Motor
Engine

	Einheit Unit	EC 160 Nr. / No. 11 811 -
Hersteller und Typ Manufacturer and model		4BT 3.9-C
Arbeitsweise Type		Viertakt-Dieselmotor mit Aufladung undDirekteinspritzung Four-stroke Diesel engine with turbocharging and directinjection
Standardleistung ISO 3046/1-IFN Standard rated output ISO 3046/1-IFN	kW	75
Nenndrehzahl (bei Vollast) Rated speed (at full load)	min $^{-1}$ rpm	2200
Leerlaufdrehzahl Idling speed	min $^{-1}$ rpm	1000
Hohe Leerlaufdrehzahl High idling speed	min $^{-1}$ rpm	2450
Zündfolge Firing sequence		1-5-3-6-2-4
Drehrichtung Direction of rotation		Auf Schwungrad gesehen links Anti-clockwise when looking atflywheel
Ventilspiel Einlaß/Auslaß (bei kaltem Motor) Valve clearance: inlet and exhaust (engine cold)	mm / mm inch / inch	0,25 / 0,51 0.01 / 0.02
Verdichtungsverhältnis Compression ratio		17,5 : 1
Öldruck Oil pressure		
bei 950 min^{-1} (Mindestdruck) at 950 rpm (Minimum allowable)	bar / psi	0,7 / 10
bei 2200 min^{-1} (Mindestdruck) at 2200 rpm (Minimum allowable)	bar / psi	2,76 / 40
Öffnungsbereich - Thermostat Thermostat at opening range	˚C ˚F	82 - 93 180 - 200

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Track chain

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Releasing track tension

WARNING

Read and observe "Safety instructions" before starting work on the track chain and the chain tensioning device.

Wear protective glasses.

The chain tension grease is under high pressure. Therefore, release the filler valve carefully.

The grease flows out into the crawler member. This prevents grease being ejected uncontrolledly.

- Clean the track unit as described in section "Cleaning the track unit".
- Park the machine on a dry level surface.

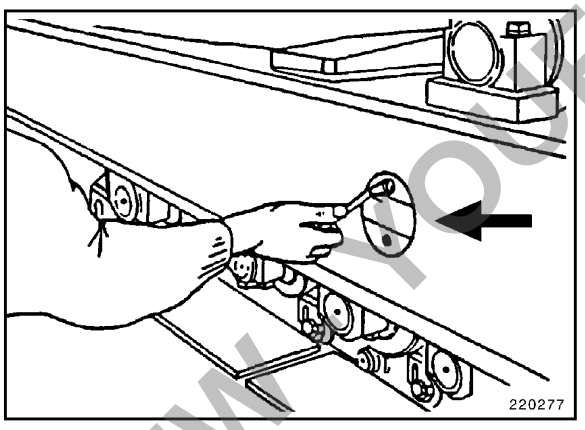


Fig. 1

- Remove cover (Fig. 1).

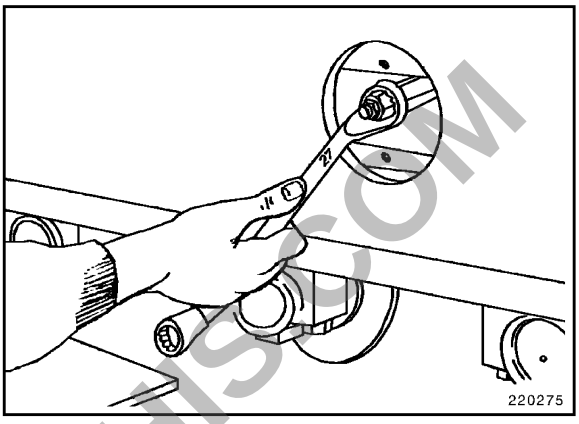


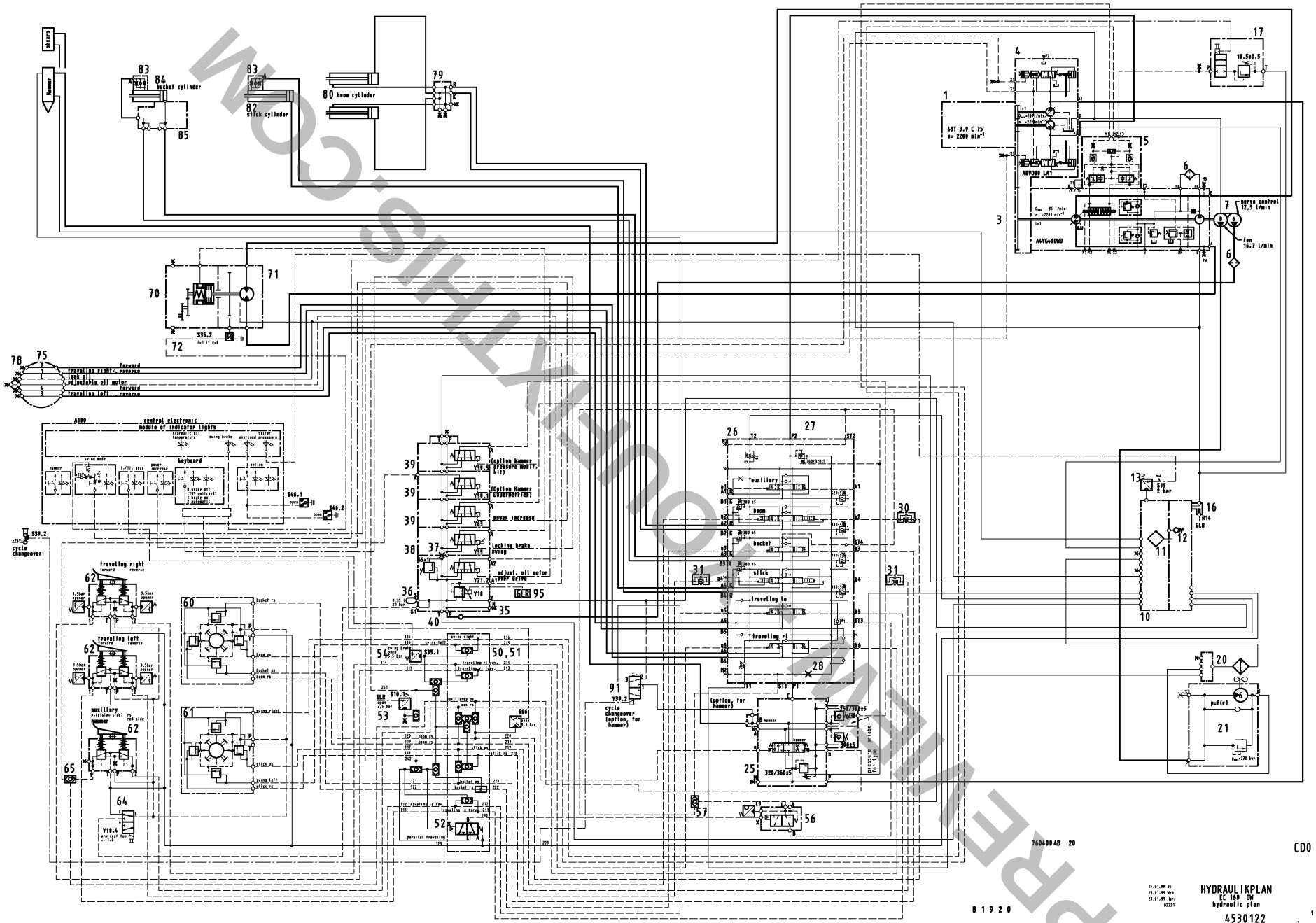
Fig. 2

- Place a ring spanner on the filler valve (Fig. 2).
- Screw out filler valve, maximum two rotations. Grease from the chain tensioning device flows out at the thread of the filler valve.

