

Operation & Maintenance Manual

D32E,P-1 D38E,P-1 D39E,P-1 BULLDOZER

SERIAL NUMBERS **D32E,P-1 - P075501**
 D38E,P-1 - P085501 and up
 D39E,P-1 - P095501

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PRODUCT PUBLICATIONS INFORMATION

VARIOUS PRODUCT PARTS & SERVICE PUBLICATIONS ARE AVAILABLE TO ALL **KOMATSU** CONSTRUCTION EQUIPMENT OWNERS, INCLUDING OPERATION AND MAINTENANCE MANUALS, PARTS BOOKS AND SHOP MANUALS.

SPECIAL PUBLICATIONS SUCH AS SERVICE TOOL, AIR CONDITIONING, AND TURBOCHARGER SHOP MANUALS ARE ALSO AVAILABLE AS WELL AS SELECTED OPERATION AND SHOP MANUALS IN FOREIGN LANGUAGES.

THE PUBLICATIONS LISTED BELOW ARE AVAILABLE FOR THESE PARTICULAR MACHINES.

DESCRIPTION	FORM NUMBER
PARTS BOOK - PAPER:	
ENGINE AND CHASSIS - D32E-1 & D32P-1	BEPB001000
ENGINE AND CHASSIS - D38E-1 & D38P-1	BEPB001100
ENGINE AND CHASSIS - D39E-1 & D39P-1	BEPB001200
PARTS BOOK - MICROFICHE:	
ENGINE AND CHASSIS - D32E-1 & D32P-1	BEPM001000
ENGINE AND CHASSIS - D38E-1 & D38P-1	BEPM001100
ENGINE AND CHASSIS - D39E-1 & D39P-1	BEPM001200
OPERATION AND MAINTENANCE MANUAL:	
CHASSIS	CEAM000700
SHOP MANUAL:	
CHASSIS	
ENGINE	
SAFETY MANUAL	CLT80-1

PARTS AND SERVICE PUBLICATIONS CAN ONLY BE ACQUIRED BY AUTHORIZED KOMATSU DISTRIBUTORS, USING THE PARTS INVENTORY PROCESSING SYSTEM (PIPS).

IF THE PIPS SYSTEM IS NOT AVAILABLE AT THE DISTRIBUTOR LOCATION, THEN THE FOLLOWING REQUISITION FOR TECHNICAL SERVICE PUBLICATIONS AND SERVICE FORMS CAN BE USED. FORM KDC91D IS SHOWN ON THE REVERSE SIDE OF THIS PAGE.

1. FOREWORD

This manual describes procedures for operation, handling, lubrication, maintenance, checking, and adjustment. It will help the operator and maintenance personnel realize peak performance through effective, economical and safe machine operation and maintenance.

Keep this manual handy and have all personnel read it periodically. If this manual is lost or becomes dirty and can not be read, request a replacement manual from Komatsu or your Komatsu distributor.

If you sell the machine, be sure to give this manual to the new owner.

Continuing improvements in the design of this machine can lead to changes in detail, which may not be reflected in this manual. Consult Komatsu or your Komatsu distributor for the latest available information on your machine or for questions regarding information in this manual.



WARNING

- ◆ **Improper operation and maintenance of this machine can be hazardous and could result in serious injury or death.**
- ◆ **Operators and maintenance personnel must read this manual thoroughly before operating or maintaining this machine.**
- ◆ **This manual should be kept near the machine for reference and periodically reviewed by all personnel who come across it.**
- ◆ **Some actions involved in operation and maintenance can cause a serious accident, if they are not performed in the manner described in this manual.**
- ◆ **The procedures and precautions given in this manual apply only to intended uses of the machine. If you use your machine for any unintended uses that are not specifically prohibited, you must be sure that it is safe for you and others. In no event should you or others engage in prohibited uses or actions as described in this manual.**
- ◆ **Komatsu delivers machines that comply with all applicable regulations and standards of the country to which it has been shipped. If this machine has been purchased in another country or purchased from someone in another country, it may lack certain safety features and specifications that are necessary for use in your country. If there is any question about whether your product complies with the applicable standards and regulations of your country, consult Komatsu or your Komatsu distributor before operating the machine.**
- ◆ **The description of safety is given in SAFETY INFORMATION on page 0-2 and in SAFETY from page 1-1.**

2. SAFETY INFORMATION

Most accidents are caused by the failure to follow fundamental safety rules for the operation and maintenance of machines. To avoid accidents, read, understand and follow all precautions and warnings in this manual and on the machine before performing maintenance and machine operations.

To identify safety messages in this manual and on machine product graphics, the following signal words are used.



DANGER! - This word is used on safety messages and product graphics where there is a high probability of serious injury or death if the hazard is not avoided. These safety messages and product graphics usually describe precautions that must be taken to avoid the hazard. Failure to avoid this hazard may also result in serious damage to the machine.



WARNING! - This word is used on safety messages and product graphics where there is a potentially dangerous situation, which could result in serious injury or death if the hazard is not avoided. These safety messages and product graphics usually describe precautions that must be taken to avoid the hazard. Failure to avoid this hazard may also result in serious damage to the machine.



CAUTION! - This word is used on safety messages and product graphics for hazards, which could result in minor or moderate injury if the hazard is not avoided. These safety messages and product graphics might also use this word for hazards where the only result could be damage to the machine.

NOTICE - This word is used for precautions that must be taken to avoid actions, which could shorten the life of the machine.

Safety precautions are described in SAFETY beginning on page 1-1.

Komatsu cannot predict every circumstance that might involve a potential hazard in operation and maintenance. Therefore the safety message in this manual and on the machine may not include all possible safety precautions. If any procedures or actions not specifically recommended or allowed in this manual are used, you must be sure that you and others can do such procedures and actions safely and without damaging the machine. If you are unsure about the safety of some procedures, contact Komatsu or your Komatsu distributor.

3.1 INTENDED USE

This Komatsu BULLDOZER is designed to be used mainly for the following work:

- ◆ Dozing
- ◆ Smoothing
- ◆ Cutting into hard or frozen ground or ditching.

See the section 12.10 WORK POSSIBLE USING BULLDOZER for further details.

3.2 FEATURES

- ◆ Simple, easy operation
 - One lever with hydraulic assist is used for the steering and directional control.
 - One lever used for the blade control (hydraulic angle/tilt dozer).
- ◆ Simple, easy maintenance
- ◆ Fuel gauge and air cleaner restriction warning lamp installed on instrument panel.

3.3 BREAKING IN THE MACHINE

Your machine has been thoroughly adjusted and tested before shipment.

However, operating the machine under severe conditions at the beginning can adversely affect the performance and shorten the machine life.

Be sure to break in the machine for the initial 100 hours (as indicated by the service meter.)

During breaking in:

- ◆ Idle the engine for 5 minutes after starting it up.
- ◆ Avoid operation with heavy loads or at high speeds.
- ◆ Avoid sudden starts, sudden acceleration, sudden steering and sudden stops except in cases of emergency.

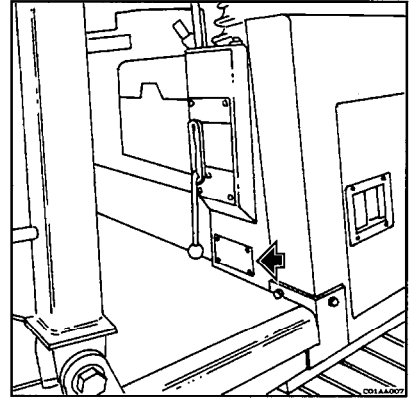
The precautions given in this manual for operating, maintenance, and safety procedures are only those that apply when this product is used for the specified purpose. If the machine is used for a purpose that is not listed in this manual, Komatsu cannot bear any responsibility for safety. All consideration of safety in such operations is the responsibility of the user.

Operations that are prohibited in this manual must never be carried out under any circumstances.

4. LOCATION OF PLATES, TABLE TO ENTER P.I.N. AND DISTRIBUTOR

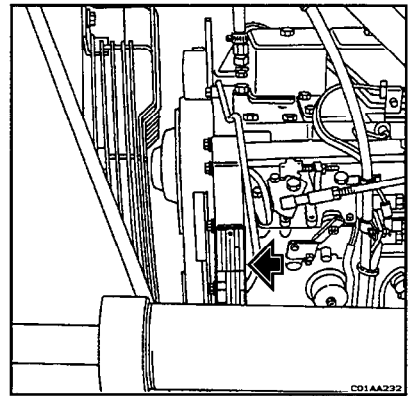
4.1 P.I.N. PLATE LOCATION

The product identification number (PIN) is stamped on a plate attached to the left hand side of the seat support below transmission control. It is also stamped into the right rear top of the rear main frame



4.2 ENGINE SERIAL NO. PLATE LOCATION

The engine serial number is stamped in a plate on the left side of the engine front gear cover above the fuel pump.



4.3 TABLE TO ENTER NUMBERS AND DISTRIBUTOR

Machine P.I.N.:	
Engine Serial No.:	
Distributor Name:	
Address:	Phone:
Service personnel for your machine:	

REMARKS

5. CONTENTS

1.	FOREWORD	0-1
2.	SAFETY INFORMATION	0-2
3.	INTRODUCTION	0-3
3.1	INTENDED USE	0-3
3.2	FEATURES	0-3
3.3	BREAKING IN THE MACHINE	0-3
4.	LOCATION OF PLATES, TABLE TO ENTER P.I.N. AND DISTRIBUTOR	0-4
4.1	P.I.N. PLATE LOCATION	0-4
4.2	ENGINE SERIAL NUMBER PLATE LOCATION	0-4
4.3	TABLE TO ENTER NUMBERS AND DISTRIBUTOR	0-4
5.	CONTENTS	0-5
SAFETY		
6.	GENERAL PRECAUTIONS	1-2
7.	PRECAUTIONS DURING OPERATION	1-6
7.1	BEFORE STARTING ENGINE	1-6
7.2	OPERATING MACHINE	1-8
7.3	TRANSPORTATION	1-11
7.4	BATTERY	1-13
7.5	TOWING	1-14
8.	PRECAUTIONS FOR MAINTENANCE	1-15
8.1	BEFORE CARRYING OUT MAINTENANCE	1-15
8.2	DURING MAINTENANCE	1-17
9.	POSITION FOR ATTACHING SAFETY LABELS	1-20
OPERATION		
10.	GENERAL VIEW	2-2
10.1	GENERAL VIEW OF MACHINE	2-2
10.2	GENERAL VIEW OF CONTROLS	2-3
10.3	UNIVERSAL SYMBOLS	2-4
11.	EXPLANATION OF COMPONENTS	2-5
11.1	GENERAL	2-5
11.2	GAUGES AND WARNING LIGHTS	2-5
11.3	SWITCHES	2-9
11.4	SUSPENSION SEAT, SEAT BELT AND ARM RESTS	2-12
11.5	CONTROL LEVERS AND PEDALS	2-13
12.	OPERATION	2-19
12.1	CHECKS BEFORE STARTING ENGINE	2-19
12.2	STARTING ENGINE	2-31
12.3	OPERATIONS AND CHECKS AFTER STARTING ENGINE	2-35
12.4	MOVING MACHINE	2-37
12.5	SHIFTING GEAR	2-40
12.6	SHIFTING BETWEEN FORWARD AND REVERSE	2-41
12.7	STEERING MACHINE	2-43
12.8	STOPPING MACHINE	2-45
12.9	PRECAUTIONS FOR OPERATION	2-47
12.10	WORK POSSIBLE USING BULLDOZER	2-48
12.11	PARKING MACHINE	2-49
12.12	CHECK AFTER FINISHING WORK	2-51
12.13	STOPPING ENGINE	2-52
12.14	CHECK AFTER STOPPING ENGINE	2-55

5. CONTENTS

12.15	LOCKING	2-55
12.16	TIPS FOR LONGER UNDERCARRIAGE LIFE	2-56
13.	TRANSPORTATION	2-59
13.1	LOADING, UNLOADING WORK	2-59
13.2	PRECAUTIONS FOR LOADING	2-59
13.3	PRECAUTION FOR TRANSPORTATION	2-59
14.	COLD WEATHER OPERATIONS	2-60
14.1	PRECAUTIONS FOR LOW TEMPERATURE	2-60
14.2	AFTER COMPLETION OF WORK	2-61
14.3	AFTER COLD WEATHER	2-62
15.	LONG TERM STORAGE (MORE THAN ONE MONTH)	2-63
15.1	BEFORE STORAGE	2-63
15.2	DURING STORAGE	2-63
15.3	AFTER STORAGE	2-63
16.	TROUBLESHOOTING	2-64
16.1	AFTER RUNNING OUT OF FUEL	2-64
16.2	IF BATTERY IS DISCHARGED	2-64
16.3	OTHER TROUBLE	2-66
16.4	METHODS OF TOWING MACHINE	2-68
MAINTENANCE		
17.	GUIDES TO MAINTENANCE	3-2
18.	OUTLINES OF SERVICE	3-4
18.1	OUTLINE OF OIL, FUEL, COOLANT	3-4
18.2	RELATING TO ELECTRICAL SYSTEM	3-6
19.	WEAR PARTS LIST	3-7
20.	USE OF FUEL, COOLANT AND LUBRICATION ACCORDING TO AMBIENT TEMPERATURE	3-8
20.1	PROPER SELECTION OF FUEL, COOLANT AND LUBRICANT	3-8
20.2	COOLING SYSTEM	3-10
20.3	FUEL SYSTEM	3-13
21.	STANDARD TIGHTENING TORQUES	3-14
21.1	INTRODUCTION OF NECESSARY TOOLS	3-14
21.2	BOLT IDENTIFICATION CHART	3-15
21.3	HYDRAULIC TUBES AND FITTINGS	3-18
21.4	HOSE CLAMPS	3-18
21.5	SPLIT FLANGE CONNECTIONS	3-18
22.	PERIODIC REPLACEMENT OF CRITICAL PARTS	3-19
23.	MAINTENANCE SCHEDULE CHART	3-22
23.1	MAINTENANCE SCHEDULE CHART	3-22
24.	SERVICE PROCEDURE	3-23
24.1	INITIAL 10 HOURS SERVICE	3-25
24.2	INITIAL 50 HOURS SERVICE	3-26
24.3	EVERY 10 HOURS SERVICE	3-30
24.4	EVERY 50 HOURS SERVICE	3-35
24.5	EVERY 100 HOURS SERVICE	3-36
24.6	EVERY 250 HOURS SERVICE	3-37
24.7	EVERY 500 HOURS SERVICE	3-41
24.8	EVERY 1000 HOURS SERVICE	3-42
24.9	EVERY 2000 HOURS SERVICE	3-47
24.10	PERIODIC	3-50

24.11 WHEN REQUIRED 3-56
24.12 SEASONAL PREPARATION 3-66
24.13 TURBOCHARGER - D38E-1, D38P-1, D39E-1 AND D39P-1 3-68

SPECIFICATIONS

25. SPECIFICATIONS 4-2
25.1 D32E-1, D32P-1 SPECIFICATIONS 4-2
25.2 D38E-1, D38P-1 SPECIFICATIONS 4-3
25.3 D39E-1, D39P-1 SPECIFICATIONS 4-4
25.4 D32E-1 DIMENSIONS 4-5
25.5 D32P-1 DIMENSIONS 4-6
25.6 D38E-1 DIMENSIONS 4-7
25.7 D38P-1 DIMENSIONS 4-8
25.8 D39E-1 DIMENSIONS 4-9
25.9 D39P-1 DIMENSIONS 4-10

OPTIONS, ATTACHMENTS

26. GENERAL PRECAUTIONS 5-2
26.1 PRECAUTIONS RELATED TO SAFETY 5-2

SAFETY




WARNING

Read and follow all safety precautions. Failure to do so may result in serious injury or death.

This safety section also contains precautions for optional equipment and attachments.

6. GENERAL PRECAUTIONS

 **WARNING:** For reasons of safety, always follow these safety precautions.

SAFETY RULES

- ◆ ONLY trained and authorized personnel should be allowed to operate and service this machine.
- ◆ Follow all safety rules, precautions and instructions when operating or performing maintenance on the machine.
- ◆ The owner and/or operator must replace any and all safety and warning product graphics if they are defaced or removed from the machine.
- ◆ Think before you act. Careful operators and service personnel are the best insurance against accidents.
- ◆ Do not rush. Hurrying can lead to accidents. Haste, carelessness and lack of training are the primary causes of equipment related injuries.
- ◆ The operator must be alert, physically fit and free from the influences of alcohol, drugs and medications that might affect his eyesight, hearing or reactions.
- ◆ Safety must always be the operator's most important concern. He must refuse to operate when he knows it is unsafe and consult his supervisor when safety is in doubt.
- ◆ When working with another operator or a person on work site traffic duty, be sure all personnel understand all hand signals that are to be used.

SAFETY FEATURES

- ◆ Be sure all guards and covers are in their proper position. Be sure to replace them after servicing the machine. Have guards and covers repaired immediately if damaged.
- ◆ Use safety features such as safety lock lever and seat belt properly.
- ◆ A seat belt is required by OSHA in almost all applications. DO NOT operate this machine without a seat belt.
- ◆ NEVER remove any safety features. ALWAYS keep them in good operating condition.

Safety lock lever ⇒ See 12.11 PARKING MACHINE.

Seat belts ⇒ See 12.1.3 ADJUST OPERATORS SEAT.

- ◆ Improper use of safety features could result in serious bodily injury or death.
- ◆ Be sure the machine has the correct equipment required by local rules and regulations.

UNAUTHORIZED MODIFICATION

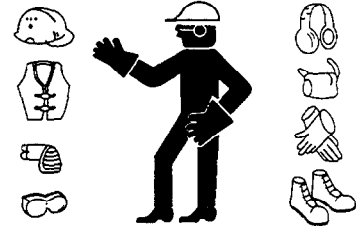
- ◆ Any modification made without authorization from Komatsu can create hazards.
- ◆ Before making a modification, consult your local distributor. Komatsu will not be responsible for any injury or damage caused by any unauthorized modification.

! WARNING: Failure to follow these safety precautions may lead to a serious accident.

6. GENERAL PRECAUTIONS

CLOTHING AND PERSONAL PROTECTIVE ITEMS

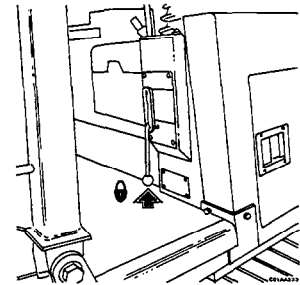
- ◆ Avoid loose clothing, jewelry, and loose long hair. They can catch on controls or in moving parts and cause serious injury or death. Also, do not wear oily clothes because they are flammable.
- ◆ Wear a hard hat, safety glasses, safety shoes, mask or gloves when operating or maintaining the machine. Always wear safety goggles, hard hat and heavy gloves if your job involves scattering metal chips or minute materials - this is particularly important when driving pins with a hammer and when cleaning the air cleaner element with compressed air.
- ◆ Also check that there are no other personnel near the machine.



Cleaning of air cleaner element ⇒ See 24.10.1 CHECK, CLEAN AND REPLACE AIR CLEANER ELEMENT.

ALWAYS APPLY LOCK WHEN LEAVING OPERATOR'S SEAT

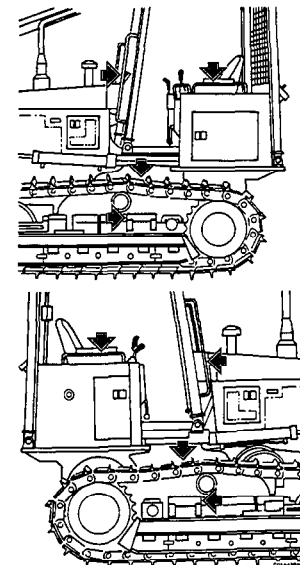
- ◆ When standing up from the operator's seat, always place the safety lock lever securely in the LOCK position. If you accidentally touch the directional and steering lever when it is not locked, the machine may move and cause serious injury or damage.
- ◆ When leaving the machine, lower the work equipment completely to the ground, set the safety lock lever to the LOCK position, then stop the engine and use the key to lock all the equipment locks. Always take the key with you.




Machine posture ⇒ See 12.11 PARKING MACHINE.

MOUNTING AND DISMOUNTING

- ◆ NEVER jump on or off the machine. NEVER get on or off a moving machine.
- ◆ When mounting or dismounting, always face the machine and use the handrails, machine or track frame steps, and track shoes.
- ◆ Do not use the machine's controls or hoses as handholds when climbing on or off the machine. Controls and hoses can move and do not provide solid support. Movement of the controls may cause unexpected machine movement and injury.
- ◆ Ensure safety by always maintaining at least three point contact of hands and feet with the handrails, steps or track shoes.
- ◆ Always remove any oil or mud from the handrails, steps and track shoes. If they are damaged, repair them and tighten any loose hardware.
- ◆ Repair any damaged handhold, and tighten any loose bolts. Handholds, track frames and shoes must free of oil, grease and/or excessive dirt.



6. GENERAL PRECAUTIONS

 **WARNING:** For reasons of safety, always follow these safety precautions.

FIRE PREVENTION FOR FUEL AND OIL

Fuel, oil, and antifreeze can be ignited by a flame. Fuel is particularly **FLAMMABLE** and can be **HAZARDOUS**.

- ◆ Keep any flame away from flammable fluids.
- ◆ Stop the engine and do not smoke when refueling.
- ◆ Tighten all fuel and oil caps securely.
- ◆ Refueling and oiling should be made in well ventilated areas.
- ◆ Keep oil and fuel in the determined place and do not allow unauthorized persons to enter.



PRECAUTIONS WHEN HANDLING AT HIGH TEMPERATURES

- ◆ Immediately after operations are stopped, the engine coolant, engine oil, and hydraulic oil are at high temperatures, and are still under pressure. Attempting to remove the cap, drain the oil or coolant, or replace the filters may lead to serious burns. Always wait for the temperature to go down, and follow the specified procedures when carrying out these operations.
- ◆ To prevent hot water from spurting out:
 - 1) Turn engine off.
 - 2) Allow coolant to cool.
 - 3) Slowly loosen cap to relieve pressure before removing.
- ◆ To prevent hot oil from spurting out:
 - 1) Turn engine off.
 - 2) Allow oil to cool.
 - 3) Slowly loosen cap to relieve pressure before removing.



CRUSHING OR CUTTING PREVENTION

- ◆ Do not enter, or put your hand or arm or any other part of your body between movable parts such as between the work equipment and cylinders, or between the machine and work equipment. If the work equipment is operated, the clearance will change and this may lead to serious damage or personal injury.

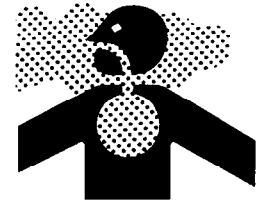


! WARNING: Failure to follow these safety precautions may lead to a serious accident.

6. GENERAL PRECAUTIONS

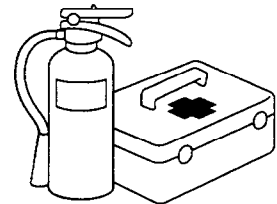
ASBESTOS DUST HAZARD PREVENTION

- ◆ Asbestos dust can be HAZARDOUS to your health if it is inhaled.
- ◆ If you handle materials containing asbestos fibers, follow these guidelines as given below:
 - 1) NEVER use compressed air for cleaning.
 - 2) Use water for cleaning to keep down the dust.
 - 3) Operate the machine with the wind to your back, whenever possible.
 - 4) Use an approved respirator if necessary.



FIRE EXTINGUISHER AND FIRST AID KIT

- ◆ Be sure fire extinguishers have been provided and know how to use them.
- ◆ Provide a first aid kit at the storage point.
- ◆ Know what to do in the event of a fire.
- ◆ Be sure you know the phone numbers of persons you should contact in case of an emergency.



PRECAUTIONS FOR ROPS


- ◆ Do not operate machine with ROPS removed (if equipped).
- ◆ The ROPS is installed to protect the operator if the machine should overturn. It is designed not only to take the load when the machine overturns, but also to absorb the impact energy.
- ◆ The Komatsu ROPS fulfills all worldwide regulations and standards, but if any unauthorized modification is carried out on it, or if it is damaged when the machine overturns, its strength will be reduced and it will not be able to provide its original capacity. It will be able to provide this capacity only if modifications and repairs are carried out in the specified way.
- ◆ When carrying out modification or repairs, always consult your Komatsu distributor first.
- ◆ Even when the ROPS is installed, if you do not fasten your seat belt securely, it cannot protect you properly. Always fasten your seat belt when operating the machine.

Seat belt ⇒ See 11.4.2 SEAT BELT

PRECAUTIONS FOR ATTACHMENTS

- ◆ When installing and using an optional attachment, read the instruction manual for the attachment and the information related to attachments in this manual.
- ◆ Do not use attachments that are not authorized by Komatsu or your Komatsu distributor. Use of unauthorized attachments could create a safety problem and adversely affect the proper operation and useful life of the machine.
- ◆ Any injuries, accidents, product failures resulting from the use of unauthorized attachments will not be the responsibility of Komatsu.

7. PRECAUTIONS DURING OPERATION

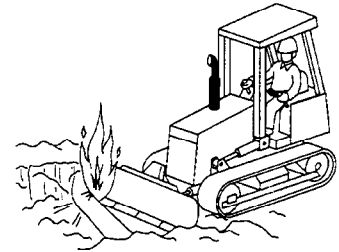
 **WARNING:** For reasons of safety, always follow these safety precautions.

7.1 BEFORE STARTING ENGINE

SAFETY AT WORK SITE

- ◆ Before entering the operator's compartment, walk completely around the machine and clear the area of personnel and obstructions.
- ◆ Before starting the engine, thoroughly check the area for any unusual conditions that could be dangerous.
- ◆ Before starting the engine, examine the terrain and soil conditions of the work site. Determine the best and safest method of operation.
- ◆ Make rough terrain areas as level as possible before operation.
- ◆ If you need to operate on a street, protect pedestrians and cars by designating a person for work site traffic duty or by installing barriers around the work site.
- ◆ If water lines, gas lines, telephone lines, and high voltage electrical lines may be buried under the work site, contact each utility and identify their locations. Be careful not to sever or cut any of these lines.
- ◆ Check the depth and flow of water before operating in water or crossing a river. NEVER be in water which is in excess of the permissible water depth.

Permissible water depth ⇒ See 12.9 PRECAUTIONS FOR OPERATION.



FIRE PREVENTION

- ◆ Thoroughly remove wood chips, leaves, paper and other flammable debris that has accumulated in or around the engine compartment. They could cause a fire.
- ◆ Check fuel, lubrication, and hydraulic systems for leaks. Have any leaks repaired. Wipe up any excess oil, fuel, or other flammable fluids.

Check point ⇒ See 12.1.1 WALK AROUND CHECK.

- ◆ Be sure a fire extinguisher is present and working.



IN OPERATOR'S COMPARTMENT

- ◆ Do not leave tools, spare parts or personal items lying around in the operator's compartment. They may damage, break or jam the control levers or switches. Always put them in their proper place.
- ◆ Keep the operators compartment floor, controls, steps and handrails free of oil, grease, snow, and excess dirt.
- ◆ Check the seat belt, buckle and hardware for damage or wear. Replace any worn or damaged parts. NEVER use bleach, dye or solvents on the seat belt because this may weaken the webbing and result in personal injury. Clean the seat belt with warm water and a mild detergent. ALWAYS use seat belts when operating your machine.

Seat belt ⇒ See 11.4.2 SEAT BELT



WARNING: Failure to follow these safety precautions may lead to a serious accident.

7. PRECAUTIONS DURING OPERATION

VENTILATION FOR ENCLOSED AREAS


- ◆ If it is necessary to start the engine within an enclosed area, provide adequate ventilation. Exhaust fumes from the engine can KILL.



PRECAUTIONS FOR MIRROR AND LIGHTS

- ◆ Remove all dirt from the surface of the mirror and lights to ensure that you can see well.
- ◆ Adjust the rear view mirror so that you can see clearly from the operator's seat, and always keep the surface of the mirror clean. If any glass is broken, replace it with a new part.
- ◆ Check that the head lamps and working lamps are installed to match the operating conditions. Check also that they light up properly.

7. PRECAUTIONS DURING OPERATION

 **WARNING:** For reasons of safety, always follow these safety precautions.

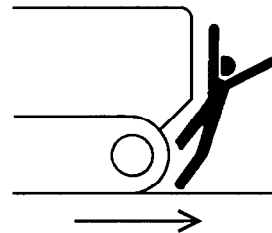
7.2 OPERATING MACHINE

WHEN STARTING ENGINE

- ◆ Perform a visual check of the machine before starting the engine. Look for such things as missing protective devices, leaks, improper fluid levels, trash buildup and loose, damaged or missing parts. **DO NOT** start the engine until any unsafe conditions are corrected.
- ◆ Walk around the machine again just before mounting it, checking for people and objects that might be in the way.
- ◆ **NEVER** start the engine if a warning tag has been attached to the control.
- ◆ Understand all control functions before starting the engine.
- ◆ When starting the engine, sound the horn as an alert
- ◆ Start and operate the machine only while seated.
- ◆ Do not allow anyone other than the operator to ride in the operators compartment or on the machine body.
- ◆ For machines equipped with a back up alarm, check that the warning device operates correctly.
- ◆ Keep hands and footwear free of grease, water and mud to insure positive control movement.
- ◆ Before driving the machine, adjust the seat and fasten the seat belt. Adjust the seat for maximum comfort and control of the machine. Adjust the seat belt to fit snugly and low around the hips to lessen the chance and severity of injury in the event of an accident. Never wear the seat belt across the abdomen.
- ◆ Before moving the machine, check the brakes, steering, equipment controls and safety devices such as the back up alarm for proper operation. **DO NOT** operate the machine until any unsafe conditions have been corrected.

PRECAUTIONS WHEN MOVING FORWARD OR BACKWARD

- ◆ When operating in areas that may be hazardous or have poor visibility, designate a person to direct worksite traffic.
- ◆ Be sure no one is around machine, particularly behind machine.
- ◆ Before starting machine motion, sound horn to alert people.
- ◆ There is a blind spot behind the machine. Make sure that nobody is present behind it before driving the machine backward.



VISIBILITY

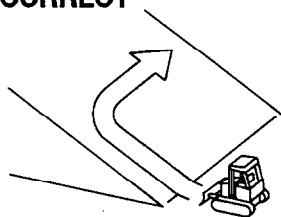
- ◆ Turn **ON** the head lamps and working lamp, when working at night or at dark sites. Provide additional lighting for the worksite if necessary.
- ◆ If visibility is diminished by fog, snow or rain, stop operation. Wait until there is adequate visibility for safe operation.

TRAVELING ON SLOPES

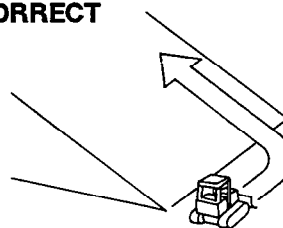
- ◆ Traveling on hills, banks or slopes that are steep could result in the machine tipping over or slipping.
- ◆ On hills, banks or slopes, carry the mounted equipment closer to the ground. Approximately 20 to 30 cm (8 to 12 in) above the ground. In case of emergency, quickly lower the mounted equipment to the ground to help the machine stop and prevent it from tipping over.
- ◆ Do not change directions on slopes. Avoid sideways travel whenever possible: rather travel up and down the slopes.
- ◆ Do not travel up and down on grass, fallen leaves, and wet steel plates. These materials may allow the machine to slip, if it is traveling sideways. Keep travel speed very low.
- ◆ When traveling downhill, drive slowly and use the engine as a brake.
- ◆ When traveling downhill with the machine being pushed by its own weight, the machine may steer in the opposite direction, so be careful.

Reverse steering when traveling downhill ⇒ See 12.7.2 TURNING WHILE DESCENDING A SLOPE.

INCORRECT



CORRECT




OPERATE CAREFULLY ON SNOW

- ◆ When working on snow or icy roads, even a slight slope may cause the machine to slip to the side, so always travel at low speed and avoid sudden starting, stopping, or turning.
- ◆ When there has been heavy snow, the road shoulder and objects placed beside the road are buried in the snow and cannot be seen, so always carry out snow-clearing operations carefully.

WORKING ON LOOSE GROUND

- ◆ Avoid operating your machine too close to the edge of cliffs, overhangs, and deep ditches. If these areas collapse, your machine could fall or tip over and result in serious injury or death. Remember that the soil after heavy rain or blasting is weakened in these areas.
- ◆ Earth laid on the ground and the soil near ditches are loose. They can collapse under the weight or vibration of your machine.
- ◆ Install the HEAD GUARD if working in areas where there is danger of falling rocks and dirt.

7. PRECAUTIONS DURING OPERATION

 **WARNING:** For reasons of safety, always follow these safety precautions.

PARKING THE MACHINE

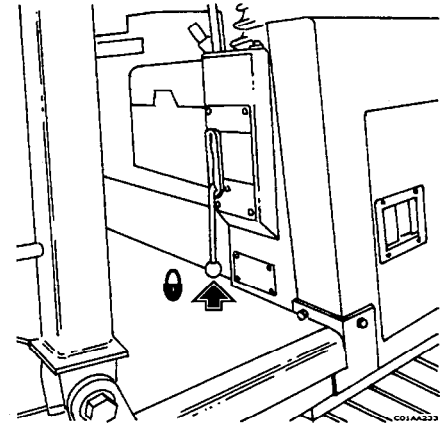
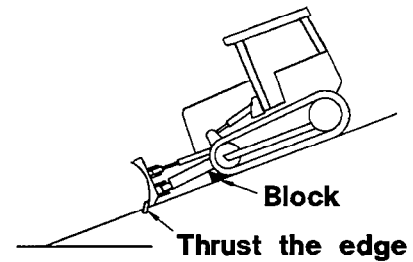
- ◆ Park on level ground whenever possible. If not possible, block the tracks, lower the mounted equipment to the ground and thrust the blade in the ground.
- ◆ When parking on public roads, provide fences and signs, such as flags or lights, on the machine to warn passersby to be careful. Be sure that the machine, flags or lights do not obstruct traffic.

Parking procedure ⇒ See 12.11 PARKING MACHINE.

- ◆ When leaving the machine, lower the work equipment completely to the ground, set the safety lock lever to the LOCK position, then stop the engine and use the key to lock all the equipment. Always take the key with you.

Work equipment posture ⇒ See 12.11 PARKING MACHINE.

Places to lock ⇒ See 12.15 LOCKING.





WARNING: Failure to follow these safety precautions may lead to a serious accident.

7. PRECAUTIONS DURING OPERATION

7.3 TRANSPORTATION

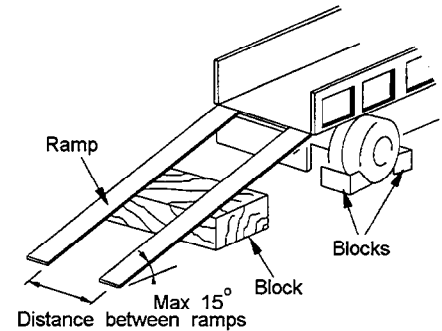
LOADING AND UNLOADING

- ◆ Loading and unloading the machine always involves potential hazards. **EXTREME CAUTION SHOULD BE USED.** When loading or unloading the machine, run the engine at low idling and travel at low speed.
- ◆ Perform loading and unloading on firm, level ground only. Maintain a safe distance from the edge of a road.
- ◆ **ALWAYS** block the wheels of the hauling vehicle and place blocks under both ramps before loading and unloading.
- ◆ **ALWAYS** use ramps of adequate strength. Be sure the ramps are wide and long enough to provide a safe loading slope.
- ◆ Be sure that the ramps are securely positioned and fastened, and that the two sides are at the same level as one another.
- ◆ Be sure the ramp surface is clean and free of grease, oil, ice and loose materials. Remove dirt from the machine tracks.
- ◆ **NEVER** correct your steering on the ramps. If necessary, drive away from the ramps and climb again.
- ◆ After loading, block the machine tracks and secure the machine with tie-downs.

Loading and unloading ⇒ See 13. TRANSPORTATION.

Tie-downs ⇒ See "13. TRANSPORTATION.

CORRECT



SHIPPING

- ◆ When shipping the machine on a hauling vehicle, obey all state and local laws governing the weight, width, and length of a load. Also obey all applicable traffic regulations.
- ◆ Determine the shipping route while taking into account the width, height and weight of the load.

7. PRECAUTIONS DURING OPERATION

⚠ WARNING: For reasons of safety, always follow these safety precautions.

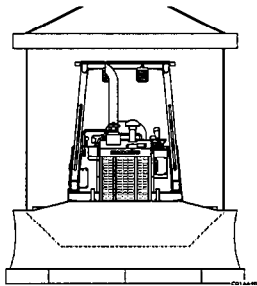
PRECAUTIONS WHEN FIXING ROPE AND RAISING MACHINE

When raising the machine, if the rope is not fixed properly, the machine may slip and cause a serious accident or injury.

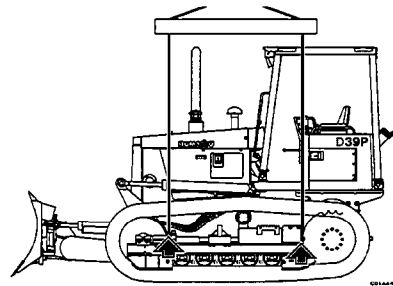
1. The weight table given below shows the weights of the machine manufactured by Komatsu when it is shipped from the factory.

Weight	D32E-1	D32P-1	D38E-1	D38P-1	D39E-1	D39P-1
Without Blade	6746 kg (14842 lb)	7340 kg (16149 lb)	7250 kg (15951 lb)	7554 kg (16619 lb)	7983 kg (17562 lb)	8133 kg (17892 lb)
With Blade	7133 kg (15725 lb)	7782 kg (17155 lb)	7675 kg (16885 lb)	8011 kg (17625 lb)	8466 kg (18625 lb)	8643 kg (19015 lb)
Maximum	8437 kg (18600 lb)	8664 kg (19400 lb)	8755 kg (19300 lb)	9072 kg (20000 lb)	9798 kg (21600 lb)	10000 kg (22000 lb)

2. Always apply the parking brake before fitting a sling or wire rope.
3. Always use a sling or rope of suitable strength when raising the machine.
4. Use protectors at sharp corners or places where the wire or cable will bite in. Position the crane so that the machine is raised horizontally. Make the width of the sledder and bar wide enough so that it does not contact the machine.
5. Method of fitting rope.



Pass cable under the undercover and the steering case



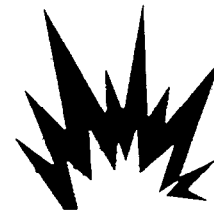
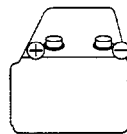
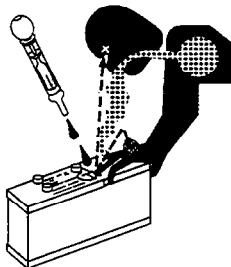
Lifting points

6. Check safety:
After fitting the rope, raise the machine 100 to 200 mm (4 to 8 in) and check that there is no slack in the wire cable and that the machine is being raised horizontally.
7. If any points are unclear, please contact your Komatsu distributor for advice.

7.4 BATTERY

BATTERY HAZARD PREVENTION

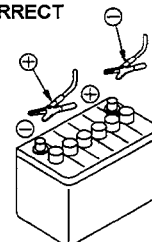
- ◆ Battery electrolyte contains sulfuric acid and can quickly burn the skin and eat holes in clothing. If you spill acid on yourself, immediately flush the area with water.
- ◆ Battery acid could cause blindness if splashed into the eyes. If acid gets into the eyes, flush them immediately with large quantities of water and see a doctor at once.
- ◆ If you accidentally drink acid, drink a large quantity of water or milk, beaten egg or vegetable oil. Call a doctor or poison prevention center immediately.
- ◆ When working with batteries. ALWAYS wear safety glasses or goggles.
- ◆ Batteries generate hydrogen gas. Hydrogen gas is very EXPLOSIVE, and is easily ignited with a small spark or flame.
- ◆ Before working with batteries, stop the engine and turn the starting switch to the OFF position.
- ◆ Avoid short-circuiting the battery terminals through accidental contact with metallic objects, such as tools, across the terminals.
- ◆ When removing or installing, check which is the positive (+) terminal and negative (-) terminal.
- ◆ Tighten the battery cap securely.
- ◆ Tighten the battery terminals securely. Loosened terminals can generate sparks and lead to an explosion.



STARTING WITH BOOSTER CABLES

- ◆ ALWAYS wear safety glasses or goggles when starting the machine with booster cables.
- ◆ When starting from another machine, do not allow the two machines to touch.
- ◆ Be sure to connect the positive (+) cable first when installing the booster cables. Disconnect the ground or negative (-) cable first when removing them.
- ◆ If any tool touches between the positive (+) terminal and the chassis, it will cause sparks. This is dangerous, so be sure to work carefully.
- ◆ Connect the batteries in parallel: positive to positive and negative to negative.
- ◆ When connecting the ground cable to the frame of the machine to be started, be sure to connect it as far as possible from the battery.

INCORRECT



Starting with booster cables ⇒ See 16.2 IF BATTERY IS DISCHARGED.

7. PRECAUTIONS DURING OPERATION

⚠ WARNING: For reasons of safety, always follow these safety precautions.

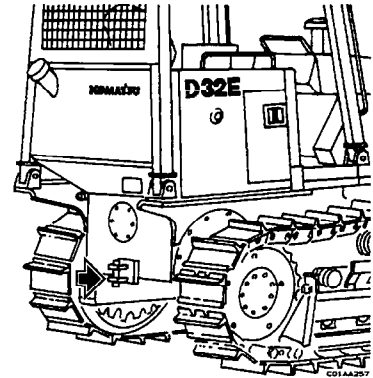
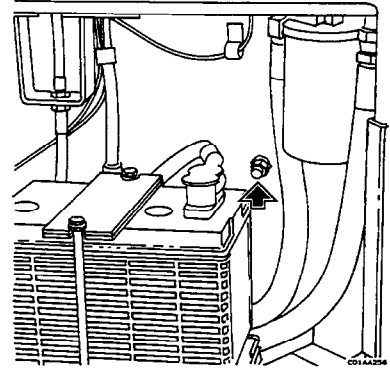
7.5 TOWING

WHEN TOWING THE MACHINE

- ◆ Injury or death could result if a disabled machine is towed incorrectly.
- ◆ If your machine is towed by another machine, ALWAYS use a wire rope with a sufficient towing capacity.
- ◆ Before the machine is towed, hydraulically release the secondary brake.

- ◆ NEVER allow a disabled machine to be towed on a slope.
- ◆ Do not use a kinked or frayed wire rope.
- ◆ Do not straddle the towing cable or wire rope.
- ◆ When connecting up a towing machine, do not let anyone enter the area between the towing machine and the equipment being towed.
- ◆ Set the towing machine and the towing connection of the equipment being towed in a straight line when connecting it.
- ◆ Place pieces of wood between the wire ropes and body to protect them from wear or damage.

Towing method ⇒ See 16.4 METHOD OF TOWING MACHINE.



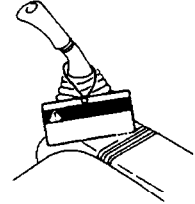
⚠ WARNING: Failure to follow these safety precautions may lead to a serious accident.

8. PRECAUTIONS FOR MAINTENANCE

8.1 BEFORE CARRYING OUT MAINTENANCE

WARNING TAG

- ◆ If others start the engine or operate the controls while you are performing service or lubrication, you could suffer serious injury or death.
- ◆ ALWAYS attach the WARNING TAG to the control lever in the operator's cab to alert others that you are working on the machine. Attach additional warning tags around the machine, if necessary.
- ◆ These tags are available from your distributor. (Part No. 09963-03000)



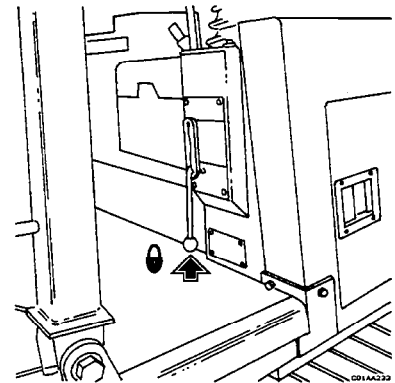
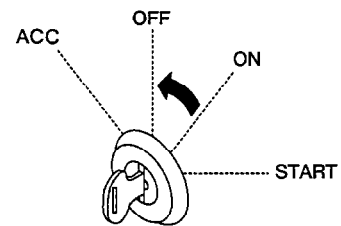
PROPER TOOLS

- ◆ Use only tools suited to the task. Using damaged, low quality, faulty, or makeshift tools could cause personal injury.



STOP THE ENGINE BEFORE CARRYING OUT INSPECTION AND MAINTENANCE

- ◆ Always stop the machine on firm flat ground and stop the engine before carrying out inspection and maintenance.
- ◆ If it is necessary to run the engine when carrying out maintenance, such as when cleaning the inside of the radiator, place the safety lock lever in the LOCK position and carry out the operation with two workers.
- ◆ One worker should sit in the operator's seat so that he can stop the engine immediately if necessary. He should also be extremely careful not to touch any lever by mistake. Touch the levers only when they have to be operated.
- ◆ The worker carrying out the maintenance should be extremely careful not to touch or get caught in any moving parts.

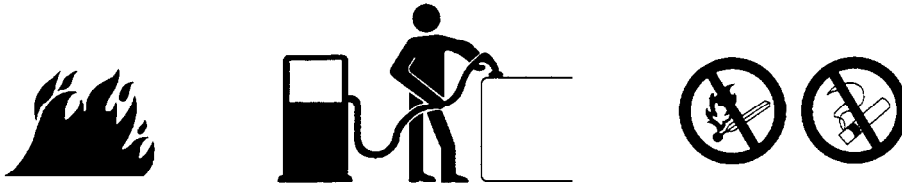


8. PRECAUTIONS FOR MAINTENANCE

⚠ WARNING: For reasons of safety, always follow these safety precautions.

RULES TO FOLLOW WHEN ADDING FUEL OR OIL

- ◆ Spilled fuel and oil may cause you to slip, so always wipe it up immediately.
- ◆ Always tighten the cap of the fuel and oil fillers securely.
- ◆ Never use fuel for washing any parts.
- ◆ Always add fuel and oil in a well-ventilated place.



PERIODIC REPLACEMENT OF SAFETY CRITICAL PARTS

- ◆ Replace the following fire-related components periodically:
 - Fuel system: Fuel hose, spilling hose, and fuel tube cap
 - Hydraulic system: Pump outlet hose, and front and rear pump branch hoses
- ◆ Replace these components periodically with new ones, regardless of whether or not they appear to be defective. These components deteriorate over time.
- ◆ Replace or repair any such components if any defect is found, even though they have not reached the time specified.

Replacement of safety critical parts ⇒ See 22. PERIODIC REPLACEMENT OF SAFETY CRITICAL PARTS.

RADIATOR COOLANT LEVEL

- ◆ If it is necessary to add coolant to the radiator, stop the engine and allow the engine and radiator to cool down before adding the coolant.
- ◆ Slowly loosen the cap to relieve pressure before removing the cap.



USE OF LIGHTING

- ◆ When checking fuel, oil, coolant, or battery electrolyte, always use lighting with anti-explosion specifications. If such lighting equipment is not used, there is danger of explosion.



⚠ WARNING: Failure to follow these safety precautions may lead to a serious accident.

8. PRECAUTIONS FOR MAINTENANCE

8.2 DURING MAINTENANCE

PERSONNEL

- ◆ Only authorized personnel can service and repair the machine. Extra precaution should be used when grinding, welding, and using a sledge hammer.



ATTACHMENTS

- ◆ Place attachments that have been removed from the machine in a safe place so that they do not fall. If they fall on you or others, serious injury could result.



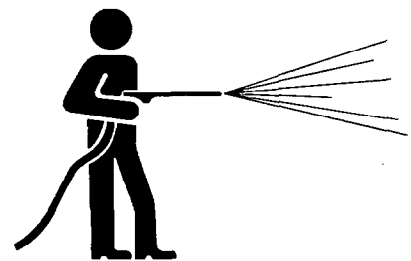
WORK UNDER THE MACHINE

- ◆ Always lower all movable work equipment to the ground or to their lowest position before performing service or repairs under the machine.
- ◆ Always block the track shoes of the machine securely.
- ◆ Never work under the machine if the machine is poorly supported.




KEEP THE MACHINE CLEAN

- ◆ Spilled oil or grease, or scattered tools or broken pieces are dangerous because they may cause you to slip or trip. Always keep your machine clean and tidy.
- ◆ If water gets into the electrical system, there is danger that the machine may not move or may move unexpectedly. Do not use water or steam to clean the sensors, connectors, or the inside of the operator's compartment.



8. PRECAUTIONS FOR MAINTENANCE

 **WARNING:** For reasons of safety, always follow these safety precautions.

HANDLING HIGH PRESSURE HOSES

- ◆ Do not bend high-pressure hoses or hit them with hard objects. Do not use any bent or cracked piping, tubes or hoses. They may burst during use.
- ◆ Always repair any loose or broken fuel hoses or oil hoses. If fuel or oil leaks, it may cause a fire.
- ◆ Avoid torching, soldering or welding on pipes, tubes or equipment that contain fuel or oils. If heated they can generate flammable fumes or mist and could cause a fire or explosion.

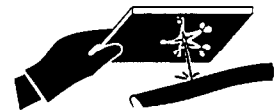
PRECAUTIONS WITH BATTERY

- ◆ When repairing the electrical system or when carrying out electrical welding, remove the negative (-) terminal of the battery to stop the flow of current.



PRECAUTIONS WITH HIGH PRESSURE OIL

- ◆ Do not forget that the work equipment circuits are always under pressure.
- ◆ Do not add oil, drain oil, or carry out maintenance or inspection before completely releasing the internal pressure.
- ◆ If you are hit by a jet of high pressure oil, consult a doctor immediately for medical attention.
- ◆ If oil is leaking under high pressure from small holes, it is dangerous if the jet of high pressure oil hits your skin or enters your eyes. Always wear safety glasses and thick gloves, and use a piece of cardboard or a sheet of wood to check for oil leakage.



PRECAUTIONS WHEN CARRYING OUT MAINTENANCE AT HIGH TEMPERATURE OR HIGH PRESSURE

- ◆ Immediately after stopping machine operations, the engine coolant and oil at all parts are at high temperatures and under high pressure. In this condition, if the radiator cap is removed, or the oil or coolant are drained, or the filters are replaced, this may result in burns or other injury. Wait for the temperature to go down, then carry out the inspection and maintenance in accordance with the procedures given in this manual.

Cleaning inside of cooling system ⇒ see 24. SERVICE PROCEDURES.

Checking coolant level, hydraulic oil level ⇒ see 24. SERVICE PROCEDURES.

Checking lubricating oil level, adding oil ⇒ see 24. SERVICE PROCEDURE.

Changing oil, replacing filters ⇒ see 24. SERVICE PROCEDURE.



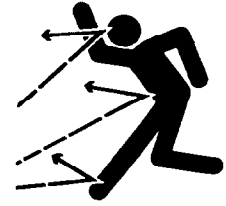
⚠ WARNING: Failure to follow these safety precautions may lead to a serious accident.

8. PRECAUTIONS FOR MAINTENANCE

PRECAUTIONS WHEN USING HIGH PRESSURE GREASE TO ADJUST TRACK TENSION

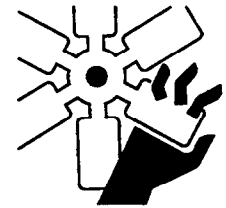
- ◆ Grease is pumped into the track tension adjustment system under high pressure. If the specified procedure for maintenance is not followed when making adjustments, the plug or grease fitting may fly out and cause damage or personal injury.
- ◆ When loosening the grease drain plug, never loosen it more than one turn.
- ◆ Never put your face, hands, feet, or any other part of your body directly in front of any grease drain plug or valve.

Adjusting track tension ⇒ see 24.2.3 TRACK TENSION AND ADJUSTMENT.



ROTATING FAN AND BELT

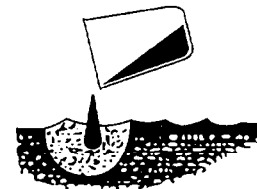
- ◆ Keep away from rotating parts and be careful not to let anything get caught in them. If your body or tools touch the fan blades or fan belt, they may be cut off or sent flying, so never touch any rotating parts.



WASTE MATERIALS

- ◆ Never dump waste oil in a sewer system, rivers, etc.
- ◆ Always put oil drained from your machine in containers. Never drain oil directly on the ground.
- ◆ Obey appropriate laws and regulations when disposing of harmful objects such as oil, fuel, coolant, solvent, filters, batteries, and others.

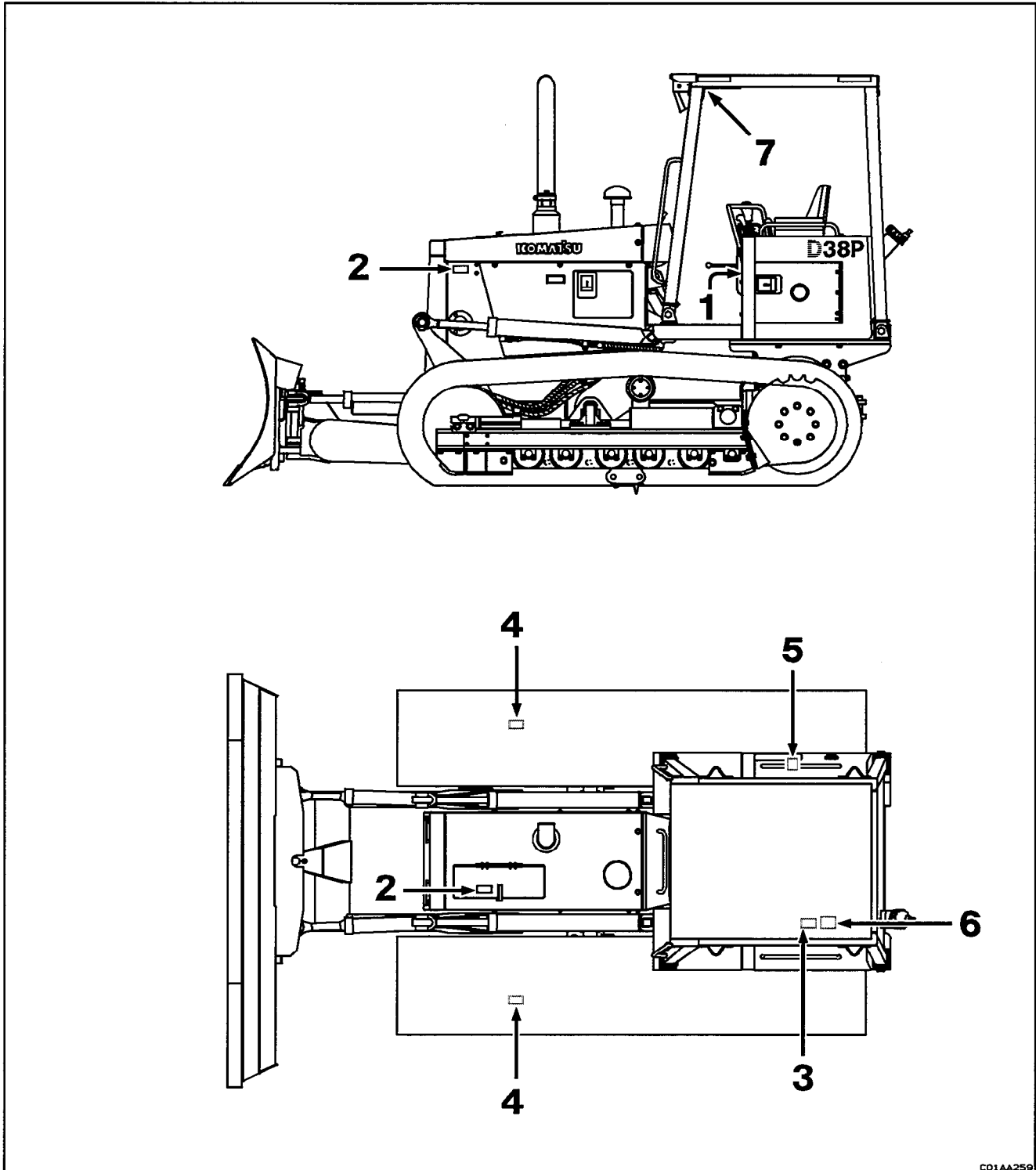
INCORRECT



9. POSITIONS FOR ATTACHING SAFETY LABELS

Always keep these labels clean. If they are lost or damaged, attach them again or replace them with a new label. There are other labels in addition to the safety labels listed as follows, so handle them in the same way. Safety labels may be available in languages other than English. To find out what labels are available, contact your distributor.

