MITSUBISHI FORKLIFT TRUCKS

Service Manual

Chassis, Mast & Options

FD80N F32C-10011-up
FD90N F32C-60011-up

For use with 6M60-TL Engine Service Manual. **99709-52100**

FOREWORD

This service manual is a guide for servicing Mitsubishi Forklift Trucks. For your convenience the instructions are grouped by systems as a ready reference.

Long productive life of your forklift truck(s) depends on regular and proper servicing. Servicing consistent with what you will learn by reading this service manual. Read the respective sections of this manual carefully and familiarize yourself with all of the components before attempting to start a test, repair or rebuild job.

The descriptions, illustrations and specifications contained in this manual are for trucks with serial numbers in effect at the time of printing. Mitsubishi Forklift Trucks reserves the right to change specifications or design without notice and without incurring obligation.

The trucks listed in this manual are powered by 6M60-TL diesel engine. For engine servicing, please refer to 6M60-TL diesel engine service manual Pub. No. 99709-51100.

Safety Related Signs

The following safety related signs are used in this service manual to emphasize important and critical instructions:

WARNING	Indicates a specific potential hazard resulting in serious bodily injury or death.
CAUTION	Indicates a specific potential hazard resulting in bodily injury, or damage to, or destruction of, the lift truck.
NOTE	Indicates a condition that can cause damage to, or shorten service life of, the lift truck.

Pub. No. 99709-52100

SAFETY

WARNING

Do not operate this truck unless you have read and understand the instructions in the OPERATION & MAINTENANCE MANUAL. Improper truck operation is dangerous and could result in injury or death.

The proper and safe lubrication and maintenance for this lift truck, recommended by Cat Lift Trucks, are outlined in the OPERATION & MAINTENANCE MANUAL for these trucks.

The serviceman or mechanic may be unfamiliar with many of the systems on this truck. This makes it important to use caution when performing service work. A knowledge of the system and/or components is important before the removal or disassembly of any component.

Because of the size of some of the truck components, the serviceman or mechanic should check the weights noted in this Manual. Use proper lifting procedures when removing any components.

Following is a list of basic precautions that should always be observed.

(1) Read and understand all warning plates and decals on the truck before operating, lubricating or repairing the product.

(2) Always wear protective glasses and protective shoes when working around trucks. In particular, wear protective glasses when pounding on any part of the truck or its attachments with a hammer or sledge. Use welders gloves, hood/goggles, apron and other protective clothing appropriate to the welding job being performed. Do not wear loose-fitting or torn clothing. Remove all rings from fingers when working on machinery.

(3) Do not work on any truck that is supported only by lift jacks or a hoist. Always use blocks or jack stands to support the truck before performing any disassembly.

WARNING

Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the OPERATION & MAINTENANCE MANUAL before performing any lubrication or maintenance.

(4) Lower the forks or other implements to the ground before performing any work on the truck. If this cannot be done, make sure the forks or other implements are blocked correctly to prevent them from dropping unexpectedly.

(5) Use steps and grab handles (if applicable) when mounting or dismounting a truck. Clean any mud or debris from steps, walkways or work platforms before using. Always face truck when using steps, ladders and walkways. When it is not possible to use the designed access system, provide ladders, scaffolds, or work platforms to perform safe repair operations.

(6) To avoid back injury, use a hoist when lifting components which weigh 23 kg (50 lb.) or more. Make sure all chains, hooks, slings, etc., are in good condition and are of the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.

(7) To avoid burns, be alert for hot parts on trucks which have just been stopped and hot fluids in lines, tubes and compartments.

(8) Be careful when removing cover plates. Gradually back off the last two bolts or nuts located at opposite ends of the cover or device and pry cover loose to relieve any spring or other pressure, before removing the last two bolts or nuts completely.

(9) Be careful when removing filler caps, breathers and plugs on the truck. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. The danger is even greater if the truck has just been stopped because fluids can be hot.

(10) Always use tools that are in good condition and be sure you understand how to use them before performing any service work.

(11) Reinstall all fasteners with same part number. Do not use a lesser quality fastener if replacements are necessary. Do not mix metric fasteners with standard nuts and bolts.

(12) If possible, make all repairs with the truck parked on a level, hard surface. Block truck so it does not roll while working on or under truck.

(13) Disconnect battery and discharge any capacitors (electric trucks) before starting to work on truck. Hang “Do not Operate” tag in the Operator’s Compartment.

(14) Repairs, which require welding, should be performed only with the benefit of the appropriate reference information and by personnel adequately trained and knowledgeable in welding procedures. Determine type of metal being welded and select correct welding proce-

dure and electrodes, rods or wire to provide a weld metal strength equivalent at least to that of parent metal.

(15) Do not damage wiring during removal operations. Reinstall the wiring so it is not damaged nor will it be damaged in operation by contacting sharp corners, or by rubbing against some object or hot surface. Do not connect wiring to a line containing fluid.

(16) Be sure all protective devices including guards and shields are properly installed and functioning correctly before starting a repair. If a guard or shield must be removed to perform the repair work, use extra caution.

(17) Always support the mast and carriage to keep carriage or attachments raised when maintenance or repair work is performed, which requires the mast in the raised position.

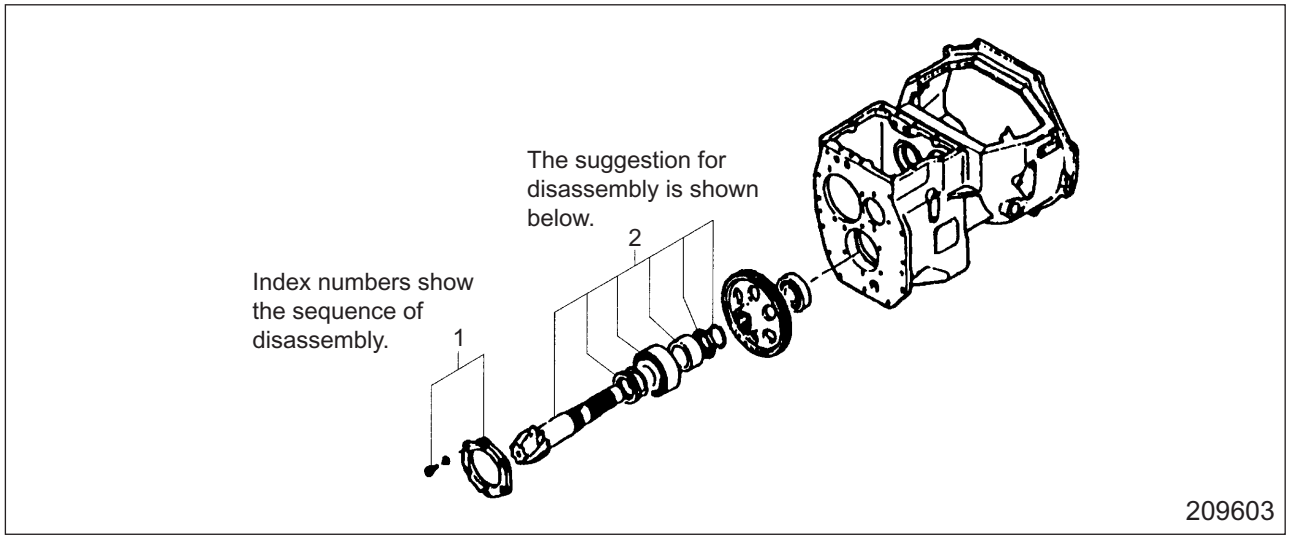
(18) Loose or damaged fuel, lubricant and hydraulic lines, tubes and hoses can cause fires. Do not bend or strike high pressure lines or install ones which have been bent or damaged. Inspect lines, tubes and hoses carefully. Do not check for leaks with your hands. Pin hole (very small) leaks can result in a high velocity oil stream that will be invisible close to the hose. This oil can penetrate the skin and cause personal injury. Use cardboard or paper to locate pin hole leaks.

(19) Tighten connections to the correct torque. Make sure that all heat shields, clamps and guards are installed correctly to avoid excessive heat, vibration or rubbing against other parts during operation. Shields that protect against oil spray onto hot exhaust components in event of a line, tube or seal failure, must be installed correctly.

