

Product: Takeuchi TL230 Skid Steer Loader Service Repair Workshop Manual(Book No.CU1E002)

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WORKSHOP MANUAL

TL230

Serial No.223000001 ~

Book No. CU1E002

WE-TL230-D

TRACK LOADER



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FOREWORD

This manual, which is written for engineers who service the machine, describes procedures for disassembly and assembly, inspection and maintenance, and troubleshooting, as well as maintenance reference values and an outline of the specifications. Refer to this manual during daily work to improve your services. Note that the information is subject to change without notice due to design modifications made to the machine from time to time by the manufacturer.

Directional terms: front, rear, left, right

In this manual, the “front” refers to the end of the machine where the bucket is mounted, while the “rear” refers to the other end where the travel motor is mounted. The “right” or “left” refers to the side viewed by a person sitting in the operator’s seat.

Machine serial number

The machine serial number is stamped on the identification plate. Be sure to include this number when sending a report or inquiry or when ordering parts.

Control of manual

Appoint a person in charge of keeping the manuals up to date in your company and inform us of the person’s name for our records. Any revisions or additions to this manual will be sent to the person.

Symbols used in this manual

The symbols used in this manual have the following meanings.

-  Indicates the machine serial number.
-  Means “Refer to the section quoted.”
-  Indicates the mass of the equipment or machine.
-  Means “Tighten to the torque specified here.”
-  Indicates the use of thread-locking compound.
-  Indicates the use of grease.

Manual structure

This manual consists of the following parts.

1. Safety
2. Service data
3. Function
4. Disassembly and assembly
5. Troubleshooting
6. Engine

SAFETY **1**

Safety alert symbol	1-2
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SAFETY ALERT SYMBOL



This symbol represents the safety alert. The message that follows the symbol contains important information regarding human safety.

Read and understand the message to avoid personal injury or death.

Safety label

Safety labels are used to alert operators or other people exposed to the risks of injury or damage. There are the following three types of labels.

Read the labels carefully as they are important for your safety.

DANGER

The word “**DANGER**” indicates an imminently hazardous situation which, if not avoided, is likely to result in serious injury or death.

WARNING

The word “**WARNING**” indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

CAUTION

The word “**CAUTION**” indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

IMPORTANT: The word “**IMPORTANT**” is used to alert operators and maintenance personnel about situations which could result in damage to the machine and its components.

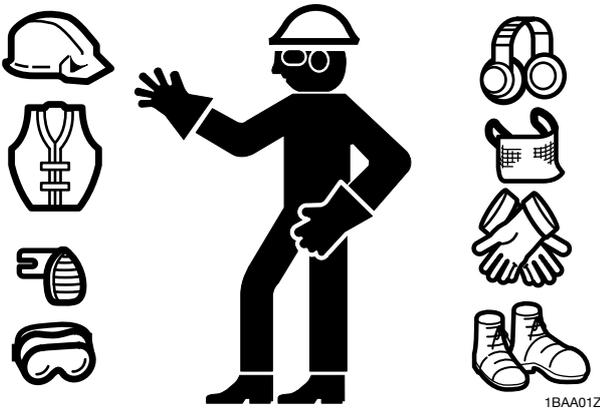
This manual is intended for trained and qualified personnel only. Warnings or cautions described in this manual do not necessarily cover all safety measures. It is also impossible to cover all hazards and risks which may be associated with the maintenance of the machine in every environment. For maintenance work, each person must take adequate safety precautions against possible hazards in the respective working environment.

SAFETY PRECAUTIONS

Observe all safety rules

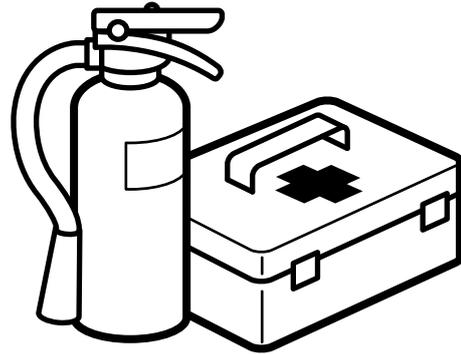
- Operation, inspection and maintenance of this machine must be performed only by a trained and qualified person.
- All rules, regulations, precautions and safety procedures must be understood and followed when performing operation, inspection and maintenance of this machine.
- Do not perform any operation, inspection or maintenance of this machine when under the influence of alcohol, drugs, medication, fatigue or insufficient sleep.

Wear safe clothing and protective gear



- Do not wear loose clothing or any accessory that can catch on the controls or the moving parts of the machine.
- Do not wear clothing stained with oil or grease that can easily catch fire.
- Wear protective gear such as helmet, safety shoes, protective goggles, respirator, gloves and earmuffs, as appropriate, depending on the work involved. Especially make sure to wear protective eye-wear and mask when working with a grinding/polishing/sanding machine, hammer or compressed air, as metal fragments or other objects could scatter in such an environment.
- Wear hearing protectors when operating the machine. Loud and prolonged noise can damage or destroy your hearing.

Install an extinguisher and a first aid kit



- Install an extinguisher to fight a fire, and learn how to use it.
- Prepare a first aid kit and keep it at a designated place.
- Decide on the procedures to be used in case of fire or other hazards.
- Decide on and take note of the contact(s) in case of emergency.

Place a “Do not operate” alert sign

Serious injury or death may result if an unauthorized person starts the engine or touches the controls during inspection or maintenance.

- Before performing maintenance, stop the engine, remove the key and store it in a safe place.
- Prominently display a “Do not operate” alert sign on places such as the starter switch and the control lever. Place another sign outside of the machine as necessary.

Use the correct tools



Do not use damaged or weakened tools or tools designed for other purposes. Use only the correct tools for the work involved.

Regularly replace the safety-critical parts

- Regularly replace fuel hoses to prevent a fire hazard. Hoses wear out over time, even if they do not show any symptom of wear.
- Regardless of the replacement schedule, replace immediately if a symptom of wear is found.

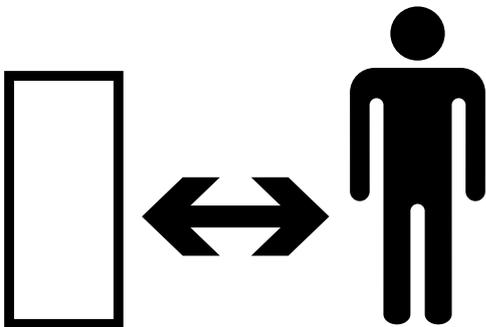
Explosionproof lighting



1BAA04Z

To prevent an ignition or explosion, use explosion-proof lights when inspecting fuel, oil, coolant or battery fluid.

Prohibit access by unauthorized persons



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Do not allow unauthorized personnel in the work area while working.

Take particular care that no unauthorized person is present when grinding, welding or using a hammer.

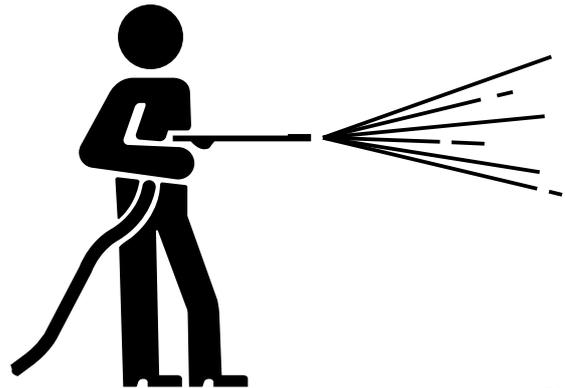
Prepare the work area

- Select a level and firm ground on which to perform maintenance work. Make sure that the work area is light enough and well ventilated.
- Straighten any obstacle or dangerous object, remove any spill of oil or grease and clean the work area.

When the canopy is tilted up

- If the canopy is raised or lowered while the engine is moving, the machine may accidentally start moving, resulting in severe injury to the maintenance personnel. Make sure that the working equipment has been lowered to the ground and the engine has been turned off before raising/lowering the canopy.
- When the canopy is tilted up, firmly secure the canopy with a stopper to prevent it from falling.

Keep the machine clean



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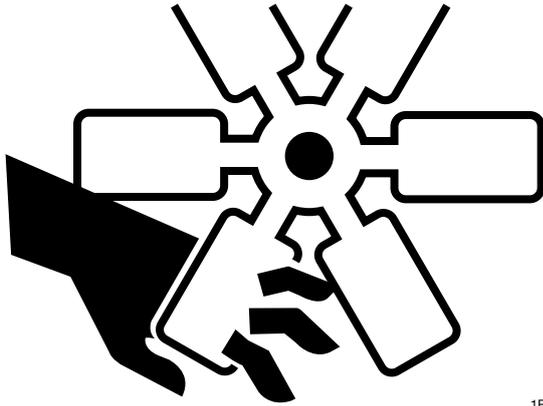
- Clean the machine before performing maintenance and try to keep it clean.
- Before washing, cover the electrical parts with vinyl to prevent water from entering, as this could cause a short-circuit or malfunction. Do not use water or steam to wash the battery, sensors, connectors or the operator's seat area.

