SERVICE MANUAL

KOMATSU
MINING GERMANY

PC 3000-1E

MACHINE MODEL

PC3000-1 Electro

SERIAL NUMBER

06220

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.

FOREWORD

GENERAL

With this **SERVICE MANUAL** KOMATSU provides you with the description of the construction and the function of the major systems of the Hydraulic Excavator **PC3000-1-E**.

We describe for you all functions and how to carry out the inspections and adjustments.

How do you find "your" desired information?

In the table of CONTENT all the functions and components are shown in their sequence of the description.

If after reading this **SERVICE MANUAL** you can give us suggestions and comments for improvements - please do not hesitate to contact us.

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The editorial staff will be pleased about your co-operation.

- FROM THE PRACTICE - FOR THE PRACTICE -

- **This service manual corresponds to the state of development of the machine at the time the manual was produced.**
  Variations based on special customers request and special equipment are not included in this manual

Millimeters to Inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

TEMPERATURE

Fahrenheit – Centigrade Conversion; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vise versa is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

1°C = 33.8°F

°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-7.2	19	66.2	12.2	54	129.2	31.7	89	192.2
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

- **Before assembling/disassembling, lifting or transporting this excavator contact your local Service Center for all the necessary instructions for safe and economic assembling/ disassembling, lifting and transportation procedures of your excavator.**
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The sequence of assembly as shown in this Manual. Disassembling is basically the reverse order of the assembling procedure.

1.3 Transportation and Lifting

The transport dimensions and weights of the excavator's components are listed in this manual are for general information only. For the correct dimensions and weights please refer to the packing list of your machine.
Observe the operating permits of the low-bed trailers used for transportation. They contain the permissible load, loading width and height.

- **Observe the federal, state and local laws and regulations for transportation of heavy units. Know the safety rules and laws before you transport this Excavator.**
- **Make sure the flat-bed trailer and the components of the Excavator are equipped with the correct safety devices.**
- **Secure the Excavator and all components transported on the trailer against movement.**
- **Use exclusively approved handling equipment**
- **When lifting components make sure that the handling elements do not cause damage to the component**
- **Secure the components safely before removing the lifting straps, ropes or chains.**

1.10 Transport Dimensions and Weights

(For the exact Dimensions and Weights refer to the packing list of your machine)

Face Shovel			Backhoe		
L.H. and R.H. Crawler side frame			**L.H. and R.H. Crawler side frame**		
Track width	800 mm		Track width	800 mm	
Dimensions (mm)	7860 x 1640 x 2160		Dimensions (mm)	7860 x 1640 x 2160	
Weight	31.900 kg /		Weight	31.900 kg /	
Carbody centre			**Carbody centre**		
Dimensions (mm)	3520 x 3940 x 2180		Dimensions (mm)	3520 x 3940 x 2180	
Weight	16.600 kg /		Weight	16.600 kg /	
			Superstructure with engine		
			Dimensions (mm)	7950 x 5400 x 3700	
			Weight	61.450 kg /	
Counterweight			**Counterweight**		
Dimensions (mm)	5050 x 2860 x 800		Dimensions (mm)	5050 x 2860 x 800	
Weight	24.000 kg /		Weight	24.000 kg /	
Fuel tank			**Fuel tank**		
Dimensions (mm)	2250 x 1650 x 2800		Dimensions (mm)	2250 x 1650 x 2800	
Weight	2.250 kg /		Weight	2.250 kg /	
Cab base			**Cab base**		
Dimensions (mm)	2140 x 1950 x 2650		Dimensions (mm)	2140 x 1950 x 2650	
Weight	3.100 kg /		Weight	3.100 kg /	
Cab guard			**Cab guard**		
Dimensions (mm)	2810 x 1920 x 2450		Dimensions (mm)	2810 x 1920 x 2450	
Weight	1.350 kg /		Weight	1.350 kg /	
Boom with 4 cylinders			**Boom 8.15 m w/o cylinders**		
Dimensions (mm)	6450 x 2100 x 2800		Dimensions (mm)	8700 x 2600 x 4000	
Weight	26.450 kg /		Weight	25.350 kg /	
Stick			**Stick 4.25 m compl.**		
Dimensions (mm)	4740 x 1950 x 1700		Dimensions (mm)	5900 x 1700 x 2300	
Weight	10.500 kg /		Weight	13.800 kg /	
14 m³ shovel bullclam bucket			**14.0 m³ backhoe bucket**		
Dimensions (mm)	3870 x 3500 x 3600		Dimensions (mm)	3500 x 3100 x 2900	
Weight	24.400 kg /		Weight	13.600 kg /	
3 cases with accessories			**4 cases accessories**		
Dimensions (mm)	Weight (kg)	Weight (lb)	Dimensions (mm)	Weight (kg)	Weight (lb)
2790 x 2050 x 3200	1.840		2790 x 2040 x 3160	1.950	
5800 x 2400 x 1800	2.850		5770 x 2390 x 1760	3.400	
4700 x 1100 x 1180	6.200		4690 x 1090 x 1060	6.200	
			4180 x 950 x 970	4.550	

2.1 Assembly of Undercarriage: Z 9030

Align side frame horizontally in both directions very exactly.
From outside place water level gauge onto steel structure of side frame.

1. Pull back all 8 pins (05) out of the outer borings (2+3) of the center section.
2. Attach carbody to the crane (oil supply lines to the travel motors pointing in direction of the travel motors).
3. Align carbody with the side frame; lower borings (3) first and insert pins (05).
4. Align upper borings (2) and insert pins (05).
5. Support carbody with wooden blocks (4) in a way that the free side is approx. 100 mm higher than the attached side. (This makes it easier to attach the 2nd side frame).
6. Lift the 2nd side frame with the crane and align with the carbody. Lower borings first and insert pins.
7. Align upper borings and insert pins.
8. Lift the undercarriage so far that it is possible to remove the wooden blocks.
9. Secure all pins with the retainer plates (06, 07, 09).
10. Connect hose pipes between the oil supply lines of the carbody to the travel motors.
11. Open the cocks inside the side frames for the hydraulic crawler tensioning system.
    Refer to the Maintenance Manual.
12. Fill up and/or check the gear oil levels (travel gear, brake, final drive).

2.5 Mounting of Hydraulic access Ladder

Mount hinged ladder(01);
Connect ladder lifting cylinder (03);
Assemble ladder bearing (17);
Tighten the self locking nuts (06) according to the values listed below.

Tightening Torque of Self Locking Nuts (06):

- New nut: 440 Nm
- Used nut: 350 Nm

Clamping Torque of Self Locking Nuts (06):

- New nut: 106 Nm
- Used nut: 12 Nm minimum

Check clamping torque of nuts (06). If clamping torque is less than the minimum value, use new nut.
Lubricate both eyes of hydraulic cylinder (03). Make sure both pivot pins (12 and 13) are properly secured with cotter pins (15).

Continue assembly after the initial start up has been carried out. For this refer to the page „Pre-checks for initial start up" at the end of this booklet.

