arresto (**21**) dal manicotto (**20**).

*Remove the sleeve (**20**).*
*If necessary remove the lock ring (**21**) from the sleeve (**20**).*

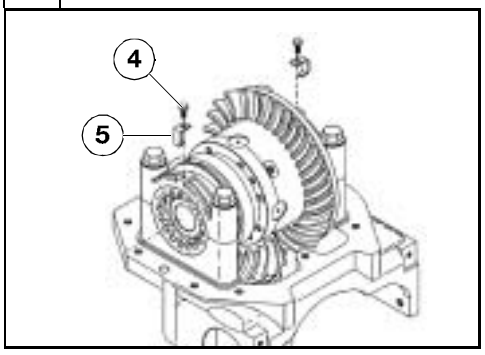
2



Svitare e togliere le viti di fissaggio (**3**) ed estrarre il supporto differenziale (**2**) dal corpo trave (**1**).
Attenzione: sostenere il supporto differenziale con una fune o con un sostegno adatto.
Nota: annotare la posizione delle viti rimosse.

*Loosen and remove the screws (**3**) on the differential support (**2**).*
*Remove the differential support (**2**) from the axle housing (**1**).*
***Warning:** support the differential support with a rope or other appropriate means.*
***Note:** remember the fastening screws position.*

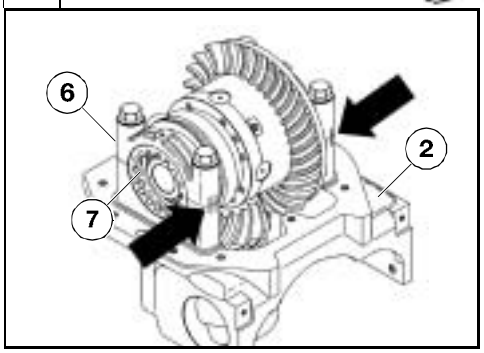
3



Togliere le viti (**4**) per rimuovere i 2 fermi ghiera (**5**).

*Loosen and remove the screws (**4**) to take out the two ring nut retainers (**5**).*

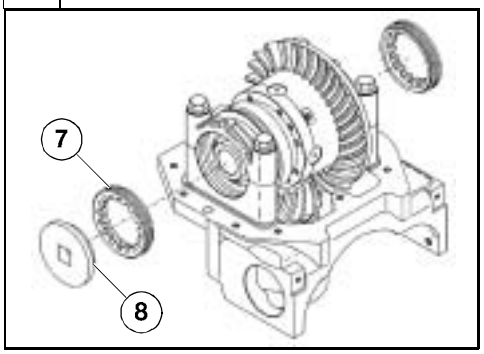
4



Prima di togliere le semicravatte (**6**), fare dei segni di riferimento indelebili sulle stesse e sul supporto differenziale in modo da non invertirle o rovesciarle in fase di rimontaggio. Fare dei segni di riferimento anche tra le ghiere (**7**) e il supporto differenziale (**2**).

*Before removing the bolts (**6**), mark both half-collars and the differential support with permanent reference marks to avoid inverting them during re-assembly. Mark the area between the ring nuts (**7**) and the differential support (**2**) as well.*

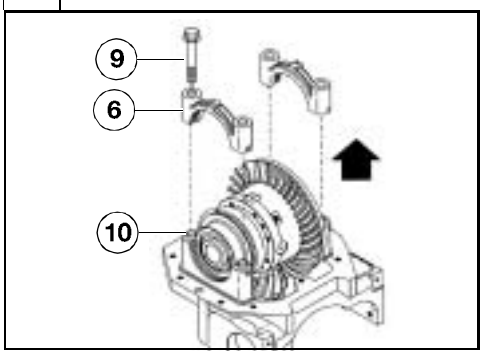
5



Svitare le due ghiere di registro (**7**) con l'attrezzo CA119030 (**8**) ed una chiave.

*Unscrew the adjuster ring nuts (**7**) using tools CA119030 (**8**) and a wrench.*

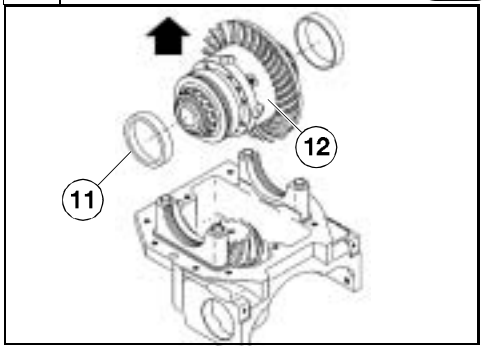
6



Svitare le 4 viti (**9**) e togliere le 2 semicravatte (**6**).
Nota: verificare che le bussole (**10**) rimangano nelle rispettive sedi.

*Remove the 4 screws (**9**) and remove both half-collars (**6**).*
***Note:** check that the bushes (**10**) remains in their housings.*

7



Rimuovere la scatola differenziale (**12**).
Recuperare le piste esterne dei cuscinetti (**11**).
Attenzione: non invertire le piste esterne dei cuscinetti se non vengono sostituiti.

*Take out the differential case (**12**).*
*Collect from ring gear side the cup bearings (**11**).*
***Warning:** don't mismatch the cup bearings if they are not to be replaced.*

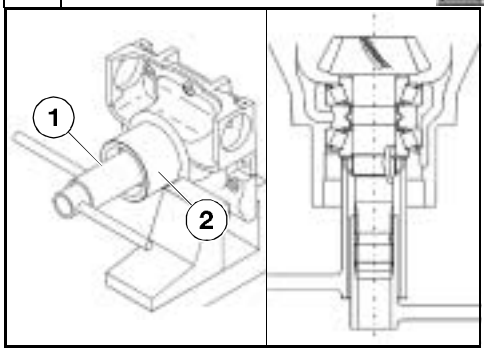
D.8 Smontaggio gruppo pignone

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.8 Pinion group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

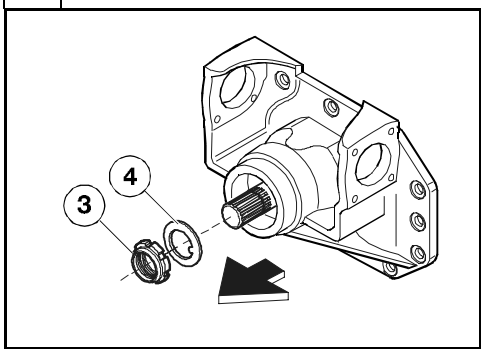
1



Fissare in morsa il gruppo differenziale (**2**).
Svitare la ghiera di serraggio utilizzando le attrezzature CA715080 e CA715081 (**1**).
Nota: Operazione distruttiva per la ghiera.

*Fit the differential support (**2**) in a vise.*
*Unscrew the lock nut using special tools CA715080 and CA715081 (**1**).*
***Note:** This operation will irretrievably damage the ring nut.*

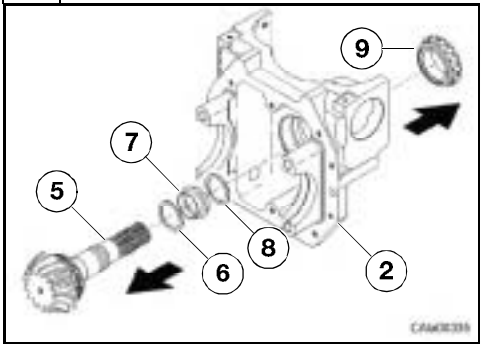
2



Togliere la ghiera (**3**) e recuperare la rondella fermo-ghiera (**4**).

*Remove the ring nut (**3**) and collect its retaining washer (**4**).*

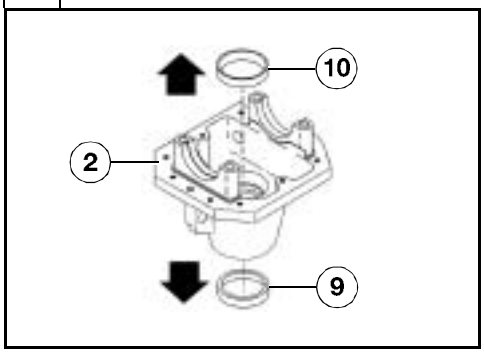
3



Battere con un martello di materiale tenero sul codolo per sfilare il pignone conico (**5**).
Attenzione: non lasciar cadere il pignone.
Recuperare le rondelle (**6, 8**), il distanziale elastico (**7**) e la pista interna (**9**) del cuscinetto a rulli conici.

*Tap the shaft with a soft hammer to remove the bevel pinion (**5**).*
***Warning:** take care not to drop the pinion.*
*Collect the washers (**6, 8**), the collapsible spacer (**7**) and the inner cone (**9**) of the tapered roller bearing.*

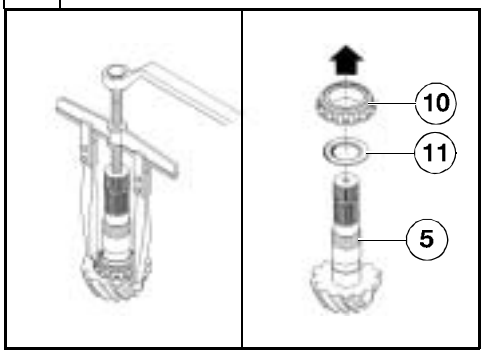
4



Posizionare su di una superficie piana stabile il supporto differenziale (**2**) come in figura, ed estrarre le piste esterne dei cuscinetti a rulli conici (**10**, **9**) con un battitoio ed un martello.

*Place the differential support (**2**) on a flat surface as shown in the figure and remove the outer cups of the taper roller bearing (**10, 9**) using a drift and a hammer.*

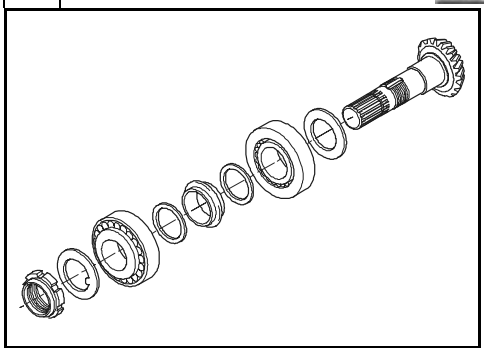
5



Per togliere la pista interna del cuscinetto a rulli conici (**10**) dal pignone conico (**5**), utilizzare un estrattore di presa da commercio.
Recuperare lo spessore (**11**) sottostante.

*To remove the inner cone of the tapered roller bearing (**10**) of the pinion (**5**), use a standard extractor.*
*Collect the underlying shim (**11**).*

6



Controllare le condizioni di tutti i particolari del pignone.
La ghiera ed il collassabile in fase di rimontaggio devono essere sostituiti.

Check all pinion components condition.
The ring nut and the collapsible spacer must be replaced when reassembling the unit.

D.9 Smontaggio gruppo differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.9 Differential group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

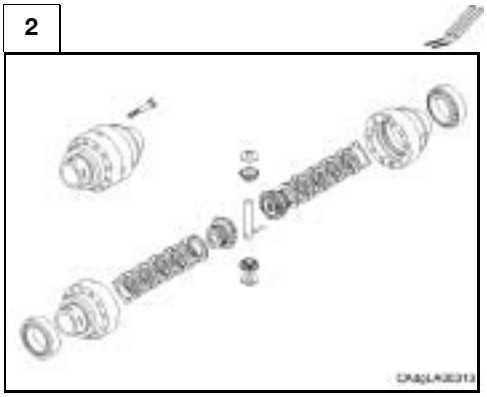
1



Recuperare il differenziale e posizionarlo in una morsa.
Svitare le viti di fissaggio e rimuovere la corona conica.
Attenzione: questa operazione libera anche le due semiscatole differenziale, non disperderne i componenti.

Collect the differential and close it in a clamp.
Unscrew the fastening screws and remove the bevel gear crown.
***Warning:** this will make both differential half boxes free, so take care not to drop the internal components.*

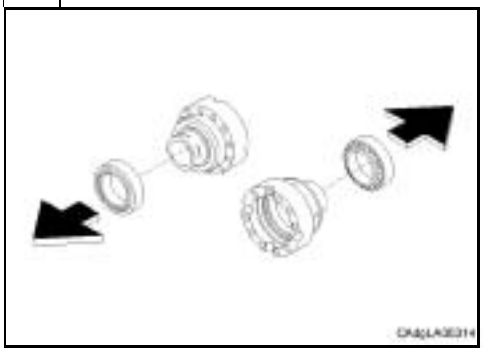
2



Disassemblare la scatola differenziale in due semiscatole complete dei rispettivi elementi.
Nota: fare dei segni di riferimento sulle due semiscatole prima di separarle, per ripristinare la loro posizione relativa in fase di montaggio.
Disassemblare tutti i particolari.
Verificare le condizioni di funzionalità e lo stato di usura dei componenti.

Disassemble the differential box in two half boxes complete with the relative components.
***Note**: mark the two half boxes before disjoining them, in order to reassemble them in the same position as the one before disassembling.*
Disassemble all the components.
Check the operating and wear conditions of the components.

3



Per estrarre il cuscinetto dalla semiscatola differenziale, utilizzare due leve oppure un estrattore a tre punti di presa da commercio.

Take the bearing out of the differential half box, using two levers or a three-hold extractor.

E OPERAZIONI DI MONTAGGIO

E.1 Montaggio gruppo pignone

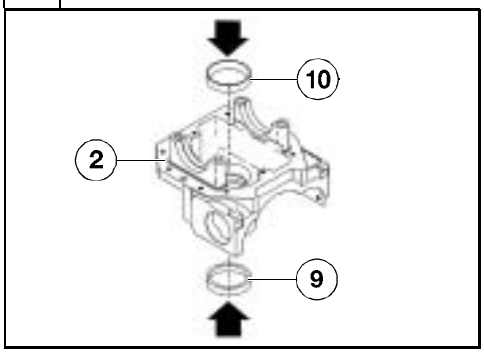
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E ASSEMBLY OPERATION

E.1 Pinion group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

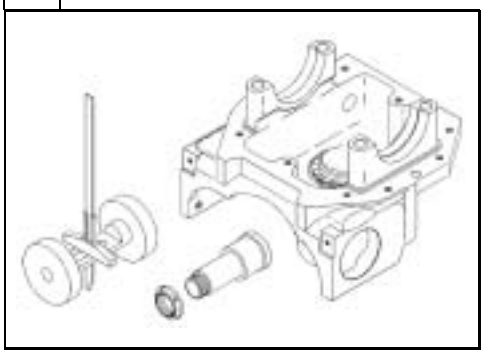
1



Posizionare su un banco di lavoro il supporto differenziale (**2**).
Piantare le piste esterne dei nuovi cuscinetti (**9, 10**), con il battitoio CA119068 ed un martello.

*Place the differential support (**2**) on a workbench.*
*Fit the outer cups of the new bearings (**9, 10**) using the special tool CA119068 and a hammer.*

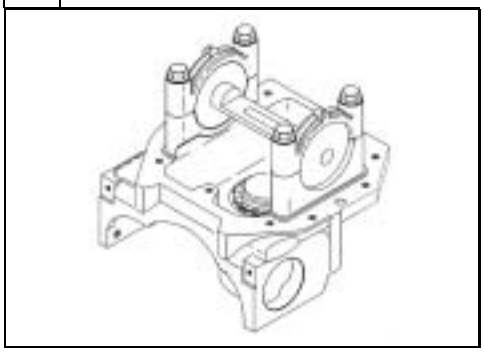
2



Per la rilevazione della distanza si utilizza il kit composto dalle attrezzature dette "falso pignone" CA715450 e "falsa scatola differenziale" CA119205 e CA119206.

In order to measure the distance, use the kit consisting of the special tools called "false pinion" CA715450 *and "false differential box"* CA119205 e CA119206.

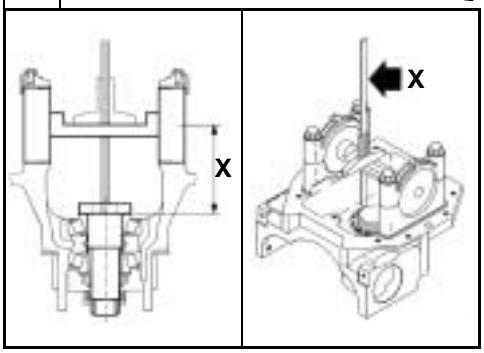
3



Inserire nelle sedi per i cuscinetti appena montate, il falso pignone CA715450 con i rispettivi cuscinetti e la ghiera.
Serrare, senza eccedere, fino ad eliminare il gioco.
Installare gli attrezzi speciali CA119205 e CA119206 sulle sedi della scatola differenziale e bloccare con le semicravatte avvitate (vedi figura).

Insert the false pinion with CA715450, together with its bearings and its ring nut, in the just mounted housings for the bearings.
Tighten without exceeding, till the backlash is eliminated.
Install special tools CA119205 and CA119206 to the differential group supports and screw in the half collar bolts (see figure).

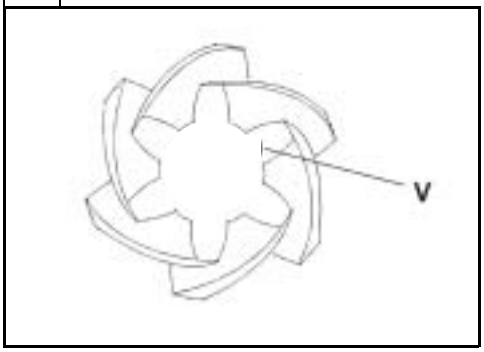
4



Schema montaggio attrezzi CA119205 e CA119206 sulla sede dei cuscinetti del differenziale sul supporto.
Utilizzare un calibro di profondità per rilevare la quota "**X**" (distanza tra l'asse dei cuscinetti della scatola differenziale e il punto di appoggio della testa del pignone, o base del cuscinetto).

Assembly diagram of the tools CA119205 and CA119206 on the bearing differential support seats.
*Use a depth gauge to measure distance "**X**" (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).*

5

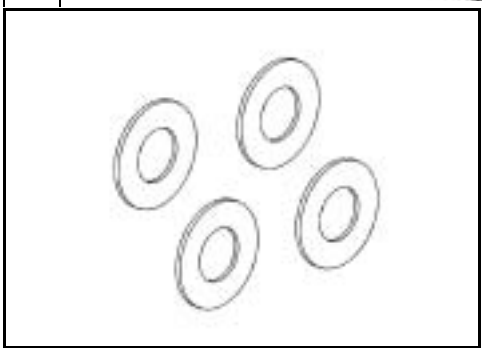


Per determinare lo spessore (**S**) necessario tra il pignone ed il cuscinetto è sufficiente sottrarre dal valore misurato (**X**) il valore stampigliato (**V**) sulla testa del pignone (**V**=distanza conica prescritta).

S=X-V

*In order to determine the necessary thickness (**S**) between the pinion and the bearing, subtract the value (**V**), stamped on the pinion head (**V**=requested conical distance), from the measured value (**X**).*

6

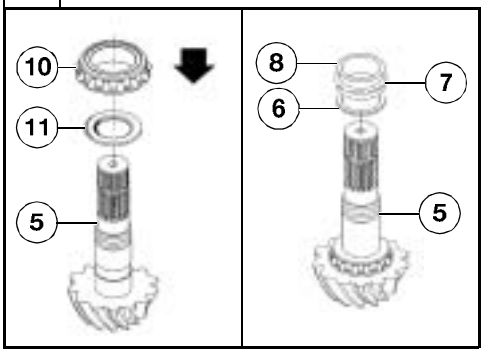


Scegliere tale spessore (**S**) tra la gamma di spessori a disposizione ed inserirlo sul codolo sotto la testa del pignone.
Nota: attenzione al corretto senso di montaggio.

GAMMA SPESSORI - SHIM RANGE										
Spess./Thick.	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4
Q.ty	---	---	---	---	---	---	---	---	---	---

*Select the thickness (**S**) from the range of available shims, and fit to shaft under the pinion head.*
***Note:** take care to assemble correctly.*

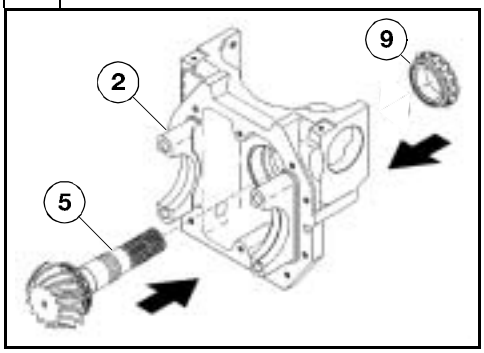
7



Dopo aver scelto ed inserito lo spessore adatto (**11**) con lo smusso rivolto verso l'ingranaggio, piantare il cuscinetto (**10**) nell'albero del pignone (**5**) sotto l'azione di una pressa con il battitoio CA715082, assicurandosi che sia ben assestato.
Inserire gli spessori (**6**, **8**) ed un nuovo distanziale elastico (**7**).
Nota: utilizzare sempre un distanziale elastico nuovo.

*Once you have chosen and inserted the suitable shim (**11**) with the chamfer against the gear, force the bearing (**10**) into the pinion shaft (**5**) end with special tool CA715082 under a press, making sure that it is well set.*
*Insert the shims (**6**, **8**) and a new elastic spacer (**7**).*
***Note:** use always a new elastic spacer.*

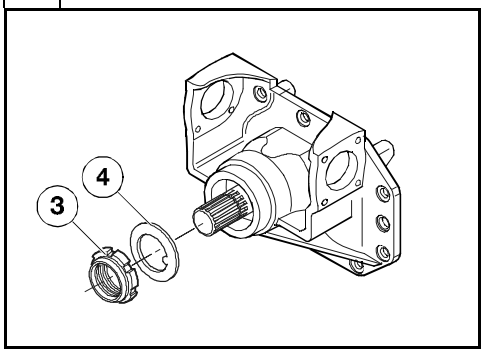
8



Inserire il gruppo pignone conico preassemblato (**5**) nel supporto differenziale (**2**) ed il secondo cuscinetto (**9**) sul codolo pignone, come in figura.
Per eseguire il piantaggio del secondo cuscinetto (**9**), utilizzare il battitoio CA715082 ed un martello.
Si consiglia di contrapporre un azione resistente alla forza battente (ad esempio con una mazza).

*Insert the bevel pinion unit (**5**) into the differential support housing (**2**) and the second bearing cone (**9**) into the pinion end, as in figure.*
*In order to force the second bearing (**9**) into position, use the special tool CA715082 and a hammer.*
It is advisable to offer resistance, for example with a sledge, to the beating force.

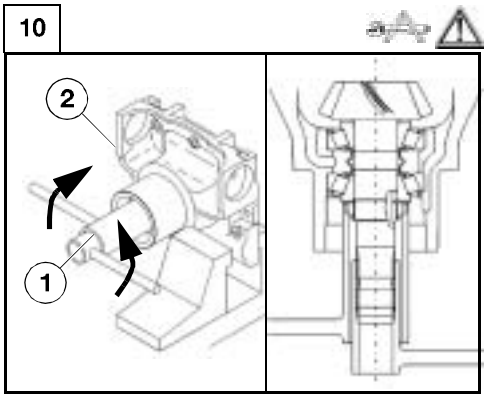
9



Inserire la rondella (**4**) fermo ghiera ed avvitare una nuova ghiera (**3**) di serraggio sul codolo del pignone.

*Insert a ring nut washer (**4**) and screw a new lock ring nut (**3**) on the pinion end.*

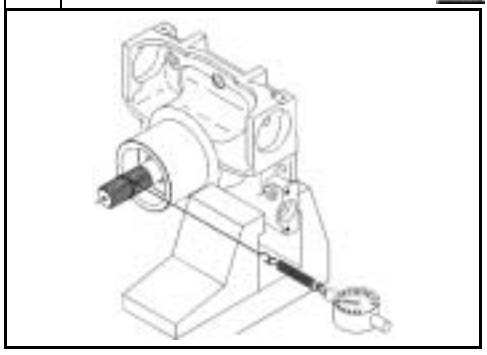
10



Avvitare la ghiera utilizzando le chiavi per ghiera CA715080 e fermo pignone CA715081.
Attenzione: La coppia di serraggio è data dalla misurazione del precarico sui cuscinetti. Serrare la ghiera progressivamente.
Nota: se il serraggio è eccessivo il distanziale elastico dovrà essere sostituito e la procedura ripetuta.
Al momento di verificare il precarico è opportuno dare piccoli colpi con martello in materiale tenero alle estremità del pignone per favorire l'assestamento dei cuscinetti

Screw the ring nut in, using the wrench for ring nut CA715080 and for pinion retainer CA715081.
***Warning:** The torque setting is given by the preloading measurement on bearings. Tighten the ring nut gradually.*
***Note:** if the tightening is excessive, the elastic spacer must be replaced and the procedure repeated. When you check the preloading, it is advisable to beat slightly both pinion ends with a soft hammer, so as to help setting the bearings.*

11

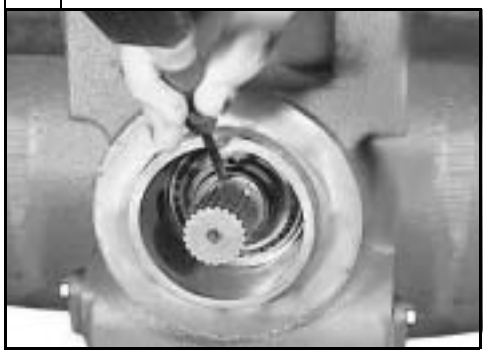


Effettuare la misurazione del precarico (**P**) dei cuscinetti conici del pignone, utilizzando un dinamometro a funicella, avvolta sul codolo scanalato del pignone.
La regolazione si effettua aumentando gradualmente il serraggio della ghiera, facendo attenzione a non eccedere.
Attenzione: tutti i precarichi devono essere misurati senza anello di tenuta.

P=10.5÷15.7 daN

*Carry out the preloading measurement (**P**) of the pinion taper roller bearings, using a dynamometer whose cord is wound on the end of pinion spline.*
The adjustment is carried out by increasing the ring nut torque gradually, being careful not to exceed.
***Warning:** all preloadings must be measured without the seal ring.*

12



Ottenuto il prescritto valore di precarico, cianfrinare la ghiera utilizzando martello e punzone.

Once the requested preloading value is achieved, caulk the ring nut, using a hammer and a chisel.

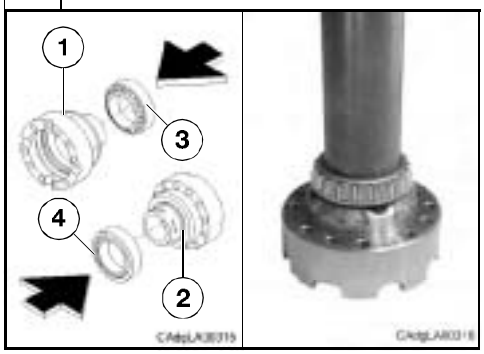
E.2 Montaggio gruppo differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.2 Differential group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

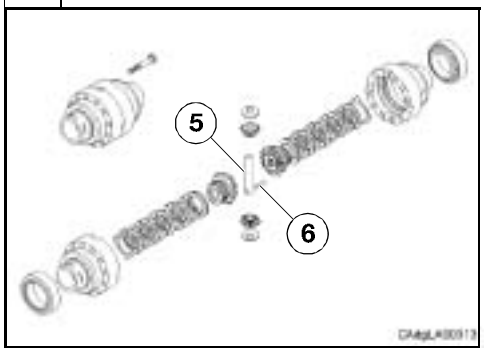
1



Montare le piste interne dei nuovi cuscinetti a rulli conici (**3, 4**) sulle semiscatole (**1, 2**), utilizzando il battitoio CA715083 ed un martello.

*Assemble the cones of the new taper roller bearings (**3, 4**) on the half boxes (**1, 2**), using the special tool CA715083 and a hammer.*

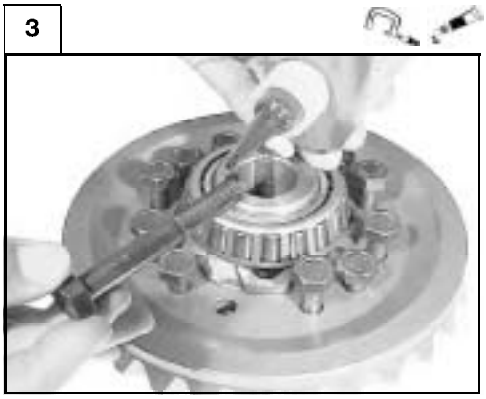
2



Posizionare una semiscatola differenziale sul banco di lavoro ed assemblare con attenzione gli elementi interni (dischi e controdischi, rondelle di rasamento, ingranaggi planetari, satelliti, ralle, perno) come in figura.
Vincolare il perno (**5**) con la spina d'arresto (**6**).
Unire le due semiscatole, allineando i riferimenti praticati sulle stesse.

Position a half box on a workbench and assemble all inner components (discs and counterdiscs, thrust washers, sun gears, planetary gears, thrust washers, spider), as shown in figure.
*Fix the pin (**5**) with the lock pin (**6**).*
Join the two half boxes, aligning the reference marks made upon them.

3



Posizionare la corona conica sulla scatola differenziale.
Applicare Loctite® 270 sul filetto delle viti di serraggio.
Serrare le viti alla coppia prevista (Sez.C.7).

Position the bevel crown gear on the differential box.
Apply Loctite® 270 on screws thread.
Fix the whole tightening the screws to the requested torque (Sec. C.7).

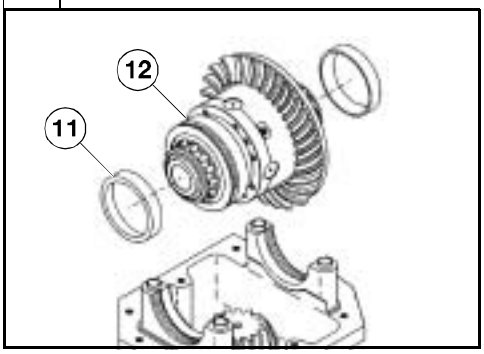
E.3 Montaggio gruppo supporto differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.3 differential support group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

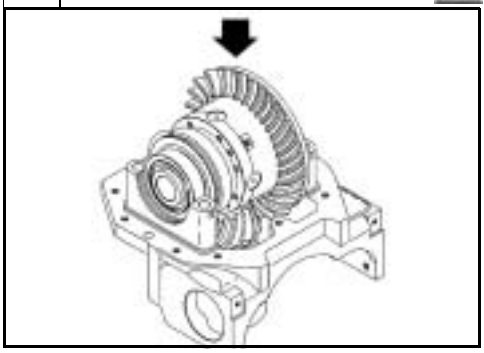
1



Montare gli anelli esterni (**11**) dei cuscinetti sulla scatola differenziale (**12**).

*Assemble the outer cups (**11**) of the taper roller bearings on both differential box bearings (**12**).*

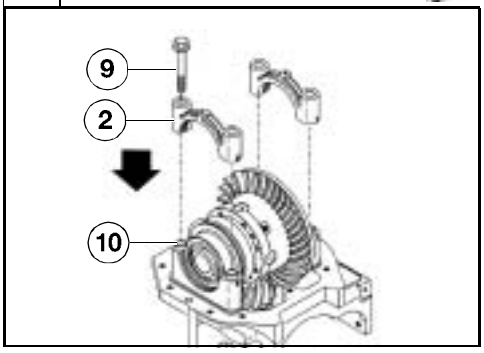
2



Montare la scatola differenziale completa sul supporto differenziale.
Attenzione: non invertire le piste esterne dei cuscinetti e soprattutto verificare il giusto lato di montaggio della corona conica.

Position the complete differential box on the differential support.
***Warning:** take care not to invert the outer cups of the taper roller bearings and check the right side of the bevel crown assembly.*

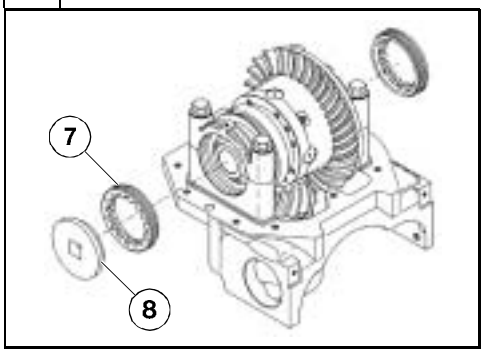
3



Spostare la scatola differenziale in modo da appoggiare la corona conica al pignone.
Verificare che tutte le bussole (**10**) siano nelle relative sedi e posizionare le due semicravatte (**2**) utilizzando i segni di riferimento riportati sulle medesime e sul supporto differenziale.
Fissare le semicravatte con le viti di fissaggio (**9**).

Move the differential group so to place the bevel crown gear on the pinion.
*Check that all bushes (**10**) are in their housings and position both half collars (**2**) on their seats using the previously traced reference marks.*
*Lock both collars with their fastening bolts (**9**).*

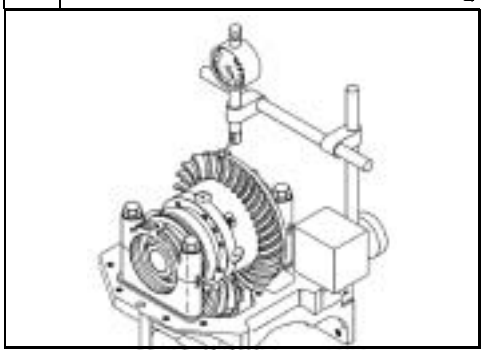
4



Montare ed avvitare le due ghiere di registrazione (**7**) nel supporto differenziale con gli attrezzi CA119030 (**8**) fino ad eliminare il gioco e precaricare leggermente i cuscinetti del differenziale.
Verificare che i cuscinetti del differenziale siano ben assestati, se necessario dare dei piccoli colpi di assestamento con un martello di materiale tenero.

*Assemble and tighten both adjustment ring nuts (**7**) in the differential support with special tools CA119030 (**8**), till the backlash is eliminated and the differential bearings are slightly preloaded.*
Check that the differential bearings are well settled; if necessary, knock slightly with a soft hammer, in order to properly set the bearings in position.

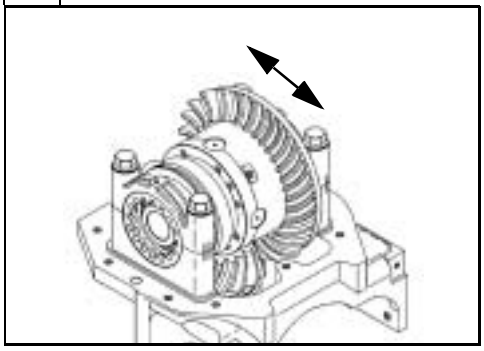
5



Posizionare un comparatore con base magnetica sul supporto differenziale, in modo che il tastatore sia a contatto e a 90° con la superficie di un dente della corona conica.

Position a magnetic-base dial gauge on the differential support, so that the feeler stylus touches the surface of one tooth of the crown gear with a 90° angle.

6



Tenendo fermo il pignone, muovere alternativamente la corona dentata ed annotare il gioco fra pignone e corona, rilevato con il comparatore.
Rilevare il gioco su due o più punti (denti) ruotando la corona in modo da ottenere un valore medio.
Verificare se il valore del gioco rilevato rientra nel campo predefinito:

0.16÷0.22 mm

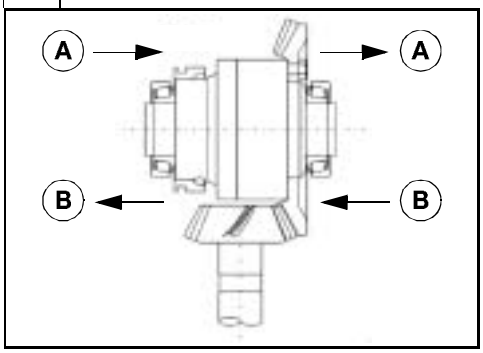
Effettuare la registrazione agendo sulle due ghiere con gli appositi attrezzi CA119030.

Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.
Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.
Check if the measured backlash value is within the requested range:

0.16÷0.22 mm

Carry out the adjustment by operating on the 2 ring nuts with the appropriate tools CA119030.

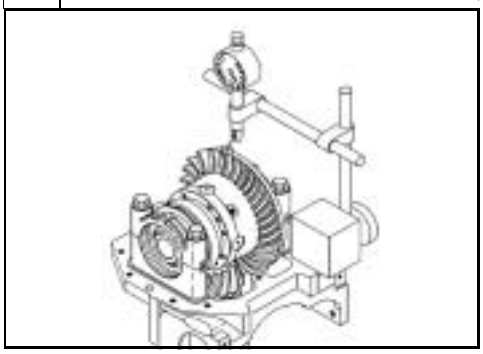
7



Registrare le ghiere ricordando che:
- se **il gioco rilevato è inferiore** al campo di tolleranza dato, svitare la ghiera lato corona ed avvitare l'altra ghiera della stessa quantità (**A**);
- se **il gioco rilevato è superiore** al campo di tolleranza dato, svitare la ghiera lato opposto corona ed avvitare l'altra della stessa quantità (**B**).

Adjust the ring nuts, remembering that:
*- if **the measured backlash is less** than the given tolerance range, unscrew the ring nut on the bevel crown gear side and screw in the opposite one by the same measure (**A**);*
*- if **the measured backlash is greater** than the given tolerance range, unscrew the ring nut on the side opposite to the bevel crown gear, and screw in the other one by the same measure (**B**).*

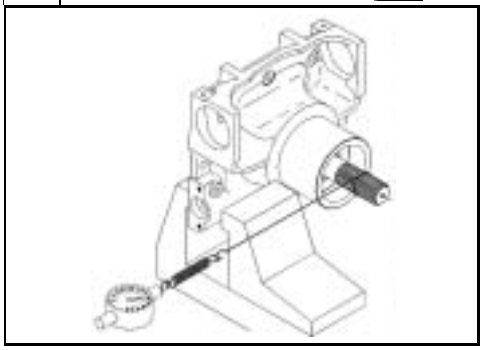
8



Effettuata la registrazione del gioco pignone-corona verificare anche che ci sia un minimo di precarico sui cuscinetti della scatola differenziale
Ripetere l'intera sequenza delle operazioni citate fino al raggiungimento delle condizioni indicate.

Once the adjustment of the pinion-ring gear backlash has been carried out, check also that there is a minimum preloading on the differential box bearings.
Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.

9



Stabilito il gioco pignone-corona, misurare il precarico totale (**T**) dei cuscinetti (sistema pignone-corona), utilizzando un dinamometro a funicella avvolta sul codolo scanalato del pignone. Il valore misurato deve rientrare nel seguente campo:

T=(P+3.9)÷(P+5.9) daN

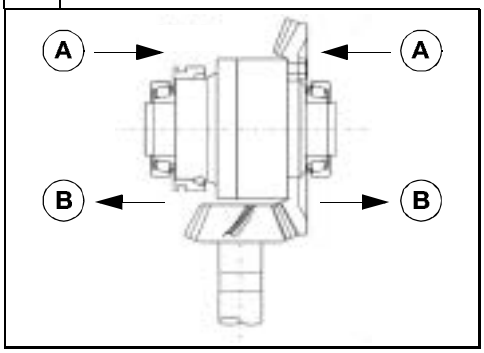
dove **P** è il precarico effettivo misurato sul pignone
Vedi: sez."Montaggio gruppo pignone".
Attenzione: tutti i precarichi vanno misurati senza anello di tenuta.

*Once the pinion-ring gear backlash has been established, measure the total preloading (**T**) of the bearings (pinion-crown bevel gear system), using a dynamometer whose cord is wound on the pinion splined end. The measured value should be within the following range:*

T=(P+3.9)÷(P+5.9) daN

*where **P** is the effectively measured pinion preloading*
***See:** sec. "Pinion assembly".*
***Warning:** all preloadings must be measured without seal ring.*

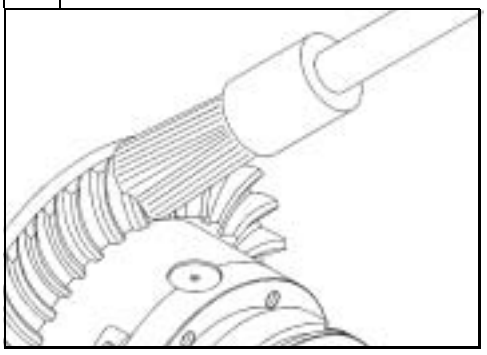
10



Se la misurazione non rientrasse nel campo prescritto, controllare bene l'assemblaggio di ogni singolo componente ed intervenire sulle ghiere di registrazione del supporto differenziale:
- se **il precarico totale è inferiore** al campo dato, avvitare della stessa quantità le due ghiere (**A**), mantenendo inalterato il valore del gioco pignone-corona;
- se **il precarico totale è superiore** al campo dato, svitare della stessa quantità le due ghiere (**B**), mantenendo inalterato il valore del gioco pignone-corona.

If the measurement is not within the requested range, check well the assembly of each component and operate on the adjusting ring nuts of the differential support:
*- if **the total preloading is less** than the given range, screw in both ring nuts by the same measure (**A**), keeping the pinion-ring gear backlash value unchanged;*
*- if **the total preloading is greater** than the given range, unscrew both ring nuts by the same measure (**B**), keeping the pinion-ring gear backlash value unchanged.*

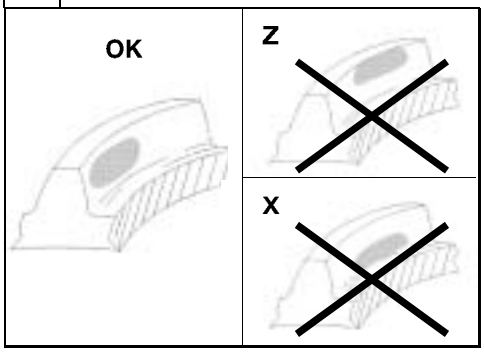
11



NOTA
Per verificare l'impronta di contatto dei denti della coppia conica, sporcare con minio la corona e rilevare il contatto.
L'esame dell'impronta di contatto deve essere eseguito sempre sui denti della corona conica, e su ambedue i fianchi.

NOTE
To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.
The marking test should be always carried out on the ring bevel gear teeth and on both sides.

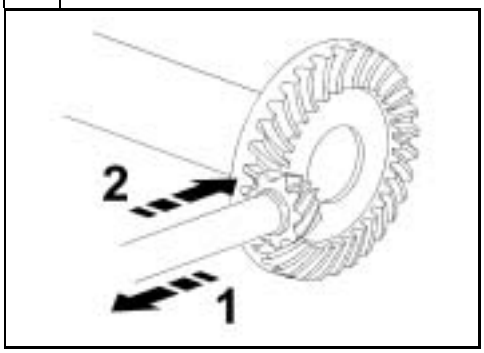
12



OK -> Contatto corretto
Se la registrazione della coppia conica è ben fatta, il contatto delle superfici delle dentature risulterà regolare.
Z -> Eccessivo contatto sulla cresta del dente.
Avvicinare il pignone alla corona ed allontanare poi la corona dal pignone per regolare il gioco.
X -> Eccessivo contatto alla base del dente.
Allontanare il pignone dalla corona ed avvicinare poi la corona al pignone per regolare il gioco.

***OK** -> Correct contact*
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.
***Z** -> Excessive contact on the tooth tip*
Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
***X** -> Excessive contact at the tooth base.*
Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.

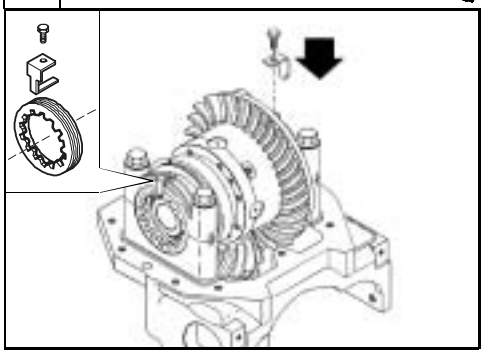
13



Spostamenti per le correzioni:
1 -> spostare il pignone per modifica contatto tipo X
2 -> spostare il pignone per modifica contatto tipo Z

Movements to correct
1 *-> move the pinion for type X contact adjustment*
2 *-> move the pinion for type Z contact adjustment.*

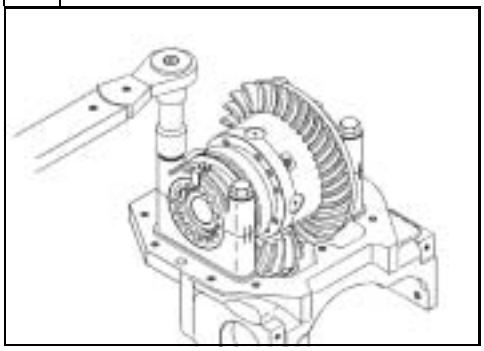
14



Dopo aver completato tutte le operazioni di registro, montare i fermo ghiera registro e le rispettive viti serrandole alla coppia prevista (Sez.C.7) con chiave dinamometrica.

Once all the adjustment operations have been completed, fit the adjuster ring nut retainers and their respective screws, tightening them to the requested torque (Sect. C.7) with a dynamometric wrench.

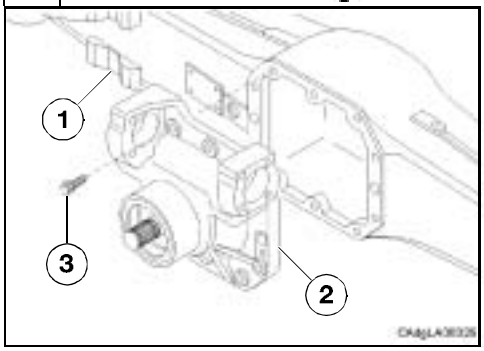
15



Serrare definitivamente le viti delle due semicravatte alla coppia prevista (Sez.C.7), con chiave dinamometrica.

Tighten the bolts of both half collars to the requested torque (Section C.7) with a dynamometric wrench.

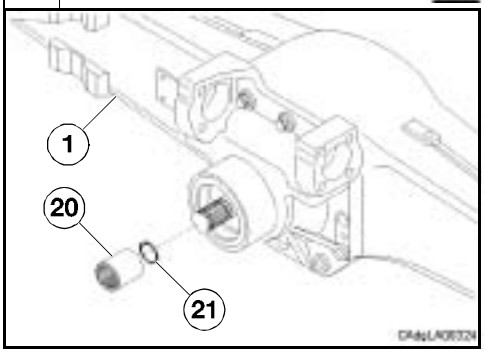
16



Prima di mettere le superfici lavorate a contatto assicurarsi che non ci siano impurità, quindi pulire bene con detergenti appositi.
Stendere un velo di Loctite® 510 sulla superficie di contatto trave/ supporto differenziale.
Montare il supporto differenziale (2) sul trave (1), fissandolo con le viti (**3**) alla coppia prevista (vedi Sez. C.7) con chiave dinamometrica.

Before matching surfaces, make sure they are perfectly clean. Degrease and clean them with appropriate detergents.
Spread a film of Loctite® 510 on the contact surface between the axle beam and the differential support.
*Position the differential support (**2**) on the axle housing (**1**), and tighten the retaining screws (**3**) to the requested torque (Section C.7).*

17



Inserire l'anello d'arresto (**21**) nel manicotto (**20**).
Assemblare il manicotto scanalato (**20**).

*Insert the lock ring (**21**) in the sleeve (**20**).*
*Assemble the sleeve (**20**).*

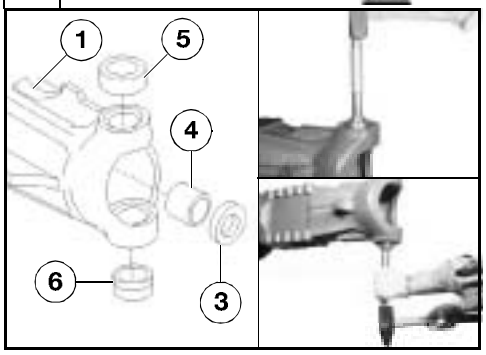
E.4 Montaggio gruppo trave

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.4 Axle beam group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

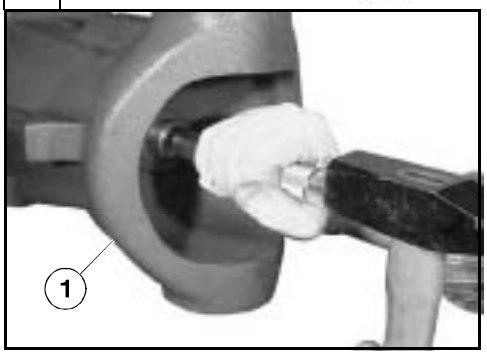
1



Montare la boccola (**5**) del perno snodo superiore nel trave (**1**) utilizzando il battitoio CA119220 ed un martello.
Montare la pista esterna (**6**) della rotula sferica nella sede inferiore sul trave utilizzando il battitoio CA715451.
Nota: per facilitare il montaggio, si consiglia di raffreddare la boccola (**5**) e la pista esterna (**6**) a temperature inferiori a -100°C.
Attenzione: usare dei guanti di protezione.

*Assemble the upper king pin bush (**5**) on the axle beam (**1**) with the special tool CA119220 and a hammer.*
*Insert the cup (**6**) of the ball bearing on the lower part of the axle beam with the special tool CA715451 and a hammer*
***Note:** to make the assembly easier, it is advisable to cool the bush (**5**) and the cup (**6**) of the ball bearing at a temperature lower than 100°C.*
***Warning:** wear safety gloves.*

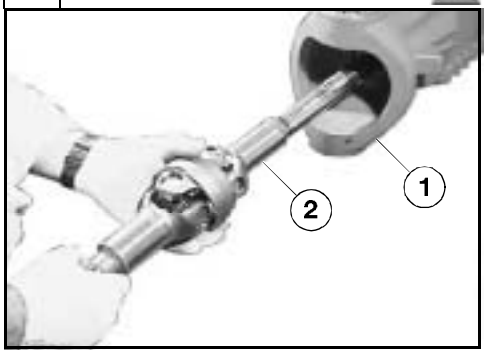
2



Montare nel trave (**1**) la bronzina (**4**) con il battitoio CA715454 ed un martello.
Montare l'anello di tenuta (**3**) nel trave con il battitoio CA715453 ed un martello.
Riempire per la camera dell'anello di tenuta con grasso.

*Assemble the bush (**4**) on the axle beam (**1**) with the special tool CA715454 and a hammer.*
*Assemble the seal ring (**3**) on the beam with the special tool CA715453 and a hammer.*
Fill of the seal ring cavity with grease.

3



Lubrificare la boccola ed il labbro dell'anello di tenuta.
Inserire il doppio giunto (**2**) all'interno del trave (**1**).
Attenzione: non rovinare la tenuta.

Lubricate the bush and the seal ring lip.
*Insert the U-Joint (**2**) inside the axle beam (**1**).*
***Warning:** be careful not to damage the seal.*

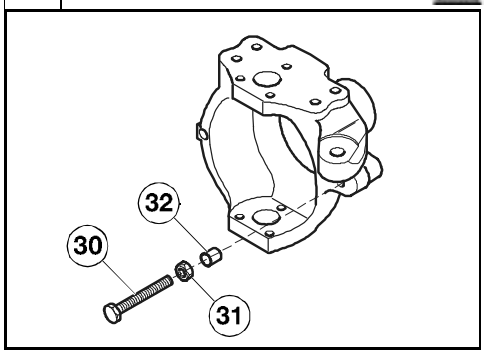
E.5 Montaggio gruppo mozzo ruota

E.5 Wheel hub group assembly

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

Some of the following pictures may not show exactly your axle, but the procedure is the same.

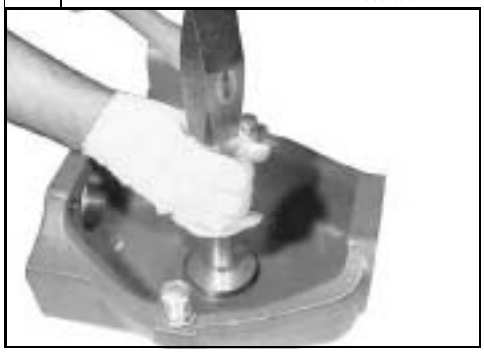
1



Se precedentemente rimosso, rimontare il fermo meccanico di sterzata costituito da: vite (**30**), dado (**31**) e distanziale (**32**).
Attenzione: inserire la boccola distanziale (**32**) sulla vite fra dado e calotta (come in figura); l'assenza del distanziale (**32**) può causare il danneggiamento dell'assale.

*If it has been removed, reassemble the steering mechanical retainer composed by: screw (**30**), nut (**31**) and spacer (**32**).*
***Warning:** insert the spacer bush (**32**) on the screw between the nut and the swivel housing (as in figure); the lack of the spacer (**32**) may produce the axle damage.*

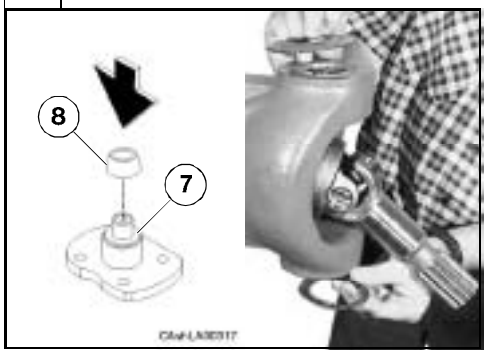
2



Piantare la bronzina nella calotta con il battitoio CA119097 ed un martello o una pressa.
Montare l'anello di tenuta nella calotta con il battitoio CA715360 ed un martello.
Riempire la camera dell'anello di tenuta per con grasso.

Force the bush into the swivel housing with the special tool CA119097 and a hammer or a press.
Assemble the seal ring on the swivel housing with the special tool CA715360 and a hammer.
Fill of the gasket cavity with grease.

3



Posizionare il perno snodo inferiore (**7**) su di un banco di lavoro e montare la pista interna (**8**) della rotula sferica con il battitoio CA715451 sotto l'azione di una pressa.
Ingrassare bene le sedi dei perni snodo con grasso specifico (Sez.C.4)
Posizionare lo spessore e le molle a tazza sulle sedi dei perni snodo superiori.
Posizionare le molle a tazza sulle sedi dei perni snodo inferiori.

*Position the lower king pin (**7**) on a workbench and assemble the cone (**8**) of the spherical joint with the special tool CA715451 under a press.*
Grease well the king pin housings with specific grease (Sec.C.4).
Position the shim and the Belleville washers on the upper king pin housings.
Position the Belleville washers on the lower king pin housings.

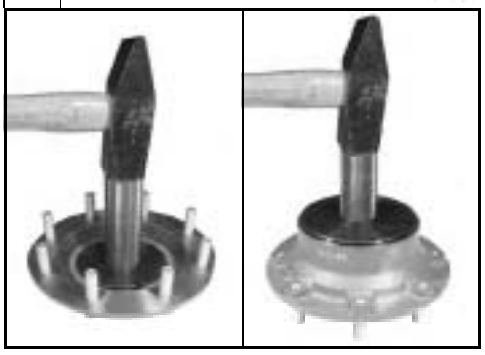
4



Pericolo: assicurare il gruppo calotta con una fune.
Lubrificare il labbro dell'anello di tenuta nella calotta ed avvolgere l'estremità scanalata del semiasse con del nastro adesivo sottile, per non danneggiare l'anello di tenuta. A montaggio avvenuto, rimuovere tutto il nastro protettivo.
Inserendo il semiasse nella calotta, assemblare la calotta al trave.
Montare i due perni snodo inferiore e superiore e serrare le viti del supporto con chiave dinamometrica alla coppia prevista (Sez.C.7).
Nota: assicurarsi che le molle a tazza rimangano nella loro posizione.

Danger: *secure the swivel housing group with a rope.*
Lubricate the seal ring lip and protect the splined end of the axle shaft by winding it with thin adhesive tape to avoid damage to the seal ring.
After assembly, remove completely the adhesive tape.
Assemble the swivel housing on the axle beam.
Assemble the two king pins, the upper and the lower, and tighten the retaining screws with dynamometric wrench to the requested torque (Sec.C.7).
Note: *make sure that the Belleville washers remain in their position.*

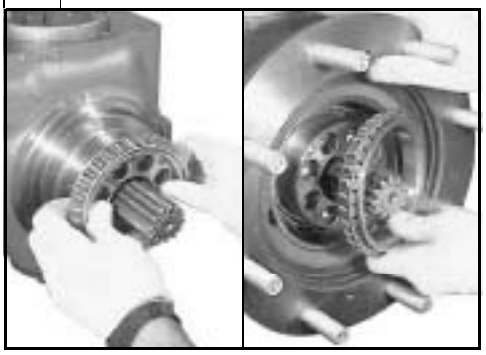
5



Posizionare il mozzo ruota su di un banco di lavoro e piantare le due piste esterne dei cuscinetti a rulli conici utilizzando l'attrezzo speciale CA715085 sotto l'azione di una pressa o di un martello.
Inserire l'anello di tenuta nel mozzo ruota con il battitoio CA715099 ed un martello.

Position the wheel hub on a workbench and force both cups of the taper roller bearings in position with the special tool CA715085 under a press or with a hammer.
Insert the seal ring into the wheel hub with the special tool CA715099 and a hammer.

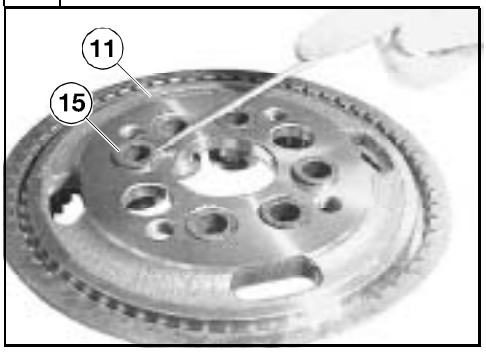
6



Montare la pista interna del cuscinetto a rulli conici sul codolo della calotta.
Montare il mozzo ruota sulla calotta e posizionare l'altra pista interna del cuscinetto a rulli conici.

Assemble the cone of the taper roller bearing on the swivel housing end.
Assemble the wheel hub on the swivel housing and fit the other cone of the taper roller bearing in position.

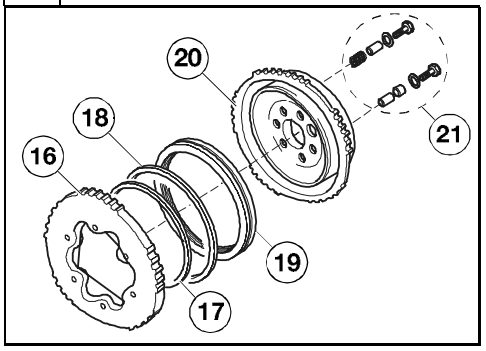
7



Posizionare il mozzo fermo corona (**11**) sul banco di lavoro e piantare le boccole (**15**) a filo della superficie con battitoio CA715086.
Almeno due boccole (diametralmente opposte) devono essere piantate leggermente oltre il filo per essere utilizzate come spine di centraggio.

*Position the wheel carrier (**11**) on a workbench and force the bushes (**15**) to the carrier surface level with the special tool CA715086.*
At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.

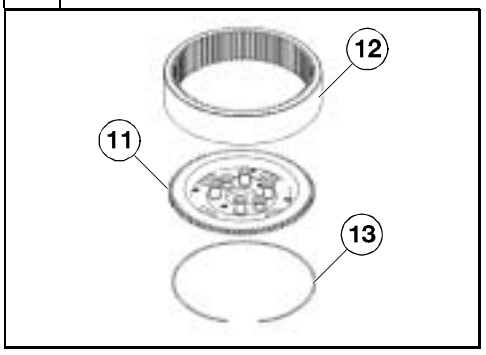
8



Montare nuovi anelli QUAD-Ring (**17, 18**) sul pistone (**19**).
Inserire il pistone (**19**) nel mozzo fermo corona (**20**).
Assemblare il controdisco freno (**16**) al mozzo-fermo corona (**20**) con le viti di fissaggio del kit self-adjust (**21**).

*Assemble new QUAD-Rings (**17, 18**) to the piston (**19**).*
*Insert the piston (**19**) in the wheel carrier (**20**).*
*Screw the kit self-adjust fastening screws (**21**) to assembly the separator disk (**16**) to the wheel carrier (**20**).*

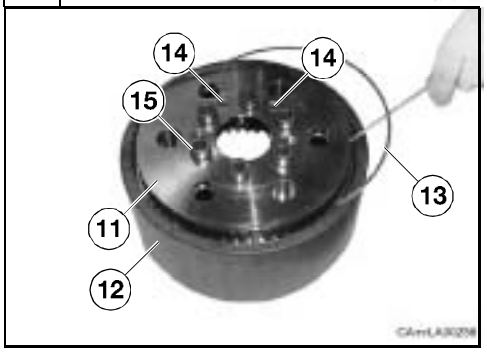
9



Assemblare il gruppo mozzo fermo corona (**11**) e corona epicicloidale (**12**) con lo speciale anello d'arresto (**13**).

*Assemble the wheel carrier (**11**) and epicyclic ring gear (**12**) group with the special locking ring (**13**).*

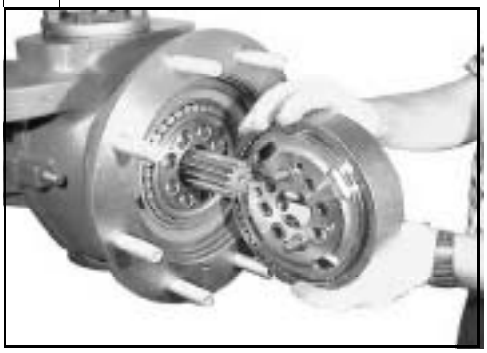
10



Inserire due nuovi anelli OR (**14**) ingrassati nelle rispettive sedi sul mozzo fermo corona (**11**).

*Insert two greased new O-Rings (**14**) in the wheel carrier (**11**).*

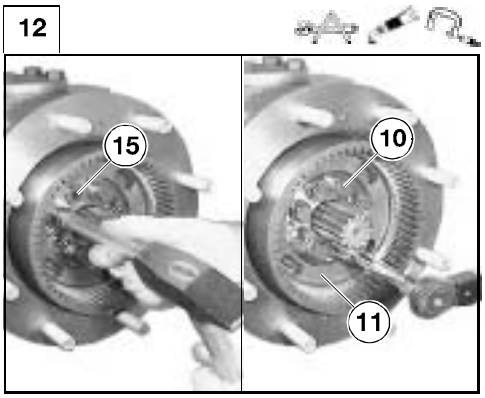
11



Nota: verificare il corretto posizionamento degli OR (**14**).
Montare il gruppo mozzo fermo corona sul mozzo ruota utilizzando le due boccole sporgenti come spine di centraggio.
Avvitare le relative viti fino a portare il gruppo a contatto con il mozzo ruota.

Note: *check O-Rings (**14**) position.*
Assemble the wheel carrier group on the wheel hub using the two projecting bushes as dowel pins and screw the relative screws in order to put in contact the ring bevel gear with the wheel hub.

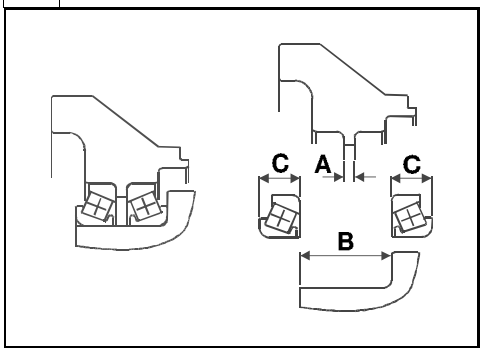
12



Piantare con il battitoio CA715086 ed un martello tutte le bussole (**15**) di centraggio mozzo fino a battuta.
Applicare Loctite® 270 sul filetto delle viti di fissaggio (**10**).
Montare le viti (**10**) di fissaggio mozzo fermo corona (**11**) e serrare alla coppia prevista (Sez. C.7).

*Force all the hub dowel bushes (**15**) completely with the special tool CA715086 and a hammer.*
*Apply Loctite® 270 on fastening screws (**10**) thread.*
*Assemble the wheel carrier (**11**) fastening screws (**10**) and tighten to the requested torque (Sec. C.7).*

13

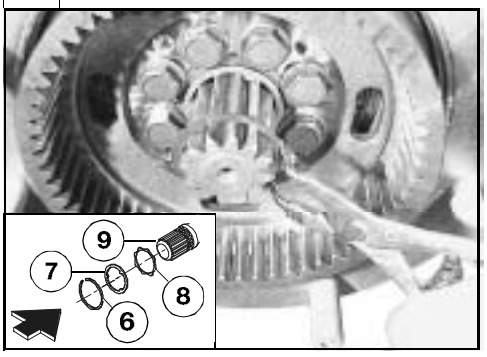


La speciale esecuzione "Set Right" dei cuscinetti non richiede specifiche registrazioni del precarico o del gioco. In ogni caso, prima del montaggio di nuove parti, controllare le dimensioni indicate.

A= 11.975 ÷ 12.025
B= 52.229 ÷ 52.279
C= 20.000 ÷ 20.100

The special operation "Set Right" of the bearings does not require specific registrations of preloading or backlash. Anyway, before assembling new components check the indicated dimensions.

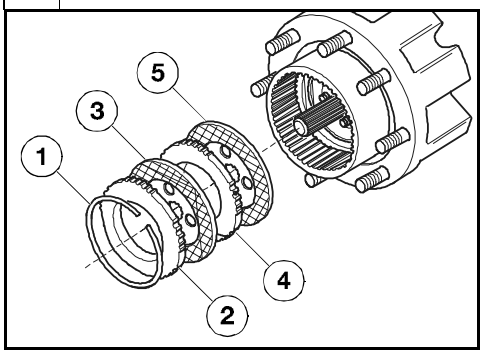
14



Infilare nel semiasse (**9**) del doppio giunto le rondelle di rasamento (**7, 8**) e montare l'anello d'arresto (**6**), inserendolo all'estremità del mozzo scanalato e spingendolo in sede.

*Slide the washers (**7, 8**) into the U-Joint shaft (**9**) and lock it with the retaining ring (**6**), inserting it at the end of the splined hub and pushing it into its housing.*

15



Inserire i controdischi (**2**, **4**) e i dischi freno (**3**, **5**) nell'ordine illustrato in figura.
Bloccare i dischi con l'anello di arresto (**1**).

*Insert separator disks (**2**, **4**) and brake disks (**3**, **5**), as in figure.*
*Lock the disks with the lock ring (**1**).*

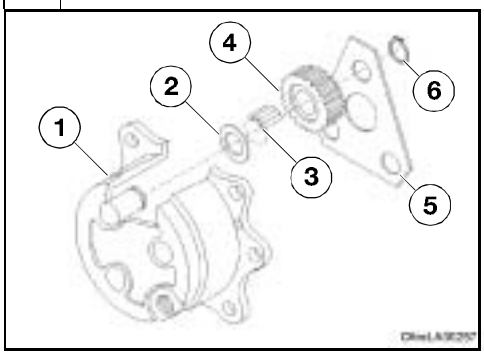
E.6 Montaggio gruppo riduttore epicicloidale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.6 Epicyclic reduction gear assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

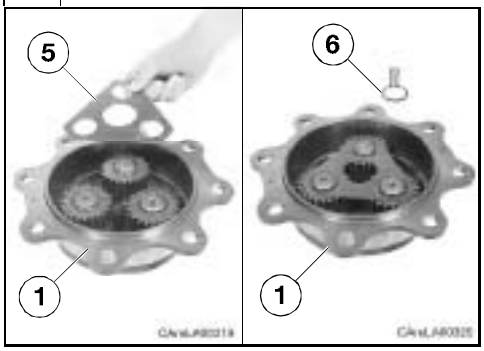
1



Recuperare tutti i componenti del riduttore epicicloidale: il treno portasatelliti (**1**), le ralle (**2**), gli ingranaggi satellite (**4**) ed i relativi rullini (**3**), la piastra triangolare (**5**) e gli anelli d'arresto (**6**) di ogni perno.
Nota: con nuovi satelliti è consigliabile montare rullini nuovi.

*Collect all epicyclic reduction gear parts: the planetary carrier (**1**), the thrust washers (**2**), the roller bearings (**3**), the planetary gears (**4**), the triangular plate (**5**) and the Seeger rings (**6**) of every pin.*
***Note:** with new planetary gears is advisable to assembly new roller bearings.*

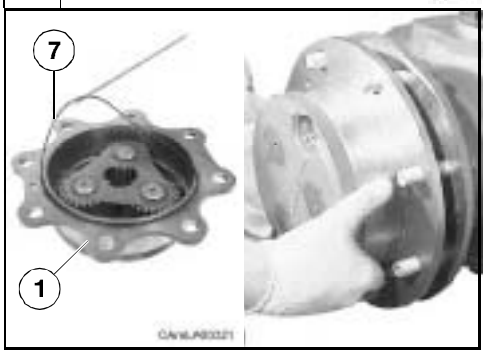
2



Posizionare su un banco di lavoro il treno porta satelliti.
Inserire nei perni del treno porta satelliti le ralle (**2**) ed i satelliti epicicloidali (**4**).
Nota: Inserire i rullini (**3**) nei satelliti (**4**).ingrassare bene i rullini.
Vedi: sez.C.4.
Montare la rondella di forma triangolare (**5**) e gli anelli di arresto (**6**).

Position the planetary carrier on a workbench.
*Insert the thrust washers (**2**) and the epicyclic gears (**4**) in the planetary carrier pins.*
***Note:** Insert the needles bearing (**3**) in the epicyclic gears (**4**).grease well the needles.*
***See:** sec.C.4.*
*Assemble the triangular plate (**5**) and the related Seeger rings (**6**).*

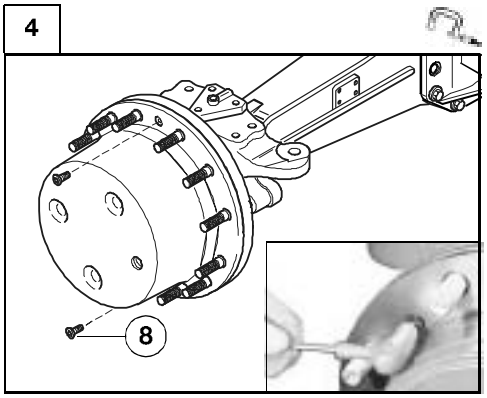
3



Inserire un nuovo anello O-Ring (**7**) sul treno portasatelliti (**1**).
Montare il gruppo riduttore epicicloidale sul mozzo ruota.

*Assemble a new O-ring (**7**) on the planetary carrier (**1**).*
Assemble the epicyclic reduction gear on the wheel hub.

