SHOP MANUAL

Document 57.4400.0100 Edition 01/15/02

Light Capability Rough Terrain Forklift (LCRTF)

TX 51-19M

CONTRACT NO. M67854-00-C-3014



Terex
202 Raleigh Street
Wilmington, NC 28412
Phone: 910-395-8500 Fax: 910-395-8507

DEALER'S OR ASSISTANCE STAMP

Shop Manual ***57.4400.0100***

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SECTION 1
INTRODUCTION

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1.0 INTRODUCTION

Owners, Users, and Operators:

Terex appreciates your choice of our machine for your application. Our number one priority is user safety, which is best achieved by our joint efforts. We feel that you make a major contribution to safety if you as the equipment users and operators:

1. **Comply** with OSHA, Federal, State, and Local Regulations.
2. **Read, Understand, and Follow** the instructions in this and other manuals supplied with this machine.
3. **Use Good, Safe Work Practices** in a common sense way.
4. **Only have trained operators** – directed by informed and knowledgeable supervision – running the machine.

NOTE: OSHA prohibits the alteration or modification of this machine without written manufacturers approval. Use only factory approved parts to service or repair this unit.

If there is anything in this manual that is not clear or which you believe should be added, please send your comments to Manager of Publication, Terex, 202 Raleigh Street, Wilmington, North Carolina 28412; or contact us by telephone at (910) 395-8500.

Thank you!



THIS SYMBOL MEANS YOUR SAFETY IS INVOLVED! READ, UNDERSTAND, AND FOLLOW ALL DANGER, WARNING, AND CAUTION DECALS ON YOUR MACHINE.

1.1 SYMBOLS

When using the machine, operators could face some situations requiring special care and particular knowledge.

When these situations involve the safety or operators or bystanders, the machine efficiency and proper utilization, this manual stresses these specific instructions by means of SPECIAL SYMBOLS. There are special (or safety) symbols in this manual, always combined with keywords, which class the situations according to their danger degree. The symbols are always followed by a text explaining the situation taken into account, the attention that must be paid to such situation, the method and the behavior, which should be adopted. When necessary, it stresses prohibitions or supplies instructions to prevent dangers. Sometimes, it can be followed by illustrations.

Listed below are special (or safety) symbols according to the relative seriousness of the hazard situation:



DANGER – Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING – Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION – Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



ATTENTION – Indicates a situation which, if not avoided, may result in property or equipment damage.

THIS SYMBOL MEANS YOUR SAFETY IS INVOLVED! READ, UNDERSTAND, AND FOLLOW ALL DANGER, WARNING, AND CAUTION DECALS ON YOUR MACHINE.

SECTION 2
SAFETY RULES

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2.0 SAFETY RULES

2.1 GENERAL

Most accidents, which occur while working, repairing or maintaining machines, are caused by not complying with the basic safety precautions. Therefore, it is necessary to pay attention to the potential hazards and the effects, which may come of operations carried out on the machine.

If you recognize hazardous situations, you can prevent accidents!

For instance, this handbook list special safety symbols to stress any potentially hazardous situation.

The instructions given in this manual are the ones established by Terex. They do not exclude other safe and most convenient ways for the machine installation, operation and maintenance which take into account the available spaces and means.

If in doubt, it is always better to ask! For this purpose, contact Terex the assistance service is at you disposal. Addresses, phone and fax numbers are given in the title page of this manual.

ATTENTION

Machine must be used, operated and maintenance in complies with ASME B56.6 Standards.

2.2 OPERATORS MAINTENANCE STAFF RESPONSIBILITIES

The operators who use the machine regularly or occasionally (i.e. for transport reasons) shall have the following:

- Make sure the machine is in proper order and all warning signals are functional before operating.
- Before and during any operation, operators shall never consume alcoholic beverages, medicines or other substances, which may alter their psychophysical conditions and, consequently, their working abilities.
- Never lift a load without a Rating Chart in the cab.
- Good eyesight, acute hearing, good coordination and ability to carry out all required operations in a safe way, according to the instructions of this manual.
- Ability to understand and apply the enforced rules, regulations and safety precautions. They shall be careful and sensible for their own as well as other's safety and shall desire to carry out the work correctly and in a responsible way.
- They shall keep calm and always be able to evaluate their own physical and metal conditions.
- Read and understand the operators' manual, its enclosed graphs and diagrams, the identification and hazard warning decals. The operator should be skilled and trained about the machine use.
- The operator might be required to have a license (or a driving license) when provided for by the laws enforced in the country where the machine works.

WARNING

From a technical point of view, the ordinary maintenance of the machine is not complex. And can be carried out by the machine operator provided that he has a basic knowledge of mechanics.

2.3 CLOTHING

Your clothing should be relatively close fitting. Loose jackets, shirt sleeves, rings, and other jewelry should be avoided because of the danger of catching them in moving parts or on controls.

2.4 PERSONAL EQUIPMENT



Use only approved personal protective equipment in good condition.

Always wear required protective items such as hard hats, safety glasses, reflective clothing, safety shoes, and ear protection as required.

2.5 SAFETY PRECAUTIONS

JOB SITE

Always take into account the features of the job site where you are going in work:

- Always examine the working area and compare it with the machine dimensions in the different configurations.



Pay the greatest attention to overhead electric lines. Always keep at a minimum safe distance of at least 20 feet from the telescopic boom and the lifted load. Electrical Hazards!

- When assembling the machine or part of it on site, you need a well-equipped area of suitable dimensions. The surface shall be even, compact and stable.
- Look for the best route to the job site.
- When the machine is running, nobody can enter its working range.
- While working, keep the working area in order. Never leave objects scattered: They could hinder the machine movements and represent a danger for personnel.

2.6 GETTING READY TO WORK

Before any operation, the following precautions should be taken:

- First of all, make sure that all maintenance has been carried out with care according to the established schedule.
- Ensure you have enough fuel to avoid a sudden stop of the engine, especially during a crucial maneuver.
- Clean instruments, data plates, lights and the cab windshield thoroughly.
- Check the correct functioning of all the safety devices installed on the machine and in the job site.
- In case of troubles or difficulties, inform the supervisor at once. Never start working under unsafe conditions.

2.7 DURING WORK OR MAINTENANCE

During work, and especially maintenance, always pay attention:

- Do not pass or stop under raised loads or machine parts supported by hydraulic cylinders or ropes only.
- Keep the machine hand holds and access steps always clean from oil, grease or dirt to prevent falls or slips.
- When entering/leaving the cab or other raised parts, always face the machine.
- When carrying out operations at hazardous heights (over 5 feet from the ground), always use approved safety belts or fall preventing devices.
- Do not get into or off the machine while it is running.

- Do not leave the operators seat when the machine is running.
- Neither stop nor carry out repairs under or between the machine wheels when engine is running. When maintenance in this area is required, stop the engine.
- Do not carry out maintenance or repair works without a sufficient lighting.
- When using the machine lights, the beam should be oriented in order not to Blind the personnel at work.
- Before applying voltage to electric cables or components, check their connection and proper functioning.
- Do not carry out repairs on electric components with voltage over 48V.
- Do not connect wet plugs or sockets.
- Plates and hazard warning stickers shall never be removed, hidden or become unreadable.
- Except for maintenance purposes, do not remove safety devices, shields, protection cases, etc. Should their removal be necessary, stop the engine, remove them with the greatest care and always remember to refit them before starting the engine and using the machine again.
- Before any maintenance or repair work, stop the engine and disconnect the batteries.
- Do not lubricate, clean or adjust moving parts.
- Do not carry out operations manually when specific tools are provided for this purpose.
- Absolutely avoid the use of tools in bad conditions or in an improper way i.e. pliers instead of adjustable wrenches, etc.
- Before carrying out operations on hydraulic lines under pressure or disconnecting hydraulic components, ensure the relevant line has been previously depressurized and does not contain any hot fluid.



Any repairs made on the hydraulic circuit must be carried out by authorized personnel. The hydraulic circuit of this machine is fitted with pressure accumulators. You and others could be seriously injured if accumulators are not completely depressurized. For this purpose, shut the engine down and step on the brake pedal 8-10 times. Operate the steering wheel and joystick several times until the wheels stop turning with the machine engine off.

- Neither smoke or open flames in areas subject to fire dangers and in presence of fuel, oil or batteries.
- Do not leave fuel cans or bottles in unsuitable places.
- Do not empty catalytic mufflers or tanks containing burning substances without taking the necessary measures.
- Carefully handle all flammable or dangerous substances.
- Do not tamper with fire-extinguishers or pressure accumulators: explosion hazard!
- After any maintenance or repair work, make sure that no tool, cloth or other object has been left within machine compartments, fitted with moving parts, or where suction and cooling air circulates.
- When working, do not give instructions or signals to several people at the same time. Instructions and signals must be given by one person only.

- Always follow the instructions given by the supervisor.
- Never distract the operator during working phases of a crucial maneuver.
- After working, never leave the machine under potentially dangerous conditions.
- The relief valves are factory preset. Adjusting the valve in the field will void machine warranty. Valves must be set only by trained personnel.

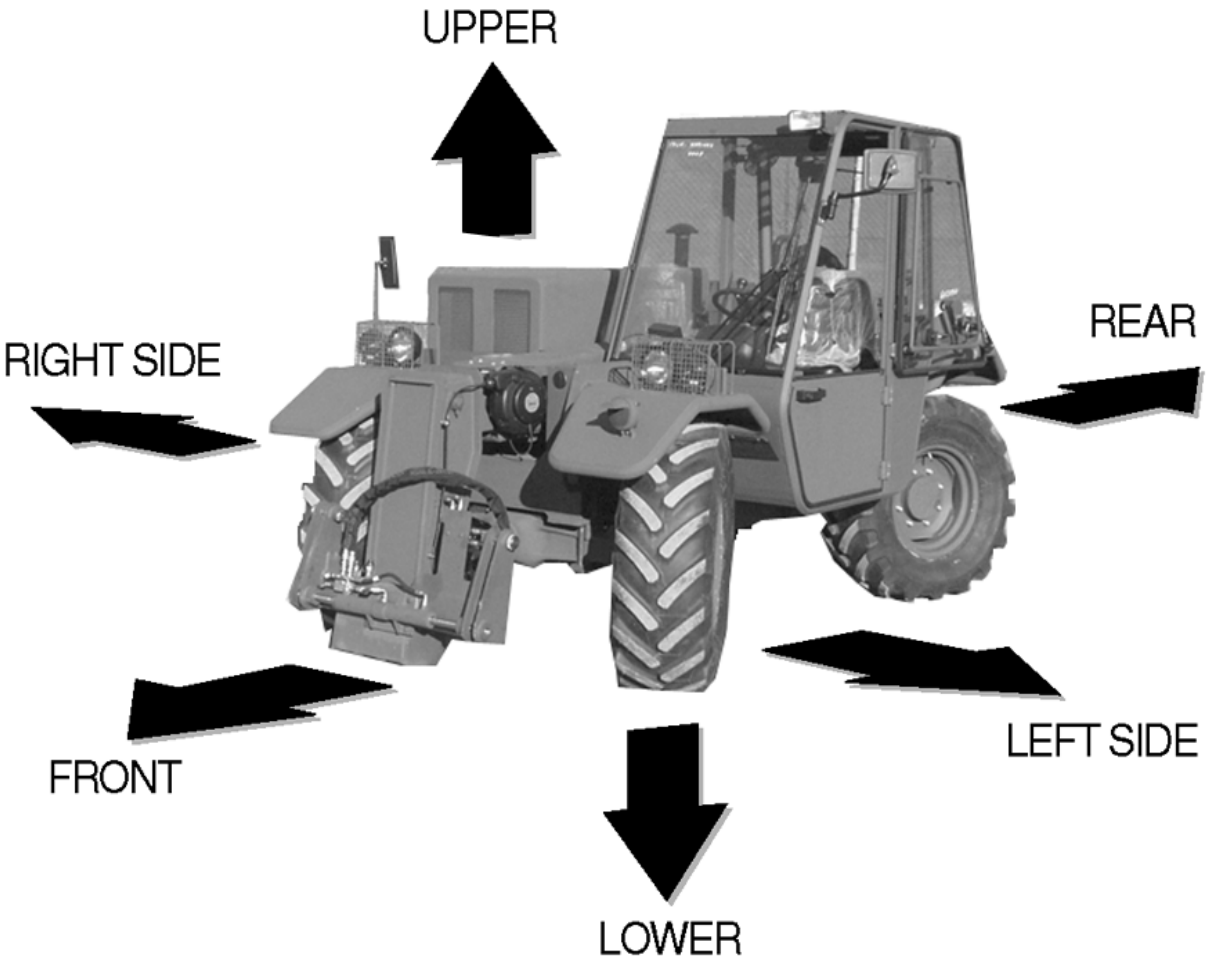
SECTION 3
GENERAL INFORMATION AND SPECIFICATIONS

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3.0 MACHINE REFERENCES

3.1 MACHINE POSITION

Any reference to the machine position will always be as if the operators is seating in the operator's seat, unless other wise specified.

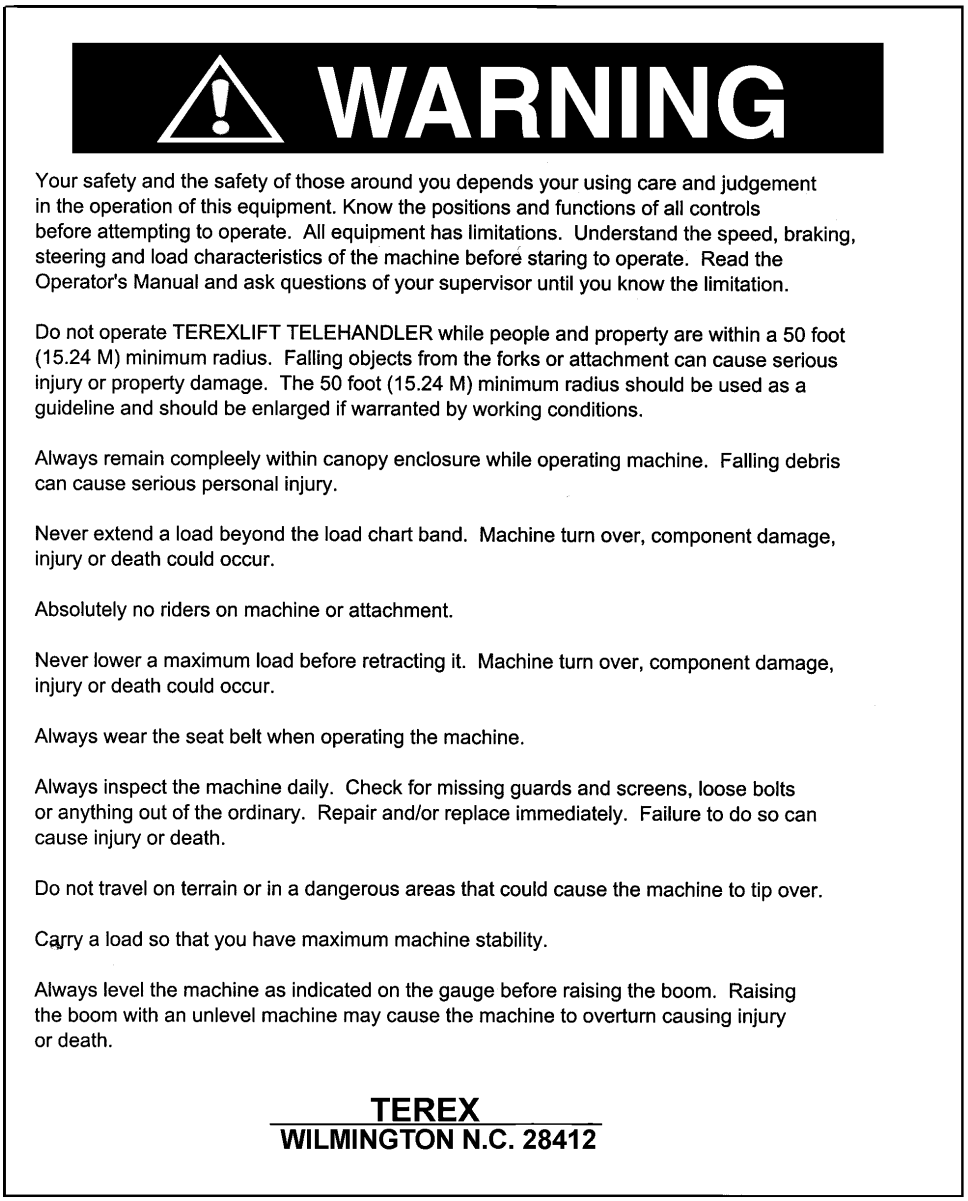


3.2 LABELS AND WARNING DECALS

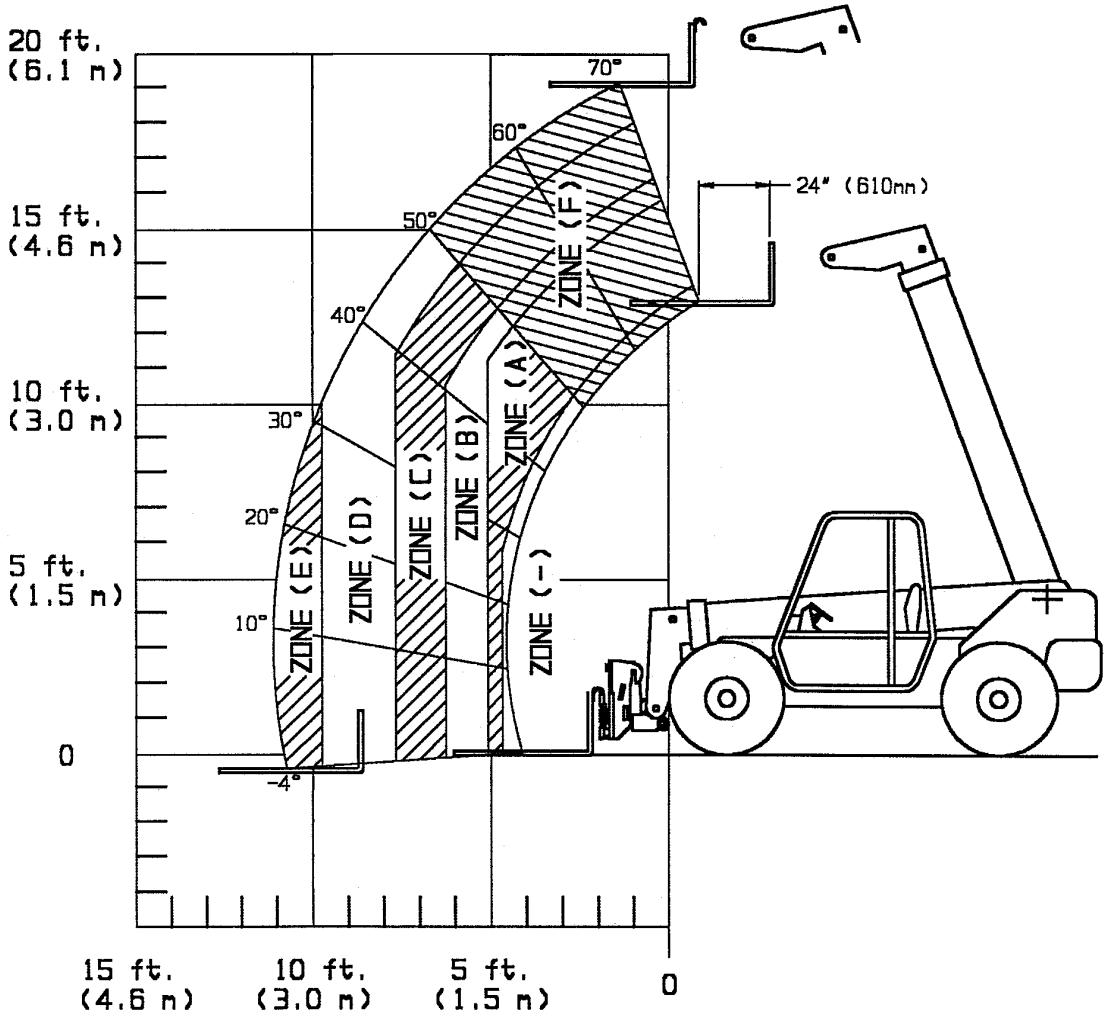
The labels and warning decals normally applied on standard machines or which can be found when special attachments are coupled to the machine are shown below.



Read and understand all decals on this machine. Make sure they are easy to read. For this purpose, clean them or replace those that become unreadable (either graphic or text). To clean labels, use a soft cloth, water and soap. Never use solvents, petrel, etc. When a label is applied on a part being replaced, make sure that the replaced part is already labeled as required or apply a new label.



TEREXLIFT TX51-19M



RATED LIFT CAPACITIES ARE WITH:
MACHINE ON A FIRM LEVEL SURFACE WITH UNDAMAGED, PROPERLY INFLATED TIRES.

TIRE SIZE: 375/75 R20
TIRE PRESSURE: 54 psi
TIRE PRESSURE - SOFT GROUND: 26 psi

S/N

LOAD LIMITS / HORIZONTAL BOOM
LAST FULLY VISIBLE LETTER

(-)	RETRACTED = 5070 LBS (2300 Kg)
(A)	LETTER VISIBLE = 4410 LBS (2000 Kg)
(B)	LETTER VISIBLE = 3305 LBS (1500 Kg)
(C)	LETTER VISIBLE = 2755 LBS (1250 Kg)
(D)	LETTER VISIBLE = 2205 LBS (1000 Kg)
(E)	LETTER VISIBLE = 1765 LBS (800 Kg)
(F)	BOOM ANGLE +50° =ALARM ONLY
	DO NOT EXCEED 500LBS (225Kg

WARNING

USE THE SEAT BELT

ALWAYS ADJUST SEAT AND FASTEN SEAT BELT BEFORE STARTING ENGINE.

WARNING



Operation & Maintenance Manual

- Do not remove manual from machine.
- Replace manual if damaged.

WARNING

BEFORE OPERATING

IMPROPER OPERATION OF THIS EQUIPMENT CAN CAUSE SEVERE INJURY OR DEATH.

READ AND UNDERSTAND THE OPERATOR'S MANUAL AND SAFETY INSTRUCTIONS BEFORE OPERATING OR SERVICING.

CAUTION

COOLING SYSTEM

PRESSURIZED COOLING SYSTEM. REMOVE CAP SLOWLY.

WARNING

NO RIDERS

WARNING

PARKING BRAKE

AN UNATTENDED MACHINE CAN MOVE OR ROLL.

SET PARKING BRAKE, LOWER CARRIAGE OR ATTACHMENT TO GROUND BEFORE LEAVING MACHINE.

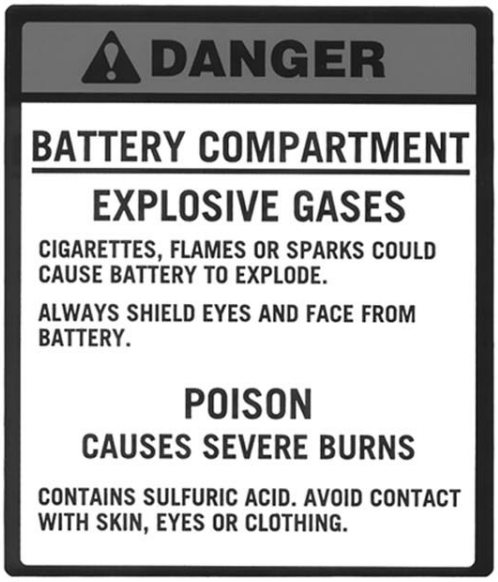
FAILURE TO HEED COULD RESULT IN DEATH OR SERIOUS INJURY.

WARNING

PINCH POINT AREA

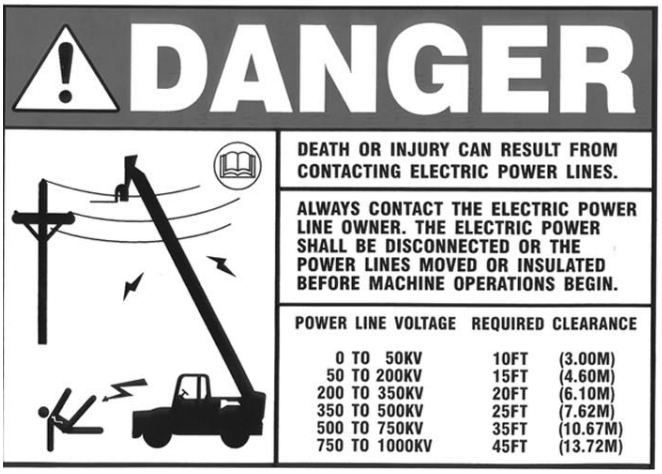
TO PREVENT INJURY KEEP CLEAR ANYTIME MACHINE IS RUNNING.


DANGER
Keep clear of boom to prevent serious bodily injury.


DANGER
BATTERY COMPARTMENT
EXPLOSIVE GASES
CIGARETTES, FLAMES OR SPARKS COULD CAUSE BATTERY TO EXPLODE.
ALWAYS SHIELD EYES AND FACE FROM BATTERY.
POISON
CAUSES SEVERE BURNS
CONTAINS SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES OR CLOTHING.


CAUTION
NO STEP


CAUTION
DO NOT WASH OR PAINT INSIDE THIS ENCLOSURE


DANGER
DEATH OR INJURY CAN RESULT FROM CONTACTING ELECTRIC POWER LINES.
ALWAYS CONTACT THE ELECTRIC POWER LINE OWNER. THE ELECTRIC POWER SHALL BE DISCONNECTED OR THE POWER LINES MOVED OR INSULATED BEFORE MACHINE OPERATIONS BEGIN.
POWER LINE VOLTAGE REQUIRED CLEARANCE
0 TO 50KV 10FT (3.00M)
50 TO 200KV 15FT (4.60M)
200 TO 350KV 20FT (6.10M)
350 TO 500KV 25FT (7.62M)
500 TO 750KV 35FT (10.67M)
750 TO 1000KV 45FT (13.72M)



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3.3 EXPLANATION OF THE DIFFERENT SYMBOLS USED ON THE MACHINE

This paragraph illustrates those symbols, which are normally applied on the main control devices and instruments of a standard machine, and those, which can be applied on accessories or special attachments. They are mainly (ISO) standardized symbols, which are now part of the common life.

Symbol	Description	Symbol	Description	Symbol	Description
	Hazard indicator lights		Steering selection		Lift/Tie Down
	Windsheild wiper		Brake pressure		Work - road setting
	Windsheild washer		Engine oil pressure		
	Cab ventilation fan		Boom raising		
	Diesel engine water temperature		Boom lowering		
	Fuel level		Boom extension		
	Hydraulic oil temperature		Boom retraction		
	Fork Rotating		Attachment locking device		
	Turn signals		Attachment releasing device		
	Parking brake		Fork pitching forward		
	Battery charge		Fork pitching back		
			Oil filter clogged		
			Air filter clogged		

3.4 MACHINE MODEL AND TYPE

Light Capability Rough Terrain Forklift (LCRTF), model TX-51-19M

3.5 MANUFACTURER

Terex
202 Raleigh Street
Wilmington, NC 28412
Phone: 910-395-8500 Fax: 910-395-8507

ATTENTION

Check that the operator and maintenance manual refers to the delivered machine. When asking for information or technical assistance, always specify model, type and serial number of the machine.

3.6 MACHINE IDENTIFICATION

Identification plates are applied on the machine.

U.S. MARINE CORPS

FORKLIFT TRUCK-ROUGH TERRAIN

MODEL #TX51-19M NSN 3930 01 478 3519

USMC S/N

DATE OF MANUFACTURE **S/N**

MANUFACTURED BY TEREX CRANES, INC.

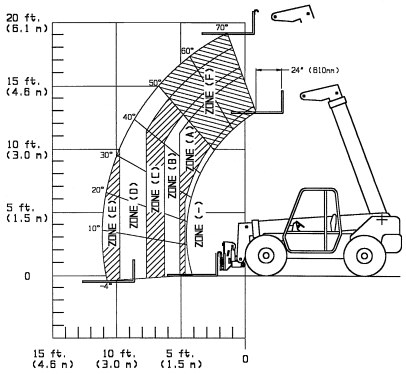
CONTRACT No. M67854-00-C-3014

The ROPS / FOPS Cert. Plate is located inside the machine.

TEREXLIFT s.r.l. ZONA INDUSTRIALE SUD 061019 UMBERTIDE (PG) ITALY	INTERNATIONAL STANDARD SAE J231 SAE J 1040 ISO 3449 ISO 3471
TX51/19M	MASS max 6125 kg
PART N° 51 . 1100 . 0004	MASS max 13.500 pounds
ROPS CERT. N° PASSED 2021 08/11/2000	SERIAL N°
FOPS CERT. N° PASSED 2021 08/11/2000	DATE

Machine Lifting Diagram is on the driver side, rear of machine, and left of the identification plate. This is to be used only as a reference. You should always use the current rating chart.

TEREXLIFT TX51-19M

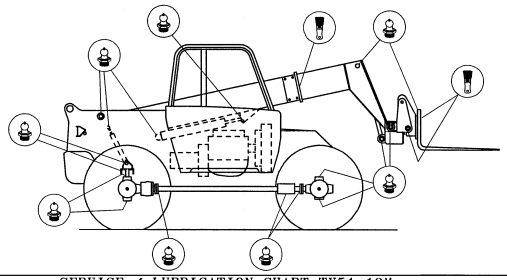


RATED LIFT CAPACITIES ARE WITH:
MACHINE ON A FIRM LEVEL SURFACE WITH UNDAMAGED, PROPERLY INFLATED TIRES.
TIRE SIZE: 375/75 R20
TIRE PRESSURE: 54 psi
TIRE PRESSURE - SOFT GROUND: 26 psi

S/N

LOAD LIMITS / HORIZONTAL BOOM
LAST FULLY VISIBLE LETTER
RETRACTED = 5070 LBS (2300 Kg)
(-) LETTER VISIBLE = 4410 LBS (2000 Kg)
(A) LETTER VISIBLE = 3305 LBS (1500 Kg)
(B) LETTER VISIBLE = 2755 LBS (1250 Kg)
(C) LETTER VISIBLE = 2205 LBS (1000 Kg)
(D) LETTER VISIBLE = 1765 LBS (800 Kg)
(E) LETTER VISIBLE = 1765 LBS (800 Kg)
(F) BOOM ANGLE +50° =ALARM ONLY
DO NOT EXCEED 500LBS (225Kg

Service Lubrication Chart is located on the inside door of the operators cab. This should be used to locate all lubrication points and will tell you what type of lubrication is required.



SERVICE / LUBRICATION CHART TX51-19M
FOR ADVERSE WEATHER CONDITIONS SEE OPERATORS MANUAL

INTERVAL	SERVICE POINTS	INDENTIFICATION	SERVICE REQUIRED	LUBRICANT SPECIFICATION (TYPE) SAE	VISCOSITY	SPECIFICATION	API	SERVICE LOCATION
50 HOURS OR WEEKLY	1	ENGINE OIL LEVEL	CHECK	EO	15W-40	MIL-L-2104F	CD-CF	DIPSTICK, RH ENGINE SIDE
	1	ENGINE COOLANT LEVEL	CHECK	---	50%/50%	---	---	OVERFLOW RESERVOIR, REAR ENGINE SUPPOR
	1	ENGINE FUEL PRE-FILTER	DRAIN	---	---	---	---	RH ENGINE SIDE
	1	HYDRAULIC RESERVOIR OIL	CHECK	HYDO	ISO 46	MIL-H-5606	29.3	SIGHT GAUGE @ OPERATING TEMP
	1	BRAKE RESERVOIR	CHECK	HYDO	ISO 46	MIL-H-5606	29.3	RESERVOIR, REAR ENGINE SUPPORT
	8	BOOM PADS	LUBE	MPG	NLGI 2	---	---	END OF BOOM
	8	AXLE KINGPINS	LUBE	MPG	NLGI 2	---	---	4 EACH AXLE, TOP & BOTTOM, EACH END
	1	AXLE REAR PIVOT PIN	LUBE	MPG	NLGI 2	---	---	TOP OF REAR AXLE
	9	CYLINDERS	LUBE	MPG	NLGI 2	---	---	BEARING EACH END OF CYLINDER
	5	FORK ATTACHMENT	LUBE	MPG	NLGI 2	---	---	PIVOTS
	1	BOOM PIVOT	LUBE	MPG	NLGI 2	---	---	BOOM PIVOT @ CENTER OF BOOM
	3	DRIVESHAFT	LUBE	MPG	NLGI2	---	---	FRONT, REAR, AND SLIP JOINT
	12	DRIVESHAFT BOLTS	CHECK	---	---	---	---	6 EACH U-JOINT, TORQUE 28 FT/LB
	4	TIRE INFLATION	CHECK	---	---	---	---	1 EACH, 54 PSI COLD
	32	TIRE WHEEL NUTS	CHECK	---	---	---	---	8 EACH WHEEL, TORQUE 294 FT/LB.
250 HOURS OR MONTHLY	1	ENGINE OIL	CHECK	EO	15W-40	MIL-L-2104F	CD-CF	SAMPLING VALVE, REAR ENGINE SUPPORT
	1	ENGINE COOLANT	CHECK	---	---	---	---	SPECIFIC GRAVITY, OVERFLOW RESERVOIR
	1	ENGINE AIR FILTER	CHECK	---	---	---	---	UNDERHOOD
	1	HYDRAULIC RESERVOIR OIL	CHECK	HYDO	ISO 46	MIL- H-5606	29.3	SAMPLING VALVE, REAR ENGINE SUPPORT
	4	AXLE, WHEEL ENDS OIL	CHECK	MPL	10W - 30	T.O.H.	GL4	LEVEL PLUG, 2 EACH AXLE
	2	AXLE, DIFFERENTIAL OIL	CHECK	MPL	10W - 30	T.O.H.	GL4	LEVEL PLUG, 1 EACH AXLE
	1	ENGINE DRIVE BELT	CHECK	---	---	---	---	FRONT OF ENGINE
	2	BATTERY	CHECK	---	---	---	---	RH REAR FENDER
500 HOURS OR QUARTERLY	1	ENGINE OIL	CHANGE	EO	15W-40	MIL-H-2104F	CD-CF	ENGINE OIL PAN
	1	ENGINE AIR FILTER	CHANGE	---	---	---	---	UNDER HOOD
	1	ENGINE OIL FILTER	CHANGE	---	---	---	---	RH ENGINE SIDE
	1	ENGINE FUEL FILTER	CHANGE	---	---	---	---	RH ENGINE SIDE
	4	ENGINE GLOW PLUGS	CHECK	---	---	---	---	ENGINE
	1	HYDRAULIC RESERVOIR FILTER	CHANGE	---	---	---	---	OUTSIDE RESERVOIR
1000 HOURS OR SEMI-ANNUALLY	8	ENGINE VALVE TIP CLEARANCE	CHECK	---	---	---	---	ENGINE
	1	ELECTRICAL, ALTERNATOR	CHECK	---	---	---	---	ENGINE LH SIDE- 24 VOLT
	1	ELECTRICAL, STARTER	CHECK	---	---	---	---	ENGINE LH SIDE- 24 VOLT
	1	ELECTRICAL, SYSTEM	CHECK	---	---	---	---	TOTAL MACHINE
	1	HYDRAULIC, HOSES & FITTINGS	CHECK	---	---	---	---	TOTAL MACHINE
	1	HYDRAULIC RESEVOIR OIL	CHANGE	HYDO	ISO 46	MIL-H-5606	29.3	RESERVOIR AND OIL FILL TUBE
	1	HYDRAULIC RESERVOIR FILTER	CHANGE	---	---	---	---	INSIDE RESERVOIR
	1	HYDRAULIC RESERVOIR MAGNET	CLEAN	---	---	---	---	INSIDE RESERVOIR
	4	AXLE, WHEEL END OIL	CHANGE	MPL	10W - 30	T.O.H.	GL4	LEVEL PLUG, 2 EACH AXLE
	2	AXLE, DIFFERENTIAL OIL	CHANGE	MPL	10W - 30	T.O.H.	GL4	LEVEL PLUG, 1 EACH AXLE
	1	ACCUMULATOR, SYSTEM	CHECK	---	---	---	---	870 PSI UNDER CENTER COVER
	1	ACCUMULATOR, STEERING	CHECK	---	---	---	---	800 PSI LH REAR FENDER
2000 HOURS OR 2 YEARS	1	ENGINE COOLANT	CHANGE	---	50%/50%	---		RADIATOR, OVERFLOW RESERVOIR ENGINE REAR
3000 HOURS OR 3 YEARS	4	ATOMISERS	CHECK	---	---	---	---	ENGINE RH SIDE

3.7 CHASSIS SERIAL NUMBER

The chassis serial number is stamped on the front left part of the chassis side member.

3.8 IDENTIFICATION PLATES

The plates of the main components, which are not directly manufactured by Terex (engines, pump, etc.), are located where originally applied by the manufacturers.

3.9 ALLOWED USE

The machines have been designed and manufactured for lifting, handling and transporting agricultural or industrial products by means of specific attachments (see section E). Any other use is considered contrary to that established and, therefore, improper. The compliance with and the strict respect of the operation, maintenance and repair conditions, indicated by the Manufacturer, represent and essential part of the allowed use. The use, maintenance and repair of the machine shall be carried out by skilled operators only who know well the special characteristics of the machine and the safety precautions to be taken.



The Manufacturer disclaims any responsibility for damage to persons or things arising from arbitrary modifications carried out on the machine.

3.10 IMPROPER USE

Improper use means a utilization of the machine following working criteria, which do not comply with the instructions of this manual, and in general, may result in risks for both operators and bystanders.



We list below some of the most frequent and hazardous situations of improper use:

- Carrying passengers on the machine
- Not strictly complying with the operation and maintenance instructions of this manual.
- Working beyond the handler working limits
- Working on unstable edges of ditches
- Working on steep slopes
- Using attachment other than those recommended
- Using attachments which are not approved or directly manufactured by Terex.
- Working in potentially explosive environments.

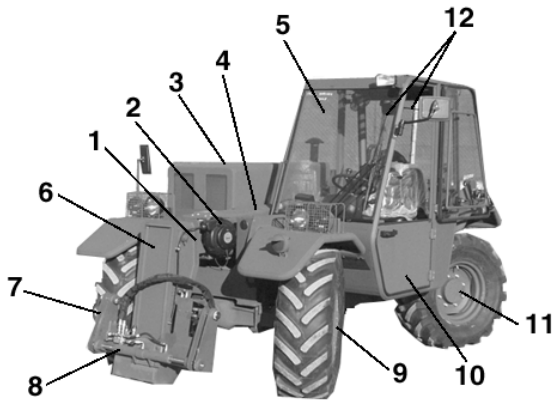
3.11 APPLICABLE STANDARDS

For ensuring the operator's safety, the following standards were followed during the risk analyze of the machine with telescopic boom:

DIRECTIVE	TITLE
89/392 CEE	Machine Directive
98/39 CEE	Steering Devices
86/295 CEE-91/368 CEE	ROPS – FOPS
86/296 CEE-91/368 CEE	Driving Place
88/465 CEE	Seats-Type-Approval
98/40 CEE	Rear view mirrors for agricultural machines
73/23 CEE-93/68 CEE	Low Voltage Directive
74/151 CEE	Tractors–Weight, Plate, etc.
79/532 CEE	Tractors – Lighting and signaling devices
80/720 CEE-97/54 CEE	Tractors–Working Ranges
89/391 CEE	Safety and Health of workers at work
89/336 CEE-92/31 CEE	Electromagnetic compatibility
96/627 CEE	Agricultural Tractors – Noise levels within the driving cab

STANDARD	TITLE
EN292-1/2	Machine Safety – Designing principles
EN294	Machine Safety – Safety distance
EN418	Machine Safety – Emergency stop
EN457	Machine Safety – Audible hazard signaling devices
EN563	Machine Safety - Surface temperature
EN574	Machine Safety – Control devices
EN811	Machine Safety – Safety distance
EN349	Machine Safety – Min. spaces
EN842	Machine Safety – Visible hazard signaling devices
EN982	Machine Safety – Hyd. systems
EN1032/5007/5008	Measurement of vibrations
EN1033/1037	Machine Safety – Prevention of accidental starting
EN1050	Machine Safety – Risk evaluation
EN1088	Machine Safety – Locking Devices
EN4871/ISO5131/7216	Acoustics
NC337-01/ISO5010	Steering devices
NC344-01/05/10	Braking devices
UNI EN 25353	Seat reference point
ISO 3767-1/2	Pictorial signs for the operator's controls
EN ISO 6682	Access to the operation controls
EN 22860/ISO 4252/4253	Minimum access dimensions
ASME B56.6 Stability	Safety standard for rough terrain forklift trucks
SAE J1040,ISO 3471	ROPS – FOPS
SAE J231, ISO 3449	ROPS – FOPS

3.12 LIST OF THE MAIN COMPONENTS



1. **2nd Boom Section**
2. **Electrical Reel**
3. **Engine Hood**
4. **Boom Base Section**
5. **Driving Cab According to ROPS-FOPS Provisions**
6. **Boom Tip Section**
7. **Attachment Holding Frame**
8. **Attachment Locking Cylinder**
9. **Left Front Wheel Reduction Gear**
10. **Cab Door**
11. **Left Rear Wheel Reduction Wheel**
12. **Windshield Wipers**

3.13 DESCRIPTION OF THE MAIN COMPONENTS

Transmission

Consists of a variable displacement hydraulic pump that drives a hydraulic motor located on the front axle. The pump only begins to drive the motor when the accelerator is depressed. The hydraulic motor adjusts to give maximum torque when under heavy loads, or maximum flow under light loads.

Steering Axles (front and rear) Differential Gears

The front axle (limited slip differential) drives the rear axle (locked differential) thru a drive shaft to provide 4 -wheel drive at all times.

Tires

The machine is equipped with tires suitable sized for the maximum load allowed on the machine. When replacement is necessary, they shall be replaced with new ones having the same dimensions and loading capacity.

Overload Warning System

The standard overload warning system installed on the vehicle enables the operator to work under the safest conditions. At the machine starting, the overload warning system carries out a diagnostics of all LED's then sets to the first green LED signaling the proper functioning of the instrument. Refer to 3B6 manual for more information.

Hydraulic Circuit

Consists of a gear pump connected to the engine which, through a steering valve, dispenses oil to the distributor for the following functions:

- Boom lifting / Lowering
- Telescopic Boom Sections Extension / Retraction
- Fork Rotation
- Fork Locking
- Fork Tilting
- Fork Side Shift
- Steering Valve
- Control Valve

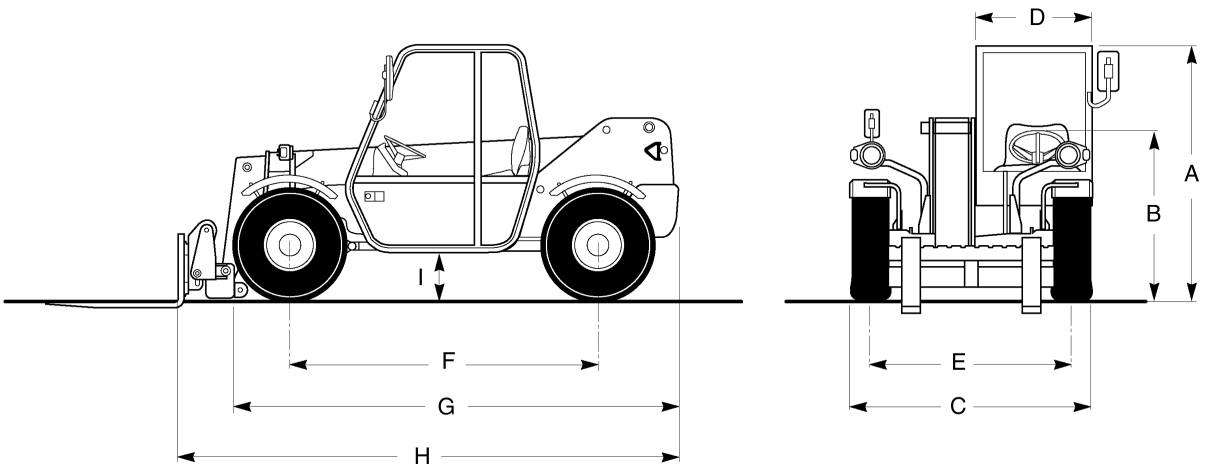
Brake Circuit

Consists of an independent reservoir and circuit: The brake pedal operates a pump which pressurizes the wet disc brakes in the front axle.

3.14 OPTIONAL ACCESSORIES

The machine can be fitted with a wide range of optional accessories, (Terex sales network). Check the accessories, which can be fitted.

3.15 TECHNICAL DATA AND PERFORMANCE



MAIN DIMENSIONS		STANDARD	Metric
A	Overheight	7' 6" Ft. In.	
B	Height Of Steering Wheel	4' 11" Ft. In.	
C	Overall Width	6' 6" Ft. In.	
D	Inside Cab Width	3' 0" Ft. In.	
E	Track	4' 11" Ft. In.	
F	Wheelbase	7' 9" Ft. In.	
G	Length At Front Wheels	12' 7" Ft. In.	
H	Length At Fork-Holder Plate	14' 10" Ft. In.	
I	Ground Clearance	1' 4" Ft. In.	
•	Outside Turn Radius	26' 8" Ft. In.	

CHARACTERISTIC ANGLES		
•	Angle Of Approach	90°
•	Departure Angle	70°

WEIGHT			
•	Weight In Running Order	Lb	13500

SPEED			
•	Working Speed (*)	Mph	5.0
•	Travel Speed (*)	Mph	20
•	Max. Slope With Full Load		45%
(*) =	either forward or reverse motion		

PAYLOAD AND REACH			
•	Max. Lifting Height	Ft. In.	18' 9"
•	Reach At Max. Height	Ft. In.	14' 8"
•	Max. Reach Forward	Ft. In.	10' 9"
•	Implement Holding Plate Rotation		135°
•	Payload At Max. Height	Lb	500
•	Payload At Max. Reach	Lb	1765
•	Payload At 50° Boom Angle	Lb	2205

DIESEL ENGINE

•	Make		Perkins
•	Model / Type		704-30t
•	Features:		Diesel
			4 Strokes
			Direct Injection
•	Cylinders		4 Cylinder In Line
•	Bore X Stroke		3.8 X 3.9 (97 X 100)
•	Total Displacement	Cu. In.	180.4 (2956)
•	Power At 2600 Rpm (*)	Hp	80

(*) = Gross Power, Calculated According To The Din 70020 Standard.

ELECTRIC SYSTEM

•	Voltage	V	24
•	Self – Regulated Alternator (On Diesel Engine)	V	24
•	Battery	Ah	2x120

MACHINE NOISE LEVELS

•	Drive By @25 feet	68	dBa
•	Static @25 feet	61	dBa

PRESSURE SETTING

•	Main Distributor Valve	4100 psi
•	Propel Pump Valve	6000 psi
•	Counterbalance Valve	5100 psi

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SECTION 4
CONTROLS AND INSTRUMENTS

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4.0 PREPARATION, INSPECTION AND ADJUSTMENTS

GENERAL

The following operating suggestions are offered as a reminder rather than as an attempt to instruct.

a. Always consult the rating chart in the cab for the maximum load, which may be lifted with the various combinations.

b. Before actually operating the machine each day, perform the pre-operation inspection check list (Section 5)

c. Clean the windows, headlights, and mirrors to ensure full vision. Also make sure the mirrors are properly adjusted to suit the needs of the operator.

d. Adjust the operator's seat to provide a comfortable and safe operating position.

DANGER

Overinflate or overheated tires can burst. A tire burst may result in serious injury; never use the machine if tires are worn, wrongly inflated or damaged.

e. Check the correct inflation of the tires (see chart below).

Dimensions		375/75 R20 x M27
Load Index		155A
Rim		11" x 20"
Wheel Disc		8 holes DIN 70361
Pressure	Bar	1.8 (soft) 3.7 (standard)
	PSI	26 (soft) 54 (standard)

f. Make sure that the tire plies are not cut or worn.

ATTENTION

Always use tires having the dimensions indicated in the vehicle registration document.

DANGER

A tire burst may result in serious injury; never use the machine if tires are worn, wrongly inflated or damaged.

4.1 ADJUSTING THE SEAT

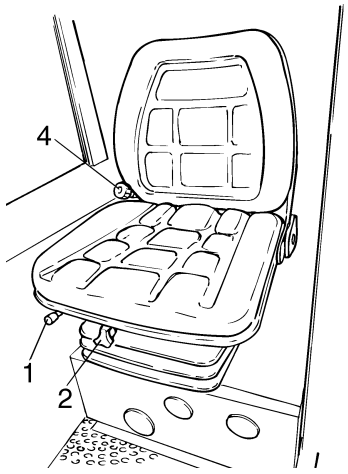
A correct adjustment of the seat ensures the operator a safe and comfortable driving. The operator's seat is fitted with devices, which allow for the adjustment of springing, back rest angle and distance from the controls.

Seat Distance From The Controls
The operator's seat is fitted with an adjusting device that allows sliding the same seat forward or back with respect to the steering column.

Springing Adjustment
Rotate knob (2) clockwise or counterclockwise until obtaining the required springing. Rotate clockwise to increase the seat springing or counterclockwise to reduce it.

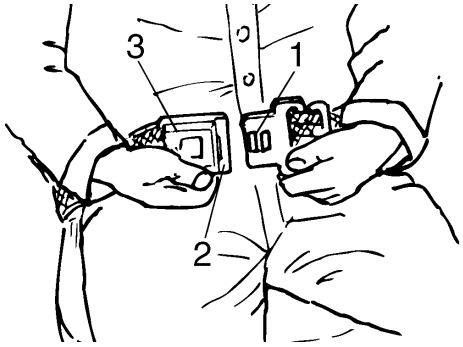
Height Adjustment
The seat height can be set to three different positions. To adjust, lift the seat until hearing he characteristic "clack" coupling sound. To lower the seat, raise to stroke end to unlock the mechanism, then release the seat; it automatically sets to the lowest position.

Back rest angle adjustment
The back rest can be adjusted by means of knob (4). Rotated clockwise, it increases the back rest angle; counterclockwise it reduces it.



4.2 FASTENING THE SEAT BELTS

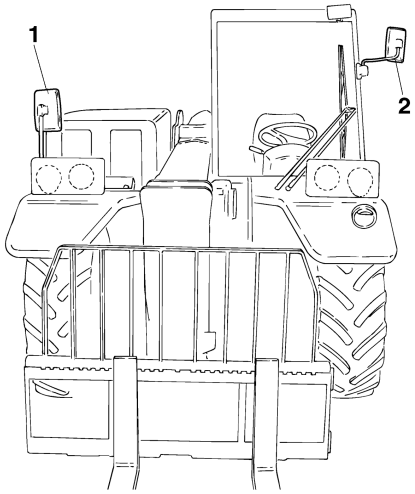
1. Sit correctly in the driving seat.
2. Check that belts are not tangled, then push tab (1) into buckle (2) until it latches.
3. To release the belt push button (3) and remove the tab from the buckle.
4. Adjust the belt across the hips and not on the stomach.
5. The two ends of the buckle can be adjusted separately, by holding the buckle in central position.



4.3 ADJUSTING THE REAR VIEW MIRRORS

The machine is fitted with two rear view mirror.

1. Right rear view mirror (1) is located on a special supporting bracket in advanced position and allows checking the area behind the machine, on the right-hand side. To adjust its position, manually rotate the joint it is fitted with.
2. Left rear view mirror (2) is placed on the left upper post of the windshield and allows checking the area behind the machine, on the left hand side. To adjust its position, manually rotate the joint it is fitted with.

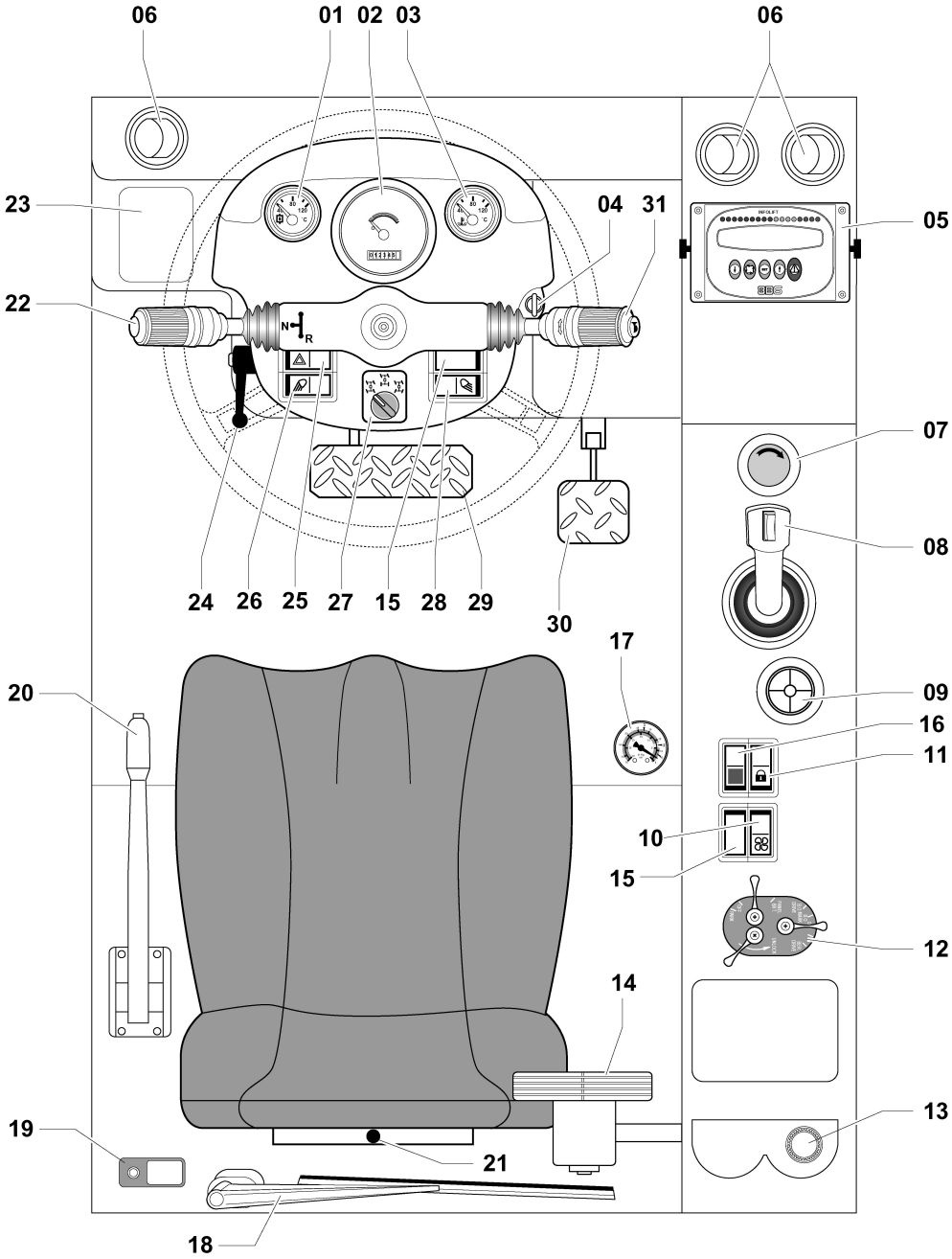


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4.4 CONTROLS AND OPERATIONS

CONTROL IDENTIFICATION

The instruments and controls are shown below. The numbers on the illustration correspond to the numbers on the following list, which identifies the controls and describes their operations.



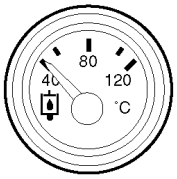
4.5 CONTROLS AND INSTRUMENTS

01. Hydraulic Oil Temperature
02. Gauge / Indicator Cluster
03. Engine Coolant Temperature
04 Ignition Switch
05. Overload Warning System
06. Air Vents
07. Emergency Stop Button
08. Joystick Lever
09. Machine Level
10. Defroster Fan Switch
11. Work - Travel Switch
12. Blackout Lighting Control Switch
13. Windshield Water Reservoir
14. Cab Fan
15. Blank
16. Fork Side Shift / Rotating Switch
17. Filter Indicator
18. Rear Wiper
19. Dome Light
20. Parking Brake Lever
21. Seat Switch
22. Forward / Neutral / Reverse Speed Lever
23. Fuse / Relay Panel
24. Steering Column Tilt Lever
25. Hazard Lights Switch
26. Front Work Light
27. Steering Selection Switch
28. Rear Work Light
29. Brake Pedal
30. Accelerator Pedal
31. Turn Signals / Horn / Wiper / Windshield Washer Switch

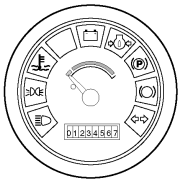
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4.6 CONTROL DESCRIPTION

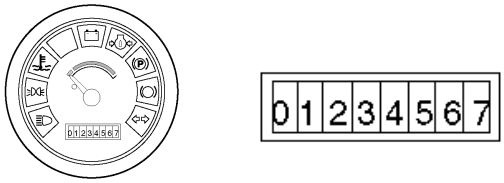
1. **Hydraulic Oil Temperature Indicator** – Indicates the oil temperature within the reservoir.



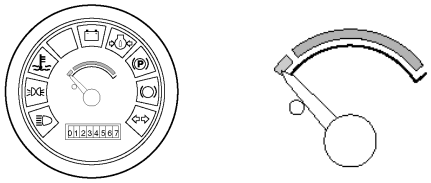
2. **Gauge / Indicator Lights:**



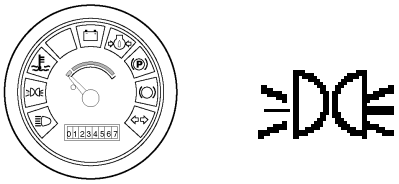
a. **Hourmeter** – This indicates the running time of the engine in hours.



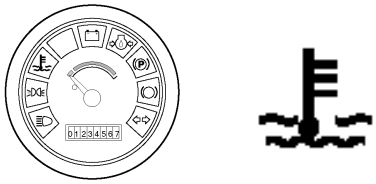
b. **Fuel Gauge** – Indicates the amount of fuel remaining in the fuel tank.



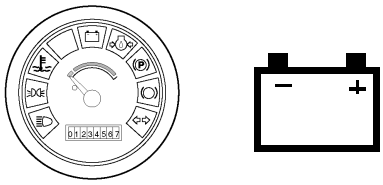
c. **Hazard Light** – Green indicator signaling when position lights are ON.



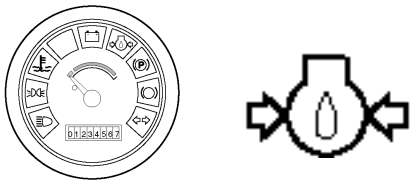
d. **Water Temperature Indicator** – Indicates when engine coolant is overheated.



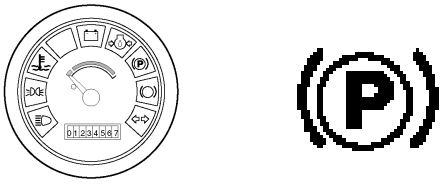
e. **Low Battery Charge** – Signals a low charge from the alternator.



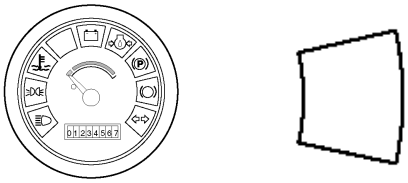
f. **Low Engine Oil Pressure** – This indicator will light up when engine oil pressure is too low. Stop the engine.



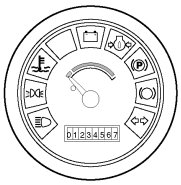
g. **Parking Brake Engaged** – Indicates the parking brake is engaged.



h. **Blank** – Not used

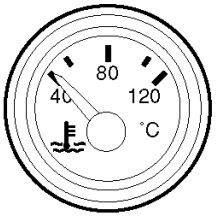


i. **Turn signal Indicator** – Green indicator signaling when turn signals are ON.





3. **Engine Coolant Temperature** –Indicates the engine coolant temperature.



ATTENTION

Engine cannot be started if the parking brake is not engages, operator completely sitting in seat and Forward/Neutral/Reverse lever in Neutral.

4. **Ignition Switch** - This switch is used to energize the electrical system of the machine and start the machine.



WARNING

Before using the machine, make sure that the first green LED of the overload warning system is ON.

The overload warning system must not be used to check the load to be lifted: it has only been designed to signal possible unbalances of the machine along its motion axis. Such unbalances may also be caused by an abrupt operation of the levers during the load handling. During work if, several indicators light up, operator the levers more smoothly.

ATTENTION

This machine is equipped with overload warning, when machine is on side slope and rear axle reaches maximum angle.

5. **Overload Warning System –** A LED warning display. The LED's switch on in sequence from the right to the left and indicates the gradual variation of the machine stability as follow:



Green LED
- 0-89% of capacity
- normal operation

Yellow LED
- 90-100% capacity

Red LED
- hazardous overload; boom down, extend cut and allows only for the load return within safety limits.

At the machine starting, the overload warning system carries out a diagnostics of all LED's then sets to the first green LED signaling the proper functioning of the instrument.

6. **Air Vents – Allows air flow in the cab. Rotate the vent to direct the air flow.**



7. **Emergency Stop Button –** Any operated function can be stopped by pressing the emergency stop button. This button allows shutting the engine down. To reset, rotate the button clockwise.



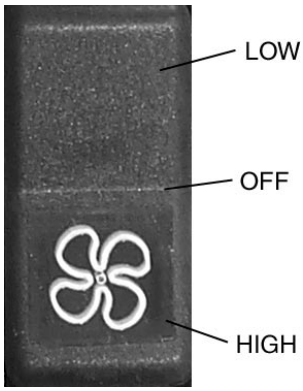
8. **Joystick Lever** – Controls the Boom / Attachment function see section on control levers functions (page)



9. **Machine Level –** Use this device to ensure that the machine is level.



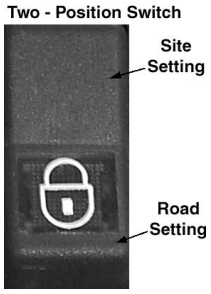
10. **Defroster Fan Switch –** Three – position switch that controls the speed of the fan. Press switch up for low speed, Press down for high speed.



WARNING

When traveling with or without a load, depress the Work - Travel Switch to lockout tilt, side shift, rotation functions on the attachment and to lockout crab and 4-wheel modes.

11. **Work - Travel Switch –** When traveling with or without a load this switch prevents operations of attachment functions and steering in crab and 4-wheel modes.



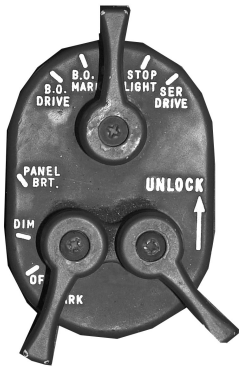
(a). Press the switch down to select the Travel Setting. This disables all attachment functions, steering in crab and 4-wheel modes.
(b.) Press the switch up to select the Work Setting and enable all attachment functions and all steering modes.

12. **Blackout Lighting Control Switch –**

(a) Mechanical Lockout Lever
- Unlock switch by moving the lock CCW when operating the light and auxiliary switch or damage can occur to the switch mechanism.
- The Mechanical Lock prevents accidental switching in Blackout Modes.

(b) Lighting Control Lever
- BO Drive position – Operates the blackout headlight, blackout stoplight-taillights and all four blackout marker lights. All internal, external lights, horn and backup alarm are not operable when blackout lights are in operation. The Auxiliary Switch lever can operate indicator lights on the dash.
- BO Marker position – Operates the two front and two rear blackout markers. All internal and external lights, horn and the backup alarm are not operable when blackout markers are in operation. The Auxiliary Switch lever can operate indicator lights on the dash.
- Off position – All lights, backup alarm, horn, panel lights, blackout headlight, blackout stoplight taillights and all four blackout marker lights are inoperable.
- Stop Light position – Operates taillights, horn and the backup alarm. Blackout headlight, blackout stoplight-taillights and blackout markers are not operable.
- Ser. Drive position – All lights, taillights, and horn and the backup alarm are operable. Blackout stoplight-taillights and blackout markers are not operable.
- Ser. Drive position – All lights, taillights, and horn and the backup alarm are operable. Blackout headlight, blackout stoplight – taillights and blackout markers are not operable.

(c) Panel Light Control lever
- Panel Brt. position – Operates the bright indicator lights on the dash.
- Dim position – dims the indicator lights on the dash.
- Off position – indicator lights on the dash are inoperable.
- Park position – dims the indicator lights on the dash.



13. **Windshield Water Reservoir –** Holds the washer / water solution.



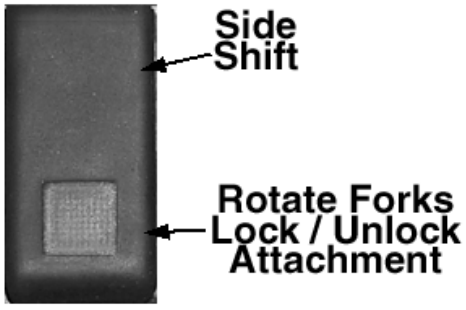
14. Cab Fan - To turn the fan on and off use the on / off switch bottom side of fan.



15. **Blank**



16. **Side Shift / Rotate Function Switch –** Works in conjunction with the rocker switch on the joystick control lever.



17. **Filter Indicator** - Indicates the degree of clogging so you will know when to change filter.

ATTENTION

Operating with indicator in red can damage the transmission pump and motor. You must change the filter. Do not wait until the filter change interval is reached.

Green Area - 0-20 (PSI) is normal condition.

Yellow Area - 20-25 (PSI) Prepare to change filter

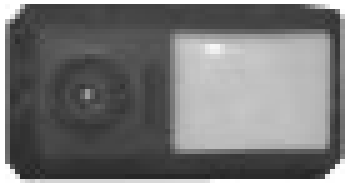
Red Area - 25-30 (PSI) Shut the machine down and change the filter.



18. **Rear Wiper –** To operate the rear wiper depress the rocker switch on the wiper motor box.



19. **Dome Light** - Three position side switch. Turn on / off to light the cab. Center position Off, Forward position Dome Light Rear Position Spot / Map Light.



20. **Parking Brake Lever –** To engage the parking brake, pull the lever upward while holding the locking button pressed. Release the button when reaching the required braking tension. This brake when engaged, by means of a proximity switch allows the machine to start and prevents transmission from going forward or reverse.



WARNING

Never use the parking brake to slow down the machine, unless in an emergency. This could cause damage to the parking brake.

ATTENTION

Engine cannot be started if the parking brake is not engaged, operator completely sitting in seat and Forward/Neutral/Reverse lever in Neutral.

21. Seat Switch - Located on bottom of seat. Enables the engine from starting unless operator is sitting in set.

ATTENTION

Engine cannot be started if the parking brake is not engages, operator completely sitting in seat and Forward/Neutral/Reverse lever in Neutral.

22. **Forward / Neutral / Reverse Speed Selection Lever –** Three position switch with locking in neutral position:

ATTENTION

Engine cannot be started if the parking brake is not engages, operator completely sitting in seat and Forward/Neutral/Reverse lever in Neutral.



N	Neutral position; drive not engaged.
F	Raise and shift lever to pos. F to select forward.
R	Raise and shift lever to pos. R to select reverse.

23. **Fuse / Relay Panel –** The electrical system is protected by fuses placed into the driving cab, on the left of steering column. Before replacing a blown fuse with a new one having the same amperage, find out why the fuse has blown.

ATTENTION

Do not use fuses having higher amperage than that recommended, since they can damage the electric system seriously.



If the fuse blows after a short time, look for the fault source by checking the electric system.

Always keep some spare fuses for an emergency.

Never try to repair or short blown fuses.

Make sure the contacts of fuses and fuse sockets ensure a good electric connection and are not oxidized.

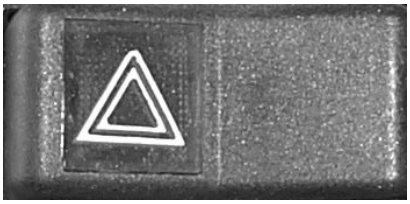
24. **Steering Column Tilt Lever –** Both the steering column and dashboard can be set to a different angle. Loosen the control lever and adjust column as required then retighten to lock the column in place.

WARNING

Before driving the machine, ensure the steering wheel is locked in place.



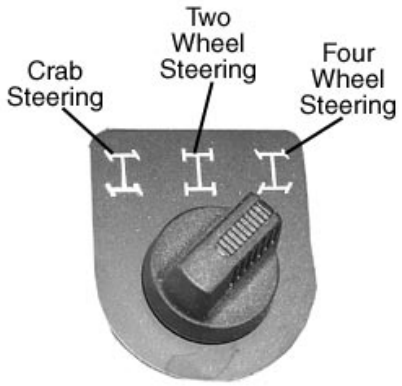
25. **Hazard Light Switch –** Fitted with on-off position, it switches on the hazard lights.



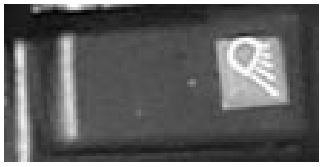
26. **Front Work Light -** A spot light located on the front of the machine, used for night working.



27. **Steering Selection Switch –** Three position switch for selecting the steering mode, See Steering / Tire Alignment.



28. **Rear Work Light -** A spot light located on the rear of the machine, used for night working



29. **Brake Pedal –** Gradually step on the brake pedal to decelerate and stop the machine. The brake operates on the front axle only.



30. **Accelerator Pedal –** Controls the engine rpm. and the machine speed. It is fitted with an adjustable stop located behind the pedal in cab.



31. **Turn Signals / Horn / Wiper / Windshield Washer Switch –**



a. **Turn Signals –** Set lever to pos. 1 to indicate a turn left or to pos. 2 to indicate a turn to the right.

b. **Windshield Wiper –** To operate the windshield wiper, rotate the lever tip to one of the four positions:

0	Wiper OFF
J	Timed wiper (if available)
1	Low Speed
2	High Speed

c. **Windshield Washer –** Push the second stage of the lever to spray windshield washer solution on the windshield.

d. **Horn Function –** By pressing the lever built- in button, horn will sound.

4-7 CONTROL LEVER

Handlers are equipped with a piloted supplied service control lever. Only one function can be operated at a time.

The lever is equipped with a two-position button that returns to central position for the selection of the Fork Attachment functions: Side Shift, Rotate, Tilt and Disconnect Attachment.

Additionally, when operated in the four directions (right / left, forward / back) it allows for the control of the boom functions (up / down, retract / extend) and the Fork Attachment functions (forward / rearward tilting), (left/right side shift), Rotate clockwise / counter clockwise, connect / disconnect attachment.



WARNING

Smoothly move the control lever. The motion speed of the actuators depends on the lever position: a small motion results in a slow control movement of the actuators; vice verse, a full range motion of the lever corresponds to the max. speed of the actuator.

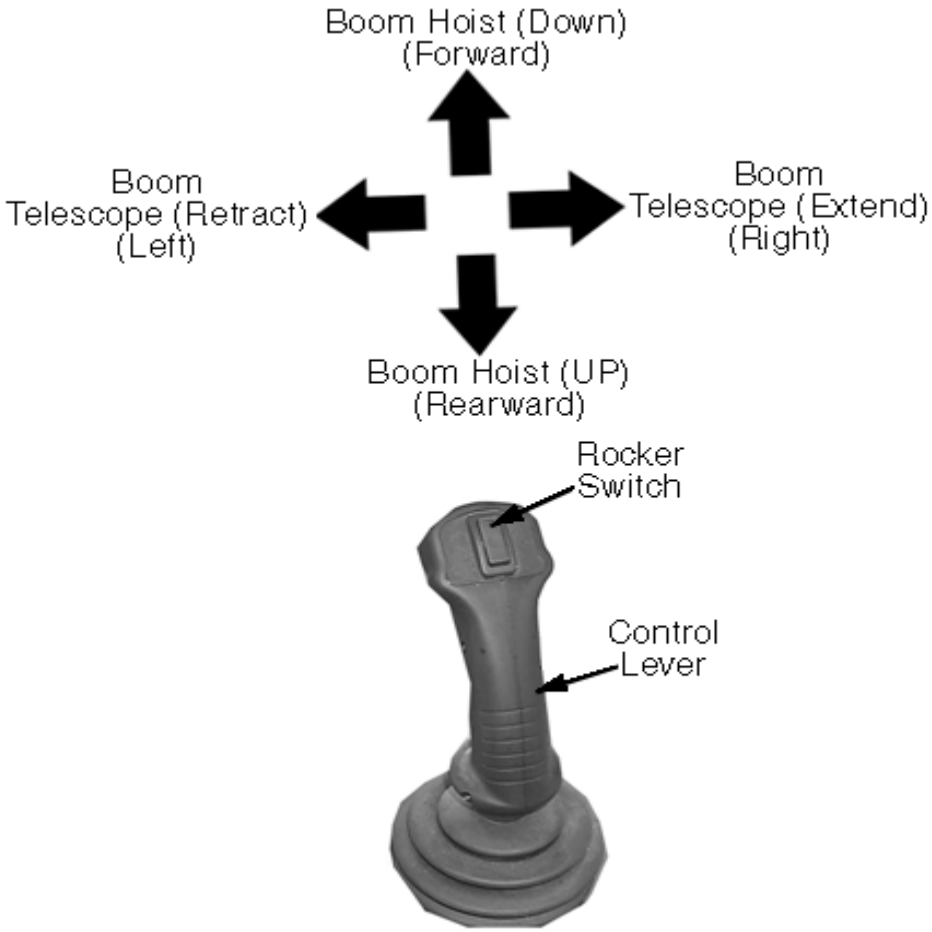
WARNING

Before operating the control lever, make sure that nobody is within the working range of the machine.

4-8 OPERATING THE CONTROL LEVER

The control lever is enabled to carry out the following functions:

- Boom hoist (Up / Down) is operated by moving the lever forward or rearward.
- Boom Reach (Telescoping) is operated by moving the lever to the left or right.
- Fork Tilting, Side shifting or Rotating is operated by depressing the rocker switch and moving the control lever in the proper position.

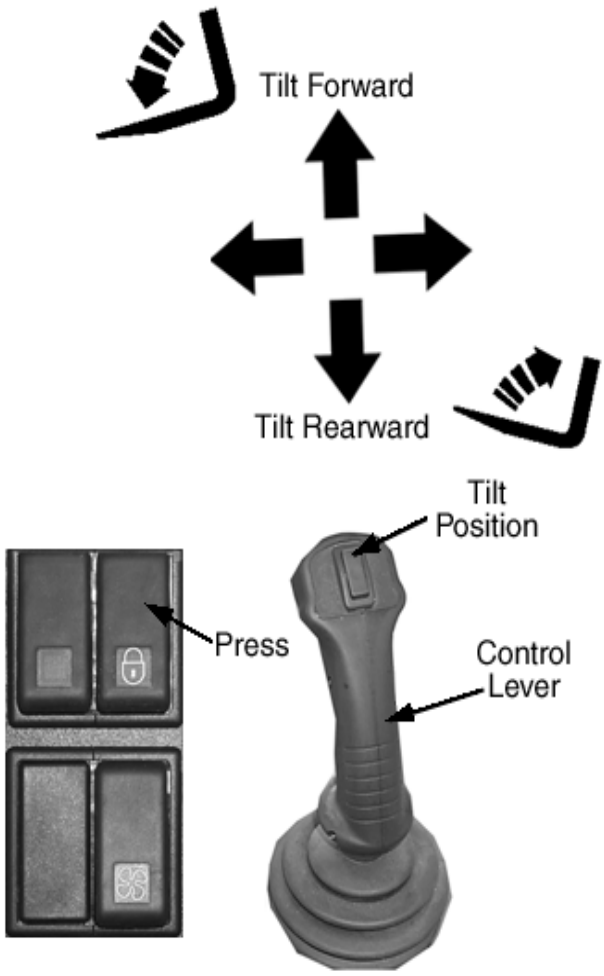


4-9 Tilting the Forks Forward and Rearward

WARNING

Before operating the boom, make sure that nobody is within the working range of the machine.

- Depress the rocker switch forward to tilt position.
- Shift the lever forward to tilt the forks forward.
- Shift the lever rearward to tilt the forks rearward.

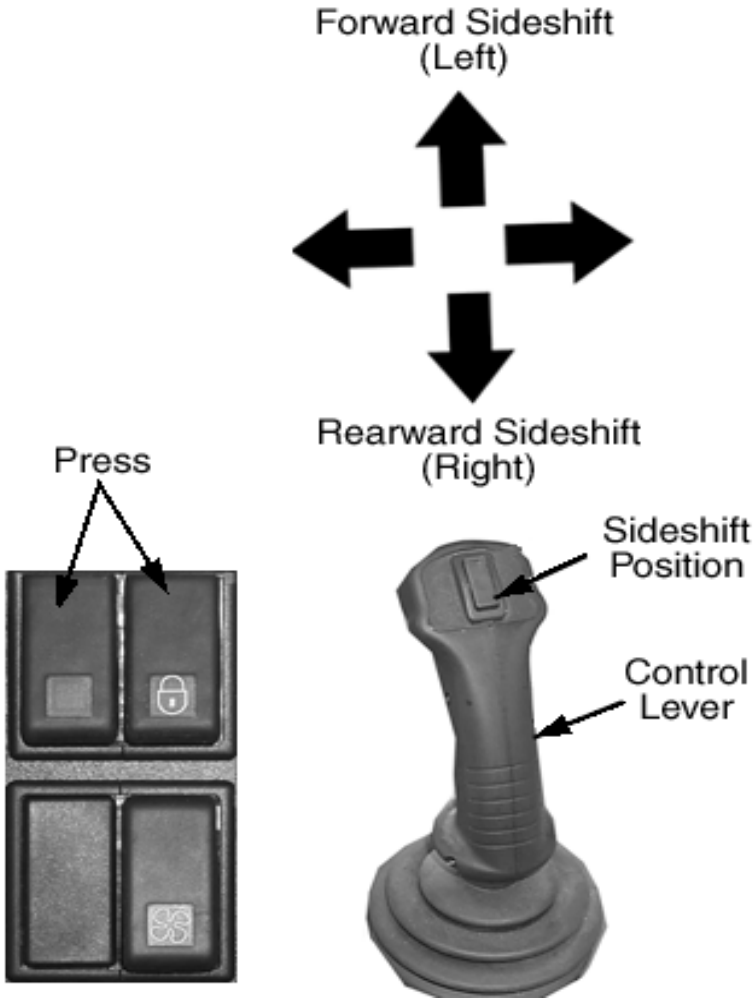


4-10 Side Shifting The Forks

WARNING

Before operating the Forks make sure that nobody is within the working range of the machine.

- Ensure the side shift / Rotate rocker switch is depressed in the Side Shift Position.
- Depress the rocker switch on the lever to the Side Shift Position.
- To Side Shift the Forks left move the control lever forward.
- To Side Shift the Forks right, move the control lever rearward.

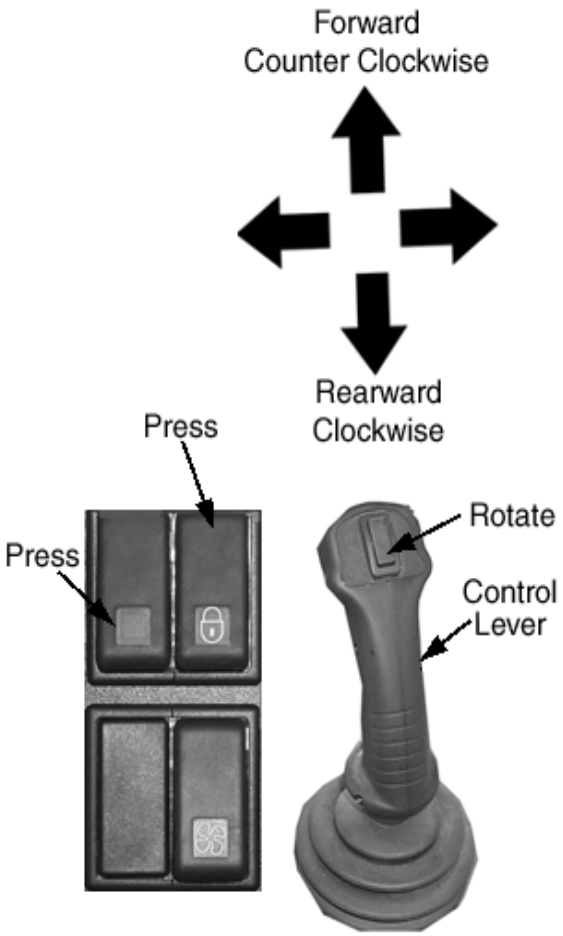


4-11 Rotating The Forks

WARNING

Before operating the boom, make sure that nobody is within the working range of the machine.

- Ensure the side shift / rotate rocker switch is in the rotate position.
- Depress the rocker switch on the control lever to the rotate position.
- To rotate the fork clockwise move the control lever rearward.
- To rotate the forks counter clockwise move the control lever forward.



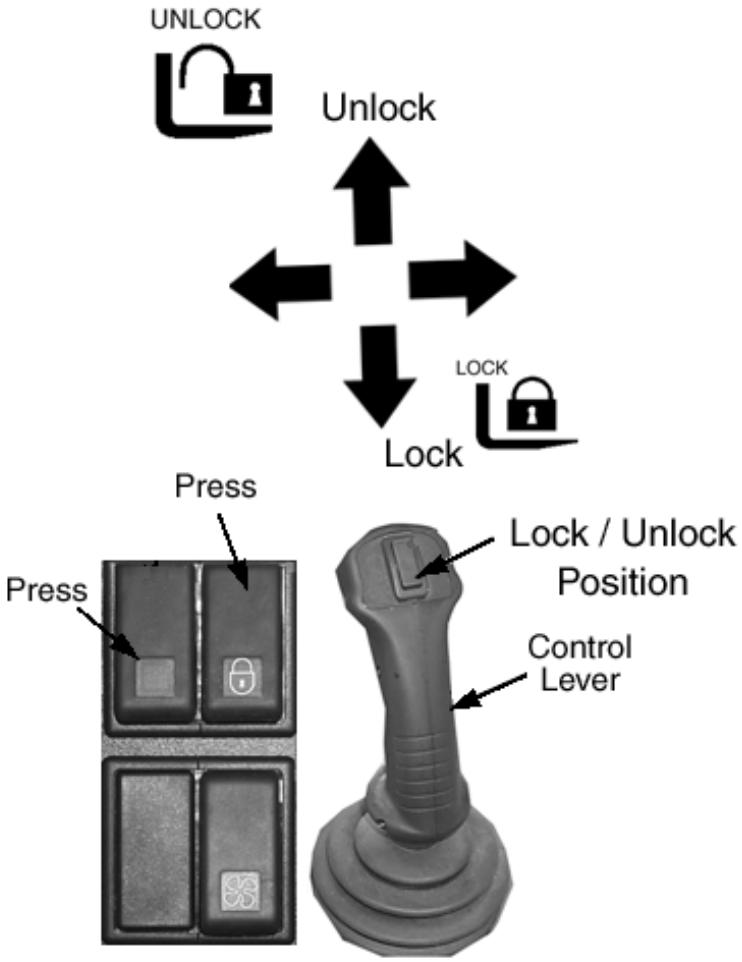
4-12 Quick-Coupling the Fork Attachment

WARNING

Before operating the boom, make sure that nobody is within the working range of the machine.

To lock / unlock the attachment couplings, it is necessary to change the connection of the hydraulic lines to the control valve placed on the fork carriage carrier element.

- Disconnect both quick couplings controlling the fork rotation.
- Connect hoses that feed the locking cylinder whose quick couplings are coupled to the hose holding attachment.
- Depress the rocker switch on the control lever to the lock/unlock position.
- To unlock the fork attachment move the lever forward.
- To lock the fork attachment move the lever rearward.



SECTION 5
PREOPERATION, INSPECTION AND ADJUSTMENT

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5-0 PREOPERATION INSPECTION AND ADJUSTMENT

General

The following operating suggestions are offered as a reminder rather than as an attempt to instruct since a machine of this size must not be entrusted to anyone except a fully qualified operator.

1. Read and understand section 4 'Controls and Instruments' prior to starting this machine.
2. Always consult the rating chart in the cab for the maximum load which may be lifted.
3. Always perform all machine operations with the engine speed set to accommodate the handling of a typical load.

5.1 PREOPERATION INSPECTION AND CHECK LIST

Before starting the engine check the items below for safe conditions:

_____ Fluid Leaks
_____ All Windows and Light Clean
_____ All lights clean
_____ Tire and Wheels
_____ Guards in Place
_____ Operators Manual and Rating Chart in Cab
_____ Boom Slide Pads
_____ Engine Air Cleaner
_____ Engine Oil Level
_____ Hydraulic Oil Level
_____ Brake Oil
_____ Engine Coolant Level
_____ Windshield Wiper Solvent

Before operating the machine verify the controls and functions listed below:

_____ Horn
_____ Gauges
_____ Brake Lights
_____ Reverse Lights
_____ Head Lights
_____ Turn Signal Lights
_____ Black Out Lights
_____ Wiper (Front and Rear)
_____ Park Brake
_____ Forward / Reverse
_____ Service Brake
_____ Accelerator
_____ Back Up Alarm
_____ Steering All 3 Selections
_____ Wheel Alignment
_____ Boom Up/Down
_____ Boom Telescope Out/In
_____ Fork Tilt Up/Down
_____ Fork Side- Shift Left / Right
_____ Fork Rotate CW/CCW
_____ Attachment Lock Out

5.2 STARTING THE ENGINE

ATTENTION

Do not operate the starter motor for more than 20 seconds at a time. If the engine fails to start within that time, release the switch lever and wait 2 minutes before trying again. If this precaution is not followed serious damage to the starter motor may result.

To start the engine proceed as follows:

1. Apply the parking brake.
2. Place the gear lever in the NEUTRAL (N) position.
3. To start the engine, turn the ignition switch on and release when the engine starts. If the engine does not start within 20 seconds, release the switch lever and wait at least 2 minutes before attempting again.
4. As soon as the engine starts reduce engine speed to idle. Wait some seconds before engaging a gear; this allows for a gradual warm up of the engine oil and a better lubrication.
5. Release the parking brake.
6. Slowly press the accelerator pedal to start moving.

5.3 JUMP-STARTING THE ENGINE

WARNING

When jump-starting the engine through the battery of another machine, make sure that the two vehicles cannot collide to prevent formation of sparks. Batteries give off a flammable gas and sparks may ignite it and cause an explosion.

Do not smoke when checking the electrolyte level.

Keep any metal object like buckles, watch straps, etc. clear of the battery positive (+) terminal. These elements can short between the terminal and nearby metal work and the operator can get burned.

The booster supply must have the same rated voltage and output of the battery installed on the handler.

To jump-start the engine with Nato Slave Connection:

1. Check that the brake is set on disabled machine.
2. Remove cover from Nato Slave connection.
3. Install the slave connection support cable into the disabled unit.
4. Check that brakes on supporting machine are set.
5. Then install the supply end to the supporting machine. Start the supporting machine to supply maximum voltage to the disable system.
6. Only from the operator's seat of disabled unit, attempt to start the unit, using proper starting procedures.
7. Upon the starting of disabled machine disconnect the slave cable from the supporting machine. Then from the machine that was disabled.
8. Reinstall weather cover on both units.

TO JUMP START THE ENGINE

1. Turn any users off by the special control levers.
2. Set the gear switch to neutral and engage the parking brake.
3. Ensure the machine battery A is connected to the frame earth, the terminals are well tightened and the electrolyte level is regular.
4. Connect the two batteries as shown. Connect first the positive terminals of the two batteries, then the negative terminal of the booster supply B to the machine frame earth.
5. If the booster supply is installed on a second vehicle, make sure that the latter does not touch the handler; then start the vehicle and reach an rpm. corresponding to ¼ of full throttle.
6. Rotate the ignition switch lever and start the handler, then follow the procedure explained in section 5.2 "Starting the Engine.

WARNING

Use only two 12V powered batteries connected in series to 24V; other devices like battery chargers, etc. may cause an explosion of the battery or result in damage to the electric system of the machine.

5.4 DISCONNECTING THE BATTERY

During maintenance or repair work, and especially while welding, cut out the battery main switch A, located in an accessible position behind the rear right wheel.

5.5 STOPPING / PARKING MACHINE



Always face the machine when getting off the driving cab; make sure that your hands and shoe soles are clean and dry, and hold to the hand holds to prevent falls and slips.



Always engage the parking brake when stopping the machine to prevent any accidental motion of the vehicle.

To stop and park the machine proceed as follows:

1. When possible, stop the machine on a dry, level and firm ground.
2. Bring the machine to a smooth stop by easing up the accelerator pedal and stepping down on the brake pedal.
3. When stopped engage the parking brake and ensure its indicator lights up.
4. Release the service brake pedal.
5. Rest the attachment coupled to the boom flat on the ground.
6. Get out the operators cab and close the cab door.
7. Set the battery cutout switch to OFF position.

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SECTION 6
LUBRICATION

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6.0 LUBRICATION

General

This section covers the lubrication of this machine and includes lubrication charts for the purposed of showing the lubrication points. The various capacities of this machine, and listing the lubricant specifications, are included.

Lubrication

To ensure proper operation of this machine, all points requiring lubrication must be serviced with the correct lubricant at the proper time interval as shown on the lubricant chart. All normal wear points, which require lubrication, are shown in the lubrication charts. The possible exception, lubrication information concerning major purchased components, information concerning purchased components, see the manufacturer's manual. If any conflict exists between the lubrication recommendations contained in this manual and the original manufacturer's service recommendations, the original manufacturer's recommendations take precedence. Points (levers, linkages, pins etc.) should be lubricated with an oil can once a week. Use a few drops of engine oil on each exposed pin or lever not equipped with grease fittings to prevent rust and to provide the limited lubrication required.

6.1 LUBRICANT SPECIFICATIONS

ATTENTION

The lubrication specifications that follow were in effect at the time this manual was printed. These specifications are periodically updated to include the most recent lubricants issued by lubricant manufacturers.

The following list defines three terms. Each one of the terms can be used to identify the type of lubricant needed to satisfy the lubricant specifications listed in the lubrication charts (see page 60)

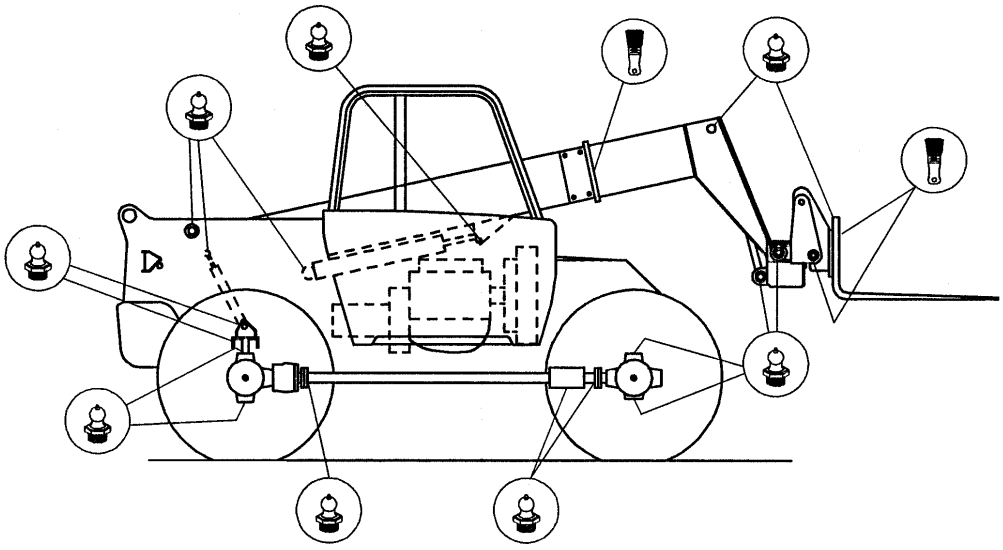
1. Terex Specification Number. This number is used in the Material Specifications system to identify a specific type of lubricant.
2. Military Specification Number. This number is used in the military lubrication system to identify a specific type of lubricant. This lubricant identified by the specification number that is listed in the same row of the lubricant specification chart.

ATTENTION

The absence of an entry in the Military Specification Column of a lubricant specification chart does not mean that the recommended lubricant does not have an equivalent military specification. It may mean that the lubricant has not been tested by the military because it is a relatively new lubricant. For this reason, the lubricant may not be certified as meeting the standards of a particular military specification even though it may be perfectly capable of meeting the military standards.

3. Equivalent Lubricant. These are lubricants that presently meet the Terex standards. These lubricants are listed under the manufacturer's trade names. The absence of a lubricant from this list does not mean that Terex considers the lubricant unsuitable. It means that Terex has not yet tested the lubricant. The order in which the lubricants appear on any list does not signify any preference or superiority of any brand name. The listings are purely random and all products on the list are equally acceptable.

6.2 LUBRICANT CHART



SERVICE / LUBRICATION CHART TX51-19M
FOR ADVERSE WEATHER CONDITIONS SEE OPERATORS MANUAL

INTERVAL	SERVICE POINTS	INDENTIFICATION	SERVICE REQUIRED	LUBRICANT SPECIFICATION (TYPE)				SERVICE LOCATION
				SAE	VISCOSITY	SPECIFICATION	API	
50 HOURS OR WEEKLY	1	ENGINE OIL LEVEL	CHECK	EO	15W-40	MIL-L-2104F	CD-CF	DIPSTICK, RH ENGINE SIDE
	1	ENGINE COOLANT LEVEL	CHECK	---	50%/50%	---	---	OVERFLOW RESERVOIR, REAR ENGINE SUPPO
	1	ENGINE FUEL PRE-FILTER	DRAIN	---	---	---	---	RH ENGINE SIDE
	1	HYDRAULIC RESERVOIR OIL	CHECK	HYDO	ISO 46	MIL-H-5606	29.3	SIGHT GAUGE @ OPERATING TEMP
	1	BRAKE RESERVOIR	CHECK	HYDO	ISO 46	MIL-H-5606	29.3	RESERVOIR, REAR ENGINE SUPPORT
	8	BOOM PADS	LUBE	MPG	NLGI 2	---	---	END OF BOOM
	8	AXLE KINGPINS	LUBE	MPG	NLGI 2	---	---	4 EACH AXLE, TOP & BOTTOM, EACH END
	1	AXLE REAR PIVOT PIN	LUBE	MPG	NLGI 2	---	---	TOP OF REAR AXLE
	9	CYLINDERS	LUBE	MPG	NLGI 2	---	---	BEARING EACH END OF CYLINDER
	5	FORK ATTACHMENT	LUBE	MPG	NLGI 2	---	---	PIVOTS
	1	BOOM PIVOT	LUBE	MPG	NLGI 2	---	---	BOOM PIVOT @ CENTER OF BOOM
	3	DRIVESHAFT	LUBE	MPG	NLGI2	---	---	FRONT, REAR, AND SLIP JOINT
	12	DRIVESHAFT BOLTS	CHECK	---	---	---	---	6 EACH U-JOINT, TORQUE 28 FT/LB
	4	TIRE INFLATION	CHECK	---	---	---	---	1 EACH, 54 PSI COLD
	32	TIRE WHEEL NUTS	CHECK	---	---	---	---	8 EACH WHEEL, TORQUE 294 FT/LB.
250 HOURS OR MONTHLY	1	ENGINE OIL	CHECK	EO	15W-40	MIL-L-2104F	CD-CF	SAMPLING VALVE, REAR ENGINE SUPPORT
	1	ENGINE COOLANT	CHECK	---	---	---	---	SPECIFIC GRAVITY, OVERFLOW RESERVOIR
	1	ENGINE AIR FILTER	CHECK	---	---	---	---	UNDERHOOD
	1	HYDRAULIC RESERVOIR OIL	CHECK	HYDO	ISO 46	MIL- H-5606	29.3	SAMPLING VALVE, REAR ENGINE SUPPORT
	4	AXLE, WHEEL ENDS OIL	CHECK	MPL	10W - 30	T.D.H.	GL4	LEVEL PLUG, 2 EACH AXLE
	2	AXLE, DIFFERENTIAL OIL	CHECK	MPL	10W - 30	T.D.H.	GL4	LEVEL PLUG, 1 EACH AXLE
	1	ENGINE DRIVE BELT	CHECK	---	---	---	---	FRONT OF ENGINE
	2	BATTERY	CHECK	---	---	---	---	RH REAR FENDER
500 HOURS OR QUARTERLY	1	ENGINE OIL	CHANGE	EO	15W-40	MIL-H-2104F	CD-CF	ENGINE OIL PAN
	1	ENGINE AIR FILTER	CHANGE	---	---	---	---	UNDER HOOD
	1	ENGINE OIL FILTER	CHANGE	---	---	---	---	RH ENGINE SIDE
	1	ENGINE FUEL FILTER	CHANGE	---	---	---	---	RH ENGINE SIDE
	4	ENGINE GLOW PLUGS	CHECK	---	---	---	---	ENGINE
	1	HYDRAULIC RESERVOIR FILTER	CHANGE	---	---	---	---	OUTSIDE RESERVOIR
1000 HOURS OR SEMI-ANNUALLY	8	ENGINE VALVE TIP CLEARANCE	CHECK	---	---	---	---	ENGINE
	1	ELECTRICAL, ALTERNATOR	CHECK	---	---	---	---	ENGINE LH SIDE- 24 VOLT
	1	ELECTRICAL, STARTER	CHECK	---	---	---	---	ENGINE LH SIDE- 24 VOLT
	1	ELECTRICAL, SYSTEM	CHECK	---	---	---	---	TOTAL MACHINE
	1	HYDRAULIC, HOSES & FITTINGS	CHECK	---	---	---	---	TOTAL MACHINE
	1	HYDRAULIC RESEVOIR OIL	CHANGE	HYDO	ISO 46	MIL-H-5606	29.3	RESERVOIR AND OIL FILL TUBE
	1	HYDRAULIC RESERVOIR FILTER	CHANGE	---	---	---	---	INSIDE RESERVOIR
	1	HYDRAULIC RESERVOIR MAGNET	CLEAN	---	---	---	---	INSIDE RESERVOIR
	4	AXLE, WHEEL END OIL	CHANGE	MPL	10W - 30	T.D.H.	GL4	LEVEL PLUG, 2 EACH AXLE
	2	AXLE, DIFFERENTIAL OIL	CHANGE	MPL	10W - 30	T.D.H.	GL4	LEVEL PLUG, 1 EACH AXLE
	1	ACCUMULATOR, SYSTEM	CHECK	---	---	---	---	870 PSI UNDER CENTER COVER
	1	ACCUMULATOR, STEERING	CHECK	---	---	---	---	800 PSI LH REAR FENDER
2000 HOURS OR 2 YEARS	1	ENGINE COOLANT	CHANGE	---	50%/50%	---		RADIATOR, OVERFLOW RESERVOIR ENGINE REAR
3000 HOURS OR 3 YEARS	4	ATOMISERS	CHECK	---	---	---	---	ENGINE RH SIDE

SECTION 7
PREVENTIVE MAINTENANCE

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7.0 PREVENTIVE MAINTENANCE

ATTENTION

The following suggested schedule check sheets are based on average operating conditions. The type of work being done, size of loads, and ground and weather conditions are all factors which must be considered when establishing a maintenance schedule for the machine. The suggested schedule basis is given for hours of operation and calendar intervals.

GENERAL

The actual operating environment of the machine governs the maintenance schedule. The suggested check sheets on the following pages indicate the areas of the machine to be checked and the intervals at which they should be checked.

Any changes in the established maintenance schedule should be preceded by a complete reanalysis of the machine operation. Carefully study previous maintenance sheets and records before making changes in, or extending, the check intervals.

The lubrication charts in Section 3 provide general locations of the individual service points and list the type of lubricant, which should be used for each component. This machine has the engine mounted on the right side of the machine; all service location references will be made with this in mind.

The relief valves are factory preset. Adjusting the valve in the field will void machine warranty. Valves must be set only by trained personnel.

7.1 USING THE SUGGESTED SCHEDULE CHECK SHEETS

The maintenance schedule check sheets are designed as a preventative maintenance guide, until adequate experience is obtained to establish a schedule to meet a specific operating environment. Following the check sheets are detailed procedures, grouped in check intervals, describing the procedure that should be used to perform the check sheet operation. The check sheets can be reproduced by any printer to obtain additional copies. Maintenance personnel making each check should then indicate on the sheet that the required check has been completed, and the machine will be ready for additional service until the next check is due. Completed check sheets should be retained as a permanent part of the machine's maintenance records for future reference.

7.2 'A' MAINTENANCE CHECKS – 50 HOURS OR WEEKLY SERVICES

Company Name _____

Company Address _____

_____

_____

Maintenance Person _____

Date Performed _____

Model Number _____ Serial Number _____

	MAINTENANCE POINT	PERFORMED BY
	Check Engine Oil Level	
	Check Coolant Level	
	Drain Fuel Pre-Filter	
	Check Hydraulic Oil Level	
	Check Brake Reservoir	
	Lube Boom Pads	
	Lube Drive Shaft	
	Lube Axle King Pins	
	Lube Rear Axle Pivot	
	Lube Cylinder	
	Lube Fork Attachment	
	Lube Boom Pivot	
	Check Tire Inflation	
	Check Wheel Lug Nuts	
	Check Drive Shaft Bolts	

7.3 'B' MAINTENANCE CHECKS – 250 HOURS OR MONTHLY SERVICES

Company Name _____

Company Address _____

_____

_____

Maintenance Person _____

Date Performed _____

Model Number _____ Serial Number _____

	MAINTENANCE POINT	PERFORMED BY
	Check Engine Oil	
	Check Engine Coolant Level	
	Check Engine Air Filter	
	Check Drive Belt Condition	
	Check Hydraulic Reservoir Oil	
	Check Wheel Ends	
	Check Differentials	
	Check Batteries	

7.4 'C' MAINTENANCE CHECKS – 500 HOURS OR QUARTERLY SERVICES

Company Name _____

Company Address _____

_____

_____

Maintenance Person _____

Date Performed _____

Model Number _____ Serial Number _____

	MAINTENANCE POINT	PERFORMED BY
	Change Engine Oil	
	Change Engine Air Filter	
	Change Engine Oil Filter	
	Change Fuel Filter Element	
	Check Glow Plugs	
	Change Hydraulic Filter	

7.5 'D' MAINTENANCE CHECKS – 1000 HOURS OR SEMIANNUALLY SERVICES

Company Name _____

Company Address _____

_____

_____

Maintenance Person _____

Date Performed _____

Model Number _____ Serial Number _____

	MAINTENANCE POINT	PERFORMED BY
	Check Valve Tip Clearance	
	Check Alternator	
	Check Starter	
	Check Electrical System	
	Check Hydraulic Hoses & Fittings	
	Change Hydraulic Reservoir Oil	
	Change Hydraulic Reservoir Filter	
	Clean Hydraulic Reservoir Magnet	
	Change Axle Wheel Ends	
	Change Axle Differentials	
	Check System Accumulator	
	Check Steering Accumulator	

7.6 'E' MAINTENANCE CHECKS – 2000 HOURS OR TWO YEARS SERVICES

Company Name _____

Company Address _____

_____

_____

Maintenance Person _____

Date Performed _____

Model Number _____ Serial Number _____

	MAINTENANCE POINT	PERFORMED BY
	Change Engine Coolant	

7.7 'F' MAINTENANCE CHECKS – 3000 HOURS OR THREE YEARS SERVICES

Company Name _____

Company Address _____

_____

_____

Maintenance Person _____

Date Performed _____

Model Number _____ Serial Number _____

	MAINTENANCE POINT	PERFORMED BY
	Check Atomisers (Fuel Injector)	

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SECTION 8
50 HOURS OR WEEKLY MAINTENANCE

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8.0 50 HOURS OR WEEKLY MAINTENANCE

GENERAL

The lubrication charts in Section 10 provide general locations of the individual service points and list the type of lubricant, which should be used for each component. Before proceeding with the 50 hours or weekly maintenance be sure you have completed the Pre-operation checklist.

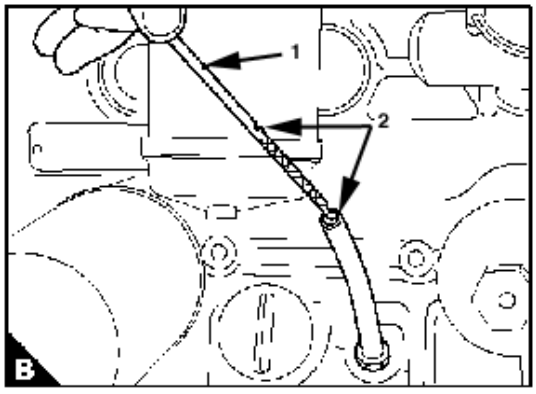
8.1 CHECK ENGINE OIL

ATTENTION

Never operate the engine with the oil, level below the low mark on the dipstick or above the high mark.

PERKINS ENGINE

The engine oil dipstick is reached from the right side of machine at the lower left center of the engine. The oil level must be kept between the low and high marks on the dipstick. If the oil is below the low mark on the dipstick, add oil of the type specified, through the filler cap. Wait at least five minutes after shutting off the engine to check the oil level. This allows time for the oil to drain to the oil pan.



8.2 ENGINE COOLANT LEVEL

WARNING

Check the coolant level only when the engine is stopped. Wait until the coolant temperature is below 50°C (122°F) before removing the pressure cap. Failure to do so can cause personnel injury from heated coolant spray.

ATTENTION

Never use a sealing additive to stop leaks in the cooling system. This can result in cooling system plugging and inadequate coolant flow.

Remove the filler cap slowly to relieve cooling system pressure. Check the engine coolant level and add water / antifreeze mixture consisting of 50% water and 50% antifreeze, as required to bring the fluid level to the lower edge of the filler pipe. Use the type and amount of antifreeze recommended by the engine manufacturer for prevailing temperature.



8.3 DRAIN ENGINE FUEL PRE-FILTER

The Perkins engine is equipped with a fuel pre-filter located at the right side of engine. The fuel pre-filter removes water from the fuel as the fuel passes through the filter. Place a container under the valve to collect the water. Drain the water by opening the valve on the bottom of the filter. Allow all water to drain, then close the drain valve securely.

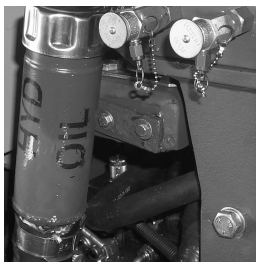


8.4 CHECK HYDRAULIC RESERVOIR OIL

ATTENTION

Cleanliness is very important. Contamination can damage the hydraulic system.

Check the hydraulic oil level with all cylinders fully retracted. If the oil level is low, clean around the fill tube cap before removing, then add specified oil to the fill tube as required, to bring the full level. The oil viscidity must match the climate. Do not mix brands of hydraulic oil.



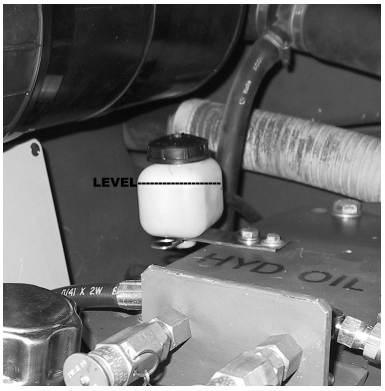


8.5 CHECK BRAKE OIL RESERVOIR LEVEL

ATTENTION

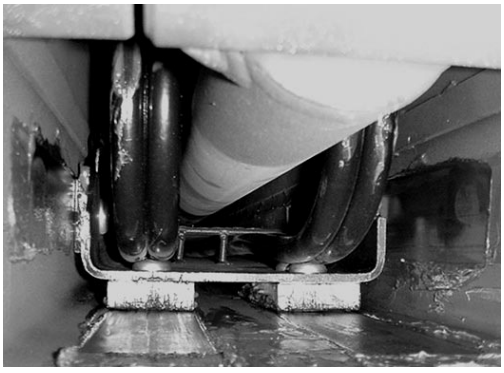
Cleanliness is very important. Contamination can damage the hydraulic system.

The brake reservoir is located behind the engine, rear engine support. If the oil level is low, clean round the cap before removing, add hydraulic oil as required, to bring the oil to full level. Do not mix brands of hydraulic oil. Do not use dot 3 brake fluid.



8.6 LUBE BOOM PADS

The boom pads are located at the end of boom. Lubricate the boom pads by using a brush or roller to apply EP2 lubrication on all eight boom pads. Clean and lubricate all areas of the boom where the pads make contact.



8.7 LUBE DRIVE SHAFT

ATTENTION

Clean all fitting before applying lubrication.

Lubricate the drive shaft by applying lubrication on all three points, the front, rear and slide of drive shaft.

Rear of Drive Shaft



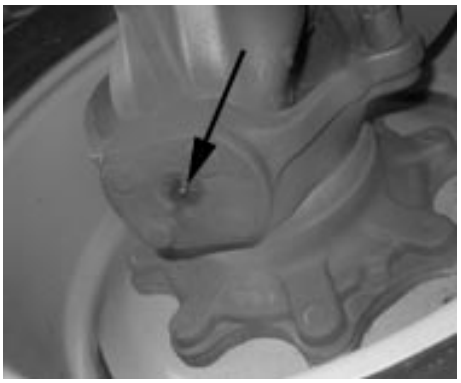
Front of Drive Shaft (2 Places)



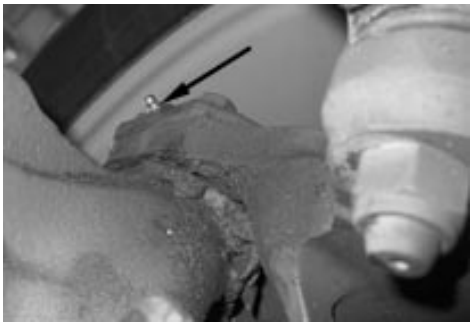
8.8 LUBE AXLE KING PINS

Apply lubricate to all eight king pins, located on top, bottom and each end of the axle.

Bottom King Pin

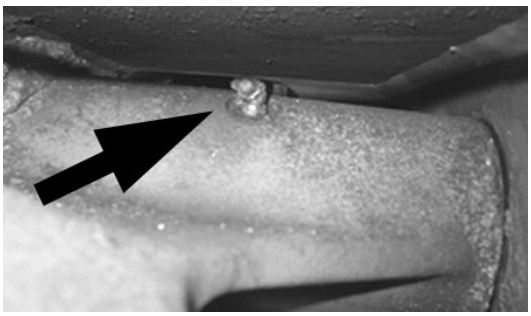


Top King Pin



8.9 LUBE AXLE REAR PIVOT PIN

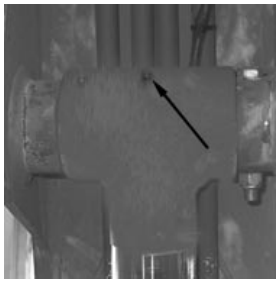
Apply lubricate to the rear pivot pin, which is located top of rear axle.



8.10 LUBE CYLINDERS

Raise the boom and clean all the grease fittings before applying EP2 lubrication. Lube all eight bearing, located on each end of cylinder.

Top Boom Cylinder



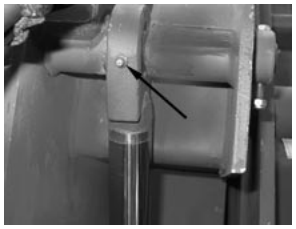
Bottom Boom Cylinder



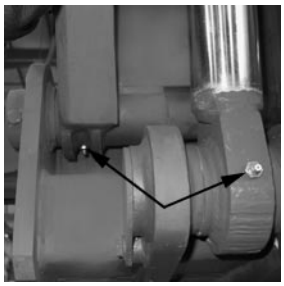
Bottom Slave Cylinder



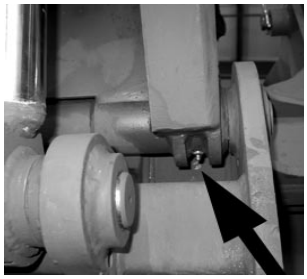
Top Slave Cylinder



LH Fork Carrier Bottom Tilt Cylinder



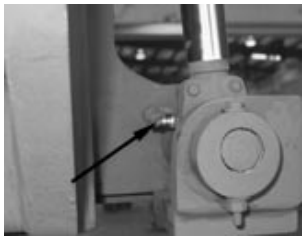
RH Fork Carrier Cylinder



Top Tilt Cylinder

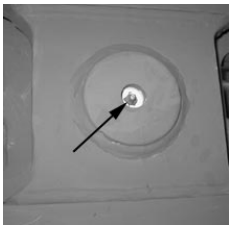


Bottom Rotation Cylinder



8.11 LUBE FORK ATTACHMENTS

Apply lubrication to all three pivots. Lube bar and bushing.





8.12 LUBE BOOM PIVOT

ATTENTION

If pin is pivot pin is removed, the complete cavity must be refilled with lubrication.

Apply lubrication to boom pivot pin.



8.13 CHECK TIRE INFLATION

DANGER

Overinflated or over heated tires can burst. A tire burst may result in serious injury; never use the machine are worn, wrongly inflated or damaged.

ATTENTION

Always use tires having the dimensions indicated in the vehicle registration document.

Dimensions		375/75 R20 x M27	
Load Index		155A	
Rim		11" x 20"	
Wheel Disc		8 holes DIN 70361	
Pressure	Bar	1.8 (soft)	3.7 (Standard)
	PSI	26 (soft)	54 (Standard)

8.14 CHECK TIRE WHEEL NUTS

ATTENTION

If wheel nuts loose torque often, check for damage of wheel.

Check tire wheel nuts (8 per wheel – 32 places) to be sure they are secure. Tighten nuts as necessary by using a 33-MM socket and torque wrench. The nut torques should be 220 Ft Lbs. / 300 Nm.



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SECTION 9
250 HOURS OR MONTHLY MAINTENANCE

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9.0 250 HOURS OR MONTHLY MAINTENANCE

GENERAL

The lubrication charts in section 10 provide general locations of the individual service points and list the type lubricant, which should be used for each component.
Before proceeding with 250 hours or Monthly Maintenance Checks, refer back to the pre-operation checklist and the 50 hours Maintenance.

9.1 CHECK ENGINE AND HYDRAULIC OIL

ATTENTION

Cleanliness is important to obtain an accurate sample.

The sampling valves are located near the rear engine support. When taking a sample, use proper containers. Clean the sampling valve and have the operator to start the engine. Remove the sampling valve cap and press front of valve to take a sample.



9.2 CHECK ENGINE COOLANT CONCENTRATION

WARNING

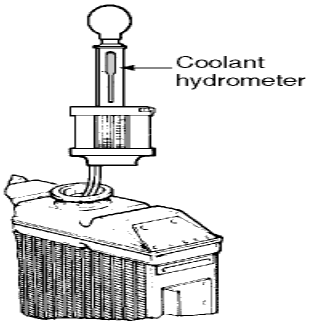
Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

ATTENTION

Perkins POWERPART antifreeze with a concentration of 50% will give protection against front to a temperature of –35°C (-31°F). It will also give protection against corrosion. This is especially important when there are aluminum components in the coolant circuit.

The coolant must be 50% Antifreeze and 50% water. The coolant mixture can be tested with a hydrometer. Remove the radiator cap (once the radiator is cool) place the tube of the hydrometer into the reservoir. Squeeze the bulb to pull coolant into the glass tube. Compare the position of the float to the graduated lines on the glass tube of the ethylene glycol. Graduations of the float indicate the freezing point of the coolant. The freezing point is 40° below zero F.





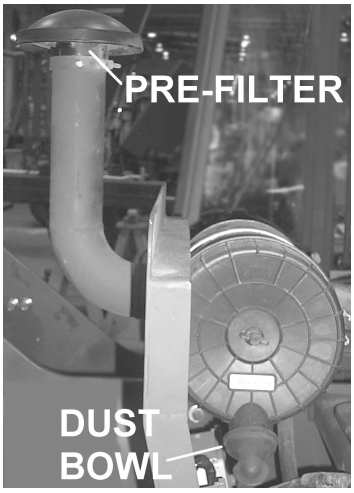
9.3 CHECK ENGINE AIR FILTER

ATTENTION

Environmental conditions have an important effect of the frequency at which the air filter needs service. If working in dusty area clean the filter and dust bowl daily. The filter element must be cleaned or renewed.

The air filter is located at the rear of the engine. Check the engine air filter as follows:

Shut the engine down and engage the parking brake. Remove the wing nut and air filter cover. Remove inner wing nut and filtering element. Clean the filter bowl and all other components using 40 psi pressure. Apply a small amount of grease to the seal. Then refit the element. Reassemble all components.



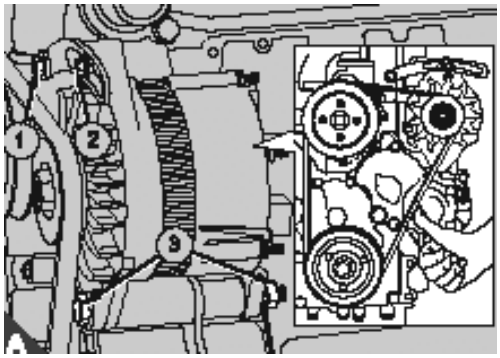


9.4 CHECK ENGINE DRIVE BELTS

ATTENTION

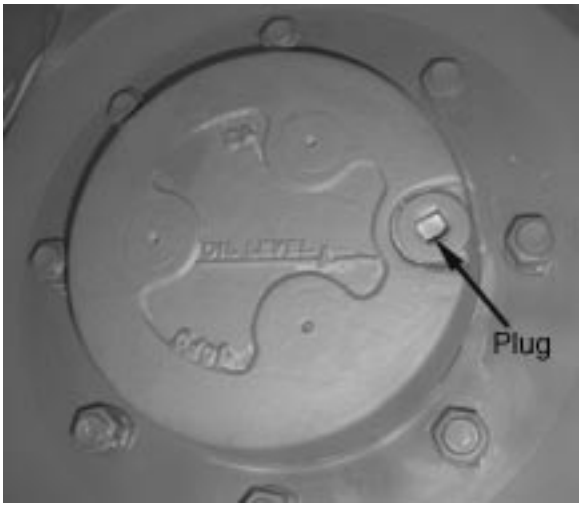
The alternator fitted to the 700 Series engine is driven by a drive belt of a specific design. Use only a Perkins POWERPART drive belt. If this is not done, an early failure of the belt may occur.

Press down the belt with the thumb at the center of the longest free length and check the deflection. With moderate thumb pressure – 45N (10 lbs.) the correct deflection of the belt is 10mm (3/8 in.). To adjust the belt tension loosen the pivot fasteners (3) of the alternator and loosen the setscrew (2) of the adjustment link. Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator and the setscrew of the adjustment link. Check the belt tension again to ensure that it is still correct. If a new belt is fitted, the belt tension must be checked again after the first 25 hours of operation.



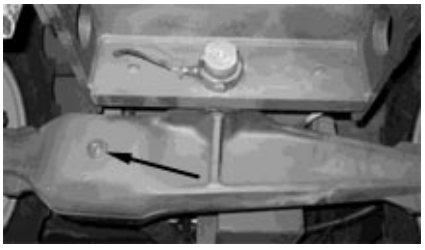
9.5 CHECK AXLE WHEEL ENDS OIL

Move machine to level ground. Rotate each wheel so oil level line is horizontal. Each axle hub has one plug level on the vertical center of axle. The oil should be at bottom of plug hole. Add oil if necessary.



9.6 CHECK AXLE DIFFERENTIAL OIL

REAR DIFFERENTIAL – One plug located on rear of axle differential. The oil level should be level with plug hole. Add oil if necessary.



FRONT DIFFERENTIAL – One plug located on rear left side of axle beside differential. The oil level should be level with plug hole. Add oil if necessary.



9.7 CHECK BATTERY



Battery Posts, terminals and related accessories contain lead and lead compounds, chemical known to the State of California to cause cancer and reproductive harm. Wash Hands after handling.



Battery electrolyte contains sulfuric acid. It can burn you if it touches your skin and eyes. Always wear goggles and protective gloves, and handle the battery with caution to prevent spillage. Keep metal objects watchstraps, rings, and necklaces, clear of the battery leads, since they can short the terminals and burn you.

The battery is located on top rear of engine.

Check the electrolyte level if necessary, add distilled water. Ensure the fluid is ¼" above the plates and the cell levels are correct. Check that the cable clips are well secured to the battery terminals. To tighten the clips, always use a wrench, never pliers. Protect the terminals by using Dielectric grease. Remove the battery and store it in a dry place, when the machine is not used for a long time. Before disconnecting the battery, set all switches in the cab to off. To disconnect the battery, disconnect negative (-) lead form the frame ground first. To connect the battery, connect the positive (+) lead first.



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SECTION 10
500 HOURS OR QUARTERLY MAINTENANCE

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10.0 500 HOURS OR QUARTERLY MAINTENANCE CHECKS

GENERAL

The lubrication charts in section 10 provide general locations of the individual service points and list the type lubricant, which should be used for each component.
Before proceeding with 500 hours or Quarterly Maintenance Checks, refer back to the pre-operation checklist and the 50, 250 hours Maintenance.

10.1 CHANGE ENGINE OIL

ATTENTION

Discard the used lubricating oil in a safe place and in accordance with local regulations.

CAUTION

If the base of the sump is divided to fit over a transmission shaft, ensure that the drain plugs on both sides of the sump are removed. If they are not only some of the lubricating oil will be drained.

CAUTION

Do not exceed the correct level of lubricating oil in the sump. If there is too much lubricating oil, the excess must be drained to the correct level. An excess of lubricating oil could enter the breather valve. This could cause the engine speed to increase rapidly without control.

Move the machine to level ground. Operate the engine until it is warm. Stop the engine. Put a container with a capacity of approximately 8 liters (14 pints) under the sump. Remove the sump drain plugs (Fig.A 1) and drain the lubricating oil from the sump. Fit the drain plugs with the new o-ring (Fig.A 2) and tighten the plugs to 34 Nm (25 Ft. lbs). Remove the filler cap and fill sump to the notch (Fig.B 2) on the dipstick (Fig.B 1) with new and clean lubricating oil of an approved grade. Remove the container of used lubricating oil. Start the engine and check for leakage from the filter. Stop the engine after 15 minutes check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump.

Fig. A

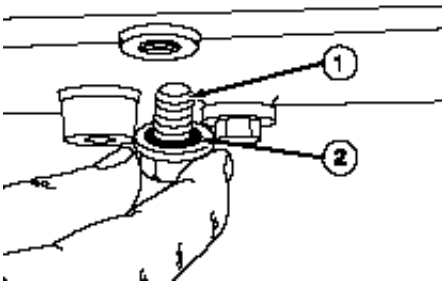
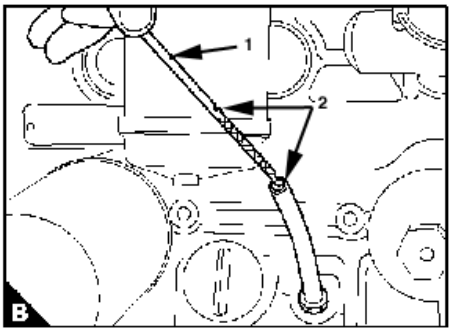


Fig.B



10.2 CHANGE ENGINE OIL FILTER

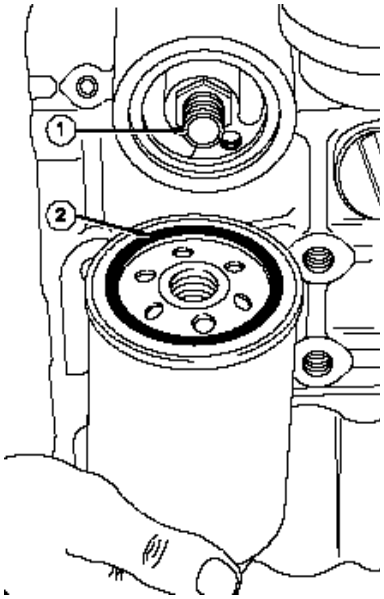
ATTENTION

Discard the used canister and lubricating oil in a safe place and in accordance with local regulation.

ATTENTION

Some application have a separate filter head that is fitted directly onto the filter mounting face on the cylinder block. The filter canister is then fitted to the filter head. Follow the procedures below for changing the oil filter.

Put a tray under the filter to retain spilt lubricating oil, clean thoroughly the outside surfaces of the filter assembly. Use a strap wrench or similar tool to loosen the filter canister. Remove and discard the canister. Ensure that the adapter (1) is secure in the filter head. Clean inside the filter head. Lubricate the seal (2) on top of the canister with clean engine lubricating oil. Fit the new canister and tighten the canister a further ½ to ¾ of turn by hand only. Do not use a strap wrench.



CAUTION

Do not fill the sump past the “FULL” Mark on the dipstick.

Ensure that there is lubricating oil in the sump. Ensure that the engine will not start and operate the starter motor until oil pressure is obtained. To ensure that the engine will not start, disconnect the electrical stop control of the fuel injection pump. Oil pressure is indicated when the warning light is extinguished or by a reading on the gauge. Ensure the electrical stop control is connected. Start the engine and check for leakage from the filter. Stop the engine after 15 minutes check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump.

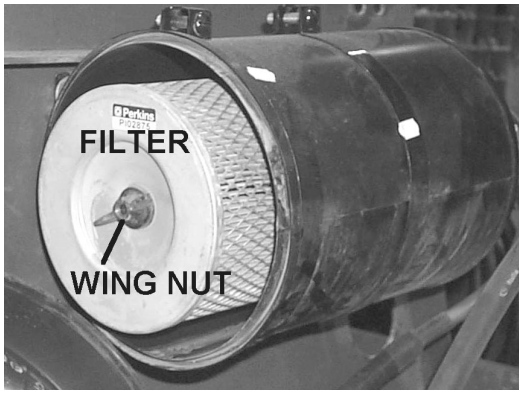
10.3 CHANGE ENGINE AIR FILTER

ATTENTION

If working in dusty area remove the filter and dust bowl daily to clean.

The air filter is located at rear of engine. Change the engine air filter as following:

Shut the engine down and engage the parking brake. Remove the wing nut and air filter cover. Remove inner wing nut and filtering element. Clean the filter bowl. Clean all components using 40 psi pressure. Check for cracks or damage of the elements and replace if necessary. Apply a small amount of grease to the seal. Then refit the element. Reassembly all components.



10.4 CHANGE ENGINE FUEL FILTER

The engine fuel filter is located on the right side of engine.

ATTENTION

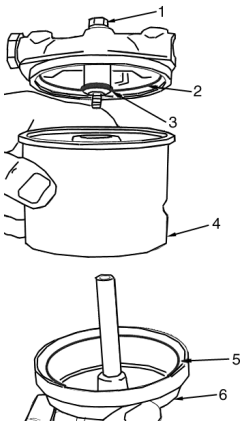
Discard the used canister filter and fuel oil in a safe place and in accordance with local regulation.

CAUTION

It is important that only genuine Perkins parts are used. The used of wrong parts could damage the fuel injection equipment.

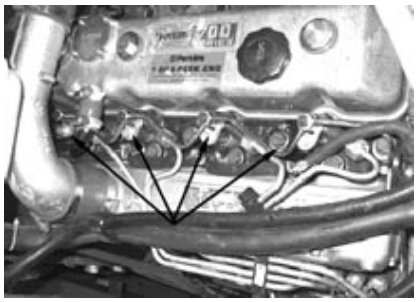
Thoroughly clean the outside surfaces of the fuel filter assembly. Hold the bottom cover of the filter element and release the setscrew (1), which is fitted through the filter head above the center of the element. Lower the bottom cover (6) of the filter. Remove the element (4) and discard it. Clean the inside surfaces of the filter head and the cover. Renew the seals (2) and (5) and the o-ring (3) and lightly lubricate them with clean fuel. Put the bottom cover under the new element and hold the element squarely to the filter head. Ensure that the element is fitted in the center against the o-ring in the filter head. With the assembly in this position, engage and tighten the setscrew. Eliminate the air from the fuel filter.





10.5 CHECK ENGINE GLOW PLUGS

The engine glow plug is located outside the reservoir. Disconnect the glow plug connection. Apply one probe of a multimeter, which can check continuity to the terminal of the glow plug and apply the other probe to a suitable ground. If the continuity is correct the multimeter will give an audible signal. It there is no audible signal, change the glow plug. Repeat this check for all of the glow plugs.



10.6 CHANGE HYDRAULIC RESERVOIR FILTER

ATTENTION

The hydraulic oil-filtering element cannot be cleaned or washed and refitted. They must be replaced with new ones of the type recommended by manufacturer.

ATTENTION

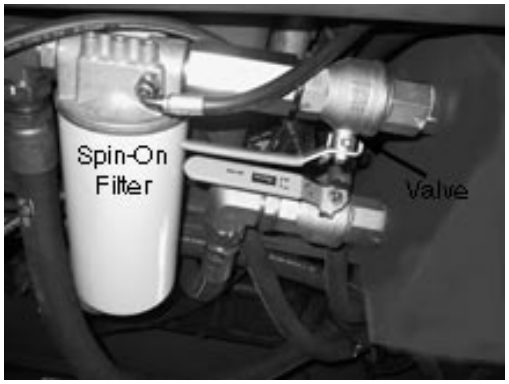
Discard the used filter in a safe place and in accordance with local regulations.

Stop the machine on a level ground and engage the parking brake. Place a container of suitable size under the filter to collect any oil leaks, then close the valve. Using a wrench, remove the filter element. Change the filtering element, then before fitting a new one, thoroughly clean and grease both seat and gasket.

WARNING

Failing to open the valve all the way can cause damage to the transmission pump and motor. Do not start the engine with the valve closed.

Hand-tighten and reopen valve. Check hydraulic oil level and add as necessary. Start the engine and inspect for any leaks.



SECTION 11
1000 HOURS OR SEMIANNUALLY MAINTENANCE

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11.0 1000 HOURS OR SEMIANNUAL

GENERAL

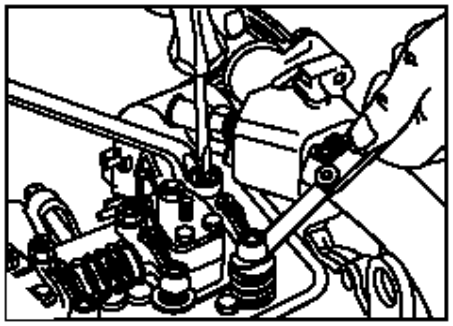
The lubrication charts in section 10 provide general locations of the individual service points and list the type lubricant, which should be used for each component. Before proceeding with 1000 hours or semiannually maintenance checks, refer back to the pre-operation checklist and the 50, 250, and 500 hours Maintenance.

11.1 CHECK ENGINE VALVE TIP CLEARANCE



If the cap nut is over tightened the stud and plate assembly for the rocker pedestal may be damage.

The valve tip clearance (8 places) is checked with a feeler gauge between the top of the valve stem and the rocker lever, with the engine cold. The correct clearance for both the inlet and the exhaust valves is 0.35mm (0.014 in.). Refer to Perkins manual for procedures for setting valve tip clearances.

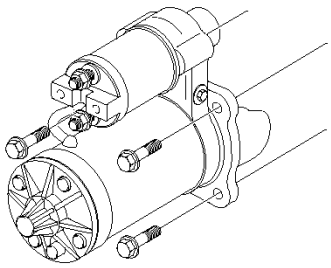


11.2 CHECK ELECTRICAL ALTERNATOR

With the engine off, check for side ply in the pulley. Start the engine. Make sure all accessories are off. Rev up the motor to a fast idle. Using a voltmeter set to the DC scale. Measure the voltage across the battery terminals - Red lead of the voltmeter on the positive terminal, black on the negative. The voltage should read around 14 volts. IF it reads less than 12 volts you may have a failed alternator. Turn on the defroster heater, headlights, work light, dome light and fan to draw power. Rev up the engine and watch the voltmeter. It should still be reading around 14 volts. If it reads lower than 13 volts the chances are that your is staring to fail. Check the field voltage at the alternator. Place ignition switch in the on position. Do not start engine. The brown / black wire on the alternator is the one that supplies the field. Check with a voltmeter to see if there is 12 volts at the field.

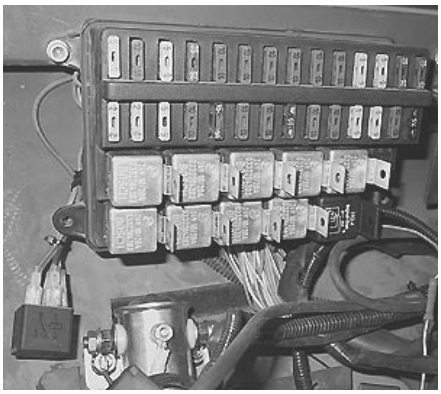
11.3 CHECK ELECTRICAL STARTER

Test the starter motor on the engine. Ensure that the battery is fully charged. Turn on the lights and operate the starter switch. Connect a voltmeter across the battery terminals and operate the starter switch. If the starter does not operate but the lights keep their power or there is no voltage drop across the battery, check the switch and all the connections and wires. Slow action of the starter can be caused by faulty wire connections. Failure to engage smoothly between the starter and the flywheel can be caused, on some types of starter motor, by dirt on the helical grooves of the starter motor drive, which can prevent free pinion movement. Clean the shaft thoroughly with cleaning fluid made especially for the purpose, and apply a small quantity of aero shell 6B or its equal. The starter is a specialist repair only.



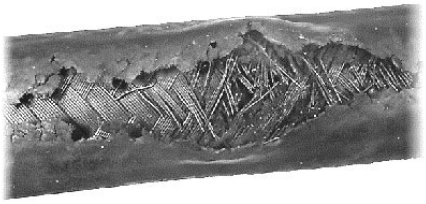
11.4 CHECK ELECTRICAL SYSTEM

Remove the fuse panel located on the left side of steering column. Inspect for corrosion. Check for damaged wires and faulty connections. Apply dielectric grease to connections. Spray waterproof / anticorrosion fluid to panel. Check the condition of all grounds. Pull solenoid caps and apply dielectric grease to connection. Check solenoid wire connections. Check wires to switches.



11.5 CHECK HYDRAULIC HOSES AND FITTING

Carefully inspect all hoses and fitting on the machine for leaks, and or damage. Leaks that cannot be stopped by tightening the connection should be removed and repaired. Make sure all fitting are tightened.



11.6 CHANGE HYDRAULIC RESERVOIR OIL, FILTER CLEANING HYDRAULIC MAGNET

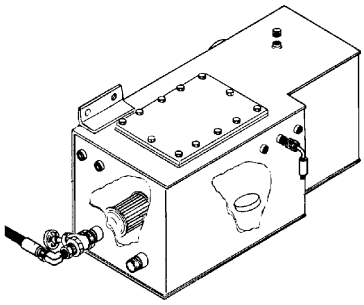
ATTENTION

When changing the oil, drain it when it is still hot and the polluting substances are in suspension.

To change the hydraulic reservoir oil procedures as follows:

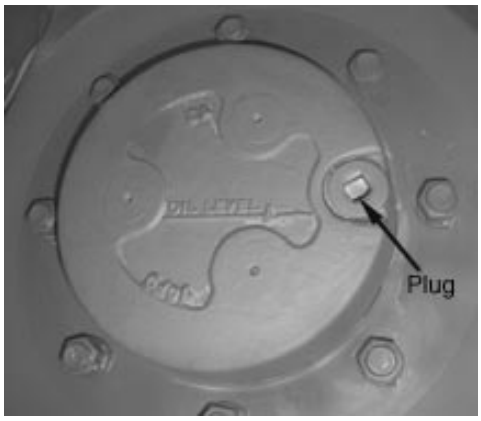
Stop the machine on level ground and engage the parking brake. Raise boom fully and support it. Eliminate any residual pressure from the hydraulic circuit. Place a 25 gallon container or larger under the drain plug. Remove the drain plug and allow oil to flow out into the container. Remove the inspection cover from tank. Wash the tank thoroughly with solvent and a jet of compressed air. Remove old filter from inside reservoir and install new one. Remove magnet from bottom of reservoir, clean and replace it. Refit the oil drain plug and the inspection cover. Add new oil, until it is present at the center of the sight glass.





11.7 CHANGE AXLE WHEEL END OIL

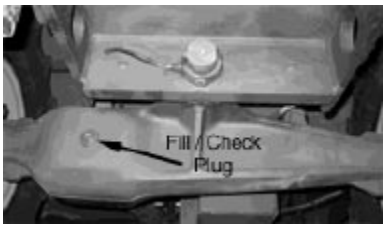
To change the oil in the axle wheel ends, turn wheel so drain / fill plug is at the bottom of the axle. Place one gallon container under the drain / fill plug. Remove plug and drain oil into container. When all fluid has drained rotate drain / fill plug to the horizontal center of the axle and add new oil. Install and tighten plug. Repeat procedures for each wheel. Travel the machine for two minutes then recheck oil levels. Add more oil if necessary.



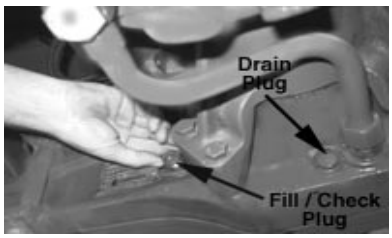
11.8 CHANGE AXLE DIFFERENTIAL OIL

The front and rear axle differentials use the same procedures. Place a two-gallon container under the drain plug. Loosen both drain plug and level plug and allow oil to flow out from the reduction gear. Refit and tighten drain plug. Add new oil through plug until it is level with the hole. Refit and tighten level plug.

Rear Axle Differential



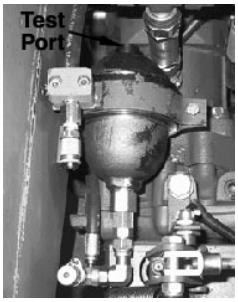
Front Axle Differential

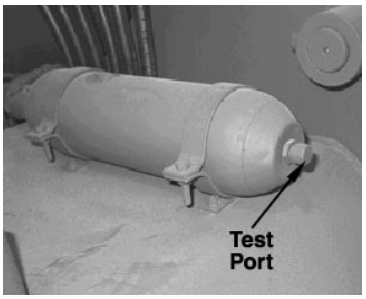


11.9 CHECK ACCUMULATOR PRE-CHARGE PRESSURE

870 PSI (60 BAR) PRE-CHARGE

800 PSI (55 BAR) PRE-CHARGE





DANGER

Pressure is present in the steering safety hydraulic circuit even when the engine is off. When disassembling, disconnecting, or checking the pre-charge of the steering accumulator, rotate the steering wheel left or right with engine shut down until the steering wheel becomes hard to move. This procedure will eliminate the trapped pressure in the steering circuit.

Use the olaer pressure regulator and gauge assembly or equivalent to check the pre-charge pressure.



Remove the protective cap from the test port. Install the pressure regulator and gauge assembly to the test port on the accumulator. Make sure the bleed valve is turned clockwise inward and verify pressure (870 PSI (60 BAR) for System Accumulator and 800 PSI (55 BAR) for Steering Accumulator). If pressure is low, check the charging valve for leaks using soapy water at the test port. Add additional dry nitrogen gas, if needed, by opening the nitrogen control valve. To release excess nitrogen gas pressure, open up bleeder valve located at bottom of pressure regulator until the correct pressure is achieved. Install the protective cap.

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SECTION 12
2000 HOURS OR TWO YEARS MAINTENANCE

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12.0 2000 HOURS OR TWO YEARS

GENERAL

The lubrication charts in section 10 provide general locations of the individual service points and list the type lubricant, which should be used for each component. Before proceeding with 2000 Hours or Two Years, refer back to the pre-operation checklist and the 50, 250, 500, and 1000 Hours Maintenance.

12.1 CHANGE ENGINE COOLANT

WARNING

Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

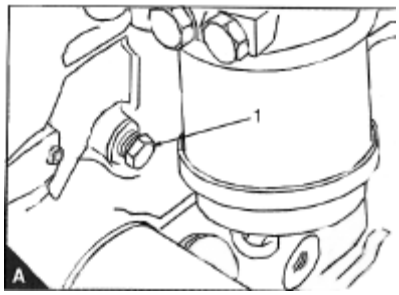
Discard the used coolant in a safe place and in accordance with local regulations.

ATTENTION

Perkins POWERPART antifreeze should be a concentration of 50% water and 50% antifreeze.

To change the engine coolant follow the procedures listed below:

Ensure that the machine is on level ground. Remove the filler cap of the cooling system. Remove the drain plug (1) from the side of the cylinder block in order to drain the engine. Ensure that the drain hole is not restricted. Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a top or drain plug, disconnect the hose at the bottom of the radiator. Flush the system with POWERPART easy flush. Fit the drain plugs and the filler cap. Close the radiator tap or connect the radiator hose.



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SECTION 13
3000 HOURS OR THREE YEARS MAINTENANCE

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13.0 3000 HOURS OR THREE YEARS

GENERAL

The lubrication charts in section 10 provide general locations of the individual service points and list the type lubricant, which should be used for each component. Before proceeding with 2000 Hours or Two Years, refer back to the pre-operation checklist and the 50, 250, 500, and 1000 Hours Maintenance.

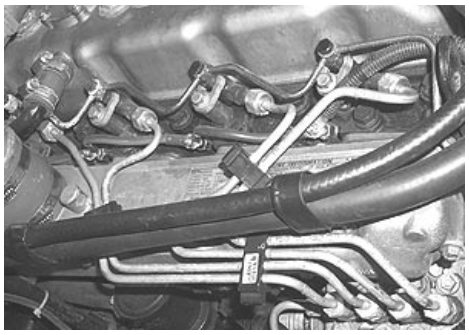
13.1 CHECK ATOMISERS (FUEL INJECTOR)

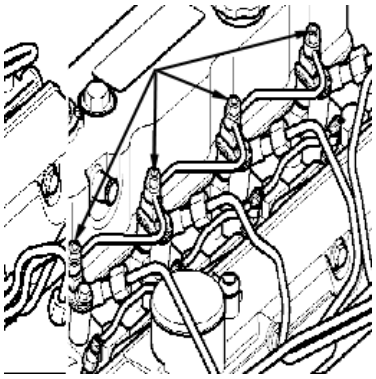


If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.

Keep away from moving parts during engine operation. Some moving parts cannot be seen clearly while the engine runs.

The atomizer is located on the engine right side. An atomizer fault can cause an engine misfire. In order to find which atomizer is defective; operate the engine at a fast idle speed. Loosen and tighten the union nut of the high-pressure fuel pipe at each atomizer. When the union nut of the defection atomizer is loosened, it has little or no effect on the engine speed. To replace the atomizer refer to the Perkins manual.





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SECTION 14
ROUTINE MAINTENANCE

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14.0 ROUTINE MAINTENANCE

GENERAL

This section provides routine maintenance procedures. A through and regular maintenance keeps the machine in a safe and efficient working condition.

For this reason, it is advisable to wash, grease and service the machine properly. Always ensure all machine components are in good condition. Check for oil leaks and loosening guards, and make sure that the safety devices are efficient. In case of defects, find and rectify them before using the machine. For purchases components always refer to the vendor manuals.

Not-respecting the ordinary maintenance schedule of this manual automatically voids Terexlift warranty. The relief valves are factory pre-set. Adjusting the valve in the field will void machine warranty. Valves must be set only by trained personnel.

14.1 REPLACING THE ATTACHMENTS

CAUTION

Use only attachments directly designed and manufactured by Terex for its handlers.

WARNING

After substitution, visually check the attachment is correctly coupled to the boom, before operating the machine. A wrongly coupled attachment may cause injury to personnel or damage equipment.

To change attachments, operator as follows:

1. Disconnect the quick connectors from teh fork rotate cylinder and connect them to the attachment lock / unlock cylinder. Then disconnect the quick connectors from the sideshift cylinder.

2. Disconnecting the quick connectors of the attachment, and connect the hydraulic locking pipes of the attachment to couplings.

3. Operator the Joystick function to unlock attachment pins.

4. Rest the attachment flat on the ground.

5. Tilt the holding frame forward and retract the boom to release the attachment upper lock.

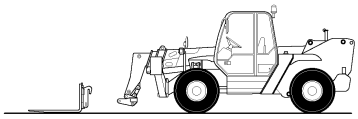
6. Move back with the machine (or with the boom) and drive to the new attachment going to be coupled.

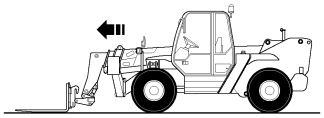
7. Hold the frame tilted forward and hook the upper pins of the new attachment.

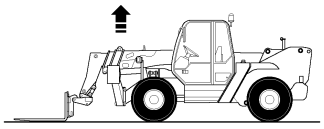
8. Retract and raise the attachment a few inches. Attachment will center automatically on the quick coupling frame.

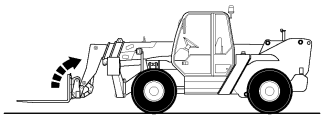
9. Operate the joystick function to lock the attachment.

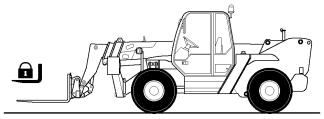
10. Couple the connectors of the attachment,to the quick couplings of the frame.











14.2 SLIDER PADS ADJUSTMENT

If the clearance between the boom sections are over (2mm), it is necessary to shim the Slider Pads of the boom sections. Usually, the Slider Pads that wear more rapidly are the lower Slider Pads of the fixed boom section and the upper Slider Pads of the moving boom section.

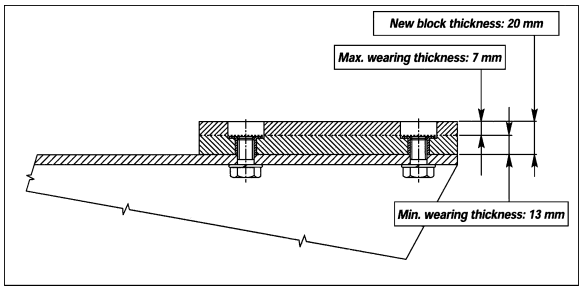
To adjust the Slider Pads follow the procedures listed below:

1. Fully retract the telescope section.

2. Rest the boom on a solid support.

3. With a thickness gauge, check the clearance of the Slider Pads. The tolerance after adjusting must be 1.0 mm to 1.5 mm.

4. Measure the thickness of the Slider Pads. The top and bottom Slider Pads of the base section and the top Slider Pads of the moving section must be at least 13 mm thick, all other Slider Pads must be 7 mm. If any of the pads are less then the above they will have to be replaced (see changing the Slider Pads).



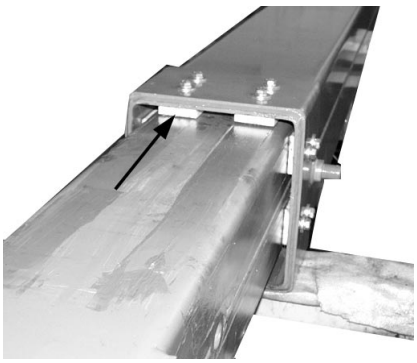
5. Remove the Slider Pads mounting screws and place shims between the boom section and the wear pad to obtain the 1.0 mm to 1.5 mm tolerance. Reinstall the mounting screws after applying a medium strength Locktite.

6. After shimming, fully extend the boom; clean the wear pad paths on the moveable boom section and grease with a thin coast of grease, (the recommended type of grease to use is Texclad 2 or any type of grease with a graphite additive).

14.3 CHANGING SLIDER PADS

If the Slider Pads must be replaced, follow the procedures listed below:

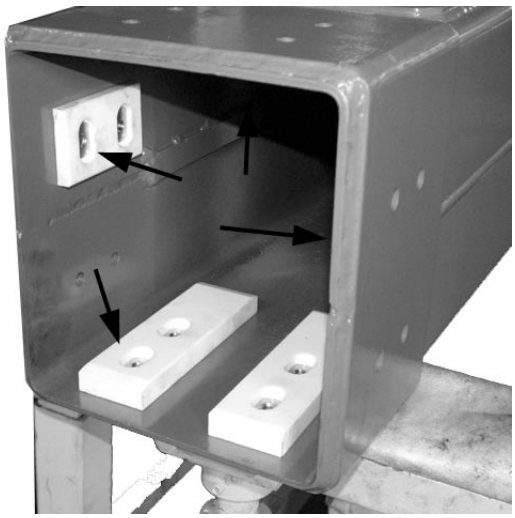
1. Put the boom in the horizontal position with the boom fully extended.



2. Support the moving section with a sling attached to a suitable lifting device. The moving section will have to be removed from the base section to access the rear Slider Pads on the moveable boom section. Before removing the moveable section several things must be done.

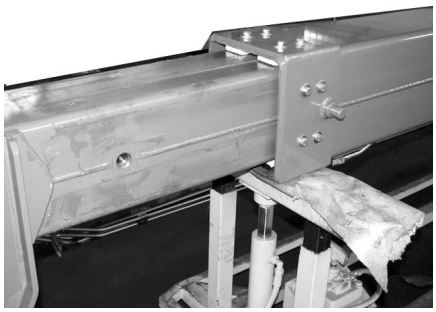
3. Support the moveable section so that the Slider Pads on the base section are free.

4. Remove the top, bottom and side Slider Pads from the base section. They are help in place by the external bolts.



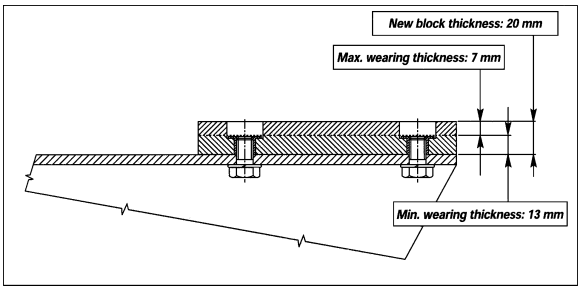
5. Remove the telescope cylinder rod eye pin from the moveable section, this will allow the section to be pulled out of the base section far enough to access the Slider Pads on the rear of this section.

6. Only pull the section out as little as possible to access the Slider Pads. Be careful not to disturb the flexible hoses.



7. Remove the Slider Pads from the rear of the moveable boom section.

8. Measure the inside of the base section, top to bottom and side to side. Measure the outside of the moveable boom section in the same manner to determine if some shims will be required under the new Slider Pads. The final clearance must range from 1 to 1.5 mm.



9. Install the new Slider Pads and shims required determined from the above measurements. Apply a drop of medium strength Loctite on the bolt threads before installing.

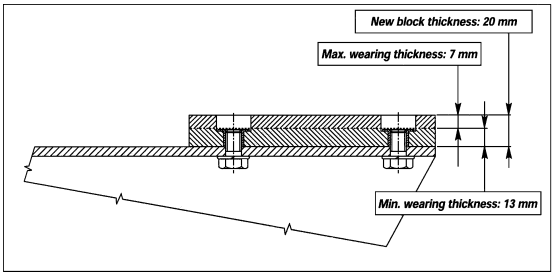
10. Reinstall the moveable boom section being very careful with the flexible hoses.

11. Reinstall the telescope cylinder rod eye pin. To align the rod with the hole use a pointed bar to raise the telescope cylinder rod eye and insert the pin from the other side.



12. Install the Slider Pads on the top bottom and sides of the base section, again using shims as necessary and applying a drop of medium strength Loctite on the bolt threads. Maintain the 1 mm to 1.5 mm clearance.





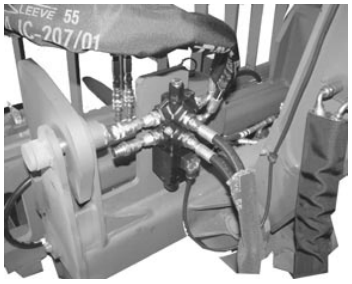
13. Clean the wear pad paths on the moveable boom section and grease with a thin coat of grease, (Texclad 2 or grease with graphite additive).

14.4 ATTACHMENT PLATE REMOVAL / INSTALLATION

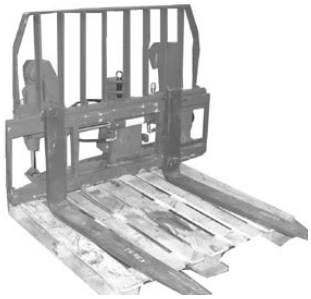
REMOVAL

Follow the procedures below for removing the attachment plate:

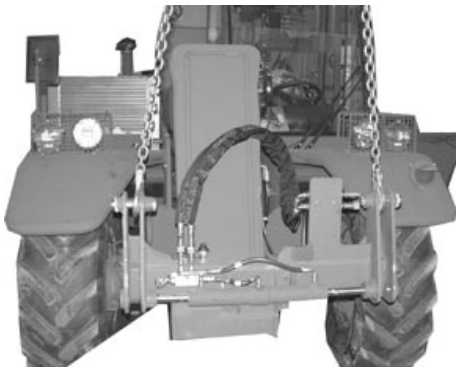
1. Disconnect the quick connectors feeding the attachment from the boom.



2. Release the attachment and rest it on a pallet to move it.

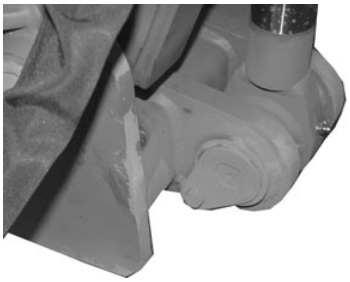


3. Using an adequate lifting device sling the attachment holding frame to support the frame weight.



4. Disconnect he quick connectors of the attachment locking cylinder.

5. Remove the bolt fixing the pin of the attachment rotation cylinder rod using a 17 mm wrench.



ATTENTION

Do not use steel hammer or pinch bar. These items can cause damage to the machine parts.

6. Remove the pin. If necessary, strike the pin using piece of soft material.

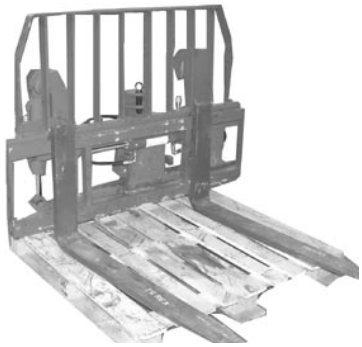
7. Remove the screw fixing the hinging pin of the attachment holding frame with two 19 mm wrenches.



ATTACHMENT INSTALLATION

Follow the procedures below for installing the attachment plate:

1. Rest the attachment holding frame on a wooden pallet to handle it.



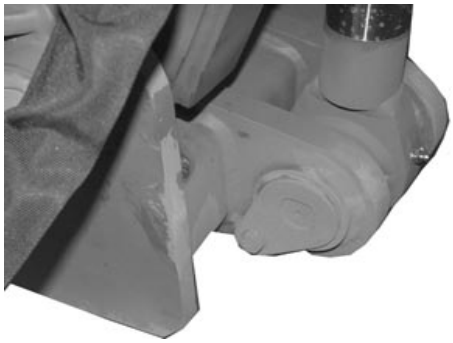
2. Apply lubrication prior to installing the hinging pins of the attachment holding frame.

3. Using two 19 mm wrench install the screw fixing the hinging pin of the attachment holding frame.



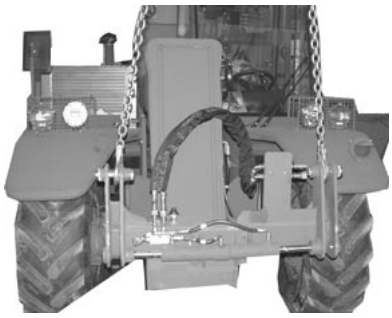
4. Apply lubrication prior to installing rotation cylinder rod pin.

5. Using a 17 mm wrench install the bolt fixing the pin of the attachment rotation cylinder rod.



6. Connect the quick connectors of the attachment locking cylinder.

7. Using an adequate lifting device sling the attachment holding frame to support the frame weight.



8. Connect the quick connector feeding the attachment from the boom.

14.5 PARKING BRAKE ADJUSTMENT

Follow the procedures below for adjusting the parking brake:

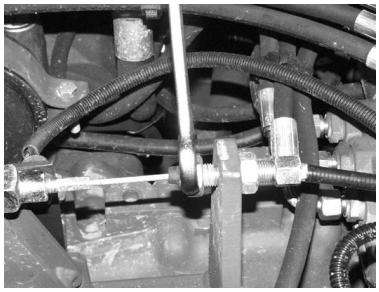
1. Position the machine on hard level surface.

2. Start machine and raise boom 45° with suitable supporting device support boom. Shut off the machine.

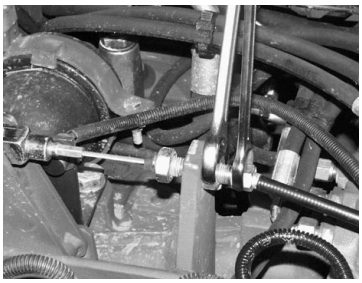
3. Using a 13 mm wrench remove bolts that are securing the upper protection plate and remove the plate.

4. Completely lower parking brake handle.

5. Using a 22 mm wrench loosen the front nut on securing bracket for the parking brake cable.



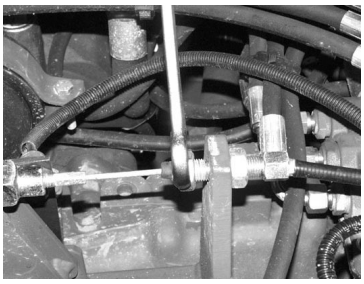
6. Use a 17 mm wrench to hold the sheath in position while using a 22 mm wrench rotate the nut clockwise to tighten the brake and counter-clockwise to loosen the brake.



7. To ensure proper parking brake adjustment the parking brake handle in the operators cab should reach full resistance on the 5th or 6th detent click position on the hand brake lever.

8. Start the machine and test the brake.

9. When parking brake is adjusted use a 22 mm wrench and lock nut in position.



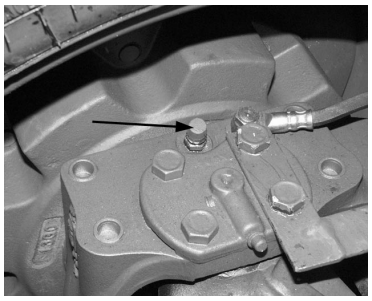
14.6 BLEEDING BRAKE SYSTEM

The proper removal of air from the brake system is very important. All too often, air has remained trapped in systems causing a spongy pedal and inadequate brakes. The air in the system will always seek the highest level. To properly bleed the system, do the following:

1. Fill the brake reservoir, located in the engine compartment with 10W hydraulic oil only.

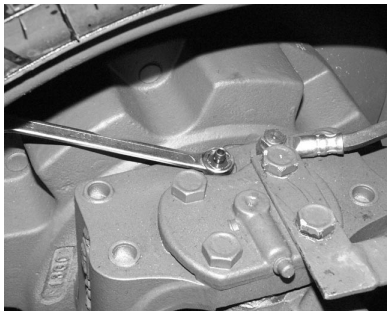


2. Remove the protection cap from the brake bleeder vent.



3. For this operation, two operators are necessary, one in the operators cab and the other close to the brake bleeder line.

4. Depress brake pedal several times until it is no longer spongy, then while holding the brake down, use a 13 mm wrench and loosen the bleeder vent to allow air to escape.



5. Retighten bleeder vent and allow pedal to return.

6. Repeat cycle until pedal is firm.

7. Protect the bleeder vent with the special cap.

8. Make several static brake applications and then repeat the cycle once more.

9. Check brake oil level. If necessary, add 10W Hydraulic oil only. (**Do not** use Brake fluid).

14.7 PROXIMITY SWITCH ADJUSTMENT

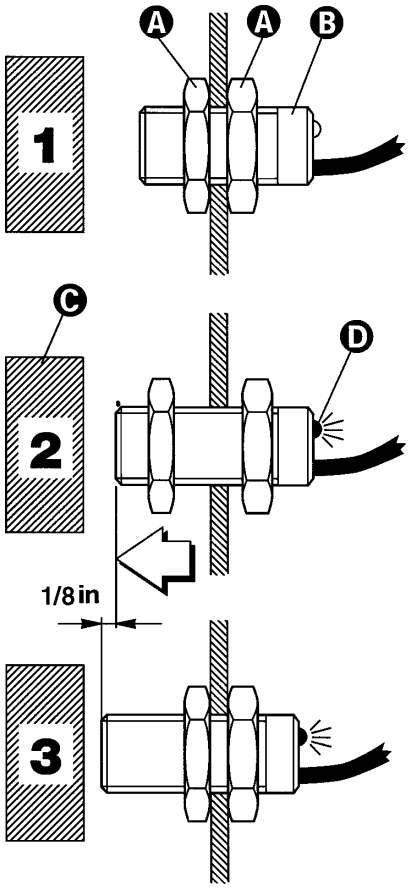
In case of a failure or complete malfunctioning of the proximity switches due to a loosening of their fixing ring nuts, re-adjust their position:

1. Loosen nuts (A) fixing the proximity switch (B).

2. Set the mobile part C of the machine, controlled by the proximity switch, as close as possible to it. Near the proximity switch to the component until the LED indicator D lights up.

3. Near the proximity switch by other 1/8". Tighten the proximity switch fitting nut at a torque of 15 Nm and the relevant lock nut.

The machine is equipped with a proximity switch on the parking brake. This switch prevents the machine starting when the parking brake is not engaged.



14.8 DRIVE SHAFT

This section contains instructions for removing and repairing these drive shafts.

DISASSEMBLY

Periodic inspections of the drive shafts are recommended to check for proper lubrication, excessive wear, and any loose, missing or damaged components.



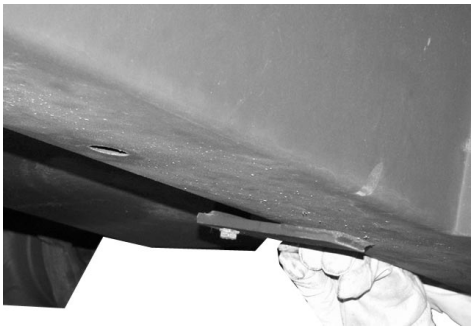
Prior to removing the drive shaft, support the drive shaft to prevent it from dropping. Block the wheels to prevent the machine from rolling.

To remove the drive shaft follow the procedures listed below:

1. Position machine on a hard level surface.

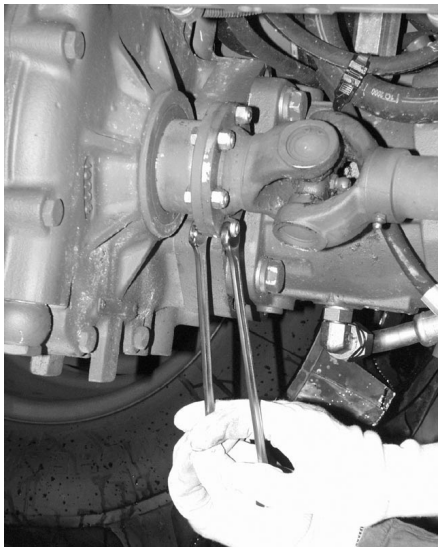
2. Block all wheels to prevent machine from rolling.

