

SERVICE

MANUAL

KOMATSU
MINING GERMANY

PC5500

MACHINE MODEL

PC5500-6 Diesel

SERIAL NUMBER

15031 and up

This service manual may contain attachments and optional equipment that are not available in your area.

Please consult your local Komatsu distributor for those items you may require.

Materials and specifications are subject to change without notice.

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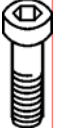


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STANDARD TIGHTENING TORQUE (1Kgm = 9,806Nm)

STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

Bolt dia.	Wrench size [mm]		Tightening torque		
			[Nm]		
			Quality grades		
			8.8	10.9	12.9
M 8	13	6	21	31	36
M 10	17	8	43	63	73
M 12	19	10	74	108	127
M 14	22	12	118	173	202
M 16	24	14	179	265	310
M 18	27	14	255	360	425
M 20	30	17	360	510	600
M 22	32	17	485	690	810
M 24	36	19	620	880	1030
M 27	41	19	920	1310	1530
M 30	46	22	1250	1770	2080
M 33	50	24	1690	2400	2800
M 36	55	27	2170	3100	3600
M 39	60		2800	4000	4700
M 42	65	32	3500	4950	5800
M 45	70		4350	6200	7200
M 48	75	35	5200	7500	8700
M 52	80		6700	9600	11200
M 56	85	41	8400	12000	14000
M 60	90		10400	14800	17400
M 64	95	46	12600	17900	20900
M 68	100		15200	21600	25500

Insert all bolts lubricated with MPG. KP2K

1. General layout**Legend for illustration (Z 22387):**

- (1) Superstructure
- (2) Under carriage
- (3) Front Shovel Attachment (FSA)
- (4) Backhoe Attachment (BHA)

1.1 Superstructure**1.1.4 Fuel tank (Fuel reservoir)****Legend for illustration (Z 21473):**

- (1) Fuel tank
- (2) Fuel tank breather valve
- (3) Main shut-off solenoid valves
- (4) Drain coupling with protection cap
- (5) Shut-off cock for fuel pressure transducer
- (6) Fuel pressure transducer

1.1 Superstructure**1.1.9 Swing gears****Legend for illustration (Z 22395):**

- (1) Swing gear box
- (2) Swing parking brake – Spring loaded multi disk brake
(Released by oil pressure)
- (3) Parking brake Control port (X)
- (4) Oil level gauge - gear box
- (5) Breather – gear box
- (6) Oil filling plug – gear box
- (7) Oil level gauge – motor adapter housing
- (8) Breather – motor adapter housing
- (9) Oil drain plug – motor adapter housing
- (10) Oil drain plug - gear box
- (20.1 + 20.2) Swing motor
- (49.1 + 49.2) Swing brake valve block

2.0 Prime drive assembly**Legend for illustration (Z 22395):**

- (1) Engine 1
- (2) Torsion type coupling
- (2) Pump distributor gear (PTO)

- (6) Engine 2
- (7) Torsion type coupling
- (8) Pump distributor gear (PTO)

- (5) Power frame

General

The drive unit, consists of the two PTO gear and the two engines, are bolted to the power frame.

The connection between engine and PTO gear is a flexible coupling.

2.4 Fan drive and radiator assembly

Legend for illustration (Z 22398):

- (1) Radiator
- (2) Fan motor (Axial piston motor)
- (3) Intake air fan
- (4) Bearing group carrier
- (5) Ball bearings
- (6) Breather filter
- (7) Oil level plug
- (8) Check valve (Anti-cavitation valve)



- **For service intervals and procedure refer to the OPERATION AND MAINTENANCE MANUAL of the corresponding machine.**

continued

Cont'd

8. Loosen lock nut (2) of the relief valve (168.x), and decrease the pressure with set screw (3) until the correct fan speed is obtained.
9. Tighten lock nut (2) and fix protection cap (3).

Basic Adjustment middle fan speed

10. Activate the 4/3 direction flow valve (Y14B-x), by connecting the solenoid plug (Y14B-x) to permanent 24 V. Use the 24V socket at the PTO *).
11. Check the fan speed with a non-contact rev counter Required fan speed: 1000 min-1
12. If adjustment is necessary loosen lock nut (5) of the relief valve (169.x), and decrease the pressure with set screw (4) until the correct fan speed is obtained.
13. Stop engine and reconnect the plugs to the correct positions.
14. Disconnect the pressure gauge from check point (M7).

Fan speed check

If the maximum fan speed is out of adjustment, increase or decrease first the pressure at relief valve (168.x), to change the speed.



- **Do not exceed the maximum permissible operating pressure of 230 bar**

If the speed can not be raised by increasing the pressure then increase the output flow of pump (10.x).

- *) Prepare a test wire with a plug ET-No. 891 039 40, and a plug ET-No. 440 305 99. Connect terminal 1 to positive (+) (center off plug 440 305 99) and terminal 2 to ground (-).

2.9 Hydraulic pumps – location, drive speed and flow rates

Legend for illustration (Z 22415a):

(1 - 6)	Axial piston pump (swash plate type) theoretical flow rate, each Drive speed* for all working motions	$V_{g \max}$ Q_{\max} n	= 500 cm ³ /rev = 700 Liter/min = 1400 min ⁻¹
(10.1), (10.3)	Axial piston pump theoretical flow rate Drive speed* for radiator fan drive	$V_{g \max}$ Q_{\max} n	= 80 cm ³ /rev = 158 Liter/min = 1973 min ⁻¹
(10.2), (10.4)	Axial piston pump theoretical flow rate Drive speed* for oil cooler fan drive	$V_{g \max}$ Q_{\max} n	= 80 cm ³ /rev = 142 Liter/min = 1770 min ⁻¹
(8.1), (8.4)	Gear pump theoretical flow rate Drive speed* for PTO gear lubrication	V_g Q_{\max} n	= 58,7 cm ³ /rev = 82,2 Liter/min = 1400 min ⁻¹
(8.2), (8.5)	Gear pump theoretical flow rate Drive speed* for hydraulic oil circulation	V_g Q_{\max} n	= 58,7 cm ³ /rev = 82,2 Liter/min = 1400 min ⁻¹
(7.1), (7.2)	Gear pump theoretical flow rate Drive speed* for pilot pressure supply	V_g Q_{\max} n	= 85,7 cm ³ /rev = 120 Liter/min = 1400 min ⁻¹

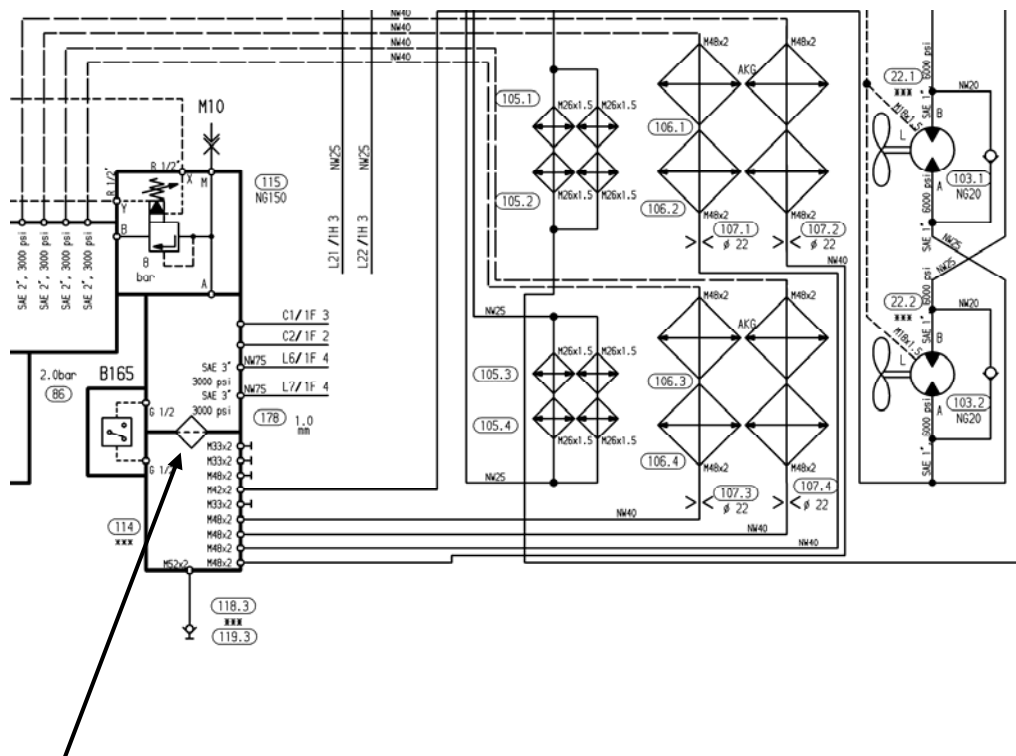


• * at 1800 min⁻¹ input drive speed

3.3 Return oil collector tube with strainer

Legend for illustration (Z 21497a):

- (1) Return oil collector tube - Part 1 -
- (2) Return oil collector tube - Part 2 -
- (3) Return oil collector tube - Part 3 -
- (4) Strainer
- (5) Bolt
- (6) Self locking nut
- (7) Gasket
- (8) Differential pressure switch B165



Task:

The strainer is installed to prevent the hydraulic oil coolers from getting clogged up in case of contamination in the main return oil circuit. Excessive increase of the hydraulic oil temperature can be an indication for a restricted strainer, i.e. bad cooling performance due to insufficient oil flow through the coolers.

In case that main components such as cylinders or motors are internal fragmentary damaged, the strainer should be inspected for metal chips.

4.1 General

The hydraulic oil cooling system maintains the hydraulic oil at a normal operating temperature.

Legend for illustration (Z 21594)

- (1) Noise shield
- (1) Cooler (Radiator)
- (2) Cooler frame
- (3) Fan
- (4) Fan motor (Axial piston motor)
- (5) Bolt
- (6) Bolt
- (7) Drive shaft
- (8) Shaft protecting Sleeve
- (9) Drive shaft seal
- (10) Ball bearings
- (11) Seeger clip ring
- (12) Bearing group carrier
- (13) Oil level plug
- (14) Breather filter

Design:

There are four* hydraulic oil coolers in front of the hydraulic tank on the R.H. side of the platform.

They are in pairs mounted in one frame, one above the other. The air stream needed for the cooling is produced by hydraulic driven fans. The air flows from **inside** to **outside** through the coolers.

For a better cleaning, the coolers can be moved to the side. (“Swing out cooler”)

The bearing group carrier is filled with oil to lubricate the bearings.

