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Hydraulics system

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Operation

1 Operation

1.1 Notices on this service manual

This service manual contains important information on how to service your machine safely, correctly and economically. Therefore, it aims not only at new operators, but it also serves as a reference for experienced ones. It helps to avoid hazardous situations and reduce repair costs and downtimes. Furthermore, the reliability and the service life of the vehicle will be increased by following the instructions in the service manual.

Careful and prudent working is the best way to avoid accidents!

Operational safety and readiness of the vehicle do not only depend on the operator's skill, but also on maintenance and servicing of the vehicle. For this reason, regular maintenance and service work is crucial.

Use only original spare parts for repairs. This ensures operational safety and readiness of your machine, and maintains its value.

Subject to modifications and printing errors.

1.2 Identification of warnings and dangers

The following symbols indicate safety instructions. They are used for alerting you to potential dangers.

Danger!

Failure to observe the instructions identified by this symbol can cause personal injury or death for the service personnel or other persons.

☞ *Measures for avoiding danger*

Attention!

Failure to observe the instructions identified by this symbol can cause damage to the machine.

☞ *Measures for avoiding danger for the vehicle*

Notice!

This symbol identifies instructions for a more efficient and economical use of the vehicle.

Environment!

Failure to observe the instructions identified by this symbol can cause damage to the environment. The environment is in danger if environmentally hazardous material (for example waste oil) is not subject to proper use or disposal.

1.3 Explanation of symbols and abbreviations

- Identifies a list
  - Subdivision of a list
    Follow the chronological order.

☞ *Identifies an activity*

☞ Subdivision of an activity to be performed
Follow the chronological order.

➥ Identifies a result according to a list/activity

➥ Subdivisionof a result according to a list/activity

Cross reference: see page *1-1* (page)

Cross reference: **7** (pos. no. or table no.)

Cross reference: *Fig. 1* (Fig. no. 1)

Cross references: *– see chapter "5 Operation" on page 5-1* (see chapter)

Cross references: *– see "Operation" on page 5-1* (– see text)

Abbreviations

Fig.	=	Figure
AUX	=	Auxiliary-hydraulics circuit
B	=	Width
o/h	=	Operating hours
approx.	=	approximately
DPF	=	Diesel particulate filter
DOC	=	Diesel oxidation catalytic converter
FGPS	=	Front Guard Protective Structure
FOPS	=	Falling Objects Protective Structure
if nec.	=	if necessary
Hydraulic quickhitch	=	Hydraulic quickhitch
LS	=	Shovel arm
max.	=	maximum
min.	=	minimum
NW	=	Nominal width
Item	=	Position
hp	=	Stabilizer blade
ROPS	=	Roll Over Protective Structure (without losing contact with the ground)
TOPS	=	Tip Over Protective Structure
e.g.	=	for example

Conversion table

The rounded imperial values are indicated in brackets, for example 1060 cm³ (64.7 in³).

Volume unit	
1 cm³	(0.061 in³)
1 m³	(35.31 ft³)
1 ml	(0.034 US fl.oz.)
1 l	(0.26 gal)
1 l/min	(0.26 gal/min)
Unit of length	
1 mm	(0.039 in)
1 m	(3.28 ft)
Weight	
1 kg	(2.2 lbs)
1 g	(0.035 oz)
Pressure	
1 bar	(14.5 psi)
1 kg/cm²	(14.22 lbs/in²)
Force/output	
1 kN	(224.81 lbf)
1 kW	(1.34 hp)
1 PS	(0.986 hp)
Torque	
1 Nm	(0.74 ft.lbs.)
Speed	
1 kph	(0.62 mph)
Acceleration	
1 m/s²	(3.28 ft/s²)

1.4 Warranty and liability

Exemption from warranty and liability

Warranty

Warranty claims can be made only if the conditions of warranty have been observed. They are included in the General Conditions of Sales and Delivery for new machines and spare parts sold by the dealers of HCE.

Furthermore, all instructions in this service manual must be observed.

Have the maintenance, delivery inspection and the entries in the service booklet completed, otherwise warranty claims will not be acknowledged.

Exemption from liability

- Modifying HCE products and fitting them with additional equipment and attachments that are not included in our delivery program requires HCE's written authorization, If this is not complied with, the warranty and product liability for resulting damage is rendered invalid.
- The safety of the vehicle can be negatively affected by performing vehicle modifications without proper authority and by using spare parts, equipment, attachments and optional equipment that have not been checked and released by HCE. Warranty and product liability for damage caused by these modifications shall not be applicable.
- HCE shall not be liable for personal injury and/or damage to property caused by failure to observe the safety instructions and service manual or by the negligence of the duty to exercise due care during:
  - Handling
  - Operating
  - Servicing and performing maintenance
  - Machine repair. This is also applicable in those cases in which special attention has not been drawn to the duty to exercise due care, in the safety instructions as well as in the Operator's and maintenance manuals.
- Read and understand the service manual before servicing or repairing the machine. Observe all safety instructions.

1.5 Labels

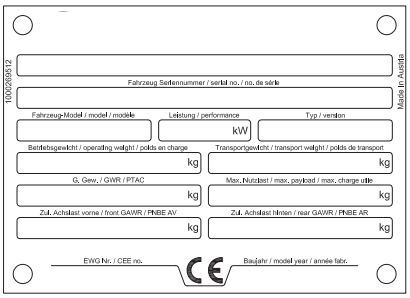


Fig. 1: Type label (symbolic representation)

Serial number

The number is located on the type label.

The serial number is also stamped on the machine chassis.

Refer to the Operator's Manual of the machine for more information.

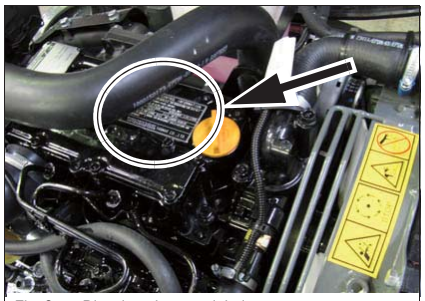


Fig. 2: Diesel engine type label

Diesel engine type label

The type label (arrow) is located on the cylinder-head cover (engine).

Fig. 3: Hydraulic pump type label

Hydraulic pump type label

The type label (arrow) is located on the hydraulic pump housing.

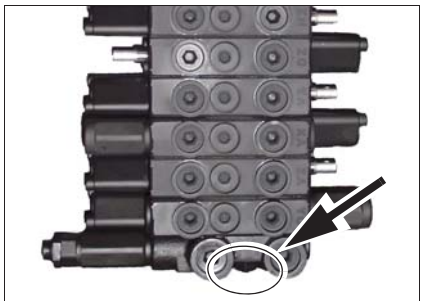


Fig. 4: Main valve block type label

Main valve block type label

The type label (arrow) is located on the lower side of the main valve block.

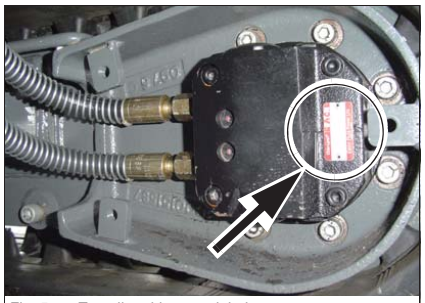


Fig. 5: Traveling drive type label

Traveling drive type label

The type label (arrow) is located on the traveling drive.

Fig. 6: Swivel unit type label

Swivel unit type label

The type label (arrow) is located on the swivel unit.

1.7 Machine overview

1	Boom light
2	Boom
3	Shovel arm
4	Track
5	Chassis
6	Stabilizer blade
7	Handhold
8	Lifting eye/tie-down point
9	Engine cover
10	Storage bin for Operator's Manual
11	Lock lever
12	Track tensioner
13	ROPS rollbar (option)
14	Shatter protection (option)

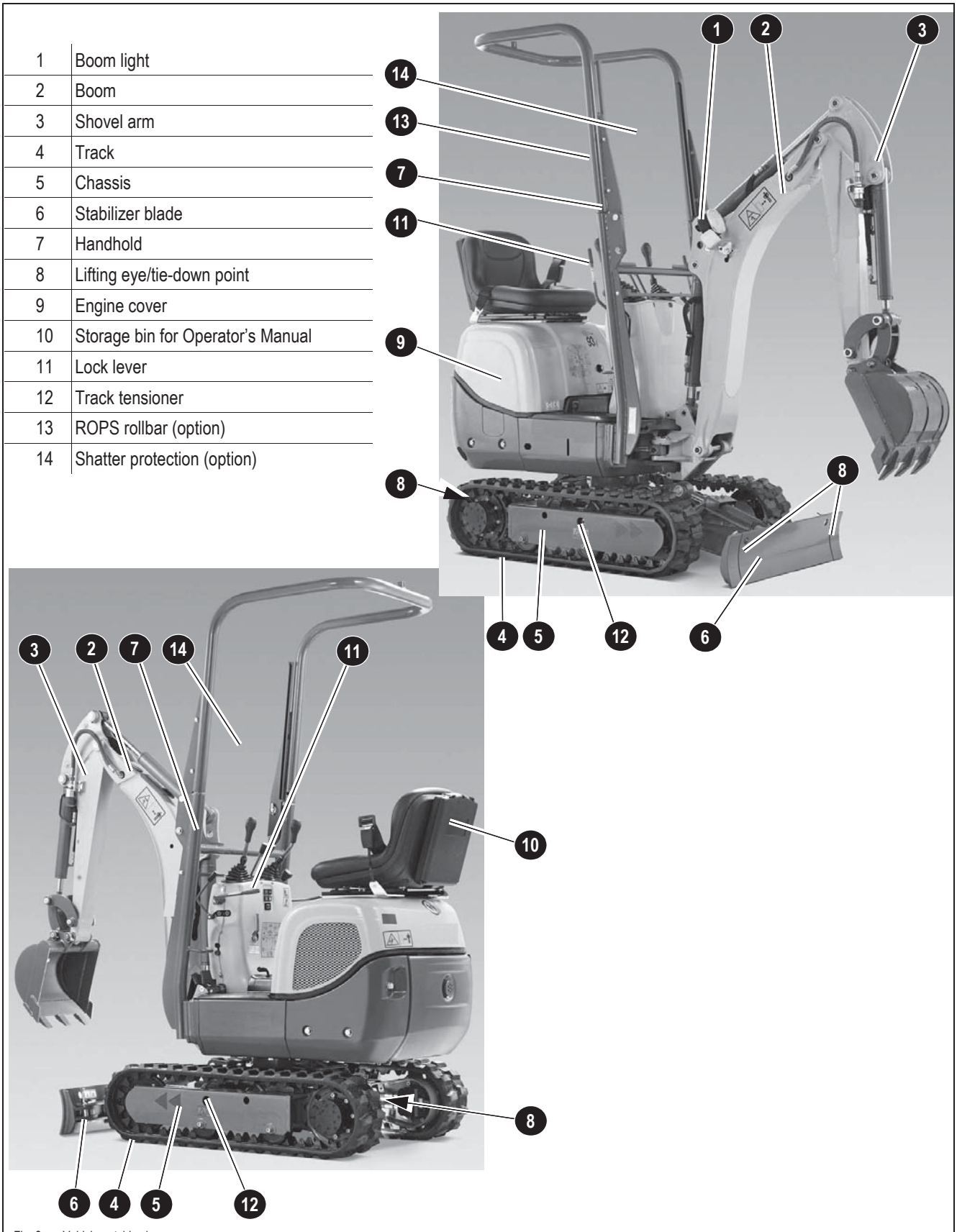
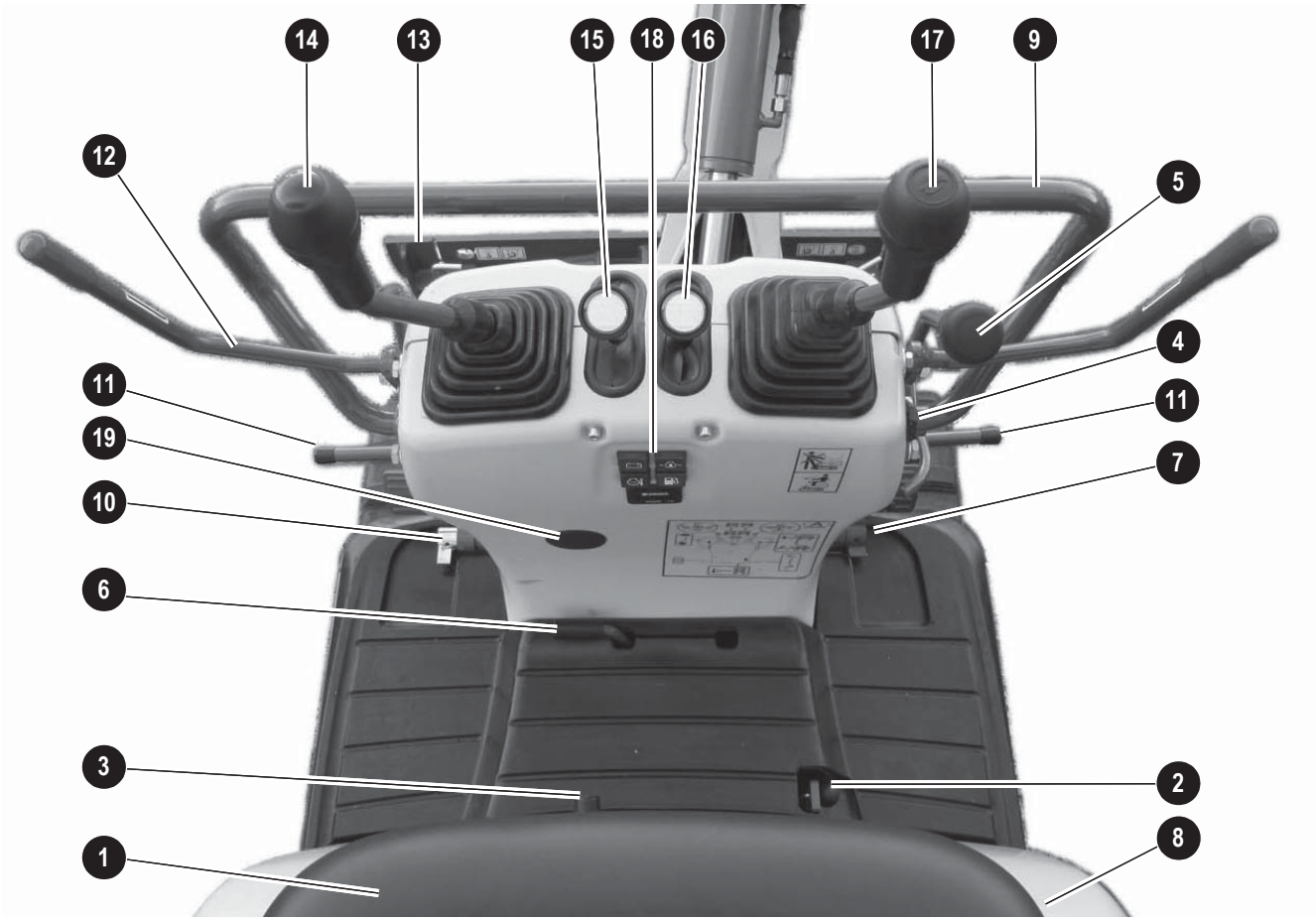


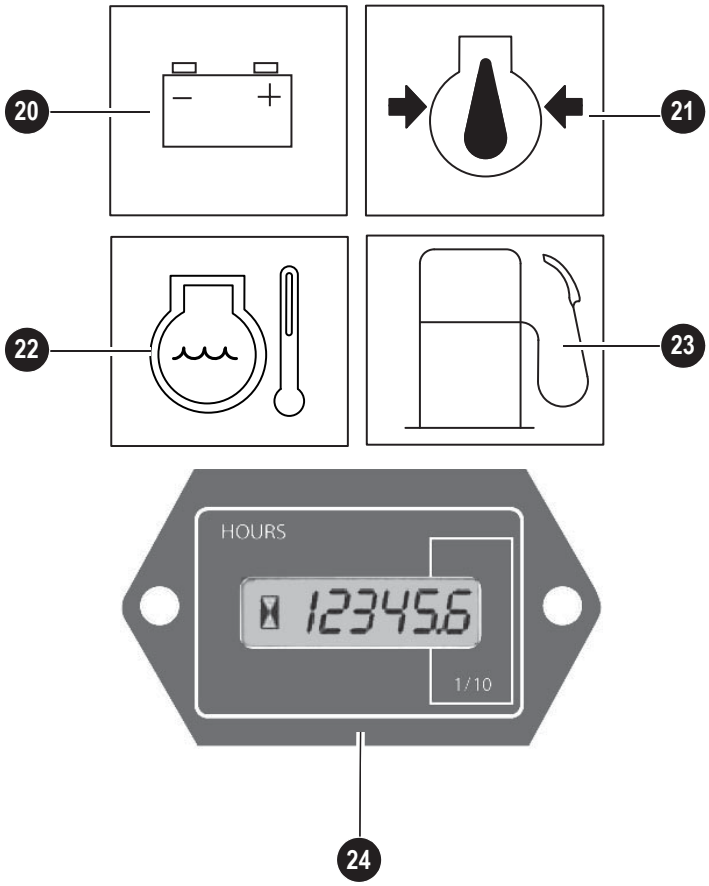
Fig. 8: Vehicle outside views

1.9 Control stand overview



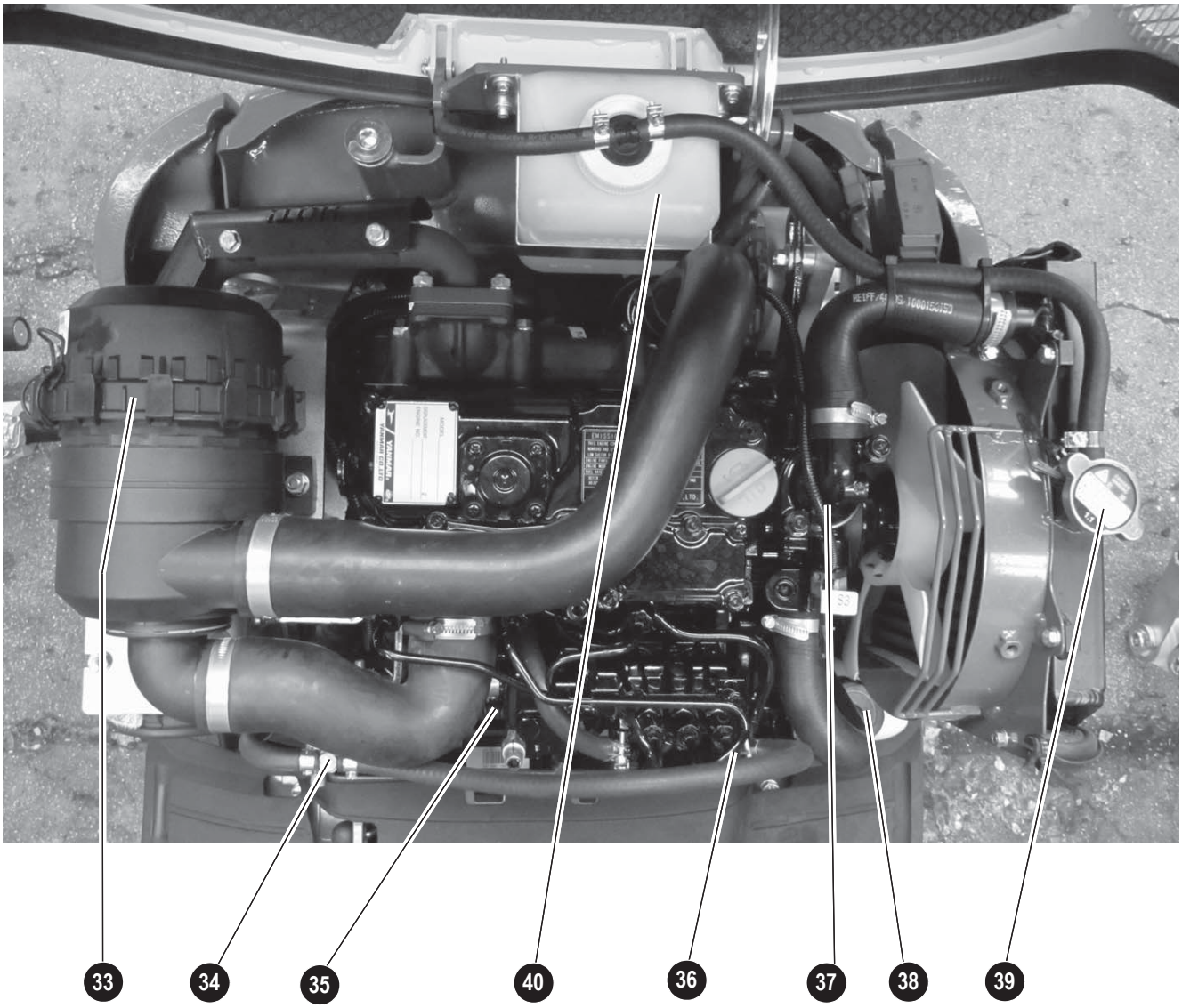
Item	Designation
1	Operator seat
2	Upper carriage lock
3	Engine cover lock
4	Ignition lock
5	Stabilizer blade/telescopic travel gear lever
6	Stabilizer blade/telescopic travel gear changeover lever
7	Boom swivel pedal
8	Engine cover
9	Handhold
10	Auxiliary hydraulics pedal
11	Footrest
12	Lock lever
13	Throttle
14	Control lever (left)
15	Drive lever (left)
16	Drive lever (right)
17	Control lever (right)
18	Display element
19	Lever for switching over hammer/grab operation (option)

1.10 Display elements (overview)



Item	Designation
20	Indicator light (red) – alternator charge function
21	Indicator light (red) – engine oil pressure
22	Indicator light (red) – coolant temperature
23	Indicator light (yellow) – fuel gage
24	Hour meter

1.12 Engine compartment overview



Item	Designation
33	Air filter
34	Fuel filter
35	Throttle cable
36	Swivel unit
37	Thermostat
38	Filler neck
39	Coolant filler inlet
40	Coolant reservoir

1.13 Battery master switch

Danger!

Danger of accident from interrupted electric power supply in the HPU operation!

Can cause serious injury or death.

☞ *The HPU operation with interrupted electric power supply is forbidden, since safety-related functions (e.g. light, horn) do not work.*

Attention!

Damage to the engine electronics can occur when the battery master switch is actuated.

☞ *Do not stop the engine if supplied with electric power.*

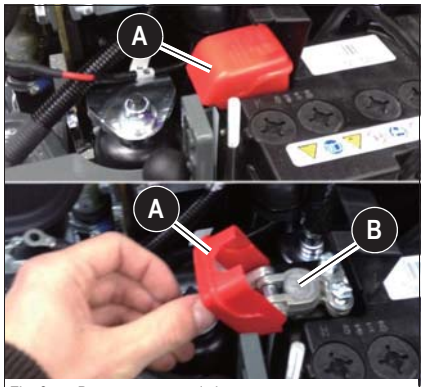


Fig. 9: Battery master switch

The battery isolator switch is located under the engine hood.

Interrupt the electric power supply:

☞ *Flip up the battery isolator switch **A** and remove from the **B** positive terminal.*

Establish the electric power supply:

☞ *Set the battery isolator switch **A** to the positive terminal **B** and fold down.*

Technical data

2 Technical data

2.1 Chassis

Sturdy steel sheet chassis, rubber-mounted engine

2.2 Engine

Engine	Model 803
Product	Yanmar diesel engine
Type	3TNV70-VNS
Design	Water-cooled 4 stroke diesel engine
Number of cylinders	3
Fuel injection system	Indirect injection
Aspiration	Natural aspiration
Cooling system	Water-cooled/blowing fan
Lubrication system	Force-feed lubrication with trochoidal pump
Displacement	854 cm³ (52.1 in³)
Nominal bore and stroke	70 x 74 mm (2.75 x 2.91 in)
Power	9.9 KW (13.3 hp) at 2100 rpm
Max. torque	51.5 Nm (38 ft lbs) at 1500 rpm
Max. engine speed without load	2270 +/− 25 rpm
Idling speed	1300 +/− 25 rpm
Valve clearance (intake = outlet)	0.15 – 0.25 mm/(0.006 – 0.01") cold
Compression	32.4 +/− 1 bar (469.9 +/− 15 psi) at 250 rpm
Engine oil pressure	2.9 – 4.4 bar (42 – 64 psi) at rated output
Pressure switch for engine oil pump	0.5 +/− 0.1 bar (7.25 +/− 1.45 psi)
Thermostat opening temperature	69.5 – 72.5 °C (157 – 163 °F)
Thermal switch	107 – 113 °C (225 – 235 °F)
Firing order	1 - 3 - 2 - 1
Direction of rotation	Anticlockwise (as seen from the flywheel)
Starting aid	Glow plugs (preheating time 4 seconds)
Specific fuel consumption	272 g/kWh (lb/hph)
Max. engine droop (all 2 pumps under full load)	By about 90 rpm
Exhaust values according to	EPA TIER IV final (up to 2012)

Fuel injection pump

Type	
Design	In-line pump
Injection pressure	118 – 128 bar (1711 – 1856 psi)
Engine speed control	Mechanical
Lubrication system	Force-feed engine oil lubrication

Engine capacities

Capacities	
Fuel tank	7 l (1.85 gal)
Engine oil (max./effect.)	2.8 l/1.3 l (0.74/0.34 gal)
Coolant (with radiator)	2.9 l (0.77 gal)
Coolant reservoir	1.1 l (0.29 gal)

Overview of capacities – siehe Betriebs- und Schmierstoffe auf Seite 3-3

Engine tightening torques

Tightening torques	
Cylinder-head bolt[1]	54 – 58 Nm (M9x1.25) (40 − 43 ft lbs)
Connecting rod bearing screw[1]	22.6 - 27.5 Nm (M7x1.0) (16.6–20.3 ft. lbs.)
Main bearing screw	75.5 - 81.5 Nm (M10x1.25) (55.7–60 ft. lbs.)
Flywheel screw	80.4 – 86.4 Nm (M10x1.25) (59.3 – 63.7 ft lbs)

1. Screws must be oiled!

2.3 Hydraulic system

Hydraulic system	Model
Pump (Tier IV final)	Twin gear pump 2 x 4 cm³ (2 x 0.24 in³/rev)
Flow rate (Tier IV final)	2 x 10.7 l/min at 2675 rpm (2 x 2.8 gpm at 2675 rpm)
Control block	9 sections
Main pressure limiting valve for pumps P1, P2	170 +/-3 bar (2465.64 +/-44 psi)
Secondary pressure limiting valve for swivel unit	70 $^{-0/+0.5}$ bar (1015.3 $^{-0/+7\ psi}$) at 11.5 l/min (3 gal/min)
Secondary pressure limiting valve, stick	250 +/-5 bar (3625.9 +/-72.5 psi)
Hydraulic reservoir capacity	13.8 l (3.6 gal)

Auxiliary hydraulics oil flow

Pressure (bar/psi)	P1 + P2 (l/min / gal/min)
12.5 / 181.3	22 / 5.8
37.8 / 548.2	20.8 / 5.5
50 / 725.2	20.4 / 5.4
79 / 1145.8	19.7 / 5.2
140 / 2030.5	18.5 / 4.8
160 / 2320.6	10.5 / 2.7
168 / 2436.6	5 / 1.3

Notice!

Output indications for auxiliary hydraulics with unpressurized return line

2.4 Travel gear and swivel unit

Travel gear/swivel unit	
Travel speeds	1.82 km/h (1.13 mph)
Hill climbing ability (no longer than 3 minutes)	30°/58 %
Track width	180 mm (7.09")
No. of track rollers on either side	2
Ground clearance	132 mm (5.2")
Ground pressure	0.24 kg/cm² (3.4 psi)
Upper carriage swivel speed	8 rpm

2.5 Stabilizer blade

Stabilizer blade	
Width (folded in/out)	700/860 mm (27.55"/33.85")
Height	198 mm (7.8")
Max. lift over/under subgrade	197/174 mm (7.76"/6.85")

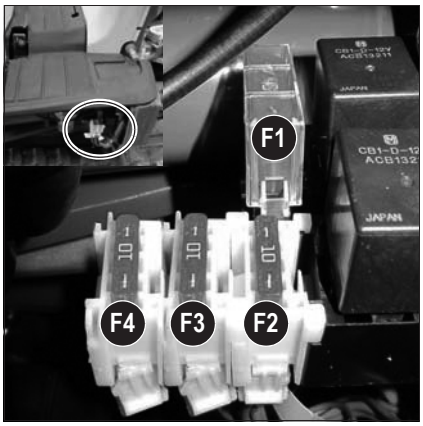
Screwable hose burst valve

Location	Thread	Gap dimension
Stabilizer blade	3/8"	0.3 mm (0.012")

2.6 Electrical system

Electrical system	
Dynamo	12 V 20 A
Starter	12 V 1.1 kW (1.5 hp)
Battery	12 V 30 Ah
Power outlet	e.g. for 12 V power outlet; 15 A max.

Fuses behind the right-hand trim



Fuse no.	Rated current (A)	Protected circuit
F1	40 A	Main fuse; Air-pressure sensor/output adaptation
F2	10 A	Fuse: relay, indicator, cutoff solenoid
F3	10 A	Fuse: travel signal (option)
F4	10 A	12 V power outlet

Relays behind the right-hand trim

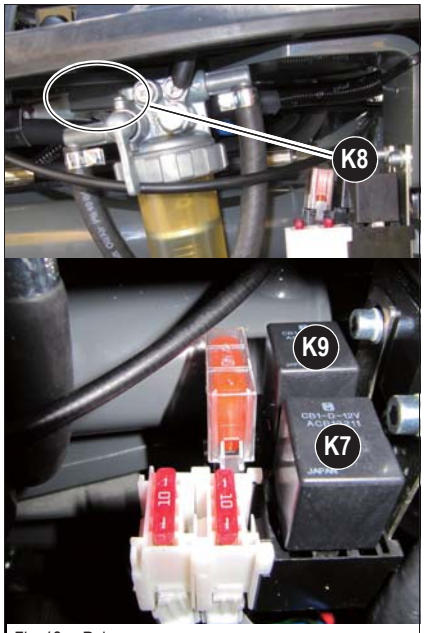


Fig. 12: Relays

Relay no.	Protected circuit
K 7	Starting relay
K 8	Cutoff solenoid time lag relay 1s
K 9	Cut-off solenoid switching relay

Fuses and relays with Dual Power option

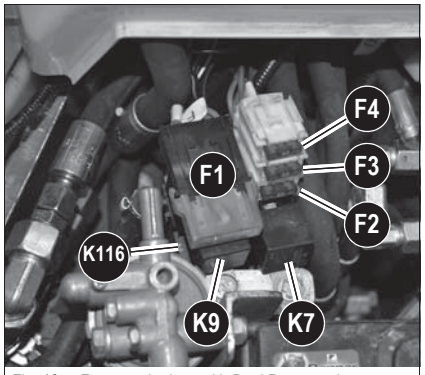


Fig. 13: Fuses and relays with Dual Power option

If the machine is equipped with the Dual Power option, the fuses and relays are located under the base plate.

Fuse no.	Rated current (A)	Protected circuit
F1	40 A	Main fuse; Air-pressure sensor/output adaptation
F2	10 A	Fuse: relay, indicator, cutoff solenoid
F3	10 A	Fuse: travel signal (option) battery control (Dual Power option)
F4	10 A	12 V power outlet

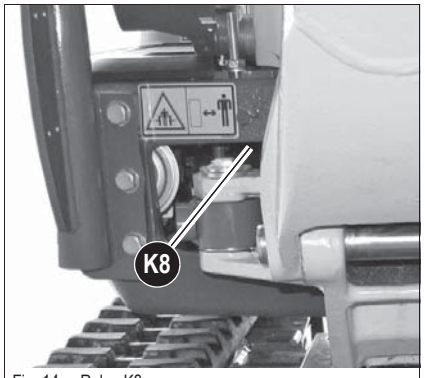


Fig. 14: Relay K8

Relay no.	Protected circuit
K 7	Starting relay
K 8	Cutoff solenoid time lag relay 1s
K 9	Cut-off solenoid switching relay
K 116	Battery monitor

2.7 Noise levels

Sound power level	
Sound power level (L_{WA})[1]	93 dB (A)
Operator-perceived sound pressure level (L_{PA})[2]	77 dB (A)
Uncertainty (K_{PA})[3]	1.2 dB (A)

1. ISO 6395 (EC Directives 2000/14/EC and 2005/88/EC)
2. EN ISO 4871 (EC Directives 2000/14/EC and 2005/88/EC)
3. ISO 6394 (EC Directives 84/532/EEC, 89/514/EEC, 95/27/EEC)

Notice!

Measurements performed on asphalted surface.

2.8 Vibration

Vibration	
Effective acceleration value for the upper extremities of the body (hand-arm vibration)	< Trigger value < 2.5 m/s^2
Effective acceleration value for the body (whole-body vibration)	< 0.5 m/s^2

Vibration values indicated in m/s².

2.9 Coolant compound table

Outside temperature	Coolant			
	Water	Anticorrosion agent		Antifreeze agent
Up to °C (°F)	% by volume	cm^3/l / (in^3/gal)	% by volume	% by volume
-37 (-34.6)	50	10 (2.6)	1	50

Use the 1:1 concentration for warm outside temperatures, too:

Protection against corrosion, cavitation and deposits

Do not mix the coolant with other coolants.

Machine filled at the factory with Eurolub SF D12 coolant (ethylene glycol basis).

2.10 Hose identification code

Example: SLHYDR2SC16PN180PD180L1950D0

SLHYDR	2SC	16	PN	18	0	PD	18	0	L1950	D	0
Hydraulic hose	Hose type	Nominal width (mm)	Fitting 1	Thread (fitting 1)	Angle (fitting 1)	Fitting 2	Thread (fitting 2)	Angle (fitting 2)	Installation length (mm)	Hose protection type	Angle of twist

2.11 Model-specific tightening torques

Model 803	Thread	Torque Nm (lb/ft)
Live ring	M12x1.25 10.9	130 (95.9)*
Track roller	M10 10.9	65 (47.9)*
Drive pinion	M10 10.9	65 (47.9)*
Travel drive	M10 10.9	65 (47.9)*
Gear motor	M12 10.9	110 (81.1)*
Angled engine bracket	M10 8.8	45 (33.2)
Engine bearing	M10 8.8	45 (33.2)
Pump base	M10 8.8	45 (33.2)
Pump	M10 8.8	45 (33.2)
Swivel joint	M10 10.9	64 (47.2)*
Bumper	M14 12.9	230 (169.6)*
Telescopic drive stop screws	M16 8.8	210 (154.9)

(*) All connections with an * must be glued with Loctite S2420 or VaryBond 12-43.

2.12 General tightening torques

Tightening torques for hydraulic screw connections (dry assembly)

Metric hose fittings for hydraulic applications (light execution, DKOL)				
Nominal Ø	Outer Ø	Thread	Wrench size	Torque Nm (ft lbs)
05	6L	M12X1.5	WS 14	15 (11)
06	8L	M14X1.5	WS 17	20 (14.7)
08	10L	M16X1.5	WS19	40 (29.5)
10	12L	M18X1.5	SW 22	50 (36.8)
12	15L	M22X1.5	SW 27	75 (55.3)
16	18L	M26X1.5	SW 32	85 (62.7)
20	22L	M30X2	SW 36	100 (73.75)
25	28L	M36X2	SW 41	180 (132.7)
32	35L	M45X2	SW 55	220 (162.3)

Galvanized and dry surface (O-ring slightly oiled). Torque tolerance: −10%
Values determined empirically and to be applied as approximate figures.

Metric hose fittings for hydraulic applications (heavy execution, DKOL)				
Nominal Ø	Outer Ø	Thread	Wrench size	Torque Nm (ft lbs)
05	8S	M16X1.5	WS19	40 (29.5)
06	10S	M18X1.5	SW 22	50 (36.8)
08	12S	M20X1.5	SW 24	60 (44.3)
10	14S	M22X1.5	SW 27	75 (55.3)
12	16S	M24X1.5	WS 30	90 (66.4)
16	20S	M30X2	SW 36	100 (73.8)
20	25S	M36X2	SW 41	180 (132.8)
25	30S	M42X2	SW 50	270 (199.1)
32	38S	M52X2	SW 60	400 (295)

Galvanized and dry surface (O-ring slightly oiled). Torque tolerance: −10%
Values determined empirically and to be applied as approximate figures.

Metric threaded fittings with various seals for hydraulic applications (Triple-Lok)					
Thread	Straight pipe fitting with thread and screwed plug			Non-return valve with elastic seal	Pipe outside diameter
	Sealing washer	Elastic seal	O-ring		
	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	mm (")
M10X1.0	9 (7)	18 (13)	18 (13)	18 (13)	6 (0.2)
M12X1.5	20 (15)	25 (18)	25 (18)	25 (18)	8 (0.3)
M14X1.5	35 (26)	45 (33)	45 (33)	35 (26)	10 (0.4)
M16X1.5	45 (33)	55 (41)	55 (41)	50 (37)	12 (0.5)
M18X1.5	55 (41)	70 (52)	70 (52)	70 (52)	15 (0.6)
M22X1.5	65 (48)	125 (92)	125 (92)	125 (92)	18 (0.7)
M26X1.5	90 (66)	180 (133)	180 (133)	145 (107)	22 (0.9)
M33X2.0	150 (111)	310 (229)	310 (229)	210 (155)	28 (1.1)
M42X2.0	240 (177)	450 (332)	450 (332)	360 (266)	35 (1.4)
M48X2.0	290 (214)	540 (398)	540 (398)	540 (398)	42 (1.7)

Tolerance for tool repeat accuracy: +10%
Torque reduction for screw-in holes made of aluminum: -35%

Metric threaded fittings with various seals for hydraulic applications in a heavy-duty design (O-Lok)					
Thread	Straight pipe fitting with thread and screwed plug			Non-return valve with elastic seal	Pipe outside diameter
	Sealing washer	Elastic seal	O-ring		
	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	mm (")
M12X1.5	20 (15)	35 (26)	35 (26)	35 (26)	6 (0.2)
M14X1.5	35 (26)	45 (33)	45 (33)	45 (33)	8 (0.3)
M16X1.5	45 (33)	70 (52)	70 (52)	55 (41)	10 (0.4)
M18X1.5	55 (41)	90 (66)	90 (66)	70 (52)	12 (0.47)
M20X1.5	55 (41)	125 (92)	125 (92)	100 (74)	14 (0.55)
M22X1.5	65 (48)	135 (100)	135 (100)	125 (92)	16 (0.6)
M27X2.0	90 (66)	180 (133)	180 (133)	135 (100)	20 (0.8)
M33X2.0	150 (111)	310 (229)	310 (229)	210 (155)	25 (0.98)
M42X2.0	240 (177)	450 (332)	450 (332)	360 (266)	30 (1.2)
M48X2.0	290 (214)	540 (398)	540 (398)	540 (398)	38 (1.5)

Tolerance for tool repeat accuracy: +10%
Torque reduction for screw-in holes made of aluminum: -35%

Imperial threaded fittings with various seals for hydraulic applications (Triple-Lok)					
Thread	Straight pipe fitting with thread and screwed plug			RHV with O-ring	Pipe outside diameter
	Sealing washer	Elastic seal	O-ring		
	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	mm (")
G1/8A	9 (7)	18 (13)	18 (13)	18 (13)	6 (0.2)
G1/4A	35 (26)	35 (26)	35 (26)	35 (26)	8 (0.3)
G1/4A	35 (26)	35 (26)	35 (26)	35 (26)	10 (0.4)
G3/8A	45 (33)	70 (52)	70 (52)	50 (37)	12 (0.5)
G1/2A	65 (48)	90 (66)	90 (66)	85 (48)	15 (0.6)
G1/2A	65 (48)	90 (66)	90 (66)	65 (48)	18 (0.7)
G3/4A	90 (66)	180 (133)	180 (133)	140 (103)	22 (0.9)
G1A	150 (111)	310 (229)	310 (229)	190 (140)	28 (1.1)
G1 1/4A	240 (177)	450 (332)	450 (332)	360 (266)	35 (1.4)
G1 1/2A	290 (214)	540 (398)	540 (398)	540 (398)	42 (1.7)

Tolerance for tool repeat accuracy: +10%
Torque reduction for screw-in holes made of aluminum: -35%

Imperial threaded fittings with various seals for hydraulic applications in a heavy-duty design (O-Lok)					
Thread	Straight pipe fitting with thread and screwed plug			RHV with O-ring	Pipe outside diameter
	Sealing washer	Elastic seal	O-ring		
	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)	mm (")
G1/4A	35 (26)	40 (29)	40 (29)	45 (33)	6 (0.2)
G1/4A	35 (26)	40 (29)	40 (29)	45 (33)	8 (0.3)
G3/8A	45 (33)	80 (59)	80 (59)	60 (44)	10 (0.4)
G3/8A	45 (33)	80 (59)	80 (59)	60 (44)	12 (0.5)
G1/2A	65 (48)	115	115	145 (107)	14 (0.55)
G1/2A	65 (48)	115	115	100 (74)	16 (0.6)
G3/4A	90 (66)	180 (133)	180 (133)	145 (107)	20 (0.8)
G1A	150 (111)	310 (229)	310 (229)	260 (192)	25 (0.98)
G1 1/4A	240 (177)	450 (332)	450 (332)	360 (266)	30 (1.2)
G1 1/2A	290 (214)	540 (398)	540 (398)	540 (398)	38 (1.5)

Tolerance for tool repeat accuracy: +10%
Torque reduction for screw-in holes made of aluminum: -35%

Tightening torques for high-resistance threaded fittings

With coarse-pitch thread			
Thread	Screws according to DIN 912, DIN 931, DIN 933, etc.		
	8.8	**10.9**	**12.9**
	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)
M5	5.5 (4)	8 (6)	10 (7)
M6	10 (7)	14 (10)	17 (13)
M8	25 (18)	35 (26)	42 (31)
M10	45 (33)	65 (48)	80 (59)
M12	87 (64)	110 (81)	147 (108)
M14	135 (100)	180 (133)	230 (170)
M16	210 (155)	275 (203)	350 (258)
M18	280 (207)	410 (302)	480 (354)
M20	410 (302)	570 (420)	690 (509)
M22	550 (406)	780 (575)	930 (686)
M24	710 (524)	1000 (738)	1190 (878)
M27	1040 (767)	1480 (1092)	1770 (1305)
M30	1420 (1047)	2010 (1482)	2400 (1770)

DIN 912 - hexagon socket head cap screws; DIN 931/DIN 933 - hexagon bolts with/without shaft;
All values subject to a friction coefficient of μ = 0.12 and are to be used as approximate figures.