3. Using a 13 mm wrench, remove the four bolts from the bottom protection cover.



4. Make a reference mark at the gear box and rear axle to ensure proper re-assembly. If part location is not marked you risk loosing the alignment location causing the drive shaft to become unbalance, which could cause damage to the machine.

5. Using two 13 mm wrenches remove the six bolts attaching the drive shaft to the gear box and the rear axle.



6. Remove the drive shaft.

ASSEMBLY

Periodic inspections of the drive shafts are recommended to check for proper lubrication, excessive wear, and any loose, missing or damaged components.

To remove the drive shaft follow the procedures listed below:

WARNING

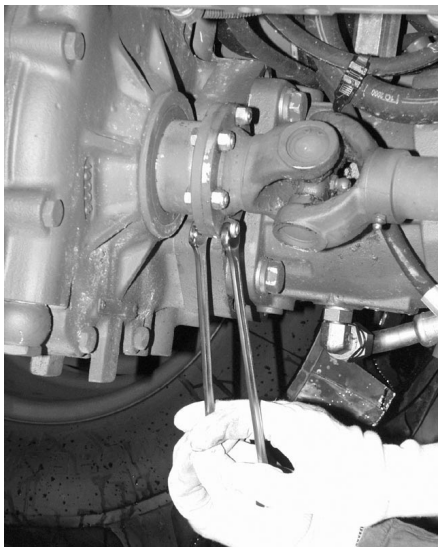
Prior to removing the drive shaft, support the drive shaft to prevent it from dropping. Block the wheels to prevent the machine from rolling.

1. Position machine on a hard level surface.

2. Block all wheels to prevent machine from rolling.

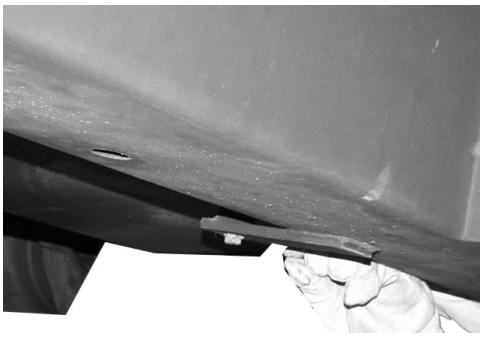
3. Install the drive shaft.

4. Using two 13 mm wrenches install the six bolts attaching the drive shaft to the gear box and the rear axle. Make sure alignment is correct. If alignment is not correct you risk loosing the balancing of the drive shaft, which can cause damage to the machine.



5. Torque bolts to 20 ft lbs.

6. Using a 13 mm wrench install bottom protection cover.



14.9 FUEL TANK

DISASSEMBLY

Follow the procedures listed below for removing the fuel tank:

1. Position the machine on a hard level surface.



The weight of the counterweight is approximately 2150 lbs. Use adequate lifting equipment to support the counterweight. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

2. Use an adequate lifting device to support the counterweight.
3. Remove the four bolts (two on the side and two on the back).
4. Lower the counterweight from the machine.
5. Carefully clean around the drain plug of the fuel tank.
6. Place a suitable container under fuel tank for draining fuel.
7. Remove fuel tank drain plug and fuller cap, allowing fuel to drain completely.
8. Use a screwdriver to loosen the hose clamps and disconnect the fuel supply and return lines.
9. Disconnect the electrical fuel gauge.
10. Use wood blocking to support the fuel tank.
11. Using a 13 mm and 19 mm wrench remove the three screws attaching fuel tank to the frame.
12. Lower and rest the fuel tank on the ground.

ASSEMBLY

Follow the procedures listed below for installing the fuel tank:

1. Install the three attaching screws to secure the fuel tank.
2. Connect the electrical fuel gauge.
3. Connect the fuel supply and return lines. Tighten the hose clamps.
4. Install the fuel tank drain plug.
5. Fill the tank and replace the fuel cap.



The weight of the counterweight is approximately 2150 lbs. Use adequate lifting equipment to support the counterweight. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

6. Use an adequate lifting device, install the counterweight.
7. Install the four bolts (two on the side and two on the back). Check for leaks.

14.10 OIL TANK

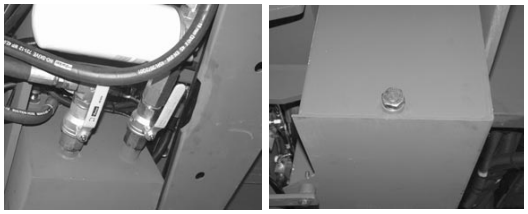
DISASSEMBLY

Follow the procedures listed below to disassembly the oil tank.

1. Remove the drive shaft protection cover by using a 13 mm wrench to loosen the four locking screws.



2. Carefully clean the area around the drain plug of the oil tank.



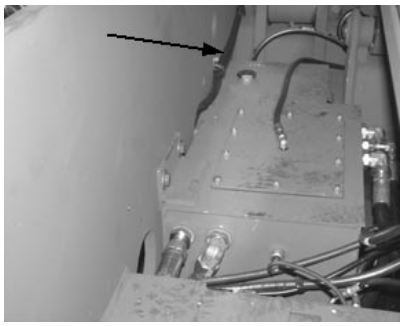
4. Place suitable container under oil tank drain plug.

3. Using a 32 mm wrench remove the drain plug and allow the oil to completely drain.

4. Close the oil valves.

5. Using a 32 mm and 36 mm wrench disconnect the valve.

6. Disconnect the three side flexible hoses by using a 22 mm – 27 mm and 32 mm wrench.



7. Disconnect the electrical wire from the sending unit.

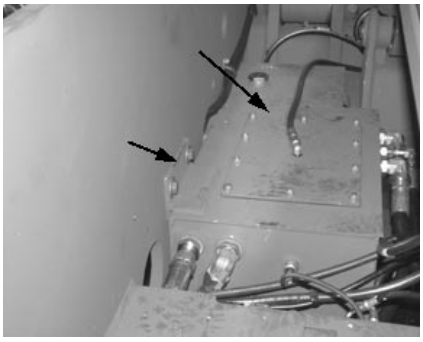
8. Use a 38 mm and a 50 mm wrench to disconnect the flexible hoses under the valve.

9. Disconnect the hose clamp of the filler extension by using a 10 mm wrench.

10. Remove the tank vent line.

11. Place a pallet with shims under the tank to support its weight.

12. Remove the screws securing the tank on the machine by using a 17 mm and 19 mm wrench.

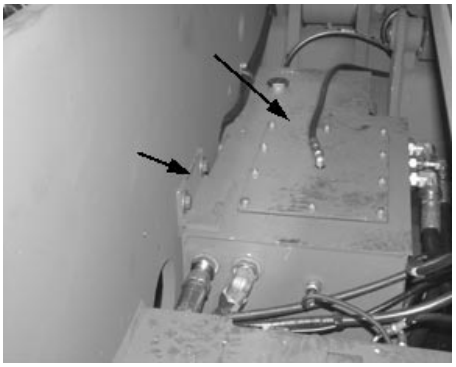


13. Lower and remove the tank from the machine.

ASSEMBLY

Follow the procedures listed below to install the oil tank:

1. Install the oil tank by using a 17 mm and 19 mm wrench to secure the four screws that attach the oil tank to the machine.



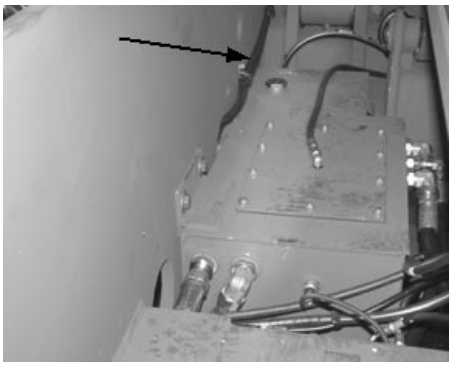
2. Connect the tank vent lines.

3. Using a 10 mm wrench connect the hose clamp of the filler extension.

4. Connect the flexible hoses under the valve by using a 38 mm and 50 mm wrench.

5. Connect the electrical wire to the sending unit.

6. Connect the three side flexible hoses by using a 22 mm – 27 mm and 32 mm wrench.



7. Using a 32 mm and 367 mm wrench connect the valve.



8. Fill the oil tank with oil and open the valves of the intake line before starting the machine.

9. Start the machine, after a few minutes, check the oil level and if necessary, add new oil.

10. Check for leaks.

14.11 RADIATOR

DISASSEMBLY

Follow the procedures listed below for removal of the radiator:

1. Carefully clean the area around the piping to be disconnected. Disconnect and immediately plug the lines and ports to prevent dust or foreign materials from entering the circuit.

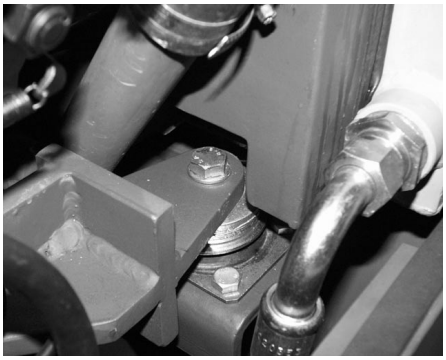
2. Using a 13 mm wrench remove the two securing bolts from the radiator fan guard and the bolts securing the fan.

3. Remove the fan.

4. Place a suitable container under the radiator drain valve.

5. Empty the radiator using the drain valve.

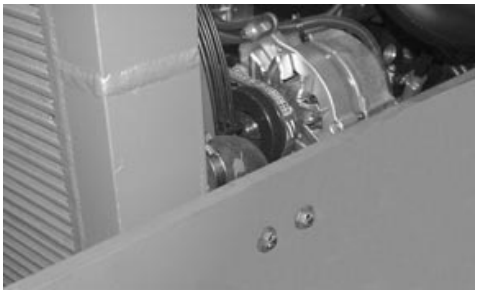
6. Disconnect the two inlet and outlet hoses from the radiator.



7. Disconnect the hydraulic pipes and plug them to prevent dust or foreign materials from entering.

8. Disconnect the water temperature gauge.

9. Using a 13 mm wrench, remove the two screws securing the radiator to the chassis.



10. Remove the two screws of the vibration supports with a 22 mm wrench.



11. Sling the radiator with a strap connected to adequate lifting device.

12. Remove radiator from machine.

ASSEMBLY

Follow the procedures listed below to install the radiator:

1. Using adequate lifting device lift the radiator into the machine.

2. Using a 22 mm wrench install the two screws on the vibration supports.



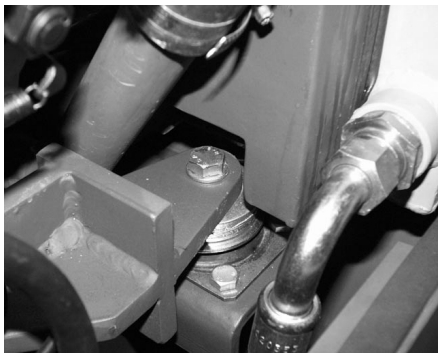
3. Install the two screws securing the radiator to the chassis by using a 13 mm wrench.



4. Connect the water temperature gauge.

5. Unplug and connect the hydraulic pipelines.

6. Connector the two inlet and outlet hoses from the radiator with a 32 mm wrench.



7. Fill the radiator with the correct amount of water / antifreeze solution.

8. Using 13 mm wrench replace the fan and securing bolts.

9. Replace the fan guard and the fan guard securing bolts.

10. Start the engine and check for leaks.

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SECTION 15
HYDRAULIC BOOM

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15.0 BOOM INTRODUCTION

GENERAL

Section D covers the boom system components used on this machine with recommended inspection.

The boom system consists of a two section hydraulic boom with one telescope cylinder and valves for boom hoist, telescope functions and tilt cylinder.

15.1 BOOM REMOVAL / INSTALLATION

GENERAL

This section provides the necessary information to remove and install the boom assembly.

BOOM REMOVAL

The following instructions are general in nature. Remove the boom as a complete unit, using these guidelines.

1. Position the machine on a hard level surface.

WARNING

The weight of the boom assembly is approximately 1323 lbs. (600 kg). The weight of each boom hoist cylinder is approximately 135 lbs (72 kg). Use adequate lifting equipment to support the boom assembly and cylinders. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

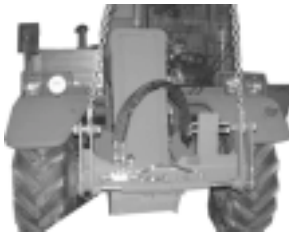
2. Raise boom to the maxuim boom height.

3. Remove glass from boom side of cab.



4. Lower boom to a good working level.

5. To remove tool coupling, disconnect hydraulic hoses.





6. Use adequate lifting device to remove the tool coupling from machine.

7. Remove the pin holding coupling to boom mask and the pin attaching the tilt cylinder.



WARNING

Before removing the boom hoist cylinder rod pins, support the boom hoist cylinders using a suitable lifting device and blocking. This will prevent the cylinders from dropping when the rod pins are removed. If this precaution is not followed serious injury to personnel or damage to the machine may result.

8. Support the boom cylinders with an adequate lifting device and place blocking under the boom hoist cylinder.

9. Remove boom hoist cylinder pin.

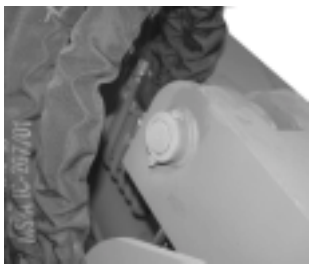



10. Support front and rear of boom assembly with an adequate lifting device.

ATTENTION

Use blocking to prevent damage to tubing when chains or sling are wrapped around boom.

11. Remove pin from small stabilizer cylinder.



12. Remove pivot pin from rear of boom.



13. Tag and disconnect hydraulic hoses.



WARNING

The weight of the boom assembly is approximately 1323 lbs (600 kg). The weight of each boom hoist cylinder is approximately 159 lbs (72 kg). Use adequate lifting equipment to support the boom assembly and cylinders. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

14. Position boom assembly on suitable support device near a strong anchor point. Support the boom with blocking to prevent damage to tubing.



BOOM INSTALLATION

The following instruction are general in nature. Install the boom as a complete unit using the following instructions as a guideline.

1. Position the machine on a hard level surface.

WARNING

The weight of the boom assembly is approximately 1323 lbs (600 kg). The weight of each boom hoist cylinder is approximately 159 lbs (72 kg). Use adequate lifting equipment to support the boom assembly and cylinders. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

2. Use an adequate lifting device supporting the front and rear of boom assembly bring boom into position over machine at a 20° angle.

ATTENTION

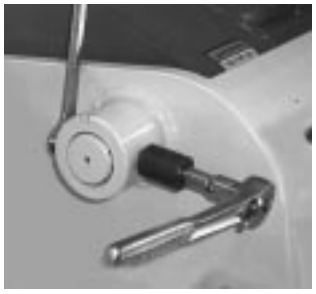
Use blocking to prevent damage to the tubing when chains or sling are wrapped around boom.

3. Connect all hydraulic hoses.

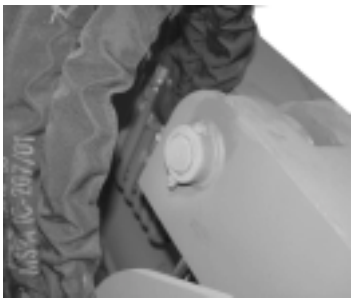


4. Lubricant all pin with ancanti-seize lubricant.

5. Insert pivot pin at the rear of boom.



6. Replace pin for small stabilizer cylinder.

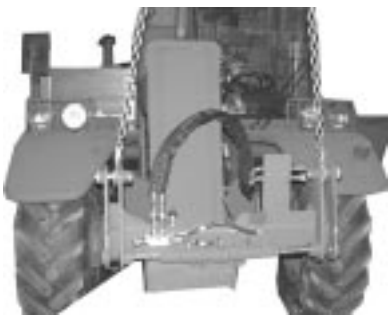


7. Insert boom hoist cylinder pin.

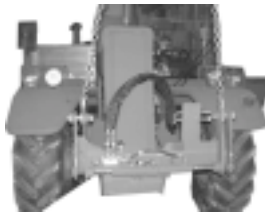




8. Using adequate lifting device to replace the tool coupling on the machine.



9. Insert the pin holding coupling to the boom mask and the pin attaching the tilt cylinder.




10. Reconnect the hydraulic hoses to the boom.

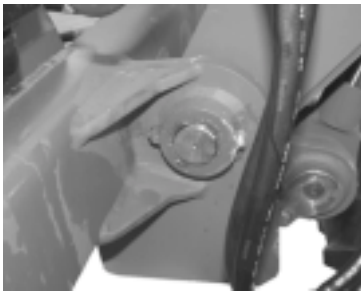


11. Start the engine and function boom to check for leaks.

15.2 TILT CYLINDER REPLACEMENT

1. Position the machine on a hard level surface.

2. Remove the pin holding coupling to boom mask and the pin attaching the tilt cylinder.



3. Unplug quick disconnect hoses.



4. Tag and remove hoses from holding valve.



5. Attach adequate lifting device, to tilt cylinder, carefully remove pin from top of boom head.



6. When removing tilt cylinder use caution not to damage holding valve.

7. Remove the holding valve.



8. Using adequate lifting device lift new cylinder into place and reinsert pin.

9. Replace the holding valve.

10. Bring tool coupling in position on heads of boom.

11. Reinsert the pin holding coupling to boom mask and the pin attaching the tilt cylinder.

12. Connect hydraulic hoses. Start engine and check for leaks.

15.3 BOOM DISASSEMBLY

1. Position the machine on a hard level surface.

2. Position the boom assembly on suitable support device near a strong anchor point. Support boom with blocking to prevent damage to tubing.



3. To remove tool coupling, disconnect hydraulic hoses.



4. Remove the pin holding coupling to boom mask and the pin attaching the tilt cylinder.





5. Use adequate lifting device to remove coupling from machine.

6. Remove the tilt cylinder.

7. Remove flow valve at back of boom.



8. Remove pin holding telescope cylinder at back of boom.



9. Pull the inner section out approximately two feet.

10. Remove slider pad, and check for wear., note location of each pad.

ATTENTION

Bottom slider pad must be removed before pulling inner section completely out.

11. Pull inner section out enough to attach an adequate lifting device to support and prevent from falling.

12. Remove inner section and inspect inner slider pads.

13. Place inner section on a suitable support device.

14. Tag and remove all tubing and hydraulic hoses.



15. Remove snap ring, and drive out the pin attaching the telescope cylinder.



16. Carefully remove telescope cylinder from inner section.

17. Inspect all hydraulic hoses for damage and replace as required.

15.4 BOOM ASSEMBLY

1. Position the machine on a hard level surface.

2. Lubricant all pin with ancanti-seize lubricant.

3. Insert the telescope cylinder pin and replace snap ring.

4. Position inner section in front of base section.

5. Connect all tubing and hydraulic hoses.

6. Push inner section approximately four feet in base section.

7. Install slider pads, then completely push inner section into base section.

8. Insert pin attaching the telescope cylinder to base section.

9. Reinstall flow valve.

10. Replace the tilt cylinder.

11. Use adequate lifting device to replace tool coupling to mask.

12. Replace the pin holding coupling to boom mask and the pin attaching the tilt cylinder.

13. Connect all hydraulic hoses.

15.5 COMPENSATION CYLINDER REMOVAL / INSTALLATION

REMOVAL

Follow the procedures below for removal of Compensation Cylinder:

1. Position the machine on a hard level surface.

2. Remove all attachments from attachment holding frame (refer to section 14.3 Attachment Removal).

3. Using two 13 mm wrenches remove retaining bolt from pivot pin.



ATTENTION

Do not use steel hammer or pinch bar. These items can cause damage to machine parts.

4. Remove pivot pin. If necessary use a lead or brass hammer strike the pivot pin. Do not use a steel hammer or pinch bar.



5. Raise the boom to the maximum height.

6. Place a container of suitable size under the hydraulic piping before disconnecting the hoses.

7. Using a 27mm wrench tag and disconnect the hydraulic hoses from the holding valves. Install covers and plugs on the lines and ports to prevent the entry of contaminants.

8. With suitable lifting device secure the rod end of the compensation cylinder.



9. Remove the retaining bolt from the lower pivot pin.

10. Remove the lower pivot pin.

11. Using suitable lifting device remove cylinder from the machine.

ASSEMBLY

1. Position the machine on a hard level surface.

2. Using suitable lifting device apply sling to the rod end of the cylinder.



3. Install the compensation cylinder in machine.

4. Apply Anti-Seize to the lower pivot pin prior to installing.



5. Install the lower retaining bolt.



6. Using a 27 mm wrench install the hydraulic hoses to the holding valve.

7. Remove sling from compensation cylinder.

8. Install rod end of compensation cylinder to boom base.

9. Align and install upper pivot pin, making sure to apply Anti-Seize.

10. Install the retaining bolt.

15.6 LOCKING CYLINDER REMOVAL / INSTALLATION

REMOVAL

Follow the procedures below for removal of Attachment Locking Cylinder:
Warning

Always use adequate lifting device when lifting heavy parts from machine. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

1. Position the machine on a hard level surface.

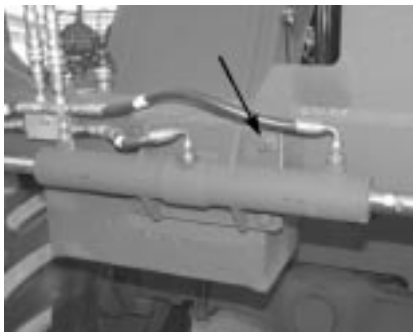
2. Remove all attachments from attachment holding frame (refer to section 14.1 Replacing Attachments).

3. Disconnect the flexible hoses connected to the valve from the quick connectors on the holding frame.



4. Using a 13 mm wrench, remove the two screws securing the valve to the attachment holding frame.

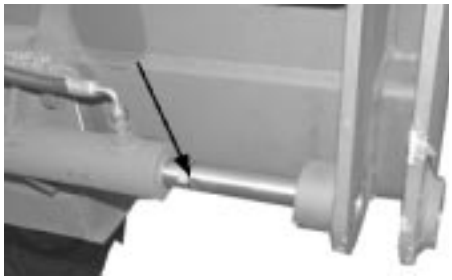
5. With a 17 mm wrench, loosen the four screws securing cylinder without removing them.



6. With a 2.5 mm wrench, remove the dowel securing the terminal pin from both sides of the cylinder.



7. Using two 27 mm wrenches, loosen and remove terminal pin.



8. Remove the four screws, previously loosened, to set the cylinder free.

9. Use adequate lifting device to remove the cylinder from machine.

10. If necessary, position the cylinder on a stand and disconnect the piping with 19 mm and 23 mm wrenches.

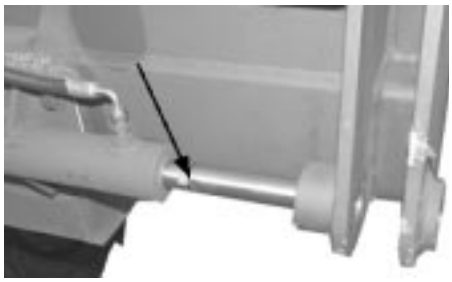
ASSEMBLY

Following the procedures below for installing the Attachment Locking Cylinder:

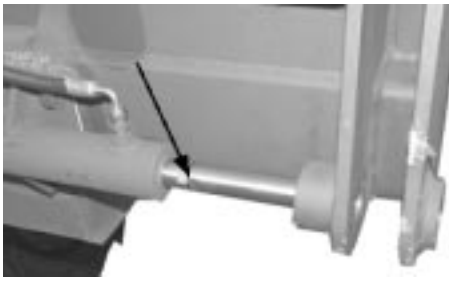
1. Using adequate lifting device, install the cylinder.

2. Apply Loctite 245 to the four screws to set the cylinder in place. Hand tighten screws.

3. Apply Loctite 245 to the terminal pins on the cylinder rod. Using two 27 mm wrenches, tighten the terminal pins in place.



4. Using a 2.5 mm wrench, install the dowel securing the terminal pin from both sides of the cylinder.



5. Using a 13 mm wrench, install the two screws securing the valve to the attachment holding frame. Apply Loctite 245.

6. Connect the flexible hoses to the valve from the quick connectors on the attachment holding frame.



7. Check for leaks.

15.7 BOOM HOIST CYLINDER

REMOVAL

Follow the procedures below for removal of hoist cylinder:

1. Position the machine on a hard level surface.

2. Remove attachment from machine (refer to section 14.1- Replacing Attachments.

WARNING

The weight of the boom assembly is approximately 1600 lbs, weight of hoist cylinder is approximately 170 lbs. Use adequate lifting equipment to support the boom assembly and cylinders. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

3. Secure attachment holding frame with an adequate lifting device.

4. Raise the boom to the maximum height. The supporting lifting device must work together with the position of the hydraulic boom.

5. When the boom is completely over the operators cab, the chains of the supporting lifting device should be slightly tensioned, once chains are slightly tensioned, stop raising the boom.

6. Place a container of suitable size under the hydraulic piping before disconnecting the hoses.

7. Using a 27mm wrench tag and disconnect the hydraulic hoses from the boom hoist cylinder and the holding valves.

8. Install covers and plugs on the lines and ports to prevent the entry of dust and contaminants.

9. Using a 13 mm wrench, remove securing bolts from retaining pin of fork compensation cylinder.



ATTENTION

Do not use steel hammer or pinch bar. These items can cause damage to the machine parts.

10. Remove upper compensation pin, if necessary use a lead or brass hammer strike the pin. Do not use a steel hammer or pinch bar.



11. Remove rod end of compensation cylinder from boom base.

12. Support the boom hoist cylinder with an adequate lifting device and place blocking under the cylinders.



13. Using two 19 mm wrenches remove the retaining bolts, securing the rod pin to the boom.



ATTENTION

Do not use steel hammer or pinch bar. These items can cause damage to the machine parts.

15. Remove boom hoist rod end pin. If necessary use a lead or brass hammer to strike the pin. Do not use a steel hammer or pinch bar.



16. Place 4 x4 short timber on top of frame cross rail just in front of the hydraulic reservoir.



17. Using adequate lifting device, lower boom onto the blocking.

18. Use two 19 mm wrenches and remove the retaining bolt from lower boom hoist cylinder.

ATTENTION

Do not use steel hammer or pinch bar. These items can cause damage to the machine parts.

19. Remove pivot pin from the cassis hole. If necessary strike the pivot pin by using a lead or brass hammer. Do not use steel hammer or pinch bar.

20. Lower the boom until the cylinder rests on the supporting blocking or stand.



21. Remove the sling securing the cylinder to the boom, then raise the boom until the boom hoist cylinder can be removed.

22. Using adequate lifting device remove the cylinder from the machine and support it on stands to prevent serious injury or damage to machine.

INSTALLATION

Follow the procedures list below to install the boom hoist cylinder.

1. Position the machine on a hard level surface.

2. Using adequate lifting device lift the boom hoist cylinder and place it in position.

WARNING

The weight of the boom assembly is approximately 1600 lbs; weight of hoist cylinder is approximately 170 lbs. Use adequate lifting equipment to support the boom assembly and cylinders. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

3. Apply antisize to the pivot pin and install pin through the cassis hole.

4. Using two 19 mm wrenches install the retaining bolt to the lower boom hoist cylinder.

5. Using adequate lifting device, lower the boom and install the rod end pin of boom hoist cylinder to boom base.

6. Install retaining bolt securing the rod pin to the boom.



7. Install compensation cylinder to boom base.



8. Using 13 mm wrench, install the securing bolts for the retaining pin of fork compensation cylinder.



9. Connect the hydraulic hoses to the boom hoist cylinder and the holding valves.

10 Start machine and extend boom hoist cylinder.

11. Check for leaks.

15.8 EXTEND CYLINDER REMOVAL / INSTALLATION

REMOVAL

Follow the procedures below for removal of extend cylinder:

1. Position the machine on a hard level surface.

2. Boom must be in the horizontal position with the boom slightly extended (approximately 2 feet).



WARNING

The weight of the boom assembly is approximately 1600 lbs, weight of extend cylinder is approximately 203 lbs. Use adequate lifting equipment to support the boom assembly and cylinders. Failure to follow this warning could cause serious injury to personnel or damage to the machine.

3. Remove the retaining bolt from the front movable section load pin.

ATTENTION

Do not use steel hammer or pinch bar. These items can cause damage to the machine parts.

4. Remove the load pin. If necessary using a lead or brass hammer strike the load pin. Do not use a steel hammer or pinch bar.

5. Place a container of suitable size under the hydraulic piping before disconnecting the hoses.

6. Using a 27mm wrench tag and disconnect the hydraulic hoses from the holding valves. Install covers and plugs on the lines and ports to prevent the entry of contaminants.

7. Remove the rear retaining bolt from back of the boom base.

8. Drive the rear telescope load pin from boom base.

9. Attach a suitable lifting device to secure the movable section.

10. With machine secure, remove and mark the location of the top and side slider pads.

11. Extend the cylinder from the base section and place a sling around the boom section, set the removed section on suitable stand.

CLEANING AND INSPECTION

Perform the following steps before assembling the cylinder:

1. Discard all O-rings, seals, and packing. Have a complete supply of new sealing parts on hand.
2. Use a clean solvent to clean all parts that are going to be inspected and considered for reuse. Blow the parts dry.
3. Inspect all parts that are going to be reused. Any parts that show wear, distortion, or damage must be replaced.
4. Inspection the cylinder rod for dents or scratches, Fine scratches can be removed by using a hand held oil honing stone. The ridge around small dents can also be removed through the use of the honing stone. If the chrome finish on the rod is worn through by the use of the honing stone, the cylinder rod must be replaced.

INSTALLATION

To assemble the boom extend cylinder proceed as follows:

1. Position the machine on a hard level surface.
2. Install the telescope cylinder in the movable section.
3. Install until the rear telescope cylinder eye lines up, then install the boom base rear load pin.
4. Install the retaining bolt.
5. Install the slider pads.
6. Using a 27 mm wrench connect the hydraulic hoses to the holding valve.
7. Start the engine and check for leaks.
8. Retract and extend to remove any air buildup.
9. After running machine retract hydraulic boom. Lower forks to ground shut off the engine and check the hydraulic system.

SECTION 16
ROUTINE MAINTENANCE

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16.0 FRONT AXLE REMOVAL / INSTALLATION

GENERAL

This covers the removal and installation of the axles used on this machine. Additional information concerning the troubleshooting, service, maintenance, and repair of the axles, are covered in the Carraro Manuals, supplied by Carraro.

DESCRIPTION

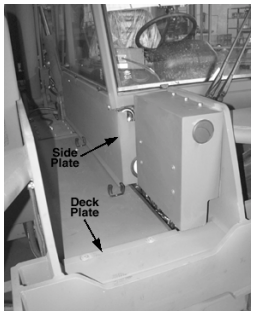
GENERAL

This machine is equipped with two drive steer axles which provide differential drive power transfer from the hydraulic drive motor to the machine wheels. The front axle is bolted directly to the carrier frame and is driven by a hydraulic drive motor. The rear axle is attached to the cassis by a pivoting pin.

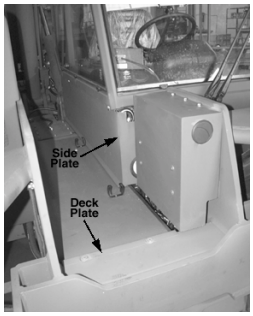
FRONT AXLE REMOVAL

To remove the front axle from the machine, proceed as follows

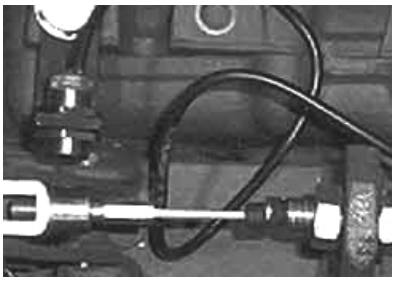
1. Remove all attachments such as fork or bucket.
2. Raise the boom to approximately 60°.
3. Remove the differential drain plug and drain the oil.
4. Raise the tires off the ground by using a lifting device. Lower the machine onto wooden blocking to support the chassis. Place additional support under the engine side of the chassis to prevent side tipping.
5. Remove the wheels.
6. Remove the side cover from cab.



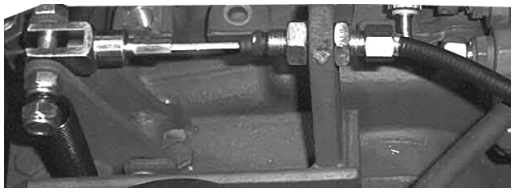
7. Remove the deck plate.



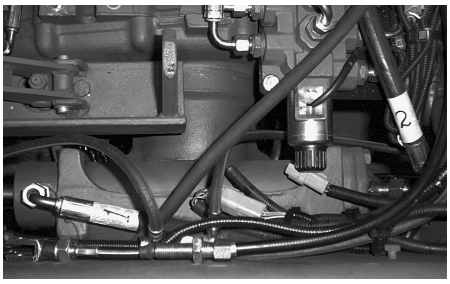
8. Remove the drive line.
9. Remove the handbrake proximity switch.



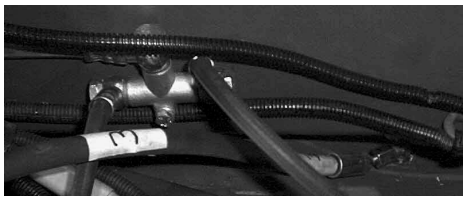
10. Disconnect the handbrake cable and spring.



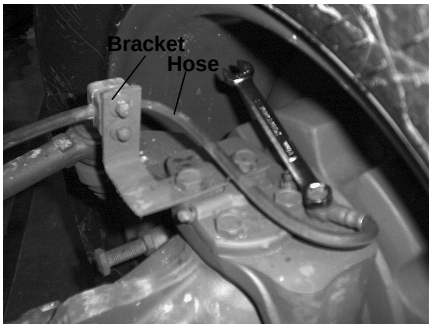
11. Tag and disconnect the hoses from the steering cylinder (#1 and #2). Place caps and covers on the hydraulic lines and cylinders to prevent hydraulic contamination.



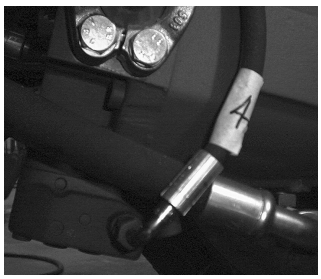
12. Tag and disconnect the axle vent hose (#3).



13. Tag and disconnect the brake supply lines bracket and hose from each side of axle.

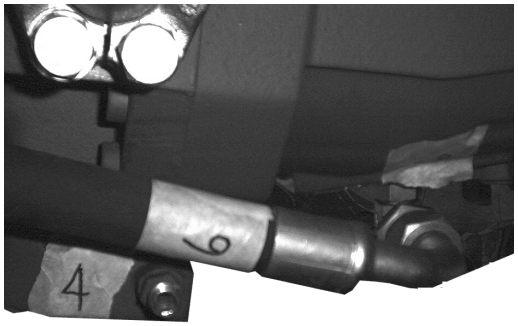


14. Tag and disconnect the small hose (#4 and #5) from the bottom sides of hydraulic drive motor.





15. Tag and disconnect large hose (#6) from bottom of drive motor.

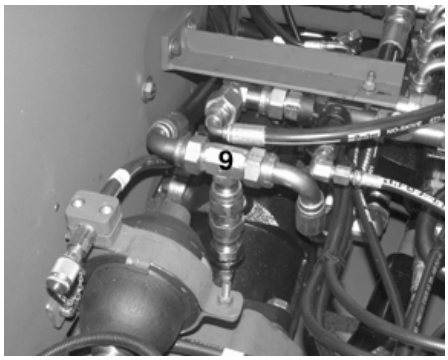


16. Tag and remove hoses (#7 and #8) from the upper rear section of drive motor. These hoses have o-ring seals which should be replaced.





17. Remove the check valve assembly (#9).



ATTENTION

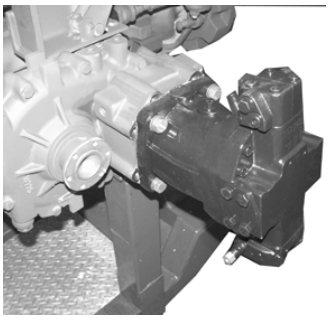
Make a thorough visual inspection of the area around the axle to make sure that all hydraulic and electric lines are clear of the axle.

18. Place a suitable jack under the axle to prevent the axle from moving while the mounting hardware is being removed.

19. Remove the mounting bolts, which secure the axle to the frame.

20. Lift the axle using a suitable sling and lifting device, and move it to a suitable work area.

21. Remove the hydraulic drive motor from old axle and installation on new axle by using a medium strength threadlock to fasten the motor and torque at 151 foot pounds.

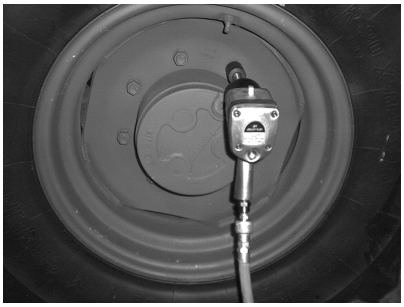


FRONT AXLE INSTALLATION

To installation the front axle on the machine, proceed as follows:

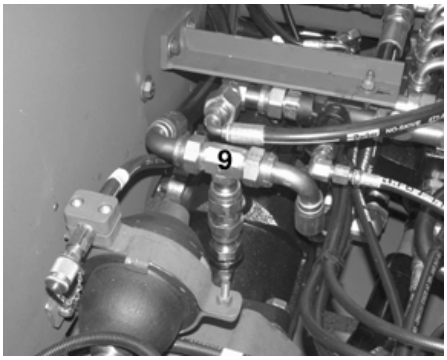
1. Position the axle below the machine. Jack the axle into position with the mounting holes aligned with the holes in the frame. Install the mounting bolts, and torque bolts at 510 foot-pounds.

2. Install the wheels and torque at 227 foot-pounds.

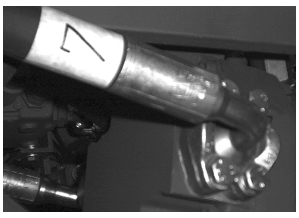


3. Install the driveline.

4. Install the check valve (#9).

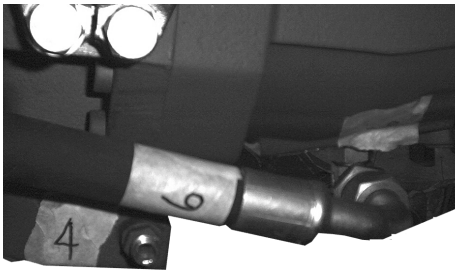


5. Install hoses (#7 and #8) on the upper section of drive motor. The hoses have o-ring seals, which should be replaced.

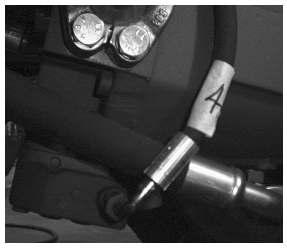




6. Connect large hose (#6) to bottom of drive motor.

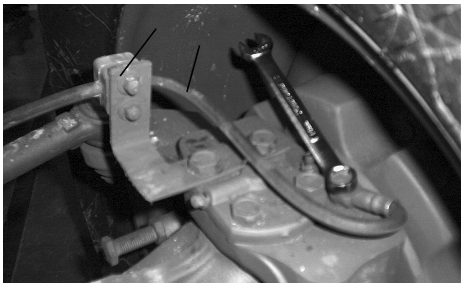


7. Connect the small hose (#4 and #5) to bottom sides of hydraulic drive motor.





8. Connect the brake supply lines bracket and hoses to each side of the axle and adjust to proper brake settings.

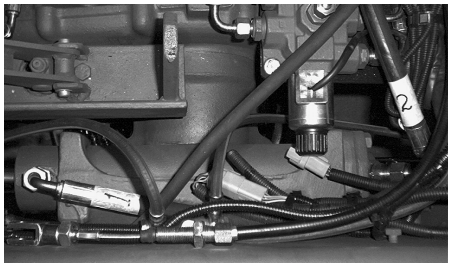


9. Reconnect any hydraulic and electric lines which may have been disconnected to remove the axle.

10. Bleed the brake line by pumping air out of the lines, starting with the right side of machine, then the left side. Repeat this procedure several times. This will force all air out of the brake lines.

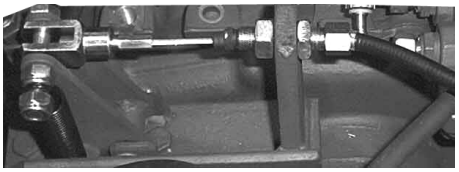
11. Connect the axle vent hose.

12. Connect the hoses to the steering cylinder (#1 and #2).

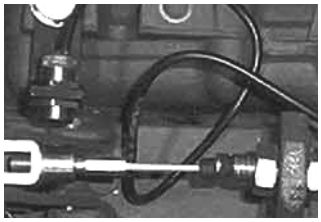


13. Bleed the steering cylinder, by setting the four wheel steering to front steering and starting the engine. Turn the wheels all the way to the left and then all the way to the right. Repeat this procedures several times. This will force all air out of the steering cylinder.

14. Connect the hand brake cable and spring.



15. Plug in the hand brake proximity switch.



16. Stop the engine and check for leaks.

17. Check the steering stop bolts for proper adjustment.

18. Fill the wheel end planetaries and the differential to the proper oil level with the gear oil recommended in the lubricant section of this manual.

19. Install the deck plate and side cover.

16.1 REAR AXLE REMOVAL / INSTALLATION

REMOVAL

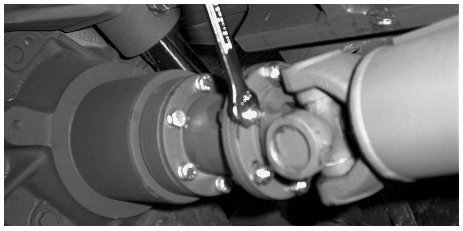
To remove the rear axle from the machine, proceed as follows:

1. Remove all attachments such as fork or bucket.

2. Remove the differential drain plug and drain the oil.

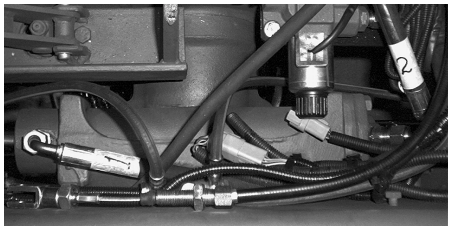
3. Raise the tires off the ground by using a lifting device. Lower the machine onto wooden blocking to support the chassis. Place additional support under the engine side of the chassis to prevent side tipping.

4. Remove the drive line extension and drive line.



5. Remove the rear wheels.

6. Tag and disconnect the hoses from the steering cylinder (#1 and #2). Place caps and covers on the hydraulic lines and cylinders to prevent hydraulic contamination.



7. Place a suitable jack under the axle to prevent the axle from moving while the mounting hardware is being removed.

8. Remove the load cell pin by using a slide hammer.



9. Slowly lower the axle approximately six inches and stop.

10. Tag and disconnect the axle vent hose.

ATTENTION

Make a thorough visual inspection of the area around the axle to make sure that all hydraulic and electric lines are clear of the axle.

11. Place a suitable jack under the axle to prevent the axle from moving while the mounting hardware is being removed.

12. Remove the mounting bolts/ pivoting pin, which secure the axle to the frame.

13. Lift the axle using a suitable sling and lifting device, and move it to a suitable work area.

REAR AXLE INSTALLATION

To install the rear axle on the machine, proceed as follows:

1. Raise axle approximately six inches to reconnect the vent hose.
2. Connect the axle vent hose.

3. Slowly raise the axle until the load cell pinhole is perfectly aligned.

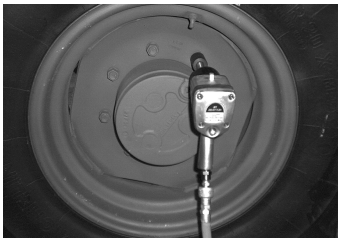
ATTENTION

When inserting the load cell pin, be careful not to damage the seals.

4. Carefully insert the load cell pin. Do not damage seals.

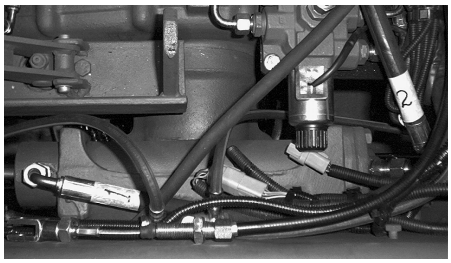
5. Insert the keeper bolt.

6. Install the wheels and torque at 227 foot-pounds.



7. Apply lubricant to all grease fittings on the axle.

8. Connect the hoses to the steering cylinder (#1 and #2).



9. Connect the drive line.

10. Reconnect any hydraulic and electric lines, which may have been disconnected to remove the axle.

11. Bleed the steering cylinder, by setting the four wheel steering to front steering and starting the engine. Turn the wheels all the way to the left and then all the way to the right. Repeat this procedures several times. This will force all air out of the steering cylinder.

12. Fill the wheel end planetaries and the differential to the proper oil level with the gear oil recommended in the lubricant section of this manual.

13. Stop the engine and check for leaks.

14. Check the steering stop bolts for proper adjustment.

CARRARO AXLES MANUAL



FRONT AXLE
REPAIR MANUAL

26.11 + TB172 AXLE MODEL

Ref. CA140112

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

REPAIR MANUAL

INDEX OF SECTIONS

SECTION	DESCRIPTION
A	SPECIFICATION AND FEATURES
B	SECTION VIEW AND SILOHUETTE
C	TORQUE SETTINGS
D	LUBRICATION
E	SPECIAL TOOLS
F	DISASSEMBLING AND ASSEMBLIMG

REPAIR MANUAL

AXLE and TRANSFER BOX

DESCRIPTION

Steering axle, with cast iron axle beam, standard differential, triple reduction (1st in drop box, 2nd differential and 3rd planetaries).
Steering cylinder integrated in the diff support.
Total ratio / reduction = 27,33 / 1

SPECIFICATION & FEATURES

BEVEL DRIVE - DIFFERENTIAL

Ratio	T	2.46
Backlash	mm.	0,16 ÷ 0,22
Shims thickness for bevel pinion position	mm.	2.5 to 3.4 (0.1 by 0.1)
Bevel pinion bearing pre - load mesured on diameter D 30.50	daN	P = 10.5 to 15.7
Bevel gear set (total) bearing pre - load (measured on the pinion queue)	daN	T = (P + 4.3) to (P + 6.4)

WHEEL HUB

Ratio	T	1:6
Wheel bearing preload	---	system 'set right'

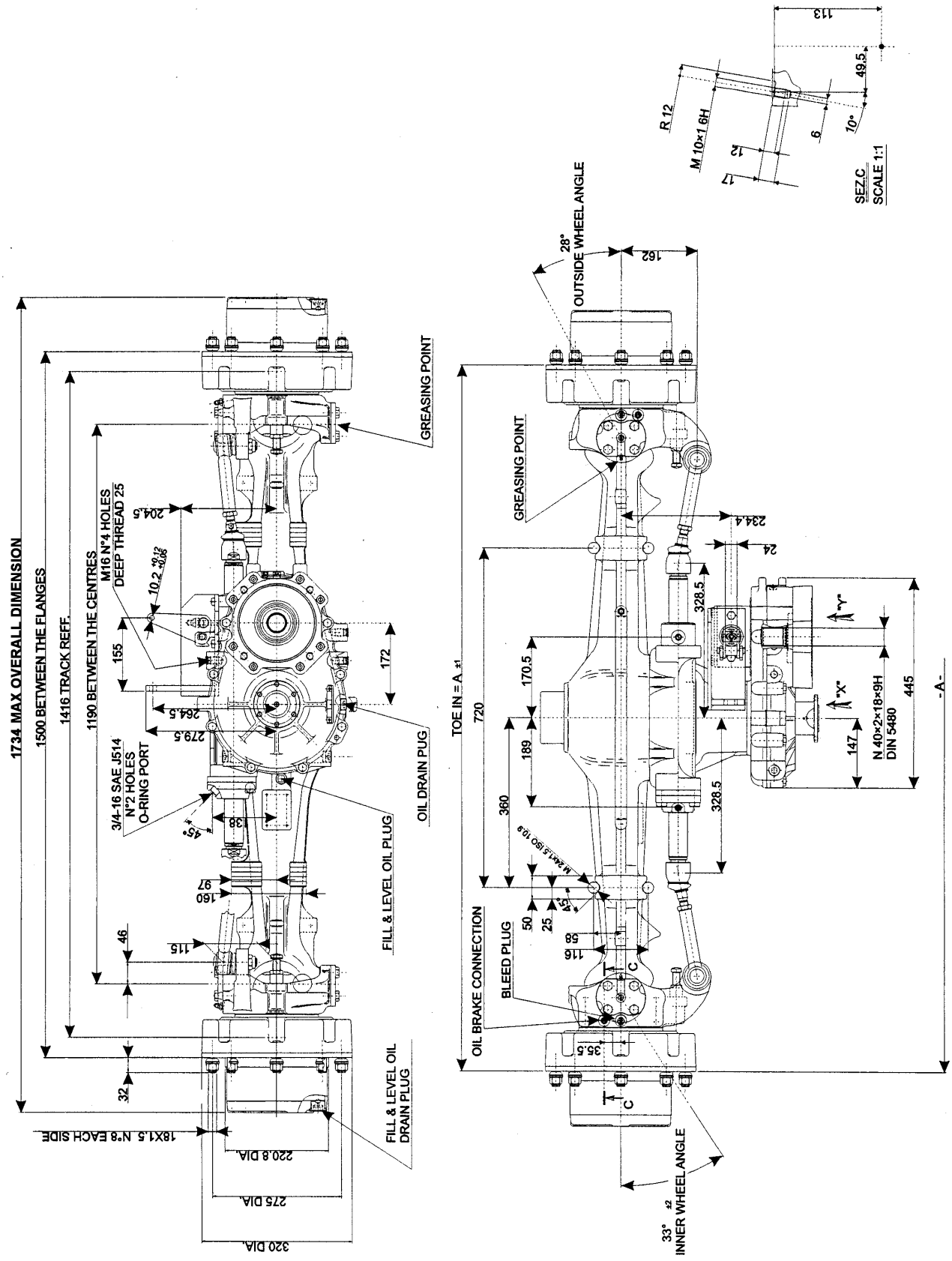
TRANSFER BOX

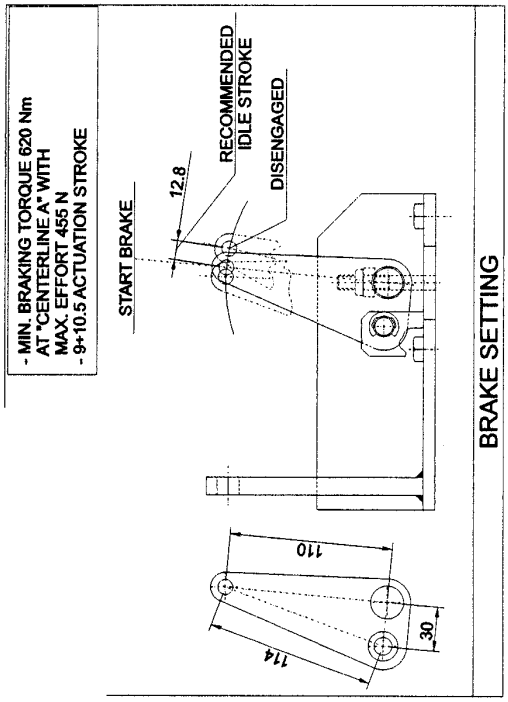
Ratio	T	1.85
Brake disc thickness	mm	4.75 to 4.90
Maximum wear of brake disc	mm.	0.3 to 0.6

REPAIR MANUAL B

SECTION B

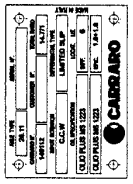
SECTION VIEW AND SILOHUETTE


1734 MAX OVERALL DIMENSION
1500 BETWEEN THE FLANGES
1416 TRACK REFF.
1190 BETWEEN THE CENTRES
M16 N°4 HOLES DEEP THREAD 25
3/4-16 SAE J514 N°2 HOLES O-RING PORT
GREASING POINT
OIL DRAIN PUG
FILL & LEVEL OIL PLUG
FILL & LEVEL OIL DRAIN PLUG
18X1.5 N°8 EACH SIDE
220.8 DIA.
275 DIA.
320 DIA.
204.5
264.5
279.5
155
172
46
115
160
97
38
45°
32
SEZ.C
SCALE 1:1
R 12
M 10×1 6H
113
49.5
10°
6
12
17
OUTSIDE WHEEL ANGLE
28°
162
GREASING POINT
234.4
24
328.5
TOE IN = A ±1
720
170.5
189
360
328.5
N 40×2×18×9H
DIN 5480
445
147
-A-
OIL BRAKE CONNECTION
BLEED PLUG
50
25
58
116
35.5
INNER WHEEL ANGLE
33° ±2



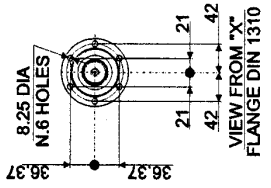
AXLE LOAD DATA DATI DI CARICO ASSALE	
DYNAMIC LOAD AT RECOMMENDED TRACK CARICO DINAMICO ALLA CARREGGIATA CONSIGLIATA	45000 N
STATIC LOAD AT RECOMMENDED TRACK CARICO STATICO ALLA CARREGGIATA CONSIGLIATA	112500 N

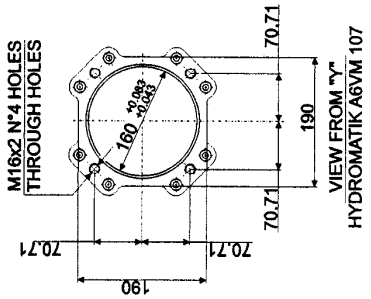
BRAKE DATA DATI FRENO	
REQ. OIL NOM. VOL. PER AXLE VOLUME OLIO RICC. PER ASSALE	10 cc
MAX PISTON STROKE CORSA MAX PISTONE	0.50mm
MAX. WHEELS BRAKING TORQUE COPPIA FRENANTE MAX. ALLE RUOTE	11360 Nm
AT MAX. OPERATING PRESSURE ALLA PRESSIONE MAX. DI ESERCIZIO	68.9 BAR
OPERATING BRAKE OIL SPECIFICATION TIPO OLIO ALIMENTAZIONE FRENI	MINERAL OIL
OPERATING TEMPERATURE TEMPERATURA DI ESERCIZIO	-40 ÷ 120°C

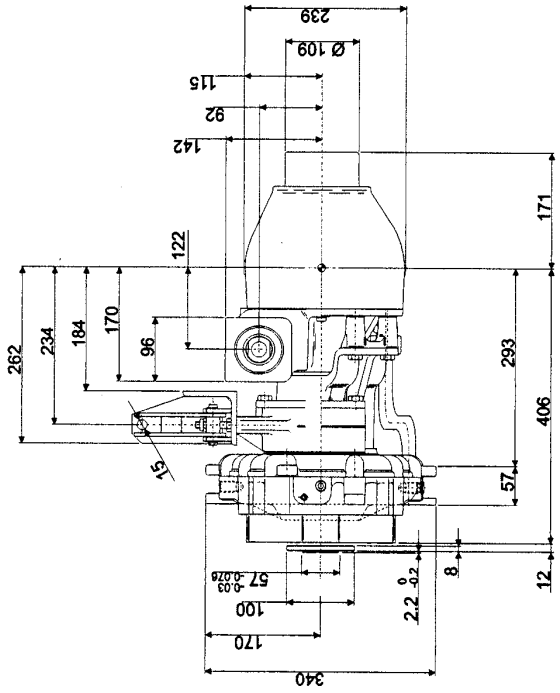


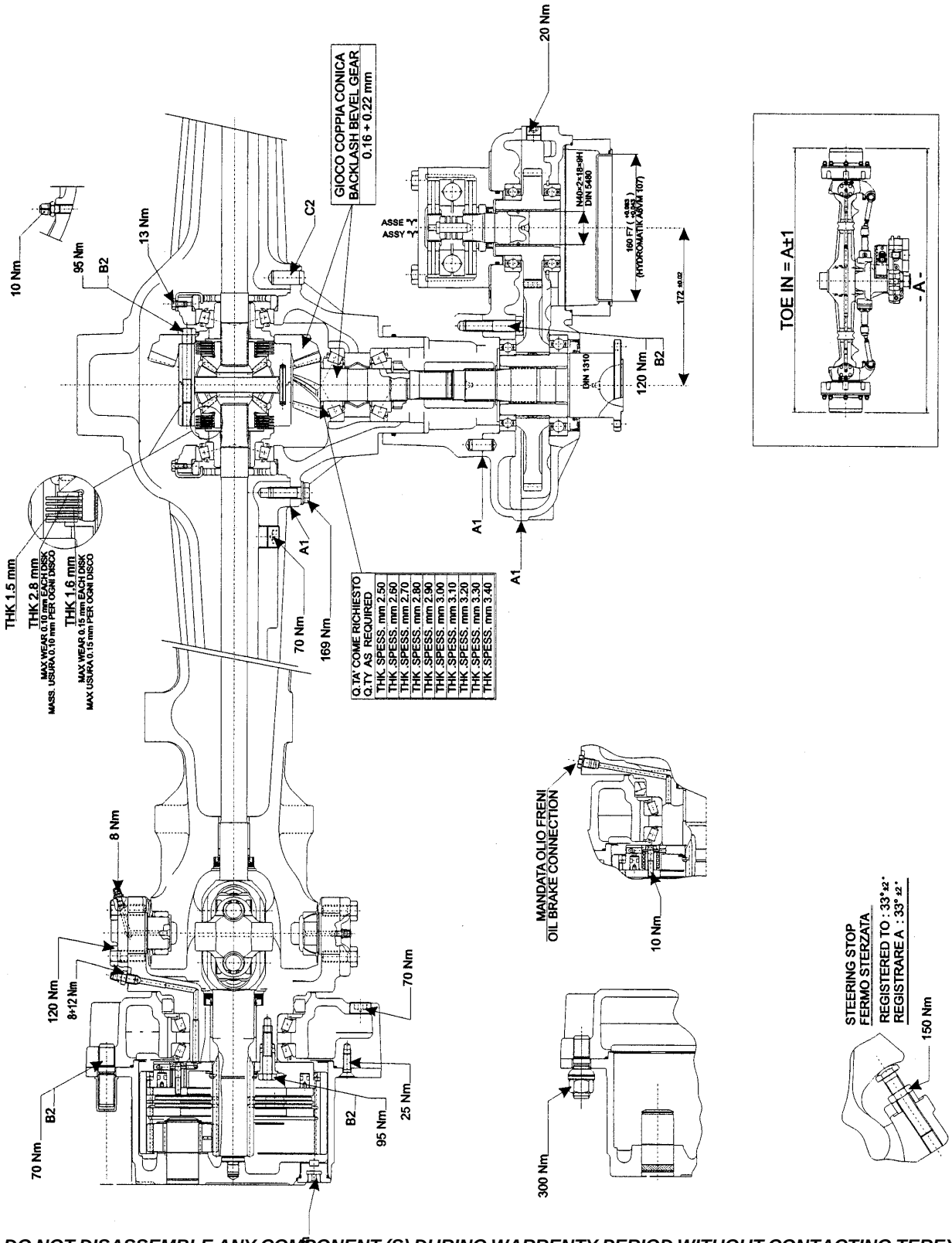
DATA PLATE

AXLE REF. CARRARO CUSTOMER		AXLE MODEL MOD.ASSALE						
140112	----	26.11						
DIFF.TYPE DIFF.TIPO	BEVEL RATIO RID. CONICA	HUB RATIO RID. EPIC.	TOTAL RATIO RID. TOTALE	BOX RATIO RID. TB.	TOTAL RATIO RID. TOTALE	INPUT ROTAT. ROTAZ.ENTR.	DRY WEIGHT PESO A SECCO
LIM. SLIP	2.46/1	6.0/1	14.769/1	1.85/1	27.33/1	C.C.W FRONT AXLE	----

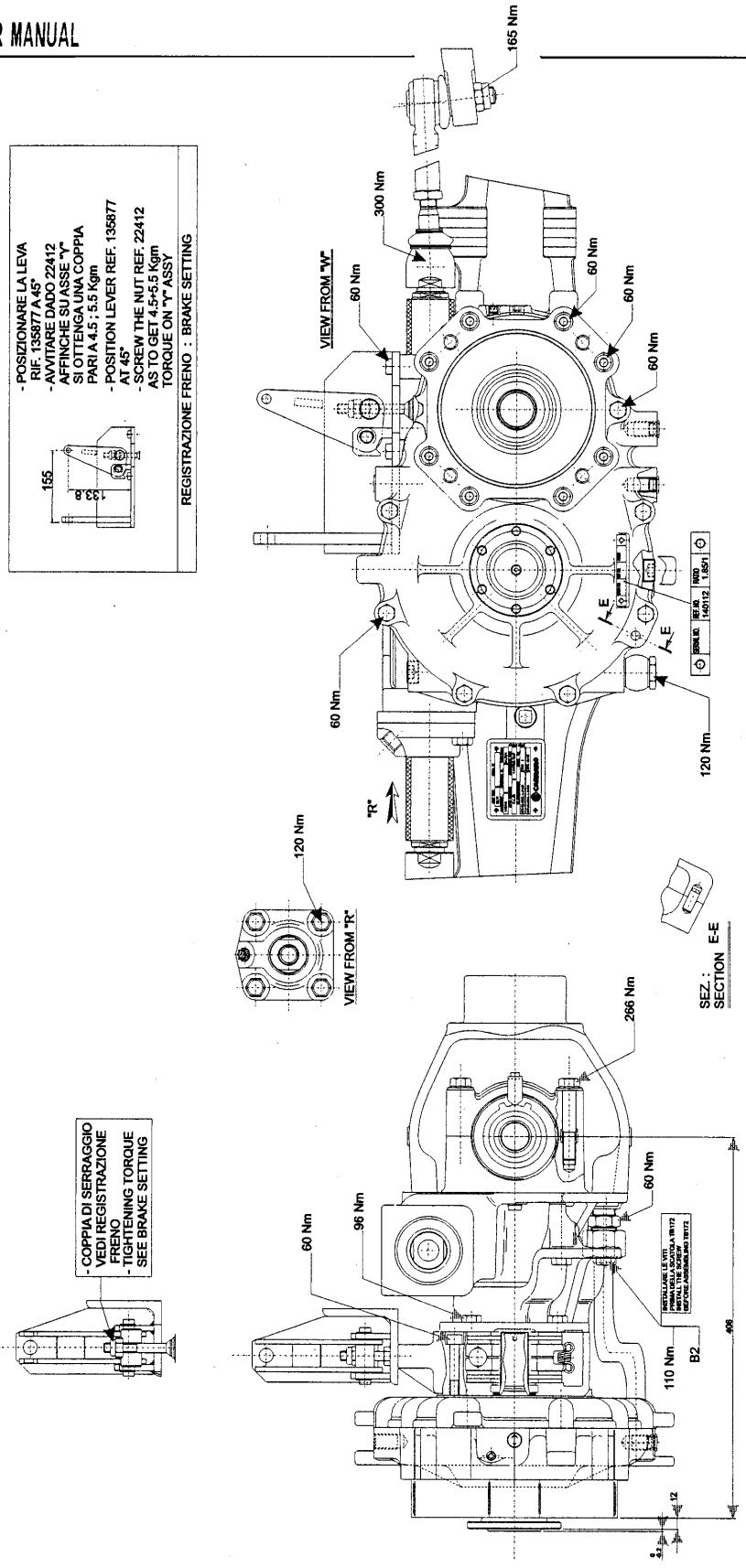








DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.


- POSIZIONARE LA LEVA RIF. 135877 A 45°
- AVVITARE DADO 22412 AFFINCHE SU ASSE "Y" SI OTTENGA UNA COPPIA PARI A 4.5 ; 5.5 Kgm
- POSITION LEVER REF. 135877 AT 45°
- SCREW THE NUT REF. 22412 AS TO GET 4.5÷5.5 Kgm TORQUE ON "Y" ASSY
REGISTRAZIONE FRENO : BRAKE SETTING
155
133.8
165 Nm
300 Nm
60 Nm
60 Nm
60 Nm
60 Nm
60 Nm
VIEW FROM "W"
120 Nm
"R"
120 Nm
VIEW FROM "R"
E-E
SEZ. : SECTION E-E
266 Nm
60 Nm
96 Nm
60 Nm
110 Nm
B2
- COPPIA DI SERRAGGIO VEDI REGISTRAZIONE FRENO
- TIGHTENING TORQUE SEE BRAKE SETTING

CARRARO AXLES 26.11

LUBRICATION

- **Differential and reduction gears (planetary hubs) :**

  - use lubricants complying with specifications MIL-L-2105D, API GL4 / GL5
  - "W" grade designation must be selected according to ambient vs. axle operating temperatures
  - as a general rule:

  80W should be used with ambient air temperature below - 10°Celsius (15°F)
  80W - 90 should be used with ambient air temperature between - 10° and + 40° Celsius (15°F to 105°F)
  85 W - 140 should be used with ambient air temperature above + 40° Celsius (above 105°F)

- **Quantities**: front differential/ axle housing 6 liters
- each reduction unit: 1.6 liters

- **Checkings:** first change after first 250 running hours
  inspection and make-up of level : every 250 running hours
  drain and refill: every 1000 hours or seasonally, whichever occurs first

- **Grease fittings:** grease king pin every 250 running hours
  grease axle pivot every 250 running hours
  grease drive shafts every 250 running hours

WARNINGS

Above figures are ment as the maximum intervals between servicing: checking and filling intervals may need a higher frequency according to ambient operating conditions and type of service.

It is forbidden to mix lubricants of different brands or makes to make-up the oil level.

Failure to observe above instructions and recommendations may void the warranty.

CARRARO service

Recommended oil and grease list

OIL LOCATION	U.S. and/or European specifications	SAE Viscosity Grades	Other specifications	Alternatives & Remarks
axle beam, differential without limited slip, wheel hubs, gearbox and drives	API GL5 MIL-L-2105D, with and without limited slip additives	SAE 80W-90 SAE 85W-90 SAE 85W-140	API CD/CE/CF/SD ZF TE-ML05	
axle beam, limited slip differential , wheel hubs, gearbox and drives with wet brakes	API GL-4, ASTM D445, ASTM D2602	SAE 10W-30		MASSEY FERGUSON M1141/M1135 NEW HOLLAND FNHA-2-C-201.00 JOHN DEERE J20C/D CASE MS1207
anti-squawk or brake chatter transmission friction modified fluids	ASTM D445		ISO 3104 DIN51550 AFNOR T60-100	JOHN DEERE J20C/D. J.I.CASE MS1223, J I.CASE 187
anti-squawk or brake chatter transmission and hydraulic fluids BELOW -30°C	MIL-L-10324A, MIL-L-46167A, ASTM D445		ISO 3104 DIN51550 AFNOR T60-100	JOHN DEERE J20D
multi-functional engine transmission and hydraulic oils (S.T.O.U.)	API GL4 MIL-L-2105	SAE 10W-30 SAE15W-40	API CC/CD/SE/SF MIL-L-2104 C,D MIL-L-46152 A, B CCMC-D4/D5	J.I.CASE JIC187 JOHN DEERE J27 FORD M2C159B1/B2/B3
steering cylinder and hydraulic dif lock actuator	API GL4/GL5 MIL-L-2105 MIL L-2105D	SAE 80W-90 SAE 85W-90 SAE 85W-140		
brake actuators (depending on system installed)	SAE J1703 ISO6743/4HH FMVSS 116 DOT3/4		ATF DEXRON II DEXRON III MERCON-M	API CD/CE/CF/SF/SG MIL-L-2104C/D/E MIL-L-46152C/D/E SAE 10W
TLB1 Power shuttle series	API GL4/GL5 CATERPILLAR TO-4 MIL-L-2105 MIL-L-2105D	SAE 10W HD, SAE 10W-30	API CD/CE/CF/SF/SG MIL-L-2104 C,D MIL-L-46152 C/D/E ZF TE-ML105	J.I.CASE HYTRANS1223 , MS1207

GREASE (Europe VDI 2202)	DIN 51502	ASTM D 4950	ISO classification	remarks
G multipurpose grease (mineral oil)	GOOR NGLI2	LB , 4B	ISO-L-XDCIB2	----
K, KT multipurpose grease (mineral oil)	KTB2 K NGLI2	LB , 4B	ISO-L-XDCIB2	MIL-G-21-21 164/81322 lithium grease, NH710 A, M1C 137-A
K, KT multipurpose grease (mineral oil)	KTCSHC 2 N NGLI2	LB , 4B	ISO-L-XDCIB2	MIL-G-21-21 164/81322 lithium grease
silicon oil based grease	KTASI1 R	----	----	lithium added
PTFE added semisynthetic grease	KH E1R	ASTM D-1743	ISO-L-XMR-XM2	TECNOLUBE SEAL POLYMER 400
arctic grease	NGLI0 NGLI1	----	----	(0°C) -:- (-30°C) MIL-G-10942C

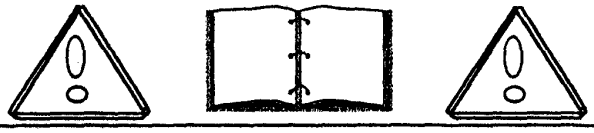
ref. STA/00010/96

Foreward

Following instructions are a complementary list of information to help the mechanic.

For YOUR SAFETY, read the entire manual before attempting to operate on the axle. Pay special attention to the warnings and recommendations across this manual.

General working instructions and recommendations



1) All equipments can be hazardous. When a machine or vehicle is correctly operated and properly maintained, it is a safe vehicle to work with. But when it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

2) A raised and badly supported machine can fall on you. Position the vehicle on a firm, level surface before arising one end. Ensure the other end is securely chocked.
Do not support the machine on cinder blocks, hollow tiles or props that may crumble under load. Do not work under the machine if supported solely by a jack and follow recommended procedures in this manual.

3) Do not rely solely on the jacks to support the vehicle when working under it: the vehicle can roll off jacks and crush you unless the wheels have been chocked.
Always chock the wheels at the opposite end of the machine that has to be jacked. always support a jacked-up machine on axle stands before working underneath it.

4) Do not work with the machine until you are sure that you can control it.

5) Do not start any job until you are sure that you and those around you will be safe.

6) If you are unsure of anything, about the vehicle or the job, ask someone who knows. Do not assume anything.

Remember: BE CAREFUL, BE ALERT, BE SAFE !

7) Make sure the vehicle will not move: shift transmission to PARK, stop the engine and remove the key.
Disconnect the battery to prevent the engine being started while you are beneath the vehicle.

8) Wear appropriate safety clothes (gloves, overalls, professional shoes) and spectacles.

9) Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards. Use power tools only to loosen threaded parts and fasteners.
For loosening and tightening hardware, use the correct size tools.
DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenche

Failure to follow the above and following instructions can cause serious injury to you and affect the efficacy of your labor.

SPECIAL TOOLS

AXLE E 1

DESCRIPTION	PART N.
to define ...	

INDEX OF PAGES

FOREWARD	F 1-2
EPICICLIC REDUCTION & WHEEL HUB	F4
WHEEL HUB	F4
SWIVEL HOUSING	F5
DRIVE SHAFT	F5
DIFFERENTIAL	F6
STEERING CYLINDER AND TOE-IN	F7
AXLE HOUSING	F8

FOREWARD

The overhauling of final drives, wheel hubs and brakes can be completed without disconnecting the axle from the machine. Sould it be necessary to remove the axle assembly, adequate supporting of the machine must be ensured to work safely,

OIL SEALS FOR ROTATING SHAFT

For an installation of oil seal adhere to the following recommendation:

- Clean the shaft and ensure the seal area of the same is not damage, fitted or grooved.
- Place the sealing lips towards the oil side.
- Lubricate the seal lip (oil is better than grease) and fill with grease the space between oil lip and dust lip of dual lip seals.
- Install the oil seal using a suitable seal driver. Avoid hammering directly on the seal.
- To avoid damages to the seal lip caused by the shaft : adequately protect the same during shaft assembly procedure.

" O " RINGS

Ensure adequate lubrification of these seal before inserting them in their seats to avoid twisting during shaft assembly.

SHIMS

For each adjustement select the correct shim/s by individual measurement.
Do not trust pack measurement or the thickness indicated on the shim.

BEARINGS

For a correct assembly it is suggested:
- Warming from 80 to 90 C before installation in their respective seats.

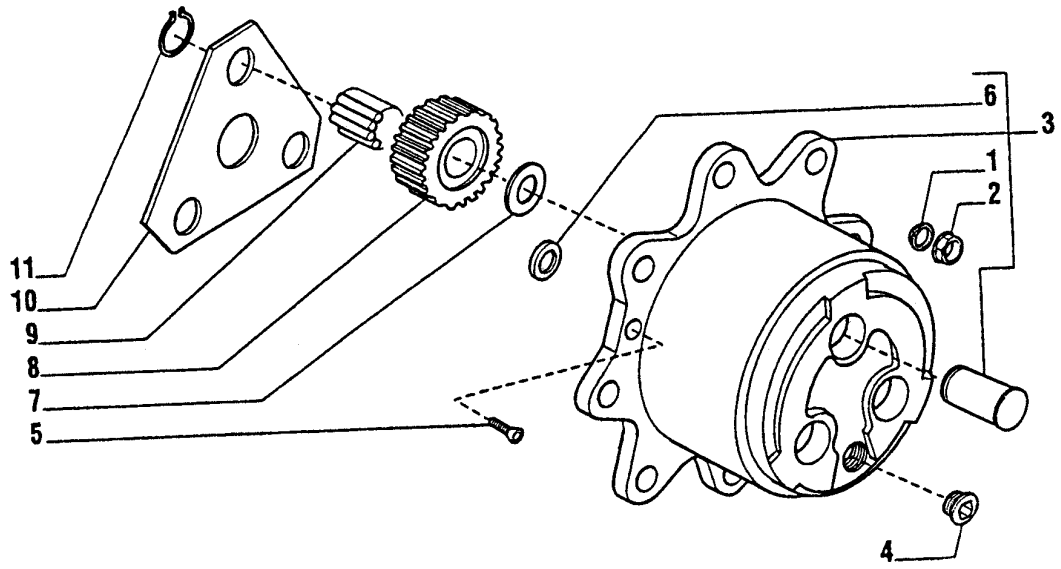
SEALING COMPOUNDS

On area to be sealed use LOCTITE 510, ensuring both side to be sealed are clean, dry and totally free from grease and oil.

REPAIR MANUAL

AXLE F 3

EPICYCLIC REDUCTION GEARS



EPICYCLIC REDUCTION GEAR

- Turn the hub so that the filler/drain plug (4) is at the lowest position and drain the hub oil.
- Remove the two screws (5) securing the planetary carrier assy to the wheel hub.
- Inspect the needle bearings (9) and the thrust washer (10) for wear and replace if necessary.
- Reassembling : if necessary hold the needle bearing in position with grease.
- Refill the hub with the correct oil, see specification. The filler/drain plug bore position must be at the top
- Check the level with the plug at the horizontal line.

HUB ASSEMBLY - EPICYCLIC REDUCTION

DISASSEMBLY

Remove the wheel assy, then rotate the hub so that the filler/drain plug (1) is at the lowest point and drain the oil. Discard O-ring seal (2).

To remove the planet carrier (3) release screws (4).

Prise off the planet carrier (3).

To remove the planet gear (8) remove circlip (6) and thrust washer plate (7).

Take care that the needle bearing rollers (8) are not misplaced.

Release circlip (15), remove thrust washer (16) and spacer (17).

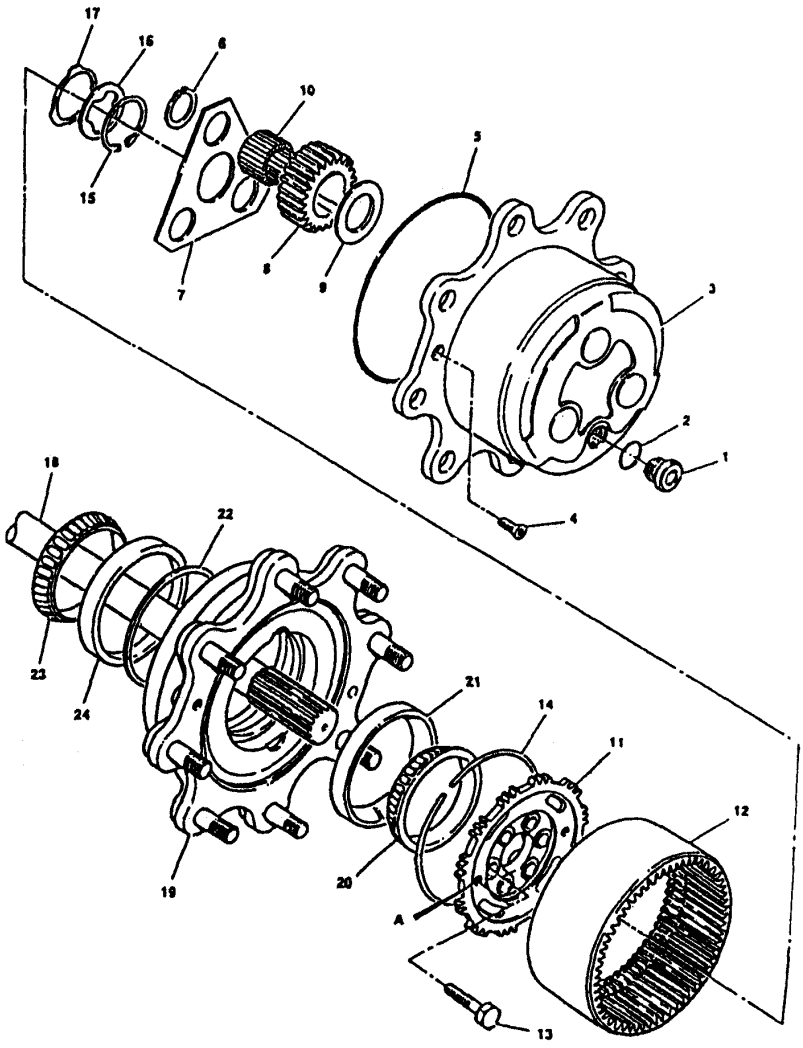
Remove annulus carrier (11) and annulus ring (12) as a complete assy.

Relase bolts (13) and use two of these bolts in threaded holes A to push the assy of.

Mark the position between annulus carrier (11) and annulus ring (12) then remove circlip (14).

Prise off bearing carrier (19).

Remove taper bearings (20) (23).



ASSEMBLY

For assembly the sequence should be reversed.

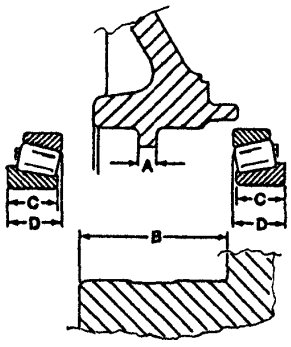
Fit new seals.

The tapered bearings (20) (23) are machined to fine tolerances and do not require pre-load or clearance checks.

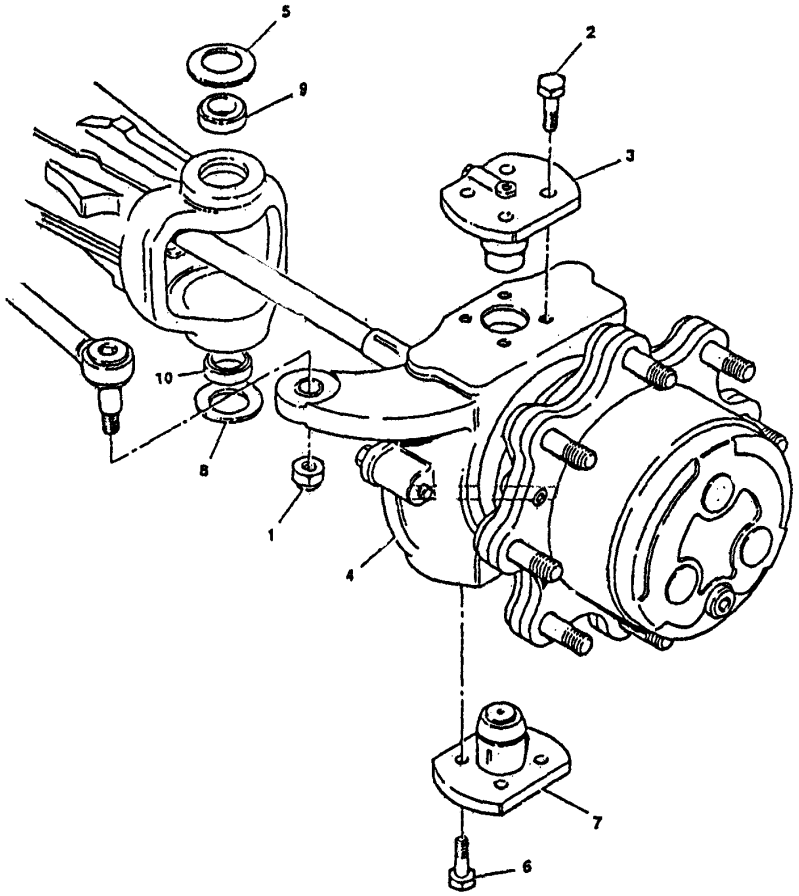
When fitting new components check that all dimensions are within the limits. If any component is outside the limits, replace by a new one.

A	11.975 + 0,050 mm
B	52,229 + 0,050 mm
C	20,00 mm
D	20,00 + 0.10 mm

Fill the hub to the correct level with the appropriate lubricant.



SWIVEL HOUSING



DISASSEMBLY

Swivels can be removed without dismantling the hubs (once the wheel tyre and rim have been removed)

Loosen and remove nut (1) and disengage track rod. Mark the relative positions of king pin (3)(7) to make sure they are properly refitted.

Release top king pin bolts (2) and prise top king pin (3) clear of swivel housing (4). Then remove the belleville washer (5).

hold the swivel, release bottom king pin bolts (6) and prise bottom king pin (7) clear of swivel housing (4).

Remove the belleville washer (8).

Remove swivel (4), but take care not to let the swivel drop or the halfshaft could be damaged.

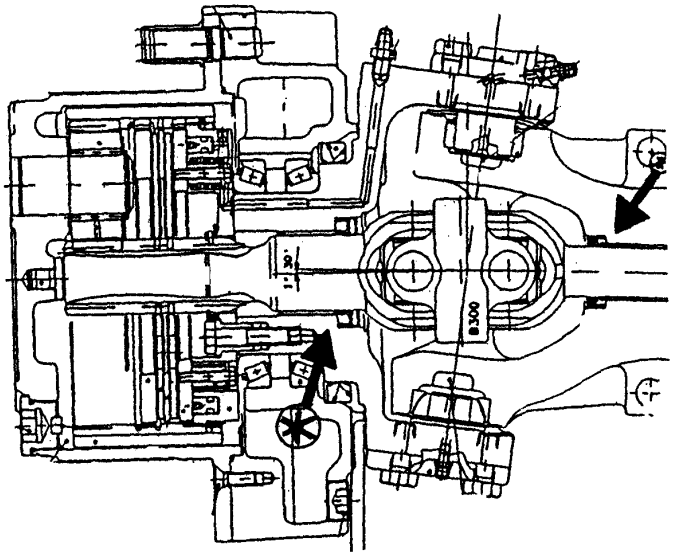
ASSEMBLY

For assembly the sequence should be reversed.

Discard old seals and fit new seals and O-rings. Check halfshaft's seals and bushing (•) and replace as necessary

To fit new pivot bearings (9)(10), the bearings must be cooled first (azote bath).

Apply recommended grease and recommended quantity to bushes and bearings surfaces before assembly.



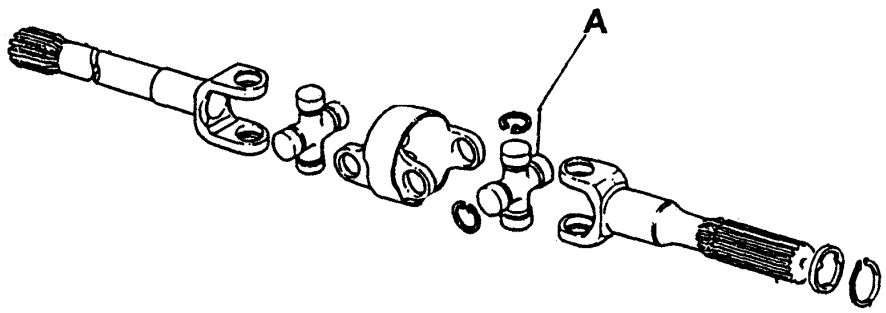
Swivel housing and king pin disassembly and assembly do not require special operations.

Check the position of belleville washer under the king pins during the assembly.

REPAIR MANUAL

AXLE F 5.2

DRIVE SHAFT



Inspect the shaft splines for damage.

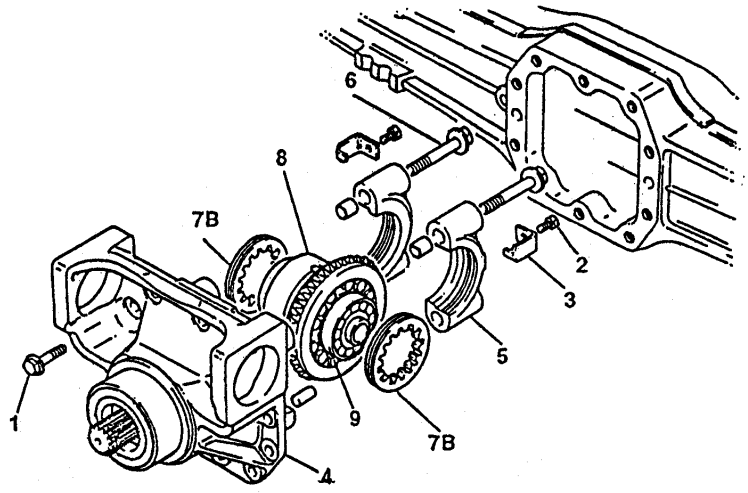
Replace the spiders **A** if worn or damaged

- Note: overhaul of the two universal joints follows conventional workshop practice.

DIFFERENTIAL, SETTING THE BEVEL GEAR SET

REMOVAL

Drain the oil from both hubs and diff housing.
Remove final drives / planetaries.
Disconnect input u-joint shfaft from input flange.
Remove input flange (after the circlip has been kept apart).
Loosen and remove bolts (1), lift carrier (4) and differential (8) clear of axle.
Mark the relative position of differential (8) and carrier (4).
Release bolts (2) and remove locking plate (3)
Mark the relative positions of bearing caps (5) and diff carrier (4).
Loosen and remove bolts (6) and lift off bearing caps (5).
Remove bearing adjusters 7A and 7B, then lift the diff (8) out of carrier (4).
Remove bearing outer races (9).

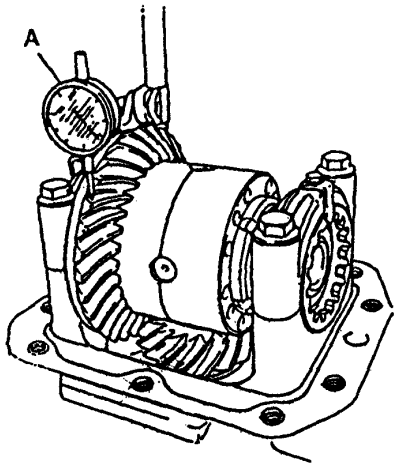


ASSEMBLY

Replacement is reversal of the removal procedure.
Ring gear and pinion are a matched pair and must be replaced as an assembly.
Fit bearings (9) and position diff (8) in carrier (4), making sure the differential is aligned as marked during disassembly.
Align location marks and fit caps (5) to locate with bolts (6)
Locate bearing adjusters (7) and tighten bolts (6). Adjust the ring gear backlash and preload (see the following instructions about setting the ring gear / pinion backlash and differential preload).
Once the setting operations have been completed, clean carrier and axle mating surfaces and apply (one of the two surfaces only) LOCTITE 518. Reinstall the differential carrier assembly onto the axle and secure with bolts (1) to the recommended torque.

SETTING RING GEAR / PINION AND DIFFERENTIAL BEARINGS PRELOAD

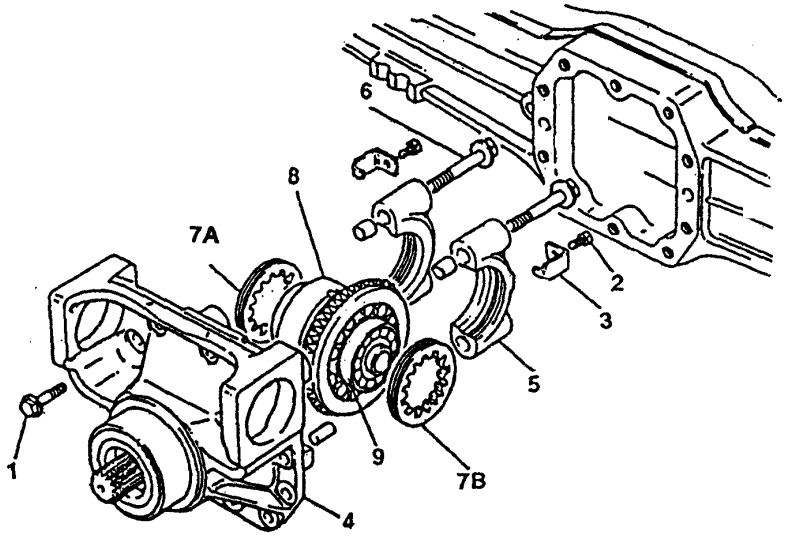
Adjustment is made by the side ring nuts (7): the nuts push the bearings and move the ring gear towards or away from the pinion as required.
Side ring nuts 7A and 7B may be difficult to turn: release a bit bolts (6) to ease movements.
Screw in side ring nut 7B clockwise until the ring gear is in contact with the pinion and, at the same time, tap the bearing cap (5) with a resin hammer to align bearings.
Screw in ring nut 7A clockwise until all clearance in the barings has been cancelled. This occurs once the ring nut is difficult to move. At the same time, tap the bearing cap (5) with a resin hammer to align bearings.



With a dial test indicator, as shown,
measure the backlash between ring gear and pinion, at 3 positions around the ring gear.
Record the clearances: if different, put the dial test indicator on the smallest value point of the ring gear.

Correct clearance should be: 0.16 to 0.22 mm

To obtain such value, adjust by moving the ring gear towards or away from the pinion, as required. Try to adjust side ring nuts 7A and 7B the same quantity.

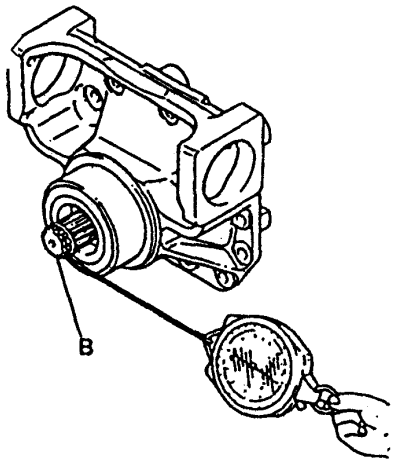


SETTING DIFFERENTIAL PINION BEARINGS PRELOAD

Tighten side ring nuts 7A and 7B by equal amounts to preserve the backlash.
With ring gear and pinion in mesh and correct backlash, rotate the pinion shaft and record the rolling torque.

Measure the rolling torque as shown in B. The total rolling torque should be the pinion's torque (see following section) plus 4,3 daN to 6,4 daN
Torque tighten bolts (6) and fit lock tabs (3), then secure with bolts (2).

Recheck the backlash to make sure it is correct.



DIFFERENTIAL

The top illustration shows a standard differential and the bottom illustration shows a limited slip differential.

DISASSEMBLY

Mark the relative positions of differential housing (1) and (2).

Loosen and remove bolts (3) to separate the housing halves.

Mark the relative positions of diff gears (4) and spherical thrust washers (5). Check and replace if necessary (using the complete kit of side and diff gears plus relevant washers).

Remove side gears and washers. On limited slip differentials (if applicable), remove spacer (8), thrust washer (9) and discs (10).

INSPECTING

Renew spacers (8) if thickness is below 2,67 mm.

Renew thrust washers (9) if thickness is below 1,47 mm.

Renew discs (10) if thickness is below 1,42 mm.

Remember to record the sequence of limited slip components for reassembly or install the new kit of discs respecting the sequence.

ASSEMBLY

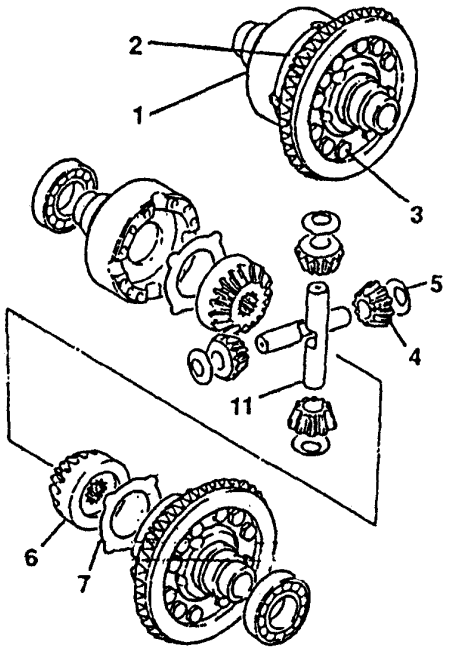
Replacement is reversal to removal procedure.

Check that relative positions of diff gears (4) and washers (5) are as marked while disassembling.

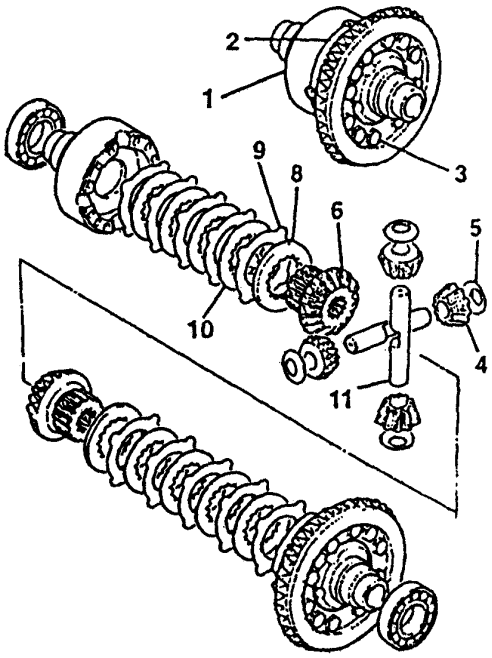
Check that relative position of housing halves match as marked.

Use LOCTITE 270 to secure bolts (3), then torque tighten up to 9,5 daN

STANDARD TYPE



LIMITED SLIP TYPE



PINION

The numerical sequence on the illustration is ment as a guide for teardown: follow the numerical sequence for proper disassembly.

ASSEMBLY

Replacement is reversal to the disassembly procedure.

Ring gear and pinion are a matched pair and must be replaced as an assembly.

Ring nut (1), lock washer (2) , spacers (4), collapsible spacer (5) MUST be replaced each time the pinion is removed.

To select the correct size of shims (7) follow the "Bevel distance setting Procedure".

BEVEL DISTANCE SETTING PROCEDURE

Hold the pinion bearings in position with the special tool A so that bearing cones can just be hand rotated.

Measure the distance from the diff support case, as shown, to the inner bearing.

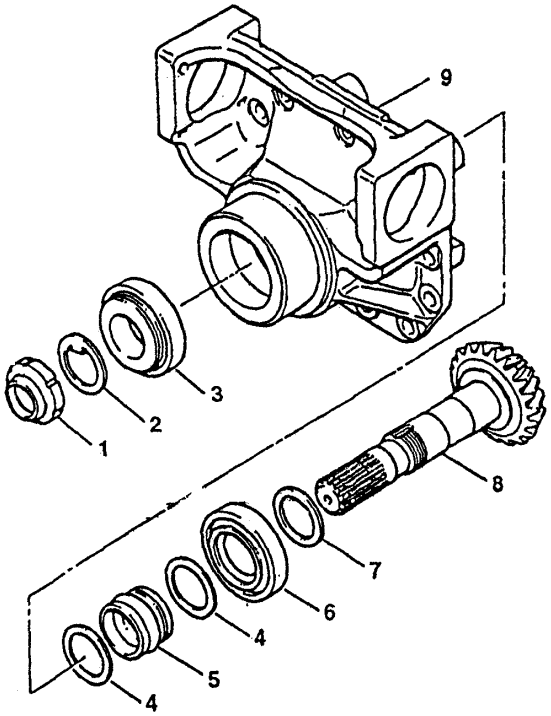
WARNING: if a bar is used to hold the depth gage, subtract the bar thickness from the recorded value.

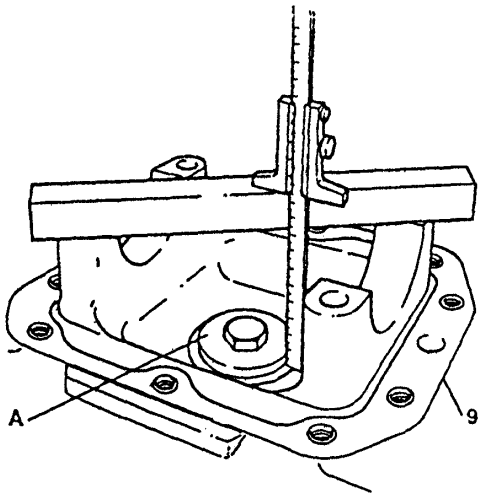
The required shim thickness is the difference between the distance measured and the dimension stamped on the pinion's head.

Select the correct total shim thickness and fit onto pinion's shaft.

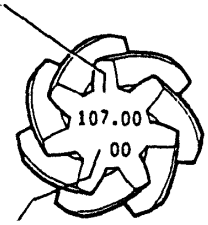
Press inner bearing (6) onto pinion's shaft.

fit new spacers (4) and collapsible spacer (5).





N = Position of gear protrusion dimension



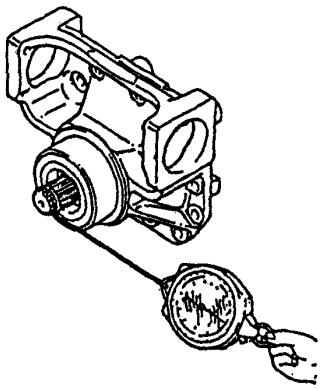
SETTING THE PINION BEARING PRELOAD

Tighten nut (1) to achieve a rolling torque so that the reading on the spring balance shows 105 to 157 N.

Check the rolling torque by pulling gently and constantly the spring balance (repeat the control three times, to have an average value).

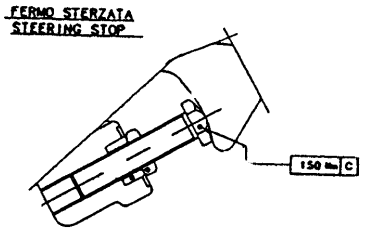
If the rolling torque (or the force) is exceeded, spacer (4) and collapsible spacer (5) MUST be replaced.

Lock nut (1) in position with lock washer (2).

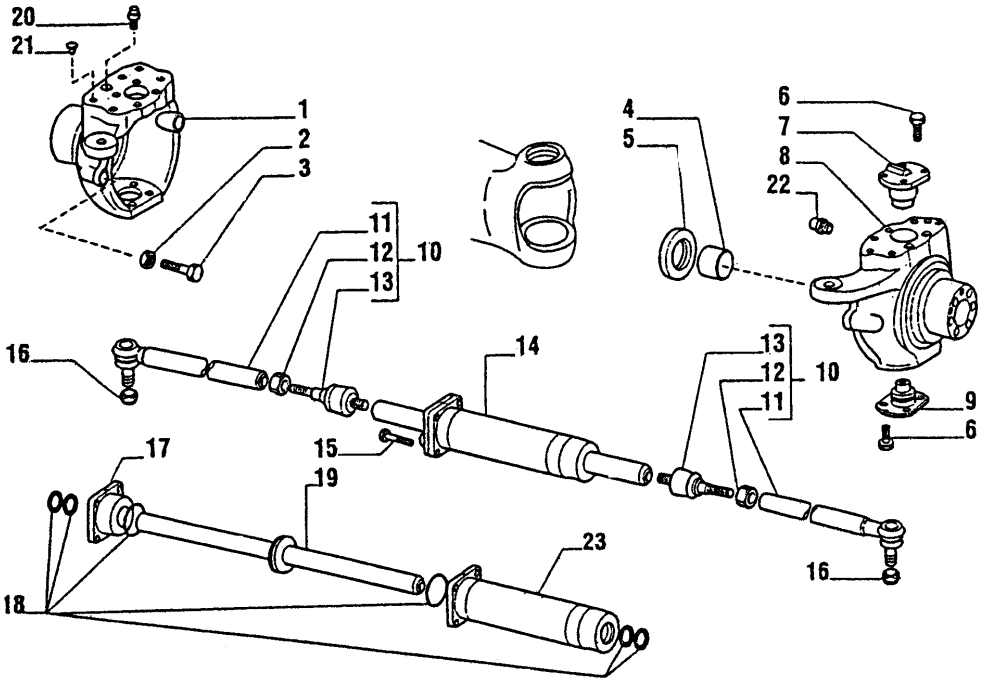


TOE IN and STEERING ANGLE SETTING

Steering angle is 32° 0° and can be adjusted by loosening or screwing in bolts as per sketch.



Toe in can vary between 0 and +1 mm.



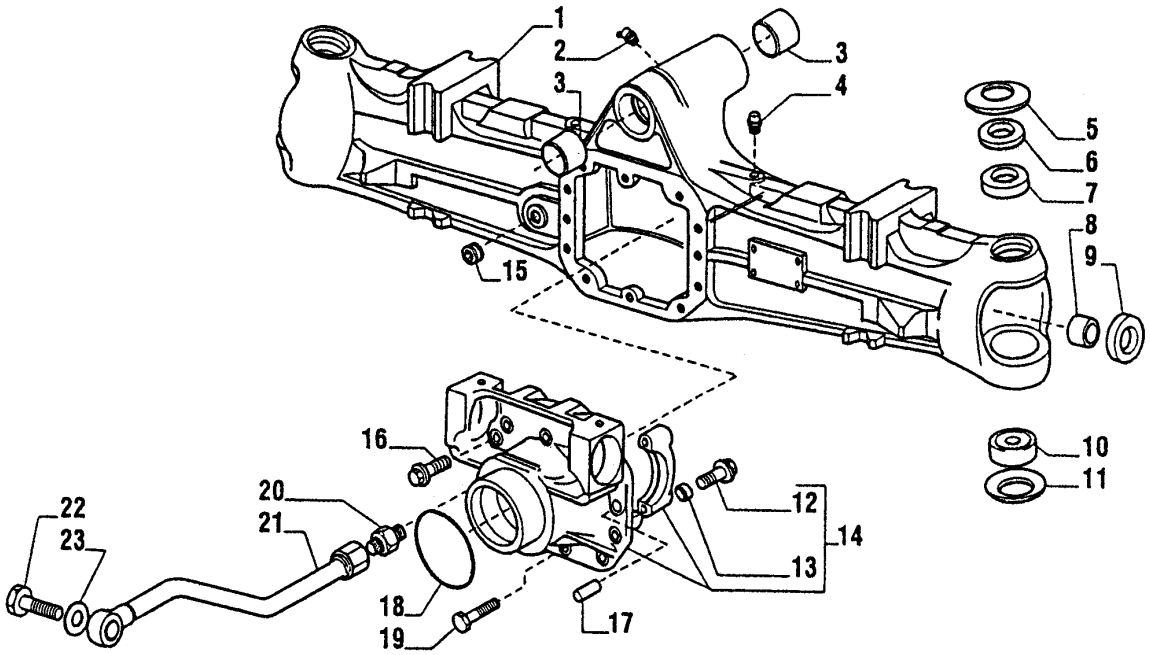
If any adjustment is necessary:
- loosen nut (12) at both ends
- make sure that steering cylinder rod is even on steering cylinder (i.e. centered)
- then rotate ball joints (13) until the adjustment is satisfactorly. CAUTION: ball joints are right hand thread.
- check that cylinder rod protrudes the same lenght both side of the cylinder (otherwise reset the system)

Then tighten lock nuts at 56 Nm torque.

STEERING CYLINDER

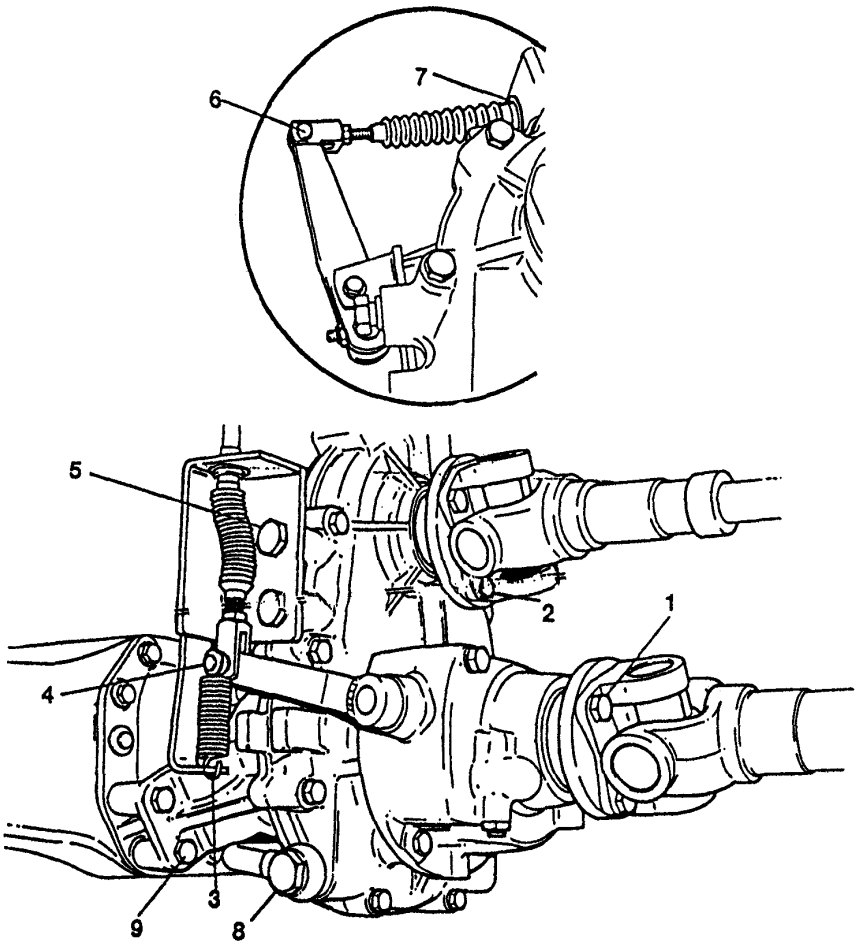
If necessary, inspect and replace cylinder seals (a specific kit is available). Take special care while inspecting the cylinder rod against scratches or grooves, which may damage seal lips.

AXLE HOUSING



Inspect breather (4) and replace as necessary.
Inspect bushes (3) for wear and tear and replace as necessary.
Check integrity of graser nipple (2) and replace if necessary.
It is recommendable to inspect visually the axle beam against oil leaks thru crackings and/or from u-joint shaft seals (9).
Check the integrity of the identification tag.

TRANSFER BOX 172 (MAIN BOX)



REMOVAL

Make sure wheels are chocked as the parking brake will no longer function when the drop box is removed.
Loosen and remove bolts (1) and disconnect bottom drive shaft.
Loosen and remove bolts (2) and disconnect top drive shaft.
Release spring (3), remove clevis pin (4) and loosen and remove bolts (5) to disconnect 2/4 wheel drive (if fitted).
Remove clevis pin (6) and spring clip (7) to disconnect parking brake.
Remove bolt (8) from oil feed and drain oil into a suitable container. Discard sealing washers.
Support the drop box, release bolts (9) and remove drop box.

REPLACEMENT

Replacement is reversal of the removal procedure.
Discard old seals and fit new seals and O-rings.
Take care not to damage O.ring seal between axle and drop box during fitting.
Adjust the parking brake cable.
Adjust (if applicable) the 2/4 wheel drive disconnect cable.
Fill to the correct level with the appropriate lubricant.

TRANSFER BOX 172

DISASSEMBLY

Remove the parking brake assembly (see next section).

Remove the 2/4 wheel drive disconnect assy (if applicable).

Release circlip (3) and remove thrust washer (4).

Remove lower drive (5).

Remove bolts (6) and separate casings (1) (2).

Remove gear (8), bearings (7) (10) and drive (9).

Remove washer (11), release circlip (12) and remove thrust washer (13).

Remove upper drive (14).

Remove gear (17), bearings (6) (18).

To remove mounting support (29) loosen and remove bolts (19)

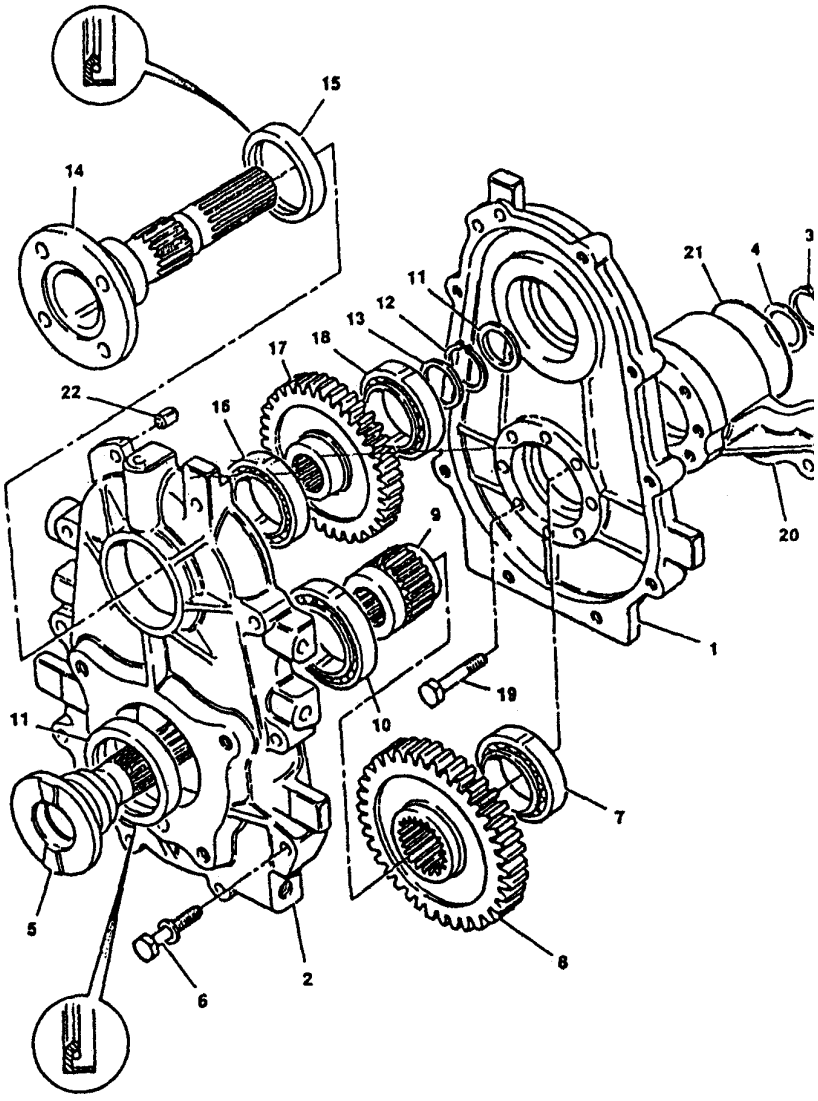
ASSEMBLY

Assembling is reversal to disassembling.

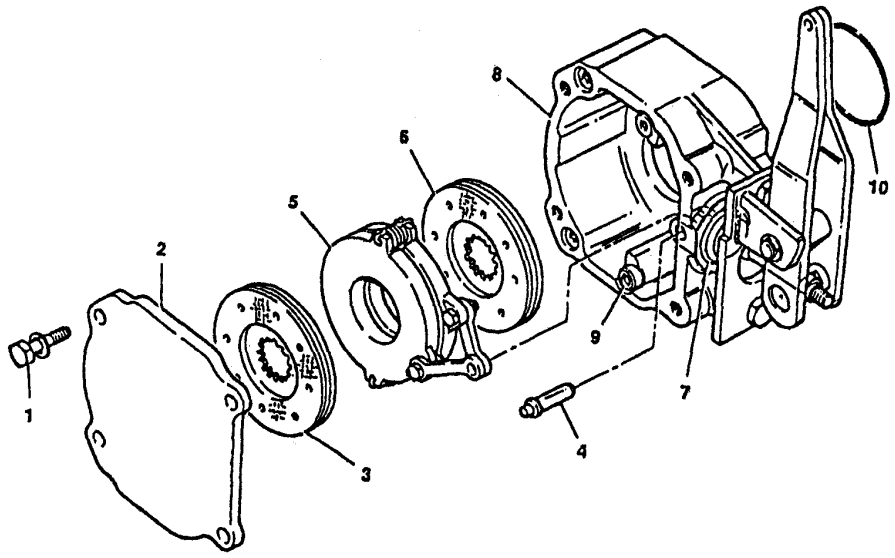
Inspect bearings and bearings seats for wear and damage and replace as necessary.

Replace all seals and clean mating surfaces of the drop box prior to apply LOCTITE 518 as a sealant (one of the two surfaces only).

Secure bolt (19) with LOCTITE 270.



TRANSFER BOX 172



DISASSEMBLY

The adjustment or removal of the brake pads requires the parking brake to be disengaged: make sure the machine is on level ground and chock all four wheels !

Loosen and remove bolt (1), remove cover plate (2) and brake disc (3).

Use pliers to pull out pin (4).

Ease cover (7) clear of housing (8) so that brake rod (11) is clear of brake actuator (5).

Remove brake actuator (5) and brake disc (6).

If required, loosen and remove bolts (9) to remove housing (8).

INSPECTION

Replace discs if the friction material shows wera (thickness should be within 9.45 and 9.83 mm).

Inspect the rubber booth (7) for damage and replace as necessary.

ASSEMBLY

Assembling is reversal to disassembling.

Discard all seals and replace by new seals and O-rings.



REAR AXLE

REPAIR MANUAL

26.11 SD AXLE MODEL

Ref. CA140113

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

REPAIR MANUAL

INDEX OF SECTIONS

SECTION	DESCRIPTION
A	SPECIFICATION AND FEATURES
B	SECTION VIEW AND SILOHUETTE
C	TORQUE SETTINGS
D	LUBRICATION
E	SPECIAL TOOLS
F	DISASSEMBLING AND ASSEMBLIMG

REPAIR MANUAL

AXLES and TRANSFER BOX A 1

DESCRIPTION
Steering axle, with cast iron axle beam, standard differential, triple reduction (1st in drop box, 2nd differential and 3rd planetaries).
Steering cylinder integrated in the diff support.
Total ratio / reduction = 14.769/1

SPECIFICATION & FEATURES

BEVEL DRIVE - DIFFERENTIAL

Ratio	T	2.46
Backlash	mm.	0.16 to 0.22
Shims thickness for bevel pinion position	mm.	2.5 to 3.4 (0.1 by 0.1)
Bevel pinion bearing pre - load mesured on diameter D 30.50	daN	P = 10.5 to 15.7
Bevel gear set (total) bearing pre - load (measured on the pinion queue)	daN	T = (P + 4.2) to (P + 6.4)

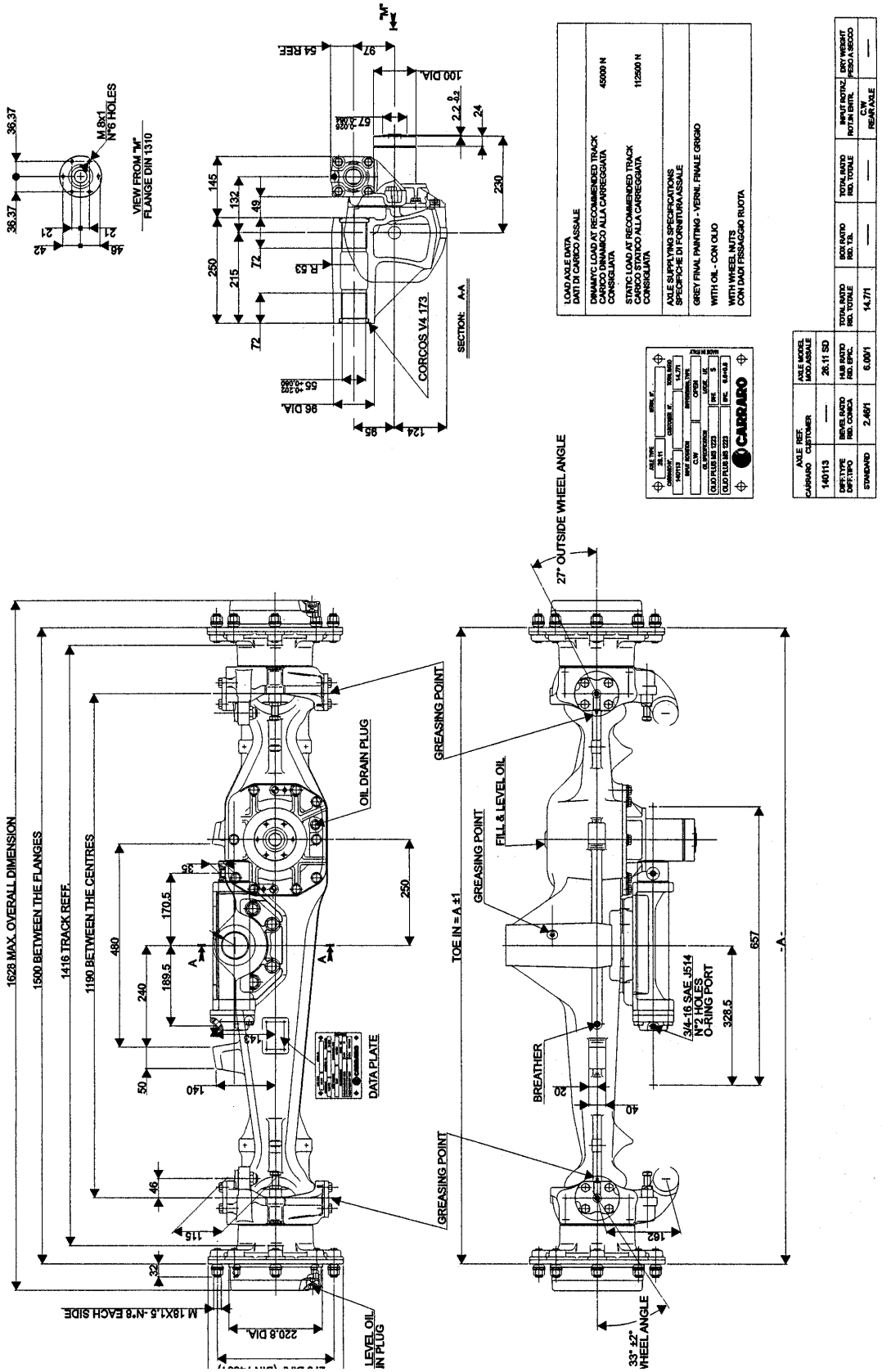
WHEEL HUB

Ratio	T	1:6
Wheel bearing preload	---	system 'set right'

REPAIR MANUAL B

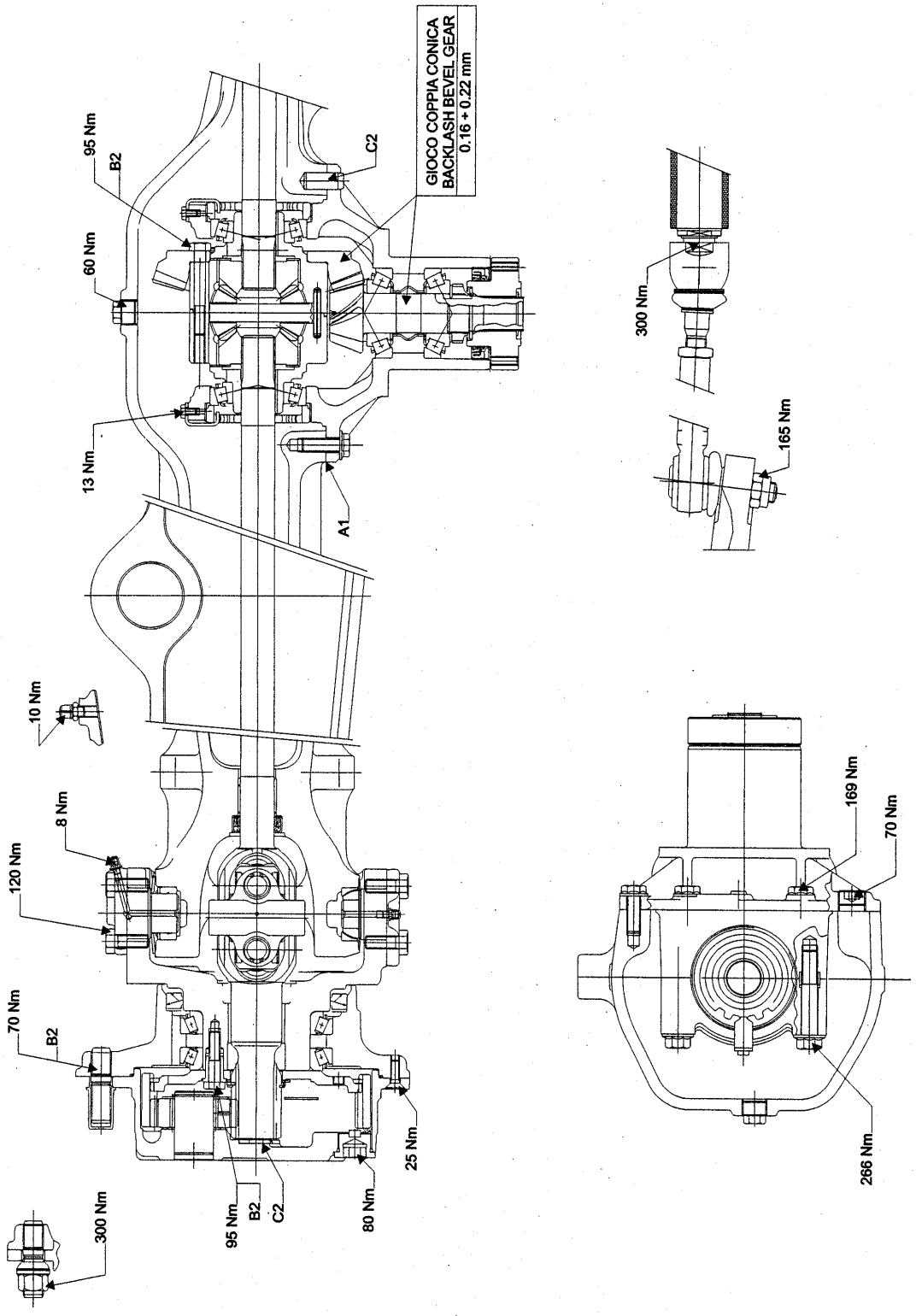
SECTION B

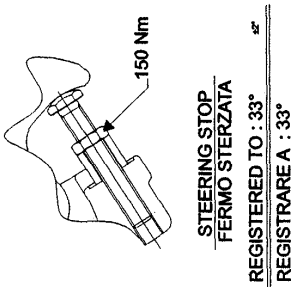
SECTION VIEW AND SILOHUETTE

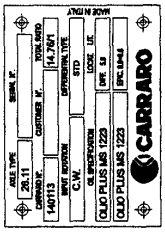


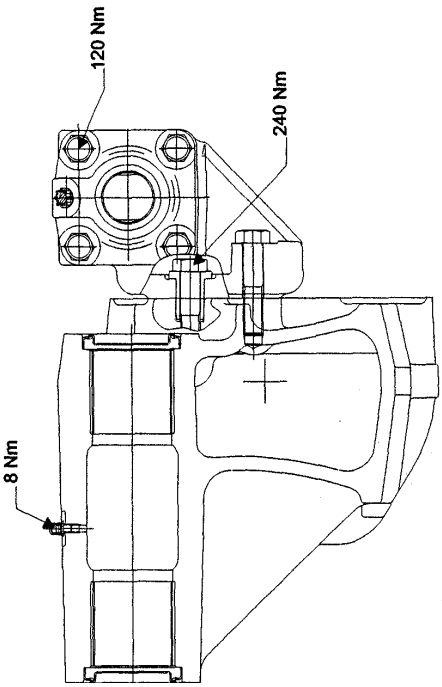
DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

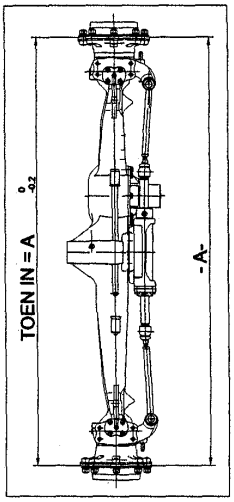
REPAIR MANUAL C1




150 Nm
STEERING STOP
FERMO STERZATA
REGISTERED TO : 33°
REGISTRARE A : 33°


CARRARO


120 Nm
240 Nm
8 Nm


TOEN IN = A
-A-

CARRARO AXLES 26.11

LUBRICATION

- **Differential and reduction gears (planetary hubs) :**

  - use lubricants complying with specifications MIL-L-2105D, API GL4 / GL5
  - "W" grade designation must be selected according to ambient vs. axle operating temperatures
  - as a general rule:

  80W should be used with ambient air temperature below - 10°Celsius (15°F)
  80W - 90 should be used with ambient air temperature between - 10° and + 40° Celsius (15°F to 105°F)
  85 W - 140 should be used with ambient air temperature above + 40° Celsius (above 105°F)

- **Quantities**: front differential/ axle housing : 5 liters
- each reduction unit: 0.6 liters

- **Checkings:** first change after first 250 running hours
  inspection and make-up of level : every 250 running hours
  drain and refill: every 1000 hours or seasonally, whichever occurs first

- **Grease fittings:** grease king pin every 250 running hours
  grease axle pivot every 250 running hours
  grease drive shafts every 250 running hours

WARNINGS

Above figures are ment as the maximum intervals between servicing: checking and filling intervals may need a higher frequency according to ambient operating conditions and type of service.

It is forbidden to mix lubricants of different brands or makes to make-up the oil level.

Failure to observe above instructions and recommendations mav void the warranty.

CARRARO service

Recommended oil and grease list

OIL LOCATION	U.S. and/or European specifications	SAE Viscosity Grades	Other specifications	Alternatives & Remarks
axle beam, differential without limited slip, wheel hubs, gearbox and drives	API GL5 MIL-L-2105D, with and without limited slip additives	SAE 80W-90 SAE 85W-90 SAE 85W-140	API CD/CE/CF/SD ZF TE-ML05	
axle beam, limited slip differential , wheel hubs, gearbox and drives with wet brakes	API GL-4, ASTM D445, ASTM D2602	SAE 10W-30		MASSEY FERGUSON M1141/M1135 NEW HOLLAND FNHA-2-C-201.00 JOHN DEERE J20C/D CASE MS1207
anti-squawk or brake chatter transmission friction modified fluids	ASTM D445		ISO 3104 DIN51550 AFNOR T60-100	JOHN DEERE J20C/D, J.I.CASE MS1223, J I.CASE 187
anti-squawk or brake chatter transmission and hydraulic fluids BELOW -30°C	MIL-L-10324A, MIL-L-46167A, ASTM D445		ISO 3104 DIN51550 AFNOR T60-100	JOHN DEERE J20D
multi-functional engine transmission and hydraulic oils (S.T.O.U.)	API GL4 MIL-L-2105	SAE 10W-30 SAE15W-40	API CC/CD/SE/SF MIL-L-2104 C,D MIL-L-46152 A, B CCMC-D4/D5	J.I.CASE JIC187 JOHN DEERE J27 FORD M2C159B1/B2/B3
steering cylinder and hydraulic dif lock actuator	API GL4/GL5 MIL-L-2105 MIL L-2105D	SAE 80W-90 SAE 85W-90 SAE 85W-140		
brake actuators (depending on system installed)	SAE J1703 ISO6743/4HH FMVSS 116 DOT3/4		ATF DEXRON II DEXRON III MERCON-M	API CD/CE/CF/SF/SG MIL-L-2104C/D/E MIL-L-46152C/D/E SAE 10W
TLB1 Power shuttle series	API GL4/GL5 CATERPILLAR TO-4 MIL-L-2105 MIL-L-2105D	SAE 10W HD, SAE 10W-30	API CD/CE/CF/SF/SG MIL-L-2104 C,D MIL-L-46152 C/D/E ZF TE-ML105	J.I.CASE HYTRANS1223 , MS1207

GREASE (Europe VDI 2202)	DIN 51502	ASTM D 4950	ISO classification	remarks
G multipurpose grease (mineral oil)	GOOR NGLI2	LB , 4B	ISO-L-XDCIB2	----
K, KT multipurpose grease (mineral oil)	KTB2 K NGLI2	LB , 4B	ISO-L-XDCIB2	MIL-G-21-21 164/81322 lithium grease, NH710 A, M1C 137-A
K, KT multipurpose grease (mineral oil)	KTCSHC 2 N NGLI2	LB , 4B	ISO-L-XDCIB2	MIL-G-21-21 164/81322 lithium grease
silicon oil based grease	KTASI1 R	----	----	lithium added
PTFE added semisynthetic grease	KH E1R	ASTM D-1743	ISO-L-XMR-XM2	TECNOLUBE SEAL POLYMER 400
arctic grease	NGLI0 NGLI1	----	----	(0°C) -:- (-30°C) MIL-G-10942C

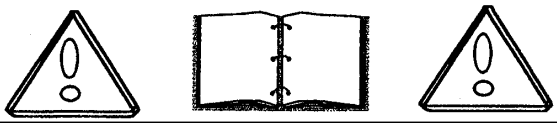
ref. STA/0001096

Foreward

Following instructions are a complementary list of information to help the mechanic.

For YOUR SAFETY, read the entire manual before attempting to operate on the axle. Pay special attention to the warnings and recommendations across this manual.

General working instructions and recommendations



1) All equipments can be hazardous. When a machine or vehicle is correctly operated and properly maintained, it is a safe vehicle to work with. But when it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

2) A raised and badly supported machine can fall on you. Position the vehicle on a firm, level surface before arising one end. Ensure the other end is securely chocked.
Do not support the machine on cinder blocks, hollow tiles or props that may crumble under load. Do not work under the machine if supported solely by a jack and follow recommended procedures in this manual.

3) Do not rely solely on the jacks to support the vehicle when working under it: the vehicle can roll off jacks and crush you unless the wheels have been chocked.
Always chock the wheels at the opposite end of the machine that has to be jacked. always support a jacked-up machine on axle stands before working underneath it.

4) Do not work with the machine until you are sure that you can control it.

5) Do not start any job until you are sure that you and those around you will be safe.

6) If you are unsure of anything, about the vehicle or the job, ask someone who knows. Do not assume anything.

Remember: BE CAREFUL, BE ALERT, BE SAFE !

7) Make sure the vehicle will not move: shift transmission to PARK, stop the engine and remove the key.
Disconnect the battery to prevent the engine being started while you are beneath the vehicle.

8) Wear appropriate safety clothes (gloves, overalls, professional shoes) and spectacles.

9) Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards. Use power tools only to loosen threaded parts and fasteners.
For loosening and tightening hardware, use the correct size tools.
DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenche

Failure to follow the above and following instructions can cause serious injury to you and affect the efficacy of your labor.

SPECIAL TOOLS

AXLE E 1

DESCRIPTION	PART N.
to define ...	

INDEX OF PAGES

FOREWARD	F 1-2
EPICICLIC REDUCTION & WHEEL HUB	F4
WHEEL HUB	F4
SWIVEL HOUSING	F5
DRIVE SHAFT	F5
DIFFERENTIAL F6	
STEERING CYLINDER AND TOE-IN	F7
AXLE HOUSING	F8

FOREWARD

The overhauling of final drives, wheel hubs and brakes can be completed without disconnecting the axle from the machine. Sould it be necessary to remove the axle assembly, adequate supporting of the machine must be ensured to work safely,

OIL SEALS FOR ROTATING SHAFT

For an installation of oil seal adhere to the following recommendation:

- Clean the shaft and ensure the seal area of the same is not damage, fitted or grooved.
- Place the sealing lips towards the oil side.
- Lubricate the seal lip (oil is better than grease) and fill with grease the space between oil lip and dust lip of dual lip seals.
- Install the oil seal using a suitable seal driver. Avoid hammering directly on the seal.
- To avoid damages to the seal lip caused by the shaft : adequately protect the same during shaft assembly procedure.

" O " RINGS

Ensure adequate lubrification of these seal before inserting them in their seats to avoid twisting during shaft assembly.

SHIMS

For each adjustement select the correct shim/s by individual measurement.
Do not trust pack measurement or the thickness indicated on the shim.

BEARINGS

For a correct assembly it is suggested:
- Warming from 80 to 90 C before installation in their respective seats.

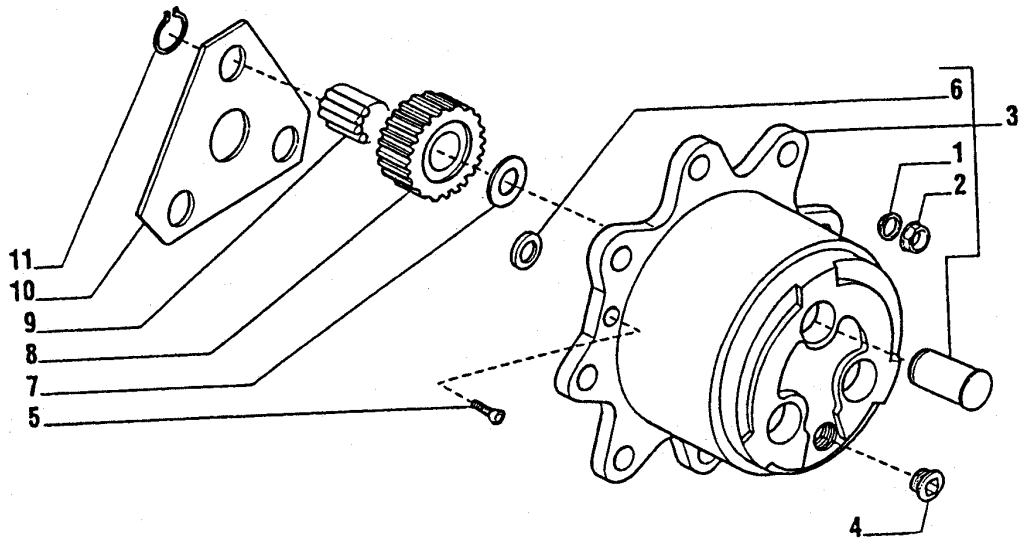
SEALING COMPOUNDS

On area to be sealed use LOCTITE 510, ensuring both side to be sealed are clean, dry and totally free from grease and oil.

F 3

REPAIR MANUAL

EPICYCLIC REDUCTION GEARS



EPICYCLIC REDUCTION GEAR

- Turn the hub so that the filler/drain plug (4) is at the lowest position and drain the hub oil.
- Remove the two screws (5) securing the planetary carrier assy to the wheel hub.
- Inspect the needle bearings (9) and the thrust washer (10) for wear and replace if necessary.
- Reassembling : if necessary hold the needle bearing in position with grease.
- Refill the hub with the correct oil, see specification. The filler/drain plug bore position must be at the top
- Check the level with the plug at the horizontal line.

REPAIR MANUAL F4

HUB ASSEMBLY - EPICYCLIC REDUCTION

DISASSEMBLY

Remove the wheel assy, then rotate the hub so that the filler/drain plug (1) is at the lowest point and drain the oil. Discard O-ring seal (2).

To remove the planet carrier (3) release screws (4).

Prise off the planet carrier (3).

To remove the planet gear (8) remove circlip (6) and thrust washer plate (7).

Take care that the needle bearing rollers (8) are not misplaced.

Release circlip (15), remove thrust washer (16) and spacer (17).

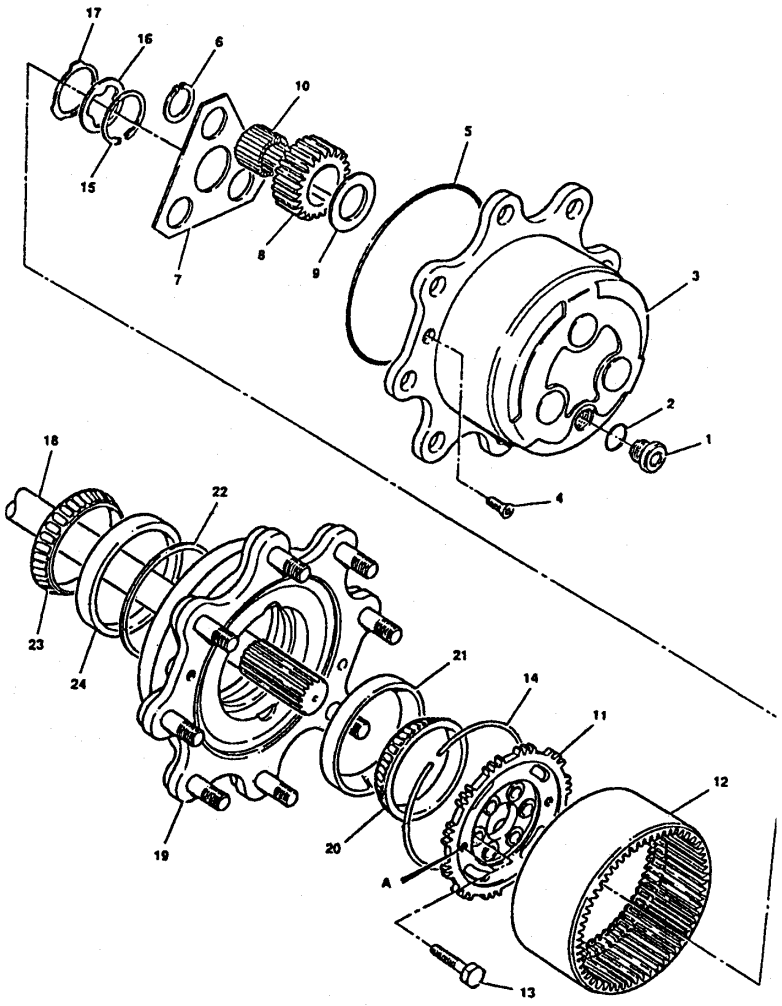
Remove annulus carrier (11) and annulus ring (12) as a complete assy.

Relase bolts (13) and use two of these bolts in threaded holes A to push the assy of.

Mark the position between annulus carrier (11) and annulus ring (12) then remove circlip (14).

Prise off bearing carrier (19).

Remove taper bearings (20) (23).



ASSEMBLY

For assembly the sequence should be reversed.

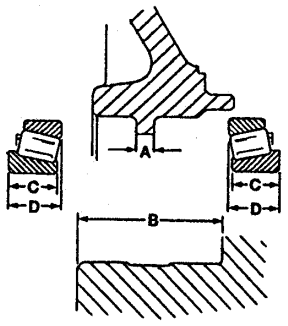
Fit new seals.

The tapered bearings (20) (23) are machined to fine tolerances and do not require pre-load or clearance checks.

When fitting new components check that all dimensions are within the limits. If any component is outside the limits, replace by a new one.

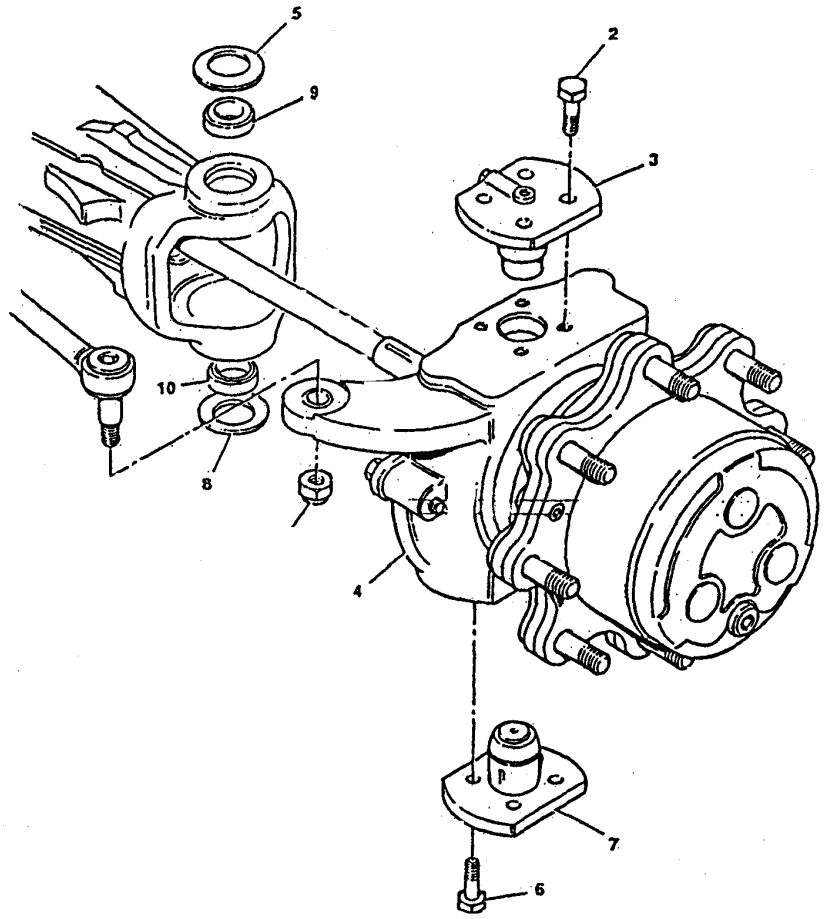
A	11.975 + 0,050 mm
B	52,229 + 0,050 mm
C	20,00 mm
D	20,00 + 0.10 mm

Fill the hub to the correct level with the appropriate lubricant.



REPAIR MANUAL F5.1

SWIVEL HOUSING



DISASSEMBLY

Swivels can be removed without dismantling the hubs (once the wheel tyre and rim have been removed)

Loosen and remove nut (1) and disengage track rod. Mark the relative positions of king pin (3)(7) to make sure they are properly refitted.

Release top king pin bolts (2) and prise top king pin (3) clear of swivel housing (4). Then remove the belleville washer (5).

hold the swivel, release bottom king pin bolts (6) and prise bottom king pin (7) clear of swivel housing (4).

Remove the belleville washer (8).

Remove swivel (4), but take care not to let the swivel drop or the halfshaft could be damaged.

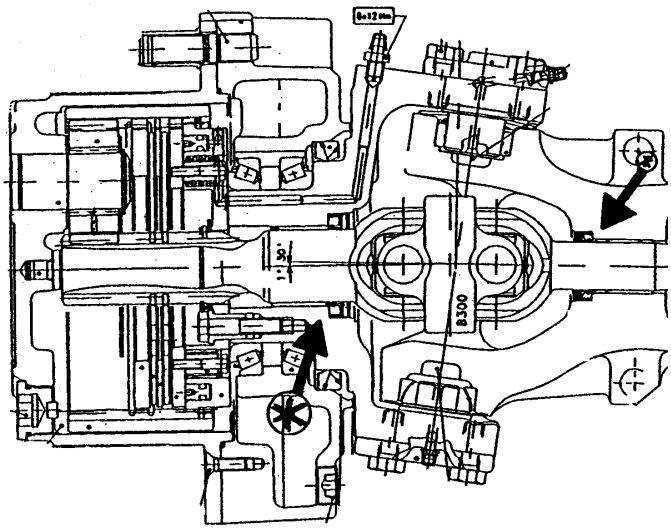
ASSEMBLY

For assembly the sequence should be reversed.

Discard old seals and fit new seals and O-rings. Check halfshaft's seals and bushing (*) and replace as necessary

To fit new pivot bearings (9)(10), the bearings must be cooled first (azote bath).

Apply recommended grease and recommended quantity to bushes and bearings surfaces before assembly.

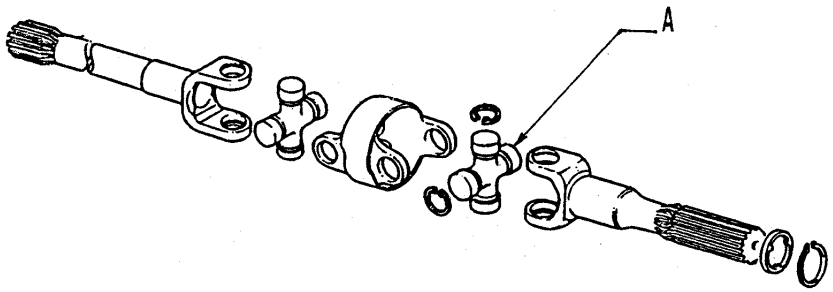


Swivel housing and king pin disassembly and assembly do not require special operations.

Check the position of belleville washer under the king pins during the assembly.

REPAIR MANUAL F5.3

DRIVE SHAFT



Inspect the shaft splines for damage.

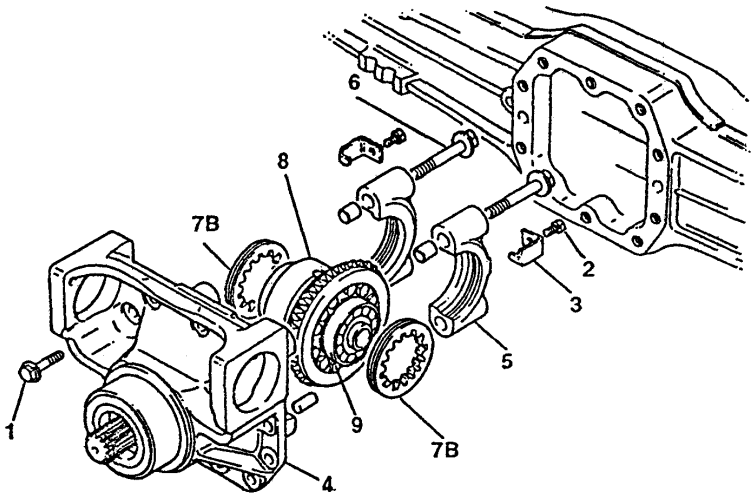
Replace the spiders A if worn or damaged.

Note: overhaul of the two universal joints follows conventional workshop practice.

DIFFERENTIAL, SETTING THE BEVEL GEAR SET

REMOVAL

Drain the oil from both hubs and diff housing.
Remove final drives / planetaries.
Disconnect input u-joint shfaft from input flange.
Remove input flange (after the circlip has been kept apart).
Loosen and remove bolts (1), lift carrier (4) and differential (8) clear of axle.
Mark the relative position of differential (8) and carrier (4).
Release bolts (2) and remove locking plate (3)
Mark the relative positions of bearing caps (5) and diff carrier (4).
Loosen and remove bolts (6) and lift off bearing caps (5).
Remove bearing adjusters 7A and 7B, then lift the diff (8) out of carrier (4).
Remove bearing outer races (9).



ASSEMBLY

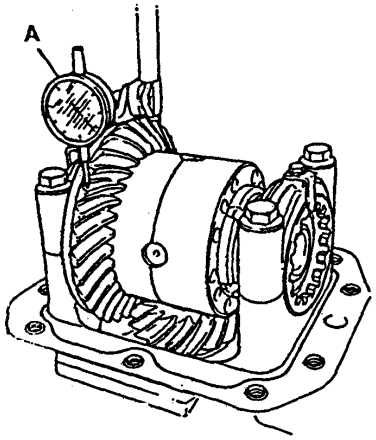
Replacement is reversal of the removal procedure.
Ring gear and pinion are a matched pair and must be replaced as an assembly.
Fit bearings (9) and position diff (8) in carrier (4), making sure the differential is aligned as marked during disassembly.
Align location marks and fit caps (5) to locate with bolts (6)
Locate bearing adjusters (7) and tighten bolts (6). Adjust the ring gear backlash and preload (see the following instructions about setting the ring gear / pinion backlash and differential preload).
Once the setting operations have been completed, clean carrier and axle mating surfaces and apply (one of the two surfaces only) LOCTITE 518. Reinstall the differential carrier assembly onto the axle and secure with bolts (1) to the recommended torque.

REPAIR MANUAL

F 6.1

SETTING RING GEAR / PINION AND DIFFERENTIAL BEARINGS PRELOAD

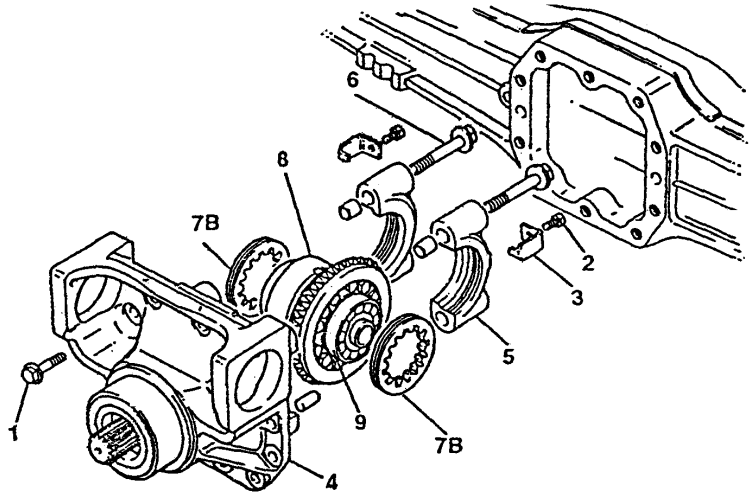
Adjustment is made by the side ring nuts (7): the nuts push the bearings and move the ring gear towards or away from the pinion as required.
Side ring nuts 7A and 7B may be difficult to turn: release a bit bolts (6) to ease movements.
Screw in side ring nut 7B clockwise until the ring gear is in contact with the pinion and, at the same time, tap the bearing cap (5) with a resin hammer to align bearings.
Screw in ring nut 7A clockwise until all clearance in the barings has been cancelled. This occurs once the ring nut is difficult to move. At the same time, tap the bearing cap (5) with a resin hammer to align bearings.



With a dial test indicator, as shown,
measure the backlash between ring gear and pinion, at 3 positions around the ring gear.
Record the clearances: if different, put the dial test indicator on the smallest value point of the ring gear.

Correct clearance should be: 0.16 to 0.22 mm

To obtain such value, adjust by moving the ring gear towards or away from the pinion, as required. Try to adjust side ring nuts 7A and 7B the same quantity.



REPAIR MANUAL F 6.2

SETTING THE PINION BEARING PRELOAD

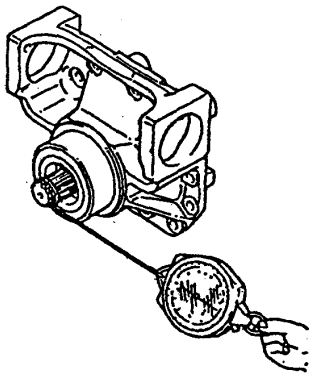
Tighten nut (1) to achieve a rolling torque so that the reading on the spring balance shows 105 to 157 N.

Check the rolling torque by pulling gently and constantly the spring balance (repeat the control three times, to have an average value).



If the rolling torque (or the force) is exceeded, spacer (4) and collapsible spacer (5) MUST be replaced.

Lock nut (1) in position with lock washer (2)



DIFFERENTIAL

The top illustration shows a standard differential and the bottom illustration shows a limited slip differential.

DISASSEMBLY

Mark the relative positions of differential housing (1) and (2).

Loosen and remove bolts (3) to separate the housing halves.

Mark the relative positions of diff gears (4) and spherical thrust washers (5). Check and replace if necessary (using the complete kit of side and diff gears plus relevant washers).

Remove side gears and washers. On limited slip differentials (if applicable), remove spacer (8), thrust washer (9) and discs (10).

INSPECTING

Renew spacers (8) if thickness is below 2,67 mm.

Renew thrust washers (9) if thickness is below 1,47 mm.

Renew discs (10) if thickness is below 1,42 mm.

Remember to record the sequence of limited slip components for reassembly or install the new kit of discs respecting the sequence.

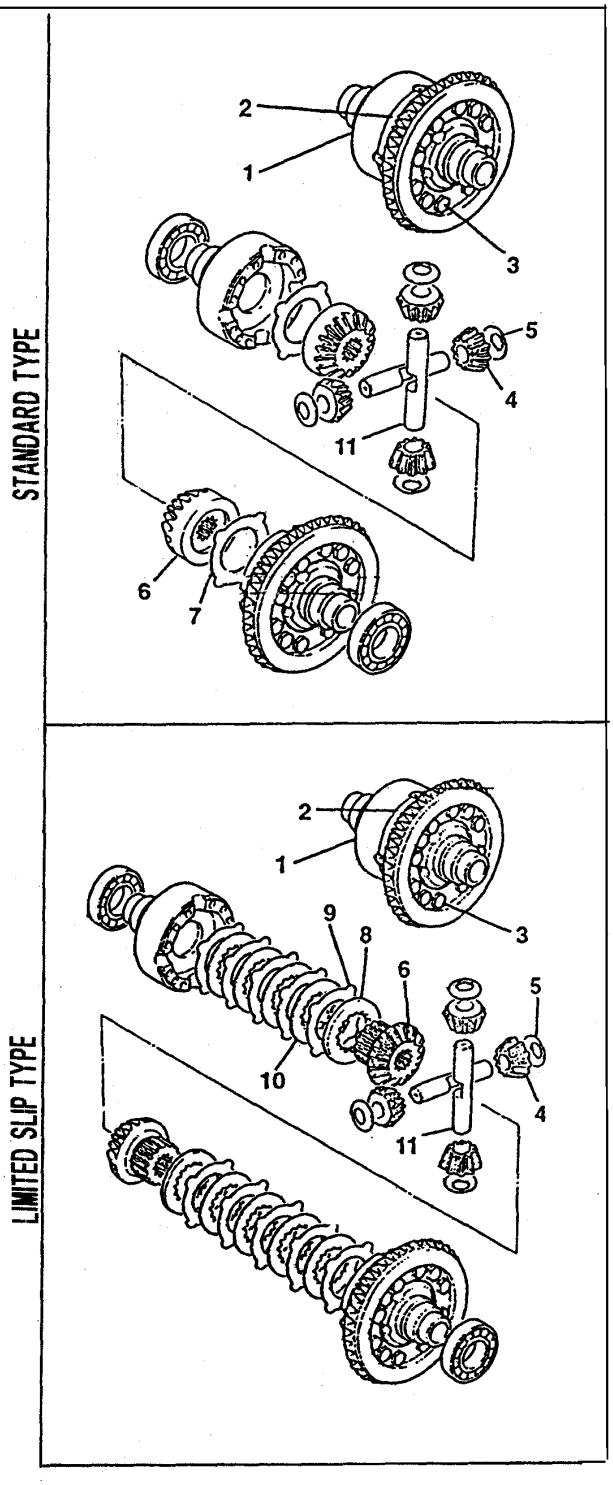
ASSEMBLY

Replacement is reversal to removal procedure.

Check that relative positions of diff gears (4) and washers (5) are as marked while disassembling.

Check that relative position of housing halves match as marked.

Use LOCTITE 270 to secure bolts (3), then torque tighten up to 95 Nm



PINION
The numerical sequence on the illustration is ment as a guide for teardown: follow the numerical sequence for proper disassembly.

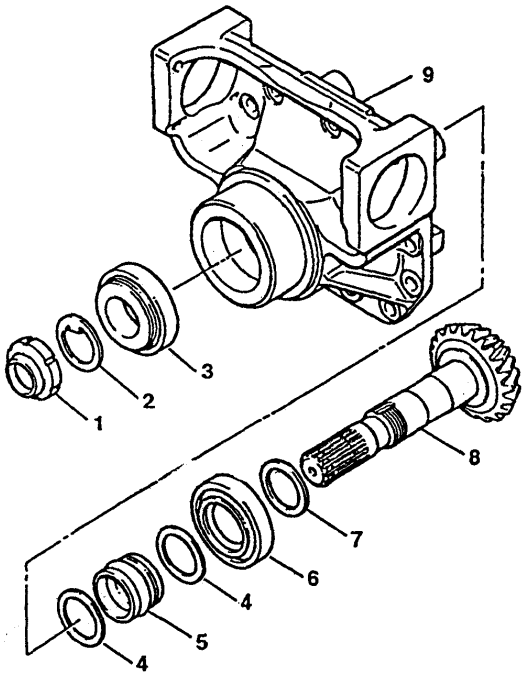
ASSEMBLY
Replacement is reversal to the disassembly procedure.
Ring gear and pinion are a matched pair and must be replaced as an assembly.
Ring nut (1), lock washer (2) , spacers (4), collapsible spacer (5) MUST be replaced each time the pinion is removed.
To select the correct size of shims (7) follow the "Bevel distance setting Procedure".

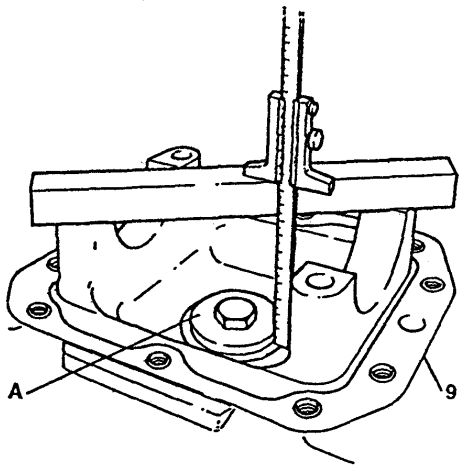
BEVEL DISTANCE SETTING PROCEDURE
Hold the pinion bearings in position with the special tool A so that bearing cones can just be hand rotated.
Measure the distance from the diff support case, as shown, to the inner bearing.

WARNING: if a bar is used to hold the depth gage, subtract the bar thickness from the recorded value.

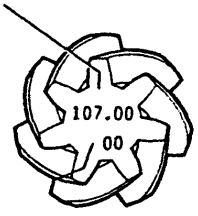
The required shim thickness is the difference between the distance measured and the dimension stamped on the pinion's head.

Select the correct total shim thickness and fit onto pinion's shaft.
Press inner bearing (6) onto pinion's shaft.
fit new spacers (4) and collapsible spacer (5).





N= Position of gear protrusion dimension



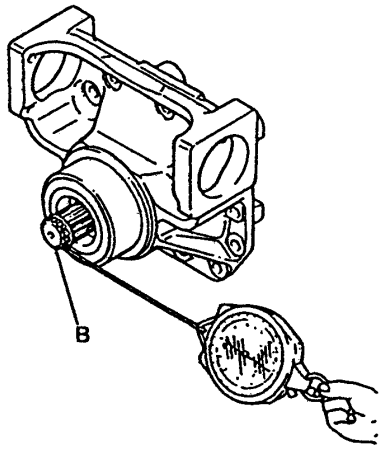
REPAIR MANUAL F 6.5

SETTING DIFFERENTIAL PINION BEARINGS PRELOAD

Tighten side ring nuts 7A and 7B by equal amounts to preserve the backlash.
With ring gear and pinion in mesh and correct backlash, rotate the pinion shaft and record the rolling torque.

Measure the rolling torque as shown in B. The total rolling torque should be the pinion's torque (see following section) plus 4.2 daN to 6.4 daN
Torque tighten bolts (6) and fit lock tabs (3), then secure with bolts (2).

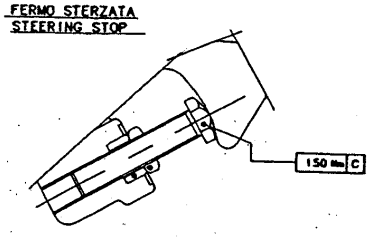
Recheck the backlash to make sure it is correct.



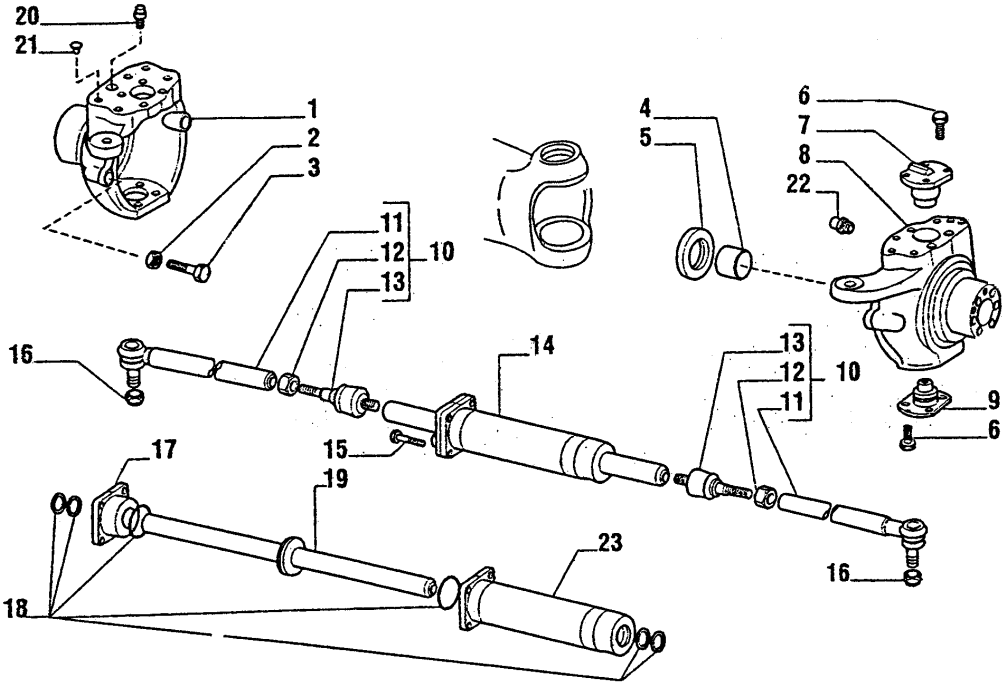
REPAIR MANUAL

F7

TOE IN and STEERING ANGLE SETTING
Steering angle is 35° and can be adjusted by loosening or screwing in bolts as per sketch.



Toe in can vary between 0 and +1 mm.