POSITION FOR ATTACHING SAFETY LABELS



CD1AA259

9. POSITION FOR ATTACHING SAFETY LABELS

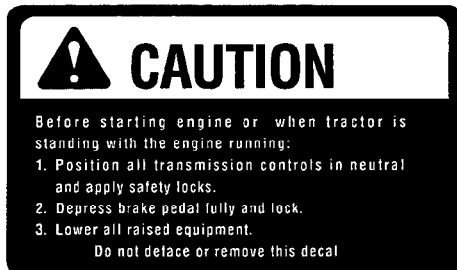
1. General Caution (737 994 C3)



2. Door Caution (667 460 C2)



3. Instructional Caution (628 135 C4)



7. ROPS Caution (737 993 C3)



4. Track Adjuster Caution (655 434 C2)



CO2AD07

5. Pressurized Reservoir (2754 473 R3)



CO2AD019

6. Safety Caution (1120 363 C2)



CO2AD020

CO2AD015

OPERATION



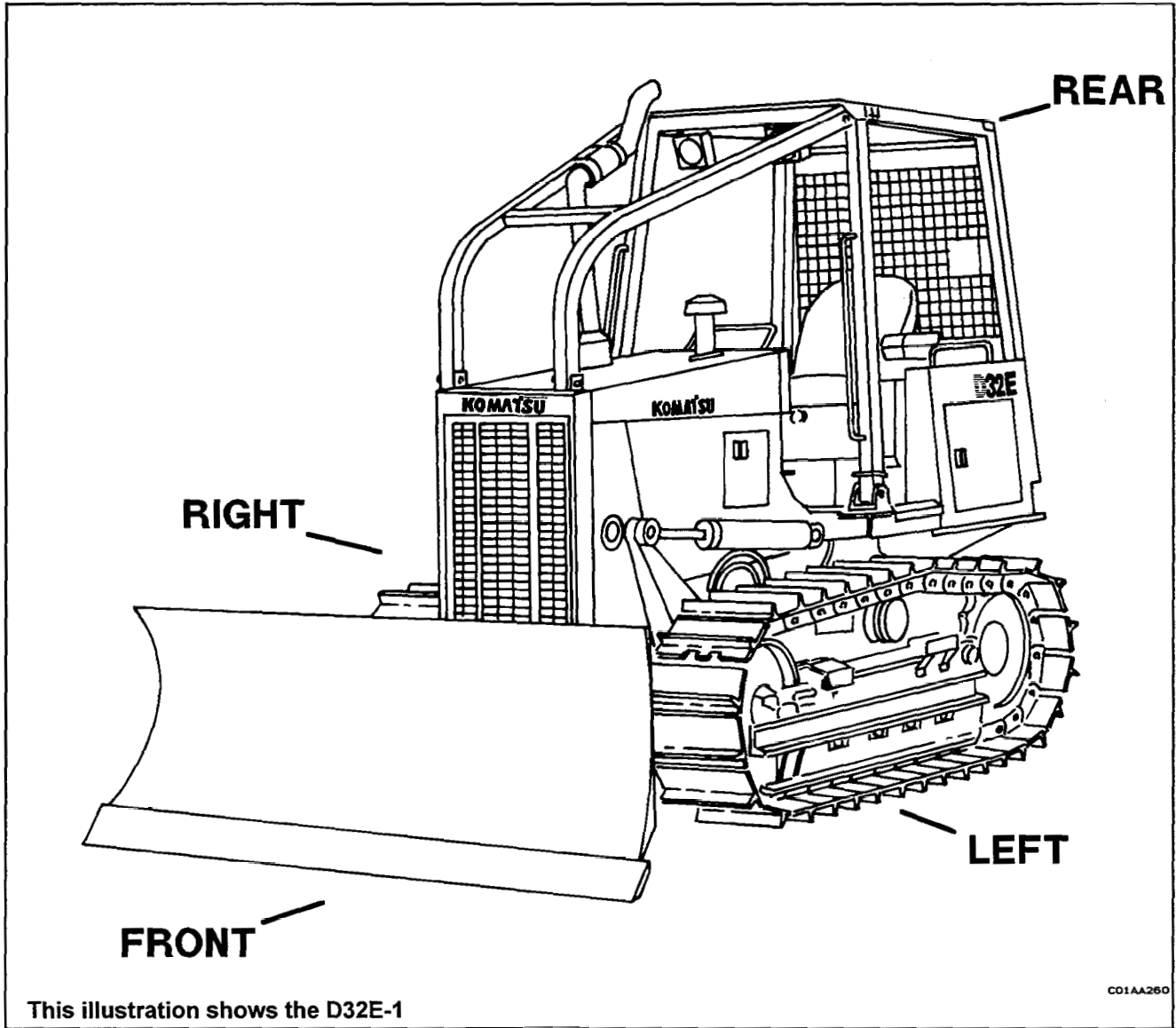
WARNING

Read and follow all safety precautions in SAFETY from page 1-1 on. Failure to do so may result in serious injury or death.

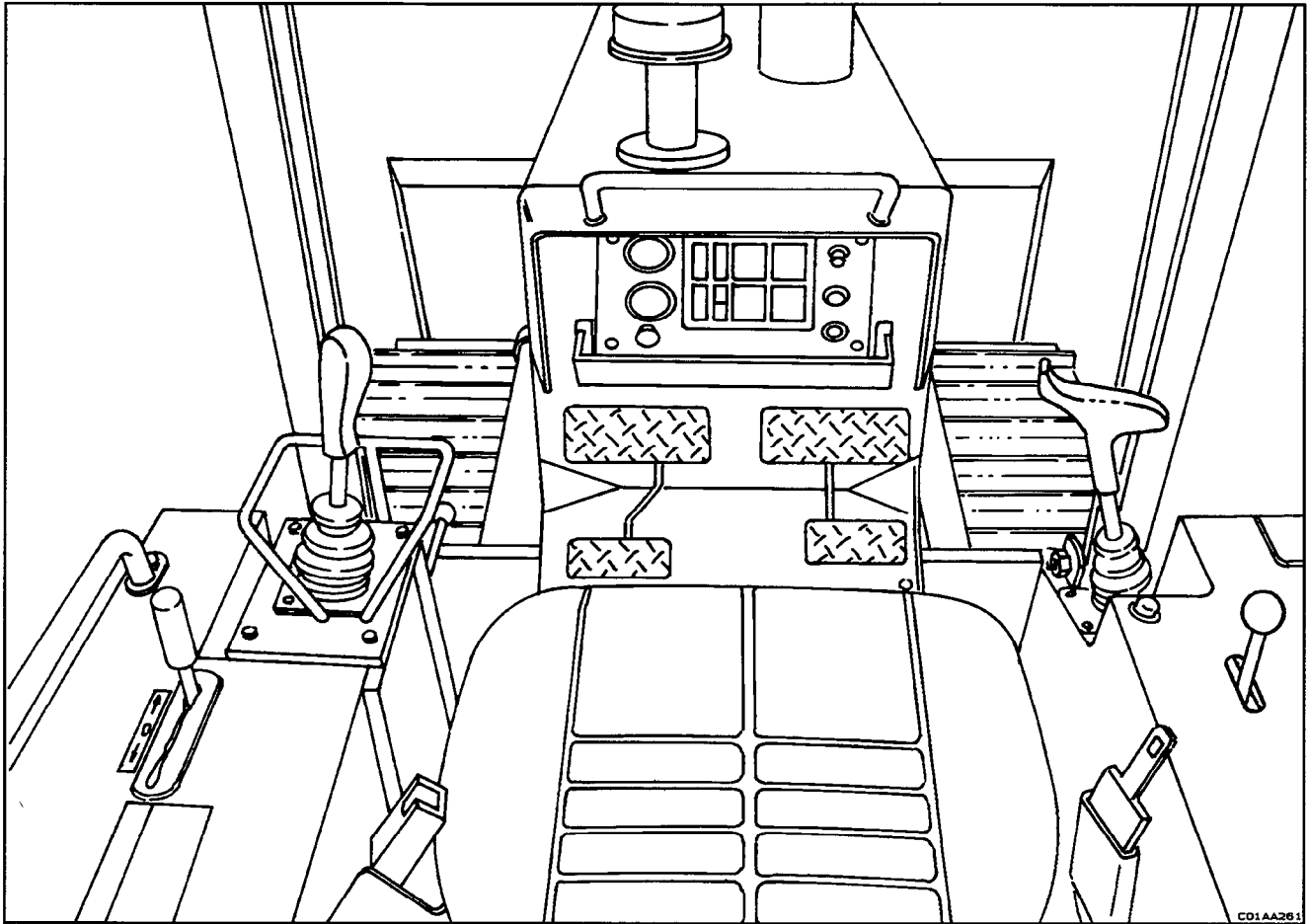
10. GENERAL VIEW

10.1 GENERAL VIEW OF MACHINE

If directions are indicated in this section, they refer to the directions shown by the arrows in the diagram below.







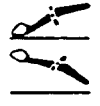




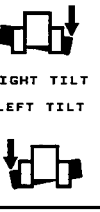
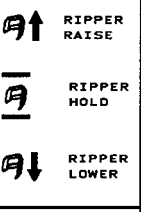
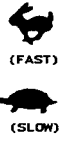
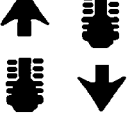


















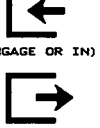

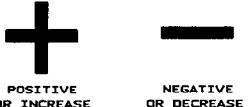













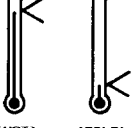







10.2 GENERAL VIEW OF CONTROLS AND GAUGES



10. GENERAL VIEW

10.3 UNIVERSAL SYMBOLS

Universal symbols are used to pictorially identify various instruments and controls. These symbols are an effort to overcome language differences for all operators in a positive way, thus enhancing their safety through quicker recognition of the instruments and controls while operating the equipment. Study the following symbols so you will know their meaning immediately and at a glance.

 HAZARD WARNING SIGNALS	 CAUTION	 CAUTION PRESSURIZED OPEN SLOWLY	 LOADER LIFT ARM CONTROL FLOAT	 LOADER LIFT ARM CONTROL LOWER AND RAISE	 LOADER BUCKET CONTROL DUMP AND ROLL BACK	 BLADE HOLD BLADE FLOAT	 BLADE RAISE BLADE LOWER
 RIGHT ANGLE LEFT ANGLE	 RIGHT TILT LEFT TILT	 RIPPER RAISE RIPPER HOLD RIPPER LOWER	 SPEED RANGE	 VEHICLE FORWARD REVERSE	 NEUTRAL	 PARK	 PARKING BRAKE
 BRAKE LINE	 BRAKE OIL LEVEL	 BATTERY	 VOLTMETER LIGHT OR AMMETER	 GREASE LUBRICANT	 OIL LUBRICANT	 DIPSTICK	 OIL LEVEL
 ENGINE OIL LEVEL	 ENGINE OIL PRESSURE	 ENGINE RPM	 COOLANT LEVEL	 TEMPERATURE	 AIR FILTER	 AIR PRESSURE	 (ENGAGE OR IN) (DISENGAGE OR OUT) ENGAGEMENT
 TURN SIGNALS	 SIGN POSITIVE OR INCREASE NEGATIVE OR DECREASE	 TRANSMISSION	 TRANSMISSION OIL PRESSURE	 TRANSMISSION OIL TEMPERATURE	 TRANSMISSION OIL FILTER	 TRANSMISSION CUT OFF	
 HYDRAULIC OIL LEVEL	 MAIN STEERING	 FUEL LEVEL	 ENGINE PREHEAT	 ALARM BUZZER STOP	 HOURS	 HORN	 LIGHTS
 TEMPERATURE	 CAB HEAT	 CAB HEATER/DEFROSTER FAN	 FRESH AIR	 INSIDE AIR	 WINDSHIELD WIPER	 WINDSHIELD WASHER	 CIGARETTE LIGHTER

C01AA429

11. EXPLANATION OF COMPONENTS

11.1 GENERAL

This area of the section covers the location and function of the various instruments and controls of this machine. In the case of controls, more detailed information regarding operation can be found in the following text within this section.

Regardless of previous experience as an operator, you must be thoroughly familiar with the location and use of all instruments and controls before operating this machine.

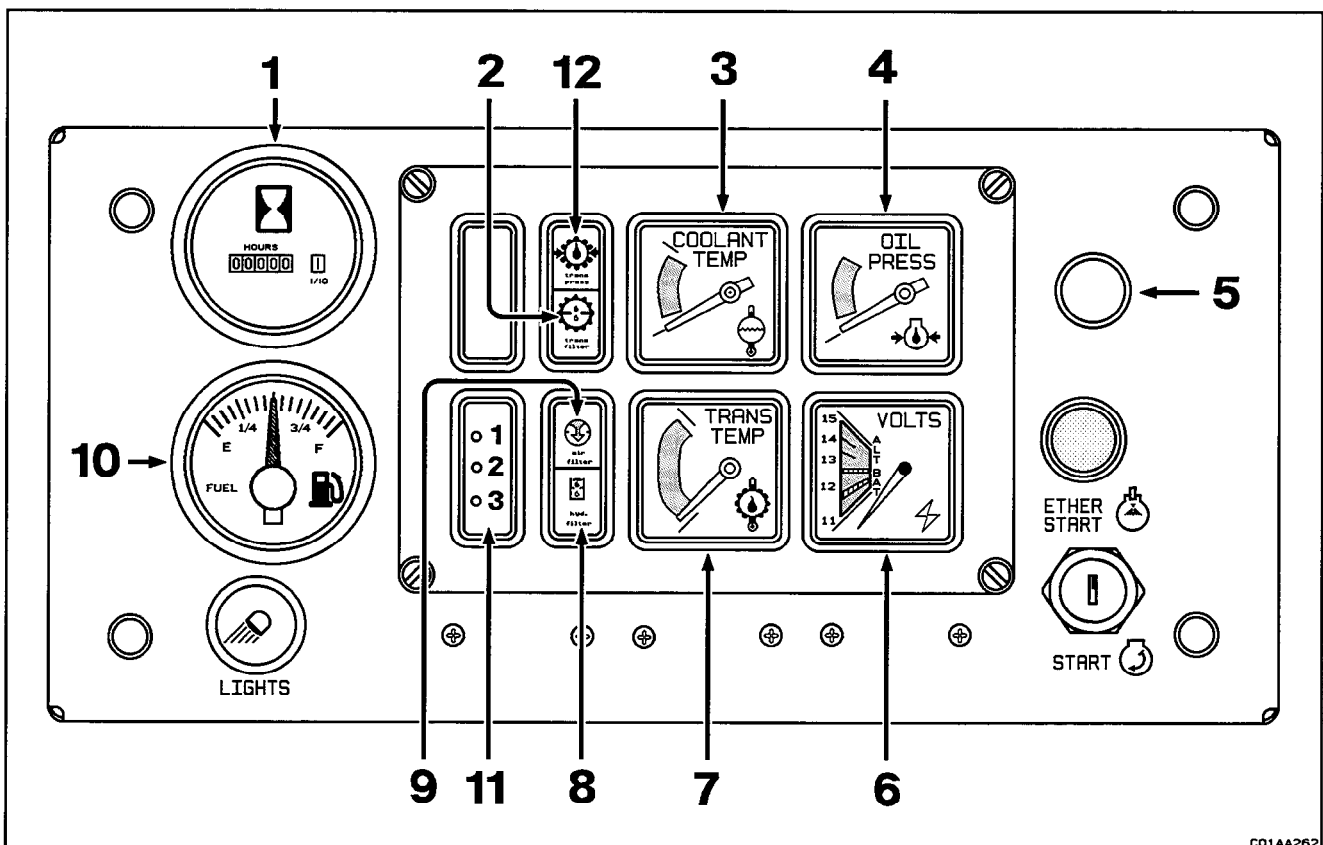
REMARK

Understand all control functions before starting the machine.

REMARK

After starting and while operating, observe instruments and warning lights frequently. Investigate any unusual indication or noises in the machine.

11.2 GAUGES AND WARNING LIGHTS



1. Hourmeter
2. Transmission Filter Warning Light
3. Coolant Temperature Gauge
4. Engine Oil Pressure Gauge
5. Illumination Lamp
6. Voltmeter

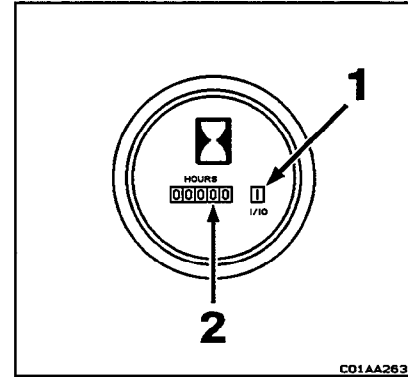
7. Transmission Temperature Gauge
8. Hydraulic Filter Warning Light
9. Air Filter Warning Light
10. Fuel Gauge
11. Gear Range Indicator
12. Transmission Pressure Warning Light

11. EXPLANATION OF COMPONENTS

11.2.1 HOURMETER

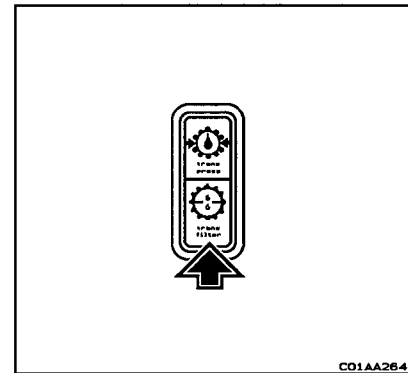
The hourmeter electrically records the actual hours of engine operation. The purpose of the hourmeter is to indicate when to perform the recommended maintenance and lubrication operations. The hourmeter will register only when the engine is running.

While the engine is running, operation display (1) in red at the end of the meter will advance in 1/10 hour increments. Meter (2) will advance by 1 for each hour of operation regardless of the engine speed.



11.2.2 TRANSMISSION OIL FILTER WARNING LIGHT

The transmission oil filter warning light will glow amber when the oil filter element reaches the maximum allowable restriction.



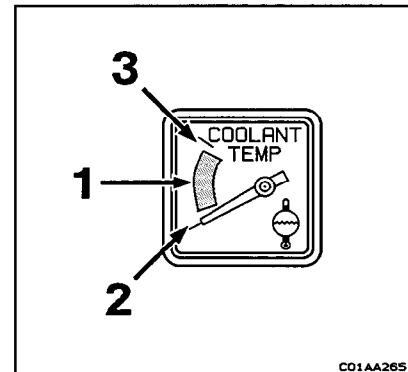
11.2.3 ENGINE COOLANT TEMPERATURE GAUGE

This gauge shows the temperature of the coolant circulating through the engine. After the engine has operated a sufficient length of time, the pointer must be in the GREEN (1) area of the gauge. During normal operating, the gauge readings may vary between the minimum and maximum indicated by the GREEN area of the gauge. Continuous engine operating below (2) the minimum temperature is harmful to the engine oil, low coolant temperatures will also cause exhaust smoke and increase the rate of fuel consumption.

REMARK

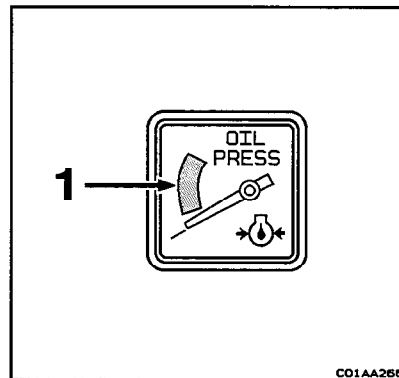
In cold weather, it may be necessary to cover part of the radiator to maintain the minimum coolant temperature indicated at the lower end of the GREEN area.

The engine temperature, under full load conditions, should remain in the GREEN area of the gauge. Continuous overheating (3) indicates the need for mechanical correction. A clogged cooling system or a low coolant level will also cause high operating temperatures.



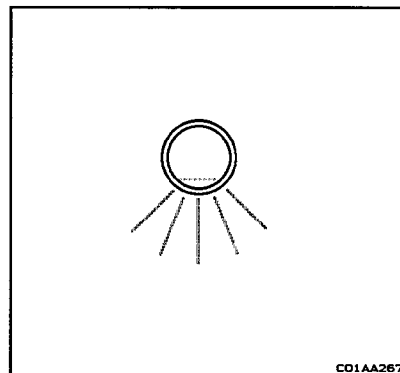
11.2.4 ENGINE OIL PRESSURE GAUGE

This gauge registers the pressure at which the lubricating oil is circulated through the engine. The pointer must register in green area (1) immediately upon engine starting and when the engine is operated at full load speeds.



11.2.5 ILLUMINATION LAMP

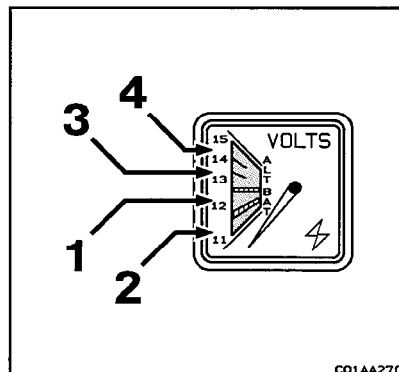
This lamp illuminates the starting switch and the ether start switch (if equipped) and is applied when the work light switch is pulled out to either position.



11.2.6 VOLTMETER

The voltmeter indicates the condition of the battery. At low idle speed, the gauge pointer should be within the green with white stripe area (1), which indicates a good battery charge. If the voltage drops below this area (2), the battery should be checked.

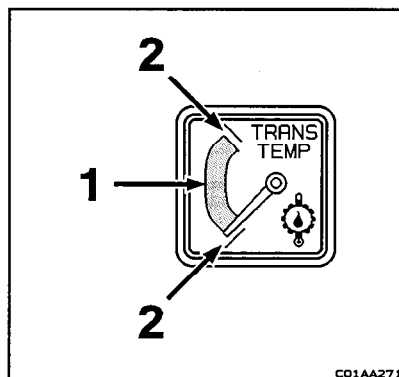
With the engine operating above low idle speed, the pointer should be within the upper green area (3), which is the normal operating range. If the pointer drops below or exceeds (4) this area, the battery and/or alternator may be at fault.



11.2.7 DRIVE TRAIN OIL TEMPERATURE GAUGE

The gauge registers the temperature of the fluid in the drive train. After the engine has operated sufficiently to reach a stabilized drive train temperature, check the gauge. The pointer must be in the green range (1). If the pointer is out of this area (2), shut down the engine and check the following:

- a. Restricted radiator or oil cooler core.
- b. Low drive train oil level.
- c. Torque converter charge pressure.
- d. Rear main frame breather.



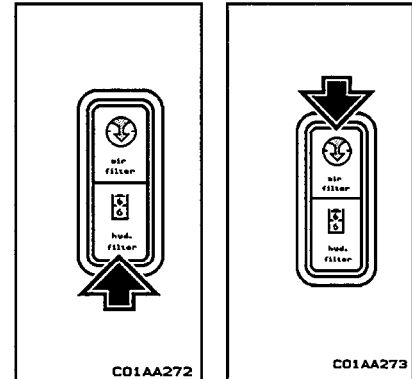
11. EXPLANATION OF COMPONENTS

11.2.8 HYDRAULIC OIL FILTER WARNING LIGHT

The hydraulic oil filter warning light will glow amber when the filter element reaches the maximum allowable restriction.

11.2.9 AIR CLEANER SERVICE LIGHT

The air cleaner filter service light will glow amber when the filter element reaches the maximum allowable restriction. When this happens, primary filter element service is required.

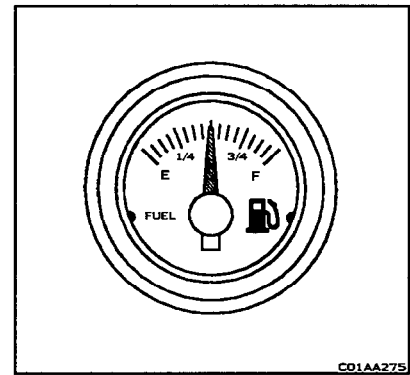


11.2.10 FUEL GAUGE

This gauge indicates the amount of fuel in the fuel tank.

- F Indicates that the tank is full.
- E Indicates that there is less than 17 ℓ (4.5 gal) of fuel remaining in the tank, so add fuel.

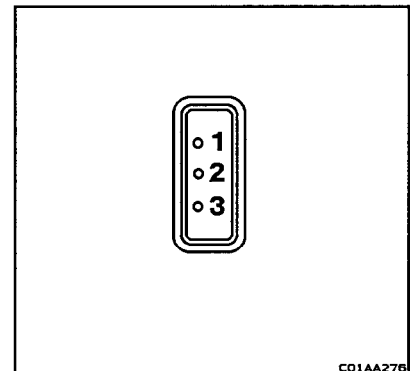
After each days operation, be sure to fill the fuel tank.



11.2.11 GEAR RANGE INDICATOR

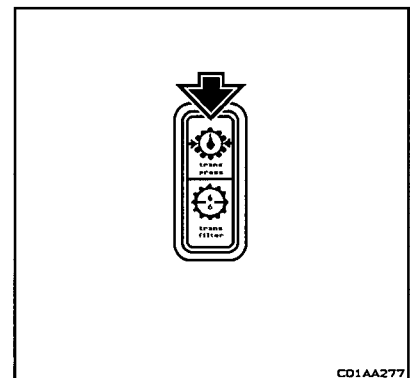
When gear shifting operation is carried out, the display indicator in the gauge cluster panel will display the speed range selected.

- 1st: ○ 1 is displayed on the panel
- 2nd: ○ 2 is displayed on the panel
- 3rd: ○ 3 is displayed on the panel

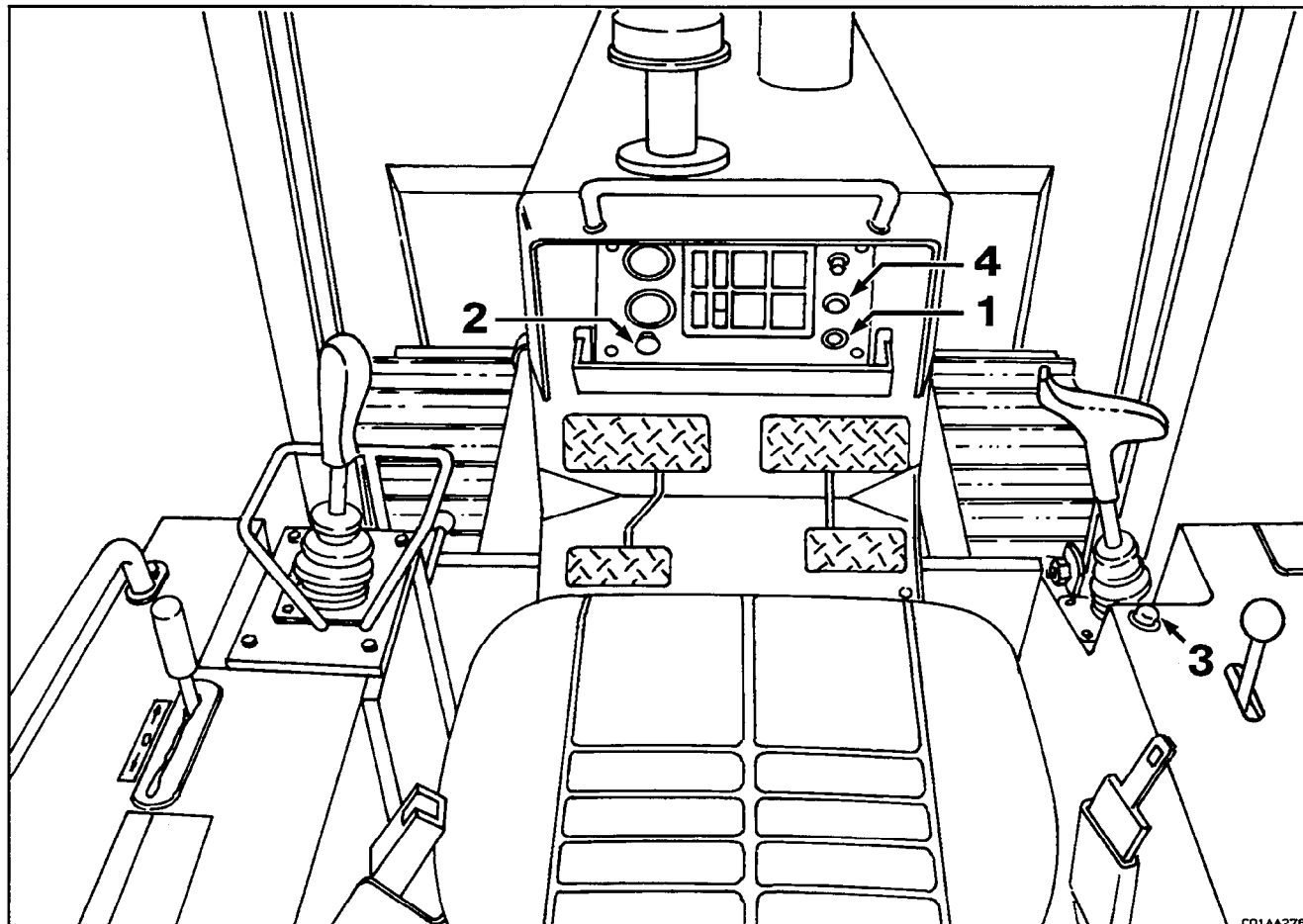


11.2.12 TRANSMISSION PRESSURE WARNING LIGHT

The transmission pressure warning light will glow red if the clutch pressure is low.



11.3 SWITCHES



11.3.1 START KEY SWITCH

This switch is used to start or stop the engine. It has four positions.

ACC position

This position is used if the engine is not running when accessories are needed.

OFF position

The key can be inserted or removed. The switches for the electric system, except the lighting circuits, are all turned off and the engine is stopped.

ON position

Electric current flows in the charging and lamp circuits. Keep the starting switch key in the ON position while the engine is running.

REMARK

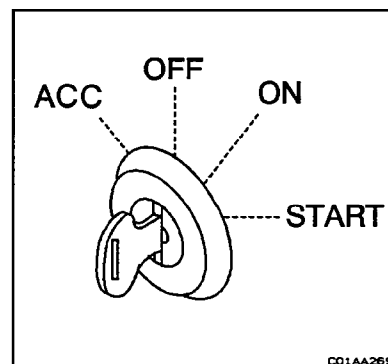
With the key in this position prior to engine start up, a bulb check of all warning lights can be performed.

START position

This is the engine start position. Keep the key at this position during cranking. Immediately after starting the engine, release the key which will automatically return to the ON position. This switch incorporates a restart protection feature to prevent engagement of the starter motor while the engine is running. Once the switch has been returned to the ON position, the key must be moved to the OFF position before it can be moved again to the START position.

REMARK

To prevent damage to the starter motor and avoid low battery output, do not continuously crank the engine for more than 30 second intervals. Allow a 1 to 2 minute recovery period between cranking.

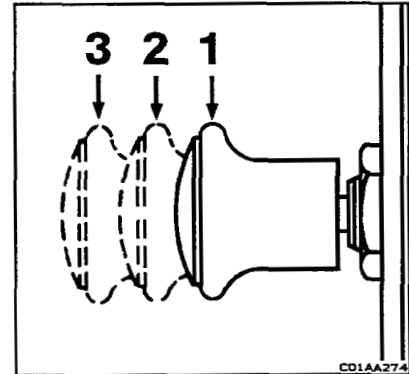


11. EXPLANATION OF COMPONENTS

11.3.2 WORK LIGHT SWITCH

This switch is a three position push pull type switch.

1. With the switch in the first position, all the lights are off.
2. With the switch pulled to the second position, the front work lights, the instrument panel gauge lights and the instrument panel illumination light are energized.
3. With the switch pulled to the third position, the front and rear work lights, the instrument panel gauge lights and the instrument panel illumination light are energized.

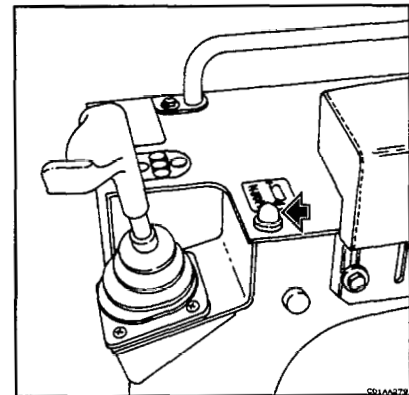


REMARK

The lighting circuits can be operated with the starting key switch in OFF position and master disconnect switch in the ON position.

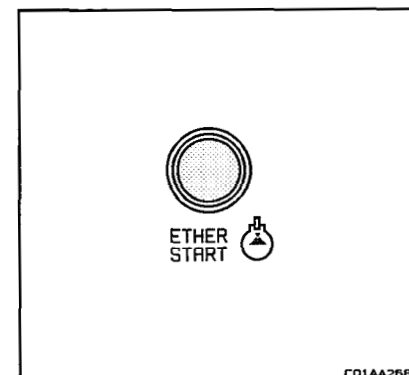
11.3.3 HORN SWITCH

Depress the switch to sound the horn.



11.3.4 ETHER START SWITCH

This switch controls the ether injector for cold weather starting. Refer to 12.2.2 COLD WEATHER STARTING.

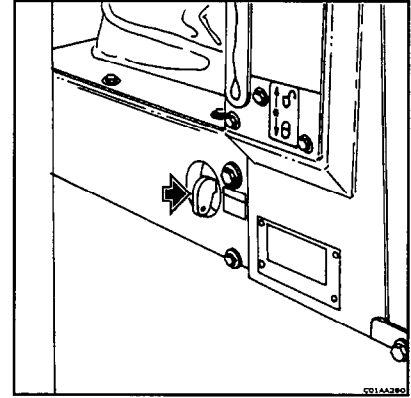


11.3.5 ELECTRICAL SYSTEM MASTER SWITCH

Turn the key (A) clockwise to connect the battery ground circuit. Turn the key counterclockwise to disconnect the battery ground circuit.

REMARK

Keep the switch on while the engine is running.



11. EXPLANATION OF COMPONENTS

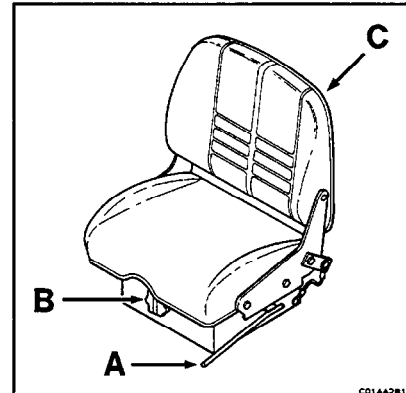
11.4 SUSPENSION SEAT, SEAT BELT AND ARM RESTS

11.4.1 SUSPENSION SEAT

Pull lever (A), and slide the seat back or forth to any one of five positions and release the lever. Be sure the seat engages the slide rail notch.

Turn the knob (B) clockwise or counterclockwise to adjust the seat to the operators weight.

Pull up on the back rest (C) and move the cushion to one of the three positions.



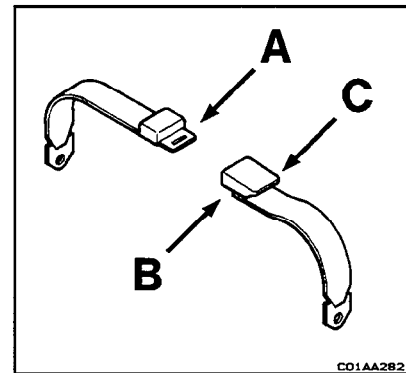
11.4.2 SEAT BELT

WARNING

Before driving the machine, adjust the seat and fasten the seat belt. Adjust the seat belt to fit snugly and low around the hips to lessen the chance and severity of injury in the event of an accident. Never wear the seat belt across the abdomen.

WARNING

Do not use bleach, color dye or solvents on the seat belt webbing which may cause a severe loss of tensile strength. This could cause the webbing to break resulting in personal injury. It is recommended that the belt be cleaned only with warm water and a mild detergent.



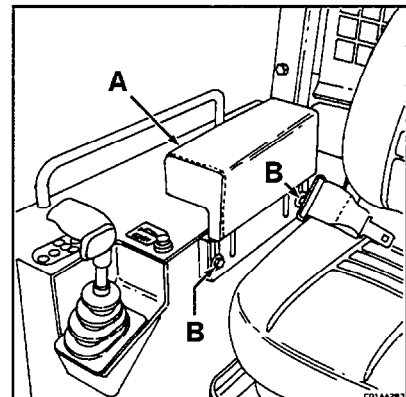
To buckle, insert the tongue portion (A) of the buckle into the locking portion (B). To release, lift the top lever plate (C) on the locking portion of the buckle and pull the tongue plate out.

Keep belts flat to avoid twisting and roping when not being used. Do not place heavy or sharp object on the belts.

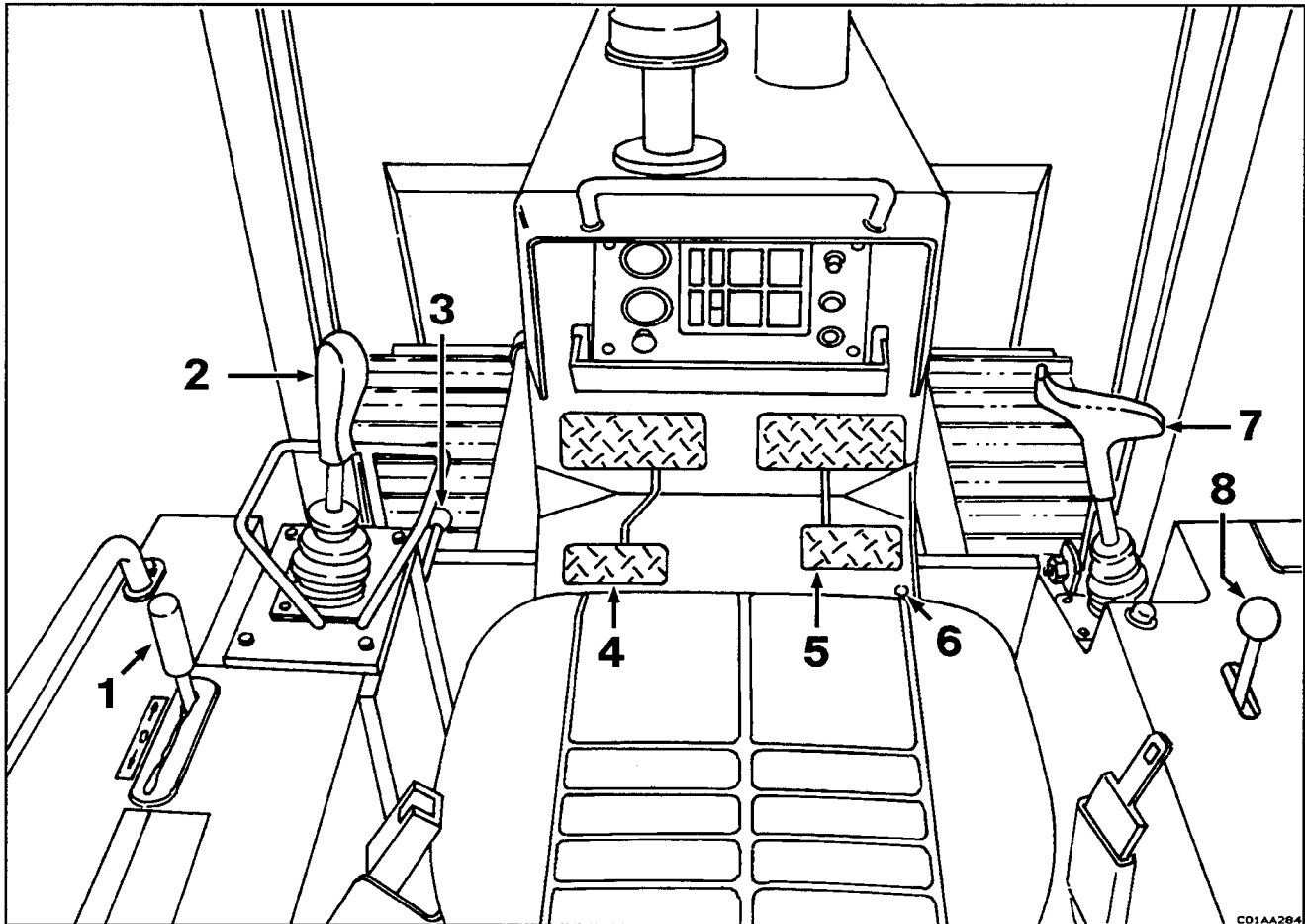
11.4.3 ARM RESTS

The arm rests may be adjusted up or down for the convenience of the operator.

To raise or lower arm rests (A), loosen the front and rear mounting bolts (B) and position to the desired height. Tighten the bolts after desired height has been obtained.



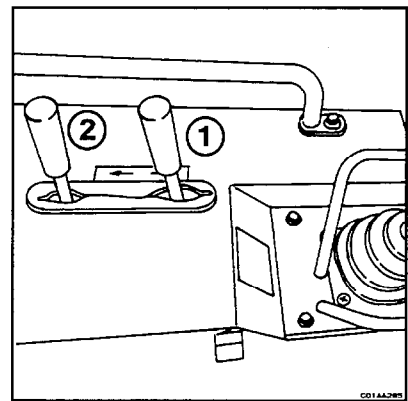
11.5 CONTROL LEVERS AND PEDALS



11.5.1 FUEL CONTROL LEVER

This lever is used to control the engine speed and output.

- ① Low idle position: Push the lever forward.
- ② High idle position: Pull the lever rearward.



11. EXPLANATION OF COMPONENTS

11.5.2 TRANSMISSION/STEERING LEVER

This lever serves three functions:

1. The lever is used to select the transmission direction and various gear ranges. Rotate the joystick to carry out gear shift operation.

- ① 1st speed: Rotate the lever to the left position.
- ② 2nd speed: Rotate the lever to the center position
- ③ 3rd speed: Rotate the lever to the right position.

REMARK

A light in the instrument panel gauge cluster will illuminate which gear range is selected.

- ④ Forward: Push the lever forward, the machine will move forward.
- ⑤ Reverse: Pull the lever rearward, the machine will move in reverse.

N Neutral: Lever centered.

REMARK

The lever is mechanically detented in the speed range and will stay in place until released by hand. The lever is hydraulically detented in the directional range only when the safety lock lever is in the up position (released) and will stay in place until released by hand.

REMARK

When the shift lever is placed in one of the reverse positions, the back up alarm will automatically sound.

2. The lever also steers the machine by controlling engine power to one track and hydraulically applying the brake on the other side.

- ⑥ Left turn: Turns the machine to the left, release the lever to apply power to both tracks.
- ⑦ Right turn: Turns the machine to the right, release the lever to apply power to both tracks.

REMARK

The farther the lever is moved in that direction, the sharper the turn.

11.5.3 SAFETY LOCK LEVER

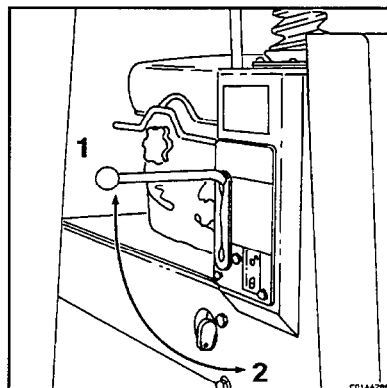
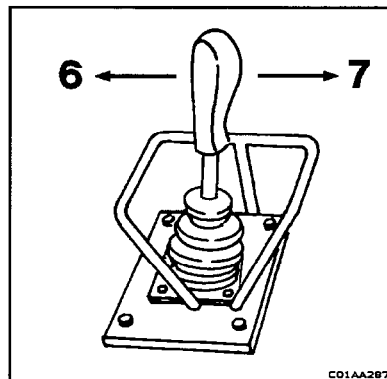
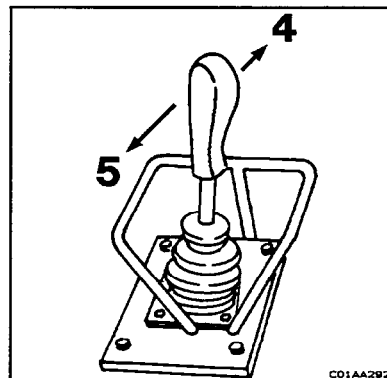
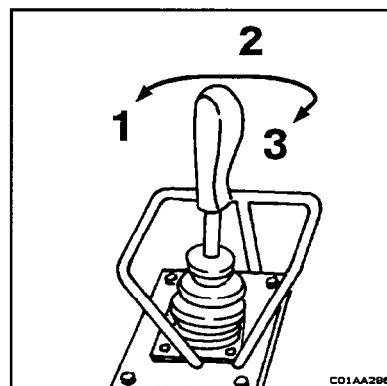
⚠ WARNING

When leaving the operators compartment, set the lever securely to the LOCK position. If the lever is not locked and is touched by mistake, this may lead to a serious accident. If the lever is not placed securely in LOCK position, the lever may not be properly locked.

This lever locks the drive train. Pull up ① to release the lever. Push down ② to apply the lever.

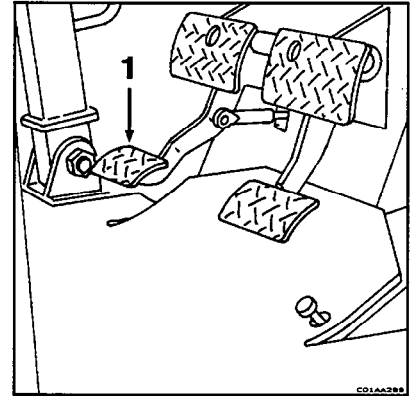
REMARK

The lever must be in the LOCK (down) position to start the engine.



11.5.4 LEFT PEDAL SECONDARY BRAKE

The left brake pedal applies the machine brake without decelerating the engine. This pedal actuates a brake valve mounted behind the dash. With the engine running and the pedal in the up position, pressure is directed to a spring extended cylinder mounted in the rear main frame. The pressure retracts the cylinder and releases the brakes. When the pedal is depressed, pressure is decreased in relation to pedal position. The decrease in pressure allows the cylinder to apply a force to the brake equalizer bar which applies the brakes. When the engine is shut down or if hydraulic transmission failure occurs, the brake will fully apply after the pedal is depressed. Once the brake pressure has been dumped the brake will stay applied until the engine is started. If the engine is not runnable a remote source of pressure must be applied to the tow port to release the brakes. See 16.4 METHODS OF TOWING MACHINE.

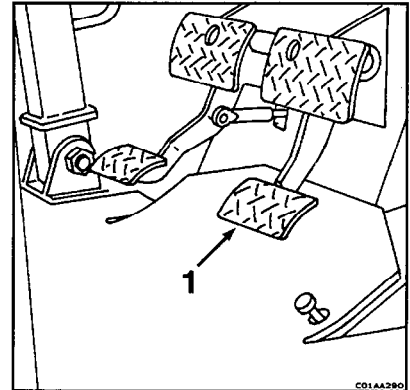


11.5.5 BRAKE AND DECELERATOR PEDAL

WARNING

Do not put your foot on this pedal unnecessarily.

This pedal ① overrides the engine speed control lever setting. Partial depression of the pedal decreases engine speed for smoother changes in machine direction and to ease the machine up to a load. Release the pedal to accelerate to the engine speed control lever setting. This pedal stops the machine when fully depressed. It also serves as a parking brake when the brake pedal lock is applied.



11.5.6 BRAKE PEDAL LOCK

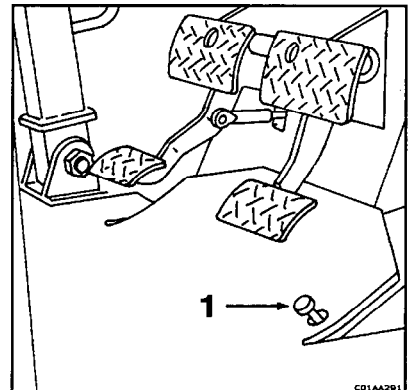
WARNING

Whenever the machine is parked, always lock the brake pedal.

This lock ① secures the right brake pedal in the applied position for parking the machine. To lock the pedal, fully depress the pedal, push down on the lock and remove your foot from the pedal. To release the brake, depress the pedal.

REMARK

Release the lock before moving the machine. The brakes could burn or be damaged if the machine is driven with them applied.

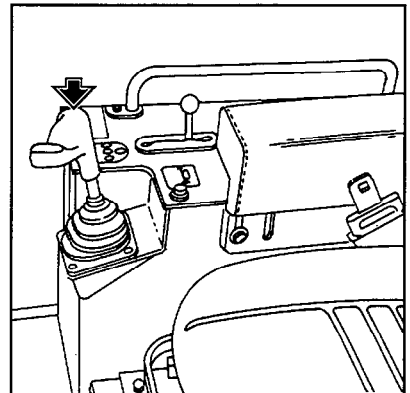
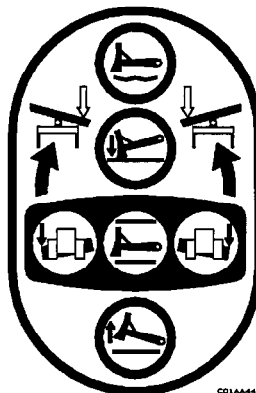


11.5.7 BLADE CONTROL LEVER

This lever controls all operation of the blade; blade raise, lower and float; right or left tilt and right and left angle.

REMARK

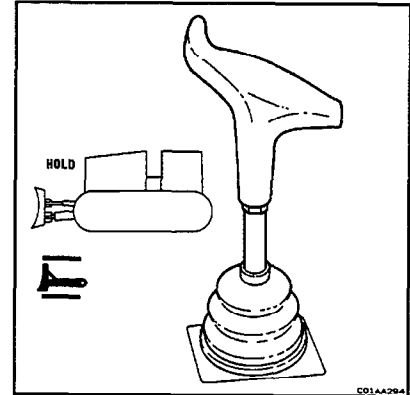
Holding the lever in any position except HOLD or FLOAT for an extended period of time after the hydraulic cylinder rod has reached the limit of its travel will produce excessive heat in the hydraulic system which may affect equipment performance.



11. EXPLANATION OF COMPONENTS

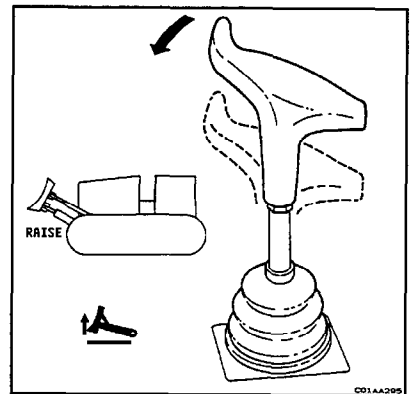
11.5.7.1 BLADE HOLD

The control lever automatically returns to this position from any position except the float position when the lever is released. The blade will remain the same position as it was when the lever was released.



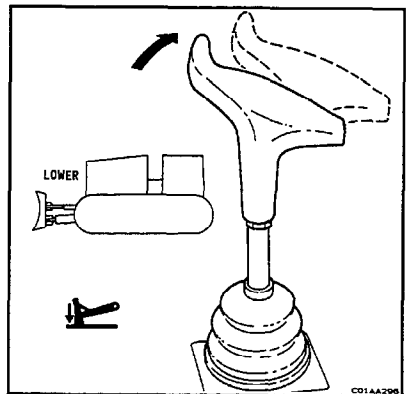
11.5.7.2 BLADE RAISE

Pull the control lever back to raise the blade. When released the lever will return to the hold position.



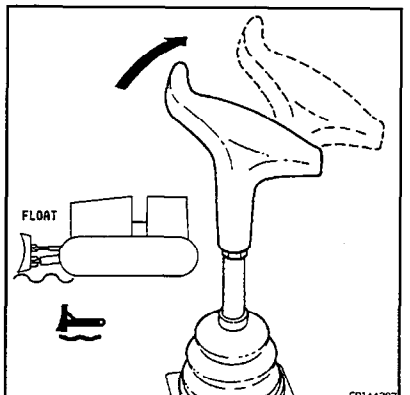
11.5.7.3 BLADE LOWER

Push the control lever forward to lower the blade. When released the lever will return to the hold position.



11.5.7.4 BLADE FLOAT

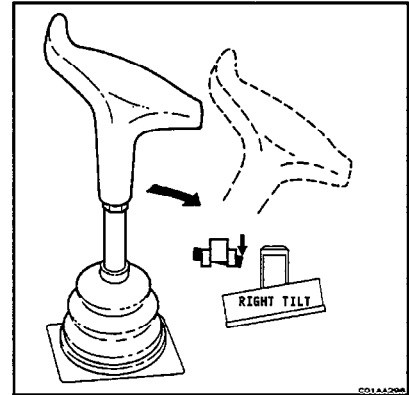
With the control lever in the float position, the blade is free to follow the contour of the ground. To place the control lever in the float position, push it all the way forward to its detented position. The lever will remain in this position until manually returned to the hold position.



11. EXPLANATION OF COMPONENTS

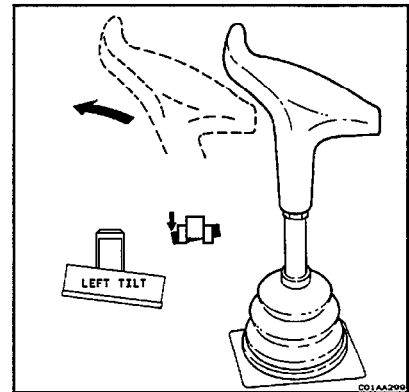
11.5.7.5 BLADE RIGHT TILT

Push the control lever to the right to lower the right hand corner of the blade. When released the lever will return to the hold position.



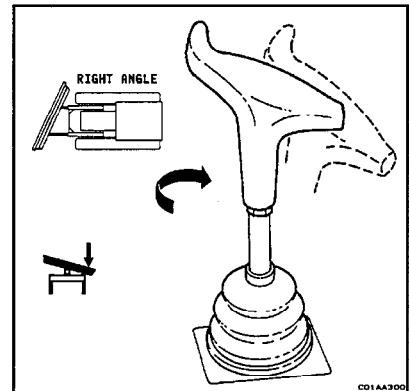
11.5.7.6 BLADE LEFT TILT

Pull the control lever to the left to lower the left hand corner of the blade. The lever will return to the hold position when released.



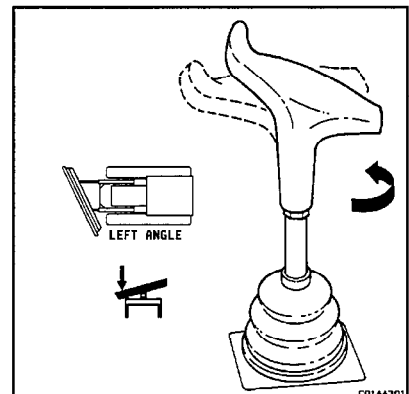
11.5.7.7 BLADE RIGHT ANGLE

Rotate the lever right to angle the blade so it will cast the dirt to the right. When released the lever will return to the hold position.



11.5.7.8 BLADE LEFT ANGLE

Rotate the lever left to angle the blade so it will cast the dirt to the left. When released the lever will return to the hold position.



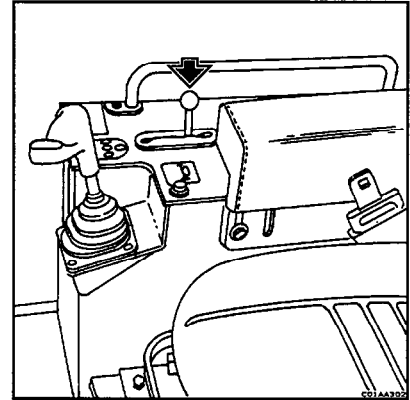
11. EXPLANATION OF COMPONENTS

11.5.8 RIPPER CONTROL LEVER

This lever controls all operation of the ripper; raise, hold and lower.

REMARK

Holding the lever in any position except HOLD for an extended period of time after the cylinder rod has reached the limit of its travel will produce excessive heat in the hydraulic system which may affect equipment performance.



11.5.8.1 LOWER

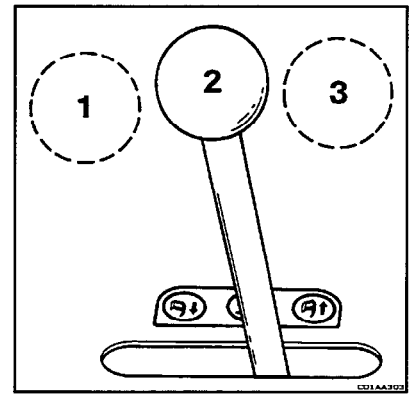
Push the control lever forward to lower the ripper. When released the lever will return to the hold position.

11.5.8.2 HOLD

The control lever will return automatically to the hold position from either the lower or raise position when released. The ripper will remain in the same position it was when the control lever was released.