With fine-pitch thread			
Thread	Screws according to DIN 912, DIN 931, DIN 933, etc.		
	8.8	**10.9**	**12.9**
	Nm (ft lbs)	Nm (ft lbs)	Nm (ft lbs)
M8X1.0	25 (18)	37 (28)	43 (32)
M10X1.0	50 (37)	75 (55)	88 (65)
M10X1.25	49 (36)	71 (52)	83 (61)
M12X1.25	87 (64)	130 (96)	150 (111)
M12X1.5	83 (61)	125 (92)	145 (107)
M14X1.5	135 (100)	200 (148)	235 (173)
M16X1.5	210 (155)	310 (229)	360 (266)
M18X1.5	315 (232)	450 (332)	530 (391)
M20X1.5	440 (325)	630 (465)	730 (538)
M22X1.5	590 (435)	840 (620)	980 (723)
M24X2.0	740 (546)	1070 (789)	1250 (922)
M27X2.0	1100 (811)	1550 (1143)	1800 (1328)
M30X2.0	1500 (1106)	2150 (1586)	2500 (1844)

DIN 912 - hexagon socket head cap screws; DIN 931/DIN 933 - hexagon bolts with/without shaft;
All values subject to a friction coefficient of μ = 0.12 and are to be used as approximate figures.

2.14 Dimensions with ROPS rollbar

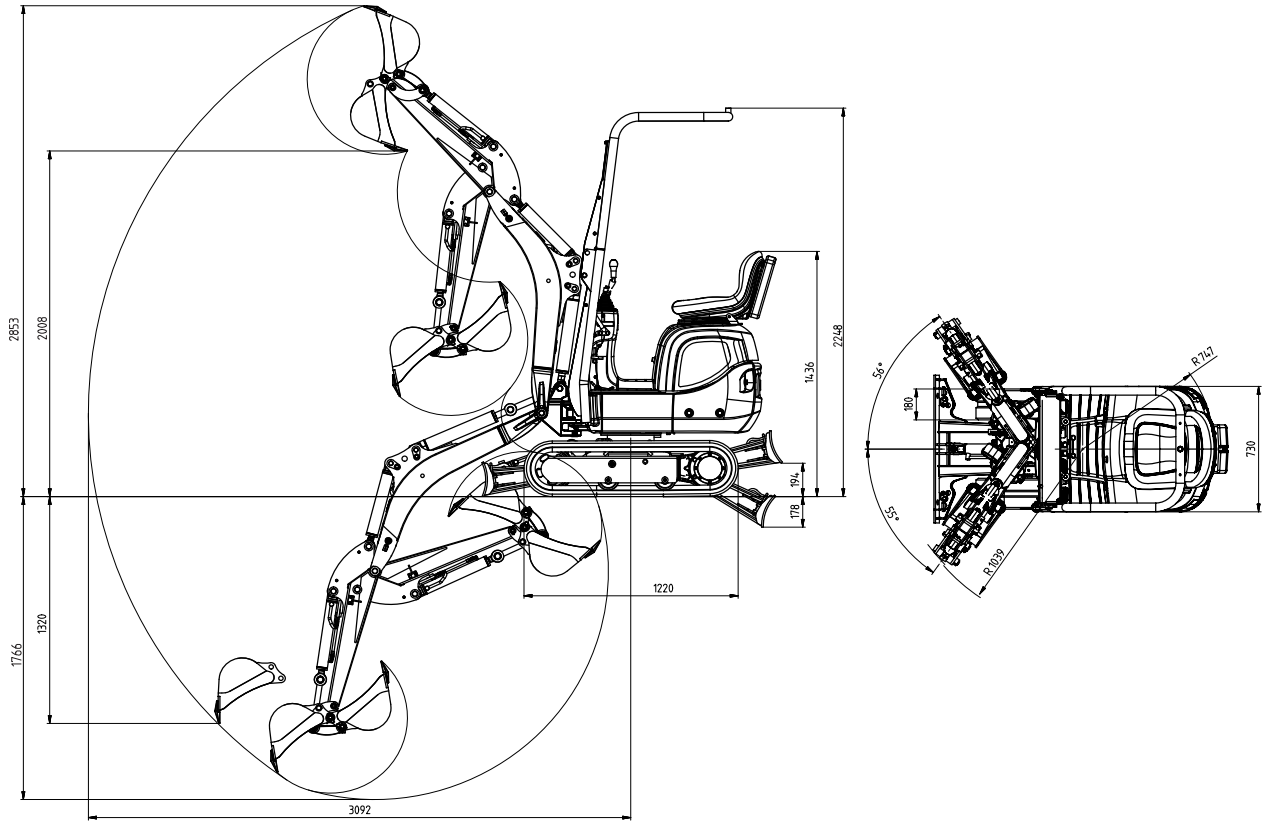


Fig. 16: Vehicle dimensions

Main data	
Operating weight	1087 kg (2396 lbs)
Transport weight	990 kg (2182 lbs)
Height (transport position)	2248 mm (7'-5")
Upper carriage width	730 mm (2'-5")
Width of telescopic travel gear (retracted/extended)	700/860 mm (2'-4"/2'-10")
Width of stabilizer blade (folded in/out)	700/860 mm (2'-4"/2'-10")
Transport length	2747 mm (9')
Max. digging depth	1766 mm (5'-10")
Stick length	890 mm (2'-11")
Max. vertical digging depth	1320 mm (4'-4")
Max. digging height	2853 mm (9'-4")
Max. tilt-out height	2008 mm (6'-7")
Max. digging radius	3092 mm (10'-2")
Max. reach at ground level	3046 mm (10')
Max. breakout force at bucket tooth	8.99 kN (2021 lbf)
Max. tearout force	4.51 kN (1014 lbf)
Min. tail end slewing radius	747 mm (2'-5")
Max. tail end lateral projection (90° rotation of upper carriage) Retracted/extended telescopic travel gear Stabilizer blade folded in/out	 397/317 mm (1'-4"/1') 397/317 mm (1'-4"/1')
Max. boom displacement to bucket center (right side)	287 mm (0'-11")
Max. boom displacement to bucket center (left side)	242 mm (0'-10")

2.15 Dimensions without ROPS rollbar

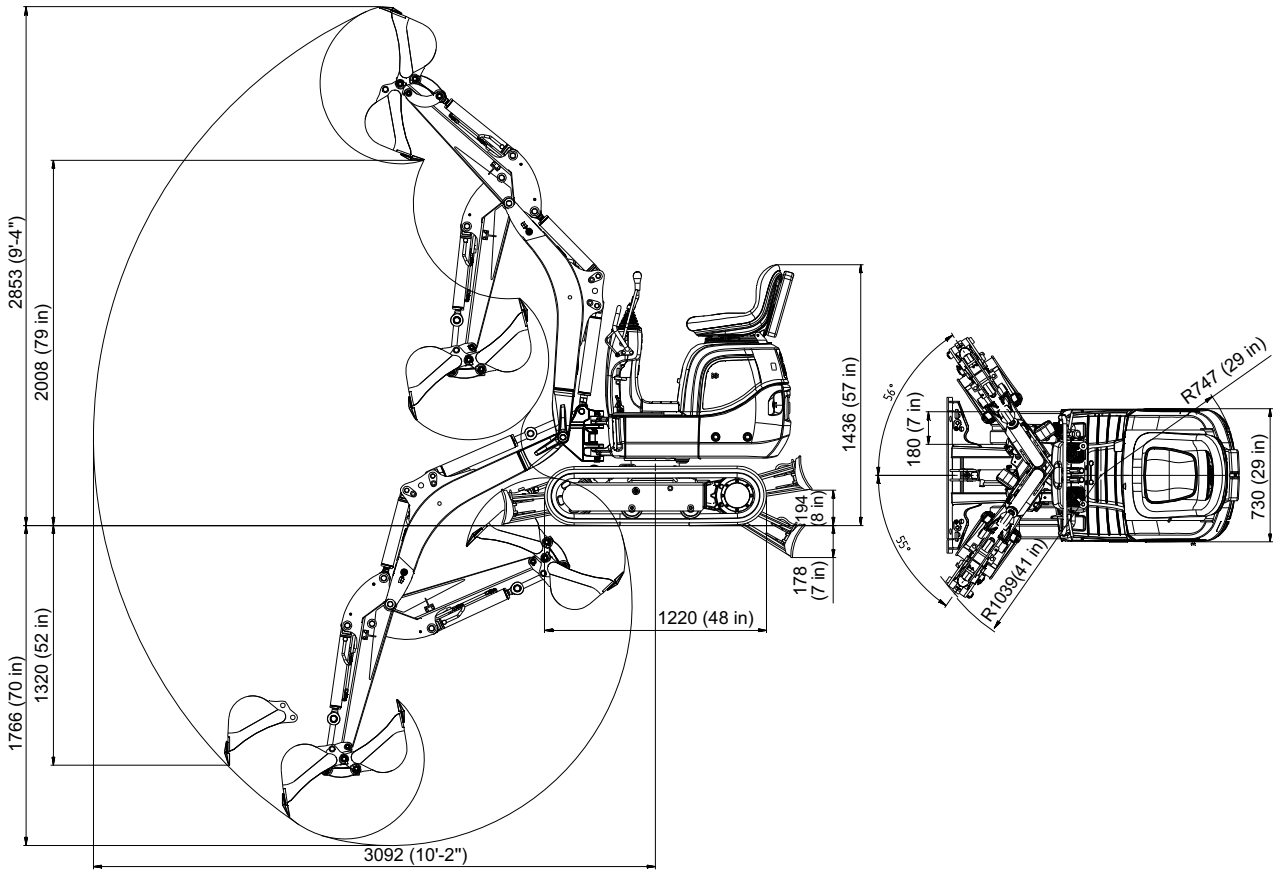


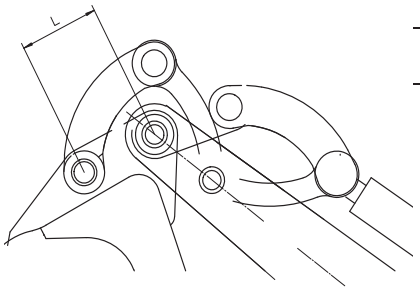
Fig. 17: Vehicle dimensions

Main data	
Operating weight	1029 kg (2268 lbs.)
Transport weight	932 kg (2055 lbs)
Height (transport position)	1436 mm (4'-9")
Upper carriage width	730 mm (2'-5")
Width of telescopic travel gear (retracted/extended)	700/860 mm (2'-4"/2'-10")
Width of stabilizer blade (folded in/out)	700/860 mm (2'-4"/2'-10")
Transport length	2747 mm (9 ft.)
Max. digging depth	1763 mm (5'-9")
Stick length	890 mm (2'-11")
Max. vertical digging depth	1320 mm (4'-4")
Max. digging height	2853 mm (9'-4")
Max. tilt-out height	2008 mm (6'-7")
Max. digging radius	3090 mm (10'-2")
Max. reach at ground level	3046 mm (10')
Max. breakout force at bucket tooth	8.99 kN (2021 lbf)
Max. tearout force	4.51 kN (1014 lbf)
Min. tail end slewing radius	747 mm (2'-5")
Max. tail end lateral projection (90° rotation of upper carriage) Retracted/extended telescopic travel gear Stabilizer blade folded in/out	 397/317 mm (1'-3"/1') 397/317 mm (1'-3"/1')
Max. boom displacement to bucket center (right side)	287 mm (0'-11")
Max. boom displacement to bucket center (left side)	242 mm (0'-10")

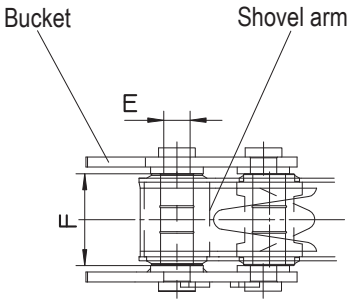
2.16 Lift capacity table

Refer to the Operator's Manual of the machine for specific data.

2.17 Kinematics



E	Pin diameter	25 mm (0.98")
F	Stick width	100 mm (3.9")
L	Pin distance from bucket mount	86.3 mm (3.4")



Maintenance

3 Maintenance

3.1 Information on maintenance

Responsibilities and prerequisites

The working order and the service life of vehicles are heavily dependent on maintenance.

Servicing and maintenance must be performed by authorized personnel.

Have the maintenance, delivery inspection and the entries in the service booklet completed, otherwise warranty claims will not be acknowledged.

This ensures optimal machine operation. Immediately repair or replace parts that are already damaged or not working properly before they are due for replacement.

Use only original spare parts for repairs.

The manufacturer shall not be liable for damage to the machine or personal injury caused by failure to observe the specific information and descriptions.

Important safety instructions on maintenance

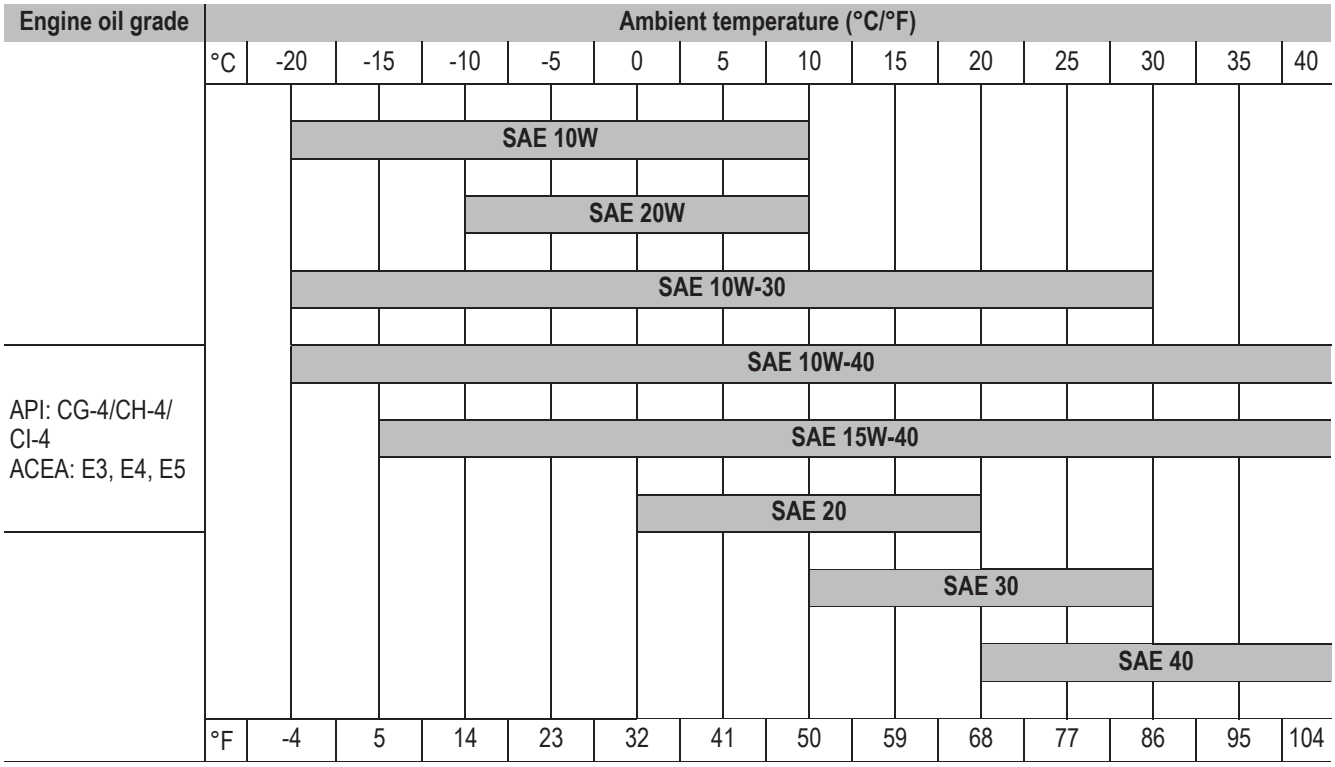
- Follow all safety instructions given in the Operator's Manual.
- Follow the maintenance and safety instructions given in the operator's manuals of the attachments.
- Wear protective equipment (for example hard hat, safety glasses, protective gloves, safety boots).
- Observe the danger indications and safety instructions during maintenance.
- In order to avoid injury hazard, do not perform work on a hot and running engine.
- Use a suitable container to collect fluids and lubricants as they flow out and dispose of them in an environmentally friendly manner.
- Attach a warning label to the control elements (for example **"Machine being serviced, do not start"**).
- In order to avoid damage to electronic components, do not perform welding work on the machine, add-on parts or tools, take suitable precautions:
  - Actuate the battery master switch
  - Disconnect both battery pole cables
- High engine load or a manual regeneration of the diesel particulate filter can lead to shorter engine oil maintenance intervals. The machine output is reduced if the maintenance interval is not complied with.
- If the machine is operated less than 500 hours per year the engine oil must be changed once a year.

3.3 Fluids and lubricantse

Component/application	Fluid/lubricant	Specification	Season/temperature	Capacities[1]
Diesel engine	Engine oil	API: CG-4/CH-4/CI-4 ACEA: E3, E4, E5	−15 °C (5 °F) +40 °C (104 °F)	2.5 l (0.66 gal)
		ACEA E3, E4, E5 (SAE10 W 40)[2]		
Hydraulic oil reservoir	Hydraulic oil	HVLP46[3]	Year-round[4]	13.8 l (3.64 gal)
		HVLP46[5]		
	Biodegradable oil[6]	PANOLIN HLP Synth 46		
		BP BIOHYD SE-46		
Grease	Roller and friction bearings	KPF2N-20[7]	Year-round	As required
	Live ring gears			
	Live ring (ball bearing race)			
	Grease nipples			
Battery terminals	Acid-proof grease[8]	FINA Marson L2	Year-round	As required
Fuel tank	Diesel fuel	2-D ASTM D975 – 94 (USA)	Depending on outside temperatures Summer or winter diesel fuel	7 l (1.85 gal)
		1-D ASTM D975 – 94 (USA)		
		EN 590 : 96 (EU)		
		ISO 8217 DMX (International)		
		BS 2869 – A1 (GB)		
		BS 2869 – A2 (GB)		
Engine cooling system	Coolant	Distilled water and antifreeze ASTM D6210 (violet)	Year-round	2.9 l (0.77 gal)
Ball socket ISO/ SAE controls	Lubricant	Gleitmo 800	Year-round	As required

1. The capacities indicated are approximate values; the oil level check alone is relevant for the correct oil level
   Capacities indicated are not system fills.
2. According to DIN 51511
3. According to DIN 51524 section 3
4. Depending on local conditions - See hydraulic oil grade on page 3-5
5. According to DIN 51524 section 3
6. Hydraulic ester oils (HEES)
7. KP2N-20 according to DIN 51502 EP multipurpose calcium sulphonate complex grease
8. Standard acid-proof grease

Oil grades for the diesel engine, depending on temperature



Additional oil change and filter replacement (hydraulic system)

Attention!

An additional oil change and filter replacement can be required depending on how the machine is used. Failure to observe these replacement intervals can cause damage to hydraulic components.

☞ *Observe the following intervals*

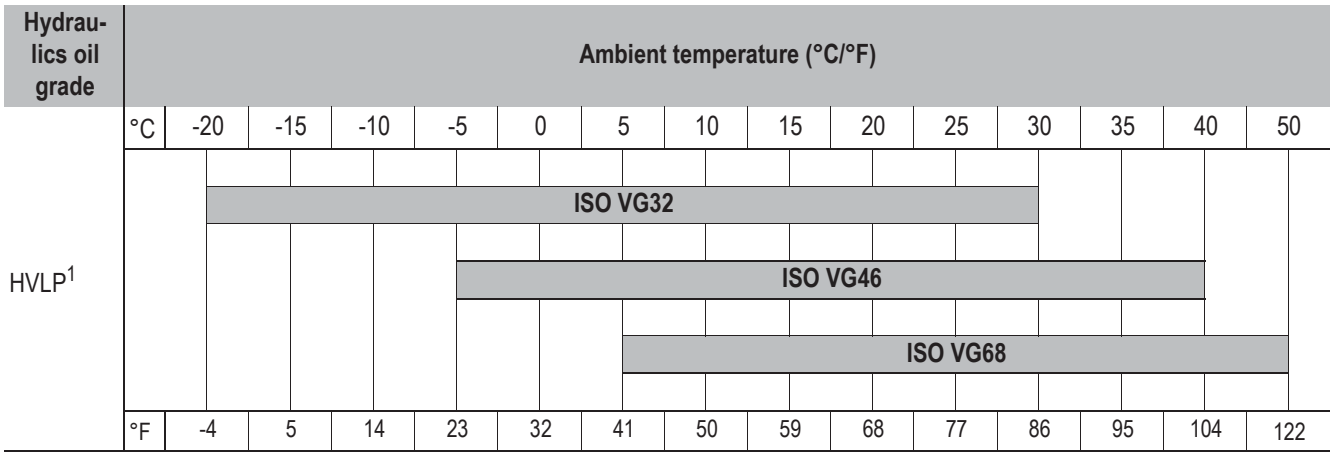
Application		Hydraulic oil	Hydraulic oil filter insert
Normal work (excavation work)		Replace the first time after 500 o/h, then every 1000 o/h	Replace the first time after 50 o/h, then every 500 o/h
Percentage of hammer work	20%	Every 800 o/h	300 o/h
	40%	Every 400 o/h	
	60%	Every 300 o/h	100 o/h
	Over 80%	Every 200 o/h	

Notice!

Please refer to the maintenance plan on page *3-9* for additional maintenance work.

Oil grades for the hydraulic system, depending on temperature

Important information regarding operation with biodegradable



1. According to DIN 51524 section 3

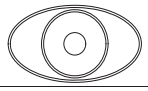
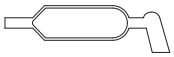
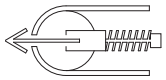
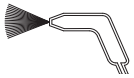
Important notes about operation with bio-hydraulic oil

hydraulic oil

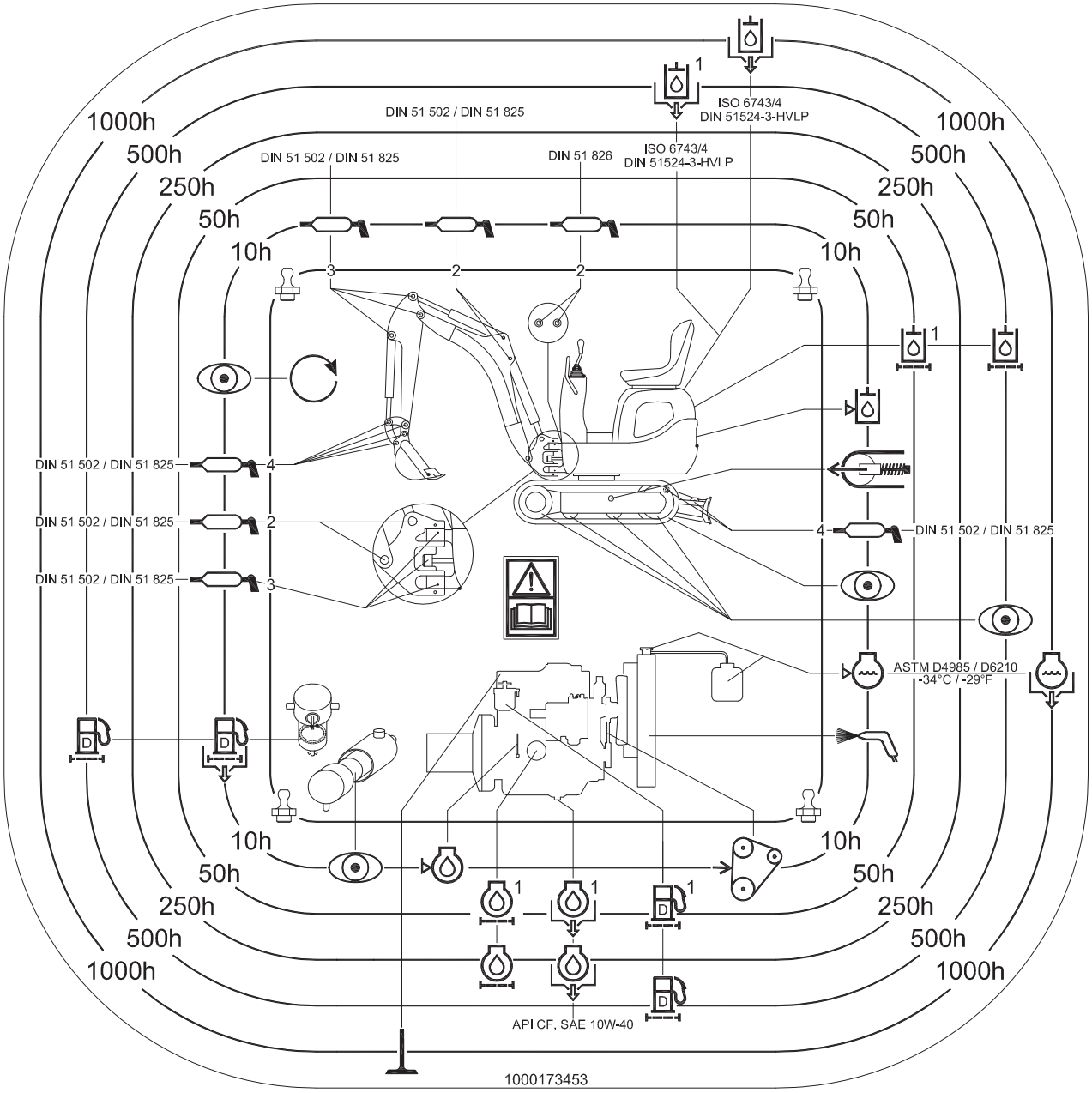
- Use only the biodegradable oils that have been tested and released by HCE.
  Refer to the Operator's Manual of the machine for more information.
- Add only biodegradable oil of the same type. The joint use of two different biodegradable oils can affect the quality of one of the oil types. When replacing the biodegradable oil, always comply with national regulations and the manufacturer's specifications.
- In order to avoid misunderstandings, attach a label near the hydraulic oil filler inlet providing clear information regarding the type of oil currently used.
- Do not add any mineral oil to prevent foaming problems, and avoid negative effects on the biodegradability of the biodegradable oil.
- When running the vehicle with biodegradable oil, the same oil and filter replacement intervals are valid as for mineral oil.
- Always drain the condensation water in the hydraulic oil reservoir before the cold season. The water content may not exceed 0.1% by weight.
- The instructions in the Operator's Manual concerning environmental protection are also valid for the use of biodegradable oil.
- Additional hydraulic attachments must be filled with the same oil as the one in the hydraulic system of the excavator.

3.4 Maintenance label

Explanation of symbols on the maintenance label

Symbol	Assembly	Explanation
	General	Visual check
	General	Grease instructions
	fuel system	Drain condensation water
	fuel system	Replace the fuel filter, clean the fuel prefilter
	Radiator	Check the coolant level
	Radiator	Drain and add new coolant
	Engine	Check valve clearance. Adjust if necessary
	Engine	Check the engine oil level
	Engine	Change the engine oil
	Engine	Replace the oil filter
	Engine	Check the V-belt tension
	Chassis	Check track tension
	Hydraulic system	Check oil level
	Hydraulic system	Replace the hydraulic oil
	Hydraulic system	Replace the hydraulic oil filter, replace the breather filter
	Radiator fins	Cleaning

Maintenance label



3.5 Maintenance plan (overview)

Work description

For servicing and maintenance on the attachment, please refer to the operation and maintenance manual of the attachment manufacturer.

	Maintenance plan/operating hours (o/h)							
	Maintenance work (daily)	Every 50 o/h	Every 250 o/h	every 500 hours	Every 1000 o/h once a year	Every 2000 s/h	Customer	Authorized service center
Fluid and filter changes ( ):								
Perform the following oil and filter changes (check oil levels after test run):								
• Engine oil[1]		●	●					●
• Engine oil filter[2]		●	●					●
• Fuel filter[3]		●		●				●
• Water separator					●			●
• Coolant					●			●
• Hydraulic oil filter insert[4]		●		●				●
• Hydraulic oil[5]				●	●			●
• Drain condensation water from the hydraulic oil reservoir				●				●
							●	
• Air filter element according to dirt indicator 6					●		●	
Inspection work ( ):								
Check the following material. Refill if necessary:								
• Engine oil	●						●	
• Engine coolant	●						●	
• Fuel	●						●	
• Hydraulic oil	●						●	
Check the function of the pedals, they must flip back automatically • Clean, lubricate or repair the pedals, check the torsion springs	●						●	
Clean water ducts[7]					●			●

3.5 Maintenance plan (overview)

Work description

For servicing and maintenance on the attachment, please refer to the operation and maintenance manual of the attachment manufacturer.

	Maintenance plan/operating hours (o/h)							
	Maintenance work (daily)	Every 50 o/h	Every 250 o/h	every 500 hours	Every 1000 o/h once a year	Every 2000 s/h	Customer	Authorized service center
Check radiator for engine and hydraulic oil for dirt. Clean if necessary	●						●	
Check cooling systems and hoses for leaks and pressure (visual check)	●						●	
Air filter (damage)	●						●	
Remove dust from dust valve	●						●	
Prefilter with water separator: drain water	●						●	
• Cleaning			●				●	
Check V-belt condition and tension	●						●	
Replacing the V-belt				●				●
Check the exhaust system for damage and condition	●						●	
Check the rollbar for damage	●						●	
Check valve clearance. Adjust if necessary					●			●
Clean and adjust the fuel injection pump[8]					●			●
Check and adjust the injection pressure of the injection nozzles, clean the injection needles/nozzles					●			●
Check and adjust injection time[9]					●			●
Empty the fuel tank and check for dirt				●				●
Check battery electrolyte. Add distilled water if necessary		●		●			●	

3.5 Maintenance plan (overview)

Work description

For servicing and maintenance on the attachment, please refer to the operation and maintenance manual of the attachment manufacturer.

	Maintenance plan/operating hours (o/h)							
	Maintenance work (daily)	Every 50 o/h	Every 250 o/h	every 500 hours	Every 1000 o/h once a year	Every 2000 s/h	Customer	Authorized service center
Check battery degasification hose for its condition (damage, contaminants, crushes, etc.)					●			
Check alternator, starter and electric connections, bearing play and function				●				●
Check preheating system and electric connections				●				●
Pressure check of primary pressure limiting valves[10]		●			●			●
Check tracks for cracks and cuts	●						●	
Check the track tension and retention the tracks if necessary	●						●	
Check bearing play of tread rollers, track carrier rollers, front idlers				●				●
Check piston rods for damage	●						●	
Check the threaded fittings of the safety devices (for example rollbar, etc.) for tightness	●						●	
Check the threaded fittings for tightness				●				●
Check pin lock	●						●	
Check line fixtures	●						●	
Check indicator lights for correct function	●						●	
Couplings, dirt pile-up on hydraulic system dust caps	●						●	
Check insulating mats in engine compartment for damage/condition		●					●	
Check labels and Operator's Manual for completeness and condition		●					●	
Lights and acoustic warning system[11]		●					●	
Check lubricant on live ring[12]		●		●				●
Check gearing of swivel unit pinion					●			●
Lubrication service ( ):								
Lubricate the following assemblies/components – *see Maintenance label* on page 3-6:								
• Stabilizer blade	●						●	

3.5 Maintenance plan (overview)

Work description

For servicing and maintenance on the attachment, please refer to the operation and maintenance manual of the attachment manufacturer.

	Maintenance plan/operating hours (o/h)							
	Maintenance work (daily)	Every 50 o/h	Every 250 o/h	every 500 hours	Every 1000 o/h once a year	Every 2000 s/h	Customer	Authorized service center
• Swiveling console	●						●	
• Swiveling cylinder	●						●	
• Boom	●						●	
• Shovel arm	●						●	
• Attachments	●						●	
• Teeth of live ring					●		●	
• Live ring (ball bearing)	●						●	
• Ball sockets (ISO/SAE changeover option)		●					●	
Functional check ( ):								
Check the function of the following assemblies/components. Rectify if necessary:								
• Lights and acoustic warning system	●						●	
• Check pedal function	●						●	
Leakage check ( ):								
Check for tightness, leaks and chafing: pipes, flexible lines and screw connections of the following assemblies and components. Repair if necessary:								
• Visual check	●						●	
☞ Engine, hydraulic system and hydraulic components	●						●	
☞ Cooling circuit	●						●	
☞ Travel drive	●						●	

1. Drain engine oil the first time after 50 o/h, then every 250 o/h
2. Replace the engine oil filter the first time after 50 o/h, then every 250 o/h
3. Replace the fuel filter the first time after 50 o/h, then every 500 o/h
4. Replace the hydraulic oil filter insert the first time after 50 o/h, then every 500 o/h
5. Replace the hydraulic oil the first time after 500 o/h, after 1000 o/h the second time, then every 1000 o/h
6. According to the dirt indicator, every 1000 o/h or once a year at the latest. (Replace after 50 o/h when in extensive use in environments with acidic air, such as acid production facilities, steel and aluminum mills, chemical plants and other nonferrous-metal plants)
7. Clean the water ducts every other 1000 o/h servicing
8. Clean and adjust the fuel injection pump every other 1000 o/h servicing
9. Check and adjust injection time every other 1000 o/h servicing
10. Check the first time after 50 o/h, then every 500 o/h
11. Check once a week
12. Check the first time after 50 o/h, then every 500 o/h

3.6 Fuel system

Specific safety instructions

- Extreme caution is essential when handling fuel – increased fire hazard!
- Never perform work on the fuel system near open flames or sparks!
- Do not smoke when working on the fuel system or when refueling!
- Before refueling, stop the engine and remove the starting key!
- Do not refuel in closed rooms!
- Wipe away fuel spills immediately!
- Keep the vehicle clean to reduce the fire hazard!

Refueling

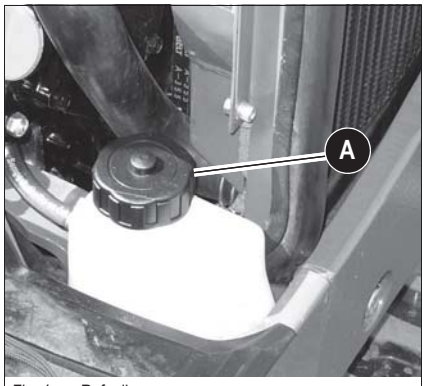


Fig. 1: Refueling

Filler inlet **A** for the fuel tank is located under the engine cover, on the left in travel direction.

Danger!

All work involving fuel carries an increased

fire and poisoning risk!

☞ *Do not refuel in closed rooms*

☞ *Never perform work on the fuel system near open flames or sparks*

Environment!

Use a suitable container to collect the fuel as it drains and dispose of it in an environmentally friendly manner!

Notice!

Do not run the fuel tank completely dry. Otherwise, air is drawn into the fuel system. This requires bleeding the fuel
system.
– *see Bleeding the fuel system* on page 3-15

Notice!

Fill up the tank with the correct fuel type at the end of each working day. This prevents condensation water from forming in the fuel tank over night. Do not fill the tank completely but leave some space for the fuel to expand.

Stationary fuel pumps

General

Only refuel from stationary fuel pumps. Fuel from barrels or cans is usually dirty.

Even the smallest particles of dirt can cause

- Increased engine wear
- Malfunctions in the fuel system and
- Reduced effectiveness of the fuel filters

Refueling from barrels

If refueling from barrels is unavoidable, please note the following (see Fig. 2):

- Barrels must neither be rolled nor tilted before refueling
- Protect the suction pipe opening of the barrel pump with a fine-mesh screen
- Immerse it down to a max. 150 mm (5.9 in) above the bottom of the barrel
- Only fill the tank using refueling aids (funnels or filler pipes) with an integral microfilter
- Keep all refueling containers clean at all times

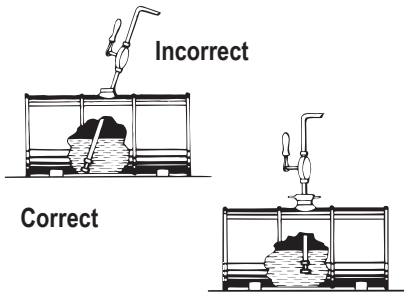


Fig. 2: Refueling from a barrel

Diesel fuel specification

Use only high-grade fuels

Grade	Use
• 2-D ASTM D975 – 94	USA
• 1-D ASTM D975 – 94	
• EN 590: 96	EU
• ISO 8217 DMX	International
• BS 2869 – A1	England
• BS 2869 – A2	

- Sulfur content < 0.05 %
- Cetane number > 45

Bleeding the fuel system

Danger!

If the fuel, as it drains, comes into contact with hot engine parts or the exhaust system, there is an increased

Fire hazard!

☞ *Never bleed the fuel system if the engine is hot!*

Bleed the fuel system in the following cases:

- After removing and fitting the fuel filter, prefilter or the fuel lines back on again
- After running the fuel tank empty
- After running the engine again, after it has been out of operation for a longer period of time

Bleed the fuel system as follows:

- Fill the fuel tank
- Turn the starting key to the first position
- Wait about 5 minutes while the feed pump bleeds the fuel system automatically
- Starts the engine
- Check for leaks after starting the engine
- Let the fuel system run by performing a test run of 5 minutes at idling speed

If the engine runs smoothly for a while and then stops, or if it does not run smoothly:

- Stop the engine
- Raise the lock lever
- Remove the starting key
- Bleed the fuel system again as described above
- Have this checked by authorized personnel if necessary

Fuel prefilter with water separator

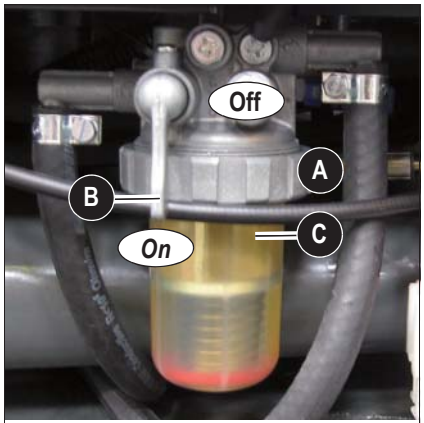


Fig. 3: Fuel prefilter

Check the fuel prefilter as follows:

☞ *Remove the right-hand chassis cover in order to be able to see the water separator.*

☞ *If the red indicator ring rises to position **C***

☞ *Unscrew thread **A***

➥ Empty the receptacle

➥ Fit the receptacle back on again

☞ *Screw thread **A** back on again*

☞ *Bleed the fuel system – see chapter Bleeding the fuel system on page 3-15*

Interrupt fuel supply as follows:

☞ *Turn ball-type cock **B** to the **OFF** mark*

➥ Fuel supply is interrupted

☞ *Turn ball-type cock **B** to the **ON** mark*

➥ Fuel supply is open again

Environment!

Thread **A** is fitted with a hose. Collect the water as it drains with a suitable container and dispose of it in an environmentally friendly manner.

Replace the fuel filter

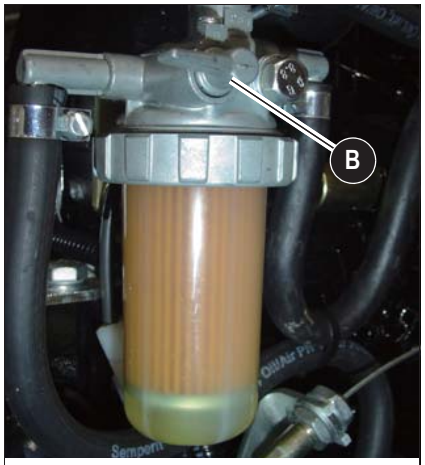


Fig. 4: Fuel filter

Danger!

If the fuel, as it drains, comes into contact with hot engine parts or the exhaust system, there is an increased

Fire hazard!

☞ *Never change the fuel filter if the engine is hot!*

Environment!

Use a suitable container to collect the fuel as it drains and dispose of it in an environmentally friendly manner!

☞ *Open the engine cover*
☞ *Close stop cock **B** (horizontal)*
☞ *Unscrew the union nut*
☞ *Remove the transparent housing*
☞ *Remove the old filter insert*
☞ *Put the new filter insert in place*
☞ *Fit the housing back on again (apply a thin coat of oil or diesel fuel to the sealing surface)*
☞ *Open stop cock **B** (vertical)*
☞ *Bleed the fuel system – see chapter Bleeding the fuel system on page 3-15*
☞ *Check the filter for tightness after a short test run.*
☞ *Dispose of the old filter insert in an environmentally friendly manner*
☞ *Close and lock the engine cover*

3.7 Engine lubrication system

Attention!

If the engine oil level is too high or too low, or if an oil change is overdue, this can cause

Engine damage and loss of output!

☞ *Have the oil changed by an authorized workshop*
– see chapter 3.5 Maintenance plan (overview) on page 3-9

Checking the oil level

Notice!

Check the oil level once a day.
We recommend checking it before starting the engine. After stopping a warm engine, wait at least 5 minutes before checking.

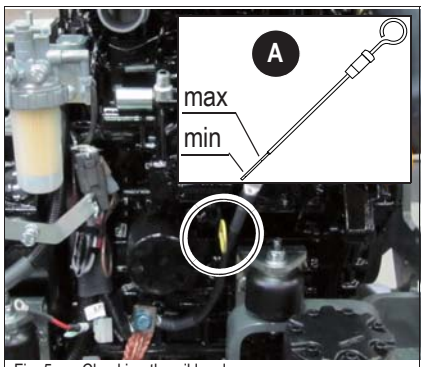


Fig. 5: Checking the oil level

- Park the vehicle on level ground
- Stop the engine
- Raise the lock lever
- Remove the starting key
- Let the engine cool down.
- Opening the engine cover
- Clean the area around the oil dipstick with a lint-free cloth
- Pull out oil dipstick **A**

☞ Wipe it with a lint-free cloth
☞ Push it back in as far as possible
☞ Withdraw it and read off the oil level
☞ Close and lock the engine cover

Notice!

The oil level must be between the MAX and MIN marks. However if necessary, add oil at the latest when the oil reaches the MIN mark on the oil dipstick **A**.

Adding engine oil

Attention!

Too much, not enough or incorrect engine oil can cause engine damage! For this reason:

☞ *Do not add engine oil above the MAX mark of oil dipstick 6/**A***

☞ *Do not fill in engine oil below the MIN mark of oil dipstick 6/**A***

☞ *Use only the specified engine oil*

Environment!

Use a suitable container to collect the engine oil as it drains and dispose of it in an environmentally friendly manner!

Attention!

Adding the engine oil too fast via filler inlet **B** in the cylinder-head cover can cause engine damage.