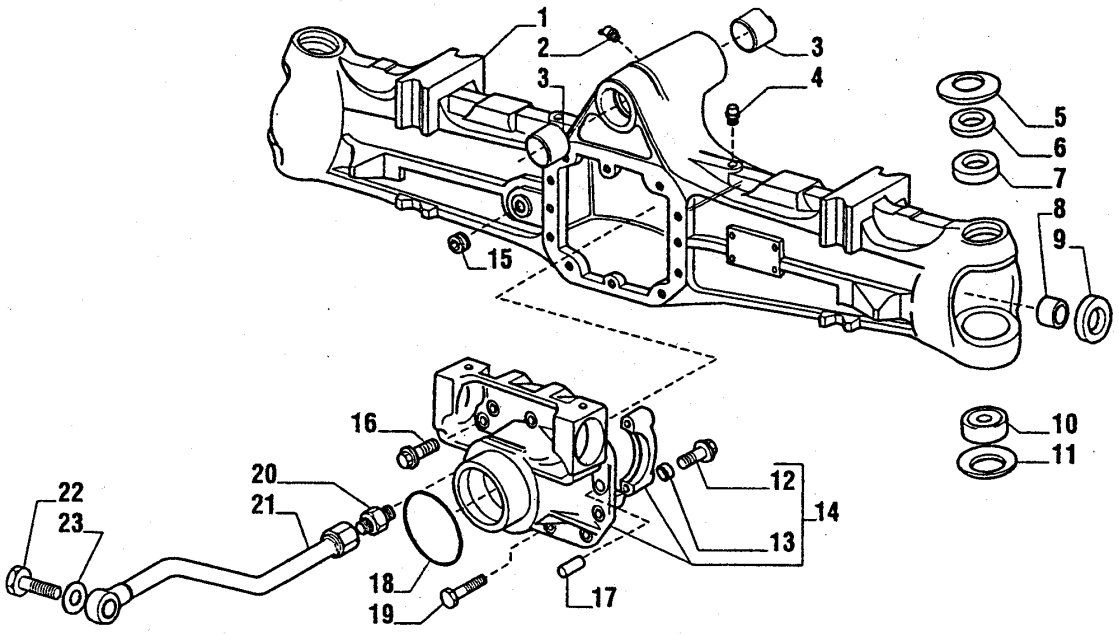
If any adjustment is necessary:
- loosen nut (12) at both ends
- make sure that steering cylinder rod is even on steering cylinder (i.e. centered)
- then rotate ball joints (13) until the adjustment is satisfactorly. CAUTION: ball joints are right hand thread.
- check that cylinder rod protrudes the same lenght both side of the cylinder (otherwise reset the system)

Then tighten lock nuts at 56 Nm torque.

STEERING CYLINDER
If necessary, inspect and replace cylinder seals (a specific kit is available). Take special care while inspecting the cylinder rod against scratches or grooves, which may damage seal lips.

REPAIR MANUAL F8

AXLE HOUSING



Inspect breather (4) and replace as necessary.
Inspect bushes (3) for wear and tear and replace as necessary.
Check integrity of graser nipple (2) and replace if necessary.
It is recommendable to inspect visually the axle beam against oil leaks thru crackings and/or from u-joint shaft seals (9).
Check the integrity of the identification tag.

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SECTION 17
TROUBLESHOOTING GUIDE

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17.0 TROUBLESHOOTING GUIDE

This section provides troubleshooting and schematic for the electrical and hydraulic system.
There are three troubleshooting charts one for General, Electrical and Hydraulic. These charts are of general nature, but should provide an intuitive feeling for a specific system. Knowing the system is the greatest aid to troubleshooting. Every component has a purpose in the system. The construction and operating characteristics of each one should be understood. Know the capabilities of the system. Each component in the system has a maximum rated speed, torque or pressure. Loading the system beyond the specification increases the possibility of failure. Know the correct operating pressures. Always set and check pressures with a gauge that is know to be accurate.

17.1 GENERAL TROUBLESHOOTING

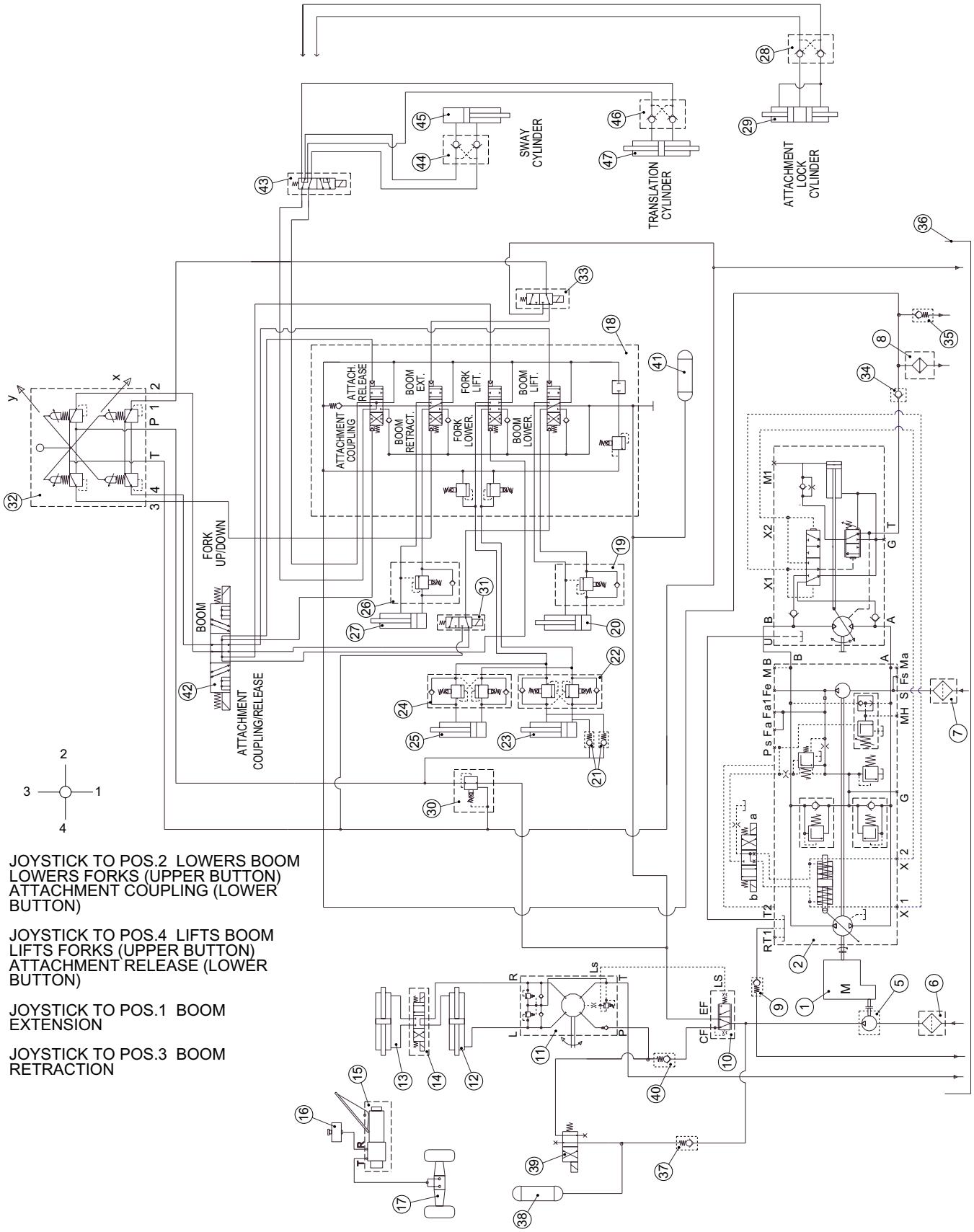
FAULT	CAUSE	SOLUTION
The hydraulic oil Thermometer does not function	This is normal, when the outside temperature is low and / or the machine is used for short periods, since the hydraulic oil cannot warm up over 40-50°C	
	The oil temperature bulb is damaged.	Check and replace the bulb
High temperature of the Engine coolant	Water level in the overflow tank	Check and, if necessary, refill
	The temperature bulb is defective	Change bulb
	The dashboard manometer is defective	Change
Low hydraulic oil level	Oil Leaks	Refill
High hydraulic oil temperature	The radiator grill is dirty	Clean the grill regularly
Low engine performance	The air filter is dirty	Clean the air filter regularly
The steering column Response is slow or noisy	Joints are damaged	Change the joints
	The spiders of the driving shaft are damaged	Change the spiders
The differential is noisy and its body temperature is high	No Oil	Check and refill
	Bearing are damaged	Change the bearings as per CARRARO instructions.
Oil leaks from axles and/or gearbox	Seals are worn	Change as per CARRARO instructions

17.2 HYDRAULIC TROUBLESHOOTING

FAULT	CAUSE	SOLUTION
The machine drive is not enough. The machine will not move	The oil filter is clogged	Change the filter.
	The max. pressure of the hydraulic system is not enough	Check teh max. pressure.
	The min. pressure of the hydraulic system is not enough	Check the min. pressure
	The drive pump and / or motor is damaged	Test the drive.
	Low hydraulic level	Visually check the oil level; if necessary, add new oil
The boom does not move	The max. pressure of the hydraulic system is too low.	Check the max. pressure.
	The min. pressure is too low	Check the min. pressure.
	The control lever is damaged	Check the lever; if necessary, replace it.
	The distributor cursor is blocked.	Check the cursor; if necessary, replace it.
The boom jerks	The accumulator is damaged or empty	Check the accumulator; if necessary, replace it.
No steering is possible with engine shut down	The one-way valve 37 to 40 is dirty or damaged	Check the valves; if necessary replace them.
Wheel misalignment	Internal cylinder blow-by	Check and change the seal
The steering column is hard (low force in the cylinders)	Low pressure	Check the pressure of the power steering circuit
	The cursor of load sensing valve 10 is blocked	Check the valve; if necessary, replace

HYDRAULIC TROUBLESHOOTING CONT'D

FAULT	CAUSE	SOLUTION
The service brake action is insufficient	No oil in the brake tank	Change the level; if necessary, refill. Check for oil leaks from teh brake circuits
	The pump seals are worn	Dismount the pump and change the seals
	The brake discs are worn	Change teh brake discs as per CARRARO instructions
	Air in the circuit	Bleed system
With engine shut down: the lifting cylidner does not hold the boom in position, forks do not rotate, the boom section cannot be retracted	The block valves are damaged	Remove and clean the valves. if the trouble persists, change the valves.
	The cylinder seals are worn	Remove the cylinders and change the seals
By lifting the boom, the machine does not sway the load	The seals of the sway cylinder are worn	Dismount the cylinder
	The shock-proof valves on the distributor are dirty or maladjusted	Remove the valves, dry-clean or change if damaged.
	The one-way vavles on the sway cylinder are dirty or maladjusted	Remove teh valves, dry-clean or change if damaged.
Forks cannot hold the load, the cylinder does not lock the load	The seals of the attachment rotation cylinder are worn	Dismount the cylinder
	The blocks valves are damaged	Remove and clean the valves. If the trouble persists, change the valves.
By operating the control lever, no action is performed	The control lever is damaged	Check if the trouble depends upon an electric trouble. If trouble persists, change the lever
	The max. pressure valve of the distributor is damaged	Check the max. pressure value,. Change the valve



JOYSTICK TO POS.2 LOWERS BOOM
LOWERS FORKS (UPPER BUTTON)
ATTACHMENT COUPLING (LOWER BUTTON)

JOYSTICK TO POS.4 LIFTS BOOM
LIFTS FORKS (UPPER BUTTON)
ATTACHMENT RELEASE (LOWER BUTTON)

JOYSTICK TO POS.1 BOOM EXTENSION

JOYSTICK TO POS.3 BOOM RETRACTION

Ref	Description	Code TEREX
1	DIESEL ENGINE	
2	HYDRAULIC DRIVE PUMP	
3	HYDRAULIC DRIVE MOTOR	
4	WASHING VALVE	
5	HYDRAULIC SERVICE PUMP	
6	SUCTION LINE FILTER	
7	SUCTION LINE FILTER	
8	THERMAL EXCHANGER	
9	ONE-WAY VALVE	
10	LOAD SENSING VALVE	
11	POWER STEERING	
12	FRONT AXLE STEERING CYLINDER	
13	REAR AXLE STEERING CYLINDER	
14	STEERING SELECTION SOLENOID VALVE	
15	BRAKE PUMP	
16	OIL BRAKE TANK	
17	FRONT AXLE	
18	4-SECTION CONTROL BLOCK	
19	LIFTING CYLINDER LOCKING VALVE	
20	LIFTING CYLINDER	
21	ONE-WAY VALVE	
22	COMPENSATION CYLINDER LOCKING VALVE	
23	COMPENSATION CYLINDER	
24	FORK MOTION CYLINDER LOCKING VALVE	
25	FORK MOTION CYLINDER	
26	EXTENSION CYLINDER LOCKING VALVE	
27	EXTENSION CYLINDER	
28	ATTACHMENT COUPLING CYLINDER LOCKING VALVE	
29	ATTACHMENT COUPLING CYLINDER	
30	PRESSURE VALVE	
31	FLOW DIVIDER (DEAD MAN)	
32	HYDRAULIC LEVER-SERVOCONTROL	
33	FLOW DIVIDER (ARB)	
34	ONE-WAY VALVE	
35	ONE-WAY VALVE	
36	TANK	
37	ONE-WAY VALVE	
38	POWER STEERING ACCUMULATOR	
39	STEERING ACCUMULATOR SOLENOID VALVE	
40	ONE-WAY VALVE	
41	CONTROL BLOCK ACCUMULATOR	
42	CONTROL BLOCK FLOW DIVIDER	
43	ATTACHMENTS FLOW DIVIDER	
44	SWAY CYLINDER LOCKING VALVE	
45	SWAY CYLINDER	
46	SIDE-SHIFT CYLINDER LOCKING VALVE	
47	SIDE-SHIFT CYLINDER	

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17.3 ELECTRICAL TROUBLESHOOTING

FAULT	CAUSE	SOLUTION
The dashboard will not illuminate	The dashboard power supply fuse F30 is broken	Replace the fuse.
	The battery is down	Check the battery condition
	The cutout switch is OFF	Turn it on
	The wire is broken or cable is disconnected	Check the line and reconnect any disconnected cable
The engine does not start. The starter does not run	The dashboard power supply fuse F30 is broken	Replace the fuse
	The parking brake is not engaged	Engage the parking brake and ensure the relevant indicator on the dashboard lights up
	The emergency button is pressed down	Reset
	The parking brake proximity switch is defective	Check and adjust the distance
	The ignition switch is damaged	Change the switch
	E6 relay is damaged	Change
	E1 relay is damaged	Change
	The cutout switch is OFF	Turn it on
	The battery is down	Recharge or change the battery
The engine does not start The starter runs, but the engine does not start	No fuel	Refuel
	The fuel filter is clogged	See Perkins Operator's Manual
	The fuel hose is empty	Refuel, then see Perkins Operator's Manual
	The engine stop solenoid valve is locked	Check if power is supplied. Replace if damaged

17.3 ELECTRICAL TROUBLESHOOTING CONT'D

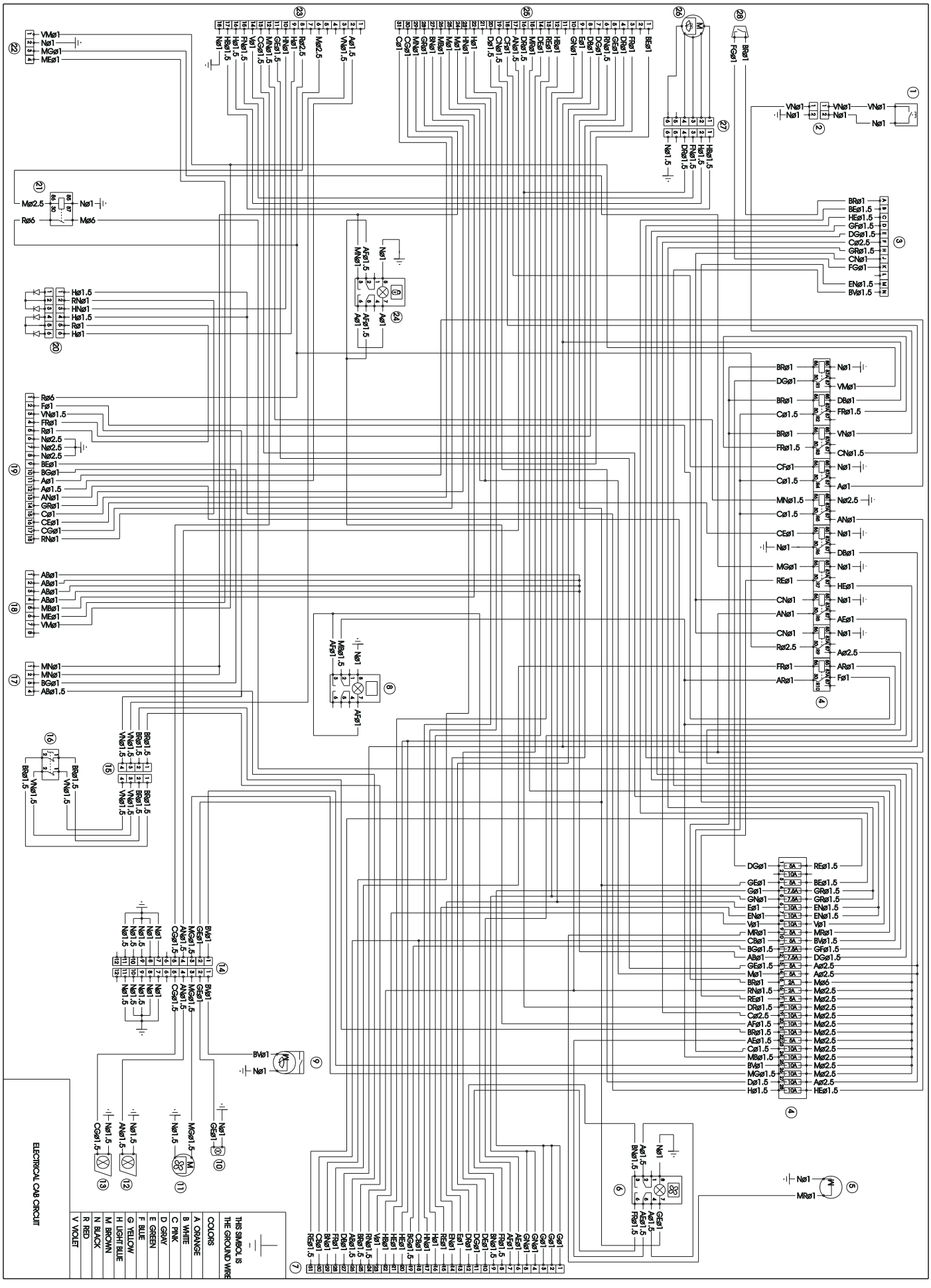
FAULT	CAUSE	SOLUTION
The machine does not move	The forward / reverse gear selector is in neutral	Set to correct position
	The parking brake is engaged	Release
	E2-E5 relays are damaged	Check or change, if necessary
	No power to the solenoid valve	Check the line with a tester
	Fuses F23-F15 are broken	Change the fuses
	No current to relay E5 from the switch	Check the line with a tester; if necessary, change the relay
	No current to the hand-control from the relay E3	Check the line with a tester; if necessary, change the relay
No selection of the steering mode. Steering selector will not operate	Fuse F20 for the steering control is broken	Change the fuse
	The "ROAD/CABIN' switch is set to ROAD	Set to CABIN
	The switch is damaged	Change
	Coil EV47 / EV48 is shorted	Check with a tester; if necessary, change the coil or the solenoid vlave.
Low parking brake action	Insufficient cable tensioning	Check and adjust the brake cable tension
The boom does not lower, does not extend, does not tilt the attachment holding frame	Fuses F1-F15-F17 are broken	Change fuses F2 and / or F24
	The emergency stop button is pressed down	Reset
	Relays E1-E7 are damaged	Check with a tester; if necessary, replace
	The ARB control until is damaged and / or in alarm	Check the control unit
	The solenoid valve of EV6-EV7 is shorted	Check with a tester; if necessary, replace

17.3 ELECTRICAL TROUBLESHOOTING CONT'D

FAULT	CAUSE	SOLUTION
The thermometer of the hydraulic oil does not function	The oil temperature bulb is damaged	Check and, in case, replace the bulb
The parking brake indicator does not light up	Fuse is broken	Change fuse F16
	Relay E6 is damaged	Check and, in case, replace
	The parking brake sensor is damaged or maladjusted	Check the sensor if damaged replace and adjust
By operating the control lever, no action is performed	Check if solenoid valve is 24V power supplied	Check with a tester
	Check if the coil of solenoid valve is shorted	Check with a tester; if in short, change the coil
	Check if the cursor of solenoid valve 42 is blocked	Check; if blocked, change the cursor of the solenoid valve
	Check if DFE distributor 43 is 24V power supplied	Check with a tester
	Check if the coil of DFE is shorted	Check with a tester; if in short, change the coil
	Check if the cursor of DFE is blocked	Check; if blocked, change the cursor or the solenoid vlave
	The reel tracks are oxidixed due to humidity	Disassembly the reel and clean the tracks. If the trouble persists due to excessive damage, change the reel.
The fuel gauge does not function	The fuel gauge is damaged	Change
	The dashboard is instrument is damaged	Change
	Harness is broken	Check with a tester and restore
The overload warning system is never in alarm or is in alarm when the unloaded machine is turned on	Check the IN/OUT tension of the loading cell	Check
	The cell is damaged	Change if damaged

17.3 ELECTRICAL TROUBLESHOOTING CONT'D

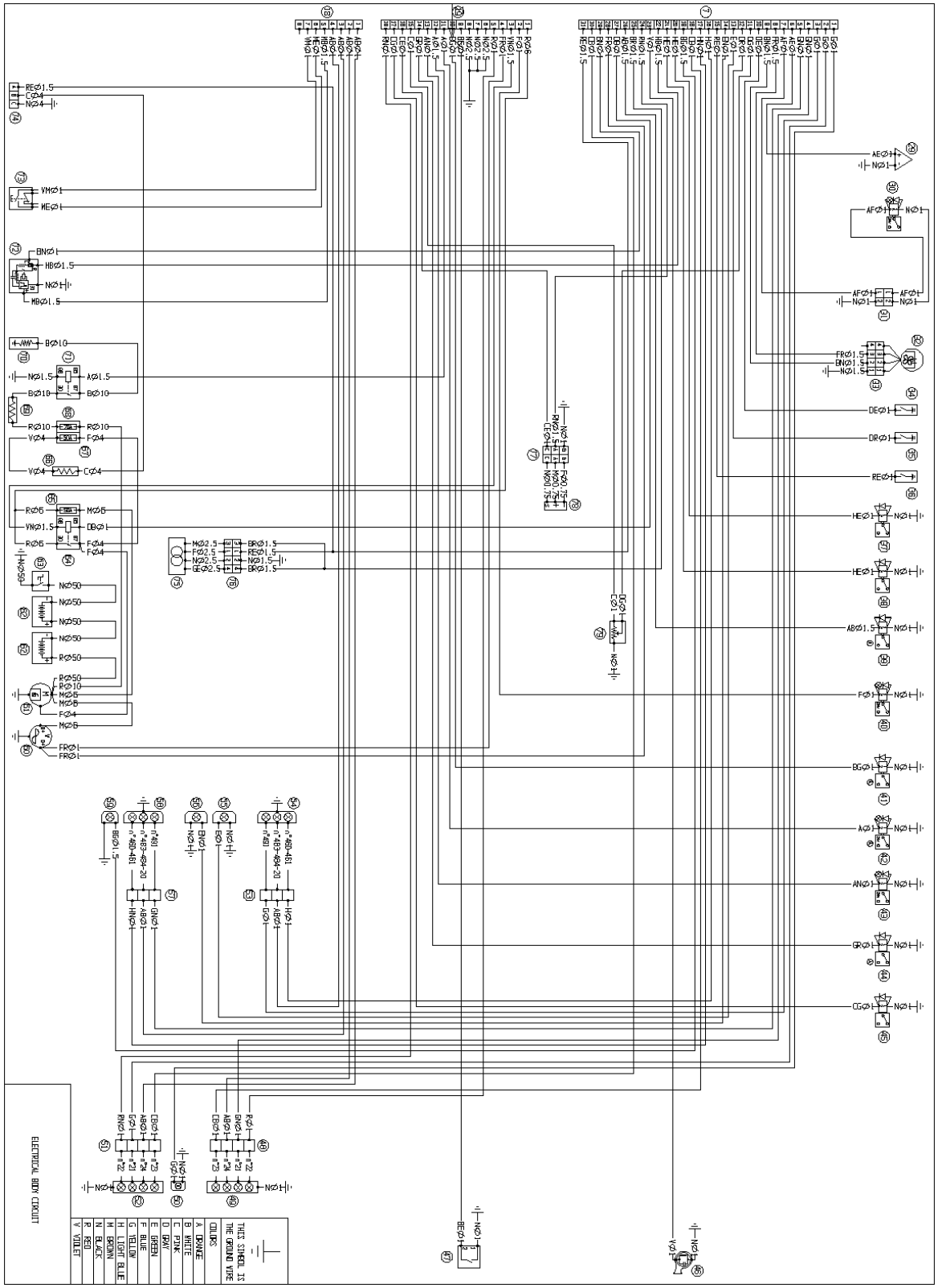
FAULT	CAUSE	SOLUTION
The light switch does not function	No 24V power	Check with a tester and restore the circuit
	The lever is damaged	Change
The front or rear windshield wiper does not function	No 24V power	Check with a tester and restore the circuit
	The motor is shorted	Change the motor
	The fuse is broken	Change Fuse F18
	The lever is damaged	Change
The heater does not function	No 24V power	Check with a tester and restore the circuit
	The heater motor 37 is shorted	Change the motor
	The fuse is broken	Change the Fuse F22
	The water cock is blocked or damaged	Change
	The air conveying line are clogged or broken	Check and rectify the problem


ELECTRICAL CAB CIRCUIT
THE SYMBOLS
THE GROUND WIRE
COLORS
A ORANGE
B WHITE
C PINK
D GRAY
E GREEN
F BLUE
G YELLOW
H LIGHT BLUE
M BROWN
N BLACK
R RED
V VIOLET

REF	DESCRIPTION	Cod.Cobo
1	SEAT SWITCH	
2	SEAT SWITCH CONNECTOR	
3	MILITARY LIGHTS SELECTOR CONNECTOR	
4	FUSE AND RELAY BOX	0003.0083
5	WINDSCREEN WASHER MOTOR	
6	HEATER FAN SWITCH	0058.0287+0011.0460
7	SYSTEM CONNECTION 31 WAYS CONNECTOR	
8	FORK SIDESHIFT / ROTATE ROCKER SWITCH	0058.0286+0011.0448
9	REAR WINDSCREEN WIPER MOTOR	
10	CAB CEILING LIGHT FIXTURE	
11	CAB FAN MOTOR	
12	REAR CAB WORK LIGHT	
13	FRONT CAB WORK LIGHT	
14	CAB-SYSTEM CONNECTION CONNECTOR	
15	SYSTEM CONNECTION CONNECTOR-EMERGENCY PUSH-BUTTON SWITCH	
16	EMERGENCY PUSH BUTTON SWITCH	0061.0050
17	JOYSTICK CONNECTOR	
18	SYSTEM CONNECTION 8 WAYS CONNECTOR	
19	SYSTEM CONNECTION 18 WAYS CONNECTOR	
20	DIODES-BOX CONNECTOR (FOR HAZARD & TURN SIGNAL CIRCUIT)	
21	SYSTEM POWER UP RELAY	0034.0387
22	3B6 OVERLOAD WARNING DISPLAY CONNECTOR	
23	COLUMN CONNECTION 18 WAYS CIRCULAR CONNECTOR	
24	WORK/ROAD SWITCH	0058.0286+0011.0450
25	COLUMN CONNECTION 31 WAYS CIRCULAR CONNECTOR	
26	FRONT WINDSCREEN WIPER MOTOR	
27	SYSTEM CONNECTION 6 WAYS CONNECTOR-FRONT WINDSCREEN WASHER MOTOR	
28	BRAKE LIGHT PRESSURE SWITCH	0034-0392
29	BACK-UP ALARM	
30	FORK SIDESHIFT / ROTATE SOLENOID VALVE	
31	CABLE REEL CONNECTOR	
32	HEATING FAN MOTOR	
33	HEATING FAN MOTOR CONNECTOR	
34	INSTRUMENT WATER TEMPERATURE SENSOR	L2M02D024
35	MOTOR OIL PRESSURE SENSOR	
36	HYDRAULIC OIL TEMPERATURE SENSOR	
37	BOOM EXTEND MOTION CUT SOLENOID VALVE	
38	BOOM DOWN MOTION CUT SOLENOID VALVE	
39	CONTROL SOLENOID VALVE FORK TILT FUNCTION	
40	T.U.V. NORMS STEERING PRESSURE SOLENOID VALVE	
41	CONTROL SOLENOID VALVE FORK SIDESHIFT / ROTATE FUNCTION	
42	FORWARD GEAR SOLENOID VALVE	
43	REVERSE GEAR SOLENOID VALVE	
44	PARALLEL SOLENOID VALVE	
45	CRAB SOLENOID VALVE	
46	HORN	0054-0009
47	WATER TEMPERATURE WARNING LAMP SENSOR	
48	RIGHT REAR LIGHT CONNECTOR	

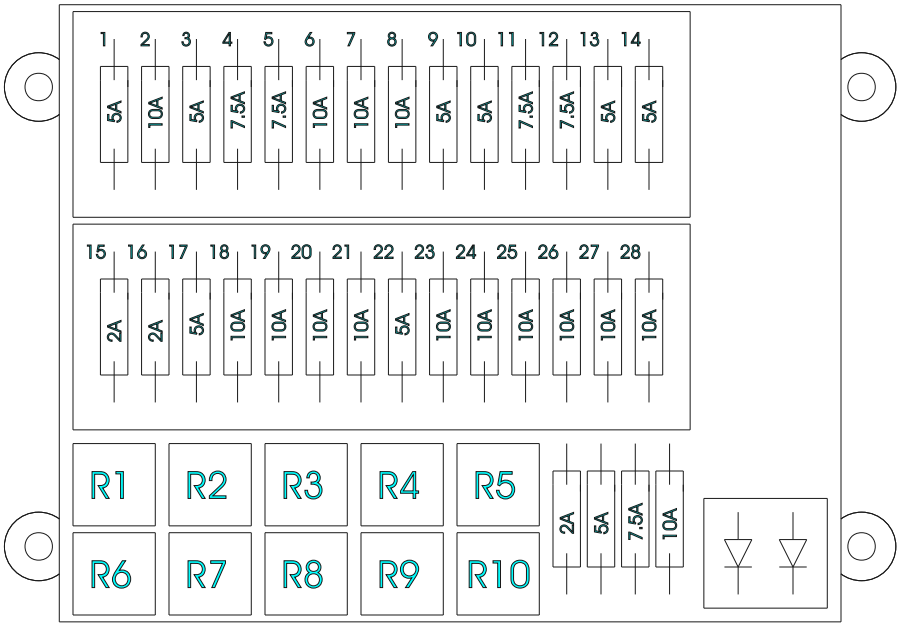
REF	DESCRIPTION	Cod.Cobo
49	REAR RIGHT LIGHT	
50	NOT USED	0001-0065
51	LEFT REAR LIGHT CONNECTOR	
52	REAR LEFT LIGHT	
53	RIGHT MILITARY HEADLIGHT CONNECTOR	
54	RIGHT FRONT MARKER LIGHT AND DIRECTIONAL TURN SIGNAL LAMP	
55	RIGHT HEADLIGHT	
56	LEFT HEADLIGHT	
57	LEFT MILITARY FRONT LIGHT CONNECTOR	
58	LEFT FRONT MARKER LIGHT AND DIRECTIONAL TURN SIGNAL LAMP	
59	MILITARY BLACKOUT LIGHT	
60	ALTERNATOR	
61	STARTER MOTOR	
62	BATTERY 12V	
63	BATTERY DISCONNECT SWITCH	0034-0549
64	START RELAY	0034-0551
65	SYSTEM PROTECTION MAXIFUSE	0014-0041
66	FUEL SOLENOID RESISTOR FOR 12 VOLTS	0034-0789
67	FUEL SOLENOID FUSE	0014-0041
68	GLOW PLUG FUSE	0014-0042
69	GLOW PLUG RESISTOR FOR 12 VOLTS	0034-0789
70	GLOW PLUG	
71	GLOW PLUG RELAY	0034-0387
72	TURN SIGNAL FLASHER	0053-0009
73	INCLINATION LIMIT SWITCH LESS THAN 50°	
74	FUEL SOLENOID (12 VOLTS) ENGINE STOP CONNECTOR	
75	TRANSFORMER 24/12 V	0034-0582
76	24/12 V TRANSFORMER CONNECTOR	
77	PARKING BRAKE CONNECTOR	
78	PARKING BRAKE SENSOR	0034-0679
79	FUEL LEVEL SENDER	
80	WARNING LAMP-HOUR METER SET INSTRUMENT/FUEL GAUGE	L08020004
81	HYDRAULIC OIL TEMPERATURE GAUGE	L06000073
82	ENGINE COOLANT TEMPERATURE GAUGE	0055-0292
83	IGNITION SWITCH	0034-0631
84	DIODES (FOR HAZARD & TURN SIGNAL CIRCUIT)	0058-0209
85	STEERING SELECTOR	
86	RESISTOR 180R-2W FOR STEERING SELECTOR	
87	FRONT LIGHT WORK SWITCH	0058-0286+0011-0458
88	HAZARD LIGHTS SWITCH	0058-0286+0011-0445
89	REAR WORK LIGHT SWITCH	0058-0286+0011-0456
90	FORWARD/REVERSE SPEED SELECTION LEVER	0034-0666
91	TURN SIGNAL/HORN/FRONT WIPER SWITCH	0034-0824

TX51-19M ELECTRICAL CIRCUIT



DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

REALAY AND FUSE UNIT



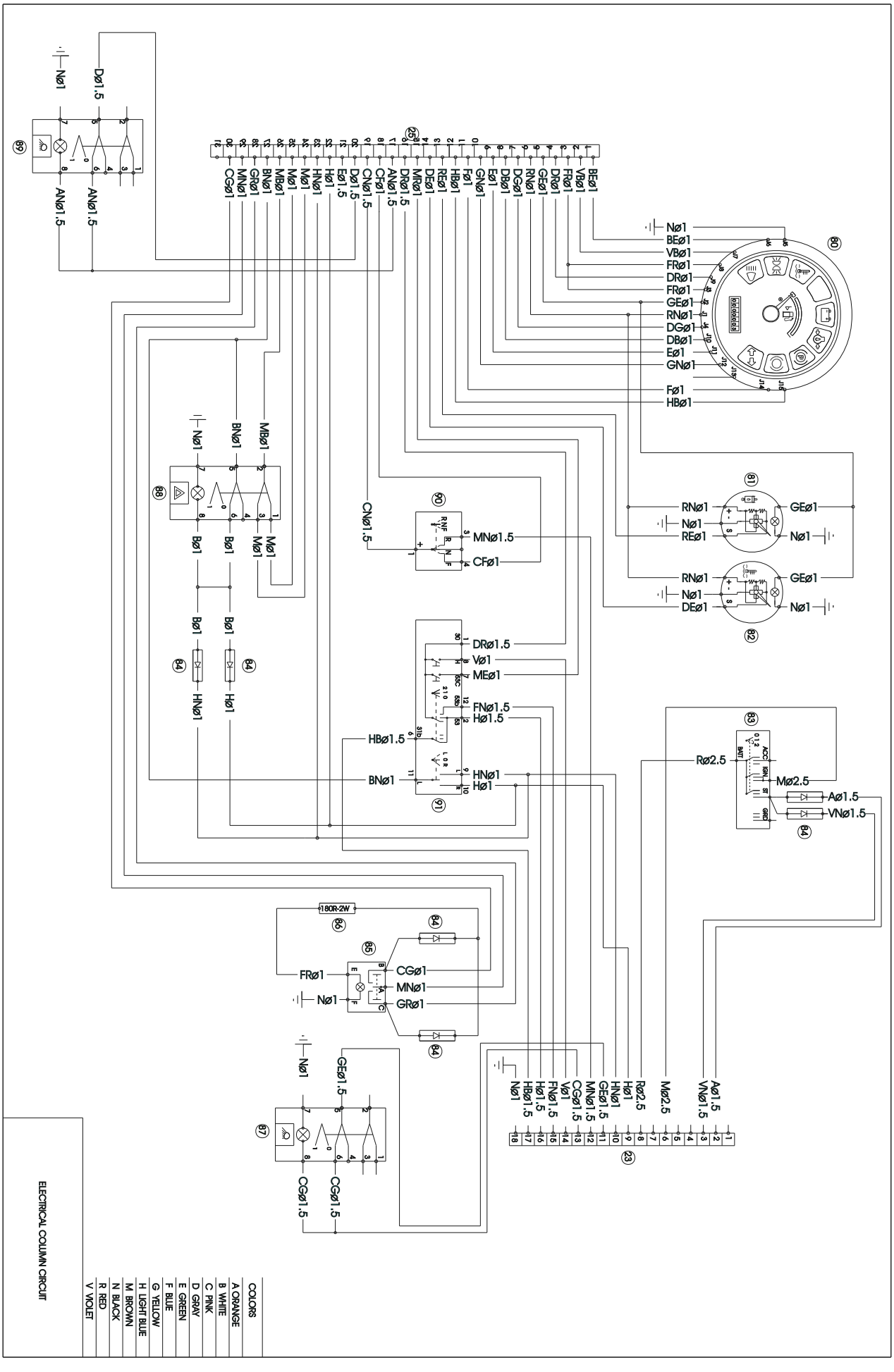
Pos	Utilizer
1	R1 RELAY POWER SUPPLY
2	OPTIONAL
3	HEATING FAN SWITCH LIGHTING , CAB CEILING LIGHT FIXTURE , WARNING LAMPS
	SET INSTRUMENT , HYDRAULIC OIL TEMPERATURE INDICATOR INSTRUMENT , FUEL INDICATOR INSTRUMENT
4	RIGHT FRONT-LEFT REAR DIPPED LIGHT,NUMBERPLATE LIGHT
5	RIGHT REAR-FRONT LEFT DIPPED LIGHT , DIPPED LIGHT WARNING LAMP
6	RIGHT HEADLIGHT , HEADLIGHTS WARNING LAMP
7	LEFT HEADLIGHT
8	HORN
9	WINDSCREEN WASHER MOTOR
10	MARKED STOP LIGHT
11	MARKED MILITARY HEADLIGHT
12	BLACKOUT MARKED LIGHT LEFT-RIGHT/ REAR-FRONT DIPPED LIGHT
13	CAB FRONT WORK LIGHT SWITCH POWER SUPPLY
14	INDICATORS (+15) EMERGENCY SWITCH POWER SUPPLY
15	STOP SWITCH POWER SUPPLY , MILITARY LIGHTS SELECTORS CONNECTOR , R1 R2 R3 RELAY EXCITATION
16	PARKING BRAKE SENSOR POWER SUPPLY , WARNING LAMPS SET INSTRUMENT ,
	HYDRAULIC OIL TEMPERATURE INDICATOR INSTRUMENT , FUEL INDICATOR INSTRUMENT
17	RELAY R7 POWER SUPPLY
18	FRONT WINDSCREEN WASHER MOTOR POWER SUPPLY , HORN-WINDSCREEN WASHER LEVER

Pos	Utilizer
19	MILITARY LIGHTS SELECTOR CONNECTOR POWER SUPPLY
20	ROAD SAFETY SWITCH POWER SUPPLY
21	24v-12v TRANSFORMER POWER SUPPLY
22	HEATING FAN SWITCH POWER SUPPLY
23	R2 , R4 , R5 RELAY POWER SUPPLY
24	ATTACHMENT CLUCTH SWITCH POWER SUPPLY , R10 RELAY, R10 RELAY EXCITATION
25	REAR WINDSCREEN WASHER POWER SUPPLY
26	FAN MOTOR POWER SUPPLY
27	CAB REAR WORK LIGHT SWITCH POWER SUPPLY
28	LEFT-RIGHT BRAKE LIGHT

RELAY UNIT

RELAY R1 :	LMI MAIN BOARD
RELAY R2 :	R3 RELAY POWER SUPPLY ENABLING COMAND
RELAY R3:	FORWARD LEVER POWER SUPPLY ENABLING COMAND
RELAY R4 :	FORWARD GEAR
RELAY R5 :	REVERSE GEAR
RELAY R6 :	PARKING BRAKE
RELAY R7 :	DEAD MAN, ANTI-OVERLOAD
RELAY R8 :	REVERSE GEAR SIREN POWER SUPPLY CONSENT
RELAY R9:	FUSE N° 25 , 26 , 27 POWER SUPPLY CONSENT
RELAY R10:	T.U.V. NORMS

TX51-19M ELECTRICAL CIRCUIT


ELECTRICAL COLUMN CIRCUIT
COLORS
A ORANGE
B WHITE
C PINK
D GRAY
E GREEN
F BLUE
G YELLOW
H LIGHT BLUE
M BROWN
N BLACK
R RED
V VIOLET
180R-2W
Nø1
Dø1.5
ANø1.5
BNø1
MBø1
Mø1
HNø1
Hø1
Eø1.5
Dø1.5
CNø1.5
CFø1
ANø1.5
DRø1.5
MRø1
DEø1
REø1
HBø1
Fø1
GNø1
Eø1
DBø1
DGø1
RNø1
GEø1
DRø1
FRø1
VBø1
BEø1
CGø1
MNø1
GRø1
Bø1
MNø1.5
CFø1
RNø1
GEø1
REø1
DEø1
DRø1.5
Vø1
MEø1
FNø1.5
Hø1.5
HBø1.5
Rø2.5
Mø2.5
Aø1.5
VNø1.5
FRø1
CGø1
MNø1
GRø1
GEø1.5
CGø1.5

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18.0 HYDRAULIC SYSTEM

GENERAL

This section provides troubleshooting, maintenance and service information for the pumps and valves and hydraulic system. A circuit description and hydraulic schematic are included to aid in troubleshooting the system.

18.1 HYDRAULIC DRIVE PUMP REMOVAL / INSTALLTION

REMOVAL

Follow the procedures below for removal of drive pump:

1. Remove the engine hood by opening and holding the hood in raised position. Use adequate lifting device to support the engine hood.
2. Remove the lock nut securing the shock absorbing gas springs by using two 13 mm wrenches.
3. Remove the four screws with lock nut and flat washer that secure the hood.
4. Remove the hood.
5. Place container of suitable size under the drive pump.
6. Using a 32 mm wrench disconnect the draining hoses.
7. Using an 18 mm wrench, disconnect the hydraulic supply hoses.
8. Using an 8 mm wrench, disconnect the two pressure hoses.
9. Close the oil tank valves.
10. Carefully clean the area around the piping prior to disconnecting the hoses.
11. Disconnect the intake hose with a 48 mm wrench.
12. Remove the two bolts locking the pump with a 14 mm wrench.
13. Use and adequate lifting device to support and pull the drive pump toward rear of machine.
14. Remove the drive pump from frame.

INSTALLATION

1. Using adequate lifting device support and install drive pump into the machine.
2. Using 14 mm wrench install the two bolts locking the pump in place.
3. Open the oil tank valves.
4. Using an 8 mm wrench, connect the two pressure hoses.
5. Use an 18 mm wrench and connect the hydraulic supply hoses.
6. Using a 32 mm wrench connect the draining hoses.
7. Fill the drive pump with the correct fluid.
8. Reinstall the engine hood.

18.2 CYLINDER HOLDING VALVE

REMOVAL

Follow the procedures below for removal of holding valve:

1. Position the machine on hard level surface.
2. Place a container of suitable size under the valve.
3. Prior to replacing any holding valves, make sure to relieve pressure from valves.
4. Use adequate lifting device to support the component.
5. Tag and disconnect hydraulic lines, releasing any residual pressure. Install covers and plugs on the lines and ports to prevent the entry of dust and contaminants.
6. Slowly remove the bolts securing the valve to the cylinder and bleed the cylinder.

INSTALLATION

1. Before reinstalling a holding valve special care must be taken to ensure all surfaces are clean.
2. Install new o-ring. You should never use old o-ring. O-ring must be replace with new o-rings.
3. Install holding valve and hand tighten the securing bolts.
4. Tighten the bolts in a cross tightening pattern.
5. Connect the hydraulic hoses in the correct locations.
6. Start machine and check for leaks.

18.2 HYDRAULIC MOTOR

REMOVAL

Follow the procedures below for removal of hydraulic motor:

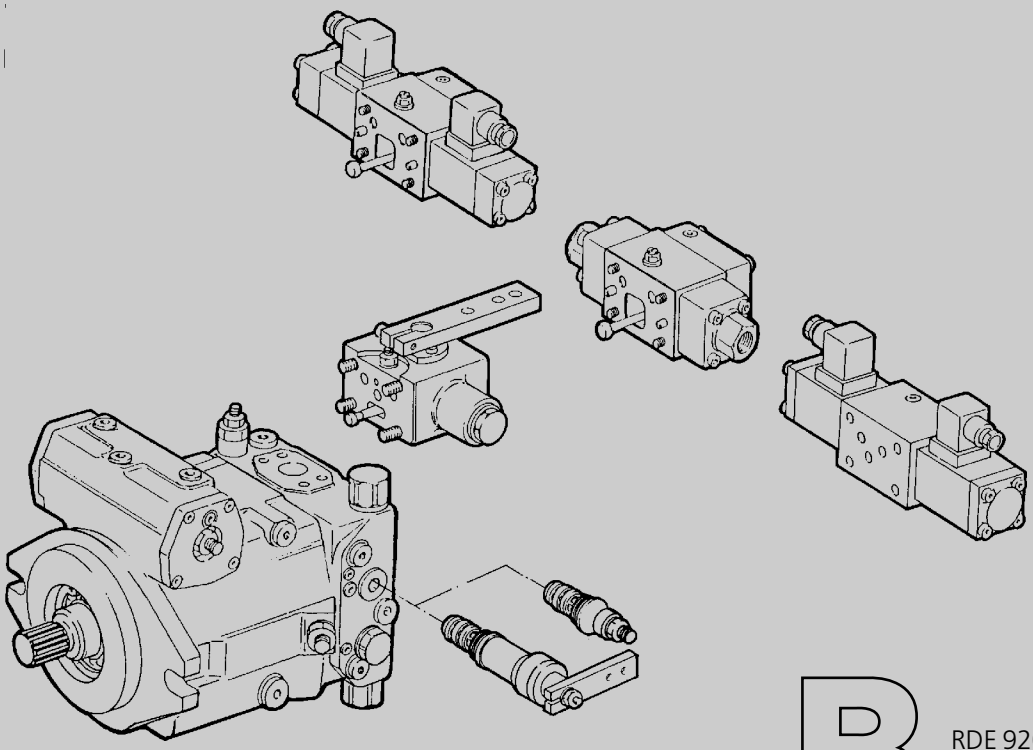
1. Position the machine on hard level surface.
2. Remove the bottom protections cover and disconnect the drive shaft.
3. Disconnect the draining hose with a 32 mm wrench.
4. Using a 18 mm wrench disconnect the displacement change feeding hose.
5. Disconnect the two delivery hoses with an 8 mm wrench.
6. Remove the four locking screws of the motor with a 24 mm wrench.
7. Pull out the motor from the power divider secured to the front axle.
8. Protect the motor connecting compartment in a suitable way to prevent the entrance of impurities.

INSTALLATION

Follow the procedures below to installation the hydraulic motor:

1. Install the four locking screws of the motor.
2. Connect the two delivery hoses using an 8 mm wrench.
3. Connect the displacement change feeding hose.
4. Connect the draining hoses.
5. Install the bottom protection cover and connect the drive shaft.
6. Check for leaks.

engineering
mannesmann
Rexroth



R

RDE 92003-01-R/05.99
ersetzt / replaces
RDE 92003-01-R/07.96

Reparaturanleitung
Repair instructions

A4VG 40 - 56 Baureihe 32

A4VG 40 - 56 Series 32

Brueninghaus
Hydromatik

HINWEIS

Bezeichnungen, Beschreibungen und Darstellungen entsprechen dem Informationsstand zum Zeitpunkt der Drucklegung dieser Unterlage.
Änderungen können den Service am Produkt beeinflussen, Verpflichtungen entstehen uns daraus nicht.
Methoden und Vorrichtungen sind Empfehlungen, für deren Resultat wir keine Haftung übernehmen können.
BRUENINGHAUS HYDROMATIK- Baugruppen, mit Angabe der Fabrik-Nr. bestellt, sind die Basis guter Reparaturen.
Einstell- und Prüfarbeiten sind bei Betriebstemperatur auf dem Teststand vorzunehmen.
Schutz von Personen und Eigentum ist durch Vorkehrungen sicherzustellen.
Sachkenntnis, die Voraussetzung für jede Service-arbeit, vermitteln wir in unseren Schulungskursen.

NOTICE

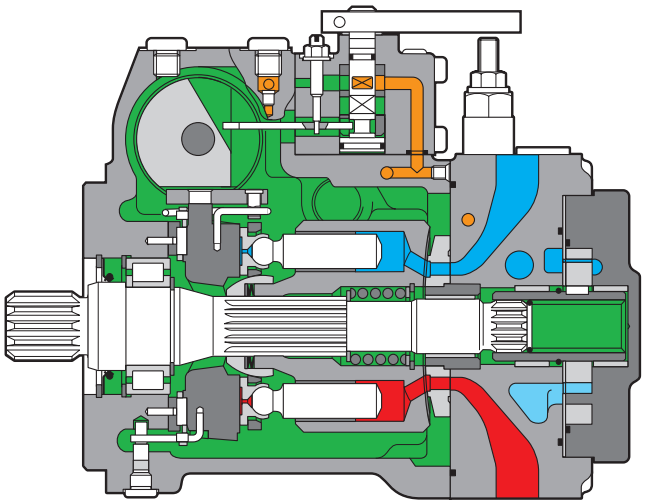
Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing.
BRUENINGHAUS HYDROMATIK reserves the right to discontinue models or options at any time or to change speci-fications, materials, or design without notice and with-out incurring obligation.
Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options.
For the available combinations refer to the relevant data sheet for the basic unit and the desired option.
Adjustment and tests have to be carried out on the test bench under operating temperatures.
Protection of personnel and property has to be guaranteed by appropriate measures.
Expert knowledge, the precondition of any service work, can be obtained in our training courses.

INHALT

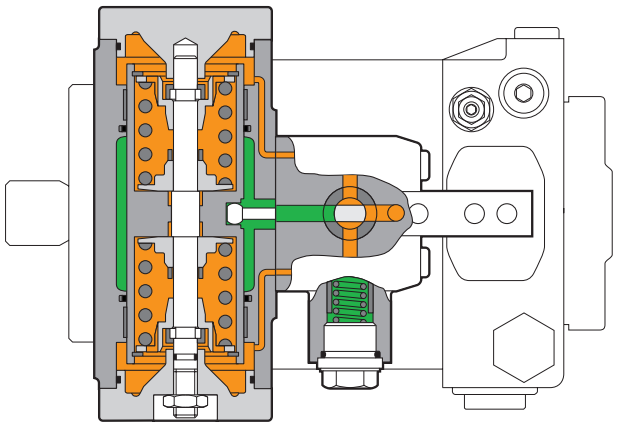
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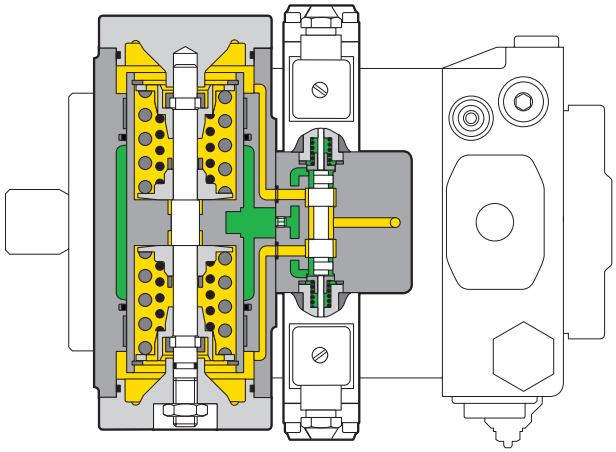
A4VG	
Sectional view	
Turcon-Glyd-ring seal	
General repair instructions	
Seal kits and sub assembly groups	
Sealing of the drive shaft	
Sealing of the boost pump	
Sealing of the control piston cover	
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Inspection notes	
Inspection of the rotary group parts	
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Tightening torques	
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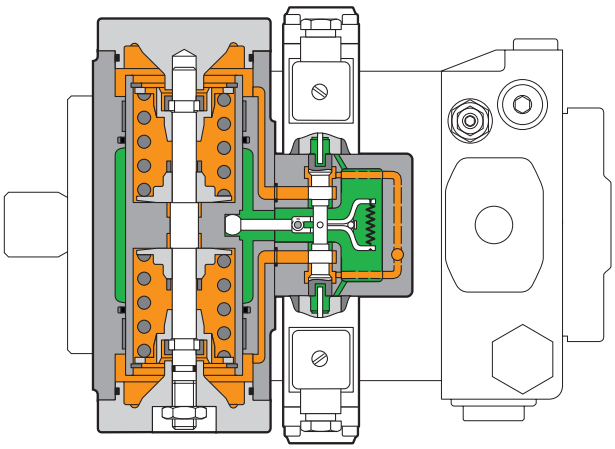
HWD



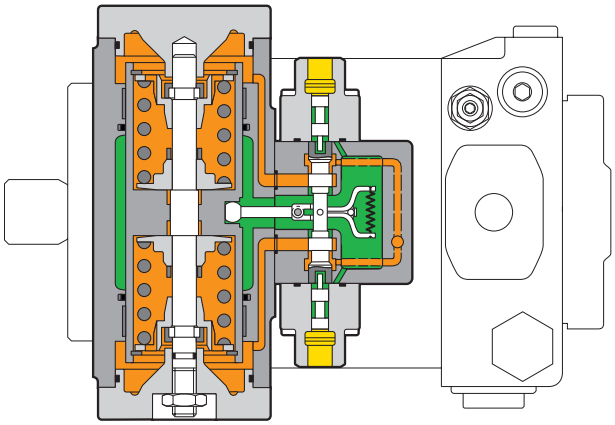
DAD



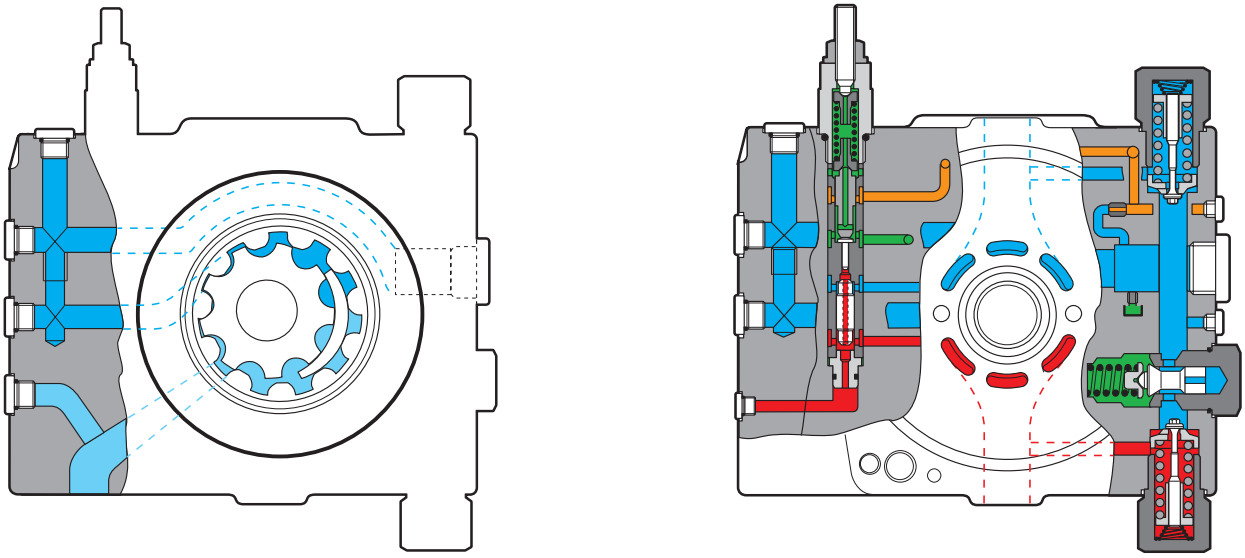
EPD



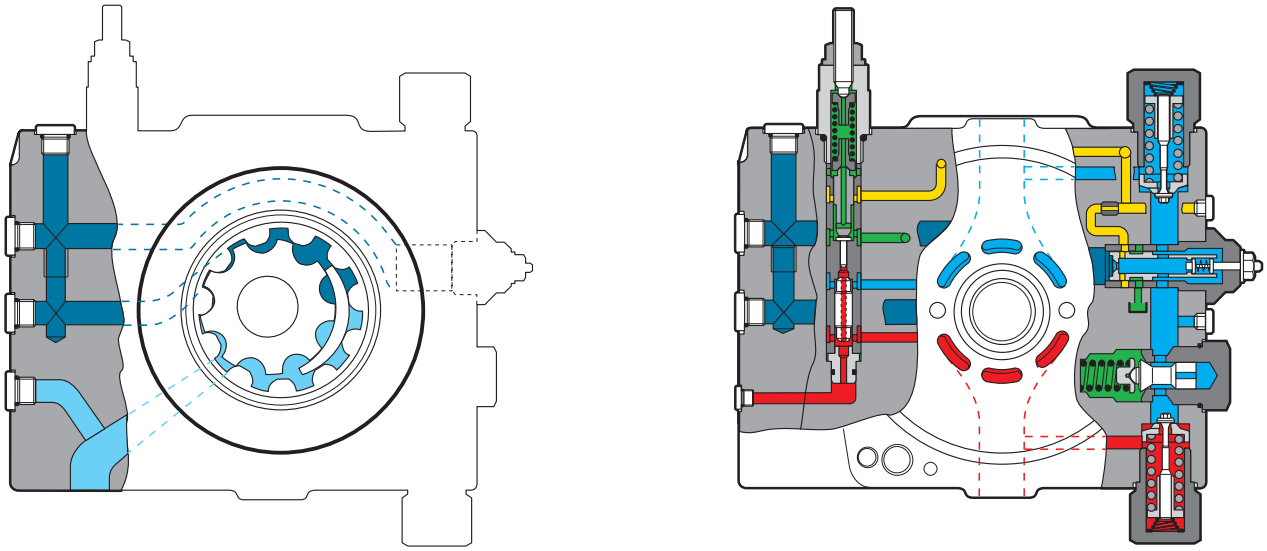
HDD

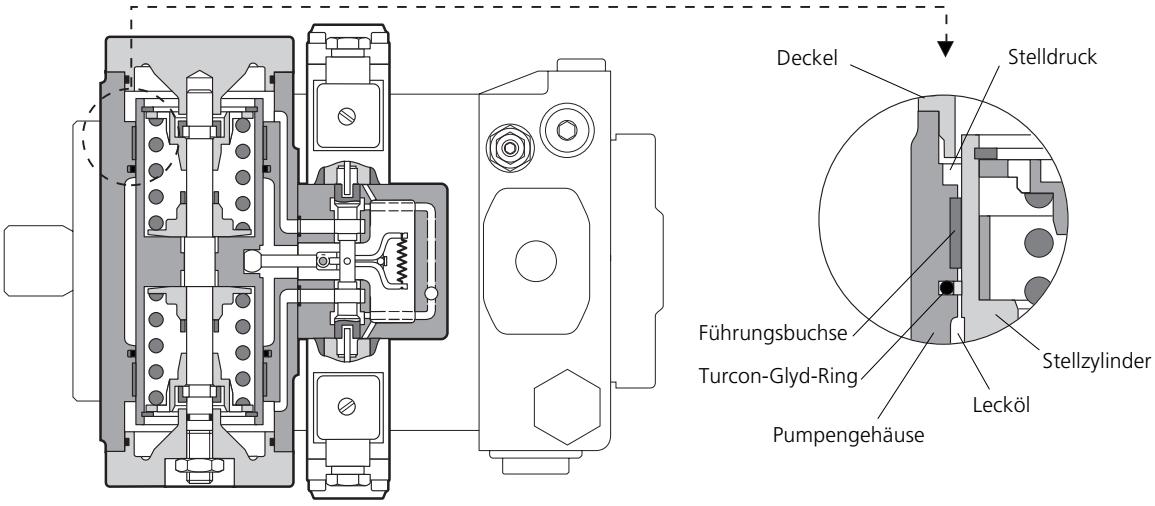


HWD / EPD / HDD



DAD





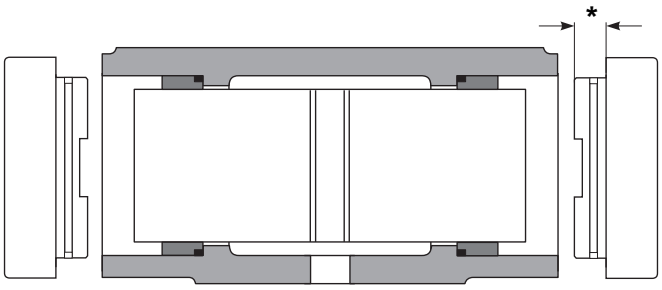
Bei den Verstellpumpen A4VG erfolgt zur Zeit die Umstellung der Verstellung auf Turcon-Dichtungen.
Die Stückliste der kompletten Einheit erhält dabei eine neue Ident.- Nummer.
Typenschlüssel, Typnummer und Außenabmeßungen bleiben dabei unverändert. (Pumpengehäuse ändert sich nur im Bereich vom Stellkolben. Stellkolben ändert sich in eine angefaste Ausführung).

⚠ Alten Stellkolben nicht bei Turcon-Dichtung verwenden (scharfkantig - Dichtungen werden beschädigt).

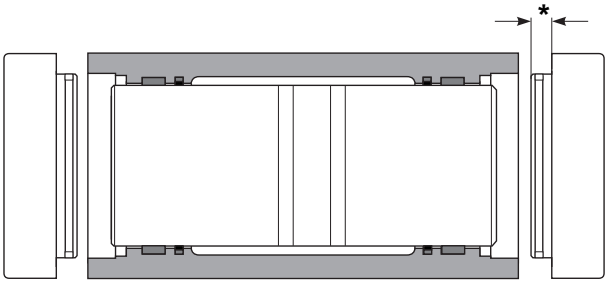
At present the change of the control into Turcon seal is made for A4VG.
The parts list of the complete unit will receive a new identification number.
Type reference and outside dimensions remain unchanged (pump housing will change at the area of the positioning piston. Positioning piston will change into chamfering design).

⚠ Do not use old positioning piston with Turcon seal (sharp edged - seal will be damaged)

Pumpengehäuse / Pump housing
mit Lagerbuchse / with bush **ALT / OLD**



Pumpengehäuse / Pump housing
mit Turcon-Dichtung / with Turcon seal **NEU / NEW**



⚠ Die Umstellung der Verstellung auf Turcon-Dichtung ist im allgemeinen mit einer Funktionsverbesserung verbunden (DA-Verhalten, geringerer Temperatureinfluß auf Stellzeiten).

⚠ Bei gleicher Düsenbestückung können sich die Stellzeiten geringfügig verändern.

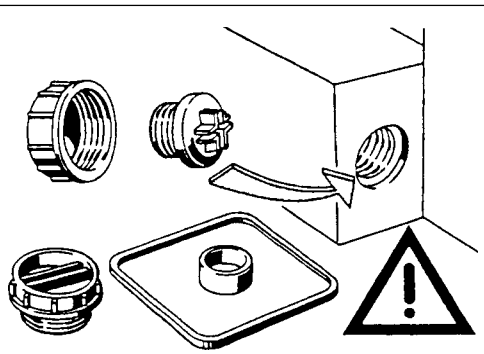
⚠ The change of the control into Turcon seal design improves in general the function (DA-behaviour, lower temperature-influence on control times).

⚠ The control times will slightly change with the same throttle sections. Therefore our customers have to be informed about this change.



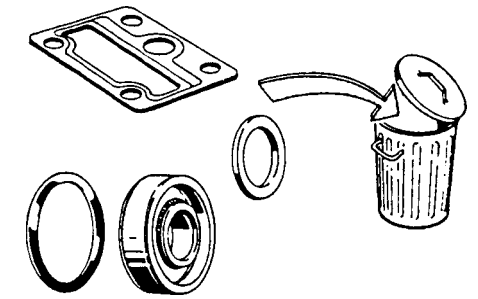
Achtung!
Nachfolgend Hinweise bei allen Reparaturarbeiten an Hydraulikaggregaten beachten!

Attention!
Observe the following notices when carrying out repair work at hydraulic aggregates!



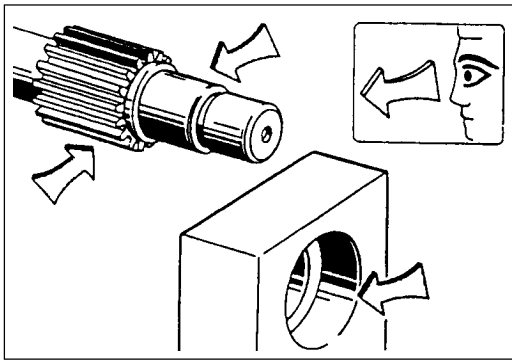
Alle Öffnungen der Hydraulikaggregate verschließen.

Close all ports of the hydraulic aggregates.



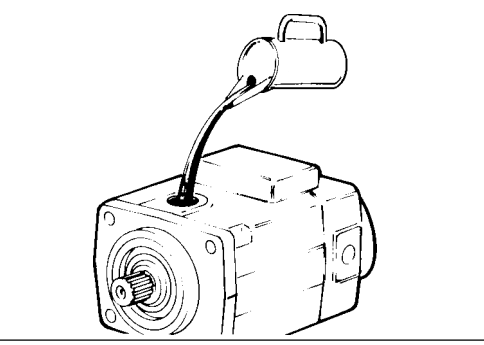
Alle Dichtungen erneuern.
Nur original BRUENINGHAUS HYDROMATIK-Ersatzteile verwenden.

Replace all seals.
Use only original BRUENINGHAUS HYDROMATIK spare parts.



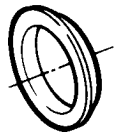
Alle Dicht- und Gleitflächen auf Verschleiß prüfen.
Achtung: Nacharbeiten an Dichtflächen z.B. durch Schleifpapier kann die Oberfläche beschädigen.

Check all seal and sliding surfaces for wear.
Attention: Rework of sealing area f. ex. with abrasive paper can damage surface.



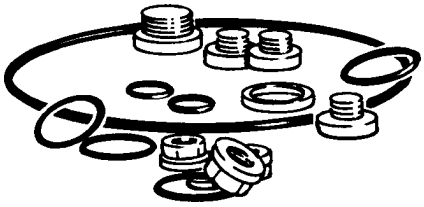
Hydraulikaggregate vor Inbetriebnahme mit Betriebsmedium befüllen.

Fill up hydraulic aggregates with medium before start- up.



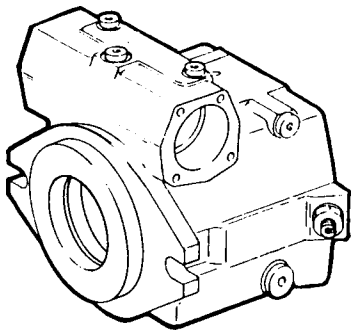
1 Dichtsatz für Triebwelle.

Seal kit for drive shaft.



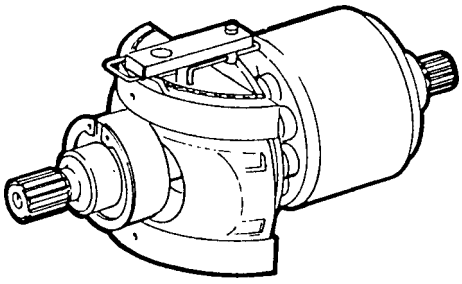
2 Äußerer Dichtsatz.

External seal kit.



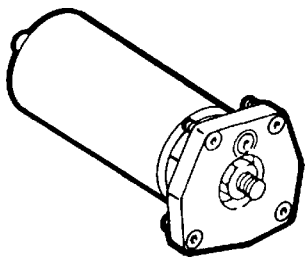
3 Gehäuse

Housing



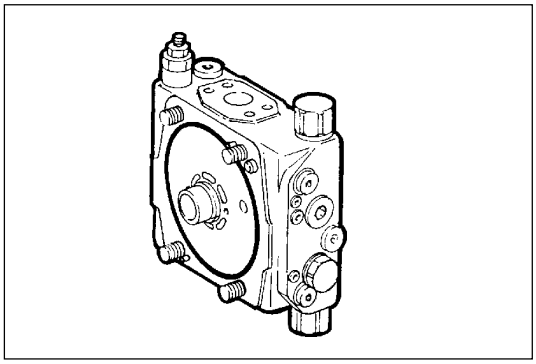
4 Triebwerk komplett.

Complete rotary group.



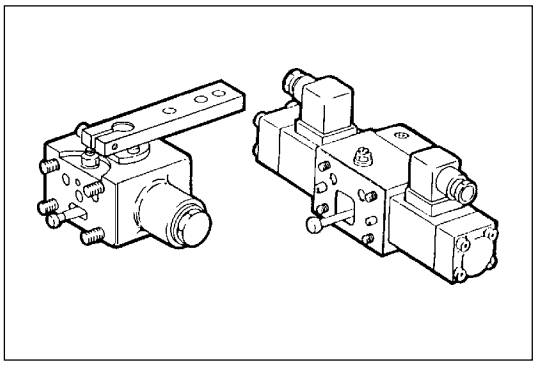
5 Stellkolben

Positioning piston



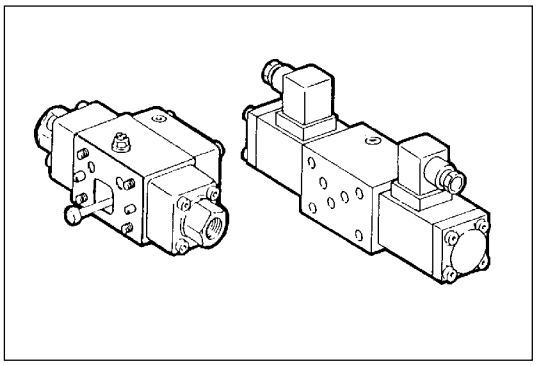
6 Anschlußplatte

Port block



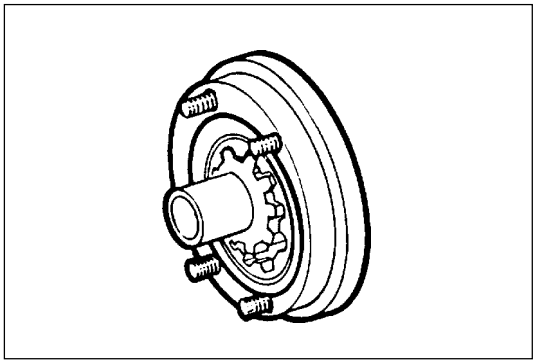
7 Ansteuergeräte **HW - EP**

Control moduls **HW - EP**



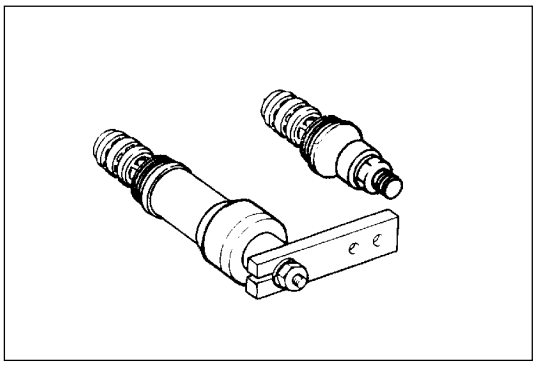
8 Ansteuergeräte **HD - DA**

Control moduls **HD - DA**



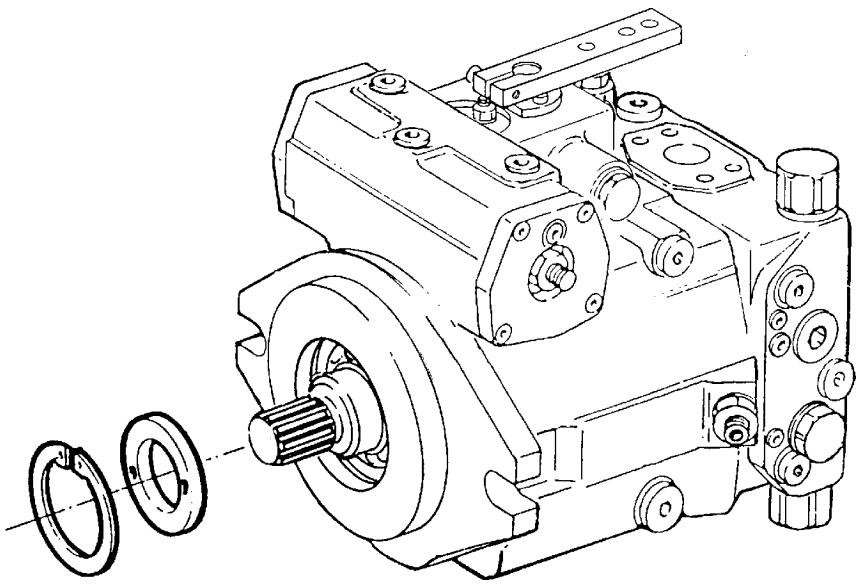
9 Hilfspumpe

Boost pump

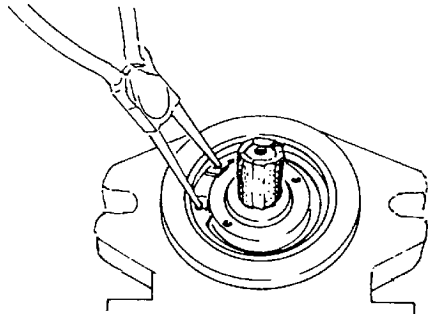


10 Regelventil

Control valve

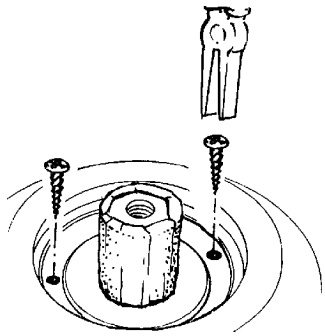


11



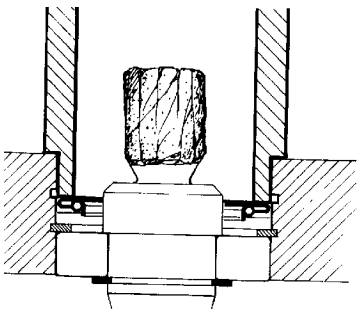
12 Triebwelle abkleben.
Sicherungsring ausbauen.

Protecting the drive shaft.
Remove retaining ring.



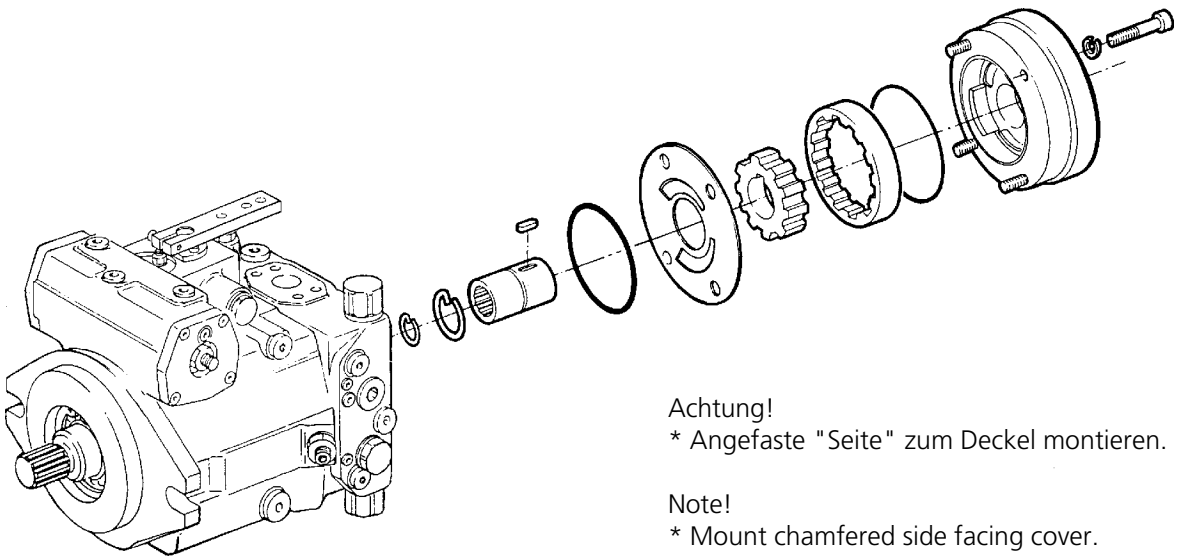
13 Blechschraube in die mit Gummi gefüllten Löcher eindrehen.
Mit Zange WDR herausziehen.

Screw in sheet metal screw into the holes fitted with rubber.
Pull out shaft seal with pliers.



14 Wellendichtring mit Buchse auf Anschlag einpressen.

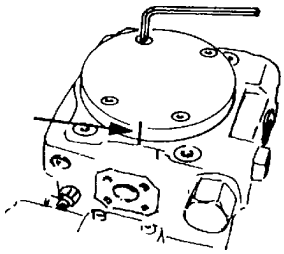
Press-in shaft seal with bush to stop.



Achtung!
* Angefaste "Seite" zum Deckel montieren.

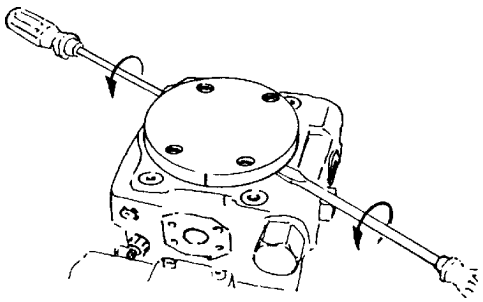
Note!
* Mount chamfered side facing cover.

15



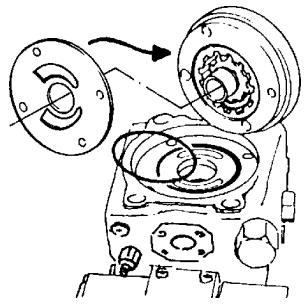
16 Lage kennzeichnen,
Befestigungsschrauben ausbauen.

Mark position,
remove fixing screws.



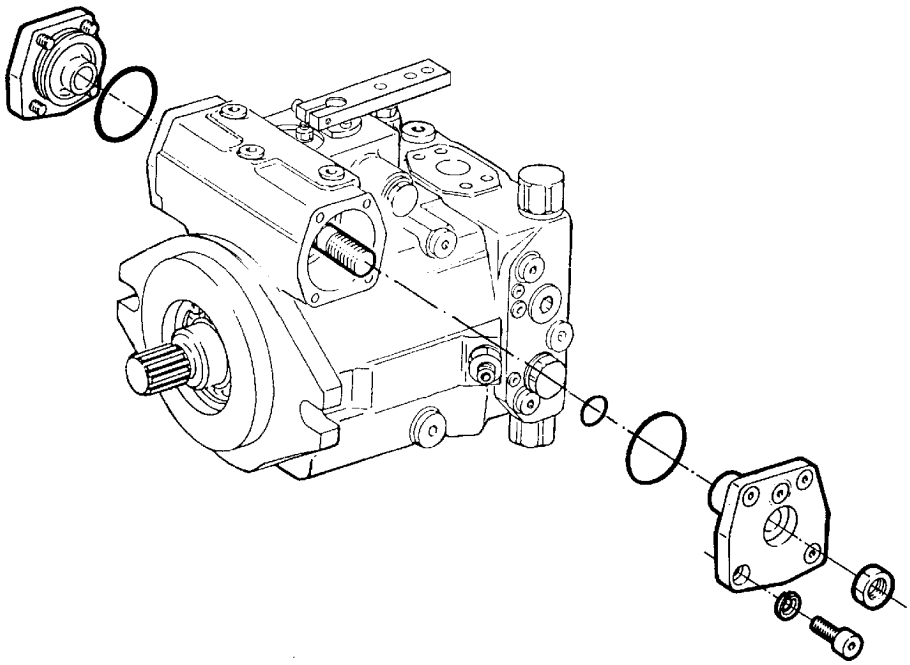
17 Deckel abdrücken.

Pry-off cover.

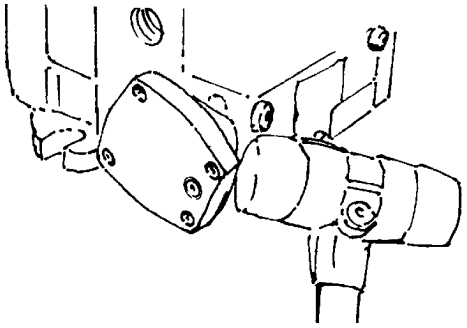


18 Teile der Hilfspumpe auf Verschleiß untersuchen.
Pumpe kann nur komplett ausgetauscht werden.

Inspect the parts of the boost pump and wear parts.
Boost pump can only be interchanged completely.

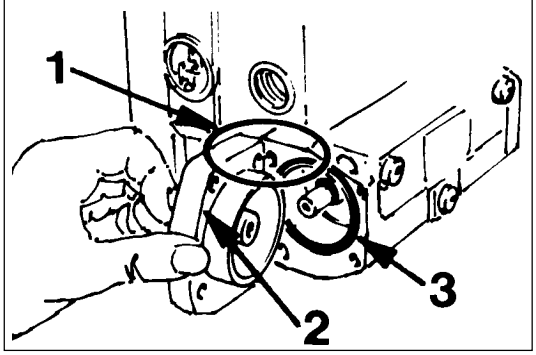


19



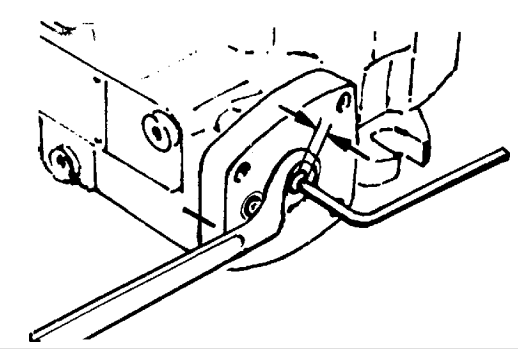
20 Befestigungsschrauben lösen.
Deckel verdrehen und mit leichten Hammerschlägen lösen.

Loosen mounting screws.
Rotate cover and release by tapping gently with hammer.



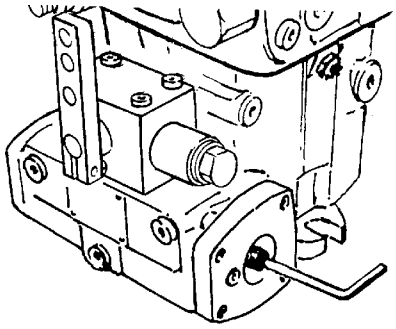
21 Kontrolle!
O-Ring (1), Nut (2), Gehäuse (3).

Check!
O-ring (1), groove (2), housing (3).



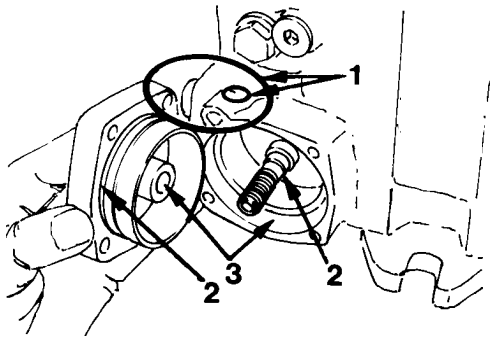
22 Kontermutter ausbauen, Stellschraube gegenhalten.
Deckel kennzeichnen. Maß festhalten, Kontermutter lösen.

Remove locknut whilst holding setting screw.
Mark cover. Must be fixed, loosen counter nut.



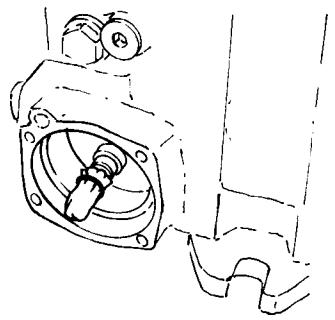
23 Über 0-Lagen-Einstellschraube Deckel abdrücken und drehen.

Pull cover off using zero position adjustment screw.



24 Kontrolle!
O-Ring (1), Nut (2), Gehäuse (3).

Check!
O-ring (19, groove (2), housing (3).



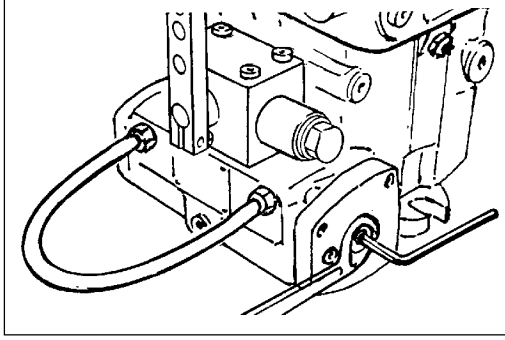
25 Gewinde abdecken, kleinen O-Ring aufschieben.
Montage in umgekehrter Reihenfolge.

Cover threads, push on small O-ring.
Assemble in reversed order.



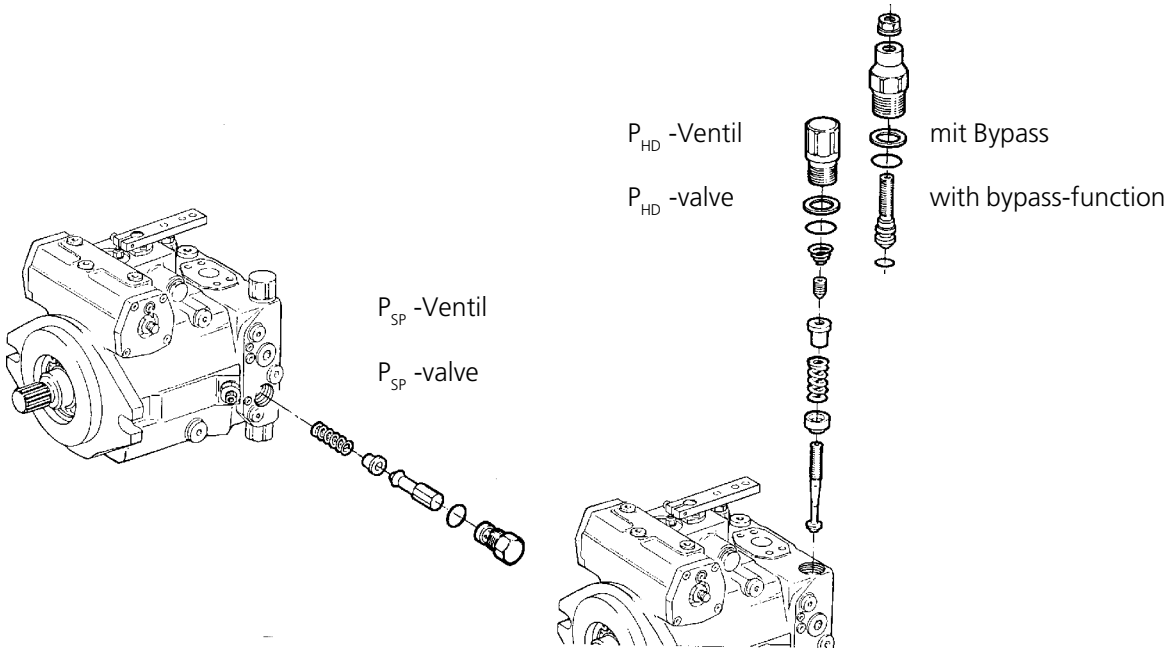
26 Achtung!
Korrekte mechanische Nullageneinstellung muß nach Einbau im Gerät bzw. Prüfstand erfolgen.

Attention!
Adjustment of the correct zero position to be carried out after installation into the machine or on the test bench.

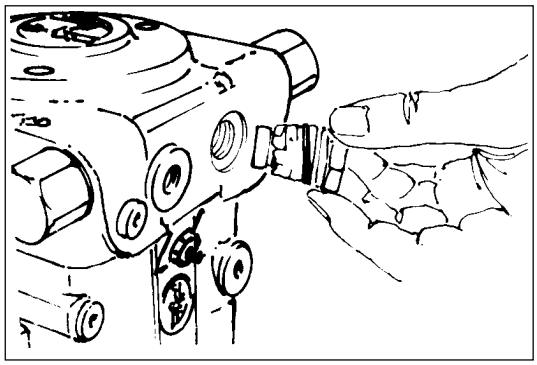


27 Mechanische Nullage neu einstellen, dazu X_1 mit X_2 verbinden (>NW6).

Reset mechanical zero position. To do this, connect X_1 to X_2 (size > 6).

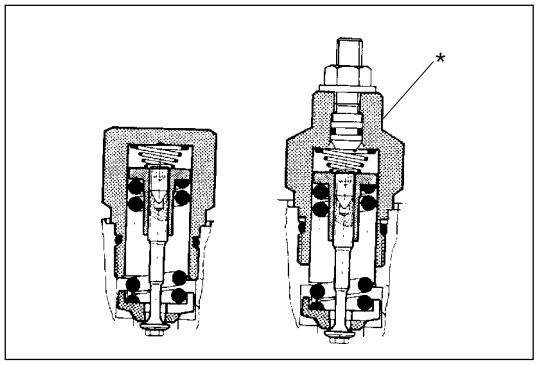


28



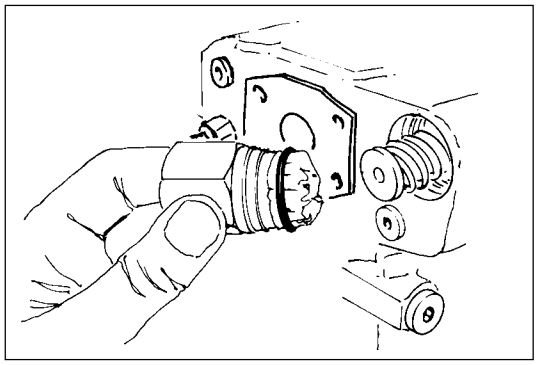
29 Gewinde vor Montage des neuen O-Ringes abkleben.
(Beschädigungsschutz).

Cover threads before fitting new O-rings.
(Damage protection).



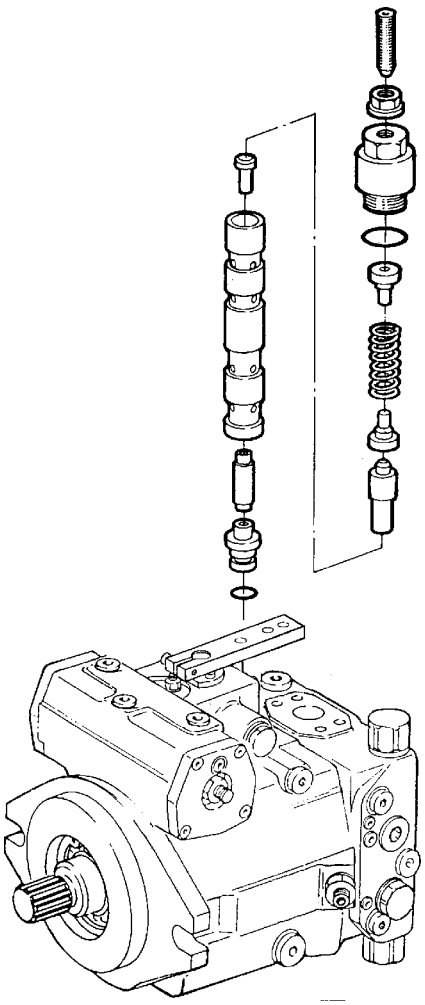
30 Ventilkegel mit Druckfeder ausbauen.
* mit Bypassfunktion

Remove valve poppet with spring.
* with bypass-function

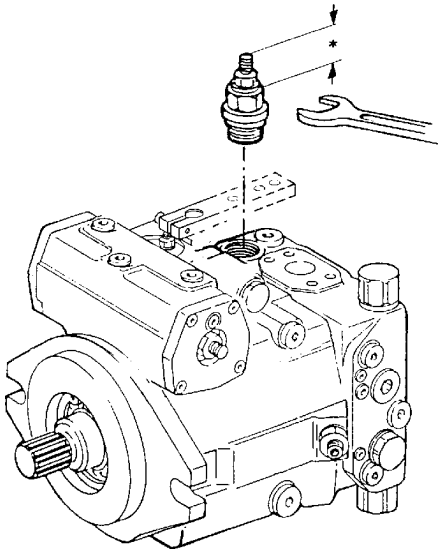


31 Gewinde vor Montage des neuen O-Ringes abkleben.
(Beschädigungsschutz).

Cover threads before fitting new O-rings.
(Damage protection).



31

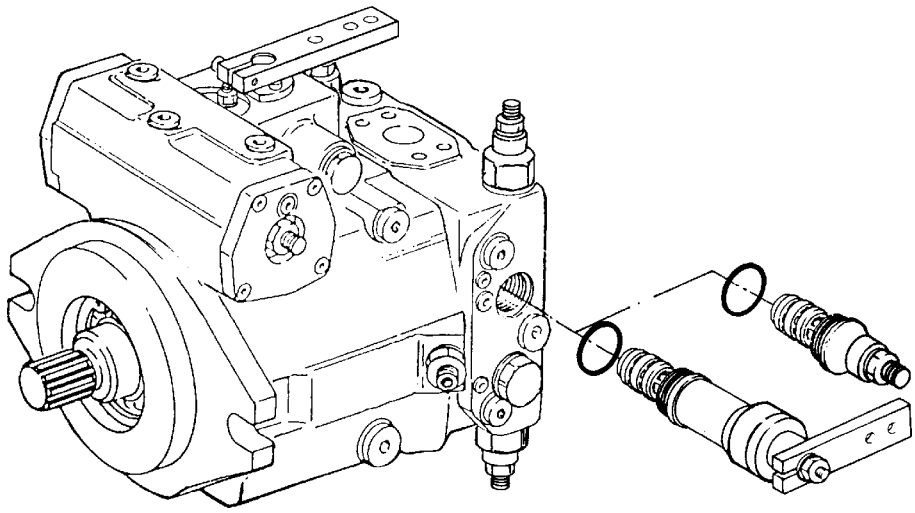


33 Wechsel der Dichtmutter.
Einstellmaß festhalten (*).

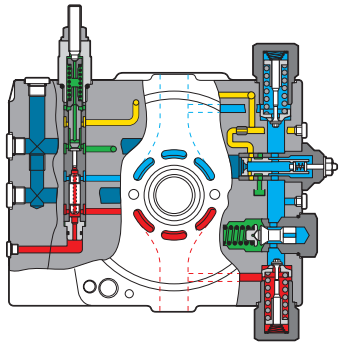
Change of the sealing nut.
Note setting measure (*).

Achtung!
Nach Einbau "Ventileinstellung" überprüfen.

Attention!
After assembly check "valve setting".

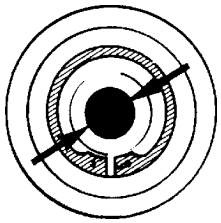


34



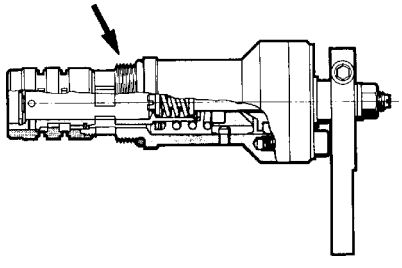
35 Regelventil ausbauen.

Remove control valve.



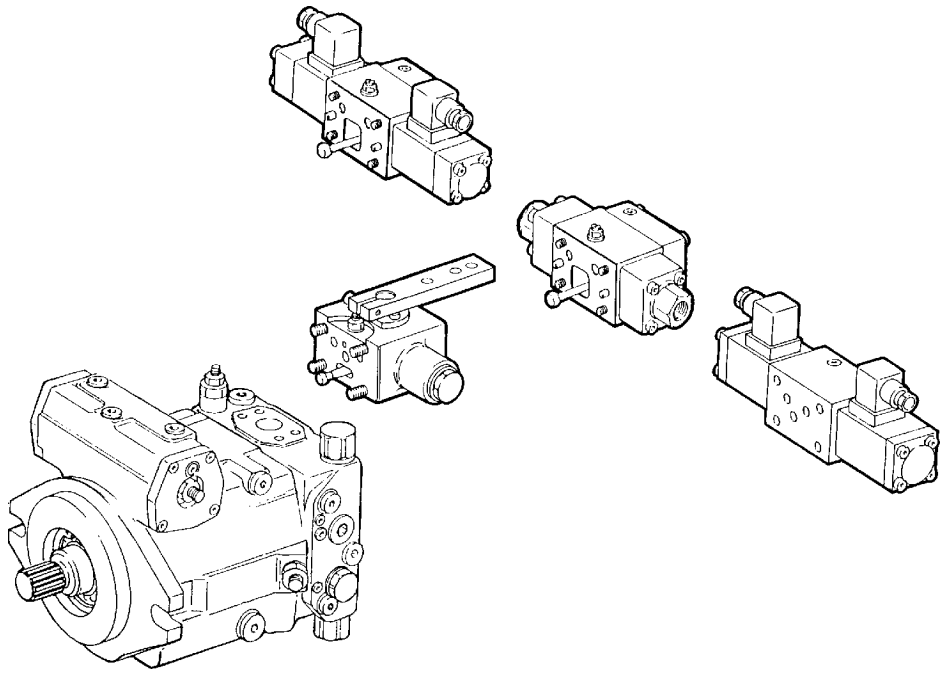
36 Blendendurchmesser nicht beschädigen.

Do not damage throttle diameter.

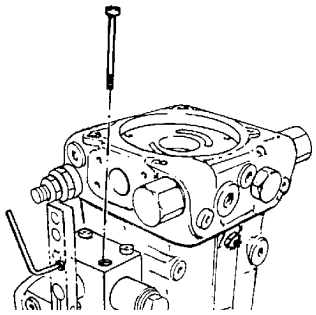


37 Gewinde vor Montage des neuen O-Ringes abkleben.

Before installing the new O-ring, tape the threads.

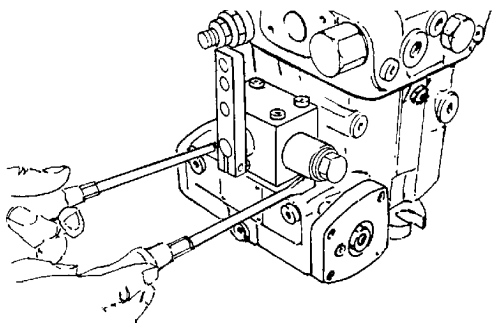


38



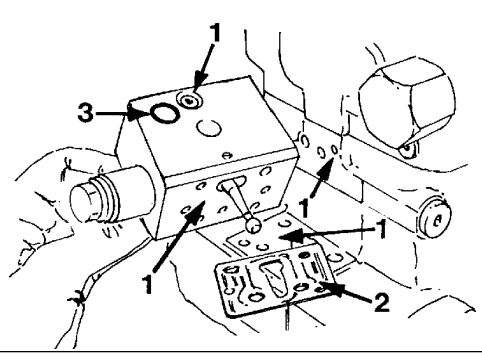
39 Befestigungsschrauben demontieren.

Remove fixing screws.



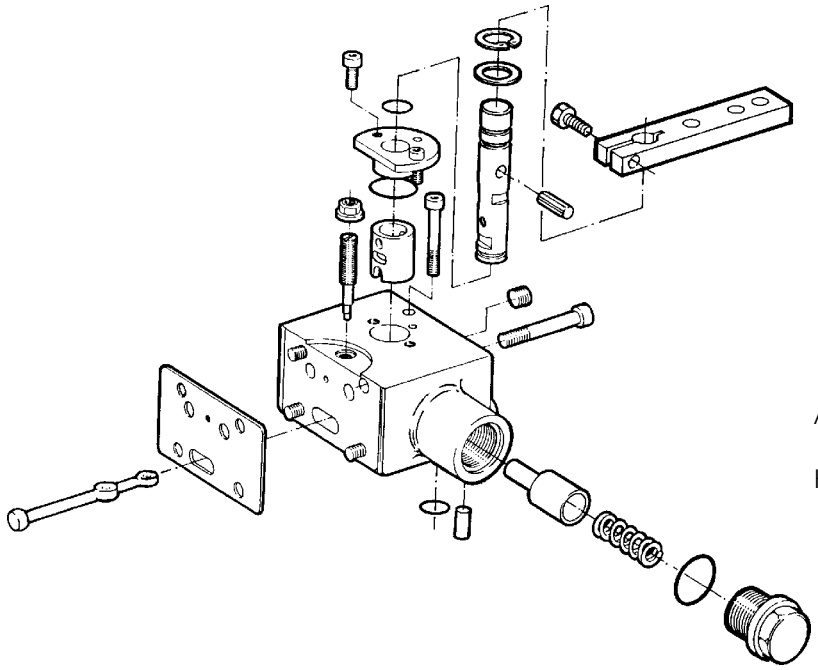
40 Ansteuergerät abdrücken.

Pry-off the control module.



41 Kontrolle
Dichtfläche (1), Flachdichtung (2), O-Ringe (3).

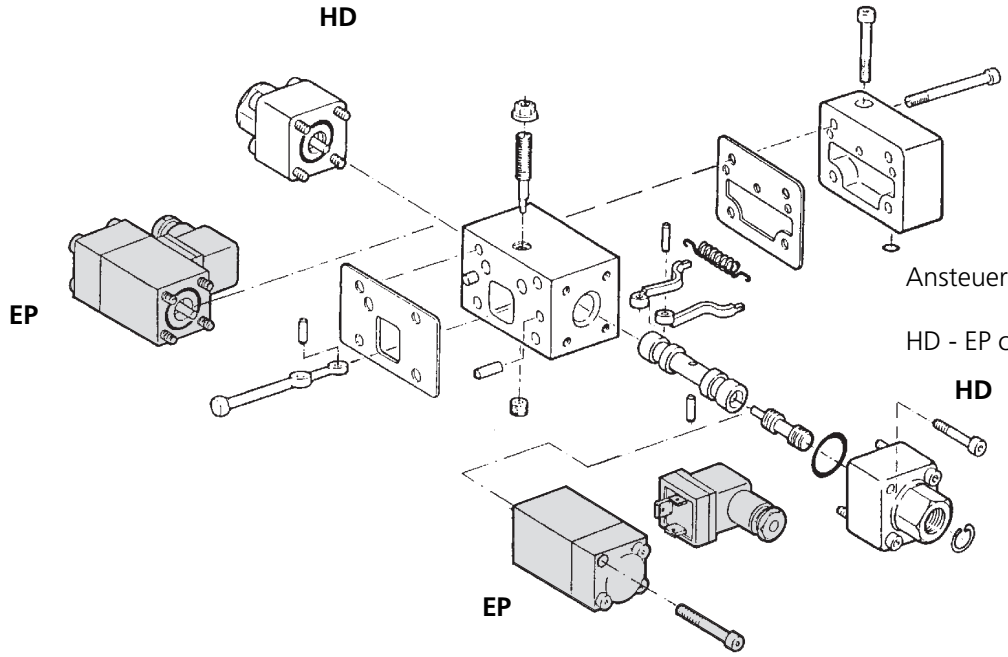
Check
Sealing surface (1), gasket (2), o-rings (3).



Ansteuergerät HW

HW control module

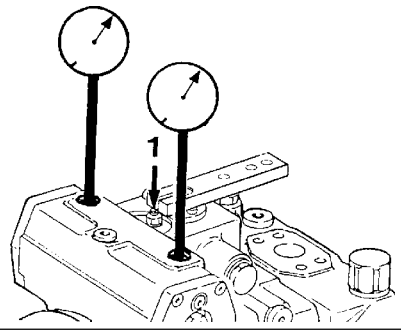
42



Ansteuergerät HD - EP

HD - EP control module

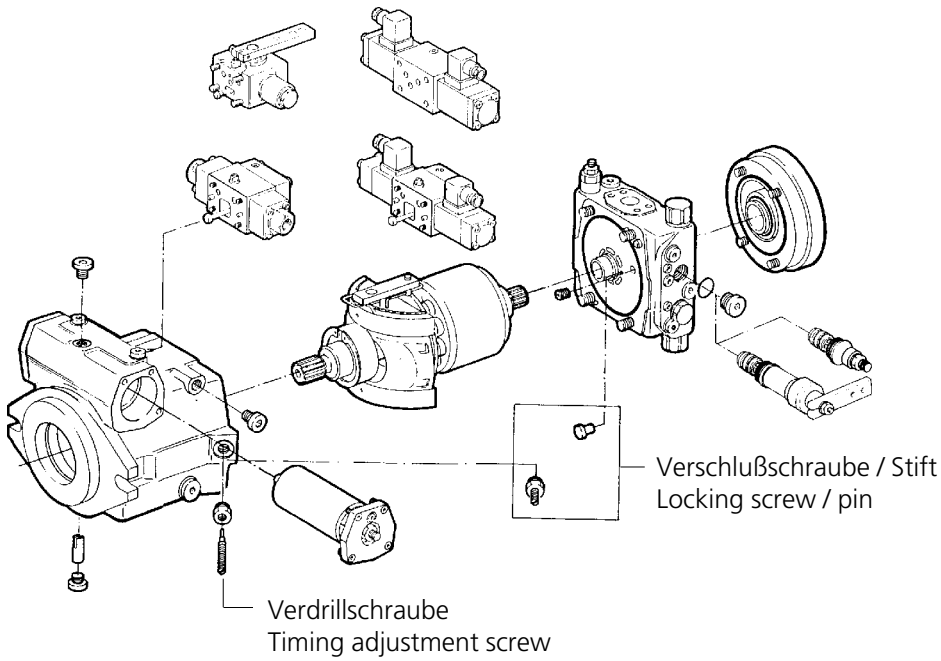
43



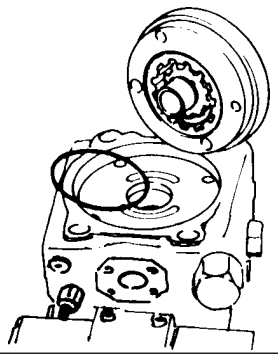
44

Hydraulische Nullage (1) neu einstellen. Beide Manometer müssen gleichen Druckwert anzeigen.

Reset hydraulic zero position (1).
Both gauges must indicate the same pressure.

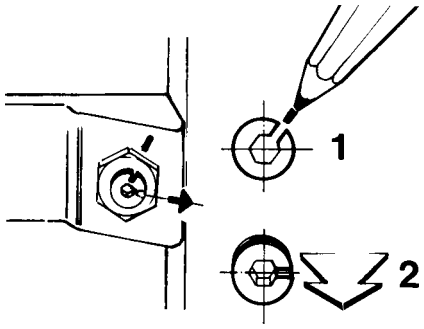


45



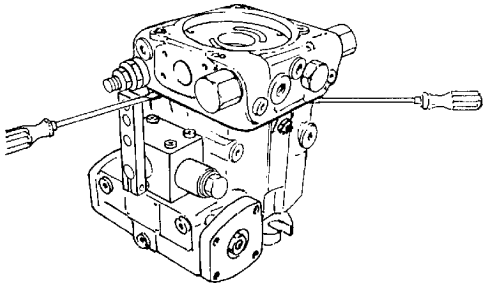
46 Lage der Hilfspumpe und Anschlußplatte markieren.
Hilfspumpe abbauen.

Mark position of the boost pump and the port plate.
Remove the boost pump.



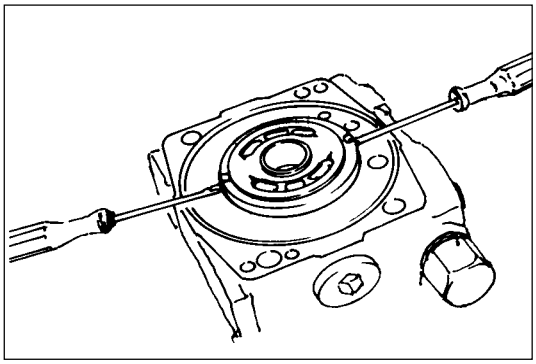
47 Lage der Verdrillschraube markieren (1).
Verdrillschraube auf Demontageposition stellen (2).

Mark the position of the indexing screw (1).
Set the indexing screw to disassembly position (2).



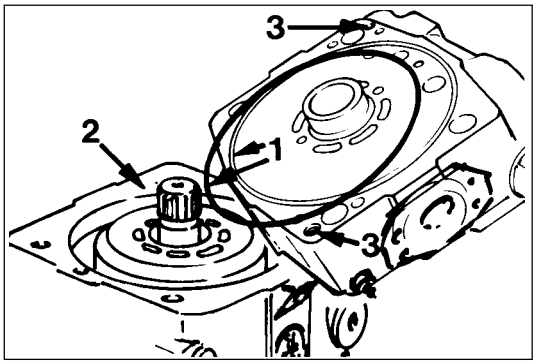
48 Anschlußplattenbefestigung lösen. Anschlußplatte abheben.
Achtung! Dichtfläche.

Release port plate fitting.
Take off port plate. If necessary, use screwdriver.
Attention! Sealing surface.



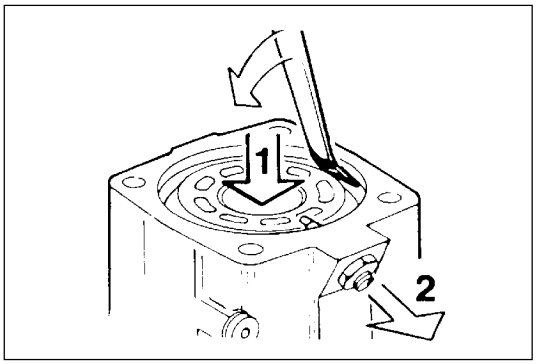
49 Steuerplatte abdrücken.
Lage notieren.

Lift off control plate.
Note position.



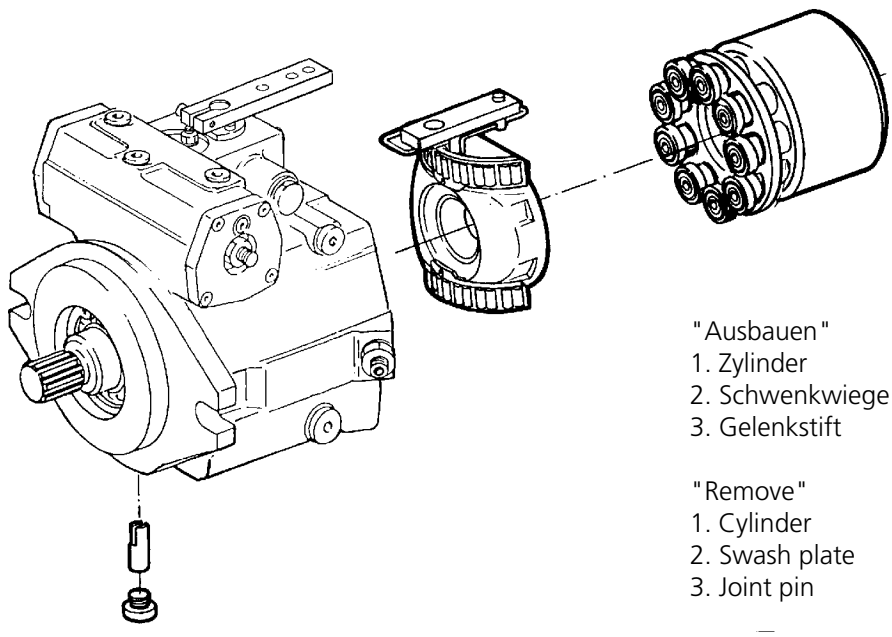
50 Kontrolle!
O-Ring mit Nut (1), Gehäuse (2), Quad-Ring und Quad-Ring Nut (3).

Check!
O-ring and groove (1), housing (2), Quad-ring and groove (3).



51 Zylinder nach unten drücken (1).
Verdrillschraube herausdrehen (2).
Triebwerk ausheben (3).

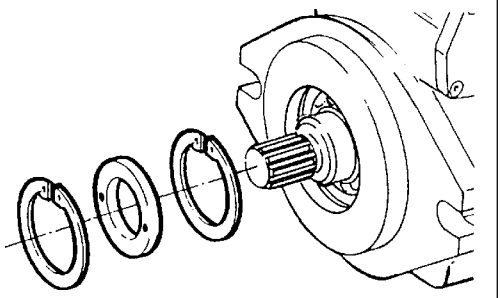
Press the cylinder to the bottom (1).
Remove fiming indexing screw (2).
Lift out rotary group (3).



"Ausbauen"
1. Zylinder
2. Schwenkwiege
3. Gelenkstift

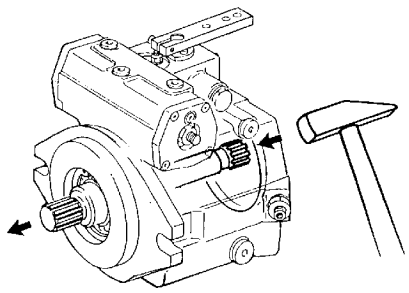
"Remove"
1. Cylinder
2. Swash plate
3. Joint pin

52



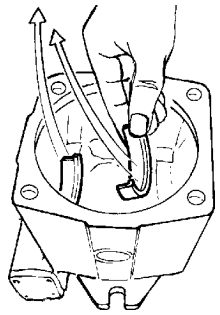
53 Seegerring, WDR ausbauen.

Remove retaining ring, radial seal ring.



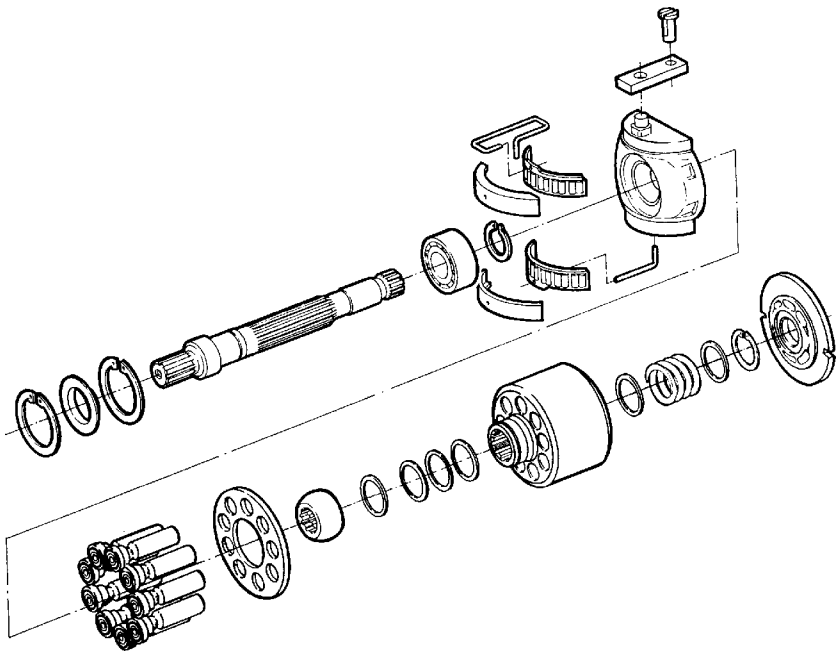
54 Triebwelle mit leichten Hammerschlägen austreiben.

Remove drive shaft with slight hammer strokes.

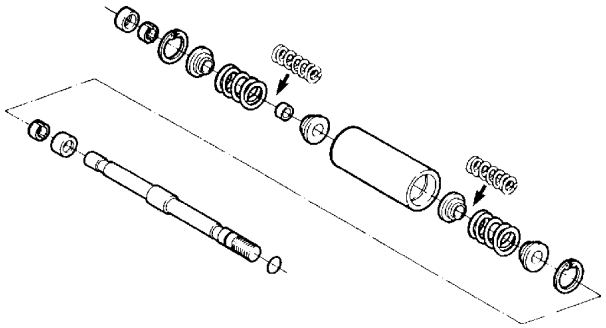


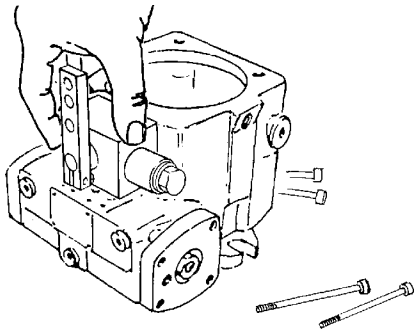
55 Lagerschalen ausbauen.

Remove bearing cups.



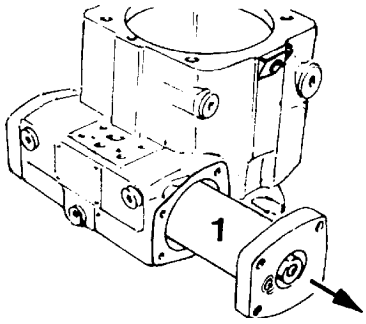
56





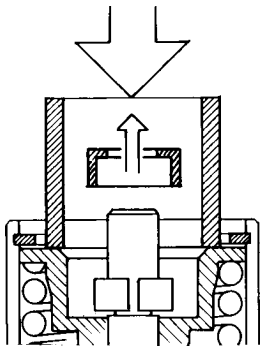
58 Steuergerät abbauen.

Remove control module.



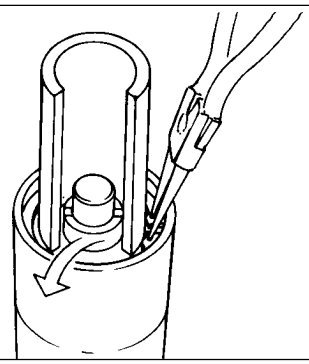
59 Stellkolben (1) ziehen.

Pull out control piston (1).



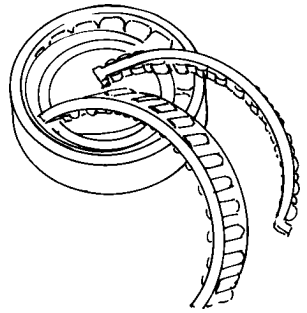
60 Vorrichtung aufsetzen und Feder vorspannen.
Aufnahmering ausbauen.

Mount fixture and tension spring.
Remove receiving ring.



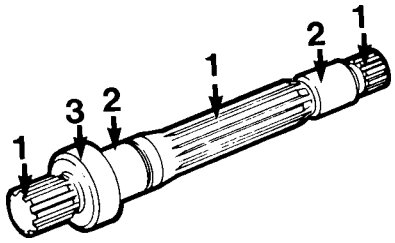
61 Ringe ausbauen.
Sicherungsring ausbauen.
Achtung! Teile stehen unter Federvorspannung.

Take out rings.
Remove retaining ring.
Note! Parts are spring loaded.



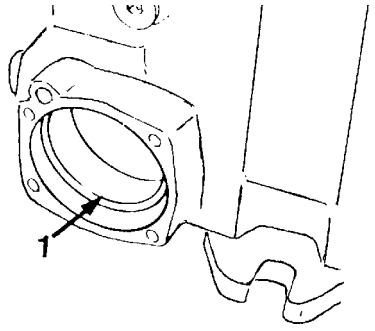
62 Alle Lager erneuern.

Replace all bearings.



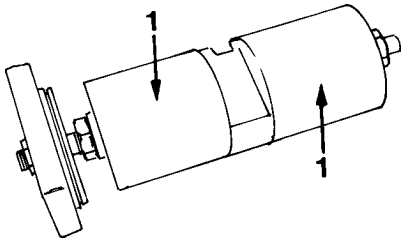
63 Kontrolle!
1. Verzahnung, ausgeschlagen, Passungsrost.
2. Lauffläche.
3. Einlaufrillen vom Wellendichtring.

Check!
1. Splines for damage or fretting.
2. Running surfaces.
3. Groove cut by shaft seal.



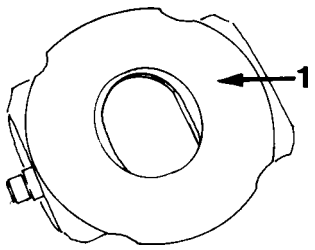
64 Stellkolbenlaufbüchse (1) riefenfrei, nicht ausgelaufen.

Check that the control piston guide bush (1) is free of grooves and has not worn out.



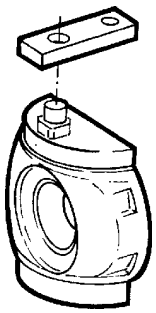
65 Kontrolle!
Stellkolben (1) riefenfrei.

Check!
Control piston (1) is not scored.



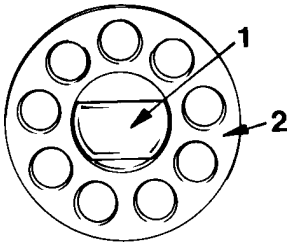
66 Kontrolle!
Gleitfläche riefenfrei.

Check!
Sliding surface free of grooves.



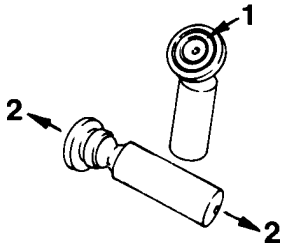
67 Kontrolle!
Verbindung Gleitstein/Schwenkzapfen spielfrei.

Check!
Make sure sliding ring/swivel pin are free of play.



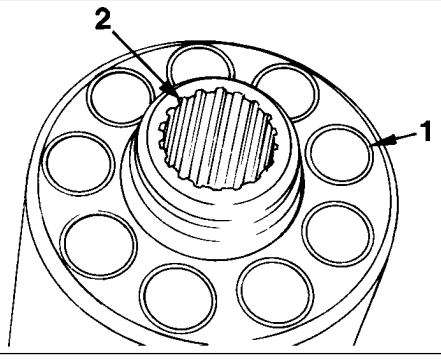
68 Kontrolle!
Rückzugeinrichtung riefenfrei (1), keine Einlaufspuren (2) im Gleitschuhbereich.

Check!
Check that return device is free of grooves (1) no wear in slipper pad area.



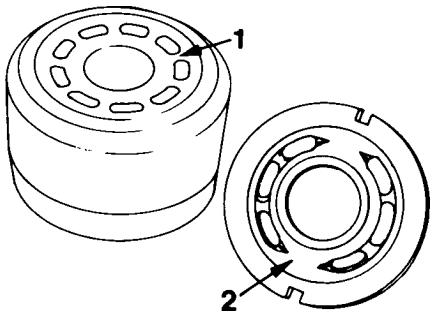
69 Kontrolle!
Lauffläche (1) keine Kratzer, keine Metalleinlagerungen, kein Axialspiel (2), (Kolben nur satzweise tauschen).

Check!
Check that there are no scratches or metal deposits on sliding surface (1), and there is no axial play (2), (otherwise: pistons must be replaced in sets).



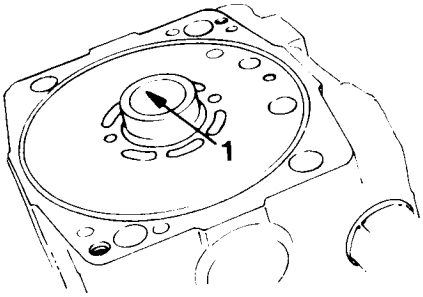
70 Kontrolle!
Zylinderbohrungen (1), Verzahnungen (2).

Check!
Cylinder bores (1), splines (2).



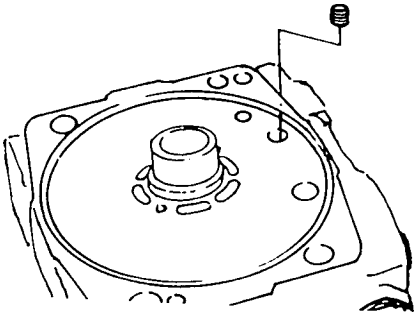
71 Kontrolle!
Zylindergleitfläche (1) riefenfrei, nicht eingelaufen, keine Einlagerungen, Steuerplatte (2) nicht riefig (nur satzweise austauschen).

Check!
Cylinder gilding surface (1) free of scratches, no traces of wear and no embedded foreign particles. No scratches on the valve plate (2). (Replace ONLY in sets).



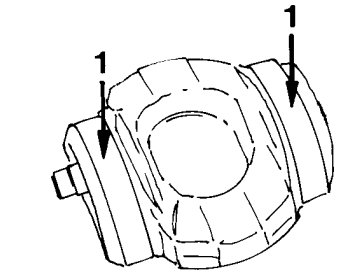
72 Kontrolle!
DU-Lagerbuchse (1) nicht ausgelaufen.

Check!
DU-bearing bush (1) is not worn out.



73 Hinweis:
Bohrung bei DA-Regelung offen. Ohne DA-Regelventil geschlossen.

Information:
Boring for DA-control open.
Without DA-control closed.



74 Kontrolle!
Lagerbahnen (1)

Check!
Bearing surfaces (1)

Gehäuse - Turcon-Glyd-Ring montieren / Assemble housing - Turcon-Glyd-ring

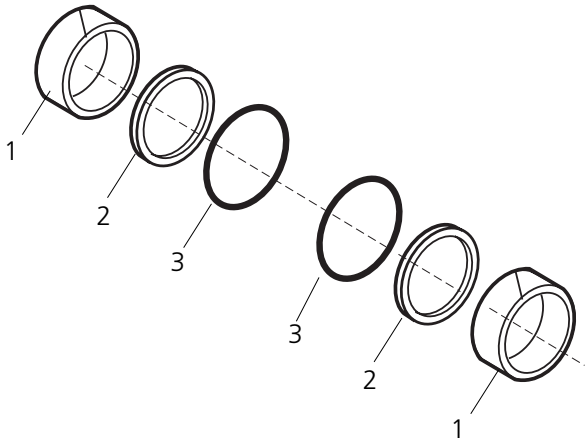
Hilfswerkzeuge / Auxiliary tools:

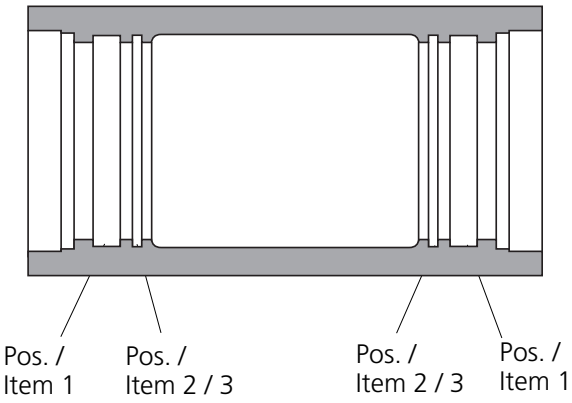
Montagezange / Assembly pliers: B+S x M22

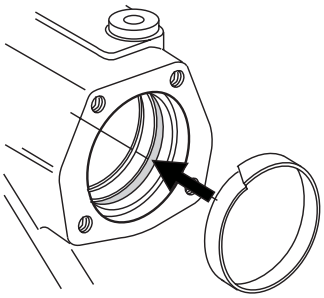
Führungsdorn / Guide thorn:

A4VG28	I: 277 4 347
A4VG40	I: 277 4 049
A4VG56	I: 277 4 050
A4VG71	I: 277 4 051
A4VG90	I: 277 4 052
A4VG125	I: 277 4 053
A4VG180	I: 277 4 054
A4VG250	I: 277 4 072

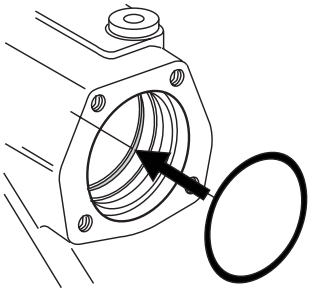
Montage / Assembly A4VG





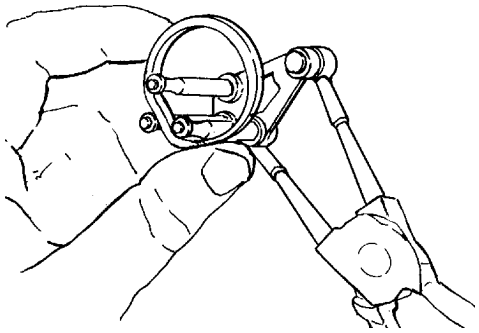


Pos. / Item 1: Stangenführungsring montieren.
Install barguide ring.



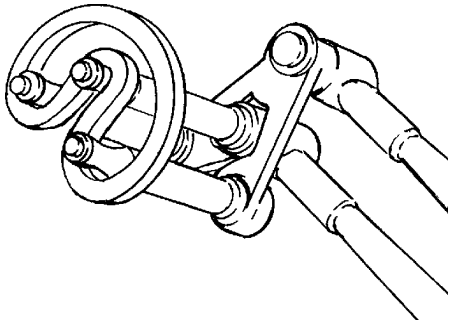
Pos. / Item 3: O-Ring montieren.
Install O-ring.

Gehäuse - Turcon-Glyd-Ring montieren / Assemble housing - Turcon-Glyd-ring



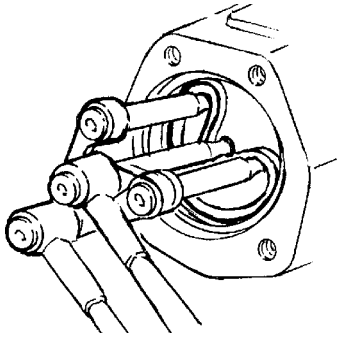
Dichtring (Pos. 2) in die Montagezange einlegen.

Fit the seal ring (Item 2) into the assembly tool.



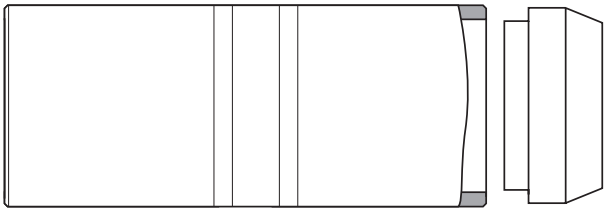
Dichtring mit Zangenschenkel nierenförmig zusammendrücken. Die Verformung von Turcon-Dichtungen ist sorgfältig vorzunehmen, damit die Dichtkanten nicht beschädigt werden.

Press the seal ring into the kidney shape using the assembly tool. The deformation of the Turcon seal has to be done with care so as not to damage the sealing edges.



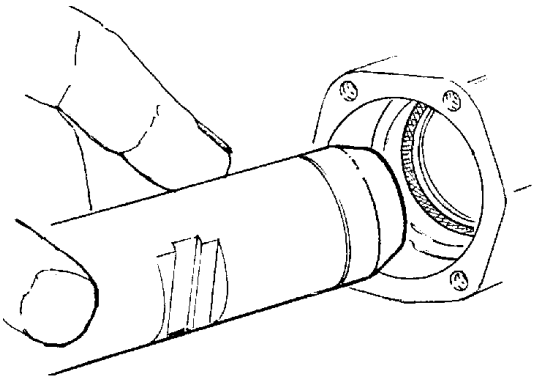
Dichtring ins Gehäuse einführen und in der Aufnahmenut plazieren. Dann Spannung lösen und Montagezange heraus ziehen. Lage des Dichtringes prüfen - eventuell mit dem Finger egalisieren.

Position the seal ring into the housing and place it into the groove. Release the tension and withdraw the assembly tool. Check the position of the seal ring if necessary straighten using a finger.



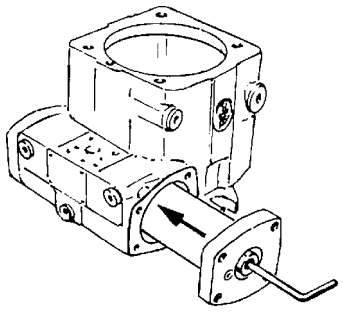
Führungsdorn in Stellkolben einbauen.

Insert guide thorn into the positioning piston.



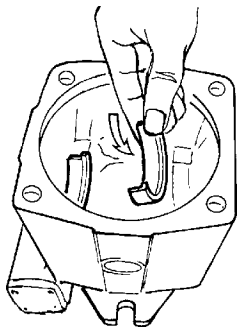
Führungsdorn leicht einfetten.
Stellkolben mit Führungsdorn einbauen.

Grease slightly guide thorn.
Install positioning piston with guide thorn.



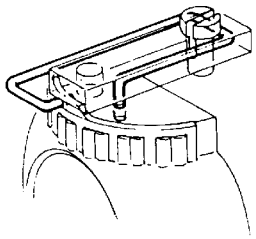
75 Stellkolben ins Gehäuse einsetzen.
Hinweis:
Stellkolben vor Einbau einölen.

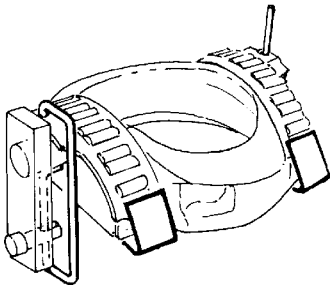
Insert positioning piston into the housing.
Instruction:
Oil positioning piston before assembly.



76 Lagerschalenpaar einsetzen.

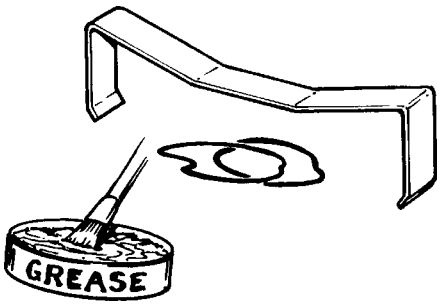
Insert bearing cup set.



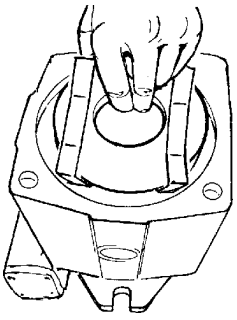


Lager, Draht, Gleitstein und Gelenkstift
montieren.
Montagehilfe: z.B. - Klammer / Gummiringe / Fett

Assemble bearing, wire, gliding stone
and articulating pin.
Assistance: Devices e.g. - Clamp / rubber rings / grease



77

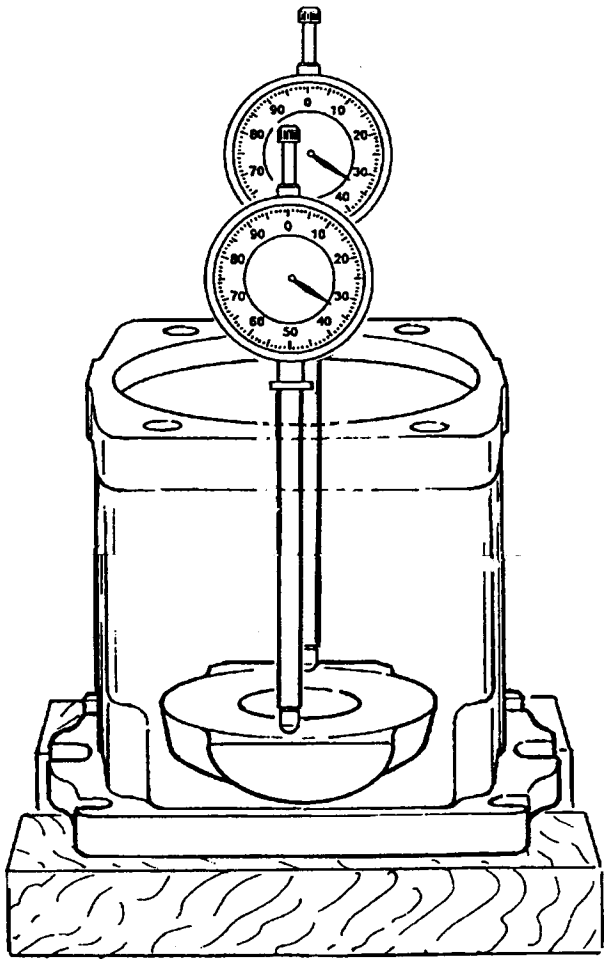


78 Schwenkwiege komplett ins Gehäuse einsetzen.
Auf korrekten Sitz der Schwenklager im Gehäuse "achten".

⚠ Montagehilfe ausbauen.

Insert completely swivel cradle into the housing.
Pay attention for correct seat of the swivel cradle in the housing.

⚠ Remove auxiliary device.

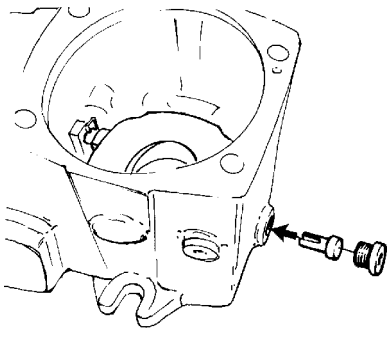


⚠ Kontrolle: Sitz der Schwenklager in der Lagerbahn.

Schwenkwiege mit Stellkolben verschwenken "Leichtgängig".
Mittig stellen mit Meßvorrichtung (Uhr oder Tiefenmaß)
Punkt 1 und 2 kontrollieren - gleiches Maß.

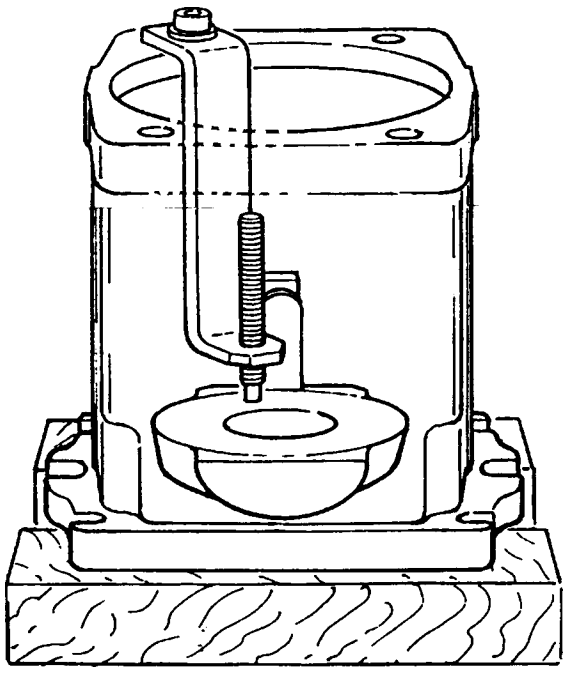
⚠ Check: Location of the swivel-bearing in the bearing.

Swivel the swivel bearing by using the control piston "it should move easily".
Centralise by using a measuring device (dial gauge or depth measurement).
Check points 1 and 2 - they should have the same dimension.



80 Gelenkstift montieren.

Fit joint pin.



Haltevorrichtung montieren.
Mit Gewindestift Schwenkwiege festhalten.

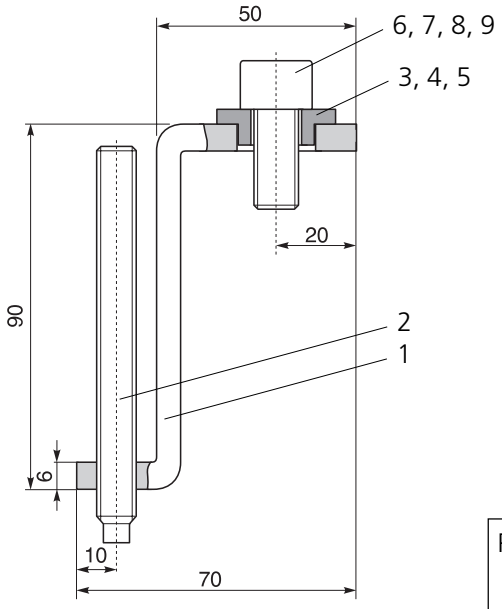
⚠ Keine Gewaltanwendung.

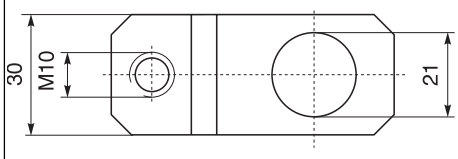
Fit holding device.
Hold swash plate in position utilising the set screw.

⚠ Do not use force.

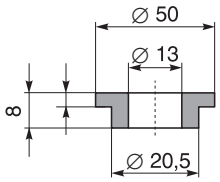
81

Haltevorrichtung "Schwenkwiege" A4V
Holding device "swivel cradle" A4V

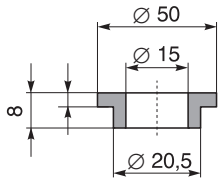




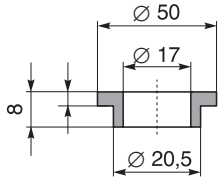
Teil/Part 3



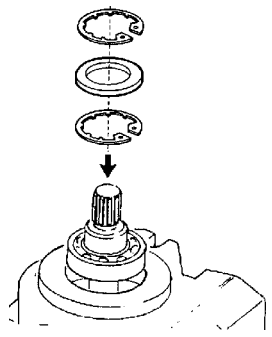
Teil/Part 4



Teil/Part 5

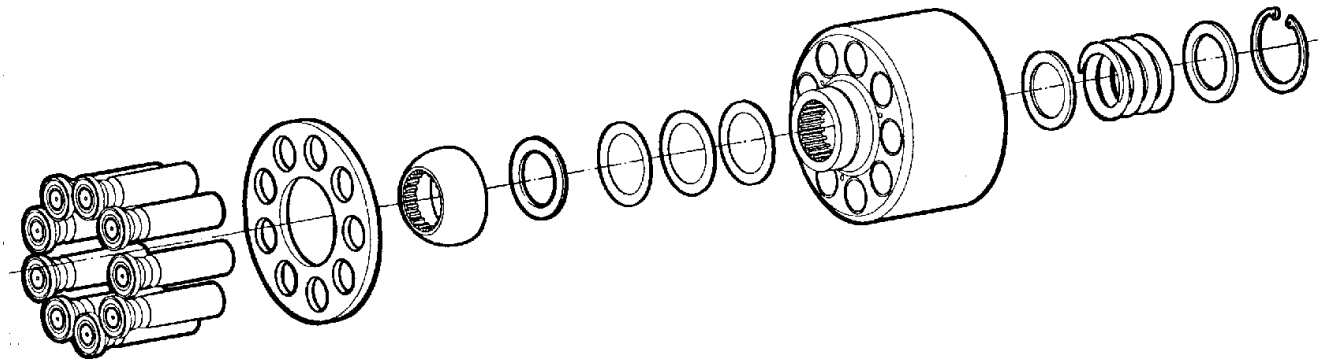


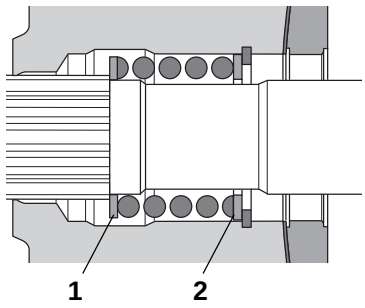
Pos./Item	Benennung/Designation	Stck./Qty.
1	Winkel/Angle	2
2	Gewindestift/Threaded pin	2
3	Scheibe/Shim	2
4	Scheibe/Shim	2
5	Scheibe/Shim	2
6	Zyl. Schraube/Cyl. screw M12 x 25 DIN 912	2
7	Zyl. Schraube/Cyl. screw M14 x 25 DIN 912	2
8	Zyl. Schraube/Cyl. screw M16 x 30 DIN 912	2
9	Zyl. Schraube/Cyl. screw M20 x 35 DIN 912	2



82 Neue Montageposition!
Triebwelle mit Lager und Wellendichtring einbauen.

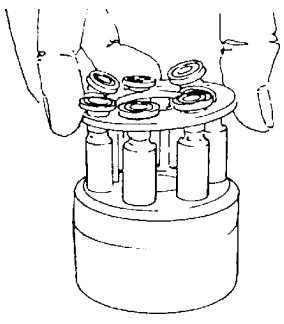
Assemble drive shaft with bearings and radial seal rings.





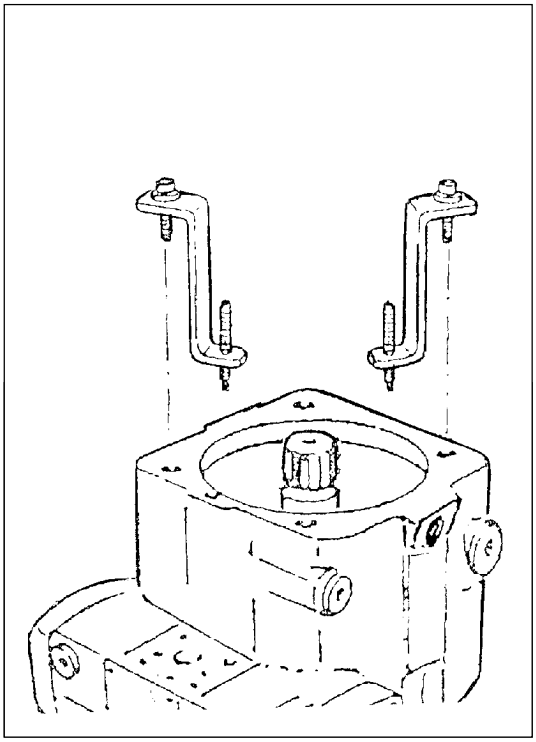
84 Scheibe 1, 2

Disc 1, 2



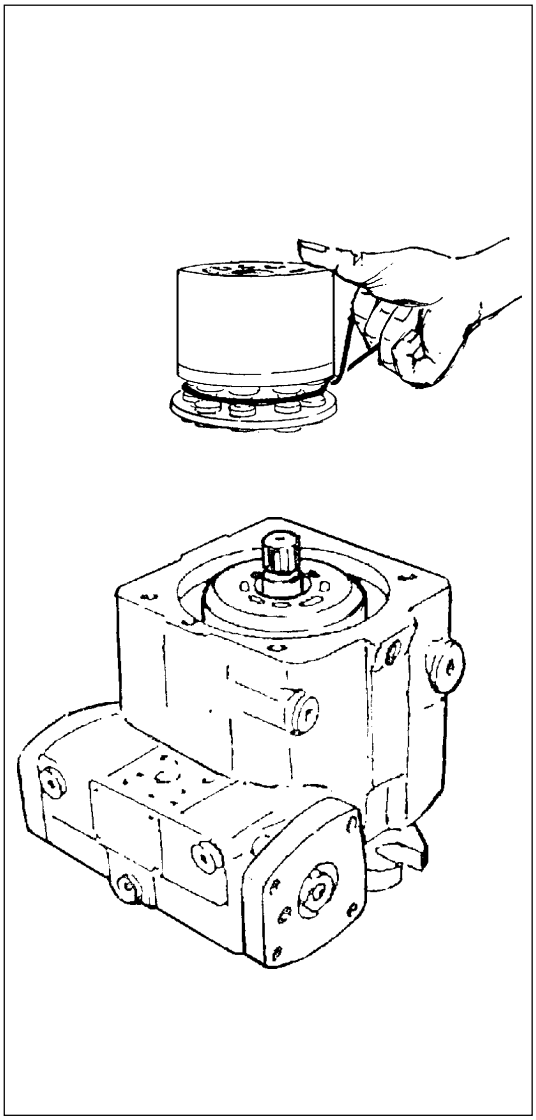
85 Kolben mit Rückzugeinrichtung montieren.
Hinweis:
Kolben, Gleitschuhe einölen.

Assemble piston with retaining plate.
Note:
Oil piston and piston pad.



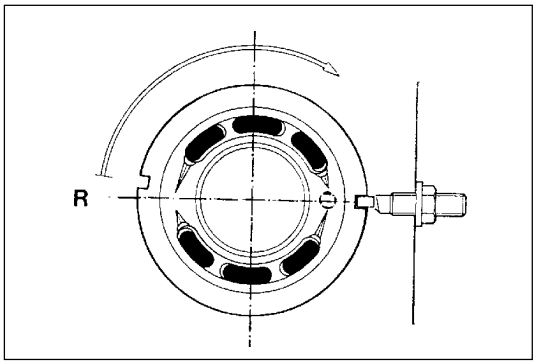
86 Vorrichtung ausbauen.
Zylinder mit Kolben und Rückzugeinrichtung einbauen.

Remove holding device.
Fit cylinder complete with pistons and retaining device.



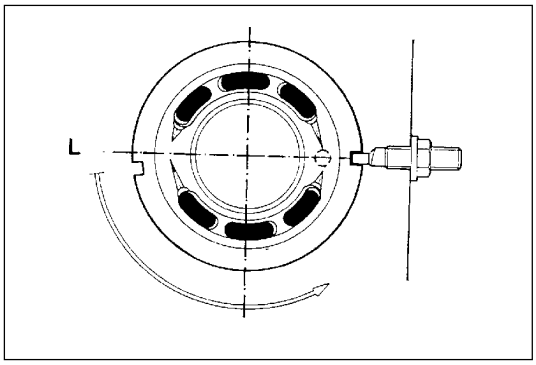
87 Montagehilfe:
Mit O-Ring Kolben festhalten.

Assembly aid:
Hold the pistons by using an O-ring.



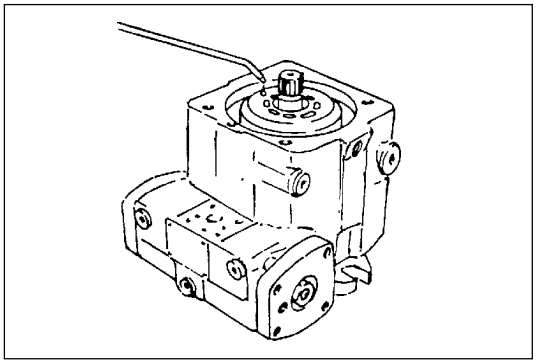
89 Steuerplatte Rechtslauf - in Drehrichtung verdreht.
Achtung!
Geräuschkerben sind drehrichtungsbezogen eingeschliffen.

Control plate clockwise rotation - indexed in the direction of rotation.
Note!
Noise grooves are machined - in based on direction of rotation.



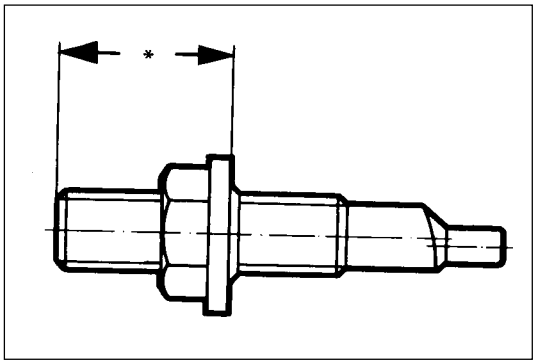
90 Steuerplatte Linkslauf - in Drehrichtung verdreht.
Achtung!
Geräuschkerben sind drehrichtungsbezogen eingeschliffen.

Control plate counter clockwise rotation - indexed in the direction of rotation.
Note!
Noise grooves are machined - in based on direction of rotation.



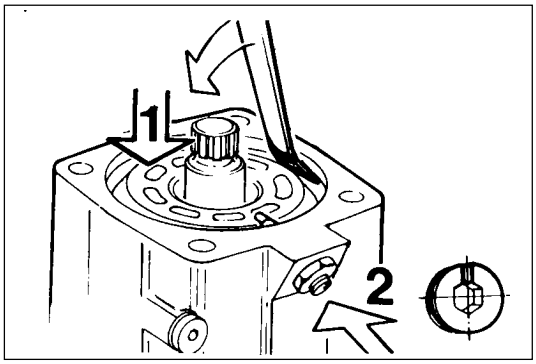
91 Zylinderflächen und DU-Lager einölen, neue O-Ringe mit Fett einreiben und einsetzen.

Oil the running surfaces of the cylinder barrel and the DU- bearing. Grease the O-rings and insert in grooves.



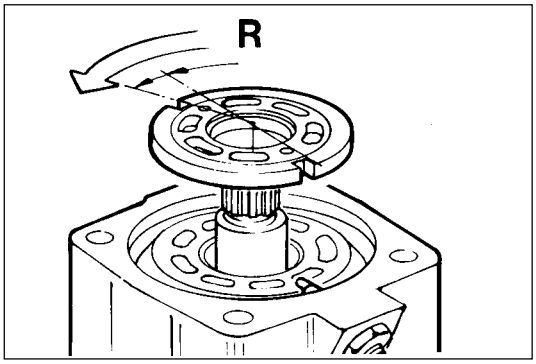
92 Grundeinstellung - Verdrillschraube
A4VG...40 * = 24 ± 0,75 mm.
A4VG...56 * = 21 ± 0,75 mm.

Basic setting - indexing screw
A4VG...40 * = 24 ± 0,75 mm.
A4VG...56 * = 21 ± 0,75 mm.



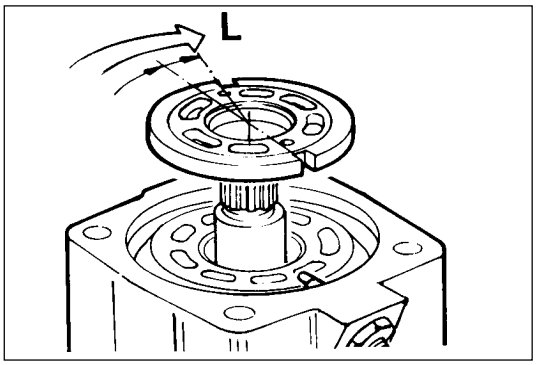
93 Zylinder nach unten drücken (1).
Verdrillschraube einbauen (2).
Kerbe in Montageposition.

Press the cylinder to the bottom (1).
Screw in the indexing screw (2).
Groove in mounting position.



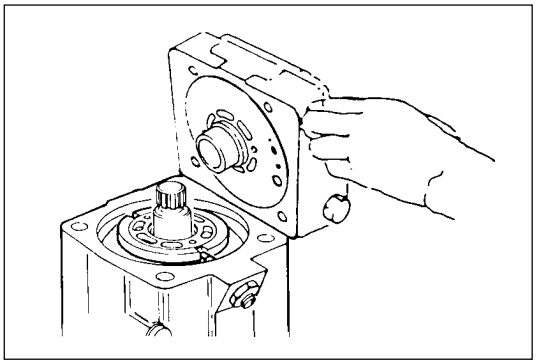
94 Steuerplatte einsetzen - Rechtslauf.

Insert the control plate - clockwise rotation.



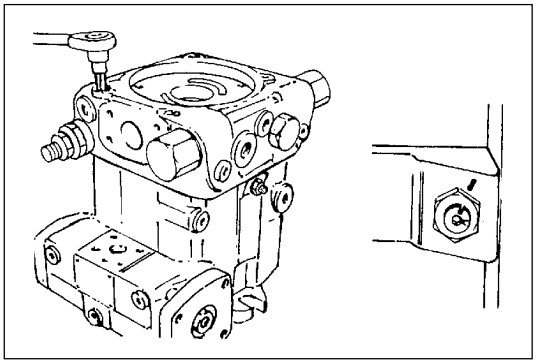
95 Steuerplatte einsetzen - Linkslauf.

Insert the control plate - Counter- clockwise rotation.



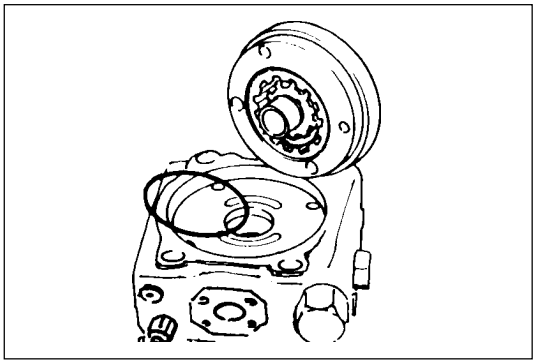
96 Lagerichtig aufsetzen.
Hinweis:
HW, HD, EP - Steuerplatte mit Fett auf Anschlußplatte.

Place in correct position.
Note:
HW, HD, EP - Put control plate with greas to the port block.



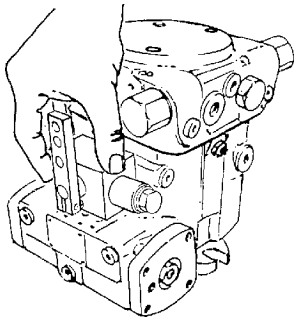
97 Schrauben über Kreuz anziehen.
Verdrillschraube auf Markierung drehen.

Tighten screws (Cross-corner).
Turn the indexing screw to marking.



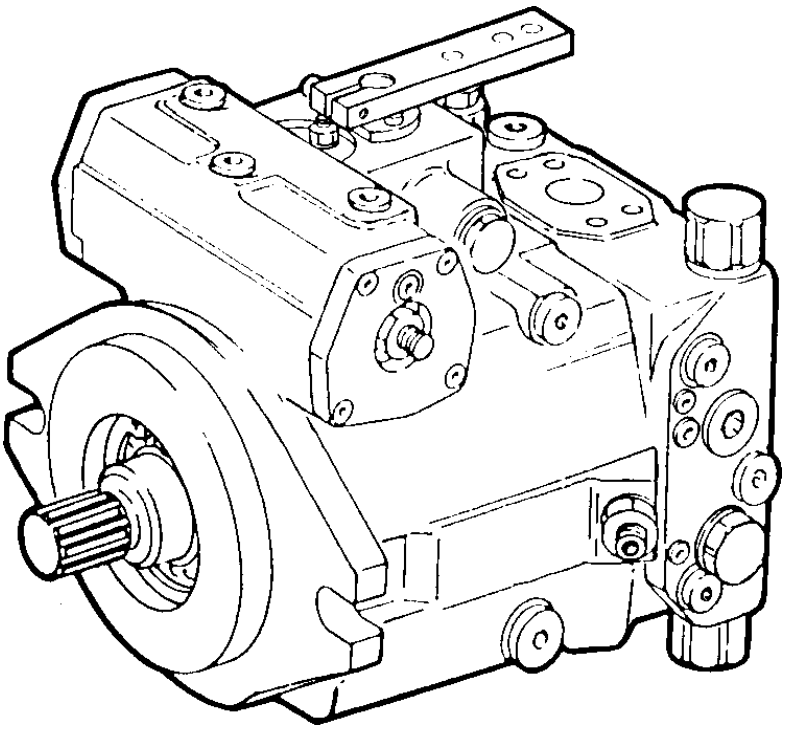
98 Hilfspumpe montieren.

Assemble boost pump.



99 Ansteuergerät montieren.

Mount control module.



100

Anziehdrehmomente für Schaftschrauben (Metrisches ISO-Regelgewinde)

Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Schaftschrauben mit metrischem ISO-Regelgewinde und Kopfauflagemaßen nach DIN 912, DIN 931 und DIN 933. Außerdem gelten diese Werte nur für leicht oder nicht geölte, unbehandelte Oberflächen, sowie nur bei Verwendung von Drehmoment- und Kraftbegrenzungsschlüsseln.

Gewinde größe	Festigkeitsklassen 8.8	10.9	12.9
	Anziehdrehmoment(Nm)		
M 3	1,3	2,0	2,3
M 4	3,1	4,5	5,3
M 5	6,1	8,9	10,4
M 6	10,4	15,5	18.0
M 8	25	37	43
M10	51	75	87
M12	87	130	150
M14	140	205	240
M16	215	310	370
M18	300	430	510
M 20	430	620	720
M 22	580	830	970
M 24	740	1060	1240
M 27	1100	1550	1850
M 30	1500	2100	2500

Tightening torques for shaft bolts (Metric ISO Standard Thread)

The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO- standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or unoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque(lb.ft)		
M 3	1,3	2,0	2,3
M 4	3,1	4,5	5,3
M 5	6,1	8,9	10,4
M 6	10,4	15,5	18.0
M 8	25	37	43
M10	51	75	87
M12	87	130	150
M14	140	205	240
M16	215	310	370
M18	300	430	510
M 20	430	620	720
M 22	580	830	970
M 24	740	1060	1240
M 27	1100	1550	1850
M 30	1500	2100	2500

Anziehdrehmomente für Verschlußschrauben VSTI (Metrisches Feingewinde)

Gewindegröße	Bezeichnung		Anziehdrehmoment(Nm)
M 8 x 1	VSTI 8 x 1	-ED/SA	= 5
M 10 x 1	VSTI 10 x1	-ED	= 10
M 12 x 1,5	VSTI 12 x 1,5	-ED	= 20
M 14 x 1,5	VSTI 14 x 1,5	-ED	= 30
M 16 x 1,5	VSTI 16 x 1,5	-ED/SA	= 30
M 18 x 1,5	VSTI 18 x 1,5	-ED/SA	= 40
M 20 x 1,5	VSTI 20 x 1,5	-ED/SA	= 50
M 22 x 1,5	VSTI 22 x 1,5	-ED	= 60
M 26 x 1,5	VSTI 16 x 1,5	-ED/SA	= 70
M 27 x 2	VSTI 27 x 2	-ED	= 90
M 30 x 1 ,5	VSTI 30 x 1,5	-ED/SA	= 100
M 33 x 2	VSTI 33 x 2	-ED/SA	= 120
M 42 x 2	VSTI 42 x 2	-ED/SA	= 200
M 48 x 2	VSTI 48 x 2	-ED	= 300

Tightening torques for locking screws VSTI (Metric ISO fine thread)

Thread size	Designation		Tightening torques (lb.ft)
M 8 x 1	VSTI 8 x 1	-ED/SA	= 4
M 10 x 1	VSTI 10 x1	-ED	= 7
M 12 x 1,5	VSTI 12 x 1,5	-ED	= 15
M 14 x 1,5	VSTI 14 x 1,5	-ED	= 22
M 16 x 1,5	VSTI 16 x 1,5	-ED/SA	= 22
M 18 x 1,5	VSTI 18 x 1,5	-ED/SA	= 29
M 20 x 1,5	VSTI 20 x 1,5	-ED/SA	= 37
M 22 x 1,5	VSTI 22 x 1,5	-ED	= 44
M 26 x 1,5	VSTI 16 x 1,5	-ED/SA	= 51
M 27 x 2	VSTI 27 x 2	-ED	= 66
M 30 x 1 ,5	VSTI 30 x 1,5	-ED/SA	= 74
M 33 x 2	VSTI 33 x 2	-ED/SA	= 88
M 42 x 2	VSTI 42 x 2	-ED/SA	= 147
M 48 x 2	VSTI 48 x 2	-ED	= 220

Anziehdrehmomente für Seal-Lock Bundmuttern (Metrisches ISO-Regelgewinde)

Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Seal-Lock Bundmuttern der Festigkeitsklasse 8.8 mit metrischem ISO-Regelgewinde.

Gewinde größe	Festigkeitsklassen 8.8	10.9	12.9
	Anziehdrehmoment (Nm)		
M 6	10		
M 8	22		
M 10	40		
M 12	69		
M 14	110		
M 16	170		

Tightening torques for seal-lock nuts (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torque (lb.ft)		
M 6	7,4		
M 8	16,2		
M 10	29,5		
M 12	50,9		
M 14	81,1		
M 16	125,3		

Anziehdrehmomente für Linsenschrauben mit Kreuzschlitz DIN 7985 (Metrisches ISO-Regelgewinde)

Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Linsenschrauben mit Kreuzschlitz DIN 7985 der Festigkeitsklasse 8.8 mit metrischem ISO-Regelgewinde

Gewinde größe	Festigkeitsklassen 8.8	10.9	12.9
	Anziehdrehmoment(Nm)		
M 3	1,1		
M 4	2,9		
M 5	6		
M 6	10		
M 8	25		
M10	49		

Tightening torques for cross-slotted lens head screws DIN 7985 (Metric ISO- Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torques (lb.ft)		
M 3	0,8		
M 4	2,1		
M 5	4,4		
M 6	7,4		
M 8	18,4		
M10	36,1		

Allgemein

- Machen Sie sich mit der Ausstattung der Maschine vertraut.
- Fahren Sie die Maschine nur, wenn Sie sich völlig mit den Bedien- und Steuerelementen sowie der Arbeitsweise der Maschine vertraut gemacht haben.
- Benutzen Sie Ihre Schutzausrüstung wie Schutzhelm, Sicherheitsschuhe und Gehörschutz.
- Machen Sie sich mit Ihrem Arbeitsgebiet vertraut.
- Benutzen Sie die Maschine nur für den ihr zugedachten Zweck.