4



Avvitare le viti di fissaggio (**8**) e serrare con chiave dinamometrica alla coppia prevista (Sez. C.7).

*Tighten the fastening screws (**8**) with a dynamometric wrench to the requested torque (Sec. C.7).*

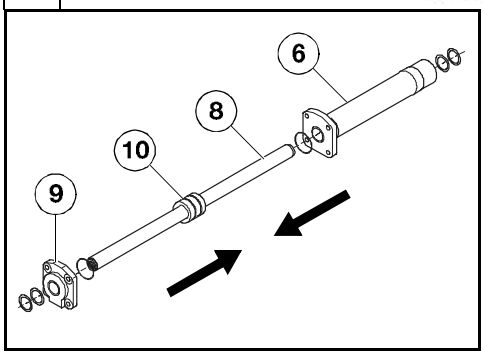
E.7 Montaggio gruppo cilindri sterzo

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.7 Steering cylinders group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

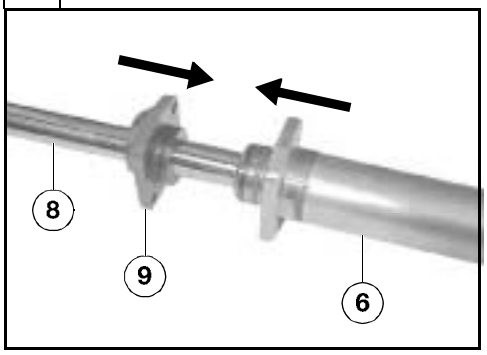
1



Montare nuovi anelli di tenuta: sulla testata del cilindro (**9**), sul pistone (**10**) e nel corpo cilindro (**6**).

*Assemble new seal rings: on the cylinder head (**9**), on the piston (**10**) and on the cylinder body (**6**).*

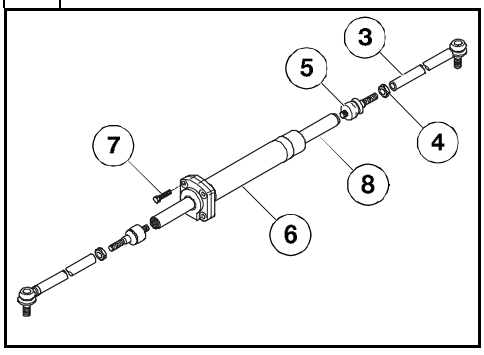
2



Infilare lo stelo (**8**) premontato nel corpo cilindro (**6**).

*Slide pre-assembled rod (**8**) into the cylinder body (**6**).*

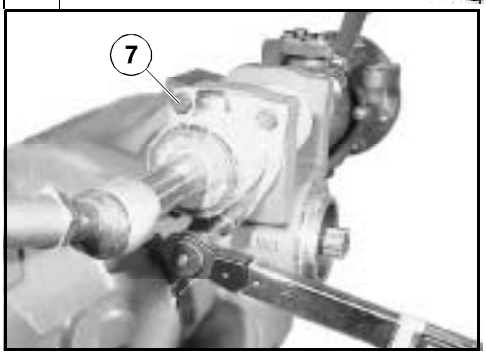
3



Montare alle estremità dello stelo (**8**) del martinetto: lo snodo sferico (**5**), il dado (**4**), le aste guida (**3**) serrandole con chiave dinamometrica alla coppia prevista (Sez.C.7).

*Fit the guide rods (**3**), the spherical joint (**5**) and the nut (**4**) to the ends of the cylinder rod (**8**) then tighten with dynamometric wrench to the requested torque (Sec. C.7).*

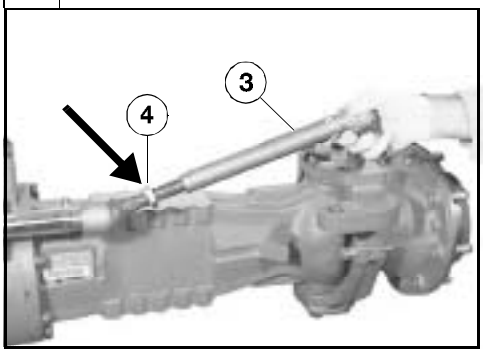
4



Installare sul corpo centrale il cilindro sterzo, completo di aste guida già montate sullo stelo.
Montare e serrare le viti di fissaggio del cilindro sterzo con chiave dinamometrica alla coppia prevista (Sez.C.7).

Install the steering cylinder on the central body, with guide rods already assembled on the stem.
Assemble and tighten the steering cylinder fastening screws with dynamometric wrench to the requested torque (Sec. C.7).

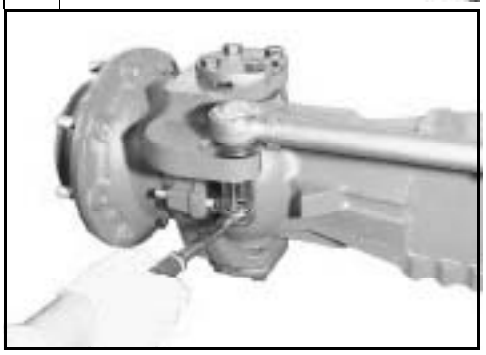
5



Posizionare le calotte in asse con l'assale (mozzi ruota paralleli).
Avvitare l'asta guida (**3**) di una quantità tale da poter infilare lo snodo sferico sul braccetto della calotta.
Nota: è importante svitare il dado di bloccaggio (**4**) per eseguire questa operazione.

Align the swivel housings with the axle (parallel wheel hub).
*Screw the guide rod (**3**) so that the ball joint can be inserted into the swivel housing arm.*
***Note**: it is important to unscrew the locking nut (**4**) to carry out this operation.*

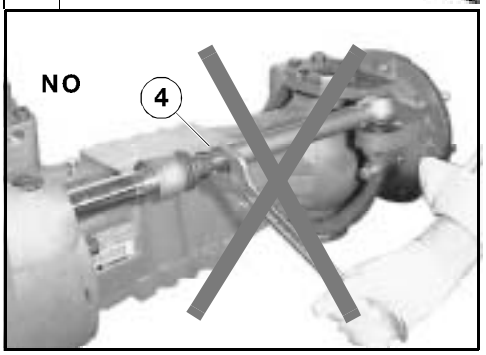
6



Inserire lo snodo sferico nella propria sede sulla calotta.
Montare e serrare il dado di fissaggio con chiave dinamometrica alla coppia prevista (Sez.C.7).

Insert the ball joint into its own housing on the swivel housing.
Assemble and tighten the lock nut with dynamometric wrench to the requested torque (Sec. C.7).

7



Non avvitare il dado di bloccaggio dell'asta guida fino a quando non si è effettuata la registrazione della convergenza.

Screw in the lock nut of the guide rod only when the toe-in adjustment has been carried out.

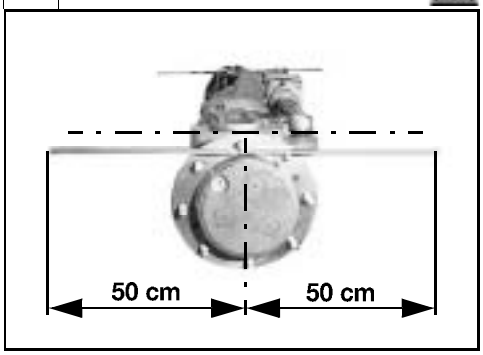
E.8 Verifica della convergenza

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.8 Toe-in adjustment

Some of the following pictures may not show exactly your axle, but the procedure is the same.

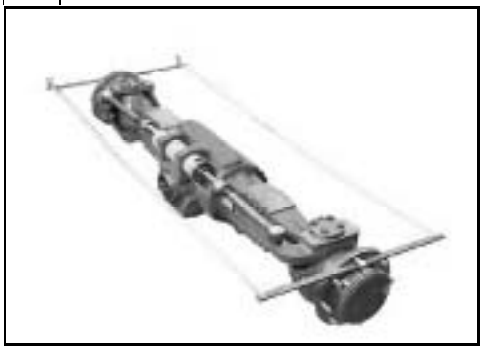
1



Montare 2 barre lineari uguali, lunghe 1 m, sui lati ruota, bloccandole con due dadi, sui prigionieri mozzo ruota.
Attenzione: Le due barre devono essere fissate alla loro mezzeria, in modo che siano perfettamente perpendicolari alla superficie di appoggio e parallele all'asse del pignone. Allineare al meglio le due barre.

Put two equal one-meter-long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.
***Warning**: The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis. Align the two bars.*

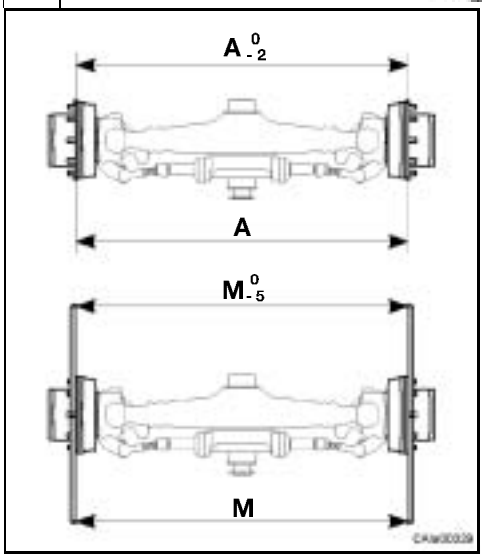
2



Rilevare con un metro a nastro, dai punti più estremi delle barre, la distanza millimetrica (**M**).
Nota: Prendere il valore minimo oscillando il punto di misurazione.

*Measure the distance in mm (**M**) between the bars ends with a tapeline.*
***Note:** Keep the minimum value, swinging the measurement point.*

3



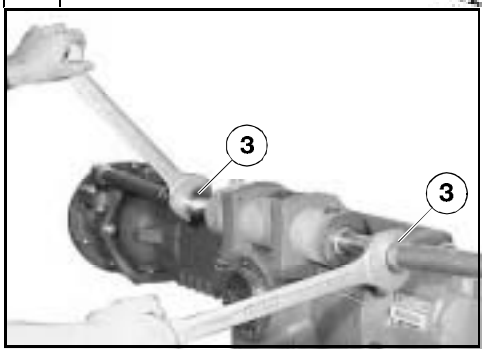
Verificare che la differenza tra le misurazioni alle estremità dei diametri dei mozzi ruota rientri nel campo di tolleranza richiesto.
Vedi: "Convergenza" in sez.C.4.
Il valore della convergenza nominale (**A**) è riferito al diametro esterno della flangia dei mozzi ruota, quindi il valore misurato (**M**) alle estremità delle barre deve essere rapportato alle loro proporzioni rispetto a tale diametro

converg. nominale (sez.C.4) = A $^{0}_{-2}$ ⟶ converg. misurata = M $^{0}_{-5}$

Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.
***See:** "Toe-in" in sec.C.4.*
*The nominal toe-in value (**A**) is referred to the external diameter of the wheel hubs flange, therefore the measured value (**M**) at the bars ends must be related to the ratio between length of the bar and flange diameter*

nominal toe-in (sec.C.4) = A $^{0}_{-2}$ ⟶ measured toe-in = M $^{0}_{-5}$

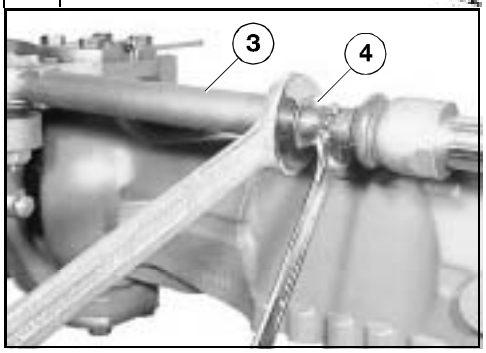
4



Nel caso che la convergenza non sia esatta agire con due chiavi sulle aste guida (**3**) avvitando e svitando i due tiranti snodo equamente, in modo che alla fine rientri nella tolleranza prevista.

*If toe-in is incorrect, operate with two wrenches on the guide rods (**3**) screwing in and out the two joint tie rods equally till the toe-in is within the requested tolerance.*

5



Eseguita la regolazione, avvitare i dadi di bloccaggio (**4**) delle aste guida (**3**) alla coppia di serraggio prevista (Sez.C.7)

*After adjusting, screw in the lock nuts (**4**) of the guide rods (**3**) to the requested tightening torque (Sec.C.7).*

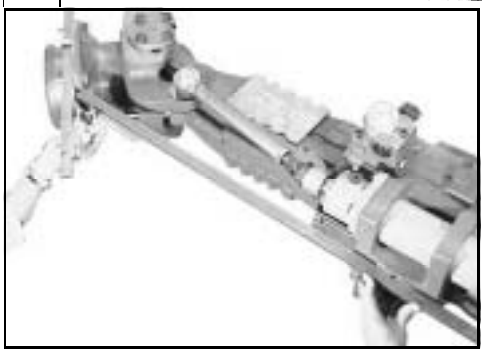
E.9 Registrazione angolo di sterzata

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.9 Steering angle adjustment

Some of the following pictures may not show exactly your axle, but the procedure is the same.

1



Utilizzare le stesse barre montate per la registrazione della convergenza ed una barra lunga, appoggiata perfettamente alla parte lavorata del corpo centrale (lato pignone), in modo che al massimo della sterzata le due barre formino un angolo acuto.

Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.

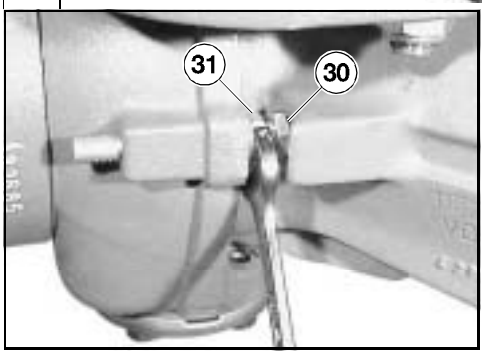
2



Regolare un goniometro all'angolo prescritto (Sez C.4) e posizionarlo sulla barra lunga.
Orientare un lato ruota fino a formare con le due barre l'angolo fissato dal goniometro.

Adjust a goniometer to the requested angle (Sec. C.4) and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the goniometer.

3



Effettuare la regolazione del fermo meccanico di sterzata, avvitando o svitando le apposite viti (**30**), bloccandole poi con controdado (**31**) alla coppia di serraggio prescritta (Sez.C.7).
Sterzare completamente dal lato opposto e ripetere le stesse operazioni.

*Adjust the steering mechanical retainer, screwing in or out the special screws (**30**), locking them with a locknut (**31**) to the requested tightening torque (Sec.C.7).*
Steer completely towards the other side and repeat the same operations.

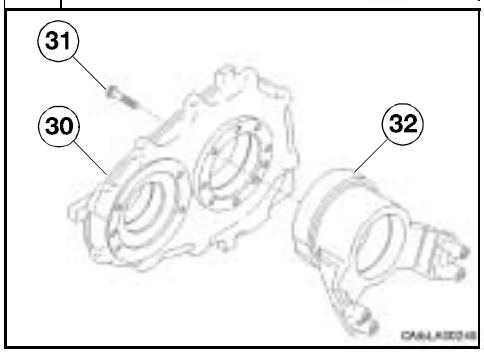
E.10 Montaggio scatola di trasmissione

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.10 Transmission box assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

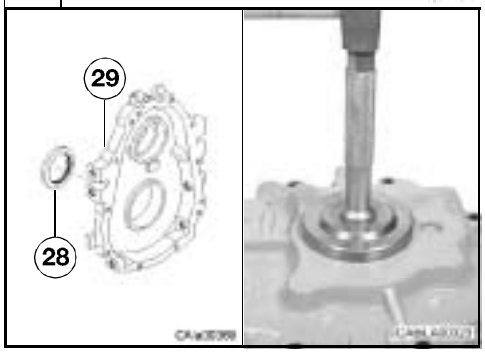
1



Assemblare la semiscatola (**30**) al supporto (**32**) avvitandone le viti di fissaggio (**31**).
Nota: stendere un velo di Loctite® 270 sul filetto delle viti di fissaggio prima del montaggio.
Serrare le viti di fissaggio alla coppia prevista (Sez.C.7).

*Assemble the support (**32**) to the transmission half box (**30**) with the fastening screws (**31**).*
***Note:** spread a film of Loctite® 270 on screws thread before assembly. Tightening the screws to the requested torque (Sec. C.7).*

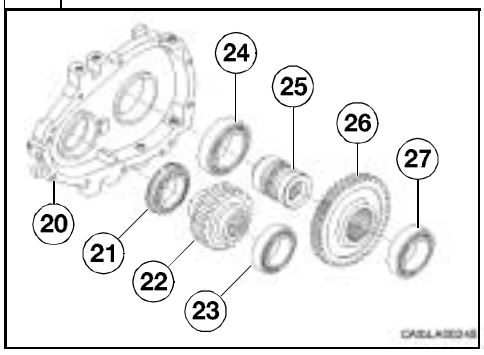
2



Posizionare l'altra semiscatola su una superficie piana.
Montare l'anello di tenuta (**28**) utilizzando il battitoio CA715038.

Position the second half box on a flat surface.
*Assemble the seal ring (**28**) using the special tool CA715038.*

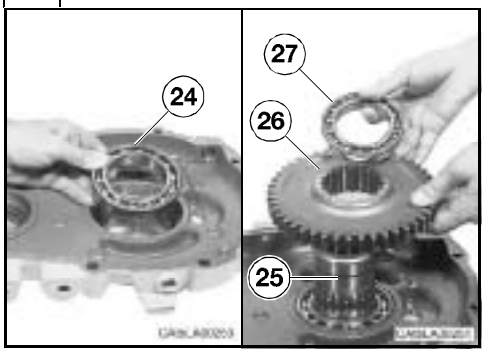
3



Vedi: ordine componenti

***See:** parts numbering.*

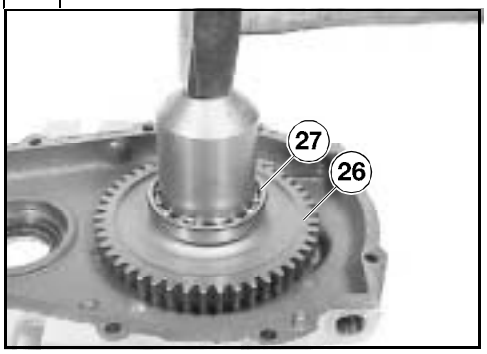
4



Assemblare il cuscinetto (**24**) ed il manicotto (**25**) alla semiscatola.
Inserire la ruota dentata (**26**) ed il cuscinetto a sfere (**27**) sul manicotto scanalato (**25**).

*Assembly the bearing (**24**) and the shaft (**25**) to the half box.*
*Insert the gear (**26**) and the ball bearing (**27**) on the shaft (**25**).*

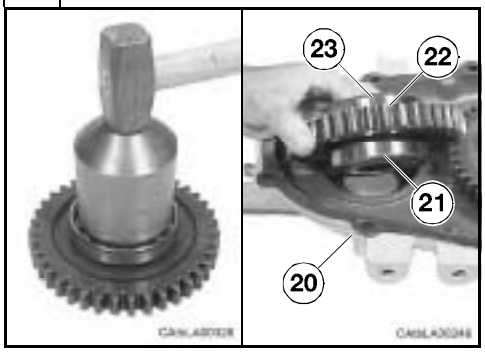
5



Piantare la ruota dentata (**26**) ed il cuscinetto (**27**), utilizzando il battitoio CA715445.

*Fit the gear (**26**) and the bearing (**27**) using the special tool CA715445.*

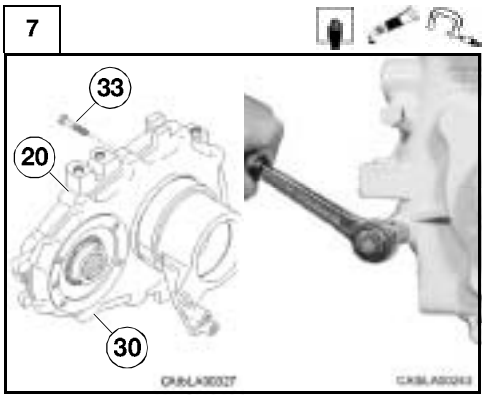
6



Posizionare la ruota dentata (**22**) sul banco di lavoro.
Montare i due cuscinetti (**21, 23**) sulla ruota (**22**) mediante battitoio CA715403 e martello.
Montare, assestandolo con martello e battitoio, il gruppo ruota dentata-cuscinetti-albero nella semiscatola.

*Position the gear (**22**) on a workbench.*
*Assemble the two bearings (**21, 23**) to the gear (**22**) using the special tool CA715403.*
Assemble the group gear-bearing-shaft to the half box, fitting it by mean of a hammer and a pad.

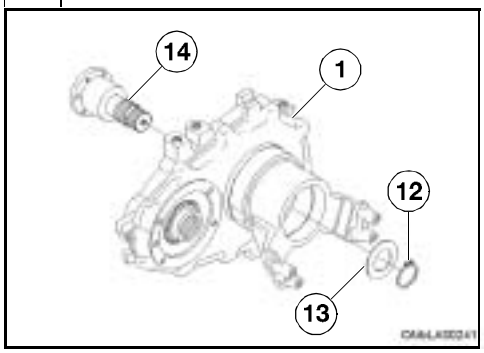
7



Dopo avere accuratamente pulito le superfici di contatto delle semiscatole stendere uniformemente della Loctite® 510.
Assemblare le semiscatole (**20, 30**), utilizzando un martello di gomma per farle aderire perfettamente.
Avvitare le viti di fissaggio (**33**) della scatola e serrarle con chiave dinamometrica alla coppia prevista (Sez.C.7).

Cleaning well the contact surfaces and spread a film of Loctite® 510.
*Assemble the half boxes (**20, 30**) using a soft hammer to fit.*
*Tighten the fastening screws (**33**) with dynamometric wrench to the requested torque (Sec.C.7).*

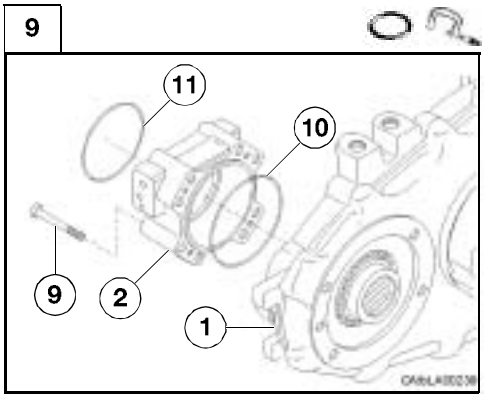
8



Inserire l'albero (**14**) sulla scatola di trasmissione.
Montare l'anello d'arresto (**12**) e la rondella (**13**) sull'albero (**14**).

*Insert the shaft (**14**) on the transmission box.*
*Assemble the lock ring (**12**) and the washer (**13**) on the shaft (**14**).*

9



Montare nuovi anelli OR (**10**, **11**) ben lubrificati nella flangia motore (**2**).
Assemblare la flangia motore (**2**), con le viti di fissaggio (**9**) alla coppia prevista (Sez.C.7).

Insert new well lubricated O-Rings (10,11) in the motor flange (2).
Assemble the motor flange (2) with the fastening screws (9) to the requested torque (Sec.C.7)

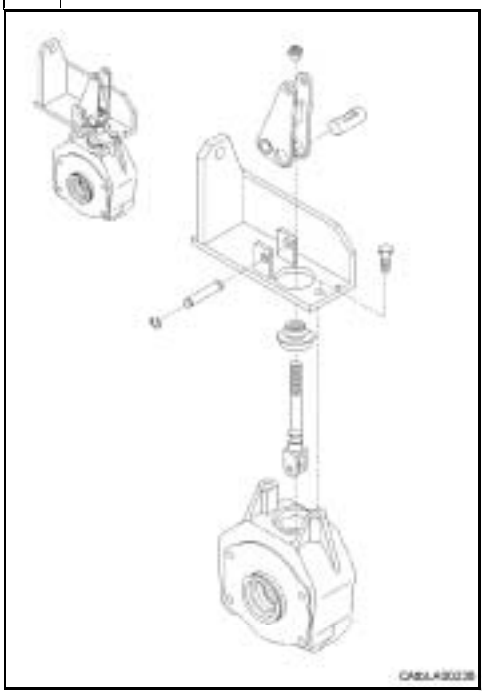
E.11 Montaggio freno di stazionamento

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.11 Parking brake assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

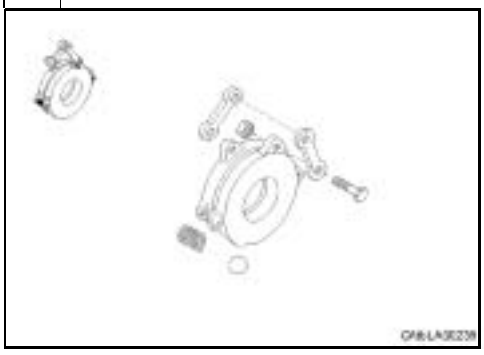
10



Assemblare i componenti del comando freno, come illustrato in figura.

If necessary, assemble control brake parts as in figure.

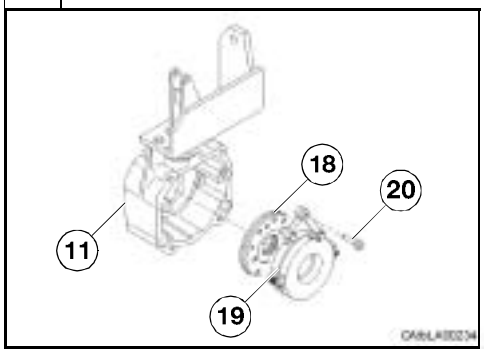
11



Assemblare l'attuatore, componendone gli elementi come illustrato in figura.

If necessary, assemble actuator body as in figure.

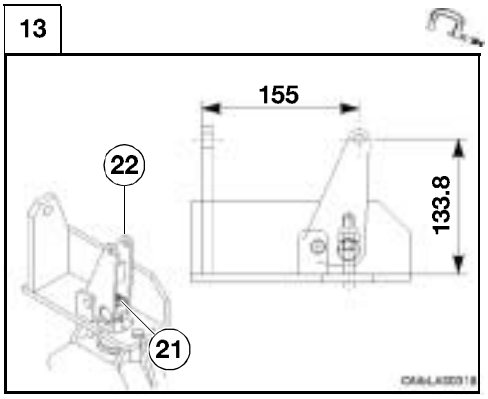
12



Inserire nella scatola freno (**11**) il disco freno (**18**) e l'attuatore (**19**).
Collegare l'attuatore al comando freno mediante il perno (**20**).

*Insert the pin (**20**) to fit the actuator body (**19**) and the brake disk (**18**) in the brake box (**11**).*

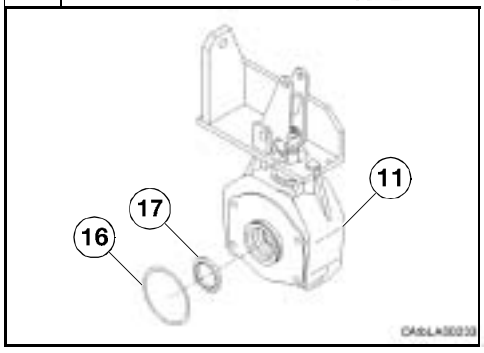
13



Registrare il dado (**21**) in modo che la leva (**22**) di azionamento del freno sia posizionata come in figura.

Adjust the nut (21) to position the brake lever (22) as in figure.

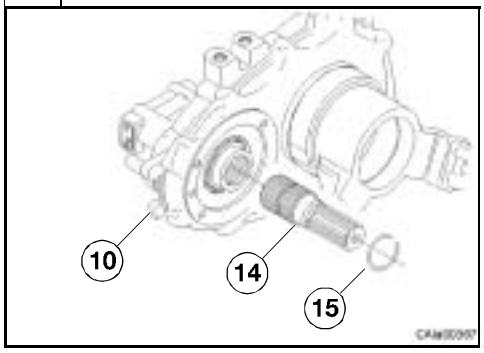
14



Montare un nuovo anello OR (**16**) e un nuovo anello di tenuta (**17**), utilizzando il battitoio CA119102, nella scatola freno di stazionamento (**11**).

*Assemble a new well lubricated O-Ring (**16**) and new seal ring (**17**), using the special tool CA119102, in the brake box (**11**).*

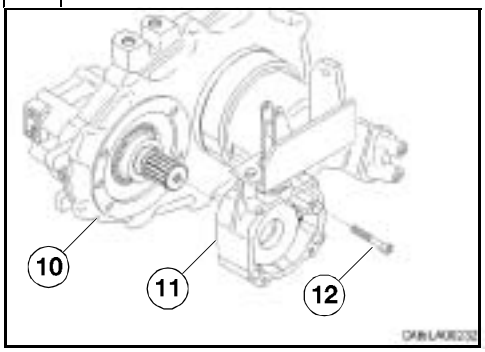
15



Montare l'anello d'arresto (**15**) sull'albero freno (**14**).
Inserire l'albero freno (**14**) nella scatola di trasmissione (**10**).

*Fit the lock ring (**15**) to the shaft (**14**).*
*Insert the brake shaft (**14**) in the transmission box (**10**).*

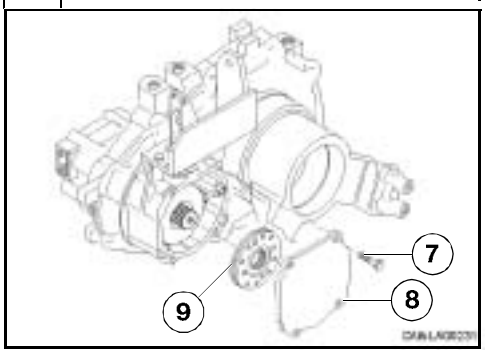
16



Assemblare la scatola freno (**11**) alla scatola di trasmissione (**10**).
Nota: prima di assemblare la scatola freno inserire le viti nel supporto scatola di trasmissione.
Avvitare le viti di fissaggio (**12**) della scatola freno (**11**) alla coppia prevista (Sez. C.7).

*Assemble the brake box (**11**) to the transmission box (**10**).*
***Note:** before assembly, insert transmission box fastening screws in the transmission box support.*
*Assemble the brake box (**11**) fastening screws (**12**) to the requested torque (Sec.C.7).*

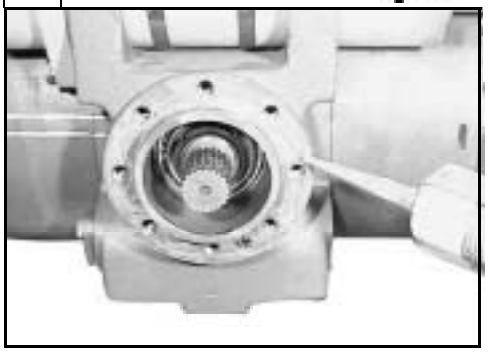
17



Assemblare il disco freno (**9**) ed il coperchio (**8**).
Avvitare le viti di fissaggio (**7**) del coperchio (**8**) alla coppia prevista (Sez. C.7).

*Assemble the brake disk (**9**) and the cover (**8**).*
*Assemble the cover (**8**) fastening screws (**7**) to the requested torque (Sec.C.7).*

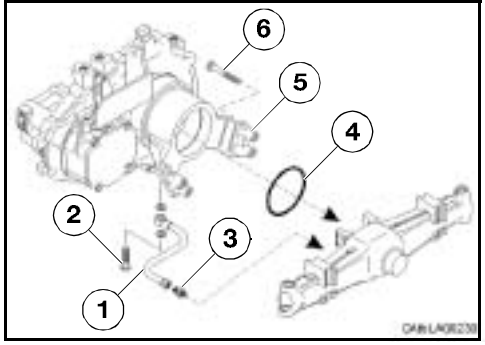
18



Dopo aver pulito accuratamente le superfici di contatto del supporto (**5**) e dell'assale, stendere un filo di Loctite® 510 sul piano d'appoggio, come in figura.

*Cleaning well the support (**5**) contact surfaces and spread a film of Loctite® 510 as in figure.*

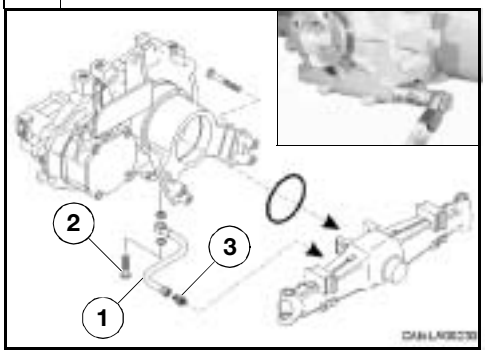
19



Montare un nuovo anello OR (**4**) all'interno del supporto (**5**).
Unire la scatola di trasmissione al gruppo.
Attenzione: non rovinare l'anello OR durante l'assemblaggio.
Avvitare le viti di fissaggio (**6**) alla coppia prevista (Sez.C.7).
Nota: stendere un velo di Loctite® 270 sul filetto delle viti di fissaggio prima di montarle.

*Insert a new O-Ring (**4**) in the support (**5**).*
Assemble the transmission box to the axle.
***Warning:** do not damage the O-Ring (**4**) during assembly operation.*
*Tighten the fastening screws (**6**) to the requested torque (Sec.C.7).*
***Note:** spread a film of Loctite® 270 on screws thread before assembly.*

20



Collegare il tubo di ricircolo dell'olio (**1**), avvitandone gli elementi di fissaggio (**2**) e (**3**) alla coppia prevista.

*Restore the hydraulic connection between axle and transmission. Assemble the oil recirculating pipe (**1**) and the relative fastening parts (**2**) and (**3**) then tighten them to the requested torque (Sec.C.7).*

E.12 Prove dopo montaggio

Passo 1
A motore spento, sollevare l'assale (i) della ruota motrice sino a che i pneumatici si siano staccati da terra.

Passo 2
Ingranare la marcia in modo che il pignone sia bloccato.

Passo 3
Con l'aiuto di un'altra persona collocata al lato opposto, iniziare la prova di montaggio ruotando per quanto possibile entrambe le ruote nel senso di marcia avanti. (Entrambe le ruote dovrebbero bloccarsi dopo poco)

Passo 4
Con il pignone sempre bloccato, liberare la ruota di destra e ruotare la ruota di sinistra nel senso (marcia avanti).
Se il montaggio è corretto si dovrà verificare che la ruota giri liberamente senza eccessivi sforzi, e la ruota di destra ruoti in senso opposto.
Ripetere l'operazione nel senso opposto (retro marcia).

SE UNA DELLE RUOTE NON GIRA LIBERAMENTE IN ENTRAMBE LE DIREZIONI, ricontrollare passo passo il montaggio.
Controllare anche che i freni siano regolati in modo da consentirne il corretto funzionamento.

E.12 Testing after assembly

Step 1
With engine off, lift the axle (i) so that the tyres get away from the ground.

Step 2
Engage the gear so that the pinion gets blocked.

Step 3
With the help of another person standing on the opposite side, begin the assembly testing by rotating as much as possible both the wheels forward. (Both the wheels should get blocked after a while.)

Step 4
Keeping the pinion blocked, free the right wheel and rotate the left one in the line of march. Rotate the right wheels in the opposite direction.
The wheel will move freely without difficulty and the right wheel will move in the opposite direction if the assembly has been carried out correctly.
Repeat the same operation in the opposite direction (reverse gear).

IF ONE WHEEL DOES NOT ROTATE FREELY IN BOTH DIRECTIONS, then check step by step all assembly operations.
Check and see that the brakes are regulated correctly and functioning properly.

F RICERCA GUASTI

PROBLEMA	POSSIBILI CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
- Vibrazioni delle ruote; resistenza del pneumatico anteriore; rottura del/i semiasse/i.	●	●	●		●						●
- Difficoltà nello sterzare; il veicolo tende ad andare dritto mentre è in curva.	●	●	●	●							●
- Non vi è azione del differenziale; inceppamento in curva.	●			●	●						●
- Rumore eccessivo nella trasmissione.	●	●	●	●	●		●		●		●
- Usura eccessiva del pneumatico.	●	●	●	●	●	●	●				●
- Rumore di attrito.	●			●	●			●	●	●	●
- In marcia avanti si avvertono vibrazioni, rumore intermittente.	●	●	●		●						●

F TROUBLESHOOTING

PROBLEMS	POSSIBLE CAUSES										
	1	2	3	4	5	6	7	8	9	10	11
- Wheel vibration; front tyre resistance; halfshaft breakage.	●	●	●		●						●
- Steering is difficult; vehicle goes straight while its turning.	●	●	●	●							●
- No differential action; jamming while steering.	●			●	●						●
- No differential action; jamming while steering.	●	●	●	●	●		●		●		●
- Uneven wear of tyre.	●	●	●	●	●	●	●				●
- Friction noise.	●			●	●			●	●	●	●
- Vibration during forward drive, intermittent noise.	●	●	●		●						●

1 Installazione scorretta / assale difettoso
Correggere l'installazione oppure, se il differenziale non supera una delle fasi di prova, ripararlo o sostituirlo.

2 Sovraccarico / distribuzione scorretta del peso
Togliere il peso in eccesso e ridistribuire il carico, rispettando le istruzioni relative al veicolo.

1 Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2 Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3 Raggio di rotazione dei pneumatici diversi
Un pneumatico con raggio più piccolo provoca un parziale slittamento della ruota quando si applica energia. L'altro pneumatico con raggio maggiore dovrà sopportare tutto il lavoro. Sostituire il pneumatico o regolare la pressione di entrambi sino a che il raggio di rotazione sia uguale.

4 Semiasse rotto
E' sconsigliato usare un veicolo con un solo semiasse. E' possibile tuttavia spostare il veicolo a vuoto con il differenziale bloccato per pochi metri.

5 Semiasse piegato
Sostituire i semiassi.

6 Differenziale bloccato
Funzionamento anomalo del differenziale e/o rottura del dispositivo di comando del bloccaggio di comando. Verificare l'installazione, eventualmente smontare e verificare i componenti.
I veicoli impostati per angoli di sterzata ampi, possono procedere a scatti, avere difficoltà di sterzo e provocare un consumo del pneumatico nelle curve strette.
Ridurre l'angolo di sterzata minimo e decelerare quando il motore inizia a procedere a scatti.

7 Allineamento scorretto della ruota
Verificare l'integrità della struttura, e cuscinetti lato ruota.

8 Parti dell'assale consumate o difettose
Controllare le condizioni della corona dentata, dell'ingranaggio del pignone, dei cuscinetti, delle guarnizioni, ecc. Sostituire dove necessario.

9 Corpi estranei nella scatola dell'assale o montaggio scorretto di alcune sue parti
Controllare se vi sono corpi estranei. Controllare il montaggio delle parti dell'assale.

10 Regolazioni della coppia conica scorrette: parti di trasmissione consumate
(ingranaggi di trasmissione, giunti, ecc.). Sostituire o regolare secondo necessità.

11 Uso scorretto del prodotto
Rivedere le istruzioni rilasciate dal produttore del veicolo.

3 Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied.The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyre.

4 Broken halfshaft
It is not advisable to operate the vehicle with a broken halfshaft. It is acceptable to move the vehicle (engine off unloaded) a few meters away only.

5 Bent halfshaft
Replace halfshaft.

6 Blocked differential
Abnormal functioning of the differential or breakage/ blockage of command device. Verify assembly and all components.
Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7 Incorrect wheel adjustment
Verify group integrity and wheel side bearings. Adjusting according.

8 Spoiled or worn out axle parts
Check the condition of ring gear, pinion gear, bearings etc. Replace when ever necessary.

9 Contamination in the axle box or incorrect assembly of parts
Look for foreign particles. Check assembly of the various parts of the axle.

10 Incorrect adjustment of bevel gear set: Parts of the transmission worn out.
(transmission gears, U joints, etc.)
Replace or adjust as required.

11 Incorrect use of the product
See the vehicle producer's instructions once again.

F.1 Controllo ed esame dei guasti

Questo capitolo offre una guida descrittiva ed esplicativa di problemi che si possono comunemente riscontrare sugli assali o di avarie che si possono verificare. La guida suggerisce anche le corrette procedure di riparazione.

Problema	Causa	Azione consigliata
Rottura verso l'estremità esterna del dente corona dentata	1. Carico dell'ingranaggio eccessivo rispetto a quello previsto 2. Regolazione ingranaggio scorretto (gioco eccessivo) 3. Dado del pignone allentato.	Sostituire la coppia conica. Seguire attentamente le operazioni raccomandate di regolazione del gioco della corona dentata e del pignone e per la rilevazione dell'impronta del dente.
Rottura verso l'estremità interna del dente corona dentata	1. Urto da carico 2. Regolazione ingranaggio scorretto (gioco insufficiente) 3. Dado del pignone allentato	Sostituire la coppia conica. Seguire attentamente le operazioni raccomandate di regolazione del gioco della corona dentata e del pignone e per la rilevazione dell'impronta del dente
Denti del pignone e della corona dentata erosi o rigati	1. Lubrificazione insufficiente 2. Lubrificante sporco 3. Lubrificante errato o con additivi impoveriti 4. Cuscinetti del pignone consumati che provocano un gioco assiale del pignone e un contatto tra pignone e corona scorretto.	Sostituire la coppia conica. Sostituire i cuscinetti del pignone facendo attenzione a sistemare correttamente la corona, il pignone e i precarichi dei cuscinetti. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Denti della corona e del pignone surriscaldati. Guardare se i denti dell'ingranaggio hanno perso la colorazione	1. Funzionamento prolungato a temperatura eccessiva. 2. Lubrificante scorretto 3. Livello dell'olio basso 4. Lubrificante sporco.	Sostituire la coppia conica. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Denti del pignone di comando butterati	1. Uso estremamente intenso 2. Lubrificazione insufficiente	Sostituire la coppia conica. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Corpo trave dell'assale piegato	1. Sovraccarico del veicolo 2. Veicolo incidentato 3. Urto da carico	Sostituire il corpo trave dell'assale
Cuscinetti consumati o butterati	1. Lubrificazione insufficiente 2. Lubrificante sporco 3. Uso estremamente intenso 4. Consumo normale 5. Dado del pignone allentato.	Sostituire i cuscinettii. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Le guarnizioni perdono olio	1. Funzionamento prolungato con temperatura dell'olio eccessiva. 2. Guarnizione dell'olio montata male 3. Bordo della guarnizione tagliata o intaccata 4. Lubrificante sporco	Sostituire la guarnizione e la superficie di accoppiamento se danneggiata. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Usura eccessiva della scanalatura della flangia di entrata.	1. Uso intenso 2. Dado del pignone allentato 3. Gioco assiale del pignone	Sostituire la flangia Controllare che la scanalatura del pignone non sia eccessivamente consumata Sostituire la coppia conica, se necessario.
Rottura per fatica del dente dell'ingranaggio del pignone. Guardare se la linea di frattura ad onda è ben delineata (linea di arresto).	1. Uso intenso 2. Sovraccarico continuo	Sostituire la coppia conica.

Problema	Causa	Azione consigliata
Rottura denti pignone e corona	Carico d'urto dei componenti del differenziale	Controllare e/o sostituire altri componenti differenziale.
Scanalature dell'ingranaggio planetario consumate (gioco eccessivo)	Uso intenso	Sostituire il gruppo ingranaggi differenziale. Sostituire il semiasse, se necessario.
Superfici della ralla di rasamento consumate o graffiate	1. Lubrificazione insufficiente 2. Lubrificazione scorretta 3. Lubrificante sporco	Sostituire tutte le ralle graffiate e quelle con uno spessore di 0,1 mm inferiore a quello delle ralle nuove. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Diametro interno del cuscinetto a rulli conici del pignone consumato	1. Uso intenso 2. Gioco assiale del pignone eccessivo 3. Lubrificazione inadeguata 4. Lubrificante sporco	Sostituire il cuscinetto Controllare il gioco assiale del pignone Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Semiasse ritorto o rotto	Funzionamento intenso del veicolo, sovraccarico	Sostituire il semiasse
Semiasse spezzato presso la flangia ruota	1. Supporto della ruota allentato 2. Corpo trave piegato	Sostituire il semiasse Controllare la distorsione del corpo trave. Accertarsi che il sostegno della ruota non sia consumato o mal regolato.

F.1 Troubleshooting

This chapter is a descriptive and explanatory guide to common axle problems. This guide suggests the repair correct procedures to be followed.

Problem	Cause	Action
Ring gear tooth broken at the outer side	1. Excessive gear load compared to the one foreseen 2. Incorrect gear adjustment (excessive backlash) 3. Pinion nut loosened	Replace bevel gear set Follow carefully the recommended operations for the adjustment of bevel gear set backlash
Ring gear tooth broken side	1. Load bump 2. Incorrect gear adjustment (insufficient backlash) 3. Pinion nut loosened	Replace bevel gear set Follow carefully the recommended operations for the adjustment of bevel gear set backlash.
Pinion or ring gear teeth or worn	1. Insufficient lubrication 2. Contaminated oil 3. Incorrect lubrication or depleted additives 4. Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of bevel gear set backlash. Use correct lubricants, fill up to the right levels and replace according to the recommended program.
Overheated ring and pinion teeth. See if gear teeth have faded	1. Prolong ed functioning at high temperatures 2. Incorrect lubrication 3. Low oil level 4. Contaminated oil	Replace bevel gear set. Use proper lubrication, fill up to right level and replace at recommended program.
Pinion teeth pitting	1. Excessive use 2. Insufficient lubrication	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Axle beam body bent	1. Vehicle over loaded 2. Vehicle's accident 3. Load bump	Replace axle beam body
Worn out or pitted bearings	1. Insufficient lubrication 2. Contaminated oil 3. Excessive use 4. Normal wear out 5. Pinion nut loosened	Replace bearings. Use correct lubrication fill up, to the right level and replace at recommended intervals
Oil leakage form gaskets and seals	1. Prolonged functioning at high temperature of the oil 2. Oil gasket assembled incorrectly 3. Seal lip damaged 4. Contaminated oil	Replace the gasket or seal and matching surface if damaged. Use correct lubrication and replace at recommended intervals.
Excessive wearing out of input flange spline	1. Exhaustive use 2. Pinion nut loosened 3. Pinion axle backlash	Replace the flange. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.
Fatigue failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	1. Exhaustive use 2. Continuos overload	Replace bevel gear set
Pinion and ring teeth breakage	1. Crash load of differential components	Check and/or replace other differential components.

Problem	Cause	Action
Side gear spline worn out. Replace all scratched washers (Excessive backlash)	Excessive use	Replace differential gear group. Replace halfshaft if required
Thrust washer surface worn out or scratched.	1. Insufficient lubrication 2. Incorrect lubrication 3. Contaminated oil	Use correct lubrication and fill up to right level. Replace at intervals recommended. Replace all scratched washers and those with 0,1mm thickness lower than the new ones.
Inner diameter of tapered roller bearing worn out.	1. Excessive use 2. Excessive pinion axial backlash 3. Insufficient lubrication 4. Contaminated oil	Replace bearing. Check pinion axial backlash. Use proper lubrication, fill up to right level and replace at recommended intervals.
Bent or broken halfshaft	Vehicle intensively operated or overloaded	Replace
Halfshaft broken at wheel side	1. Wheel support loosened 2. Beam body bent	Replace Check that wheel support is not worn out or wrongly adjusted.

F.2 Diagnosi per problemi all'assale

Problema	Causa	Azione consigliata
Rumore durante la guida	1. Gioco tra corona dentata e pignone eccessivo 2. Pignone e corona dentata consumati 3. Cuscinetti del pignone consumati 4. Cuscinetti del pignone allentati 5. Gioco assiale del pignone eccessivo 6. Cuscinetti del differenziale consumati 7. Cuscinetti del differenziale allentati 8. Eccessiva scentratura della corona dentata 9. Livello lubrificante basso 10. Lubrificante di grado povero od errato 11. Semiasse piegato	1. Regolare 2. Sostituire 3. Sostituire 4. Regolare 5. Regolare 6. Sostituire 7. Regolare 8. Sostituire 9. Rabboccare 10. Sostituire 11. Sostituire
Rumore durante l'andatura in folle	1. I rumori provenienti dall'assale con il veicolo in movimento di solito si sentono durante l'andatura in folle anche se non molto forti 2. Errato gioco tra pignone e corona (il rumore che si sente decelerando sparisce all'aumentare della velocità). 3. Usura scanalatura pignone o flangia entrata	1. Regolare o sostituire (vedere sopra) 2. Regolare 3. Sostituire
Rumore intermittente	1. Corona dentata danneggiata 2. Bulloni della scatola del differenziale allentati	1. Sostituire coppia conica 2. Serrare a coppia
Rumore costante	1. Danni sui denti della corona dentata o del pignone 2. Cuscinetti usurati 3. Scanalature del pignone consumate 4. Semiasse piegato	1. Sostituire coppia conica 2. Sostituire 3. Sostituire 4. Sostituire
Rumore in curva	1. Satelliti planetari differenziale consumati 2. Scatola differenziale e/o perni del differenziale consumati 3. Ralle di rasamento del differenziale consumate 4. Scanalature del semiasse consumate	1. Sostituire 2. Sostituire 3. Sostituire 4. Sostituire

F.2 Axle problem and diagnosis

Problem	Cause	Action
Noise while driving	1. Excessive backlash between pinion and ring gear 2. Worn out pinion and gear ring 3. Worn out pinion bearings 4. Pinion bearings loosened 5. Excessive axial pinion backlash 6. Worn out differential bearings 7. Differential bearings loosened 8. Ring gear out of roundness 9. Low lubricant level 10. Poor or wrong lubricant 11. Bent halfshaft	1. Adjust 2. Replace 3. Replace 4. Adjust 5. Adjust 6. Replace 7. Adjust 8. Replace 9. Oil level 10. Replace 11. Replace
Noise while driving in neutral	1. Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud. 2. Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed) 3. Pinion or input flange worn out	1. Replace or adjust (see above) 2. Replace 3. Adjust
Intermittent noise	1. Ring gear damaged 2. Differential box bolts loosened	1. Replace bevel gear set 2. Tighten to torque
Constant noise	1. Ring gear teeth or pinion damaged 2. Worn out bearings 3.Pinion spline worn out 4. Bent halfshaft	1. Replace bevel gear set 2. Replace 3. Replace 4. Replace
Noise while seering	1. Worn out differential gears 2. Worn out differential box or spider 3. Differential thrust washers worn out 4. Half shaft spline worn out	1. Replace 2. Replace 3. Replace 4. Replace

C CARATTERISTICHE GENERALI

C.1 Usi previsti

Questo assale è stato progettato e costruito per essere installato in macchine di tipo industriale. L'assale è un componente che ha la funzione di trasmettere la potenza dal motore alle ruote.
L'assale in oggetto, costruito secondo specifiche fornite dal cliente, permette:

- l'aumento della forza di trazione riducendo il numero di giri;
- la compensazione della velocità delle ruote interne con quelle esterne durante la sterzata.

Non installare mai questo assale su macchine diverse da quelle per cui e stato progettato e costruito.

L'assale, se utilizzato in un impiego diverso da quello previsto, è da considerarsi soggetto ad "uso non previsto".
CARRARO SpA declina ogni responsabilità per danni o incidenti risultanti da un uso diverso da quello previsto; tali conseguenze saranno a carico esclusivo del cliente.
Costituisce inoltre un elemento essenziale, nell'ambito dell'uso previsto, l'osservanza scrupolosa delle modalità di funzionamento e delle regolari manutenzioni e riparazioni specificate da CARRARO SpA.

C.2 Identificazione del prodotto

Targhetta di identificazione dell'assale

C GENERAL SPECIFICATIONS

C.1 Foreseen uses

This axle has been designed and manufactured to be mounted on industrial machines.
The axle is a component that transmits the power from the engine to the wheels.
The axle, manufactured according to the customer's technical specifications, allows:

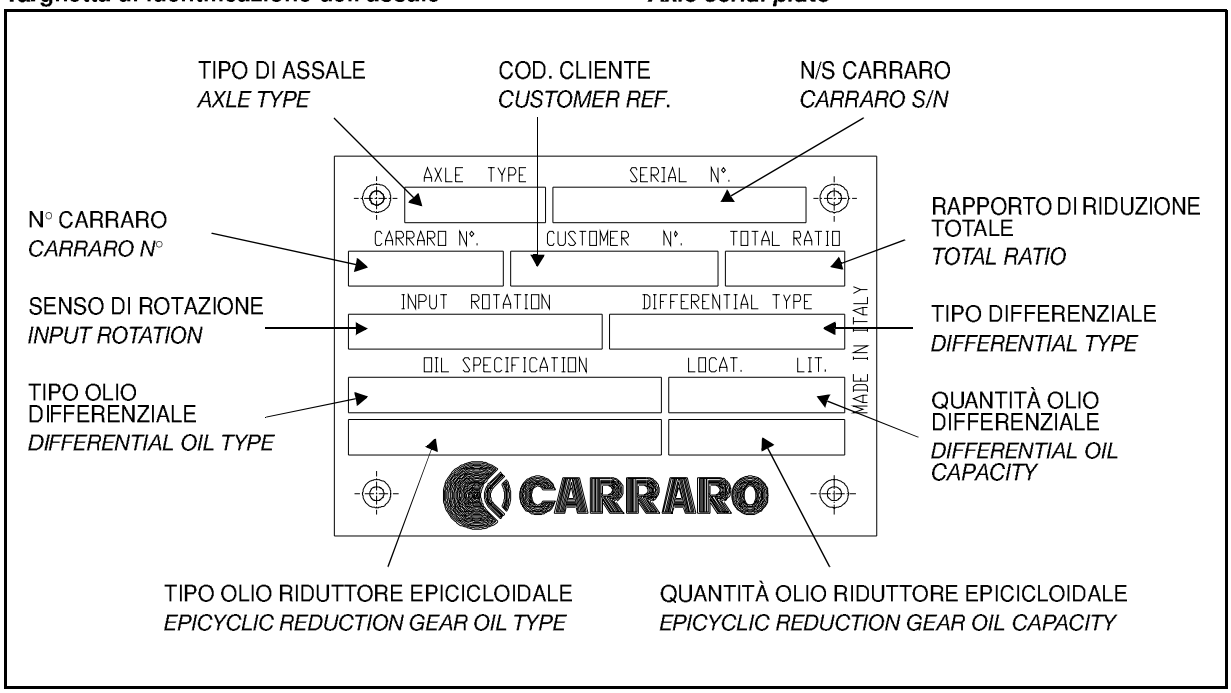
- *increasing of tractive force, reducing the number of revolutions*
- *adjusting of inner wheels' speed with outer wheels' speed during steering.*

Never mount this axle on machines different from the ones for which it has been designed and manufactured

If the axle is used for any other purpose than the one foreseen, CARRARO SpA declines any responsibility regarding damages or accidents caused by it. All consequences will be at the expense of the client.
However, when used as foreseen, operational formalities as well as regular maintenance repair specifications given by CARRARO SpA are to be observed strictly.

C.2 Product identification

Axle serial plate

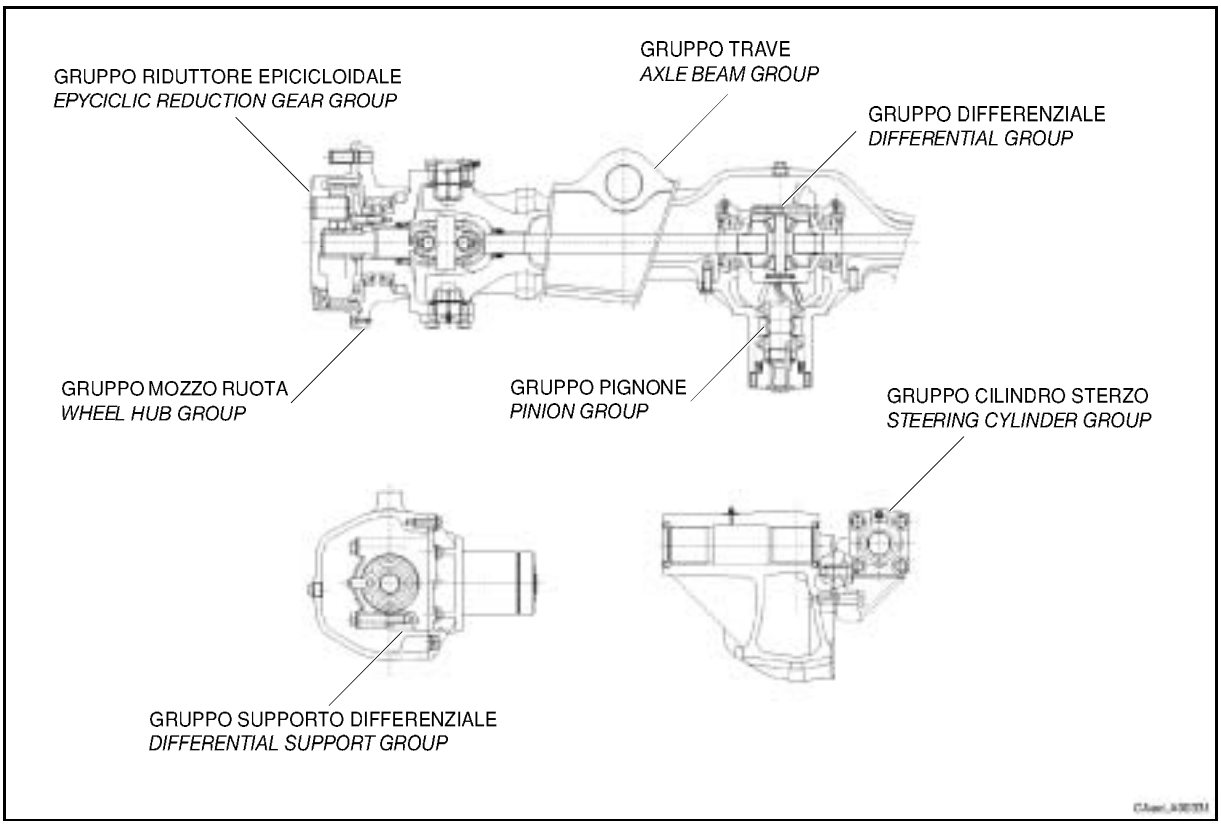


C.3 Descrizione generale

L'assale in oggetto, progettato e costruito secondo le richieste del cliente, è costituito da un corpo trave contenente il gruppo differenziale e dai gruppi mozzo ruota alle estremità.
Il gruppo differenziale è supportato da due cuscinetti montati in un'apposita struttura ove è possibile effettuare le operazioni di registrazione della coppia conica.
La posizione della corona conica si registra agendo su due ghiere contrapposte, mentre quella del pignone conico, supportato da due cuscinetti, si effettua mediante interposizione di spessori di registro.
I mozzi ruota contenenti i riduttori epicicloidali, sono supportati da due cuscinetti a rulli conici e vengono comandati da un gruppo sterzante ad azionamento idraulico con aste guida registrabili per la regolazione della convergenza.

C.3 General description

The axle described in this manual designed and manufactured following the client requests, consists of a beam casing housing the differential and a wheel hub unit at each end.
The differential is supported by two bearings mounted on a suitable structure allowing the bevel gear set to be adjusted.
The ring bevel gear is adjusted by means of ring nuts located opposite each other.
The position of the bevel pinion, supported by two bearings, is adjusted by inserting adjusting shims.
The wheel hubs containing the epicyclic reduction gears are supported by two tapered roller bearings and are powered by a hydraulically-operated steering unit by means of adjustable guide rods to correct the toe-in.

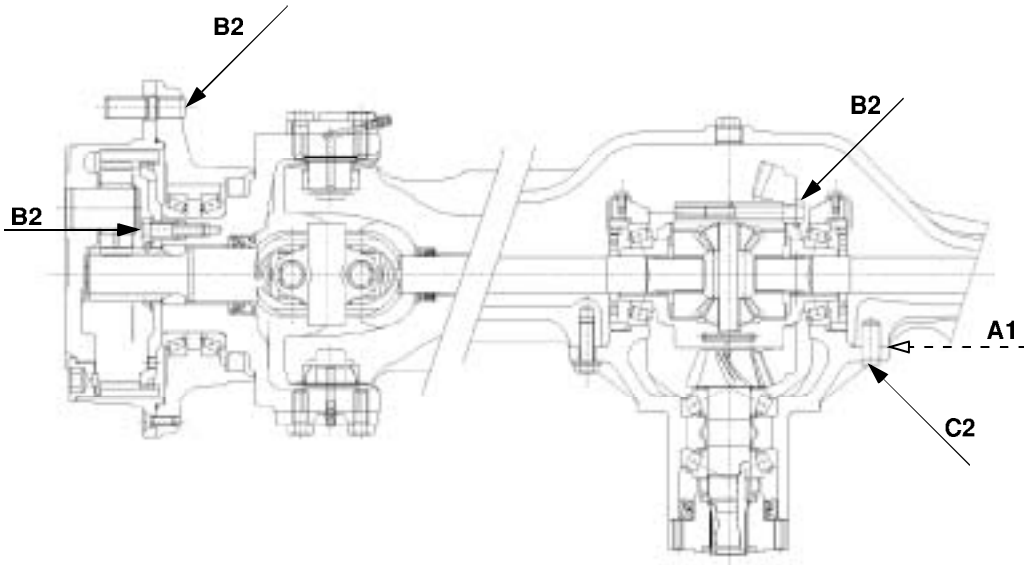


C.4 Caratteristiche Tecniche — *C.4 Technical Features*

MACCHINA	**Assale Posteriore - *Rear Axle***	*MACHINE*
CODICE	**CA140113**	*CODE*
MODELLO	**26.11**	*MODEL*
TIPO DIFFERENZIALE	**Open**	*DIFFERENTIAL TYPE*

DESCRIZIONE	**VALORI** ***VALUES***	***DESCRIPTION***
Riduzione coppia conica	2.46 / 1	*Bevel gear ratio*
Riduzione riduttore epicicloidale	6.00 / 1	*Epicyclic reduction gear ratio*
Riduzione totale	14.7 / 1	*Total ratio*
Peso a secco	238 Kg	*Dry weight*
Rotazione in entrata SENSO ORARIO SENSO ANTIORARIO	 ● ○	*Input rotation* *CLOCK WISE (C.W.)* *COUNTER CLOCK WISE (C.C.W.)*
Angolo di sterzata	$36°\ ^{0}_{-0,2}$	*Steering angle*
Convergenza	$A^{\pm 1}$	*Toe-in*
Gioco di accoppiamento coppia conica	0.16÷0.22 mm	*Bevel gear set backlash*
Precarico cuscinetti pignone conico (misurato sul D=30.5 mm senza anello di tenuta)	P= 10.5÷15.7 daN	*Pinion bearings preloading (measured D=30.5 mm without seal)*
Precarico totale cuscinetti corona-pignone (misurato sul D=30.5 mm senza anello di tenuta)	T= (P+4.2)÷(P+6.4) daN	*Total pinion-ring gear bearing preloading (measured D=30.5 mm without seal)*
Quantità olio differenziale	5 litri	*Differential oil capacity*
Quantità olio riduttore epicicloidale per lato	0.6 litri/Liter	*Epicyclic reduction gear oil capacity each side*
Specifica olio Nota: NON USARE OLIO DI SINTESI O VEGETALE SENZA IL CONSENSO DEL COSTRUTTORE DELL'ASSALE	SAE 80W to comply API GL4 respectively MIL-L-2105	*Oil specification* *Note:* *DO NOT USE SYNTHETIC OR VEGETABLE OIL WITHOUT CONSENT OF THE AXLE MANUFACTURER*
Specifica grasso	TECNOLUBE SEAL POLYMER 400/L DIN = KHER1R ISO-I-XMR-XM2	*Grease specification*
Flangia ingresso differenziale	DIN1310	*Differential input flange*

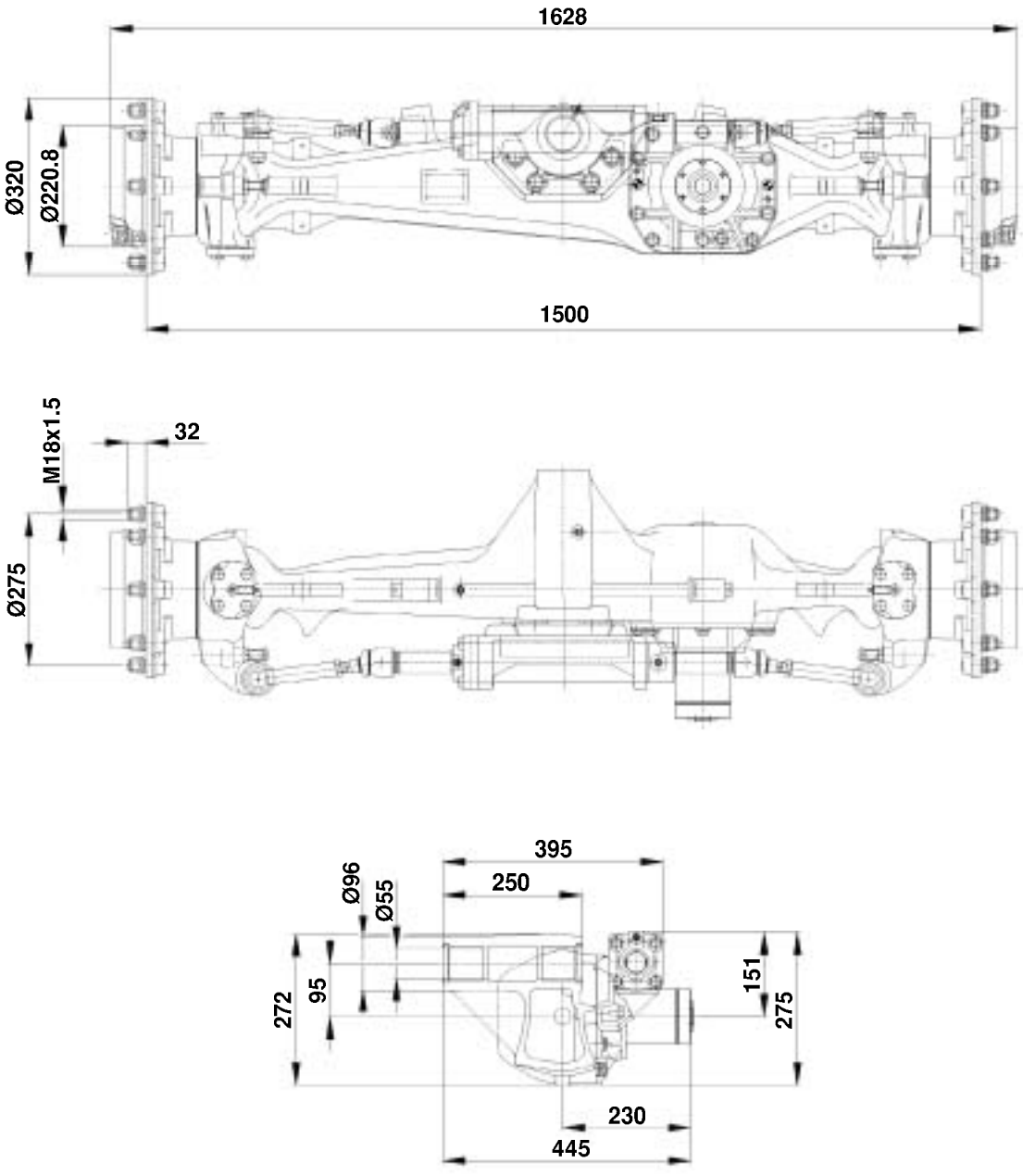
Sigillanti e collanti *Sealing compounds and adhesives*



A1= LOCTITE® 510	●	**B2**= LOCTITE® 270	●
A2= LOCTITE® 573	○	**C1**= LOCTITE® 405	○
A3= LOCTITE® 518	○	**C2**= LOCTITE® 496	●
B1= LOCTITE® 542	○	**C3**= LOCTITE® 638	○
◁ - - - - - -	Applicare sulle superifici a contatto		
	Apply on the contact surfaces		
◀——	Applicare sulla filettatura delle viti / sui perni		
	Apply on bolt screws / on pins		

Dimensioni d'ingombro
(Millimetri)

Overall dimensions
(Millimeters)

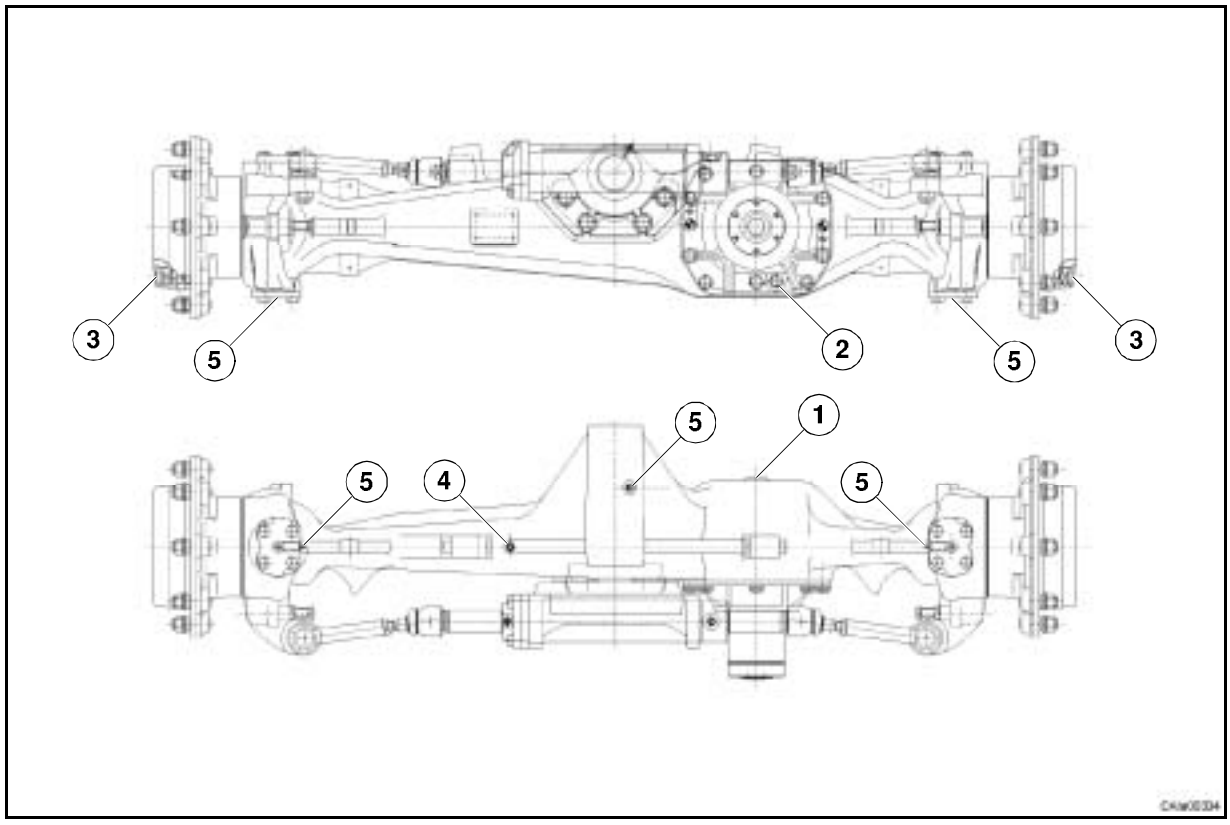


C.5 Rifornimento e verifiche

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

C.5 Filling and checks

Some of the following pictures may not show exactly your axle, but the procedure is the same.