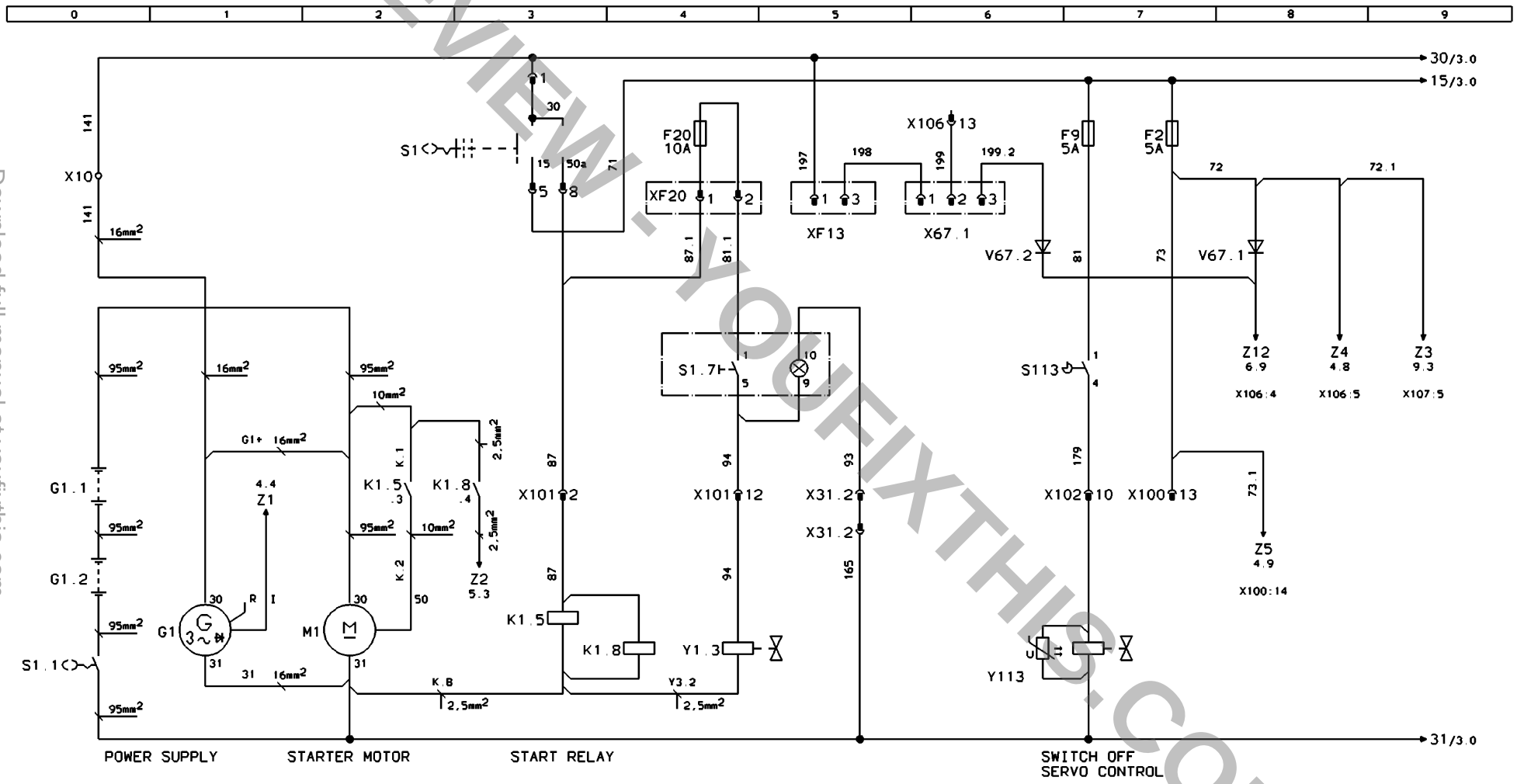
  The track chain tension has been released when grease no longer flows out of the filler valve and maximum track chain sag is present between the top rollers, and between top roller and driven wheel/front idler.
- Remove grease from track member and dispose of it in an environmentally responsible manner.
- Close filler valve securely.
- Tension track chain as described in section "Tensioning the track chain".
- Reattach cover (Fig. 1).
- Tension track chain of other track unit using the same procedure.
  The sag of both track chains should be identical. □

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Schrauben mit Regelgewinde nach DIN 13 - 13
Bolts with standard thread DIN 13 - 13

Gewinde-Nenn Ø Thread nominal Ø	Festigkeits-klasse Material quality	Anziehdrehmomente M_A in Nm Tightening torques M_A in Nm		
		gesamt total 0,10[1]	gesamt total 0,12[2]	gesamt total 0,16 (L)[3]
M 5	8.8 10.9 12.9	4,9 7,3 8,5	5,5 8,1 9,5	6,5 9,5 11,2
M 6	8.8 10.9 12.9	8,5 12,5 14,5	9,5 14 16,5	11,2 16,5 19,5
M 8	8.8 10.9 12.9	20,5 30 35	23 34 40	27 40 47
M 10	8.8 10.9 12.9	41 60 71	46 68 79	55 80 94
M 12	8.8 10.9 12.9	71 104 195	79 117 215	94 140 260
M 16	8.8 10.9 12.9	170 250 300	195 280 330	230 340 400
M 20	8.8 10.9 12.9	350 490 580	390 560 650	470 670 780
M 24	8.8 10.9 12.9	600 850 1000	670 960 1120	800 1140 1350
M 30	8.8 10.9 12.9	1190 1700 2000	1350 1900 2250	1600 2300 2700
M 36	8.8 10.9 12.9	2100 3000 3500	2350 3300 3900	2800 4000 4700

[1] Schraube und/oder Mutter galvanisch verzinkt (A3B).
Screw and/or nut electro-galvanized.

[2] Schraube schwarz vergütet oder phosphatiert, Gewinde geölt.
Screw black-plated or phosphatized, thread oiled.

[3] Schrauben mit flüssiger Schraubensicherung z.B. Loctite 242, 243.
Screws with liquid screw fixer, e.g. Loctite 242, 243.

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To evaluate the reported faults and to analyze the amount of damage (spare-parts requirements / scope of repair work), the table below (FAULT CODE) sets out the individual codes and the effect on the machine for servicing purposes.

Most of the faults listed in the table are stored by the ODC automatically after occurrence of the event in a non-volatile memory in the form of text building blocks (see "Fault storage").

FAULT CODE table

Code	Trouble	Fault	Effect
02	engine temperature sensor	cable broken	power loss
04	engine temperature sensor	short-circuit	power loss
05	Centry error	Centry	
08	proportional valve 1, PLC	short-circuit	engine power reduction
09	engine error	engine	
10	proportional valve 1, PLC	cable broken	engine power reduction
200	hydr. temperature sensor	cable broken	power loss
400	hydr. temperature sensor	short circuit	power loss
800	hydraulik temperature	too high	power loss
1000	engine temperature	too high	power loss
2000	speed 0 and DSI active		power loss
8000	internal software error		
10000	sensor E-speed	cable broken	
40000	communication error	control panel	engine power reduction
80000	pressure sensor SLI	cable broken	

PLC = Power-Limiting Control

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01 Foreword / Safety instructions

02 Service Data

03 Tools

04 Undercarriage

05 Superstructure

06 Diesel engine

07 Gear boxes

08 Hydraulic system

09 Electrical system

10 Equipment

11 Fittings, pipes and hoses
Welding for maintenance and repair
Sealing, protective, checking and cleaning agents

12

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⚠ FUNDAMENTAL SAFETY INSTRUCTIONS

Warnings and symbols

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The following signs are used in the manual to designate instructions of particular importance:

⚠ DANGER

Imminent danger involving the risk of death or of severe injuries.

⚠ WARNING

Precautionary rules and measures designed to protect the machine operator and other persons from life-threatening danger or injuries and to prevent extensive damage.

⚠ CAUTION

Information and precautionary measures designed to prevent damage to the machine or other property.