11.5.8.3 RAISE

Pull the control lever back to raise the ripper. When released the lever will return to the hold position.



11.5.8.4 OPERATING TECHNIQUES

WARNING

Lower the ripper to the ground before making any adjustments or whenever the machine is to be idle for any length of time.

When starting to rip, lower the ripper slowly until the desired penetration is achieved. If the machine will not pull three shanks through the material to be ripped, the center shank must be removed, using only the two end shanks. In very hard material, it is normal practice to remove the two end shanks and use only the center shank for ripping.

Rock and shale will often rip easier in one direction than it will in another, so, where it is possible, try ripping at various angles until the best results are obtained. Ripping should be done at depths giving the greatest production without overloading the machine engine. Try to keep the area being ripped as level as possible.

Care must be exercised not to jack the rear of the machine off the ground when ripping, as this results in loss of tractive effort and increases wear on the track system of the machine. It is advisable to raise the shanks out of the ground when making turns of 15° or more. Turns of more than 15° with the shanks in the ground put undue strain on the ripper and machine and repeated practice could cause serious damage.

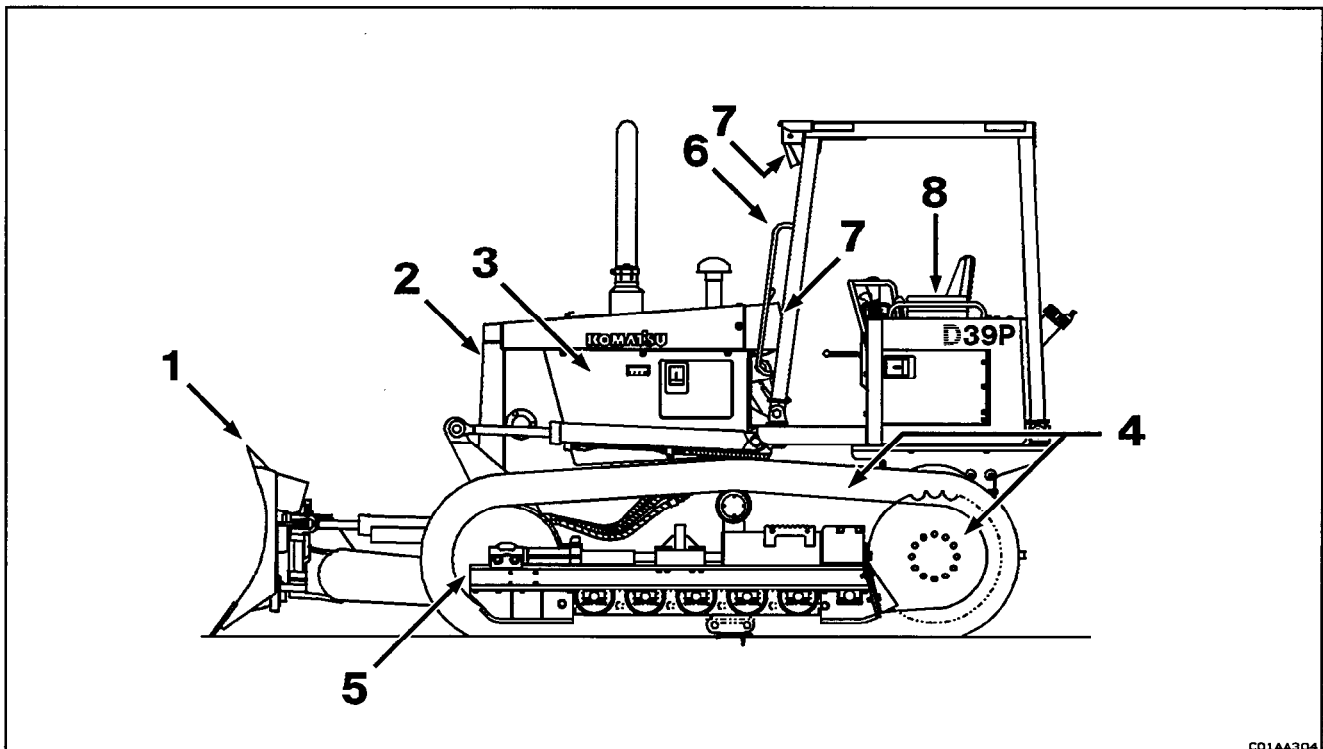
12.1 CHECKS BEFORE STARTING ENGINE

12.1.1 WALK-AROUND CHECK

 WARNING

Dirt, oil or fuel around the parts of the engine which reach high temperatures may cause fire and damage to the machine. Check carefully, and if any abnormality is found, always repair it or contact your Komatsu distributor.

Before starting the engine, look around the machine and under the machine to check for loose nut or bolts, or leakage of oil, fuel, or coolant, and check the condition of the work equipment and hydraulic system. Check also for loose wiring, play, and collection of dust at places which reach high temperatures.



12. OPERATION

12.1.1.1 CHECK FOR DAMAGE, WEAR, AND/OR PLAY IN WORK EQUIPMENT, CYLINDERS, LINKAGE, HOSES.

Check that there are no cracks, excessive wear, or play in the work equipment, cylinders, linkage, or hoses. If any abnormality is found, repair it.

12.1.1.2 REMOVE DIRT FROM AROUND ENGINE, RADIATOR.

Check that there is no dirt accumulated around the engine or radiator. If any dirt is found, remove it.

12.1.1.3 CHECK FOR LEAKAGE OF WATER OR OIL AROUND ENGINE.

Check that there is no leakage of oil from the engine or leakage of water from the cooling system. If any abnormality is found, repair it.

12.1.1.4 CHECK FOR OIL LEAKAGE FROM TORQUE CONVERTER, TRANSMISSION, REAR MAIN FRAME HOUSING, FINAL DRIVES, HYDRAULIC TANK, HOSES, JOINTS.

Check that there is no oil leakage. If any abnormality is found, repair the place where the oil is leaking.

12.1.1.5 CHECK THE UNDERCARRIAGE (TRACK, SPROCKET, IDLER, GUARD) FOR DAMAGE, WEAR, LOOSE BOLTS, OR LEAKAGE OF OIL FROM ROLLERS.

12.1.1.6 CHECK FOR DAMAGE TO HANDRAIL.

Repair any damage and tighten any loose connections.

12.1.1.7 CHECK FOR DAMAGE TO GAUGES, LAMPS ON INSTRUMENT PANEL.

Check that there is no damage to the panel, gauges and lamps. If any abnormality is found, replace the parts. Clean off any dirt on the surface.

12.1.1.8 CHECK FOR DAMAGE TO SEAT BELT AND MOUNTING AREAS.

Check that there is no abnormality in the seat belt or mounting areas. If there is any damage, replace with new parts.

12.1.2 CHECK BEFORE STARTING

12.1.2.1 CHECK AND REFILL COOLANT

1. Check the coolant level in radiator sight glass to make sure coolant is present.

WARNING

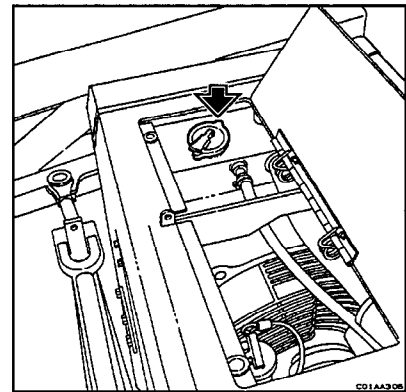
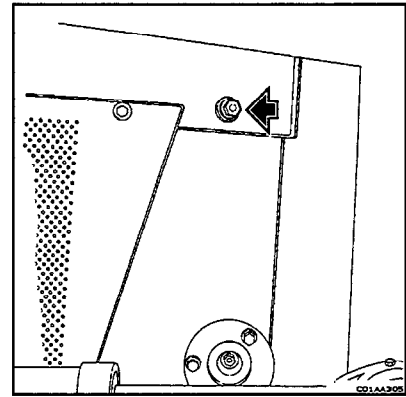
Do not remove cap while coolant is hot. Hot coolant may spout out. When removing cap, wait until the coolant temperature goes down and release radiator pressure little by little by loosening caps slowly, then remove the cap.

2. Open the hood door at the front of the machine.
3. Remove the radiator cap and check that the coolant level is visible. If level is low, add coolant until it is visible in sight gauge.

REMARK

For details of the coolant to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

4. After adding coolant, tighten the cap securely.



12.1.2.2 CHECK FUEL LEVEL

WARNING

When adding fuel, never let the fuel overflow. This may cause a fire. If spilling fuel, thoroughly clean up any spillage.

1. Check the fuel level using fuel gauge.
2. After completing work, fill the fuel tank through the filler port .

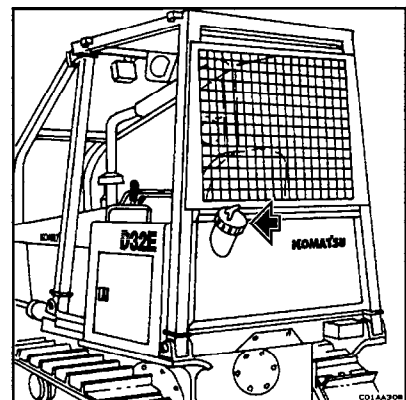
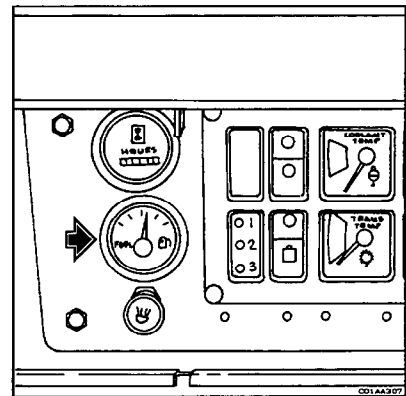
REMARK

For details of the fuel to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

3. After adding fuel, tighten the cap securely.

REMARK

Fuel capacity: 146 ℓ (38.5 gal)



12. OPERATION

12.1.2.3 CHECK ENGINE OIL LEVEL

 **WARNING**

Park the machine on level ground, stop the engine, lower all mounted equipment to the ground, apply the safety lock, apply the brake pedal lock, turn off the electrical system master switch.

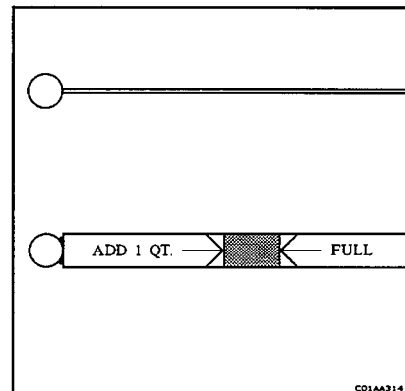
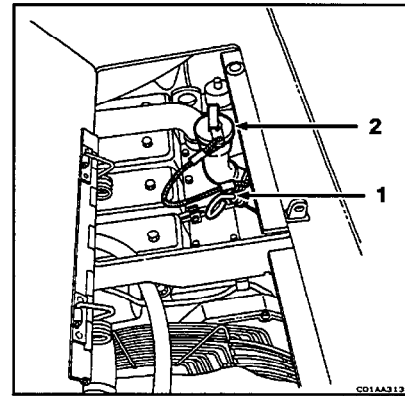
1. With the engine stopped, check the oil level. For an accurate reading wait for the oil to drain into the crankcase pan.
2. Open hood access door. Remove the oil level gauge and wipe it clean. Reinsert the gauge completely.
3. Remove the gauge and check the oil level. If the level is at or below the ADD mark, add oil through the filler opening (2) to bring the level up to the FULL mark on the gauge.

REMARK

For details of the oil to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

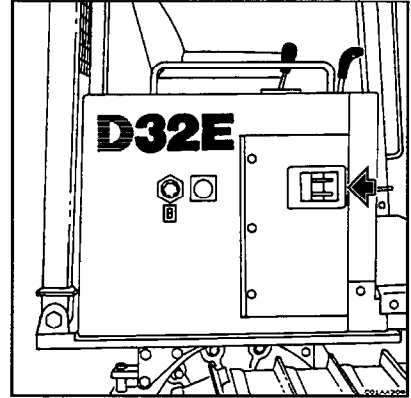
REMARK

Never run the engine if the level of the oil is at or below the ADD mark on the oil level gauge.

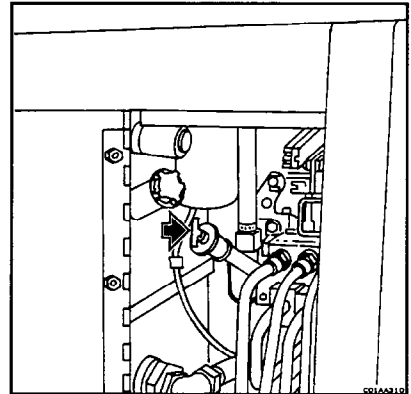


12.1.2.4 CHECK OIL LEVEL IN DRIVE TRAIN, ADD OIL

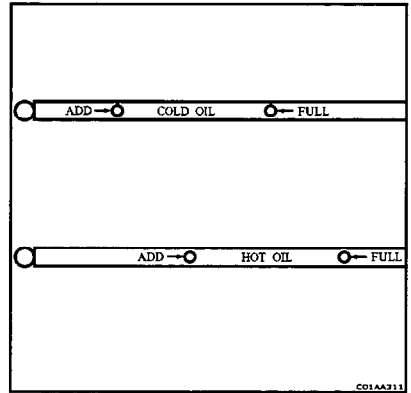
1. Open the right side door at the hydraulic reservoir.



2. Unscrew the T handle of the oil level gauge, remove the gauge and wipe it clean.



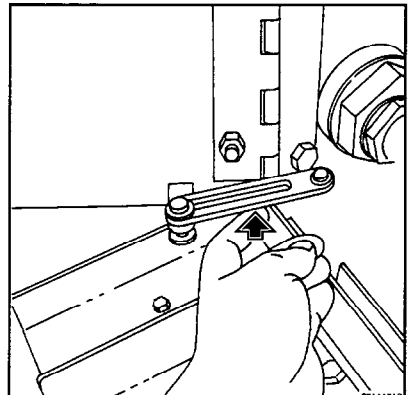
3. Insert the gauge fully into the filler sleeve. Do not tighten. Remove the gauge and check the lubricant level. If necessary, add oil through the filler to bring the level up the FULL mark on the gauge. Reinstall and secure the gauge.



REMARK

For details of the oil to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

4. Lift up on lock lever and close door.



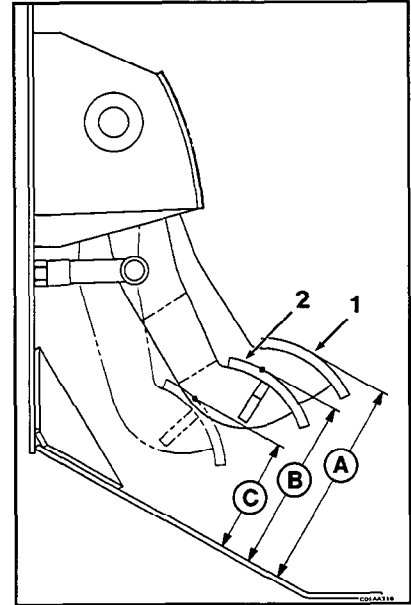
12. OPERATION

12.1.2.5 CHECK BRAKE AND DECELERATOR PEDAL TRAVEL

1. Measure the pedal (1) free height (A) from the floor plate; 137 mm (5.4 in).
2. When this value exceeds this amount, or the brake fails to work, refer to your Komatsu distributor.

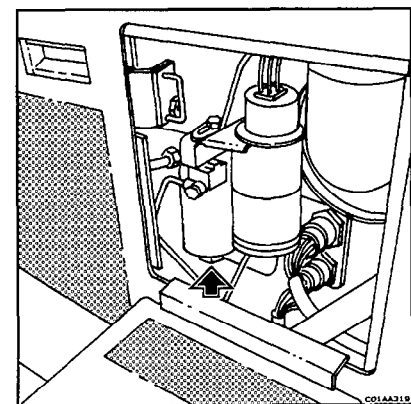
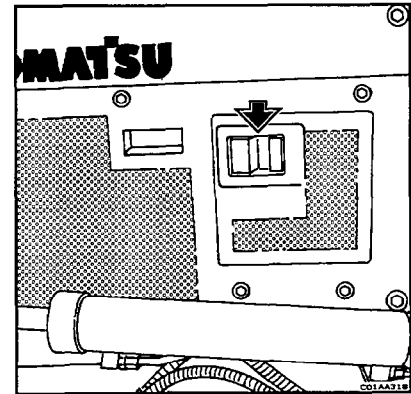
12.1.2.6 CHECK SECONDARY BRAKE PEDAL TRAVEL

1. Depress secondary brake pedal (2) all the way until it stops.
2. Measure the pedal travel from fully depressed position (C) to the fully released position (B); 38 mm (1.5 in).
3. When this value exceeds this amount, or the brake fails to work, refer to your Komatsu distributor.



12.1.2.7 CHECK FUEL FILTER WATER DRAIN, DRAIN

1. Open access door at left engine side sheet.
2. Open the valve and drain water and sediment from the filter until clean diesel fuel appears. Close the valve and access door.

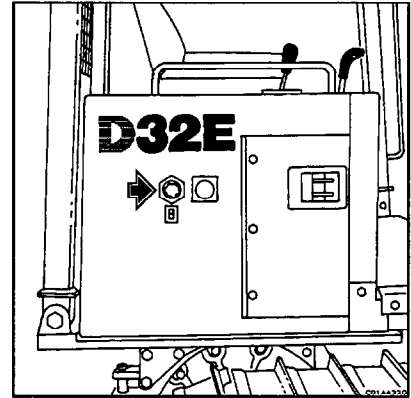


12.1.2.8 CHECK OIL LEVEL IN HYDRAULIC TANK, ADD OIL

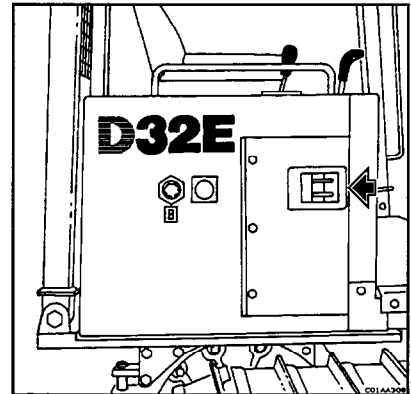
 **WARNING**

When removing the oil filler cap, oil may spurt out, so stop the engine and wait for the oil temperature to go down then turn the cap slowly to release the internal pressure before removing the cap.

1. Check the hydraulic oil level in the tank at the sight gauge. The proper level is when cold; At bottom of sight gauge.
when hot; At center of sight gauge.
Add oil as required.



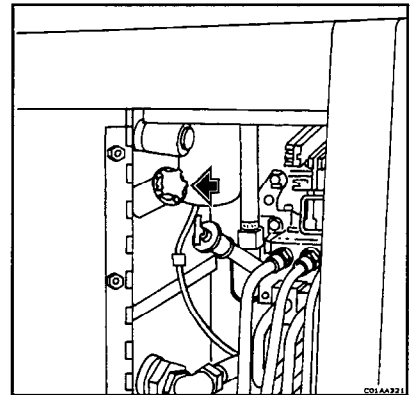
2. Open the right side door at the hydraulic reservoir.



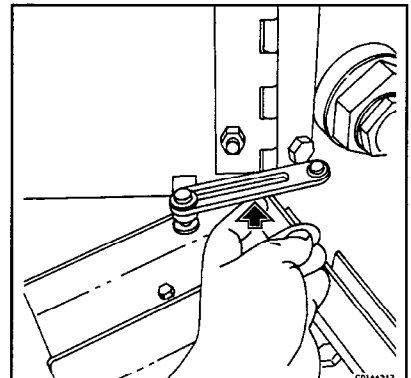
3. Remove the filler cap and add oil to the proper level. Install filler cap.

REMARK

For details of the oil to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



4. Lift up on lock lever and close door.



12. OPERATION

12.1.2.9 CHECK ELECTRICAL WIRING

 **WARNING**

If a circuit breaker opens frequently, or there are traces of short-circuiting in the electric wiring, always locate and repair the cause.

Check for damage of the circuit breakers and any sign of disconnection or short circuit in the electric wiring. Check also for loose terminals and tighten any loose parts. Check the following points carefully.

- ◆ Battery
- ◆ Starting Motor
- ◆ Alternator

Please contact your Komatsu distributor for investigation and correction of the cause.

 **WARNING**

Accumulation of flammable material (dead leaves, twigs, grass, etc.) around the battery may cause fire, so always check and remove such material.

When performing walk around checks or checks before starting, always check if there is any accumulation of flammable material around the battery, and remove such flammable material.

12.1.3 ADJUST OPERATORS SEAT

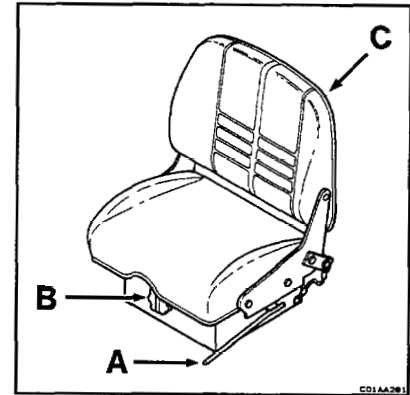
 **WARNING**

- ◆ **Adjust the seat position at the beginning of each shift or when operators change.**
- ◆ **Adjust the seat so that the brake pedal can be depressed all the way with the operator's back against the backrest.**

Pull lever (A), and slide the seat back or forth to any one of five positions and release the lever. Be sure the seat engages the slide rail notch.

Turn the knob (B) clockwise or counterclockwise to adjust the seat to the operators weight.

Pull up on the back rest (C) and move the cushion to one of the three positions.



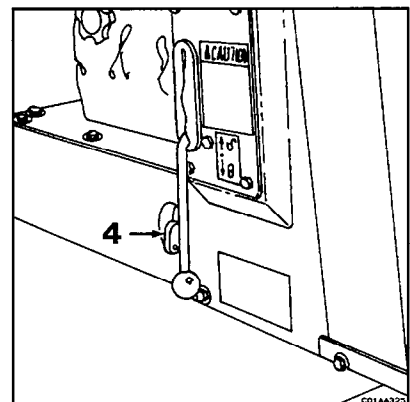
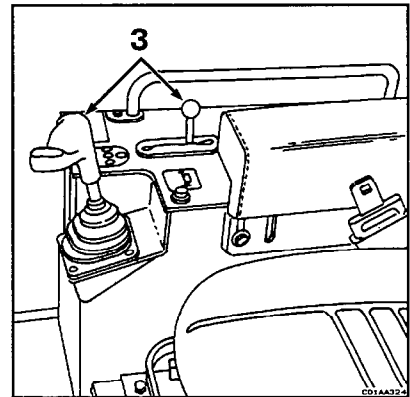
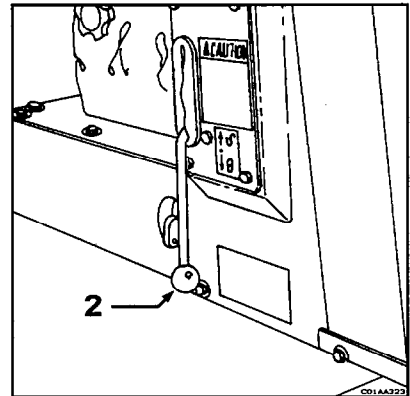
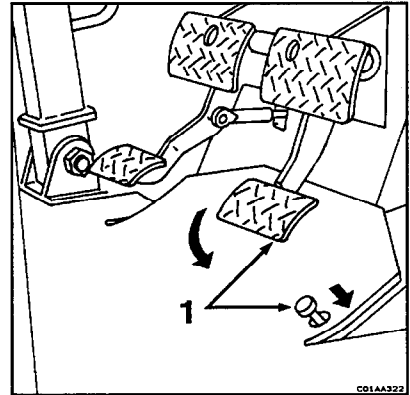
12. OPERATION

12.1.4 OPERATIONS AND CHECKS BEFORE STARTING ENGINE

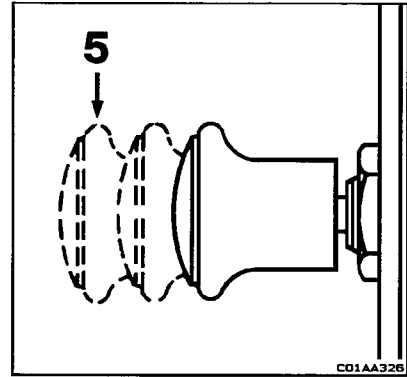
⚠ WARNING

If the control levers are touched by accident, the work equipment or the machine may move suddenly. When leaving the operator's compartment, always set the safety lever securely to the LOCK position.

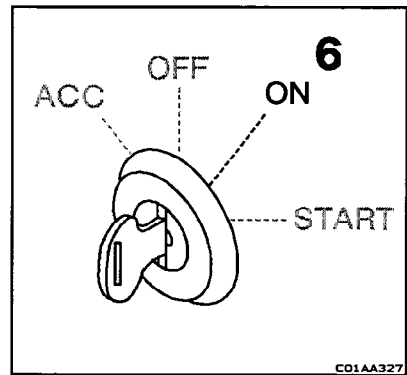
1. Check that the brake pedal is applied with the lock.
2. Check that the safety lock lever is engaged (down position).
3. Check that the mounted equipment is lowered on the ground or properly blocked and the blade control lever is in the hold position.
4. Turn the master disconnect switch to the on position (clockwise).



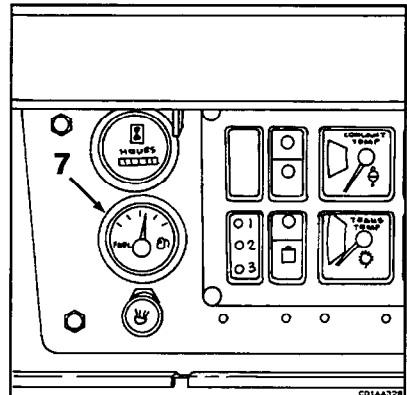
5. Pull light switch out to the furthest position. Check that the front and rear work lights are on and the instrument panel gauges are illuminated.



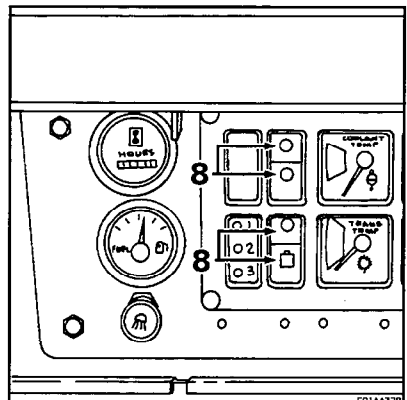
6. Insert the key in the starting switch and turn to the ON position.



7. Check the fuel level on the fuel gauge.

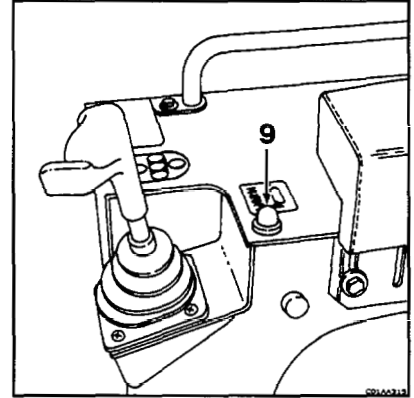


8. Check each warning light for illumination.



12. OPERATION

9. Press the horn switch and check that the horn sounds.



12.2 STARTING ENGINE

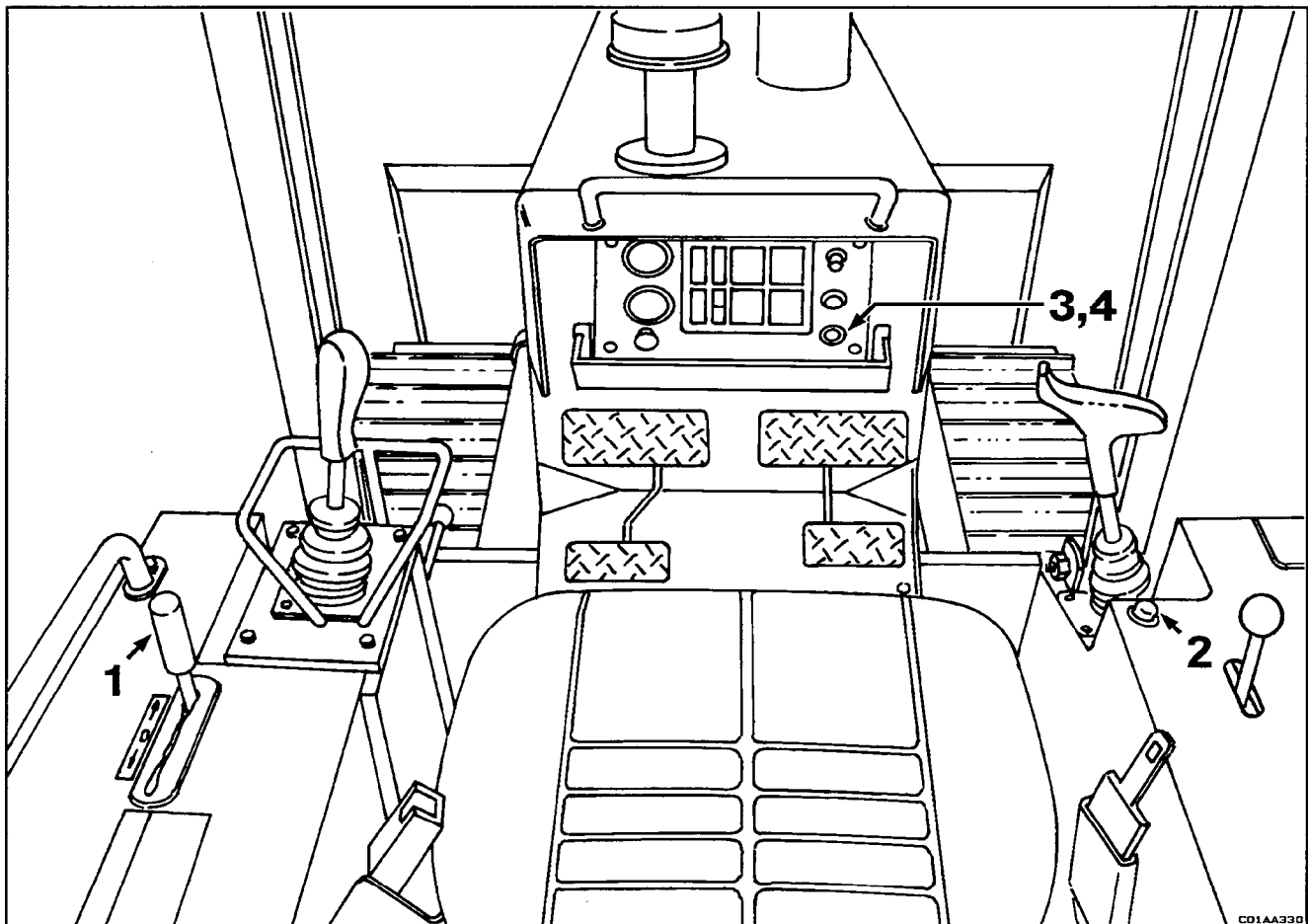
REMARK

This engine cannot be started by towing, pushing or coasting the machine.

WARNING

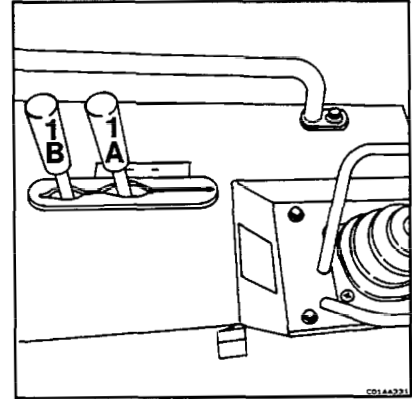
- ◆ Before entering the operator's area walk completely around the machine and clear the area of personnel and obstructions.
- ◆ Understand all control functions before starting the engine. Sound the horn. Make sure the operators seat is adjusted properly and fasten the safety seat belt.
- ◆ Never start the engine indoors unless proper exhaust ventilation is provided to remove deadly exhaust gases. Once the engine is running, move the machine outdoors as soon as possible. Exhaust gases are hazardous and can cause unconsciousness and death.
- ◆ Read all warning product graphics before starting, operating, maintaining, or repairing the machine.
- ◆ Do not jump on or off the machine. Keep two hands and one foot, or two feet and one hand, in contact with the steps and handholds at all times. Place objects on machine from ground level before climbing on. Always face the machine when climbing on or off the reduce the chances of slipping and injury.

12.2.1 NORMAL STARTING

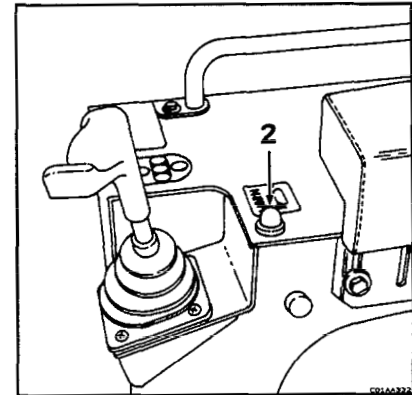


12. OPERATION

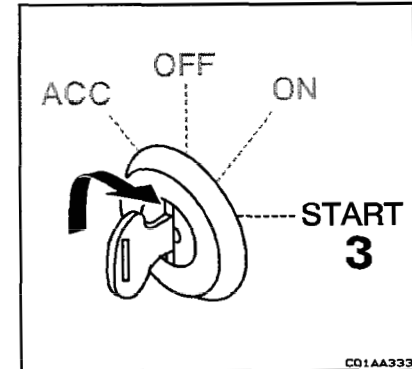
1. Move the fuel control lever to the ½ speed position (A) (mid range) for temperatures above 10°C (50°F). Move the engine speed control lever to the full speed position (B) for temperatures below 10°C (50°F).



2. Sound the horn to clear all personal from the immediate area.



3. Turn the key of starting switch to the START position and release the key the instant the engine starts.



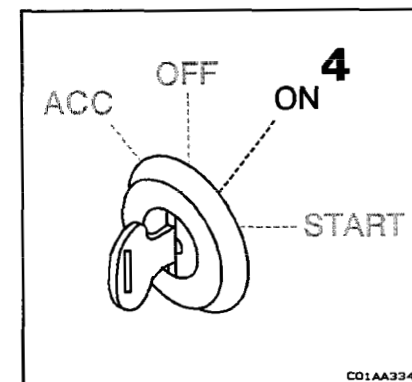
4. The key will automatically return to the ON position.

REMARK

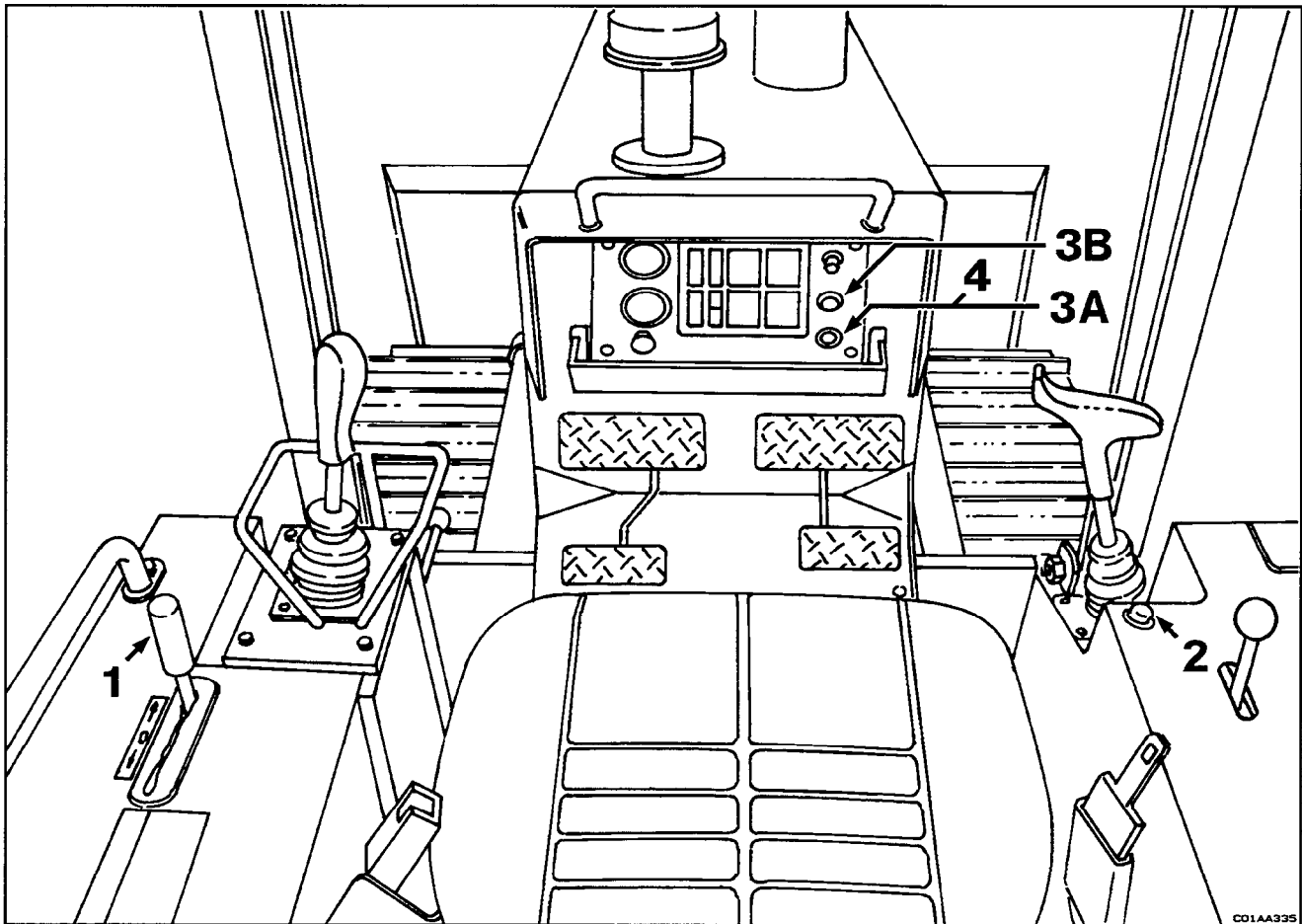
This switch incorporates a restart protection feature to prevent engagement of the starter motor while the engine is running. Once the switch has been returned to the ON position, the key must be moved to the OFF position before it can be moved again to the START position.

REMARK

To prevent damage to the starter motor and avoid low battery output, do not continuously crank the engine for more than 30 second intervals. Allow at least 2 minute recovery period between cranking.



12.2.2 COLD WEATHER STARTING



⚠ WARNING

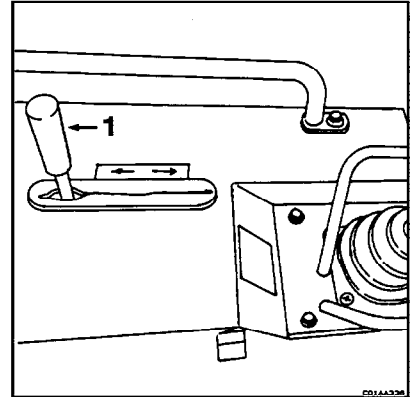
- ◆ Ether starting fluid is highly flammable. Follow the precautions printed on the ether cylinder. An explosion can result if sparks or flame contact the ether in the starting fluid cylinder or if you store the cylinder in an area with the temperature above 49°C (120°F). Observe the following precautions.
- ◆ Do not use the ether injector when the air temperature is above freezing. Do not smoke when using ether starting fluid. Do not store fluid containers in the operator's compartment. Store the container in a cold, well ventilated place. Keep the fluid cylinder out of reach of children. Do not breathe the hazardous ether vapor. Do not let ether contact your skin, because it can cause frostbite. Never puncture the fluid container or put it into a fire. Dispose of empty container properly. For your safety, remove the ether container when welding, grinding, or using a torch on the machine. Follow the correct method for starting the engine.
- ◆ Before any starting attempt, check the ether cylinder to insure that a supply of starting fluid is available under pressure and the system is in working condition. Ether injection is controlled by a button type switch on the instrument panel.

REMARK

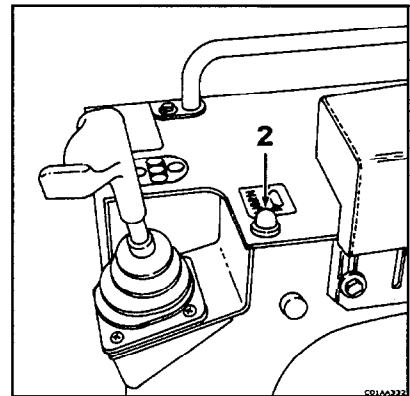
Ether injector is to be used only for starting. Misuse of ether injector while engine is running can result in serious damage to engine. The ether injector should be used only when the air temperature is below freezing.

12. OPERATION

1. Move the fuel control lever to the full speed position



2. Sound the horn to clear all personal from the immediate area.

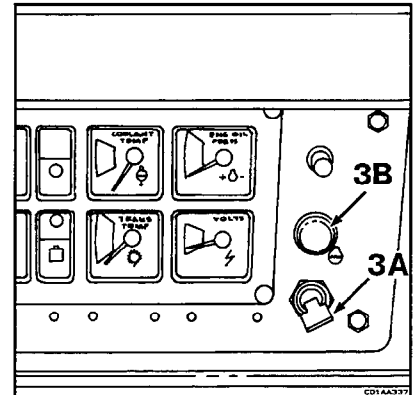


3. Turn the key (A) of starting switch to the START position and press ether injector button (B) simultaneously. Allow one to two seconds for chamber in valve to fill; then, with engine cranking, release ether injector button to release a measured shot of starting fluid into the engine. If temperature is below -18°C (0°F), additional ether may be required. If engine does not fire with a maximum of 4 injections, determine cause and correct before again attempting a start.

REMARK

If the engine will not start or runs roughly, it may be due to the following:

- a. Air may be in the fuel system.
- b. Ether injector is not functioning correctly.



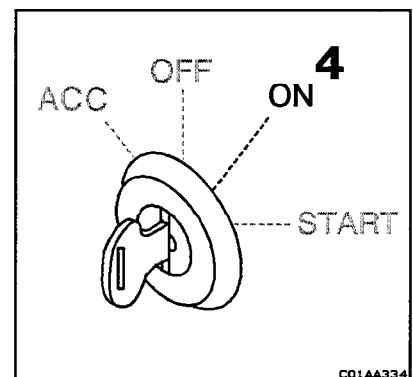
4. Release the key the instant the engine starts. The key will automatically return to the ON position.

REMARK

This switch incorporates a restart protection feature to prevent engagement of the starter motor while the engine is running. Once the switch has been returned to the ON position, the key must be moved to the OFF position before it can be moved again to the START position.

REMARK

To prevent damage to the starter motor and avoid low battery output, do not continuously crank the engine for more than 30 second intervals. Allow at least 2 minute recovery period between cranking.

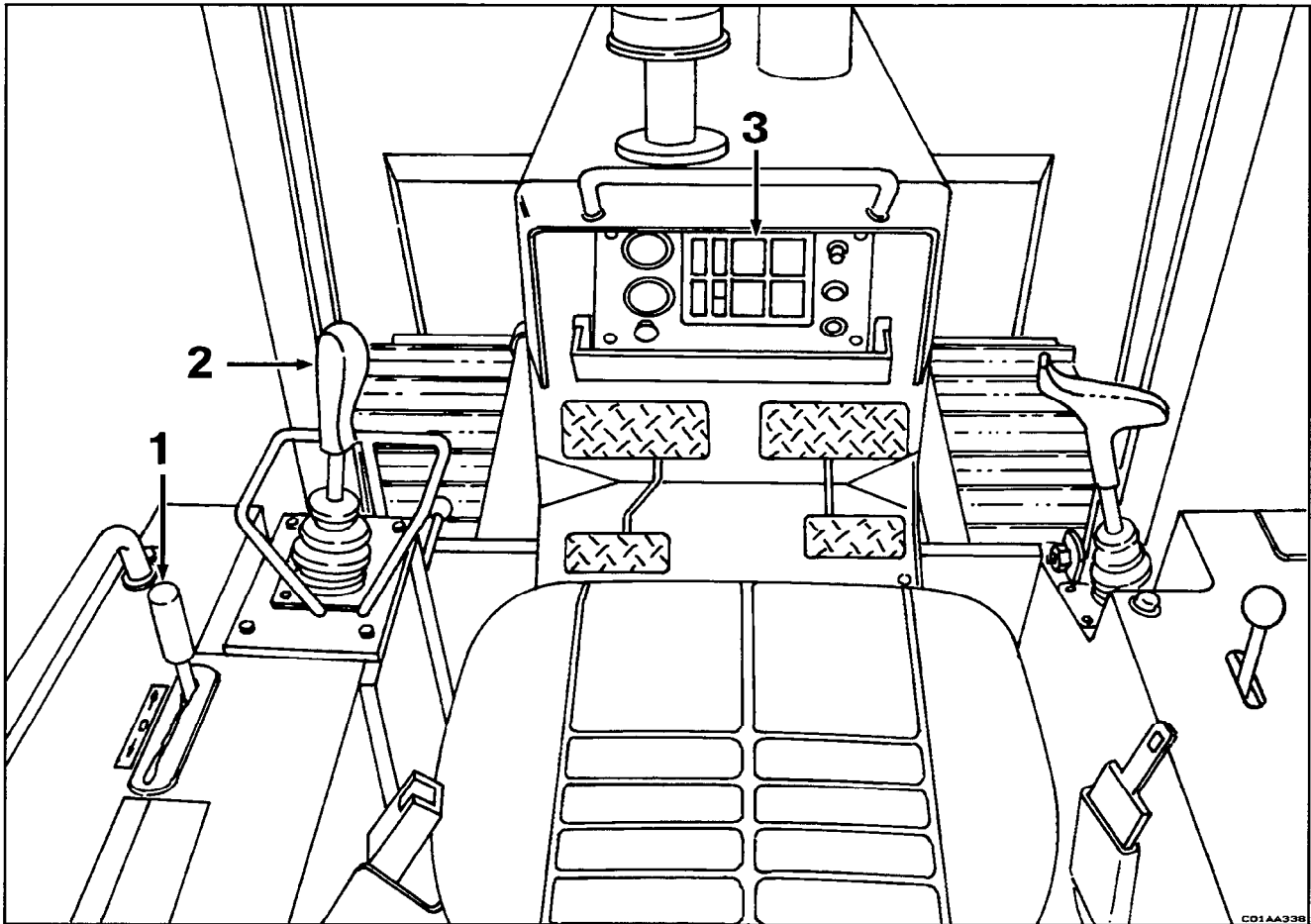


12.3 OPERATIONS AND CHECKS AFTER ENGINE STARTS

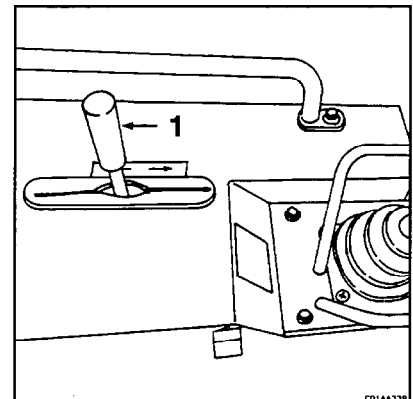
After starting the engine, do not immediately start operations. First, carry out the following operations and checks.

NOTICE

Avoid abrupt acceleration until warm up run is completed. Do not run the engine at low idling or high idling for more than 20 minutes. If it is necessary to run the engine at idling, apply a load or run at a medium speed from time to time.

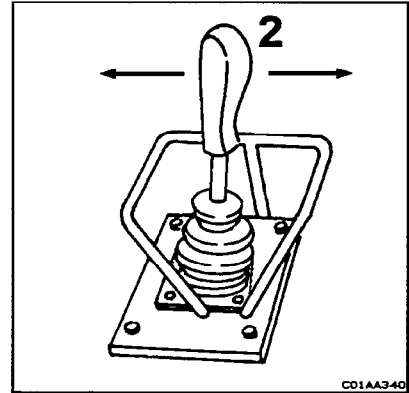


1. Pull fuel control lever to the center position between LOW IDLING and HIGH IDLING and run the engine at medium speed for about 5 minutes with no load.

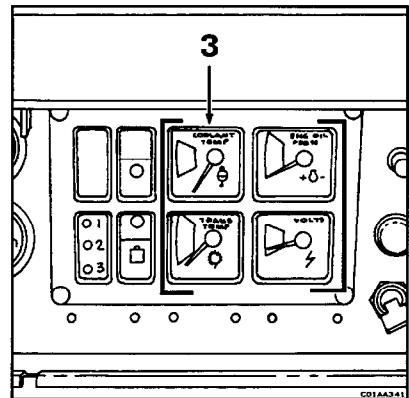


12. OPERATION

2. When starting in cold weather, operate the transmission/steering lever as follows. Move the lever within the N (neutral) band range. Move the lever fully in left direction and hold it for 5 seconds, then move the lever fully in right direction and hold it for 5 seconds. Repeat this operation in each direction in turn for 5 minutes with engine running under no load.



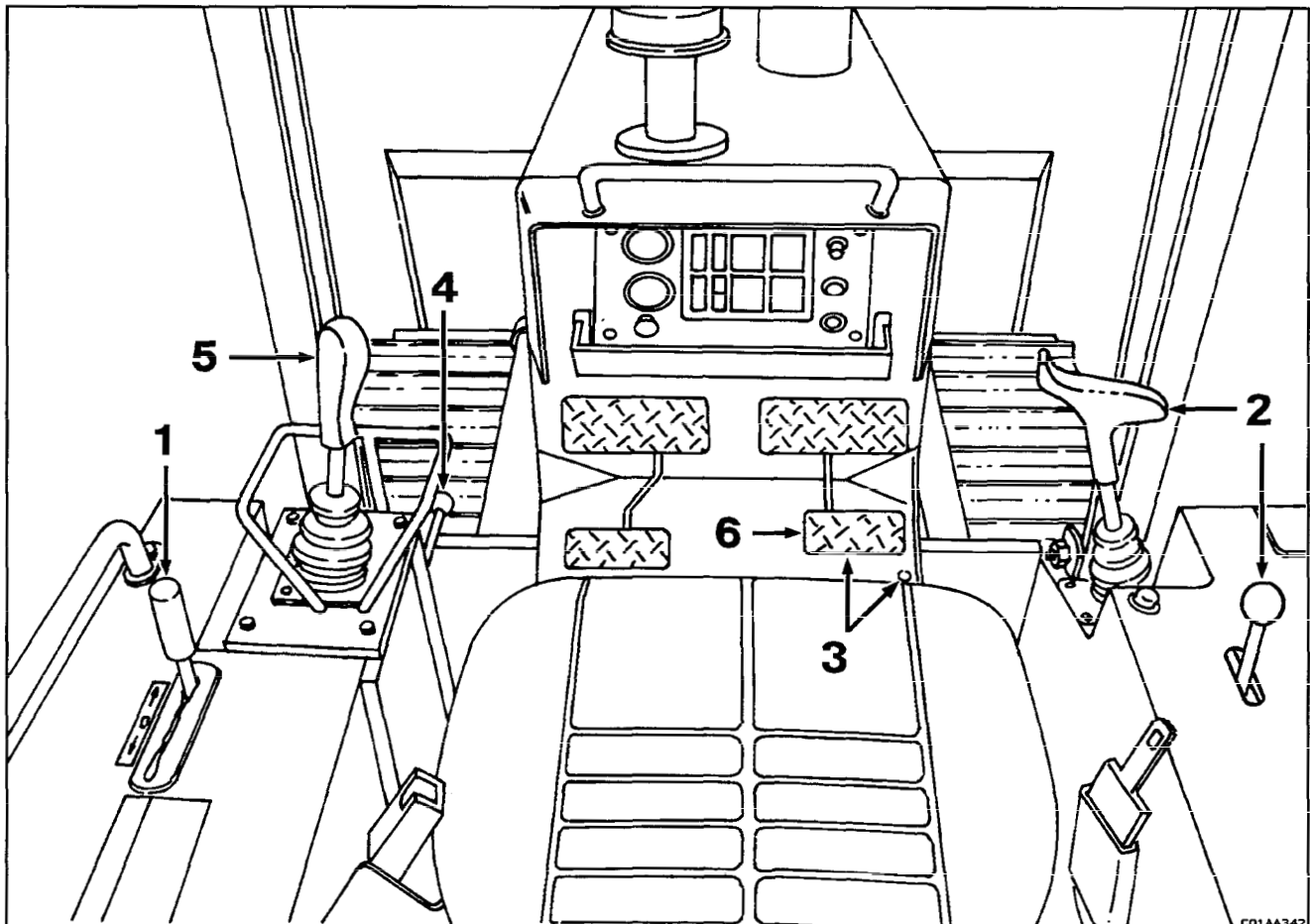
3. After warm up run is completed, check gauges, warning lamps and charge lamp for proper operation. If any abnormality is found, repair it. Continue to run the engine at light load until engine coolant temperature gauge indicator falls within the green range.
4. Check that there is no abnormal exhaust gas color, noise, or vibration. If any abnormality is found, repair it.



12.4 MOVING MACHINE

⚠ WARNING

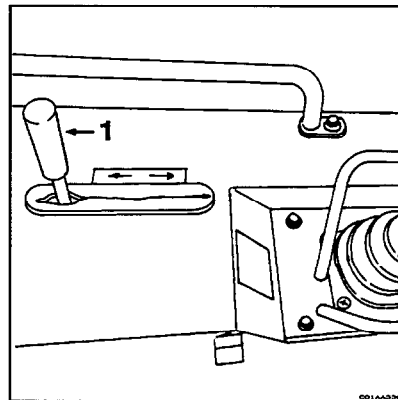
- ◆ When moving off, check that the area around the machine is safe, and sound the horn before moving. Clear all personnel from the machine and the area. Clear all obstacles from the path of the machine. Use extreme care when reversing the machine. Note there is a blind spot behind the machine.
- ◆ When starting on slopes, always keep the brake pedal depressed even after releasing brake lock lever.
- ◆ When starting the machine on a steep uphill grade, run the engine at full throttle and rotate gear shift lever into 1st and move transmission/steering lever to the F (forward) or R (reverse) position with brake pedal depressed. When the machine has started slowly (or track shoes are slipping), propel the machine by slowly releasing brake pedal.



C01AA342

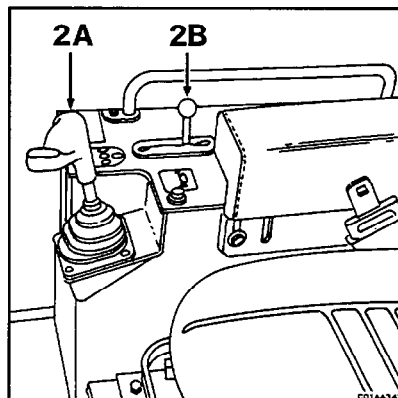
12. OPERATION

1. Pull the fuel control lever to the high idle position.

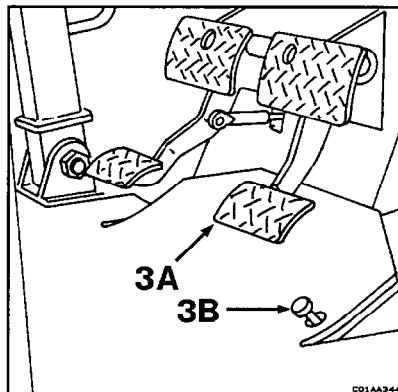


2. Pull the blade control lever (A) rearward to raise the blade 360 to 508 mm (15 to 20 in) off the ground.

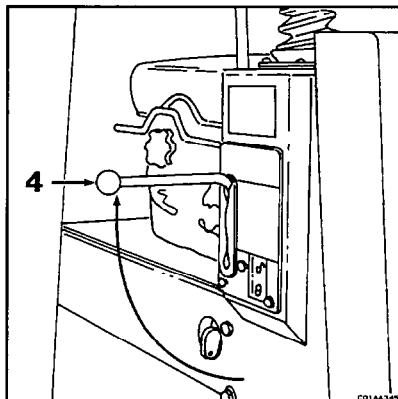
If equipped, pull the ripper control lever (B) rearward to raise the ripper 360 to 508 mm (15 to 20 in) off the ground.