☞ *Add the engine oil slowly so it can go down without entering the intake system.*

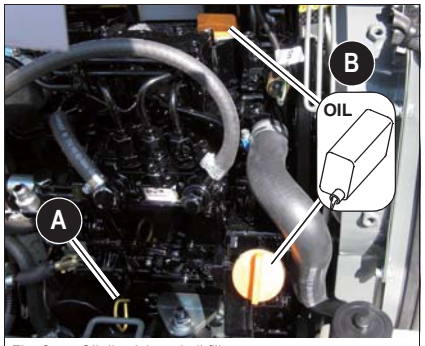


Fig. 6: Oil dipstick and oil filler cap

- Clean the area around oil filler cap **B** with a lint-free cloth
- Open filler cap **B**
- Pull out oil dipstick **A** and wipe it with a lint-free cloth
- Adding engine oil
- Approx. 3 minutes, until the oil has run into the oil sump completely.
- Check the oil level – *see Checking the oil level* on page 3-17
- Add oil if necessary and check the oil level again
- Close filler cap **B**
- Push oil dipstick **A** back in as far as possible
- Completely remove all oil spills
- Close and lock the engine cover

Change the engine oil

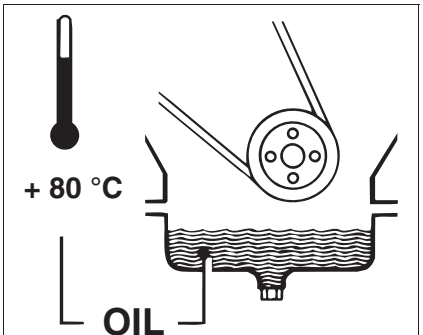


Fig. 7: Optimum engine oil temperature

Danger!

Caution when draining hot engine oil –

Burn hazard!

☞ *Wear protective gloves*

☞ *Use suitable tools*

Environment!

Use a suitable container to collect the engine oil as it drains and dispose of it in an environmentally friendly manner!

☞ *Change the engine oil as follows:*

- Park the machine on level ground
- Let the engine run until reaching operating temperature (oil temperature about 80 °C)
- Stop the engine
- Place a container under the opening to collect the oil as it drains
- Unscrew the oil drain plug
- Completely drain the oil
- Add engine oil – *see chapter Adding engine oil* on page 3-18
- Screw the oil drain plug back on again
- Start the engine and let it run briefly at low speed
- Stop the engine
- Wait a moment until all the oil has run into the oil sump
- Check the oil level again
- Add oil if necessary and check again
- Completely remove all oil spills from the engine
- Close and lock the engine cover

Replacing the engine-oil filter cartridge

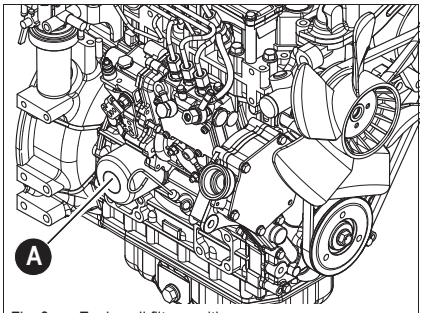


Fig. 8: Engine oil filter position

Danger!

Caution when draining hot engine oil –

Burn hazard!

☞ *Wear protective gloves*

Environment!

Collect the drained engine oil in a suitable container.
Dispose of used oil and filters in an environmentally friendly manner!

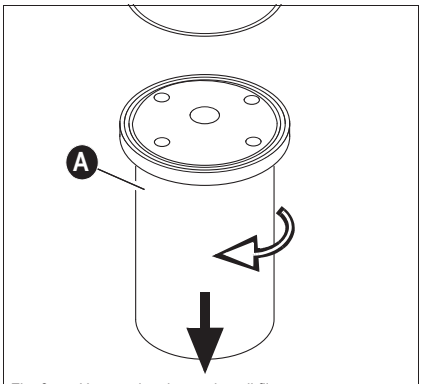


Fig. 9: Unscrewing the engine oil filter

☞ *Change the filter as follows:*

- Stop the engine
- Place a suitable container underneath the oil filter to collect the oil as it drains
- Clean the area around the oil filter
- Slowly loosen oil filter cartridge **A** using a commercially available oil filter wrench
- Let the oil drain into the container
- Remove the filter cartridge once the oil is completely drained
- Ensure that the thread adapter is correctly placed in the filter head

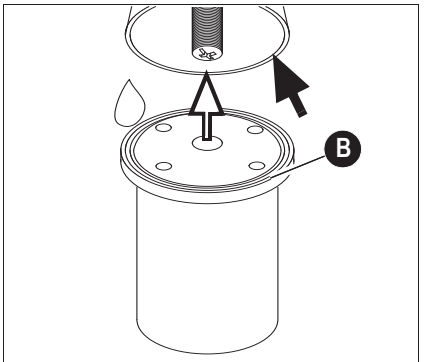


Fig. 10: Cleaning the filter head and oiling the gasket

- Clean the filter head inside with a lint-free cloth
- Apply a thin coat of fresh engine oil to rubber seal **B** of the new oil filter cartridge
- Tighten the new filter cartridge by hand until the gasket makes contact

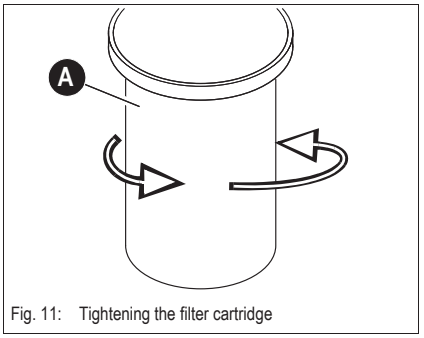


Fig. 11: Tightening the filter cartridge

- Tighten oil filter cartridge **A** by hand by about a further half revolution
- Ensure that the oil level is correct!
- Let the engine run briefly
- Stop the engine
- Check the seal of oil filter cartridge **A** and retighten by hand
- Check the oil level and add engine oil if necessary
- Completely remove all oil spills from the engine
- Dispose of the used oil filter in an environmentally friendly manner
- Close and lock the engine cover

3.8 Cooling system

The radiator is located in the engine compartment, on the right of the engine.
The coolant reservoir is also located in the engine compartment, behind the engine

Specific safety instructions

- Dirt on the radiator fins reduces the radiator's heat dissipation capacity!
  To avoid this:
  ☞ Clean the outside of the radiator at regular intervals. Use oil-free compressed air (2 bar max.) to clean. Maintain a certain distance from the radiator to avoid damage to the radiator fins. Refer to the maintenance plans in the appendix for the cleaning intervals
  ☞ In dusty or dirty work conditions, clean more frequently than indicated in the maintenance plans
- An insufficient coolant level reduces the cooling capacity as well and can cause engine damage! Therefore:
  ☞ Check the coolant level at regular intervals. Refer to the maintenance plans in the appendix for the intervals
  ☞ If coolant must be added frequently, check the cooling system for leaks and/or contact your dealer!
  ☞ Never add cold water/coolant if the engine is warm!
  ☞ After filling the coolant reservoir, make a test run with the engine and check the coolant level again after stopping the engine
- The use of the wrong coolant can destroy the engine and the radiator. Therefore:
  ☞ Add enough antifreeze compound to the coolant – but never more than 50 %. According to specified standard
  – *see chapter 3.3 Fluids and lubricantse* on page 3-3
  ☞ Observe the coolant compound table
  – *see chapter 2.9 Coolant compound table* on page 2-8
  ☞ Do not use cooler cleaning compounds if an antifreeze compound has been added to the coolant – otherwise this causes sludge to form, which can damage the engine
- Once you have filled the coolant reservoir:
  ☞ Test run the engine
  ☞ Stop the engine
  ☞ Let the engine cool down.
  ☞ Check the coolant level again

Environment!

Use a suitable container to collect the coolant as it drains and dispose of it in an environmentally friendly manner!

Checking the coolant level/adding coolant

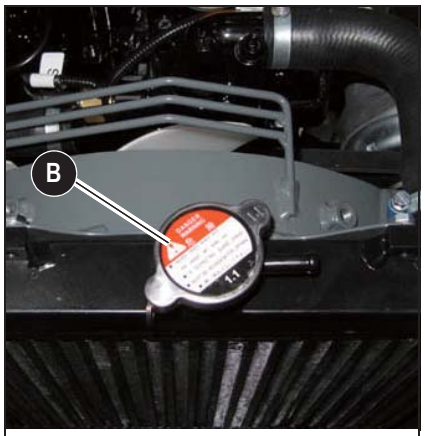


Fig. 12: Radiator cap

Danger!

Never open the coolant reservoir and never drain coolant

if the engine is warm since the cooling system is under high pressure.

–

Burn hazard!

☞ *Wait at least 15 minutes after stopping the engine!*

☞ *Wear protective gloves and clothing*

☞ *Open filler cap **B** to the first notch and release the pressure*

☞ *Ensure that the coolant temperature is sufficiently low so you can touch the radiator plug with your hands*

Danger!

Coolant is flammable and poisonous.

Accident hazard!

☞ *Keep away from flames*

☞ *Avoid eye contact with coolant*

- If coolant comes into contact with the eyes

➥ Immediately rinse with clean water and seek medical assistance

Notice!

Do not add a different coolant to the one in the reservoir.

- Use only the coolant prescribed by HCE.
  – see Fluids and lubricants on page 3-3.

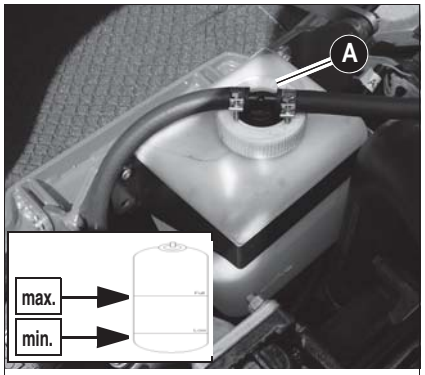


Fig. 13: Coolant reservoir

Checking the coolant level

☞ *Park the vehicle on level ground*

☞ *Stop the engine!*

☞ *Raise the control lever base*

☞ *Remove the key and carry it with you*

☞ *Let the engine and the coolant cool down*

☞ *Opening the engine cover*

☞ *Check the coolant level on the transparent coolant reservoir **13**/**A** and on radiator **12**/**B***

☞ If the coolant level is below the lower mark or if there is no coolant at the radiator's filler inlet:

➥ Adding coolant

☞ *Close and lock the engine cover*

Notice!

Check the coolant level once a day.
We recommend checking it before starting the engine.

Fig. 14: Adding coolant

Adding coolant

After the engine has cooled down:

☞ *Release overpressure in the radiator*

☞ Carefully open the cap to the first notch and fully release the pressure

☞ *Open filler cap **14/B***

☞ *Add coolant to the lower edge of the filler inlet (radiator)*

☞ *Close filler cap **14/B***

☞ *Fill up the coolant reservoir*

☞ *Start the engine and let it warm up for about 5 – 10 minutes.*

☞ *Stop the engine*

☞ *Remove the key and carry it with you*

☞ *Let the engine cool down.*

☞ *Check the coolant level again*

➥ The coolant level must be above the sheet-metal bracket of the coolant reservoir

☞ *If necessary, add coolant and repeat the procedure until the coolant level remains constant*

☞ *Close and lock the engine cover*

Attention!

Do not add a different coolant to the one in the reservoir.

☞ Only use the coolant recommended by HCE.
– see chapter 2.9 Coolant compound table on page 2-8.

Notice!

Check the coolant every year before the cold season sets in!

Draining coolant

Danger!

Never open the coolant reservoir and never drain coolant if the engine is warm since the cooling system is under high pressure
–

Burn hazard!

☞ *Wait at least 10 minutes after stopping the engine!*

☞ *Wear protective gloves and clothing*

☞ *Open filler cap **14/B** to the first notch and release the pressure*

Notice!

Do not add a different coolant to the one in the reservoir.

- Use only the coolant prescribed by HCE
  – see Fluids and lubricantse on page 3-3.

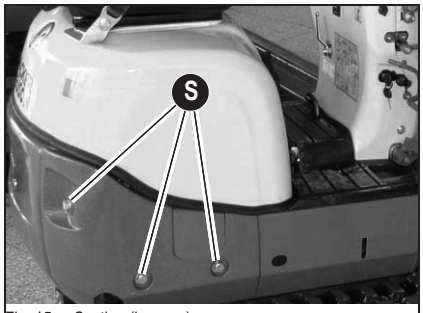


Fig. 15: Casting (bumper)

After the engine has cooled down:

☞ *Release overpressure in the radiator*

☞ *Open the cap to the first notch and fully release the pressure*

☞ *Open filler cap **14/B***

☞ *Remove the left-hand articulation screw of the rollbar (option)*

☞ *Remove screws **S***

☞ *Remove the casting and the rollbar element (option)*

☞ *Open the drain plug on the lower side of the radiator and drain the coolant*

☞ *Close the drain plug again*

☞ *Fill up the radiator with suitable coolant*
– see chapter 3.3 Fluids and lubricantse on page 3-3

☞ *Check the coolant level*
– see chapter Checking the coolant level on page 3-22

3.10 Air filter

Attention!

The air filter element will be damaged if it is washed or brushed out!
Bear in mind the following to avoid premature engine wear or damage:

☞ *Do not clean the air filter element.*

☞ *Replace the air filter element according to the indicator or maintenance plan.*

☞ *Never reuse damaged air-filter elements.*

☞ *Ensure cleanliness when replacing the air filter element!*

Fig. 19: Indicator for air filter contamination

The air filter elements must be replaced:

- If “Service” (red mark) is displayed on dirt indicator **A**
- According to the maintenance plan

Attention!

Air filter elements degrade prematurely when in service in acidic air for longer periods of time. This risk is present, for example, in acid production facilities, steel and aluminum mills, chemical plants and other nonferrous-metal plants

☞ *Check air filter elements every 50 operating hours at the latest, and replace it if necessary!*

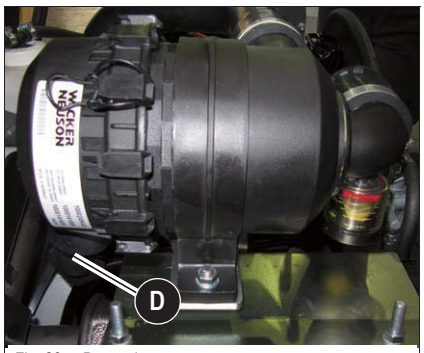


Fig. 20: Dust valve

General instructions for air filter maintenance:

- Store air filter elements in their original packaging and in a dry place!
- Do not knock the air filter element against other objects as you install it!
- Check air filter attachments, air intake hoses and air filter elements for damage, and immediately repair or replace if necessary!
- Check the screws at the induction manifold and the clamps for tightness!
- Check the function of the discharge slot of the dust valve **D**, clean and replace it if necessary.

  ☞ Squeeze the discharge slot of dust valve **D**.

  ☞ Clean the discharge slot if necessary.

Replacing air filter elements

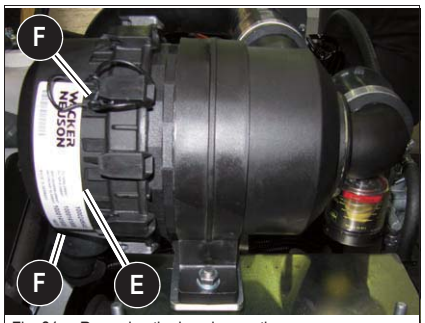


Fig. 21: Removing the housing section

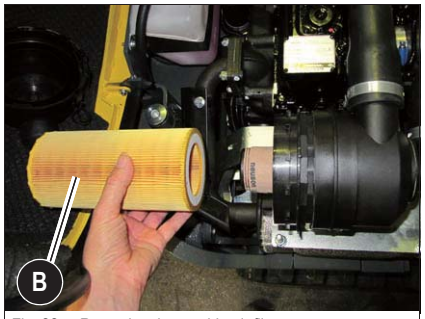


Fig. 22: Removing the outside air filter

Replace the outside air filter element *B* as follows:

☞ *Stop the engine*

☞ *Raise the lock lever*

☞ *Remove the starting key and carry it with you*

☞ *Let the engine cool down.*

☞ *Opening the engine cover*

☞ *Remove dirt and dust from the air filter element and the area around the air filter*

☞ *Open bow clips* **F** *on housing section* **E**

☞ *Remove housing section* **E**

☞ *Cautiously remove air filter element* **B** *by rotating it gently*

☞ **Ensure that** *all dirt (dust) inside the housing section and cover* **E**, *including dust valve* **D**, *has been removed*

☞ Clean the parts with a clean lint-free cloth, do not use compressed air

☞ *Check the new outside air filter* **B** *for damage and carefully insert it in the housing section (install only intact air filter elements)*

☞ *Position housing section* **E** *(ensure that it is properly seated)*

☞ *Close bow clips* **F** *on housing section* **E**

Notice!

Ensure that dust valve **D** shows downward once it is installed!

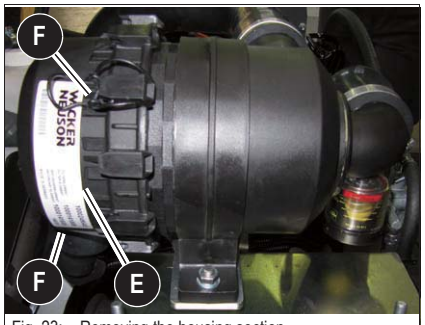


Fig. 23: Removing the housing section

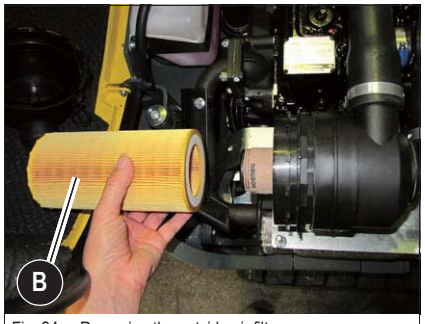


Fig. 24: Removing the outside air filter

Replace the inside air filter element *C* as follows:

☞ *Stop the engine*

☞ *Raise the lock lever*

☞ *Remove the starting key and carry it with you*

☞ *Let the engine cool down.*

☞ *Opening the engine cover*

☞ *Remove dirt and dust from the air filter element and the area around the air filter*

☞ *Open bow clips* **F** *on housing section* **E**

☞ *Remove housing section* **E**

☞ *Carefully remove outside air filter* **B** *with slightly turning movements*

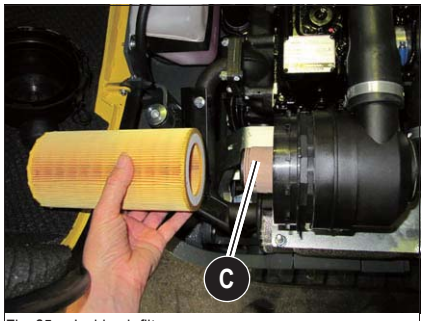


Fig. 25: Inside air filter

☞ *Carefully pull out inside air filter* **C** *with slightly turning movements*

☞ Cover the air supply at the end of the filter with a clean lint-free cloth to prevent dust from entering the engine

☞ **Ensure that** *all dirt (dust) inside the housing section and cover* **E**, *including dust valve* **D**, *has been removed*

☞ Clean the parts with a clean lint-free cloth, do not use compressed air

☞ Remove the cloth from the air supply

☞ *Check the new inside air filter* **C** *for damage and carefully insert it in the housing section (install only intact air filter elements)*

☞ *Carefully insert outside air filter* **B** *in the housing section*

☞ *Position housing section* **E** *(ensure that it is properly seated)*

☞ *Close bow clips* **F** *on housing section* ***E***

☞ *Close and lock the engine cover*

Notice!

Ensure that dust valve **D** shows downward once it is installed!

3.11 V-belt

Danger!

Only check or retension/replace the V-belt when the engine is stopped –

Risk of injury!

☞ *Stop the engine before performing inspection work in the engine compartment!*

☞ *Let the engine cool down.*

☞ *Interrupt the electric power supply.*

Attention!

Cracked and stretched V-belts cause engine damage.

☞ *Replace the V-belt.*

Check the V-belt once a day or every 10 operating hours, and retension it if necessary.
Retension new V-belts after about 15 minutes of running time.

Checking V-belt tension

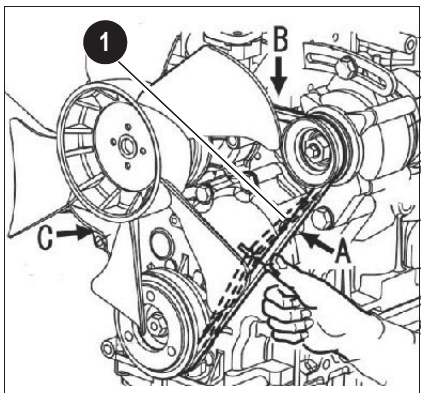


Fig. 26: Checking V-belt tension

☞ *Stop the engine*

☞ *Locking the control lever*

☞ *Remove the key and carry it with you*

☞ *Let the engine cool down.*

☞ *Opening the engine cover*

☞ *Interrupt the electric power supply*

☞ *Carefully check V-belt* **1** *for damage, cracks or cuts*

☞ *Replace the V-belt if it touches the base of the V-belt groove or the disks of the pulley*

- If the V-belt is damaged:

☞ *Have the V-belt replaced by authorized personnel*

☞ *Press with your thumb about 100 N to check the deflection of the V-belt between the crankshaft disk and the fan wheel* ***position C****. A new V-belt should have a deflection of 6 to 8 mm, a used V-belt (after about 5 minutes running time) should have a deflection of 7 to 9 mm.*

☞ *Retension the V-belt if necessary*

☞ *Re-establish the electric power supply*

☞ *Close and lock the engine cover*

Retensioning the V-belt

Attention!

Overtensioning the V-belt can damage the V-belt, the V-belt guide and the water pump bearing.
Avoid contact of oil, grease, or similar substances with the V-belt.

☞ Check the V-belt tension
– see Checking V-belt tension on page 3-31

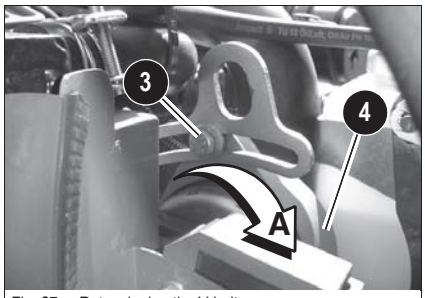


Fig. 27: Retensioning the V-belt

☞ *Stop the engine*
☞ *Raise the control lever base*
☞ *Remove the key and carry it with you*
☞ *Let the engine cool down.*
☞ *Opening the engine cover*
☞ *Interrupt the electric power supply*
☞ *Loosen fastening screw* **3** *and the articulation screw of dynamo* **4**
☞ *Use suitable auxiliary tools to push the dynamo in the direction of arrow* **A** *until the correct V-belt tension is achieved (fig.) 27)*
☞ *Keep the dynamo in this position, and at the same time retighten fastening screw* **3**
☞ *Tighten the articulation screw of the dynamo*
☞ *Check V-belt tension again and adjust it if necessary*
☞ *Re-establish the electric power supply*
☞ *Close and lock the engine cover*

3.12 Pressure check

General

Fig. 28: Plug instead of measurement connection

- Run the machine warm before checking the pressure! Hydraulic oil temperature: 50 °C min. (operating temperature)
- In order to measure the secondary pressure limiting valves of the swivel unit, replace the plug in the measurement connection thread by a measurement connection (no.1000161137).
- Ensure utmost cleanliness of all measuring points and connections, micro measuring lines and pressure gages that are connected for checking pressure => even the slightest traces of dirt, for example a grain of sand, can impair tightness and cause leaks

Fig. 29: Secondary pressure limiting valve measurement connection

Checking the secondary pressure limiting valve (SPLV)

☞ *The plug and the measurement connection have conical threads and must be sealed with Teflon tape.*

☞ *Lock the upper carriage*

☞ *Connect the measuring instrument*

☞ *Actuate the swivel unit at full work engine speed.*

☞ *Check and make a note of the pressure value*

Checking pressure drop

☞ *Actuate the swivel unit at full work engine speed.*

☞ *Swiftly reduce engine speed from maximum to minimum*

☞ *Check and make a note of the pressure value*

➥ The pressure should not drop by more than 10 %.

Pressure check of gear pump P2

Fig. 30: Primary pressure limiting valve measurement connection

Hydraulic supply of rotation, left-hand drive and stick functions

Checking primary pressure limiting valve 1 (PPLV 1)

☞ *Install a pressure gage with a T-fitting (EVL 8L no.1000015515) and a measurement connection*
(8L no.1000015578) temporarily in the stick circuit.

☞*At maximum engine speed, actuate the stick cylinder as far as it will go to either side*

☞*Check and make a note of the pressure value.*

Checking pressure drop

☞ *At maximum engine speed, actuate the stick cylinder as far as it will go to either side*

☞ *Swiftly reduce engine speed from maximum to minimum -> pressure drop*

☞ *Check and make a note of the pressure value.*

➥ Pressure drop should not exceed the specified value by more than 10%

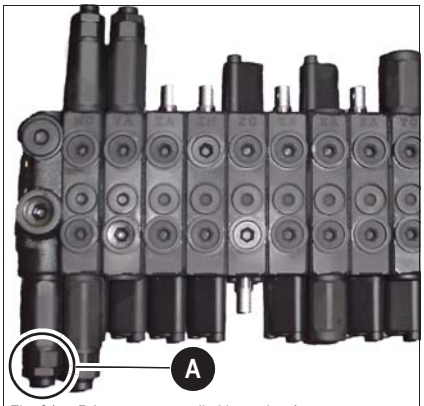


Fig. 31: Primary pressure limiting valve 1

Adjusting primary pressure limiting valve 1 (PPLV 1)

☞ *Adjust the pressure at the primary pressure limiting valve (PPLV 1)* ***A*** *on the main valve block*

☞ Loosen the locknut of the pressure limiting valve

☞ Unscrew the pressure limiting valve until you can read off a pressure drop on the pressure gage

➥ The valve seat may be stuck and must be loosened first

☞ Adjust the pressure limiting valve and tighten the locknut

☞ *Check the primary pressure limiting valve 1 and the pressure drop once adjustment is over*

Also check by extending/retracting the stick cylinder!

Pressure check of gear pump P1

Hydraulic supply for swivel, bucket and boom functions

Checking primary pressure limiting valve 2 (PPLV 2)

☞ *Install a pressure gage with a T-fitting (EVL 8L no.1000015515) and a measurement connection (8L no.1000015578) temporarily on the boom cylinder.*

☞ *At maximum engine speed, actuate the boom cylinder as far as it will go to either side*

Checking pressure drop

☞ *At maximum engine speed, actuate the boom cylinder as far as it will go to either side*

☞ *Swiftly reduce engine speed from maximum to minimum -> pressure drop*

☞ *Check and make a note of the pressure value.*

➥ Pressure drop should not exceed the specified value by more than 10%

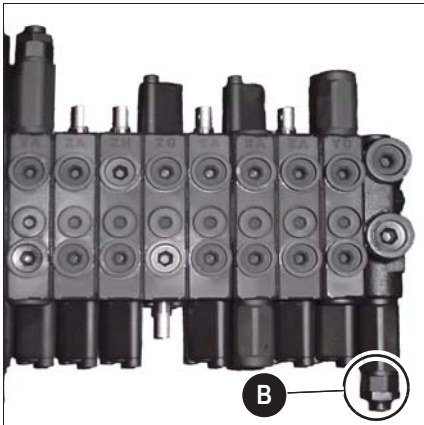


Fig. 32: Primary pressure limiting valve 2

Adjusting primary pressure limiting valve 2 (PPLV 2)

☞ *Adjust the pressure at the primary pressure limiting valve (PPLV 2)* ***B*** *on the main valve block*

☞ Loosen the locknut of the pressure limiting valve

☞ Unscrew the pressure limiting valve until you can read off a pressure drop on the pressure gage

➥ The valve seat may be stuck and must be loosened first

☞ Adjust the pressure limiting valve and tighten the locknut

☞ *Check the primary pressure limiting valve 2 and the pressure drop once adjustment is over*

Also check by extending/retracting the boom cylinder!

3.1 Test report

Pump 1

Function	Movement	Symbol	Pressure limiting valve	Measurement connection	Specified values		Measured	✔
Rotate	LEFT		Secondary pressure limiting valve SPLV-A1 and B1	Micro measurement connection Control block	Rated value	$70^{\pm 5}$ bar		
					Drop	7 bar		
	RIGHT				Rated value	$70^{\pm 5}$ bar		
					Drop	7 bar		
Shovel arm	OFF		Main pressure limiting valve PPLV-1	EVL in flexible line	Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	ON				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
Machine travel (left)	FORWARD				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	REVERSE				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		

Pump 2

Function	Movement	Symbol	Pressure limiting valve	Measurement connection	Specified values		Measured	✔
Machine travel (right)	FORWARD		Main pressure limiting valve PDBV-2	EVL in flexible line	Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	REVERSE				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		

3.1 Test report

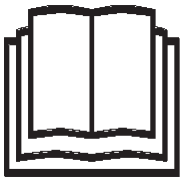
Boom swiveling	LEFT		Main pressure limiting valve PDBV-2	EVL in flexible line	Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	RIGHT				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
Bucket cylinder	OFF				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	ON				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
Boom	UP				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	DOWN				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		

Pump 1 and 2

Function	Movement	Symbol	Pressure limiting valve	Measurement connection	Specified values		Measured	✔
Stabilizer blade/ telescopic undercarriage	UP/RETRACT		Main pressure limiting valves PPLV-1 and 2	EVL in flexible line	Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
	DOWN/EXTEND				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		
Auxiliary hydraulics	A5				Rated value	$170^{\pm 3}$ bar		
					Drop	17 bar		

3.14 Hydraulic system

Specific safety instructions



- Release the pressure in all lines carrying hydraulic oil prior to any maintenance and repair work. To do this:
  - Lower the boom or the attachment to the ground
  - Move all control levers of the hydraulic control valves several times
- Raise the lock lever
- Hydraulic oil escaping under high pressure can penetrate the skin and cause serious injury. Always consult a doctor immediately even if the wound seems insignificant – otherwise serious infections could set in!
- If the hydraulic oil in the sight glass is cloudy, this indicates that water or air has penetrated the hydraulic system. This can cause damage to the hydraulic pump!
- Oil or fuel flowing out of high pressure lines can cause fire or malfunctions, and serious injury or damage to property. Interrupt work immediately if loose nuts or damaged hoses and lines are detected.

Attention!

Dirty hydraulic oil, lack of oil or wrong hydraulic oil –

Risk of serious damage to the hydraulic system!

☞ *Take care to avoid dirt when working!*

☞ *Always add hydraulic oil by means of a screen or the return filter!*

☞ *Only use authorized oils of the same type*
– see "Fluids and lubricants" on page 3-2

☞ *Always add hydraulic oil before the level gets too low*
– see "Adding hydraulic oil" on page 3-38

☞ *If the hydraulic system is filled with biodegradable oil, then only use biodegradable oil of the same type for adding oil – observe the sticker on the hydraulic oil reservoir!*

☞ *Contact your dealer immediately if the hydraulic system filter is contaminated with metal chippings. Otherwise, follow-on damage can result!*

Environment!

Collect drained hydraulic oil and biodegradable oil in a suitable container! Dispose of drained oil and used filters by an ecologically safe method. Always contact the relevant authorities or commercial establishments in charge of oil disposal before disposing of biodegradable oil.

Checking the hydraulic oil level

Attention!

Do not add oil if the oil level is above the **FULL** mark, otherwise the hydraulic system can be damaged and escaping oil can cause serious injury.

☞ *Check the hydraulic oil level each time the vehicle is put into operation or once a day*

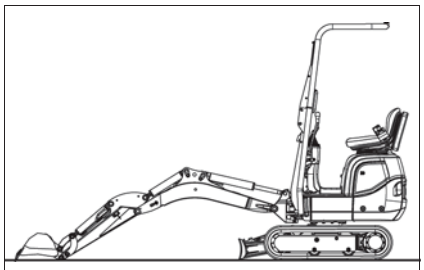


Fig. 33: Parking the excavator

- If the attachment is not positioned as shown:

☞ Start the engine and let it run at idling speed

☞ Retract the bucket and boom cylinders, lower the boom, the bucket teeth and the stabilizer blade to the ground.

☞ Stop the engine again.

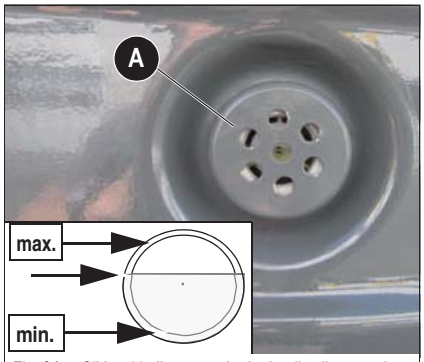


Fig. 34: Oil level indicator on the hydraulic oil reservoir

☞ *Proceed as follows:*

- Park the machine on level ground
- Stop the engine
- Raise the control lever base
- Opening the engine cover
- Sight glass **A** is located at the rear of the excavator
- Check the oil level on sight glass **A**
- The oil level should be at the middle of the sight glass
  - A yellowish color of the entire sight glass is a sign that too much oil has been filled in

If the oil level is lower

- Adding hydraulic oil

The oil level varies according to the machine's operating temperature:

Machine condition	Temperature	Oil level
• Before putting into operation	Between 10 and 30 °C (50 – 86 °F)	In the lower part of the sight glass
• Normal operation	Between 50 and 90 °C (122 – 194 °F)	In the upper part of the sight glass

Notice!

Measure the oil level of the hydraulic system only after the machine reaches its operating temperature.

Adding hydraulic oil

Danger!

Removing the filler plug can cause oil to escape.

Accident hazard!

☞ *Carefully unscrew the plug to slowly reduce the pressure inside the oil reservoir.*

Do not add hydraulic oil unless the engine is stopped. Otherwise, hydraulic oil will overflow at the filler opening on the hydraulic oil reservoir.

Fig. 35: Hydraulic oil filler inlet with screen

☞ *Park the vehicle on level ground*
☞ *Lower the lifting arm and the attachment as shown in* ***fig. 27***
☞ *Lower the stabilizer blade to the ground*
☞ *Position the boom straight ahead*
☞ *Stop the engine*
☞ *Remove the key and carry it with you*
☞ *Raise the control lever base*
☞ *Let the engine cool down.*
☞ *Opening the engine cover*
☞ *Clean the area around filler opening with a cloth*
☞ *Open the filler opening with tool no. 12* **B**
☞ *Add clean hydraulic oil through the screen*
☞ *Check the hydraulic oil level on sight glass* **28/A**
☞ *Add if necessary and check again*
☞ *Close the filler opening*
☞ *Close and lock the engine cover*

Notice!

You can also refill through the return filter to avoid contamination of the hydraulic oil as you add oil.

Replace the hydraulic oil

Notice!

Only change the hydraulic oil if it is warm (about 50°C).
Retract all hydraulic cylinders before changing the oil.

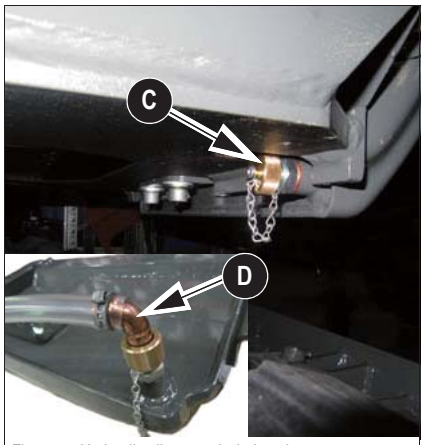
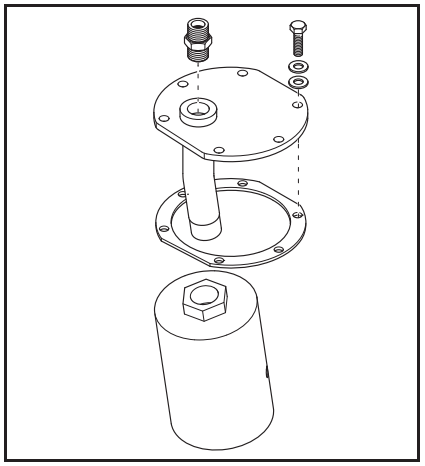


Fig. 36: Hydraulic oil reservoir drain valve

- ☞ *Open the filler plug to release pressure*
- ☞ *Open drain valve **C** on the lower side of the reservoir and install drain hose **D** (included in the scope of delivery of the excavator) to drain the oil into a container*
- ☞ *Check the hydraulic oil reservoir for contamination and clean it if necessary*
- ☞ *Screw the drain plug back in correctly*
- ☞ *Add clean hydraulic oil through a screen*
  – see “Adding hydraulic oil” on page 3-38
- ☞ *Close the hydraulic oil reservoir correctly*
- ☞ *Close and lock the engine cover*
- ☞ *Let the machine run at idling speed without load for some minutes*

Replacing the filter cartridge



- ☞ *Opening the engine cover*
- ☞ *Remove the coolant reservoir*
- ☞ *Unscrew the return line from the filler cap*
- ☞ *Loosen the filler cap of the hydraulic oil reservoir*
- ☞ *Remove the cover with the connection piece and the filter cartridge*
- ☞ *Replacing the filter*
- ☞ *Reassemble in the reverse order*
- ☞ *Check for tightness after a short test run*
- ☞ *Check the fluid levels*
- ☞ *Close and lock the engine cover*

Checking the hydraulic system and hydraulic hoses

Danger!

Use caution when checking the hydraulic lines; especially when searching for leaks.
Hydraulic oil escaping under high pressure can penetrate the skin and cause serious injury.

Risk of injury!

☞ *Always consult a doctor immediately, even if the wound seems insignificant – otherwise serious infections could set in!*

☞ *Always observe the following instructions:*

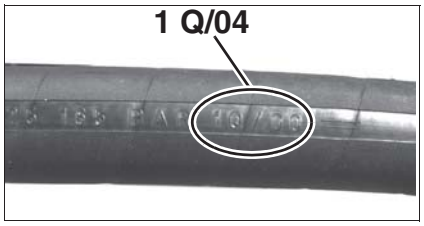
- Retighten leaking screw connections and hose connections only when the system is not under pressure. In other words, release the pressure before working on pressurized lines!
- Never weld or solder damaged or leaking pressure lines and screw connections. Replace damaged parts with new ones!
- Never search for leaks with your bare hands, but wear protective gloves!
- Use paper or wood to check for minor leaks. Never use an unprotected light or open flame!

Notice!

Leaks and damaged pressure lines must be immediately repaired or replaced. This not only increases the operating safety of the vehicle but also helps to protect the environment.

- Have hydraulic hoses replaced every 6 years from the date of manufacture, even if they do not seem to be damaged.

In this respect, we recommend that you observe all the relevant safety regulations for hydraulic lines, as well as the safety regulations regarding accident prevention and occupational health and safety in your country. Also observe DIN 20 066, part TI. 5.



The article number is marked on the clamping section, and the date of manufacture is indicated on the hose of each hose connection.

Example:

The indication **"1 Q/04"** means manufactured in the 1st quarter of 2004.

Replace a line if one of the following problems is detected:

- Damaged or leaky hydraulic seals.
- Worn or torn shells or uncovered reinforcement branches.
- Expanded shells in several positions.
- Entangled or crushed movable parts.
- Foreign bodies jammed or stuck in protective layers.

3.15 Tracks

- Track wear can vary according to work and ground conditions.

☞ We recommend checking track wear and tension once a day.

☞ Park the machine on firm and level ground to check and perform maintenance.

Checking track tension

Danger!

Working under the machine with the tracks off the ground and only supported by the attachment is extremely dangerous.

Caution, danger!

☞ *Firmly support the machine with chocks or suitable brackets*

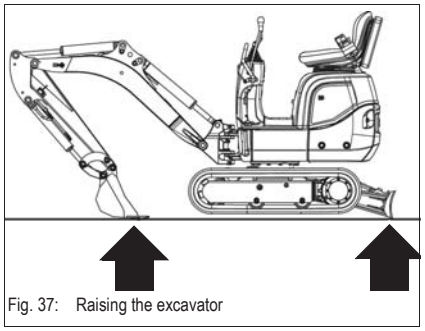


Fig. 37: Raising the excavator

Check track tension as follows:

☞ *Stop the machine on firm, level and horizontal ground*

☞ *Raise the machine evenly and horizontally*

☞ *Raise the machine by means of the boom and the stabilizer blade*

☞ Slowly and carefully actuate the control levers

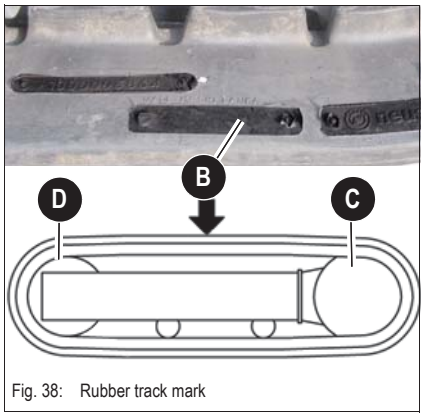


Fig. 38: Rubber track mark

- The rubber track has a mark **B** as shown in *Fig. 38*

☞ Place the excavator so that mark **B** of the rubber track is between the drive pinion **C** and the track tension roller **D**

☞ *Stop the engine*

☞ *Remove the key and carry it with you*

☞ *Locking the control lever*

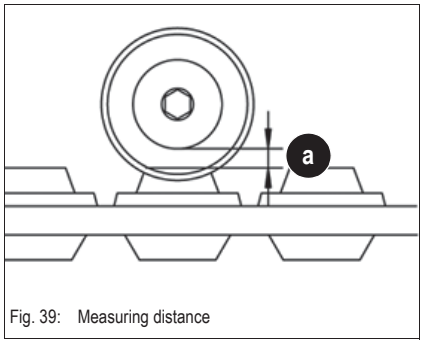


Fig. 39: Measuring distance

- Standard play **a** between the shoulder of the sliding block and the contact area of the second support roller of the drive pinion is 15 – 20 mm (0.6 – 0.8").

☞ Set the tension as follows if it is not in accordance with the rated value.

Setting the tracks

Danger!

The lubricating valve can be squeezed out due to the high grease pressure in the hydraulic cylinder.

Risk of injury!

☞ Do not loosen and unscrew the lubricating valve by more than one turn.

☞ Loosen no other component except the lubricating valve.

☞ Keep your face away from the lubricating valve connection.

➥ Contact HCE'S dealer if this does not reduce the tension of the rubber sliding block.

Attention!

Excessive tension of the tracks causes serious damage to the cylinder and the track.