DESCRIZIONE	POSIZIONE / POSITION	DESCRIPTION
Tappo carico e livello olio	**1**	Oil filling and level plug
Tappo scarico olio	**2**	Oil drain plug
Tappo livello, carico e scarico olio riduttore epicicloidale	**3**	Level, filling and drain plug of epicyclic reduction gear oil
Sfiato olio	**4**	Oil breather
Punti di ingrassaggio	**5**	Greasing point

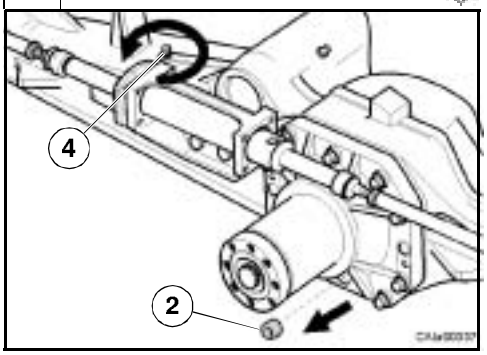
Controlli periodici:

Il livello dell'olio deve essere a filo dei tappi di controllo, altrimenti provvedere al rabbocco con lubrificante dello stesso tipo, come di seguito indicato.
Nel caso in cui si riscontri una perdita o altro che determini l'abbassamento del livello, è opportuno intervenire immediatamente onde evitare possibili danni agli organi meccanici.

Routine checks:

Oil should be flush with control plugs, if not, make up level with the same lubricant, as shown in following procedures.
If leakage or any other factor determining fall in the oil level is found, then it is advisable to check immediately, in order to avoid damages to the mechanical parts.

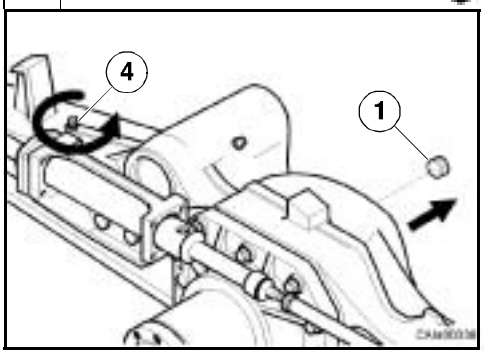
1



Prima di effettuare l'operazione di scarico dell'olio, svitare l'apposito sfiato (**4**) per eliminare eventuale pressione interna. Richiuderlo poi con chiave dinamometrica serrandolo alla coppia prevista (Sez.C.7).
Per effettuare lo scarico dell'olio dal corpo centrale svitare il tappo (**2**) del foro di scarico.
Richiudere il tappo (**2**) alla coppia prevista (Sez.C.7).

*Before draining the oil, loosen the breather (**4**) to release possible internal pressure, then tighten the plug with a torque wrench to the prescribed torque (Sec.C.7).*
*Drain the oil from the appropriate plug (**2**).*
*Tighten the plug (**2**) to the prescribed torque (Sec.C.7).*

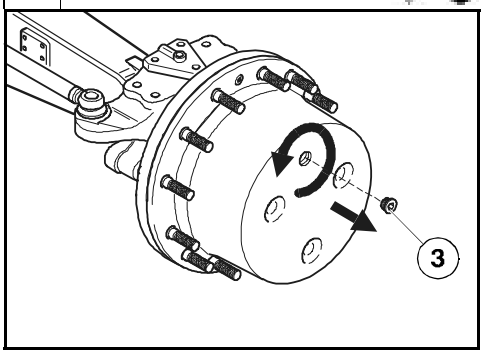
2



Prima di agire sul tappo di livello dell'olio (**1**), svitare sempre l'apposito sfiato (**4**) per eliminare l'eventuale pressione interna.
Verificare il livello dell'olio (alla soglia del foro) ed eventualmente rabboccare.
Riavvitare il tappo (**1**) serrandolo alla coppia prevista (Sez.C.7)

*Before draining the oil from the plug (**1**), always loosen the breather (**4**) to release possible internal pressure.*
Check oil level and top up if necessary.
*Tighten the plug (**1**) to the prescribed torque (Sec.C.7).*

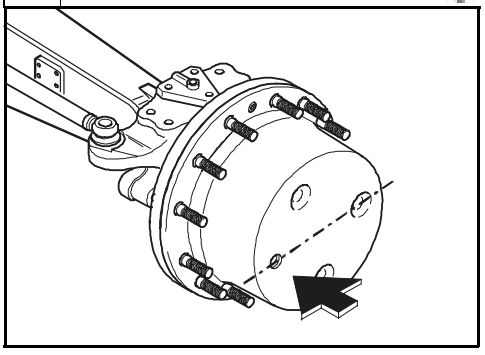
3



Prima di effettuare l'operazione di scarico o rabbocco dell'olio, posizionare il mozzo ruota con il tappo (**3**) nel punto più alto e svitarlo di qualche giro in modo da eliminare l'eventuale pressione interna, quindi rimuoverlo completamente.

*Before draining the oil, position the wheel hub so that the filer cap is in the highest point, then loosen the plug (**3**) to release possible internal pressure.*

4



Ruotare gradualmente il mozzo fino a disporlo con il foro all'altezza dell'asse ruota in modo che la linea di livello dell'olio sia orizzontale.
Verificare il livello dell'olio ed eventualmente rabboccare.
Riavvitare il tappo (**3**) serrandolo alla coppia prevista (Sez.C.7)

Position the wheel hub so that the filer cap is on the centre line of the horizontal axis.
Check oil level and top up if necessary.
*Tighten the plug (**3**) to the prescribed torque (Sec.C.7).*

C.6 Programma di lubrificazione — *C.6 Service schedule*

Operazione	▲ Primo Intervento *First time*	◆ Ad ogni stagione od ogni 1500 ore(1) *Seasonally or every 1500 operating hours*(1)	*Operation*
Cambio olio assale	150 - 200 ore/*hours* ●	◆ ■	*Axle oil change*
Operazioni di lubrificazione	▲ ■	◆ ■	*Lubrication works*
Controllo e rabbocco olio	50 - 100 ore/*hours* ■	mensilmente/*monthly* ●	*Check and adjust oil level*
Pulizia tappo magnetico scarico olio	150 - 200 ore/*hours* ■	ad ogni cambio olio/ *every oil change* ●	*Clean magnetic oil plugs*
Pulizia sfiato olio	▲ ■	mensilmente/*monthly* ●	*Clean oil breather*
Ingrassaggio	150 - 200 ore/*hours* ●	settimanalmente/*weekly* ●	*Greasing*

legenda

● operazioni eseguibili solamente da personale autorizzato dal costruttore
■ operazioni eseguibili solamente da personale addestrato
(1) quale delle due condizioni si verifica prima

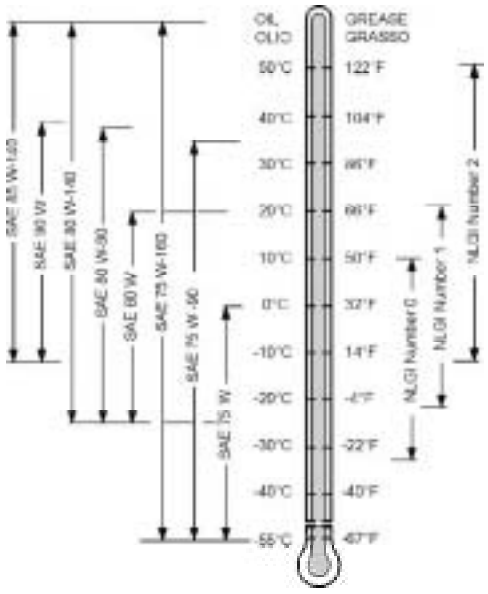
remarks

● *operation performed only by personnel authorized by the manufacturer*
■ *operation performed only by trained personnel*

(1) *which of both conditions comes first*

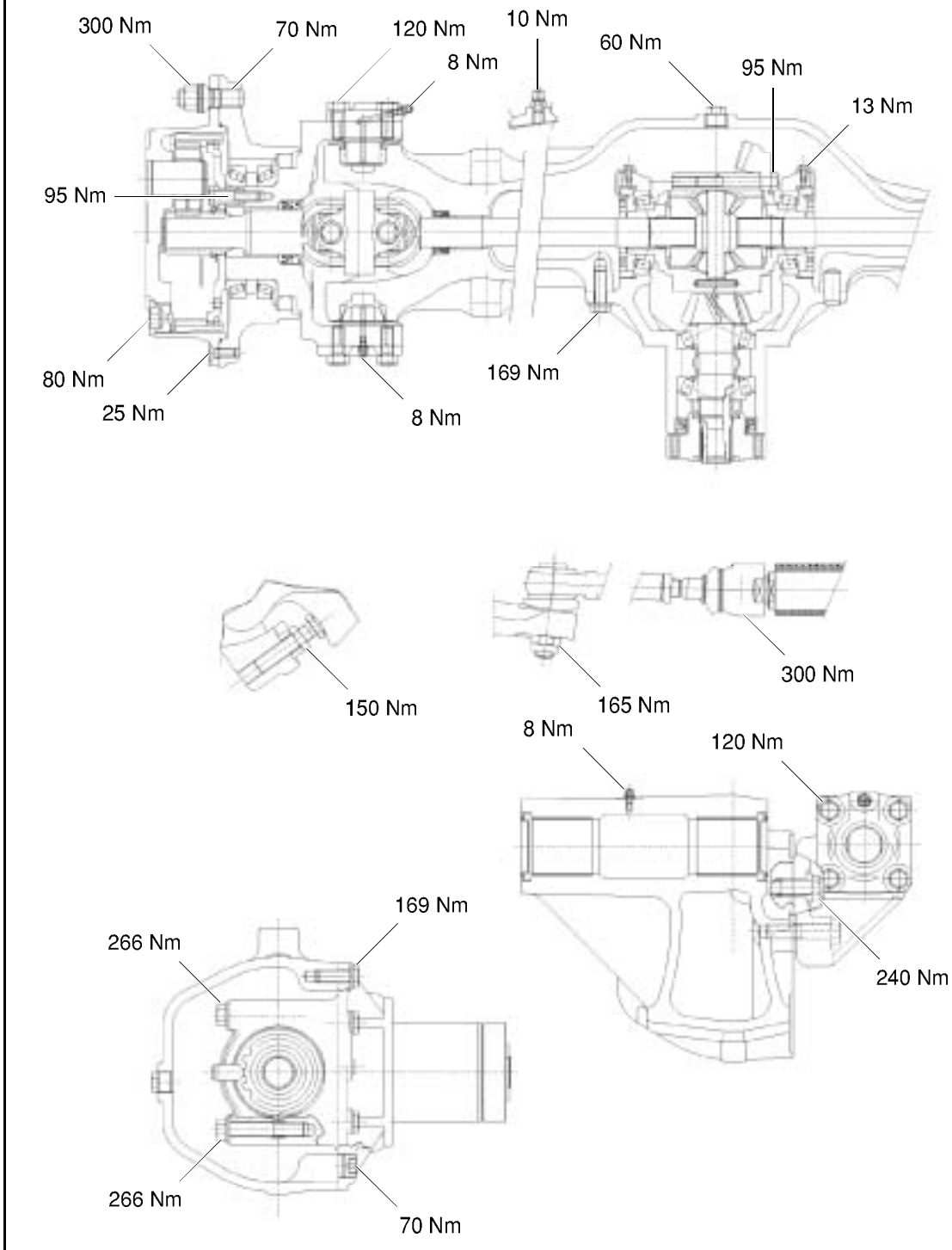
Lubrificazione / ingrassaggio: gradazioni e relativi campi di applicazione

Lubrication / greasing: grades and application range



C.7 Coppie di serraggio

C.7 Tightening torques



D OPERAZIONI DI SMONTAGGIO

D.1 Smontaggio gruppo cilindro sterzo

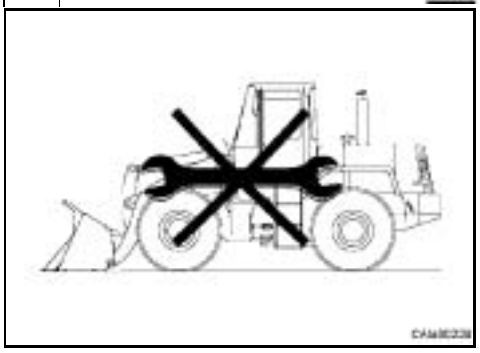
Le istruzioni di smontaggio presuppongono che il gruppo sia già stato rimosso dal veicolo e posizionato su un adatto banco di lavoro.
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D DISASSEMBLY OPERATIONS

D.1 Steering cylinder group disassembly

The disassembly instructions presume that the unit has been removed from the vehicle and positioned on a suitable workbench.
Some of the following pictures may not show exactly your axle, but the process is the same.

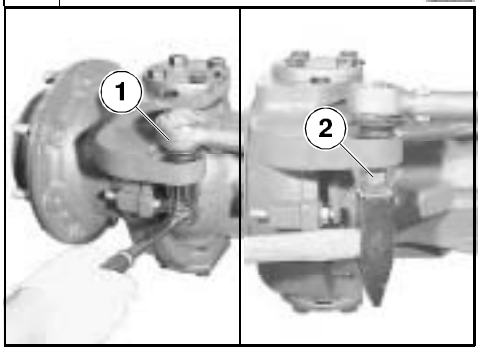
1



Attenzione: le operazioni di disassemblaggio qui descritte, prevedono che il gruppo sia già stato rimosso dal veicolo e posizionato su un adatto banco di lavoro; se si opera sul gruppo installato sul veicolo, seguire le istruzioni del costruttore del veicolo per operare in condizioni di totale sicurezza.

Warning: *execute disassembly operation only if the group is removed from the vehicle and placed on a suitable workbench; if the group is on the vehicle, see the vehicle manufacturer instructions to work in totally safety.*

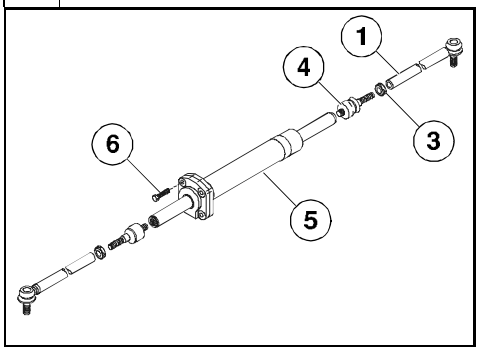
1



Allentare il dado di fissaggio (**2**) dell'asta guida (**1**) di qualche giro fino a portarlo oltre l'estremità del perno filettato.
Con un martello battere sul dado per staccare l'asta guida dalla calotta.
Attenzione: non colpire l'estremità del perno filettato.
Nota: questa operazione è distruttiva per il dado.

*Unloose the guide rod (**1**) locknut (**2**) of some turns till it is over the end of the threaded pin.*
Beat on the nut with a hammer in order to disjoin the guide rod from the swivel housing.
Warning: *do not beat on the end of the threaded pin.*
Note*: this is a destructive operation for the nut.*

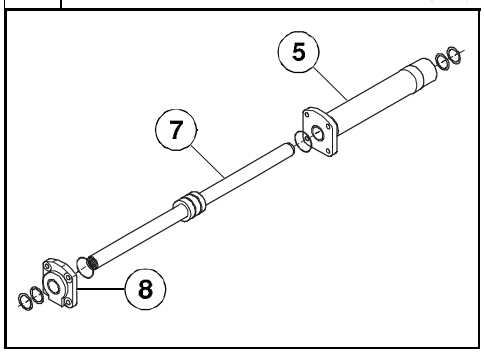
2



Rimuovere il tirante (**1**) dell'asta guida allentando con chiave adatta il dado (**3**), controllarne poi le condizioni.
Svitare le viti di fissaggio (**6**) del martinetto (**5**), quindi sfilarlo dalla sua sede, se necessario aiutandosi con un martello di gomma.
Rimuovere solo i particolari che devono essere revisionati e/o sostituiti.

*Remove the guide rod link (**1**) by unloosing the nut (**3**) with a suitable wrench, then check its conditions.*
*Unscrew the fastening screws (**6**) of the cylinder, then take the cylinder (**5**) out of its housing and, if necessary, use a rubber hammer.*
Remove only that parts that need to be overhauled and/or replaced.

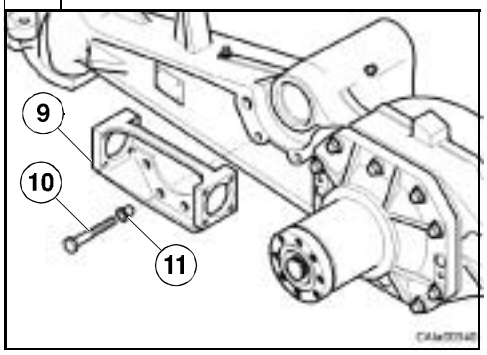
3



Staccare la testata (**8**) dal corpo del cilindro (**5**).
Sfilare la testata e lo stelo (**7**) dal corpo cilindro.
Recuperare tutti gli anelli di tenuta.

*Separate the cylinder head (**8**) from the cylinder case (**5**).*
*Remove off the cylinder head and the rod (**7**) from the cylinder case.*
Remove all the seals and O-Rings.

4



Rimuovere le viti di fissaggio (**10**) e staccare il supporto (**9**) del cilindro.
Solo se necessario rimuovere le boccole (**11**).

*Remove the fastening screws (**10**) and collect the cylinder carrier (**9**).*
*If necessary remove the bushes (**11**).*

D.2 Smontaggio gruppo riduttore epicicloidale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.2 Epicyclic reduction gear disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

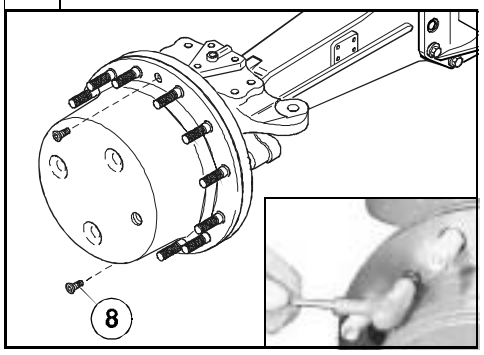
1



Vedi: sezioni C.5 e C.8.
Prima di effettuare l'operazione di scarico dell'olio, posizionare il mozzo ruota con il tappo nel punto più alto e svitarlo di qualche giro per eliminare l'eventuale pressione interna, quindi rimuoverlo completamente.
Ruotare il mozzo fino a portare il foro nel punto più basso.
Scaricare completamente l'olio.

See: *sections C.5 and C.8.*
Before draining the oil, position the wheel hub with the plug on the upper part and loosen it of some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside-down till the hole is in the lowest point.
Drain the oil completely.

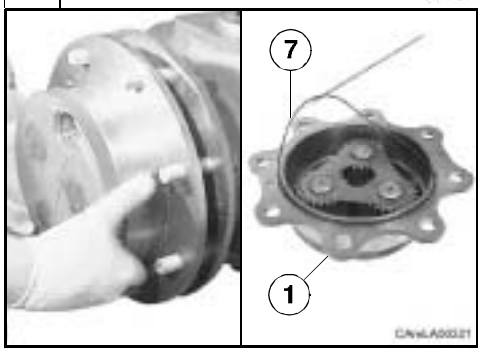
2



Svitare e togliere le due viti di fissaggio (**8**) del treno portasatelliti con una chiave da commercio.

*Unscrew and remove both fastening screws (**8**) of the planetary carrier with a wrench.*

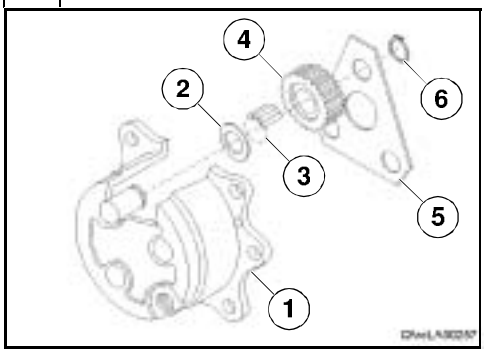
3



Rimuovere il treno portasatelliti (**1**) dal mozzo ruota e recuperare il relativo anello OR (**7**).
Posizionare il treno portasatelliti (**1**) su di un piano e verificarne le condizioni di usura.

*Remove the planetary carrier (**1**) from the wheel hub and collect the relative O-Ring (**7**).*
*Position the planetary carrier (**1**) on a workbench and check its wear conditions.*

4



Per eseguire l'eventuale sostituzione degli ingranaggi satelliti:
- rimuovere gli anelli d'arresto (**6**) da ogni perno;
- rimuovere la piastra triangolare (**5**);
- estrarre gli ingranaggi satellite (**4**) dai perni;
- recuperare i rullini (**3**) verificandone le condizioni;
- recuperare la rondella (**2**).

Nota: con nuovi satelliti è consigliabile montare rullini nuovi.

To carry out any possible replacements of the planetary gears:
- *remove the Seeger rings (**6**) on every pin;*
- *remove the triangular plate (**5**);*
- *take the planetary gears (**4**) out of the pins;*
- *collect the roller bearings (**3**), checking their conditions;*
- *collect the washer (**2**).*

***Note:** with new planetary gears is advisable to assembly new roller bearings.*

D.3 Smontaggio gruppo mozzo ruota

Prima di smontare il mozzo ruota, assicurarlo con una cinghia o una fune ad un paranco od altro sistema di sostegno, per evitarne la caduta accidentale che potrebbe danneggiare sia l'operatore che il gruppo.

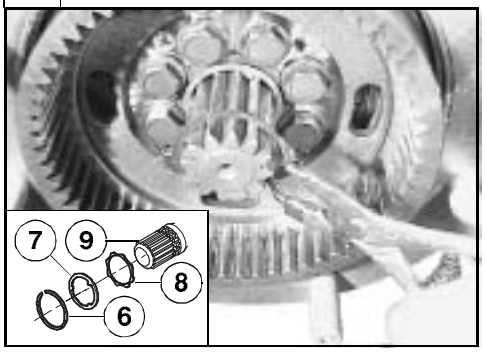
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.3 Wheel hub group disassembly

Before disassembling the wheel hub, it is advisable to secure it with a belt or a rope on a hoist or any other supporting device, in order to avoid its accidental fall that could damage either the operator or the wheel hub group.

Some of the following pictures may not show exactly your axle, but the process is the same.

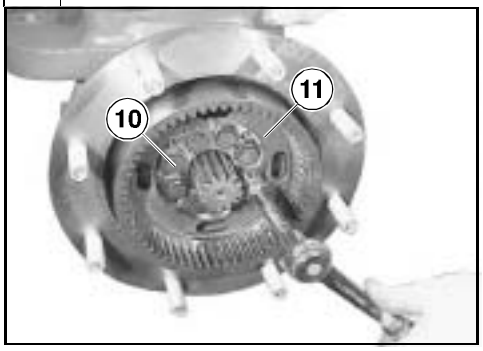
1



Rimuovere dal semiasse (**9**) l'anello d'arresto (**6**), utilizzando una pinza adatta.
Recuperare le rondelle (**7**, **8**) dal semiasse.

*Remove the lock ring (**6**) from the U-Joint shaft (**9**) using a suitable pliers.*
*Collect the U-Joint shaft washers (**7, 8**).*

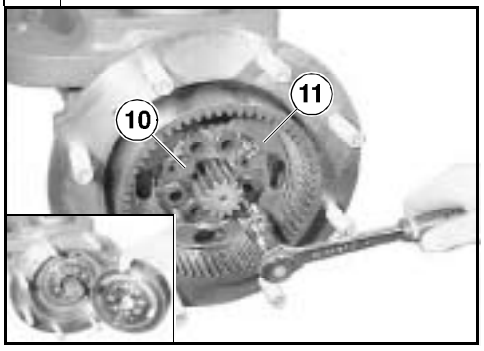
2



Svitare e togliere le viti di fissaggio (**10**) del mozzo fermo corona (**11**).

*Unscrew and remove the fastening screws (**10**) from the wheel carrier group (**11**).*

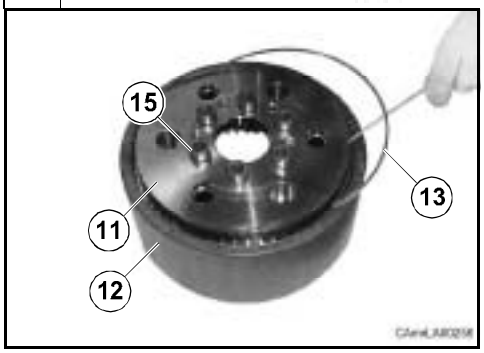
3



Per sfilare il mozzo-fermo corona dalla sua sede, recuperare due delle viti (**10**) appena tolte ed avvitarle nei fori filettati di estrazione.
Estrarre e rimuovere il mozzo fermo corona (**11**) completo di corona epicicloidale (**12**).

*In order to remove the wheel carrier group from its housing, screw two of the just removed screws (**10**) in the threaded extraction holes.*
*Extract and remove the wheel carrier (**11**) together with the epicyclic ring gear (**12**).*

4



Rimuovere l'anello di arresto d'acciaio (**13**) e separare il mozzo fermo corona (**11**) dalla corona epicicloidale (**12**).
Solo se necessario, togliere le bussole di centraggio (**15**) del mozzo fermo corona con un martello e l'attrezzo CA715086.

*Remove the steel lock ring (**13**) and disjoin the wheel carrier (**11**) from the epicyclic ring gear (**12**).*
*Only if necessary, remove the centering bushes (**15**) from the wheel carrier with a hammer and the special tool* CA715086.

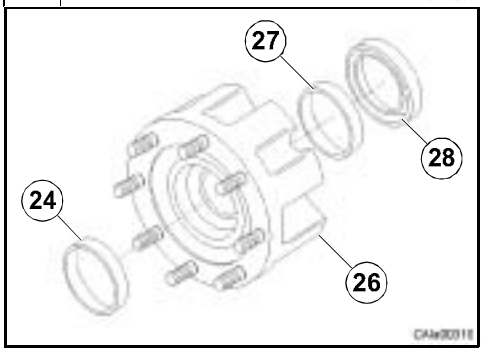
5



Sfilare il mozzo ruota, facilitando lo smontaggio con leve e martello.
Nota: recuperare la pista interna del cuscinetto.

Remove the wheel hub, using levers and a hammer to facilitate the operation.
***Note**: collect the bearing cone.*

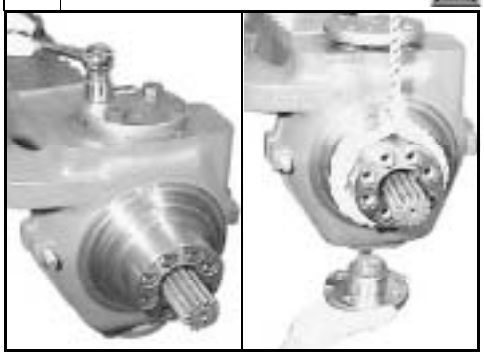
6



Posizionare su di una superficie piana il mozzo ruota (**26**) ed estrarre l'anello di tenuta (**28**) con una leva.
Nota: è un'operazione distruttiva per l'anello di tenuta.
Estrarre le piste esterne dei cuscinetti (**27**, **24**), con un battitoio ed un martello.o utilizzando un estrattore da commercio.

*Position the wheel hub (**26**) on a flat surface and take the seal ring (**28**) out with a lever.*
***Note**: this is a destructive operation for the seal ring.*
*Take the bearing cups (**27**, **24**) out, using a hammer and a suitable drift or using a suitable extractor.*

7



Rimuovere le viti di fissaggio del perno snodo superiore ed inferiore.
Pericolo: prima di rimuovere i perni snodo, assicurare la calotta con una cinghia o una fune ad un paranco od altro sistema di sostegno.
Rimuovere i perni.
Nota: recuperare le molle a tazza e lo spessore dall'assale.

Remove the fastening screws from the upper and lower king pin.
***Danger:** before removing the king pins, secure the swivel housing with a belt or a rope to a hoist or any other supporting device.*
Remove the king pins.
***Note:** collect the belleville washers and the shim.*

8



Sfilare la calotta dal trave e dal semiasse corto del doppio giunto.
Posizionare la calotta su di una superficie piana ed estrarre l'anello di tenuta con una leva.
Nota: operazione distruttiva per l'anello di tenuta.
Girare la calotta ed estrarre la bronzina utilizzando un battitoio ed un martello.

Remove the swivel housing from the axle beam and from the short shaft of the U-Joint.
Position the swivel housing on a flat surface and take the seal ring out with a lever. Note: this is a destructive operation for the seal ring.
Turn the swivel housing and take the bush out, using a drift and a hammer.

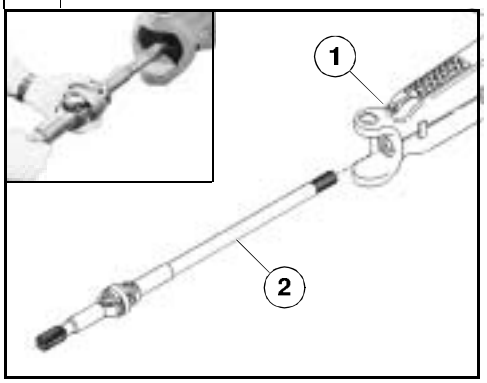
D.4 Smontaggio gruppo trave

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.4 Axle beam group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

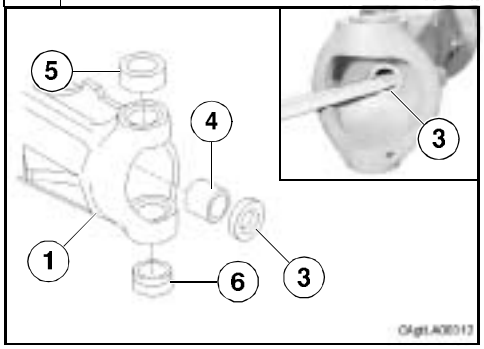
1



Sfilare il doppio giunto (**2**) dal trave (**1**).

*Remove the U-Joint (**2**) from the axle beam (**1**).*

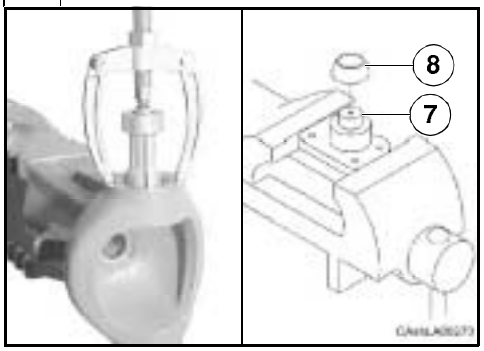
2



Estrarre l'anello di tenuta (**3**) dal trave (**1**) con una leva.
Nota: è un'operazione distruttiva per l'anello di tenuta.
Rimuovere la bronzina (**4**) dal trave con estrattore da commercio.
Nota: esaminare la bronzina prima della rimozione ed eseguire la sua sostituzione solo se le condizioni di usura lo richiedono.

*Take the seal ring (**3**) out of the axle beam (**1**) with a lever.*
***Note:** this is a destructive operation for the seal ring.*
*Remove the bush (**4**) from the beam with a suitable extractor.*
***Note:** examine the bush before the removal and replace it only if the wear conditions require this.*

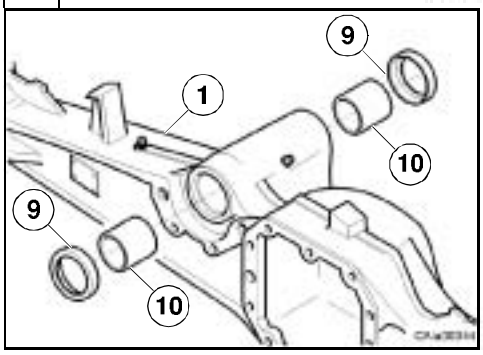
3



Estrarre le boccole superiori (**5**) ed inferiori (**6**, **8**) dalle sedi dei perni snodo e dai perni snodo (**7**) con estrattore da commercio.

*Take the upper (**5**) and lower (**6, 8**)bushes out of the king pin housings (**7**) and out of king pin with a suitable extractor.*

4



Estrarre gli anelli di tenuta (**9**) dal trave (**1**) con una leva.
Nota: è un'operazione distruttiva per gli anelli di tenuta.
Rimuovere le boccole (**10**) dal trave con estrattore da commercio.
Nota: esaminare la boccole prima della rimozione ed eseguire la sostituzione solo se le condizioni di usura lo richiedono.

*Take the seal rings (**9**) out of the axle beam (**1**) with a lever.*
***Note:** this is a destructive operation for the seal rings.*
*Remove the bush (**10**) from the beam with a suitable extractor.*
***Note:** examine the bushes before the removal and replace only if the wear conditions require this.*

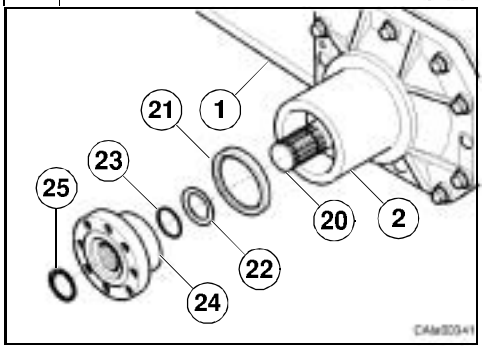
D.5 Smontaggio gruppo supporto differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.5 Differential support group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

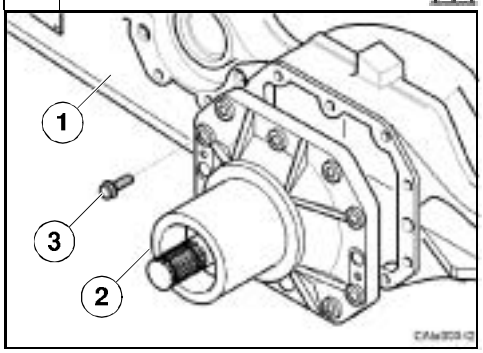
1



Rimuovere l'anello d'arresto (**25**) dal codolo del pignone.
Sfilare la flangia (**24**).
Rimuovere l'anello OR (**23**) e la rondella (**22**).
Rimuovere l'anello di tenuta (**21**) dal supporto differenziale (**2**).
Nota: è un'operazione distruttiva per l'anello di tenuta.

*Remove the lock ring (**25**) from the pinion end.*
*Remove the flange (**24**).*
*Remove the O-Ring (**23**) and the washer (**22**).*
*Remove the seal ring (**21**) from the differential support (**2**).*
***Note:** this is a destructive operation for the seal ring.*

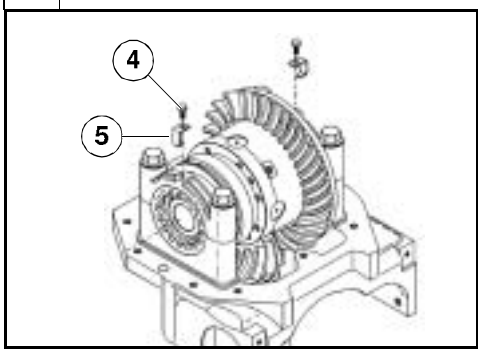
2



Svitare e togliere le viti di fissaggio (**3**) ed estrarre il supporto differenziale (**2**) dal corpo trave (**1**).
Attenzione: sostenere il supporto differenziale con una fune o con un sostegno adatto.

*Loosen and remove the screws (**3**) on the differential support (**2**).*
*Remove the differential support (**2**) from the axle housing (**1**).*
***Warning:** support the differential support with a rope or other appropriate means.*

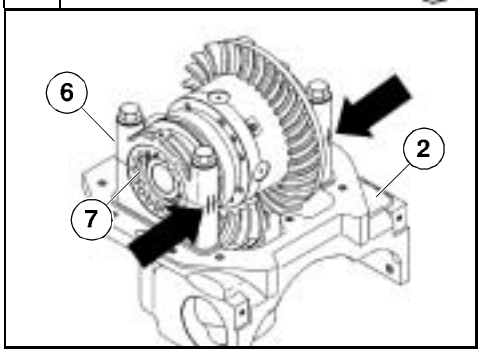
3



Togliere le viti (**4**) per rimuovere i 2 fermi ghiera (**5**).

*Loosen and remove the screws (**4**) to take out the two ring nut retainers (**5**).*

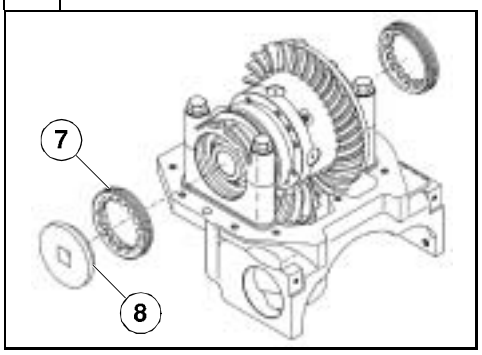
4



Prima di togliere le semicravatte (**6**), fare dei segni di riferimento indelebili sulle stesse e sul supporto differenziale in modo da non invertirle o rovesciarle in fase di rimontaggio. Fare dei segni di riferimento anche tra le ghiere (**7**) e il supporto differenziale (**2**).

*Before removing the bolts (**6**), mark both half-collars and the differential support with permanent reference marks to avoid inverting them during re-assembly. Mark the area between the ring nuts (**7**) and the differential support (**2**) as well.*

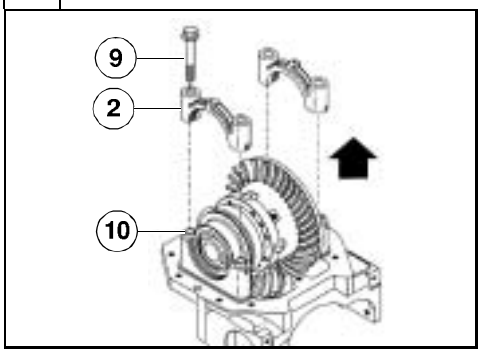
5



Svitare le due ghiere di registro (**7**) con l'attrezzo CA119030 (**8**) ed una chiave.

*Unscrew the adjuster ring nuts (**7**) using tools CA119030 (**8**) and a wrench.*

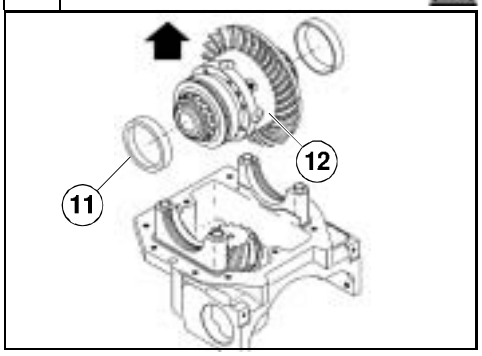
6



Svitare le 4 viti (**9**) e togliere le 2 semicravatte (**6**).
Nota: verificare che le bussole (**10**) rimangano nelle rispettive sedi.

*Remove the 4 screws (**9**) and remove both half-collars (**6**).*
***Note:** check that the bushes (**10**) remains in their housings.*

7



Rimuovere la scatola differenziale (**12**).
Recuperare le piste esterne dei cuscinetti (**11**).
Attenzione: non invertire le piste esterne dei cuscinetti se non vengono sostituiti.

*Take out the differential case (**12**).*
*Collect from ring gear side the cup bearings (**11**).*
***Warning:** don't mismatch the cup bearings if they are not to be replaced.*

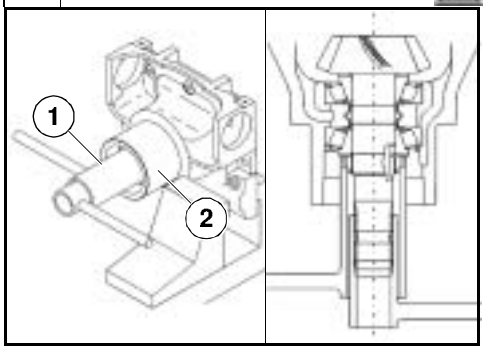
D.6 Smontaggio gruppo pignone

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.6 Pinion group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

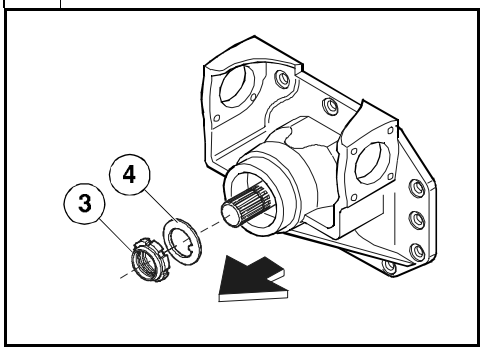
1



Fissare in morsa il gruppo differenziale (**2**).
Svitare la ghiera di serraggio utilizzando le attrezzature CA715080 e CA715081 (**1**).
Nota: Operazione distruttiva per la ghiera.

*Fit the differential support (**2**) in a vise.*
*Unscrew the lock nut using special tools CA715080 and CA715081 (**1**).*
***Note:** This operation will irretrievably damage the ring nut.*

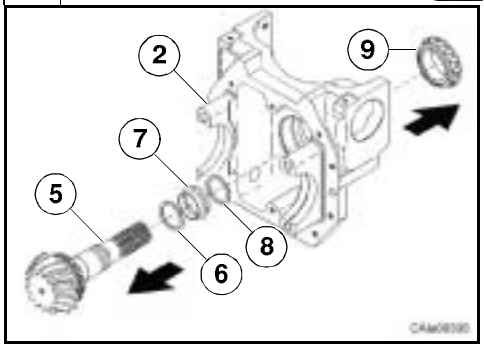
2



Togliere la ghiera (**3**) e recuperare la rondella fermo-ghiera (**4**).

*Remove the ring nut (**3**) and collect its retaining washer (**4**).*

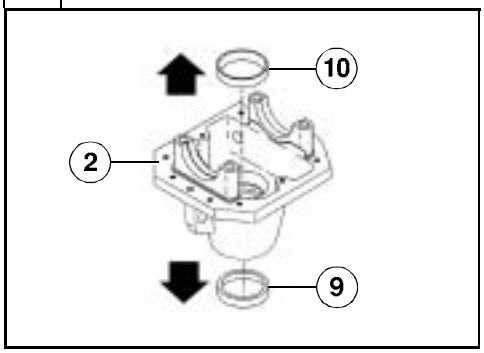
3



Battere con un martello di materiale tenero sul codolo per sfilare il pignone conico (**5**).
Attenzione: non lasciar cadere il pignone.
Recuperare le rondelle (**6, 8**), il distanziale elastico (**7**) e la pista interna (**9**) del cuscinetto a rulli conici.

*Tap the shaft with a soft hammer to remove the bevel pinion (**5**).*
***Warning:** take care not to drop the pinion.*
*Collect the washers (**6, 8**), the collapsible spacer (**7**) and the inner cone (**9**) of the tapered roller bearing.*

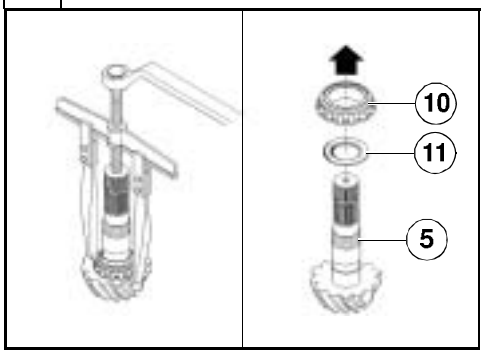
4



Posizionare su di una superficie piana stabile il supporto differenziale (**2**) come in figura, ed estrarre le piste esterne dei cuscinetti a rulli conici (**10**, **9**) con un battitoio ed un martello.

*Place the differential support (**2**) on a flat surface as shown in the figure and remove the outer cups of the taper roller bearing (**10, 9**) using a drift and a hammer.*

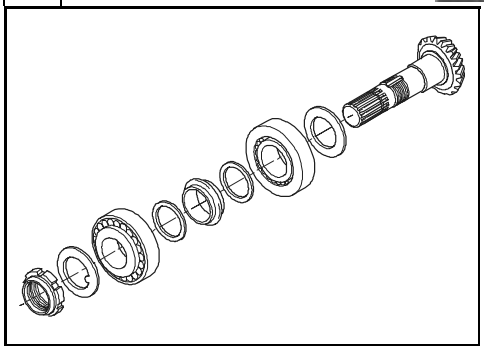
5



Per togliere la pista interna del cuscinetto a rulli conici (**10**) dal pignone conico (**5**), utilizzare un estrattore di presa da commercio.
Recuperare lo spessore (**11**) sottostante.

*To remove the inner cone of the tapered roller bearing (**10**) of the pinion (**5**), use a standard extractor.*
*Collect the underlying shim (**11**).*

6



Controllare le condizioni di tutti i particolari del pignone.
Nota: la ghiera ed il collassabile in fase di rimontaggio devono essere sostituiti.

Check all pinion components condition.
***Note:** the ring nut and the collapsible spacer must be replaced when reassembling the unit.*

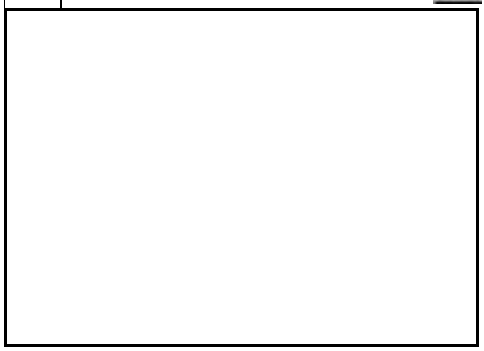
D.7 Smontaggio gruppo differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.7 Differential group disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

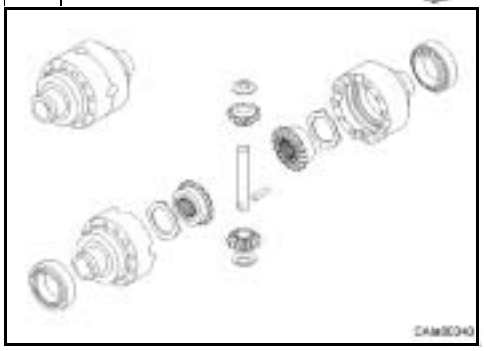
1



Recuperare il differenziale e posizionarlo in una morsa.
Svitare le viti di fissaggio e rimuovere la corona conica.
Attenzione: questa operazione libera anche le due semiscatole differenziale, non disperderne i componenti.

Collect the differential and close it in a clamp.
Unscrew the fastening screws and remove the bevel gear crown.
***Warning:** this will make both differential half boxes free, so take care not to drop the internal components.*

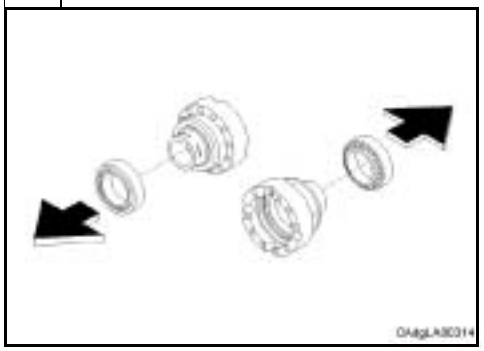
2



Disassemblare la scatola differenziale in due semiscatole complete dei rispettivi elementi.
Nota: fare dei segni di riferimento sulle due semiscatole prima di separarle, per ripristinare la loro posizione relativa in fase di montaggio.
Disassemblare tutti i particolari.
Verificare le condizioni di funzionalità e lo stato di usura dei componenti.

Disassemble the differential box in two half boxes complete with the relative components.
***Note**: mark the two half boxes before disjoining them, in order to reassemble them in the same position as the one before disassembling.*
Disassemble all the components.
Check the operating and wear conditions of the components.

3



Per estrarre il cuscinetto da ogni semiscatola differenziale, utilizzare due leve oppure un estrattore a tre punti di presa da commercio.

Take the bearing out of each differential half box, using two levers or a three-hold extractor.

E OPERAZIONI DI MONTAGGIO

E.1 Montaggio gruppo pignone

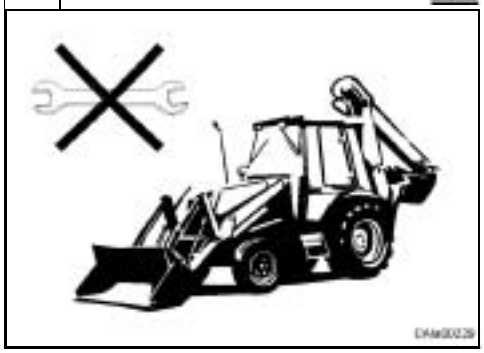
Le istruzioni di montaggio presuppongono che il gruppo sia già stato rimosso dal veicolo e posizionato su un adatto banco di lavoro.
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E ASSEMBLY INSTRUCTIONS

E.1 Pinion group assembly

The assembly instructions presume that the unit has been removed from the vehicle and positioned on a suitable workbench.
Some of the following pictures may not show exactly your axle, but the procedure is the same.

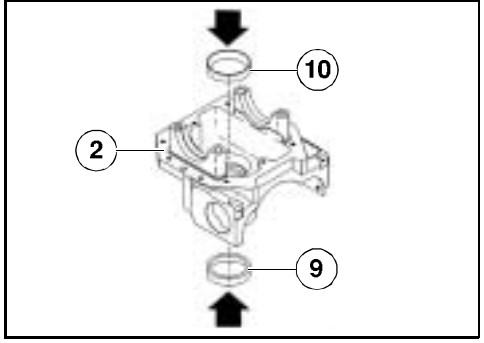
1



Attenzione: le operazioni di assemblaggio qui descritte, prevedono che il gruppo sia già stato rimosso dal veicolo e posizionato su un adatto banco di lavoro; se si opera sul gruppo installato sul veicolo, seguire le istruzioni del costruttore del veicolo per operare in condizioni di totale sicurezza.

Warning: *execute assembly operation only if the group is removed from the vehicle and placed on a suitable workbench; if the group is on the vehicle, see the vehicle manufacturer instructions to work in totally safety.*

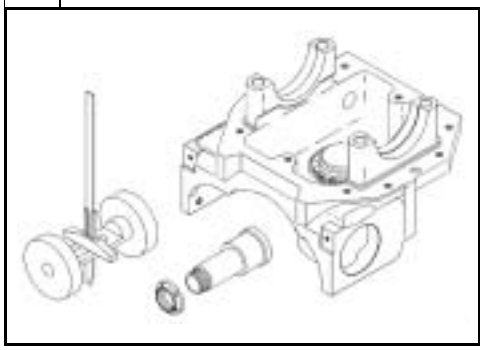
2



Posizionare su un banco di lavoro il supporto differenziale (**2**).
Piantare le piste esterne dei nuovi cuscinetti (**9**, **10**), con il battitoio CA119068 ed un martello.

*Place the differential support (**2**) on a workbench.*
*Fit the outer cups of the new bearings (**9**, **10**) using the special tool CA119068 and a hammer.*

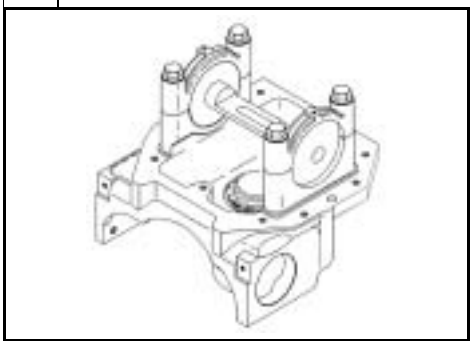
3



Per la rilevazione della distanza si utilizza il kit composto dalle attrezzature dette “falso pignone” CA715450 e “falsa scatola differenziale” CA119205 e CA119206.

In order to measure the distance, use the kit consisting of the special tools called “false pinion” CA715450 *and “false differential box”* CA119205 e CA119206.

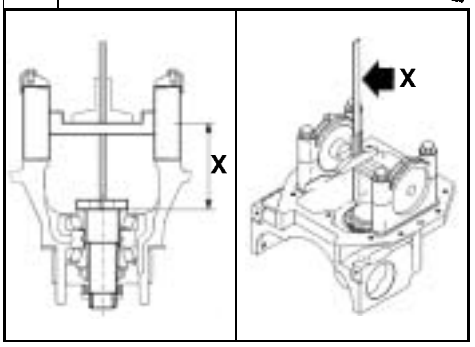
4



Inserire nelle sedi per i cuscinetti appena montate, il falso pignone CA715450 con i rispettivi cuscinetti e la ghiera.
Serrare, senza eccedere, fino ad eliminare il gioco.
Installare gli attrezzi speciali CA119205 e CA119206 sulle sedi della scatola differenziale e bloccare con le semicravatte avvitate (vedi figura).

Insert the false pinion with CA715450, together with its bearings and its ring nut, in the just mounted housings for the bearings.
Tighten without exceeding, till the backlash is eliminated.
Install special tools CA119205 and CA119206 to the differential group supports and screw in the half collar bolts (see figure).

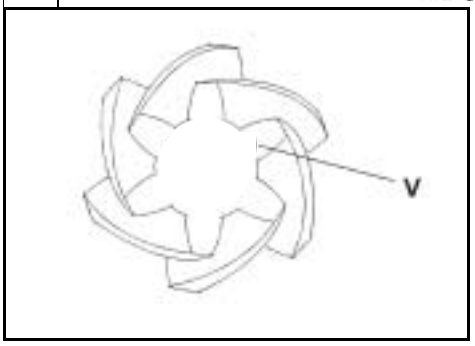
5



Schema montaggio attrezzi CA119205 e CA119206 sulla sede dei cuscinetti del differenziale sul supporto.
Utilizzare un calibro di profondità per rilevare la quota "**X**" (distanza tra l'asse dei cuscinetti della scatola differenziale e il punto di appoggio della testa del pignone, o base del cuscinetto).

Assembly diagram of the tools CA119205 and CA119206 on the bearing differential support seats.
*Use a depth gauge to measure distance "**X**" (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).*

6

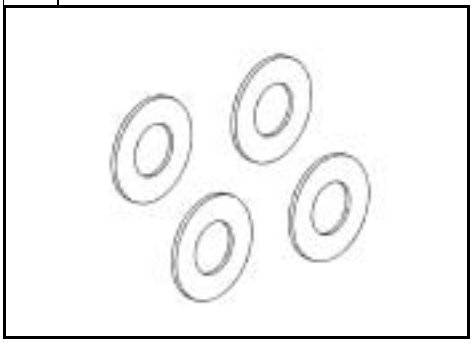


Per determinare lo spessore (**S**) necessario tra il pignone ed il cuscinetto è sufficiente sottrarre dal valore misurato (**X**) il valore stampigliato (**V**) sulla testa del pignone (**V**=distanza conica prescritta).

S=X-V

*In order to determine the necessary thickness (**S**) between the pinion and the bearing, subtract the value (**V**), stamped on the pinion head (**V**=requested conical distance), from the measured value (**X**).*

7

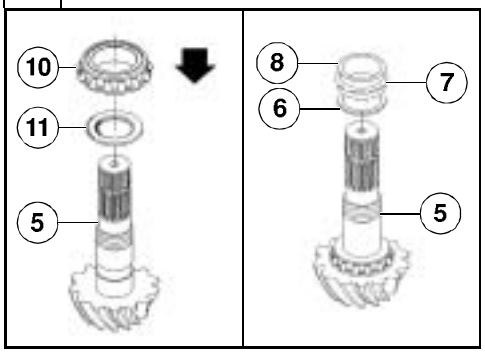


Scegliere tale spessore (**S**) tra la gamma di spessori a disposizione ed inserirlo sul codolo sotto la testa del pignone.
Nota: attenzione al corretto senso di montaggio.

GAMMA SPESSORI - SHIM RANGE										
Spess./Thick.	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4
Q.ty	---	---	---	---	---	---	---	---	---	---

*Select the thickness (**S**) from the range of available shims, and fit to shaft under the pinion head.*
***Note:** take care to assemble correctly.*

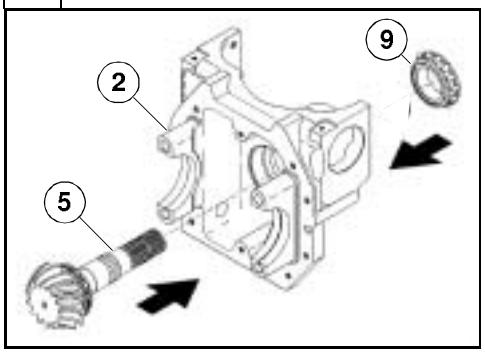
8



Dopo aver scelto ed inserito lo spessore adatto (**11**) con lo smusso rivolto verso l'ingranaggio, piantare il cuscinetto (**10**) nell'albero del pignone (**5**) sotto l'azione di una pressa con il battitoio CA715082, assicurandosi che sia ben assestato.
Inserire gli spessori (**6, 8**) ed un nuovo distanziale elastico (**7**).
Nota: utilizzare sempre un distanziale elastico nuovo.

*Once you have chosen and inserted the suitable shim (**11**) with the chamfer against the gear, force the bearing (**10**) into the pinion shaft (**5**) end with special tool CA715082 under a press, making sure that it is well set.*
*Insert the shims (**6, 8**) and a new elastic spacer (**7**).*
***Note:** use always a new elastic spacer.*

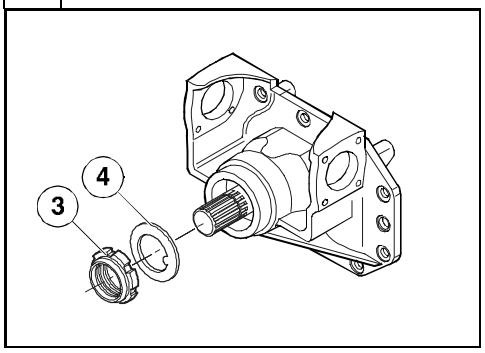
9



Inserire il gruppo pignone conico preassemblato (**5**) nel supporto differenziale (**2**) ed il secondo cuscinetto (**9**) sul codolo pignone, come in figura.
Per eseguire il piantaggio del secondo cuscinetto (**9**), utilizzare il battitoio CA715082 ed un martello.
Si consiglia di contrapporre un azione resistente alla forza battente (ad esempio con una mazza).

*Insert the bevel pinion unit (**5**) into the differential support housing (**2**) and the second bearing cone (**9**) into the pinion end, as in figure.*
*In order to force the second bearing (**9**) into position, use the special tool CA715082 and a hammer.*
It is advisable to offer resistance, for example with a sledge, to the beating force.

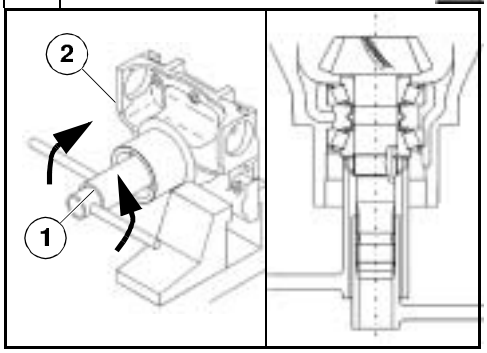
10



Inserire la rondella (**4**) fermo ghiera ed avvitare una nuova ghiera (**3**) di serraggio sul codolo del pignone.

*Insert a ring nut washer (**4**) and screw a new lock ring nut (**3**) on the pinion end.*

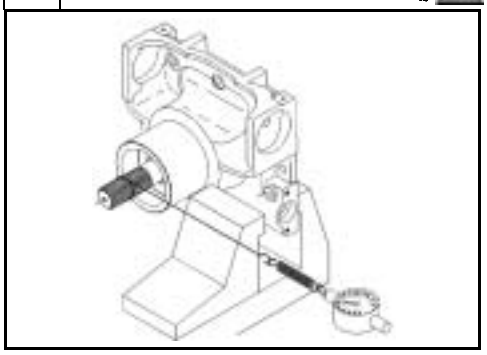
11



Avvitare la ghiera utilizzando le chiavi per ghiera CA715080 e fermo pignone CA715081.
Attenzione: La coppia di serraggio è data dalla misurazione del precarico sui cuscinetti. Serrare la ghiera progressivamente.
Nota: se il serraggio è eccessivo il distanziale elastico dovrà essere sostituito e la procedura ripetuta.
Al momento di verificare il precarico è opportuno dare piccoli colpi con martello in materiale tenero alle estremità del pignone per favorire l'assestamento dei cuscinetti

Screw the ring nut in, using the wrench for ring nut CA715080 and for pinion retainer CA715081.
***Warning:** The torque setting is given by the preloading measurement on bearings. Tighten the ring nut gradually.*
***Note:** if the tightening is excessive, the elastic spacer must be replaced and the procedure repeated. When you check the preloading, it is advisable to beat slightly both pinion ends with a soft hammer, so as to help setting the bearings.*

12



Effettuare la misurazione del precarico (**P**) dei cuscinetti conici del pignone, utilizzando un dinamometro a funicella, avvolta sul codolo scanalato del pignone.
La regolazione si effettua aumentando gradualmente il serraggio della ghiera, facendo attenzione a non eccedere.
Attenzione: tutti i precarichi devono essere misurati senza anello di tenuta.

P=10.5÷15.7 daN

*Carry out the preloading measurement (**P**) of the pinion taper roller bearings, using a dynamometer whose cord is wound on the end of pinion spline.*
The adjustment is carried out by increasing the ring nut torque gradually, being careful not to exceed.
***Warning:** all preloadings must be measured without the seal ring.*

13



Ottenuto il prescritto valore di precarico, cianfrinare la ghiera utilizzando martello e punzone.

Once the requested preloading value is achieved, caulk the ring nut, using a hammer and a chisel.

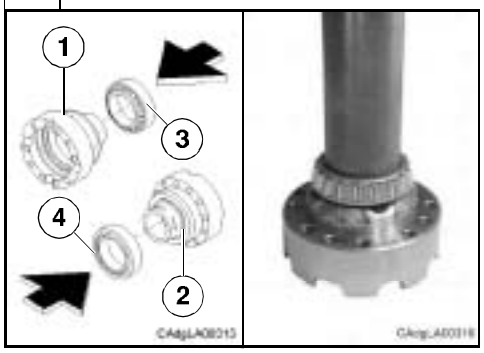
E.2 Montaggio gruppo differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.2 Differential group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

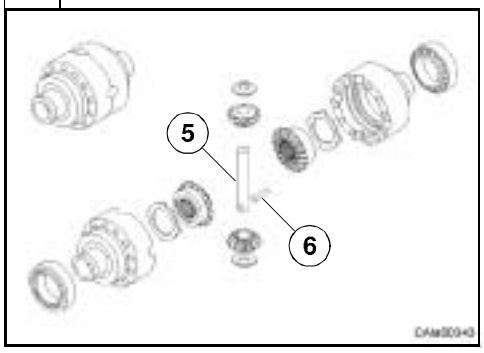
1



Montare le piste interne dei nuovi cuscinetti a rulli conici (**3**, **4**) sulle semiscatole (**1**, **2**), utilizzando il battitoio CA715083 ed un martello.

*Assemble the cones of the new taper roller bearings (**3**, **4**) on the half boxes (**1**, **2**), using the special tool CA715083 and a hammer.*

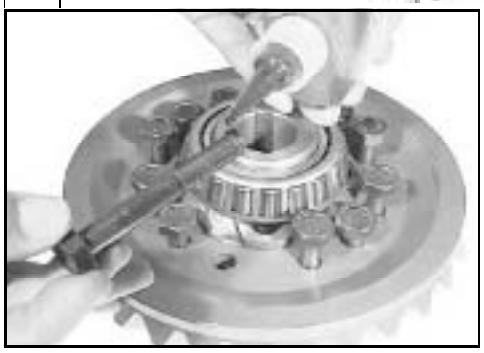
2



Posizionare una semiscatola differenziale sul banco di lavoro ed assemblare con attenzione gli elementi interni (rondelle di rasamento, ingranaggi planetari, satelliti, controdischi bloccaggio differenziale, perno centrale) come in figura.
Vincolare il perno (**5**) con la spina d'arresto (**6**).
Unire le due semiscatole, allineando i riferimenti praticati sulle stesse.

Position a half box on a workbench and assemble all inner components (thrust washers, sun gears, planetary gears, locking differential counterdisks, central pin), as shown in figure.
*Fix the pin (**5**) with the lock pin (**6**).*
Join the two half boxes, aligning the reference marks made upon them.

3



Posizionare la corona conica sulla scatola differenziale.
Applicare Loctite® 270 sul filetto delle viti di fissaggio.
Serrare le viti alla coppia prevista (Sez.C.7).

Position the bevel crown gear on the differential box.
Apply Loctite® 270 on screws thread.
Fix the whole tightening the screws to the requested torque (Sec. C.7).

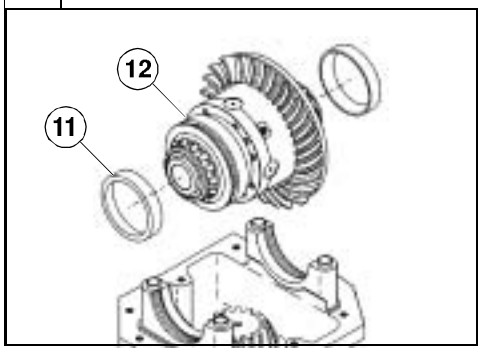
E.3 Montaggio gruppo supporto differenziale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.3 differential support group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

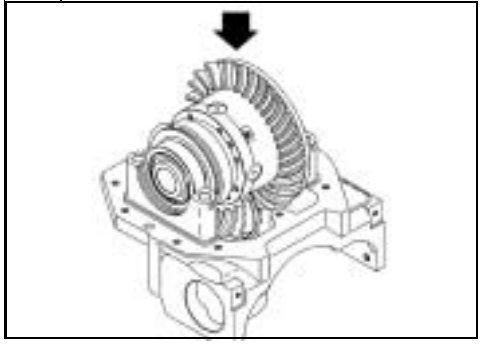
1



Montare gli anelli esterni (**11**) dei cuscinetti sulla scatola differenziale (**12**).

*Assemble the outer cups (**11**) of the taper roller bearings on both differential box bearings (**12**).*

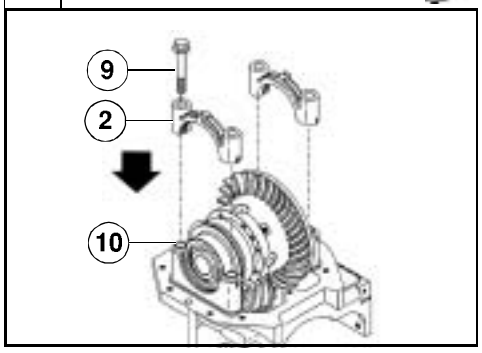
2



Montare la scatola differenziale completa sul supporto differenziale.
Attenzione: non invertire le piste esterne dei cuscinetti e soprattutto verificare il giusto lato di montaggio della corona conica.

Position the complete differential box on the differential support.
***Warning:** take care not to invert the outer cups of the taper roller bearings and check the right side of the bevel crown assembly.*

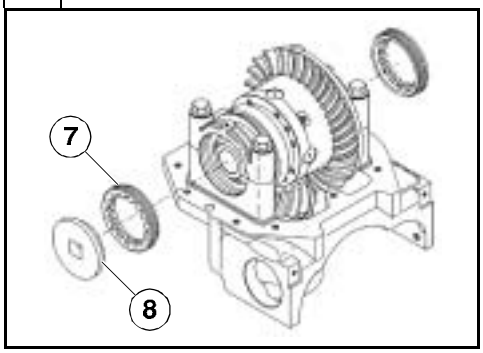
3



Spostare la scatola differenziale in modo da appoggiare la corona conica al pignone.
Verificare che tutte le bussole (**10**) siano nelle relative sedi e posizionare le due semicravatte (**2**) utilizzando i segni di riferimento riportati sulle medesime e sul supporto differenziale.
Fissare le semicravatte con le viti di fissaggio (**9**).

Move the differential group so to place the bevel crown gear on the pinion.
*Check that all bushes (**10**) are in their housings and position both half collars (**2**) on their seats using the previously traced reference marks.*
*Lock both collars with their fastening bolts (**9**).*

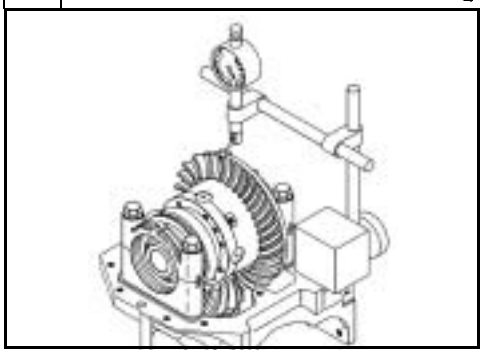
4



Montare ed avvitare le due ghiere di registrazione (**7**) nel supporto differenziale con gli attrezzi CA119030 (**8**) fino ad eliminare il gioco e precaricare leggermente i cuscinetti del differenziale.
Verificare che i cuscinetti del differenziale siano ben assestati, se necessario dare dei piccoli colpi di assestamento con un martello di materiale tenero.

*Assemble and tighten both adjustment ring nuts (**7**) in the differential support with special tools CA119030 (**8**), till the backlash is eliminated and the differential bearings are slightly preloaded.*
Check that the differential bearings are well settled; if necessary, knock slightly with a soft hammer, in order to properly set the bearings in position.

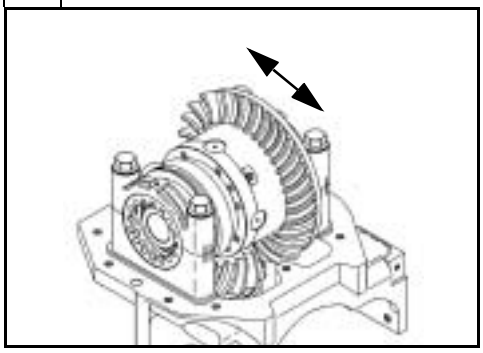
5



Posizionare un comparatore con base magnetica sul supporto differenziale, in modo che il tastatore sia a contatto e a 90° con la superficie di un dente della corona conica.