□

Danger in the event of non-observance of the safety instructions

⚠ WARNING

This hydraulic excavator has been built in accordance with state-of-the-art standards and the recognized safety rules.

However, operating the machine if a fault is suspected or has occurred, or carrying out repair work inexpertly may

- **endanger the lives of persons in contact with it**
- **damage the machine and other property.**

The hydraulic excavator must be stopped immediately on any damage being suspected or occurring to ensure that the safety of the operator, of other persons at the place of use or of other material property is not compromised.

All components are carefully co-ordinated. Trouble-free operation and a long service life can only be achieved with original spare parts.

□

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FOREWORD

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This **Technical Handbook (THB)** has been written with **the servicing mechanic** in mind and contains important information required to carry out repair and servicing procedures.

Read through the **Technical Handbook**, but also the **Operating Instructions** for the **hydraulic excavator** before commencing any servicing or repair work. The **Technical Handbook**, as well as the **Operating Instructions** and **Spare Parts List** should be used as a source of reference and assistance - even when the user is well acquainted with the range of excavators.

Using the Technical Handbook allows the experienced mechanic to carry out repair work in a correct manner.

Using the Technical Handbook

The Technical Handbook is divided into main and sub-groups that deal with the machine as actually delivered. Any auxiliary attachments or optional upgrading introduced later are not described.

The main table of contents allows to find the required information quickly.

For the sake of clarity, the illustrations have been simplified and can therefore differ slightly from the actual appearance of the machine.

Servicing and repair

Servicing and repair work should be carried out as soon as possible. This keeps overall servicing & repair costs to a minimum and increases the availabilily of the excavator

During servicing and repair work, always follow the instructions contained in the Technical Handbook and Operating instructions.

Major work that is not described in the Technical Handbook will be gladly undertaken by the **After Sales Service.**

The **After Sales Service** is always available for assistance and advice.

When making any enquiries, please always state the Machine Model and the machine's Serial No.

□

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Kraftstoffverbrauch
Fuel consumption

1 g / PS h	=	1,3596 g / kW h	1 g / kW h	=	0,7355 g / PS h
1 lb / HP H	=	608,277 g / kW h	1 g / kW h	=	0,001644 lb / HP H
1 liq pt / HP H	=	634,545 cm^3 / kW h	1 cm^3 / kW h	=	0,001576 liq pt / HP H
1 pt (UK) HP H	=	762,049 cm^3 / kW h	1 cm^3 / kW h	=	0,001312 pt (UK) / HP H

	Umrechnung von Conversion for			Umrechnung von Conversion for				Umrechnung von Conversion for	
	g/PS h	g/kW h		lb HP H	liq pt HP H	pt (UK) HP H		miles gal (US)	miles gal (UK)
	in g / kW h	in g / PS h		in g / kW h	in cm^3 / kW h	in cm^3 / kW h		in l / 100 km	in l / 100 km
100	136,0	73,55	0,10	60,83	63,45	76,20	10	23,5	28,2
120	163,2	88,26	0,15	91,24	95,18	114,3	11	21,4	25,7
140	190,3	103,0					12	19,6	23,5
160	217,5	117,7	0,20	121,7	126,9	152,4	13	18,1	21,7
180	244,7	132,4	0,25	152,1	158,6	190,5	14	16,8	20,2
200	271,9	147,1	0,30	182,5	190,4	228,6	15	15,7	18,8
220	299,1	161,8	0,32	194,6	203,1	243,9	16	14,7	17,7
240	326,3	176,5	0,34	206,8	215,7	259,1	17	13,8	16,6
260	353,5	191,2	0,36	219,0	228,4	274,3	18	13,1	15,7
280	380,7	205,9	0,38	231,1	241,1	289,6	19	12,4	14,9
300	407,9	220,6	0,40	243,3	253,8	304,8	20	11,8	14,1
320	435,1	235,4	0,42	255,5	266,5	320,1	22	10,7	12,8
340	462,3	250,1	0,44	276,6	279,2	335,3	24	9,80	11,8
360	489,5	264,8	0,46	279,8	291,9	350,5	26	9,05	10,9
380	516,6	279,5	0,48	292,0	304,6	365,8	28	8,40	10,1
400	543,8	294,2	0,50	304,1	317,3	381,0	30	7,84	9,42
420	571,0	308,9	0,52	316,3	330,0	396,3	32	7,35	8,83
440	598,2	323,6	0,54	328,5	342,7	411,5	34	6,92	8,31
460	625,4	338,3	0,56	340,6	355,3	426,7	36	6,53	7,85
480	652,6	353,0	0,58	352,8	368,0	442,0	38	6,19	7,43
500	679,8	367,7	0,60	365,0	380,7	457,2	40	5,89	7,06
520	707,0	382,5	0,62	377,1	393,4	472,5	42	5,60	6,73
540	734,2	397,2	0,64	389,3	406,1	487,7	44	5,35	6,42
560	761,4	411,9	0,66	401,5	418,8	503,0	46	5,11	6,14
580	788,6	426,6	0,68	413,6	431,5	518,2	48	4,90	5,88
600	815,8	441,3	0,70	425,8	444,2	533,4	50	4,70	5,65
650	883,7	478,1	0,75	456,2	475,9	571,5	55	4,28	5,14
700	951,7	514,8	0,80	486,6	507,6	609,6	60	3,92	4,71
750	1020	551,6	0,85	517,0	539,4	647,7	70	3,36	4,04
800	1088	588,4	0,90	547,4	571,1	685,8	80	2,94	3,53
900	1224	661,9	0,95	577,9	602,8	723,9	90	2,61	3,14

Beispiel:
Example:
240 g / PS h = 326,3 g / kW h

Beispiel:
Example:
0,68 liq pt / HP H = 431,5 cm^3 / kW h

Beispiel:
Example:
18 miles / gal (US) = 13,1 l / 100 km

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UNDERCARRIAGE

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Foreword

The "Technical Specifications" manual contains important information for personnel servicing the machine. Machine specifications listed elsewhere in the machine documents are not always repeated in this book.

The documentation includes:

- the operating instructions
- the spare-parts list
- the dimension table with the technical data of the machine.

The present brochure does not contain the specifications of auxiliary units for the operation of additional or optional equipment or the specifications of individual machines.

The refilling quantities specified for consumables are approximate quantities which are intended as a help for planning consumable requirements. Each unit is equipped with suitable checking devices, e.g. dipstick or checking plugs, permitting the operator to check proper filling of the units.

Safety Instructions

Danger in the event of non-obser-vance of the safety instructions

⚠ WARNING

This hydraulic excavator has been built in accordance with state-of-the-art standards and the recognized safety rules.

However, operating the machine if a fault is suspected or has occurred, or carrying out repair work inexpertly may

- **endanger the lives of persons in contact with it**
- **damage the machine and other property.**

The hydraulic excavator must be stopped immediately on any damage being suspected or occurring to ensure that the safety of the operator, of other persons at the place of use or of other material property is not compromised.

All components are carefully co-ordinated. Trouble-free operation and a long service life can only be achieved with original spare parts.

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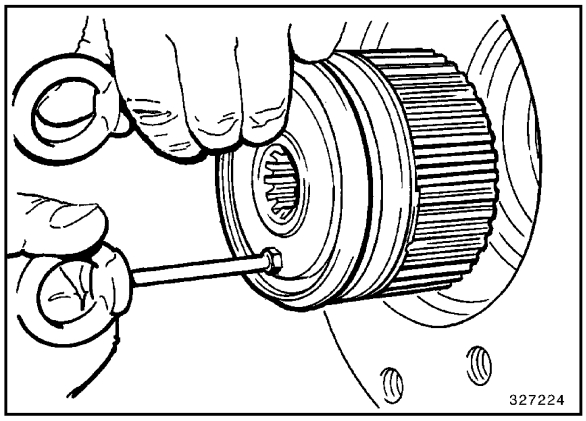


Fig. 17
Lift out the brake by means of two long M6 screws. For rebuild information, refer to page 27.