Stop the engine before performing maintenance

Make sure the engine is stopped before starting inspection or maintenance. If maintenance must be performed with the engine running, always work as a 2-person team, communicating with each other.

- One of them must sit at the operator's seat and stop the engine whenever necessary. He/she must take care not to touch the lever or pedal unless necessary.
- The one who performs maintenance must make sure to keep his/her body or clothing away from the moving part of the machine.

Keep clear of the moving fan and belt



1BAA07Z

- Any object that can be easily caught in moving parts must be kept away.
- If a hand or tool becomes trapped in the fan or fan belt, you could lose your finger. Do not touch the fan or belt while they are moving.

When working under the machine



1BAA08Z

- Before performing maintenance or repairs under the machine, set all movable equipment against the ground or in the lowermost position.
- Place chocks under the crawler tracks to secure the machine.
- If it is unavoidably necessary to work under the raised machine or working equipment, be sure to firmly support it by using an arm stopper, wooden block, stand or safety brace. Never go under the raised machine or working equipment without such protection measures.

When working on the machine



1BAA09Z

- To prevent slipping/falling from machine, clear the footing and observe the following:
 - a. Do not spill oil or grease on the machine.
 - b. Keep the machine tidy and clean.
 - c. Be careful when walking around the machine.
- Never jump down from the machine. Climb up/down the ladder (steps) holding the handrail to support your weight in a three point secure stance (hand and feet).
- Wear protective gear according to the work involved.

Securing the working equipment

When replacing/repairing the bucket teeth or side cutter, secure the relevant equipment to prevent any accidental movement.

Secure the engine hood and guard when they are open

Firmly secure the machine when the engine hood or guard is left open. Do not keep the hood or guard open on a windy day or if the machine is parked on a slope.

Place heavy components in a stable position



1BAA10Z

When it is necessary to temporarily place a heavy component, such as the hoe attachment, on the ground during removal or installation, be sure to place it in a stable position.

Caution when filling with fuel or oil



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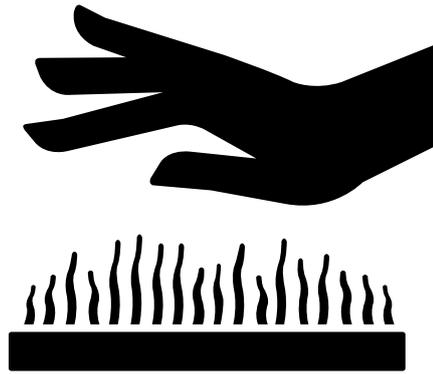
- Keep away from heat, sparks and flame while filling with fuel or oil.
- Never remove the fuel cap or try to fuel when the engine is running or still hot.
- Maintain control of the fuel filler nozzle when filling the tank.
- Refill with fuel or oil outdoors or in a well ventilated place, with the engine turned off.
- Clean up spilled fuel or oil immediately.
- Do not overfill the tank.
- Firmly tighten the fuel cap or oil cap. If the fuel cap is lost, replace it only with the original manufacturer's approved cap. Use of a non-approved cap without proper venting may result in pressurization of the tank.
- Never use fuel for cleaning.
- Use the correct grade of fuel for the operating season.

Handling of hoses

Oil leak or fuel leak can cause a fire.

- Do not twist, bend or hit the hoses.
- Never use twisted, bent or cracked pipes, tubes or hoses; otherwise, they may burst.
- Retighten loose connections.

Be careful with hot and pressurized components



1BAA12Z

Before performing inspection and maintenance, stop the engine and allow the machine to cool down.

- The engine, muffler, radiator, hydraulic lines, sliding parts and many other parts of the machine are hot immediately after the engine is stopped. Wait until it cools before making any inspection or adjustments.
- The engine coolant, hydraulic oil and other oils are also hot and under high pressure. Touching these liquids will cause burns.

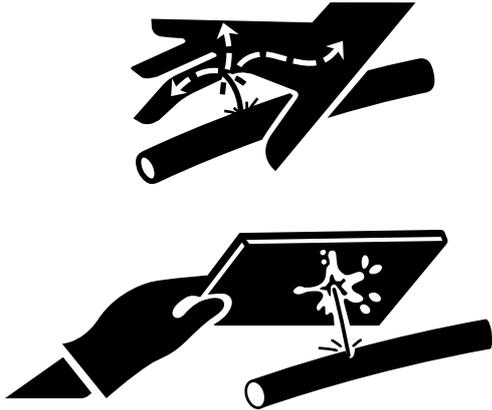
Handling of radiator



1BAA13Z

Do not remove the radiator cap when the coolant is hot. Wait until it cools down, and then remove the radiator cap by loosening it slowly to release the internal pressure.

Be careful with oils under pressure



1BAA14Z

Pressure is maintained in the hydraulic circuit long after the engine has been shut down.

- Do not fill with, dispose of fuel/oil, or perform the inspection and maintenance until the internal pressure is completely released.
- The hydraulic oil escaping from a small hole can be hazardous if contacted. It is under high enough pressure to penetrate the skin or eyes and cause serious injury. If leak is suspected, protect your eyes and skin by wearing protective glasses and thick gloves to search for a leak. Also use a paperboard or plywood to keep your skin from oil spurting. If oil penetrates the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury.

Release internal pressure before working on the hydraulic system

Oil may spurt out if caps or filters are removed or pipes are disconnected before releasing the pressure in the hydraulic system.

- Gradually loosen the vent plug to release the internal pressure of the hydraulic oil tank.
- Move all the control levers and pedals several times in all directions to release the pressure from the circuit of the working equipment (for link type controls).
- When removing plugs or screws, or when disconnecting hoses, stand to the side and loosen them slowly to gradually release the internal pressure before removing.

Be careful with grease under pressure



1BAA15Z

In the track adjuster, the grease has been injected under high pressure. If the tension is adjusted without following the prescribed procedure, the grease discharge valve may fly off, resulting in injury.

- Loosen the grease discharge valve slowly.
- Do not put your face, arms, legs or body in front of the grease discharge valve.

Handling of the accumulator



1BAA16Z

Be sure to handle the high-pressure nitrogen gas enclosed in the accumulator with care according to procedure. If handled incorrectly, it could explode and cause serious injury. Strictly observe the following precautions:

- Do not disassemble.
- Do not allow flame near it or throw it into a fire.
- Do not drill, weld or fuse.
- Do not subject it to physical shock such as hitting, rolling or dropping.
- Before disposing of the unit, the sealed gas must be drained. Contact your sales or service dealer for help with this.

Disconnect the battery

Disconnect the wiring from the both terminals (+ and -) on the battery before working on the electrical system or doing electric welding. Otherwise, short-circuit and explosion of the battery can result.

Use caution when handling batteries



1BAA17Z

- Batteries contain sulfuric acid which will damage eyes or skin if contacted.
 - If eye contact occurs, flush immediately with clean water and get prompt medical attention.
 - If accidentally swallowed, drink large quantities of water or milk and call a physician immediately.
 - If acid contacts skin or clothing, wash off immediately with a lot of water.
- Wear protective glasses and gloves when working with batteries.
- Batteries generate flammable hydrogen gas which may explode. Keep away from flame and sparks.
- Do not use or charge the battery when the electrolyte level is lower than the lower limit: otherwise, it could cause an explosion.
- Be sure to stop the engine by turning off the starter switch before inspecting or handling the battery.
- Be careful not to let metal tools (or any metal objects) such as a hammer or spanner come into contact with the battery terminals.
- When disconnecting the battery wiring, always disconnect it from the earth side (-). When connecting, connect the earth side last.
- Loose battery terminals may result in sparks. Be sure to fasten terminals tightly.
- Make sure the battery caps are tightened securely.
- Do not charge a battery or jump-start the engine if the battery is frozen; otherwise it may explode.
Warm the frozen battery to 15°C (60°F) before use.