4.5 Pressure relief valves and solenoid valves**Pressure relief valves (168.x)****Legend for illustration (Z 21598b)**

- (1) Valve cartridge
- (2) Spring
- (3) Spring chamber
- (4) "X" port
- (5) Jet bore, Pilot poppet
- (6) Jet bore, Main piston
- (7) Main piston
- (8) Valve housing
- (9) Pilot poppet
- (Y) External leak oil port
- (A) Pressure port
- (B) Return oil port

Function:

Pressure in line A affects the main piston (7). At the same time there is pressure via the jet bore (6) on the spring-loaded side of the main piston and via jet bore (5) at the pilot poppet (9) of the relief valve cartridge (1).

If system pressure in line A exceeds the value set at the spring (2), pilot poppet (9) opens. The signal for this comes from line A via the jet bores (6) and (5).

The oil on the spring-loaded side of the main piston (7) now flows via the jet bore (5) and poppet (9) into the spring chamber (3).

From here it is fed internally by means of the control line (Y) to tank (port B).

Due to the state of equilibrium at the main piston (7), oil flows from line A to line B, while the set operating pressure is maintained.

The pressure relief valve can be changed (Remote controlled) by means of the port "X" and the function of the solenoid valve Y6A-x / Y6B-x and pressure reduction valve 169.x. (Function see next page)

continued

Cont'd

8. Loosen lock nut (2) of the relief valve (168.x), and decrease the pressure with set screw (3) until the correct fan speed is obtained.
9. Tighten lock nut (2) and fix protection cap (3).

Basic Adjustment middle fan speed

10. Activate the 4/3 direction flow valve (Y6B-x), by connecting the solenoid plug (Y6B-x) to permanent 24 V. Use the 24V socket at the PTO *).
11. Check the fan speed with a non-contact rev counter Required fan speed: **1000 min⁻¹**
12. If adjustment is necessary loosen lock nut (5) of the relief valve (169.x), and decrease the pressure with set screw (4) until the correct fan speed is obtained.
13. Stop engine and reconnect the plugs to the correct positions.
14. Disconnect the pressure gauge from check point (M5-x).

Fan speed check

If the maximum fan speed is out of adjustment, increase or decrease first the pressure at relief valve (168.x), to change the speed.



- **Do not exceed the maximum permissible operating pressure of 230 bar**

If the speed can not be raised by increasing the pressure then increase the output flow of pump (10.x).

- *) Prepare a test wire with a plug ET-No. 891 039 40, and a plug ET-No. 440 305 99. Connect terminal 1 to positive (+) (center off plug 440 305 99) and terminal 2 to ground (-).

Cont'd.:

The pressure relief valve (70.2) maintains the adjusted pressure of 35 bar it is the X2-pressure.

X2 – pressure: Pilot pressure system
Pump regulation system
Capacity regulation swing motors
Travel- and Swing gear house brakes (spring loaded multi - disk brakes)

The pressure accumulator (85) holds an amount of oil under pressure to ensure sufficient pilot pressure during normal operations and a limited number of operations without engine power.

The check valves (91) prevents return flow of the pilot pressure oil.

Cont'd:

5.4 Function principle of the Electro-Hydraulic- Proportional Control

(Exemplary illustration of the function of two axis with one Amplifier only)

Legend for illustration (Z 21638a)

- (1) Control lever (joystick)
- (2) Capacitor-Module
- (3) Ramp time module
- (4) Proportional-Amplifier-Module
- (5) Relay (Supply Voltage)
- (6) Proportional solenoid valve-(Pressure-Reducing Valve)
- (7) Directional solenoid valve
- (8) Control block spool

General Function

Control lever (1) is supplied with 24 V_{DC} battery voltage for the switch contacts and for the internal electronics to create the signal voltage.

When moving lever (1) out of its neutral position, 24 V_{DC} battery voltage arrives at relay (5) and energizes the **Proportional Amplifier (4)** with capacitor supported 24 V_{DC} via terminal 1.

Depending on the function of the control lever, 1 to 4 Amplifiers can be involved for the „**Y-axis**“ (forward/ backwards direction) and 1 to 4 Amplifiers for the „**X-axis**“ (left/right direction.)

The polarity of the **Output Signal** from joystick (1), **either positive or negative**, between 0 and 10 V_{DC} indicates the direction of the lever movement and is proportional to the lever deflection. This is the **Input Signal** to the ramp time module (3) at terminal 5 which will arrive after the adjusted ramp time delay via terminal 7 to the proportional amplifier (4) at terminal 5.

This Input Signal (between 0 and 10 V_{DC}) is amplified to an **Output Signal between 0 to 1000 mA** and is simultaneously send via terminal 7 (negative) or terminal 8 (positive) to the **Proportional Solenoid valve (6)** and to the **Directional solenoid valve (7)** via terminal 3 (negative) or terminal 9 (positive) to the “a” or “b”-side.

The proportional Solenoid valve (6) alters the pilot pressure (“X2”) of 35 bar to a value **proportional to the Current Signal**.

This pressure controls the movement of the control block spool (8) between neutral and full stroke position.

Cont'd:

5.12 Adjusting the Amplifiers Type B, illustration (Z 21643)

9. Turn the potentiometer (P) of the Service-Module further until the multimeter shows **10 VDC**; the multimeter for the current reading will show a value which should correspond to the value giving in the circuit diagram e.g. **500 mA**. (100 % value).

If necessary correct the value with potentiometer (R2).



- **It is important that the pilot pressure for the pressure increasing valve is 19 ± 1 bar.**

For more information refer to section 8.2 „Swing Circuit“

10. Repeat settings of item 8 and 9 until both mA values are stabilized, because R1 and R2 influence each other.
11. Remove multimeter, test wire, close* the terminals and reconnect the wire to terminal 5 of the amplifier module.

* How to open and close the terminal:

Push the yellow stud (1) down with a screw driver and turn it 90° to the left to open or to the right to close the terminal. A spring pushes then the stud outwards and the contacts are either open or closed.

Table of contents section 6.0

Section		Page
6.0	Components	
6.1	Hydraulic	
6.1.1	Main Control Blocks and High Pressure Filter FSA	2-3
6.1.2	Main Control Blocks and High Pressure Filter BHA	4-5
6.1.3	Distributor Manifold – Restrictor blocks FSA	6
6.1.4	Distributor Manifold – Restrictor blocks BHA	7
6.1.5	Restrictor Block with Pressure Relief Valve	8
6.1.6	Anti Cavitation Valve Block	9
6.1.7	Remote Control Valves	10
6.1.8	Directional Solenoid Valves (4 way / 3 positions)	11
6.1.9	Proportional Solenoid Valves	12
6.1.10	High Pressure Filter	13
6.1.11	Control Blocks and Valves	14-17
6.1.12	Load Holding Valve	18
6.1.13	Travel Brake Valve	19
6.1.14	Pressure Reducing Valve	20
6.1.15	Directional Solenoid Valves (2 positions / 4-ways)	21
6.1.16	Pressure Increasing Valve	22

6.1.3 Distributor Manifold - Location of restrictor blocks and anti cavitation valves

Front Shovel Attachment (FSA)

Legend for illustration (Z 22434):

- (1) Distributor manifold
- (2) Synchronization (Equalization) lines
- (3) Synchronization (Equalization) lines
- (4) Anti Cavitation Valve Block (ACV)
- (5) Restrictor Block (Throttle valve)
- (6) Restrictor Block (Throttle valve)
- (7) Service-line **Relief Valve**

6.1.8 Directional Solenoid Valves

(4/3 direction flow valve = 4 way / 3 positions)



- **This solenoid operated directional spool valves are installed to control the start, stop and direction of an oil flow.**

Legend for illustration (Z 21839):

- (1) Housing
- (2) Solenoids
- (3) Control spool
- (4) Reset springs
- (5) Plunger
- (6) End cover

Function:

In un-operated condition the control spool (3) is held in the neutral or starting position by the reset springs (4). Operation of the control spool is by means of oil immersed solenoids (2).

The force of the solenoid (2) acts via the plunger (5) on the control spool (3) and pushes its from its resting position into the required end position. This results in the required free flow from P to A and B to T or from P to B and A to T.

When the solenoid (2) is de-energised, the control spool (3) is returned to its original position by the reset springs (4).

6.1.11 Control Blocks and Valves**Legend for illustration (Z 22441):**

- (1) Spool
- (2) Reset springs
- (3) Load holding valve

Function:

Reset springs (2) moves the spool (1) in neutral position.

Fine control grooves provide for sensitive controlling, because a motion is started always while the pressure oil and the return oil first passes this fine control grooves before spool (1) is inter connecting the entire groove to the user channel.

In neutral position of spool (1) the pump oil is flowing back via port PU to the tank.

Lower picture:

Example. The spool is moved by pilot pressure on the left spool side to right position: Port PU is closed and the connection through the holding valve (3) to the user (port A) is open. Also the connection from the other user side (port B return) is connected to the port T (return line to tank).

6.1.15 Directional Solenoid Valves (2 positions / 4-ways)

- **This solenoid operated directional spool valves are installed to control the start, stop or direction of an oil flow.**

Legend for illustration (Z 21845):

- (1) Housing
- (2) Solenoid
- (3) Control spool
- (4) Return spring
- (5) Plunger
- (6) Dust cap with stem for manual operation

Function:

When there is no flow through the valve, control spool (3) is held in neutral or output position by means of the return springs (4). The control spool (3) is operated by means of oil immersed solenoid (2).

The force of the solenoid (2) effects control spool (3) by means of the plunger (5) and pushes it from its resting position to the required end position.

This results in free flow from P to B and A to T.

When solenoid (2) is de-energized, control spool (3) is moved back to its resting position by means of return springs (4).

An optional hand emergency (6) allows movement of the control spool (3) without energizing the solenoid.

7.0 Main hydraulic pumps and pump regulation system

Pump regulation system general

Function:

Solenoid valve Y17: (33/7)*

If solenoid valve Y17 is de-energized pumps (1-6) are in Q-min position. It gets energized as soon as one of the control levers/pedals has been operated and de-energized when ever all controls are in neutral position for more than 20 seconds (exception: high oil temperature >T3).