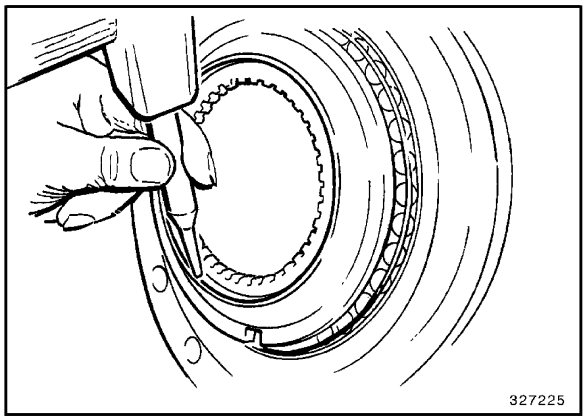


Fig. 18
Drive the four locking points of the slotted round nut out of the axle tube grooves by means of a suitable cross-cut chisel.

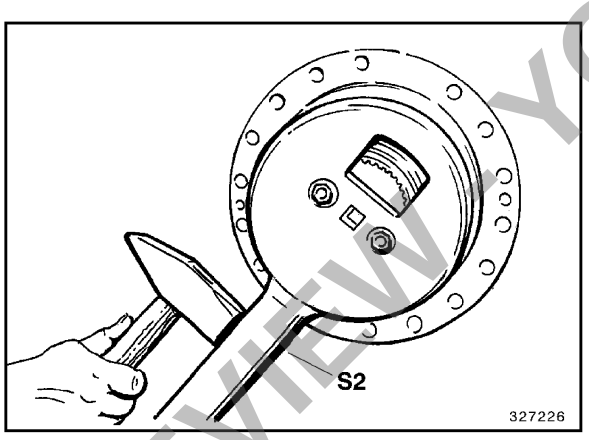


Fig. 19
Slacken the slotted round nut with special spanner S2.

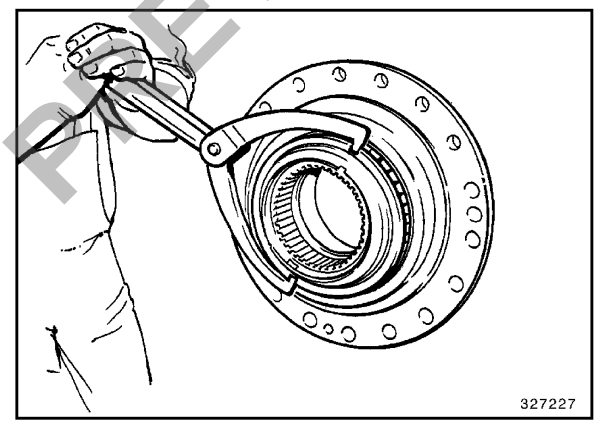


Fig. 20
Unscrew the slotted round nut with a pin spanner.

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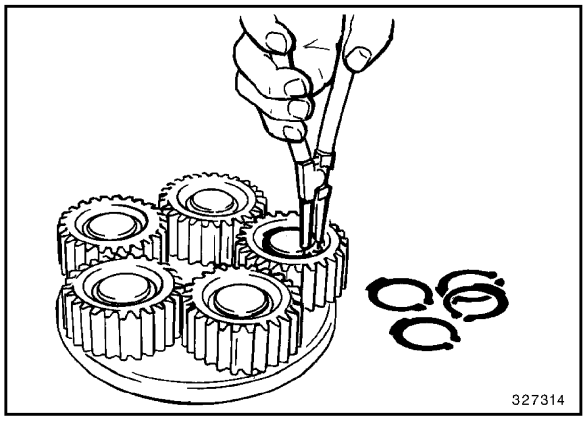


Fig. 19
Planetary gear set
Remove the snap rings.

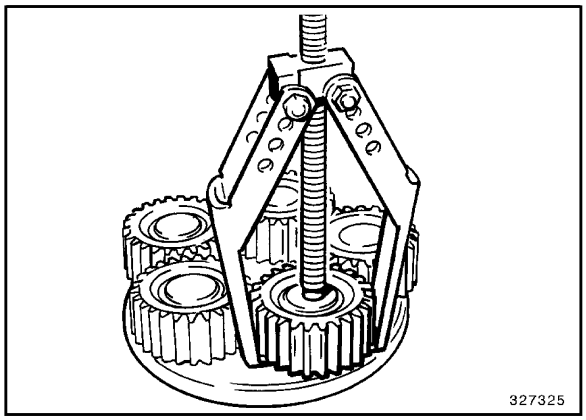
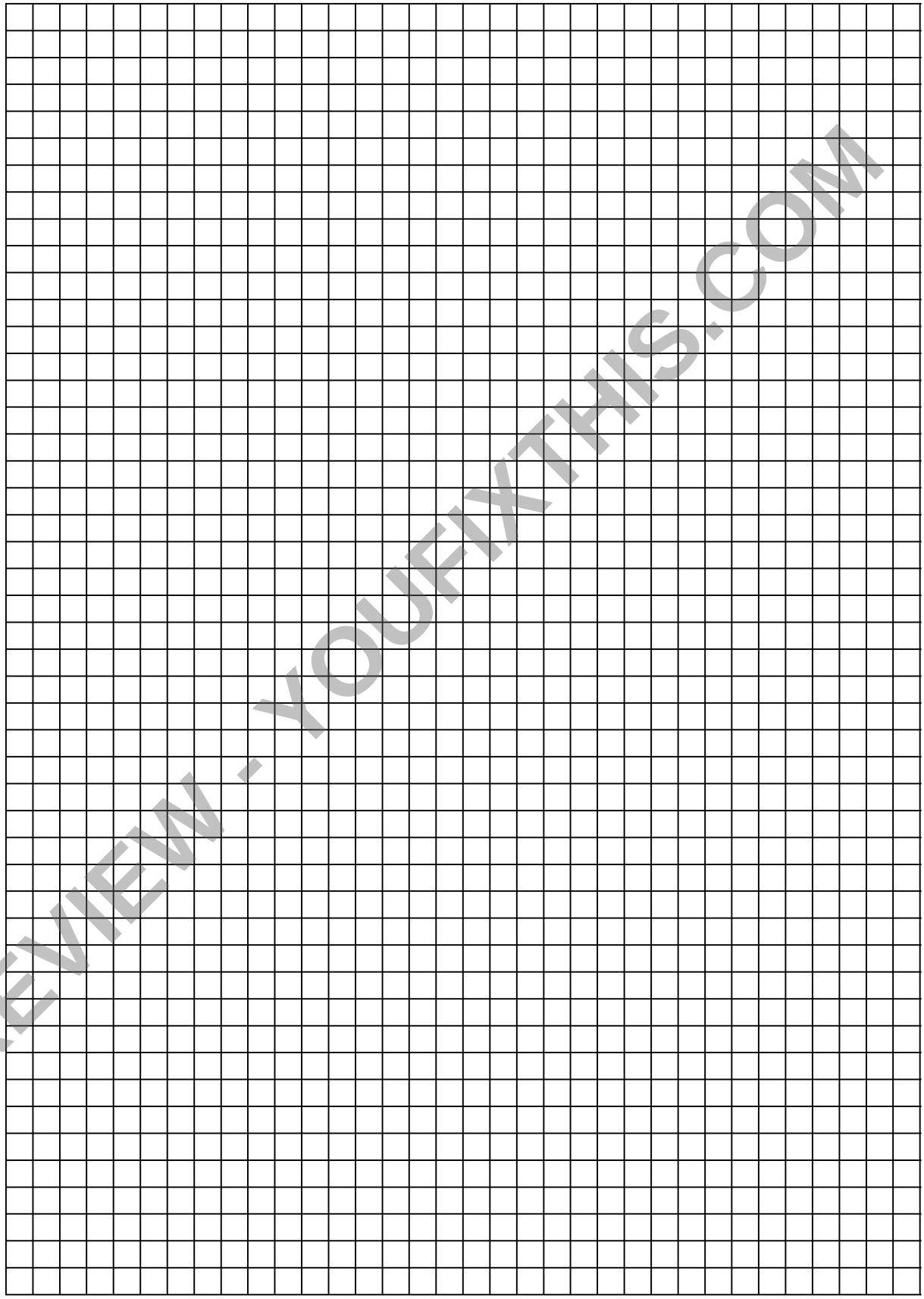


Fig. 20
Draw off the spur wheels together with the bearings using a suitable extracting tool.
Spur wheels = outer bearing ring, i.e. always replace spur wheels and bearing together. □

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Notes



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Sealing plug (37, Fig. 12)

The plug separates the back-pressure-loaded reservoir channel of the base unit (35) from the reservoir channel of the flange-mounted solenoid valve.