Position a magnetic-base dial gauge on the differential support, so that the feeler stylus touches the surface of one tooth of the crown gear with a 90° angle.

6



Tenendo fermo il pignone, muovere alternativamente la corona dentata ed annotare il gioco fra pignone e corona, rilevato con il comparatore.
Rilevare il gioco su due o più punti (denti) ruotando la corona in modo da ottenere un valore medio.
Verificare se il valore del gioco rilevato rientra nel campo predefinito:

0.16÷0.22 mm

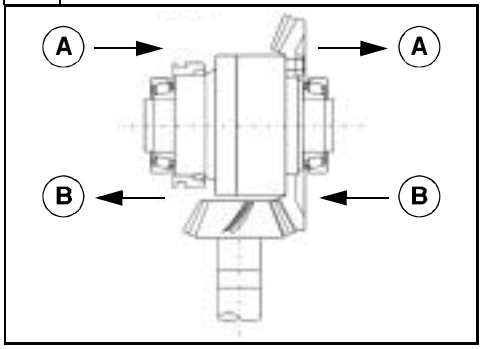
Effettuare la registrazione agendo sulle due ghiere con gli appositi attrezzi CA119030.

Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.
Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.
Check if the measured backlash value is within the requested range:

0.16÷0.22 mm

Carry out the adjustment by operating on the 2 ring nuts with the appropriate tools CA119030.

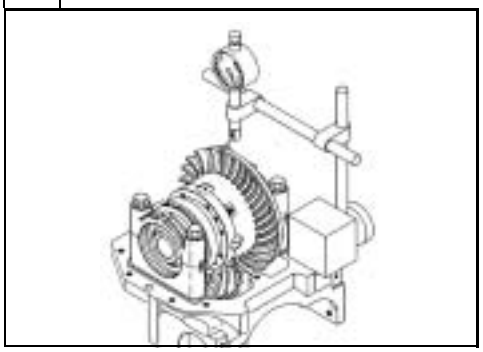
7



Registrare le ghiere ricordando che:
- se **il gioco rilevato è inferiore** al campo di tolleranza dato, svitare la ghiera lato corona ed avvitare l'altra ghiera della stessa quantità (**A**);
- se **il gioco rilevato è superiore** al campo di tolleranza dato, svitare la ghiera lato opposto corona ed avvitare l'altra della stessa quantità (**B**).

Adjust the ring nuts, remembering that:
*- if **the measured backlash is less** than the given tolerance range, unscrew the ring nut on the bevel crown gear side and screw in the opposite one by the same measure (**A**);*
*- if **the measured backlash is greater** than the given tolerance range, unscrew the ring nut on the side opposite to the bevel crown gear, and screw in the other one by the same measure (**B**).*

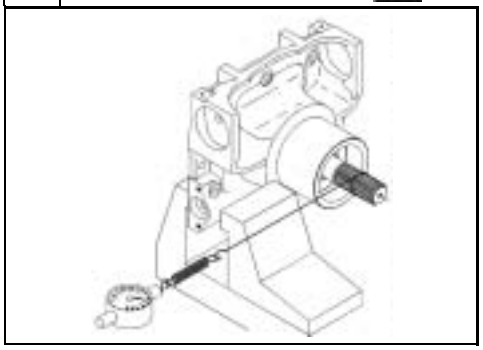
8



Effettuata la registrazione del gioco pignone-corona verificare anche che ci sia un minimo di precarico sui cuscinetti della scatola differenziale
Ripetere l'intera sequenza delle operazioni citate fino al raggiungimento delle condizioni indicate.

Once the adjustment of the pinion-ring gear backlash has been carried out, check also that there is a minimum preloading on the differential box bearings.
Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.

9



Stabilito il gioco pignone-corona, misurare il precarico totale (**T**) dei cuscinetti (sistema pignone-corona), utilizzando un dinamometro a funicella avvolta sul codolo scanalato del pignone. Il valore misurato deve rientrare nel seguente campo:

T=(P+4.2)÷(P+6.4) daN

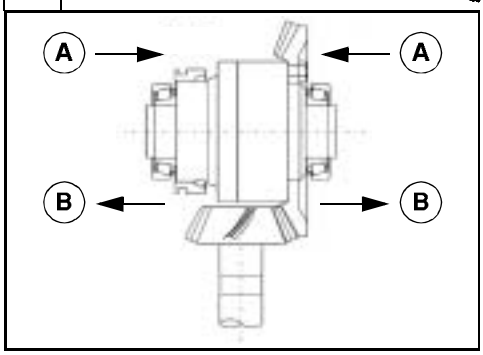
dove **P** è il precarico effettivo misurato sul pignone
Vedi: sez."Montaggio gruppo pignone".
Attenzione: tutti i precarichi vanno misurati senza anello di tenuta.

*Once the pinion-ring gear backlash has been established, measure the total preloading (**T**) of the bearings (pinion-crown bevel gear system), using a dynamometer whose cord is wound on the pinion splined end. The measured value should be within the following range:*

T=(P+4.2)÷(P+6.4) daN

*where **P** is the effectively measured pinion preloading*
***See:** sec. "Pinion assembly".*
***Warning:** all preloadings must be measured without seal ring.*

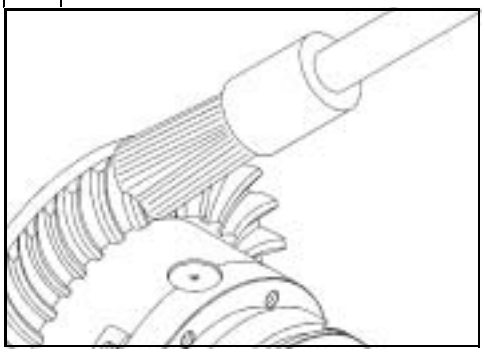
10



Se la misurazione non rientrasse nel campo prescritto, controllare bene l'assemblaggio di ogni singolo componente ed intervenire sulle ghiere di registrazione del supporto differenziale:
- se **il precarico totale è inferiore** al campo dato, avvitare della stessa quantità le due ghiere (**A**), mantenendo inalterato il valore del gioco pignone-corona;
- se **il precarico totale è superiore** al campo dato, svitare della stessa quantità le due ghiere (**B**), mantenendo inalterato il valore del gioco pignone-corona.

If the measurement is not within the requested range, check well the assembly of each component and operate on the adjusting ring nuts of the differential support:
*- if **the total preloading is less** than the given range, screw in both ring nuts by the same measure (**A**), keeping the pinion-ring gear backlash value unchanged;*
*- if **the total preloading is greater** than the given range, unscrew both ring nuts by the same measure (**B**), keeping the pinion-ring gear backlash value unchanged.*

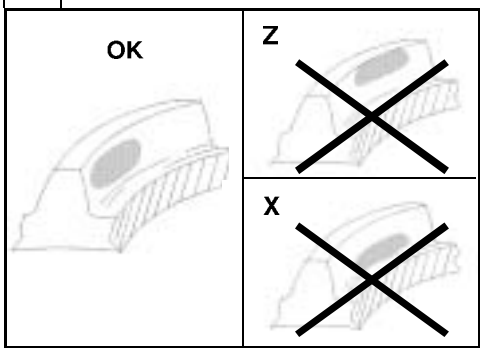
11



NOTA
Per verificare l'impronta di contatto dei denti della coppia conica, sporcare con minio la corona e rilevare il contatto.
L'esame dell'impronta di contatto deve essere eseguito sempre sui denti della corona conica, e su ambedue i fianchi.

NOTE
To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.
The marking test should be always carried out on the ring bevel gear teeth and on both sides.

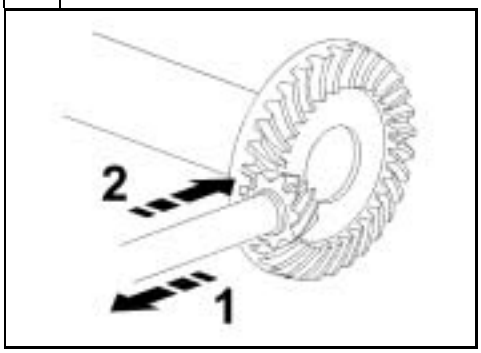
12



OK -> Contatto corretto
Se la registrazione della coppia conica è ben fatta, il contatto delle superfici delle dentature risulterà regolare.
Z -> Eccessivo contatto sulla cresta del dente.
Avvicinare il pignone alla corona ed allontanare poi la corona dal pignone per regolare il gioco.
X -> Eccessivo contatto alla base del dente.
Allontanare il pignone dalla corona ed avvicinare poi la corona al pignone per regolare il gioco.

***OK** -> Correct contact*
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.
***Z** -> Excessive contact on the tooth tip*
Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
***X** -> Excessive contact at the tooth base.*
Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.

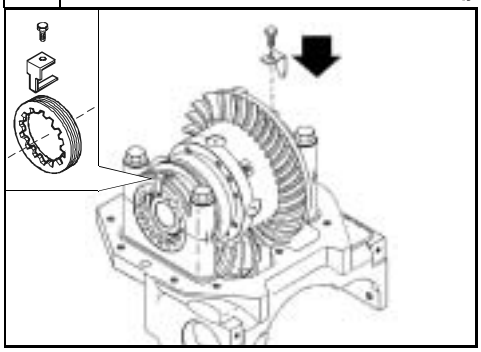
13



Spostamenti per le correzioni:
1 -> spostare il pignone per modifica contatto tipo X
2 -> spostare il pignone per modifica contatto tipo Z

Movements to correct
1 *-> move the pinion for type X contact adjustment*
2 *-> move the pinion for type Z contact adjustment.*

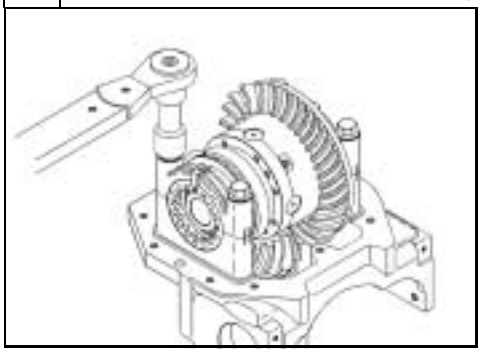
14



Dopo aver completato tutte le operazioni di registro, montare i fermo ghiera registro e le rispettive viti serrandole alla coppia prevista (Sez.C.7) con chiave dinamometrica.

Once all the adjustment operations have been completed, fit the adjuster ring nut retainers and their respective screws, tightening them to the requested torque (Sect. C.7) with a dynamometric wrench.

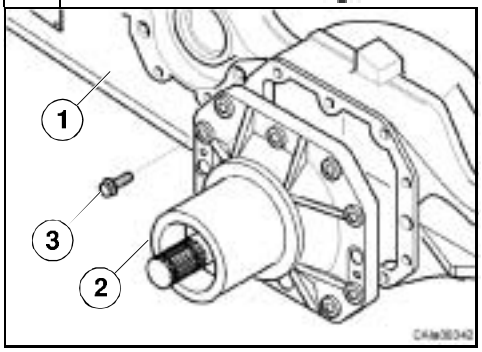
15



Serrare definitivamente le viti delle due semicravatte alla coppia prevista (Sez.C.7), con chiave dinamometrica.

Tighten the bolts of both half collars to the requested torque (Section C.7) with a dynamometric wrench.

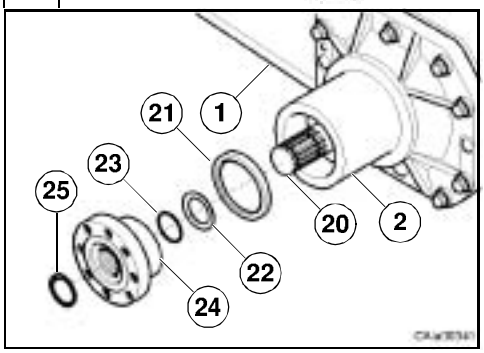
16



Prima di mettere le superfici lavorate a contatto assicurarsi che non ci siano impurità, quindi pulire bene con detergenti appositi.
Stendere un velo di Loctite® 510 sulla superficie di contatto trave/ supporto differenziale.
Montare il supporto differenziale (**2**) sul trave (**1**), fissandolo con le viti (**3**) alla coppia prevista (Sez. C.7).

Before matching surfaces, make sure they are perfectly clean. Degrease and clean them with appropriate detergents.
Spread a film of Loctite® 510 on the contact surface between the axle beam and the differential support.
*Position the differential support (**2**) on the axle housing (**1**), and tighten the retaining screws (**3**) to the requested torque (Section C.7).*

17



Montare l'anello di tenuta (**21**) nel supporto differenziale (**2**) con il tampone CA715165.
Nota: ingrassare il labbro interno dell'anello di tenuta.
Vedi: sez.C.4.
Inserire la rondella (**22**) ed un nuovo anello OR (**23**) sul codolo del pignone (**20**).
Inserire la flangia (**24**).
Montare l'anello d'arresto (**25**) sul codolo del pignone (**20**).

*Assemble the seal ring (**21**) in the differential support (**2**) by mean of special tool CA715165.*
***Note:** lubricate with grease the seal ring lip.*
***See:** sec.C.4.*
*Insert the washer (**22**) and the new O-Ring (**23**) on the pinion end (**20**).*
*Insert the flange (**24**).*
*Assemble the lock ring (**25**) to the pinion end (**20**).*

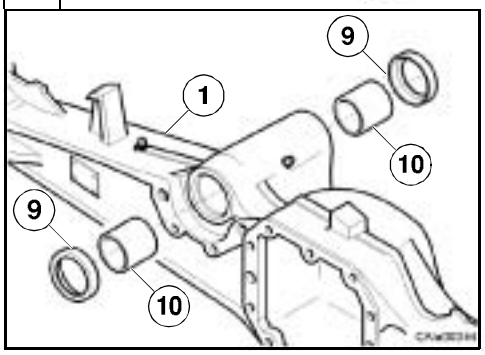
E.4 Montaggio gruppo trave

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.4 Axle beam group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

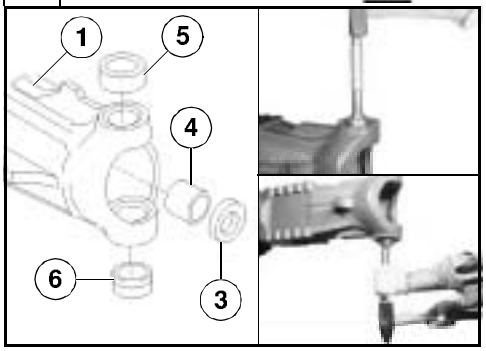
1



Inserire le boccole (**10**) nel trave con il battitoio CA119083.
Nota: per facilitare il montaggio si consiglia di raffreddare le boccole (**10**) a temperature inferiori a -100°C.
Montare gli anelli di tenuta (**9**) nel trave (**1**) con il battitoio CA715140.

*Insert the bushes (**10**) in the beam with the special tool CA119083.*
***Note:** to make the assembly easier it is advisable to cool the bushes (**10**) at a temperature lower than 100°C.*
*Assemble the seal rings (**9**) to the axle beam (**1**) with the special tool CA715140.*

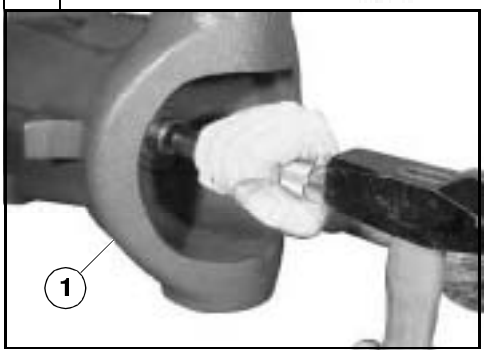
2



Montare la boccola (**5**) del perno snodo superiore nel trave (**1**) utilizzando il battitoio CA119220 ed un martello.
Montare la pista esterna (**6**) della rotula sferica nella sede inferiore sul trave utilizzando il battitoio CA715451.
Nota: per facilitare il montaggio, si consiglia di raffreddare la boccola (**5**) e la pista esterna (**6**) a temperature inferiori a -100°C.
Attenzione: usare dei guanti di protezione.

*Assemble the upper king pin bush (**5**) on the axle beam (**1**) with the special tool CA119220 and a hammer.*
*Insert the cup (**6**) of the ball bearing on the lower part of the axle beam with the special tool CA715451 and a hammer*
***Note:** to make the assembly easier, it is advisable to cool the bush (**5**) and the cup (**6**) of the ball bearing at a temperature lower than 100°C.*
***Warning:** wear safety gloves.*

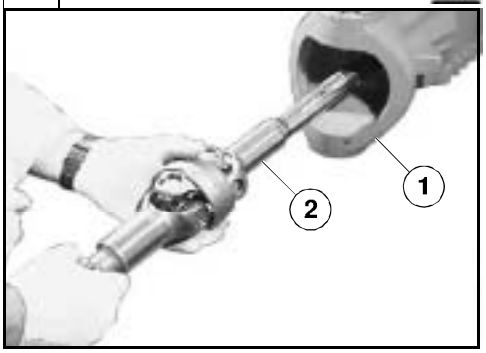
3



Montare nel trave (**1**) la bronzina (**4**) con il battitoio CA715454 ed un martello.
Montare l'anello di tenuta (**3**) nel trave con il battitoio CA715453 ed un martello.

*Assemble the bush (**4**) on the axle beam (**1**) with the special tool CA715454 and a hammer.*
*Assemble the seal ring (**3**) on the beam with the special tool CA715453 and a hammer.*

4



Ingrassare il labbro dell'anello di tenuta e la boccola.
Inserire il doppio giunto (**2**) all'interno del trave (**1**).
Attenzione: non rovinare la tenuta.

Lubricate with grease the seal ring lip and the bush.
*Insert the U-Joint (**2**) inside the axle beam (**1**).*
***Warning:** be careful not to damage the seal.*

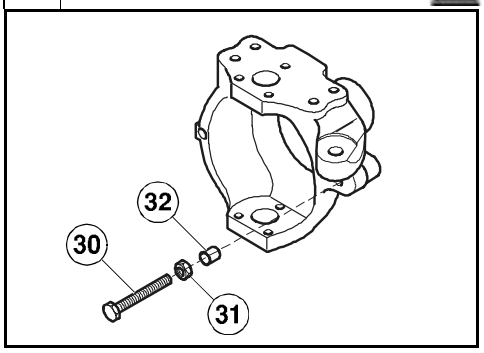
E.5 Montaggio gruppo mozzo ruota

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.5 Wheel hub group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

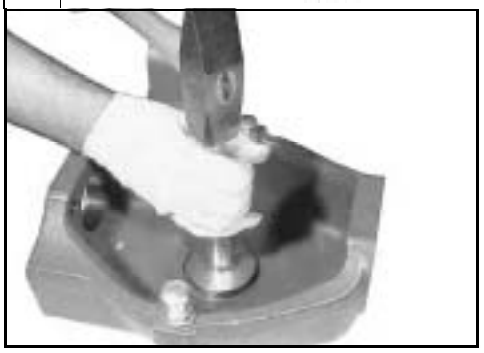
1



Se precedentemente rimosso, rimontare il fermo meccanico di sterzata costituito da: vite (**30**), dado (**31**) e distanziale (**32**).
Attenzione: inserire la boccola distanziale (**32**) sulla vite fra dado e calotta (come in figura); l'assenza del distanziale (**32**) può causare il danneggiamento dell'assale.

*If it has been removed, reassemble the steering mechanical retainer composed by: screw (**30**), nut (**31**) and spacer (**32**).*
***Warning:** insert the spacer bush (**32**) on the screw between the nut and the swivel housing (as in figure); the lack of the spacer (**32**) may produce the axle damage.*

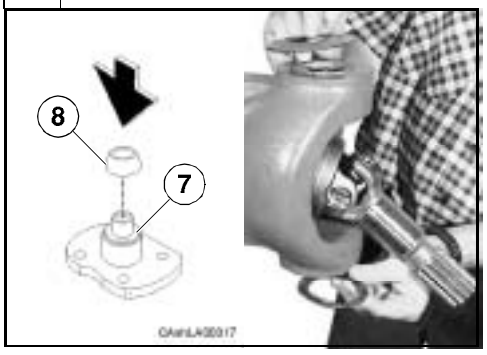
2



Piantare la bronzina nella calotta con il battitoio CA119097 ed un martello o una pressa.
Montare l'anello di tenuta nella calotta con il battitoio CA715360 ed un martello.
Riempire la camera dell'anello di tenuta con grasso.
Vedi: sez.C.4.

Force the bush into the swivel housing with the special tool CA119097 and a hammer or a press.
Assemble the seal ring on the swivel housing with the special tool CA715360 and a hammer.
Fill of the gasket cavity with grease.
***See:** sec.C.4.*

3



Posizionare il perno snodo inferiore (**7**) su di un banco di lavoro e montare la pista interna (**8**) della rotula sferica con il battitoio CA715451 sotto l'azione di una pressa.
Ingrassare bene le sedi dei perni snodo con grasso
Vedi: sez.C.4.
Posizionare lo spessore e le molle a tazza sulle sedi dei perni snodo superiori.
Posizionare le molle a tazza sulle sedi dei perni snodo inferiori.

*Position the lower king pin (**7**) on a workbench and assemble the cone (**8**) of the spherical joint with the special tool CA715451 under a press.*
Grease well the king pin housings with grease.
***See:** sec.C.4.*
Position the shim and the Belleville washers on the upper king pin housings.
Position the Belleville washers on the lower king pin housings.

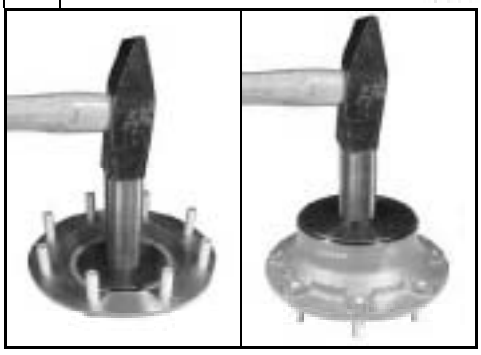
4



Pericolo: assicurare il gruppo calotta con una fune.
Lubrificare il labbro dell'anello di tenuta nella calotta ed avvolgere l'estremità scanalata del semiasse con del nastro adesivo sottile, per non danneggiare l'anello di tenuta. A montaggio avvenuto, rimuovere tutto il nastro protettivo.
Inserendo il semiasse nella calotta, assemblare la calotta al trave.
Montare i due perni snodo inferiore e superiore e serrare le viti del supporto con chiave dinamometrica alla coppia prevista (Sez.C.7).
Nota: assicurarsi che le molle a tazza rimangano nella loro posizione.

Danger: *secure the swivel housing group with a rope.*
Lubricate the seal ring lip and protect the splined end of the axle shaft by winding it with thin adhesive tape to avoid damage to the seal ring.
After assembly, remove completely the adhesive tape.
Assemble the swivel housing on the axle beam.
Assemble the two king pins, the upper and the lower, and tighten the retaining screws with dynamometric wrench to the requested torque (Sec.C.7).
Note: *make sure that the Belleville washers remain in their position.*

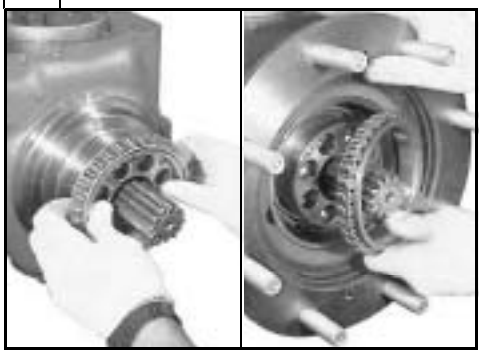
5



Posizionare il mozzo ruota su di un banco di lavoro e piantare le due piste esterne dei cuscinetti a rulli conici utilizzando l'attrezzo speciale CA715085 sotto l'azione di una pressa o di un martello.
Inserire l'anello di tenuta nel mozzo ruota con il battitoio CA715099 ed un martello.

Position the wheel hub on a workbench and force both cups of the taper roller bearings in position with the special tool CA715085 under a press or with a hammer.
Insert the seal ring into the wheel hub with the special tool CA715099 and a hammer.

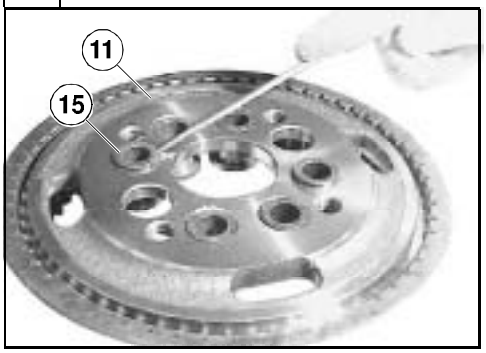
6



Montare la pista interna del cuscinetto a rulli conici sul codolo della calotta.
Montare il mozzo ruota sulla calotta e posizionare l'altra pista interna del cuscinetto a rulli conici.

Assemble the cone of the taper roller bearing on the swivel housing end.
Assemble the wheel hub on the swivel housing and fit the other cone of the taper roller bearing in position.

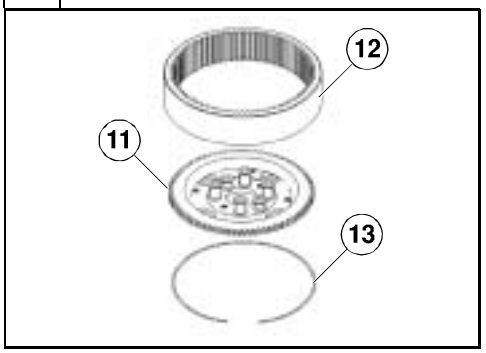
7



Posizionare il mozzo fermo corona (**11**) sul banco di lavoro e piantare le boccole (**15**) a filo della superficie con battitoio CA715086.
Almeno due boccole (diametralmente opposte) devono essere piantate leggermente oltre il filo per essere utilizzate come spine di centraggio.

*Position the wheel carrier (**11**) on a workbench and force the bushes (**15**) to the carrier surface level with the special tool CA715086.*
At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.

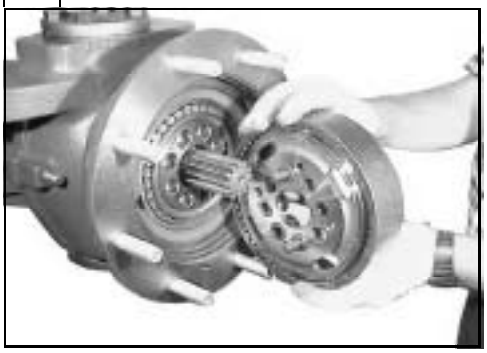
8



Assemblare il gruppo mozzo fermo corona (**11**) e corona epicicloidale (**12**) con lo speciale anello d'arresto (**13**).

*Assemble the wheel carrier (**11**) and epicyclic ring gear (**12**) group with the special locking ring (**13**).*

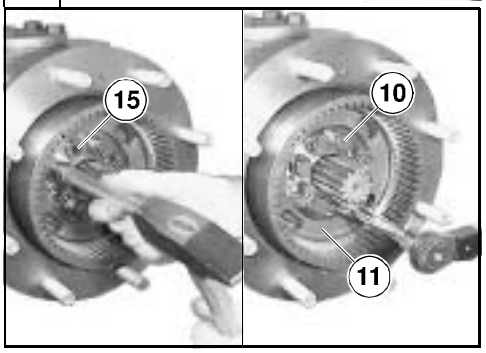
9



Montare il gruppo mozzo fermo corona sul mozzo ruota utilizzando le due boccole sporgenti come spine di centraggio.
Avvitare le relative viti fino a portare il gruppo a contatto con il mozzo ruota.

Assemble the wheel carrier group on the wheel hub using the two projecting bushes as dowel pins and screw the relative screws in order to put in contact the ring bevel gear with the wheel hub.

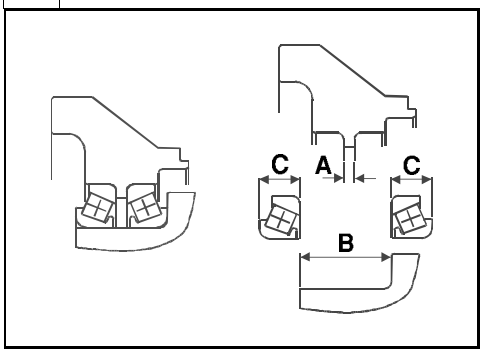
10



Piantare con il battitoio CA715086 ed un martello tutte le bussole (**15**) di centraggio mozzo fino a battuta.
Applicare Loctite® 270 sul filetto delle viti di fissaggio (**10**).
Montare le viti (**10**) di fissaggio mozzo fermo corona (**11**) e serrare alla coppia prevista (Sez. C.7).

*Force all the hub dowel bushes (**15**) completely with the special tool CA715086 and a hammer.*
*Apply Loctite® 270 on fastening screws (**10**) thread.*
*Assemble the wheel carrier (**11**) fastening screws (**10**) and tighten to the requested torque (Sec. C.7).*

11

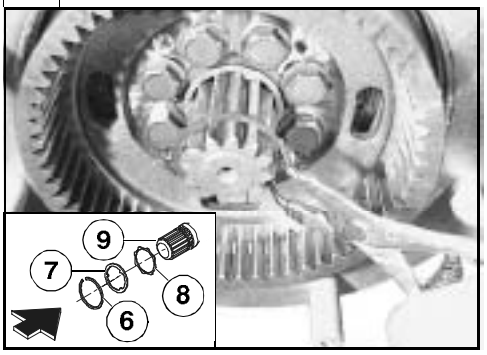


La speciale esecuzione “Set Right” dei cuscinetti non richiede specifiche registrazioni del precarico o del gioco. In ogni caso, prima del montaggio di nuove parti, controllare le dimensioni indicate.

A= 11.975 ÷ 12.025
B= 52.229 ÷ 52.279
C= 20.000 ÷ 20.100

The special operation “Set Right” of the bearings does not require specific registrations of preloading or backlash. Anyway, before assembling new components check the indicated dimensions.

12



Infilare nel semiasse (**9**) del doppio giunto le rondelle di rasamento (**7**, **8**) e montare l’anello d’arresto (**6**), inserendolo all’estremità del mozzo scanalato e spingendolo in sede.

*Slide the washers (**7, 8**) into the U-Joint shaft (**9**) and lock it with the retaining ring (**6**), inserting it at the end of the splined hub and pushing it into its housing.*

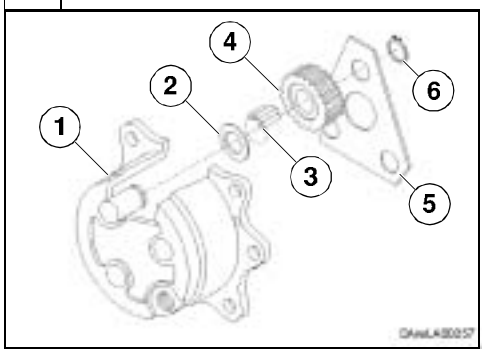
E.6 Montaggio gruppo riduttore epicicloidale

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.6 Epicyclic reduction gear assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

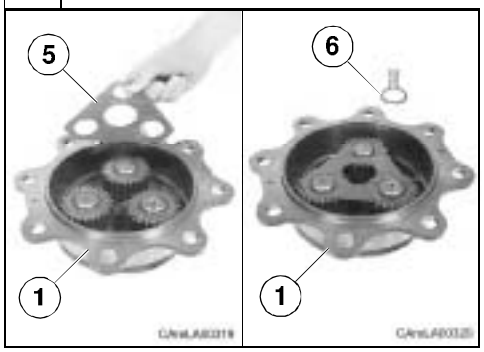
1



Recuperare tutti i componenti del riduttore epicicloidale: il treno portasatelliti (**1**), le ralle (**2**), gli ingranaggi satellite (**4**) ed i relativi rullini (**3**), la piastra triangolare (**5**) e gli anelli d'arresto (**6**) di ogni perno.
Nota: con nuovi satelliti è consigliabile montare rullini nuovi.

*Collect all epicyclic reduction gear parts: the planetary carrier (**1**), the thrust washers (**2**), the roller bearings (**3**), the planetary gears (**4**), the triangular plate (**5**) and the Seeger rings (**6**) of every pin.*
***Note:** with new planetary gears is advisable to assembly new roller bearings.*

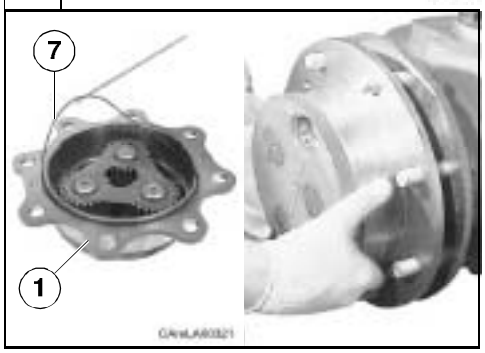
2



Posizionare su un banco di lavoro il treno porta satelliti.
Inserire nei perni del treno porta satelliti le ralle (**2**) ed i satelliti epicicloidali (**4**).
Inserire i rullini (**3**) nei satelliti (**4**).
Nota: ingrassare bene i rullini.
Vedi: sez.C.4.
Montare la rondella di forma triangolare (**5**) e gli anelli di arresto (**6**).

Position the planetary carrier on a workbench.
*Insert the thrust washers (**2**) and the epicyclic gears (**4**) in the planetary carrier pins.*
*Insert the needles (**3**) in the epicyclic gears (**4**).*
***Note:** grease well the needles.*
***See:** sec.C.4.*
*Assemble the triangular plate (**5**) and the related Seeger rings (**6**).*

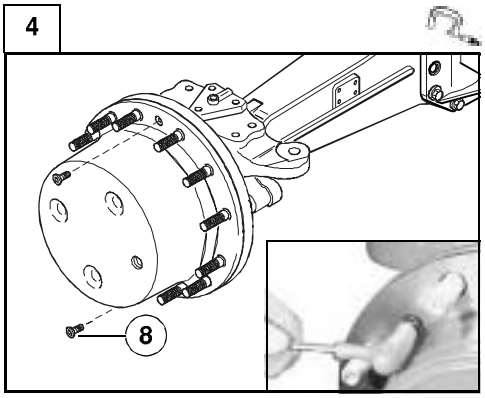
3



Inserire un nuovo anello O-Ring (**7**) sul treno portasatelliti (**1**).
Montare il gruppo riduttore epicicloidale sul mozzo ruota.

*Assemble a new O-ring (**7**) on the planetary carrier (**1**).*
Assemble the epicyclic reduction gear on the wheel hub.

4



Avvitare le viti di fissaggio (**8**) e serrare con chiave dinamometrica alla coppia prevista (Sez. C.7).

*Tighten the fastening screws (**8**) with a dynamometric wrench to the requested torque (Sec. C.7).*

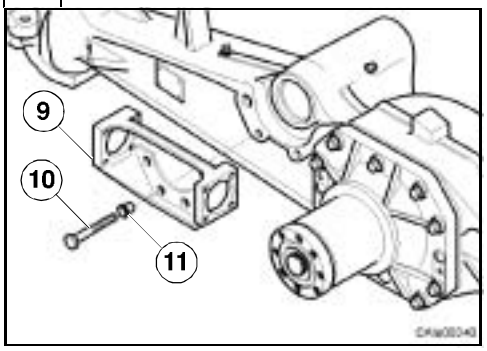
E.7 Montaggio gruppo cilindri sterzo

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.7 Steering cylinders group assembly

Some of the following pictures may not show exactly your axle, but the procedure is the same.

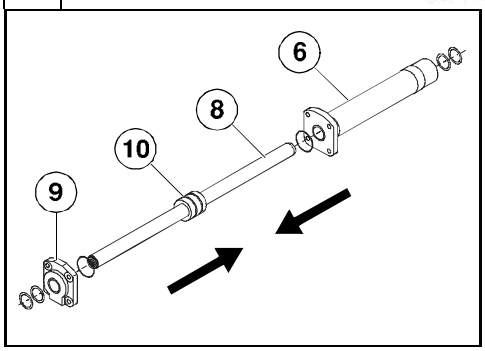
1



Inserire le boccole (**11**) nel supporto cilindro (**9**).
Assemblare il supporto cilindro (**9**) al corpo dell'assale con le viti di fissaggio (**10**).
Serrare le viti (**10**) alla coppia prevista (Sez.C.7).

*Insert the bushes (**11**) in the cylinder carrier (**9**).*
*Assemble the cylinder carrier (**9**) to the axle body with the fastening screws (**10**).*
*Tighten the fastening screws (**10**) to the requested torque (Sec. C.7).*

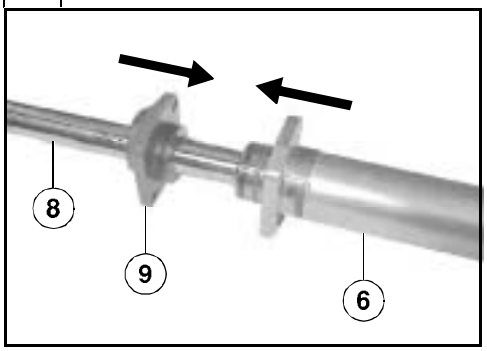
2



Montare nuovi anelli di tenuta: sulla testata del cilindro (**9**), sul pistone (**10**) e nel corpo cilindro (**6**).

*Assemble new seal rings: on the cylinder head (**9**), on the piston (**10**) and on the cylinder body (**6**).*

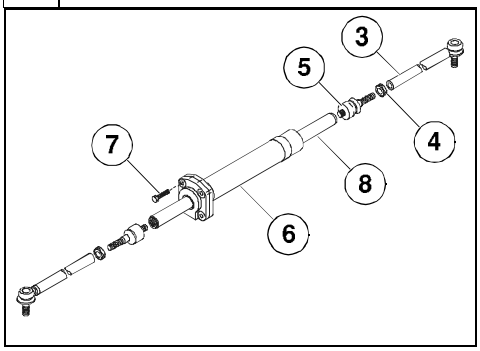
3



Infilare lo stelo (**8**) premontato nel corpo cilindro (**6**).

*Slide pre-assembled rod (**8**) into the cylinder body (**6**).*

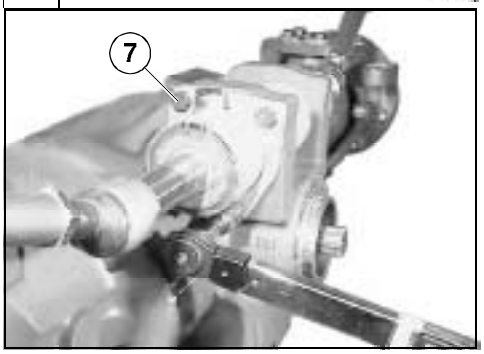
4



Montare alle estremità dello stelo (**8**) del martinetto: lo snodo sferico (**5**), il dado (**4**), le aste guida (**3**) serrandole con chiave dinamometrica alla coppia prevista (Sez.C.7).

*Fit the guide rods (**3**), the spherical joint (**5**) and the nut (**4**) to the ends of the cylinder rod (**8**) then tighten with dynamometric wrench to the requested torque (Sec. C.7).*

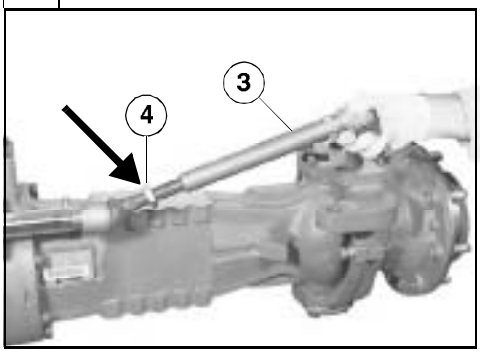
5



Installare sul corpo centrale il cilindro sterzo, completo di aste guida già montate sullo stelo.
Montare e serrare le viti di fissaggio del cilindro sterzo con chiave dinamometrica alla coppia prevista (Sez.C.7).

Install the steering cylinder on the central body, with guide rods already assembled on the stem.
Assemble and tighten the steering cylinder fastening screws with dynamometric wrench to the requested torque (Sec. C.7).

6



Posizionare le calotte in asse con l'assale (mozzi ruota paralleli).
Avvitare l'asta guida (**3**) di una quantità tale da poter infilare lo snodo sferico sul braccetto della calotta.
Nota: è importante svitare il dado di bloccaggio (**4**) per eseguire questa operazione.

Align the swivel housings with the axle (parallel wheel hub).
*Screw the guide rod (**3**) so that the ball joint can be inserted into the swivel housing arm.*
***Note**: it is important to unscrew the locking nut (**4**) to carry out this operation.*

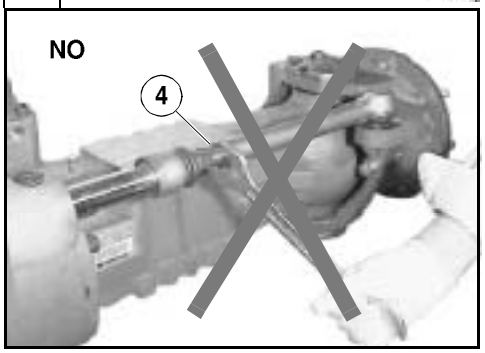
7



Inserire lo snodo sferico nella propria sede sulla calotta.
Montare e serrare il dado di fissaggio con chiave dinamometrica alla coppia prevista (Sez.C.7).

Insert the ball joint into its own housing on the swivel housing.
Assemble and tighten the lock nut with dynamometric wrench to the requested torque (Sec. C.7).

8



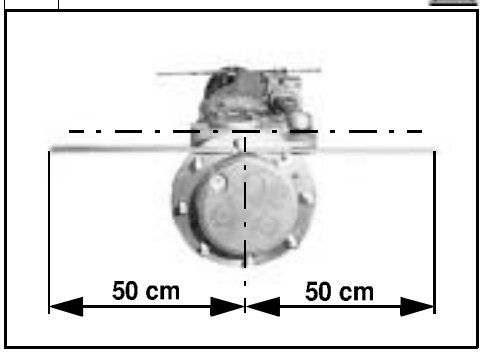
Non avvitare il dado (**4**) di bloccaggio dell'asta guida fino a quando non si è effettuata la registrazione della convergenza.

*Screw in the lock nut (**4**) of the guide rod only when the toe-in adjustment has been carried out.*

E.8 Verifica della convergenza

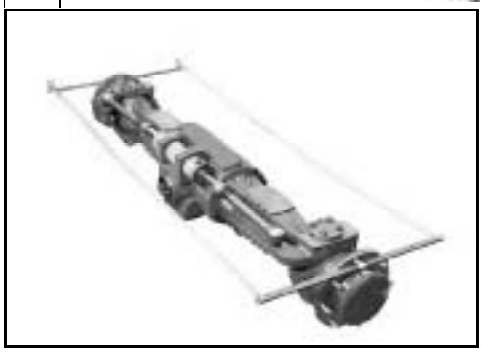
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

1



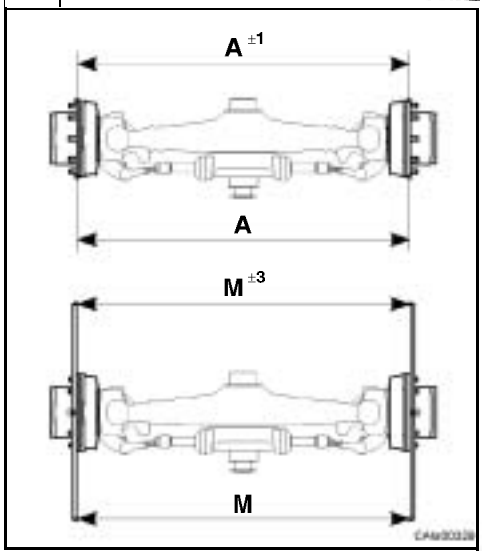
Montare 2 barre lineari uguali, lunghe 1 m, sui lati ruota, bloccandole con due dadi, sui prigionieri mozzo ruota.
Attenzione: Le due barre devono essere fissate alla loro mezzeria, in modo che siano perfettamente perpendicolari alla superficie di appoggio e parallele all'asse del pignone. Allineare al meglio le due barre.

2



Rilevare con un metro a nastro, dai punti più estremi delle barre, la distanza millimetrica (**M**).
Nota: Prendere il valore minimo oscillando il punto di misurazione.

3



Verificare che la differenza tra le misurazioni alle estremità dei diametri dei mozzi ruota rientri nel campo di tolleranza richiesto.
Vedi: "Convergenza" in sez.C.4.
Il valore della convergenza nominale (**A**) è riferito al diametro esterno della flangia dei mozzi ruota, quindi il valore misurato (**M**) alle estremità delle barre deve essere rapportato alle loro proporzioni rispetto a tale diametro

converg. nominale (sez.C.4) = A $^{\pm 1}$ ⟶ converg. misurata = M $^{\pm 3}$

E.8 Toe-in adjustment

Some of the following pictures may not show exactly your axle, but the procedure is the same.

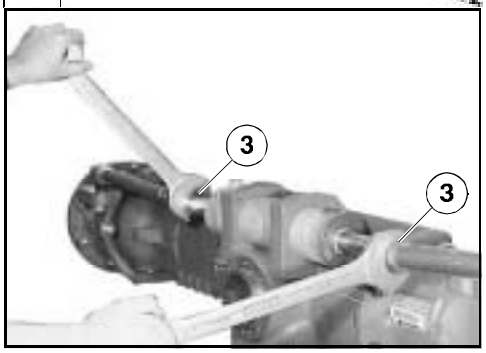
Put two equal one-meter-long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.
***Warning**: The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis. Align the two bars.*

*Measure the distance in mm (**M**) between the bars ends with a tapeline.*
***Note:** Keep the minimum value, swinging the measurement point.*

Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.
***See:** "Toe-in" in sec.C.4.*
*The nominal toe-in value (**A**) is referred to the external diameter of the wheel hubs flange, therefore the measured value (**M**) at the bars ends must be related to the ratio between length of the bar and flange diameter*

nominal toe-in (sec.C.4) = A $^{\pm 1}$ ⟶ measured toe-in = M $^{\pm 3}$

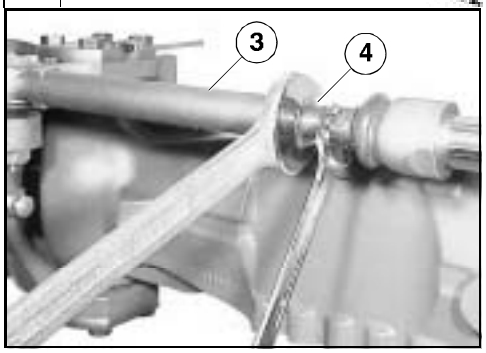
4



Nel caso che la convergenza non sia esatta agire con due chiavi sulle aste guida (**3**) avvitando e svitando i due tiranti snodo equamente, in modo che alla fine rientri nella tolleranza prevista.

*If toe-in is incorrect, operate with two wrenches on the guide rods (**3**) screwing in and out the two joint tie rods equally till the toe-in is within the requested tolerance.*

5



Eseguita la regolazione, avvitare i dadi di bloccaggio (**4**) delle aste guida (**3**) alla coppia di serraggio prevista (Sez.C.7)

*After adjusting, screw in the lock nuts (**4**) of the guide rods (**3**) to the requested tightening torque (Sec.C.7).*

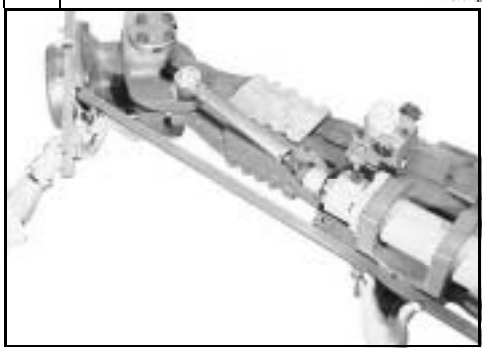
E.9 Registrazione angolo di sterzata

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

E.9 Steering angle adjustment

Some of the following pictures may not show exactly your axle, but the procedure is the same.

1



Utilizzare le stesse barre montate per la registrazione della convergenza ed una barra lunga, appoggiata perfettamente alla parte lavorata del corpo centrale (lato pignone), in modo che al massimo della sterzata le due barre formino un angolo acuto.

Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.

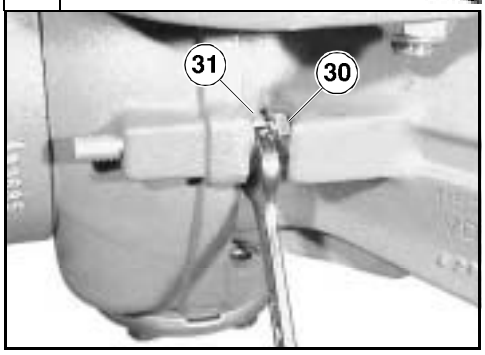
2



Regolare un goniometro all'angolo prescritto (Sez C.4) e posizionarlo sulla barra lunga.
Orientare un lato ruota fino a formare con le due barre l'angolo fissato dal goniometro.

Adjust a goniometer to the requested angle (Sec. C.4) and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the goniometer.

3



Effettuare la regolazione del fermo meccanico di sterzata, avvitando o svitando le apposite viti (**30**), bloccandole poi con controdado (**31**) alla coppia di serraggio prescritta (Sez.C.7).
Sterzare completamente dal lato opposto e ripetere le stesse operazioni.

*Adjust the steering mechanical retainer, screwing in or out the special screws (**30**), locking them with a locknut (**31**) to the requested tightening torque (Sec.C.7).*
Steer completely towards the other side and repeat the same operations.

E.10 Prove dopo montaggio

Passo 1
A motore spento, sollevare l'assale (i) della ruota motrice sino a che i pneumatici si siano staccati da terra.

Passo 2
Ingranare la marcia in modo che il pignone sia bloccato.

Passo 3
Con l'aiuto di un'altra persona collocata al lato opposto, iniziare la prova di montaggio ruotando per quanto possibile entrambe le ruote nel senso di marcia avanti. (Entrambe le ruote dovrebbero bloccarsi dopo poco)

Passo 4
Con il pignone sempre bloccato, liberare la ruota di destra e ruotare la ruota di sinistra nel senso (marcia avanti).
Se il montaggio è corretto si dovrà verificare che la ruota giri liberamente senza eccessivi sforzi, e la ruota di destra ruoti in senso opposto.
Ripetere l'operazione nel senso opposto (retro marcia).

SE UNA DELLE RUOTE NON GIRA LIBERAMENTE IN ENTRAMBE LE DIREZIONI, ricontrollare passo passo il montaggio.
Controllare anche che i freni siano regolati in modo da consentirne il corretto funzionamento.

E.10 Testing after assembly

Step 1
With engine off, lift the axle (i) so that the tyres get away from the ground.

Step 2
Engage the gear so that the pinion gets blocked.

Step 3
With the help of another person standing on the opposite side, begin the assembly testing by rotating as much as possible both the wheels forward. (Both the wheels should get blocked after a while.)

Step 4
Keeping the pinion blocked, free the right wheel and rotate the left one in the line of march. Rotate the right wheels in the opposite direction.
The wheel will move freely without difficulty and the right wheel will move in the opposite direction if the assembly has been carried out correctly.
Repeat the same operation in the opposite direction (reverse gear).

IF ONE WHEEL DOES NOT ROTATE FREELY IN BOTH DIRECTIONS, then check step by step all assembly operations.
Check and see that the brakes are regulated correctly and functioning properly.

F RICERCA GUASTI

PROBLEMA	POSSIBILI CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
- Vibrazioni delle ruote; resistenza del pneumatico anteriore; rottura del/i semiasse/i.	•	•	•		•						•
- Difficoltà nello sterzare; il veicolo tende ad andare dritto mentre è in curva.	•	•	•	•							•
- Non vi è azione del differenziale; inceppamento in curva.	•			•	•						•
- Rumore eccessivo nella trasmissione.	•	•	•	•	•		•		•		•
- Usura eccessiva del pneumatico.	•	•	•	•	•	•	•				•
- Rumore di attrito.	•			•	•			•	•	•	•
- In marcia avanti si avvertono vibrazioni, rumore intermittente.	•	•	•		•						•

F TROUBLESHOOTING

PROBLEMS	POSSIBLE CAUSES										
	1	2	3	4	5	6	7	8	9	10	11
- Wheel vibration; front tyre resistance; halfshaft breakage.	•	•	•		•						•
- Steering is difficult; vehicle goes straight while its turning.	•	•	•	•							•
- No differential action; jamming while steering.	•			•	•						•
- No differential action; jamming while steering.	•	•	•	•	•		•		•		•
- Uneven wear of tyre.	•	•	•	•	•	•	•				•
- Friction noise.	•			•	•			•	•	•	•
- Vibration during forward drive, intermittent noise.	•	•	•		•						•

1 Installazione scorretta / assale difettoso
Correggere l'installazione oppure, se il differenziale non supera una delle fasi di prova, ripararlo o sostituirlo.

2 Sovraccarico / distribuzione scorretta del peso
Togliere il peso in eccesso e ridistribuire il carico, rispettando le istruzioni relative al veicolo.

1 Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2 Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3 Raggio di rotazione dei pneumatici diversi
Un pneumatico con raggio più piccolo provoca un parziale slittamento della ruota quando si applica energia. L'altro pneumatico con raggio maggiore dovrà sopportare tutto il lavoro. Sostituire il pneumatico o regolare la pressione di entrambi sino a che il raggio di rotazione sia uguale.

4 Semiasse rotto
E' sconsigliato usare un veicolo con un solo semiasse. E' possibile tuttavia spostare il veicolo a vuoto con il differenziale bloccato per pochi metri.

5 Semiasse piegato
Sostituire i semiassi.

6 Differenziale bloccato
Funzionamento anomalo del differenziale e/o rottura del dispositivo di comando del bloccaggio di comando. Verificare l'installazione, eventualmente smontare e verificare i componenti.
I veicoli impostati per angoli di sterzata ampi, possono procedere a scatti, avere difficoltà di sterzo e provocare un consumo del pneumatico nelle curve strette.
Ridurre l'angolo di sterzata minimo e decelerare quando il motore inizia a procedere a scatti.

7 Allineamento scorretto della ruota
Verificare l'integrità della struttura, e cuscinetti lato ruota.

8 Parti dell'assale consumate o difettose
Controllare le condizioni della corona dentata, dell'ingranaggio del pignone, dei cuscinetti, delle guarnizioni, ecc. Sostituire dove necessario.

9 Corpi estranei nella scatola dell'assale o montaggio scorretto di alcune sue parti
Controllare se vi sono corpi estranei. Controllare il montaggio delle parti dell'assale.

10 Regolazioni della coppia conica scorrette: parti di trasmissione consumate
(ingranaggi di trasmissione, giunti, ecc.). Sostituire o regolare secondo necessità.

11 Uso scorretto del prodotto
Rivedere le istruzioni rilasciate dal produttore del veicolo.

3 Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied.The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyre.

4 Broken halfshaft
It is not advisable to operate the vehicle with a broken halfshaft. It is acceptable to move the vehicle (engine off unloaded) a few meters away only.

5 Bent halfshaft
Replace halfshaft.

6 Blocked differential
Abnormal functioning of the differential or breakage/ blockage of command device. Verify assembly and all components.
Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7 Incorrect wheel adjustment
Verify group integrity and wheel side bearings. Adjusting according.

8 Spoiled or worn out axle parts
Check the condition of ring gear, pinion gear, bearings etc. Replace when ever necessary.

9 Contamination in the axle box or incorrect assembly of parts
Look for foreign particles. Check assembly of the various parts of the axle.

10 Incorrect adjustment of bevel gear set: Parts of the transmission worn out.
(transmission gears, U joints, etc.)
Replace or adjust as required.

11 Incorrect use of the product
See the vehicle producer's instructions once again.

F.1 Controllo ed esame dei guasti

Questo capitolo offre una guida descrittiva ed esplicativa di problemi che si possono comunemente riscontrare sugli assali o di avarie che si possono verificare. La guida suggerisce anche le corrette procedure di riparazione.

Problema	Causa	Azione consigliata
Rottura verso l'estremità esterna del dente corona dentata	1. Carico dell'ingranaggio eccessivo rispetto a quello previsto 2. Regolazione ingranaggio scorretto (gioco eccessivo) 3. Dado del pignone allentato.	Sostituire la coppia conica. Seguire attentamente le operazioni raccomandate di regolazione del gioco della corona dentata e del pignone e per la rilevazione dell'impronta del dente.
Rottura verso l'estremità interna del dente corona dentata	1. Urto da carico 2. Regolazione ingranaggio scorretto (gioco insufficiente) 3. Dado del pignone allentato	Sostituire la coppia conica. Seguire attentamente le operazioni raccomandate di regolazione del gioco della corona dentata e del pignone e per la rilevazione dell'impronta del dente
Denti del pignone e della corona dentata erosi o rigati	1. Lubrificazione insufficiente 2. Lubrificante sporco 3. Lubrificante errato o con additivi impoveriti 4. Cuscinetti del pignone consumati che provocano un gioco assiale del pignone e un contatto tra pignone e corona scorretto.	Sostituire la coppia conica. Sostituire i cuscinetti del pignone facendo attenzione a sistemare correttamente la corona, il pignone e i precarichi dei cuscinetti. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Denti della corona e del pignone surriscaldati. Guardare se i denti dell'ingranaggio hanno perso la colorazione	1. Funzionamento prolungato a temperatura eccessiva. 2. Lubrificante scorretto 3. Livello dell'olio basso 4. Lubrificante sporco.	Sostituire la coppia conica. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Denti del pignone di comando butterati	1. Uso estremamente intenso 2. Lubrificazione insufficiente	Sostituire la coppia conica. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Corpo trave dell'assale piegato	1. Sovraccarico del veicolo 2. Veicolo incidentato 3. Urto da carico	Sostituire il corpo trave dell'assale
Cuscinetti consumati o butterati	1. Lubrificazione insufficiente 2. Lubrificante sporco 3. Uso estremamente intenso 4. Consumo normale 5. Dado del pignone allentato.	Sostituire i cuscinettii. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Le guarnizioni perdono olio	1. Funzionamento prolungato con temperatura dell'olio eccessiva. 2. Guarnizione dell'olio montata male 3. Bordo della guarnizione tagliata o intaccata 4. Lubrificante sporco	Sostituire la guarnizione e la superficie di accoppiamento se danneggiata. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Usura eccessiva della scanalatura della flangia di entrata.	1. Uso intenso 2. Dado del pignone allentato 3. Gioco assiale del pignone	Sostituire la flangia Controllare che la scanalatura del pignone non sia eccessivamente consumata Sostituire la coppia conica, se necessario.
Rottura per fatica del dente dell'ingranaggio del pignone. Guardare se la linea di frattura ad onda è ben delineata (linea di arresto).	1. Uso intenso 2. Sovraccarico continuo	Sostituire la coppia conica.

Problema	Causa	Azione consigliata
Rottura denti pignone e corona	Carico d'urto dei componenti del differenziale	Controllare e/o sostituire altri componenti differenziale.
Scanalature dell'ingranaggio planetario consumate (gioco eccessivo)	Uso intenso	Sostituire il gruppo ingranaggi differenziale. Sostituire il semiasse, se necessario.
Superfici della ralla di rasamento consumate o graffiate	1. Lubrificazione insufficiente 2. Lubrificazione scorretta 3. Lubrificante sporco	Sostituire tutte le ralle graffiate e quelle con uno spessore di 0,1 mm inferiore a quello delle ralle nuove. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Diametro interno del cuscinetto a rulli conici del pignone consumato	1. Uso intenso 2. Gioco assiale del pignone eccessivo 3. Lubrificazione inadeguata 4. Lubrificante sporco	Sostituire il cuscinetto Controllare il gioco assiale del pignone Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Semiasse ritorto o rotto	Funzionamento intenso del veicolo, sovraccarico	Sostituire il semiasse
Semiasse spezzato presso la flangia ruota	1. Supporto della ruota allentato 2. Corpo trave piegato	Sostituire il semiasse Controllare la distorsione del corpo trave. Accertarsi che il sostegno della ruota non sia consumato o mal regolato.

F.1 Troubleshooting

This chapter is a descriptive and explanatory guide to common axle problems. This guide suggests the repair correct procedures to be followed.

Problem	Cause	Action
Ring gear tooth broken at the outer side	1. Excessive gear load compared to the one foreseen 2. Incorrect gear adjustment (excessive backlash) 3. Pinion nut loosened	Replace bevel gear set Follow carefully the recommended operations for the adjustment of bevel gear set backlash
Ring gear tooth broken side	1. Load bump 2. Incorrect gear adjustment (insufficient backlash) 3. Pinion nut loosened	Replace bevel gear set Follow carefully the recommended operations for the adjustment of bevel gear set backlash.
Pinion or ring gear teeth or worn	1. Insufficient lubrication 2. Contaminated oil 3. Incorrect lubrication or depleted additives 4. Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of bevel gear set backlash. Use correct lubricants, fill up to the right levels and replace according to the recommended program.
Overheated ring and pinion teeth. See if gear teeth have faded	1. Prolong ed functioning at high temperatures 2. Incorrect lubrication 3. Low oil level 4. Contaminated oil	Replace bevel gear set. Use proper lubrication, fill up to right level and replace at recommended program.
Pinion teeth pitting	1. Excessive use 2. Insufficient lubrication	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals
Axle beam body bent	1. Vehicle over loaded 2. Vehicle's accident 3. Load bump	Replace axle beam body
Worn out or pitted bearings	1. Insufficient lubrication 2. Contaminated oil 3. Excessive use 4. Normal wear out 5. Pinion nut loosened	Replace bearings. Use correct lubrication fill up, to the right level and replace at recommended intervals
Oil leakage form gaskets and seals	1. Prolonged functioning at high temperature of the oil 2. Oil gasket assembled incorrectly 3. Seal lip damaged 4. Contaminated oil	Replace the gasket or seal and matching surface if damaged. Use correct lubrication and replace at recommended intervals.
Excessive wearing out of input flange spline	1. Exhaustive use 2. Pinion nut loosened 3. Pinion axle backlash	Replace the flange. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.
Fatigue failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	1. Exhaustive use 2. Continuos overload	Replace bevel gear set
Pinion and ring teeth breakage	1. Crash load of differential components	Check and/or replace other differential components.

Problem	Cause	Action
Side gear spline worn out. *Replace all scratched washers (Excessive backlash)*	*Excessive use*	*Replace differential gear group.* *Replace halfshaft if required*
Thrust washer surface worn out or scratched.	*1. Insufficient lubrication* *2. Incorrect lubrication* *3. Contaminated oil*	*Use correct lubrication and fill up to right level.* *Replace at intervals recommended.* *Replace all scratched washers and those with 0,1mm thickness lower than the new ones.*
Inner diameter of tapered roller bearing worn out.	*1. Excessive use* *2. Excessive pinion axial backlash* *3. Insufficient lubrication* *4. Contaminated oil*	*Replace bearing.* *Check pinion axial backlash.* *Use proper lubrication, fill up to right level and replace at recommended intervals.*
Bent or broken halfshaft	*Vehicle intensively operated or overloaded*	*Replace*
Halfshaft broken at wheel side	*1. Wheel support loosened* *2. Beam body bent*	*Replace* *Check that wheel support is not worn out or wrongly adjusted.*

F.2 Diagnosi per problemi all'assale

Problema	Causa	Azione consigliata
Rumore durante la guida	1. Gioco tra corona dentata e pignone eccessivo 2. Pignone e corona dentata consumati 3. Cuscinetti del pignone consumati 4. Cuscinetti del pignone allentati 5. Gioco assiale del pignone eccessivo 6. Cuscinetti del differenziale consumati 7. Cuscinetti del differenziale allentati 8. Eccessiva scentratura della corona dentata 9. Livello lubrificante basso 10. Lubrificante di grado povero od errato 11. Semiasse piegato	1. Regolare 2. Sostituire 3. Sostituire 4. Regolare 5. Regolare 6. Sostituire 7. Regolare 8. Sostituire 9. Rabboccare 10. Sostituire 11. Sostituire
Rumore durante l'andatura in folle	1. I rumori provenienti dall'assale con il veicolo in movimento di solito si sentono durante l'andatura in folle anche se non molto forti 2. Errato gioco tra pignone e corona (il rumore che si sente decelerando sparisce all'aumentare della velocità). 3. Usura scanalatura pignone o flangia entrata	1. Regolare o sostituire (vedere sopra) 2. Regolare 3. Sostituire
Rumore intermittente	1. Corona dentata danneggiata 2. Bulloni della scatola del differenziale allentati	1. Sostituire coppia conica 2. Serrare a coppia
Rumore costante	1. Danni sui denti della corona dentata o del pignone 2. Cuscinetti usurati 3. Scanalature del pignone consumate 4. Semiasse piegato	1. Sostituire coppia conica 2. Sostituire 3. Sostituire 4. Sostituire
Rumore in curva	1. Satelliti planetari differenziale consumati 2. Scatola differenziale e/o perni del differenziale consumati 3. Ralle di rasamento del differenziale consumate 4. Scanalature del semiasse consumate	1. Sostituire 2. Sostituire 3. Sostituire 4. Sostituire

F.2 Axle problem and diagnosis

Problem	Cause	Action
Noise while driving	1. Excessive backlash between pinion and ring gear 2. Worn out pinion and gear ring 3. Worn out pinion bearings 4. Pinion bearings loosened 5. Excessive axial pinion backlash 6. Worn out differential bearings 7. Differential bearings loosened 8. Ring gear out of roundness 9. Low lubricant level 10. Poor or wrong lubricant 11. Bent halfshaft	1. Adjust 2. Replace 3. Replace 4. Adjust 5. Adjust 6. Replace 7. Adjust 8. Replace 9. Oil level 10. Replace 11. Replace
Noise while driving in neutral	1. Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud. 2. Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed) 3. Pinion or input flange worn out	1. Replace or adjust (see above) 2. Replace 3. Adjust
Intermittent noise	1. Ring gear damaged 2. Differential box bolts loosened	1. Replace bevel gear set 2. Tighten to torque
Constant noise	1. Ring gear teeth or pinion damaged 2. Worn out bearings 3.Pinion spline worn out 4. Bent halfshaft	1. Replace bevel gear set 2. Replace 3. Replace 4. Replace
Noise while seering	1. Worn out differential gears 2. Worn out differential box or spider 3. Differential thrust washers worn out 4. Half shaft spline worn out	1. Replace 2. Replace 3. Replace 4. Replace

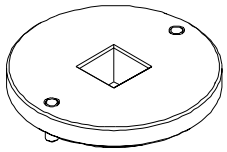
G ATTREZZATURE SPECIALI
G.1 Attrezzature speciali

Battitoi e tamponi per il montaggio di tenute, cuscinetti e bronzine devono essere utilizzati con il manico intercambiabile CA119033; se ne raccomanda l'uso abbinato ad un'impugnatura di sicurezza per la protezione delle mani (da commercio).

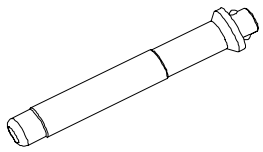
G SPECIAL TOOLS
G.1 Special tools

The special drifts/pad used to assembly the seals, bearings and bushes should always be used with the interchangeble handle CA119033; its use is recommended togheter with a suitable safety handle in order to protect the hands.

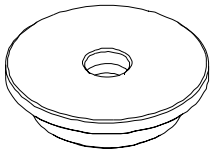
CA119030 Chiave / *Wrench*



CA119033 Manico / *Handle*



CA119068 Battitoio / *Driver*

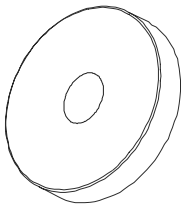


CA119083 Battitoio / *Driver*

CA119097 Battitoio / *Driver*



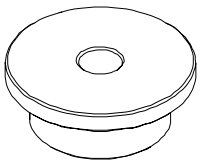
CA119205 Falsa scatola differenziale / *False differential box*



CA119206 Falsa scatola differenziale / *False differential box*



CA119220 Battitoio / *Driver*



CA715080 Chiave / *Wrench*



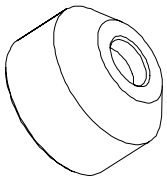
CA715081 Chiave / *Wrench*



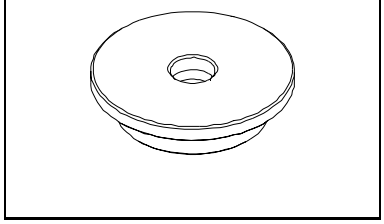
CA715082 Battitoio / *Driver*



CA715083 Battitoio / *Driver*



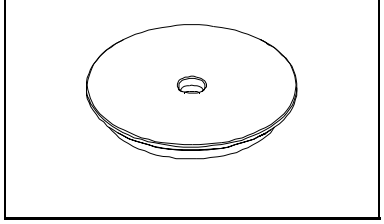
CA715085	Battitoio / *Driver*



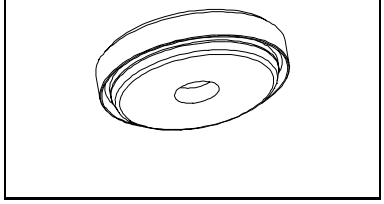
CA715086	Battitoio / *Driver*



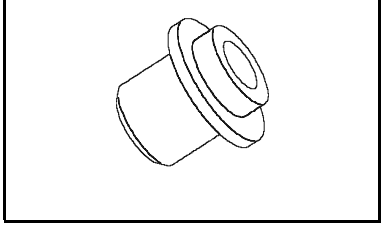
CA715099	Battitoio / *Driver*



CA715140	Battitoio / *Driver*



CA715165	Battitoio / *Driver*



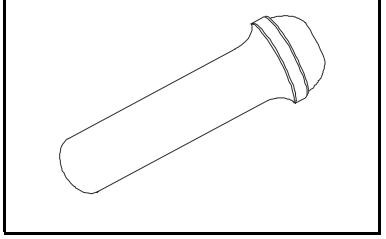
CA715360	Battitoio / *Driver*



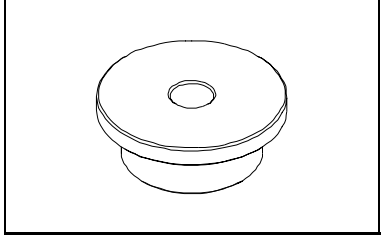
CA715450	Falso pignone / *False pinion*



CA715451	Battitoio / *Driver*



CA715453	Battitoio / *Driver*

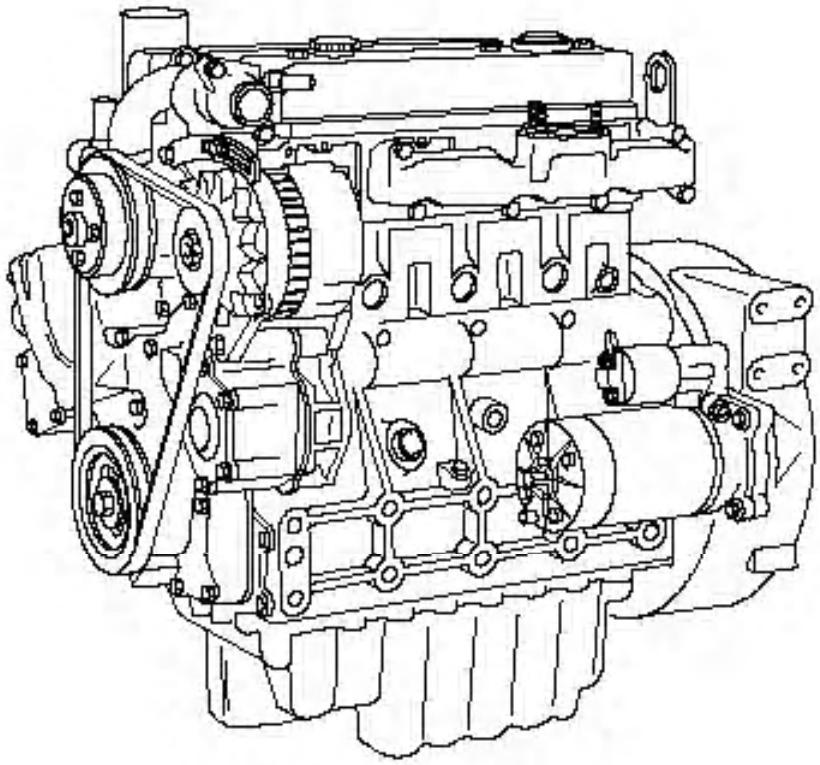


CA715454	Battitoio / *Driver*



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Section H
PERKINS ENGINE MAINTENANCE



• 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. Use the periods which are shortest. When the operation of the engine must conform to 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 and lubricating oil which conform to the specifications given in this handbook.