3. Depress the brake and decelerator pedal (A) and this will release the brake lock (B).

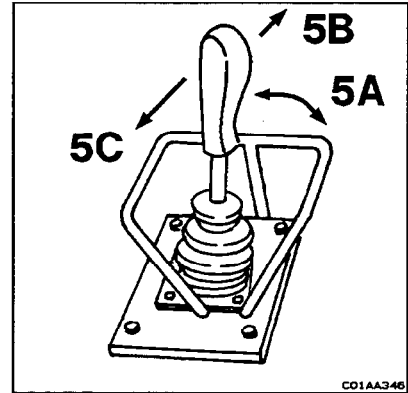


4. Move the safety lock lever to up (unlock) position.

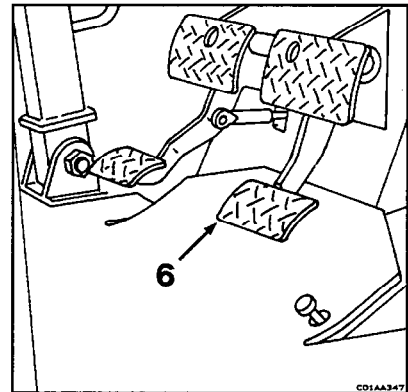


5. Rotate the transmission/steering lever (A) to the desired position; 1st, 2nd or 3rd. A light in the instrument panel cluster will inform you as to what gear range has been selected. The lever is mechanically detented at which ever gear range selected.

Move the lever to either the Forward (B) or Reverse (C) position. The lever is hydraulically detented whichever position is selected.

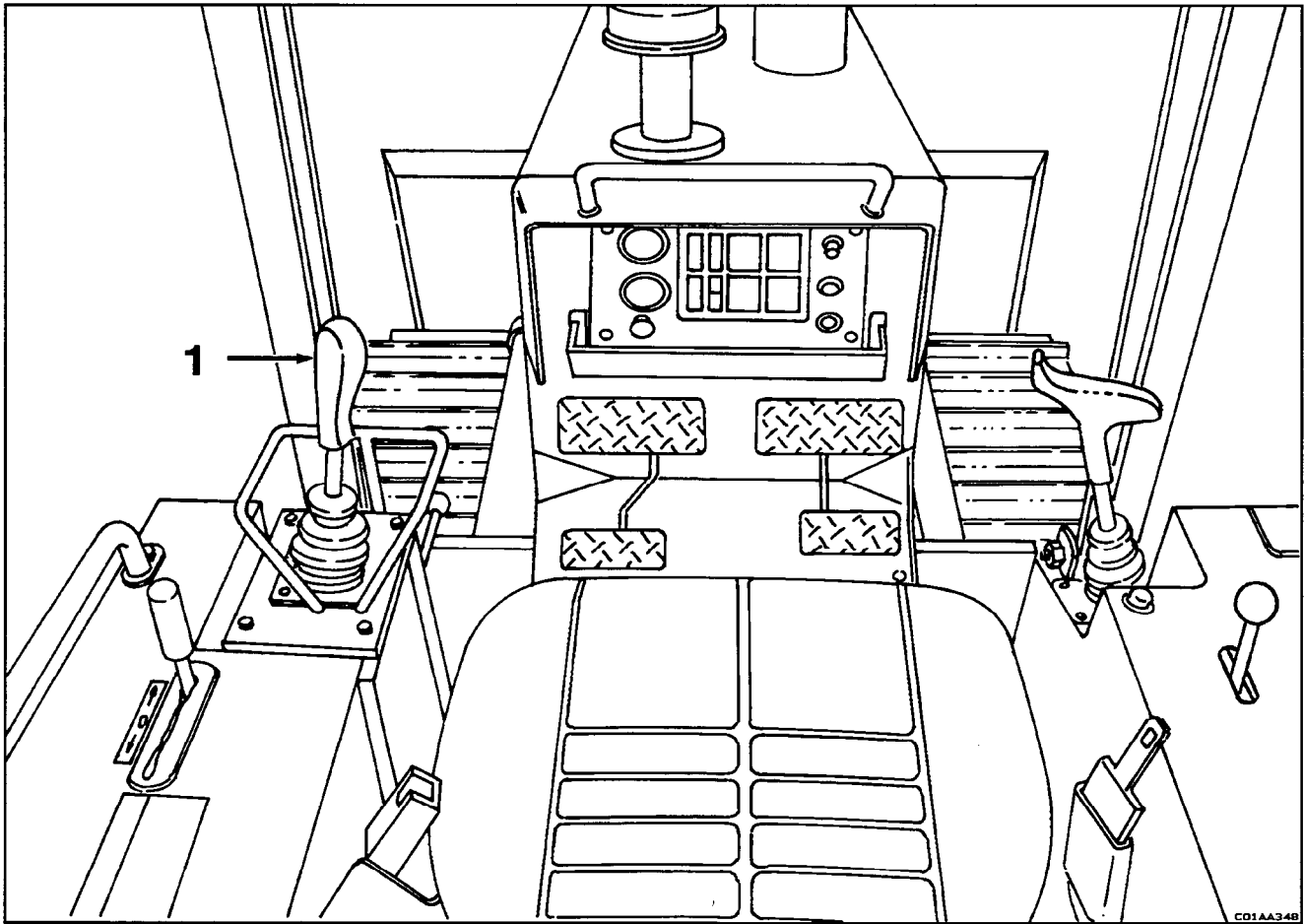


6. Release the brake pedal and the machine will start to move.

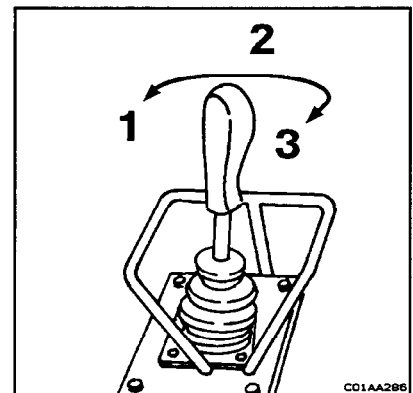


12. OPERATION

12.5 SHIFTING GEAR



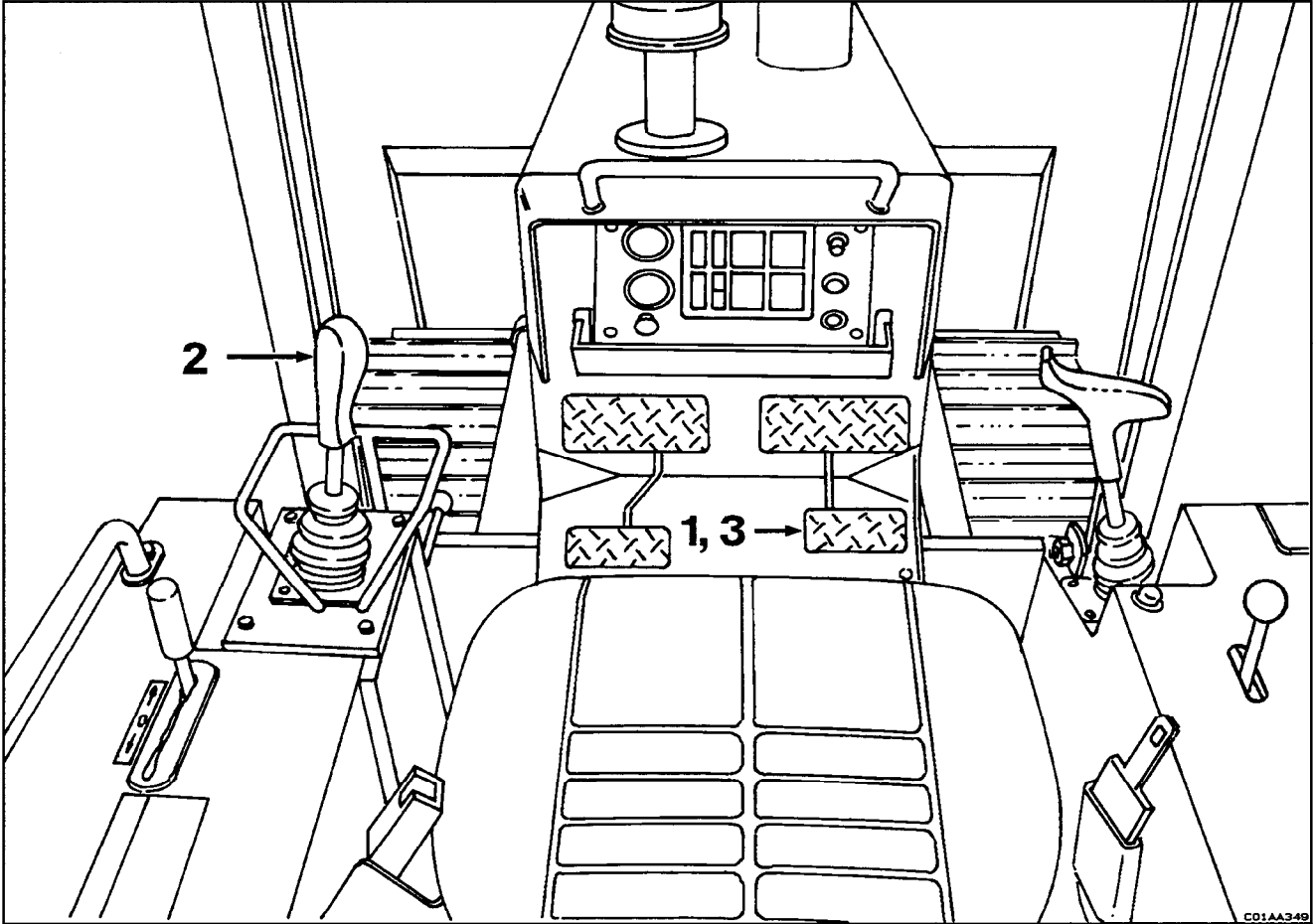
1. There is no need to stop the machine to shift gear. Rotate the transmission/steering lever to the desired position. A light in the instrument panel cluster will inform you as to what gear range has been selected.



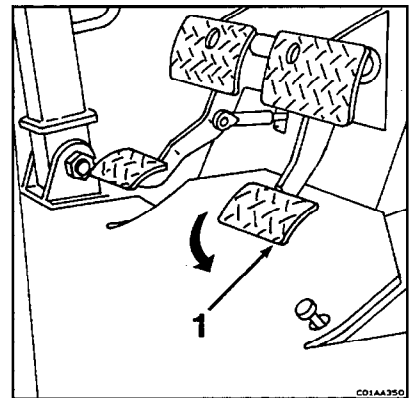
12.6 SHIFTING BETWEEN FORWARD AND REVERSE

 CAUTION

Forward reverse shifting should be made after reduction of machine speed for safety purposes and preventing shock to the machine

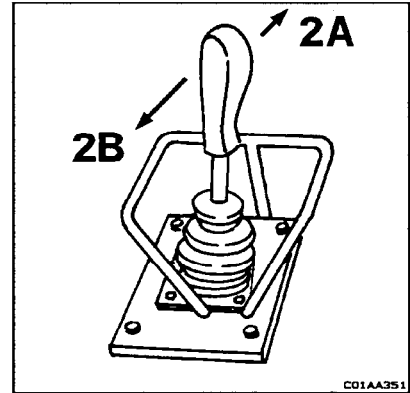


1. Depress the brake and decelerator pedal to lower the engine speed.

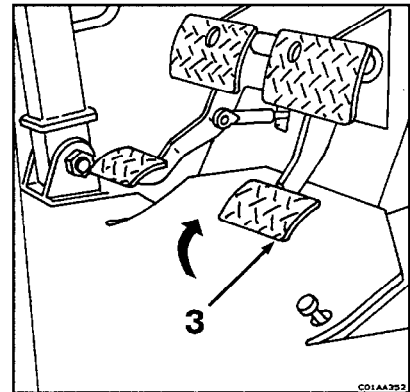


12. OPERATION

2. Move the transmission/steering lever Forward (A) or Reverse (B) position. The lever is hydraulically detented whichever position is selected.



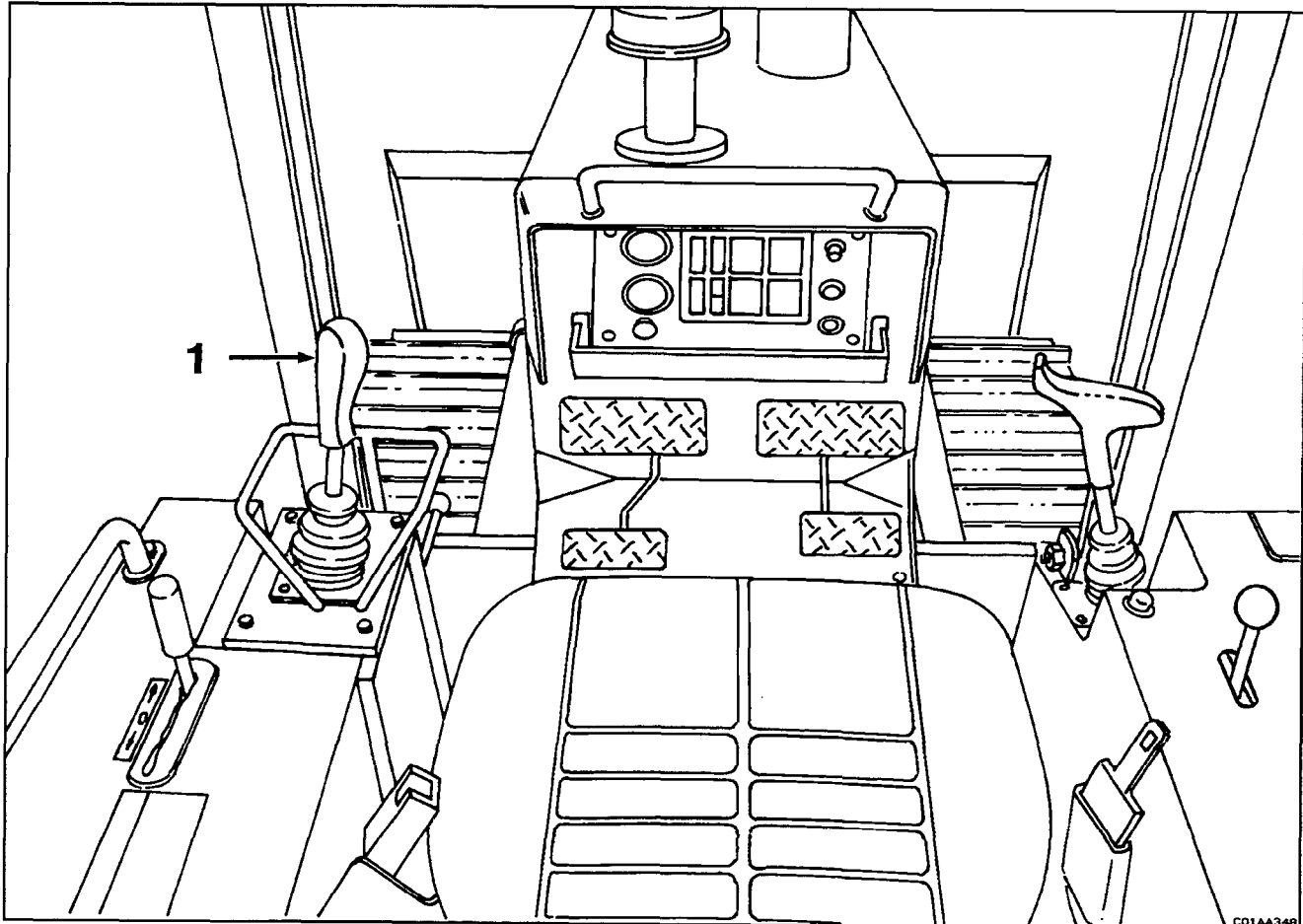
3. Release the brake and decelerator pedal.



12.7 STEERING MACHINE

 **WARNING**

- ◆ Avoid as much as possible turning the machine on a slope. The machine will tend to slip sideways. Particular care should be taken on soft or clay land.
- ◆ Never make a pivot turn at high speed.



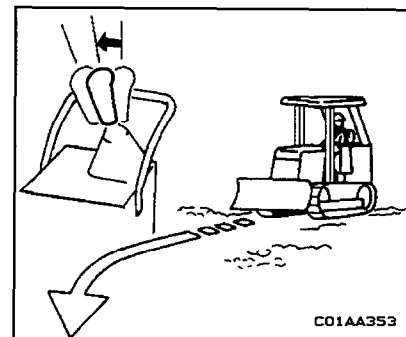
C01AA346

12.7.1 NORMAL TURNING

1. To turn the machine while traveling, incline the transmission/steering lever in the direction to turn.
- ◆ **To make a gradual left turn;** If the transmission/steering lever is moved partially to the left, the steering clutch is disengaged and the machine turns gradually to the left.

REMARK

To make a gradual right turn, move the transmission/steering lever partially to the right.



C01AA353

12. OPERATION

Using the lever guide for fine control.

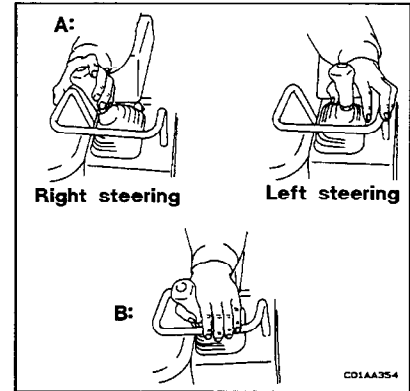
If you use the lever guide, it is easier to make fine adjustments in the steering direction.

There are the following two methods of using the lever guide.

A: Hook your fingers or thumb over the left or right guides, and operate the steering with a light touch.

B: Keep your wrist fixed and run all your fingers along the front of the guide to operate the steering.

Select the method which you find best matches the frequency and ease of use.

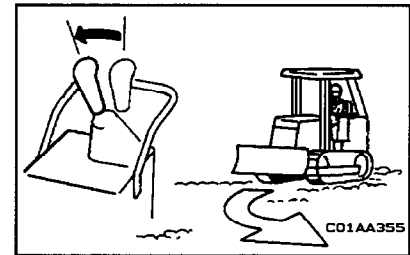


◆ To make a pivot left turn

If the transmission/steering lever is moved fully to the left, the steering clutch is disengaged and the steering brake is applied, so the machine will carry out a pivot turn to the left.

REMARK

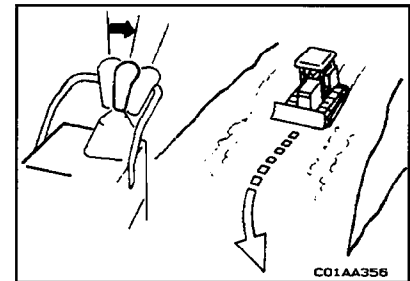
To make a pivot right turn, move the transmission/steering lever fully to the right.



12.7.2 TURNING WHILE DESCENDING A SLOPE

⚠ WARNING

When descending such a sharp slope that the machine will go down of its own weight or when going down a slope with a scraper or the like, you should exercise great care. The machine will turn to the opposite side to the direction of the moved lever.



◆ To make a gradual left turn

If the transmission/steering lever is moved partially to the right, the steering clutch is disengaged and the machine turns gradually to the left (compensation steering).

REMARK

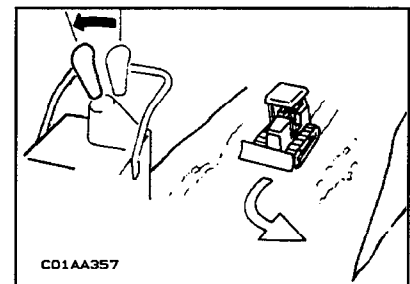
To make a gradual right turn, move the transmission/steering lever partially to the left (compensation steering).

◆ To make a pivot left turn

If the transmission/steering lever is moved fully to the left, the steering clutch is disengaged and the steering brake is applied, so the machine will carry out a pivot turn to the left (no compensation steering).

REMARK

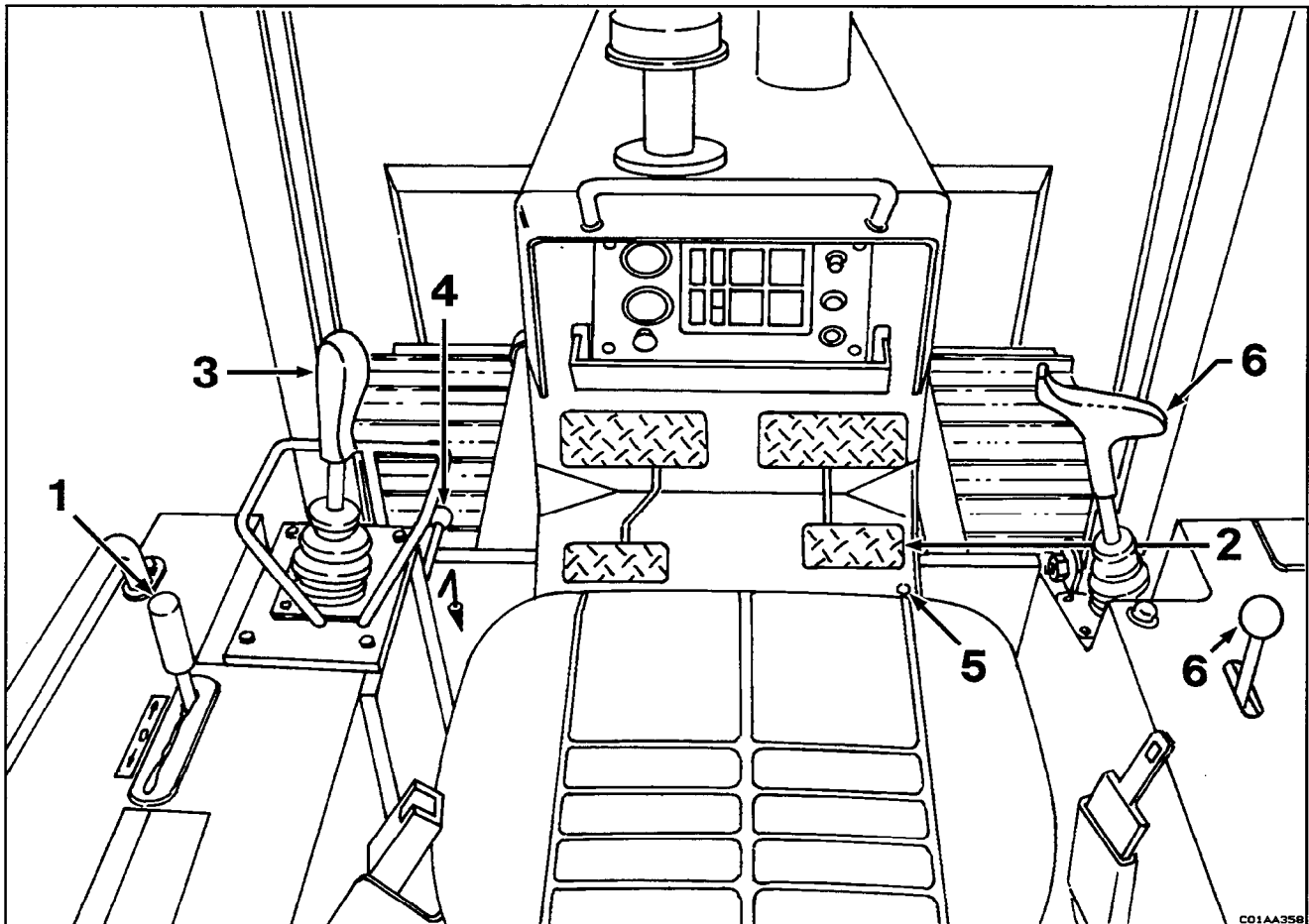
To make a pivot right turn, move the transmission/steering lever fully to the right (no compensation steering).



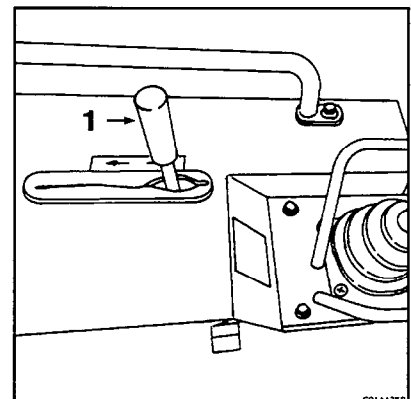
12.8 STOPPING MACHINE

 **WARNING**

- ◆ Avoid stopping suddenly. Give yourself ample room when stopping.
- ◆ When stopping the machine, select flat hard ground and avoid dangerous places. If it is unavoidably necessary to park the machine on a slope, insert blocks underneath the track shoes. As an additional safety measure, thrust the blade into the ground.
- ◆ If the control lever is touched by accident, the work equipment or the machine may move suddenly, and this may lead to a serious accident. Before leaving the operator's compartment, always apply the lock securely.

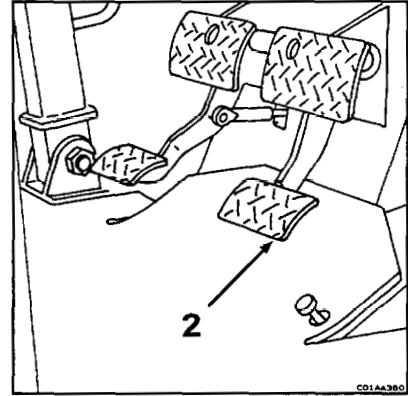


1. Move the engine speed control lever forward to the low idle position.

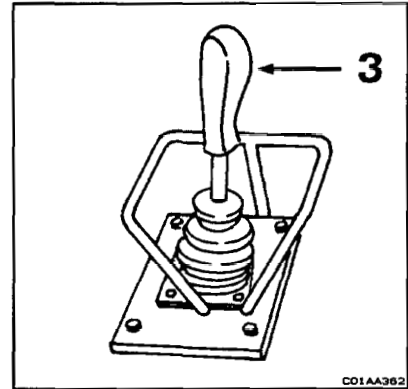


12. OPERATION

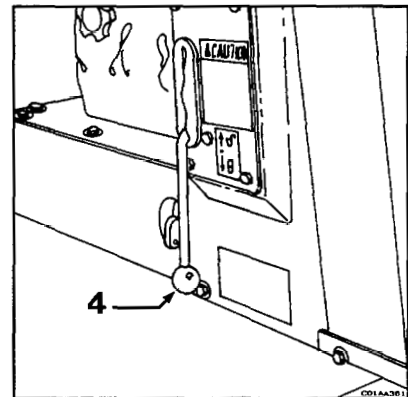
2. Depress the brake and decelerator pedal until the machine is stopped.



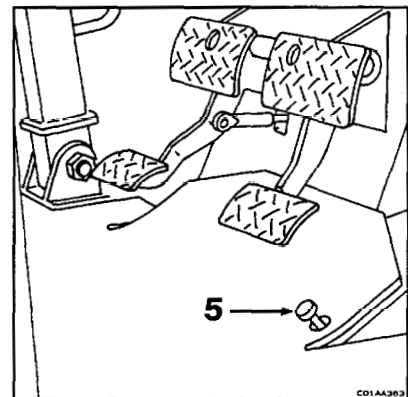
3. Place the transmission/steering lever in NEUTRAL.



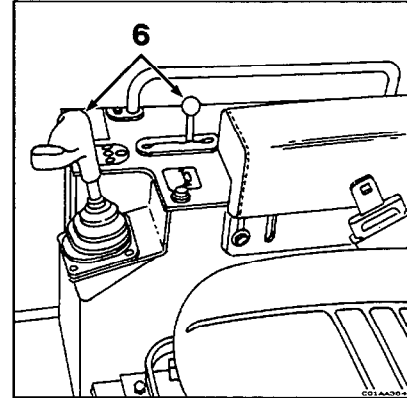
4. Place the safety lock lever in the ON, locked, (downward) position.



5. Lock the brake pedal.



6. Lower all mounted equipment to the ground.



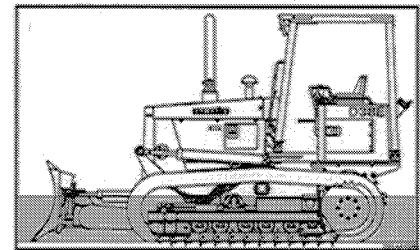
12.9 PRECAUTIONS FOR OPERATION

12.9.1 METHOD FOR USING STEERING CLUTCH

If the steering clutch one side is used frequently or if many gradual turns are made with steering clutch half engaged, the steering clutch will wear out in a short time. Design the travel road well and steer the machine properly.

12.9.2 PERMISSIBLE WATER DEPTH

When operating in water, always keep the bottom of the carrier roller above the surface of the water. Also, be careful that the engine cooling fan will not come in contact with water. The fan can be damaged.



12.9.3 PRECAUTIONS WHEN TRAVELING UP OR DOWN HILLS

12.9.3.1 USE ENGINE AS A BRAKE

When going downhill, shift gear shift lever into low speed to run engine at slow speed and travel down slope using the engine as a brake. Never coast down slope with the steering and directional lever in the N (neutral) position.

12.9.3.2 BRAKING WHEN TRAVELING DOWNHILL

While descending a slope using the engine as a brake, also apply the brakes. Failure to brake may result in overrunning, causing engine trouble.

12.9.4 PRECAUTIONS ON SLOPES

12.9.4.1 BE CAREFUL OF FUEL LEVEL

If the fuel level in the fuel tank becomes low when working on slopes, the engine may suck in air because of the angle of the machine or the swaying of the machine. If this makes the engine stop, be careful not to let the fuel level in the fuel tank become too low.

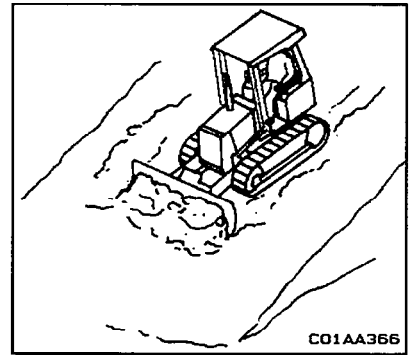
12.9.4.2 PRECAUTIONS WHEN ENGINE STOPS ON SLOPES

If the engine stops while working or traveling on a hill, immediately depress the brake pedal, lower the blade to the ground to stop the machine, then lock the brake pedal with the brake lock lever. Thereafter, move the steering and directional lever to the N (neutral) position, lock the lever, then restart the engine.

12. OPERATION

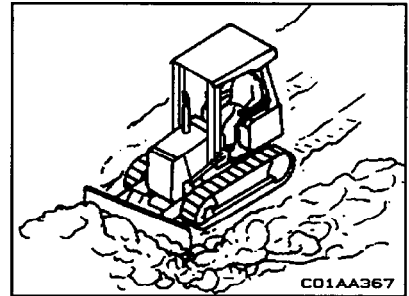
12.10 WORK POSSIBLE USING BULLDOZER

In addition to the following, it is possible to further increase the range of applications by using various attachments.



12.10.1 DOZING

A bulldozer digs and transports dirt in a forward direction. Slope excavation can always be most effectively carried out by proceeding from the top downward. When dozing toward one side only, operate with angled blade.

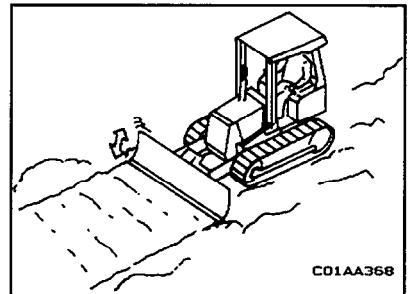


12.10.2 SMOOTHING

NOTICE

Avoid smoothing on rocky or stony ground. It can damage the blade.

Uneven ground surfaces remaining after digging can be leveled off by fine operation of blade. The basic method is to operate the machine at low speeds with the blade fully loaded with soil and sand. A flat finished surface is also possible by slowly backing the machine with the blade floating so it is dragged across the surface. However, avoid this on rocky or stony ground, as it may damage the blade.

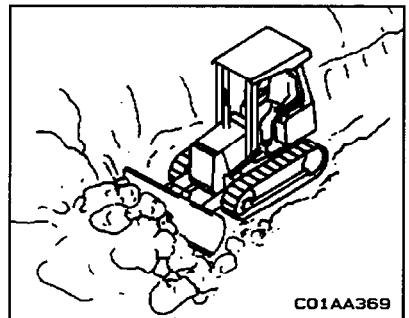


12.10.3 CUTTING INTO HARD/ FROZEN GROUND OR DITCHING

NOTICE

Do not perform severe operations such as uprooting by angling or tilting the blade.

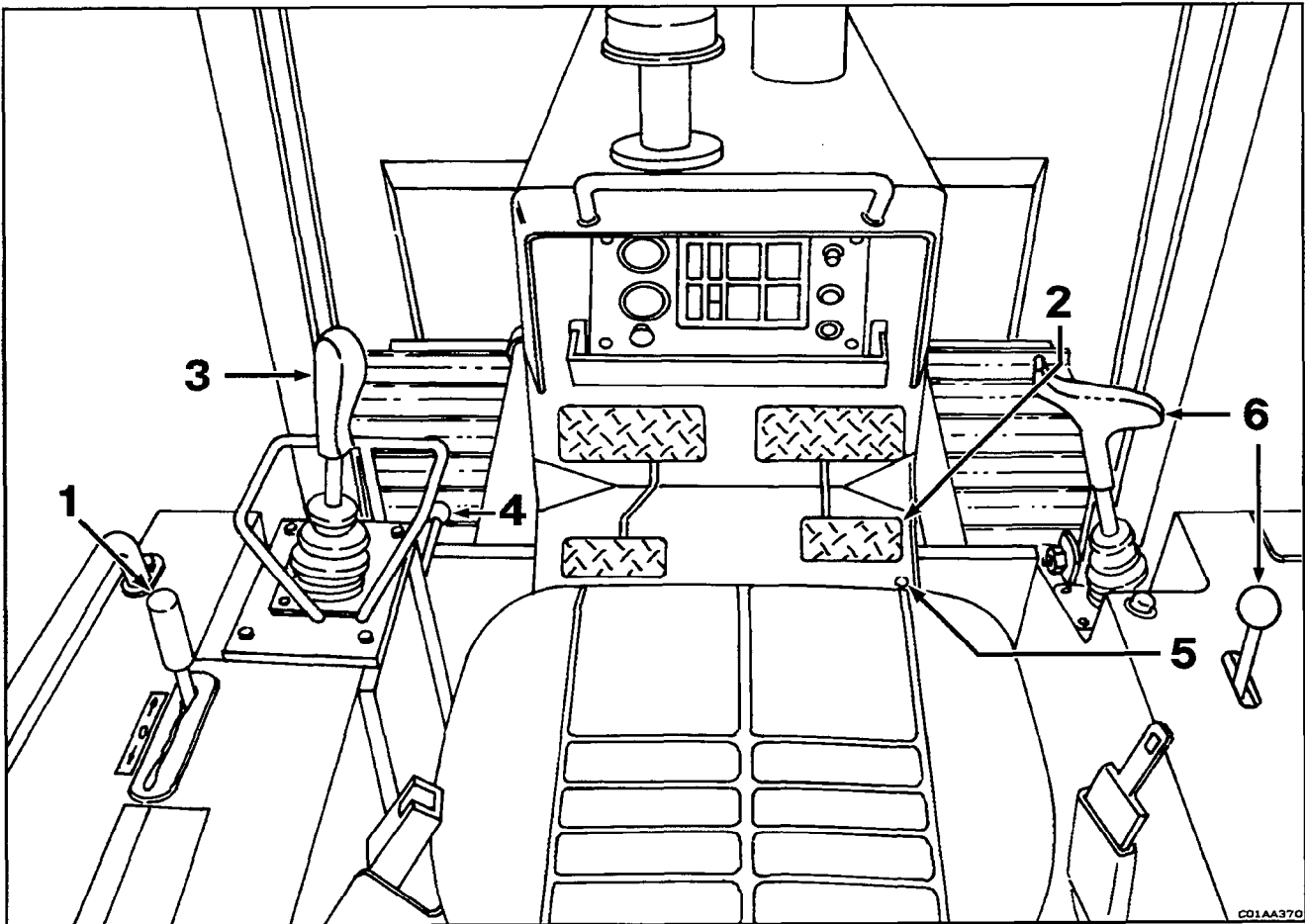
For digging and ditch excavation of hard or frozen ground, tilt the blade. Even hard ground can be dug effectively by a tilted or angled blade.



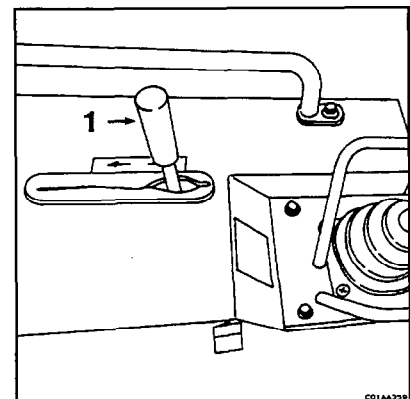
12.11 PARKING MACHINE

 **WARNING**

- ◆ Avoid stopping suddenly. Give yourself ample room when stopping.
- ◆ When stopping the machine, select flat hard ground and avoid dangerous places. If it is unavoidably necessary to park the machine on a slope, insert blocks underneath the track shoes. As an additional safety measure, thrust the blade into the ground.
- ◆ If the control lever is touched by accident, the work equipment or the machine may move suddenly, and this may lead to a serious accident. Before leaving the operator's compartment, always apply the lock securely.

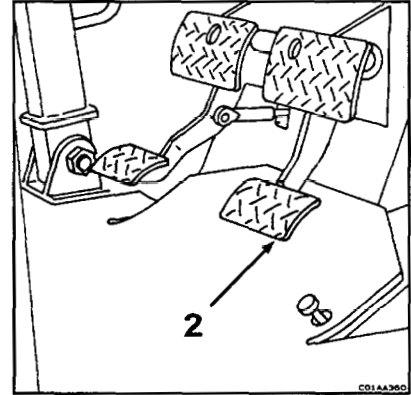


1. Move the engine speed control lever forward to the low idle position.

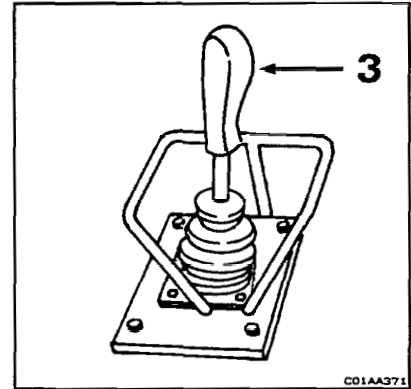


12. OPERATION

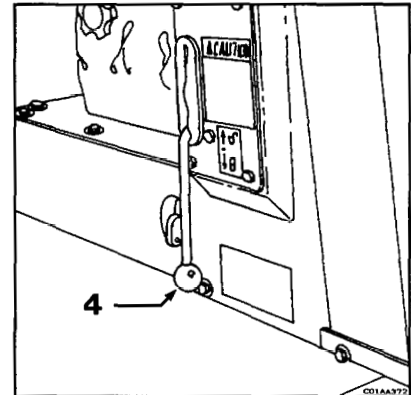
2. Depress the brake and decelerator pedal until the machine is stopped.



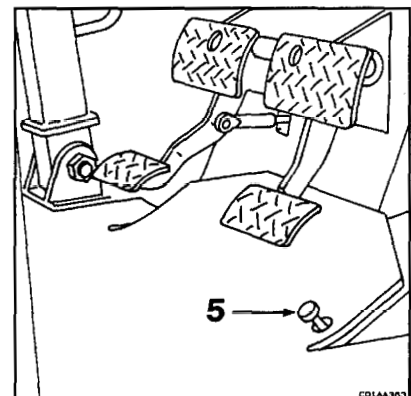
3. Place the transmission/steering lever in NEUTRAL.



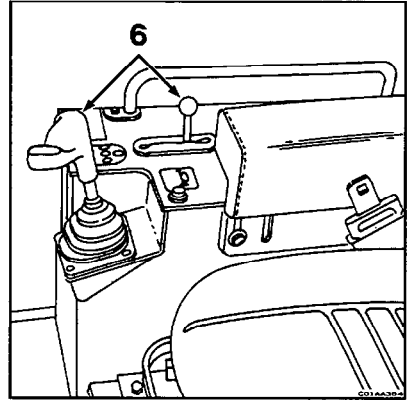
4. Place the safety lock lever in the ON, locked, (downward) position.



5. Lock the brake pedal.

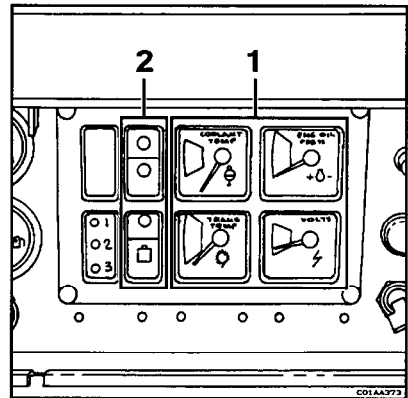


6. Lower all mounted equipment to the ground.



12.12 CHECK AFTER FINISHING WORK

1. Check all the gauges for proper operation.
2. Check all the warning lights so that none are illuminated.

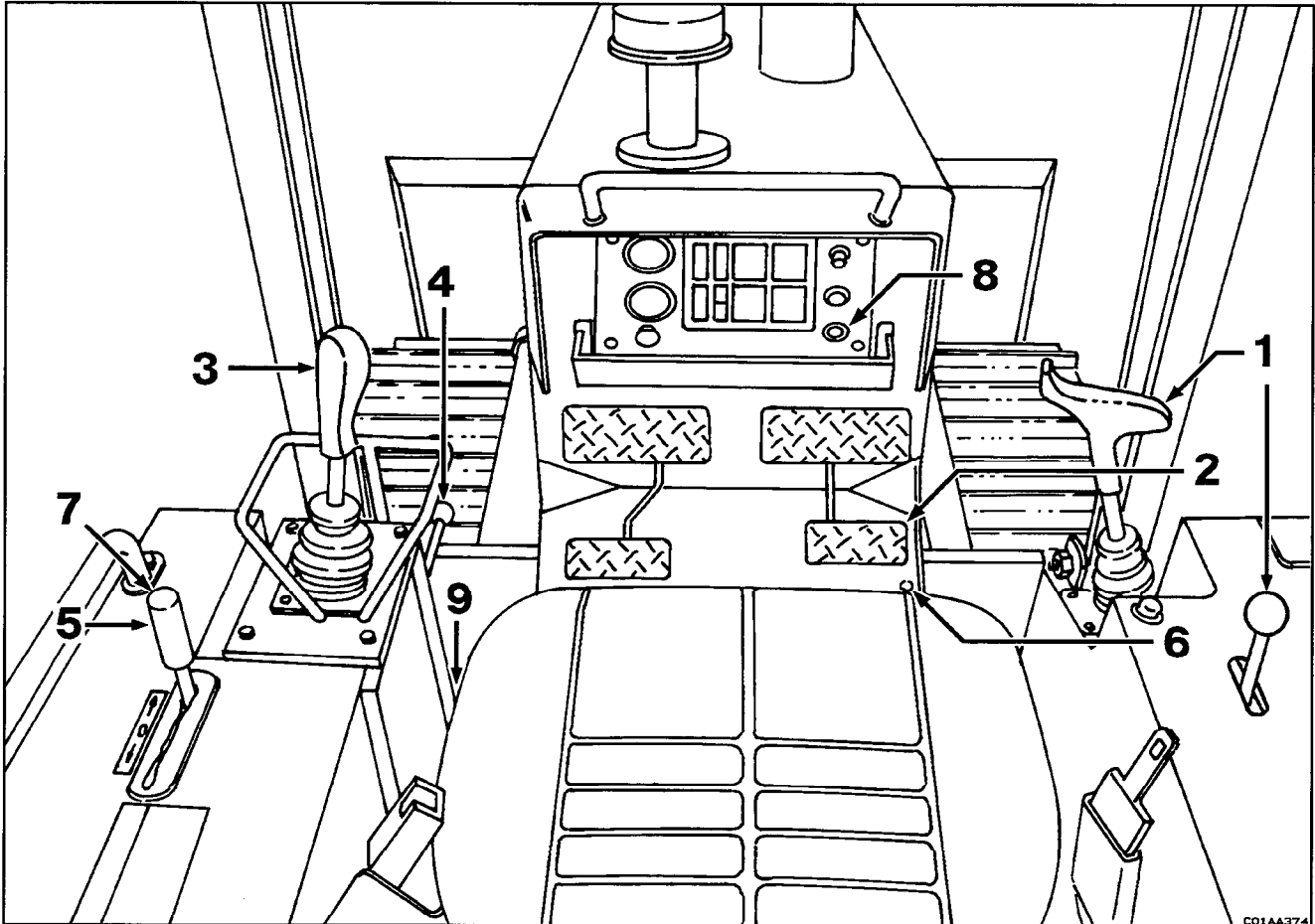


12. OPERATION

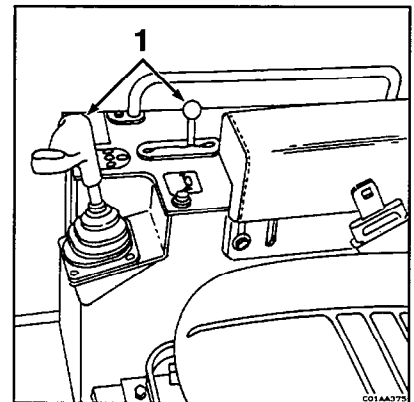
12.13 STOPPING ENGINE

NOTICE

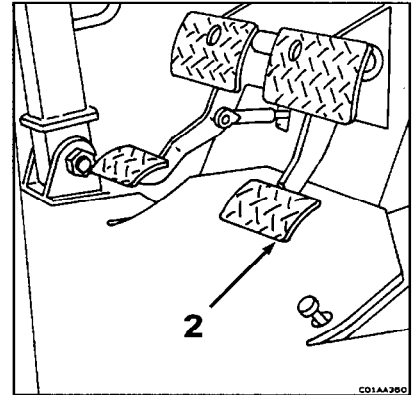
If the engine is abruptly stopped before it has cooled down, engine life may be greatly shortened. Consequently, do not abruptly stop the engine apart from an emergency. In particular, if the engine has overheated, do not abruptly stop it but run it at medium speed ($\frac{1}{2}$ throttle) to allow it to cool gradually, then stop it.



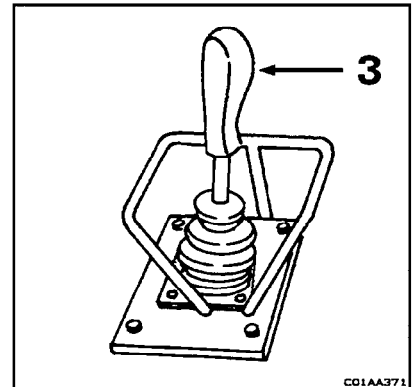
1. Lower all mounted equipment to the ground.



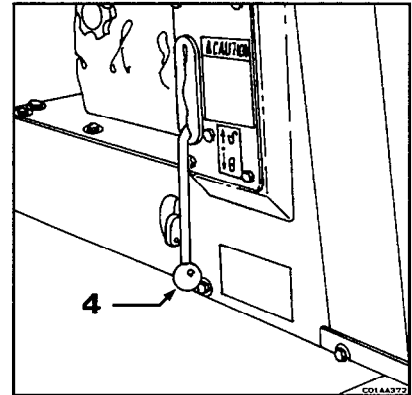
2. Depress the brake and decelerator pedal until the machine is stopped.



3. Place the transmission/steering lever in NEUTRAL.



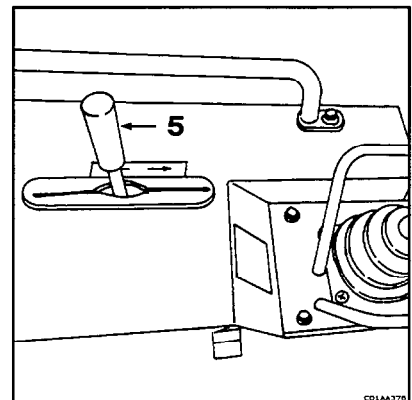
4. Place the safety lock lever in the ON, locked, (downward) position.



5. Operate the engine at one half speed (no load) for three to five minutes, then move the engine speed control lever to the low idle position.

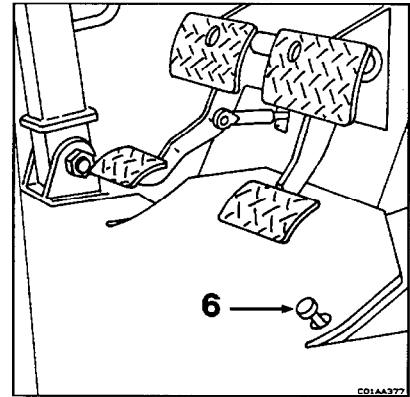
REMARK

Serious damage can result to the engine and turbocharger (if equipped) if this cool down step is neglected.

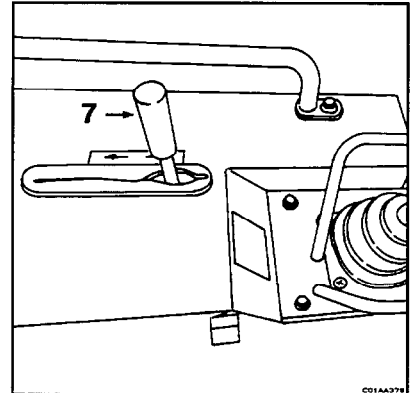


12. OPERATION

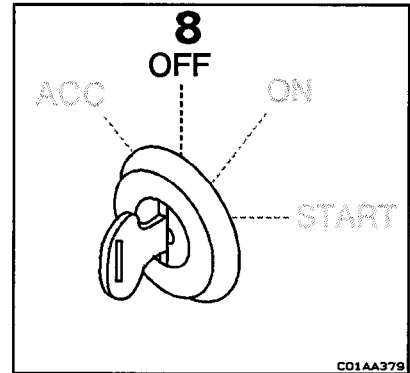
6. Depress and lock the brake and decelerator pedal.



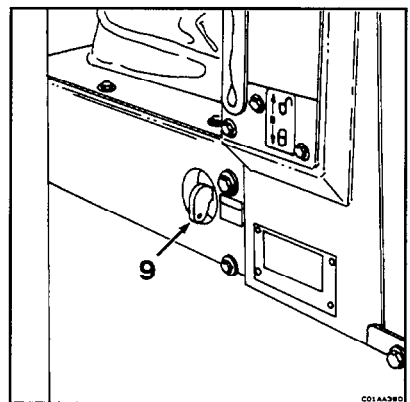
7. Move the engine speed lever fully forward.



8. Turn the key switch to the off position. Remove the key from the starting switch.



9. Turn the electrical system master switch to the OFF position (counter-clockwise).



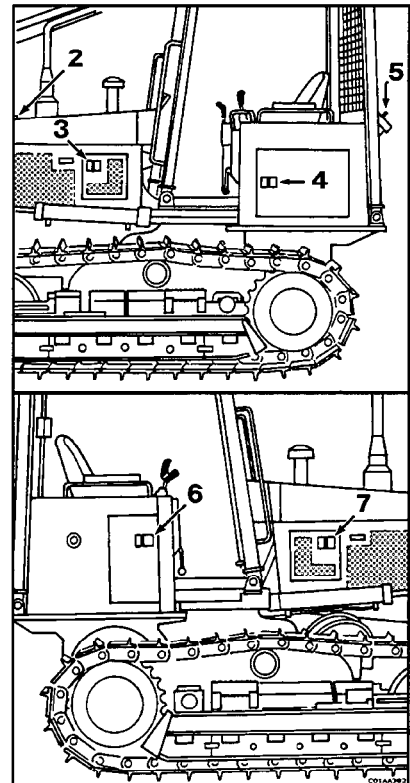
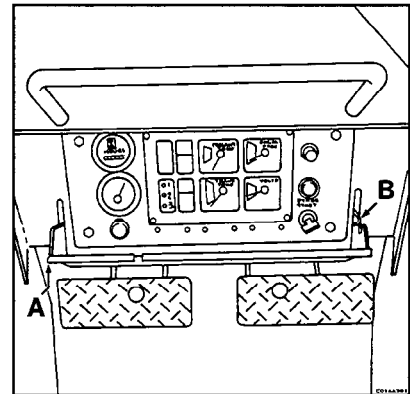
12.14 CHECK AFTER STOPPING ENGINE

1. Walk around the machine and check the work equipment, paintwork, and undercarriage, and check also for leakage of oil or water. If any abnormalities are found, repair them.
2. Fill the fuel tank.
3. Check the engine compartment for paper and debris. Clean out any paper and debris to avoid a fire hazard.
4. Remove any mud stuck to the undercarriage.

12.15 LOCKING

Always lock the following places. Commercially available locks can be fitted to the following places.

1. Instrument panel; Rotate cover (A) upward and secure with lock through tang (B).
2. Access cover on engine hood.
3. Left side engine access door.
4. Battery box door.
5. Fuel tank cap.
6. Hydraulic tank door.
7. Right side engine access door.



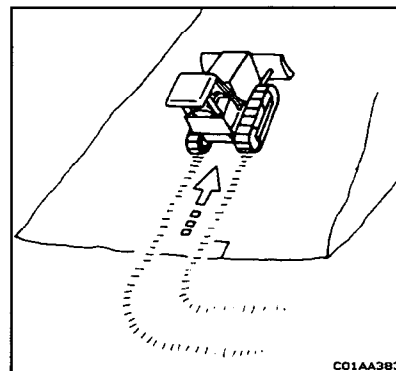
12. OPERATION

12.16 TIPS FOR LONGER UNDERCARRIAGE LIFE

Undercarriage life varies greatly depending on operation method, inspection and maintenance. Track components have a certain dimension when new. As wear occurs dimensions will decrease (or increase in case of track pitch and front idler flange height) until a decision must be made whether to rebuild or recondition components, replace them or run them to destruction. For each component or condition, five different dimensions are measured. 100% is dimension of component when new. 075%, 050% and 025% indicate percentage of wear remaining before a maintenance action should be taken. 000% is point at which either maintenance must take place or components run to destruction. For most efficient operation, keep the following point in mind.

12.16.1 OPERATION METHOD

- ◆ Select the track shoe that best suits the type of soil to be encountered in service. Please consult your distributor when selecting track shoes.
- ◆ Do not allow shoe slipping to occur during operation. If shoe slipping occurs, reduce load to the blade until slipping stops.
- ◆ Avoid sudden starts, acceleration or stops, unnecessarily high speeds and sharp turns.
- ◆ Always operate machine in a straight line whenever possible. When making turns, be careful not to allow the machine to stay to one side, so operation in both turning directions can be done properly. Make turns with the largest possible radius.
- ◆ Prior to operation, clear boulders and obstacles to prevent machine from riding over them while operating.
- ◆ On a slope, operate the machine parallel to the inclination of the slope. Do not operate across the slope. Also when stopping the machine on a slope, the machine should face toward the top of the slope.
- ◆ When ground inclines to left or right during digging operation, do not continue to dig with machine inclined. Move machine back to level ground and start to dig again.
- ◆ When idlers or sprockets are lifted due to obstacles during dozing, do not attempt to force the machine to perform. Because work at this time exceeds machine working capability.

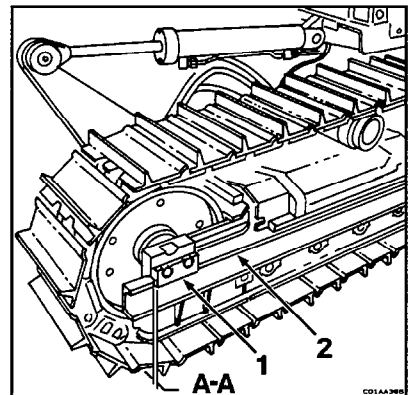
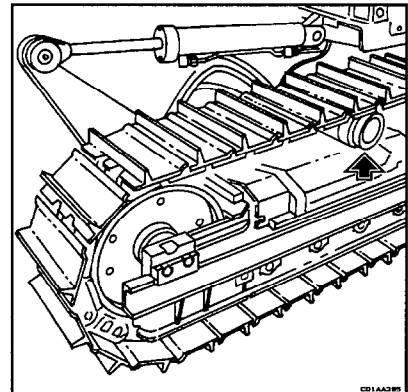
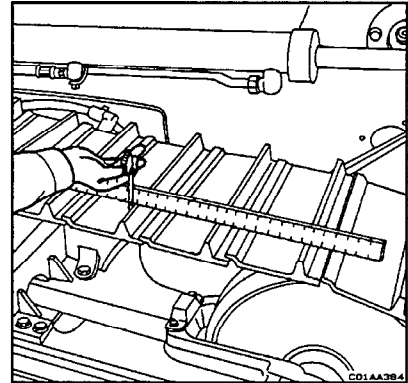


12.16.2 INSPECTION AND ADJUSTMENT

- ◆ Properly adjust track tension. Tension should be measured at clearance shown in the diagram - usually 50 to 63 mm (2 to 2.5 in) at this point. For rocky terrain, tighten tracks slightly. In clay or sandy areas, slightly loosen them. For inspection and adjustment procedures, see 24.2.3 TRACK TENSION AND ADJUSTMENT.

- ◆ Check idler rollers for oil leakage as well as for loose bolts. If any trouble is detected, repair immediately.

