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01.02 Safety and Accident Prevention

01.02.1 Introductory remarks

Please read the operating instructions carefully before putting an earth-moving machine into operation and strictly follow the following remarks for a safe operation.

National safety regulations - e.g. the Accident Prevention Regulations, “Earth-Moving Machinery” (VBG 40) and “Vehicles” (VBG 12) in the Federal Republic of Germany - must also be complied with.

In addition to the operating instructions, legal regulations governing road traffic and road safety measures must also be observed. Such requirements could also apply in respect of handling hazardous goods or the wearing of personal safety equipment, for example.

Furthermore, safety laws governing work in particular locations (tunnels, audits, quarries, pontoons, contaminated areas, etc.) must likewise be observed.

01.02.2 Correct use

The earth-moving machine with normal shovel equipment is only to be used for work which is suitable for the machine’s functions and its attachment.

Such work includes the digging, loading, displacing and dumping out of earth, stones or other materials and the loading of these materials onto Lorries, conveyor belts or other means of transportation. The transport of the loading material, however, is mainly carried out by moving the earth-moving machine.

If special attachments, such as Uni-shovel, side dump shovel, sweeper, fork lift attachment etc. are mounted, special jobs can be done with the attachment.

Another or additional application, e.g. for transportation of passengers or using the lifting device as working platform etc. is not considered as correct use. The supplier is not liable for subsequent damage. The end-user himself bears the full risk.

It is part of the correct use to follow the operating and maintenance instructions and to carry out the maintenance as well as to follow the maintenance intervals.

01.02.3 General safety notes

It is important to refrain from any working methods which impair safety.

The earth-moving machine may only be used when it is in a safe, operational condition.

The manufacturer’s operating instructions must be complied with for operation, maintenance, repair, assembly and transportation.

The plant operator must provide additional special safety instructions, wherever necessary, for specific local conditions.

The operating instructions and any information pertaining to safety must be carefully kept in the driver’s cab.

The operating instructions and safety notes must be complete and fully readable.
Safety devices on earth-moving machines must not be deactivated or removed

Lubricants cannot be taken internally and repeated skin contact should be avoided. There is no special danger to health if lubricants are used correctly. Please follow the safety recommendations issued by the mineral oil companies.

Only the hoses specified by the manufacturer may be used.

Hydraulic hoses must be routed and assembled by expert personnel.

Never smoke or handle open flames near or around the fuel tank and batteries.

01.02.18 Towing, loading, transportation

The towing of earth-moving machines may only be done with towing devices sufficiently dimensioned.

The fixing devices specified by the manufacturer must be employed.

For loading and transportation, earth-moving machines and all necessary auxiliary equipment must be secured against unwanted movement.

The travelling gear and track-laying gear of earth-moving machines must be sufficiently cleaned of mud, snow and ice to ensure that ramps can be driven up without risk of slipping.

When the earth-moving machine is transported on lorries, flat-bed trailers or by rail, it has to be carefully secured with wheel chocks and tie-downs at the fastening points.

Before setting off, the route to be taken must be examined to determine whether the roads are wide enough, entrances and passages under bridges are large enough and that roads and bridges have sufficient carrying capacity.

01.02.19 Monitoring and inspections

The machine must be thoroughly inspected by an authorized and trained person according to the safety regulations valid in your country:

- prior to the first commissioning and prior to re-commissioning after major changes
- at least once a year
- periodically according to the operating conditions and the conditions in the operator's company

The inspection report is to be put in writing and kept for future reference.

Furthermore, prior to each work shift, the machine operator must check the earth-moving machine according to the inspection chart.

Hydraulic hoses must be replaced as soon as the following damages are recognized:

-Damages to the outer layer which reach the intermediate layer
-Embrittled patches on the outer layer
-Deformations when under pressure or without pressure which differ from the original shape of the installed hose
-Leakages

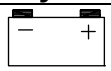
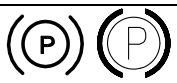
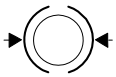
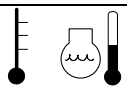
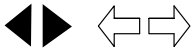
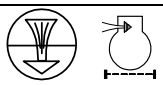
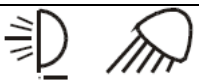
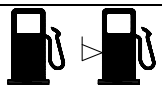
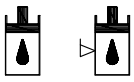
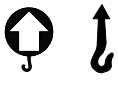
-Damages to hose fittings or to the connection between the fitting and the hose

The coolant level must only be checked when it has cooled down; the cap must be turned carefully in order to bleed off excess pressure.

