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1. COMPONENTS

1.1 GENERAL

Bulbs

Headlight (main beam)		halogen	70 W
Headlight (dipped beam)		halogen	70 W
Parking light		spherical bulb	5 W
Rear light		spherical bulb	2 x 5 W
Rear fog lamp		spherical bulb	21 W
Reversing light		spherical bulb	21 W
Stop light		spherical bulb	21 W
Direction indicator lamp		spherical bulb	21 W
Marker light		spherical bulb	5 W
Side marker light		special type	3 W
Combilamp:	fog lamp	halogen	70 W
	spotlight	halogen	70 W
Interior lighting		spherical bulb	10 and 21 W
Bunk light		spherical bulb	10 W
Stepwell lighting		spherical bulb	5 W
Marker light		spherical bulb	5 W
Work lamp:	white	halogen lamp	70 W
	yellow	spherical bulb	35 W

Max. current and wire diameter (mm^2)				
Wire diameter	**< 2 m**	**2 - 4 m**	**4 - 8 m**	**> 8 m**
1	9	5	4	
1.5	22.5	13.5	7.5	6
2.5	37.5	22.5	12.5	10
4	60	36	20	16
6	90	54	30	24
10	150	90	50	40
16	240	144	80	64
25	375	225	125	100
35	525	315	175	140
50	750	450	250	200
70	1050	630	350	280
95	1425	855	475	380
120	1800	1080	600	480

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Alternator

NCB1

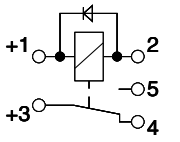
Max. current	80 A
Rated voltage	28 V

NCB2

Max. current	100 A
Rated voltage	28 V

Micro relay

Maximum cut in current making connection between points 3 and 5:	10 A
Maximum cut out current breaking connection between points 3 and 4:	5 A



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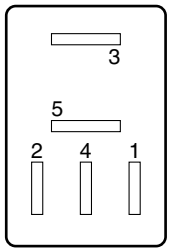

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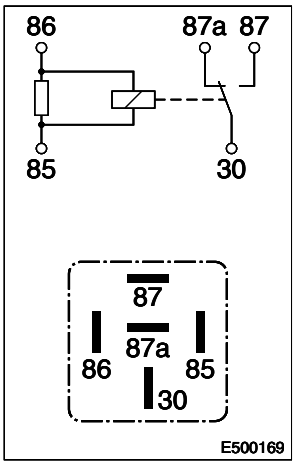
Mini relay

Maximum cut in current making connection between points 30 and 87:	20 A
Maximum cut out current breaking connection between points 30 and 87a:	10 A



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Handheld transmitter CDS

Battery type (2x)	CR1620, 3 V

1.2 TIGHTENING TORQUES

Tightening torques

Drive pulley	80 Nm ± 5 Nm
B+ connection	15 Nm
Chassis earth connection	65 Nm

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1. BATTERIES

1.1 FAULT-FINDING TABLE

SYMPTOM: NEW BATTERY HEATS UP CONSIDERABLY DURING FILLING	
Possible cause	**Remedy**
Inadequate formation because of storage in unsuitable or damp conditions over a long period	Allow to cool Charge fully Check the relative density

SYMPTOM: BATTERY ACID LEAKING FROM THE PLUG HOLES	
Possible cause	**Remedy**
Battery overfilled	Siphon off some of the fluid
Overcharging	Check the charger and repair if necessary

SYMPTOM: ELECTROLYTE LEVEL TOO LOW	
Possible cause	**Remedy**
Leaking battery	Replace the battery
Excessive gas development due to charging current being set too high	Check/repair the charger

SYMPTOM: RELATIVE DENSITY TOO LOW (< 1.240) STARTING TROUBLE	
Possible cause	**Remedy**
Power consumer left on by mistake	Charge the battery
Insufficient charging	Check/repair the charger
Short circuit in the charging circuit	Check the charging circuit