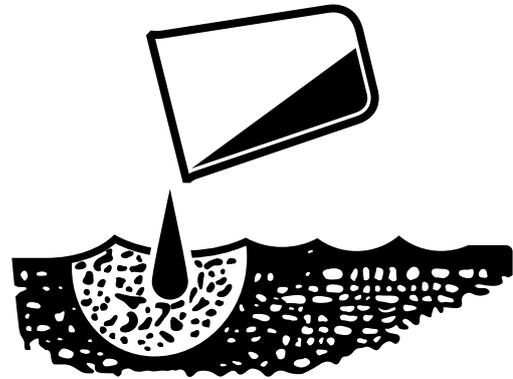
Have a service agent repair welding cracks or other damage

Ask a service agent to make any repairs that require welding. If the agent is unavailable, make sure the welding is done by a qualified person in a properly equipped work-place.

Checks after maintenance

- Gradually raise the engine speed from low idle to maximum and check that no oil or water is leaking from the parts serviced.
- Move the controls and check that the machine is operating properly.

Disposing of wastes



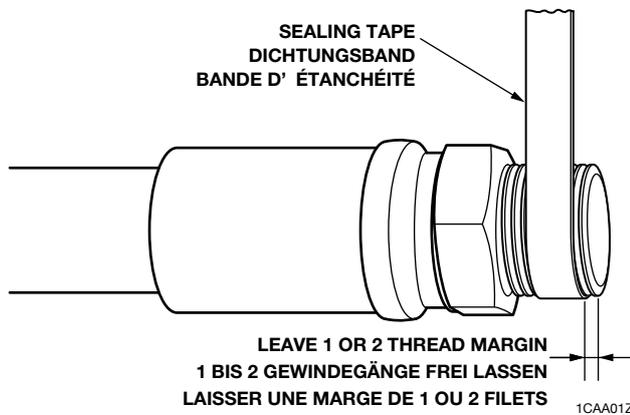
1BAA18Z

- Always collect oil that is drained from the machine in containers. Improperly disposed waste oil can cause environmental harm.
- Follow appropriate laws and regulations when disposing of harmful objects such as oil, fuel, coolant, solvent, filters and batteries.

CAUTIONS WHEN WORKING

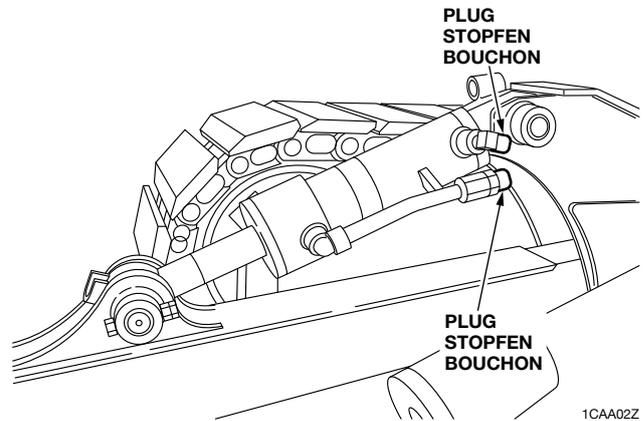
When disassembling or assembling

- Clean the machine before disassembly.
- Check the following items and record the results:
 - a. Model, machine serial number, hour meter.
 - b. Reason for repair, repair history.
 - c. Are the filters dirty?
 - d. The conditions of the fuel and oil.
 - e. Any damage or looseness to any part?
- Where necessary, draw alignment indicators to avoid assembly errors. To avoid misconnection, place indicators such as reference tags on pipes.
- Clean all disassembled parts and new parts, arrange them neatly, and place indicators as necessary.
- Be sure to replace all seals and cotter pins with new ones.
- Keep those parts that should not come in contact with water or oil away from those with oil on the surface.
- When installing bearings, bushings and oil seals, a press tool should be used. If a hammer is used, use a cushioning material to avoid damage.
- Wipe all joining surfaces clean until there is no dirt or dust adhering to them.
- Wrap the thread tight with seal tape starting 1 or 2 threads away from the thread end. The tape should be overlapped by about 10 mm.



When removing/installing the hydraulic unit

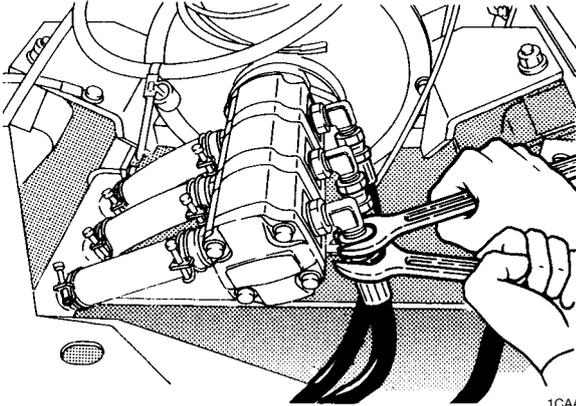
- Make sure that the temperature of the hydraulic oil has dropped and is cool enough to work with.
- To prevent the hydraulic oil from escaping under pressure, release the residual pressure in the piping.
- Be sure to install caps or plugs on all openings in the hydraulic unit to prevent dirt from getting into the unit through them.



- The hydraulic oil adhering to the unit is often mistaken for an oil leak, so wipe off the unit thoroughly.
- Be sure that no damage is caused to the plating on the rod in the hydraulic cylinder.
- Removal and installation of the hydraulic cylinder should be done with the rod fully retracted.
- Be sure to bleed the air after installing the hydraulic cylinder. (☞ "4. Disassembly and assembly: Cylinder")
- Always bleed the air when hydraulic oil is changed or a hydraulic device is replaced. (☞ "4. Disassembly and assembly: Drive system")

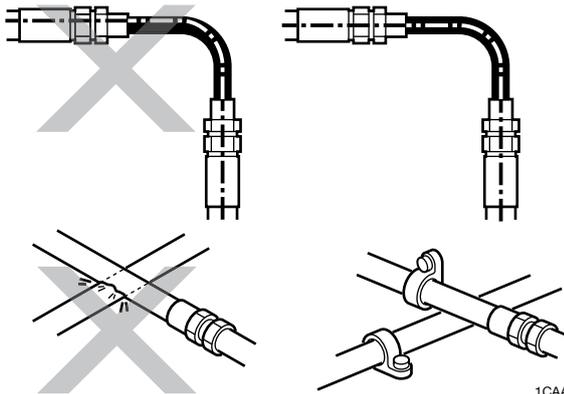
When connecting/disconnecting the hoses or pipes

- When hydraulic hoses or pipes are connected, tighten them once to the prescribed torque, then loosen them slightly and retighten them to the prescribed torque.
 - a. Tighten the fittings after the installation surfaces fit snugly together.
 - b. The above procedures do not apply to fittings with seal tape.
- Use two spanners, one to tighten/loosen and the other to secure the mating hose/pipe to ensure that the hose is not twisted.



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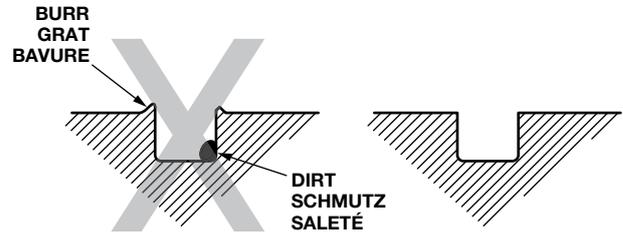
- After connecting the hydraulic hoses or pipes, apply the maximum working pressure five or six times to check for leakage.
- If high pressure, vibration or shock is applied to a twisted hose, oil leak, hose breakage or damage to the hose fitting can result.
- Be sure that the hydraulic hoses are not contacting sharp objects or each other. This could cause surface flaws on the hoses, resulting in breakage.



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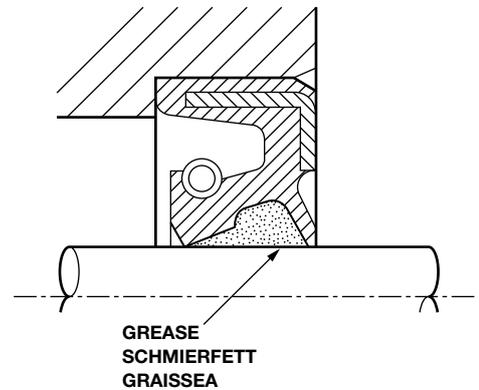
Handling of seals

- Clean the grooves for O-rings and remove any burrs.



1CAA05Z

- Be careful not to twist the O-rings. If twisted, remove it with your fingertips.
- When inserting, be careful not to damage the seal.
- Handling of the floating seal
 - a. After removal, wipe all oil off the O-ring and housing of the floating seal.
 - b. When assembling, apply a thin coating of gear oil to the contact surface of the housing,
 - c. After assembly, turn the seal two or three times to get it to fit snugly.
- Apply grease to the lip of the oil seal.
 - a. This is to prevent wear from occurring upon first start up after assembly.