(20) Relieve all pressure in air, oil or water systems before any lines, fittings or related items are disconnected or removed. Always make sure all raised components are blocked correctly and be alert for possible pressure when disconnecting any device from a system that utilizes pressure.

(21) Do not operate a truck if any rotating part is damaged or contacts any other part during operation. Any high speed rotating component that has been damaged or altered should be checked for balance before reusing.

HOW TO READ THIS MANUAL
Disassembly diagram (example)

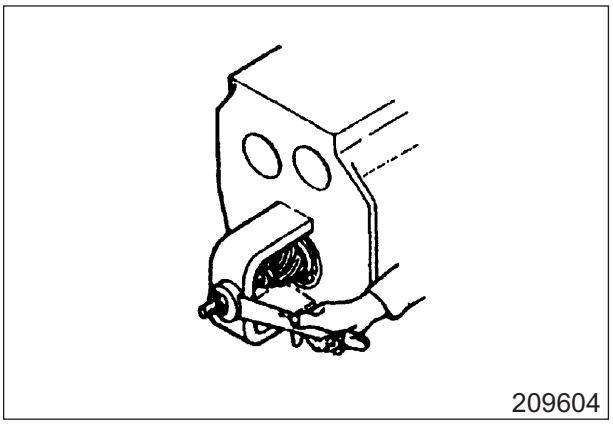


Sequence

1 Cover, Bolt, Washer (part name)
2 Output shaft (part name)

Suggestion for disassembly

(1) Output shaft removal



Symbols or abbreviations

OP	Option
R1/4	Taper pipe thread (external) 1/4 inch (formerly PT1/4)
Rc1/8	Taper pipe thread (internal) 1/8 inch (formerly PT1/8)
G1/4A	Straight pipe thread (external) 1/4 inch (formerly PF1/4-A)
Rp1/8	Straight pipe thread (internal) 1/8 inch (formerly PS1/8)

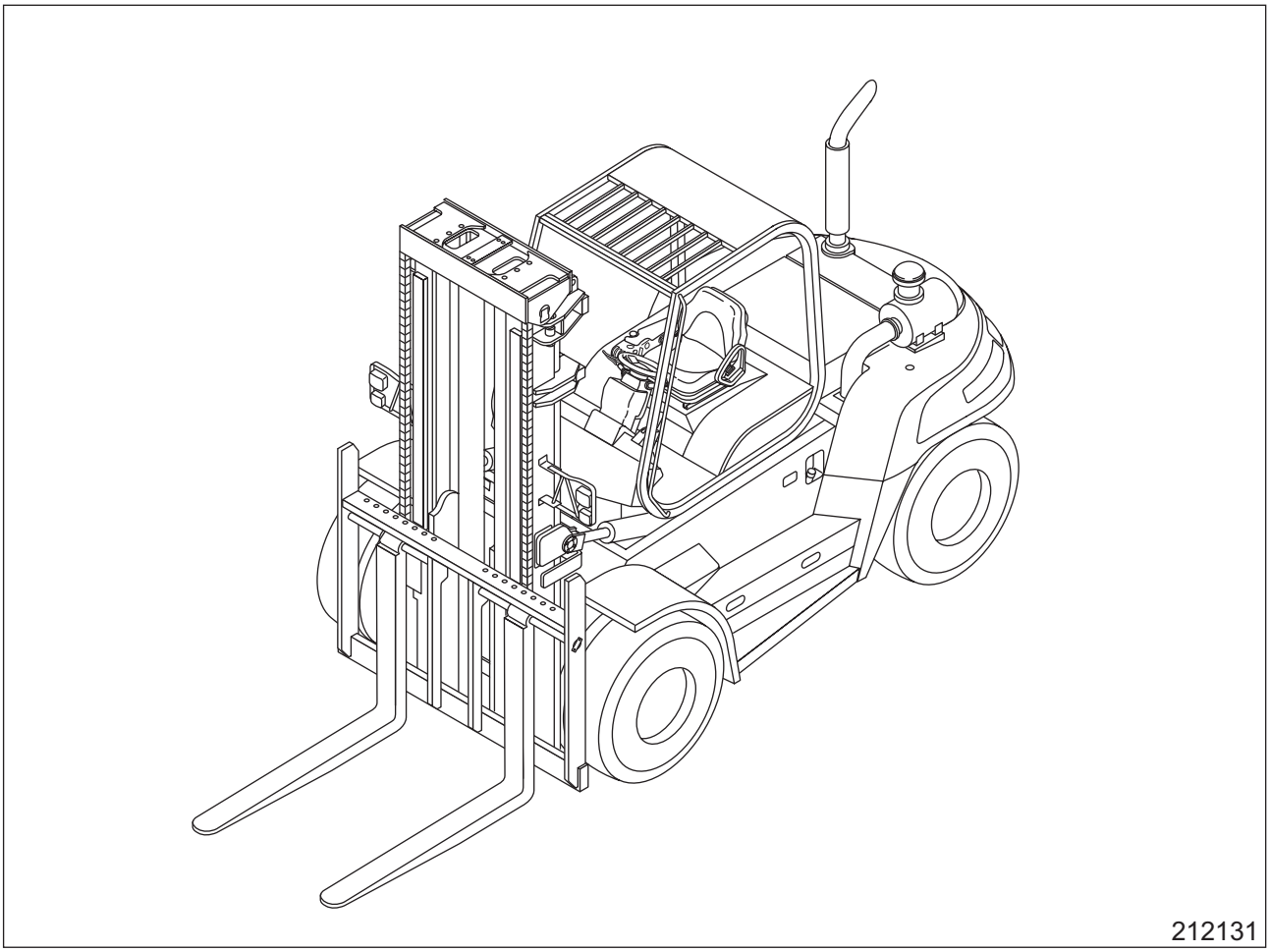
Clearance between cylinder and piston	Standard valve	0.020 to 0.105 mm (0.00079 to 0.00413 in.)
	Repair service unit	0.15 mm (0.059 in.)

GROUP INDEX

GROUP INDEX	Items
GENERAL INFORMATION	Model View, Truck Models Covered, Serial Number Locations, Chassis and Mast Model Identification, Dimensions, Main Specifications
COOLING SYSTEM	Specifications, Structure, Removal and Installation, Inspection and Adjustment, Troubleshooting
ELECTRICAL SYSTEM	Specifications, Location of Components, Structure, Disassembly and Reassembly, Batteries and Charging, Troubleshooting, Electrical Wiring Diagram
CONTROLLER	Outline, Service Tool Functions, Error Code List, Troubleshooting
TILTABLE	Specifications, Structure, Oil supply, Hydraulic circuit diagram, Service Data
POWER TRAIN	Specifications, Structure, Reduction ratio, Removal and Installation of Engine and Transmission Unit
3-SPEED POWERSHIFT TRANSMISSION	Specifications, Description, Suggestions for Removal and Installation, Disassembly and Reassembly, Adjustment, Troubleshooting, Service Data
FRONT AXLE AND REDUCTION DIFFERENTIAL	Specifications, Structure, Suggestions for Removal and installation, Front Axle and Reduction Differential, Disassembly and Reassembly, Troubleshooting, Service Data
REAR AXLE	Specifications, Structure, Suggestions for Removal and Installation, Disassembly and Reassembly, Readjustment, Troubleshooting, Service Data
BRAKE SYSTEM	Specifications, Structure, Suggestions for Removal and Installation, Disassembly and Reassembly, Adjustment and Testing, Troubleshooting, Service Data
STEERING SYSTEM	Specifications, Structure, Procedure and Suggestions for Removal and Installation, Troubleshooting, Service Data
HYDRAULIC SYSTEM	Specifications, Structure, Suggestions for Removal and Installation, Gear Pump, Flow regulator valve, Down safety valve, Lift cylinder, Tilt cylinder, Inspection and Adjustment, Tests, Troubleshooting, Service Data
MASTS AND FORKS	Specifications, Structure, Suggestions for Removal and Installation, Mast assembly, Troubleshooting, Service Data
FORK POSITIONER	FORK POSITIONER (FD80N), Applicable Attachment Models, Specifications, Structure, Removal and installation, Troubleshooting, Service Data, FORK POSITIONER (FD90N) Applicable Attachment Models, Specifications, Structure, Removal and installation, Troubleshooting, Service Data
SERVICE DATA	Maintenance Chart, Tightening Torque of Standard Bolts, Lubrication Standards