Prior to operations, the machine operator must check the function of the safety devices

01.05 Pictograms

The following Table explains the meaning of the pictograms which may be attached to your machine.

	Symbol	Description		Symbol	Description
001		Battery charge indicator	016		Operational status, operating hours
002		Pre-heat	017		Parking brake
003		Engine oil pressure	018		Brake accumulator pressure
004		Engine oil temperature	019		Excavator brake
005		Engine oil level	020		Service brake
006		Coolant temperature	021		Hazard warning system
007		Coolant level	022		Direction indicator, left/right
008		Air filter	023		Working floodlights
009		Fuel, fuel level	024		Upper beam indicator
010		Fan, Heater / ventilation	025		Direction of travel forward/reverse
011		Windscreen wash/ wipe system	026		Rotating beacon
012		Hydraulic oil, hydraulic oil level	027		Light, lower beam
013		Hydraulic oil temperature	028		Central grease system
014		Hydraulic oil filter clogging indicator	029		Lashing points
015		Horn	030		Overload warning device / Overload warning indicator

01.07.01 Drift values in mm / minute

Machinery type	Boom cylinder	Intermediate boom cylinder	Dipper stick cylinder
TC 15	***5,0***		***6,5***
TC 16	***5,0***		***6,5***
TC 16 Twin Drive	***5,0***		***6,5***
TC 20	***5,0***		***6,5***
TC 25	***2,0***		***2,0***
TC 29	***4,0***		***7,0***
TC 35	***4,0***		***7,0***
TC 37	***4,0***		***6,5***
TC 48	***3,0***		***3,0***
TC 50			

01.07.02 Test conditions

1. Hydraulic oil temperature approx. 50 - 60 °C.
2. Fit test port with gauge on the cylinder.
3. Retract and extend cylinder several times and operate working equipment to its maximum reach until the gauge indicates a load pressure of 100 bar (if necessary charge with weight).
4. Measure piston rod length of cylinder
5. Measure piston rod length again after 5 minutes
6. The difference converted into 1 minute is the drift of the cylinder
7. The values indicated are valid for hydraulic oil 10 W 40 (viscosity at 50°C approx. 35 mm2/s (cST)

There may be differences if hydraulic oil with a different specification is used.

01.08.07 Newton per meter (Nm) - Pound per inch (lbf/in) – Pound per foot (lbf/ft)

Newton per meter (Nm)	Pound per inch (lbf/in)	Pound per foot (lbf/ft)
1	8,86	0,74
2	17,71	1,48
3	26,57	2,21
4	35,42	2,95
5	44,28	3,69
6	53,13	4,43
7	61,99	5,16
8	70,84	5,90
9	79,70	6,64
10	88,55	7,38
20	177,10	14,75
30	265,65	22,13
40	354,20	29,50
50	442,75	36,88
60	531,30	44,25
70	619,86	51,63
80	708,41	59,00
90	796,96	66,38
100	885,51	73,76
200	1771,01	147,51
300	2656,52	221,27
400	3542,03	295,02
500	4427,54	368,78
600	5313,04	442,54
700	6198,55	516,29
800	7084,06	590,05
900	7969,57	663,81
1000	8855,07	737,56