Solenoid valve Y35 (38, Fig. 12)

The solenoid valve controls both holding brakes in the swing gearboxes. With no voltage applied to the valve, the brakes are without pressure and blocked by spring force. When voltage is applied to the valve, servo control pressure is admitted to the holding brakes. The brakes are released and the superstructure is free to swing.
The valve is equipped with an emergency unlock function.

Solenoid valve Y 63 (39, Fig. 12)

The valve is operated electrically by the power boost key. It switches servo control pressure to the pressure cut-in stages of the primary valves, thus raising the max. pump pressure.

Solenoid valve Y39.1 (39, Fig. 12)

The valve is controlled electrically by depressing the hammer key on the control panel and the push-button in the left lever handle. The servo control pressure flows through the cascade (50 - 54) to the hammer control block (25) and the regulators of pump 1 and pump 2, port X1, thus enabling operation of the hammer.

Solenoid valve Y39.5 (39, Fig. 12)

The solenoid valve is electrically activated by a switch for options, e.g. scissors. The servo control pressure flows to the pressure cut-in stage at control block (25), thus enabling high working pressure for the scissors.

Check valve (40, Fig. 12)

The check valve prevents the diaphragm accumulator (36) from losing pressure to the pump after a stop of the Diesel engine.

At the same time, all solenoid valves of the valve assembly receive pressure energy from the accumulator.

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Piston rod guide boom and bucket cylinders

Dismantling and checking:

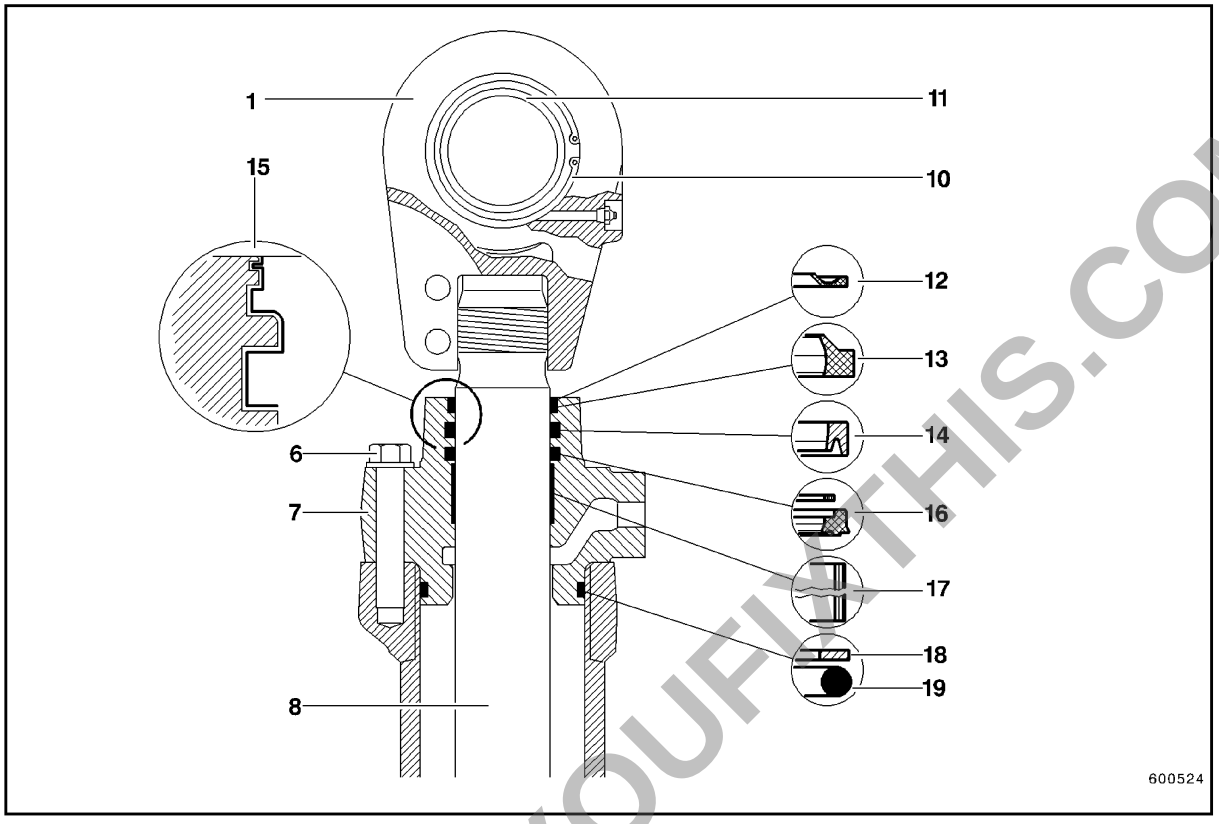


Fig. 9

- Drain hydraulic oil from the cylinder. Collect escaping oil in a suitable recipient.
- Remove the bearing eye (1, Fig. 9).
- Loosen the fastening screws (6).
- Dislodge guide (7) from the barrel by means of two M 12 x 150 jack screws or M 10 x 150.
- Withdraw the guide (7).
  Remove all sealing elements and wear parts using suitable tools such as, for instance, snub-nosed screwdrivers to prevent the sealing surfaces from being damaged.
- Check the guide (7). Replace if damaged. The other sealing elements and wear parts will otherwise be irreparably damaged in a very short time. Always replace all wear parts (wipers, lip seal, etc.).

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Maintenance

1) Basic rules

   Working on the electrical part of the starting motor involves the risk of short-circuits. It is therefore recommended to disconnect the ground terminal from the battery before undertaking such work. Do not place tools on the battery.

2) Carbon brushes

   The carbon brushes must be checked from time to time for condition (cf. figure). After removing the end cover, the spring pressing the carbon brush against the collector is lifted with a hook. Do not bend spring sideways and do not lift more than necessary before checking whether the carbon brushes move easily in the brush-holder guide.

3) Collector

   The collector should present a uniform and smooth surface of greyish black colour and must be free from oil and grease. Contaminated collectors must be cleaned with a clean and petrol-stained cloth (do not use cleaning wool) and properly dried. Collectors presenting scoring and out-of-roundness due to wear must be repaired by turning off on a lathe in a specialized workshop. Under no circumstances must collectors be treated with emery-paper or a file.