GENERAL INFORMATION

1. Model View

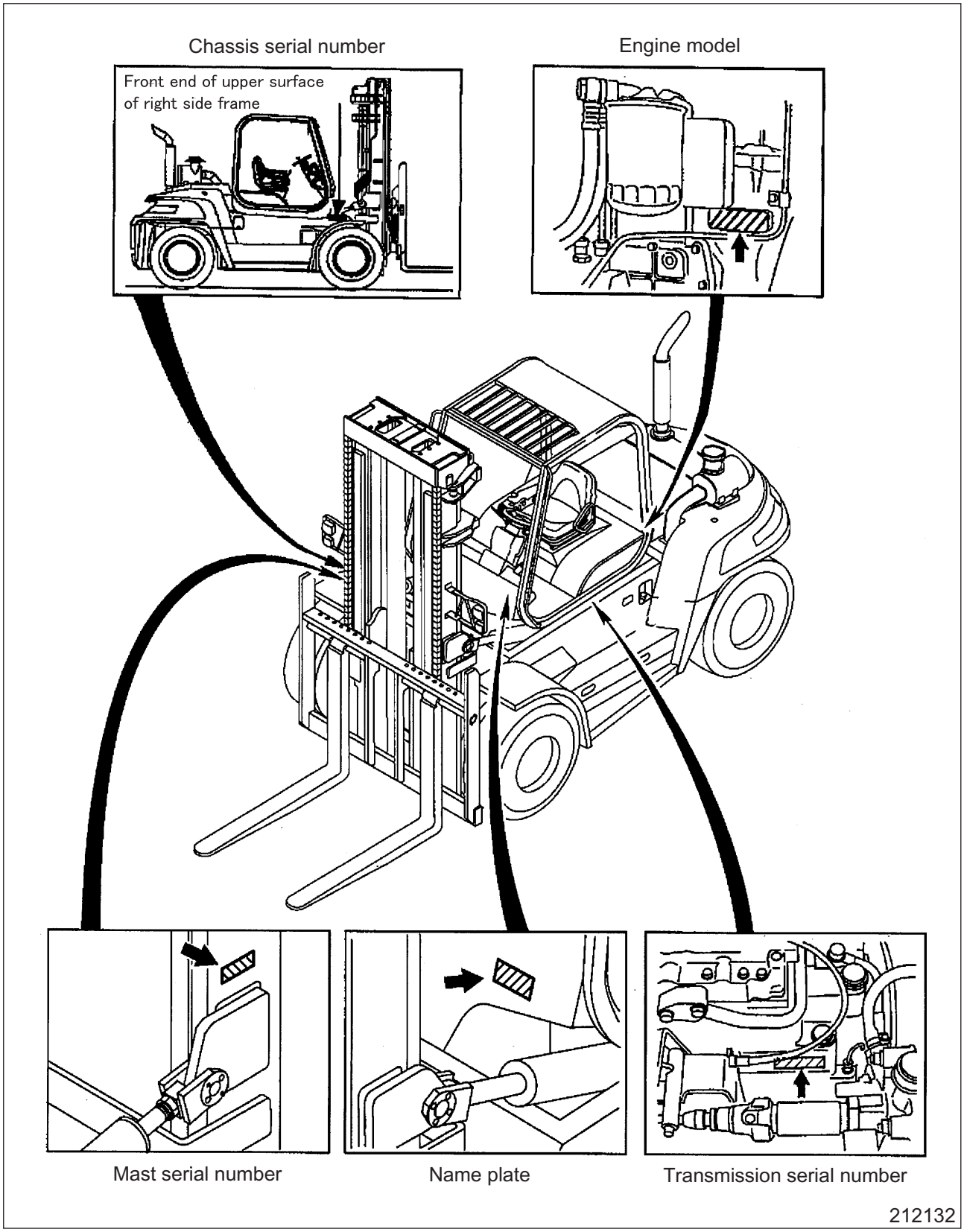


2. Truck Models Covered

This Service Manual furnishes servicing and maintenance information for the following trucks:

Truck model	Transmission	Model code - Serial number	Engine mounted
FD80N	Powershift	F32C-10011-up	Mitsubishi 6M60-TL diesel engine
FD90N	Powershift	F32C-60011-up	Mitsubishi 6M60-TL diesel engine

3. Serial Number Locations

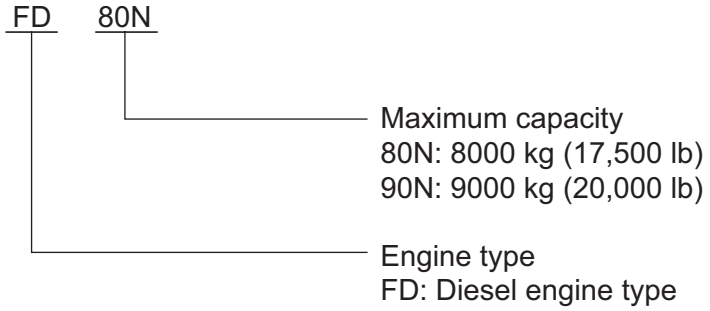


4. Main specifications

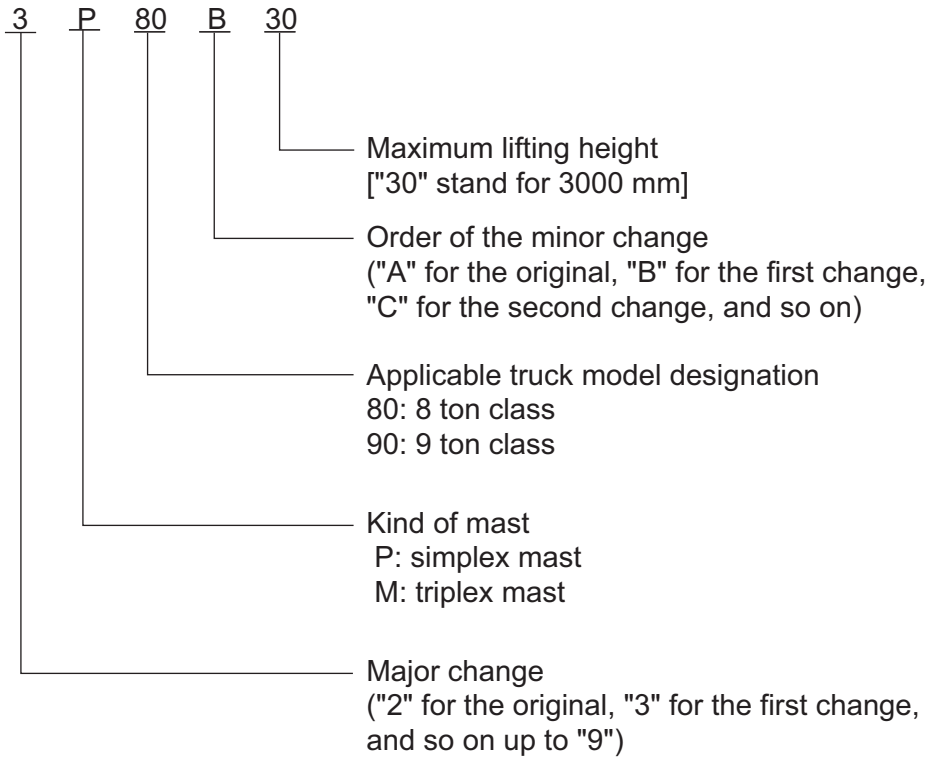
Truck model			FD80N	FD90N
Designation			Mitsubishi F32C	
Type			Standard (with 3-speed powershift transmission)	
General	Capacity/load center		8000/600 kgf/mm (17500/24 lbf/in.)	9000/600 kgf/mm (20000/24 lbf/in.)
	Lift		3300 mm (130 in.)	
	Lift speed (unloaded/loaded)		530/500 mm/sec (104/98 fpm)	430/400 mm/sec (85/81 fpm)
	Lowering speed (unloaded/loaded)		500 mm/sec (98 fpm)	400 mm/sec (79 fpm)
	Tilt angle (forward-backward)		15°– 12°	
	Free lift		220 mm (8.7 in.)	0
Performance	Travel speeds (unloaded/loaded)	Forward	34.0/28.0 km/h (21.1/17.4 mph)	33.0/27.0 km/h (20.5/16.8 mph)
		Reverse		
	Minimum turning radius		3740 mm (147 in.)	3835 mm (151 in.)
	Turning angle	Inside	74°	
		Outside	48°25’	
	Minimum intersecting aisle		3300 mm (130 in.)	3400 mm (134 in.)
	Gradeability (rated load)	At 1.6 km/h (1 mph)	43%	37%
		At 2 km/h (1.2 mph)	38%	34%
Tires	Size of tires (front and rear)		9.00-20-12PR (I)	9320 kg (20540 lb)
	Inflation pressure of tires (front and rear)		650 kPa (6.6 kgf/cm^2) [94 psi]	750 kPa (7.7 kgf/cm^2) [94 psi]
Weight and axle loading (unload)	Weight		11320 kg (25000 lb)	13060 kg (28800 lb)
	Front axle loading		5310 kg (11700 lb)	6010 kg (13300 lb)
	Rear axle loading		6010 kg (13300 lb)	7050 kg (15550 lb)