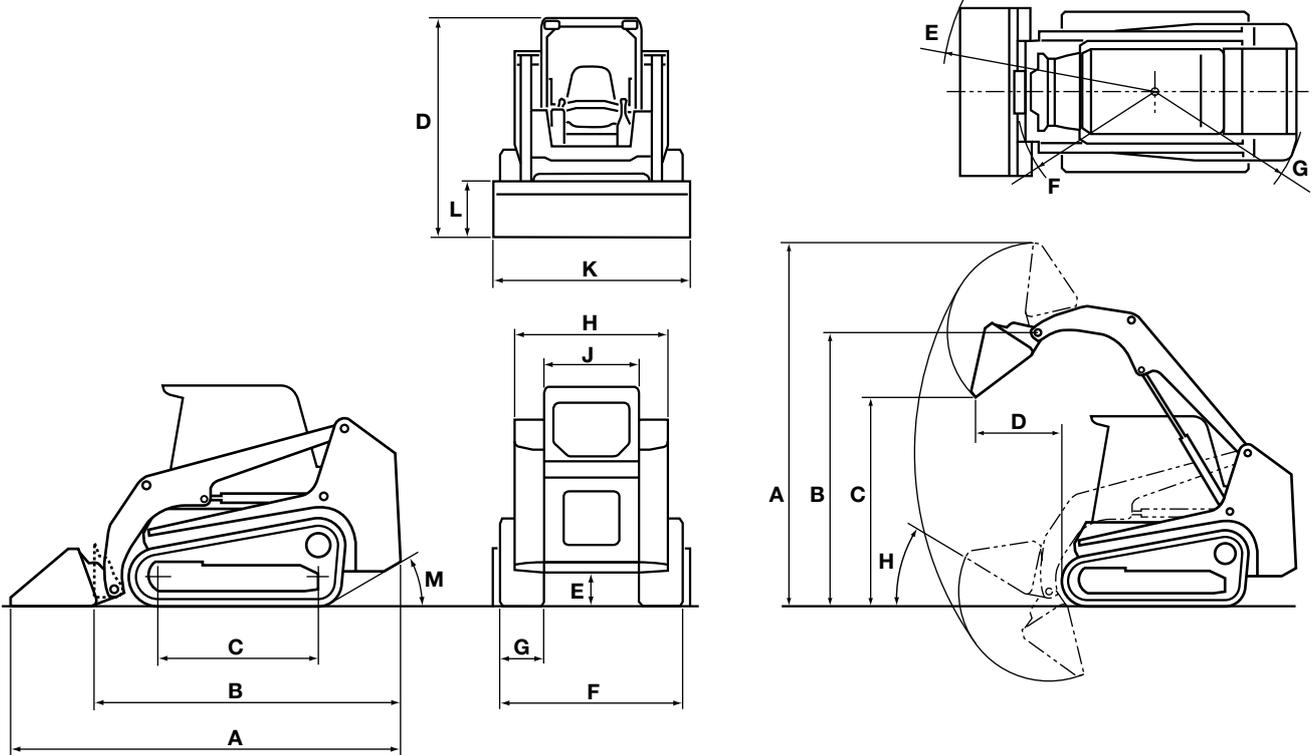


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SERVICE DATA **2**

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DIMENSIONAL DRAWING



2AAD01Z

Machine dimensions

Unit: mm

	Standard bucket	
	Rubber crawler	
	Canopy	Cab
A	3430	←
B	2740	←
C	1390	←
D	2235	2130
E	310	←
F	1580	←
G	320	←
H	1430	←
J	985	980
K	1675	←
L	510	←
M	30°	←

Operating range

Unit: mm

	Standard bucket	
	Rubber crawler	
	Canopy	Cab
A	3905	←
B	3030	←
C	2370	←
D	730	←
E	2080	←
F	1375	←
G	1590	←
H	30°	←

SPECIFICATIONS TABLES

Performance

Bucket type		Standard bucket	
Bucket capacity	m ³	0.351	
Tipping load	kg	2380	
Rated loading mass	kg	735	
Breakout force	kN	29.9	
Raising time (load)	s	4.0	
Lowering time	s	2.6	
Bucket forward tilting time	s	2.6	
Travel speed	Forward 1st	km/h	7.3
	Forward 2nd	km/h	10.9
	Reverse 1st	km/h	7.3
	Reverse 2nd	km/h	10.9
Maximum tractive force		kN	40.6
Gradeability		degree (°)	30
Minimum turning radius	Bucket outside	m	2.082

Dimensions

Overall length in transport condition	Without teeth	mm	3430	
	With teeth	mm	–	
Overall width (body)		mm	1580	
Bucket width		mm	1675	
Overall height	Bucket on ground	Canopy	mm	2130
		Cab	mm	2235
	Max. raised height of bucket		mm	3905
Crawler bearing length		mm	1390	
Track gauge		mm	1260	
Shoe width		mm	320	
Crawler bearing area		m ²	0.890	
Ground clearance of undercarriage		mm	310	
Bucket hinge pin height		mm	3030	
Dumping clearance (at 45-degree forward tipping)	Without teeth	mm	2370	
	With teeth	mm	–	
Dumping reach (at 45-degree forward tipping)	Without teeth	mm	730	
	With teeth	mm	–	
Bucket roll back angle	On ground	degree (°)	29.3	
Bucket dumping angle	Maximum height position	degree (°)	38.6	
Maximum digging depth		mm	0	

Mass

Gross machine mass	Canopy	kg	4270
	Cab	kg	4360
Operating mass	Canopy	kg	3710
	Cab	kg	3800
Machine mass	Canopy	kg	3635
	Cab	kg	3725
Shipping mass	Canopy	kg	3580
	Cab	kg	3670

Engine

Model		Yanmar 4TNV98-ZNTBL	
Type		4-cycle, vertical, water-cooled, in-line, 4-cylinder, direct-injection	
Number of cylinders – Internal diameter x stroke		4 – 98 × 110	
Total displacement		L	3.318
Performance	Rated engine speed	min ⁻¹	2500
	Rated horsepower	kW	50.1
	Maximum torque	N·m	222.7 to 242.5/1600 min ⁻¹
	Specific fuel consumption (at rated output)	g/kW·h	250 (184)
Fuel system	Speed governor	Electronic governor	
Lubrication system	Type	Trochoid pump	
	Filter system	Filter paper	
	Cooling system	Water cooling	
Air cleaner		Cyclone filter	
Cooling system	Fan	Pusher type	
	Radiator	Pressurized	
Generator	AC/DC	Three-phase alternating current, self-rectifying	
	Voltage	V	12
	Output	kW	0.48
Starting system	Voltage	V	12
	Output	kW	3
Battery	Type	130E41R	
	Voltage	V	12
	Capacity	A·h	80
	Quantity	1	

Hydraulic drive system

Pump	Model		Sauer-Danfoss-Daikin PVM2828
	Type		Variable displacement piston
	Displacement	cm ³ /rev	0 to 28
	Quantity		2
Travel motor	Model		Sauer-Danfoss-Daikin BMVT32C
	Type		Variable displacement piston
	Motor displacement	cm ³ /rev	20.6/31.5
	Quantity		2
Set pressure	Effective differential pressure	MPa	34.5
Reduction gears		Epicycle reduction gear	

Brake device

Parking brake	Spring-loaded, wet type disc brake
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Undercarriage

Suspension system		Rigid type	
Roller, Idler	Seal system		Floating seal
	Carrier roller (one side)	Q'ty	—
	Track roller (one side)	Q'ty	5
Crawler	Track adjuster		By injecting grease
	Type		One-piece design, single groucer, rubber crawler
	Grouser height	mm	30
	Number of shoes (one side)	Q'ty	52 (lugs)
	Pitch	mm	86
	Shoe width	mm	320

Operating device

Cab/canopy	Location		Center of machine
	Type		ROPS/FOPS canopy & cab
Operator's seat			Suspension seat, adjustable
Control lever and pedal	Lever		Travel, attachments
	Pedal		Accelerator
Instruments			Cluster gauge (12 V): Water temperature gauge, Fuel gauge, Hourmeter, Charge, Oil, Air cleaner, Line filter, Glow, 2nd-speed pilot
Lighting device	Front light		12 V, 55 W x 2
	Rear light		12 V, 55 W x 2
Others	Horn	Q'ty	1
	Back-up buzzer	Q'ty	1
	Inside rear view mirror	Q'ty	2
	Rear view mirror	Q'ty	1

Working equipment

Bucket blade type			Without teeth
Bucket teeth	Type		—
	Quantity		—
Auto adjustment mechanism			Hydraulic leveling device for bucket raising

Hydraulic system

Arm cylinder	Type		Independent piston
	Quantity		2
	Internal diameter	mm	65
	Stroke	mm	705
Bucket cylinder	Type		Independent piston
	Quantity		2
	Internal diameter	mm	65
	Stroke	mm	475
Hydraulic pump	Type		Double gear pump
	Displacement	cm ³ /rev	27.8 + 16.2
Control valve	Type		Hydraulic pilot operated
	Set pressure	MPa	3.3

LUBRICANT AND FUEL CHART

Select the appropriate fuel, lubricant and grease according to the temperature by referring to the table below.