Schedules

The schedules which follow must be applied at the intervals (hours or months) which occur first.

A First service at 25/50 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 3000 hours

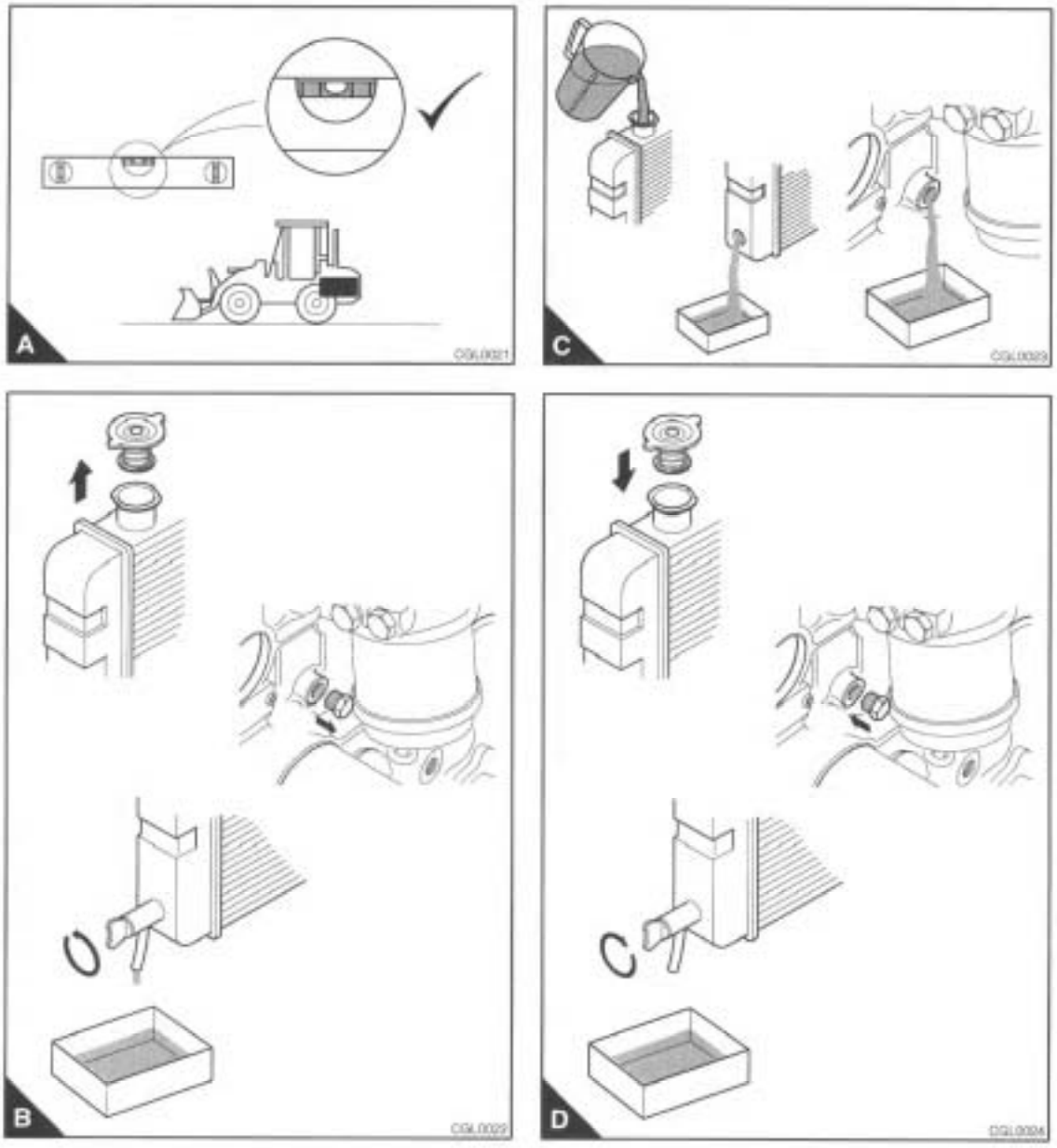
A	B	C	D	E	F	G	Operation
●	●						Check the amount of coolant
		●					Check the specific gravity of the coolant (2) (3)
●		●					Check the tension and the condition of the drive belt
●	●						Drain water from the fuel pre-filter (1)
			●				Renew the canister of the fuel filter and renew the fuel strainer
						●	Ensure that the atomisers are checked (always use new clamps - UA and UC engines) (2)
●							Ensure that the idle speed is checked and adjusted, if it is necessary (2)
	●						Check the amount of lubricating oil in the sump
	●						Check the lubricating oil pressure at the gauge (1)
●			●				Renew the engine lubricating oil - UA and UC engines (4) (5)
●			●				Renew the canister of the lubricating oil filter - UA and UC engines
		●					Renew the engine lubricating oil - UB engines (5)
		●					Renew the canister of the lubricating oil filter - UB engines
							Clean the air cleaner or empty the dust bowl of the air filter
●	●						- extremely dusty conditions
			●				- normal conditions
			●				Clean or renew the air filter element, if this has not been indicated earlier
●				●			Ensure that the valve tip clearances of the engine are checked and, if necessary, adjusted (2)
				●			Check all hoses and connections
				●			Remove and clean the components and the pipe for the engine breather - UA and UB engines (2)
					●		Ensure that the engine breather is renewed - UA and UB engines (2) (6)
				●			Ensure that the alternator, the starter motor, etc. are checked (2)
			●				Ensure that the glow plugs are checked (2)

(1) If one is fitted.
(2) By a person who has had the correct training.
(3) Renew the antifreeze every 2 years. If a coolant inhibitor is used instead of antifreeze, it should be renewed every 6 months.
(4) Change oil every 250 hours if the oil sump capacity is less than 8 litres.
(5) The oil change interval will vary with the sulphur content of the fuel (see the table below and the Fuel Specification in section 5). The interval to change the canister of the lubricating oil filter is not affected.
(6) UC engines: Renew the engine breather valve every 5000 hours **(2)**. Refer to the workshop manual.

How to drain the cooling system

Danger

- ***Do not remove the radiator plug or another component of the cooling system while the engine is hot and the system is under pressure because dangerous hot coolant can be discharged.***
- ***Dispose of the old coolant in a safe place in accordance with local regulations.***



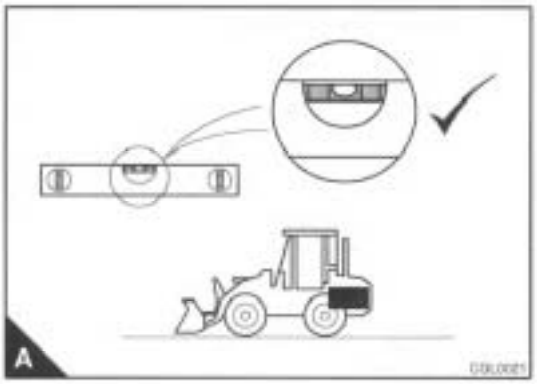
How to check the specific gravity of the coolant

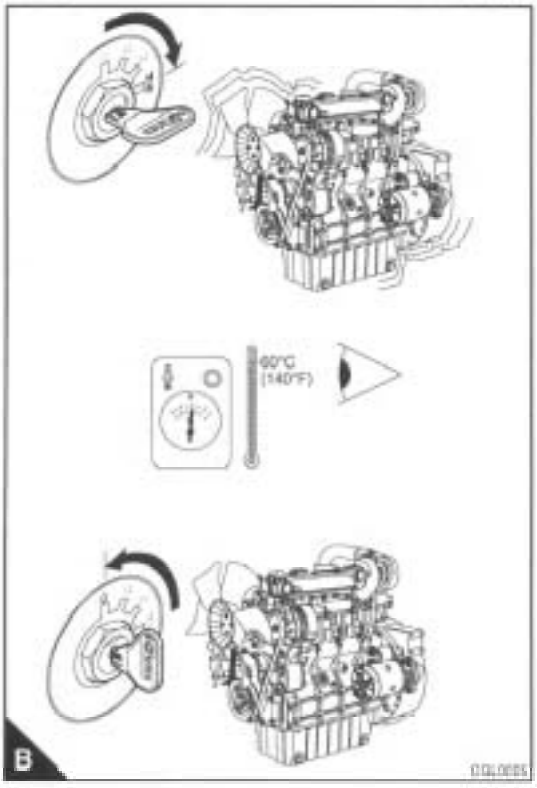
Danger
Do not remove the radiator plug or another component of the cooling system while the engine is hot and the system is under pressure because dangerous hot coolant can be discharged.

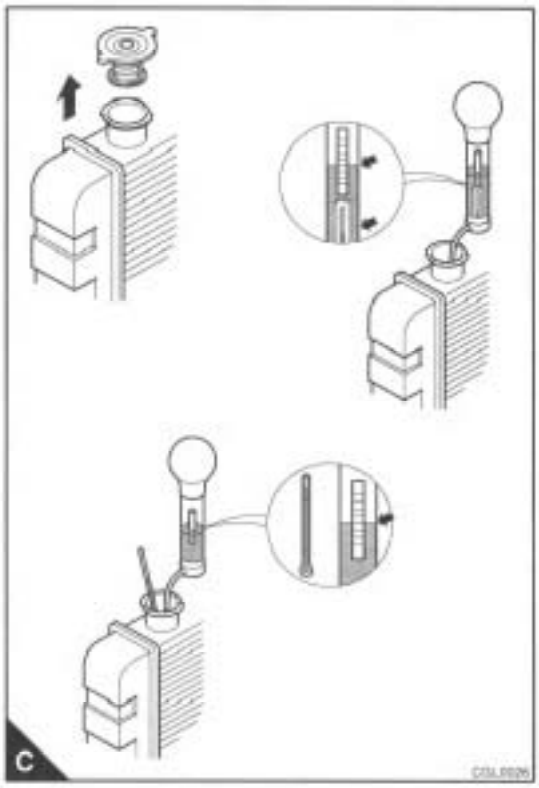
If a special coolant hydrometer is not available, put a hydrometer and a separate thermometer into the antifreeze mixture and check the readings on both instruments. Compare the readings with the chart (D).

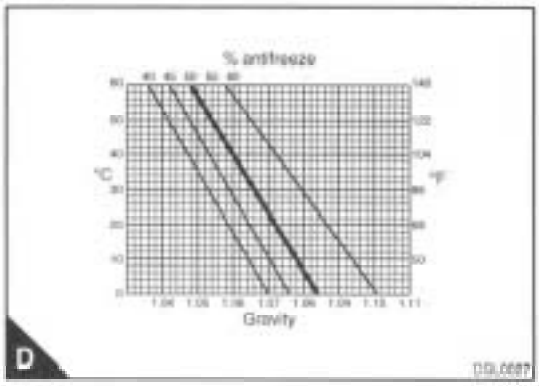
If necessary refill or replenish the cooling system during maintenance. To do this, mix the coolant to the correct strength before it is added to the cooling system.

The use of an antifreeze approved by the manufacturer of the equipment with a concentration of 50% will give protection against frost down to -35 °C. It will also give protection against corrosion. This is especially important when the cooling system has aluminium components.





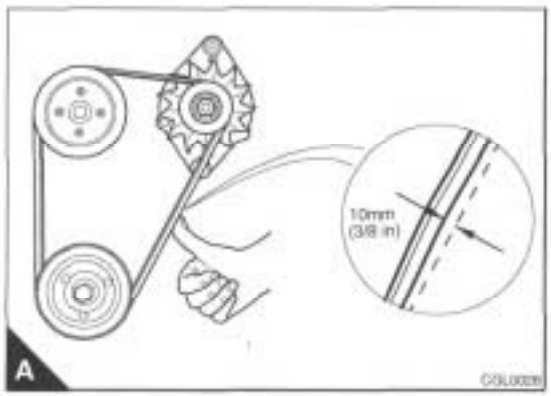


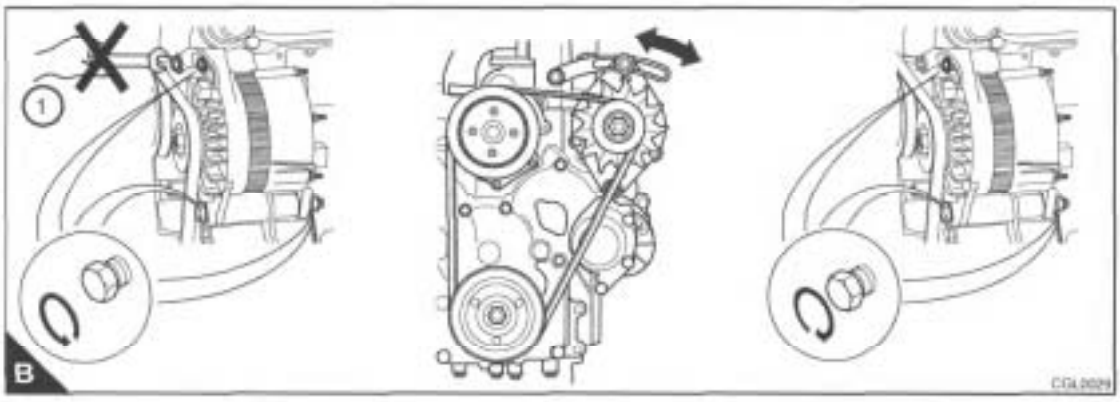


How to check and adjust the belt tension

Caution
Do not loosen the fixing screw (B1). If this screw is loosened, the seal between the thermostat housing and the cylinder head can break and result in a leakage of coolant.

Note: If you fit a new belt, check again the tension after 25 operating hours.





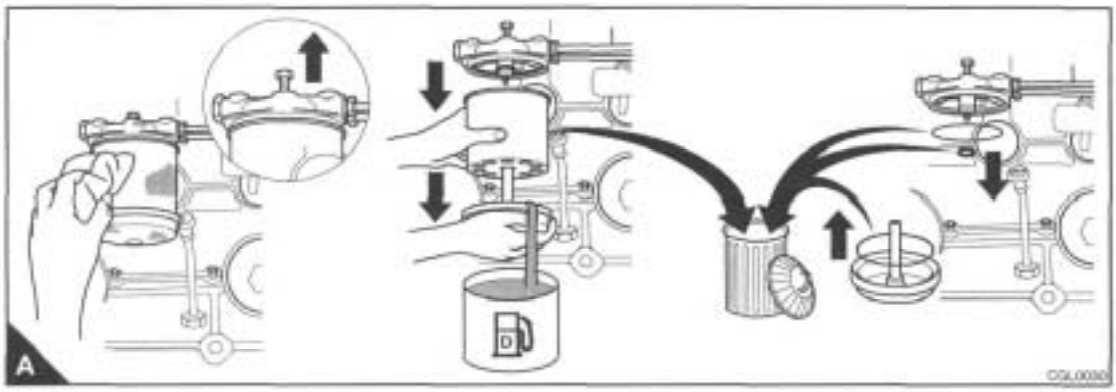
How to renew the canister of the fuel filter

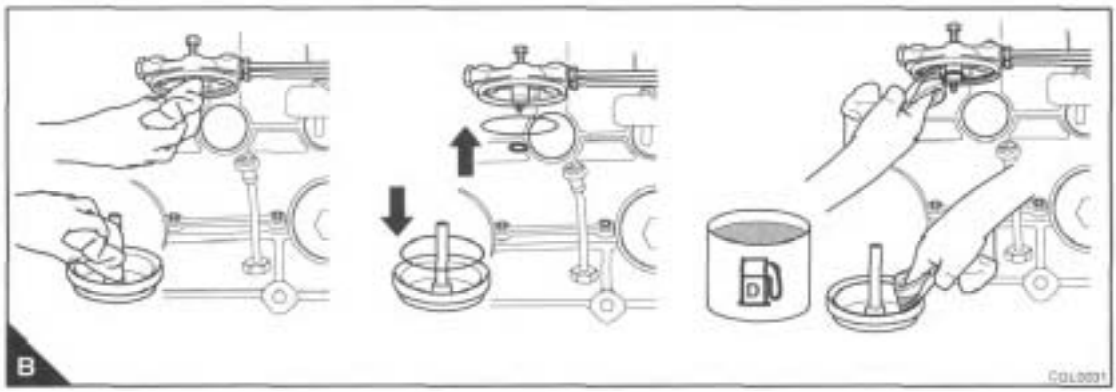
Danger
Dispose of old canisters and used fuels in a safe place in accordance with local regulations.

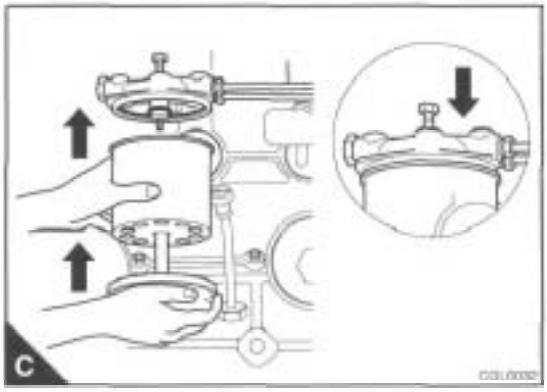
Caution

Use only original spare parts. The use of non genuine spares may damage the injection equipment.

To bleed the fuel filter, see page H9.







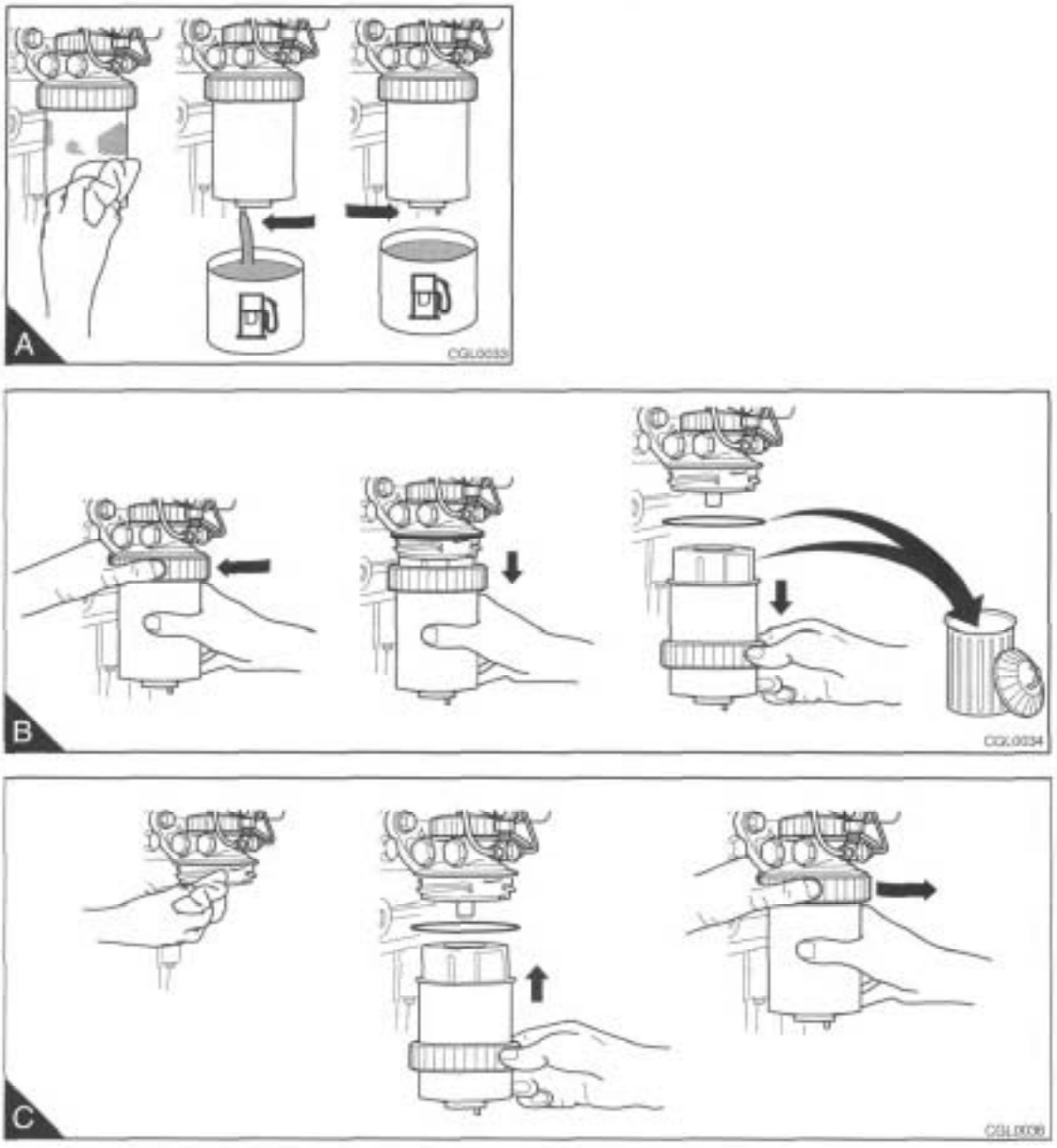
How to renew the canister of the fuel filter

Danger
Dispose of old canisters and used fuels in a safe place in accordance with local regulations.

Caution

Use only original spare parts. The use of non genuine spares may damage the injection equipment.

To bleed the fuel filter, see page H9.



How to eliminate air from the fuel system

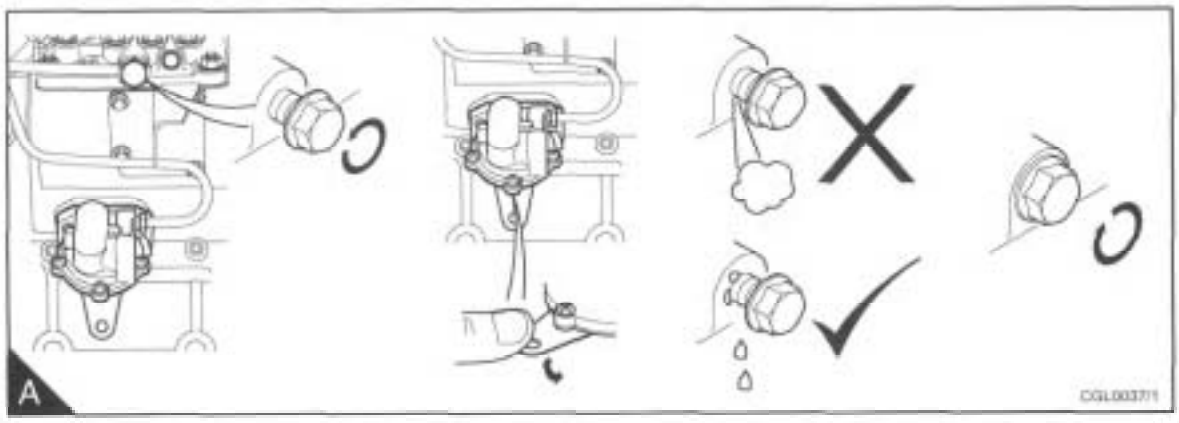
Caution
When air has to be eliminated from the fuel system, use only the starter motor to start the engine after air has been eliminated from the low pressure side of the fuel system. Attempt to start the engine with the starter motor letting it run 15 seconds every time. It is important to let electrical components cool down for 30 seconds between one starting attempt of 15 seconds and the other.

Air in the fuel system can cause damage and must be eliminated.

Air can enter the system if:

- the fuel tank iss drained during normal operation;
- low pressure pipes are disconnected;
- there is a leakage in the low pressure fuel system during engine operation.

Eliminate air from the system as detailed below.
If the engine runs smoothly for a short time, and then begins to run roughly or stops, check again for air in the fuel system.
If there is air in the fuel system, there is probably a leakage in the low pressure system.



Stop the engine and turn the ignition key to “OFF”. Check for air leaks.

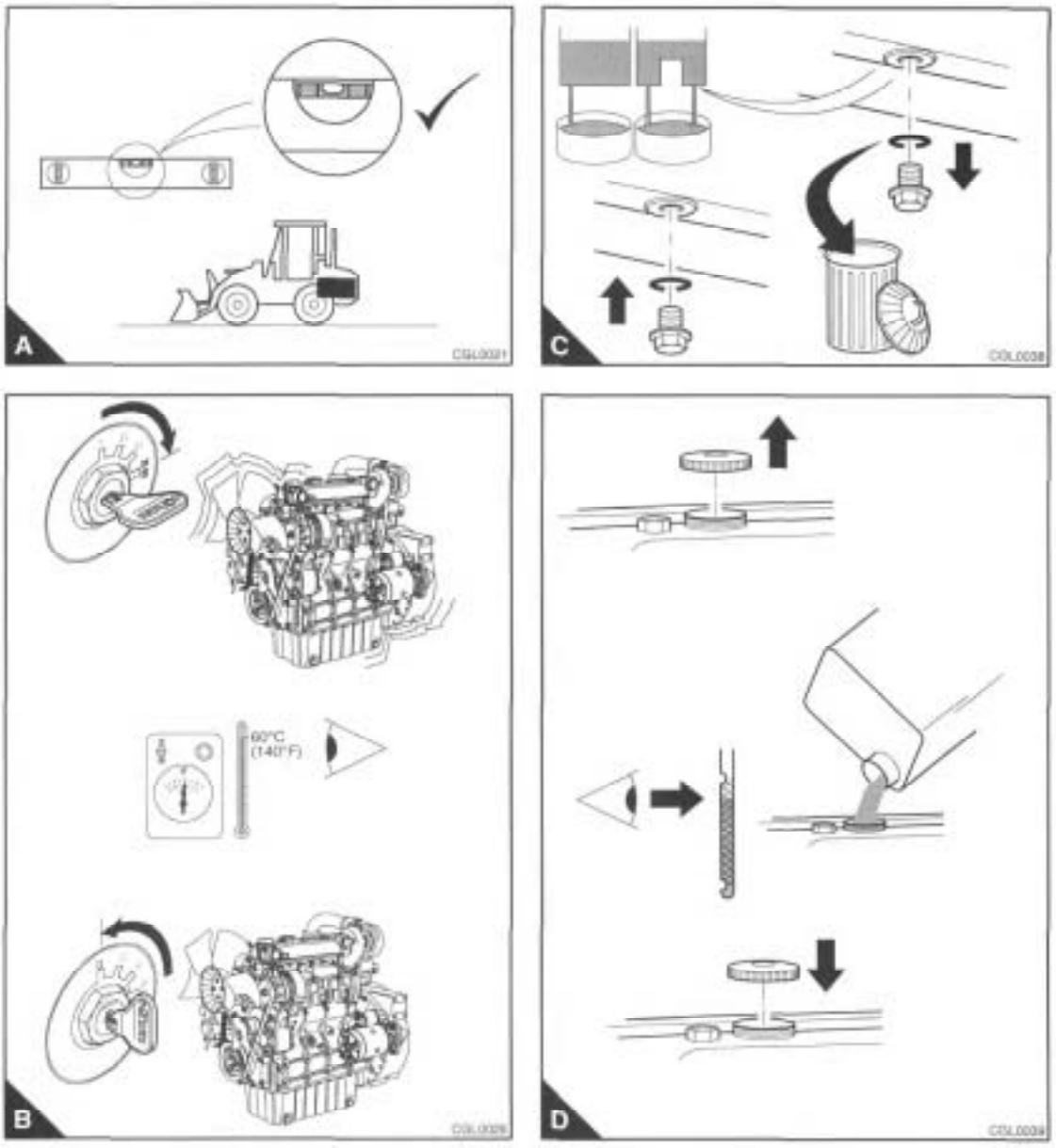
How to change the lubricating oil

Danger
Dispose of used oil in a safe place in accordance with local regulations.

Caution:

- ***If the base of the oil sump is divided to fit over a transmission shaft, remove the drain plugs on both sides of the oil sump. Failure to do so, only some of the lubricating oil will be drained.***
- ***Do not exceed the recommended level of lubricating oil in the sump. If too much oil is added, drain to correct level. Oil in excess can penetrate the breather valve. This could cause the engine speed to increase rapidly without control.***

Run the engine and check for lubricant leaks. Stop the engine. After 15 minutes check the oil level on the dipstick and add new lubricating oil if necessary.



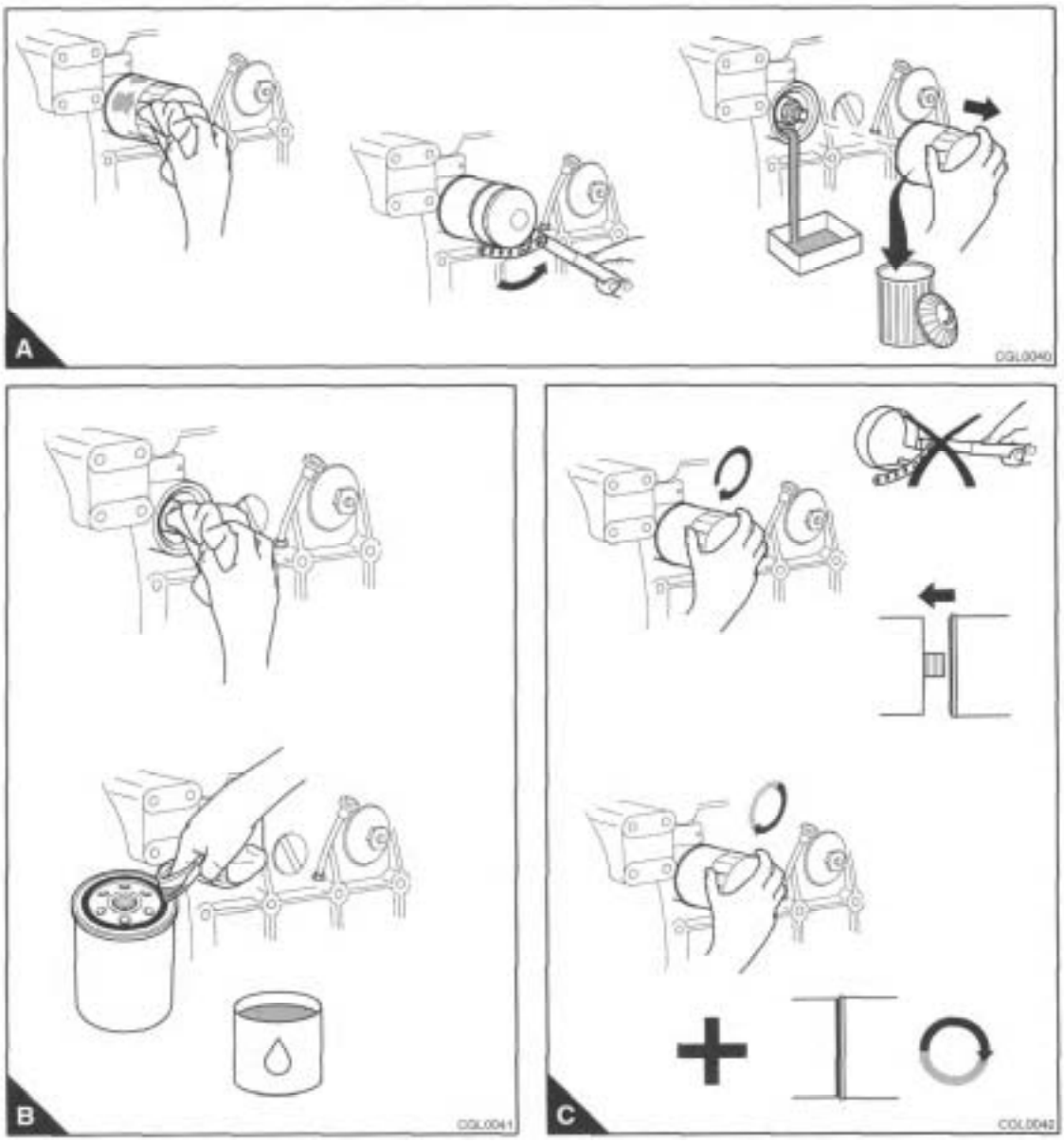
How to renew the canister of the lubricating oil filter

Danger
Dispose of old canisters and used oils in a safe place in accordance with local regulations.

Caution
Make sure the application is on a level surface to ensure an accurate reading on the dipstick. Never exceed the "FULL" mark on the dipstick during refilling - see "Caution" on the previous page.

Note: Some applications have a separate filter head directly fitted onto the mounting face of the filter on the cylinder block. The filter canister is then fitted to the filter head. To renew the filter canister, obey the following procedure. Turbocharged enginees have an oil cooler fitted between the filter head and the filter canister. Obey the following procedure to renew the canister.

Run the engine and check for lubricant leaks. Stop the engine. After 15 minutes check the oil level on the dipstick and add new lubricant if necessary.



Air filter

Caution
Do not run the engine if there is a blockage in the air filter or the induction hose. Failure to do so, lubricant may enter the cylinders through the engine breather valve.

Environmental conditions have an important effect on the frequency at which the air filter needs service.

The filter element must be cleaned or replaced as per manufacturer's instructions.

Restriction indicator
If the machine is equipped with a restriction indicator, this will indicate exactly when the air filter element has to be cleaned. This prevents the premature renewal of the filter element and the resulting extra costs, or a late renewal of the element which can cause loss of engine power.

• Engine fluids

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:	50 minimum
Viscosity:	2.0/4.5 centistokes at 40 °C
Density:	0.835/0.855 kg/litre
Sulphur:	0.2% of mass, maximum
Distillation:	85% at 350 °C

A high sulphur content (not normally found in Europe, North America or Australasia) can cause engine wear. Where only high sulphur fuels are available, it is necessary to use a highly alkaline lubricating oil in the engine or to renew the lubricating oil more frequently, see table below:

Low temperature fuels

Fuel sulphur content (%)	Oil change interval
<0.5	Normal
0.5 to 1.0	75% of normal
>1.0	50% of normal

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, address to the nearest authorised dealer.

Aviation kerosene fuels

For these engines, use only JP8 fuel.

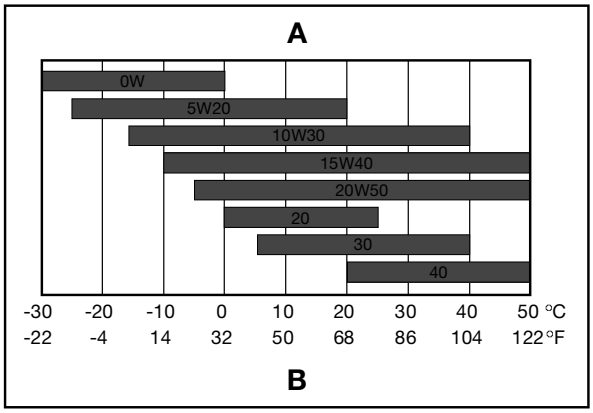
Lubricating oil specification

For naturally aspirated engines use only a good quality lubricating oil which is not less than the specification API CC or ACEA E1. API CD or ACEA E2 / E3 can be used, but is not recommended during the first 25 to 50 hours nor for light load applications.

For turbocharged engines use only a good quality lubricating oil which is not less than the specification API CG4 o ACEA E3.

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"

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.



Viscosity chart

A = Recommended viscosity
B = Ambient temperature

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 made 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 coolant circuit.

If frost protection is not necessary, it is still 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, do not hesitate to contact the equipment manufacturer.

Note: If combustion gases are released into the coolant circuit, the coolant must be renewed after the repair of the fault.

Use an antifreeze miture approved by the equipment manufacturer and containing the correct 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. Concentrations of less than 50% of antifreeze will dilute the corrosion inhibitor in the antifreeze and allow corrosion of the engine components. Concentrations of more than 50% of antifreeze may have an adverse effect on the performance of the coolant.

• Engine trouble 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, 12,13, 14, 15, 17	34, 35, 36, 37, 38, 42, 43
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13 14, 15, 16, 17, 19	34, 36, 37, 38, 40, 42, 43, 44
Not enough power	8, 9, 10, 11, 12, 13, 16, 20, 21	34, 36, 37, 38, 39, 42, 43, 44, 63, 64, 66
Misfire	8, 9, 10, 12, 13, 15, 20, 22	34, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11, 13, 15, 17, 18, 19, 23, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63
Black exhaust smoke	11,13,15,17,19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63,64
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 61, 62
The pressure of the lubricating oil system is too low	4, 24, 25, 26	46, 47, 48, 50, 51, 59
The engine knocks	9, 13, 15, 17, 20, 22, 23	36, 37, 40, 42, 44, 46, 52, 53, 60
The egine runs erratically	8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 22, 23	34, 38, 40, 41, 44, 52, 60
Vibration	13, 18, 20, 27, 28	34, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil system is too high	4, 25	49
The engine oil temperature is too high	11, 13, 15, 19, 27, 29, 30, 32, 65	34, 36, 37, 39, 52, 55, 56, 57, 66
Block under pressure	31, 33	39, 42, 44, 45, 52, 61
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

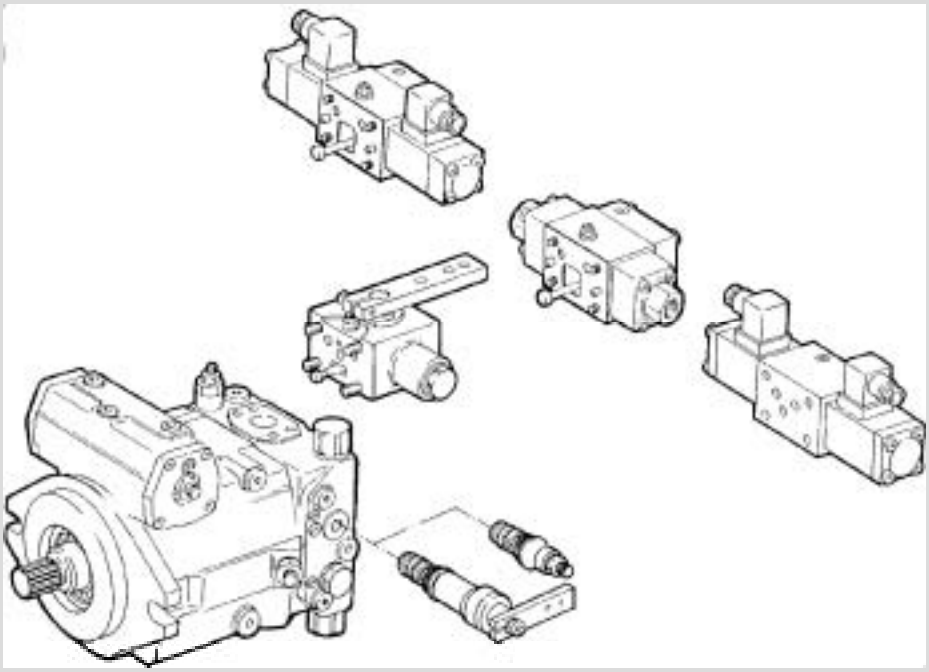
1 Battery capacity low.
2 Bad electrical connections.
3 Fault in starter motor.
4 Wrong grade of lubricating oil.
5 Starter motor turns engine too slowly.
6 Fuel tank empty.
7 Fault in stop control.
8 Restriction in a fuel pipe.
9 Fault in fuel lift pump.
10 Dirty fuel filter element.
11 Restriction in 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 Incorrect valve tip clearances.
23 Too much oil or oil of the wrong type is used in wet type air cleaner, if one is fitted
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 leak or fault in exhauster.
34 Fault in fuel injection pump.
35 Broken drive on fuel injection pump.
36 Timing of fuel injection pump 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 close.
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.
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.
64 Turbocharger impeller is damaged or dirty.
65 Drive belt for water pump is loose.
66 Induction system leaks (turbocharged engines).

For information:

Toll-free number: 199-151-616
www.perkins.com

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Section I
REPAIR INSTRUCTIONS
REXROTH PUMP



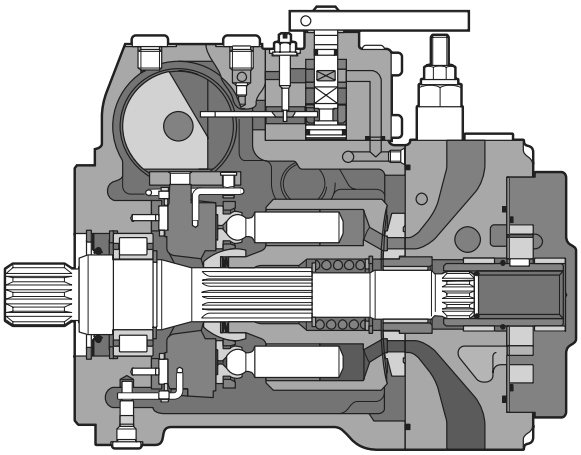
Istruzioni di riparazione
Repair instructions
Mod. A4VG

AVVERTENZA

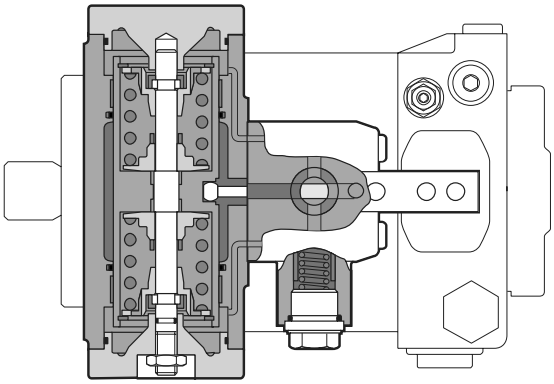
Le specifiche, le descrizioni ed il materiale illustrativo del presente documento si riferiscono alle caratteristiche tecniche valide al momento della stampa.
La BRUENINGHAUS HYDROMATIK si riserva il diritto di interrompere la produzione di modelli ed optional in qualsiasi momento e di apportare modifiche alle caratteristiche tecniche, ai materiali o alla progettazione in qualsiasi momento e senza alcun preavviso.
Attrezzature opzionali ed accessori possono comportare un aumento del prezzo base ed alcune opzioni possono essere disponibili solo in combinazione con alcuni modelli o opzioni richieste.
Per le combinazioni disponibili fare riferimento al foglio dati dell'unità base e dell'opzione richiesta.
Eventuali regolazioni e prove devono essere effettuate sul banco prova alle temperature operative.
Prendere tutte le misure necessarie per evitare danni a persone e cose.
La necessaria esperienza, condizione indispensabile per qualsiasi riparazione, può essere acquisita seguendo i corsi di addestramento da noi organizzati.

NOTICE

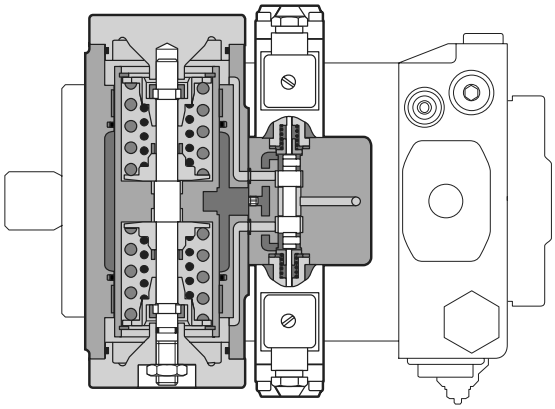
Specifications, descriptions and illustrative material shown herein are as accurate as known at the time this publication was approved for printing.
BRUENINGHAUS HYDROMATIK reserves the right to discontinue models or options at any time or to change specifications, materials, or design without notice and without incurring any 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.



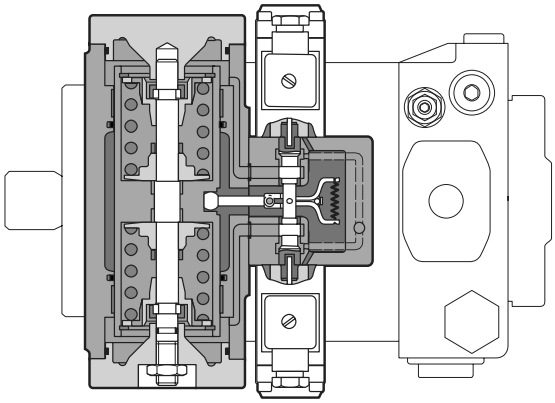
HWD



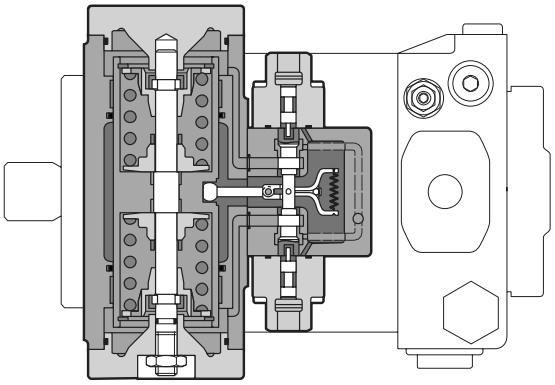
DAD



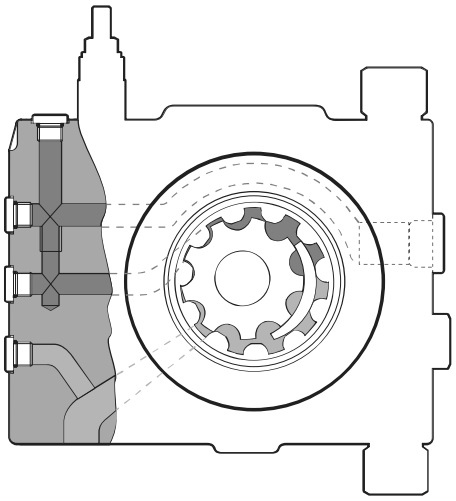
EPD

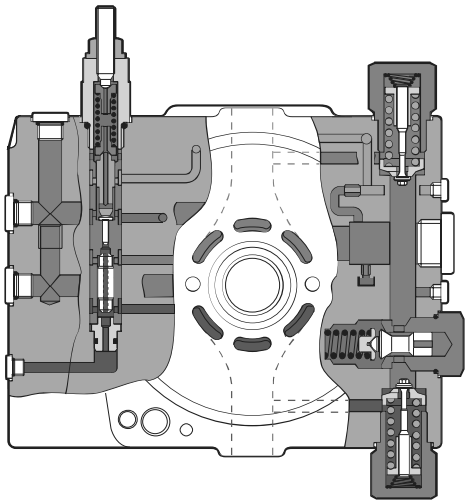


HDD

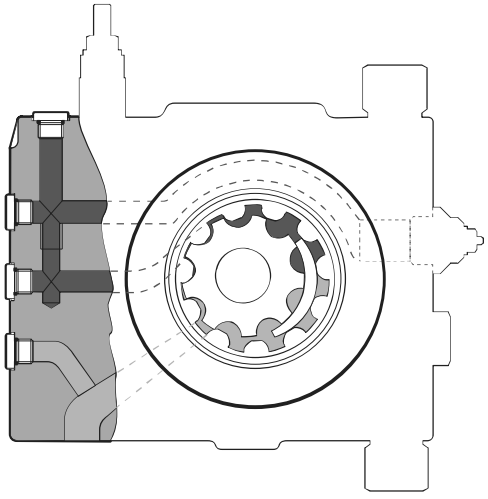


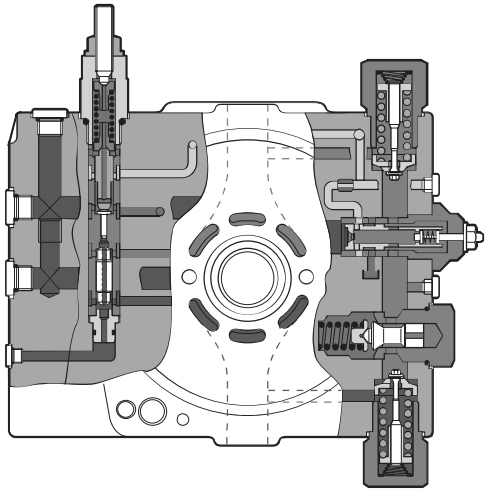
HWD / EPD / HDD

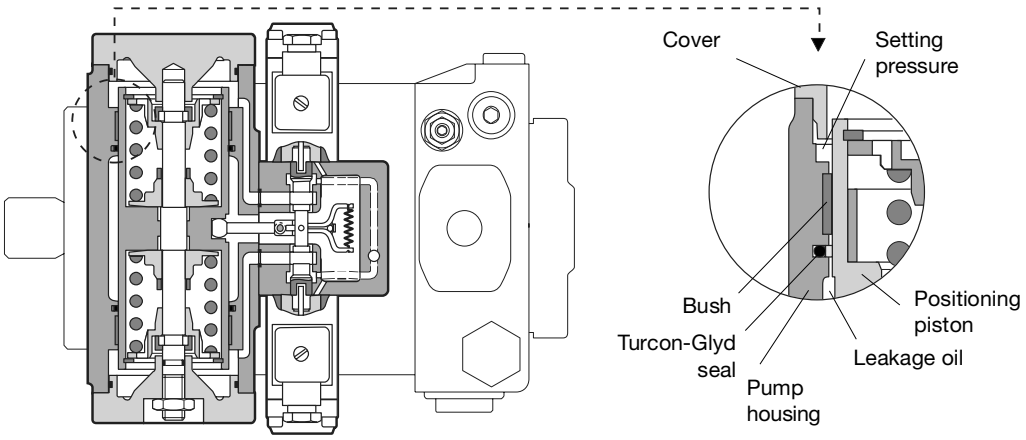




DAD







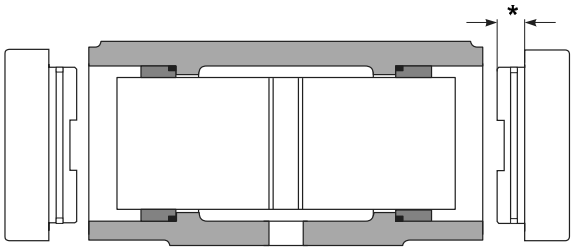
Attualmente sulle pompe a portata variabile A4VG si installano tenute Turcon.
Alle parti del gruppo completo verrà assegnato un nuovo codice di identificazione.
Il codice di riferimento e le dimensioni esterne restano invariate (l'alloggiamento della pompa varia unicamente nel settore del pistone di regolazione. Quest'ultimo verrà realizzato in versione scanalata).

⚠ Non utilizzare il vecchio pistone di regolazione con tenuta Turcon (angolo acuto – la tenuta potrebbe danneggiarsi).

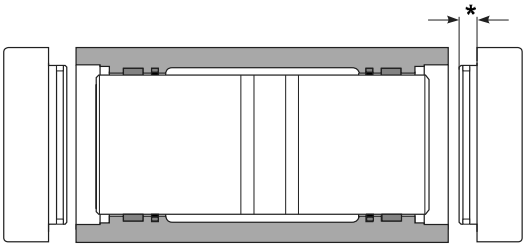
At present the change of the control into Turcon seal is made for A4VG.
The parts list of the complete unit will receive a new identification number.
Type reference and outside dimensions remain unchanged (pump housing will change at the area of the positioning piston. Positioning piston will change into chamfering design).

⚠ Do not use old positioning piston with Turcon seal (sharp edged - seal will be damaged)

Alloggiamento pompa / Pump housing con tenuta Turcon / with bush **PREC./OLD**



Alloggiamento pompa / Pump housing con tenuta Turcon / with Turcon seal **NUOVO/ NEW**

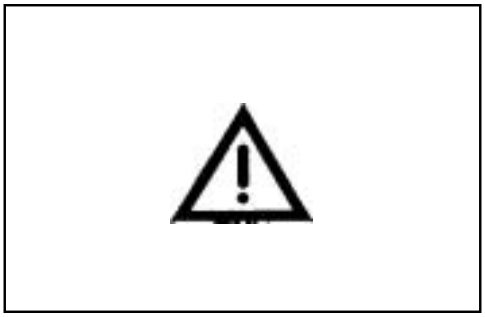


⚠ La modifica della regolazione sulla tenuta Turcon migliora normalmente il funzionamento (curva DA, influenza basse temperature su tempi di regolazione).

⚠ I tempi di regolazione possono subire una leggera variazione con alcune sezioni di strozzamento. Pertanto è necessario informare i clienti della modifica.

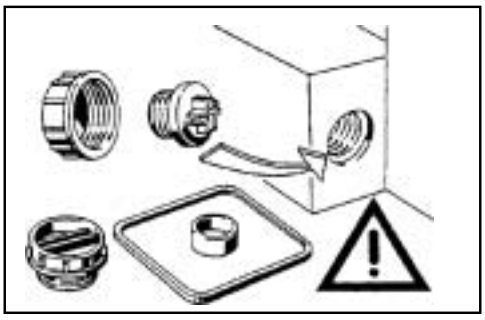
⚠ The change of the control into Turcon seal design improves in general the function (DA-behaviour, lower temperature-influence on control times).

⚠ The control times will slightly change with the same throttle sections. Therefore our customers have to be informed about this change.



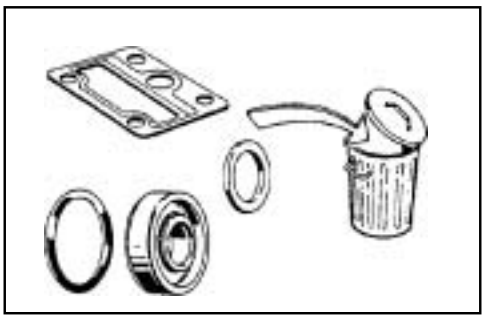
Attenzione!
Rispettare le seguenti avvertenze per qualsiasi riparazione sui gruppi idraulici.

Attention!
Observe the following notices when carrying out repair work at hydraulic aggregates!



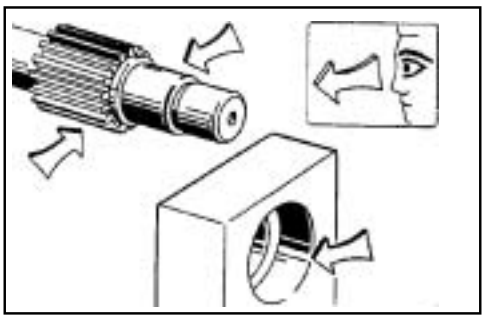
Chiudere tutte le aperture dei gruppi idraulici.

Close all ports of the hydraulic aggregates.



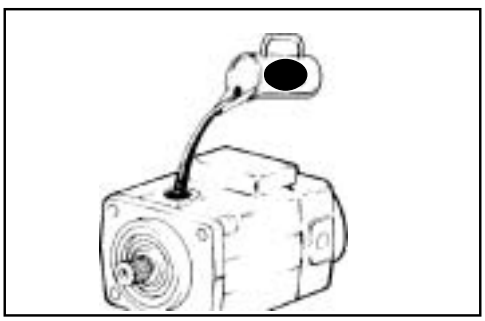
Sostituire tutte le guarnizioni.
Utilizzare unicamente parti di ricambio originali BRUENINGHAUS HYDROMATIK..

Replace all seals.
Use only original BRUENINGHAUS HYDROMATIK spare parts.



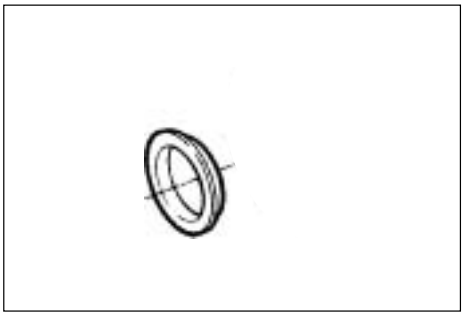
Verificare il grado di usura di tutte le superfici di tenuta e scorrimento.
Attenzione: la rilavorazione delle superfici di tenuta, utilizzando ad esempio carta abrasiva, può causare danni alla superficie.

Check all seal and sliding surfaces for wear.
Attention: Rework of sealing area, f. ex. with abrasive paper, can damage surface.



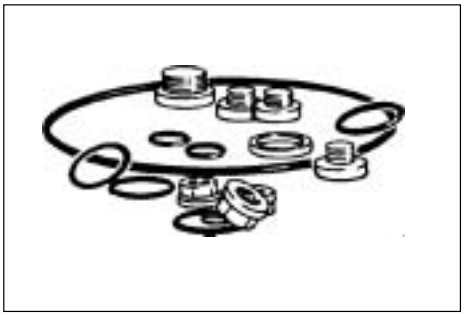
Riempire i gruppi idraulici prima della messa in funzione.

Fill up hydraulic aggregates with medium before start-up.



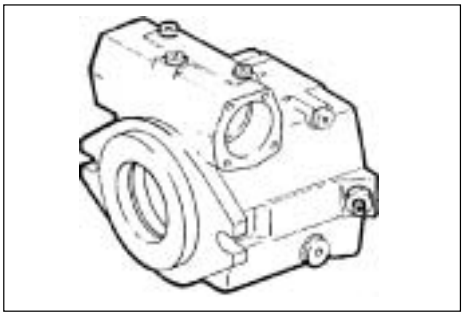
1 Tenuta per albero motore.

Seal kit for drive shaft.



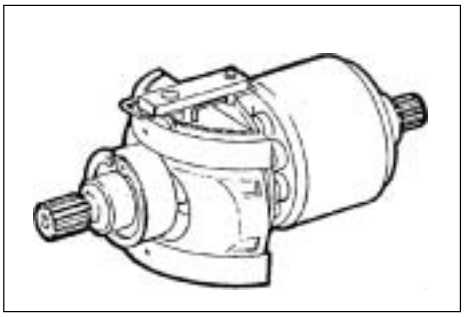
2 Tenuta esterna.

External seal kit.



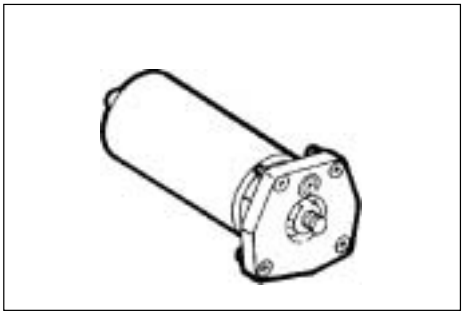
3 Corpo pompa.

Housing.



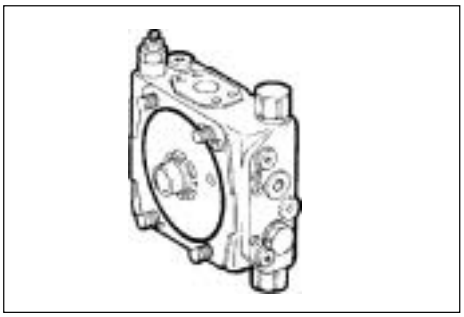
4 Gruppo rotante completo.

Complete rotary group.



5 Pistone di regolazione.

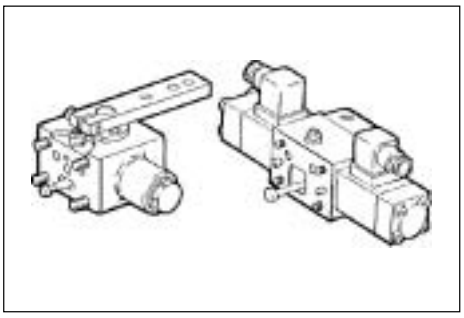
Positioning piston.



6

Piastra di chiusura.

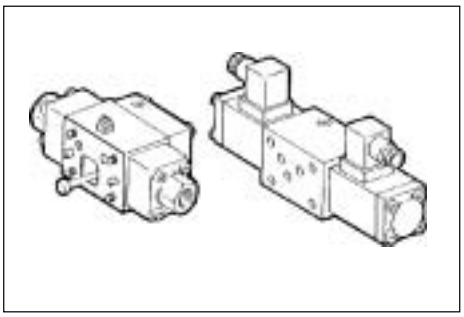
Port block.



7

Moduli di comando **HW - EP.**

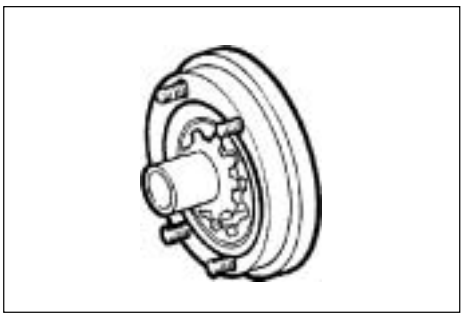
Control modules **HW - EP.**



8

Moduli di comando **HD - DA.**

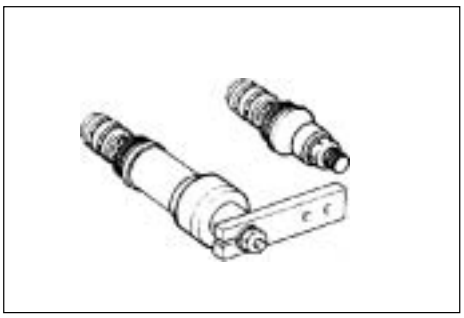
Control modules **HD - DA.**



9

Pompa ausiliaria.

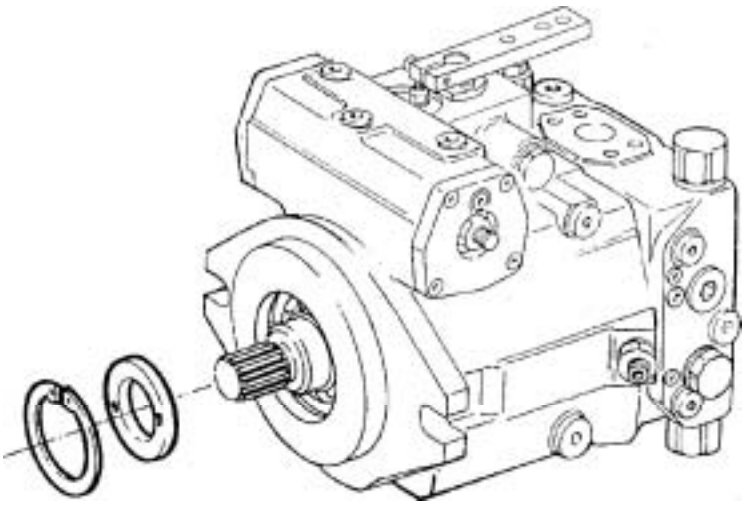
Boost pump.



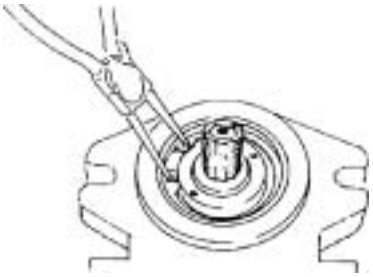
10

Valvola di regolazione.

Control valve.



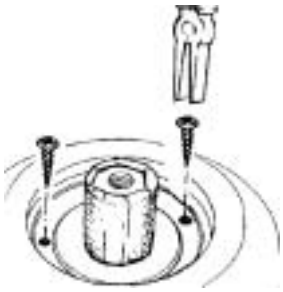
11



12

Proteggere l'albero motore.
Rimuovere l'anello di fissaggio.

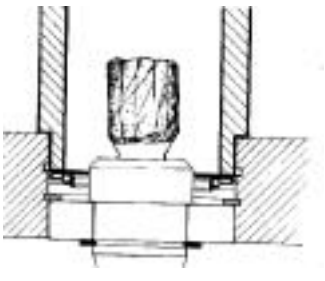
Protect the drive shaft.
Remove retaining ring.



13

Inserire le viti in lamiera nei fori con gomma.
Estrarre la tenuta dell'albero con un paio di pinzette.

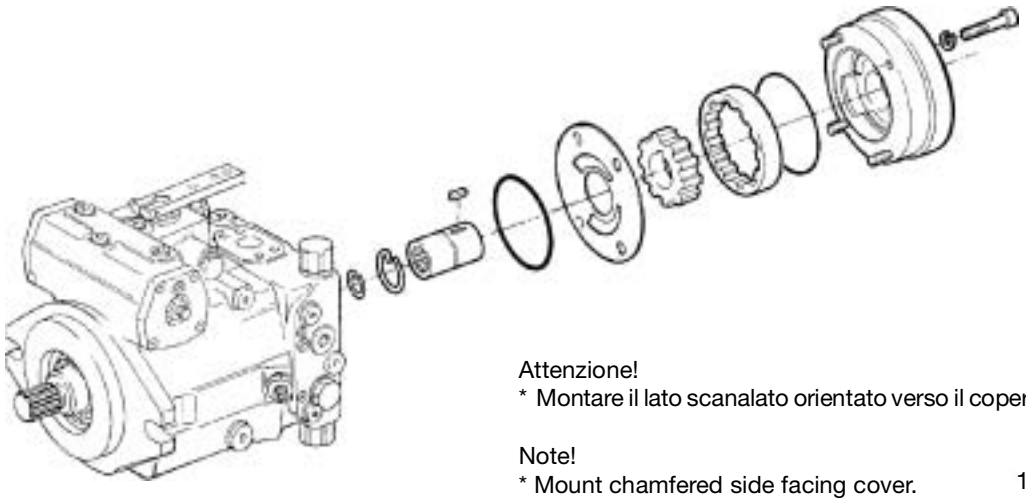
Screw in sheet metal screws into the holes fitted with rubber.
Pull out shaft seal with pliers.



14

Inserire a pressione la tenuta dell'albero con boccola fino a battuta.

Press-in shaft seal with bush to stop.



Attenzione!
* Montare il lato scanalato orientato verso il coperchio.

Note!
* Mount chamfered side facing cover. 15



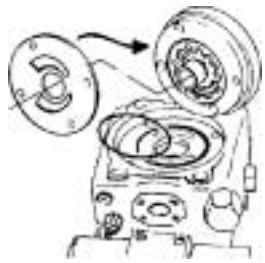
16 Marcare la posizione e rimuovere le viti di fissaggio.

Mark position, remove fixing screws.



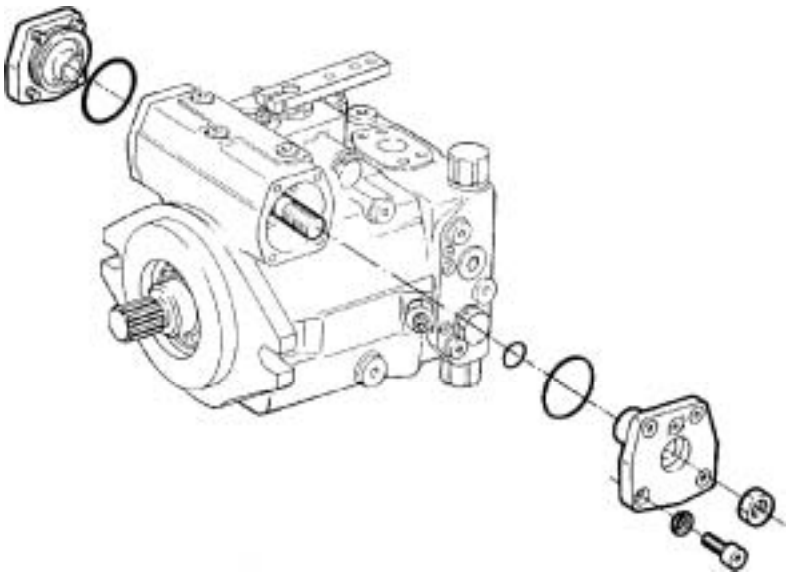
17 Rimuovere il coperchio con una leva.

Pry-off cover.

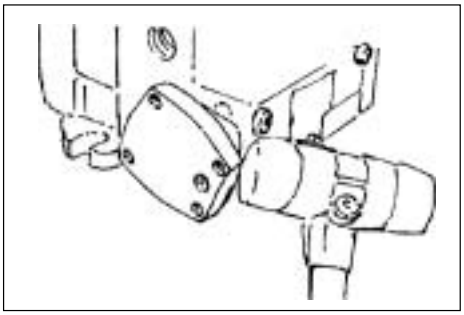


18 Verificare le parti della pompa ausiliaria.
In caso di usura, la pompa deve essere sostituita integralmente.

Inspect the parts of the boost pump and wear parts.
Boost pump can only be interchanged completely.



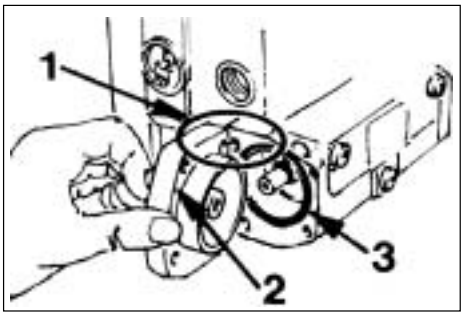
19



20

Allentare le viti di fissaggio.
Ruotare il coperchio e rimuoverlo battendo con cautela con un martello.