5. Chassis and Mast Model Identification

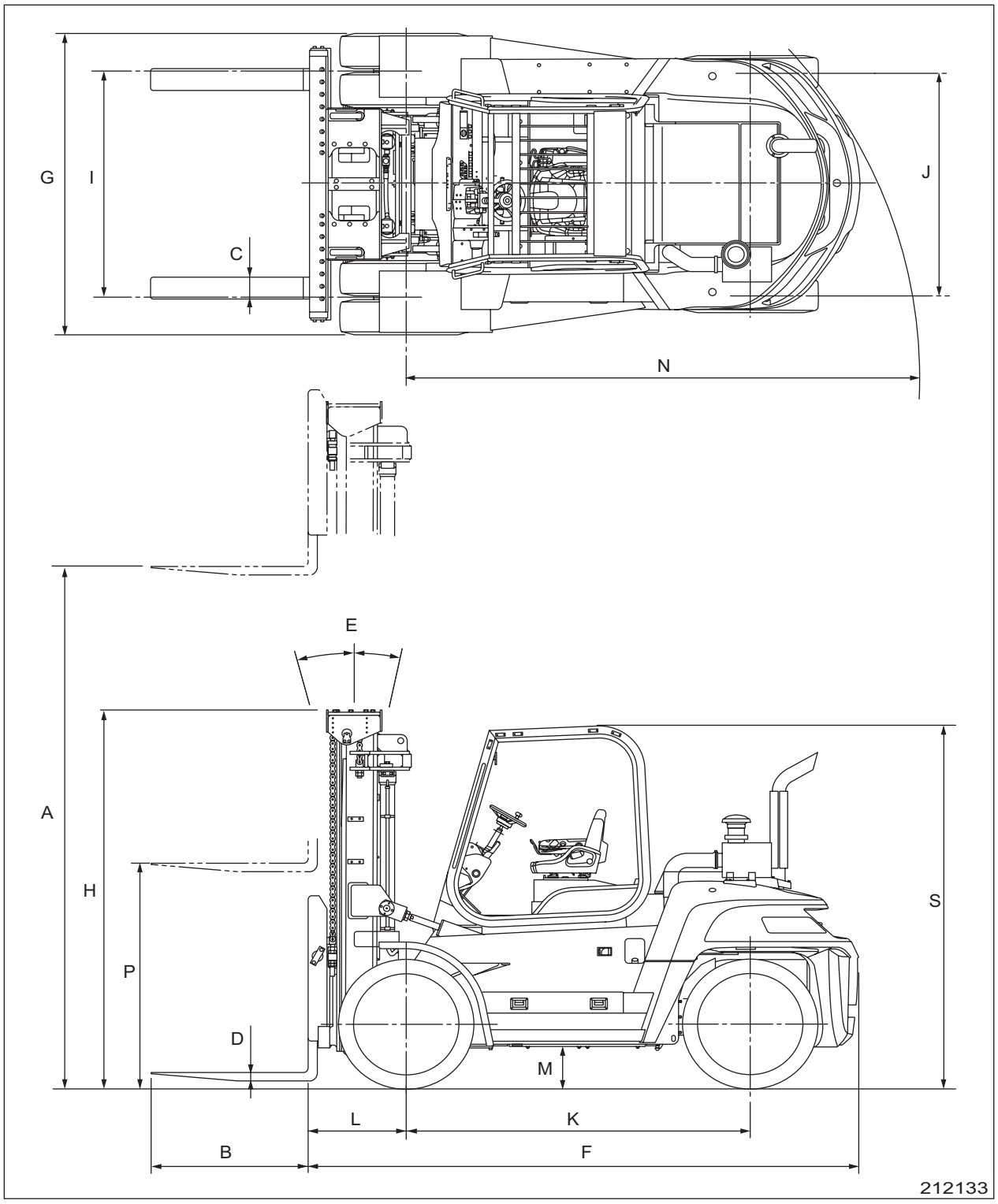
[Chassis]



[Mast]



6. Dimensions (Approximate)



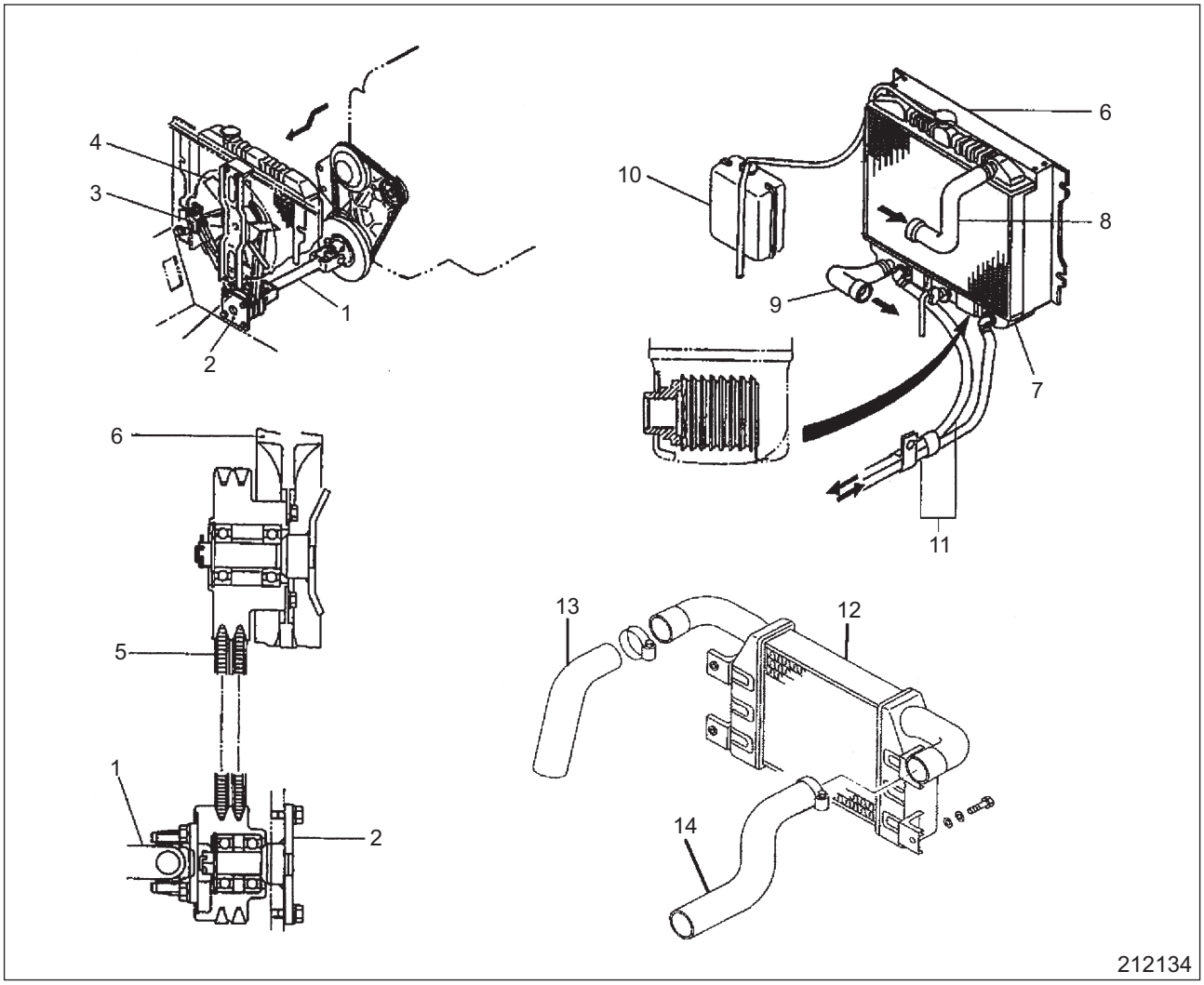
No.	Truck model		FD80N	FD90N
A	Lift	Simplex mast	3300 mm (130 in.)	
		Triplex mast	4580 mm (180.3 in.)	–
B	Fork length		1220 mm (48 in.)	
C	Fork width		180 mm (7.1 in.)	
D	Fork thickness		64 mm (2.5 in.)	72 mm (2.6 in.)
E	Tilt angle (forward-backward)	Simplex mast	15˚–12˚	
F		Triplex mast	6˚–6˚	–
G	Overall length		3390 mm (133 in.)	4170 mm (164 in.)
	Overall width (outside of tires)		2390 mm (94 in.)	
H	Overall height (to top of mast lowered)	Simplex mast	2295 mm (115 in.)	3120 mm (123 in.)
		Triplex mast	2295 mm (115 in.)	–
K	Tread (front)		1820 mm (72 in)	
L	Tread (rear)		1750 mm (69 in)	
K	Wheelbase		2580 mm (102 in)	
L	Front overhang	Simplex mast	670 mm (26 in.)	755 mm (30 in.)
		Triplex mast	725 mm (28.5 in.)	–
M	Ground clearance (at frame)		230 mm (9.1 in.)	
N	Minimum turning radius		3830 mm (151 in.)	3930 mm (155 in.)
P	Free lift (floor to fork top, Triplex mast)		1655 mm (65.5 in.)	–