Beachten Sie bitte die Richtlinien der Berufsgenossenschaft und des Maschinenherstellers



Vor dem Start

- Beachten Sie die Bedienungshinweise vor dem Starten.
- Prüfen Sie die Maschine auf auffällige Fehler.
- Fahren Sie die Maschine nicht mit defekten Instrumenten, Kontrolleuchten oder Steuerorganen.
- Alle Schutzvorrichtungen müssen fest auf ihrem Platz sein.
- Nehmen Sie keine losen Gegenstände mit bzw. befestigen Sie diese an der Maschine.
- Halten Sie die Maschine von öligem und zündfähigem Material frei.
- Prüfen Sie vor dem Besteigen der Maschine, ob sich Personen oder Hindernisse neben oder unter der Maschine befinden.
- Vorsicht beim Besteigen der Maschine, benützen Sie Treppen und Griffe.
- Stellen Sie vor dem Start Ihren Sitz ein.

General advice

- Make yourself familiar with the equipment of the machine.
- Only operate the machine if your are completely familiar with the operating and control elements as well as the functioning of the machine.
- Use your safety equipment like helmet, safety shoes and hearing protection.
- Make yourself familiar with your working field.
- Only operate the machine for its intended purpose.

Please observe the guidelines of the Professional Association and the machine manufacturer.



Before starting

- Observe the operating instructions before starting.
- Check the machine for obvious faults.
- Do not operate the machine with defective instruments, warning lights or control elements.
- All safety devices must be in a secure position.
- Do not carry with you movable objects or secure them to the machine.
- Keep oily and inflammable material away from the machine.
- Before entering thc driver's cabin, check if persons or obstacles are beside or beneath the machine.
- Be careful when entering the driver's cabin, use stairs and handles.
- Adjust your seat before starting.

Starten

- Beim Starten müssen alle Bedienhebel in "Neutralstellung" stehen.
- Die Maschine nur vom Fahrersitz aus Starten.
- Prüfen Sie die Anzeigeinstrumente nach dem Start, um sicher zu gehen, daß alles ordnungsgemäß funktioniert.
- Lassen Sie die Maschine nicht unbewacht, während der Motor läuft.
- Beim Start mit Batterieverbindungskabeln verbinden Sie Plus mit Plus und Minus mit Minus. Massekabel (Minus) immer zuletzt anschliesen und zuerst abtrennen.

Vorsicht

- Auspuffgase sind lebensgefährlich. Bei Start in geschlossenen Räumen für ausreichende Luftzufuhr sorgen!

Hydraulikanlage

1. Hydraulikanlage steht unter hohem Druck!

⚠ Unter hohem Druck austretende Hochdruck-Flüssigkeiten (Kraftstoff, Hydrauliköl) können die Haut durchdringen und schwere Verletzungen verursachen. Daher sofort einen Arzt aufsuchen, da anderenfalls schwere Infektionen entstehen können!

2. Bei der Suche nach Leckstellen wegen Ver letzungsgefahr geeignete Hilfsmittel verwenden!
3. Vor Arbeiten an der Hydraulikanlage diese unbedingt drucklos machen und angebaute Geräte absenken!
4. Bei Arbeiten an der Hydraulikanlage unbedingt Motor abstellen und Maschine gegen Wegrollen sichern (Feststellbremse, Unterlegkeil)!
5. Beim Anschließen von Hydraulikzylindern und -motoren ist auf vorgeschriebenen Anschluß der Hydraulikschläuche zu achten!
6. Bei Vertauschen der Anschlüsse umgekehrte Funktionen (z.B. Heben/Senken) - Unfallgefahr!
7. Hydraulikschlauchleitungen regelmäßig kontrollieren und bei Beschädigung und Alterung austauschen! Die Austauschschlauchleitungen müssen den technischen Anforderungen des Geräteherstellers entsprechen!

⚠ Öle, Kraftstoffe und Filter ordnungsgemäß entsorgen!

Start

- When starting all operating levers must be in "neutral position".
- Only start the machine from the driver's seat
- Check the indicating instruments after start to assure that all functions are in order.
- Do not leave the machine unobserved when the motor is running.
- When starting with battery connection cables connect plus with plus and minus with minus. Always connect negative (-) cable last and disconnect negative cable first.

Attention

- Exhaust gas is dangerous. Assure sufficient fresh air when starting in closed rooms!

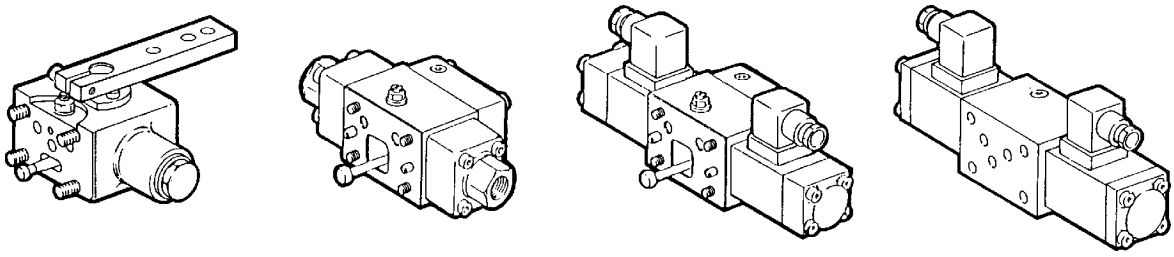
Hydraulic equipment

1. Hydraulic equipment is standing under high pressure.

⚠ High pressure fluids (fuel, hydraulic oil) which escape under high pressure can penetrate the skin and cause heavy injuries.
Therefore immediately consult a doctor as otherwise heavy infections can be caused.

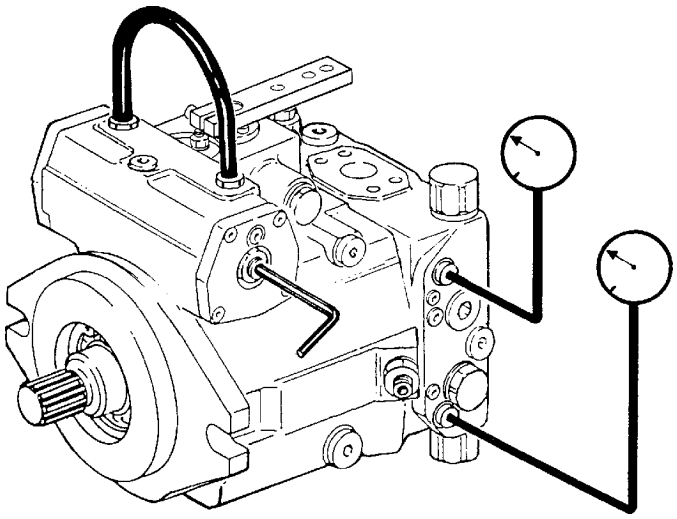
2. When searching leakages use appropriate auxiliary devices because of the danger of accidents.
3. Before working at the hydraulic equipment, lower pressure to zero and lower working arms of the rnachine.
4. When working at the hydraulic equipment, absolutely stop motor and secure machine against rolling away (parking brake, shim)!
5. When connecting hydraulic cylinders and motor pay attention to correct connection of hydraulic flexible hoses.
6. In case of exchanging the ports, the tunctions are vice versa (f. ex. lift-up/lower) - danger of accidents!
7. Check hydraulic flexible hoses regularly and replace them in case of dammage or wear! The new hose pipes must comply with the technical requirements of the machine manufacturer!

⚠ Orderly disposal or recycling of oil, fuel and filters!



HW **HD** **EP** **DA**

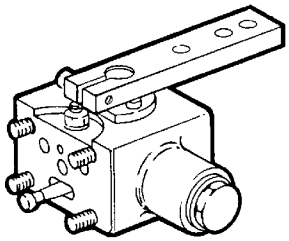
101



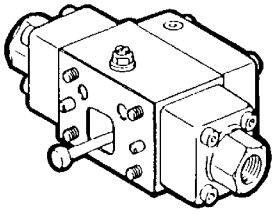
Achtung!
Sicherheitsbestimmungen beachten!
Mit Schlauch NW6 beide Stellkammern verbinden. Vermeidung von Restsignal aus hydraulischer Nullage.
Manometer an M_A und M_B anschließen.
Nullage so einstellen, daß bei blockiertem Antrieb beide Manometer auf gleichem Druckwert stehen.
Hinweis:
Totband der Nullage - vermitteln.

Attention!
Observe safety regulations!
Connect both control chambers with hose NW6. Avoidance of rest signal from hydraulic zero position.
Connect manometer to M_A and M_B. Adjust zero position so that at blocked drive both manometer indicate the same pressure valve.
Note:
Adjust death line of zero position.

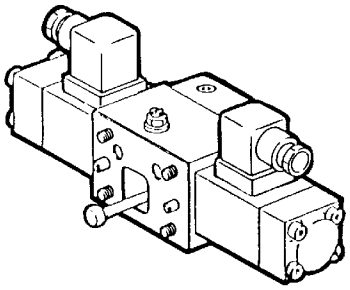
102



HW



HD

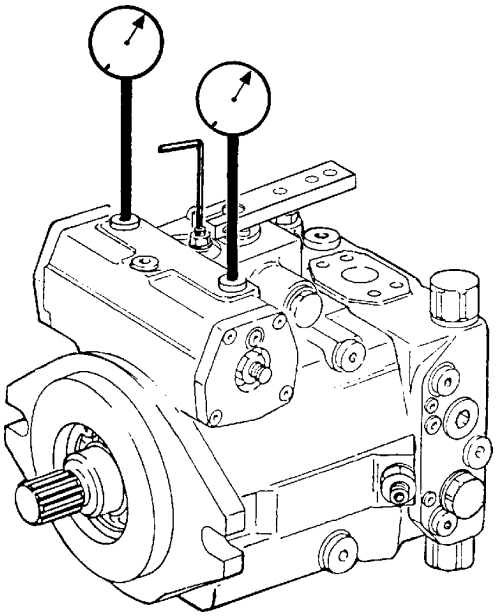


EP

Achtung!
Sicherheitsbestimmungen beachten!

Attention!
Observe safety regulations!

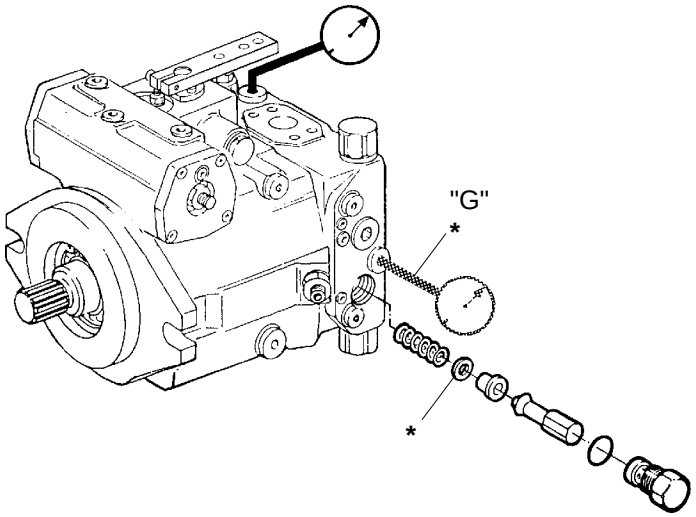
103



Manometer an X_1 und X_2 anschließen.
Nullage so einstellen, daß bei blockiertem Antrieb beide Manometer auf gleichem Druckwert stehen.
Hinweis:
Excenterjustierung
- nicht über ±90° verdrehen.

Connect manometer to X_1 and X_2.
Adjust zero position so that at blocked drive both manometer indicate the same pressure value.
Note:
Eccentric adjusting
- Do not turn over ±90°.

104



Achtung!
Sicherheitsbestimmungen beachten!

Hinweis:
Nachjustierung nur bei Betriebstemperatur.

Manometer an "G" anschließen.

Achtung!
***** Speisedruckeinstellung!
Nenndruck p_H - 18 bar
Höchstdruck p_H - 40 bar
Bei Max.-Drehzahl.

Hinweis:
Einstelldaten nach Werksauftrag.

* bei DA-Ausführung

Attention!
Observe safety regulations!

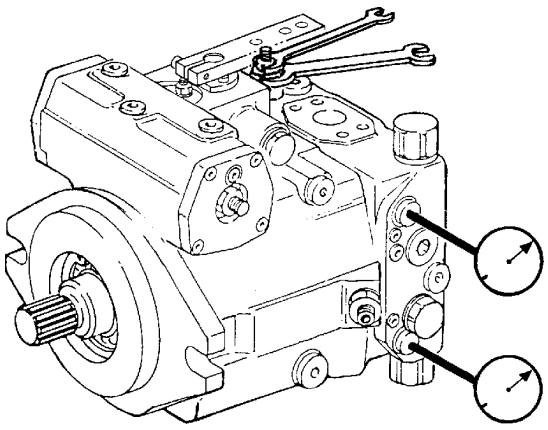
Note:
Readjusting only at operating temperature.

Connect manometer to "G".

Attention!
***** Boost pressure setting!
Nominal pressure p_H - 18 bar
Peak pressure p_H - 40 bar
at max. speed.

Note:
Adjusting data according to order.

Druckabschneidung
Pressure cut-off



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Achtung!
Sicherheitsbestimmungen beachten!

HD-Ventil ohne Bypass

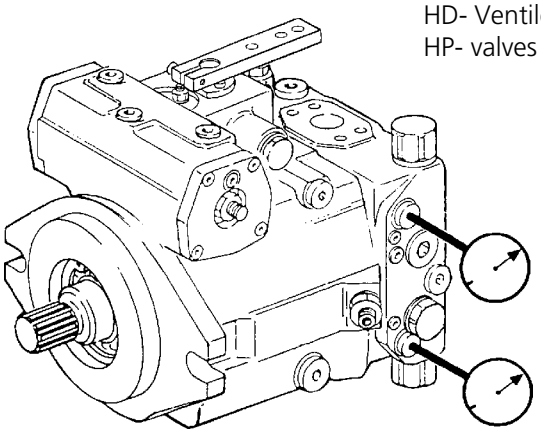
1 . HD- Ventile sind immer 10% höher eingestellt als die Druckabschneidung.
Bei Veränderung eines Einsteilwertes immer beide kontrollieren.
2. Nachjustierung nur bei Betriebstemperatur

Manometer an M_A und M_B anschließen.
Druckabschneidung: Maß X Einstellschrauben notieren!
Einstellschraube auf Block drehen.

HD- Ventile: Mit geringer Pumpenmenge über Ventile fahren. Einstellwert kontrollieren.
(Nur kurzzeitig "Temperatur".)
Drucklos "Einstellwert" verändern - Kontrolle

Druckabschneidung:
Einstellschraube auf Maß (*) zurückdrehen.
Druckwert kontrollieren bzw. nachjustieren.
Achtung! Differenz von 10% HD- Ventile und Druckabschneidung beachten!
Hinweis: Einstelldaten nach Werksauftrag.

HD- Ventile
HP- valves



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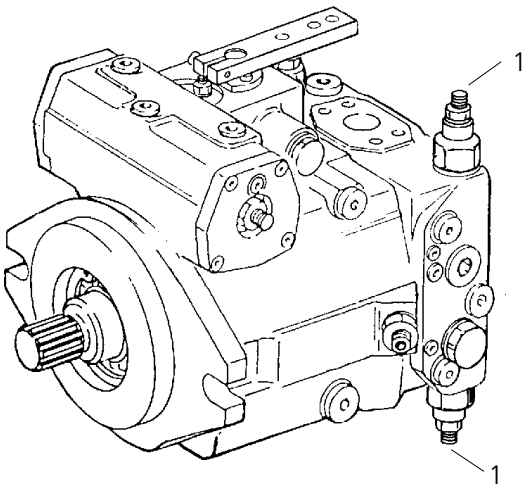
Attention!
Observe safety regulations.

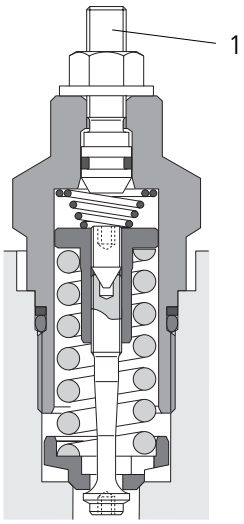
HP valve without bypass-function

1 . HP valves are always adjusted 10% higher than the pressure cut-off.
If one setting value is changed, always check both values.
2. Readjusting only at operating temperature.

Connect manometer M_A and M_B.
Pressure cut-off: Note measure X setting screw! Turn setting screw on block.
HP valves: Operate valves with small pump flow volume.
Check setting value. ("temperature" only for a short time).
Change "setting value" - check.

Pressure cut-off:
Turn back setting screw to measure (*).
Check pressure value and readjust.
Attention! Observe 10% pressure difference HP valves and pressure cut-off!





108

Fahrzeuge mit rein-hydrostatischem Fahrantrieb bzw. mit hydrostatischem Fahrantrieb und Schalt-**getriebe ohne Leerlaufstellung (Freilauf).**

Vehicle with hydrostatic transmission and gear shift without idling setting position (free wheeling).

Hydrostatischer Antrieb / Bypaß-Schaltung

Hydrostatic transmission / Bypass-switching

In diesem Fall wird der Fahrantrieb auf freien Umlauf geschaltet. Zu diesem Zweck haben die in der Verstellpumpe integrierten Hochdruck-begrenzungsventile eine sogenannte Bypaß-Funktion. D.h. durch Drehen der entsprechenden Schraube (Pos.1) wird der Ventil-Einsatz so entspannt, daß ein freier Öl-Umlauf möglich ist.

⚠ Bypass:Pos.1 einschrauben bis eben mit Mutter. Mutter wieder anziehen.

In this case the travel transmission is switched on to free wheeling.For this purpose the variable displacement pump has incorporated high pressure relief valves with bypass function.
The screw (item 1) is unscrewed to such an extent, that the valve cartridge is released and free oil circulation is possible.

⚠ Bypass: Screw in item1 up to planeness with nut. Screw up nut again.

Schleppgeschwindigkeit
Die maximale Schleppgeschwindigkeit sollte 2 km/h nicht überschreiten.

- Höhere zulässige Schleppgeschwindigkeiten sind abhängig von der Hydromotordrehzahl bzw. dem eingelegten Gang.

Towing speed
The max. towing speed of 2 km/h should not be exceeded.

- Higher admissible towing speeds depend on the avaiable hydr. motor speed and engaged gear shift.

Abschleppdistanz
Die Schleppentfernung sollte 1 km nicht überschreiten.

- Bei fehlender Einspeisung entleert sich der Hydraulik-Kreislauf.
  Zu beachten ist die Wärmeentwicklung im Hydromotor-Triebwerk.

Towing distance
The towing distance should not exceed 1 km.

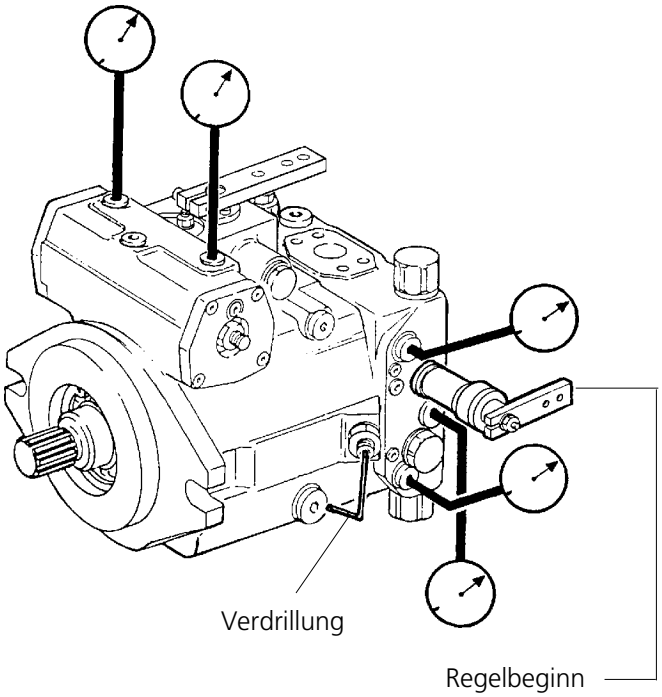
- If there is a lack of oil boosting, the hydraulic circuit will get empty.
  Take care of the heat development in the hydr. motor-rotary group.

Abschleppvorgang beendet
Nach beendetem Abschleppvorgang Pos.1 zurück-drehen. Der ursprüngliche Einstellwert der Hochdruck-ventile liegt somit wieder vor.

⚠ Ventilfunktion: Pos.1 zurückschrauben bis Anschlag. Mutter anziehen.

Towing operation terminated
After termination of the towing operation turn item 1 back. The original pressure value setting of the high pressure relief valves will be avaiable again.

⚠ Valve function: Screw back item 1 up to stop. Screw up the nut.



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Achtung!
Sicherheitsbestimmungen beachten!

Überprüfung der Einstelldaten
Betriebstemperatur soll während des Überprüfungsvorgangs weitgehend konstant gehalten werden.
Antriebsmotor starten, Leerlaufdrehzahl

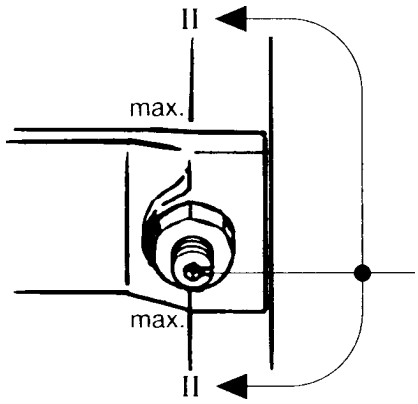
Blockzustand
Fahrtrichtungsschalter **"0"**
Motordrehzahl langsam steigern bis zur max. Motordrehzahl, dabei Meßgeräte beobachten.
Speisedruck:
Leerlaufdrehzahl
Psp = ca. 15-20 bar
max. Motordrehzahl
Psp = ... bar*

Blockzustand
Fahrtrichtungsschalter - vorwärts
(Straßengang und Festgebremst)

Einstelldaten Pumpe A4V/DA überprüfen
Regelbeginn
HD 40 - 50 bar
Motordrehzahl . min.[1] * Psp . . . . . bar*
HD . . . . . bar
Nachjustierung - Regelbeginnschraube

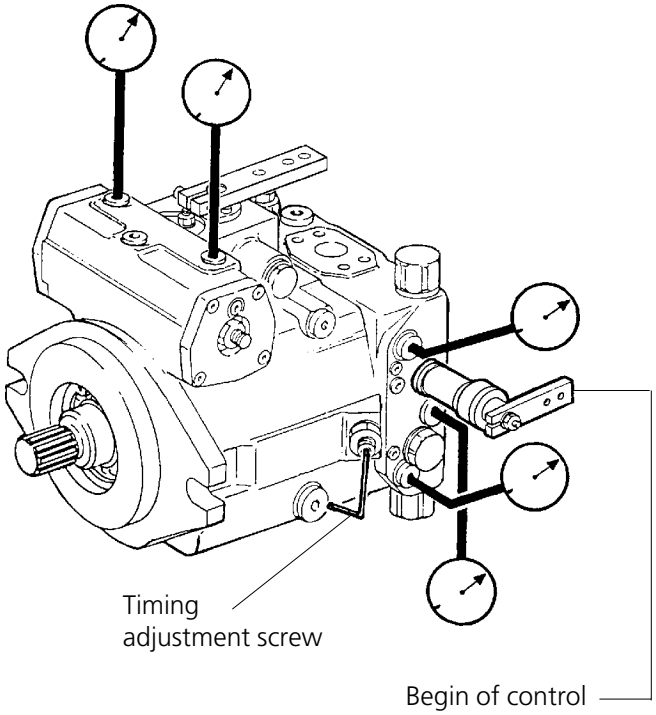
Regelende
HD . . . . . bar*
Motordrehzahl . . . . . min.[1] * Psp . . . . . bar*
Nachjustierung - Verdrillschraube

Hinweis:
Excenterjustierung - Drehrichtung beachten



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Hinweis: * Einstelldaten nach Werksauftrag!



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Attention!
Observe safety regulations!

Check setting data.
Operating temperature should be kept largely constant during the check procedure.
Start prime mover, idle speed.

Block position
Drive direction switch - **"0"**.
Slowly increase motor speed up to the max. motor speed and thereby observe measuring instruments.

Boost pressure:
Idle speed of prime mover
Psp = approx. 15 - 20 bar
max. motor speed
Psp = ... bar*

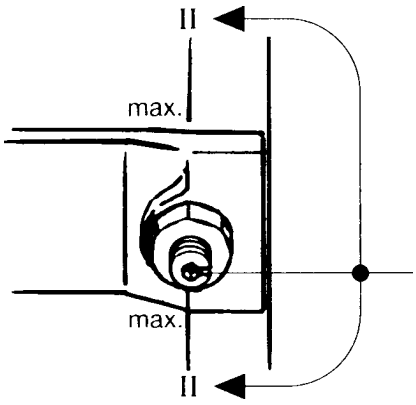
Block position
Drive direction switch - **forward**
(Road gear and fully applied brake)

Check setting data pump A4VIDA
Begin of control:
HD 40 - 50 bar
Motor speed . . . . . rpm* Psp . . . . . bar*
HD . . . . . bar*
Readjusting - control start screw

End of control
HD . . . . . bar
Motor speed . . . . . rpm* Psp . . . . . bar*
Readjusting timing adjustment screw

Note:
Eccentric adjusting - observe direction of rotation

* Setting data according to order!



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MANNESMANN
REXROTH

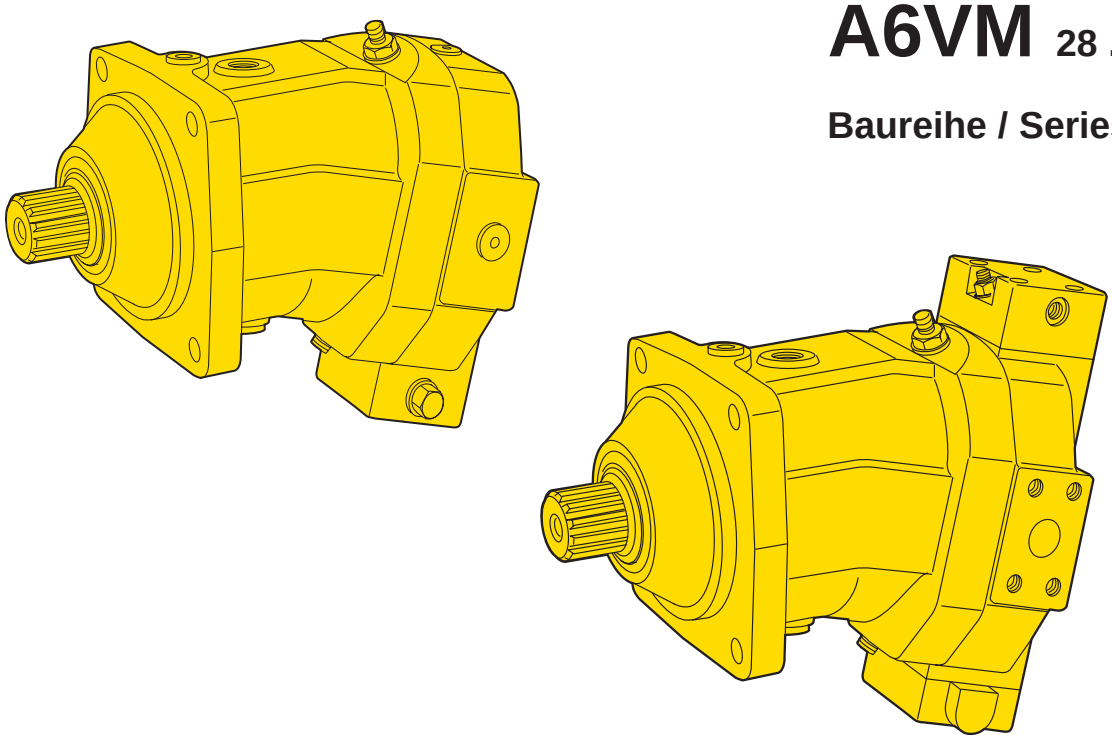
Brueninghaus Hydromatik

R

Reparaturanleitung
Repair Instructions

A6VM 28 ... 200

Baureihe / Series 63



RDE 91604-01-R
08.96

Typschlüssel | A6V | M | | | / | 6 | 3 | W |

Axialkolbenmaschine

Schrägscheibenbauart, verstellbar	A6V

Betriebsart

Motor	M

Nenngröße

≅ Schluckvolumen $V_{g\,max}$ in cm³	

NG 250 - 1000 siehe RD 91603

Regel- und Verstelleinrichtung					**28**	**55**	**80**	**107**	**140**	**160**	**200**	
Hydraulische Verstellung, steuerdruckabhängig	HD	1			●	●	●	●	●	●	●	**HD1**
	HD		2		●	●	●	●	●	●	●	**HD2**
	HD	1		D	●	●	●	●	●	●	●	**HD1D**
	HD		2	D	●	●	●	●	●	●	●	**HD2D**
Hydraulische Zweipunktverstellung	HZ1				●	-	-	-	●	●	●	**HZ1**
	HZ3				-	●	●	●	-	-	-	**HZ2**
Elektrische Verstellung mit Proportionalmagnet	EP	1			●	●	●	●	●	●	●	**EP1**
	EP		2		●	●	●	●	●	●	●	**EP2**
	EP	1		D	●	●	●	●	●	●	●	**EP1D**
	EP		2	D	●	●	●	●	●	●	●	**EP2D**
Elektr. Zweipunktverstellung mit Schaltmagnet	EZ	1			●	-	-	-	●	●	●	**EZ1**
	EZ		2		●	-	-	-	●	●	●	**EZ2**
	EZ	3			-	●	●	●	-	-	-	**EP3**
	EZ		4		-	●	●	●	-	-	-	**EP4**
Automatische Verstellung, hochdruckabhängig	HA	1			●	❍	❍	❍	●	●	●	**HA1**
	HA		2		●	●	●	●	●	●	●	**HA2**
	HA	3			-	●	●	●	-	-	-	**HA3**
Hydraulische Verstellung, drehzahlabhängig												
p_{ST}/p_{HD} = 5/100, hydraulisches Fahrtrichtungsventil					●	●	●	●	●	●	●	**DA1**
el. Fahrtrichtungsventil (12 V) + el. Q_{max} Schaltung (12 V)					●	●	●	●	●	●	●	**DA2**
el. Fahrtrichtungsventil (24 V) + el. Q_{max} Schaltung (24 V)					●	●	●	●	●	●	●	**DA3**
p_{ST}/p_{HD} = 8/100, hydraulisches Fahrtrichtungsventil					●	●	●	●	●	●	●	**DA4**
el. Fahrtrichtungsventil (12 V) + el. Q_{max} Schaltung (12 V)					●	●	●	●	●	●	●	**DA5**
el. Fahrtrichtungsventil (24 V) + el. Q_{max} Schaltung (24 V)					●	●	●	●	●	●	●	**DA6**

Steuerdruckanstieg Δ p = 10 bar
Steuerdruckanstieg Δ p = 25 bar
mit Druckregelung

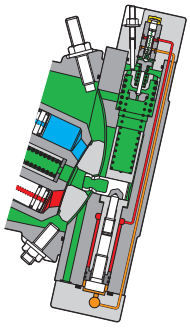
Steuerspannung 12 V
Steuerspannung 24 V
mit Druckregelung

Steuerspannung 12 V
Steuerspannung 24 V

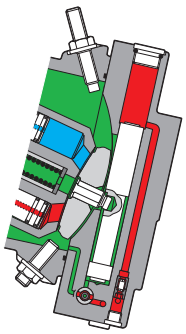
Ausführung ohne Druckanstieg
Ausführung mit Druckanstieg Δ p = 100 bar

Übersteuerung	**HA1**	**HA2**	**HA3**	
ohne Übersteuerung (kein Zeichen)	●	●	●	
mit hydraulischer Übersteuerung	●	●	●	**T**
mit elektrischer Übersteuerung, 12 V	●	●	●	**U1**
mit elektrischer Übersteuerung, 24 V	●	●	●	**U2**
mit el. Überst. + el. Fahrtrichtungsventil, 12 V	❍	❍	-	**R1**
mit el. Überst. + el. Fahrtrichtungsventil, 24 V	❍	❍	-	**R2**

Gleichgang-kolben



Differential-kolben



Type code A6V | M | | | / | 6 | 3 | W

Axial piston unit

Bent axis design, variable displacement	A6V

Mode of operation

Motor	M

Size

≅ Displacement $V_{g\,max}$ in cm³	28 55 80 107 140 160 200

Size 250 - 1000 see RE 91603

Control and regulating device

					28	55	80	107	140	160	200	
Hydraulische Verstellung, steuerdruckabhängig	HD	1			●	●	●	●	●	●	●	HD1
	HD		2		●	●	●	●	●	●	●	HD2
	HD	1		D	●	●	●	●	●	●	●	HD1D
	HD		2	D	●	●	●	●	●	●	●	HD2D
Hydraulic two-position control	HZ1				●	-	-	-	●	●	●	HZ1
	HZ3				-	●	●	●	-	-	-	HZ2
Electrical control, with proportional solenoid	EP	1			●	●	●	●	●	●	●	EP1
	EP		2		●	●	●	●	●	●	●	EP2
	EP	1		D	●	●	●	●	●	●	●	EP1D
	EP		2	D	●	●	●	●	●	●	●	EP2D
Electr. two-position control, w. switching solenoid	EZ	1			●	-	-	-	●	●	●	EZ1
	EZ		2		●	-	-	-	●	●	●	EZ2
	EZ	3			-	●	●	●	-	-	-	EP3
	EZ		4		-	●	●	●	-	-	-	EP4
Automatic control, high pressure related	HA	1			●	❍	❍	❍	●	●	●	HA1
	HA		2		●	●	●	●	●	●	●	HA2
	HA	3			-	●	●	●	-	-	-	HA3

with constant pressure control

Pilot pressure increase Δ p = 10 bar
Pilot pressure increase Δ p = 25 bar

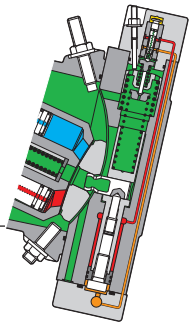
Control voltage 12 V
Control voltage 24 V

Model without pressure increase
Model with pressure increase Δ p = 100 bar

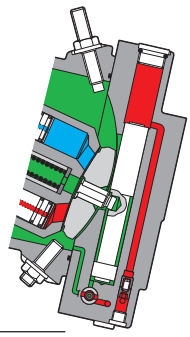
Override	HA1	HA2	HA3	
without override (no code)	●	●	●	
hydraulic override	●	●	●	T
electrical override, 12 V	●	●	●	U1
electrical override, 24 V	●	●	●	U2
el. override + el. valve for travel direction, 12 V	❍	❍	-	R1
el. override + el. valve for travel direction, 24 V	❍	❍	-	R2

Hydraulic control, speed related								
p_{ST}/p_{HD} = 5/100, hydraulic valve for travel direction	●	●	●	●	●	●	●	DA1
el. valve for travel direction (12 V) + el. Q_{max} switch (12 V)	●	●	●	●	●	●	●	DA2
el. valve for travel direction (24 V) + el. Q_{max} switch (24 V)	●	●	●	●	●	●	●	DA3
p_{ST}/p_{HD} = 8/100, hydraulic valve for travel direction	●	●	●	●	●	●	●	DA4
el. valve for travel direction (12 V) + el. Q_{max} switch (12 V)	●	●	●	●	●	●	●	DA5
el. valve for travel direction (24 V) + el. Q_{max} switch (24 V)	●	●	●	●	●	●	●	DA6

Synchronizing piston



Differential piston



HINWEIS

Bezeichnungen, Beschreibungen und Darstellungen entsprechen dem Informationsstand zum Zeitpunkt der Drucklegung dieser Unterlage.

Änderungen können den Service am Produkt beeinflussen, Verpflichtungen entstehen uns daraus nicht.

Methoden und Vorrichtungen sind Empfehlungen, für deren Resultat wir keine Haftung übernehmen können.

BRUENINGHAUS HYDROMATIK- Baugruppen, mit Angabe der Fabrik-Nr. bestellt, sind die Basis guter Reparaturen.

Einstell- und Prüfarbeiten sind bei Betriebstemperatur auf dem Teststand vorzunehmen.

Schutz von Personen und Eigentum ist durch Vorkehrungen sicherzustellen.

Sachkenntnis, die Voraussetzung für jede Servicearbeit, vermitteln wir in unseren Schulungskursen.

NOTICE

Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing.

BRUENINGHAUS HYDROMATIK reserves the right to discontinue models or options at any time or to change specifications, materials, or design without notice and without incurring obligation.

Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options.

For the available combinations refer to the relevant data sheet for the basic unit and the desired option.

Adjustment and tests have to be carried out on the test bench under operating temperatures.

Protection of personnel and property has to be guaranteed by appropriate measures.

Expert knowledge, the precondition of any service work, can be obtained in our training courses.

INHALT

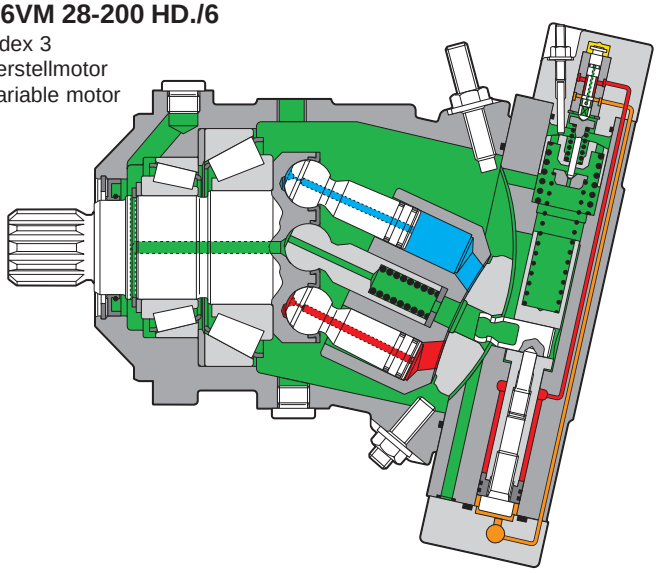
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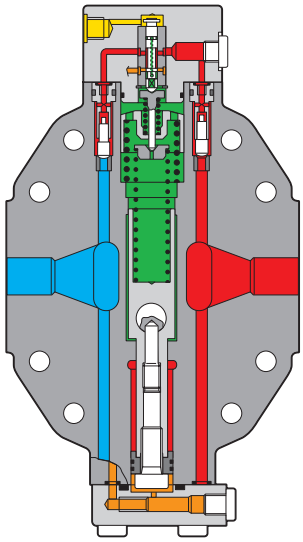
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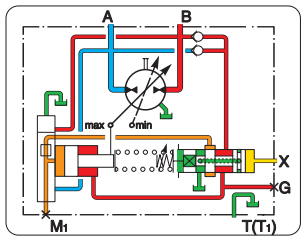
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Type code	
Notice / Contents	
Sectional view	
General repair instructions	
Seal kits and sub assembly groups	
Component groups / Control components	
Replace seal nut	
Sealing of the cover plate	
Sealing of the control parts	
Sealing of the hydraulic parts	
Disassembly of the port plate	
Remove of the positioning piston	
Remove rotary group	
Exchanging of the rotary group	
Inspection notes	
Rotary group assembly	
Rotary group adjustment	
Assembly of the port plate	
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Safety regulations	

A6VM 28-200 HD./6

Index 3
Verstellmotor
Variable motor

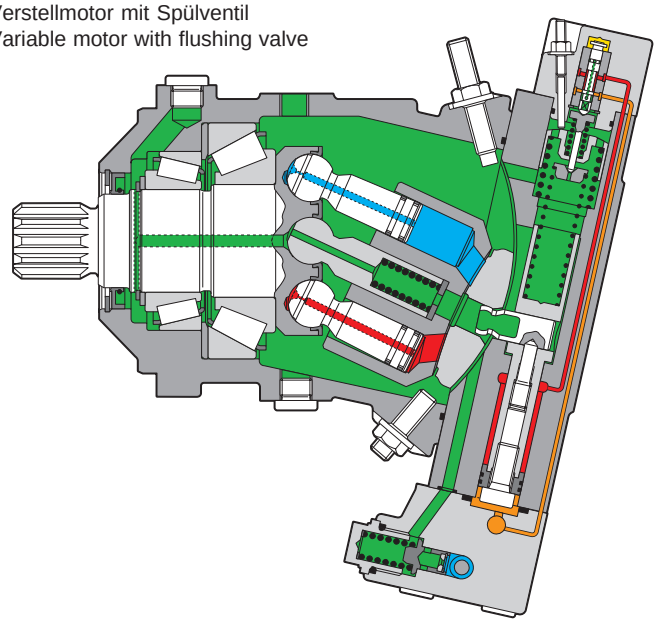


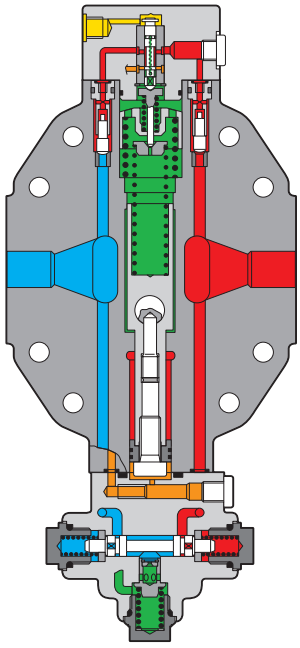


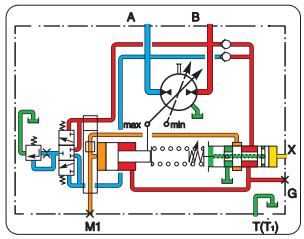


A6VM 28-200 HD./6

Index 3
Verstellmotor mit Spülventil
Variable motor with flushing valve

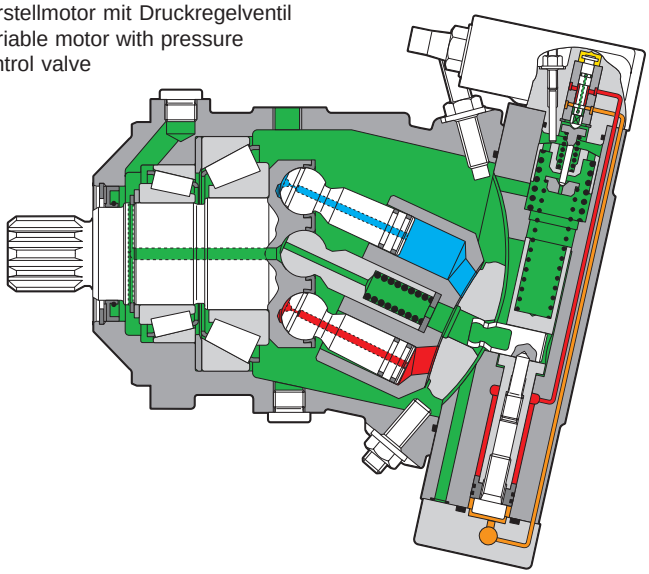


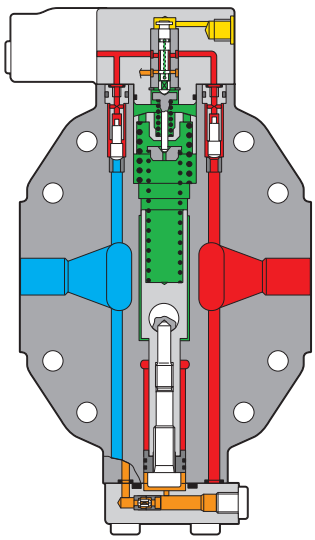


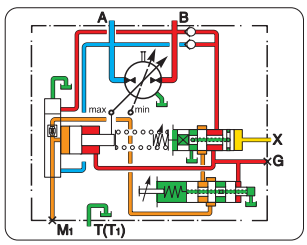


A6VM 28-200 HD1D/6

Index 3
Verstellmotor mit Druckregelventil
Variable motor with pressure control valve

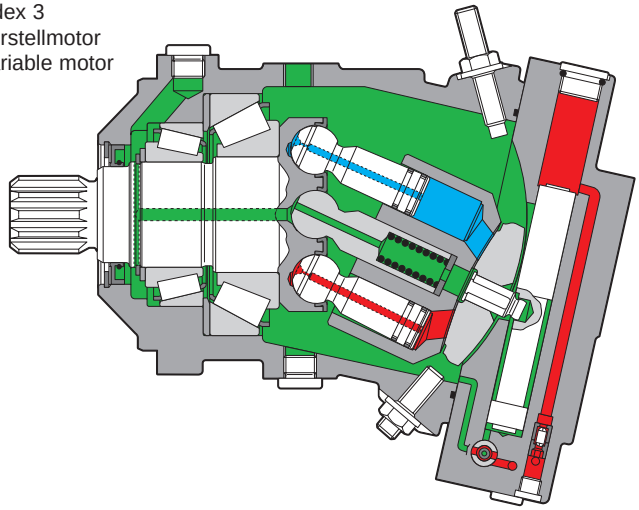


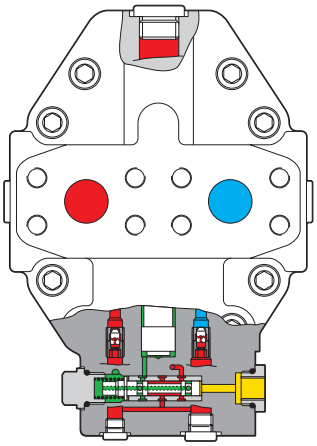


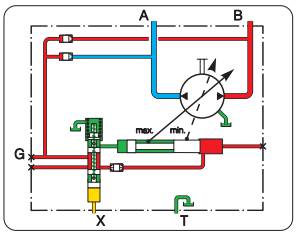


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Index 3
Verstellmotor
Variable motor

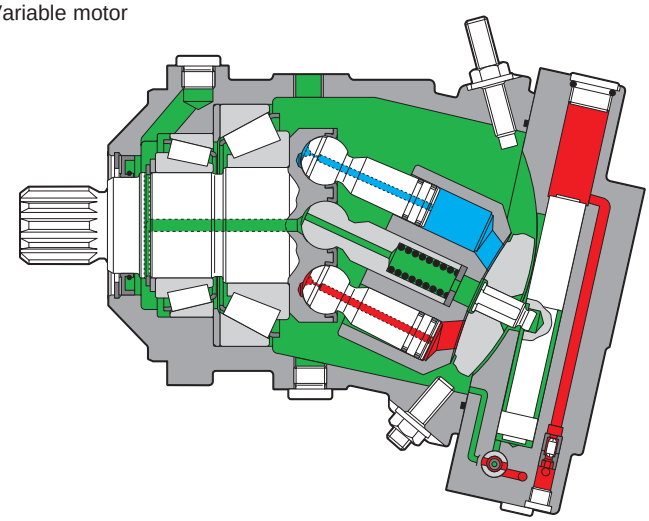


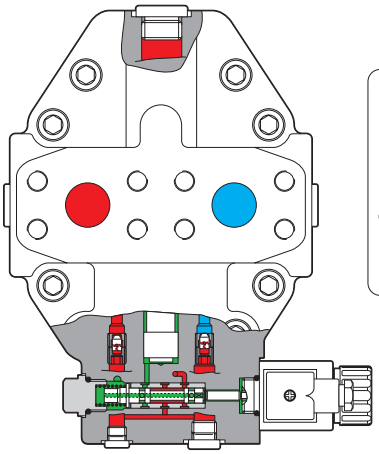


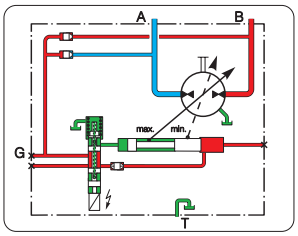


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Index 3
Verstellmotor
Variable motor

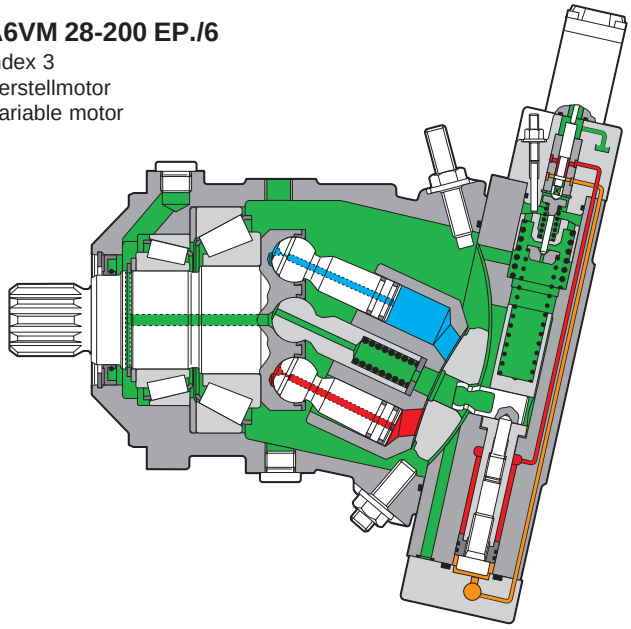


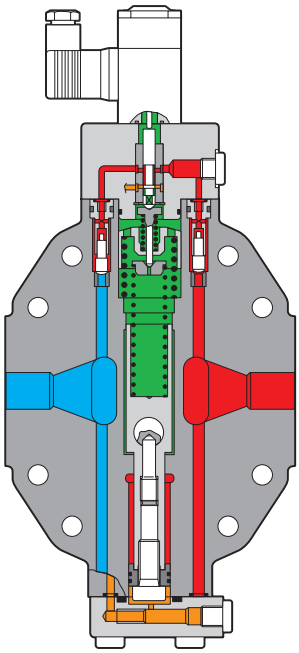


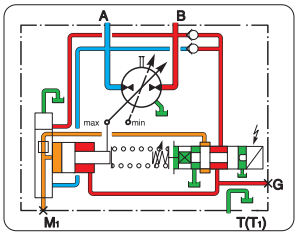


A6VM 28-200 EP./6

Index 3
Verstellmotor
Variable motor

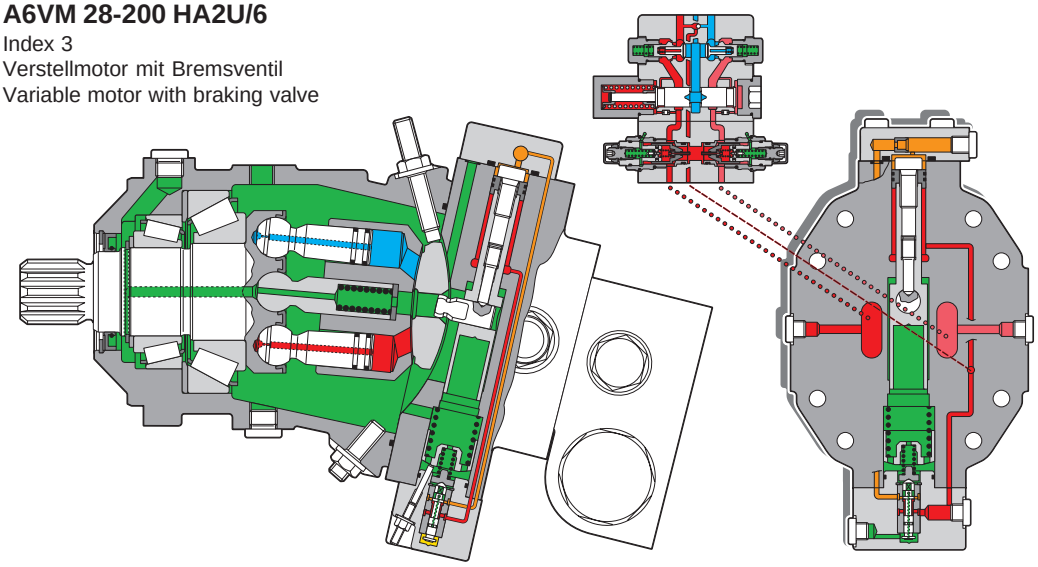


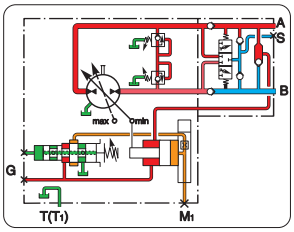




A6VM 28-200 HA2U/6

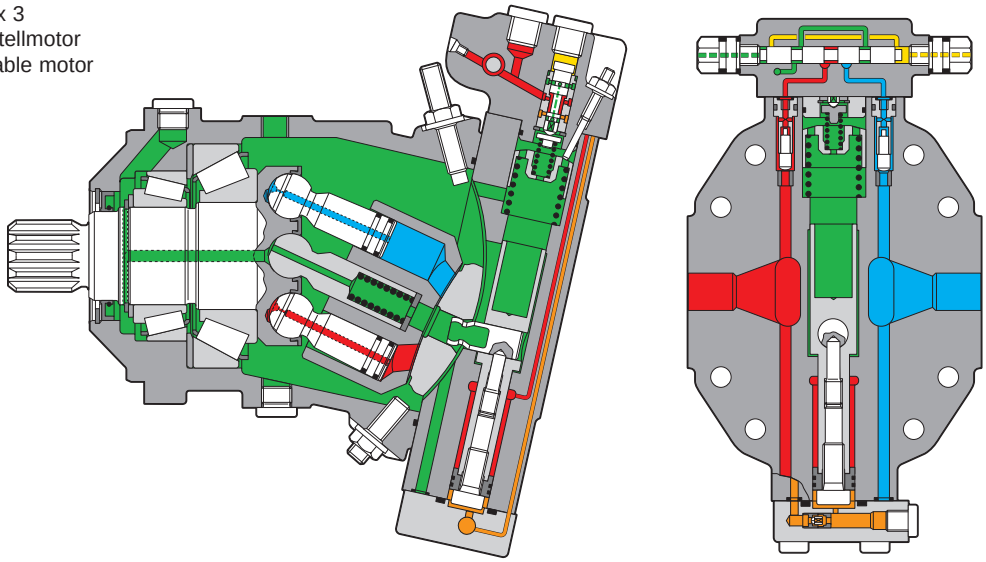
Index 3
Verstellmotor mit Bremsventil
Variable motor with braking valve

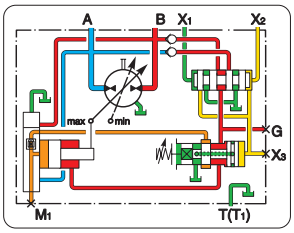




A6VM ... DA1/6

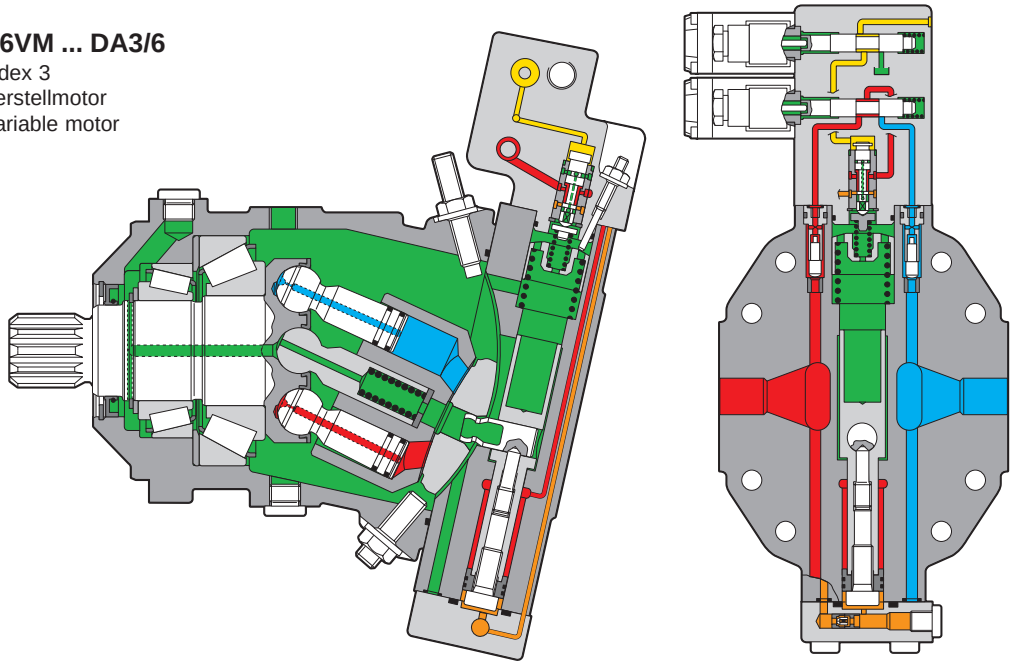
Index 3
Verstellmotor
Variable motor

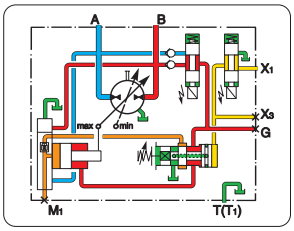




A6VM ... DA3/6

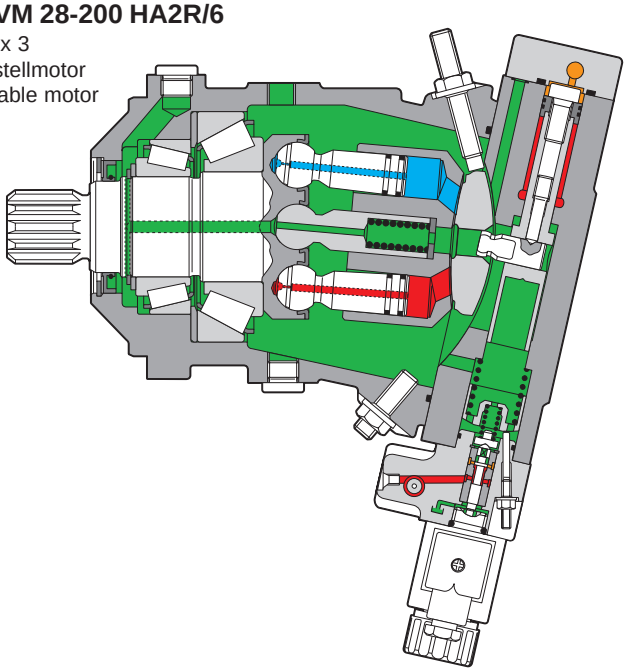
Index 3
Verstellmotor
Variable motor

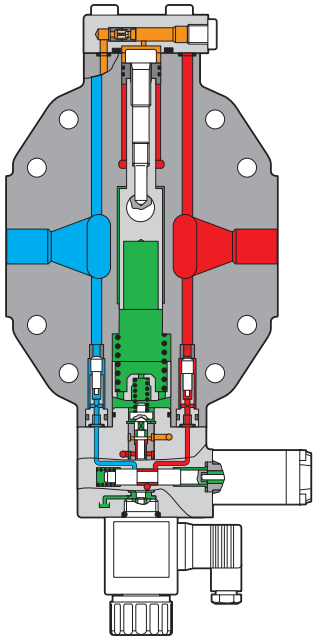


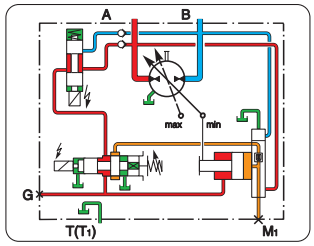


A6VM 28-200 HA2R/6

Index 3
Verstellmotor
Variable motor

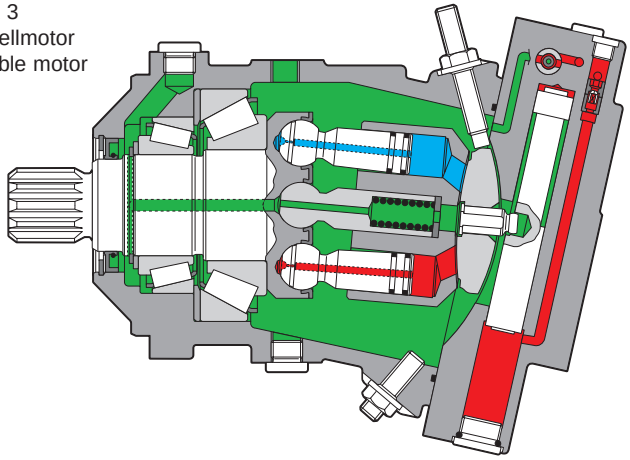


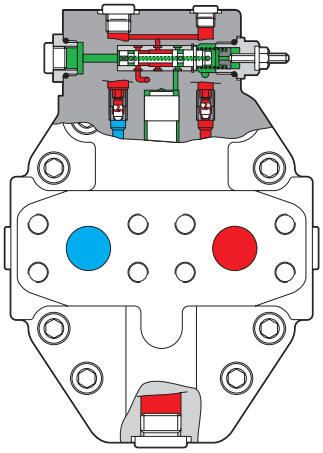


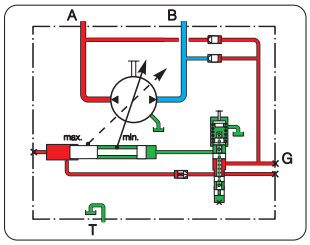


A6VM 55-107 HA3/6

Index 3
Verstellmotor
Variable motor

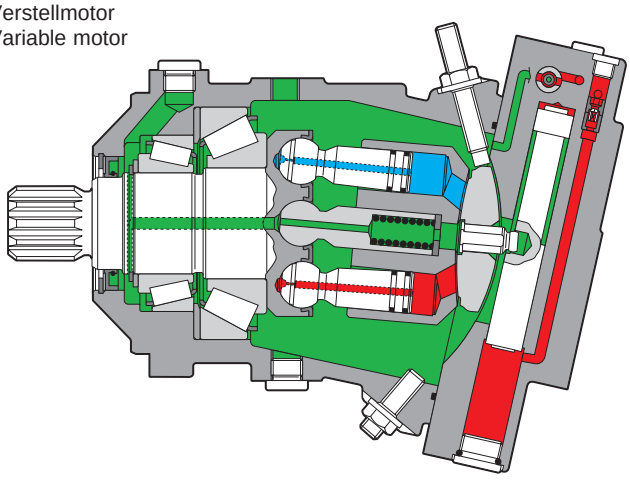


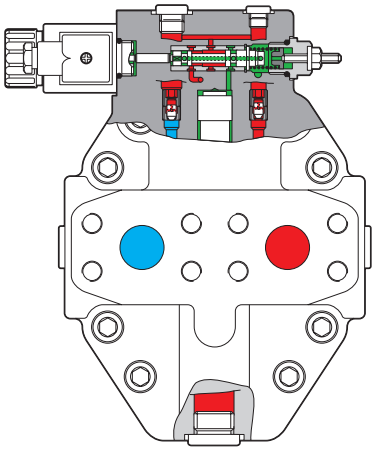


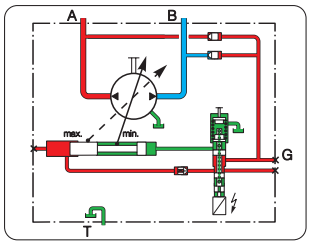


A6VM 55-107 HA3U/6

Index 3
Verstellmotor
Variable motor



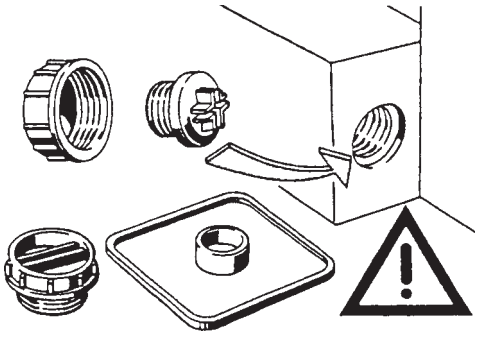






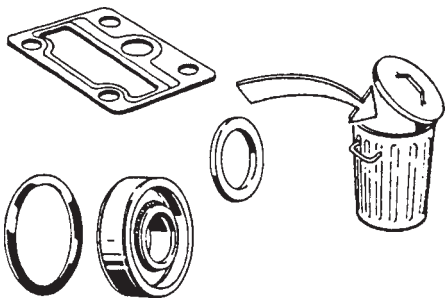
Achtung!
Nachfolgend Hinweise bei allen Reparaturarbeiten an Hydraulikaggregaten beachten!

Attention!
Observe the following notices when carrying out repair work at hydraulic aggregates!



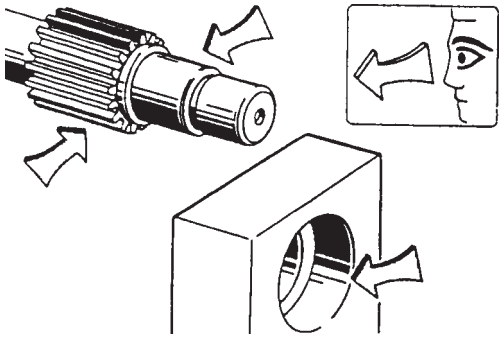
Alle Öffnungen der Hydraulikaggregate verschließen.

Close all ports of the hydraulic aggregates.



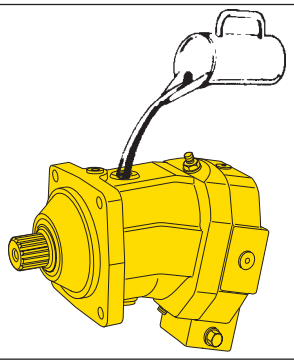
Alle Dichtungen erneuern.
Nur original HYDROMATIK-Ersatzteile verwenden.

Replace all seals.
Use only original HYDROMATIK spare parts.



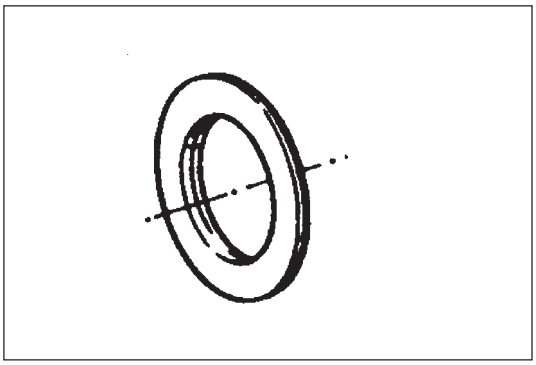
Alle Dicht- und Gleitflächen auf Verschleiß prüfen.
Achtung: Nacharbeiten an Dichtflächen z.B. durch Schleifpapier kann die Oberfläche beschädigen.

Check all seal and sliding surfaces for wear.
Attention: Rework of sealing area f. ex. with abrasive paper can damage surface.



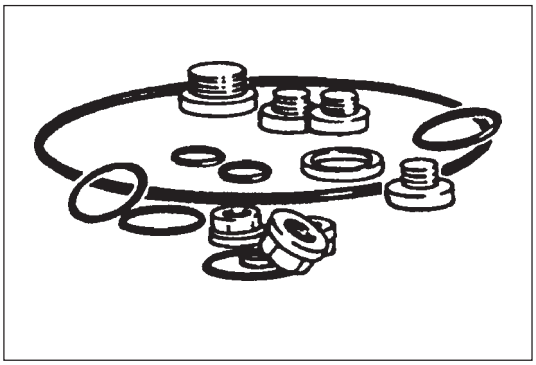
Hydraulikaggregate vor Inbetriebnahme mit Betriebsmedium befüllen.

Fill up hydraulic aggregates with medium before start- up.



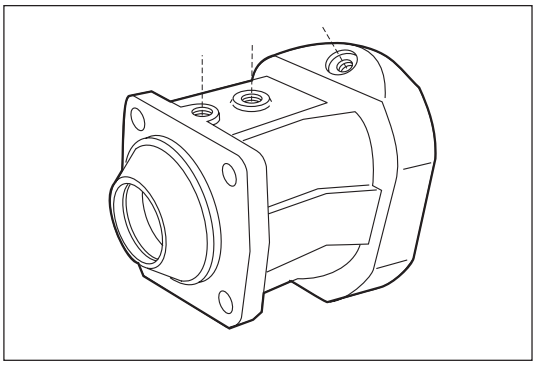
1 Dichtsatz für Triebwelle.

Seal kit for drive shaft.



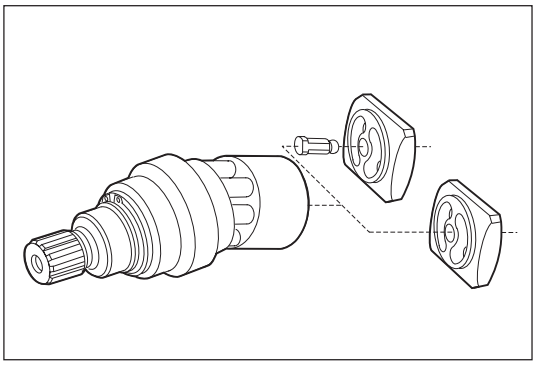
2 Äußerer Dichtsatz.

External seal kit.



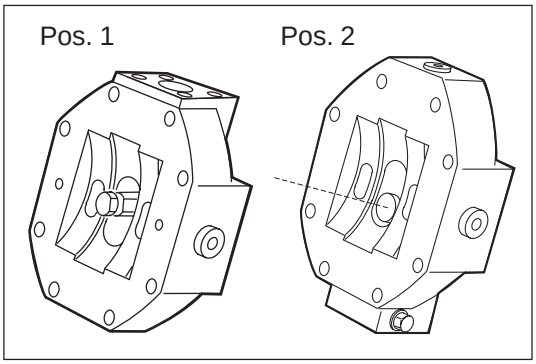
3 Gehäuse

Housing



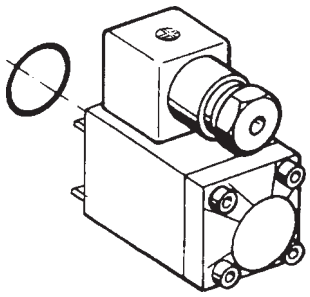
4 Triebwerk komplett
Hinweis: Pos. 1 - Für Anschlußplatte mit Differentialkolben
Pos. 2 - Für Anschlußplatte mit Gleichgangkolben

Complete rotary group
Note: Pos. 1 - For port plate with differential piston
Pos. 2 - For port plate with synchronizing piston



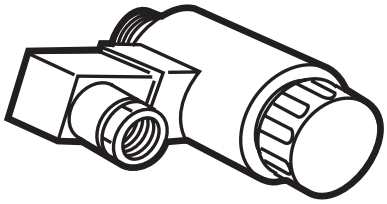
5 Anschlußplatte mit Stellkolben
Hinweis: Pos. 1 - Für Anschlußplatte mit Differentialkolben
Pos. 2 - Für Anschlußplatte mit Gleichgangkolben

Port plate with control piston
Note: Pos. 1 - For port plate with differential piston
Pos. 2 - For port plate with synchronizing piston



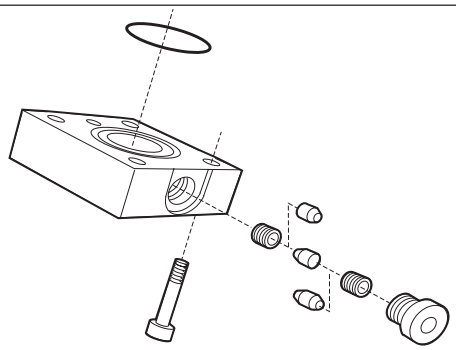
6 Proportionalmagnet (EP)

Proportional solenoid (EP)



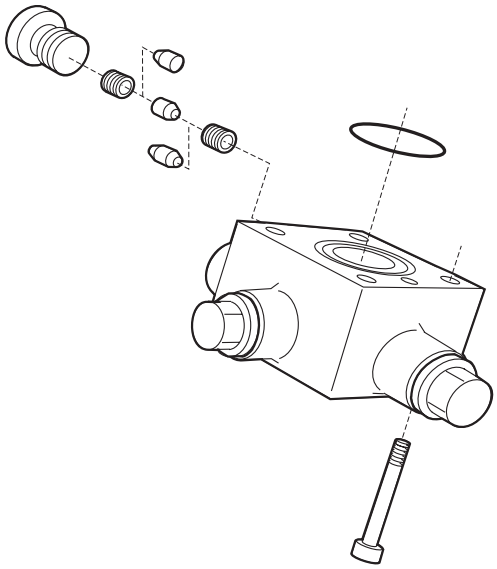
7 Schaltmagnet

Solenoid



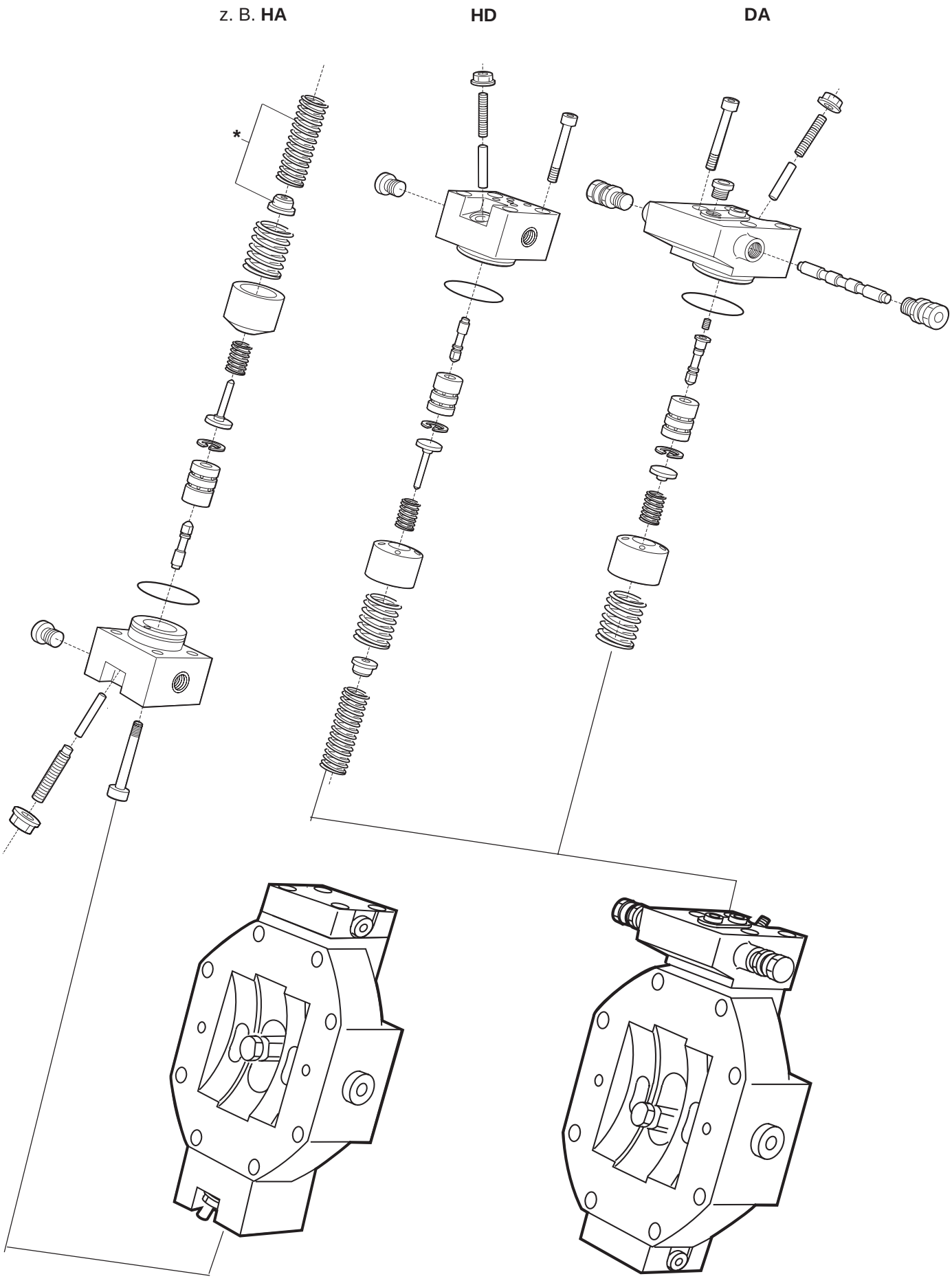
8 Deckel mit * Drosselstift.
* Drosselstift "Auftragsbezogen".

Cover with * throttle pin.
* Throttle pin "as to order requirement".

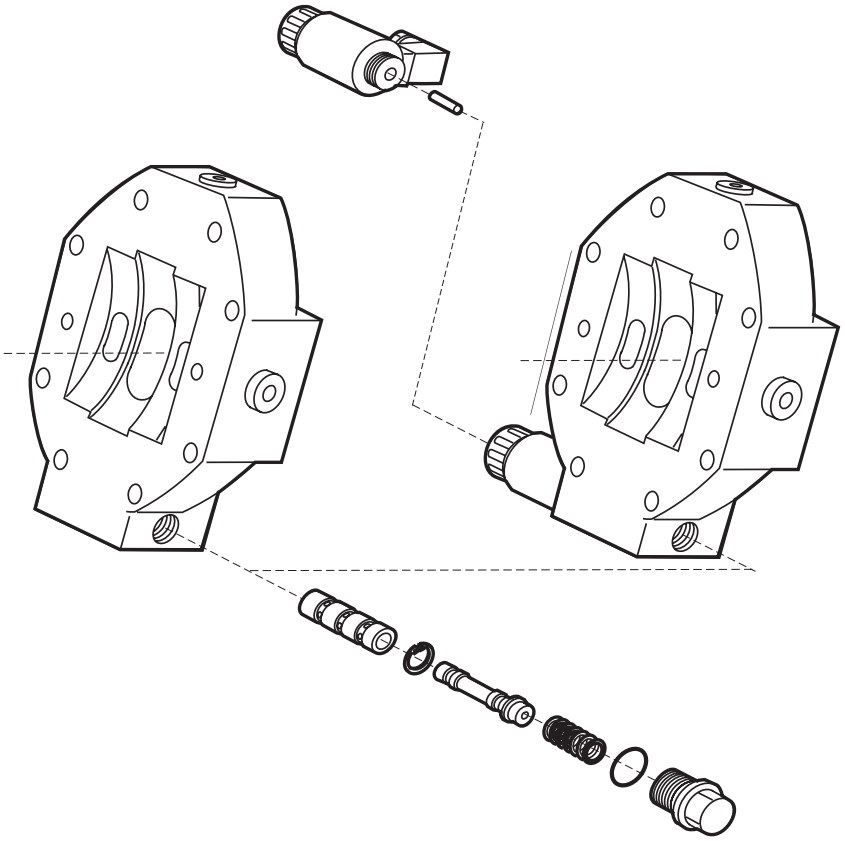


9 Deckel mit Spül- und Speisedruckventil und * Drosselstift
* Drosselstift "Auftragsbezogen".

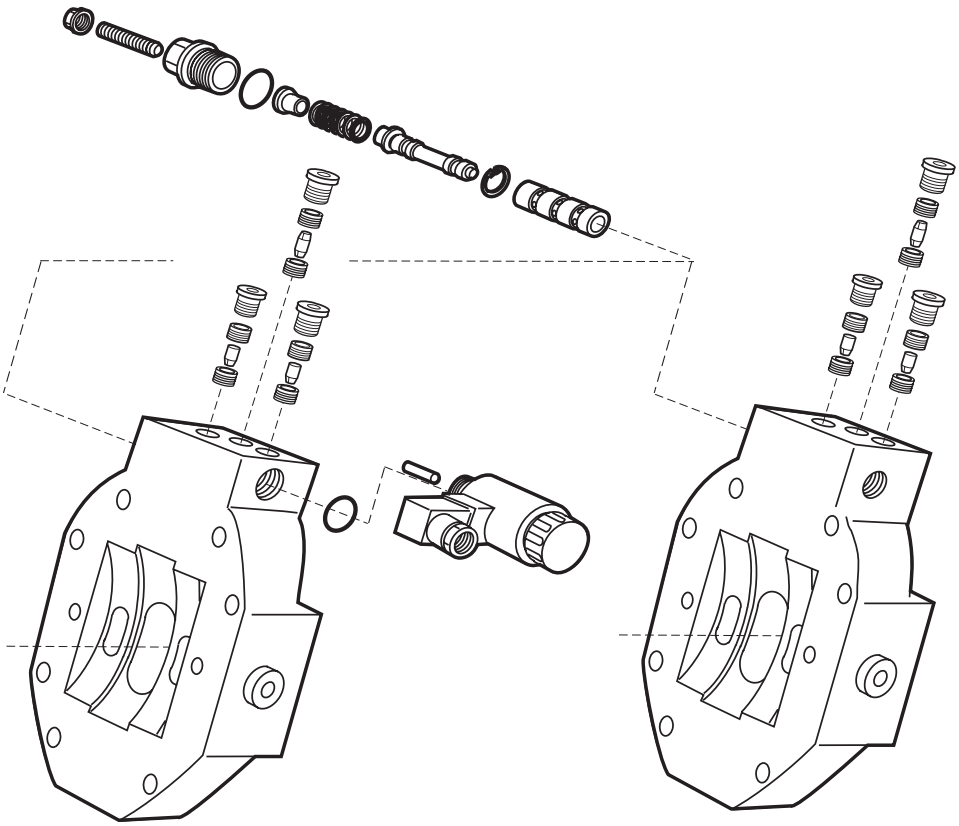
Cover with flushing and boost pressure valve and
* throttle pin.
* Throttle pin "as to order requirement".

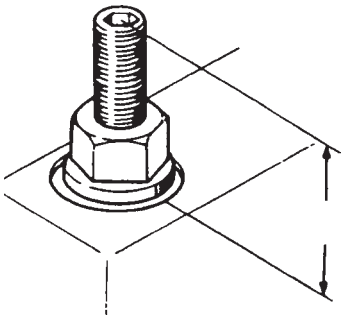

z. B. **HA**
HD
DA
*

z. B. **HZ3 / EZ3**



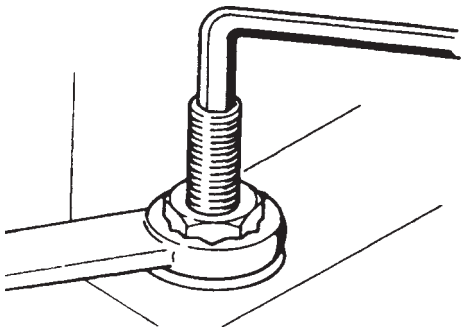
HA3 / HA3U





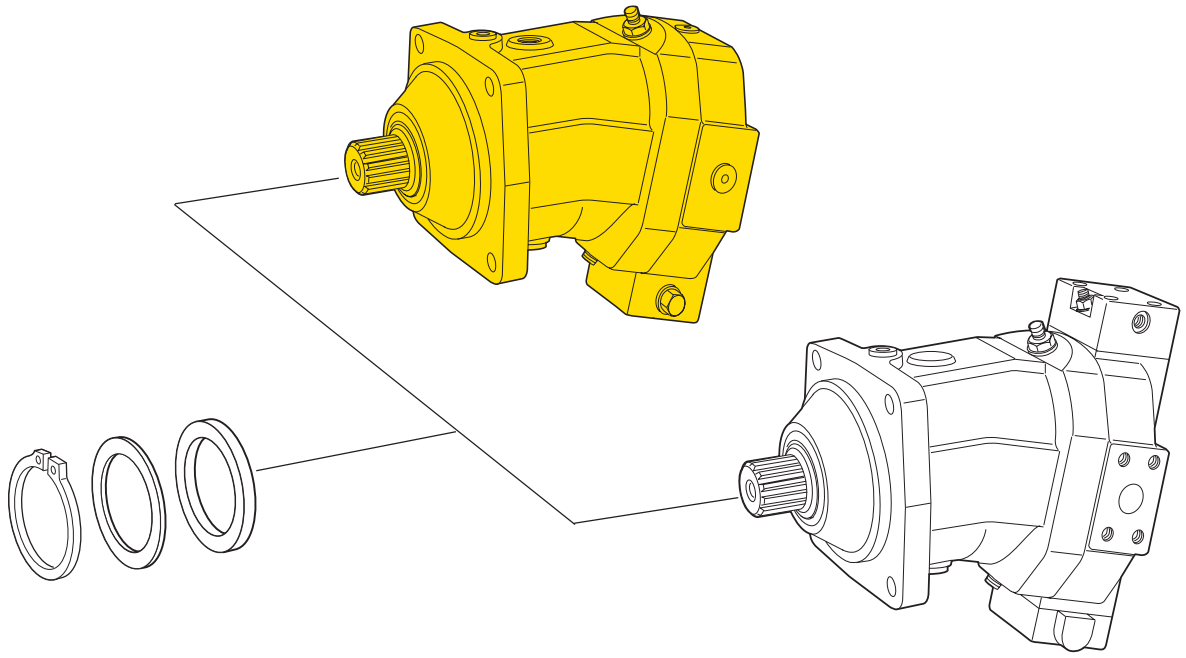
10 Dichtmutter austauschen.
Zuerst Einstellhöhe messen und festhalten.

Replace seal nut.
First measure and record setting height.

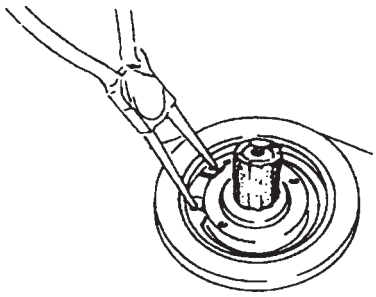


11 Beim Anziehen Einstellschraube gegenhalten, anschließend Einstellhöhe kontrollieren.

When tightening, counterhold setting screw, then check setting height.

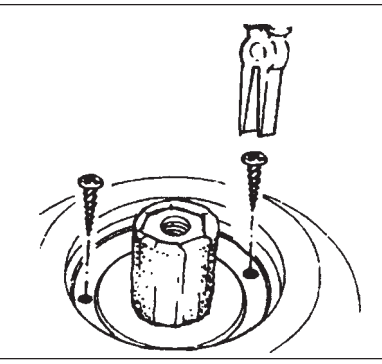


12



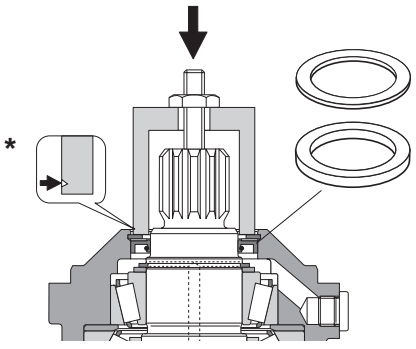
13 Triebwelle abkleben.
Sicherungsring und Scheibe ausbauen.

Protecting the drive shaft.
Remove retaining ring and shim.



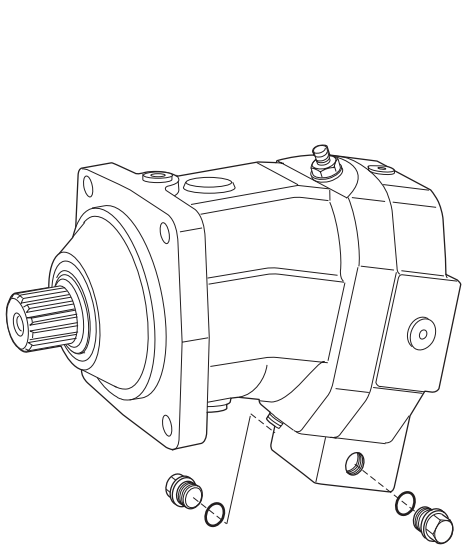
14 Blechschraube in die mit Gummi gefüllten Löcher eindrehen.
Mit Zange WDR herausziehen.

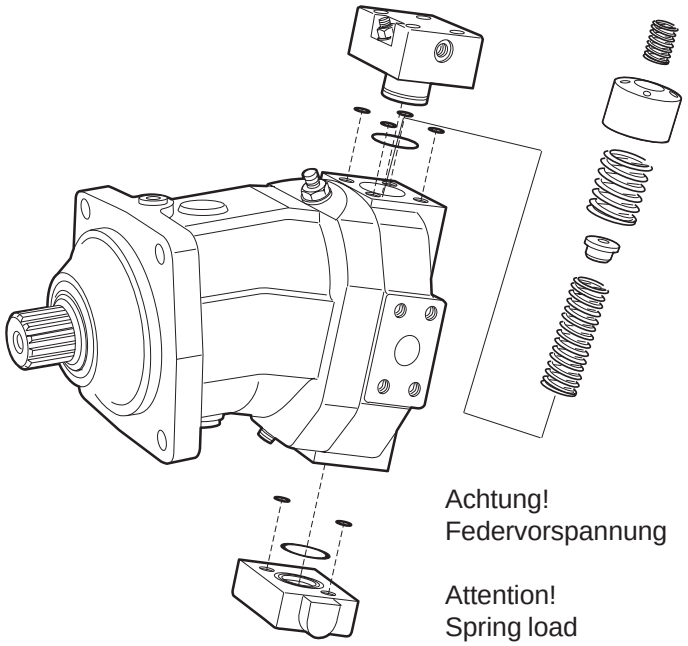
Screw in sheet metal screw into the holes fitted with rubber.
Pull out seal with pliers.



15 Wellendichtring und Scheibe mit Montagehülse einpressen.
⚠ Einpresstiefe beachten! * Marke für Einpresstiefe.
Sicherungsring einbauen.

Press in shaft seal ring and shim with bush to stop.
⚠ Take note of press-in depth!
Install mark for press-in depth of safety ring.

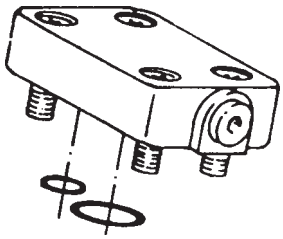




Achtung!
Federvorspannung

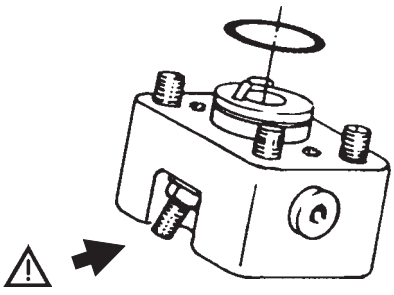
Attention!
Spring load

16



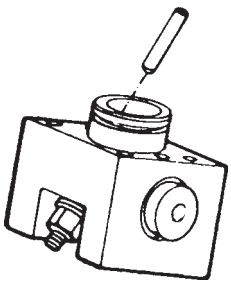
17 Kontrolle
Bohrung im Gehäuse, O-Ring, Nut.

Inspect
Drilling in housing, O-ring, groove.



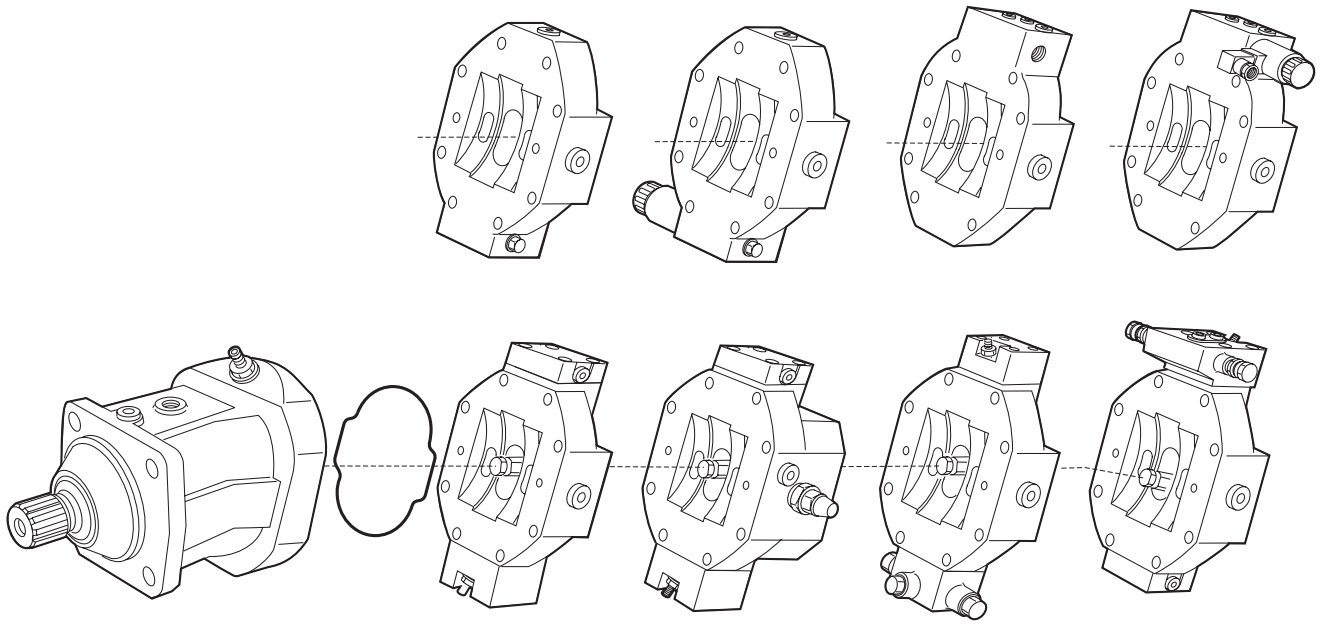
18 ⚠ Einstellschraube nicht ausbauen.
Kontrolle
O-Ring, O-Ring-Nut, Gehäuse

⚠ Do not remove adjustment screw.
Inspect
O-ring, O-ring groove, housing

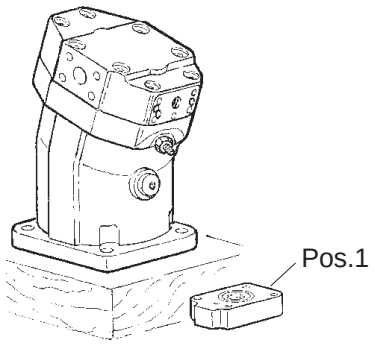


19 Montagehilfe
Stift mit Fett einkleben.

Assembly aid
Insert pin with grease.

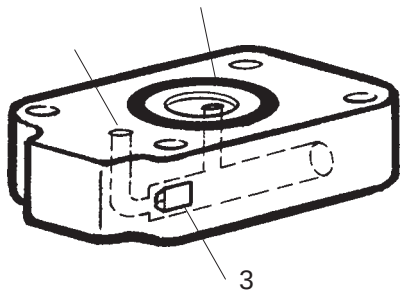


20



21 Beispiel: A6VM ... HD Verstellung
Demontageposition:
Deckel Pos. 1 abbauen.

Example: A6VM ... HD control
Disassembly position:
Remove cover pos. 1

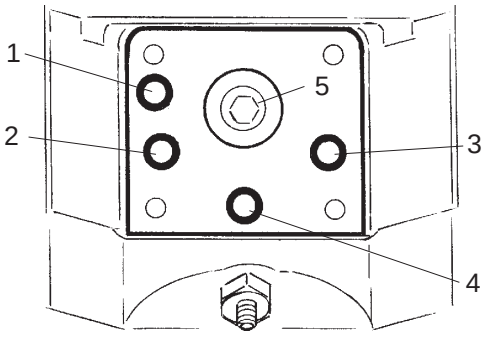


22
1. O-Ring
2. Stellölzulauf
3. Drosselstift

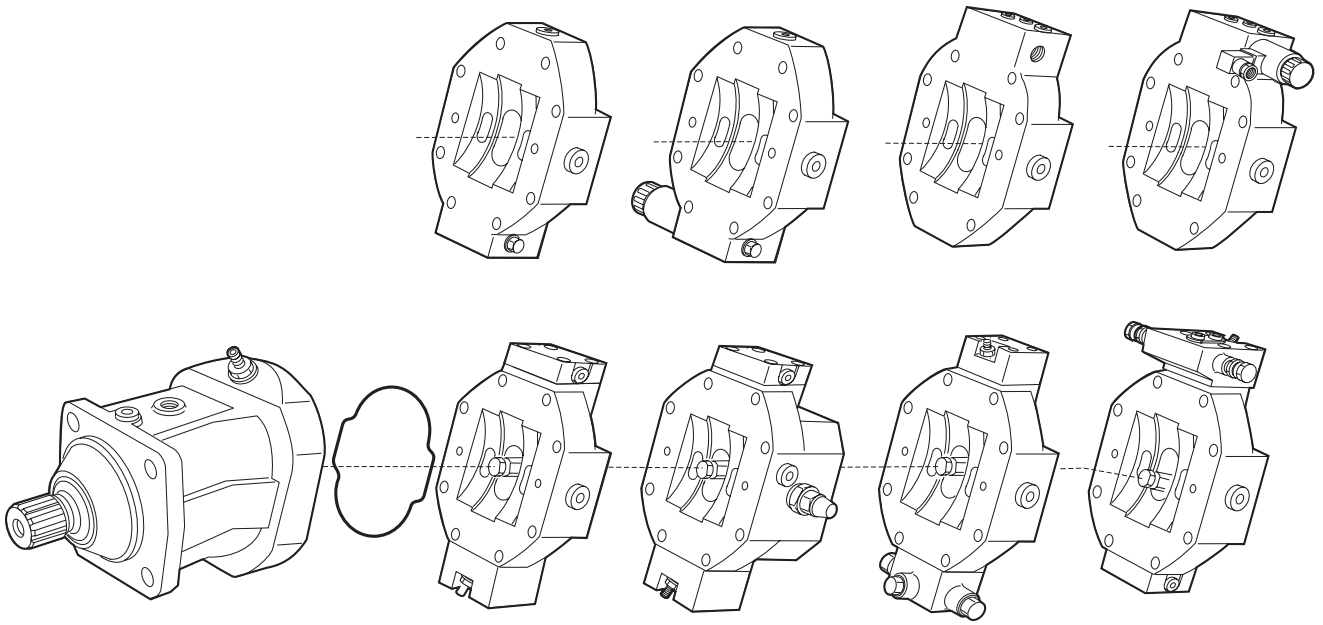
⚠ Einbaulage je nach Steuerteil verschieden.

1. O-ring
2. Input flow of oil control
3. Throttle pin

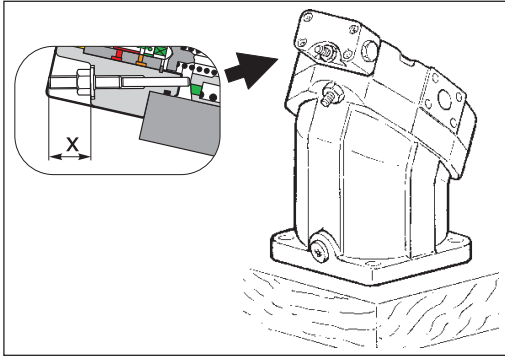
⚠ Installation position differs according to the control components



23
1. Stellölzulauf
2. Hochdruck bzw. Niederdruck
3. Hochdruck bzw. Niederdruck
4. Lecköl
5. Stellkolben

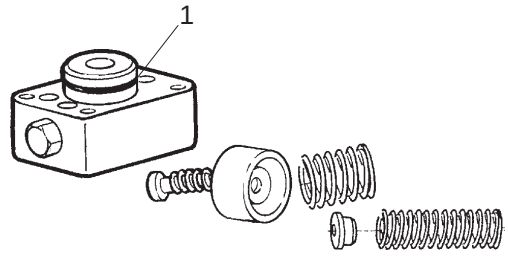


24



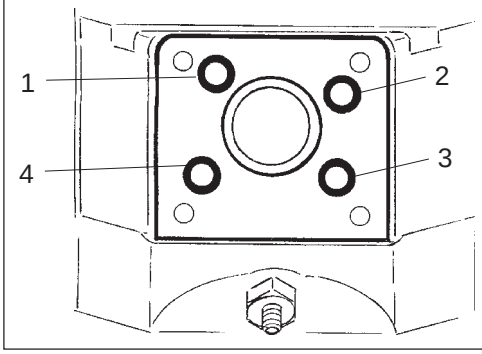
25 Beispiel: A6VM ... Verstellung - **Differentialkolben**
Demontageposition: Deckel Pos. 2 abbauen.
⚠ Achtung! Federvorspannung.
Maß x: Maß festhalten (Regelbeginn).

Example: A6VM... control - **differential piston**
Disassembly position: Remove cover pos. 2.
⚠ Attention! Spring load.
Dimension x: Note dimension (begin of regulation).



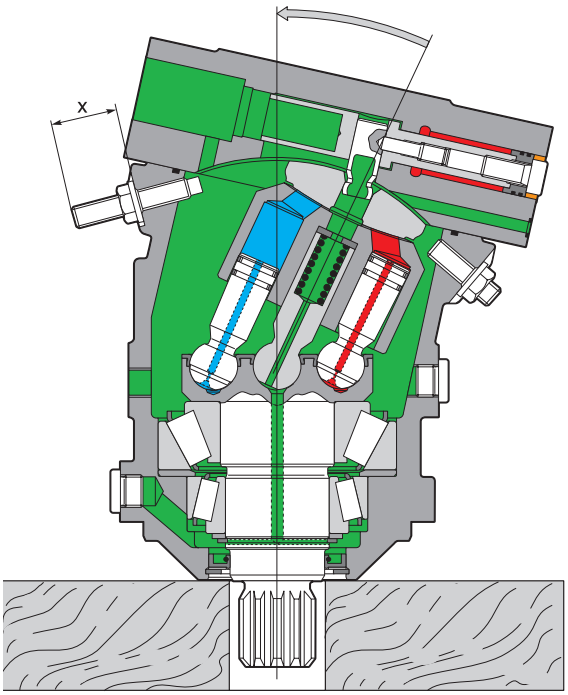
26 1. O-Ring Kontrolle

1. Check of O-ring



27 1. Hochdruck - kleine Stellkolbenseite
2. Stelldruck
3. Hochdruck - Rückschlagventil
4. Hochdruck - Rückschlagventil

1. High pressure - small control piston side
2. Control pressure
3. High pressure - check valve
4. High pressure - check valve



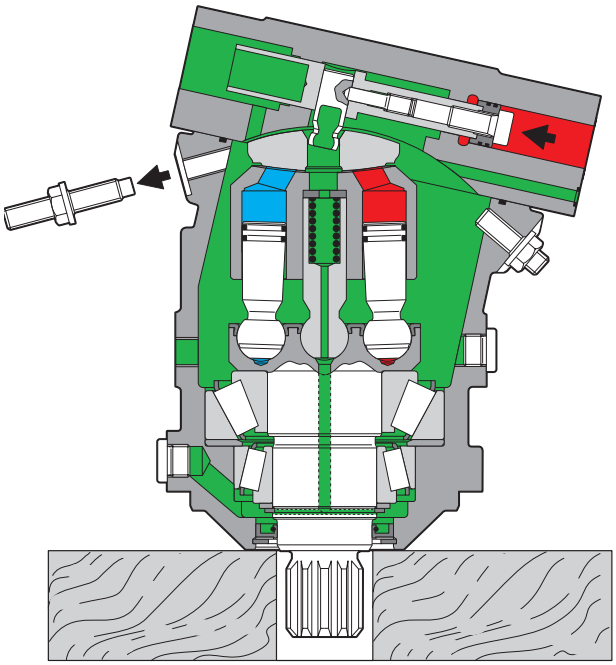
Differentialkolben:
Maß X festhalten.

Diferential piston:
Note dimension x

⚠

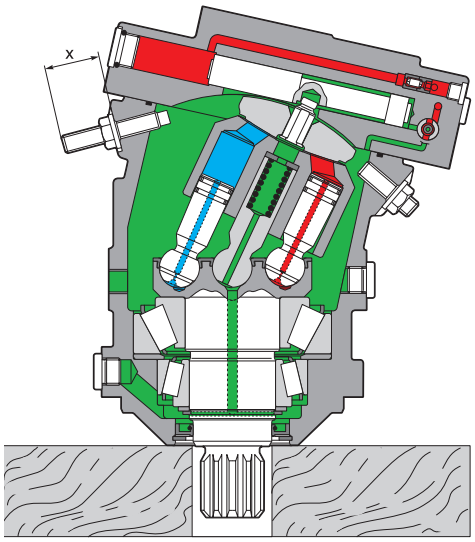
Bei "Demontage" der Anschlußplatte "Triebwerk" immer auf Null schwenken. Kolbenringe hängen aus der Zylinderbohrung aus.

For disassembly of the port plate, swivel always rotary group to zero position. Piston rings to hang out of the cylinder boring.



Q_{min}-Schraube ausbauen.
Triebwerk auf 0^{o} schwenken.

Remove Q_{min}-screw.
Swivel rotary group to 0^{o}.



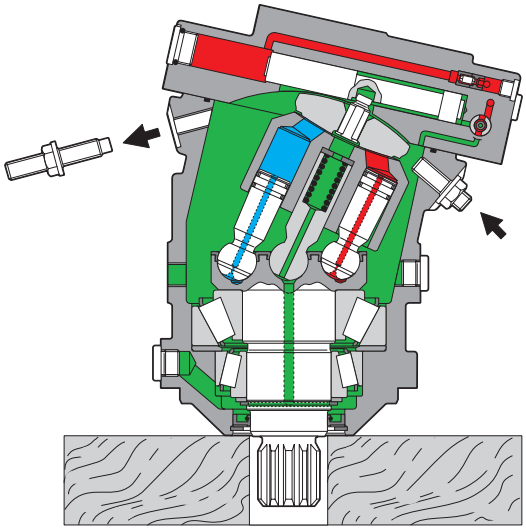
Gleichgangkolben:
Maß X festhalten.

Synchronizing piston:
Note dimension x.

⚠

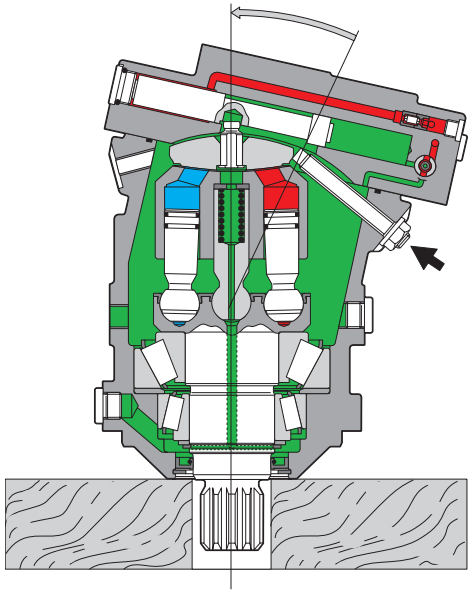
Bei "Demontage" der Anschlußplatte "Triebwerk" immer auf Null schwenken. Kolbenringe hängen aus der Zylinderbohrung aus.

For disassembly of the port plate, swivel always rotary group to zero position. Piston rings to hang out of the cylinder boring.



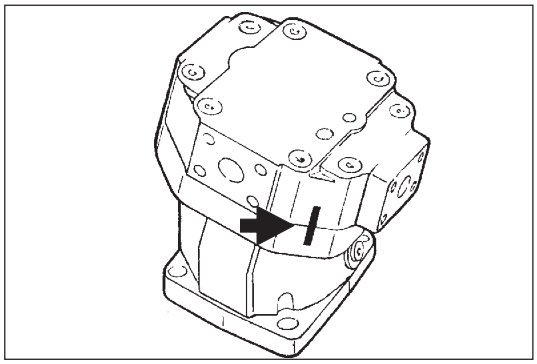
Q_{min}-Schraube und Verschlußschraube ausbauen.

Remove Q_{min}-screw and plug.



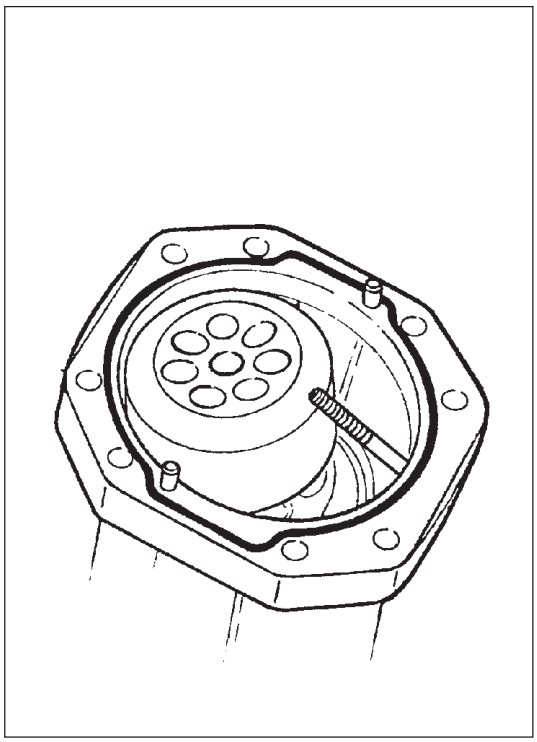
Mit Schraube Q_{min} Triebwerk auf 0^{o} schwenken.

Swivel rotary group to zero position with screw Q_{min} .



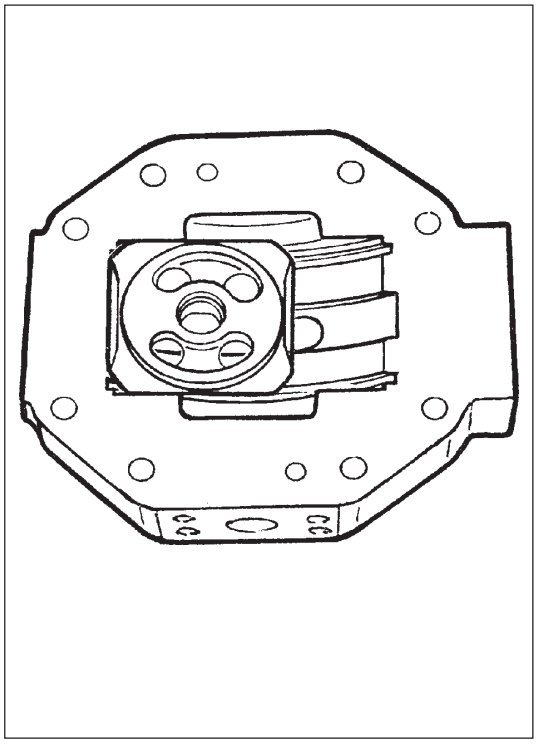
28 Anschlußplatte
Lage markieren. Schrauben lösen.
Abbauen

Port plate
Mark position. Loosen screws.
Removal



29 O-Ring austauschen.
Neuer O-Ring mit etwas Fett einkleben.
⚠ Treibwerk nicht ausschwenken.
Kolbenringe hängen aus der Zylinderbohrung aus.

Check O-ring.
Stick new O-ring with some grease.
⚠ Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.



30 ⚠ Steuerlinse in Gleitbahn mit Fett einkleben.
Fertigmontage in umgekehrter Reihenfolge.
Anschlußplatte aufsetzen.

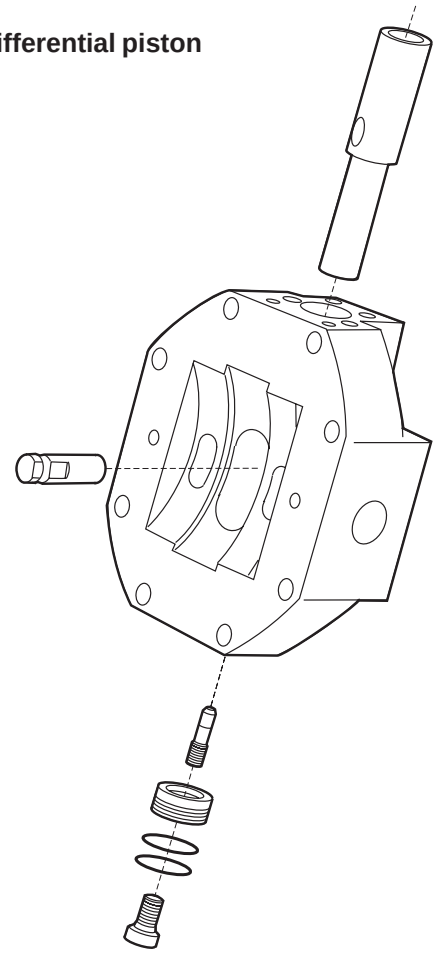
⚠ Triebwerk senkrecht.

⚠ Stick control lens in sliding surface with grease.
Assembly in reversal order.
Mount port plate.

⚠ Rotary group vertical.

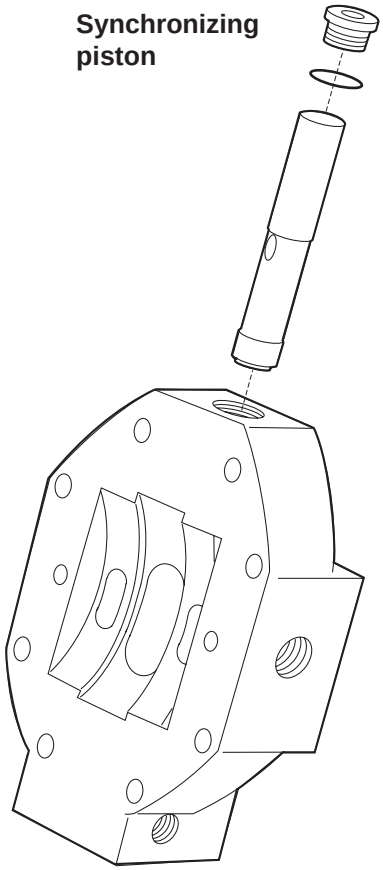
Differentialkolben

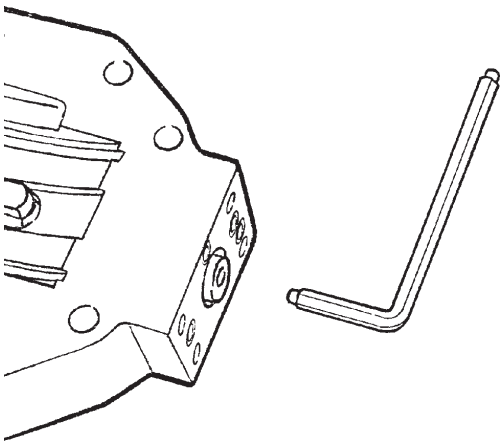
Differential piston



Gleichgangkolben

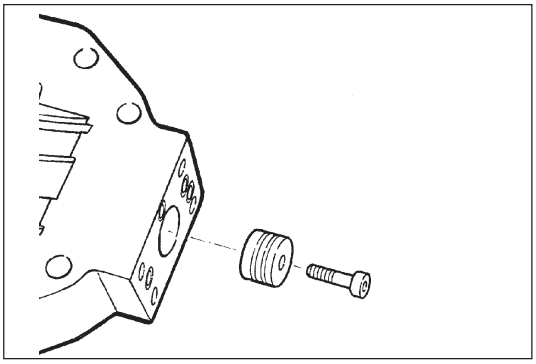
Synchronizing piston





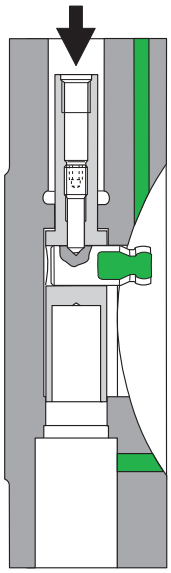
32 Befestigungsschraube lösen.
Nur Zapfenschlüssel verwenden.

Loosen fixing screw.
Use only socket wrench.



33 Kolben mit Kolbenring ausbauen.

Remove piston with piston ring



34 **Differentialkolben**

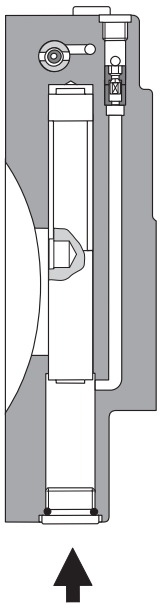
Befestigungsschraube für Stellzapfen über Bohrung erwärmen. (Schraube geklebt - herausdrehen)

Neue Schraube verwenden
Precote Beschichtung
⚠ Anziehdrehmomente beachten!

Differential piston

Warm up fixation screw for positioning plug via boring (screw glued - to turn out).

Use new screw.
Precote coating.
⚠ Note tightening torque!



35 **Gleichgangkolben**

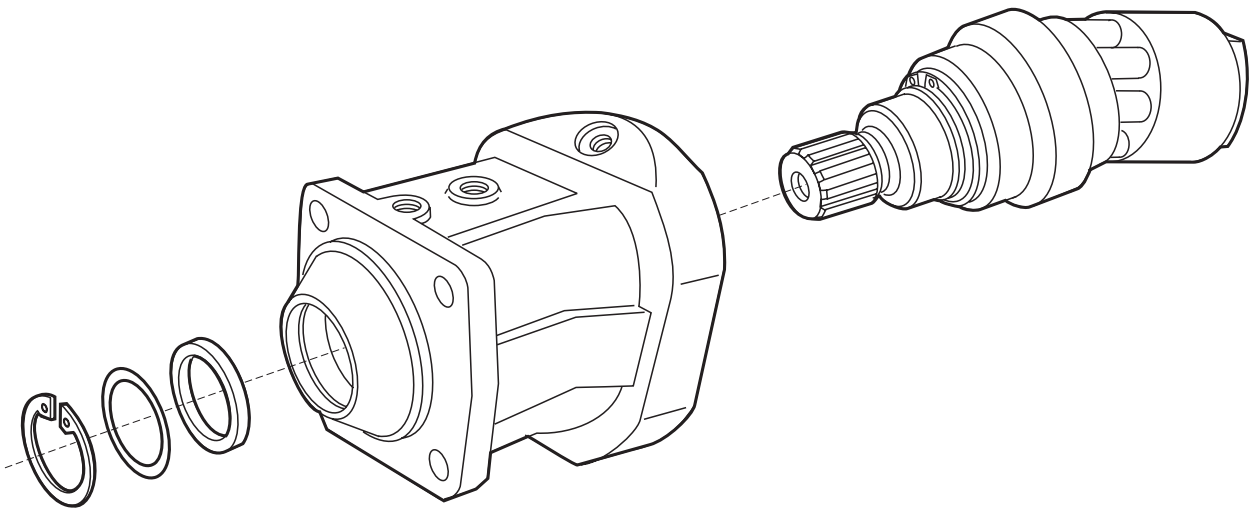
Schraube ausbauen.
Kolben ausbauen.

⚠ Einbaulage beachten.

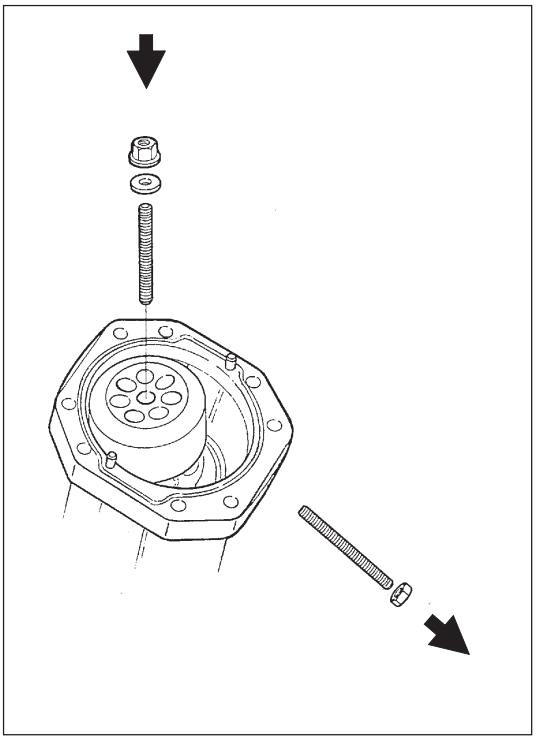
Synchronizing piston

Remove screw.
Remove piston.

⚠ Note installation position.



36

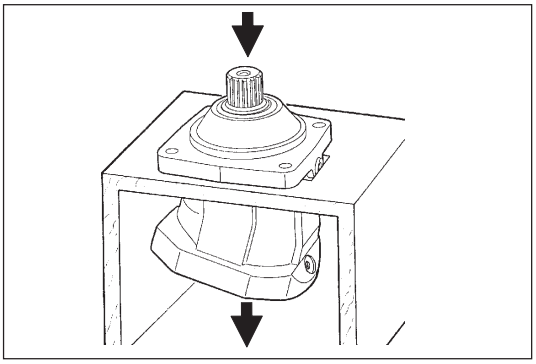


37

Gewindestift in Mittelzapfen einschrauben,
mit Scheibe und Mutter Zylinder befestigen.
Q_{max} - Anschlagschraube ausbauen.

Screw in threaded pin into center pin.
Fix the cylinder with disc and locknut.
Remove Q_{max} -stop screw.

Nenngröße / Size	28 :	M4 x 58 mm
	55 :	M5 x 71 mm
	80 :	M6 x 82 mm
	107 :	M6 x 92 mm
	140 :	M8 x 105 mm
	160 :	M8 x 105 mm
	200 :	M8 x 109 mm



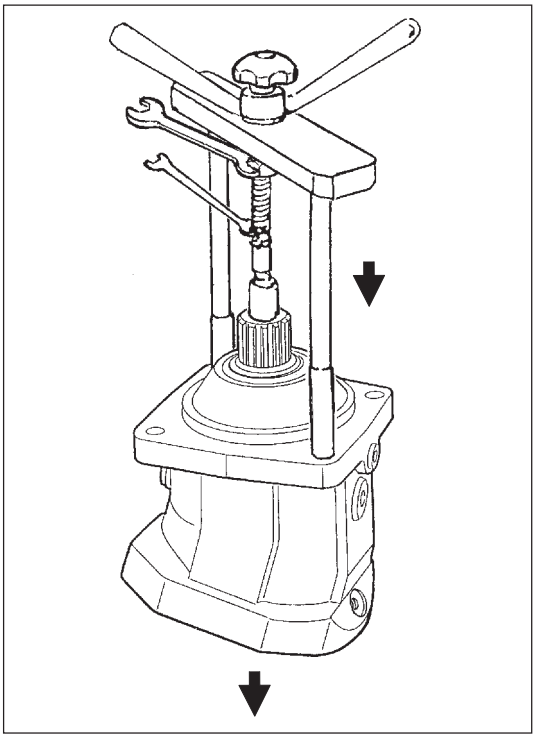
38

Triebwerk auspressen!

⚠ Bei Wiederverwendung der Lager nicht schlagen.

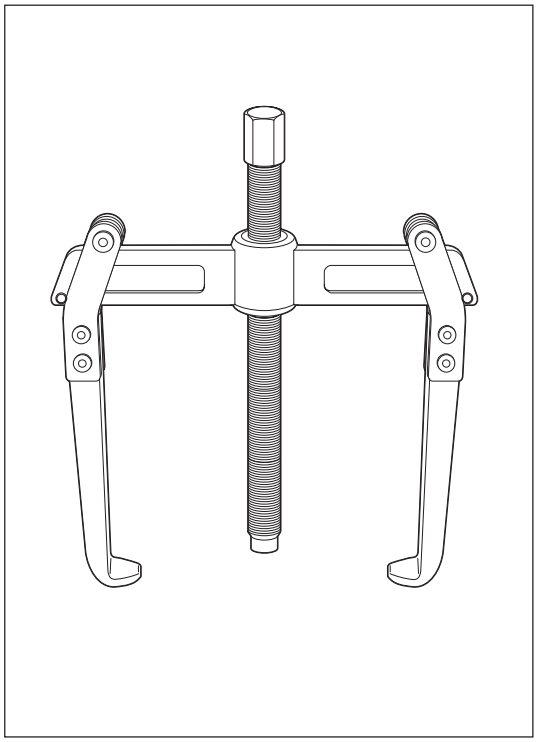
Press out rotary group!

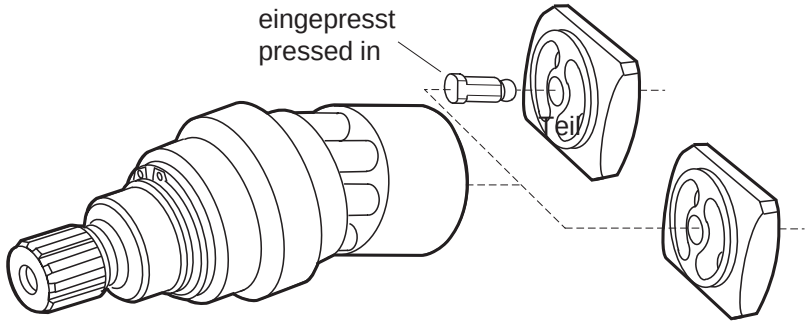
⚠ If the bearings are used again do not hit on the drive shaft.



39 Oder mit Abziehvorrichtung ausdrücken.

Or press-out with extraction device.





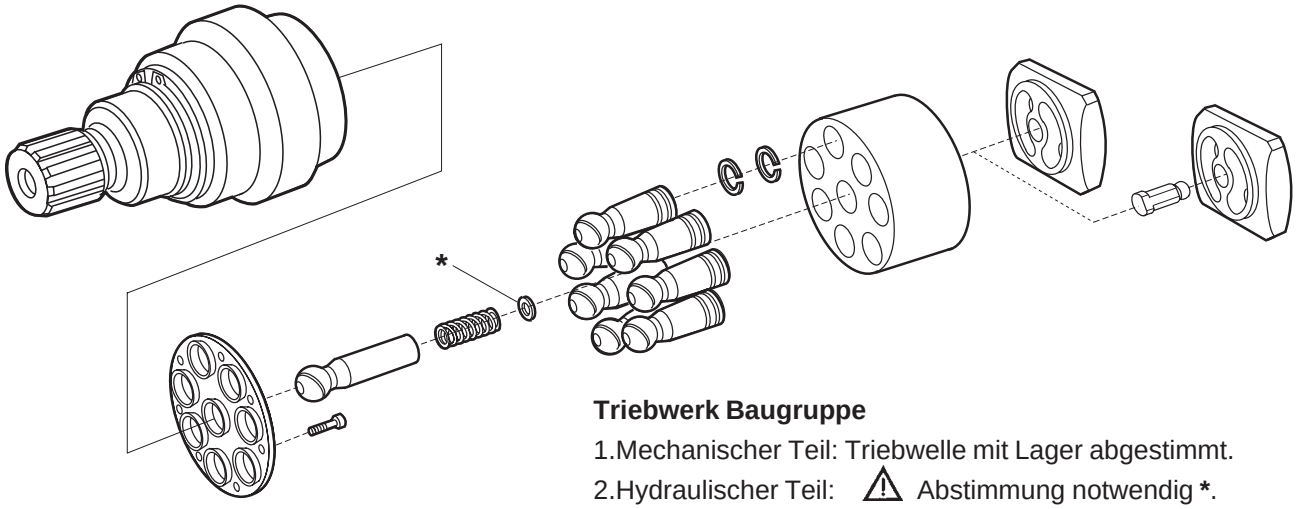
Triebwerk komplett

⚠ Abstimmung hydraulischer Teil notwendig.

Complete rotary group

⚠ Setting of hydraulic part necessary.

40



Triebwerk Baugruppe

1.Mechanischer Teil: Triebwelle mit Lager abgestimmt.

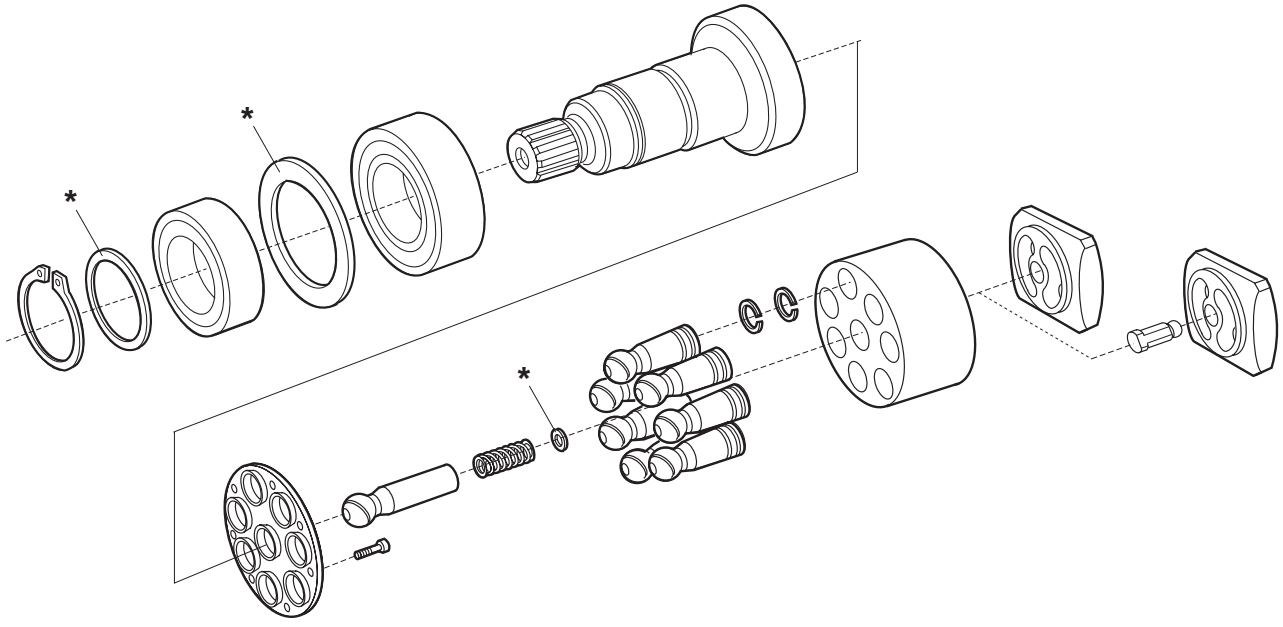
2.Hydraulischer Teil: ⚠ Abstimmung notwendig *****.

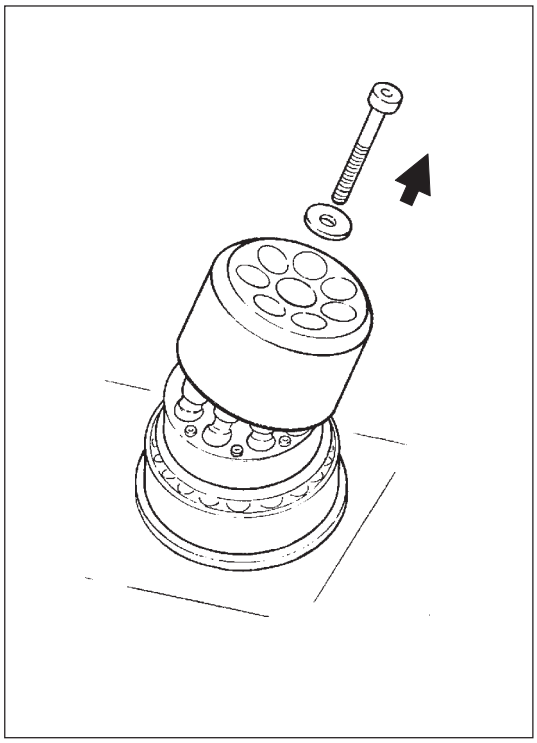
Rotary group

1. Mechanical part: Adjust drive shaft with bearing.

2. Hydraulic part: ⚠ Adjustment necessary

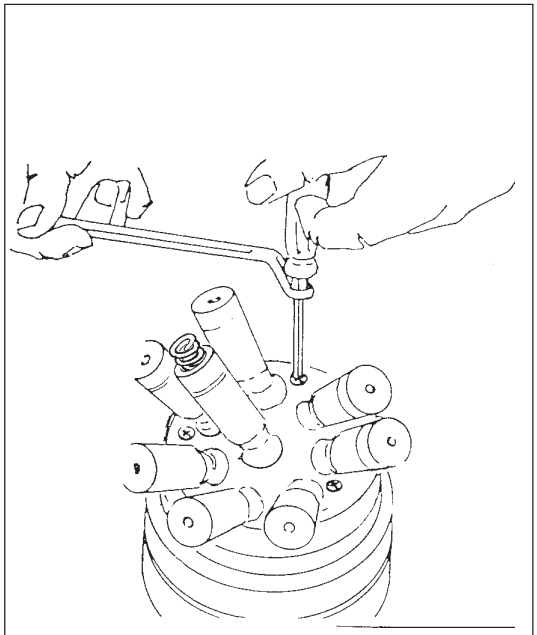
41





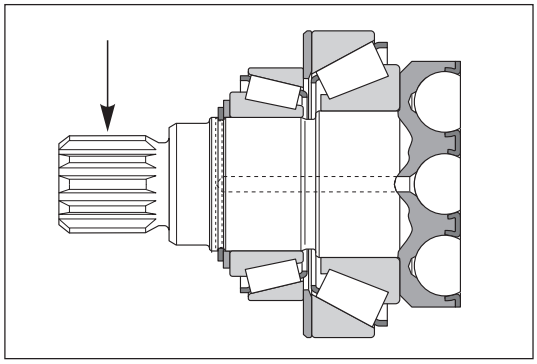
43 Befestigungsschraube (Zylinder) ausbauen.
Zylinder abheben.

Remove fixing screw (cylinder).
Remove cylinder.



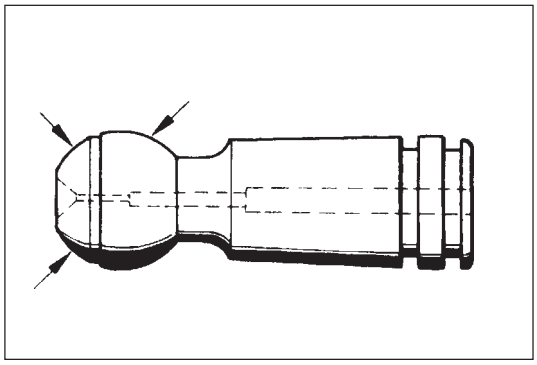
44 Rückzugplatte demontieren.
⚠ Schrauben sind eingeklebt.
Torx-Werkzeug verwenden.

Disassemble retaining plate.
⚠ Screws are glued.
Use Torx-tools.



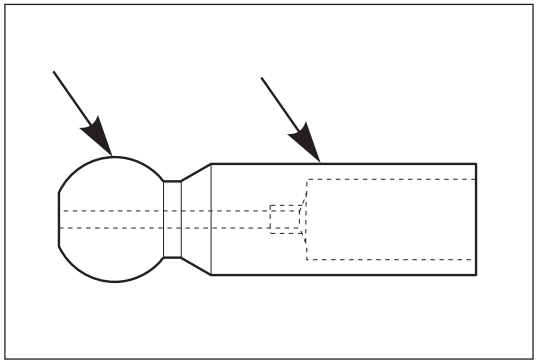
45 Kein Passungsrost, nicht ausgeschlagen.

Free of corrosion, erosion or fretting; no damage to splines or keyways.



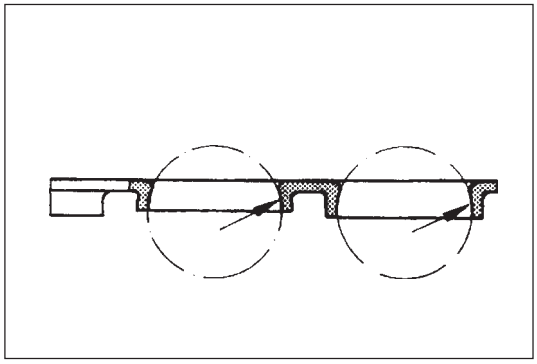
46 Kolben
Riefenfrei und keine Pittings.

Pistons
No scoring and no pittings.



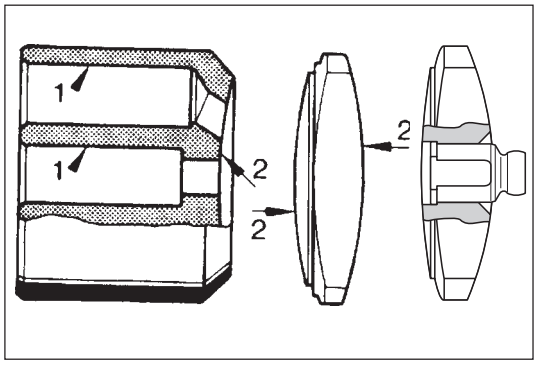
47 Mittelzapfen
Riefenfrei und keine Pittings.

Center pin
No scoring and no pittings.



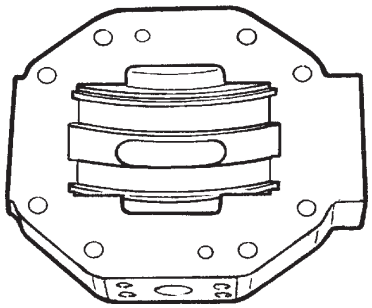
48 Rückzugplatte
Riefenfrei und keine Ausbrüche.

Retaining plate
No scoring and no evidence of wear



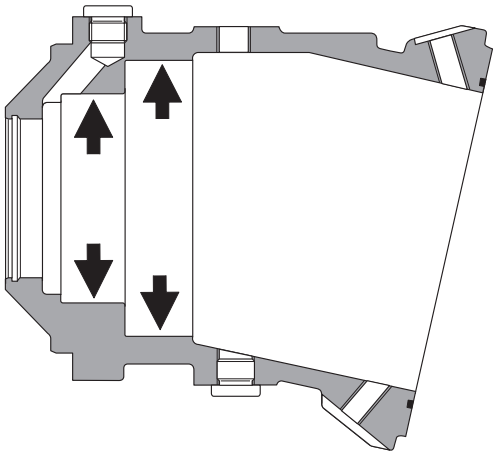
49 Zylinder / Steuerlinse
1 Bohrungen riefenfrei, nicht ausgelaufen.
2 Gleichmäßiges Tragbild, riß- und riefenfrei.

Cylinder block / control lens
1 Bores free of scoring, no evidence of wear.
2 Faces smooth and even, free of cracks and scoring.



50 Reglergehäuse
Gleitbahn und Seitenführung riefenfrei,
nicht ausgelaufen.

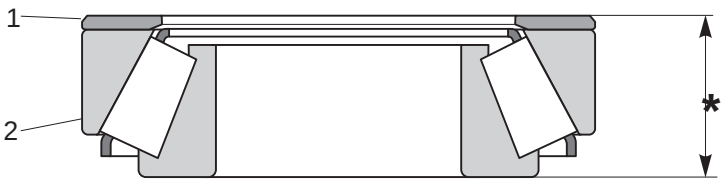
Control housing
Sliding surface and side guides free of scoring
and no wear.



51 Sichtkontrolle:
Im Lagerbereich riefenfrei und keine Einlaufspuren.

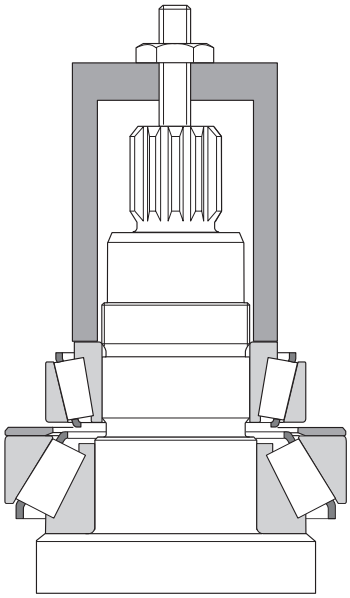
Visual check:
Bearing areas free of scoring and no evidence of wear.

Triebwelle: mechanischer Teil
Rotary group: mechanical part



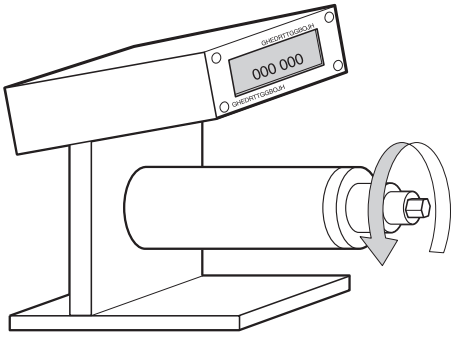
Abstimmung Maß *****
und Lagerdrehmomente
siehe Serviceinfo.

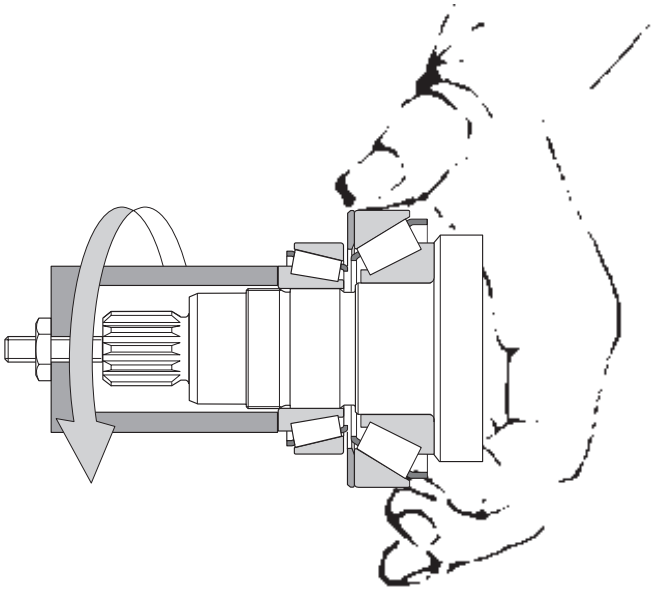
Adjustment dimension *****
and bearing torque
see service infoprmation.



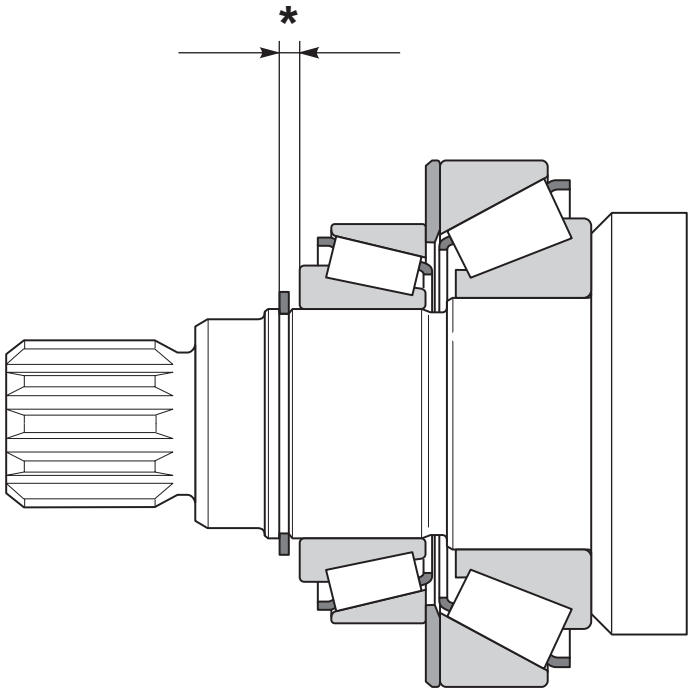
Lager aufpressen.
Beim Aufpressen Lager-
drehmoment nicht überschreiten.

Press on bearing.
Do not exeed bearing torque
during press-on.



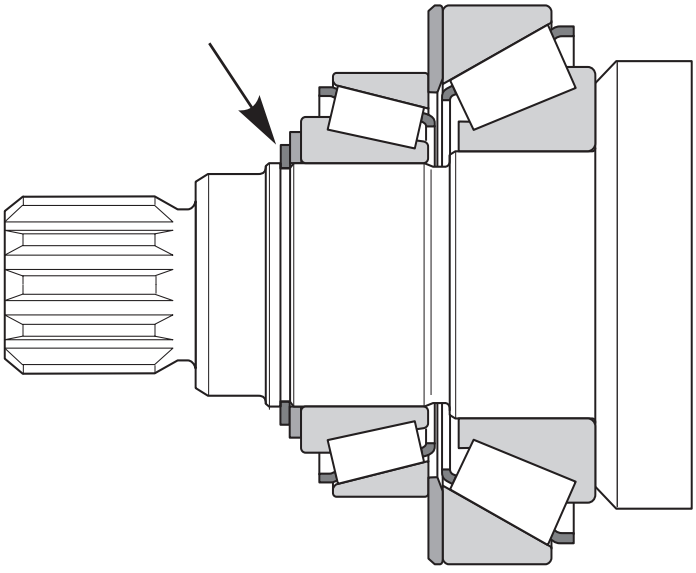


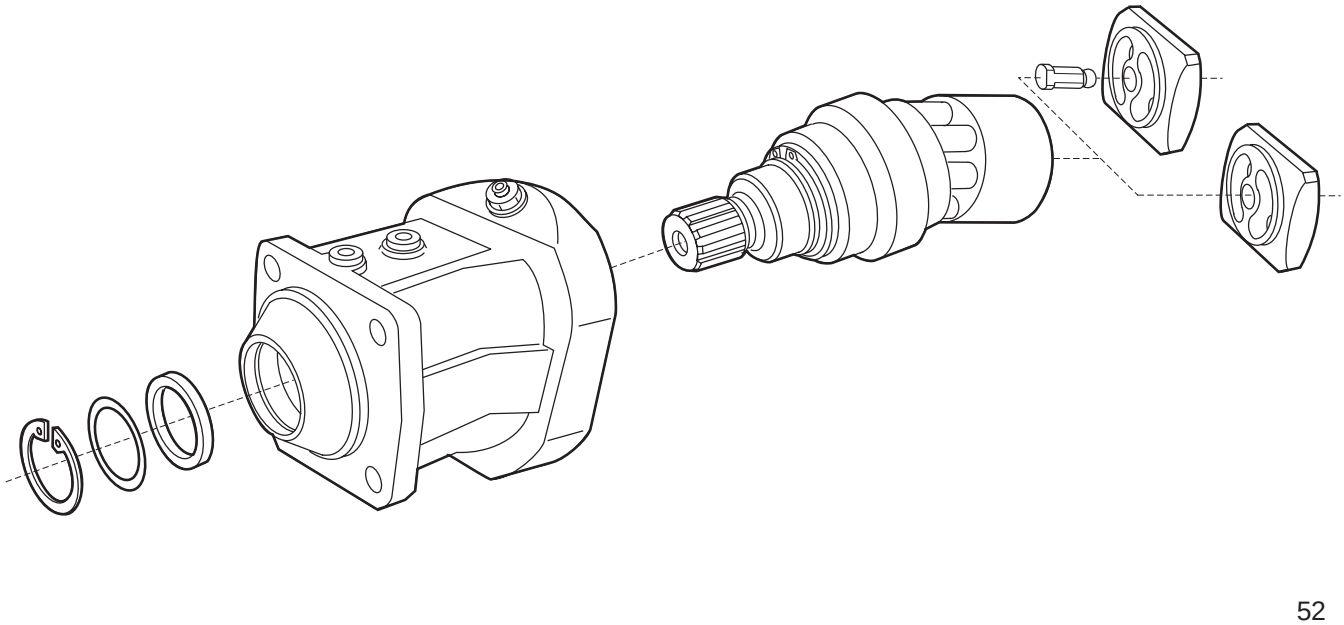
Triebwelle: mechanischer Teil
Rotary group: mechanical part



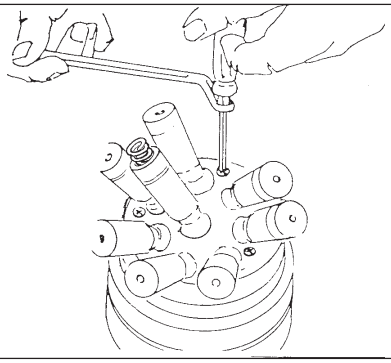
Sicherungsring montieren.
Maß * für Abstimmscheibe mit Endmaßen ermitteln (überkreuz).

Assemble safety ring.
Determine dimension for adjustment disc with final dimensions (crossover).



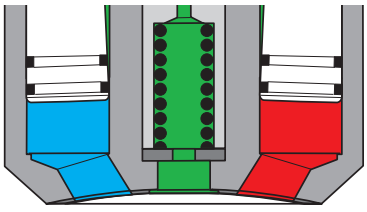


52



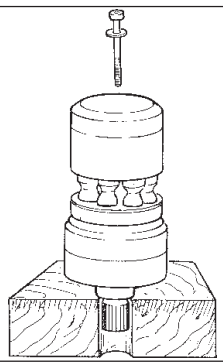
53 Rückzugplatte mit Kolben und Mittelzapfen einsetzen.
Schrauben mit Precote-Beschichtung verwenden.

Insert retaining plate with piston and center pin.
Use screw with Precote-coating.



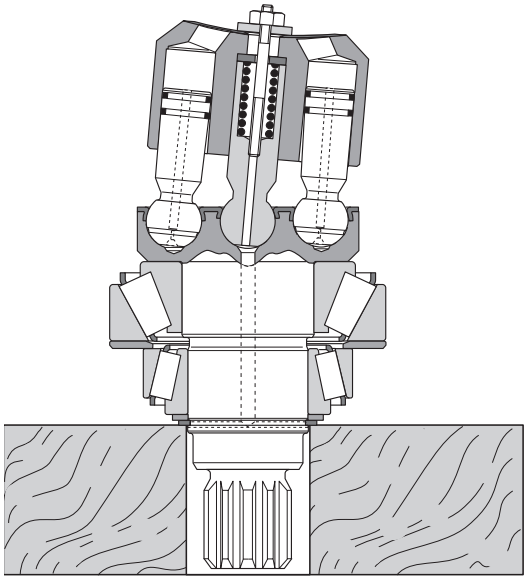
54 Auf richtige Schichtung aller Teile achten.

Make sure all parts are fitted in correctly.



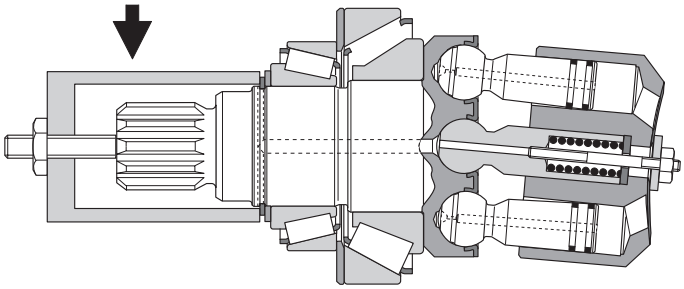
55 Triebwerk max. ausschwenken und Zylinder befestigen.

Swivel cylinder block to max. and fix the cylinder.



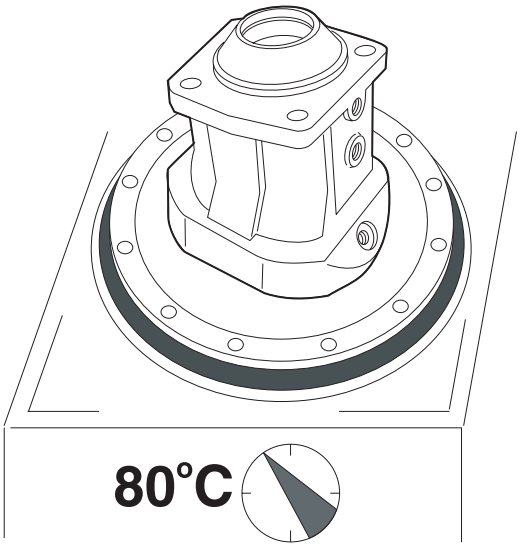
Triebwerk komplett zum Einbau fertig.

Rotary group completely assembled ready for assembly.



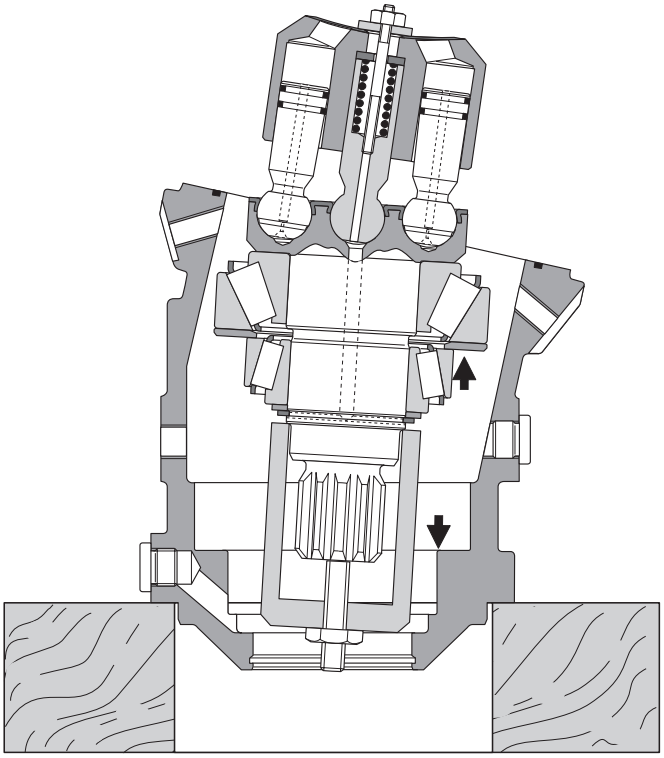
Montagehülse montieren.

Place assembly sleeve.



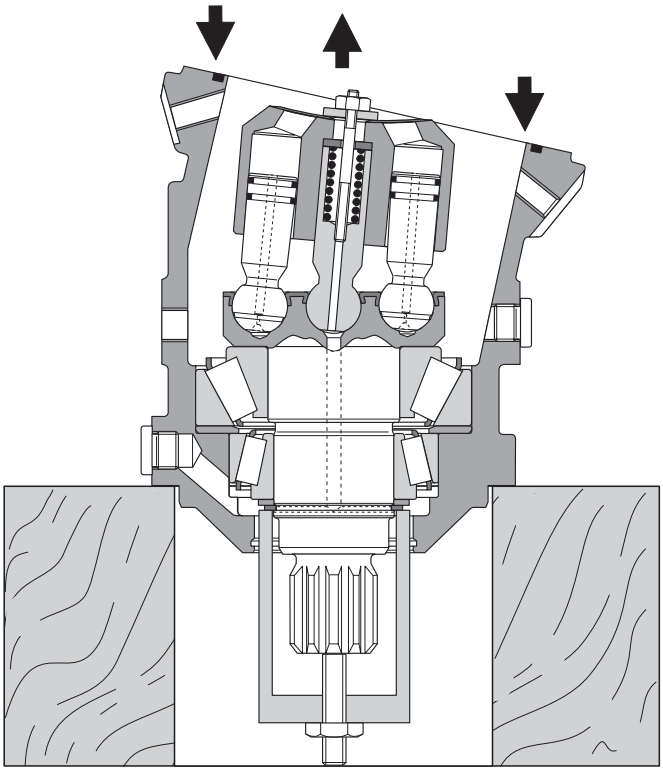
Gehäuse auf 80°C erwärmen.

Warm up housing to 80°C.



Triebwerk ins Gehäuse auf Anschlag einsetzen.

Insert rotary group into housing to seat position.

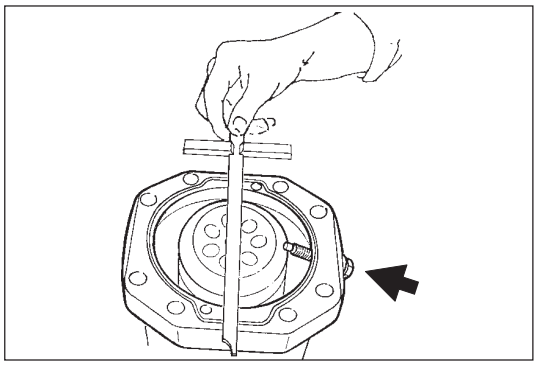


Zylinder in Nullposition ausrichten.

1. Zylinderbefestigungsschraube demontieren.
2. O-Ring einsetzen.

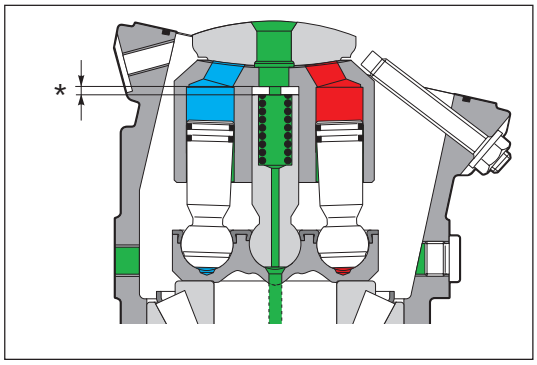
Fix zero position of cylinder with Q_{max}-screw.

1. Disassemble cylinder fixing screw.
2. Insert O-ring.



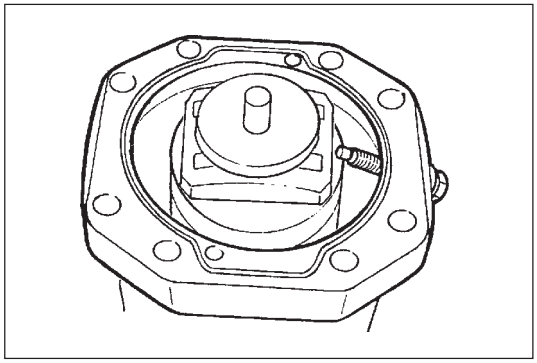
56 Mit Schraube Zylinderausschwenkung vermitteln.

Determine cylinder swivel range to max. angle with screw.



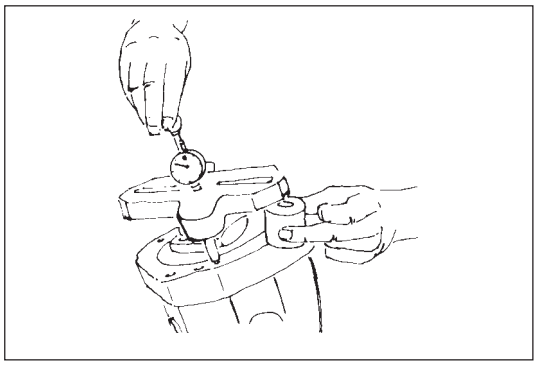
57 * Scheibe

* Disc



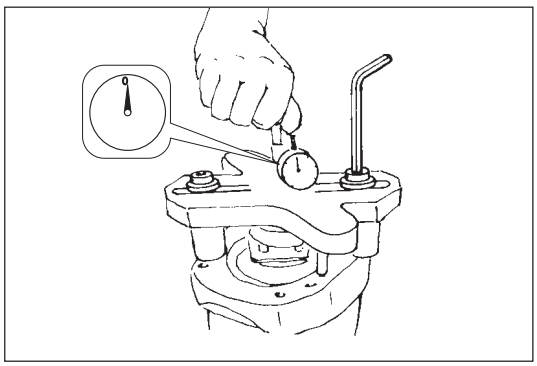
58 Zentrierscheibe aufsetzen.

Place centering disc.



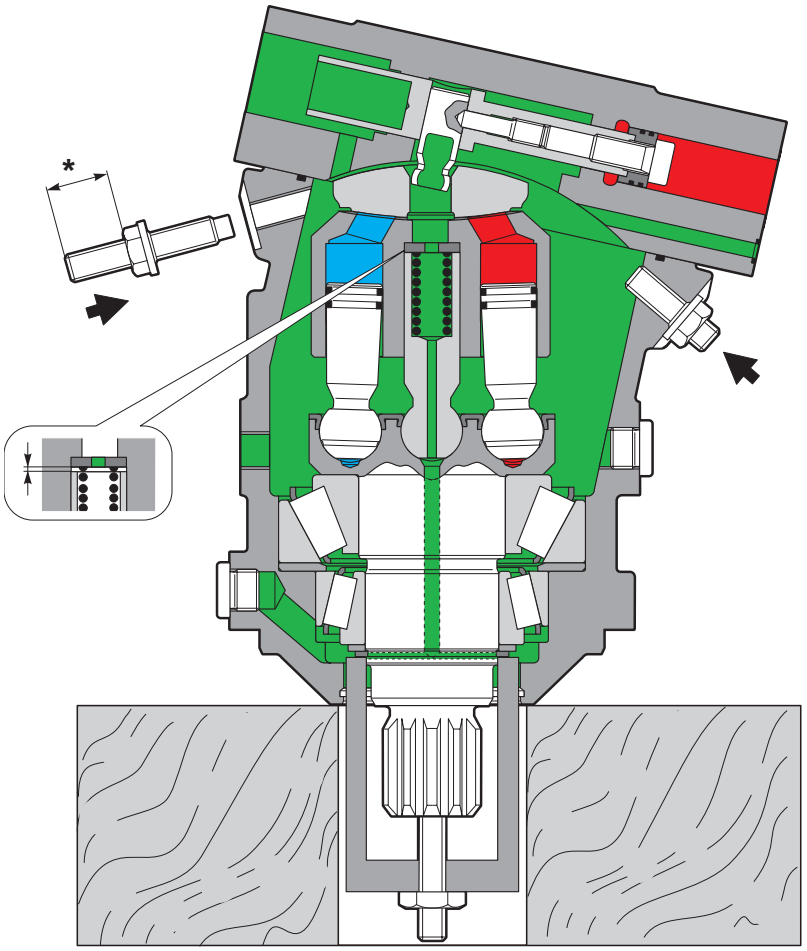
59 Meßvorrichtung aufbauen.

Mount measuring device.



60 Maß X überprüfen.

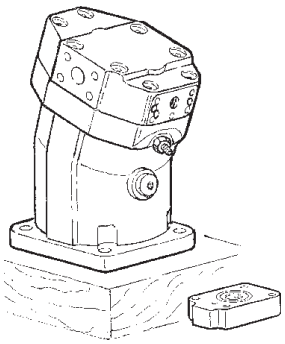
Check dimension X.



1. Anschlußplatte mit Differential-kolben montieren.
⚠ Montageausführung beachten!
⚠ Befestigungsschrauben mit Drehmoment anziehen.
2. Triebwerk in "Ausgangsstellung" schwenken.
3. Q_{min} -Schraube auf Maß * einstellen.
4. Verschlußschraube einbauen.
5. Montagehülse demontieren.

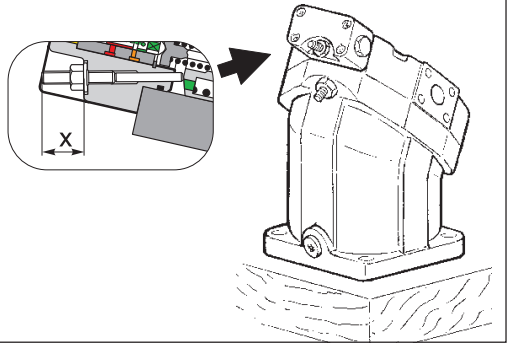
1. Assemble port plate with differential piston.
⚠ Take care of assembly design!
⚠ Tighten fixing screws with torque.
2. Swivel rotary group to "starting position".
3. Set Q_{min} -screw to dimension*.
4. Assemble plug.
5. Remove assembly sleeve.