☞ *Tighten the tracks only up to the prescribed measuring distance*

Tightening the tracks

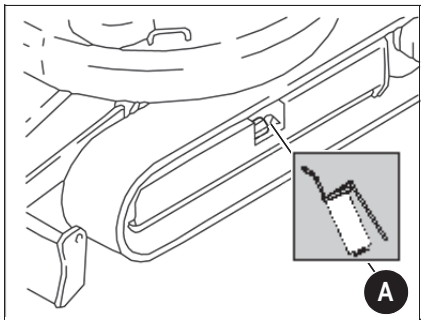


Fig. 40: Tightening the tracks

☞ *Inject grease with the pump through lubricating valve **A***

☞ *Check the tension is correct by starting the engine, letting it run at idling speed and slowly moving the machine forward and reverse and switching it off again*

☞ *Check the tension of the tracks again*

➥ If it is not correct:

☞ Adjust again

☞ *Should the track still be slack after injecting more grease, replace the track or the seal in the cylinder.*

Reducing tension

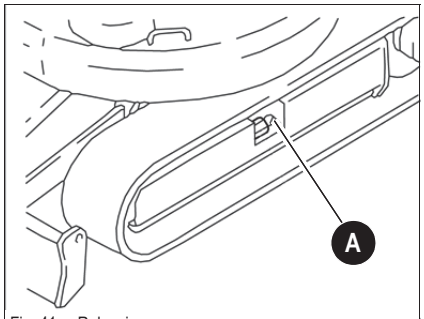


Fig. 41: Releasing grease

- Draining grease in a way different from the one described below is very dangerous. Also bear in mind the safety instructions on this page

☞ *Slowly open the lubricating valve **A** by 1 turn to allow the grease to flow out.*

☞ Place a suitable container underneath to collect the grease

➥ The grease flows out of the groove of the lubricating valve

☞ *Retighten lubricating valve **A***

☞ *Check the tension is correct by starting the engine, letting it run at idling speed and slowly moving the machine forward and reverse and switching it off again*

☞ *Check the tension of the tracks again*

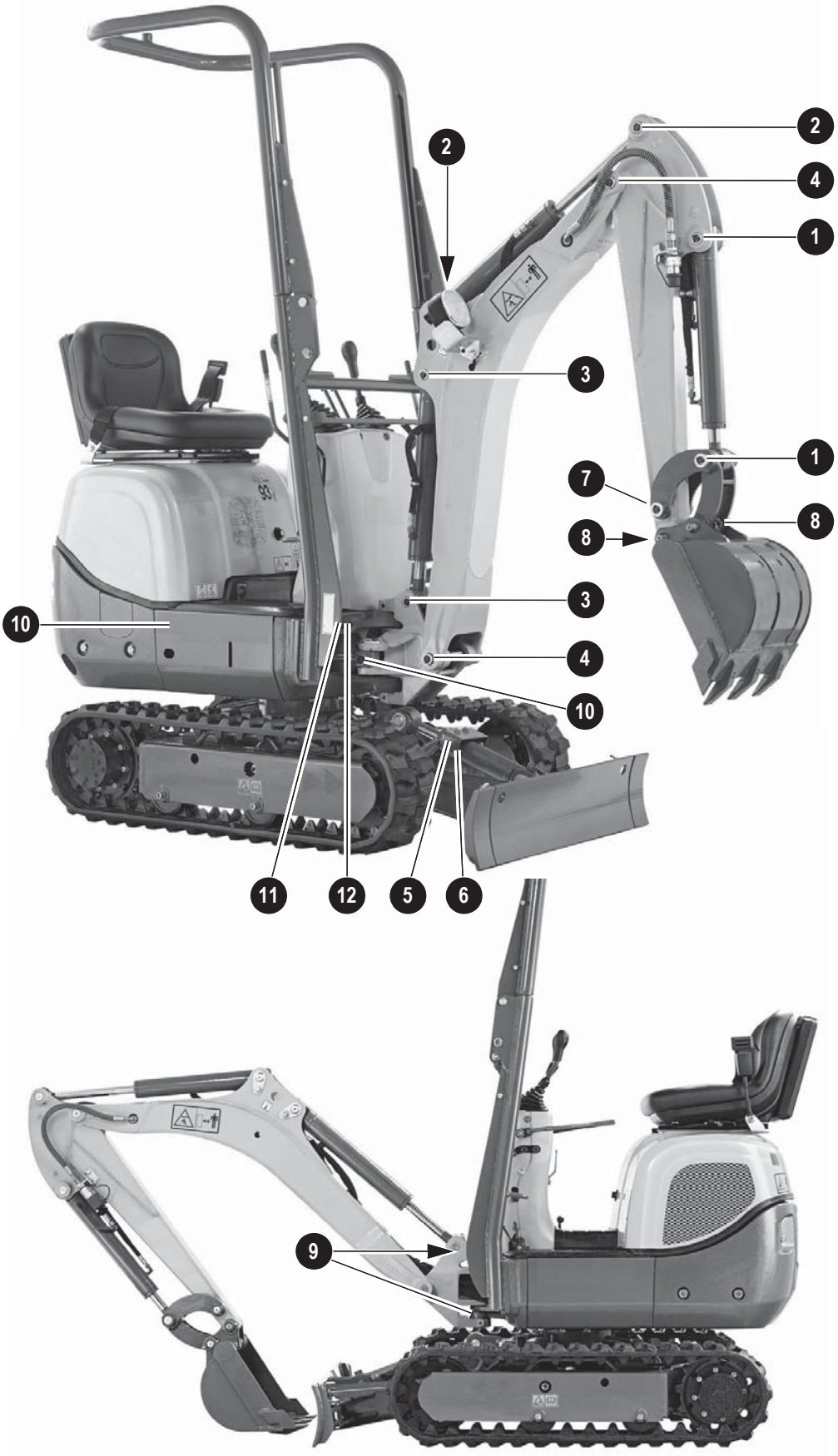
➥ If it is not correct:

☞ Adjust again

Environment!

Use a suitable container to collect the grease as it flows out and dispose of it in an environmentally friendly manner.

3.17 Overview of lubrication points



Item	Lubrication point	Quantity
1	Bucket cylinder	2
2	Stick cylinder	2
3	Boom cylinder	2
4	Boom	2
5	Stabilizer blade cylinder – *see chapter "Lubrication points on the stabilizer blade and stabilizer blade cylinder"* on page 3-47	2
6	Stabilizer blade – *see chapter "Lubrication points on the stabilizer blade and stabilizer blade cylinder"* on page 3-47	2
7	Shovel arm	1
8	Bucket	2
9	Swiveling console – *see chapter "Lubrication points on swiveling console"* on page 3-47	2
10	Swiveling cylinder	2
11	Live ring (ball bearing) – *see chapter "Lubrication points on live ring (ball bearing)"* on page 3-48	1
12	Live ring teeth – *see chapter "Lubrication points of live ring teeth"* on page 3-49	1
13	Ball sockets (ISO/SAE changeover option)	2

Notice!

Keep the lubrication points clean and remove ejected grease.

Parking the machine

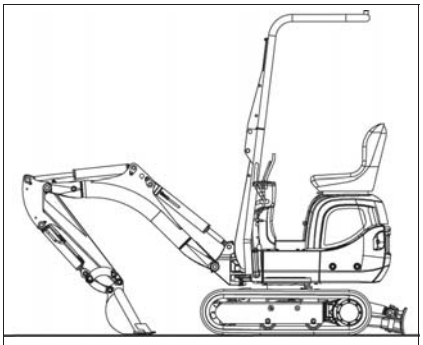


Fig. 44: Parking the excavator

☞ Park the machine on level and horizontal ground.
☞ Lower the boom and the attachment to the ground.
☞ Lower the stabilizer blade to the ground.
☞ Stop the engine.
☞ Remove the starting key and carry it with you.
☞ Move joysticks **15** and **16** in all directions repeatedly.
☞ Raise the lock lever.
☞ Get off the machine, lock the engine cover.

Lubrication points on the stabilizer blade and stabilizer blade cylinder

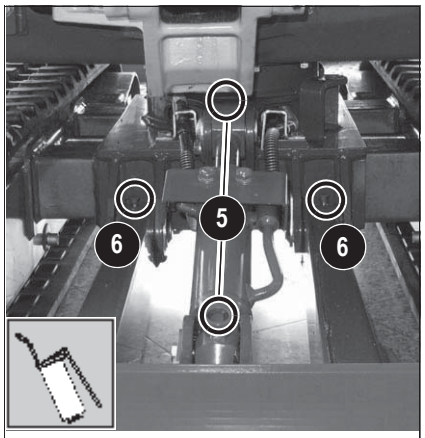


Fig. 45: Lubrication points on the stabilizer blade

☞ *Apply grease to lubrication points **5** on the stabilizer blade cylinder*

☞ *Apply grease to lubrication points **6** on the stabilizer blade*

Lubrication points on swiveling console

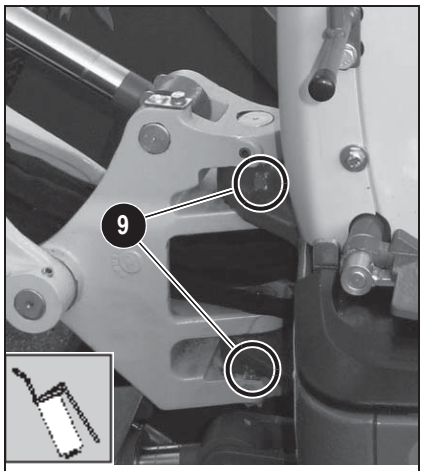


Fig. 46: Lubrication point on the swiveling console

☞ *Apply grease to lubrication points **9** of the swiveling console*

Swiveling cylinder lubrication points

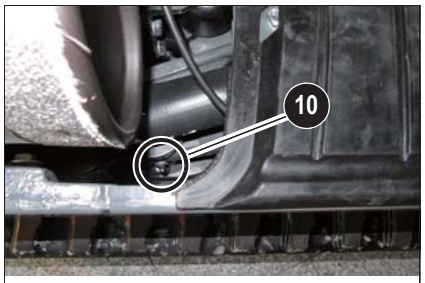


Fig. 47: Lubrication point on swiveling cylinder (engine cover)

☞ Stop and park the vehicle.
☞ Open the engine cover.
☞ The lubrication point is located on the right under the engine cover.
☞ Apply grease to lubrication point **10** with a grease gun.
☞ Remove ejected grease.

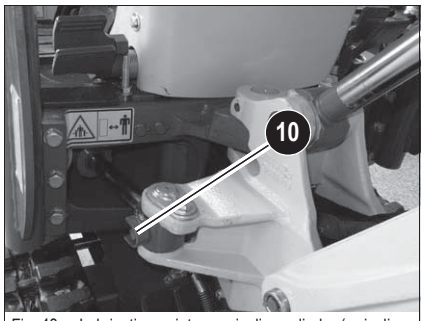


Fig. 48: Lubrication point on swiveling cylinder (swiveling

☞ A further lubrication point is located on the right on the swiveling console.
☞ Apply grease to lubrication point **10** with a grease gun.
☞ Remove ejected grease.

Lubrication points on live ring (ball bearing)

Danger!

Do not rotate the machine during lubrication!

Risk of serious crushing that can cause death or serious injury!

☞ Stop and park the vehicle – *see chapter "Parking the machine" on page 3-46*

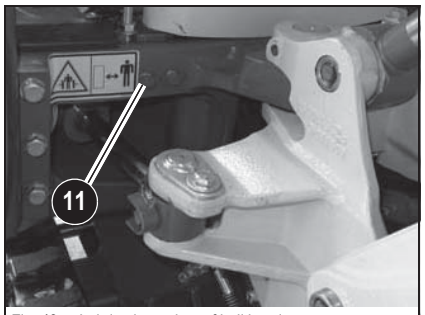


Fig. 49: Lubrication points of ball bearing race

☞ Stop and park the vehicle.

☞ The lubrication point is located at the front right on the upper carriage.

☞ Apply grease to lubrication point **11** with one stroke of the grease gun.

☞ Remove ejected grease.

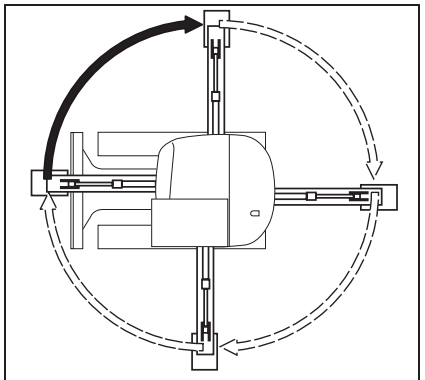


Fig. 50: Lubricating the machine every 90°

☞ Turn the machine 90° three more times and apply grease to lubrication point **11** with one stroke of the grease gun in the following three positions.

☞ Remove ejected grease.

☞ Turn the machine 360° a few times.

Lubrication points of live ring teeth

Danger!

Do not rotate the machine during lubrication!

Risk of serious crushing that can cause death or serious injury!

☞ *Stop and park the machine. – see chapter "Parking the machine" on page 3-46*

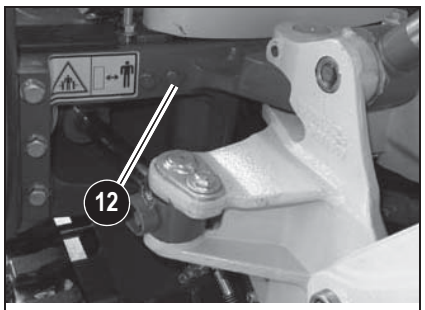


Fig. 51: Teeth lubrication point

☞ Stop and park the vehicle.

☞ The lubrication point is located at the front right on the upper carriage.

☞ Apply grease to lubrication point **12** with one stroke of the grease gun.

☞ Remove ejected grease.

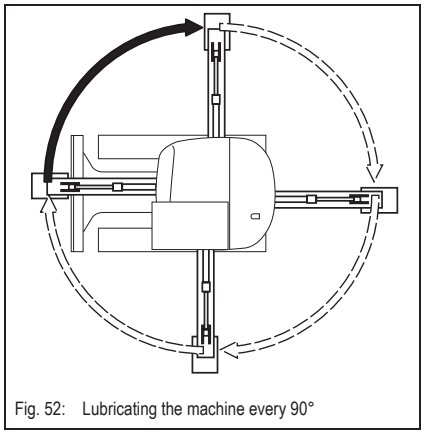


Fig. 52: Lubricating the machine every 90°

☞ Turn the vehicle by 90° three more times and apply grease to lubrication point **12** with one stroke of the grease gun in the following three positions.

☞ Remove ejected grease.

☞ Turn the machine 360° twice.

Ball sockets (ISO/SAE changeover option)

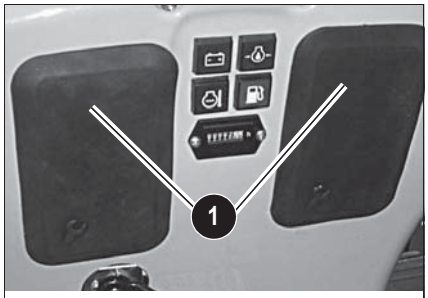


Fig. 53: Control stand covers

☞ Stop and park the vehicle.

☞ Raise covers **1**.

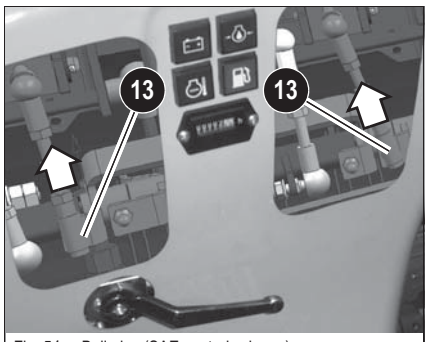


Fig. 54: Ball pins (SAE controls shown)

☞ Slide the knurled sleeve **13** upward, and hold, unhitch and grease it with Gleitmo 800 lubricant.

☞ The sleeve is safely locked if it is firmly connected with the ball pin and if it is engaged in the lower position.

☞ Lower covers **1**.

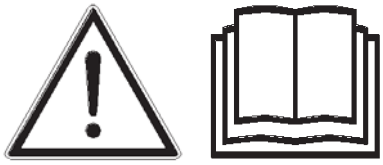
Maintenance of attachments

Notice!

Correct maintenance and service is absolutely necessary for smooth and continuous operation, and for an increased service life of the attachments. Observe the lubrication and maintenance instructions in the Operator's Manuals of the attachments.

3.18 Electrical system

Specific safety instructions



- The battery contains sulfuric acid! This acid must not be allowed to come into contact with the skin, the eyes, clothing or the machine

  Therefore when recharging or working near the battery:

  ☞ Always wear safety glasses and protective clothing with long sleeves

If acid is spilled:

  ☞ Thoroughly rinse all affected surfaces immediately with plenty of water!

  ☞ Thoroughly wash any part of the body touched by the acid immediately with plenty of water and seek medical attention at once!

- Especially when charging batteries, as well as during normal operation of batteries, an oxyhydrogen mixture is formed in the battery cells – explosion hazard!
- Do not attempt to jump-start the machine if the battery is frozen or if the acid level is low. The battery can burst or explode!

  ☞ Replace the battery immediately

- Avoid open flames and sparks and do not smoke near open battery cells – otherwise the gas produced during normal battery operation can ignite!
- Use only 12 V power sources. Higher voltages will damage the electrical components
- When connecting the battery leads, ensure that the poles +/− are not inverted, otherwise sensitive electrical components will be damaged
- Do not interrupt voltage-carrying circuits at the battery terminals – sparking hazard!
- Never place tools or other conductive articles on the battery – risk of short circuit!
- Disconnect the negative (−) battery terminal from the battery before starting repair work on the electrical system
- Dispose of used batteries properly

Servicing and maintenance at regular intervals

Before performing machine travel

☞ *Check every time before performing machine travel:*

- Is the light system OK?
- Do the lights and the acoustic warning system work?

Every week

☞ *Check once a week:*

- Electric fuses – *see "Relays"* on page 2-7
- Cable and grounding connections
- Battery charge condition – *see "Battery"* on page 3-54
- Condition of battery terminals

Instructions concerning specific components

Cables, bulbs and fuses

Always observe the following instructions:

- Malfunctioning components of the electrical system must always be replaced by a HCE service center. Lamps and fuses may be replaced by unqualified persons.

- When performing maintenance on the electrical system, pay particular attention to ensuring good contact in leads and fuses
- Blown fuses indicate overloading or short circuits. The electrical system must therefore be checked before installing the new fuse
- Only use fuses with the specified load capacity (amperage)
  – see "Fuse box at the right under the control stand behind the side trim" on page 2-7.

Notice!

Always disconnect and remove the battery before performing welding work on the machine, and short-circuit the terminal cables of the machine to avoid damage to the electronic components.

Alternator

Fig. 55: Alternator

Observe the following instructions:

- Start the engine only if the battery is connected
- When connecting the battery, ensure that the poles (+/−) are not inverted
- Always disconnect the battery before performing welding work or connecting a quick battery charger!
- Replace malfunctioning charge indicator lights immediately
  – *see "Alternator charge function indicator light (red)"*

Battery

Battery state of charge

☞ *Stop and park the vehicle. Stop the engine.*

- The battery is maintenance-free according to DIN.
- However check the battery at regular intervals to ensure that the electrolyte level is between the MIN and MAX marks.

More maintenance is required if:

- The engine does not start easily.
- The battery is used in areas with higher temperatures.
- The machine was out of operation over a longer period of time (2 – 3 months).

Notice!

The battery must be removed before it can be checked.

Charging the battery

☞ *Stop and park the vehicle. Stop the engine.*

☞ *Remove the battery with a suitable tool – see Replacing the battery on page 3-53.*

☞ *Charge the battery with a suitable battery charger.*

- Recommended battery charging current: 1/10 of the battery capacity.

☞ *After charging the battery, check the electrolyte level to ensure that it is between the MIN and MAX marks.*

☞ Correct the electrolyte level if necessary.

Replacing the battery

The battery is located under the floor panel directly in front of the control stand.

Always follow the specific battery safety instructions.

☞ *Stop and park the vehicle. Stop the engine.*

☞ *Open the engine cover.*

☞ *Remove floor panel **B** with a suitable tool.*

☞ *First remove the black battery lead from the negative terminal (−), then the red battery lead from the positive terminal (+).*

☞ *Replace the battery.*

☞ *First install the battery lead on the positive terminal (+), then on the negative terminal (−).*

☞ *Install floor panel **B**.*

☞ *Close the engine cover.*

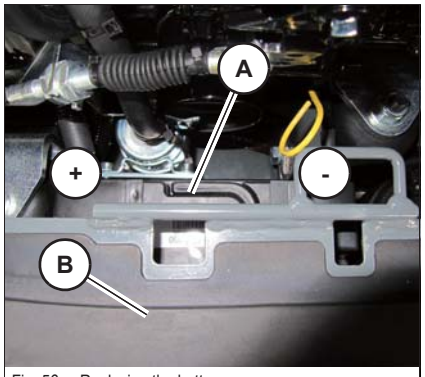


Fig. 56: Replacing the battery

Notice!

In order to avoid damage to the engine electronics, do not disconnect the battery while the engine is running.

Check battery degassing hose

Danger!

Batteries give off explosive gases that can cause deflagrations if ignited. The squirting battery acid can then cause serious injuries or death.

Caustic injury hazard due to chemicals!

- Fire, open flames and smoking is prohibited.
- Wear protective equipment.
- In case of contact with battery acid, immediately rinse the affected parts of the body with plenty of clear water and immediately consult a physician.

Attention!

Possible damage caused by defective or missing battery degassing hose.

☞ *Observe maintenance interval in the maintenance plan.*

The battery degassing hose leads gases from the battery to the outside.

Check the battery degassing hose, e.g. for:

- Correct installation
- Condition (no cracks, bruises, contaminants, etc.)

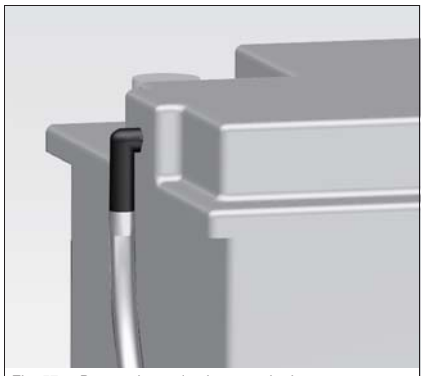


Fig. 57: Battery degassing hose on the battery (symbolic representation)

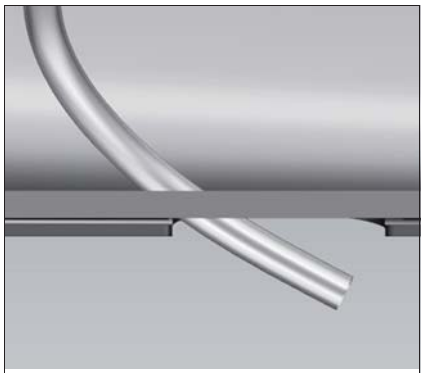


Fig. 58: battery degassing hose passage to the outside (symbolic representation)

3.19 General maintenance

Cleaning

Cleaning the machine is divided into 2 separate areas:

- Exterior of the vehicle
- Engine compartment

The wrong choice of cleaning equipment and agents can impair the operating safety of the vehicle on the one hand, and on the other undermine the health of the persons in charge of cleaning the vehicle. It is therefore essential to observe the following instructions.

General instructions for all areas of the vehicle

Cleaning with washing solvents

- Ensure sufficient room ventilation
- Wear suitable protective clothing
- Do not use flammable liquids, such as gasoline or diesel

Cleaning with compressed air

- Work carefully
- Wear safety glasses and protective clothing
- Do not aim the compressed air at the skin or at other people
- Do not use compressed air for cleaning your clothing

Cleaning with a high-pressure cleaner or steam jet

- Electrical components and damping material must be covered and not directly exposed to the jet
- Cover the hydraulic oil reservoir and the covers of the fuel tank, the hydraulic oil reservoir, etc.
- Protect the following components from moisture:
  - Engine
  - Electrical components such as the alternator, etc.
  - Control devices and seals
  - Air intake filters, etc.

Cleaning with volatile and easily flammable anti-corrosion agents and sprays:

- Ensure sufficient room ventilation
- Do not use unprotected lights or open flames
- Do not smoke

Control stand

Attention!

Never use high-pressure cleaners, steam jets or high-pressure water to clean the control stand. Water under high pressure can
• penetrate into the electrical system and cause short circuits and
• damage seals and disable the controls!

We recommend using the following aids to clean the control stand:

- Damp cloth
- Brush
- Water with mild soap solution

Cleaning the seat belt:

- Clean the seat belt (which remains fitted in the machine) with a mild soap solution only. Do not use chemical agents as they can destroy the fabric!

Exterior of the vehicle

The following articles are generally suitable:

- High-pressure cleaner
- Steam jet

Engine compartment

Danger!

Clean the engine only when it is at a standstill –

Risk of injury!

☞ *Stop the engine before cleaning it*

Attention!

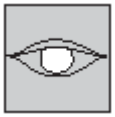
When cleaning the engine with a water or steam jet

☞ *The engine must be cold*

☞ *and do not point the jet directly at electric sensors such as the oil pressure switch.*

The humidity penetrating any such sensors causes them to fail and leads to engine damage!

Threaded fittings and attachments



All threaded fittings must be checked regularly for tightness, even if they are not listed in the maintenance plans. This applies in particular to:

☞ *Engine fastening screws*

☞ *Fastening screws on the hydraulic system*

☞ *Bucket teeth and pin fastenings on the attachment*

☞ *Rollbar fastening screws*

Retighten loose connections immediately.

Pivots and hinges

All mechanical pivot points on the machine (for example door hinges, joints) and fittings (for example door arresters) must be lubricated regularly, even if they are not listed in the lubrication schedule.

3.20 Preparatory work before taking out of service

The measures indicated below refer to putting the machine out of operation for 30 days or longer.

- See chapter 2 “Safety instructions for maintenance” in the Operator’s Manual
- If the machine is stored outdoors, place it on a wooden base and cover it with a water-tight tarp to protect it against humidity
- Check whether oil or other fluids leak from the machine
- Lower the boom and the stabilizer blade to the ground
- Clean the engine with a high-pressure cleaner in a suitable place.
  Observe the following chapter – see Cleaning with a high-pressure cleaner or steam jet on page 3-56
- Carefully clean and dry the entire machine
- Spray an anticorrosion agent onto bare metal parts of the machine (piston rods of hydraulic cylinders, for example)
- Apply grease to all lubrication points
- Change the engine oil
- Check all oil levels in the units and add oil if necessary
- Check the hydraulic oil level and if necessary, add oil
- Fill up the fuel tank to the maximum level
- Check the coolant, change as required
- Remove the grounding strap from the battery, or remove the battery and store it in a safe place. Charge the battery and perform battery maintenance at regular intervals
- Close the exhaust pipe and the air intake opening of the air filter system

3.21 Maintenance when out of service for a longer period of time

The following measures must be taken if the machine is out of service for more than 30 days.

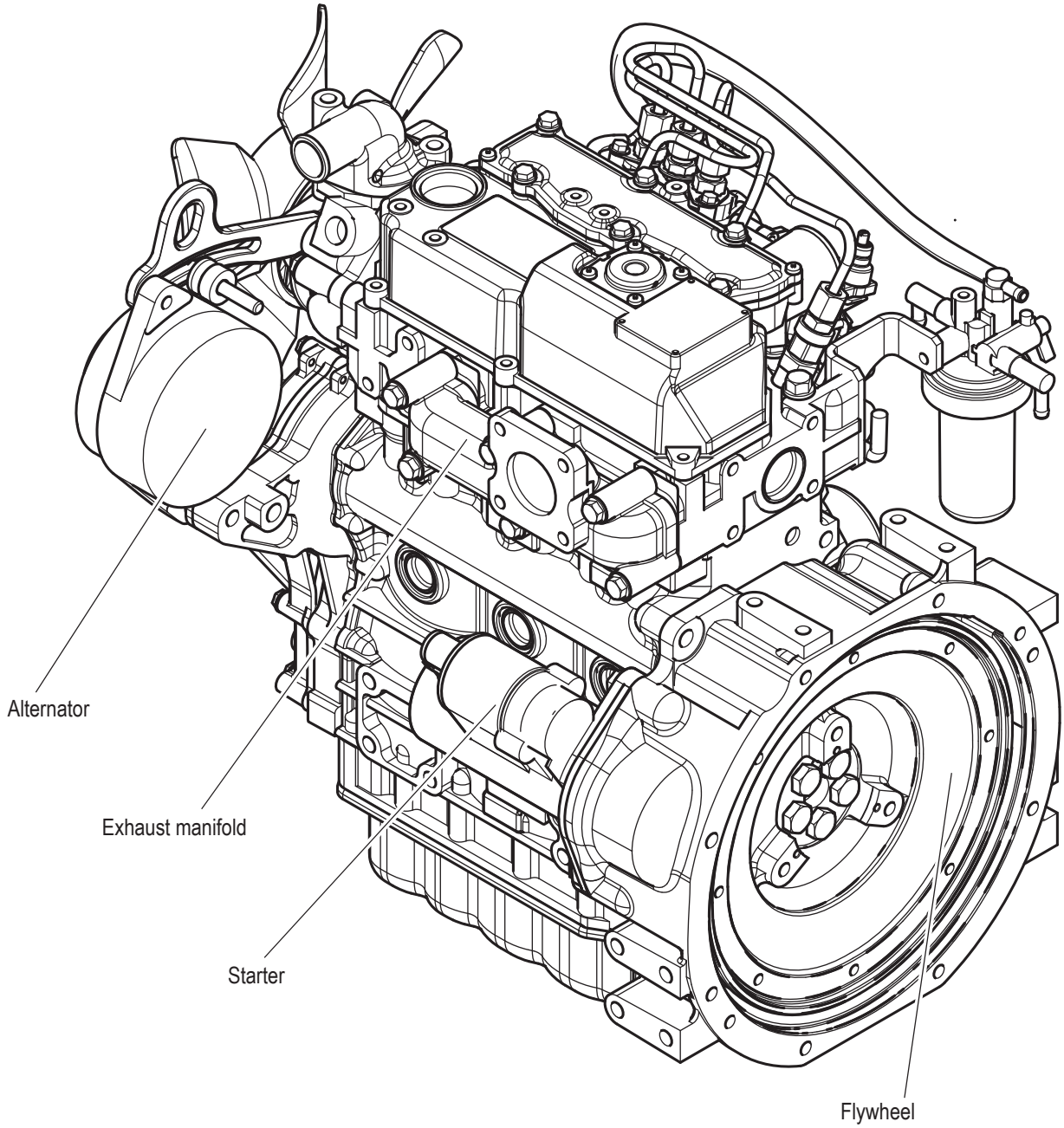
Putting into operation again

- Remove anticorrosion agent from the piston rods
- Charge, install and connect the battery
- Remove the seals from the exhaust pipe and the air filter intake
- Check the condition of the air filter element and replace the element if necessary
- Check the dust valve
- Refueling
- Switch on the fuel prefilter on the upper carriage and the fuel filter on the engine (turn to ON).
- Turn the starter to position 1 for 2 minutes (to supply the engine with fuel)
- If the machine was out of service for over 6 months, change the oil in the gearbox, engine, etc. and the hydraulic oil reservoir
- Check the engine oil
- Also replace hydraulic oil filters (return and breather filters) if the machine has been out of service for over 6 months
- Lubricate the machine according to the lubrication plan
- Check the levels
- Check the coolant, change as required
- Remove the starting key, remove fuse F2 on the right-hand cover
- Let the engine run 15 seconds
- Wait 15 seconds
- Let the engine run 1 minute again
- Remove the starting key, put fuse F2 back in
- Start the diesel engine
- Let the engine run at idling speed at least 15 minutes without load.
- Check all oil levels in the units and add oil if necessary

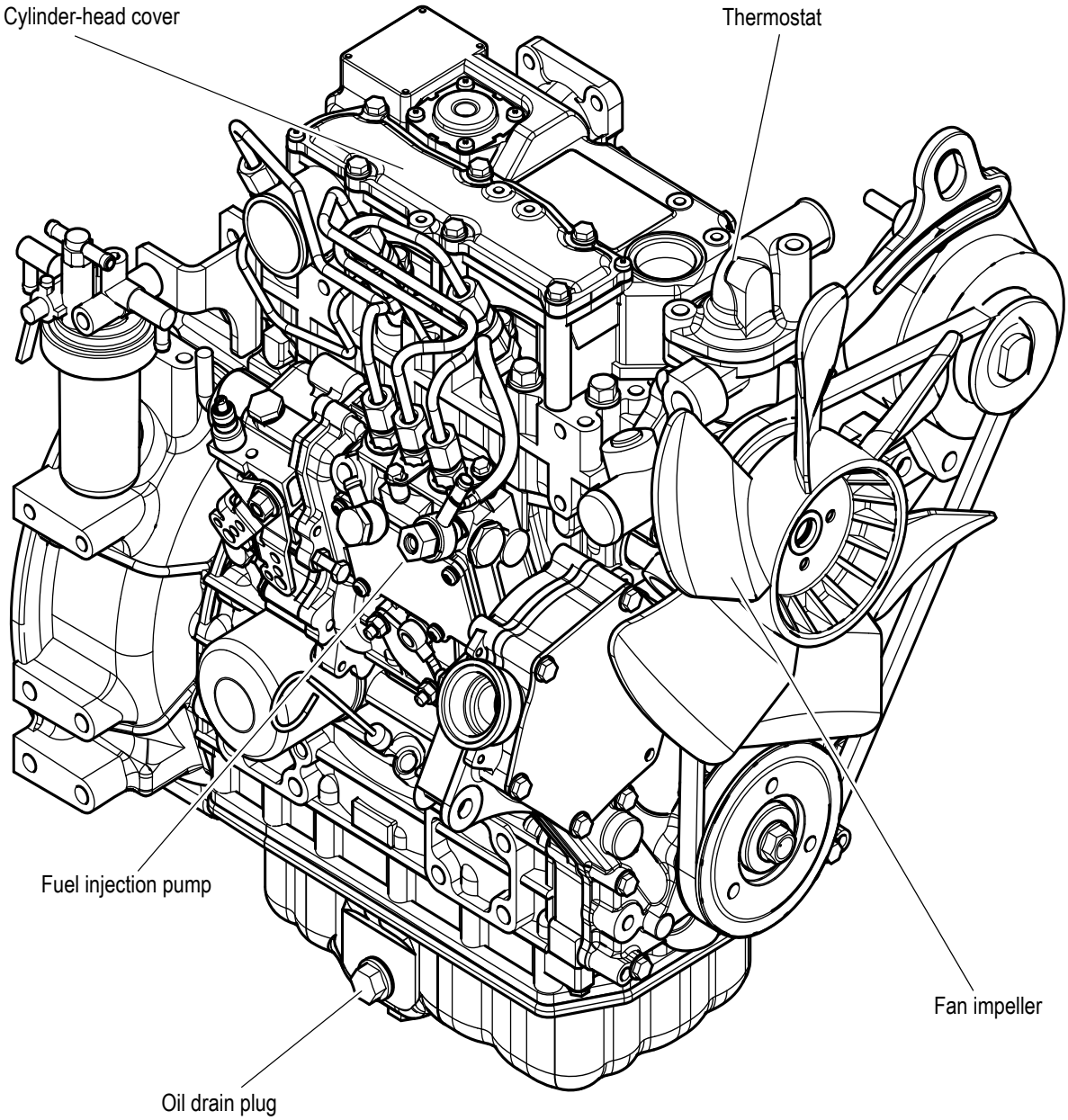
Engine

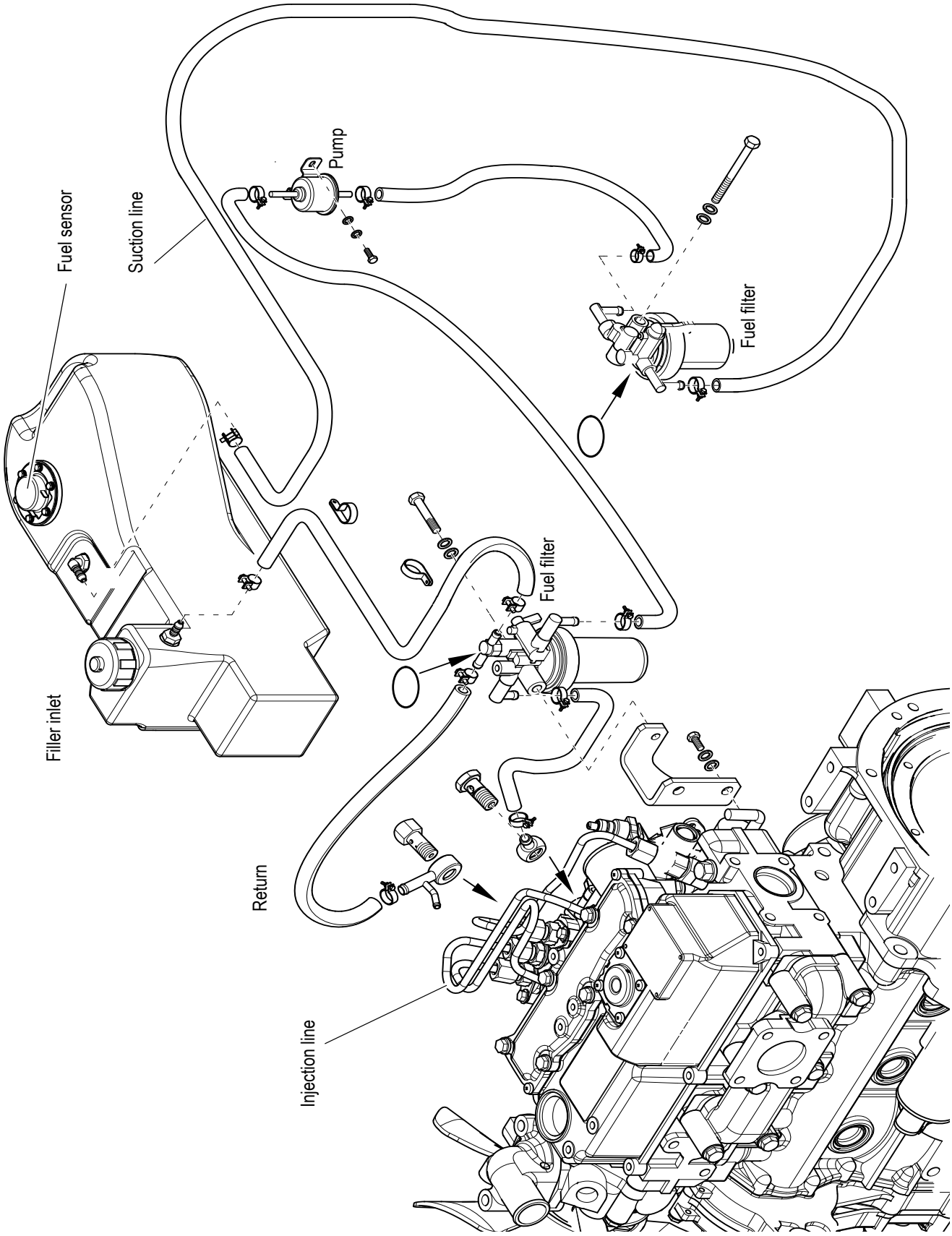
4 Engine

4.1 Overview of engine 3TNV70-VNS



4.2 Fuel system




Fuel sensor
Suction line
Pump
Fuel filter
Fuel filter
Filler inlet
Return
Injection line

4.3 Checking and adjusting valve clearance

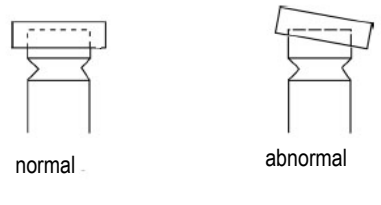


Fig. 1: Valve cap wear

☞ *Standard setting of valve clearance is possible:*

➥ On a cold engine

☞ *Remove the cylinder-head cover*

☞ *Turn the engine with a screwdriver (as in 4.7) until the cylinder reaches the top dead center of the compression cycle.*

➥ Valve overlapping

☞ *Check the valve cap for abnormal wear*

☞ *Check valve clearance with feeler gage* **2/A**

➥ Valve clearance: 0.15 – 0.25 mm (0.0059" – 0.0098")

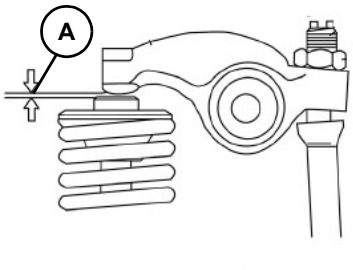


Fig. 2: Checking valve clearance

☞ *Repeat the procedure for each cylinder*

☞ *Reset valve clearance if necessary (valve clearance not within the tolerance range).*

☞ *Loosen the locknut on the rocker arm and reset valve clearance with a screwdriver.*

☞ *Hold the screw with the screwdriver and counter again.*

☞ *Position the cylinder-head cover gasket*

☞ *Install the cylinder-head cover.*

4.4 Tightening order for cylinder head bolts

☞ *Install the cylinder-head bolts*

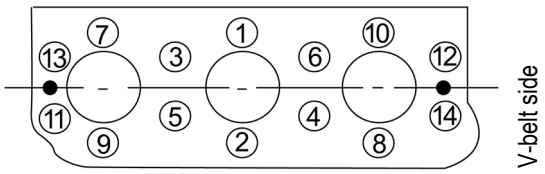
➥ Tightening torque:

1st position	26 – 30 Nm	19.1 – 22.1 ft lbs
2nd speed	53.9 – 57.9 Nm	39.75 – 42.7 ft lbs

Attention!

Bear in the mind the order for tightening the cylinder-head bolts!

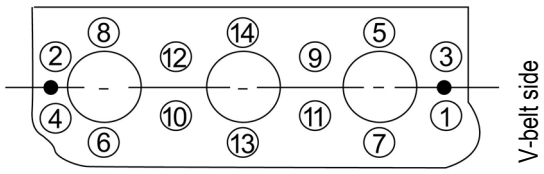
☞ *See figure*



Notice!

Apply oil to the threads and contact surfaces before installing.

☞ *Order for removing the cylinder-head bolts*



Notice!

Always perform work on the cylinder head on a cold engine!