COOLING SYSTEM

1. Specifications

Truck model		FD80N	FD90N
Cooling system	Cooling method	Forced circulation of coolant	
	Radiator type	Corrugated fins with pressure cap	
	Coolant capacity	23 Liters (6.1 U.S. gal.)	
	Water pump type	Volute type, V-belt driven	
	Thermostat type	Wax pellet	

2. Structure



1 Universal joint
2 Pulley boss
3 Tensioner pulley
4 Cooling fan
5 Fan belt
6 Radiator
7 Transmission oil cooler
8 Upper hose (radiator)
9 Lower hose (radiator)
10 Reserve tank
11 Transmission oil cooler hose
12 Intercooler
13 Upper hose (intercooler)
14 Lower hose (intercooler)

A reserve tank and a transmission oil cooler come standard on this cooling system. Fan belt adjustment is easy.
An intercooler comes standard to cope with emission regulations of various countries of the world.

3. Suggestions for Removal and Installation

3.1 Removing radiator and intercooler

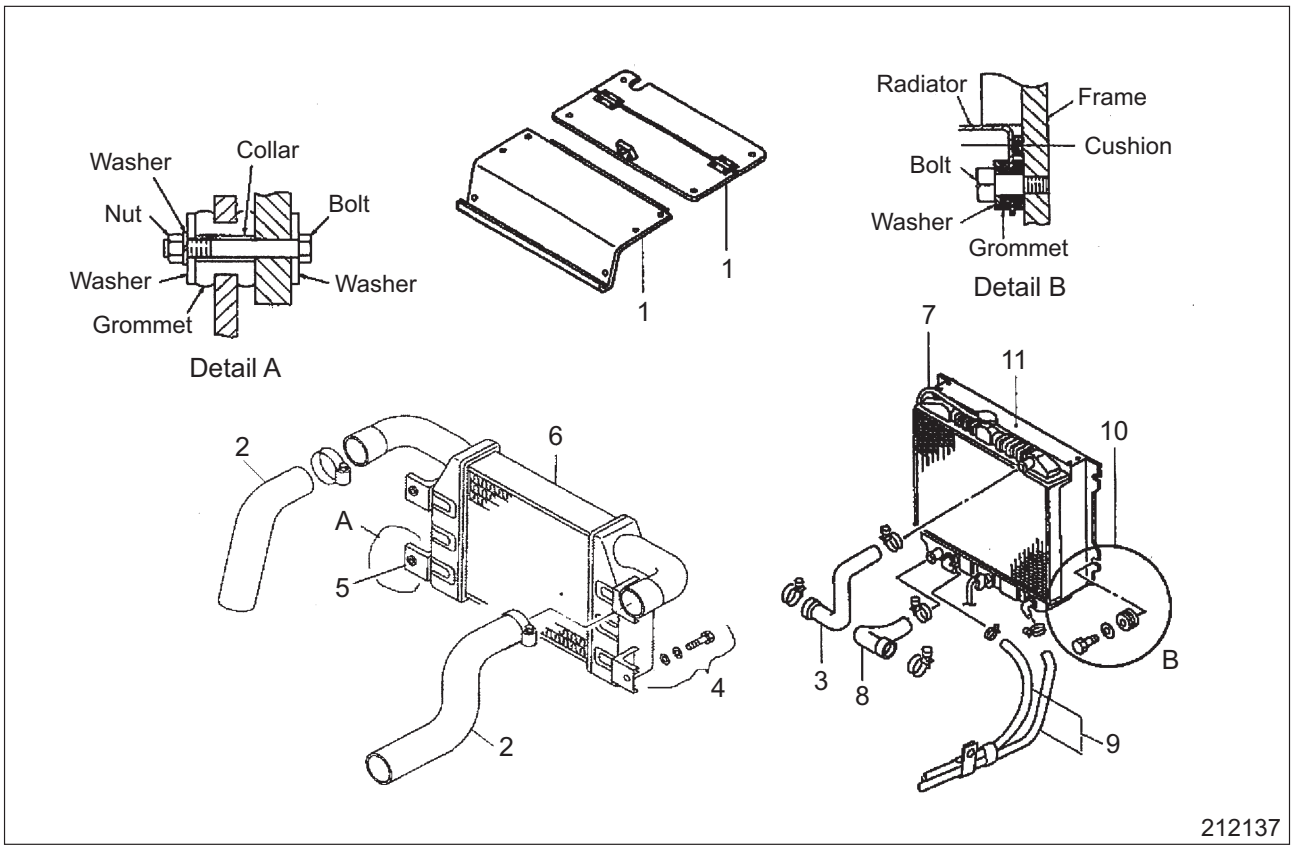
3.1.1 Preparation

(1) Remove the engine cover and gas spring.
(2) Open the drain cock to drain coolant from radiator.

⚠WARNING

Make sure the coolant temperature is not hot and the radiator cap is removed before opening the drain cock.