2.10 Mounting of Stick

1. Lift the stick with the bucket cylinders attached.
2. Lift the stick to the bearing position stick to boom.
3. Lower the stick until stick and boom borings are aligned.

Backhoe attachment

Legend for illustration Z2289

A Location of Pins with a fine thread end
1. Pin
2. Cap for mounting
3. Final cap
4. Nut for mounting the final cap
5. Nut for mounting whirl
6. Safety bolt
7. Hole for the cotter pin
8. Cotter pin

Installing of this kind of pins:
1. Secure the thread with the mounting cap.
2. Install the pin.
3. Remove the mounting cap.
4. Install a whirl (M20) in the nut (5).
5. Lift the Final cap (3) with a crane, tilt it and turn it on the pin(1) by using the nut (4) (M30).
6. Secure the cap as shown with the bolt (6).
7. Secure the bolt (6) with the cotter pin (8).

Install hoses at boom/stick connections.

- **There is only one mounting cap for all pins.**
- **Be careful when opening the hoses!**
  There may be still some pressure in the system.

2.15 Mounting of Stick Cylinders to the Stick: Z 20952

1. Hook up stick cylinders to chain pull and remove transport fastening.
2. Lower stick cylinder by means of chain pull and extend cylinder rod. Align with bearing at stick.
3. Install pin (1), plat (2) and washer (3) with bolt (4).

2.20 Putting the Central Lubrication System into operation.

In order to ensure adequate pre-lubrication of all attachment bearings.
It is necessary to manually lubricate the attachment bearings by applying a grease gun to the grease fittings on each grease injector.

To this, remove protection cap (3) illustration Z 19721 and press in grease until a grease collar appears at the connected bearing.
Be sure to repeat the procedure until all pivot bearings of the attachment and cylinder bearings are lubricated.

Control Blocks, Slew Gear

Legend: Fig. 3

(1) Main control blocks
(2) High-pressure filter
(3) Rotary joint
(4) Travel motors
(5) Attachment cylinders
(6) Slew motor
(7) Distributor manifold

Drive Coupling

Task:

The coupling is the connecting link in between the drive motor and the PTO-Pump Distributor Gear and dampens torsional vibrations and axial movements

Legend: **Fig. 8**

(1) Drive
(2) PTO Connecting flange
(3) Rubber element
(4) Motor flange mounting bolts
(5) Rubber element fastening bolts
(6) PTO connecting flange bolts
(7) Fastening bolts

Function:

The combination of the high elasticity of its rubber element viscous damping ensures that the coupling removes major critical speeds outside the normal motor speed range and dampens minor torsional vibrations effectively.
By this the widest motor speed range free of vibration periods and dangerous resonance's is obtained.
Furthermore, employment of these couplings with their very dampening characteristics generally results in lower stresses in all motor driven shafts and gears.

- **For further information see Service bulletin 21- 574**

Location of the pumps, drive speed and flow rate

Legend:		**Fig. 13**
(1 - 3)	Swash Plate Axial piston pump theoretical flow rate, each for all working motions	 890 Liter/min. n *= 890 RPM
(4)	Man. variable axial piston pump theoretical flow rate for cooler fan drive	 112 - 150 Liter/min. n *= 1961 RPM
(5a)	Gear pump, theoretical flow rate for pump bearing lubrication	 105 Liter/min. n* = 1500 RPM
(5b)	Gear pump, theoretical flow rate for pilot pressure, pump regulation	 64 Liter/min. n* = 1500 RPM
(6)	Gear pump, theoretical flow rate for PTO gear lubrication	 82 Liter/min. n* = 1961 RPM
(7)	Gear pump, theoretical flow rate Circulating pumps for cooling circuit	(optional) 212 Liter/ min. n*.= 1961 RPM
(8)	Variable displacement axial piston pump, (optional) theoretical flow rate Generator drive circuit	 135 Liter/ min. n*.= 1961 RPM

*** n (Input Drive Speed)= 1500 RPM.**

Location of pressure switches and sensors

Legend: Z 22192

(B4) Hydraulic oil level switch

(B15) Temp. sensor max. hydraulic oil temperature

(B24) Vacuum switch (switch point: 0.05 bar low pressure), hydraulic tank breather filter

(B25) Pressure switch (switch point: 1.0 bar) Leak oil filter camber

(B26) Pressure switch (switch point: 3.0 bar) Return oil filter camber

(S31) Position switch on hydraulic oil gate valve

(B32) Temp. sensor for analogue temperature gauge in the drivers cab

(B40) Temp. sensor for hydraulic oil cooler fan regulation

(B42) Hydraulic oil max. filling level switch

(B46) Final pressure switch for slew ring lubrication system

(B49) Temp. sensor for max. PTO gear oil temperature

(B75) Temp. sensor for min. hydraulic oil temperature

Checks to be Performed

Z 22195

If Hydraulic Temperature is too High *

* I.e., Hydraulic oil temperatures above the relevant normal operating temperatures

Precondition for these checks:

- Confirm the proper hydraulic oil is used (type/grade).
- Proper fan drive and cooling system.
- No defect in the operating hydraulic system.
- No abnormal ambient temperatures.

If the above conditions have been met and the hydraulic oil temperature rises excessively nevertheless, the following checks must be performed:

1. Adjust a pressure which is 40 % of the peak point **.
2. Carry out hydraulic stall with above pressure (e.g. Boom and stick to limit stop) until hydraulic oil temperature reaches a steady temperature **"T1"** (a temperature which doesn't increase anymore). This temperature can be seen at the dash board gauge.
3. Measure the ambient temperature **"T2"** in the air stream to the cooler.
4. Determine differential temperature " **Δ T**" as follows:
   I.e: : T1 = 62° C and T2 = 25° C
   62° C minus 25° C= **Δ T** = 37° C (Difference temperature).
5. **Determination of the permissible ambient temperature**:
   Max. permissible temperature for the filled in hydraulic oil , refer to table (e.g. 85° C for VG 100) minus the calculated difference temperature**Δ T**.

T2 permissible = 85° C - 37° C = **48° C**

** Pressure at start of de-stroking. e.g.: 40 % = 80 bar at 200 bar.

Cont'd.

Z 21852a

9. Tighten the lock nuts.
10. Loosen lock nut (2) of the valve and **decrease** the pressure with the set screw (3) until the correct fan speed is obtained.
11. Tighten lock nut (2) and fix protection cap (3).
12. Install plug Y6 to the solenoid valve and secure with its bolt.

II. Later on speed checks only

1. Unplug solenoid Y6, it ensures max. fan speed.
2. Connect pressure gauge to check point (M6).
3. Start diesel engine and run at high idle.
4. Check fan speed with phototach

△ **Be careful not to get caught in the fan or other rotating parts!**

The fan speed must be: **1300** rpm* with **AKG** cooler and Cummins C1500 engine
1100 rpm* with **MESABI** cooler

5. If the fan speed is not correct try to increase the speed by increasing the relief valve setting first*. If not possible the pump swivel angle must be increased as well.
   See procedure in section I.
6. Re-install plug to the solenoid valve and secure with its bolt.