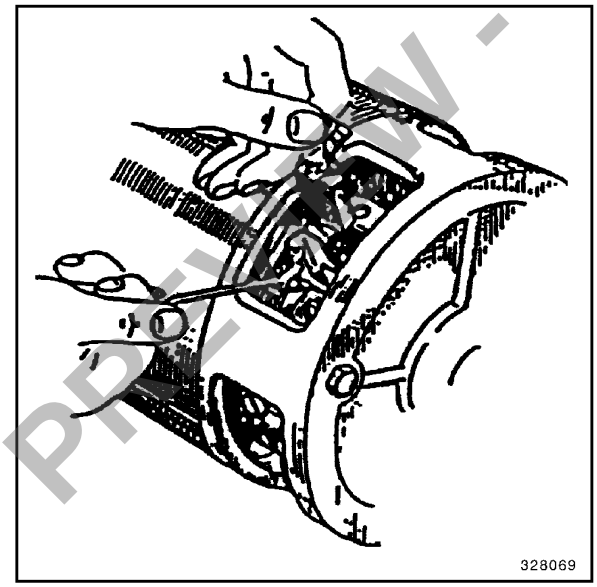


Fig. 13

Lubrication

Both bearings of pre-engaged-drive starting motors are self-lubricating. This means that they must not be lubricated. This type of bearing must not be treated with fat-dissolving detergents.

Carbon brushes and brush holders must be free from oil and grease. If these parts are contaminated or jamming, they must be cleaned with a clean and petrol-stained cloth (do not use cleaning wool because it is not lint-free) and well dried. Do not treat the bright metal sliding surface of the carbon brushes with emery-paper, files or knives. Brush holders must be blown clean. If a carbon brush is broken, unsoldered or worn out to such an extent that the spring or the stranded wire soldered into the brush threatens to contact the brush holder, the carbon brush must be replaced. When inserting the carbon brush, care must be taken that the spring does not tap on the brush

Carbon brushes should always be replaced during general repairs of the motor.

The collector should be repaired by turning off on a lathe whenever the carbon brushes are replaced.

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CHECKING AND TESTING EQUIPMENT

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All methods of fault detection described in the present Technical Handbook can be carried out with simple measuring instruments and testers.

The use of these devices is explained in this handbook by means of the step-by-step method (cf. section "Basic measuring and testing procedures").

The present handbook will not deal with technically more complicated testing devices for automotive electrical systems. These devices have their own operating instructions with detailed information about how to handle them. The operating instructions must therefore be read before using such equipment.

Depending on the manufacturer, the testing equipment used in the field can differ from the instruments shown in this handbook. Due to the large number of commercially available types it is impossible to show all the types in this handbook. For this reason, the handbook dispenses with brand names and names of manufacturers.

Solenoid-valve tester

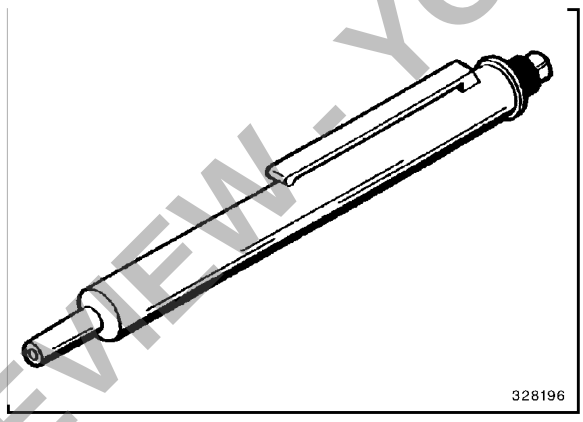


Fig. 1

The solenoid-valve tester indicates whether the coil of a solenoid valve or a relay produces a magnetic field.

The magnetic field is generated when current flows through the coil.

Operation of the solenoid tester shown requires two batteries (1.5 V, type AAA).

Test lamp

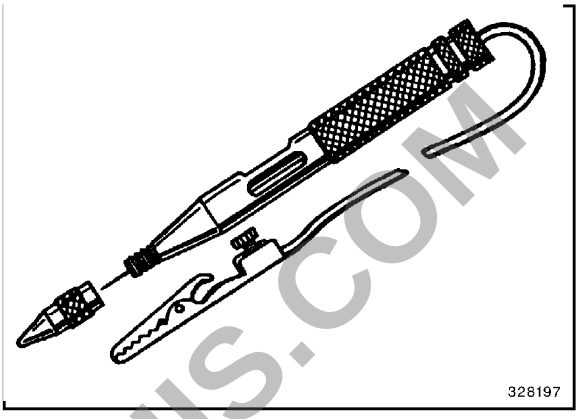


Fig. 2

Important:

Never use the test lamp for testing on circuit boards equipped with electronic components. Sensitive electronic components may be damaged by the strong current flowing through the test lamp. The housing of the test lamp is metallic and therefore conducts electric currents. The housing may therefore cause a short-circuit between two adjacent components on the board.

The test lamp lights up when the tested component is under tension.

Test lamps are manufactured for different system voltages. The test lamp must be designed for the voltage of the electrical system, as a 12-volt test lamp will be damaged if it is used in 24-volt systems.

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On-Board Computer (A10)