3.1.2 Removal sequence



1 Radiator cover, Cover
2 Intercooler hoses (upper, lower)
3 Radiator hose (upper)
4 Intercooler mount, Grommet, Collar, Washer, Bolt
5 Intercooler bracket
6 Intercooler
7 Reservoir tank hose
8 Radiator hose (lower)
9 Transmission oil cooler hose
10 Radiator mount, Grommet, Washer, Cushion, Bolt
11 Radiator

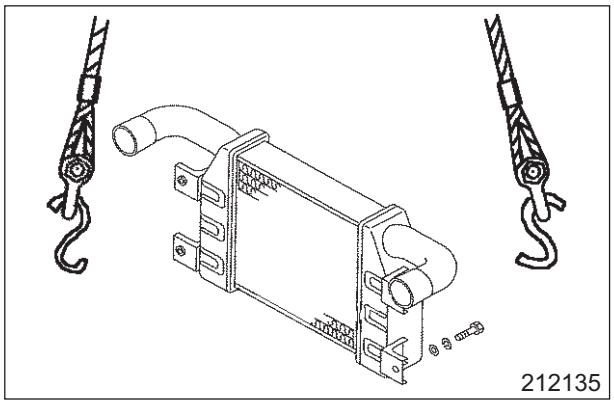
3.1.3 Suggestions for Removal and Installation

(1) Intercooler

(a) Attach a lifting hook through the top mounting bolt holes on the left hand and right hand of the intercooler brackets.

(b) Hitch a rope to the hook and lift with a crane.

Weight of intercooler	9 kg (20 lb)

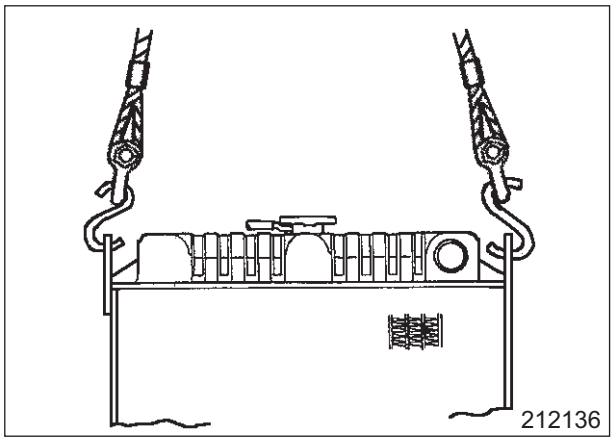


(2) Radiator

(a) Support the radiator with crane.

(b) Remove the radiator mounts (four places) and lift the radiator.

Weight of radiator	22.5 kg (50 lb)



3.1.4 Inspection and Repair

(1) Intercooler

(a) Replace any rubber mount which is inelastic or hardened.

(b) When foreign matters, such as insects and dust, have been adhered to the fins of the core, blow them out with compressed air from the opposite side and remove them, taking care not to damage the fins.
Wear goggles for the sake of safety.

(c) Replace the intercooler, if the corrosion and rusting are remarkable or the fin is not repairable.

(d) Check the intercooler hoses (upper, lower) for bulge, damage to the hose clamp sections. Replace them if any abnormality is found.

(2) Radiator

(a) Replace any rubber mount which is inelastic or hardened.

(b) When foreign matters, such as insects and dust, have been adhered to the fin of the core, wash them out with pressurized water from the opposite side and remove remaining foreign matters carefully so as not to damage the water pipes.

(c) Replace the radiator, if the corrosion and rusting are remarkable or the fin is not repairable.

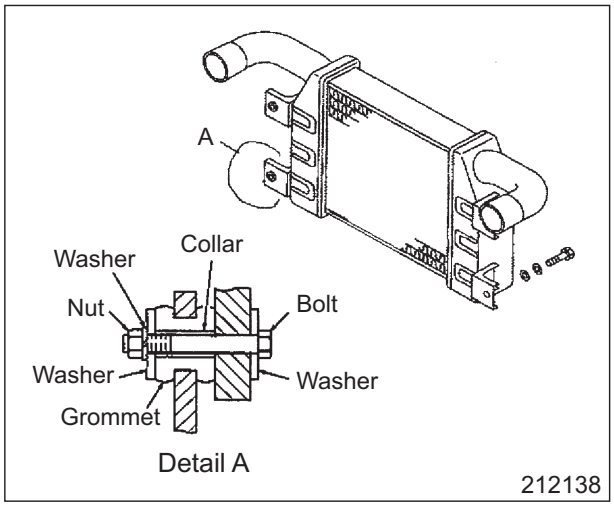
(d) Check the radiator hoses (upper, lower) for bulge, damage to the hose clamp sections. Replace them if any abnormality is found.

3.1.5 Installation

Follow the removal procedure in reverse while noting the following instructions.

(1) Intercooler

(a) Lower the intercooler and align the lower mount with the mounting pin of the frame mount.



(2) Hose

(a) Connect each hose to intercooler or radiator making sure the end of the hose reaches the base of the fitting. Tighten the clamp and make sure the hose end is stopped at the flare of the fitting and can not come off of the fitting.

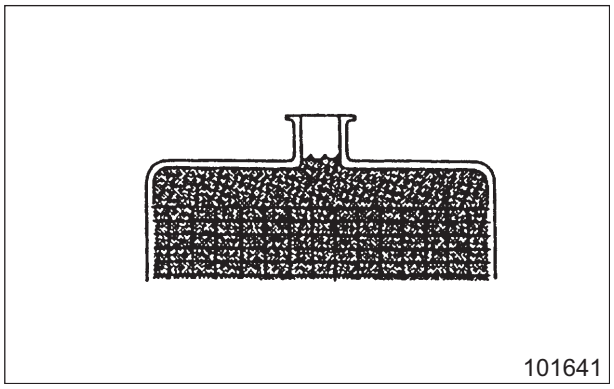
(3) Antifreeze and coolant

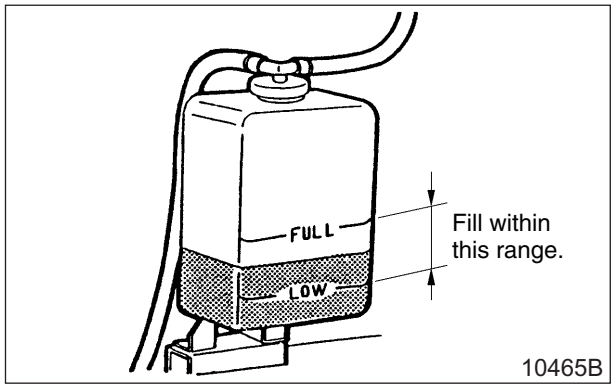
(a) Mix the coolant with antifreeze to specified concentration, and fill the radiator with it until the fluid level comes to the top of the inlet.

(b) In addition, fill the reserve tank with the mixed solution to the specified level.

(c) Start and warm up the engine while checking for abnormal sound.

(d) If coolant in reserve tank decreases, supply the mixed solution to the specified range.