4.5 Checking the injection nozzles

Pressure check

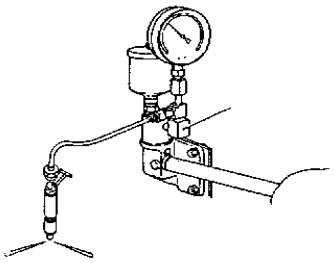


Fig. 3: Nozzle tester

☞ *Remove the injection line and the injection nozzle*

☞ *Connect the injection nozzle with the high pressure line of the nozzle tester*

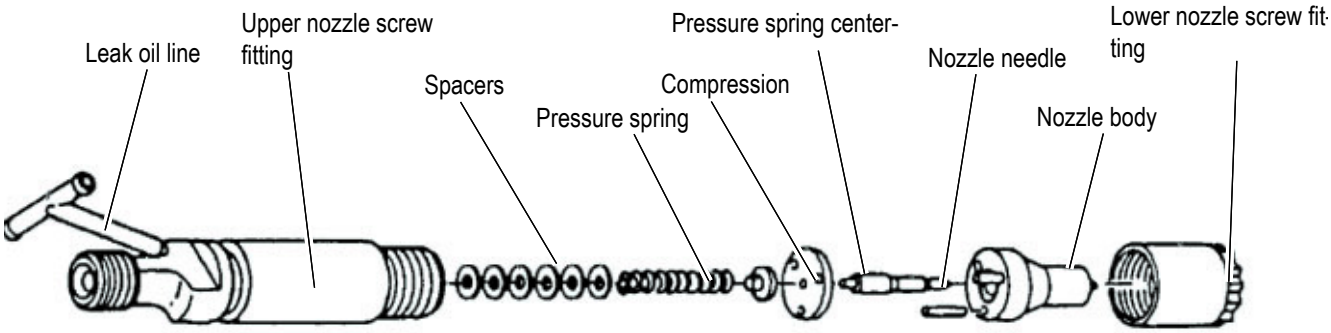
☞ *Slowly increase pressure until the nozzle ejects fuel and read the pressure off the pressure gage*

☞ *If the injection pressure is too low, replace the spacer in the nozzle by a thicker one. If the pressure is too high, replace the spacer by a thinner one.*

➥ Injection pressure: **120–130 bar (1740–1885 psi)**

- Spacer thickness of 0.1 mm (0.0039") corresponds to modification by 7 – 10 bar (101 – 145 psi).
- Check the injection nozzle for drips after it has ejected fuel.

☞ Create a pressure of about 20 bar (290 psi) below injection pressure and check whether fuel drips from the nozzle.



4.6 Checking the nozzle jet

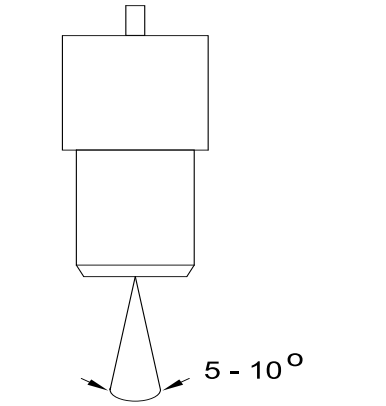


Fig. 4: Correct shape of nozzle jet

☞ *Remove the injection lines and the injection nozzles*

☞ *Connect the injection nozzle with the high pressure line of the nozzle tester*

☞ *Quickly create pressure until the nozzle ejects fuel (ejection 3 – 4 times)*

☞ *Hold a white sheet of paper about 30 cm (11.8") away from the nozzle and let the nozzle eject fuel*

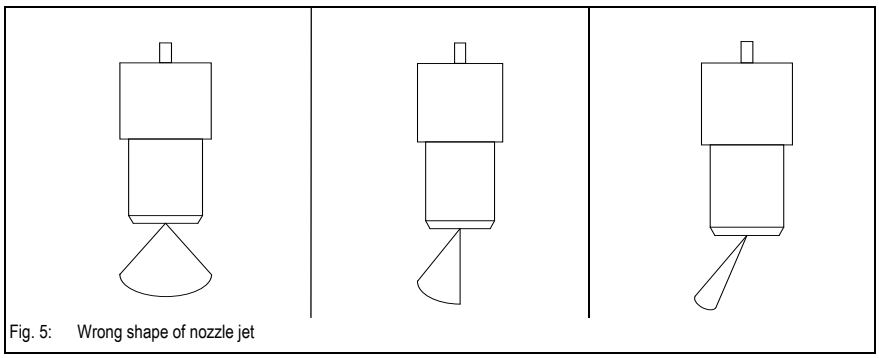


Fig. 5: Wrong shape of nozzle jet

4.7 Injection time

Checking and adjusting injection time

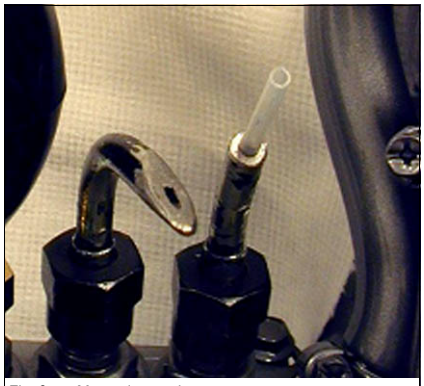


Fig. 6: Measuring equipment

- Preparations:

☞ *Mark the actual position of the fuel injection pump on the engine block.*

☞ *Trace the mark with a touch-up applicator.*

☞ *Set the throttle to work position.*

☞ *Unscrew only the injection line on the pump side and bend it a little to the side so that you can see the opening to the fuel injection pump.*

☞ *In order to be able to see better, you can use a section of an injection line or a transparent tube instead of the injection line (**as required**)*

- Measurement:

☞ *Slowly turn the engine clockwise, as seen from the radiator side.*

☞ *As you do so, carefully watch the opening where the injection line was.*

☞ *Stop turning as soon as fuel starts coming out.*

☞ *Wipe away the fuel and turn back to about 20° before top dead center.*

☞ *Repeat the measurement.*

☞ *Read the mark on the crankshaft (15°).*
Injection time is set correctly if it corresponds to this value.

☞ *If it does not correspond to this value, loosen the fuel injection pump (do not unscrew it completely) and rotate it a little.*

➥ Rotated toward the engine: earlier injection time

➥ Rotated away from the engine: later injection time

☞ *Screw the fuel injection pump firmly and check.*

☞ *Repeat the procedure as required.*

Fig. 7: Mark on housing

Notice!

Bend the injection lines as you install them so they are not subject to tension once they are installed. Bleed the injection lines once they are installed.

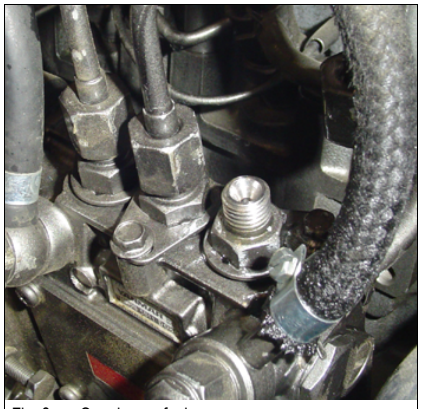


Fig. 8: Opening on fuel pump

Replacement of fuel injection pump

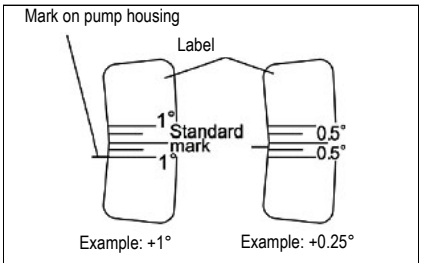


Fig. 9: Correction of injection angle

☞ *Mark the initial position on the pump and wheel case housing before removing the fuel injection pump – see Fig. 9*

☞ *Remove gear casing cover* **10/1** *of the fuel injection pump*

☞ Mark the position of the gear of the fuel injection pump **11/A** in relation to gear **11/B**

☞ *Completely loosen lock nut* **11/2** *of the drive pinion*

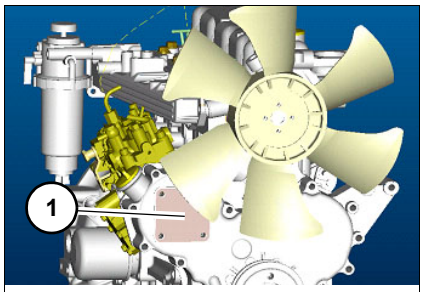


Fig. 10: Gear casing cover

☞ *Remove the fuel injection pump*

☞ Read off the injection angle on the pump

☞ Read off the injection angle on the new pump

➥ Read off the imprint on the engine side of the fuel injection pump

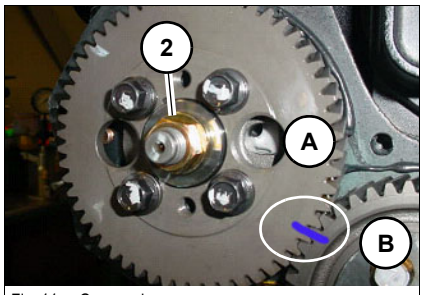


Fig. 11: Gear casing

☞ *Difference of "Angle of new pump" – "Angle of old pump" gives you the mounting angle of the new fuel injection pump*

➥ Positive value: later injection time (toward the engine)

➥ Negative value: earlier injection time (away from the engine)

☞ *Install the new fuel injection pump*

☞ Check the marked position of the drive pinion of the fuel injection pump (fig. *Fig. 11*)

☞ *Screw on and tighten nut* ***11/2***

☞ *Check injection time*

☞ *Install gear casing cover* **10/1** *of the fuel injection pump*

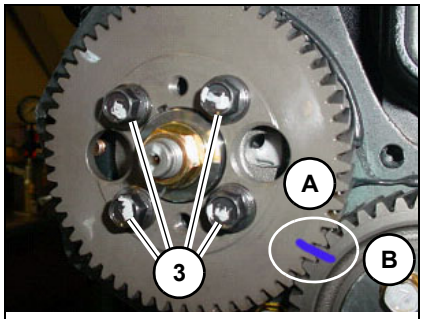


Fig. 12: Gear casing

Notice!

Do not loosen screws **11/3** of the drive pinion of the fuel injection pump. These screws specify the precision setting of the fuel injection pump set by the manufacturer!

4.8 Adjusting engine speed

Notice!

The maximum engine speed is set and sealed by the manufacturer without the pump and may not be increased!

Adjust engine speed without load!

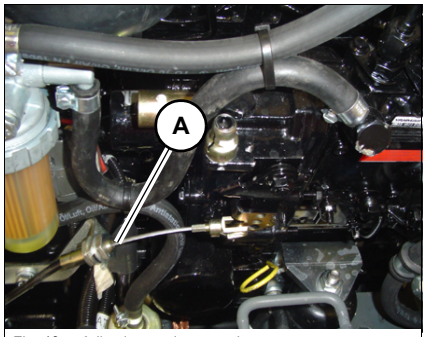


Fig. 13: Adjusting engine speed

☞ *Run the diesel engine until it reaches operating temperature*

☞ *Check idling speed and maximum engine speed with all attachment functions in neutral*

➥ Idling speed: 1100 +/− 50 rpm

➥ Max. engine speed: 2270 +/− 10 rpm

4.9 Compression

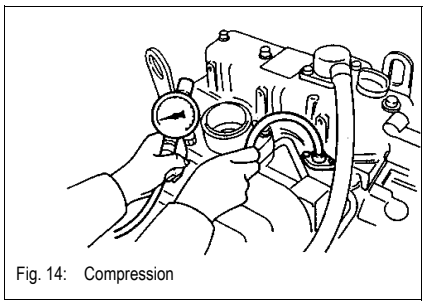


Fig. 14: Compression

☞ *Remove the injection lines and the injection nozzles*

☞ *Set the fuel injection pump to zero delivery (remove the plug for the cutoff solenoid)*

☞ *Turn the engine*

☞ *Install the compression gage on the cylinder you want to measure*

☞ *Turn the engine with the starter and read the pressure off the pressure gage*

➥ Specified value: **33 +/− 1 bar (478.6 psi +/− 14.5) at 250 rpm**

➥ Threshold value: **26 +/− 1 bar (377 psi +/− 14.5) at 250 rpm**

4.10 Checking the coolant thermostat

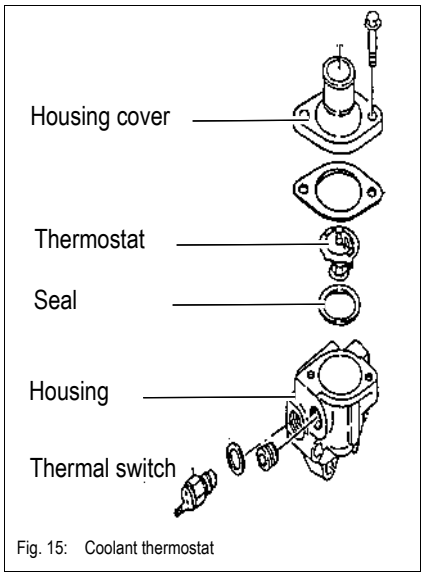
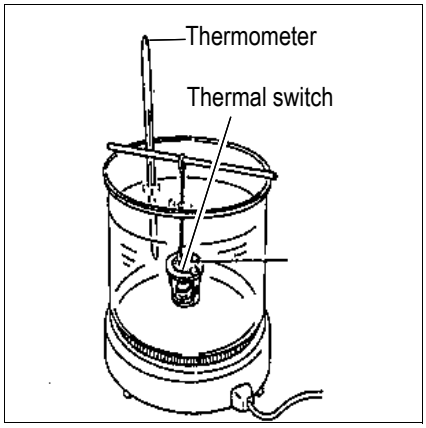


Fig. 15: Coolant thermostat

☞ *Remove the thermostat*

➥ The thermostat is located on the water pump

– *see Overview of engine 3TNV70-VNS (Tier IV final up to 2012)* on page 4-2



☞ *Warm up the thermostat in a container with water*

☞ *Check whether the thermostat opens at the specified temperature (check with a temperature gage)*

➥ Thermostat opening temperature: **69.5 – 72.5 °C (157.1 – 162.5 °F)**

4.11 Checking the thermal switch

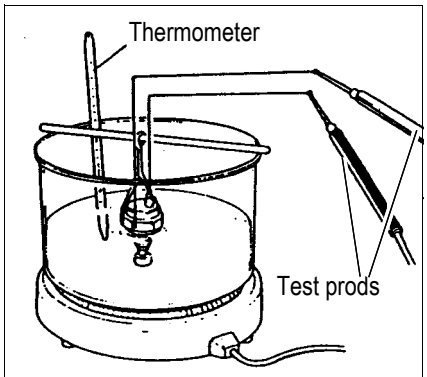


Fig. 16: Checking the thermal switch

☞ *Remove the thermal switch*

☞ *Warm up the thermal switch in a container with coolant or oil*

☞ *Measure the resistance of the thermal switch as shown by means of an ohmmeter.*

➥ The switch must allow the coolant to pass at a temperature of **107 – 113 °C (224.6 – 235.4 °F)**

4.12 Oil pressure switch

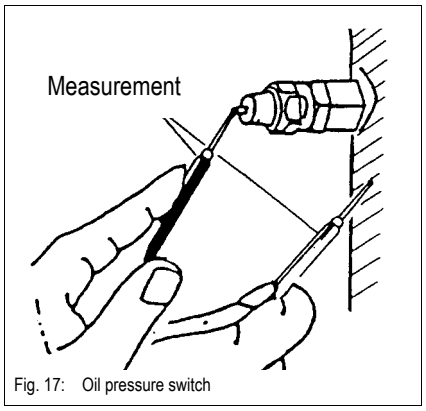


Fig. 17: Oil pressure switch

☞ *Remove the cable connection from the oil pressure switch (in the area of the cutoff solenoid)*

☞ *Start the engine, check for correct idling speed*

☞ *Measure the resistance of the oil pressure switch as shown by means of an ohmmeter.*

➥ Oil pressure switch OK: infinite resistance.

➥ The oil pressure switch is malfunctioning if the oil can pass

4.13 Checking the coolant circuit

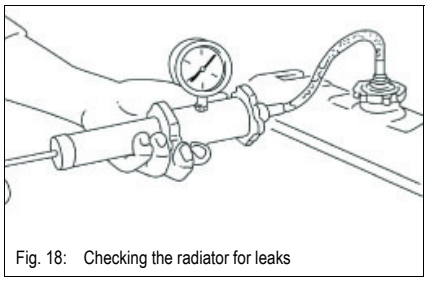


Fig. 18: Checking the radiator for leaks

Leakage check

☞ *Fill up the radiator completely*

☞ *Install an adapter on the radiator as shown*

☞ *Increase the pressure in the cooling system by means of a hand pump to about **1 bar***

➥ Check the lines and the connections for leaks if the pressure drops at the pressure gage

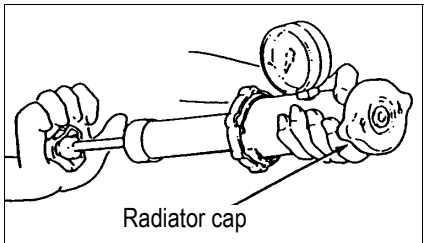


Fig. 19: Checking the radiator cap

Checking the radiator cap

☞ *Remove the radiator cap and install it on the adapter as shown*

☞ *Increase the pressure to about 1 bar (stamped onto the radiator cap) with the hand pump*

➥ The radiator cap must open

4.14 Engine malfunctions

Problem	Possible cause
Engine does not start or is not easy to start	Wrong SAE grade of engine lubrication oil
	Fuel grade does not comply with specifications
	Malfunctioning or empty battery
	Loose or oxidized cable connections in starter circuit
	Malfunctioning starter, or pinion does not engage
	Wrong valve clearance
	Malfunctioning fuel injector
	Malfunctioning starting relay
	Malfunctioning glow plug
	Malfunctioning solenoid switch
	Cutoff solenoid does not attract
	Cutoff solenoid without current
	High pressure created immediately in the hydraulic system
	Malfunctioning fuses
Engine starts, but does not run smoothly or faultless	Fuel grade does not comply with specifications
	Wrong valve clearance
	Injection line leaks
	Malfunctioning fuel injector
	Air in fuel system
	Dirty fuel filter
Engine overheats. Temperature warning system responds	Oil level too low
	Oil level too high
	Dirty air filter
	Dirty radiator fins
	Malfunctioning fan, torn or loose V-belt
	Resistance in cooling system too high, flow capacity too low
	Malfunctioning fuel injector
	Not enough coolant
	Cooling system leaks

Problem		Possible cause
Insufficient engine power		Oil level too high
		Fuel grade does not comply with specifications
		Dirty air filter
		Malfunctioning air filter maintenance switch or gage
		Wrong valve clearance
		Injection line leaks
		Malfunctioning fuel injector
		Air in fuel system
Engine does not run on all cylinders		Injection line leaks
		Malfunctioning fuel injector
		Malfunctioning fuel injection pump
Insufficient or no engine oil pressure		Oil level too low
		Machine inclination too high (max. 25°)
		Wrong SAE grade of engine lubrication oil
		Malfunctioning oil pump
Engine oil consumption too high		Oil level too high
		Machine inclination too high (max. 25°)
Engine smoke	Blue	Oil level too high
		Machine inclination too high (max. 25°)
		Engine oil combustion (malfunctioning cylinder-head gasket)
	White	Engine starting temperature too low
		Fuel grade does not comply with specifications
		Malfunctioning fuel injector
		Coolant combustion (malfunctioning cylinder-head gasket)
		Exteme misalignment of injection time
	Black	Dirty air filter
		Malfunctioning air filter maintenance switch or gage
		Wrong valve clearance
		Malfunctioning fuel injector (drips)
		Wrong fuel injection pump setting

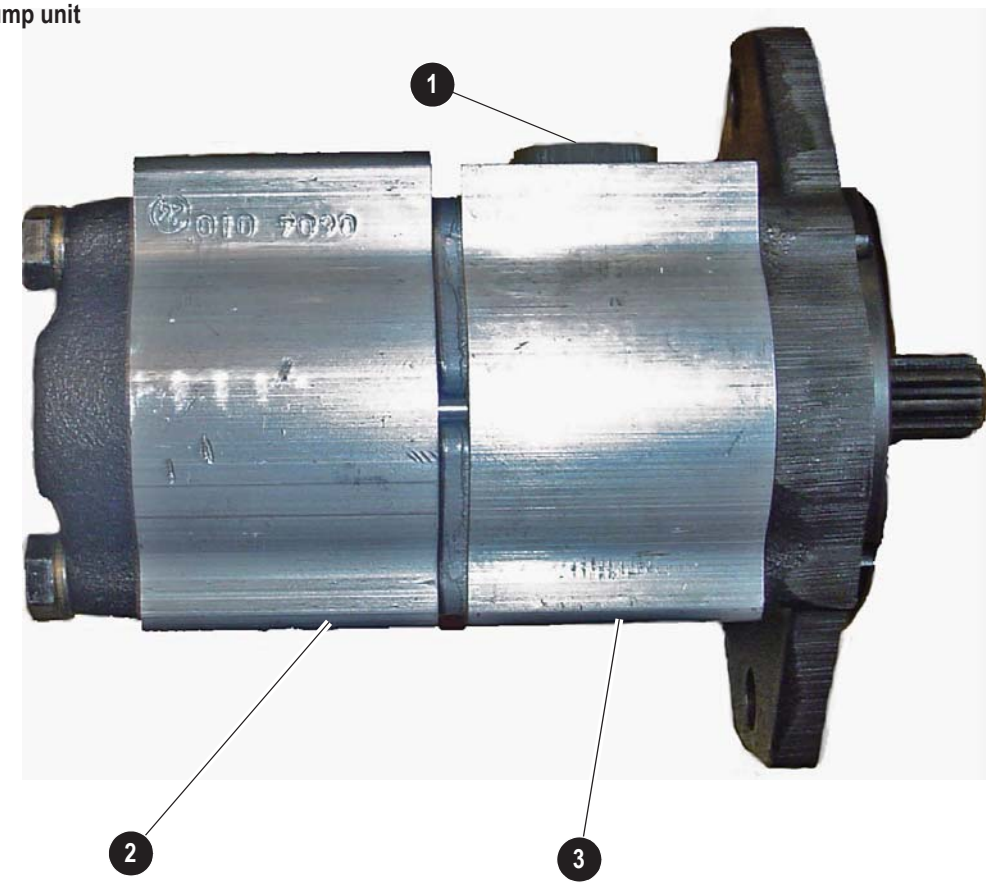
Hydraulic system

5 Hydraulic system

5.1 Hydraulic pump

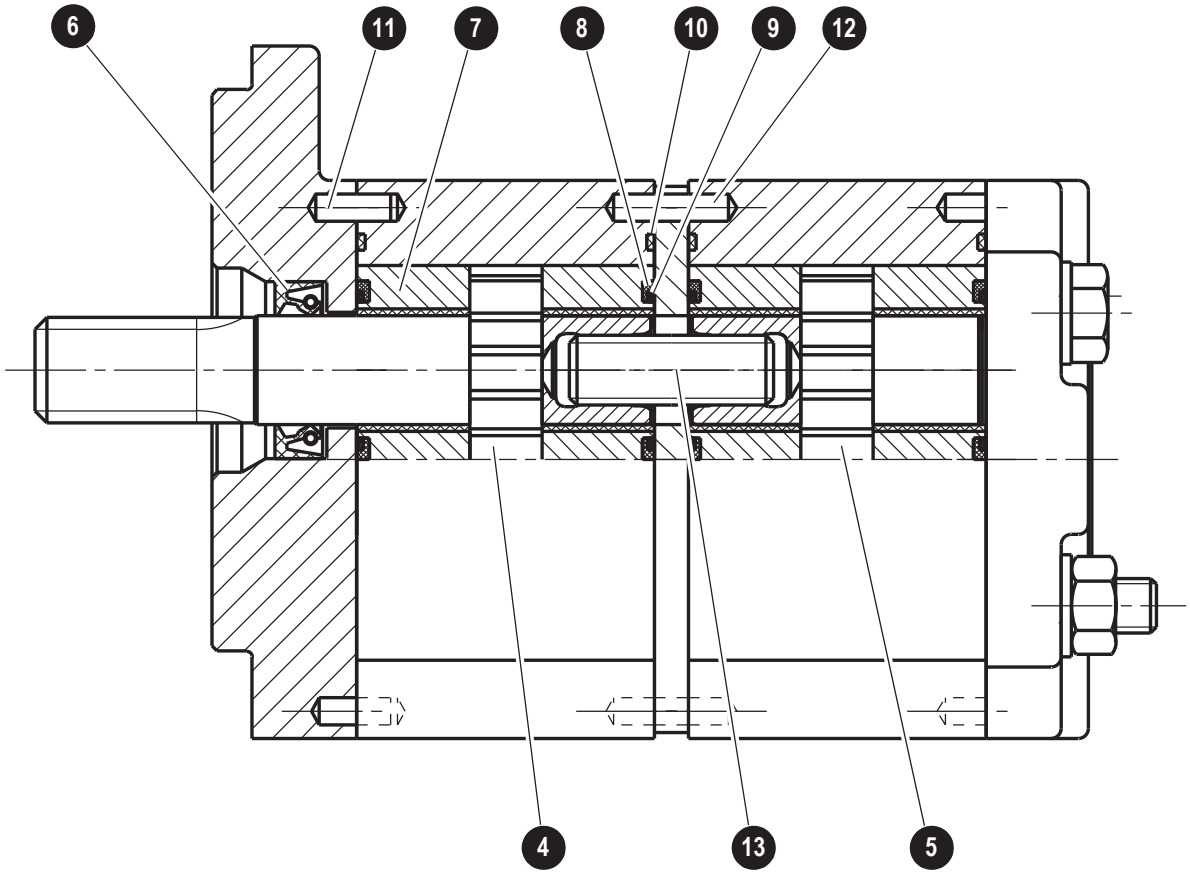
2 coupled gear pumps

Gear pump unit



Item	Designation
1	Suction line Connection
2	Pressure line P1 connection
3	Pressure line P2 connection

Pump unit: exploded view



Item	Designation
4	Gear shaft set
5	Gear set
6	Lip seal
7	Sleeve
8	Sealing ring
9	Prop ring
10	Seal
11	Parallel pin
12	Parallel pin
13	Connecting shaft

5.3 Main valve block

Connections

Input P1

Rotate

Shovel arm

Machine travel (left)

Stabilizer blade/tele-scopic under-carriage

Auxiliary hydraulics

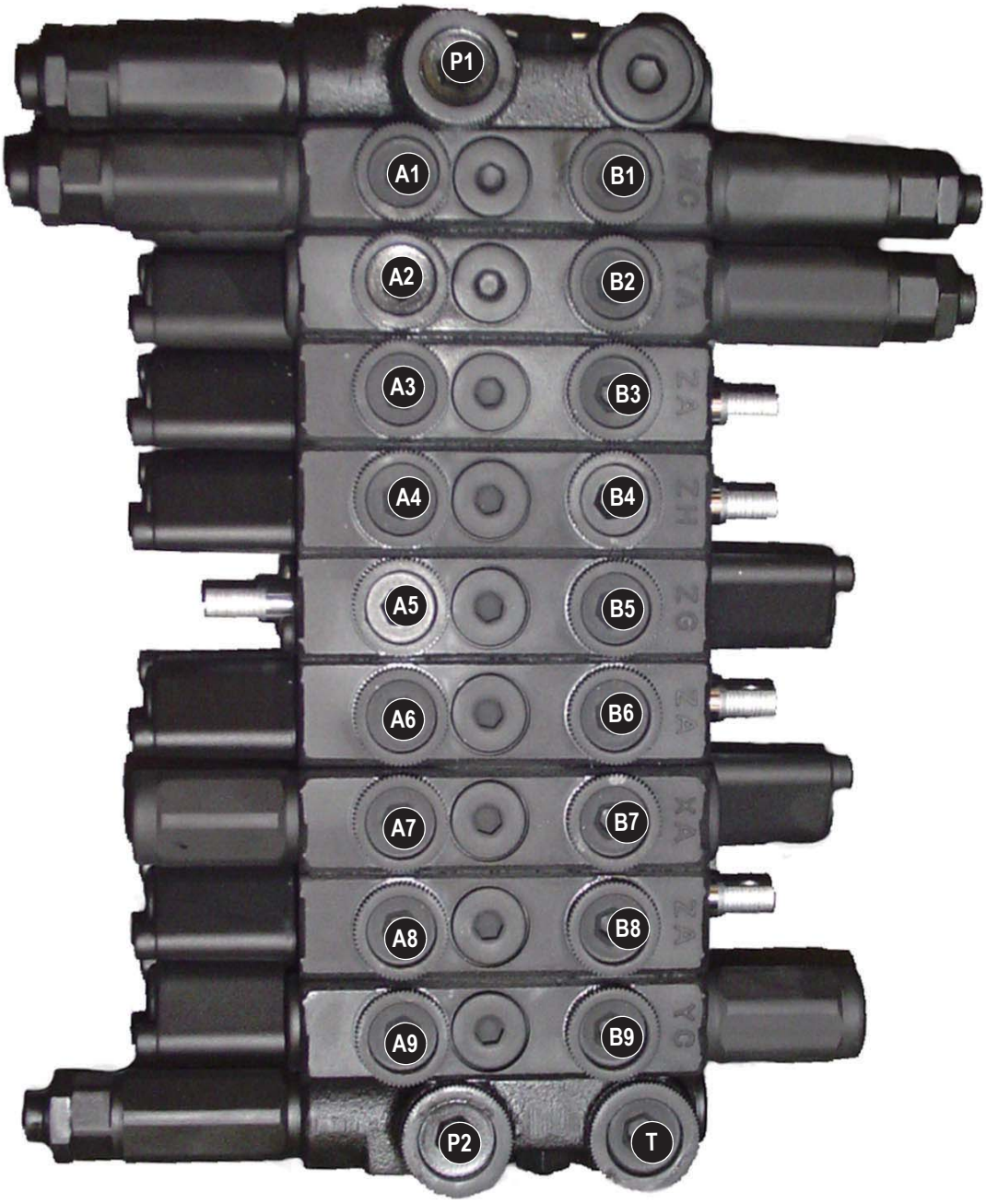
Machine travel (right)

Swivel

Bucket

Boom

Input P2



Legend

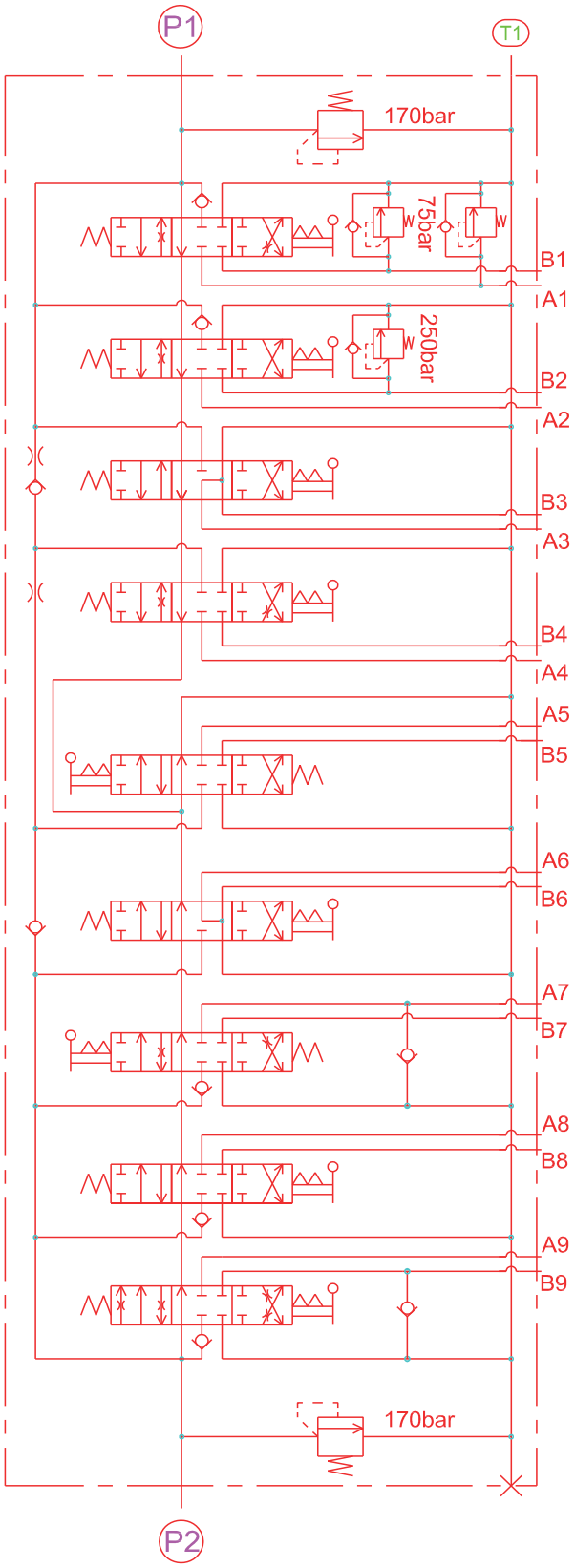
Main control lines

Connection	Legend
B1	Rotation to the left
A1	Rotation to the right
B2	Stick cylinder rod side
B1	Stick cylinder base side
B3	Left-hand traveling drive reverse
A3	Left-hand traveling drive forward
B4	Stabilizer blade/telescopic undercarriage rod side
A4	Stabilizer blade/telescopic undercarriage base side
A5	Auxiliary hydraulics
B5	Closed
A6	Right-hand traveling drive forward
B6	Right-hand traveling drive reverse
A7	Swiveling cylinder rod side
B7	Swiveling cylinder base side
A8	Bucket cylinder base side
B8	Bucket cylinder rod side
A9	Boom cylinder rod side
B9	Boom cylinder base side

Pump/reservoir lines

Connection	Legend
P1	Pump 1 connection
P2	Pump 2 connection
T1	Reservoir line via non-return valve and filter in reservoir

Main valve block diagram



Rotate

Shovel arm

Machine travel (left)

Stabilizer blade/tele-scopic undercarriage

Auxiliary hydraulics

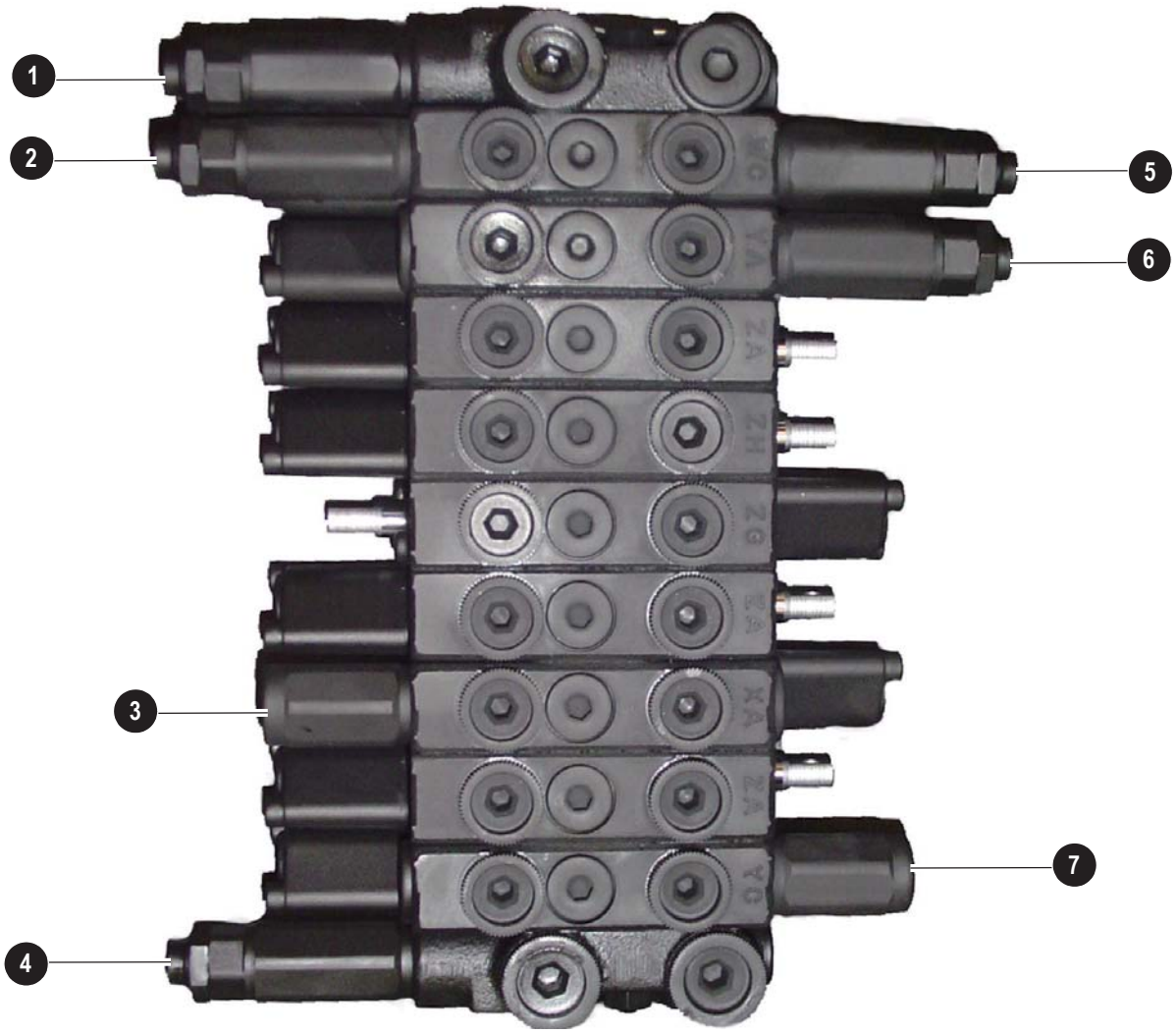
Machine travel (right)

Swivel

Bucket

Boom

Pressure limiting valves



Item	Designation
1	Primary pressure limiting valve P1
2	Secondary pressure limiting valve, swivel, right
3	Anti-cavitation valve
4	Primary pressure limiting valve P2
5	Secondary pressure limiting valve, swivel, left
6	Secondary pressure limiting valve, stick
7	Anti-cavitation valve

Pump assignment

Hydraulic supply by pump 1

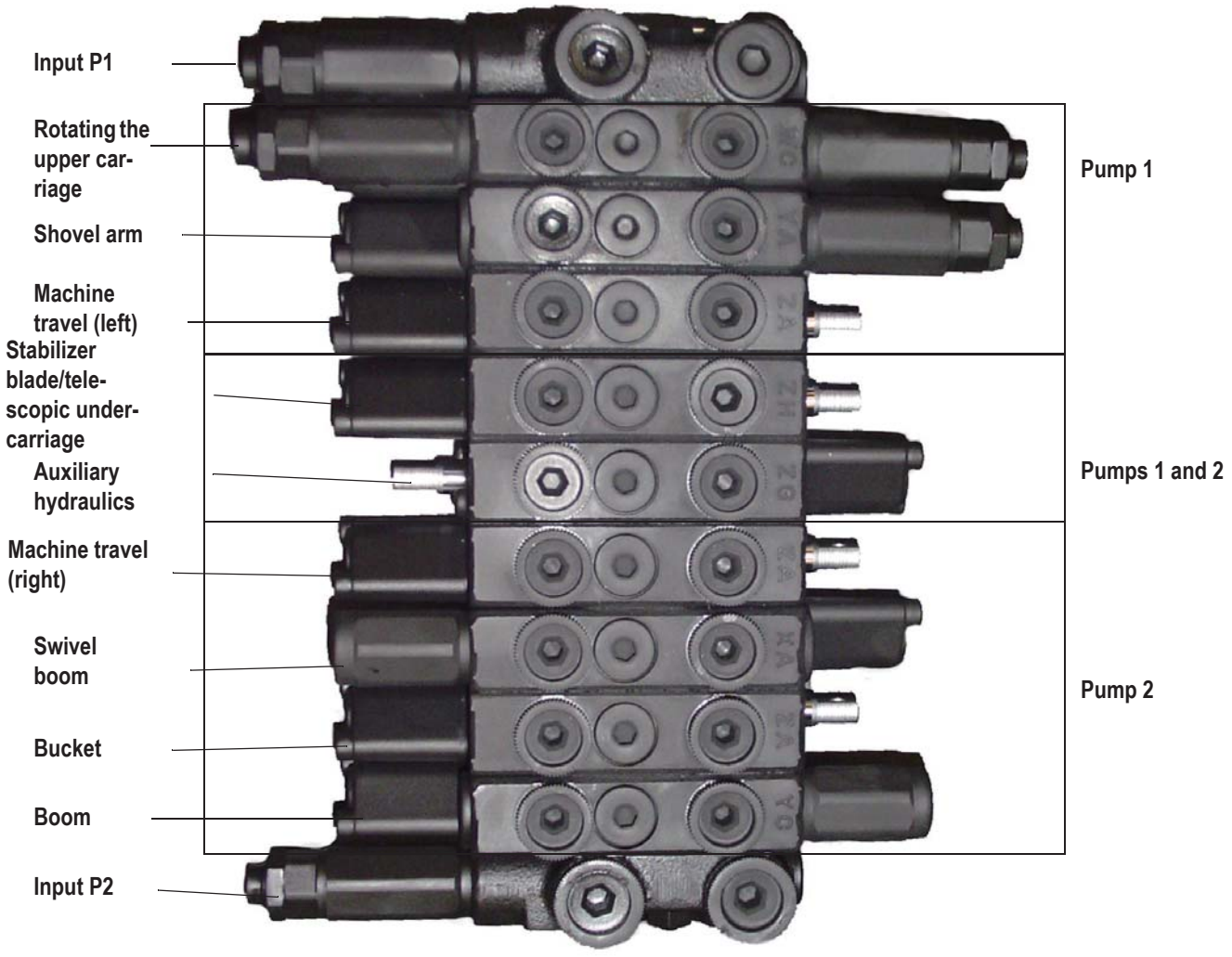
- Upper carriage rotation section
- Stick section
- Machine travel (left) section

Supplied by pumps 1 and 2

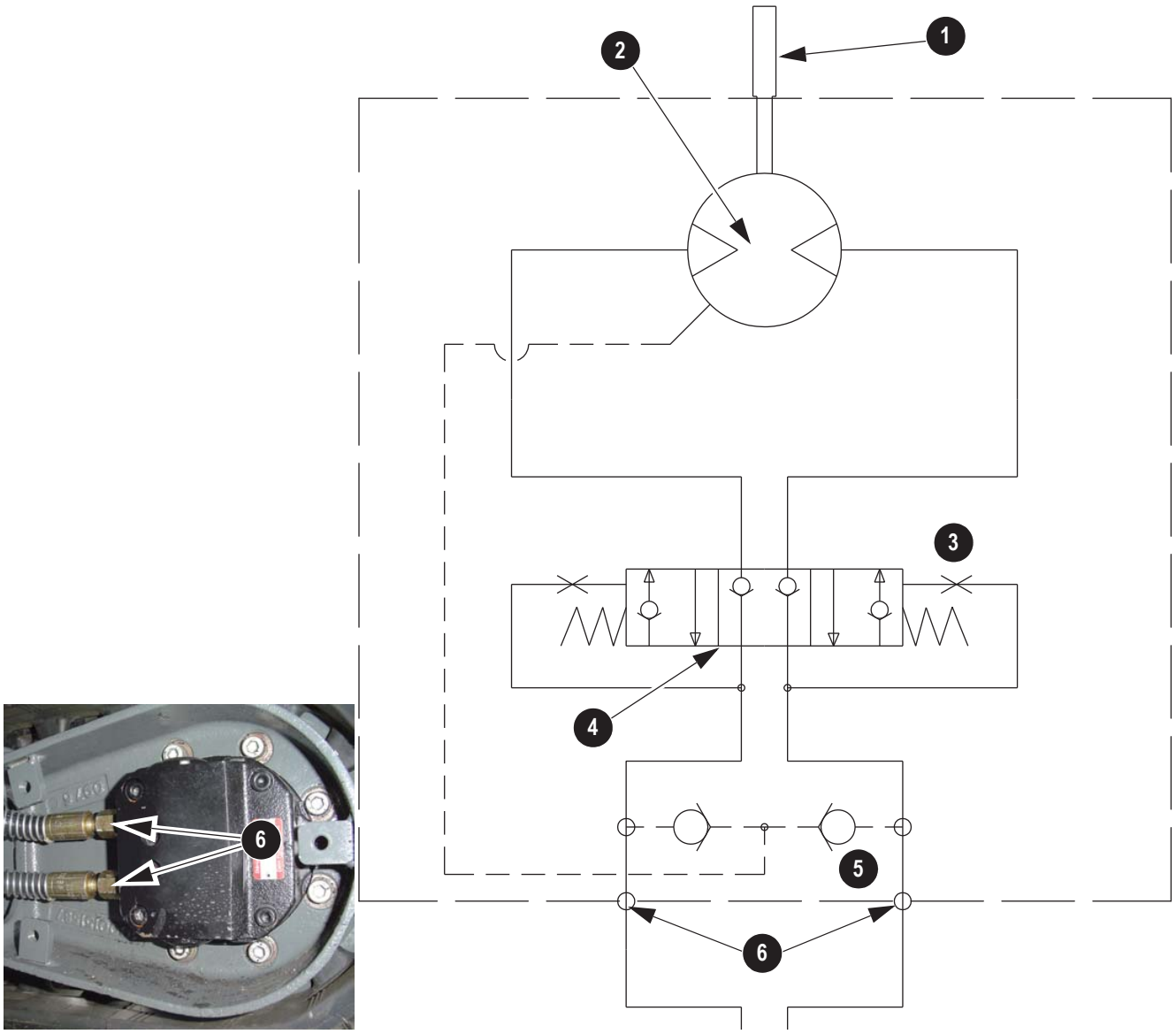
- Stabilizer blade/telescopic undercarriage section
- Auxiliary hydraulics section

Hydraulic supply by pump 2

- Machine travel (right) section
- Swivel boom section
- Bucket section
- Boom section



5.4 Travel drive



Item	Designation
1	Drive shaft
2	Engine
3	Damping
4	Brake valve
5	Non-return valve
6	Connections

The hydraulic motor is slow-running Geroller motor without gears and with internal leak oil drain.