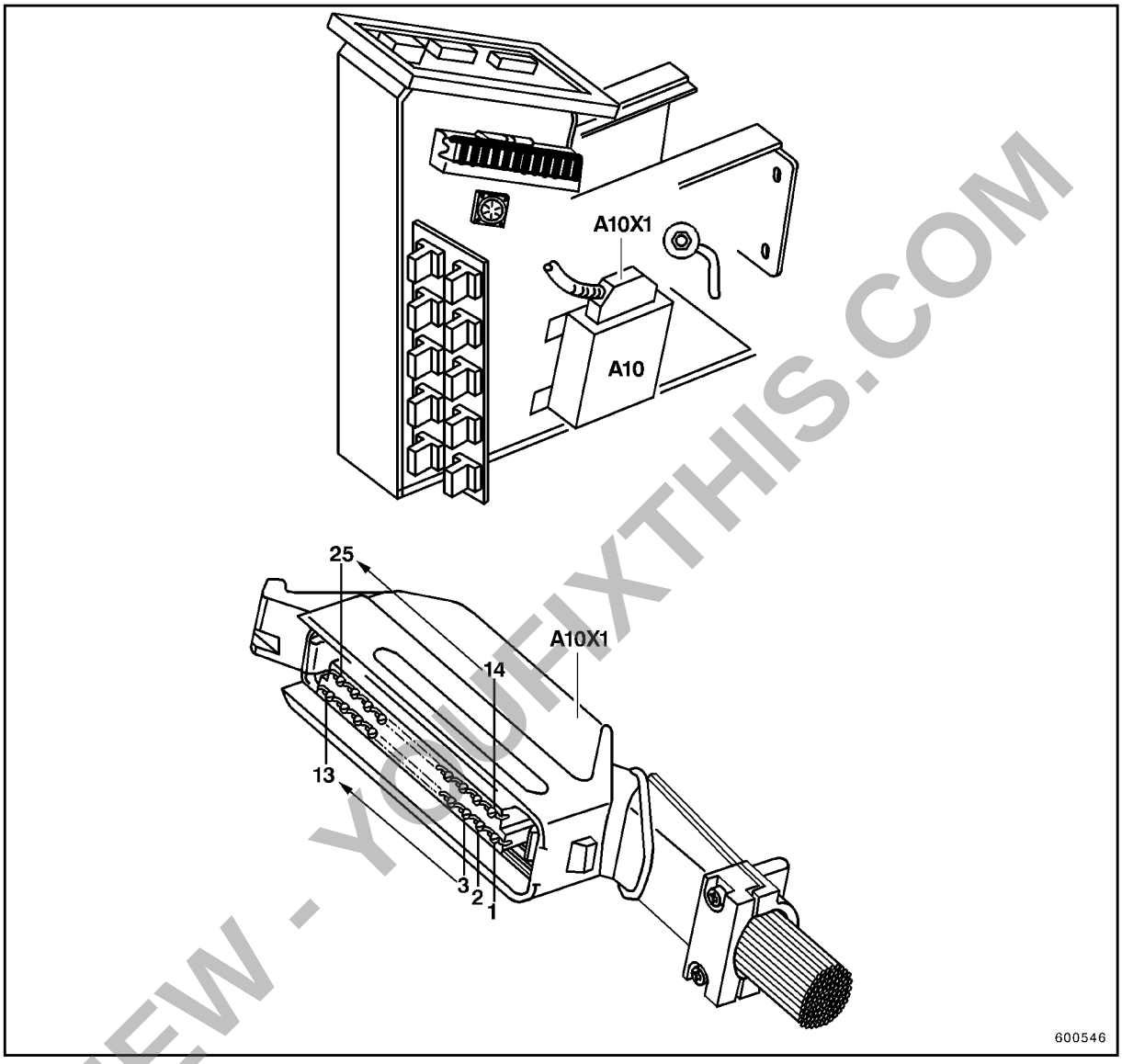


Fig. 1

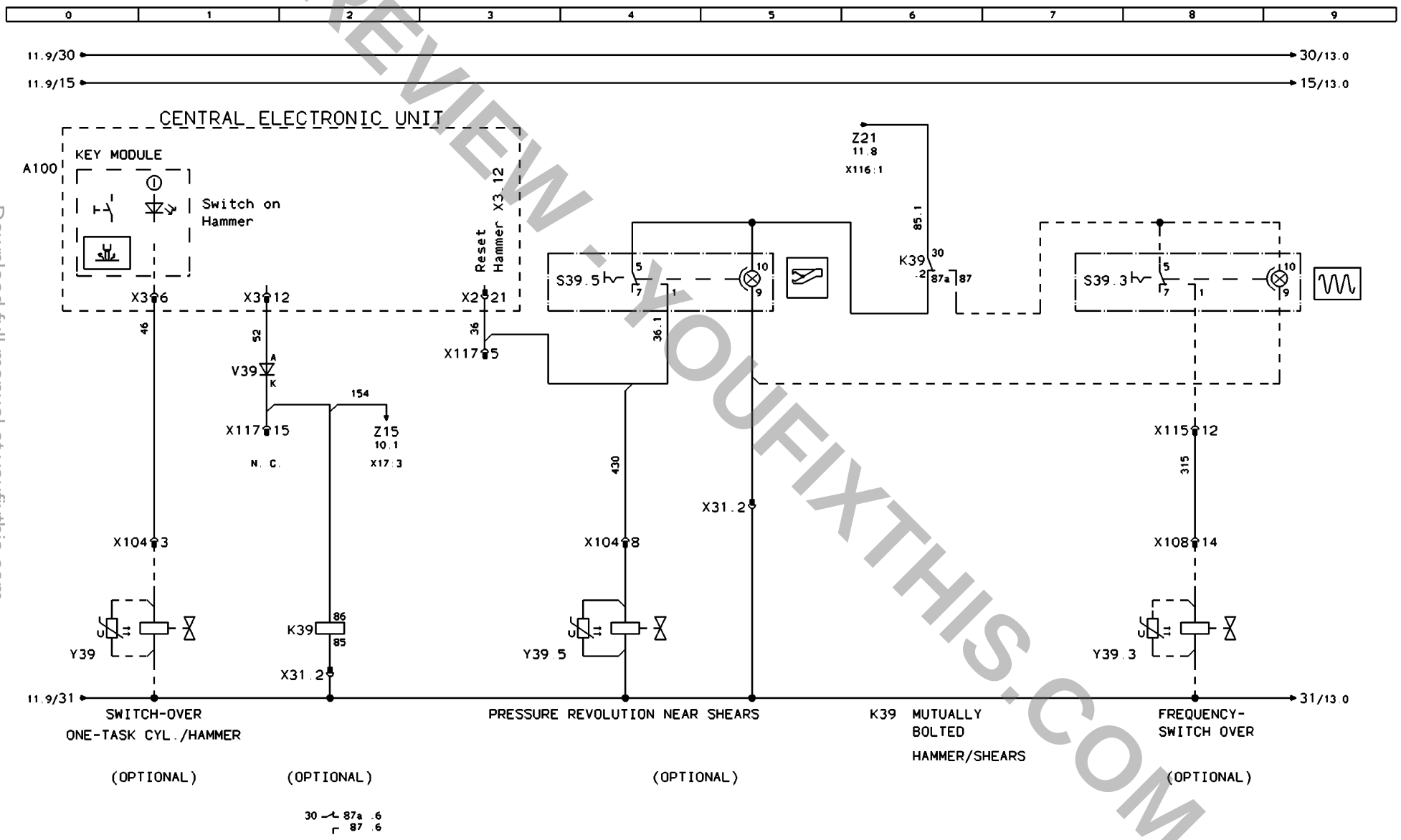
Connector A10X1 (Fig. 1):

AMP Junior Timer	25 poles

The contacts of female connector A10X1 are numbered in numerical order from 1 thru 25 following the arrow.

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Wear a safety harness when carrying out maintenance work at greater heights.

Keep all handles, steps, handrails, platforms, landings and ladders free from dirt, snow and ice.

Clean the machine, especially connections and threaded unions, of any traces of oil, fuel or preservatives before carrying out maintenance/repair. Never use aggressive detergents. Use lint-free cleaning rags.

Before cleaning the machine with water, steam jet (high-pressure cleaning) or detergents, cover or tape up all openings which - for safety and functional reasons - must be protected against water, steam or detergent penetration. Special care must be taken with electric motors and switchgear cabinets.

Ensure during cleaning of the machine that the temperature sensors of the fire-warning and fire-fighting systems do not come into contact with hot cleaning agents as this might activate the fire-fighting system.

After cleaning, remove all covers and tapes applied for that purpose.

After cleaning, examine all fuel, lubricant, and hydraulic fluid lines for leaks, loose connections, chafe marks and damage. Any defects found must be rectified without delay.

Always tighten any screwed connections that have been loosened during maintenance and repair.

Any safety devices removed for set-up, maintenance or repair purposes must be refitted and checked immediately upon completion of the maintenance and repair work.

Ensure that all consumables and replaced parts are disposed of safely and with minimum environmental impact.

Warning of special dangers

Electric energy

Use only original fuses with the specified current rating. Switch off the machine immediately if trouble occurs in the electrical system.

When working with the machine, maintain a safe distance from overhead electric lines. If work is to be carried out close to overhead lines, the working equipment must be kept well away from them. Caution, danger! Check out the prescribed safety distances.

If your machine comes into contact with a live wire

- do not leave the machine
- drive the machine out of the hazard zone
- warn others against approaching and touching the machine
- have the live wire de-energized
- do not leave the machine until the damaged line has been safely de-energized.

The electrical equipment of machines is to be inspected and checked at regular intervals. Defects such as loose connections or scorched cables must be rectified immediately.

Gas, dust, steam and smoke

Operate internal combustion engines and fuel-operated heating systems only on adequately ventilated premises. Before starting the machine on enclosed premises, make sure that there is sufficient ventilation.

Observe the regulations in force at the respective site.

Carry out welding, flame-cutting and grinding work on the machine only if this has been expressly authorized, as there may be a risk of explosion and fire.

Before carrying out welding, flame-cutting and grinding operations, clean the machine and its surroundings from dust and other inflammable substances and make sure that the premises are adequately ventilated (risk of explosion).