Solenoid valve Y17a: (33/5)*

The solenoid is de-energized as long the hydraulic oil temperature is below the values of temperature range „T2“ (depending on the filled in hydraulic oil) shown in the table. (pumps (1-6) are in ½ Q-max. position)

temperature hydraulic oil						
temperature in °C	viscosity grade according to ISO					
	VG22	VG32	VG46	VG68	VG100	Harmony HVI 36
TypNr. / type no.	0	1	2	3	4	5
T1 (1000 cSt)	-20	-14	-6	0	5	-22
T2 (100 cSt)	9	16	25	32	39	14
T3 (30 cSt)	32	41	50	58	67	44
T4 (10 cSt -5°C)	58	69	79	85	85	80



* Electric circuit diagram page / column (based on id # 897 889 40)

Cont'd:

7.1 Main Pumps

7.1.3 Operating Principles

Symbol of main hydraulic pump A4VSLO 750 LR3DN / 30L

Legend for illustration (Z 22447):

- (1) Main pump (swash plate pump, variable displacement)
- (2) Pump bearing group
- (3) Drive shaft
- (4) Non return valves
- (5) Remote control valve
- (5.1) Mechanical stroke limitation*
- (5.2) Remote pressure (P_{ST}) operated piston for item 6
- (5.3) Mechanical stroke limitation*
- (6) Spool valve (pressure balance valve)
- (7) Nozzle
- (8) Power control valve
- (9) Nozzle
- (10) Pressure cut-off valve
- (11) Auxiliary pump (Gear pump, fixed displacement)
- (12) Positioning piston
- (13) Slipper pad piston
- (14) Lever
- (15) Cam
- (16) Through drive shaft



- *** Factory side adjusted, no field adjustment required**

- B/B1 Pressure port
- S Oil intake (suction port)
- MB Operating pressure check point
- Mst Control pressure check point
- R(L) Filler and bleeder port
- T, K1, K2 Connection port for chip indicator
- P Pump support pressure ("X4"-pressure)
- Pst Remote control pressure port ("X3"-pressure)
- U Bearing flushing port
- XLR Regulating pressure port ("X1"-pressure)

continued

Cont'd:

7.1 Main Pumps

7.1.3 Operating Principles, illustration (Z 21555a)

De-stroking: (Pump moves from Q-max. into of Q-min. direction)

When does the pumps start to de-stroke

- Engine running
- and** hydraulic at normal operating temperature ($> T_2$)
- and** Service switch S150 deactivated
- and** The load stalls the engine RPM below 1800 min^{-1}
- \Rightarrow (The electronic pump regulation system will reduce the X1-pressure)
- or** With pump pressure above $\approx 150 \text{ bar}$ (Hydraulic constant regulation)
(Constant X1-pressure of approximately 8 bar)

Example with the following conditions:

- Engine running ($> 1800 \text{ min}^{-1}$)
- Pump pressure 260 bar adjustable at main relief valve, present at the slipper pad of piston (13) and the small area side of the positioning piston (12)
- X1 = 12 bar (constant regulation pressure adjustable at pressure reducing valve 81.2) Change over valve (79.1 / 73.2) switched to hydraulic mode
- X3 = 35 bar (remote control pressure); Y17 energized **and** Y17a energized
- X4 = 60 bar (pump support pressure), present at valve (7).

Response of pump control mechanism:

Valve (6) moves to position "a" because the spring force is supported by the X4-pressure, since the oil flow back to tank is blocked at valve (5) (which is in position "b", due to the 35 bar remote control pressure X3).

The operating pressure (with the value for **start of de-stroking**) at the slipper pad of piston (13) moves the power control valve (8) into position "b" (against the spring force supported by the X1-pressure).

This in turn connects the operating pressure to the large area side of positioning piston (12).

Because the large area side of positioning piston (12) is approximately three times larger as the small area side, the operating pressure present on both sides, resulting in stronger force at the large area side, moving the pump in Q-min direction.

The pump de-strokes until the forces at positioning piston (12) are balanced

continued

Cont'd:

7.1 Main Pumps

7.1.4 Checks / Adjustments

Pressure cut-off valve (DR control valve), illustration (Z21560)

The sense of this check is to make sure that the pump is in Q-min. position at an operating pressure between 300 bar and 310 bar.

1. Connect a 400 bar pressure gauge to the pressure check point at the respective high pressure filter for the pumps being checked.
2. Insert an Allen key into the angle indicator bolt (see illustration) for better visibility of the start of destroking.
3. Start the respective engine, let it run with max. speed, stall the hydraulic for the pump to be checked and alter the operating pressure with the MRV between 280 and 310 bar.
4. The angle indicator must indicate Q-min. position at a pressure of 300 bar shown at the gauge connected to the high pressure filter.

If readjustment is required proceed as follow:

- a) Loosen lock nut (8).
- b) Turn set bolt (9), so that the pump is in Q-min. position at the required value.
- c) Tighten lock nut (8).
5. Re-adjust the operating pressure at the MRV to 310⁺¹⁰ bar
6. Remove Allen key and gauges.

continued

7.2 Electronic Pump Regulation System

7.2.3 Checks and adjustments Micro controller MC7, illustration (Z 21717a)

Method A - X1-pressure with 24V supply to separating terminals at the X2-switch board

Pre-conditions: Normal operating temperature, correct pilot pressure setting and the system must be free of air.

1. Make sure the change over valves is in position “Electronic Pump Regulation”
2. Connect a pressure gauge to the respective check point (M20-1 or M20-2), using a long pressure gauge hose to be able reading the pressure in front of the X2-panel.
3. **Selection of adjusting mode:**
Turn the main key switch in on position, and activate the adjusting mode as follows:
Connect 24V, simultaneously to terminal 127 and 128 for 10 seconds, using two test leads and disconnect the voltage thereafter.
4. **Selection of the required proportional solenoid valve:**
With the main key switch still in on position, select the applying terminal (X2-board) for proportional solenoid valve Y61-1 (engine1) or Y61-2 (engine2) as follows:
Y 61-1 →No connections at selecting terminals required.
Y 61-2 →Connect 24V, to terminal 126, using one test lead.
5. **Adjusting the X1-pressure:**
Start the engine, let it run with maximum speed.
Read the pressure, required = $24 \pm 0,5$ bar
If necessary **increase** the X1-pressure as follows:
Connect 24V temporarily to **terminal 127**.
 - **As long as voltage is supplied, the X1-pressure drops to zero. After interrupting the voltage supply, the gauge pointer will move slowly to the new present X1-pressure.**
 - **Example:**
Keeping voltage supply for two seconds , will increase the X1-pressure of approximately 1 bar.
6. To **decrease** the X1-pressure connect 24V to terminal **128** and proceed as described under item 5, keeping voltage supply for two seconds , will decrease the X1-pressure of approximately 1 bar.
7. After the adjustment is finished, remove the test leads and pressure gauge and turn the main key switch in OFF position to deactivate the adjusting mode.



7.2 Electronic Pump Regulation System

**7.2.3 Checks and adjustments Micro controller MC7,
illustration (Z 22357)**

Method B

X1-Pressure (maximum current) Adjustment:

Press **F1** **Config/Cal.**



Press **2** **Max current**



Start the respective diesel engine and let it run with maximum speed. (high free idle)
Do not load the diesel engine.

Press **1** **Val ve 1.** (Engine 1) or
2 **Val ve 2** (Engine 2)



Check the X1-pressure with a pressure gauge and set it to the desired value by pressing **↑** or **↓**.



Press **ENTER.** **Acceptance of new value**



Press **MENU.** **Return to sub menu.**



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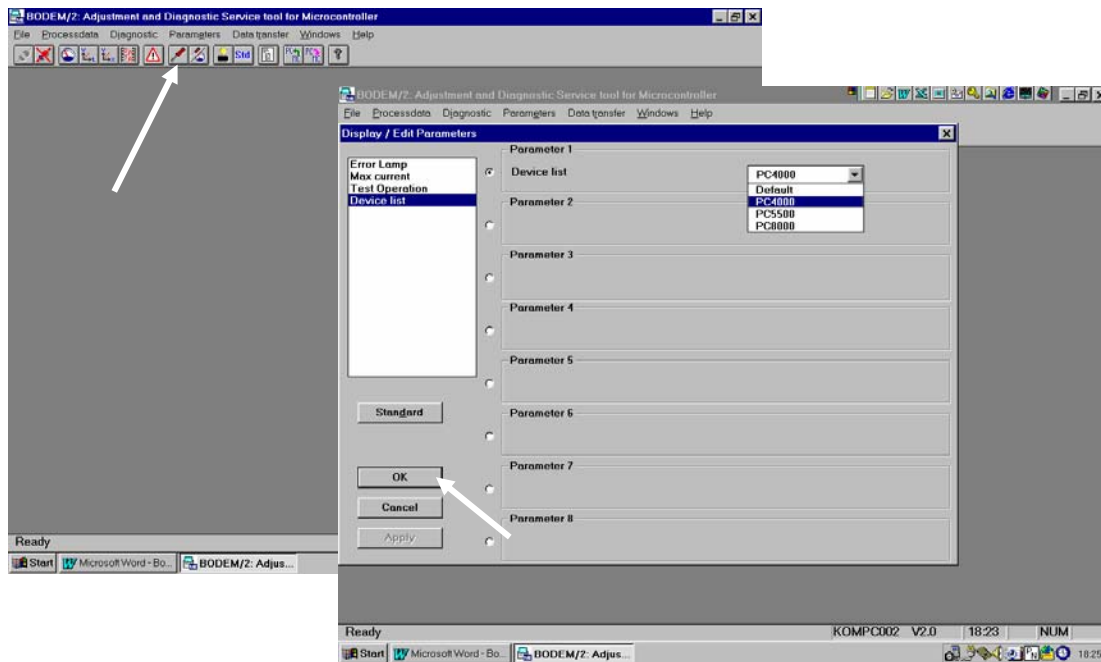
7.2 Electronic Pump Regulation System

**7.2.3 Checks and adjustments Micro controller MC7,
illustration (Z 22358)**

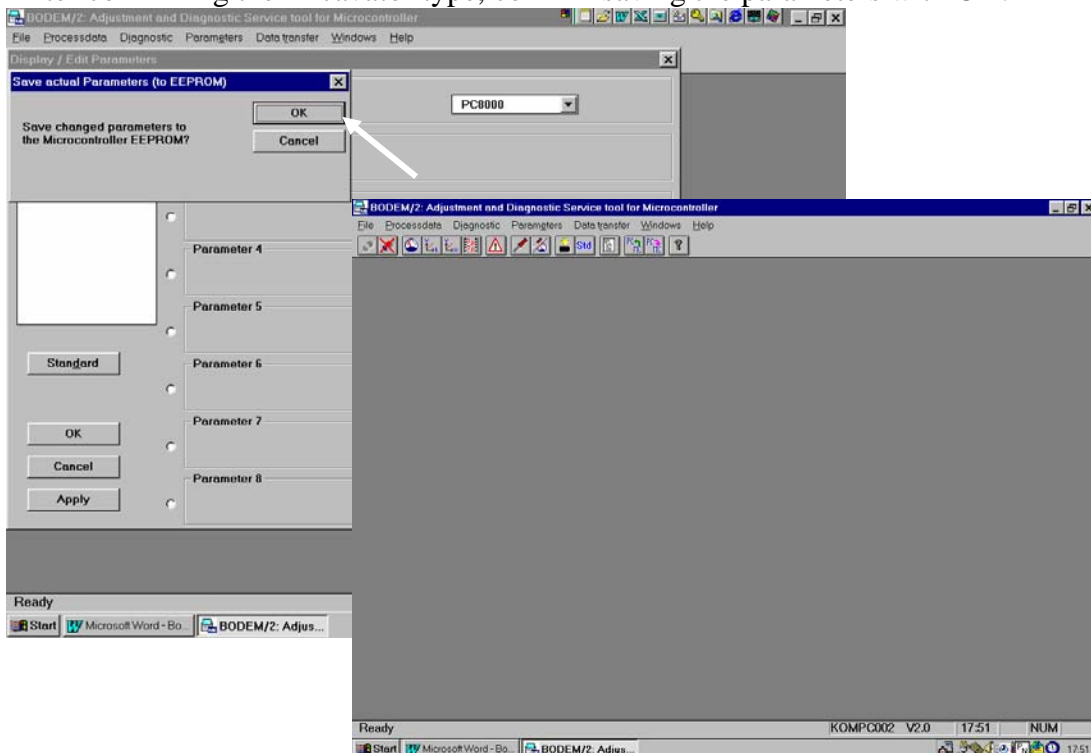
Method C

Excavator Type selection:

Open menu  Display/Edit parameters → Device list , select the required Excavator type and confirm with OK .