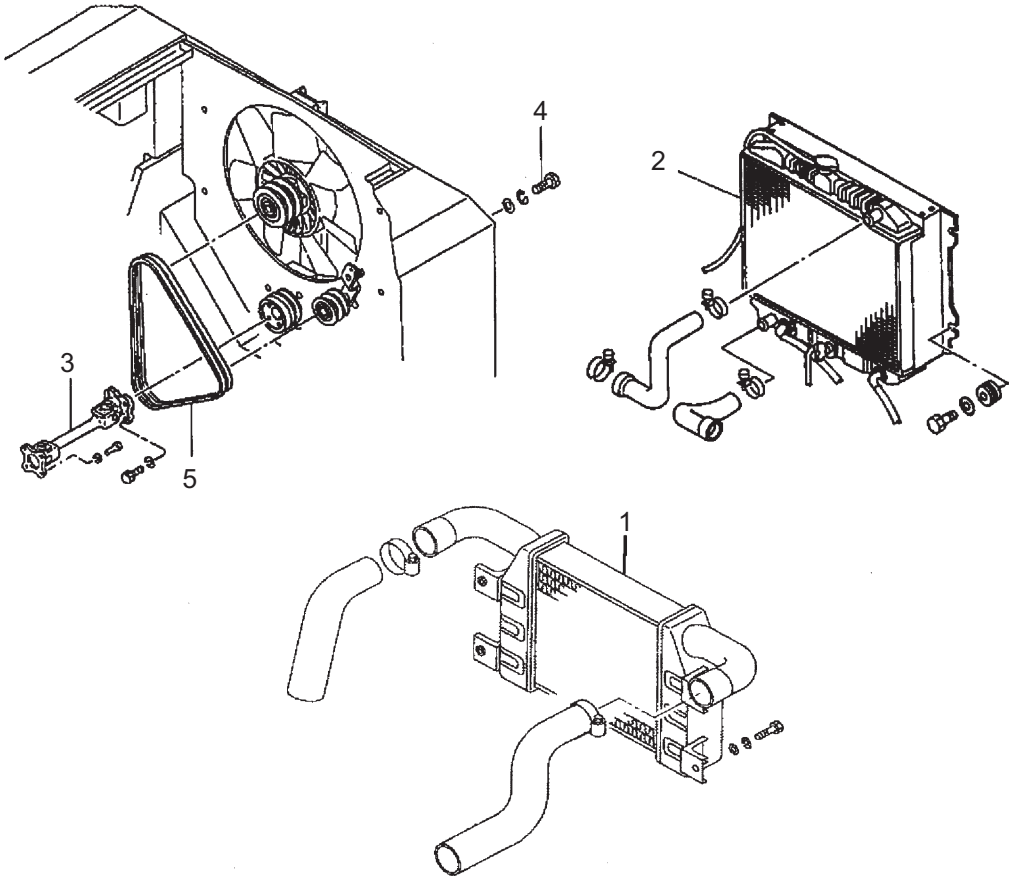


3.2 Procedure involving removal of radiator

3.2.1 Preparation

Refer to pages 2-3 to 2-4 for removal of intercooler and radiator.

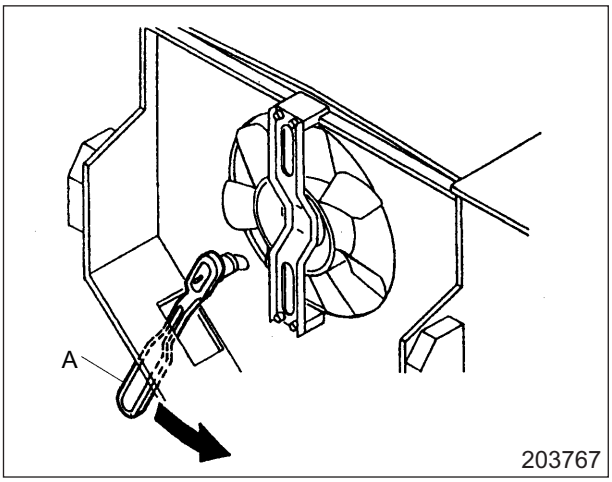
3.2.2 Removal sequence



1 Intercooler
2 Radiator
3 Universal joint
4 Tensioner pulley locking bolt
5 Fan belt

3.2.3 Suggestions for Removal and Installation

(1) Through the adjustment hole in the frame, loosen the tensioner pulley locking bolt one or two turns using a ratchet wrench A.
(2) Using a bar, fully slide the tension pulley to the fan side.
(3) Tighten the tension pulley locking bolt in the above condition, and remove the fan belt.



3.2.4 Installation

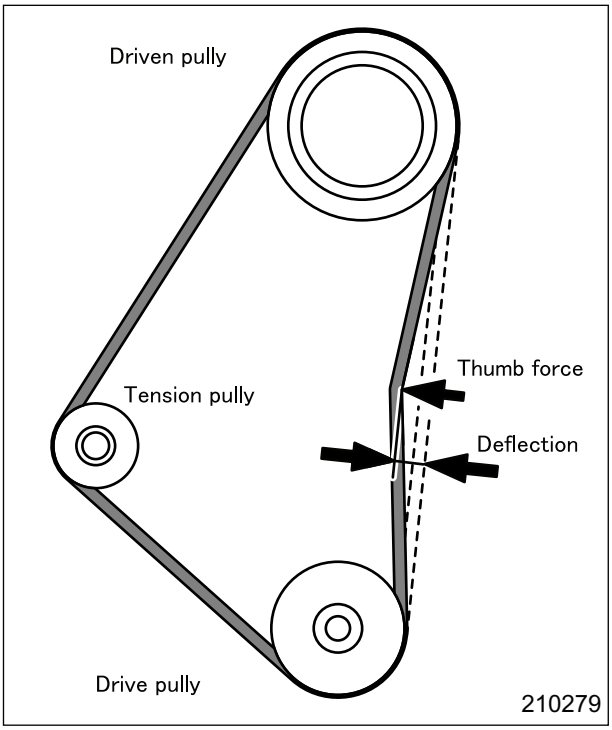
Follow the removal procedure in reverse while noting the following instructions.

(1) Fan belt
(a) Turn the fan with the fan belt removed and check that it rotates smoothly. Replace the bearing if it generates abnormal sound.
(b) Install the fan belt in position and push the belt at the midpoint of driven pulleys with the following specified value to check the deflections.

A: Standard value, B: Repair limit
Repair service limit

Pushing force	A	19.6 N (4.4 lbf)
Deflection	A	20 to 25 mm (0.8 to 0.9 in.)
	B	28 mm (1.1 in.)

(c) If the deflection is not within the specified value, adjust the tension pulley.
(d) After the adjustment is completed, tighten the tension pulley lock bolt firmly.

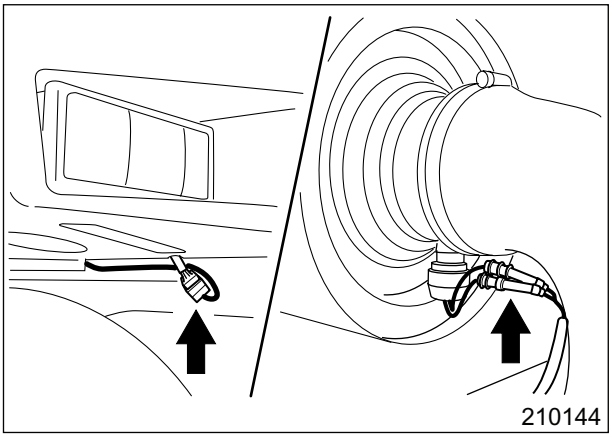


(2) Radiator, Intercooler
Refer to steps of installation of intercooler and radiator. (Refer to pages 2-5 to 2-6.)

3.3 Procedure involving removal of counterweight

3.3.1 Preparation

(1) Disconnect the wiring harness of rear combination lamps and air cleaner.
(2) Refer to pages 2-3 to 2-5 for removal of intercooler.
(3) Hook the sling on the counterweight and support with the crane, then remove the bolts that hold the counterweight and remove the counterweight with the crane.

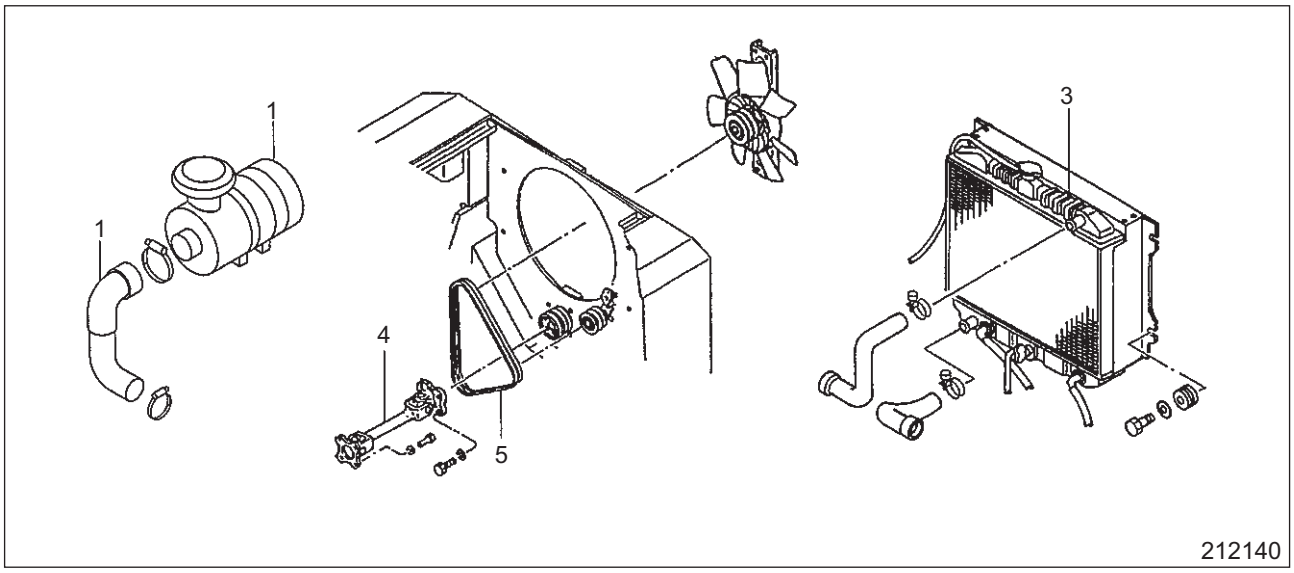


NOTE

Before hoisting, check the weight of the counterweight and select a sling appropriate for lifting the weight.

