

Chapter 0

General instructions

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Foreword

The Shop Manual is prepared as an aid to performing quality repairs by giving the service personnel an understanding of the dump truck, and showing the correct way perform repairs and make judgements.

Make sure that you understand the manual and use it at every available opportunity. The manual will also serve as a useful guide to office personnel and other persons who are involved with the dump truck in one way or another.

How to use the SHOP MANUAL:

The main index give an view of the chapters index page no.

The manual is divided into the following chapters:

Chapter 1:	Engine XPI/PDE	Chapter 6:	Electric system
Chapter 2:	Transmission	Chapter 7:	Front frame
Chapter 3:	Drive line	Chapter 8:	Rear frame
Chapter 4:	Lubrication	Chapter 10:	Error codes list
Chapter 5:	Hydraulic system		

In the chapters index you will find the page no. for the description of each part.

Each part will describe:

Structure and function:

This section explains how the components are built and how they work.

Testing and adjusting:

This section explains checks to be made before and after performing repairs, as well as adjustments to be done at the completion of the checks and repairs.

Disassembly and assembly:

This section describes how to remove, install, disassemble, repair and assemble components, and the work order. Special tools are listed at the end of each chapter. The special tools are an excellent aid in the work shop. By using special tools, the job will be easier to perform and in some cases a special tool is required to carry out the work. List of all special tools for the complete truck are listed in the "Special Tool Guide".

Maintenance standard:

This section gives the judgement standards when inspecting disassembled parts.

Troubleshooting:

When a fault is detected, this section is used as before the practical fault finding starts. A skilled and trained mechanic together with the Shop Manual is the best combination for troubleshooting when repair instruction is needed.

At the end of each chapters are the main Troubleshooting

This manual is valid for the serial nos. listed on the first page.

Distributing and updating:

Subscribed Shop Manuals will automatically be updated at revisions.

This manual is originally produced by Doosan Infracore Norway , 6440 Elnesvågen, Norway, and must not be reproduced, translated or made available to a third party, fully or partly, without our written permission.

NOTE

Because of the different variants the parts and images which are contained in this book can be different from the current model of dump truck . For the spare parts please used the parts catalogue for current model.

Hyundai ADT Payload Policy

Hyundai ADT 10/10/20 Policy:

"Hyundai's ADT payload overload policy, referred to as the "10/10/20" policy, states that "The mean (average) of the payload distribution shall not exceed the target payload and no more than 10% of payloads may exceed 1.1 times the truck target payload and no single payload shall ever exceed 1.2 times the target payload."

This will affect the warranty for our dealers and customer, and give clear direction on operation parameters

Torque limit table

This tables indicates standard torque limits in Nm for the various screw and bolt qualities and dimensions. The torques are valid for screws on the outside of the components.

Quality class: Dimension	8.8 M (Nm)	10.9 M (Nm)	12.9 M (Nm)
M 8	24	33	40
M 10	47	65	79
M 12	81	114	136
M 14	128	181	217
M 16	197	277	333
M 18	275	386	463
M 20	385	541	649
M 22	518	728	874
M 24	665	935	1120
M 27	961	1350	1620
M 30	1310	1840	2210
M 33	1770	2480	2980
M 36	2280	3210	3850

Quality class: Dimension	8.8 M (Nm)	10.9 M (Nm)	12.9 M (Nm)
3/8" UNC	38	54	68
7/16" UNC	61	87	108
1/2" UNC	93	131	163
9/16" UNC	133	187	234
5/8" UNC	183	259	323
3/4" UNC	322	455	568
7/8" UNC	516	729	909
1" UNC	772	1090	1360
1 1/8" UNC	1090	1550	1930
1 1/4" UNC	1530	2160	2690
1 3/8" UNC	2020	2850	3550
1 1/2" UNC	2650	3750	4680

Quality class: Dimension	8.8 M (Nm)	10.9 M (Nm)	12.9 M (Nm)
M 8 x 1	25	35	42
M 10 x 1,25	48	68	81
M 10 x 1	49	70	84
M 12 x 1,5	83	117	140
M 12 x 1,25	85	120	144
M 14 x 1,5	135	190	288
M 16 x 1,5	204	287	344
M 18 x 1,5	294	413	496
M 20 x 1,5	408	574	688
M 22 x 1,5	546	768	921
M 24 x 2	696	979	1170
M 27 x 2	1000	1410	1690
M 30 x 2	1390	1950	2340
M 33 x 2	1860	2610	3130
M 36 x 2	2350	3310	3970

Quality class: Dimension	8.8 M (Nm)	10.9 M (Nm)	12.9 M (Nm)
3/8" UNF	41	59	73
7/16" UNF	66	93	115
1/2" UNF	99	141	175
9/16" UNF	142	201	250
5/8" UNF	197	279	347
3/4" UNF	344	486	606
7/8" UNF	547	772	963
1" UNF	814	1150	1430
1 1/8" UNF	1170	1660	2060
1 1/4" UNF	1620	2290	2850
1 3/8" UNF	2170	3070	3820
1 1/2" UNF	2840	4000	5000

Bolt quality marking

Strength marking on screws consists of two numerals that may be separated by a point (.). The numerals indicate tensile and yield limits of material in N/mm².

- Numeral 1 denotes a hundredths of the tensile limit in N/mm².
- Numeral 1 x numeral 2 denotes a tenth of the yield limit in N/mm².

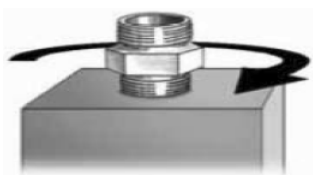
A bolt designated 8.8 thus has tensile limit 800 N/mm² and yield limit 640 N/mm².

Nut quality marking

The designation for nuts consists of one numeral. The numeral denotes that the nut is of equal strength to a bolt with the same first number.

A nut of strength class 8 is thus equally strong to a bolt of class 8.8.

Hydraulic hoses, couplings, fittings and adapters.



Lubricate thread and o-ring with oil



Control o-ring and surface. Hands tighten the fittings.



Tighten the fittings to correct torque shown in the table

Correct torque on hose couplings:

Tightening with torque spanner - Metric			
mm threads	Spanner size	Serie L/S	Torque Nm
M 14x1,5	17mm	08L	16
M 16x1,5	19mm	10L	26
M 18x1,5	22mm	12L	37
M 22x1,5	27mm	15L	47
M 30x2	36mm	22L	116
M 36x2	41mm	28L	137
M 45x2	50mm	35L	226
M 52x2	60mm	42L	347
M 24x1,5	30mm	16S	84
M 36x2	46mm	25S	179
M 42x2	50mm	30S	263
Tightening with torque spanner - ORFS (UNF)			
UNF Threads	Spanner size	ORFS dim	Torque Nm
1"-14	30mm	-10	85
1.3/16"-12	36mm	-12	122
1.7/16"-12	41mm	-16	156

Correct torque on hydraulic Fittings/Adaptors:

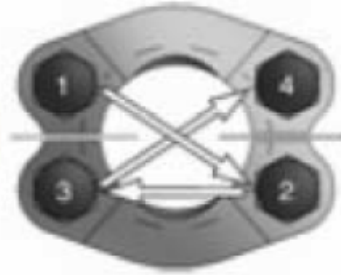
Torque (Nm) - Metric thread L Series					
EO-L	Thread/ spanner size	ED seal	O-ring	Adj w/ o-ring	Swivel w/o-ring
8	12x1,5 / 17 mm	25	25	25	1/4 turn
10	14x1,5 / 19 mm	45	35	35	1/4 turn
12	14x1,5 / 19 mm	45	35	35	1/4 turn
12	16x1,5 / 22 mm	55	40	40	1/4 turn
15	16x1,5/ 24 mm	55	40	40	1/4 turn
15	18x1,5/ 24 mm	70	45	45	1/4 turn
15	22x1,5/ 27 mm	125	60	60	1/4 turn
18	22x1,5/ 27 mm	125	60	60	1/4 turn
22	26x1,5/ 32 mm	180	100	100	1/4 turn
22	27x2/ 32mm	180	100	100	1/4 turn
28	26x1,5/ *	180	100	100	1/4 turn
28	42x2/ 50 mm	450	210	210	1/4 turn
35	42x2/ 50 mm	450	210	210	1/4 turn
42	48x2/ 55 mm	540	260	260	1/4 turn
Torque (Nm) - Metric threaded S serie					
16	22x1,5/ 27 mm	135	100	100	1/4 turn

Torque (Nm) - Inch thread					
EO-L	Thread/ spanner size	ED seal	O-ring	Adj w/ o-ring	Swivel w/o-ring
Torque (Nm) - UNF thread L series					
12	3/4-16 UN/ 24 mm		60	60	
15	3/4-16 UN/ 24 mm		60	60	
Torque (Nm) - UNF thread S series & ORFS					
10	3/4-16 UN/ 24 mm		80	80	55
Torque (Nm) - NPT thread L series (Tapped thread)					
22	3/4-14 NPT/ 32 mm		80	80	55
Torque (Nm) - BSPP thread L series					
8	1/4" / 19 mm	35		35	1/4 turn
12	3/8" / 22 mm	70		70	1/4 turn
12	1/2" / 27 mm	90		90	1/4 turn
15	1/2" / 27 mm	90		90	1/4 turn
22	1/2" / 32 mm	90		90	1/4 turn
22	3/4" / 32 mm	180		180	1/4 turn
42	1,1/4" / 55 mm	450		450	1/4 turn
Torque (Nm) BSPP thread S series & ORFS					
16	1/2" / 27 mm	115		110	1/4 turn
20	3/4" / 32 mm	180		115	1/4 turn
25	1" / 41 mm	310		420	1/4 turn
30	1" / 46 mm	310		420	1/4 turn

Correct Installation and torque on SAE flange:



Lubricate the o-ring with oil

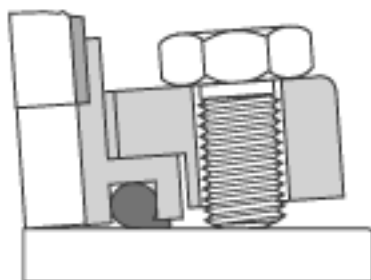


Tighten bolts evenly by hand

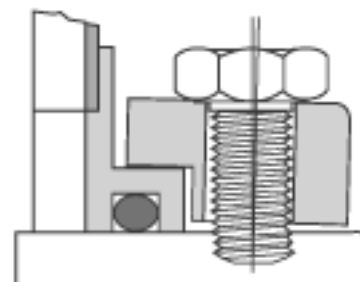


The bolts tighten to correct torque show in the table

Torque SAE flange		
Hyundai art. No.	Screw description	Nm
MX053266	Screw M12x35 ISO 4017-10.9	98
MX053429	Screw M10x30 ISO 4017-10.9	62
MX161497	Screw M12x30 ISO 4017-10.9	98
MX053415	Screw M12x40 ISO 4017-10.9	122
MX509356	Screw M12x45 ISO 4017-10.9	122
MX161487	Screw M10x25 ISO 4017-10.9	62
MX053270	Screw M12x25 ISO 4017-10.9	109
MX516100	Screw 7/16 UNCx1 1/4" NS963-8.8	84
MX516099	Screw 3/8 UNCx1 1/4" NS963-10.9	52



Incorrect



Correct

Types of sealing-/locking compounds and lubricants

- Loctite 242/243: Middle strength (for locking of screws, bolts and nuts).
- Loctite 270/2701: High strength (for locking of screws, bolts and nuts).
- Loctite 603: High strength (for locking of bearings bushings, etc.).
- Loctite 638: Extra high strength (for locking of bearings, bushings, etc.).
- Loctite 574: Master gasket as floating gasket.
- Loctite 7063: For cleaning of surfaces prior to lubrication or glue.
- Molycote 321R*: Anti-obstruction and running in lubricant.
- Würth 210/Loctite 8201: Anti-corrosion spray for electrical wires and components.