Function

Starting machine travel:

If high pressure is applied to a traveling drive, the brake valve is first moved in the corresponding direction and the oil moves the eccentric gear of the Gerotor in the respective direction of rotation.

Stopping:

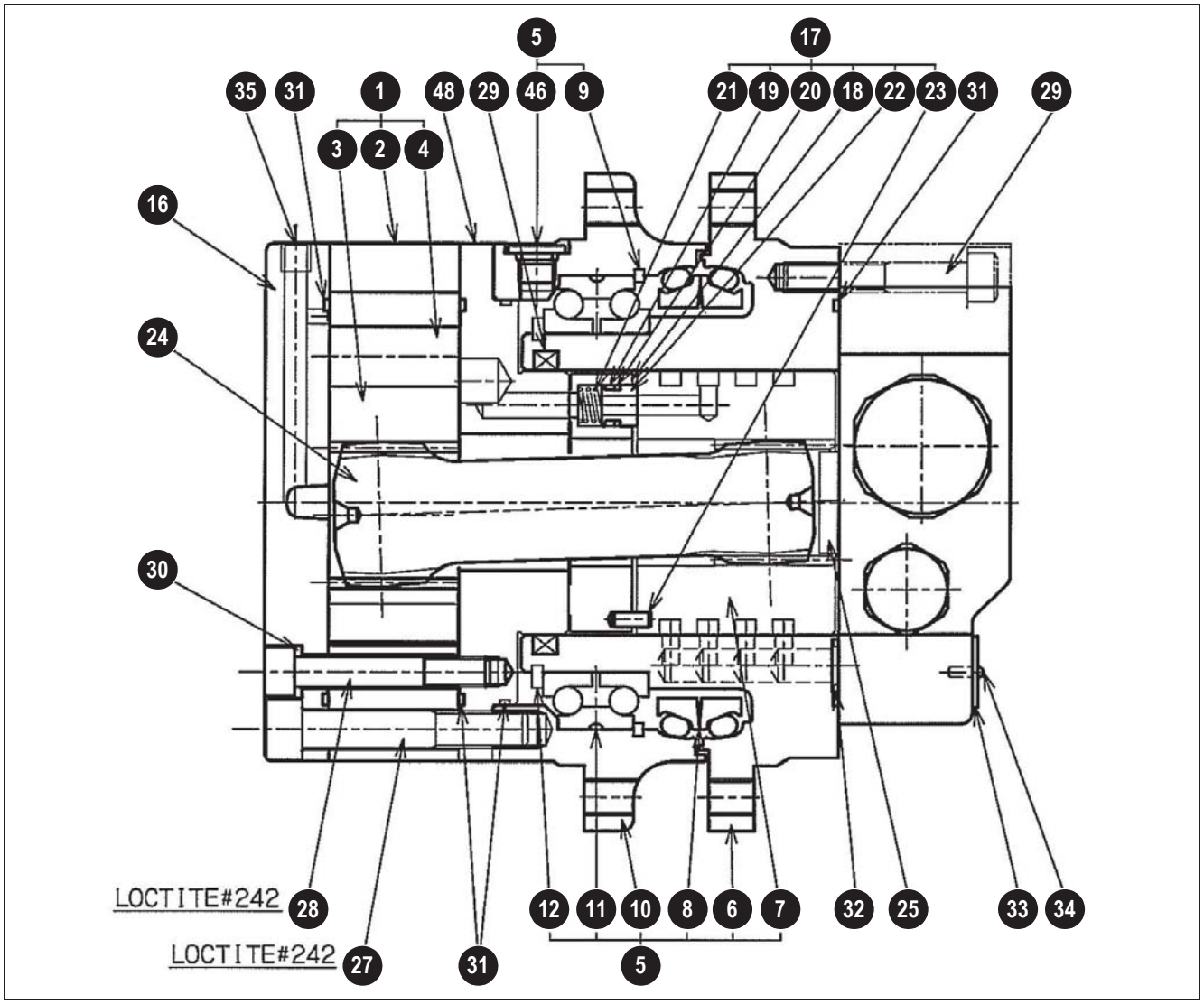
As soon as no more pressure is applied to the traveling drive, the integrated brake valve returns to its initial position by spring action.

This interrupts the oil flow from the motor.

A braking effect sets in and the excavator stops.

The brake valve is dampened for smooth braking.

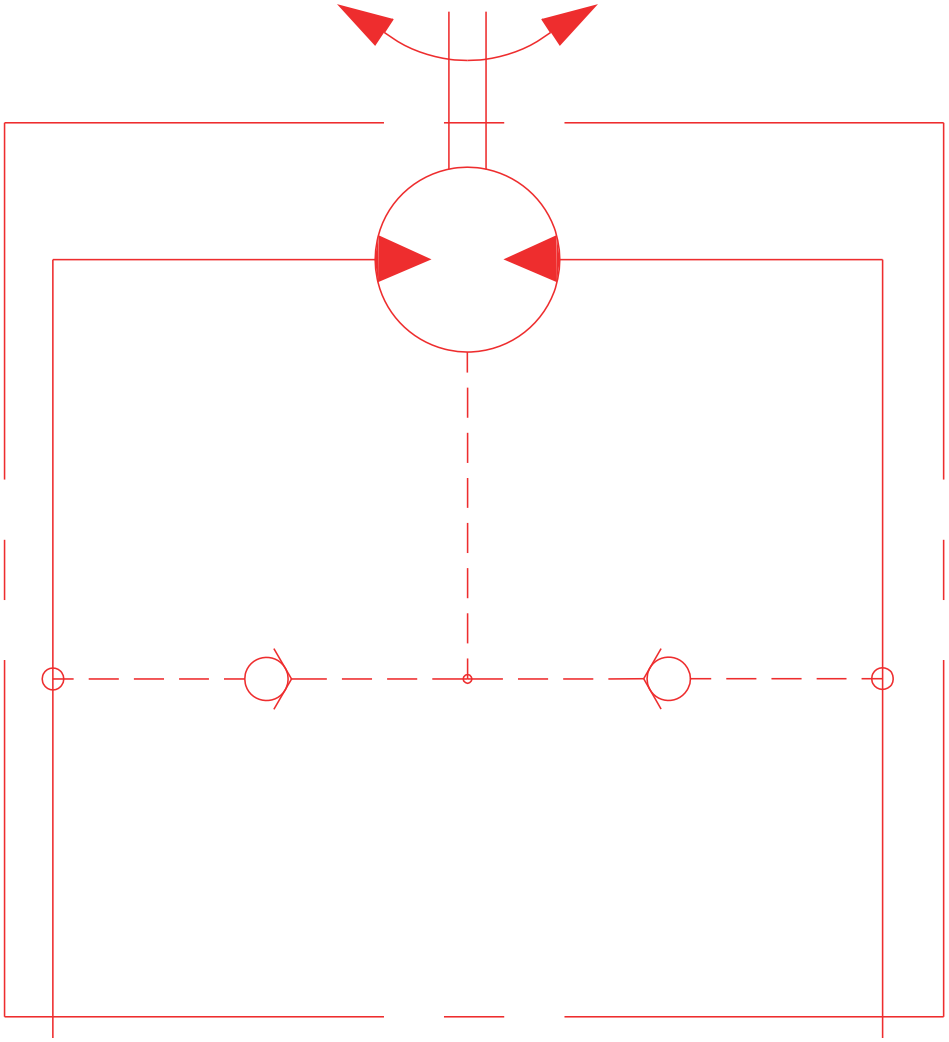
This also works on slopes and keeps the excavator in its position.



Item	Designation	Item	Designation
1	Geroller unit	19	O-ring
2	Geroller ring	20	Prop ring
3	Geroller star wheel	21	Spring
4	Geroller roller	22	Control sleeve
5	Housing assembly	23	Pin
6	Housing element (undercarriage side)	24	Shaft
7	Valve bushing	25	Spacer washer
8	Seal	26	X ring
9	Snap ring	27	Screw
10	Housing element (torus wheel side)	28	Screw
11	Ball bearing	29	Screw
12	Snap ring	30	Sealing washer
13	Plug	31	O-ring
15	Control plate	32	O-ring
16	Geroller cover	33	Type label
17	Valve	34	Rivet
18	Valve	35	Plug

5.5 Swivel unit

The swivel unit is a slow-running Gerotor motor without gears.

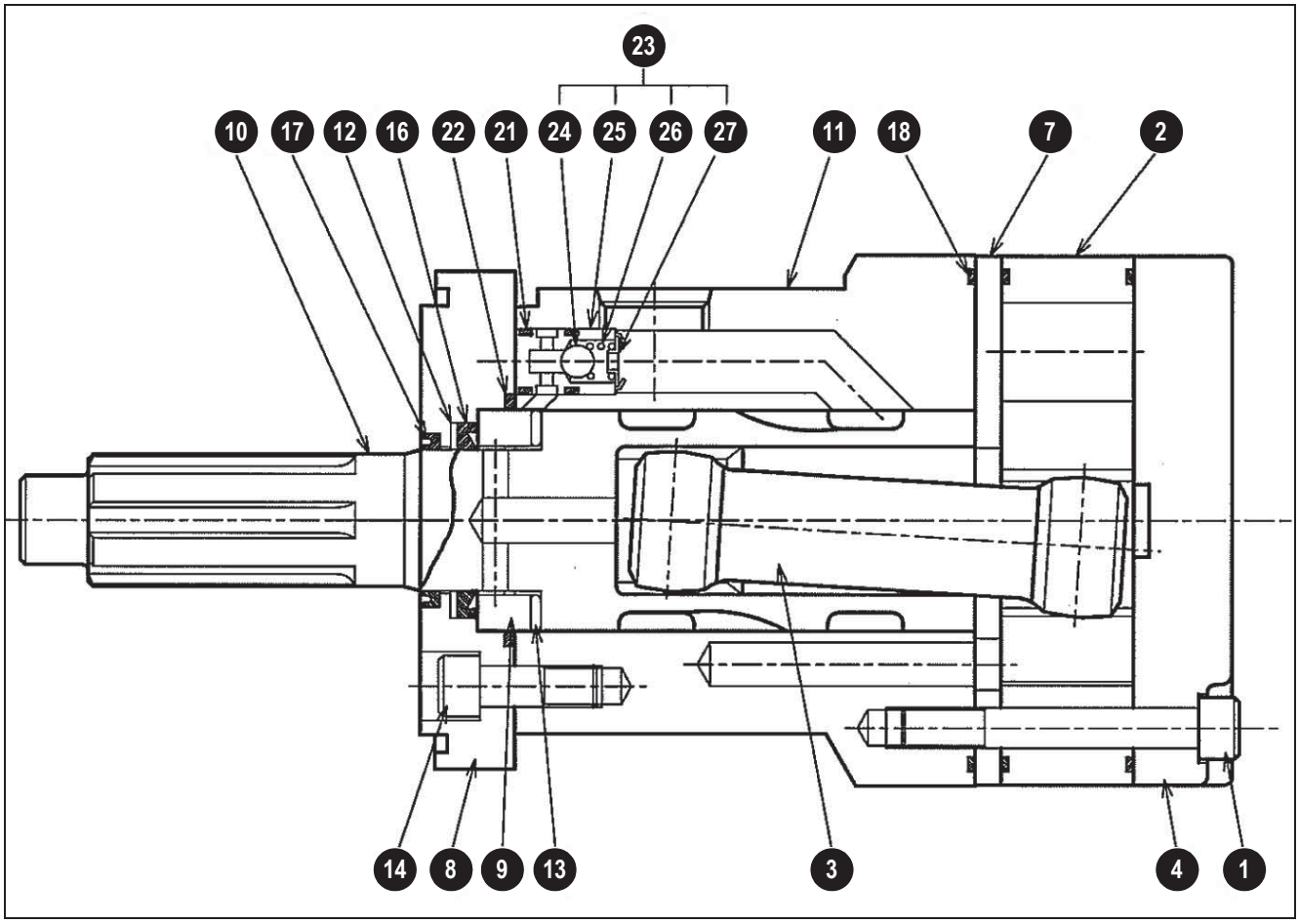


If the gear motor is not actuated, the feed lines are closed by the spool, i.e. the upper carriage stops and does not continue turning by itself.

Notice!

Ensure that the parts are in their exact positions when assembling the Gerotor.

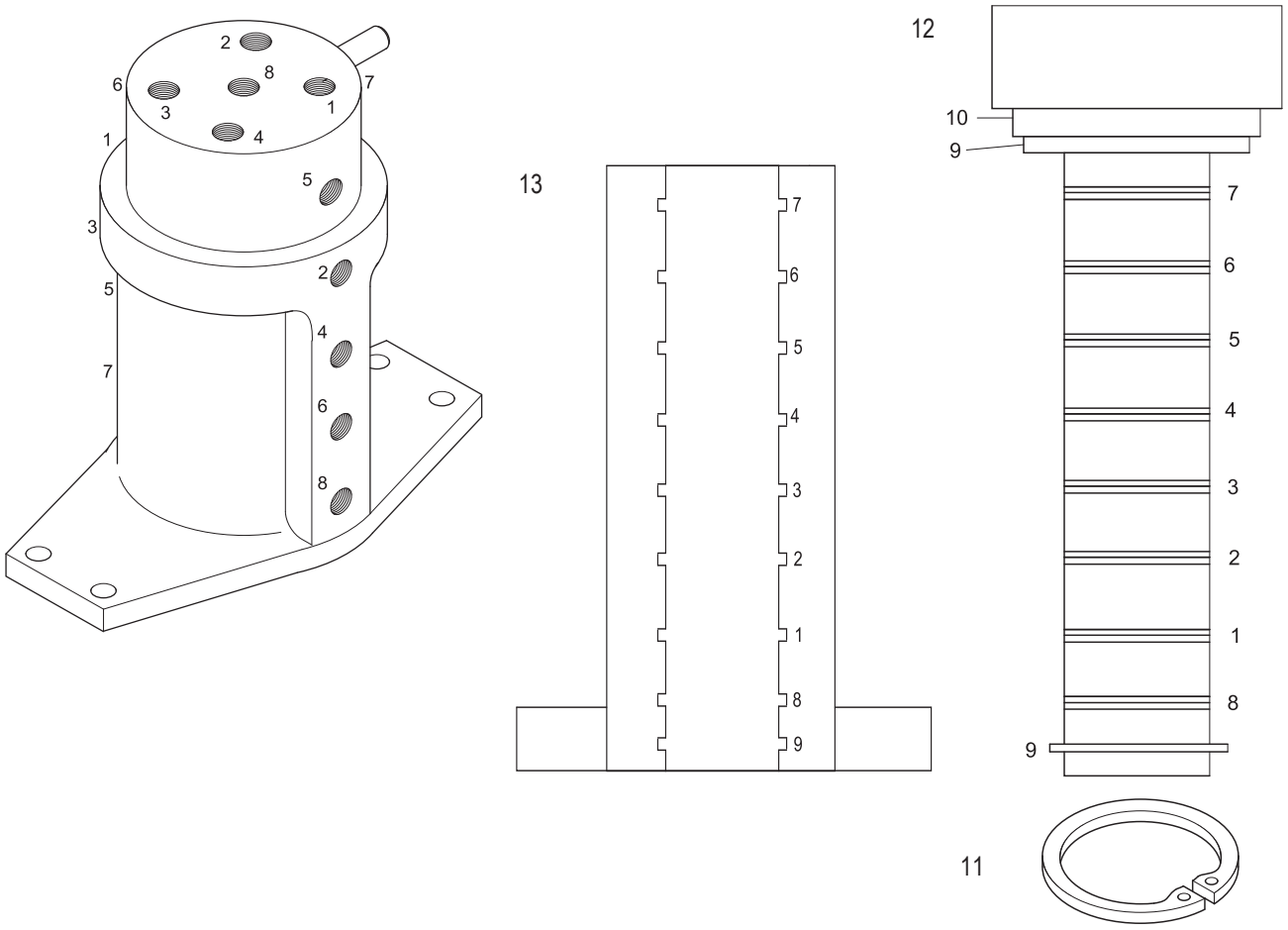
Swivel unit



Item	Designation	Item	Designation
1	Screw	16	Oil sealing ring
2	Geroller	17	Dust seal
3	Shaft	18	O-ring
4	Geroller cover	19	Type label
7	Spacer washer	20	Rivet
8	Screwed flange	21	O-ring
9	Axial bearing ball race	22	O-ring
10	Output shaft	23	Ball check
11	Housing	24	Ball
12	Prop ring	25	Housing
13	Axial needle bearing	26	Spring
14	Bolt 5/16 – 2 UNF	27	Washer

5.6 Swivel joint

8-channel swivel joint



Item	Connection
1a and 6a	Stabilizer blade cylinder
2a and 4a	Traveling drive (right)
3a and 5a	Traveling drive (left)
7a and 8a	Telescopic undercarriage cylinder

Item	Designation
1-8	Sealing rings
9	PU prop ring
10	V sealing ring
11	Circlip
12	Inside part
13	Outside part

Sealing

☞ *Loosen the circlip on the lower side.*

☞ *Pull the swivel joint apart.*

☞ *Replace the sealing rings.*

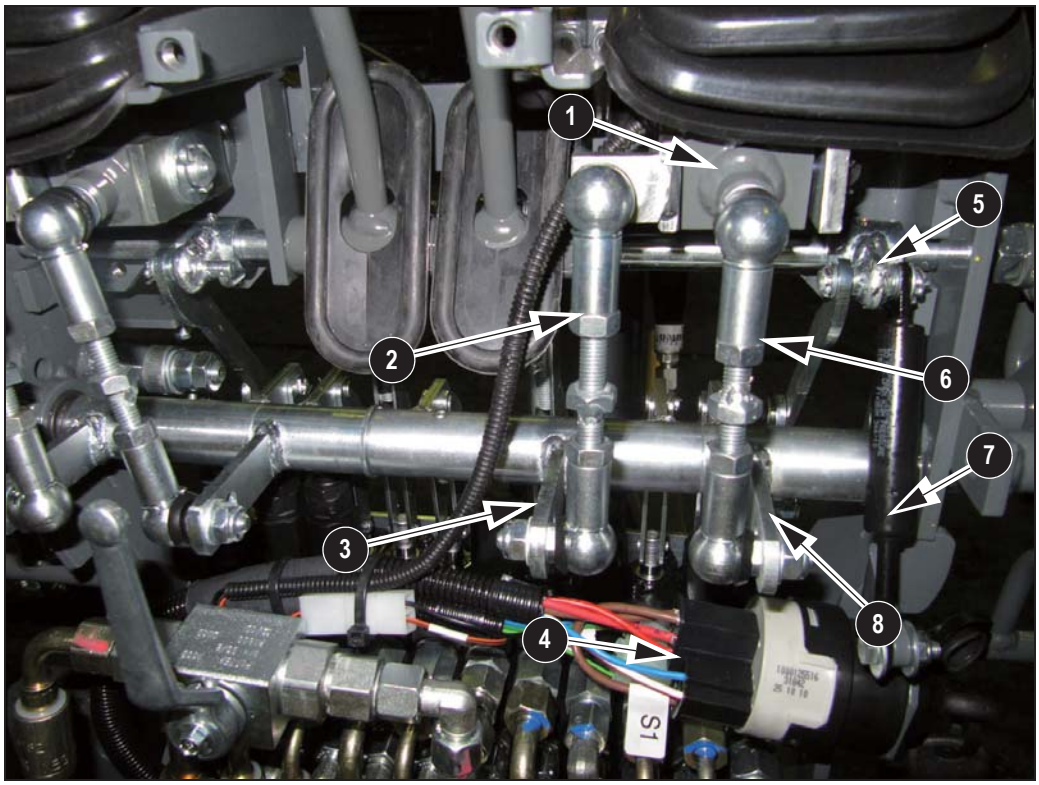
☞ *Push the inside and outside parts together again.*

☞ *Insert the circlip again*

5.7 Mechanical control

Control levers

All hydraulic functions of the Vehicle are controlled mechanically. Accessing the elements of the mechanical pilot control requires removing the plastic trims – *see chapter 5.9 Plastic trims* on page 5-22.



Item	Connection	Item	Connection
1	Joystick	5	Lock lever rocker
2	Bucket segment adjustment linkage	6	Boom segment adjustment linkage
3	Bucket segment rocker	7	Lock lever gas strut
4	Preheating start switch	8	Boom segment rocker

Setting the control levers

☞ *Replacing damaged elements requires setting the control levers again.*

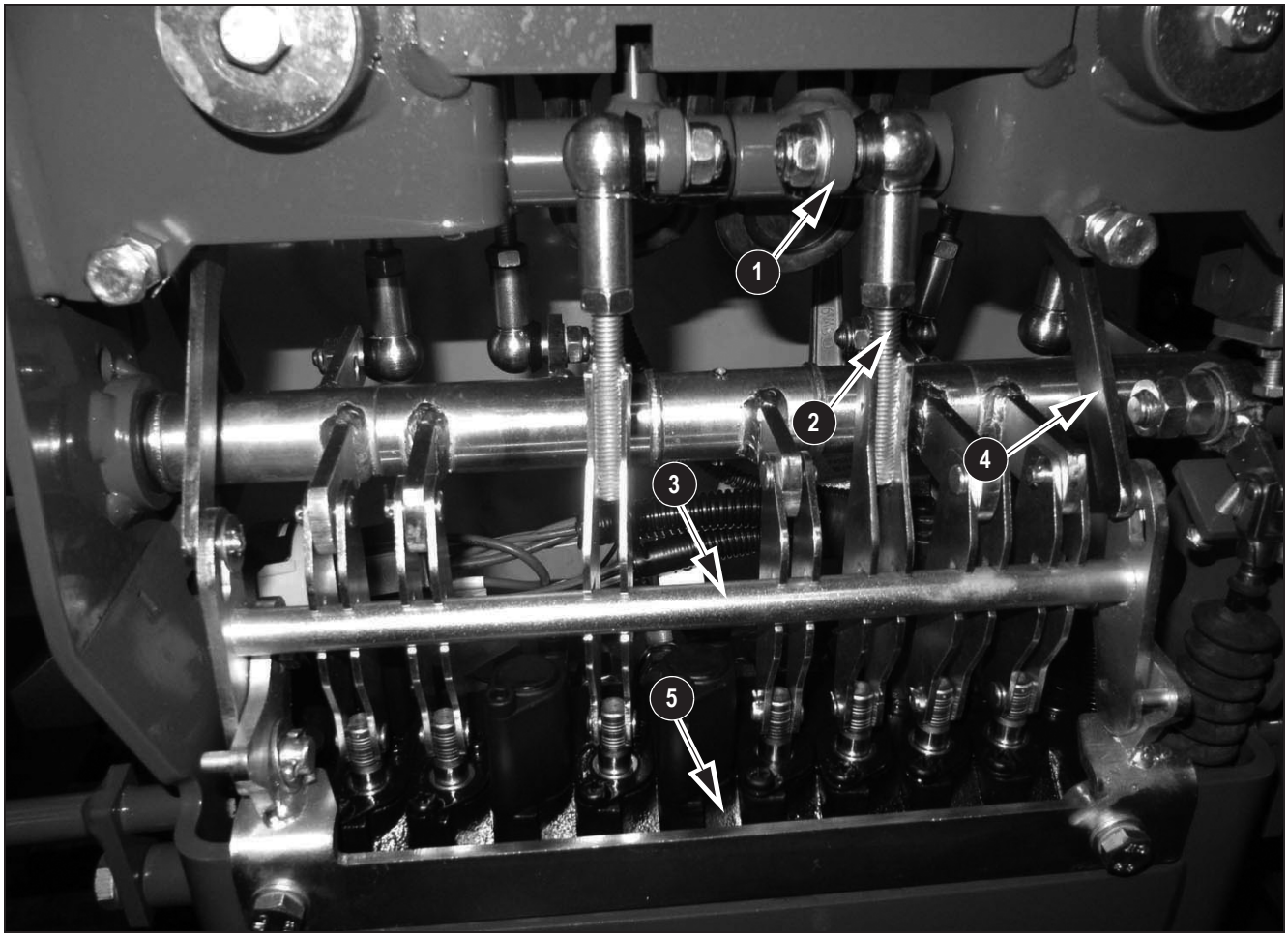
☞ *Modify the position of the adjustment linkage so that the lock lever can be locked and unlocked easily without applying any force.*

☞ *Adjust the control levers so that they remain in their positions when the lock is released.*

☞ *The lock cannot be applied if the adjustment is not correct.*

☞ *Check for correct setting.*

Drive levers



Item	Connection
1	Shackle on drive lever
2	Adjustment linkage
3	Lock
4	Lock linkage
5	Main valve block

Setting the drive levers

☞ *Park the machine horizontally*

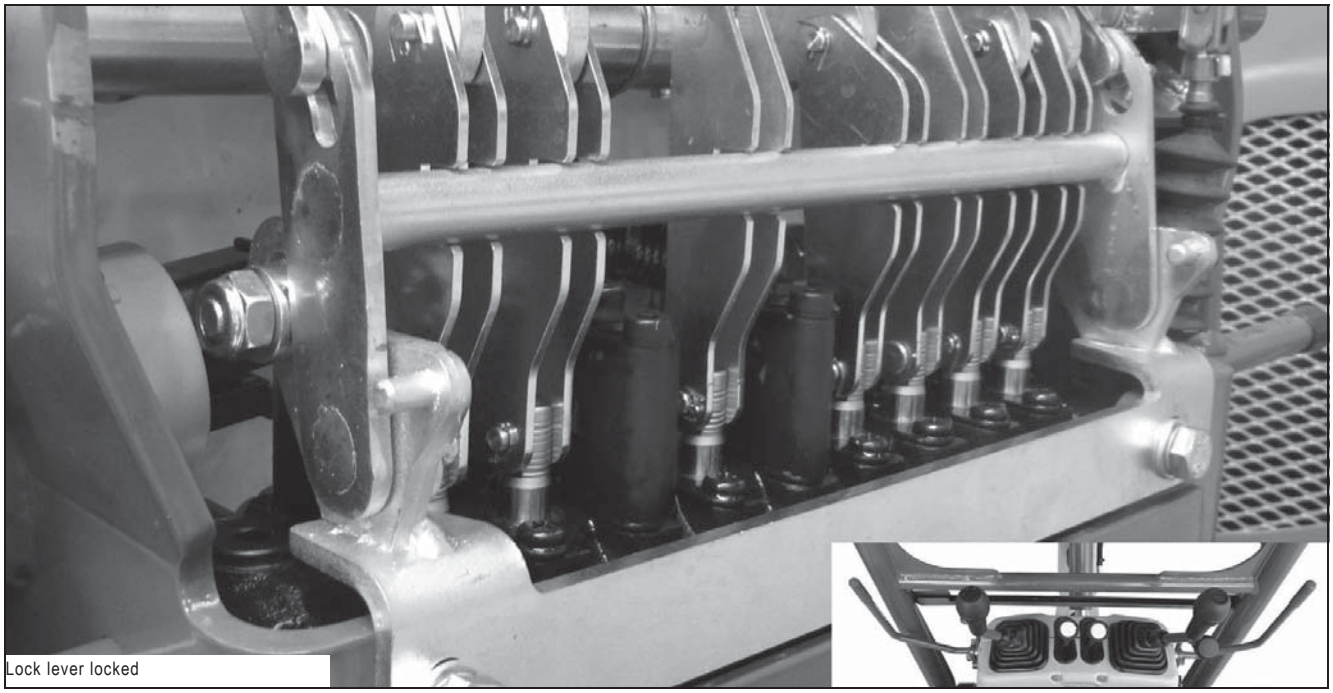
☞ *Adjust the length of the adjustment linkage so that the shackle on the drive lever remains horizontal without any appreciable resistance in neutral position when the lock is actuated.*

➥ A correct setting ensures maximum operating comfort and best possible straight-ahead driving features.

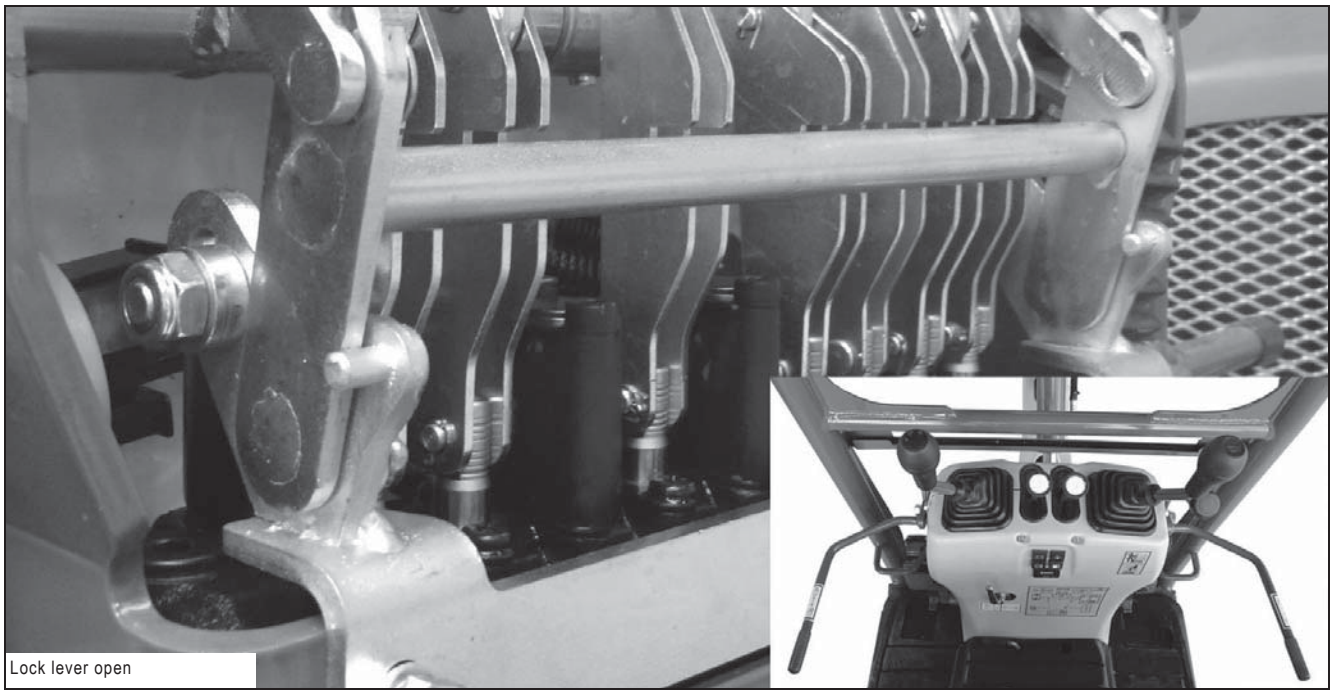
Notice!

The pedals for the auxiliary hydraulics and for swiveling cannot be adjusted.

Lock lever



Lock lever locked



Lock lever open

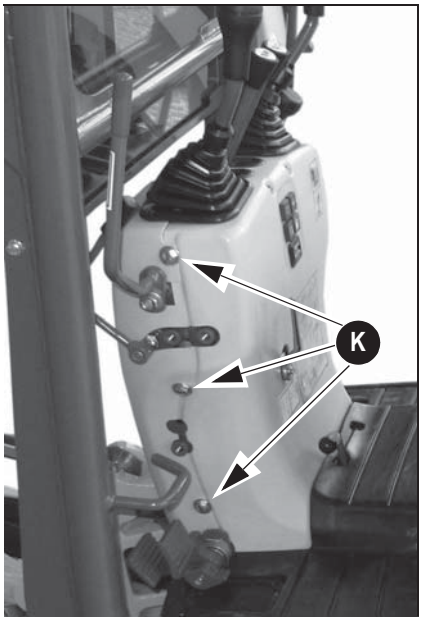
Notice!

When the lock lever is locked, all control stand functions are locked and the excavator is protected against unintentional operation of the levers.

5.8 Malfunctions in the hydraulic system

Problem	Possible causes
Hydraulic system without function	Hydraulic oil level too low
	Malfunctioning control lever lock
Hydraulic hammer does not work correctly	Quick couplers not connected correctly
	Hydraulic oil quantity too high/too low
	Hydraulic oil pressure too high/too low

5.9 Plastic trims



Removing the plastic trim on machines without ROPS bar

☞ *Stop and secure the excavator*

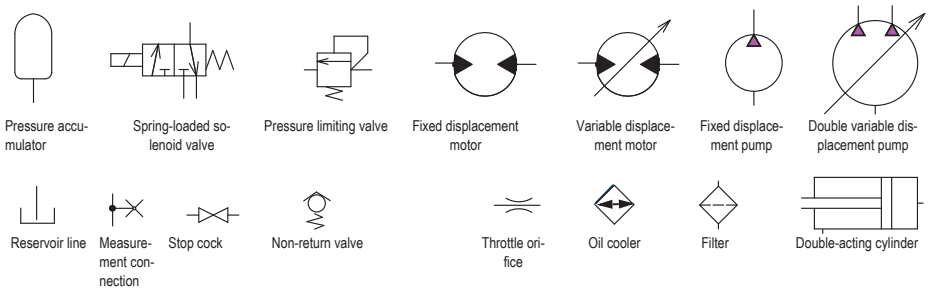
☞ *Loosen clamp screws **K** on either side of the excavator.*

☞ *Fold away the plastic trim to the front and rear.*

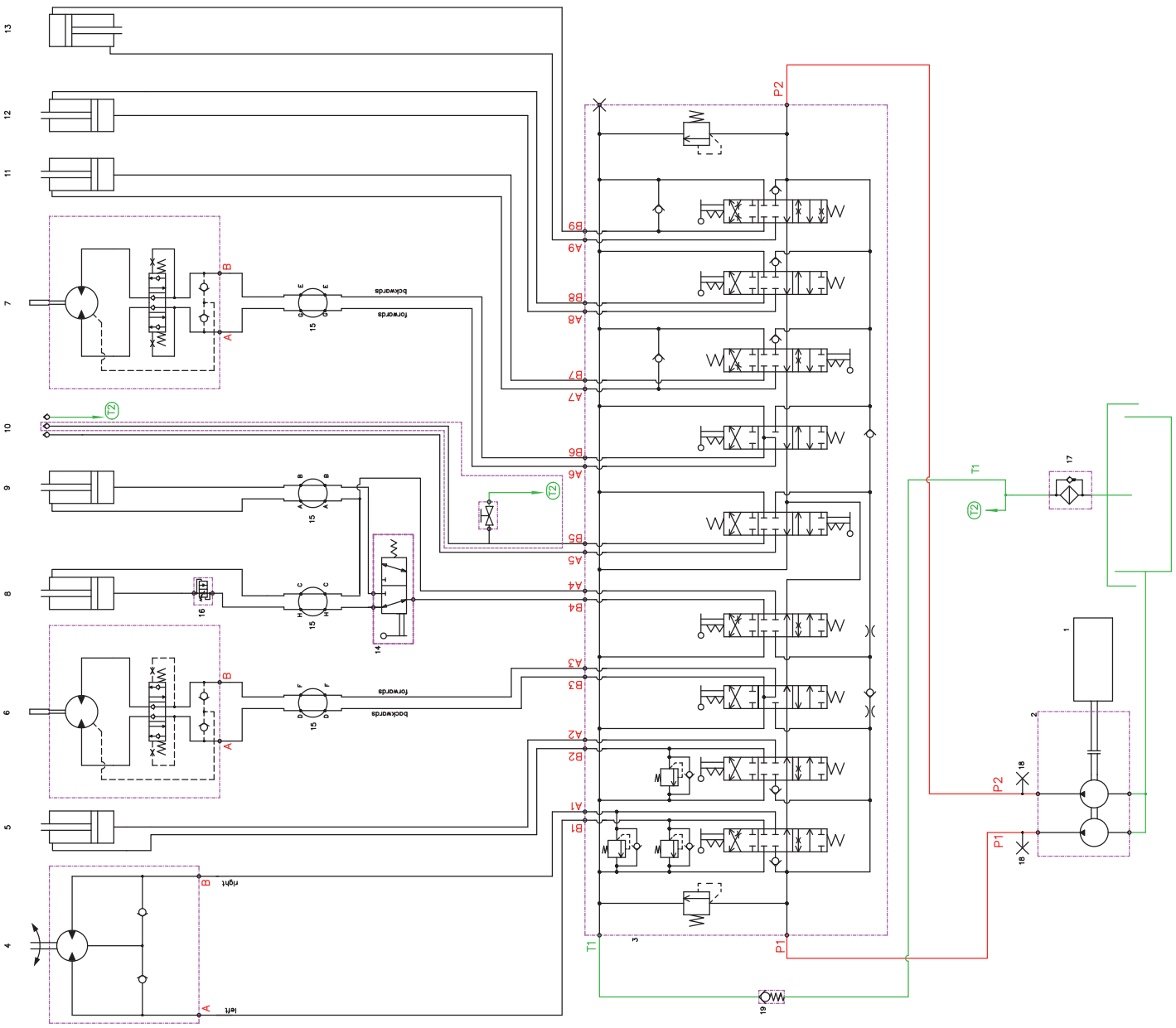
Hydraulics diagram

5.10 Hydraulics diagram (legend)

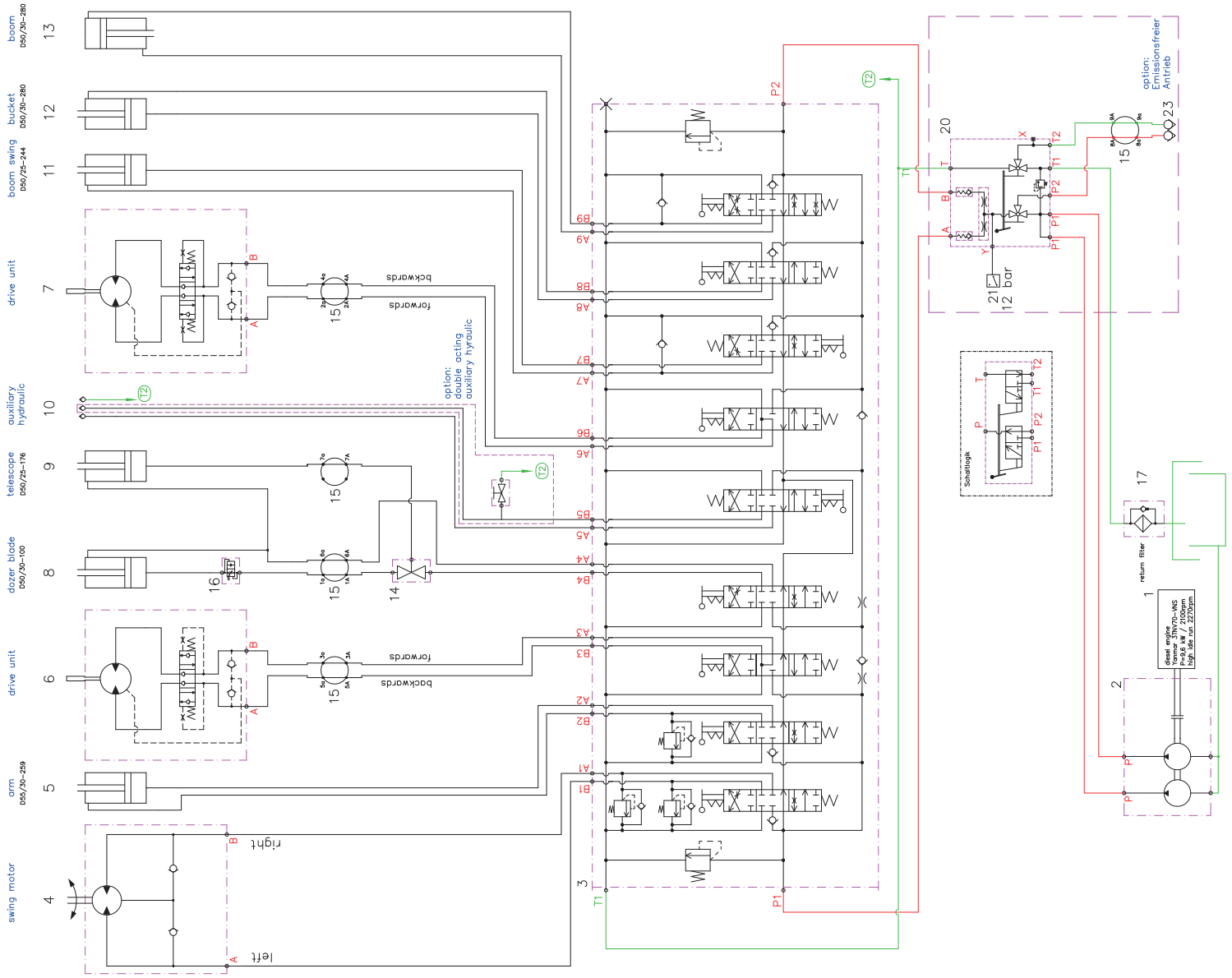
Item	Designation
1	Diesel engine
2	Gear pump
3	Main valve block
4	Swivel unit
5	Stick cylinder
6	Traveling drive (left)
7	Traveling drive (right)
8	Stabilizer blade cylinder
9	Telescopic cylinder
10	Auxiliary hydraulics
11	Swiveling cylinder
12	Bucket cylinder
13	Boom cylinder
14	Boom swivel/auxiliary hydraulics ball-type cock
15	Swivel joint
16	Pipe breakage protection
17	Oil filter
18	Measurement connection
19	Non-return valve