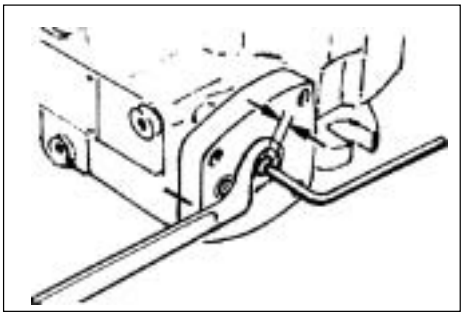
Loosen mounting screws.
Rotate cover and release by tapping gently with hammer.



21

Controllare: O-ring (1), scanalatura (2), corpo pompa (3).

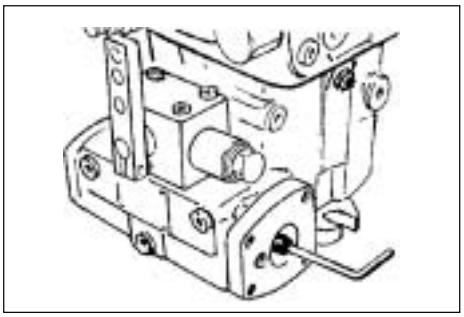
Check!
O-ring (1), groove (2), housing (3).



22

Rimuovere il controdado mantenendo in posizione la vite di regolazione.
Marcare il coperchio. Determinare la misura ed allentare il controdado.

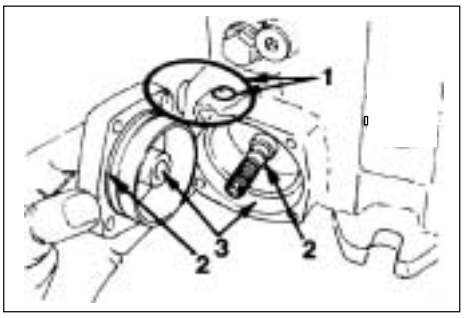
Remove locknut while holding setting screw.
Mark cover. Note measure, and loosen counter nut.



23

Estrarre il coperchio ruotando la vite di regolazione della posizione zero.

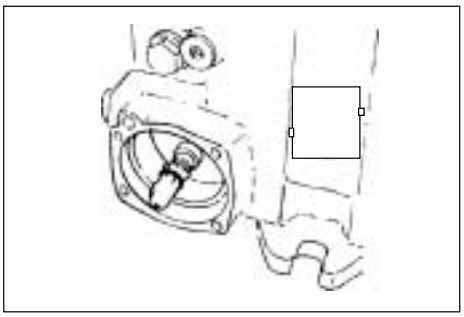
Pull cover off using zero position adjustment screw.



24

Controllare: O-ring (1), scanalatura (2), corpo pompa (3).

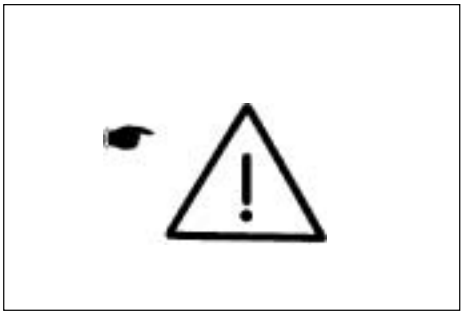
Check!
O-ring (19), groove (2), housing (3).



25

Coprire i filetti ed inserire l'O-ring piccolo.
Assemblare seguendo la sequenza inversa.

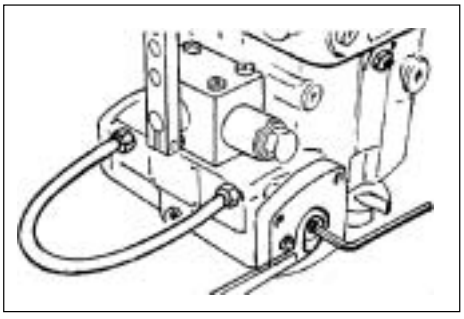
Cover threads, push on small O-ring.
Assemble in reversed order.



26

Attenzione!
La regolazione della posizione dello zero meccanico deve essere effettuata dopo l'installazione sulla macchina o sul banco di prova.

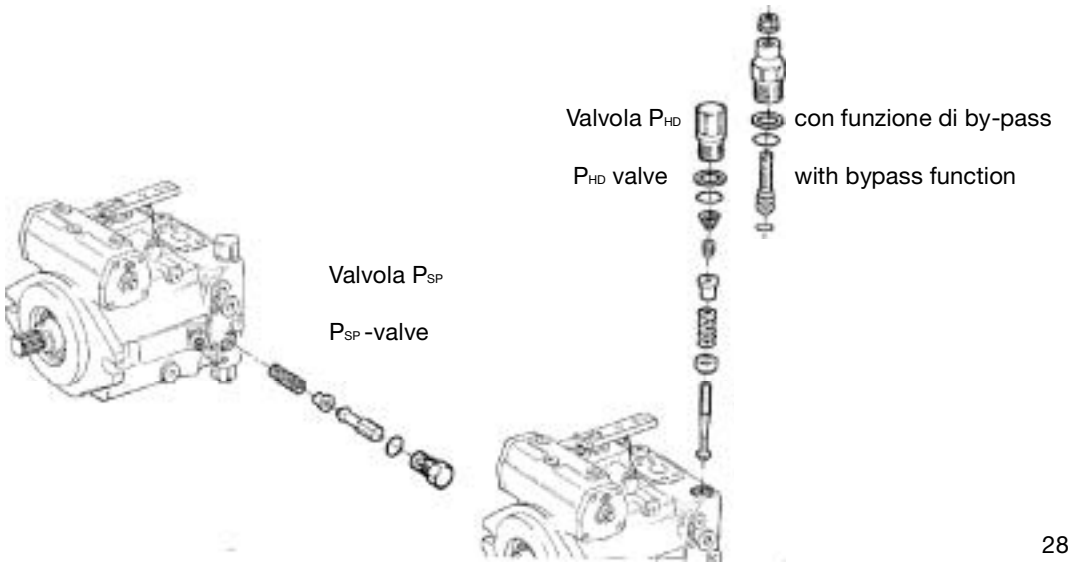
Attention!
Adjustment of the correct zero position shall be carried out after installation into the machine or on the test bench.



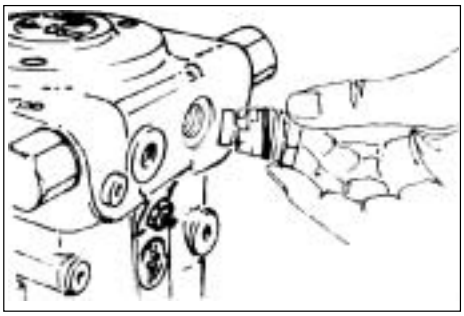
27

Resettare lo zero meccanico. Allo scopo, collegare X_1 a X_2 (>NW6).

Reset mechanical zero position. To do this, connect X_1 to X_2 (size > 6).

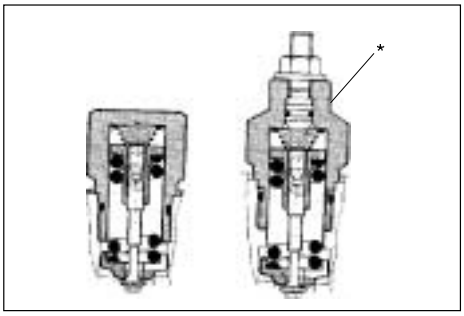


28



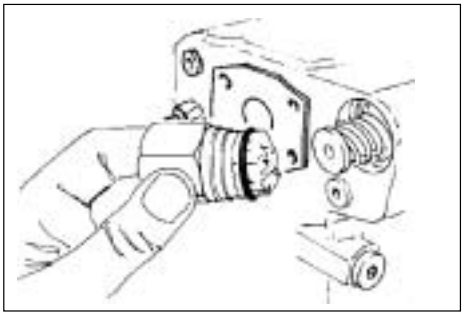
29 Proteggere i filetti prima di inserire il nuovo O-ring (per evitare danni).

Cover threads before fitting new O-rings (to prevent damage).



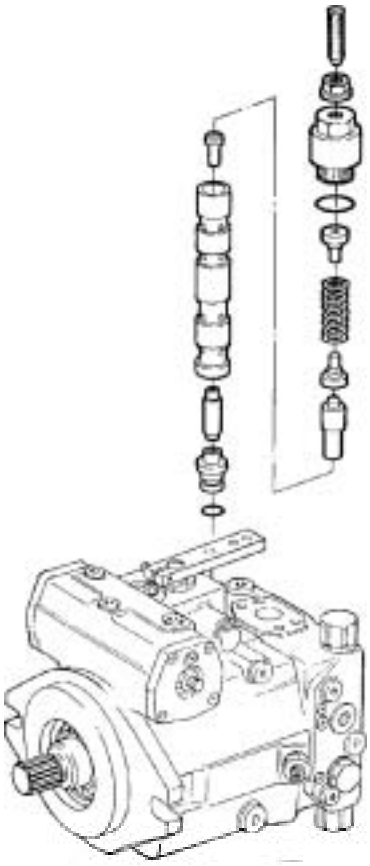
30 Rimuovere il fungo della valvola con molla
* con funzione di by-pass

Remove valve poppet with spring.
* with bypass-function

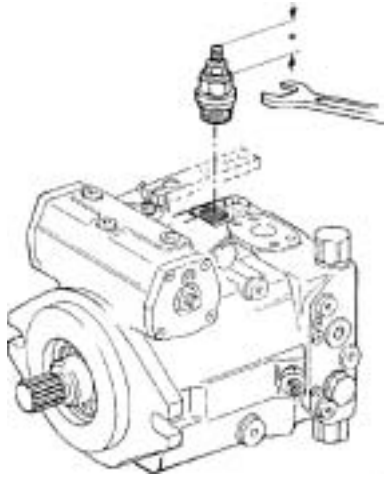


31 Proteggere i filetti prima di inserire il nuovo O-ring (per evitare danni).

Cover threads before fitting new O-rings (to prevent damage).



32



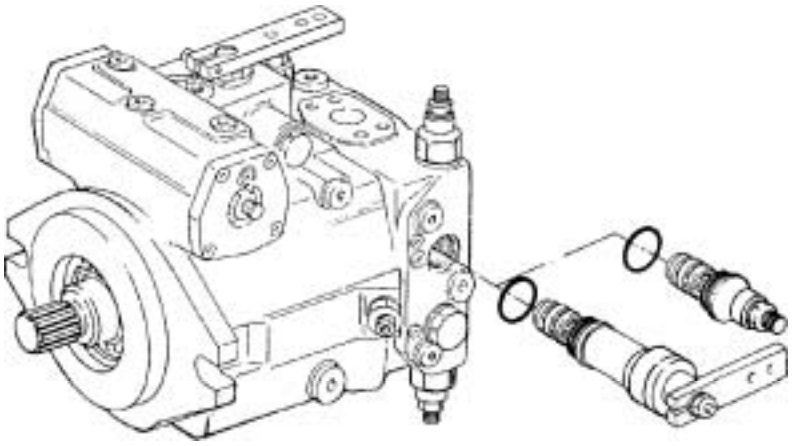
33

Sostituire il dado di fissaggio.
Prendere nota della misura di regolazione (*).

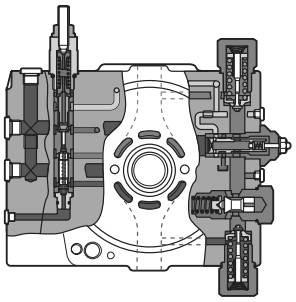
Change of the sealing nut.
Note setting measure (*).

Attenzione!
Dopo il montaggio verificare la “regolazione della valvola”.

Attention!
After assembly check “valve setting”.



34



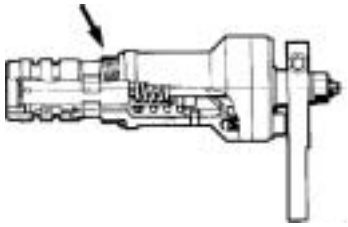
35 Smontare la valvola di regolazione.

Remove control valve.



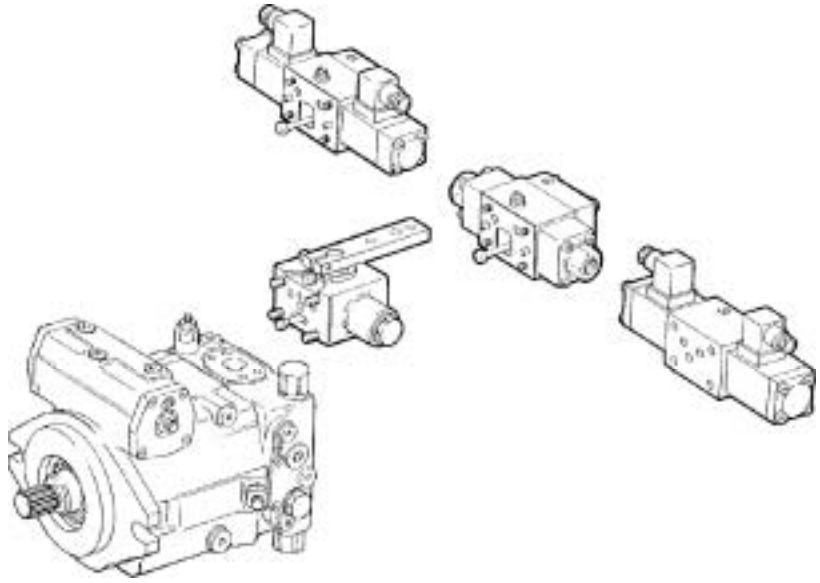
36 Evitare di danneggiare il diametro della farfalla.

Do not damage throttle diameter.

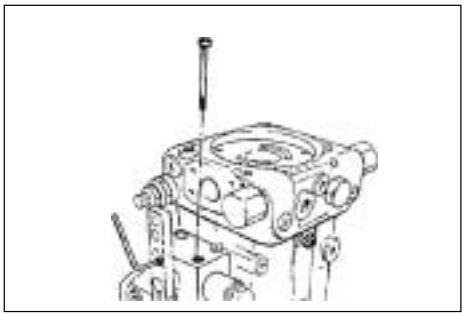


37 Prima di procedere con l'installazione del nuovo O-ring, proteggere i filetti con nastro isolante.

Before installing the new O-ring, tape the threads.



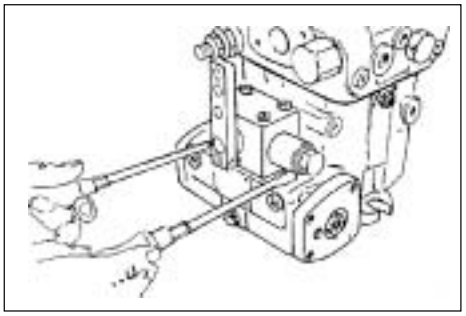
38



39

Rimuovere le viti di fissaggio.

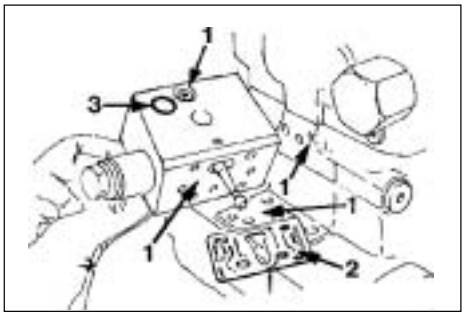
Remove fixing screws.



40

Rimuovere il modulo di controllo esercitando una leggera pressione.

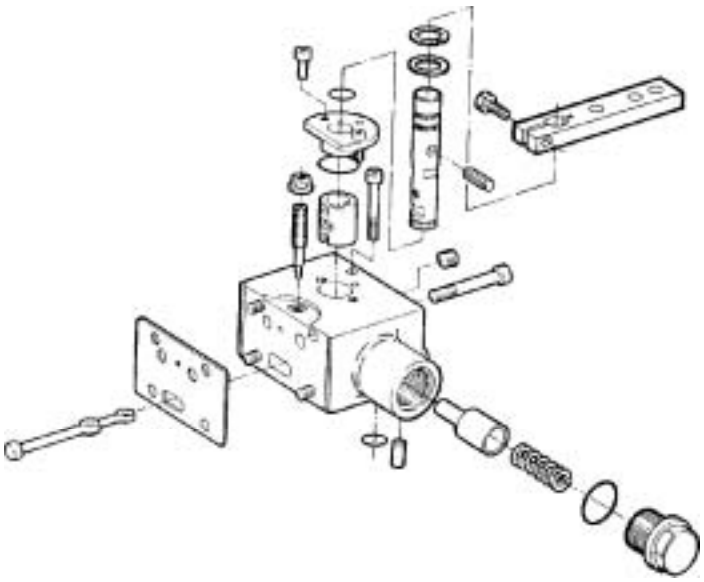
Pry-off the control module.



41

Controllare: superficie di tenuta (1), guarnizione (2), O-ring (3).

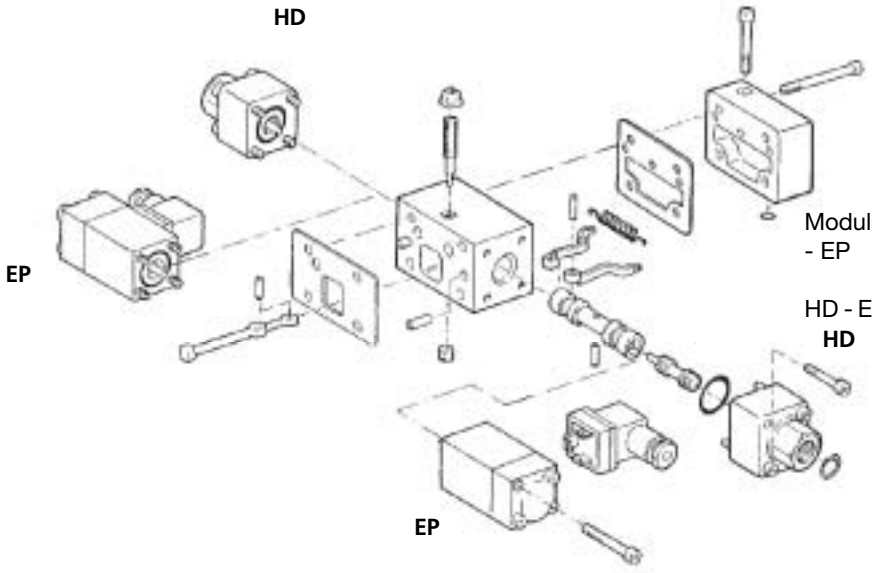
Check
Sealing surface (1), gasket (2), O-rings (3).



Modulo di comando HW

HW control module

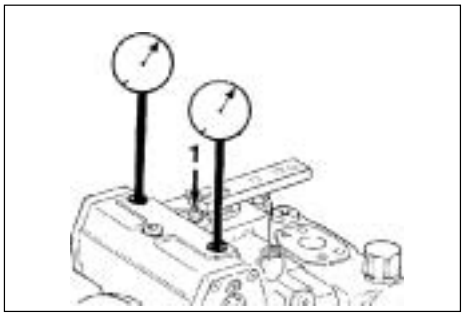
42



Modulo di comando HD - EP

HD - EP control module

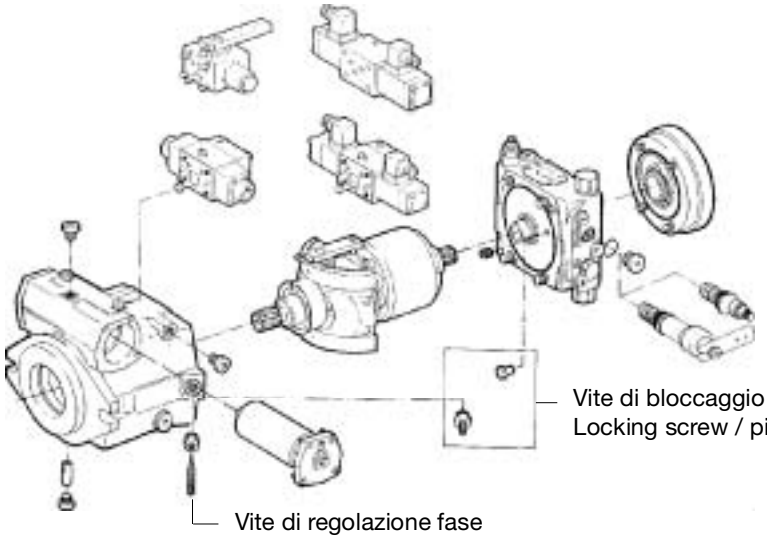
43



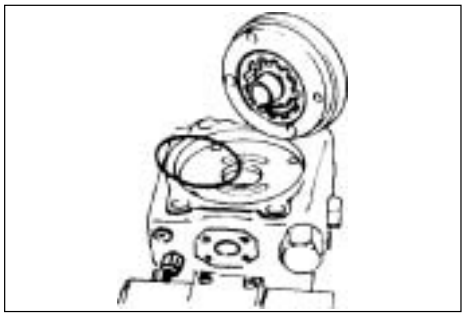
44

Ristabilire la posizione di zero idraulico (1).
Entrambi i manometri devono rilevare la stessa pressione.

Reset hydraulic zero position (1).
Both gauges must indicate the same pressure.

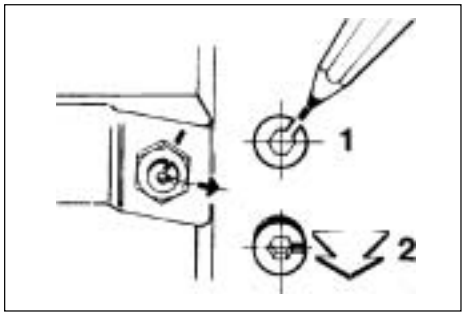


45



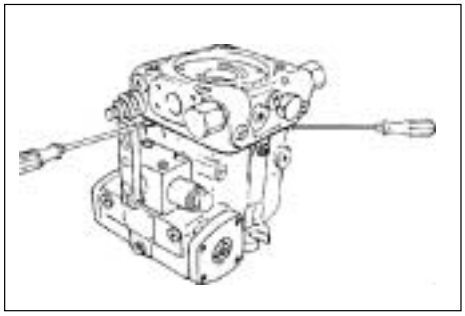
46 Marcare la posizione della pompa ausiliaria e della piastra di chiusura.
Smontare la pompa ausiliaria.

Mark position of boost pump and port plate.
Remove boost pump.



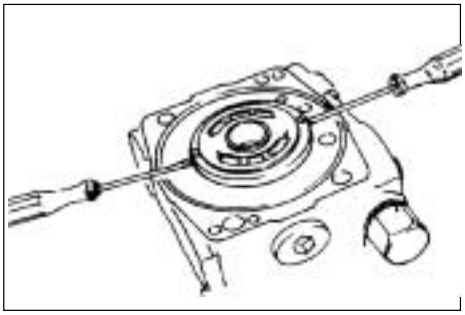
47 Marcare la posizione della vite di regolazione fase (1).
Portare la vite in posizione di smontaggio (2).

Mark the position of the timing adjustment screw (1).
Set the timing adjustment screw to disassembly position (2).



48 Allentare il fissaggio della piastra di chiusura.
Rimuovere la piastra utilizzando, se necessario, un cacciavite.
Attenzione alla superficie di tenuta.

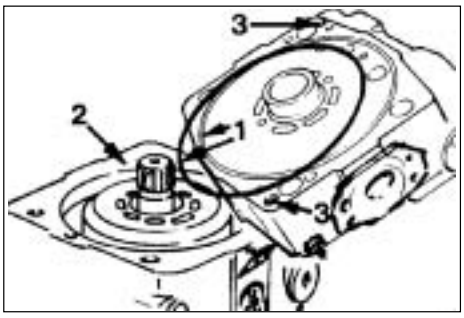
Release port plate fitting.
Take off port plate. If necessary, use screwdriver.
Attention! Sealing surface.



49

Sollevare la piastra di regolazione.
Annotarne la posizione.

Lift off control plate.
Note position.



50

Controllare l'O-ring e relativa scanalatura (1), il corpo (2), la tenuta quadrata e relativa scanalatura (3).

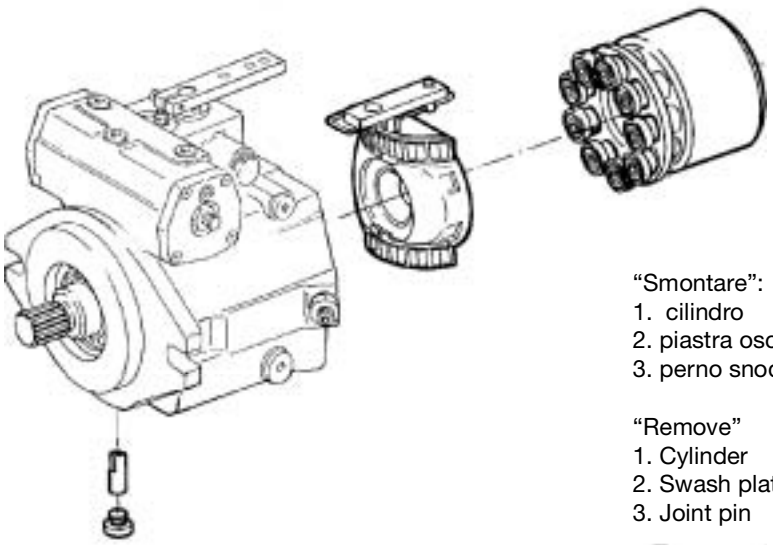
Check!
O-ring and groove (1), housing (2), Quad-ring and groove (3).



51

Spingere il cilindro verso il basso (1).
Rimuovere la vite di regolazione fase (2).
Estrarre il gruppo rotante (3).

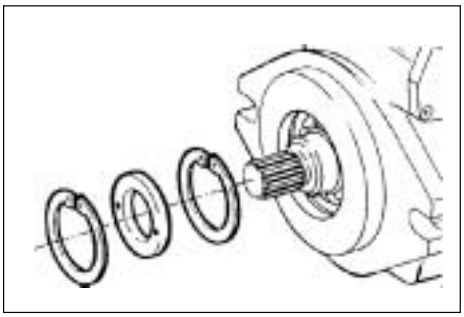
Press cylinder to the bottom (1).
Remove timing adjustment screw (2).
Lift out rotary group (3).



"Smontare":
1. cilindro
2. piastra oscillante
3. perno snodato

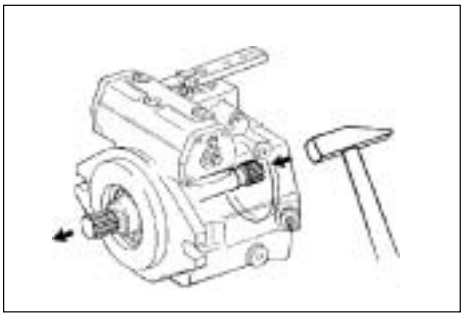
"Remove"
1. Cylinder
2. Swash plate
3. Joint pin

52



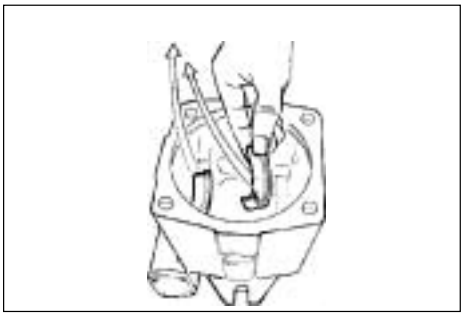
53 Rimuovere il Seeger e l'anello di tenuta radiale.

Remove retaining ring and radial seal ring.



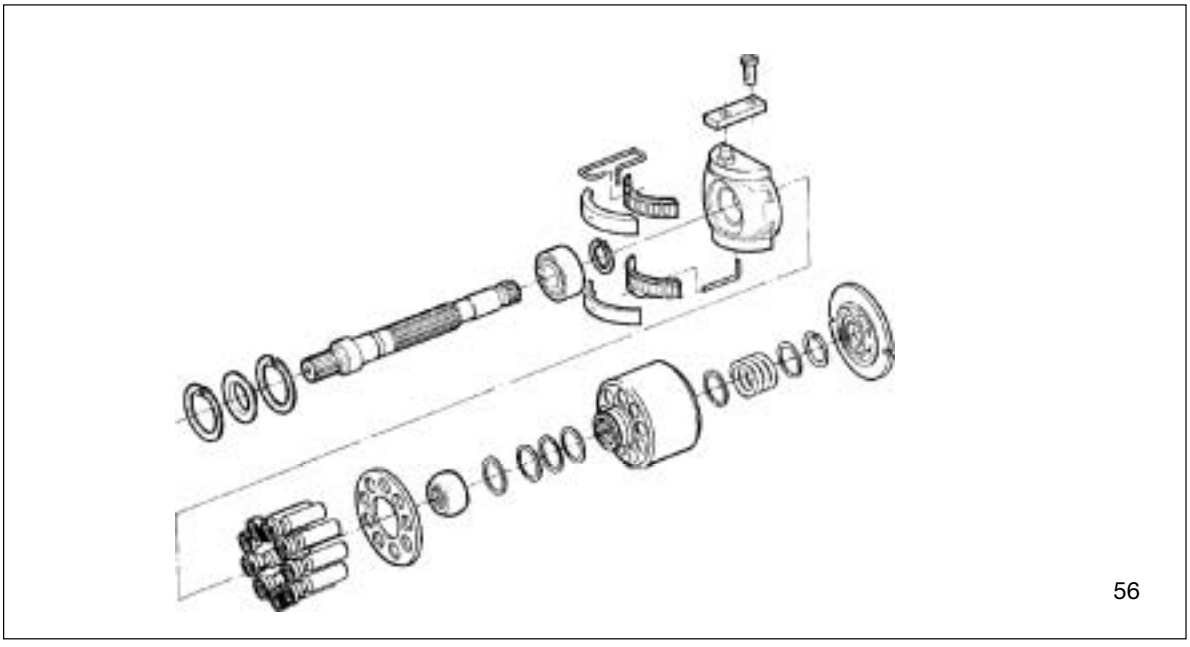
54 Rimuovere l'albero motore battendo leggermente con un martello.

Remove drive shaft with slight hammer strokes.

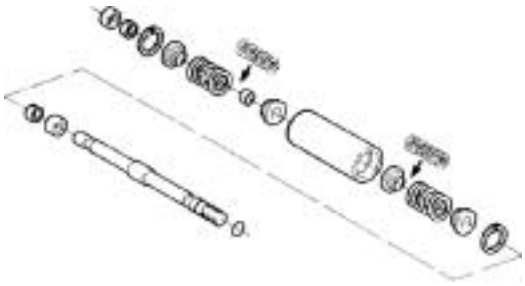


55 Smontare i semigusci dei cuscinetti.

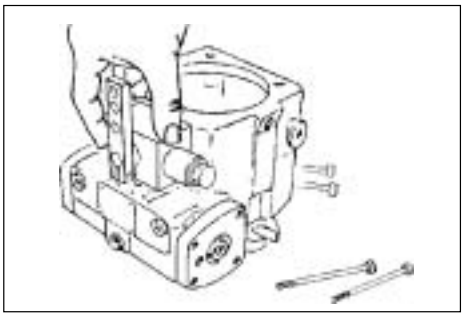
Remove bearing cups.



56

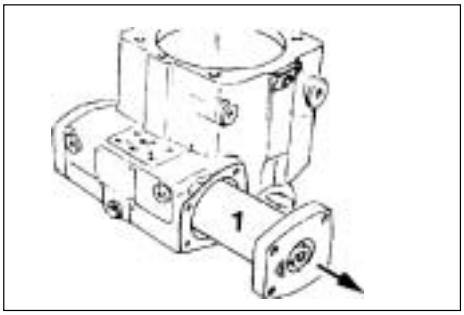


57



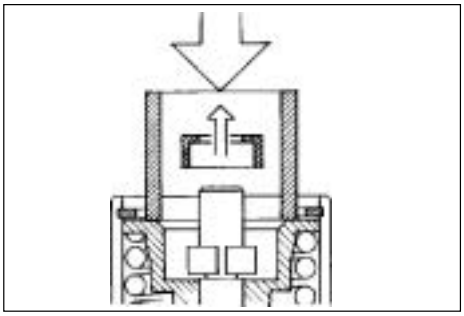
58 Rimuovere il modulo di comando.

Remove control module.



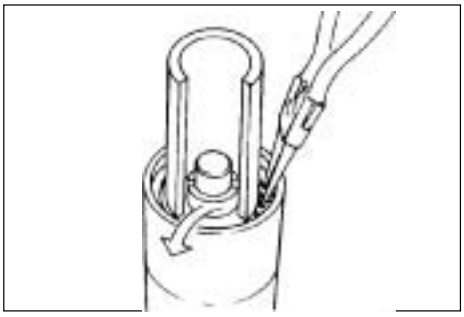
59 Estrarre il pistone di regolazione (1).

Pull out control piston (1).



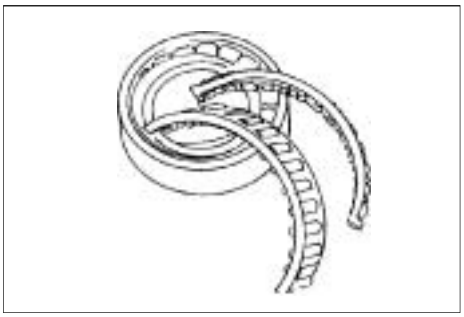
60 Montare il dispositivo di fissaggio e precaricare la molla.
Rimuovere l'anello di alloggiamento.

Mount fixture and tension spring.
Remove receiving ring.



61 Smontare gli anelli.
Rimuovere l'anello di fissaggio.
Attenzione! Le parti sono precaricate

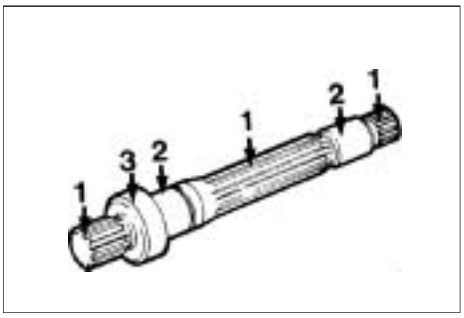
Take out rings.
Remove retaining ring.
Note! Parts are spring loaded.



62

Sostituire tutti i cuscinetti.

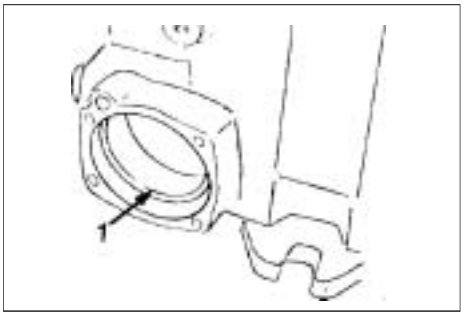
Replace all bearings.



63

Controllare:
1. gli ingranaggi per eventuali danni o usura
2. e superfici di rotolamento
3. eventuali graffiature sulla tenuta dell'albero.

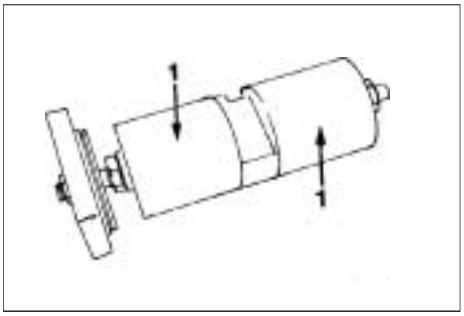
Check!
1. Splines for damage or fretting.
2. Running surfaces.
3. Groove cut by shaft seal.



64

Verificare che la boccola di guida del pistone di regolazione (1) non sia rigata e non presenti segni di usura.

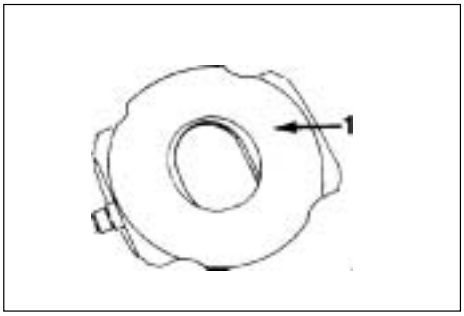
Check that the control piston guide bush (1) is free of grooves and is not worn out.



65

Verificare che il pistone (1) non sia rigato.

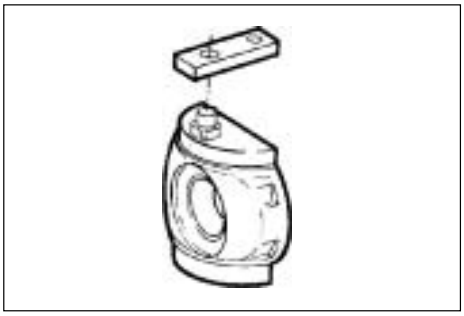
Check!
Control piston (1) is not scored.



66

Controllare che le superfici di scorrimento non siano graffiate.

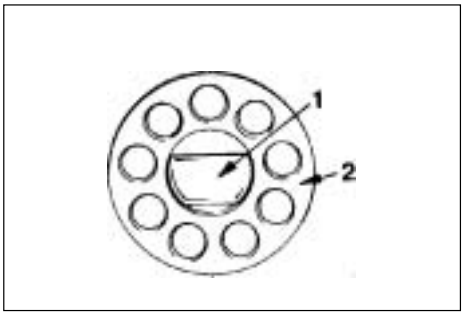
Check!
Sliding surface free of grooves.



67

Verificare che non ci sia gioco tra il perno snodato e l'anello di scorrimento.

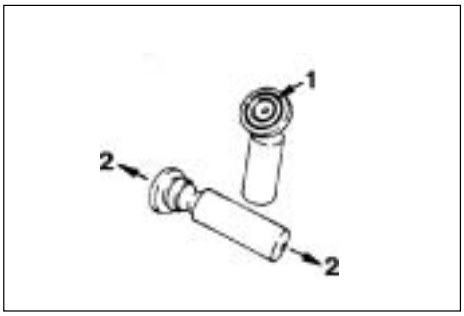
Check!
Make sure sliding ring/swivel pin are free of play.



68

Controllare che il dispositivo di ritorno non presenti graffi (1) o tracce d'usura nella zona dell'ammortizzatore di scorrimento.

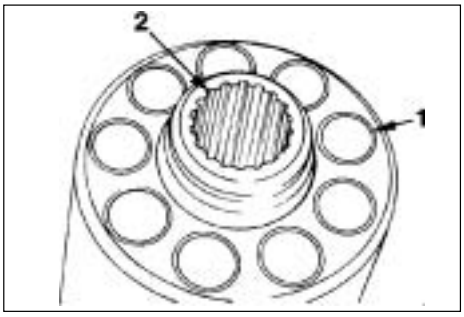
Check!
Check that return device is free of grooves (1) and there is no wear in slipper pad area.



69

Controllare che la superficie di scorrimento non mostri graffi o tracce di residui (1) e che non vi sia gioco assiale (2) (in caso contrario, è necessario sostituire il set di pistoni).

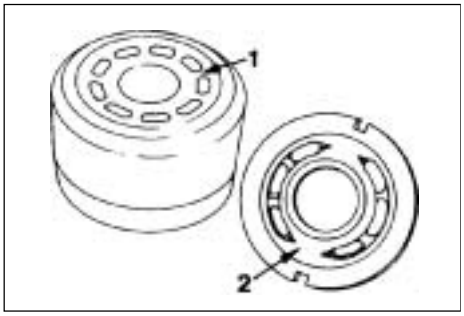
Check!
Check that there are no scratches or metal deposits on sliding surface (1), and there is no axial play (2), (otherwise: pistons must be replaced in sets).



70

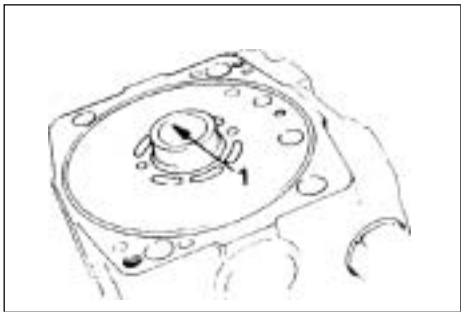
Controllare l'alesaggio dei cilindri (1) e le scanalature (2).

Check!
Cylinder bores (1), splines (2).



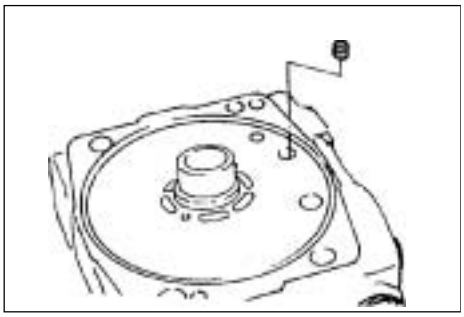
71 Verificare che la superficie di scorrimento (1) non mostri graffiature, tracce d'usura e corpi estranei incollati. Assicurarsi che la piastra della valvola (2) non sia graffiata (sostituire SOLO in set).

Check!
Cylinder sliding 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).



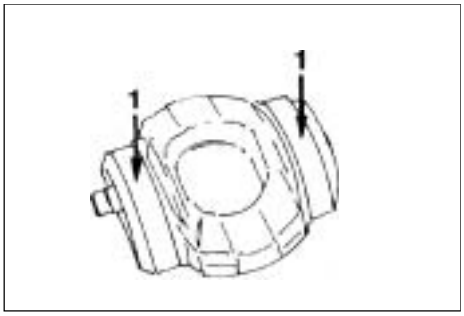
72 Verificare che la boccola del cuscinetto DU (1) non sia usurata.

Check!
DU-bearing bush (1) is not worn out.



73 Avvertenza:
Fori aperti in caso di valvola DA.
Nessun foro se DA non è installato.

Information:
Boring for DA-control open.
Without DA-control closed.



74 Controllare le superfici dei cuscinetti (1).

Check!
Bearing surfaces (1).

Montaggio corpo e anello Turcon-Glyd / Assemble housing - Turcon-Glyd-ring

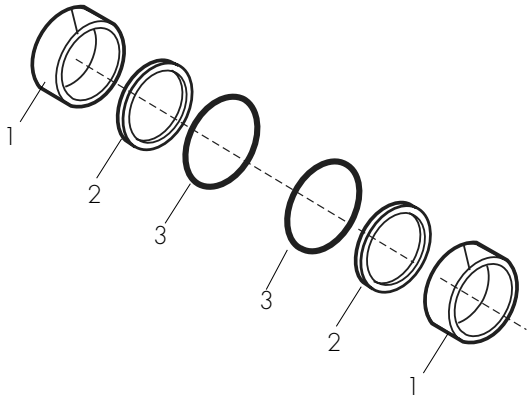
Attrezzi necessari: / Auxiliary tools:

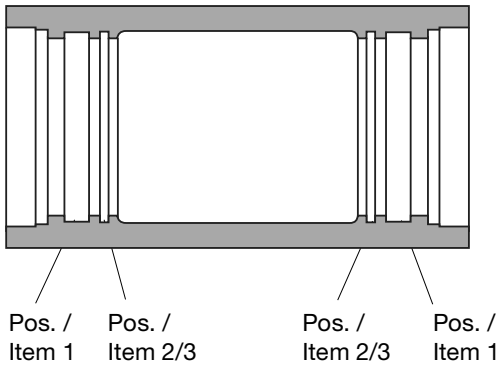
Pinze di montaggio / Assembly pliers: B+S x M22

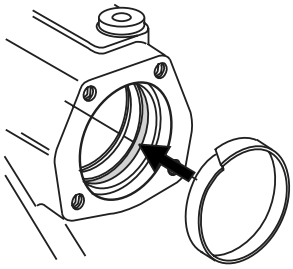
Mandrino guida /
Guide thorn:

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

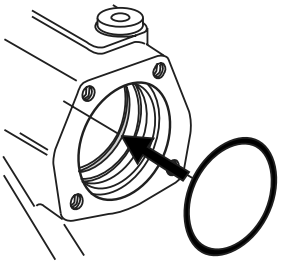
Montaggio / Assembly A4VG





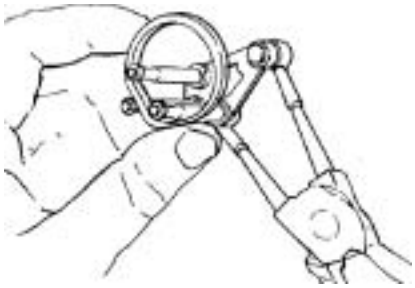


Pos. / Item 1: Montare l'anello guida dell'asta.
Install bar guide ring.



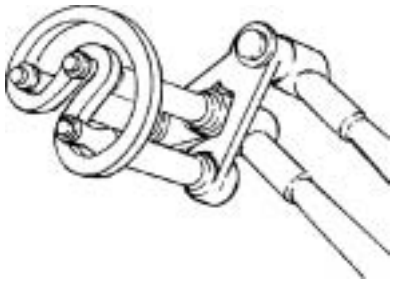
Pos. / Item 3: Montare l'O-Ring.
Install O-ring.

Montaggio corpo e anello Turcon-Glyd / Assemble housing - Turcon-Glyd-ring



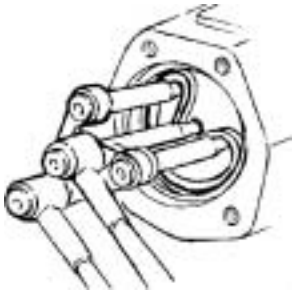
Posizionare l'anello di tenuta (Pos. 2) nella pinza di montaggio.

Fit the seal ring (Item 2) into the assembly tool.



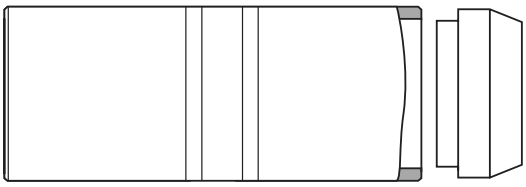
Comprimere con la pinza l'anello di tenuta a forma di rene. La deformazione della tenuta Turcon deve essere effettuata con cautela per evitare di danneggiare i labbri della tenuta stessa.

Press the seal ring into the kidney-shaped ring using the assembly tool. The deformation of the Turcon seal has to be done with care so as not to damage the sealing edges.



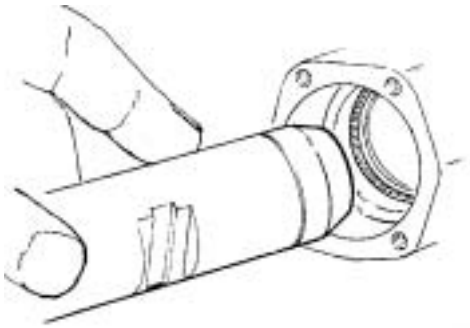
Inserire l'anello di tenuta nella sede posizionandolo nell'apposita scanalatura. Allentare la tensione ed estrarre le pinze di montaggio. Verificare la posizione dell'anello di tenuta; eventualmente aggiustare con un dito.

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.



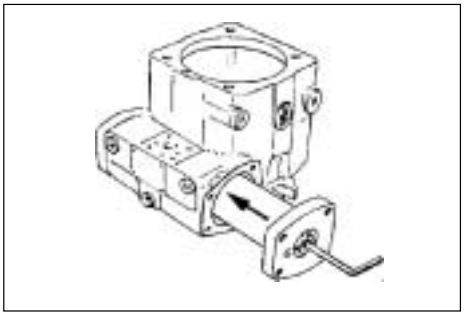
Montare il mandrino di guida nel pistone di regolazione.

Insert guide thorn into the positioning piston.



Ingrassare leggermente il mandrino.
Assemblare il pistone col mandrino.

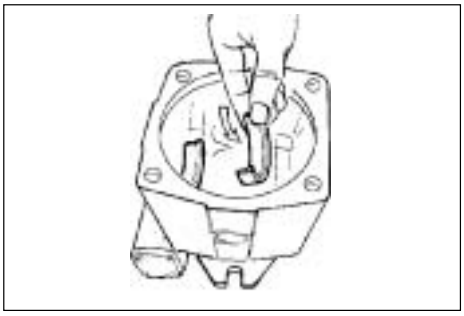
Grease slightly guide thorn.
Install positioning piston with guide thorn.



75

Inserire il pistone di regolazione nel corpo.
Avvertenza:
Oliare prima di posizionare il pistone.

Insert positioning piston into the housing.
Instruction:
Oil positioning piston before assembly.

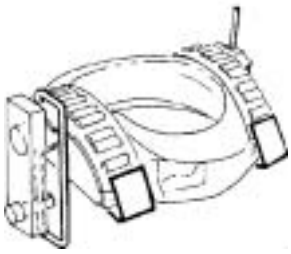


76

Inserire i semigusci dei cuscinetti.

Insert bearing cup set.





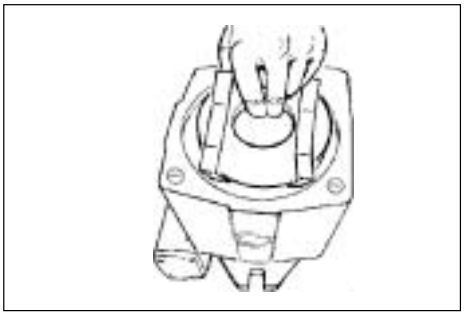
Montare il cuscinetto, il filo, il corsoio ed il perno snodato.
Per agevolare il montaggio utilizzare grappa / anelli in gomma / grasso.

Assemble bearing, wire, sliding stone and articulating pin.
Assistance: Devices e.g. - Clamp / rubber rings / grease





77



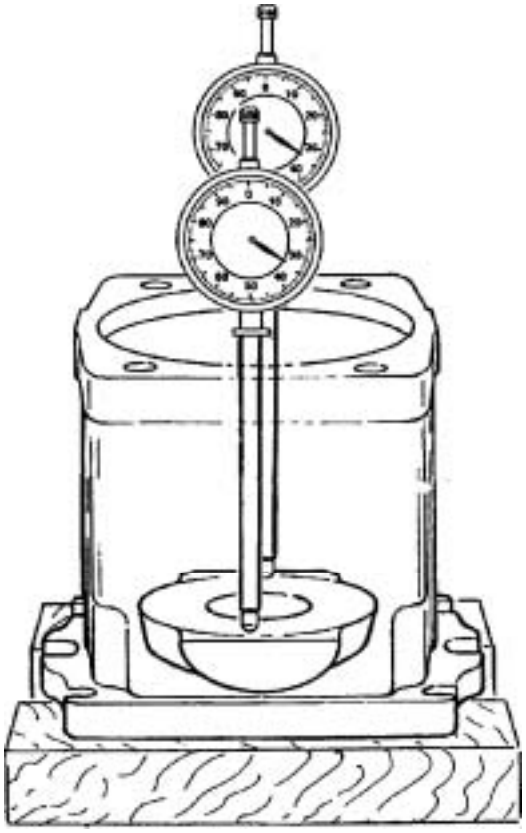
78

Inserire completamente il disco oscillante nel corpo.
Verificare che entri correttamente in sede.

⚠ Rimuovere l'attrezzo di montaggio.

Insert completely swivel cradle into the housing.
Pay attention for correct seat of the swivel cradle in the housing.

⚠ Remove auxiliary device.



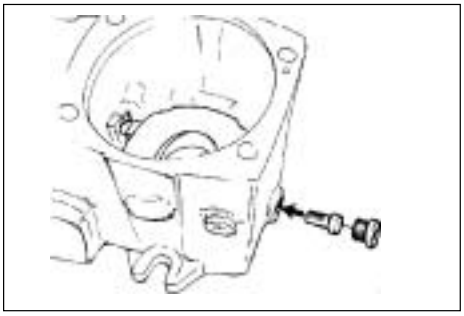
⚠ Controllare: la posizione del cuscinetto oscillante nella guida di scorrimento.

Provare a muovere la piastra oscillante utilizzando il pistone di regolazione e controllare che “si muova senza sforzi”.
Centrare con un dispositivo di misurazione (calibro a quadrante o misura profondità).
Verificare che i punti 1 e 2 abbiano la stessa dimensione.

⚠ Check: Location of the swivel bearing in the bearing.

Swivel the swashplate using the control piston “it should move easily”.
Centralise using a measuring device (dial gauge or depth measurement).
Check points 1 and 2 - they should have the same dimension.

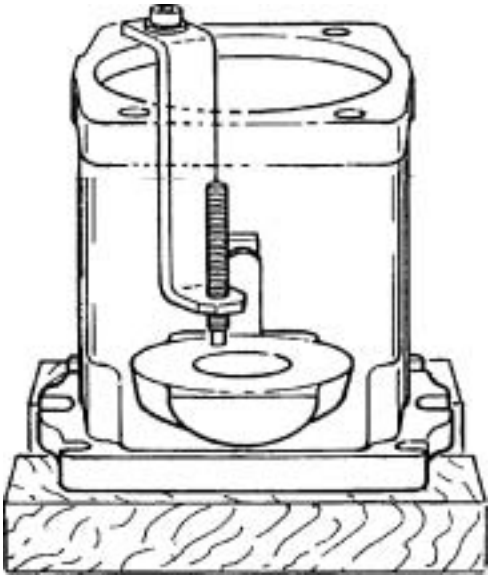
79



80

Inserire il perno snodato.

Fit joint pin.



Montare la staffa di fissaggio.
Tenere in posizione la piastra oscillante con una vite senza testa

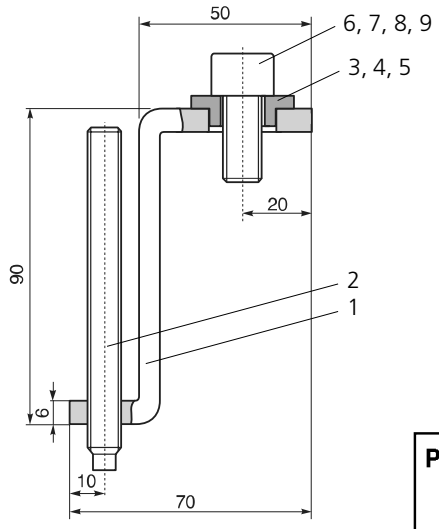
⚠ Non forzare!

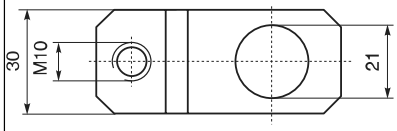
Fit holding device.
Hold swashplate in position using the set screw.

⚠ Do not use force.

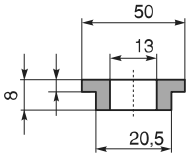
81

Dispositivo di fissaggio piastra oscillante A4V
Holding device “swivel cradle” A4V

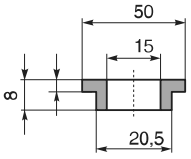




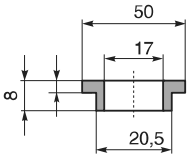
Parte/Part 3



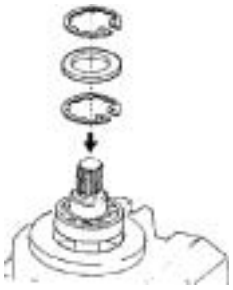
Parte/Part 4



Parte/Part 5



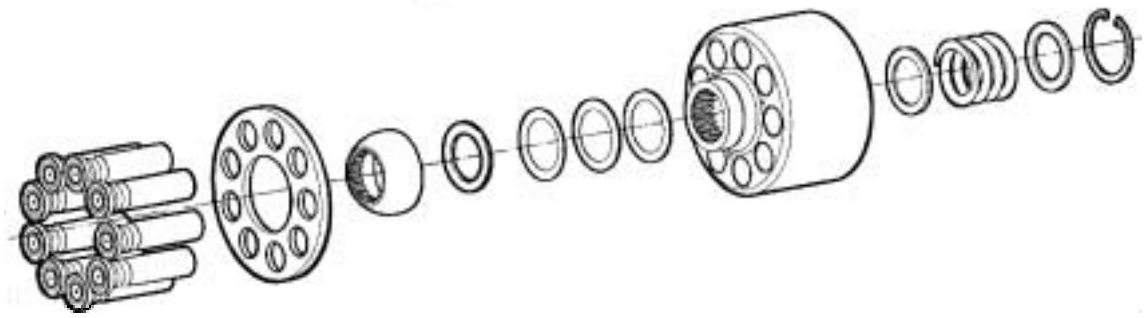
Pos./Item	Descrizione/Designation	Q.tà/Qty.
1	Staffa a L/Angle	2
2	Perno filettato/Threaded pin	2
3	Spessore/Shim	2
4	Spessore/Shim	2
5	Spessore/Shim	2
6	Vite cilindrica/Cyl. screw M12 x 25 DIN 912	2
7	Vite cilindrica/Cyl. screw M14 x 25 DIN 912	2
8	Vite cilindrica/Cyl. screw M16 x 30 DIN 912	2
9	Vite cilindrica/Cyl. screw M20 x 35 DIN 912	2



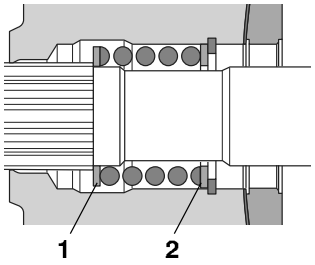
82

Nuova posizione di montaggio!
Assemblare l'albero motore con i cuscinetti e gli anelli di tenuta radiali.

New assembly position!
Assemble drive shaft with bearings and radial seal rings.



83



84

Disco 1, 2.

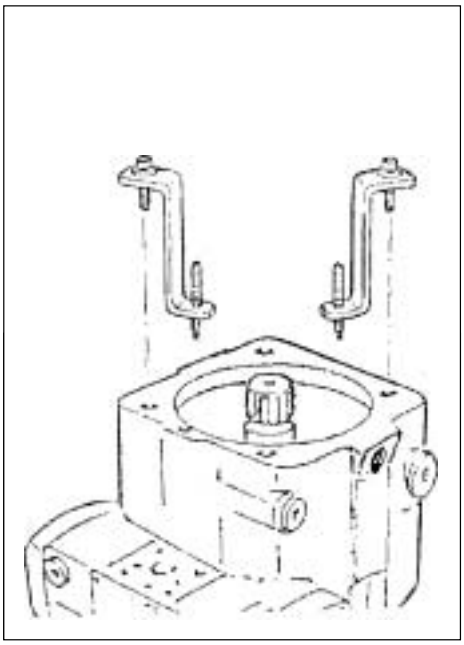
Disc 1, 2.



85

Montare il pistone con la piastra di tenuta.
Avvertenza:
Oliare il pistone e l'ammortizzatore del pistone.

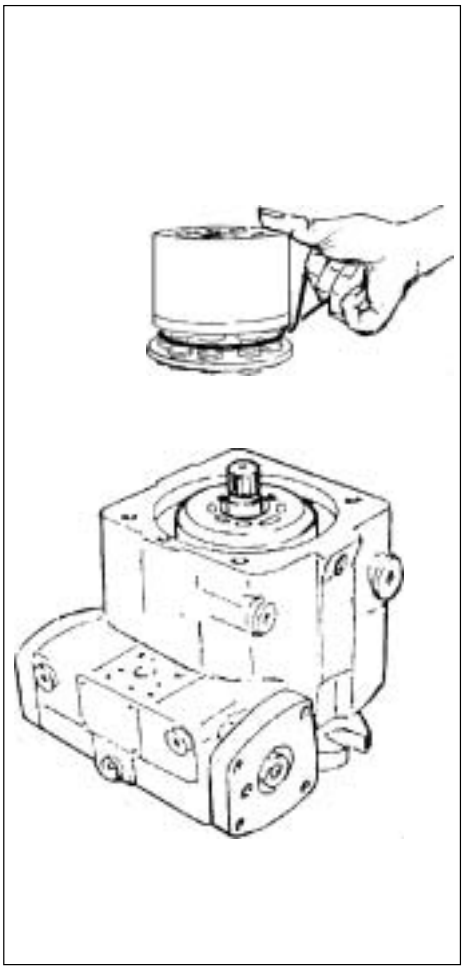
Assemble piston with retaining plate.
Note:
Oil piston and piston pad.



86

Smontare il dispositivo di fissaggio.
Inserire il cilindro completo di pistoni e dispositivo di tenuta.

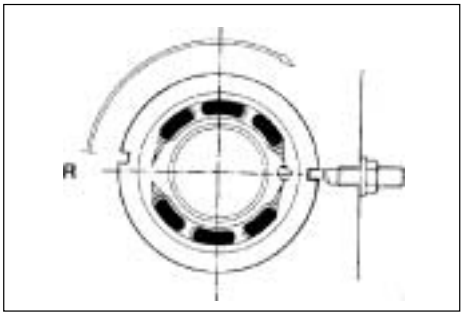
Remove holding device.
Fit cylinder complete with pistons and retaining device.



87

Nota utile per il montaggio:
Tenere i pistoni in posizione con un anello O-ring.

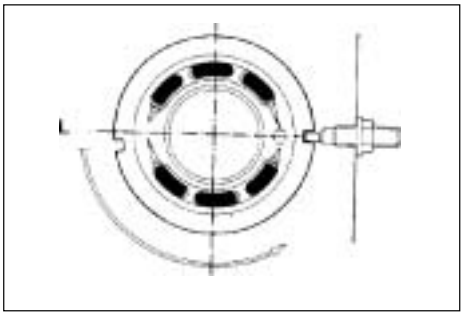
Assembly aid:
Hold the pistons in position using an O-ring.



89

Rotazione oraria piastra di controllo – avvitata nel senso di rotazione.
Nota! Le scanalature antirumore sono lavorate meccanicamente in base al senso di rotazione.

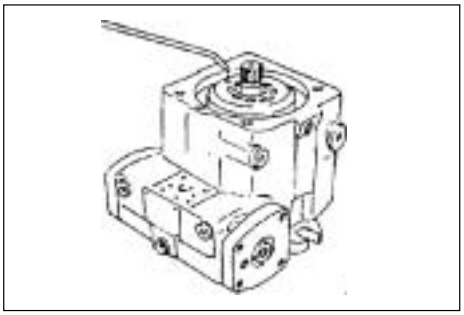
Control plate clockwise rotation - indexed in the direction of rotation.
Note! Noise grooves are machined depending on direction of rotation.



90

Rotazione antioraria piastra di controllo – avvitata nel senso di rotazione.
Nota! Le scanalature antirumore sono lavorate meccanicamente in base al senso di rotazione.

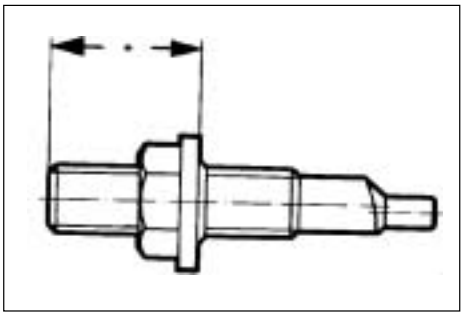
Control plate counter clockwise rotation - indexed in the direction of rotation.
Note! Noise grooves are machined depending on direction of rotation.



91

Oliare le superfici del cilindro e del cuscinetto DU. Ingrassare gli O-ring ed inserirli nelle scanalature.

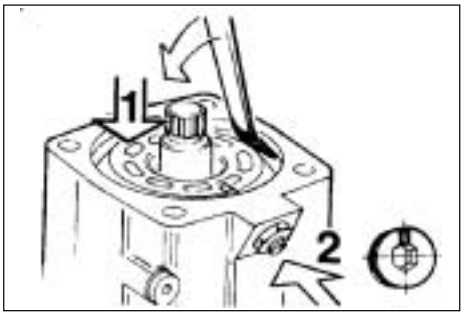
Oil the running surfaces of the cylinder barrel and the DU-bearing. Grease the O-rings and insert into grooves.



92

Regolazione di base vite graduata
A4VG...40 * = 24 ± 0,75 mm.
A4VG...56 * = 21 ± 0,75 mm.

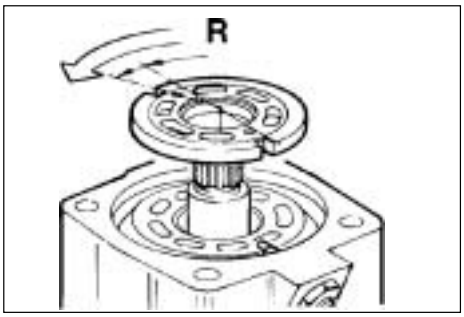
Basic setting - indexing screw
A4VG...40 * = 24 ± 0.75 mm.
A4VG...56 * = 21 ± 0.75 mm.



93

Spingere verso il basso il cilindro (1).
Montare la vite graduata (2).
Scanalatura in posizione di montaggio.

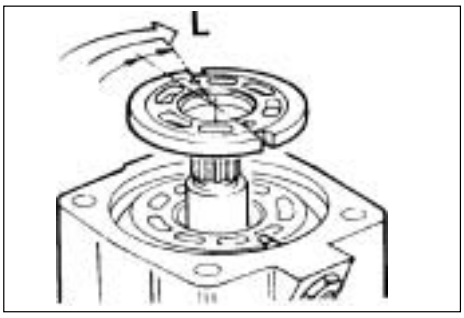
Press the cylinder to the bottom (1).
Screw in the indexing screw (2).
Groove in mounting position.



94

Inserire la piastra di comando - rotazione oraria.

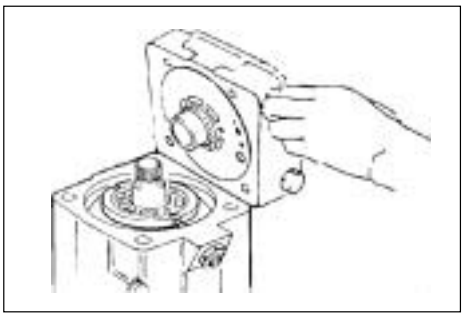
Insert the control plate - clockwise rotation.



95

Inserire la piastra di comando - rotazione antioraria.

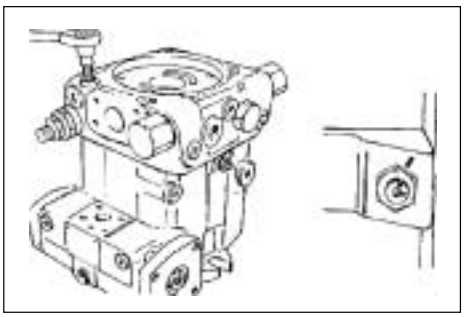
Insert the control plate - Counter-clockwise rotation.



96

Posizionare correttamente.
Nota:
HW, HD, EP - Applicare la piastra di comando sul blocco di chiusura previo ingrassaggio.

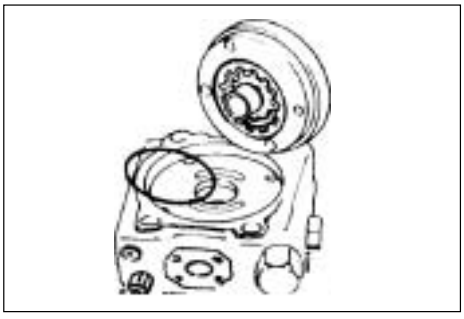
Place in correct position.
Note:
HW, HD, EP - Put control plate with grease to the port block.



97

Serrare le viti (a croce).
Portare la vite graduata sul segno tracciato in precedenza.

Tighten screws (cross-corner).
Turn the indexing screw to mark.



98

Montare la pompa ausiliaria.

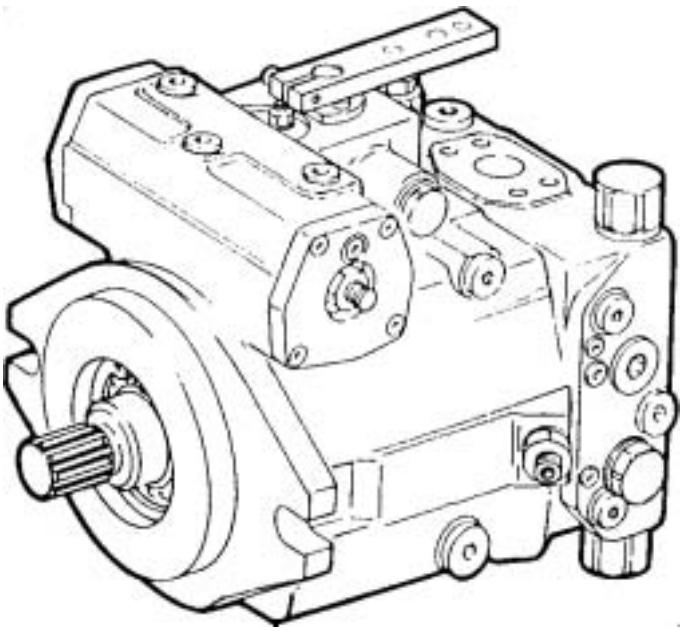
Assemble boost pump.



99

Montare il modulo di comando

Mount control module.



100

Coppie di serraggio per viti albero (filettatura metrica standard ISO)

I valori riportati nella tabella valgono unicamente per perni con filettature metriche ISO standard e per dimensioni delle superfici di supporto conformi alle richieste DIN 912, DIN 931 e DIN 933. Tali valori sono inoltre validi solo per superfici non trattate, non oliate o leggermente oliate e per uso di chiavi o limitatori con indicazione della coppia di serraggio.

Dimensione filettatura	Classi di resistenza 8.8	10.9	12.9
	Momento di serraggio (Nm)		
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 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 surfaces 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

Coppie di serraggio per viti di bloccaggio VSTI (filettatura metrica ISO a passo fine)

Dim. filettatura	Descrizione		Momento serraggio (Nm)
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 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

Coppie di serraggio per dadi seal-lock (filettatura metrica standard ISO)

I valori di coppia riportati nella tabella si applicano solo a dadi "seal-lock" con classe di resistenza 8,8 e filettatura metrica standard ISO.

Dimensioni filettatura	Classe di resistenza 8.8	10.9	12.9
	Momento di serraggio (Nm)		
M 6	10	-	-
M 8	22	-	-
M10	40	-	-
M12	69	-	-
M14	110	-	-
M16	170	-	-

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	-	-

Coppie di serraggio per viti con testa a croce DIN 7985 (filettatura metrica standard ISO)

I valori di coppia riportati nella tabella si applicano solo a viti DIN 7985 con classe di resistenza 8,8 e filettatura metrica standard ISO.

Dimensioni filettatura	Classe di resistenza 8.8	10.9	12.9
	Momento di serraggio (Nm)		
M 3	1,1	-	-
M 4	2,9	-	-
M 5	6	-	-
M 6	10	-	-
M 8	25	-	-
M10	49	-	-

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	-	-

Avvertenze generali

· Familiarizzare con i dispositivi della macchina.

· Utilizzare la macchina solo dopo aver completamente familiarizzato con gli elementi di comando e di controllo ed aver appreso il funzionamento della macchina.
· Utilizzare dispositivi di protezione personale (es. casco, scarpe di sicurezza e protettori per l'udito).
· Familiarizzare con l'ambiente di lavoro.
· Utilizzare la macchina solo per lo scopo previsto.