- ◆ Check the clearance between the idler guide plate and the track frame. If clearance **A-A** increases, the idler may develop side motion and the tracks may come off. For inspection and adjustment procedures, see 24.2.3 TRACK TENSION AND ADJUSTMENT.

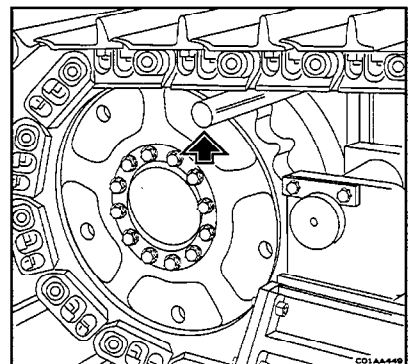


12.16.3 INSPECTION AND REPAIR

Frequent inspection and prompt repair will reduce repair costs. The following items for inspection will serve as a guide to maintenance service of each undercarriage part. Perform periodical inspection and contact the distributor in your area when machine has approached repairable limits and reversing limits.

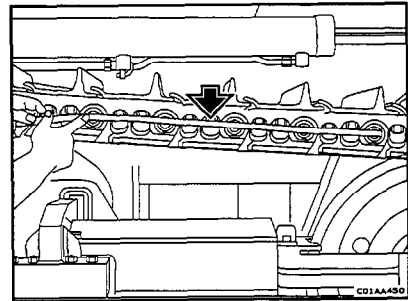
12.16.3.1 MEASURING LINK PITCH

1. Insert a wooden block between track shoe and sprocket to take up the slack in track shoes.



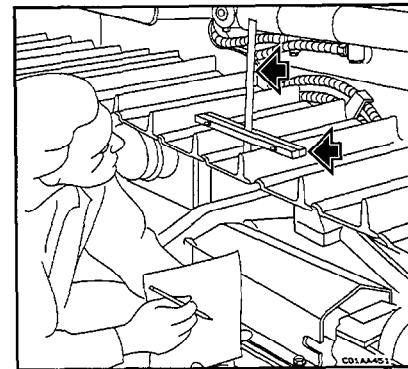
12. OPERATION

2. Measure pitch length of 4 links in stretched portion. Of length obtained, $\frac{1}{4}$ is the link pitch.



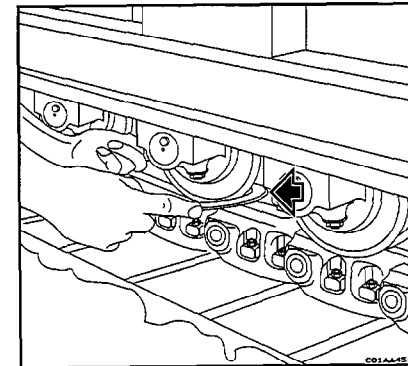
12.16.3.2 MEASURING HEIGHT OF GROUSER

Clean off all materials on the shoe plate and grouser tops. Lay a squeeze bar (1) across grousers approximately $\frac{1}{4}$ of way in from the end of the shoe. Insert a 305 mm (12 in) scale (2) in the squeeze bar so that the scale is against the top of the track plate and take a reading.



12.16.3.3 MEASURING OUTSIDE DIAMETER OF TRACK ROLLER

Place the tips of a 305 mm (12 in) caliper (1) against tread area of roller. Adjust caliper so a slight drag is present when caliper is removed. Using a 305 mm (12 in) scale measure distance between caliper tips.



13. TRANSPORTATION

When transporting the machine, observe all related laws and regulations, and be careful to assure safety.

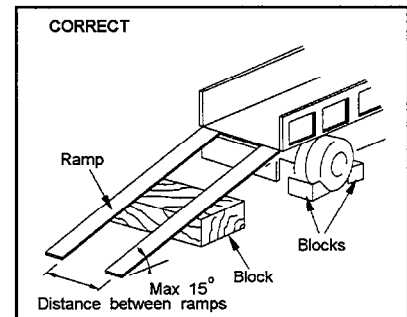
13.1 LOADING, UNLOADING WORK

WARNING

- ◆ Make sure the ramp has sufficient width, length and thickness to enable the machine to be safely loaded and unloaded. If the ramp sags appreciably, reinforce it properly.
- ◆ When loading and unloading the machine, park the trailer on a flat firm roadbed. Keep a fairly long distance between the road shoulder and the machine.
- ◆ Remove the mud from the undercarriage to prevent the machine from slipping to the side on slopes.
- ◆ Be sure the ramp surface is clean and free of grease, oil, ice and loose materials.
- ◆ Never change the direction of travel when on the ramps. If it is necessary to change direction, drive off the ramps and correct the direction, then drive on to the ramps again.

When loading or unloading, always use ramps or a platform and carry out the operations as follows.

1. Properly apply the brakes on the trailer and insert block beneath the tires to ensure that it does not move. Then fix the ramps in line with the centers of the trailer and the machine. Be sure that the two sides are at the same level as one another.
2. Determine the direction of the ramps, then slowly load or unload the machine.
3. Load the machine correctly in the specified position on the trailer.



13.2 PRECAUTIONS FOR LOADING

WARNING

When the edge of the blade protrudes beyond the trailer, angle the blade.

After loading to the specified position, secure the machine as follows.

1. Lower the blade slowly.
2. Lock the safety lever.
3. Depress the brake and decelerator pedal and push the lock lever to apply the brakes.
4. Move the fuel control lever to the low idling position and turn the starting switch key to the OFF position to stop the engine. Remove the key. Turn the master disconnect switch to OFF and remove key.
5. When transporting the machine, place rectangular timber underneath the front and rear track shoes to prevent the machine from moving about. Also, hold it down with chains or rope. Be particularly careful to ensure that the machine does not slip sideways.

13.3 PRECAUTIONS FOR TRANSPORTATION

WARNING

Determine the route for transporting the machine by taking into account the width, height and weight of the machine.

Obey all state and local laws governing the weight, width and length of a load, Observe all regulations governing wide loads.

14. COLD WEATHER OPERATION

14.1 PRECAUTIONS FOR LOW TEMPERATURE

If the temperature becomes low, it becomes difficult to start the engine, and the coolant may freeze, so do as follows:

14.1.1 FUEL AND LUBRICANTS

Change to fuel and oil with low viscosity for all components. For details of the specified viscosity, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

14.1.2 COOLANT

 **WARNING**

Keep antifreeze fluid away from an open flame. Never smoke when using antifreeze.

NOTICE

Never use methanol, ethanol or propanol based antifreeze.

Where no permanent antifreeze is available, an ethylene glycol antifreeze without corrosion inhibitor may be used only for the cold season. In this case, clean the cooling system twice a year (in spring and autumn). When refilling the cooling system, add antifreeze in autumn, but do not add any in spring. Absolutely avoid using any water leak preventing agent irrespective of whether it is used independently or mixed with an antifreeze. Do not mix one antifreeze with a different brand. For details of the antifreeze mixture when changing the coolant, see 20.2.3 ANTIFREEZE. Use a Permanent Antifreeze (ethylene glycol mixed with corrosion inhibitor, antifoam agent, etc.) meeting the standard requirements as shown below. With permanent antifreeze, no change of coolant is required for a year. If it is doubtful that an available antifreeze meets the standard requirements, ask the supplier of that antifreeze for information.

Standard requirements for permanent antifreeze.

- ◆ SAE J1034
- ◆ FEDERAL STANDARD O-A-548D


14.1.3 BATTERY

 **WARNING**

- ◆ **To avoid gas explosions, do not bring fire or sparks near the battery.**
- ◆ **Battery electrolyte is dangerous. If it gets in your eyes or on your skin, wash it off with large amounts of water, and consult a doctor.**

When the ambient temperature drops, the capacity of the battery will also drop. If the battery charge ratio is low, the battery electrolyte may freeze. Maintain the battery charge as close as possible to 100%, and insulate it against cold temperature so that the machine can be started easily the next morning.

Measure the specific gravity and calculate the rate of charge from the following conversion table.

Fluid temp 	20°C	0°C	-10°C	-20°C
Rate of charge	68°F	32°F	14°F	-4°F
100%	1.28	1.29	1.30	1.31
90%	1.26	1.27	1.28	1.29
80%	1.24	1.25	1.26	1.27
75%	1.23	1.24	1.25	1.26

14.2 AFTER COMPLETION OF WORK

To prevent mud, water, or the undercarriage from freezing and making it impossible for the machine to move on the following morning, always observe the following precautions.

- ◆ Mud and water on the machine body should be completely removed. This is to prevent damage to the seal caused by mud or dirt getting inside the seal with frozen drops of water.
- ◆ Park the machine on concrete or hard ground. If this is impossible, park the machine on wooden boards. The boards help protect the tracks from freezing in the soil and the machine can start next morning.
- ◆ Open the drain valve and drain any water collected in the fuel system to prevent it from freezing.
- ◆ As the battery capacity drops markedly in low temperatures, cover the battery or remove it from the machine, keep it in a warm place, and install it again the next morning.
- ◆ If electrolyte level is found low, add distilled water in the morning before beginning work. Do not add the water after the day's work so as to prevent fluid in the battery from freezing in the night.

14. COLD WEATHER OPERATION

14.3 AFTER COLD WEATHER

When season changes and the weather becomes warmer, do as follows:

- ◆ Replace the fuel and oil for all parts with oil of the viscosity specified. For details, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.
- ◆ If for any reason permanent antifreeze cannot be used, and an ethylene glycol base antifreeze (winter, one season type) is used instead, or if no antifreeze is used, drain the cooling system completely, then clean out the inside of the cooling system thoroughly, and fill with fresh coolant.

15. LONG TERM STORAGE (MORE THAN ONE MONTH)

15.1 BEFORE STORAGE

 **WARNING**

If possible, prepare the machine for long term storage outdoors. If this must be done indoors, open doors and windows for ventilation to prevent carbon monoxide poisoning.

When putting the machine in storage for a long time, do as follows:

- ◆ After every part is washed and dried, the machine shall be housed in a dry building. Never leave it outdoors. In case it is necessary to leave it outdoors, park the machine on the flat ground and cover it with canvas etc.
- ◆ Completely fill the fuel tank, lubricate and change the oil before storage.
- ◆ Apply a thin coat of grease to metal surface of the hydraulic piston rods and the idler adjusting rods.
- ◆ Disconnect the negative terminals of the battery and cover it, or remove it from the machine and store it separately.
- ◆ If the ambient temperature is expected to drop below 0°C (32°F), always add antifreeze to the coolant.
- ◆ Place the safety lock lever in the ON, locked (downward) position and place the fuel control lever in the low idling position. Do not lock the brake pedal; use blocks to stop the machine from moving.

15.2 DURING STORAGE

- ◆ Operate the engine and move the machine for a short distance once a month so that a new film of oil will be coated over movable parts and component surfaces. At the same time, also charge the battery.
- ◆ Before operating the work equipment, wipe off the grease on the hydraulic piston rod.

15.3 AFTER STORAGE

NOTICE

If the machine is stored without carrying out the monthly rust prevention operation, request your distributor for service.

Carry out the following procedure when taking the machine out of long term storage:

- ◆ Wipe off the grease from the hydraulic cylinder rods.
- ◆ Add oil and grease to all places.

16. TROUBLESHOOTING

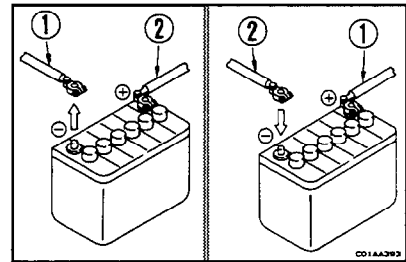
16.1 AFTER RUNNING OUT OF FUEL

When starting after running out of fuel, fill with fuel, then fill the fuel filter cartridge with clean fuel and bleed the air from the fuel system before starting. For details of bleeding the air, see 24.11.4 VENTING THE FUEL SYSTEM.

16.2 IF BATTERY IS DISCHARGED

WARNING

- ◆ When checking or handling the battery, stop the engine and turn the starting key to the OFF position before starting.
- ◆ The battery generates hydrogen gas, so there is danger of explosion. Do not bring lighted cigarettes near the battery, or do anything that will cause sparks.
- ◆ Battery electrolyte is dilute sulphuric acid, and it will attack your clothes and skin. If it gets on your clothes or on your skin, wash it immediately off with large amounts of water. If it gets in your eyes, wash it out with fresh water, and consult a doctor.
- ◆ When handling battery, always wear protective goggles.
- ◆ When removing the battery, first disconnect the cable from the ground (normally, from the negative (-) terminal). When installing, install the positive (+) terminal first. If a tool touches the cable connecting the positive terminal and the chassis, there is danger that it will cause sparks.
- ◆ If the terminals are loose, there is danger that the defective contact may generate sparks that will cause an explosion. When installing the terminals, install them tightly.



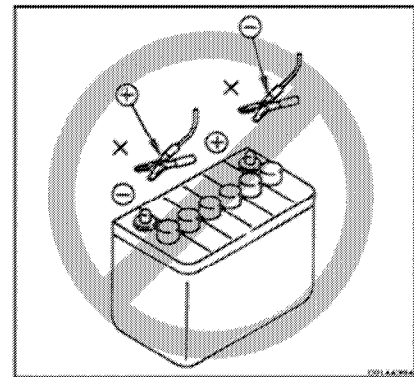
16.2.1 STARTING ENGINE WITH BOOSTER CABLE

When starting the engine with a booster cable, do as follows:

Precautions when connecting and disconnecting booster cable

WARNING

- ◆ When starting the engine from another machine, connect the batteries in parallel.
- ◆ When connecting the cables, never contact the positive (+) and negative (-) terminals.
- ◆ When starting the engine with a booster cable, always wear safety glasses.
- ◆ Be careful not to let the normal machine and problem machine contact each other. This prevents sparks from generating near the battery which could ignite the hydrogen gas given off by the battery. If hydrogen gas explodes. It could cause serious injury.
- ◆ Make sure that there is no mistake in the booster cable connections. The final connection is to the engine block of the problem machine, but sparks will be generated when this is done, so connect to a place as far as possible from the battery.
- ◆ Use care when removing the cables from the machine that has been started. Do not allow the cable ends to contact each other or the machine, to avoid hydrogen explosion.



NOTICE

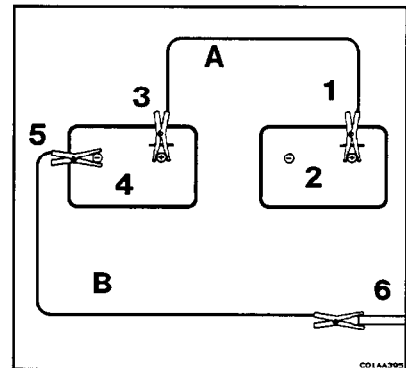
- ◆ The size of the booster cable and clip should be suitable for the battery size.
- ◆ The battery of the normal machine must b/e the same capacity as that of the engine to be started.
- ◆ Check the cables and clips for damage or corrosion.
- ◆ Make sure that the cables and clips are firmly connected.

16.2.1.1 CONNECTING THE BOOSTER CABLES

Keep the starting switch at the OFF position.

Connect the booster cable as follows, in the order of the numbers marked in the diagram.

1. Make sure that the starting switches of the normal machine and problem machine are both at the OFF position.
2. Connect one clip of booster cable (A) to the positive terminal (1) of the problem machine (2).
3. Connect the other clip of booster cable (A) to the positive (+) terminal (3) of the normal machine (4).
4. Connect one clip of booster cable (B) to the negative (-) terminal (5) of the normal machine (4).
5. Connect the other clip of booster cable (B) to the engine block (6) of the problem machine (2).

**16.2.1.2 STARTING THE ENGINE**

1. Make sure the clips are firmly connected to the battery terminals.
2. Start the engine of the normal machine and let it to run at high idle.
3. Turn the starting switch of the problem machine to the START position and start the engine. Refer to 12.2 STARTING ENGINE.

16.2.1.3 DISCONNECTING THE BOOSTER CABLES

After the engine has started, disconnect the booster cables in the reverse of the order in which they were connected.

1. Remove one clip of booster cable (B) from the engine block (6) of the problem machine (2).
2. Remove the other clip of booster cable (B) from the negative (-) terminal (5) of the normal machine (4).
3. Remove one clip of booster cable (A) from the positive (+) terminal (3) of the normal machine (4).
4. Remove the other clip of booster cable (A) from the positive (+) terminal (1) of the problem machine (2).

16. TROUBLESHOOTING

16.3 OTHER TROUBLE

(): Always contact your Komatsu distributor when handling these items.

◆ In cases of abnormalities or causes which are not listed below, please contact your distributor for repairs.

16.3.1 ELECTRICAL SYSTEM

Problem	Main Cause	Remedy
Voltmeter does not register charge when engine runs at high idle	◆ Defective wiring	◆ (Check, repair loose terminals, disconnections)
Voltmeter flickers while engine is running	◆ Defective adjustment of fan belt tension	◆ Adjust fan belt tension. For details, see 24.11 WHEN REQUIRED
Voltmeter registers extreme high charge	◆ Defective alternator ◆ Defective wiring	◆ (Replace) ◆ (Check, repair)
Abnormal noise is generated from alternator	◆ Defective alternator	◆ (Replace)
Starting motor does not turn when key switch is turned to START	◆ Defective wiring ◆ Insufficient battery charge	◆ (Check, repair) ◆ Charge
Pinion of starting motor keeps going in and out	◆ Insufficient battery charge	◆ Charge
Starting motor turns engine sluggishly	◆ Insufficient battery charge ◆ Defective starting motor	◆ Charge ◆ (Replace)
Starting motor disengages before engine starts	◆ Defective wiring ◆ Insufficient battery charge	◆ (Check, repair) ◆ Charge

16.3.2 CHASSIS

Problem	Main Cause	Remedy
When transmission/steering lever is moved to desired position, machine does not start or traveling speed is slow	◆ Oil pressure of drive train is not raised 1. Insufficient oil in drive train system 2. Clogged strainer in transmission case	◆ Add oil to specified level, see 24.4 EVERY 50 HOURS SERVICE ◆ Clean strainer
When transmission/steering lever is moved to turn machine, machine does not turn and goes straight	◆ Steering clutch of moved side is not disengaged ◆ Brake of moved side is not actuated	◆ Adjust brake.
When brake pedal is depressed, machine does not stop	◆ Brakes out of adjustment	◆ Adjust brake.
Track comes off	◆ Track too loose	◆ Adjust track tension, see 24.11 WHEN REQUIRED
Abnormal wear of sprocket	◆ Track too loose or too tight	
Blade rises slowly, does not rise	◆ Lack of hydraulic oil	◆ Add oil to specified level, see 24.3 EVERY 10 HOURS SERVICE

16.3.3 ENGINE

Problem	Main Cause	Remedy
Engine oil pressure warning light remains lit when engine speed is raised after completion of warm up	<ul style="list-style-type: none"> ◆ Engine oil pan oil level is low ◆ Clogged oil filter element ◆ Defective warning light 	<ul style="list-style-type: none"> ◆ Add oil to specified level, see 24.3 EVERY 10 HOURS SERVICE ◆ Replace element, see 24.6 EVERY 250 HOURS SERVICE ◆ (Replace light)
Steam is emitted from top part of radiator	<ul style="list-style-type: none"> ◆ Cooling water level low, water leakage ◆ Loose fan belt ◆ Dirt or scale accumulated in cooling system 	<ul style="list-style-type: none"> ◆ Add cooling water, see 24.3 EVERY 10 HOURS SERVICE ◆ Adjust fan belt tension, see 24.11 WHEN REQUIRED ◆ Change cooling water, clean inside of system, see 24.9 EVERY 2000 HOURS SERVICE
Indicator of water temperature gauge is out of run range	<ul style="list-style-type: none"> ◆ Clogged radiator fins or damaged fins ◆ Defective thermostat ◆ Loose radiator filler cap (high altitude operation) ◆ Defective water temperature gauge 	<ul style="list-style-type: none"> ◆ Clean or repair, see 24.7 EVERY 500 HOURS SERVICE ◆ (Replace thermostat) ◆ Tighten cap or replace ◆ (Replace water temperature gauge)
Engine does not start when starting motor is engaged	<ul style="list-style-type: none"> ◆ Lack of fuel ◆ Air in fuel system ◆ Defective fuel injection pump or nozzle ◆ Starting motor cranks engine sluggishly ◆ Defective compression <ul style="list-style-type: none"> ◇ Defective valve clearance 	<ul style="list-style-type: none"> ◆ Add fuel, see 24.3 EVERY 10 HOURS SERVICE ◆ Repair place where is sucked in ◆ (Replace pump or nozzle) ◆ See 16.3.1 ELECTRICAL SYSTEM <ul style="list-style-type: none"> ◇ (Adjust valve clearance)
Exhaust smoke is white or blue	<ul style="list-style-type: none"> ◆ Too much oil in oil pan ◆ Improper fuel 	<ul style="list-style-type: none"> ◆ Add oil to specified level, see 24.3 EVERY 10 HOURS SERVICE ◆ Change to specified fuel
Exhaust smoke occasionally turns black	<ul style="list-style-type: none"> ◆ Clogged air cleaner element ◆ Defective nozzle ◆ Defective compression 	<ul style="list-style-type: none"> ◆ Clean or replace, see 24.10 PERIODIC ◆ (Replace nozzle) ◆ (Adjust valve clearance)
Combustion noise occasionally makes breathing sound	<ul style="list-style-type: none"> ◆ Defective nozzle 	<ul style="list-style-type: none"> ◆ (Replace nozzle)
Abnormal noise generated (combustion or mechanical)	<ul style="list-style-type: none"> ◆ Low grade fuel being used ◆ Overheating ◆ Damage inside muffler ◆ Excessive valve clearance 	

16. TROUBLESHOOTING

16.4 METHODS OF TOWING MACHINE

WARNING

- ◆ When using a chain or cable, be sure it is strong enough for the expected load and it is properly secured to the drawbar pins or tow hooks (if equipped).
- ◆ When pulling with a chain or cable, take up the slack slowly to avoid jerking. A chain or cable which fails under load can whip and cause serious injury. Stand clear. Do not pull or tow unless the operator's compartment is guarded against or out of reach of a whipping chain or cable. Attach only to the machine tow hook or drawbar. Failure to follow these instructions could cause serious injury.

REMARK

If the steering drive, final drive or tracks are damaged, do not tow. The machine must be transported on a carrier to avoid further damage.

To avoid the possibility of power train damage, limit the towing to a distance of 0.8 km (0.5 mile) at speeds less than 1.6 km/h (1 mph). The brakes on this machine are automatically spring applied when the engine is stopped. The brakes can only be released hydraulically. A towing port for applying external pressure to release the brakes is located in the battery box below the drive train pressure filter.

If the machine can be towed and the engine and steering hydraulic system can be operated, proceed as follows:

1. Position the safety lock lever in the down position. Start the engine. Use a towing cable of sufficient strength. Keep the engine running at half throttle and the safety lock locked in the down position during the tow.

If the machine can be towed but the engine and/or steering hydraulic system is/are inoperable, proceed as follows:

1. Open the battery box door. Modify a grease gun by installing a female quick disconnect fitting and a hose of sufficient length to allow operating the grease gun from the operator's seat for releasing the spring applied brakes.

REMARK

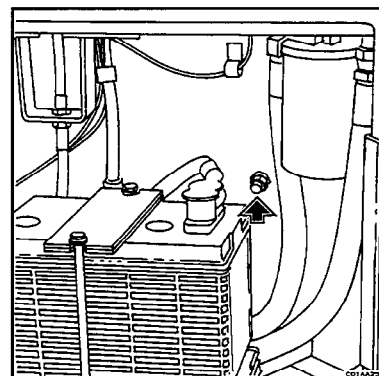
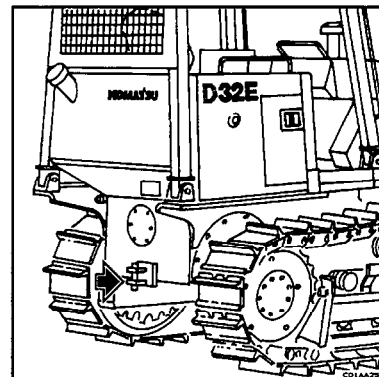
Do not intermix the male and female quick disconnect fittings with each other. Refer to Service Bulletin **B 07C 89A** for proper identification.

2. Pump sufficient grease into the fitting to release the brakes. The amount of grease required depends on the amount of pressure of dissipation in the system.
3. Use a towing cable of sufficient strength. During the tow, it may be necessary to pump more grease into the brake release fitting to replace the loss of pressure.

WARNING

Stop towing the machine before applying grease to fitting.

4. Depressing the secondary brake pedal will relieve pressure and apply the brakes. When towing is completed, remove the grease gun and close the battery box door.



MAINTENANCE

 **WARNING**

Read and follow all safety precautions in SAFETY from page 1-1 on. Failure to do so may result in serious injury or death.

17. GUIDES TO MAINTENANCE

Obey all safety precautions in this manual and Product Graphics on the machine when performing maintenance.

Do not carry out any inspection and maintenance operation that is not given in this manual.

Perform maintenance work on hard, flat ground.

Check service hourmeter:

- ◆ Check the service hourmeter reading every day to see if the time has come for any necessary maintenance to be carried out.

Komatsu genuine replacement parts:

- ◆ Use Komatsu genuine parts specified in the Parts Book list as replacement parts.

Komatsu genuine oils:

- ◆ Use Komatsu genuine oils and grease. Choose oils and grease with proper viscosities specified for ambient temperature.
- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

Clean oil and grease:

- ◆ Use clean oil and grease. Also, keep containers of the oil and grease clean. Keep foreign materials away from oil and grease.

Keeping the machine clean:

- ◆ Always keep the machine clean. This makes it easier to find the parts causing problems. Keep in particular grease fittings, breathers and oil level gauges clean and avoid foreign matters from getting in them.

Be careful of hot coolant and oil:

- ◆ Draining hot oils and coolant and removing their filters immediately after the engine stops are hazardous. Allow the engine to cool.
- ◆ If the oil has to be drained when it is cold, warm up the oil to a suitable temperature, ≈ 20 to 40°C (68 to 104°F), before draining it.

Checking for foreign materials in drained oil:

- ◆ After oil is changed and/or filters are replaced, check the oil and filters for metallic particles and foreign materials. If large quantities of metallic particles or foreign materials are found, consult your Komatsu distributor.

Fuel strainer:

- ◆ If your machine is equipped with a fuel strainer, do not remove it while fueling.

Oil change:

- ◆ Check or change oils in the places where dust is scarce to keep foreign materials away from oils.

Warning tag:

- ◆ Attach the warning tag to the starting switch or other appropriate control lever to avoid someone who is not aware of the circumstances from starting the engine.

Welding instructions:

- ◆ Turn off the engine starting switch and master switch.
- ◆ Do not apply more than 200 V continuously.
- ◆ Connect the ground cable within 1 m (3.28 ft) from the area to be welded.
- ◆ Avoid seals or bearings from being between the area to be welded and the position of grounding point.

Fire prevention:

- ◆ Use nonflammable cleaner or light oil for cleaning parts. Keep flame or lit cigarette away from light oil.

Clamp faces:

- ◆ When o-rings or gaskets are removed, clean the clamp faces and replace the o-rings and gaskets with new ones. Be sure to fit o-rings and gaskets when assembling.

Objects in your pockets:

- ◆ Keep your pockets free of loose objects which can fall out and drop into the machinery; especially when you work on the machinery while bending over it.

Checking undercarriage:

- ◆ When working in rocky areas, check for damage to the undercarriage and for looseness, flaws, wear and damage in bolts and nuts. Loosen the track tension a little when working in such areas.

Cleaning machine:

- ◆ Do not direct a high-pressure jet directly at the radiator.
- ◆ Do not splash water over the electrical equipment.

Pre- and post-work checks:

- ◆ Before starting work in mud, rain, snow or at seashore, check plugs and valves for tightness. Wash the machine immediately after the work to protect components from rusting.
- ◆ Lubricate components more frequently than usual. Be sure to lubricate work equipment pins daily if they are submerged in water.

Dusty work sites:

When working at dusty work sites, do as follows:

- ◆ Check the air cleaner for clogging more frequently. Clean the air cleaner at shorter intervals than specified.
- ◆ Clean the radiator core frequently to avoid clogging.
- ◆ Clean and replace the fuel filter frequently.
- ◆ Clean electrical components, especially the starting motor and alternator, to avoid accumulation of dust.

Avoid mixing oils:

- ◆ Never mix oils of different brands. If you have only oil which is a different brand from the one that is used in the machine, do not add it but replace all the oil.

18. OUTLINES OF SERVICE

- ◆ Use Komatsu genuine parts for replacement.
- ◆ When changing or adding oil, do not use a different type of oil.
- ◆ Unless otherwise specified, the oil and coolant used at the time of shipment from the factory are as shown in the table below.

Item	Kind of Fluid
Engine oil pan	EO1
Drive train; transmission, torque converter and rear main frame	HDTF
Final drive	MPL
Undercarriage Components	EO1
Hydraulic tank	HDTF or EO2
Fuel tank	D975 No. 2
Radiator	50-50 Antifreeze/Water

- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

18.1 OUTLINE OF OIL, FUEL, COOLANT

18.1.1 OIL

- ◆ Oil is used in the engine and work equipment under extremely severe conditions (high temperature, high pressure), and it deteriorates with use. Always use oil that matches the grade and temperature for use given in this Operation & Maintenance Manual. Even if the oil is not dirty, always replace the oil after the specified interval.
- ◆ Oil corresponds to blood in the human body, so always be careful when handling it to prevent any impurities (water, metal particles, dirt, etc.) from getting in. The majority of problems with machine are caused by the entry of such impurities. Take particular care not to let any impurities get in when storing or adding oil.
- ◆ Never mix oils of different grades or brands.
- ◆ Always add the specified amount of oil. Having too much oil or too little oil are both causes of problems.
- ◆ If the oil in the work equipment is not clear, there is probably water or air getting into the circuit. In such cases, please contact your Komatsu distributor.
- ◆ When changing the oil, always replace the related filters at the same time.
- ◆ We recommend you to have an analysis made of the oil periodically to check the condition of the machine. For those who wish to use this service, please contact your Komatsu distributor.

18.1.2 FUEL

- ◆ The fuel pump is a precision instrument, and if fuel containing water or dirt is used, it cannot work properly.
- ◆ Be extremely careful not to let impurities get in when storing or adding fuel.
- ◆ Always use the fuel specified in this Operation & Maintenance Manual. Fuel may congeal depending on the temperature when it is used (particularly in low temperature below -15°C (5°F), so it is necessary to change to a fuel that matches the temperature.
- ◆ To prevent the moisture in the air from condensing and forming water inside the fuel tank, always fill the fuel tank after completing the day's work.

- ◆ Before starting the engine, or when 10 minutes have passed after adding fuel, drain the sediment and water from the fuel tank.
- ◆ If the engine runs out of fuel, or if the filters have been replaced, it is necessary to bleed the air from the circuit.

18.1.3 COOLANT

- ◆ River water contains large amounts of calcium and other impurities, so if it is used, scale will stick to the engine and radiator, and this will cause defective heat exchange and overheating. Do not use water that is not suitable for drinking.
- ◆ When using antifreeze, always observe the precautions given in this Operation and Maintenance Manual.
- ◆ Komatsu machines are supplied with Komatsu original antifreeze in the coolant when the machine is shipped. This antifreeze is effective in preventing corrosion of the cooling system. The antifreeze can be used continuously for two years or 4000 hours. Therefore, it can be used as it is even in hot areas.
- ◆ Antifreeze is volatile, so be extremely careful not to expose it to flame or fire.
- ◆ The proportion of antifreeze to water differs according to the ambient temperature. For details of the mixing proportions, see 20.2.3 ANTIFREEZE.
- ◆ If the engine overheats, wait for the engine to cool before adding coolant.
- ◆ If the coolant level is low, it will cause overheating and will also cause problems with corrosion from the air in the coolant.

18.1.4 GREASE

- ◆ Grease is used to prevent twisting and noise at the joints.
- ◆ The nipples not included in the maintenance section are nipples for overhaul, so they do not need grease. If any part becomes stiff after being used for a long time, add grease.
- ◆ Always wipe off all of the old grease that is pushed out when greasing. Be particularly careful to wipe off the old grease in places where sand or dirt sticking in the grease would cause wear of the rotating parts.

18.1.5 STORING OIL AND FUEL

- ◆ Keep indoors to prevent any water, dirt, or other impurities from getting in.
- ◆ When keeping drum cans for a long period, put the drum on its side so that the filler port of the drum can is at the side, to prevent moisture from being sucked in. If drum cans have to be stored outside, cover them with a waterproof sheet or take other measures to protect them.
- ◆ To prevent any change in quality during long-term storage, be sure to use in the order of first in - first out (use the oldest oil or fuel first).

18.1.6 FILTERS

- ◆ Filters are extremely important safety parts. They prevent impurities in the fuel and air circuits from entering important equipment and causing problems. Replace all filters periodically. For details, see the procedures in this Operation and Maintenance Manual. However, when working in severe conditions, it is necessary to consider replacing the filters at shorter intervals according to the oil and fuel (sulfur content) being used.
- ◆ Never try to clean the filters (cartridge type) and use them again. Always replace with new filters.
- ◆ When replacing oil filters, check if any metal particles are stuck to the old filter. If any metal particles are found, please contact your Komatsu distributor.
- ◆ Do not open packs of spare filters until just before they are to be used.
- ◆ Always use Komatsu genuine filters.

18. OUTLINES OF SERVICE

18.2 RELATING TO ELECTRICAL SYSTEM

- ◆ If the wiring gets wet or the insulation is damaged, the electric system leaks and this could result in hazardous malfunction of the machine.
- ◆ Services relating to the electric system are (1) check of fan belt tension, (2) check of damage or wear in the fan belt and (3) check of battery fluid level.
- ◆ Never remove or disassemble any electric components installed in the machine.
- ◆ Never install any electric components other than these specified by Komatsu.
- ◆ Be careful to keep the electric system free of water when washing the machine or when it rains.
- ◆ When working on the seashore, carefully clean the electric system to prevent corrosion.
- ◆ Never connect any optional power source to the fuse, starting switch, battery relay, etc.

19. WEAR PARTS LIST

Wear parts such as the filter element, cutting edge, etc. are to be replaced at the time of periodic maintenance or before their abrasion limits. The wear parts should be changed correctly in order to use the machine economically. For part change, Komatsu genuine parts of excellent quality should be used.

Item	Part No.	Part Name	Qty.	Replacement Frequency
Engine oil filter	1258 952 H1	Cartridge	1	Every 250 Hours Service
Fuel filter	1240 619 H2	Cartridge	1	Every 250 Hours Service
Hydraulic oil filter	1266 751 H2	Cartridge	1	Every 1000 Hours Service
Drive train pressure filter	1266 751 H2	Cartridge	1	Every 1000 Hours Service
Drive train suction strainer (clean or replace)	619 214 C1	60 Mesh element	1	Every 1000 Hours Service
Drive train breather	662 250 C1 or 666 156 C1	Breather	1	Every 1000 Hours Service
Engine fan belt	1257 761 H1	Fan belt	1	Periodic or when required
Air cleaner	1105 717 C1	Primary element	1	Periodic or when required
	529 852 R5	Secondary element	1	Periodic or when required
Blade - D32E-1	620 563 C1	Inner cutting edge	2	---
	1267 328 H1	Outer cutting edge	2	
	646 534 C1	Plow bolt	16	
	25 529 R1	Hex nut	16	
Blade - D32P-1	620 563 C1	Inner cutting edge	2	---
	1267 329 H1	Outer cutting edge	2	
	646 534 C1	Plow bolt	20	
	25 529 R1	Hex nut	20	
Blade - D38E-1	620 563 C1	Inner cutting edge	2	---
	1267 328 H1	Outer cutting edge	2	
	646 534 C1	Plow bolt	16	
	25 529 R1	Hex nut	16	
Blade - D38P-1	620 563 C1	Inner cutting edge	2	---
	1267 329 H1	Outer cutting edge	2	
	646 534 C1	Plow bolt	20	
	25 529 R1	Hex nut	20	
Blade - D39E-1	1282 468 H1	Inner cutting edge	2	---
	1283 143 H1	Outer cutting edge	2	
	646 534 C1	Plow bolt	16	
	25 529 R1	Hex nut	16	
Blade - D39P-1	1282 468 H1	Inner cutting edge	2	---
	1283 144 H1	Outer cutting edge	2	
	646 534 C1	Plow bolt	20	
	25 529 R1	Hex nut	20	

20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE

20.1 PROPER SELECTION OF FUEL, COOLANT AND LUBRICANT

It is not our policy to approve lubricants or to guarantee oil performance in service. The responsibility of quality of the lubricant must remain with the supplier of the lubricant. When in doubt consult your Komatsu distributor. The lubricants specified for this machine are shown below.

RESERVOIR	TYPE	AMBIENT TEMPERATURE																CAPACITY				
		°C -34	-29	-23	-18	-12	-7	-1	4	10	16	21	27	32	38	43	49		°C			
		°F -30	-20	-10	0	10	20	30	40	50	60	70	80	90	100	110	120	°F				
Crankcase with filter change	EO1																		SAE 15W-40	⇔	9.5 ℓ (2.5 gal)	
Front idler (rebuilt)	HDTF or EO2																				0.35 ℓ (12 oz)	
																						0.35 ℓ (12 oz)
																						0.4 ℓ (13.5 oz)
Track roller (rebuilt)	HDTF or EO2																				0.35 ℓ (12 oz)	
																						0.35 ℓ (12 oz)
																						0.47 ℓ (16 oz)
Top idler (rebuilt)	HDTF or EO2																				0.1 ℓ (4 oz)	
																						0.1 ℓ (4 oz)
																						0.1 ℓ (4 oz)
Final drive	MPL																				9.5 ℓ (2.5 gal)	
																						9.5 ℓ (2.5 gal)
																						15.2 ℓ (4 gal)
Drive train %	HDTF																				79.5 ℓ (21 gal)	
Hydraulic system, equipment #	HDTF, EO2 or HTF																					51.1 ℓ (13.5 gal)
Fuel tank	DF																					146 ℓ (38.5 gal)
Cooling system		See 20.2 COOLING SYSTEM																26.5 ℓ (7 gal)				

* SAE 5W-30 may be substituted.

% Drive train consists of the rear main frame, steering drive, transmission, torque converter, oil cooler and all appropriate lines.

Capacity may vary depending on hydraulic equipment mounted on machine.

20. USE OF FUEL, COOLANT AND LUBRICANTS

- HDTF Komatsu heavy duty transmission fluid or equivalent fluid meeting C-4 or TO-4 and must NOT contain viscosity index improver.
- EO1 Komatsu engine oil or multigrade diesel engine oil or engine oil API CF/CC or MIL-L-2104 with sulphated ash of 1.65%.
- EO2 (For service only) Komatsu hydraulic fluid or engine oil API CD/CC, CD or MIL-L-2104 and passing TO-2 and C-3 test with 0.10% minimum zinc.
- MPL Komatsu gear lube or multi-purpose gear lube API GL-5 or MIL-L-2105.
- MPG Komatsu super grease or multi-purpose grease 251 HEPM or NLGI grade #2 multi-purpose lithium grease with 3% MoS₂ (molybdenum disulfide).
- HTF (For service only) Komatsu hydraulic transmission fluid.
- DF Diesel fuel per ASTM D975, Grade 1 or 2 depending on ambient temperature.
- SAE: Society of Automotive Engineers
API: American Petroleum Institute
NLGI: National Lubricating Grease Institute
ASTM: American Society of Testing and Materials

20. USE OF FUEL, COOLANT AND LUBRICANTS

20.2 COOLING SYSTEM

20.2.1 GENERAL

The cooling system operates under pressure which is controlled by the pressure relief valve in the radiator cap.

The belt driven water pump circulates the coolant through the engine block, cylinder heads, radiator, and engine oil cooler. Circulation is controlled by the thermostat which by-passes coolant flow around the radiator until the engine reaches operating temperature.

Proper cooling is possible only when the system is sealed, the radiator cap gasket is in good condition, the pressure relief valve and thermostats are operating properly. The system is free of coolant and air flow restrictions and the system is filled to the proper level.

Selection and maintenance of the engine coolant is important to long engine life. The following information provides recommendations for selecting the engine coolant, maintaining the coolant inhibitors and servicing the cooling system.

The system operates successfully with a water/antifreeze mixture or inhibited/conditioned water as the coolant. Water alone allows rust, scale deposits, and corrosion to occur within this system.

After 2000 hours or one year of operation, whichever comes first, the cooling system should be drained, flushed and refilled.

20.2.2 WATER

Use water which has a low mineral content. Water used in conjunction with antifreeze, coolant filters and inhibited water must meet the following standards:

20.2.2.1 TOTAL HARDNESS

Not to exceed 170 parts per million (10 grains/gallon maximum) to prevent scale deposits. Water containing dissolved magnesium and calcium (the usual reason for water hardness) above the specified amount will cause scale deposits to develop in the engine.

20.2.2.2 CHLORIDES

Not to exceed 40 parts per million (2.5 grains/gallon maximum) to prevent corrosion.

20.2.2.3 SULFITES

Not to exceed 100 parts per million (5.8 grains/gallon maximum) to prevent corrosion.

20.2.2.4 DISSOLVED SOLIDS

Not to exceed 340 parts per million (20 grains/gallon maximum) to minimize sludge deposits, scale deposits, corrosion or a combination of these.

If any of the requirements cannot be met, use distilled, de-ionized, or de-mineralized water. To determine if local water supplies meet these standards, water samples can be tested by water treatment laboratories. Softened water that is prepared using common salt (sodium chloride) contains excessive amounts of chlorides and should not be used.

REMARK

Never use water alone in the cooling system because corrosion will occur.

20. USE OF FUEL, COOLANT AND LUBRICANTS

20.2.3 ANTIFREEZE

Low silicate ethylene glycol antifreeze is recommended. The antifreeze should contain no more than 0.1% anhydrous alkali metasilicate. Low silicate antifreeze is recommended to avoid the formation of silica-gel (hydro-gel). This gel formation can occur when the cooling system contains an over concentration of high silicate antifreeze and/or supplemental coolant additive. DO NOT use methanol or alcohol as an antifreeze because of its low boiling point. Antifreeze may retain its freeze protection for more than one season but coolant conditioners must be added to maintain corrosion protection. Antifreeze formulated with methoxy propanol, or propylene glycol, is not recommended for this system.

REMARK

Do not mix types of antifreeze solutions. Mixed solutions make it impossible to determine the protection against freezing. Antifreeze containing sealer or antileak additives should NOT be used in this system. Sealer or antileak additives will cause plugging problems in the cooling system.

WARNING

Use extreme caution when adding coolant to a hot radiator to avoid being burned. Wear gloves and goggles and keep face away from the filler neck.

Check the solution periodically and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing. An antifreeze concentration greater than 68% will adversely affect freeze protection and heat transfer rates. Antifreeze concentrations between 68% and 100% actually have a higher freezing point than a 68% antifreeze concentration and should not be used due to reduced heat transfer rates.

REMARK

Do not use a 100% antifreeze solution for freezing protection, This will cause severe corrosion in the cooling system and if not detected will cause radiator and oil cooler core damage. Use a water/antifreeze solution as described in the following table.

The following table shows the approximate percentage of antifreeze solution required for various temperatures.

Approximate Freezing Point	Percentage of Antifreeze Concentration by Volume	Specific Gravity at 16°C (60°F)
0°C (+32°F)	0	1.000
-7°C (+20°F)	15	1.025
-12°C (+10°F)	25	1.040
-18°C (0°F)	33	1.053
-23°C (-10°F)	40	1.062
-29°C (-20°F)	45	1.070
-34°C (-30°F)	48	1.074
-40°C (-40°F)	53	1.080
-46°C (-50°F)	56	1.083
-51°C (-60°F)	59	1.088
-57°C (-70°F)	62	1.092
-62°C (-80°F)	65	1.095
-68°C (-90°F)	67	1.097
-96°C (-92°F)	68	1.098

20. USE OF FUEL, COOLANT AND LUBRICANTS

20.2.4 INHIBITORS/CONDITIONERS

1. All cooling system inhibitors, including those in antifreeze solutions, become depleted through normal operation. If the inhibitors in antifreeze are allowed to become depleted, the antifreeze becomes corrosive and attacks and coats the metallic surfaces of the cooling system which reduces heat transfer. Cooling system conditioners which contain these inhibitors must be added to maintain corrosion protection.
2. SOLUBLE OIL IS NOT RECOMMENDED for use in this engine as its use will reduce heat transfer.
3. There are no miracle additives that will increase heat transfer or prevent overheating. Conditioned water is still the best coolant.

20.2.4.1 MAINTENANCE OF COOLING SYSTEM INHIBITORS

Keeping the engine coolant properly inhibited will keep the engine and radiator free of rust, scale deposits and corrosion.

New vehicles are delivered with Antifreeze protection.

Each time the coolant is drained and replaced, the coolant must be recharged with DCA4. New coolant can be correctly charged with supplemental coolant additives by using DCA4 concentrate listed in the table DCA4 Unit Guide.

If coolant is added between drain intervals, additional DCA4 will be required.

20.2.4.2 COOLANT TESTING FOR CONDITIONER CONCENTRATION

DCA4 UNIT GUIDE	
Fleetguard Part No.	DCA4 Units
DCA4 Liquid DCA60LDCA80L	4 - 0.473 ℓ (1 pt) 1760 - 208 ℓ (55 gal)
DCA4 Powder DCA95	20

When the cooling system is maintained as recommended, the conditioner concentration should be satisfactory. The DCA4 concentration must not fall below 1.0 unit per 3.8 ℓ (1 gal) or exceed 2 units per 3.8 ℓ (1 gal). The only accurate method for testing chemical concentrations in coolant with mixed chemical compounds is a laboratory analysis. For this reason, the coolant inhibitor should be maintained as shown in the MAINTENANCE SCHEDULE CHART.

REMARK

Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over-concentration can cause formation of gel that can cause restriction, plugging of passages and overheating.

20.2.4.3 REPLENISHING THE COOLANT CONDITIONER

When antifreeze is added, add coolant conditioner equal to 1.0 unit per 3.8 ℓ (1 gal) of antifreeze.

REMARK

Mixing of DCA4 and other supplemental coolant additives is not recommended because there is currently no test kit available to measure concentration levels with mixed chemical solutions.

20. USE OF FUEL, COOLANT AND LUBRICANTS

20.3 FUEL SYSTEM

20.3.1 GENERAL

Cleanliness of diesel fuel determines the service life of the fuel injection components. Water and contaminants, allowed to reach precision injection components, cause rapid wear and poor performance. Clean fuel and regular servicing of the fuel tank and fuel filtering components are necessary for long service life. Always clean the area around the fuel tank filler cap before refueling.

REMARK

Below -12°C (10°F) the paraffin in Grade 2 diesel fuel will change to wax particles and clog the fuel filters. For best results use Grade 1 in cold weather.

Check the solution periodically and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing.

WARNING

Fire hazard - never mix gasoline, gasohol and/or alcohol with diesel fuel. This practice creates an extreme fire hazard and under certain conditions an explosion which could result in personal injury or death.

WARNING

Never remove the fuel tank filler cap or refill the fuel tank while the engine is running or hot or when the machine is indoors. Fumes are dangerous, a spark or flame could result in a fire or explosion.

20.3.2 DIESEL FUEL SPECIFICATIONS

ASTM refers to American Society for Testing and Materials. The D-396 fuels must also meet the cetane number and sulfur requirements of the D-975 specifications.


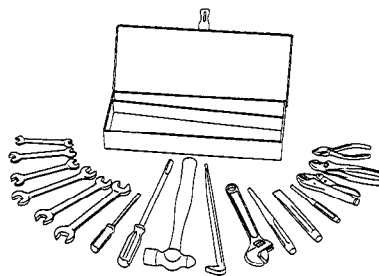
DIESEL FUEL SPECIFICATIONS	
Type of Operation	Preferred Specifications
Normal Service Above -12°C (10°F)	ASTM D-975 Grade 2/D ASTM D-396 Grade 2
Below -12°C (10°F) or Extended Idling	ASTM D-975 Grade 1-D ASTM D-396 Grade 1

Optionally, the equivalent grades of recognized Federal Government specifications may be used; latest revisions of VV-F-800a.

21. STANDARD TIGHTENING TORQUES

21.1 INTRODUCTION OF NECESSARY TOOLS

The following tools are needed when carrying out maintenance.


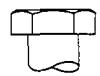

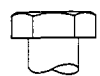



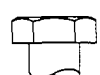

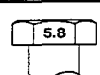

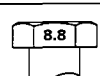

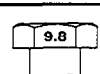

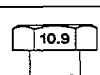

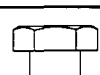

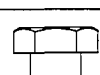

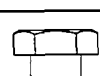

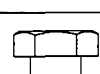

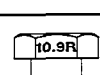

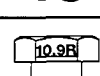

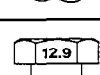

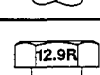
No.	Name of tool	Part No.	Remarks
1.	Wrench Set	09000-30006	Width across flats S1, S2 End wrench - 8x10 mm End wrench - 12x14 mm End wrench - 13x17 mm End wrench - 19x22 mm End wrench - 24x27 mm End wrench - 30x33 mm 
2.	Tool Kit	276 820 R91	End wrench - 7/16X1/2 End wrench - 9/16x5/8 End wrench - 5/8x11/16 End wrench - 3/4x13/16 End wrench - 15/16x1 Screwdriver - 1/4 shank Screwdriver - 3/8 shank Ball peen hammer Pry bar - 9/16x16 Adjustable wrench Punch - 5/16x10 Chisel - 7/8x10 Punch - 3/16x10 Vise grip wrench Slip joint plier Diagonal (side) cutter Tool box 
3.	Filter Wrench	DR02-535	Removal of filter cartridges.
4.	Grease Pump	999 677 R91	For lubrication of machine.
5.	Grease Cartridge		For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

If any of the above tools are broken, please order them from your Komatsu distributor.

When not using the tools, always put them in the appropriate tool box.

21. STANDARD TIGHTENING TORQUES

21.2 BOLT IDENTIFICATION CHART

TYPE/CLASS	DESCRIPTION	HEAD MARKING	
Type 5 Inch Thread	Three radial lines on top and none on side of head. Medium carbon steel quenched and tempered.		
Type 5.2 Inch Thread	Three radial lines on top and none on side of head. Low carbon boron steel quenched and tempered.		
Type 8 Inch Thread	Six radial lines on top and none on side of head. Medium carbon or carbon alloy steel quenched and tempered.		
Type 8.2 Inch Thread	Six radial lines on top and none on side of head. Low carbon boron steel quenched and tempered.		
Class 5.8 Metric Thread	Marked on top or side of head. Low or medium carbon steel.		
Class 8.8 Metric Thread	Marked on top or side of head. Medium carbon or carbon alloy or low carbon boron steel quenched and tempered.		
Class 9.8 Metric Thread	Marked on top or side of head. Medium carbon or carbon alloy or low carbon boron steel quenched and tempered.		
Class 10.9 Metric Thread	Marked on top or side of head. Medium carbon or carbon alloy or low carbon boron steel quenched and tempered.		
Type 8R Inch Thread	Six radial lines on head with type designation, none on sides. Medium carbon or medium carbon alloy steel quenched and tempered.		
Type 8R Inch Thread	Six radial lines on head with type designation, none on sides. Low carbon boron steel quenched and tempered.		
Type 9 Inch Thread	Six radial lines on head with type designation, none on sides. Medium carbon alloy steel quenched and tempered.		
Type 9R Inch Thread	Six radial lines on head with type designation, none on sides. Medium carbon alloy steel quenched and tempered.		
Class 10.9R Metric Thread	Marked on top or side of head. Medium carbon or carbon alloy steel quenched and tempered.		
Class <u>10.9R</u> Metric Thread	Marked on top or side of head and underlined. Low carbon boron steel quenched and tempered.		
Class 12.9 Metric Thread	Marked on top or side of head. Medium carbon alloy steel quenched and tempered.		
Class 12.9R Metric Thread	Marked on top or side of head. Medium carbon alloy steel quenched and tempered.		

21. STANDARD TIGHTENING TORQUES

21.2.1 GRADE 5 AND 8 NON-PHOSPHATE COATED HARDWARE

Recommended torque for all Standard Application Nuts and Bolts, provided; all thread surfaces are clean and lubricated with SAE-30 engine oil or joints are rigid, that is, no gaskets or compressible materials are used. When reusing nuts or bolts, use minimum torque values.

THREAD	GRADE 5	
	N•m	lbf ft
1/4NC	8	6
1/4NF	9	7
5/16NC	18	13
5/16NF	20	15
3/8NC	33	24
3/8NF	37	27
7/16NC	52	38
7/16NF	57	42
1/2NC	79	58
1/2NF	88	65
9/16NC	114	84
9/16NF	126	93
5/8NC	156	115
5/8NF	175	130
3/4NC	278	205
3/4NF	312	240
7/8NC	414	305
7/8NF	454	334
1NC	617	455
1NF	691	510
1-1/8NC	827	610
1-1/8NF	929	685
1-1/4NC	1166	860
1-1/4NF	1295	955
1-3/8NC	1532	1130
1-3/8NF	1749	1290
1-1/2NC	2034	1400
1-1/2NF	2291	1690
1-3/4NC	3213	2370
2NC	4813	3550

THREAD	GRADE 8	
	N•m	lbf ft
1/4NC	12	9
1/4NF	15	11
5/16NC	24	18
5/16NF	28	21
3/8NC	46	34
3/8NF	52	38
7/16NC	73	54
7/16NF	81	60
1/2NC	111	82
1/2NF	122	90
9/16NC	163	120
9/16NF	179	132
5/8NC	224	165
5/8NF	251	185
3/4NC	393	290
3/4NF	434	320
7/8NC	617	455
7/8NF	698	515
1NC	942	695
1NF	1064	785
1-1/8NC	1342	990
1-1/8NF	1505	1110
1-1/4NC	1898	1400
1-1/4NF	2102	1550
1-3/8NC	2481	1830
1-3/8NF	2827	2085
1-1/2NC	3295	2430
1-1/2NF	3701	2730
1-3/4NC	5166	3810
2NC	7810	5760

Multiply the standard torque by 0.65 when finished jam nuts are used, 0.7 when Molykote, white lead or similar mixture are used as lubricants, 0.75 when parkerized bolts or nuts are used, 0.85 when cadmium plated bolts or nuts and zinc bolts w/waxed zinc nuts are used or 0.9 when hardened surfaces are used under the nut or bolt head. The General Torque must be used in all cases where SPECIAL TORQUES are not given. Values listed in this manual are lubricated (wet) threads; values should be increased 1/3 for non-lubricated (dry) threads.

21. STANDARD TIGHTENING TORQUES

21.2.2 GRADE 8 PHOSPHATE COATED HARDWARE

NOMINAL THREAD	STANDARD TORQUE $\pm 10\%$	
	N•m	lbf ft
1/4	10	8
5/16	21	16
3/8	38	28
7/16	60	45
1/2	92	70
9/16	130	100
5/8	180	140
3/4	325	240
7/8	520	390
1	780	580
1-1/8	1110	820
1-1/4	1565	1160
1-3/8	2050	1520
1-1/2	2720	2020
1-3/4	3380	2510
2	5080	3780

This chart provides tightening torque for general purpose applications using original equipment standard hardware as listed in the Parts Books for the machine involved.

DO NOT SUBSTITUTE.

Original equipment standard hardware is defined as Grade 8, coarse thread bolts and nuts and thru hardened flat washers (Rockwell "C" 38-45), all phosphate coated and assembled without supplemental lubrication (as received) condition.

The torques shown also apply to the following;

Phosphate coated bolts used in tapped holes in steel or gray iron. Phosphate coated bolts used with phosphate coated prevailing torque nuts (nuts with distorted threads or plastic inserts). Phosphate coated bolts used with copper plated weld nuts.

Markings on bolt heads or nuts indicate material grade ONLY and are NOT to be used to determine required torque.

21.2.3 STANDARD METRIC FASTENERS

NOMINAL THREAD	STANDARD TORQUE $\pm 10\%$	
	N•m	lbf ft
MILLIMETERS		
M6	10	7
M7	16	12
M8	23	17
M10	46	34
M12	80	60
M14	125	90
M16	200	150
M18	275	200
M20	385	290
M22	530	390
M24	670	500
M27	980	730
M30	1330	990
M33	1790	1330
M36	2325	1730
M39	3010	2240

This chart provides tightening torque for general purpose applications using original standard hardware as listed in the Parts Book for the machine involved.

DO NOT SUBSTITUTE.

Original standard hardware is defined as metric class 10.9 bolts and class 10.0 nuts and thru flat washers (Rockwell "C" 38-45), all phosphate coated and assembled without supplemental lubrication.