5.11 Hydraulics diagram

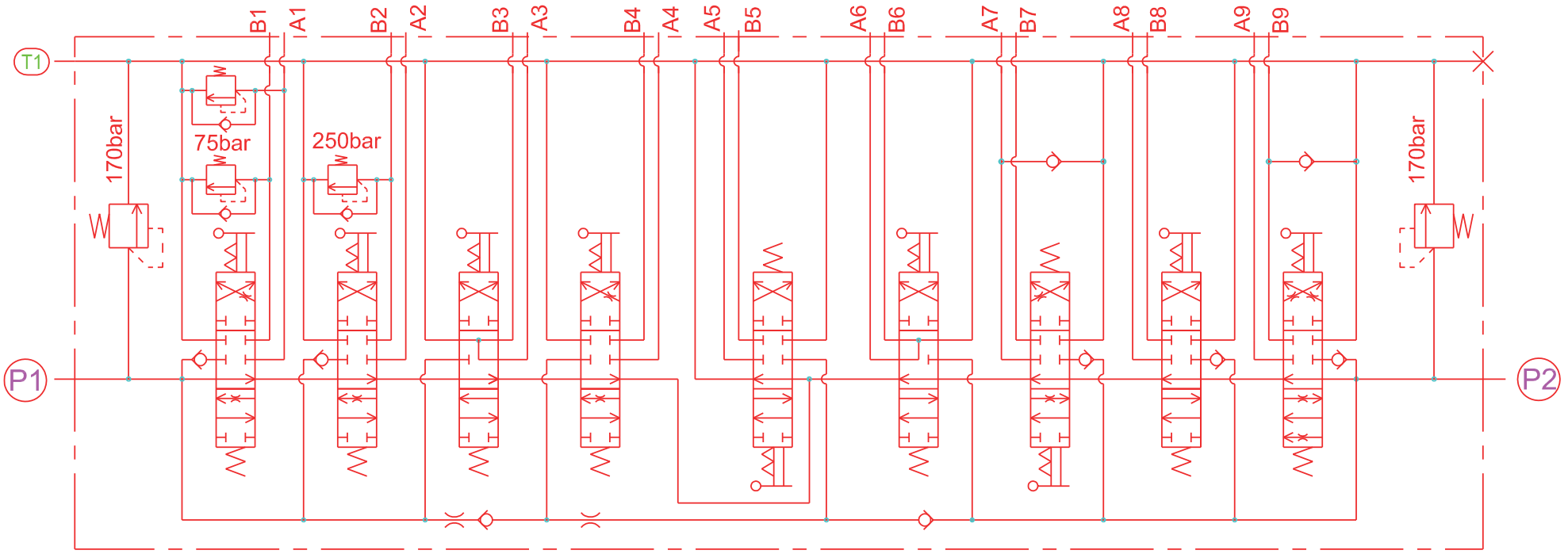

P2
T1
P1
T2
forwards
backwards
right
left

5.13 Hydraulics diagram (Dual Power option)



Item	Designation
1	Diesel engine
2	Gear pump
3	Main valve block
4	Swivel unit
5	Stick cylinder
6	Traveling drive (left)
7	Traveling drive (right)
8	Stabilizer blade cylinder
9	Telescopic cylinder
10	Auxiliary hydraulics
11	Swiveling cylinder
12	Bucket cylinder
13	Boom cylinder
14	Ball-type cock (stabilizer blade/undercarriage extension/retraction)
15	Swivel joint
16	Pipe breakage protection
17	Oil filter
18	Measurement connection
19	Non-return valve
20	Double ball-type cock
21	Pressure switch
22	Non-return valve
23	Quick coupler

5.14 Main valve block diagram



Main control lines

Connection	Legend
A1, B1	Swivel unit
A2, B2	Shovel arm
A3, B3	Traveling drive (left)
A4, B4	Stabilizer blade/telescopic undercarriage
A5	Auxiliary hydraulics
A6, B6	Traveling drive (right)
A7, B7	Swiveling cylinder
A8, B8	Bucket cylinder
A9, B9	Boom cylinder

Pump/tank lines

Connection	Legend
P1	Pump 1 connection
P2	Pump 2 connection
T1 and T2	Reservoir line via non-return valve and filter in reservoir

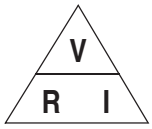
Electrical system

6 Electrical system

6.1 Ohmic law (current, voltage, resistance); Power

It describes the interrelation between current, voltage and resistance.
Current "**I**" – Ampere (A)
Voltage "**U**" – Volt (V)
Resistance "**R**" – Ohm (Ω)

! Mnemonic:



Power
Power "P" – Watt (W)
$P = U \times I = R \times I^2 = U^2/R$

6.2 Measuring equipment, measuring methods

Multifunction measuring device

- Measurements of values (U, R, I, f)
- Continuity test
- Diode test

Calculate the measuring range using known data (P, U, R, I) and set before measuring!
Observe AC/DC basic setting.

➥ AC = alternating current/voltage

➥ DC = direct current/voltage

Test device with acoustic and optical signal output

- Continuity test in de-energized vehicle electrical system and of wiring harnesses.

Measuring methods – multifunction measuring device

- Measuring current (starter switched on):
  - Connect in series to consumer.
- Measuring voltage (starter switched on):
  - Connect in parallel to consumer.
- Measuring resistance (starter switched off):
  - Connect in parallel to consumer.

6.3 Cable color coding

Color	Code
Black	blk
Brown	brn
Red	red
Orange	org
Yellow	yel
Green	grn
Blue	blu
Violet	vio
Gray	gry
White	wht
Pink	pnk

6.4 Relays

Use, mode of function

Relays are used for switching electric loads (high currents) whereby the control power of the relay coil is relatively low. Relays can therefore be controlled by microelectronics or microswitches (for example, touchpad keyboards, sensors). The switch contacts can be make-contact, break-contact or changeover switches. These undertake the actual switching function.

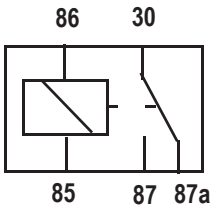


Fig. 1: Terminal description on relay

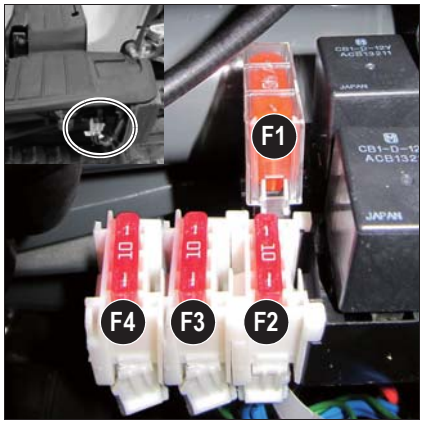
Zero-center relay

86 = Start of coil (control line)
85 = End of coil (ground)
30 = Input (load line)
87 = Make-contact switch output (load line)
87 a= Break-contact switch output (load line)

6.5 Electrical system

Electrical system	
Dynamo	12 V 20 A
Starter	12 V 1.1 kW (1.5 hp)
Battery	12 V 30 Ah
Power outlet	e.g. for 12 V power outlet; 15 A max.

Fuses behind the right-hand trim



Fuse no.	Rated current (A)	Protected circuit
F1	40 A	Main fuse; Air-pressure sensor/output adaptation
F2	10 A	Fuse: relay, indicator, cutoff solenoid
F3	10 A	Fuse: travel signal (option)
F4	10 A	12 V power outlet

Relays behind the right-hand trim

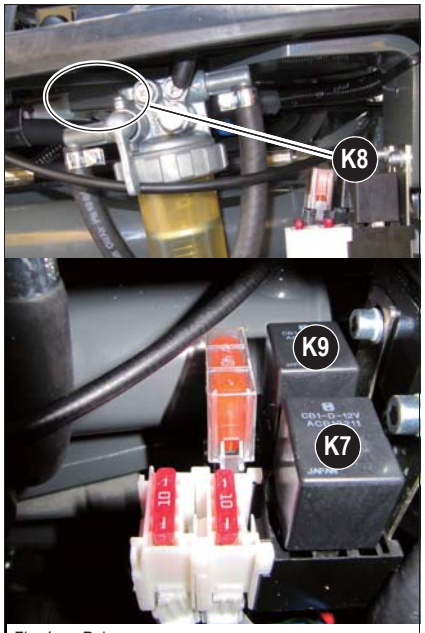


Fig. 4: Relays

Relay no.	Protected circuit
K 7	Starting relay
K 8	Cutoff solenoid time lag relay 1s
K 9	Cut-off solenoid switching relay

Fuses and relays with Dual Power option

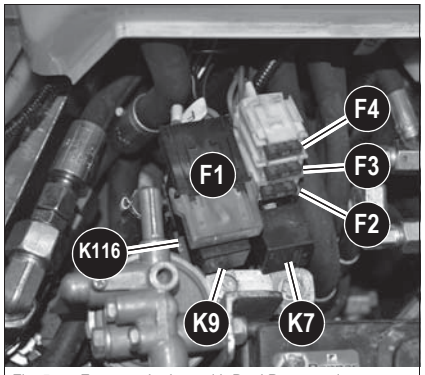


Fig. 5: Fuses and relays with Dual Power option

If the machine is equipped with the Dual Power option, the fuses and relays are located under the base plate.

Fuse no.	Rated current (A)	Protected circuit
F1	40 A	Main fuse; Air-pressure sensor/output adaptation
F2	10 A	Fuse: relay, indicator, cutoff solenoid
F3	10 A	Fuse: travel signal (option) battery control (Dual Power option)
F4	10 A	12 V power outlet

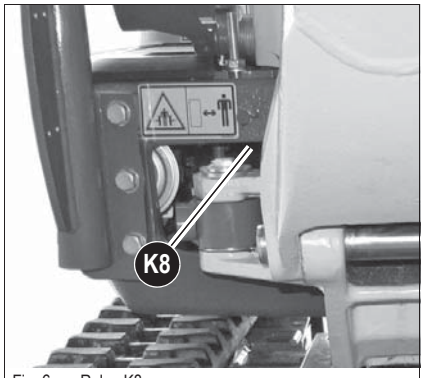


Fig. 6: Relay K8

Relay no.	Protected circuit
K 7	Starting relay
K 8	Cutoff solenoid time lag relay 1s
K 9	Cut-off solenoid switching relay
K 116	Battery monitor

6.6 Control lever push button

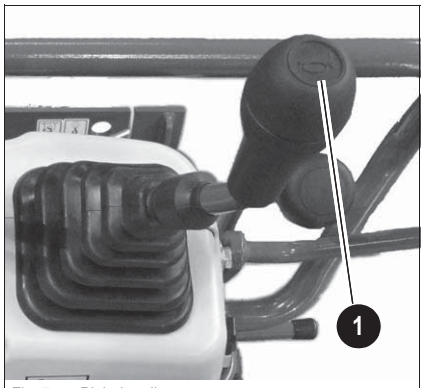
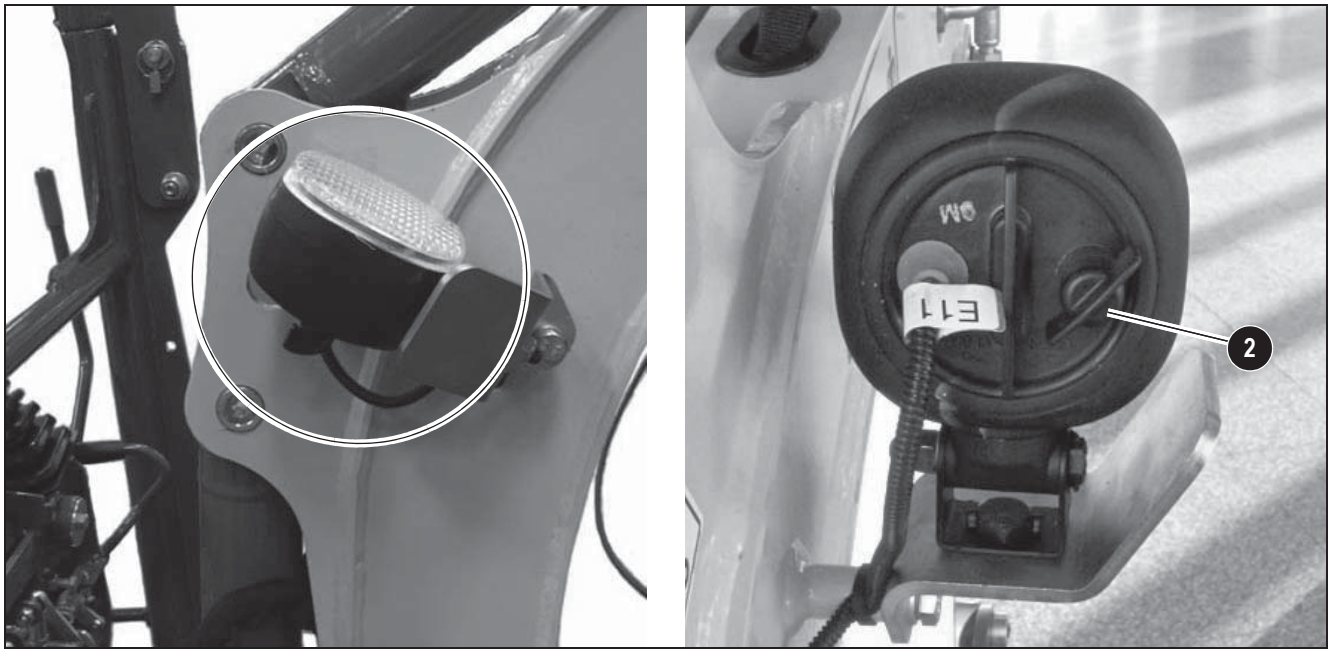


Fig. 7: Right handle

Right handle

Item	Designation
1	Horn

6.7 Working light



Item	Designation
2	Working light rotary switch

6.8 Dynamo

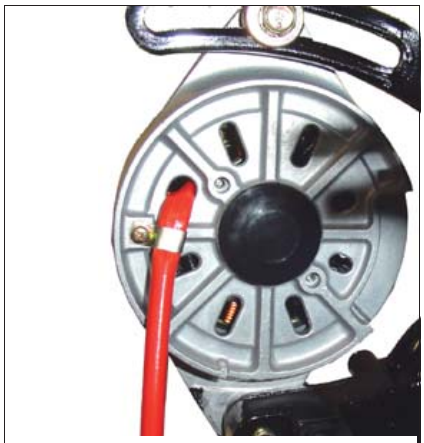


Fig. 8: Dynamo

The dynamo supplies the alternating current (rectified by the rectifier) to the electric consumers and for charging the battery.

Item	Designation
1	Alternating voltage to rectifier

6.9 Rectifier

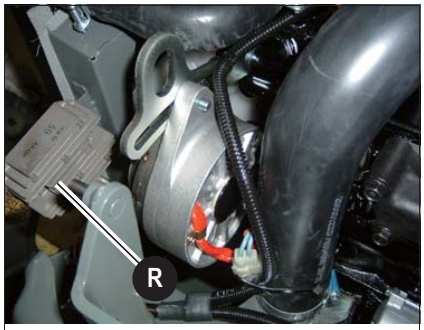


Fig. 9: Rectifier

Rectifier **R** rectifies the dynamo voltage.

Wiring:

Color	Assignment
Blue	Alternating voltage (dynamo)
Black	Ground
Red	Battery +
Orange	12 V starter
Brown	Start interlock
Yellow	Charge indicator light

6.10 Starter

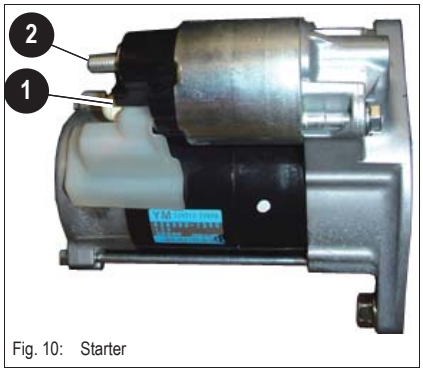


Fig. 10: Starter

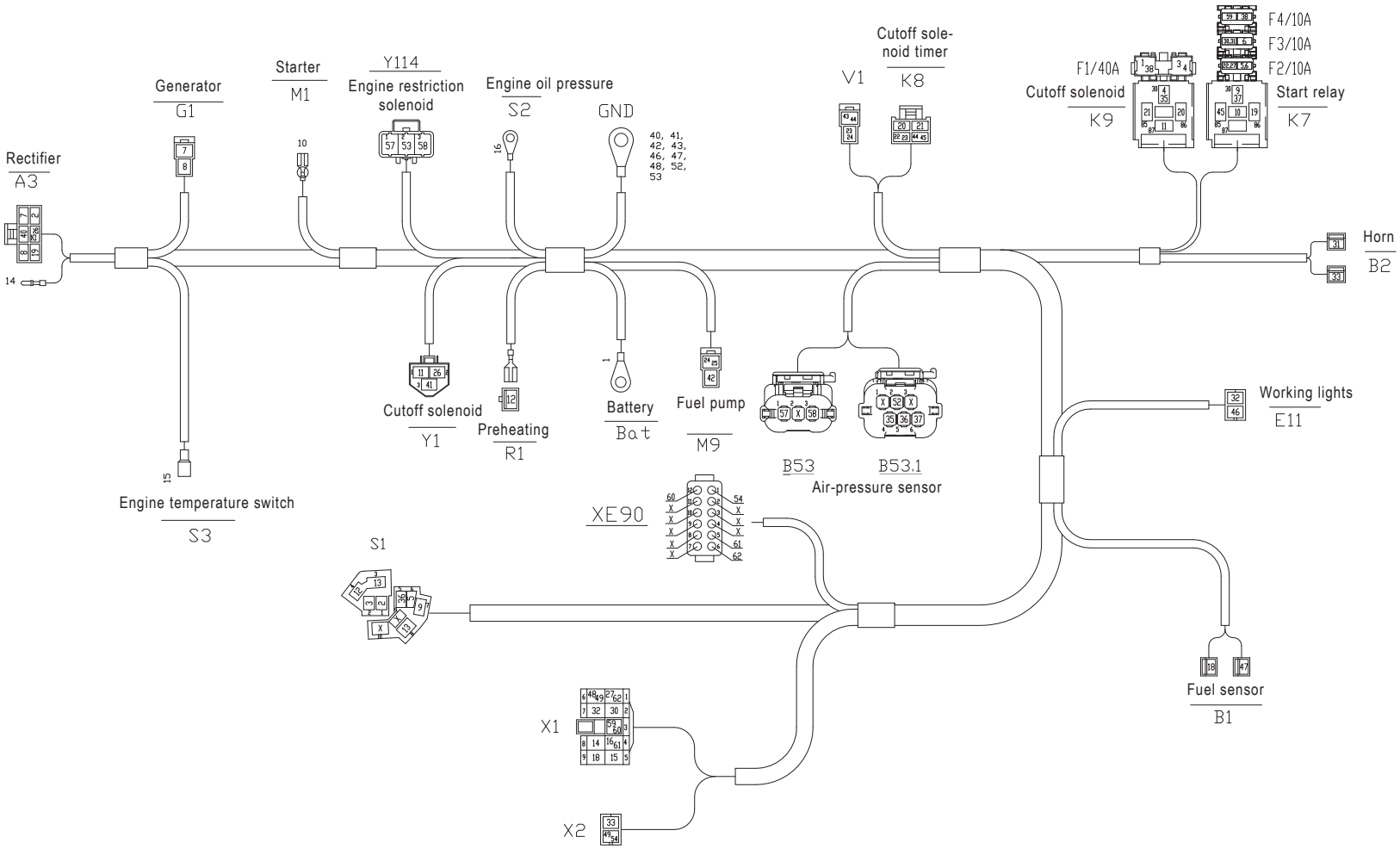
Item	Designation
1	Connection S starting relay
2	Connection B battery

Wiring harnesses

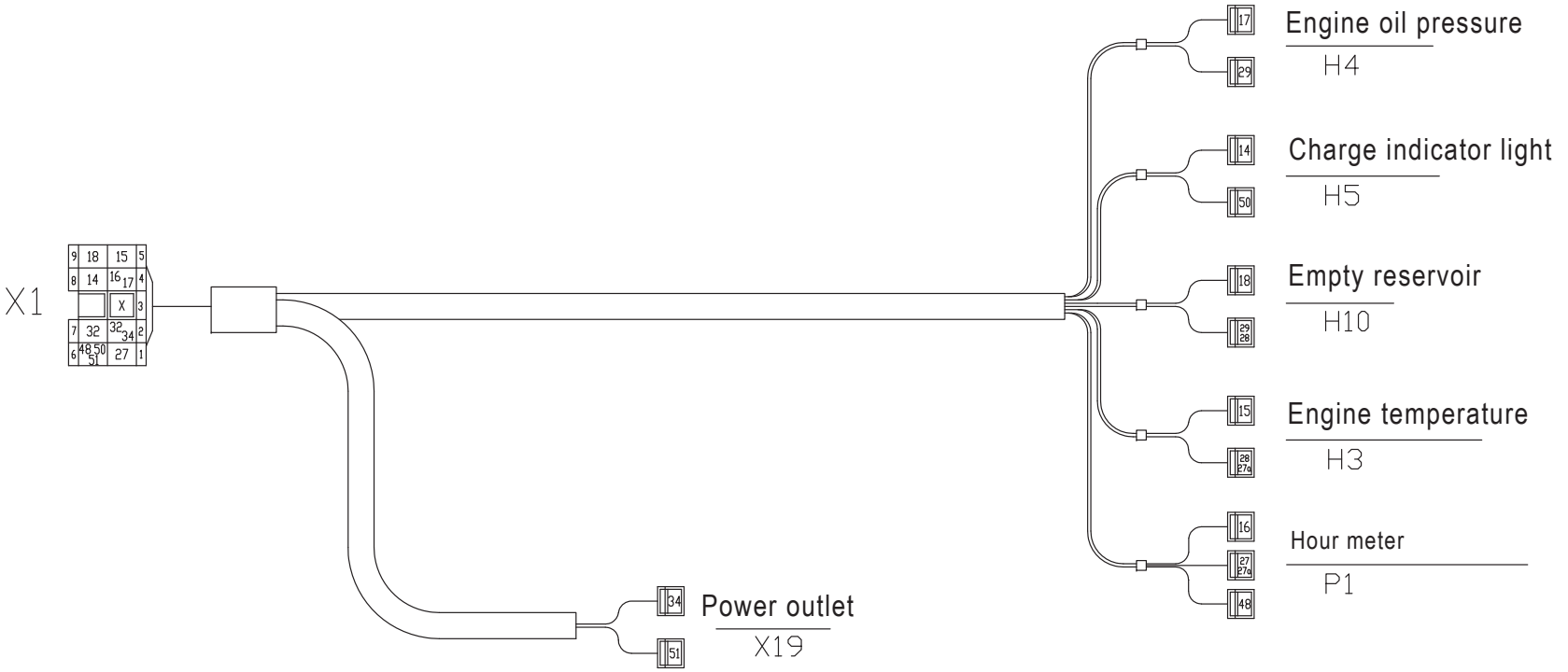
6.13 Engine wiring harness legend

nr.	To	To	Color	mm2	Function
1	Battery	F1/1	red	6	12 V 30
2	S1/1	A3	red	2.5	12 V 30
3	F1/2	S1/2	red	4	12 V 30 starter
4	F1/2	K9/30	red	2.5	12 V 30 relay
5	S1/6	F2/1	blu	2.5	12 V/15 fuses
6	F3/1	F2/1	blu	2.5	12 V/15 fuses
7	G1	A3	blu/red	2.5	Generator
8	G1	A3	blu/red	2.5	Generator
9	S1/7	K7/30	wht/red	2.5	Starter
10	M1	K7/87a	wht/red	2.5	Starter
11	Y1/1	K9/87	wht	2.5	Pull contact cutoff solenoid
12	R1	S1/4	brn	4	Preheating
13	S1/8	S1/3	brn	4	Preheating
14	A3	X1/8	pnk	1	Charge indicator light
15	S3	X1/5	blk/grn	1	Engine temperature switch
16	S2	X1/4	wht/grn	1	Engine oil pressure
18	B1	X1/9	vio/blk	1	Fuel level indicator
19	A3	K7/86	brn/blk	1	Start interlock
20	K8	K9/86	blu/blk	1	Cutoff solenoid relay
21	K8	K9/85	pnk/blk	1	Cutoff solenoid relay
22	F2/2	K8	blu	1	12 V/15 relay
23	V1	K8	blu	1	12 V/15 relay
24	V1	M9	blu	1	Fuel pump
25	A3	M9	blu	1	12 V/15 regulator
26	A3	Y1/2	blu	1	Holding contact cutoff solenoid
27	F2/2	X1/1	blu	1	12 V/15 indicators
30	F3/2	X1/2	grn	1	12 V lights, horn
31	F3/2	B2	grn	1	12 V lights, horn
32	E11/1	X1/7	grn/yel	1	Working lights
33	B2	X2/1	org/blk	1	Horn
35	B53.1/4	K9/30	red	1.5	12 V/30 relay
36	B53.1/5	S1/5	blu	1.5	12 V/15
37	B53.1/6	K7/30	wht/red	1.5	Starter
38	F1/1	F4/1	red	1.5	12 V/30
40	GND	A3	blk	1	Ground
41	GND	Y1/3	blk	1	Ground

nr.	To	To	Color	mm2	Function
42	GND	M9	blk	1	Ground
43	GND	V1	blk	1	Ground
44	K8	V1	blk	1	Ground
45	K8	K7/85	blk	1	Ground
46	GND	E11/2	blk	1	Ground
47	GND	B1	blk	1	Ground
48	GND	X1/6	blk	1	Ground
49	X2/2	X1/6	blk	1	Ground
52	GND	B53.1/2	blk	1	Ground
53	GND	Y114/2	blk	1.5	Ground
54	XE90/1	X2/2	blk	1	Ground
57	B53/1	Y114/1	blu	1	Holding contact
58	B53/3	Y114/3	wht	1.5	Pull contact
59	F4/2	X1/3	red	1	12 V 30
60	XE90/12	X1/3	red	1	12 V 30
61	XE90/5	X1/4	wht/grn	1	Engine oil pressure
62	XE90/6	X1/1	blu	1	12 V/15 indicating instrument

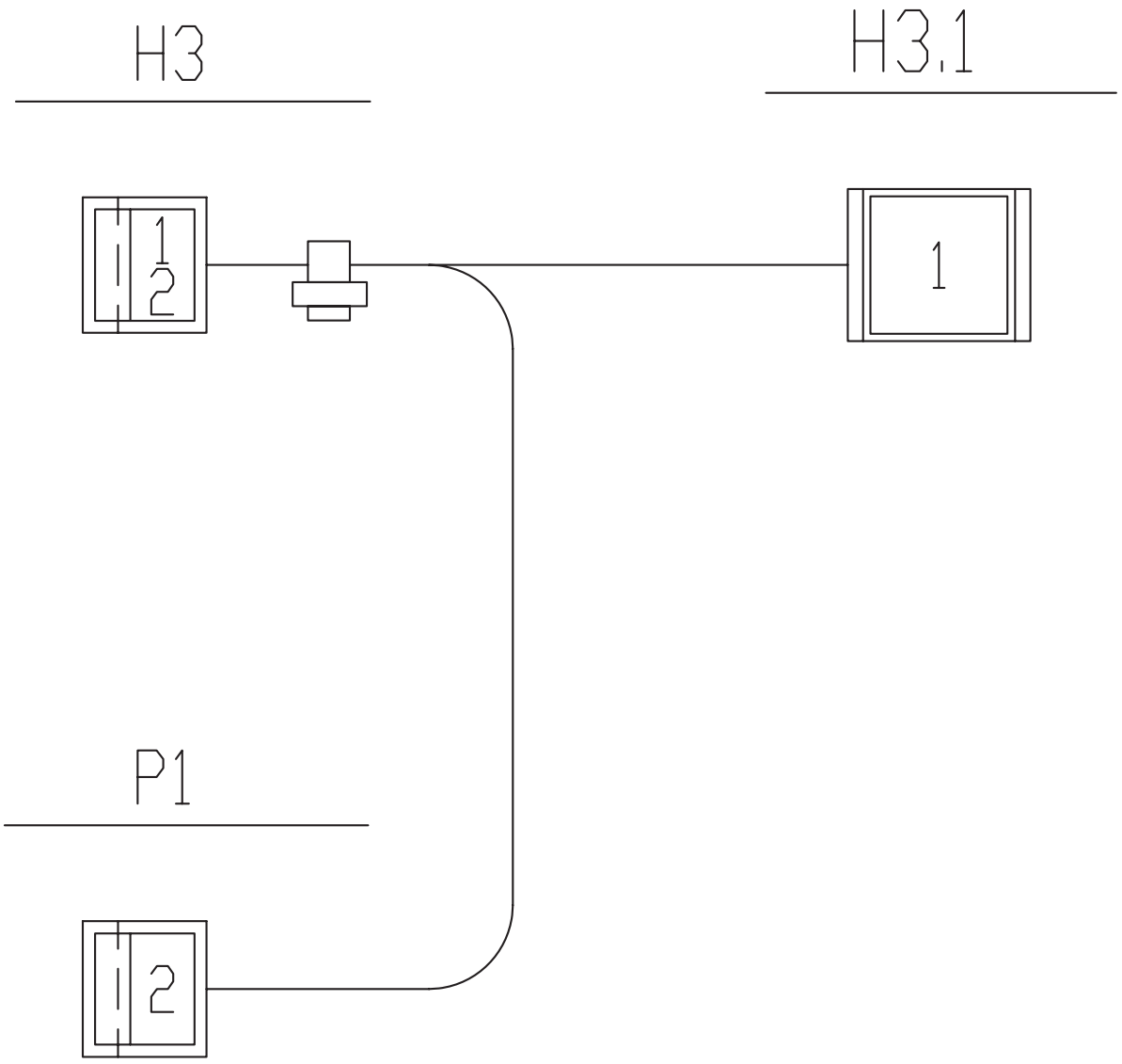

Rectifier
A3
Generator
G1
Starter
M1
Y114
Engine restriction solenoid
Engine oil pressure
S2
GND
40, 41, 42, 43, 46, 47, 48, 52, 53
V1
Cutoff sole-noid timer
K8
F1/40A
Cutoff solenoid
K9
F4/10A
F3/10A
F2/10A
Start relay
K7
Horn
B2
Cutoff solenoid
Y1
Preheating
R1
Battery
Bat
Fuel pump
M9
B53
B53.1
Air-pressure sensor
Working lights
E11
Engine temperature switch
S3
XE90
S1
X1
X2
Fuel sensor
B1

6.16 Wiring harness for indicators

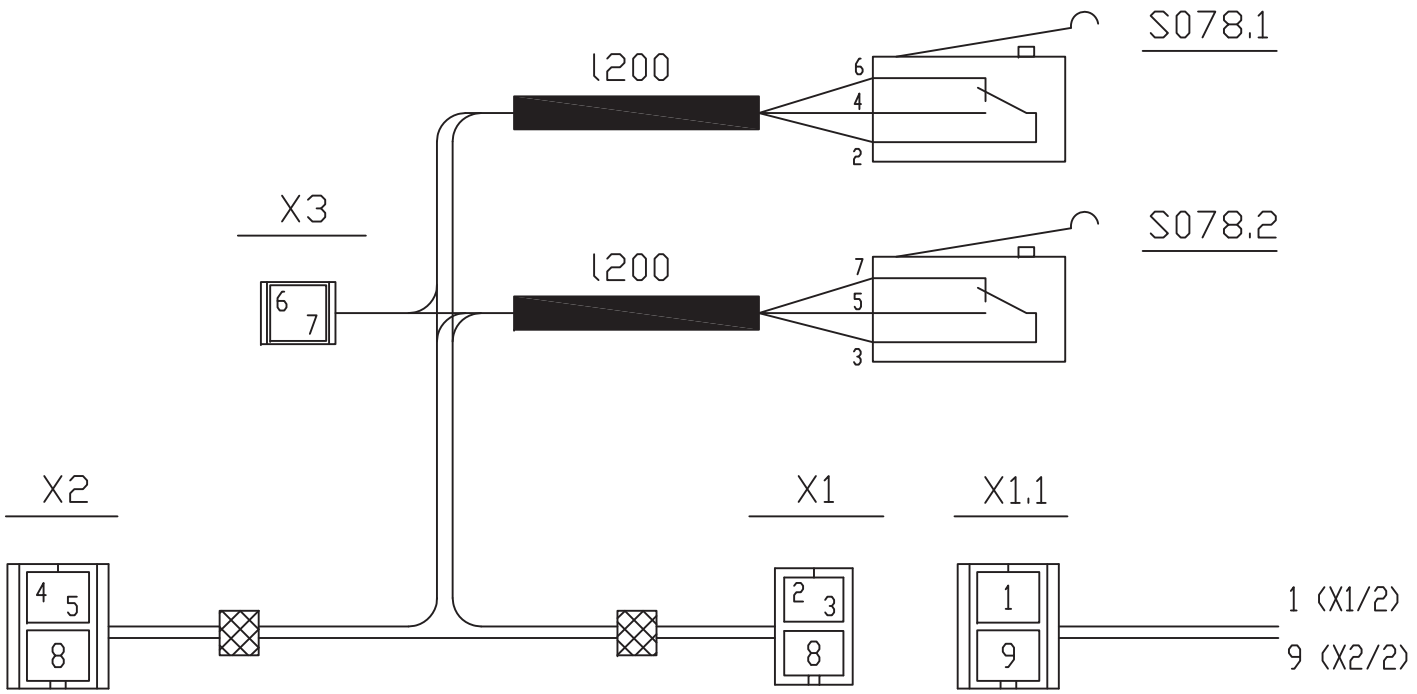


nr.	To	To	Color	mm²	Function
14	X1/8	H5	pnk	1	Charge indicator light
15	X1/5	H3	blk/grn	1	Engine temperature switch
16	X1/4	P1	wht/grn	1	Hour meter
17	X1/4	H4	wht/grn	1	Engine oil pressure
18	X1/9	H10	vio/blk	1	Fuel level indicator
27	X1/1	P1/1	blu	1	12 V/15 indicators
27a	P1/1	H3	blu	1	12 V/15 indicators
28	H10	H3	blu	1	12 V/15 indicators
29	H10	H4	blu	1	12 V/15 indicators
32	X1/7	X1/2	grn/yel	1	Working lights
34	X1/2	X19	grn/yel	1	Power outlet
48	X1/6	P1	blk	1	Ground
50	X1/6	H5	blk	1	Ground
51	X1/6	X19	blk	1	Ground

6.17 Cable power supply for the operating hour meter

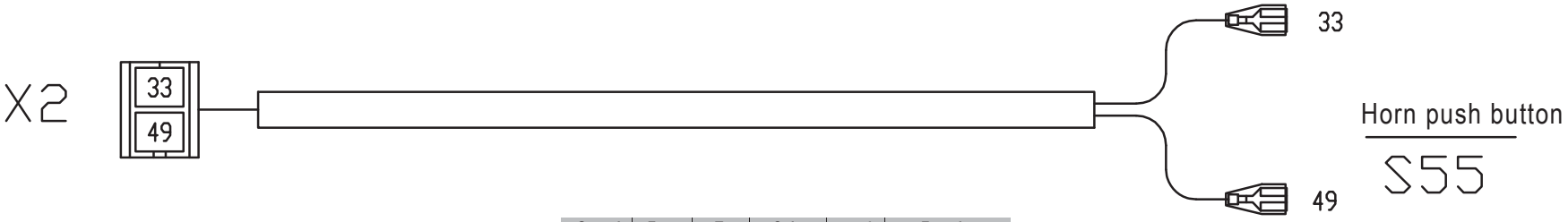


6.18 Traveling signal wiring harness (option)



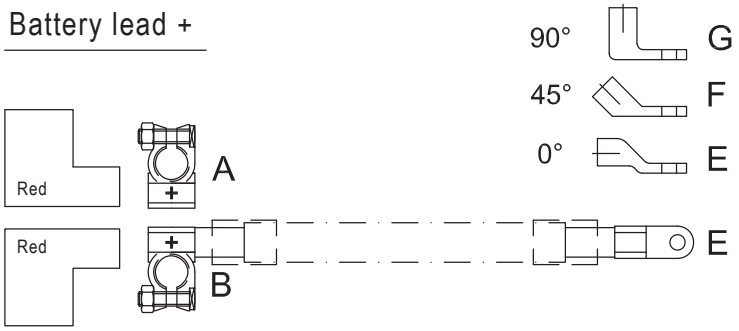
Strand	From	To	mm²	Color
1		X1.1/1	1	blu
2	X1/1	S78.1	1	blk
3	X1/1	S78.2	1	blk
4	S78.1	X2/1	1	blu
5	S78.2	X2/1	1	blu
6	S78.1	X3	1	red
7	S78.2	X3	1	red
8	X2/2	X1/2	1	blk
9	X1.1/2		1	blk

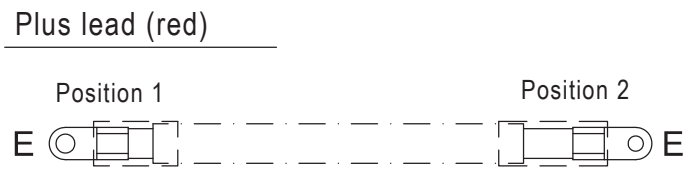
6.19 Horn wiring harness

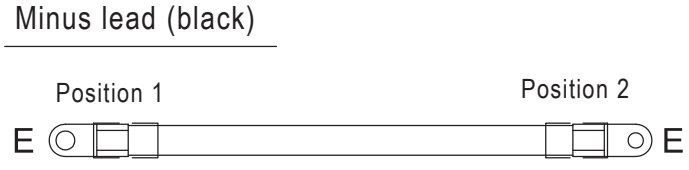


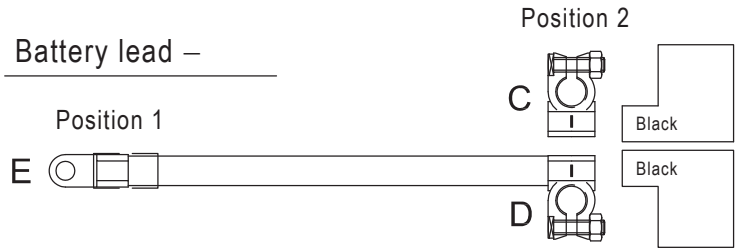
Strand	From	To	Color	mm²	Function
33	X2/1	S55	org/blk	1	Horn
49	X2/1	S55	blk	1	Ground

6.20 Battery lead





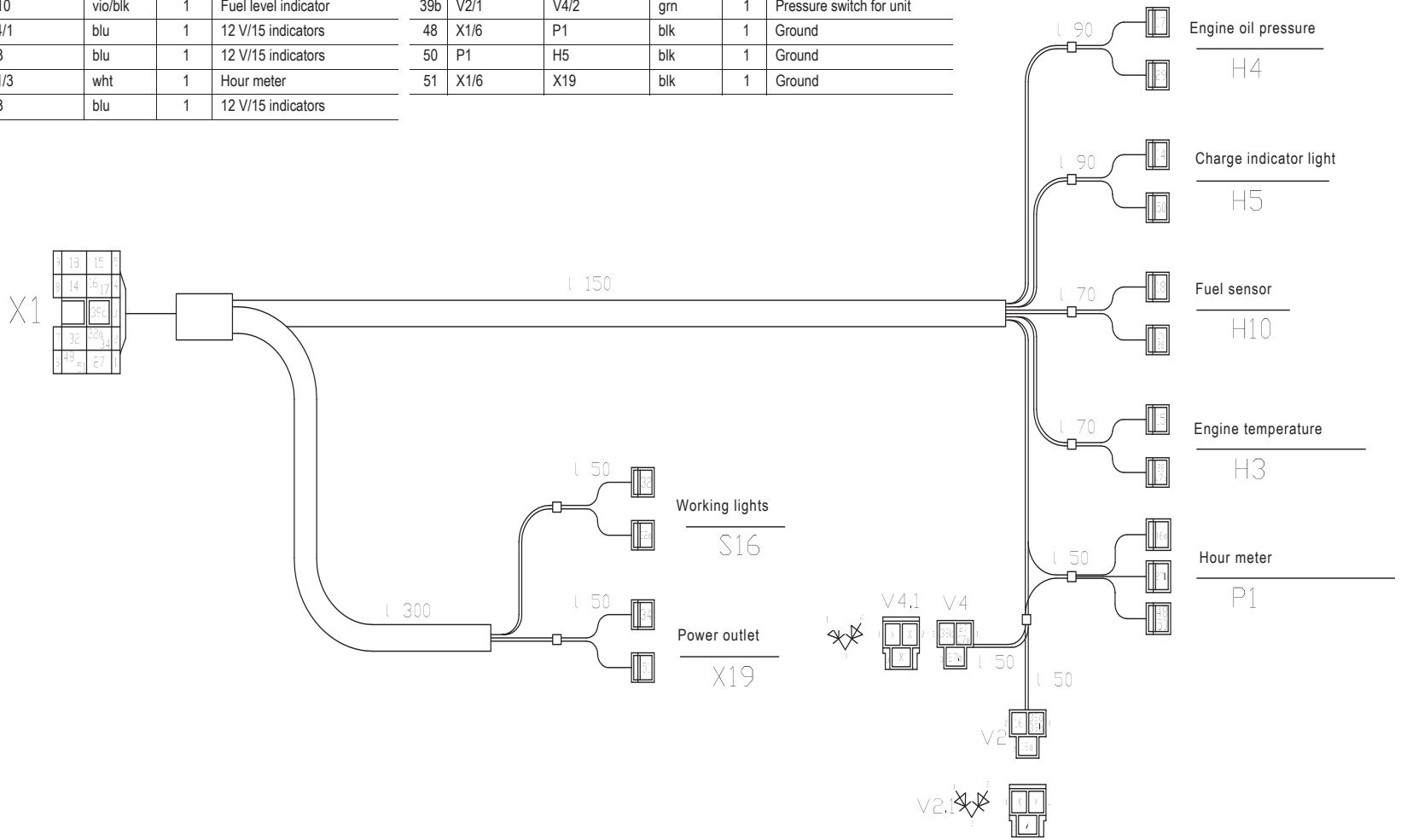




6.21 Indicating instrument wiring harness (Dual Power option)

nr.	To	To	Color	mm²	Function
14	X1/8	H5	pnk	1	Charge indicator light
15	X1/5	H3	blk/grn	1	Engine temperature switch
16	X1/4	V2/2	wht/grn	1	Hour meter
16a	V2/3	P1	wht/grn	1	Hour meter
17	X1/4	H4	wht/grn	1	Engine oil pressure
18	X1/9	H10	vio/blk	1	Fuel level indicator
27	X1/1	V4/1	blu	1	12 V/15 indicators
27a	V4/1	H3	blu	1	12 V/15 indicators
27b	V4/3	P1/3	wht	1	Hour meter
28	H10	H3	blu	1	12 V/15 indicators

nr.	To	To	Color	mm²	Function
29	H10	H4	blu	1	12 V/15 indicators
32	X1/7	S16/1	grn/yel	1	Battery monitor
32a	X1/2	S16/2	grn/yel	1	Battery monitor
34	X1/2	X19	grn/yel	1	Power outlet
39a	X1/3	V2/1	grn	1	Pressure switch for unit
39b	V2/1	V4/2	grn	1	Pressure switch for unit
48	X1/6	P1	blk	1	Ground
50	P1	H5	blk	1	Ground
51	X1/6	X19	blk	1	Ground