Rispettare le direttive dell'Associazione di categoria e le istruzioni del costruttore della macchina.

Prima di partire



· Leggere le istruzioni d'uso prima di iniziare il lavoro.
· Verificare che la macchina sia efficiente.
· Non utilizzare la macchina in caso di malfunzionamenti di strumenti, indicatori o elementi di comando.
· Verificare che tutti i dispositivi di sicurezza siano fissati in posizione.
· Non lasciare oggetti sparsi, fissarli in modo sicuro alla macchina.
· Tenere gli olli ed i materiali infiammabili lontano dalla macchina.
· Prima di entrare nella cabina di guida accertarsi che non vi siano persone o ostacoli accanto o sotto alla macchina.
· Prestare la massima attenzione salendo nella cabina di guida: utilizzare i gradini e le maniglie di accesso previsti.
· Regolare il sedile prima di avviare la macchina.

General advice

· Become familiar with the equipment of the machine.
· Only operate the machine if you are completely familiar with the operating and control elements as well as the functioning of the machine.
· Always wear personal protection equipment (e.g. helmet, safety shoes and hearing protection).
· Become 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



· Read and understand 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 leave loose objects scattered all around; secure them to the machine.
· Keep oily and flammable material away from the machine.
· Before entering the 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.

Avviamento

· Prima dell'avviamento verificare che tutte le leve di comando siano in posizione neutra.
· Avviare la macchina solo se seduti al posto di guida.
· Dopo l'avviamento verificare l'efficienza di tutti gli strumenti.
· Non lasciare la macchina incustodita con il motore in moto.
· In caso di avviamento con cavi ponte ausiliari collegare sempre polo positivo con polo positivo e polo negativo con polo negativo. Collegare per ultimo il cavo (-) negativo; scollegare per primo il cavo (-) negativo.

Attenzione

· I gas di scarico sono nocivi. Verificare che negli ambienti chiusi ci sia sufficiente ventilazione!

Impianto idraulico

1. L'impianto idraulico è da considerarsi sempre sotto pressione.

⚠ La fuoriuscita di fluidi ad alta pressione (carburante, olio idraulico) può penetrare la pelle e causare gravi ferite.
In caso di contatto consultare immediatamente un medico per evitare la formazione di serie infezioni.

2. Quando si ricercano eventuali perdite utilizzare sempre dispositivi adeguati per evitare qualsiasi incidente.
3. Prima di qualsiasi intervento sull'impianto idraulico, scaricare completamente la pressione ed abbassare a terra i bracci operativi della macchina.
4. In caso di interventi sull'impianto idraulico, arrestare il motore e bloccare la macchina per evitare qualsiasi movimento accidentale (freno di stazionamento, cunei).
5. Durante il collegamento di martinetti idraulici e motore prestare particolare attenzione all'esatto collegamento dei tubi idraulici.
6. Se i collegamenti vengono invertiti accidentalmente, le funzioni della macchina si invertiranno di conseguenza (es. sollevamento/discesa) con possibili rischi di incidente.
7. Verificare regolarmente i tubi idraulici e sostituirli in caso di danni o usura. I nuovi tubi devono soddisfare le specifiche tecniche del costruttore della macchina!

⚠ Smaltire gli olii, il carburante ed i filtri secondo le leggi in vigore!

Start

· When starting all operating levers must be in the "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 unattended when the engine 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 at high pressure.

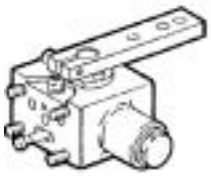
⚠ Fine jets of fluids (fuel, hydraulic oil) at high pressure can penetrate the skin and cause serious injuries.
If high pressure fluids penetrate your skin get medical help quickly to prevent the risk of a serious infection.

2. When ckecking for leaks use appropriate auxiliary devices to prevent accidents or injury.
3. Before any job on the hydraulic equipment, lower pressure to zero and lower the working arms of the machine to the ground.
4. Before any job on the hydraulic equipment, stop the engine and block the machine to prevent it from rolling off (parking brake, wheel chocks)!

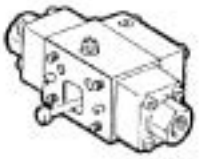
5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. If ports are reversed accidentally, functions are vice versa (f. ex. lift-up/lower) - danger of accidents!

7. Check hydraulic flexible hoses regularly and replace them in case of damage or wear! The new hose pipes must comply with the technical requirements of the machine manufacturer!

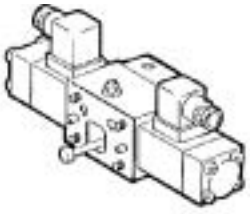
⚠ Orderly disposal or recycling of oil, fuel and filters!



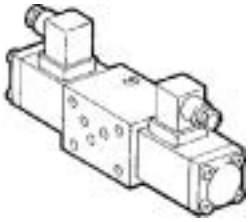
HW



HD

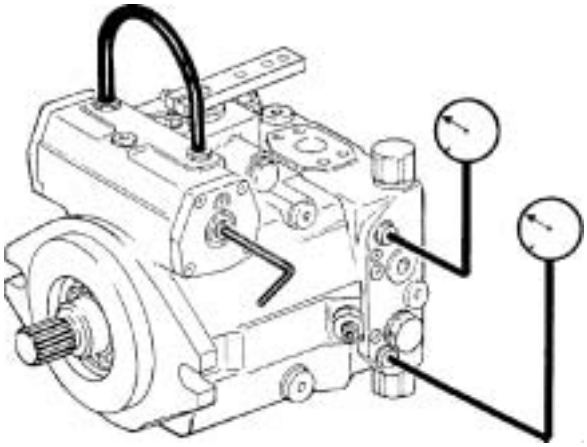


EP



DA

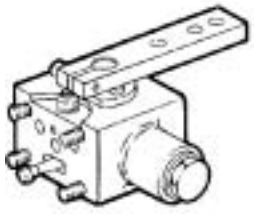
101



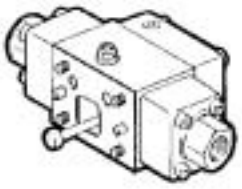
Attenzione!
Rispettare le avvertenze di sicurezza!
Collegare entrambe le camere di controllo con un tubo NW6.
Evitare segnali residui dallo zero idraulico.
Collegare i manometri a M_A e M_B.
Regolare lo zero in modo tale che con trasmissione bloccata i due manometri riportino lo stesso valore di pressione.
Nota: Regolare il punto morto della posizione zero.

Attention!
Observe safety precautions!
Connect both control chambers with hose NW6.
Avoidance of rest signals from hydraulic zero position.
Connect manometers to M_A and M_B.
Adjust zero position so that, at blocked drive, both manometers indicate the same pressure valve.
Note:
Adjust death line of zero position.

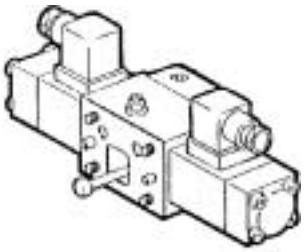
102



HW



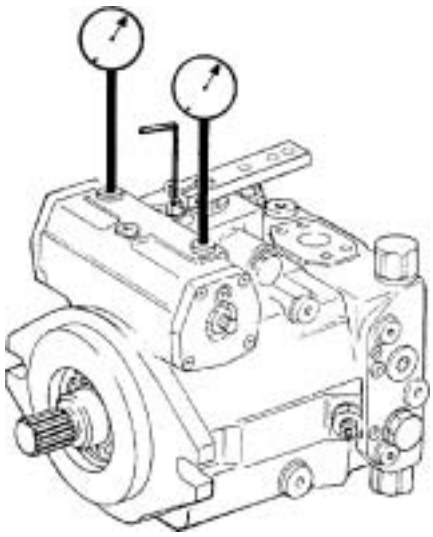
HD



EP

Attenzione!
Rispettare le avvertenze di sicurezza!

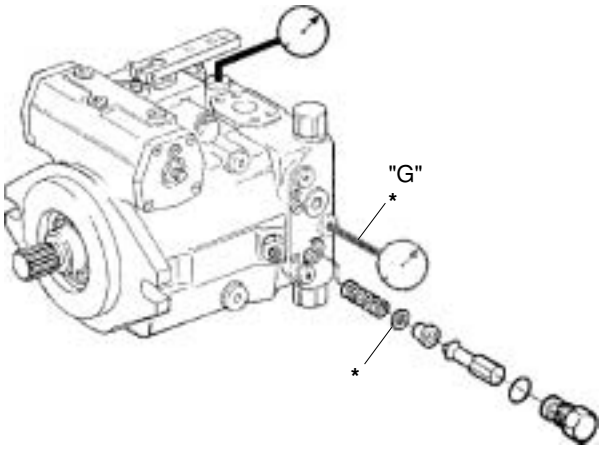
Attention!
Observe safety precautions! 103



Collegare i manometri a X_1 e X_2.
Regolare lo zero in modo tale che con trasmissione bloccata i due manometri indichino lo stesso valore di pressione.
Nota:
Regolazione eccentrica:
Non ruotare oltre ±90°.

Connect manometer to X_1 and X_2.
Adjust zero position so that, at blocked drive, both manometers indicate the same pressure value.
Note:
Eccentric adjusting
- Do not turn over ±90°.

104



105

Attenzione!
Rispettare le avvertenze di sicurezza!

Nota:
Ritarare solo alla temperatura operativa.

Collegare il manometro al punto “G”.

Attenzione:
* Regolazione pressione di alimentazione!
Pressione nominale p_H -18 bar
Pressione di picco p_H - 40 bar a regime massimo.

Nota:
Dati di regolazione in base ad ordine

* per esecuzione DA

Attention!
Observe safety precautions!

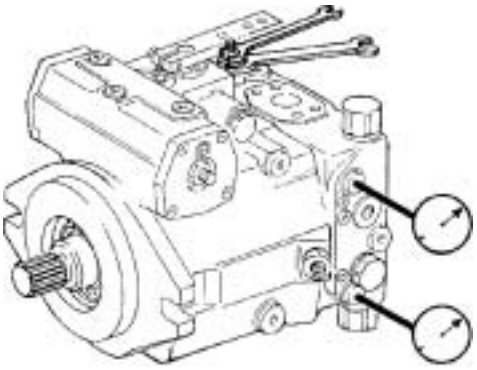
Note:
Readjust only at operating temperature.

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.

Taglio pressione
Pressure cut-off



106

Attenzione!
Rispettare le avvertenze di sicurezza!

Valvole HP senza by-pass

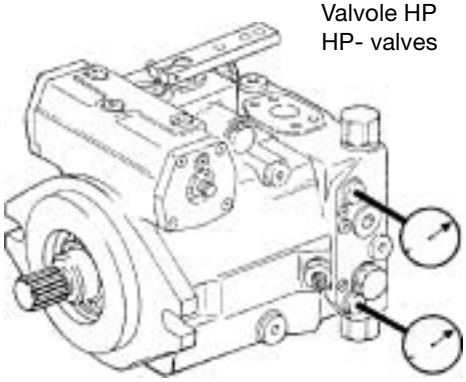
1. Le valvole ad alta pressione devono sempre essere regolate ad un valore superiore del 10% rispetto alla valvola di taglio.
   Se uno dei valori di regolazione cambia, verificare sempre entrambi i valori.
2. Ritarare solo alla temperatura operativa.

Collegare i manometri a M_A e M_B.
Taglio pressione: Prendere nota della misura X delle viti di regolazione! Girare le viti di regolazione nel blocco..

Valvole HP: Azionare le valvole ad una portata bassa. Verificare il valore di regolazione ("temperatura" solo per breve tempo).
Modificare il valore di regolazione e verificare.

Taglio pressione:
Riportare la vite di regolazione alla misura (*).
Verificare il valore di pressione e regolare nuovamente.
Attenzione! Mantenere una differenza del 10% tra valvole ad alta pressione e valvola di taglio!
Nota: Dati di regolazione in base ad ordine.

Valvole HP
HP- valves



107

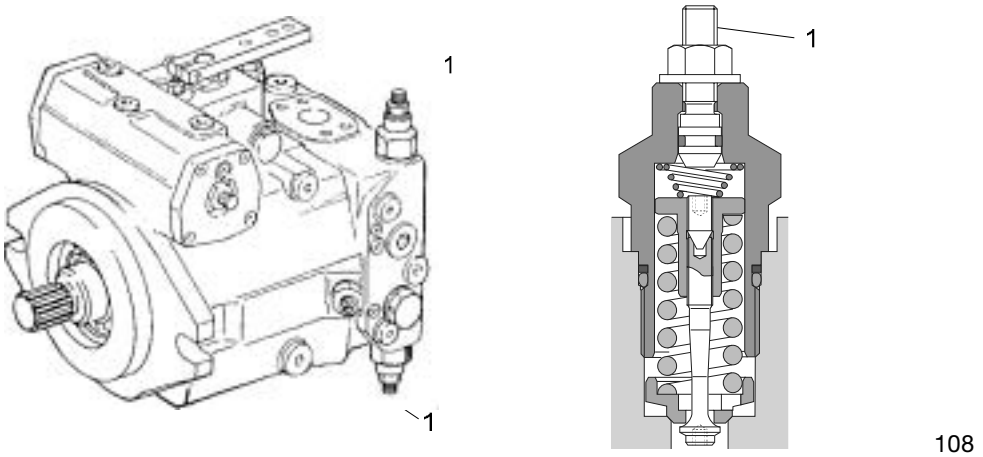
Attention!
Observe safety regulations.

HP valve without bypass function

1. HP valves are always adjusted 10% higher than pressure cut-off.
   If one setting value is changed, always check both values.
2. Readjust 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!



Veicoli con trasmissione idrostatica e cambio senza posizione di regolazione folle (ruote liberi)

Trasmissione idrostatica / Commutazione by-pass
In questo caso la trasmissione è commutata sulle ruote libere. Allo scopo la pompa a portata variabile incorpora valvole di massima con funzione di by-pass.
La vite (1) viene svitata fino allo sblocco della cartuccia della valvola e alla libera circolazione dell'olio.

⚠ By-pass: Avvitare (1) a livello con il dado. Riserrare il dado.

Velocità di traino
La velocità max. di traino non deve essere superiore a 2 km/h.
- Velocità di traino più elevate dipendono dal numero di giri del motore idraulico e dalla marcia innestata.

Distanza di traino
La distanza di traino non deve essere superiore ad 1 km.
- In caso di mancato afflusso d'olio, il circuito idraulico si svuoterà. Fare attenzione ad eventuali surriscaldamenti del gruppo motore idraulico / rotante.

Al termine delle operazioni di traino
Al termine delle operazioni di traino ruotare (1) alla posizione iniziale. Il settaggio di pressione originale delle valvole di massima sarà nuovamente disponibile.

⚠ Funzione valvola: Riavvitare (1) fino alla battuta. Serrare il dado.

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.

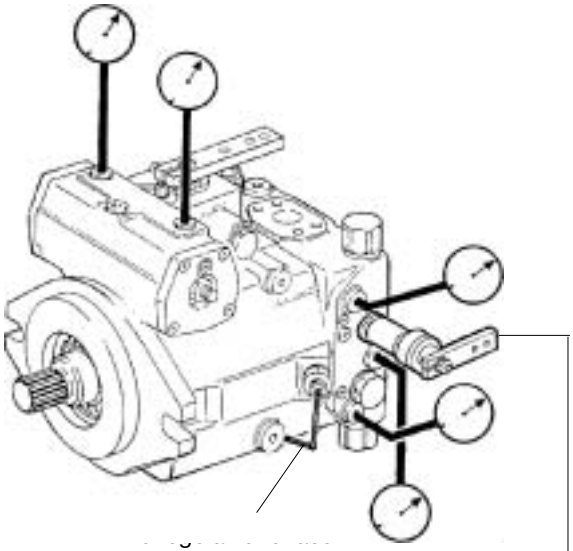
⚠ Bypass: Screw in item1 up to planeness with nut. Screw up nut again.

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.



109

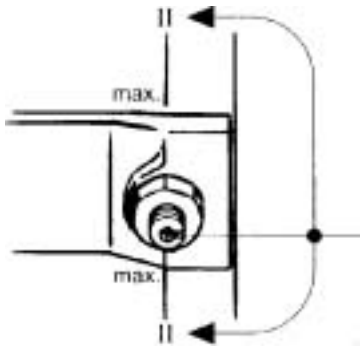
Attenzione!
Rispettare le avvertenze di sicurezza!

Verifica dei dati di regolazione
Durante l'operazione di controllo la temperatura deve essere mantenuta costante.
Avviare il motore di comando al minimo.

Posizione blocco
Selettore di direzione - **"0"**
Aumentare lentamente il regime del motore fino a raggiungere il regime max. e verificare sugli strumenti di misurazione.
Pressione di alimentazione:
Regime minimo:
Psp = ca. 15-20 bar
Regime massimo:
Psp = ... bar*

Posizione blocco
Selettore di direzione - **avanti**
(marcia da crociera e freno di stazionamento tirato)

Verificare i dati di regolazione della pompa A4V/DA
Inizio regolazione
HP 40-50 bar
Regime motore . min.[1] * Psp . . . . . bar*
HP . . . . . bar
Ritarare la vite di inizio regolazione

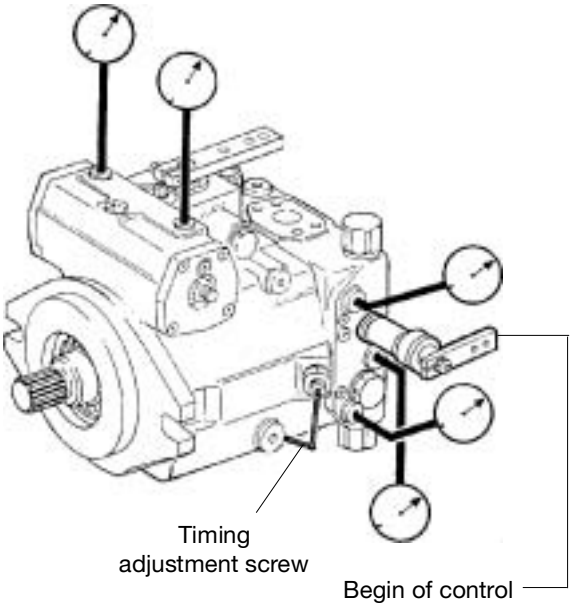


110

Fine regolazione
HP . . . . . bar*
Regime motore . min.[1] * Psp . . . . . bar*
Ritarare la vite di regolazione fase

Nota:
Regolazione eccentrica - rispettare il senso di rotazione.

Nota: *Dati di regolazione in base ad ordine.



111

Attention!
Observe safety precautions!

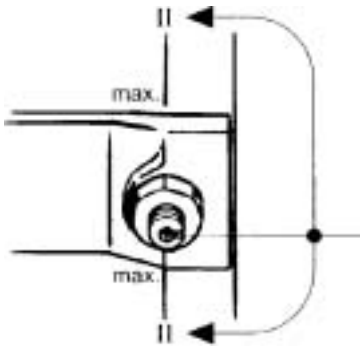
Check setting data.
Operating temperature should be kept largely constant during the check procedure.
Start prime mover, idle speed.

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



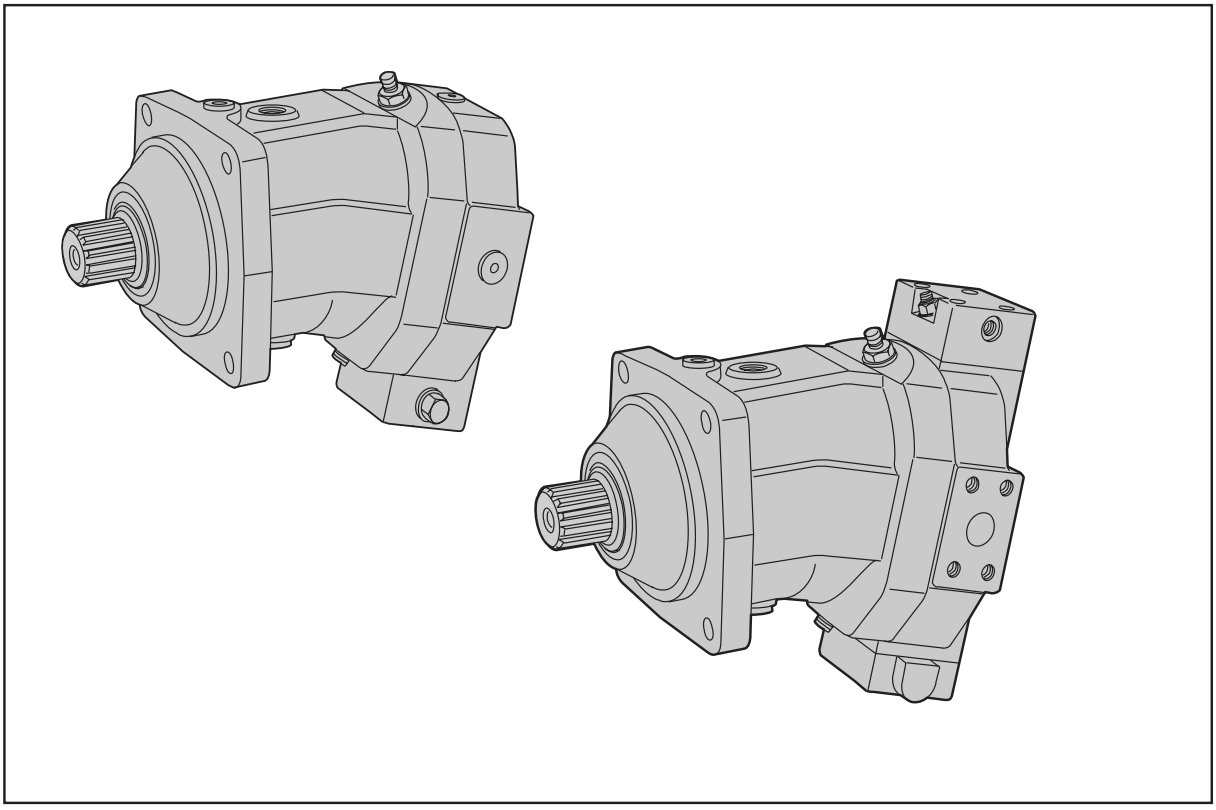
112

End of control
HD . . . . . bar
Motor speed . . . . . rpm* Psp . . . . . bar*
Readjust timing adjustment screw

Note:
Eccentric adjustment - observe direction of rotation

* Setting data according to order!

Section L
REPAIR INSTRUCTIONS
REXROTH MOTOR



Istruzioni di riparazione
Repair instructions
Mod. A6VM

Codice tipo A6V M _ _ / 6 3 W

Unità a pistoni assiali
Modello ad assi inclinati, a portata variabile — A6V

Azionamento
a motore — M

Dimensioni nominali
≙ Cilindrata $V_{g\,max}$ in cm³ — 28 55 80 107 140 160 200
Taglia 250 - 1000 vedi RE 91603

Dispositivo di regolazione e controllo					28	55	80	107	140	160	200	
Regolazione idraulica, dipendente da pressione pilota	HD	1			●	●	●	●	●	●	●	HD1
	HD		2		●	●	●	●	●	●	●	HD2
	HD	1		D	●	●	●	●	●	●	●	HD1D
	HD		2	D	●	●	●	●	●	●	●	HD2D
Regolazione idraulica a due punti	HZ1				●	-	-	-	●	●	●	HZ1
	HZ3				-	●	●	●	-	-	-	HZ2
Regolazione elettrica con solenoide proporzionale	EP	1			●	●	●	●	●	●	●	EP1
	EP		2		●	●	●	●	●	●	●	EP2
	EP	1		D	●	●	●	●	●	●	●	EP1D
	EP		2	D	●	●	●	●	●	●	●	EP2D
Regolazione elettrica a due punti con elettromagnete	EZ	1			●	-	-	-	●	●	●	EZ1
	EZ		2		●	-	-	-	●	●	●	EZ2
	EZ	3			-	●	●	●	-	-	-	EP3
	EZ		4		-	●	●	●	-	-	-	EP4
Regolazione automatica, dipendente da alta pressione	HA	1			●	❍	❍	❍	●	●	●	HA1
	HA		2		●	●	●	●	●	●	●	HA2
	HA	3			-	●	●	●	-	-	-	HA3
Regolazione idraulica, dipendente da regime												
p_{ST}/p_{HD}=5/100, valvola di direzione idraulica					●	●	●	●	●	●	●	DA1
valvola di direzione elettrica (12 V) + azionamento elettrico Q_{max} (12 V)					●	●	●	●	●	●	●	DA2
valvola di direzione elettrica (24 V) + azionamento elettrico Q_{max} (24 V)					●	●	●	●	●	●	●	DA3
p_{ST}/p_{HD}=8/100, valvola di direzione idraulica					●	●	●	●	●	●	●	DA4
valvola di direzione elettrica (12 V) + azionamento elettrico Q_{max} (12 V)					●	●	●	●	●	●	●	DA5
valvola di direzione elettrica (24 V) + azionamento elettrico Q_{max} (24 V)					●	●	●	●	●	●	●	DA6

Aumento pressione pilota Δ p = 10 bar
Aumento pressione pilota Δ p = 25 bar
con regolazione pressione

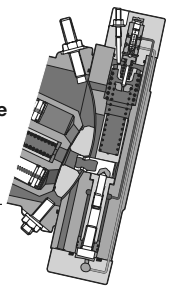
Tensione di alimentazione 12 V
Tensione di alimentazione 24 V
con regolazione pressione

Tensione di alimentazione 12 V
Tensione di alimentazione 24 V

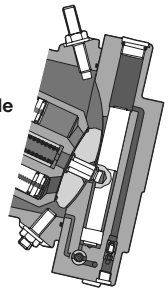
Modello senza aumento di pressione
Modello con aumento di pressione Δ p = 100 bar

Sovraeccitazione	HA1	HA2	HA3	
senza sovraeccitazione (nessun contrassegno)	●	●	●	
sovraeccitazione idraulica	●	●	●	T
sovraeccitazione elettrica, 12 V	●	●	●	U1
sovraeccitazione elettrica, 24 V	●	●	●	U2
sovraeccitazione el. + valvola el. dir. marcia, 12 V	❍	❍	-	R1
sovraeccitazione el. + valvola el. dir. marcia, 24 V	❍	❍	-	R2

Pistone di sincronizzazione



Pistone differenziale



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	
Hydraulic control, pilot pressure related	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

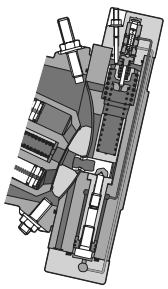
Control voltage 12 V
Control voltage 24 V
with constant pressure control

Control voltage 12 V
Control voltage 24 V

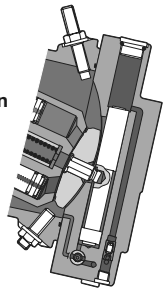
Model without pressure increase
Model with pressure increase Δ p = 100 bar

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



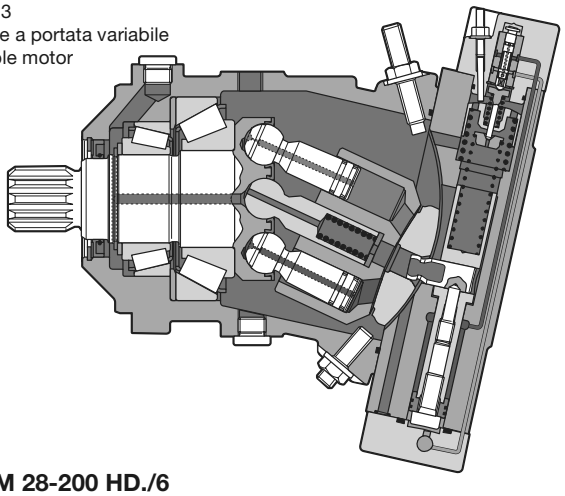
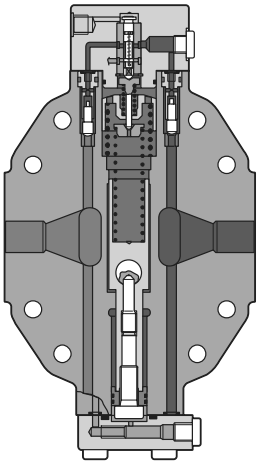
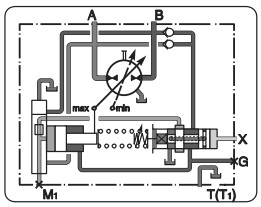
AVVERTENZA

Specifiche, descrizioni e materiale illustrativo del presente documento corrispondono alle caratteristiche tecniche in vigore al momento della stampa.
La BRUENINGHAUS HYDROMATIK si riserva il diritto di interrompere la produzione di modelli e optional in qualsiasi momento e di apportare modifiche alle caratteristiche tecniche, ai materiali o alla progettazione in qualsiasi momento e senza alcun preavviso.
Attrezzature opzionali ed accessori possono comportare un aumento del prezzo base ed alcune opzioni possono essere disponibili solo in combinazione con alcuni modelli o altre opzioni.
Per le combinazioni disponibili fare riferimento al foglio dati dell'unità base e dell'opzione richiesta.
Eventuali regolazioni e prove devono essere effettuate sul banco prova alle temperature operative.
Prendere tutte le misure necessarie per evitare danni a persone e cose.
La necessaria esperienza, condizione indispensabile per qualsiasi riparazione, può essere acquisita seguendo i corsi di addestramento da noi organizzati.

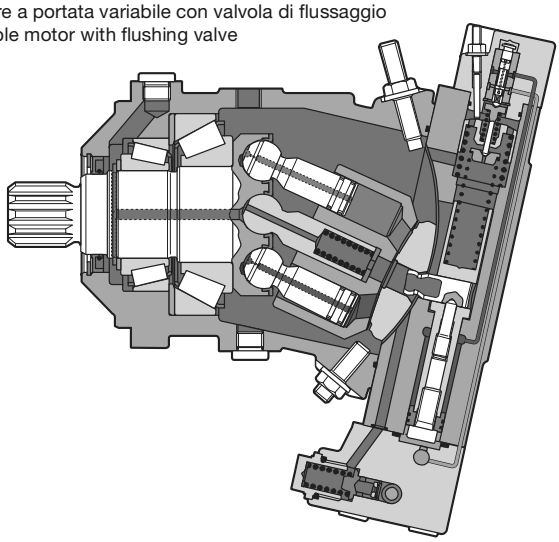
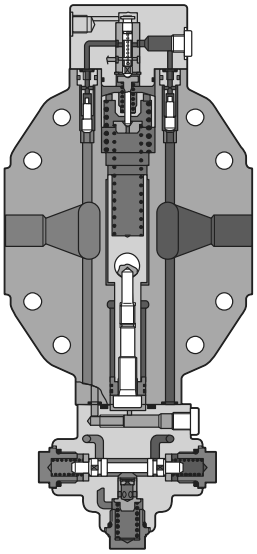
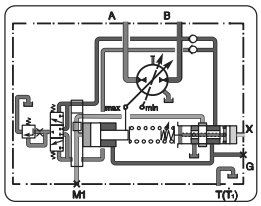
NOTICE

Specifications, descriptions and illustrative material shown herein are 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 any 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.

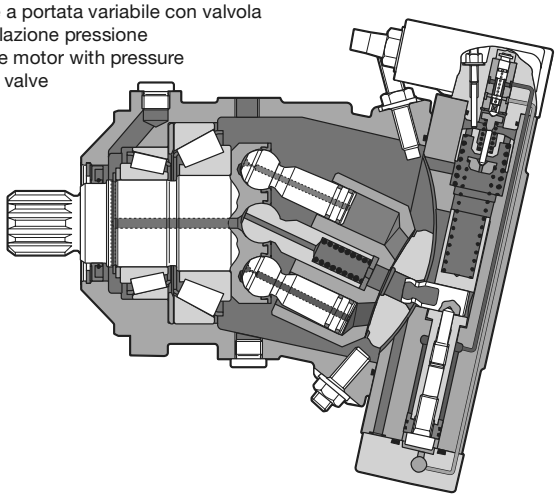
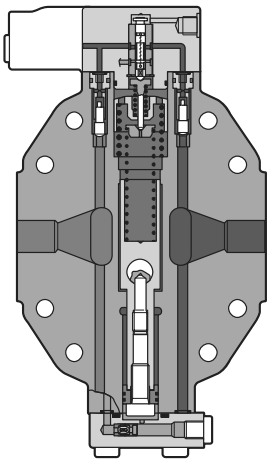
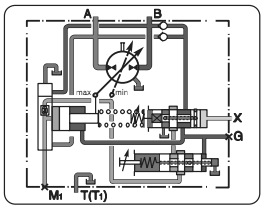
A6VM 28-200 HD./6
Index 3
Motore a portata variabile
Variable motor

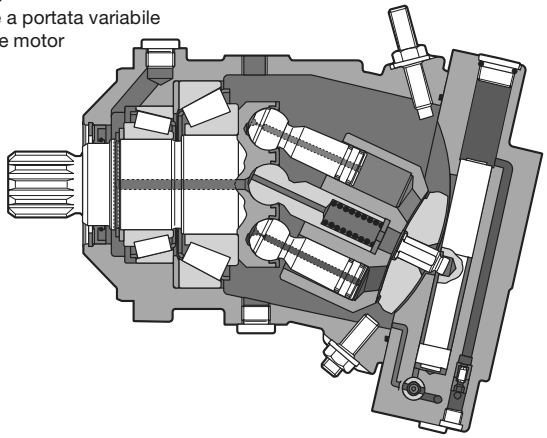
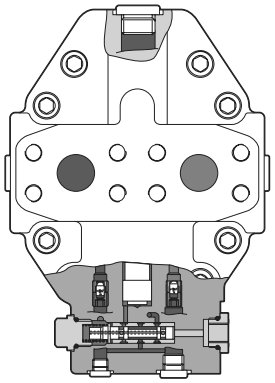
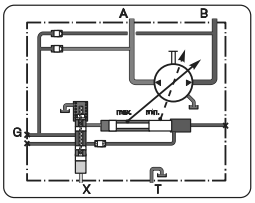
A6VM 28-200 HD./6
Index 3
Motore a portata variabile con valvola di flussaggio
Variable motor with flushing valve

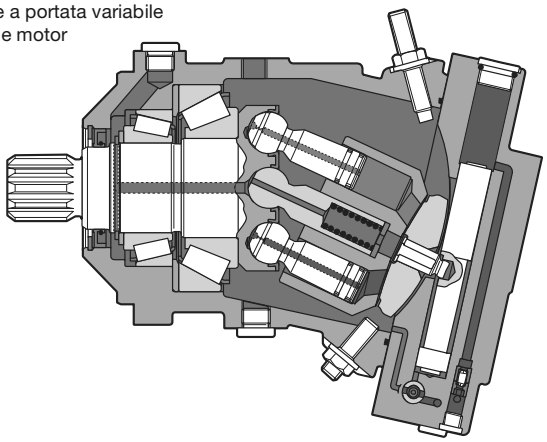
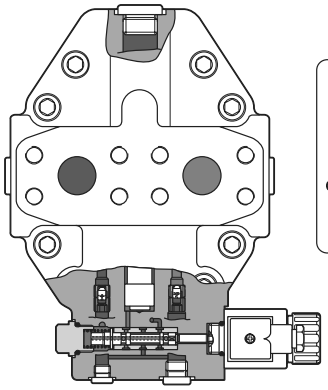
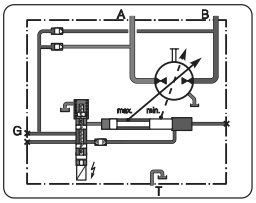
A6VM 28-200 HD1D/6
Index 3
Motore a portata variabile con valvola di regolazione pressione
Variable motor with pressure control valve

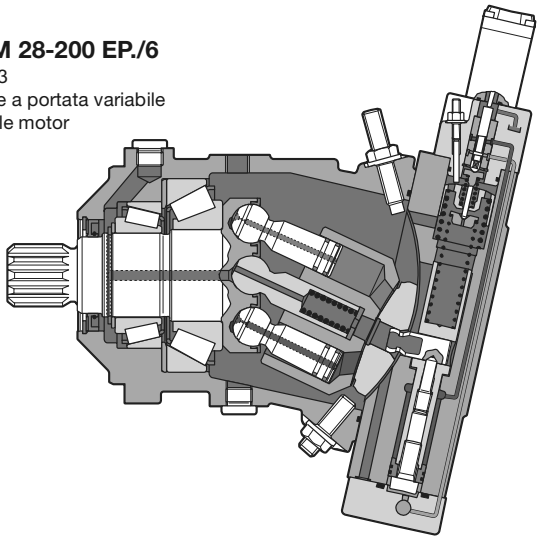
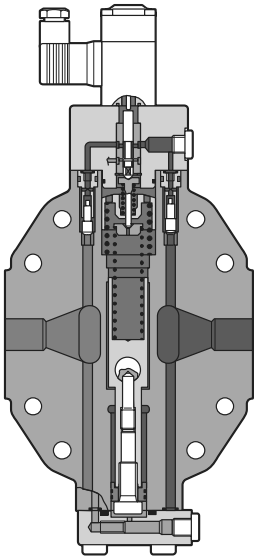
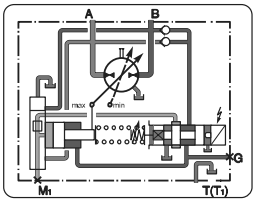
A6VM 55-107 HZ3/6
Index 3
Motore a portata variabile
Variable motor

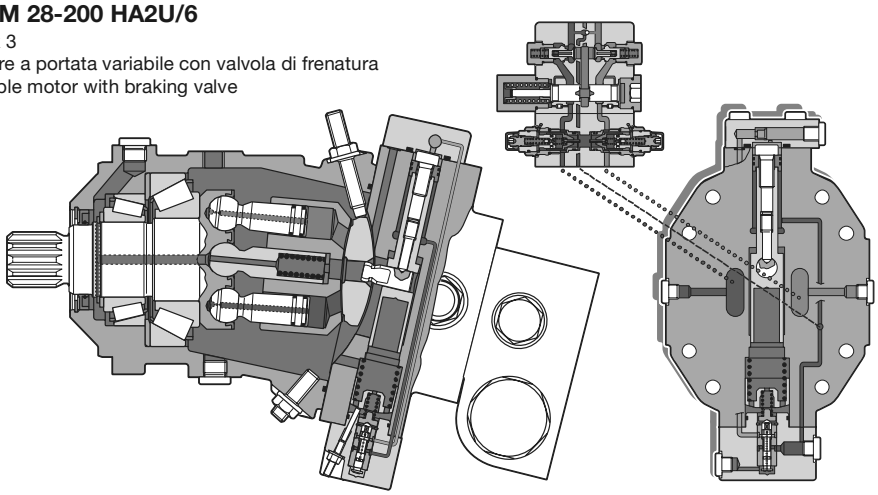
A6VM 55-107 EZ3/6
Index 3
Motore a portata variabile
Variable motor

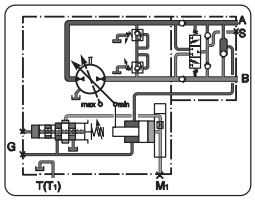




A6VM 28-200 EP./6
Index 3
Motore a portata variabile
Variable motor

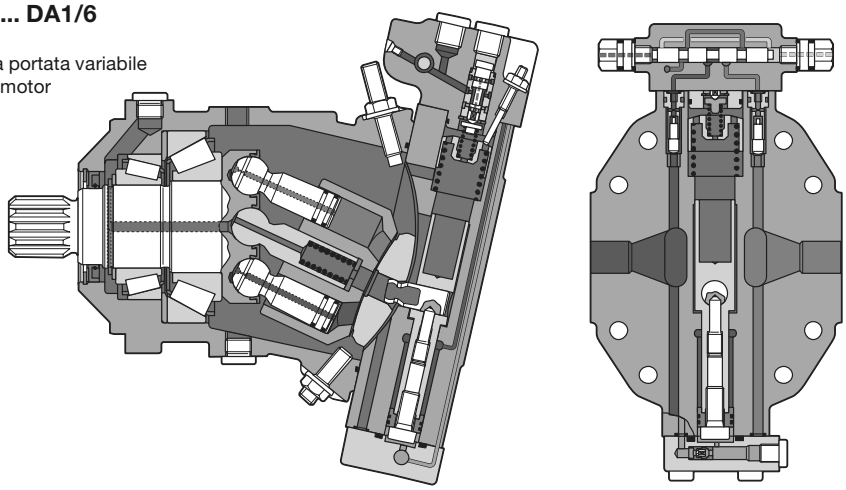




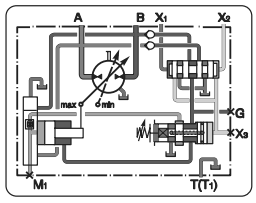
A6VM 28-200 HA2U/6
Index 3
Motore a portata variabile con valvola di frenatura
Variable motor with braking valve



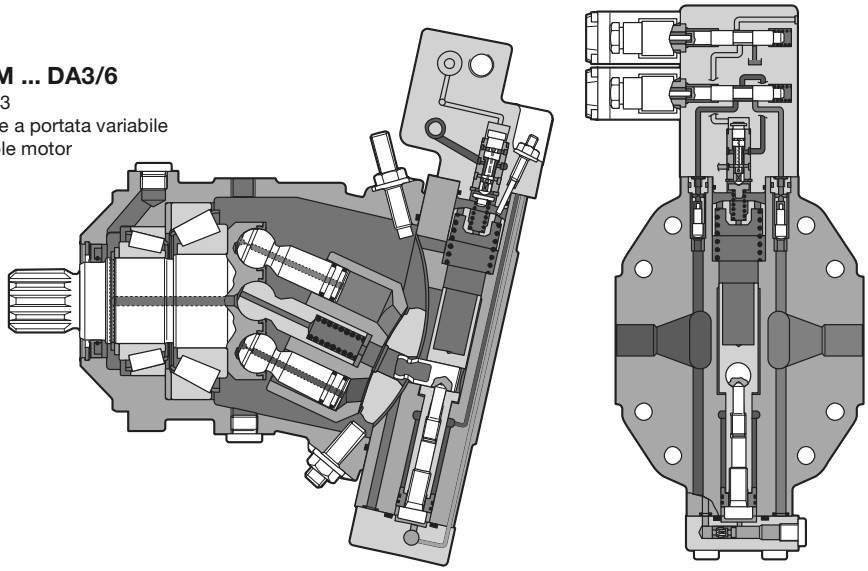


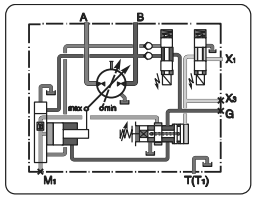
A6VM ... DA1/6
Index 3
Motore a portata variabile
Variable motor





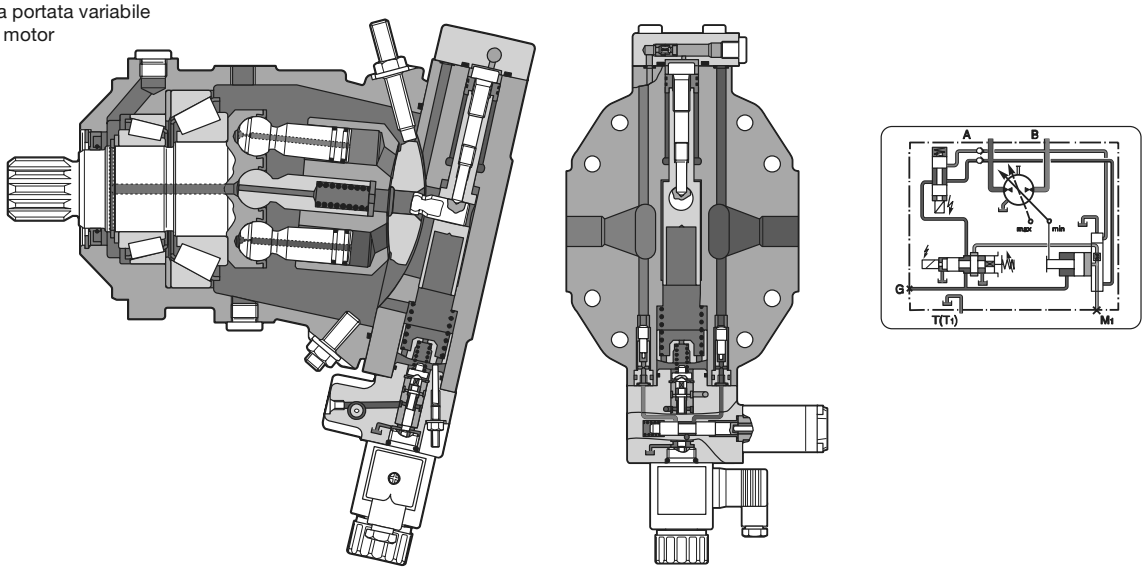
A6VM ... DA3/6
Index 3
Motore a portata variabile
Variable motor





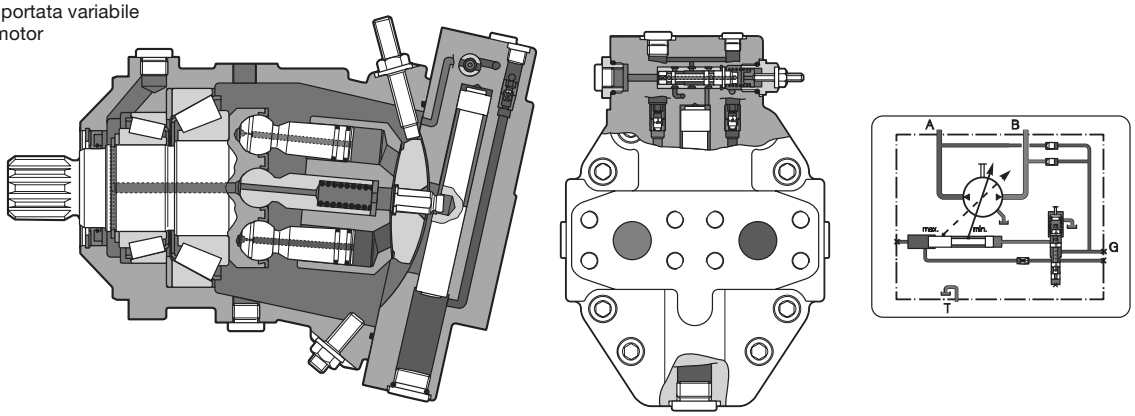
A6VM 28-200 HA2R/6

Index 3
Motore a portata variabile
Variable motor



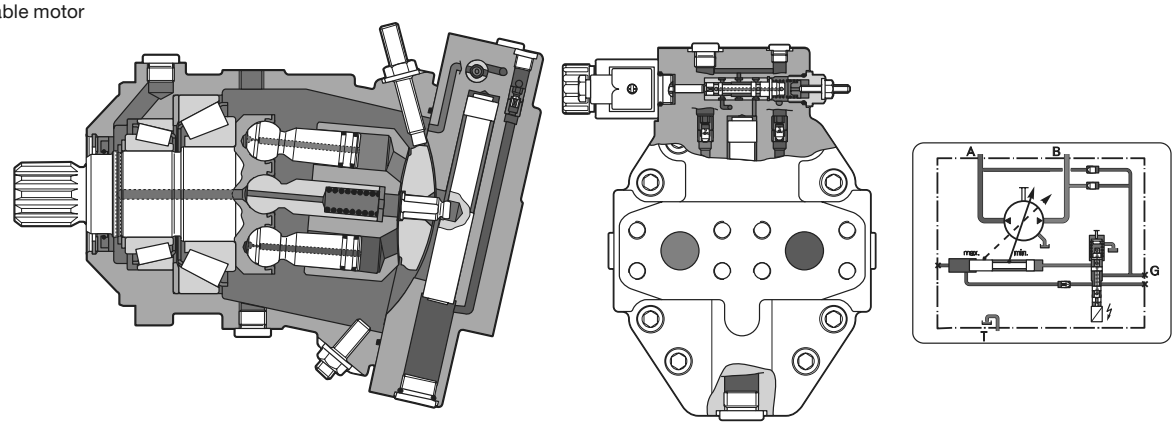
A6VM 55-107 HA3U/6

Index 3
Motore a portata variabile
Variable motor



A6VM 55-107 HA3/6

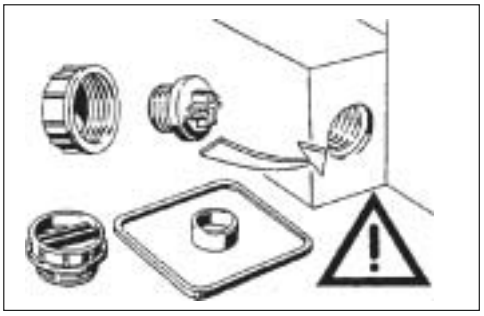
Index 3
Motore a portata variabile
Variable motor





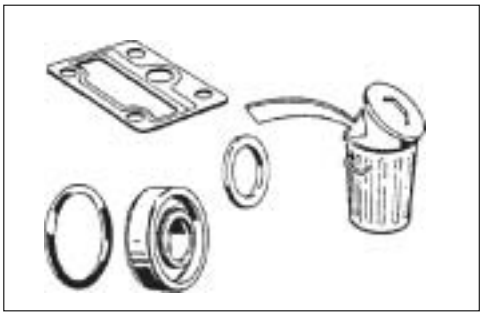
Attenzione!
Rispettare le seguenti avvertenze per qualsiasi riparazione sui gruppi idraulici.

Attention!
Observe the following notices when carrying out repair work at hydraulic aggregates!



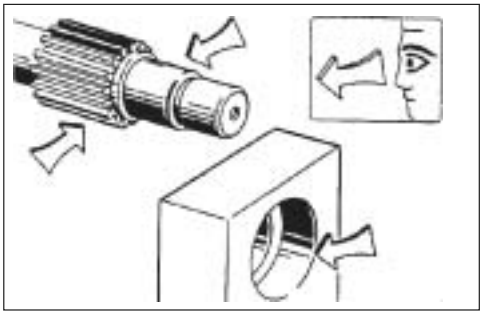
Chiudere tutte le aperture dei gruppi idraulici.

Close all ports of the hydraulic aggregates.



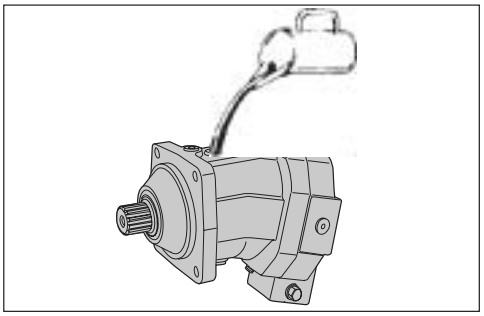
Sostituire tutte le guarnizioni.
Utilizzare unicamente parti di ricambio originali HYDROMATIK.

Replace all seals.
Use only original HYDROMATIK spare parts.



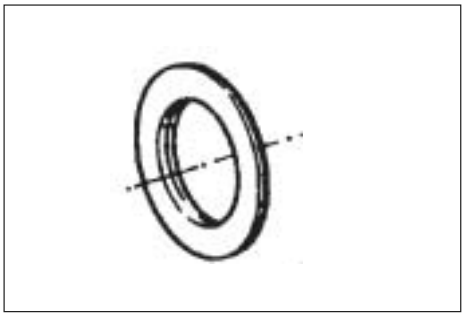
Verificare il grado di usura di tutte le superfici di tenuta e scorrimento.
Attenzione: la riparazione delle superfici di tenuta utilizzando ad es. carta abrasiva può causare danni alla superficie.

Check all seal and sliding surfaces for wear.
Attention: Rework of sealing area, f. ex. with abrasive paper, can damage surface.



Riempire i gruppi idraulici prima della messa in funzione.

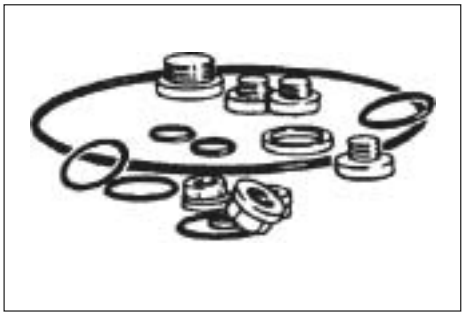
Fill up hydraulic aggregates with medium before start-up.



1

Tenuta albero motore.

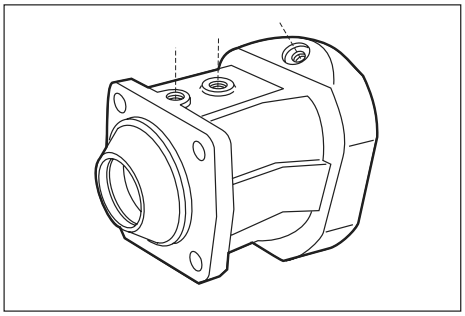
Seal kit for drive shaft.



2

Tenuta esterna.

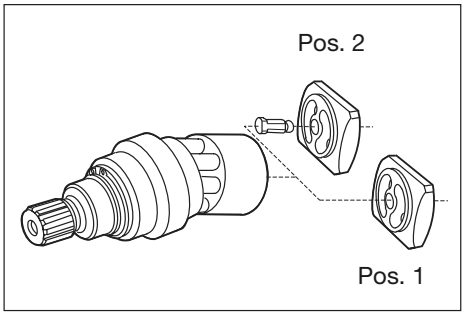
External seal kit.



3

Corpo.

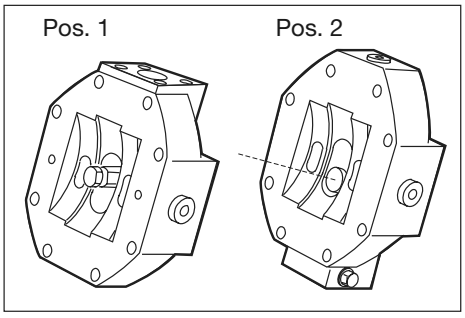
Housing.



4

Gruppo rotante completo
Nota:
Pos. 1 - piastra di raccordo con pistone differenziale
Pos. 2 - piastra di raccordo con pistone di sincronizzazione

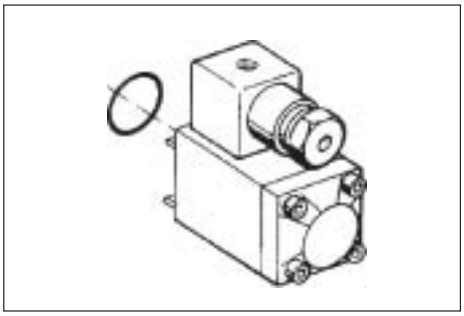
Complete rotary group
Note:
Pos. 1 - For port plate with differential piston
Pos. 2 - For port plate with synchronizing piston



5

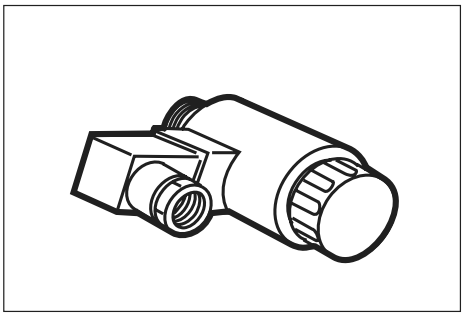
Piastra di raccordo a pistone di regolazione
Nota:
Pos. 1 - piastra di raccordo con pistone differenziale
Pos. 2 - piastra di raccordo con pistone di sincronizzazione

Port plate with control piston
Note:
Pos. 1 - For port plate with differential piston
Pos. 2 - For port plate with synchronizing piston



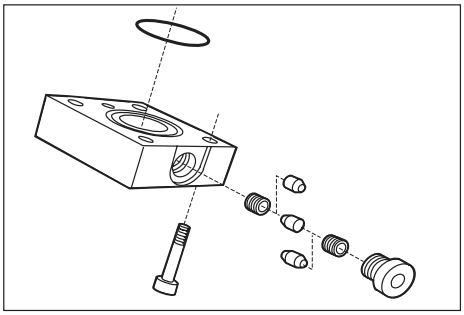
6 Solenoide proporzionale (EP).

Proportional solenoid (EP).



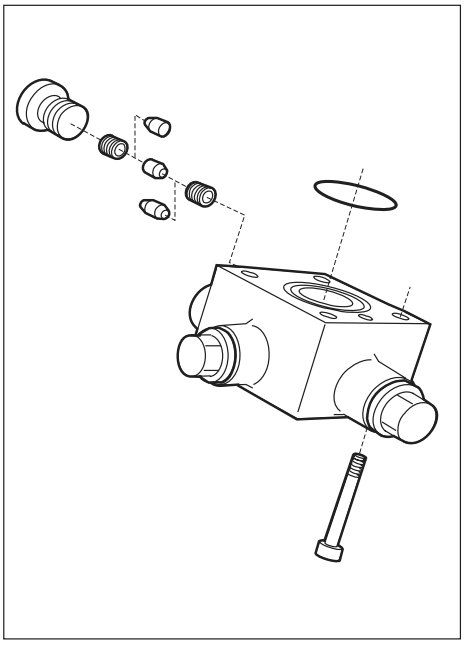
7 Solenoide.

Solenoid.



8 Coperchio con * perno di regolazione .
* Perno di regolazione “come da ordine”

Cover with * throttle pin.
* Throttle pin “as to order requirement”.



9 Coperchio con valvola di flussaggio e valvola pressione di alimentazione e * perno di regolazione
* * Perno di regolazione “come da ordine”.

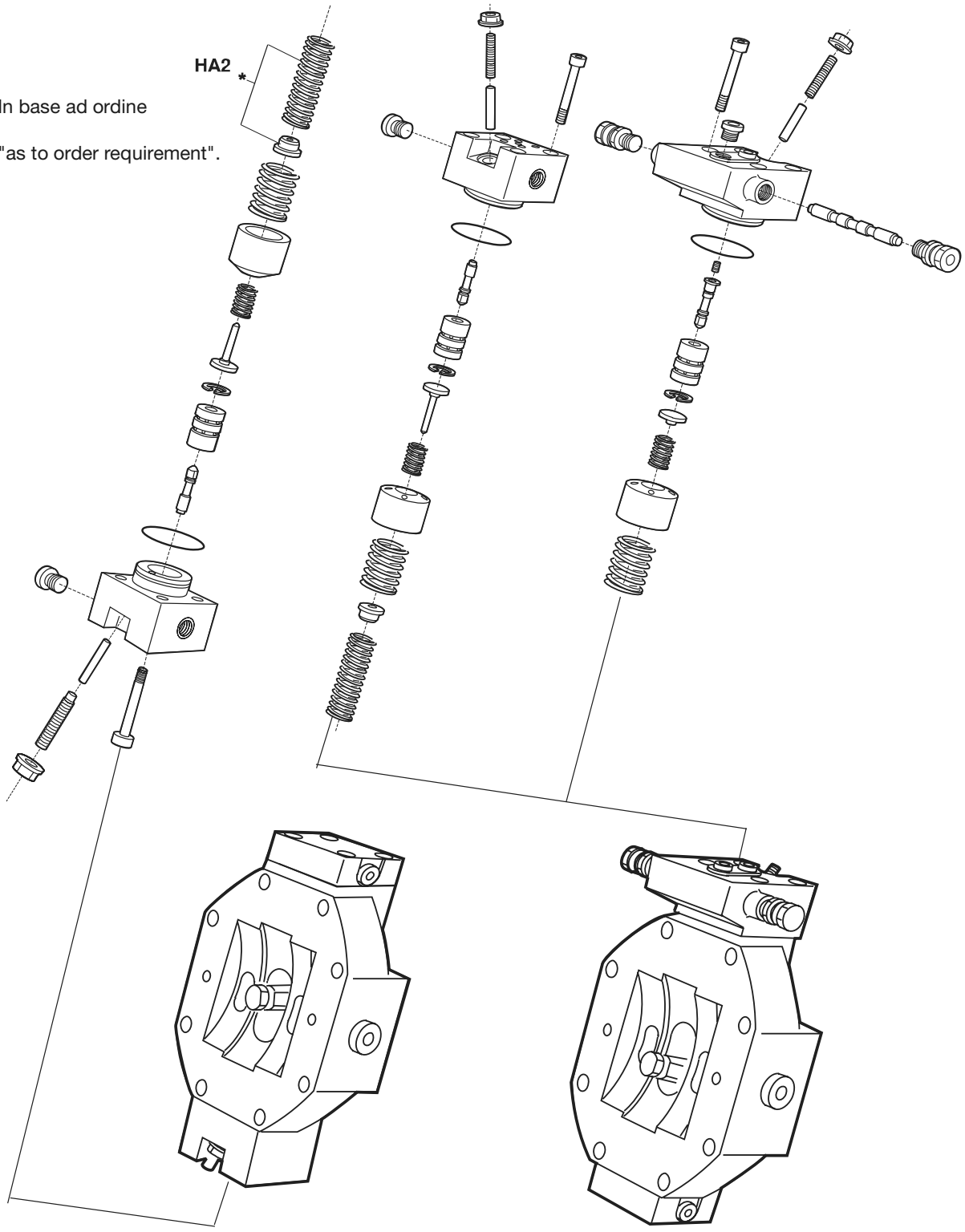
Cover with flushing and boost pressure valve and
* throttle pin.
* Throttle pin “as to order requirement”.

z. B. **HA** **HD** **DA**

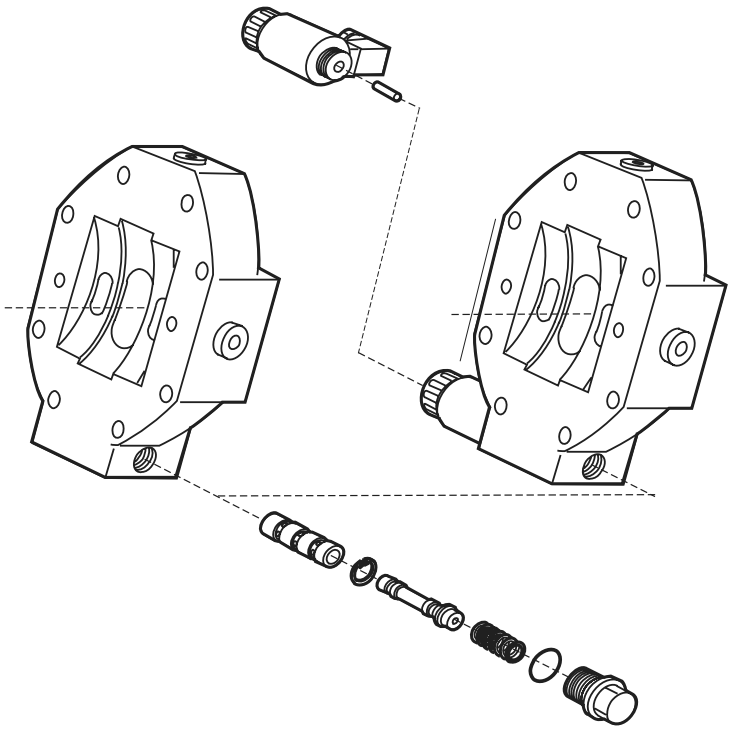
HA2 *

In base ad ordine

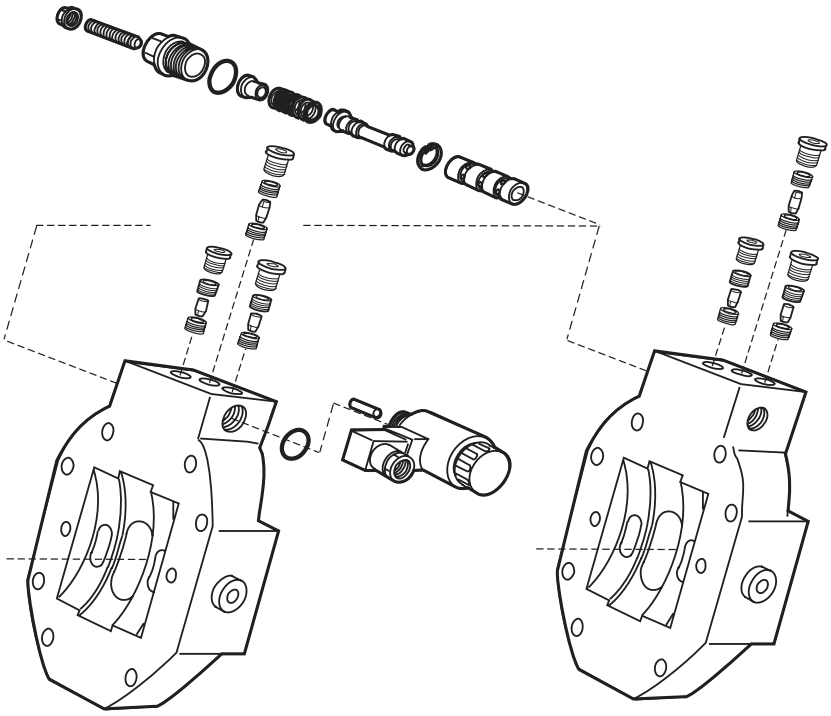
"as to order requirement".

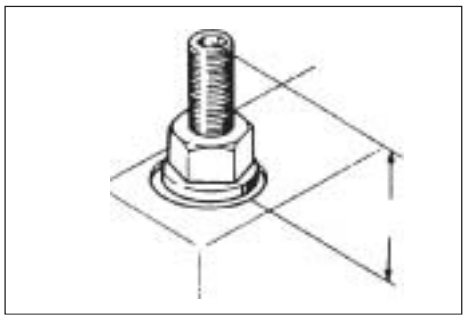


z. B. **HZ3** / **EZ3**



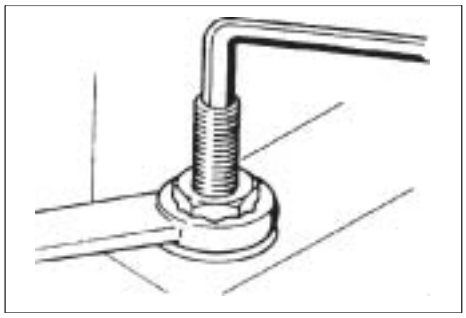
HA3 / **HA3U**





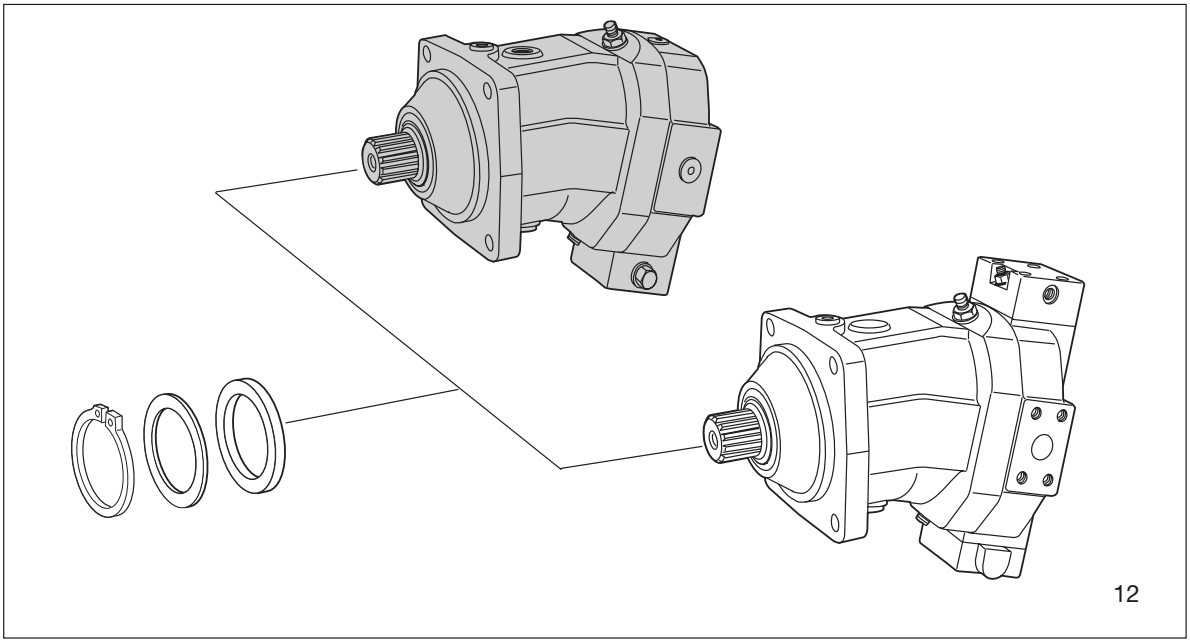
10 Sostituire il dado di tenuta dopo aver determinato ed annotato l'altezza di regolazione..

Replace seal nut.
First measure and record setting height.

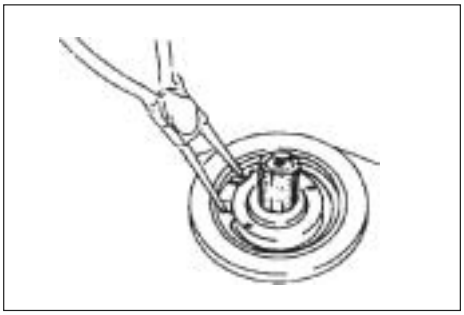


11 Durante il serraggio, mantenere bloccata la vite di regolazione, quindi verificare l'altezza di regolazione.

When tightening, counterhold setting screw, then check setting height.



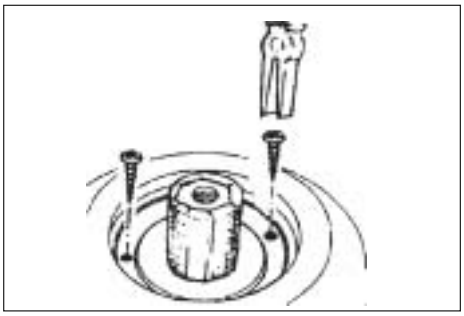
12



13

Proteggere l'albero motore.
Rimuovere l'anello di fissaggio e lo spessore.

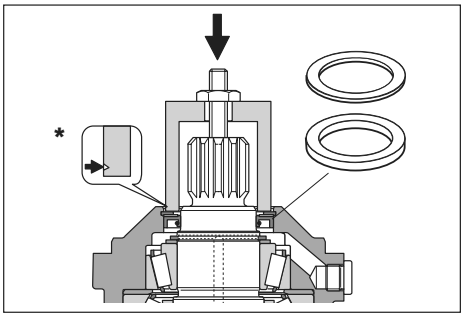
Protect the drive shaft.
Remove retaining ring and shim.