The torques shown also apply to the following;

Phosphate bolts used in tapped holes in steel or gray iron, with phosphate coated prevailing torque nuts or with copper plated weld nuts.

Markings on bolt heads or nuts indicate material class ONLY and are NOT to be used to determine required torque.

21. STANDARD TIGHTENING TORQUES

21.3 HYDRAULIC TUBES AND FITTINGS

The torque figures are recommended for plain, cadmium or zinc plated fittings, dry or wet installations. Swivel nuts either swaged or brazed. Figures are for tube nuts used with 37° flared fittings and JIC - 37° seat O-Ring boss plugs and swivel nuts.

TUBE NUTS				O - RING BOSS PLUGS AND SWIVEL NUTS		
FOR 37° FLARED FITTINGS				JIC - 37° SEAT		
SIZE	TUBING O.D.	THREAD SIZE	MINIMUM N•m	MAXIMUM N•m	MINIMUM lbf ft	MAXIMUM lbf ft
4	1/4	7/16-20	12	16	9	12
5	5/16	1/2-20	16	20	12	15
6	3/8	9/16-18	29	33	21	24
8	1/2	3/4-16	47	54	35	40
10	5/8	7/8-14	72	79	53	58
12	3/4	1-1/16-12	104	111	77	82
14	7/8	1-3/16-12	122	136	90	100
16	1	1-5/16-12	149	163	110	120
20	1-1/4	1-5/8-12	190	204	140	150
24	1-1/2	2-1/2-12	217	237	162	175
32	2	2-1/2-12	305	325	225	240

21.4 HOSE CLAMPS

The following chart provides the tightening torques for hose clamps used in all rubber applications (radiator, air cleaner, operating lever boots, hydraulic system, fuel systems etc.).

CLAMP TYPE AND SIZE	TORQUE ± 0.6 N•m (5 lbf in)			
	RADIATOR, AIR CLEANER, BOOTS, ETC.		HYDRAULIC SYSTEM	
	N•m	lbf in	N•m	lbf in
T Bolt	6.2 to 7.3	55 to 65	-----	-----
Worm Drive - 1-3/4 in Open Diameter and Under	2.2 to 3.3	20 to 30	4.5 to 5.6	40 to 50
Worm Drive - Over 1-3/4 in Open Diameter	4.5 to 5.6	40 to 50	-----	-----
Worm Drive - All Ultra-Tite	10.7 to 11.8	95 to 105	4.5 to 5.6	40 to 50

21.5 SPLIT FLANGE CONNECTIONS

The following chart provides the tightening torques for split flange connections used in hydraulic systems. Flanges and fitting shoulders should fit squarely. Install all bolts, finger tight, then torque evenly. Over torquing bolts will damage the flanges and/or bolts, which may cause leakage.

FLANGE SIZE	BOLT SIZE	BOLT TORQUE	
		N•m	lbf ft
1/2	5/16	20 to 24	15 to 18
3/4	3/8	30 to 37	22 to 27
1	3/8	37 to 47	27 to 35
1-1/4	7/16	47 to 61	35 to 45
1-1/2	1/2	62 to 79	46 to 58
2	1/2	75 to 88	55 to 65
2-1/2	1/2	107 to 123	79 to 91
3	5/8	187 to 203	138 to 150
3-1/2	5/8	159 to 180	117 to 133

22. PERIODIC REPLACEMENT OF CRITICAL PARTS

To ensure safety at all times when operating or driving the machine, the user of the machine must always carry out periodic maintenance. In addition, to further improve safety, the user should also carry out periodic replacement of the parts given in the table on the next page. These parts are particularly closely connected to safety and fire prevention.

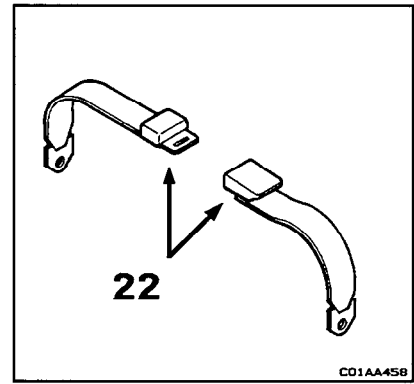
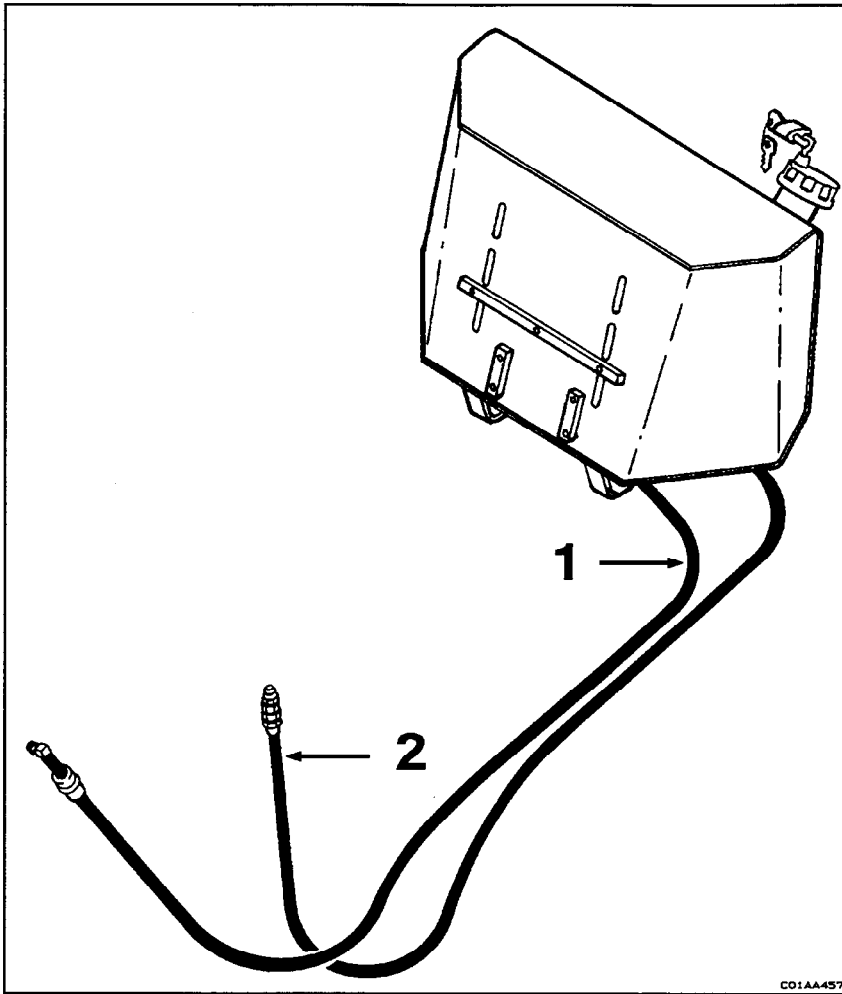
With these parts, the material changes as time passed, or they easily wear or deteriorate. However, it is difficult to judge the condition of the parts simply by periodic maintenance, so they should always be replaced after a fixed time has passed, regardless of their condition. This is necessary to ensure that they always maintain their function completely.

However, if these parts show any abnormality before the replacement interval has passed, they should be repaired or replaced immediately. If the hose clamps show any deterioration, such as deformation or cracking, replace the clamps at the same time as the hoses.

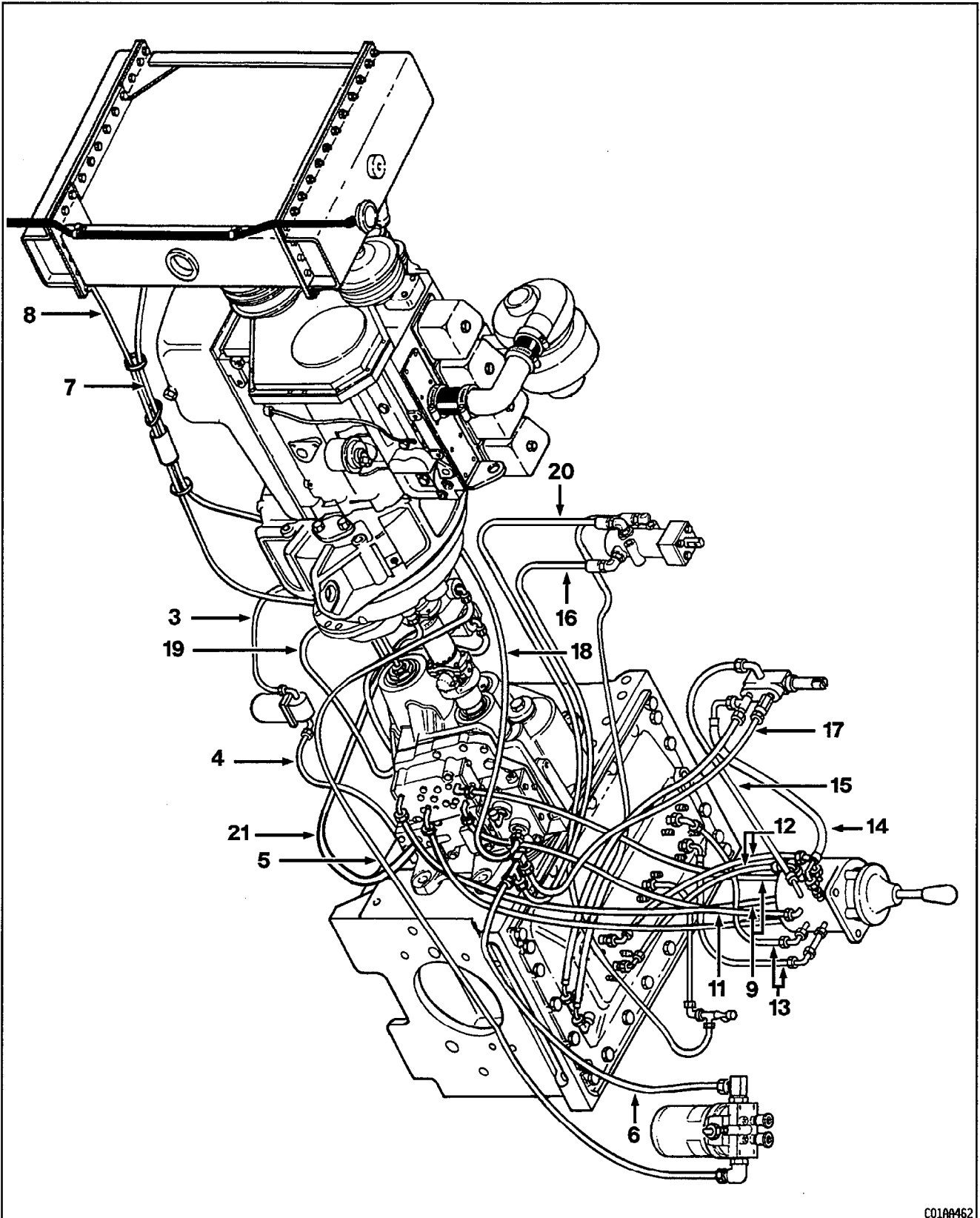
When replacing the hoses, always replace the o-rings, gaskets, and other such parts at the same time. Ask your Komatsu distributor to replace the critical parts.

No.	Safety critical parts for periodic replacement	Qty.	Replacement interval
1	Fuel supply hose	1	Every 2 years or 4000 hours, whichever comes sooner
2	Fuel return hose	1	
3	Drive train hose - strainer to pump	1	
4	Drive train hose - rear main frame to strainer	1	
5	Drive train hose - pump to pressure filter	1	
6	Drive train hose - pressure filter to transmission	1	
7	Drive train hose - converter to cooler	1	
8	Drive train hose - cooler to transmission	1	
9	Drive train hose - transmission/steering valve to transmission	2	
10	Drive train hose - transmission/steering valve to transmission	1	
11	Drive train hose - transmission/steering valve to transmission	1	
12	Drive train hose - transmission/steering valve to steering cylinder	2	
13	Drive train hose - transmission/steering valve to steering cylinder	2	
14	Drive train hose - transmission/steering valve drain to neutral valve	1	
15	Drive train hose - neutral valve to transmission/steering valve	1	
16	Drive train hose - transmission to secondary brake valve	1	
17	Drive train hose - transmission to neutral valve	1	
18	Drive train hose - transmission to torque converter	1	
19	Drive train hose - scavenge pump to rear main frame	1	
20	Drive train hose - secondary brake valve to quick disconnect	1	
21	Drive train hose - transmission to scavenge pump	1	
22	Seat belt	1	Replace every 3 years

22. PERIODIC REPLACEMENT OF CRITICAL PARTS



22. PERIODIC REPLACEMENT OF CRITICAL PARTS



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23. MAINTENANCE SCHEDULE CHART

23.1 MAINTENANCE SCHEDULE CHART

	SERVICE ITEM	PAGE
▲ 10	INITIAL 10 HOURS SERVICE - 24.1	▲ 10
	1. Check torque of blade cutting edge and end bit hardware	3-25
	2. Check torque of track shoe bolts	3-25
● 50	INITIAL 50 HOURS SERVICE (SEE NOTE) - 24.2	● 50
	1. Replace drive train system pressure filter	3-26
	2. Clean drive train system suction strainer	3-27
	NOTE: Perform Steps 1 and 2 for machines with a new or rebuilt transmission and/or steering drive.	
	3. Check track tension and adjust as necessary	3-28
▲ 10	EVERY 10 HOURS SERVICE - 24.3	▲ 10
	1. Check radiator coolant level	3-30
	2. Check engine crankcase oil level	3-30
	3. Check equipment hydraulic system oil level	3-31
	4. Fill fuel tank at end of each days operation	3-31
	5. Drain fuel filter/water separator	3-32
	6. Open fuel shut off valve	3-32
	7. Clean pre-cleaner hood	3-32
	8. Check brake pedal travel	3-33
	9. Perform ground level inspection	3-33
● 50	EVERY 50 HOURS SERVICE - 24.4	● 50
	1. Check drive train system fluid level	3-35
	2. Lubrication	3-36
	◆ Ripper linkage (12 points)	3-36
	◆ Blade angle frame to C frame pin (2 points)	3-36
■ 100	EVERY 100 HOURS SERVICE - 24.5	■ 100
	1. Check torque of blade cutting edge hardware	3-36

23. MAINTENANCE SCHEDULE CHART

	SERVICE ITEM	PAGE
250	EVERY 250 HOURS SERVICE - 24.6	250
	1. Replace engine oil filter	3-37
	2. Change engine crankcase oil	3-38
	3. Check final drive oil level	3-38
	4. Replace fuel filter water separator	3-39
	5. Check engine drive belt for wear	3-40
	6. Check operation of the decelerator	3-40
	7. If equipped with a reversible fan, reverse fan blades	3-40
500	EVERY 500 HOURS SERVICE - 24.7	500
	1. Check torque on all hose clamps (except on air intake system)	3-41
	2. Check torque on ROPS mounting hardware	3-41
	3. Check torque of track shoe bolts	3-41
	4. Inspect mounted equipment for operational damage	3-41
	5. Check for and correct leaks at radiator and its connections	3-41
	6. Clean the outside of radiator core	3-41
1000	EVERY 1000 HOURS SERVICE - 24.8	1000
	1. Clean transmission suction strainer	3-42
	2. Change drive train system fluid	3-43
	3. Drain, flush and refill final drive oil	3-43
	4. Replace drive train system breather	3-44
	5. Replace drive train system pressure filter	3-44
	6. Replace equipment hydraulic system return filter	3-45
	7. Clean neutral valve inlet strainer	3-46
	8. Lubricate steering/transmission valve cam plate	3-46
	9. Check torque of sprocket mounting bolts	3-46
2000	EVERY 2000 HOURS SERVICE - 24.9	2000
	1. Drain, flush and refill cooling system	3-47
	2. Clean hydraulic suction strainer	3-48
	3. Clean hydraulic reservoir relief valve	3-49
	4. Change hydraulic system fluid	3-49

23. MAINTENANCE SCHEDULE CHART

SERVICE ITEM		PAGE
PER	PERIODIC - 24.10	PER
1.	Clean air cleaner elements (per indicator)	3-50
2.	Clean fuel tank strainer	3-53
3.	Drain fuel tank sediment bowl	3-54
4.	Replace in-line fuel strainer	3-54
5.	Lubricate	3-54
	◆ Mounted equipment controls (5 w/o ripper, 6 with)	3-54
	◆ Left and right foot pedals (2 points)	3-54
	◆ Right pedal under floor linkage (3 points)	3-55
6.	Inspect seat belt for wear and tear	3-55
REQ	WHEN REQUIRED - 24.11	REQ
1.	Fan belt	3-56
2.	Electrical system	3-56
3.	Ether start	3-61
4.	Venting fuel system	3-62
5.	Angling frame to blade	3-62
6.	Reverse and/or replace cutting edges	3-63
7.	Check track tension and adjust as necessary	3-64
8.	Adjust idler clearance	3-65

24.1 INITIAL 10 HOURS SERVICE

24.1.1 BLADE CUTTING EDGE HARDWARE

Check the torque of the blade cutting edge hardware.

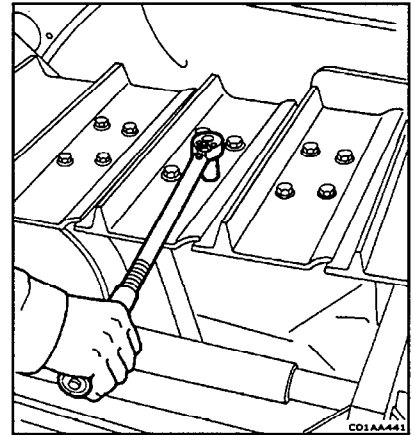
 Plow bolt nuts: **455 N•m (335 lbf ft)**

24.1.2 TRACK SHOE BOLT TORQUE

The bolts used for attaching the track shoes to the tracks are heat treated alloy bolts and will stand a considerable tightening strain. Ordinary bolts must not be used. Nuts must be assembled so that washer face is not against track link. Radius side of nuts must be against track link. Torque bolts to below listed value.

 Track shoe bolt: **90 ±20 N•m (65 ±15 lbf ft) plus 120°**

◆ 120° designates two flats of bolt head.



24. SERVICE PROCEDURE

24.2 INITIAL 50 HOURS SERVICE

24.2.1 REPLACING DRIVE TRAIN PRESSURE FILTER

REMARK

If the pressure filter indicator light on the instrument panel, remains on at operating oil temperature with the engine running, the pressure filter must be changed.

1. With the engine stopped, operate the transmission/steering lever several times to relieve any pressure. Open the battery box side door. Remove all outside dirt from filter. Using a filter wrench remove the spin on filter. Wipe the filter base, removing all of the old oil from the seal area.
2. Coat the seal (1) on the new filter (2) with clean oil. Install the filter by threading (do not spin) it onto the filter base (3) until the seal contacts the base, turn the filter by hand an additional $\frac{1}{4}$ to $\frac{1}{2}$ turn.

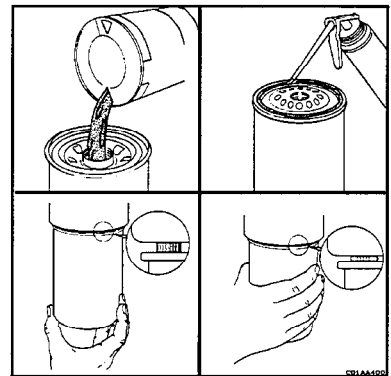
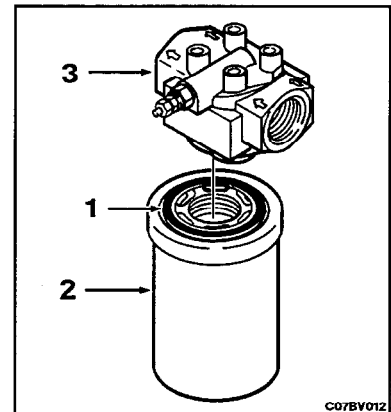
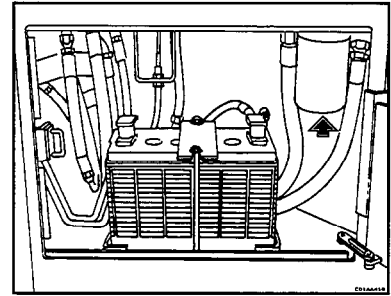
REMARK

Do not over-tighten the filter or use any tools for installation because this can damage the gasket and filter.

REMARK

Mechanical over-tightening may distort the filter header threads or damage the element seal.

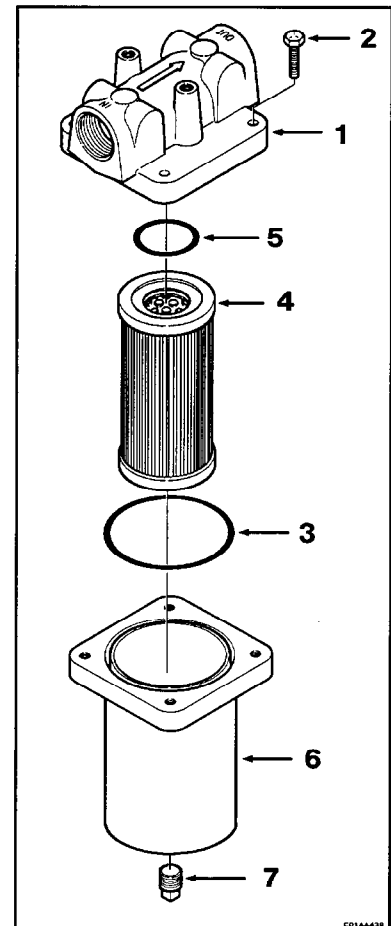
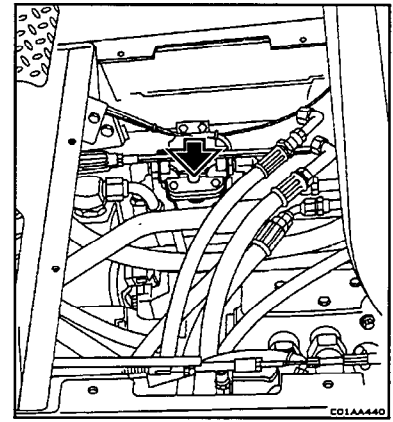
3. Check the level in the drive train system.



24.2.2 SERVICING THE DRIVE TRAIN SUCTION STRAINER

1. Remove the operators compartment floor board to locate the strainer.
2. Remove the four bolts (2) and separate the housing (6) from the base (1). Remove the element (4) with o-ring (5).
3. Wash the element and housing in a commercial solvent and dry thoroughly. Replace o-rings (3 and 5). Remove all dirt from the inside of the base using a cloth dampened with solvent.
4. Check that the new o-ring (5) is in place in the groove in the element (4). Slip the non o-ring end of the element into the housing. Secure the housing to the base (1) with the hardware previously removed.
5. Start the engine and let it idle for approximately five minutes. During this time, check the strainer for leaks. Correct all leaks no matter how minor. Then check the level in the drive train system. Reinstall the operators compartment floor board.

- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24. SERVICE PROCEDURE

24.2.3 TRACK TENSION AND ADJUSTMENT

24.2.3.1 PROPER ADJUSTMENT

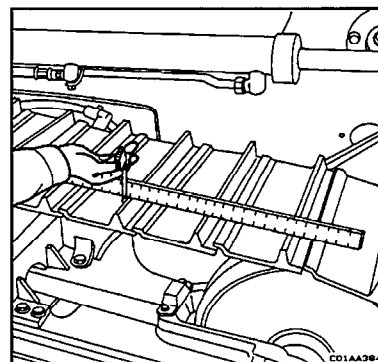
Tracks adjusted too tightly increase operating loads on final drives and accelerate wear on undercarriage components, especially in packing conditions.

A machine in forward operation with correctly adjusted tracks will experience track loads only along the ground from the front idler to where the bushings engage the sprocket.

Lubricated track systems are to be adjusted to provide a sag in the track chain between to front top idler and the front idler. Correct tension reduces stress levels throughout the undercarriage system.

24.2.3.2 CHECKING THE TENSION

1. Place a wooden block, ≈ 305 mm (12 in) in height, under the front most track shoe lug. Drive the machine forward until the track chain is tight along the ground and around the sprocket. Apply and lock the brake pedal, lock the transmission shift lever in the NEUTRAL position and stop the engine.
2. Stand on the track between the front idler and the first track idler in order to accumulate all the chain slack at this point.
3. Place a straightedge on the track so the ends rest over the front idler and track idler. Measure the clearance between the bottom of the straightedge and the top of the shoe grouser with a ruler at the midway point between the idlers.



REMARK

If the distance is more than 64 mm (2-½ in) or less than 50 mm (2 in), adjust the track tension.

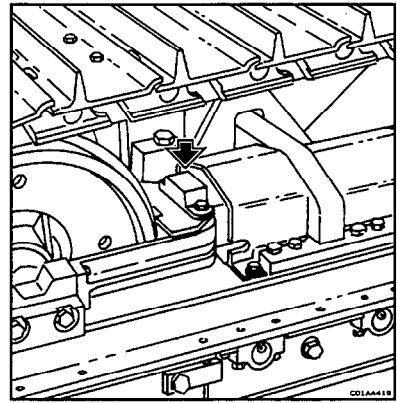
24.2.3.3 ADJUSTING TENSION

The track chains are adjusted by hydraulic pressure. When lubricant is introduced into the front idler fork through the lubrication fitting, it acts upon the piston within the front idler fork forcing the front idler fork and front idler forward for track adjustment.

WARNING

To avoid possible injury, always stand to the side of the bleeder plug when making track adjustment. The pressure in the front idler fork is held by the bleeder plug and check valve. A loose or improper thread fit of either of these parts can allow them to be ejected by the pressure of the lubricant, causing possible injury. When increasing track tension, be sure the bleeder plug and check valve are properly torqued. When relieving track tension, never loosen the bleeder plug and check valve more than 2 ½ turns. Before adding lubricant for track adjustment, be sure the ball check and relief valve are properly torqued.

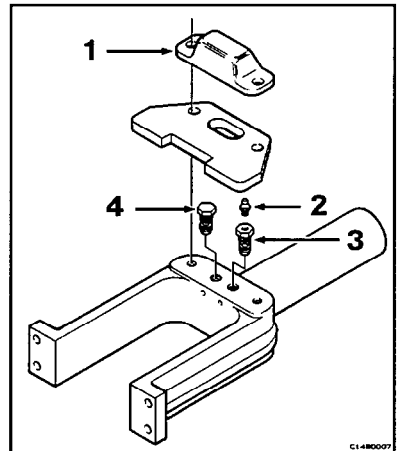
1. Remove the bolts and track adjuster cover.
2. To increase track tension, connect a lubricator nozzle to the lubrication fitting (2). Determine the amount of adjustment necessary, and add lubricant to obtain the proper track chain tension. It is advisable to move the machine forward and backward slightly to be sure the correct tension has been obtained.
3. To reduce track tension, loosen the bleeder valve (3) ½ to 1 full turn to allow the pressurized lubricant to escape through the relief passage. If lubricant does not appear, loosen the check valve (4) (located under the lubrication fitting) ½ to one full turn to allow the pressurized lubricant to escape from a second relief passage.
4. If lubricant still does not appear, use the following emergency method. Should the relief passages still be blocked, unscrew the ball check and/or relief valve an additional 1-½ to 2 turns (2-½ total turns). This will allow a greater amount of pressurized lubricant to free the passages.



⚠ WARNING

Use extreme care when relieving pressure with the following emergency method. If loosened excessively, the ball check or relief valve can be ejected by the cylinder pressure. NEVER loosen these parts more than a total of 2-½ turns.

5. When the proper tension has been obtained, tighten the ball check and/or relief valve to value given below. Install the cover and secure with removed hardware.



Ball Check or Relief Valve:

68 N·m (50 lbf ft)

REMARK

Never remove one link to bring a stretched track to within the range of proper track adjustment. A track that is worn badly enough to take up the length of one link, will be so far out of pitch that the increased wear on the sprocket will far more than offset the saving obtained by the removal of one link in the track chain.

24. SERVICE PROCEDURE

24.3 EVERY 10 HOURS SERVICE (CHECK BEFORE STARTING)

24.3.1 CHECK RADIATOR COOLANT LEVEL

REMARK

Check the coolant level before starting the engine.

1. Check the coolant level in radiator sight glass to make sure coolant is present.

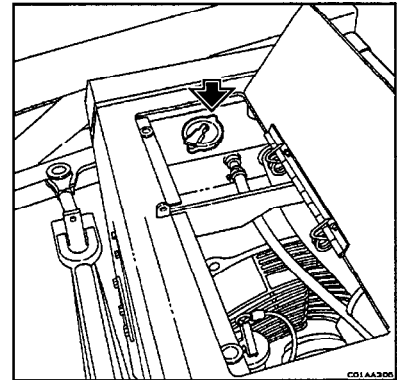
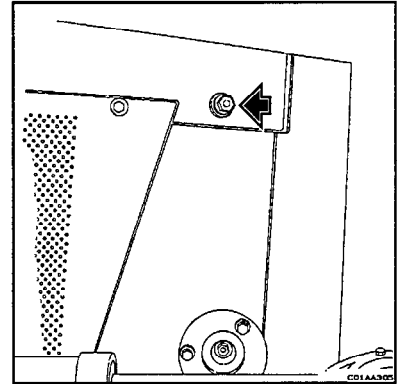
WARNING

- ◆ Hot, scalding coolant can spray out if the radiator cap is removed suddenly. Relieve system pressure by slowly turning the cap to the first notch or lifting the safety lever (if equipped). Remove the cap only after the pressure is relieved.
- ◆ Use extreme caution when adding coolant to a hot radiator to avoid being burned. Wear gloves and goggles and keep face away from the filler neck.

2. If coolant must be added, remove radiator cap by turning it to the left or counterclockwise up to the safety stop until all pressure is released. Press down on the cap and continue to turn until the cap is free to be removed.

3. Add fluid until visible in sight glass.

- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24.3.2 CHECK ENGINE CRANKCASE OIL LEVEL

WARNING

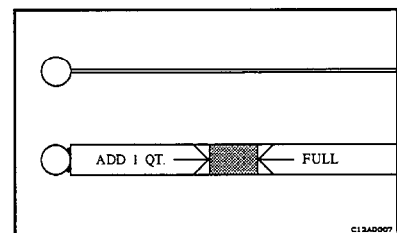
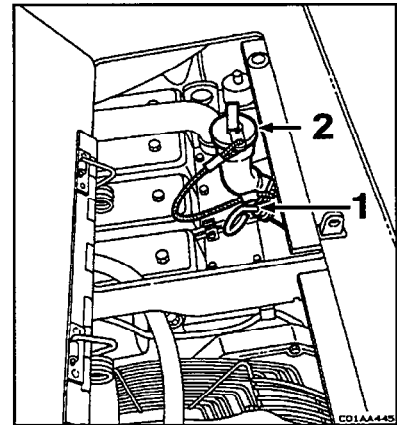
Park the machine on level ground, stop the engine, lower all mounted equipment to the ground, move the safety lever into the vertical (down) position, apply the brake pedal lock, turn off the electrical system master switch.

Stop the engine and check level. For an accurate reading wait for the oil to drain into the crankcase pan. Open hood access door. Remove the oil level gauge (1) and wipe it clean. Reinsert the gauge completely. Remove the gauge and check the oil level. If the level is at or below the ADD mark, add oil through the filler opening (2) to bring the level up to the FULL mark on the gauge.

REMARK

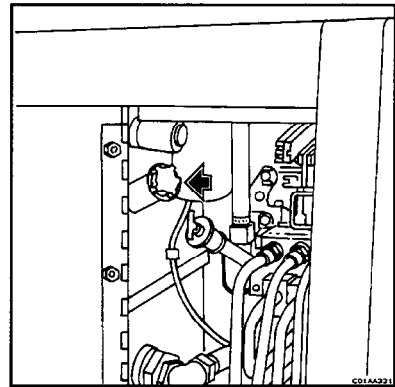
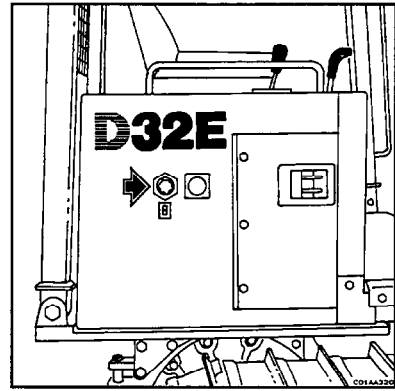
Never run the engine if the level of the oil is at or below the ADD mark on the oil level gauge.

- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24.3.3 CHECK EQUIPMENT SYSTEM HYDRAULIC OIL LEVEL

1. With the oil at operating or ambient temperature, park the machine on level ground, lower the blade to the ground, release the control lever and stop the engine.
 2. Check oil level at sight gauge on the side of the reservoir. Add oil if level is below the center line of the gauge.
 3. Slowly loosen the reservoir fill cap to relieve any reservoir pressure, then remove cap.
 4. Add fluid to the reservoir to bring the level up to the center line of the sight gauge. Replace reservoir filler cap.
- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24.3.4 FILL FUEL TANK

WARNING

When adding fuel, never allow the fuel to over flow. This may cause a fire. If fuel is spilt, thoroughly clean up any spillage.

1. Check the fuel level using the fuel gauge.
2. After completing work, fill the fuel tank through the filler port .

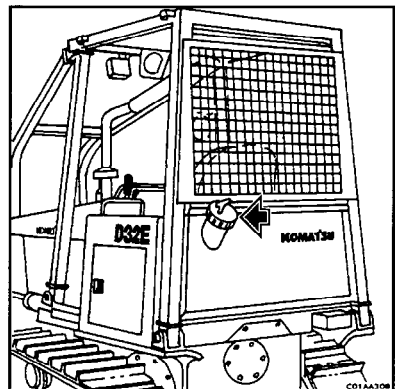
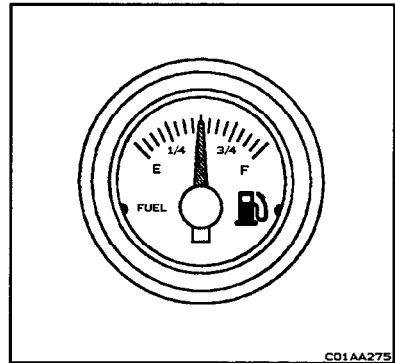
REMARK

For details of the fuel to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.

3. After adding fuel, tighten the cap securely.

REMARK

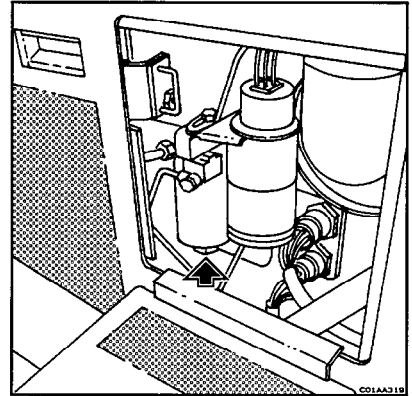
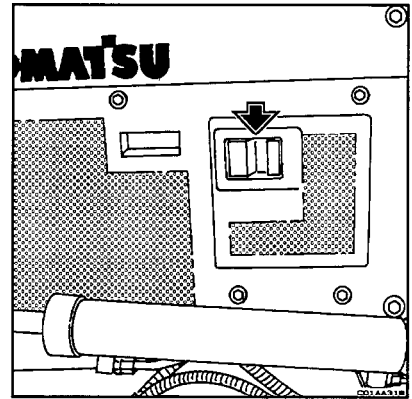
Fuel capacity: 146 ℓ (38.5 gal)



24. SERVICE PROCEDURE

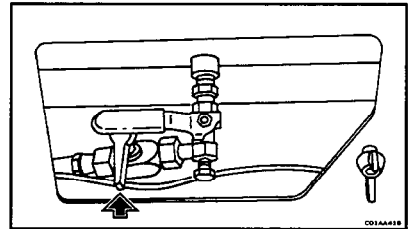
24.3.5 DRAIN FUEL FILTER WATER SEPARATOR

1. Open access door at left engine side sheet.
2. Open the valve and drain water and sediment from the filter until clean diesel fuel appears. Close the valve and access door.



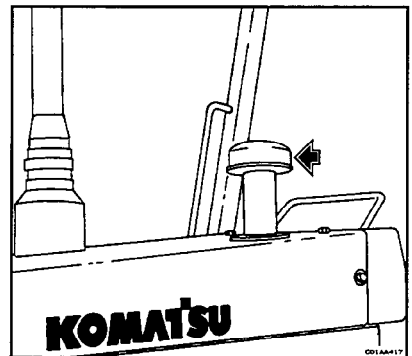
24.3.6 OPEN FUEL SHUT OFF VALVE

1. Open the fuel shut off valve. The shut off valve is open when the valve lever handle is parallel with the hose.



12.3.7 CLEAN PRE-CLEANER HOOD

Remove the cap by twisting and pulling upward. Use compressed air to clean the screen. If compressed air is not available, wash in clean, hot water or preferably water containing a small amount of nonsudsing detergent.



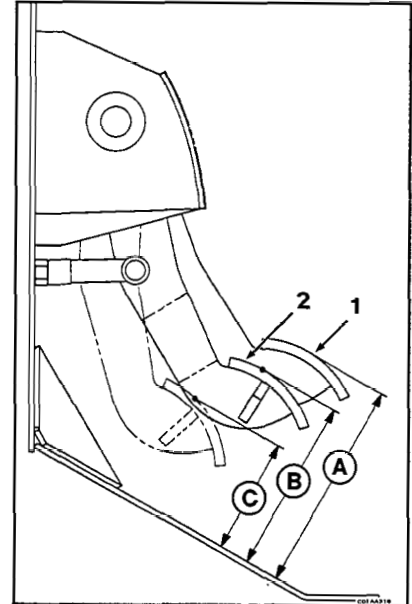
24.3.8 CHECK BRAKE PEDAL TRAVEL

24.3.8.1 CHECK BRAKE AND DECELERATOR PEDAL TRAVEL

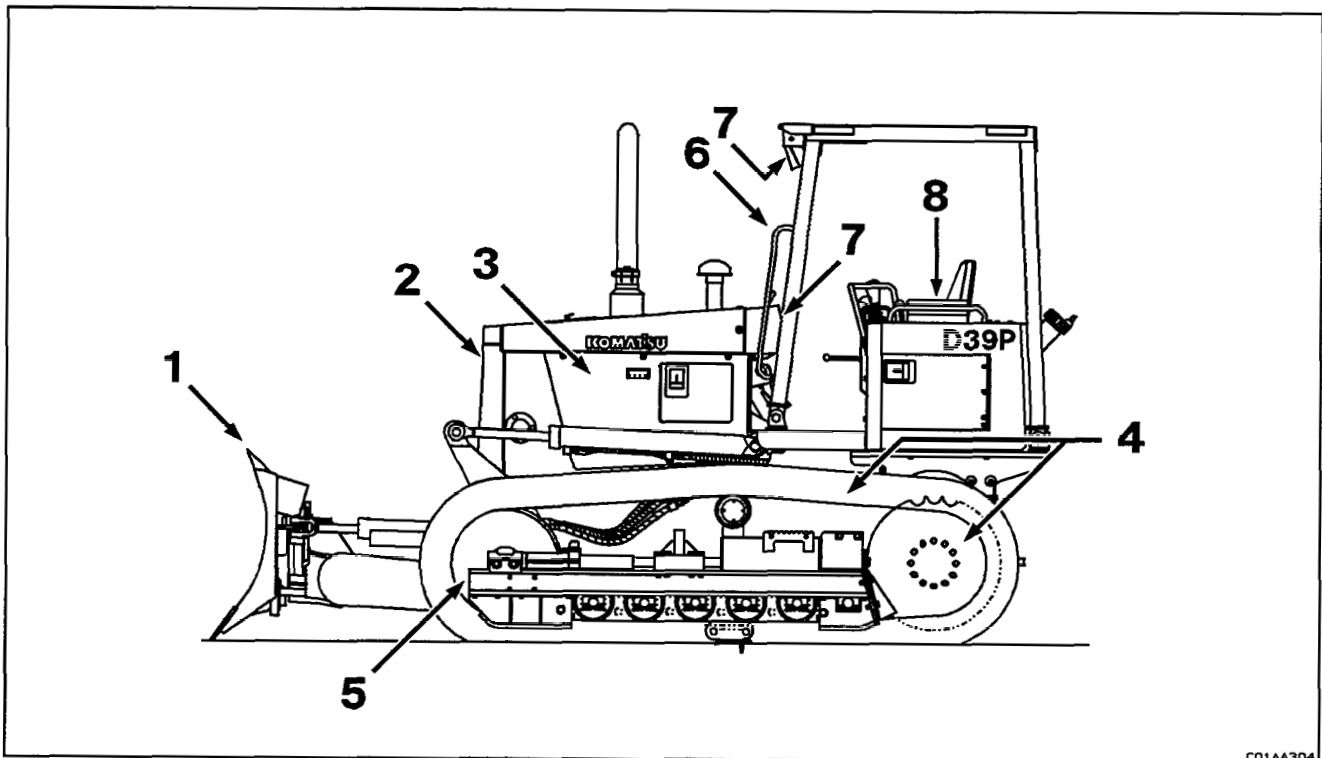
1. Measure the pedal (1) free height (A) from the floor plate; 137 mm (5.4 in).
2. When this value exceeds this amount, or the brake fails to work, refer to your Komatsu distributor.

24.3.8.2 CHECK SECONDARY BRAKE PEDAL TRAVEL

1. Depress secondary brake pedal (2) all the way until it stops.
2. Measure the pedal travel from fully depressed position (C) to the fully released position (B); 38 mm (1.5 in).
3. When this value exceeds this amount, or the brake fails to work, refer to your Komatsu distributor.



24.3.9 PERFORM GROUND LEVEL INSPECTION



24. SERVICE PROCEDURE

 **WARNING**

Dirt, oil or fuel around the parts of the engine which reach high temperatures may cause fire and damage to the machine. Check carefully, and if any abnormality is found, always repair it or contact your Komatsu distributor.

Before starting the engine, look around the machine and under the machine to check for loose nut or bolts, or leakage of oil, fuel, or coolant, and check the condition of the work equipment and hydraulic system. Check also for loose wiring, play, and collection of dust at places which reach high temperatures.

24.3.9.1 CHECK FOR DAMAGE, WEAR, AND/OR PLAY IN WORK EQUIPMENT, CYLINDERS, LINKAGE, HOSES.

Check that there are no cracks, excessive wear, or play in the work equipment, cylinders, linkage, or hoses. If any abnormality is found, repair it.

24.3.9.2 REMOVE DIRT FROM AROUND ENGINE, RADIATOR.

Check that there is no dirt accumulated around the engine or radiator. If any dirt is found, remove it.

24.3.9.3 CHECK FOR LEAKAGE OF WATER OR OIL AROUND ENGINE.

Check that there is no leakage of oil from the engine or leakage of water from the cooling system. If any abnormality is found, repair it.

24.3.9.4 CHECK FOR OIL LEAKAGE FROM TORQUE CONVERTER, TRANSMISSION, REAR MAIN FRAME HOUSING, FINAL DRIVES, HYDRAULIC TANK, HOSES, JOINTS.

Check that there is no oil leakage. If any abnormality is found, repair the place where the oil is leaking.

24.3.9.5 CHECK THE UNDERCARRIAGE

Track, sprocket, idler, guard for damage, wear, loose bolts, or leakage of oil from rollers.

24.3.9.6 CHECK FOR DAMAGE TO HANDRAIL.

Repair any damage and tighten any loose.

24.3.9.7 CHECK FOR DAMAGE TO GAUGES, LAMPS ON INSTRUMENT PANEL.

Check that there is no damage to the panel, gauges and lamps. If any abnormality is found, replace the parts. Clean off any dirt on the surface.

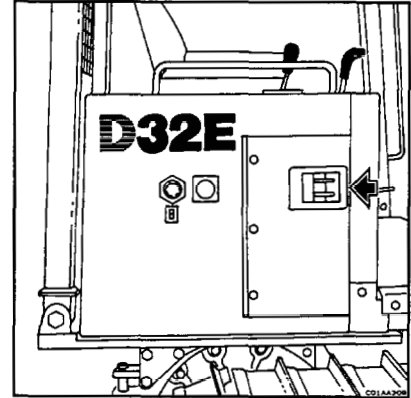
24.3.9.8 CHECK FOR DAMAGE TO SEAT BELT AND MOUNTING AREAS.

Check that there is no abnormality in the seat belt or mounting areas. If there is any damage, replace with new parts.

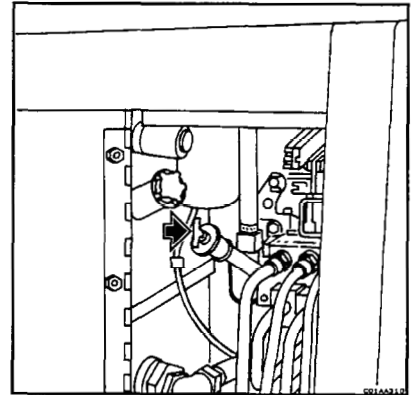
24.4 EVERY 50 HOURS SERVICE

24.4.1 CHECK OIL LEVEL IN DRIVE TRAIN

1. Open the right side door at the hydraulic reservoir.



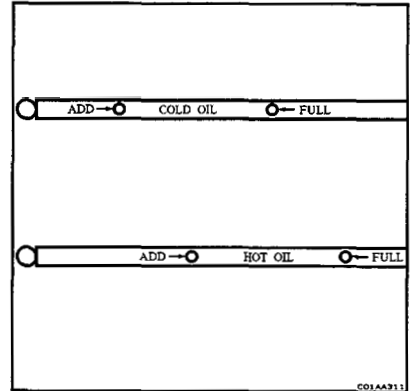
2. Unscrew the T handle of the oil level gauge, remove the gauge and wipe it clean.



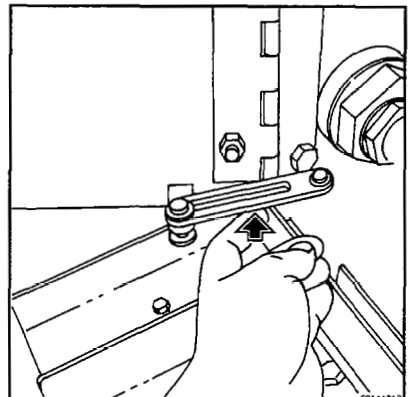
3. Insert the gauge fully into the filler sleeve. Do not tighten. Remove the gauge and check the lubricant level. If necessary, add oil through the filler to bring the level up the FULL mark on the gauge. Reinstall and secure the gauge.

REMARK

For details of the oil to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



4. Lift up on lock lever and close door.

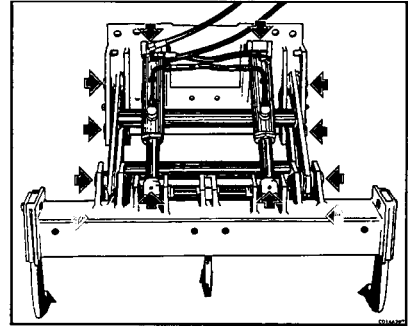


24. SERVICE PROCEDURE

24.4.2 LUBRICATION

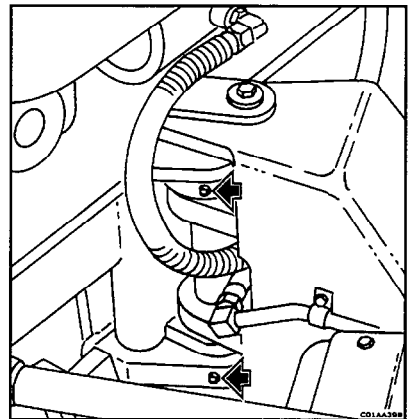
24.4.2.1 RIPPER LINKAGE (12 POINTS)

1. Lower all mounted equipment to the ground.
2. Apply grease until clean lubricant is visible. Always use a clean lubricator and wipe dirt from fittings before fresh grease is applied. If grease fails to go through the fitting, determine the cause and correct it. After greasing, wipe off any old grease that was purged.



24.4.2.2 BLADE ANGLE FRAME TO C FRAME PIN (2 POINTS)

1. Lower all mounted equipment to the ground.
2. Apply grease until clean lubricant is visible. Always use a clean lubricator and wipe dirt from fittings before fresh grease is applied. If grease fails to go through the fitting, determine the cause and correct it. After greasing, wipe off any old grease that was purged.



24.5 EVERY 100 HOURS SERVICE

24.5.1 BLADE CUTTING EDGE HARDWARE

Check the torque of the blade cutting edge hardware.



Plow bolt nuts:

455 N•m (335 lbf ft)

24.6 EVERY 250 HOURS SERVICE

24.6.1 REPLACE ENGINE OIL FILTER

The lubricating oil filter is a spin-on type. This filter cannot be cleaned and should not be disturbed except when it is necessary to replace it.

REMARK

Use only recommended filters available from your Komatsu distributor.

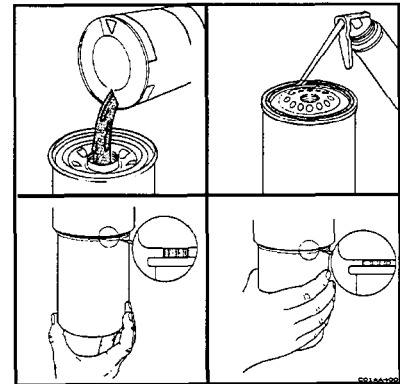
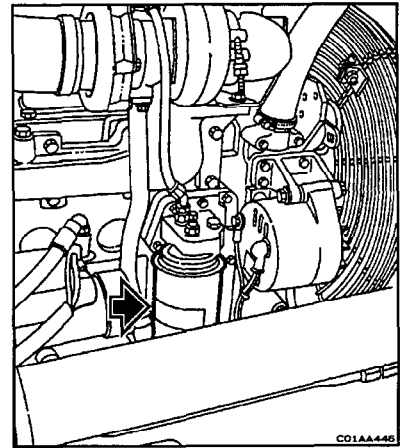
1. After reaching operating temperature, stop the engine and drain the crankcase oil. Refer to 24.6.2 CHANGING CRANKCASE OIL.
2. Clean the outside of the filter. Remove the spin-on type filter by turning it counterclockwise. Discard the old filter in a suitable, covered refuse container.
3. Fill the new filter element with clean engine oil and apply a little clean engine oil to the seal.
4. Thread the filter on by hand (do not spin) by turning it clockwise until the seal just makes contact the filter header. Give the element an additional $\frac{1}{4}$ to $\frac{1}{2}$ turn. Change the crankcase oil per step 24.6.2 following.

REMARK

Do not over tighten the filter or use any tools for installation because this can damage the gasket and filter.

REMARK

Mechanical over tightening may distort the filter header threads or damage the element seal.



24. SERVICE PROCEDURE

24.6.2 CHANGE ENGINE CRANKCASE OIL

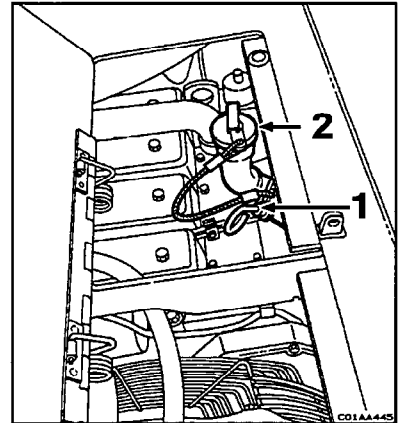
⚠ WARNING

Hot parts - wear gloves. Fire hazard - do not smoke.

⚠ WARNING

Whenever working under the machine, turn off the electrical system master switch and tag the controls to prevent inadvertent starting.

1. After reaching operating temperature, stop the engine. Remove the oil pan door to gain access to the crankcase oil pan drain plug.
 2. Reach up through the access opening and remove the crankcase oil pan drain plug. Allow the oil to drain completely into a suitable container. Remove the spin-on engine oil filter. Refer to 24.6.1 REPLACE THE ENGINE OIL FILTER.
 3. Reinstall and tighten the crankcase drain plug. Reinstall the oil pan door. Replace the spin-on oil filter. Refer to 24.6.1 REPLACE THE ENGINE OIL FILTER.
 4. Remove the engine oil filler cap (2). Fill the crankcase with the quantity and grade oil specified. Reinstall and secure the filler cap. Operate the engine at low idle until normal oil pressure registers on gauge.
- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



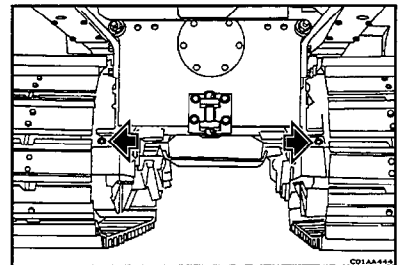
24.6.3 CHECKING FINAL DRIVE OIL LEVEL

Position the machine on level ground. Remove the magnetic filler and level plug, check the lubricant and, if the lubricant is low, fill to the level of the plug opening. Also, check the plug for metallic particles that may be present. If this condition continues after periodic checks, consult your Komatsu distributor. Reinstall the plug and tighten.

⚠ WARNING

When working under the machine, turn off the electrical system master switch and tag the controls to warn against starting the machine.

- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24.6.4 REPLACE FUEL FILTER WATER SEPARATOR

24.6.4.1 WHEN TO REPLACE THE FILTER

Replace the primary filter when the engine is misfiring, loss of power is evident or after 250 hours.

24.6.4.2 REPLACING THE FUEL FILTER

Keep the new filter in the original package until ready for installation. Before loosening the filter, clean the filter head to prevent dirt or foreign material from entering the system.

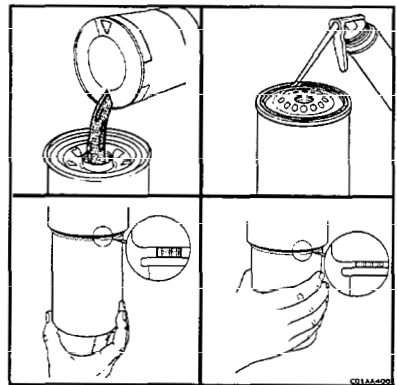
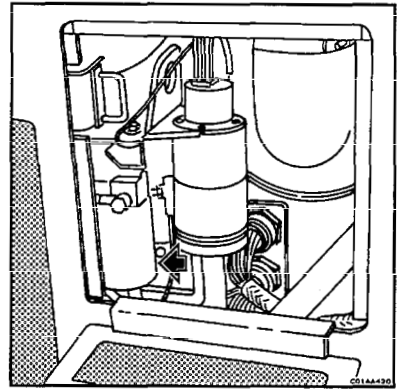
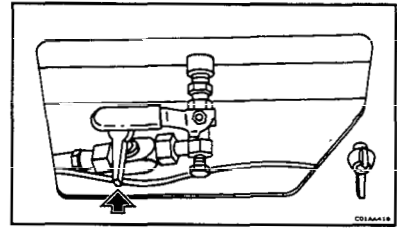
1. Close the fuel shutoff valve under the fuel tank.
2. Remove the fuel filter from the filter header by turning counterclockwise. A filter removal wrench can be used if unable to turn the filter by hand. Discard the fuel filter in a suitable container.
3. Thoroughly clean the filter header with kerosene or diesel fuel to prevent dirt or foreign material from falling into the new filter.
4. Fill fuel filters with clean fuel.
5. Apply a light coating of clean engine oil or chassis grease to the seal surface on the new filter.
6. Install, but do not spin, the new filter, turning it until the seal just contacts the filter head. Make aligning marks on the filter and the filter header and tighten the filter an additional $\frac{1}{4}$ to $\frac{1}{2}$ turn. Open the fuel line shutoff valve.

REMARK

Do not over tighten the filter or use any tools for installation because this can damage the gasket and filter.

REMARK

Mechanical over tightening may distort the filter header threads or damage the element seal.



24. SERVICE PROCEDURE

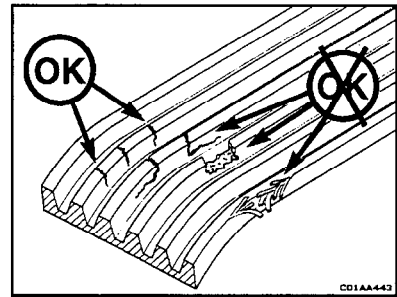
24.6.5 CHECK ENGINE DRIVE BELT FOR WEAR

 **WARNING**

Keep clear of fan and fan belts when the engine is running. Rotating fan and belt contact can cause injury.

Replace badly worn, greasy or cracked belts immediately. These conditions prevent proper belt function.

Visually inspect the drive belt for intersecting cracks. Transverse (across the belt width) cracks are acceptable. Longitudinal (direction of belt length) cracks that intersect with transverse cracks are not acceptable. Replace the belt if it is frayed or has pieces of material missing.