Safety in workshop

Purpose

This section is intended as general information about dangers of various types of workshop activities.

Follow the workshop manual

The workshop manual provides instructions about work methods and equipment that reduces the risk of accidents.

Mechanical skill

This is a very important factor. The Hyundai-mechanic is skilled and well trained for his job. Without these qualities, risks are much greater and more difficult to anticipate.

Common sense

This characteristic should form the basis of activities in the workshop.

Negligence and carelessness cannot be allowed.

Work with a safety margin

Always expect that something can go wrong during the work.
Always work with a safety margin where there are risks.

Legislation and local rules

In most countries there are legislation and local practices that apply to safety at work. Follow them at all times.

Warnings (parts or packages)

Always read and follow warnings and instructions.

Do not trust your own knowledge of the risks. The properties of a part or the chemical composition of a product could have been changed during transit.

You have to know where the risks are

In this way you can avoid them. In many cases, risks are so obvious that you do not have to search for them, e.g. carbon monoxide - true it is invisible, but you know that it is lethal. Therefore protect yourself.

The hidden dangers

Dangers are found in all work environments and the most serious danger is in not being aware of them.

The three demands of safety

- * Knowledge: You have to know your job and also where the risks are.
- * Apprehension: You must be aware that you are exposed to risks, or at least to suspect that you are.
- * Caution: You have to protect yourself, do not take chances.

Incidents are warning signals

An incident is an unforeseen event without injury or damage.

The next time the consequence of the same event may be worse.

An incident demonstrates that there is a risk. Every incident must be taken as a warning signal - exactly as if there had been an accident or someone had been taken ill.

Look out

Do not trust others to point out the hazards. It is difficult to remember all pointers and exhortations. New and unexpected risks may also occur.

Therefore; **look out!**

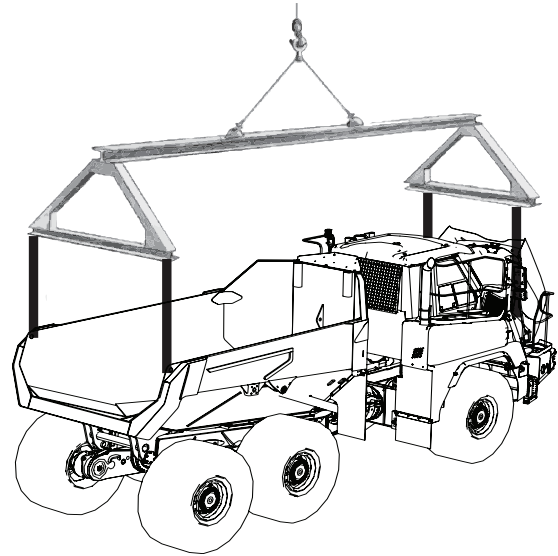
As a guide, a number of examples follow. They are not to be regarded as a comprehensive listing.

Working on machine



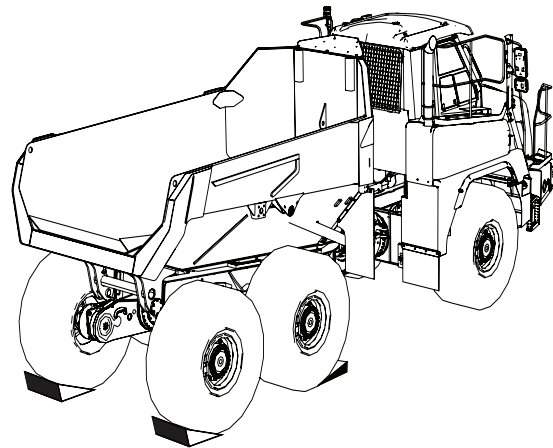
WARNING

Instructions are necessary before operating or servicing machine. Read and understand the Operation and Maintenance Manual and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments repairs or service. Untrained operators and failure to follow instructions can cause death or serious injury.



When performing maintenance operations on machine, prevent tripping and falling by keeping area around your feet clean and free of objects and debris. Always do the following:

- Do not spill oil or grease.
- Do not leave tools laying around.
- Watch your step when walking.
- Never jump down from machine. When getting on or off machine, use steps and handrails, and maintain a three-point contact (both feet and one hand or both hands and one foot) to support yourself.
- If job requires it, wear protective clothing.
- To prevent injury from slipping or falling, when working on hood or covers, never stand or walk on areas except areas equipped with nonslip pads.
- If it is necessary to work under raised equipment or the machine, support work equipment and machine securely with blocks and stands strong enough to support weight of work equipment and machine.
- Do not work under the machine if machine is lifted off ground and the machine is supported only with work equipment. If any control levers are moved, or there is damage to hydraulic system, work equipment or the machine will suddenly drop causing death or serious injury.
- Never service Hyundai equipment without instructions.
- Always lower lift arm and attachment to ground before doing any maintenance.



- Use correct procedure to lift and support machine.
- Cleaning and maintenance are required daily.
- Welding or grinding painted parts must be done in well ventilated areas.
- Wear a dust mask when grinding painted parts. Toxic dust and gas can be produced.
- Vent exhaust to outside when engine must be running for service.
- Exhaust system must be tightly sealed. Exhaust fumes are hazardous and can cause death or serious injury.
- Stop and allow engine to cool and clean engine of flammable materials before checking fluids.
- Never service or adjust machine with engine running unless instructed to do so in this manual.
- Avoid contact with leaking hydraulic fluid or diesel fuel under pressure. It can penetrate skin or eyes.
- Never fill fuel tank while engine running, while smoking, or when near an open flame or sparks.
- Keep body, jewelry and clothing away from moving parts, electrical components, hot parts and exhaust.
- Wear eye protection to guard from battery acid, compressed springs, fluids under pressure and flying debris when engines is running or tools are used. Use eye protection approved for welding.
- Lead-acid batteries produce flammable and explosive gases.
- Keep arcs, sparks, flames and lighted tobacco away from batteries.
- Batteries contain acid which burns eyes or skin on contact.
- Wear protective clothing. If acid contacts body, flush well with water. For eye contact flush well and get immediate medical attention from a physician familiar with this injury.
- The maintenance procedures which are given in this manual can be performed by the owner or operator without any specific technical training. Maintenance procedures which are not in this manual must be performed **ONLY BY QUALIFIED SERVICE PERSONNEL**. Always use genuine Hyundai replacement parts.
- Only authorized personnel should service and repair the machine. Do not allow unauthorized personnel access to the machine or into work area.

- Lower work equipment and stop engine before performing maintenance.
- Park machine on firm, level ground.
- Turn starter switch to "ON" position and set pilot cutoff switch to "I" (ON) position. Cycle work levers (joysticks) back and forth, left and right at full stroke 2 to 3 times to eliminate remaining internal pressure in hydraulic circuit.
- Check that battery relay is "OFF" and main power is shut off. (Wait for approximately one minute after turning "OFF" engine starter switch key and press horn button. If horn does not sound, the main power is shut off.)
- Put blocks against tire to prevent the machine from moving.
- To prevent injury, do not perform maintenance with engine running. If maintenance must be done with engine running, perform maintenance with at least two workers and do the following:
 - One worker must always sit in the operator's seat and be ready to stop engine at any time. All workers must maintain contact with other workers.
 - When maintenance operations are near fan, fan belt, or other rotating parts, there is a potential hazard of being caught in rotating parts. Keep hands and tools away.
- Never drop or insert tools or other objects into rotating fan or fan belt. Parts can break off and hit someone.
- Do not touch any control levers or control pedals. If any control levers or control pedals must be operated, always give a signal to other workers and instruct them to move away.
- When performing maintenance of engine that causes exposure to engine noise for long periods of time, wear hearing protection while working.
- If noise from the machine is too loud, it can cause temporary or permanent hearing loss and/or other problems.
- Do not smoke when you service an air conditioner or if refrigerant gas is present.
- Inhaling fumes either from a flame or gas from a cigarette that has contacted air conditioner refrigerant can cause death or serious injury.
- Never put maintenance fluids into glass containers. Drain all liquids into a suitable containers.
- Unless instructed otherwise, perform maintenance with equipment in servicing position. Refer to this manual for the proper procedure for placing equipment in servicing position.

Personal Protective Equipment (PPE)

Do not wear loose clothing and accessories. Secure long hair. These items can snag on controls or on other parts of equipment. Do not wear oily clothes. They are highly flammable. Do not forget that some risks to your health may not be immediately apparent.

Exhaust gases and noise pollution may not be visible, but these hazards can cause disabling or permanent injuries. Breathing masks and/or ear protection may be required. Wear a hard hat, safety shoes, safety goggles, mask, leather gloves, earplugs and other protective equipment, as required. While working on machine, never use inadequate tools. They could break or slip, or they may not adequately perform intended functions.



Know Your Machine

Know how to operate your machine. Know the purpose of all controls, gauges, signals, indicators and monitor displays. Know the rated load capacity, speed range, braking and steering characteristics, turning radius and operating clearances. Keep in mind that rain, snow, ice, loose gravel, soft ground, slopes etc., can change operating capabilities of your machine.

Proper Work Tools and Attachments

Only use work tools and attachments that are recommended by Hyundai for use on Hyundai's machines. When installing and using optional attachments, read instruction manual for attachment, and general information related to attachments in this manual. Because Hyundai cannot anticipate, identify or test all attachments that owners may want to install on their machines, contact Hyundai for written authorization and approval of attachments, and their compatibility with optional kits.



Vibration

When using vibrating tools e.g. chisel hammer, impact drill, impact nut runner, grinder injuries may be sustained by transition of tool vibrations to the hands.



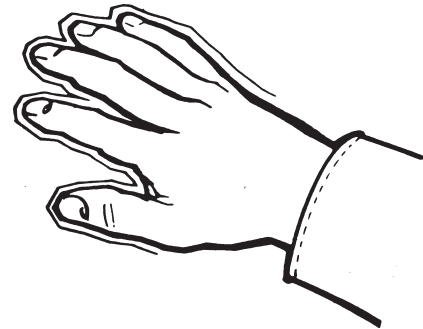
Risks

Vibrations may cause vascular spasms (prickling and pain) in the surface veins. The fingers turn white, cold and senseless. Also nerves, muscles, bones, sinews and joints may be injured.