61



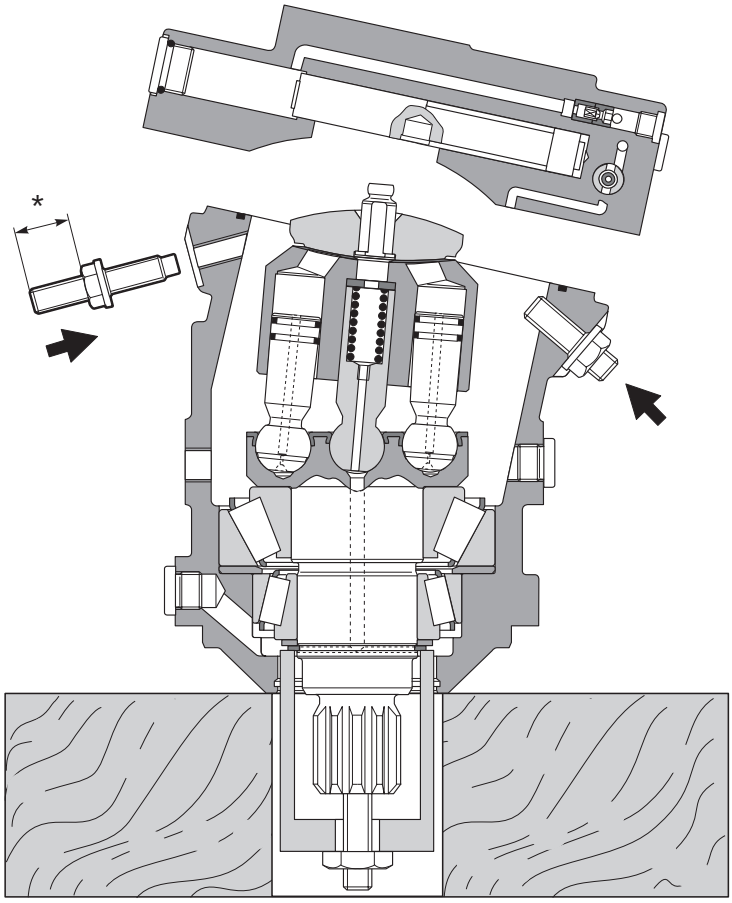
62 Deckel montieren.

Assemble cover.



63 Steuerteil montieren.

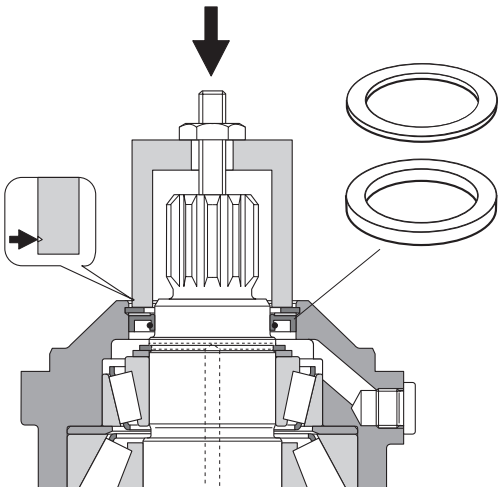
Assemble control components.



1. Anschlußplatte mit Gleichgang-kolben montieren.
⚠ Montageausführung beachten!
⚠ Befestigungsschrauben mit Drehmoment anziehen.
2. Triebwerk in "Ausgangsstellung" schwenken.
3. Q_{min} -Schraube auf Maß ***** einstellen.
4. Verschlußschraube einbauen.
5. Montagehülse demontieren.

1. Assemble port plate with synchronizing piston.
⚠ Take care of assembly design!
⚠ Tighten fixing screws with torque.
2. Swivel rotary group to "starting position".
3. Set Q_{min} -screw to dimension***.**
4. Assemble plug.
5. Remove assembly sleeve.

64



65 Wellendichtring, Scheiben und Sicherungsring montieren.
Mit Montagehülse einpressen.

⚠ Einpresstiefe beachten!

Assemble shaft seal, disc and safety ring.
Press-in with assembly sleeve.

⚠ Take care of press-in depth.

Anziehdrehmomente für Schaftschrauben (Metrisches ISO-Regelgewinde)

Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Schaftschrauben mit metrischem ISO-Regelgewinde und Kopfauflagemaßen nach DIN 912, DIN 931 und DIN 933. Außerdem gelten diese Werte nur für leicht oder nicht geölte, unbehandelte Oberflächen, sowie nur bei Verwendung von Drehmoment- und Kraftbegrenzungsschlüsseln.

Gewindegröße	Festigkeitsklassen 8.8	10.9	12.9
	Anziehdrehmoment(Nm)		
M 3	1,1	1,6	1,9
M 4	2,9	4,1	4,9
M 5	6	8,5	10
M 6	10	14	17
M 8	25	36	41
M10	49	69	83
M12	86	120	145
M14	135	190	230
M16	210	295	355
M18	290	405	485
M 20	410	580	690
M 22	550	780	930
M 24	710	1000	1200
M 27	1050	1500	1800
M 30	1450	2000	2400

Tightening torques for shaft bolts (Metric ISO Standard Thread)

The values for tightening torques shown in the table are valid only for shaft bolts with metric ISO- standard threads and head support surface dimensions in accordance with DIN 912, DIN 931 and DIN 933. These values are also valid only for light or unoiled, untreated surface as well as for use only with torque-indicating wrenches and force limiting tools.

Thread size	Strength Classes 8.8	10.9	12.9
	Tightening Torque (lb.ft)		
M 3	0,8	1,2	1,4
M 4	2,1	3,0	3,6
M 5	4,4	6,3	7,4
M 6	7,4	10,3	12,5
M 8	18,4	25,8	30,2
M10	36,1	50,9	61,2
M12	63,4	88,4	106,9
M14	99,5	140,0	169,5
M16	154,8	217,4	261,6
M18	213,7	298,5	357,4
M 20	302,2	427,5	508,5
M 22	405,4	574,9	685,4
M 24	523,5	737,0	884,4
M 27	773,9	1105,5	1326,6
M 30	1068,7	1474,0	1768,8

Anziehdrehmomente für Verschlußschrauben VSTI (Metrisches Feingewinde)

Gewindegröße	Bezeichnung		Anziehdrehmoment(Nm)
M 8 x 1	VSTI 8 x 1	-ED/SA	= 5
M 10 x 1	VSTI 10 x1	-ED	= 10
M 12 x 1,5	VSTI 12 x 1,5	-ED	= 20
M 14 x 1,5	VSTI 14 x 1,5	-ED	= 30
M 16 x 1,5	VSTI 16 x 1,5	-ED/SA	= 30
M 18 x 1,5	VSTI 18 x 1,5	-ED/SA	= 40
M 20 x 1,5	VSTI 20 x 1,5	-ED/SA	= 50
M 22 x 1,5	VSTI 22 x 1,5	-ED	= 60
M 26 x 1,5	VSTI 16 x 1,5	-ED/SA	= 70
M 27 x 2	VSTI 27 x 2	-ED	= 90
M 30 x 1 ,5	VSTI 30 x 1,5	-ED/SA	= 100
M 33 x 2	VSTI 33 x 2	-ED/SA	= 120
M 42 x 2	VSTI 42 x 2	-ED/SA	= 200
M 48 x 2	VSTI 48 x 2	-ED	= 300

Tightening torques for locking screws VSTI (Metric ISO fine thread)

Thread size	Designation		Tightening torques (lb.ft)
M 8 x 1	VSTI 8 x 1	-ED/SA	= 4
M 10 x 1	VSTI 10 x1	-ED	= 7
M 12 x 1,5	VSTI 12 x 1,5	-ED	= 15
M 14 x 1,5	VSTI 14 x 1,5	-ED	= 22
M 16 x 1,5	VSTI 16 x 1,5	-ED/SA	= 22
M 18 x 1,5	VSTI 18 x 1,5	-ED/SA	= 29
M 20 x 1,5	VSTI 20 x 1,5	-ED/SA	= 37
M 22 x 1,5	VSTI 22 x 1,5	-ED	= 44
M 26 x 1,5	VSTI 16 x 1,5	-ED/SA	= 51
M 27 x 2	VSTI 27 x 2	-ED	= 66
M 30 x 1 ,5	VSTI 30 x 1,5	-ED/SA	= 74
M 33 x 2	VSTI 33 x 2	-ED/SA	= 88
M 42 x 2	VSTI 42 x 2	-ED/SA	= 147
M 48 x 2	VSTI 48 x 2	-ED	= 220

Anziehdrehmomente für Seal-Lock Bundmuttern (Metrisches ISO-Regelgewinde)

Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Seal-Lock Bundmuttern der Festigkeitsklasse 8.8 mit metrischem ISO-Regelgewinde.

Gewindegröße	Festigkeitsklassen 8.8	10.9	12.9
	Anziehdrehmoment (Nm)		
M 6	10		
M 8	22		
M 10	40		
M 12	69		
M 14	110		
M 16	170		

Tightening torques for seal-lock nuts (Metric ISO-Standard Thread)

The values for tightening torques shown in the table are valid only for seal-lock nuts of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torque (lb.ft)		
M 6	7,4		
M 8	16,2		
M 10	29,5		
M 12	50,9		
M 14	81,1		
M 16	125,3		

Anziehdrehmomente für Linsenschrauben mit Kreuzschlitz DIN 7985 (Metrisches ISO-Regelgewinde)

Die nebenstehenden Werte für Anziehdrehmomente gelten nur für Linsenschrauben mit Kreuzschlitz DIN 7985 der Festigkeitsklasse 8.8 mit metrischem ISO-Regelgewinde

Gewindegröße	Festigkeitsklassen 8.8	10.9	12.9
	Anziehdrehmoment(Nm)		
M 3	1,1		
M 4	2,9		
M 5	6		
M 6	10		
M 8	25		
M10	49		

Tightening torques for cross-slotted lens head screws DIN 7985 (Metric ISO- Standard Thread)

The values for tightening torques shown in the table are valid only for cross-slotted lens head screws DIN 7985 of the strength class 8.8 and with metric ISO-standard thread.

Thread size	Strength classes 8.8	10.9	12.9
	Tightening torques (lb.ft)		
M 3	0,8		
M 4	2,1		
M 5	4,4		
M 6	7,4		
M 8	18,4		
M10	36,1		

Allgemein

- Machen Sie sich mit der Ausstattung der Maschine vertraut.
- Fahren Sie die Maschine nur, wenn Sie sich völlig mit den Bedien- und Steuerelementen sowie der Arbeitsweise der Maschine vertraut gemacht haben.
- Benutzen Sie Ihre Schutzausrüstung wie Schutzhelm, Sicherheitsschuhe und Gehörschutz.
- Machen Sie sich mit Ihrem Arbeitsgebiet vertraut.
- Benutzen Sie die Maschine nur für den ihr zugedachten Zweck.

Beachten Sie bitte die Richtlinien der Berufsgenossenschaft und des Maschinenherstellers





Vor dem Start

- Beachten Sie die Bedienungshinweise vor dem Starten.
- Prüfen Sie die Maschine aut auffällige Fehler.
- Fahren Sie die Maschine nicht mit defekten Instrumenten, Kontrolleuchten oder Steuerorganen.
- Alle Schutzvorrichtungen müssen fest auf ihrem Platz sein.
- Nehmen Sie keine losen Gegenstände mit bzw. befestigen Sie diese an der Maschine.
- Halten Sie die Maschine von öligem und zündfähigem Material frei.
- Prüfen Sie vor dem Besteigen der Maschine, ob sich Personen oder Hindernisse neben oder unter der Maschine befinden.
- Vorsicht beim Besteigen der Maschine, benützen Sie Treppen und Griffe.
- Stellen Sie vor dem Start Ihren Sitz ein.

Starten

- Beim Starten müssen alle Bedienhebel in “Neutral-stellung” stehen.
- Die Maschine nur vom Fahrersitz aus Starten.
- Prüfen Sie die Anzeigeinstrumente nach dem Start, um sicher zu gehen, daß alles ordnungsgemäß funktioniert.
- Lassen Sie die Maschine nicht unbewacht, während der Motor läuft.
- Beim Start mit Batterieverbindungskabeln verbinden Sie Plus mit Plus und Minus mit Minus. Massekabel (Minus) immer zuletzt anschliesen und zuerst ab-trennen.

Vorsicht

- Auspuffgase sind lebensgefährlich. Bei Start in geschlossenen Räumen für ausreichende Luftzufuhr sorgen!

Hydraulikanlage

1. Hydraulikanlage steht unter hohem Druck!

⚠ Unter hohem Druck austretende Hochdruck-Flüssigkeiten (Kraftstoff, Hydrauliköl) können die Haut durchdringen und schwere Ver-letzungen verursachen. Daher sofort einen Arzt aufsuchen, da anderenfalls schwere Infektionen entstehen können!

2. Bei der Suche nach Leckstellen wegen Ver letzungsgefahr geeignete Hilfsmittel verwenden!
3. Vor Arbeiten an der Hydraulikanlage diese un-bedingt drucklos machen und angebaute Geräte absenken!
4. Bei Arbeiten an der Hydraulikanlage unbedingt Motor abstellen und Traktor gegen Wegrollen sichern (Feststellbremse, Unterlegkeil)!
5. Beim Anschließen von Hydraulikzylindern und -motoren ist auf vorgeschriebenen Anschluß der Hydraulikschläuche zu achten!
6. Bei Vertauschen der Anschlüsse umgekehrte Funktionen (z.B. Heben/Senken) - Unfallgefahr!
7. Hydraulikschlauchleitungen regelmäßig kontrol-lieren und bei Beschädigung und Alterung aus-tauschen! Die Austauschschlauchleitungen müs-sen den technischen Anforderungen des Geräte-herstellers entsprechen!

⚠

⚠ Öle, Kraftstoffe und Filter ordnungsgemäß entsorgen!

⚠

Hinweis!

Um eine ordnungsgemäße Abwicklung von Ersatzteil-Aufträgen sicherzustellen, muß die Bestellung folgende Angaben enthalten:

Typenschlüssel
Typ-Nr.
Fabrikations-Nr.
Baugruppe
Position
Benennung

Zur Reparatur des Gerätes empfehlen wir die Verwendung von vormontierten und teilgeprüften Baugruppen.

Note!

In order to supply proper spare parts, please provide following specifications when ordering spares:

Type Code
Type Number
Serial Number
Assembly Group
Item
Designation

In repairing the unit, we recommend the use of pre-assembled partially tested assembly groups.

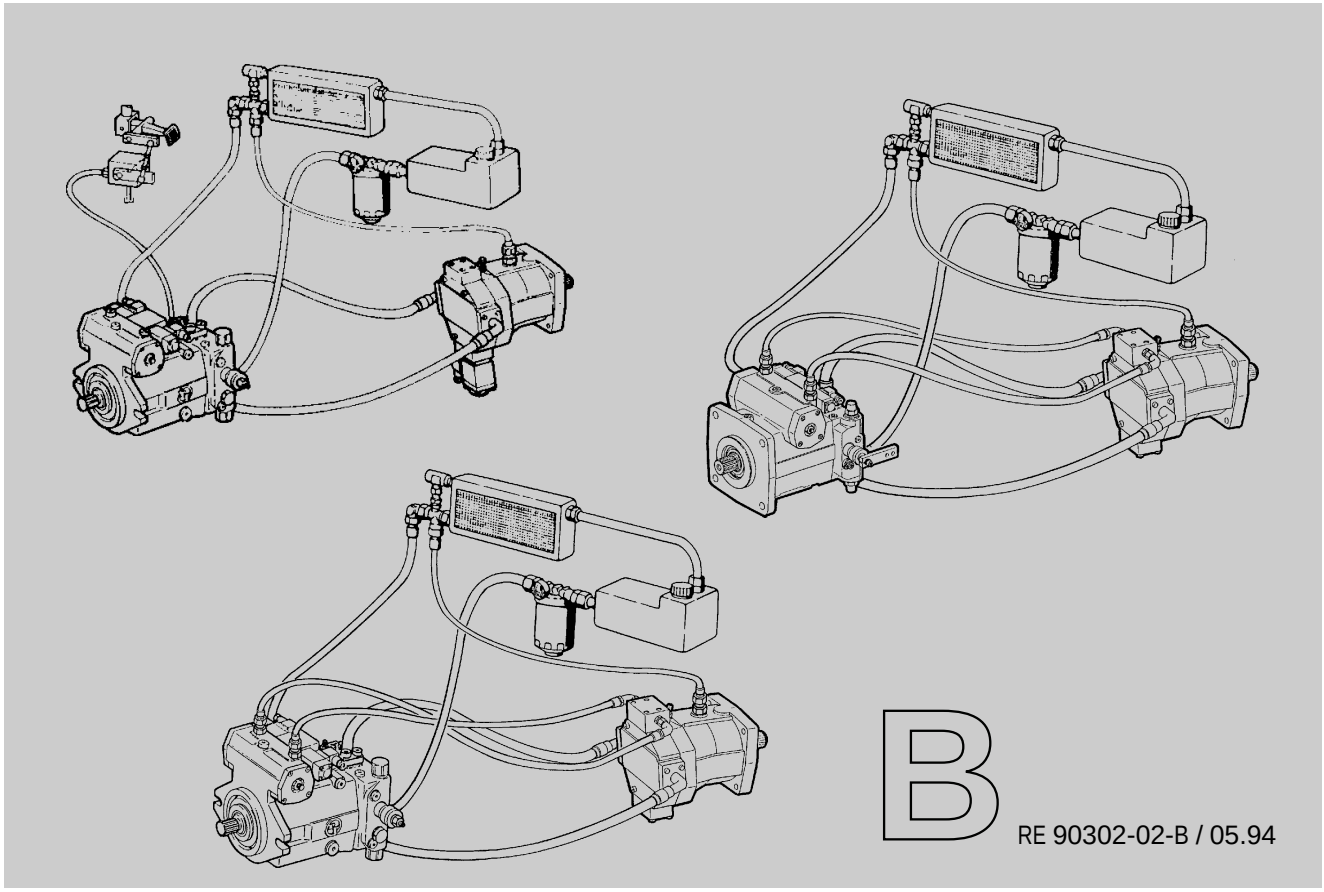
HYPROMATIK GmbH

Glockeraustraße 2
D-89275 Elchingen
Postanschrift: Postfach 22 60, D-89012 Ulm
Telefon (0 73 08) 8 20
Telex 712538

Telefax (0 73 08) 72 74, 72 73

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

engineering mannesmann Rexroth



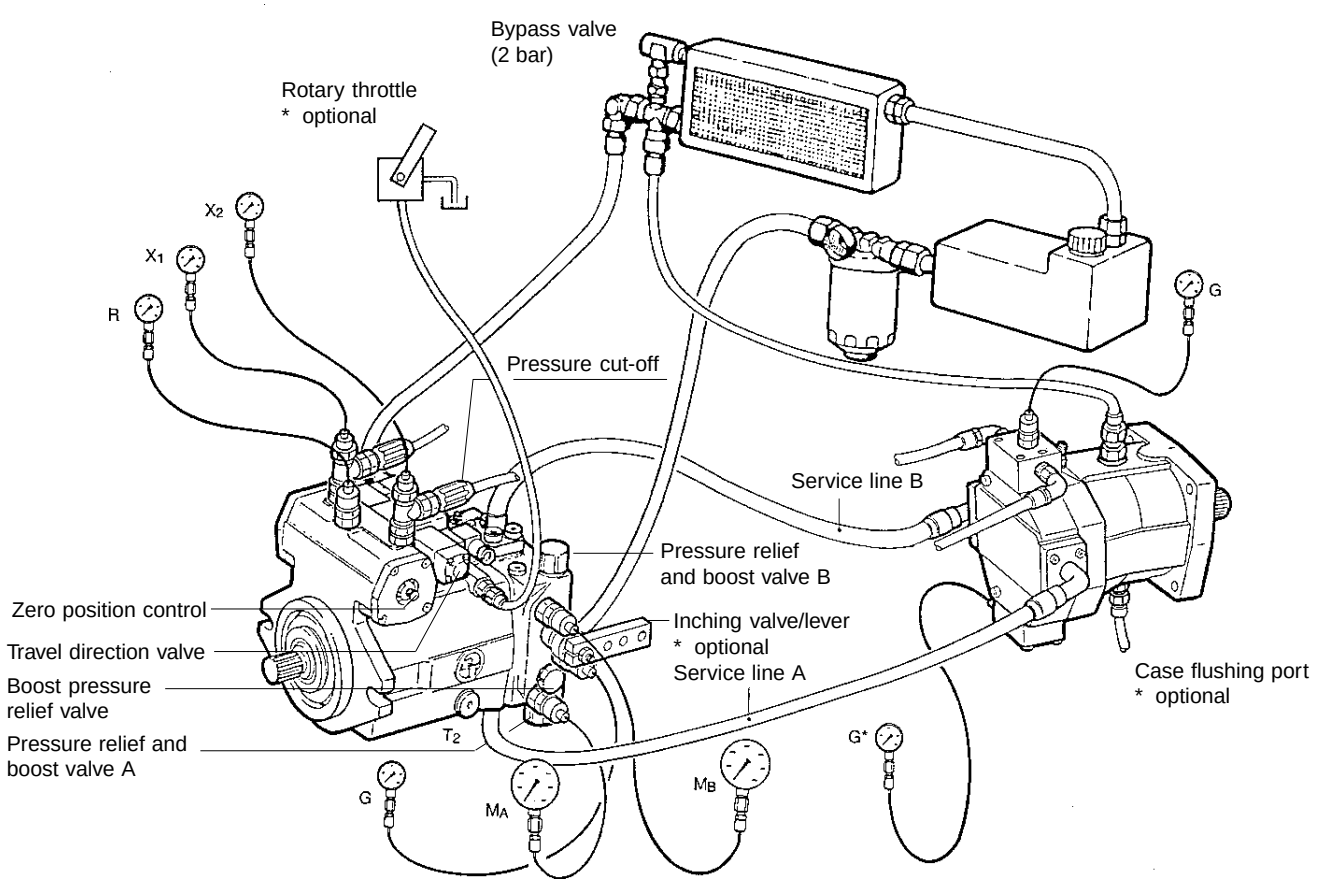
B

RE 90302-02-B / 05.94

Betriebsanleitung - Installation A4VG...DA/A6VM...DA/A6VM...HA

Operating Instruction - Fault finding A4VG...DA/A6VM...DA/A6VM...HA

Brueninghaus Hydromatik

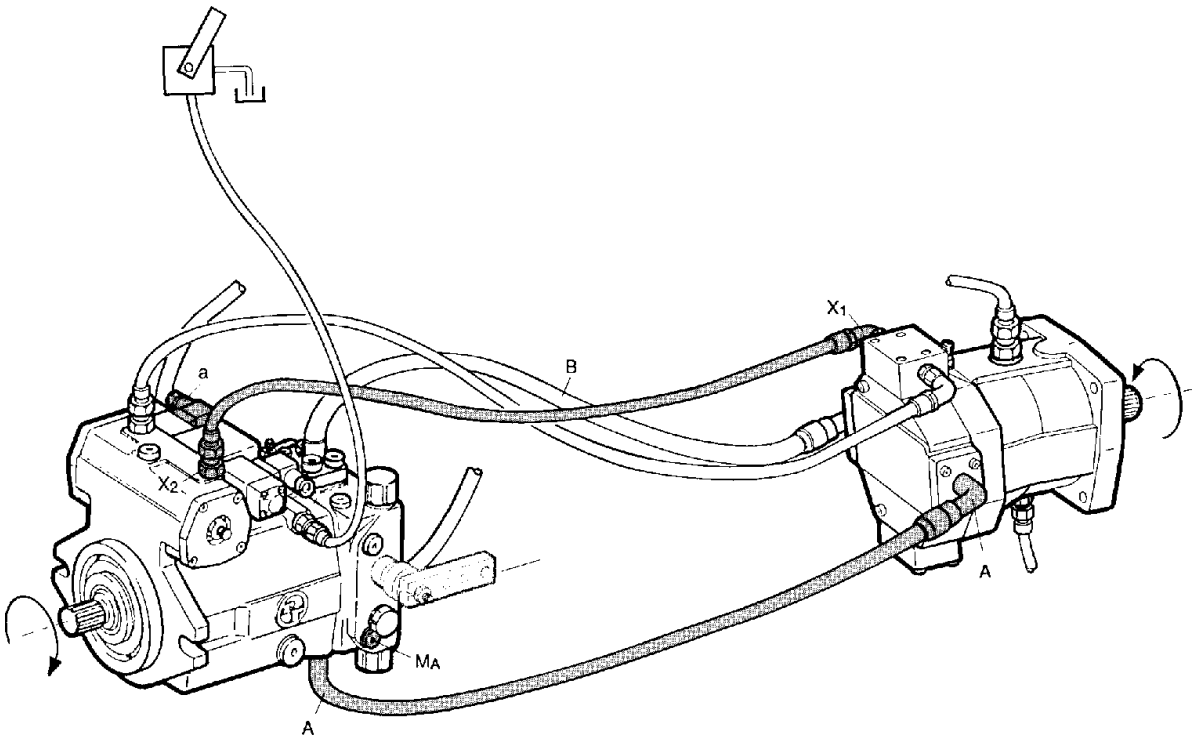


Installation

Orifice A4VG/DA		Size 40	Size 56
A, B	Service lines	SAE 3/4"	SAE 3/4"
G	Pressure connection for auxiliary circuits	M 12x1,5	M 14x1,5
$T_1(T_2)$	Oil infill and return	M 22x1,5	M 22x1,5
$T_1(T_2)$	Oil discharge	M 22x1,5	M 22x1,5
S	Suction port	M 33x2	M 33x2
M_A/M_B	Service line Measuring connections	M 12x1,5	M 12x1,5
R	Bleeding	M 12x1,5	M 12x1,5
X_1/X_2	Control pressure	M 12x1,5	M 12x1,5
P_S	Control pressure supply	M 14x1,5	M 14x1,5

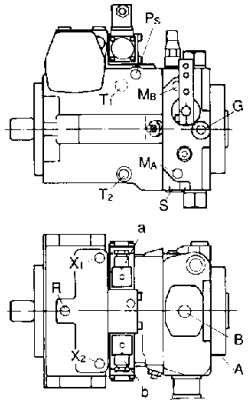
Orifice A6VG/DA		Size 55	Size 80	Size 107	Size 160	Size 200
A, B	Service lines	SAE 3/4"	SAE 1"	SAE 1"	SAE 1 1/4"	SAE 1 1/4"
T_1	Case drain port	M 18x1,5	M 18x1,5	M 18x1,5	M 22x1,5	M 22x1,5
X_1/X_2	Pilot pressure ports	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G^V	Operating pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G*	Control pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5

Measuring points A4Vg/DA - A6VM/DA		Pressure gauge (pressure range)
M_A	Service line A	600 bar
G_{A6VM}	Service line A/B	600 bar
M_B	Service line B	600 bar
G_{A4VG}	Boost pressure	40 bar
R	Housing pressure	10 bar
S	Negative suction pressure	1 bar (absolut)
X_1/X_2	Pilot pressure	40 bar
G*	Control pressure	600 bar



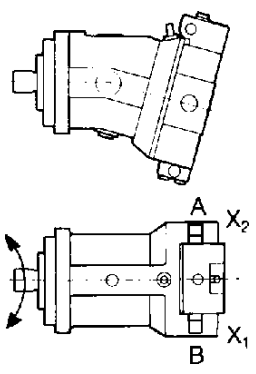
A4V/DA

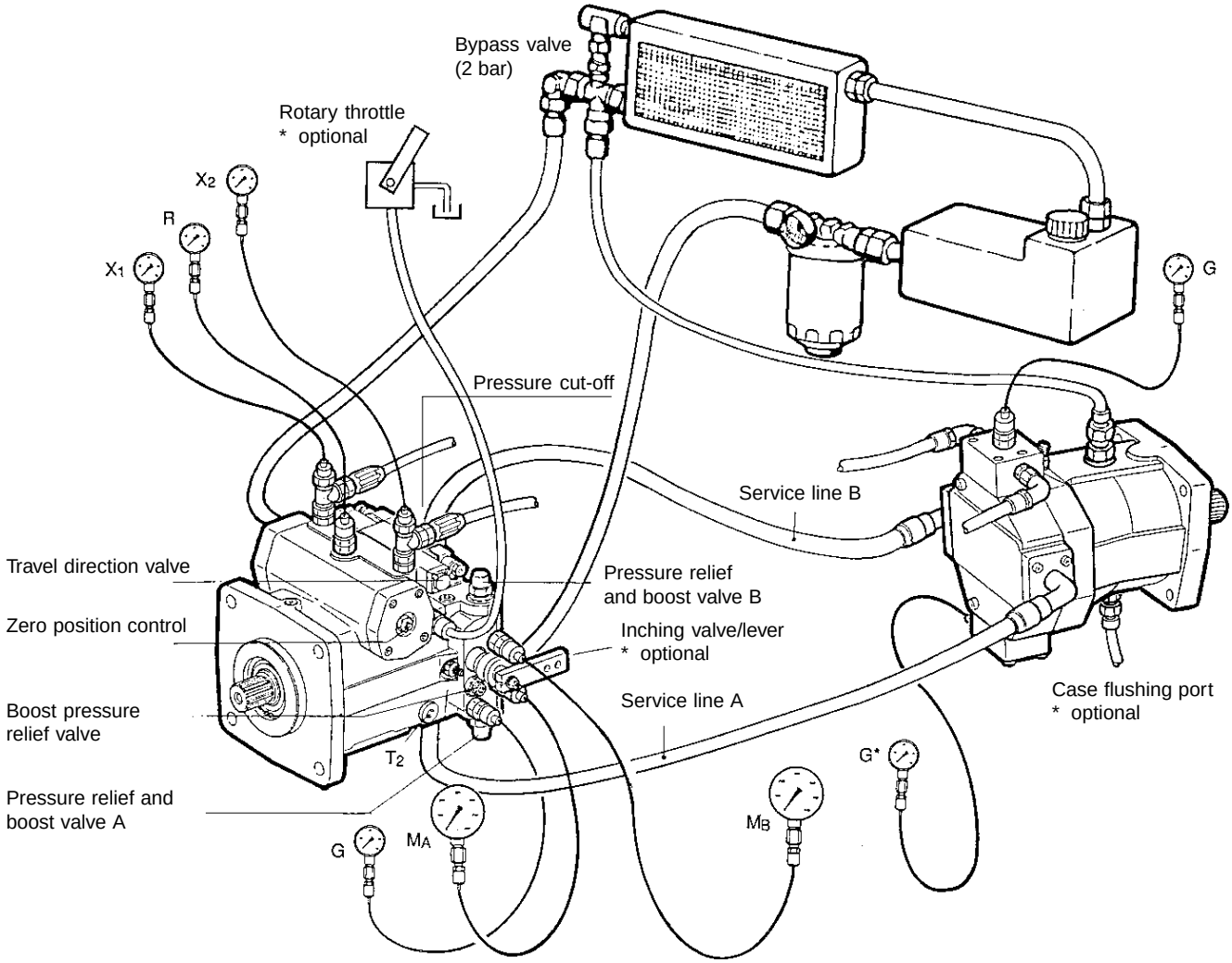
Direction of rotation	Clockwise		Anti-clockwise	
Solenoid operation	a	b	a	b
Control pressure in	X_2	X_1	X_2	X_1
Direction of through flow	B-A	A-B	A-B	B-A
Service pressure	M_A	M_B	M_B	M_A



A6VM/DA

Clockwise	Anti-clockwise
X_1	X_2
A -B	B - A



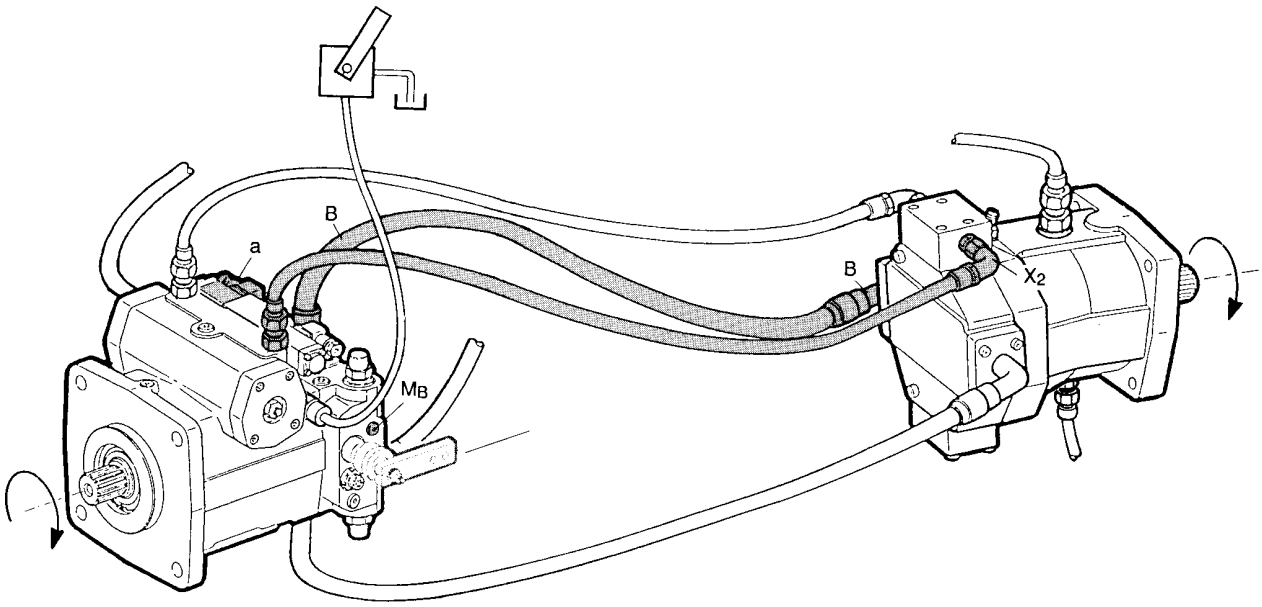


Installation

Orifice A4VG/DA		Size 71	Size 90	Size 125	Size 180
A, B	Service lines	SAE 1"	SAE 1"	SAE 1 1/4"	SAE 1 1/4"
G	Pressure connection for auxiliary circuits	M 18x1,5	M 18x1,5	M 22x1,5	M 22x1,5
$T_1(T_2)$	Oil infill and return	M 26x1,5	M 26x1,5	M 33x2	M 42x2
$T_1(T_2)$	Oil discharge	M 26x1,5	M 26x1,5	M 33x2	M 42x2
S	Suction port	M 42x2	M 42x2	M 48x2	M 48x2
M_A/M_B	Service line Measuring connections	M 12x1,5	M 12x1,5	M 12x1,5	M 12x1,5
R	Bleeding	M 12x1,5	M 16x1,5	M 16x1,5	M 16x1,5
X_1/X_2	Control pressure	M 12x1,5	M 16x1,5	M 16x1,5	M 16x1,5
P_S	Control pressure supply	M 14x1,5	M 18x1,5	M18x1,5	M 14x1,5

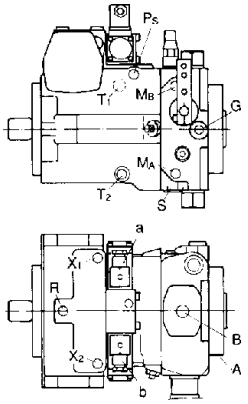
Orifice A6VG/DA		Size 55	Size 80	Size 107	Size 160	Size 200
A, B	Service lines	SAE 3/4"	SAE 1"	SAE 1"	SAE 1 1/4"	SAE 1 1/4"
T_1	Case drain port	M 18x1,5	M 18x1,5	M 18x1,5	M 22x1,5	M 22x1,5
X_1/X_2	Pilot pressure ports	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G^V	Operating pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G*	Control pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5

Measuring points A4Vg/DA - A6VM/DA		Pressure gauge (pressure range)
M_A	Service line A	600 bar
G_{A6VM}	Service line A/B	600 bar
M_B	Service line B	600 bar
G_{A4VG}	Boost pressure	40 bar
R	Housing pressure	10 bar
S	Negative suction pressure	1 bar (absolut)
X_1/X_2	Pilot pressure	40 bar
G*	Control pressure	600 bar



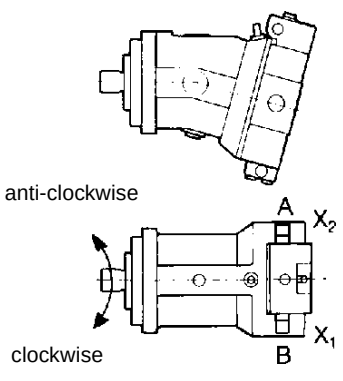
A4V/DA

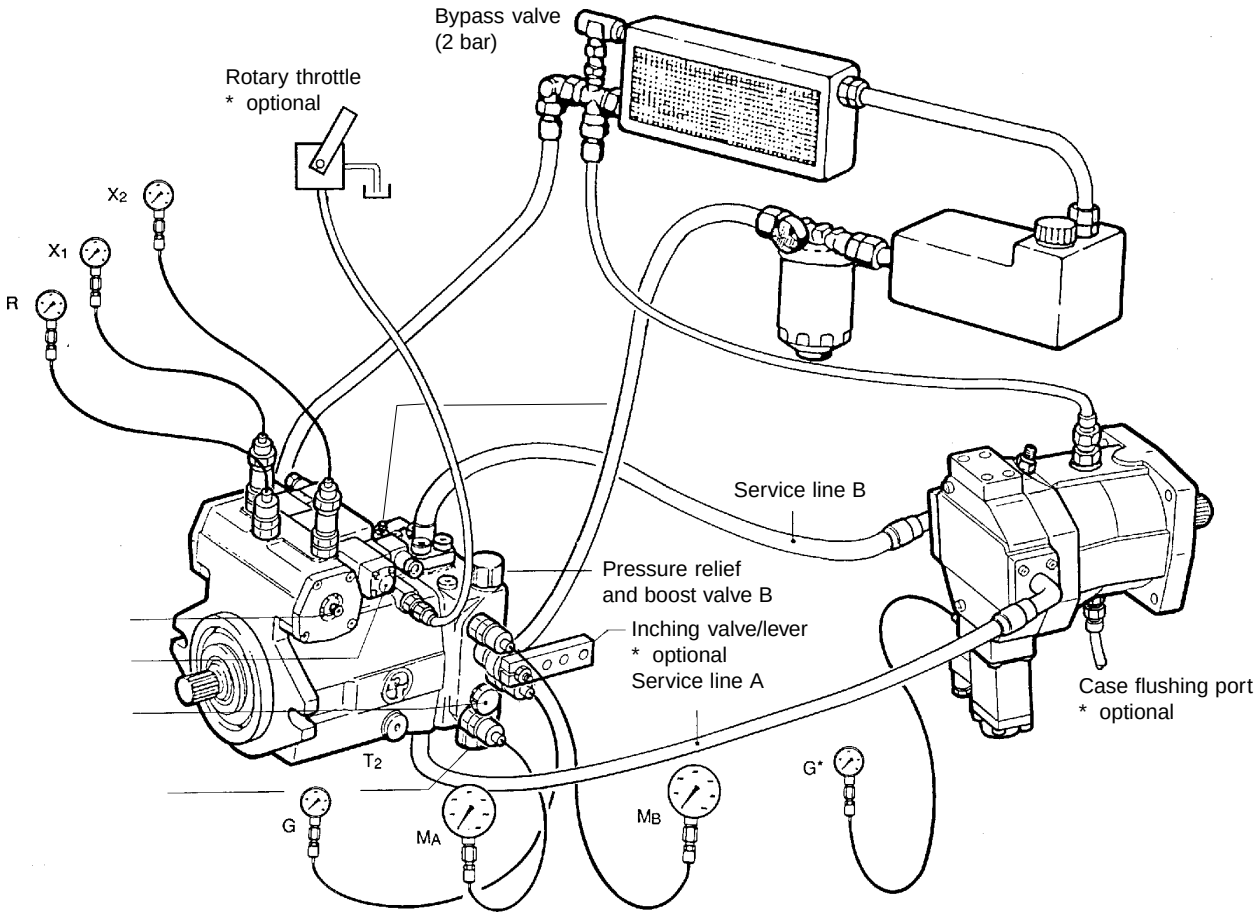
Direction of rotation	Clockwise		Anti-clockwise	
Solenoid operation	a	b	a	b
Control pressure in	X_2	X_1	X_2	X_1
Direction of through flow	A-B	B-A	B-A	A-B
Service pressure	M_B	M_A	M_A	M_B



A6VM/DA

Clockwise	Anti-clockwise
X_1	X_2
A -B	B - A



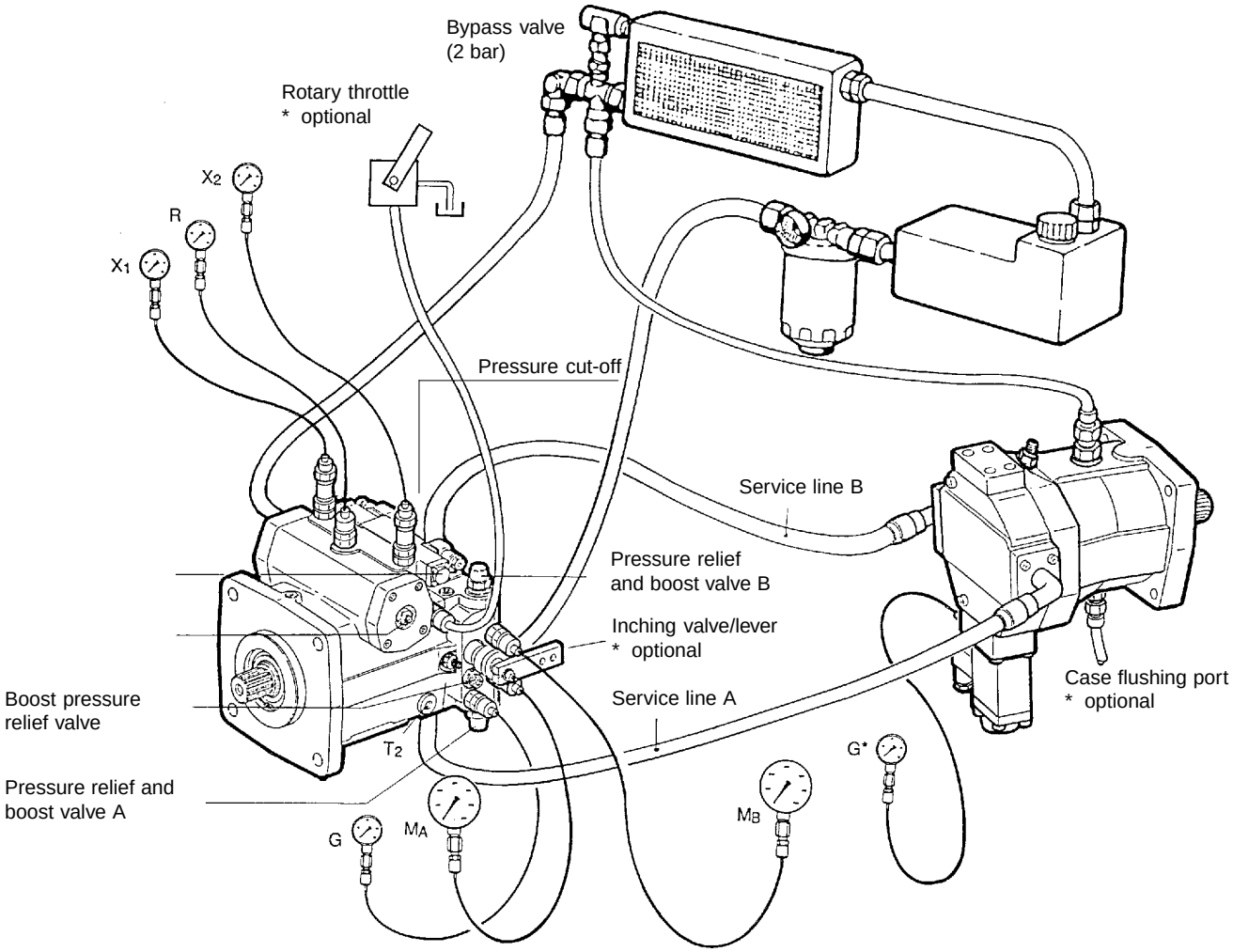


Installation

Orifice A4VG/DA		Size 40	Size 56
A, B	Service lines	SAE 3/4"	SAE 3/4"
G	Pressure connection for auxiliary circuits	M 12x1,5	M 14x1,5
$T_1(T_2)$	Oil infill and return	M 22x1,5	M 22x1,5
$T_1(T_2)$	Oil discharge	M 22x1,5	M 22x1,5
S	Suction port	M 33x2	M 33x2
M_A/M_B	Service line Measuring connections	M 12x1,5	M 12x1,5
R	Bleeding	M 12x1,5	M 12x1,5
X_1/X_2	Control pressure	M 12x1,5	M 12x1,5
P_S	Control pressure supply	M 14x1,5	M 14x1,5

Measuring points A4Vg/DA - A6VM/HA		Pressure gauge (pressure range)
M_A	Service line A	600 bar
G_{A6VM}	Service line A/B	600 bar
M_B	Service line B	600 bar
G_{A4VG}	Boost pressure	40 bar
R	Housing pressure	10 bar
S	Negative suction pressure	1 bar (absolut)
X_1/X_2	Pilot pressure	40 bar
G*	Control pressure	600 bar

Orifice A6VG/DA		Size 55	Size 80	Size 107	Size 160	Size 200
A, B	Service lines	SAE 3/4"	SAE 1"	SAE 1"	SAE 1 1/4"	SAE 1 1/4"
T_1	Case drain port	M 18x1,5	M 18x1,5	M 18x1,5	M 22x1,5	M 22x1,5
X_1/X_2	Pilot pressure ports	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G^V	Operating pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G*	Control pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5



Installation

Orifice A4VG/DA		Size 71	Size 90	Size 125	Size 180
A, B	Service lines	SAE 1"	SAE 1"	SAE 1 1/4"	SAE 1 1/4"
G	Pressure connection for auxiliary circuits	M 18x1,5	M 18x1,5	M 22x1,5	M 22x1,5
$T_1(T_2)$	Oil infill and return	M 26x1,5	M 26x1,5	M 33x2	M 42x2
$T_1(T_2)$	Oil discharge	M 26x1,5	M 26x1,5	M 33x2	M 42x2
S	Suction port	M 42x2	M 42x2	M 48x2	M 48x2
M_A/M_B	Service line Measuring connections	M 12x1,5	M 12x1,5	M 12x1,5	M 12x1,5
R	Bleeding	M 12x1,5	M 16x1,5	M 16x1,5	M 16x1,5
X_1/X_2	Control pressure	M 12x1,5	M 16x1,5	M 16x1,5	M 16x1,5
P_S	Control pressure supply	M 14x1,5	M 18x1,5	M18x1,5	M 14x1,5

Orifice A6VG/DA		Size 55	Size 80	Size 107	Size 160	Size 200
A, B	Service lines	SAE 3/4"	SAE 1"	SAE 1"	SAE 1 1/4"	SAE 1 1/4"
T_1	Case drain port	M 18x1,5	M 18x1,5	M 18x1,5	M 22x1,5	M 22x1,5
X_1/X_2	Pilot pressure ports	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G^V	Operating pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5
G^*	Control pressure	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5	M 14x1,5

Measuring points A4Vg/DA - A6VM/HA		Pressure gauge (pressure range)
M_A	Service line A	600 bar
G_{A6VM}	Service line A/B	600 bar
M_B	Service line B	600 bar
G_{A4VG}	Boost pressure	40 bar
R	Housing pressure	10 bar
S	Negative suction pressure	1 bar (absolut)
X_1/X_2	Pilot pressure	40 bar
G*	Control pressure	600 bar

Measuring equipment

The following pressure gauges (damped design) and measuring devices should be available:

2 pressure gauges up to 600 bar
HP measurements at measuring ports $M_B/M_A/G_A$IG*

2 pressure gauges up to 40 bar
Pilot pressure measurements at the measuring ports X_1/X_2 (control lines) and boost pressure measurements at measuring port G

1 pressure gauge up to 10 bar
Housing pressure measurements at port R of variable displacement pump and in oil motor drain line

1 vacuum pressure gauge up to 1 bar absolute
Measurement in suction line of oil motor

1 thermometer up to 100°C

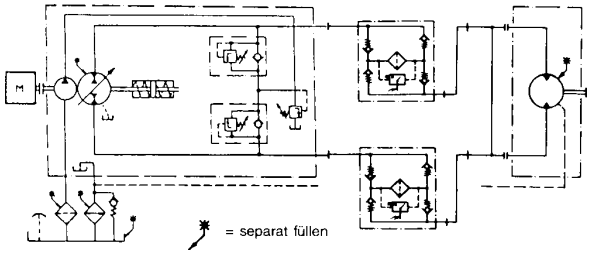
1 tachometer up to 3000 rpm
Prime mover speed measurement

1 volt- and ammeter
Measuring range I = 1.5 A
U up to 30 volts

For checking solenoids

Safety Notes RDE 90 301 - 01

Flushing
During commissioning of the installation we recommend a flushing run for the filtering of the main circuit.
If a flushing run is carried out, this must be undertaken under zero load prior to the actual function test and under normal circumstances should last an hour.
With the installation ready for operation two HP super-fine filters, mounted as shown in service lines A and B between the variable displacement pump and the oil motor, will ensure that a flushing run can be carried out in both directions without additional assembly work.
At the same time this ensures that the pump and motor are protected before the first run takes place.
The pore size of the fiushing filter should correspond to that of the hydraulic installation. It should, however, have a beta value of at least $ß_{30} = 100$. The flushing filters should be fitted with a clogging indicator instead of a bypass valve.



Commissioning

Prior to start

Has the tank been cleaned and flushed?

Have the lines been cleaned, are pipes free of tension and hoses correctly mounted ?

Are all lines connected correctly as shown in the circuit diagram ?

Fittings and flanges properly screwed up?

Are coupling or drive elements between prime mover and pump or motor and gearbox correctly mounted and aligned?

Does the direction of rotation of the prime mover agree with the direction of rotation of the pump ?

Is the filter correctly mounted in the direction of flow ?

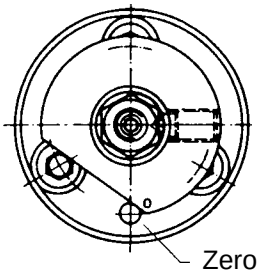
Connect measuring devices for test measurements during commissioning.

Fill oil tank with the prescribed fluid to maximum oil level mark.

Important: Depending on the installation position of the pump fill the housing via return line port T_1/T_2 and motor housing via drain port T up to overflow. If, due to particular installation conditions, the suction line has not been filled prior to start, this mustbe filled separately.

Please note: Control device for variable displacement pump should be set to zero (solenoids de-energised).

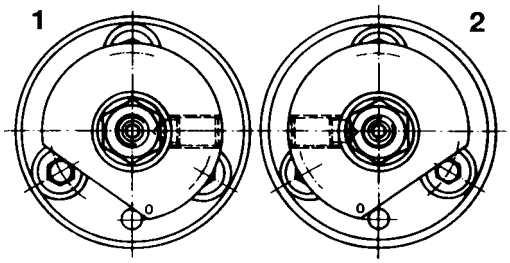
Please check mechanical actuation of speed control at prime mover and, if necessary, set so that, with the gas pedal fully operated, the speed control lever touches the full load stop.
Check direction of operation of the inch control valve.
Check whether control valve is at zero position.



Zero position

Check direction of inch for reduced speed.
Note: The stop at the control valve may be turned through 180°, thus permitting a choice to be made between clockwise or anti-clockwise inch direction.

Mounting Mounting



Depress inch pedal fully, check whether positioning distance is adequate. The angle of rotation of the control lever is 70°.
Please note: The mechanical; stop at the inch pedal must be set so that, when the pedal is fully depressed, the stop ring at the control valve does not touch the stop pin.

Start - First Run

Rotate the prime mover by means of the starter motor until the oil flows out of gauge port "G" of A6VM/DA without bubbles.

Start prime mover in the normal way, checking boost pressure at gauge port "G" of A4V/DA.

Do not drive the vehicle yet!

NB: Continually check the oil level in the tank. If necessary add more oil. Foaming indicates leakage in the suction line.

Please note: An oiltight suction line is not necessarily airtight.

During the start-up phase pressure oscillations may occur at the boost pressure gauge. At idle speed the boost pressure must find its level at a constant 15-20 bar.

Turn off prime mover. Connect the electrical control and check the functioning of the solenoids.

Check oil level in the tank.

Start prime mover.

Check function under no load.

Check the measuring devices.

Keep installation running until it is warmed up to 50-60° (measured in the circuit}.

Pay attention to any noises.

Once the operating temperature is reached switch off the prime mover.

Check setting data

The operating temperature should be kept at a predominantly constant level

Lock out inch pedal rods

Start drive motor, idle speed

Blocked state: switch for travel direction at "0"
Increase motor speed slowly up to max. motor speed, at the same time checking measuring devices

Boost pressure:	Motor at idle speed	
	Psp	= ca. 15-20 bar
	Max. motor speed	
	Psp	= ..... bar*
Housing pressure:	R	= min. ..... bar
		= max. ..... bar
Suction pressure:	(Test port at suction filter)	
		= min. ..... bar*
		= max. ..... bar*

Boost pressure: Travel direction switch in forward position
(In "road" gear, fully braked)
Check setting data for A4V/DA pump

Start of control

HP 40-50 bar - motor speed ..... rpm. Psp ..... bar*
HP ..... bar - motor speed ..... rpm. Psp ..... bar*

Checking pressure cut-off valve HP ..... bar*
⚠ Should be 30 - 40 bar below setting of safety valve

Checking safety relief valve HP ..... bar*
⚠ Block pressure cut off valve
⚠ Operate safety valves for very short period only (risk of overheating)

Turn off prime mover

Engage inch pedal rods
Check: Repeat checking of start and end of control and set the inch pedal rods so that , from an engine speed of ..... ±100 rpm, the setting lever on the control valve moves to provide a constant high pressure of HP - 20 bar* until the maximum motor speed is reached.

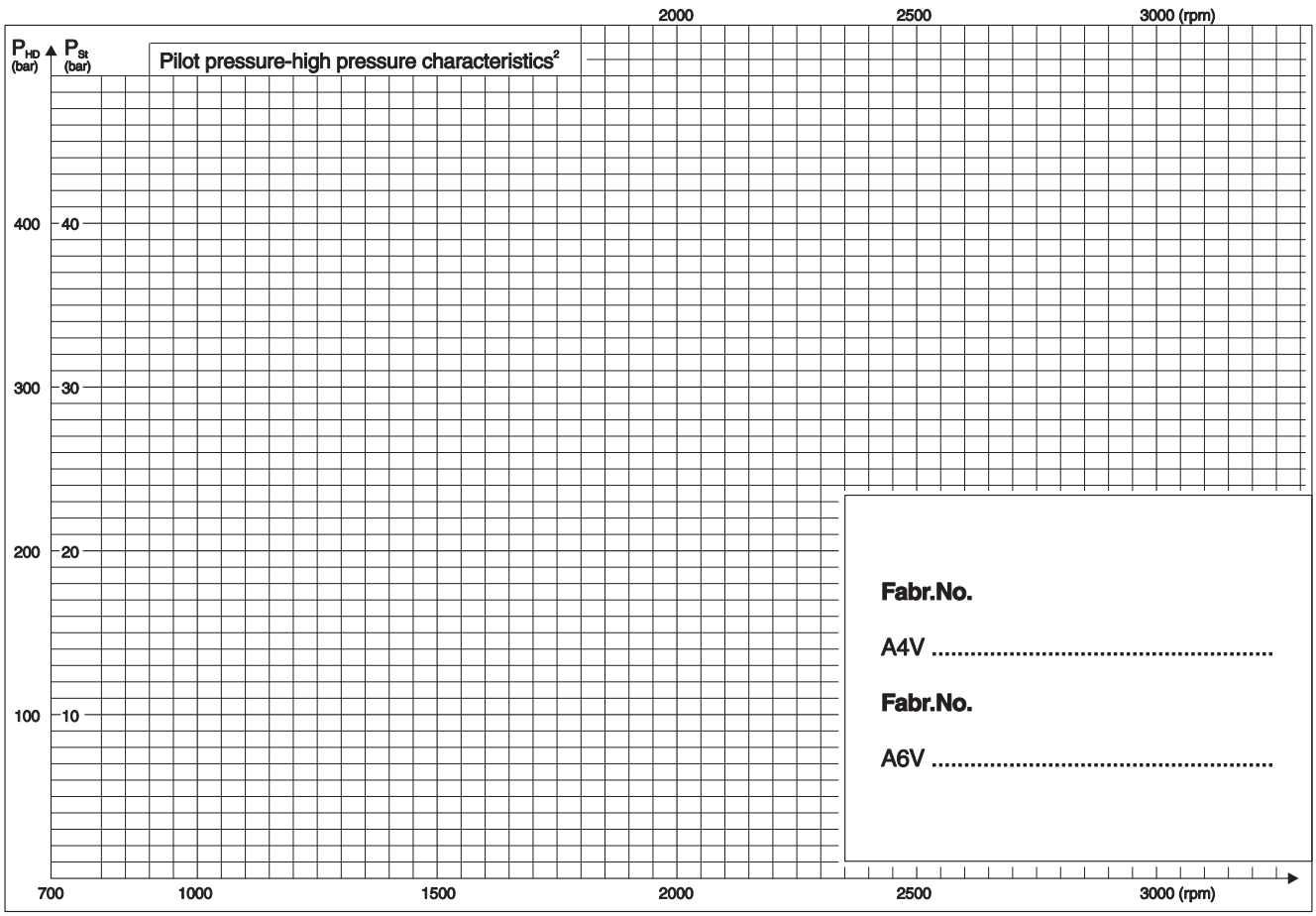
⚠ This high pressure level must be 30-40 bar lower than the safety valve setting .

Leak test
Stop prime mover.
Tighten all fittings, flanges, plugs, even if they are already tight.

Nachziehen nur bei druckloser Anlage

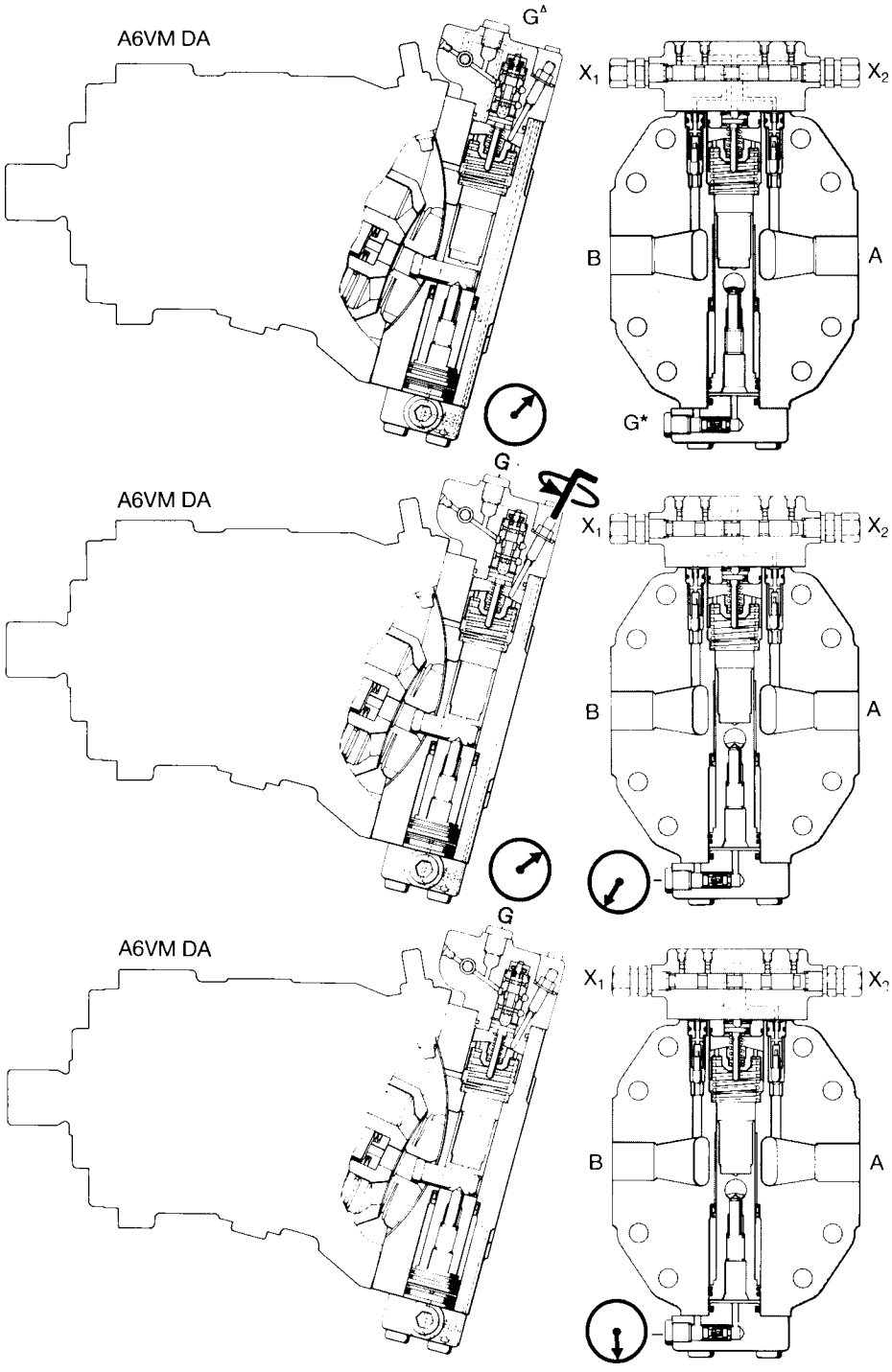
* For supplementary information see order confirmation.

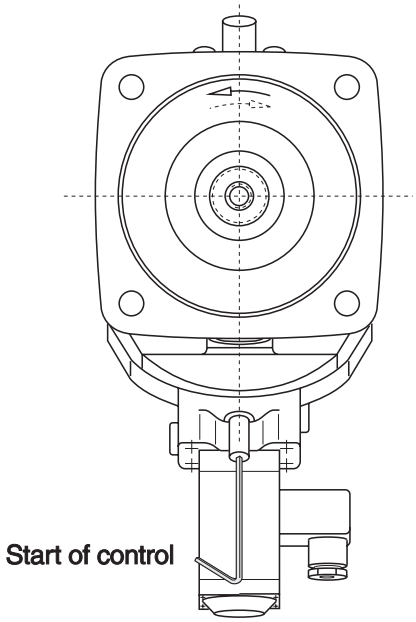
A4V/DA-A6V/ DA Installation



Set values		Command values
Diesel engine speed		
1. Min. idle speed	(n-min)	
2. Nom. speed	(n-last)	
3. Min. speed	(n-max)	
Pump speed		
1.	(n-min)	
2.	(n-min)	
3.	(n-min)	
Oil temperature		
Tank		
Return line in front of cooler	L	
Boost pressure	(P_{SP})	
At nominal speed	(n-last)	
Suction pressure	(P_S)	
Housing pressure	(R)	
Pressure cut-off	(P_{HD})A	
	(P_{HD})B	
Start -up values		
Diesel engine speed	(N)	
High pressure	(P_{HD})	
Pilot pressure	(P_{ST})	
Blockkurve		
a) High pressure	= 50 bar	
Engine speed		
Boost pressure		
Pilot pressure		
b) High pressure	= 200 bar	
Engine speed		
Boost pressure		
Pilot pressure		
c) High pressure	= P_{HD} = Max	
Engine speed		
Boost pressure		
Pilot pressure		

Set values		Actual values
Diesel engine speed		
1. Min. idle speed	(n-min)	
2. Nom. speed	(n-last)	
3. Min. speed	(n-max)	
Pump speed		
1.	(n-min)	
2.	(n-min)	
3.	(n-min)	
Oil temperature		
Tank		
Return line in front of cooler	L	
Boost pressure	(P_{SP})	
At nominal speed	(n-last)	
Suction pressure	(P_S)	
Housing pressure	(R)	
Pressure cut-off	(P_{HD})A	
	(P_{HD})B	
Start -up values		
Diesel engine speed	(N)	
High pressure	(P_{HD})	
Pilot pressure	(P_{ST})	
Blockkurve		
a) High pressure	= 50 bar	
Engine speed		
Boost pressure		
Pilot pressure		
b) High pressure	= 200 bar	
Engine speed		
Boost pressure		
Pilot pressure		
c) High pressure	= P_{HD} = Max	
Engine speed		
Boost pressure		
Pilot pressure		


A6VM DA
G^
X1
X2
B
A
G*
A6VM DA
G
X1
X2
B
A
A6VM DA
G
X1
B
A



Checking settings (start of control)

Notes on setting

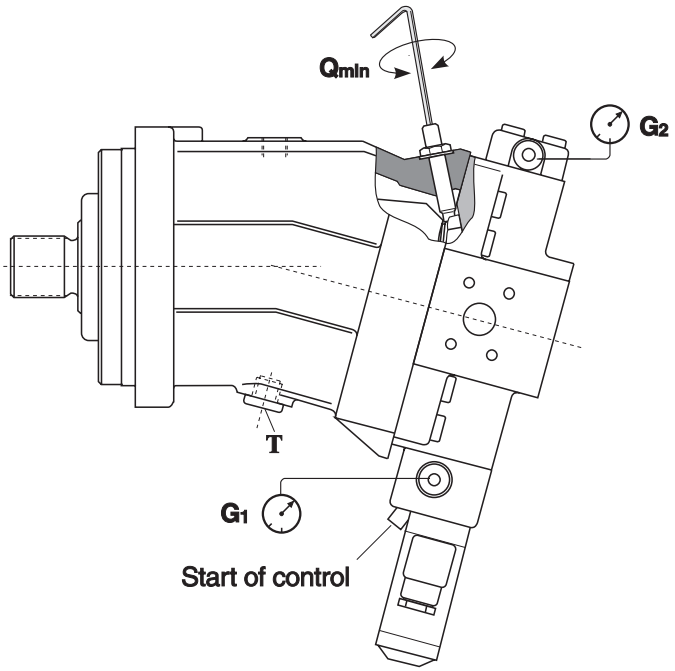
Observe safety regulations!
All settings to conform to works order
Blocked state ("road" gear and fully braked)
Pressure gauge to be connected at 400 bar to G_1 and G_2

Start of control: (see works order)
Pressure gauge at G_1 = operating pressure
Pressure gauge at G_2 = set pressure

Example:
Start of control 200 bar
Increase operating pressure slowly until pressure gauge G_1 reaches 200 bar
At the operating pressure, reading pressure gauge G_2, approx. 1 /3 of operating pressure should be present i.e. a set pressure of approx. 70 bar.
"This is start of control"

Set pressure adjustment at the setscrew - start of control

Note:
Rotate in clockwise direction - start of control falls



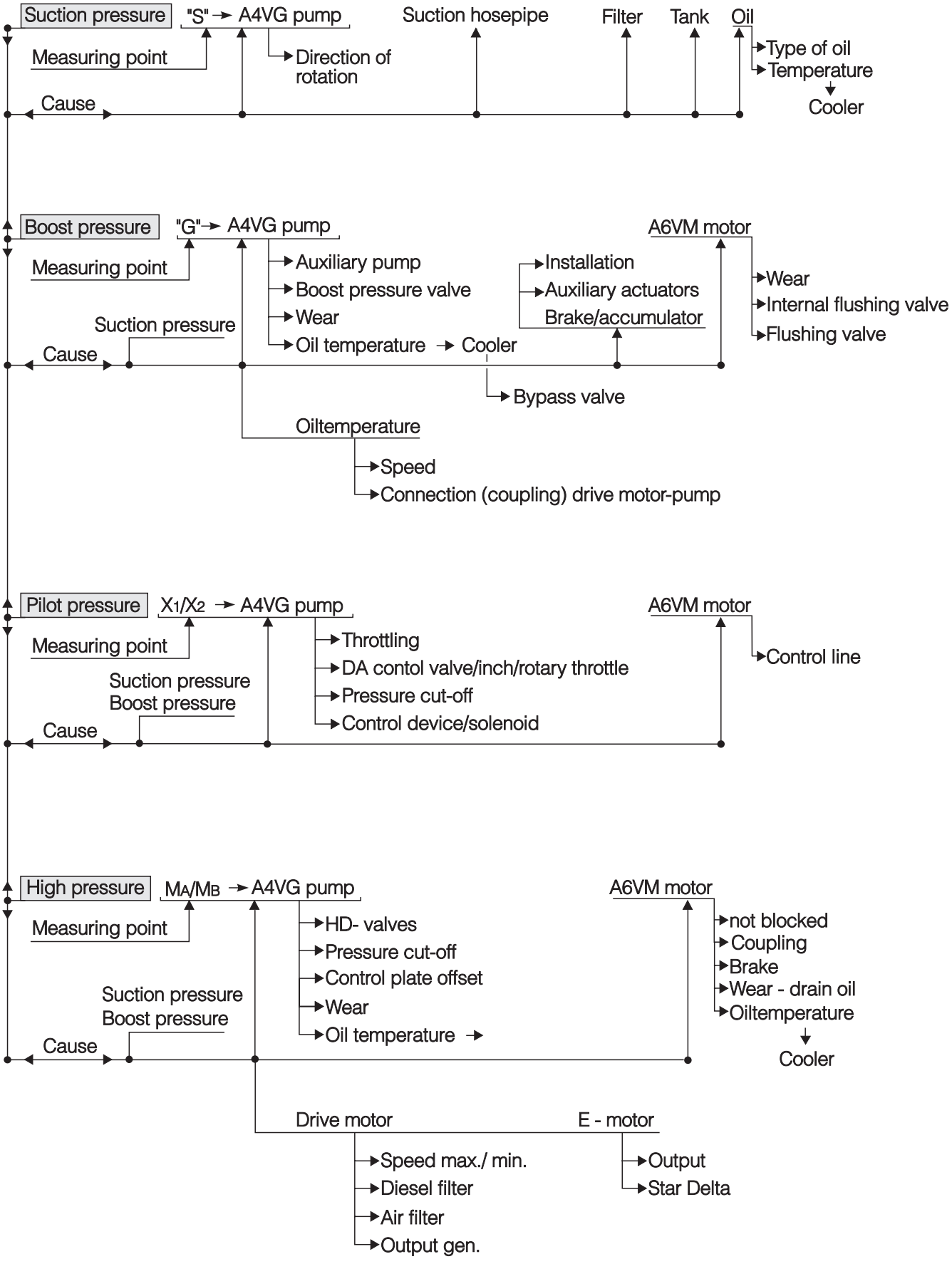
In installations with two or more motors e.g. tracked vehicles the following setting may also be used:
Destroy safety cap at Q_{min} stop
Loosen lock nut
Do not permit setting screw Q_{min} to turn
Connect operating pressure gauge to G_1

Example:
Increase operating pressure slowly until pressure gauge at G_1 shows 200 bar
Check: Q_{min} setscrew is "secure" (control lens is pressed against setting screw).
After 200 bar operating pressure the screw becomes loose (control lens oscillates in Q_{max} direction)
"This is the start of control"

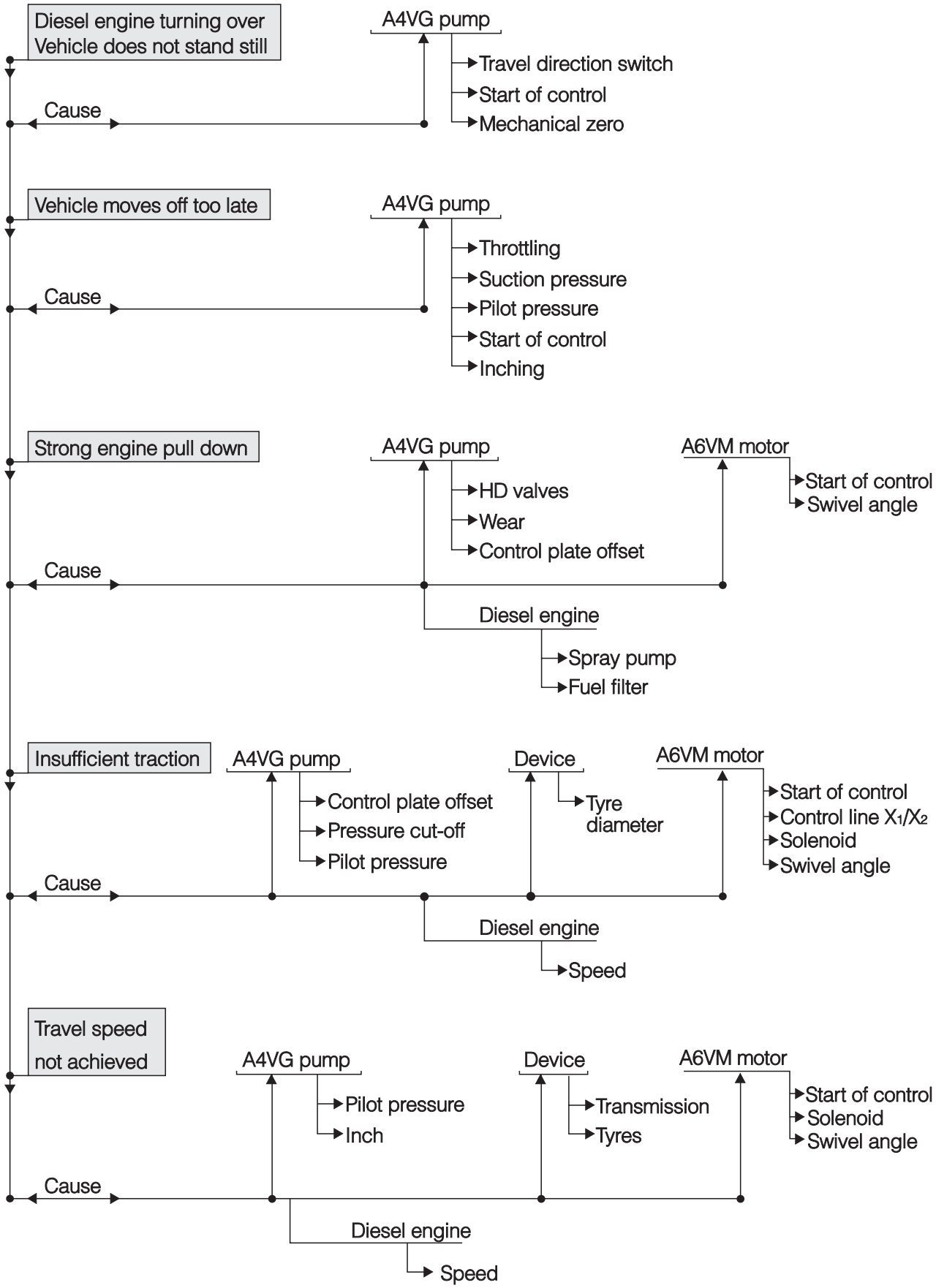
NB
Do not alter set value Q_{min} screw
Note:
Adjustment at start of control setting screw

Note:
After checking or setting operations start of control adjustment screws and adjustment screw Q_{min} should be fitted with new safety caps.
Original HYDROMATIK caps yellow - equipment manufacturers caps are orange

Fault finding - equipment



Fault finding - equipment



Hydromatik GmbH, Glockeraustr. 2, D-89275 Elchingen, Telefon (07308) 820, Telex 712538, Telefax (07308) 7274, 7273
Brueninghaus Hydraulik GmbH, An den Kelterwiesen 14, D-72160 Horb, Telefon (07451) 920, Telex 765321, Telefax (07451) 8221

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

SECTION 19
ENGINE

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19.0 ENGINE INTRODUCTION

GENERAL

This section includes a general troubleshooting guide for engines and covers the removal and installation procedures for this machine. For additional information concerning the service, maintenace, and repair of the optional engines which are provided on the individual machines, see the enclosed engine manufacturer's manual.

19.1 ENGINE REMOVAL / INSTALLATION

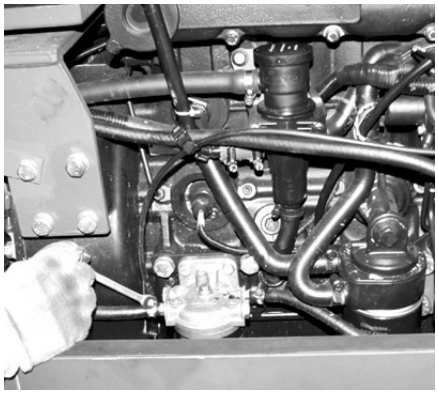
REMOVAL

Follow the procedures below for removal of the engine

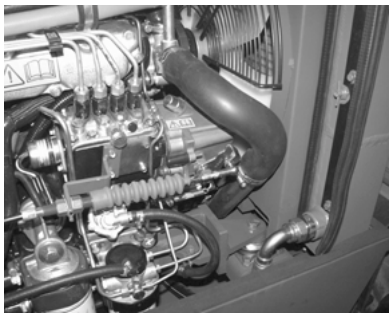
1. Remove the engine hood.

2. Use 13 mm wrench, remove the lower protection cover under the engine held in position by four screws.

3. Disconnect the supply and return lines held in position by the hose-clamps.



4. Disconnect the accelerator cable by removing the locking clip and loosen the cable register with a 17 mm wrench to pull out the cable.

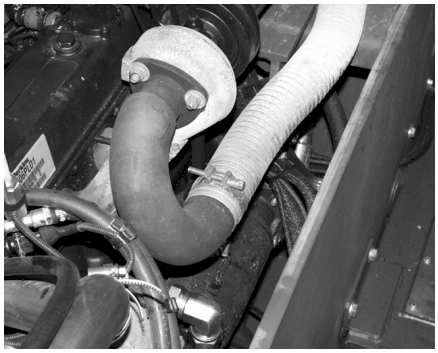


5. Close the oil tank valves.



6. Disconnect the filler extension of the oil tank using a 19 mm and 10 mm wrench.

7. Disconnect the flexible pipe of the muffler loosening the clamps with a 10 mm wrench.



8. Use a screwdriver or a 7 mm wrench, loosen the hose-clamps of the air filter sleeve; and then disconnect the air filter.
09. Tag and disconnect the electrical wires.

10. Tag and disconnect the two drains of the hydraulic pump with a 32 mm wrench.

11. Using a 46 mm wrench disconnect the intake line of the hydraulic pump.

12. Using an 18 mm wrench, disconnect the supply hose and use 8 mm wrench to disconnect the two pressure lines of the hydraulic pump.

13. Tag and disconnect the pressure and intake line on the distribution.

14. Tag and disconnect the two hoses one the water-oil radiator by using a 32 mm wrench.

15. Remove the four screws of the front and back vibration supports with a 22 mm wrench.

16. Using adequate lifting device sling the engine, make sure no parts are still connecting the engine to the machine.

17. Lift and remove the engine from the machine, rest it on a suitable support and secure it in position.

INSTALLATION

Follow the procedures below for the installation of the engine:

1. Install the engine in the machine.

2. Install the four screws of the front and back vibration supports with a 22 mm wrench.

3. Connect the two hoses on the water – oil radiator by using a 32 mm wrench.

4. Connect the pressure and intake line on the distribution.

5. Using an 18 mm wrench, connect the supply hose and use 8 mm wrench to connect the two pressure lines of the hydraulic pump.

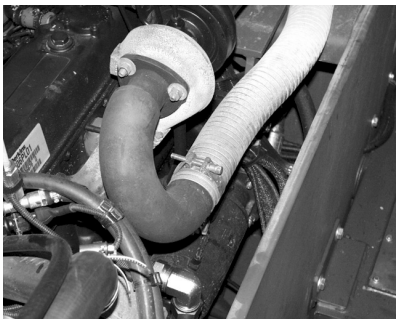
6. Using a 46 mm wrench connect the intake line of the hydraulic pump.

7. Connect the two drains of the hydraulic pump with a 32 mm wrench.

8. Connect the electrical wires.

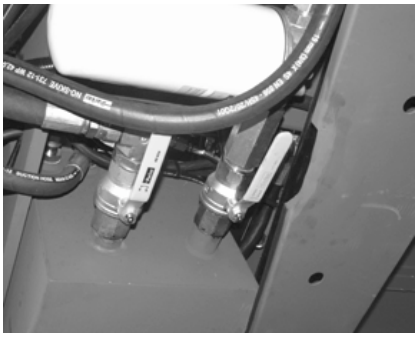
9. Use a screwdriver or a 7 mm wrench, tighten the hose-clamps of the air filter sleeve; and then disconnect the air filter.

10. Connect the flexible pipe of the muffler loosening the clamps with a 10 mm wrench.



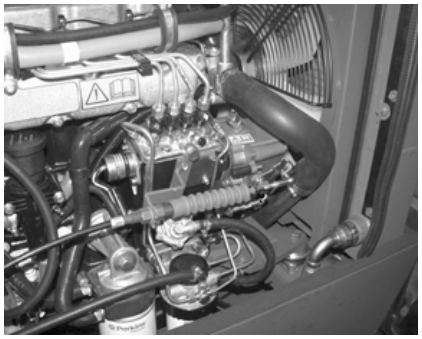
11. Connect the filler extension of the oil tank using a 19 mm and 10 mm wrench.

12. Open the oil tank valves.

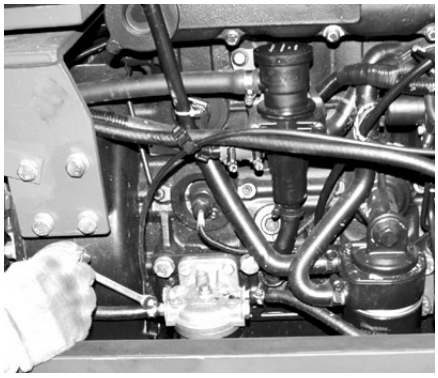


13. Using a 19 mm wrench reinstall the batteries and battery compartment.

14. Connect the accelerator cable by installing the locking clip and tightening the cable register with a 17 mm wrench.



15. Connect the supply and return lines help in position by the hose-clamps.



16. Use a 13 mm wrench, install the lower protection cover under the engine.

17. Install the engine hood.

19.2 PERKINS USER HANDBOOK

19.3 PERKINS 700 SERIES WORKSHOP MANUAL

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DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

PERKINS ENGINE MANUAL

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

Perkins 700 Series User's Handbook

Models UA, UB and UC

4 Cylinder naturally aspirated and turbocharged diesel engines for industrial, agricultural and fork lift truck applications

Publication TPD 1336E Issue 6
This publication is written for worldwide use. In territories where legal requirements govern engine smoke, emission, noise, safety factors, etc., then all instructions, data and dimensions given must be applied in such a way that, after servicing (preventive maintenance) or repairing the engine, it does not contravene the local regulations when in use.
The information is correct at time of print.
Published in May 1999 by Technical Publications, Hawtal Whiting Engineering Ltd.

05/99

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Introduction

The Perkins 700 Series engines are some of the latest developments from Perkins Engines Company Limited, a world leader in the design and manufacture of high performance diesel engines.

The current range of engines includes the naturally aspirated and turbocharged versions of the 704-30 direct injection, water cooled diesel engines. These engines are designed for industrial and agricultural applications. Also in the range there is the naturally aspirated 704-26 indirect injection, water cooled diesel engine. This engine is designed for fork lift truck applications.

These engines conform to Stage 1 off-highway emissions to C1-8 mode cycle.

More than sixty years of diesel production experience, together with the latest technology, have been applied to the manufacture of your engine to give you reliable and economic power.

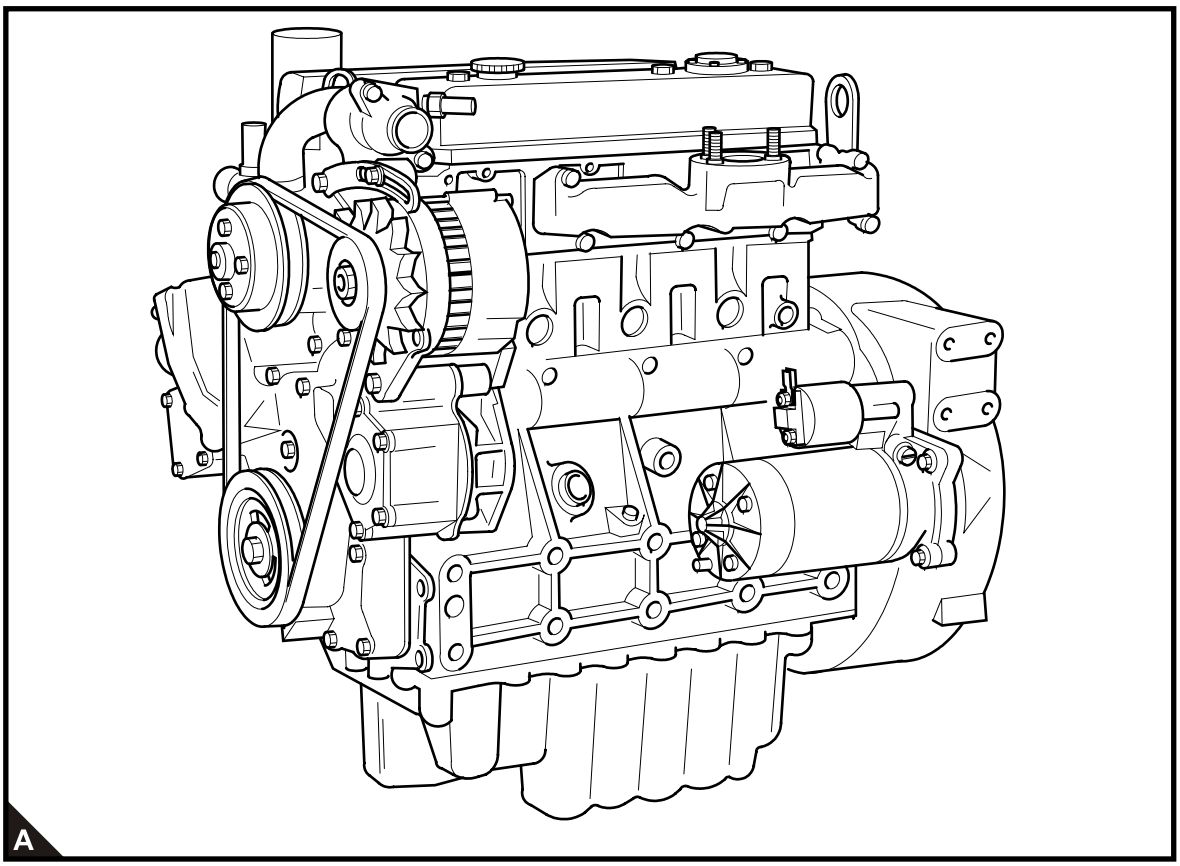
Note: To ensure that you use the relevant information for your specific engine type, refer to "Engine identification" on page 7.

Danger is indicated in the text by two methods:

Warning! *This indicates that there is a possible danger to the person.*

Caution: *This indicates that there is a possible danger to the engine.*

Note: *Is used where the information is important, but there is not a danger.*



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How to care for your engine

Caution: *Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.*

This handbook has been written to assist you to maintain and operate your engine correctly.

To obtain the best performance and the longest life from your engine, you must ensure that the maintenance operations are done at the intervals indicated in "Preventive maintenance". If the engine works in a very dusty environment or other adverse conditions, certain maintenance intervals will have to be reduced. Renew the filter canister and lubricating oil regularly in order to ensure that the inside of your engine remains clean.

Ensure that all adjustments and repairs are done by personnel who have had the correct training. Perkins distributors have this type of personnel available. You can also obtain parts and service from your Perkins distributor, enquire at one of the Perkins companies listed on page 8.

The terms "left side" and "right side" apply when the engine is seen from the flywheel end.

Warning! *Read the "Safety precautions" and remember them. They are given for your protection and must be applied at all times.*

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Safety precautions

These safety precautions are important. You must refer also to the local regulations in the country of use. Some items only apply to specific applications.

- Always refer to the text of this handbook for specific warnings and cautions.
- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not make adjustments that you do not understand.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel in the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme caution must be used to prevent injury).
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine, auxiliary equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.

Warning! *Keep away from moving parts during engine operation. Warning! Some moving parts cannot be seen clearly while the engine runs.*

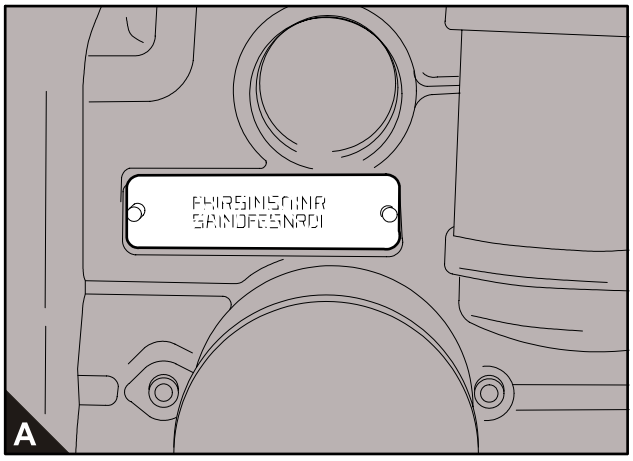
- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap or any component of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operator's position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets.
- Discard used lubricating oil and coolant in accordance with local regulations to prevent contamination.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a container of water. Fit safety wires to secure the plugs which seal the hose connections of a component which is to be pressure tested.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.
- Turbochargers operate at high speed and at high temperatures. Keep fingers, tools and debris away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Some components are not waterproof and should not be washed with a high-pressure water jet or steam.
- Fit only genuine Perkins parts.

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Engine identification



704-30 engine - identification letters UA

704-30T engine - identification letters UC

704-26 engine - identification letters UB

The engine number is stamped on the left side of the cylinder block (A1), behind the high pressure pump.

The engine number is stamped on a plate on the right side of the cylinder block.

An example of an engine number is UA80862U123456F

UA	Type code letters
8086	Build list number
U	Built in the UK
123456	Engine serial number
F	Year of manufacture

If you need parts, service or information for your engine, you must give the complete engine number to your Perkins distributor.

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Perkins companies

Australia

Perkins Engines Australia Pty. Ltd,
Suite 4, 13A Main Street,
Mornington 3931, Victoria, Australia.
Telephone: 0061 (0) 597 51877
Telex: Perkoil AA30816
Fax: 0061 (0) 597 1305

France

Moteurs Perkins S.A.,
"Parc des reflets",
165 Avenue du Bois de la Pie,
95700 Roissy Charles de Gaulle, France.
Telephone: 0033 (01) 49-90-7171
Fax: 0033 (01) 49-90-7190

Germany

Perkins Motoren GmbH,
Saalaeckerstrasse 4,
63801 Kleinostheim,
Germany.
Telephone: 0049 6027 5010
Fax: 0049 6027 501124

Italy

Motori Perkins S.p.A.,
Via Socrate 8,
22070 Casnate con Bernate (Como), Italy.
Telephone: 0039 (0) 31 564633/564625
Fax: 0039 (0) 31 565480/564145/396001

Japan

Perkins Engines (Japan) K.K.,
Reinanzaka Building, 5th Floor,
14-2 Akasaka, 1-chome, Minato-ku,
Tokyo 107, Japan.
Telephone: 0081 (0) 3 586 7377
Telex: Perkoil J2424823
Fax: 0081 (0) 3 582 1596

Singapore

Perkins Engines (Far East) pte Ltd
Tuas Avenue 13
Singapore 638999
Telephone: (65) 861 1318
Fax: (65) 861 6252

United Kingdom

Perkins Engines Company Ltd,
Eastfield, Peterborough PE1 5NA,
England.
Telephone: 0044 (0) 1733 583000
Telex: 32501 Perken G
Fax: 0044 (0) 1733 582240

United States of America

Perkins International - North America,
26200 Town Center Drive,
Suite 280,
Novi, Michigan 48375
USA
Telephone: 001 248 374 3100
Fax: 001 248 374 3110

Perkins Engines Latin America Inc,
Suite 620,
999, Ponce de Leon Boulevard,
Coral Gables,
Florida 33134, U.S.A.
Telephone: 001 305 442 7413
Telex: 32501 Perken G
Fax: 001 305 442 7419

In addition to the above companies, there are Perkins distributors in most countries. Perkins Engines Company Limited., Peterborough or one of the above companies can provide details.

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Engine views

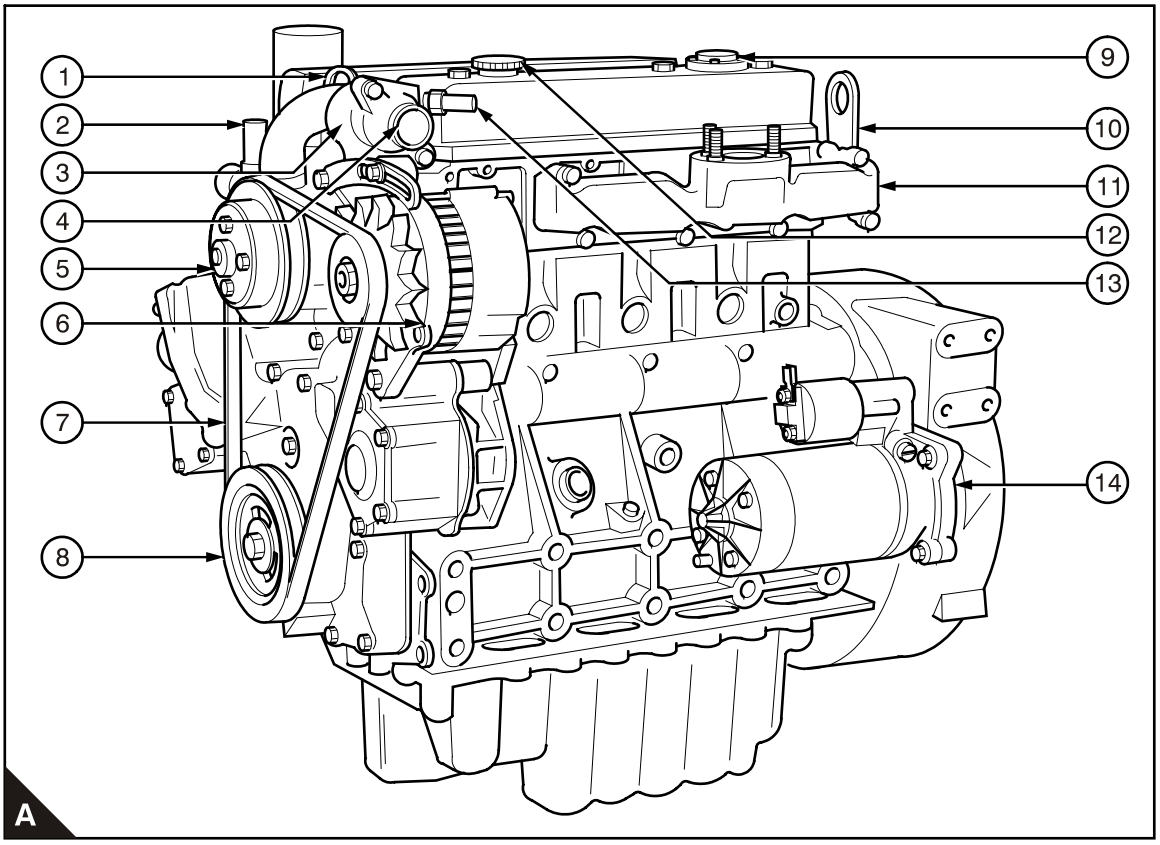
Introduction

Perkins engines are built for specific applications and the views which follow do not necessarily match your engine specification.

Location of engine parts

Front and left side view of a UA or a UB engine (A)

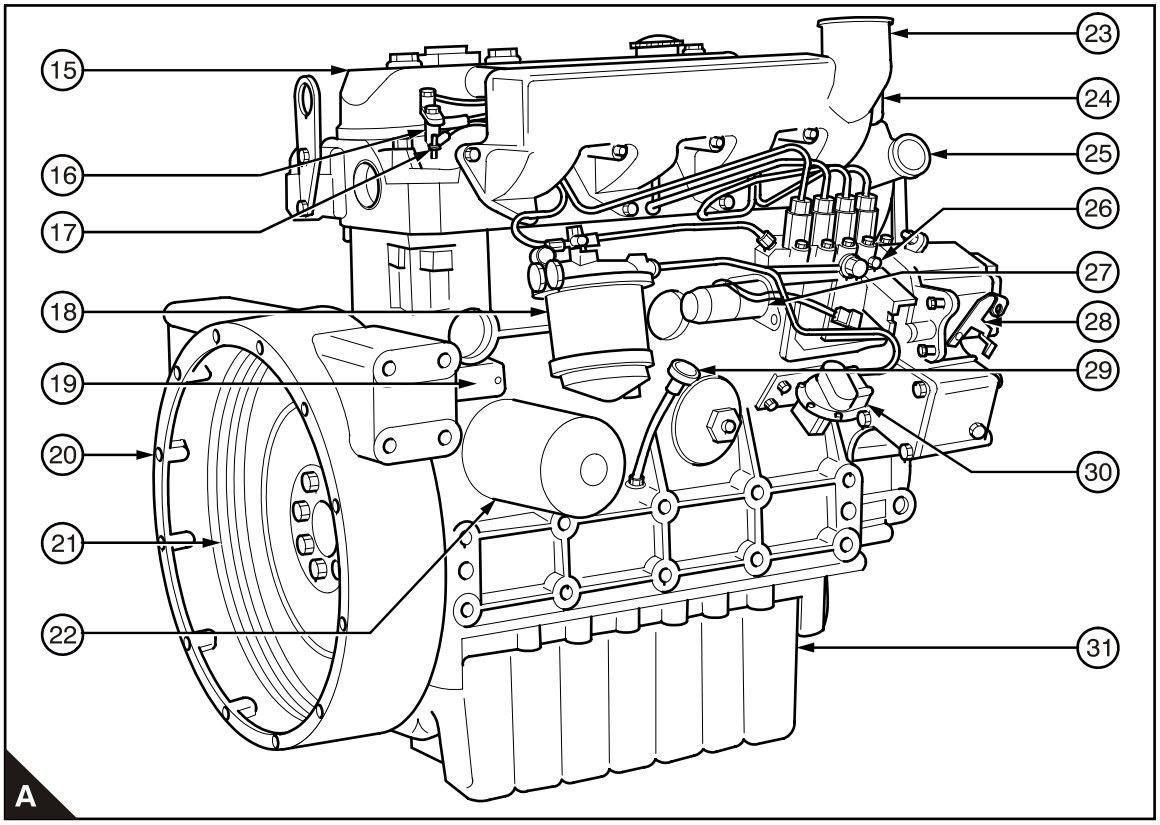
1 Front lift bracket
2 Return connection from the heater
3 Thermostat housing
4 Outlet connection for the coolant
5 Coolant pump pulley
6 Alternator
7 Drive belt
8 Crankshaft pulley
9 Engine breather
10 Rear lift bracket
11 Exhaust manifold
12 Filler cap for the lubricating oil
13 Outlet connection for the heater
14 Starter motor



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Rear and right side view of a UA or a UB engine (A)

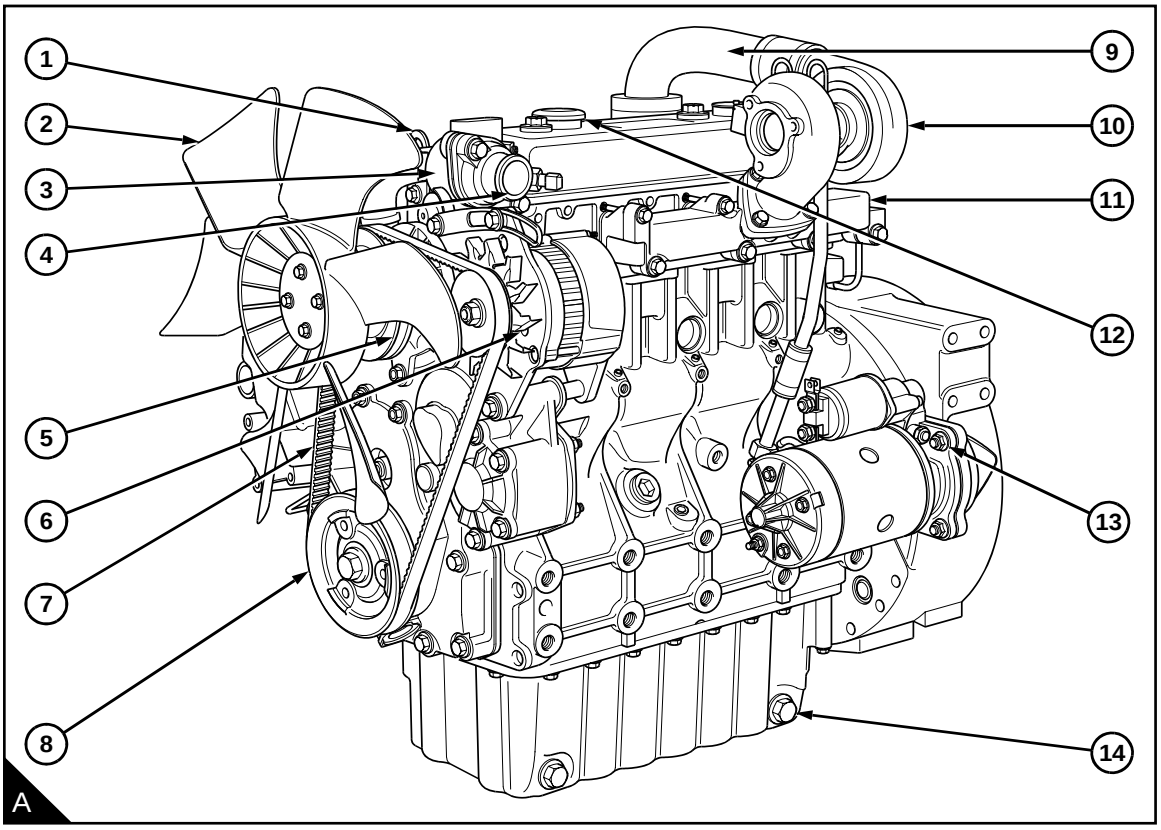
15 Rocker cover
16 Atomiser
17 Glow plug
18 Fuel filter
19 Engine identification number
20 Flywheel housing
21 Flywheel
22 Canister for the lubricating oil filter
23 Air inlet connection
24 Induction manifold
25 Inlet connection for the coolant
26 Fuel injection pump
27 Stop control solenoid
28 Speed control
29 Lubricating oil dipstick
30 Fuel lift pump
31 Sump for the engine lubricating oil



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Front and left side view of a UC engine (A)

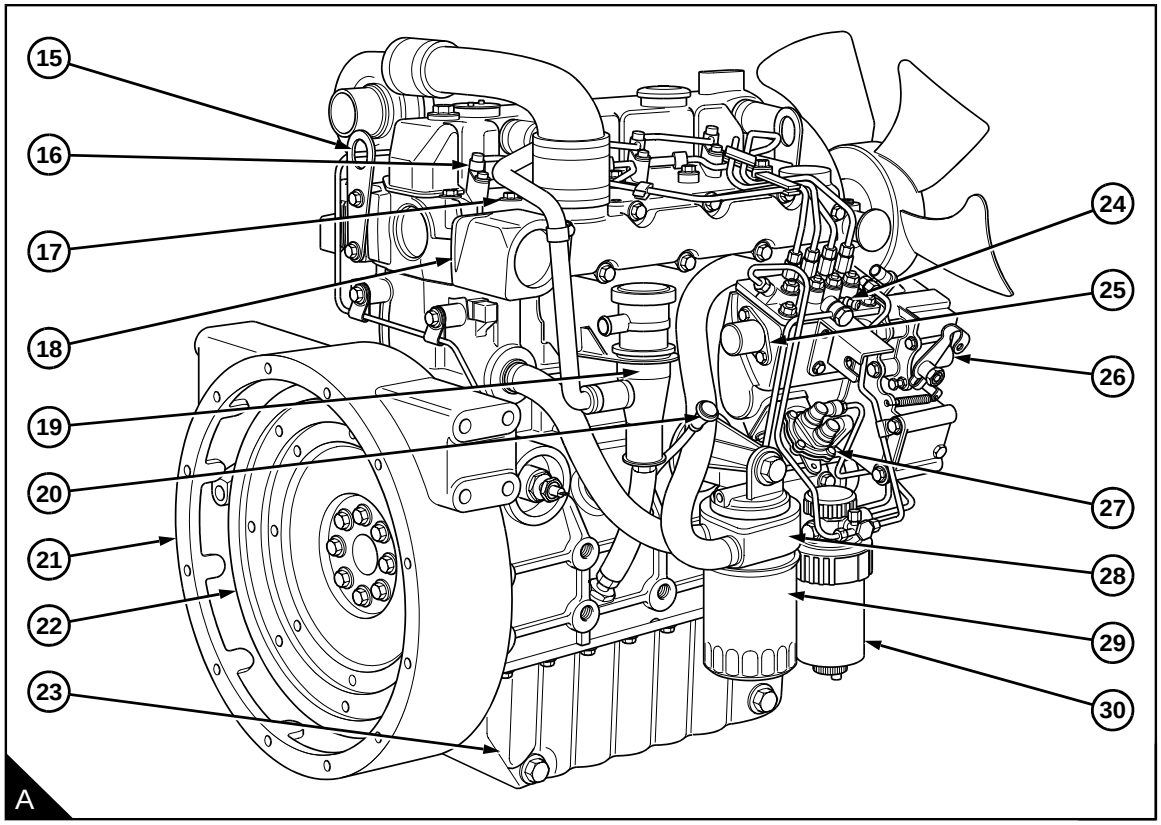
1 Front lift bracket
2 Fan
3 Thermostat housing
4 Outlet connection for the coolant
5 Coolant pump pulley
6 Alternator
7 Drive belt
8 Crankshaft pulley
9 Cross-over pipe
10 Turbocharger
11 Exhaust manifold
12 Filler cap for the lubricating oil
13 Starter motor
14 Drain plug for the lubricating oil



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Rear and right side view of a UC engine (A)

15 Rear lift bracket
16 Atomiser
17 Glow plug
18 Induction manifold
19 Engine breather
20 Lubricating oil dipstick
21 Flywheel housing
22 Flywheel
23 Lubricating oil sump
24 Fuel injection pump
25 Stop control solenoid
26 Engine speed control
27 Fuel lift pump
28 Lubricating oil cooler
29 Lubricating oil filter canister
30 Fuel filter canister



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How to start the engine

Warning! *Ether type fuels must not be used in 700 Series engines.*

Use only this procedure to start the engine; it has been designed to protect the engine and the environment.

Several factors affect engine start, for example:

- The power of the batteries
- The performance of the starter motor
- The viscosity of the lubricating oil
- The installation of a cold start system.

Diesel engines need a cold starting aid if they are to start in cold conditions. The 700 Series engines are equipped with glow plugs. These electrically operated plugs are fitted into the combustion chamber of each cylinder. The use of these glow plugs is only necessary in cold conditions.

These engines can be fitted with an "automatic control system" to operate the glow plugs before and after the engine has started. This system is designed to help the engine run evenly and reduce smoke when the engine is first started in cold temperatures. The period of time that the glow plugs will operate has been set automatically according to ambient temperatures.

Before the engine is started the operator should understand fully the reason for the controls and their use.

Before the engine is started:

1 Check that there is enough coolant and, if necessary, add the correct coolant, see section 4 of this handbook.

2 Check that there is enough lubricating oil in the sump and, if necessary, add lubricating oil, see section 4 of this handbook. Ensure that the lubricating oil is of the correct grade for the ambient conditions.

3 Fill the fuel tank with fuel of the correct specification.

4 Check the air filter and its connections.

5 Ensure that all of the electrical connections are tight.

Notes:

- See section 5 of this handbook for the correct engine fluids.
- The procedures to start the engine may vary according to the application. If possible, consult the User's Handbook for the application.

Cautions:

- *Do not operate the engine at high speeds without a load.*
- *If the engine has not run for several weeks, see "Caution" on page 39.*

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How to start a cold engine in cold conditions

Warning! *Ether type fuels must not be used in 700 Series engines.*

Note: Use this method when the cylinder head temperatures are below 0°C (32°F).

1 Adjust the engine speed control to the maximum speed position.

2 If a combined heat/start switch (A) is used:

Move the start key to the "H" position (A) for a period of ten seconds. Move the start key to the "HS" position (A) to engage the starter motor. When the engine starts, release the start key to the "H" position (A) and hold in this position. As the engine speed begins to increase, quickly reduce the engine speed. When the engine runs evenly, adjust the speed control to get an even idle speed.

If separate heat and start switches are used: Actuate the glow plugs for a period of ten seconds. Engage the starter motor with the glow plugs still actuated. When the engine starts, release the starter switch. As the engine speed begins to increase, quickly reduce the engine speed and continue to actuate the glow plugs until the engine runs evenly and then adjust the speed control to get an even idle speed.

3 If the engine does not start in 15 seconds, move the combined heat/start key to the "R" position (A) for 30 seconds or release the separate switches for 30 seconds. Then repeat the start procedure.

For engines fitted with automatic glow plug control

1 Adjust the engine speed control to the maximum speed position.

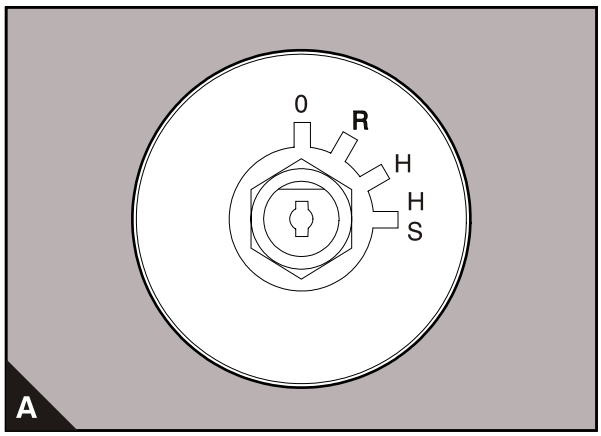
2 Move the start key to the "R" position (B). A light will be illuminated to indicate glow plug operation. When the light is switched off (automatically), move the start key to the "S" position (B) to engage the starter motor. When the engine starts, release the start key to the "R" position (B). As the engine speed begins to increase, quickly reduce the engine speed. At this point, the glow plugs will continue to operate for a short period of time.

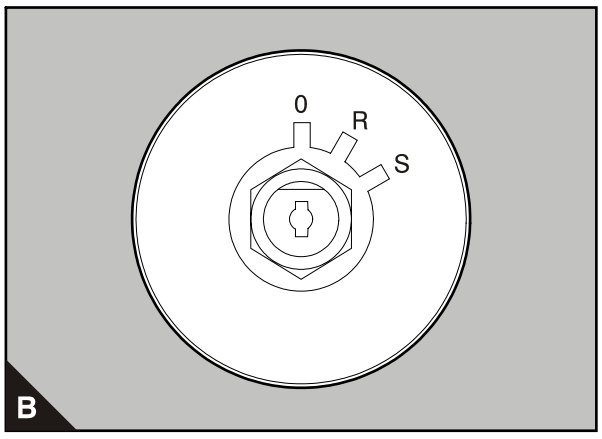
Note: The amount of time will vary according to the ambient temperature.

Caution: *Always ensure that the engine and starter motor are stationary before the starter motor is engaged again.*

3 If the engine does not start in 15 seconds, move the start key to the "O" position (B) and repeat paragraphs 1 and 2.

When the engine runs evenly, adjust the speed control to get an even idle speed.



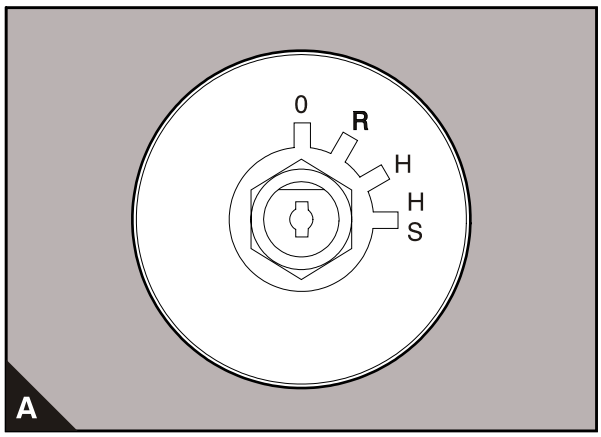


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How to start a cold engine in temperate conditions



1 Adjust the engine speed control to the maximum speed position.

2 Move the start key to the "HS" position (A) to engage the starter motor. When the engine starts, release the start key to the "R" position. As the engine speed begins to increase, quickly reduce the engine speed. Then adjust the engine speed control to get an even idle speed.

3 If the engine does not start in 15 seconds, move the start key to the "R" position and hold it there for 30 seconds. Then engage the starter motor again for a maximum period of 15 seconds. If the engine still does not start, use the start procedure for cold conditions.

How to stop the engine

Note: If the engine has operated at normal operating temperature for a long period of time, run the engine at idle speed for 30 seconds before the engine is stopped. This will allow heat from the large ferrous components to pass into the lubricating oil and the engine coolant.

Move the engine start key to the "OFF" position.

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Adjustment of engine speed range

These engines conform with USA (EPA/CARB) stage 1 and EEC stage 1 emissions legislation for agricultural and industrial applications.

The idle or maximum speed settings must not be changed by the engine operator, because this can damage the engine or the transmission.

Specialist equipment, which is available at your Perkins Distributor, is needed to adjust the idle or maximum speed settings. The warranty of the engine can be affected if the seals on the fuel injection pump are broken during the warranty period by a person who is not approved by Perkins.

Engine operation at idle speed

Do not operate the engine for prolonged periods at idle speed as this could have an adverse affect on the engine performance or damage the engine.

Running-in

Cautions:

- *Do not operate the engine at high speeds without a load.*
- *Do not overload the engine.*

A gradual running-in of a new engine or an exchange engine is not necessary. Prolonged operation at light loads during the early life of the engine can cause lubricating oil to enter the exhaust system. Maximum load can be applied to a new engine as soon as the engine is put into service and the coolant temperature has reached a minimum of 60 ^{o}C (140 ^{o}F).

The engine will benefit if the load is applied as soon as possible after the engine is put into service.

Altitude

The engine will run correctly up to an altitude of 600m (2,000 ft). If the engine is to run at an altitude above this, an increase in smoke may be seen; this is normal for a naturally aspirated engine. Turbocharged engines can run correctly up to an altitude of 3000m (10 000 ft). Contact your Perkins distributor if adjustments are necessary.

Angle of tilt

Caution: *Do not operate the engine an angle of tilt greater than 30^{o}. This is especially important for turbocharged engines. If there is doubt, contact the Perkins Service Department. If the approved angle is exceeded, an excess of lubricating oil could enter the breather valve. This could cause the engine speed to increase rapidly without control.*

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Preventive maintenance periods

These preventive maintenance periods apply to average conditions of operation. Check the periods given by the manufacturer of the equipment in which the engine is installed. Use the periods which are shortest . When the operation of the engine must conform to the local regulations these periods and procedures may need to be adapted to ensure correct operation of the engine.

It is good preventive maintenance to check for leakage and loose fasteners at each service.

These maintenance periods apply only to engines that are operated with fuel and lubricating oil which conform to the specifications given in this handbook.

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Schedules

The schedules which follow must be applied at the interval (hours or months) which occur first.

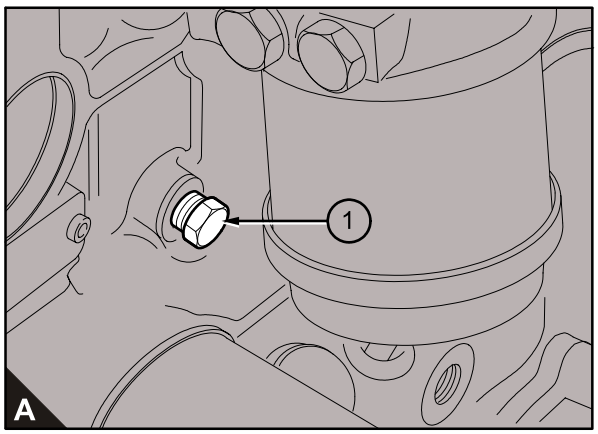
A First service at 25/50 hours
B Every day or every 8 hours
C Every 250 hours or 6 months
D Every 500 hours or 12 months
E Every 1000 hours
F Every 2000 hours
G Every 3000 hours

A	B	C	D	E	F	G	Operation
●	●						Check the amount of coolant
		●					Check the specific gravity of the coolant **(2) (3)**
●		●					Check the tension and the condition of the drive belt
●	●						Drain water from the fuel pre-filter **(1)**
			●				Renew the canister of the fuel filter and renew the fuel strainer
						●	Ensure that the atomisers are checked (always use new clamps - UA and UC engines) **(2)**
●							Ensure that the idle speed is checked and adjusted, if it is necessary **(2)**
	●						Check the amount of lubricating oil in the sump
	●						Check the lubricating oil pressure at the gauge **(1)**
			●				Renew the engine lubricating oil - UA and UC engines **(4)**
			●				Renew the canister of the lubricating oil filter - UA and UC engines
		●					Renew the engine lubricating oil - UB engines **(4)**
		●					Renew the canister of the lubricating oil filter - UB engines
							Clean the air cleaner or empty the dust bowl of the air filter
●		●					-extremely dusty conditions
			●				-normal conditions
			●				Clean or renew the air filter element, if this has not been indicated earlier
				●			Ensure that the valve tip clearances of the engine are checked and, if necessary, adjusted **(2)**
				●			Check all hoses and connections
				●			Remove and clean the components and the pipe for the engine breather - UA and UB engines**(2)**
					●		Ensure that the engine breather is renewed - UA and UB engines **(2) (5)**
				●			Ensure that the alternator, the starter motor, etc. are checked **(2)**
			●				Ensure that the glow plugs are checked **(2)**
				●			Inspect the electrical system **(2)**

(1) If one is fitted.
(2) By a person who has had the correct training.
(3) Renew the antifreeze every 2 years. If a coolant inhibitor is used instead of antifreeze, it should be renewed every 6 months.
(4) The oil change interval will change with the sulphur content of the fuel (see the table below and the Fuel Specification in section 5). The interval to change the canister of the lubricating oil filter is not affected.
(5) UC engines: Renew the engine breather valve every 5000 hours (2). Refer to the workshop manual.

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How to drain the cooling system



Warnings!

- *Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.*
- *Discard used coolant in a safe place and in accordance with local regulations*

1 Ensure that the machine is on level ground.

2 Remove the filler cap of the cooling system.

3 Remove the drain plug (A1) from the side of the cylinder block in order to drain the engine. Ensure that the drain holes are not restricted.

4 Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a tap or drain plug, disconnect the hose at the bottom of the radiator.

5 Flush the system with POWERPART Easy Flush.

6 Fit the drain plugs and the filler cap. Close the radiator tap or connect the radiator hose.

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How to check the specific gravity of the coolant

For mixtures which contain inhibited ethylene glycol:

1 Ensure that the machine is on level ground.

2 Operate the engine until it is warm enough to open the thermostat. Continue to run the engine until the coolant has circulated the cooling system.

3 Stop the engine.

4 Allow the engine to cool until the temperature of the coolant is below 60 ^{o}C (140 ^{o}F).

Warning! Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

5 Remove the filler cap of the cooling system.

6 Drain some coolant from the cooling system into a suitable container.

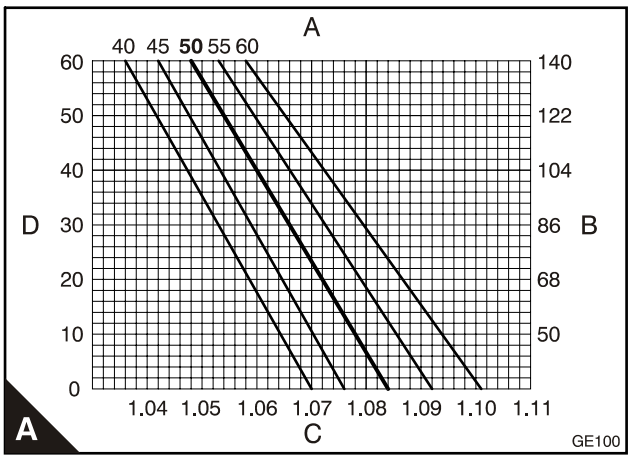
7 Use a special coolant hydrometer that will check the temperature and the specific gravity of the coolant, follow the manufacturer's instructions.

Note: If a special coolant hydrometer is not available, put a hydrometer and a separate thermometer into the antifreeze mixture and check the readings on both instruments. Compare the readings with the chart (A).

8 Adjust the strength of the mixture as necessary.

Note: If it is necessary to fill or replenish the coolant system in service, mix the coolant to the correct strength before it is added to the coolant system.

Perkins POWERPART antifreeze with a concentration of 50% will give protection against frost to a temperature of -35 ^{o}C (-31 ^{o}F). It will also give protection against corrosion. This is especially important when there are aluminium components in the coolant circuit.



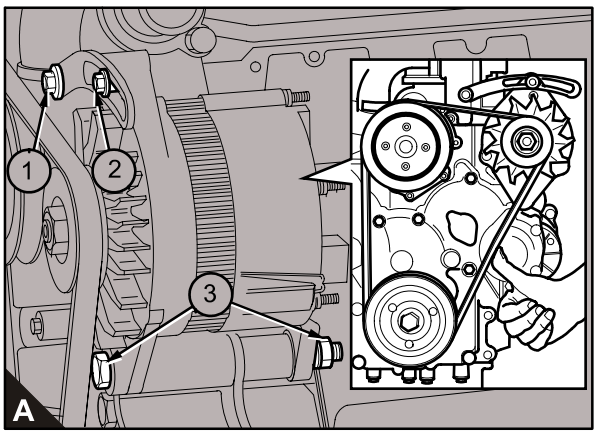
Specific gravity chart

A = Percentage antifreeze by volume
B = Mixture temperature in Fahrenheit
C = Specific gravity
D = Mixture temperature in celcius

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How to check the drive belt

Press down the belt with the thumb at the centre of the longest free length and check the deflection (A). With moderate thumb pressure - 45N (10 lbf) 4,5 kgf - the correct deflection of the belt is 10 mm (3/8 in).



How to adjust the belt tension

***Cautions**:*

- *The alternator fitted to the 700 Series engine is driven by a drive belt of a specific design. Use only a Perkins POWERPART drive belt. If this is not done, an early failure of the belt may occur.*
- *Do not loosen the setscrew (A1). If this setscrew is loosened, the thermostat housing to cylinder head seal could be broken and result in a leakage of coolant.*

1 Loosen the pivot fasteners (A3) of the alternator and loosen the setscrew (A2) of the adjustment link.

2 Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator and the setscrew of the adjustment link.

3 Check the belt tension again to ensure that it is still correct. If a new belt is fitted, the belt tension must be checked again after the first 25 hours of operation.

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How to renew the element / canister of the fuel filter

Warning! *Discard the used canister and fuel oil in a safe place and in accordance with local regulations.*

Caution: *It is important that only the genuine Perkins parts are used. The use of wrong parts could damage the fuel injection equipment.*

1 Thoroughly clean the outside surfaces of the fuel filter assembly.

2 Hold the bottom cover of the filter element and release the setscrew (A1) which is fitted through the filter head above the centre of the element.

3 Lower the bottom cover (A6) of the filter.

4 Remove the element (A4) and discard it.

5 Clean the inside surfaces of the filter head and the cover.

6 Renew the seals (A2) and (A5) and the 'O' ring (A3) and lightly lubricate them with clean fuel.

7 Put the bottom cover under the new element and hold the element squarely to the filter head. Ensure that the element is fitted in the centre against the 'O' ring in the filter head. With the assembly in this position, engage and tighten the setscrew.

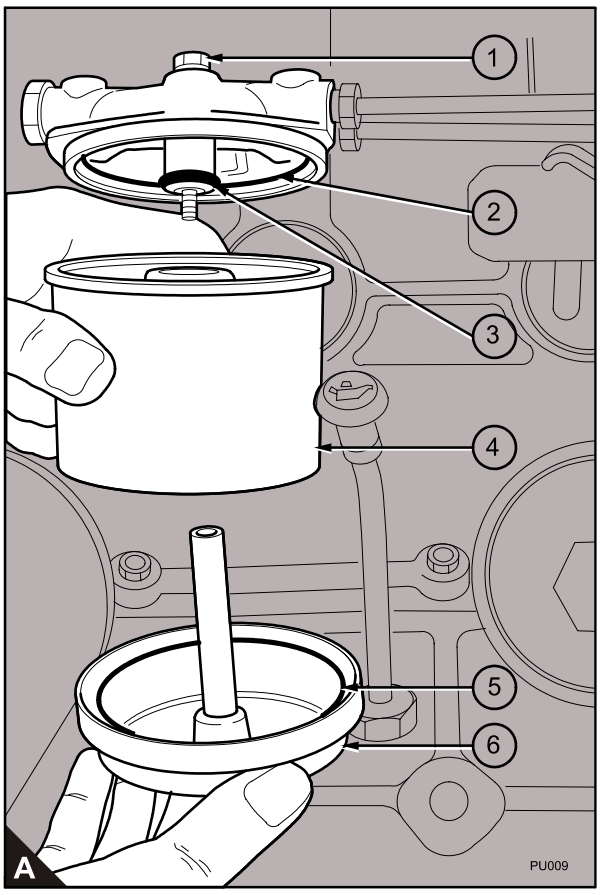
8 Eliminate the air from the fuel filter, see page 26.

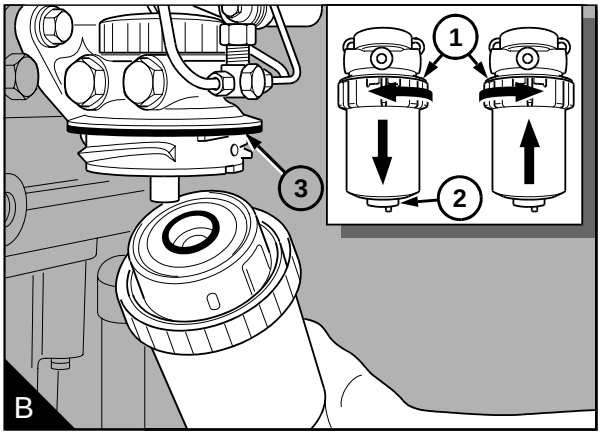
9 If a quick release canister (B) is fitted, loosen the drain device (B2) at the bottom of the canister. Support the canister and rotate the ring (B1) to the left to release the ring.

10 Give the canister a direct pull downwards to remove the canister from the filter head. Discard the old canister in accordance with local regulations.

11 Clean the filter head. Ensure that the seal (B3) is in position. Push the new canister fully into the filter head and rotate the ring to the right to fasten the canister to the filter head.

12 Eliminate the air from the fuel filter, see page 26.





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Atomiser fault

Warnings!

- *If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.*

Warnings!

- *Keep away from moving parts during engine operation. Some moving parts cannot be seen clearly while the engine runs.*

An atomiser fault can cause an engine misfire.

In order to find which atomiser is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of the high-pressure fuel pipe at each atomiser. When the union nut of the defective atomiser is loosened, it has little or no effect on the engine speed.

How to renew an atomiser - UA and UC engines

Cautions*:*

- *A new clamp (A5) must be used every time an atomiser is fitted to the engine.*
- *Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.*
- *Use a separate spanner to prevent movement of the outlets of the fuel injection pump when the high-pressure pipes are released or tightened.*
- *When the atomiser is fitted into the cylinder head, ensure that the sharp edges (A4) do not damage the "O" ring.*

Note: Identification letters for the atomiser are shown on the nozzle holder (A2).

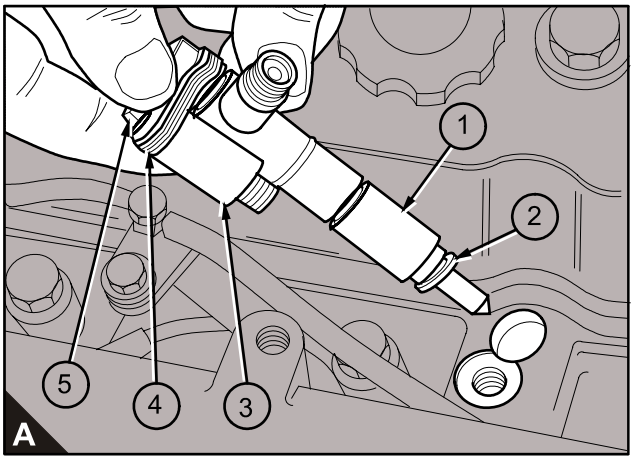
1 Clean thoroughly the area around the atomiser to be removed.

2 Remove the fuel leak-off pipe.

3 Remove the union nuts of the high-pressure pipe from the atomiser and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamps.

4 Remove the setscrew (A7) of the atomiser clamp and remove the clamp (A6), the spacer (A5), the atomiser (A2) and its seat washer (A3).

5 Put the new atomiser in position together with a new seat washer and a new 'O' ring (A1). Fit the atomiser into the cylinder head with a new clamp, the spacer, and engage the screw. Ensure that the atomiser is not tilted and tighten the setscrew to 22 Nm (16 lbf ft) 2,2 kgf m.



Cautions*:*

- *If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet.*
- *Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.*
- *Fit the high-pressure fuel pipe and tighten the union nuts to 27 Nm (20 lbf ft) 2,8 kgf m. If necessary, fit the pipe clamps.*

6 Renew the sealing washers and fit the leak-off pipe. Tighten the banjo bolts to 12 Nm (9 lbf ft) 1,2 kgf m.

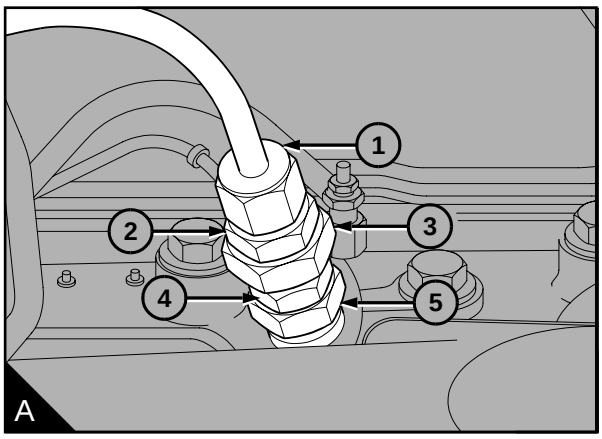
7 Eliminate air from the fuel system, see page 26.

8 Operate the engine and check for leakage of fuel and air.

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How to renew an atomiser - UB engines



Notes:

- On UB (704-26) engines, the body of the atomiser is threaded and is fitted, without clamps, into the top face of the cylinder head.
- Identification marks for the atomiser are stamped onto the side face of the nut (A4).
- To remove one atomiser, it will be necessary to remove all of the high-pressure pipes and the leak-off pipe.

***Cautions**:*

- *Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.*
- *Use a separate spanner to prevent movement of the outlets of the fuel injection pump when the high-pressure pipes are released or tightened.*
- *The atomiser must be loosened and tightened with the nut (A5). Do not use the nut (A4) as this will split the body of the atomiser assembly.*

1 Clean thoroughly the area around the atomiser to be removed.

2 Use a spanner to hold the nut (A4) and release the union nuts (A1) for the high-pressure pipes. Also release the union nuts at the fuel injection pump. Do not bend the pipes. If necessary, remove the pipe clamps and remove the pipe.

3 Use a spanner to hold the nut (A4) and release the nut (A2) that retains the leak-off banjo union (A3). Do this for each atomiser. Remove the copper washers that seal the leak-off rail and remove the leak-off pipe.

4 Use a 22 mm extended socket spanner to remove the atomiser from the cylinder head.

5 Clean thoroughly the threads on the body of the atomiser and fit plastic caps to the atomiser.

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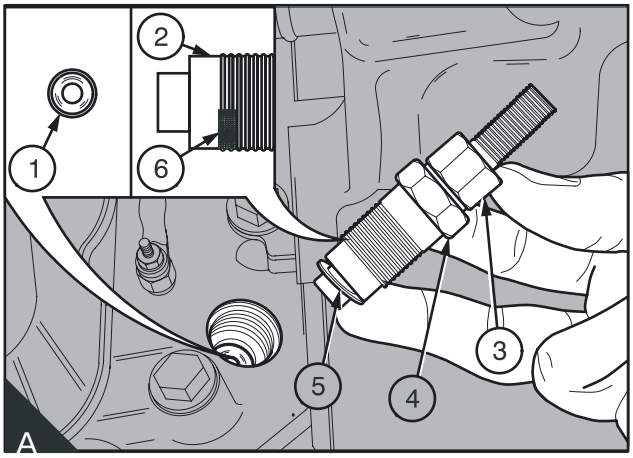
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6 Remove the plastic cap from the bottom of the atomiser. Apply a 2 mm bead of POWERPART atomiser thread sealant to extend 6 mm around each of the first two threads (A6). Ensure that the sealant does not contact the body (A2) of the atomiser.

Caution: *Do not move the atomiser after it has been tightened, the seal that is made when torque has been applied will be broken and leakage past the atomiser seat may occur.*

7 Fit a new flame shield washer (A1) with the red identification mark to the top. Put the atomiser in position together with a new seat washer (A5). Tighten the nut (A4) of the atomiser to 39 Nm (16 lbf ft) 2,2 kgf m. Do not tighten the atomiser with nut (A3) as this could damage the atomiser.



Cautions*:*

- *If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet.*
- *Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.*

8 Remove the plastic caps from the top of the atomisers. Put a new copper sealing washer onto each atomiser. Put the leak-off pipe into position and put a copper sealing washer onto each banjo union. Fit the leak-off nuts finger tight. Use a separate spanner to hold the nut (A3) and tighten the leak-off nuts to 34 Nm (25 lbf ft) 3,4 kgf m.

9 Fit the high-pressure fuel pipes. Use a separate spanner to hold the nut (A3) and tighten the union nuts to 27 Nm (20 lbf ft) 2,8 kgf m. Fit the pipe clamps.

10 Eliminate air from the fuel system, see page 26.

11 Operate the engine and check for leakage of fuel and air.

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How to eliminate air from the fuel system

Caution: *When air is to be eliminated from the fuel system, only use the starter motor to start the engine after air has been eliminated from the low-pressure side of the fuel system.*

If air enters the fuel system, it must be eliminated before the engine can be started.

Air can enter the system if:

- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

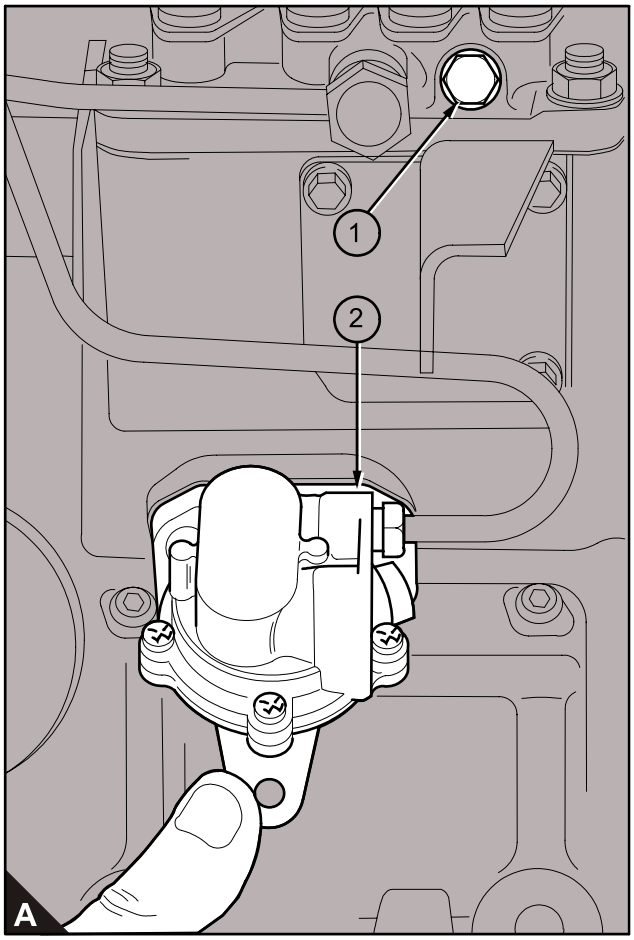
In order to eliminate air from the fuel system, proceed as follows:

1 Loosen the vent plug (A1) on the side of the fuel injection pump.

2 Operate the priming lever (A2) of the fuel lift pump until fuel, free from air, comes from the vent point. Tighten the vent plug.

3 Turn the start key to the "ON" position.

4 Operate the starter motor for intervals of 15 seconds until the engine starts. It is important to allow the electrical components to cool for 30 seconds between each 15 second interval of operation. If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system. Stop the engine and turn the start key to the "OFF" position. Check for air leaks.



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How to renew the lubricating oil

Warning! *Discard the used lubricating oil in a safe place and in accordance with local regulations.*

Caution: *Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.*

1 Operate the engine until it is warm.

2 Stop the engine.

Caution: If the base of the sump is divided to fit over a transmission shaft, ensure that the drain plugs on both sides of the sump are removed. If they are not, only some of the lubricating oil will be drained.

3 Put a container with a capacity of approximately 8 litres (14 pints) under the sump. Remove the sump drain plugs (A1) and drain the lubricating oil from the sump. Fit the drain plugs with new "O" rings (A2) and tighten the plugs to 34 Nm (25 lbf ft) 3,4 kgf m.

4 Remove the filler cap.

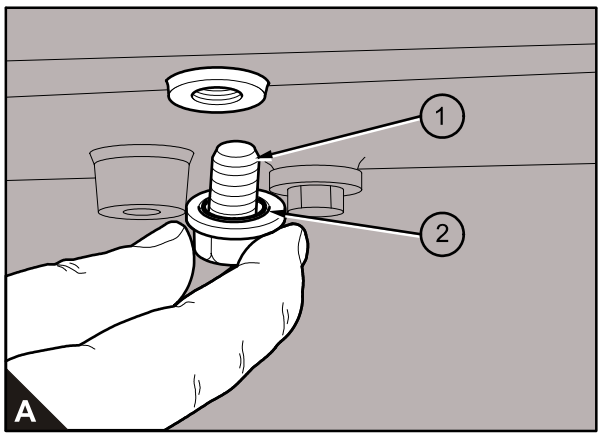
Caution: *Do not exceed the correct level of lubricating oil in the sump. If there is too much lubricating oil, the excess must be drained to the correct level. An excess of lubricating oil could enter the breather valve. This could cause the engine speed to increase rapidly without control.*

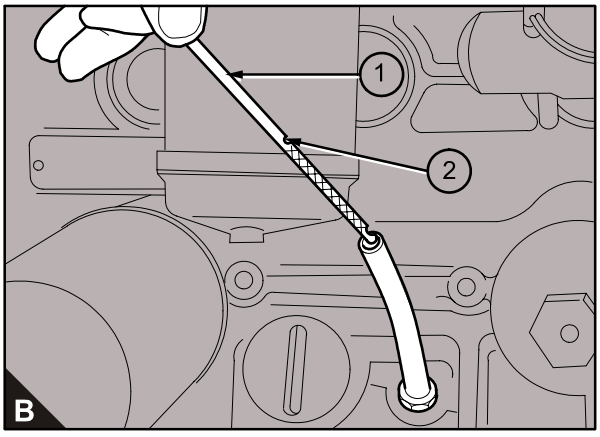
5 Fill the sump to the notch (B2) on the dipstick (B1) with new and clean lubricating oil of an approved grade, see page 34.

6 Fit the dipstick and the filler cap.

7 Remove the container of used lubricating oil from under the engine.

8 Start the engine and check for lubricating oil leakage. Stop the engine. After 15 minutes check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump.





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How to renew the canister of the lubricating oil filter

Warning! *Discard the used canister and lubricating oil in a safe place and in accordance with local regulations.*

Caution: Ensure that the application is on a level *surface to ensure an accurate reading on the dipstick.*

Note: Some applications have a separate filter head that is fitted directly onto the filter mounting face on the cylinder block. The filter canister is then fitted to the filter head. Use the same procedure below to change the canister.Turbocharged engines have an oil cooler fitted between the filter head and the filter canister. Use the same procedures below to change the canister.

1 Put a tray under the filter to retain spilt lubricating oil. Clean thoroughly the outside surfaces of the filter assembly.

2 Use a strap wrench or similar tool to loosen the filter canister. Remove and discard the canister. Ensure that the adaptor (A1) is secure in the filter head.

3 Clean inside the filter head.

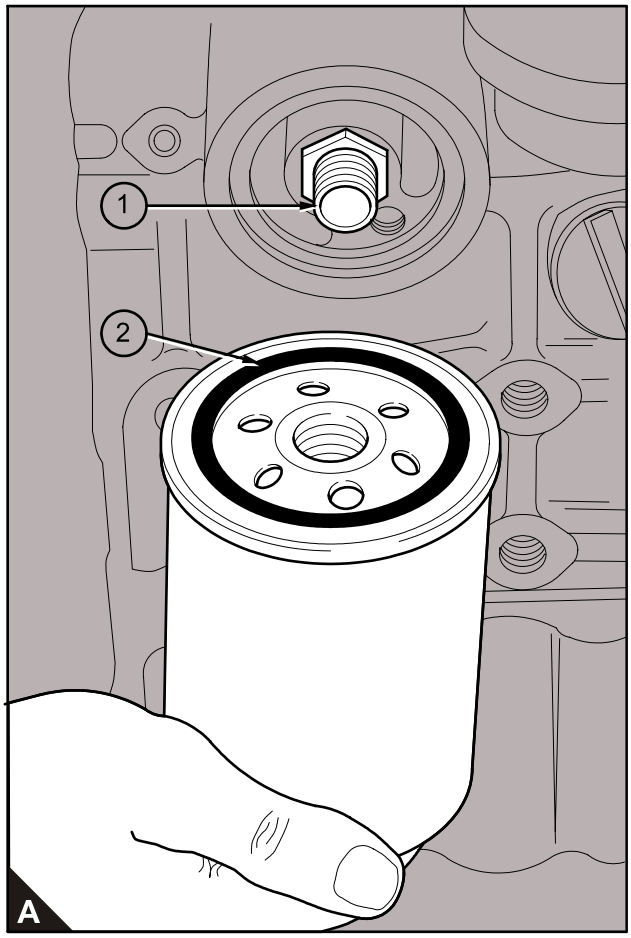
4 Lubricate the seal (A2) on top of the canister with clean engine lubricating oil.

5 Fit the new canister and tighten by hand until the seal contacts the filter head. Tighten the canister a further 1/2 to 3/4 of a turn by hand only. Do not use a strap wrench.

6 Ensure that there is lubricating oil in the sump. Ensure that the engine will not start and operate the starter motor until oil pressure is obtained. To ensure that the engine will not start, disconnect the electrical stop control of the fuel injection pump. Oil pressure is indicated when the warning light is extinguished or by a reading on the gauge.

7 Ensure that the electrical stop control is connected. Start the engine and check for leakage from the filter. Stop the engine. After 15 minutes check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump.

Caution: *Do not fill the sump past the "FULL" mark on the dipstick, see "Caution" on page 27.*

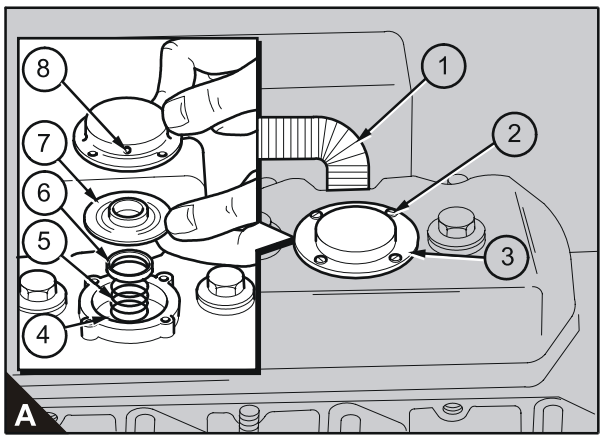


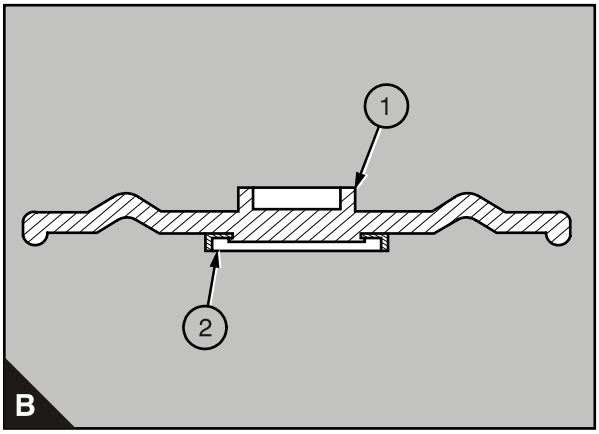
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How to renew the engine breather assembly - UA and UB engines





***Cautions**:*

- *It is important that the area around the vent hole (A8) is kept clean and the vent hole is not restricted.*
- *Ensure that the pipe (A1) does not contact other components as this may cause the failure of the pipe.*
- *Ensure that the components of the breather assembly are fitted in their correct positions (A). If they are fitted incorrectly, the engine can be damaged.*

1 Remove the rocker cover.

2 Release the four setscrews (A2) and remove the breather cover (A3).

3 Remove the diaphragm (A7) and location ring (A6). Remove the spring (A5).

4 Release the clips that retain the breather pipe and remove the breather pipe (A1).

5 Clean the breather cavity (A4) in the rocker cover, the passage through the rocker cover, the breather pipe and the vent hole (A7). Ensure that they are not restricted.

6 Fit a new spring into the cavity in the rocker cover.

7 Fit a new location ring (B2) onto the new diaphragm (B1) and fit this assembly onto the spring. Ensure that the location ring is on the spring.

8 Fit the breather cover, fit and tighten the four setscrews.

9 Fit the breather pipe and tighten the clips.

10 Fit the rocker cover and tighten the cap nuts to 11 Nm (8 lbf ft) 1,1 kgf m.

Note: For UC engines refer to the workshop manual, publication number TPD 1392E issue 1.

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Air filter

Caution: *Do not operate the engine if there is a blockage in the air filter or the induction hose. This can cause lubricating oil to enter the cylinders through the engine breather valve.*

Environmental conditions have an important effect on the frequency at which the air filter needs service.

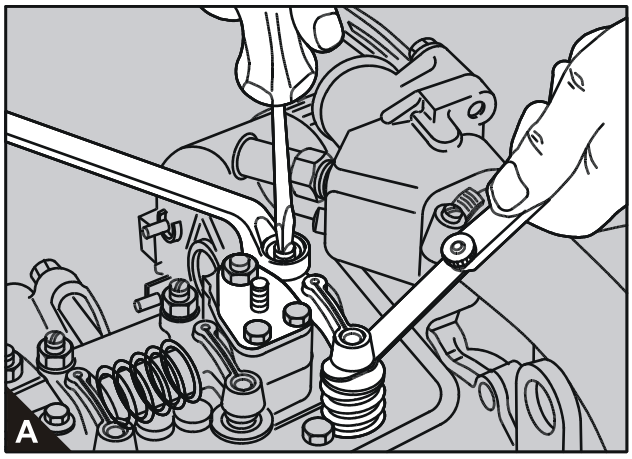
The filter element must be cleaned or renewed according to the manufacturer's recommendations.

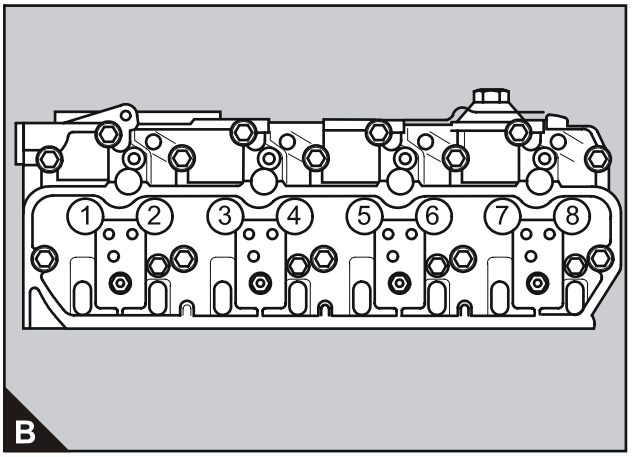
Restriction indicator

If a restriction indicator is fitted, it will indicate precisely when the air filter element needs service. This prevents the premature removal of the filter element which causes extra cost, and prevents the late removal of the element which can cause loss of engine power.

The filter element must be cleaned or renewed according to the manufacturer's recommendations.

How to set the valve tip clearances





Notes:

- The valve tip clearance is checked with a feeler gauge between the top of the valve stem and the rocker lever (A), with the engine cold. The correct clearance for both the inlet and the exhaust valves is 0,35 mm (0.014 in).
- The arrangement of the valves is shown in (B). Valve numbers (B1) and (B2) are for number 1 cylinder which is at the front of the engine.
- Clockwise rotation is when seen from the front of the engine.

1 Disconnect the breather pipe from the rocker cover.

2 For turbocharged engines it will be necessary to remove the pipe between the turbocharger and the induction manifold. To do this: release the hose clips of the hoses that connect the pipe to the turbocharger and to the induction manifold. Remove the pipe and cover the holes in the turbocharger and the induction manifold to prevent the entry of dirt.

3 Remove the three cap nuts (A1 page 32), steel washers (A2 page 32) and rubber seals (A3 page 32). Lift off the rocker cover.

4 Rotate the crankshaft in a clockwise direction until the valve (B7) has just opened and the valve (B8) has not closed completely. Check the clearances of the valves (B1) and (B2) and adjust them, if necessary.

5 Rotate the crankshaft in a clockwise direction until the valve (B3) has just opened and the valve (B4) has not closed completely. Check the clearances of the valves (B5) and (B6) and adjust them, if necessary.

6 Rotate the crankshaft in a clockwise direction until the valve (B1) has just opened and the valve (B2) has not closed completely. Check the clearances of the valves (B7) and (B8) and adjust them, if necessary.

7 Rotate the crankshaft in a clockwise direction until the valve (B5) has just opened and the valve (B6) has not closed completely. Check the clearances of the valves (B3) and (B4) and adjust them, if necessary.

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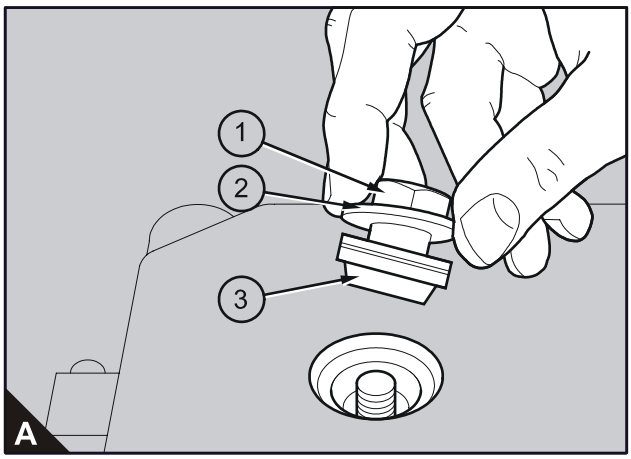
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Caution: *If the cap nut (A1) is overtightened, the stud and plate assembly, for the rocker pedestal may be damaged.*

8 Fit the rocker cover. Ensure that the cap nuts (A1), washers (A2) and the rubber seals (A3) are fitted correctly. Tighten the cap nuts to 11 Nm (8 lbf ft) 1,1 kgf m.). Fit the breather pipe.

9 For turbocharged engines: remove the covers from the turbocharger and the induction manifold. Fit the pipe between the turbocharger and the induction manifold and tighten the hose clips.



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Fuel specification

To get the correct power and performance from your engine, use good quality fuel. The recommended fuel specification for Perkins engines is indicated below:

Cetane number . 45 minimum
Viscosity . . . . . 2.0/4.5 centistokes at 40˚C
Density . . . . . 0,835/0,855 kg/litre
Sulphur . . . . . 0.2% of mass, maximum
Distillation . . . . . 85% at 350˚C

Cetane number indicates ignition performance. A fuel with a low cetane number can cause cold start problems and affect combustion.

Viscosity is the resistance to flow and engine performance can be affected if it is outside the limits.

Density: A lower density reduces engine power, a higher density increases engine power and exhaust smoke.

Sulphur: A high sulphur content (not normally found in Europe, North America or Australasia) can cause engine wear. Where only high sulphur fuels are available, it is necessary to use a highly alkaline lubricating oil in the engine or to renew the lubricating oil more frequently, see table below:

Fuel sulphur content (%)	Oil change interval
<0.5	Normal
0.5 to 1.0	75% of normal
>1.0	50% of normal

Distillation: This is an indication of the mixture of different hydrocarbons in the fuel. A high ratio of light-weight hydrocarbons can affect the combustion characteristics.

Low temperature fuels

Special winter fuels may be available for engine operation at temperatures below 0˚C. These fuels have a lower viscosity and also limit the wax formation in the fuel at low temperatures. If wax formation occurs, this could stop the fuel flow through the filter.

If you need advice on adjustments to an engine setting or to the lubricating oil change periods which may be necessary because of the standard of the available fuel, consult your nearest Perkins Distributor or one of the companies listed on page 8.

Aviation kerosene fuels

If there is a requirement to operate with these fuels, contact Perkins Service Department before the fuel is used.

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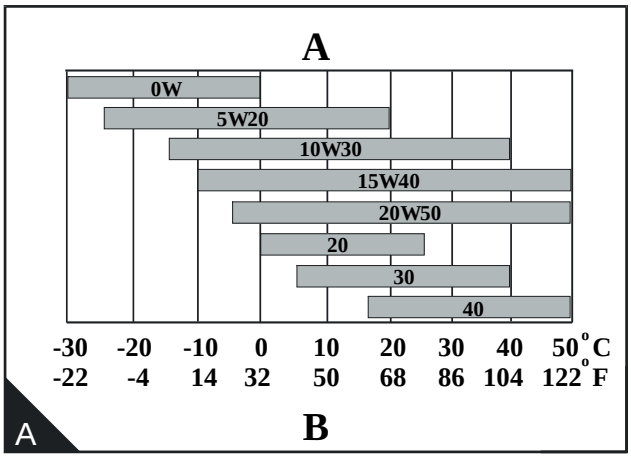
Lubricating oil specification

For naturally aspirated engines use only a good quality lubricating oil which is not less than the specification API CC or ACEA E1. API CD or ACEA E2 / E3 can be used, but is not recommended during the first 25 to 50 hours nor for light load applications.

For turbocharged engines use only a good quality lubricating oil which is not less than the specification API CF4 / CG4, or ACEA E2 / E3

Caution: *The type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details see "Fuel specification" on page 33.*

Always ensure that the correct viscosity grade of lubricating oil is used for the ambient temperature range in which the engine will run as shown in the chart (A).



Viscosity chart

A = Recommended viscosity
B = Ambient temperature

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Coolant specification

The quality of the coolant which is used can have a great effect on the efficiency and life of the cooling system. The recommendations indicated below can help to maintain a good cooling system and to protect it against frost and/or corrosion.

If the correct procedures are not used, Perkins cannot be made responsible for damage caused by frost or corrosion.

Caution: *An antifreeze which contains the correct inhibitor must be used at all times to prevent damage to the engine by corrosion, because of the use of aluminium in the coolant circuit.*

If frost protection is not necessary, it is still extremely important to use an approved antifreeze mixture because this gives a protection against corrosion and also raises the boiling point of the coolant.

If the approved antifreeze mixture is not available, add a correct mixture of corrosion inhibitor to the water. If the correct inhibitor is not used, the engine will be damaged by corrosion. If there is doubt about the corrosion inhibitor to be used, contact the Technical Service Department of Perkins Engines Company Limited, see page 8.

Note: If combustion gases are released into the coolant circuit, the coolant must be renewed after the repair of the fault.

The antifreeze that is recommended is Perkins POWERPART Antifreeze, part number 21825166 (1 litre) or 21825167 (5 litres). This antifreeze contains the correct inhibitor which is especially suitable for this engine.

If it is possible, use clean soft water in the coolant.

The quality of the antifreeze coolant must be checked at least once a year, for example, at the beginning of the cold period. The coolant must be renewed every two years.

The antifreeze mixture must consist of equal quantities of antifreeze and water. Concentrations of less than 50% of antifreeze will dilute the corrosion inhibitor in the antifreeze and allow corrosion of the engine components. Concentrations of more than 50% of antifreeze may have an adverse effect on the performance of the coolant.

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Problems and possible causes

Problem	Possible causes	
	Checks by the user	**Checks by the workshop personnel**
The starter motor turns the engine too slowly	1, 2, 3, 4	
The engine does not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17	34, 35, 36, 37, 38, 42, 43
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19	34, 36, 37, 38, 40, 42, 43, 44
Not enough power	8, 9, 10, 11, 12, 13, 16, 8, 9, 20, 21	34, 36, 37, 38, 39, 42, 43, 44, 63, 64, 66
Misfire	8, 9, 10, 12, 13, 15, 20, 22	34, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11, 13, 15, 17, 18, 19, 23, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63
Black exhaust smoke	11, 13, 15, 17, 19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63, 64
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 61, 62
The pressure of the lubricating oil system is too low	4, 24, 25, 26	46, 47, 48, 50, 51, 59,
The engine knocks	9, 13, 15, 17, 20, 22, 23	36, 37, 40, 42, 44, 46, 52, 53, 60
The egine runs erratically	8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 22, 23	34, 38, 40, 41, 44, 52, 60
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Bad compression	11, 22	37, 39, 40, 42, 43, 44, 45, 53, 60
The engine starts and stops	10, 11, 12	

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List of possible causes

1 Battery capacity low.
2 Bad electrical connections.
3 Fault in starter motor.
4 Wrong grade of lubricating oil.
5 Starter motor turns engine too slowly.
6 Fuel tank empty.
7 Fault in stop control.
8 Restriction in a fuel pipe.
9 Fault in fuel lift pump.
10 Dirty fuel filter element.
11 Restriction in air induction system.
12 Air in fuel system.
13 Fault in atomisers or atomisers of an incorrect type.
14 Cold start system used incorrectly.
15 Fault in cold start system.
16 Restriction in fuel tank vent.
17 Wrong type or grade of fuel used.
18 Restricted movement of engine speed control.
19 Restriction in exhaust pipe.
20 Engine temperature is too high.
21 Engine temperature is too low.
22 Incorrect valve tip clearances.
23 Too much oil or oil of the wrong type is used in wet type air cleaner, if one is fitted.
24 Not enough lubricating oil in sump.
25 Defective gauge.
26 Dirty lubricating oil filter element.
27 Fan damaged.
28 Fault in engine mounting or flywheel housing.
29 Too much lubricating oil in sump.
30 Restriction in air or water passages of radiator.
31 Restriction in breather pipe.
32 Insufficient coolant in system.
33 Vacuum pipe leak or fault in exhauster.
34 Fault in fuel injection pump.
35 Broken drive on fuel injection pump.
36 Timing of fuel injection pump incorrect.
37 Valve timing is incorrect.
38 Bad compression.
39 Cylinder head gasket leaks.
40 Valves are not free.
41 Wrong high-pressure pipes.
42 Worn cylinder bores.
43 Leakage between valves and seats.
44 Piston rings are not free or they are worn or broken.
45 Valve stems and/or guides are worn.
46 Crankshaft bearings are worn or damaged.
47 Lubricating oil pump is worn.
48 Relief valve does not close.
49 Relief valve does not open.
50 Relief valve spring is broken.
51 Fault in suction pipe of lubricating oil pump.
52 Piston is damaged.
53 Piston height is incorrect.
54 Flywheel housing or flywheel is not aligned correctly.
55 Fault in thermostat or thermostat is of an incorrect type.
56 Restriction in coolant passages.
57 Fault in water pump.
58 Valve stem seal is damaged.
59 Restriction in sump strainer.
60 Valve spring is broken.
61 Turbocharger impeller is damaged or dirty.
62 Lubricating oil seal of turbocharger leaks.
63 Induction system leaks.
64 Turbocharger impeller is damaged or dirty.
65 Drive belt for water pump is loose.
66 Induction system leaks (turbocharged engines).

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Introduction

The recommendations indicated below are designed to prevent damage to the engine when it is withdrawn from service for a prolonged period. Use these procedures after the engine is withdrawn from service. The instructions for the use of POWERPART products are given on the outside of each container.

Procedure

1 Completely clean the outside of the engine.

2 When a preservative fuel is to be used, drain the fuel system and fill it with the preservative fuel. POWERPART Lay-Up 1 can be added to the normal fuel to change it to a preservative fuel. If preservative fuel is not used, the system can be completely filled with normal fuel but the fuel must be drained and discarded at the end of the storage period together with the fuel filter canister.

3 Operate the engine until it is warm. Then correct leakages of fuel, lubricating oil or air. Stop the engine and drain the lubricating oil from the sump.

4 Renew the canister of the lubricating oil filter.

5 Fill the sump to the full mark with new and clean lubricating oil, see page 27 and add POWERPART Lay-up 2 to the oil to protect the engine against corrosion. If POWERPART Lay-Up 2 is not available, use a correct preservative fluid instead of the lubricating oil. If a preservative fluid is used, this must be drained and the lubricating oil sump must be filled to the correct level with normal lubricating oil at the end of the storage period.

6 Drain the coolant circuit, see page 19. In order to protect the cooling system against corrosion, fill it with an approved antifreeze mixture because this gives protection against corrosion, see page 35.

Caution: *If protection against frost is not necessary and a corrosion inhibitor is to be used, it is recommended that you consult the Technical Service Department, Perkins Engines Company Limited, Peterborough.*

7 Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.

8 Disconnect the battery. Then put the battery into safe storage in a fully charged condition. Before the battery is put into storage, protect its terminals against corrosion. POWERPART Lay-Up 3 can be used on the terminals.

9 Clean the engine breather pipe(s).

10 Remove the atomisers, see page 23 for UA and UC engines or page 24 for UB engines. Spray POWERPART Lay-Up 2 for one to two seconds into each cylinder bore with the piston at bottom dead centre. Slowly rotate the crankshaft one revolution and then fit the atomisers, complete with new seat washers and new clamps (new clamps are necessary only for UA and UC engines).

11 Remove the air filter. Then, if necessary, remove the pipe(s) installed between the air filter and induction manifold or turbocharger. Spray POWERPART Lay-Up 2 into the induction manifold or turbocharger. It is recommended that the spray time for the turbocharger is 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold or the turbocharger with waterproof tape.

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12 Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold. Seal the manifold with waterproof tape. It is recommended that the spray time for the turbocharger is 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold or the turbocharger with waterproof tape.

13 Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.

14 Remove the drive belt and put it into storage.

15 In order to prevent corrosion, spray the engine with POWERPART Lay-Up 3. Do not spray the area inside the alternator cooling fan.