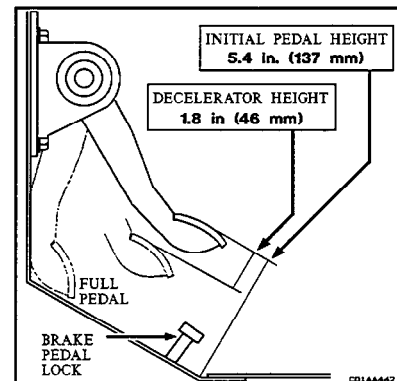


24.6.6 CHECK OPERATION OF THE DECELERATOR

This pedal overrides the engine speed control lever setting. Partial depression of the pedal decreases engine speed for smoother changes in machine direction and to ease the machine up to a load. Release the pedal to accelerate to the engine speed control lever setting.

This pedal stops the machine when fully depressed. It also serves as a parking brake when the brake pedal lock is applied.

Periodic adjustment of the pedal might be required, refer to your Komatsu distributor if pedal values are not within those shown.

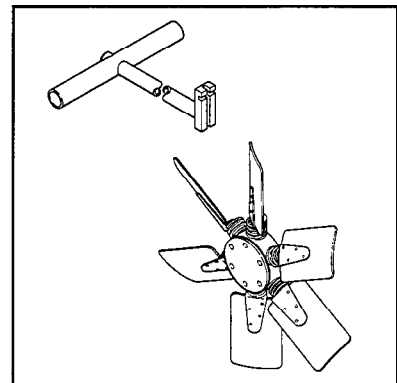


24.6.7 REVERSE REVERSIBLE FAN BLADES

 **WARNING**

Keep clear of fan and fan belts when the engine is running. Rotating fan and belt contact will result in serious injury.

The fan blades must be reversed to prevent corrosion and dirt build up that may cause binding of the shafts in the fan hub. After reversing the blades return the blades to the desired position.



24.7 EVERY 500 HOURS SERVICE

24.7.1 CHECK HOSE CLAMP TORQUE

REMARK

Check all hose clamps except those on the air intake system.

Check the torque. Refer to 21. STANDARD TIGHTENING TORQUES.

24.7.2 CHECK ROPS MOUNTING BOLT NUT TORQUE

Check the torque at four places.

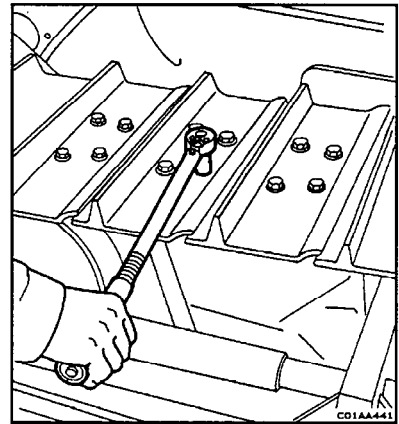
 Mounting Bolt Nuts: **822 ±47 N•m (605 ±35 lbf ft)**

24.7.3 CHECK TRACK SHOE BOLT TORQUE

The bolts used for attaching the shoes to the tracks are heat treated alloy bolts and will stand a considerable tightening strain. Ordinary bolts must not be used. Nuts must be assembled so that washer face is not against track link. Radius side of nuts must be against track link. Torque bolts to below listed value.

 Track shoe bolt: **90 ±20 N•m (65 ±15 lbf ft) plus 120°**

◆ 120° designates two flats of the bolt head.



24.7.4 INSPECT MOUNTED EQUIPMENT

Inspect for operational damage. Correct as required.

24.7.5 RADIATOR LEAKS

1. Check for and correct any leaks at the radiator and its connecting parts.

24.7.6 OUTSIDE OF RADIATOR CORE

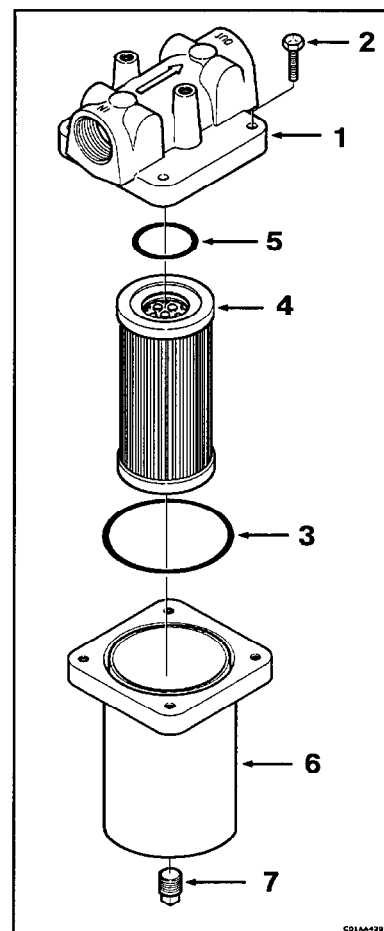
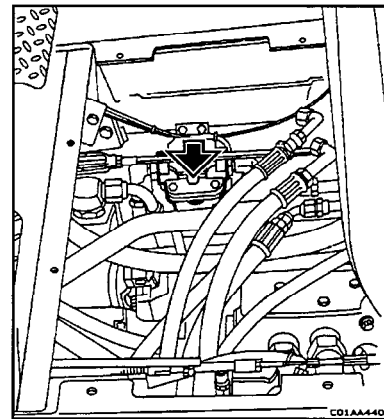
1. Clean the outside of the radiator core.

24. SERVICE PROCEDURE

24.8 EVERY 1000 HOURS SERVICE

24.8.1 SERVICING THE DRIVE TRAIN SUCTION STRAINER

1. Remove the operators compartment floor board to locate the strainer.
 2. Remove the four bolts (2) and separate the housing (6) from the base (1). Remove the element (4) with o-ring (5).
 3. Wash the element and housing in a commercial solvent and dry thoroughly. Replace o-rings (3 and 5). Remove all dirt from the inside of the base using a cloth dampened with solvent.
 4. Check that the new o-ring (5) is in place in the groove in the element (4). Slip the non o-ring end of the element into the housing. Secure the housing to the base (1) with the hardware previously removed.
 5. Start the engine and let it idle for approximately five minutes. During this time, check the strainer for leaks. Correct all leaks no matter how minor. Then check the level in the drive train system. Reinstall the operators compartment floor board.
- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



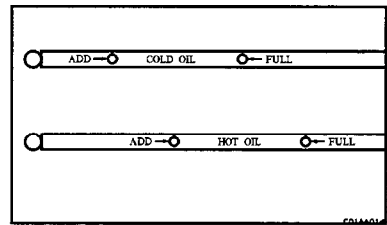
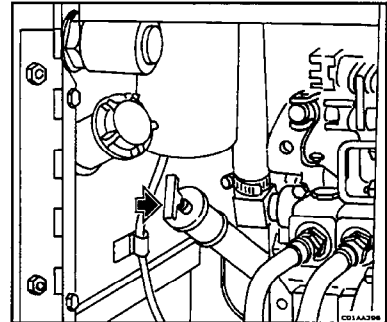
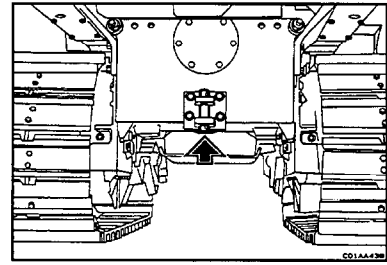
24.8.2 CHANGING DRIVE TRAIN SYSTEM OIL

1. Remove the drain plug immediately after operation while the lubricant is still warm. Drain into a suitable container.

⚠ WARNING

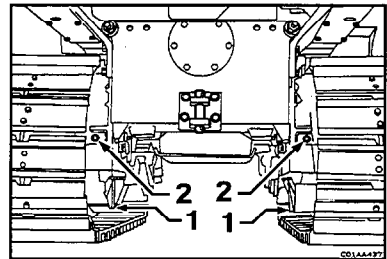
When working under the machine, turn off the electrical system master switch and tag the controls to warn against starting the machine.

2. After the system has been completely drained, reinstall and tighten the drain plug.
 3. Remove the oil level gauge with cap. Pour lubricant into the rear frame through the filler tube to bring the level up to the FULL mark on the gauge.
- ◆ For details of the oil to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24.8.3 DRAIN, FLUSH AND REFILL FINAL DRIVE OIL

1. While the lubricant is at operating or warm ambient temperature, park the machine on level ground. Remove the drain plugs (1) and allow the lubricant to drain into a suitable container. Install and tighten the drain plugs. Remove the filler and level plug (2). Fill the housing with fuel oil up to the filler and level plug opening and install the pipe plug.
 2. Operate the machine in low gear (with no load) for a few minutes. Remove the drain plugs and thoroughly drain the fuel oil into a suitable container. Reinstall and tighten the drain plugs. Remove the filler and level plugs. Fill the housing with fresh lubricant up to the bottom of the filler and level plug opening. Reinstall and tighten the filler and level plugs.
- ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.



24. SERVICE PROCEDURE

24.8.4 REPLACE DRIVE TRAIN SYSTEM BREATHER

REMARK

To prevent dirt from entering the critical areas of the transmission system, keep the breather clean. Replace the breather as indicated by 23. MAINTENANCE SCHEDULE CHART.

The breather is located on the transmission system filler tube. Unscrew the breather from the reducer nipple. Install the new breather on the nipple.

24.8.5 REPLACING DRIVE TRAIN PRESSURE FILTER

REMARK

If the pressure filter indicator light on the instrument panel, remains on at operating oil temperature with the engine running, the pressure filter must be changed.

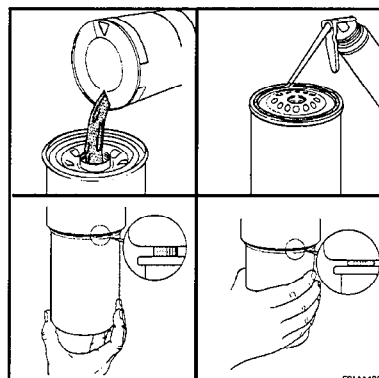
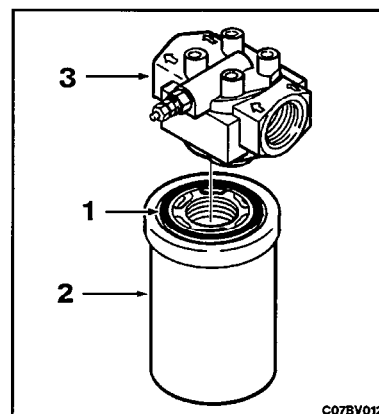
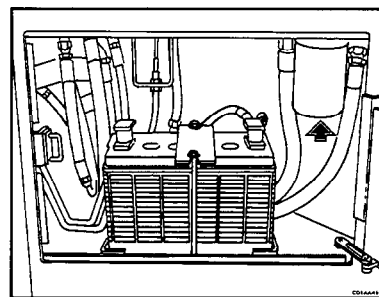
1. With the engine stopped, operate the transmission/steering lever several times to relieve any pressure. Open the battery box side door. Remove all outside dirt from filter. Using a filter wrench remove the spin on filter. Wipe the filter base, removing all of the old oil from the seal area.
2. Coat the seal (1) on the new filter (2) with clean oil. Install the filter by threading it onto the filter base (3) until the seal contacts the base, turn the filter by hand an additional $\frac{1}{4}$ to $\frac{1}{2}$ turn.
3. Check the level in the drive train system.

REMARK

Do not over-tighten the filter or use any tools for installation because this can damage the gasket and filter.

REMARK

Mechanical over-tightening may distort the filter header threads or damage the element seal.



24.8.6 REPLACE HYDRAULIC SYSTEM RETURN FILTER

The hydraulic reservoir does not have to be drained in order to service this filter

If the pressure filter indicator light on the instrument panel, remains on at operating oil temperature with the engine running, the pressure filter must be changed.

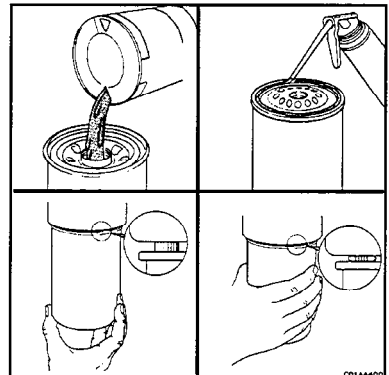
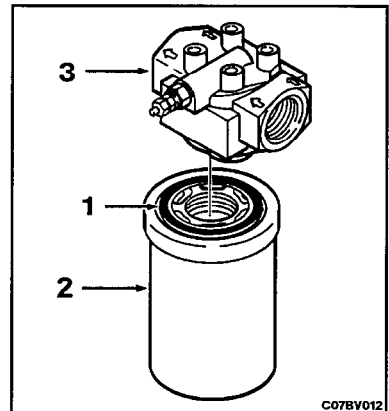
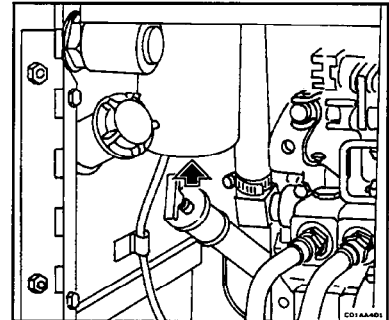
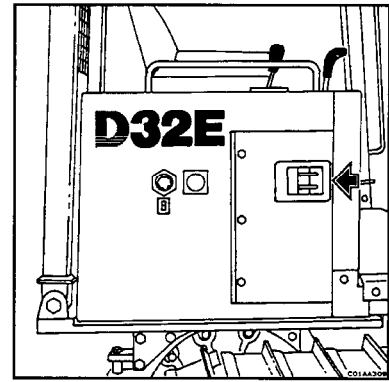
1. Park the machine on level ground, lower the blade to the ground and stop the engine. Turn the electrical master switch to OFF. Tag all controls to prevent inadvertent starting.
2. With the engine stopped, operate the equipment lever several times to relieve any pressure. Open the right side door at the hydraulic reservoir. Loosen the reservoir filler cap to relieve any pressure in the reservoir, then retighten.
3. Remove all outside dirt from filter. Using a filter wrench remove the spin on filter. Wipe the filter base, removing all of the old oil from the seal area.
4. Fill the filter element with clean oil. Coat the seal (1) on the new filter element (2) with clean oil. Install the new element by threading it onto the filter base (3) until the seal contacts the base, turn the filter by hand an additional ¼ to ½ turn. Check the oil level in the system.

REMARK

Do not over-tighten the filter or use any tools for installation because this can damage the gasket and filter.

REMARK

Mechanical over-tightening may distort the filter header threads or damage the element seal.



24. SERVICE PROCEDURE

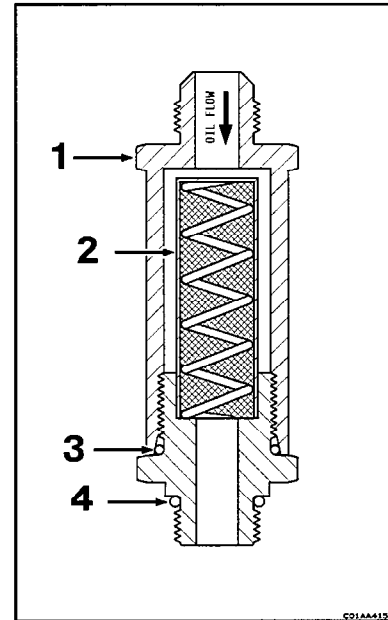
24.8.7 CLEAN NEUTRAL VALVE INLET STRAINER

1. Remove the operators seat and seat mounting plate. Remove the hose coming from the pressure regulator valve to the neutral valve inlet strainer. Remove the strainer assembly from the neutral valve.
2. Remove the strainer body (1) from the connector and strainer element (2). Using a commercial solvent, wash the element and housing and dry thoroughly. Replace the o-rings (3 and 4).

REMARK

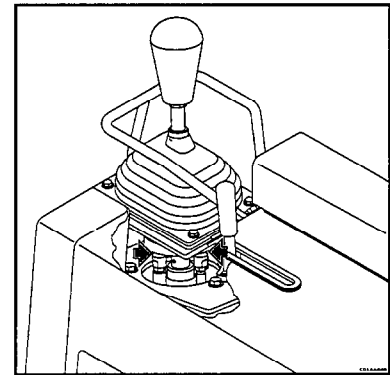
The strainer element is soldered to the connector. If the strainer shows any sign of deterioration or remains plugged after cleaning, replace it.

3. Remove all dirt from the neutral valve. Reinstall the strainer and connect hose. Start the engine and let it idle for 5 minutes. During this time check the strainer for leaks and correct, no matter how minor.
4. Install seat plate and seat. Check the drive train system oil level. For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.




24.8.8 LUBRICATE VALVE CAM PLATE

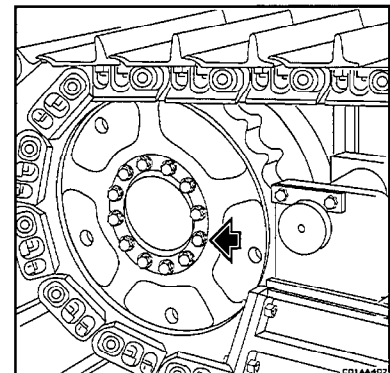
1. Remove control knob and control cover boot. Clean the cam surface and apply a generous amount of MPG to the cam.
2. Inspect control cover boot for tears or any sign of deterioration. Replace if any are found.
3. Wipe off all dirt/dust from the boot mounting surface and install control cover boot with hardware removed. Install control knob.



24.8.9 CHECK TORQUE OF SPROCKET MOUNTING BOLTS

Check torque of sprocket mounting bolts.

	Torque	Qty. Per Side
D32E-1 D38E-1	3/4NF - 455 N•m (335 lbf ft)	8
D32P-1 D38P-1	3/4NC - 455 N•m (335 lbf ft)	8
D39E-1 D39P-1	3/4NC - 455 N•m (335 lbf ft)	12

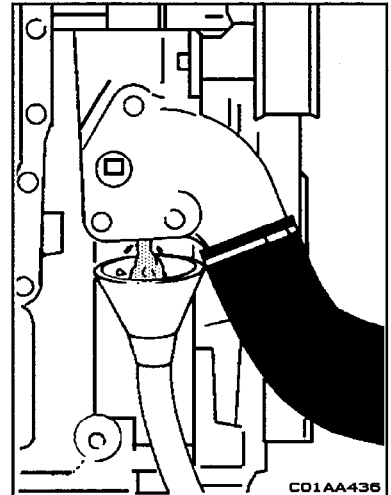
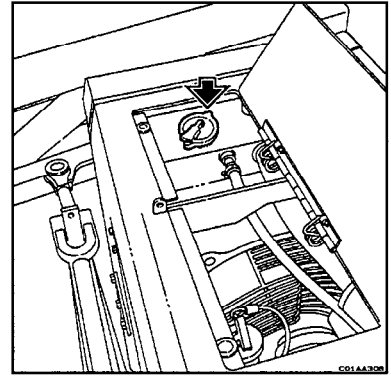


24.9 EVERY 2000 HOURS SERVICE

24.9.1 DRAIN, FLUSH AND REFILL COOLING SYSTEM

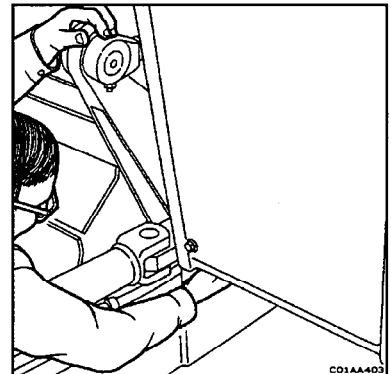
WARNING

- ◆ Soon after the engine has been stopped, the coolant is hot and can cause personal injury. Allow the engine cool before draining the coolant.
- ◆ Never remove the radiator cap when the engine is at operating temperature. At operating temperature, the coolant is under pressure. Steam blowing up from the radiator could cause personal injury. Allow the engine to cool until the radiator filler cap is cool enough to touch with your hands. Remove the filler cap slowly to relieve pressure.
- ◆ Never be under the machine with the engine running. To avoid serious injury, always stop the engine before being under the machine to open the drain valve.
- ◆ When removing drain plug, avoid pouring coolant on yourself.
- ◆ Antifreeze is flammable, so keep it away from any flame.
- ◆ Flushing agents, neutralizing agents, and anticorrosive agents are strong acids or alkalize, so be careful not to get them on your skin. If you should get any of these on your skin, wash off immediately with ample water.
- ◆ After using the agent, do not use the empty packet for keeping food, etc.



24.9.1.1 DRAINING THE SYSTEM

1. Turn the radiator cap slowly to remove it.
2. Remove the crankcase coolant drain plug located on the bottom of the coolant inlet.
3. Open the radiator drain valve. Allow the system to completely drain into a suitable container. Do not let drain outlets plug up during draining.
4. Close the radiator drain valve. Install the crankcase drain plug.



24.9.1.2 FLUSHING THE SYSTEM

1. Be sure the radiator drain valve and crankcase drain plug are closed and tightened.
2. Fill the system with clean water and add a flushing compound that is compatible with aluminum. Flush the system in accordance with the instructions furnished with compound.
3. After flushing, rinsing and completely draining the system, refill with clean coolant, see the following.

24. SERVICE PROCEDURE

24.9.1.3 REFILLING THE SYSTEM

1. Be sure the radiator drain valve and crankcase drain plug are closed and tightened.
2. Fill the cooling system to maximum capacity. Fill with antifreeze according to the instructions printed on the container.
 - ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.
3. Start engine and run until normal operating temperature is reached. Add coolant to keep the proper level at the bottom of the filler neck tube.
4. After all air is removed and level remains fixed, install the radiator cap.

24.9.2 CLEAN HYDRAULIC SUCTION STRAINER

1. Park the machine on level ground, lower the blade to the ground and stop the engine as outlined above. Turn the electrical master switch to OFF. Tag all controls to prevent inadvertent starting. With the engine stopped, operate the equipment lever several times to relieve any pressure. Open the right side door at the hydraulic reservoir. Loosen the reservoir filler cap to relieve any pressure in the reservoir, then retighten. Drain the hydraulic system.
2. Disconnect elbow (1) from strainer (2) and position out of the way. Remove the strainer from the reservoir and discard the o-ring and replace with new.
3. Clean the suction strainer (2) in a nonflammable commercial solvent and dry thoroughly. Thoroughly clean the interior of the reservoir being sure all particles are removed from the corners.

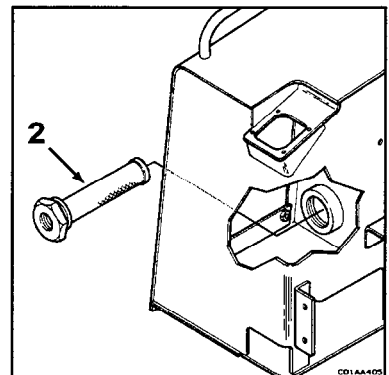
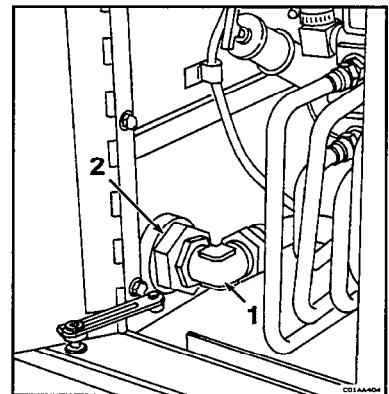
 **WARNING**

Fire hazard - do not use kerosene, diesel fuel or flammable liquids to clean parts. A spark or a flame could cause a fire or an explosion. Use a nonflammable commercial solvent.

REMARK

If the strainer shows any signs of deterioration or remains plugged after cleaning, replace it.

4. Install the strainer with new o-ring and connect elbow. Fill the system, see 24.9.4 CHANGING HYDRAULIC FLUID.

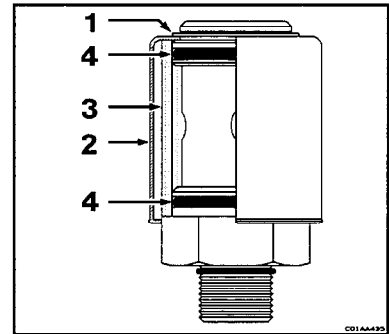
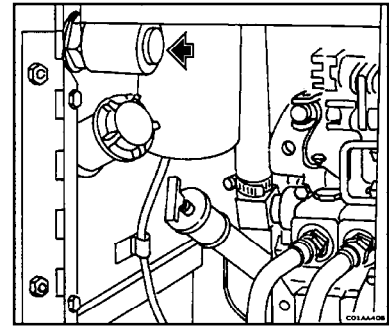


24.9.3 CLEAN HYDRAULIC RESERVOIR RELIEF VALVE

⚠ WARNING

- ◆ **Pressurized Reservoir.** Always loosen the filler plug slowly in case there is still some pressure in the system.
- ◆ **Fire hazard - do not use kerosene, diesel fuel or flammable liquids to clean parts. A spark or a flame could cause a fire or an explosion. Use a nonflammable commercial solvent.**

1. Park the machine on level ground, lower the blade to the ground and stop the engine as outlined above. Turn the electrical master switch to OFF. Tag all controls to prevent inadvertent starting. With the engine stopped, operate the equipment lever several times to relieve any pressure. Open the right side door at the hydraulic reservoir. Remove all outside dirt from breather.
2. Slowly loosen the filler plug on the reservoir in order to relieve any pressure in the reservoir, then retighten.
3. Remove the lock ring (1) and cover (2). Remove the element (3) and clean in a nonflammable commercial solvent. Dry thoroughly. Check o-ring (4) for wear or deterioration. Replace if necessary. Replace filter (3) and cover (2). Secure with lock ring (1). Reinstall the filler cap.



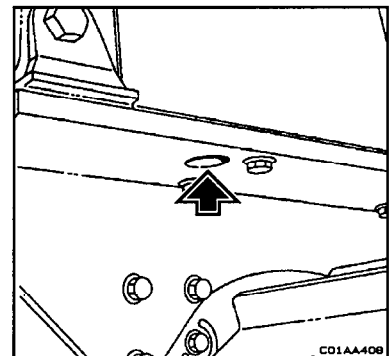
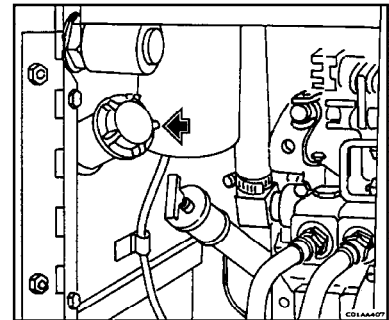
24.9.4 CHANGE HYDRAULIC SYSTEM FLUID

1. Start the engine and operate the blade to warm the oil for easy draining.
2. Position the machine to permit the blade to drop below ground level. Be sure the piston rods are completely extended so the blade is entirely supported by both cylinders at the maximum LOWER position. Place the control lever in the FLOAT position.
3. Stop the engine. Shift to neutral and apply the neutral lock lever. Apply and lock the parking brake. Turn the electrical system master switch to OFF. Slowly loosen reservoir filler plug to relieve reservoir pressure.
4. Drain the reservoir into a suitable container by removing the filler plug and the drain plug.
5. Service the return filter and the suction strainer.

REMARK

Use clean oil from a clean container. Maintain all packaging and fittings so as to prevent leakage.

6. Reinstall the drain plug. Fill the reservoir with lubricant up to the center line of the sight gauge. Reinstall the filler cap.
 - ◆ For details of the fluid to use, see 20. USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE.
7. Start the engine and run it at low idle speed. Operate all the controls through all positions four or five times so the cylinders are filled with oil and air expelled. Check the oil level and repeat until the fluid level remains at the specified level in the reservoir.



24. SERVICE PROCEDURE

24.10 PERIODIC

24.10.1 CLEAN AIR CLEANER ELEMENTS

24.10.1.1 GENERAL

This machine is equipped with a dry-type air cleaner with replaceable filter elements. The air cleaner has two elements, a primary and a safety. The primary element can be cleaned for a limited number of times before replacement is necessary, however, the safety element must be replaced when plugged. Detailed service procedures for this air cleaner are covered in the following text.

24.10.1.2 PRECAUTIONS

As a precaution against dirt entering the engine:

- ◆ Make sure the air cleaner connections and the turbocharger mounting gaskets are in good condition and all joints and connections are tight.
- ◆ Never operate the engine unless a filter element is in place and the filter end cover gasket is installed.
- ◆ Never remove the element from the air cleaner while the engine is running.

24.10.1.3 PRIMARY FILTER ELEMENT

24.10.1.3.1 Service

The air cleaner primary element must be serviced whenever indicated by the air cleaner filter service light. Refer to 11.2 GAUGES AND WARNING LIGHTS. After servicing the primary element, if the air cleaner filter service light continues to operate, check the air inlet screen or precleaner tubes for obstructions. If service remains illuminated, replace the safety element. After servicing the primary element and replacing the safety element, if the service light continues to operate, replace the primary element too.

The primary element can be cleaned by either of two methods: washing or compressed air. Washing is the preferred method as it removes more dust and soot and restores the element to an almost new condition. The result is better performance and longer intervals between required element service. It is suggested that a spare element be obtained for use while the serviced element is drying.

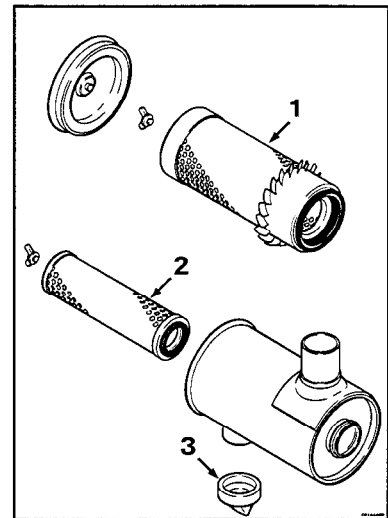
REMARK

A filter element must be replaced after six washings or cleanings.

Cleaning the element with compressed air is not an entirely satisfactory method. Some dust will remain in the element causing more frequent servicing of the element. Use this method only as a temporary measure until time is available to wash the element.

REMARK

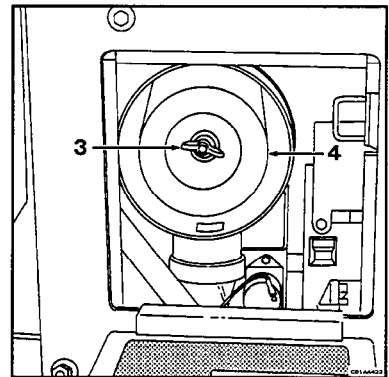
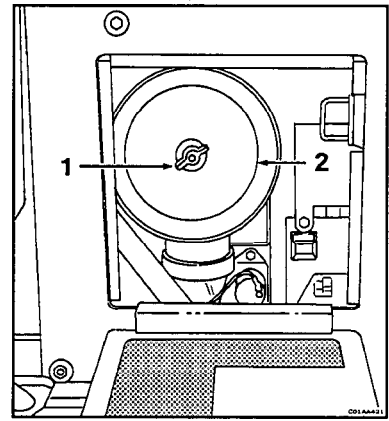
After cleaning, if an element is to be stored for later use, place it in a plastic bag and store in an element shipping container to protect against dirt and damage.



1. Primary Filter Element
2. Safety Filter Element
3. Dust Vacuator Valve

24.10.1.3.2 Removal

1. Stop the engine and lower all mounted equipment to the ground. Open the right engine side door. Remove all dirt from the cover end of the air cleaner body.
2. Loosen the wing nut (1) on the cover (2) and remove the cover from the air cleaner body.
3. Remove the wing nut with gasket (3) and slide out the primary element (4) being careful not to dislodge dust from the dirty element onto the safety element.
4. Check the condition of the gasket on the end of the primary element. If the gasket is damaged or missing, replace the element. Remove all dirt from the inside of the air cleaner body with a damp cloth. A small amount of nonsudsing detergent added to water will ease the removal of soot.

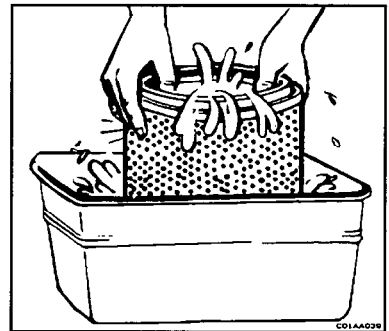


24.10.1.3.3 Washing

REMARK

Never wash elements in fuel oil, gas or solvent. **DO NOT OIL ELEMENTS.** Do not attempt to take elements apart. Do not tap the element against a hard surface; this will damage the element.

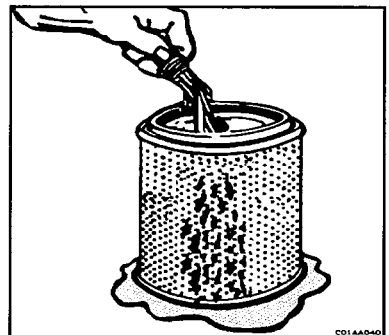
1. Carefully tap the side or end of the element against the palm of your hand to remove loose dirt.
2. Wash the element in clean, warm water, 21 to 38°C (70 to 100°F). A small amount of nonsudsing detergent added to the water will remove the soot.
3. Rinse the element in clear water (if a hose is used, do not exceed 275 kPa (40 psi)). Shake the element carefully to remove excess water.



REMARK

Do not use compressed air to speed the drying of the element; the air pressure will rupture the wet element.

4. Lay the element on its side and allow it to air dry before reinstalling. Overnight drying is usually sufficient. When drying the element, protect it from dirt and/or freezing.



REMARK

If no spare element is available, the wet element, after excess water has been shaken out, may be installed in the air cleaner and the engine operated at low idle for 10 minutes before operating the machine.

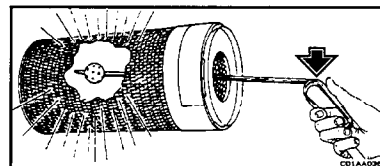
5. Inspect the element for damage.

24. SERVICE PROCEDURE

24.10.1.3.4 Compressed Air

 **WARNING**

Wear eye protection when using air under pressure to clean parts. Limit air pressure to 206 kPa (30 psi).



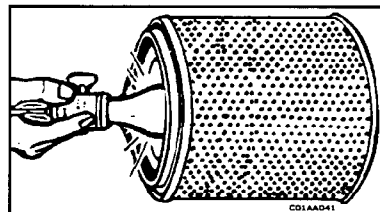
REMARK

Do not tap the element against a hard surface; this will damage the element.

1. Carefully tap the side or end of the element against the palm of your hand to remove loose dust.
2. Direct clean dry compressed air up and down the pleats on the inside of the element. Always direct the flow of compressed air opposite the normal operating air flow direction through the element.
3. Inspect the element for damage.

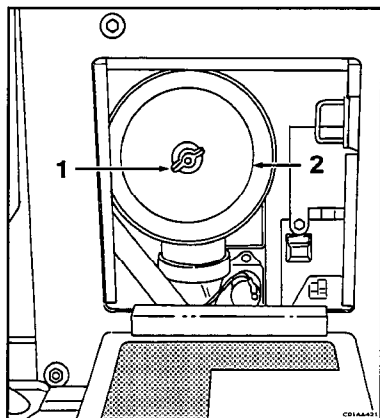
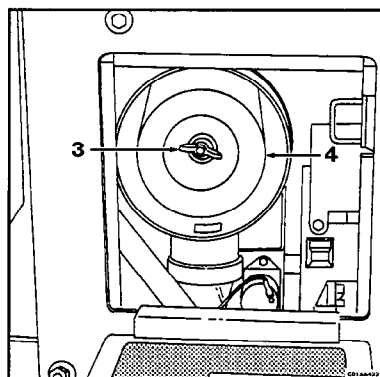
24.10.1.3.5 Inspection

1. Inspect the filter element for leaks or damage by placing a bright light inside the element. Inspection of the element on the outside will disclose any holes where concentrated light shines through. The slightest rupture requires replacement of the filter element.
2. Inspect the contact surfaces of the air cleaner body. If faulty or damaged surfaces are noted, correct these conditions immediately.



24.10.1.3.6 Installation

1. Insert the open end of the primary element (4) into the air cleaner body and secure with the wing nut and gasket (3). Install the cover (2) onto the air cleaner body. Secure with the wing nut (1) making sure the cover is not cocked.
2. Inspect and tighten all air cleaner connections before resuming operation. Start the engine. If the air cleaner filter service light continues to show air flow restriction, replace the primary or primary and safety filter element.



24.10.1.4 SAFETY FILTER ELEMENT

24.10.1.4.1 Service

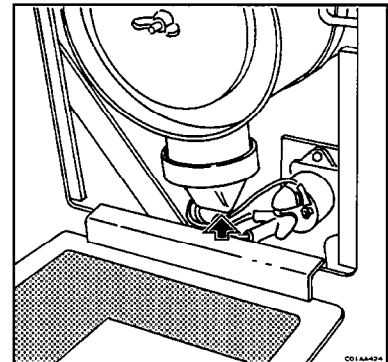
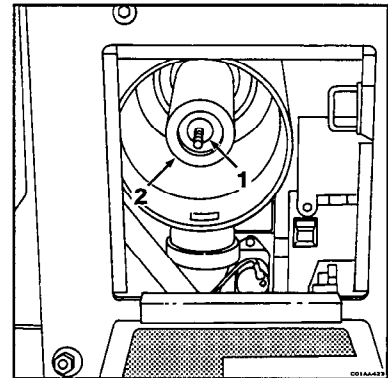
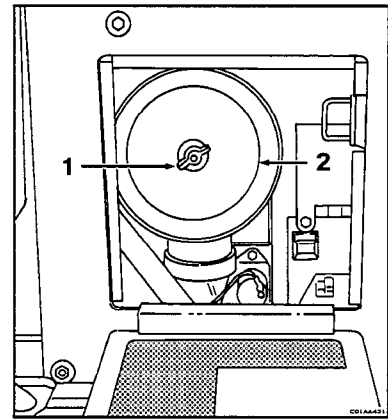
Replace the safety element with every third change of the primary element or when plugged, as shown by the service light.

24.10.1.4.2 Removal

1. Remove the primary filter element, refer to 24.10.1.3 PRIMARY FILTER ELEMENT.
2. Remove wing nut with gasket (1) and remove the safety element (2). Clean the inside of the body with a damp cloth. Check the condition of the gasket on the end of the safety element. If the gasket is damaged or missing, replace the element.

24.10.1.4.3 Installation

1. Install the new safety element in the body and secure with wing nut and gasket.
2. Install the primary element over the safety element and secure with wing nut and gasket. Install the cover and secure with the nut making sure the cover is not cocked.

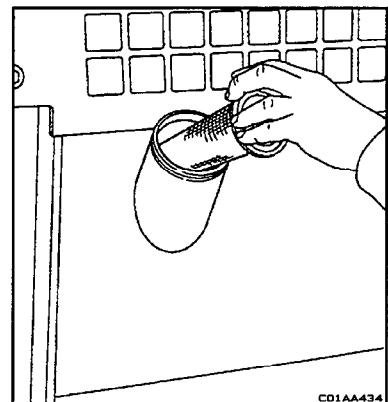


24.10.1.5 DUST VACUATOR VALVE

The dust vacuator valve will automatically remove dust and water from the air cleaner. To function, the vacuator valve lips must point downward and be kept free of debris. The lips should be closed except when engine is idling slowly or stopped. If the vacuator valve is lost or damaged, replace it to maintain the air cleaners efficiency and normal element service life.

24.10.2 CLEAN FUEL TANK STRAINER

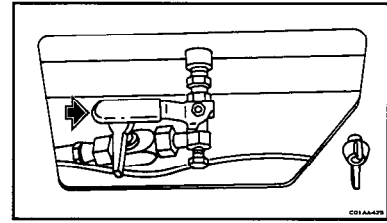
This screen filters the fuel entering the tank and eases the job of the fuel filter. Remove and clean the screen with a nonflammable commercial cleaning solvent.



24. SERVICE PROCEDURE

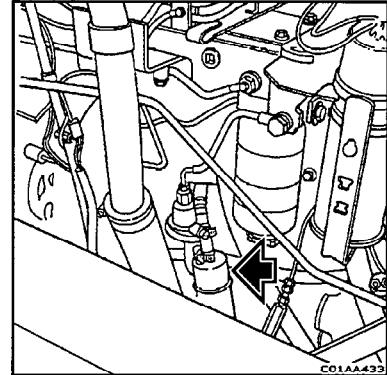
24.10.3 DRAIN FUEL TANK SEDIMENT BOWL

Open the valve and drain water and sediment from the fuel tank until clean diesel fuel appears. Close the valve.



24.10.4 REPLACE IN-LINE FUEL STRAINER

1. Close the shut off valve under the fuel tank.
2. Loosen the clamps holding the hose to the strainer at both ends and remove the strainer.
3. Install the new strainer with the arrow pointing in the direction of flow (away from the fuel tank). Open the fuel shut off valve.



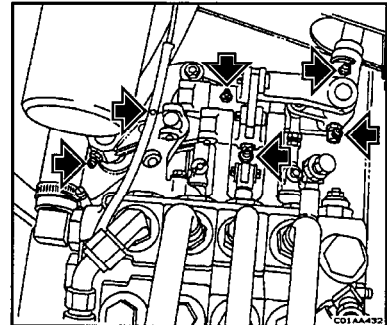
24.10.5 LUBRICATE

24.10.5.1 MOUNTED EQUIPMENT CONTROLS

REMARK

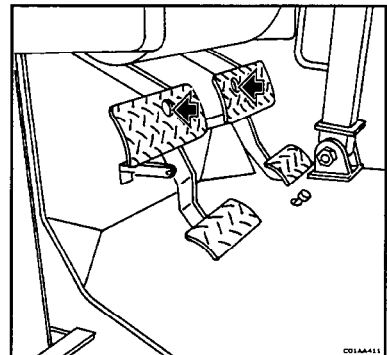
Five fittings without a ripper or six fittings with a ripper.

Apply grease until clean lubricant is visible. Always use a clean lubricator and wipe dirt from fittings before fresh grease is applied. If grease fails to go through the fitting, determine the cause and correct it. After greasing, wipe off any old grease that was purged.



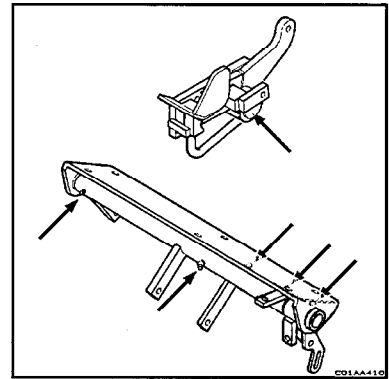
24.10.5.2 LEFT AND RIGHT FOOT PEDALS

Apply grease until clean lubricant is visible. Always use a clean lubricator and wipe dirt from fittings before fresh grease is applied. If grease fails to go through the fitting, determine the cause and correct it. After greasing, wipe off any old grease that was purged.



24.10.5.3 UNDERFLOOR LINKAGE

Apply grease until clean lubricant is visible. Always use a clean lubricator and wipe dirt from fittings before fresh grease is applied. If grease fails to go through the fitting, determine the cause and correct it. After greasing, wipe off any old grease that was purged.



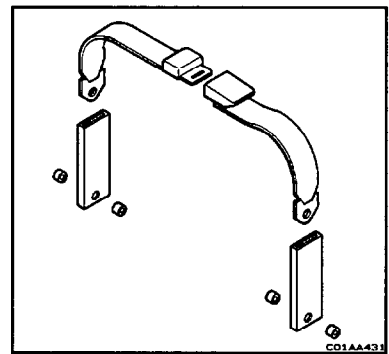
24.10.6 SEAT BELT

⚠ WARNING

Seat belt - do not clean with solvents or bleach or redye color of webbing as this may cause a severe loss of strength. This could cause the webbing to break and result in personal injury. Wash in warm water with a mild detergent.

Keep the belt flat to avoid twisting and roping when not being used. Do not place heavy or sharp objects on the belt.

The entire seat belt assembly should be inspected periodically for corrosion, wear, fraying or wear spots. The seat belt mounting bolts should also be periodically inspected for tightness.



24. SERVICE PROCEDURE

24.11 WHEN REQUIRED

24.11.1 FAN BELT

24.11.1.1 CHECKING TENSION

The engine is equipped with an automatic belt tensioner that maintains correct tension on the drive belt. To check belt tension a Burroughs type gauge must be used because of the wide drive belt. Proper tension should be 110 to 150 N (80 to 110 lbs).

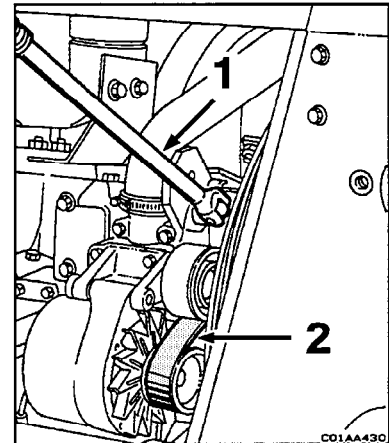
If a Burroughs type gauge is not available, tension may be checked by belt deflection. Press the belt with your finger at the longest span and measure the deflection. Maximum deflection 9.5 to 12.7mm (0.37 to 0.50 in).

24.11.1.2 ADJUSTING

With the automatic tensioner, adjustment isn't required.

24.11.1.3 REPLACEMENT

To replace the drive belt, place a ½ in. drive breaker bar (1) in the square hole in the belt tensioner. Push the breaker bar UP to loosen the tensioner. Remove the old belt (2). Inspect belt tensioner. The tensioner pulley should spin freely with no rough spots detected under hand pressure. Install the new belt.



24.11.2 ELECTRICAL SYSTEM

24.11.2.1 PRECAUTIONS

⚠ WARNING

- ◆ **Before working on the engine or electrical system, disconnect the negative (ground) battery cable. Tag the cable and controls to warn against starting.**
- ◆ **When installing the battery be sure to connect the ground cable to the negative terminal. When connecting a booster battery or battery charger make certain to connect the negative terminal to the negative terminal and the positive terminal to the positive terminal. Do not short across or ground any terminals of the alternator or regulator. Failure to observe these precautions will result in severe damage to the harness and alternator.**

All terminals must be clean and fastened securely. Never paint electrical connections or the alternator. Repair or replace all broken wires immediately.

Surface under all terminals must be clean and good electrical connections must be established after reassembly. Also all clips must grip cables tightly to prevent vibrations and rapid cable wear. All clips and straps must be closed in a workmanlike manner, so as not to damage the insulation.

24.11.2.2 ALTERNATOR

24.11.2.2.1 General

The alternator requires no lubrication since its bearings are factory lubricated for life and require attention only at time of major overhaul. The alternator is equipped with an integral, transistorized voltage regulator.

24.11.2.2.2 Precautions

If the alternator fails to operate properly, consult your authorized Komatsu distributor.

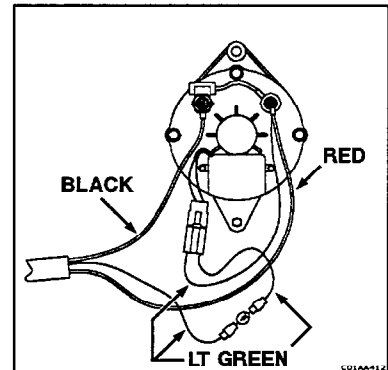
REMARK

The unit electrical system is negative ground. Be certain the ground polarity is correct when installing a new battery, connecting a battery charge or using a booster. Failure to observe proper polarity will result in damage to the alternator.

- ◆ NEVER use a fast charger as a booster to start the engine.
- ◆ NEVER turn OFF the electrical system master switch or unhook a battery terminal while the engine is running.
- ◆ NEVER disconnect the alternator cable while the engine is running.

24.11.2.2.3 Connections

Be sure the terminals on the back of the alternator are clean and the cables are fastened securely to the proper terminals as shown.

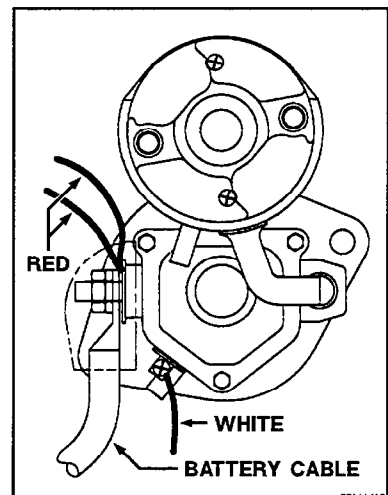


24.11.2.3 CRANKING MOTOR

Should it become necessary to remove the motor in the process of engine servicing, tag all disconnected cables for ease of correct installation.

1. Disconnect all electrical cables and remove cranking motor. Clean outer surfaces.
2. Saturate all wicks and lightly lubricate the splines underneath the clutch housing with clean engine oil.
3. Install the cranking motor and connect all electrical cables. Tighten the cranking motor mounting bolts.

If the cranking motor fails to operate properly, consult your authorized Komatsu distributor.



24. SERVICE PROCEDURE

24.11.2.4 CIRCUIT BREAKERS

The lighting and horn circuits are protected by an automatic reset circuit breaker (1). A 20 amp circuit breaker is mounted on the underside of the instrument panel. In the event of a short circuit or ground, the circuit breaker will open and close until the trouble clears or is corrected. The circuit breaker will then return to and stay in its normal closed position. It is important to use the same capacity circuit breaker for replacement. To install a new circuit breaker, remove the instrument panel and pull from housing. Retain nuts and remove the two screws (panel face) securing the circuit breaker. Disconnect the wiring and replace with a new circuit breaker.

The starting and ether circuits are protected by an automatic reset circuit breaker (2). A 20 amp circuit breaker is mounted on the underside of the instrument panel. In the event of a short circuit or ground, the circuit breaker will open and close until the trouble clears or is corrected. The circuit breaker will then return to and stay in its normal closed position. It is important to use the same capacity circuit breaker for replacement. To install a new circuit breaker, remove the instrument panel and pull from housing. Retain nuts and remove the two screws (panel face) securing the circuit breaker. Disconnect the wiring and replace with a new circuit breaker.

The back up alarm, fuel gauge, gear range indicator, gauge cluster lamps, and engine shut down solenoid circuits are protected by an automatic reset circuit breaker (3). A 6 amp circuit breaker is mounted on the underside of the instrument panel. In the event of a short circuit or ground, the circuit breaker will open and close until the trouble clears or is corrected. The circuit breaker will then return to and stay in its normal closed position. It is important to use the same capacity circuit breaker for replacement. To install a new circuit breaker, remove the instrument panel and pull from housing. Retain nuts and remove the two screws (panel face) securing the circuit breaker. Disconnect the wiring and replace with a new circuit breaker.

REMARK

Under the inside mounting screw nut on the 6 amp circuit breaker there are a pair of two ground wire connectors.

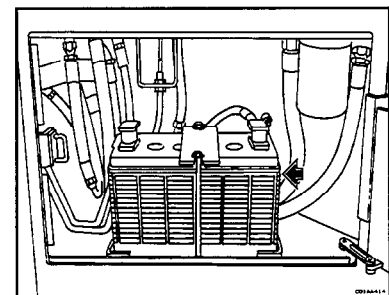
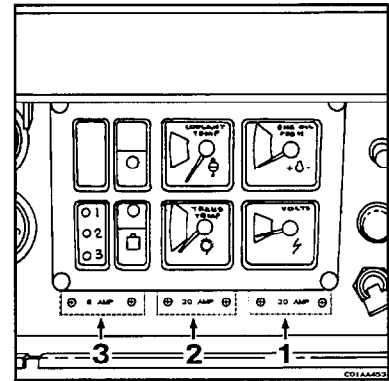
24.11.2.5 BATTERY

24.11.2.5.1 General

WARNING

- ◆ A battery gives off highly flammable gas. Never allow sparks, open flame or lighted smoking material near the battery. Avoid spilling any electrolyte on hands or clothing. Always wear safety glasses when working on a battery.
- ◆ When using a booster battery and jumper cables, connect the negative (ground) cable to the machine's frame, away from the battery. Always connect the ground cable last and disconnect it first to avoid sparks near the battery. A spark could cause a battery explosion and injury.
- ◆ Never check the battery charge by placing a metal object across the terminals. The sparks could cause a battery explosion. Use a voltmeter or hydrometer to measure charge.
- ◆ Be sure the electrical system master switch is off when connecting or disconnecting the battery to minimize the chance of sparks and explosion.

The machine is equipped with one 12 volt battery. It is located in the battery box. Never allow a battery to stand on concrete, ground or a metal support unless proper insulation is provided. A wooden platform or board is sufficient insulation. Be sure the battery is fastened securely to avoid damage from vibration.



24.11.2.5.2 Maintenance

Proper battery maintenance will assure maximum service. Following are a few simple rules:

- ◆ Keep battery cable terminals clean and tight.
- ◆ Keep filler cap vent holes unplugged.
- ◆ Replace worn, cracked, broken or corroded cables.
- ◆ Keep battery fastened securely in frame.

REMARK

Excessive tightening can warp or crack battery case.

- ◆ Maintain the correct battery liquid level. (Conventional battery only).
- ◆ Always charge the battery in a ventilated area.
- ◆ Keep the battery clean.

The following precautions must be taken when working around batteries:

- ◆ Use a battery carrier to avoid spilling electrolyte on clothing.
- ◆ Wearing rubber aprons and gloves is advisable.
- ◆ Be careful that tools or other metallic objects do not fall across the battery terminals.
- ◆ Never break a live circuit at the terminals. This could cause sparks.
- ◆ Make sure charger cable clamps or booster leads are clean and making good contact.
- ◆ If it becomes necessary to prepare electrolyte of a desired specific gravity, always pour the acid into the water.
- ◆ Always turn the charger to the OFF position before connecting or removing charger leads to the battery.
- ◆ When charging a battery, it is recommended that the vent caps be left on. A damp cloth should be placed on top of the vent caps.

24.11.2.5.3 Cleaning the Battery



WARNING

Battery acid causes severe burns. Avoid contact with eyes, skin, or clothing. Wear goggles, rubber gloves, and apron. If eye contact occurs, flush with water for 15 minutes and get prompt medical attention. If skin contact occurs, flush with soap and water.

24. SERVICE PROCEDURE

If the top of a battery is dirty, it may be cleaned with a brush dipped in ammonia or soda solution. The vent plugs must be tightened and sealed to prevent any solution from getting into the battery cells. After the foaming stops, flush off the battery with clean water and unseal the vent plugs. Brighten the terminal contact surfaces with steel wool or a stiff brush.

24.11.2.5.4 Liquid Level - Conventional Battery

The electrolyte in each cell must be at the proper level, 6 to 13 mm ($\frac{1}{4}$ to $\frac{1}{2}$ in) above the plates, at all times to prevent battery failure. Check the level of the electrolyte. When the electrolyte is below this level, pure distilled water must be added. Never use hydrant water or any water which has been in a metal container. Acid or electrolyte must never be added except by a skilled battery man. Under no circumstances add any special battery solutions or powders.

It is especially important to keep the battery at full charge for cold weather operation. Add distilled water to the battery in freezing temperatures only when the engine is to operate for several hours, to thoroughly mix the water and the electrolyte, or damage to the battery may occur.

24.11.2.5.5 Charging Fully Discharged Maintenance-Free Battery

When a machine is not in use for an extended period, the maintenance-free battery can become discharged. For this reason, when a machine will not be used for over 30 days, it is recommended that the negative ground terminal cable be disconnected.

Prior to starting up a machine that has been idle, always make a visual inspection of the battery and take an open circuit voltage test. A reading of 12.3 volts (65% of full charge) or less indicates a state of discharge. The open circuit voltage test should be taken after removing the surface charge. This is accomplished with a draw of 300 amps for 15 seconds. Wait for a couple of minutes, then check the open circuit voltage.

The point to remember is the lower the open circuit voltage, the longer it will take before the battery begins to accept a measurable amount of charge. Charge the battery until a minimum open circuit voltage of 12.4 volts is reached. Then test the battery.

If an open circuit voltage reading of 12.4 volts is not attained at the end of 12 hours, it can be assumed that the battery has failed. If the voltage does not drop below 9.6 volts at 21°C (70°F) for the duration of the load test, the battery is good.

24.11.3 ETHER START

24.11.3.1 PRECAUTIONS

 **WARNING**

Ether starting fluid is highly flammable. Follow the precautions on the container. An explosion can result if sparks or flame contact the ether or if the container is stored where the temperature exceeds 49°C (120°F). Observe the following precautions:

Do not use the ether injector when the air temperature is above freezing. Do not smoke when using ether starting fluid. Do not store fluid containers in the operator's compartment. Store the containers in a cool, well-ventilated place. Keep the fluid containers out of the reach of children. Do not breathe the hazardous ether vapor. Do not let ether contact you skin, because it can cause frostbite. Never puncture the fluid container or put it into a fire. Dispose of empty containers properly. For your safety, remove the ether container when welding, grinding, or using a torch on the machine. Follow the correct method for starting the engine, see 12.2.2 COLD WEATHER STARTING.