After confirming the Excavator type, confirm saving the parameters with OK.



**7.4 Determination of the Peak point (Engine performance) ,
illustration (Z 22360a)**

13. Re-set the **X1-pressure** at pressure reducing valve (81.2) as recorded **.
14. Shift the three way cock valve (22) to position “Electronic regulation“
15. Reset the MRV's to 310 bar^{+5bar}, and remove the gauges.
16. Check MRV on single valve block IV

***Altering the MRV-Setting:**

- Remove dust cap (a).
- Loosen lock nut (b).
- Turning the set screw (c) **cw** the pressure will increase.
- Turning the set screw **ccw** the pressure will decrease.

****Altering the X1-Setting:**

- Remove dust cap (d).
- Loosen the lock nut (e).
- Turning the set screw (f) **cw** the pressure will increase.
- Turning the set screw **ccw** the pressure will decrease

Boom:**S95 ON K160 ON** Float position **deactivated**

A10 deactivated

Floating spool block I section 4 off

A10A activated

Standard spool block II section 3 **ON****S95 OFF K160 OFF** Float position **activated**

A10 activated

Floating spool block I section 4 **ON**

A10A deactivated

Standard spool block II section can be on or off

Stick:**S98 ON K170 ON** Float position **deactivated**

A8B deactivated

Floating spool block III section 4 off

A8A activated

Standard spool block II section 4 **ON****S98 OFF K170 OFF** Float position **activated**

A8B activated

Floating spool block III section 4 **ON**

A8A deactivated

Standard spool block II section can be on or off



- **Due to the two different operation modes for lowering, the lowering speed of boom and stick cylinder must be adjusted twice:**
 - A. Float position **deactivated**
 - B. Float position **activated**

8.1.2 Electric / Hydraulic flowchart “ Boom lowering ” FSA, Auto Float on
Legend for illustration (Z 22531):

(E19)	Control lever (Joy stick)
(D32)	Time relay – Pilot control: Neutral position monitoring
(+Y)	Direction (axis) of joy stick
(+10V)	Signal voltage (Maximum)
(gn)	Color code of signal voltage cable (Joy stick)
(X2...)	Terminal rail with number
(E49)	Ramp time module
(A10)	Amplifier module – Boom
(A10A)	Amplifier module – Boom
(A10B)	Amplifier module – Boom
(K76A)	Relay – pilot control: Contacts 6 / 10 open while extending the stick.
(K79)	Relay – pilot control: Contacts 6 / 10 open while filling the bucket.
(K80)	Relay – pilot control: Contacts 8 / 12 closed while moving the boom up.
(K160)	Relay – pilot control: Contacts 2 / 10 closed and 5 / 9 open while auto floating on.
(K207C)	Relay – pilot control: Contacts 5 / 9 closed while warming up hydraulic oil (S205).
(45.1 – 45.3)	Remote control valves
(Y23, Y26, Y29)	Proportional solenoid valve
(Y23b, Y26b, Y29b)	Directional solenoid valve
(I – III)	Main control blocks I – III

Electrical signal flow (EURO control).

The auto float button in the right lever E19 is disengaged and relay K160 is de-energized. Signal voltage of joy stick (E19) arrives via ramp time module (E49) only at terminal 5 of the amplifier modules (A10 and A10b) and further to the proportional and directional solenoid valve of the remote control blocks (45.1 and 45.3).

Hydraulic signal flow. (pilot pressure)

When the proportional and directional solenoid valves are energized pilot pressure oil flows to the pilot pressure ports of the respective main control blocks.

Hydraulic oil flow

Now the pump oil flow still back to the return line. Both pressure lines at valve block I section 3 (A3 and B3) are connected to the same back pressure charged return line. Valve spool 2 of main valve block III connect only port B2 to the return line. The return line, the piston side and the piston rod side of the boom cylinders now connected together. The boom can moved up and down by external force.

8.1.3 Electric / Hydraulic flowchart “ Stick retracting ” FSA, Auto Float active

Legend for illustration (Z 22535a):

(E20)	Control lever (Joy stick)
(D32)	Time relay – Pilot control: Neutral position monitoring
(-Y)	Direction (axis) of joy stick
(-10V)	Signal voltage (Maximum)
(gn)	Color code of signal voltage cable (Joy stick)
(X2...)	Terminal rail with number
(E48)	Ramp time module
(A8)	Amplifier module – Stick
(A8a)	Amplifier module – Stick
(A8b)	Amplifier module – Stick
(45.1-45.3)	Remote control valves
(Y21, Y27, Y31)	Proportional solenoid valve
(Y21a, Y27a, Y27b)	Directional solenoid valve
(I, II, III)	Main control blocks I, II III

Electrical signal flow (EURO control).

The auto float button in the left lever E20 is disengaged relay K170 is de-energized. Signal voltage of joy stick (E20) arrives via ramp time module (E48) at terminal 5 of the amplifier modules (A8, A8a and A8b) and further to the proportional and directional solenoid valve of the remote control blocks (45.1 and 45.3). Amplifier module A8a disengaged with open K80 if bucket filling is actuated..

Hydraulic signal flow. (pilot pressure)

When the proportional and directional solenoid valves are energized pilot pressure oil flows to the pilot pressure ports of the respective main control blocks.

Hydraulic oil flow

Both pressure lines at valve block III section 4 (A4 and B4) are connected to the same back pressure charged return line. Valve spool 4 of main valve block I connect only port B2 to the return line. The return line, the piston side and the piston rod side of the stick cylinders now connected together. The stick can move forward and backward by external force.

If only the stick retracting function is active section 4 of main valve block II opened additional port A4 and B4 to extend the max. oil flow for max. stick speed.

8.1.6 Electric / Hydraulic flowchart “ Bucket dump ” BHA
Legend for illustration (Z 22477):

(E19)	Control lever (Joy stick)
(D32)	Time relay – Pilot control: Neutral position monitoring
(+X)	Direction (axis) of joy stick
(+10V)	Signal voltage (Maximum)
(ws / gn)	Color code of signal voltage cable (Joy stick)
(X2...)	Terminal rail with number
(A9)	Amplifier module – Bucket
(A9a)	Amplifier module – Bucket
(A9b)	Amplifier module – Bucket
(K50)	Relay – pilot control: Bucket cut-off Contacts 6 / 10 only closed if the hydraulic oil is overheated.
(14.1 + 14.3)	Remote control valves
(15)	Remote control valves
(Y64)	Proportional solenoid valve
(Y71 + Y75)	Proportional solenoid valve
(Y23 + Y45)	Directional solenoid valve
(Y37)	Directional solenoid valve
(II, III + IV)	Main control blocks II, III + IV
(42)	Distributor manifold

Electrical signal flow (EURO control)

Signal voltage of joy stick (E19) arrives via relay contacts K50 at terminal 5 of the amplifier modules (A9, A9a, A9b) and further to the proportional and directional solenoid valves of the remote control blocks (45.1, 45.2 and 45.3).

Hydraulic signal flow. (pilot pressure)

When the proportional and directional solenoid valves are energized pilot pressure oil flows to the pilot pressure ports of the main control blocks .

Hydraulic oil flow

Now the oil of the main pumps flows through the main control blocks (II, III, IV) and arrives via distributor manifold (42) at the hydraulic cylinders.

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8.1.11 Checks and adjustments of the Service Line Relief Valves (SRV), illustration (Z 22482):

Boom cylinder “piston side” FSA + BHA

There are three service line relief valves (secondary valves) installed, all three at the distributor manifold, to limit the maximum possible pressure peaks in the service line.

Since the opening pressure of the SRV's is higher than the setting of the Main Relief Valves (MRV's) it is necessary to increase the main relief pressure for testing and adjusting purposes.

SRV FSA	SRV BHA	Press. check point	Location
141.1	138.1	M23	Manifold section B
141.2	138.2.	M29.1	Manifold section N
141.3	138.3	M29.2	Manifold section N
MRV I		M12.1 (at HP filter)	Double HP filter R.H.
MRV II		M12.3 (at HP filter)	Single HP filter, block II
MRV III		M12.4 (at HP filter)	Double HP L.H..
MRV IV		M12.2 (at HP filter)	Single HP filter, block IV

1. Connect gauges to all above listed check points (min. 400 bar).
2. Start both motors..
3. Extend the boom cylinder to the stop position until the hydraulic system stalls.
4. Increase slowly the pump supply line pressure, by turning in set screws (3) of the MRV's in control block I, II, III and IV, while observing the pressure gauges. Stop as soon the pressure does not raise any further. The gauge pointers should remain at 350 bar ^{+ 5 bar}.



- **Since the piston side of the boom cylinders are protected by several SRV's, the pressure gauges show the pressure of that valve with the lowest setting.**

Even when the gauges show the required pressure it is possible that one or more valves have a higher setting.

- **To ensure that only the SRV's open during checks and adjustments it is necessary to further increase the setting of both MRV's.**

5. Remove protective cap (1) of MRV.
6. Loosen lock nut (2).
7. Turn set screw (3) of the MRV's ½ turn further in, the gauge pointers will remain at the value shown at item #4 (350 bar ^{+ 5 bar}).
8. Tighten lock nut (2).

continued

Cont'd:

8.1.11 Checks and adjustments of the Service Line Relief Valves (SRV), illustration (Z 22542):

Stick cylinder “piston side” FSA

9. Adjust all three SRV's equally, until all gauges show a pressure of 360 bar.

Adjust in steps of ¼ turn of set screw (3) in the following sequence:

142.5 142.6 142.7

Remove protective cap (1) of SRV's.