14

Inserire le viti in lamiera nei fori con gomma.
Estrarre la tenuta dell'albero con un paio di pinzette..

Screw in sheet metal screw into the holes fitted with rubber.
Pull out seal with pliers.



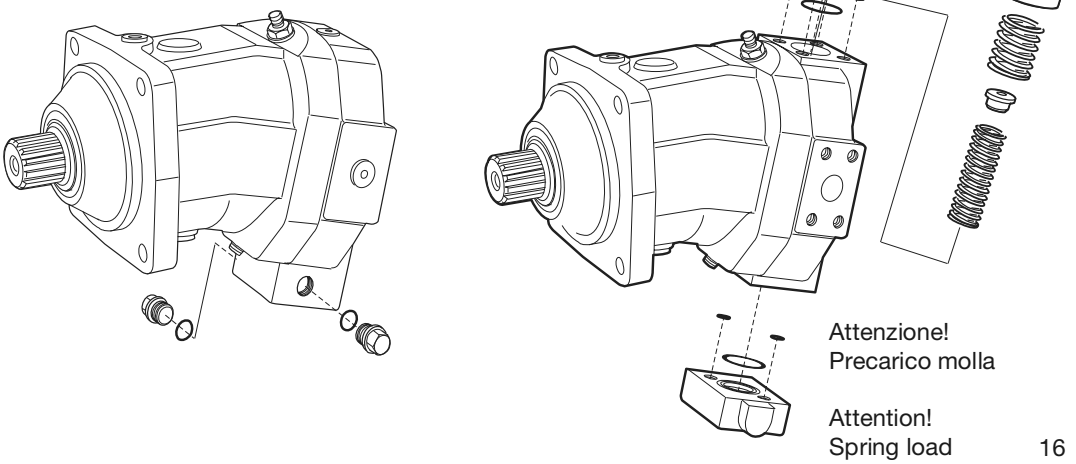
15

Inserire a pressione l'anello di tenuta con spessore e con boccola fino a battuta.

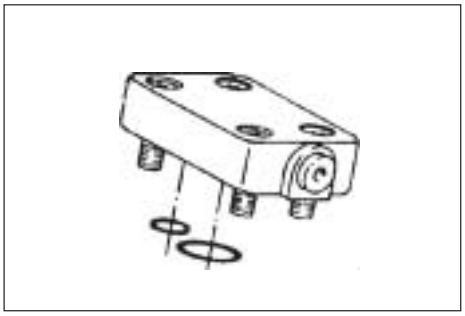
⚠ Annotare la profondità di inserimento! * Marcare la profondità di inserimento dell'anello di sicurezza.

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.



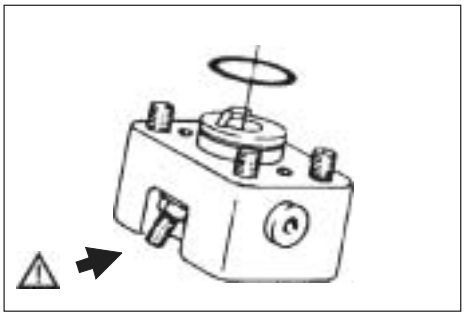
16



17

Controllare le forature nel corpo, l'O-ring e la scanalatura.

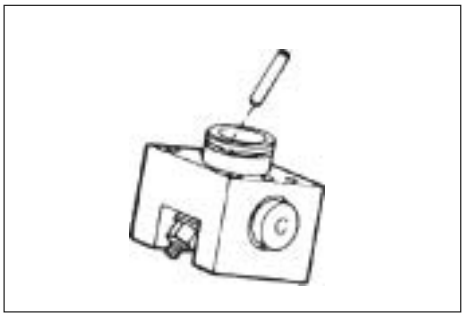
Inspect:
Drilling in housing, O-ring, groove.



18

⚠ Non rimuovere la vite di regolazione..
Verificare:
O-ring, dado O-ring e corpo.

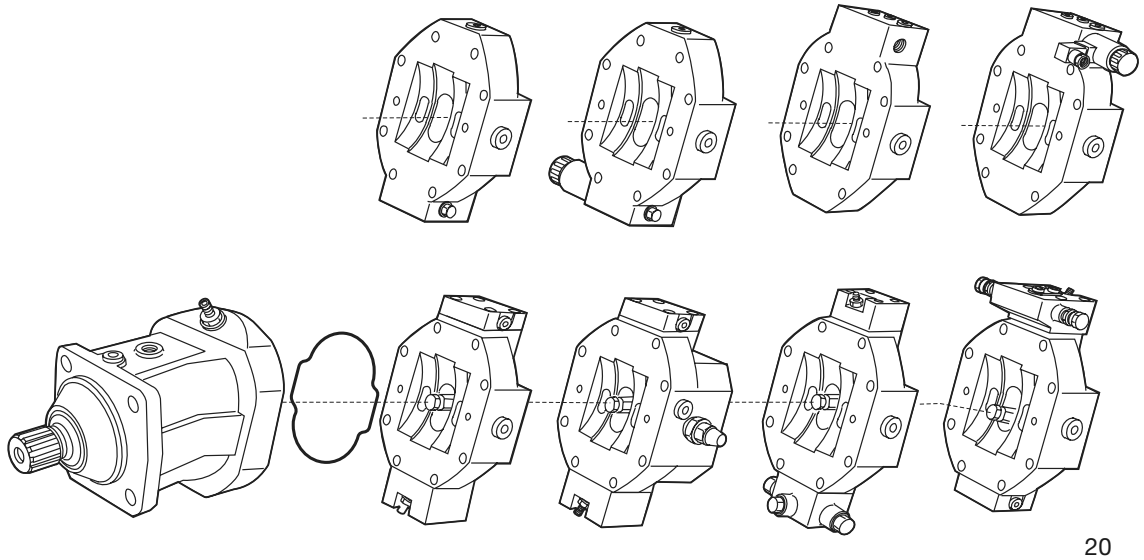
⚠ Do not remove adjustment screw.
Inspect:
O-ring, O-ring groove, housing.



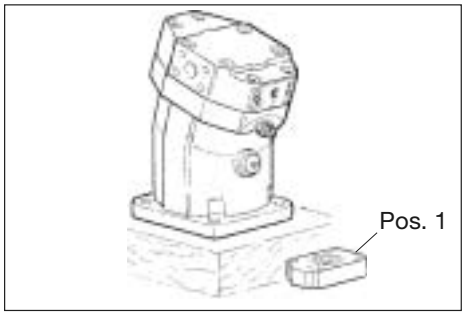
19

Consigli per il montaggio:
ingrassare il perno prima dell'inserimento.

Assembly aid:
Insert pin with grease.



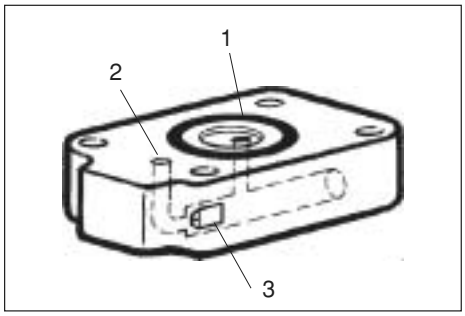
20



21

Esempio: regolazione A6VM…HD
Posizione di smontaggio:
Rimuovere il coperchio pos. 1.

Example: A6VM ... HD control
Disassembly position:
Remove cover pos. 1



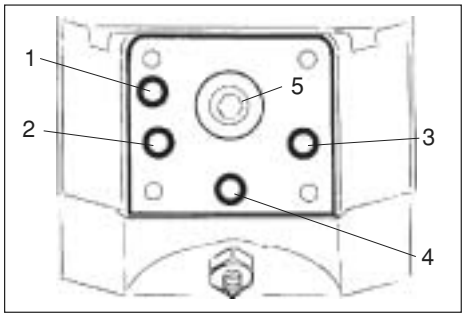
22

1. O-ring, 2. Alimentazione olio, 3. Perno di regolazione

⚠ La posizione di installazione varia in funzione dei componenti del comando.

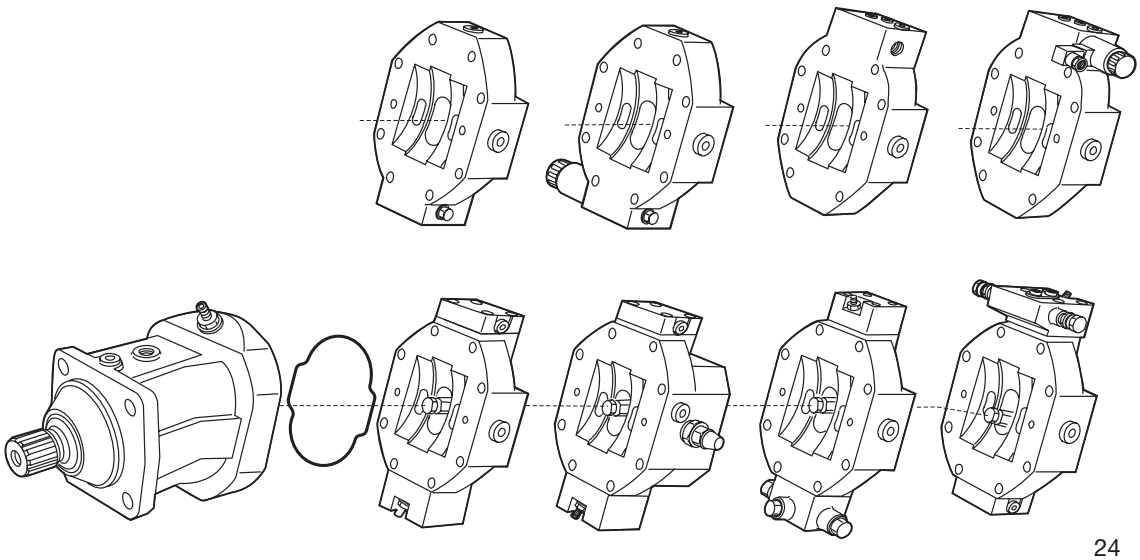
1. O-ring, 2. Input flow of oil control, 3. Throttle pin

⚠ Installation position differs according to the control components

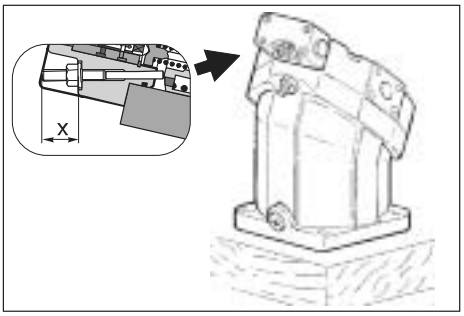


23

1. Alimentazione olio	1. Input flow of oil control
2. Alta / bassa pressione	2. High pressure/ low pressure
3. Alta / bassa pressione	3. High pressure/ low pressure
4. Olio di recupero	4. Leckage oil
5. Pistone di regolazione	5. Control piston



24



25

Esempio: regolazione A6VM... - **Pistone differenziale**
Posizione di smontaggio: Rimuovere il coperchio pos. 2

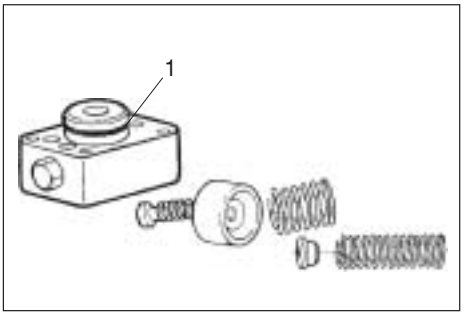
⚠ Attenzione: Molla precaricata !

Determinare la misura **X** (inizio regolazione)

Example: A6VM... control - **differential piston**
Disassembly position: Remove cover pos. 2.

⚠ Attention! Spring load.

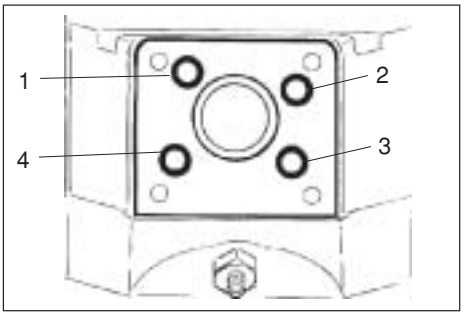
Dimension **x**: Note dimension (begin of regulation).



26

1. Controllare l'O-ring

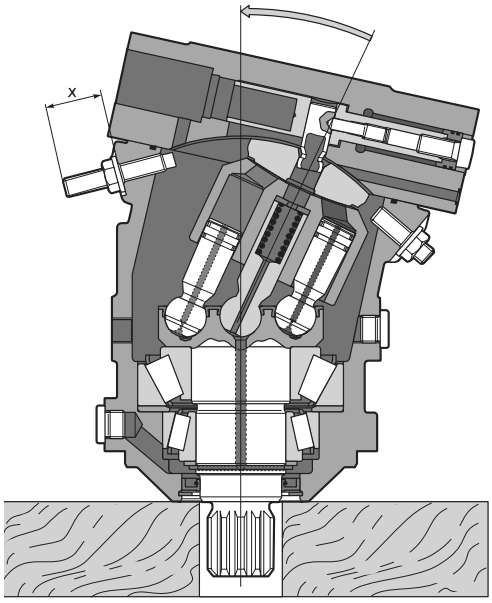
1. Check O-ring



27

1. Alta pressione - lato corto pistone di regolazione
2. Pressione di regolazione
3. Alta pressione - valvola di non ritorno
4. Alta pressione - valvola di non ritorno

1. High pressure - small control piston side
2. Control pressure
3. High pressure - check valve
4. High pressure - check valve



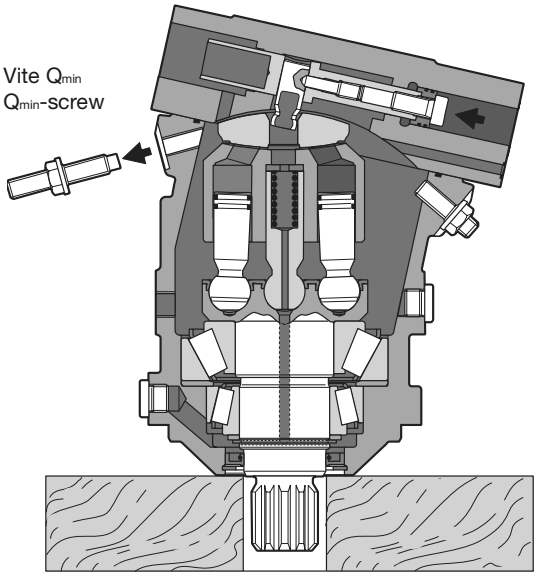
Pistone differenziale
Determinare la misura **x**.

Diferential piston:
Note dimension **x**.

⚠

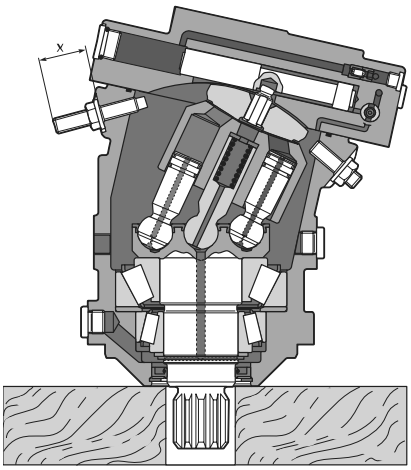
Durante lo smontaggio della piastra di raccordo mantenere sempre il gruppo rotante sulla posizione zero. Gli anelli del pistone pendono fuori dal foro del cilindro.

For disassembly of the port plate, always swivel rotary group to zero position.
Piston rings to hang out of the cylinder boring.



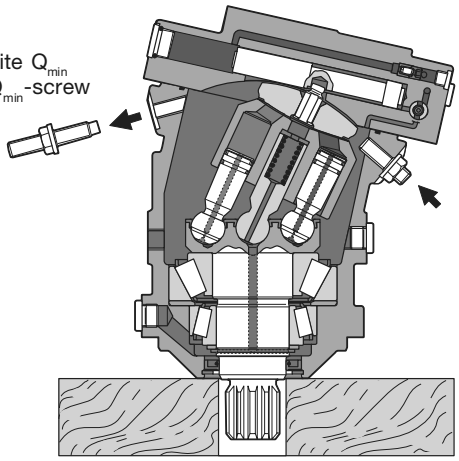
Smontare la vite Q_{min}.
Ruotare il gruppo rotante su 0°.

Remove Q_{min}-screw.
Swivel rotary group to 0°.



Pistone di sincronizzazione:
Determinare la misura **x**.

Synchronizing piston:
Note dimension **x**.



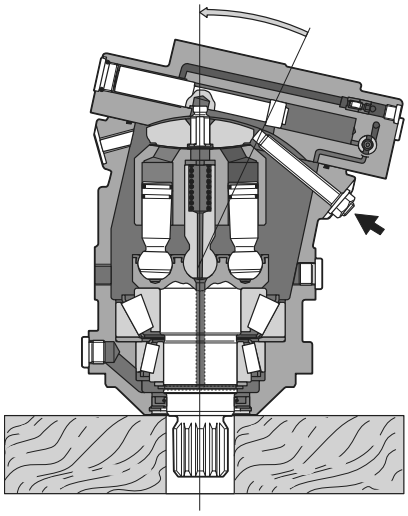
⚠

Durante lo smontaggio della piastra di raccordo mantenere il gruppo rotante sempre sulla posizione zero. Gli anelli del pistone pendono fuori dal foro del cilindro.

For disassembly of the port plate, always swivel rotary group to zero position.
Piston rings to hang out of the cylinder boring.

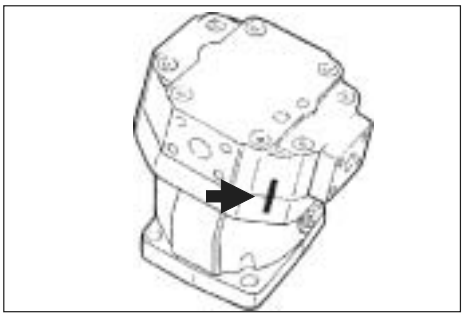
Smontare la vite Q_{min} ed il tappo di chiusura.

Remove Q_{min}-screw and plug.



Ruotare il gruppo rotante su 0° con la vite Q_{min}.

Swivel rotary group to zero position with screw Q_{min}.



28

Contrassegnare la posizione della piastra di raccordo, allentare le viti e smontare.

Port plate
Mark position, loosen screws, remove.



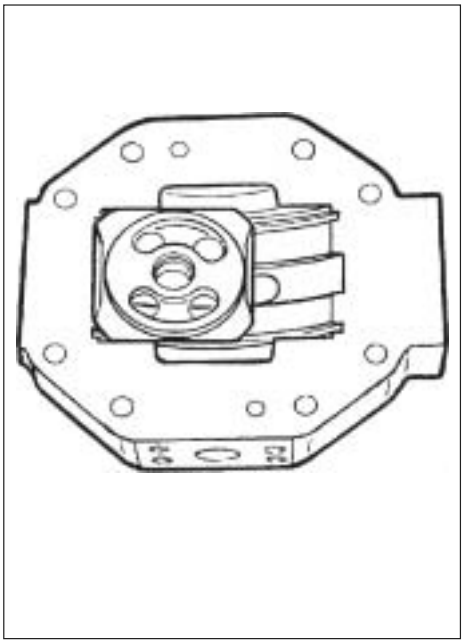
29

Sostituire l'O-ring.

⚠ Spalmare un leggero strato di grasso sul nuovo O-ring.
Non girare il gruppo rotante.
Le tenute dei pistoni pendono fuori dal foro del cilindro.

Change O-ring.

⚠ Smear new O-ring with some grease.
Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.



30

⚠ Spalmare con grasso la lente di controllo ed inserirla nella guida di scorrimento.
Rimontare seguendo la sequenza inversa.
Montare la piastra di raccordo.

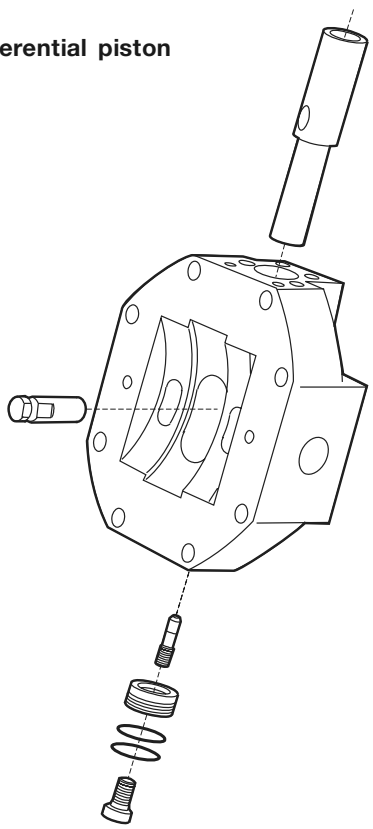
⚠ Gruppo rotante verticale.

⚠ Smear control lens in sliding surface with grease.
Assemble in reversal order.
Mount port plate.

⚠ Rotary group vertical.

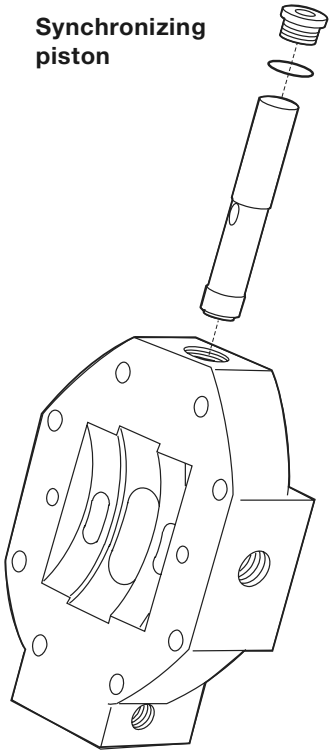
Pistone differenziale

Differential piston

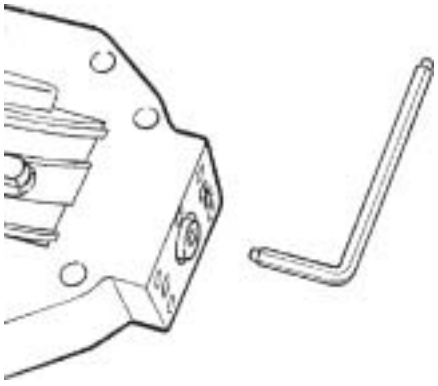


Pistone di sincronizzazione

Synchronizing piston



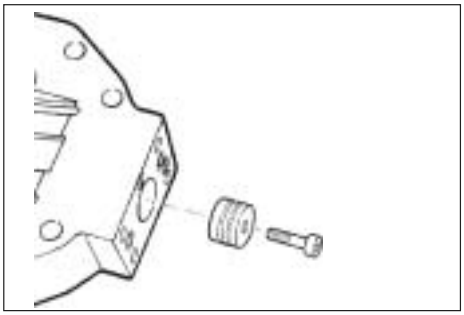
31



32

Rimuovere la vite di fissaggio.
Allo scopo utilizzare esclusivamente una chiave a tubo.

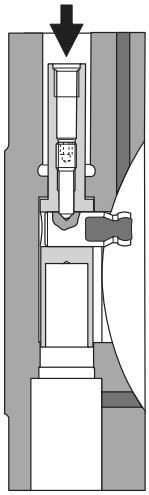
Loosen fixing screw.
Use only socket wrench.



33

Rimuovere il pistone completo di tenuta.

Remove piston with piston ring.



34

Pistone differenziale

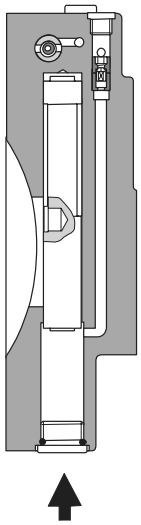
Riscaldare la vite di fissaggio per il posizionamento del tappo attraverso l'alesaggio (vite incollata da girare)

⚠ Utilizzare una nuova vite.
Rivestimento Precote.
Serrare alla coppia di serraggio consigliata!

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

Pistone di sincronizzazione

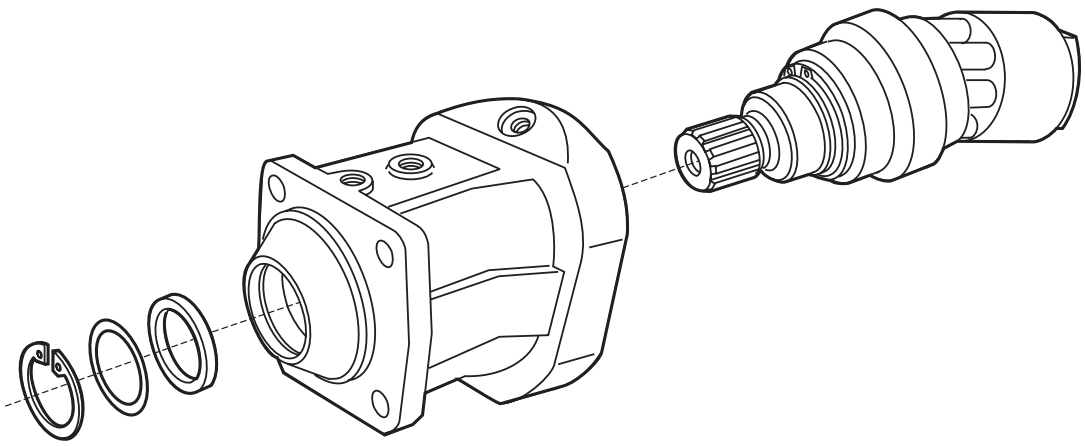
Rimuovere la vite.
Smontare il pistone.

⚠ Annotare la posizione di montaggio.

Synchronizing piston

Remove screw.
Remove piston.

⚠ Note installation position.



36

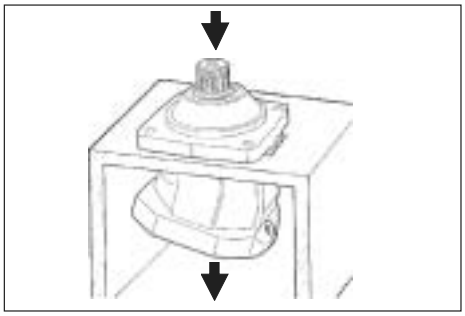


37

Avvitare il perno filettato nel perno di centraggio.
Fissare il cilindro con rondella e controdado.
Rimuovere la vite di battuta Q_{max}.

Screw in threaded pin into center pin.
Fix the cylinder with disc and locknut.
Remove Q_{max}-stop screw.

Dimensioni / 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



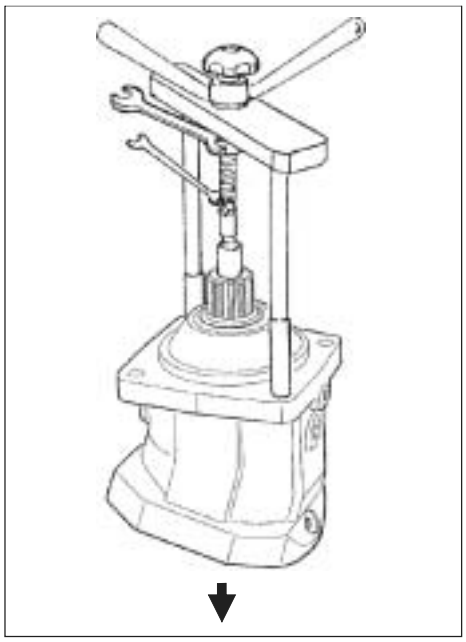
38

Premere verso l'esterno il gruppo rotante.

⚠ Se i cuscinetti devono essere riutilizzati, evitare di battere sull'albero motore.

Press out rotary group!

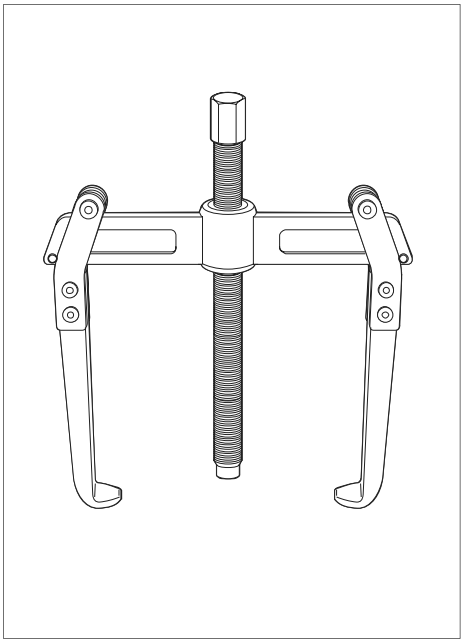
⚠ If the bearings are to be used again, do not hit on the drive shaft.

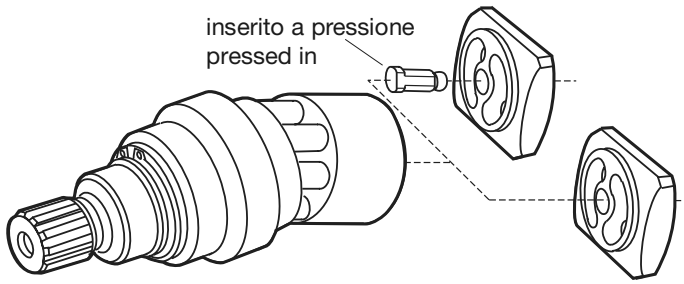


39

In alternativa, utilizzare l'apposito estrattore.

Or press-out with extraction device.





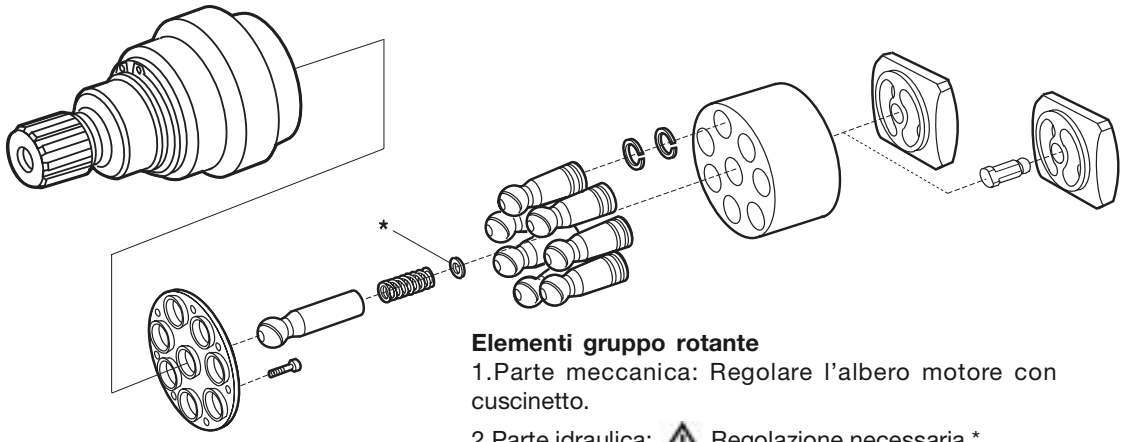
Gruppo rotante completo

⚠ Regolare la parte idraulica.

Complete rotary group

⚠ Setting of hydraulic part necessary.

40



Elementi gruppo rotante

1.Parte meccanica: Regolare l'albero motore con cuscinetto.

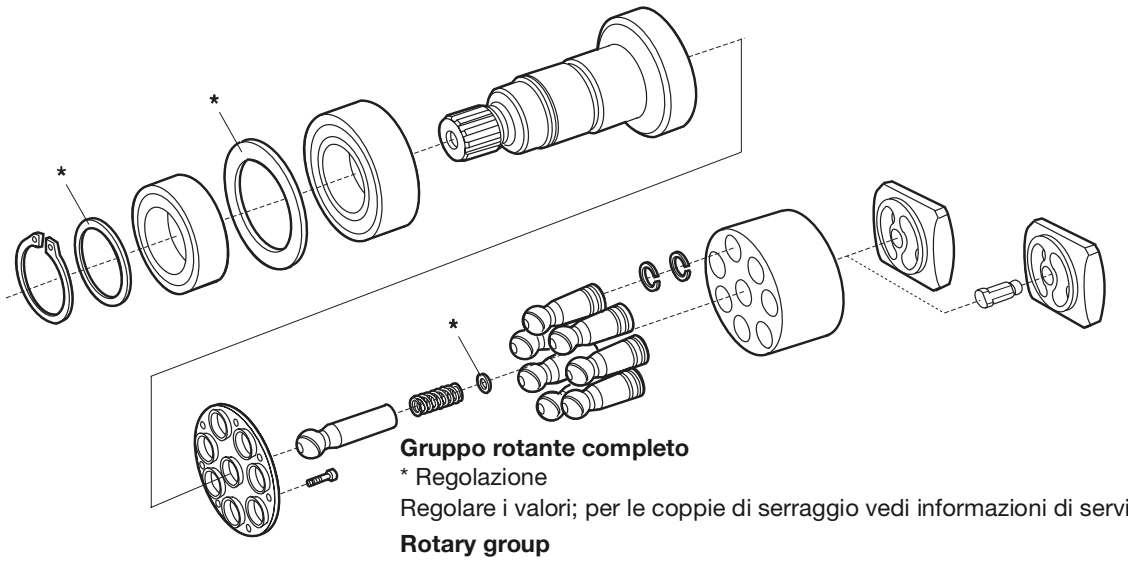
2.Parte idraulica: ⚠ Regolazione necessaria *.

Rotary group

1. Mechanical part: Adjust drive shaft with bearing.

2. Hydraulic part: ⚠ Adjustment necessary

41



Gruppo rotante completo

* Regolazione

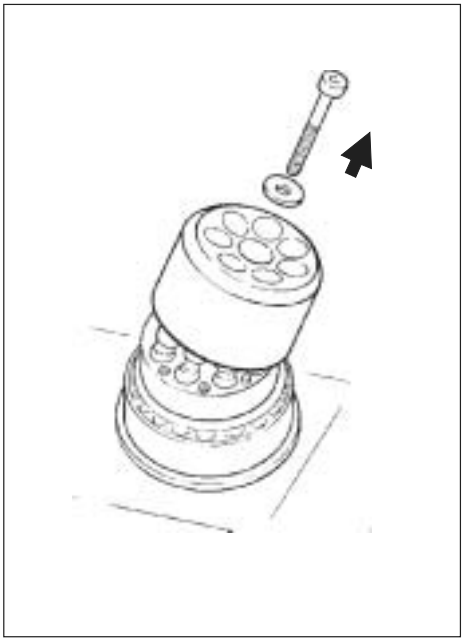
Regolare i valori; per le coppie di serraggio vedi informazioni di servizio.

Rotary group

* Setting

Set values. For torque, see service information.

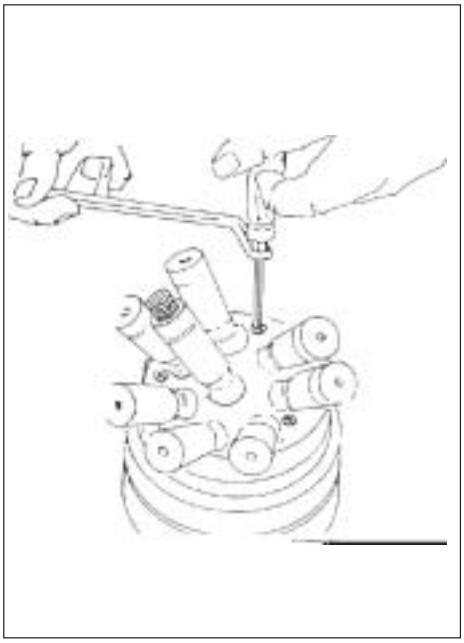
42



43

Rimuovere la vite di fissaggio (cilindro).
Togliere il cilindro sollevandolo.

Remove fixing screw (cylinder).
Remove cylinder.



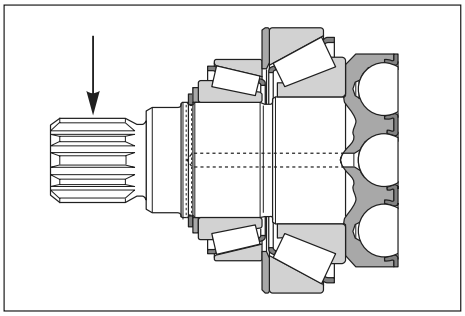
44

Smontare la piastra di tenuta.

⚠ Le viti sono incollate.
Rimuovere con gli attrezzi Torx.

Disassemble retaining plate.

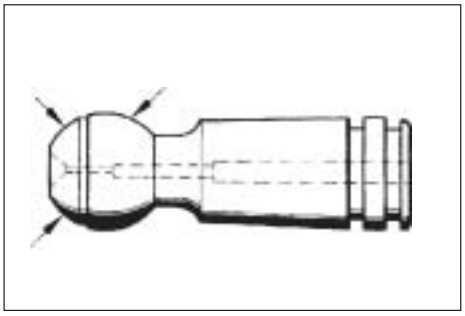
⚠ Screws are glued.
Use Torx-tools.



45

Nessuna corrosione, erosione o usura da frizione; nessun danno a scanalature o calettature.

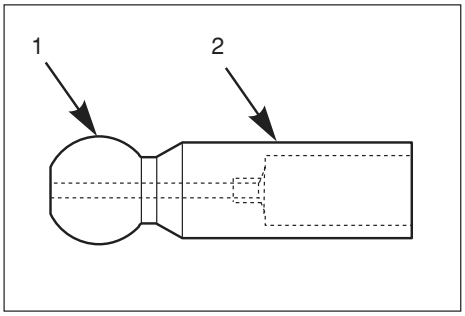
Free of corrosion, erosion or fretting; no damage to splines or keyways.



46

Pistoni:
nessuna rigatura o pittatura.

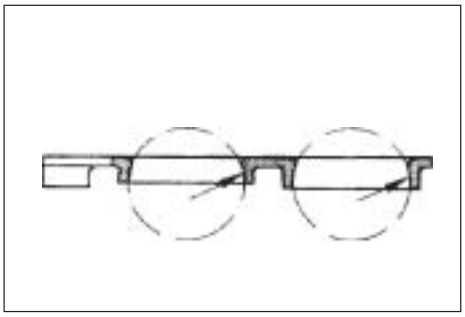
Pistons
No scoring and no pittings.



47

Perno centrale:
nessuna rigatura o pittatura.

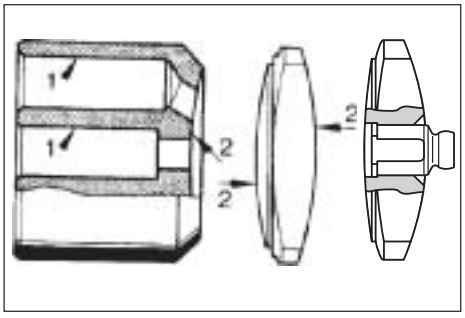
Center pin
No scoring and no pittings.



48

Piastra di tenuta:
nessuna rigatura o traccia d'usura

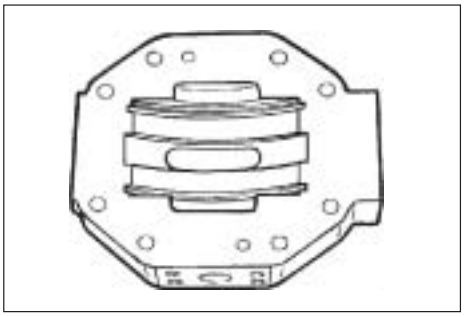
Retaining plate
No scoring and no evidence of wear



49

Blocco cilindri / lenti di controllo:
1 Alesaggio senza tracce di rigatura o d'usura
2 Superfici lisce e uniformi senza graffiature o rigature.

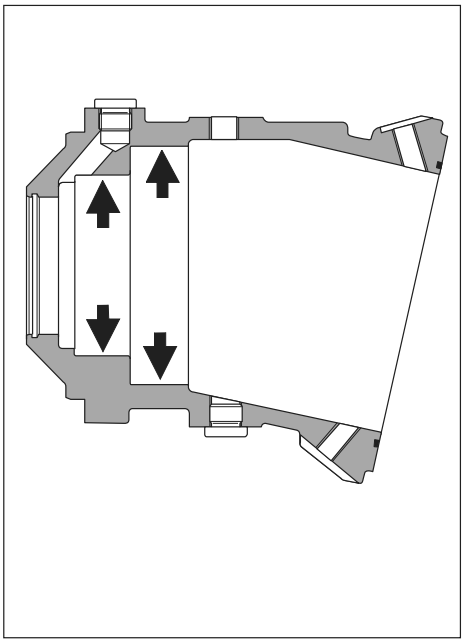
Cylinder block / control lens
1 Bores free of scoring, no evidence of wear.
2 Faces smooth and even, free of cracks and scoring.



50

Sede gruppo di regolazione:
superficie di scorrimento e guide laterali senza tracce di rigatura o usura.

Control housing
Sliding surface and side guides free of scoring and no wear.

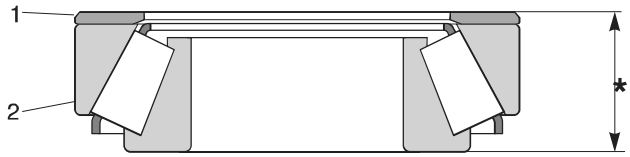


51

Controllo visivo:
Nessuna rigatura o traccia d'usura nelle zone dei cuscinetti.

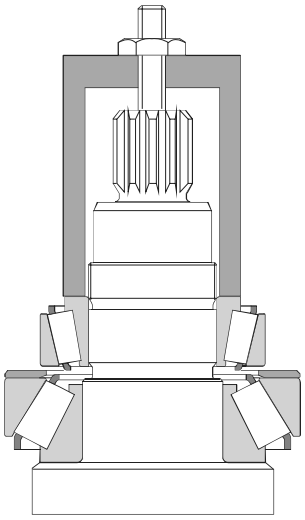
Visual check:
Bearing areas free of scoring and no evidence of wear.

Gruppo rotante: parte meccanica
Rotary group: mechanical part



Regolazione misura * e coppia cuscinetti: vedi informazioni di servizio.

Adjustment dimension * and bearing torque see service information.

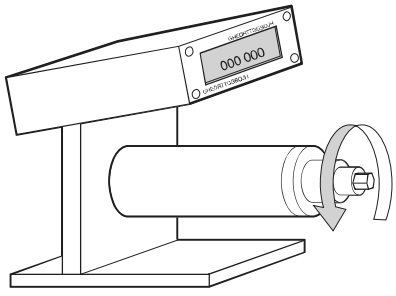


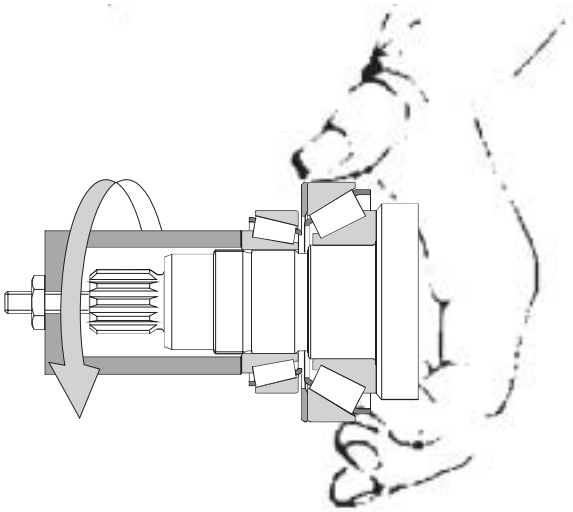
Fare pressione sul cuscinetto.
Durante tale pressione non eccedere il valore di coppia del cuscinetto.

Press on bearing.
Do not exeed bearing torque during press-on.

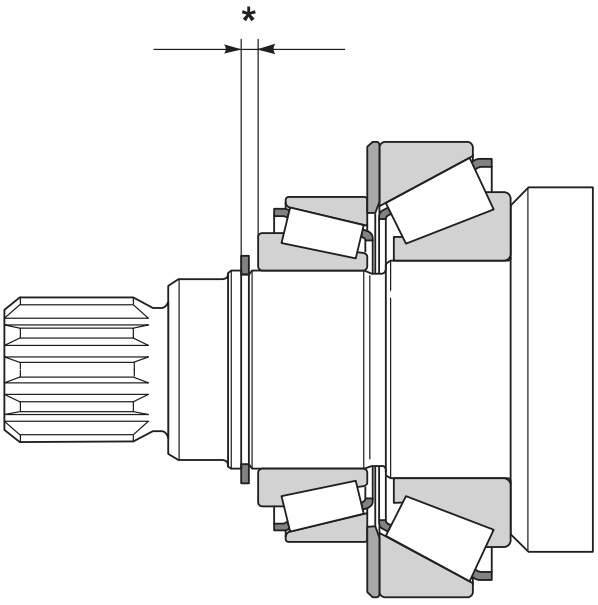
Precaricare il cuscinetto con il manicotto di montaggio e verificare costantemente la coppia di serraggio.

Preload bearing with assembly sleeve and check torque steadily.



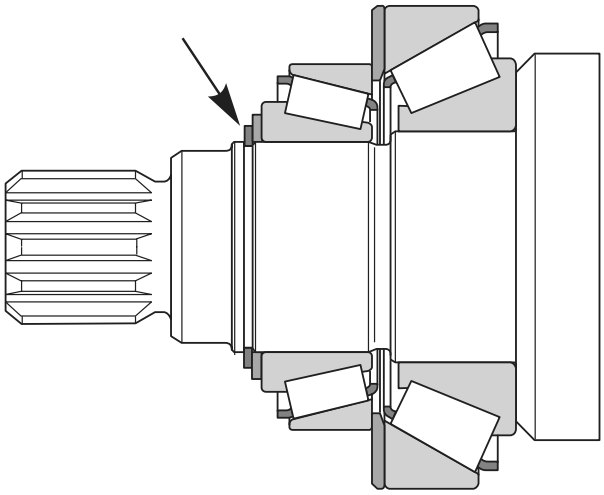


Gruppo rotante: parte meccanica
Rotary group: mechanical part



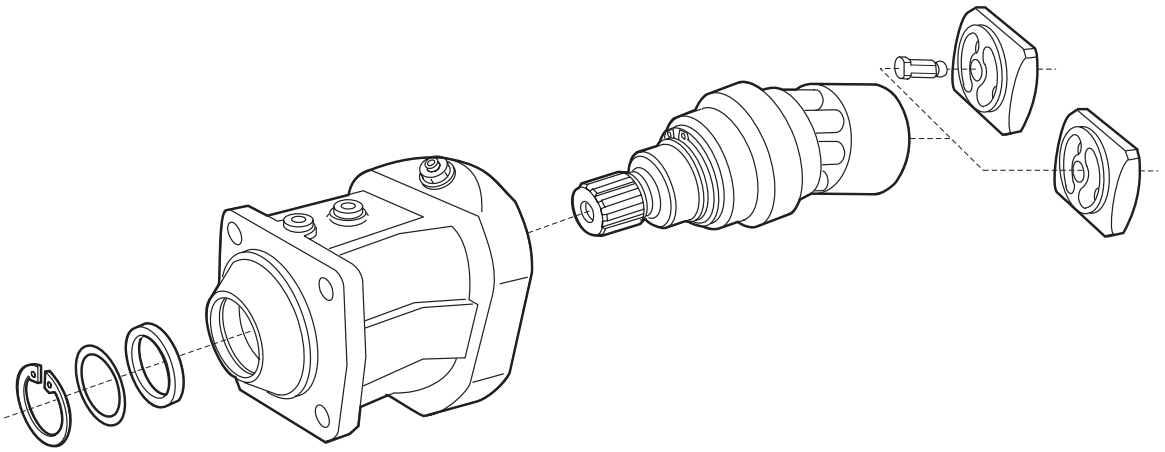
Montare l'anello di sicurezza.
Determinare la misura * per la regolazione del disco alle dimensioni finali (incrociato).

Assemble safety ring.
Determine dimension for adjustment disc with final dimensions (crossover).

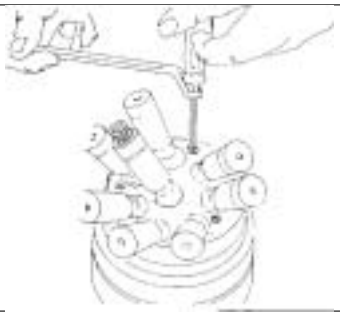


Montare il disco di regolazione.
Assemblare l'anello di sicurezza.
L'albero motore è pronto per il montaggio.

Install adjustment disc.
Assemble safety ring.
Drive shaft ready for assembly.

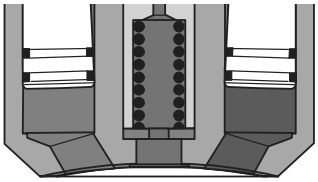


52



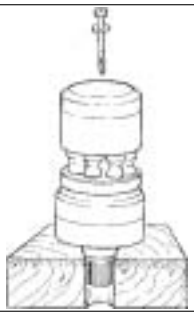
53 Inserire la piastra di tenuta con pistone e perno centrale.
Utilizzare viti con rivestimento Precote.

Insert retaining plate with piston and center pin.
Use screws with Precote-coating.



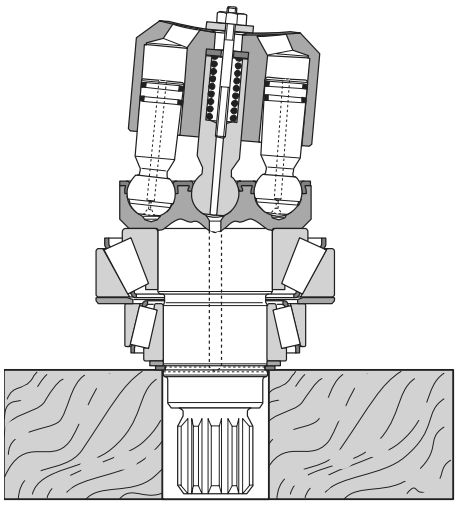
54 Verificare il corretto inserimento di tutte le parti.

Make sure all parts are fitted in correctly.



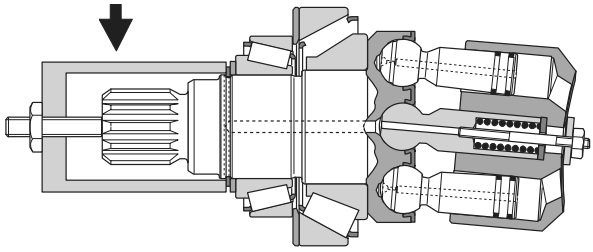
55 Far oscillare il blocco cilindro fino alla massima escursione e fissare il cilindro.

Swivel cylinder block to max. and fix the cylinder.



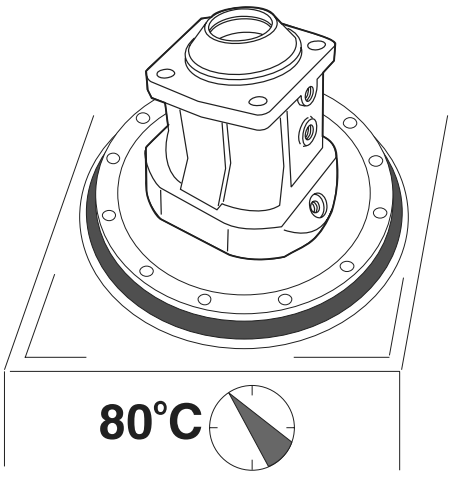
Il gruppo rotante completamente assemblato è pronto per il montaggio.

Rotary group completely assembled ready for assembly.



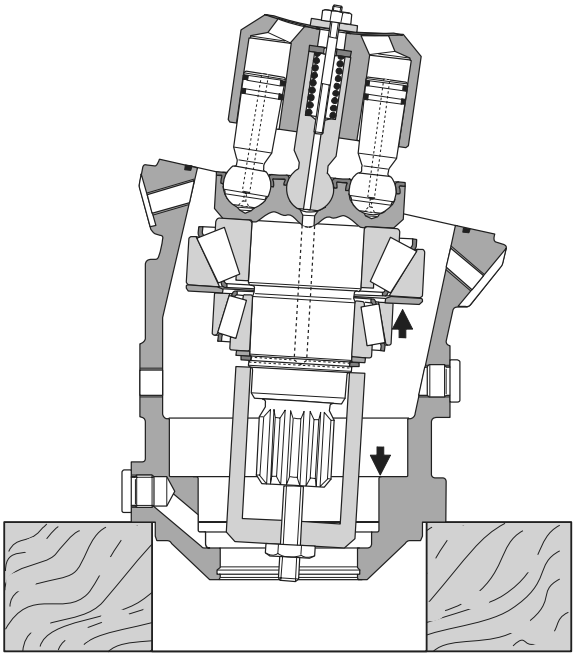
Posizionare il manicotto di montaggio.

Place assembly sleeve.



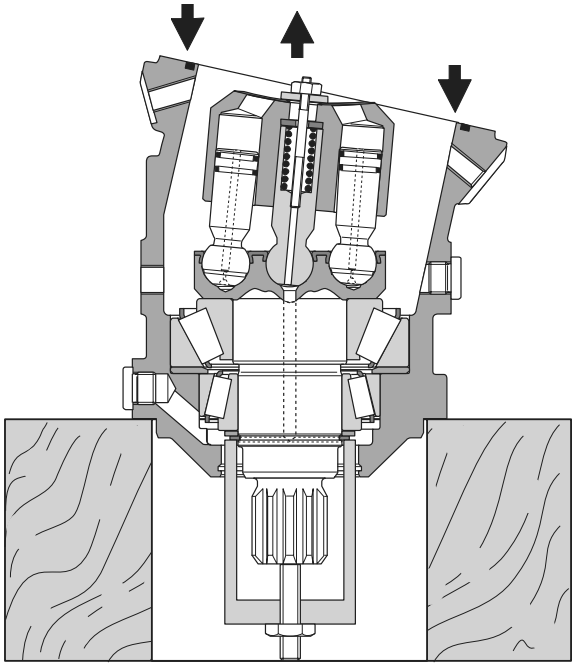
Riscaldare l'alloggiamento ad 80 °C.

Warm up housing to 80°C.



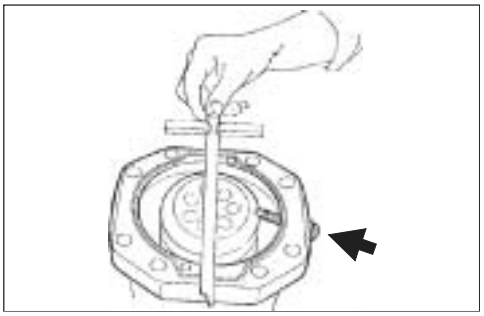
Inserire in sede il gruppo rotante.

Insert rotary group into housing to seat position.



Allineare il cilindro sulla posizione zero utilizzando la vite Q_{max}.
1. Smontare la vite di fissaggio del cilindro.
2. Inserire l'O-ring.

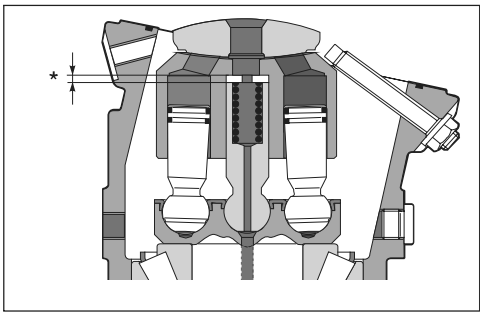
Fix zero position of cylinder with Q_{max}-screw.
1. Disassemble cylinder fixing screw.
2. Insert O-ring.



56

Determinare il campo di escursione del cilindro con la vite.

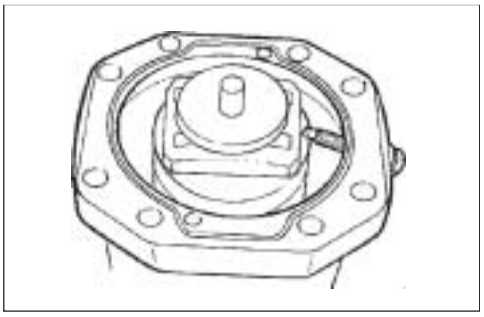
Determine cylinder swivel range to max. angle with screw.



57

* Disco

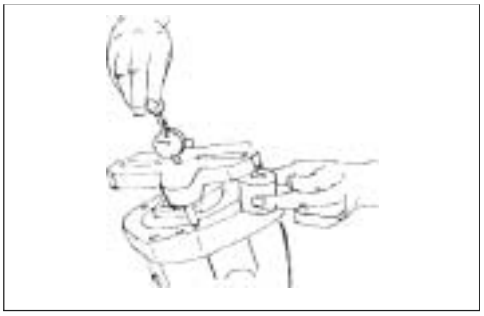
* Disc



58

Posizionare il disco di centraggio.

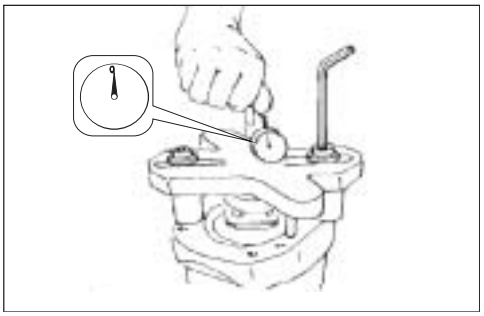
Place centering disc.



59

Montare il dispositivo di misurazione.

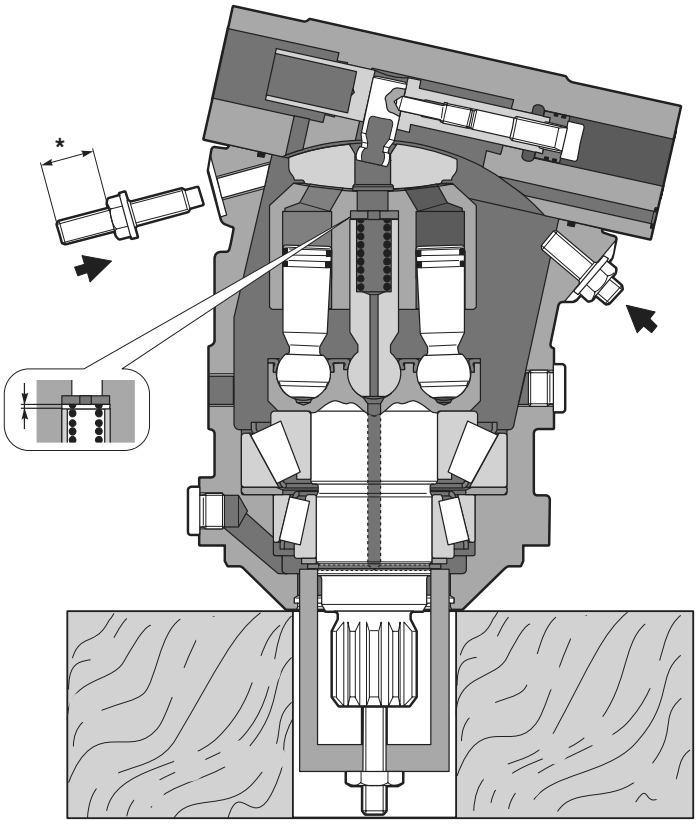
Mount measuring device.



60

Verificare la misura **X**.

Check dimension **X**.



1. Montare la piastra di raccordo con pistone differenziale.

⚠ Rispettare la sequenza di montaggio!

⚠ Serrare le viti di fissaggio alla coppia consigliata.

2. Girare il gruppo rotante sulla "posizione di partenza".
3. Portare la vite Q_{min} alla misura*.
4. Assemblare il tappo di chiusura.
5. Rimuovere il manicotto di montaggio.

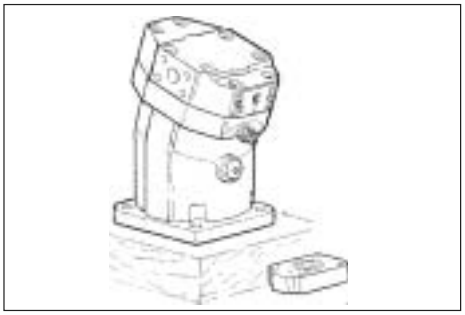
1. Assemble port plate with differential piston.

⚠ Take care of assembly design!

⚠ Tighten fixing screws to torque.

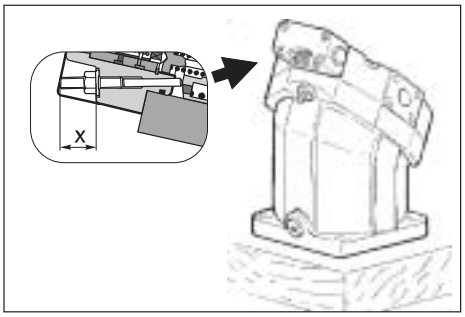
2. Swivel rotary group to "starting position".
3. Set Q_{min}-screw to dimension*.
4. Assemble plug.
5. Remove assembly sleeve.

61



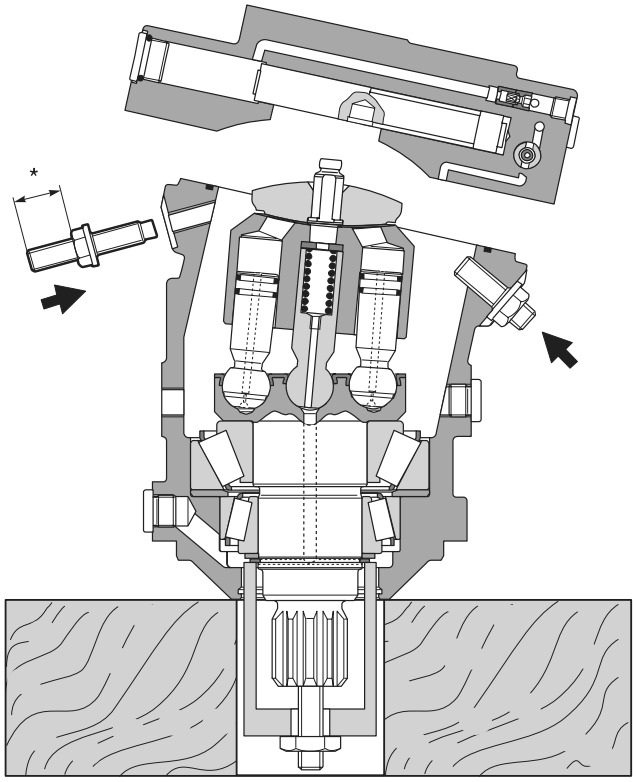
62 Montare il coperchio.

Assemble cover.



63 Assemblare le parti di comando.

Assemble control components.



1. Montare la piastra di raccordo con pistone di sincronizzazione.

⚠ Rispettare la sequenza di montaggio!

⚠ Serrare le viti di fissaggio alla coppia consigliata.

2. Girare il gruppo rotante sulla "posizione di partenza".
3. Portare la vite Q_{min} alla misura *.
4. Montare il tappo di chiusura.
5. Rimuovere il manicotto di montaggio.

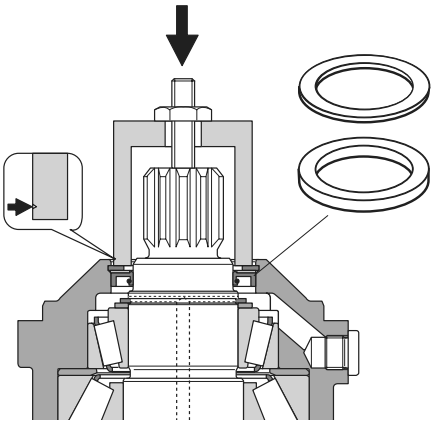
1. Assemble port plate with synchronizing piston.

⚠ Take care of assembly design!

⚠ Tighten fixing screws to torque.

2. Swivel rotary group to "starting position".
3. Set Q_{min}-screw to dimension*.
4. Assemble plug.
5. Remove assembly sleeve.

64



65

Montare la tenuta dell'albero, le rondelle e l'anello di sicurezza.
Inserire a pressione con il manicotto di montaggio.

⚠ Rispettare la profondità di inserimento!

Assemble shaft seal, disc and safety ring.
Press-in with assembly sleeve.

⚠ Take care of press-in depth.

Coppie di serraggio per viti albero (filettatura metrica standard ISO)

I valori riportati nella tabella valgono unicamente per perni con filettature metriche ISO standard e per dimensioni delle superfici di supporto conformi alle richieste DIN 912, DIN 931 e DIN 933. Tali valori sono inoltre validi solo per superfici non trattate, non oliate o leggermente oliate e per uso di chiavi o limitatori con indicazione della coppia di serraggio.

Dimensione filettatura	Classi di resistenza 8.8	10.9	12.9
	Momento di serraggio (Nm)		
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 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 surfaces 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

Coppie di serraggio per viti di bloccaggio VSTI (filettatura metrica ISO a passo fine)

Dim. filettatura	Descrizione	Momento serraggio (Nm)
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 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

Coppie di serraggio per dadi seal-lock (filettatura metrica standard ISO)

I valori di coppia riportati nella tabella si applicano solo a dadi "seal-lock" con classe di resistenza 8,8 e filettatura metrica standard ISO.

Dimensioni filettatura	Classe di resistenza 8.8	10.9	12.9
	Momento di serraggio (Nm)		
M 6	10	-	-
M 8	22	-	-
M10	40	-	-
M12	69	-	-
M14	110	-	-
M16	170	-	-

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	-	-

Coppie di serraggio per viti con testa a croce DIN 7985 (filettatura metrica standard ISO)

I valori di coppia riportati nella tabella si applicano solo a viti DIN 7985 con classe di resistenza 8,8 e filettatura metrica standard ISO.

Dimensioni filettatura	Classe di resistenza 8.8	10.9	12.9
	Momento di serraggio (Nm)		
M 3	1,1	-	-
M 4	2,9	-	-
M 5	6	-	-
M 6	10	-	-
M 8	25	-	-
M10	49	-	-

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	-	-

Avvertenze generali

- Familiarizzare con i dispositivi della macchina.
- Utilizzare la macchina solo dopo aver completamente familiarizzato con gli elementi di comando e di controllo ed aver appreso il funzionamento della macchina.
- Utilizzare dispositivi di protezione personale (es. casco, scarpe di sicurezza e protettori per l'udito).
- Familiarizzare con l'ambiente di lavoro.
- Utilizzare la macchina solo per lo scopo previsto.

General advice

- Become familiar with the equipment of the machine.
- Only operate the machine if you are completely familiar with the operating and control elements as well as the functioning of the machine.
- Always wear personal protection equipment (e.g. helmet, safety shoes and hearing protection).
- Become familiar with your working field.
- Only operate the machine for its intended purpose.

Rispettare le direttive dell'Associazione di categoria e le istruzioni del costruttore della macchina.

Please observe the guidelines of the Professional Association and the machine manufacturer.

Prima di partire

Before starting





- Leggere le istruzioni d'uso prima di iniziare il lavoro.
- Verificare che la macchina sia efficiente.
- Non utilizzare la macchina in caso di malfunzionamenti di strumenti, indicatori o elementi di comando.
- Verificare che tutti i dispositivi di sicurezza siano fissati in posizione.
- Non lasciare oggetti sparsi, fissarli in modo sicuro alla macchina.
- Tenere oli e materiali infiammabili lontano dalla macchina.
- Prima di entrare nella cabina di guida accertarsi che non vi siano persone o ostacoli accanto o sotto alla macchina.
- Prestare la massima attenzione salendo nella cabina di guida: utilizzare i gradini e le maniglie di accesso previsti.
- Regolare il sedile prima di avviare la macchina.

- Read and understand 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 leave loose objects scattered all around; secure them to the machine.
- Keep oily and flammable material away from the machine.
- Before entering the 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.

Avviamento

· Prima dell'avviamento verificare che tutte le leve di comando siano in posizione neutra.
· Avviare la macchina solo se seduti al posto di guida.
· Dopo l'avviamento verificare l'efficienza di tutti gli strumenti.
· Non lasciare la macchina incustodita con il motore in moto.
· In caso di avviamento con cavi ponte ausiliari collegare sempre polo positivo con polo positivo e polo negativo con polo negativo. Collegare per ultimo il cavo (-) negativo; scollegare per primo il cavo (-) negativo.

Attenzione

· I gas di scarico sono nocivi. Verificare che negli ambienti chiusi ci sia sufficiente ventilazione!

Impianto idraulico

1. L'impianto idraulico è da considerarsi sempre sotto pressione.

⚠ La fuoriuscita di fluidi ad alta pressione (carburante, olio idraulico) può penetrare la pelle e causare gravi ferite.
In caso di contatto consultare immediatamente un medico per evitare la formazione di serie infezioni.

2. Quando si ricercano eventuali perdite utilizzare sempre dispositivi adeguati per evitare qualsiasi incidente.
3. Prima di qualsiasi intervento sull'impianto idraulico, scaricare completamente la pressione ed abbassare a terra i bracci operativi della macchina.
4. In caso di interventi sull'impianto idraulico, arrestare il motore e bloccare la macchina per evitare qualsiasi movimento accidentale (freno di stazionamento, cunei).
5. Durante il collegamento di martinetti idraulici e motore prestare particolare attenzione all'esatto collegamento dei tubi idraulici.
6. Se i collegamenti vengono invertiti accidentalmente, le funzioni della macchina si invertiranno di conseguenza (es. sollevamento/discesa) con possibili rischi di incidente.
7. Verificare regolarmente i tubi idraulici e sostituirli in caso di danni o usura. I nuovi tubi devono soddisfare le specifiche tecniche del costruttore della macchina!

⚠ Smaltire gli olii, il carburante ed i filtri secondo le leggi in vigore!

Start

· When starting all operating levers must be in the "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 unattended when the engine 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 at high pressure.

⚠ Fine jets of fluids (fuel, hydraulic oil) at high pressure can penetrate the skin and cause serious injuries.
If high pressure fluids penetrate your skin get medical help quickly to prevent the risk of a serious infection.

2. When ckecking for leaks use appropriate auxiliary devices to prevent accidents or injury.
3. Before any job on the hydraulic equipment, lower pressure to zero and lower the working arms of the machine to the ground.
4. Before any job on the hydraulic equipment, stop the engine and block the machine to prevent it from rolling off (parking brake, wheel chocks)!

5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. If ports are reversed accidentally, functions are vice versa (f. ex. lift-up/lower) - danger of accidents!

7. Check hydraulic flexible hoses regularly and replace them in case of damage 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!

Avvertenza!
Per semplificare la fornitura di parti di ricambio corrette, specificare sempre i seguenti dati al momento dell'ordine:

Codice tipo
N° tipo
N° di serie
Gruppo
Articolo
Descrizione

Per la riparazione dell'unità si consiglia di utilizzare gruppi premontati e preregolati.

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.

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