SYMPTOM: RELATIVE DENSITY TOO HIGH (> 1.290)	
Possible cause	**Remedy**
Topped up with acid instead of distilled water	Siphon off some of the fluid and top up with distilled water If necessary, repeat this after mixing (charging)

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SYMPTOM: STARTING TROUBLE POOR STARTING TEST RESULT POWER FAILS UNDER LOAD	
Possible cause	**Remedy**
Discharged battery	Charge the battery
Worn battery (plates corroded and worn away)	Replace the battery
Defective battery (‘dead cell’)	Replace the battery
Battery too small	Replace with battery of a higher capacity
Battery sulphated (plates have hardened)	Replace the battery

SYMPTOM: BURNT IN BATTERY POLES	
Possible cause	**Remedy**
Terminals not securely fitted, or poor contact	Have the battery poles repaired, fit the terminals properly and replace the terminals if necessary

SYMPTOM: 1 OR 2 CELLS BUBBLE EXCESSIVELY UNDER HIGH LOADS (STARTING OR STARTING TEST)	
Possible cause	**Remedy**
Defective cells	Replace the battery
Leaking cell partition	Replace the battery

SYMPTOM: BATTERY DISCHARGES VERY FAST (DOES NOT RETAIN POWER)	
Possible cause	**Remedy**
Insufficient charging	Check the charging. Is the charging time (driving time) sufficient?
Short circuit in charging circuit	Check the charging circuit
Major self discharging, for example due to contamination	Clean the battery
Battery sulphated (on examining the plates, they are found to be hard and, in some cases, whitened)	Replace the battery

SYMPTOM: SHORT BATTERY LIFE	
Possible cause	**Remedy**
Wrong type of battery chosen (for example, in the case of tail lifts)	Install Super Heavy Duty or semi-traction battery
Often too deeply discharged	Intermediate charging with rectifier
No recharging after deep discharge (white deposits)	Always charge the battery after deep discharge

SYMPTOM: BATTERY HOT DURING OPERATION WITH EXCESSIVE WATER CONSUMPTION	
Possible cause	**Remedy**
Overloading, or charging voltage too high	Check the charger (voltage regulator)

SYMPTOM: BATTERY HAS EXPLODED	
Possible cause	**Remedy**
Fire or sparks during or just after charging	Ensure good ventilation and exercise due caution as regards fire and sparks
Short-circuiting by tools	Be careful where tools are put down
Internal defect (loose connection)	Replace the battery

SYMPTOM: DEFECTIVE ALTERNATOR AND/OR DIODES (RADIO AND OTHER POLARITY SENSITIVE EQUIPMENT NOT WORKING)	
Possible cause	**Remedy**
Reversed battery polarity, or incorrect charging	Discharge the battery and charge in the correct direction If necessary, replace the battery

SYMPTOM: BATTERY IS INACTIVE (NO VOLTAGE)	
Possible cause	**Remedy**
Internal open circuit	Replace the battery
Battery very deeply discharged	Charge the battery and test it; replace if necessary

1.2 SERVICE LIFE

The service life of a battery is significantly shortened if it is used 'cyclically'.
This means that the batteries are used a lot without their being charged.
For example when using a tail lift, cab heater, microwave oven and a cooler box.
This is why batteries in commercial vehicles and vehicles used for international transport often fail prematurely (within 1.5 years).

The battery must be charged whenever the voltage measured across the battery falls below 12.5 V. If the battery is not charged, the 'sulphating' process will begin.
This is a chemical reaction in the battery that produces lead sulphate. Lead sulphate adheres to the battery plates and can cause short circuiting between the plates, reducing the capacity of the battery.
However, most lead sulphate breaks down when the battery is recharged.
If a battery is used (discharged) while it is not being charged by the alternator, short circuiting between the battery plates will occur sooner.
This reduces the capacity and consequently the service life of the battery.