* The value of the RPM and the max. pressure adjusted at the relief valve:
  Refer to at you Hydraulic circuit diagram!

Checks and Adjustment of Pilot Pressure

Z 22201a

50 bar pressure, valve (99.1):

1. Connect pressure gauge to check point (M5.1)
2. Start drive engine and run in high idle.
3. Read pressure, required = 50 bar
   If re-adjustment is required *:

*** Valve adjustment:**

a Remove dust cap (1).
b. Loosen lock nut (2).
c. Set pressure with set screw (3).
d. Tighten lock nut (2) and re-fit dust cap (1).

35 bar pressure, valve (99.2):

1. Connect pressure gauge to check point (M5.2)
2. Start drive engine and run in high idle.
3. Read pressure, required = 35^{+3} bar
   If re-adjustment is required *:

*** Valve adjustment:**

a .Remove dust cap (1).
b. Loosen lock nut (2).
c. Set pressure with set screw (3).
d. Tighten lock nut (2) and re-fit dust cap (1).

Refer to next page for accumulator function check

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Restrictor Block with Pressure Relief Valve

- **A restrictor block is used for limiting cylinder lowering speeds.**

Legend: Z 22210
(Type 63.1 - 63.9 of the hydraulic circuit diagram)

(1)	Adjustment spindle
(2 + 3)	O-ring with back-up ring
(4)	Retainer
(5 + 6)	O-ring with back-up ring
(7)	Spring
(8)	Spring cup
(9)	Throttle sleeve
(10)	O-ring
(11	Housing
(12)	Return line port, T
(13)	Pressure relief valve
(14)	Bolt
(15)	Clip ring
(16)	Lock nut
A + B	Line ports
M	Pressure check point
Y	Control oil drain port

Function:
Pre-setting of the cylinder speed (flow B to A) is achieved by means of the spindle (1). Depending on the spindle setting, the radial holes (9.1) in the valve poppet (9) will be partially opened to produce the required throttling of the oil flow.
The extra holes (fixed throttle 9.2) prevents the valve from becoming completely blocked.
For the lifting operation (flow A to B), the valve poppet (9), which is guided by the spindle (1), is pressed against the spring (7) to allow the valve to fully open.

Control Blocks

Legend: Z 22215

(It is a principle drawing only, in detail it may vary with the built in control block and Fig. 43 shows L.H. valve block I)

(1) Control block housing
(2) Primary pressure relief valve (MRV)
(3) Boom lifting / lowering, Spool (special)
(4) Long cap ("B" side)
(5) "B" side service line ports
(6) Centering springs
(7) Solid spool (50 mm dia.)
(8) Short cap ("A" side)
(9) "A" side service line ports
(10) Load check valves
(11) Quick warm up flushing grooves
(12) Fine controlling grooves
(13) Type plate

It is a control block with "**Open Center and Closed Ports**".
Refer to hydraulic circuit diagram for spool details. The spool travel is 17.5 mm
Each spool is provided with "Fine Controlling Grooves", ring grooves for hydraulically centering of the spool and "Quick warm up" flushing grooves.
The spool (3) is special designed which allows while the function "Boom lowering" is selected that the pressure canal is still connected to the center pressure canal and is available for other functions, the rest of the spools are like the spool (7).
The **Load Holding Valves** are installed beneath a plug from the service port side of the control block.
The **MRV** is a pilot operated pressure relief valve.
The R.H. valve block II is from the same design and all spools are like (7).

Travel Brake Valve

Z 22220

A travel brake valve is provided in the two circuits of the travel motors.

These travel brake valves are controlled by the system pressure. Consequently the vehicle is braked automatically. However, this only applies for a certain incline. Exceeding this, braking must be accomplished by returning the travel control lever to the neutral position.

- **The vehicle is accelerated by the total weight of the machine on a considerable inclined route. This results in interruption of the fed flow and dropping of pump pressure.**
  Discharge bores of the control valve are closed by spring force.
  Dynamic pressure is developed acting on the travel motor and braking the vehicle.
  The passage is kept hydraulically open via port A and B during normal travel.

Function:

On its way to the travel motor the hydraulic oil flows through the travel block from A to A1 or from B to B1, respectively. The pressure moves the valve piston No. 6 against spring force of spring 11 and opens flow of the return oil.

If the pressure of the returning oil drops to such an extend that the spring power prevails, the flow is reduced which, on the other hand, results is braking the vehicle.

Auxiliary Gear Pumps

(Auxiliary gear pumps are used for the pilot pressure circuit, pump bearing lubrication and the PTO gear box lubrication).
Either as single pumps or double pumps

Legend: Z 22224

(1) Drive shaft
(2) Housing parts
(3) Dowel pins
(4) Needle bearings
(5) Gear on the drive shaft (shaft and gear is one solid part)
(6) Seal plates with seals
(7) O-ring
(8) 2nd. gear
(9) Radial seal rings

Cont'd.

Fig. 63

Description of the SL-bearing

SL = Super long life respectively slipper bearing

- **Pumps with slipper bearing are used in cases when longer operation times at high pressures are required or when higher life expectancy values are generally necessary compared with the standard design.**

Design:

(1) Slipper pads
(2) Piston
(3) Thrust washer
(4) Tapered roller bearing
(5) Spring
(6) Roller bearing
(U) Flushing port "U"

Function:

The main part of the axial forces is supported by the slipper pads (1) which are installed on the driving circular side of the drive shaft.
Each piston is allocated to one slipper pad.

These slipper pads are located with the pressure in the cylinder chamber by the piston borings (2). The slipper pads support themselves on the thrust washer (3) and discharge axially the tapered roller bearing (4).
Under no pressure the slipper pads are kept on the thrust washer by means of a spring (5).

Cont'd.

Fig. 68

Pressure check / Adjustment

1. Connect pressure gauge to check point (M1).
2. Start motor.
3. Read pressure: required 6 $\pm$2 bar.**
   Altering the pressure can be done by shims only.

Legend:

(1) Stroke limiter*
(2) Shim
(3) Spring
(4) Cap screw

* **Never use the valve without the stroke limiter.**

** **With thin oil like VG22, pressure check and adjusting must be done as follows:**

- **Disconnect the line to the pump bearings and plug the line and the port.**
- **Check the pressure and adjust if necessary.**
- **Re-connect the line.**

Adjusting the Damper bolt.

Fig. 73

1. Check if the X2-pressure (pilot pressure) is 35 bar.
   Adjust if necessary (see corresponding Section)
2. Loosen lock nut (1) and release the tension of spring (4) by turning out the damper bolt (2) as much as required.
3. Start drive motor.
4. Adjust X1-pressure to 10 bar. (see corresponding Section).
   This will cause the pump moving to 1/2 of its max. angle, assumed the start of de-stroking is correct adjusted.*
5. Turn in the damper bolt (2) till the flow respective the angle wants to start altering** then tighten lock nut (1).
   In this position the damper spring (4) operates in the range of the control edges of the pilot spool.

* The **average** of the outer length of the bolts are for:

the damper bolt	16,5 mm
the start of de-stroking adjustment bolt	20,5 mm.