Loosen lock nut (2).

Turn set screw (3) **-clockwise to increase, Counter-clock wise to decrease the setting.**

Tighten lock nut (2) and install cap (1).

10. Reduce the pressure at SRV 142.5 to a value below the required value, and increase up to the required pressure (350 bar), while observing all gauges.



- **Now all gauges will show the same value of 350 bar, but only SRV-65.2 has the correct setting.**

11. Proceed with the other valves in the same manner in the following sequence: 142.6 142.7



- **Strong pulsation of the return line hoses, indicates deviation in opening pressure of SRV's and must be avoided. Repeat the adjusting procedure until the oil returns well-balanced via all three service line relief valves.**

12. Reset the MRV to 310 bar ^{+5 bar} (320 bar block IV) after the check / adjustment is finished, as follows:

Remove protective cap (1).

Loosen lock nut (2).

Turn set screw (3) **-clockwise to increase pressure, Counter-clock wise to decrease pressure.**

Tighten lock nut (2) and install cap (1).



- **It is important that the valve body of MRV-valve and the SRV-valve are firmly tightened (with 300 Nm). Otherwise, the internal sealing is not properly which results in loud flow noises and wrong adjustments.**

Cont'd:

**8.1.11 Checks and adjustments of the Service Line Relief Valves (SRV),
illustration (Z 22543a):**

Stick cylinder “piston rod side” FSA



- **Strong pulsation of the return line hoses, indicates deviation in opening pressure of SRV's and must be avoided.**
Repeat the adjusting procedure until the oil returns well-balanced via all service line relief valves.

14. Reset the MRV's to 310 bar ^{+5 bar} after the check / adjustment is finished
15. Stop engine.
16. Install all protective cups (1).



- **It is important that the valve body of MRV-valve and the SRV-valve are firmly tightened (with 300 Nm). Otherwise, the internal sealing is not properly which results in loud flow noises and wrong adjustments.**

8.1.11 Checks and adjustments of the Service Line Relief Valves (SRV), illustration (Z 22486):

Bucket cylinder “Piston side” BHA

There are three service line relief valves (secondary valves) installed at the distributor manifold, to limit the maximum possible pressure peaks in the service line.

Since the opening pressure of the SRV’s is higher than the setting of the Main Relief Valves (MRV’s) it is necessary to increase the main relief pressure for testing and adjusting purposes.

Valve	Press. check point	Location
SRV 142.1	M24.1	Manifold section C
SRV 142.2	M24.2	Manifold section C
SRV 142.3	M25	Manifold section D
MRV circuit I	M12.1 (High pressure filter)	Double high pressure filter R.H.
MRV circuit II	M12.3 (High pressure filter)	Single high pressure filter, block II
MRV circuit III	M12.4 (High pressure filter)	Double high pressure filter L.H..
MRV circuit IV	M12.2 (High pressure filter)	Singe high pressure filter, block IV

1. Connect gauges to all above listed check points.
2. Start both engines and let them run with max. speed.
3. Extend the bucket cylinder (Bucket filling) to the stop position until the hydraulic system stalls.
4. Increase slowly the pump supply line pressure, by turning in set screws (3) of MRV in control block I, II, III and IV, while observing the pressure gauges. Stop as soon the pressure does not raise any further. The gauge pointers should remain at 350 bar ^{+5 bar}.



- **Since the piston side of the bucket cylinders are protected by several SRV’s, the pressure gauges show the pressure of that valve with the lowest setting. Even when the gauges show the required pressure it is possible that one or more valves have a higher setting.**
- **To ensure that only the SRV’s open during checks and adjustments it is necessary to further increase the setting of both MRV’s.**

5. Remove protective cap (1) of MRV.
6. Loosen lock nut (2).
7. Turn set screw (3) of both MRV’s ½ turn further in, the gauge pointers will remain at the value shown at item #4 (350 bar ^{+5 bar}).
8. Tighten lock nut (2) and install cap (1).

continued

Cont'd:

8.1.11 Checks and adjustments of the Service Line Relief Valves (SRV), illustration (Z 22487):

Bucket cylinder "Piston rod side" BHA

9. Adjust all SRV's equally, until all gauges show a pressure of 360 bar.

Adjust in steps of ¼ turn of set screw (3) in the following sequence:

142.8 142.9 142.10

Remove protective cap (1) of SRV's.

Loosen lock nut (2).

Turn set screw (3) **-clockwise** to **increase** pressure, **Counter-clock wise** to **decrease** pressure.

Tighten lock nut (2) and install cap (1).

10. Reduce the pressure, at SRV- 142.8 to a value below the required value and then increase up to the required pressure (350 bar), while observing all gauges.



- **Now all gauges will show the same value of 350 bar, but only SRV-142.8 has the correct setting.**

11. Proceed with the other valves in the same manner in the following sequence: 142.9 142.10



- **Strong pulsation of the return line hoses, indicates deviation in opening pressure of SRV's and must be avoided. Repeat the adjusting procedure until the oil returns well-balanced via all three service line relief valves.**

12. Reset the MRV's to 310 bar ^{+5 bar} after the check / adjustment is finished, as follows:

Remove protective cap (1).

Loosen lock nut (2).

Turn set screw (3) **-clockwise** to **increase** pressure, **Counter-clock wise** to **decrease** pressure.

Tighten lock nut (2) and install cap (1).



- **It is important that the valve body of MRV-valve and the SRV-valve are firmly tightened (with 300 Nm). Otherwise, the internal sealing is not properly which results in loud flow noises and wrong adjustments.**

Cont'd:

**8.1.12 Checks and adjustments of the lowering speed,
illustration (Z 22489):**

Boom cylinder FSA

Adjustments / Checks:

II. Float position deactivated (with push button S95):

1. Adjust the throttle adjustment bold of throttle valve 141.2 to the same amount of revolutions as the valve 141.1 and 141.3.
2. Use a stop watch to measure the cylinder running time.
3. Raise the fully extended attachment with **empty** bucket to the maximum height position (A).
4. Shift the engines to high idle speed.
5. Press push button S95 and keep it depressed while lowering the attachment. Rapidly move the control lever (E19) to the front end position (start the stop watch) and hold it until the final position (B) is reached.(stop the stop watch).



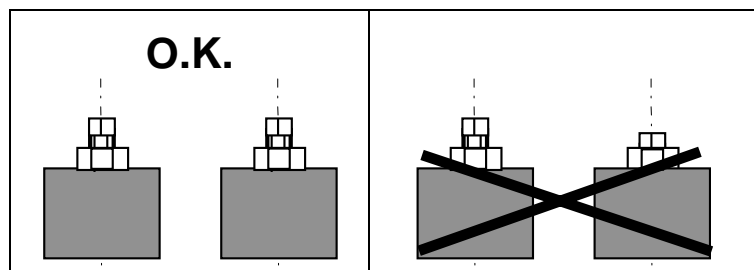
- **Lower the boom so, that the bucket stops just above the ground.**

6. The lowering speed will be the same as with floating position. If the lowering speed is too high, i.e. the measured time is less than the permissible time, the speed must be reduced by altering the throttle valve 141.1, 141.2 and synchronous 141.3 at the distributor manifold section B and N.

Adjust as follows:

To decrease the lowering speed loosen lock nut (1) and turn the bolt (2) cw. To increase the lowering speed loosen lock nut (1) and turn the bolt (2) ccw.

The adjusting screws have to be turned in by the same amount of revolutions.



7. Check lowering speed again and repeat the adjustment if necessary.
8. If the adjustment is finished tighten lock nut (1).

**8.1.12 Checks and adjustments of the lowering speed,
illustration (Z 22562):**

Bucket cylinder FSA

Maximum permissible lowering speed:

	Cylinder retracting time/meter (s /m)	Total time (s)
Bucket FSA	1,1	3,0

Adjustments / Checks:

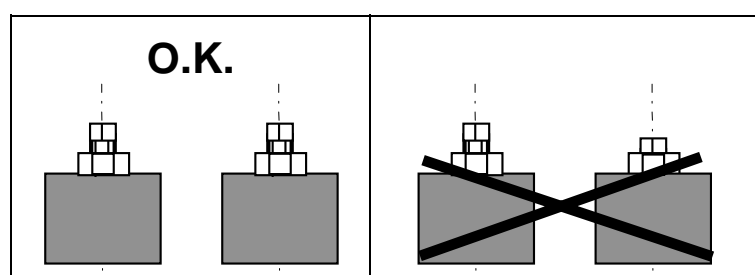
1. Use a stop watch to measure the cylinder running time.
2. Raise the fully extended attachment with **empty** bucket to the maximum height position (A).
3. Start both engines and let it run in high idle.
4. Rapidly move the control lever (E19) to the r.h. end position (start the stop watch) and hold it until the final position (B) is reached.(stop the stop watch).
5. If the lowering speed is too high, i.e. the measured time is less than the permissible time, the speed must be reduced by **altering the throttle valves 142.1, 142.2 and 142,3 at the distributor manifold section C and D.**

Adjust as follows:

To decrease the lowering speed loosen lock nut (1) and turn the bolt (2) cw.

To increase the lowering speed loosen lock nut (1) and turn the bolt (2) ccw.

Since there are several valves throttling the return oil flow of the bucket cylinder the valves must be set synchronously. The adjusting screws have to be turned in by the same amount of revolutions.



6. Check lowering speed again and repeat the adjustment if necessary.
7. If the adjustment is finished tighten lock nut (1).

8.2.1 Swing Circuit (Brief description)

Legend for illustration (Z 22501b):

(I - VI)	Main pumps
(13)	Single control block IV
(48)	Manifold
(20.1+ 20.2)	Swing motors
(71.1+ 71.2)	Manifold at the control and filter panel
(25.2)	Double check valve
(49.1 + 49.2)	Pressure increasing valve (swing brake valve)
(Y48)	Swing motors power control valve
(Y120)	Solenoid valve
(43)	Remote control valve block
(Y32)	Proportional valve of the remote control block
(Y32a/b)	Directional solenoid valve of the remote control block
(20)	Control lever left hand
(50)	Ramp module
(A7)	Amplifier module

Brief description (Control circuits)

(Study together with the for the machine valid hydraulic and electric circuit diagram).

When the lever (E20) is moved out of its neutral position, proportional solenoid valves Y32 are energized. Simultaneously the directional solenoid valves Y32a (R.H.-swing) or Y32b (L.H.-swing) are energized.

By the function of the remote control valve (43) pilot pressure oil is sent to one side of the control block (13/IV) when operating the control lever for "Swinging". At the same time by the function of the proportional valve (Y127) pilot pressure (proportional to the lever deflection) is present at port „X“ pressure increasing valve (PIV) of each brake valve block (49.1+ 49.2) thus a internal pressure built up (higher as 150 bar) in the service lines is possible.

continued

8.2.2 Checks and Adjustments, illustration Z22432

Preconditions before starting checks and adjustments:

1. Main pump 3 must be in full flow position (X1-pressure = 35 bar), no action required because stabilized X1 pressure is automatic activated during swinging
2. MRV's and SRV's (pressure increasing valves) correctly adjusted.