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R

Repair work - safety instructions 8

S

Safety instructions governing specific operational phases 3

Seal rings..... 27

Sealing and connecting components..... 27

Sealing pipe couplings..... 19

Selection and qualification of personnel - basic responsibilities..... 3

Special work in conjunction with utilization of the machine - maintenance and repairs during operation - disposal of parts and consumables 4

Standard operation 3

Steel pipes..... 10

Stircomatic seal rings 21

Stud couplings and male nipples..... 20

Swivel coupling with long male adaptor..... 22

Swivel coupling with straight male thread acc. to DIN 22

Swivel couplings 22

T

Table 1: Seal rings for flange couplings..... 39

Table 2: Double - Hex. Bolts 40

Table 3: Parts Nos. for 90˚§ flanges 42

Table 4: Parts Nos. for gauge connections and accessories..... 43

Transporting and towing - recommissioning 6

W

Warning of special dangers..... 5

Warnings and symbols 2

Wedge rings 27

WORKING EQUIPMENT..... 7

Z

Zako-system 32

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3.6.1.3 V-butt weld with backing strip

V-butt weld with backing strip 25x4 (fig. 51). Seam accessible from 1 side

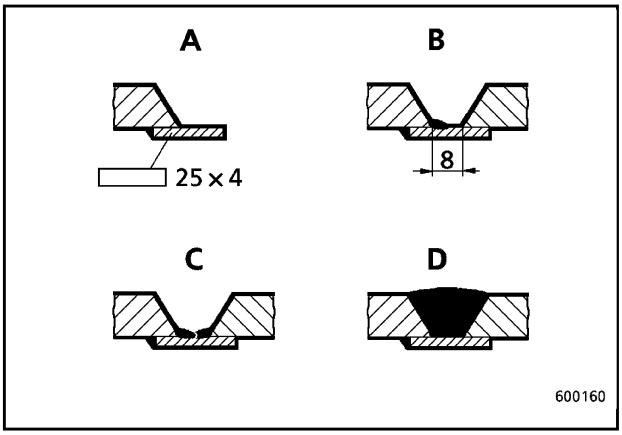


Fig. 51

A Backing strip attached
B Joint prepared and 1st root bead welded
C 2nd root bead welded
D Seam welded

V-butt weld with backing strip 30x6 (fig. 52). Seam accessible from 1 side

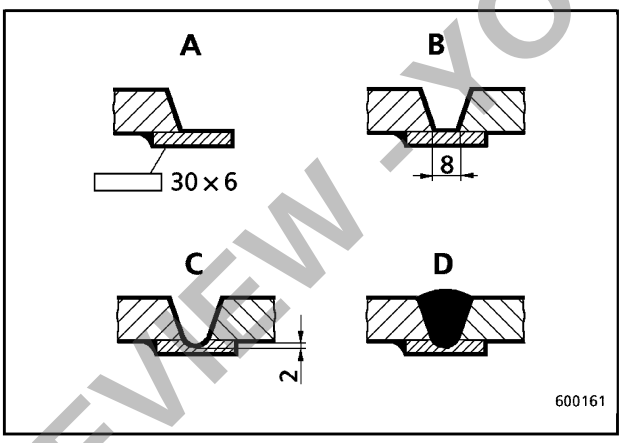


Fig. 52

A Weld-backing strip attached
B Joint prepared
C Joint gouged out (grinding)
D Seam welded

3.6.2 T-joints

3.6.2.1 T-joints (fig. 53), accessible from 2 sides

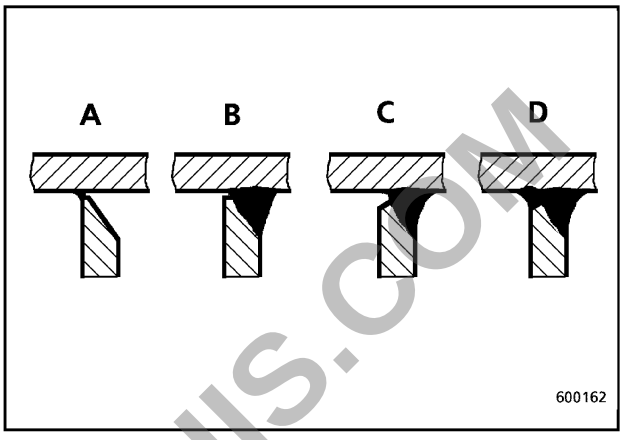


Fig. 53

A Web and chord plates tacked
B Single-bevel weld deposited
C Root gouged out
D Seam welded

3.6.2.2 T-joints with backing strip (fig. 54), accessible from 1 side

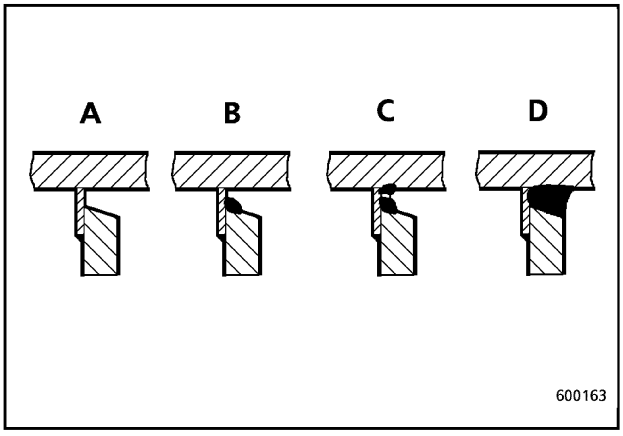


Fig. 54

A Backing strip welded
B 1st root bead welded
C 2nd root bead welded
D Seam welded

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Full-face build-up welding

Relatively small areas subject to heavy wear are hard-faced by a full-face build-up weld.
This ensures full-face protection of the base material (fig. 7).

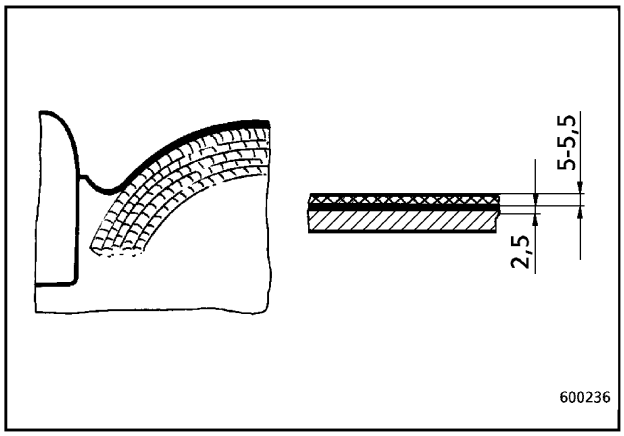


Fig. 7

9.2.2 Special hints

- Before carrying out build-up welding, the base materials are to be preheated depending on their material properties.
- During welding, the interpass temperature is to be kept below 250°C (480°F).
- Build-up welding should be used only for the protection of base materials with a hardness not exceeding a B.H.N. of abt. 300.

  Due to the welding heat introduced, build-up welding on base materials of greater hardness causes microstructural transformations in zones of the material close to the surface, with the result that hardness diminishes considerably.

Another consequence is the formation of high internal stresses in the base material.
Only tough base materials can deal with these internal stresses, such as materials with a max. B.H.N. of 300 .

9.3 Filler metals

9.3.1 For buffer layers

Rod electrodes:
EN 499: E 38 2 RA 22
AWS 5.1: E 6013

Wire electrodes:
EN 440: G 3 Si 1
AWS 5.18: ER 70 S-6

9.3.2 For hard-facing layers

Only for gravity position welding, e.g. original hard-facing in the workshop:

Wire electrodes:
DIN 8555 : MF 10 - GF - 60 - RT
filler wire Ø 2 mm
P/N 73171549

Reference analysis:

C	Cr	Nb	Si	Mn	
5.0	22.0	7.0	0.5	0.7	%

Rod electrode
DIN 8555 : E 10 - UM - 60 GRZ
Ø 5 mm x 450 mm
P/N 73171538

Reference analysis:

C	Cr	Nb	V	Mo	W	
5.0	22.0	8.0	1.5	8.0	2.5	%

For out-of-position welding, e.g. subsequent hard-facing in the field:

Rod electrode:
DIN 8555 - E 6 - UM - 60 P
basic-type coating
alloyed core wire
P/N 73171539
Trade name: EA 600 Kb : VALCO Düsseldorf

Reference analysis:

C	Cr	Si	Mn	
0.5	6.0	1.3	1.3	%

Key:

R = rust-proof
Z = heat-resistant
P = impact-resistant
UM = coated
MF = metal-arc welding with filler wire
GF = flux-filled
T = high-temperature resistant
G = abrasion-resistant

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