02.01 Technical Data

02.01.01 ENGINE (Diesel Tier 4)

Manufacturer:		Mitsubishi
Type:		L 3 E – W 462 KL
Output in line with DIN 70020 & ECE-R 24:	kW / HP	13,1 / 17,8 at 2.250 rpm
Design:		3 cylinders in line
Cooling:		water / antifreeze
Displacement :	cm^3	952
High idle speed:	rpm	2.450 $^{+35}$ / $^{-10}$
Low idle speed:	rpm	1.020 $^{+50}$
Specific fuel consumption (at full load):	g/kWh	272
Fuel – bleeding:		automatic
Valve lash – inlet/exhaust:	mm	0,25 (cold)
Start of delivery:	°v. OT	15
Engine oil pressure:	bar	min. 0.8 (low idle speed, warm) min. 2,5 (high idle speed, warm)
Tightening torque cylinder head screws:	Nm	M10 : 75 – 85 M8 : 20 – 30
Electric fuel delivery pump:	Nm	0.18
	l/min	0,9
Injection pressure:	kgf/cm2 psi kPa	140 1,991 13,729
Further specifications:		see Engine Operating Instructions

02.01.02 MOTOR (3-phase electric motor)

Type:		Y2132S2BPC
Output in line with DIN 70020	kW	11 at 400/690V 50Hz
Speed:	rpm	3000
Connection	Volt Ampere	400 32

02.01.05 TRAVEL DRIVE

Drive motors:	Make/Type	SOM MOR 015
Drive gear:	Make/Type	SOM PGR 132 N
Travel speed:	km/h	0 up to 2.4 (option "high speed" up to 4.2)

02.01.06 EXCAVATOR AND TRAVEL HYDRAULICS

Variable displacement motor:	Make/Type	Bosch Rexroth A 10 VNO 28
Capacity:	cm^3/U	0 – 28 (max. 67 l/min)
Pilot pressure (working hydraulics on load):	bar	30 (warm)
Pressure reducing valve, incl. accumulator:	Make	Hydac
Control valve:	Make/Type	Rexroth 9 SX 10
Coordinate lever:	Make/Type	Rexroth 9 SX 10
Capacity at additional control circuit:	l/min	at 100 bar ➔ ca. 32 at 140 bar ➔ ca. 26

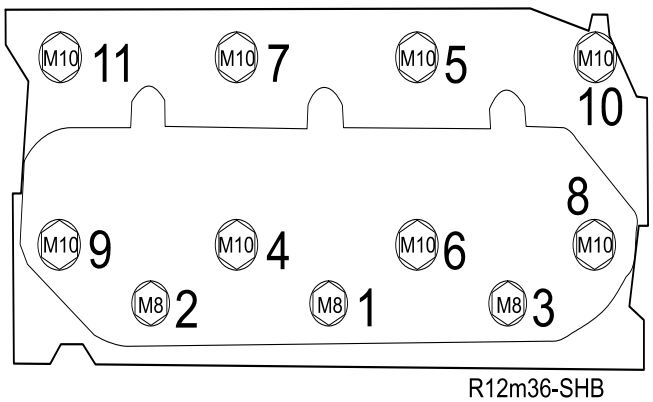
03.01.06 Technical Data

Valve clearance	cold	0.25	mm		inlet & exhaust
Injection nozzle pressure			140	bar	(+ 10 / - 0)
Compression pressure	new:	28	bar		lower limit 22
Injection timing		15°	v.OT*		up to 2000 min^{-1}
Injection timing		17°	v.OT*		more than 2000 till 3600 min^{-1}
Injection timing		19°	v.OT*		3600 min^{-1}

v.OT* = before top dead centre

03.01.07 Tightening torques

Crankshaft pulley	M 16	100 to 120 Nm
Main bearing cap	M 10	50 to 55 Nm
Connecting rod cap	M 8	32 to 35 Nm
Flywheel bolts	M 10	85 to 95 Nm
Nozzle holder	M 20	50 to 60 Nm
Glow plug	M 10	15 to 20 Nm
General bolts	M 6	7 Nm
General bolts	M 8	17 Nm
General bolts	M 10	35 Nm
General bolts	M 12	64 Nm



cylinder head - tightening order

Cylinder head bolts	M 10	75 to 85 Nm
Cylinder head bolts	M 8	20 to 30 Nm

05.02 Rohrbruchsicherung
Hose rupture valve

05.02.01 Einstellanweisung Rohrbruchsicherung
Adjustment instructions hose rupture valve

Eingeschraubt im Stützschildzylinder, bodenseitig.
Installed in dozer hydraulic cylinder, bottom side