Checking the Q-max. and Q-min. stop bolt setting.

Q-max : The average outer length of 25.1 mm must not be altered because the max. possible swivel angle is used.

Q-min : The Qmin. adjustment depends on the max. permissible swing speed (with reduced swivel angle). The average outer length is 36.1 mm



- **It is important that the adjustment is equal on both motors!**

How to check the Q-min. adjustment.

1. Lift the extended attachment to horizontal position.
2. Measure the time for 5 revolutions after swinging one turn as an approach swing.
The time should be $t_{5rev} = 90+5 \text{ sec}$.
3. If a adjustment is required:
Turn off box nut (1) and loosen lock nut (3)
Turn bolt (2) further in for less speed or further out for higher speed.
One turn of the Qmin bolt (2) cause a change of approx. $\Delta t_{5rev} = 4.6 \text{ sec}$.
4. Re-check speed and tighten lock nut and re-fit box nut (1) after setting is finished.

How to check / adjust the start of regulation.

1. Activate manually relay K153 to energize Y48 to pressurized swing motor port X with X2-pressure.
2. Connect a pressure gauge (0-400 bar) to check point M12.2 at high pressure filter of single control block IV.
3. Measure and note **outer length (L) of Qmax stop bolt (2)** (for resetting later on)
Loosen lock nut (3) approx. $\frac{1}{2}$ turn **without turning the stop bolt..**
4. Start engine 1 and let it run in high idle.
5. Apply the swing parking brake.
6. Operate carefully the control lever for swing in one direction and keep it in end position. The resulting operating pressure should be 320 bar.
7. Loosen lock nut of MRV at single control block IV.
8. Decrease / increase alternately the operating pressure between 300 bar and 260 bar at MRV set screw. Check by turning the Qmax stop bolt (2) by hand, if the motor control lens touches the Qmax stop bolt:
The lens must **touch** the stop bolt with a pressure **higher** than 280 bar.
The lens must **not touch** the stop bolt with a pressure **lower** than 280 bar
9. Correct the start of regulation with valve (8) if necessary.
10. Reset MRV. Stop engine and deactivate K153

Cont'd.:

8.2.5 Swing Brake Valves

Anti cavitation prevention. Illustration Z 22672a

- (1) Return oil collector tube
 - (2) Main back pressure valve
 - (3) Gear pump (8.2 + 8.5)..
 - (4) Swing motor back pressure valve blocks (195.1 + 195.2)
 - (5) Swing brake valve blocks (49.1 + 49.2).
 - (6) Swing motor (20.1 + 20.2)
 - (7) Pressure relieve valve (swing motor back pressure)
 - (8) Check valve
 - (9) Pressure check point M35.1 and M35.2
 - (10) Valve drain connection
- A** Input from gear pump
B Output to swing brake block
T Tank connection to return oil collector tube

During the swing down phases the swing motors (6) are working as “pumps”. It means that the pressure side change to a suction side and the suction side change to a pressure side. To prevent cavitation in the swing motors during this change there are two back pressure valves (4) fitted. The valves (4) together with the gear pumps (3) increase the main back pressure up to 15 bar. Port B is direct connected to the tank port (return line) of the swing brake valve block (5).

Adjustments - Measurements -Settings

Setting of the swing circuit back pressure valves (3)

1. Connect pressure gauge (0 – 25 bar) to check points M35.1 and M35.2 at the valve blocks (195.1 +195.2). The valve blocks fitted at the return oil collector tube in front of the hydraulic tank.
2. Start both engines and let them run in high idle.
3. The pressure at the gauges should be 15 bar if the gauges shows a different value the pressure relieve valves in the back pressure valve must be adjusted.
 - a) Loosen lock nut
 - b) Turn in or out set screw to increase or decrease the pressure.
 - c) Tighten lock nut
4. Stop engines
5. Disconnect the gauges.

8.2.9 Checks and adjustments for the swing circuit



- **It is important that the complete MRV-valve and the Pressure Increasing Valve is firmly (with 300 Nm) tightened. Otherwise, the internal sealing sealed not properly which results in: difficulty setting, loud flow noises and abnormal temperatures.**
- **Whenever pressure checks are carried out, they must be carried out for both, r.h. and l.h. swing, to make sure the check valves in the brake valve are in good shape.**
- **Because the Swing motors are working hydraulically in combined operation, the pressure gauge shows the pressure of the pressure increasing valve with the lowest setting. Even when the gauge shows the required pressure it is possible that one valve has a higher setting. Therefore lower the pressure on one valve below the required pressure and then increase up to required pressure. Proceed with next valve in the same manner.**

High pressure check / adjustment

1. Connect the gauge (0-400 bar) to check point M12.2 at the high pressure filter units (153.3) of single control block IV.
2. **Release the pilot pressure by several movements of the lever** with motor / engine stand still. The key switch S1 must be on the ladder and service arm must be in up position. Disconnect carefully the pilot pressure lines from the pressure increasing valves and close the lines with a suitable plug.
3. Loosen lock nut (3) of **both** pressure increasing valves (PIV) and screw in set screw (4) until piston (5) comes to stop.
4. Start engine and let it run with max. speed.
5. Lower attachment to ground and **apply house brake** (swing parking brake).
6. Actuate either l.h. or r.h. rotation until the hydraulic system stalls and increase slowly the MRV-pressure while observing the pressure gauge. Gauge value must remain at 330 -5 bar. Increase MRV setting additional 1/8 turn cw..
7. If the gauge shows a lower or higher value the pressure increasing valves must be adjusted.

continue

8.3.1 Service circuits (Z22521)

(Study together with the valid hydraulic and electric circuit diagram for the machine).

The travel motors (21.1 - 21.4) are driven by the pumps (1; 2; 5; 6).

The oil flows from the pumps through check valves and the filters (46.1 + 46.2) to the control blocks (14 / I + 16 / III).

In neutral position of the spools the oil flows via the return oil lines into the collector tube (35, not shown). From the collector tube (35) flows the oil via the return oil lines (L6 + L7, not shown) into the collector tube (114) and further to the tank. On its way to tank the oil must flow through the back pressure valve (115) or the oil coolers (106.1 – 106.4) and the return oil filter (117.1 - 117.4). (Back pressure valve function see section 4.)

When operating the foot pedal for "Travelling" the pump line of each control block is connected with the corresponding service line (A1 or B1) via the rotary distributor (34) and the valve blocks (175 + 176) to the travel motors (21.1 - 21.4).

The oil flows from the travel motors via the rotary distributor back to the control blocks and further to tank.

Each travel gear includes two spring loaded multi disk brakes (House brakes) (52.1 - 52.4). They are used as parking brakes, automatically applied (by the function of Y16) whenever both motors stopped. The brake release pressure is monitored by the pressure switch (B48).

The leak oil (case drain) flows through the line (L) and the leak oil filter (108) back to tank.

8.3.5 Parking Brake

Illustration Z 22525

The Spring Loaded Multi-disk Brake is used as a safety brake (parking brake); applied by spring force and released by oil pressure.

Legend:

- (1) Disk housing
- (2) Piston
- (3) Back-up ring with radial seal rings (15)
- (4) Back-up ring
- (5) Coupler
- (6) Inner disks (lamellas)
- (7) Outer disks
- (8 + 9) Springs
- (10 - 12) O-ring
- (13) Clip ring
- (14) Clip ring
- (16) Release pressure port
- (17) Quad-Ring with back-up rings (18)
- (19) Quad-Ring with back-up rings (20)
- (21 + 22) Plug screw with seal ring

Function:

Brake applied:

The outer disks (7) engaged to the housing by serration and the inner disks (6) in serration connection with the coupler, are pressed together by the springs (8 + 9). This results in a fixed connection between housing and coupler.

Brake released:

Oil pressure via port (16) reaches the left side of the piston (2) and forces the piston towards the back-up ring (4), as shown.

This function eliminates the spring force onto the disks thus the brake is released.

The releasing pressure is 18 bar, the maximum permissible pressure 60 bar.

This brake named "Wet Brake" because the brake housing is filled with gear oil.

For maintenance see MAINTENANCE MANUAL

For more details see PARTS BOOK

Table of contents section 9.0

Section		Page
9.0	Hydraulic Track Tensioning System	
	General	2
9.1	Functional description	3 + 4
9.2	Pressure Increasing Valve	5
9.3	Tensioning Cylinder	6
9.4	Adjustments / Checks	7 – 9
9.5	Functional test	9

9.3 Tensioning cylinder:

Legend for illustration (Z 21929):

- (1) Cylinder tube
- (2) Piston
- (3) Piston guide ring
- (4) Piston guide strap
- (5) Seal ring
- (6) O-ring
- (7) Scraper
- (8) Retracting device
- (M) Bleeder port
- (P) Oil supply

- **Maximum permissible piston stroke 350mm!**
During bench test an external stroke limitation must be used!

m

10. Access ladder hydraulic operated**General****Legend for Illustration Z22494a**

- (A) Access ladder in lowered position
- (B) Access ladder in upper position
- (C) Stop bar
- (R1) Slow ladder movement in both directions
- (R2) Fast ladder movement in both directions
- (R3) Slow ladder movement only towards final stop (C).
- (Z) Hydraulic cylinder
- (S84) Ladder control switch for lowering
- (S84a) Ladder control switch for raising.
- (S84A) Pull switch for emergency lowering of the ladder.
- (S22) Monitor and control sensor : Cut off of the pilot control system and actuation of the slew brake as soon as the ladder leaves the range R3.
- (S91) Control sensor. This sensor controls the moving speed in range R1.

The access ladder is hydraulic driven by the hydraulic cylinder (Z) via the 60 bar X4 pressure. S84 is the control switch to move the ladder up and down. It is possible to lower the ladder without engine running. For lifting the ladder the engine must run.



If the ladder is out of range R3 the pilot control will cut off to prevent any machine movement . At the same time the hydraulical swing brake will be applied and the text display in the cab will show a message.

10.1 Function of hydraulic operated refilling arm illustration (Z 22496):

Legend:

(A)	Refilling arm
(B)	Control switch (pull switch) S87
(C)	Hydraulic cylinder
(D)	Limit switch S23
(7.1+7.2)	Pilot Pump
(68.1)	Pilot filter with filter monitoring switch B22
(70.1)	Pressure relieve valve (60 bar)
(70.2)	Pressure relieve valve (35 bar)
(162.1+161.22)	Check valves
Y124A	Solenoid valve: refilling arm up
Y124B	Solenoid valve: refilling arm down
Y125	Solenoid valve: security valve "refilling arm locking"
(163)	Hydraulic cylinder

The engine is running

Additional to the hydraulic diagram from illustration Z22496 use the respective electric diagram.