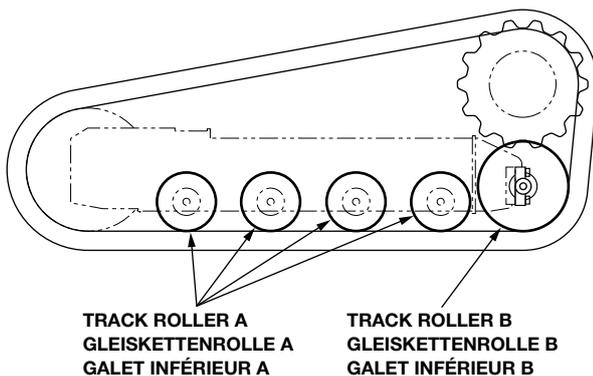
- Regardless of the specified time, change the oil if it becomes too dirty or degraded.
- When refilling, never mix oils of different brands. If a brand is to be changed, replace the whole fuel/oil.

Part	Type	Type by air temperature							When to change/ replenish	Capacity	
		-30	-20	-10	0	10	20	30			40°C
Engine oil pan	Diesel engine oil API: CF class or more				SAE 10W-30					Every 250 hrs after the first 50 hrs	Upper limit 10.2 L
					SAE 15W-40						
Hydraulic oil tank	Diesel engine oil API: CD class				SAE 10W-30					Every 1000 hrs	Total amount of oil: 58 L Tank capacity: 39 L
					SAE 10W-40						
Engine cooling system	**Cooling water (water + coolant)				Mixture of 50% coolant					Every 1000 hrs	16.5 L
					Mixture of 30% coolant						
Travel reduction gear	Gear oil API: GL-4				SAE 90					Every 500 hrs after the first 250* hrs	1.0 L
Track roller A	Diesel engine oil API: CD class				SAE 30					—	0.18 L
Track roller B	Mobilgear SHC680				—					—	0.14 L
Idler	Diesel engine oil API: CD class				SAE 30					—	0.12 L
Working equipment	Lithium grease EP-2				—					Daily or every 10 hrs	As required
Lever/pedal	NLGI No.2									When required	

* If the ratio of traveling time to total operating time is high, replace the gear oil earlier than the specified time.

** For water, use tap water (soft). Do not use well or river water.

When the ambient temperature drops below 0°C, add coolant (antifreeze). Follow the coolant manufacturer's instructions to determine the mixture ratio.



2CAD01Z

Diesel fuel standards

Use the diesel fuel that is compliant with any of the standards below. The table below shows the standards from the various countries.

Diesel fuel standards	Region
No. 2-D, No. 1-D, ASTM D975-94	USA
EN590:96	EU
ISO 8217 DMX	International standard
BS 2869-A1 (or A2)	UK
JIS K2204 Grade, 2-go	Japan
KSM-2610	Korea
GB252	China

Part	Type	Capacity
Fuel tank	Desel fuel <ul style="list-style-type: none"> • The sulfur content must be less than 0.5% by volume. The recommended value, however, is less than 0.05%. The electronically-controlled engine with an EGR system should use fuel containing less than 0.05% sulfur. Fuel containing a high content of sulfur may cause sulfuric acid corrosion inside the cylinder. • Do not mix fuel with any kerosene, used engine oil or leftover fuel. • Poor quality fuel can degrade the engine performance. It also can damage the engine. • Avoid using additives to fuel. Some fuel additives can degrade the engine performance 	75 L

Bio-diesel fuel

In various European countries and the US, fuel sources such as rapeseed oil methyl ester (RME) and soybean oil methyl ester (SOME) are used as extenders for diesel fuel made from mineral oil. These RME and SOME are collectively called fatty acid methyl ester (FAME).

Bio-diesel fuel is permitted to be used provided its total mixing rate by volume is at least 95% approved mineral oil and no more than 5% FAME. Note that bio-diesel fuel containing 5% SOME is referred to as B5 diesel fuel.

This B5 diesel fuel must meet certain standards:

- It must meet the minimum standard requirements of the country in which it is used.
 - In Europe, bio-diesel fuel must meet the European standard EN14214.
 - In the US, bio-diesel fuel must meet the US standard ASTM D6751.
- It must be purchased from a certified diesel fuel store.

Precautions when using bio-diesel fuel

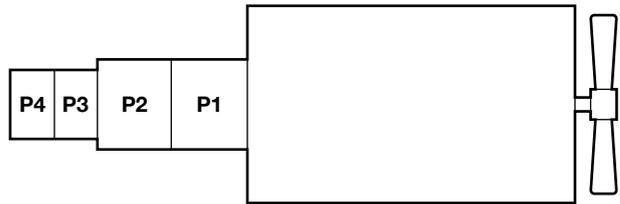
- There is a risk that the free methanol in FAME could cause corrosion of some parts of the fuel injection equipment (FIE) made from aluminum or zinc.
- The free water in FAME may cause clogging of the fuel filter or increased growth of bacteria.
- The fuel viscosity may increase and the fuel may become difficult to flow at low temperature. Also, operation of the injection pump may become faulty or the spray performance of the injection nozzle may decrease.
- FAME may damage some rubber materials (seals), causing fuel to leak or the engine oil to become thinner.
- Even when the bio-diesel fuel meets the appropriate standard, care should be taken to maintain the quality of the equipment and the fuel in the fuel tank. It is important always to add clean new fuel. It may become necessary to regularly wash out the dirt from the fuel line and fuel tank.
- The warranty of the engine manufacturer may be voided by using a bio-diesel fuel that does not meet the standard of the diesel engine manufacturer or diesel fuel injection equipment, or deteriorated fuel as described in the above precautions.

PERFORMANCE CRITERIA

Standard values table

Item			Standard value	Allowable value	
Engine speed	Low		min ⁻¹	1130 ±70	
	High		min ⁻¹	2650 ±60	
Hydraulic oil pressure	Travel	Right	MPa	34.3 ^{+5.9} _{-0.5}	
		Left	MPa	34.3 ^{+5.9} _{-0.5}	
	Charge	Low	MPa	1.5 ±0.2	
		High	MPa	2.0 ±0.2	
	Bucket		MPa	20.6 ^{+1.2} _{-0.5}	
	Pilot		MPa	3.1 ±0.4	
High flow		MPa	20.6 ±1.0		
Cylinder speed	Lowering speed when the lift arm is in float		s	4.4 ±1.4	
	Lift arm	Raising	s	4.0 ±0.4	
		Lowering	s	2.7 ±0.4	
	Bucket	Roll back	s	2.0 ±0.4	
Dump		s	2.8 ±0.4		
Travel speed (10 m)	1st	Forward	s	4.9 ±0.5	
		Reverse	s	4.9 ±0.5	
	2nd	Forward	s	3.3 ±0.4	
		Reverse	s	3.3 ±0.4	
Track shoe (5 revs.)	1st	Light	Forward	s	11.1 ±0.6
			Reverse	s	11.1 ±0.6
		Left	Forward	s	11.1 ±0.6
			Reverse	s	11.1 ±0.6
	2nd	Light	Forward	s	7.3 ±0.5
			Reverse	s	7.3 ±0.5
		Left	Forward	s	7.3 ±0.5
			Reverse	s	7.3 ±0.5
Straight-ahead traveling		Forward	mm	125 ⁰ ₋₁₂₅	
		Reverse	mm	125 ⁰ ₋₁₂₅	
Cylinder spontaneous drop		Lift arm	mm	5 ⁺⁰ ₋₅	
		Bucket	mm	5 ⁺⁰ ₋₅	
Natural travel drop	Engages parking brake	Forward	mm	0	
		Reverse	mm	0	
Bucket front edge		Difference between right and left	mm	10 ⁰ ₁₀	
Lever	Lever operating force	Arm	N	10 ±4	
		Bucket	N	10 ±4	
		Travel	N	10 ±4	
	Lever play	Arm	mm	4 ⁰ ₋₄	
		Bucket	mm	4 ⁰ ₋₄	
		Travel	mm	4 ⁰ ₋₄	
Crawler tension		mm	25 to 50	—	