HR 11 / 12 / 13 TC 15 - (HR 1.5) / TC 16 - (HR 1.6) / TC 20- (HR 2.0)

- A - ROHRBRUCHSICHERUNG **Ersatzteilnr. 5 368 632 258** R1/4“
Hose rupture valve **Spare part no.**

TC 29- (HR 14) / TC 35- (HR 16) / TC 37- (HR 3.7)

- B - ROHRBRUCHSICHERUNG **Ersatzteilnr. 5 368 632 262** R3/8“
Hose rupture valve **Spare part no.**

HR 22 / TC 75- (HR 32) / TC 125- (HR 42)

- C - ROHRBRUCHSICHERUNG **Ersatzteilnr. 5 368 632 256** R1/2“
Hose rupture valve **Spare part no.**

TC 48- (HR 18) / TC 50

- C - ROHRBRUCHSICHERUNG **Ersatzteilnr. 5 368 632 272** R1/2“
Hose rupture valve **Spare part no.**

TC 60- (HR 20)

- C - ROHRBRUCHSICHERUNG **Ersatzteilnr. 5 368 632 277** R1/2“
Hose rupture valve **Spare part no.**

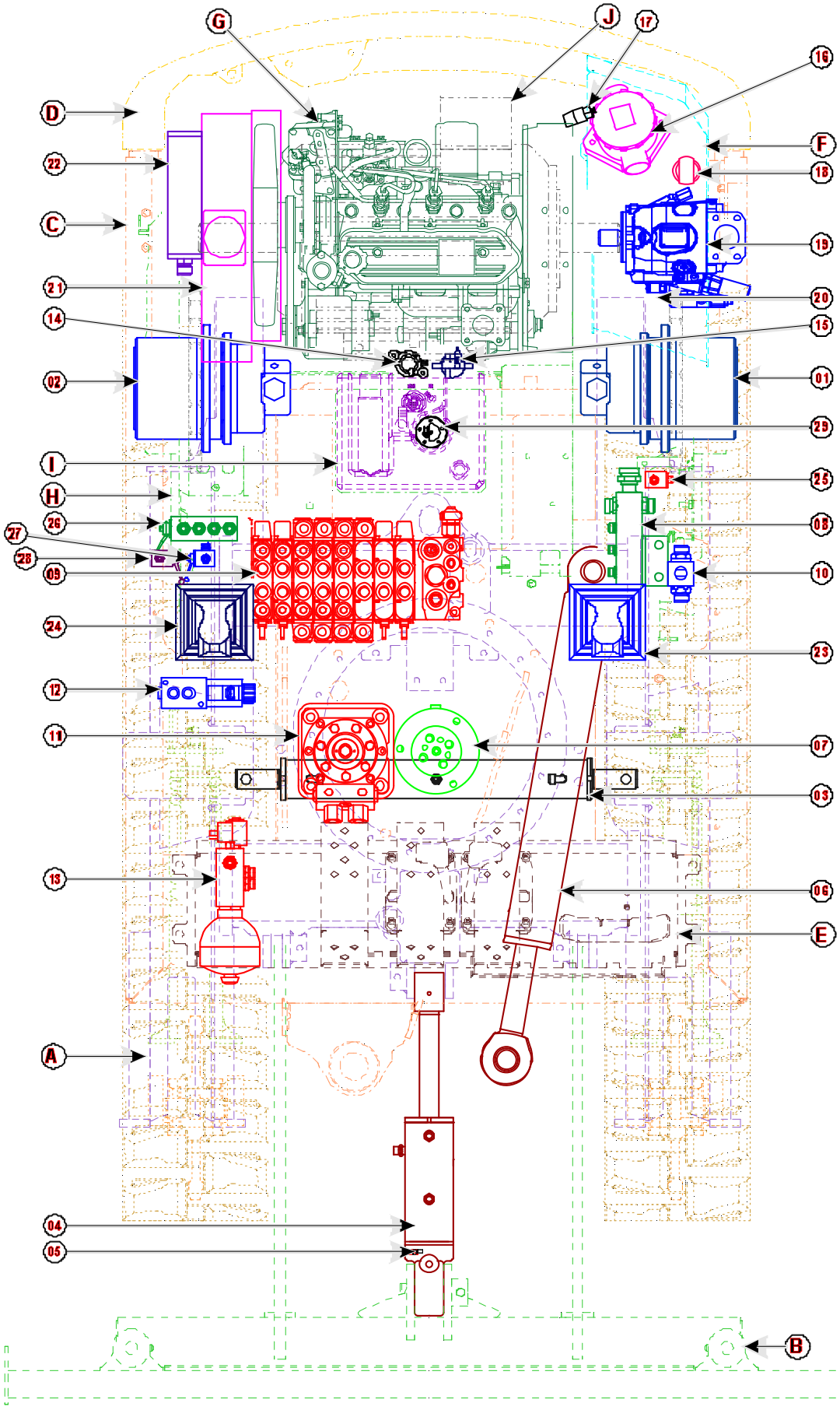
	Rohrbruchsicherungsgewinde **Hose rupture valve thread**	**Ersatzteilnummer für Einschraubwerkzeug** **Spare part number for spezial tool**
A	R1/4“	5 368 655 672
B	R3/8“	5 368 655 673
C	R1/2“	5 368 655 674