** A test bolt (M) similar as for the adjusting of the start of de-stroking can be used.

- **If the adjustment is not possible, the measuring piston (3) or its boring in the cover is worn to much. In this case it is necessary replace the complete cover.**

Cont'd.

Fig. 78

II: Setting The X1-Pressure:

9. Shift the three way cock valve (33) in to the position "Stop Gap Operation" (Hydraulic Emergency Mode)
10. Set the X1-pressure on the adjustment of the pressure reducing valve (103.1) to approximately 10 bar ** .
11. Set the pressure at all 3 MRV **equally** to 260 bar **.
12. Create max. load on pumps (e.g. stall out boom and stick cylinder), and read engine speed . Must be = **1830 ± 10 rpm.**
13. If the engine speed is not within the requirements alter the X1-pressure on the adjustment of the pressure reducing valve (103.1) until the engine speed is correct.
    The pressure will be approx. 11 bar
    Record the X1-pressure for other settings.
14. Set the MRV individually to 310 bar **.
15. Shift the three way cock valve (33) in to the position "Electronic Regulation".

The hydraulic pump regulation setting is finished.

* **Altering the X1-Setting:**

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

** **Altering the MRV-Setting:**

- Remove dust cap (1).
- Loosen lock nut (2).
- Turning the set screw (3) cw will increase the pressure.
- Turning the set screw (3) ccw will decrease the pressure.

Cont'd.

Fig. 83

Adjustments at the ELL module 8A34

Checks and adjustments have to be done for the:
NOMINAL Value with the "S"-Potentiometer, the X1-pressure with the "O"-Potentiometer and an eventually fine tuning for the regulation dynamics with the "P"-Potentiometer.

△

- **The "I" and "D" potentiometer settings are under no circumstances allowed to be altered, because a setting is possible only by computer assistance.!**

X1-pressure adjustment:

To make the following adjustments easier and to ensure that all valves and piping of the regulation system at operating temperature.

This is done as follows:

1. Connect pressure gauge to check point M10.

2. Move the change over (33) "Hydraulic / Electronic " regulation into position "E", electronic regulation.

3. Start drive motor.

4. After the motor runs already 30 seconds*, read the X1-pressure.

* The time is necessary to have enough response time for the electronics because of the new operation conditions.

The X-1 pressure must correspond with the pressure for start of destroking (Normally 15 bar).

If the pressure doesn't correspond, turn the "O"-Potentiometer of the ELL Module till the correct X1-pressure is reached.

5. Stop drive motor and remove the gauge.

continued

Testing the ESR-Module, 8A32 + 8A33

Fig. 88

- **The modules are made for the specific Network-Frequency. Therefore pay attention that at the module marked frequency matches the network frequency.**

- **None of the settings are allowed to be altered, because the settings can be done only by means of a high frequency generator and an oscilloscope.**
  If the potentiometer set-positions have been altered, a new Module, with sealed potentiometers, must be ordered.

Function check:
Disconnect the cable at terminal (23) and measure the supply voltage at terminal (11, 31, 32, 33) to GND.
If the voltage reading is not correct check the ESR Module.
If the voltage reading is correct, measure the **effective AC-Voltage** either with an AC-Meter or with a Multi-meter (in position AC) between the Module terminals (21 u. 41). This must be done at a constant motor power (e. g. no load on the motor, free idle).
The measured DC-Voltage must be 1/2 of the AC-Voltage.

Example: $\frac{5\ V_{DC}}{10\ V_{AC}} = 0{,}5$ (1 % plus/minus is OK)

Small variations are based on amplitude variations of the AC-Input voltage while measuring the DC-Output voltage.
Greater variation denotes a faulty ESR Module.
The AC-Input Voltage can be compared with a calculated AC- Voltage Value. The calculation can be done with the ratios of the intermediate transformers given in the circuit diagram, and by the Voltmeter and Ammeter readings of the cab gauges. (see page 20 + 21 for more information)

Cont'd.

Fig. 93

Pre-Conditions:

1. Check the DIP-Switches position of the ELL-MODULE:
   Upper switch "T" in position "Off"
   Next three "D, I, P" in "position "ON"
2. With the engine at High Free Idle following LED's must be on:
   At the ELL-MODULE +15, -15, +5

At the Prop.-Amplifier the upper LED, if not carry out following test:

Open the corresponding terminal in the X2-box -between the amplifier terminal 8 and the proportional valve connect an Amp-meter and measure the current. *(see picture of page 2)
Should be: see formula at bottom of page 14.
If the Current Value is OK. The proportional valve must be checked**.
If the Current Value is not OK. The Control Electronic must be checked. (See pages 9 - 15)

** **Checking the proportional solenoid valve function:**

1. Stop the engine (Eliminate the Idle Time function for the time the valve gets checked, see page 5.)
2. Connect gauge to check point M10.
3. Unplug the proportional solenoid valve (Y61).
4. Start motor.
5. After the motors run already 30 seconds*, read the X1-pressure:

The gauge shows no or only a little pressure, **the valve is in this position OK.**

6. Stop motor and re-plug Y61.
7. Start motor.
8. After the motor runs already 30 seconds*, read the X1-pressure:

The X1-pressure must be now approx. 15 bar.
Pressure OK., Valve-Mechanism is OK.,
Pressure not OK., the valve function is disturbed or the valve is defect. Clean the valve and repeat the check.

* The time is necessary to have enough response time for the electronics because of the new operation conditions.

Cont.:

Z 22253

Service Line Relief Valves (SRV), boom cylinder LBA

Boom "Lifting" (Raising):

Valve	Press. check point	Location
70.1	M11 (320 bar *)	Manifold (57) section B
70.2	M12 (320 bar *)	Manifold (57) section N
98.1	M12 (320 bar *)	Control block II (10) section A1
MRV	High pressure filter	One of each on the control block

Boom "Lowering"

Valve	Press. check point	Location
66.4	M12 (350 bar)	Control block II (10) section B1
MRV	High pressure filter	One of each on the control block

1. Connect the gauge to the required check point.
2. Start engine and let it run with max. speed.
3. Extend cylinder to full or retract to minimum for the valve being tested until the hydraulic system stalls.
4. Increase slowly the MRV-pressure while observing the pressure gauge. Gauge value must remain at 350 bar $\pm$ 5 bar (*. 320 bar $\pm$ 5 bar)
   If the gauge shows a smaller or greater value the SRV must be adjusted.
   How to alter a valve adjustment:
   a. Remove protective cap (1).
   b. Loosen lock nut (2).
   c. Turn set screw (3) -**clockwise** to increase pressure,
      -**counter-clockwise** to decrease pressure.
   d. Tighten lock nut (2) and replace cap (1).
5. Re-set MRV to 310 bar $^{+}$ 5 bar after the check / adjustment is finished.

- **Because the piston and the rod side of the boom cylinders are protected by more than one valve, the pressure gauge shows the pressure of the 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.
- **If the pressure for boom "Lowering" can not be obtained it may be due to the faulty anti cavitation valve 64.1 at the manifold section A**

continued

Z 22456

Floating Function of Boom and Stick Cylinder

General:

The Excavator operates automatically with the float position for boom and stick activated.