The risk of injury is believed to increase by smoking and also by low temperatures e.g. if the tools are cold or if the hands are exposed to chilling air.

The injuries become apparent especially when the fingers are cold, often when not working.

Vibration injuries are curable if taken care of in time.



Protective measures

Use heavy gloves. Gloves provide some protection against vibrations and low temperatures.

Alternate between vibration-free and vibrating jobs to provide the body with a possibility to rest from vibrations.

By varying the work posture and grips, the body is not one-sidedly exposed to vibrations.

Avoid smoking before and during the work to help the blood circulation as much as possible.

If you notice any signs of vibration injury consult a doctor.



Protection against vibration

- Heavy gloves
- Alternate jobs
- Do not smoke before and during the work

Injurious noise

Rule of thumb:

Noise that is louder than 85 db (A) and that prevails for more than 8 hours is classed as injurious. (Some countries have other limits.) High frequency noise (high-pitched) is more injurious than low frequency noise (low-pitched) of the same amplitude.

Hearing protection may be needed when machine is operated with an open operator station for extended periods or in a noisy environment. See Operation and Maintenance Manual for sound levels for your machine.



Risks

Partial deafness, in difficult cases impaired hearing beyond cure.

It is impossible to train your tolerance to noise. You may believe that you are doing that if you notice less of the noise after some time.

IN THAT CASE YOU ARE REALLY IN DANGER !

Probably your sense of hearing is already impaired.



Protective measures

With noise absorbers on roof and walls and screens between work places it is easier to limit the propagation of noise. Against injurious noise you have to protect yourself with ear muffs. Ear muffs must be tested and approved.

Protection against noise:

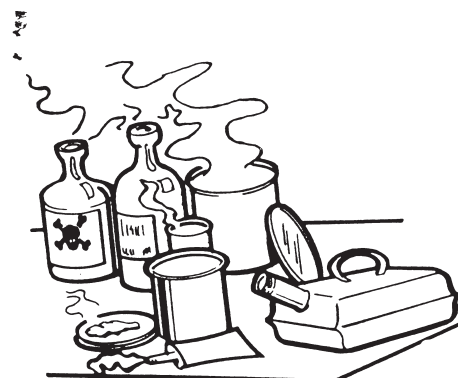
- Use ear muff

Organic solvent

Organic solvents are mixtures of organic liquids (different from e.g. water) that dissolve grease, paint, varnish, wax, oil, glue, rubber etc.

Examples:

- | | |
|----------------------|-------------------------------------|
| - Petroleum spirits | -Toluen |
| - Trichlore ethylene | -Thinner |
| - Petrol | -Alcohols |
| - Xylen | -Plastics and
appertaining glues |



Risks

Solvents release fumes. Fumes may cause dizziness, loss of balance, headache and nausea. Fumes may also irritate the windpipe.

Solvent exposure may also lead to injury to the central nervous system. This may result in insomnia, depressions, nervousness, poor memory and a general sense of feeling tired.

When solvents come in direct contact with the skin, it will become dry and cracked. The risk of skin allergies increases and, additionally, there is a risk of a solvent causing dermatitis.

Many solvents are flammable.



Protective measures

As a first measure, arrange for ventilation that prevents fumes from mixing with the air you breath. Note that the ventilation has to be fire-proof if a solvent is flammable.

If a problem cannot be resolved with ventilation it is necessary to wear either a face mask or breathing protector with filter against dust and organic fumes.

Never leave tins with paint or solvent uncovered.

Use solvent with low content of aromatics. This reduces the risk.

Ensure that solvents do not come into contact with the skin and do not use them as detergent.

Use plastic gloves when working. Gloves of certain materials can be penetrated by a solvent or even dissolved by such solvents.

Make certain.



Protection against organic solvents:

- Fireproof ventilation
- Face mask or breathing protection with filter
- Replace caps/lids
- Use as harmless solvents as possible
- Avoid contact with the skin
- Do not wash the skin with solvent
- Use gloves



Fueling

Use caution when you are refueling a machine. Fuel is flammable and can catch fire if it is brought close to a flame. Stop engine and let it cool before adding fuel. Do not smoke while you are refueling a machine. Do not refuel a machine near flames or sparks. Fill fuel tank outdoors. Keep fuel and other fluid reservoir caps tight and do not start engine until caps have been secured. Store fuels and lubricants in properly marked containers away from unauthorized personnel.

Store oily rags and any flammable materials in protective containers. Static electricity can produce dangerous sparks at fuel filling nozzle. In very cold, dry weather or other conditions that could produce a static discharge, keep tip of fuel nozzle in constant contact with neck of fuel filling nozzle, to provide a ground and prevent sparks. Always place plastic fuel containers on the ground before filling.



Fire and Explosion Prevention

All fuels, most lubricants and some coolant mixtures are flammable and can cause a fire resulting in death or serious injury, and property damage. Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause fire.

Inspect for and remove all flammable materials such as spilled fuel and oil, and debris from machine. Do not allow any flammable materials to accumulate on machine.

Always observe the following:

- Add fuel, oil, antifreeze and hydraulic fluid to machine only in a well ventilated area. Machine must be parked with controls, lights and switches turned "OFF." Engine must be "OFF" and any flames, glowing embers, auxiliary heating units or spark causing equipment must be extinguished, or turned "OFF" and kept well clear of machine.
- Dust that is generated from repairing or grinding nonmetallic hoods or nonmetallic fenders can be toxic, flammable and explosive. Repair these components in a well ventilated area away from flames or sparks and wear a dust mask when grinding painted parts.



Maintenance

The machine and some attachments have components that reach high temperatures under normal operating conditions. The primary source of high temperatures are the engine and exhaust system. If damaged or incorrectly maintained, the electrical system can be a source of arcs or sparks. Flammable debris (leaves, straw, etc.) must be removed regularly. If flammable debris is allowed to accumulate, it can cause a fire hazard. Clean machine often to avoid this accumulation. Flammable debris in an engine compartment is a potential fire hazard. The operator's area, engine compartment and engine cooling system must be inspected every day and cleaned. This is necessary to prevent fire hazards and overheating.



Operation

Do not use machine where exhaust, arcs, sparks or hot components can contact flammable material, explosive dust or gases. Do not operate machine near any flame. Exhaust shields (if equipped) protect hot exhaust components from oil spray or fuel spray in case of a break in a line, hose, or seal. Exhaust shields must be correctly installed and maintained properly.

Electrical

Check all electrical wiring and connections for damage daily. Keep battery terminals clean and tight. Repair or replace any damaged parts or wires that are loose or frayed. Clean all electrical connections and tighten all electrical connections. Never check battery charge by placing a metal object across terminal posts. Use a voltmeter or a hydrometer. Battery gas can explode and can result in death or serious injury.

Follow procedures in this manual for connecting battery and for jump-starting. Do not jump-start or charge a frozen or damaged battery. Keep all flames and sparks away from batteries. Do not smoke in battery charging area. Improper jumper cable connections can cause an explosion that can result in death or serious injury. Refer to Operation and Maintenance Manual for proper procedure in this manual. Do not charge a frozen battery. This can cause an explosion. After market radios or other electric operated equipment in cabin must have a fuse in the electrical circuit.

Fire and explosion risks

Examples of flammable and explosive substances are:

- Oil
- Petrol
- Diesel fuel
- Organic solvents (varnish, plastic, detergents)
- Anti-corrosive
- Acetylene and other gas for welding and heating



Examples of reason for setting on fire:

- Welding, cutting
- Smoking
- Machine grinding
- Sparks caused by static electricity or electric equipment
- Heat generated in waste and rags soaked with certain types of oil and paint (linseed oil)
- Oxygen increases the risk of ignition. Containers, pipes and valves for oxygen therefore have to be free of oil and grease



Special cases:

- **Battery charging**

- When charging batteries the water content in the battery acid is split into oxygen and hydrogen. This makes a gas mixture that is very explosive. The risk is especially acute when using an auxiliary battery or a speed charging unit.
- When boost starting from another machine or vehicle do not allow two machines to touch. Wear safety goggles and gloves while battery connections are made.

- **Diesel fuel**

The flash point may have been lowered by mixing with petrol. Such a mixture is then explosive in normal room temperature. If diesel fuel is heated it is more explosive than petrol.



Protection against fire and explosion

- Store dangerous substances in approved containers and ensure that it is closed.
- Keep ignition sources removed from or completely screened from the dangerous substances.
- Ventilation, evacuation.

In case of Fire

If a fire occurs:

- Do not attempt to move machine or continue operations.
- Turn starter switch to "O" (OFF) position to stop engine.
- Use handrails and steps to get off machine.
- Immediately call for help or fire station.
- When using a fire extinguisher, always aim extinguisher at base of fire.
- If an optional fire extinguishing system is in place, be familiar with its operating procedures.



NOTE

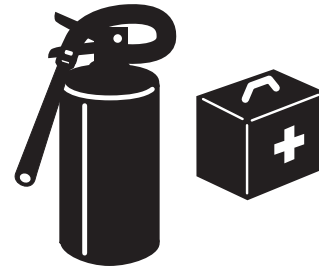
Depending on job conditions, other procedures could be necessary if a fire occurs.

Fire Extinguisher and First-Aid Kit

(Emergency Medical Kit)

To be prepared in the event of a fire:

- Be sure that fire extinguishers have been provided and read labels to ensure that you know how to use them. It is recommended that an appropriately sized (2.27 kg [5 lb] or larger) multipurpose A/B/C fire extinguisher be mounted in cabin. Check and service fire extinguisher at regular intervals and make sure that all work site crew members are adequately trained in its use.
- Inspect fire extinguisher and service fire extinguisher regularly.
- Follow instructions on extinguisher instruction plate.
- Keep a first aid kit in storage compartment (Figure 15) and keep another kit at work site. Check kit periodically and keep it properly supplied.
- Keep emergency numbers for doctor, ambulance service, hospital and fire department readily available.



Coolant

Risks

Attempting to remove caps, drain oil or coolant, or replacing filters may lead to serious burns, if done when hot. Relieve all pressure in cooling system, before any lines, fittings or related items are disconnected.

The cooling system is over-pressurized when the coolant is hot. Coolant that leaks or bursts out may cause scalding.

Coolant consists of water and corrosion inhibitor, and if necessary, anti-freeze. The anti-freeze may consist of ethylene glycol.

Ethylene glycol and corrosion inhibitor are injurious and dangerous to consume. Splashes in the eyes are dangerous and, in contact with the skin, such substances can penetrate and cause dermatitis.

Coolant may also consist of other mixtures that may imply other risks.

Protective measures

To prevent hot oil or coolant from spraying out, stop engine and wait for oil and coolant to cool. Using gloves, slowly loosen cap to relieve pressure.

If possible, avoid working with coolant lines and containers when coolant is still hot.