05.03 Valve bank SX10

05.03.01 Directional valve element (cut-and schema representation)

Pos. Item Rep. No.	Deutsch	English	Français
	Wegeventilelement	**Directional valve element**	**Elément de distribution**
1	Gehäuse	Housing	Corps
2	Steuerschieber mit Federrückstellung	Spool with spring return	Tiroir principal avec rappel ressort
3	Rückschlagventil	Check valve	Clapet anti-retour
4	Druckwaage	Pressure compensator	Balance de pression
5	Sekundärventil	Secondary relief valve	Clapet secondaire
6	Verschlußschraube	Plug	Bouchon
7	Deckel für Kolbenrückstellung	Cover for spool return	Couvercle pour rappel tiroir
8	Platte	Plate	Plaque
9	Verschlussschraube für Druckwaage	Plug for pressure compensator	Bouchon pour balance de pression
10	Verschlussschraube für Sekundärventil	Plug for secondary relief valve	Bouchon pour clapet secondaire
11	Steuerschieberzunge	Spool tongue	Embbout à tenon de tirior principal
12	Zylinderschraube mit Schlitz	Slotted haed screw	Vis à tête fendue cylindrique
13	Schraube für Deckel	Screw for cover	Vis pour couvercle
14	Schraube für Platte	Screw for plate	Vis pour plaque