That means the lowering movement of boom and stick is always done in the float position.

For **deactivation of the float position**, two push buttons are installed:

a) **S95** in the **left** joy stick for the **Stick** float function

b) **S95.1** in the **right** joy stick for the **Boom** float function

Press the respective button and keep it depressed as long as the float position shall be deactivated.

When releasing the button the float position is activated again.

Function:

The additionally installed single control blocks (Y132, Y133 and Y135) connect the piston side of the cylinders with the rod side and also with the tank:

Y132 and Y133 for the Stick cylinders

Y135 for the Boom cylinders

In normal operation mode (i.e. float position) the pilot pressure oil is directed via Y132b and Y132c to the **single control blocks** when lowering the boom or stick.

If a pressurised lowering of the cylinders is required the pilot pressure oil is directed via Y132b and Y132c to the **main control blocks**.

The solenoid valves Y132b - Y132c (4/2-directional control valves) are controlled by push button S95 and S95.1

Stick:	S95 **OFF**	⇒	Y132b **OFF**	⇒	Float position **activated**
	S95 **ON**	⇒	Y132b **ON**	⇒	Float position **deactivated**
Boom:	S95.1 **OFF**	⇒	Y132c **OFF**	⇒	Float position **activated**
	S95.1 **ON**	⇒	Y132c **ON**	⇒	Float position **deactivated**

Due to the two different operation modes for lowering, the lowering speed of boom and stick cylinder must be adjusted twice:

A. Float position **activated**

B. Float position **deactivated**

Swing motor

Swing motor (Axial piston motor A2FM series 5)
The axial piston units of product group A2FM with fixed displacement can operate as a hydraulic motor only.
The drive speed is proportional to the consumption capacity.
The output torque increases with the pressure drop between high and low pressure side.
The motor converts hydrostatic energy into mechanical energy.

Legend: Z 22259

(1) Drive flange assy.
(2) Housing
(3) External lubrication port (not used)
(4) Case drain port
(5) Retaining plate
(6) Piston
(6a) Pivot (center) pin
(7a) Upper dead point
(8) Cylinder
(9) Control lens
(10) End plate
(11) Centering spring
(7b) Lower dead point
(12) Standard ball bearing (not for our swing motor)
(12SL) SL Taper roller bearing (SL = Super long life)
description see Section 7 page 5
(13) Roller bearing
(14) Sealing flange
(15) Seeger clip ring
(16) Radial seal ring

continued

Cont.:

Z 22262

If after a swing motion the joy stick is put into neutral position without using the foot brake, the superstructure is turned by centrifugal force and the hydraulic motor acts as a pump because it is driven by the swing gear.
In this period the pressure in the service line is lower than the pressure in the return line, because there is a back pressure valve at the tank, and oil is forced through the anti cavitation valves into the service line.

Function of the pressure increasing valve.
When ever a swing motion is carried out or the foot brake is used, pilot pressure arrives the pressure increasing valve (1) at port "X". The pilot pressure pre-loads these valves.
By applying pilot pressure via the external port X to piston (12), the pre-tensioning of the pressure spring (12) is increased by the amount of the piston stroke "S", which results in the actual valve setting.
The system pressure is in front of the main piston (13) and via the jet bore (6) also in the chamber of the spring (7) and via the jet bore (8) at the pressure relief valve poppet (9).
Due to the force balance the piston (13) is kept in its position supported by the spring (7).
Overcomes the system pressure the setting of the valve (9), this valve opens a channel to the dump line port (Y). Due to the drop of force the piston (13) is moved to the right.
The pressure line gets connected with the return line (T).
Damped opening and closing are obtained by the throttled volumetric change that is caused by the nozzle and orifice.

Braking

Z 22266

Control lever for "Swinging" in neutral:

When operating the foot brake (88) pilot pressure is sent to the shuttle valve (75.5), the ball in the valve closes the opposite port and the oil continues to the pressure increasing valve (DZ) of the swing brake valve (61).

This pressure increasing valve is preloaded. Thus the flow from one side of the swing motor (60) to other side of motor is blocked which causes the braking of the super structure.

The max. braking pressure results from the pressure adjustment. of the pressure increasing valve.

Z 22269

Checking the pilot pressure for the swing brake:

1. Connect pressure gauge to check point (M33).

2. Start engine and run it with max. rpm.

3. Depress foot brake pedal and read pressure. Value = 19 $\pm$1 bar.

- **The pressure output on the pedal is factory adjusted , i. e. Adj. of the pressure is not possible**

Cont.:

Z 22259

Function:

The pressure oil inlet (A or B) and consequent oil outlet (B or A) determine the output drive direction of the drive flange (1).

Direction of rotation:

"Clockwise" = Direction of flow A to B

"Counter-clockwise" = Direction of flow B to A

with view onto drive shaft!

Via the control lens (9) the oil is directed to the cylinder bores.

The piston (6) is moved from the lower (7b) to the up- per dead point (7a) by means of the force acting on it and causes the drive flange to rotate. On further rotation of the drive flange (additional pistons are pressurized) this piston is moved towards the lower dead point again and oil of the cylinder chamber is forced out through the kidney formed openings of the control lens. This oil is fed back to the tank via the return line.

If the supply and return line is changed it changes the output drive direction of the drive flange.

By means of the angled arrangement of the cylinder (8) (bent axis design), a certain piston stroke is produced which results in a fixed displacement per revolution of the drive flange. According to the size of the applied flow this therefore produces a specific output speed.

The output torque at the drive flange is dependent on the size of the motor and the required operating pressure.

The port (3) is provided for an external bearing lubrication at extreme operating conditions.

Anti-Cavitation Circuit

Z 22276

General:

Due to internal leakage of the hydraulic motors and in order to avoid a vacuum in the system, i.e. due travelling downhill, additional oil must be fed into the circuit.

This is done by the anti-cavitation valves (68.5 + 68.6, 68.9 + 68.10) mounted on the main valve blocks.

Function:

The line from port T of the control blocks is connected to the return oil collector (R). Due to the adjustment of the back pressure valve (25) under all circumstances there is enough oil under pressure available at the anti-cavitation valves. At any time the pressure in the service line to the motor is less than the back pressure additional oil is fed through the anti-cavitation valves into the circuit.

Hydraulic Track Tension System.

Legend:	**Z 22280**
(58)	Rotary distributor
(L12)	Supply line, pilot pres. / travel brake circuit
(L14)	Return oil line
(L9)	Return oil line (leakage oil)
(111)	Pilot pressure shut-off valve
	"O" = open (Normal position)
	"C" = closed
(87)	Pressure increasing valve
(89.1)	Main shut-off cock
	"C" = closed (Normal position)
	"O" = open
(93.1 + 93.2)	Pressure accumulator, 5 liter
	Pre-charge pressure 150 bar
100.1 + 100.2	Pressure accumulator, 1.3 liter
	Pre-charge pressure 31 bar
(89.4 + 89.3)	Shutoff cocks, R.H & L.H
	"O" = open (Normal position)
	"C" = closed
(94.1 - 94.4)	Track adjusting cylinders
	160 mm dia. X 280 mm stroke

General:

The hydraulic track adjusting system maintains automatically the correct track tension.