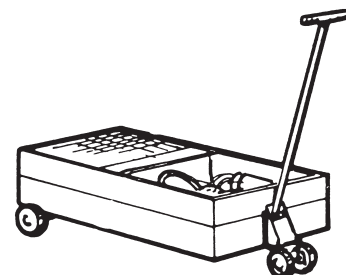
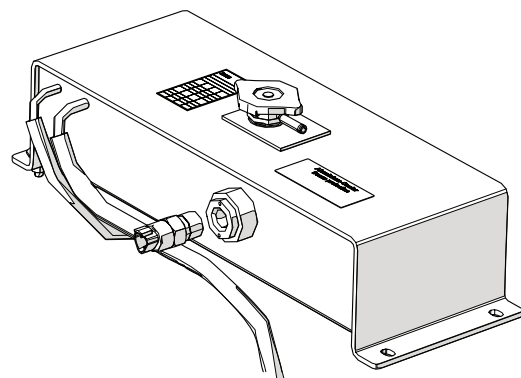
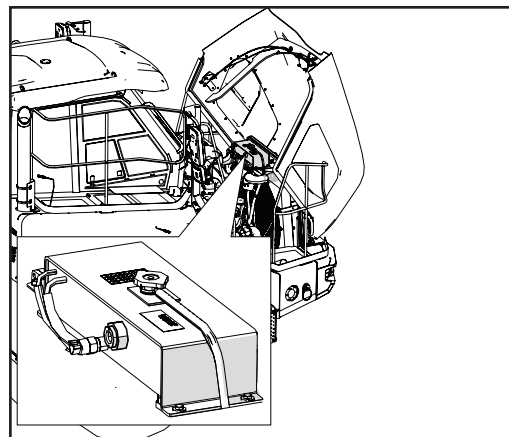
First remove the filler cap carefully to release the overpressure. Hot steam and coolant may burst out.

If there is a risk of splashing you must use rubber gloves and protective goggles. Change clothes if coolant has splashed on them. Contact with the skin may be dangerous.

Use special equipment for draining and filling e.g.a. cart with container and pump. It is not permitted to dump coolant in sewer systems or on the ground.

Protection against coolant

- Preferably wait until coolant has become cold
- Remove filler cap carefully
- Use rubber gloves and protective goggles
- Use special equipment for draining and filling



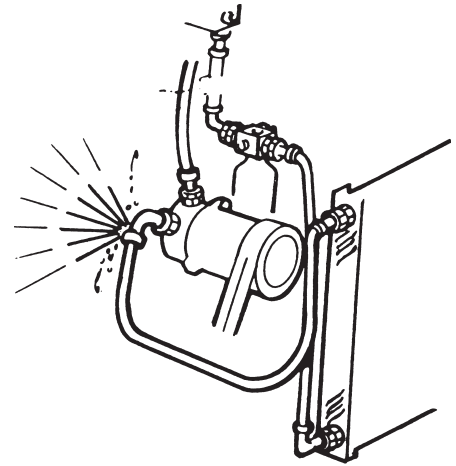
Refrigerant

Refrigerants are used in various thermal equipment e.g. air conditioning in vehicles.

Risks

Refrigeration equipment operates under pressure. A refrigerant that is leaking may cause frost-bite.

A refrigerant that is leaking and exposed to heat e.g. by a welding flame or cigarette becomes very dangerous to breath.

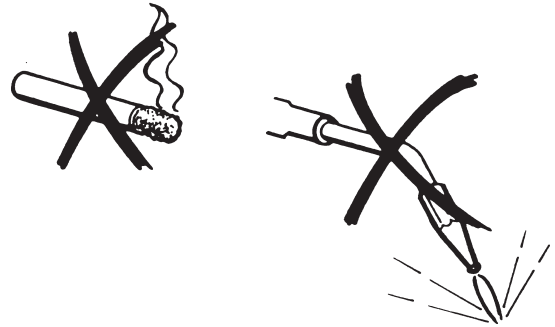


Protective measures

Always use special equipment when draining or filling refrigeration equipment. This reduces the risk of leakage.

Do not loosen connections on refrigeration equipment without first draining the system or reducing the pressure.

Avoid welding and smoking when carrying out work that implies a risk of leakage. A leaking refrigerant is not noticed as the gas is practically odourless. The gas is heavier than air and therefore a portable air evacuator at floor level is suitable.



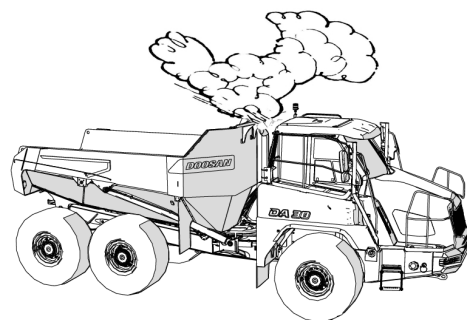
Protection against refrigerant

- Use special equipment for draining and filling
- Drain system before loosening connections
- Avoid smoking and naked flame
- Use portable air ventilator

Air pollution

Examples:

- Carbon monoxide present in exhaust fumes
- Nitric oxide - present in exhaust fumes
- Welding fumes, especially fumes from galvanized or painted metals.
- Oil mist (e.g. in anti-corrosion treatment)
- Sulphuric acid mist (e.g. when charging batteries)
- Grinding dust and fumes formed when grinding and heating plastic, varnish, anti-corrosive, lubricants, paint etc.



Risks

Carbon monoxide reduces the ability of the blood to supply the brain and other parts of the body with oxygen.

Carbon monoxide poisoning = "Internal asphyxiation".

Nitric oxides and gases and the fumes from plastic, varnish, anti-corrosive, lubricants, paint etc may damage the lungs.

Oil mist from certain oils may cause skin problems such as blemishes, boils and eczema. Sulphuric acid mist is erosive and may damage the windpipe.

Protective measures

Avoid running engines indoors. Immediately attach evacuation equipment to the exhaust pipe if an engine has to be kept running indoors. Also parking heaters admit exhaust fumes when in operation (portable air evacuator is suitable).

Use plastic gloves and breathing protection if there is a risk of oil mist (e.g. anti-corrosion treatment). Before starting work, treat unprotected skin with protective cream that does not dissolve in oil. Ensure that the ventilation is satisfactory where you weld, charge batteries or apply anti-corrosive, if necessary, also complemented with portable air evacuator.

When working with eroding substances (e.g. when battery charging) there must be a possibility for rinsing the eyes.



Protection against air pollution

- Ventilate properly. Use portable air evacuator when welding.
- Preferably avoid running engines indoors.
- Use evacuation equipment if engines have to be run indoors.
- Use plastic gloves and breathing protection if there is a risk of oil mist.
- Avoid contact with the skin.
- Ensure that there are facilities to rinse the eyes when working with eroding substances.

Operation in extreme conditions

Operation In Extreme Cold

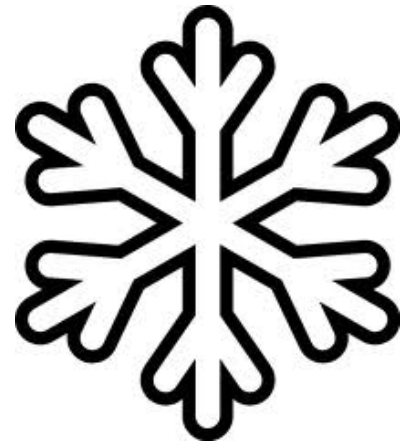
In extremely cold weather, avoid sudden travel movements and stay away from even slight slopes. The machine could slide down the slope.

Snow accumulation could hide potential hazards and slippery surfaces.

Warming up the engine for a short period may be necessary to avoid operating with sluggish or reduced working capacity. The jolting shocks and impact loads caused by bumping or bottoming boom or attachment could cause severe stress in very cold temperatures. Reducing work cycle rate and workload may be necessary.

If machine is to be operated in extremely cold weather temperatures, certain precautions must be taken. The following checks should be made before operating the machine:

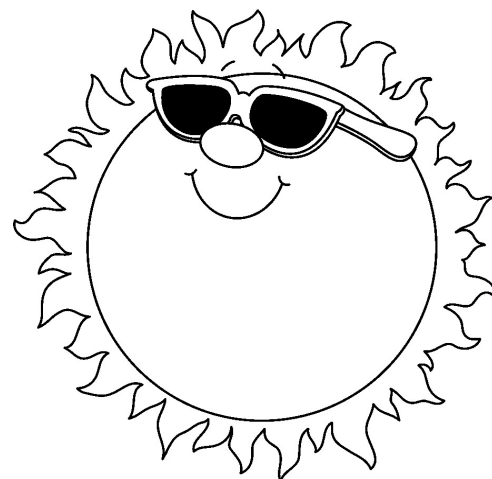
1. Check cooling system for correct mixture of antifreeze solution for lowest expected temperature. Carefully inspect cooling system and repair as necessary.
2. Keep batteries fully charged to prevent freezing. If distilled water is added to batteries, run engine at least one hour to mix electrolyte solution.
3. Keep engine in good mechanical condition for easy starting and good performance during adverse weather.
4. Use engine oil with proper specifications for expected temperatures. Refer to Operation and Maintenance Manual.
5. Always keep fuel tank full. Drain condensation from tank before and after operation. Drain and service fuel filter. To eliminate clogging of fuel filters because of wax crystal formation in fuel, be sure that fuel used has a cloud point specification below lowest expected temperature.
6. Lubricate entire machine according to Operation and Maintenance Manual and/or the lubrication chart on machine.
7. Start engine and allow it to reach normal operating temperature before operating.
 - If mud and ice collects and freezes on any of moving parts while machine is idle, apply heat to thaw frozen material before attempting to operate machine.
 - Operate hydraulic units with care until they have reached a temperature which enable them to operate normally.
 - Check all machine controls, pedals and functions to be sure they are operating correctly before operating.
8. An extra outer air filter must be kept in operator's cabin to replace existing element that could become iced and cause restricted airflow to engine.
9. Clean off all mud, snow and ice to prevent freezing. Cover machine with a tarp if possible and keep ends of tarp from freezing to ground.



Operation in Extreme Heat

Continuous operation of machine in high temperatures can cause machine to overheat. Monitor engine and hydraulic system temperatures and stop machine to let it cool, when necessary.

1. Frequently inspect and maintain fan and radiator. Check coolant level in radiator. Check grilles and radiator fins for accumulation of dirt, debris and insects which could block cooling passages.
 - Formation of scale and rust in cooling system occurs more rapidly in extremely high temperatures. Change antifreeze each year to keep corrosion inhibitor at full strength.
 - If necessary, flush cooling system periodically to keep passages clear. Avoid use of water with a high alkali content which increases scale and rust formation.



NOTE

Do not store acid type storage batteries near stacks of tires. Acid fumes can damage rubber.