06.01 Location of hydraulic components



06.03 Travel motor – travel brake spool

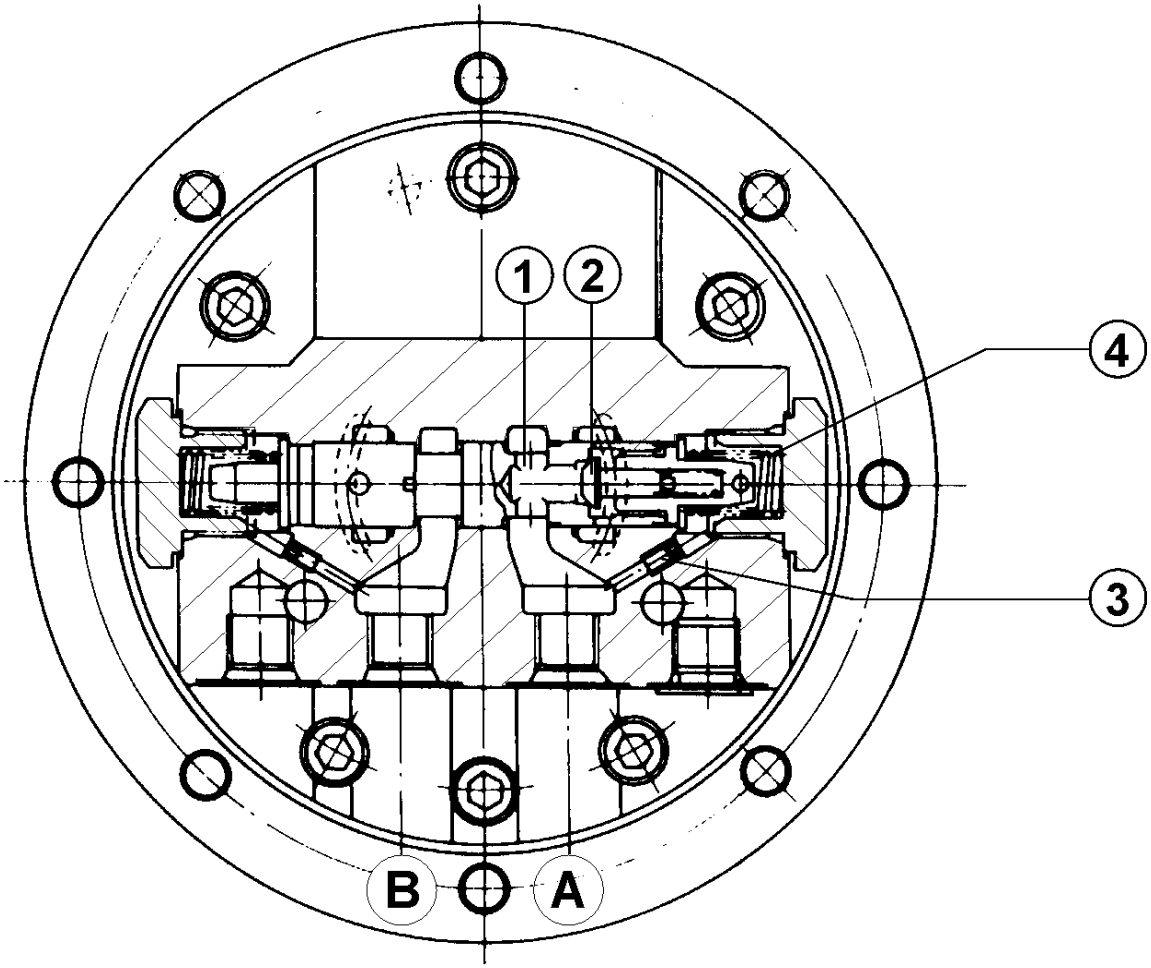
06.03.01 Start-up:

Pressurization of A:

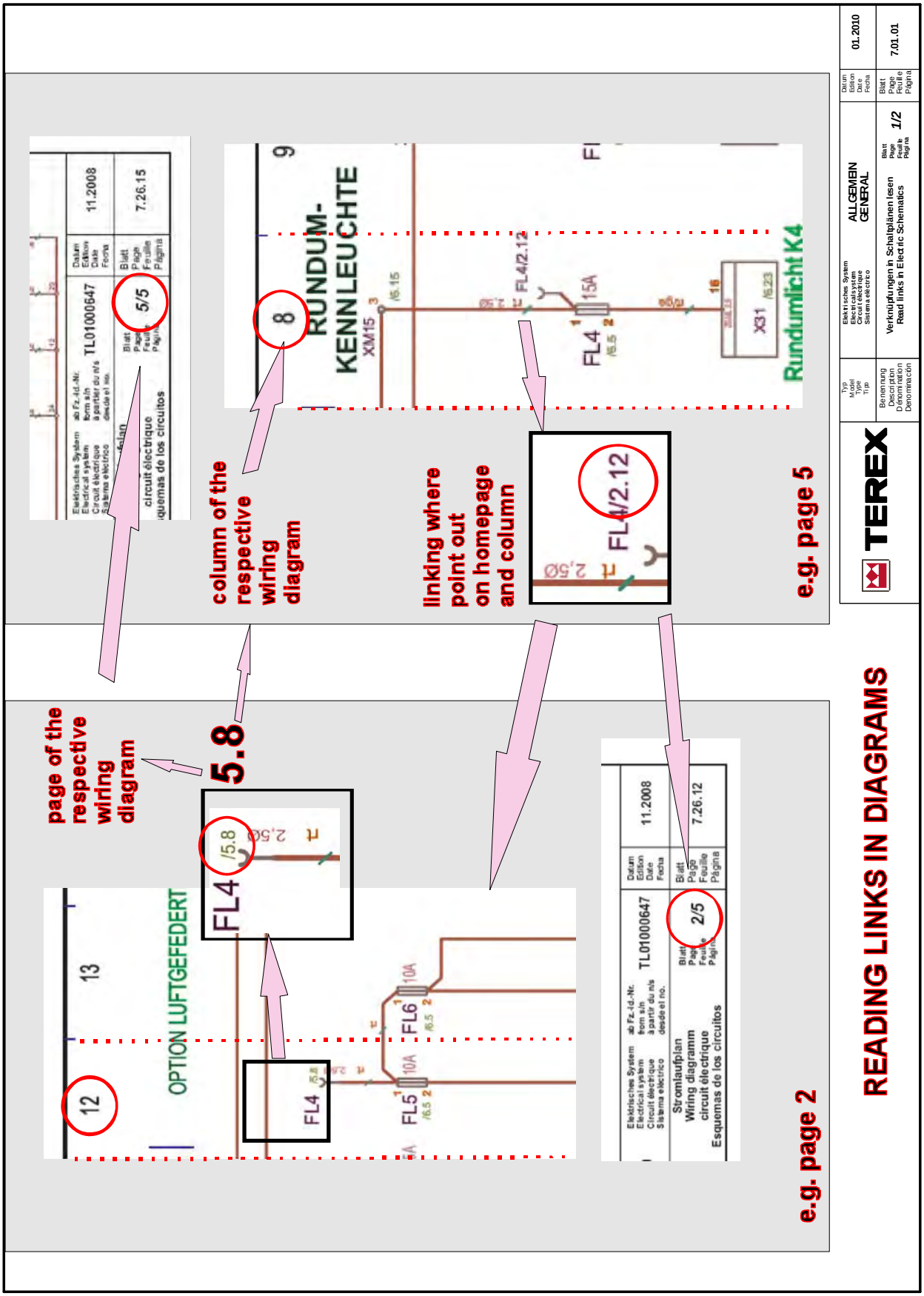
The hydraulic oil flows through the cross hole (1) in the groove of the spool to the check valve (2) and via the control slots through the valve plate to the travel motor pistons.
The return line is still blocked. The pressure is fed into the spring compartment (4) via the orifice (3), the spool moves to the left and releases the return line B.
The travel motor turns, the machine travels.

06.03.02 Brakes (downhill):

The pressure side relieves during downhill travel as the travel motor, driven by the machine's own weight, turns into a pump.
By this pressure drop in the spring compartment (**4**) the spool moves towards neutral position.
The return line **B** is blocked until pressure is again built up on the feed side **A**.
The spool levels out in this position and keeps the travel speed constant.
When reverse travel the process is analogous.



07.01 Reading links in wiring diagrams general



07.05 Generator charging test

In case of a bad battery charge, the functioning of the battery has to be checked prior to the generator replacement !

- Check tightness of eye connections at the generator **B+** = battery+ and **D+** = dynamo+, retighten if need be

- Check ground connection of **generator** to **engine** and **engine** to **chassis**

Simple test method:
- With volt meter with diesel engine turned off:
  from battery positive pole to generator housing

The volt meter must indicate the voltage of the battery.

- With volt meter with running diesel engine:
  from ground cable to generator housing

The volt meter must indicate nearly nothing.

⇒ **In case of voltage drop, clean ground connection surfaces, ensure good contact.**

- Checking of the charge performance of the generator

- connect volt meter to the battery
- start the diesel engine
- voltage after approximately 5 minutes: **13.5 - 14.5 Volt**

⇒ **If one or several consumers (e.g. headlamps, windscreen wipers etc.) are switched on, the voltage must not drop below 13 V.**

Note: Also check the diodes in the fuse box.