The pilot pressure oil for the travel gear house brake circuit is used to pressurize the four adjusting cylinders (94.1-94.4). The resulting force moves the guide wheels toward the front, until the correct track tension is obtained. External forces acting upon the guide wheels are absorbed through the pressure accumulators (100.1+100.2, first stage) + (93.1+93.2, second stage).

For description of function see next page.

Adjustments.

Z 22284

Checking / Setting the 50 bar valve (22)

1. Connect pressure gauge to pilot pressure check point M5.
   (see Section 5 page 3 with diesel engine drive.)
2. Start Diesel engine run with max RPM.
3. Increase slowly the pressure at valve (99) while observing the pressure gauge. Gauge value must remain at 50 bar $\pm$ 1 bar.
   If the gauge shows a lower or greater value the 50 bar valve must be adjusted.

Adjustment: Valve (22)

4. Loosen lock nut (1).
5. Adjust the pressure with the adjustment screw (2).
6. Tighten lock nut (1).
7. Set pilot pressure to the required value.

continued

Access Ladder Hydraulic Operated

Legend: Z 22279

(5)	Pilot pump
(30)	Filter
(99.1)	Pressure relieve valve (50 bar)
(99.2)	Pressure relieve valve (35 bar)
(106)	4/3 valve (ladder up or down)
(35.11)	4/2 valve (lower speed limit)
(107)	Pressure relieve valve (40 bar)
(115.1, 115.2, 115.3)	Check valve
(116+120)	Orifice
(105)	Ladder cylinder
----------	drain line
————	main line

Function:

1. The engine is running

The pump (5) delivers oil through filter (30) and pressure relieve valve (99.1) to port P of the solenoid valve (106). Pressure relief valve (99.2) reduces the pressure to 35 bar. This pressure its called X2-pressure. The oil pressure of 50 bar in front of valve (99.1) is used for the automatic lubrication systems.

If the solenoid Y123 a or b is energized the valve change the position and the oil flows to the ladder cylinder. Depending on the valve position the ladder will go up or down.

The pressure relief valve (107) prevent the ladder cylinder for excessive hydraulic pressure to max. 40 bar. This valve is fix adjusted.

Return oil flows back through valve (35.11) pass orifice (116) and valve (35.11).

If the ladder reaches nearly the final up or down position a sensor (S 22 – in up position; S 91 – in down position) de energize Y125 and the valve change the oil flow through orifice (120). This orifice (120) is smaller as orifice (116). The ladder motion will be slowed down.

If the ladder is in the "Up – position" the sensor S22 (see next page) de energizes Y125 and relay K134 energizes Y123a. The cylinder of the ladder is in this position always charged with pressure.

If the ladder is in the "down – position" the sensor S91 (see next page) de energizes the solenoid (Y125) and the ladder is blocked.

Table of Contents

Cont.:

(64.1-64.7)	Anti cavitation valve blocks
(65.1-65.3)	Service line relief valves with check valve
(66.1-66.11)	Service line relief valves on main control blocks
(67.1)	Service line relief valve on control block, for clam closing
(68.1-68.10)	Anti cavitation valves on main control blocks
(69.1-69.19)	Cover plates for anti cavitation valves and empty block positions
(70.1-70.2)	One way restrictor with service line relief valves and check valve
(71)	L.H- Joystick
(72)	R.H- Joystick
(73+74)	Foot pedals for travelling motion
(75.1-75.3)	Shuttle valves
(76.1)	Diaphragm pressure switch B37
(76.2)	Diaphragm pressure switch B47
(77)	Pressure relief valve with solenoid valve Y49
(78)	Cover plate
(79)	Oil filter for generator drive *
(80)	Hydraulic motor, generator drive *
(81)	Check valve, anti cavitation valve for (80) *
(82)	Breather filter at pump distributor gear
(83.1-83.3)	Orifice (8 mm), pump bearing lubrication
(84)	Check valve (none return valve)
(85)	Orifice 4.4 mm, for creating a pressure difference *
(86.1+86.2)	Orifice 20 mm
(87)	Pressure increasing valve for hydraulic crawler tension
(88)	Swing brake pedal
(89.1)	2-way valve, by-passing of pressure relief valve (87)
(89.2+89.3)	2-way valve, shut off for tension cylinder (94)
(90)	Crawler tension control block
(91.1+91.2)	Check valve, supply line
(92.1+92.2)	Check valve, line to relief valve
(93.1+93.2)	Pressure accumulator for crawler tensioning device
(94.1-94.4)	Crawler tensioning cylinder
(96.1+96.2)	Connection block
(97.1+97.2)	Orifice 1 mm$^{\varnothing}$
(98.1+98.2)	Service line relief valve, Boom lifting 320 bar
(99)	Pressure relief valve, Pilot pressure
(100.1 + .2)	Accumulator in side frame

* option

continued

How to read the circuit diagram

Example: Swing circuit
Diagram sheet 01:
Oil supply.

Pump (3) co-ordinates A9 port P to the HP- filter (12.3), port A co-ordinates D7.
Filter port B to the control block (11) in D/E3 port P.

A **if the spool is in neutral position:**

1. From port P via the spool to outlet port T of the control block to the return oil collector pipe (15) in B2. Beneath the component No. is the hint 2C6 given; that means:
   The continuation or the origin of (15) is found on sheet 2 co-ordinates C6.
2. Sheet 2C6:
   From the collector pipe (15), extreme left port to port A of the back pressure valve (25) in B6. If the pressure is greater than adjusted further to the port B into the filter chamber and through the three return oil filters (50.2-50.4) A6/7 into the tank (51) A5-A11.
   Simultaneously:
   From the collector pipe (15) in C5-7 via the oil coolers (16.1+16.2) in B4 to the orifices (86.1+86.2) in B5. then to the ports 1+6 in B6 of the filter chamber.

B **if the first spool in the main valve block (11) is moved downwards:**

Port P in D/E6+7 via the load holding valve to port A1 in E7, further to port A in G1 of the swing brake valve (61) in G1 and to the port A of the swing motor (60) in H1.
From port B of the motor to port B in G1 of the swing brake valve (61) to port B1 in E7 of the control block (11).
Further via the spool to the outlet port T in D5 and into the return oil collector pipe (15) in B1-3.
Now same as described under A 2.

C **if the spool is moved upwards:**

Now you should be able to find it out yourself.

KMG Circuit Diagrams

Z 22374
General information.

Each sheet has the following information in the bottom right hand corner:
Diagram Number Example: 897 856 40
Machine Type Example: PC 3000
Sheet Number Example: 05/

Each sheet is numbered from left to right 8 to 1 along the top and bottom edges, and lettered up the left and right sides from bottom to top A to F. This number and letter system enables you to find components easily.