Hydraulic pump assignment table



2DAA01Z

P1	Left travel	70.0 L/min
P2	Right travel	70.0 L/min
P3	Arm, bucket, auxiliary	69.5 L/min
P4	Charge pressure, pilot pressure	40.5 L/min

Pump P1

Left travel	Pressure: 34.3 MPa	Test port P1
-------------	--------------------	--------------

Pump P2

Right travel	Pressure: 34.3 MPa	Test port P2
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Pump P3

Arm	Pressure: 20.6 MPa	Test port P3
Bucket	Pressure: 20.6 MPa	Test port P3
Auxiliary	Pressure: 20.6 MPa	Test port P3

Pump P4

Charge pressure:Low/ high	Pressure: 1.6/2.1 MPa	Test port C
Pilot pressure	Pressure: 3.1 MPa	Test port P4

Methods for inspecting performance

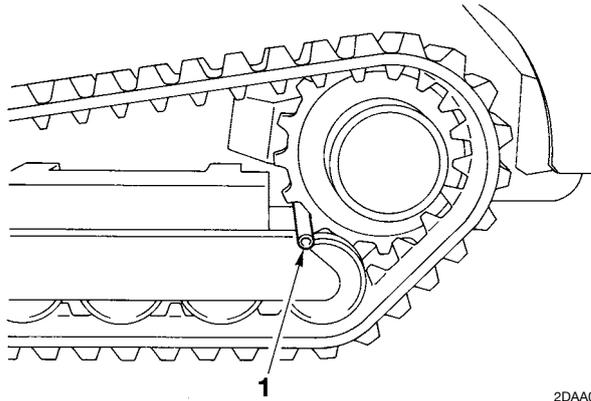
Hydraulic oil pressure

Travel

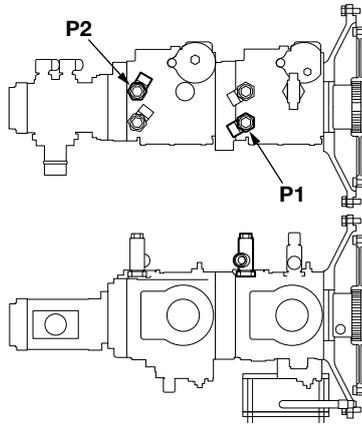
Measuring method

- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Install a pressure gauge on the pressure detection port. Fit the pipe (1) on the travel motor sprocket to deactivate the motor. Then, start up the hydraulic circuit to be tested and measure the relief pressure.

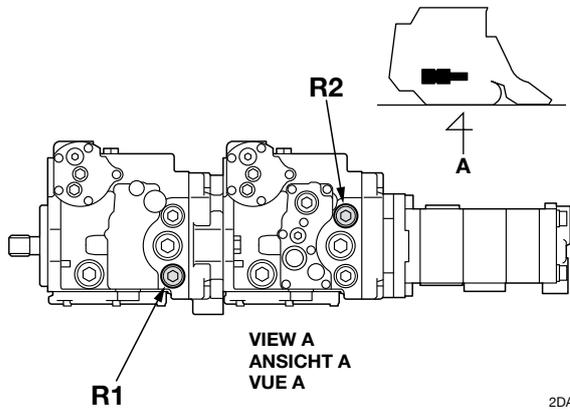
Circuit	Pressure detection port		Relief valve
	Port location	Size	
Left travel (forward)	P1	G1/4	R1
Right travel (forward)	P2	G1/4	R2



2DAA02Z



2DAA01Z



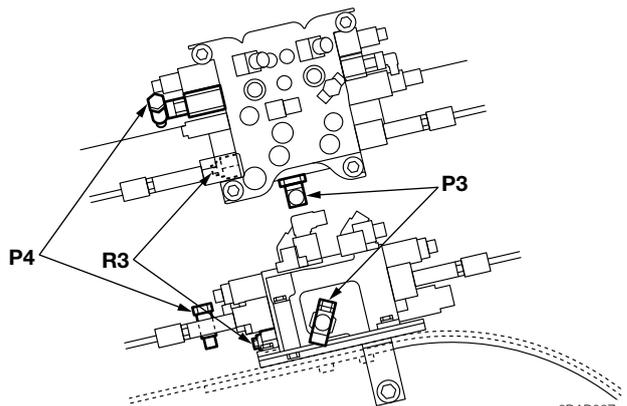
2DAA04Z

Lift arm, bucket

Measuring method

- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Install a pressure gauge on the pressure detection port. Operate the hydraulic circuit to be tested and measure the relief pressure.

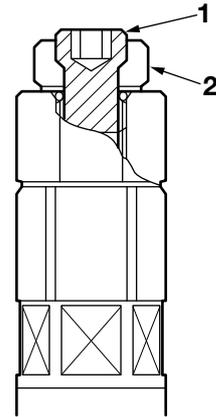
Circuit	Pressure detection port		Relief valve
	Port location	Size	
Arm, bucket	P3	G1/4	R3



2DAD02Z

Adjusting method

1. Loosen the locknut (2), and turn the setscrew (1) to adjust the set pressure.
 - To increase the set pressure, turn the setscrew clockwise.
 - To decrease the set pressure, turn the setscrew counterclockwise.
2. Upon completion of the adjustment, tighten the locknut (2) by holding the setscrew (1) to prevent it from turning.
3. Operate the relief valve again to confirm that the newly set pressure is stabilized.



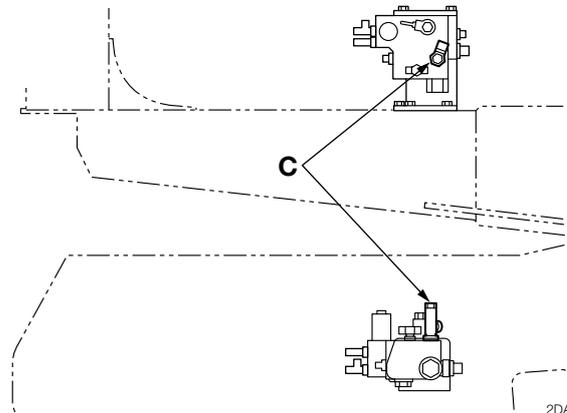
2DAA06Z

Charge pressure

Measuring method

- Engine: Idling/Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Install a pressure gauge on the pressure detection port.

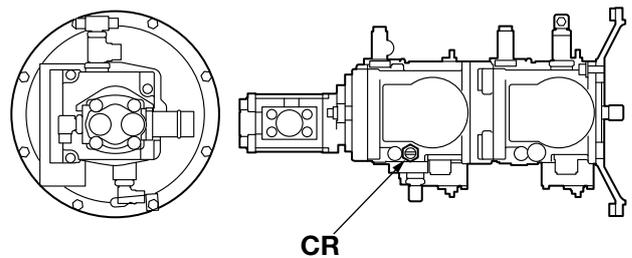
Pressure detection port		Relief valve
Port location	Size	
C	G1/4	CR



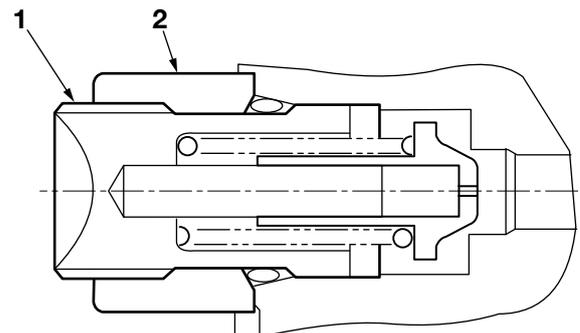
2DAA03Z

Adjusting method

1. Loosen the locknut (2), and turn the setscrew (1) to adjust the set pressure.
 - To increase the set pressure, turn the setscrew clockwise.
 - To decrease the set pressure, turn the setscrew counterclockwise.
2. Upon completion of the adjustment, tighten the locknut (2) by holding the setscrew (1) to prevent it from turning.
3. Operate the relief valve again to confirm that the newly set pressure is stabilized.



2DAA07Z



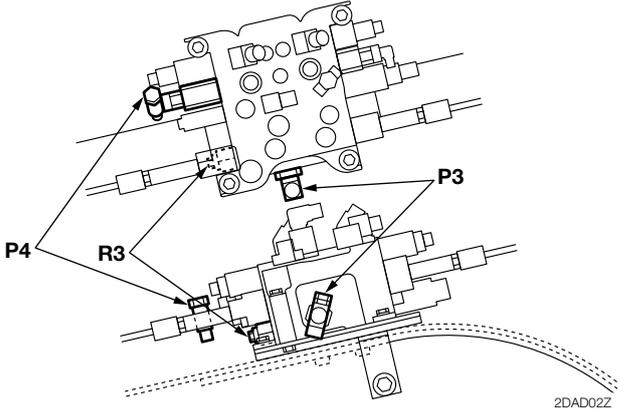
2DAA08Z

Pilot pressure

Measuring method

- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Install a pressure gauge on the pressure detection port. Operate the hydraulic circuit to be tested and measure the relief pressure.