2. ALTERNATOR

2.1 FAULT-FINDING TABLE

SYMPTOM: ALTERNATOR NOT PRODUCING POWER WHEN IDLING	
Possible cause	**Remedy**
Open circuit in connection 15 on alternator	Repair connection 15
Connection 15 on alternator short circuited to earth	Repair connection 15
Internal defect	Replace regulator

SYMPTOM: ALTERNATOR WARNING (YELLOW)	
Possible cause	**Remedy**
Open circuit in 'S' connection	Measure the regulated alternator voltage with as many consumers as possible switched on and with the engine turning above idling speed
Open circuit in 'L' connection	Check/repair wiring
Open circuit in connection 15	Increase the engine speed to approx. 1500 rpm. If voltage is still present, check connection 15 on the alternator
Voltage difference between 'B+' and 'S' connections is greater than 2.5 V	Check all contacts between alternator and batteries (contact resistances). Internal battery resistance too high.
Voltage too low <16 V	Check alternator drive. Check wiring on contact resistances Check regulated voltage
Open circuit in voltage regulator	Replace voltage regulator

SYMPTOM: ALTERNATOR VOLTAGE HIGH (RED)	
Possible cause	**Remedy**
Voltage too high >31 V	Measure voltage
Internal defect	Replace regulator/alternator

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3. FAULT FINDING

The following test equipment and tools can be used to trace faults.

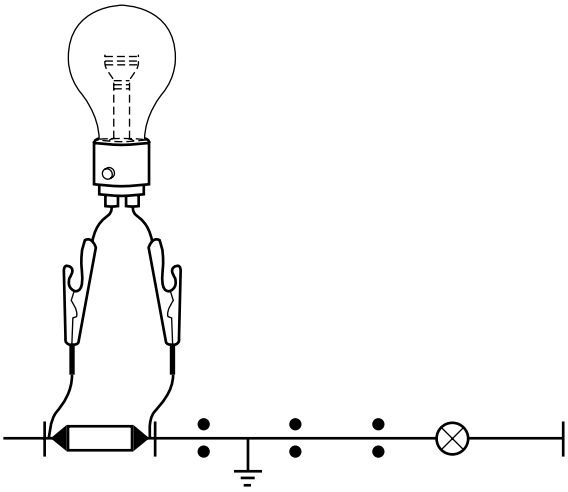
1. The best instrument for this is a digital multimeter. This instrument can be used to measure voltages, currents and resistances avoiding reading errors, and it can be used to trace virtually any faults.
2. Many, but not all, faults are easily traced by means of warning lamps. Failures caused by poor earthing cannot normally be detected by a warning lamp or buzzer.

The most frequently occurring faults are:

a. short circuit
b. open circuits
c. earthing problems (poor earthing due to corrosion).

3.1 SHORT CIRCUITS

A short circuit is caused by a positive wire shorting to earth somewhere. In most cases this will cause a fuse to blow.
To remedy this failure, use a test lamp of approximately 70 W. First check the diagram to see which consumers are connected to the fuse in question, and then switch them all off.
Remove the fuse and connect the test lamp in its place. Now switch each of the consumers on and off one by one. If the lamp comes on very brightly when a consumer is switched on, the fault is almost certainly in the wiring of that consumer. Now check the diagram to see via which connectors the consumer is connected.
Now disconnect the first wiring connection (as seen from the fuse).
If the lamp is still bright, the fault is between the fuse and this wiring connection.



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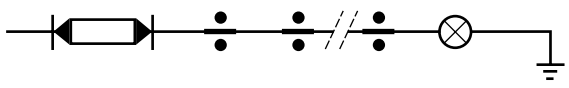
If, however, the lamp goes out, the fault is somewhere further on in the wiring.
Now reconnect the connectors and disconnect the next wiring connection. If the lamp is still bright, the failure is between these two wiring connections.
However, if the lamp goes out again, the fault-finding procedure must be continued.
The faulty wiring section can be found in this way.