Wires at the top half of the sheet (above line C) are Positive and at the bottom of the sheet in line C are Negative or ground.

All 24 volt wires are blue and have at each 10 cm of the wires a printed code. It is important to remember that numbers on at each end of a wire do not necessarily have the same numbers. The number indicates the terminal to which it is to be connected.

All circuits are drawn with no current flowing and all relays and switches are in Neutral position.

Adjustments **Z 22379**

PT100

0°C	100.00 Ohm
5°C	101.95 Ohm
10°C	103,90 Ohm
15°C	105.85 Ohm
20°C	107.79 Ohm
25°C	109.73 Ohm
30°C	111.67 Ohm
35°C	113.61 Ohm
40°C	115,54 Ohm
45°C	117,47 Ohm
50°C	119,40 Ohm
55°C	121,32 Ohm
60°C	123,24 Ohm
65°C	125,16 Ohm
70°C	127,07 Ohm
75°C	128,98 Ohm
80°C	130,89 Ohm
85°C	132,80 Ohm
90°C	134,70 Ohm
95°C	136.60 Ohm
100°C	138.50 Ohm
105°C	140.39 Ohm
110°C	142.29 Ohm
115°C	114.17 Ohm
120°C	146.06 Ohm

The above shown table should simplify trouble shooting and line resistance compensation which is done with the potentiometer on the mounting side of the temperature modules (X2-Box). (for further details see service bulletin 21-412a)

Introduction

The electronic text and monitoring system **ETM** with a plain text display provide continuous monitoring of all hydraulic shovel functions and operating conditions.
Fault messages are displayed, stored and can be called up at any time.
A print out is possible by a portable printer.
Through it faults are rapidity noticed so that repair or maintenance can be done purposeful.

General

The **ETM** has the capability to cover a total amount of 60 different messages.
Up to 1300 messages can be stored in the record memory and registered in the statistic's memory.
Data protection for all texts, clock, date and values at 25° C for approx.
10 to 20 years. at 60° C for 5 to 10 years.
The text messages can be selected in two languages.
The **ETM** works in the last (most important) message mode. The messages are divided into four groups according to their importance. The last message received by the **ETM** will be displayed. If there are several messages at the same time, the most important message will be displayed. The other messages are kept in the background. They are indicated by a flashing number on the screen and can be called up.
Recording of the messages is accomplished with „coming - going“ registration.
The statistic's memory counts the frequency of coming messages and establishes their total amount.

- **More detailed information how to use the System see Section 5 of the OPERATORS MANUAL in the following pages**

Legend for illustration (Z 20915):

(29) Location for radio installation

(35) **Air conditioning** *
(36) Air conditioner blower switch
(37) Air conditioner temperature control switch
(38) Air flow control louvers

(40) Main windshield wiper
(41) Light switch, interior cab lighting
(42) Water reservoir, windshield washer system (located bottom partition of the cabinet)
(43) Water pump, windshield washer system
(44) Cab blower unit
(44) Control unit for fire detection, actuation and suppression system (if so equipped)
*) Special Equipment

- **For Operation and Maintenance instructions of the Air Conditioning, refer to Section 6.8 in this Manual and to the separate Manual "AIR CONDITIONER UNIT" in part 3 of this binder.**

Functions of the ETM System and their Utilization, illust. (Z 20919)

After switching on the Excavator's key operated switch, the name of the manufacturer will be displayed for a period of 5 seconds.

- **If during this period a key is being actuated, the manufacturers name remains on the screen for further 20 seconds.**

Thereafter the basic ETM display, as shown in the illustration, normally automatically appears on the screen. This display is for general information during operation.

If a fault or an information condition occurs during operation, the basic display is automatically replaced by a message in text. If a further condition occurs, the message will be displayed if it is more important than the present message on the screen, so that the operator is always shown the latest, most important message. A flashing number on the screen shows the total number of the current messages. The message text provides the operator with an explanation of the condition in standard texts as listed in the annexes "Message Texts". When a fault message is displayed the number of operating hours is displayed at the same time.

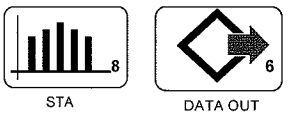
Information conditions are held as long as they occur, but are not stored.

Basic Display (message page no. 0):

DATE:	**TIME OF DAY:**	**OPERATING HOURS (h):**
		TRUCK COUNTER:

Print out Content of Statistics Memory:

15.02.98 14 : 36 : 30 h: 1351:20



The complete statistics are now being printed out.

Display:

******* STATISTICS PRINTOUT ******

Printing statistics table, please wait....

- **It is re-commended to erase all entries in the statistics memory with key switch (M) after each main service period in order to keep the statistic clear. Prior erasure of the statistics, print out or record the content of the statistics memory in the table on page 11 to ensure complete service record of the excavator. The date and operating hours should also be recorded.**

Print out Content of Record (PROTOCOL) Memory:

Print out the *complete* Content of Record (PROTOCOL) Memory

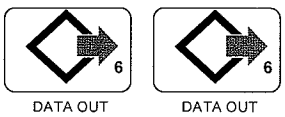
Press until the maximum amount of entries **(39)** is reached

Display:

Print from the last > 1< PRO entries
page no all * PRO has 39 entries *P*

⇓

Print from the last > 39< PRO entries
page no all * PRO has 39 entries *P*



The complete PROTOCOL is now being printed out.

Distinctive marks for "OLD" and "NEW" entries:

New entries, not yet displayed/called up on ETM are marked with ***P*.**

After being displayed/called up the marking will change to **-P-.**

Settings of the Text Display Unit, illust. (Z20919)

Setting: DATE (Message page 27)

Set Enable key switch „Adjustments“ **(L)** to **ON** position

Set Selector switch „Adjustments“ **(K)** to **D** position

The cursor flashes in the enter zone.
Use key 4 (PAGE NO) to shift the cursor to the desired input place.
Change the values using key 2 (UP) or 3 (DOWN). Check the new values and then press key 1 (MESSAGE) or key 6 (DATA OUT) to accept the new values and to finish the input function.

Example:

# F:	date:	03.01.98
	new date:	10.02.98

Setting: TIME OF DAY (Message page 28)

With enable key switch (L) in ON position, set selector switch (K) to „T“ position. Input procedure is the same as described under DATE.

Example:

# F:	time:	08.41.30
	new time:	15.50.15

Setting: HOUR METER (Message page 29)

With enable key switch (L) in ON position, set selector switch (K) to „HM“ position. Input procedure is the same as described under DATE.

TABLE OF MESSAGES

Message Pages Number 6 to 11.