Caution: *After a period in storage, but before the engine is started, operate the starter motor with the engine stop control in the "stop" position until oil pressure is indicated. Oil pressure can be indicated either by a gauge or when a low pressure warning light is extinguished. If a solenoid stop control is used on the fuel injection pump, it must be disconnected for this operation.*

If the engine protection is done correctly according to the above recommendations, no corrosion damage will normally occur. Perkins are not responsible for damage which may occur when an engine is in storage after a period in service.

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Introduction

If problems occur with your engine or with the components fitted onto it, your Perkins distributor can make the necessary repairs and will ensure that only the correct parts are fitted and that the work is done correctly.

Service literature

Workshop manuals, installation drawings and other service publications are available from your Perkins distributor at a nominal cost.

Training

Local training for the correct operation, service and overhaul of engines is available at certain Perkins distributors. If special training is necessary, your Perkins distributor can advise you how to obtain it at the Perkins Customer Training Department, Peterborough, or other main centres.

POWERPART recommended consumable products

Perkins have made available the products recommended below in order to assist in the correct operation, service and maintenance of your engine and your machine. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion. Part number 1 litre 21825166 or 5 litres 21825167.

POWERPART Atomiser thread sealant

To seal the threads of the atomiser into the cylinder head. Part number 21825474

POWERPART Chisel

Allows easy removal of old gaskets and joints. Part number 21825163.

POWERPART Compound

To seal the outer diameter of seals. Part number 1861147.

POWERPART Easy Flush

Cleans the cooling system. Part number 21825001.

POWERPART Gasket eliminator

Improves flange sealing when a gasket is not used. It provides a seal with temperature resistance that is flexible in positions where vibration and pressure occur. Part number 21826040.

POWERPART Jointing compound

Universal jointing compound which seals joints. Part number 1861155 or 1861117.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. Part number 1772204.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. Part number 1762811.

POWERPART Lay-Up 3

Protects outside metal parts. Part number 1734115.

POWERPART Liquid gasket

To seal flat faces of components where no joint is used. Especially suitable for aluminium components. Part number 21820518

POWERPART Nutlock

To retain and seal threaded fasteners and cup plugs where easy removal is necessary. Part number 21820242

POWERPART Platelock

Medium strength anaerobic threadlock for tight fitted metal surfaces. Suitable for metal plated surfaces and stainless steel. Part number 21826039.

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POWERPART Repel

Dries damp equipment and gives protection against corrosion. Passes through dirt and corrosion to lubricate and to assist removal of components. Part number 21825164.

POWERPART Retainer (high strength)

To retain components which have an interference fit. Part number 21820638.

POWERPART Retainer (oil tolerant)

To retain components which have a transition fit. Part number 21820603.

POWERPART Silicone adhesive

An RTV silicone adhesive for application where low pressure tests occur before the adhesive sets. Used for sealing flange where oil resistance is needed and movement of the joint occurs. Part number 21826038.

POWERPART Silicone rubber sealant

Silicone rubber sealant which prevents leakage through gaps. Part number 1861108.

POWERPART Studlock

To permanently retain large fasteners and studs. Part number 21820270.

POWERPART Threadlock

To retain small fasteners where easy removal is necessary. Part number 21820222.

POWERPART Threadlock (heavy duty)

To provide a heavy duty seal to components that have a light interference fit. Part number 21820262.

POWERPART Threadlock (hydraulic/pneumatic)

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Part number 21820542

POWERPART Threadlock (pipe)

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Part number 21820575.

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Engine

Number of cylinders 4

Cylinder arrangement ..... In line

Cycle ..... Four stroke

Induction system

- UA and UB engines ..... Naturally aspirated
- UC engines ..... Turbocharged

Combustion system

- UA and UC engines ..... Direct injection
- UB engines ..... Indirect injection

Nominal bore:

- UA and UC engines ..... 97,0 mm (3.82 in)
- UB engines ..... 91,0 mm (3.58 in)

Stroke ..... 100,0 mm (3.94 in)

Compression ratio

- UA and UC engines 17.5:1
- UB engines 22:1

Cubic capacity:

- UA and UC ..... 2,9 litres (183 in^3)
- UB ..... 2,6 litres (159 in^3)

Firing order 1, 3, 4, 2

Valve tip clearances (cold):

- Inlet and exhaust ..... 0,35 mm (0.014 in)

Lubricating oil pressure (minimum) at maximum engine speed and at normal engine temperature:

UA, UC ..... 350 kPa (51 lbf/in^2) 3,8 kgf/cm^2

UB ..... 280 kPa (41 lbf/in^2) 2,9 kgf/cm^2

Capacity of a typical lubricating oil sump (1):

- Initial total ..... 8,3 litres (14.6 pints)
- To fill when renewed ..... 7 litres (12.3 pints)

Typical coolant capacity (engine only) ..... 4 litres (7 pints)

Direction of rotation ..... Clockwise from the front

(1) The capacity of the sump may vary according to the application. Fill to the "Full" mark on the dipstick. Do not exceed the "Full" mark, see page 27 for cautions.

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Perkins 700 Series Workshop Manual

Models UA, UB and UC

4 Cylinder naturally aspirated and turbocharged diesel engines

Publication TPD 1392E Issue 1
This publication is written for worldwide use. In territories where legal requirements govern engine smoke, emission, noise, safety factors, etc., then all instructions, data and dimensions given must be applied in such a way that, after servicing (preventive maintenance) or repairing the engine, it does not contravene the local regulations when in use.
The information is correct at time of print.
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FOREWORD

This manual is illustration based and the usual Perkins sections of 10 to 25 have been used. The aim of the manual is to provide the trained technician with enough information to service and overhaul all of the Perkins 700 Series engines. It has been compiled for use in conjunction with normal workshop practice and information contained in current service bulletins. Mention of certain accepted practices therefore, has been purposely omitted in order to avoid repetition. For overhaul procedures the assumption is made that the engine is removed from the application.

Note: With effect from engine number U------ U806626D, a requirement of emissions legislation is that access to adjustments that affect the engine's exhaust emissions is limited to personnel approved by Perkins Engines Company Limited. These adjustments are on the timing case, therefore, only Perkins approved personnel should remove and fit the timing case. If there is doubt, contact Perkins Service Department or your nearest Perkins distributor. Any claim including but not limited to warranty will not be acceptable to Perkins Engines Company Limited if it can be seen that an adjustment has been made by a person not approved by Perkins.

How to use this manual
The illustrations in each section follow the sequence for the complete disassembly of a particular assembly or component. Reassembly is achieved by using the illustrations in reverse order from the rear of the section. Reference to renewing joints has been omitted, it being understood that this will be carried out when applicable. Similarly, it is understood that in reassembly and inspection, all parts are to be thoroughly cleaned and lubricated, and where present, burrs and scale are to be removed. Any open ports of high precision components, e.g. fuel injection equipment exposed by dismantling, must be blanked off until reassembly, to prevent the ingress of debris.
When fitting setscrews into "through" holes into the interior of the engine, the threads should be cleaned and fitted with a suitable sealant. Throughout this manual, whenever the "left" or "right" of the engine is referred to, it is that side of the engine when viewed from the flywheel end. Special tools have been made available and a list of these tools is given in section 25. Reference to the relevant special tools is also made at the beginning of each operation.

Warning! Read and remember the "Safety precautions". They are given for your protection and must be used at all times.

Note: Most of the general information which is included in the User's Handbook (sections 1 to 9), has not been repeated in this workshop manual and the two publications should be used together. The engines referred to in this manual are the UA (3,0 litre - direct injection), the UB (2,6 litre - indirect injection) and the UC (3,0 litre - turbocharged direct injection). The engines conform to Stage 1 off-highway emissions to C1-8 mode cycle ref. ISO 8178 part 4.
The 3,0 litre versions are, water cooled, naturally aspirated or turbocharged, four cylinder diesel engine with direct injection. They have been specifically designed for industrial and agricultural applications. The 2,6 litre version, is a water cooled, naturally aspirated, four cylinder diesel engine with indirect injection. It has been specifically designed for fork-lift truck applications.
Where the information applies to only one engine type, this will be indicated in the text and/or illustration by use of the particular code letters.

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Special information panels
A special information panel is shown on the top of each page and has essential information needed for each operation: special torques, special precautions, special notes and sealants. Recommended consumable products are listed in section 10. Reference to the relevant consumable products is also made at the beginning of each operation, where relevant. Data and dimensions are included in section 11.

Note: Always use the full engine number to order new parts.

Danger is indicated in the text by two methods:
Warning! *This indicates that there is a possible danger to the person.*
Caution: *This indicates that there is a possible danger to the engine.*
Note: Is used where the information is important, but there is not a danger.

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Safety

General safety precautions

These safety precautions are important. You must refer also to the local regulations in the country of use. Some items only apply to specific applications.

- Always refer to the text of the operations within this workshop manual for specific warnings and cautions.
- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel in the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme caution must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine, auxiliary equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation.

Warning! *Some moving parts cannot be seen clearly while the engine runs.*

- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap or any component of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operator's position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets.
- Discard used lubricating oil in accordance with local regulations to prevent contamination.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- Use extreme care if emergency repairs must be made in adverse conditions.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Read and use the instructions relevant to lift equipment which are given on page 10.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a container of water. Fit safety wires to secure the plugs which seal the hose connections of a component which is to be pressure tested.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.

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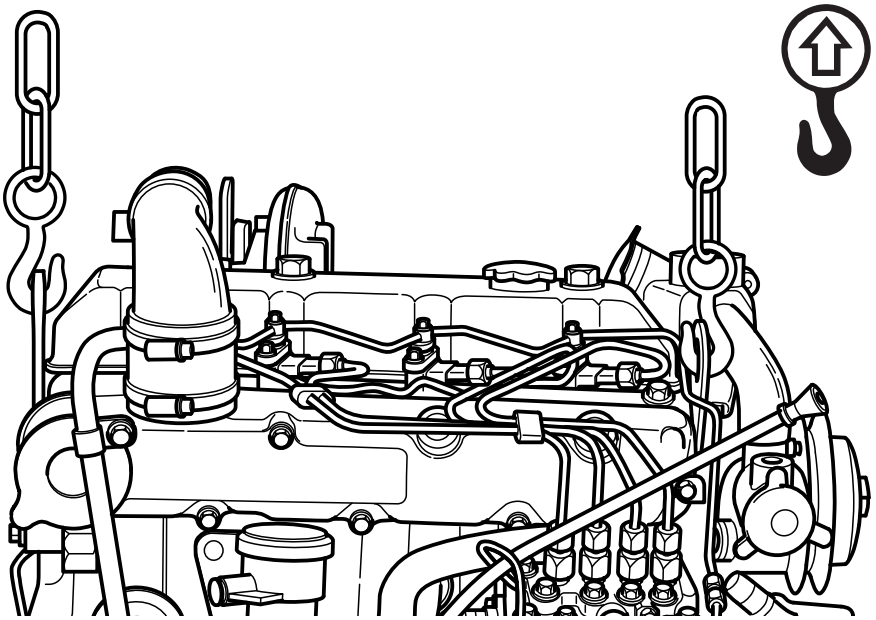
- Turbochargers operate at high speed and at high temperatures. Keep fingers, tools and items away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.
- Some components are not waterproof and should not be washed with a high-pressure water jet or steam.
- Fit only genuine Perkins parts.

Engine lift equipment

Caution: *If the sump contains engine lubricating oil and the engine is tilted to an extreme angle or turned onto its side or end faces, lubricating oil can enter the closed breather system, pass into the induction manifold and the cylinder bores. If this occurs, it will cause an hydraulic lock in the engine and the engine may be damaged. If it is necessary to move an engine in this way, the lubricating oil must first be drained.*

The maximum weight of the engine without coolant, lubricant or a gearbox fitted will vary for different applications. It is recommended that lift equipment of 300 kg (662 lbs) minimum capacity is used.

Before the engine is lifted:
Always use engine lift equipment of the approved type and of the correct capacity to lift the engine. It is recommended that lift equipment of the type shown in is used to provide a vertical lift, directly above the engine lift brackets. Never use a single lift bracket to raise an engine.
Check the engine lift brackets for damage and that they are secure before the engine is lifted.
The torque for the setscrews for the engine lift brackets is 18.5 Nm (14 lbf ft) 1,9 kgf m.
To prevent damage to the rocker cover, ensure that there is clearance between the hooks and the rocker cover.
Use lift equipment or obtain assistance to lift heavy engine components such as the cylinder block, the cylinder head, the flywheel housing, the crankshaft and the flywheel.



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Viton Seals.
Some seals used in engines and in components fitted to engines are made of Viton.
Viton is used by many manufacturers and is a safe material under normal conditions of operation.
If Viton is burned, a product of this burnt material is an acid which is extremely dangerous.
Never allow this burnt material to come into contact with the skin or with the eyes.
If it is necessary to come into contact with components which have been burnt, ensure that the precautions which follow are used:
• Ensure that the components have cooled
• Use Neoprene gloves and discard the gloves safely after use
• Wash the area with calcium hydroxide solution and then with clean water.
• Disposal of components and gloves which are contaminated must be in accordance with local regulations.

If there is contamination of the skin or eyes wash the affected area with a continuous supply of clean water or with calcium hydroxide solution for 15 - 60 minutes. Obtain immediate medical attention.

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Consumable products.

These products are available and are recommended to assist in the correct operation, service and maintenance of your engine and your machine. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

Antifreeze
Protects the cooling system against frost and corrosion 1 litre. Part number 21825166.

Atomiser thread sealant
To seal the threads of the atomiser into the cylinder head. Currently Hylomar Advance Formulation. Part number 21825474

Chisel
Allows easy removal of old gaskets and joints. Part number 21825163

Compound
To seal the outer diameter of seals. Currently Loctite Forma Gasket No 2. Part number 1861147

Gasket eliminator.
Improves flange sealing when a gasket is not used. It provides a seal with temperature resistance that is flexible in positions where vibration and pressure occur. Currently Loctite 515. Part number 21826040

Easy flush
Cleans the cooling system. Part number 21825001

Jointing compound
Universal jointing compound which seals joints. Currently Hylomar. Part number 1861155 or 1861117.

Liquid gasket
To seal flat faces of components where no joint is used. Especially suitable for aluminium components. Currently Loctite 518. Part number 21820518.

Lay-up 1
A diesel fuel additive for protection against corrosion. Part number 1772204

Lay-up 2
Protects the inside of the engine and other closed systems. Part number 1762811

Lay-up 3
Protects outside metal parts. Part number 1734115

Nutlock
To retain and seal threaded fasteners and cup plugs where easy removal is necessary. Currently Loctite 242e. Part number 21820242.

Platelock
For tight fitted metal surfaces. Suitable for metal plated surfaces and stainless steel. Part number 21826039

Continued

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Repel
Dries damp equipment and gives protection against corrosion. Passes through dirt and corrosion to lubricate and to assist removal of components. Part number 21825164

Retainer (high strength)
To retain components which have an interference fit. Currently Loctite 638. Part number 21820638.

Retainer (oil tolerant)
To retain components which have a transition fit. Currently Loctite 603. Part number 21820603.

Silicon adhesive
An RTV silicon adhesive for application where low pressure tests occur before the adhesive sets. Used for sealing flange where oil resistance is needed and movement of the joint occurs. Currently Loctite 5900. Part number 21826038.

Silicone gasket sealant
Silicone adhesive used for sealing where oil or water resistance is needed. Part number 21826046

Silicon rubber sealant
Silicon rubber sealant which prevents leakage through gaps. Currently Hylosil. Part number 1861108.

Studlock
To permanently retain large fasteners and studs. Currently Loctite 270. Part number 21820270.

Threadlock
To retain small fasteners where easy removal is necessary. Currently Loctite 222e. Part number 21820222.

Threadlock (heavy duty)
To provide a heavy duty seal to components that have a light interference fit. Currently Loctite 262. Part number 21820262

Threadlock (hydraulic/Pneumatic)
To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Currently Loctite 542. Part number 21820524

Threadlock (pipe)
To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Currently Loctite 575. Part number 21820575

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Operation:
Engine identification - location

The engine number is stamped on a label which is located on the right rear side of the engine. It consists of the following:

Abbreviations and codes.

Engine build list numbering system
The engine parts list numbering system is defined as follows:

Code	I	II	III	IV	V
Example	UA	80862	U	000001	A

Code I Engine type code

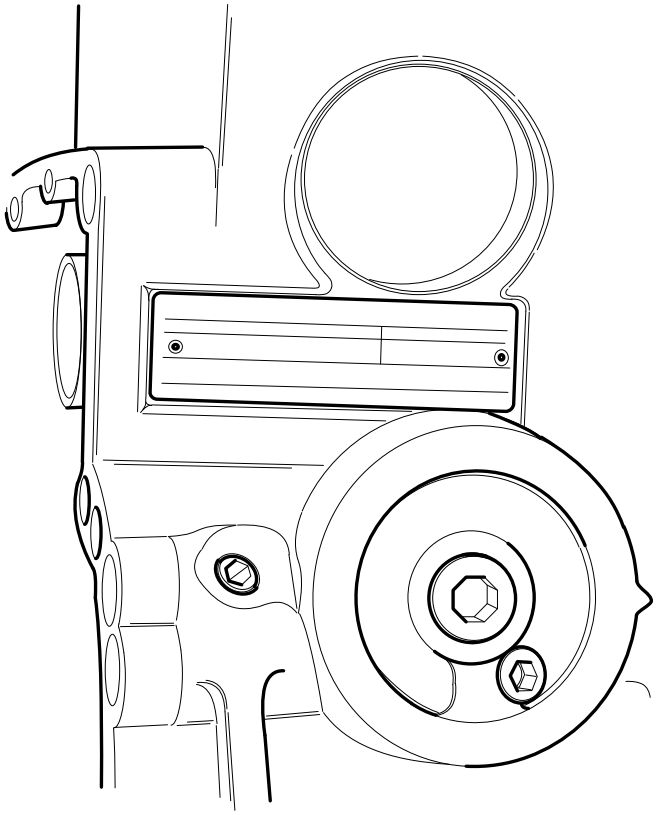
704 - 26	UB
704 - 30	UA
704 - 30T	UC

Code II Engine build list number
Build list number is dependent upon specifcation.

Code III Country of manufacture
U = Made in U.K.

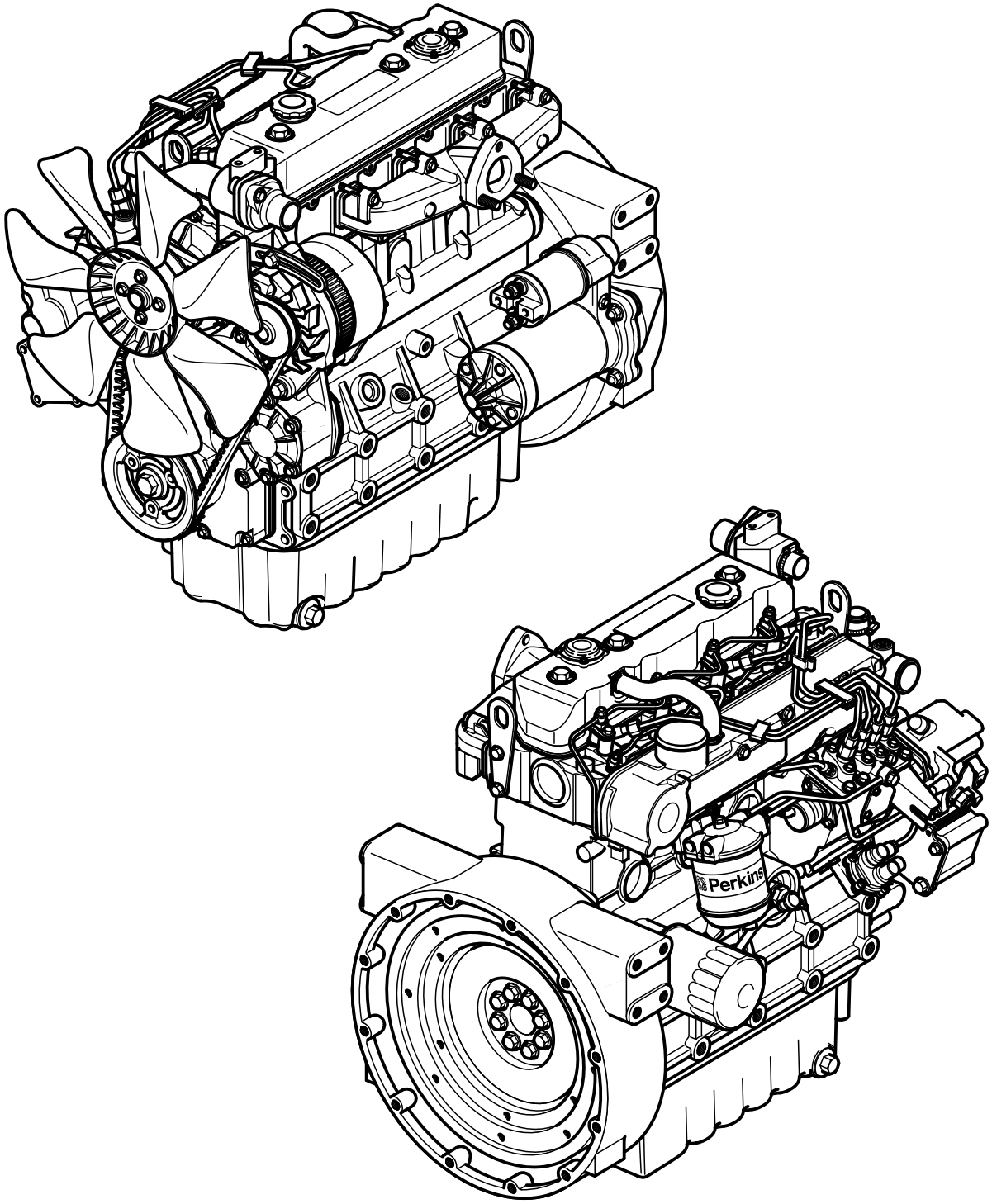
Code IV Engine serial number
The engine serial number is sequential.

Code V Year of Manufacture
A = 1995
B = 1996
C = 1997
D = 1998
E = 1/1/1999 - 31/3/1999
F = 1/4/1999 - 31/12/1999
G = 2000



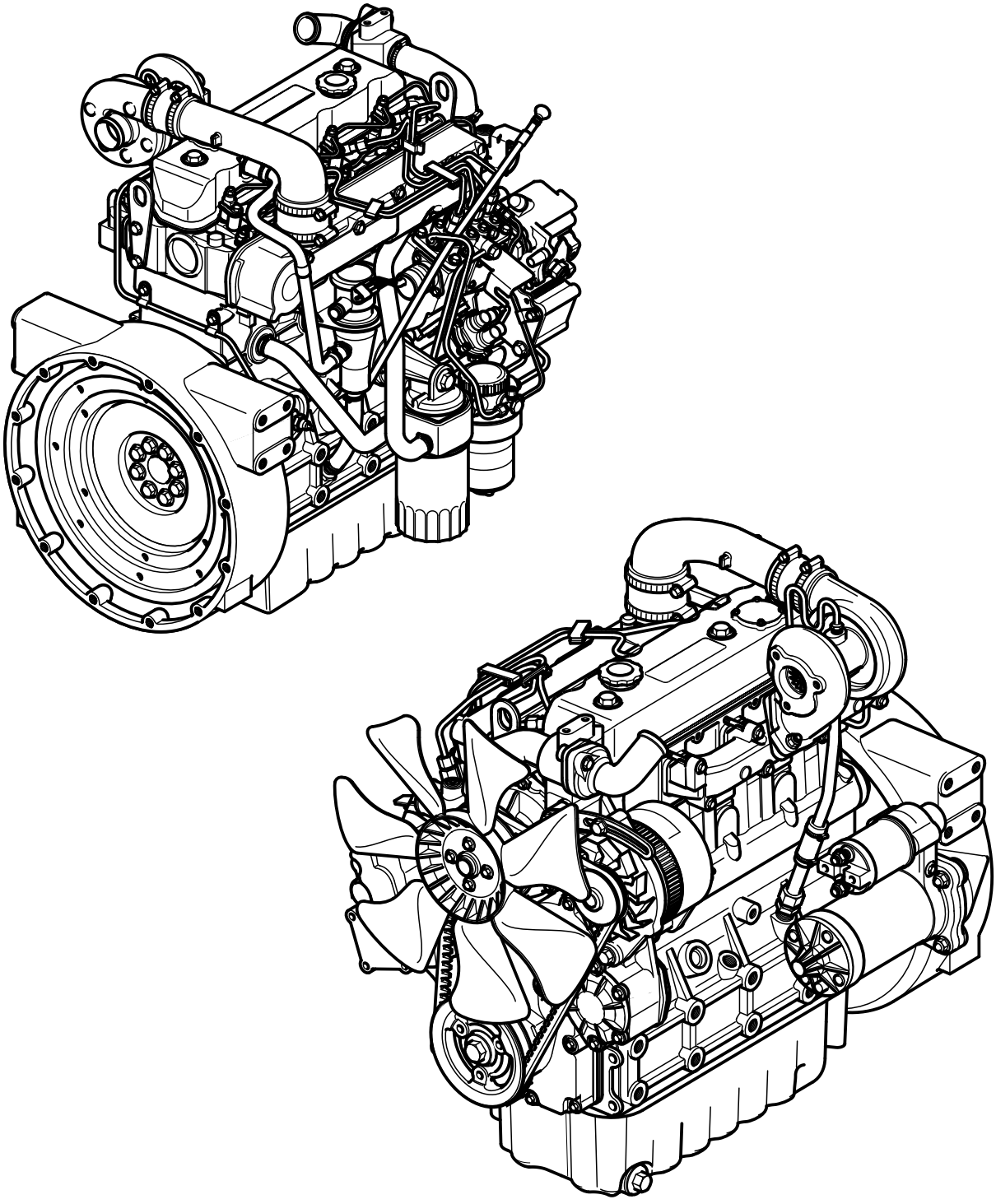
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Operation:
Engine views - naturally aspirated engine



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Operation:
Engine views - turbocharged engine



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Compression test data

Tests have shown that many factors affect compression pressures. Battery and starter motor condition, ambient conditions and the type of gauge used can give a wide variation of results for a given engine.
It is not possible to give accurate data for compression pressure, but tests have shown that the results should be within 2000/3500 kPa (300/500 lbf/in^2) 21,0/35,0 kgf/cm^2 for diesel engines.
Compression tests should only be used to compare between the cylinders of an engine. If one or more cylinders vary by more than 350 kPa (50 lbf/in^2) 3,5 kgf/cm^2, then those cylinders may be faulty.
Compression tests should not be the only method used to show the condition of an engine, but they should be used together with other symptoms and tests.

How to do a compression test

Caution: *Before the compression test, ensure that the battery is in good condition and that it is fully charged. Also ensure that the starter motor is in good condition.*

1 Ensure that the valve tip clearances are set correctly.
2 Remove the atomisers.
3 Fit a suitable gauge into the hole in the cylinder head for the atomiser.
4 Disconnect the stop solenoid or put the stop control in the no-fuel position. Operate the starter motor and note the maximum pressure indicated on the gauge.
5 Repeat for each cylinder.

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Operation:
Specifications

Basic engine data

Cycle … Four stroke
Number of cylinders …4
Cylinder arrangement … In line
Firing order … 1,3,4,2
Direction of rotation … Clockwise from the front
Induction system:
UA and UB … Naturally aspirated
UC … Turbocharged
Cubic capacity:
UA and UC engines … 2956 cc (183 in^3)
UB engines … 2602 cc (159 in^3)
Compression ratio:
UA and UC … engines 17.5:1
UB engines … 22.0:1
Combustion system:
UA and UC engines … Direct injection
UB engines … Indirect injection
Nominal bore:
UA and UC engines … 97,0 mm (3.82 in)
UB engines … 91,0 mm (3.58 in)
Stroke … 100,0 mm (3.94 in)
Valve tip clearances (cold):
- Inlet and exhaust … 0,35 mm (0.014 in)
Lubricating oil pressure **(1)** : … … … … … … … … … … … … … … 280 kPa (41 lbf/in^2) 2,86 kgf/cm^2
Typical dry installed engine weight **(2)** … … … … … … … … … … … … … … … … … … 200 kg (440 lb)

(1) Minimum pressure at maximum engine speed and normal engine temperature
(2) Engine weight may alter with final specification.

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Operation:
Recommended torque tensions

Most of the fasteners referred to in this manual have standard torque tensions which are shown in the table below. Those fasteners that need special torque tensions are listed in separate table.

Procedures referred to in this manual will have the torque tensions (standard or special) shown in the text and also listed in the table for special torque tensions.

Note:
The torque tensions that are shown in this manual apply to fasteners with threads lightly lubricated with clean engine oil.

Standard torque tension for setscrews, studs and nuts

Thread size	Torque tension - setscrews and nuts				Torque tension - studs (metal end)		
	Nm	lbf ft	kgf m	Spanner size mm	Nm	lbf	kgf m
M6 x 1,00	9	7	0,9	8	5	4	0,5
M8 x 1,25	22	16	2,2	10	11	8	1,1
M10 x 1,50	44	33	4,5	13	18	13	1,8
M12 x 1,75	78	58	8,0	15	25	18	2,5
M14 x 2,00	124	91	12,6	18	-	-	-
M16 x 2,00	190	140	19,3	21	-	-	-

Special torque tension for setscrews and nuts.

Description	Thread size	Torque tension		
		Nm	lbf ft	kgf m
Crankshaft assembly				
Setscrews, main bearings	M14	147	108	15,0
Setscrews, pulley/ damper assembly	M16	185	136	18,9
Cylinder block				
Piston cooling valve, UC engines	3/8 UNF	27	20	2,8
Breather deflector, UC engines	M18	18	13	1,8

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Operation:
Recommended torque tensions

Special torque tension for setscrews and nuts

Description	Thread size	Torque tension		
		Nm	lbf ft	Kgf m
Cylinder head assembly				
Setscrews, cylinder head, see section 12				
Setscrews, engine lift brackets	M8	18,5	14	1,9
Setscrews, exhaust manifold to cylinder head (powerlock)	M8	18	13	1,8
Nut, rocker cover	M14	11	8	1,1
Flywheel				
Setscrews, flywheel	M12	100	74	10,2
Fuel system				
Banjo bolt, leak-off pipe, UA and UC engines	M6	12	9	1,2
Nut, leak-off pipe, UB engines	M12	34	25	3,5
Gland nut, atomiser, UB engines	M20	39	29	4,0
Union nut, high-pressure pipe	M12	27,5	20	2,8
Setscrew, filter bracket to cylinder block, - UC engines	M14	75	55	7,6
Lubrication system				
Relief valve assembly to timing case	M18	20	15	2,0
Plug, sump	3/4 UNF	34	25	3,5
Connector, oil cooler, UC engines	3/4 UNF	57,5	42	5,9
Pistons and connecting rod assemblies				
Nuts, connecting rods	M9	54	40	5,5
Timing case and drive assembly				
Angleichung unit to timing case	M16	27	20	2,8
Turbocharger				
Nut, turbocharger oil drain	7/8 UNS	40	30	4,1
Nut, turbocharger oil feed	7/16 UNS	18	13	1,8
Electrical				
Glowplug	M10	17	13	1,7
Connection, glow plug	M4	1,15	0.8	0,12

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Data and dimensions:

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in production.

Timing data

Fuel injection pump
Make ..... Zexel PFR-KX in-line cassette type
Direction of rotation ..... Clockwise from drive end
Fuel pump code letters ..... See table below
For identification purposes, a plate which shows the part number of the pump and the rating code letters is fitted to the side of the pump. An example of this is:
- Pump part number 2644D051
- Pump code letters ..... AJ
Timing details for fuel injection ..... See table below

Timing data

Engine type	Fuel pump code letters	Static timing position in degrees before TDC	Piston displacement	
			mm	in
UA	AJ	16	2,51	0.099
UA	BJ	16	2,51	0.099
UB	CJ	14	1,97	0.078
UB	DJ	10	1,01	0.040
UB	EJ	10	1,01	0.040
UA	FJ	16	2,51	0.099
UA	GJ	22	4,71	0.185
UA	HJ	22	4,71	0.185
UA	JJ	22	4,71	0.185
UC	KJ	18	3,17	0.125

Timing shims

Part number	Thickness mm (in)
3621F011	0,1 (0.004)
3621F012	0,2 (0.008)
3621F013	0,3 (0.012)
3621F014	0,4 (0.016)
3621F015	0,5 (0.020)

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Cylinder block

Height between top and bottom faces ... ... 360,925/361,075 mm(14.2096/14.2156 in)
Diameter of parent bore for main bearing ... ... 69,000/69,019 mm (2.7165/2.7173 in)
Diameter of bores for camshaft:
- Number one (for bush) ... ... 51,84/51,87 mm (2.041/2.042 in)
- Numbers two three four and five ... ... 48,025/48,50 mm (1.8907/1.9094 in)

Bore of camshaft bush, (fitted in cylinder block) - camshaft numbers:
- U3112A001 and 3112E009 ... ... 48,025/48,080 mm (1.8907/1.8929 in)
- U3112E021... ... ... 48,035/48,090 mm (1.8911/1.8933 in)

Diameter of cylinder bores:
- UA and UC engines ... ... 97,000/97,025 mm (3.8189/3.8199 in)
- UB engines ... ... 91,000/91,025 mm (3.5827/3.5837 in)

Maximum permissible wear in cylinder bore ... ... 0,25 mm (0.01 in)

Oversize bores

Diameter of oversize cylinder bores before they are honed
- UA and UC engines ... ... 97,35/97,42 mm (3.833/3.835 in)
- UB engines ... ... 91,35/91,42 mm (3.596/3.599 in)

Surface finish ... ... RA 3.0/5.0

Surface finish of the diamond hone

Hone angle (cross hatch) ... ... 30°/35°

Surface finish size, diamond honed:
- UA and UC engines ... ... 97,472/97,482 mm (3.8374/3.8378 in)
- UB engines ... ... 91,472/91,482 mm (3.6012/3.6016 in)

Grade of surface finish ... ... RA 2,0/2,5 micro-meters
Maximum ovality and taper ... ... 0,010 mm (0.0004 in)

Surface finish of the silicone carbide base hone

Hone angle (cross hatch) ... ... 30°/35°

Surface finish size, silicon carbide base hone
- UA and UC engines ... ... 97,507 mm (3.8388 in)
- UB engines ... ... 91,507 mm (3.6026 in)

Grade of surface finish ... ... RA 1,2/1,5 micro-meters
Maximum ovality and taper ... ... 0,010 mm (0.0004 in)

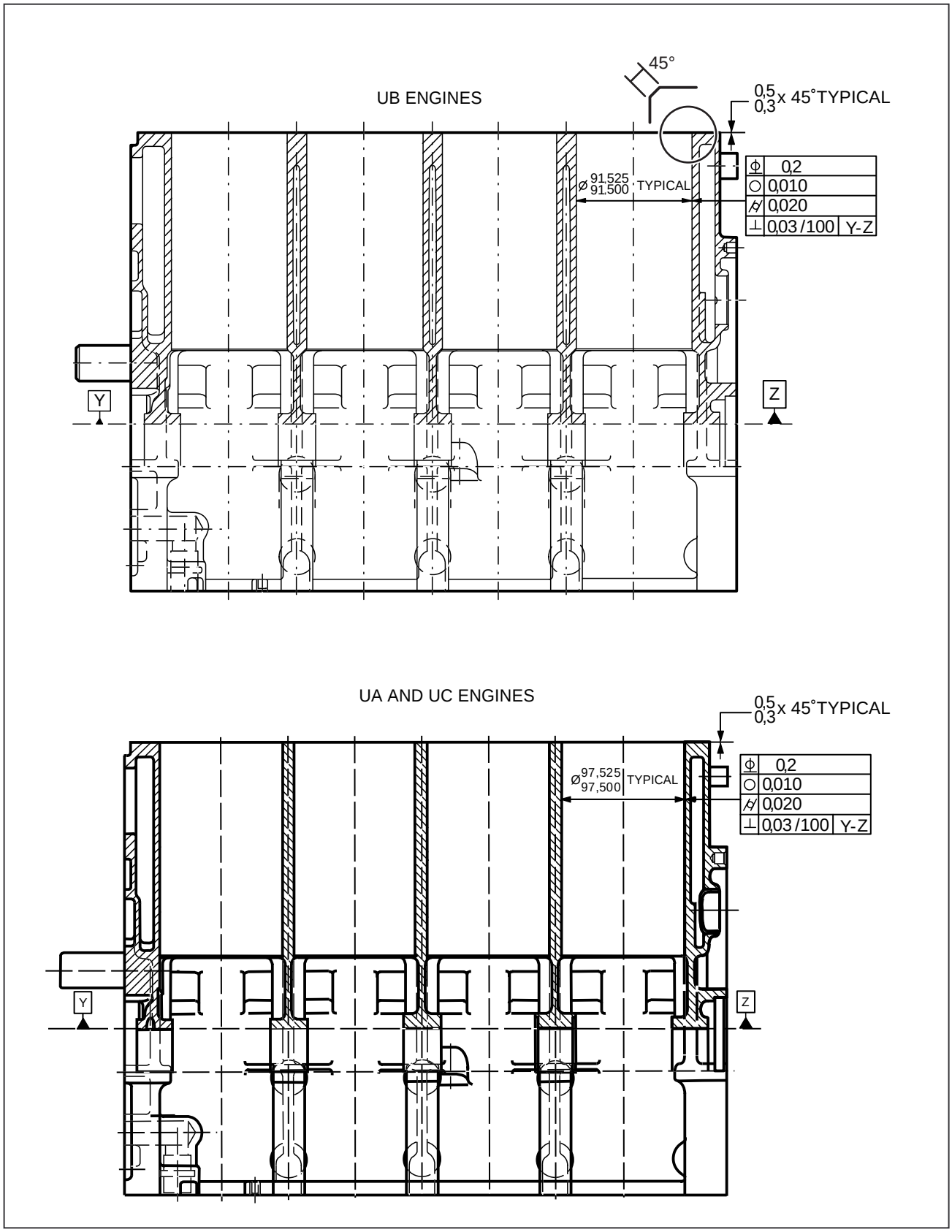
Surface finish of the silicone carbide plateau hone

Final surface finish size, silicon carbide (plateau hone):
- UA and UC engines ... ... 97,500/97,525 mm (3.8386/3.8396 in)
- UB engines ... ... 91,500/91,525 mm (3.6024/3.6033 in)

Final surface finish grade, silicon carbide (plateau hone) ... ... 0,65/1,3 micro-meters

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Cylinder head assembly

Angle of valve seats
- Inlet ... ... 45° (90° included angle)
- Exhaust ... ... 45° (90° included angle)

Diameter of parent bores for valve guides ... ... 12,000/12,027 mm (0.4724/0.4735 in)
Leak test pressure ... ... 200 kPa (29 lbf/in^2) 2,0 kgf/cm^2
Cylinder head thickness ... ... 79,95/80,05 mm (3.148/3.151 in)
Minimum permissible thickness after cylinder head has been machined
- UA and UC: engines ... ... 79,8 mm (3.142 in)
- UB engines: The cylinder head for this engine must not be machined, see caution on page 51

Maximum protrusion of the atomiser nozzle ... ... 2,7 mm (0.11 in)

Valve guides

Inside diameter ... ... 7,027/7,052 mm (0.2767/0.2776 in)
Outside diameter ... ... 12,034/12,047 mm (0.4738/0.4743 in)
Interference fit of guide in cylinder head ... ... -0,007/-0,047 mm (-0.0003/-0.0019 in)
Length ... ... 45,2/45,7 mm (1.78/1.80 in)
Protrusion above the valve spring seat. ... ... 7,7/7,85 mm (0.30/0.31 in)
Maximum permissible clearance of a new valve in the valve guide (operation 12.12)
- Inlet 0,24 mm (0.009in)
- Exhaust 0,28 mm (0.011in)

Inlet valves

Diameter of valve stem ... ... 6,970/6,985 mm (0.2704/0.2750 in)
Diameter of valve head
- UA and UC engines ... ... 43,9/44,1 mm (1.73/1.74 in)
- UB engines ... ... 41,9/42,1 mm (1.65/1.66 in)

Angle of valve face ... ... 45°
Depth of valve head below cylinder head face
- UA and UC engines ... ... 0,376/0,730 mm (0.0150/0.029 in)
- UB engines ... ... 0,308/0,671 mm (0.012/0.026 in)

Service limit
- UA and UC engines ... ... 0,98 mm (0.039 in)
- UB engines ... ... 0,93 mm (0.037 in)

Overall length of valve ... ... 106,275/106,625mm(4.184/4.197 in)
Seal arrangement ... ... Rubber seal fitted to valve guide

Exhaust valves

Diameter of valve stem ... ... 6,945/6,960 mm (0.2734/0.2740 in)
Diameter of valve head
- UA and UC engines ... ... 37,1/37,3 mm (1.46/1.47 in)
- UB engines ... ... 33,9/34,1 mm (1.33/1.34 in)

Angle of valve face ... ... 45°

Continued

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Depth of valve head below cylinder head face
- UA and UC engines ... ... 0,521/0,887 mm (0.021/0.035 in)
- UB engines ... ... 0,408/0,771 mm (0.016/0.030 in)

Service limit
- UA and UC engines ... ... 1,14 mm (0.045 in)
- UB engines ... ... 1,03 mm (0.041 in)

Overall length of valve
- UA and UC engines ... ... 106,125/106,475mm (4.1781/4.1919 in)
- UB engines ... ... 106,275/106,625 mm (4.1841/4.1978 in)

Seal arrangement ... ... Rubber seal fitted to valve guide

Valve springs

Fitted length ... ... 32,0 mm (1.26 in)

Load at fitted length ... ... 375/415 N (84.4/93.2 lbf) 38,3/42,3 kgf

Number of active coils 3,9

Direction of coils ... ... Left hand

Tappets

Diameter of tappet stem ... ... 26,959/26,980 mm (1.0613/1.0622 in)

Diameter of tappet bore in cylinder block ... ... 27,000/27,021 mm (1.0631/1.0641 in)

Clearance of tappet in cylinder block ... ... 0,020/0,062 mm (0.0008/0.0024 in)

Rocker shaft

Outside diameter ... ... 21,962/21,987 mm (0.8646/0.8656 in)

Rocker levers

Bore diameter ... ... 22,013/22,051 mm (0.8667/0.8681 in)

Clearance fit on rocker shaft ... ... 0,026/0,084 mm (0.0010/0.0033 in)

Maximum permissible clearance ... ... 0,124 mm (0.0048 in)

Valve tip clearances (cold) ... ... 0,35 mm (0.014 in)

Continued

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Maximum permissible distortion of cylinder head

A1 ... ... 0,08 mm (0.003 in)
A2... ... ... 0,15 mm (0.006 in)
A3... ... ... 0,15 mm (0.006 in)

Dimensions of a recess for a valve seat insert

Inlet - UA and UC engines

B1... ... ... Radius 0,38 mm (0.015 in) maximum
B2... ... ... … 45° chamfer
B3... ... ... 49,0/49,2 mm (1.93/1.94 in)
B4... ... ... 45,175/45,200 mm (1.7785/1.7795 in)
B5... ... ... 8,35/8,55 mm (0.329/0.337 in)

Exhaust - UA and UC engines

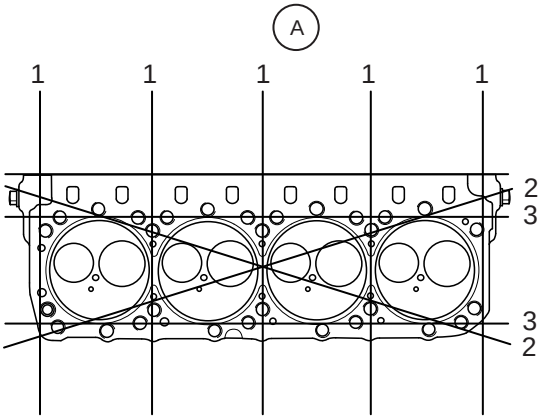
B1... ... ... Radius 0,38 mm (0.015 in) maximum
B2... ... ... … 45° chamfer
B3... ... ... 42,5/42,3 mm (1.67/1.79 in)
B4... ... ... 38,475/38,500 mm (1.5148/1.5157 in)
B5... ... ... 8,35/8,55 mm (0.329/0.337 in)

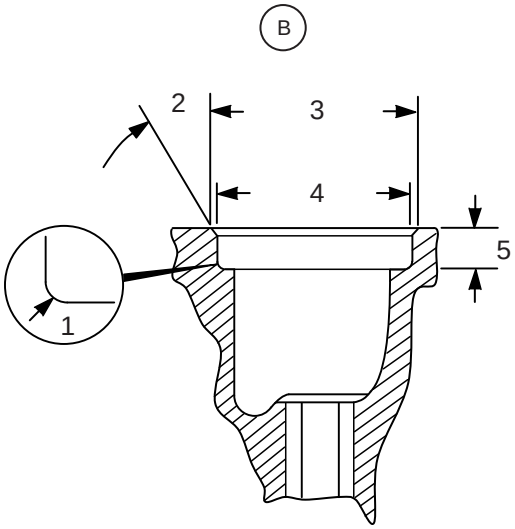
Inlet - UB engines

B1... ... ... Radius 0,38 mm (0.015 in) maximum
B2... ... ... … 45° chamfer
B3... ... ... 46,9/47,1 mm (1.84/1.85 in)
B4... ... ... 43,325/43,350 mm (1.7057/1.7067 in)
B5... ... ... 8,2/8,4 mm (0.32/0.33 in)

Exhaust - UB engines

B1... ... ... Radius 0,38 mm (0.015 in) maximum
B2... ... ... … 45° chamfer
B3... ... ... 38,7/38,9 mm (1.52/1.53 in)
B4... ... ... 35,125/35,150 mm (1.3828/1.3838 in)
B5... ... ... 8,2/8,4 mm (0.32/0.33 in)





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Dimensions for a valve seat insert tool (A)

Inlet: UA and UC engines

A1 . ... 1,5 mm (0.06 in)
A2 . ... 19,0 mm (0.7 in)
A3 . ... 6,5 mm (0.26 in)
A4 . ... 60,0 mm (2.4 in)
A5 . ... 38,82/38,85 mm (1.528/1.529 in)
A6 . ... 44,6/45,1 mm (1.76/1,78 in)
A7 . ... 0,8 mm (0.03 in)
A8 . ... 1,5 mm (0.06 in)
A9 . ... 1,5 mm (0.06 in)
A10 ... ... 6,95/6,97 mm (0.273/0.274 in)

Exhaust : UA and UC engines

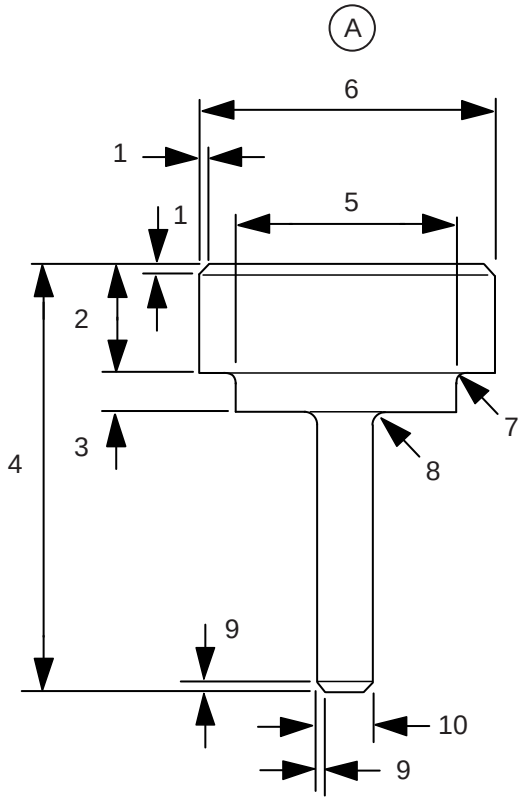
A1 . ... 1,5 mm (0.06 in)
A2 . ... 19,0 mm (0.7 in)
A3 . ... 6,5 mm (0.26 in)
A4 ... ... 60,0 mm (2.4 in)
A5 . ... 31,42/31,45 mm (1.237/1.238 in)
A6 . ... 38,43/38,45 mm (1.513/1.514 in)
A7 . ... 0,8 mm (0.031 in)
A8 . ... 1,5 mm (0.06 in)
A9 . ... 1,5 mm (0.06 in)
A10 ... ... 6,95/6,97 mm (0.273/0.274 in)

Inlet: UB engines

A1 . ... 1,5 mm (0.06 in)
A2 . ... 19,0 mm (0.7 in)
A3 . ... 6,1 mm (0.26 in)
A4 . ... 60,0 mm (2.4 in)
A5 . ... 37,15/37,22 mm (1.46/1.47 in)
A6 . ... 42,75/43,25 mm (1.683/1.703 in)
A7 . ... 0,8 mm (0.03 in)
A8 . ... 1,5 mm (0.06 in)
A9 . ... 1,5 mm (0.06 in)
A10 ... ... 6,95/6,97 mm (0.273/0.274 in)

Exhaust: UB engines

A1 ... ... 1,5 mm (0.06 in)
A2 ... ... 19,0 mm (0.7 in)
A3 ... ... 6,1 mm (0.26 in)
A4 ... ... 60,0 mm (2.4 in)
A5 ... ... 28,95/29,02 mm (1.139/1.143 in)
A6 ... ... 35,08/35,10 mm (1.38/1.38 in)
A7 ... ... 0,8 mm (0.031 in)
A8 ... ... 1,5 mm (0.06 in)
A9 ... ... 1,5 mm (0.06 in)
A10 ... ... 6,95/6,97 mm (0.273/0.274 in)



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Crankshaft
Diameter of main journals … … … … … … … … … … … … … … 64,951/64,970 mm (2.5571/2.5578 in)
Maximum wear and ovality on journals and crank pins … … … … … … … … … … 0,04 mm (0.0016 in)
Width of front journal… … … … … … … … … … … … … … … … … … … …32,80/34,20 mm (1.29/1.35 in)
Width of number four journal … … … … … … … … … … … … … … 33,000/33,040 mm (1.2992/1.3008 in)
Width of all other journals … … … … … … … … … … … … … … … … … 32,95/33,05 mm (1.297/1.301 in)
Diameter of crank pins … … … … … … … … … … … … … … … … … … 52,95/52,97 mm (2.085/2.085 in)
Width of crank pins … … … … … … … … … … … … … … … … … … 30,05/32,95 mm (1.183/1.297 in)
Diameter of crankshaft palm … … … … … … … … … … … … … … 94,965/95,000 mm (3.7837/3.7401 in)
Depth of recess for spigot bearing … … … … … … … … … … … … … … 11,6/12,6 mm (0.46/0.50 in)
Bore of recess for spigot bearing … … … … … … … … … … … 40,000/40,025 mm (1.5748/1.5757 in)
Crankshaft end-float … … … … … … … … … … … … … … … … … 0,040/0,275 mm (0.0015/0.0108 in)
Maximum permissible end-float … … … … … … … … … … … … … … … … … 0,405 mm (0.0159 in)
Fillet radii of journals and crank pins … … … … … … … … … … … … … … … 3,3/3,7 mm (0.13/0.14 in)
Undersizes journals and crank pins … … … … … … … … … … … … … … … … … … - 0,25 mm (0.010 in)
… - 0,50 mm (0.020 in)
… - 0,70 mm (0.030 in)

Crankshaft heat treatment
Engine types:
UA and UB… … … …… Induction hardened journals
UC… …Induction hardened journals and fillet radii
Crankshaft run-out
With the crankshaft on vee blocks at the front and rear journals, the maximum run-out (total indicator reading) at the journals must not be more than the figures in the table shown below.
Run-out must not be opposite. The difference in run-out between one journal and the next must not be more than 0,10 mm (0.004 in).

Journal	Crankshaft
1	Mounting
2	0,08 mm (0.003 in)
3	0,15 mm (0.006 in)
4	0,08 mm (0.003 in)
5	Mounting

Main bearings
Type … Steel back, aluminium / tin face
Width of bearing … 25,70/26,00 mm (1.01/1.02 in)
Thickness at centre of bearing … … … … … … … … … … … … … 1,993/1,999 mm (0.0784/0.0787 in)

Available undersizes bearings … -0,25 mm (0.010 in)
… -0,50 mm (0.020 in)
… -0,75 mm (0.030 in)

Crankshaft thrust washers
Type …… … Steel back, lead / bronze bearing material
Position … … … … … … … … … … … In cylinder block only, each side of number four main bearing
Thickness:
- Standard … 2,380/2,440 mm (0.0937/ 0.0961 in)
- Oversize … 2,58/2,64 mm (0.102/0.104 in)

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Timing case and drive assembly

Camshaft
Diameter of number 1 camshaft journals - camshaft numbers:
- U3141D143 … … … … … … … … … … … … … … … … … … 47,982/47,992 mm (1.8891/1.8894 in)
- 3141D091 … … … … … … … … … … … … … … … … … … 47,945/47,975 mm (1.8875/1.8888 in)
- 3141D095, 3141D097, 3141D144 … … … … … … … … … … 47,955/47,975 mm (1.8880/1.8888 in)

Diameter of number 2, 3, 4 and 5 camshaft journals … … … … 47,945/47,975 mm (1,8876/1.8888 in)
Clearance of number 1 journal in cylinder block - camshaft numbers:
- U3141D143 … … … … … … … … … … … … … … … … … … 0,043/0,108 mm (0.0017/0.0043 in)
- 3141D091 … … … … … … … … … … … … … … … … … … … 0,050/0,135 mm (0.0020/0.0053 in)
- 3141D095, 3141D097, 3141D144 … … … … … … … … … 0,050/0,125 mm (0.0020/0.0049 in)
- numbers two, three, four and five … … … … … … … … … … 0,050/0,115 mm (0.0020/0.0045 in)

Cam lift:
- Inlet … 7,06/7,16 mm(0.278/0.282 in)
- Exhaust … 7,35/7,45 mm(0.289/0.293 in)

End-float - camshaft numbers (production limit):
- 3141D091,3141D095, 3141D097 … … … … … … … … … … … 0,100/0,225 mm (0.004/0.009 in)
- U3141D143, 3141D144 … … … … … … … … … … … … … … … … 0,10/0,25 mm (0.004/0.010 in)

Service limit … 0,35 mm (0.014 in)

Camshaft thrust washer
Type … 360°
Thickness … 2,30/2,40 mm (0.091/0.095 in)

Camshaft gear
Number of teeth … 60

Fuel pump gear
Number of teeth … 60
End float for fuel pump camshaft. … … … … … … … … … … … 0,005/0,140 mm (0.0002/0.0055 in)

Crankshaft gear
Number of teeth … 30
Diameter of bore … … … … … … … … … … … … … … … … … … 31,936/31,961 mm (1.2573/1.2583 in)
Diameter of crankshaft nose … … … … … … … … … … … … … 31,979/32,000 mm (1.2590/1.2600 in)
Interference fit of gear on crankshaft … … … … … … … … … -0,018/-0,064 mm (-0.0007/-0.0025 in)

Idler gear and hub
Number of teeth … 59
Diameter of bore of bushes in gear … … … … … … … … … … 28,077/28,098 mm (1.1054/1.1062 in)
Diameter of hub fitted to cylinder block … … … … … … … … 28,048/28,061 mm (1.1043/1.1048 in)
Clearance fit of gear on hub … … … … … … … … … … … … … … 0,016/0,050 mm (0.0006/0.0020 in)

Backlash for gears:
- Crankshaft to oil pump and idler gears … … … … … … … … … … … 0,076 mm (0.003 in) minimum
- Gears other than those referred to above … … … … … … … … … … 0,05 mm (0.002 in) minimum

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Lubricating oil pump

Type ... ... Differential rotor, gear driven
Number of lobes ... ... Inner rotor 4, outer rotor 5
Maximum permissible clearance of outer rotor to pump body ... ... 0,19 mm (0.007in)
Inner rotor to outer rotor ... ... 0,25 mm (0.010 in)
Inner and outer rotor end clearance ... ... 0,15 mm (0.006 in)

Lubricating oil relief valve

Diameter of bore in pump body ... ... 11,000/11,018 mm (0.5605/0.5625 in)
Outside diameter of plunger ... ... 10,970/10,982 mm (0.5585/0.5595 in)
Clearance fit of plunger in bore ... ... 0,018/0,048 mm (0.0007/0.0019 in)
Length of spring (fitted) ... ... 25,5 mm (1.004 in)
Load on spring (fitted) ... ... 26,2/27,7 N (5.9/6.2 lbf) 2,7/2,8 kgf
Pressure to open valve ... ... 240/290 kPa (34.8/42.1 lbf/in^2) 2,4/3,0 kgf m^2

Lubricating oil filter

Type ... ... Full flow, screw-on type canister
Pressure to open by-pass valve ... ... 55/83 kPa (8/12 lbf/in^2) 0,6/0,8 kgf/cm^2

Cooling system

Type ... ... Thermostat controlled - pump assistance

Coolant pump

Type ... ... Centrifugal, belt driven

Thermostat

Type ... ... Single, wax element

Nominal temperature stamped on the base of the by-pass valve	“Start to open” temperature	“Fully open” temperature	Minimum valve lift, fully open
82,0°C (179.6°F)	77/85°C (170.6/185.0°F)	92/98°C (197.6/208.4°F)	9 mm (0.35 in)
71,0°C (159.8°F)	67/75°C (152.6/167.0°F)	85/88°C (185.0/190.4°F)	9 mm (0.35 in)

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Pistons

Type
- UA engines ... ... Re-entrant combustion bowl
- UB engines ... ... Flat top with recess for valves
- UC engines ... ... Re-entrant combustion bowl, inserted top ring groove

Height of piston above top face of cylinder block ... ... 0,386/0,511 mm (0.0152/0.0201 in)
Diameter of bore for gudgeon pin ... ... 30,003/30,009 mm (1.1812/1.1814 in)

Width of groove for top ring
- UA and UC engines ... ... 2,06/2,08 mm (0.081/0.082 in)
- UB engines ... ... 2,08/2,10 mm (0.082/0.083 in)

Width of groove for second ring ... ... 2,06/2,08 mm (0.081/0.082 in)
Width of groove for third ring ... ... 4,04/4,06 mm (0.159/0.160 in)
Service height grade ... ... See section 13
Oversize piston ... ... 0,5 mm (0.020 in) on the diameter

Piston rings

Top compression ring ... ... Chromium / barrel faced
Second compression ring ... ... Taper face, cast iron
Oil control ring ... ... Coil spring loaded, chromium faced
Width of top ring ... ... 1,97/1,99 mm (0.077/0.078 in)
Width of second ring ... ... 1,97/1,99 mm (0.077/0.078 in)
Width of third ring ... ... 3,97/3,99 mm (0.156/0.157 in)

Clearance of top ring in groove
- UA and UC engines ... ... 0,07/0,11 mm (0.003/0.004 in)
- UB engines ... ... 0,003/0,005 mm (0.09/0.13 in)

Clearance of second ring in groove ... ... 0,07/0,11 mm (0.003/0.004 in)
Clearance of third ring in groove ... ... 0,05/0,09 mm (0.002/0.004 in)
Gap of top ring ... ... 0,20/0,48 mm (0.008/0.019 in)
Gap of second ring ... ... 0,30/0,63 mm (0.012/0.025 in)
Gap of third ring ... ... 0,20/0,48 mm (0.008/0.019 in)

Connecting rods

Type ... ... "H" section
Diameter of parent bore for big-end ... ... 56,000/56,015 mm (2.2047/2.2053 in)
Diameter of parent bore for small end ... ... 32,930/32,955 mm (1.2964/1.2974 in)
Length between centres (parent bores) ... ... 159,975/160,025 mm (6.2982/6,3002 in)
Length grades, see section 13.

Continued

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Big-end bearings

Type:

UA and UB … Steel back, aluminium / tin face

UC … Steel back, copper / lead face

Width … 22,87/23,13 mm (0.900/0.911 in)

Thickness at centre of bearings

UA and UB … … … … … … … … … … … … … … … … … … … 1,500/1,506 mm (0.0591/0.0593 in)

UC … 1,496/1,506 mm (0.0599/0.0593 in)

Available undersizes bearings … … … … … … … … … … … … … … … … … -0,25 mm (-0.010 in)

… -0,50 mm (-0.020 in)

… -0,75 mm (-0.030 in)

Gudgeon pins

Type … Fully floating

Outside diameter … … … … … … … … … … … … … … … … … … 29,995/30,000 mm (1.1809/1.1811 in)

Small end bushes

Type … Steel back, lead / bronze face

Inside diameter (reamed) … … … … … … … … … … … … … … 30,012/30,025 mm (1.1816/1.1821 in)

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Fuel injection pump

Make …… … … Zexel PFR-KX in-line cassette type
Direction of rotation … Clockwise from drive end
Fuel pump code letters:
- UA engines … AJ, BJ, FJ, GJ, HJ, JJ
- UB engines … CJ, EJ, DJ
- UC engines …KJ

Code letters, see table below:

Fuel lift pump

Type …Diaphragm
Method of drive … … … … … … … … … … … … … … Eccentric on camshaft for fuel injection pump.
Static pressure - no delivery … … … … … … … … … … … … 42/70 kPa (6/10 lbf/in^2) 0,4/0,7 kgf/cm^2
Test pressure 75% of minimum static pressure … … … … … … … … 31 kPa (4.5 lbf/in^2) 0,32 kgf/cm^2

Atomisers

Atomiser code letters
- UA and UC engines (two stage injection) … UA
- UB engine (single stage injection) … UB

Engine type	Code letters	Set pressure **(1)** Bar (lbf in^2) Mpa		Reset pressure**(2)** Bar (lbf in^2) Mpa	
		Stage one	Stage two	Stage one	Stage two
UA,UC	UA	190 (2793) 19,25	230 (3381) 23,3	200 (2940) 20,3	243 (3572) 24,6
UB	UB	120 (1764) 12,2	Not applicable	130 (1911) 13,2	Not applicable

(1) For original atomisers
(2) For atomisers that have been overhauled (e.g. fitted with new springs)

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Electrical equipment

Alternator

Make … Magnetti Marelli A127-65
Rating … 12V/65A

Starter motor

Make … … … … … … … … … … … … … … … … … …… … … … … … … … … Magnetti Marelli 2M113
Voltage … 12V
Number of teeth on pinion … 10
Maximum starter cable resistance at 20°C (68°F) … … … … … … … … … … … … … … 0.0012 ohm

Starting aid

Type … Glow plugs
Current:
- UA and UC … 7.0 amperes after 30 seconds
- UB … 6.5 amperes after 30 seconds

Electrical stop solenoid

Current:
- Pull in … 36.5 amperes
- Hold … 1 amperes
Voltage … 12 Volts
Cable identification (colour)
- Pull in … White
- Hold … Red
- Earth … Black

Auxiliary equipment

Power take-off

Number of teeth on helical gear … 24
Number of splines in drive shaft … 9, 10 or 11
Outside diameter of shaft for ball bearing … … … … … … … … 35,002/35,013 mm (1.3780/1.3785 in)
Outside diameter of shaft for roller bearing … … … … … … … … 31,96/31,99 mm (1.2583/1.2594 in)
Nominal inside diameter of ball bearing … … … … … … … … … … … … … … … … 35 mm (1.378 in)
Nominal inside diameter of roller bearing … … … … … … … … … … … … … … … … 32 mm (1.260 in)
Bore of recess in timing case for ball bearing … … … … … … … … 80,00/80,03 mm (3.1496/3.1508 in)
Bore of recess in rear housing for roller bearing … … … … … … 52,00/52,03 mm (2.0472/2.0484 in)
Nominal outside diameter of ball bearing … … … … … … … … … … … … … … … … 80 mm (3.149 in)
Nominal outside diameter of roller bearing … … … … … … … … … … … … … … … 52 mm (2.047 in)

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Operation:
Rocker cover - to remove and to fit **12.01**

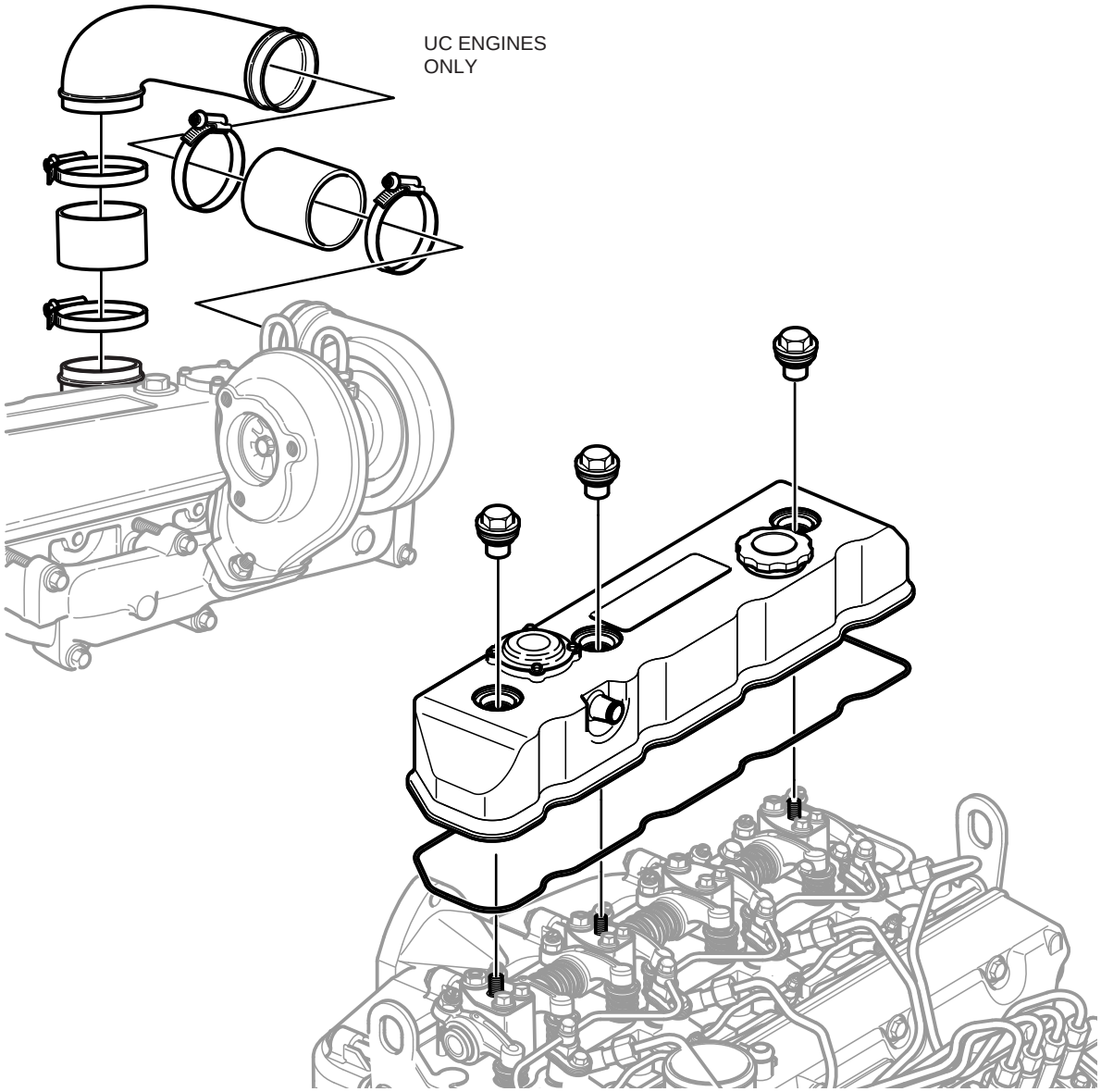
Recommended torque:

Engine type	Nm	lbf ft	kgf m
Cap nuts	**11**	**8**	**1,1**

Special notes:

Caution: *If the cap nut is over-tightened, the stud and plate assembly for the rocker pedestal may be damaged.*
When the crossover pipe is removed, cover the holes in the turbocharger and in the induction manifold to prevent the entry of dirt.

Note: On UC engines, the crossover pipe must be removed first.



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Operation:
Rocker assembly (latest engine) - to remove and to fit **12.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrews	**9**	**7**	**0,9**
Nuts	**22**	**16**	**2,2**

Service operations:
1. Remove rocker cover … … … …**12.01**

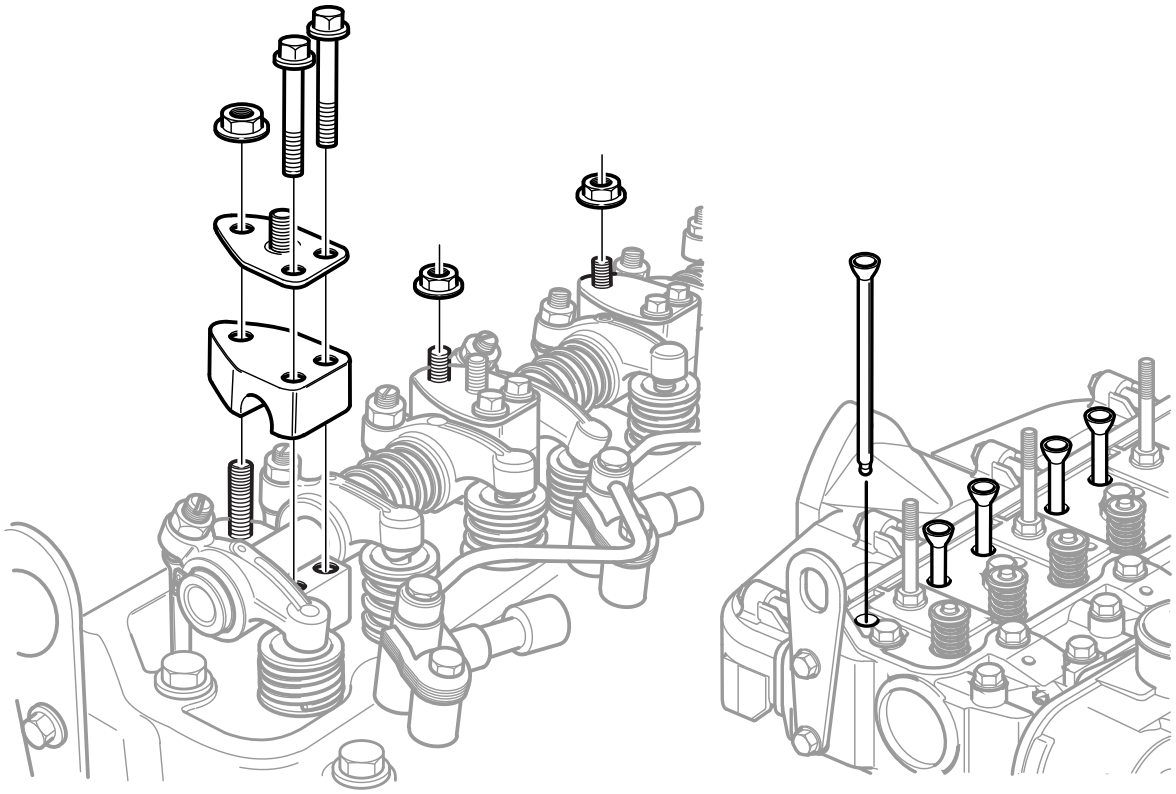
Special notes:
Caution: *Before the rocker assembly is fitted, ensure that the oil holes are free of dirt.*
Check that the push rods fit correctly in the sockets of the tappets.
As the fasteners are gradually tightened, ensure that the ends of the adjustment screws fit correctly in the socket of the push rods.

To remove
1. Release the two setscrews on each bracket starting from the outer brackets and move in toward the centre.
2. Release the nuts on each bracket starting from the outer brackets and move in toward the centre.

Caution: *Note the position of the brackets, as they must be kept in their pairs.*

3. Remove the upper brackets, remove the rocker assembly. Note that the hollow dowel fits into the hole in the front lower bracket.

To fit
1. Fit the rocker shaft, ensure that the hollow pin in the rocker shaft locates in the hole in the front lower bracket.
2. Put the caps in position on the rocker shaft. Ensure that each cap is correctly matched with its lower half. Tighten the nuts starting with the inner nuts and moving outwards.
3. Tighten the setscrews starting with the inner setscrews and moving outwards



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Operation:
Rocker assembly (earlier engines) - to remove and to fit **12.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrews	9	7	0,9
Nuts	22	16	2,2

Service operations:
1. Remove rocker cover… … … … **12.01**
2. Adjust valve tip clearance … … **12.04**

Special notes:
Caution: *Before the rocker assembly is fitted, ensure that the oil holes are free of dirt.*
Check that the push rods fit correctly in the sockets of the tappets.
As the fasteners are gradually tightened, ensure that the ends of the adjustment screws fit correctly in the socket of the push rods.

To remove

1. Release the eight setscrews for the brackets of the rocker shaft. Release gradually and evenly the outer nuts and then the inner nuts for the brackets of the rocker shaft.

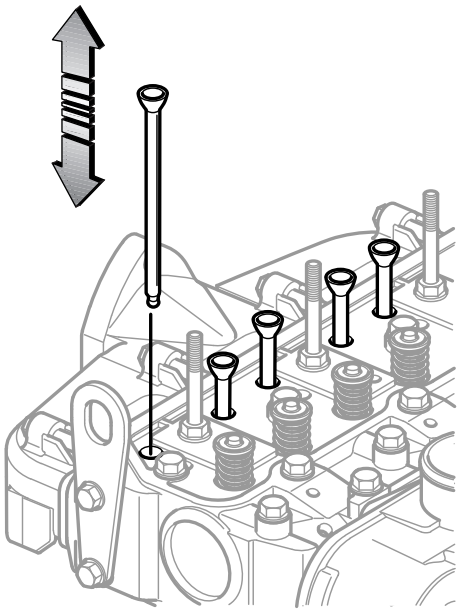
Note: The rocker assembly contains three plates which include the studs for the rocker cover. The plates must be fitted to the correct rocker brackets.

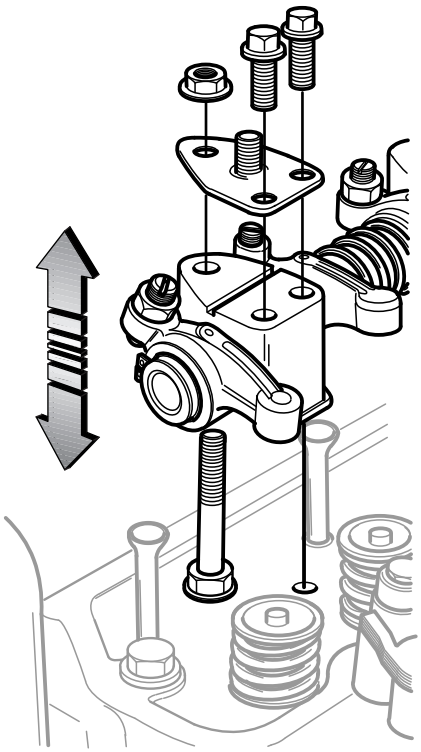
2. Remove the nuts and lift off the rocker assembly.

Note: A hardened steel pin is fitted in the lower part of the front bracket. The purpose of this pin, is to ensure that the bracket is in the correct position on the rocker shaft. The hole in the bracket will align with the oil hole in the cylinder head and ensure correct lubrication of the rocker assembly. Protect these holes to ensure that dirt cannot enter.

To fit

1. Before the rocker assembly is fitted, ensure that the oil holes and are free of dirt.
2. Check that the push rods fit correctly in the sockets of the tappets.
3. Fit the fasteners finger tight.
4. Tighten gradually and evenly, the inner nuts and then the outer nuts to 22 Nm (16 lbf ft) 2,2 kgf m.
5. Tighten gradually and evenly, the eight setscrews to 9 Nm (7 lbf ft) 0,9 kgf m.
6. Adjust the valve tip clearances.





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Operation:
Rocker shaft (latest engines) - to dismantle, to inspect and to assemble **12.03**

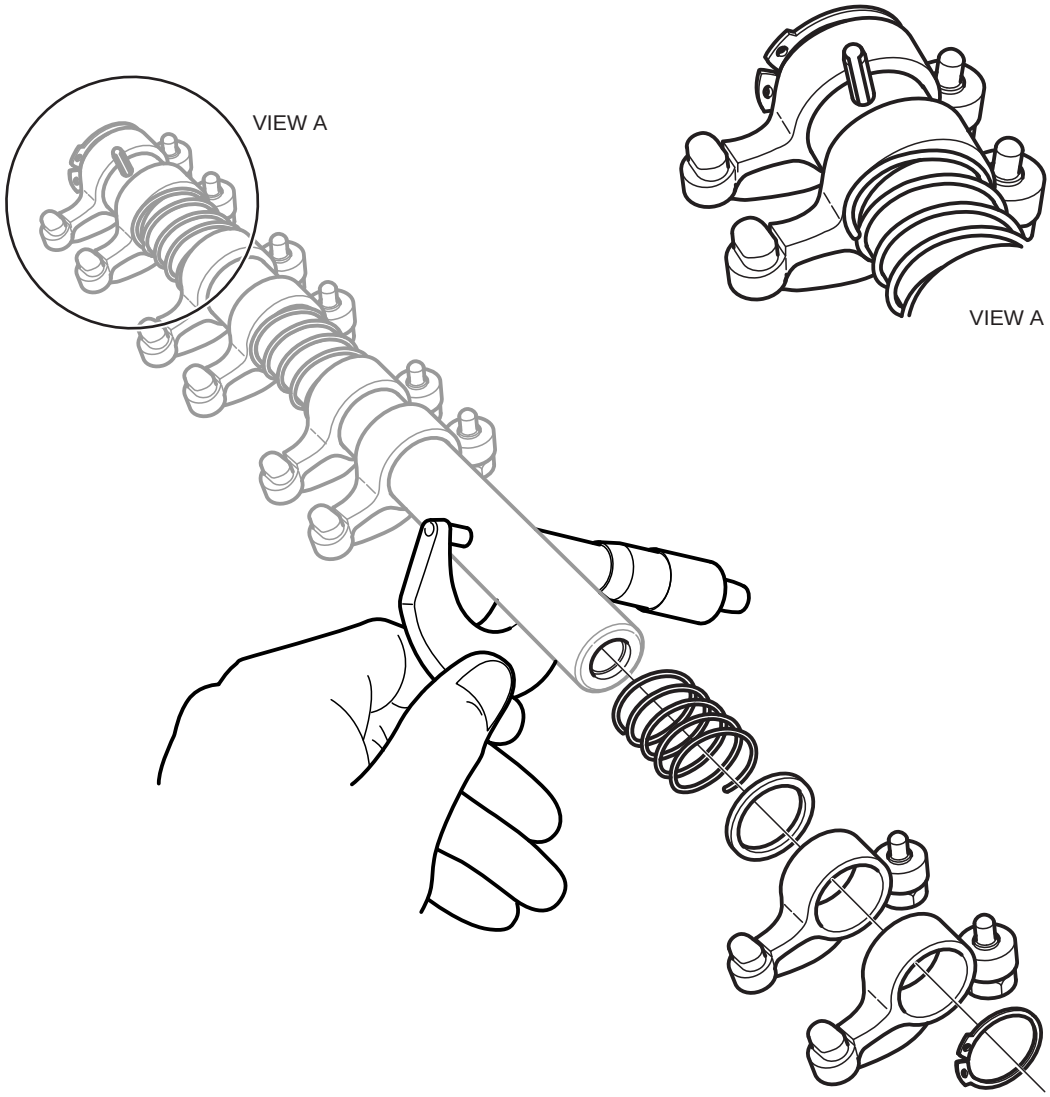
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-	-	-	-

Service operations:

1. Remove rocker cover … … … … **12.01**
2. Remove rocker shaft … … … … **12.02**

Special tools:
Special tools: Micrometer.
Note: A hollow pin in the rocker shaft (view A) locates in the front rocker shaft bracket.
This pin will align with the oil hole in the cylinder and ensure correct lubrication of the rocker assembly.
Protect these holes to ensure that dirt cannot enter.



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Operation:
Rocker shaft (earlier engines)- to dismantle, to inspect and to assemble **12.03**

Recommended torque:

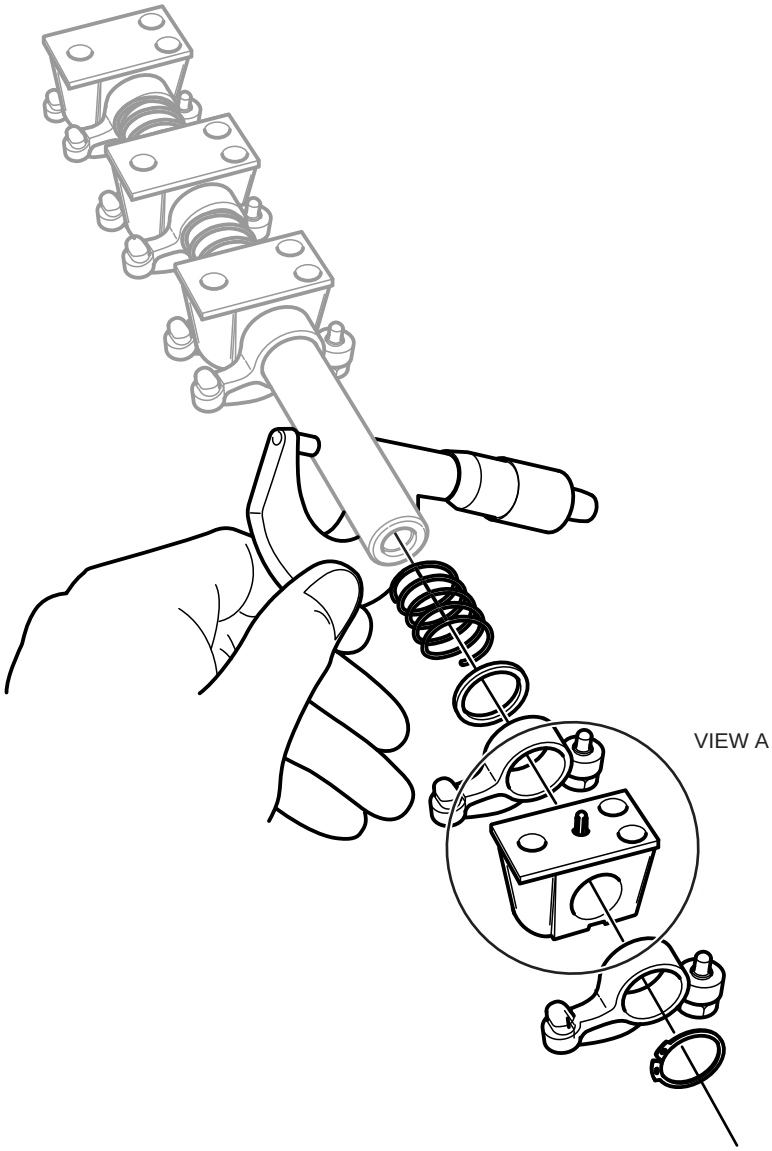
Engine type	Nm	lbf ft	kgf m
-			

Service operations:

1. Remove rocker cover … … … … **12.01**
2. Remove rocker shaft … … … … **12.02**

Special tools:

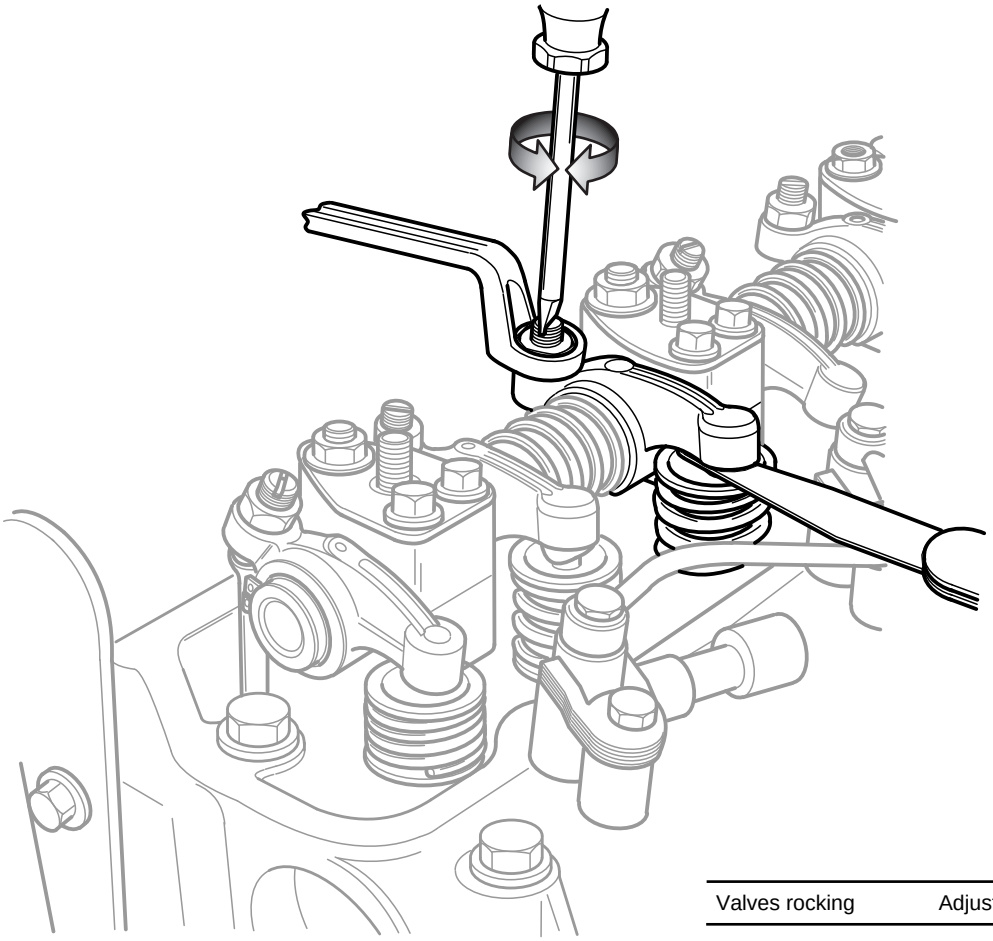
Special tools: Micrometer.
Note: A hardened steel pin is fitted in the lower part of the front bracket (view A).
The purpose of this pin, is to ensure that the bracket is in the correct position on the rocker shaft. The hole in the bracket will align with the oil hole in the cylinder head and ensure correct lubrication of the rocker assembly. Protect these holes to ensure that dirt cannot enter.



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Operation: **Valve tip clearance - to check**	**12.04**
Recommended torque: **Engine type Nm lbf ft kgf m** **Service operations:** 1. Remove rocker cover **12.01**	**Special notes and tools:** **Note:** Adjust when the engine is cold, the valve sequence is viewed from front of engine. The rotation of the crankshaft should be clockwise from front. Use feeler gauge.

Adjust the clearance of both inlet and exhaust valves to 0,35mm (0.014in) with the adjustment screw.



Valves rocking	Adjust valves
No.4 Cyl	1 and 2
No.2 Cyl	5 and 6
No.1 Cyl	7 and 8
No.3 Cyl	3 and 4

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Operation:
Valve springs (with cylinder head fitted) - to remove and to fit **12.05**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove rocker cover … … … … **12.01**

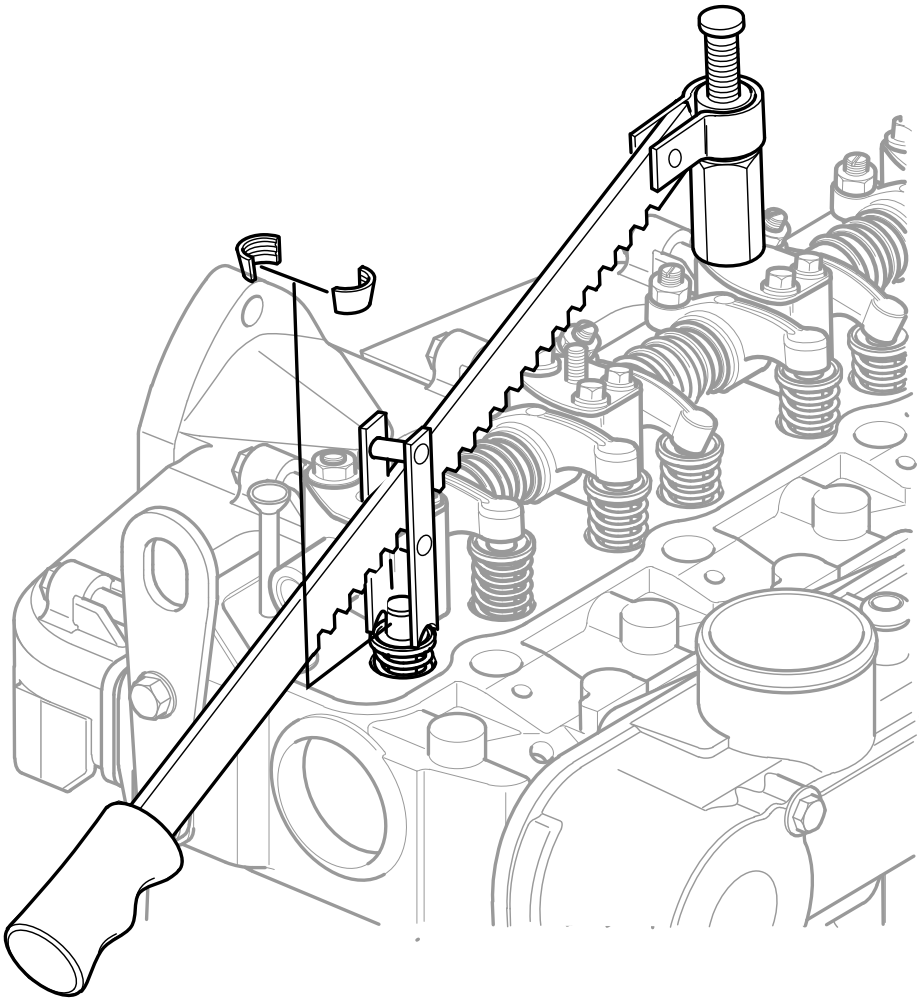
Special tools and notes:
Special tools: Valve spring compressor, part number 21825666
Stud adaptor, part number 27610016

Warning! *Wear eye protection when the valve spring is compressed.*

Caution: *Do not rotate the crankshaft while the valve springs are removed. Ensure that the valve spring is compressed squarely or damage can occur to the valve stem.*

Note: *If other or all of the valve springs are to be changed, they can be changed one cylinder at a time in the sequence of cylinders 1 and 4, 2 and 3.*

Piston must be at T.D.C before removing spring



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Operation:
Exhaust / Induction manifolds and gaskets - to remove and to fit **12.06**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Early setscrews	**22**	**16**	**2,2**
Latest setscrews	**18**	**13**	**1,8**

Service operations:

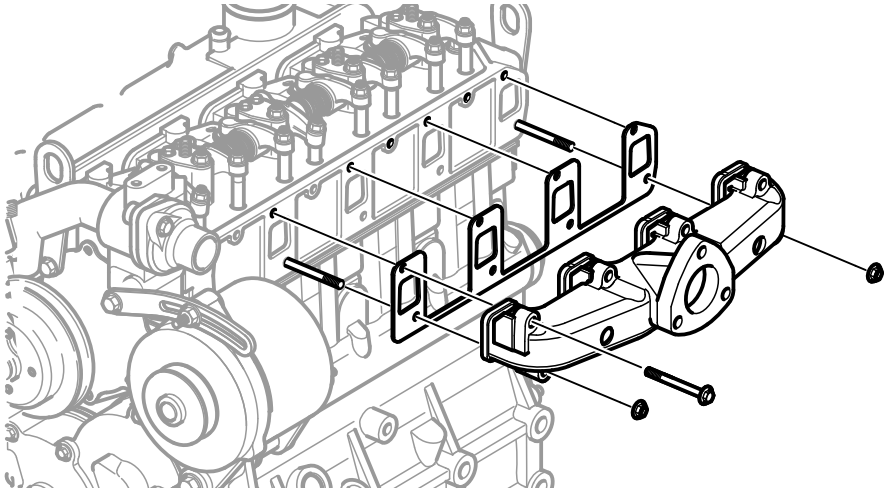
(Turbocharged engines only)
1. Remove crossover pipe … … … **12.01**
2. Remove turbocharger … … … **18.01**

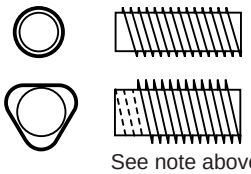
Special notes:

Caution: *Some coolant may enter the cylinder bores and the threaded holes for the cylinder head setscrews when the cylinder head is removed. Ensure that any coolant is removed immediately to prevent corrosion.*

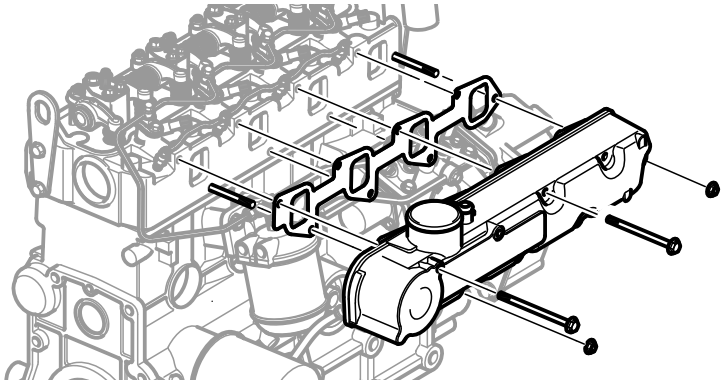
Note: To retain the exhaust manifold, earlier engines were fitted with two studs and six setscrews. If these are found to be loose, remove them and fit the manifold with eight of the latest powerlock setscrews. The threaded part of the new setscrew is machined to a three lobe shape.
The new setscrew was introduced from engine number U#####-801620C.
The threaded part of the old setscrew is the standard shape.

Caution: *If the latest setscrews are fitted instead of the old fasteners, and the bosses on the manifold have been machined, a plain washer, part number 0920003, 1,83 mm (0,072 in) thick must be fitted under the head of each new setscrew. This is to prevent contact of the new setscrew, which is longer, with the bottom of the tapped hole in the cylinder head. If the manifold bosses have not been machined, it is not necessary to use the plain washer.*





See note above.



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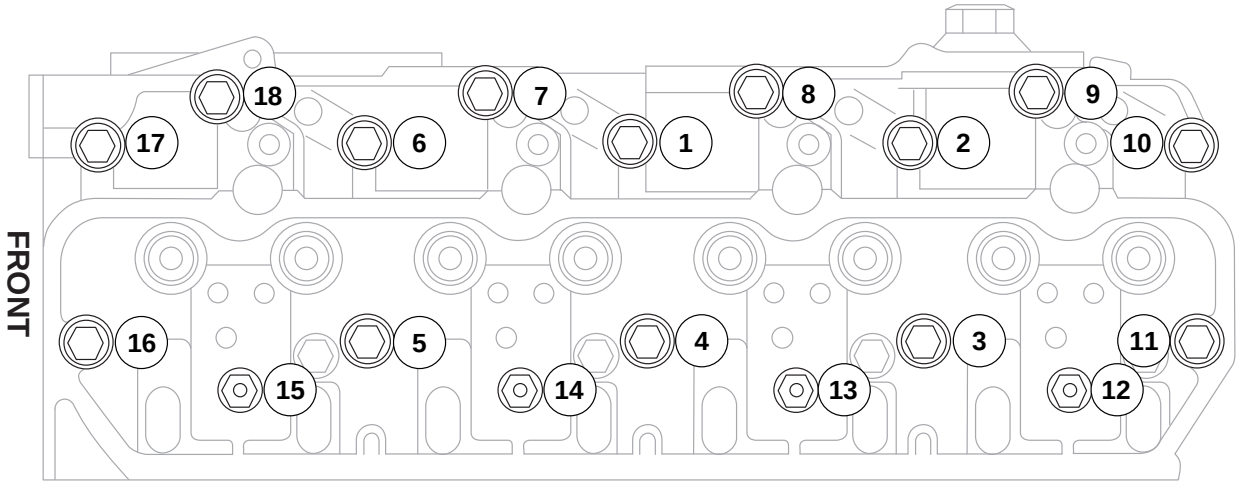
Operation:
Cylinder head setscrews - to remove and to fit **12.07**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
All variants			
1st torque	**70**	**52**	**7,1**
2nd torque	**100**	**74**	**10,2**

Special notes:
Tighten and recheck torque.
Release the setscrews in reverse of the sequence shown.

Note: Lubricate threads and under flange of the setscrews.



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Operation:
Cylinder head gasket - to remove and to fit **12.08**

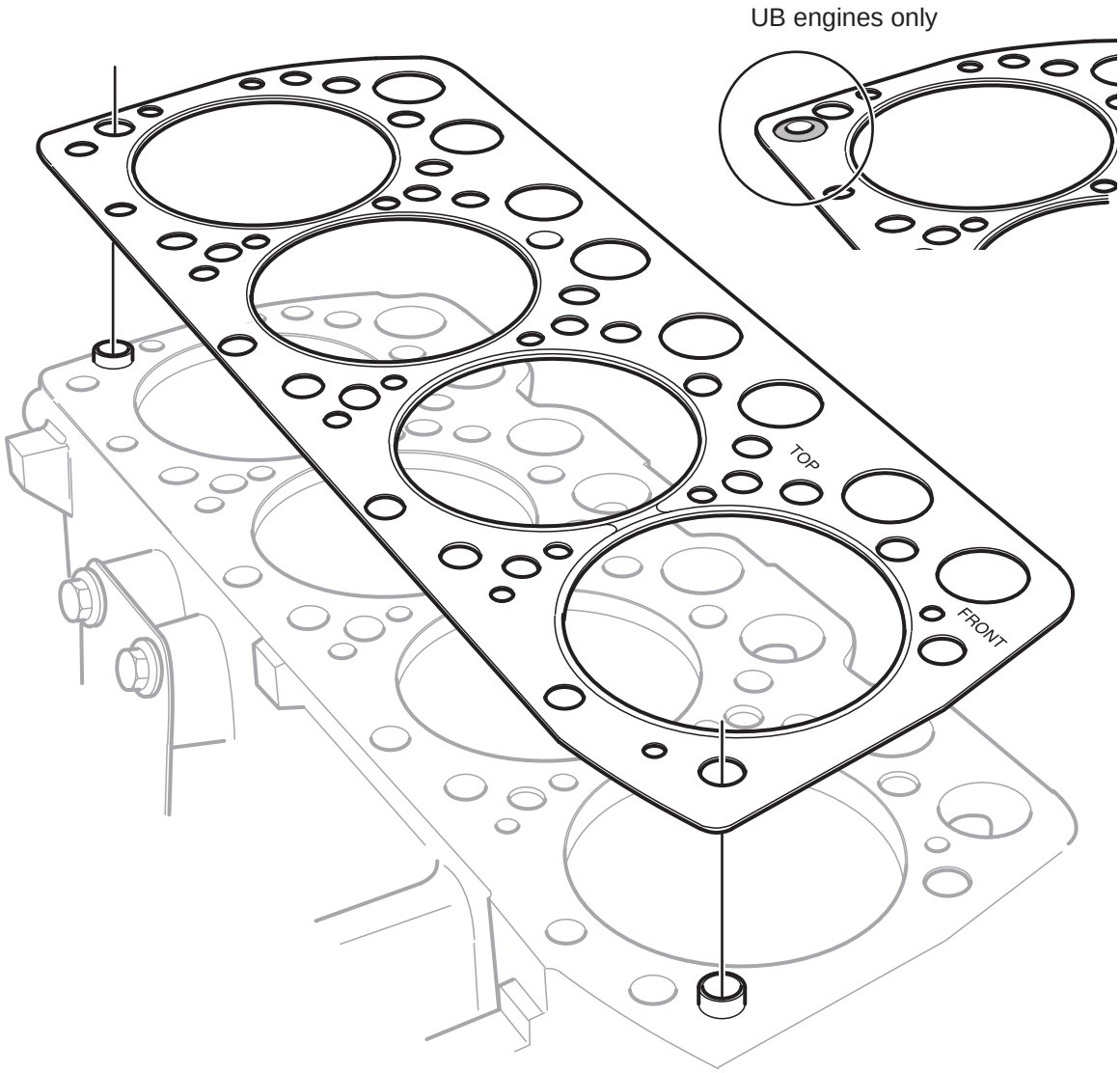
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes:

Note: Two dowels are fitted to the cylinder block to ensure that the cylinder head gasket and the cylinder head remain in the correct position when the setscrews are tightened.

Cautions: *There is a rubber grommet fitted in the cylinder head gasket for UB engines. To prevent damage to the cylinder head gasket, ensure that the dowels are fitted in the cylinder block before the gasket and head are fitted. Jointing compound must not be used with the cylinder head gasket.*



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Operation:
Valve and valve springs - to remove and to fit **12.09**

Recommended torque:

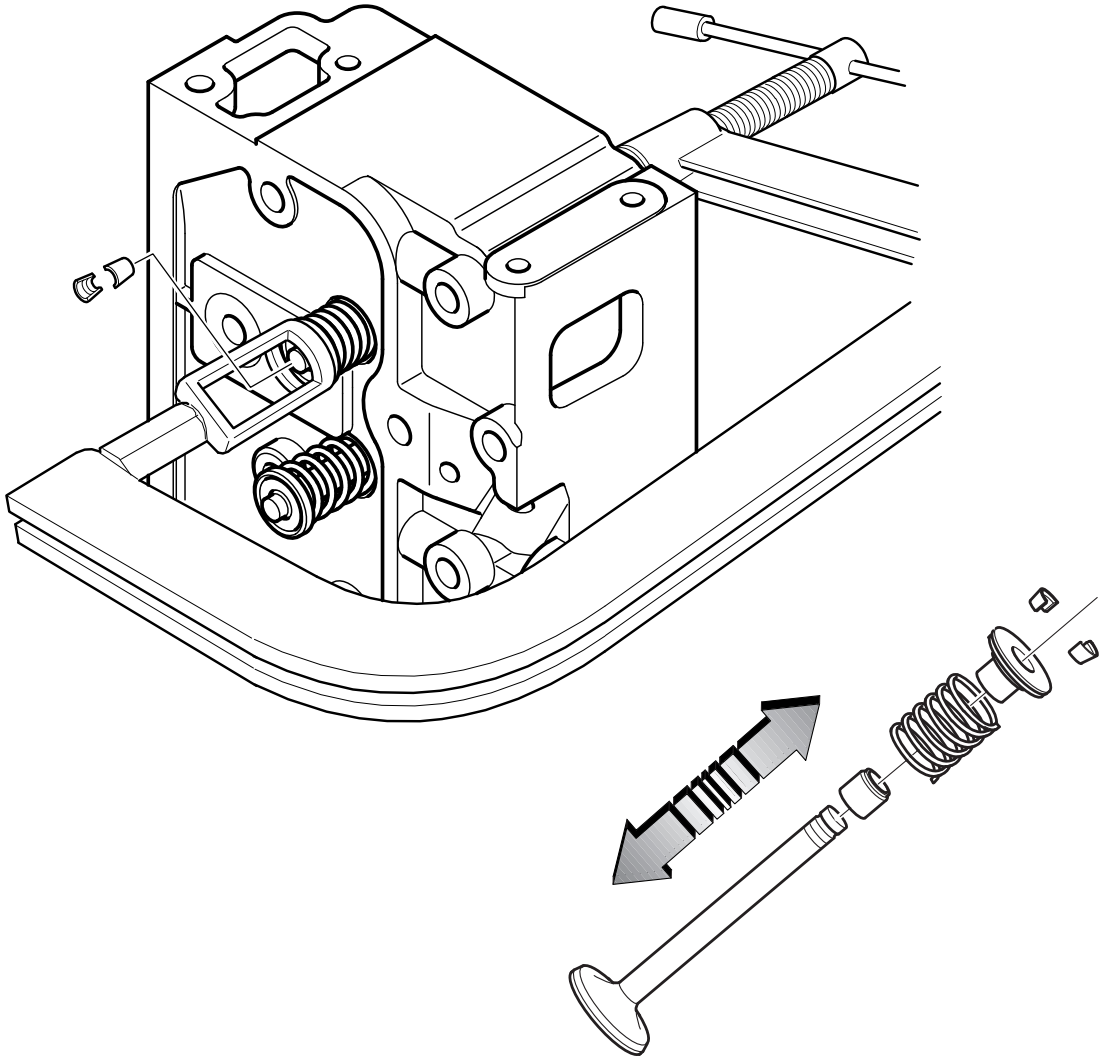
Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:

Special tools: Valve spring compressor, 27610020

Warning! *Wear eye protection during this operation.*

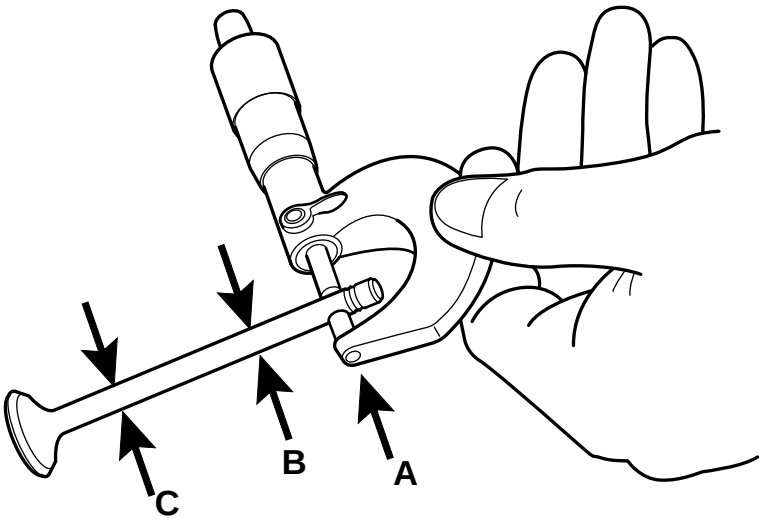
Caution: *Ensure that the valve springs are compressed squarely or the valve stem can be damaged.*
Genuine valve stem seals must be used. If they are not, damage can occur to the valve stems and valve seats.



Visually inspect the valve springs for damage. To check that the load on the valve springs is correct at their fitted length, see data and dimensions in section 11. Fit new valve springs at every complete engine overhaul.

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Operation: **Valve stem - to inspect**	**12.10**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** -	**Special notes and tools:** **Special tools:** Micrometer ***Warning!*** *Wear eye protection during this operation.* ***Caution:*** *Ensure that the valve springs are compressed squarely or the valve stem can be damaged.* *Genuine valve stem seals must be used. If they are not, damage can occur to the valve stems and valve seats.*

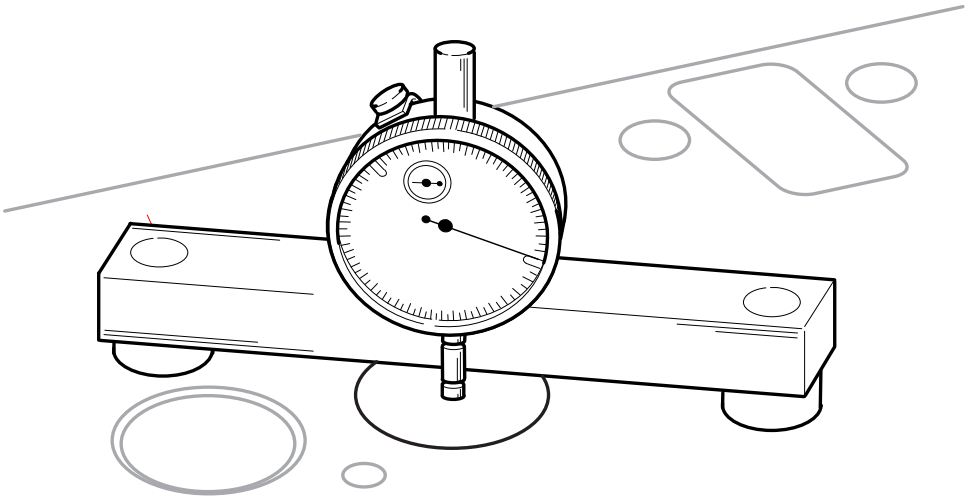


Check the valve stem for excessive wear or damage. If found to be excessively worn or damaged, renew.
Check valve stem diameters at positions A, B and C with a micrometer. If the diameter is less than the standard minimum diameter, renew.

INLET VALVE	**EXHAUST** VALVE
Standard diameter	Standard diameter
6,970-6,985 mm (0.2704-0.2750 in)	6,945-6,960 mm (0.2734-0.2740 in)

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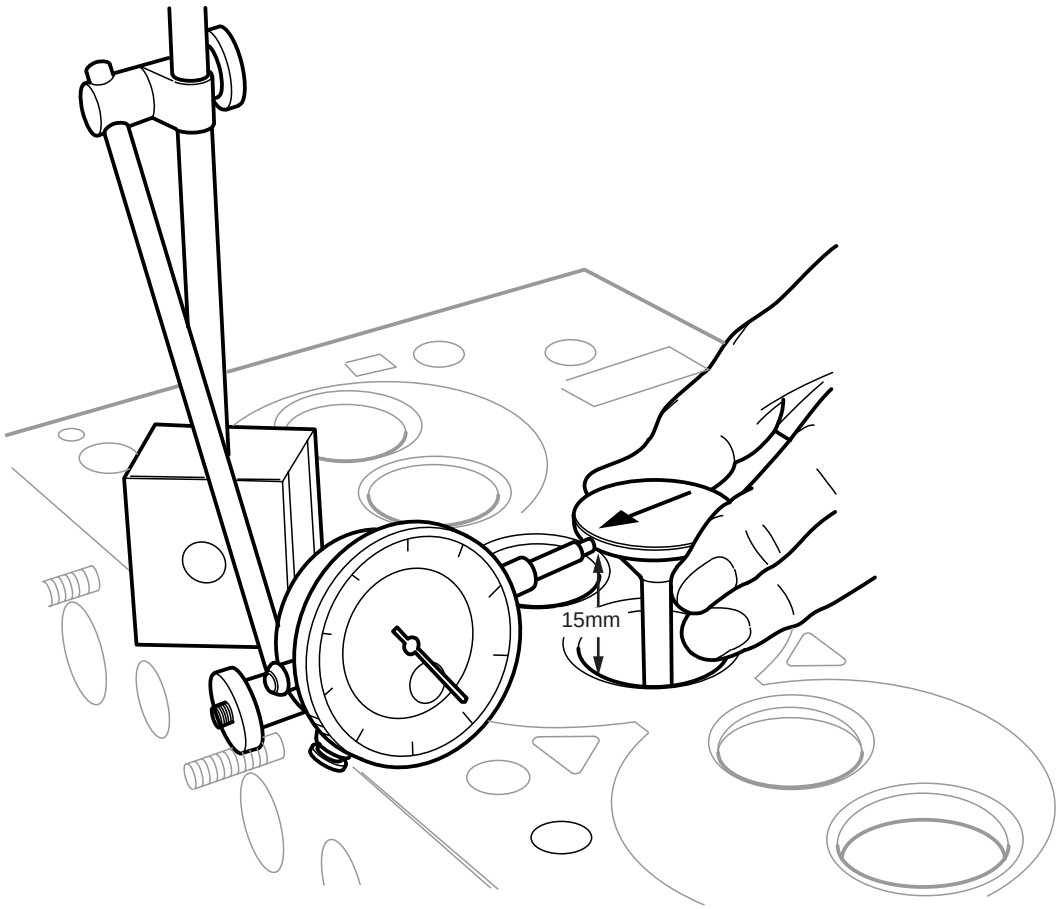
Operation: **Valve depth - to check**	**12.11**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** -	**Special tools:** Gauge, valve depth, part number 21825496. Dial gauge, part number 21825617, for use with gauge, valve depth.



For valve depth specifications see data and dimensions in section 11.

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Operation: **Valve guides - to check**	**12.12**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** -	**Special notes and tools:** **Special tools:** Dial test indicator. **Note:** A new valve must be used to check guide.



Note: There must be a valve lift of 15 mm
Check the clearance between the valve and valve guide. If the clearance exceeds the service limit, renew valve guide.

INLET VALVE	**EXHAUST** VALVE
Maximum permissible clearance	Maximum permissible clearance
0,24mm (0.009in)	0,28mm (0.011in)

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Operation:
Valve guides - to remove and to fit **12.13**

Recommended torque:

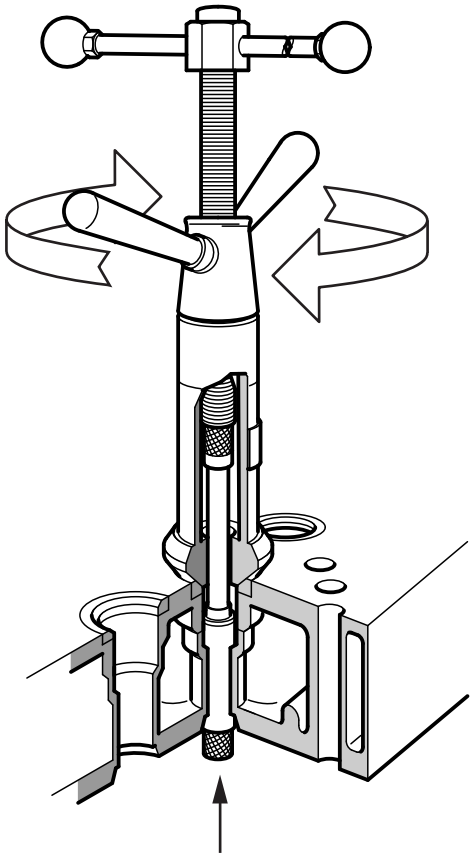
Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:

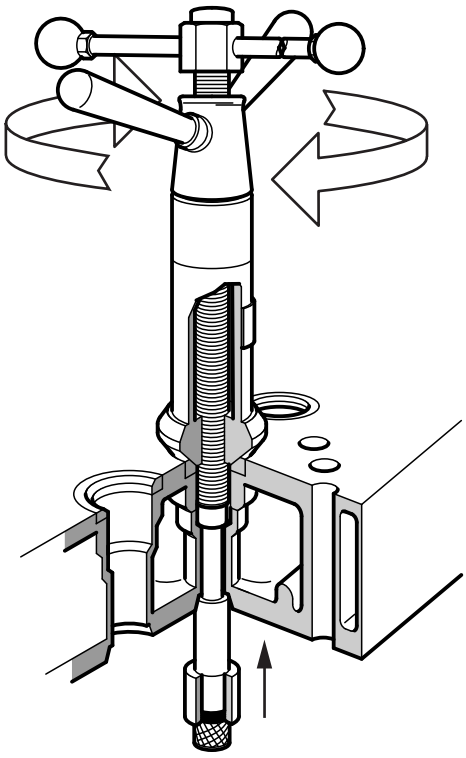
Special tools: Remover /replacer for valve guides(main tool),
Part no 21825478
Spacer, Part no 21825480
Adaptor (replacer), Part no 27610017
Adaptor (remover), Part no 27610019

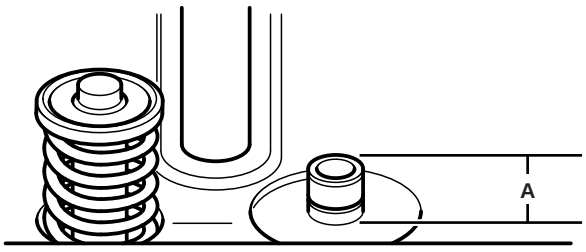
Note: The internal recess in the valve guide must be towards the tool.

To Remove



To Fit / Replace



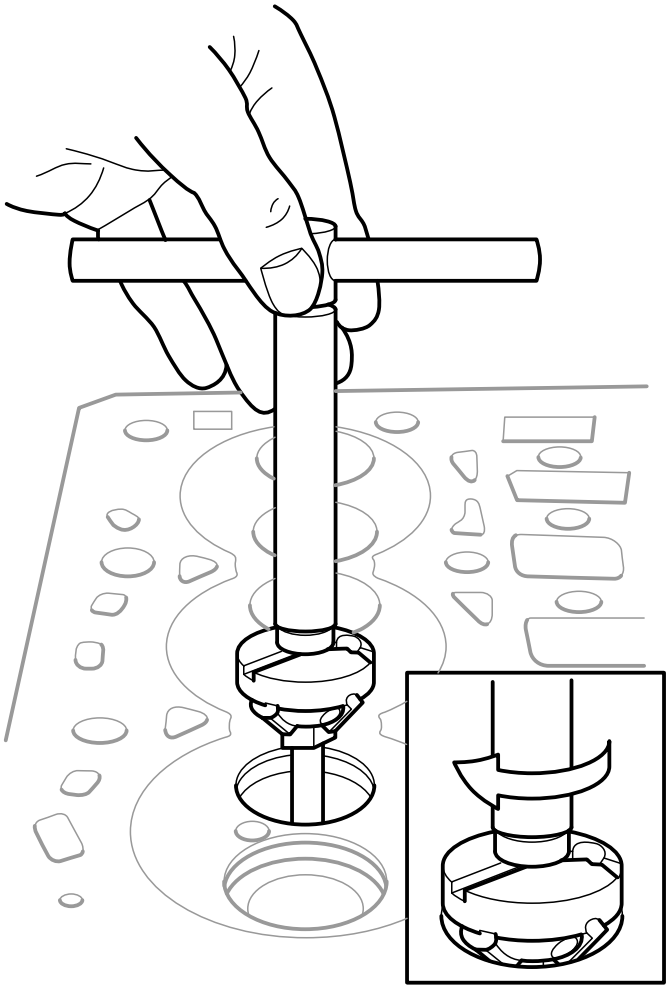


A: Valve guide protrusion

7,7 / 7,9mm (0.30/0.31in)

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Operation: **Valve seats - to correct**	**12.14**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** - - -	**Special notes:** **Special tools:** Valve seat cutting tool - kit, part number 21825938 **Note:** If a valve seat has become too damaged or too worn to correct, a valve seat insert can be fitted, operation 12.15.



1. Fit the pilot in the valve guide and tighten the pilot.
2. Select the relevant cutter. Set the blades of the cutters to the diameter of the valve seat to be cut. Fit the cutter on the pilot and fit the handle. Ensure that the cutter is not allowed to fall on to the seat as this can damage the blades.
3. Carefully rotate the cutter in a clockwise direction . Remove only the minimum material to ensure a good seat. Keep the seat as narrow as possible.
4. When the seat is cut, remove the cutter and the pilot. Remove any debris from the area of the valve seat and the port.
5. Fit the valve and lightly lap the valve and the seat.
6. Check that the valve depth is within limits, see Data and dimensions in **section 11**.

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Operation: **Valve seat insert - to fit**	**12.15**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			
-			
-			

Special notes:

Caution: *A new valve guide must be fitted to the cylinder head before a new valve seat insert is fitted. This is necessary to maintain concentricity between the valve guide and the seat for the valve.*

Note: Cylinder heads that are fitted with new valve seat inserts and new valve guides (pre-finished) are available.

1. Remove the valve guide and clean the bore into which the guide is to be fitted.
2. Fit new valve guides, operation **12.13**.
3. With the bore of the new valve guide used as a pilot, machine out the old valve seat insert. Remove all debris and clean the recess for the insert.

Caution: *If the bottom face of the cylinder head has been machined, the depth of the recess for the valve seat may have changed.*

4. Measure the depth of the recess in two places 90° apart. The correct depths are:
- UA and UC engines: 8,35/8,55 mm (0.329/0.337 in)
- UB engines: 8,20/8,40 mm (0.320/0.330 in)

5. If the depth of the recess has been reduced, surface grind the bottom face of the insert by an equivalent amount. Check the depth of the insert and ensure that it is fitted correctly.
6. If the insert has been surface ground, ensure that the outer edge of the back face of the insert has a 0,7/1,2 mm (0.03/0.05 in) chamfer at 29° /31°, to the vertical.
7. With the bore of the valve guide used as a pilot, and with the rear face of the insert towards the cylinder head, press the insert into the recess with the valve seat insert tool, see Data and dimensions.

Caution: *Do not use a hammer or use lubrication to fit the insert. Use a hydraulic press or a hand press in one continuous movement.*

8. Ensure that when fitted, the bottom face of the insert is in contact with the bottom of the recess in the cylinder head. When fitted correctly, the depth of the insert, below the bottom face of the cylinder head should be:
- UA and UC engines: 2,15/2,45 mm (0.085/0.096 in)
- UB engines: 2,4/2,7 mm (0.09/0.11 in)

The depth of the insert should be measured in two places, at 90° to each other.
9. Cut the valve seat at 45° (an included angle of 90°) for all valves, operation **12.14**.
Ensure that the depth of the valve head below the face of the cylinder head is within the production limits, see data and dimensions. Work as near as possible to the minimum figure to allow for future wear on the valve seat.

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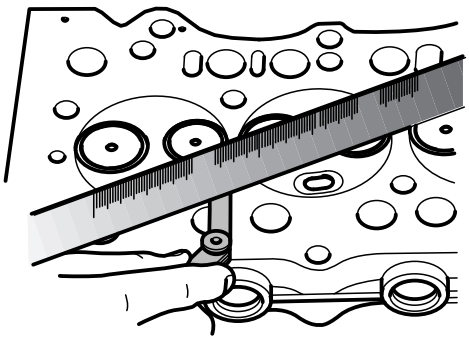
Operation:
Cylinder head - to check the distortion of the lower face **12.16**

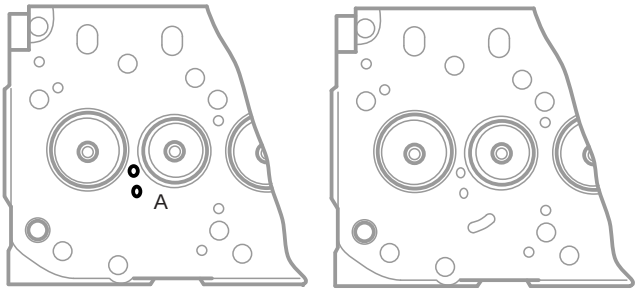
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			
-			
-			

Special tools:
Straight edge and feeler gauge.

Caution: *The bottom face of the cylinder head for the UB engine should not be machined. If it is, the edge of the pre-combustion chamber will be too thin and could break off during the combustion process. If the bottom face of the cylinder head is damaged or the distortion exceeds the service limits, the cylinder head assembly must be renewed.*





1. Inspect the cylinder head for signs of gas or coolant leakage.
2. Remove the valve springs and the valves, operation **12.09**.
3. Clean the face of the cylinder head and the passages for coolant and for lubricating oil.
4. Test the cylinder head for leaks at the pressure given in Data and dimensions.
5. When the cylinder head is thoroughly clean, check it for cracks. Check carefully the areas around the valve seats, the holes for the atomiser nozzles and glow plugs **(A)**, and the port in the pre-combustion chambers. If there are cracks in these areas, the cylinder head assembly should be renewed.
6. The bottom face of the cylinder head for only UA and UC engines can be machined if, there is distortion, deep scratches or the valve depths are below the service limit.
7. Use a straight edge and feeler gauges to check the cylinder head for distortion as shown in Data and dimensions.
8. Check the valve seats for wear and for damage.
9. Where there is little damage, the valve and valve seat can be lapped. When the valve seats are lapped, keep the seat as narrow as possible and ensure that all the compound used to lap the valve and the seat is removed.
10. More badly damaged valve seats can be corrected by use of the cutter tool, operation 12.14, or new inserts can be fitted, operation 12.15.

Cautions:
If the cylinder head of a UA or a UC engine has been machined, the maximum nozzle protrusion must not exceed 2,7 mm (0.11 in), when measured with the nozzle seat washer fitted.
If the cylinder head has been machined, check the depth of each valve head, below the bottom face of the cylinder head. If necessary, cut the valve seat to obtain the correct dimension, see Data and dimensions. It is better to work to the minimum limit to allow for later wear.
Before any work is done on the valve seats, new valve guides must be fitted, operation ***12.13.***

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Operation:
Big end bearing and cap - to remove and to fit **13.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Big end bolts	54	40	5,5

Service operations:

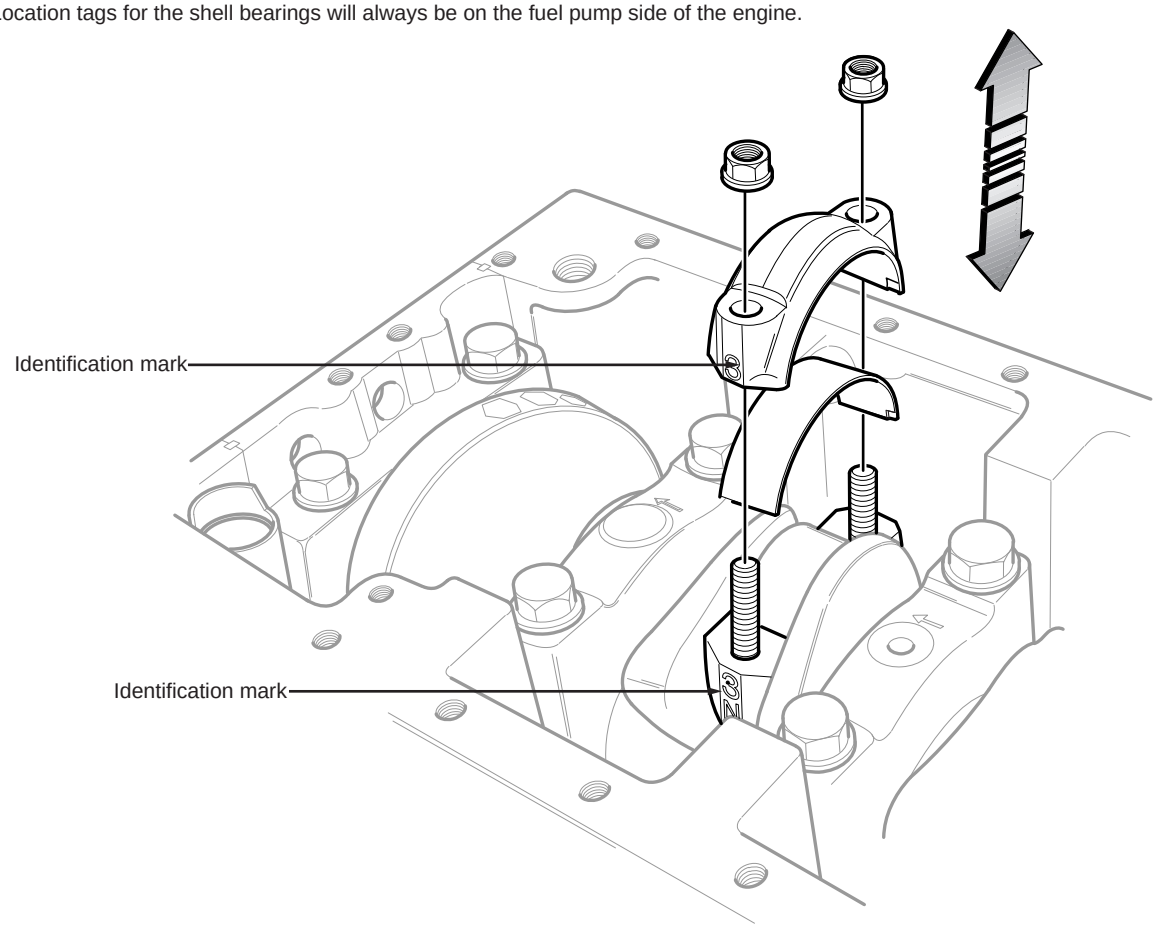
1. Remove sump … … … … … … **19.03**
2. Remove strainer pipe … … … … **19.04**

Special notes:

Identify connecting rod to cylinders and piston when dismantled.
Ensure that when the rods are fitted an axial play is provided.

Cautions: *The big-end bolts are fitted to the connecting rod by a special process and must not be removed. If the bolts are removed, the connecting rod, and the bolts will be damaged.*
Ensure that the bolts for the connecting rod do not damage the crank pin when the connecting rod is removed or fitted. If necessary, fit a temporary plastic sleeve to the big-end bolts.
The pistons and connecting rods are matched to the relevant cylinder. Note the position of each connecting rod and piston for correct assembly.

Notes on connecting rods:
The cylinder number is engraved on the left side of the connecting rod and cap.
The letter that indicates the length grade for the connecting rod is also engraved on the left side. Some early engines had the length grade engraved on the right side of the connecting rod and cap.
The letter which is engraved on the right side of the connecting rod is the manufacturer's reference number.
The part number shown on the connecting rod should always be towards the front of the engine.
Location tags for the shell bearings will always be on the fuel pump side of the engine.



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Operation:
Piston and connecting rod - to dismantle and assemble **13.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

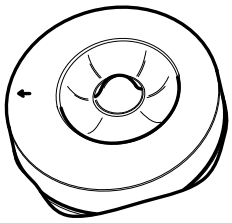
Service operations:

1. Remove cylinder head … … **section12**
2. Remove big end bearing bolts… **13.01**

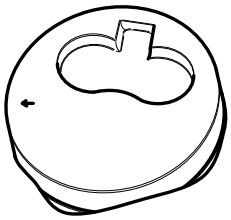
Special notes:

Caution: *The big-end bolts are fitted to the connecting rod by a special process and must not be removed. If the bolts are removed, the connecting rod, and the bolts will be damaged.*

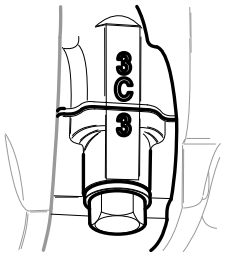
Note: The pistons and connecting rods are matched to the relevant cylinder. Note the position of each connecting rod and piston for correct assembly.



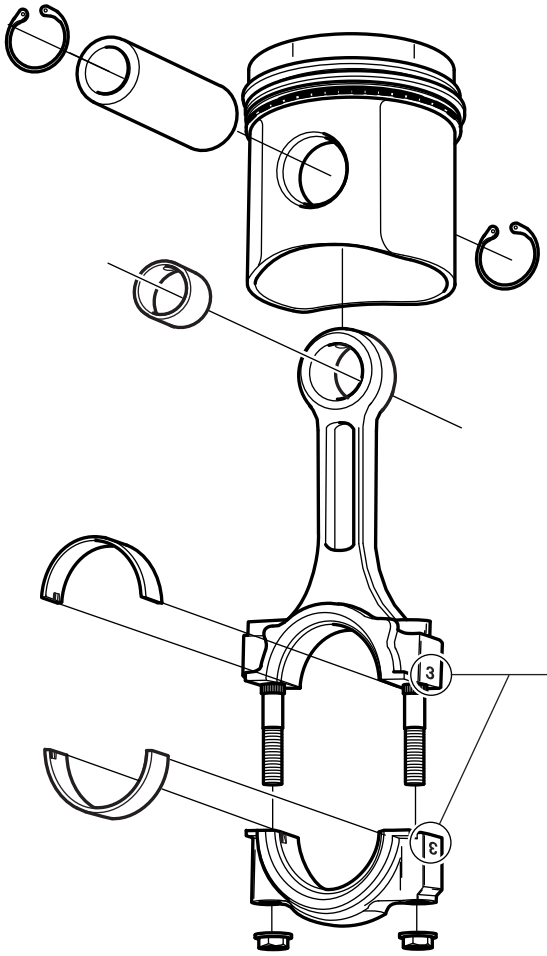
UA &UC Engines



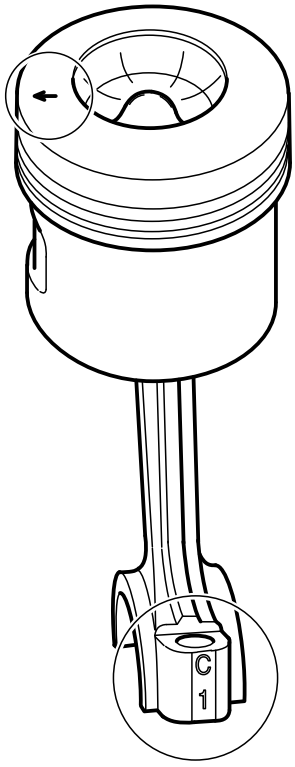
UB Engines



View A



Align matching numbers
View A



Orientation of piston and connecting rod

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Operation:
Piston and piston ring - inspection **13.03**

Recommended torque:

Engine type	Nm	lbf ft	kgf m

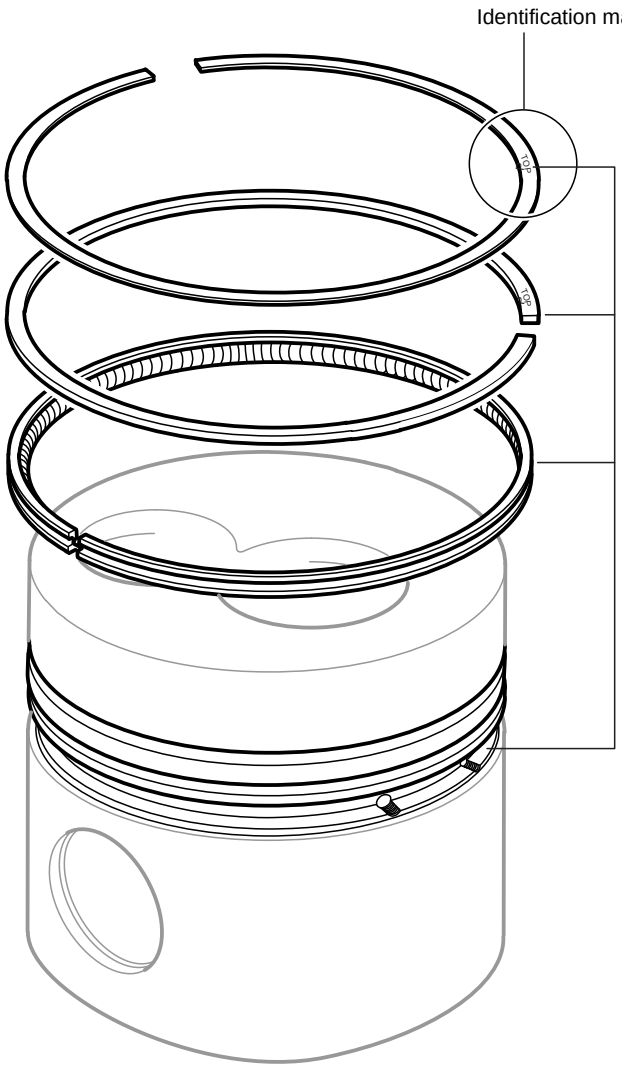
Service operations:

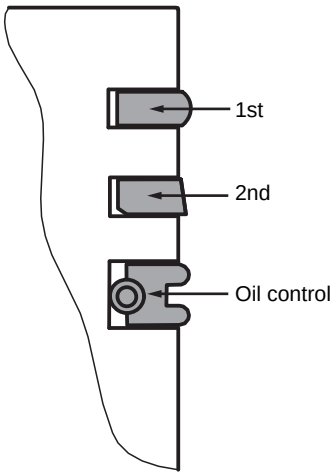
1. Remove piston assembly … … … **13.02**

Special notes:

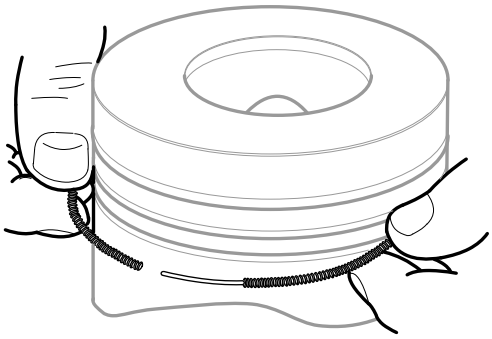
Any letters or markings on a surface of a ring will always be on the top face (facing upwards).

Caution: *Only expand the ring gaps enough to ensure that the ends of the rings do not damage the piston when the ring is removed or put into position. Fit the spring of the oil control ring in the bottom groove of the piston, with the latch pin inside both ends of the spring. Fit the oil control ring over the spring. Ensure that the ring gap is at 180° to the latch pin. The manufacturer's symbol or the word 'TOP', must be towards the top of the piston.*



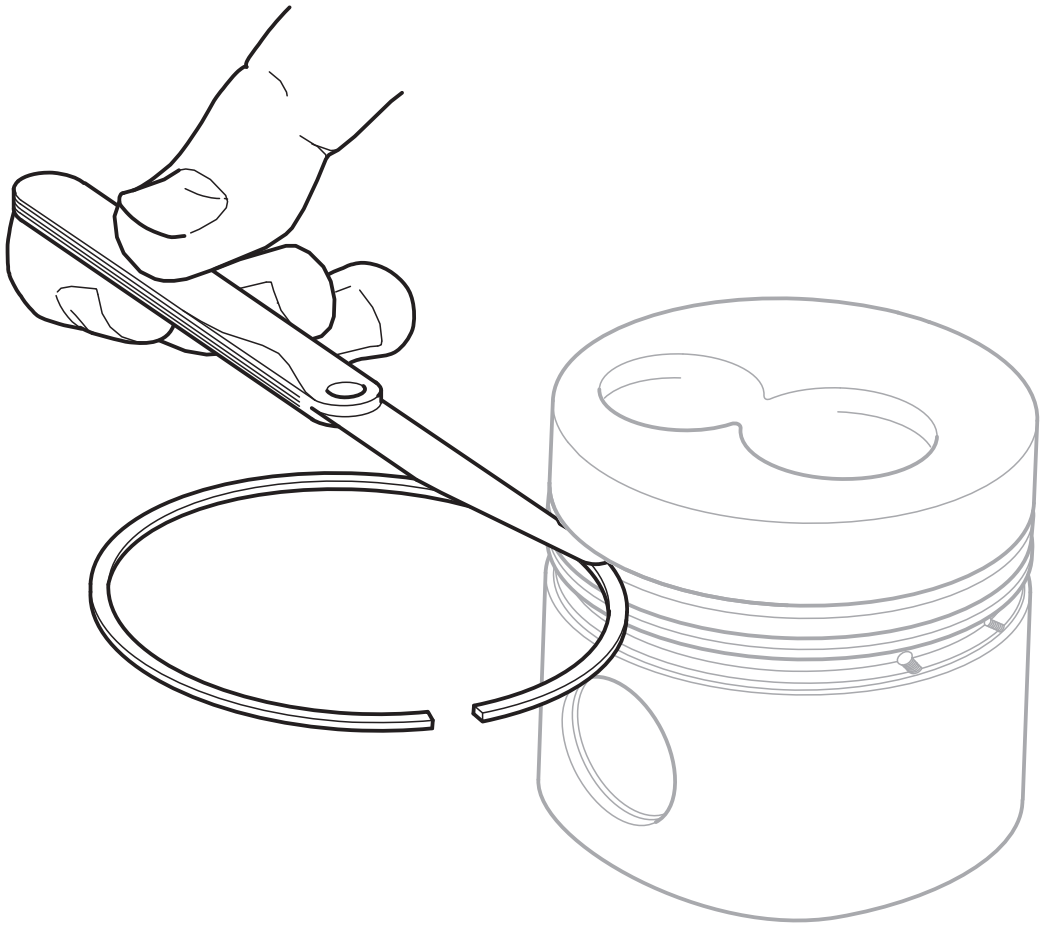


Profile of piston rings



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Operation: **Piston and piston ring - to inspect**	**13.04**
Recommended torque: **Engine type Nm lbf ft kgf m** - **Service operations:** 1. Remove piston rings … … … … **13.03**	**Special tools:** Feeler gauge.



Fit new piston rings in the grooves in the piston and check for wear of the grooves with feeler gauges. Compare the piston ring clearance in the groove to that given for new components in Data and dimensions. Renew the piston, if the grooves are worn too much.

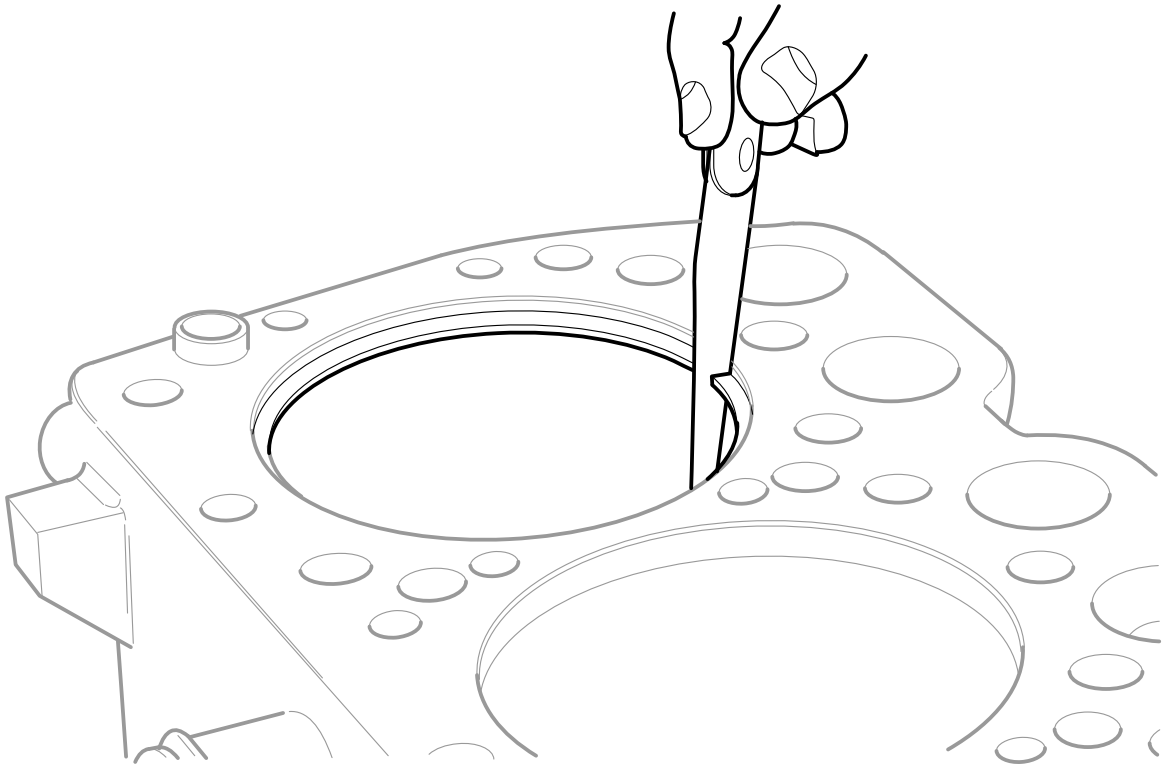
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Operation: **Piston and piston ring - to inspect**	**13.04**
Recommended torque: **Engine type Nm lbf ft kgf m** - **Service operations:** 1. Remove piston assembly … … **13.02**	**Special tools:** Feeler gauge.



Piston ring
If the piston ring is worn or damaged, renew it.
Piston ring gap: Clean all carbon from the top of the cylinder bores. Fit each of the piston rings in the top unworn part of the cylinder bore and measure the ring gap with feeler gauges. If the gap exceeds the limit, renew the piston ring

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Operation:
Piston and connecting rod - to fit **13.05**

Recommended torque:

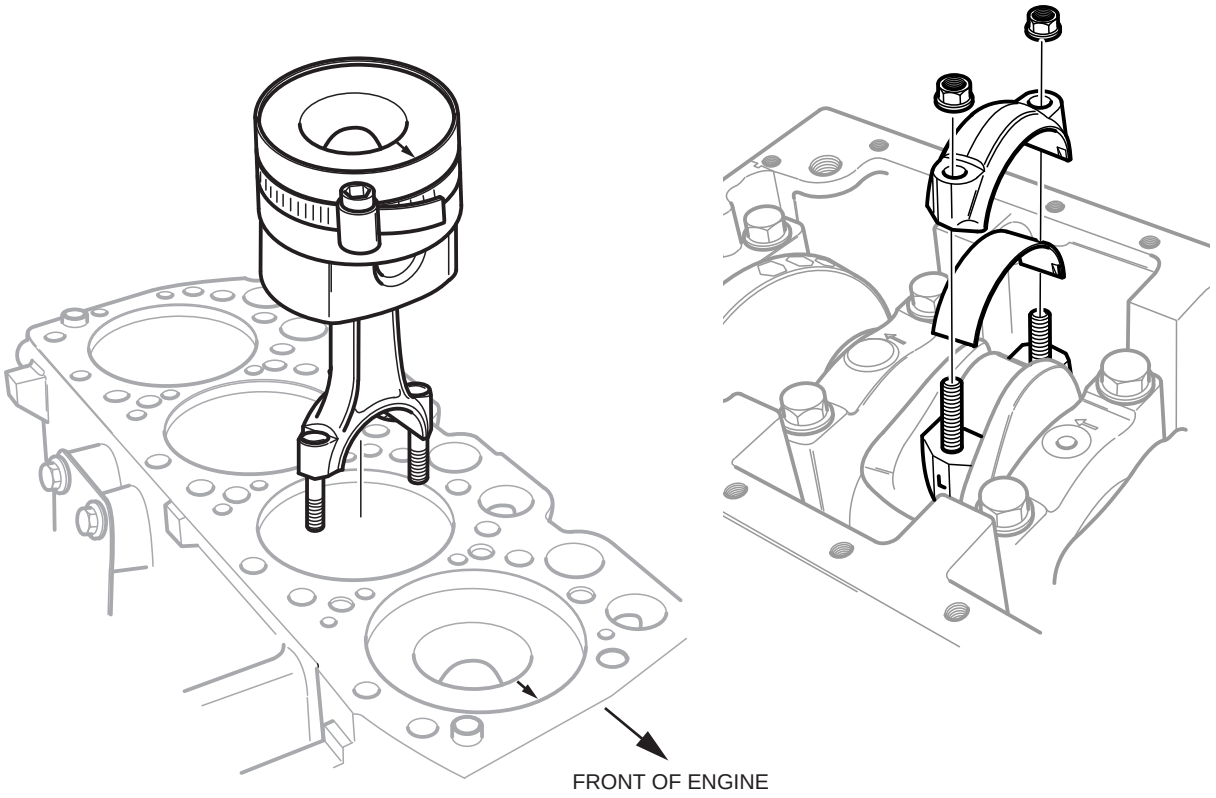
Engine type	Nm	lbf ft	kgf m
All variants			
Big end bolts	**54**	**40**	**5,5**

Special Notes and tools:

Piston ring compressor.

Caution: *The correct piston height must be maintained in service to prevent damage to the pistons and valves, and ensure that the engine conforms to emissions legislation.*
Ensure that the bolts for the connecting rod do not damage the crank pin when the connecting rod is removed or fitted. If necessary, fit a temporary plastic sleeve to the big-end bolts.
Ensure that the piston and connecting rod assembly is fitted to the same cylinder bore from which it was removed.
On UC engines, ensure that the connecting rod does not contact the piston cooling jet.

Note: Rotate the crankshaft counter-clockwise to ensure that the shell bearing in the big-end remains in position.
Arrows on piston crown must face front of the engine.



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Operation:
Connecting rod - to check for bend and to inspect **13.06**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

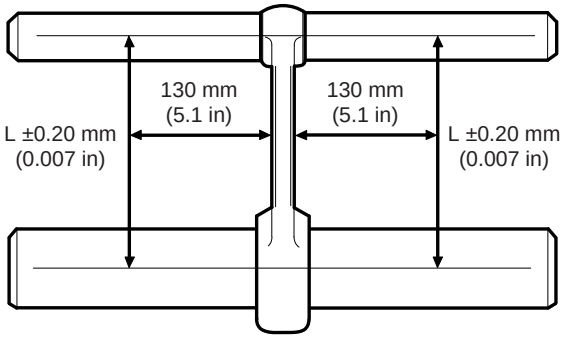
Service operations:

1. Remove piston assembly … … **13.02**
2. Refit piston assembly … … … … **13.06**

Special notes:

Caution: *Do not use a letter stamp to mark the connecting rod. The new letter must be engraved onto the big-end of the connecting rod.*
If the original piston is used, ensure that it is assembled to the correct connecting rod and is used in the original cylinder.
The top of the piston must not be machined to obtain the correct height.

Note: The large and small end bores must be square and parallel with each other within the limits of +/- 0,20 mm (0.0007 in) measured 130 mm (5.1 in) each side of the connecting rod axis on a test mandrel. See A.



A To check the connecting rod for bend

In service, initially, three pistons of different heights (High, Nominal and Low) were supplied and one connecting rod. The connecting rod was identified by an 'X' engraved onto the side of the big-end. The small end bush was machined concentrically. This was later changed to three connecting rod lengths and one piston height.
The crown of the piston is marked “std”. The small end bush is machined eccentrically. A concentric small end bush, part number 3112E008 can be obtained, which can be fitted to the original connecting rod and then machined to obtain the correct length grade, refer to operation **13.10.**
Connecting rod kits are also available with the small end bush fitted and machined to obtain the correct connecting rod grade, refer to the table below.

Production grade letters	Service grade letters	Kit numbers
A and B	B (High)	ZZ0193
C and D	D (Nominal)	ZZ0194
E and F	F (Low)	ZZ0195

Pistons with a larger diameter are also supplied, to be fitted if the cylinder bores are bored oversize. The single height grade also applies to service pistons that are oversize on diameter. See Data and dimensions in section 11.
The piston height above the top face of the cylinder block will still be 0,38/0,51 mm (0.015/0.020 in).
Note: Always use the full engine number to order new parts.
In the factory, the correct piston height is obtained by the use of six length grades of connecting rod and one piston height grade. The small end bush is machined eccentrically to obtain the different connecting rod lengths.
The correct piston height is important to ensure that the piston does not contact the cylinder head and to ensure the efficient combustion of the fuel.
If the crankshaft or the cylinder block is to be renewed, it may be necessary to change the grade of the connecting rods. This will occur if the correct piston height above the top face of the cylinder block cannot be maintained with the original connecting rod assemblies.
Check the length grade of the original connecting rod, operation **13-08.**

Note: If it is necessary, fit a new small end bush,operation **13-09**.
Check the piston height above the cylinder block, operation **13-10**.

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Connecting Rod Assembly

Operation:
Connecting rod - to check the length and to inspect **13.07**

Recommended torque:

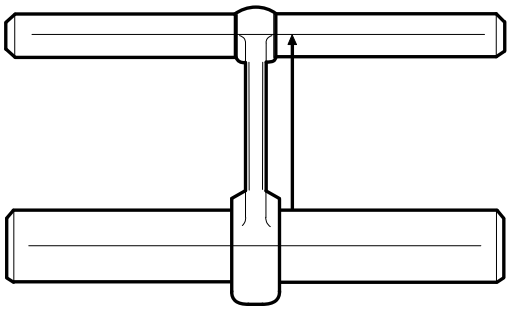
Engine type	Nm	lbf ft	kgf m
-			

Service operations:

1. Remove piston assembly … … **13.02**
2. Connecting rod to check for bend … … … … … … … … … **13.07**

Special notes:

Caution: *The big-end bolts are fitted to the connecting rod by a special process and must not be removed.*
As the connecting rod, and the bolts will be damaged.
It is important that the piston does not contact the cylinder head.
Ensure that the piston height above the cylinder block is correct.
Ensure that the connecting rods are fitted in the correct cylinder.
Record the position of the connecting rod and its relevant cylinder when it is removed from the engine.



If the grade letter on the connecting rod cannot be seen, the length can be checked by the measurement of the dimension on each side of the connecting rod. Measure as close as possible to the connecting rod. Calculate the average of the two measurements to find the length of the connecting rod. Before the length of the connecting rod is measured, ensure that the bores of the big-end and the small-end are square and parallel, operation **13.07**.
The length is checked with the big-end bearing removed and the original small-end bush fitted.

A concentric small end bush, which can be fitted to the original connecting rod and machined to obtain the correct length grade is available. Specialist equipment and personnel with the correct training are needed to machine the partially finished small end bush.
Connecting rod kits are also available with the small end bush fitted and machined to give the correct connecting rod grade.
To ensure that the piston height above the cylinder block is correct, the engine may have up to three length grades (B, D and F) of connecting rods fitted.
Identification of the length grade is by a letter, which is marked on the left side of each connecting rod.
The cylinder number is marked on the left side of the connecting rod and cap. The letter B is the longest grade of connecting rod and letter F is the shortest grade. The difference between each grade is 0,06mm (0.002 in). The letter which is marked on the right side of the connecting rod is the manufacturer's reference number.

The dimensions for the service grades are listed in the table below

Production grade letters	Service grade letters	Length (mm)
A and B	B	132,05/132,08
C and D	D	131,99/132,02
E and F	F	131,93/131,96

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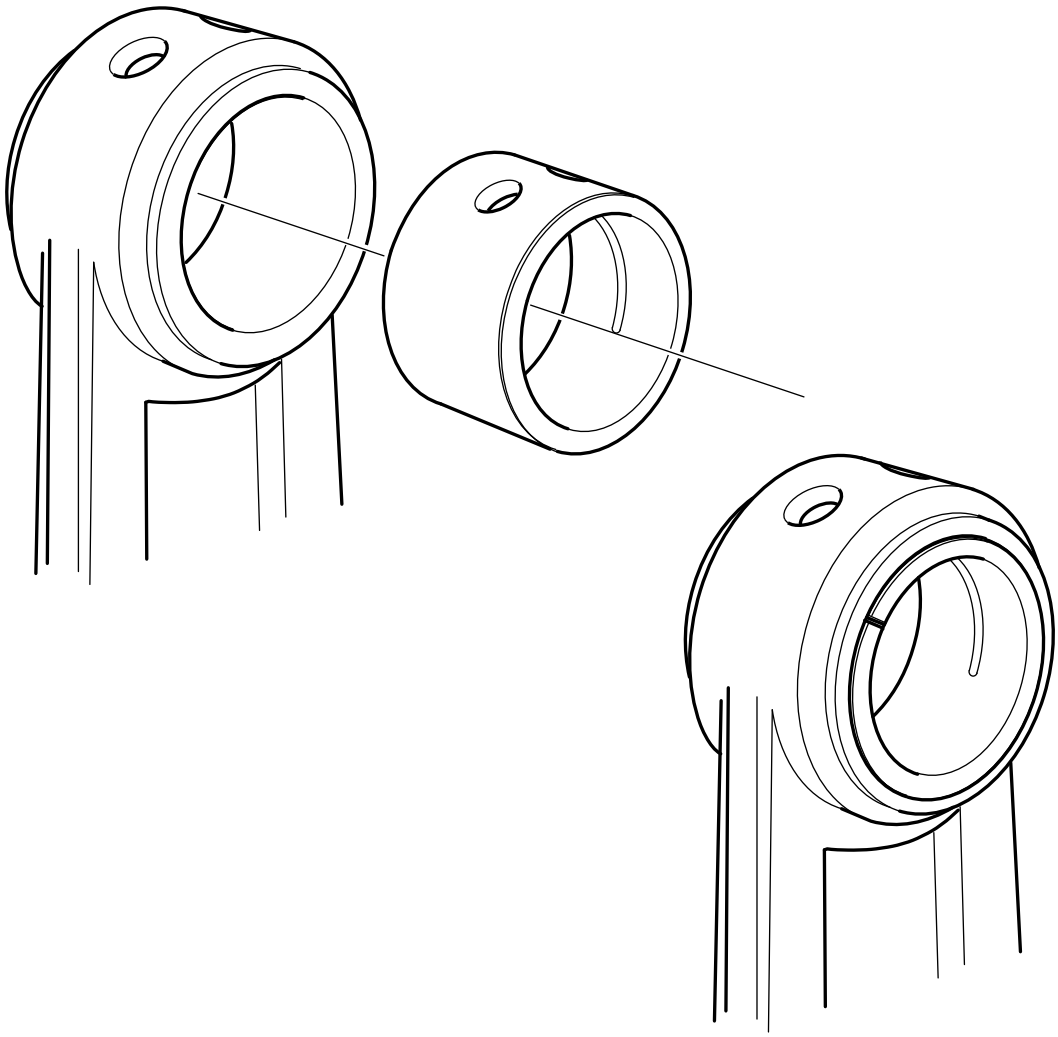
Operation:
Small end bush - to remove and to fit **13.08**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove piston assembly … … **13.02**

Special notes:
Caution: *Do not use a reamer, specialist equipment and personnel with the correct training are needed to machine the partially finished small end bush.*
For further information refer to the Technical Service Department, Perkins Engines, Peterborough, England.
Do not use a letter stamp to mark the connecting rod. The new letter must be engraved onto the big-end of the connecting rod.



Clean the parent bore of the connecting rod and remove any sharp edges.
Press in the service bush, part number 3112E008.
Ensure that the lubrication hole in the bush is on the same side as, and is aligned with, the hole in the top of the connecting rod.
Machine the bush. To obtain the correct connecting rod grade, refer to operation **13.07**. The surface finish of the bush is RA 0,8 micro-meters, all other dimensions are in the workshop manual.

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Operation:
To check the piston height above the cylinder block **13.09**

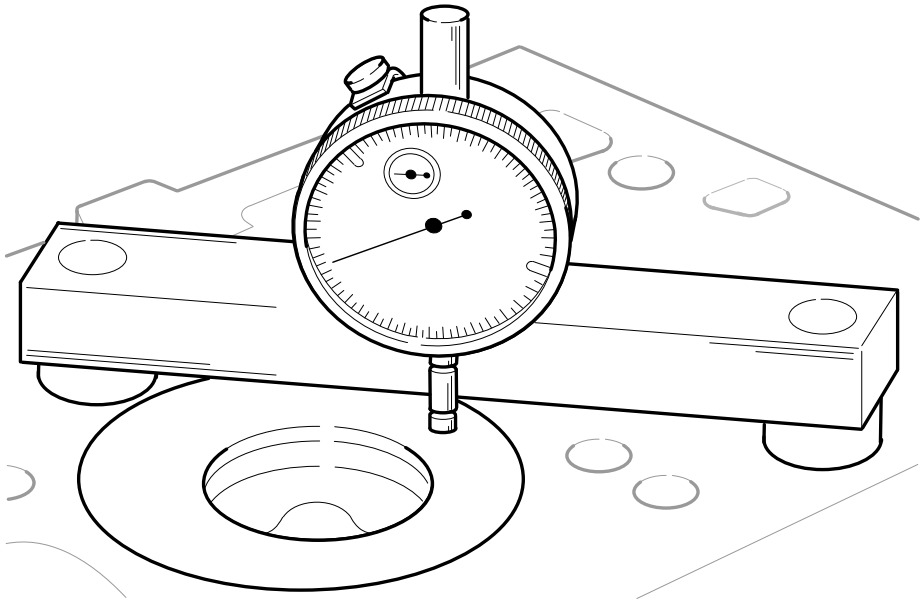
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove piston assembly… … **section 12**

Special notes and tools:
Piston height tool, part number 21825496
Dial gauge, part number 21825617 for use with the piston height tool

Caution: *The correct piston height must be maintained in service to prevent damage to the pistons and valves and ensure that the engine conforms to emissions legislation.*



1. Put the piston height tool on the face of the cylinder block and rotate the dial of the gauge to the zero position.
2. Rotate the crankshaft until the piston is just before top dead centre (TDC).
3. Carefully put the tool over the top of the piston with the plunger of the gauge in contact with the piston above the axis of the gudgeon pin. Rotate the crankshaft to ensure that the piston is at the highest position and make a note of the gauge indication. The piston height above the top face of the cylinder block should be 0,38/0,51 mm (0.015/0.020in).

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Operation:
Piston cooling jets (UC engines) - to remove and to fit and to align **13.10**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:

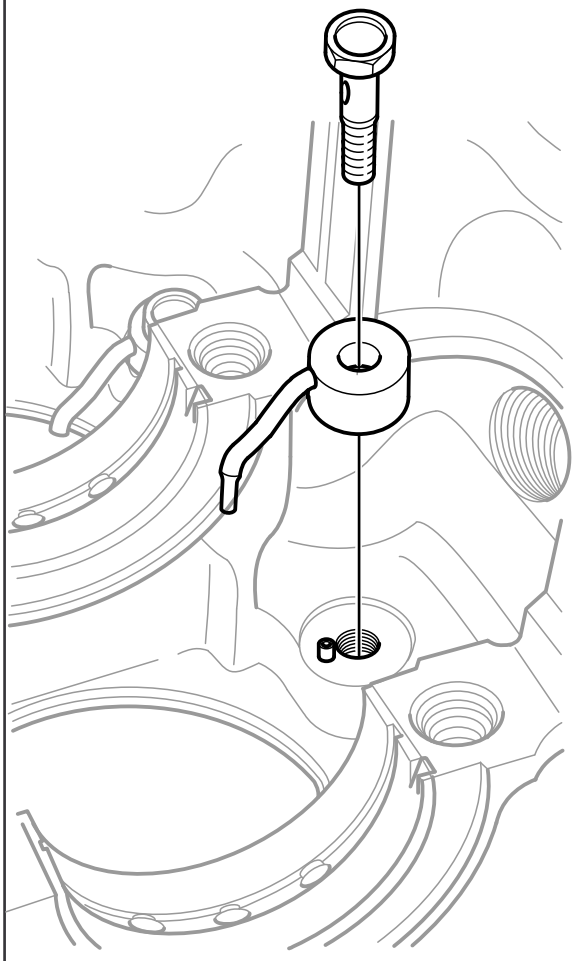
1. Remove sump … … … … … … … **19.03**
2. Remove strainer pipe … … … … … **19.04**
3. Remove bearing caps… … … … … **13.01**
4. Remove pistons… … … … … … … **13.02**
5. Remove crankshaft… … … … … … **14.11**

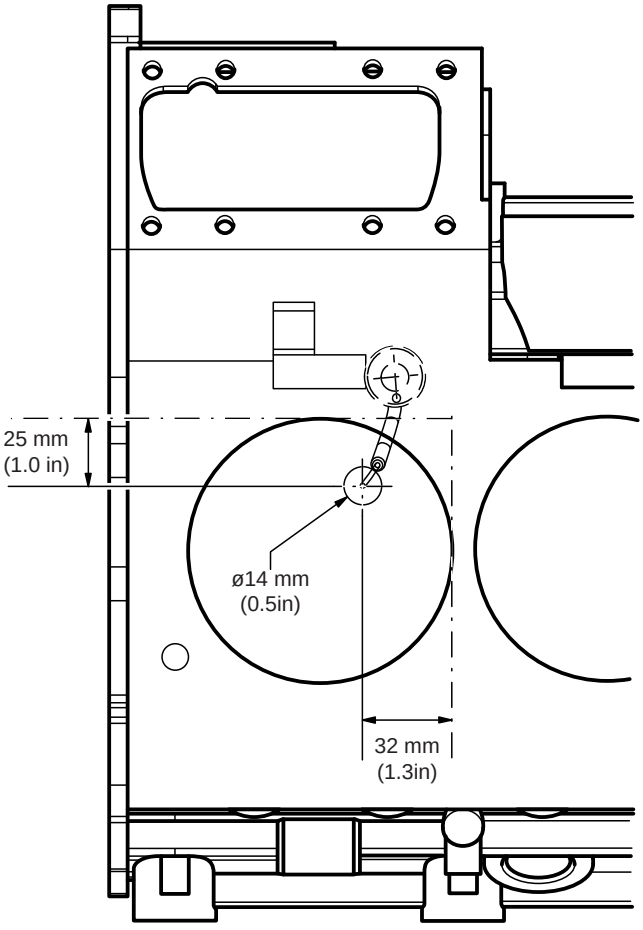
Special notes:

Piston cooling jets are fitted inside the cylinder block to spray oil onto the inner surface of the piston skirt. There is one piston cooling jet for each cylinder.