3.2 OPEN CIRCUIT

Suppose a consumer is not functioning. The fault may be in the consumer itself, or there may be an open circuit in the wiring.
First switch on the consumer. Then check the consumer for voltage using a test lamp. If no voltage is found, first check whether the fuse is still intact.
If there is voltage at the fuse, check the wiring from the fuse to the consumer. This means every wiring connection must be checked.
Stop at the first wiring connection that has no voltage. The open circuit will be between this connection and the previous one.
However, if there was a voltage at the consumer, there may still be an open circuit in the negative (earth) wiring. Check this using a test lamp.
Ensure that the relevant circuit is switched on.
Connect one end of the test lamp to earth and the other end to the earth connection of the component to be checked.
If the test lamp starts burning, the earth connection of the component is interrupted. If the test lamp does **not**light up, the earth connection will in many cases be in good condition.
If both the positive and negative connections are in good order, the consumer in question must be replaced.



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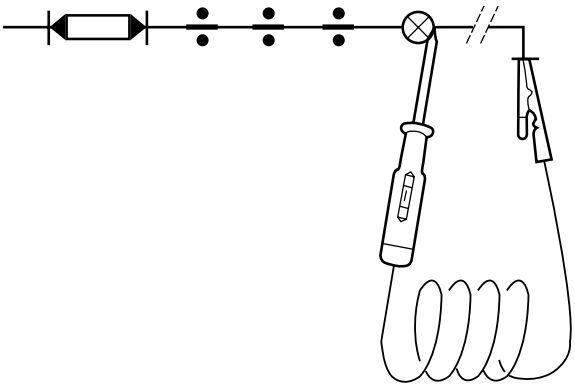

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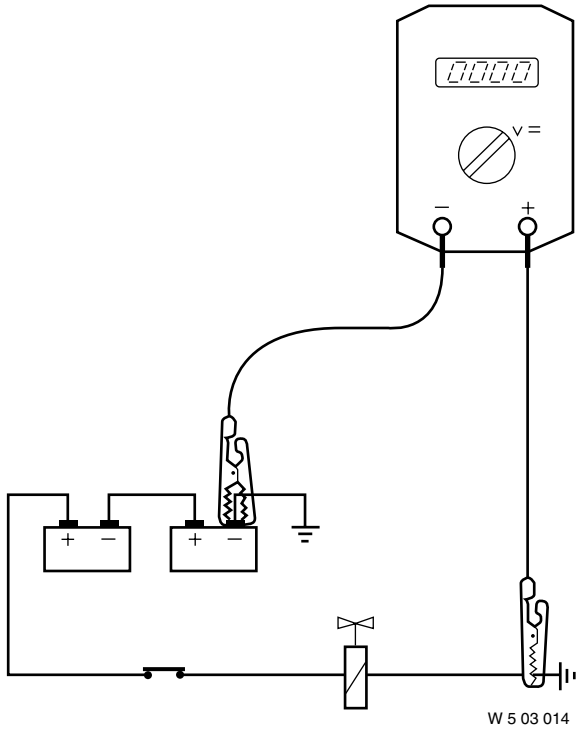
3.3 EARTHING PROBLEMS

Earthing problems are mainly caused by corrosion between the contact surfaces of electrical connections.
Earthing problems can only be detected using a multimeter (preferably digital). A digital tester is preferable because usually only a few volts will be measured and an analogue meter is generally not precise enough for this purpose.
To find out whether a specific earthing point has a good earth connection, use a voltmeter to measure the voltage between the negative battery pole and this earthing point.
Switch on as many consumers as possible.
If there is a correct earth connection, **no** voltage should be found.
In practice, however, a loss of approx. 0.5 volts will often be measured.
If the reading is higher, the earth connection must be checked carefully.
In this way, the earth connections of all consumers can be checked and measured.



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