2. Check level of battery electrolyte daily. Keep electrolyte above plates to prevent damage to batteries. Use a slightly weaker electrolyte solution in hot climates. Batteries self-discharge at a higher rate if left standing for long periods at high temperatures. If machine is to stand for several days, remove batteries and store in a cool place.
3. Service fuel system as directed in Operation and Maintenance Manual. Check for water content before filling fuel tank. High temperatures and cooling off cause condensation in storage drums.
4. Lubricate as specified in Operation and Maintenance Manual Lubrication Decal on machine.
5. Do not park machine in sun for long periods of time. If possible, park machine under cover to protect it from sun, dirt and dust.
 - A. Cover machine if no suitable shelter is available. Protect engine compartment and hydraulics from dirt and debris.
 - B. In hot, damp climates, corrosion will occur on all parts of machine and will be accelerated during rainy season. Rust and paint blisters will appear on metal surfaces and fungus growth will appear on other surfaces.
 - C. Protect all unfinished, exposed surfaces with a film of preservative lubricating oil. Protect cables and terminals with ignition insulation compound. Apply paint or suitable rust preventive to damaged surfaces to protect them from rust and corrosion.

Operation In Dusty and Sandy Areas

Operation of machine can cause dust in almost any area. However, when in predominantly dusty or sandy areas, additional precautions must be taken.

1. Keep cooling system fins and cooling areas clean. Blow out with compressed air, if possible, as often as necessary.



WARNING

Wear goggles when using compressed air to prevent face or eye injury.

2. Use care when servicing fuel system to prevent dust and sand from entering tank.
3. Service air cleaner at frequent intervals, check air restriction indicator daily and keep dust cup and dust valve clean. Prevent dust and sand from entering engine parts and compartments as much as possible.
4. Lubricate and perform services outlined on current lubrication chart on machine and Operation and Maintenance Manual. Clean all lubrication fittings before applying lubricant. Sand mixed with lubricant becomes very abrasive and accelerates wear on parts.
5. Protect machine from dust and sand as much as possible. Park machine under cover to keep dust and sand from damaging unit.

Operation in Rainy or Humid Conditions

Operation under rainy or humid conditions is similar to that as in extreme heat procedures previously listed in addition:

1. Keep all exposed surfaces coated with preservative lubricating oil. Pay particular attention to damaged or unpainted surfaces. Cover all paint cracks and chip marks as soon as possible to prevent corrosive effects.

Operation in Saltwater Areas

Saltwater and saltwater spray is very corrosive. When operating in saltwater areas, or in or around snow, observe the following precautions:

1. When exposed to saltwater, dry machine thoroughly and rinse with freshwater, as soon as possible.
2. Keep all exposed surfaces coated with preservative lubricating oil. Pay attention to damaged paint surfaces.
3. Keep all painted surfaces in good repair.
4. Lubricate machine as prescribed on lubrication chart on machine or Operation and Maintenance Manual. Shorten lubricating intervals for parts exposed to salt water.
5. Check operating controls to ensure proper functionality and that they return to "NEUTRAL" when released.

Operation at High Altitudes

Operation instructions at high altitudes are the same as those provided for extreme cold. Before operating at high altitudes, engine fuel and air mixture may have to be adjusted according to appropriate engine manual.

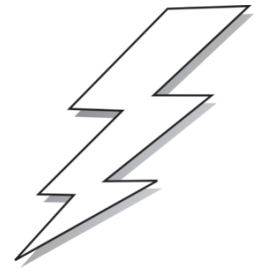
1. Check engine operating temperature for evidence of overheating. The radiator cap must make a perfect seal to maintain coolant pressure in cooling system.

- Perform warming-up operation thoroughly. If machine is not thoroughly warmed up before control levers or control pedals are operated, reaction of machine will be slow.
- If battery electrolyte is frozen, do not charge battery or start engine with a different power source. There is a potential hazard that could cause a battery explosion or fire.
- Before charging or starting engine with a different power source, thaw battery electrolyte and check for any leakage of electrolyte before starting.

Operation During Electrical Storms

During electrical storms, do not enter or exit machine.

- If you are off machine, keep away from machine until storm passes.
- If you are in cabin, remain seated with machine stationary until storm passes. Do not touch controls or anything metal.



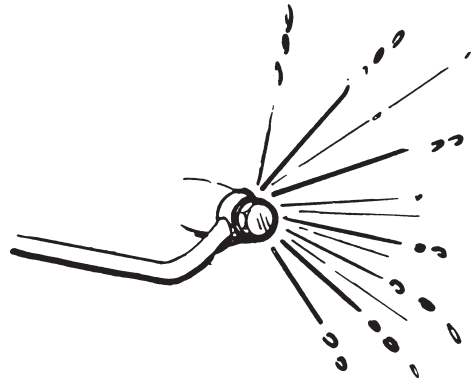
Liquid or gas under high pressure

Pipes etc may become damaged when working and liquid or gas may burst out. Liquid or gas may also burst out when loosening a connection. High pressure may remain in the system even if a pump has stopped.

Gas containers for e.g. welding gases may explode if exposed to rough handling e.g. when an oxygen tube drops on a hard floor. Valves may become damaged and gas leak out if a gas tube falls.

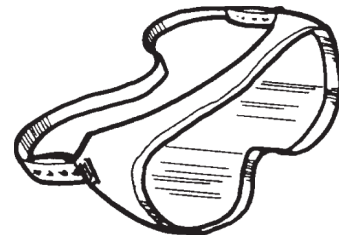
Risks

- There are risks, for instance, when working with:
- Fuel system
- Power steering
- Trailing axle hoist
- Tipper
- Brake system
- Compressed air from the workshop compressed air system may also be risky.
For risks in rubber repair, see "Splinters, flying objects".



Dangerous - in what way?

- Spray can penetrate the skin and cause serious tissue injury
- Eyes may sustain serious injury
- Many substances may cause poisoning
- Leak testing or test pressurizing with compressed air or other gas may cause explosion



Protective measure

Do not work with pressure in the system unnecessarily. First stop the pump and release remaining pressure carefully. Use goggles. Gloves are also to be preferred. Never use compressed air or other gas to blow dirt from the clothes. Use liquid for testing leaks (of e.g. oil cooler).



Protection against gas and liquid under pressure

- Use goggles and gloves
- Do not work with pressure in the system if not absolutely necessary
- Be careful when handling compressed air

Asbestos

The dust that is emitted by brake and clutch linings partly consists of asbestos fibres.

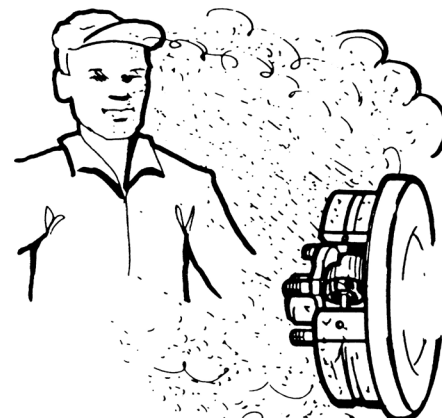


WARNING

Avoid exposure to dust containing asbestos as it can cause death or serious injury to the lungs and other organs (mesothelioma, lung and other cancers, and asbestosis).

Risks

Asbestos dust can be HAZARDOUS to your health if it is inhaled. Asbestos dust that is inhaled may cause lung diseases and cancer in various organs. Breathing air that contains asbestos fiber can ultimately cause serious or fatal lung damage or diseases such as mesothelioma, lung and other cancers, and asbestosis. The risk of contracting lung cancer is considerably more acute for people who smoke. This risk remains many years after giving up smoking.



Protective measures

- Bind the dust with water before starting to work with brakes and clutches.
- Wash brake and clutch parts with water or clean with special vacuum cleaner.
- Never blow with compressed air.
- Use breathing protection with suitable dust filter. A simple paper mask does not suffice.
- Avoid brushing or grinding materials that contain asbestos.
- Comply with applicable laws and regulations for workplace.

Protection against asbestos

- Clean with water or special vacuum cleaner
- Use breathing protection

Lead

The dust that is formed when grinding lead filler and certain paints that contains lead.

Risks

Lead may be absorbed by the blood by skin contact and cause poisoning.

Protection against lead

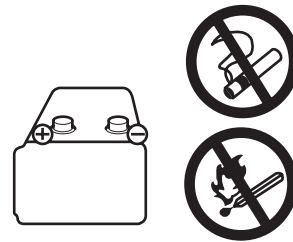
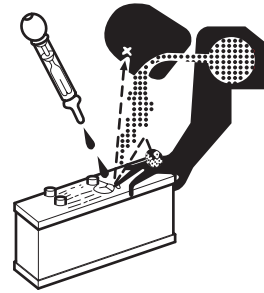
- Avoid contact with the skin and inhaling.
- Use gloves, breathing protection and face mask.



Battery hazard prevention

Battery electrolyte contains diluted sulfuric acid and generates hydrogen gas. Hydrogen gas is highly explosive, and improper handling can cause death or serious injury, or fire. Do not allow electrolyte to contact skin or eyes. Always wear safety goggles and protective clothing when servicing batteries. Wash hands after touching batteries and connectors. Use of acid-resistant gloves is recommended. Always observe the following precautions.

- Do not smoke or bring any flame near battery.
- When working with batteries, always wear safety goggles, protective clothing, and acid-resistant gloves.
- If you spill battery electrolyte on yourself or your clothes, immediately flush area with water.
- If battery electrolyte gets into your eyes, flush them immediately with large quantities of water and get immediate medical attention from a physician familiar with this injury.
- If you accidentally drink battery electrolyte, call a poison prevention center immediately and get immediate medical attention from a physician familiar with this injury.
- When cleaning top surface of battery, wipe it with a clean, damp cloth. Never use gasoline, thinner, or any other organic solvent or detergent.
- Tighten battery caps.
- If battery electrolyte is frozen, do not charge battery or start engine with power from another source. This could cause the battery to explode and start a fire.
- When charging battery or starting with power from another source in cold temperatures let battery electrolyte thaw and check that there is no leakage of battery electrolyte before starting operation.
- Always remove battery from machine before charging.
- Do not use or charge battery if battery electrolyte level is below LOW LEVEL line. This can cause an explosion. Periodically check battery electrolyte level and add distilled water to bring electrolyte level to FULL LEVEL line.
- Before maintaining or working with batteries, turn starter switch to "O" (OFF) position. Since there is a potential hazard that sparks could be generated, always do the following:
 - Do not let tools, rings or other metal objects make any contact between battery terminals. Do not leave tools or other metal objects lying near battery.



- When disconnecting battery terminals, wait for approximately one minute after turning engine starter switch key to "O" (OFF) position, and be sure to disconnect grounding terminal; negative (-) terminal first. Conversely, when connecting them, begin with positive (+) terminal and then grounding (-) terminal, Make sure that all terminals are connected securely.
- Flammable hydrogen gas is generated when battery is charged. Remove battery from machine, take it to a well ventilated place, and remove battery caps, before charging it.
- After charging, tighten battery caps securely.
- After charging, secure battery back in machine. When repairing or welding electrical system, wait for approximately one minute after turning engine starter switch key "OFF." Then disconnect negative (-) terminal of battery to stop flow of electricity.