Truck model	FD80N	FD90N
Weight of the counterweight	3380 kg (7450 lbf)	4390 kg (9680 lbf)

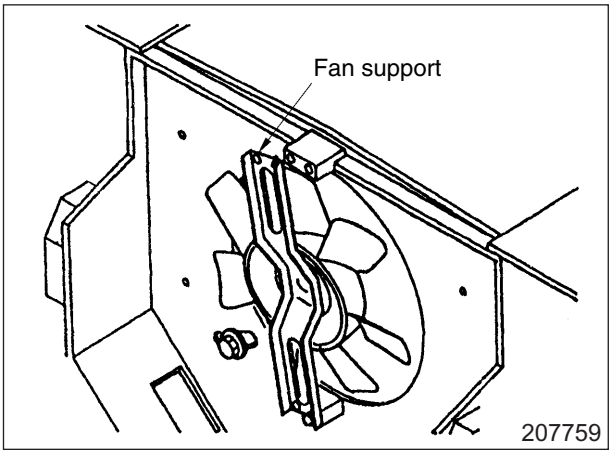
3.3.2 Removal sequence



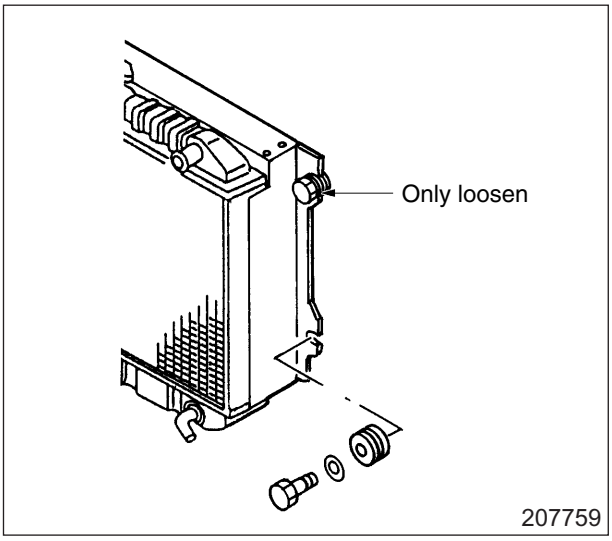
1 Air cleaner and hose
2 Intercooler
3 Radiator
4 Universal joint
5 Fan belt

3.3.3 Suggestions for Removal and Installation

(1) Remove the fan support bolt and remove the belt from the driven pulley to remove the fan assembly. Place the removed fan assembly facing the fan support down, and rotate the fan. Replace the bearing if it generates abnormal sound.



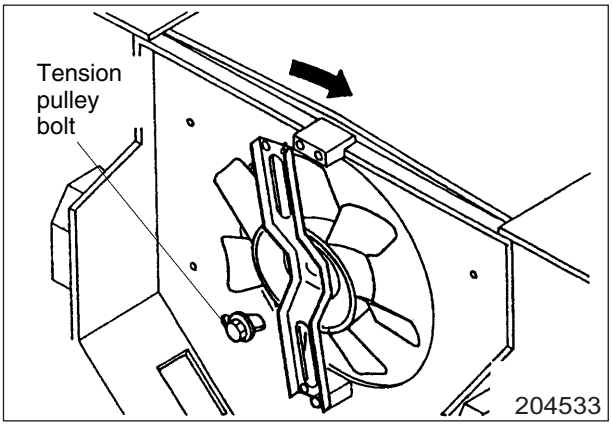
(2) Remove the two bolts at the bottom of the radiator. Loosen but do not remove the two bolts at the upper side.
(3) Push the radiator toward the engine side to remove the belt from the tension pulley, letting it fall onto the universal joint.



3.3.4 Installation

Follow the removal procedure in reverse while noting the following instructions.

(1) Installing fan assembly
(a) Place the belt on the driven pulley (of fan assembly), and lightly tighten the bolt at the lower side of fan support. Then, loosen the tension pulley locking bolt, slide it to the mounting boss (frame) by holding the top of the fan support, and secure with the bolt.
(b) Push the belt between the drive and driven pulleys through a clearance of the fans to check that the tensioner pulley can move, and tighten the tension pulley locking bolt.



4. Inspection and Adjustment

4.1 Inspection of Fan Belt

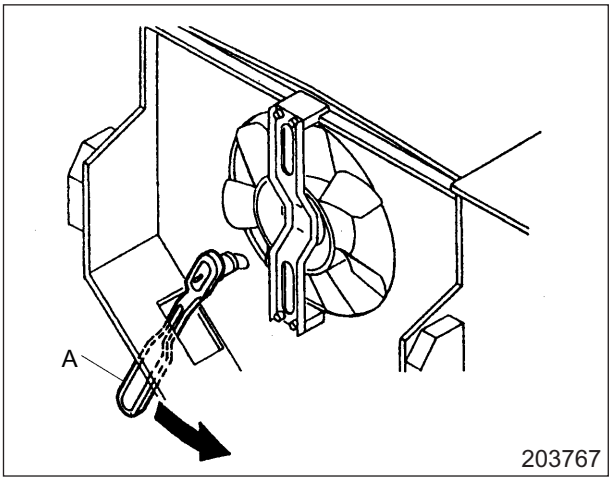
(1) Check the belt for oil, grease, dust and other dirt adhered on it. If necessary, replace the belt. If dirt is small in amount, clean with shop towel or paper towel. Never use gasoline, petroleum or other oil for washing to avoid unnecessary dangers.

(2) Check the belt thoroughly and closely every time when the engine is overhauled or the belt tension is adjusted. If any damage is found, replace the belt with a new one.

4.2 Fan Belt Tension Adjustment

(1) Through the adjustment hole in the frame, loosen the tensioner pulley locking bolt one or two turns using a ratchet wrench A.

(2) The belt will become taut by the force of the tensioner spring. Then tighten the pulley locking bolt.



5. Troubleshooting

Water leaks from radiator	Radiator has been corroded due to prolonged activity or others	Repair corroded part or replace if there is remarkable corrosion.
	Deterioration of upper or lower hose	Replace.
	Poor tightening of hose clamp	Retighten or replace.
	Faulty drain cock	Replace drain cock.
	Cracks etc. occurred in engine cooling system, overheating	Inspect and repair engine cooling system.
Engine overheat	Clogging of radiator fins	Clean tubes with copper or steel wire so as not to damage them.
	Extreme deformation of fin	Repair or replace the fin.
	Loosened fan belt and water pump belt	Check belts for tension, elongation and crack due to ageing, and replace if there is any defect.
	Defective thermostat	Inspect and repair, or replace.
	Insufficient coolant	Refill.
Oil leaks from oil cooler hose	Poor tightening of hose clamp	Retighten or replace.
	Oil cooler has been corroded due to prolonged activity or others	Repair corroded part or replace if there is remarkable corrosion.

ELECTRICAL SYSTEM

1. Specifications

Truck model		FD80N	FD90N
Battery	Model number and quantity	65D23R × 2	
	Voltage (V)	12	
	Capacity (Ah)	52	
Direction lever		Electric	
Console box		With OK monitor	
3-speed automatic transmission controller		ECU (Electronic Control Unit)	
Starter switch		Anti-restart type (with the built-in mechanical lockout for preventing duplicated starting)	
Lamps		24V, Refer to “Lamp Bulb Specifications”.	