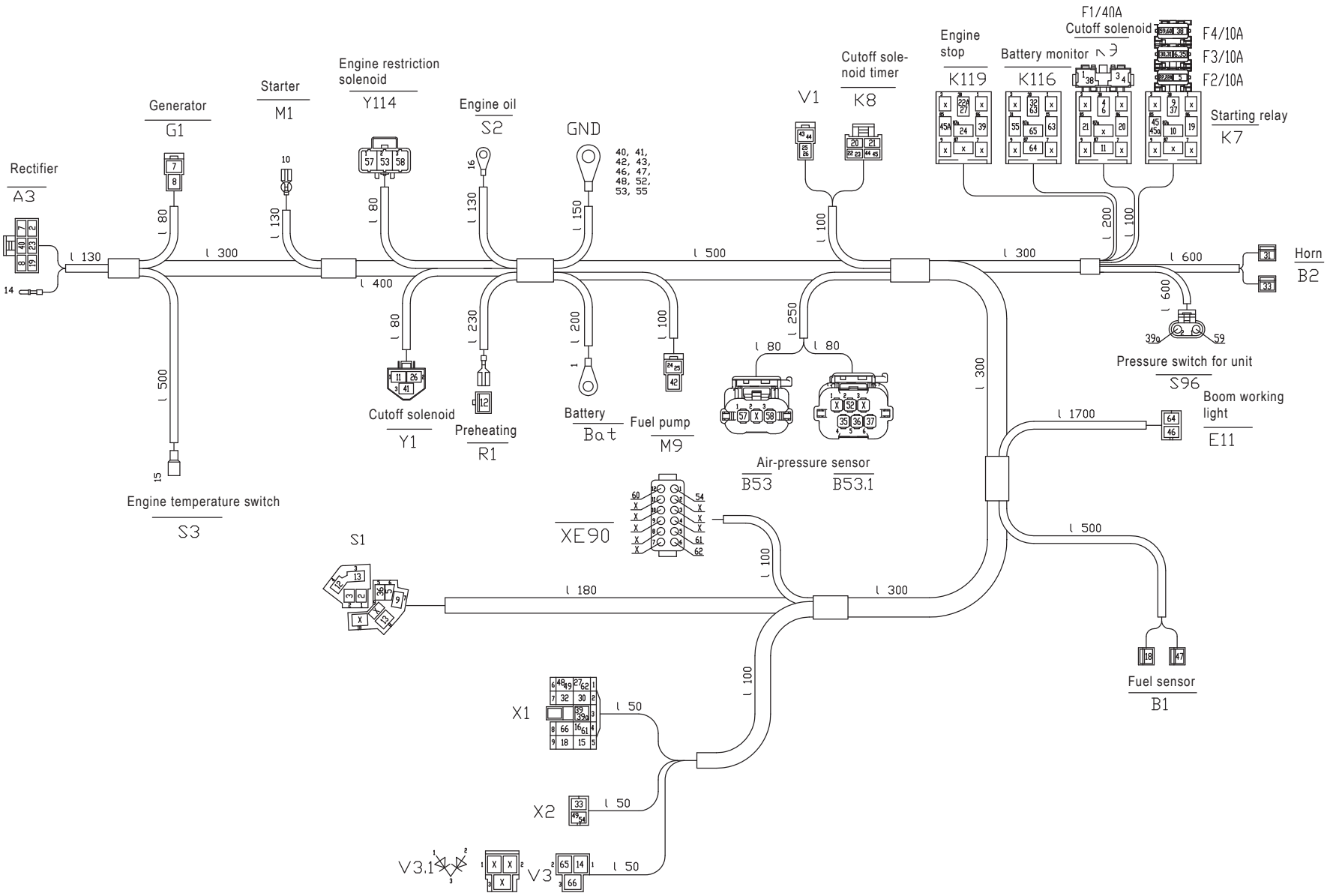


6.22 Legend of engine/chassis wiring harness (Dual Power option)

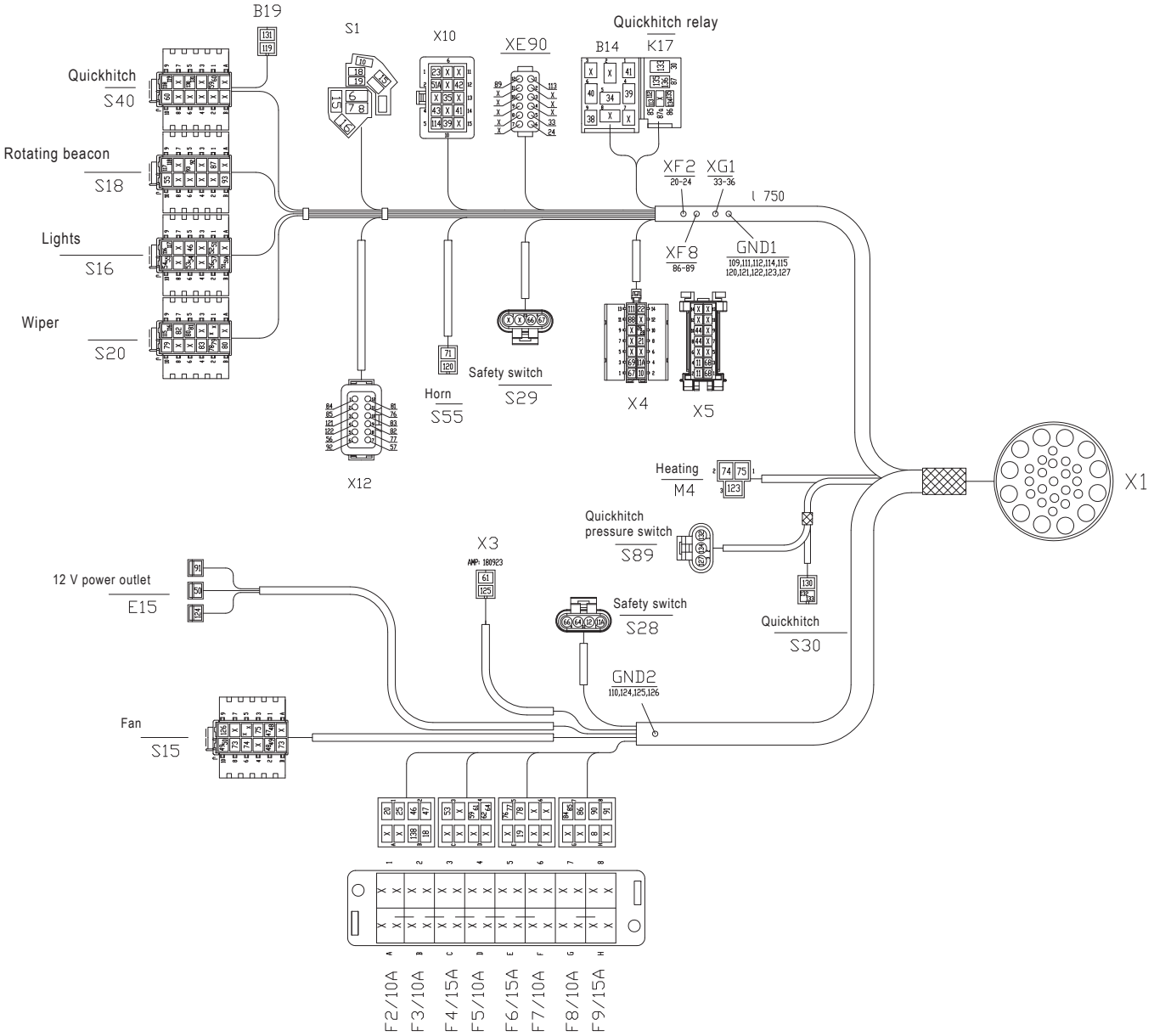
nr.	To	To	Color	mm2	Function
1	Battery	F1/1	red	6	12 V 30
2	S1/1	A3	red	2.5	12 V 30
3	F1/2	S1/2	red	4	12 V 30 starter
4	F1/2	K9/30	red	2.5	12 V 30 relay
5	S1/6	F2/1	blu	2.5	12 V/15 fuses
6	F3/1	K9/30	blu	2.5	12 V/15 fuses
7	G1	A3	blu/red	2.5	Generator
8	G1	A3	blu/red	2.5	Generator
9	S1/7	K7/30	wht/red	2.5	Starter
10	M1	K7/87a	wht/red	2.5	Starter
11	Y1/1	K9/87	wht	2.5	Pull contact cutoff solenoid
12	R1	S1/4	brn	4	Preheating
13	S1/8	S1/3	brn	4	Preheating
14	A3	V1/3	pnk	1	Charge indicator light
15	S3	X1/5	blk/grn	1	Engine temperature switch
16	S2	X1/4	wht/grn	1	Hour meter
18	B1	X1/9	vio/blk	1	Fuel level indicator
19	A3	K7/86	brn/blk	1	Start interlock
20	K8	K9/86	blu/blk	1	Cutoff solenoid relay
21	K8	K9/85	pnk/blk	1	Cutoff solenoid relay
22	F2/2	K8	blu	1	12 V/15 relay
22a	F2/2	K119/30	blu	1	12 V/15 relay
23	A3	K8	blu	1	12 V/15 regulator
24	K119/87a	M9	blu	1	12 V/15 relay
25	V1	M9	blu	1	12 V/15 fuel pump
26	V1	Y1/2	blu	1	Holding contact cutoff solenoid
27	K119/30	X1/1	blu	1	12 V/15 indicators
30	F3/2	X1/2	grn	1	12 V lights, horn
31	F3/2	B2	grn	1	12 V lights, horn
32	K116/30	X1/7	grn/yel	1	Battery monitor
33	B2	X2/1	org/blk	1	Horn
35	B53.1/4	F3/1	red	2	12 V/30 relay
36	B53.1/5	S1/5	blu	2	12 V/15
37	B53.1/6	K7/30	wht/red	2	Starter
38	F1/1	F4/1	red	1.5	12 V/30
39	K119/86	X1/3	grn	1	Pressure switch for unit

nr.	To	To	Color	mm2	Function
39a	S96/2	X1/3	grn	1	Pressure switch for unit
40	GND	A3	blk	1	Ground
41	GND	Y1/3	blk	1	Ground
42	GND	M9	blk	1	Ground
43	GND	V1	blk	1	Ground
44	K8	V1	blk	1	Ground
45	K8	K7/85	blk	1	Ground
45a	K7/85	K119/85	blk	1	Ground
46	GND	E11/2	blk	1	Ground
47	GND	B1	blk	1	Ground
48	GND	X1/6	blk	1	Ground
49	X2/2	X1/6	blk	1	Ground
52	GND	B53.1/2	blk	2	Ground
53	GND	Y114/2	blk	2.5	Ground
54	XE90/1	X2/2	blk	1	Ground
55	GND	K116/31	blk	1	Ground
57	B53/1	Y114/1	blu	2.5	Holding contact
58	B53/3	Y114/3	wht	2.5	Pull contact
59	F4/2	S96/1	red	1	12 V 30
60	F4/2	XE90/12	red	1	12 V 30
61	XE90/5	X1/4	wht/grn	1	Engine oil pressure
62	XE90/6	X1/1	blu	1	12 V/15 indicating instrument
63	K116/30	K116/15	grn/yel	1	Battery monitor
64	E11/1	K116/87	grn/yel	1	Working lights
65	K116/87a	V3/2	grn/yel	1	Battery monitor
66	V3/3	X1/8	pnk	1	Charge indicator light

6.23 Engine/chassis wiring harness (Dual Power option)

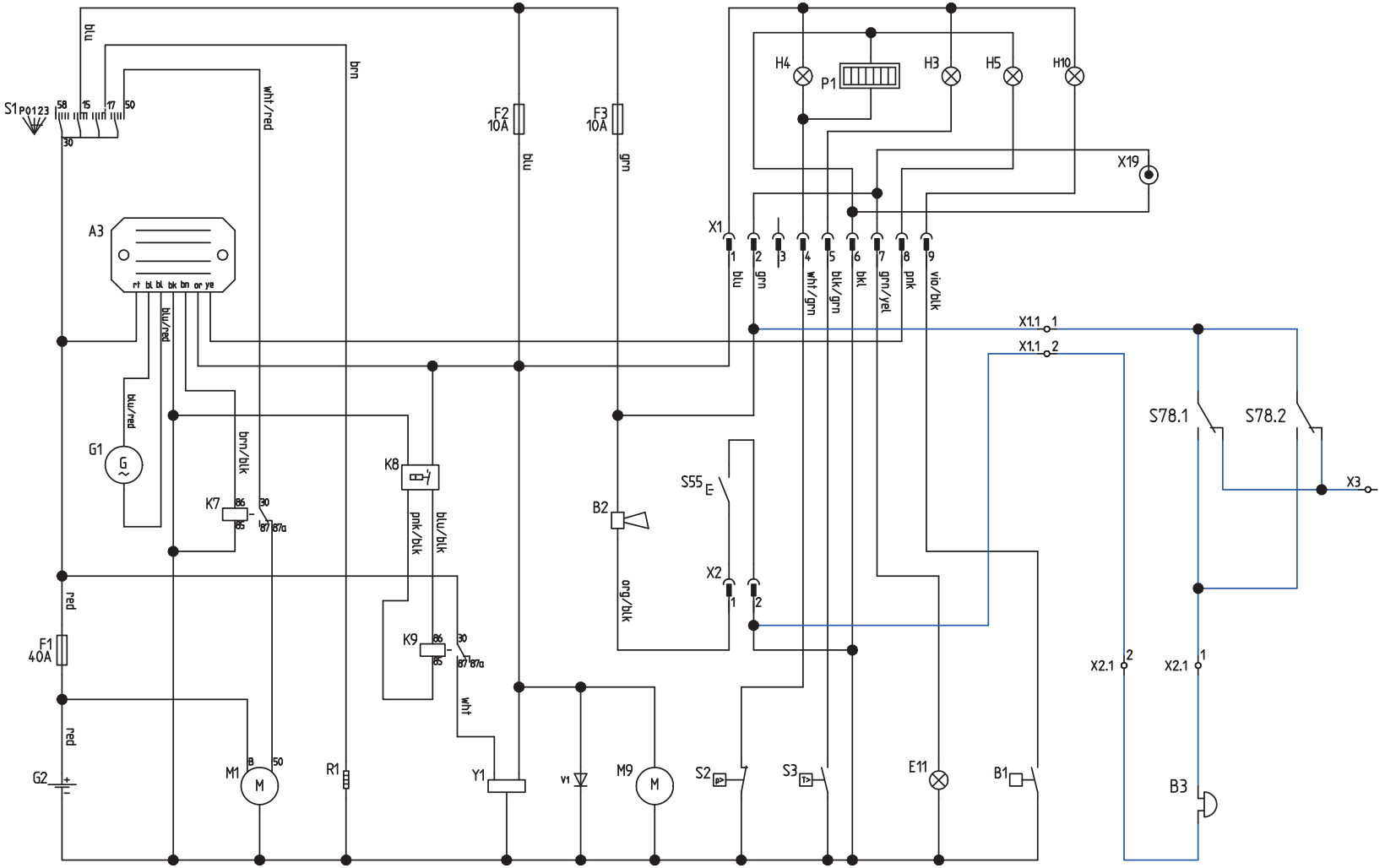


6.24 Seat console wiring harness



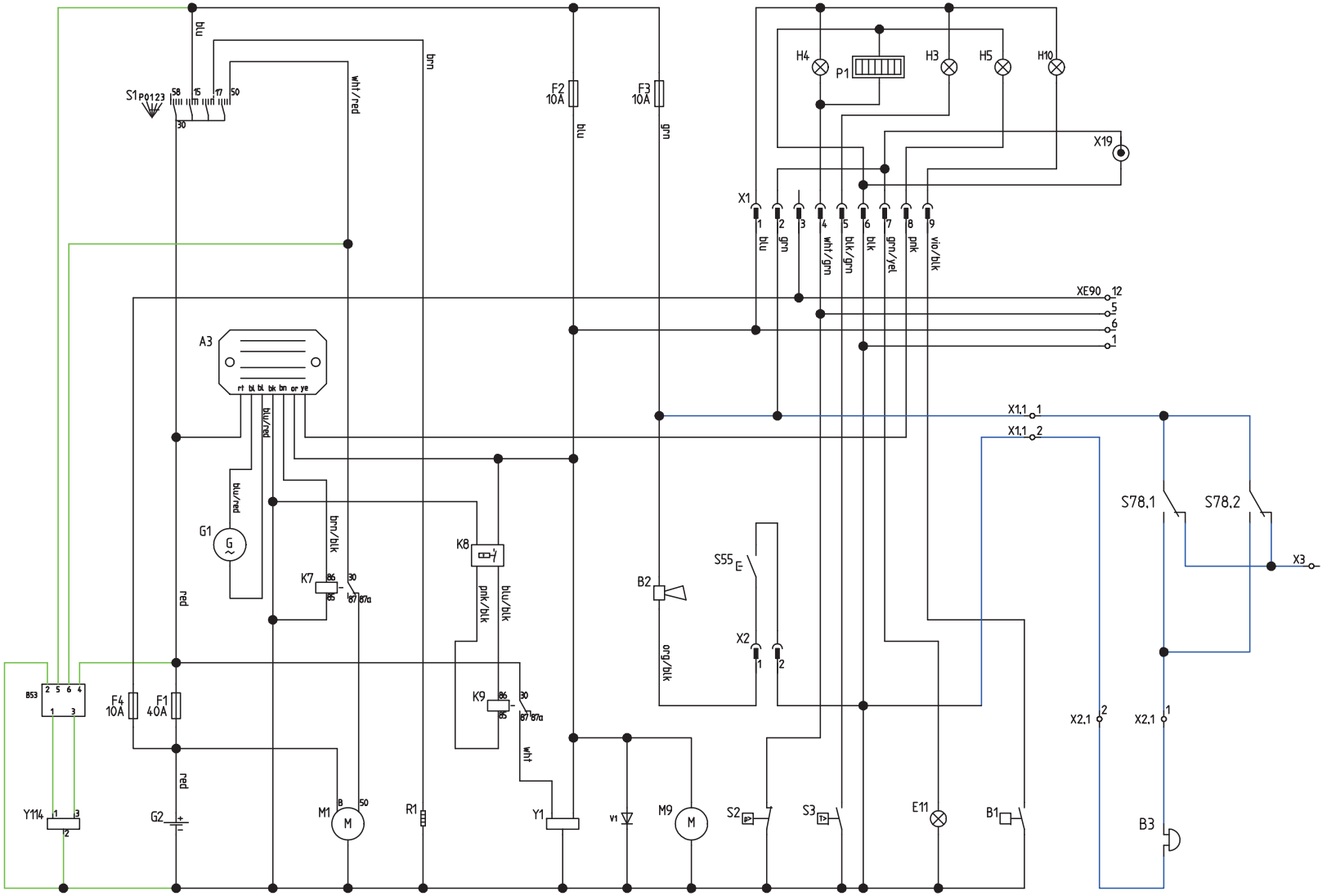
Wiring diagrams

6.25 Wiring diagram



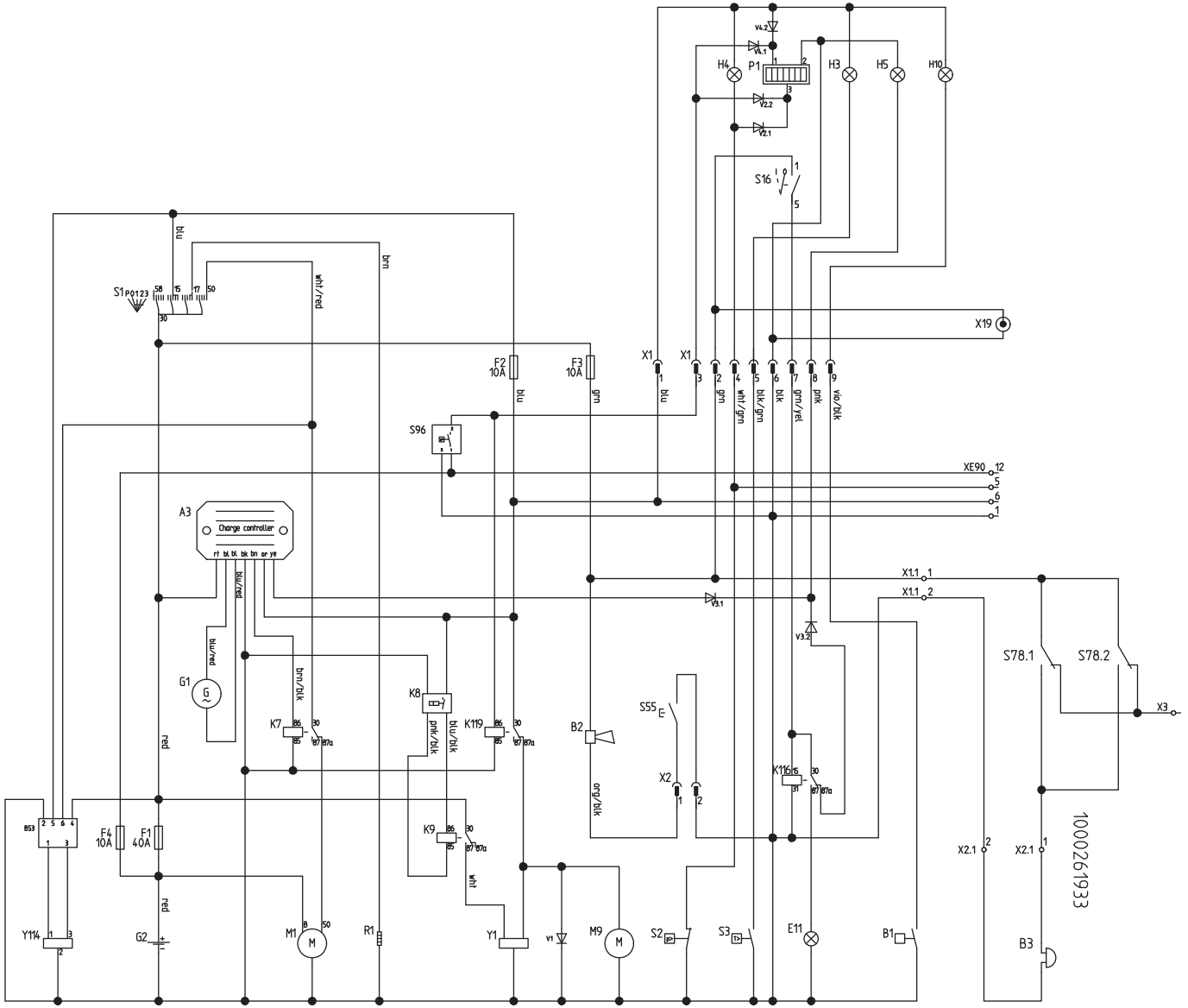
nr.	Designation
A3	Regulator
B1	Fuel indicator
B2	Horn
E11	Working lights
F1	Master fuse
F2	Fuse: relay, indicator, cutoff solenoid
F3	Fuse: horn, working light
G1	Dynamo
G2	Battery
H3	Engine temperature indicator light
H4	Engine oil pressure indicator light
H5	Dynamo charge function indicator light
H10	Fuel level indicator light
K7	Start high-current relay
K8	Time lag relay 1s cut-off solenoid
K9	Cutoff solenoid switching relay
M1	Starter
M9	Fuel pump
P1	Hour meter
R1	Glow plug
S1	Preheating start switch
S2	Engine oil pressure switch
S3	Engine temperature switch
S55	Horn push button
Y1	Cutoff solenoid

6.26 Wiring diagram Tier IV (Yanmar)



nr.	Designation
A3	Regulator
B1	Fuel indicator
B2	Horn
B53	Atmospheric pressure sensor
E11	Working lights
F1	Master fuse
F2	Fuse: relay, indicator, cutoff solenoid
F3	Fuse: horn, working light
G1	Dynamo
G2	Battery
H3	Engine temperature indicator light
H4	Engine oil pressure indicator light
H5	Dynamo charge function indicator light
H10	Fuel level indicator light
K7	Start high-current relay
K8	Time lag relay 1s cut-off solenoid
K9	Cutoff solenoid switching relay
M1	Starter
M9	Fuel pump
P1	Hour meter
R1	Glow plug
S1	Preheating start switch
S2	Engine oil pressure switch
S3	Engine temperature switch
S55	Horn push button
Y1	Cutoff solenoid
Y114	Diesel engine limitation solenoid

6.28 Wiring diagram (Dual Power option)



nr.	Designation
A3	Regulator
B1	Fuel level indicator
B2	Horn
B3	Travel signal
B53	Atmospheric pressure sensor
E11	Working lights
F1	Master fuse
F2	Fuse, display, cut-off solenoid, relay
F3	Fuse: horn, working light
G1	Dynamo
G2	Battery
H3	Engine temperature indicator light
H4	Engine oil pressure indicator light
H5	Charge indicator light
H10	Fuel level indicator light
K7	Starting relay
K8	Cutoff solenoid time lag relay
K9	Cutoff solenoid switching relay
K116	Battery monitor
M1	Starter
M9	Fuel pump
P1	Hour meter
R1	Glow plug
S1	Starter
S2	Engine oil pressure switch
S3	Engine temperature switch
S16	Working light switch
S55	Horn push button
S78.1	Drive signal switch
S78:2	Drive signal switch
S96	Pressure switch
V1	Diode
V1.1	Diode
V1.2	Diode
Y1	Cutoff solenoid
Y114	Diesel engine limitation solenoid

Options

7 Options

- Article numbers for options and retrofit kits: please refer to the spare parts list.

7.1 Rollbar

- ROPS – Roll Over Protection Structure

Lowerable ROPS rollbar

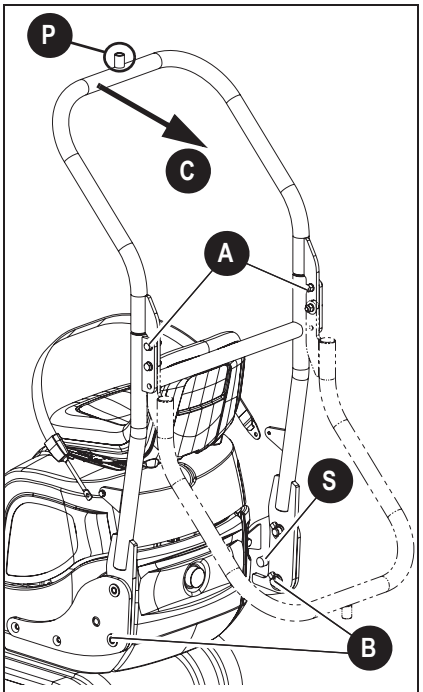


Fig. 2: Lowerable ROPS rollbar (option)

Raising/lowering the rollbar:

Danger!

The ROPS rollbar is very heavy, folding it up and down, or lowering and raising it, is very

Dangerous!

☞ *Use suitable lifting gear and auxiliary means to lower, raise and fold the rollbar up and down.*

Always fasten the lap belt if the rollbar is folded up.
Do not use the lap belt without the rollbar!

Accident hazard!

In case of structural damage on the rollbar, replace it immediately otherwise safety is no longer ensured!

Notice!

For safety reasons, always use the ROPS bar if it is fitted on your machine.

Bracket **P** for installing a rotating beacon is located on top of the rollbar.

Raising the rollbar:

☞ *Park the machine on level ground*
☞ *Stop the engine*
☞ *Locking the control lever*
☞ *Install suitable lifting gear on the rollbar*
☞ *Remove the lock nuts and screws **A** on either side*
☞ *Slowly and carefully raise the rollbar with suitable lifting gear and auxiliary means*
☞ *Insert the screws again on either side and secure them with the lock nuts*

Lowering the rollbar:

☞ *Park the machine on level ground*
☞ *Stop the engine*
☞ *Locking the control lever*
☞ *Install suitable lifting gear on the rollbar*
☞ *Remove the lock nuts and screws **A** on either side*
☞ *Slowly and carefully lower the rollbar with suitable lifting gear and auxiliary means*
☞ *Insert the screws again on either side and secure them with the lock nuts*

Lowering and raising the rollbar

Lowering the rollbar:

☞ *Park the machine on level ground*

☞ *Stop the engine*

☞ *Locking the control lever*

☞ *Install suitable lifting gear on the rollbar*

☞ *Remove the split pins and pins **B** on either side*

☞ *Slowly and carefully lower the rollbar with suitable lifting gear and auxiliary means toward **C**, as far as it will go **S**.*

Raising the rollbar:

☞ *Park the machine on level ground*

☞ *Stop the engine*

☞ *Locking the control lever*

☞ *Install suitable lifting gear on the rollbar*

☞ *Slowly and carefully raise the rollbar with suitable lifting gear and auxiliary means*

☞ *Fit pins **B** again on either side and secure them with the split pins*

Lowerable ROPS rollbar

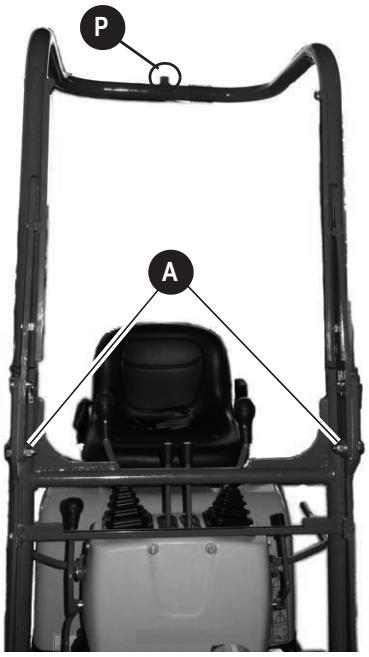


Fig. 3: Raised ROPS rollbar (option)

Danger!

The ROPS rollbar is very heavy, folding it up and down, or lowering and raising it, is very

Dangerous!

☞ *Use suitable lifting gear and auxiliary means to lower, raise and fold the rollbar up and down.*

Always fasten the lap belt if the rollbar is folded up.
Do not use the lap belt without the rollbar!

Accident hazard!

In case of structural damage on the rollbar, replace it immediately otherwise safety is no longer ensured!

Notice!

For safety reasons, always use the ROPS bar if it is fitted on your machine.

Bracket **P** for installing a rotating beacon is located on top of the rollbar.

Raising/lowering the rollbar:

Fig. 4: Lowered ROPS rollbar (option)

Raising the rollbar:

☞ *Park the machine on level ground*

☞ *Stop the engine*

☞ *Locking the control lever*

☞ *Install suitable lifting gear on the rollbar*

☞ *Remove the linch pins and pins **A** on either side*

☞ *Slowly and carefully raise the rollbar with suitable lifting gear and auxiliary means*

☞ *Fit pins **A** again on either side and secure them with the linch pins*

Lowering the rollbar:

☞ *Park the machine on level ground*

☞ *Stop the engine*

☞ *Locking the control lever*

☞ *Install suitable lifting gear on the rollbar*

☞ *Remove the linch pins and pins **A** on either side*

☞ *Slowly and carefully lower the rollbar with suitable lifting gear and auxiliary means*

☞ *Fit pins **A** again on either side and secure them with the linch pins*

7.2 ISO/SAE changeover (option)

Danger!

Accident hazard due to modified control lever operation! Can cause serious injury or death.

Accident hazard!

☞ *Change over the controls only on level and firm ground, and only if the starting key is removed.*

☞ *Ensure that you know which control mode has been selected before starting work.*

Attention!

The spool segment function remains the same when changing over (ISO/SAE), only the control lever functions are changed.

The changeover is located under both covers **1** on the control stand.

Changeover is possible between ISO controls A (Europe) and SAE controls B (USA).

☞ *Park the machine on firm, level and horizontal ground, lower the boom to the ground, stop the engine and remove the starting key.*

☞ *Raise covers **1**.*

☞ *Slide the knurled sleeve **2** upward, and hold, unhitch and grease it.*

☞ *Slide the knurled sleeve **2** upward and hitch it into ball pin **A** or **B** as required.*
The sleeve is safely locked if it is firmly connected with the ball pin and if it is engaged in the lower position.

☞ *Lower covers **1**.*

Fig. 5: Control stand covers

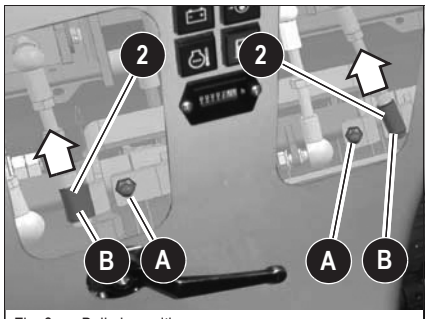


Fig. 6: Ball pin position

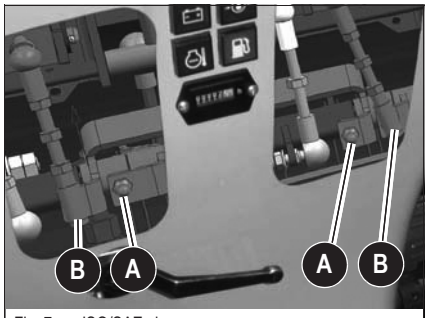


Fig. 7: ISO/SAE changeover

Wiring diagram	Controls	
A	ISO controls (Europe)	Ball pin position A (inside)
B	SAE controls (US)	Ball pin position B (outside)

7.3 Travel signal (option)

A signal sounds if a drive lever is actuated.

Danger!

Accident hazard during forward/backward machine travel. Serious crushing hazard causing death or serious injury.

☞ *Do not allow anyone to stay in the danger zone.*

☞ *Do not rely on the travel signal under any circumstances.*

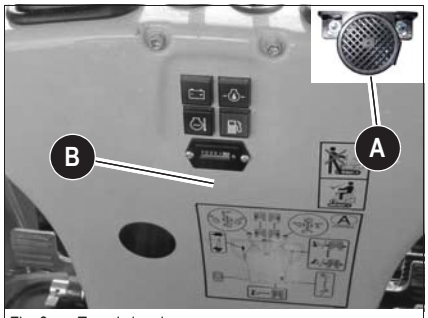


Fig. 8: Travel signal

Signal transmitter **A** is located behind trim **B** on the control stand.

Cable assignment – *see chapter 6.18 Traveling signal wiring harness (option)* on page 6-16.

7.4 Telematic

Fig. 9: Telematic

After installing the Telematic system, module **A** is enabled and sends data to the Telematic web portal.

Technical data

- This works in 90 countries with currently 160 roaming partners with a GPRS data network.
- The GPS receiver registers the movements and has a low power consumption.
- Backup battery for additional safety with an autonomy time of 48 – 96 hours.
- Supplies additional information via the web-based Telematic software.
- Module has 3 digital inputs and one digital output of which 2 digital inputs (engine and starter) are assigned at the factory. One input and output is freely assignable with other functions, such as for monitoring an additional heating system or particulate-soot filter or controlling these functions via SMS.
- Certified according to IP67.

Connections

Item	Connection	Color	Designation
1	Power supply	rd	12 V permanent plus via a series-connected 1 ampere high-speed fuse
2	Ground	bl	-
3	Digital input 1	wh	Engine START/STOP signal
4	Digital input 2	bn	Starter ON/OFF signal
5	Digital input 4	pk	Not assigned at the factory. Can be used for determining an operating state.
6	Digital output 1	ye	The digital output of the module can be used for enabling/disabling additional functions via SMS, such as an auxiliary heater. Important: Selection is only possible for comfort functions. Remote-control of safety-relevant functions or functions affecting handling is prohibited under all circumstances.

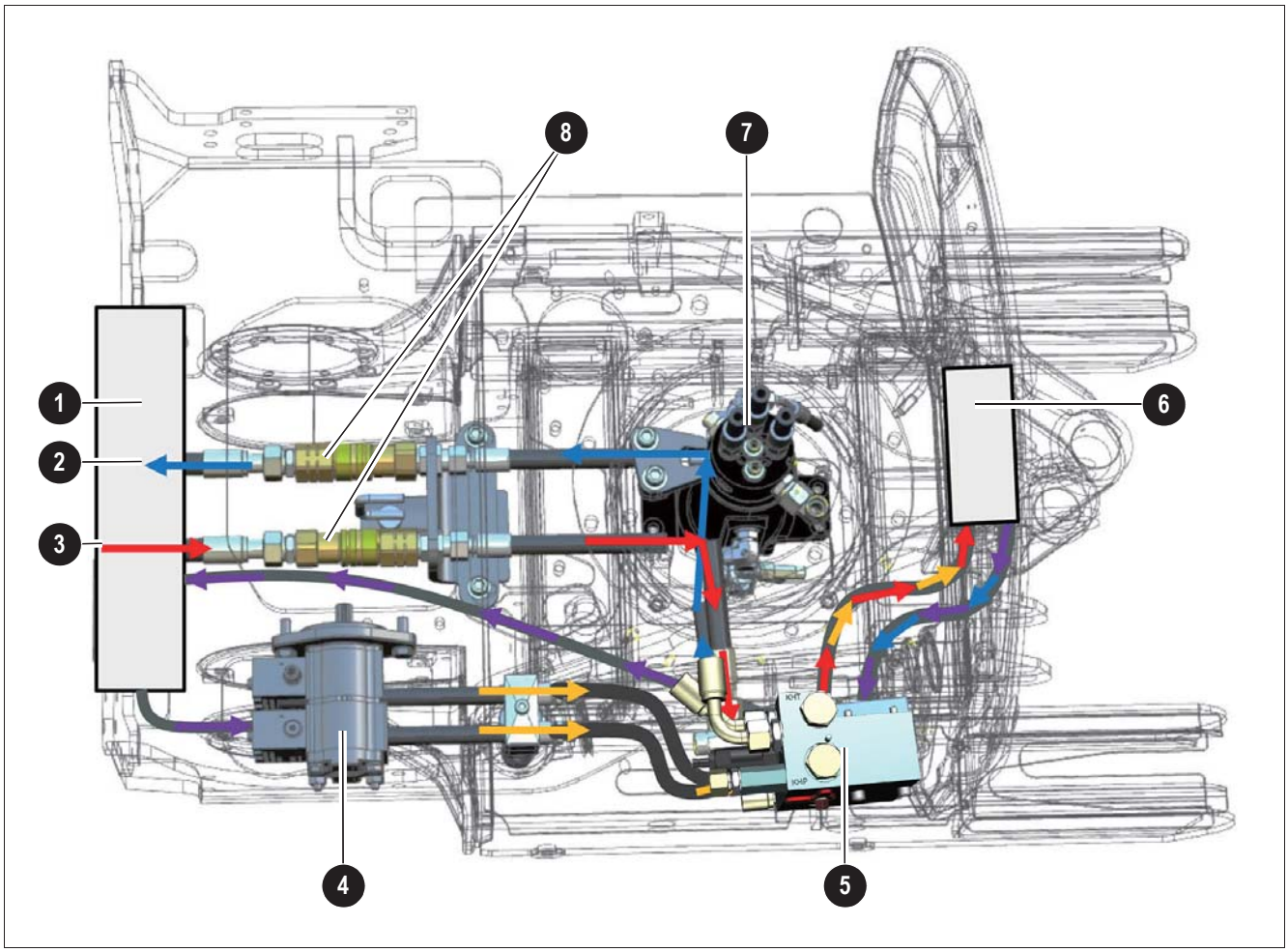
Functional check/diode

LED mode	Operating state
Steady green light with short, red flashing interruptions	The unit is connected with the GSM network and the GPS module is navigating > all is OK
No light	The unit is not connected with a power source
Steady red light	The unit is supplied with power, but is not connected with a GSM network
Short red flashing	The unit is supplied with power and is connected with a GSM network
Steady green light	The unit is navigating (fixed GPS satellite position)

7.5 Zero-emission Dual Power drive

- Diesel operation is identical to standard version.
- During HPU operation, this unit ensures the oil supply by means of a connection on the travel gear (via the swivel joint to the double ball-type cock).
- Diesel engine OFF: oil flows from HPU to main control block.
  ➥ Return via double ball-type cock and swivel joint to HPU.
- Diesel engine ON: oil from hydraulic pump to main control block.
  ➥ Return via double ball-type cock and return filter to hydraulic oil reservoir.

Overview



Item	Designation
1	Hydraulic oil reservoir
2	Return
3	Supply
4	Hydraulic pump
5	Double ball-type cock
6	Main control block
7	Swivel joint
8	Couplings