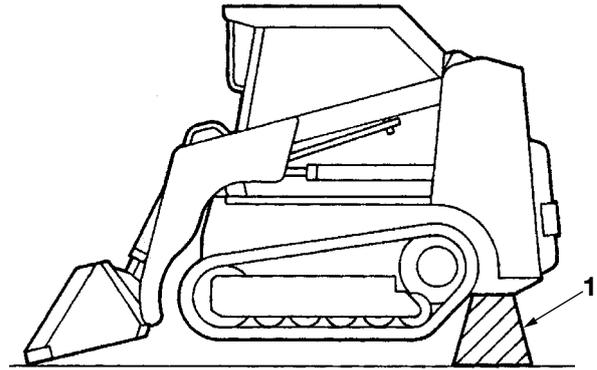
Circuit	Pressure detection port	
	Port location	Size
Bucket dump	P4	G1/4



2DAD02Z

Travel speed (5 revs.)

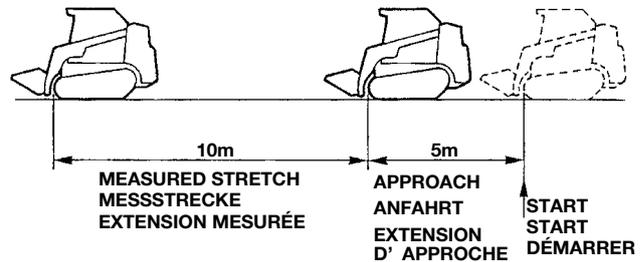
- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: Place the block (1) under the rear of the machine to support it and raise the machine by using the arm and bucket. Be sure to do this work on a flat and firm ground.
- Start turning both right and left crawler belts at the same time. Wait for the first turn to finish and then start measuring the time required for the belts to finish another five turns (measurement after synchronized turning).



2DAA09Z

Travel speed (10 m)

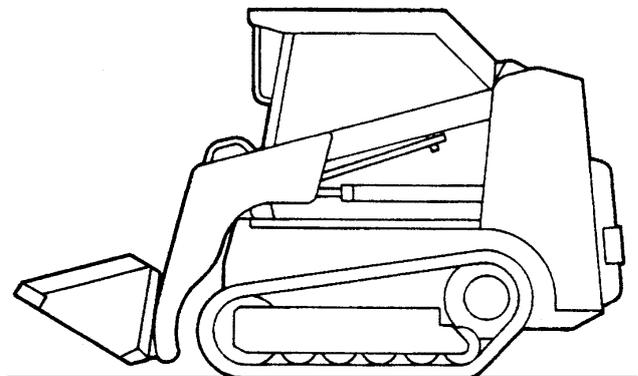
- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: Traveling
- Drive 5 meters first and then start measuring the time required for the machine to travel another 10 meters. Be sure to do this work on a flat and firm ground.



2DAA10Z

Traveling attitude

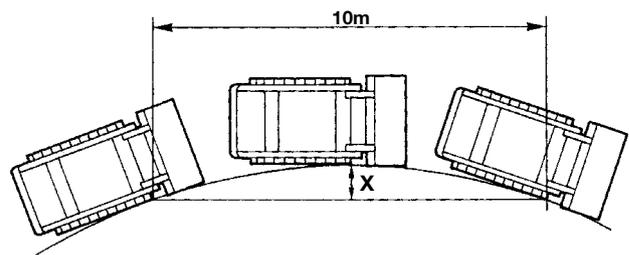
The arm and bucket cylinders should be retracted as far as possible.



2DAA11Z

Straight-ahead travering

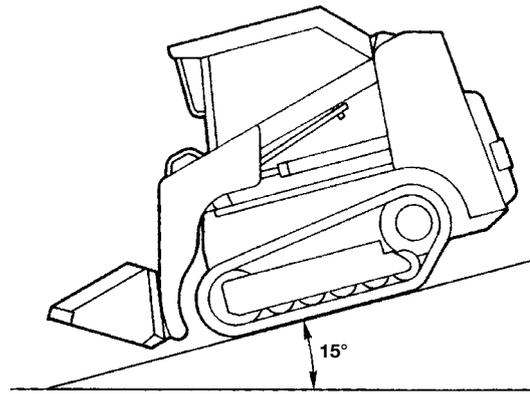
- Engine: 1500 ±100 min⁻¹
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: Traveling
- Drive 5 meters first and then 10 meters. Measure the distance "X" shown in the figure on the right. Be sure to do this work on a flat and firm ground.



2DAA12Z

Spontaneous travel drop

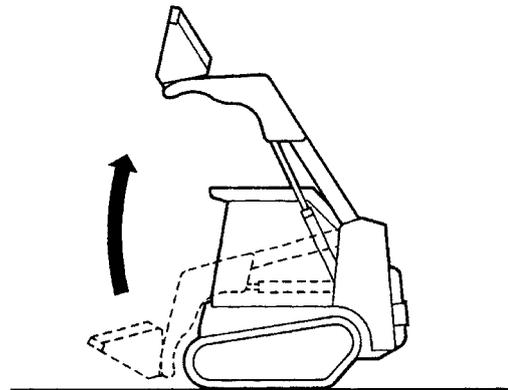
- Engine: Idling
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: Traveling
- Inclination angle: 15°
- Park the machine without applying the parking brake, and wait for one minute. Then, measure the spontaneous travel drop.



2DAA13Z

Arm cylinder speed

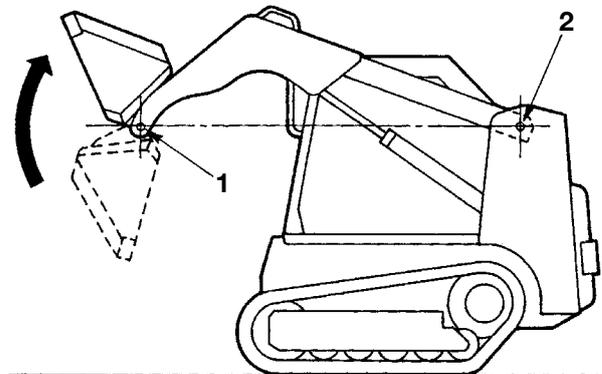
- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: The bucket cylinder should be retracted as far as possible.
- Measure the time required to raise the arm from the fully retracted position to the fully extended position, and vice versa (exclusive of cushion operating time).



2DAA14Z

Bucket cylinder speed

- Engine: Maximum RPM
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: Make sure that the bucket pin (1) and the arm foot pin (2) are at the same height.
- Measure the time required for the bucket cylinder to move from the fully retracted position to the fully extended position, and vice versa.

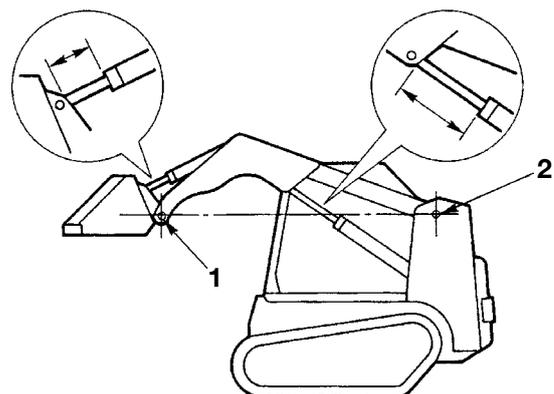


2DAA15Z

Cylinder spontaneous drop

Lift arm, bucket, bucket tip

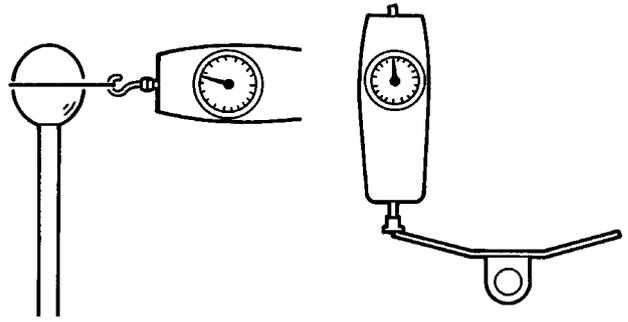
- Engine: Stopped
- Hydraulic oil temp.: 50 to 60°C
- Measuring attitude: Make sure that the bucket pin (1) and the arm foot pin (2) are at the same height and the bucket is level.
- Maintain this attitude for 10 minutes, and then measure the change in the rod length and the distance the bucket tip moved.