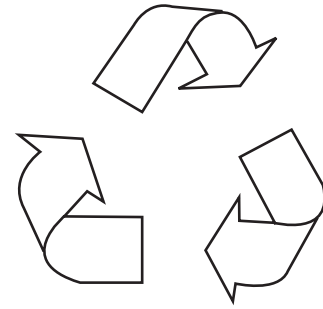
Disposal of hazardous materials

Physical contact with used motor oil or gear oil could create a health risk. Wipe oil from your hands promptly and wash off any remaining residue. Used motor oil or gear oil is an environmental contaminant and should only be disposed of at approved collection facilities. To prevent pollution of environment, always do the following:

- Never dump waste oil in a sewer systems, rivers, etc.
- Always put drained oil from your machine in approved, leak proof containers. Never drain oil directly onto ground.
- Obey appropriate laws and regulations when disposing of harmful materials such as oil, fuel, solvent, filters, and batteries.

Improperly disposing of waste can threaten environment. Potentially harmful fluids must be disposed of according to local laws and regulations.

Use all cleaning solutions with care. Report all necessary repairs.



Jacked up vehicle or bodywork

Risks

Mechanical or hydraulic lifting equipment may topple and could also be lowered because of incorrect handling or interference.

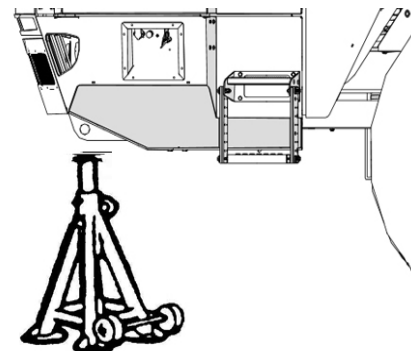
Falling objects may also cause crushing.

Protective measures

Do not crawl underneath a vehicle that is jacked up without stands.

Check that the supporting surface is firm and level and use stands.

Before starting to work under a jacked up body or other bodywork it has to be supported with a stay as well as the normal latches.



Protection against sinking or falling vehicle/ components

- Use safe stands, check that the supporting surface is suitable.
- Use reliable stays and secure in the normal manner.

Crushing and Cutting Danger

Keep objects away from moving fan blades. Fan blades can throw and cut objects.

Do not use a wire rope that is kinked or frayed, or a wire rope with any loss of diameter. Wear leather gloves when handling a wire rope.

When striking a loose retainer pin, it can fly out and can cause a serious injury. Make sure that area is clear of personnel when striking a retainer pin. To avoid injury to your eyes, wear safety goggles when striking a retainer pin.

Do not put your hand, arm or any other part of your body between movable parts. If going between movable parts is necessary, always position and secure work equipment so it cannot move. Properly support equipment before performing any work or maintenance under raised equipment.

If control levers are operated, clearance between machine and work equipment will change and this may lead to serious damage or can result in death or serious injury. Stay clear of areas that may have a sudden change in clearance with machine movement or equipment movement. Stay clear of all rotating and moving parts. Unless instructed, never attempt adjustments while machine is moving or while engine is running.

Do not depend on hydraulic cylinders to support raised equipment. Equipment can fall if a control is moved, or if a hydraulic line breaks, is loosened or disconnected.

If it is necessary to remove guards to perform maintenance, always install guards after maintenance is completed.

Always have at least two people working together if the engine must be running during service. One person needs to remain in the operator's seat, ready to work the controls to stop the machine or stop engine, if necessary.



Heavy units

Risks

Lifting heavy objects may cause back injuries.

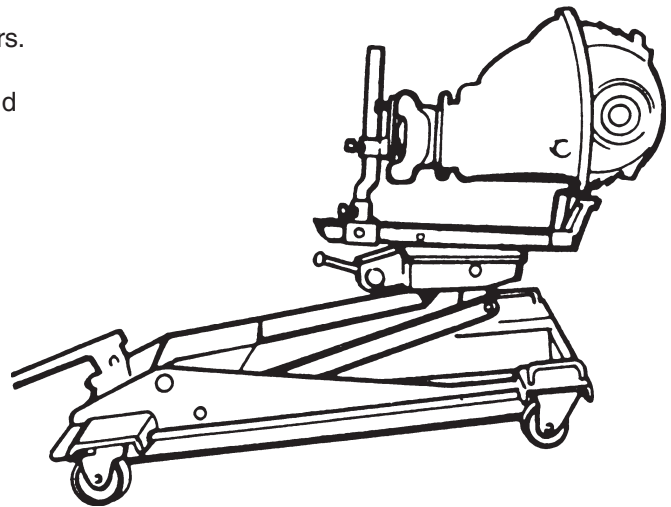
Dropping a unit or letting it fall from a lifting device may cause both injury and damage.

Example:

- When lifting a unit (gearbox, central gear) away from a vehicle it may drop from the jack.
- Unsuitable lifting straps may break or cause unit to slip.
- A unit that is set up on a stand may pivot round the shaft of the stand. By, for instance, removing the planetary box from a gearbox the point for stable balance is changed and this may cause the unit to pivot.

Protective measures

- Use lifting equipment.
- Ask for help, if needed.
- Use jack with special fixture for lifting out central gears.
- Use special equipment for handling wheels, brake and springs.
- Use purpose adapted lifting straps and lever blocks for lifting engines.
- Use stand with automatic locking (self-locking screw or brakes).



Protection against damage and injury in handling heavy units

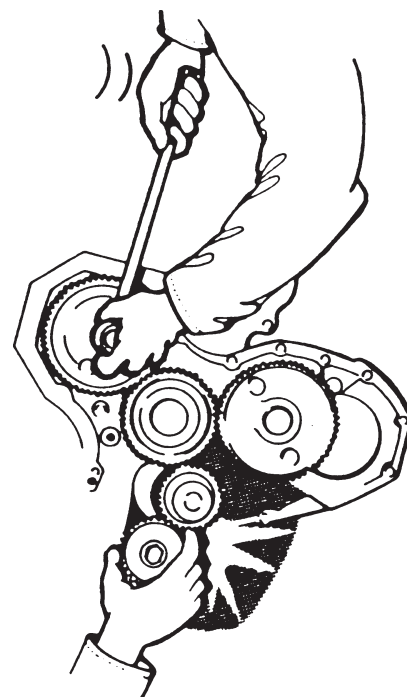
- Use lifting equipment.
- Keep in mind the balance of the unit on a stand.
- Ask for help, when needed.
- If you have to lift:
 - Object near body
 - Bend your knees, not your back
 - Do not twist your body when lifting.

More than one person working with the same object

If more than one person is working on the same vehicle, involuntary movements could injure another person.

Example:

- By turning a wheel on a drive axle, parts of another drive wheel may be caused to turn and injure somebody who is working with e.g. the hub reduction gear.
- Working with the suspension equipment of axles (springs, shock-absorber) may cause parts on the opposite side to start moving.
- Manoeuvring from the driver's seat (tipper, trailing axle hoist, loader) may cause parts to start moving, thereby causing serious injury.



Protect others who work on the same vehicle

- Be aware of the risks.
- Warn those who work on the same vehicle or in its vicinity.
- Do not start working with more than one drive wheel at the same time until the half shaft has been removed.

Involuntary start of electric motors etc.

Protective measures

Remove the negative (-) cable from the battery.

If power is needed from the electric system, connect a line fuse (8A) between the battery terminal and the cable clamp.

This precaution also reduces the risk of burns and fires caused by battery power.

Windscreen wipers

Even if the wipers have been turned off with the switch there is voltage to the wiper motor (for the return stroke to parking position). Only a slight turn of the motor is needed to start it.

Risk of injuring the fingers.

Protective measures

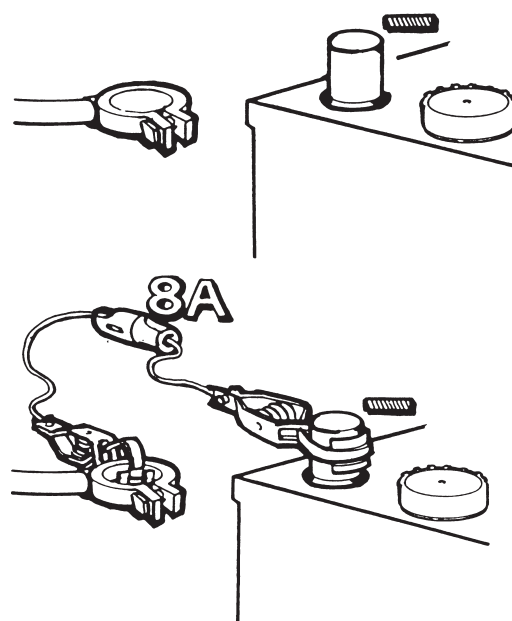
Do not loosen wiper motor before being sure that the power is disconnected.

Other electric equipment

Disconnecting the batteries is a good safety precaution against involuntary connections.

Protection against involuntary connection of electric equipment

- Be aware of the risks.
- Disconnect the batteries when it is justified.



Rotating parts

Examples:

- Cooling fan
- Belts
- Injection pump coupling
- Propeller shaft
- Drilling machines, lathes and other machines with rotating parts.

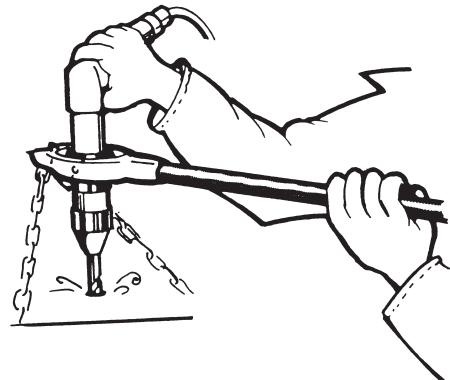
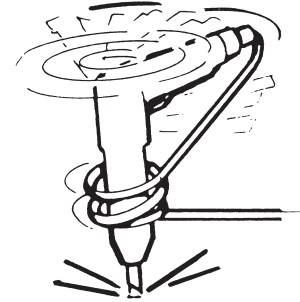
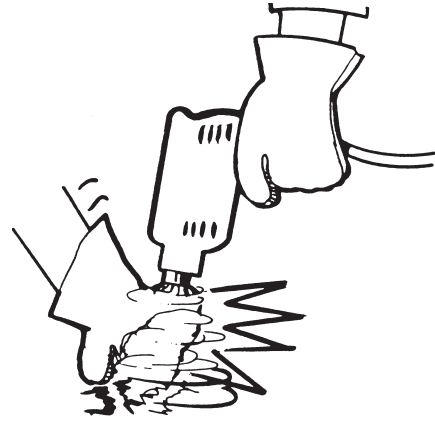
Risks

Rotating parts may cause injury when touched by e.g. inserting the fingers in the cooling fan.

Rotating parts may also cause a serious accident by catching clothes, gloves or long hair.

Even a completely smooth shaft may be dangerous.

When drilling large holes with a hand drilling machine, it can be turned out of your hands and begin to spin around. It may carry on spinning until its cable is torn off.