The pumps (7.1) and (7.2) are delivering oil through filter (68.1) to port P of the solenoid valve Y124A/B and the pressure relief valve (70.1) port A. The pressure relief valve (70.1) maintains the adjusted pressure of maximum 60 bar.

If the solenoid valves Y124A together with solenoid valve Y124C is energised pressurised oil flows to the arm cylinder piston side and the refilling arm will move up. If the solenoid valves Y124B together with solenoid valve Y124C is energised pressurised oil flows to the arm cylinder rod side and the refilling arm will move down.

Solenoid valve Y124C act as a security lock to prevent a uncontrolled down moving of the refilling arm. This valve is a special 100% leak oil free valve.

All solenoid valves Y124A/B and C are PLC controlled. Control switch B (S87) is connected to the PLC and act as a remote control. The refilling arm can only moved down or up with activated key contact (key switch S1 in the cabin). Only down moving is possible by gravity with engines stand still.

12.1 Symbols

12.1.4 Valves, valve components		
Symbol	Description	Used as / at / on
25 	Manuel operated unit Lever	Valve in track tensioning system,
26 	Electric / magnetic operated unit Solenoid	Solenoid valve
27 	Pilot pressure controlled unit	Pressure relief valve, disc brake, ...
28 	Spring, with fixed force	Solenoid valves,
29 	Spring adjustable spring force is adjustable	Pressure relieve valves,....
30 	Check valve In drawn pos.: from right to left free flow, from left to right blocked flow.	e.g. main pump outlet, swing brake valve block, anti cavitation valves at main control blocks or distribution manifold
31 	Check valve spring loaded Opened in flow direction only against spring force = pressure	By pass of the return oil filter, by pass of secondary filter
32 	Double check valve, in drawn pos.: opened only from the left to the bottom or from the right to bottom	Swing brake control,

13.1 Designation of electrical devices

Indicating letter	Kind of component
A	System, subassembly, parts group, trigger boxes, control units
B	Transducer for conversion of non-electrical variables to electrical variables, and vice versa. Speed sensors, pressure sensors, pressure switches, oil-pressure switches, temperature sensors
C	Condenser, capacitor, Condensers and capacitors, general
D	Elements with time lag, memory elements, binary elements
E	Various devices and equipment
F	Protection device Fuses, current protection circuits
G	Power supply, generator Batteries, generators, alternators
H	Monitor, alarm, signaling device Indicator lights, signal lights, headlights, warning buzzers, horn
K	Relay, contactors
L	Inductor Coils, windings
M	Motor
N	Regulators, amplifiers
P	Measuring instrument
Q	High voltage switching units
R	Resistors, heating devices
S	Switches, selectors
T	Transformer
U	Modulator, converter from one electrical in an other electrical value
V	Semiconductor, electron tubes, diodes, rectifiers, zener diodes
W	Transmission path, conductor, antenna
X	Terminal, Plug, Plug and socket connection
Y	Electrically actuated mechanical device Solenoid-operated valves
Z	Compensating units, filters, limiters cable connection

13.4 Reading a Circuit Diagram.

Legend for illustration (Z 21825):



- **Examples are shown by sectional drawings out of the electric circuit diagram 897 844 40 page 08.**

(1) Section F8 / sheet 08

The hint F11/06.1 indicates that the wire from F11 is continued on sheet 06 column 1.

(2) Section C4 / sheet 08

Shown is the relay coil K51-1 only and not its contacts.

The contacts are shown somewhere else in the diagram.

Switching and contact positions are shown below at the foot of that particular circuit in row C-C as shown below.

Example for K51-1:

08.5		opens on sheet 8 section 5 when relay is energized
:		Not used
:		Not used
:		Not used

When diodes are fitted to a relay, they are fitted to allow a current flow in one direction only. An LED* (Light Emitting Diode) indicates a current flow if it lights up.

When diodes ** are fitted anti-parallel to a relay coil, they absorb the high induced voltage caused by making and breaking the current flow through the coil.

This occurs each time we operate a switch supplying current to the coil. The diode effect allows the induced current to circulate within the coil windings and decay when the energy to the coil is cut.

- * LED between A1 and coil
- ** Diode between A1 and A2.

(3) Section F7 / sheet 08

Connectors and Terminals are identified by a letter and number code. X2 o 23-28 = Terminal box X2 Terminals 23 to 28 are linked with a metal bridge.

continued

14.1.3 PLC *DIGSY* plus® (circuit diagram code E6)

Legend for illustration Z 21409b

1. Central Processing Unit (CPU) board.
2. Binary Module (BIM) board.
3. Analogues Module (ANM) board.
4. MK Output short circuit marker LED red
5. Input state-LED green, Inputs E1.1 - E1.8 up to E14.1-E14.8
6. Input or Output State-LED red (A2/ E9, Af/E10, A6/E11, A8/E12, A14/E21) Can be used as Inputs or Outputs
7. Output state-LED red, Output A1.1 - A1.8 up to A13.1-E13.8
8. Diagnostic-LED (DIAG), (green flashing = OK.)
5Volt Voltage-LED (+5V), (green = OK.)
9. Diagnostic LED for ANM
10. COM SP Interface (COM SP) (Text display connection)
11. COM SK Interface (COM SK) (PC-Connection)
12. Binary Module BIM-plug-in location (slots) (X1-X5)
13. Analogous Module ANM-plug-in location (slots) (X6-X8)
14. Ground Connection (GND)



- **The quantity and configuration of the BIM and ANM Module can be vary, depend on the excavator typ and additional options.**

MK-LED, The short circuit marker are used to indicate an external short to GND

- MK1, MK3, MK5, MK7 & MK9- LED for outputs A1.1 - A1.8
A3.1 - A3.8, A5.1 - A5.8, A7.1 - A7.8 & A13.1 – A13.8
- MK2, MK4 , MK6, MK8 and MK10 if there groups as outputs used
- A MK-marker is placed, if an output (e.g. A1.1) gets from the program an output signal and at the same output happens an external short. The red MK 1-LED lights ON



- **If there is a short all outputs of the resp. Output group i.e.. A1.1 - A1.8) are switched Off**
- **The short circuit marker remains until the control system gets switched Off/ON (after eliminating the short).**

State-LED Input lights up with a present 24 Volt signal.

State-LED Output lights up with a switched On output.

5V-LED, indicate specified operation states by different colors and duration of lightning (Continuos On or flashing). For detail information see Section 4.

DIAG-LED, indicate specified operation states by different colors and duration of lightning (Continuos On or flashing). For detail information see Section 4.

14.2 How to Proceed due Maintenance and Installation

Cont'd.:



- Serious damage may happen at irrelevant opening and improper repair.
Open always the **resp. circuit breaker** before opening a unit.
I/O – cables may only be connect or disconnect in a powerless state.

A BIM module will be damaged while supplying an external power of 24V_{DC} to the inputs and/ or outputs. If it is necessary for faultfinding or external unit checks the connection to the PLC has to be interrupted.

- Without power interruption the interface cable are only allowed to be disconnect or connect when following preconditions are given:
 1. The cable must be shielded and the shield must be connected to the cover of the plug-in connector.
 2. A potential balance must be made by connecting the GND potential parts of the plug connector parts before connecting the cables.
- Replace the fuses only by fuses which matches the values given in the technical dates



- Do not through batteries into open flame and do not solder at their cell body, explosion can occur (max. Temperature 100° C). Do not open and do not recharge batteries that contain lithium or mercury. Replace them by same type only!
- Dispose batteries and accumulators as special waste.

14.3 Front Connector Arrangement

14.3.1 Front Connector Arrangement, BIM Module (Digital Input / Output)



- This is an example for the first Slot. Additional BIM Modules can vary depend on configuration of the variable input/output port A2/E9/ A4E10, A6/E11, A8/E12 or A14/E21.
- The configuration for the respective excavator is written in the EA-Configuration chart (EA-Belegungsliste) see Appendix.

Pin	Symbol	Operand	Definition
1	Input 1.1	E 1.1	Input 1 of the input group. 1
2	Input 1.2	E 1.2	Input 2 of the input group. 1
3	Input 1.3	E 1.3	Input 3 of the input group 1
4	Input 1.4	E 1.4	Input 4 of the input group 1
5	Input 1.5	E 1.5	Input 5 of the input group 1
6	Input 1.6	E 1.6	Input 6 of the input group 1
7	Input 1.7	E 1.7	Input 7 of the input group 1
8	Input 1.8	E 1.8	Input 8 of the input group 1
9	Input 9.1	E 9.1	Input 1 of the output group 2
10	Input 9.2	E 9.2	Input 2 of the output group 2
11	Input 9.3	E 9.3	Input 3 of the output group 2
12	Input 9.4	E 9.4	Input 4 of the output group 2
13	Input 9.5	E 9.5	Input 5 of the output group 2
14	Input 9.6	E 9.6	Input 6 of the output group 2
15	Input 9.7	E 9.7	Input 7 of the output group 2
16	Input 9.8	E 9.8	Input 8 of the output group 2
17	0 V (GND)		Ground
18	Input 2.2	E2.2	Input 2 of the input group 2
19	Input 2.4	E2.4	Input 4 of the input group 2
20	Input 2.6	E2.6	Input 6 of the input group 2
21	Input 2.8	E2.8	Input 8 of the input group 2

continued

14.3 Front Connector Arrangement

14.3.4 Interface-connection COM SK / SP

Legend for illustration Z 21425a (Exemplary picture about what possible)

- (1) Text display
- (2) PLC
- (3) Plug socket "X27"
- (4) Laptop computer
- (5) Memory card system
- (6) Portable printer
- (7) Field dispatch system

Cables:

- VL3 X27 to Laptop
- VL4 X27 to Memory Card System
- VL5 24V Power supply to Memory Card System
- VL6 X27 to Portable Printer
- VL7 24V Power supply to Portable Printer
- VL8 X27 to Field Computer System

Communication interface:

COM-SK => Programming interface (Baud rate 19200)

COM-SP => Communication with text display (Baud rate 9600)



- **Data cables and/or communication systems are optional equipment.**
- **For more detailed information see OPERATION MANUAL of the shovel and the Software Program for the individual Communication System**

14.5 Function explanations with electrical diagram**14.5.2 Pressure Measuring (Hydraulic System), Illustration Z 22805**
(study with the respective circuit diagram)
(Program run see Flowchart)**Analogous Inputs:**

„EW 14.1“ for pressure sensor B87A (0 up to 500 bar)

Measuring channel: 0.....10 V

Function:

- Voltage supply for the pressure sensor: 24 V
 - Output voltages **U_a** (OUT+, pin 2) of the pressure sensors:
 - Sensor **0 – 0,4 bar** K= 25 V / bar
 - Sensor **0 – 60 bar** K= 0,1667 V / bar
 - Sensor **0 – 500 bar** K= 0,02 V / bar
- (Pressure sensors with +1 V Offset)

Possible voltage checks:

24 V Supply between supply line 15 (start at circuit breaker) and GND.

Output voltage OUT (pin 2) of the sensor

between GND. Use respective circuit diagram for terminal numbers.