REMARK

Improper starting fluids can cause valve seizure and severe damage to the engine. Consult your distributor for the recommended starting fluid to be used.

REMARK

The ether starting valve inlet must be sealed against the entry of dirt at all times by having a fluid container installed or by installing the dust cap provided with the valve.

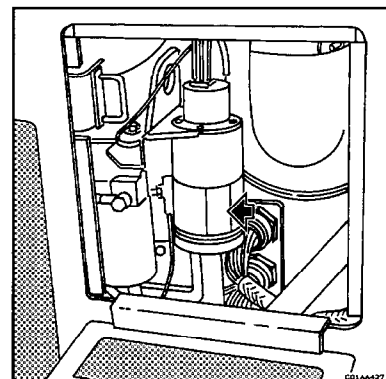
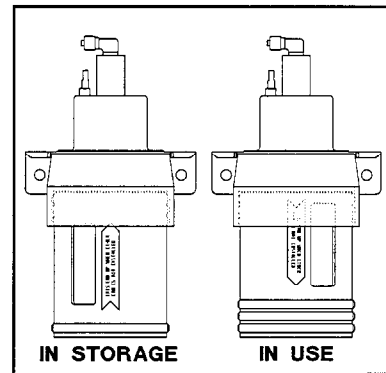
24.11.3.2 INSPECTION AND CLEANING

Make certain that ether is available under pressure. To do so, remove the ether container and check if a good spray is obtained. If not, replace with a new container. If a good spray was obtained, reinstall the container and test the ether injector as follows:

Disconnect the ether tube at the spray nozzle in the engine manifold. Remove the spray nozzle. Reconnect the nozzle to the tube. Direct the nozzle away from the engine and actuate the ether injector. Dribbling or no spray indicates a blocked spray nozzle or tube. If necessary, clean or replace spray nozzle and/or tube.

24.11.3.3 CHANGING THE FLUID CONTAINER

1. Unscrew the plastic fluid container housing from the ether starting valve. Remove fluid container and check condition of o-ring. Discard the empty fluid can in a suitable, closed refuse container.
2. Install the new fluid container in the plastic housing. Secure the container in place by threading it into the valve.



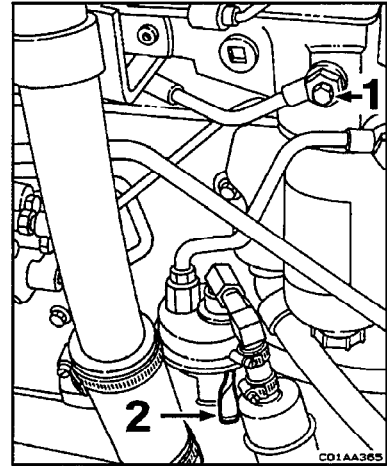
24. SERVICE PROCEDURE

24.11.4 VENTING THE FUEL SYSTEM

Controlled venting is provided at the injection pump through the fuel drain manifold. Small amounts of air introduced by changing the filter or injection pump supply line will be vented automatically, if the fuel filter is changed in accordance with the instructions. Manual bleeding is required if, the fuel filter is not filled prior to installation, initial engine start up or start up after an extended period of on engine operation or the machine fuel tank has run empty.

24.11.4.1 LOW PRESSURE FILTER LINES AND FUEL FILTER

1. Open the vent screw (1). Operate the hand lever (2) on the fuel lift pump until the fuel flowing from the fitting is free of air. Tighten the vent screw.



24.11.4.2 HIGH PRESSURE LINES

⚠ WARNING

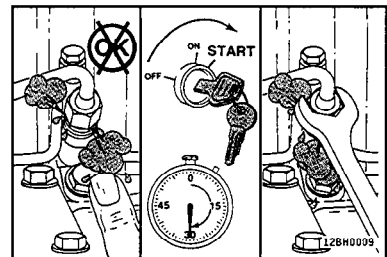
- ◆ The pressure of the fuel in the line is sufficient to penetrate the skin and cause serious bodily harm.
- ◆ For your personal protection never perform any adjustments alone with the engine running. Always have another experienced person helping in the operator's compartment when adjustments must be done with the engine running. When making adjustments, lock the safety lever in the down position and apply the brake.

Venting is accomplished by loosening one injector fitting and cranking the engine to allow entrapped air to bleed from the line.

1. Loosen the fitting at the injector, and crank the engine to allow entrapped air to bleed from the lines. Tighten the fittings.
2. Start the engine and vent one line at a time until the engine runs smoothly.

REMARK

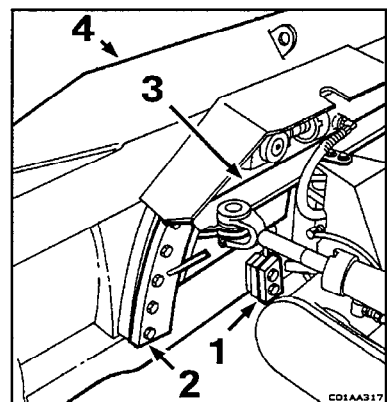
Run engine at low idle when venting lines.



24.11.5 ANGLING FRAME TO BLADE

Periodically or as required the lower (1) and upper (2) shims (both sides) may have to be removed to take up wear between the angling frame (3) and the blade (4). The gap between the angling frame and blade should not exceed 3 mm (0.12 in) minimum gap.

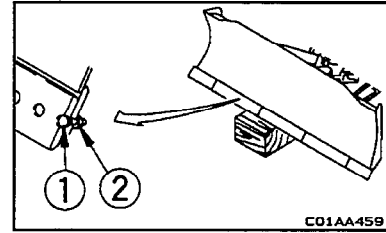
The lower shim pack is to consist of no less than 1 shim and no more than 6 shims. The upper shim pack is to consist of no less than 2 shim and no more than 7 shims. The gap should permit free movement between the angling frame and blade without any binding.



24.11.6 REVERSE AND REPLACE THE END BITS AND CUTTING EDGES

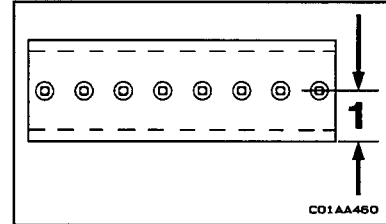
⚠ WARNING

It is dangerous if the work equipment moves by mistake when the cutting edges and end bits are being reversed or replaced. Set the work equipment in a stable condition, then stop the engine and lock the blade control lever securely with the safety



Reverse or replace the cutting edges before it is worn out to the blade end.

1. Raise the blade to a proper height and apply a block to the frame so as to prevent fall of the blade.
2. Measure the wear of the cutting edge in accordance with the wear standards given below.



Unit: mm (in)

Item		Judgement standard		
No.	Measurement point	Standard dimension	Repair limit	
1.	Height of cutting edge (from center of bolt mounting hole to end face)	D32E&P D38E&P	76.2 (3.0)	58 (2.3)
		D39E&P	101.6 (4.0)	

If the cutting edge on both sides is worn out, replace with new one. If it has been worn out up to the fitting surface, repair the fitting surface and then reverse or replace.

3. Remove the cutting edge and clean the mounting surface.
4. Reverse or replace the cutting edge when worn out.

 Nut tightening torque: **455 N•m (335 lbf ft)**

If bolt ① and nut ② are damaged, replace them with new hardware at the same time.

24. SERVICE PROCEDURE

24.11.7 TRACK TENSION AND ADJUSTMENT

24.11.7.1 PROPER ADJUSTMENT

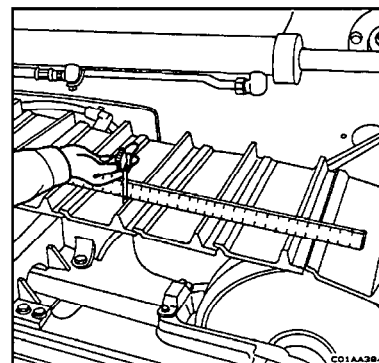
Tracks adjusted too tightly increase operating loads on final drives and accelerate wear on undercarriage components, especially in packing conditions.

A machine in forward operation with correctly adjusted tracks will experience track loads only along the ground from the front idler to where the bushings engage the sprocket.

Lubricated track systems are to be adjusted to provide a sag in the track chain between to front top idler and the front idler. Correct tension reduces stress levels throughout the undercarriage system.

24.11.7.2 CHECKING THE TENSION

1. Place a wooden block, ≈ 305 mm (12 in) in height, under the front most track shoe lug. Drive the machine forward until the track chain is tight along the ground and around the sprocket. Apply and lock the brake pedal, lock the transmission shift lever in the NEUTRAL position and stop the engine.
2. Stand on the track between the front idler and the first track idler in order to accumulate all the chain slack at this point.
3. Place a straightedge on the track so the ends rest over the front idler and track idler. Measure the clearance between the bottom of the straightedge and the top of the shoe grouser with a ruler at the midway point between the idlers.



REMARK

If the distance is more than 64 mm (2.5 in) or less than 50 mm (2 in), adjust the track tension.

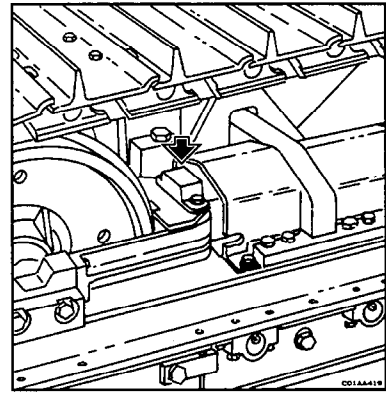
24.11.7.3 ADJUSTING TENSION

The track chains are adjusted by hydraulic pressure. When lubricant is introduced into the front idler fork through the lubrication fitting, it acts upon the piston within the front idler fork forcing the front idler fork and front idler forward for track adjustment.

WARNING

To avoid possible injury, always stand to the side of the bleeder plug when making track adjustment. The pressure in the front idler fork is held by the bleeder plug and check valve. A loose or improper thread fit of either of these parts can allow them to be ejected by the pressure of the lubricant, causing possible injury. When increasing track tension, be sure the bleeder plug and check valve are properly torqued. When relieving track tension, never loosen the bleeder plug and check valve more than 2 ½ turns. Before adding lubricant for track adjustment, be sure the ball check and relief valve are properly torqued.

1. Remove the bolts and track adjuster cover.
2. To increase track tension, connect a lubricator nozzle to the lubrication fitting (2). Determine the amount of adjustment necessary, and add lubricant to obtain the proper track chain tension. It is advisable to move the machine forward and backward slightly to be sure the correct tension has been obtained.
3. To reduce track tension, loosen the bleeder valve (3) $\frac{1}{2}$ to 1 full turn to allow the pressurized lubricant to escape through the relief passage. If lubricant does not appear, loosen the check valve (4) (located under the lubrication fitting) $\frac{1}{2}$ to one full turn to allow the pressurized lubricant to escape from a second relief passage.
4. If lubricant still does not appear, use the following emergency method. Should the relief passages still be blocked, unscrew the ball check and/or relief valve an additional $1\frac{1}{2}$ to 2 turns ($2\frac{1}{2}$ total turns). This will allow a greater amount of pressurized lubricant to free the passages.



WARNING

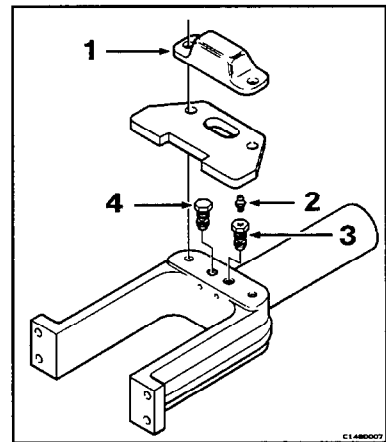
Use extreme care when relieving pressure with the following emergency method. If loosened excessively, the ball check or relief valve can be ejected by the cylinder pressure. NEVER loosen these parts more than a total of $2\frac{1}{2}$ turns.

5. When the proper tension has been obtained, tighten the ball check and/or relief valve to value given below. Install the cover and secure with removed hardware.

 Ball Check or Relief Valve: **68 N•m (50 lbf ft)**

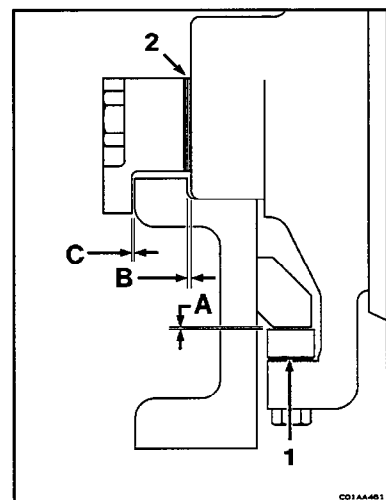
REMARK

Never remove one link to bring a stretched track to within the range of proper track adjustment. A track that is worn badly enough to take up the length of one link, will be so far out of pitch that the increased wear on the sprocket will far more than offset the saving obtained by the removal of one link in the track chain.



24.11.8 ADJUST FRONT IDLER CLEARANCE

1. Measure gap A and add shims (1) to obtain a 0.152 to 0.762 mm (0.006 to 0.030 in) clearance (A).
2. Equalize gap B on both sides of the front idler. Measure gap C and add shims (2) to obtain a 0.152 to 0.762 mm (0.006 to 0.030 in) clearance (C).
3. Repeat steps 1 and 2 for remaining front idler.



24. SERVICE PROCEDURE

24.12 SEASONAL PREPARATION

24.12.1 GENERAL

Proper maintenance and mechanical efficiency is enhanced during seasonal air temperatures changes, when the following instructions are followed.

24.12.2 OUTSIDE SOURCE OF HEAT

Machines left outside for prolonged periods in sub-zero weather will suffer from cold-soak. Lubricants become viscous and incapable of lubricating moving parts. Extreme wear could result to the engine, transmission and final drives unless proper precautions are taken.

A source of outside heat is necessary under these conditions. There are electric as well as propane-fired engine coolant heaters available. Gas-fired forced air heaters may also be obtained to heat the transmission and final drives. When using such, be sure to follow the manufacturer's instructions for personal safety.

 **WARNING**

Use caution and follow the manufacturer's instructions when using external heaters to warm the power train in cold weather.

24.12.3 LUBRICATION

Lubricate and service your machine at intervals specified in 23.1 MAINTENANCE SCHEDULE CHART. Service performed at specified intervals will prolong the life of the machine. Refer to 20.1 PROPER SELECTION OF FUEL, COOLANT AND LUBRICANT. Always select oils and lubricants specified at Anticipated Air Temperature when making seasonal preparations.

24.12.4 FUEL SYSTEM

For details of the fuel to use, see 20.1 PROPER SELECTION OF FUEL, COOLANT AND LUBRICANT.

24.12.5 COOLING SYSTEM

Prepare the cooling system as follows:

1. Check the entire system for leaks.
2. Inspect the condition of all hoses and replace the hoses and hose clamps as necessary.
3. Check the operation of the thermostat by observing the engine coolant temperature gauge on the instrument panel during operation. If the engine warms up slowly, the thermostat may be stuck in the open position. If the engine overheats, the thermostat may be inoperative by remaining closed.

REMARK

If improper thermostat operation is indicated, refer to your Engine Shop Manual for removal and installation procedures.

4. Clean cooling system and add coolant conditioner. For this procedure, refer to 24.9.1 DRAIN, FLUSH AND REFILL COOLING SYSTEM.
5. Check the tension and condition of the belts and adjust or replace if necessary. For these procedures, refer to 24.11.1 FAN BELT.
6. Remove all debris from the radiator core using air or water under pressure. Direct the flow through the core, opposite the normal direction of air flow

 **WARNING**

For your personal protection, water pressure should not exceed 275 kPa (40 psi) and air pressure should not exceed 210 kPa (30 psi). Wear eye protection.

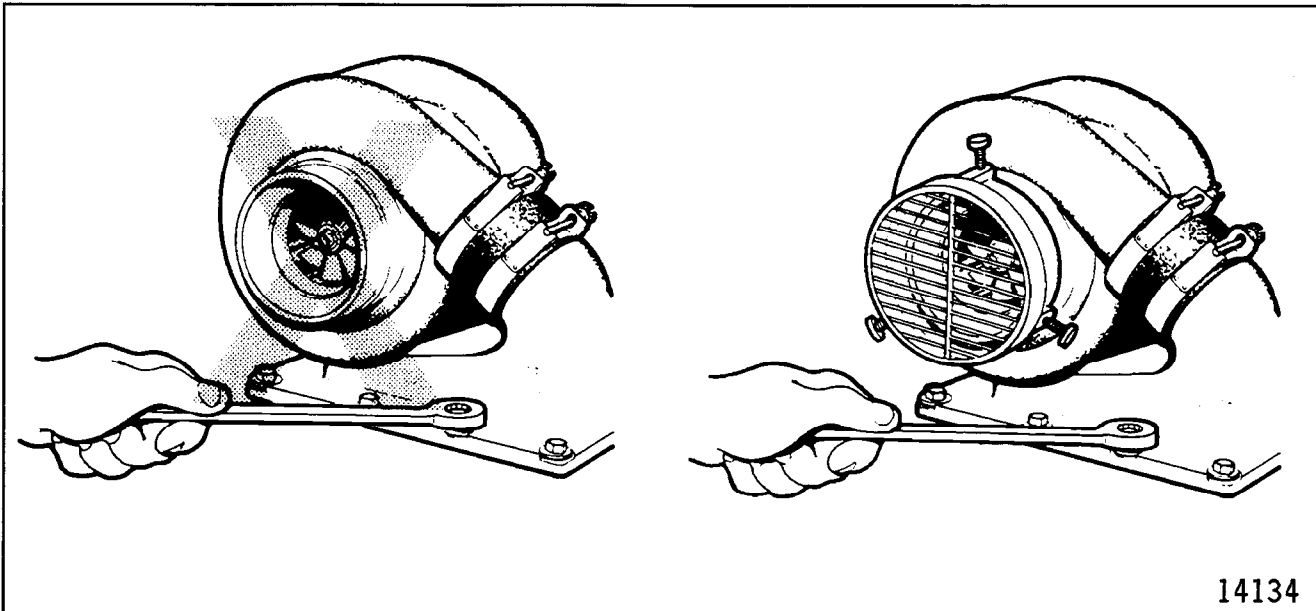
7. Clean the radiator guard and outside of the core.
8. Protect your cooling system from damage by using an antifreeze coolant. Refer to 20.2 COOLING SYSTEM.
9. Keep your cooling system clean and minimize corrosion by adding coolant conditioner at correct intervals. Refer to 20.2 COOLING SYSTEM.

24.12.6 ELECTRICAL SYSTEM

Remove all corrosion from battery terminals and cables. Repair or replace all wires which have worn, cracked or frayed insulation and broken or loose wires. Service the battery. Refer to 16.3.1 ELECTRICAL SYSTEM.

24. SERVICE PROCEDURE

24.13 TURBOCHARGER: D38E-1, D38P-1, D39E-1 AND D39P-1



MOVING IMPELLER ACCESSIBLE
TO OBJECTS AND HANDS

INLET SHIELD PROTECTS
HAND AND TURBOCHARGER

24.13.1 PRECAUTIONS

⚠ WARNING

In certain type of engine service, the turbocharger air inlet hose must be removed so other parts are accessible for service or repairs. When the air inlet hose is removed, THE TURBOCHARGER IMPELLER IS EXPOSED AND CAN CAUSE SERIOUS PERSONAL INJURY AND/OR ENGINE DAMAGE. Engine operation creates vacuum in the compressor strong enough to suck objects into the impeller. It is imperative to install a safety shield on the turbocharger inlet opening whenever air inlet hoses are removed. Failure to follow this precaution could result in serious injury.

REMARK

Only in extreme circumstances should an engine be run without clean, filtered air.

REMARK

Shield is available from your distributor.

Shut down engine prior to removing air intake hose or attempting to install a protective shield.

⚠ WARNING

Tag all controls to prevent inadvertent starting.

To install shield, remove air intake hose. Position shield over air intake opening so screen rests securely against edge of opening. Position adjustable thumb screws so shield is firmly attached.

When the air inlet hose is removed, the turbocharger can be damaged by entry of any foreign material during engine operation. When service work is completed, remove shield and store for future use. Reinstall air intake hose with hose clamp.

As a precaution against dirt getting into the engine, frequently inspect the flexible rubber hose connections clamped to the turbocharger compressor housing. If signs of deterioration are evident, replace immediately. To eliminate undue strain on the rubber hose connections, insure that pipes are properly aligned.

All the joints between the air cleaner and the turbocharger and between the turbocharger and the cylinder heads must be tight. All the gaskets must be in good condition and the bolts must be drawn up tight.

24.13.2 PRIMING

The turbocharger must be primed when the engine has been idle for more than 30 days or more. Prime the turbocharger as follows:

Be sure the hydraulic lock lever is applied. Disconnect the lead to the engine fuel shut off solenoid. Turn the ignition switch to the START position. Crank the engine until oil pressure is indicated by the engine oil pressure monitor on the control console. This should provide an adequate amount of oil to lubricate the turbocharger. Cranking the engine must be limited to 30 second periods with two minute between periods.

SPECIFICATIONS

25. SPECIFICATIONS

25.1 D32E-1, D32P-1 SPECIFICATIONS

	D32E-1	D32P-1
WEIGHT		
• Operating weight w/o operator	kg (lbs)	7133 (15725)
		7782 (17155)
BLADE		
• Equipment weight (including cylinders)	kg (lbs)	1173 (2586)
		1245 (2744)
• Blade capacity	m ³ (yd ³)	1.2 (1.6)
		1.45 (1.9)
PERFORMANCE		
• Travel speeds	km/h (mph) Forward	1st
		3.6 (2.2)
		2nd
		6.0 (3.7)
		3rd
		9.3 (5.8)
	Reverse	1st
		4.3 (2.7)
		2nd
		6.5 (4.1)
		3rd
		11.2 (7.0)
• Maximum drawbar pull	kg (lbs)	11681 (25751)
• Ground pressure	kg/cm ² (psi)	0.51 (7.3)
		0.31 (4.4)
ENGINE		
• Model	Komatsu 4D102-1 Diesel Engine	
• Flywheel horsepower	52.2 kW (70 hp) @ 2500 RPM	
• Maximum torque	247 N•m (182 lbf ft) @ 1200 RPM	
• Starting motor	2.7 kW (12V)	
• Alternator	2.7 kW (12V) @ 65A	
• Battery	2.7 kW (12V) @ 700 CCA	

25.2 D38E-1, D38P-1 SPECIFICATIONS

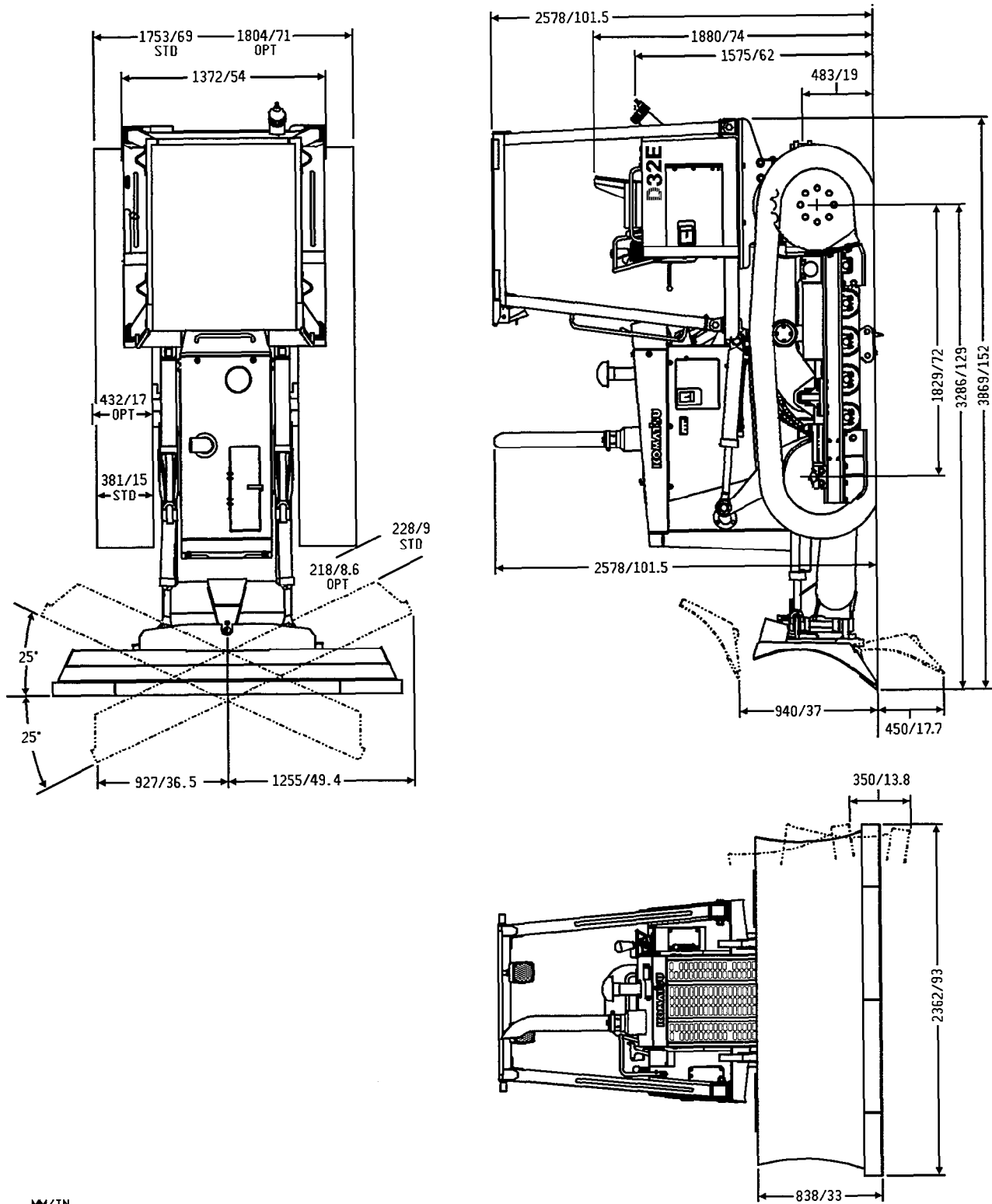
	D38E-1	D38P-1
WEIGHT		
• Operating weight w/o operator kg (lbs)	7659 (16885)	7995 (17625)
BLADE		
• Equipment weight (including cylinders) kg (lbs)	1212 (2671)	1245 (2744)
• Blade capacity m ³ (yd ³)	1.45 (1.9)	1.45 (1.9)
PERFORMANCE		
• Travel speeds km/h (mph) Forward 1st	3.3 (2.1)	
	2nd	
	5.6 (3.5)	
	3rd	
	9.3 (5.8)	
	Reverse 1st	
4.0 (2.5)		
2nd		
6.7 (4.1)		
3rd		
11.2 (6.9)		
• Maximum drawbar pull kg (lbs)	14217 (31343)	
• Ground pressure kg/cm ² (psi)	0.47 (6.8)	0.31 (4.4)
ENGINE		
• Model	Komatsu S4D102-1 Diesel Engine	
• Flywheel horsepower	59.6 kW (80 hp) @ 2500 RPM	
• Maximum torque	314 N•m (232 lbf ft) @ 1200 RPM	
• Starting motor	2.7 kW (12V)	
• Alternator	2.7 kW (12V) @ 65A	
• Battery	2.7 kW (12V) @ 700 CCA	

25. SPECIFICATIONS

25.3 D39E-1, D39P-1 SPECIFICATIONS

	D39E-1	D39P-1	
WEIGHT			
<ul style="list-style-type: none"> Operating weight w/o operator 	kg (lbs)	8448 (18625)	
BLADE			
<ul style="list-style-type: none"> Equipment weight (including cylinders) 	kg (lbs)	1303 (2872)	
<ul style="list-style-type: none"> Blade capacity 	m ³ (yd ³)	1.7 (2.2)	
PERFORMANCE			
<ul style="list-style-type: none"> Travel speeds 	km/h (mph) Forward	1st	3.3 (2.1)
		2nd	5.6 (3.5)
		3rd	9.5 (5.9)
	Reverse	1st	4.0 (2.5)
		2nd	6.8 (4.3)
		3rd	11.3 (7.0)
<ul style="list-style-type: none"> Maximum drawbar pull 	kg (lbs)	14832 (32699)	
<ul style="list-style-type: none"> Ground pressure 	kg/cm ² (psi)	0.42 (6.1)	0.33 (4.7)
ENGINE			
<ul style="list-style-type: none"> Model 	Komatsu S4D102-1 Diesel Engine		
<ul style="list-style-type: none"> Flywheel horsepower 	67.1 kW (90 hp) @ 2500 RPM		
<ul style="list-style-type: none"> Maximum torque 	334 N•m (246 lbf ft) @ 1200 RPM		
<ul style="list-style-type: none"> Starting motor 	2.7 kW (12V)		
<ul style="list-style-type: none"> Alternator 	2.7 kW (12V) @ 65A		
<ul style="list-style-type: none"> Battery 	2.7 kW (12V) @ 700 CCA		

25.4 D32E-1 DIMENSIONS

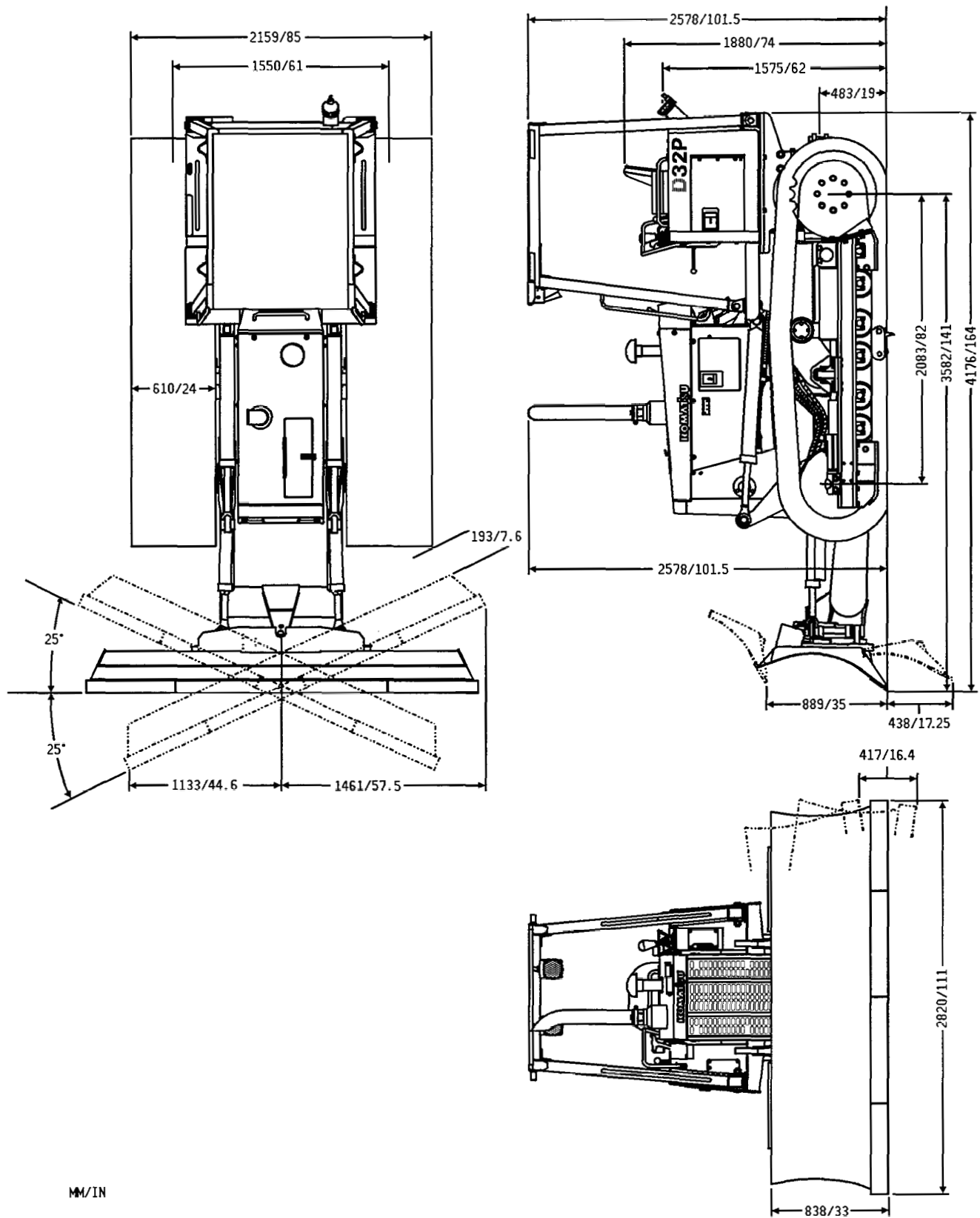


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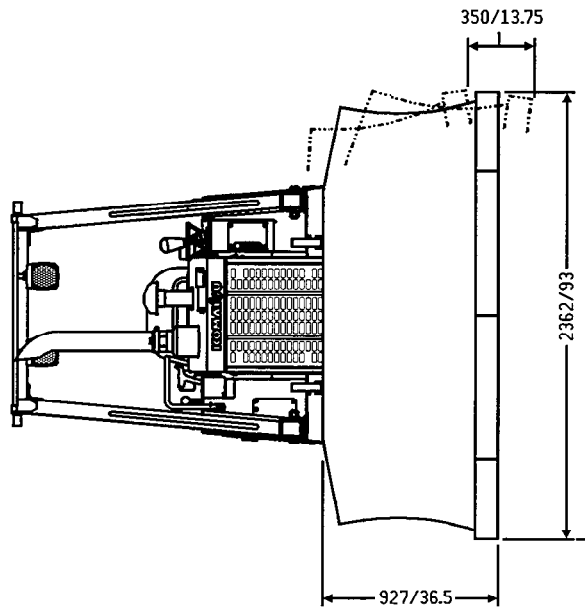
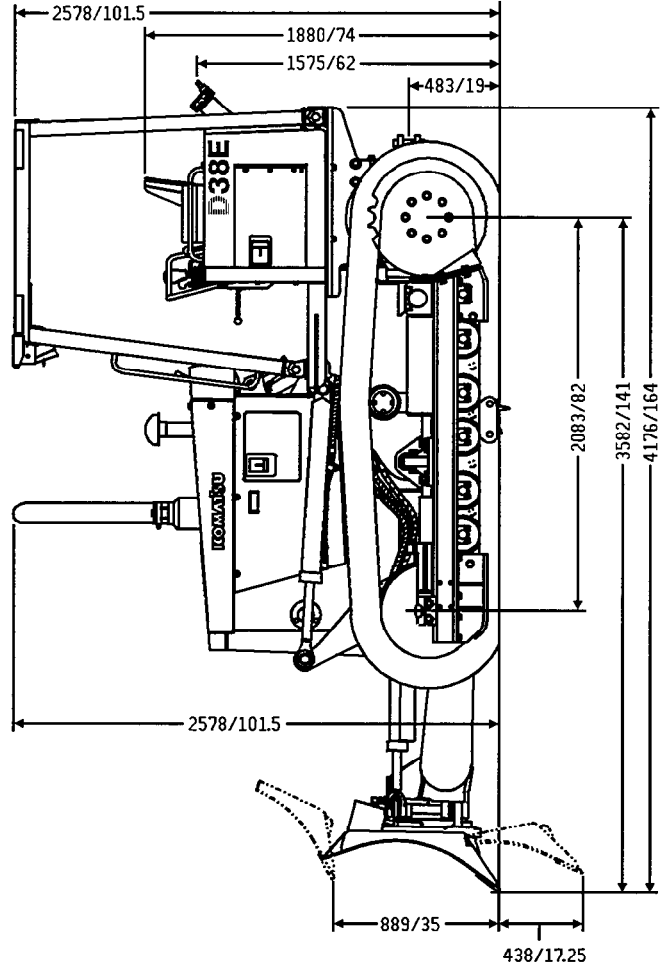
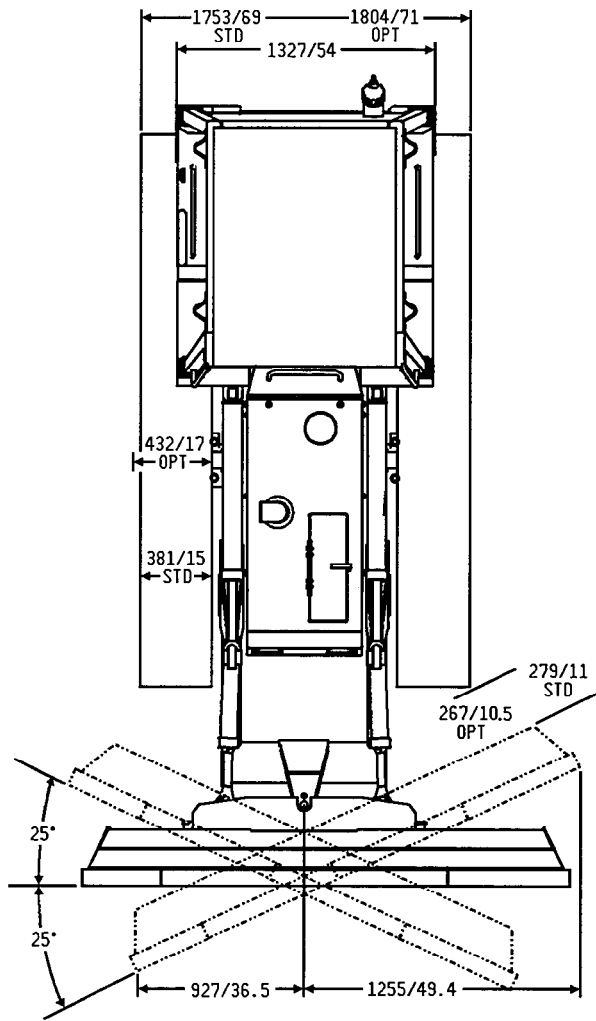
25. SPECIFICATIONS

25.5 D32P-1 DIMENSIONS



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25.6 D38E-1 DIMENSIONS

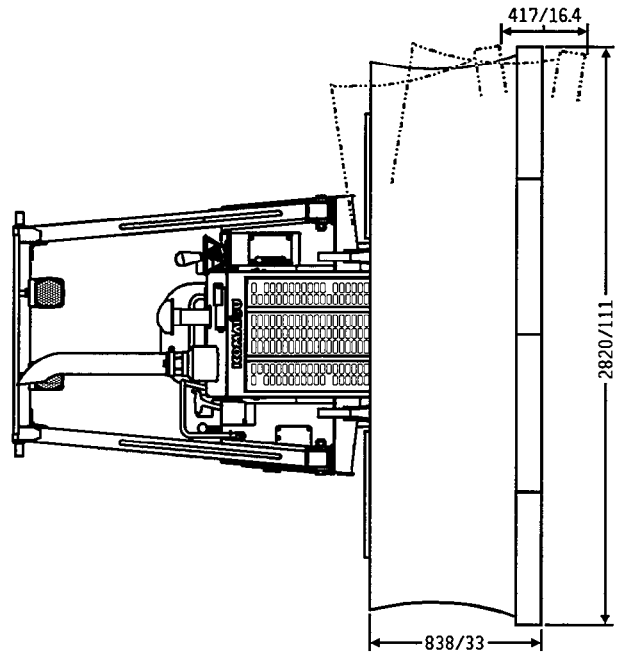
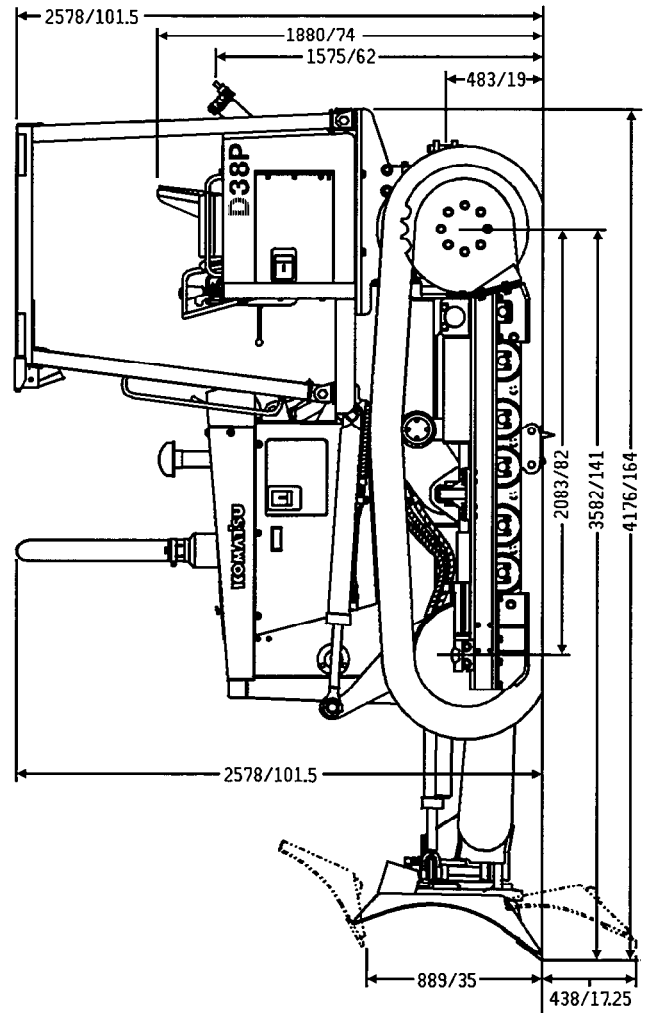
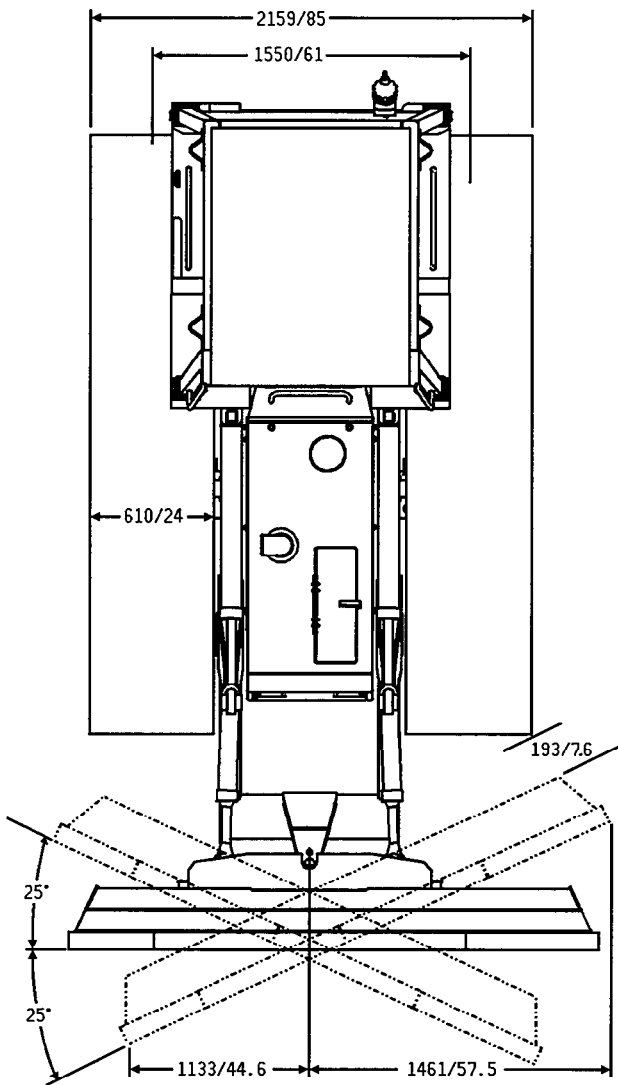


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25. SPECIFICATIONS

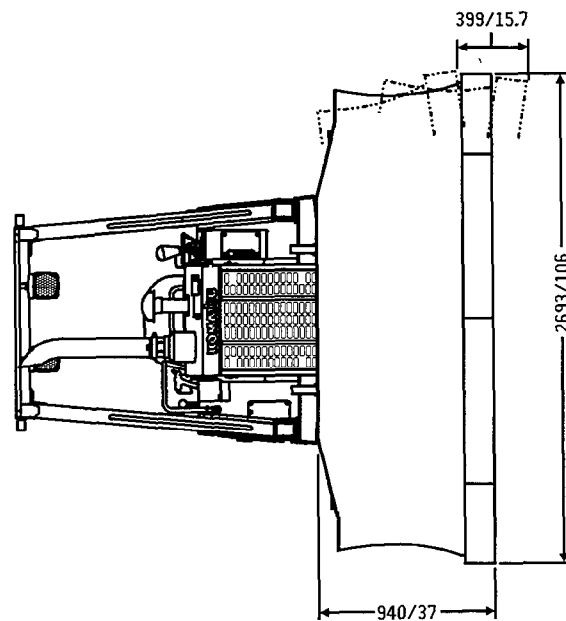
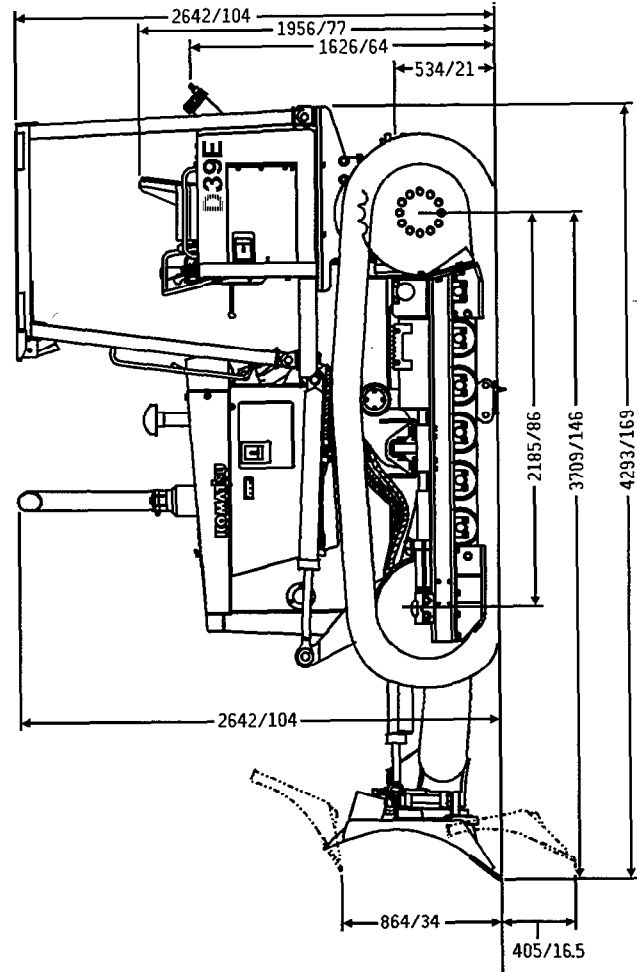
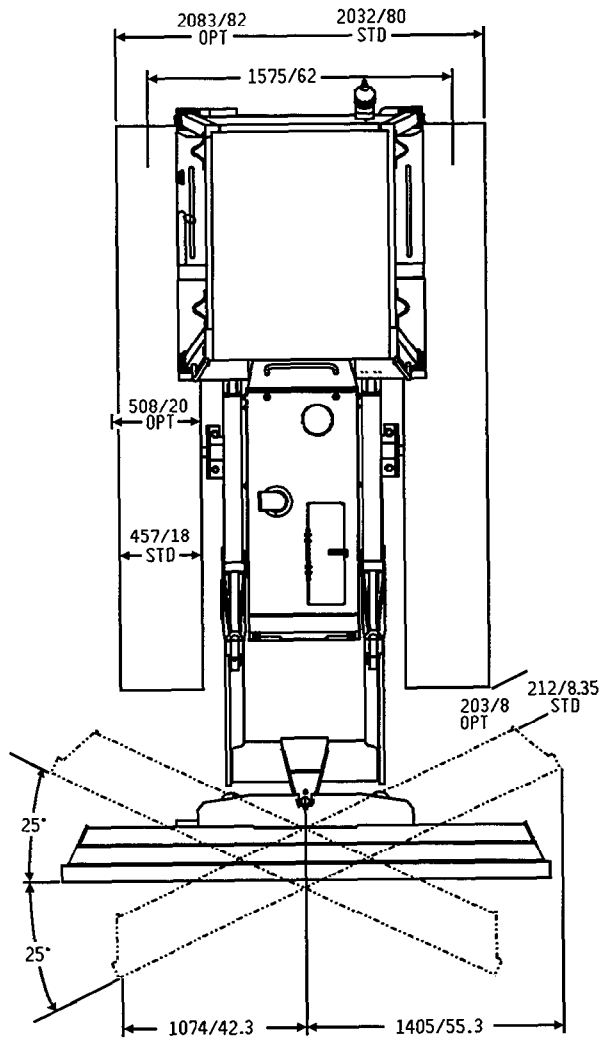
25.7 D38P-1 DIMENSIONS



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25.8 D39E-1 DIMENSIONS

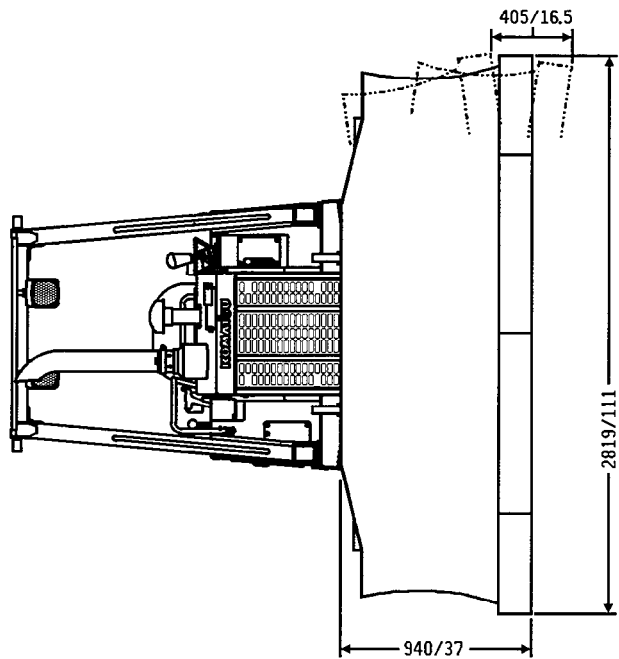
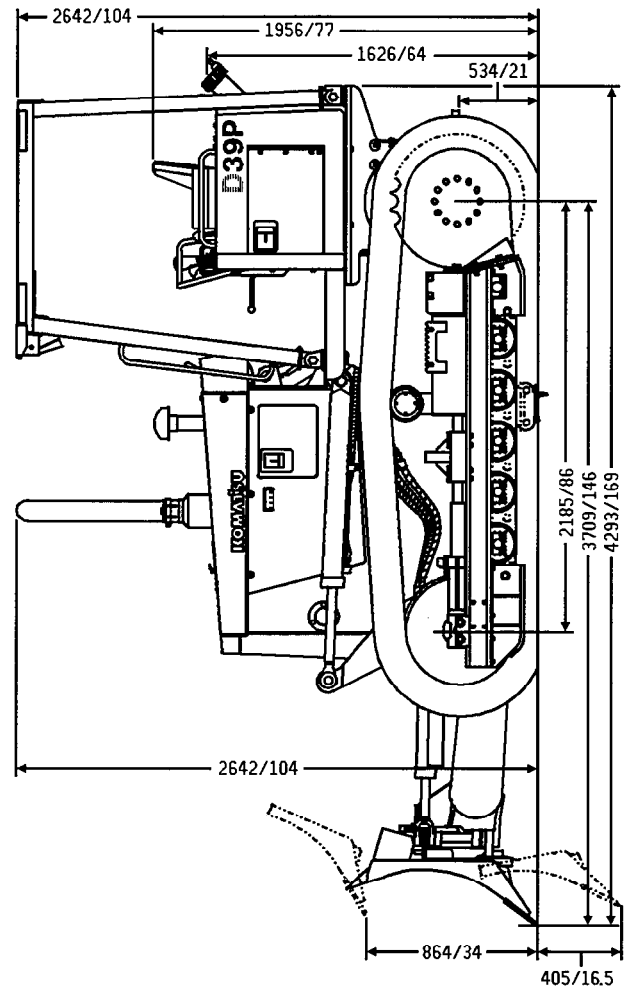
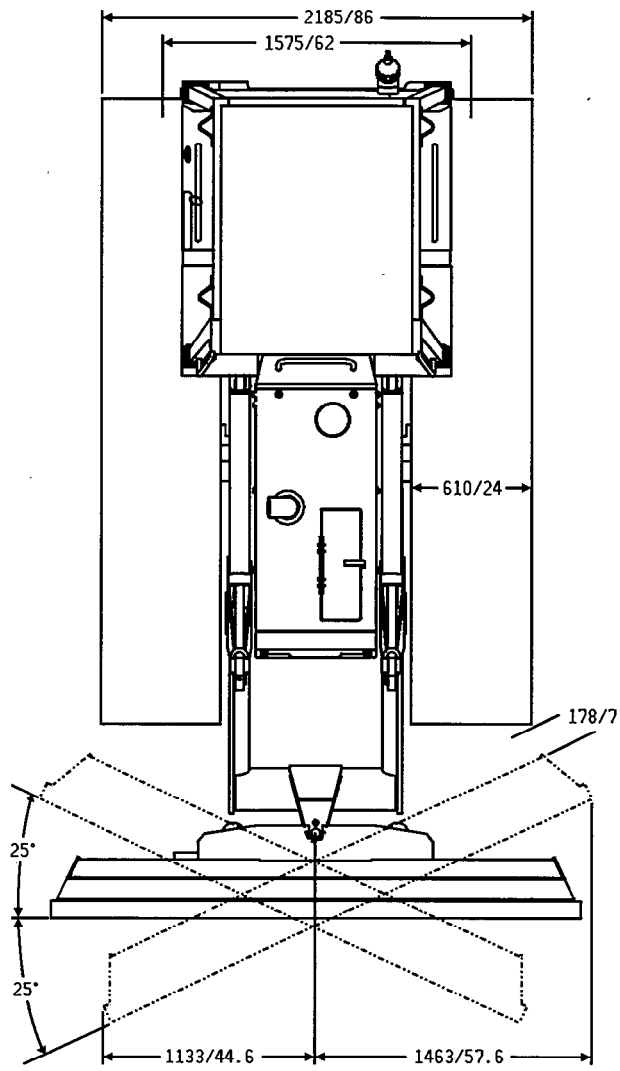


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25. SPECIFICATIONS

25.9 D39P-1 DIMENSIONS



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OPTIONS, ATTACHMENTS



WARNING

Read and follow all safety precautions in SAFETY from page 1-1 on. Failure to do so may result in serious injury or death.

26. GENERAL PRECAUTIONS

26.1 PRECAUTIONS RELATED TO SAFETY

If attachments or options other than those authorized by Komatsu are installed, this will not only affect the life of the machine, but will also cause problems with safety. When installing attachments not listed in this Operation and Maintenance Manual, please contact your Komatsu distributor first. If you do not contact Komatsu we cannot accept any responsibility for any accident or failure.

 **WARNING**

Precautions for removal and installation operations

- ◆ **When removing or installing attachments, obey the following precautions and take care to ensure safety during the operation.**
- ◆ **Carry out the removal and installation operations on a flat, firm ground surface.**
- ◆ **When the operation is carried out by two or more workers, determine signals and follow these during the operation.**
- ◆ **When carrying heavy objects (more than 25 kg/55 lbs), use a crane.**
- ◆ **When removing heavy parts, always support the part before removing it. When lifting such heavy parts with a crane, always pay careful attention to the position of the center of gravity.**
- ◆ **It is dangerous to carry out operations with the load kept suspended. Always set the load on a stand, and check that it is safe.**
- ◆ **It is dangerous to carry out operations with the load kept suspended. Always set the load on a stand, and check that it is safe.**
- ◆ **Never go under a load suspended from a crane. Always stand in a position that is safe even if the load should fall.**

NOTICE

Qualifications are required to operate a crane. Never allow the crane to be operated by an unqualified person. For details of the removal and installation operations, please contact your Komatsu distributor.

PROPOSAL FOR MANUAL REVISION

FOR INTERNAL USE ONLY -- No. PMR

P R O P O S E R	NAME OF COMPANY:	LOCATION:			
	DEPARTMENT:	PHONE NO:			
	NAME:	DATE:			
	MANUAL NAME:				
MANUAL NO:					
MACHINE MODEL: S/N IF APPLICABLE:					
PAGE NO:					
PROBLEM:					
Attach photo or sketch. If more space is needed, use another sheet.					
FOR INTERNAL USE ONLY					
CORRECTIVE ACTION:					