2DAA16Z

Lever operating force

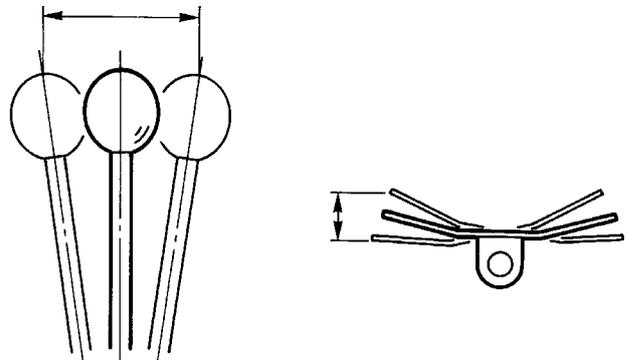
- While the engine is turned off, place a push-pull scale on the handle grip center or the pedal edge to measure the force. Record the readings at the point the lever/pedal reaches the full stroke.



2DAA17Z

Lever play

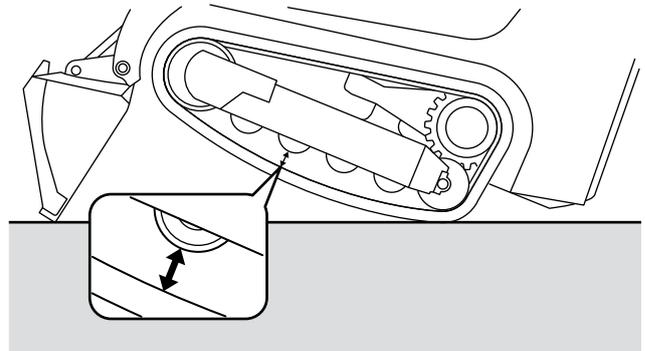
- Measure any discernible play at the tip of the lever or pedal.



2DAA18Z

Crawler tension

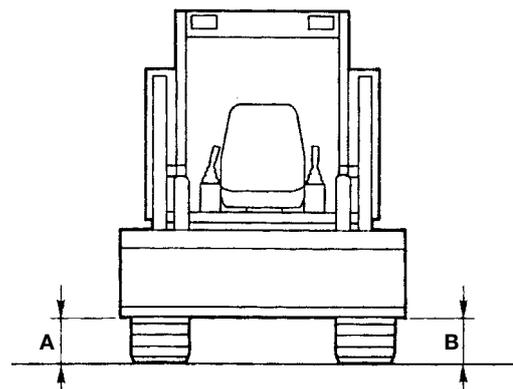
- In a stable, level location, lower the lift arm, tilt the bucket forward and lift the front of the crawler off the ground. Measure the distance between the central track roller and the top of the crawler shoe.



2DAD04Z

Level of bucket front edge

- Measuring attitude: Keep the bucket level so that the bucket front edge is approximately 20 centimeters above the ground.
- Determine the difference by measuring the distances between the ground and the front edges of right and left.

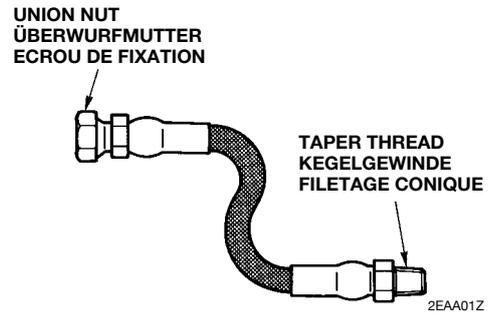


2DAA20Z

TIGHTENING TORQUE

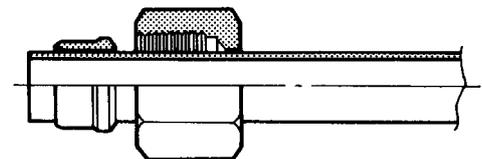
Hydraulic hose

Hose fitting size	Tightening torque	
	Union nut (G)	Taper thread (R)
	N·m	N·m
1/8	9.8 ^{+4.9} ₀	11.8 ±1.2
1/4	24.5 ^{+4.9} ₀	29.4 ±2.9
3/8	49.0 ^{+4.9} ₀	53.9 ±5.4
1/2	58.8 ^{+4.9} ₀	88.3 ±8.8
3/4	117.7 ^{+4.9} ₀	147.1 ±14.7
1	137.3 ^{+4.9} ₀	196.1 ±19.6



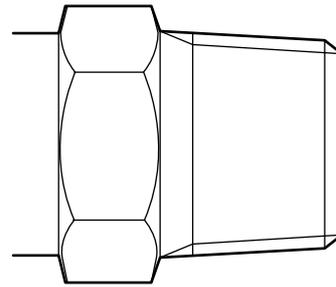
Bite-type pipe fitting for steel pipe

Pipe outer diameter (mm)	Tightening torque
	N·m
8	34.3 ±4.9
10	41.7 ±2.5
12	58.8 ±4.9
15	88.3 ±4.9
16	93.2 ±4.9
18	132.4 ±4.9
22	205.9 ±9.8
27.2	245.2 ±9.8
28	313.8 ±19.6
32	313.8 ±19.6
35	411.9 ±19.6



Joint for piping

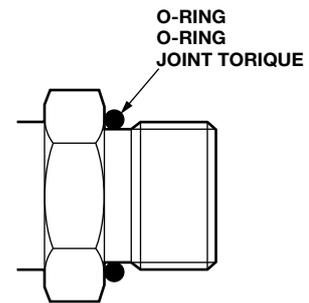
Nominal thread diameter	Tightening torque	
	Steel	Cast steel
	N·m	N·m
1/8	11.8 ±1.2	10.8 ±1.1
1/4	29.4 ±2.9	24.5 ±2.5
3/8	53.9 ±5.4	49.0 ±4.9
1/2	88.3 ±8.8	73.5 ±7.4
3/4	147.1 ±14.7	127.5 ±12.7
1	196.1 ±19.2	171.6 ±17.2



2EAA03Z

Joint for piping (O-ring seal type)

Nominal thread diameter (G)	Tightening torque
	N·m
1/8	19.6 ±2.0
1/4	34.3 ±4.9
3/8	53.9 ±4.9
1/2	63.7 ±4.9
3/4	93.2 ±4.9
1	107.9 ±9.8
1-1/4	117.7 ±9.8
1-1/2	137.3 ±9.8



2EAA04Z

Nominal thread diameter (UNF)	Tightening torque
	N·m
7/19-20	16.7 ±2.0
1/2-20	22.6 ±2.0
9/16-18	31.4 ±2.9
3/4-16	59.8 ±4.9
1-1/16-12	102.0 ±5.9
1-5/16-12	135.3 ±7.8
1-5/8-20	181.4 ±9.8

Bolts and nuts (JIS strength category 10.9)

Thread	Size × pitch	Tightening torque	
		General tightening points	Special tightening points
		N·m	N·m
Coarse	M6 × 1.0	9.8 ±0.5	11.8 ±1.1
	M8 × 1.25	22.6 ±1.1	26.5 ±2.5
	M10 × 1.5	47.1 ±2.4	54.9 ±4.9
	M12 × 1.75	83.4 ±4.1	97.1 ±7.4
	M14 × 2.0	134.4 ±6.7	155.9 ±12.7
	M16 × 2.0	207.9 ±10.4	241.2 ±17.2
	M20 × 2.5	410.9 ±20.5	475.6 ±23.7
Fine	M8 × 1.0	24.5 ±1.2	28.4 ±1.4
	M10 × 1.25	50.0 ±2.5	58.8 ±2.9
	M12 × 1.5	87.3 ±4.3	102.0 ±5.1
	M14 × 1.5	135.3 ±6.8	157.9 ±7.8
	M16 × 1.5	220.6 ±11.0	256.0 ±12.7
	M20 × 1.5	452.1 ±22.6	524.7 ±26.1

1. General tightening points (non-lubricated)
All securing points that have no special tightening torque specified in this manual and that are not special tightening points.
2. Special tightening points (grease with molybdenum disulfide applied)
Points where a specific tightening torque is specified in this manual.
3. Points where thread-locking compound should be applied (ThreeBond #1324).
4. If a tightening torque value is specified in this manual for a point not listed in the table above, follow the specification in the manual.
5. To tighten multiple bolts and nuts evenly, alternately tighten opposite bolts/nuts as a pair.