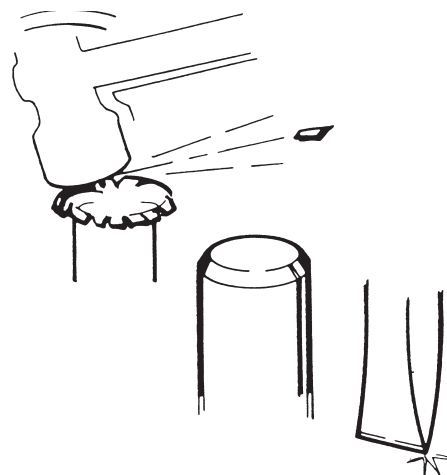


Protection against injuries from rotating parts

- Never use gloves when drilling.
- Never wear loosely hanging scarf or tie.
- Do not wear clothes with wide sleeves or trouser legs.
- Ensure that your clothes are intact.
- Collect loose hair under a hair net.
- Do not wear rings or bracelets.
- Use hand drilling machine with long lever when suitable.

Splinters, flying object When using certain tools

RISKS	PROTECTIVE MEASURES
Burr loosens from drift or chisel.	<ul style="list-style-type: none"> * Check tools * Grind where necessary
Hammer head loosens from handle.	<ul style="list-style-type: none"> * Check * Repair or change
Saw jabs or wobbles.	<ul style="list-style-type: none"> * Keep the supporting hand away from underside of saw
Flying objects when machining (e.g grinding machine, cutting disc, lathe).	<ul style="list-style-type: none"> * Use protective screen or goggles

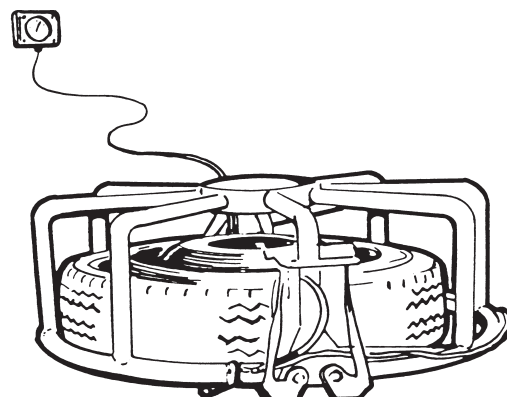


When working with tires and wheels

RISKS	PROTECTIVE MEASURES
Removal of tyres: Wheels, rims, lock rings fly off.	<ul style="list-style-type: none"> * Deflate tyres first of all
Fitting of tyres	<ul style="list-style-type: none"> * Check that tyres, rims and lock rings are intact. Never repair a damaged ring or lock ring
Inflating tyres: Wheels, rims, lock rings fly off	<ul style="list-style-type: none"> * Place wheel in protective cage * Tighten inflation hose on tyre valve with tensioner * Step back from the tyre with the pressure gauge during inflation. * Check at the latest by 40 psi (3.bar) that the lock ring is properly lodged
Machine scrubbing, turning: Flying splinters	<ul style="list-style-type: none"> * Use protective screen or goggles



AN EARTHMOVER TIRE CONTAINS ENOUGH ENERGY TO RAISE A 1360 kg CAR 26m OFF THE GROUND!



Springs under load

Examples:

- Balancing springs for bonnets and front panels
- Parking brake chambers
- Return springs for brake shoes
- Retaining rings
- Valve springs

Risks

By loosing the grip a spring and flying parts may cause injury. Even small springs and retaining rings are dangerous as they could injure the eyes.

The parking brake chamber springs are under high compression and may cause very serious injury.

Also gas springs and gas shock absorbers may be under high load and are dangerous in the same way as "normal" springs. Also scrapped gas springs and gas shock absorbers may be dangerous to handle.

Protective measures

Small springs, retaining rings

Retaining ring pliers must be of suitable type and size and in good condition. Remember that even small springs may be dangerous.

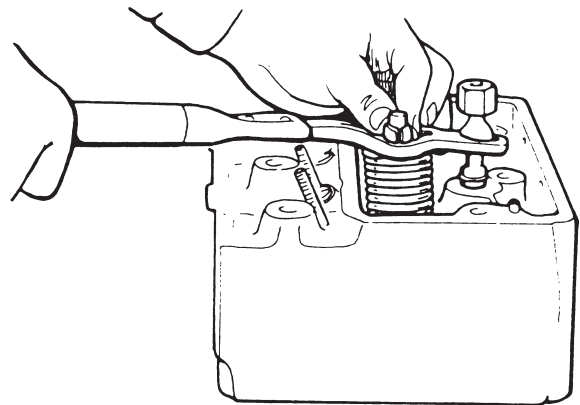
Use protective goggles.

Heavy springs

Always use recommended tools and safety devices. Follow the instructions in the work descriptions.

Prevent people with insufficient knowledge and experience from handling parking brake chambers.

To protect people that handle scrapped gas springs and gas shock absorbers from injury, special instructions apply in certain cases for e.g. drilling a hole in the gas cylinder before discarding scrapped parts.



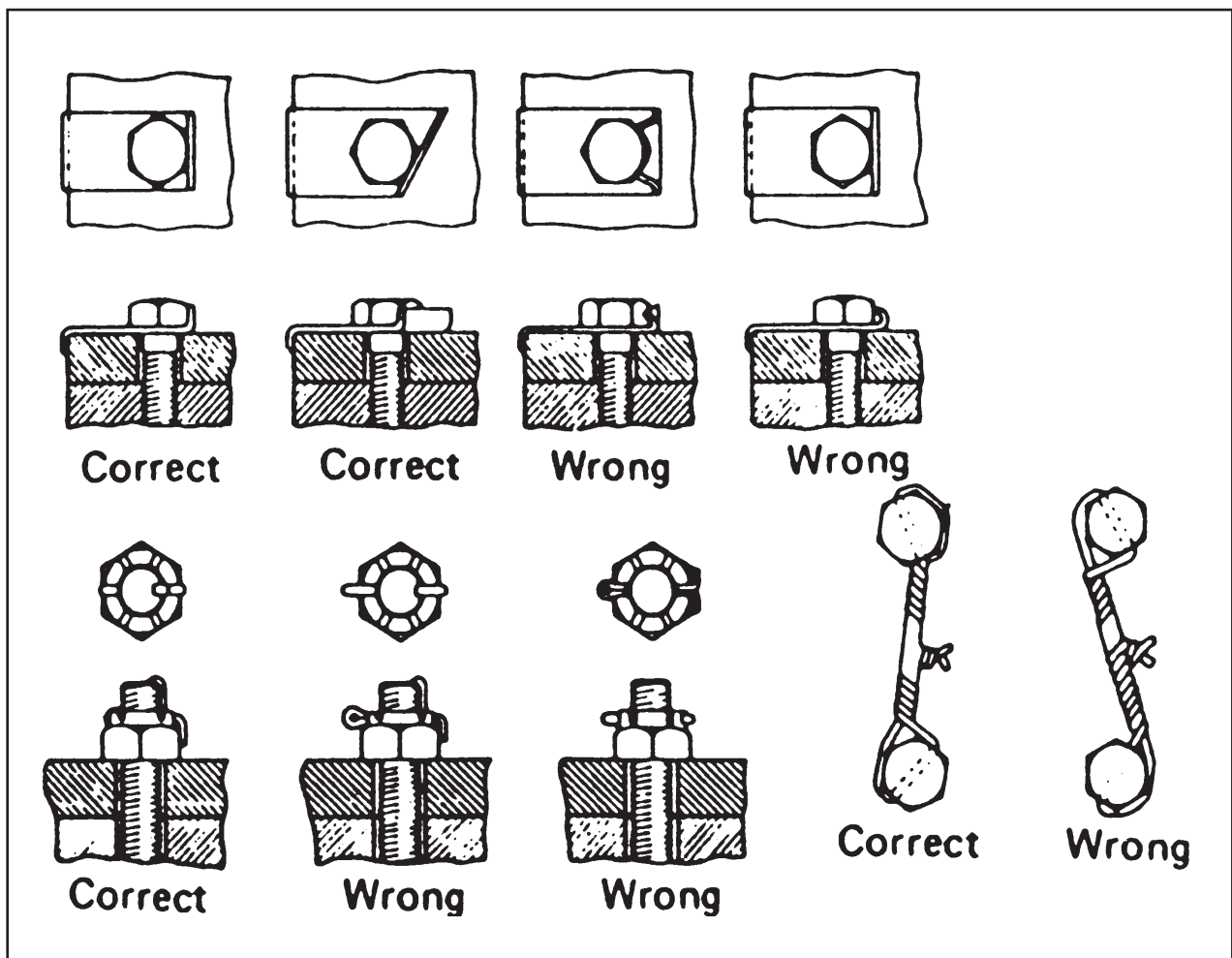
Precautions for disassembly and assembly

Disassembly

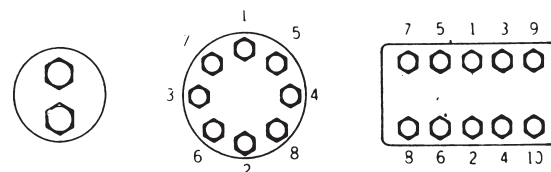
- Before attempting to disassemble, determine the cause of the trouble by systematically checking and analyzing the symptoms. Needless disassembly will not only hinder troubleshooting, but will also result in losses through unnecessary replacement of parts and man-hour costs.
- During disassembly, carefully check every sliding part for any sign of seizing, interference or contact, since these may reveal hidden faults which could be the actual cause of the trouble.
- Unless major disassembly, based on definite reason is to be made, the related parts should be first briefly inspected, and disassembly started after confidence in the operation is established.
- Thoroughly clean the part of the machine to be disassembled, before attempting to disassemble.
- Proceed with the disassembly by confirming the fitting conditions of the relative parts; their position fore-and-aft, left-and-right and upper-and-lower, and the proper sequence of their removal.
- When draining lubricating oils, take note of their viscosity, color and state of contamination. Observation of used oils often provides clues to the wear condition of the lubricated parts (specially whit regard to gears and bearings).
- Put match marks across mating joints where required before separating parts. The parts should be clearly marked to prevent confusion at the time of assembly.
- For disassembly of certain parts, only use the special tools prescribed for this purpose.
- When a part, after removal of fastening nuts and bolts, is still found to be unremovable, never force the parts; but carefully check for the cause of the tightness.
- When looseness exists between force-fitted or taper-fitted, parts, check both of the mating surfaces for damage or wear. Repair or replace the part(s) if necessary.
- When removing a control-link assembly, be careful to maintain the original adjustment of the length of the rods unless any readjustment is necessary. Check the original length of each rod and record it before removal of the link assembly if it is necessary to remove the rod-end for disassembly.
- Wash disassembled parts clean, neatly arrange the parts for each assembly, and keep in storage, free from dust and dirt. Use two vessels filled with detergent oil, one for washing dirty parts and two for rinsing them.
- Keep each set of shims stacked in its original arrangement so that the same clearances as before disassembly can be obtained when the machine is reassembled.

Assembly

- Thoroughly clean all parts before assembly. Wash clean those parts relating to the drive line. Also, check for scratches and nicks on the surfaces of the parts and repair, if any. Wash new parts to remove rust preventives, if coated, before assembly. Use trichloroethylene or diesel fuel.
- Employ a press or a driving tool when assembling bearings, bushings and oil seals. When installing a bearing, pay attention to keep the marking on the bearing facing outward, unless it is necessary to install otherwise because of the construction (this permits easy identifying of the bearing installed).
- Be sure to positively lock bolts and nuts which are usually invisible from the outside or used for some important parts that require locking, by the use of wires, cotter pins or lockwasher.