* How to calculate the Output voltage **U_a**:

U_a = output voltage proportional to the pressure input.

P = input pressure

K = calculation factor for the respective pressure sensor.

$$\mathbf{U_a = (P \times K) + 1 V}$$

Example for 200 bar and a 0 – 500 bar sensor:

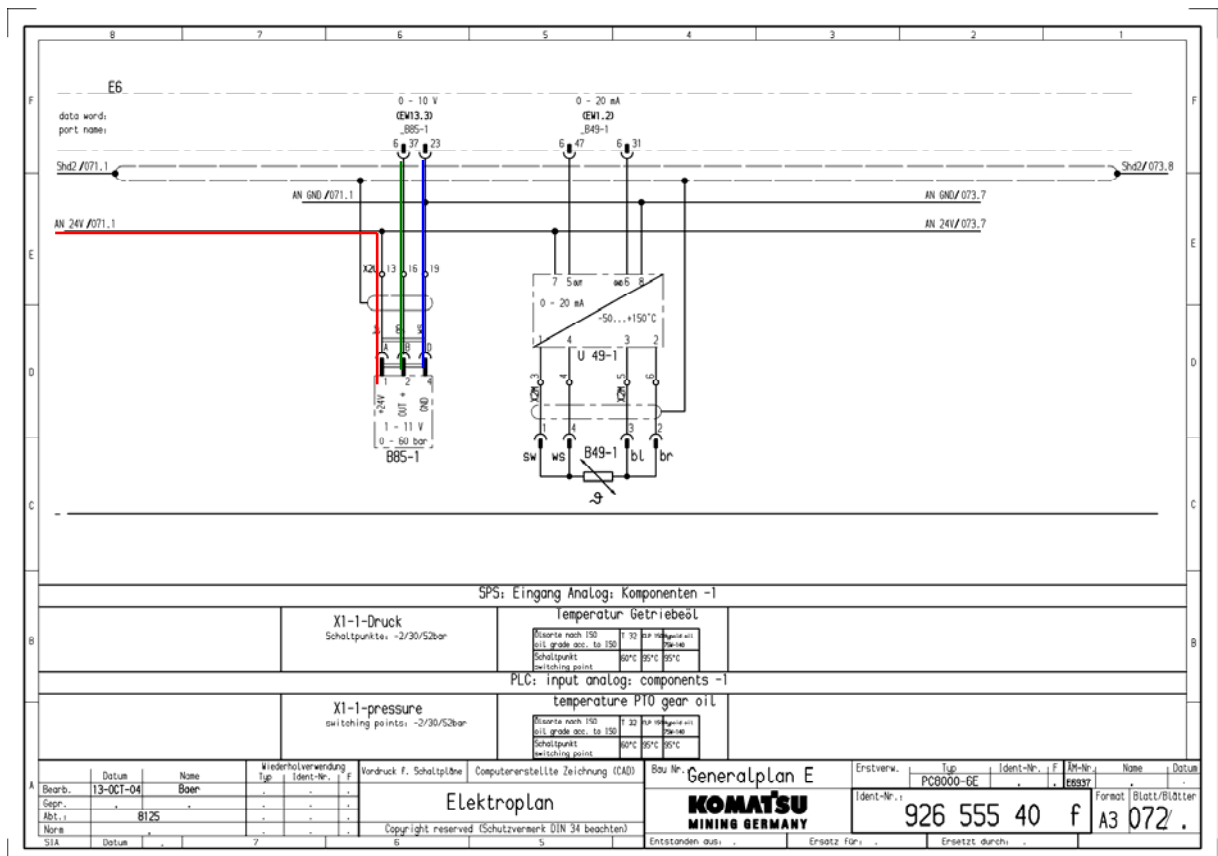
$$U_a = (200 \times 0,02) + 1 V = 5 V$$

14.6 Hints for reading the functional flow charts

14.6.2 Example: Monitoring the X1-pressure for pump control, illustration Z25072

Grey shaded fields in the table below shows the normal way , used from the program, if the excavator is in “standard condition”.

Item	query	Yes	No
1)	Sensor or cable defect?	B85-X : 5 sec. < --6bar i.e. <1V at EW13.3 or B85-X : 5 sec. > +55,3bar i.e. > 11V at EW13.3 ↓ Fault message No 1190	B85-X : 5 sec. : Voltage between 1V and 11V at EW13.3
2)	_running_motor-x > 15 sec ?	Motor X is running for more than 15 seconds	Motor X is not running
3)	X1-pressure to high?	B85-X : 2 sec. > 40bar i.e. > 6,5V at EW13.3 ↓ Fault message No 962	B85-X : 5 sec. : Voltage below 6,5V at EW13.3



Oscillation Cylinder and Control Block, illustration Z 21174**Description:**

Oscillation cylinder (6) is auto directional controlled, non pressure related. This differential cylinder is connected to the pilot pressure supply line (P) and a tank line (T). The speed is controlled by a flow control valve (3) and the maximum working pressure is controlled by a pressure reducing valve (2).

Function:

The Oscillation cylinder (6) starts as soon pilot pressure is sent via the connection (P) to the control block (1). Design related the cylinder (6) retract always first after start or from any position the piston has stopped before. When the cylinder reaches the fully retracted position the flow will be redirected automatically and the cylinder moves in the extending position. If the cylinder comes to a stop in between the end positions whether the oil supply get stopped or the cylinder is hold back by a higher work resistance than the supply pressure, the cylinder changes direction and retracts.

Cont'd:

Illustr. Z 21177a

The next lubrication cycle starts after the decreasing time and pause time has expired.

With the switch S24 an additional lubrication can be carried out any time provided the end of line pressure switch (B43) contact is closed.

Monitoring:

The orderly built-up of the pressure in the lubricant supply line is monitored by the end-of-line switch (B43 or B46).

If the pressure adjusted at the end-of-line switch is not reached within the adjusted maximal increasing time the PLC switch off both solenoid (Y7 and Y7A or Y9 and Y9A) valves and send the fault message "Central lubrication system fault" or "Swing ring lubrication system fault" to the text display at the dash board.

If the excavator is still working additional four hours with faulty lubrication system the PLC stop the bucket function. This function is to prevent trouble depend on a lack of lubricant.

Continued

Cont'd.

Illustr. Z 21183a

The actual operating pressure can be monitored at the pressure gauge (14) and checked at the pressure check point (17). When all injector pistons have reached their final position no more lubricant will be accepted from the supply line (8) which causes a pressure increase in the supply line.

Depend on different factory settings vent valve (7) de-energize together with solenoid valve (2) or after a fixed adjusted time of max. 5 minutes.

With **de-energized** solenoid valve (7) the port to vent line (15) (return line to the lubricant container) opens and releases the lubricant and lubricant pressure into the container.

With the diminishing pressure in the main line the pistons of the injector (18) are forced by spring force into their initial position and the discharge chambers fill up with grease for the following lubrication cycle.

The system is prepared for the next lubrication cycle. The operation is reinitiated after the next "**Pause Time**".

The proper build-up of the pressure in the supply line (8) is monitored by the end-of-line switch (16).

If the pressure adjusted at the end-of-line switch is not reached within the adjusted "**Monitoring Time**" the fault message "Slew ring gear lubrication system fault" is shown on the text display and the pump switches off.



• **Grease qualities to be used:**

According to NLGI classes 000, 00, 0 and 1 according to the lowest ambient temperature in the operation area



- 1. The content of molybdenum must not exceed 5 %.**
- 2. Only synthetic graphite must be contained in graphic lubricants**

Cont'd:

Injectors, illustr. 21181:

Series SL-1 injector:

Lubricant output adjustable from 0.13 up to 1.3 cm³ per cycle. Hydraulic type fitting with screw type cover cap is provided for initial filling of feeder line, and may also be used for visual check of injector operation.

Series SL-1 injectors incorporate a stainless steel visual indicator.

Series SL-11 injector:

Lubricant output adjustable from 0.82 up to 8.2 cm³ per cycle.

Designed for systems where a high amount of lubricant is required.

Principle of operation similar to series SL-1.

Adjusting the lubricant output:

1. Loosen lock nut (C).
2. Turn adjusting screw (A) counterclockwise (OUT) for more lubricant output or clockwise (IN) for less lubricant output.
3. Tighten lock nut (C).



- **The max. lubricant output is adjusted if the indicator stem (B) moves not more further outwards**

Cont'd:

Connection of one or more injectors, illustr. Z 21189

The injectors are designed so that the lubricant out- put of two or more injectors can be combined without the use of tees.

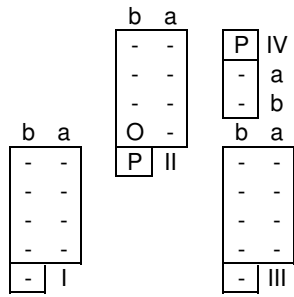
The injector body (1) has two outlets ports (a + b), one above the other.

The connector tube (2) is used to couple the injectors together.

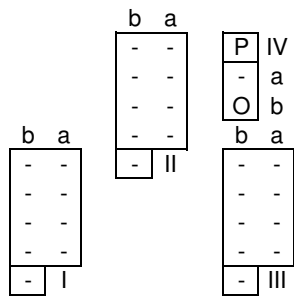
Lubricant from injector No. 1 is directed through the connector tube into the discharge chamber of injector No. 2 but simply combines with the lubricant delivery of injector No. 2 to yield double output from the out- let of injector No. 2.

This does not interfere with the operation of injector No. 2.

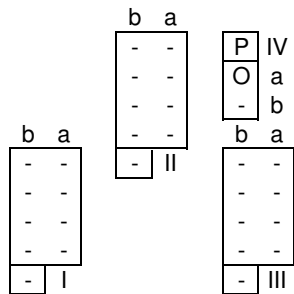
13 Clam close



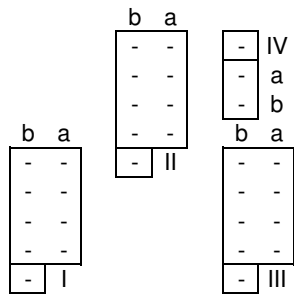
14 Swing right



15 Swing left



16 Check Automatic Priority (title)



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