Page No.:

6:	$h:	Leak oil filter restricted Leckoelfilter verschmutzt
7:	$h:	Hydraulic oil temperature too high Hydraulikoeltemperatur zu hoch
8:	$h:	Too low hydraulic oil level! Switch off the motor! Hydraulikölstand zu niedrig! Motor abstellen!
9:	$h:	Main transformer temperature too high Temperatur Haupttrafo zu hoch
10:	Not used	
11:	$h:	High pressure filter #1 restricted Hochdruckfilter 1 verschmutzt

Adjustments

End of line switch setting, illustration Z 21185

1. Connect pressure gauge to check point close to the end of line pressure switch.

☞ • **Use an other gauge as for checking hydraulic pressures because the gauge remains filled with grease after the test**

2. Block the swing function with the swing ring parking, use the switch at the dash board.
3. Start engine.
4. Start a lube cycle with the dashboard switch S26 and activate for a short time the swing function to the left or right.
5. Watch pressure gauge. At a pressure of 180^{+10} bar the end of line switch must react and the lubricants pump must be stopped.*

* If at the same time the pressure shown at the built-in gauge is noted down, this pressure can be taken for later on checks as a **reference** pressure.
But be careful this pressure is higher than the pressure shown at the test gauge because of the long distance between pump and end of the supply line.

☞ • **180 bar is the normal setting.**
Under particular circumstances it may be necessary to increase the pressure slightly

If re-setting is required:

6. Screw out screw (1) and take off cover (2).
7. Alter the spring tension with adjustment screw (3) that the switch operates at 180 bar.
8. Install cover (2) and screw (1).

continued

Lubricant Injector (metering valve), illustr. Z 21187

TASK:

A readjusted (at the injector) volume of grease is pushed with the injectors to the bearings or to the progressive distributors.

Design: (model SL1)

(01+02)	Metering valve, assy.
(03+04)	Injector bar
(05)	Adjusting screw
(06)	Nut
(07)	Plug screw
(08)	Seal ring
(09)	Disk
(10)	Seal ring
(11)	Bolt with nut
(12)	Disk
(13)	Seal ring
(14)	Piston
(15)	Compression spring
(16)	Spring retainer
(17)	Seal ring
(18)	Disk
(19)	Seal ring
(20)	Disk
(21)	Piston
(22)	Seal
(23)	Adapter bolt
(24)	Valve housing
(25)	Union

Design: (model SL11)

(01)	Metering valve, assy.
(02)	Adjusting screw
(03)	Nut
(04)	Plug screw
(05)	O-ring
(06)	Disk
(07)	Seal ring
(08)	Disk
(09)	Guide
(10)	Indicator pin
(11)	Seal ring
(12)	Piston
(13)	Seal ring
(14)	Pin
(15)	Compression spring
(16)	Spring retainer
(17)	Bolt with piston
(18)	Seal ring
(19)	Valve housing
(20)	Union

continued

Vent valve, illustr. Z 21192

TASK:

By the function of the vent valve the lubricant supply line gets pressure-relieved, after the lubrication cycle is finished. The injector pistons can move into their initial position.

Legend: (Valve VP1 S-G). Fig. 19

(1) Solenoid
(2) Valve assy.
(3) Solenoid stem
(4) Lever
(5) Main valve cone
(6) Auxiliary valve cone
(7) Reset spring

Function:

The solenoid gets **energized**. When the lubrication starts.
The connection from **A** to **B** gets closed, thus a pressure build-up is possible.
The solenoid gets **de-energized,** as soon as the lubrication cycle is finished.
This causes opening of the connection **A** to **B,** thus the **supply line to the lubricant barrel is open**. The lubricant flows from A to B or vice versa along the main valve cone (5).

Explanation of the statistics print-out

You receive for example the following print-out:

Column 1	2		3	4		5
Good:	0	=	0.0 %	02:00:00	=	33.3 %
1:	1	=	14.3 %	01:00:00	=	25.0 %
2:	1	=	14.3 %	01:00:00	=	25.0 %
3:	3	=	42.6 %	02:30:00	=	62.5 %
4:	2	=	28.6 %	01:00:00	=	25.0 %
Err:	7	=	100.0 %	04:00:00	=	66.6 %

Column 1:

Good: Time with no faults,
number of faults = 0

Err : Time, where faults have occurred,
number of faults = 7

The numbers 1, 2, etc. indicate the message page number in the text store.

Column 2:
The number indicates, how often the fault has occurred, for example the fault of page no. 3 has occurred 3 times. In line „Err" (Error) the number of faults is summed up, the result is 7.

Column 3:
Here is indicated in percent, how often the fault has occurred applying to the total number of faults (7 = 100%).

Column 4:
The time indicates, how long the fault has been present. If a fault has occurred more than one time, the sum of time will be indicated here.

Column 5:
The duration of the fault applying to the total time with faults (Err), = 4:00:00 (4 hours). This number results in the temporal overlapping of the faults. If you sum up the times, you receive 5:30:00. Good and Err apply to the sum of Good and Err, respectively. Refer to the diagram on next page for more information.

Cont.:

Illustration Z 21173c

E After the pilot pressure has been reduced it passes to the hydraulic cylinder which operates the grease pump.

F The oil cylinder shuttle's the grease cylinder at 18 – 20 double strokes per minute and delivering 612 – 680 cm^3 (37.3 – 41.5 in^3) of lubricant per minute (approx. 550 – 612 g / 19.64 – 21.45 oz.)

G With the vent valve (7) (*) closed the pump continues to cycle until maximum pressure is achieved and the injectors have metered lubricant to the bearings. In most lubrication systems this is 185 bar (2630 psi.).

H When the maximum system pressure is reached the end-of-line switch (*) opens.

I The open pressure switch signals the controller to stop the pumping cycle.

J At this time the controller terminates the signals to the solenoid valves 2 and 7.

K As solenoid valves are de-energized the hydraulic oil stops flowing to the pump and the vent valve 7 connects the lubricant line 15 with the barrel.

L As the vent valve 7 is de-energized it opens and allows the grease pressure to drop to zero so the injectors can recharge for their next output cycle.

M The system is now at rest, ready for another lube cycle and the sequence repeats itself.

* circuit diagram code table

Solenoid valve 2	Vent valve 7	end-of-line switch
Y7, CLS	Y7a, CLS (1)	B43, CLS
	Y8a, CLS (2)	
Y9, SLS	Y9a, SLS	B46, SLS

SLS = Slew Ring Teeth Lubrication System

CLS = Central Lubrication System

Cont'd.

Illustr. Z 21176

When all injectors pistons have reached there final position no more lubricant is accepted from the supply line which causes a pressure increase in the supply line (8).

As soon as the pressure reaches the adjusted value of the **end-of-line switch** (16) the solenoid valves (2) **de-energized** and the lubricant pump switched **Off**. Depend on different factory settings vent valve (7) de energize together with solenoid valve (2) or after a fix adjusted time of max. 5 minutes.

With **de-energized** solenoid valve (7) the port to vent line (15) (return line to the lubricant container) opened and release the lubricant and lubricant pressure in to the container.

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

The system is now prepared for a new lubrication cycle. The operation is re-initiated after the next "**Pause Time**" is elapsed.

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 will not reached within the adjusted "**Monitoring Time**" the fault message **"Central lubrication system fault"** comes up on the text display and the system switch 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 allowed in graphite contained lubricants**

Cont'd:

Injectors, illustr. 21181:

Series SL-1 injector:
Lubricant output adjustable from 0.13 up to 1.3 cm^3 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 cm^3 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**