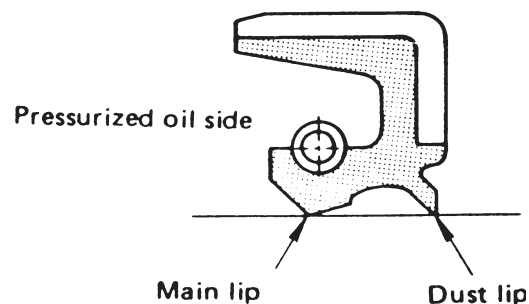


- Be sure to tighten each bolt to the specified torque with a suitable torque wrench. Apply an even tightening force to the bolts by screwing them alternately or in a criss-cross fashion.
- Apply thread locking (see table for sealing/locking compounds) to important bolts. Prior to coating with Loctite™, wash the bolt with light oil/trichloroethylene or Loctite™ superclean.
- Tighten bolts in the prescribed sequence figures so that they can be tightened evenly to the specified torque.
- Be careful not to tighten bolts excessively.
- Be sure to align match marks if provided.
- Keep the working area, tools, worker's hands, etc. clean during assembly operation.
- Coat the surfaces of parts to be press-fitted with Molykote grease.

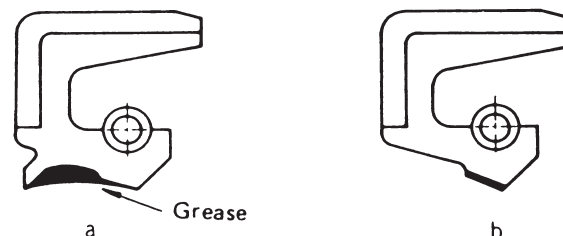


Handling of oil seals

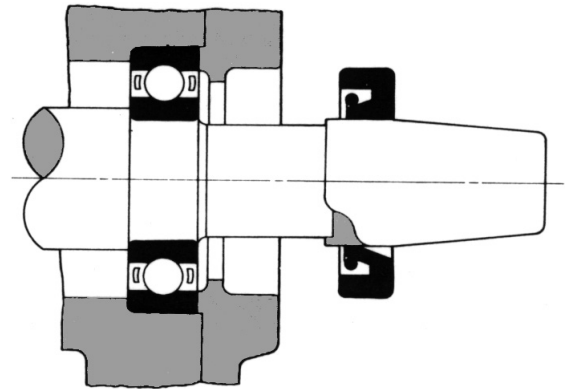
- Be careful to install an oil seal with its lips in a proper direction as shown below.



- Before installing an oil seal, coat it with grease to prevent dry-friction, which may occur during the break-in operation of the machine, according to the following procedure:
 - a) In case of a double-lip type, uniformly coat the surface of the groove around the lip with grease.
 - b) In case of a single-lip type, uniformly and evenly coat the surface surrounding the lip on the opposite side of the sealing surface of lip.



- Apply the lube oil or grease to the surface and chamfered edge of the shaft on which the oil seal is to be installed, so that the shaft may be smoothly inserted into the oil seal without pinching the lip and that a proper lubrication of the shaft during the break-in period of the machine is accomplished.
- Be sure to apply grease only by the fingers. Restrict the amount of grease to be applied in the range of 40 to 60 percent of the vacancy formed between the lips.
- When fitting an oil seal, use of a guide shown below is recommended to prevent the lips of the oil seal from being scratched or soiled with dust.
- Make sure that there are no scratches and dust on the contact surface (with the shaft) of an oil seal.
- Do not use any hydraulic press to fit press-fit an oil seal. Use only a hand press and a jig. The jig should be a snap cylinder of 1 to 3 mm smaller in the outer diameter than the oil seal, and the press-fit surface of the oil seal should be free from scratches and deformation.
- When installed, the oil seal should not be inclined at an angle. Press-fitted angle of an oil seal should not exceed the permissible limit of 0.2 mm/100 mm diameter.

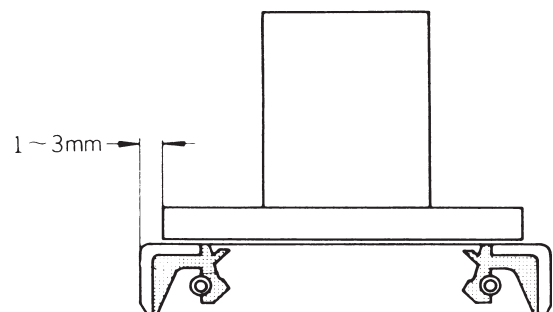


Handling of gaskets

- Discard copper gaskets whenever they are disassembled.
- Immerse leather gaskets in oil before assembly.
- Coat liquid gasket compound to the specially designated gaskets and O-rings (specified in each step). Make sure that the surface to be coated with liquid gasket is free from large scratches or any other damage. Wipe off dust, paint or oil, if any, from the surfaces to be coated with liquid gasket. Uniformly apply liquid gasket to the contact surface, and wait for a few minutes to allow drying of the gasket. When the liquid gasket becomes dry enough for the finger touch, put the gasket or O-ring in place.

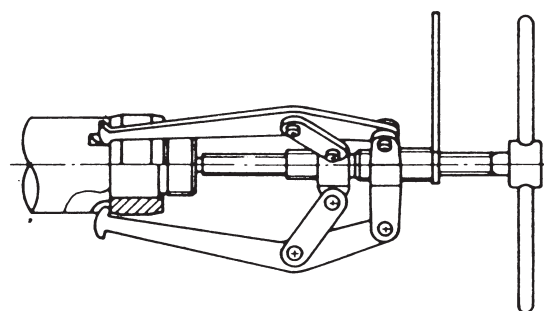
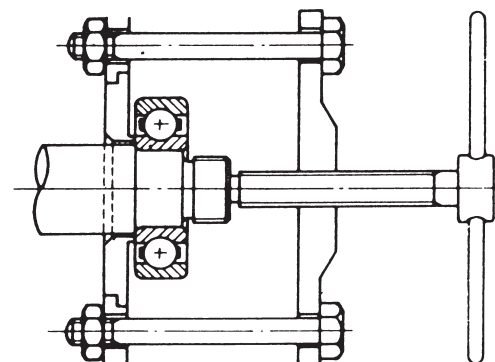
Handling of O-ring seals

- Replace a seal, if rust exists on the circumference of its contact surface.
- Apply a thin coat of oil to the contact surfaces when installing a seal.
- Insert the O-ring in the housing groove taking care not to twist the O-ring. An O-ring installed with a twisting condition will jump out of the groove when the seal is turned round under pressure.

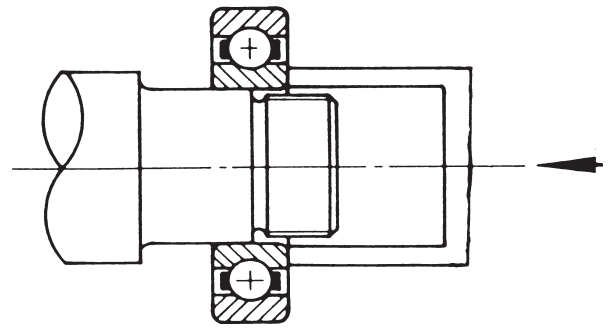


Handling of bearings

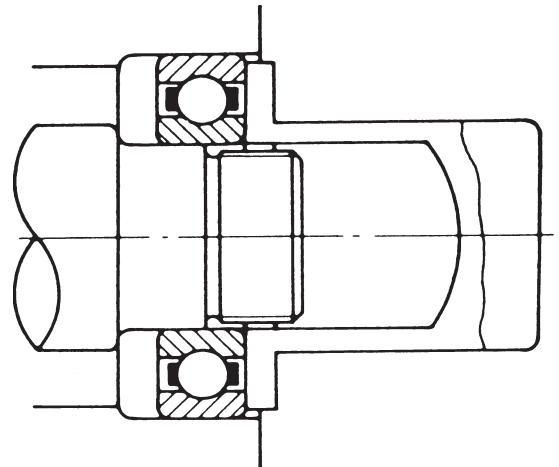
- Keep the bearings and their surroundings clean. Every dust and dirt particle, even though they are invisibly small can affect bearings. Always take sufficient care to protect bearings against dust and dirt.
- Handle bearings with the utmost care. Because of the high precision structure and the increased hardness which is provided by heat-treatment to improve wear resistance, bearings require special care to handle them. Shock due to careless handling of bearings will cause dents to form on the inner and outer races or break the bearings.
- Avoid excessive heating. The hardness of bearings will be lowered at temperatures higher than 120°C, this may cause considerably reduced life of the bearings.
- Use the proper jigs for handling the bearings. Under no circumstances should any other jig be used as a substitute for the proper one.
- Take necessary rust-preventive means.
- Keep the work where bearings are to be handled clean. Also, do not unpack a bearing package until just before the installation of the bearing.
- Be careful not to drive an outer race onto an inner race by tapping the outer race, and vice versa. Such unreasonable handling will cause dents to form on the sliding surfaces between the races, and the bearing will be damaged early in its life.
- Be careful not to force a bearing for removal. The use of a proper removing jig shown below is recommended.
- To wash bearings, neutral and anhydride solvents such as light oil and kerosene may be used. Two vessels filled with washing oil should be provided; one for washing dirty bearings and the other for rinsing. Rapidly shake a soiled bearing in the washing oil to remove dirt. Rotating bearing races, instead of shaking the bearing in the washing oil, should be avoided because bearing races may be damaged by foreign particles such between the races. It is also necessary to keep washing oil clean by filtering it from time to time.



- To press-fit a small bearing having a little interference, use of a jig shown below is recommended. In this case, be careful to press only the inner race. Should the outer race be forced, dents will be produced on the sliding surfaces between the races.



- To install a non-separate type bearing in which both the inner and outer races require interference, press-fit both races at a time by means of a screw press or a hydraulic press. Do not drive the bearing in with a hammer, this is liable to damage the bearing races.



Handling of hydraulic hoses

Lubricate threads and o-ring with oil, and the coupling tightening 50 -70% of the torque. Mark a line with felt pen.



Tighten coupling nuts with correct torque. This is your signature that you have used the procedure.

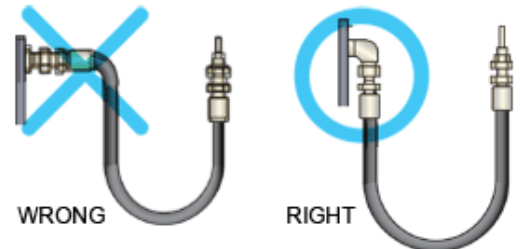


Mark with a new line with felt Penn.



Avoid sharp bends on the hose when install

The hose must have a straight length on min one fitting length before bending



Avoid torsion on the hose when install.

Use always two spanners when tightening.



Dynamic pulsations request over length on hose.

The hose need minimum 50 mm side movement.