Cautions:*The crankshaft has been removed to show clearly the piston cooling jet.*

Note: To check the jet alignment;
Insert a 1,70 mm (0.067 in) diameter rod, of suitable length, into the jet. If a suitable rod is not available, reduce the end of a thicker rod to the correct diameter for a length of 16,0 mm (0.630 in). When the rod is inserted into the jet, it must extend out of the top of the cylinder within the area shown.





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Operation:
Crankshaft pulley - to remove and to fit **14.01**

Recommended torque:

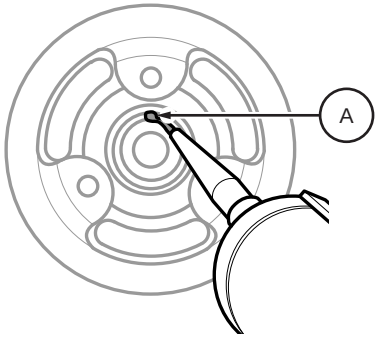
Engine type	Nm	lbf ft	kgf m
Setscrews	185	136	19,0

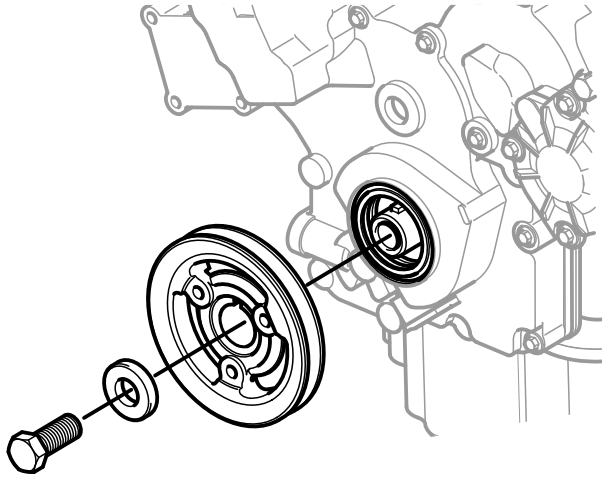
Special notes:

Note: Some applications have an axial power take-off that is driven off the crankshaft pulley. The crankshaft pulley, on these applications, is retained by a retainer **(B)** as well as a washer and setscrew.
If an axial power take-off is used, it will be necessary to use an extractor to remove the crankshaft pulley.
Lock the crankshaft to prevent its counter-clockwise movement.

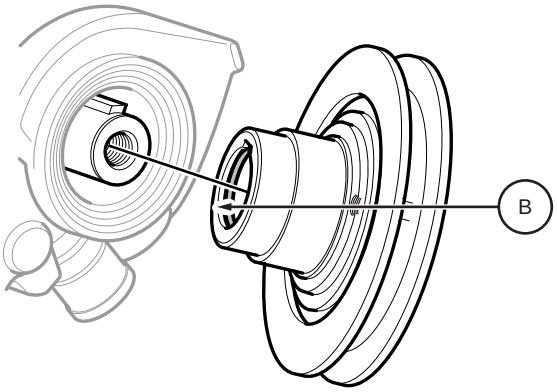
Caution: *Remove the device used to lock the crankshaft.*

Note: If the surface for the oil seal is damaged or there is a deep groove that is caused by the oil seal, it may be possible to fit a wear sleeve, operation **14.02**.





A. Silicon sealant;
All engines without axial power take-off.



B. For axial power take-off variants only
(no silicon sealant is required).

Apply a thin continuous 360° bead of loctite 648 approximately 6 mm (0.23 in) beyond the chamfer on the recess in the crankshaft pulley **(B)**. The bead should also be applied to the keyway. Apply only sufficient loctite to ensure that the bead will spread to give a 6 mm wide bead when the pulley is fitted. Allow 4 hours before the power take off is used, to ensure that the loctite is dry. Full strength is obtained in 24 hours.

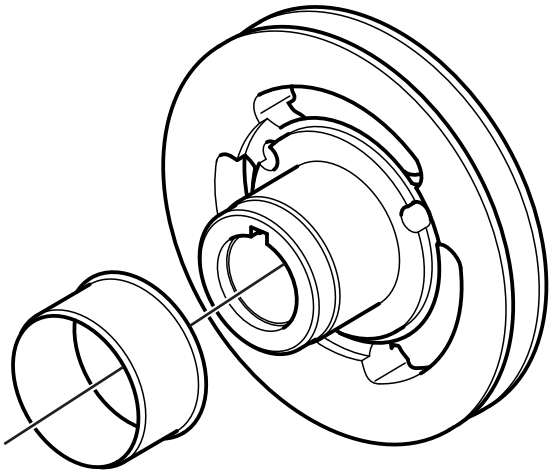
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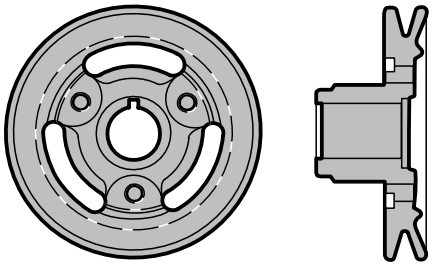
Operation:
Crankshaft pulley - to fit a wear sleeve **14.02**

Recommended torque:

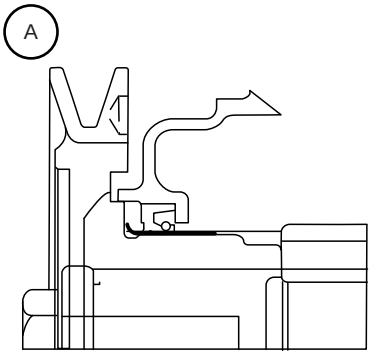
Engine type	a	lbf ft	kgf m
-			
-			
-			

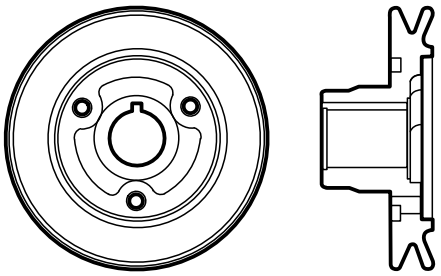
Special notes and tools:
With the pulley removed, carefully fit the wear sleeve in accordance with the manufacturers instructions (supplied with the sleeve).
Ensure that the sleeve is fitted correctly to the pulley **(A)** .





Suitable for a wear sleeve





Unsuitable for a wear sleeve

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Operation:
Rear oil seal - to remove **14.03**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

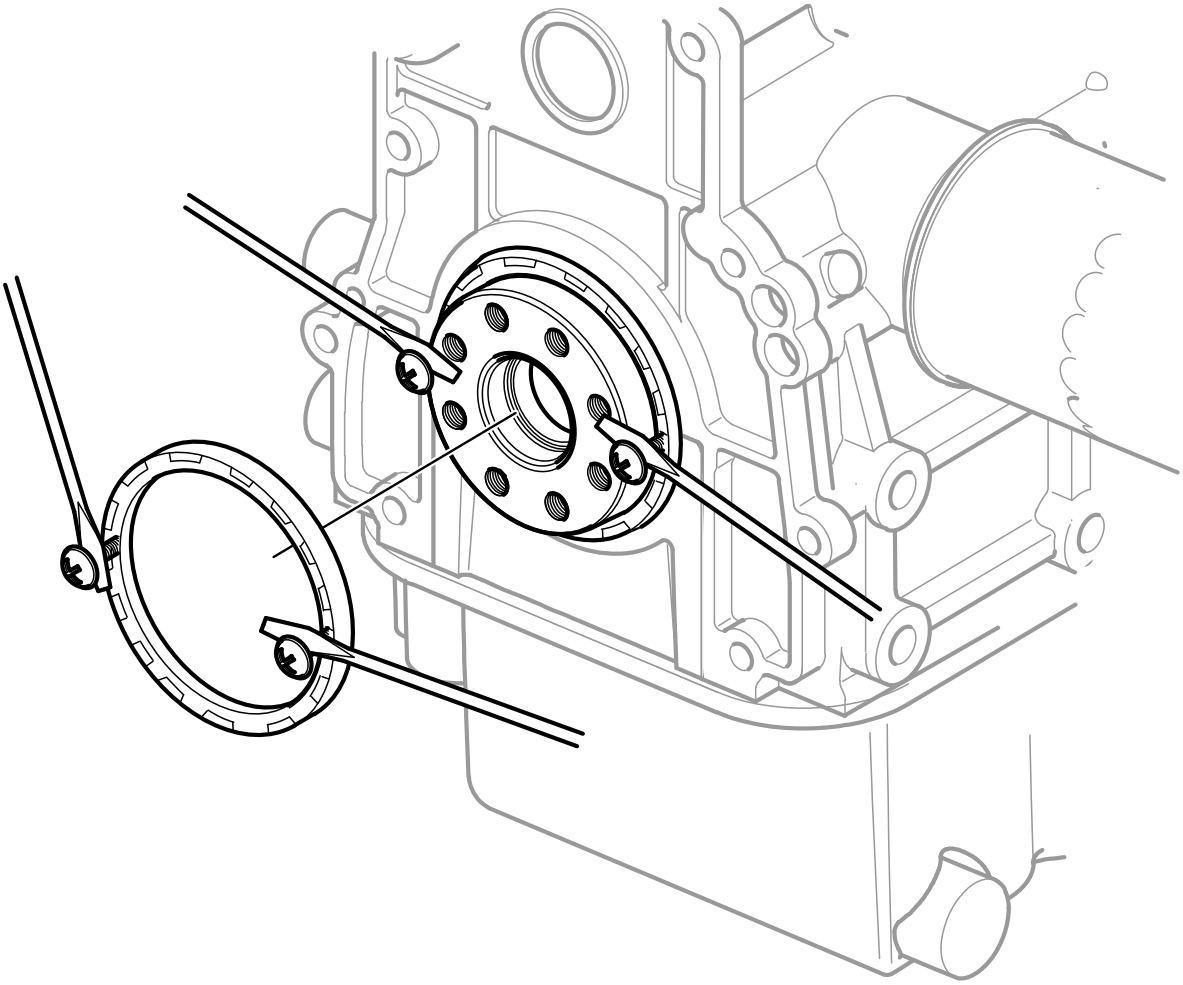
Service operations:

1. Remove flywheel … … … … … **22.01**
2. Remove flywheel housing … … **22.03**

Special notes and tools:

Caution: *When the screws (self tapping) are fitted to the seal, do not damage the crankshaft palm or the recess for the oil seal.*
Use suitable levers to remove the oil seal.

Note: Fit the screws 180° apart.



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Operation:
Rear oil seal - to fit **14.04**

Recommended torque:

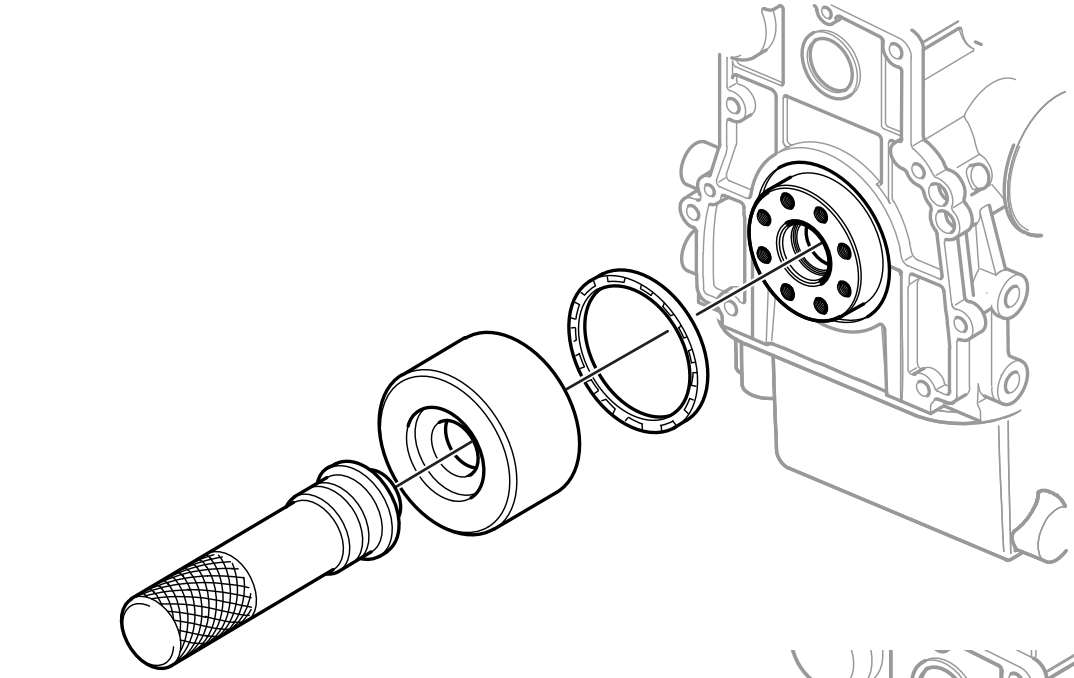
Engine type	Nm	lbf ft	kgf m
-			
-			
-			

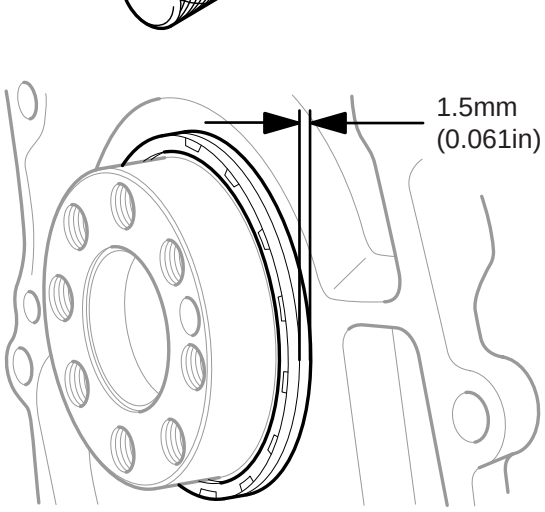
Special notes and tools:

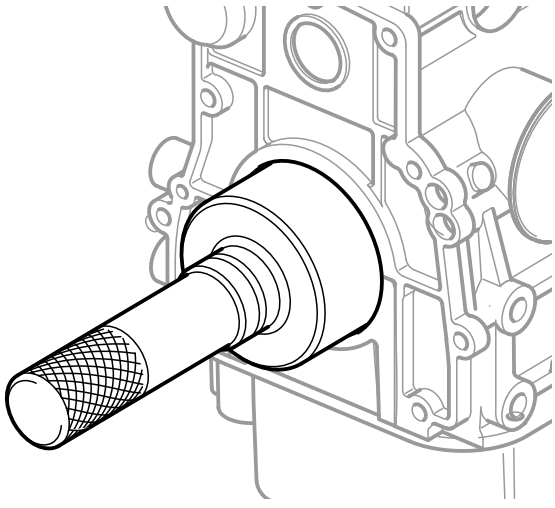
Rear oil seal replacer, Part number 27610021
Universal drive handle, Part number 21825639
Note: Lubrication of the seal is necessary to prevent damage to the lip of the seal when the engine is first started

Caution: *Do not damage the crank palm when the seal is fitted.*

Note: The seal is fitted correctly when it protrudes 1,5 mm (0.06 in) from the rear face of the cylinder block / bearing cap.







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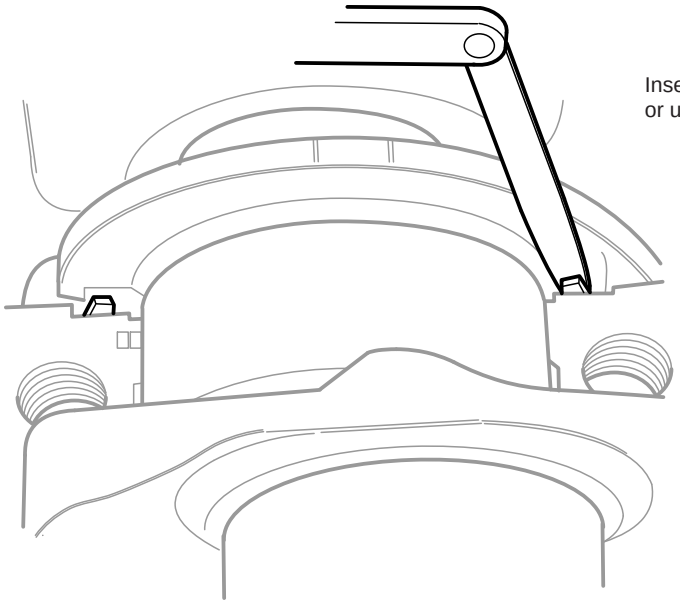
Operation:
Thrust washers and crankshaft end-float - to inspect **14.05**

Recommended torque:

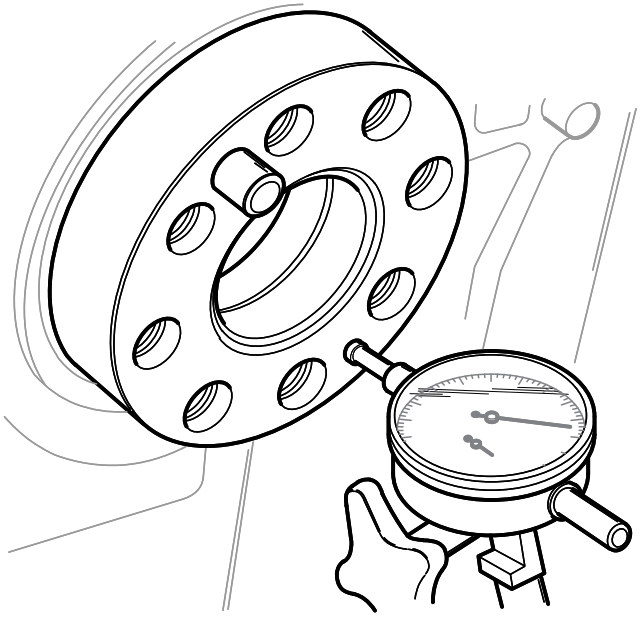
Engine type	Nm	lbf ft	kgf m
-			
-			
-			

Special notes and tools:
Special tools: Feeler gauge, dial test indicator.

Note: If the end-float is more than the tolerance allowed, oversize thrust washers are available to reduce the end-float.



Insert a feeler gauge between thrust washer and crankshaft or use a dial test indicator on the rear of the crankshaft.



Maximum permissible end float

0,405 mm
(0.0159 in)

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Operation:
Thrust washers - to remove and to fit **14.06**

Recommended torque:

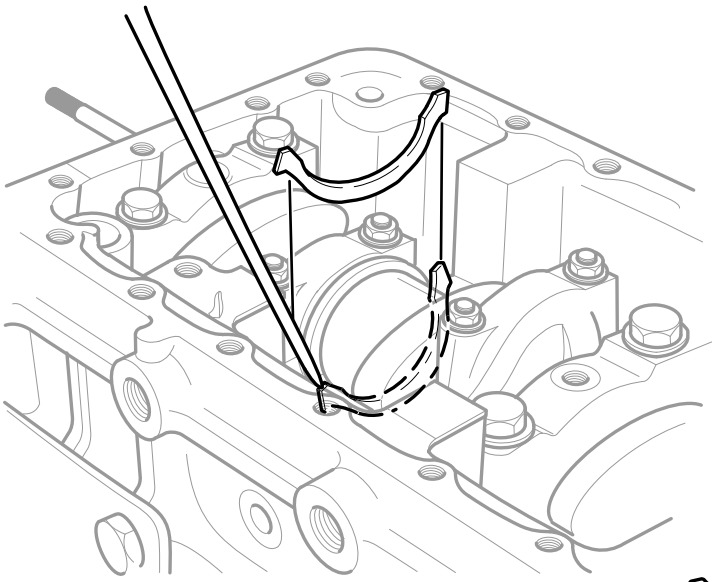
Engine type	Nm	lbf ft	kgf m
-			

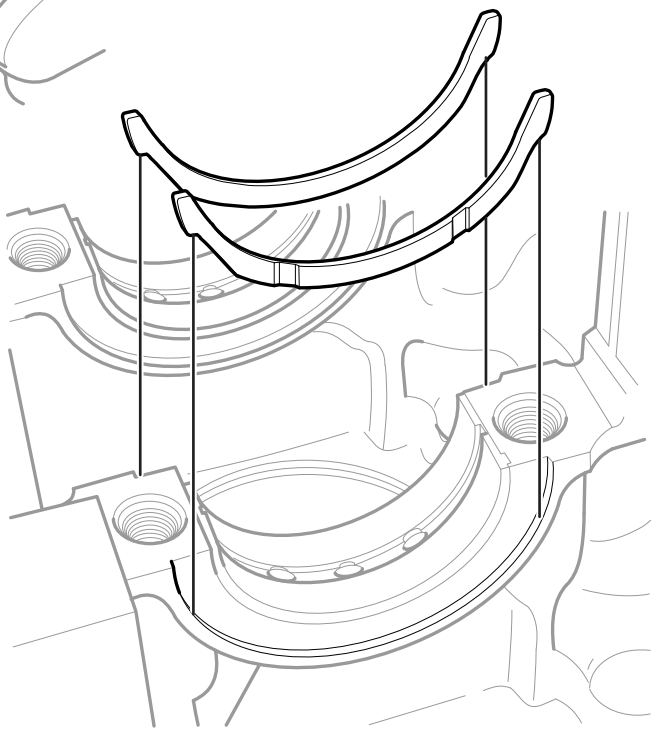
Service operations:

1. To remove sump … … … … … … **19.03**
2. To remove strainer … … … … **19.04**

Special notes:

Ensure that the main journals of the crankshaft are clean. Carefully put the crankshaft into position on the upper bearings.
Clean and lubricate the thrust washers. Slide them into the recesses in the cylinder block each side of number four journal. The grooves in the thrust washers must be towards the crankshaft.





Position of thrust washers in cylinder block.

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Operation:
Main bearing caps (with crankshaft in position) - to remove and to fit **14.07**

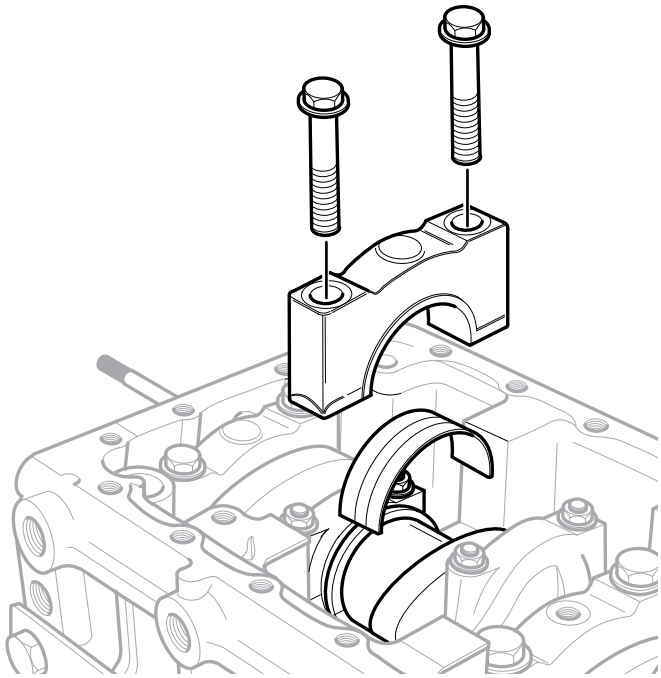
Recommended torque:

Engine type	Nm	lbf ft	kgf m
Bearing caps	147	108	15,0

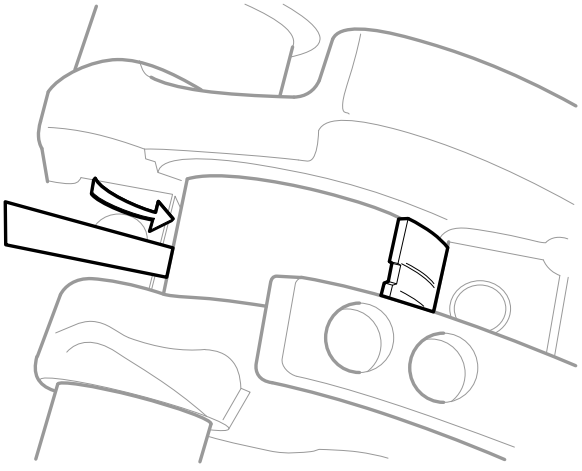
Special notes and tools:

Use a suitable tool to push the upper half of the shell bearing from the side opposite to the location tag. Carefully rotate the crankshaft to release the bearing from its housing.
Keep the bearing halves in their relevant positions.

Caution: *The shell bearings which do not have an oil hole must only be fitted to the cap. If they are fitted to the cylinder block, the bearing will not receive lubricating oil and this will cause a seizure of crankshaft and bearings.*

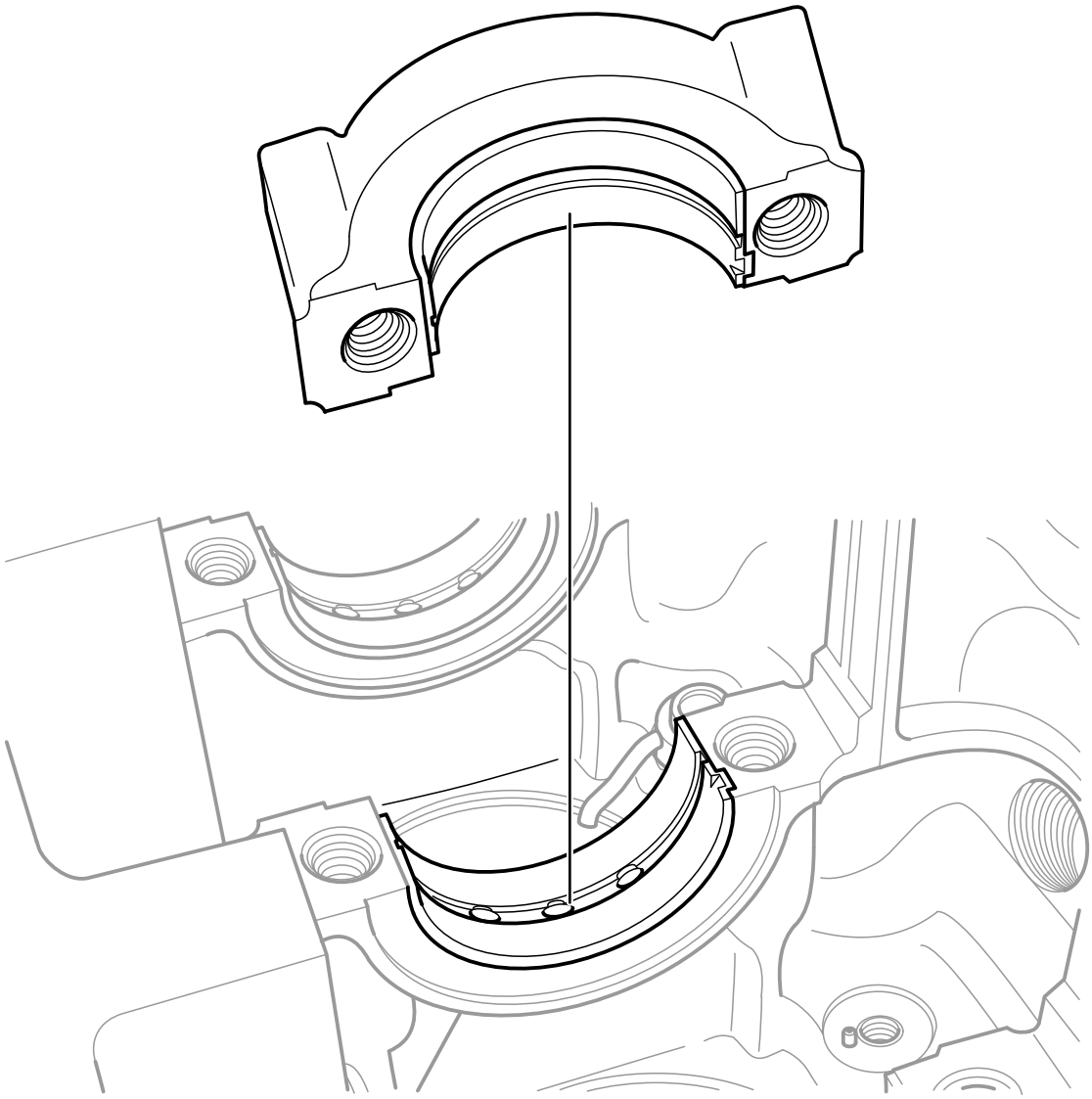


Lubricate the main bearings with clean engine oil.
Put the bearing (with the oil hole) onto the journal and slide the plain end around between the journal and the cylinder block until the tag is fitted correctly into the recess.
Fit the bearing into the cap with the tag of the bearing fitted correctly in the recess in the cap.
Fit the bearing cap with the location tags of both bearings on the same side.
After each cap is tightened, ensure that the crankshaft turns freely. If the thrust washers have been removed and fitted, check the crankshaft end-float, operation 14.05.



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Operation: **Main bearings - to inspect**	**14.08**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** -	**Special notes:** Inspect the bearings for wear and for other damage. If a bearing is worn or damaged, renew the shell bearings and check the conditions of the other bearings. Bearing shells are only available in complete sets.



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Operation:
Main bearing caps (front and rear) - to remove **14.09**

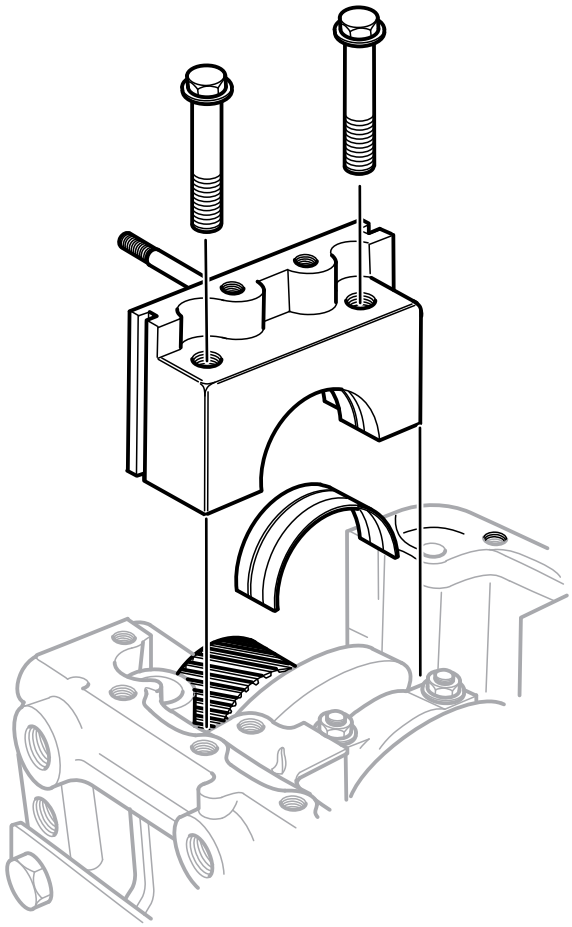
Recommended torque:

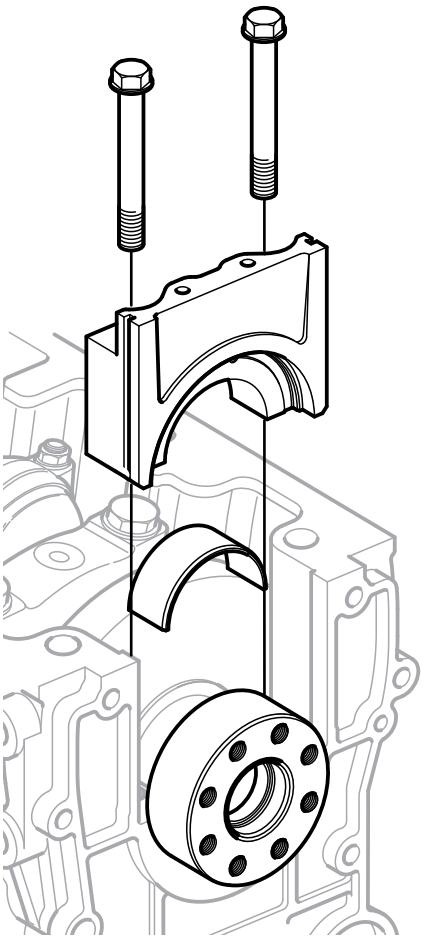
Engine type	Nm	lbf ft	kgf m
Bearing caps	147	108	15,0

Service operations:

1. Remove sump … … … … … … … **19.03**
2. Remove strainer … … … … … … **19.04**
3. Remove rear oil seal … … … … … **14.03**
4. Fit timing case backplate… … … **15.03**

Special notes:
Note: Seals are fitted in the front and rear bearing holders. These must be replaced when refitting.
The front and rear, bearing caps are fitted to the cylinder block with special seals.
The rear bearing cap provides half of the recess for the rear oil seal. When the cap is removed, remove the seal and check for wear, renew if necessary.





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Operation:
Main bearing caps (front and rear) - to fit **14.10**

Recommended torque:

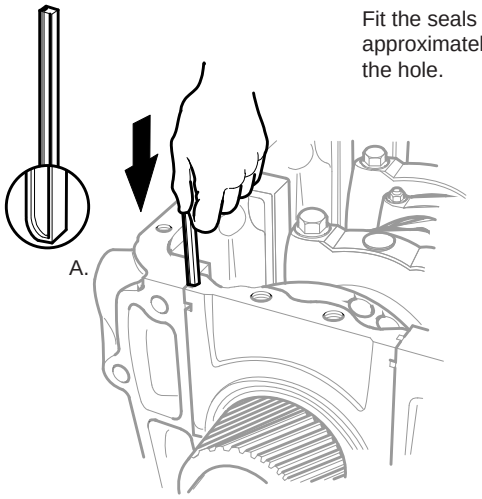
Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:

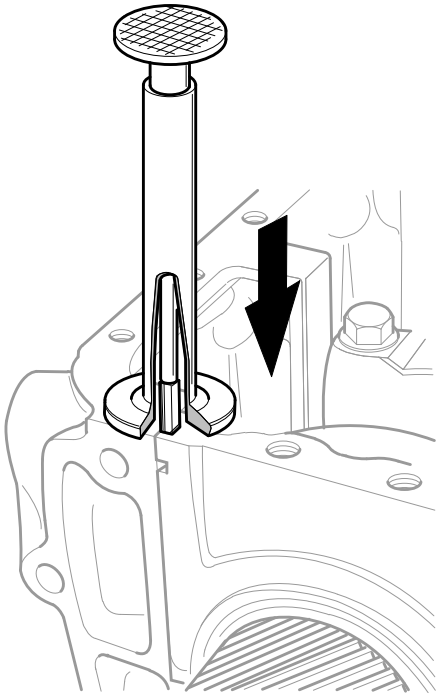
Special tools: Rubber plug replacer tool part number 27610013

Note: Before the front and rear bearing caps are fully tightened, use a straight edge to check their alignment with the front / rear faces of the cylinder block.

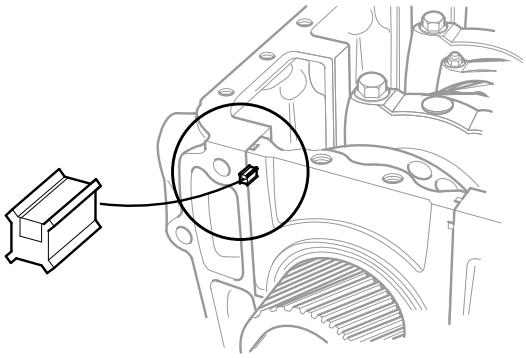
Caution: *The seals for the front and rear bearing caps have a curve at one end **(A)** which must be fitted towards the side of the engine and with the curve inserted first into the hole.*
The seals have a soft metal insert. Be careful not to bend the seal when it is first inserted into the hole.
*After the rear cap has been tightened, it is important to remove any sealant from inside the recess for the rear oil seal, see operation **14.12**. If this is not done, the oil seal will not fit correctly and will cause oil leakage.*



Fit the seals initially by hand and push, approximately 30% of the seal, into the hole.



Use a small drift to push the seal below the surface of the cap, until a resistance is felt; the seal is now fitted to the bottom of the hole. Remove any excess sealant from around the holes.



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Operation:
Crankshaft - to remove **14.11**

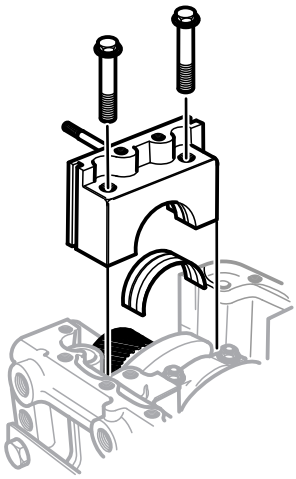
Recommended torque:

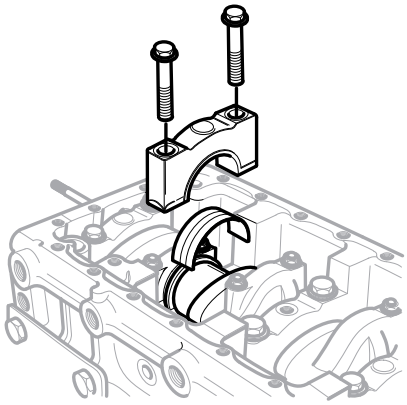
Engine type	Nm	lbf ft	kgf m
-			

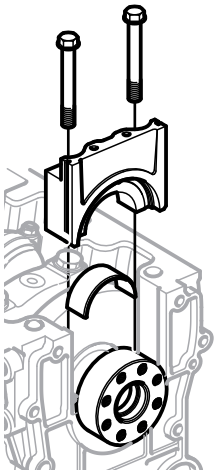
Special notes:

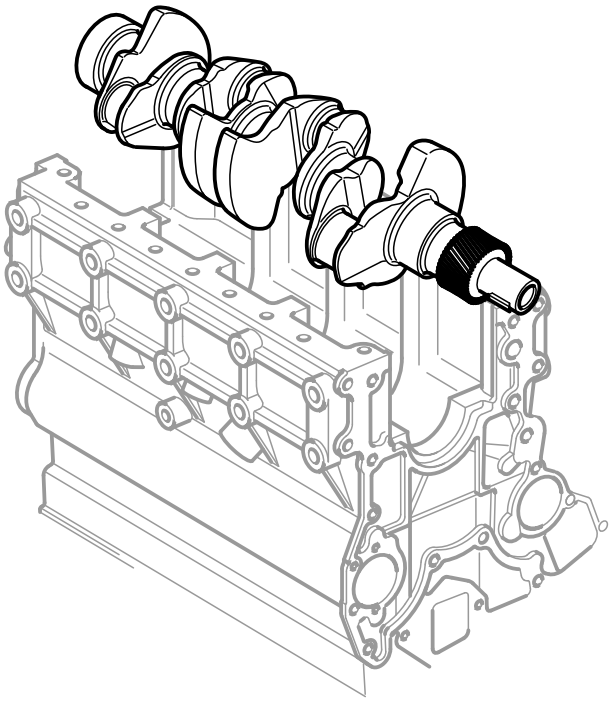
Warning! *Use lift equipment or obtain assistance to lift heavy engine components, such as the flywheel, the flywheel housing and the crankshaft.*

Note: Perkins recommend, for safety reasons, that this operation is done with the engine upside down. This will ensure that the crankshaft can be lifted out and that the pistons will be retained in the cylinder bores.
If the main bearings are to be used again, they must be fitted in the same positions from which they were removed. The rear oil seal should be renewed.









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Operation:
Crankshaft - to fit **14.12**

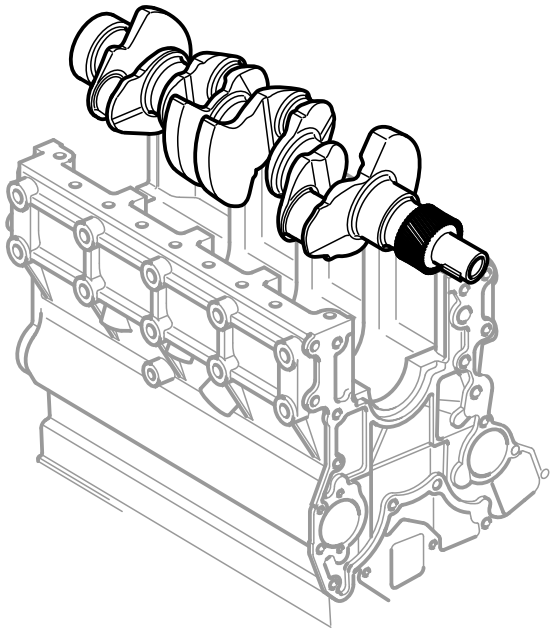
Recommended torque:

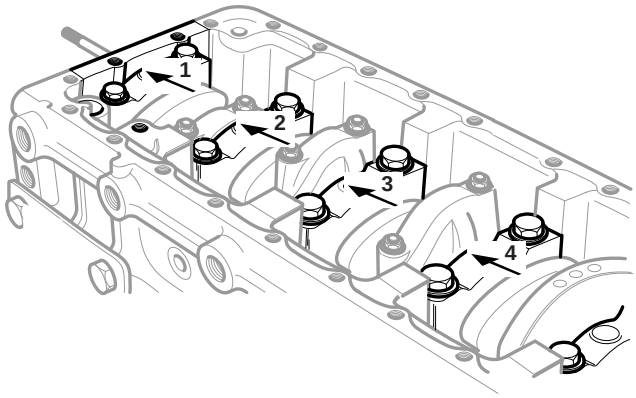
Engine type	Nm	lbf ft	kgf m
Bearing caps	147	108	15,0

Special notes and tools:

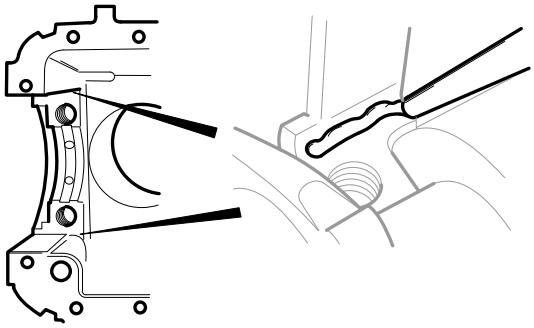
Note: Before the front and rear bearing caps are fully tightened, use a straight edge to check their alignment with the front / rear faces of the cylinder block.

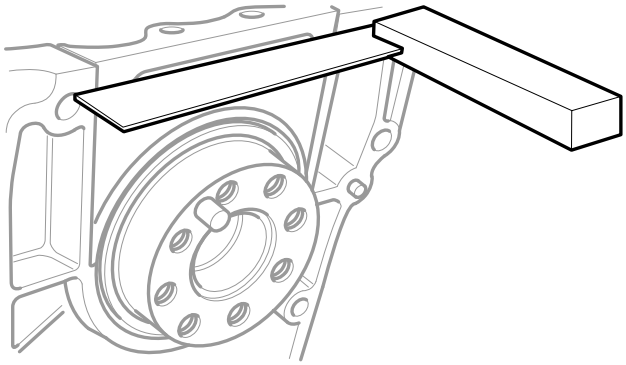
Caution: *After the crankshaft has been overhauled, it must be thoroughly cleaned and the oil holes inspected for debris.*
After the rear cap has been tightened, it is important to remove any sealant from inside the recess for the rear oil seal. If this is not done, the oil seal will not fit correctly and will cause oil leakage.





Apply a small amount of silicone adhesive, part number 21826038 to the corners of the cylinder block for the rear main bearing cap. (See caution above.)





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Operation:
Crankshaft - to inspect and to overhaul **14.13**

Recommended torque:

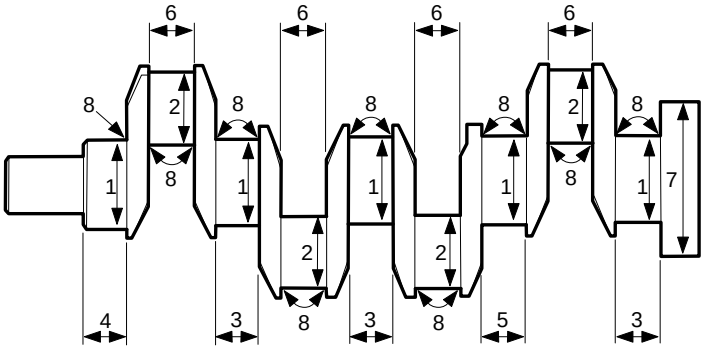
Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:

Note: Check the crankshaft for cracks before and after it is ground.
Demagnetise the crankshaft after it has been checked for cracks.
After the crankshaft has been machined, remove any sharp corners from the lubricating oil holes.
Surface finish and fillet radii must be maintained.
Further information can be found in Data and dimensions at the end of **section 11**.

Caution: *After the crankshaft has been overhauled, it must be thoroughly cleaned and the oil holes inspected for debris.*

Crankshaft heat treatment:
The crankshaft is induction hardened. On UC engines the fillet radii are also induction hardened.
Note: Induction hardened crankshafts need not be hardened after they have been machined undersize.



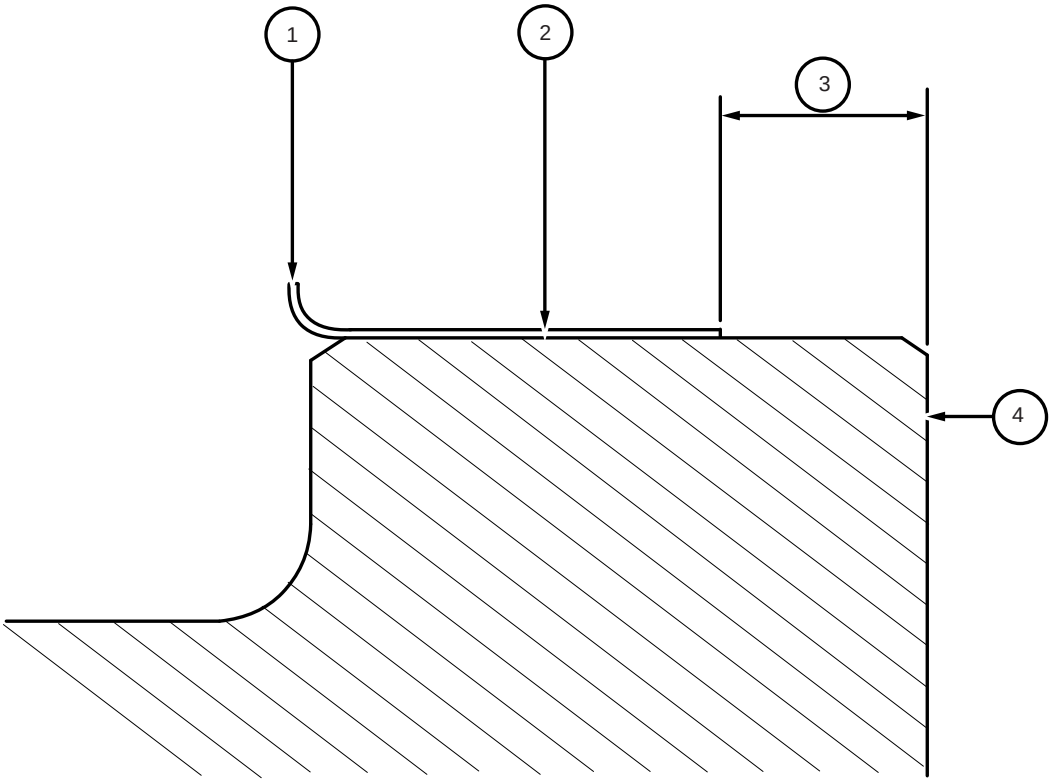
To inspect
Check the crankshaft for wear and other damage. The maximum permissible wear and ovality on the crankshaft journals and crank pins is 0,04 mm (0.0016in).
The main journals and the crank pins of standard size crankshafts can be machined to 0,25mm (0.010in), 0,50mm (0.020") or 0,75 mm (0.030in) undersize on diameter, see data and dimensions in **section 11**. Special undersize bearings are available. If the seal position on the crankshaft palm is worn, a wear sleeve can be fitted to the palm, see operation **14.14**.

Crankshaft overhaul
The finished sizes for crankshaft journals which have been ground undersize are given in the table below:
Note: The surface finish for the journals, the crank pins and the fillet radii must be 0,4 microns (16 micro inches). The surface finish for the seal area of crankshaft palm must be 0,4/1,1 microns (16/43 micro inches).

Item	0,25 mm (0.010in)	0,50 mm (0.020in)	0,75 mm (0.030in)
1	64,70/64,72 (2.547/2.548)	64,45/64,47 (2.537/2.538)	64,20/64,22 (2.527/2.528)
2	52,70/52,72 (2.075/2.076)	52,45/52,47 (2.065/2.066)	52,20/52,22 (2.055/2.056)
3	32,95/33,05 (1.297/1.301)		
4	32,8/34,2 (1.29/1.35)		
5	33,00/33,04 (1.297/1.301)		
6	30,05/32,95 (1.183/1.297)		
7	94,965/95,000 (3.7388/3.7401)		
8	3,3/3,7 (0.13/0.15)		

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Operation: **Wearsleeve - to fit**	**14.14**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes:** ***Caution:*** *After the sleeve has been fitted, the curved part (1) which is used to fit the sleeve, must be removed. If this is not done, when the crankshaft is fitted, the sleeve will be in contact with the cylinder block. When the engine is started, the sleeve, the cylinder block and the oil seal will be damaged.*



To fit:
1 Remove the crankshaft, operation **14.11.**
2 Fit the wear sleeve, in accordance with the manufacturer's instructions, supplied with the sleeve. Ensure that the sleeve (2) is fitted to the crankshaft palm (4) to a dimension (3) of 12,0 mm (0,47 in).

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Operation:
Tamper proof screws **15.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

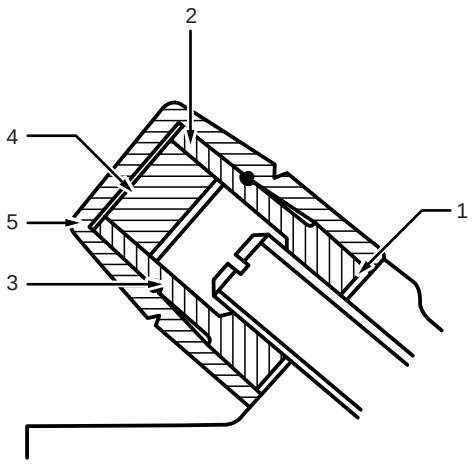
Service operations:

1. Remove throttle cable bracket … … … … … … **20.10**

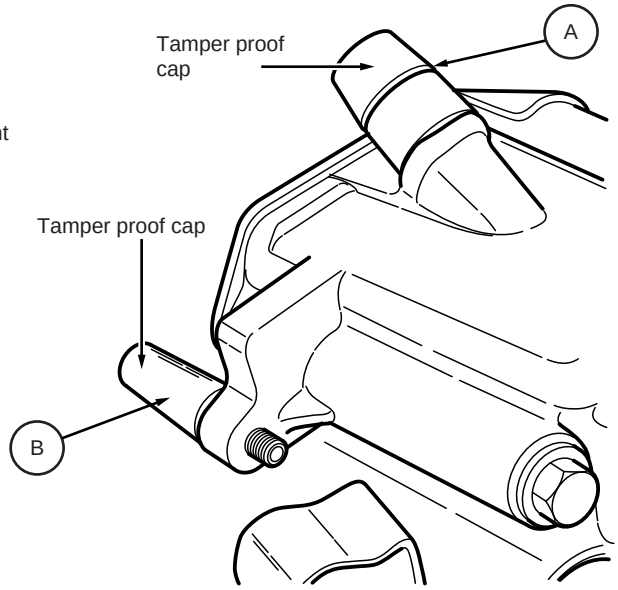
Special notes:
A requirement of emissions legislation, is that access to adjustments that affect the engine's exhaust emissions is limited to personnel approved by Perkins Engines Company Limited.
The adjustments affected, are the fuel adjustment and the maximum speed adjustment. A warranty claim will not be acceptable, if it can be seen that an adjustment has been made by personnel not approved by Perkins.

To remove and to fit the cap for the maximum fuel adjustment screw
The tamper proof assembly for the fuel adjustment consists of a:
1 Sealing washer
2 Lock nut
3 Retainer ring
4 Rubber plug
5 Cap

Use a suitable hacksaw to cut through the cap **(5)** and the nut **(2)** at the groove **(A)**. This will give access to the adjustment screw.
Remove the lock nut and the sealing washer **(1)**.
Fit a new sealing washer and a new lock nut from the service kit.
Make the adjustment and tighten the lock nut.
Fit the new retainer ring to the lock nut.
Fit the rubber plug **(4)** into the end of the lock nut.
Put the cap onto the lock nut and carefully press the cap on by hand. Ensure that the cap is held by the retainer ring.
The maximum speed adjustment has a plastic cap that is pressed by hand onto the lock nut of the adjustment screw. This cap can be removed with a suitable lever to make the adjustment.
The only permitted adjustment to the maximum speed is to correct the speed, in accordance with the speed shown on the data plate of the fuel injection pump.
A new cap (in red colour) will be supplied only to approved personnel and must not be supplied to end users.



To remove and to fit the cap for the maximum speed adjustment
Remove the plastic cap **(B)** from the maximum speed adjustment with a suitable lever.
Make the adjustment and fit a new cap, part number 2648A119.
The cap is pressed onto the lock nut, by hand.



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Operation:
Timing case - to remove and to fit **15.02**

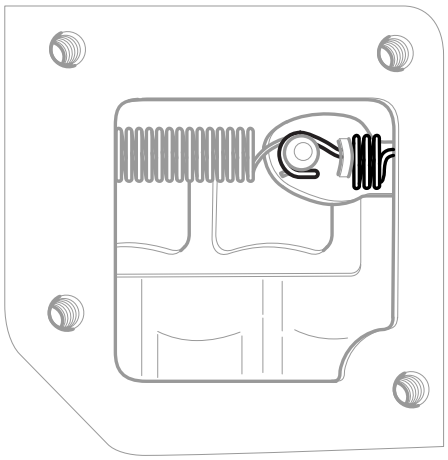
Recommended torque:

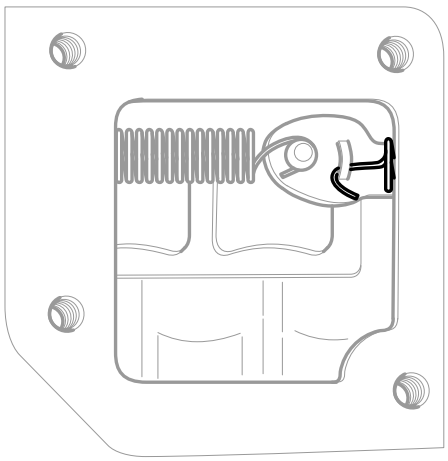
Engine type	Nm	lbf ft	kgf m
-			

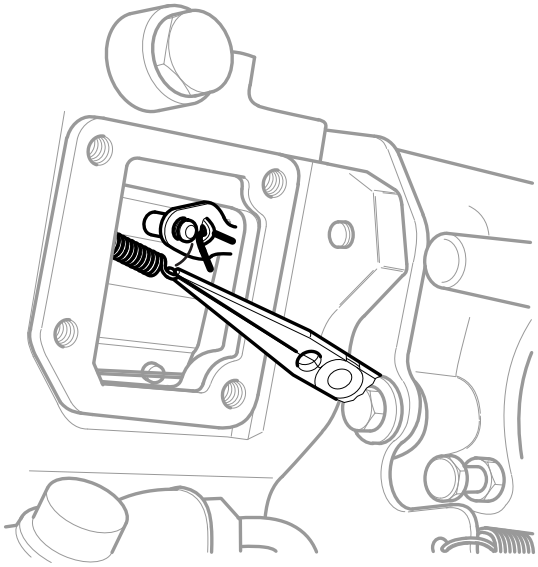
Sevice operations:
1. Remove crankshaft pulley … … **14.01**

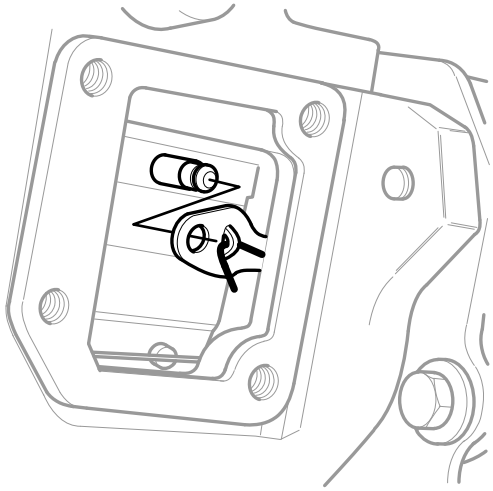
Special notes and tools:
Tools: Pliers

Caution: *If a timing case is removed or renewed, the correct setting for the maximum fuel can be lost. To ensure that the maximum fuel is set correctly, a reference setting is necessary, before the timing case is removed and this setting must be used when the original, or the new timing case, is fitted to the engine.*
Refer to ***operation 20.16*** *before timing case is removed.*









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Operation:
Timing case - to remove and to fit **15.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes:

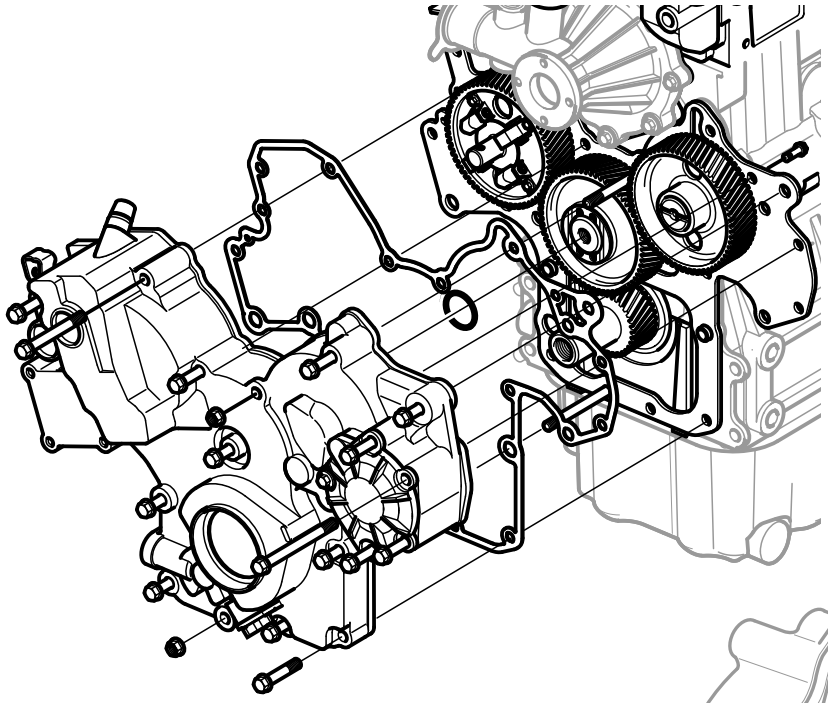
Mount the engine vertically with the crankshaft nose upwards.This will enable the timing case and the gears to be aligned correctly. If the alignment is not correct, the gears will be damaged.

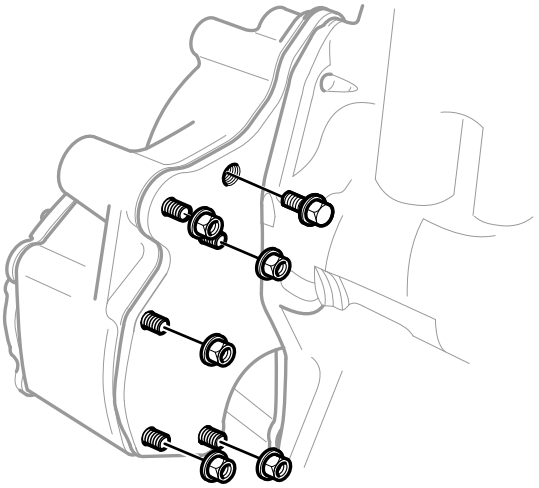
Note the position of the setscrews, as they are of different lengths and thread sizes.

To prevent damage to the threads, they must be fitted to the correct holes.

Caution: *To ensure that there will be no side loads on the camshaft gear, tighten the fasteners for the timing case gradually and evenly, except for the setscrew in the centre, which must be tightened last.*

The "O" ring must be renewed.





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Operation:
Timing case - to fit **15.03**

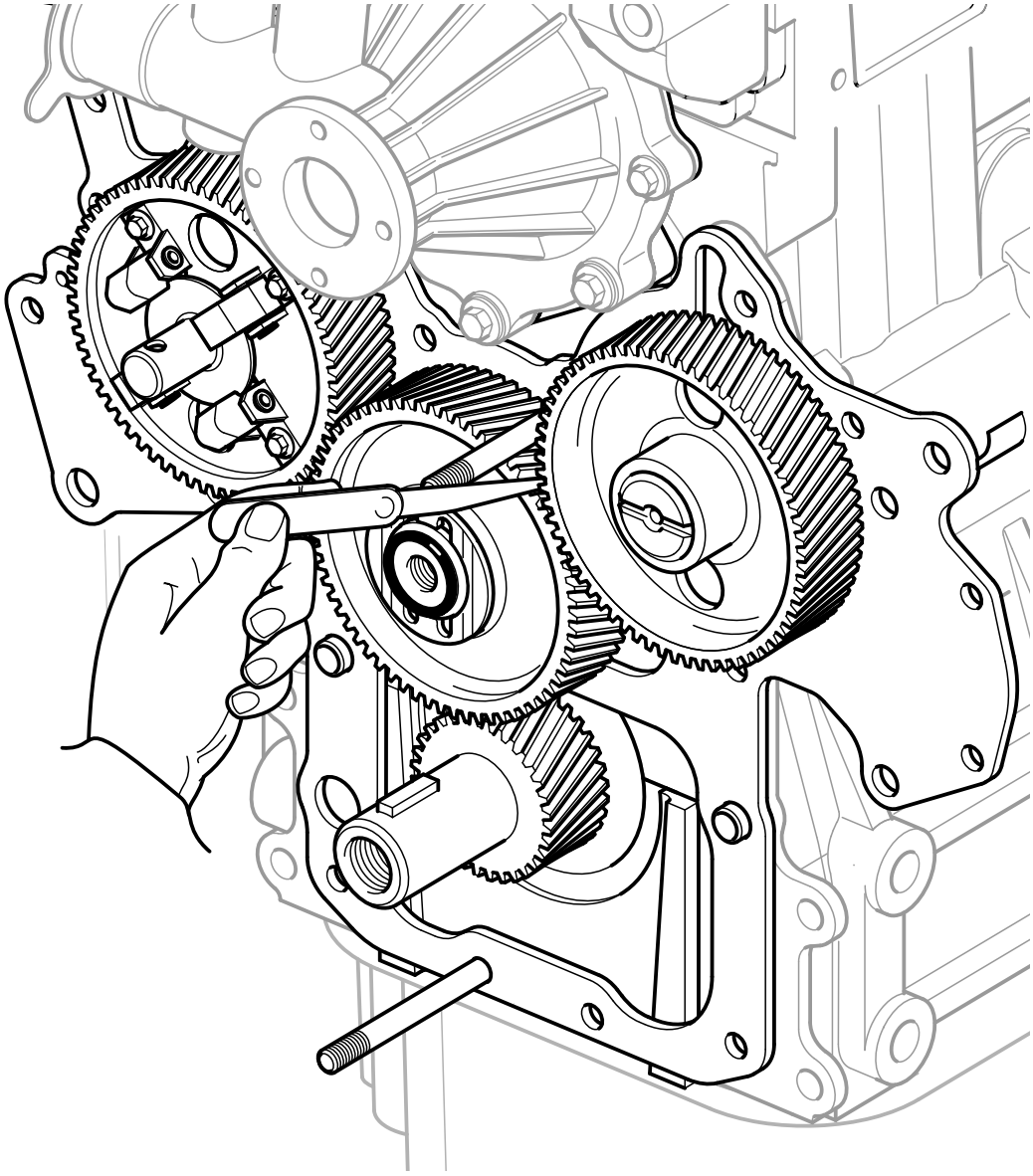
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			
-			
-			

Special notes and tools:

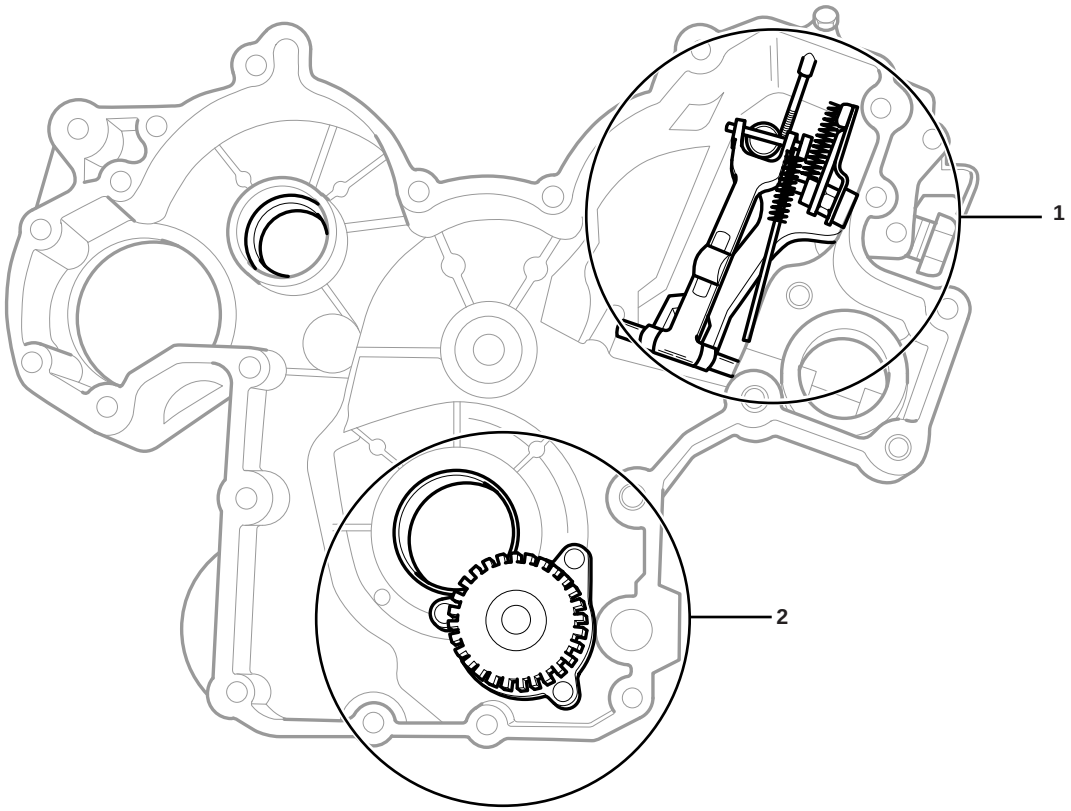
If a new gear has been fitted, check the backlash. The backlash between the crankshaft gear and the other gears that are in mesh with it is 0,076 mm (0.003in). The backlash between the idler gear and the gears for the camshaft is 0,05 mm (0.002in).

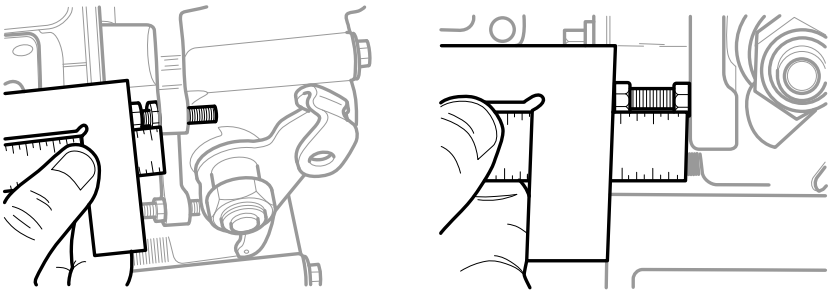
Caution: *The maximum fuel setting will be affected if: a sealant is used on the joint faces of the timing case or back plate.*
Ensure the governor weight assembly is free to move.



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Operation: **Timing case - to renew**	**15.04**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** **-**	**Special notes:** 1. See **section 20** (Fuel System) for further information. 2. See **section 19** (Lubrication System) for further information.





On early engines, if the timing case is to be renewed, measure the protrusion of the speed adjustment screws. This will provide a basic setting for the timing case.

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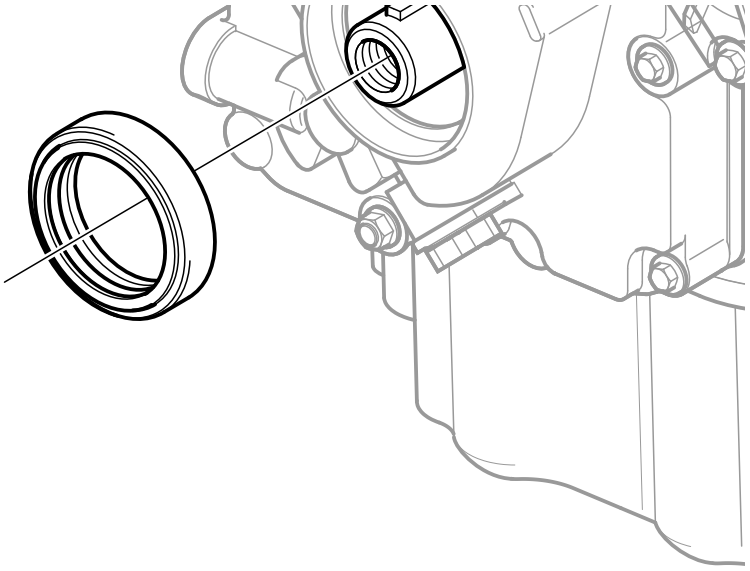
Operation:
Front oil seal - to remove and to fit **15.05**

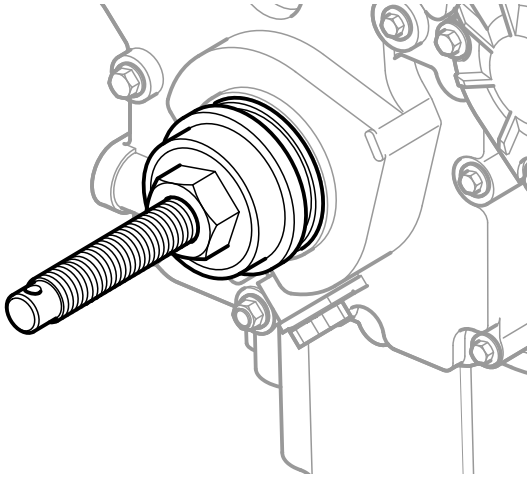
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove crankshaft pulley … … **14.01**

Special notes and tools:
Special tools: Replacer tool for front oil seal (main tool), part number 21825577
Adaptor, fitted to crankshaft nose, part number 27610026, for use with the main tool.
Adaptor, to position seal, part number 27610027 for use with the main tool.
Note: Remove the oil seal with a suitable lever behind the main lip of the oil seal.
Do not damage the edge of the oil seal housing.





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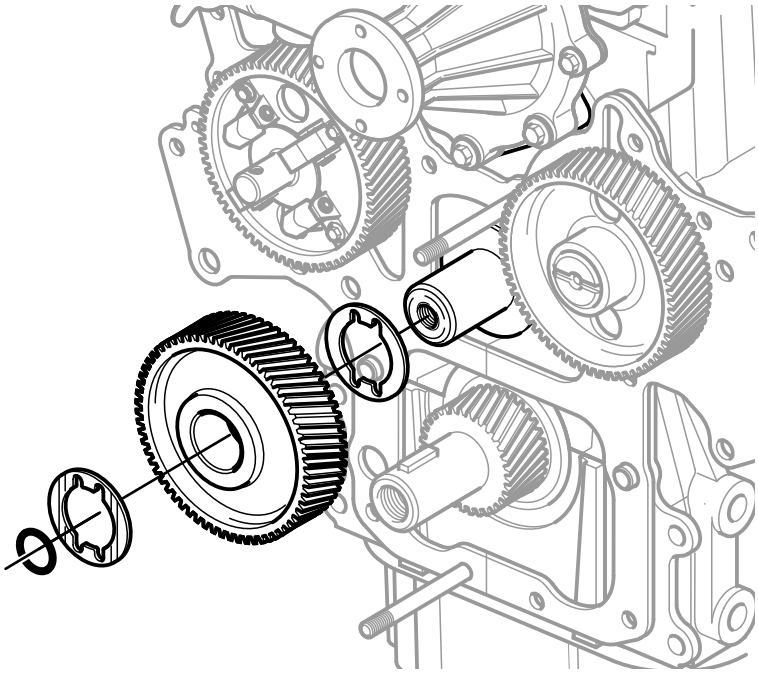
Operation:
Idler gear - to remove **15.06**

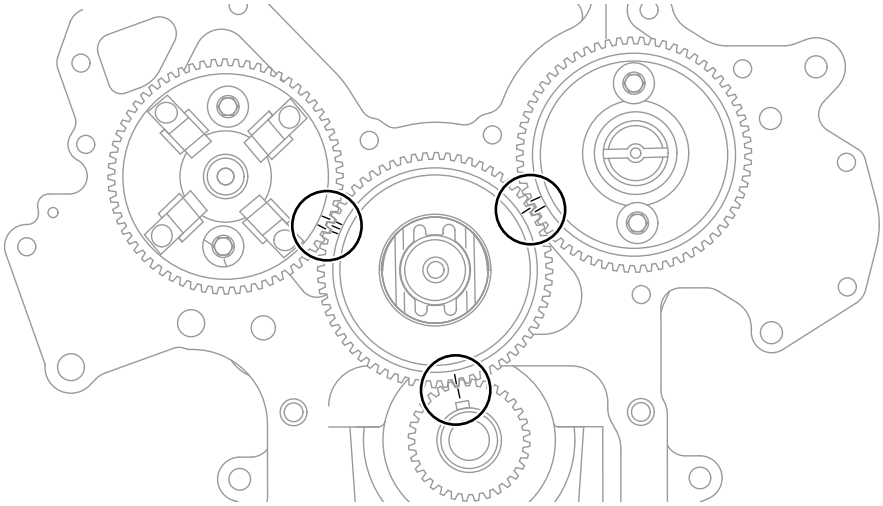
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove crankshaft pulley … … **14.01**
2. Remove timing cover … … … … **15.02**

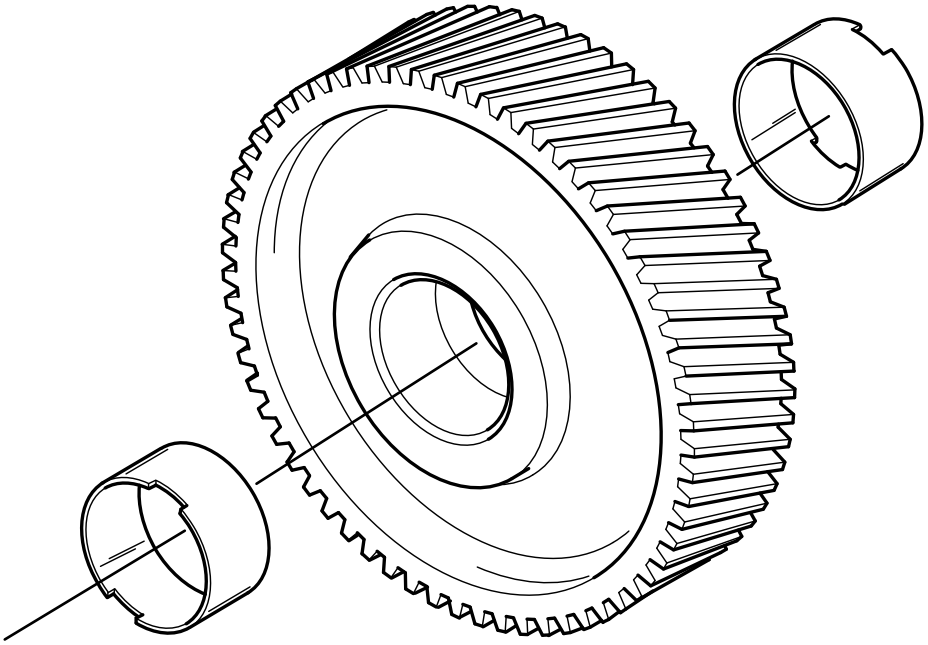
Special notes and tools:
Note: When the timing marks on the gears are aligned and the idler gear is removed, do not rotate the crankshaft. If the crankshaft is rotated, top dead centre (TDC) will have to be set on number 1 cylinder.
Ensure that the oil hole is not restricted and that the hub is clean.

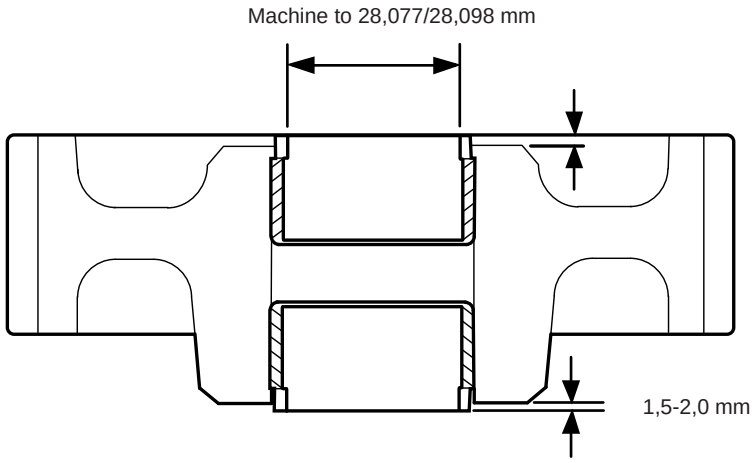




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Operation: **Idler gear bushes - to remove and to fit**	**15.07**
Recommended torque: **Engine type Nm lbf ft kgf m** -	**Special notes:** Machine to dimension shown.





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Operation:
Idler gear hub - to remove and to fit **15.08**

Recommended torque:

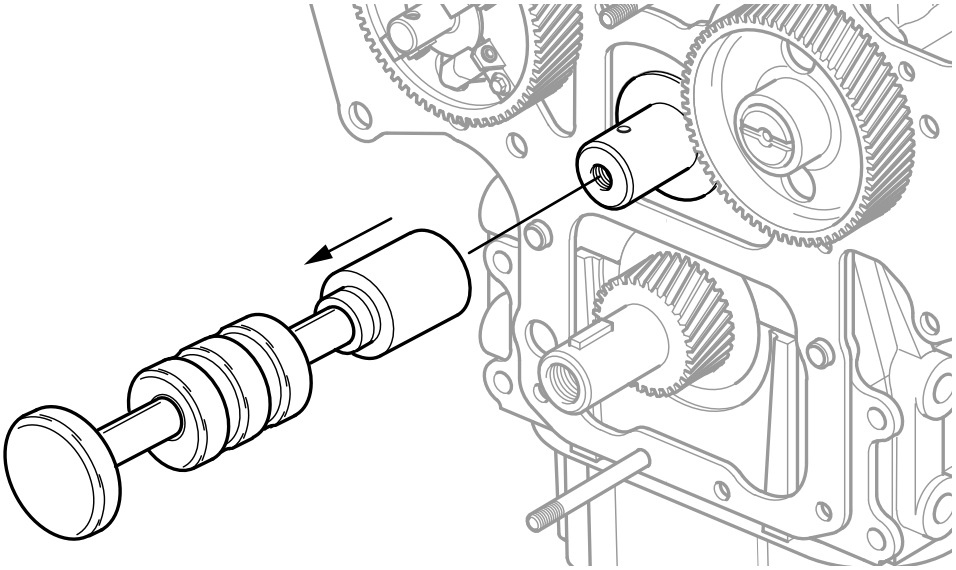
Engine type	Nm	lbf ft	kgf m
-			

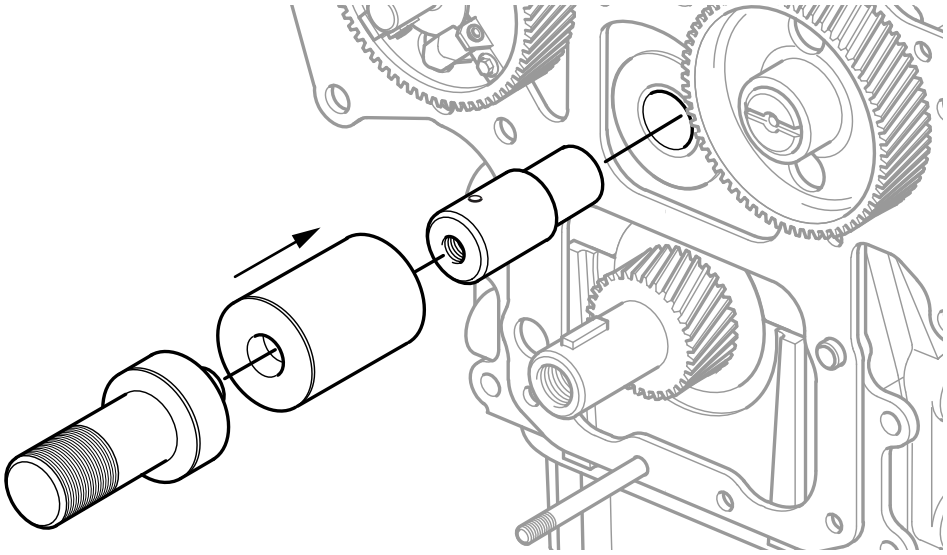
Service operations:

1. Remove crankshaft pulley … … **14.01**
2. Remove timing cover … … … … **15.02**
3. Remove Idler gear … … … … … **15.06**

Special notes and tools:

Special tools: Remover tool (slide hammer), part number 21825577
Adaptor, part number 27610025 for use with the slide hammer.
Universal drive handle, part number 21825639
Replacer tool, part number 27610021, for use with the universal drive handle.
Note: With the oil hole towards the top, fit the new hub initially, with a soft hammer until the edge of the hub is just inside the bore. Ensure that it is square to the front face of the cylinder block.
Caution: *Ensure that the replacer tool is clean and smooth, and does not damage the new hub when it is fitted.*





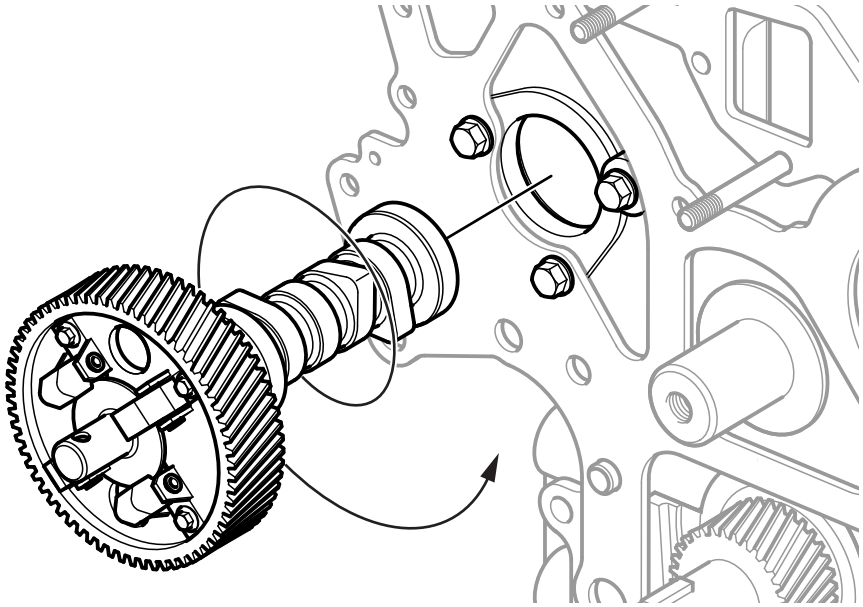
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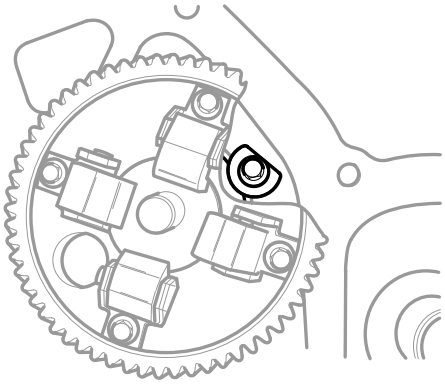
Operation:
Camshaft assembly for the fuel injection pump - to remove and to fit **15.09**

Recommended torque:

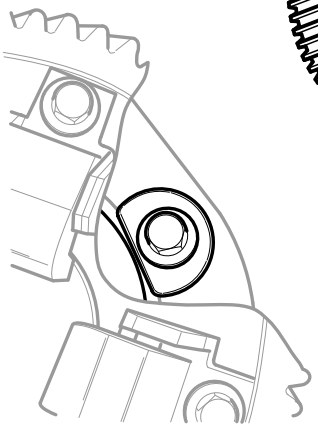
Engine type	Nm	lbf ft	kgf m
-			
-			
-			

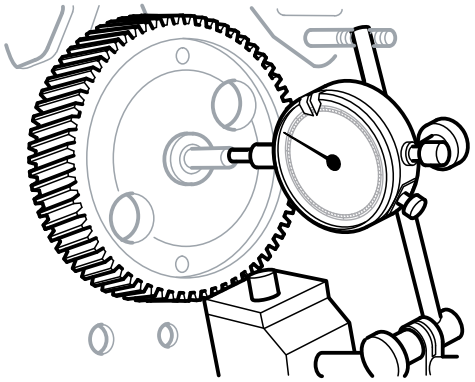
Special notes and tools:
Note: The camshaft is supplied only as an assembly of camshaft, bearing and gear. If the bearings, the cams or the gear is worn, a new camshaft assembly will have to be fitted. If this occurs, the fuel injection timing will have to be set, see operation **17.04.**





Release the setscrew for the plate that retains the camshaft bearing.
Rotate the plate 180° and tighten the setscrew.
This will hold the plate away from the bearing.



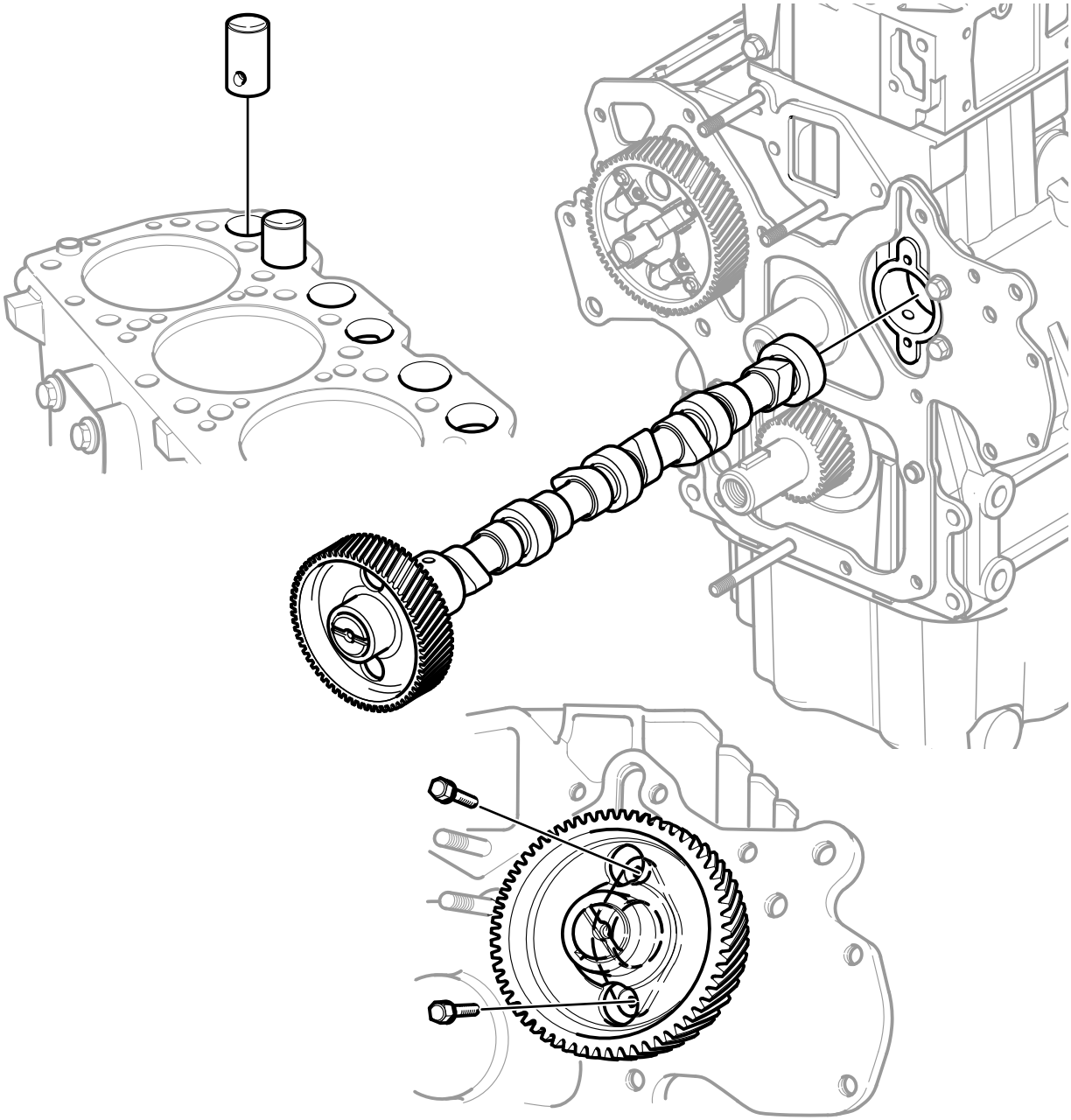


Maximum permissible end float

0,35 mm
(0.014 in)

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Operation: **Camshaft assembly and tappets for the valves - to remove and to fit**	**15.10**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:**



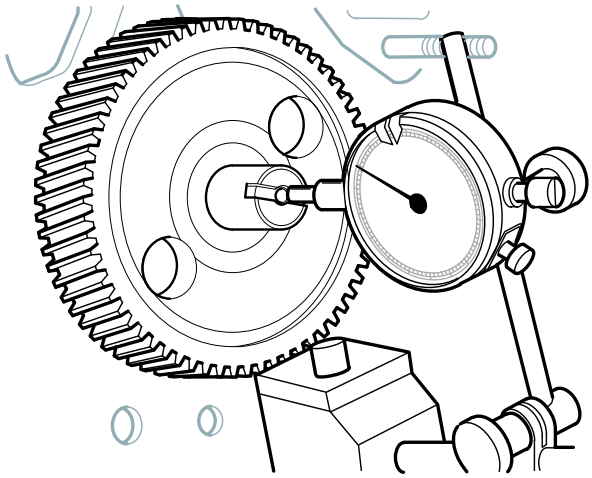
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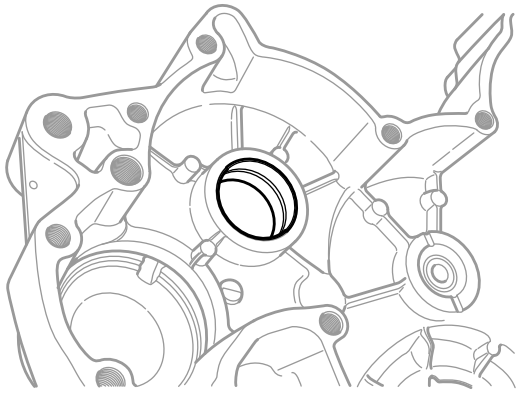
Operation:
Camshaft assembly for the valves - to remove and to fit **15.11**

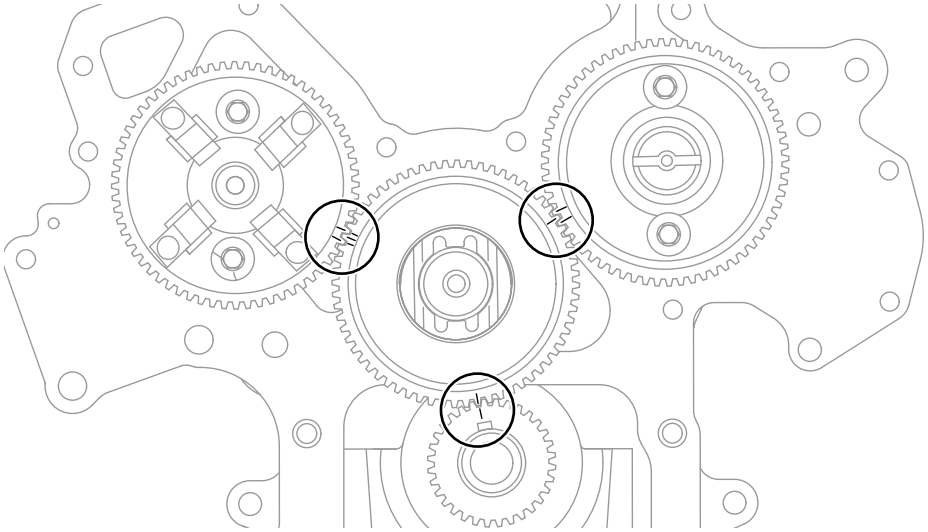
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes:
Note: The camshaft is supplied as an assembly of camshaft, thrust plate and gear. Rotate the crankshaft until the marked teeth of the crankshaft gear, the gear for the camshaft for the valves, and the gear for the camshaft for the fuel injection pump, are aligned with the marked teeth of idler gear. Check that the camshaft end float is within the limits shown in Data and dimensions (end of **section 11**).

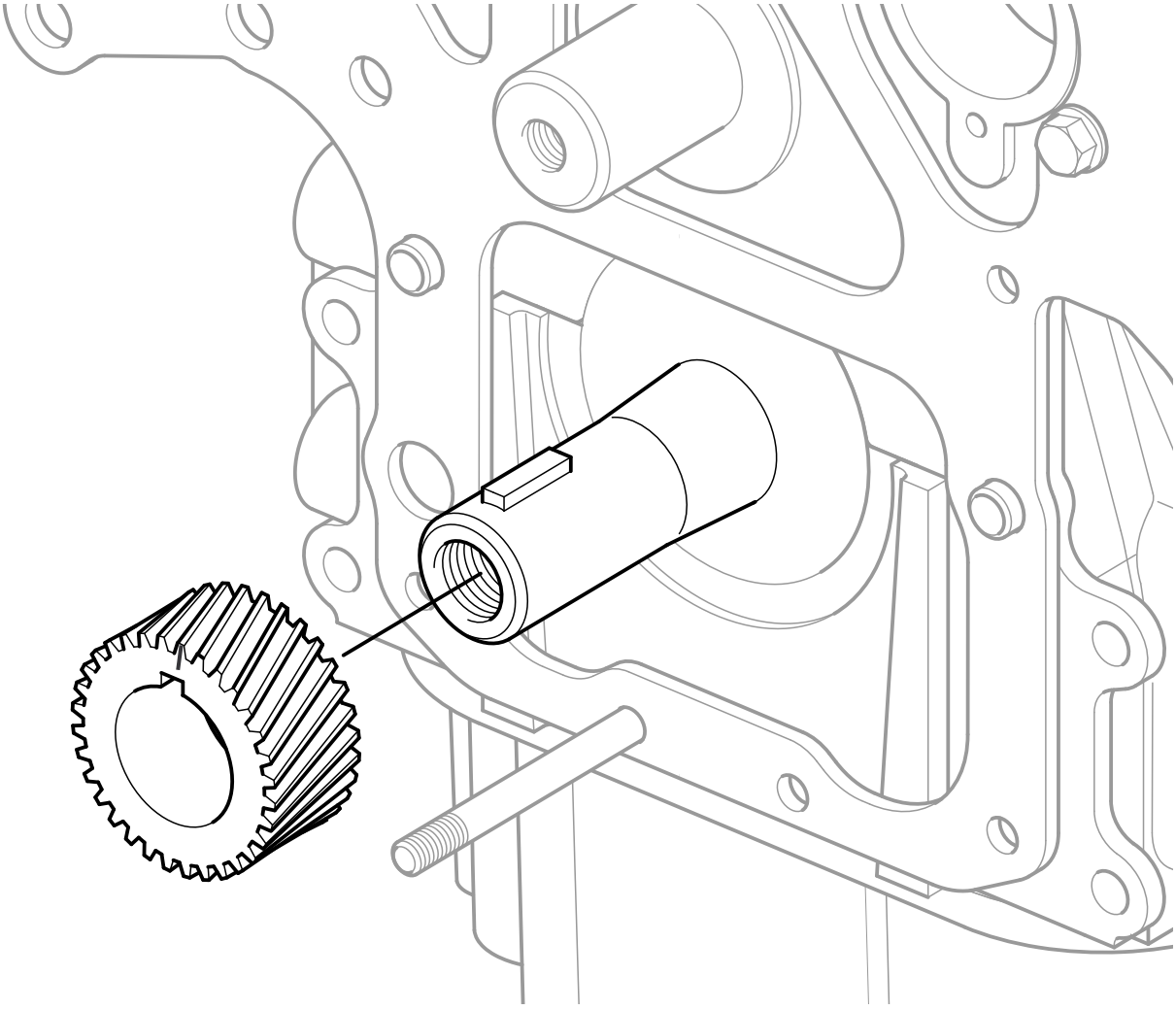






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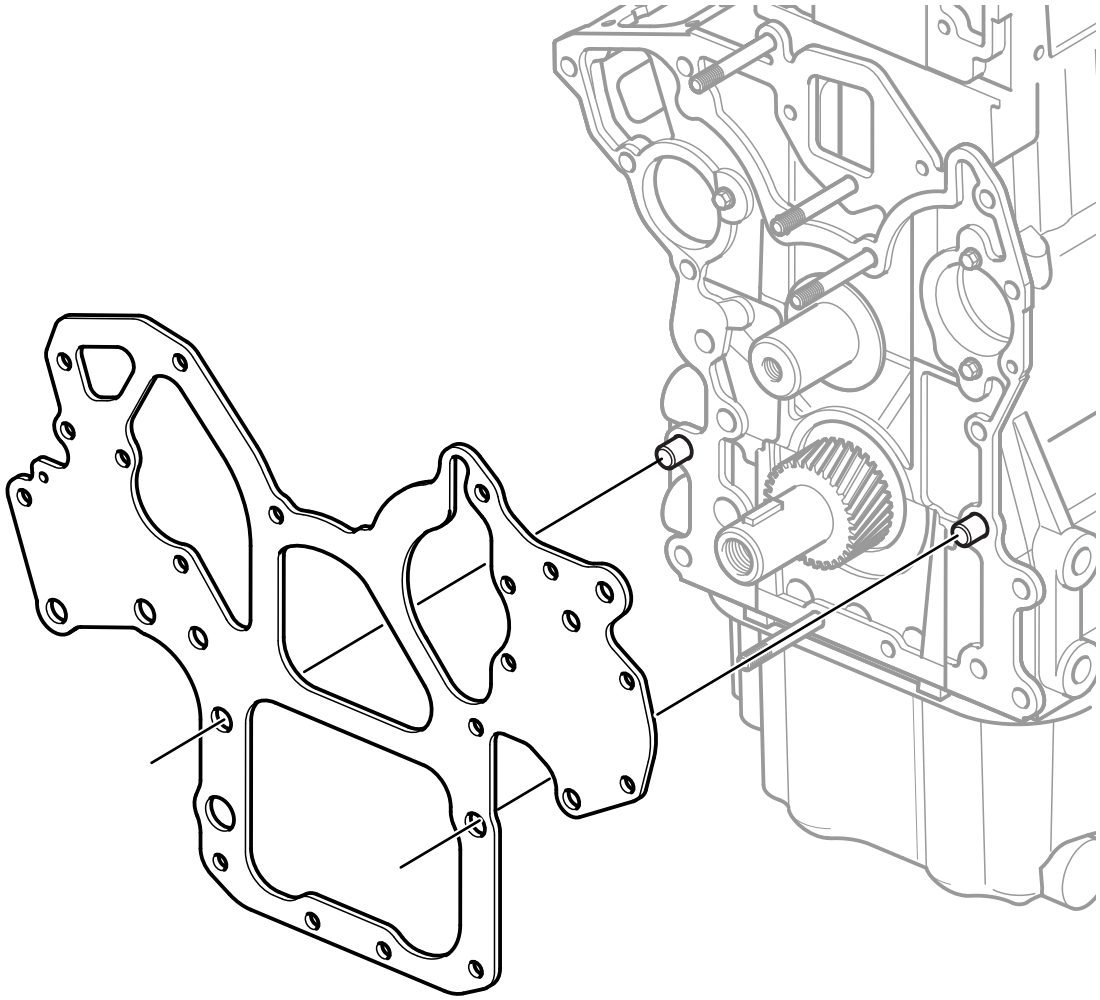
Operation: **Crankshaft gear - to remove and to fit**	**15.12**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:** The crankshaft gear is an interference fit on the crankshaft. It may be removed with a suitable puller. If this is not possible, it will be necessary to remove the crankshaft, and press the gear off. ***Warning!*** *Heat is used to fit the gear, ensure that suitable leather gloves are worn to protect the hands.*



To fit the gear, it will be necessary to heat the gear before it will fit onto the crankshaft. Heat the gear gradually to not more than 300° C (572° F). Do not use a flame as this can cause local damage. Fit the gear with the timing marks towards the front.

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Operation: **Backplate - to remove and to fit**	**15.13**
Recommended torque: **Engine type Nm lbf ft kgf m** - - -	**Special notes:** ***Caution:*** *The maximum fuel setting will be affected if:* *sealant is used on the joint faces of the timing case or back plate; the joint faces are damaged when the old joint is removed.*



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Operation:
Cylinder block bores - to inspect **16.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

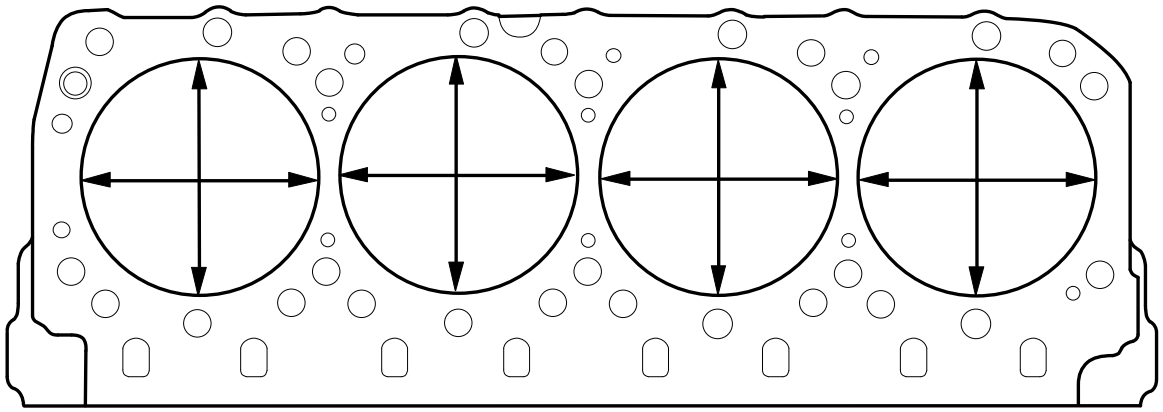
Service operations:
1. Remove cylinder head … … **section 12**

Special notes and tools:
Check for areas where the honed finish has been polished away. Check especially the area around the top of the bore just below the carbon ring. In this area, there is maximum wear from the top piston ring.

Caution: *An engine can have high oil consumption with very little wear of the bores, if the surfaces of the bores are glazed.*

Check the cylinder bores for wear and other damage. The bores should be checked at the top, the centre, the bottom and in two directions, across the engine and along the centre line.
If the cylinder bores are worn by more than 0,25 mm (0.01 in), the bores can be bored and honed 0,5 mm (0.020 in) oversize in diameter and oversize pistons fitted. To ensure that the engine will conform to emissions legislation after it has been bored, the cylinder bores must be diamond honed, silicon carbide base honed and then silicon carbide plateau honed to the surface finish shown in Data and dimensions.

Caution: *If the cylinder block is to be bored, all cylinders must be bored and new pistons fitted as a complete set.*



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Operation:
Camshaft bush - to renew **16.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:

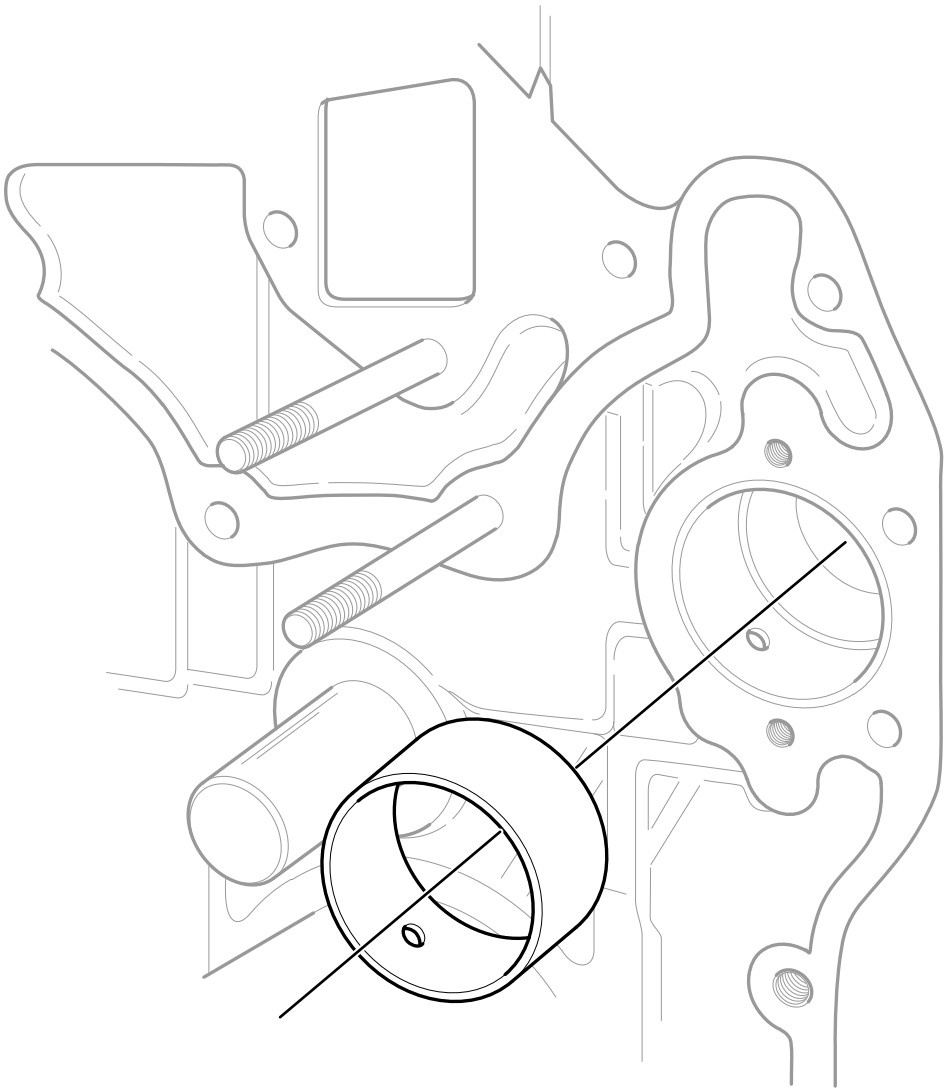
1. Remove timing case … … … … **13.02**
2. Remove the camshaft for the valves … … … … … … **15.09**

Special notes and tools:

Note: Use a suitable adaptor to remove the old bush. Do not damage the bore in the cylinder block.

Caution: *Ensure that the oil holes in the bush are aligned with the oil holes in the cylinder block.*

When the new bush is fitted, check in six places, that the diameter of the bush is correct.



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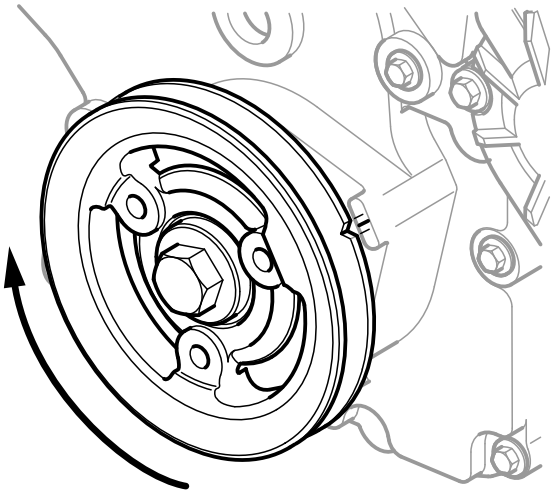
Operation:
To set accurately number 1 piston to TDC on the compression stroke **17.01**

Recommended torque:

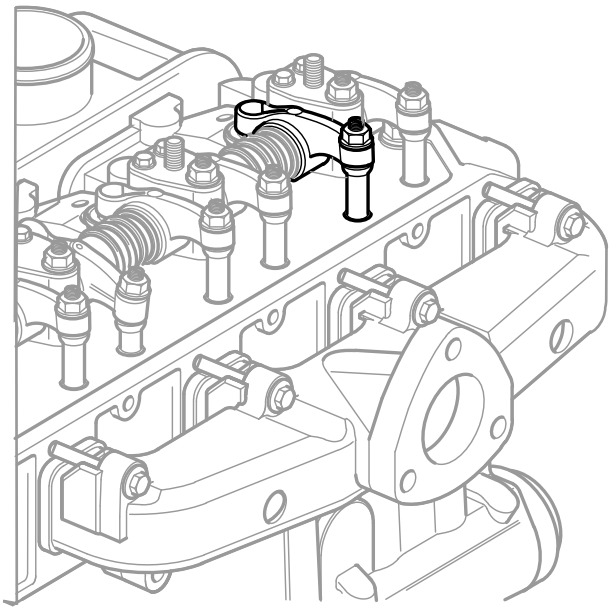
Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove rocker cover … … … … **12.01**

Special notes and tools:
Note: Clockwise / counter-clockwise direction is when seen from the front of the engine.



Rotate the crankshaft, clockwise, until the push rod for the inlet valve of the rear cylinder just tightens. The piston for number one cylinder will be near to TDC and the mark on the crankshaft pulley should be near to the mark on the timing case



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Operation:
To set approximately number 1 piston to TDC on the compression stroke **17.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

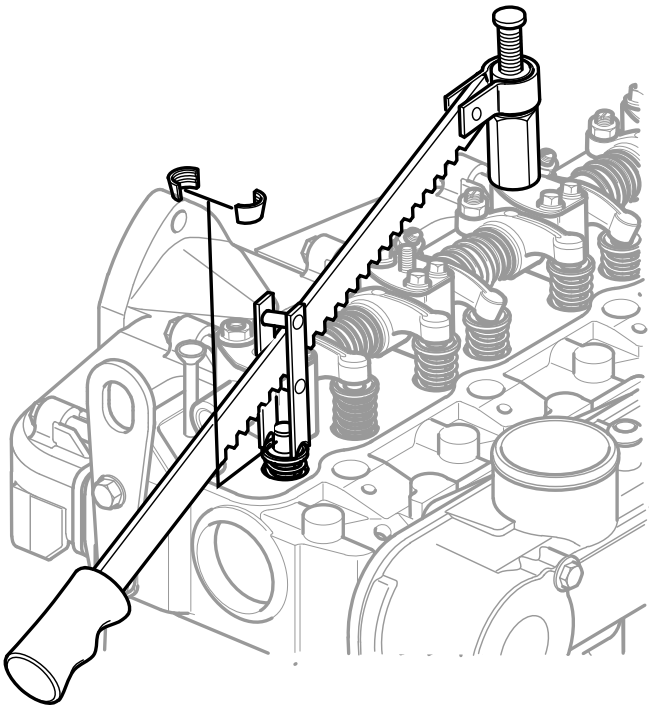
Service operations:
1. Remove rocker cover… … … … **12.01**

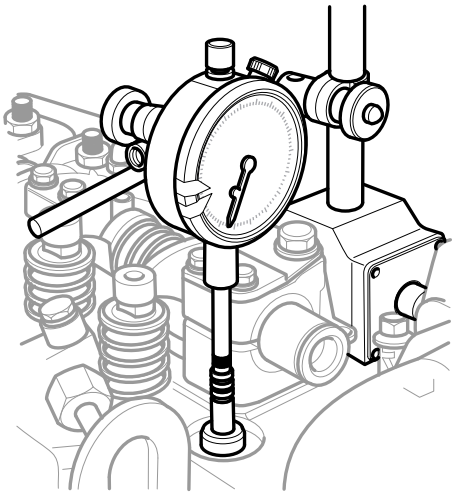
Special notes and tools:
Special tools: Valve spring compressor, part number 21825666
Stud adaptor, part number 27610016, for use with the valve spring compressor

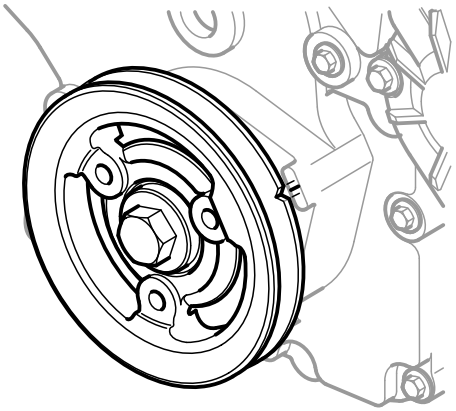
Caution: *When the valve spring is removed, ensure that the collets do not fall into the holes for the push rods.*

Warning: *Wear eye protection during this operation,*

Remove the spring clip and the spacer from the front of the rocker shaft. Release the fasteners of the first two pedestals of the rocker shaft. Release the tappet adjustment screw and remove the front rocker lever. Tighten the fasteners of the rocker shaft pedestals.
Remove the valve spring and the cap from the front valve with the valve spring compressor and the adaptor, for the pedestal studs.
Allow the valve to be held by the top of the piston.
Fasten a dial test indicator with its plunger in contact with the top of the valve stem and with a reading shown on the gauge.
Rotate slowly, the crankshaft counter-clockwise 45°. Then rotate slowly, the crankshaft clockwise until the clockwise movement of the dial gauge pointer stops.
With the pointer in the maximum clockwise position, the piston for number one cylinder will be at TDC on the compression stroke.







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Operation:
To check valve timing **17.03**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove rocker cover … … … … **12.01**
2. Set valve tip clearances … … … **12.04**

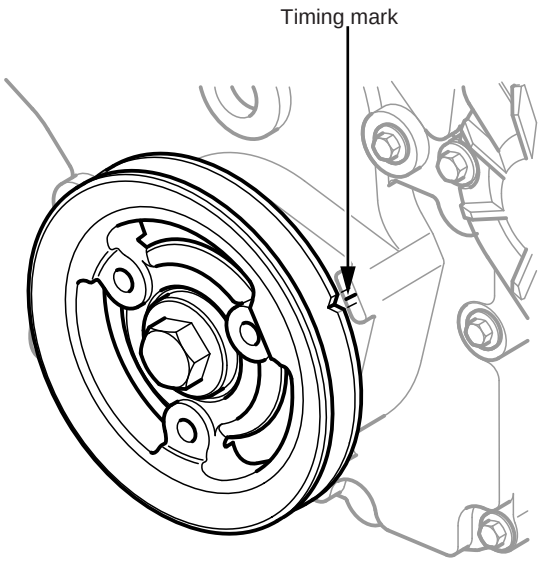
Special notes:

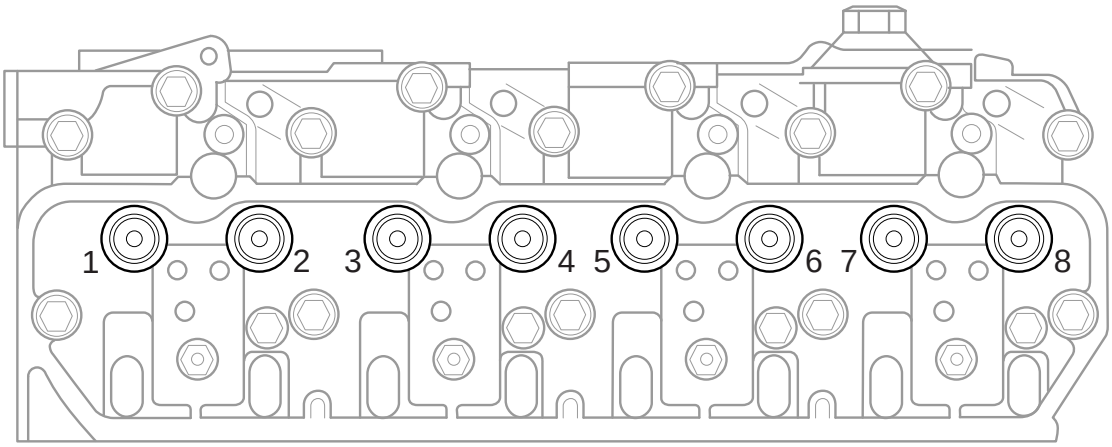
Check and, if necessary, adjust the valve tip clearances.
Rotate the crankshaft, clockwise from the front, until the valve is fully open. The piston for number one cylinder is now on the compression stroke.
Set the valve tip clearance for the valve to 0,59 mm (0.023 in).
Rotate the crankshaft, clockwise from the front, until the push rod for the valve just tightens. In this position, check if the mark on the crankshaft pulley is within 2.5° of the mark on the timing case. If it is, the valve timing is correct.
If the timing is more than 2.5° out of position, the timing gears are probably not in correct mesh.
Note: Use the formula below to find the measurement on the pulley which is equal to 2.5°.

$$\frac{C \times P}{360}$$

Where:
- C = the circumference of pulley
- P = 2.5°

Rotate the crankshaft, clockwise from the front, until the valve (7) has just opened and the valve (8) has not closed completely. Set the valve tip clearance of the valves (1 and 2) to 0,35 mm (0.014 in).





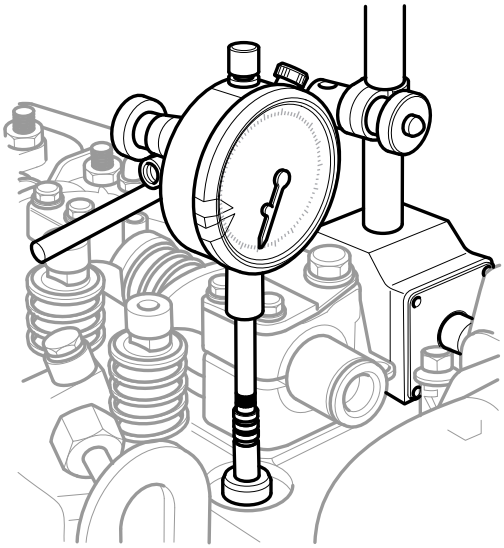
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Operation:
Fuel injection pump timing **17.04**

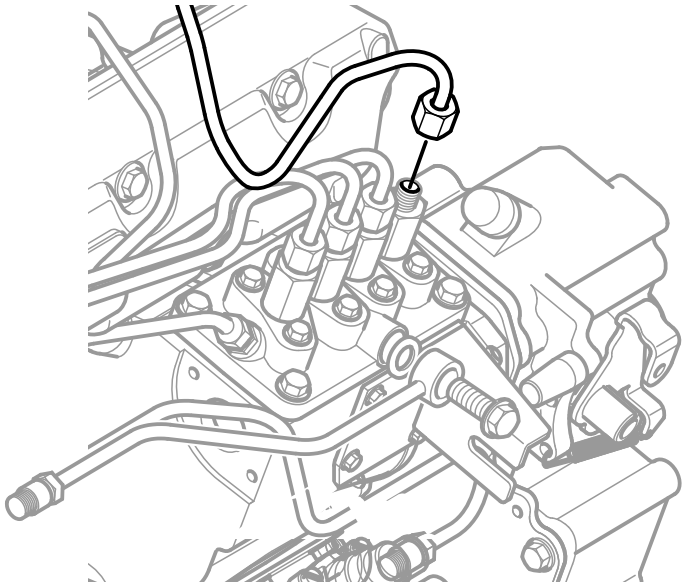
Recommended torque:

Engine type	Nm	lbf ft	kgf m
High Pressure Fuel Pipes	27	20	2.7
Low Pressure Fuel Pipes	20	15	2.0

Special notes and tools:
Notes: The method used to check the timing of the fuel injection pump is spill timing.
The timing marks on the crankshaft pulley and on the timing case are not accurate enough when the engine is spill timed.
Clockwise / counter-clockwise direction is when seen from the front of the engine.



With the dial gauge still on the first valve, rotate the crankshaft counter-clockwise until the dial gauge pointer moves counter-clockwise 5,08 mm (0.20 in).



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Operation:
Fuel injection pump timing **17.04**

Recommended torque:

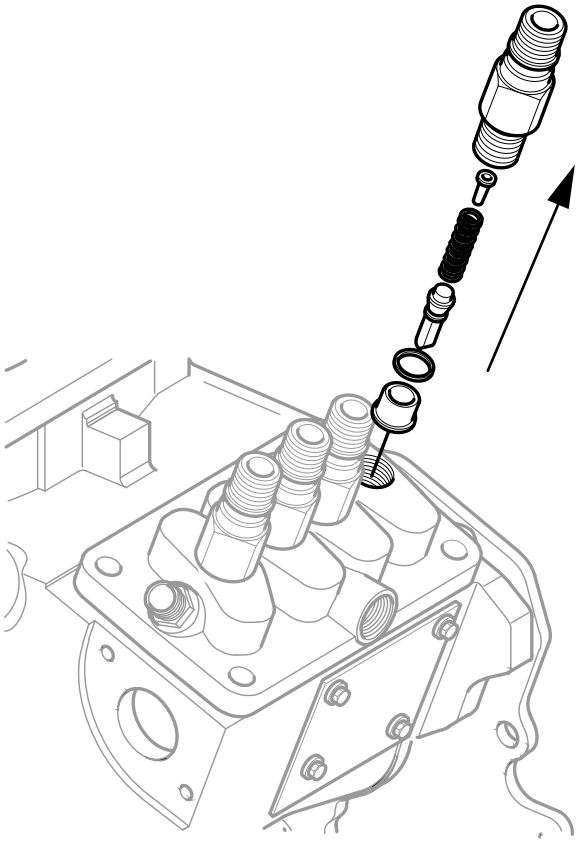
Engine type	Nm	lbf ft	kgf m
Delivery valve holder	43	(32)	4,3

Service operations:

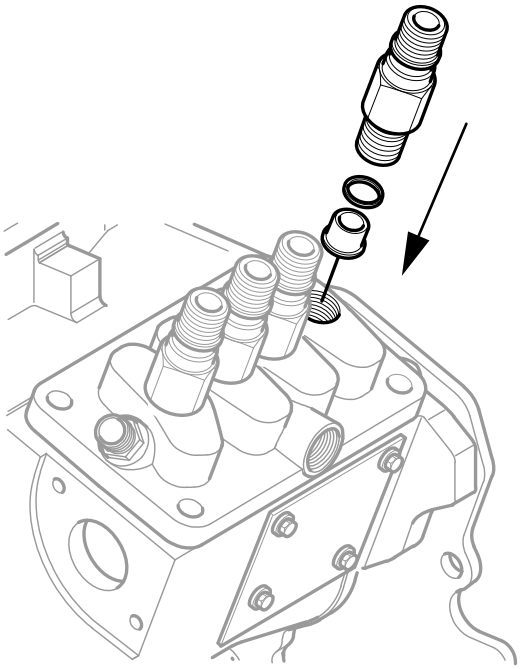
1. Remove electrical stop solenoid … … … … … … … … … **23.06**

Special notes and tools:

Cautions: *When the delivery valve holder is removed from the pump, the crankshaft must not be rotated. If this does occur, the injection pump will be permanently damaged.*
Extreme care must be used with the components when the delivery valve assembly is removed and fitted during the spill timing procedure.
The area inside the delivery valve chamber must remain completely clean at all times.
Do not tighten the delivery valve holder unless the components are aligned. If they are not aligned correctly, the injection pump will be permanently damaged.



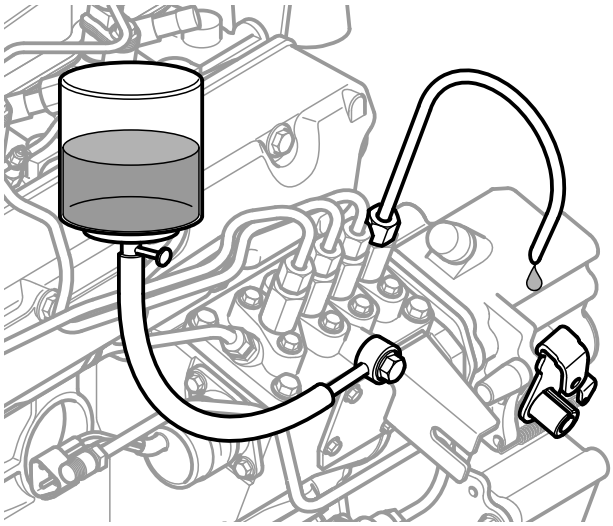
Remove the delivery valve holder for number 1 cylinder and remove the delivery valve, the spring and the location pin.
Keep these components in clean diesel fuel.



Fit in the correct sequence, the holder, the washer and the seat to the pump.

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Operation: **Fuel injection pump timing**	**17.04**
Recommended torque: **Engine type Nm lbf ft kgf m**	**Special notes and tools:**



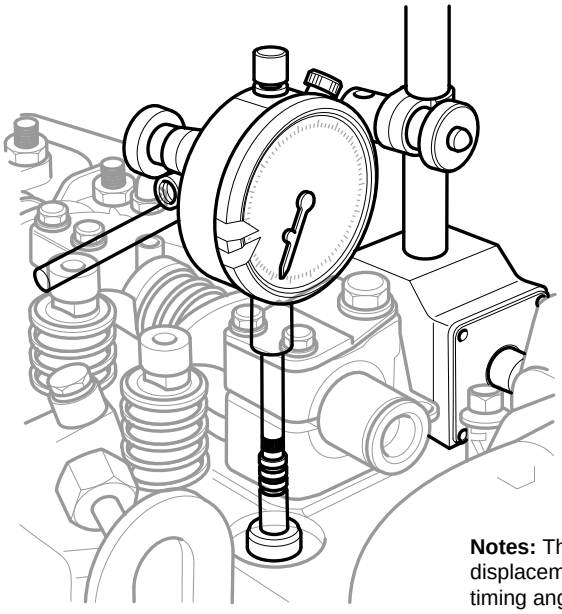
Connect a suitable clean tank, with a capacity of approximately 0,75 litres (1.32 pints) and a valve, to the inlet of the fuel pump. The outlet from the tank should be approximately 152 mm (6 in) above the pump. This will ensure that the fuel is supplied to the pump at a constant pressure.

Connect a swan neck pipe to the delivery valve holder for number one cylinder. Put a suitable container below the swan neck pipe to retain the spilt fuel.

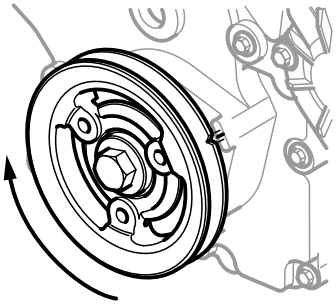
Add 0,5 litres (0.9 pints) of clean fuel to the container.

Open the valve.

Ensure that the engine speed control lever is kept in the maximum fuel position during this procedure.



Rotate clockwise



Turn the crankshaft slowly in a clockwise direction, until the flow of fuel from the swan neck pipe, is reduced to one drop every 7-10 seconds. Record the reading on the dial test indicator.

Notes: The reading on the indicator shows piston displacement. For the correct displacement / static timing angles, see Data and dimensions in section 11.

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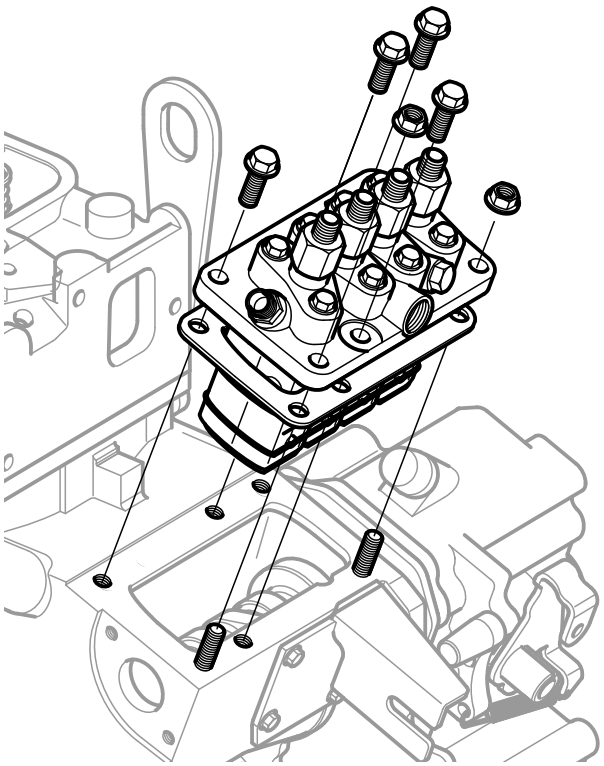
Operation:
Fuel injection pump timing **17.04**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Holder	43	32	4.3

Service operations:
1. Remove high pressure fuel pipes … … … … … … … … … **20.03**
2. Remove leak off rail … … … … **20.04**

Special notes and tools:



If it is necessary to adjust the timing, remove the pump and fit a shim of the correct thickness, see table below.

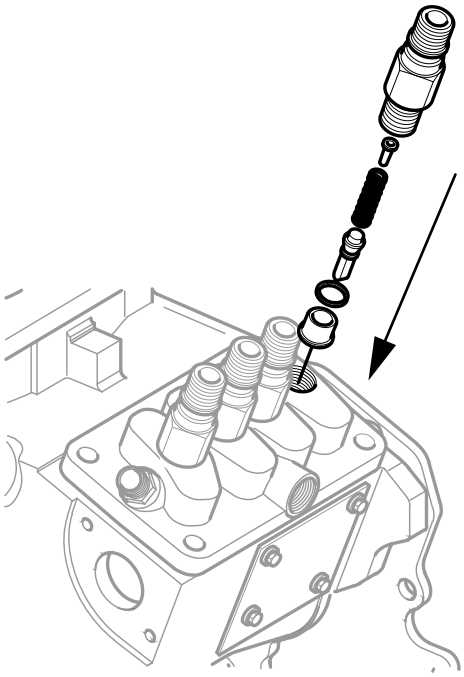
To retard the timing; fit a thicker shim. To advance the timing; fit a thinner shim.

The timing will change approximately 1° for each 0,10 mm (0.004 in) of shim thickness

If the shim has to be changed, it will be necessary to repeat procedure.

When the timing is correct, remove the swan neck pipe and the tank assembly.

Part number	Thickness mm (inches)
3621F011	0,1 (0.004)
3621F012	0,2 (0.008)
3621F013	0,3 (0.012)
3621F014	0,4 (0.016)
3621F015	0,5 (0.020)



Remove the delivery valve holder from the pump.

Tighten the holder to 43 Nm (32 lbf ft) 4,3 kgf m.

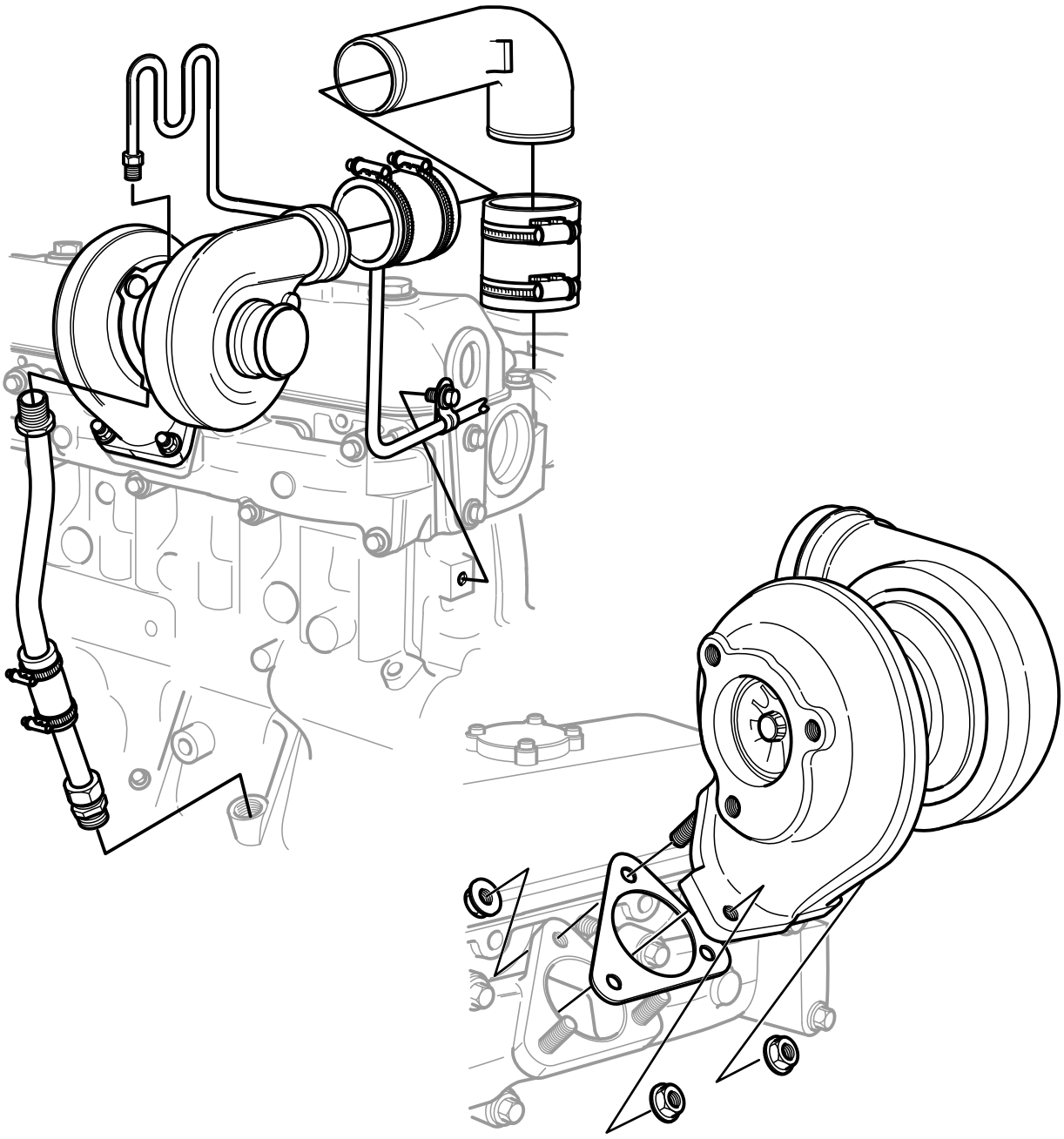
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Operation:
Turbocharger - to remove and to fit **18.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Nuts	**22**	**16**	**2,2**

Special notes:
Caution: *Lubricate the bearing housing of the turbocharger with clean engine lubricating oil before re-assembly.*



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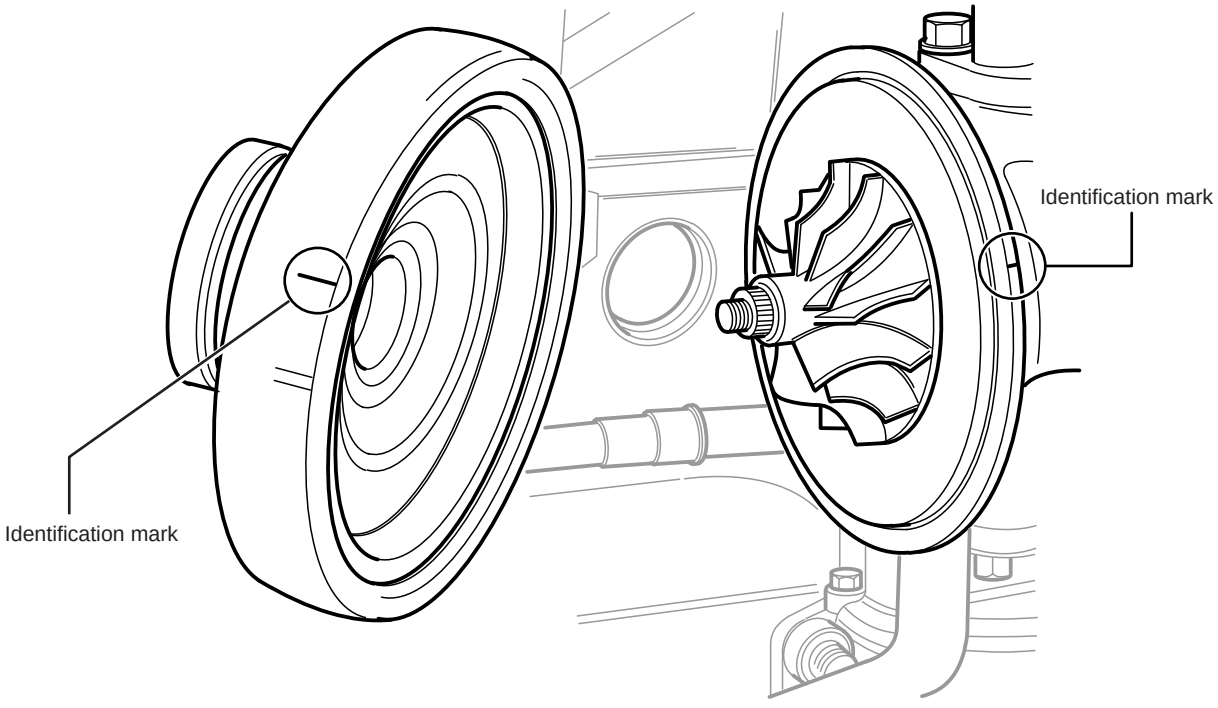
Operation: **To clean the impeller and compressor casing**	**18.02**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:**

Generally, it is not necessary to remove the turbocharger to remove the compressor casing, except on some engines where access to the circlip is not always possible.

- Release the clip and remove the hose from the compressor inlet. Release the clips and push the hose up the cross over pipe.
- Make a reference mark on the compressor casing and on the bearing housing to ensure correct assembly later.
- Release the circlip. It may be necessary to remove the turbocharger if access to the circlip is not possible.

Caution: *Be careful not to damage the impeller blades, as the turbocharger must then be renewed.*

- Remove carefully the compressor casing from the turbocharger. If the casing is tight, lightly hit it with a soft faced hammer.
- Put the compressor casing in a suitable container that contains a non-caustic solution. Allow the dirt to become soft and then clean the casing with a hard brush and/or a soft scraper. Dry the casing with clean, compressed air at low pressure.
- Clean the impeller with a soft brush.
- Push carefully the compressor impeller towards the bearing housing and turn the impeller by hand. Check that there is no restriction of movement and that there is no noise which can indicate a fault. If there is a fault, remove the turbocharger for inspection by a specialist.
- Fit the circlip loosely to the bearing housing.
  Ensure that the flat face of the circlip is toward the compressor casing. Fit the casing to the turbocharger and align the marks on the casing and on the bearing housing. Fit the circlip in its groove.
- Fit the hoses to the compressor inlet and tighten the clip. Slide the hose along the cross over pipe onto the compressor outlet. Tighten the clips.



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Operation:
Engine breather assembly - to renew **18.03**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:

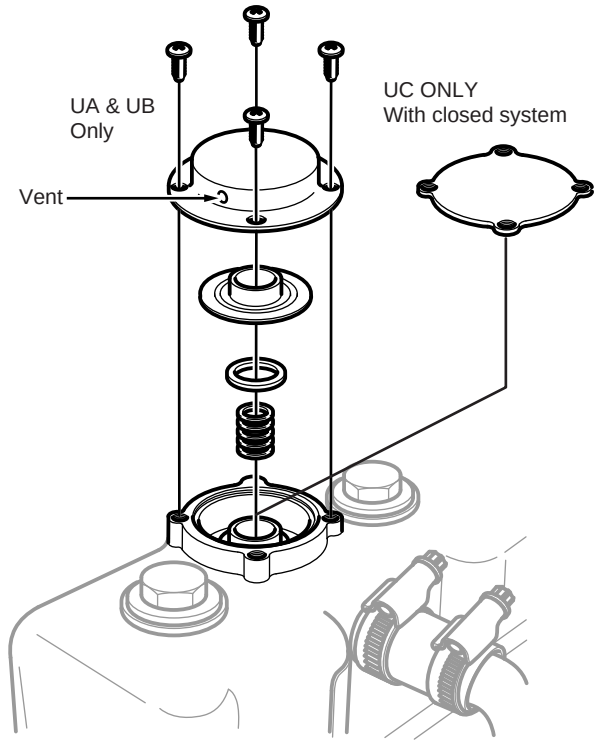
Cautions: *It is important that the area around the vent hole is kept clean and the vent hole is not restricted.*
Ensure that the pipe, when fitted, does not contact other components as this may cause the failure of the pipe. Ensure that the pipe connections are tight.
Ensure that the components of the breather assembly are fitted in their correct positions.
If they are fitted incorrectly, the engine can be damaged.

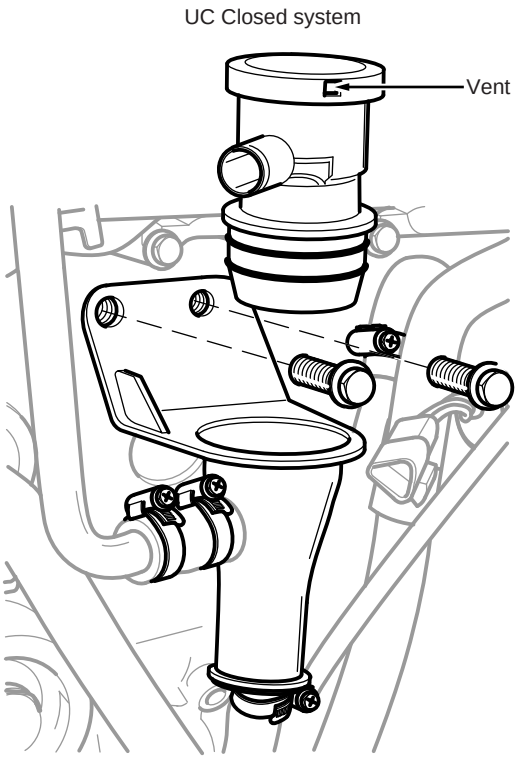
Engine types UA and UB only;
Notes: The breather assembly should be renewed every 2000 hours.
The breather components and the pipe should be removed and cleaned every 1000 hours.

Engine types UC only;

Warning!: *Ensure that the breather pipe connections are tight.*
Do not exceed the correct level of lubricating oil in the sump. If there is too much lubricating oil, the excess must be drained to the correct level. An excess of lubricating oil could enter the breather. This could cause the engine speed to increase rapidly without control.

Note: The breather valve assembly should be renewed every 5000 hours.





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Operation:
Oil filter canister - to renew **19.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:

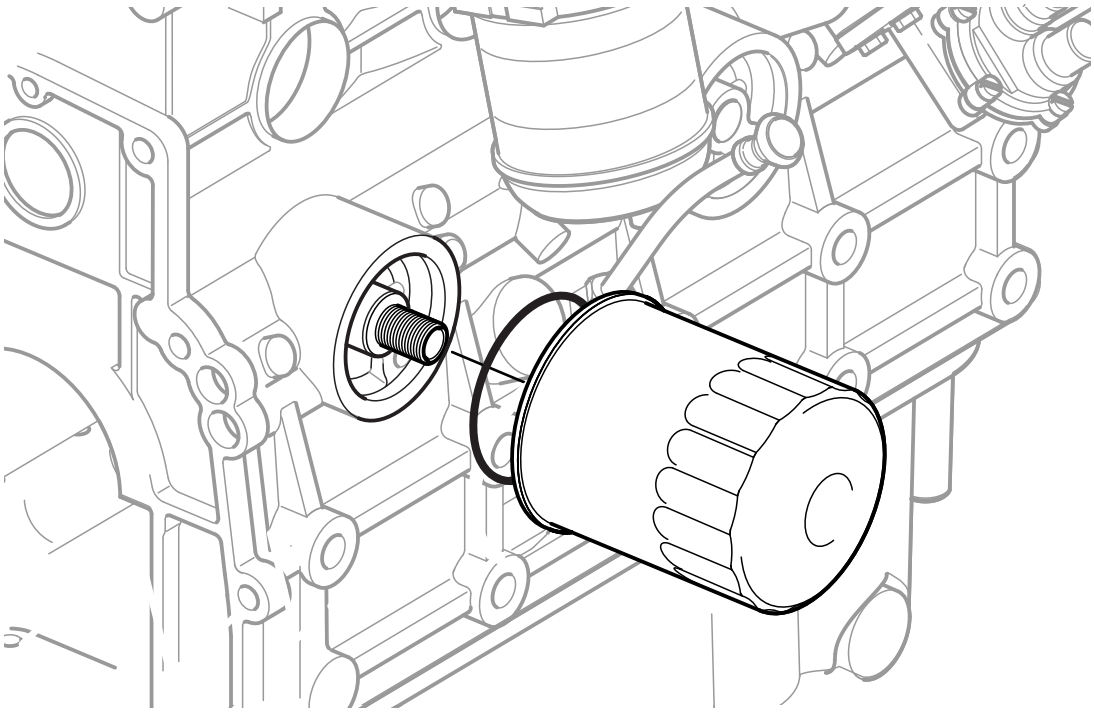
Special tools: Strap wrench (or similar tool)

Warning! *Discard the used canister and lubricating oil in a safe place and in accordance with local regulations.*
Any excess lubricating oil must be drained to the correct level.
An excess of lubricating oil could enter the breather valve.This could cause the engine speed to increase rapidly without control.

Cautions: *Ensure that the application is on a level surface to ensure an accurate reading on the dipstick. When the sump is filled with lubricating oil, ensure that the level of the oil is not above the notch on the dipstick.*

Note: Some engines have a separate filter head that is fitted to the cylinder block, directly onto the filter mounting face. The filter canister is then fitted to the filter head.

Remove and discard the canister. Ensure that the adaptor is secure in the filter head.
Fit the new canister and tighten by hand until the seal contacts the filter head, or the mounting face. Tighten the canister a further 1/2 to 3/4 of a turn by hand only. Do not use a strap wrench.



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Operation:
Engine lubricating oil - to renew **19.02**

Recommended torque:

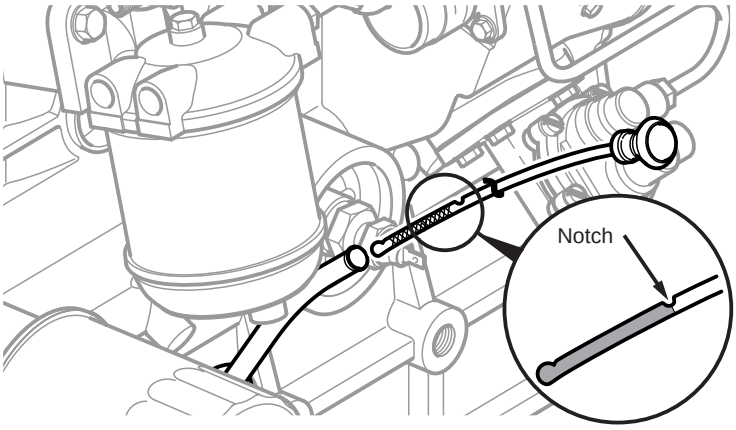
Engine type	Nm	lbf ft	kgf m
Sump drain plug	34	25	3,5

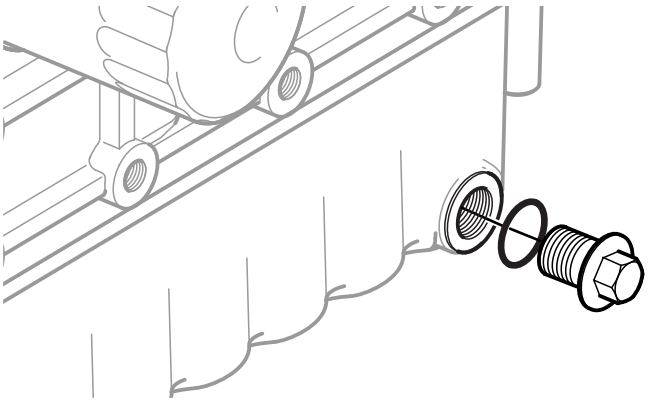
Special notes and tools:

Warning! *Discard the used canister and lubricating oil in a safe place and in accordance with local regulations.*
Do not fill the sump past the notch on the dipstick.
Any excess lubricating oil must be drained to the correct level.
An excess of lubricating oil could enter the breather valve.
This could cause the engine speed to increase rapidly without control.

Cautions: *Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.*

Fill the sump to the correct level.
To ensure that the engine will not start, disconnect the electrical stop control of the fuel injection pump. Operate the starter motor until oil pressure is obtained. Oil pressure is indicated when the warning light is extinguished or by a reading on the gauge.
Start the engine and check for leakage from the filter. Stop the engine. After 15 minutes, check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump. Fill the sump to the notch on the dipstick with an approved lubricating oil.





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Operation:
Filter head and oil cooler - to remove and fit **19.03**

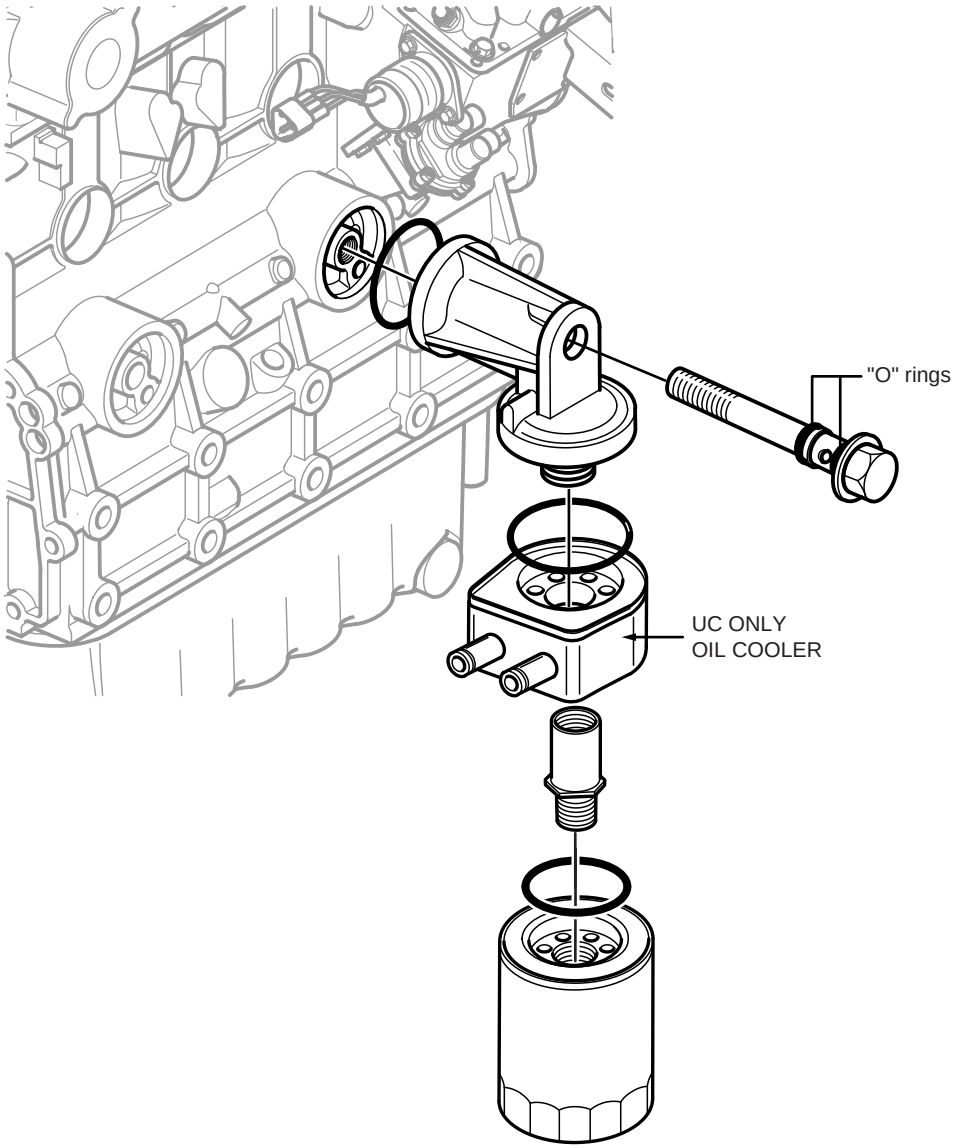
Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrew	80	59	8,2
Adaptor	57	42	5,8

Special notes and tools:

Note: Renew "O" rings when refitting.

Release the setscrew and remove the filter head from the cylinder block. Discard the "O" rings on the setscrew and the "O" ring on the filter head. Fit the filter head together with a new "O" ring. Fit new "O" rings to the setscrew and tighten the setscrew to the torques shown.



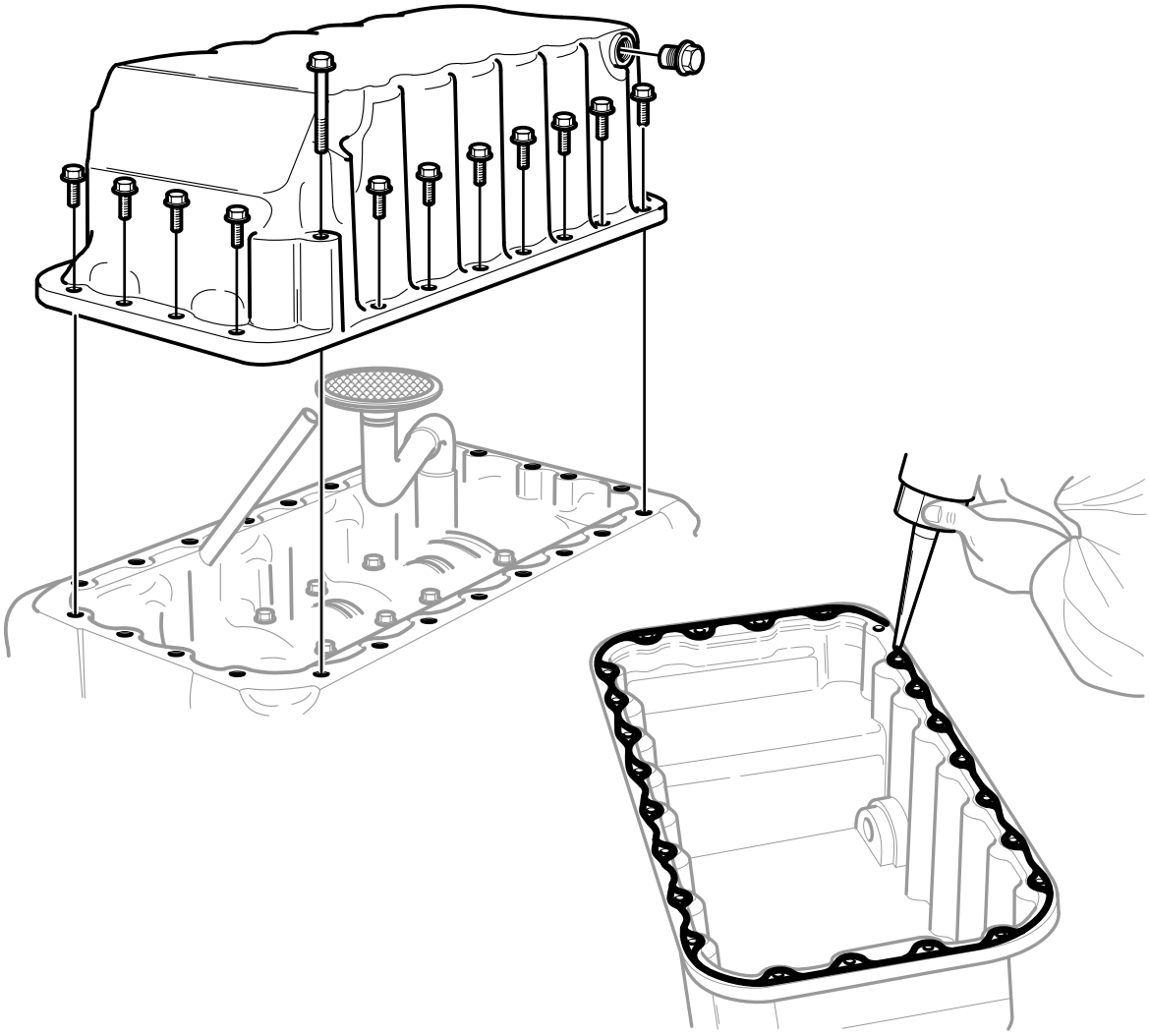
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Operation:
Sump - to remove and to fit **19.04**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrews	**22**	**16**	**2,2**
Drainplugs	**34**	**25**	**3,5**

Special notes and tools:
Special tools: Silicone adhesive, part number 21826038
Refer to Operation **19.02** for renewal of engine oil.
Note: Some agricultural applications have an engine with a divided sump to allow for a drive shaft. If this sump is used, both drain plugs must be removed, to ensure that all of the lubricating oil is drained.
When refitting, put a bead of Silicone adhesive along the flange of the sump.



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Operation:
Oil strainer and suction pipe - to remove and fit **19.05**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrew	22	16	2,2

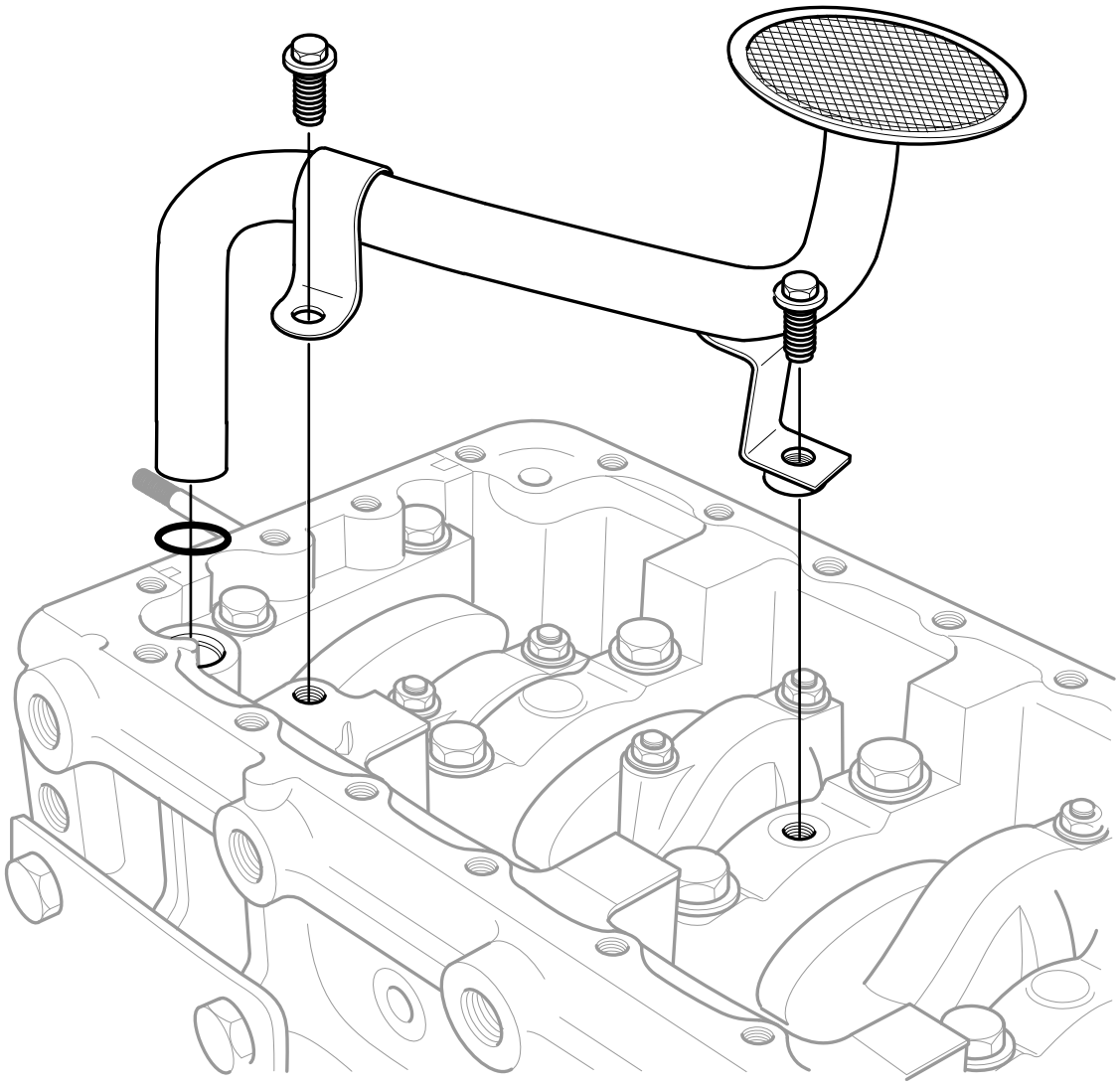
Service operations:

1. Remove sump … … … … … … **19.04**

Special notes and tools:

Caution: *When the setscrew for the suction pipe bracket is tightened, ensure that a downward load (towards the block), is applied to the pipe. When fitted, it should not be possible to move the pipe by hand.*

Fit a new "O" ring into the groove in the hole in the cylinder block for the suction tube.



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Operation:
Lubricating oil pump - to renew **19.06**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Cap screws	9	7	0,7

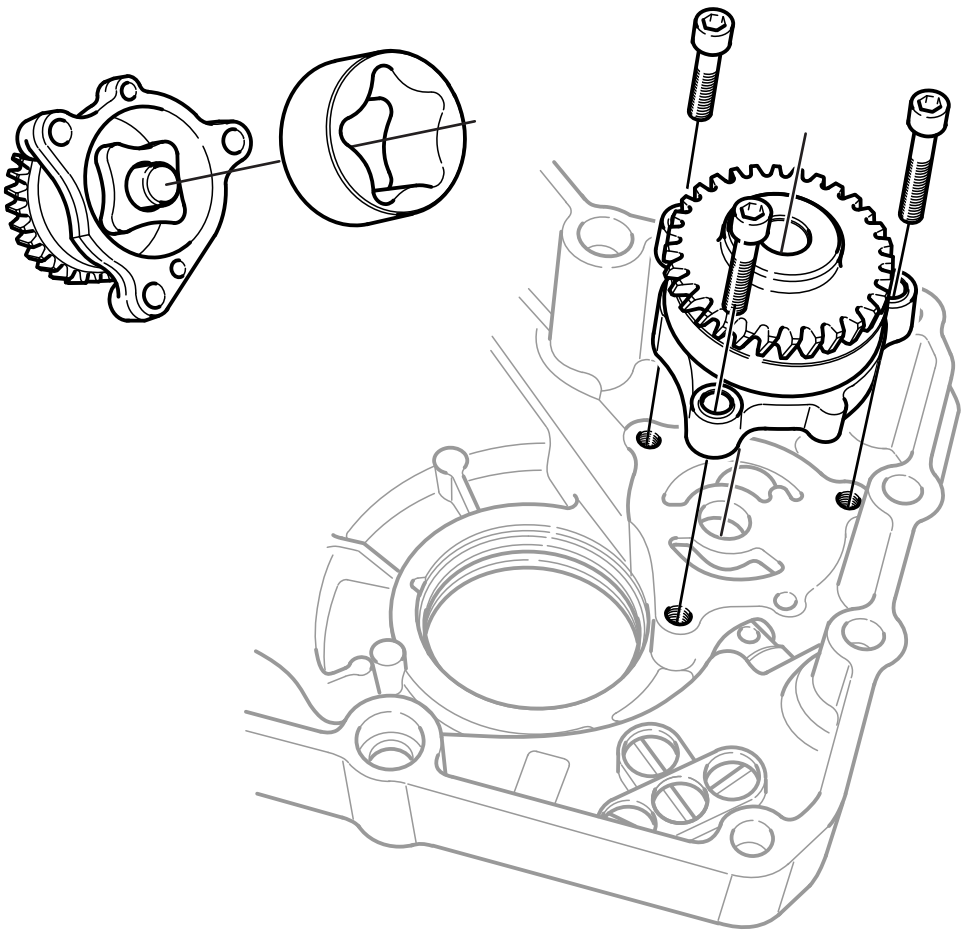
Service operations:

1. Remove crankshaft pulley … … **14.01**
2. Remove timing case … … … … **15.02**

Special notes:

Note: The cap screws are of different lengths. Ensure they are fitted from where they were removed.

Caution: *The latest engines do not have dowels to align the oil pump. On these engines it is important to tighten the cap screws gradually and evenly to the correct torque. When the cap screws are tight, rotate the shaft of the oil pump by hand to ensure that it is free to move easily.*



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Operation:
Lubrication oil pump - to inspect **19.07**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:

1. Remove crankshaft pulley … … **14.01**
2. Remove timing case … … … … **15.02**
3. Remove lubricating oil pump … … … … … … … … … **19.06**

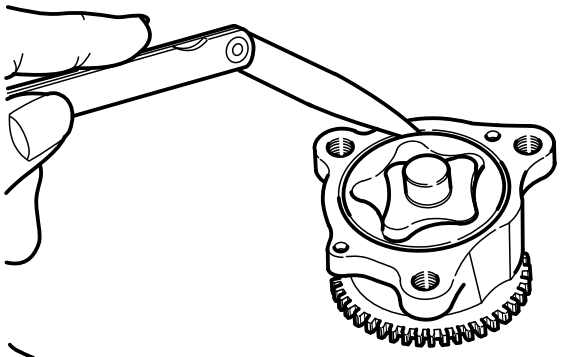
Special notes and tools:

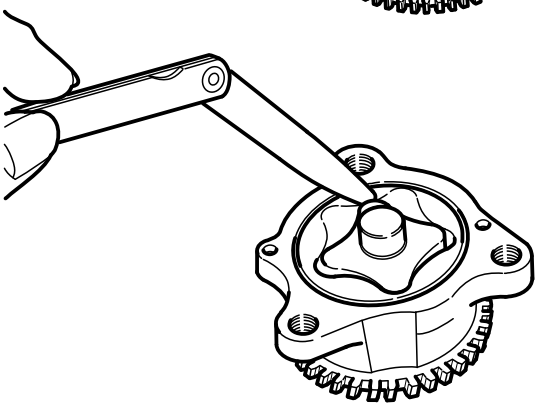
Special tools: Feeler gauge.

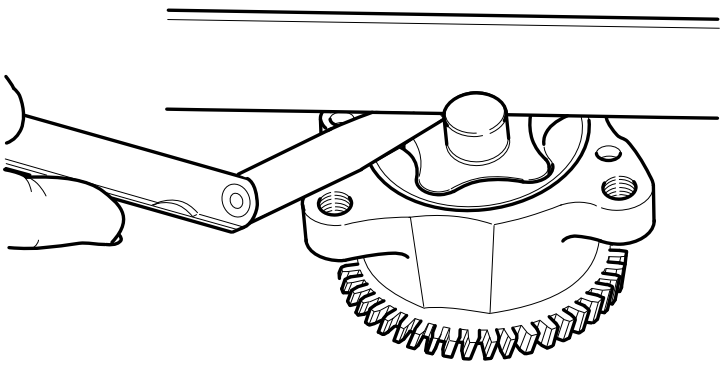
Notes: Fit the outer rotor and check the outer rotor to body clearance with a feeler gauge.

Check the inner rotor to outer rotor clearance.

Check the rotor end-float with a straight edge and a feeler gauge. For the above clearances, see Data and dimensions in **section 11**.







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Operation:
Relief valve - to remove, to fit and to renew **19.08**

Recommended torque:

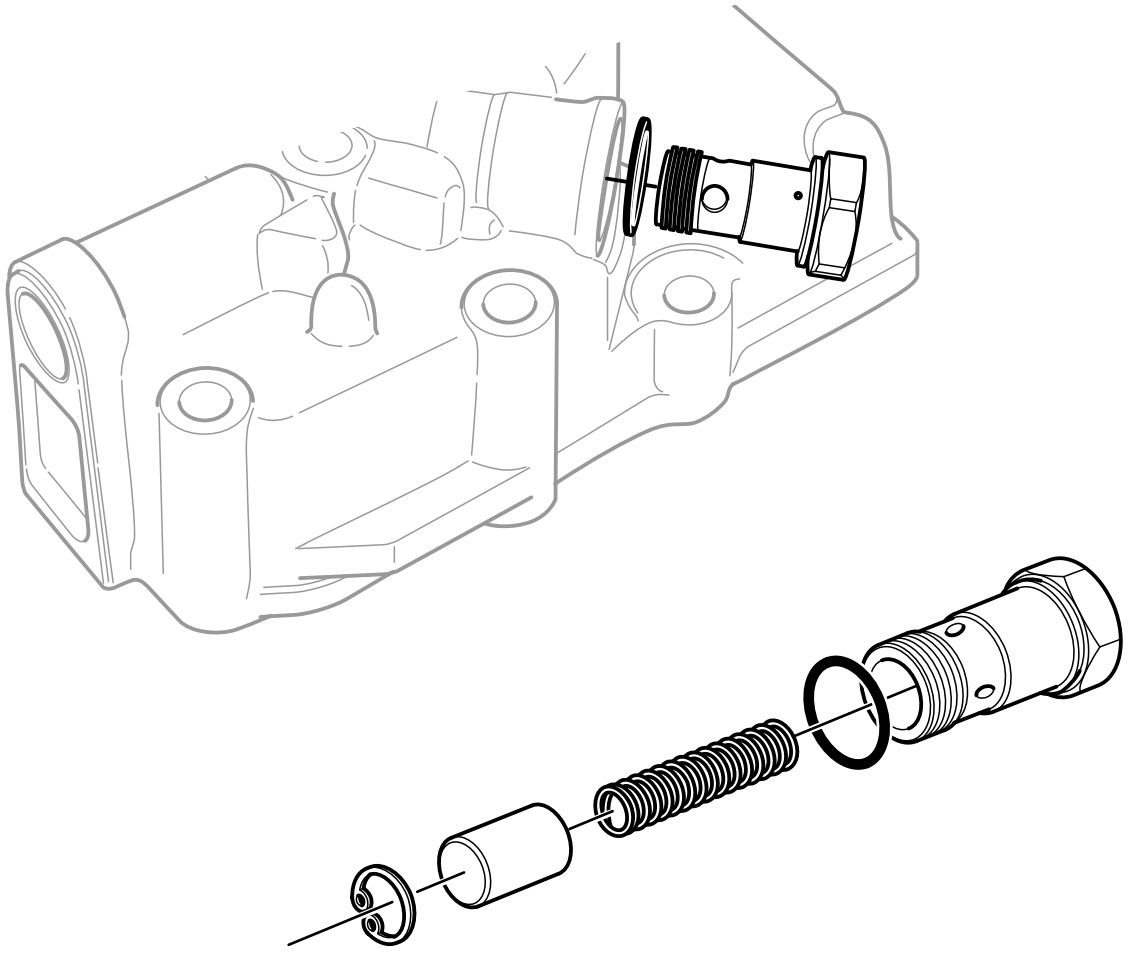
Engine type	Nm	lbf ft	kgf m
Relief valve	20	15	2,0

Special notes and tools:

Note: Fit a new "O" ring to the relief valve and fit the relief valve into the timing case. Ensure that all the components are cleaned and then lubricated lightly with clean engine lubricating oil.

Caution: *Do not try to change the operating pressure of the relief valve. If necessary, fit new components.*

Check all components for wear and correctness of operation. Check the load necessary to compress the spring to its fitted length, see data and dimensions in **section 11**.
Renew worn or damaged components.



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Operation:
Fuel filter element - to renew **20.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m

Service operations

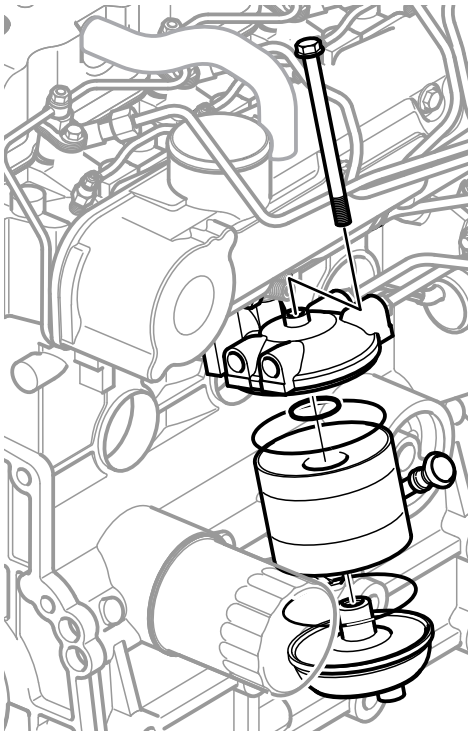
1. Eliminate air from the fuel system	… … … …	**20.09**

Special notes:

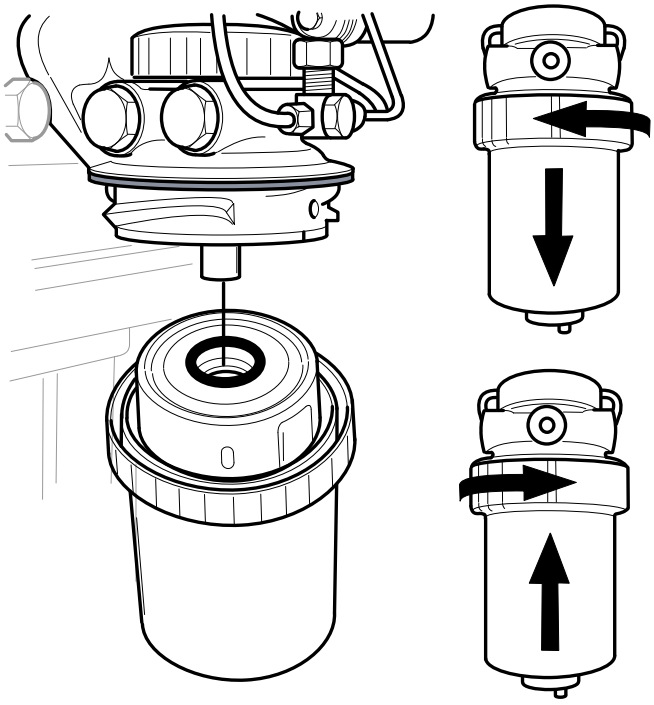
Warning! *Discard the used canister and fuel oil in a safe place and in accordance with local regulations.*

Cautions: *It is important that only genuine parts are used. The use of wrong parts could damage the fuel injection equipment.*
Do not allow dirt to enter the fuel system. Clean thoroughly the area around all of the components before they are removed and fit suitable covers to all open connections.

Renew the seals and the 'O' ring.
Ensure that the element is fitted in the centre, against the 'O' ring in the filter head.
Eliminate the air from the fuel filter, operation **20.09**.



UC ONLY



If a quick release canister is fitted, loosen the drain device at the bottom of the canister. Support the canister and rotate the ring to the left to release the ring. Give the canister a direct pull downwards to remove it from the filter head. Discard the old canister in accordance with local regulations.

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Operation:
Atomiser fault - to inspect **20.02**

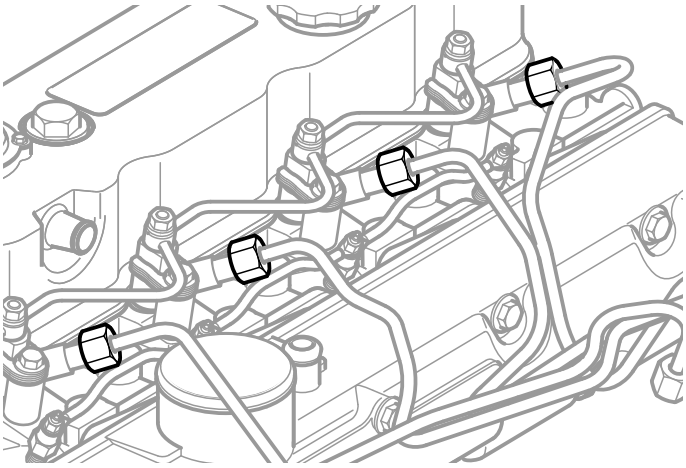
Recommended torque:

Engine type	Nm	lbf ft	kgf m
High pressure fuel pipes	27	20	2,8

Special notes and tools:

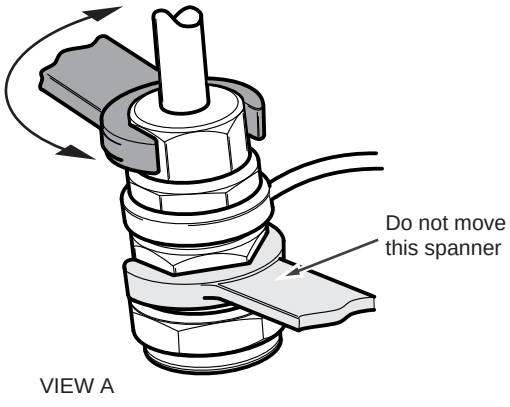
Warnings! *If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.*
Keep away from moving parts during engine operation. Some moving parts cannot be seen clearly while the engine runs.

An atomiser fault can cause an engine misfire.
In order to find which atomiser is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of the high-pressure fuel pipe at each atomiser in turn. Do not loosen the union nut more than half a turn. When the union nut of the defective atomiser is loosened, it will have little or no effect on the engine speed. Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.

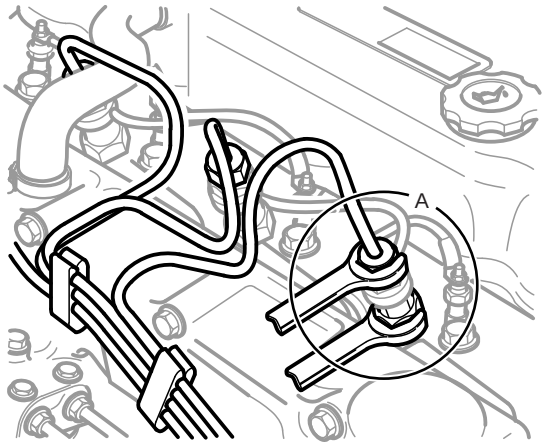


UA AND UC ENGINES

UB ENGINES



VIEW A



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Operation:
High pressure fuel pipes - to remove and to fit **20.03**

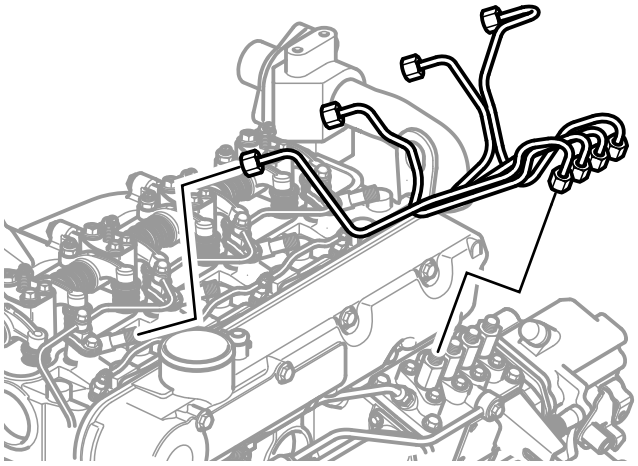
Recommended torque:

Engine type	Nm	lbf ft	kgf m
Union nuts	27	20	2,8

Special notes:
UA and UC engines

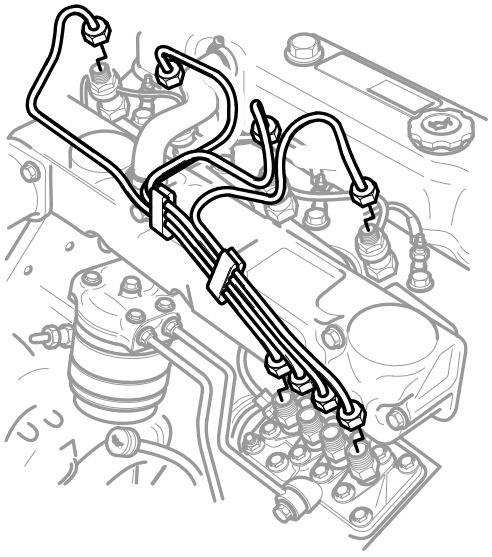
Caution: *Use a separate spanner to prevent movement of the outlets of the fuel injection pump when the high-pressure pipes are released or tightened. If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet.*
Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.

Note: Fit caps to the atomiser and fuel pump outlets.



UA AND UC ENGINES

UB ENGINES



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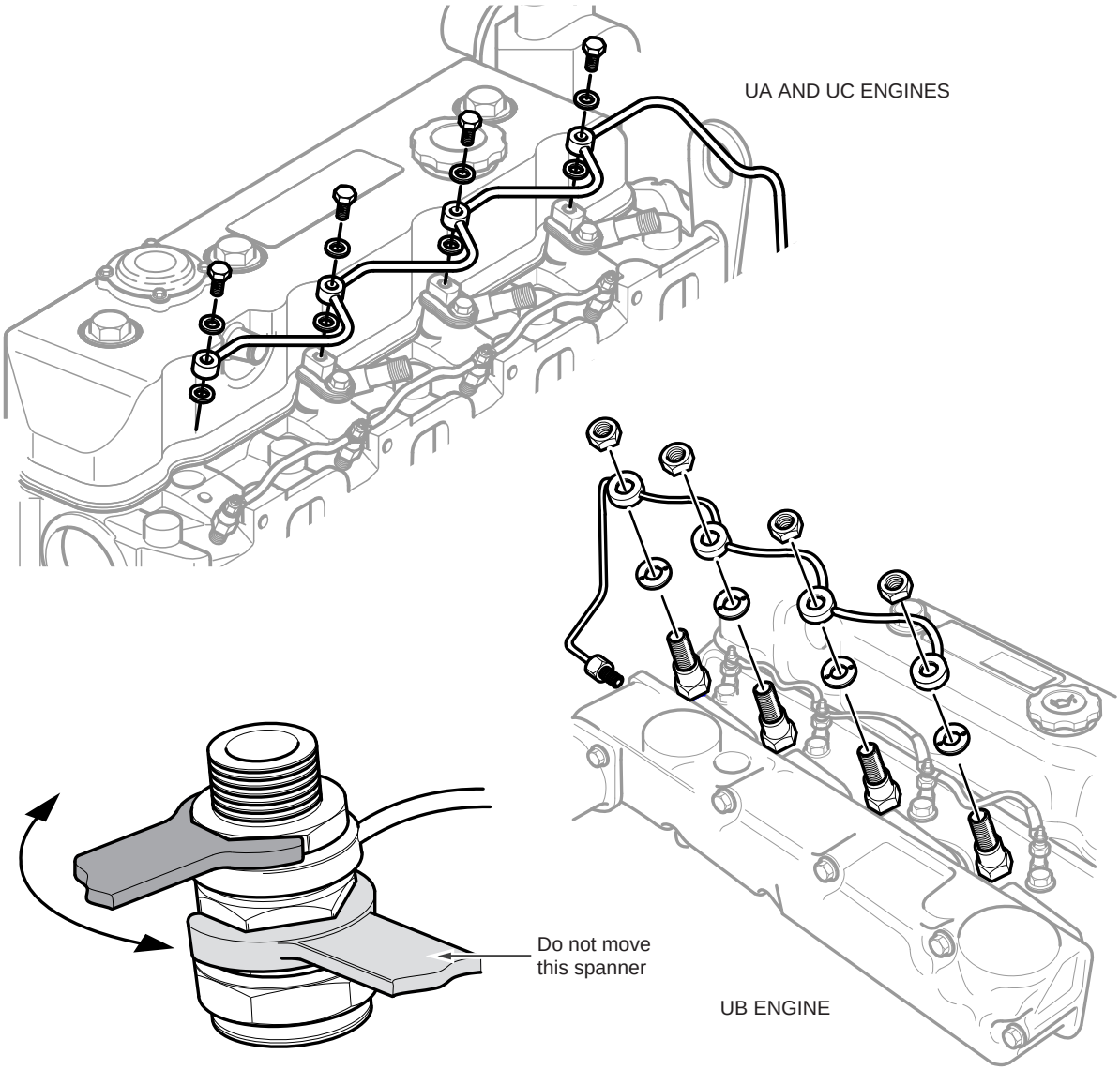
Operation:
Leak off rail - to remove and to fit **20.04**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
UA and UC			
Banjo bolts	**9**	**7**	**0,9**
UB only			
Leak off nuts	**34**	**25**	**3,4**

Service operations
1. High pressure fuel pipes … … … **20.03**

Special notes:



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Operation:
Atomisers - to remove and to fit **20.05**

Recommended torque:

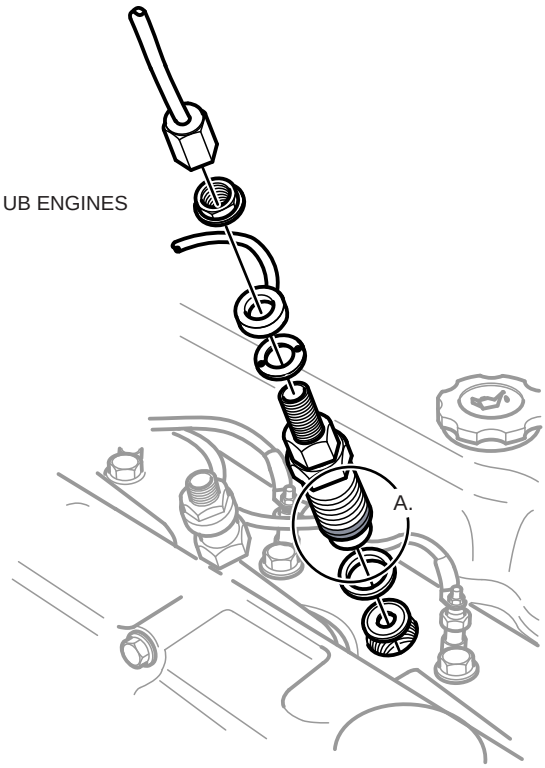
Engine type	Nm	lbf ft	kgf m
UB Atomisers	**39**	**29**	**4,0**
UA and UC			
Union nuts	**27**	**20**	**2,8**
Setscrews	**22**	**16**	**2,2**

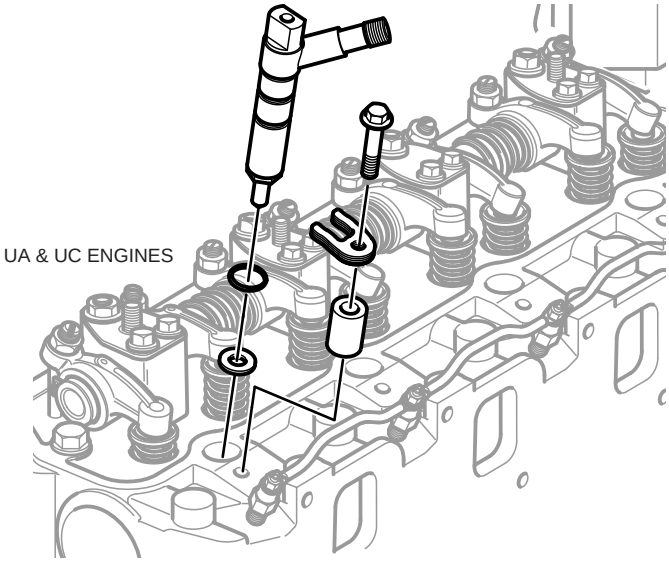
Service operations
1. High pressure fuel pipes … … … **20.03**
2. Leak-off pipes … … … … … … **20.04**

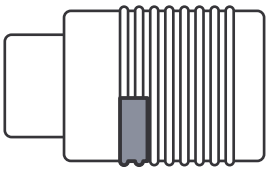
Special notes and tools:
UA and UC engines
Put the atomiser in position together with a new seat washer.

Caution: *A new clamp must be used every time the atomiser is fitted to the engine.*

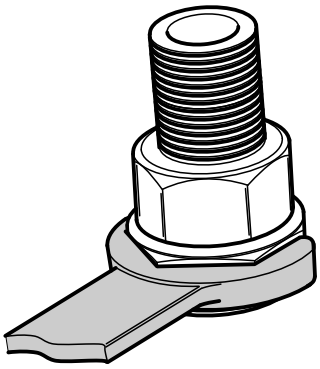
UB engines
Caution: *Do not move the atomiser after it has been tightened, as the seal that is made when torque has been applied will be broken and corrosion of the threads may occur.*
Fit a new flame shield washer with the red identification mark to the top.
Put the atomiser in position together with a new seat washer.







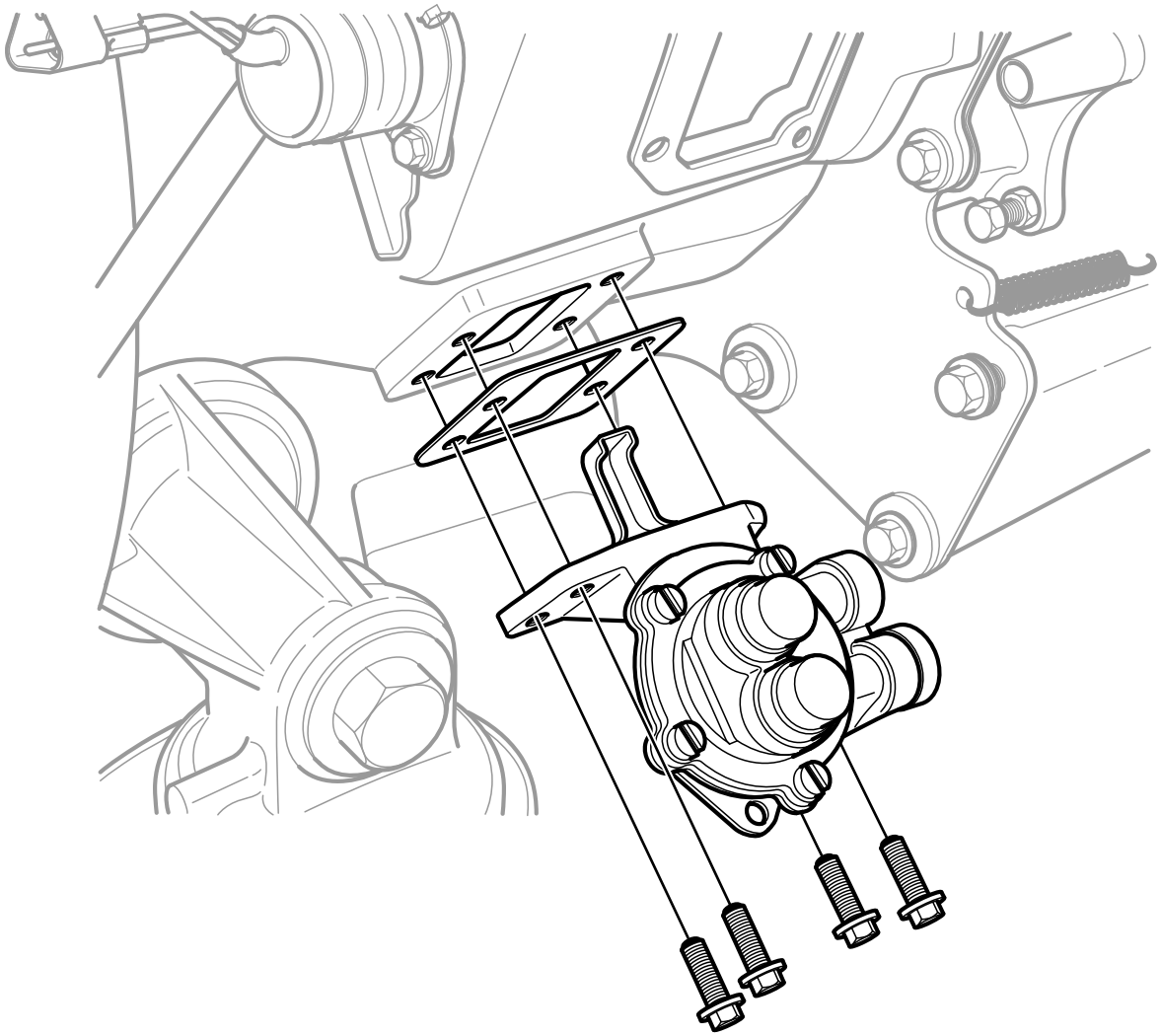
A. Apply a 2 mm bead of atomiser thread sealant, part number 21825474 to extend 6 mm around each of the first two threads. Ensure that the sealant does not contact the body of the atomiser.



Use a second spanner when a leak-off nut is tightened or released, see operation **20.04.**

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Operation: **Fuel lift pump - to remove and to fit**	**20.06**
Recommended torque: **Engine type** **Nm** **lbf ft** **kgf m** **Setscrews** **22** **16** **2,2**	**Special notes:**



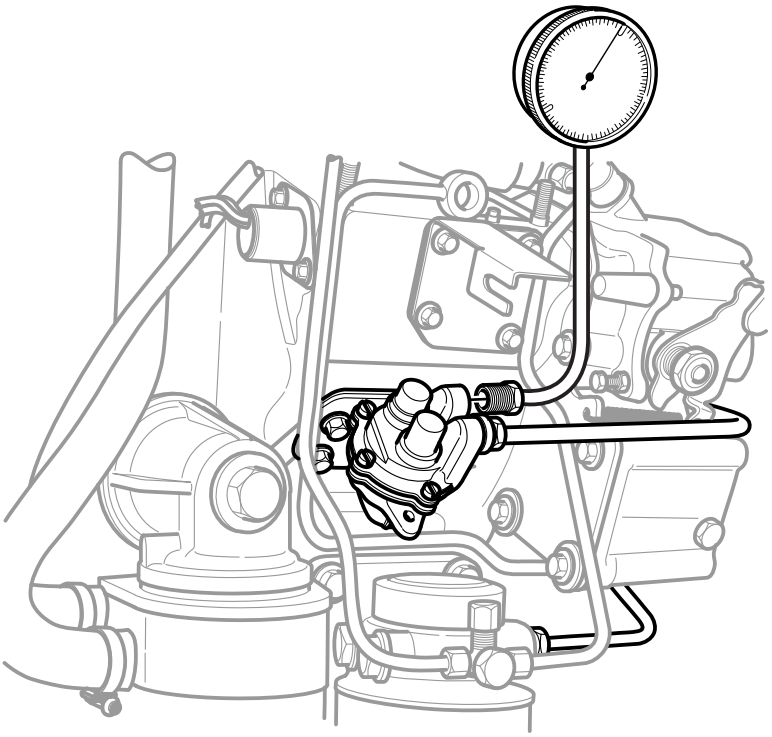
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Operation:
Fuel lift pump - to test **20.07**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
All variants	27	20	2,7

Special notes:



To test

1 Disconnect the fuel outlet pipe from the fuel lift pump. Fit a 0-70 kPa (0-10 lbf/in^2) 0-0,7 kgf/cm^2 pressure gauge to the outlet of the lift pump. Release the connection at the gauge and operate the priming lever of the lift pump to eliminate air from the pipe. When fuel, free of air, flows from the pipe tighten the connection. Ensure that there are no leaks at the connections between the pump and the gauge.
2 Operate the starter motor for 10 seconds with the engine stop control in the stop position or with the stop solenoid disconnected.
3 Note the maximum pressure indicated on the gauge. If the pressure indicated is less than the test pressure of 31 kPa (4,5 lbf/in^2) 0,32 kgf/m^2, repair or renew the pump. Also check the rate at which the pressure reduces to half the maximum pressure obtained. If this is less than 30 seconds, repair or renew the pump.
4 Remove the gauge and connect the outlet pipe to the lift pump. Release the vent screw on the fuel filter head and operate the priming lever until fuel, free of air, flows from the vent screw. Tighten the vent screw.
5 Connect the engine stop solenoid.

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Operation:
Fuel injection pump - to remove and to fit **20.08**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Fuel pipes	20	15	2,0.

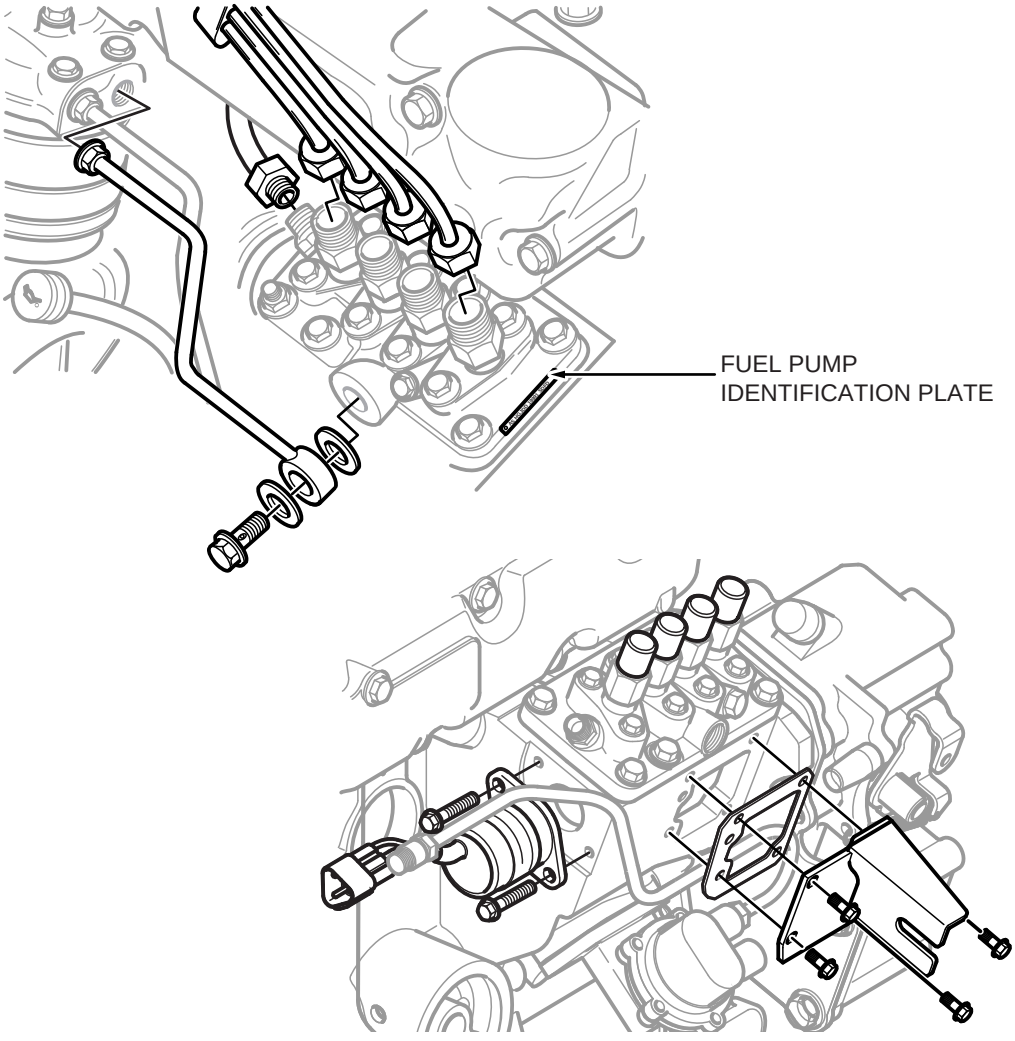
Service operations

1. Remove high pressure fuel pipes **20.03**
2. Remove electrical stop solenoid **23.06**

Special notes and tools:

Cautions: *Clean around the edges of the fuel injection pump before it is removed to prevent dirt from entering the inside of the engine.*
Use a separate spanner to prevent movement of the outlets of the fuel injection pump when the high-pressure pipes are released or tightened.

Release the union nuts of the high-pressure pipes from the atomisers and fuel injection pump and remove the pipes. Do not bend the pipes.
Remove the support bracket / blanking plate from the side of the cylinder block. Record the position of the four setscrews, because on some earlier engines, they are of different lengths.



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Operation:
Fuel injection pump - to remove and to fit **20.08**

Recommended torque:

Engine type	Nm	lbf ft	kgf m

Service operations:

1. Remove access plate … … … **20.16**
2. Remove electrical stop solenoid … … … … … … **23.06**

Special notes:

To remove

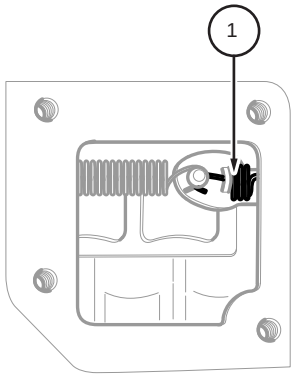
Remove the spring **(A1)** and then the spring **(B1)** from the peg.

Caution: *When the spring **(B1)** is disconnected from the peg , it is possible for the spring to become disconnected from the pin. If this occurs, the spring can fall into the sump!*

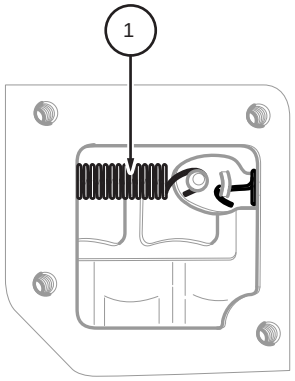
To fit

Caution: *Debris may fall into the engine if the hole in the cylinder block for the pump is not protected. When the pump is fitted, new shim **(D1)** of the correct size must be fitted, without sealant. A thin layer of sealant is included within the final thickness of each new shim. Extra sealant will affect the timing of the fuel injection. The spring **(A1)** must retain at all times, the spring **(B1)** and the governor control link onto the peg. If the governor control link becomes separated from the peg, control of the engine speed will be lost .*

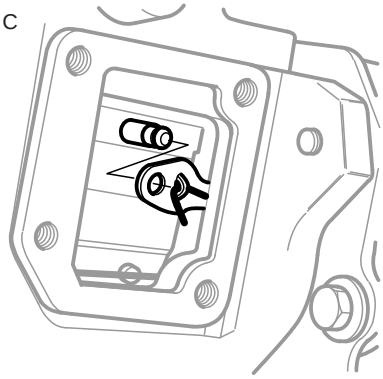
A



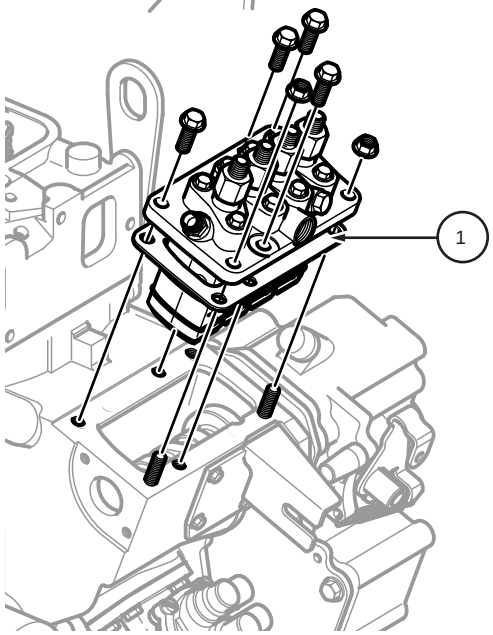
B



C



D



Timing shims

Part number	Thickness mm (in)
3621f011	0,1 (0.004)
3621f012	0,2 (0.008)
3621f013	0,3 (0.012)
3621f014	0,4 (0.016)
3621f015	0,5 (0.020)

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Operation:
To eliminate air from fuel system **20.09**

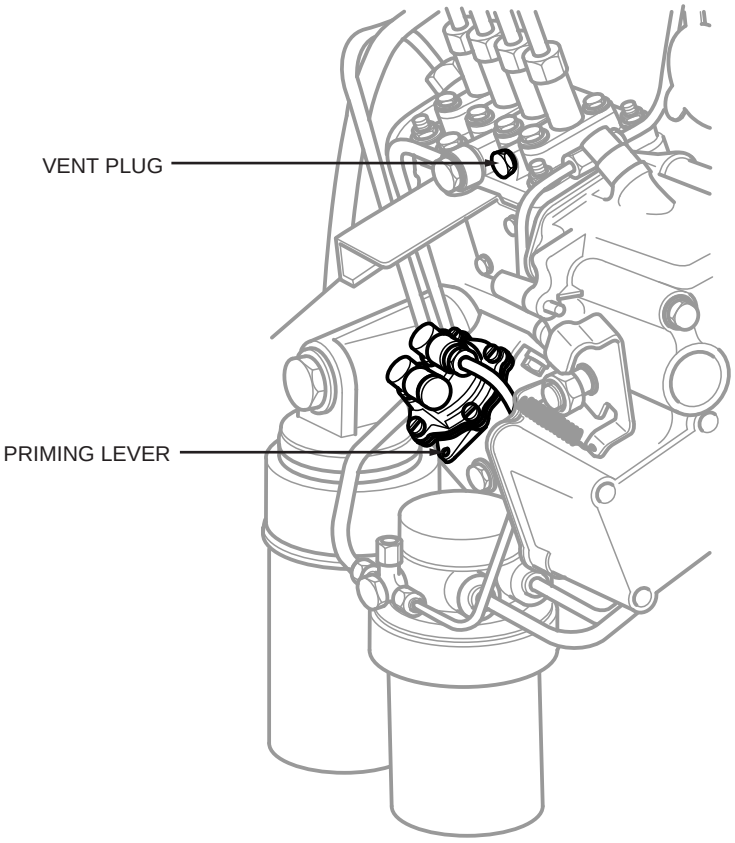
Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes:

Cautions: *Damage can occur to the electrical components e.g. the electrical stop solenoid and the starter motor if they are energized for too long. This can occur when starting the engine and especially when air is to be eliminated from the system.*
The correct procedure to eliminate air from the fuel system is to only use the starter motor to start the engine after air has been eliminated from the low-pressure side of the fuel system.

Note: If air enters the fuel system, it must be eliminated before the engine can be started.



1 Loosen the vent plug on the side of the fuel injection pump.
2 Operate the priming lever until fuel, free from air, comes from the vent point. Tighten the vent plug.
3 Turn the start key to the "ON" position.
4 Operate the starter motor for intervals of 15 seconds until the engine starts. It is important to allow the electrical components to cool for 30 seconds between each 15 second interval of operation.
If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system.

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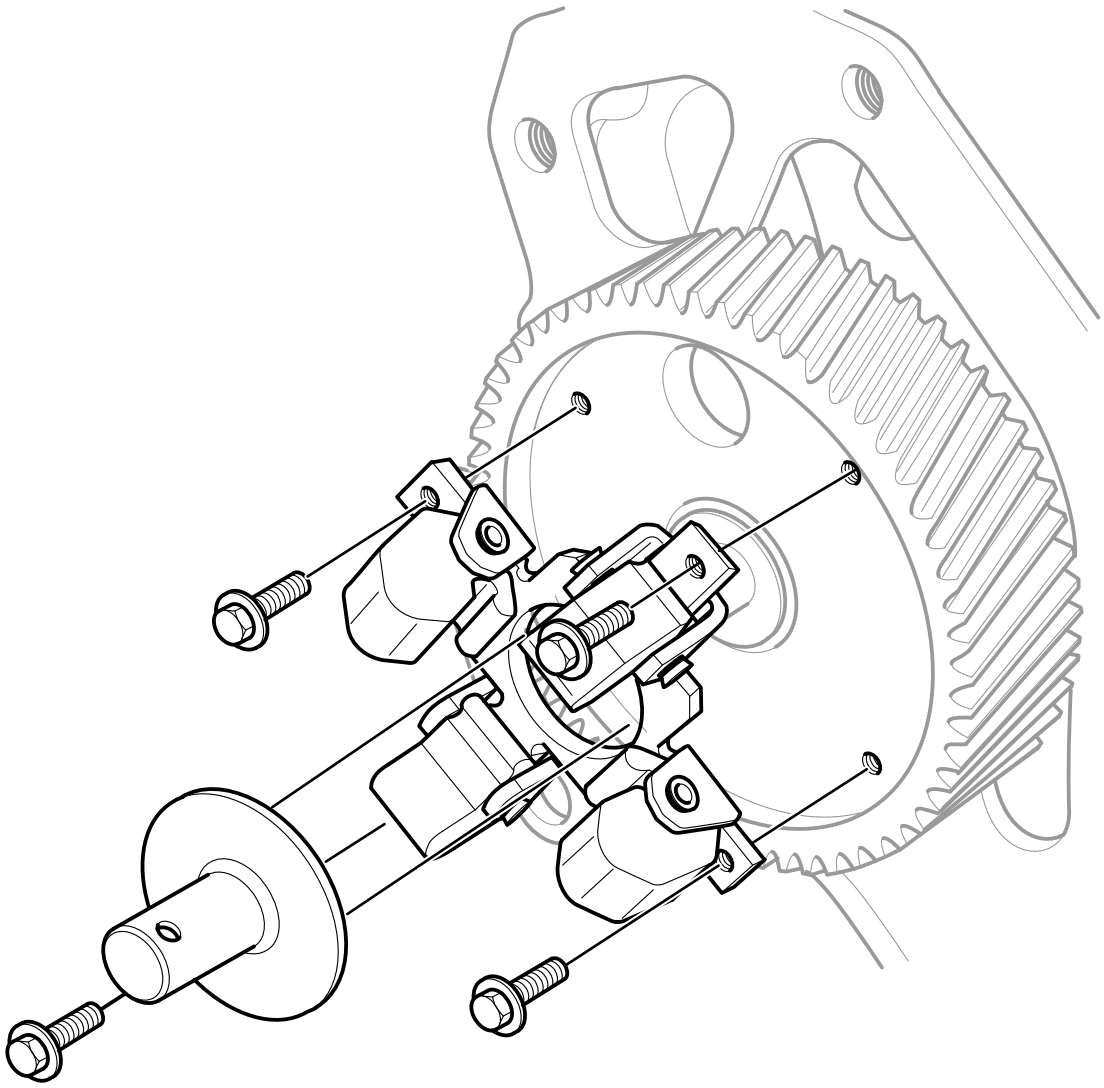
Operation:
Governor weight assembly - to remove and to fit **20.10**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrews	7	5	0,7

Service operations
1. Remove crankshaft pulley… … …**14.01**
2. Remove timing case… … … … …**15.02**

Special notes and tools:
-



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Operation:
Speed control lever assembly - to remove and to fit **20.11**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Nut	10.5	8	1,1

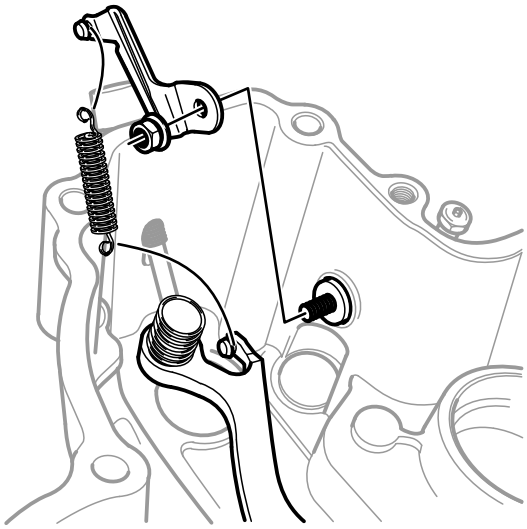
Service operations

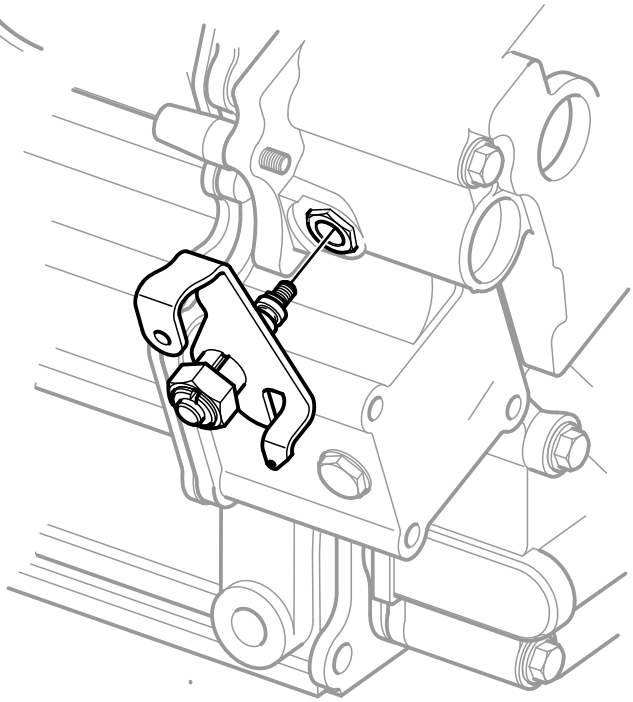
1. Remove crankshaft pulley … …**14.01**
2. Remove timing case … … … …**15.02**

Special notes and tools:

Special tools: Platelock, part number 21826039

Caution: *The bush is fitted to the timing case with a special adhesive and must not be removed, as the threads in the timing case will be damaged. Apply a small quantity of Platelock to the threads of the shaft and tighten the nut.*
Ensure that the platelock does not enter the bore of the bush.





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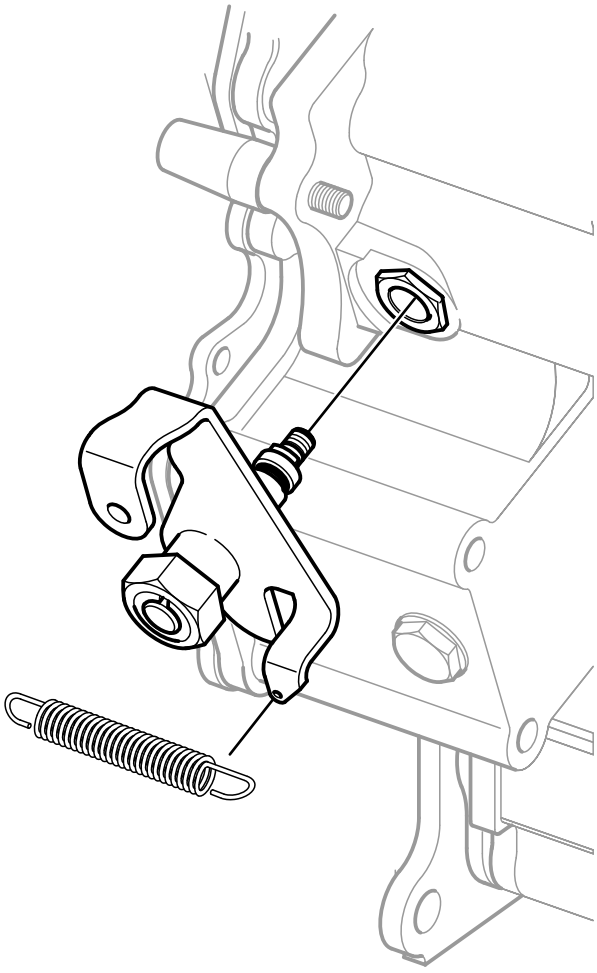
Operation:
Speed control lever assembly - to renew **20.12**

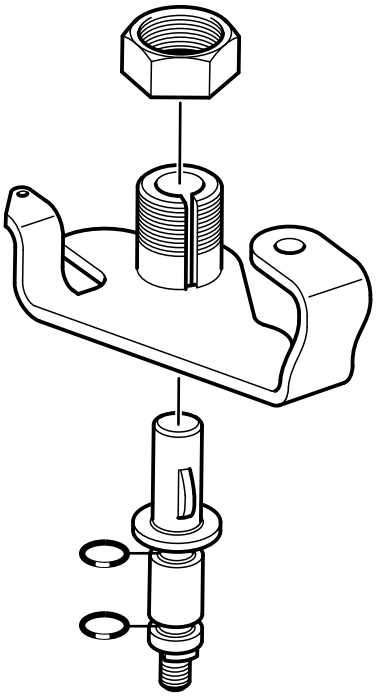
Recommended torque:

Engine type	Nm	lbf ft	kgf m
Nut	38	28	0,39

Service operations:
1. Remove timing case … … … … **15.02**

Special notes:
Early engines had a plain bush that is an interference fit in the timing case. The latest engines have the threaded bush. If the threaded bush is damaged, it cannot be renewed. A new timing case, part number 4142C006, will be necessary. If there is a leakage of oil, use the procedure given in operation **15.02.**
If leakage occurs past the outside of the plain bush, renew the bush using the threaded bush, see operation **20.13**.





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Operation:
To change a plain bush to a threaded bush **20.13**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Bush	18	13	1,8

Service operations:

1. Remove crankshaft pulley … … **14.01**
2. Remove timing case … … … … **15.02**
3. Remove speed control lever … **20.11**

Special notes and tools:

Special tools: Platelock, part number 21826039

Early engines have a plain bush pressed into the timing case, Part number 4142C005. Later engines have a threaded bush, Part number 3343A005. If it is necessary to renew the plain bush, a threaded bush must be fitted instead, see the operation below. The threaded bush cannot be renewed; a new timing case will be necessary, Part number 4142C006.

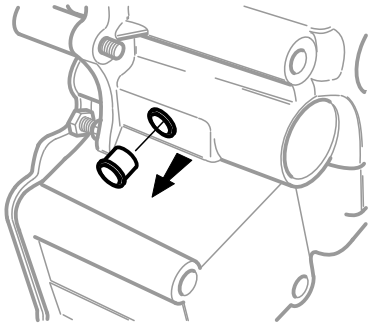
Withdraw the lever assembly from the bush. Check the components for wear or damage.

1. Use a suitable extractor (M10) to remove the plain bush from the timing case.
2. Cut an M16 X 1 mm thread in the parent bore for the bush.
3. Fit the threaded bush.

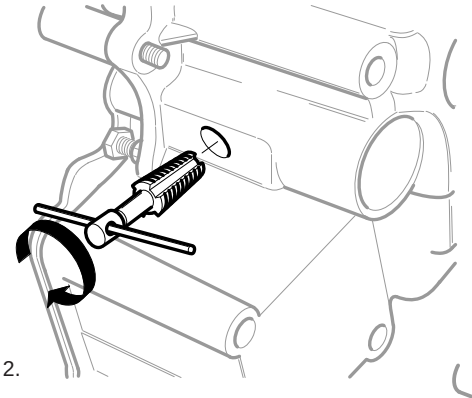
Note: The threads of the bush have a sealant that is applied by the manufacturer.

Caution: *Ensure that the Platelock does not enter the bore of the bush.*

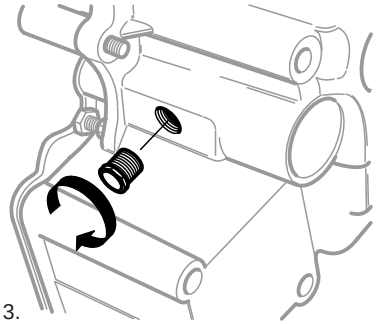
1.



2.



3.



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Operation:
Fuel injection pump linkage - to remove and to fit **20.14**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Nut	10,5	8	1,1

Service operations:

1. Remove engine speed control lever … … … … … … … … **20.11**
2. Remove timing case … … … … **15.02**

Special notes and tools:

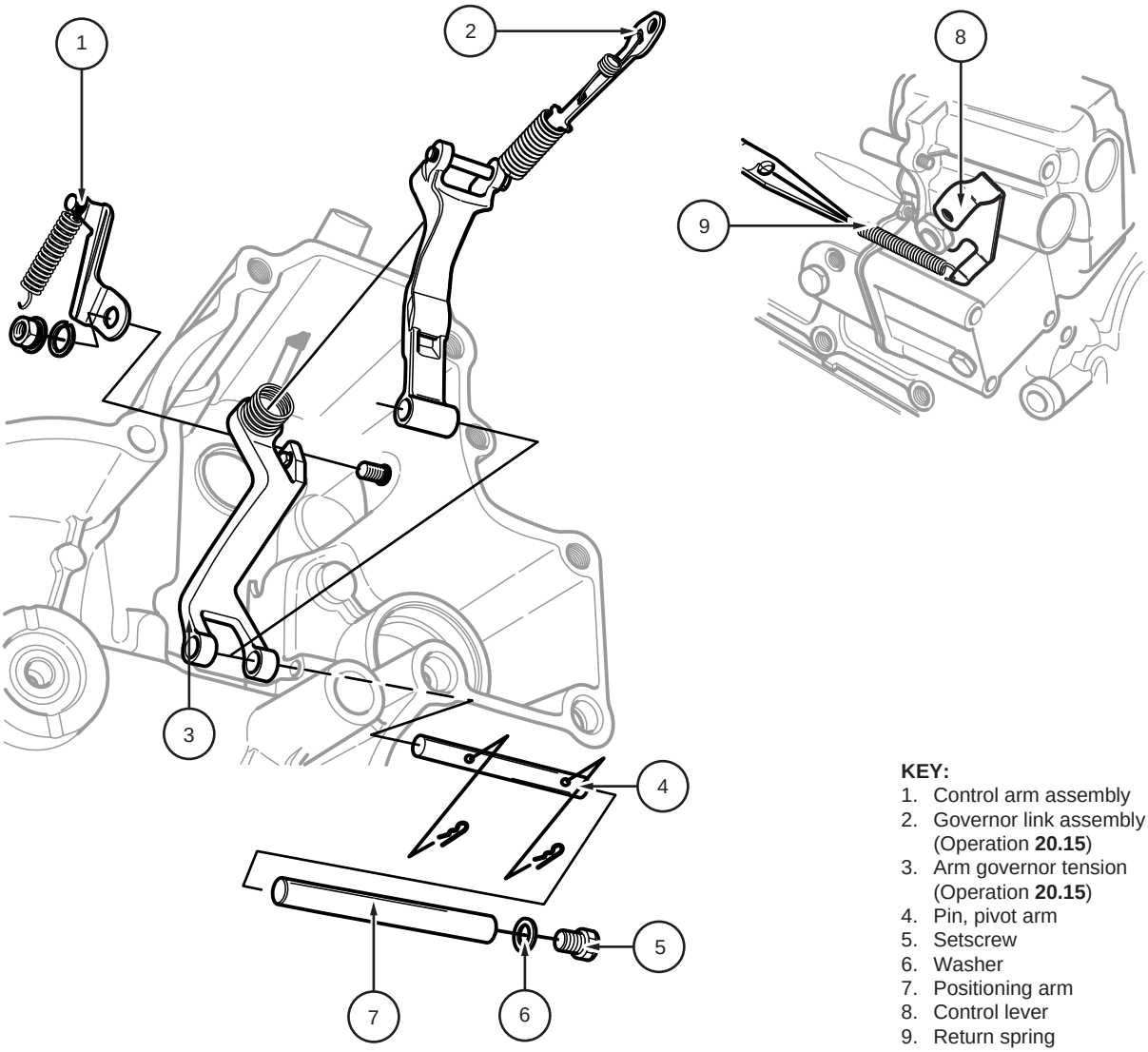
Special tools: Platelock, part number 21826039

Note: The fuel injection pump linkage is contained within the timing case assembly.

The linkage contains two lever assemblies, one for the governor control and one for the fuel control.

Caution: *Ensure that Platelock does not enter the bore of the bush.*

Apply a small quantity of Platelock to the threads of the shaft.



KEY:

1. Control arm assembly
2. Governor link assembly (Operation **20.15**)
3. Arm governor tension (Operation **20.15**)
4. Pin, pivot arm
5. Setscrew
6. Washer
7. Positioning arm
8. Control lever
9. Return spring

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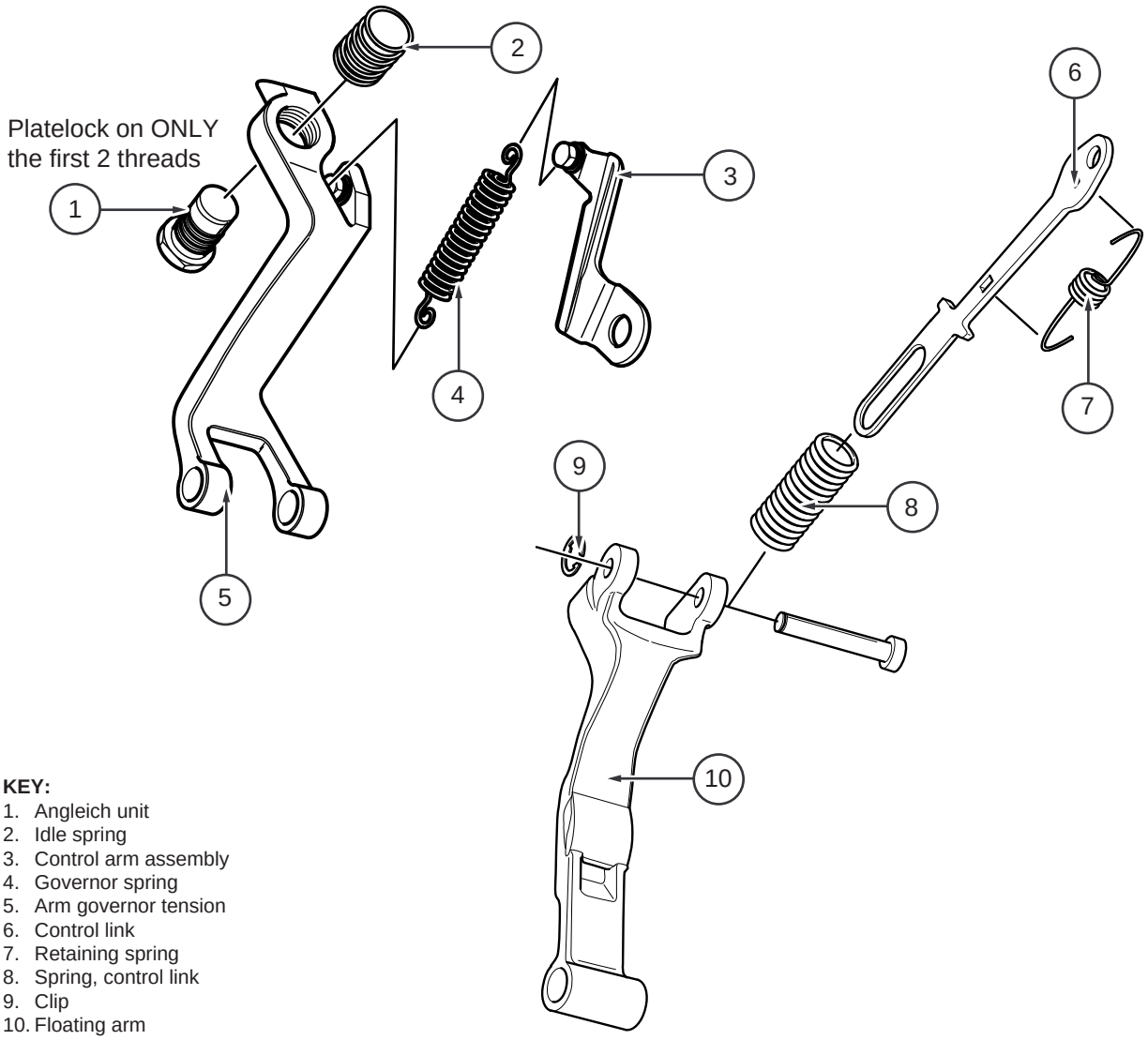
Operation:
Fuel injection pump linkage - to renew **20.15**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Angleich unit	18	13	1,3

Special notes and tools:
Special tools: Platelock, part number 21826039
Note: The fuel injection pump linkage is contained within the timing case assembly.
The linkage contains two lever assemblies, one for the fuel control and one for the governor control.

Caution: *When the fuel injection pump linkage is removed / renewed, or a new timing case is fitted, the setting for the maximum fuel may be affected.*



KEY:
1. Angleich unit
2. Idle spring
3. Control arm assembly
4. Governor spring
5. Arm governor tension
6. Control link
7. Retaining spring
8. Spring, control link
9. Clip
10. Floating arm

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Operation:
To record the maximum fuel position of the fuel control rack **20.16**

Recommended torque:

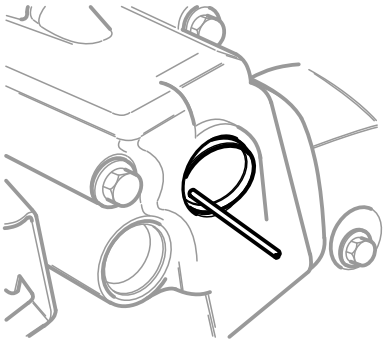
Engine type	Nm	lbf ft	kgf m

Service Operation:
1.Electrical stop solenoid
to remove and fit … … … … … 23.06

Special notes and tools:
Special tools: Rack position tool, part number 27610089
Clamp tool, part number 271610018

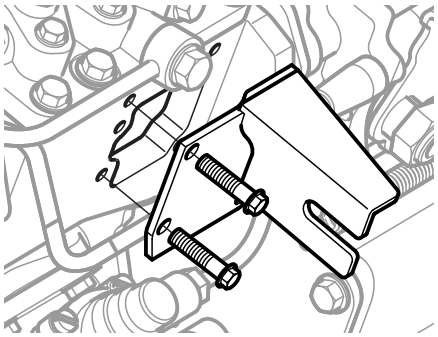
Caution: *Ensure that the components behind the ©D© plug are not damaged when removing.*

1



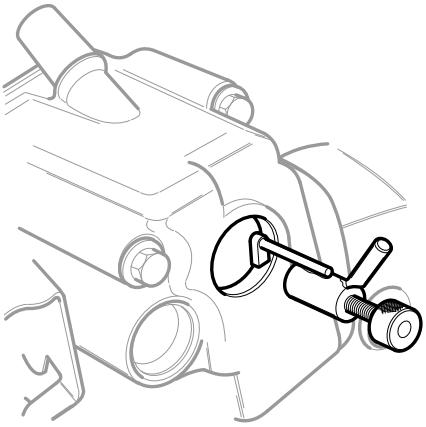
1. Remove the 'D' plug from the timing case.

2



2. Remove the access plate from the cylinder block.

3

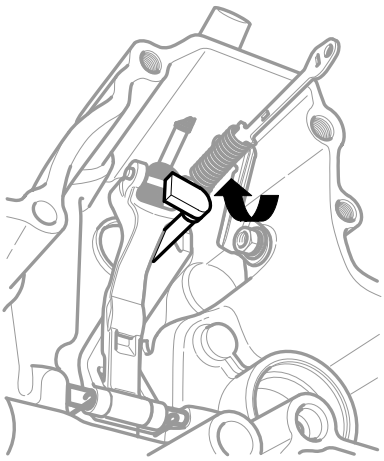


3. Put the clamp into the timing case such that the end of the clamp points downwards.

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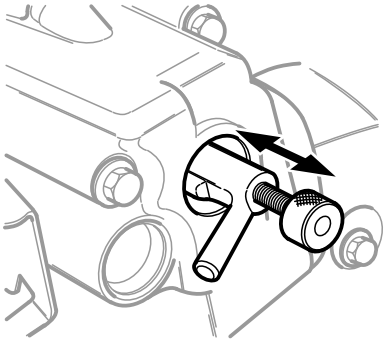
Operation: **To record the maximum fuel position of the fuel control rack**	**20.16**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:** **Special tools:** Rack position tool, part number 27610089 Clamp tool, part number 271610018

4



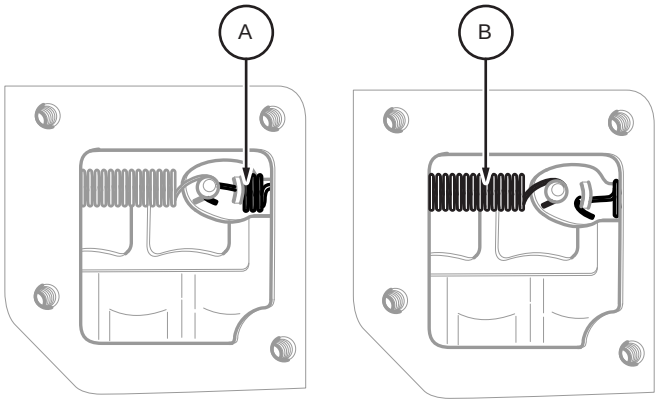
4. When the end of the clamp is entered far into the timing case, rotate the tool counter-clockwise 90° to engage the lever. The end of the clamp should now be behind the lever.
Tighten the adjustment screw, finger tight, to hold together the two levers.

5



5. To ensure that the tool has held both the levers, move the tool backwards and forwards. The peg on the fuel control rack should move with the tool. Ensure that the sides of the clamp do not touch the bore.

6

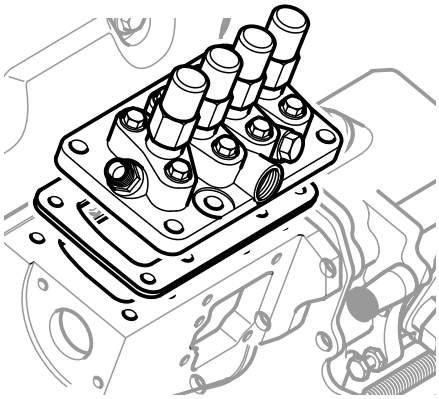


6. Remove the spring **(A)** and then the spring **(B)** from the peg.
Caution: *When the spring is disconnected from the peg, it is possible for the spring to become disconnected from the pin. If this occurs, the spring can fall into the sump!*

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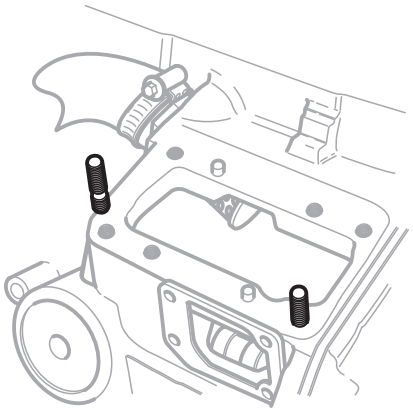
Operation: **To record the maximum fuel position of the fuel control rack**	**20.16**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:** **Special tools:** Rack position tool, part number 27610089 Clamp tool, part number 271610018

7



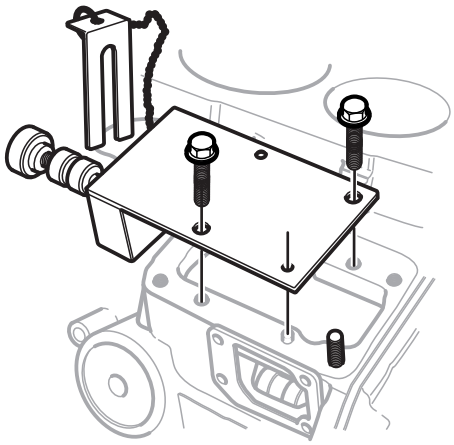
7. Remove the fuel injection pump.
Remove the shim from the fuel pump housing.

8



8. Remove the stud from the fuel pump housing.
Clean the flange face of the fuel pump housing.

9

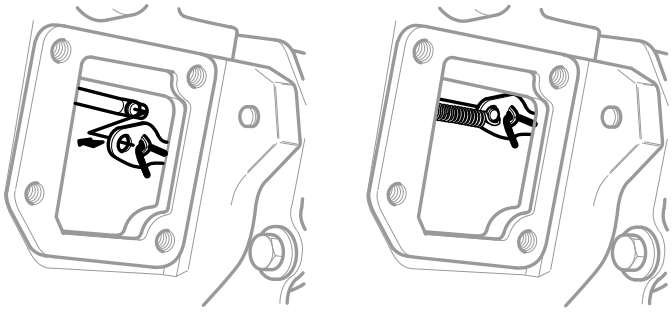


9. Put the tool into position on the two dowels in the fuel pump housing; the adjustment rod of the tool enters the pump housing through the hole for the stop solenoid. Fit the two setscrews and tighten them to secure the tool to the fuel pump housing.

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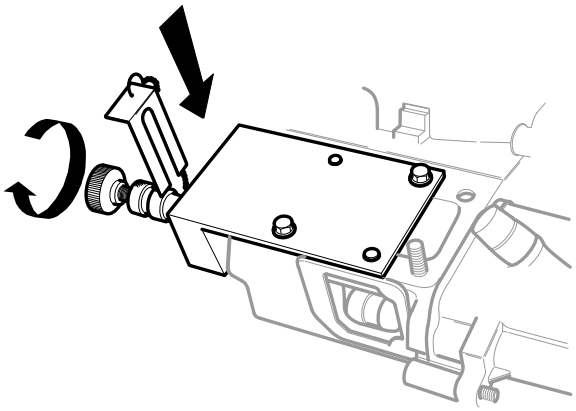
Operation: **To record the maximum fuel position of the fuel control rack**	**20.16**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:** **Note:** The engine should be partially built without the fuel injection pump, but with the timing case.

10



10. Put the peg on the end of the adjustment rod into the hole in the control link. Fit the retaining spring to the peg. Push the clamping tool towards the timing case, rotate the adjustment knob counter-clockwise slowly until the control link is just in tension.

11

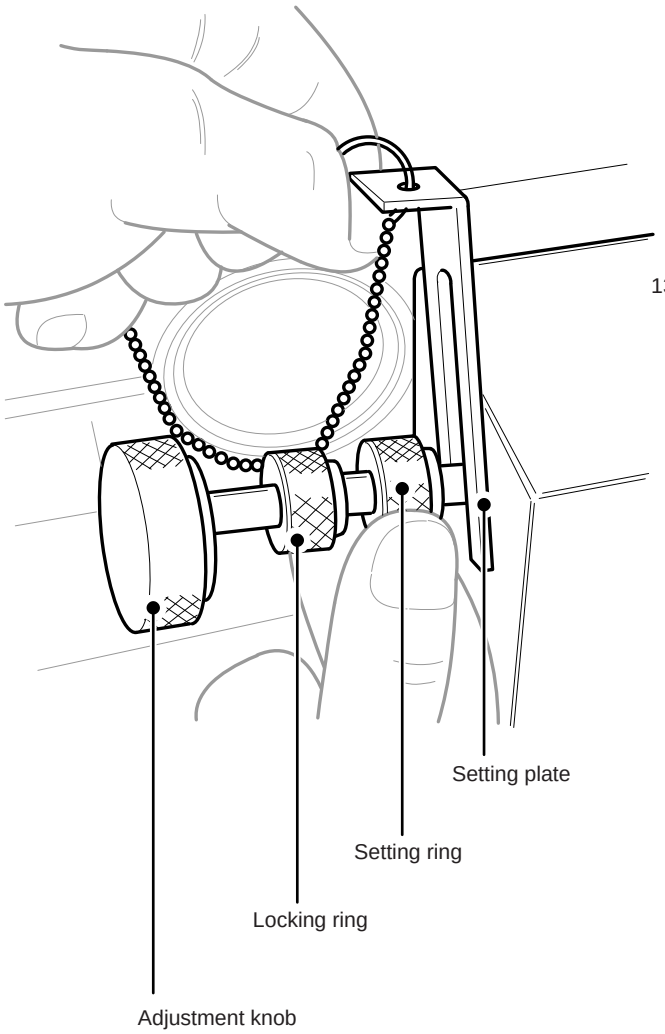


11. Ensure that the setting ring is not in contact with the locking ring see page 131. Check that the control link is still in tension.With the setting plate flat against the rear face of the tool, adjust the setting ring to obtain a feeler gauge fit between the setting ring and the setting plate. Always ensure that the control link remains in tension.

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Operation: **To record the maximum fuel position of the fuel control rack**	**20.16**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes and tools:** **Special tools:** Rack position tool, part number 27610089 Clamp tool, part number 271610018

12



12. When the feeler gauge fit between the setting plate and the setting ring is correct, keep pressure on the adjustment knob to retain tension on the control link. Use the locking ring to lock the setting ring. Check that the setting is still correct. If it is not correct, repeat the procedure from 12 until the adjustment is correct. The maximum fuel reference is now set. Carefully remove the setting plate and carefully rotate the adjustment rod one quarter turn to enable the control link to be removed from the peg.

13. Remove the tool from the engine and ensure that the setting and locking rings are not disturbed.

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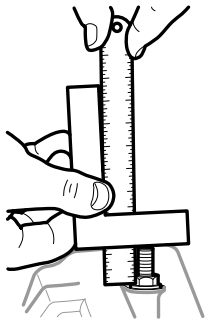
Operation:
How to use the reference setting for maximum fuel **20.17**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

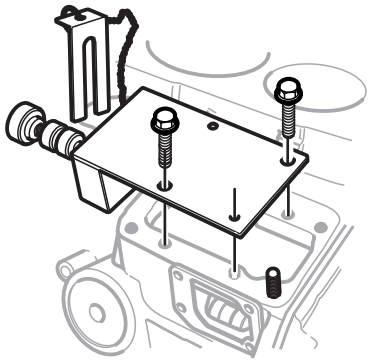
Special notes and tools:
Special tools: Rack position tool, part number 27610089
Clamp tool, part number 271610018
Note: The engine should be partially built without the fuel injection pump, but with the timing case.

1



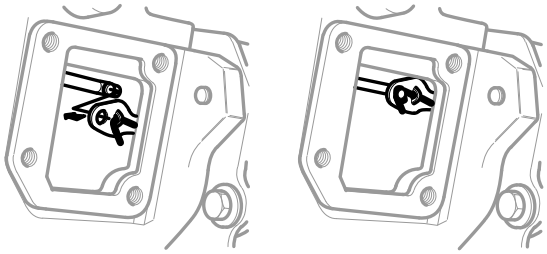
1. Check that the adjustment screw for the maximum fuel adjustment protrudes approximately 25 mm (1.0 in) from the timing case.

2



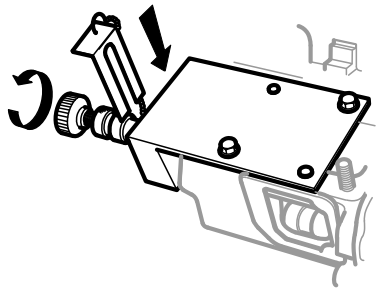
2. Put the tool into position on the two dowels in the fuel pump housing; the adjustment rod of the tool enters the pump housing through the hole for the stop solenoid. Fit the two setscrews and tighten them to secure the tool to the fuel pump housing.

3



3. Put the peg on the end of the adjustment rod into the hole in the control link. Fit the spring to the peg of the adjustment rod.

4



4 Put the setting plate into position, between the rear face of the tool and the setting ring, and with the adjustment knob, rotate the adjustment rod clockwise, to give the correct setting for the setting plate; a feeler gauge fit.

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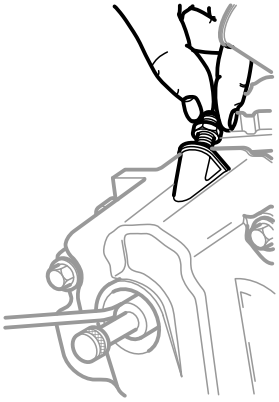
Operation:
How to use the reference setting for maximum fuel **20.17**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Special notes and tools:
Special tools: Rack position tool, part number 27610089
Clamp tool, part number 271610018

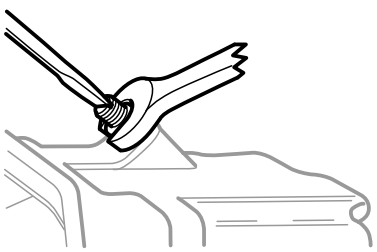
5

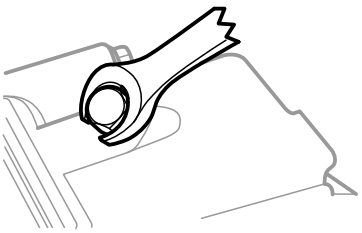


Note: This operation applies to earlier engines only

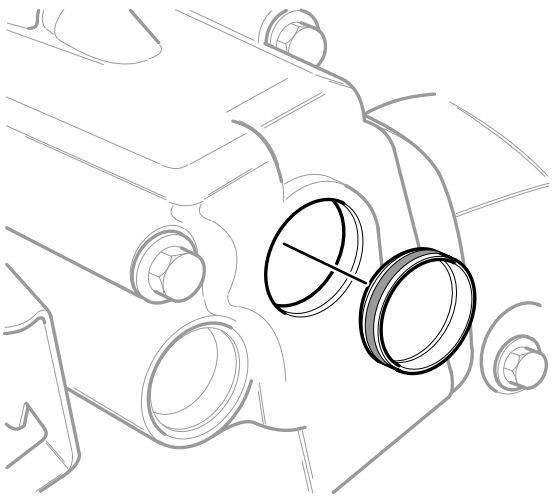
5. Release the lock nut of the maximum fuel adjustment and rotate the adjustment screw clockwise until finger tight. Hold the adjustment screw with a screwdriver and tighten the lock nut. The maximum fuel adjustment is now set.
6. Fit the cap nut to the adjustment screw. The latest engines have a tamper proof cap, see operation **15.01**.
   Check and if necessary adjust the maximum and idle speed adjustments.

6





7



7. Remove the setting plate. Carefully rotate the adjustment knob clockwise approximately 1/4 turn to release the tension on the control link. Disconnect the spring and the adjustment rod from the peg. Remove the tool from the housing.
8. Remove clamp from the timing case.
   Apply Liquid gasket to the side faces of a new "D" plug and fit the "D" plug.
9. Ensure that the flange face of the fuel pump housing is clean and fit the shim for the fuel injection pump.

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Operation:
To drain and to fill **21.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

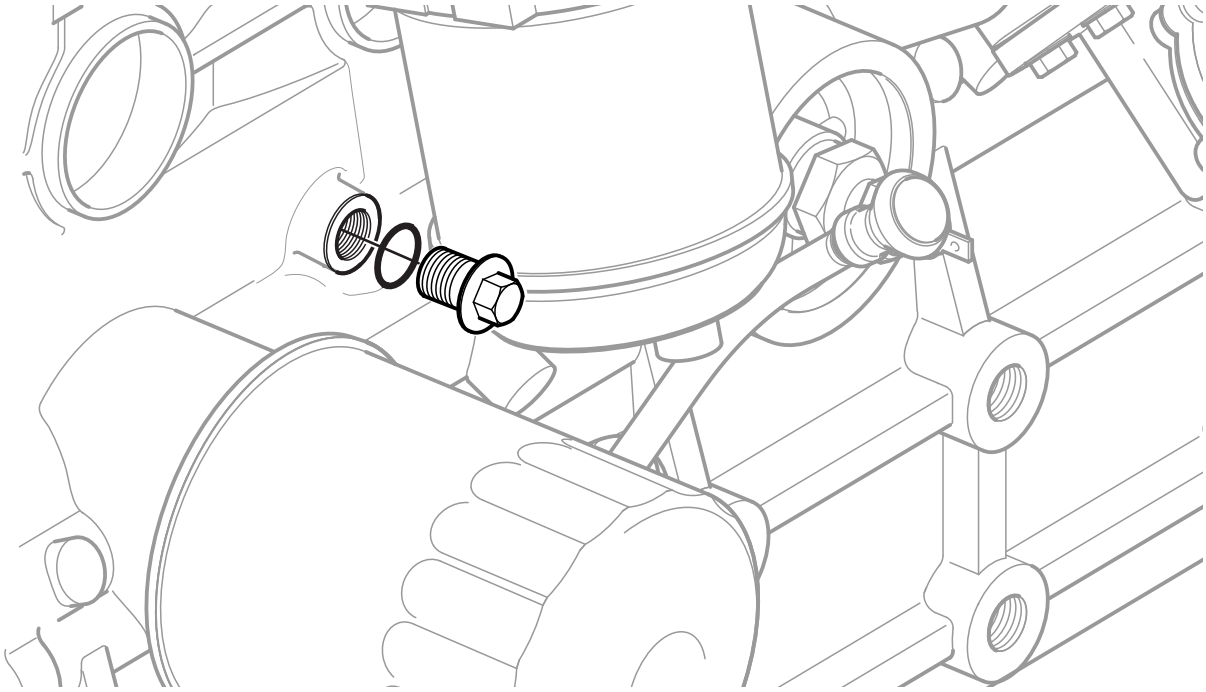
Special notes and tools:

Special Tools:

Easy Flush, part number 21825001(is available if required)

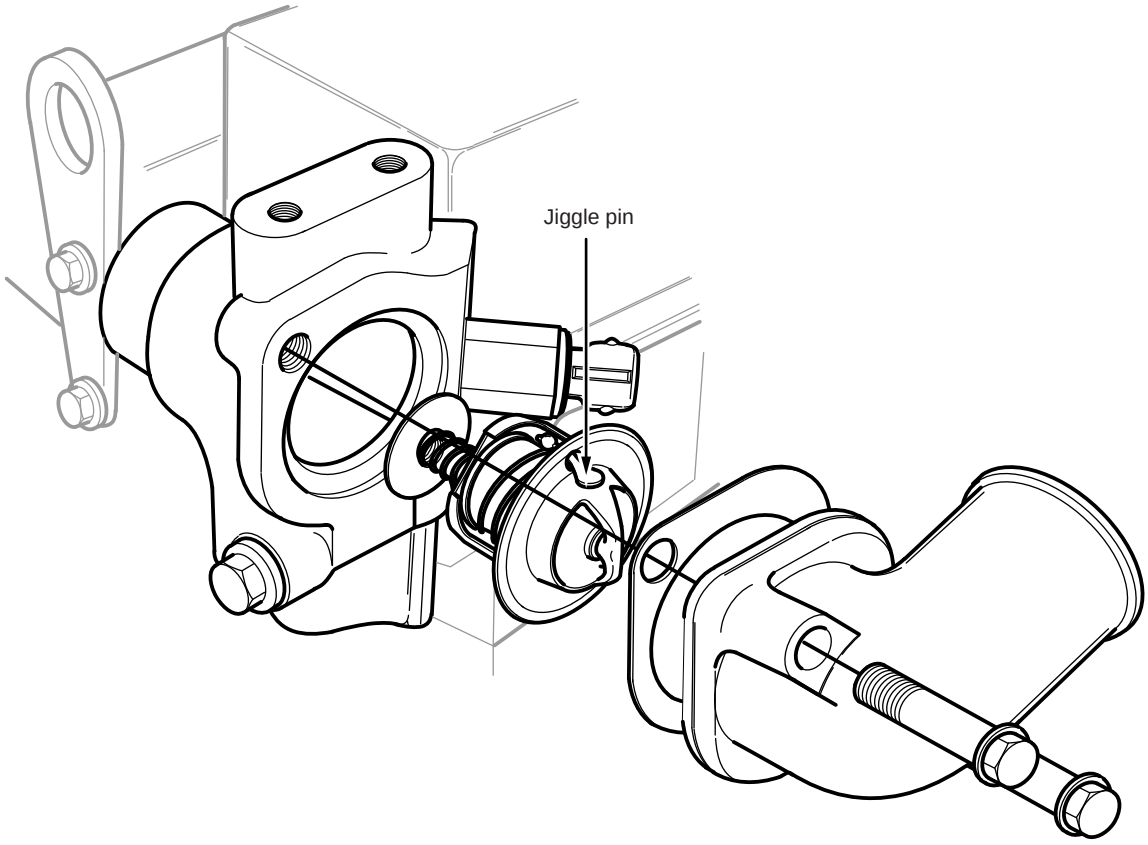
Warnings! *Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged. Discard used coolant in a safe place and in accordance with local regulations. If coolant is to be added to the system during service, allow the engine to cool first.*
Remove the filler cap slowly.
Do not put too much coolant in the cooling system. There is a relief valve in the filler cap which will open and release hot coolant.

Cautions: *If coolant is added to the system during service, it must be of the same specification as the original that was used to fill the system. See "Coolant specification" in section 5 of the users handbook. Air will remain in the system if coolant is added too quickly, or if the machine is not on a horizontal surface.*
If the engine is operated with air in the system, the temperature of operation will be too high and the engine will be damaged.



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Operation: **Thermostat - to remove and to fit**	**21.02**
Recommended torque: **Engine type Nm lbf ft kgf m** **-**	**Special notes:** Ensure that the jiggle pin is at the highest point, and is free to move. ***Caution:*** *If the thermostat does not operate correctly, it must be renewed. Do not try to adjust the settings.* *Do not operate the engine without a thermostat as the engine will overheat.*



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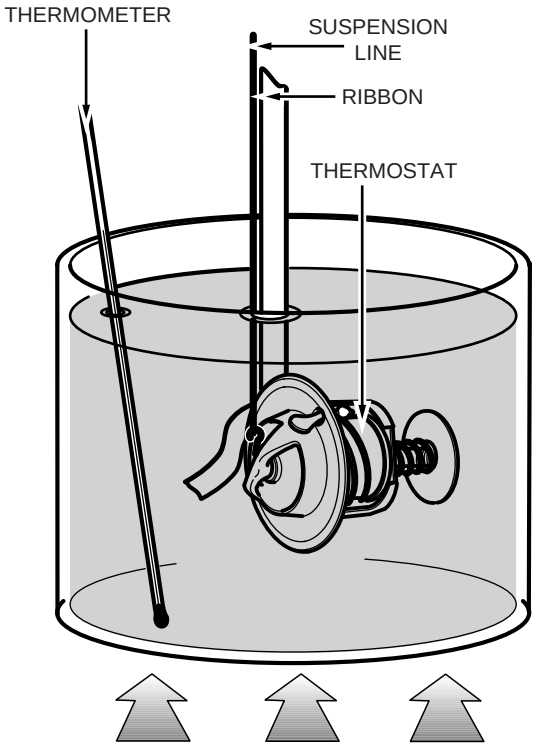
Operation:
Thermostat - to test **21.03**

Recommended torque:

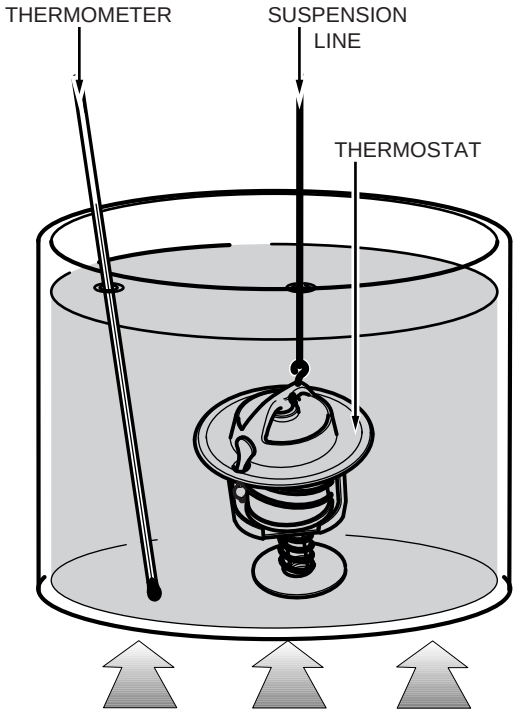
Engine type	Nm	lbf ft	kgf m
-			

Special notes:

Caution: *If the thermostat does not operate correctly, it must be renewed. Do not try to adjust the settings.*



"START TO OPEN" TEMPERTURE TEST
(RIBBON TEST)



"FULL OPEN" TEMPERTURE TEST
(MINIMUM SLEEVE TRAVEL TEST)

Hang the thermostat unit in a suitable container filled with coolant.
Heat the coolant gradually. Use a thermometer to check the temperature at which the valve starts to open, when it will fall from the ribbon. Also check the temperature at which it is fully open. The correct temperature is given in the Data and dimensions.

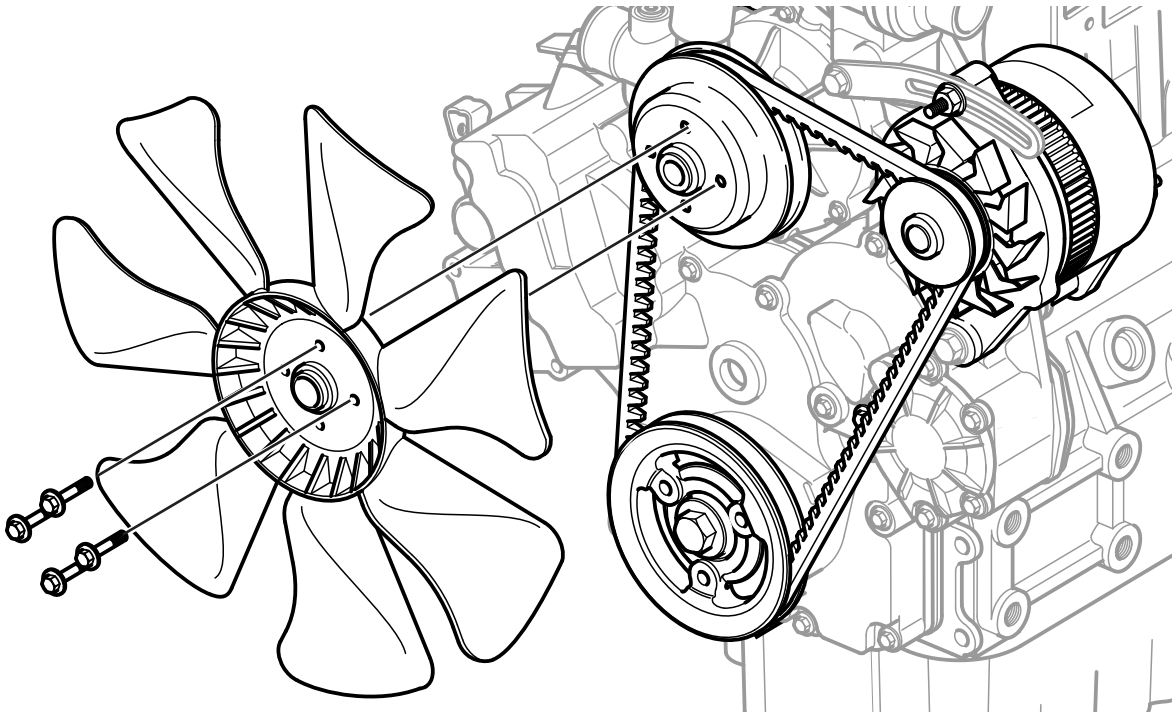
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Operation:
Fan - to remove and to fit **21.04**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
All variants	22	16	2,2

Special notes:
Release the tension on the belt, see operation 23.01.



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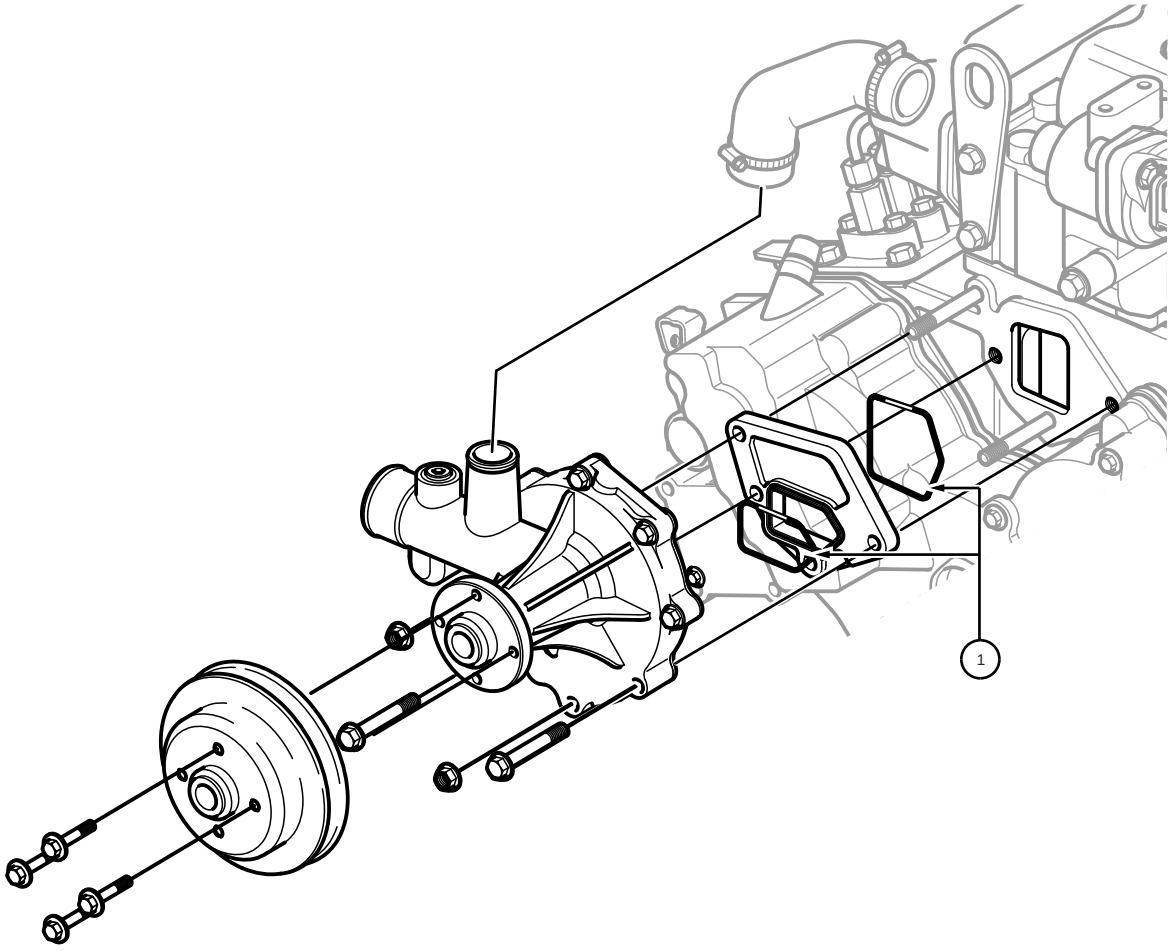
Operation:
Coolant pump - to remove and to fit **21.05**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Nuts and setscrews	22	16	2,2

Service operations:
1. Remove cooling fan … … … … **21.04**
2. Remove drive belt … … … … … **23.01**

Special notes:
1. Renew the "O" ring on each side of the spacer.



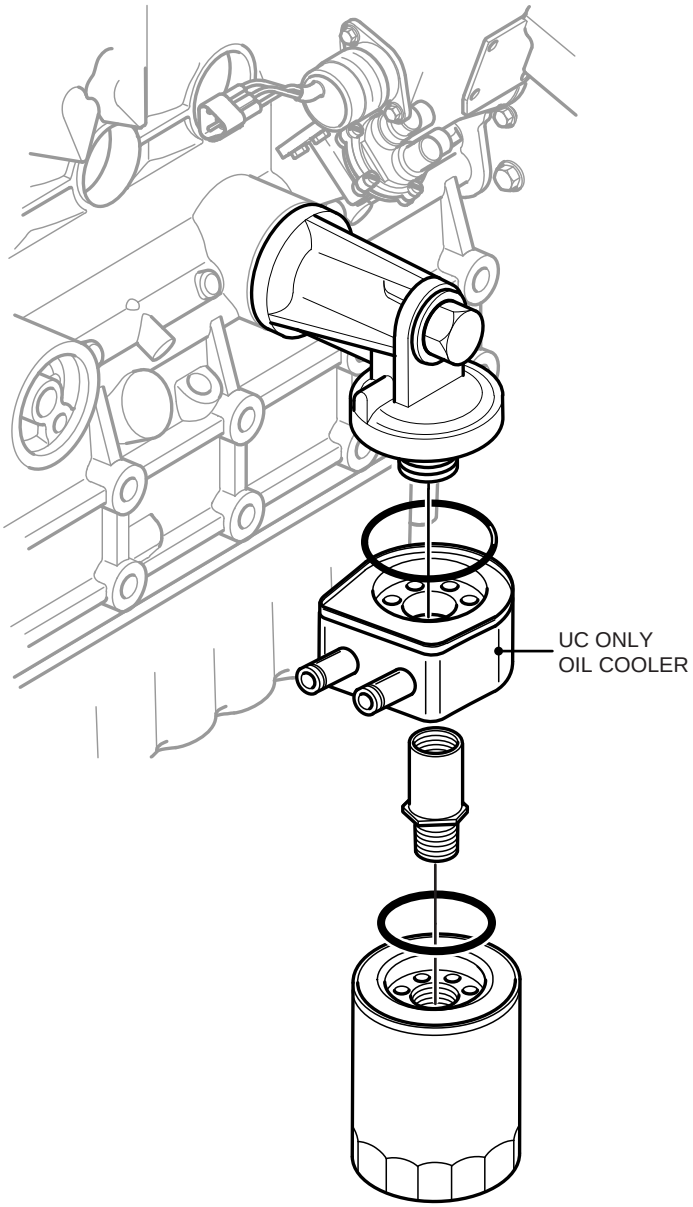
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Operation: **Oil cooler - to remove and to fit**	**21.06**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Adaptor	57	42	5,8

Special notes:



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Operation:
Flywheel - to remove and to fit

22.01

Recommended torque:

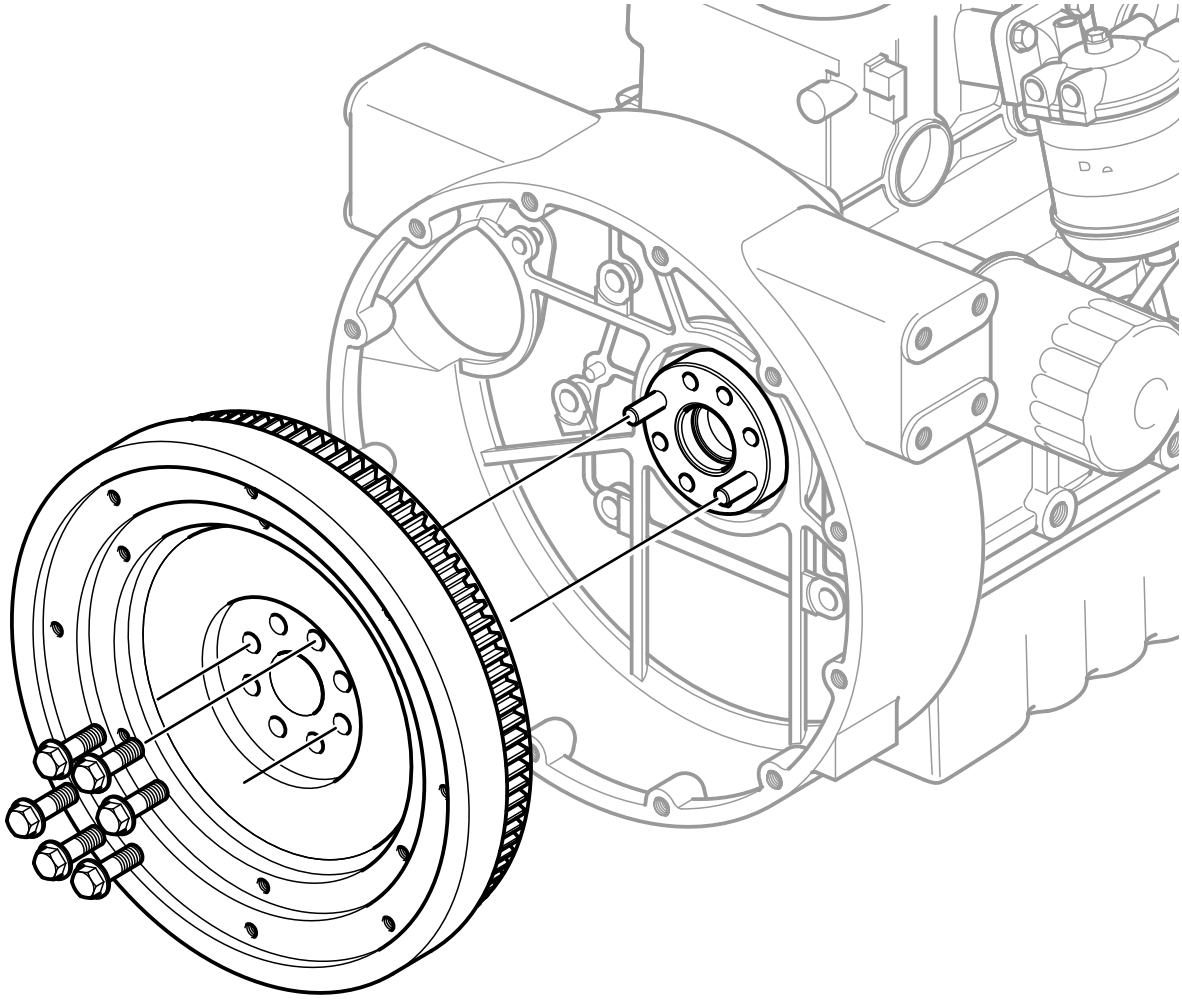
Engine type	Nm	lbf ft	kgf m
Setscrews	100	74	10,2

Special notes and tools:

Special tools: Retainer (oil tolerant)

Warning! *The flywheel is very heavy, use lift equipment or get assistance with the lift operation before removal of the flywheel fasteners.*

Remove two opposite setscrews from the flywheel and fit temporarily two guide studs to ensure safety when the flywheel is removed and fitted. Apply Retainer (oil tolerant) to the first three threads of the setscrews.



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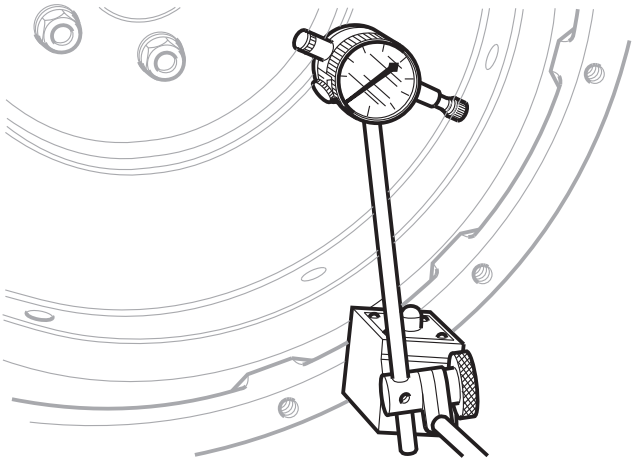
Operation:
Flywheel - to inspect **22.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrews	100	74	10,2

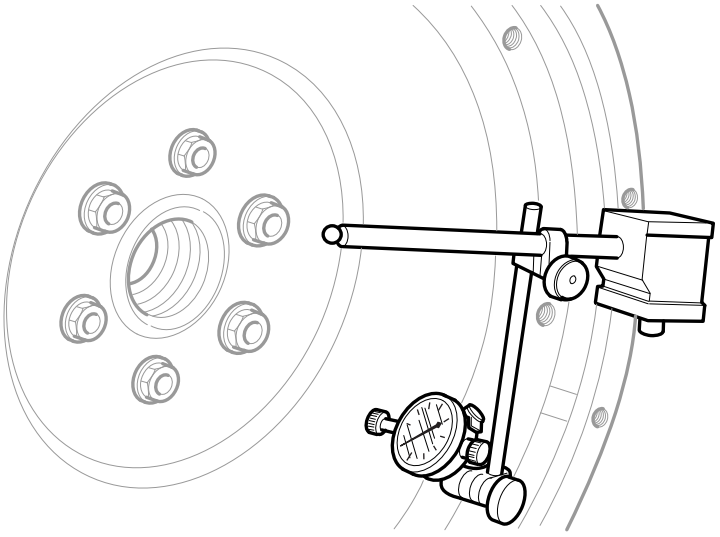
Special notes and tools:
Special tools: Retainer (oil tolerant)

Warning! *The flywheel is very heavy, use lift equipment or get assistance with the lift operation before removal of the flywheel fasteners.*
Remove two opposite setscrews from the flywheel and fit temporarily two guide studs to ensure safety when the flywheel is removed and fitted.
Apply Retainer (oil tolerant) to the first three threads of the setscrews.



Check the flywheel run-out with a dial test indicator. This must be less than 0,30 mm (0.012 in) total indicator reading.

Check the alignment of the flywheel face. The error in alignment must not be more than 0,03 mm (0.001 in) total indicator reading for every 25 mm (1.0 in) of the flywheel radius from the crankshaft axis to the indicator plunger. During this operation, keep the crankshaft pressed toward the front to remove the effect of crankshaft end-float.



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Operation:
Starter ring - to remove and to fit **22.03**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

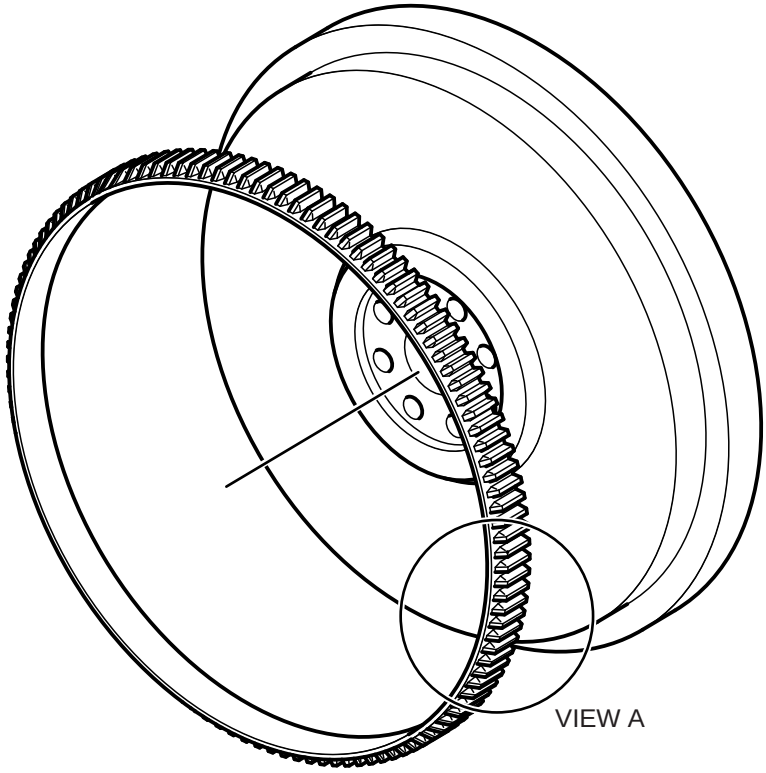
Service operations:
1 Remove flywheel … … … … … **22.01**

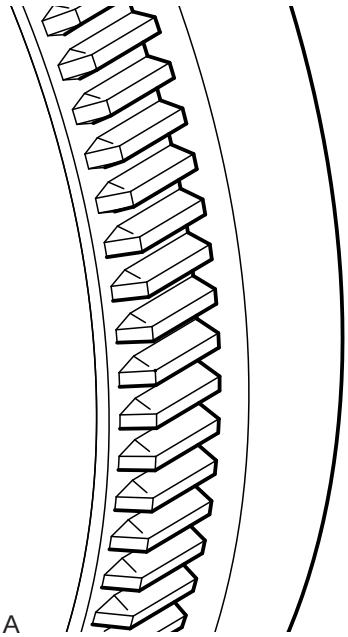
Special notes:

Warning! *Wear eye protection during this operation.*

Caution: *To ensure that the new ring gear is fitted correctly, record the direction of the chamfer of the gear teeth. Fit the new gear with the chamfer in the same direction.*

To remove the ring gear, use a hammer and a chisel to break the ring. Ensure that the flywheel is not damaged during this operation.





The ring gear is heated onto the flywheel. When a new gear is to be fitted, ensure that it is not heated to more than 250° C (480° F). Ensure that the chamfer on the teeth of the gear is in the correct direction.

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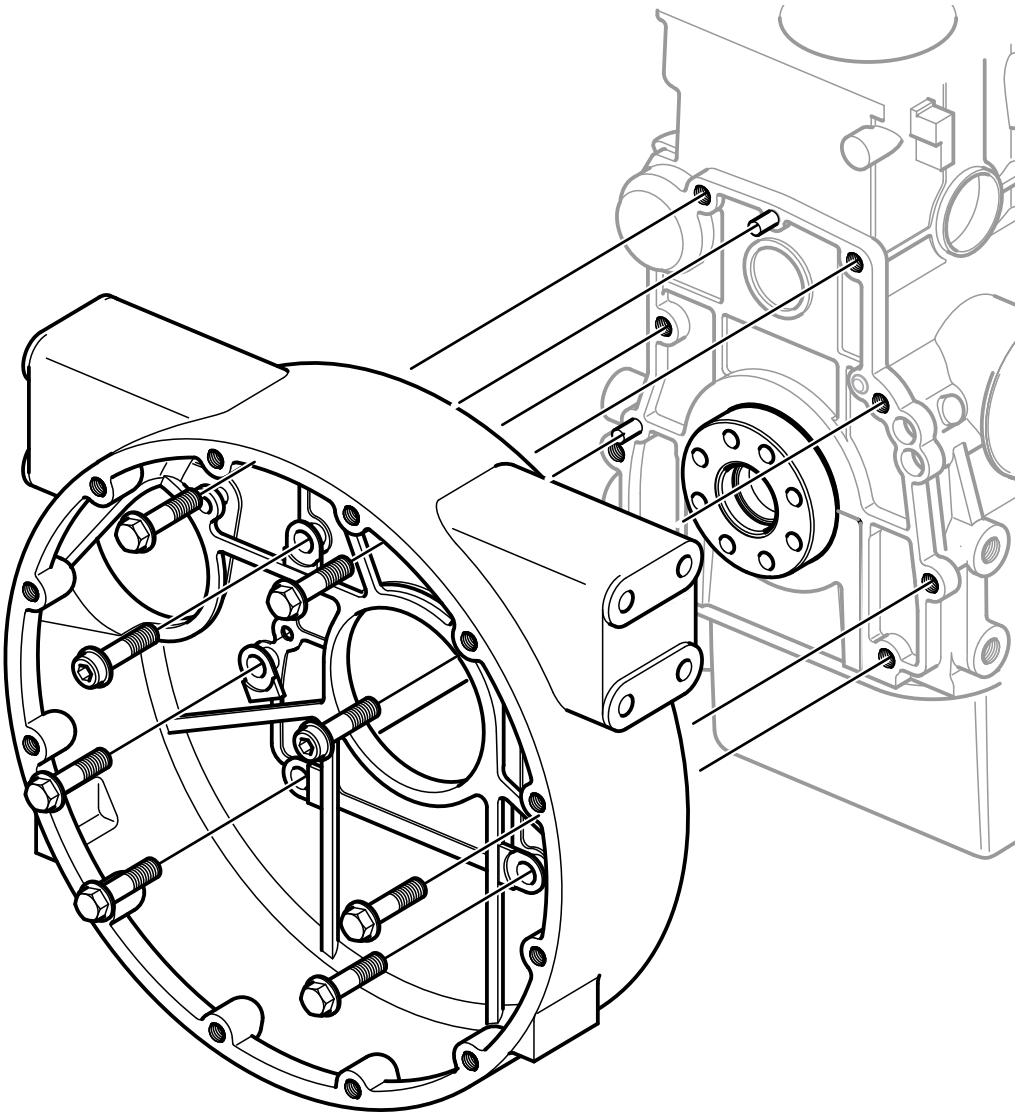
Operation:
Flywheel housing- to remove and to fit **22.04**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrews	44	32	4,5

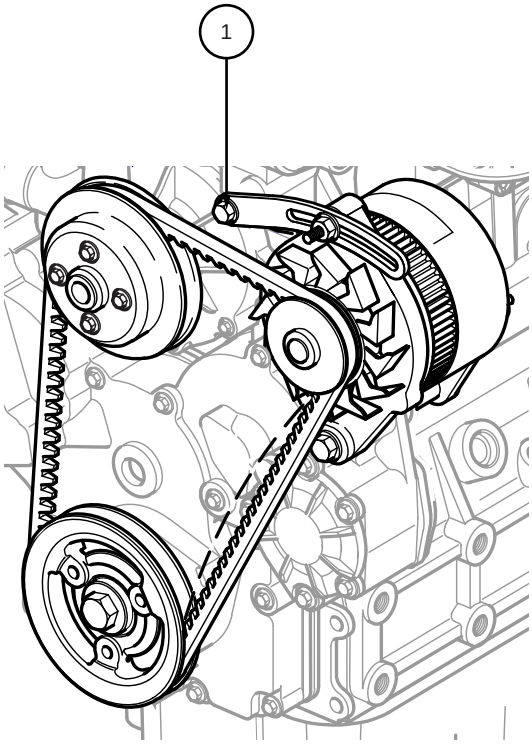
Service operations:
1. Remove flywheel … … … … … **22.01**

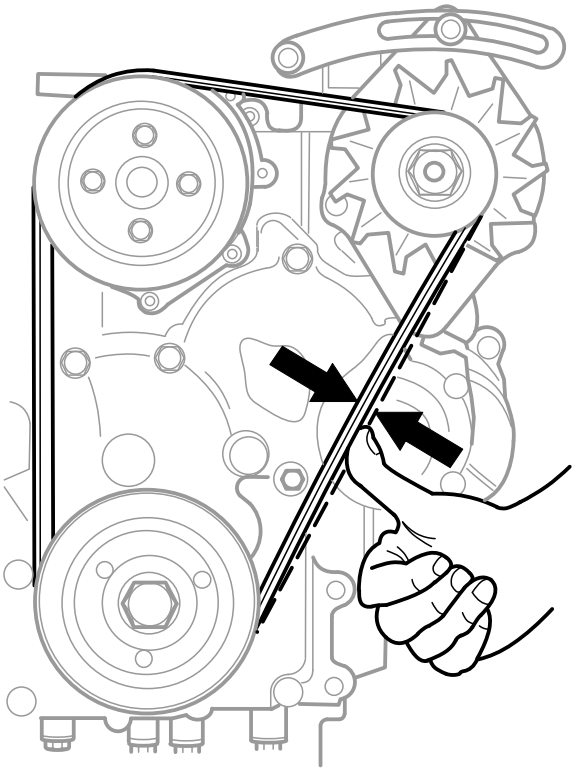
Special notes and tools:
Warning! *The flywheel housing is heavy, use lift equipment or get assistance with the lift operation before removal of the flywheel housing fasteners.*



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Operation: **Drive belt - to remove and to fit**	**23.01**
Recommended torque: **Engine type Nm lbf ft kgf m**	**Special notes:** ***Cautions:*** *The alternator fitted to the 700 Series engine is driven by a drive belt of a specific design. Use only a genuine part drive belt. If this is not done, an early failure of the belt may occur.* *Do not loosen the setscrew* ***(1)****, as the thermostat housing to cylinder head seal could be broken and result in a leakage of coolant.* **Note:** If a new belt is fitted, the belt tension must be checked again after the first 25 hours of operation.





The condition of the belt should be checked at the intervals shown in the user's handbook, and the belt should be renewed if there are cracks or if the belt is contaminated by oil or grease.
To check the tension, press the belt with the thumb at the centre of the longest free length and check the deflection. With moderate thumb pressure 45 N (10 lbf) 4,5 kgf, the correct deflection of the belt is 10mm (3/8 in).

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Operation:
Alternator - to remove and to fit **23.02**

Recommended torque:

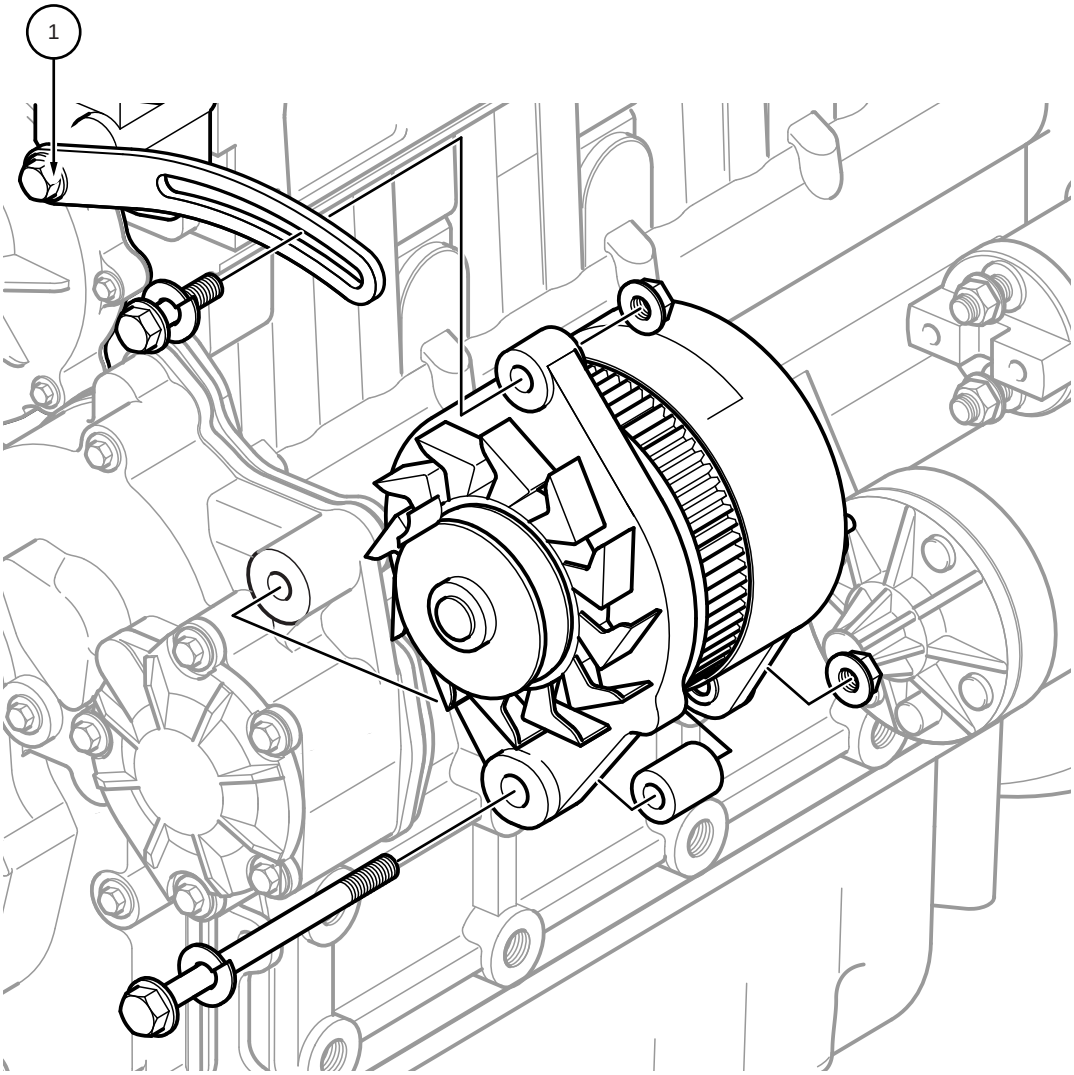
Engine type	Nm	lbf ft	kgf m
Setscrew	12	9	1,2
Nut	24	18	2,4
Nut, alternator pully	60	44	6,1

Service operations:
1. Remove drive belt … … … … … **23.01**

Special notes

Caution: *Do not loosen the setscrew* ***(1)*** *as the thermostat housing to cylinder head seal could be broken and result in a leakage of coolant.*

Note: Ensure that any washers and distance pieces are fitted in their correct positions and that the alternator pulley is aligned to the crankshaft pulley within +/- 2,4 mm (3/32 in).



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Operation:
Glowplugs (starting aid) - to remove and to fit **23.03**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Glowplug	17	13	1,7
Nuts	1,5	1	0,2

Service operations:

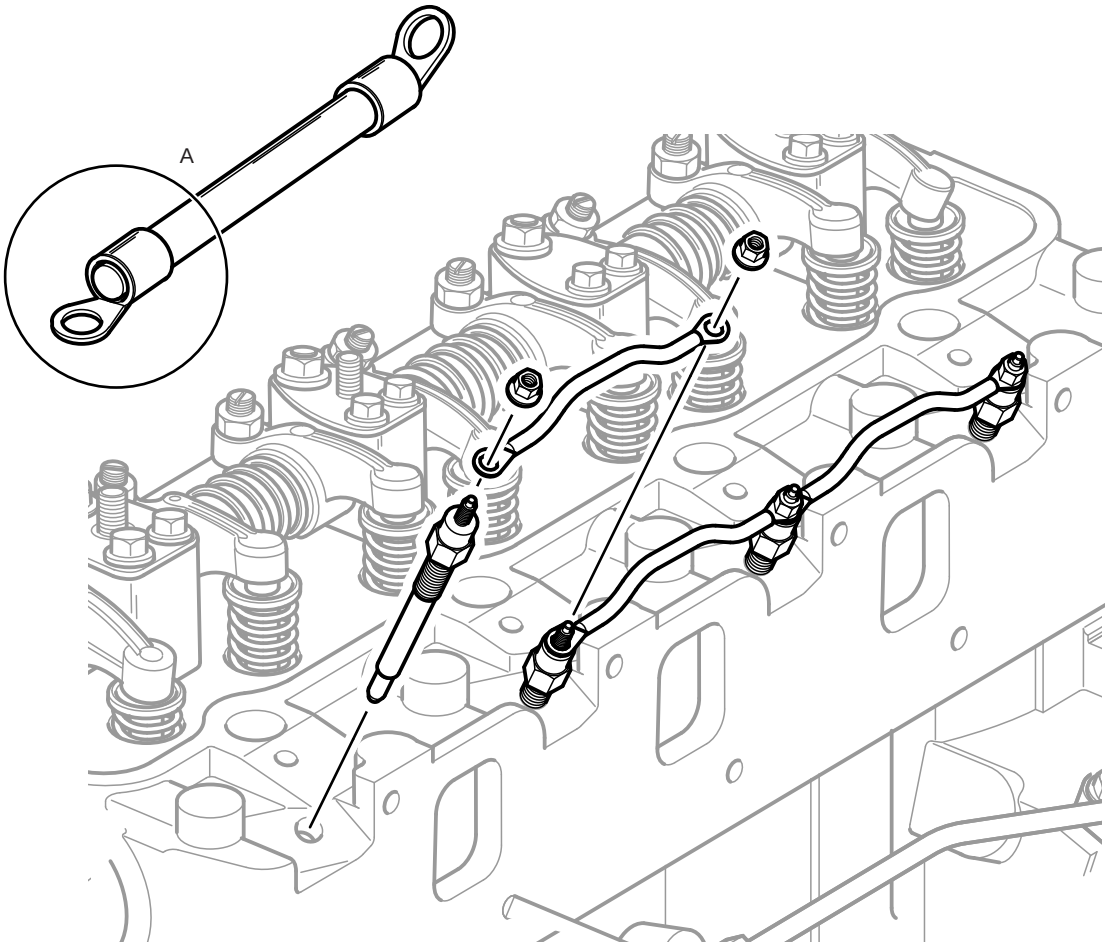
1. Remove induction manifold … … … … … … … … … **12.06**

Special notes and tools:

Note: In order to remove the glow plugs on the UA and UC engines, some types of induction manifold will have to be removed first. The induction manifolds fitted to UB engines need not be removed.
For UA and UC engines: fit the cable with the straight connection **(A)** toward the front of the engine.
For UB engines: fit the cable with the straight connection toward the rear of the engine.

Cautions: *Ensure that the cables for the glow plug does not contact the high-pressure fuel pipes. On early engines, bend the connections away from the high-pressure pipes after the cables have been fitted, as it is possible for a short circuit to occur between the connection and the high-pressure pipe. Later engines are fitted with a cable which has a terminal that is already bent to the correct shape.*

See operation **23.04** to check the glowplugs.



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Operation: Glowplugs (starting aid) - to check 23.04

To check power supply and continuity

1 Disconnect the glow plug connection.
2 Apply one probe of a multi-meter, which can check continuity, to the terminal of the glow plug and apply the other probe to a suitable earth. If the continuity is correct the multi-meter will give an audible signal. If there is no audible signal, renew the glow plug. Repeat this check for all of the glow plugs.
3 If a multi-meter is not available, connect a 12V test lamp between the positive terminal of the battery and earth to check that the lamp will light.
4 Connect the test lamp between the terminal of the glow plug, which is furthest away from the power supply, and earth. Operate the control switch and the test lamp should be illuminated if the power supply is correct.
5 Disconnect the cables at each glow plug.
6 Connect the test lamp to the positive terminal of the battery and to the terminal of a glow plug. The lamp will be illuminated if the continuity is correct. If the test lamp is not illuminated, renew the glow plug.
7 When all of the glow plugs have been checked, connect the cables to the glow plugs.

To check the operation of the glow plugs

1 Disconnect the power supply cable and the connection cables from the terminals of the glow plugs.
2 Connect a 50-0-50 ammeter between the power supply cable and the terminal of a glow plug.
Connect a voltmeter between the glow plug terminal and earth.
3 Engage the control switch and check the readings of the ammeter and the voltmeter.

Iskra glow plugs

With a 12 volt supply, there should be an initial current of approximately 12.5 amperes, which should reduce to approximately 7 ± 1 amperes after 30 seconds for UA and UC engines. For UB engines, the initial current should be approximately 12.5 amperes, which should reduce to approximately 6.5 ± 1 amperes after 30 seconds.

Beru B80 glow plugs

With a 12 volt supply, there should be an initial current of approximately 25 amperes, which should reduce to approximately 7 ± 1 amperes after 30 seconds for UA and UC engines. For UB engines, the initial current should be approximately 25 amperes, which should reduce to approximately 6.5 ± 1 amperes after 30 seconds.
If the ammeter reading is low or there is no reading, renew the glow plug. If there is no voltmeter reading, check the switch and the power cable.
When all of the glow plugs have been checked, remove the ammeter and the voltmeter and connect the power supply cable. Check that the glow plugs have been connected correctly.

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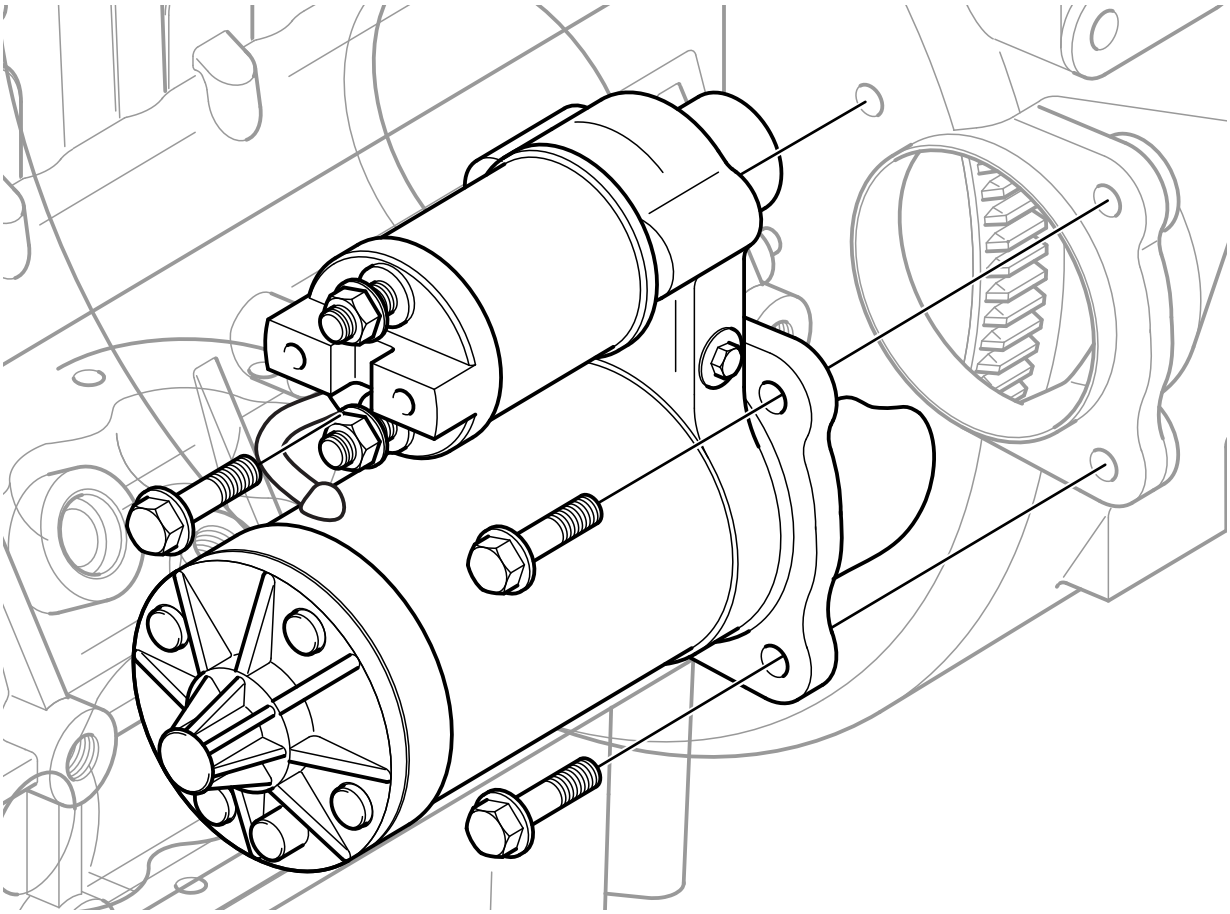
Operation:
Starter motor - to remove, to fit and to test **23.05**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Setscrew	44	32	4,4

Special notes:
To test on the engine;
Ensure that the battery is fully charged.
Turn on the lights and operate the starter switch. If no lights are fitted to the machine, connect a voltmeter across the battery terminals and operate the starter switch.
If the starter does not operate but the lights keep their power or there is no voltage drop across the battery, check the switch and all the connections and wires. Slow action of the starter can be caused by faulty connections.
Failure to engage smoothly between the starter and the flywheel can be caused, on some types of starter motor, by dirt on the helical grooves of the starter motor drive, which can prevent free pinion movement.
Clean the shaft thoroughly with gasolene, or a fluid made especially for the purpose, and apply a small quantity of Aero Shell 6B or its equal.

The starter is specialist repair only.



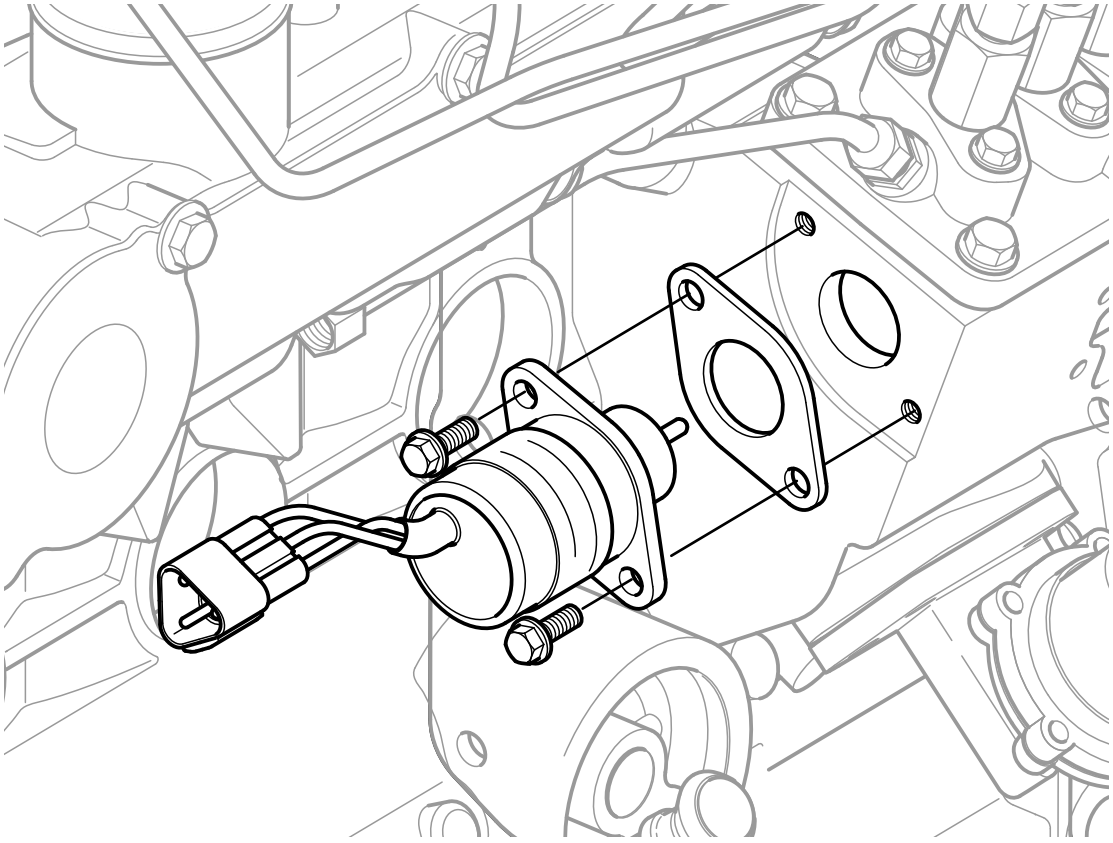
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Operation:
Electrical stop solenoid - to remove and to fit **23.06**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
All variants			
Setscrews	9	6.6	0,92

Special notes:



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Operation:
Power take-off assembly - to remove and to fit **24.01**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
Nuts	**44**	**32**	**4,4**
Setscrews	**22**	**16**	**2,2**
M6 Setscrew	**9**	**6**	**0,9**

Special notes

Special tools: Gasket eliminator, part number 21826040

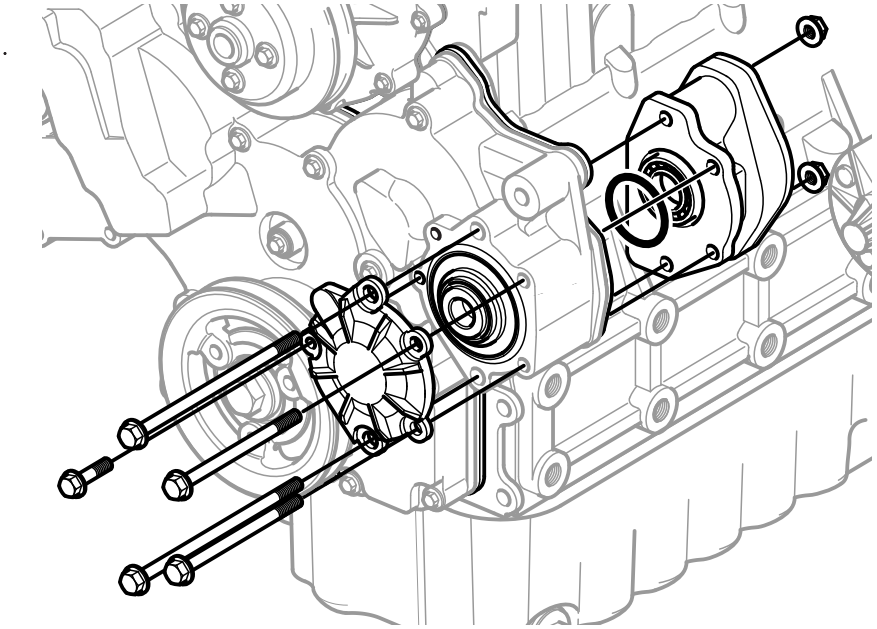
Note: From engine number U-----U802891C an extra setscrew was introduced to retain the PTO cover. The M6 setscrew is tightened to 9 Nm (7lbf ft) 0,9 kgf m.

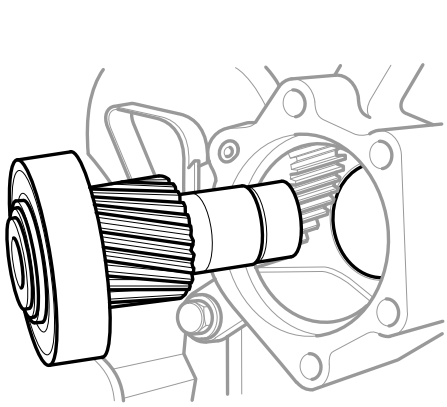
Fit a new "O" ring to the rear housing.

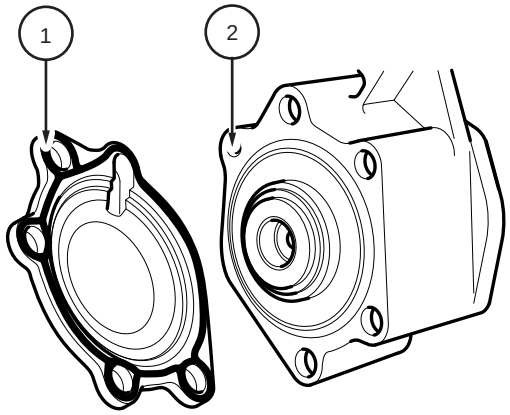
Apply a 2,5/3,0 mm bead of Gasket eliminator to the flange face of the front cover plate (1).

Clean and lubricate the recess in the timing case for the ball bearing, with clean engine oil.

Caution: *Ensure that the oil hole (2) in the front cover plate is not blocked by sealant.*







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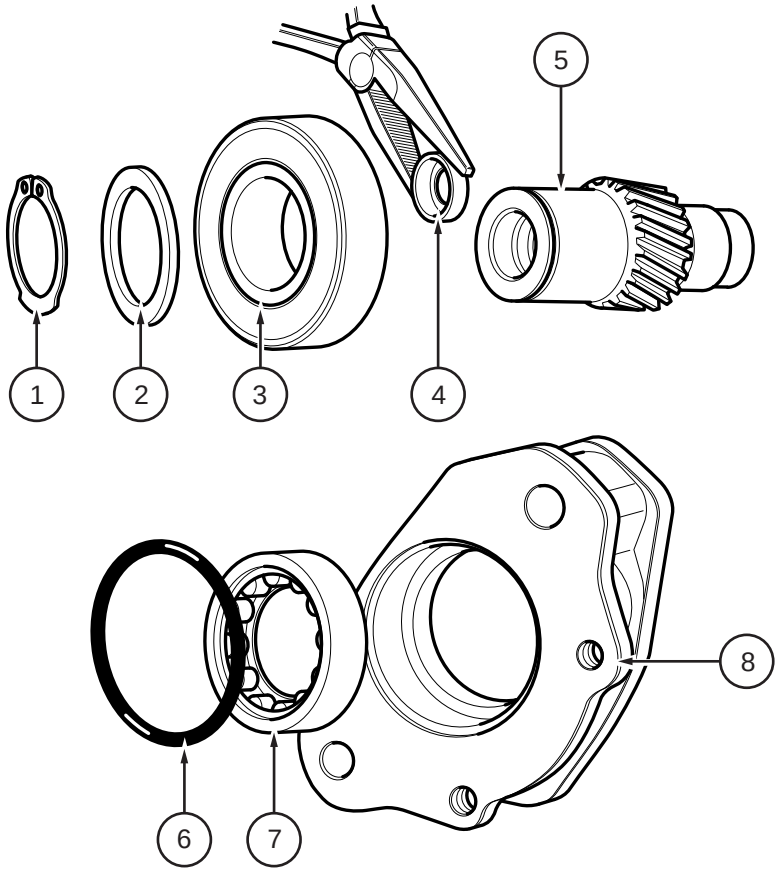
Operation:
Power take-off assembly - to dismantle and to assemble **24.02**

Recommended torque:

Engine type	Nm	lbf ft	kgf m
-			

Service operations:
1. Remove power take-off assembly … … … … … **24.01**

Special notes:

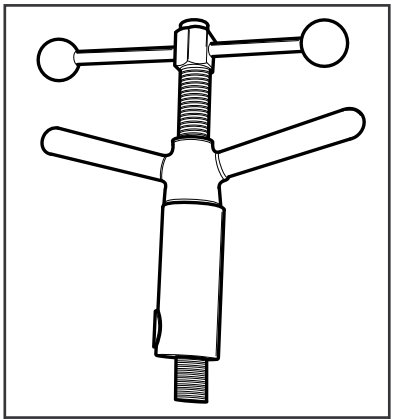


To dismantle
1 Remove the circlip (1). Remove the spacer (2). Press the shaft (5) out of the ball bearing (3).
2 Remove the "O" ring (6). Press the roller bearing (7) out of the housing.
3 Press the cup (4) out of the front of the drive shaft.
To assemble
1 Press the cup (4) fully into the drive shaft.
2 Press the ball bearing (3) fully onto the shoulder of the shaft. Fit the spacer (2). Fit the circlip (1).
3 Lightly lubricate the recess in the front of the rear housing (8) and press in the roller bearing onto the shoulder of the recess.
4 Renew the "O" ring (6).

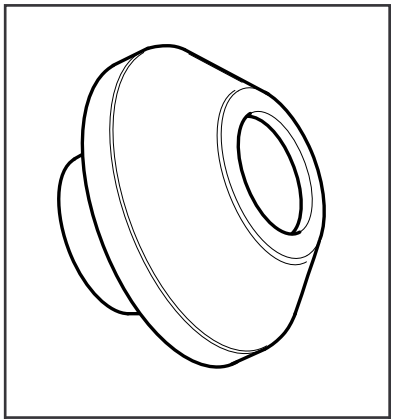
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Operation:
List of special tools **25.01**

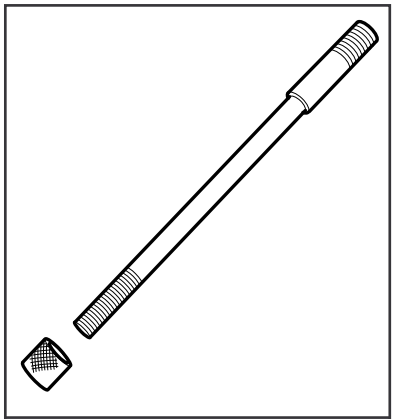
Tool number	Part number	Description
PD.1D	21825478	Remover/replacer for valve guides
PD.1D/2	21825480	Spacer used with main tool PD.1D
PD.1D-13	27610019	Adaptor for use with main tool PD.1D
PD.41D	21825496	Gauge for piston height and valve depth
PD.170	21825577	Replacer tool for front oil seal (main tool)
PD.184	21825589	Slide hammer
PD.208	21825617	Dial gauge for use with PD.41D
PD.243	27610013	Rubber plug replacer tool
PD.244	27610016	Adaptor for PD.6118B
PD.249	27610017	Adaptor for valve guide depth, used with PD.1D-13
PD.254	27610018	Clamp tool for use with PD.261
PD.255	27610021	Replacer tool for rear oil seal, use with MS.550
PD.256	27610022	Replacer tool for idler gear hub, use with MS.550
PD.258	27610025	Adaptor/remover idler hub for use with PD.184
PD.259	27610026	Adaptor, main tool to crankshaft nose, for use with PD.170
PD.260	27610027	Adaptor for front seal, for use with PD.170
PD261	27610089	Rack position tool
PD.6118B	21825666	Valve spring compressor
MS.76A	21825938	Set of adjustable cutters for valve seats
MS.550	21825639	Universal drive handle
MS.1519A	27610020	Valve spring compressor
NO.8	21825491	Piston ring compressor



21825478



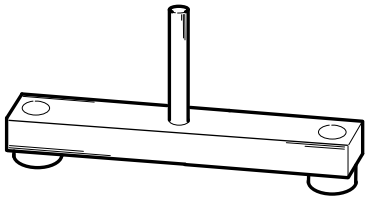
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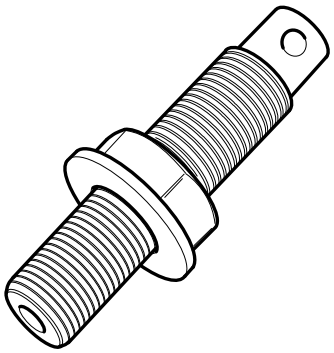
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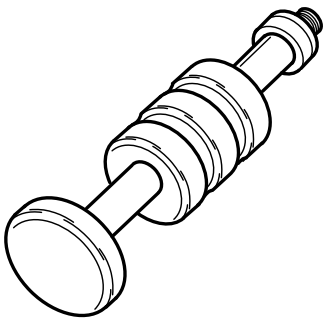
Operation:
List of special tools **25.01**



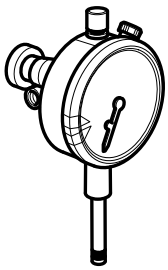
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21825577



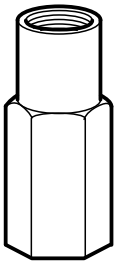
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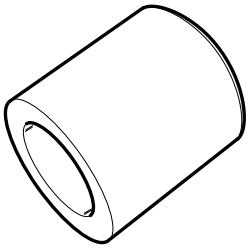
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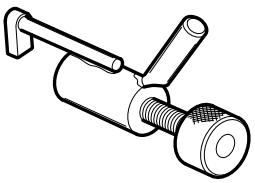
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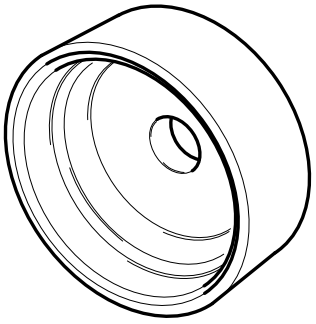
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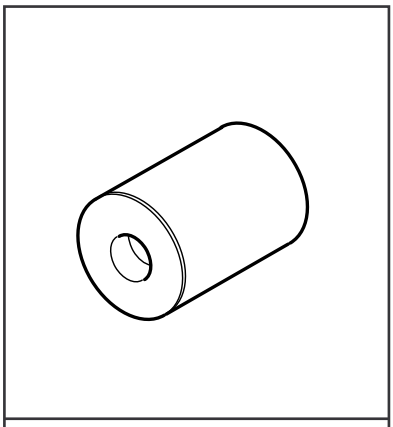
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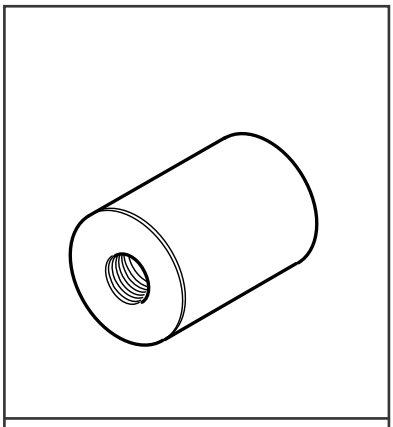
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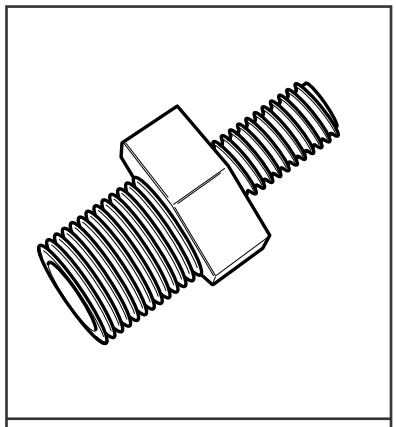
Operation:
List of special tools **25.01**



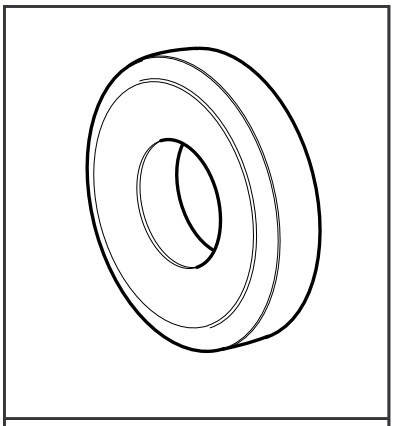
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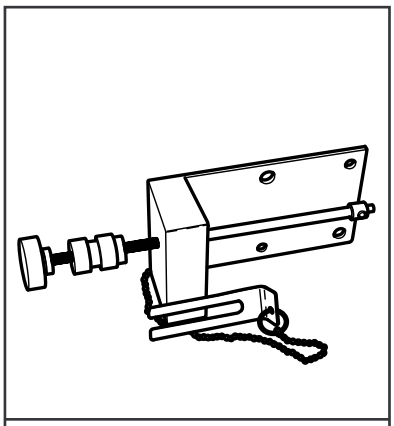
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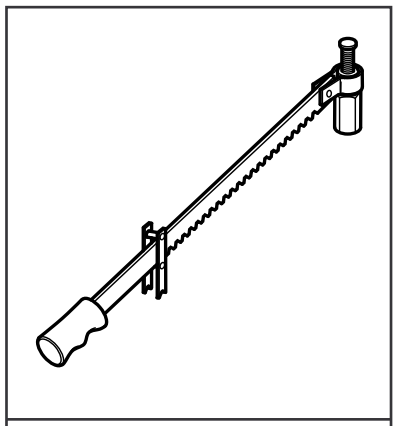
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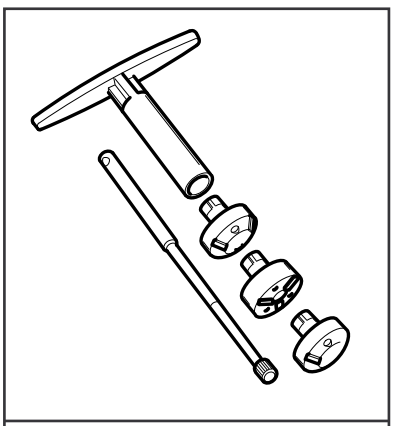
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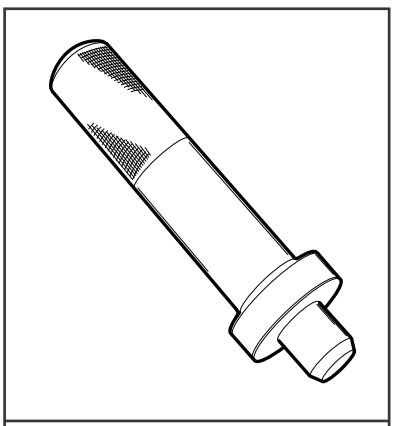
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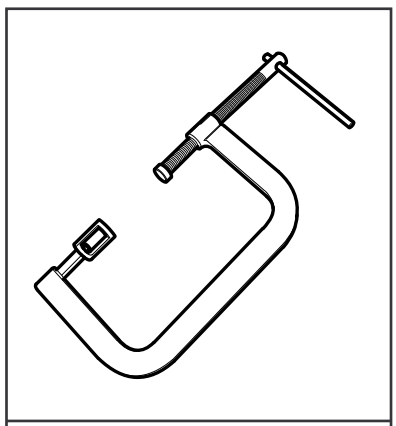
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21825938



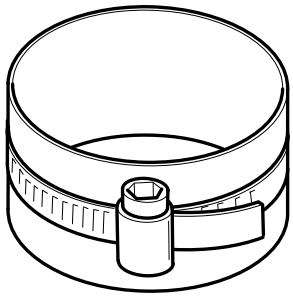
21825639



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Operation:
List of special tools **25.01**



21825491

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DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

D x p	Torque wrench setting (Nm)			
	4.8	**8.8**	**10.9**	**12.9**
M 4 x 0,7	1.2	2.3	3.2	3.9
M 5 x 0,8	2.3	4.5	6.3	7.5
M 6 x 1	3.9	7.7	10.8	12.10
M 8 x 1,25	9.1	18.2	25.6	30.7
M 8 x 1	9.6	19.2	26.8	32.4
M 10 x 1,5	18.6	36.10	54.10	62.5
M 10 x 1,25	19.4	38.7	54.4	65.3
M 12 x 1,75	31.3	62.6	87.8	105.6
M 12 x 1,25	**33.5**	**66.9**	**93.8**	**112.10**
M 14 x 2	49.8	99.7	140.3	168.3
M 14 x 1,5	52.9	105.6	149.1	178.6
M 16 x 2	75.3	151.3	212.6	255.4
M 16 x 1.5	78.10	157.10	222.9	267.2
M 18 x 2,5	104.8	208.9	293.8	352.8
M 18 x 1,5	113.7	227.3	320.3	383.8
M 20 x 2,5	147.6	295.2	414.8	497.4
M 20 x 1,5	159.4	318.1	447.10	537.3
M 22 x 2,5	196.3	392.7	552.1	661.10
M 22 x 1,5	211.1	421.4	592.7	711.5
M 24 x 3	254.6	509.10	716.6	863.5
M 24 x 2	269.4	539.5	760.2	907.8
M 27 x 3	372.7	745.4	1047.10	1254.6
M 27 x 2	394.1	789.7	1107	1328.4
M 30 x 3,5	506.3	1011.1	1424.4	1704.8
M 30 x 2	544.7	1092.3	1535.1	1837.7

ATTENTION

Sensor maximum driving torque: 15 Nm.

Transmission

Min. 725 PSI - 1100 RPM
Max. 6230 PSI - 2500 RPM

Distributor Valve
3500 PSI

DO NOT DISASSEMBLE ANY COMPONENT (S) DURING WARRENTY PERIOD WITHOUT CONTACTING TEREXLIFT.

20.3 SPECIAL TOOL LIST

SPECIAL TOOLS LIST
TX51-19M Light Capability Rough Terrain Forklift
Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
Hydraulic Cylinders - USAG					
Cylinder disassembly & assembly	USAG 282T SN/50/80 Wrench / 4.5mm Dia. Pin				
Cylinder disassembly & assembly	USAG 281C/215 Wrench / 6mm Dia. Pins				

SPECIAL TOOLS LIST

TX51-19M Light Capability Rough Terrain Forklift

Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
Fork Carriage Assembly - Terex Corporation					
Rotation nut on fork carriage	Fork Rotation nut wrench	3221N8			

SPECIAL TOOLS LIST

TX51-19M Light Capability Rough Terrain Forklift

Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
Diesel Engine - Perkins Engine Company					
Crankshaft & Flywheel	Drive Handle		21825639	MS.550	Churchill / Kent Moore
Crankshaft & Flywheel	Front crank seal replacer		21825577	PD.170	Churchill / Kent Moore
Crankshaft & Flywheel	Rear oil seal replacer Tool (use with 21825639)		27610021	PD.255	Churchill / Kent Moore
Crankshaft & Flywheel	Front crank seal replacer		21825577	PD.170	Churchill / Kent Moore
Crankshaft & Flywheel	Adapter, main tool to crankshaft nose (use with 21825577)		27610026	PD.259	Churchill / Kent Moore
Crankshaft & Flywheel	Adapter for front oil seal (use with 21825577)		27610027	PD.260	Churchill / Kent Moore
Cylinder Block & Crankcase	Rubber strip seal installer		27610013		
Cylinder Head	Adapter for valve spring compressor (used with 21825666)				
Fuel System	Kit, governor arm lock, Clamp Tool		27610018	PD.254	Churchill / Kent Moore
Fuel System	Rack position Tool (use with 27610018)		27610089		
Timing Tools	Idler gear hub replacer (use with 21825639)		27610022	PD.256	Churchill / Kent Moore
Timing Tools	Adapter, Remover Idler gear hub (use with 21825589)		27610025	PD.258	Churchill / Kent Moore

SPECIAL TOOLS LIST

TX51-19M Light Capability Rough Terrain Forklift

Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name

SPECIAL TOOLS LIST
TX51-19M Light Capability Rough Terrain Forklift
Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
Front & Rear Axles - Carraro					
Front & Rear Axle					
differential support cups bearing	differential support cups bearing driver-27349		119068		
Front Axle Only					
	Carraro Part # tool is used with				
false pinion	false pinion-124897		715450		
bushing for conic distance measurement	bushing for conic distance measurement		119205		
shaft	shaft		119206		
pinion bearing	Driver for pinion bearing-27349		715082		
ring nut	ring nut wrench-118445		715080		
locking pinion	locking pinion wrench-126441		715081		
differential housing bearing	driver for differential housing bearing-27308		715083		
ring nut	ring nut wrench-107400		119030		
axle beam bushing	driver for axle beam bushing-124615		119220		

SPECIAL TOOLS LIST

TX51-19M Light Capability Rough Terrain Forklift

Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
battitoio per rotula sferica su trave assale	battitoio per rotula sferica su trave assale-27692		715451		
spheric bearing	driver for spheric bearing-118504		715454		
bushing	driver for bushing-126398		715453		
oil seal	driver for oil seal-125390		119097		
swivel housing bushing	driver for swivel housing bushing-127684		715166		
swivel housing oil seal	driver for swivel housing oil seal-134293		715085		
wheel hub oil seal	driver for wheel hub oil seal-139279		715099		
wheel hub oil sea	driver for wheel hub oil seal-127994		715086		
brake housing ring	driver for brake housing ring-25144		119102		
bearings	driver for bearings-25741/25820		715403		
transmission housing bearing	driver for transmission housing bearing-25742		715028		
transmission housing bearing	driver for transmission housing bearing-25743		715445		
oil seal	driver for oil seal-141045		715298		
	interchangeable handler		119033		
Rear Axle Only					

SPECIAL TOOLS LIST
TX51-19M Light Capability Rough Terrain Forklift
Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
false pinion	false pinion-126441		715450		
conic distance measurement	bushing for conic distance measurement		119205		
shaft	shaft		119206		
pinion bearing	driver for pinion bearing-27349		715082		
ring nut	ring nut wrench-118445		715080		
locking pinion	locking pinion wrench-126441		715081		
differential housing bearing	driver for differential housing bearing-27308		715083		
ring nut	ring nut wrench-118445		119030		
oil seal	driver for oil seal-139420		715165		
bushing	driver for bushing-124615		119220		
spheric bearing	driver for spheric bearing-27692		715451		
bushing	driver for bushing-118504		715454		
oil seal	driver for oil seal-126398		715453		
swivel housing bushing	driver for swivel housing bushing-125390		119097		
swivel housing oil seal	driver for swivel housing oil seal-127684		715166		
wheel hub bearings	driver for wheel hub bearings-118378		715085		
wheel hub oil seal	driver for wheel hub oil seal-139279		715099		
wheel hub oil seal	driver for wheel hub oil seal-127994		715086		

SPECIAL TOOLS LIST

TX51-19M Light Capability Rough Terrain Forklift

Contract M67854-00-C-3014

Where Used & OEM Name	Tool Description	Terex Tool Part Nbr.	OEM Tool Part Nbr.	Other Supplier	
				Tool Part Nbr.	Name
pivot oil seal	driver for pivot oil seal-25124		715140		
pivot bushing	driver for pivot bushing-119926		119083		
	interchangeable handler		119033		